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Chemical Oxygen Demand

Introduction

Wastewater needs to be monitored closely to prevent environmental pollution and human illness.

Oxygen Demand and COD

Chemical Oxygen Demand (COD) is a measure of the biologically available and inert oganic matter that is susceptible to oxidation by a strong oxidizing agent.

The Hanna COD method is based on the well established closed dichromate-reflux colorimetric method. The colorimetric measurement of COD is faster and easier to perform than the titrimetric analysis; additional reagents are not required. The sample is added to the reagent vial and digested under closed reflux conditions and allowed to cool before measurement is taken. Reference standards can be made using potassium hydrogen phthalate (KHP), 1 mg of KHP is equal to 1.175 mg COD.

The US Environmental Protection Agency (EPA) specifies that the dichromate reflux method is the only method acceptable for reporting purposes. The advantage in using this method includes certifiable results as well as high accuracy.

COD Testing Applications

COD is used as a measurement of pollutants. It is normally measured in both municipal and industrial wastewater treatment plants and gives an indication of the efficiency of the treatment process. COD is measured on both influent and effluent water. The efficiency of the treatment process is normally expressed as COD removal, measured as a percentage of the organic matter purified during the cycle. COD has further applications in power plant operations, chemical manufacturing, commercial laundries, pulp and paper mills, agriculture and animal waste runoff, environmental studies and general education. Hanna equipment can be used in the laboratory or for on-site testing. The measurement procedure has been designed for ease of use by personnel at any skill level.

Wastewater monitoring examples:

COD Influent	COD Effluent	COD Removal
1214	451	62%
948	328	63%
1341	307	77%

Beyond COD: Nitrogen and Phosphorus

The goal in wastewater treatment is not only COD reduction, but also to control nitrogen and phosphorus, which are responsible for eutrophication phenomena in natural environments. COD, nitrogen, and phosphorus control are performed not only to obey environmental protection laws, but also to optimize plant costs.

Effective monitoring and control of parameters such as ammonia, nitrate, total nitrogen and total reactive phosphorus allow plant managers to profile and improve the health of aquatic ecosystems. By accurately monitoring levels of each specific pollutant, operational parameters can be adjusted to maintain high efficiency of biodegradation treatments while also minimizing costs.

Nitrogen

When a treatment plant uses processes like nitrification and denitrification, it is important to monitor and maintain the equilibrium between ammonia nitrogen, nitrate and total nitrogen during the bio-treatment. The nitrogen level is important because it relates to the quantity of oxygen provided in the nitrification area. Ammonia is also controlled because it can become very toxic for the bacteria responsible for denitrification.

Nitrification

$$NH_3 + O_2 \xrightarrow[\text{bacteria}]{\text{nitrosomonas}} NO_2^- + 3H^+ + 2e^-$$

$$NO_2^- + H_2O \xrightarrow[\text{bacteria}]{\text{nitrobacter}} NO_3^- + 2H^+ + 2e^-$$

Denitrification

$$3NO_3^- + 10e^- + 12H^+ \longrightarrow N_2 + 6H_2O$$

Phosphorus

Phosphorus is measured during both biological and chemical dephosphorization. An excessive amount of phosphate discharged in superficial waters or in bio-treatment tanks causes an increase of algae and system eutrophication.

HI83224

COD Meter and Multiparameter Photometer

The HI83224* is a multiparameter bench photometer that includes 15 methods for the measurement of ammonia, COD, chlorine, nitrate, nitrogen and phosphorus.

The HI83224 features a powerful interactive user support system that assists you before, during and after analysis. On-screen tutorials guide users through set-up, calibration and measurement procedures while context sensitive help screens are available at a push of a button.

See page 11.4

HI83399

Multiparameter Photometer with COD for Water and Wastewater

with Digital pH Electrode Input

HI83399 benchtop photometer measures 40 different key water and wastewater quality parameters using 73 different methods that allow for multiple ranges and variations in chemistry for specific applications. The Chemical Oxygen Demand (COD) parameter is included for industrial and municipal wastewater treatment. The Phosphorous and Nitrogen parameters included are beneficial to municipal wastewater treatment customers that need to monitor their biological and chemical nutrient removal process.

See page 11.6

HI83314

Multiparameter Photometer with COD for Wastewater

with Digital pH Electrode Input

HI83314 benchtop photometer measures 10 different key wastewater quality parameters using 20 different methods that allow for multiple ranges and variations in chemistry for specific applications.

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HI83224

COD Meter and Multiparameter Photometer

with Barcode Recognition of Sample Vials

Application Designed Photometers

From ammonia to phosphorus, the HI83224 benchtop photometer offers 15 measurement methods for different key water quality parameters in addition to chemical oxygen demand (COD) in 3 different ranges. The HI83224 features a barcode reader that can be used for barcoded sample vials. The reader scans each vial and automatically identifies the method and range, eliminating potential errors and simplifying the testing process.

This photometer features an advanced optical system that uses special tungsten lamps, narrow band interference filters, and silicon photodetectors to ensure accurate photometric readings every time. The HI83224 uses a graphic backlit LCD that allows for an intuitive user interface, offering a tutorial mode that gives a step-by-step procedure for performing a measurement. The result obtained can be displayed in various chemical forms based on the user's preference. For tracking of data, results can be logged and then exported to a Windows® compatible PC using the HI92000 software and HI920013 USB cable.

Barcode Recognition

Automatic recognition of bar coded samples is an exciting feature of the HI83224. This advanced meter scans each vial inserted into the vial holder and automatically identifies the sample method and range. The barcode has four digits: the first two digits are for parameter identification and the second two digits are for reagent lot ID. Vials for different methods can be distinguished by a barcode printed on the vial and the cap color - the barcodes for different methods are shown in the table below. For parameters that don't use a barcoded reagent, the vials supplied with the instrument can be used.

Vial Rotation

During the measurement phase of the analysis, the state-of-the-art vial rotator spins the vial to identify the method via the barcode, then rotates while taking a number of absorbance readings. The instrument then converts the readings to concentration units and displays the result on the easy to read screen.

- Improved Accuracy
  - Using the "average" function further improves reading accuracy. When enabled in the setup menu, the instrument takes 180 absorbance readings through the vial as it rotates. Each individual reading represents a measurement through a new optical path. Averaging the absorbance readings minimizes errors due to vial inconsistencies.
- Method Verification
  - A dedicated METHOD CHECK button is available to verify the vial barcode, eliminating the potential for vial confusion or incorrect sample readings.
- Backlit Graphic LCD Display
  - The HI83224 features an adjustable backlit graphic display with virtual keys and on-screen help to provide for an intuitive user interface.
- Data Logging
  - Users can store up to 200 readings by simply pressing the LOG key. Logged readings are just as easily recalled by pressing the dedicated RCL button. Stored data includes parameter, test results, sample number, lot number, instrument ID, date and time.
- PC Connectivity
  - Logged readings can be transferred to a PC via USB using HI92000 Windows® compatible software.
- Result Conversion
  - Eliminates confusion by automatically converting readings to other chemical forms. Common conversions are available at the touch of a button.
- On-screen Tutorial
  - With the tutorial function enabled, short guides relating to the current operation are displayed.
- Built-in Timer
  - Display of time remaining before a measurement is taken. Ensures that all readings are taken at the appropriate reaction intervals for the test being performed.
- Error Messages
  - Messages on display alerting to problems including barcode error, wrong vial, and different reagent lot.
- Cooling Lamp Indicator
  - To maintain the desirable wavelength to be used for absorbance, it is necessary to ensure components are not overheated from the heat generated by the tungsten lamp. Each photometer is designed to allow a minimal amount of time for components to cool.

Specifications	HI83224
Light Source	tungsten lamps with narrow band interference filters
Light Detector	silicon photocell
Data Logging	up to 200 samples
PC Connectivity	USB
Environment	0 to 50°C (32 to 122°F); RH max 90% non-condensing
Power Supply	230 VAC or 115 VAC
Dimensions	235 x 212 x 143 mm (9.2 x 8.34 x 5.62")
Weight	2.3 kg (5.1 lb)
Ordering Information	**HI83224-01** (115V) and **HI83224-02** (230V) are supplied with sample vials (10), vial cleaning cloths (4), scissors, power cable, and instruction manual.

- Bar code reader detects the method and range automatically

COD Test	Range	Resolution	Accuracy	Method	Reagent Code
COD LR - 150°C, 2 hours	0 to 150 mg/L (as O_2) 0 to 150 mg/L 0 to 150 mg/L	1 mg/L 1 mg/L 1 mg/L	±5 mg/L or ±5% of reading** ±5 mg/L or ±5% of reading** ±5 mg/L or ±5% of reading**	dichromate EPA‡ dichromate mercury-free◊◊ dichromate ISO◊	**HI94754A-25** (25 tests) **HI94754D-25** (25 tests) **HI94754F-25** (25 tests)
COD MR - 150°C, 2 hours	0 to 1500 mg/L (as O_2) 0 to 1500 mg/L 0 to 1500 mg/L	1 mg/L 1 mg/L 1 mg/L	±15 mg/L or ±4 % of reading** ±15 mg/L or ±4% of reading** ±15 mg/L or ±4% of reading**	dichromate EPA‡ dichromate mercury-free◊◊ dichromate ISO◊	**HI94754B-25** (25 tests) **HI94754E-25** (25 tests) **HI94754G-25** (25 tests)
COD HR - 150°C, 2 hours	0 to 15000 mg/L (as O_2)	1 mg/L	±150 mg/L or ±3 % of reading**	dichromate	**HI94754C-25** (25 tests)

COD Rapid Method: It is now possible to get results for process control monitoring in a fraction of the time using any of the Hanna COD reagents. The Rapid Method digestion time is reduced from 2 hours to 15 minutes when the digestion temperature is increased from 150°C to 170°C.

COD Test	Range	Resolution	Accuracy	Rapid Method	Reagent Code
COD LR / Rapid Method - 170°C, 15 minutes	0 to 150 mg/L (as O_2) 0 to 1500 mg/L 0 to 1500 mg/L	1 mg/L 1 mg/L 1 mg/L	±8 mg/L or 5% of reading** ±8 mg/L or 5% of reading** ±8 mg/L or 5% of reading**	adaptation of dichromate EPA adaptation of dichromate mercury-free adaptation of dichromate ISO	**HI94754A-25** (25 tests) **HI94754D-25** (25 tests) **HI94754F-25** (25 tests)
COD MR / Rapid Method - 170°C, 15 minutes	0 to 150 mg/L (as O_2) 0 to 1500 mg/L 0 to 1500 mg/L	1 mg/L 1 mg/L 1 mg/L	±20 mg/L or 4% of reading** ±20 mg/L or 4% of reading** ±20 mg/L or 4% of reading**	adaptation of dichromate EPA adaptation of dichromate mercury-free adaptation of dichromate ISO	**HI94754B-25** (25 tests) **HI94754E-25** (25 tests) **HI94754G-25** (25 tests)

Test	Range	Resolution	Accuracy*	Method	Reagent Code
Ammonia LR	0.00 to 3.00 mg/L (as NH_3–N)	0.01 mg/L	±0.10 mg/L or ±5 % of reading**	Nessler	**HI94764A-25** (25 tests)
Ammonia HR	0 to 100 mg/L (as NH_3–N)	1 mg/L	±1 mg/L or ±5 % of reading**	Nessler	**HI94764B-25** (25 tests)
Chlorine, Free**	0.00 to 5.00 mg/L	0.01 mg/L below 0.99 mg/L; 0.1 mg/L above 0.99 mg/L	±0.03 mg/L or ±4 % of reading**	DPD	**HI93701-01** (100 tests) **HI93701-03** (300 tests)
Chlorine, Total**	0.00 to 5.00 mg/L	0.01 mg/L below 0.99 mg/L; 0.1 mg/L above 0.99 mg/L	±0.03 mg/L or ±4 % of reading**	DPD	**HI93711-01** (100 tests) **HI93711-03** (300 tests)
Nitrate	0.0 to 30.0 mg/L (as NO_3–N)	0.1 mg/L	±1.0 mg/L or ±5 % of reading** @20°C	chromotropic acid	**HI94766-50** (50 tests)
Nitrogen, Total LR	0.0 to 25.0 mg/L (as N)	0.1 mg/L	±1.0 mg/L or ±5 % of reading** @20°C	chromotropic acid	**HI94767A-50** (50 tests)
Nitrogen, Total HR	10 to 150 mg/L (as N)	1 mg/L	±3 mg/L or ±4 % of reading**	chromotropic acid	**HI94767B-50** (50 tests)
Phosphorus, Acid Hydrolyzable	0.00 to 1.60 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±5 % of reading**	ascorbic acid	**HI94758B-50** (50 tests)
Phosphorus, Reactive	0.00 to 1.60 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±5 % of reading**	ascorbic acid	**HI94758A-50** (50 tests)
Phosphorus, Reactive HR	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±5 % of reading**	vanadomolybdophosphoric acid	**HI94763A-50** (50 tests)
Phosphorus, Total	0.00 to 1.15 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±6 % of reading**	ascorbic acid	**HI94758C-50** (50 tests)
Phosphorus, Total HR	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±5 % of reading**	vanadomolybdophosphoric acid	**HI94763B-50** (50 tests)

Notes:
‡ Method with chromium-sulfuric acid is officially recognized by EPA for wastewater analysis.
◊ The HI94754F-25 and HI94754G-25 method follows the official method ISO 15705.
◊◊This method is recommended for general purpose analysis with no chloride interference.

* @ 25°C (77°F) unless otherwise stated
** Whichever is greater

HI83399

Multiparameter Photometer with COD for Water and Wastewater

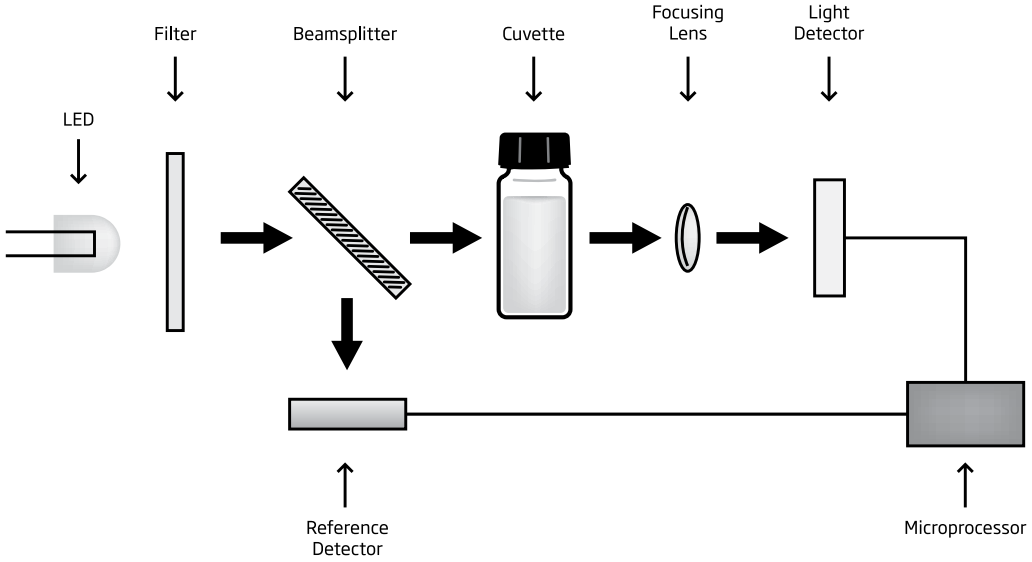
with Digital pH Electrode Input

Application Designed Photometers

HI83399 benchtop photometer measures 40 different key water and wastewater quality parameters using 73 different methods that allow for multiple ranges and variations in chemistry for specific applications. The Chemical Oxygen Demand (COD) parameter is included for industrial and municipal wastewater treatment. The Phosphorous and Nitrogen parameters included are beneficial to municipal wastewater treatment customers that need to monitor their biological and chemical nutrient removal process. This photometer features an innovative optical system that uses LEDS, narrow band interference filters, focusing lens and both a silicon photodetector for absorbance measurement and a reference detector to maintain a consistent light source ensures accurate and repeatable photometric readings every time.

To save valuable laboratory benchtop space, the HI83399 doubles as a professional pH meter with its digital pH/temperature electrode input. Now one meter can be used for both photometric and pH measurements.

- Water and wastewater treatment digestion parameters
  - Allows measurement of COD, Total Nitrogen and Total Phosphorus
- Advanced optical system
  - Innovative optical design that utilizes a reference detector and focusing lens to eliminate errors from changes in the light source and from imperfections in the glass cuvette.
- Backlit 128 x 64 Pixel Graphic LCD Display
  - Backlit graphic display allows for easy viewing in low light conditions
  - The 128 x 64 Pixel LCD allows for a simplified user interface with virtual keys and on-screen help to guide the user through use of the meter
- Built-in Reaction Timer for Photometric Measurements
  - The measurement is taken after the countdown timer expires.
  - Countdown timer ensures that all readings are taken at the appropriate reaction intervals regardless of user for better consistency in measurements
- Absorbance mode
  - Hanna's exclusive CAL Check cuvettes for validation of light source and detector
  - Allows for the user to plot concentration versus absorbance for a specific wavelength for use with user supplied chemistry or for teaching principles of photometry
- Units of Measure
  - Appropriate unit of measure along with chemical form is displayed along with reading
- Result Conversion
  - Automatically convert readings to other chemical forms with the touch of a button
- Cuvette Cover
  - Aids in preventing stray light from affecting measurements
- Digital pH Electrode Input
  - Measure pH and temperature with a single probe
  - Good Laboratory Practice (GLP) to track calibration information including date, time, buffers used, offset and slope for traceability
  - pH CAL Check alerts user to potential problems during the calibration process
  - Space saving having a pH meter and photometer built into one meter
- Data Logging
  - Up to 1000 photometric and pH readings can be stored by simply pressing the dedicated LOG button. Logged readings are just as easily recalled by pressing the RCL button
  - Sample ID and User ID information can be added to a logged reading using alphanumeric keypad
- Connectivity
  - Logged readings can be quickly and easily transferred to a flash drive using the USB-A host port or to a computer using the micro USB-B port
  - Data is exported as a .CSV file for use with common spreadsheet programs
- Rechargeable Battery
  - Li-polymer rechargeable battery lasts for 500 measurements or 50 hours of pH measurement
- Battery Status Indicator
  - Indicates the amount of battery life left
- Error Messages
  - Photometric error messages
  - pH calibration messages include clean electrode, check buffer and check probe



Improved Optical System

HI83300 family is designed with an innovative optical system that incorporates a beam splitter so that light can be used for absorbance readings and for a reference detector. The reference detector monitors the intensity of light and modulates when there is drift due to power fluctuation or the heating of the optical components. Each part has an important role in providing unparalleled performance from a photometer.

High Efficiency LED Light Source

An LED light source offers superior performance as compared to a tungsten lamp. LEDs have a much higher luminous efficiency, providing more light while using less power. They also produce very little heat, which could otherwise affect the optical components an electronic stability.

Quality Narrow Band Interference Filters

The narrow band interference filter not only ensures greater wavelength accuracy (±1 nm) but is also extremely efficient, allowing a brighter, stronger signal to be transmitted. The end result is increased measurement stability and less wavelength error.

Reference Detector for a Stable Light Source

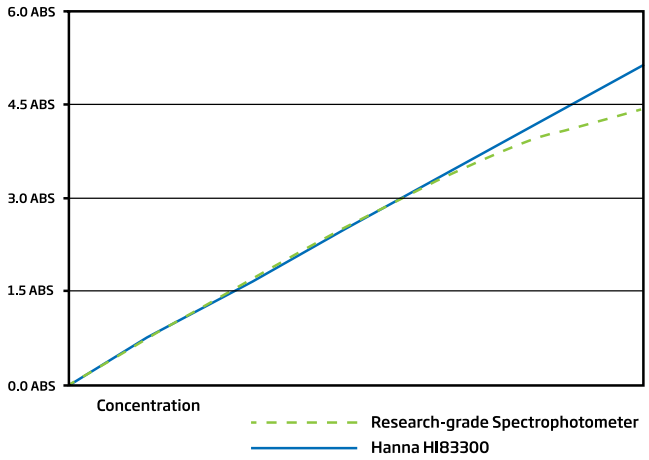
A beam splitter is used as part of the internal reference system of the HI83300 photometer. The reference detector compensates for any drift due to power fluctuations or ambient temperature changes. Now you can rely on a stable source of light.

Large Cuvette Size

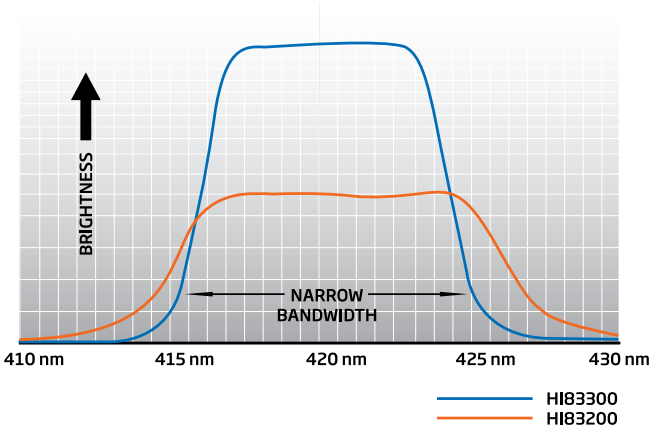
The sample cell of the HI83300 fits a round, glass cuvette with a 25 mm path length. Along with the advanced optical components, the larger size of the cuvette greatly reduces errors in rotation from the indexing mark of the cuvettes. The relatively long path length of the sample cuvette allows the light to pass through more of the sample solution, ensuring accurate measurements even in low absorbance samples.

Focusing Lens for Greater Light Yield

Adding a focusing lens to the optical path allows for the collection of all of the light that exits the cuvette and focusing the light on the silicon photo detector. This innovative approach to photometric measurements cancels the errors from imperfections and scratches present in the glass cuvette eliminating the need to index the cuvette.



- Better linearity than research-grade spectrophotometers



- Improved optical filters – higher wavelength accuracy and light throughput

Cuvette Adapter

The HI83399 is supplied with a 16 mm cuvette adapter that accepts digestion vials.

Digestion Vial Methods

Compatible with COD (EPA, ISO, and mercury free methods), Nitrogen and Phosphorous reagetns packaged in 16 mm digestion vial. Reagents are sold separately.

COD Reactor for Digestion Vials

A COD reactor is used to heat the digestion vials. The digestion vials must be heated to a specific temperature for a period time making the HI839800 an important accessory required to have a complete wastewater treatment monitoring system. HI839800 sold separately.

Connectivity

① pH Connectivity

Any of our digital pH electrodes can be connected to the HI83300 family by a 3.5 mm input. Plugging in an electrode has never been easier; there are no alignment issues or broken pins. Simply connect the electrode and start taking measurements.

② Dual Power Supply

The HI83399 is equipped with a rechargeable lithium ion battery that lasts up to 500 photometer measurements or 50 hours of continuous pH measurements. A power supply can also be plugged into the micro USB port at the back of the meter.

②③ USB Connectivity

Both a USB and micro USB port are located on the HI83399. Each of these ports can be used to transfer data via flash drive or direct connection to a PC or MAC. Data is transferred as CSV files for easy processing and widespread compatibility.

Photometer Capabilities

Concentration Measurement Function

Users can access the menu of measurement methods with the simple press of a button. Low, medium, and high range methods of several parameters are available for users to obtain a high accuracy reading. Each method is assigned a concentration unit of measure. Parameters can be expressed in different chemical forms based on their preference.

CAL Check Functionality

Hanna's exclusive CAL Check feature allows for performance verification of the independent measuring channels. Our CAL Check standard vials are developed to simulate a specific absorbance value at each wavelength to verify its' accuracy.

Built-in Reaction Timer

Reaction time is of key importance when performing colorimetric measurements, which is why the built-in timer of the HI83300 is an ideal feature. The countdown timer displays the time remaining until a measurement will be taken, ensuring consistent results between measurements and users.

pH Measurement

The HI83300 family offers the ability to connect a digital pH electrode. Users can connect any sensor from our extensive line of digital pH electrodes. Whether a user requires a glass or plastic body, a spheric or conic tip shape, or the ability for safe use with food samples, our digital electrode offering is suitable for nearly everyone.

Large Cuvettes

The sample cell of these meters fits a round, glass cuvette with a 25 mm path length. The relatively long path length of the sample cuvette allows the light to pass through more of the sample solution, ensuring accurate measurements even in low absorbance samples. This cuvette size also provides a larger opening, making it easier for users to dispense ready-made liquid or powder reagents into the sample.

An affixed, light-blocking cover panel closes over the sample cell, reducing stray light from affecting any measurement readings.

Absorbance Measurement Mode

Users can select to calibrate and measure samples in absorbance mode for each wavelength used by the meter. This mode is a convenient way for users to develop their own calibration curves and measure samples with customized chemistries.

Data Management Capabilities

User ID and Sample ID

An alphanumeric keypad can be used to enter sample ID and user ID to be stored with the measurement reading. The recall key allows the user to review the data along with the date and time that the reading was taken.

Data Management

The HI83399 can store up to 1000 photometer and pH electrode readings, which can be logged by pressing the LOG key on the face of the meter. pH readings are logged along with comprehensive GLP (Good Laboratory Practice) information such as date, time, calibration buffers, and electrode offset and slope.

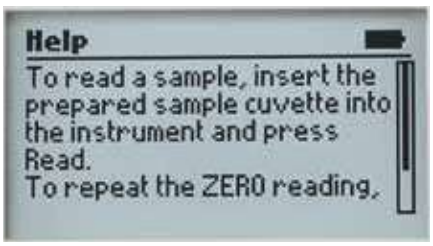
USB for Data Transfer

Two USB ports are provided for transferring data. One port allows the data to be transferred to a flash drive while the other USB is used for direct connection to a computer. All data is transferred as a .csv file that can be used with many spreadsheet programs for documentation.

Display Features

Backlit Graphic LCD Display

A backlit, graphic LCD display provides an easy to read, user-friendly interface.



Intuitive Display

With virtual keys, a battery status indicator, and practical error messages, users will find the meter interface intuitive. On-screen guides provide information relating to the current meter operation, and can be used at any stage in the setup or measurement process to show contextual help.

Specifications

Measurement Channels		5 x optical channels; 1 x digital electrode channel (pH measurement)
Absorbance	Range	0.000 to 4.000 Abs
	Resolution	0.001 Abs
	Accuracy	±0.003 Abs (at 1.000 Abs)
	Light Source	light-emitting diode
	Bandpass Filter Bandwidth	8 nm
	Bandpass Filter Wavelength Accuracy	± 1.0 nm
	Light Detector	silicon photocell
	Cuvette Type	round, 24.6 mm diameter and 16 mm diameter
	Number of Methods	128 max
pH	Range	-2.00 to 16.00 pH (±1000 mV)*
	Resolution	0.01 pH (0.1 mV)
	Temperature Compensation	Automatic (-5.0 to 100.0°C; 23.0 to 212.0°F)*
Temperature	Range	-20 to 120°C (-4.0 to 248.0 °F)
	Resolution	0.1 °C (0.1 °F)
Additional Specifications	pH electrode	digital pH electrode (not included)
	Logging	1000 readings (mixed photometer and electrode); log on demand with user name and sample ID optional input
	Display	128 x 64 pixel LCD with backlight
	Connectivity	USB-A host for flash drive; micro-USB-B for power and computer connectivity
	Battery Life	3.7 VDC Li-polymer rechargeable battery / >500 photometric measurements or 50 hours of continuous pH measurement
	Power Supply	5 VDC USB 2.0 power adapter with USB-A to micro-USB-B cable (included)
	Environment	0 to 50°C (32 to 122°F); 0 to 95% RH, non-condensing
	Dimensions	206 x 177 x 97 mm (8.1 x 7.0 x 3.8 in.)
	Weight	1.0 kg (2.2 lbs.)

Parameter	Range	Resolution	Accuracy	LED with Narrow Band Interference Filter	Method
Alkalinity	0 to 500 mg/L (as $CaCO_3$)	1 mg/L	±5 mg/L ±5% of reading at 25 °C	@ 610 nm	Bromocresol green
Alkalinity, Marine	0 to 300 mg/L (as $CaCO_3$)	1 mg/L	±5 mg/L ±5% of reading at 25 °C	@ 610 nm	Bromocresol green
Aluminum	0.00 to 1.00 mg/L (as Al_3^+)	0.01 mg/L	±0.04 mg/L ±4% of reading at 25 °C	@ 525 nm	aluminon
Ammonia Low Range	0.00 to 3.00 mg/L (as NH_3-N)	0.01 mg/L	±0.04 mg/L ±4% of reading at 25 °C	@ 420 nm	Nessler
Ammonia Low Range (16 mm vial)	0.00 to 3.00 mg/L (as NH_3-N)	0.01 mg/L	± 0.10 mg/L or ± 5% of reading at 25 °C, whichever is greater	@ 420 nm	Nessler
Ammonia Medium Range	0.00 to 10.00 mg/L (as NH_3-N)	0.01 mg/L	±0.05 mg/L ±5% of reading at 25 °C	@ 420 nm	Nessler
Ammonia High Range	0.0 to 100.0 mg/L (as NH_3-N)	0.1 mg/L	±0.5 mg/L ±5% of reading at 25 °C	@ 420 nm	Nessler
Ammonia High Range (16 mm vial)	0.0 to 100.0 mg/L (as NH_3-N)	0.1 mg/L	± 1 mg/L or ± 5% of reading at 25 °C, whichever is greater	@ 420 nm	Nessler
Bromine	0.00 to 8.00 mg/L (as Br_2)	0.01 mg/L	±0.08 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Calcium	0 to 400 mg/L (as Ca^{2+})	1 mg/L	±10 mg/L ±5% of reading at 25 °C	@ 466 nm	oxalate
Calcium, Marine	200 to 600 mg/L (as Ca^{2+})	1 mg/L	±6% of reading at 25 °C	@ 610 nm	zincon
Chloride	0.0 to 20.0 mg/L (as Cl^-)	0.1 mg/L	±0.5 mg/L ±6% of reading at 25 °C	@ 466 nm	mercury (II) thiocyanate
Chlorine Dioxide	0.00 to 2.00 mg/L (as ClO_2)	0.01 mg/L	±0.10 mg/L ±5% of reading at 25 °C	@ 575 nm	chlorophenol red
Chlorine, Free	0.00 to 5.00 mg/L (as Cl_2)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Chlorine, Free Ultra Low Range	0.000 to 0.500 mg/L (as Cl_2)	0.001 mg/L	±0.020 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Chlorine, Total	0.00 to 5.00 mg/L (as Cl^-)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Chlorine, Total Ultra Low Range	0.000 to 0.500 mg/L (as Cl_2)	0.001 mg/L	±0.020 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Chlorine, Total Ultra High Range	0 to 500 mg/L (as Cl_2)	1 mg/L	±3 mg/L ±3% of reading at 25 °C	@ 525 nm	iodometric
Chromium(VI) Low Range	0 to 300 µg/L (as Cr^{6+})	1 µg/L	±1 µg/L ±4% of reading at 25 °C	@ 525 nm	diphenylcarbohydrazide
Chromium(VI) High Range	0 to 1000 µg/L (as Cr^{6+})	1 µg/L	±5 µg/L ±4% of reading at 25 °C	@ 525 nm	diphenylcarbohydrazide
COD Low Range (16 mm vial)*	0 to 150 mg/L (as O_2)	1 mg/L	±5 mg/L or ±4% of reading @ 25 °C, whichever is greater	@ 420 nm	ISO, EPA and mercury-free dichromate
COD Medium Range (16 mm vial)*	0 to 1500 mg/L (as O_2)	1 mg/L	±15 mg/L or ±4% of reading @ 25 °C, whichever is greater	@ 610 nm	ISO, EPA and mercury-free dichromate
COD HR (16 mm vial)*	0 to 15000 mg/L (as O_2)	1 mg/L	±150 mg/L or ±2% of reading @ 25 °C, whichever is greater	@ 610 nm	dichromate

***COD Rapid Method available.**

Parameter	Range	Resolution	Accuracy	LED (λ nm) with Narrow Band Interference Filter	Method
Color of Water	0 to 500 PCU (Platinum Cobalt Units)	1 PCU	±10 PCU ±5% of reading at 25 °C	@ 420 nm	colorimetric platinum cobalt
Copper Low Range	0.000 to 1.500 mg/L (as Cu^{2+})	0.001 mg/L	±0.01 mg/L ±5% of reading at 25 °C	@ 575 nm	bicinchoninate
Copper High Range	0.00 to 5.00 mg/L (as Cu^{2+})	0.01 mg/L	±0.02 mg/L ±4% of reading at 25 °C	@ 575 nm	bicinchoninate
Cyanuric Acid	0 to 80 mg/L (as CYA)	1 mg/L	±1 mg/L ±15% of reading at 25 °C	@ 525 nm	turbidimetric
Fluoride Low Range	0.00 to 2.00 mg/L (as F^-)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 575 nm	SPADNS
Fluoride High Range	0.0 to 20.0 mg/L (as F^-)	0.1 mg/L	±0.5 mg/L ±3% of reading at 25 °C	@ 575 nm	SPADNS
Hardness, Calcium	0.00 to 2.70 mg/L (as $CaCO_3$)	0.01 mg/L	±0.11 mg/L ±5% of reading at 25 °C	@ 525 nm	calmagite
Hardness, Magnesium	0.00 to 2.00 mg/L (ppm) (as $CaCO_3$)	0.01 mg/L	±0.11 mg/L ±5% of reading at 25 °C	@ 525 nm	calmagite
Hardness, Total Low Range	0 to 250 mg/L (as $CaCO_3$)	1 mg/L	±5 mg/L ±4% of reading at 25 °C	@ 466 nm	calmagite
Hardness, Total Medium Range	200 to 500 mg/L (as $CaCO_3$)	1 mg/L	±7 mg/L ±3% of reading at 25 °C	@ 466 nm	calmagite
Hardness, Total High Range	400 to 750 mg/L (as $CaCO_3$)	1 mg/L	±10 mg/L ±2% of reading at 25 °C	@ 466 nm	calmagite
Hydrazine	0 to 400 µg/L (as N_2H_4)	1 µg/L	±4% of full scale reading at 25 °C	@ 466 nm	p-Dimethylaminobenzaldehyde
Iodine	0.0 to 12.5 mg/L (as I_2)	0.1 mg/L	±0.1 mg/L ±5% of reading at 25 °C	@ 525 nm	DPD
Iron Low Range	0.000 to 1.600 mg/L (as Fe)	0.001 mg/L	±0.01 mg/L ±8% of reading at 25 °C	@ 575 nm	TPTZ
Iron High Range	0.00 to 5.00 mg/L (as Fe)	0.01 mg/L	±0.04 mg/L ±2% of reading at 25 °C	@ 525 nm	phenanthroline
Magnesium	0 to 150 mg/L (as Mg^{2+})	1 mg/L	±5 mg/L ±3% of reading at 25 °C	@ 466 nm	calmagite
Manganese Low Range	0 to 300 µg/L (as Mn)	1 µg/L	±10 µg/L ±3% of reading at 25 °C	@ 575 nm	PAN
Manganese High Range	0.0 to 20.0 mg/L (as Mn)	0.1 mg/L	±0.2 mg/L ±3% of reading at 25 °C	@ 525 nm	periodate
Molybdenum	0.0 to 40.0 mg/L (as Mo^{6+})	0.1 mg/L	±0.3 mg/L ±5% of reading at 25 °C	@ 420 nm	mercaptoacetic acid
Nickel Low Range	0.000 to 1.000 mg/L (as Ni)	0.001 mg/L	±0.010 mg/L ±7% of reading at 25 °C	@ 575 nm	PAN
Nickel High Range	0.00 to 7.00 g/L (as Ni)	0.01 g/L	±0.07g/L ±4% of reading at 25 °C	@ 575 nm	EDTA
Nitrate	0.0 to 30.0 mg/L (as NO_3^-- N)	0.1 mg/L	±0.5 mg/L ±10% of reading at 25 °C	@ 525 nm	cadmium reduction
Nitrate (16 mm vial)	0.0 to 30.0 mg/L Nitrate (as NO_3^-- N)	0.1 mg/L	±1.0 mg/L or ±3% of reading at 25 °C, whichever is greater	@ 420 nm	chromotropic acid
Nitrite Ultra Low Range, Marine	0 to 200 µg/L (as NO_2^-- N)	1 µg/L	±10 µg/L ±4% of reading at 25 °C	@ 466 nm	diazotization
Nitrite Low Range	0 to 600 µg/L (as NO_2^-- N)	1 µg/L	±20 µg/L ±4% of reading at 25 °C	@ 466 nm	diazotization
Nitrite High Range	0 to 150 mg/L (as NO_2^-- N)	1 mg/L	±4 mg/L ±4% of reading at 25 °C	@ 575 nm	ferrous sulfate
Nitrogen, Total Low Range (16 mm vial)	0.0 to 25.0 mg/L (as NO_3^-- N)	0.1 mg/L	±1.0 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 420 nm	chromotropic acid
Nitrogen, Total High Range (16 mm vial)	0 to 150 mg/L (as N)	1 mg/L	±3 mg/L or ±4% of reading at 20 °C, whichever is greater	@ 420 nm	chromotropic acid
Oxygen, Dissolved	0.0 to 10.0 mg/L (as O_2)	0.1 mg/L	±0.4 mg/L ±3% of reading at 25 °C	@ 420 nm	Winkler
Oxygen Scavengers	0.00 to 1.50 mg/L (as Carbohydrazide)	0.01 mg/L	±5 µg/L ±5% of reading at 25 °C	@ 575 nm	iron reduction
Oxygen Scavengers	0 to 1000 µg/L (as DEHA)	1 µg/L	±5 µg/L ±5% of reading at 25 °C	@ 575 nm	iron reduction
Oxygen Scavengers	0.00 to 2.50 mg/L (as Hydroquinone)	0.01 mg/L	±5 µg/L ±5% of reading at 25 °C	@ 575 nm	iron reduction
Oxygen Scavengers	0.00 to 4.50 mg/L (as Iso-ascorbic acid)	0.01 mg/L	±5 µg/L ±5% of reading at 25 °C	@ 575 nm	iron reduction
Ozone	0.00 to 2.00 mg/L (as O_3)	0.01 mg/L	±0.02 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
pH	6.5 to 8.5 pH	0.1 pH	±0.1 pH at 25 °C	@ 525 nm	phenol red
Phosphate Ultra Low Range, Marine	0 to 200 µg/L (as P)	1 µg/L	±5 µg/L ±5% of reading at 25 °C	@ 610 nm	ascorbic acid
Phosphate Low Range	0.00 to 2.50 mg/L (ppm)	0.01 mg/L	±0.04 mg/L ±4% of reading at 25 °C	@ 610 nm	ascorbic acid
Phosphate High Range	0.0 to 30.0 mg/L (as PO_4^{3-})	0.1 mg/L	±1 mg/L ±4% of reading at 25 °C	@ 525 nm	amino acid
Phosphorus Reactive Low Range (16 mm vial)	0.00 to 1.60 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±4% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus Reactive High Range (16 mm vial)	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±4% of reading at 25 °C, whichever is greater	@ 420 nm	vanadomolybdophosphoric acid
Phosphorus Acid Hydrolyzable (16 mm vial)	0 to 1.6 mg/L (ppm) (as P)	0.1 mg/L	±0.05 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus, Total Low Range (16 mm vial)	0.00 to 1.15 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±6% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus, Total High Range (16 mm vial)	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 420 nm	vanadomolybdophosphoric acid
Potassium	0.0 to 20.0 mg/L (as K)	0.1 mg/L	±3.0 mg/L ±7% of reading at 25 °C	@ 466 nm	turbidimetric tetraphenylborate
Silica Low Range	0.00 to 2.00 mg/L (as SiO_2)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 610 nm	heteropoly blue
Silica High range	0 to 200 mg/L (as SiO_2)	1 mg/L	±1 mg/L ±5% of reading at 25 °C	@ 466 nm	molybdosilicate
Silver	0.000 to 1.000 mg/L (as Ag)	0.001 mg/L	±0.020 mg/L ±5% of reading at 25 °C	@ 575 nm	PAN
Sulfate	0 to 150 mg/L (as SO_4^{2-})	1 mg/L	±5 mg/L ±3% of reading at 25 °C	@ 466 nm	turbidimetric
Surfactants, Anionic	0.00 to 3.50 mg/L (as SDBS)	0.01 mg/L	±0.04 mg/L ±3% of reading at 25 °C	@ 610 nm	methylene blue
Zinc	0.00 to 3.00 mg/L (as Zn)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 575 nm	zincon

Ordering Information	**HI83399-01** (115V) and **HI83399-02** (230V) is supplied with sample cuvettes and caps (4 ea.), digestion vials (6), vial adapter, cloth for wiping cuvettes, USB to micro USB cable connector, power adapter, instrument quality certificate, and instruction manual.
Standards	**HI83399-11** CAL Check Cuvette Kit for HI83399

HI83314

Multiparameter Photometer with COD for Wastewater

with Digital pH Electrode Input

Application Designed Photometers

HI83314 benchtop photometer measures 10 different key wastewater quality parameters using 20 different methods that allow for multiple ranges and variations in chemistry for specific applications. The Chemical Oxygen Demand (COD) parameter is included for industrial and municipal wastewater treatment. The Phosphorous and Nitrogen parameters included are beneficial to municipal wastewater treatment customers that need to monitor their biological and chemical nutrient removal process. This photometer features an innovative optical system that uses LED's, narrow band interference filters, focusing lens and both a silicon photodetector for absorbance measurement and a reference detector to maintain a consistent light source ensures accurate and repeatable photometric readings every time.

To save valuable laboratory benchtop space, the HI83314 doubles as a professional pH meter with its digital pH/temperature electrode input. Now one meter can be used for both photometric and pH measurements.

- Advanced optical system
  - Innovative optical design that utilizes a reference detector and focusing lens to eliminate errors from changes in the light source and from imperfections in the glass cuvette.
- Backlit 128 x 64 Pixel Graphic LCD Display
  - Backlit graphic display allows for easy viewing in low light conditions
  - The 128 x 64 Pixel LCD allows for a simplified user interface with virtual keys and on-screen help to guide the user through use of the meter
- Built-in Reaction Timer for Photometric Measurements
  - The measurement is taken after the countdown timer expires.
  - Countdown timer ensures that all readings are taken at the appropriate reaction intervals regardless of user for better consistency in measurements
- Absorbance mode
  - Hanna's exclusive CAL Check cuvettes for validation of light source and detector
  - Allows for the user to plot concentration versus absorbance for a specific wavelength for use with user supplied chemistry or for teaching principles of photometry
- Units of Measure
  - Appropriate unit of measure along with chemical form is displayed along with reading
- Result Conversion
  - Automatically convert readings to other chemical forms with the touch of a button
- Cuvette Cover
  - Aids in preventing stray light from affecting measurements
- Digital pH Electrode Input
  - Measure pH and temperature with a single probe
  - Good Laboratory Practice (GLP) to track calibration information including date, time, buffers used, offset and slope for traceability
  - pH CAL Check alerts user to potential problems during the calibration process
  - Space saving having a pH meter and photometer built into one meter
- Data Logging
  - Up to 1000 photometric and pH readings can be stored by simply pressing the dedicated LOG button. Logged readings are just as easily recalled by pressing the RCL button
  - Sample ID and User ID information can be added to a logged reading using alphanumeric keypad
- Connectivity
  - Logged readings can be quickly and easily transferred to a flash drive using the USB-A host port or to a computer using the micro USB-B port
  - Data is exported as a .CSV file for use with common spreadsheet programs
- Rechargeable Battery
  - Li-polymer rechargeable battery lasts for 500 measurements or 50 hours of pH measurement
- Battery Status Indicator
  - Indicates the amount of battery life left
- Error Messages
  - Photometric error messages
  - pH calibration messages include clean electrode, check buffer and check probe

Specifications

Measurement Channels		5 x optical channels; 1 x digital electrode channel (pH measurement)
Absorbance	Range	0.000 to 4.000 Abs
	Resolution	0.001 Abs
	Accuracy	±0.003 Abs (at 1.000 Abs)
	Light Source	light-emitting diode
	Bandpass Filter Bandwidth	8 nm
	Bandpass Filter Wavelength Accuracy	± 1.0 nm
	Light Detector	silicon photocell
	Cuvette Type	round, 24.6 mm diameter and 16 mm diameter
	Number of Methods	128 max
pH	Range	-2.00 to 16.00 pH (±1000 mV)*
	Resolution	0.01 pH (0.1 mV)
	Temperature Compensation	Automatic (-5.0 to 100.0°C; 23.0 to 212.0°F)*
Temperature	Range	-20 to 120°C (-4.0 to 248.0 °F)
	Resolution	0.1 °C (0.1 °F)
Additional Specifications	pH electrode	digital pH electrode (not included)
	Logging	1000 readings (mixed photometer and electrode); log on demand with user name and sample ID optional input
	Display	128 x 64 pixel LCD with backlight
	Connectivity	USB-A host for flash drive; micro-USB-B for power and computer connectivity
	Battery Life	3.7 VDC Li-polymer rechargeable battery / >500 photometric measurements or 50 hours of continuous pH measurement
	Power Supply	5 VDC USB 2.0 power adapter with USB-A to micro-USB-B cable (included)
	Environment	0 to 50°C (32 to 122°F); 0 to 95% RH, non-condensing
	Dimensions	206 x 177 x 97 mm (8.1 x 7.0 x 3.8 in.)
	Weight	1.0 kg (2.2 lbs.)

Parameter	Range	Resolution	Accuracy	LED (λ nm) with Narrow Band Interference Filter	Method
Ammonia Low Range	0.00 to 3.00 mg/L (as NH_3-N)	0.01 mg/L	±0.04 mg/L ±4% of reading at 25 °C	@ 420 nm	Nessler
Ammonia Low Range (16 mm vial)	0.00 to 3.00 mg/L (as NH_3-N)	0.01 mg/L	± 0.10 mg/L or ± 5% of reading at 25 °C, whichever is greater	@ 420 nm	Nessler
Ammonia Medium Range	0.00 to 10.00 mg/L (as NH_3-N)	0.01 mg/L	±0.05 mg/L ±5% of reading at 25 °C	@ 420 nm	Nessler
Ammonia High Range	0.0 to 100.0 mg/L (as NH_3-N)	0.1 mg/L	±0.5 mg/L ±5% of reading at 25 °C	@ 420 nm	Nessler
Ammonia High Range (16 mm vial)	0.0 to 100.0 mg/L (as NH_3-N)	0.1 mg/L	± 1 mg/L or ± 5% of reading at 25 °C, whichever is greater	@ 420 nm	Nessler
Chlorine, Free	0.00 to 5.00 mg/L (as Cl_2)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
Chlorine, Total	0.00 to 5.00 mg/L (as Cl^-)	0.01 mg/L	±0.03 mg/L ±3% of reading at 25 °C	@ 525 nm	DPD
COD Low Range (16 mm vial)*	0 to 150 mg/L (as O_2)	1 mg/L	±5 mg/L or ±4% of reading @ 25 °C, whichever is greater	@ 420 nm	ISO, EPA and mercury-free dichromate
COD Medium Range (16 mm vial)*	0 to 1500 mg/L (as O_2)	1 mg/L	±15 mg/L or ±4% of reading @ 25 °C, whichever is greater	@ 610 nm	ISO, EPA and mercury-free dichromate
COD HR (16 mm vial)*	0 to 15000 mg/L (as O_2)	1 mg/L	±150 mg/L or ±2% of reading @ 25 °C, whichever is greater	@ 610 nm	dichromate
Nitrate (16 mm vial)	0.0 to 30.0 mg/L (as NO_3^-- N)	0.1 mg/L	±1.0 mg/L or ±3% of reading at 25 °C, whichever is greater	@ 420 nm	chromotropic acid
Nitrite Ultra Low Range, Marine	0 to 200 µg/L (as NO_2^-- N)	1 µg/L	±10 µg/L ±4% of reading at 25 °C	@ 466 nm	diazotization
Nitrite Low Range	0 to 600 µg/L (as NO_2^-- N)	1 µg/L	±20 µg/L ±4% of reading at 25 °C	@ 466 nm	diazotization
Nitrite High Range	0 to 150 mg/L (as NO_2^-- N)	1 mg/L	±4 mg/L ±4% of reading at 25 °C	@ 575 nm	ferrous sulfate
Nitrogen, Total Low Range (16 mm vial)	0.0 to 25.0 mg/L (as NO_3^-- N)	0.1 mg/L	±1.0 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 420 nm	chromotropic acid
Nitrogen, Total High Range (16 mm vial)	0 to 150 mg/L (as N)	1 mg/L	±3 mg/L or ±4% of reading at 20 °C, whichever is greater	@ 420 nm	chromotropic acid
Phosphorus Reactive Low Range (16 mm vial)	0.00 to 1.60 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±4% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus Reactive High Range (16 mm vial)	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±4% of reading at 25 °C, whichever is greater	@ 420 nm	vanadomolybdophosphoric acid
Phosphorus Acid Hydrolyzable (16 mm vial)	0 to 1.6 mg/L (ppm) (as P)	0.1 mg/L	±0.05 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus, Total Low Range (16 mm vial)	0.00 to 1.15 mg/L (as P)	0.01 mg/L	±0.05 mg/L or ±6% of reading at 25 °C, whichever is greater	@ 610 nm	ascorbic acid
Phosphorus, Total High Range (16 mm vial)	0.0 to 32.6 mg/L (as P)	0.1 mg/L	±0.5 mg/L or ±5% of reading at 25 °C, whichever is greater	@ 420 nm	vanadomolybdophosphoric acid

Ordering Information

HI83314-01 (115V) and **HI83314-02** (230V) is supplied with sample cuvettes and caps (4 ea.), digestion vials (6), vial adapter, cloth for wiping cuvettes, USB to micro USB cable connector, power adapter, instrument quality certificate, and instruction manual.

Standards

HI83314-11 CAL Check Cuvette Kit for HI83399

***COD Rapid Method available.**

General Accessories for HI83399 and HI83314

HI83300-100 sample preparation kit consisting of activated carbon for 50 tests, 100 g demineralizer bottle, 170 mL graduated beaker, 100 mL beaker, 3 mL pipette, 60 mL syringe, 5 mL syringe, graduated cylinder, spoon, funnel, paper filters (25)

HI72083300 carrying case for HI83300 family

HI920015 USB to micro USB cable connector

HI740224 plastic beaker 170 mL (6)

HI76404A electrode holder for HI83300 family

HI731318 cuvette cleaning cloth (4)

HI740225 60 mL graduated syringe

HI731331 cuvette (4)
HI731335N caps for cuvette (4)

HI740226 5 mL graduated syringe

HI11310 digital combination pH electrode

HI93703-55 activated carbon for 50 tests

HI75110/230 USB power supply

HI740036P beaker, plastic 100 mL (10)
HI740034P cap for 100 mL plastic beaker (10)

COD Certified Standards and Reagents

HI93754A

Each box of 25 vials is supplied with a Hanna certificate of quality. The reagents are traceable to NIST SRM® 930.

- Three measurement ranges to satisfy every need
  - As COD levels vary depending on the application and process measuring points, Hanna offers reagents to cover three separate ranges. Simply choose the best range for the application: low range: 0 to 150 mg/L O_2 medium range: 0 to 1500 mg/L O_2 high range: 0 to 15000 mg/L O_2
- Accurate and repeatable measurements
  - Hanna COD reagents have been developed in accordance with Standard Methods 5220D, USEPA 410.4 and ISO 15705:2002 methods.
- Pre-dosed vials
  - Hanna vials contain approximately 3 mL of pre-dosed reagent. The operator just needs to add a small quantity of the sample.
- Quick and accurate measurements
  - With pre-dosed vials, test preparation time is dramatically reduced. There is no time-consuming reagent preparation procedure or glassware cleaning.
- Safe reagents
  - Hanna COD reagents are safe for operators and the environment. Vials and caps have been designed to avoid accidental reagent spills. Due to the pre-dosed reagents, the amount of chemicals and handling time is minimized.

COD Test	Range	Method	Reagent Code
COD LR	0 to 150 mg/L	dichromate EPA‡	**HI93754A-25**
		dichromate mercury-free°°	**HI93754D-25**
		dichromate ISO°	**HI93754F-25**
COD MR	0 to 1500 mg/L	dichromate EPA‡	**HI93754B-25**
		dichromate mercury-free°°	**HI93754E-25**
		dichromate ISO°	**HI93754G-25**
COD HR	0 to 15000 mg/L	dichromate	**HI93754C-25**

COD Standards

HI93754-11 500 ppm COD standard, 500 mL bottle

HI93754-12 14000 ppm COD standard, 500 mL bottle

HI93754E

Notes:
* Method with chromium-sulfuric acid is officially recognized by EPA for wastewater analysis.
** This method is recommended for general purpose analysis with no chloride interference.
*** Method follows the official method ISO 15705. COD MR ISO method is 0-1000 mg/L. Meter can read higher.

HI839800

COD Test Tube Heater

with 25 Vial Capacity

- Predefined Temperature Settings
  - The test tube heater features two predefined temperature profiles at 150°C (221°F) and 105°C (301°F) that can be selected at the press of a button.
- Temperature Alerts
  - The HI839800 alerts users in the event that the temperature of the heating block is either above or below the set temperature. A timer icon reminds users to wait until the heating block has cooled or warmed up before inserting their samples.
- Built-in Timer
  - A built-in countdown timer of up to 180 minutes allows users to easily set the required digestion time by simply pressing the up and down arrows. Once a time has been set and the heating element is stable, a press of the START button begins the digestion procedure.
- Status Indicator Lights
  - Three LED lights are featured on the HI839800. A green LED indicates the heater has been turned on; a yellow LED indicates when the heater is actively heating up to a set temperature; a red LED indicates when the heater goes above 50°C, reminding the user that the aluminum element is hot.
- Overheating Prevention
  - The HI839800 contains a thermal fuse that prevents overheating. Should overheating occur, the heater automatically shuts down and all LED indicator lights turn off.
- Reference Temperature Well
  - In addition to the 25 vial capacity of the aluminum heating block, a small well is available for a temperature probe for users that wish to verify their heating block.
- Two Operating Modes
  - The HI839800 features two operating modes: idle and heating. Idle mode is the default mode in which the heater measures and displays the current temperature, target temperature, set reaction time, and an "idle" tag. Heating mode is activated when users press the START button; it starts when actively heating and continues during the countdown timer.
- Continuous LCD Display
  - The block temperature is continuously displayed on the easy to read LCD display, even when there is no active temperature program running. All relevant information in addition to temperature are easily visible during idle and heating mode.
- Error Messages
  - Messages on display alerting to problems including high or low temperature, hot surface, or heating system malfunction.

The HI839800 COD Test Tube Heater features two predefined temperature profiles: 150°C and 105°C. Digestions for chemical oxygen (COD) and total phosphorus are conducted at 150°C, while total nitrogen digestions are conducted at 105°C. The test tube heater automatically heats up to the set temperature, holding it until the countdown timer has finished. Once the timer has ended, a beep will sound and the heating element will turn off. The outer casing of the HI839800 remains cool to the touch, even during a timed digestion. An optional lab safety shield and test tube cooling rack provide a complete setup for sample digestions.

Outer casing stays cool to the touch!

HI740217
Lab Safety Shield

HI740216
Test Tube Cooling Rack

For safety, the optional HI740217 safety shield and HI740216 test tube cooling rack for the HI839800 are strongly recommended.

Specifications	HI839800
Temperature of Reaction	105°C or 150°C (221°F or 302°F)
Temperature Stability	±0.5°C (±0.9°F)
Temperature Range	-10°C to 160°C (14°F to 320°F)
Accuracy	±2°C (±3.6°F)
Capacity	25 vials (dia 16 x 100 mm), one receptacle for a stainless steel reference thermometer
Warm-up Time	10-15 minutes, depending on selected temperature
Operating Mode	timed (0 to 180 minutes) or infinity mode
Block	aluminum
Environment	5 to 50°C (41 to 122°F)
Power Supply (fuse protected)	HI839800-01: 115 VAC; 60 Hz; 250 W; HI839800-02: 230 VAC; 50 Hz; 250 W
Dimensions	190 x 300 x 95 mm (7.5 x 11.8 x 3.7")
Weight	approximately 4.8 kg (10.6 lb.)
Ordering Information	**HI839800-01** (115V) and **HI839800-02** (230V) is supplied with power cable and instructions.

Table of Contents

Introduction to Turbidity

Turbidity of water is an optical property that causes light to be scattered and absorbed, rather than transmitted. The scattering of light that passes through a liquid is primarily caused by suspended solids. The higher the turbidity, the greater the amount of scattered light. Even a very pure fluid will scatter light to a certain degree; no solution will have zero turbidity.

There are different measurement standards used based on applications, and with these standards are applied units. The ISO standard adopted the FNU (Formazin Nephelometric Unit) while the EPA uses the NTU (Nephelometric Turbidity Unit). Other units include the JTU (Jackson Turbidity Unit), FTU (Formazin Turbidity Unit), EBC (European Brewery Convention Turbidity Unit) and diatomaceous earth (mg/L SiO_2).

	JTU	FTU (NTU/FNU)	SiO_2 (mg/L)
JTU	1	19	2.5
FTU (NTU/FNU)	0.053	1	0.13
SiO_2 (mg/L)	0.4	7.5	1

Monitoring for Natural Water Supplies

In natural water, turbidity measurements are taken to gauge general water quality and its compatibility in applications where there are aquatic organisms. It has been found that there is a strong correlation between turbidity and BOD (Biochemical Oxygen Demand) value. Moreover, by definition, turbidity obstructs light, thus reducing the growth of marine plants, eggs and larvae, which are usually found in the lower levels of an aquatic ecosystem.

Wastewater Treatment and Turbidity

Historically, turbidity is one of the main parameters monitored in wastewater. In fact, the monitoring and treatment process was once solely based on the control of turbidity. Currently, the measurement of turbidity at the end of the wastewater treatment process is necessary to verify that the values are within regulatory standards. Generally speaking, the turbidity value has to be between 0 and 50 FTU, with an accuracy of ±3 FTU depending on the phase of the wastewater treatment process. By monitoring the turbidity level, it can be determined if the different stages of the process, particularly in the filtration and purification stages, have been completed correctly.

The Hanna Solution

There are three analytical test methods for turbidity:

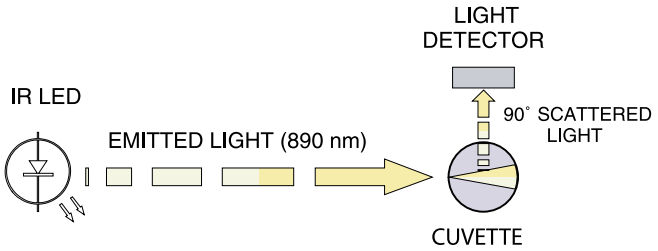
- ISO 7027 "Water Quality: Determination of Turbidity"
- USEPA Method No. 180.1, "Turbidity"
- Seawater and Wastewater No. 2130, "Turbidity"

Specific wavelengths are recommended for each method. For the USEPA and Standard Methods, the wavelength in the visible range of the spectrum is recommended, where the European ISO method requires an infrared light source.

The Infrared Method (ISO 7027)

The ISO 7027 standard specifies the key parameters for the optical system to measure turbidity for drinking and surface water, using the formazin-based metric method. The HI98713 portable turbidimeter meets or exceeds the criteria specified by the ISO 7027 standard.

ISO turbidity meters operate by passing a beam of infrared light through a vial containing the sample to be tested. The light source is a High Emission Infrared LED. A sensor positioned at 90° with respect to the direction of the light detects the amount of light scattered by the undissolved particles present in the sample. A microprocessor converts these readings into FTU (FNU) values.



The US Environmental Protection Agency Approved Method (180.1)

The USEPA Method 180.1 specifies the key parameters for the optical system to measure turbidity for drinking, saline and surface water, in a 0 to 40 NTU range, using the nephelometric method.

Meters compliant with EPA approved methods are designed to meet or exceed the criteria specified by the USEPA Method 180.1 and Standard Method 2130 B.

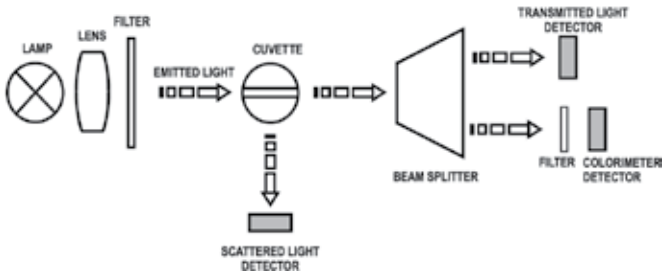
Principle of Operation

The light beam that passes through the sample is scattered in all directions. The intensity and pattern of the scattered light is affected by many variables, such as wavelength of the incident light, particle size and shape, refractive index, and color. The optical system includes a tungsten filament lamp or IR LED, a scattered light detector (90°), and a transmitted light detector (180°).

In the ratio turbidimeter range, the microprocessor of the instrument calculates the turbidity value from the signals that reach the two detectors by using an effective algorithm. This algorithm corrects and compensates for interferences of color, making the turbidimeters color-compensated. The optical system and measuring technique also compensate for the lamp or LED intensity fluctuations; minimizing the need for frequent calibration.

In the non-ratio turbidimeter range, the turbidity value is calculated from the signal on the scattered light detector (90°). This method offers a high linearity on the low range but is more sensitive to lamp or LED intensity fluctuations.

The lower detection limit of a turbidimeter is determined by stray light. Stray light is the light detected by the sensors that is not caused by light scattering from suspended particles. The optical systems of turbidimeters are designed to have very low stray light, providing accurate results for low turbidity samples.



Standardization

The nephelometric turbidity meter is designed to be routinely standardized with a known light scattering standard. As with all analytical standards or reference materials, a turbidity standard should be able to perform the following: provide traceability, demonstrate the accuracy of results, calibrate the equipment and methodology, monitor user performance, validate tests, and facilitate comparability; this ensures that when the correct procedures have been followed, the same analysis of the same materials will produce results that agree with each other whenever they are performed.

Standards and reference materials should be produced and characterized in a technically competent manner and should be homogenous, stable, certified and have available a known uncertainty of measurement. Presently, there are at least two standards recognized and approved by the USEPA, Standard Methods, ASTM and other regulatory agencies; these are formazin and AMCO AEPA-1.

Formazin

Formazin is an aqueous suspension of an insoluble polymer formed by the condensation reaction between hydrazine sulphate and hexamethylenetetramine. Although formazin was suggested as a turbidity standard as early as 1926, it has many limitations, such as its high toxicity, low shelf life, quick rate of settling and easy agglomeration. Also, the diluent for formazin standards must be turbidity-free water. This is often difficult to obtain, particularly in a field situation.

AMCO AEPA-1 Standard

Fortunately, since 1982, there is a standard available which overcomes the shortcomings of formazin. This has been developed by the American company, Advanced Polymer Systems, and is a suspended mixture of styrene divinylbenzene polymer spheres. These standards have the following characteristics:

Stability: AMCO AEPA-1 turbidity standards are a stabilized suspension of cross linked styrene divinylbenzene copolymer microbeads in ultrapure water. These beads are chemically inert and keep their chemical balance in a water medium regardless of concentration.

The size scatter of the beads only ranges from 0.06 to 0.2 microns. This small size accounts for random Brownian movement of these beads in suspension, keeping them in constant motion and totally dispersed within the ultra pure water matrix.

Physical properties: Particle size, uniform shape and refractive index make these spheres ideal to characterize light absorption and scatter for 90° behavior in the UV-VIS range. In addition, the bead's spherical shape and size impedes the agglomeration or precipitation of the standard. For these reasons, the AMCO AEPA-1 standards are very stable.

Reliability: These standards are prepared and bottled in a clean room facility. They are tested for accuracy and stability, fully validated before bottling, and free from any toxic or carcinogenic chemicals or compounds.

Hanna turbidity calibration standards are prepared from NIST traceable primary standard reference materials. All prepared standards are compared to formazin turbidity standard solutions. The values reported on Hanna Certificate of Analysis are the results obtained on the date of analysis. The evaluation of these data is based on Standard Methods.

Purification of Drinking Water

Turbidity is one of the most important parameters used to determine the quality of drinking water. Public water suppliers are required to treat their water to remove turbidity. In the United States, for systems that use conventional or direct filtration methods, turbidity cannot be higher than 1.0 nephelometric turbidity units (NTU) at the plant outlet, and all samples for turbidity must be less than or equal to 0.3 NTU for at least 95% of the samples in any month. Adequately treated surface water does not usually present a turbidity problem. The World Health

Introduction to Turbidity

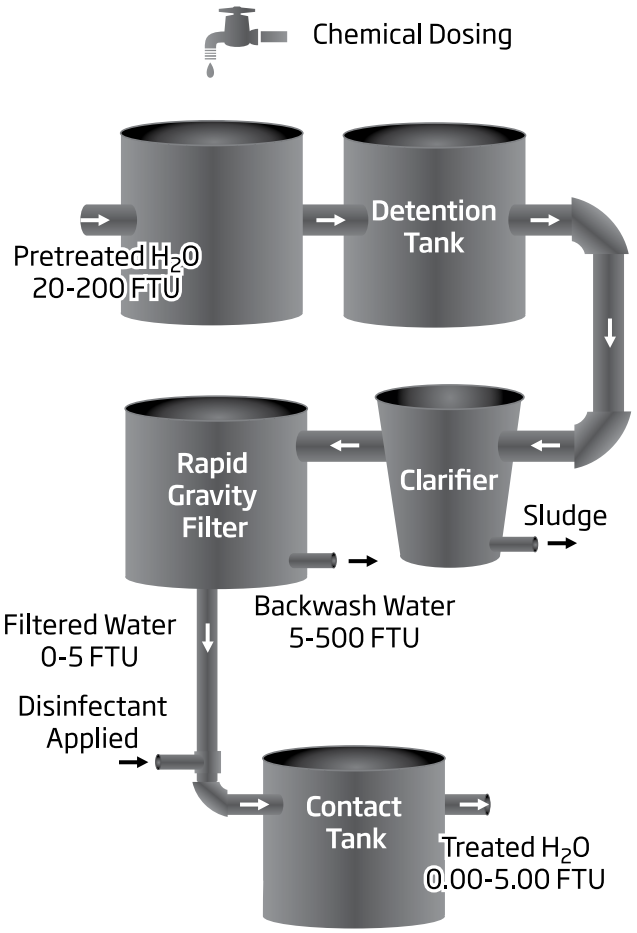
Organization indicates 5 NTU as the reference turbidity value of water for trade. This value has been established based on the aesthetic characteristics of water. From a hygienic point of view, 1 NTU is the recommended value. Many drinking water utilities strive to achieve levels as low as 0.1 NTU.

Turbidity is an indicator and will not give results for a specific pollutant. It will, however, provide information on the degree of overall contamination. The flow chart for the water treatment process of drinking water shows the turbidity reference values for each phase.

Typical sources of turbidity in drinking water include the following:

- Waste discharge
- Run-off from watersheds, especially those that are disturbed or eroding
- Algae or aquatic weeds and products of their breakdown in water reservoirs, rivers, or lakes
- Humic acids and other organic compounds resulting from decay of plants, leaves, etc. in water sources
- High iron concentrations which give water a rust-red coloration (mainly in ground water and ground water under the direct influence of surface water)
- Air bubbles and particles from the treatment process

Treatment Process of Drinking Water



	Turbidity	pH	Free Chlorine	Total Chlorine	Bromine (Br)	Iodine (I)	Cyanuric Acid (CYAC)	Iron, LR (Fe, LR)	Ratio Mode	Non-Ratio Mode	FNU Mode	FAU Mode	NTU Ratio Mode	NTU Non-Ratio Mode	Max. Calibration Points	CAL Check™	Logging	EPA Compliant	ISO	GLP	PC Connectivity	Fast Tracker™	Backlit LCD	Auto-off	Page
EPA Compliant Meters																									
HI83414	•		•	•					•	•					5	•	•	•		•	•		•	•	12.6
HI88703	•								•	•					5		•	•		•	•		•	•	12.10
HI93414	•		•	•											4	•	•	•		•	•	•	•	•	12.12
HI98703	•														4		•	•		•	•	•	•	•	12.14
ISO Compliant Meters																									
HI88713	•										•	•	•	•	5		•		•	•	•		•		12.18
HI98713	•														4		•		•	•	•	•	•	•	12.17
HI93703	•														3				•	•				•	12.20
Application Specific Meters																									
HI93102	•	•	•	•	•	•	•	•							2		•	•						•	12.16
HI83749	•								•						4		•	•		•	•	•	•	•	12.21
HI847492	•														4		•			•	•	•	•	•	12.22

HI83414

Turbidity and Free/ Total Chlorine Meter

EPA Compliant

The HI83414 is a multiparameter instrument that measures the most important parameters in drinking water: turbidity and chlorine. The instrument is based on a state-of-the-art optical system which provides accurate results by minimizing stray light and color interferences. Periodic calibration with the supplied standards compensates for any variations in intensity of the tungsten lamp. The colorimeter portion of the meter uses a 525 nm narrow band interference filter for maintaining the proper wavelength in the measurement of free and total chlorine. All measurements are performed with 25 mm round cuvettes composed of special optical glass to ensure maximum repeatability of turbidity and chlorine measurements.

EPA Compliant

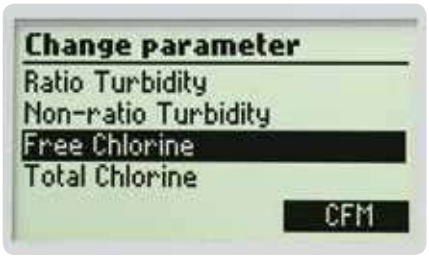
The HI83414 meets and exceeds the requirements of EPA and Standard Methods both for turbidity and colorimetric chlorine measurements. When in EPA mode all turbidity readings are rounded accordingly to meet reporting requirements.

Backlit Graphic LCD Display

A graphic LCD display provides an easy to understand, user-friendly interface. All messages are in plain text making them easy to read.

Light blocking cuvette cover

An affixed, light-blocking cuvetter cover closes over the sample cell, reducing stray light from affecting any measurement readings.



Four Measurement Modes

The HI83414 features four measurement modes including ratio or non-ratio mode for turbidity, free chlorine, and total chlorine. In ratio mode the turbidity is 0.00 to 4000 NTU (Nephelometric Turbidity Units) while in the non-ratio mode the range is 0.00 to 40.0 NTU. The range for free or total chlorine measurements is 0.00 to 5.00 mg/L (ppm) range.

Multiple Turbidity Units of Measure

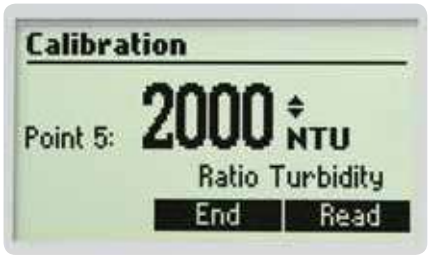
Turbidity can be displayed as nephelometric turbidity units (NTU), European Brewing Convention units (EBC) or Nephelos units.

Multiple reading modes

Normal measurement, continuous measurement, or signal averaging measurement are reading modes available

CAL Check™

With the powerful CAL Check function, reliable performance of the chlorine colorimeter can be validated at any moment by using the exclusive HANNA ready-made, NIST traceable standards. All standards are supplied with a Certificate of Analysis (COA) for traceability.



Calibration

A two, three, four, or five-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100, 750, and 2000 NTU) standards. Calibration points can be modified if user-prepared standards are used. For free and total chlorine, the CAL Check standard can be used for calibration to 1.00 mg/L (ppm).

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are stable and reusable with a long shelf life. These standards are used for calibration and performance verification of the HI83414 turbidity meter.

- All measurements are performed with 25 mm round cuvettes composed of special optical glass to ensure maximum repeatability of turbidity and chlorine measurements.

Calibration Error Messages

The calibration is successfully performed if the reading is within certain limits.

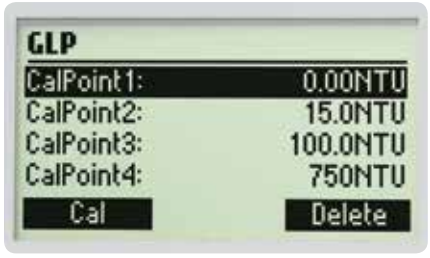
If the CAL Check™ standard value is too high, the display will show a high standard message. If this message appears, check if the correct cuvet was used.

If the CAL Check standard value is too low, the display will show low standard message. If this message appears, check if the correct cuvet was used.

If the calculated calibration coefficients are outside a certain range a calibration error message is displayed.

Out of Cal Range Function

The instrument has a mechanism to prevent taking measurements in a range where the calibration does not assure the best results.



GLP Data

The HI83414 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.

Data Logging

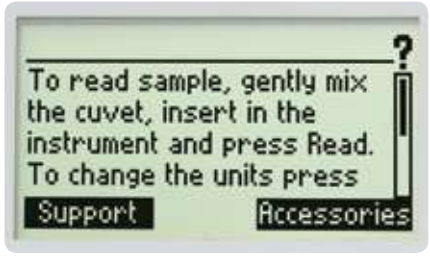
Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows compatible PC using the USB port and the HI92000 software.

Tutorial Mode

The unique tutorial mode provides additional information to help the user during measurements. When enabled, the instrument displays explanations and a confirmation button when a preparation or other operation has to be performed.



Contextual Help

Contextual help is always available through a dedicated HELP button. Clear tutorial messages and directions are available on-screen to quickly and easily guide users through setup and calibration. The help information displayed is relative to the setting/option being viewed.

CAL Check™ standards with certificate

The HI93414-11 free and total chlorine and HI88703-11 turbidity CAL Check standards are used for calibration and performance verification of the HI83414.

- Supplied with Certificate of Analysis
  - Lot number
  - Expiration date
  - Standard value @ 25 °C
  - Reference meter NIST traceable
- Provided storage containers
  - Light tight
  - Protects from accidental breakage

HI83414 Turbidity Specifications

Non-Ratio Mode	Range	0.00 to 9.99; 10.0 to 40.0 NTU 0.0 to 99.9; 100 to 268 Nephelos 0.00 to 9.80 EBC
	Resolution	0.01; 0.1 NTU 0.1; 1 Nephelos 0.01 EBC
Ratio Mode	Range	0.00 to 9.99; 10.0 to 99.9; 100 to 4000 NTU 0.0 to 99.9; 100 to 26800 Nephelos 0.00 to 9.99; 10.0 to 99.9; 100 to 980 EBC
	Resolution	0.01; 0.1; 1 NTU 0.1; 1 Nephelos 0.01; 0.1, 1 EBC
Range Selection		automatic
Accuracy		±2% of reading plus 0.02 NTU (0.15 Nephelos; 0.01 EBC); ±5% of reading above 1000 NTU (6700 Nephelos; 245 EBC)
Repeatability		±1% of reading or 0.02 NTU (0.15 Nephelos; 0.01 EBC) whichever is greater
Stray Light		< 0.02 NTU (0.15 Nephelos; 0.01 EBC)
Light Detector		silicon photocell
Method		nephelometric method (90°) or ratio nephelometric method (90° & 180°), adaptation of the USEPA method 180.1 and standard method 2130 B
Measuring Mode		normal, average, continuous
Turbidity Standards		<0.1, 15, 100, 750 and 2000 NTU
Calibration		two, three, four or five-point calibration

HI83414 Free and Total Chlorine Specifications

Range	0.00 to 5.00 mg/L (ppm)
Resolution	0.01 mg/L (ppm) from 0.00 to 3.50 mg/L (ppm) ; 0.10 above 3.50 mg/L (ppm)
Accuracy @25°C/77°F	±0.02 mg/L @ 1.00 mg/L
Detector	silicon photocell with 525 nm narrow band interference filters
Method	adaptation of the USEPA Method 330.5 and Standard Method 4500-Cl G.
Standards	1.00 mg/L (ppm) free chlorine; 1.00 mg/L (ppm) total chlorine
Calibration	one-point calibration

HI83414 General Specifications

Light Source/ Life	tungsten filament lamp / greater than 100,000 readings
Display	40 x 70 mm graphic LCD (64 x 128 pixels) with backlight
Log Memory	200 records
Connectivity	USB
Environment	0 to 50°C (32 to 122°F); max 95% RH non-condensing
Power Supply	230/115 Vac; 50/60 Hz; auto shut-off after 15 minutes of non-use
Dimensions	230 x 200 x 145 mm (9.0 x 7.9 x 5.7")
Weight	2.5 kg (88 oz.)
Ordering Information	**HI83414-01** (115V) and **HI83414-02** (230V) are supplied with sample cuvettes and caps (5), calibration cuvettes for turbidity (HI88703-11) and colorimeter (HI93414-11), silicone oil (HI98703-58), cuvette wiping cloth, scissors, power cord, instrument quality certificate, and instruction manual.

See page 12.24 for standards and accessories

HI88703

Precision Turbidity Benchtop Meter

EPA Compliant

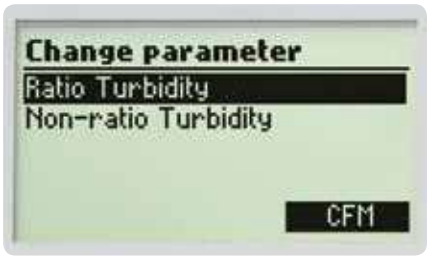
The HI88703 Precision Turbidity Benchtop Meter is specially designed for water quality measurements, providing reliable and accurate readings, especially in the low turbidity range. The instrument is based on a state-of-the-art optical system which guarantees accurate results, assures long term stability, and minimizes stray light and color interferences. Periodic calibration with the supplied standards compensates for any variations in intensity of the tungsten lamp. The 25 mm round cuvettes composed of special optical glass guarantee the repeatability of turbidity measurements.

EPA Compliant

The HI88703 meets and exceeds the requirements of EPA and Standard Methods for turbidity measurements. When in EPA mode all turbidity readings are rounded accordingly to meet reporting requirements.

Backlit Graphic LCD Display

A graphic LCD display provides an easy to understand, user-friendly interface. All messages are in plain text making them easy to read.



Two Measurement Modes

The HI88703 features two options for turbidity measurement: ratio and non-ratio mode. Turbidity measurements can be made in the 0.00 to 4000 NTU (Nephelometric Turbidity Units) when using the ratio mode and in the 0.00 to 40.0 NTU range when non-ratio mode is used.

Multiple reading modes

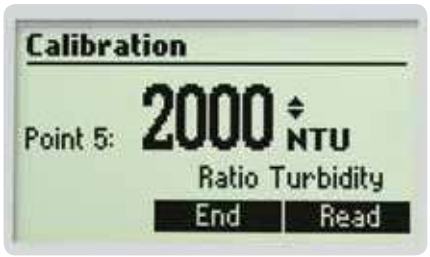
Normal, continuous, or signal averaging measurement reading modes available.

Multiple Turbidity Units of Measure

Turbidity can be read as Nephelometric Turbidity Units (NTU), European Brewing Convention units (EBC), or Nephelos units.

Light blocking cuvette cover

An affixed, light-blocking cuvetter cover closes over the sample cell, reducing stray light from affecting any measurement readings.



Calibration

The HI88703 has a powerful calibration function that compensates for lamp aging or changing. A two, three, four, or five-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100, 750, and 2000 NTU) standards. Calibration points can be modified if user-prepared standards are used.

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are reusable and stable with a long shelf life.

GLP Data

The HI88703 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.

Data Logging

Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows compatible PC using the USB port and the HI92000 software.

Tutorial Mode

Tutorial mode provides additional information to help the user during measurements. When enabled, the instrument displays explanations and a confirmation button when a preparation or other operation has to be performed.

Contextual Help

Contextual help is always available through a dedicated HELP button. Clear tutorial messages and directions are available on-screen to guide users through setup and calibration. The help information displayed is relative to the setting/option being viewed.

Specifications		HI88703
Non-ratio Mode	Range	0.00 to 9.99; 10.0 to 40.0 NTU 0.0 to 99.9; 100 to 268 Nephelos 0.00 to 9.80 EBC
	Resolution	0.01; 0.1 NTU 0.1; 1 Nephelos 0.01 EBC
Ratio Mode	Range	0.00 to 9.99; 10.0 to 99.9; 100 to 4000 NTU 0.0 to 99.9; 100 to 26800 Nephelos 0.00 to 9.99; 10.0 to 99.9; 100 to 980 EBC
	Resolution	0.01; 0.1; 1 NTU 0.1; 1 Nephelos 0.01; 0.1, 1 EBC
Additional Specifications	Range Selection	automatic
	Accuracy	±2% of reading plus 0.02 NTU (0.15 Nephelos; 0.01 EBC); ±5% of reading above 1000 NTU (6700 Nephelos; 245 EBC)
	Repeatability	±1% of reading or 0.02 NTU (0.15 Nephelos; 0.01 EBC) whichever is greater
	Stray Light	< 0.02 NTU (0.15 Nephelos; 0.01 EBC)
	Light Detector	silicon photocell
	Light Source/ Life	tungsten filament lamp / greater than 100,000 readings
	Display	40 x 70 mm graphic LCD (64 x 128 pixels) with backlight
	Method	nephelometric method (90°) or ratio nephelometric method (90° & 180°), adaptation of the USEPA method 180.1 and standard method 2130 B
	Measuring Mode	normal, average, continuous
	Turbidity Standards	<0.1, 15, 100, 750 and 2000 NTU
	Calibration	two, three, four or five-point calibration
	Log Memory	200 records
	PC Interface	USB
	Environment	0 to 50°C (32 to 122°F); max 95% RH non-condensing
	Power Supply	230/115 Vac; 50/60 Hz); auto shut-off after 15 minutes of non-use
	Dimensions	230 x 200 x 145 mm (9 x 7.9 x 5.7")
	Weight	2.5 kg (88 oz.)
Ordering Information		**HI88703-01** (115V) and **HI88703-02** (230V) is supplied with sample cuvettes and caps (5), calibration cuvettes (HI88703-11), silicone oil (HI98703-58), cuvette wiping cloth, power cord, instrument quality certificate, and instruction manual.

See page 12.24 for standards and accessories

HI93414

Turbidity and Free/ Total Chlorine Portable Meter

Fast Tracker™ Technology, EPA Compliant

The HI93414 is a multiparameter instrument that measures the most important parameters in drinking water: turbidity and chlorine. The instrument is based on a state-of-the-art optical system which provides accurate results by minimizing stray light and color interferences. Periodic calibration with the supplied standards compensates for any variations in intensity of the tungsten lamp. The colorimeter portion of the meter uses a 525 nm narrow band interference filter for maintaining the proper wavelength in the measurement of free and total chlorine. All measurements are performed with 25 mm round cuvettes composed of special optical glass to ensure maximum repeatability of turbidity and chlorine measurements.

EPA Compliant

The HI93414 meets and exceeds the requirements of EPA and Standard Methods both for turbidity and colorimetric chlorine measurements. When the meter is in EPA mode all turbidity readings are rounded accordingly to meet reporting requirements.

Backlit Display

A backlit LCD display provides an easy to understand, user-friendly interface. Displayed codes guide the user step-by-step through routine operation and calibration.

Three Measurement Modes

The HI93414 features three options for measurement including ratio mode for turbidity, free chlorine, and total chlorine. Turbidity measurements can be made in the 0.00 to 1000 NTU (Nephelometric Turbidity Units) range, while free or total chlorine measurements can be made in the 0.00 to 5.00 mg/L (ppm) range.

Multiple reading modes

Normal measurement, continuous measurement, or signal averaging measurement are reading modes available.

CAL Check™

With the CAL Check function, reliable performance of the chlorine colorimeter can be validated at any moment by using the exclusive HANNA ready-made, NIST traceable standards. All standards are supplied with a Certificate of Analysis (COA) for traceability.

Calibration

A two, three, or four-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100, and 750 NTU) standards. Calibration points can be modified if user-prepared standards are used. For free and total chlorine, the 1.00 mg/L (ppm) CAL Check standard can be used for calibration and performance verification.

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are reusable and stable with a long shelf life.

GLP Data

The HI93414 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.

Data Logging

Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows compatible PC using the RS232 or USB ports and the HI92000 software.

HI93414 Turbidity

Range	0.00 to 9.99 NTU; 10.0 to 99.9 NTU; 100 to 1000 NTU
Range Selection	automatic
Resolution	0.01; 0.1; 1
Accuracy	±2% of reading plus 0.02 NTU
Repeatability	±1% of reading or 0.02 NTU, whichever is greater
Stray Light	< 0.02 NTU
Light Detector	silicon photocell
Method	ratio nephelometric method (90° and 180°), ratio of scattered and transmitted light; adaptation of the USEPA method 180.1 and standard method 2130 B
Measuring Mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100 and 750 NTU
Calibration	two, three or four-point calibration

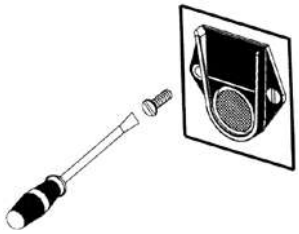
HI93414 Free and Total Chlorine

Range	0.00 to 5.00 mg/L
Resolution	0.01 mg/L (0.00 to 3.50 mg/L); 0.10 mg/L (above 3.50 mg/L)
Accuracy @25°C /77°F	±0.02 mg/L @ 1.00 mg/L
Detector	silicon photocell with 525 nm narrow band interference filter
Method	adaptation of the USEPA method 330.5 and standard method 4500-Cl G.
Standards	1 mg/L free chlorine, 1 mg/L total chlorine
Calibration	one-point calibration

HI93414 General Specifications

Light Source	tungsten filament lamp
Lamp Life	greater than 100,000 readings
Log Memory	200 records
Serial Interface	USB or RS 232
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)
Ordering Information	**HI93414-01** (115V) and **HI93414-02** (230V) is supplied with iButton® tags with tag holders (5), sample cuvettes and caps (5), calibration cuvettes for turbidity (HI98703-11), calibration cuvettes for chlorine (HI93414-11), silicone oil (HI98703-58), cuvette wiping cloth, scissors, batteries, AC adapter, instrument quality certificate, instruction manual and rugged carrying case.

FastTracker™
location traceability



iButton® Tags are Easy to Install

Install tags near your sampling points for quick and easy iButton® readings. Each tag contains a computer chip with a unique identification code encased in stainless steel. You can install a practically unlimited amount of tags.

HI920005 Tag holders with tags (5)

Fast Tracker™

For advanced, field applications, the HI93414 is equipped with Fast Tracker™ Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements using iButton® tags near sampling points for quick and easy readings. Each iButton® tag contains a computer chip with a unique identication code encased in stainless steel.

See page 12.24 for standards and accessories

HI98703

Turbidity Meter

Fast Tracker™ Technology,
EPA Compliant

The HI98703 Precision Turbidity Portable Meter is specially designed for water quality measurements, providing reliable and accurate readings, especially in the low turbidity range. The instrument is based on a state-of-the-art optical system which guarantees accurate results, assures long term stability, and minimizes stray light and color interferences. Periodic calibration with the supplied standards compensates for any variations in intensity of the tungsten lamp. The 25 mm round cuvettes composed of special optical glass guarantee the repeatability of turbidity measurements.

EPA Compliant Measurement

The HI98703 meets and exceeds the requirements of EPA and Standard Methods for turbidity measurements. When the meter is in EPA mode all turbidity readings are rounded accordingly to meet reporting requirements.

Backlit Display

A backlit LCD display provides an easy to understand, user-friendly interface. Displayed codes guide the user step-by-step through routine operation and calibration.

Multiple reading modes

Normal, continuous, or signal averaging measurement are reading modes available.

Calibration

A two, three, or four-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100, and 750 NTU) standards. Calibration points can be modified if user-prepared standards are used.

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are reusable and stable with a long shelf life.

GLP Data

The HI98703 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.

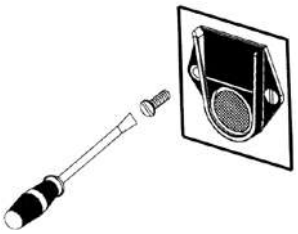
Data Logging

Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows compatible PC using the RS232 or USB port and the HI92000 software.

FastTracker™
location traceability



iButton® Tags are Easy to Install

Install tags near your sampling points for quick and easy iButton® readings. Each tag contains a computer chip with a unique identification code encased in stainless steel. You can install a practically unlimited amount of tags.

HI920005 Tag holders with tags (5)

Fast Tracker™

For advanced field applications, the HI98703 is equipped with Fast Tracker™ Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements using iButton® tags near sampling points for quick and easy readings. Each iButton® tag contains a computer chip with a unique identication code encased in stainless steel.

Specifications	HI98703
Range	0.00 to 9.99 NTU; 10.0 to 99.9 NTU; 100 to 1000 NTU
Range Selection	automatic
Resolution	0.01; 0.1; 1
Accuracy	±2% of reading plus 0.02 NTU
Repeatability	±1% of reading or 0.02 NTU, whichever is greater
Stray Light	< 0.02 NTU
Light Detector	silicon photocell
Light Source	tungsten filament lamp
Lamp Life	greater than 100,000 readings
Method	ratio nephelometric method (90° and 180°), ratio of scattered and transmitted light; adaptation of the USEPA method 180.1 and standard method 2130 B
Measuring mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100 and 750 NTU
Calibration	two, three or four-point calibration
Log Memory	200 records
Serial Interface	USB or RS232
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)
Ordering Information	**HI98703-01** (115V) and **HI98703-02** (230V) are supplied with iButton® tags with tag holders (5), sample cuvettes and caps (5), calibration cuvettes, silicone oil (HI98703-58), cuvette wiping cloth, batteries, AC adapter, instruction manual, instrument quality certificate, and rugged carrying case.

See page 12.24 for standards and accessories

HI93102

Meter for Water Analysis

Turbidity, Cl_2, pH, Br, Fe, I and CYAC

- EPA standard
  - Meets the USEPA standards
- Custom calibration points
  - Advanced electronics allow operators to calibrate the meter
- Logging
  - Log and recall up to 25 different samples.

The most important parameters needed for water analysis, especially in drinking water, can be measured with Hanna's HI93102 portable meter. This instrument not only measures turbidity, but also pH, total and free chlorine, bromine, iodine, iron, and cyanuric acid (CYAC). Achieve laboratory results in the field quickly and easily.

Measurements are made quickly and repeatedly through a sophisticated, yet easy-to-use microprocessor. In colorimetric mode, users can select between factory pre-programmed calibration or calibrating the meter on their own, and measure either concentration or relative absorbance of the sample. Up to 25 measured samples can be stored in memory, together with time and date. Miniaturization of the electronics has made it possible to offer unsurpassed accuracy and quality in a portable unit weighing just one pound.

Specifications		HI93102	
Parameter Specifications		**Turbidity**	**Br–Bromine**
	Range	0.00 to 50.0 NTU†	0.00 to 8.00 mg/L (ppm)
	Resolution	0.01 (0.00 to 9.99) and 0.1 NTU (10.0 to 50.0)	0.01 mg/L (ppm)
	Accuracy @25°C	±0.5 NTU or ±5% of reading (whichever is greater)	±0.08 mg/L (ppm) ±3% of reading
		Free and Total Chlorine	**CYAC–Cyanuric Acid**
	Range	Free: 0.00 to 2.50 mg/L (ppm); Total: 0.00 to 3.50 mg/L (ppm)	0 to 80 mg/L (ppm)
	Resolution	0.01 mg/L (ppm)	1 mg/L (ppm)
	Accuracy @25°C	±0.03 mg/L (ppm) ±3% of reading	±1 mg/L (ppm) ±15% of reading
		I–Iodine	**Fe LR–Iron LR**
	Range	0.0 to 12.5 mg/L (ppm)	0.00 to 1.00 mg/L (ppm)
	Resolution	0.1 mg/L (ppm)	0.01 mg/L (ppm)
	Accuracy @25°C	±0.1 mg/L (ppm) ±5% of reading	±0.02 mg/L (ppm) ±3% of reading
		pH	
	Range	5.9 to 8.5 pH	
	Resolution	0.1 pH	
	Accuracy @25°C	±0.1 pH	
Additional Specifications	Turbidity Calibration	two-point; selectable between 0.00 - 50.0 FTU (0.00 and 20.0 FTU recommended)	
	Light Source / Detector	pure green LED / silicon photocell (2)	
	Battery Type / Life	1.5V AA (4) / approximately 60 hours of continuous use or 1000 measurements; automatic shut-off selectable after 10, 20, 30, 40, 50 or 60 minutes of non-use	
	Environment	0 to 50°C (32 to 122°F); RH max 95% (non condensing)	
	Dimensions / Weight	220 x 82 x 66 mm (8.7 x 3.2 x 2.6") / 510 g (1.1 lb.)	
Ordering Information		**HI93102** is supplied with measurement cuvette cap, batteries and instruction manual.	

† 1 NTU (Nephelometric Turbidity Unit) = FTU (Formazine Turbidity Unit)
* set of 300 tests available, -03
** set of 150 tests available, -03

See page 12.25 for standards and accessories

HI98713

Turbidity Meter

with Fast Tracker™ Technology, ISO

The HI98713 Precision ISO Turbidity Portable Meter is specially designed for water quality measurements, providing reliable and accurate readings, even within low turbidity ranges.

Ratio Measurement Mode

The HI98713 measures turbidity using the ratio method with a 90° and 180° light detector for accurate measurements.

Multiple reading modes

Normal, continuous, or signal averaging measurement reading modes available.

ISO Compliant

The HI98713 meets and exceeds the requirements of ISO 7027 method for turbidity measurements by use of an infrared LED light source.

Calibration

The HI98713 has a powerful calibration function that compensates for variation in light intensity. A two, three, or four-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100 and 750 FNU) standards. Calibration points can be modified if user-prepared standards are used.

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are reusable and stable with a long shelf life.

GLP Data

The HI98713 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.

Data Logging

Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows® compatible PC using the USB or RS232 port and the HI92000 software.

Fast Tracker™

For advanced field applications, the HI98713 is equipped with Fast Tracker™ Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements using iButton® tags near sampling points for quick and easy readings. Each iButton® tag contains a computer chip with a unique identication code encased in stainless steel.

Backlit Graphic LCD Display

A graphic LCD display provides an easy to understand, user-friendly interface. All messages are in plain text making them easy to read.

Specifications	HI98713
Range	0.00 to 1000 FNU
Resolution	0.01 (0.00 to 9.99 FNU); 0.1 (10.0 to 99.9 FNU); 1 (100 to 1000 FNU)
Accuracy	±2% of reading plus 0.1 FNU
Range Selection	automatic
Repeatability	±1% of reading or 0.01 FNU, whichever is greater
Stray Light	< 0.1 FNU
IR Detector	silicon photocell
Light Source	860 nm infrared LED
Lamp Life	greater than 100,000 readings
Method	adaptation of ISO 7027, ratio method with 90° and 180° detector
Measuring Mode	normal, average, continuous.
Turbidity Standards	<0.1, 15, 100 and 750 FNU
Calibration	two, three or four-point calibration
Log Memory	200 records
Serial Interface	USB or RS232
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)
Ordering Information	**HI98713-01** (115V) and **HI98713-02** (230V) is supplied with sample cuvettes and caps (5), calibration cuvettes, silicone oil (HI98703-58), cuvette wiping cloth, batteries, AC adapter, instructions and rugged carrying case.

See page 12.25 for standards and accessories

HI88713

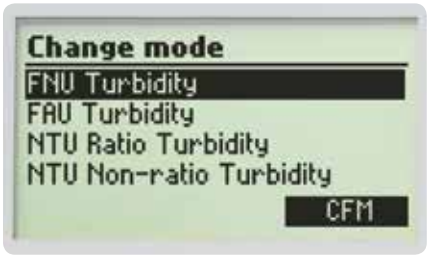
Turbidity Benchtop Meter

ISO Compliant

The HI88713 Precision ISO Turbidity Benchtop Meter is specially designed for water quality measurements, providing reliable and accurate readings, even within low turbidity ranges. The instrument is based on a state-of-the-art optical system which guarantees accurate results, assures long term stability, and minimizes stray light and color interferences. Periodic calibration with the supplied standards compensates for any variations in intensity of the tungsten lamp. The 25 mm round cuvettes composed of special optical glass guarantee the repeatability of turbidity measurements.

ISO Compliant

The HI88713 meets and exceeds the requirements of ISO 7027 method for turbidity measurements by use of an infrared LED light source.



Four Measurement Modes

The HI88713 features four options for turbidity measurement: FNU (Formazin Nephelometric Units), FAU (Formazin Attenuation Units), and NTU (Nephelometric Turbidity Units) ratio and non-ratio mode. Turbidity ranges for each mode are 0.00 to 1000 FNU, 10.0 to 4000 FAU, 0.00 to 4000 NTU (ratio mode), and 0.00 to 1000 NTU (non-ratio mode).

Multiple Turbidity Units of Measure

Turbidity can be read as Formazin Nephelometric Units (FNU), Formazin Attenuation Units (FAU), European Brewing Convention units (EBC), and Nephelometric Turbidity Units (NTU).

Multiple reading modes

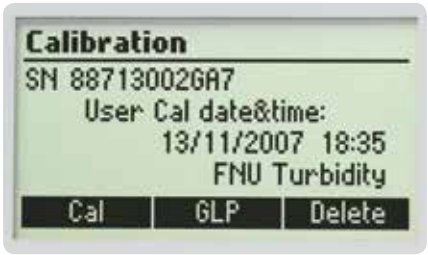
Normal, continuous, or signal averaging measurement reading modes available

AMCO AEPA-1 Primary Turbidity Standard

The AMCO AEPA-1 supplied standards are recognized as a primary standard by the USEPA. These non-toxic standards are made of styrene divinylbenzene polymer spheres that are uniform in size and density. The standards are reusable and stable with a long shelf life.

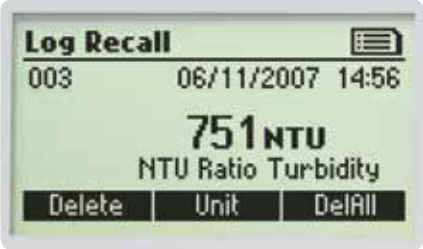
Calibration

The HI88713 has a powerful calibration function that compensates for variation in light intensity. A two, three, four, or five-point turbidity calibration can be performed by using the supplied (<0.1, 15, 100, 750 FNU, and 2000 NTU) standards. Calibration points can be modified if user-prepared standards are used.



GLP Data

The HI88713 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. Data includes calibration points, date, and time.



Data Logging

Up to 200 measurements can be stored in the internal memory and recalled at any time.

Data Transfer

For further storage or analysis options, logged data can be downloaded to a Windows compatible PC via USB and HI92000 software.

Tutorial Mode

Tutorial mode provides additional information to help during measurements. When enabled, the instrument displays explanations and a confirmation button when a preparation or other operation has to be performed.

Contextual Help

Contextual help is always available through a dedicated HELP button. Clear tutorial messages and directions are available on-screen to quickly and easily guide users through setup and calibration. The help information displayed is relative to the setting/option being viewed.

Backlit Graphic LCD Display

A graphic LCD display provides an easy to understand, user-friendly interface. All messages are in plain text making them easy to read.

Specifications		HI88713
FNU Mode	Range	0.00 to 1000 FNU
	Resolution	0.01 (0.00 to 9.99 FNU); 0.1 (10.0 to 99.9 FNU); 1 (100 to 1000 FNU)
	Accuracy	±2% of reading plus stray light
FAU Mode	Range	10.0 to 4000 FAU
	Resolution	0.1 (10.0 to 99.9 FAU); 1 (100 to 4000 FAU)
	Accuracy @25°C/77°F	± 10% of reading
NTU Ratio Mode	Range	0.00 to 4000 NTU; 0.00 to 980 EBC
	Resolution	0.01 (0.00 to 9.99 NTU); 0.1 (10.0 to 99.9 NTU); 1 (100 to 4000 NTU) / 0.01 (0.00 to 9.99 EBC); 0.1 (10.0 to 99.9 EBC); 1 (100 to 980 EBC)
	Accuracy	±2% of reading plus stray light; ±5% of reading above 1000 NTU
NTU Non-ratio Mode	Range	0.00 to 1000 NTU; 0.00 to 245 EBC
	Resolution	0.01 (0.00 to 9.99 NTU); 0.1 (10.0 to 99.9 NTU); 1 (100 to 1000 NTU) / 0.01 (0.00 to 9.99 EBC); 0.1 (10.0 to 99.9 EBC); 1 (100 to 245 EBC)
	Accuracy @25°C/77°F	±2% of reading plus stray light
Additional Specifications	Range Selection	automatic
	Repeatability	±1% of reading or stray light, whichever is greater
	Stray Light	< 0.1 NTU (0.05 EBC)
	Light Detector	silicon photocell
	Light Source	IR LED
	Method	ISO 7027 method
	Measuring Mode	normal, average, continuous.
	Turbidity Standards	<0.1, 15, 100, 750 FNU and 2000 NTU
	Calibration	two, three, four or five-point calibration
	Log Memory	200 records
	Serial Interface	USB
	Environment	0°C to 50°C (32 to 122°F); max 95% RH non-condensing
	Power Supply	12 Vdc
	Dimensions / Weight	230 x 200 x 145 mm (9 x 7.9 x 5.7") / 2.5 Kg (88 oz.)
Ordering Information	**HI88713-01** (115V) and **HI88713-02** (230V) are supplied with sample cuvettes and caps (6), calibration cuvettes (HI88713-11), silicone oil (HI98703-58), cuvette wiping cloth, power adapter and instruction manual.	

See page 12.25 for standards and accessories

HI93703

Turbidity Meter

ISO Compliant

- Positive-locking system ensures cuvette is firmly placed in the cell
- Auto shut-off
- Logging and real time clock (HI93703-11)

The HI93703 turbidity meter is a portable, microprocessor-based instrument used to determine the turbidity of water and wastewater with high precision in the field as well as in the laboratory. The meter is very simple to use and troubleshooting functions can be performed with displayed error code guides.

The HI93703 covers a 0 to 1000 FTU range in two scales: 0.00 to 50.00 FTU and 50 to 1000 FTU. The auto-ranging feature sets the appropriate range for the measurement.

The HI93703-11 adds a real time clock, logging for up to 199 measurements and PC compatibility.

The HI93703 has been designed according to the ISO7027 International Standard, consequently the turbidity unit is the FTU (Formazine Turbidity Unit). FTU is equivalent to the other internationally recognized unit: NTU (Nephelometric Turbidity Unit).

The one-point calibration at 10 FTU* can be easily performed using the available standard. Hanna has chosen 10 FTU* as the calibration point because it is the value that best fitsthe water turbidity measurements in different applications, from drinking water to wastewater treatment.

HANNA instruments uses the primary standard AMCO-AEPA-1 to avoid all formazine-related problems. Formazine is a very toxic, unstable substance, which requires particular care: its standards have to be prepared only a few minutes before performing the calibration, and can-not be reused because of their short life. The HI93703 can be used with both standards.

Specifications	HI93703
Range	0.00 to 1000 FTU*
Resolution	0.01 (0.00 to 50.00 FTU); 1 (50 to 1000 FTU)
Accuracy @25°C/77°F	±0.5 FTU or ±5% of reading (whichever is greater)
Calibration	three points (0 FTU, 10 FTU and 500 FTU*)
Light Source / Life	infrared LED / Life of instrument
Light Detector	silicon photocell
Battery Type / Life	1.5V AA (4) /approximately 60 hours of continuous use or 900 measurements; auto-off after 5 minutes of non-use
Environment	0 to 50°C (32 to 122°F); RH max 95% (non condensing)
Dimensions	220 x 82 x 66 mm (8.7 x 3.2 x 2.6")
Weight	510 g (1.1 lb.)
	HI93703-11
Data Logging	199 measurement, on-demand
PC Connection	through RS232 and HI92000 PC software (optional)
Real Time Clock	yes
Ordering Information	**HI93703** is supplied complete with glass cuvette, batteries and instructions. **HI93703C**, includes HI93703 meter, HI731313 maintenance kit (consisting of: cuvettes with caps (2), HI93703-0 AMCO-AEPA-1 0 FTU calibration solution (30 mL), HI93703-10 AMCO-AEPA-1 10 FTU calibration solution (30 mL), HI93703-05 AMCO-AEPA-1 500 FTU calibration solution (30 mL), cuvette wiping cloth, batteries, rugged carrying case and instructions. **HI93703-11** is supplied complete with glass cuvette, batteries and instructions in a rugged carrying case.

*HI93703 has been designed according to the ISO 7027 International Standard, consequently the turbidity unit is the FTU (Formazine Turbidity Unit). FTU is equivalent to the other internationally recognized unit: NTU (Nephelometric Turbidity Unit).

See page 12.25 for standards and accessories

HI83749

Portable Turbidity Meter

and Bentonite Monitoring

- GLP Features
  - Meets Good Laboratory Practices
- Backlight
  - Backlit LCD
- Connectivity
  - PC interface via USB

Wines with low phenol contents, such as rosé, light reds and whites should be checked for protein stability before bottling. Hanna offers a quick test meter to verify the risk of future protein haze formation. If protein instability is detected, a subsequent test can help define the right amount of bentonite to be added for improving protein stability. It is important not to overdose bentonite to avoid stripping wine flavor, body, and significant loss of color, especially in young red wines. Moreover, adding only the necessary amount of bentonite to obtain the desired protein stability also saves costs.

The HI 83749 measures turbidity of samples from 0.00 to 1200 NTU (Nephelometric Turbidity Units) and is USEPA compliant. In the USEPA measurement mode the instrument rounds the readings to meet USEPA reporting requirements.

Fast Tracker™

The HI83749 is equipped with Fast Tracker™ Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements using iButton® tags near sampling points for quick and easy readings. Each iButton® tag contains a computer chip with a unique identication code encased in stainless steel.

Specifications	HI83749
Range	0.00 to 1200 NTU
Range Selection	automatic
Resolution	0.01 (0.00 to 9.99 NTU); 0.1 (10.0 to 99.9 NTU); 1 (100 to 1200 NTU)
Accuracy @25°C/77°F	±2% of reading plus 0.05 NTU
Repeatability	±1% of reading of 0.02 NTU, whichever is greater.
Stray Light	< 0.05 NTU
Light Source	tungsten filament lamp
Light Detector	silicon photocell
Method	ratio nephelometric method
Display	60 x 90 mm backlit LCD
Calibration	two, three or four points
LOG Memory	200 records
Serial Interface	RS 232 or USB 1.1
Environment	0 to 50°C (32 to 122°F); max 95% RH non-condensing
Battery Type	1.5V AA batteries (4) / 12 VDC adapter
Auto Shut-off	after 15 minutes of non-use
Dimensions	224 x 87 x 77 mm (8.8 x 3.4 x 3.0")
Weight	512 g (18.0 oz.)
Ordering Information	**HI83749-01** (115V) and **HI83749-02** (230V) are supplied with iButton® tags with tag holders (5), sample cuvettes and caps (6), calibration cuvettes (4), bentocheck reagent, silicone oil (HI98703-58), 1000 µL automatic pipette with two tips and instructions sheet, 25 mL glass vials with caps (4), 1 mL syringe with two tips, funnel, filter paper (25), cuvette cleaning cloth, 12 VDC adapter, batteries, instructions and rugged carrying case.
Reagents and Standards	**HI83749-11** Turbidity Calibration Set **HI83749-20** Bentocheck Solution

* NTU (Nephelometric Turbidity Units)

See page 12.26 for standards and accessories

HI847492

Haze Meter

for Beer Quality Analysis

- Can report measurements in FTU, EBC, ASBC and HELM
- PC compatible via USB
- GLP Features
- Log-on-demand
- Large, backlit LCD

No more judging by eye!

The HI847492 is auto-diagnostic meter designed to measure the haze in beer. Each instrument features a different measuring unit or light source to comply with different standard requirements.

HI847492 is designed according to the ASBC (American Society of Brewing Chemists) standard for haze in beer measurements.

This instrument compensates beer color to guarantee accurate readings during the brew process. The optical system consists of an LED and multiple detectors. A two, three or four-point calibration can be easily performed at any time using the supplied or user-prepared standards.

HI847492 has all the necessary GLP (Good Laboratory Practice) features to allow maximum traceability of data. Features include a real time clock, log on demand (up to 200 measurements), and Fast Tracker™ –Tag Identification System.

This meter also incorporates a continuous measurement mode to measure the settling rate of suspended matter, and a signal average (AVG) mode to accumulate multiple readings, giving a final average value. The average mode is particularly useful to measure samples with suspended particles with different dimensions.

This meter also features a user-friendly interface, with a large backlit LCD. Acoustic signals and display codes to guide the user step-by-step through routine operations.

FastTracker™
location traceability

The HI847492 is equipped with Fast Tracker™ Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements using iButton® tags near sampling points for quick and easy readings. Each iButton® tag contains a computer chip with a unique identication code encased in stainless steel.

Methods

Many methods were used to measure turbidity over the years. The Jackson Candle Turbidimeter was used to measure turbidity as Jackson turbidity units (JTU). The method is visual and is not considered very accurate. To obtain more accurate readings, a nephelometer should be used as a turbidity reading instrument.

HI847492 can report the measurements in FTU (Formazin Turbidity Units), EBC (European Brewing Convention), ASBC (American Society of Brewing Chemists) and HELM. FTU units are equal to NTU units (Nephelometric Turbidity Units). A conversion table between these measurement units is shown below.

	NTU/FNU/FTU	EBC	ASBC	HELM
1 NTU/1 FNU/1 FTU	1	0.25	17.25	10
1 EBC	4	1	69	40
1 ASBC	0.058	0.014	1	0.579
1 HELM	0.1	0.025	1.725	1

Specifications	HI847492
Range	0.00 to 9.99; 10.0 to 99.9; 100 to 1000 FTU; 0.00 to 9.99; 10.0 to 99.9; 100 to 250 EBC; 0.00 to 9.99; 10.0 to 99.9; 100 to 17250 ASBC; 0.00 to 9.99; 10.0 to 99.9; 100 to 10000 HELM
Range Selection	automatic
Resolution	0.01, 0.1, 1 FTU,EBC,ASBC, HELM
Accuracy	±2% of reading plus 0.05 FTU (0.01 EBC, 0.86 ASBC, 0.5 HELM)
Repeatability	±1% of reading or 0.02 FTU, 0.01 EBC, 0.035 ASBC, 0.2 HELM; whichever is greater
Stray Light	<0.1 FTU, 0.03 EBC, 1.73 ASBC, 1 HELM
Light Source	LED @ 580 nm
Light Detector	silicon photocell
Method	ratio nephelometric method.
Display	60 x 90 mm backlit LCD
Calibration	two, three or four-point calibration
Log Memory	200 records
Serial Interface	USB
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter
Auto-off	after 15 minutes of non-use
Dimensions	224 x 87 x 77 mm (8.8 x 3.4 x 3.0")
Weight	512 g (18 oz.)
Ordering Information	**HI847492-01** (115V) and **HI847492-02** (230V) is supplied with iButton® tags with tag holders (5), sample cuvettes and caps (6), calibration cuvettes (4), silicone oil (HI98703-58), 25 mL glass vials with caps (4), cuvette cleaning cloth, batteries, AC adapter, HI98501 thermometer, instrument quality certificate, instructions and rugged carrying case.
Accessories	**HI847492-11** Calibration standard cuvette

Why this instrument is so important...

Beer haze may be defined as an insoluble or semi-soluble particulate matter which is small enough to form a colloidal suspension in beer. These particles scatter transmitted light and are observed as a degradation in the transparency of the beer.

The beer clarity is a parameter constantly controlled in a brewery, and to assure a consistent product quality, the brewmaster needs more than visual inspection.

Several substances can cause haze in beer, but the most frequently encountered problem is due to a cross-linking of polyphenol and protein.

A range of stabilization treatments are available for avoiding haze problems. The products have to be controlled on several steps during the brewing process, in particular after filtration and before the beer enters the single tanks.

Beer Haze Table

Grade	EBC	ASBC
Brilliant	0.0 to 0.5	0.0 to 34.5
Almost Brilliant	0.5 to 1.0	34.5 to 69
Very Slightly Hazy	1.0 to 2.0	69 to 138
Slightly Hazy	2.0 to 4.0	138 to 276
Hazy	4.0 to 8.0	276 to 552
Very Hazy	> 8.0	> 552

See page 12.26 for standards and accessories

Standards and Accessories

HI83414 Standards and Accessories

Reagent Code	Description
HI93414-11	CAL Check™ calibration standards for free and total chlorine
HI93701-01	free chlorine (Cl_2) reagent kit, 100 tests
HI93701-03	free chlorine (Cl_2) reagent kit, 300 tests
HI93711-01	total chlorine (Cl_2) reagent kit, 100 tests
HI93711-03	total chlorine (Cl_2) reagent kit, 300 tests
HI88703-11	turbidity calibration standards (<0.1, 15, 100, 750 and 2000 NTU)

Accessory Code	Description
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI740234	replacement lamp for EPA turbidimeter
HI92000	Windows® compatible software
HI920013	USB cable for PC connection

See page HI83414 on page 12.6

HI93414 Standards and Accessories

Reagent Code	Description
HI93414-11	CAL Check calibration standards for free and total chlorine
HI93701-01	free Chlorine (Cl_2) reagent kit, 100 tests
HI93701-03	free Chlorine (Cl_2) reagent kit, 300 tests
HI93711-01	total Chlorine (Cl_2) reagent kit, 100 tests
HI93711-03	total Chlorine (Cl_2) reagent kit, 300 tests
HI98703-11	turbidity calibration standards (<0.1, 15 100 and 750 NTU)

Accessory Code	Description
HI920005	tag holders with tags (5)
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI740234	replacement lamp for EPA turbidimeter
HI92000	Windows® compatible software
HI920013	USB cable for PC connection
HI920011	5 to 9 pin RS232 connection cable

See page HI93414 on page 12.12

HI88703 Standards and Accessories

Reagent Code	Description
HI88703-11	turbidity calibration standards (<0.1, 15, 100, 750 and 2000 NTU)

Accessory Code	Description
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI740234	replacement lamp for EPA turbidimeter
HI92000	Windows® compatible software
HI920013	USB cable for PC connection

See page HI88703 on page 12.10

HI98703 Standards and Accessories

Reagent Code	Description
HI98703-11	turbidity calibration standards (<0.1, 15, 100 and 750 NTU)

Accessory Code	Description
HI920005	tag holders with tags (5)
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI740234	replacement lamp for EPA turbidimeter
HI92000	Windows® compatible software
HI920013	USB cable for PC connection
HI920011	5 to 9 pin RS232 connection cable

See page HI88703 on page 12.14

HI93102 Solutions and Accessories

Reagent Code	Description
HI93102-0	AMCO-AEPA-1 calibration solution, 0 NTU, 30 mL bottle
HI93102-20	AMCO-AEPA-1 calibration solution, 20 NTU, 30 mL bottle
HI93701-01	free chlorine (Cl_2) reagent kit, 100 tests
HI93701-03	free chlorine (Cl_2) reagent kit, 300 tests
HI93710-01	pH reagent kit, 100 tests
HI93710-03	pH reagent kit, 300 tests
HI93711-01	total chlorine (Cl_2) reagent kit, 100 tests
HI93711-03	total chlorine (Cl_2) reagent kit, 300 tests
HI93716-01	bromine (Br) reagent kit, 100 tests
HI93716-03	bromine (Br) reagent kit, 300 tests
HI93718-01	iodine (I) reagent kit, 100 tests
HI93718-03	iodine (I) reagent kit, 300 tests
HI93722-01	cyanuric acid (CYAC) reagent kit, 100 tests
HI93722-03	cyanuric acid (CYAC) reagent kit, 300 tests
HI93746-01	iron (Fe) low range reagent kit, 100 tests
HI93746-03	iron (Fe) low range reagent kit, 300 tests

Accessory Code	Description
HI920005	tag holders with tags (5)
HI93703-50	cuvette cleaning solution, 230 mL
HI731318	cuvette wiping cloth (4)
HI731321	spare glass cuvettes, small (4)

See page HI93102 on page 12.16

HI88713 Standards and Accessories

Reagent Code	Description
HI88713-11*	turbidity calibration standards (<0.1, 15, 100, 750 FNU and 2000 NTU)

Accessory Code	Description
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large, turbidity (4)
HI92000	Windows® compatible software
HI920013	USB cable for PC connection
HI920011	5 to 9 pin RS232 connection cable

* Vials marked FNU cannnot be used in FNU mode – for Ratio NTU calibration only.

See page HI88713 on page 12.18

HI98713 Standards and Accessories

Reagent Code	Description
HI98713-11*	turbidity calibration standards (<0.1, 15, 100 and 750 FNU)

Accessory Code	Description
HI920005	tag holders with tags (5)
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI92000	Windows® compatible software
HI920013	USB cable for PC connection
HI920011	5 to 9 pin RS232 connection cable

* Vials marked FNU cannnot be used in FNU mode – for Ratio NTU calibration only.

See page HI98713 on page 12.17

HI93703 Standards and Accessories

Reagent Code	Description
HI93703-0	AMCO-AEPA-1 calibration solution, 0 FTU, 30 mL bottle
HI93703-05	AMCO-AEPA-1 calibration solution, 500 FTU, 30 mL bottle
HI93703-10	AMCO-AEPA-1 calibration solution at 10 FTU, 30 mL bottle

Accessory Code	Description
HI731313	maintenance kit: rugged carrying case containing HI93703-0, HI93703-05 and HI93703-10 calibration standards, cuvettes with caps (2) and cuvette wiping cloth
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731321	spare glass cuvettes, small (4)

See page HI98703 on page 12.20

Standards and Accessories

HI83749 Standards and Accessories

Reagent Code	Description
HI83749-11	turbidity calibration kit (<0.10, 10, 100, 500 NTU)
HI83749-20	bentocheck, 100 mL

Accessory Code	Description
HI920005	tag holders with tags (5)
HI740220	25 mL glass vial with cap (2)
HI731341	1000 µL automatic pipette
HI731351	1000µL automatic pipette tips (25)
HI740233	filter paper type II (100)
HI740142P	1 mL graduated syringe (10)
HI740144P	1 mL graduated syringe tips (10)
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI740234	replacement lamp for EPA turbidimeter
HI92000	Windows® compatible software
HI920013	USB cable for PC connection

See page HI83749 on page 12.21

HI847492 Standards and Accessories

Reagent Code	Description
HI847492-11	calibration standard cuvette (<0.10, 15, 100 and 800 FTU)

Accessory Code	Description
HI920005	tag holders with tags (5)
HI93703-50	cuvette cleaning solution, 230 mL
HI98703-58	silicone oil, 15 mL
HI731318	cuvette wiping cloth (4)
HI731331	glass cuvettes, large (4)
HI731335N	caps for cuvettes, large (4)
HI92000	Windows® compatible software
HI920013	USB cable for PC connection

See page HI847492 on page 12.22

Table of Contents

Hanna Digital Refractometers

- Automatic Temperature Compensation
  - For exceptionally accurate measurements
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- BEPS
  - (Battery Error Prevention System) alerts the user in the event that low battery power could adverselyaffect readings
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions
- Single-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Stainless steel sample well
  - Easy to clean and corrosion-resistant
- ABS thermoplastic casing
- Startup
  - When powered on, the meter displays battery life and the set measurement units
- Unit selection
  - Pressing the RANGE key quickly cycles through the units of measurement (if applicable)

Refractive Index

Refractive Index is an optical characteristic of a substance and the dissolved particles in it.

The refractive index of a substance is strongly influenced by temperature and the wavelength of light used to measure it. Therefore, care must be taken to control or compensate for temperature differences and wavelength. The refractive index measurements are usually reported at a reference temperature of 20°C (68°F), which is considered to be room temperature.

Refractive index is defined as the ratio of the speed of light in a vacuum to the speed of light in a substance. A result of this property is that light will "bend," or change direction, when it travels through a substance with a different refractive index. This is called refraction.

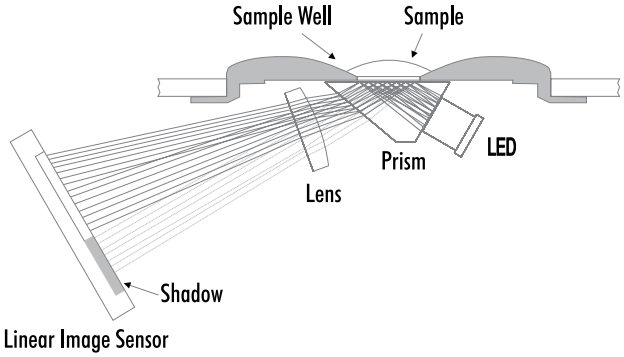
When passing from a material with a higher to lower refractive index, there is a critical angle at which an incoming beam of light can no longer refract, but will instead be reflected off the interface between the two substances. This is called total internal reflection.

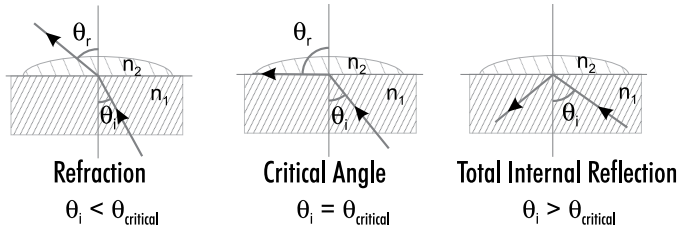
The critical angle can be used to easily calculate the refractive index according to the equation:

$$\sin(\Theta_{critical}) = n_2 / n_1$$

Where n_2 is the refractive index of the lower-density medium; n_1 is the refractive index of the higher-density medium.

A digital refractometer uses an LED to pass light through a prism in contact with the sample. An image sensor determines the critical angle at which the light is no longer refracted through the sample. Specialized algorithms then apply temperature compensation to the measurement and convert the refractive index to the specified parameter.





θ_i = angle of incidence
θ_r = angle of refraction
n_1, n_2 - refractive index

HI96841

Digital Refractometer

for Measurement of Wort Sugar Analysis

- Dual-level LCD
  - Dual-level LCD displays measurement and temperature readings simultaneously
- ATC
  - Automatic Temperature Compensation
- BEPS
  - Alerts the user of low battery power that could adversely affect readings.
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions.
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds
- One-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Easy to clean and corrosion-resistant
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- ABS thermoplastic casing

°Plato scale in Brewing

The °Plato scale is a way to quantify the concentration of sugars and dissolved solids in wort. It is used as an indicator of the potential alcoholic strength of a brewing and expresses the fermentability. The HI96841 converts the refractive index reading to °Plato based on the tables maintained by the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) and the American Society of Brewing Chemists (ASBC).

Specifications		HI96841
Sugar Content	Range	0 to 30 °Plato
	Resolution	0.1 °Plato
	Accuracy (@25°C/77°F)	±0.2 °Plato
Temperature	Range	0 to 80°C (32 to 176°F)
	Resolution	0.1°C (0.1°F)
	Accuracy (@25°C/77°F)	±0.3°C (±0.5°F)
Additional Specifications	Temperature Compensation	automatic between 0 and 40°C (32 to 104°F)
	Measurement Time	approximately 1.5 seconds
	Minimum Sample Volume	100 µL (to cover prism totally)
	Light Source	yellow LED
	Sample Cell	stainless steel ring and flint glass prism
	Auto-off	after three minutes of non-use
	Enclosure Rating	IP65
	Battery Type / Battery Life	9V / approximately 5000 readings
	Dimensions / Weight	192 x 102 x 67 mm (7.6 x 4.01 x 2.6") / 420 g (14.8 oz.)
Ordering Information	**HI96841** is supplied with battery and instruction manual.	

Digital Refractometer for Brewing

The HI96841 Digital Refractometer combines form and function into one compact unit. Featuring a 1.5 second response time, the HI96841 measures the refractive index of wort and converts it to °Plato with temperature compensation. The improved easy-to-read LCD screen displays temperature units (°C or °F) and measurements simultaneously. The HI96841's IP65 water-resistant casing and sealed sample well are built to perform under harsh conditions, making it suitable for use in any brewery.

HI96811 · HI96812 · HI96813
HI96814 · HI96816

Digital Refractometers

for Measurement of Sugar in Wine

- Dual-level LCD
  - Dual-level LCD displays measurement and temperature readings simultaneously
- ATC
  - Automatic Temperature Compensation
- BEPS
  - Alerts the user of low battery power that could adversely affect readings.
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions.
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds
- One-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Easy to clean and corrosion-resistant
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- ABS thermoplastic casing

Five Instruments for Wine Analysis

Hanna offers five wine refractometers to meet the various requirements throughout the wine industry. The HI96811, HI96812, HI96813, HI96814 and HI96816 Digital Wine Refractometers are rugged, lightweight and waterproof for measurements in the lab or field.

Refractive Index

These optical instruments employ the measurement of the refractive index to determine parameters pertinent to the wine industry.

The actual measurement of the refractive index is simple and quick and provides the vintner a standard accepted method for sugar content analysis. Samples are measured after a simple user calibration with deionized or distilled water. Within seconds, the instrument measures the refractive index of the grape must. These digital refractometers eliminate the uncertainty associated with mechanical refractometers and are ideal for fast, reliable measurements.

Instrument Descriptions

HI96811, **HI96813** and **HI96814** convert the refractive index of the sample to sucrose concentration in units of percent by weight, % Brix (also referred to as °Brix). The conversion used is based on the ICUMSA Methods Book (International Commission for Uniform Methods of Sugar Analysis). Since the majority of sugar in grape juice is fructose and glucose and not sucrose, the reading is sometimes referred to as "Apparent Brix".

HI96812 has units of °Baumé. The °Baumé scale is based on density and was originally designed to measure the mass of sodium chloride in water. °Baumé is used in winemaking to measure the sugar in must. The HI96812 converts the % Brix reading to °Baumé based on the table found in the Official Methods of Analysis of AOAC International, 18th Edition. One °Baumé is approximately equal to 1.8 % Brix, and 1°Baumé is roughly equivalent to 1% alcohol when the wine is fully fermented.

In addition to % Brix, **HI96814** includes two other scales used in the wine industry: °Oechsle and °KMW.

°Oechsle (°Oe) is mainly used in the German, Swiss and Luxenbourgish winemaking industry to measure the sugar content of must. The °Oe scale is based on specific gravity at 20°C (S.G.(20/20)) and is the first 3 digits following the decimal point. One °Oe is roughly equal to 0.2 % Brix.

°Oe = [(S.G.(20/20)) - 1] x 1000

°Klosterneuburger Mostwaage (°KMW) is used in Austria to measure the sugar content of must. °KMW is related to °Oe by the following equation:

°Oe = °KMW x [(0.022 x °KMW) + 4.54]

1 °KMW is roughly equivalent to 1% Brix or 5 °Oe. °KMW is also known as °Babo.

"Potential" or "probable" alcohol is an estimation of the alcohol content (% vol/vol) in finished wine based on the conversion of sugar to alcohol. This conversion depends on many factors, such as the type of grapes, the grape maturity, the growing region and yeast fermentation efficiency and temperature.

The **HI96813** allows the user to tailor the instrument to their specific needs based on their experience, since no fixed conversion factor is universally applicable. The first conversion is based on the % Brix value and an adjustable conversion factor between 0.50 and 0.70 (0.55 is a common value).

Potential alcohol (% v/v) = (0.50 to 0.70) x % Brix

One drawback of the above equation is that it does not take into account the nonfermentable sugars and extract. A second equation was also added that takes these factors into account and can give a more accurate estimate of the potential alcohol content in the finished wine. This conversion is named "C1" on the meter, and uses the following equation:

Potential Alcohol (%V/V) = 0.059 x [(2.66 x °Oe) - 30] (C1)

The HI 96816 potential alcohol curve is based on the tables found in the European Economic Community Commission Regulation No 2676/90 of September 17, 1990, Determining Community Methods for the Analysis of Wine and International Organization of Vine and Wine (OIV). The potential alcohol curve is based on the following equation:

Potential alcohol (%v/v) = g/L of Sugar / 16.83

Specifications		HI96811	HI96812	HI96813	HI96814	HI96816
Sugar Content	Range	0 to 50% Brix	0 to 28°Baumé	0 to 50% Brix; 0 to 25% V/V Potential Alcohol	0 to 50% Brix; 0 to 230°Oechsle; 0 to 42°KMW	4.9 to 56.8% V/V potential alcohol; (10 to 75% Brix)*
	Resolution	0.1% Brix	0.1°Baumé	0.1% Brix; 0.1% V/V Potential Alcohol	0.1% Brix; 1°Oechsle 0.1°KMW	0.1 %V/V Potential Alcohol
	Accuracy (@25°C/77°F)	±0.2% Brix	±0.1°Baumé	±0.2% Brix; ±0.2 %V/V Potential Alcohol	±0.2% Brix; 1°Oechsle ±0.2°KMW	±0.2 %V/V Potential Alcohol
Temperature	Range	0 to 80°C (32 to 176°F)				
	Resolution	±0.1°C (0.1°F)				
	Accuracy (@25°C/77°F)	±0.3°C (±0.5°F)				
Additional Specifications	Temperature Compensation	automatic between 10 and 40°C (50 to 104°F)				
	Measurement Time	approximately 1.5 seconds				
	Minimum Sample Volume	100 µL (to cover prism totally)				
	Light Source	yellow LED				
	Sample Cell	stainless steel ring and flint glass prism				
	Auto-off	after three minutes of non-use				
	Enclosure Rating	IP65				
	Battery Type / Battery Life	9V / approximately 5000 readings				
	Dimensions / Weight	192 x 102 x 67 mm (7.6 x 4.01 x 2.6") / 420 g (14.8 oz.)				
Ordering Information		**HI96811**, **HI96812**, **HI96813**, **HI96814** and **HI96816** are supplied with battery and instruction manual.				
Standard		**HI4020-11** Brix standard 50%, 10 mL				

* hidden range

HI96800 · HI96801 · HI96802
HI96803 · HI96804

Digital Refractometers

for Sugar Analysis Throughout the Food Industry

- Ideal for the analysis of:
  - Fruits, energy drinks, puddings, soy milk, juices, jam, marmalade, honey, soups, jelly, tofu and condiments
- Dual-level LCD
  - The dual-level LCD displays measurement and temperature readings simultaneously
- ATC
  - Automatic Temperature Compensation
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds
- One-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Easy to clean and corrosion-resistant
- ABS thermoplastic casing

Five Instruments for Sugar Analysis

Hanna offers five sugar refractometers to meet the requirements of the food industry. The HI96800 Refractive Index/Brix, HI96801 % Brix (sucrose), HI96802 Fructose, HI96803 Glucose and HI96804 Invert Sugar digital refractometers are rugged, portable and water-resistant for measurements in the lab or field.

These optical instruments employ the measurement of the refractive index to determine parameters pertinent to sugar concentration analysis.

Refractive Index

The actual measurement of refractive index is simple, quick and provides the operator a standard accepted method for sugar content analysis. Samples are measured after a simple user calibration with deionized or distilled water. Within seconds these instruments measure the refractive index, apply any necessary calculations and display the results in the selected unit. These digital refractometers eliminate the uncertainty associated with mechanical refractometers and are easily portable for measurements in the field.

Features

These five instruments utilize internationally recognized references for unit conversion and temperature compensation and employ methodology recommended in the ICUMSA Methods Book (internationally recognized body for sugar analysis).

Temperature (in °C or °F) is displayed simultaneously with the measurement on the large dual-level display along with icons for low power and other helpful messages.

5 Digital Refractometers for Sugar Analysis to Choose from

HI96800

Measures the refractive index in aqueous solutions. Readings can also be displayed with sucrose temperature compensation (nD_{20}) or % Brix.

- 1.3300 to 1.5080 Refractive Index range with ±0.0005 accuracy
- 0 to 85% Brix range with ±0.2% accuracy

HI96801

Measures the refractive index to determine the % Brix of sugar in aqueous solutions. The refractive index of the sample is converted to % Brix concentration units.

- Temperature Compensation algorithms based on sucrose solution
- 0 to 85% Brix range with an accuracy of ± 0.2%

HI96802

Measures the refractive index to determine the % fructose in aqueous solutions. The refractive index of the sample is converted to % mass (% w/w) concentration units.

- Temperature Compensation algorithms based on fructose solution
- 0 to 85% fructose byweight range with an accuracy of ± 0.2%

HI96803

Measures the refractive index to determine the % glucose in aqueous solutions. The refractive index of the sample is converted to % mass (% w/w) concentration units.

- Temperature Compensation algorithms based on glucose solution
- 0 to 85% glucose by weight range with an accuracy of ± 0.2%

HI96804

Measures the refractive index to determine the % invert sugar in aqueous solutions. The refractive index of the sample is converted to % mass (% w/w) concentration units.

- Temperature Compensation algorithms based on invert sugar solution
- 0 to 85% invert sugar by weight range with an accuracy of ± 0.2%

Making a Standard % Brix Solution

To make a Brix Solution, follow the procedure below:

- Place container (such as a glass vial or dropper bottle that has a cover) on an analytical balance.
- Tare the balance.
- To make an X % Brix solution, weigh out X grams of high purity sucrose (CAS #: 57-50-1) directly into the container.
- Add distilled or deionized water to the container so the total weight of the solution is 100 g.

Note: Solutions above 60% Brix need to be vigorously stirred or shaken and heated in a water bath. Remove solution from bath when sucrose has dissolved. The total quantity can be scaled proportionally for smaller containers but accuracy may be sacrificed.

Example with 25% Brix:

% Brix	25
g Sucrose	25.000
g Water	75.000
g Total	100.000

Specifications		HI96800	HI96801	HI96802	HI96803	HI96804
Sugar Content	Range	1.3300 to 1.5080 nD; 1.3330 to 1.5040 nD_{20}; 0.0 to 85.0% Brix	0 to 85% Brix	0 to 85% mass (% w/w fructose)	0 to 85% mass (% w/w glucose)	0 to 85% mass (% w/w invert sugar)
	Resolution	0.0001 nD; 0.0001 nD_{20}; 0.1 % Brix	0.1 % Brix	0.1 % mass	0.1 % mass	0.1 % mass
	Accuracy (@25°C/77°F)	±0.0005 nD; ±0.0005 nD_{20}; ±0.2% Brix	±0.2% Brix	±0.2% mass	±0.2% mass	±0.2% mass
Temperature	Range	0.0 to 80.0°C (32.0 to 176.0°F)				
	Resolution	0.1°C (0.1°F)				
	Accuracy (@25°C/77°F)	±0.3°C (±0.5°F)				
Additional Specifications	Temperature Compensation	automatic between 10 and 40°C (50 to 104°F)				
	Measurement Time	approximately 1.5 seconds				
	Minimum Sample Volume	100 µL (to cover prism totally)				
	Light Source	yellow LED				
	Sample Cell	stainless steel ring and flint glass prism				
	Auto-off	after three minutes of non-use				
	Enclosure Rating	IP65				
	Battery Type / Battery Life	9V / approximately 5000 readings				
	Dimensions / Weight	192 x 102 x 67 mm (7.6 x 4.01 x 2.6") / 420 g (14.8 oz.)				
Ordering Information		**HI96800, HI96801**, **HI96802**, **HI96803** and **HI96804** are supplied with battery and instruction manual.				
Standard		**HI4020-11** Brix standard 50%, 10 mL				

HI96821

Digital Refractometer

for Sodium Chloride Measurement Throughout the Food Industry

- Ideal for the analysis of:
  - Salad dressings, cheeses, condiments, pickles, canned foods, jarred foods, milk, juices, energy drinks, soups, brines and whey
- High accuracy measurements in g/100 g, g/100 mL, specific gravity and °Baume
- Dual-level LCD
  - The dual-level LCD displays measurement and temperature readings simultaneously
- ATC
  - Automatic Temperature Compensation
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- BEPS
  - Alerts the user of low battery power that could adversely affect readings.
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds.
- Single-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Easy to clean and corrosion resistant
- ABS thermoplastic casing

Ideal for the Food Industry

Hanna offers the HI96821 digital sodium chloride refractometer to meet the requirements of the food industry. This optical instrument employs the measurement of the refractive index to determine sodium chloride concentration in aqueous solutions used in food preparation. It is not intended for seawater salinity measurements.

Refractive Index

The measurement of refractive index is simple and quick and provides the user an accepted method for sodium chloride analysis. Samples are measured after a simple user calibration with deionized or distilled water. Within seconds the instrument measures the refractive index of the solution, apply the necessary calculations and display the results in the selected unit. The digital refractometer eliminates the uncertainty associated with mechanical refractometers and is portable for measurements where you need them.

Features

The instrument utilizes internationally recognized references for unit conversion and temperature compensation. It can display the measurement of NaCl concentration 4 different ways: g/100 g, g/100 mL, Specific Gravity, and °Baumé.

Temperature (in °C or °F) is displayed simultaneously with the measurement on the large dual level display along with icons for Low Power and other helpful message codes.

Easy to Operate

Startup Screens

When the HI96821 is turned on, all of the LCD segments will be displayed followed by the percentage of battery life remaining.

Calibration

Perform a quick and easy calibration after startup:

1. Using a pipette, completely cover the prism in the sample well with distilled or deionized water.
2. Press the ZERO key.

Unit Selection

Just press the RANGE key to cycle through the HI96821's units of measurement (g/100 g, g/100 mL, Specific Gravity and °Baumé).

Measurement

Achieve fast, accurate results:

1. Using a plastic pipette, place sample onto the prism surface until the well is full.
2. Press the READ key and the results are displayed in the selected units.

Making a Standard Sodium Chloride Solution

To make a standard NaCl solution (g/100 g), follow the procedure below:

- Place a container (such as a glass vial or dropper bottle that has a cover) on an analytical balance.
- Tare the balance.
- To make an X NaCl solution weigh out X grams of high purity dried Sodium Chloride (CAS #: 7647-14-5: MW 58.44) directly into the container.
- Add distilled or deionized water to the container so the total weight of the solution is 100 g.

Example with g/100 g NaCl:	
g/100 g NaCl	10
g NaCl	10.000
g Water	90.000
g Total	100.000

Specifications		HI96821
g/100 g	Range	0 to 28
	Resolution	0.1
	Accuracy (@25°C/77°F)	±0.2
g/100 mL	Range	0 to 34
	Resolution	0.1
	Accuracy (@25°C/77°F)	±0.2
Specific Gravity (S.G.)	Range	1.000 to 1.216
	Resolution	0.001
	Accuracy (@25°C/77°F)	±0.002
°Baumé	Range	0 to 26
	Resolution	0.1
	Accuracy (@25°C/77°F)	±0.2
Temperature	Range	0 to 80°C (32 to 176°F)
	Resolution	0.1°C (0.1°F)
	Accuracy (@25°C/77°F)	±0.3°C (±0.5°F)
Additional Specifications	Temperature Compensation	automatic between 10 and 40°C (50 to 104°F)
	Measurement Time	approximately 1.5 seconds
	Minimum Sample Volume	100 µL (to cover prism totally)
	Light Source	yellow LED
	Sample Cell	stainless steel ring and flint glass prism
	Auto-off	after three minutes of non-use
	Enclosure Rating	IP65
	Battery Type / Battery Life	9V / approximately 5000 readings
	Dimensions / Weight	192 x 102 x 67 mm (7.6 x 4.01 x 2.6") / 420 g (14.8 oz.)
Ordering Information	**HI96821** is supplied with battery and instruction manual.	

HI96822

Digital Refractometer

for Natural or Artificial Seawater Analysis

- Designed for seawater salinity analysis
- High accuracy measurements displayed as PSU, ppt and specific gravity
- Dual-level LCD
  - The dual-level LCD displays measurement and temperature readings simultaneously
- ATC
  - Automatic Temperature Compensation
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- IP65 water protection
  - Built to perform under the harsh field conditions associated with environments containing seawater.
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds
- Single-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Easy to clean and corrosion-resistant
- ABS thermoplastic casing

Ideal for Seawater Analysis

Hanna's HI96822 Digital Refractometer is a rugged, portable, water resistant device that utilizes the measurement of the refractive index to determine the salinity of natural and artificial seawater, ocean water or brackish intermediates. The HI96822 reflects Hanna's years of experience as a manufacturer of analytical instruments. This digital refractometer eliminates the uncertainty associated with mechanical refractometers and is durable and compact enough to be used at home, in the lab, or out in the field.

The HI96822 is an optical device that is quick and easy to use. After a simple user calibration with distilled or deionized water, a seawater sample can be introduced into the sample well.

Within seconds, the refractive index and temperature are measured and converted into one of three popular measurement units: Practical Salinity Units (PSU), parts per thousand (ppt), or specific gravity (S.G. (20/20)). All conversion algorithms are based upon respected scientific publications using the physical properties of seawater.

The Importance of Salinity Measurement Throughout a Variety of Applications

Salinity is a critical measurement in many applications, such as aquaculture, environmental monitoring, aquariums, desalination plants, well water, and many more. Until now, the available technology to measure salinity has relied on mechanical instruments, such as hydrometers and mechanical refractometers, or on high-tech conductivity meters. While easy to use, getting a reading on a mechanical refractometer can be difficult since they are highly susceptible to changes in temperature. Hydrometers, though inexpensive, are typically made of glass and subject to breakage.

The Hanna HI96822 is the solution to all these issues. It is lightweight, easy to use, cost-efficient, and extremely accurate. With the ability to read in three of the most widely used salinity units (PSU, ppt, and Specific Gravity), it is the ideal instrument for any application.

Easy to Operate

Start-up Screens

When the HI96822 is turned on, all of the LCD segments will be displayed followed by the percentage of battery life remaining.

Calibration

Perform a quick and easy calibration after start-up:

1. Using a plastic pipette, completely cover the prism in the sample well with distilled or deionized water.
2. Press the ZERO key.

Unit Selection

Just press the RANGE key to cycle through the HI96822's units of measurement. PSU, ppt, Specific Gravity (20/20).

Measurement

Achieve fast, professional results:

1. Using a plastic pipette, drip sample onto the prism surface until the well is full.
2. Press the READ key and the results are displayed in the selected units.

Making a Standard Sodium Chloride Solution

Sodium Chloride solutions can be used to check the accuracy of the meter. The table below lists two Sodium Chloride solutions and their expected ppt Seawater value. To make a Standard NaCl Solution (g/100 g), follow the procedure below:

- Place container (such as a glass vial or dropper bottle that has a cover) on an analytical balance.
- Tare the balance.
- To make an X NaCl solution weigh out X grams of high purity dried Sodium Chloride (CAS #: 7647-14-5: MW 58.44) directly into the container.
- Add distilled or deionized water to the beaker so the total weight of the solution is 100g.

Example Standard NaCl solution:

	NaCl (g)	Water (g)	Total	Expected Seawater Value (ppt)
3.5% NaCl	3.50	96.50	100.000	34
10% NaCl	10.00	90.00	100.000	96

Specifications		HI96822
PSU	Range	0 to 50
	Resolution	1
	Accuracy (@25°C/77°F)	±2
ppt	Range	0 to 150
	Resolution	1
	Accuracy (@25°C/77°F)	±2
Specific Gravity (S.G.)	Range	1.000 to 1.114
	Resolution	0.001
	Accuracy (@25°C/77°F)	±0.002
Temperature	Range	0 to 80°C (32 to 176°F)
	Resolution	0.1°C (0.1°F)
	Accuracy (@25°C/77°F)	±0.3°C (0.5°F)
Additional Specifications	Temperature Compensation	automatic between 0 and 40°C (32 to 104°F)
	Measurement Time	approximately 1.5 seconds
	Minimum Sample Volume	100 µL (to cover prism totally)
	Light Source	yellow LED
	Sample Cell	stainless steel ring and flint glass prism
	Auto-off	after three minutes of non-use
	Enclosure Rating	IP65
	Battery Type / Life	9V / approximately 5000 readings
	Dimensions	192 x 102 x 67 mm (7.6 x 4.01 x 2.6")
	Weight	420 g
Ordering Information	**HI96822** is supplied with battery and instruction manual.	

Some specific examples of the importance of salinity:

Aquaculture: Young salmon start their lives in fresh water. As they mature, they reach a stage ("smolt") when they transition to salt water. When farming salmon, it is critically important to maintain proper salinity levels at each life stage to prevent unnecessary stress that could negatively affect growth and development.

Salinity is a vital parameter to monitor accurately when raising eggs and larval fish, optimizing juvenile and adult growth, and culturing live food such as rotifers and artemia.

Aquaria: Whether it is the world-renowned, eight million gallon Georgia Aquarium, or a 20 gallon reef tank at home, salinity is a crucial parameter to measure. In closed systems such as these, salinity is easily affected. As water evaporates, it leaves the salt behind, raising the salinity. When evaporated water is replaced with fresh water, the salinity is lowered. The potential for disaster is inherent in both situations. Use Hanna's digital refractometer to accurately measure salinity and to help prevent any mishaps.

HI96831 · HI96832

Digital Refractometers

for Ethylene and Propylene Glycol Analysis

- 0 to -50 °C freezing point range with ±0.5 °C accuracy
- Dual-level LCD
  - Displays measurement and temperature readings simultaneously
- Automatic Temperature Compensation (ATC)
- Easy measurement
  - Place a few drops of the sample in the well and press the READ key
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- IP65 water protection
  - Built to perform under harsh laboratory and field conditions.
- Quick, accurate results
  - Readings are displayed in approximately 1.5 seconds
- Single-point calibration
  - Calibrate with distilled or deionized water
- Small sample size
  - Sample size can be as small as 2 metric drops
- Automatic shut-off
  - After three minutes of non-use
- Stainless steel sample well
  - Resists corrosion from salt water
- ABS thermoplastic casing

The HI96831 for Ethylene Glycol and HI96832 for PropyleneGlycol Digital Refractometers are rugged, portable, water-resistant devices that utilizes the measurement of the refractive index to determine the percent volume and freezing point of ethylene and propylene glycol based solutions respectively.

These digital refractometers eliminate the uncertainty associated with mechanical refractometers. Samples are measured after a simple user calibration with distilled or deionized water. Within seconds, the refractive index and temperature are measured and converted into one of two measurement units; % volume or freezing point. Both meters use internationally recognized references for unit conversion and temperature compensation for glycol solutions (e.g. CRC Handbook of Chemistry and Physics, 87th Edition).

Specifications		HI96831 Ethylene Glycol	HI96832 Propylene Glycol
% Volume (% v/v)	Range	0 to 100%	0 to 100%
	Resolution	0.1 %	0.1 %
	Accuracy (@25°C/77°F)	±0.2 %	±0.3 %
Freezing Point (FP)	Range	0 to -50°C (32 to -58°F)	0 to -51°C (32 to -59.8°F)
	Resolution	0.1°C (0.1°F)	0.1°C (0.1 °F)
	Accuracy (@25°C/77°F)	±0.5°C (±1.0°F)	±0.5°C (±1.0°F)
Temperature	Range	0 to 80°C (32 to 176°F)	0 to 80°C (32 to 176°F)
	Resolution	0.1°C (0.1°F)	0.1°C (0.1°F)
	Accuracy (@25°C/77°F)	±0.3°C (±0.5°F)	±0.3°C (±0.5°F)
Additional Specifications	Temperature Compensation	automatic between 0 and 40°C (32 to 104°F)	
	Measurement Time	approximately 1.5 seconds	
	Minimum Sample Volume	100 µL (to cover prism totally)	
	Light Source	yellow LED	
	Sample Cell	stainless steel ring and flint glass prism	
	Auto-off	after three minutes of non-use	
	Enclosure Rating	IP65	
	Battery Type / Battery Life	9V / approximately 5000 readings	
	Dimensions / Weight	192 x 102 x 67 mm (7.6 x 4.01 x 2.6") / 420 g (14.8 oz.)	
Ordering Information		**HI96831** and **HI96832** are supplied with battery and instruction manual.	

Table of Contents

Thermometers Introduction

About Thermometers

Precise process control is one of the most important factors in maintaining high quality in production, just as precision and accuracy are the key to research. Temperature is a crucial variable in both production and research.

Glass and metal thermometers use thermal expansion to measure temperature. This method uses a physical law which gives a false sense of reliability, since one assumes the measurement is "true" because he or she can see how it works. This system is no longer suitable for many reasons and their accuracy and range are very limited. Glass construction is fragile and can be dangerous to a person's health, as well as to the environment. For these reasons, an alternative way of measuring temperature has become necessary. Hanna electronic thermometers are designed to withstand mechanical stress and extreme environments while maintaining high accuracy.

Electronic thermometers have provided the versatility, speed and accuracy requested by operators in all areas of temperature measurement. Speed is important when the reactions being monitored change rapidly. Small, compact sensors are preferable for tightly arranged areas, such as electronics and other miniature applications. Electronic thermometers allow users to monitor maximum, minimum and even average temperatures.

Dedicated research teams, precision process control, integrated production facilities and an overall team effort is required to meet the demanding applications of our users. Hanna's extensive professional thermometer line constitutes the true dedication Hanna commits to thermometer design and production.

Measurement Unit

Temperature is one of the most common physical properties in our everyday life. It is defined as the property of a body that determines the transfer of heat to or from other bodies. Physically, temperature affects variations in the macroscopic parameters of a body such as volume and pressure, among others.

The fundamental temperature scale is the absolute, thermodynamic or Kelvin scale. The Kelvin (K) unit of thermodynamic temperature, is the fraction 1/273.16 of thermodynamic temperature of the triple point of water. The triple point of water is a standard fixed point at which ice, liquid water, and water vapor are in equilibrium.

Two empirical temperature scales are in common use: the Celsius and Fahrenheit scales. These scales are based on two fixed points.

The Celsius (formally Centigrade) temperature scale uses the Celsius (°C) units, defined as 1/100th of the difference between the temperature of boiling (100°C) and freezing points (0°C) of water. The relationship between the Kelvin and Celsius scales is given by:

$$K = °C + 273.15$$

The Fahrenheit scale uses Fahrenheit (°F) units, where the temperature of boiling water is taken at 212°F, and the temperature of the freezing point at 32°F. The scale originally used the temperature of a mixture of ice and common salt as 0°F, and the inventor's approximate body temperature as 96°F. The relationship between the Fahrenheit and Celsius scales is calculated by:

$$°F = °C \bullet 9/5 + 32$$

Achieving Thermometer Accuracy

Even though it is easy to show resolutions of 0.1°C with digital thermometers, there is no relationship between resolution and accuracy of measurements.

Here is a list of the main causes that can have an effect on accuracy in temperature measurements:

- Instrument
  - The instrument may have an extended scale and 19,000 points of measurement may be obtained. Within these 19,000 points, the instrument may perform differently because of internal linearity.
- Electronic components
  - The internal electronics have a drift that depends on the ambient temperature. For this reason, the accuracy of the instrument is stated at a specific temperature of 20 or 25°C, and the drift has to be specified for each degree of variation with respect to the reference temperature.
- LCD
  - Liquid crystals have an operating limitation which is a function of temperature. Their normal range is between 0 and 50°C, but there are components capable of performing between -20 and 70°C.
- Batteries
  - Instrument battery power supply also has limitations of use.
- Temperature sensor
  - This is a separate accuracy, which is to be added to the instrument's error.

Also, if the probe supplied is connected to the meter during factory calibration, the probe error is eliminated but will reappear if the probe is replaced.

With all the possible forces influencing accuracy, calibration verification is essential. Hanna's CAL Check™ can verify an accurate calibration quickly and easily.

Importance of Accuracy

Up to a few years ago, accuracy was not a very critical aspect and tolerances of a few degrees did not jeopardize a process. From the time that hazard analysis and critical control points (HACCP) programs became a necessity, measurement accuracy has become a discriminating factor. Due to health risk factors, now an error of a few tenths of a degree can decide whether food can still be kept or must be discarded. In 1990, Hanna began to produce thermometers for our customers' HACCP programs to comply with new governmental regulations. Soon after, Hanna became the market leader in Europe as a result of the technological solutions offered to our users.

User Calibration of Typical Thermometers

To calibrate typical thermometers you need:

- For thermocouple thermometers
  - A simulator of the emf (electromotive force) generated by the thermocouple
- For thermometers with NTC/PTC sensor
  - At least two thermostatic baths
- For Pt100 thermometers
  - A resistance simulator
- For infrared thermometers
  - A heat source (panel) at controlled temperature

Few users can afford this investment in time and materials for checking their thermometers' accuracy. Hanna's exclusive CAL Check is a quick and cost effective way to verify accuracy.

Hanna CAL Check™ Calibration Feature

As previously described, the electronic components of an instrument shift with time. Hanna has made it possible for users, with the simple touch of a button, to verify whether the response of the instrument is within the tolerance limit of ±0.02°C.

The CAL Check system acts by substituting the sensor with an internal resistor which corresponds to 0°C; thus simulates the response that the temperature probe would have at 0°C.

Standardization

Hanna has designed a series of pre-calibrated temperature probes with a maximum error of 2°C for trouble-free replacement.

Thermocouple Thermometer Calibration

Although quite fast, thermocouple thermometers read with a response time much slower than other sensors and technologies. Unfortunately, the measurement of the thermocouple emf (electromotive force) loses accuracy because of the measuring system itself, based on the emf generated by the temperature difference between cold and hot junctions. The same emf may be generated under different conditions, for example:

- Hot junction at 100°C; cold junction at 20°C; difference: 80°C
  or Hot junction at 90°C; cold junction at 10°C; difference: 80°C

A temperature difference of 80°C is obtained with two different temperatures of the sample. It is, therefore, very important to determine the cold junction temperature very precisely. The ability to

do this has a large effect on the accuracy of the measuring system. A thermocouple thermometer is made of two thermometers, one that measures the cold junction, and one for measuring the emf generated by the thermocouple. The cold junction is usually measured with an NTC type sensor, which has response times different from those of the thermocouple. Another crucial point is measuring the actual value of the cold junction, without any environmental influence and dispersions.

To partially solve this problem, Hanna has devised the calibration of the instrument-thermocouple system by dipping the probe in melting ice, thus allowing the user to calibrate the measuring system at 0°C.

Thanks to this solution, it is now possible to use thermocouple thermometers for HACCP controls with an accuracy of ±0.3°C, which is the same performance of our Pt100 or NTC thermometers, but with a higher response time.

Calibration Test Keys

To check the calibration status of the instrument, calibrated keys have been prepared in the range from -18 to 70°C. These keys reproduce the value of the sensor at different temperatures. Simply disconnect the measuring probe, replace it with the key and ensure that the instrument reads the simulated value.

Hanna calibrates all thermometers with a standard probe. All NTC temperature probes are inspected and calibrated with standard instruments. During quality inspection, our technicians make sure that the reading errors are within the stated accuracies.

In addition, Hanna provides users with the necessary tools to verify that your thermometers read accurate values. Our complete line of electronic thermometers provides fast and precise measurements down to a tenth of a degree Celsius.

Hanna thermometers may be divided into four main categories: thermistor thermometers, thermocouple thermometers, Pt100 thermometers and infrared thermometers.

Thermometers Introduction

Thermistor Thermometers

The thermistor is a semi-conductor device whose resistivity (r) varies as a function of temperature (T):

$$R = R_0 [1 + a (T-T_0)]$$

where

R = resistance of temp. at T **T = temp at the end of measurement**
R_0 = resistance of temp. at T_0 **T_0 = temp at the beginning of measurement**

Temperature resistance coefficient is the parameter that determines if the resistivity variation is positive (as with the Positive Temperature Coefficient, or PTC sensors) or negative (as with the Negative Temperature Coefficient, or NTC thermistors). It is possible to determine the temperature by applying a potential difference and measuring the resistance.

Thermistor sensors are suitable for a temperature range of -50 to 150°C (-58 to 302°F). Higher temperatures may damage the semi-conductor sensor. Accurate temperature measurements are possible (tenths of degree) due to the high sensitivity of the sensor.

Thermocouple Thermometers

The thermocouple consists of the junction of two wires of different metals. At a given temperature, a potential difference results at the opposite extremes of the two wires (Seebeck effect), with the respective variations linearly related within small intervals. It is therefore possible to determine the temperature given the potential difference and characteristics of the two metals. The measurement end of the thermocouple probe is called the hot junction, while the connection of the thermocouple to the meter is the cold junction. An error is introduced as the cold junction is exposed to the ambient temperature. This error can be eliminated by physically putting the cold junction into an ice bath and forcing a reference temperature of 0°C, or by electronically compensating for the cold junction temperature effect. There are various types of thermocouples, identified by an ANSI code using a letter of the alphabet. The K type is the most commonly used themocouple.

Pt100 Thermometers

The operating principle of resistance thermometers is based on the increase of electric resistance of metal conductors (RTD: Resistance Temperature Detectors) with temperature.

This physical phenomenon was discovered by Sir Humphry Davy in 1821. In 1871, Sir William Siemens described the application of this property using platinum, thereby introducing an innovation in the manufacturing of temperature sensors. Platinum resistance thermometers have been used as an international standard for measuring temperatures between hydrogen triple point at 13.81 K and the freezing point of antimony at 630.75°C (1167.26°F).

Among the various metals to be used in the construction of resistance thermometers, platinum (Pt), a noble metal, is the one that can measure temperatures throughout a wide range; from -251°C (-419.8°F) to 899°C (1650.2°F), with a linear behavior.

Platinum RTD thermometers were common in the seventies but have now been replaced with thermistor sensors because of their smaller dimensions and faster response to temperature changes. The most common RTD sensor using platinum is the Pt100, which means a resistance of 100Ω at 0°C with a temperature coefficient of 0.00385Ω per degree Celsius. For a higher price one can buy platinum sensors with 250, 500 or 1000/ (Pt1000).

The main disadvantage of RTD probes is the resistance of the connection cable. This resistance prevents the use of standard two-wire cables for lengths over a few meters, since it affects the accuracy of the reading. For this reason, to obtain high levels of accuracy in industrial and laboratory applications, the use of a three or four-wire system is recommended.

For all its Pt100 thermometers and probes, Hanna has chosen the multiple-wire technology for higher accuracy.

Infrared Thermometers

All objects emit a radiant energy in the infrared (IR) spectrum that falls between visible light and radio waves.

The origins of IR measurements can be traced back to Sir Isaac Newton's prism and the separation of sunlight into colors and electromagnetic energy. In 1800, the relative energy of each color was measured, but it was not until early 20th century that IR energy was quantified. It was then discovered that this energy is proportional to the 4th power of the object's temperature.

IR instrumentation using this formula has been around for over 50 years. They almost exclusively use an optic device that detects the heat energy generated by the object that the sensor is aimed at. This is then amplified, linearized and converted into an electronic signal which in turn shows the surface temperature in Celsius or Fahrenheit degrees.

Infrared measurements are particularly suitable for areas where it is difficult or undesirable to take surface measurements using conventional contact sensors. Applications for IR meters include non-destructive testing of foodstuffs, moving machinery, and high temperature surfaces.

An ideal surface for IR measurements is a black body or radiator with an emissivity of 1.0. Emissivity is the ratio of the energy radiated by an object at a certain temperature to that emitted by a perfect radiator at the same temperature.

The shinier or more polished the surface, the less accurate the measurements. For example, the emissivity of most organic material and rough or painted surfaces is in the 0.95 region and hence, suitable for IR measurements.

On the other hand, surfaces of highly polished or shiny material, such as mirrors or aluminum, may not be appropriate for this application without using some form of filtration. This is due to other factors, namely, reflectivity and transmissivity. The former is a measure of an object's ability to reflect infrared energy while the latter is its ability to transmit it.

Another important and practical concern with IR measurements is the field of view. Infrared meters measure the average temperature of all objects in their field of view. To obtain an accurate result, it is important that the object completely fills the instrument's field of view and there are no obstacles between the meter and the object. The distance-to-target ratio, or the optic coefficient, is therefore an important consideration.

Reference Temperatures

In 1990, NIST established 17 fixed points of the International Temperature Scale (ITS-90) related to reproducible physical phenomena in nature. The ITS-90 Fixed Points are shown in the chart below:

Equilibrium state	K	°C
Vapor pressure point of helium	3 to 5	-270.15 to -268.19
Triple point of hydrogen	13.8033*	-259.346*
Boiling point of hydrogen at a pressure of 33.330.6 Pa	17.042*	-256.108*
Boiling point of equilibrium hydrogen	20.28*	-252.87*
Triple point of neon	27.102	-246.048
Triple point of oxygen	54.361	-218.789
Triple point of argon	83.8058	-189.3442
Triple point of mercury	234.3156	-38.8344
Triple point of water	273.16	0.01
Triple point of gallium	302.9146	29.7646
Melting point of indium	429.7485	156.5985
Melting point of tin	505.078	231.928
Melting point of zinc	692.677	419.527
Melting point of aluminum	933.473	660.323
Melting point of silver	1234.93	961.78
Melting point of gold	1337.33	1064.18
Melting point of copper	1357.77	1084.62

* Given for e-H2 , which is hydrogen at the equilibrium concentration of the ort and para molecular forms.

Product Spotlights

HI93501

Thermistor Thermometer for the Food Industry

HI93501 is a thermistor style thermometer that includes a stainless steel replaceable style penetration probe (FC762PW). It measures temperatures from -50 to 150°C (-58 to 302.0°F).

Standard features include waterproof casing and stainless steel penetration probe for measurements in semi solid foods, liquids or pastes. HI93501 also includes features such as CAL Check™, low battery detection, auto-off capability, and long battery life.

See page 14.28

HI935001

K-Type Thermocouple Thermometer for the Food Industry

HI935001 is a thermometer that includes a K-type thermocouple stainless steel replaceable style penetration probe (FC766PW). This thermometer offers a large range of temperature measurement; from -50 to 300°C (-58.0 to 572°F)

Standard features include waterproof casing and stainless steel penetration probe for measurements in semi solid foods, liquids or pastes. HI935001 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

See page 14.29

HI935004

T-Type Thermocouple Thermometer for the Food Industry

HI935004 is a thermometer that that includes a T-type thermocouple stainless steel replaceable style penetration probe (FC767PW). This thermometer offers temperature measurement from -50 to 300°C (-58.0 to 572°F)

Standard features include waterproof casing and stainless steel penetration probe for measurements in semi solid foods, liquids or pastes. HI935004 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

See page 14.31

	K-type	T-type	K,J,T - type	Range	CAL Button	CAL Check™	PC Compatibility	BEPS	HOLD Feature	Waterproof	Autoranging	Logging	Alarm	Interchangeable Probe	Multiple Channels	Backlit LCD	Stability Bargraph	Page
Thermocouple Thermometers																		
HI935005	•			°C/°F				•	•	•				•				14.8
HI935002	•			°C/°F				•	•	•				•	•			14.9
HI93531	•			°C/°F				•	•	•				•				14.10
HI93531N	•			°C/°F	•			•	•	•				•		•		14.10
HI93531R	•			°C/°F	•		•	•	•	•				•		•		14.10
HI93532	•			°C/°F				•	•	•				•	•			14.11
HI93532R	•			°C/°F	•		•	•	•	•				•	•	•		14.11
HI93530	•			°C/°F				•	•	•				•				14.12
HI93530N	•			°C/°F	•			•	•	•				•		•		14.12
HI93551			•	°C/°F				•	•	•				•				14.13
HI93551N			•	°C/°F	•			•	•	•				•				14.13
HI93542			•	°C/°F				•	•	•				•	•			14.14
HI93552R			•	°C/°F	•		•	•	•	•				•	•	•		14.14
HI935001	•			°C/°F		•				•				•				14.29
HI935007	•			°C/°F		•				•								14.30
HI935004		•		°C/°F		•				•				•				14.31
HI935008		•		°C/°F		•				•								14.32
Thermistor Thermometers																		
HI93501				°C/°F		•				•				•				14.28
HI93510				°C/°F				•	•	•				•				14.33
HI93510N				°C/°F	•			•	•	•				•		•		14.33
Infrared Thermometers																		
HI99551				°C/°F					•									14.39
HI99556				°C/°F					•					•				14.39
Pt100 Thermometers																		
HI955501				°C							•			•				14.40
HI955502				°C							•							14.40
Temperature Dataloggers																		
HI141				°C/°F			•	•		•		•	•		•			14.42
HI140				°C/°F			•	•		•		•	•					14.44
HI143				°C/°F			•					•	•					14.45

HI935005

K-Type Thermocouple Thermometers

- °C/°F Readout
  - Measurements can be displayed in either degrees Celsius or Fahrenheit. A simple press of the °C/°F button will switch between the scales.
- Interchangeable Probes
  - A wide range of K-type thermocouple probes are available to meet the specific needs of users. Any of the HI766 series of probes can be interchanged with the HI935005 to measure temperature of surfaces, gases, air, liquid, semi-solid samples, and more.
- High/Low Function
  - The maximum and minimum temperature values are continuously monitored and displayed on the lower portion of the HI935005 LCD display during a measurement session. The CLR button clears the high and low values on the LCD display.
- HOLD Function
  - The HOLD button on the face of the meter freezes the display to allow the user time to record readings. Although the display is frozen, the meter continues to internally monitor the temperature and update the high and low measurement values.
- Auto Shut-off
  - Users can select to enable automatic shut off after 8 or 60 minutes of non-use or select to disable the shut-off feature.
- Battery Error Prevention System (BEPS)
  - The Battery Error Prevention System detects when the batteries become too weak to ensure reliable measurements.
- Low Battery Indicator
  - When the battery level is below 10%, a warning symbol will blink to indicate low battery condition.

The HI935005 is a K-type thermocouple thermometer that can be used with a wide variety of K-type probes. This thermometer offers two measurement ranges from -50.0 to 199.9°C and 200 to 1350°C which can also be displayed in °F (-58.0 to 399.9°F and 400 to 2462°F). With a ±0.2% full scale accuracy, the HI935005 waterproof thermometers are perfectly suited for temperature measurements in the laboratory or the field.

Specifications	HI935005	
Range	-50.0 to 199.9°C and 200 to 1350°C; -58.0 to 399.9°F and 400 to 2462°F	
Resolution	0.1°C (-50.0 to 199.9°C) and 1°C (outside); 0.1°F (-58.0 to 399.9°F) and 1°F (outside)	
Accuracy	±0.2% FS (excluding probe error)	
Probe	HI766 series K-type thermocouple (not included)*	
Battery Type / Life	1.5V AA (3) / approximately 1600 hours of continuous use; auto-off selectable after 8 or 60 minutes of non-use (can be disabled)	
Environment	-10 to 50°C (14 to 122°F); RH max 100%	
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight	235 g (8.3 oz.)	
Ordering Information	**HI935005** is supplied with batteries and instruction manual.	
Probes	**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
	HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable
	HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI935002

Dual-channel, K-Type Thermocouple Thermometer

- Multiple input channels
  - Dual input channels
- HOLD
  - HOLD function
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at startup
- Waterproof
  - Compact, heavy-duty and waterproof

HI935002 is a 2-channel, waterproof, K-type thermometer that offers accurate temperature measurements in a wide range, as well as 1600 hours of battery life.

These units display current temperature along with the minimum and maximum temperature for each channel achieved during the measuring session. The difference between each channel can be shown, or a relative value can be set on each channel and variances around that value can be monitored.

The HOLD button freezes the display to allow the user time to record readings.

The instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Specifications	HI935002	
Range	-50.0 to 199.9°C and 200 to 1350°C; -58.0 to 399.9°F and 400 to 2462°F	
Resolution	0.1°C (-50.0 to 199.9°C) and 1°C (outside); 0.1°F (-58.0 to 399.9°F) and 1°F (outside)	
Accuracy	±0.2% f.s. (for 1 year, excluding probe error)	
Probe	HI766 series K-type thermocouple (not included)*	
Battery Type / Life	1.5V AA (3) / approx. 1600 hours of continuous use	
Environment	-10 to 50°C (14 to 122°F); RH max 100%	
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight	235 g (8.3 oz.)	
Ordering Information	**HI935002** is supplied with batteries and instructions.	
Probes	**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
	HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable
	HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI93531 · HI93531N · HI93531R

0.1° Resolution K-Type Thermocouple Thermometers

- HOLD
  - HOLD function
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at startup
- Backlight
  - Backlit display (N and R versions)
- Waterproof
  - Compact, heavy-duty and waterproof
- Connectivity
  - PC and printer compatible (R version)

These waterproof thermometers feature 0.1° resolution in the -149.9 to 999.9°C (-24.9 to 999.9°F) range, making them ideal for precise temperature measurements. The instruments display the current temperature along with the minimum and maximum extremes achieved.

The HOLD button freezes the display to allow the user time to record readings. The °C/°F button switches between the Celsius and Fahrenheit temperature scale. The CLR button restarts the evaluation of high and low values.

The HI93531N and HI93531R feature a user-activated backlight for low or no light conditions. The CAL button allows a simple one-point calibration in an ice bath at 0°C when probe interchange occurs. The HI93531R adds RS232 output that allows for data transfer to a PC or printer.

The instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Specifications	HI93531	HI93531N	HI93531R
Range	-200.0 to 999.9°C; 1000 to 1371°C -328.0 to 999.9°F; 1000 to 2500°F		
Resolution	0.1°C (-149.9 to 999.9°C); 0.2°C (-200.0 to -150.0°C); 1°C (outside) 0.1°F (-24.9 to 999.9°F); 0.2°F (-249.9 to -25.0°F); 0.3°F (-328.0 to -250.0°F); 1°F (outside)		
Accuracy	±0.5°C (-100.0 to 999.9°C); ±1°C (outside); ±1°F (-148.0 to 999.9°F); ±1.5°F (outside) (for 1 year, excluding probe error)		
Probe	HI766 series K-type thermocouple (not included)*		
CAL Button	N/A	yes	yes
Backlit LCD	N/A	yes	yes
RS232	N/A	N/A	yes
Battery Type / Life	1.5V AA (3) / approximately 500 hours of continuous use (with backlight off); auto-off after 60 minutes of non-use (can be disabled) Auto-off after 8-60 minutes (HI93532R)		
Environment	-10 to 60°C (14 to 122°F); RH max 100%		
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")		
Weight	235 g (8.3 oz.)		
Ordering Information	**HI93531**, **HI93531N** and, **HI93531R** are supplied with batteries and instructions.		
Probes*	**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable	
	HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable	
	HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable	

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI93532 · HI93532R

Dual-input, K-Type Thermocouple Thermometers

- HOLD
  - HOLD function
- Multiple input channels
  - Dual input
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at start-up
- Waterproof
  - Compact, heavy-duty and waterproof
- Backlight
  - Backlit display (N and R versions)
- Connectivity
  - PC and printer compatible (R version)

Conditions often require the measurement of two samples at the same time. The HI93532 series feature two built-in channels for two K-type probe connectors.

These thermometers display current temperature along with the high and low values in either channel. You can also see the difference between the two channels simultaneously with the high and low of the difference.

The HOLD button freezes the display to allow the user time to record readings.

The HI93532R feature a user-activated backlight for low or no light conditions. The CAL button allows the operator to perform a simple one-point calibration in an ice bath at 0°C when probe interchange occurs.

The HI93532R adds RS232 output that allows for data transfer to a PC or printer.

The instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Specifications	HI93532	HI93532R
Range	-200.0 to 999.9°C; 1000 to 1371°C; -328.0 to 999.9°F; 1000 to 2500°F	
Resolution	0.1°C (-149.9 to 999.9°C); 0.2°C (-200.0 to -150.0°C); 1°C (outside) 0.1°F (-24.9 to 999.9°F); 0.2°F (-249.9 to -25.0°F); 0.3°F (-328.0 to -250.0°F); 1°F (outside)	
Accuracy	±0.5°C (-100.0 to 999.9°C); ±1°C (outside); ±1°F (-148.0 to 999.9°F); ±1.5°F (outside) (for 1 year, excluding probe error)	
Probe	HI766 series K-type thermocouple (not included)*	
CAL Button	N/A	yes
Backlit LCD	N/A	yes
RS232	N/A	yes
Battery Type / Life	1.5V AA (3) / approximately 500 hours of continuous use (with backlight off); auto-off after 60 minutes of non-use (can be disabled); auto-off after 8 minutes (HI93532R)	
Environment	-10 to 60°C (14 to 122°F); RH max 100%	
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight	235 g (8.3 oz.)	
Ordering Information	**HI93532** and **HI93532R** are supplied with batteries and instructions.	
Probes*	**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
	HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable
	HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI93530 · HI93530N

0.1° Resolution K-Type Thermocouple Thermometers

- HOLD
  - HOLD function
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at startup
- Waterproof
  - Waterproof casing
- Backlight
  - Backlit display (N version)

The HI93530 and HI93530N are waterproof thermometers that can read with a resolution of 0.1 in the -149.9 to 999.9°C (-24.9 to 999.9°F) range.

The HOLD button freezes the display to allow the user time to record readings. The °C/°F button switches between the Celsius and Fahrenheit temperature scale.

For high accuracy, the HI93530N features a CAL button to allow the operator a simple one-point calibration in an ice bath at 0°C when probe interchange occurs.

The HI93530N also incorporates a user-activated backlight for low or no light conditions.

Remaining battery power is displayed at startup, and these instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Several interchangeable probes are available to meet your specific needs. Optional rubber boots are also available.

Specifications	HI93530	HI93530N
Range	-200.0 to 999.9°C; 1000 to 1371°C; -328.0 to 999.9°F; 1000 to 2500°F	
Resolution	0.1°C (-149.9 to 999.9°C); 0.2°C (-200.0 to -150.0°C); 1°C (outside) 0.1°F (-24.9 to 999.9°F); 0.2°F (-249.9 to -25.0°F); 0.3°F (-328.0 to -250.0°F); 1°F (outside)	
Accuracy	±0.5°C (-100.0 to 999.9°C); ±1°C (outside); ±1°F (-148.0 to 999.9°F); ±1.5°F (outside) (for 1 year, excluding probe error)	
Probe	HI766 K-type thermocouple (not included)*	
CAL Button	N/A	yes
Backlit LCD	N/A	yes
Battery Type / Life	1.5V AA (3) / approximately 500 hours of continuous use (with backlight off); auto-off after 60 minutes of non-use (can be disabled)	
Environment	-10 to 60°C (14 to 122°F); RH max 100%	
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight	235 g (8.3 oz.)	
Ordering Information	**HI93530** and **HI93530N** are supplied with batteries and instructions.	
Probes	**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
	HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable
	HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI93551 · HI93551N

K, J, T-Type Thermocouple Thermometers

- HOLD
  - HOLD function
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at startup
- Waterproof
  - Waterproof casing

These instruments offer the ability to take temperature measurements with different types of thermocouples and are equipped with a single button that switches between K-type, J-type or T-type thermocouples.

The HOLD button freezes the display to allow the user time to record readings. The CLR button restarts the evaluation of high and low values.

These thermometers display the current temperature along with the high and low extremes achieved during measurement.

For high accuracy, the HI93551N features a CAL button to allow the operator a simple one-point calibration in an ice bath at 0°C when probe interchange occurs.

The instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Specifications		HI93551	HI93551N
Range	K	-200.0 to 999.9°C and 1000 to 1371°C; -328.0 to 999.9°F and 1000 to 2500°F	
	J	-200.0 to 999.9°C; -328.0 to 999.9°F and 1000 to 1832°F	
	T	-200.0 to 400.0°C; -328.0 to 752.0°F	
Resolution	K	0.1°C (-149.9 to 999.9°C); 0.2°C (-200.0 to -150.0°C); 1°C (1000 to 1371°C); 0.1°F (-24.9 to 999.9°F); 0.2°F (-249.9 to -25.0°F); 0.3°F (-328.0 to -250.0°F); 1°F (1000 to 2500°F)	
	J	0.1°C (-200.0 to 999.9°C); 0.1°F (-149.9 to 999.9°F); 0.2°F (-328.0 to -150.0°F); 1°F (1000 to 1832°F)	
	T	0.1°C (-149.9 to 400.0°C); 0.2°C (-200.0 to -150.0°C); 0.1°F (0.0 to 752.0°F); 0.2°F(-270.0 to -0.1°F); 0.3°F (-328.0 to -270.1°F)	
Accuracy		±0.5°C (-100.0 to 999.9°C); ±1°C (outside); ±1°F (-148.0 to 999.9°F); ±1.5°F (outside) (for 1 year, excluding probe error)	
Probe		HI766 series K-type thermocouple (not included)*	
CAL Button		N/A	yes
Battery Type / Life		1.5V AA (3) / approximately 500 hours of continuous use (with backlight off); auto-off after 60 minutes of non-use (can be disabled); auto-off after 8 minutes (HI93551R)	
Environment		-10 to 60°C (14 to 122°F); RH max 100%	
Dimensions / Weight		150 x 80 x 36 mm (5.9 x 3.1 x 1.4") / 235 g (8.3 oz.)	
Ordering Information		**HI93551** and **HI93551N** are supplied with batteries, instructions and protective case.	
Probes		**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
		HI766D	Air/gas, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable
		HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

*K-type thermocouple probes should be ordered separately to meet your specific application.

Thermocouple probes begin on page 14.15

HI93542 · HI93552R

Dual-channel, K, J, T-Type Thermocouple Thermometers

- HOLD
  - HOLD function
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery life indicator at startup
- Waterproof
  - Waterproof casing
- Backlight
  - Backlit display (HI93552R)
- Connectivity
  - PC and printer compatible (HI93552R)

The HI93542 and HI93552R are dual-channel waterproof K, J, and T-type thermocouple thermometers that can switch between thermocouple types at the touch of a button.

At any time, users can switch views to see all information on either channel, display current temperature or average along with the high and low values. Users can also see the difference between the two channels simultaneously, along with the high and low of the difference.

The HOLD button freezes the display to allow the user time to record readings. The °C/°F button switches between the Celsius and Fahrenheit temperature scale. The CLEAR button restarts the evaluation of high and low values.

For high accuracy, the HI93552R features a CAL button to allow the operator a simple one-point calibration in an ice bath at 0°C when probe interchange occurs.

The HI93552R also adds an RS232 output that allows for data transfer to a PC or printer.

The instruments are equipped with BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

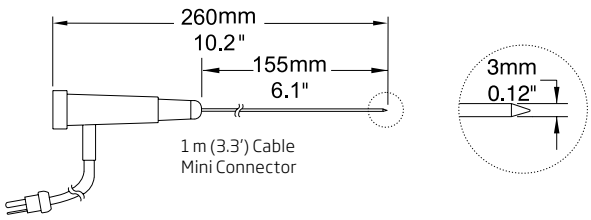
Specifications		HI93542	HI93552R
Range	K	-200.0 to 999.9°C and 1000 to 1371°C; -328.0 to 999.9°F and 1000 to 2500°F	
	J	-200.0 to 999.9°C; -328.0 to 999.9°F and 1000 to 1832°F	
	T	-200.0 to 400.0°C; -328.0 to 752.0°F	
Resolution	K	0.1°C (-149.9 to 999.9°C); 0.2°C (-200.0 to -150.0°C); 1°C (1000 to 1371°C); 0.1°F (-24.9 to 999.9°F); 0.2°F (-249.9 to -25.0°F); 0.3°F (-328.0 to -250.0°F); 1°F (1000 to 2500°F)	
	J	0.1°C (-200.0 to 999.9°C); 0.1°F (-149.9 to 999.9°F); 0.2°F (-328.0 to -150.0°F); 1°F (1000 to 1832°F)	
	T	0.1°C (-149.9 to 400.0°C); 0.2°C (-200.0 to -150.0°C); 0.1°F (0.0 to 752.0°F); 0.2°F(-270.0 to -0.1°F); 0.3°F (-328.0 to -270.1°F)	
Accuracy		±0.5°C (-100.0 to 999.9°C); ±1°C (outside); ±1°F (-148.0 to 999.9°F); ±1.5°F (outside) (for 1 year, excluding probe error)	
Probe		HI766 series K-type thermocouple (not included)	
CAL Button		N/A	yes
Backlit LCD		N/A	yes
RS232		N/A	yes
Battery Type / Life		1.5V AA (3) / approximately 500 hours of continuous use (with backlight off); auto-off: after 60 minutes of non-use (HI93542); selectable after 8 or 60 minutes of non-use (HI93552) (can be disabled for all models)	
Environment		-10 to 60°C (14 to 122°F); RH max 100%	
Dimensions		150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight		235 g (8.3 oz.)	
Ordering Information		**HI93542** and **HI93552R** are supplied with batteries, instructions and protective case.	
Probes		**HI766C**	Penetration, stainless steel K-type thermocouple temperature probe with 1 m cable
		HI766E1	General purpose/penetration, stainless steel K-type thermocouple temperature probe with 1 m (3.3') cable

Thermocouple probes begin on page 14.15

HI766 K-Type Thermocouple Probes with Handle

HI766C, Penetration Probe

K-type thermocouple probe with sharp tip for penetration of semi-solid samples.

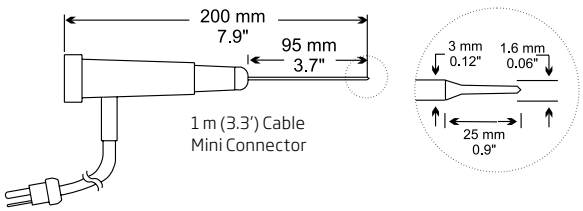


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766C	semi-solids, meat, rubber	900°C (1650°F)	15 seconds	L 155 mm x dia 3 mm (6.1 x 0.12")	stainless steel	green / 1 m (3.3')
HI766CL	semi-solids, meat, rubber	900°C (1650°F)	15 seconds	L 310 mm x dia 5 mm (12.2 x 0.19")	stainless steel	green / 1 m (3.3')

HI766C1, Ultra-Fast Penetration Probe

Penetration probe with fast response time.

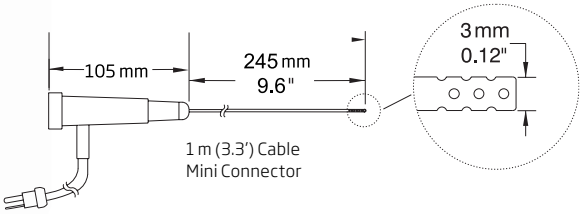


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766C1	semi-solids, food	300°C (570°F)	4 seconds	L 95 mm x dia 1.6 mm (3.7 x 0.06")	stainless steel	green / 1 m (3.3')

HI766D Probe for Air and Gas

K-type thermocouple probe for measuring the temperature of air and gases.



Specifications

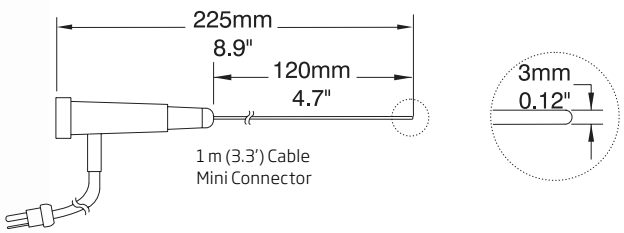
Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766D	air, gases	300°C (570°F)	20 seconds	L 245 mm x dia 3 mm (9.6 x 0.12")	stainless steel	green / 1 m (3.3')

HI766

HI766 K-Type Thermocouple Probes with Handle

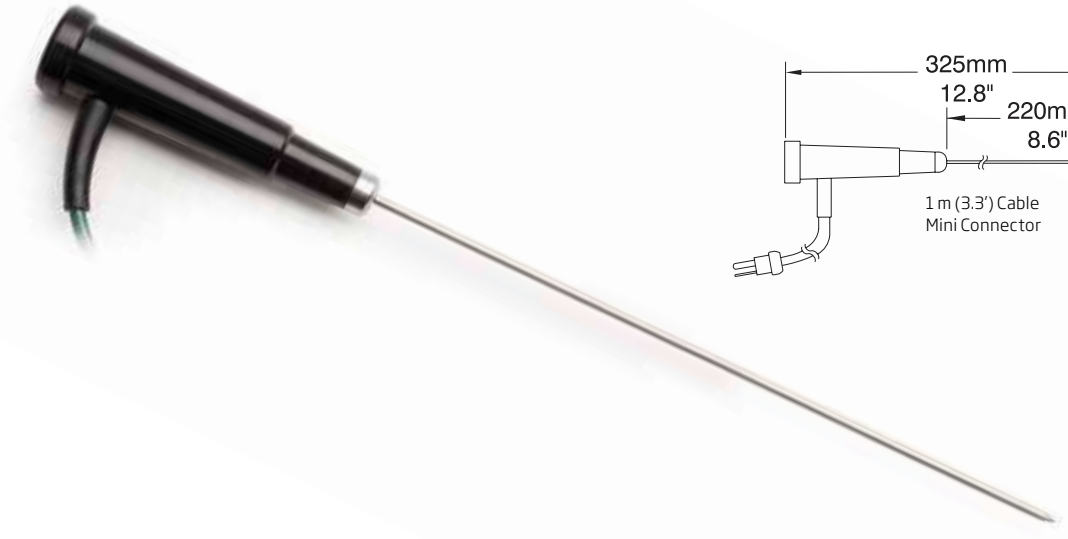
HI766E1, General Purpose Probe

General purpose, penetration probe.



Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766E1	liquids, air, gases	900°C (1650°F)	6 seconds	L 120 mm x dia 3 mm (4.7 x 0.12")	stainless steel	green / 1 m (3.3')



HI766E2, General Purpose Probe

General purpose, penetration probe.

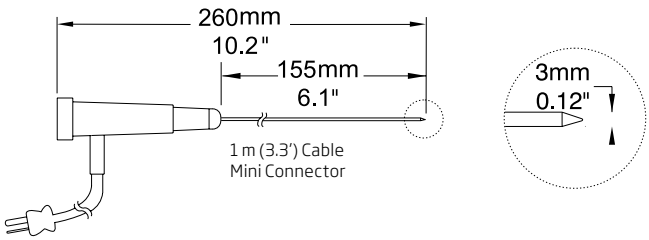
Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766E2	liquids, air, gases	900°C (1650°F)	6 seconds	L 220 mm x dia 5 mm (8.5 x 0.2")	stainless steel	green / 1 m (3.3')

Thermocouple Probes with Handle for Food Applications

FC766PW, Penetration Probe

K-type thermocouple probe with sharp tip for penetration of food samples.

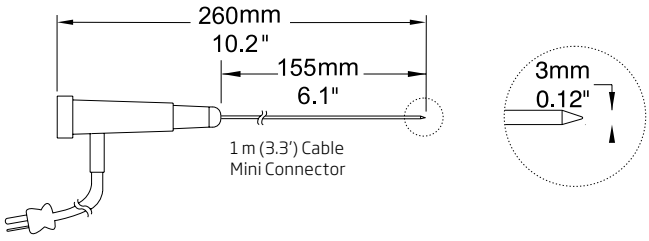


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
FC766PW	Food	300°C (572°F)	15 seconds	L 155 mm x dia 3 mm (6.1 x 0.12")	stainless steel	white / 1 m (3.3')

FC767PW, Penetration Probe

T-type thermocouple probe with sharp tip for penetration of food samples.



Specifications

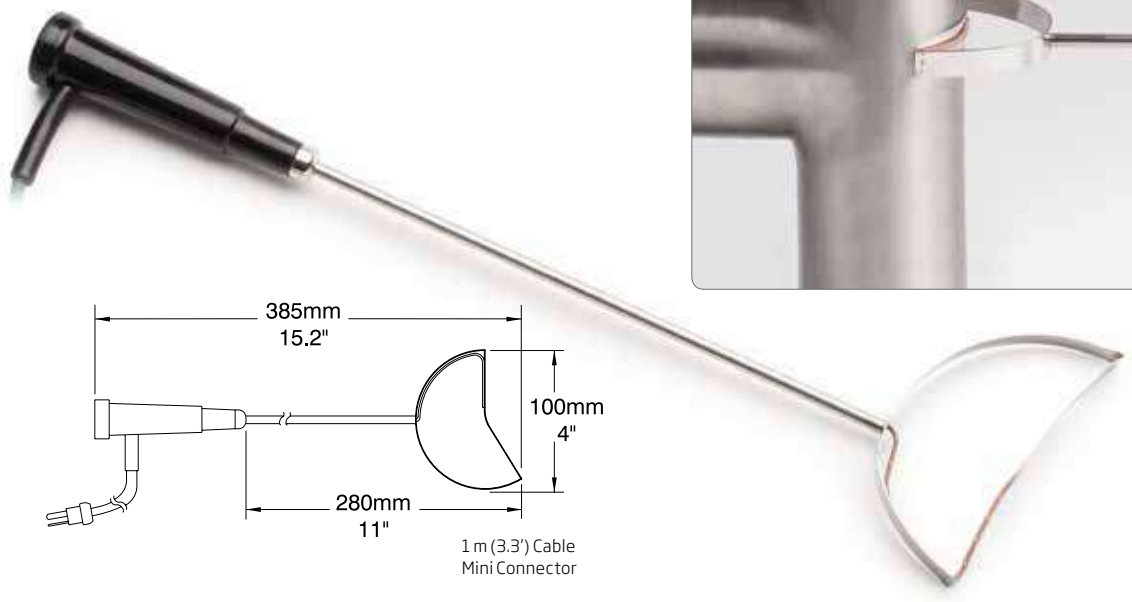
Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color
FC767PW	Food	300°C (572°F)	15 seconds	L 155 mm x dia 3 mm (6.1 x 0.12")	stainless steel	white / 1 m (3.3')

HI766

HI766 K-Type Thermocouple Surface Probes

HI766A, Roller Surface Probe

This probe is designed to measure the temperature of convex surfaces.

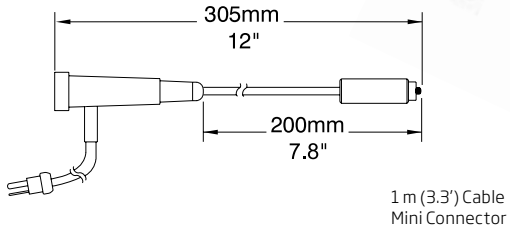


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766A	convex surfaces, moving rollers	320°C (600°F)	7 seconds	280 mm (11') (probe length)	stainless steel	green / 1 m (3.3')

HI766B, Surface Probe

Temperature probe for measurements on surfaces.



Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Color / Length
HI766B	hot solids, furnaces, molds	650°C (1200°F)	8 seconds	L 200 mm x dia 16 mm (7.9 x 0.6")	stainless steel	green / 1 m (3.3')

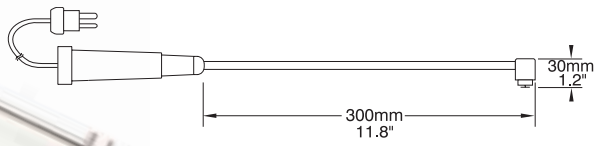
HI766 K-Type Thermocouple Surface Probes

The following probes are designed to ensure optimal contact with surfaces of different shapes and dimensions.

When using these probes, the handle temperature must never exceed 150°C (302°F) to avoid possible damage to the probe.

HI766B1, 90° Angle Surface Probe

Probe for measuring the temperature of 90° angle surfaces.

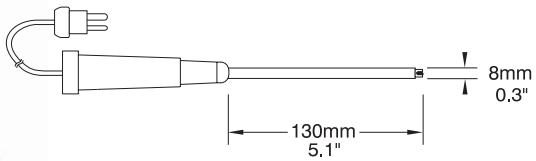


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Sensor	Cable Color / Length
HI766B1	hard to reach surfaces	450°C (840°F)	8 seconds	L 300 mm x dia 30 mm (11.8 x 1.2")	stainless steel	spring-loaded	green / 1 m (3.3')

HI766B2, Surface Probe

Probe for measuring the temperature of round surfaces.

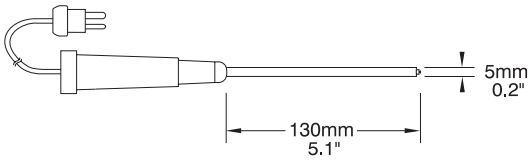


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Sensor	Cable Color / Length
HI766B2	solids, furnaces, molds	900°C (1650°F)	3 seconds	L 130 mm x dia 8 mm (5.1 x 0.3")	stainless steel	spring-loaded	green / 1 m (3.3')

HI766B3, Small Surface Probe

Probe for measuring the temperature of small surfaces.



Specifications

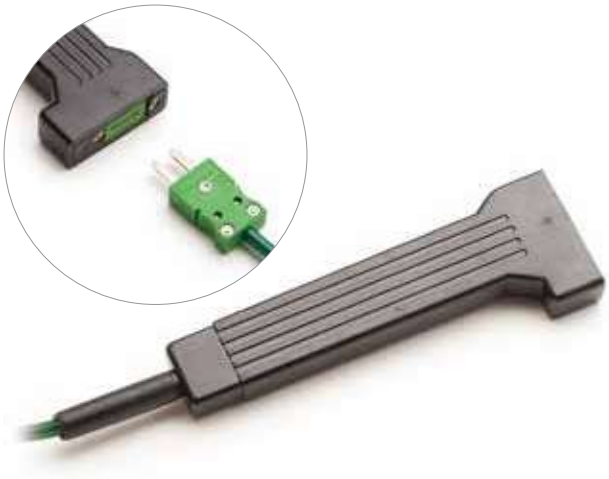
Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Sensor	Cable Color / Length
HI766B3	small surfaces	200°C (390°F)	6 seconds	L 130 mm x dia 5 mm (5.1 x 0.2")	stainless steel, insulated tube	spring-loaded	green / 1 m (3.3')

HI766 K-Type Thermocouple Probes

HI766PX Series, Probes with Detachable Handle

The HI766PX series are K-type thermocouple temperature probes to be used with thermocouple thermometers. These probes are ideal for measuring samples at very high temperatures, such as in industrial applications.

All probes are made of stainless steel for long life and easy cleaning. The HI766PX series includes a wide range of probes for measurement of liquids, air, gas and penetration in semisolids, as well as curved, planed or hard-to-reach surfaces. In addition, models are available with interchangeable or fixed handles for maximum versatility.



HI766HD, Probe Handle

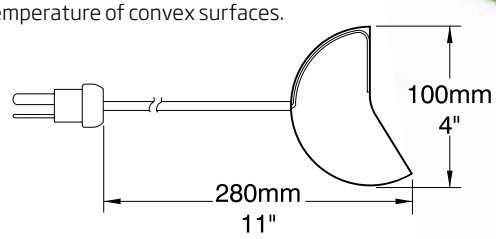
A rugged, PVC handle with a 1 meter (3.3') cable. It is provided with a female connector, which allows the connection of any HI766Px probe.

HI766EX, Extension Cable

A coiled cable which extends the probe cable by 1 m (3.3') , with two connectors at the two ends (1 male and 1 female).

HI766PA, Roller Surface Probe

This probe is designed to measure the temperature of convex surfaces.

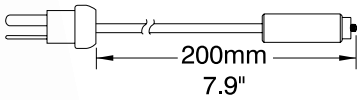


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Length	Probe
HI766PA	convex surfaces, moving rollers	320°C (600°F)	7 seconds	280 mm (11')	stainless steel

HI766PB, Surface Probe

Temperature probe for measurements on surfaces.



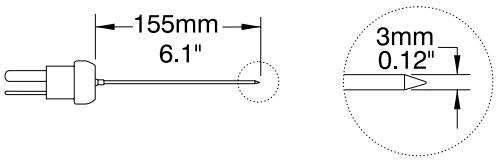
Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe
HI766PB	hot solids, furnaces, molds	650°C (1200°F)	8 seconds	L 200 mm x dia 16 mm (7.9 x 0.6")	stainless steel

HI766 K-Type Thermocouple Probes

HI766PC, Penetration Probe

K-type thermocouple probe with sharp tip for penetration of semi-solid samples.

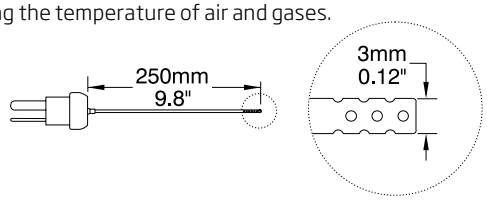


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe
HI766PC	semi-solids, meat, rubber	900°C (1650°F)	15 seconds	L 155 mm x dia 3 mm (6.1 x 0.12")	stainless steel

HI766PD, Probe for Air and Gas

K-type thermocouple probe for measuring the temperature of air and gases.

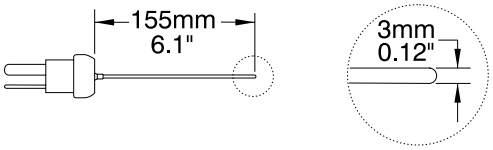


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe
HI766PD	air, gases	300°C (570°F)	20 seconds	L 250 mm x dia 3 mm (9.8 x 0.12")	stainless steel

HI766PE1, General Purpose Probe

General purpose, penetration probe.

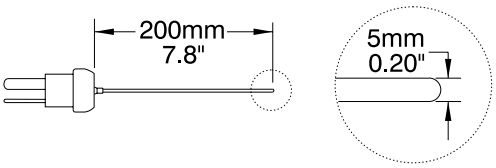


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe
HI766PE1	liquids, air, gases	900°C (1650°F)	6 seconds	L 155 mm x dia 3 mm (6.1 x 0.12")	stainless steel

HI766PE2, General Purpose Probe

General purpose, penetration probe.



Specifications

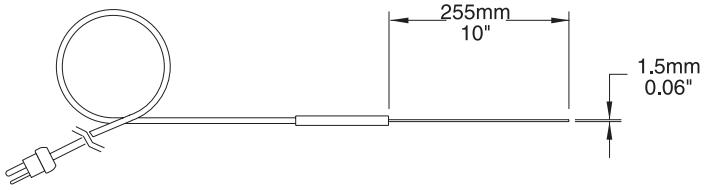
Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe
HI766PE2	liquids, air, gases	900°C (1650°F)	6 seconds	L 200 mm x dia 5 mm (7.8 x 0.2")	stainless steel

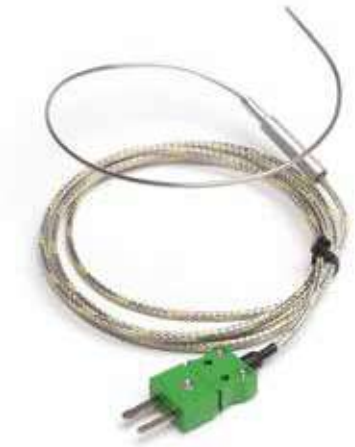
HI766

HI766 K-Type Thermocouple Probes for Specific Applications

HI766F, High Temperature Probe

Probe with flexible sheath without handle, designed to measure high temperatures.



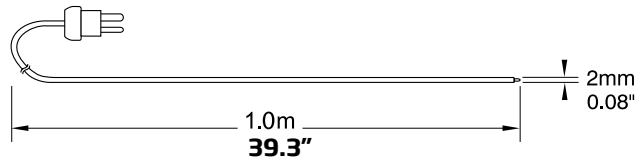


Specifications

Code	Application	Max. Temperature	Response Time (90% of final value)	Probe Dimensions	Probe	Cable Length
HI766F	high temperature	1100°C (2000°F)	4 seconds	L 255 mm x dia 1.5 mm (10 x 0.06")	AISI 316 stainless steel	1 m (3.3')

HI766F1, Wire Temperature Probe

Wire probe, designed to access hard to reach places. Probe does not incorporate a handle.



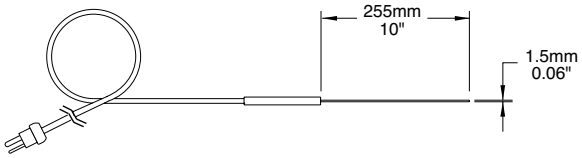
Specifications

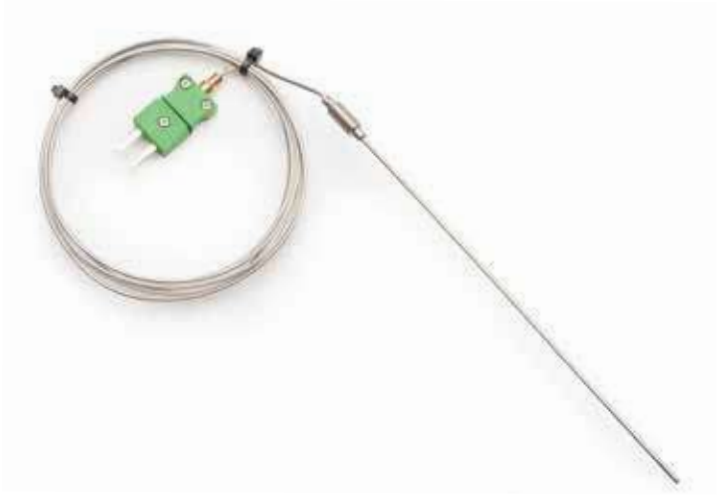
Code	Application	Max. Temperature	Response Time (63.2% F.S.)	Probe Dimensions	Sensor	Wire length
HI766F1	hard to reach areas	480°C (900°F)	1 second	dia 2 mm (0.08")	exposed wires	1 m (3.3')
HI766F1/5	hard to reach areas	480°C (900°F)	1 second	dia 2 mm (0.08")	exposed wires	5 m (16.4')

HI766 K-Type Thermocouple Probes for Specific Applications

HI766Z, Wire Temperature Probe

Wire probe, designed to measure temperature inside ovens.



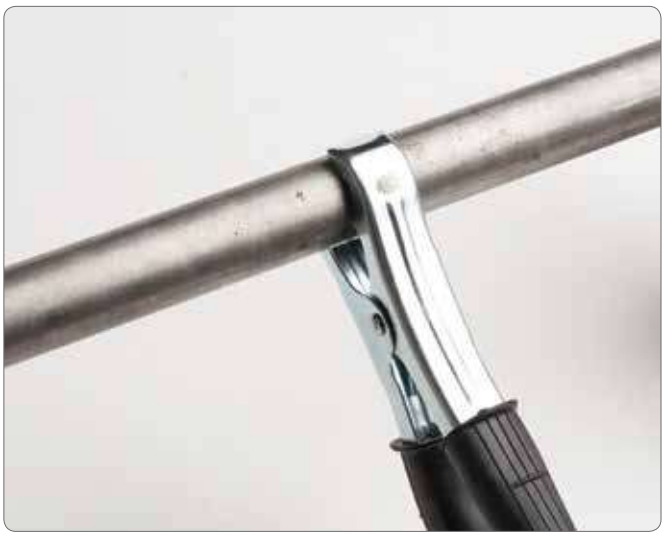


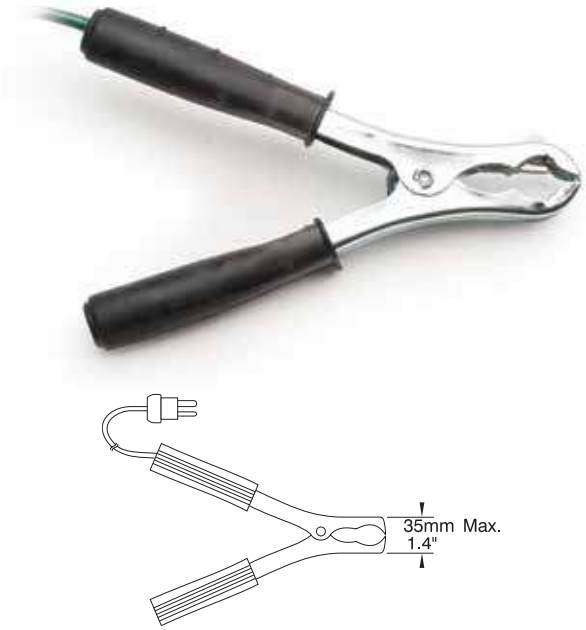
Specifications

Code	Application	Max Temperature	Response Time (90% of final value)	Probe Dimensions	Sensor	Cable Length
HI766Z	ovens	1100°C (2000°F)	4 seconds	L 255 mm x dia 1.5 mm (10 x 0.06")	stainless steel	1.7 m (5.6')
HI766Z/3	ovens	1100°C (2000°F)	4 seconds	L 255 mm x dia 1.5 mm (10 x 0.06")	stainless steel	3 m (9.9')
HI766Z/7	ovens	1100°C (2000°F)	4 seconds	L 255 mm x dia 1.5 mm (10 x 0.06")	stainless steel	7 m (22.9')

HI766TV1, Pipe Clamp Probe

Probe for measuring the temperature of pipes and tubes.





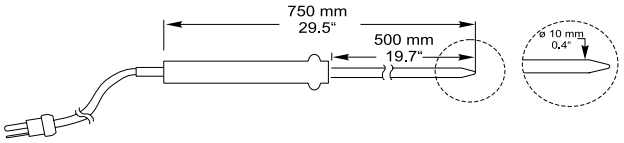
Specifications

Code	Application	Max. Temperature	Response Time (90% of final Value)	Clamp Opening Diameter	Sensor
HI766TV1	pipes, tubes	200°C (390°F)	8 seconds	max 35 mm (1.4")	housed inside the clamp

HI766 K-Type Thermocouple Probes for Specific Applications

HI766TR1, Penetration Probe

K-type thermocouple probe with sharp tip for penetration of semi-solid samples.

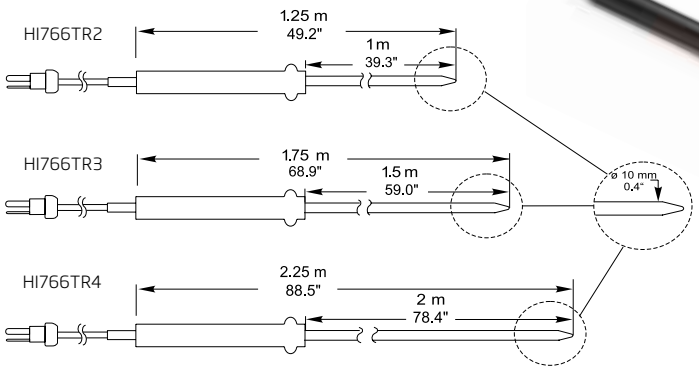


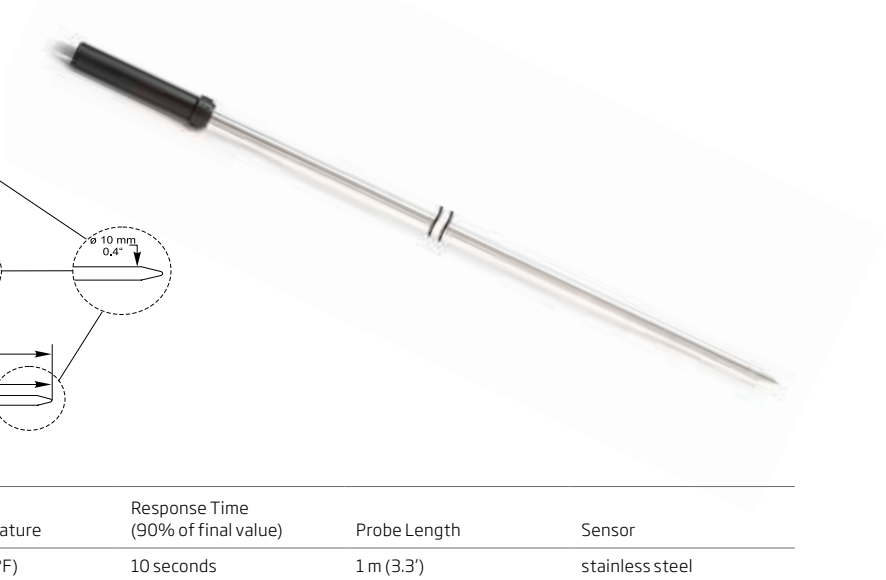
Specifications

Code	Application	Max Temperature	Response Time (90% of final value)	Probe Dimensions	Sensor
HI766TR1	semi-solids, liquids	250°C (482°F)	10 seconds	L 500 mm x dia 10 mm (19.7 x 0.4")	stainless steel

HI766TR2, HI766TR3, HI766TR4 Penetration Probes

K-type thermocouple probes with sharp tip for penetration of semi-solid samples.





Specifications

Code	Application	Max Temperature	Response Time (90% of final value)	Probe Length	Sensor
HI766TR2	semi-solids, liquids	250°C (482°F)	10 seconds	1 m (3.3')	stainless steel
HI766TR3	semi-solids, liquids	250°C (482°F)	10 seconds	1.5 m (5')	stainless steel
HI766TR4	semi-solids, liquids	250°C (482°F)	10 seconds	2 m (6.6')	stainless steel

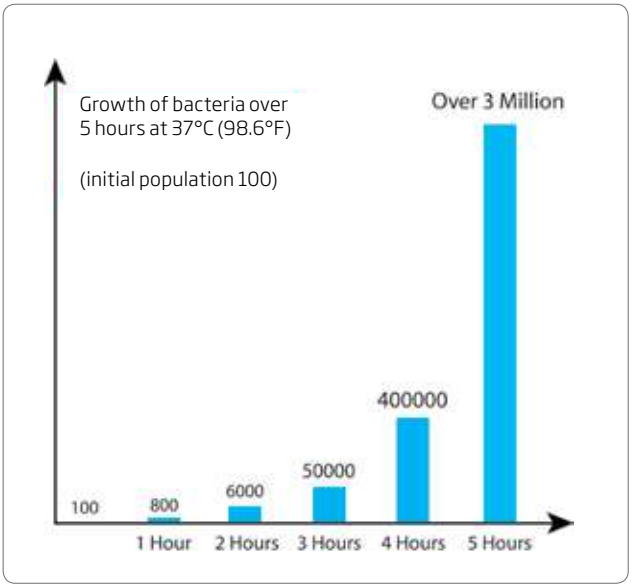
Hanna Thermometers for the Food Sector

Operators in the food sector need an extensive range of products in order to guarantee the quality and safety of food supplied to the public while maintaining compliance with local and federal laws. In order to satisfy the need for quality, safety, and compliance, Hanna manufactures a vast range of products with the necessary accuracy and reliability to check the quality of food in all phases of preparation and distribution.

Many of Hanna's portable and pocket thermometer lines have become synonymous with temperature control in restaurants and catering facilities.

For the adverse measurement conditions found in food production areas, typically with high humidity and condensation problems, Hanna has manufactured a substantial array of waterproof meters.

To satisfy the requirements of HACCP, Hanna supplies a complete range of thermometers and pH meters to check goods from production to transport and from catering to storage. Documentation is a must in certain production cycles and important for HACCP programs. For this Hanna offers a range of logging meters. These are stand-alone meters that can measure and log the parameters without any supervision. Shock-resistant protective boots are available for many of our instruments.



Temperature

Temperature of food is constantly monitored to keep growth of pathogens and microorganisms under control. Temperature is important in production to ensure that the food is not spoiled and the quality is not compromised, therefore enhancing it's value. Food needs to be kept at the correct temperature while stored, displayed, and on the move. If temperature is not properly controlled, bacteria can grow to dangerous levels in just a few hours.

The table below lists recommended temperatures for different products. It is vital to monitor and document the temperature to which food has been exposed.

Product	Temp.	Product	Temp.
Chunks of Meat	≤ 7°C	Smoked Fish	≤ 7°C
Minced Meat	≤ 4°C	Frozen Food	≤ -18°C
Innards	≤ 3°C	Milk	≤ 7°C
Frozen Chicken	≤ -12°C	Fruit and Vegetables	≤ 10°C
Deep-freeze Chicken	≤ -18°C	Eggs	≤ 8°C
Fresh Fish	≤ 2°C	Dried Fruit	≤ 25°C

Products and their recommended storage temperatures

Temperature plays an important role in the processing and preparation of edible products containing meat

Meat

The temperature of meat at slaughterhouses is a vital quality control test and needs to be checked at various points of production. Fresh meat should be stored at about 2°C (35.6°F).

For deep-freeze meat in storage, it should have an internal temperature around -22°C (-7.6°F) with the surface temperature reaching -35°C (-31°F). In order to thaw the meat properly, the surrounding temperature should be 7°C (44.6°F).

Ham and Sausages

The temperature of salted meat stored for several months is around 2°C (35.6°F). Afterwards, the product is rinsed and dried at around 25°C (77°F) prior to maturing at a preset temperature for a particular product. For sausages, the mixed ingredients are cooked at a certain temperature and then cooled at around 5 to 15°C (41 to 59°F).

Beverages

The temperature of spring or deep well waters that are extracted for beverage production must be continuously monitored to ensure purity. During the production of soft drinks, syrup is pasteurized before being added, to prevent bacteriological problems. In order to prepare fruit juices, fruit pulp is heated to just below boiling point for a few seconds to reduce the presence of microorganisms. During both of these processes, accurate temperature monitoring is crucial.

Temperature control also plays a crucial role in beer production. For example, malt has to be heated to 75°C (167°F) during the mash process. Once the mash is cooled, the vessel is heated above boiling point to prepare the mash for a strainer; later the mash is heated to up to 120°C (248°F) for a few seconds to pasteurize it. The type of yeast then used for the fermentation process is also temperature dependent. By controlling the fermentation temperature, operators can determine the time needed for the product to fully develop. Temperature is also controlled during filtration, which is needed in order to remove particles and improve the taste and longevity of beer. In order to remove protein, beer is cooled down to almost 0°C (32°F). As with many other products on the market, beer is pasteurized at around 60°C (140°F) after it has been bottled to eliminate the presence of microorganisms.

Milk and Dairy Products

Milk is checked for impurities and bacteria upon collection. During storage, the temperature of milk is normally kept below 5°C (41°F). In order to slow down cream formation, milk is homogenized at about 60°C (140°F).

The pasteurization of milk results in the reduction of microorganisms by 95% and is attained by raising the temperature to over 72°C (161.6°F). For UHT (ultra heat treated), milk is heated to 135/150°C (275/302°F) in a pressurized vessel for a few seconds. If the process is repeated for several minutes, all microorganisms, including spores, are destroyed and the sterilized milk will have a 12 month shelf life. For cheese, temperature needs to be adjusted before and during various processes, for example, when rennet is added.

Temperature in the maturation chamber also determines the period of maturation needed. Likewise, temperature is important in the production of butter. For example, skimmed milk is separated from cream at around 55°C (131°F) and the cream is then cooled to about 8°C (46.4°F). The temperature of incoming milk is raised to 45°C (113°F) before the addition of a culture for yogurt manufacturing. In order to denature the whey proteins, milk is raised to very high temperatures. The incubation temperature is maintained for a few hours prior to its cooling to about 10°C (50°F).

Chocolate

Fermentation of cocoa beans is started by increasing the temperature to about 50°C (122°F). At different stages of chocolate manufacturing such as crystallization, accurate temperature measurement is a must. Once the chocolate is ready, the storage temperature should be monitored to ensure that it stays in the 15°C (59°F) range.

Bread and Pasta

The temperature of stored grain in silos is controlled to ensure that premature fermentation does not occur. During pasta production, water at about 25°C (77°F) is added to wheat flour during fermentation of dough for bread-making, the temperature is kept at around 30°C (86°F). The oven temperature for baking should be around 260°C (500°F) and once baked, bread is cooled to room temperature. For semi-finished products that can be flash-baked, the dough has to be stored at very low temperatures.

Sanitization of Machinery

The temperature of cleansing agents, together with their concentration, have a significant bearing on how effectively the machinery is sanitized. The temperature for fermentation vessels can range from room temperature to 40°C (104°F). For milk and yogurt, tanks may reach 70°C (158°F) and as high as 150°C (302°F) for steam sterilizers. In addition, regulatory bodies recommend a certain minimum temperature for cleaning agents to be effective; this can vary from 24°C (75.2°F) for iodine and ammonia and 49°C (120.2°F) for chlorine.

Coffee

In order to invoke an aroma, coffee beans are heated up to 200°C (392°F). During roasting, the temperature is closely monitored. In order to provide a long shelf life, the finished product is frozen at -40°C (-40°F) prior to drying. To produce a good coffee, it is important to ensure that the temperature of coffee machines does not exceed 80°C (176°F).

HI93501

Thermistor Thermometer

- EN 13485 compliant
- FC762PW thermistor probe
- CAL Check™ feature
- Remaining battery life indication / low battery detection
- Auto-off
- IP65 Waterproof casing

Food service, food preparation, packaging, storage and transport of food require temperature to be monitored or controlled. Spot checking temperatures with Hanna food thermometers ensures daily work routines are carried out at the correct temperature.

HI93501 is a thermistor style thermometer that includes a stainless steel replaceable style penetration probe (FC762PW). It measures temperatures from -50 to 150°C (-58 to 302.0°F).

Standard features include waterproof casing (rated IP65) and stainless steel penetration probe designed for continuous contact with foodstuffs in accordance with regulation (EC) number 1935/2004. HI93501 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

Interchangeable with FC762 series thermistor probes

Our optional HI710026 blue shockproof rubber boot offers maximum impact protection.

Specifications	HI93501
Range*	-50.0 to 150.0°C; -58.0 to 302.0°F
Resolution	0.1°C; 0.1°F
Meter Accuracy @ 23.0°C ±5°C	±0.1°C (-50.0 to 150.0°C); ±0.2°F (-58.0 to 302.0°F)
Probe Accuracy (FC762PW)	±0.3°C (-10.0 to 80.0°C); ±0.5°F (-14 to 176°F); ±0.7°C / ±1.3°F remaining range
Probe	FC762PW general purpose penetration probe with 1 m (3.3') white cable and white handle
Battery Type / Life	1.5V AAA (3) / approximately 4500 hours of continuous use; user-selectable auto-off after 8 or 60 minutes of non-use (can be disabled).
Environment	for air measurement: Type E
	for product internal measurement: rated operating condition: -20 to 50°C (-4 to 122°F) limiting condition: -30 to 50°C (-22 to 122°F) storage and transportation condition: -40 to 70°C (-40 to 158°F)
	relative humidity 100 %
Storage/transport temperature	-40 to 70°C (-40 to 158°F)
Dimensions	140 x 57 x 28 mm (5.5 x 2.2 x 1.1")
Mass	175 g (6.17 oz.)
Certification	EN 13485:2001 suitability: storage and transport; climatic environment: E; accuracy class: 1;
Ordering Information	**HI93501** is supplied with FC762PW temperature probe, batteries and instructions.

* The measurement range may be limited by probe type, and applies to the probe shaft.

calibration test keys begin on page 14.38

Interchangeable with FC766 series thermocouple probes

HI935001

K-Type Thermocouple Thermometer

- FC766PW K-type thermocouple probe
- CAL Check™ feature
- Remaining battery life indication/ low battery detection
- Auto-off
- Waterproof casing

Food service, food preparation, packaging, storage and transport of food require temperature to be monitored or controlled. Spot checking temperatures with Hanna food thermometers ensures daily work routines are carried out at the correct temperature.

HI935001 is a thermometer that includes a K-type thermocouple stainless steel replaceable style penetration probe (FC766PW). This thermometer offers a large range of temperature measurement; from -50 to 300°C (-58.0 to 572°F).

Standard features include waterproof casing (rated IP65) and stainless steel penetration probe designed for continuous contact with foodstuffs in accordance with regulation (EC) number 1935/2004. HI935001 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

Specifications	HI935001
Range*	-50.0 to 199.9°C / 200 to 300°C; -58.0 to 399.9°F / 400 to 572°F
Resolution	0.1°C (-50.0 to 199.9°C) / 1°C (200 to 300°C); 0.1°F (-58.0 to 399.9°F) / 1°F (400 to 572°F)
Meter Accuracy @ 23.0°C ±5°C	±0.4°C (-50.0 to 300°C); ±0.7°F (-58.0 to 572°F)
Probe Accuracy (FC766PW)	±1.6°C (-50.0 to 300°C); ±2.9°F (-58.0 to 572°F)
Probe	FC766PW penetration, K-type thermocouple probe with 1 m (3.3') white cable and white handle
Battery Type / Life	1.5V AAA (3) / approximately 3500 hours of continuous use; user-selectable auto-off after 8 or 60 minutes of non-use (can be disabled).
Environment	limiting condition: -30 to 50°C (-22 to 122°F)
	storage and transportation condition: -40 to 70 °C (-40 to 158°F)
	relative humidity 100 %
Storage/transport temperature	-40 to 70°C (-40 to 158°F)
Dimensions	140 x 57 x 28 mm (5.5 x 2.2 x 1.1")
Weight	178 g (6.27 oz.)
Ordering Information	**HI935001** is supplied with FC766PW temperature probe, batteries and instructions.

* The measurement range may be limited by probe type, and applies to the probe shaft.

Our optional HI710027 blue shockproof rubber boot offers maximum impact protection.

HI935007

K-Type Thermocouple Thermometer

- Fixed K-type thermocouple probe
- CAL Check™ feature
- Remaining battery life indication/ low battery detection
- Auto-off
- IP65 Waterproof casing

Food service, food preparation, packaging, storage and transport of food require temperature to be monitored or controlled. Spot checking temperatures with Hanna food thermometers ensures daily work routines are carried out at the correct temperature.

HI935007 is a thermometer that incorporates a fixed K-type thermocouple stainless steel penetration probe to provide the greatest accuracy. This thermometer offers a large range of temperature measurement; from -50 to 300°C (-58.0 to 572°F).

Standard features include waterproof casing (rated IP65) and stainless steel penetration probe designed for continuous contact with foodstuffs in accordance with regulation (EC) number 1935/2004. HI935007 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

Fixed thermocouple probe

Our optional HI710026 blue shockproof rubber boot offers maximum impact protection.

Specifications	HI935007
Range*	-50.0 to 199.9°C / 200 to 300°C; -58.0 to 399.9°F / 400 to 572°F
Resolution	0.1°C (-50.0 to 199.9°C) / 1°C (200 to 300°C); 0.1°F (-58.0 to 399.9°F) / 1°F (400 to 572°F)
System Accuracy (Meter @ 23.0°C ±5°C)	±1°C (-50.0 to 100.0°C) / ±2 °C (100.0 to 300°C); ±1.8°F (-58.0 to 212°F) / ±3.6 °F (212 to 572°F)
Probe	fixed penetration, K-type thermocouple probe with 1 m (3.3') white cable and white handle
Battery Type / Life	1.5V AAA (3) / approximately 3500 hours of continuous use; user-selectable auto-off after 8 or 60 minutes of non-use (can be disabled).
Environment	limiting condition: -30 to 50°C (-22 to 122°F)
	storage and transportation condition: -40 to 70°C (-40 to 158°F)
	relative humidity 100 %
Storage/transport temperature	-40 to 70°C (-40 to 158°F)
Dimensions	140 x 57 x 28 mm (5.5 x 2.2 x 1.1")
Mass	178 g (6.27 oz.)
Ordering Information	**HI935007** is supplied with fixed temperature probe, batteries and instructions.

* The measurement range applies to the probe shaft.

Interchangeable with FC767 series thermocouple probes

HI935004

T-Type Thermocouple Thermometer

- EN 13485 compliant
- FC767PW T-type thermocouple probe
- CAL Check™ feature
- Remaining battery life indication / low battery detection
- Auto-off
- IP65 Waterproof casing

Food service, food preparation, packaging, storage and transport of food require temperature to be monitored or controlled. Spot checking temperatures with Hanna food thermometers ensures daily work routines are carried out at the correct temperature.

HI935004 is a thermometer that that includes a T-type thermocouple stainless steel replaceable style penetration probe (FC767PW). This thermometer offers temperature measurement from -50 to 300°C (-58.0 to 572°F).

Standard features include waterproof casing (rated IP65) and stainless steel penetration probe designed for continuous contact with foodstuffs in accordance with regulation (EC) number 1935/2004. HI935004 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

Specifications	HI935004
Range*	-50.0 to 199.9°C / 200 to 300°C; -58.0 to 399.9°F / 400 to 572°F
Resolution	0.1°C (-50.0 to 199.9°C) / 1°C (200 to 300°C); 0.1°F (-58.0 to 399.9°F) / 1°F (400 to 572°F)
Meter Accuracy @ 23.0°C ±5°C	±0.4°C (-50.0 to 300°C); ±0.7°F (-58.0 to 572°F)
Probe Accuracy (FC767PW)	±0.6°C (-50 to 100.0°C); ±1.6°C (100.0 to 300°C); ±1.1°F (-58 to 212°F); ±2.9°F (212 to 572°F)
Probe	FC767PW penetration, T-type thermocouple probe with 1 m (3.3') white cable and white handle
Battery Type / Life	1.5V AAA (3) / approximately 3500 hours of continuous use; user-selectable auto-off after 8 or 60 minutes of non-use (can be disabled).
Environment	for air measurement: Type E
	for product internal measurement: rated operating condition: -20 to 50°C (-4 to 122°F) limiting condition: -30 to 50°C (-22 to 122°F) storage and transportation condition: -40 to 70°C (-40 to 158°F)
	relative humidity 100 %
Storage/transport temperature	-40 to 70°C (-40 to 158°F)
Dimensions	140 x 57 x 28 mm (5.5 x 2.2 x 1.1")
Mass	178 g (6.27 oz.)
Certification	EN 13485:2001 suitability: storage and transport; climatic environment: E; accuracy class: 1;
Ordering Information	**HI935004** is supplied with FC767PW temperature probe, batteries and instructions.

* Range may be limited by probe type.

Our optional HI710027 blue shockproof rubber boot offers maximum impact protection.

HI935008

T-Type Thermocouple Thermometer

- EN 13485 compliant
- Fixed T-type thermocouple probe for HI935008
- CAL Check™ feature
- Remaining battery life indication / low battery detection
- Auto-off
- IP65 Waterproof casing

Food service, food preparation, packaging, storage and transport of food require temperature to be monitored or controlled. Spot checking temperatures with Hanna food thermometers ensures daily work routines are carried out at the correct temperature.

HI935008 is a thermometer that incorporates a fixed T-type thermocouple stainless steel penetration probe to provide the greatest accuracy. This thermometer offers temperature measurement from -50 to 300°C (-58.0 to 572°F).

Standard features include waterproof casing (rated IP65) and stainless steel penetration probe designed for continuous contact with foodstuffs in accordance with regulation (EC) number 1935/2004. HI935008 also includes features such as CAL Check, low battery detection, auto-off capability, and long battery life.

Fixed thermocouple probe

Specifications	HI935008
Range*	-50.0 to 199.9°C / 200 to 300°C; -58.0 to 399.9°F / 400 to 572°F
Resolution	0.1°C (-50.0 to 199.9°C) / 1°C (200 to 300°C); 0.1°F (-58.0 to 399.9°F) / 1°F (400 to 572°F)
System Accuracy (Meter @ 23.0°C ±5°C)	±0.5°C (-50.0 to 100.0°C); ±1°C (100.0 to 300°C); ±0.9°F (-58.0 to 212°F); ±1.8°F (212 to 572°F)
Probe	fixed penetration, T-type thermocouple probe with 1 m (3.3') white cable and white handle
Battery Type / Life	1.5V AAA (3) / approximately 3500 hours of continuous use; user-selectable auto-off after 8 or 60 minutes of non-use (can be disabled).
Environment	for air measurement: Type E
	for product internal measurement: rated operating condition: -20 to 50°C (-4 to 122°F) limiting condition: -30 to 50°C (-22 to 122°F) storage and transportation condition: -40 to 70°C (-40 to 158°F)
	relative humidity 100 %
Storage / Transport Temperature	-40 to 70°C (-40 to 158°F)
Dimensions	140 x 57 x 28 mm (5.5 x 2.2 x 1.1")
Weight	178 g (6.27 oz.)
Certification	EN 13485:2001 suitability: storage and transport; climatic environment: E; accuracy class: 0.5
Ordering Information	**HI935008** is supplied with fixed temperature probe, batteries and instructions.

* The measurement range applies to the probe shaft.

Our optional HI710026 blue shockproof rubber boot offers maximum impact protection.

HI93510 · HI93510N

Thermistor Thermometers

- HOLD
  - HOLD Feature
- BEPS
  - Alerts the user of low battery power that could adversely affect readings
- Battery indicator
  - Battery level indicator at startup
- Backlight
  - Backlit display (N version)
- Waterproof
  - Compact, heavy-duty and waterproof

The HI93510 is a waterproof thermometer tailored for the lab and field. The LCD displays the highest and lowest readings in the cycle along with the current temperature. To freeze the reading for easy recording, simply press the HOLD button. Celsius or Fahrenheit range can be selected at the touch of a button.

The HI93510N offers all the features of the HI93510 plus a CAL button to allow the operator to calibrate the meter and probe in an ice bath at 0°C. This will assure the removal of the combined meter and probe interchange error. In addition to calibration capabilities, HI93510N has a user-activated backlit display.

A diverse assortment of HI762 probes and cable lengths are available. Probes can be ordered with different handle colors to prevent cross-contamination.

Advanced battery management features include a display of remaining battery power at startup, low battery warning and BEPS (Battery Error Prevention System), which alerts the user in the event that low battery power could adversely affect readings.

Specifications	HI93510	HI93510N
Range	-50.0 to 150.0°C; -58.0 to 302.0°F	
Resolution	0.1°C; 0.1°F (-58.0 to 230.0°F) and 0.2°F (outside)	
Accuracy	±0.4°C; ±0.8°F (for 1 year, excluding probe error)	
Probe	HI762BL air/liquid, stainless steel thermistor temperature probe with black handle and 1 m (3.3') cable (included)	
CAL Button	N/A	yes
Backlit LCD	N/A	yes
Battery Type / Life	1.5V AA (3) / approximately 2000 hours of continuous use (with backlight off); HI93510 only: auto-off selectable after 8 or 60 minutes of non-use (can be disabled)	
Environment	-10 to 50°C (14 to 122°F); RH max 100%	
Dimensions	150 x 80 x 36 mm (5.9 x 3.1 x 1.4")	
Weight	235 g (8.3 oz.)	
Ordering Information	**HI93510** and **HI93510N** are supplied with HI762BL temperature probe, batteries and instructions.	
Probes	**HI762L**	Liquid, stainless steel thermistor temperature probe with white handle and 1 m (3.3') cable
	HI762A	Air/gas, stainless steel thermistor temperature probe with white handle and 1 m (3.3') cable

Thermistor probes begin on page 14.34; calibration test keys begin on page 14.38

HI762

HI762/FC762 Thermistor Probes

HI762/FC762 temperature probes have the following specifications:

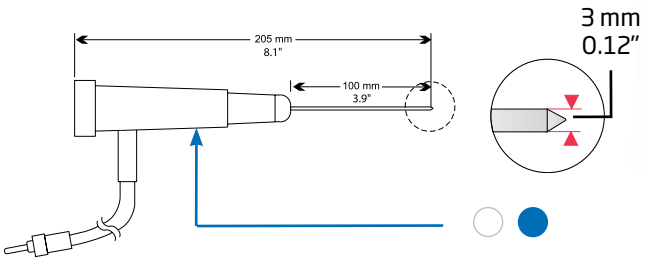
HI762/FC762 Probes	
Range	-50 to 150°C (-58 to 302°F)
Sensor	NTC thermistor
Accuracy	±0.2°C (±0.4°F) for HI762 types ±0.3°C/±0.7°F for FC762PW
Probe Handle	ABS
Interchange Error	±0.2°C (±0.4°F)
Probe	AISI 316 stainless steel
Response Time (90% of final value)	6 seconds

The HI762 and FC762 series with NTC thermistor sensor offers a wide range of stainless steel probes for measuring liquids, air and gases, and for penetration in semi-solids.

Models are available with a 1, 2 or 10 meter cable, and have colored handles for easy identification when measuring different samples.

HI762PW, FC762PW, HI762PBL

General purpose, penetration probe with colored handle.

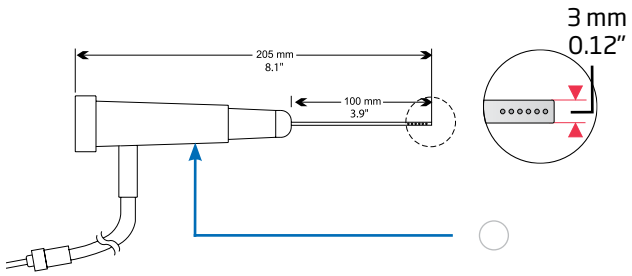


Specifications

1 m (3.3') Cable	2 m (6.6') Cable	Handle Color
HI762PW	–	white
FC762PW	–	white
HI762PBL	–	blue

HI762A

Thermistor probe for measuring the temperature of air and gases.



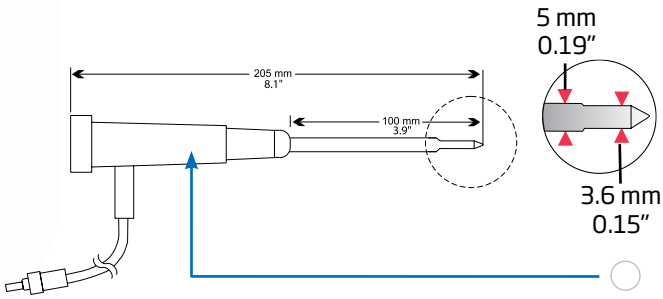
Specifications

1 m (3.3') Cable	2 m (6.6') Cable	Handle Color
HI762A	–	white

HI762 Thermistor Probes

HI762PWL

Thermistor probe with sharp tip for penetration of semi-solid samples.

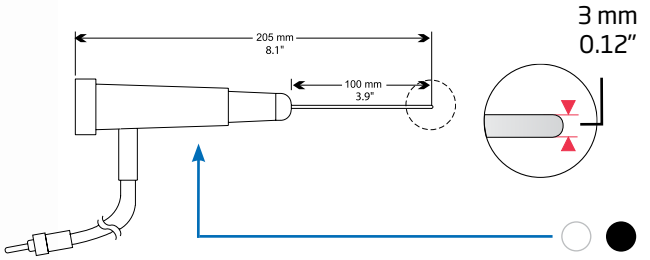


Specifications

1 m (3.3') Cable	2 m (6.6') Cable	10 m (32.8') Cable	Handle Color
HI762PWL	–	–	white

HI762L, HI762BL

Liquid probe.

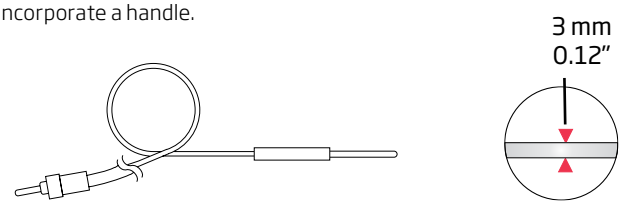


Specifications

1 m (3.3') Cable	2 m (6.6') Cable	10 m (32.8') Cable	Handle Color
HI762L	**HI762L/2**	**HI762L/10**	white
HI762BL	–	–	black

HI762W

Wire probe, designed to access hard to reach places. Probe does not incorporate a handle.



Specifications

1 m (3.3') Cable	2 m (6.6') Cable	10 m (32.8') Cable	Handle Color
HI762W	–	**HI762W/10**	–

HI765

HI765 Thermistor Probes

The HI765 temperature probes are provided with a PTC thermistor sensor, and have the following specifications:

HI765 Specifications

Range	-50 to 150°C (-58 to 302°F)
Accuracy	±0.2°C (±0.4°F)
Sensor	PTC thermistor
Probe Handle	ABS
Interchange Error	±0.2°C (±0.4°F)
Probe	AISI 316 stainless steel
Response Time (90% of final value)	8 seconds

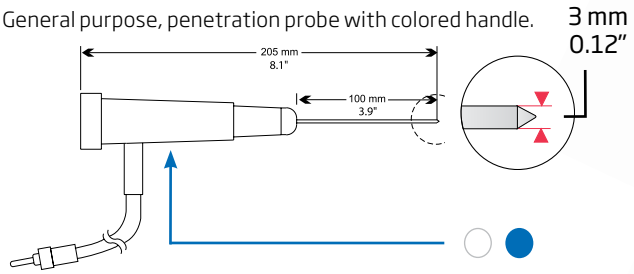
All probes are pre-calibrated with a maximum error of ±0.2°C (±0.4°F).

The HI765 series can be identified by the white cap on the top of the handle. This series offers a wide range of probes for measuring liquids, air and gases, and for penetration in semi-solids.

Models are available with a cable length of 1 or 10 meters and have colored handles for easy identification during measurements of different samples.

HI765PW, HI765PBL

General purpose, penetration probe with colored handle.

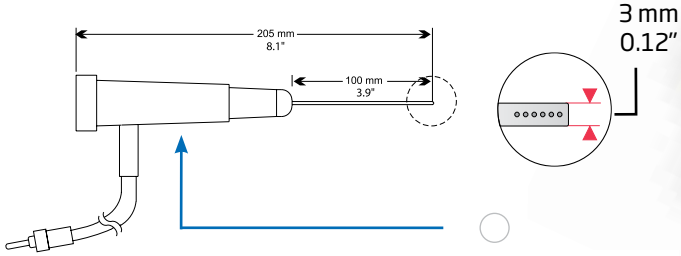


Specifications

1 m (3.3') Cable	10 m (32.8') Cable	Handle Color
HI765PW	**HI765PW/10**	white
HI765PBL	–	blue

HI765A

Thermistor probe for measuring the temperature of air and gases.



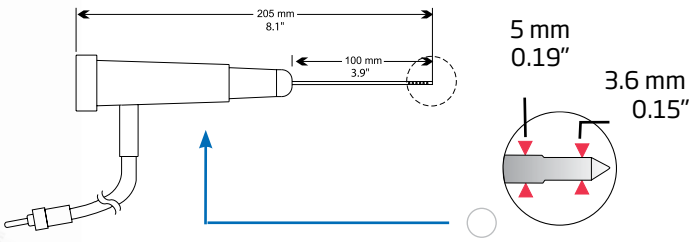
Specifications

1 m (3.3') Cable	10 m (32.8') Cable	Handle Color
HI765A	**HI765A/10**	white

HI765 Thermistor Probes

HI765PWL

Thermistor probe with sharp tip for penetration of semi-solid samples.

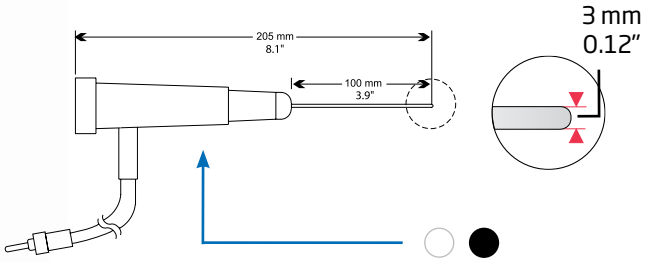


Specifications

1 m (3.3') Cable	2 m (6.6') Cable	Handle Color
HI765PWL	–	white

HI765L, HI765BL

Liquid probe.

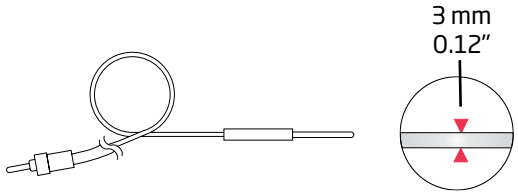


Specifications

1 m (3.3') Cable	10 m (32.8') Cable	Handle Color
HI765L	–	white
HI765BL	–	black

HI765W

Wire probe, designed to access hard-to-reach places. Probe does not incorporate a handle.



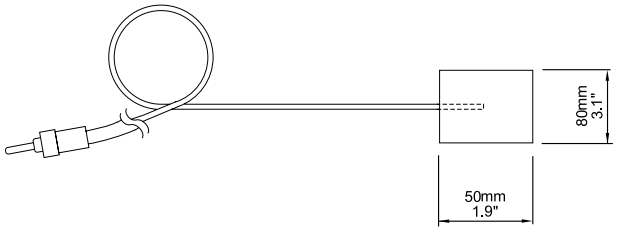
Specifications

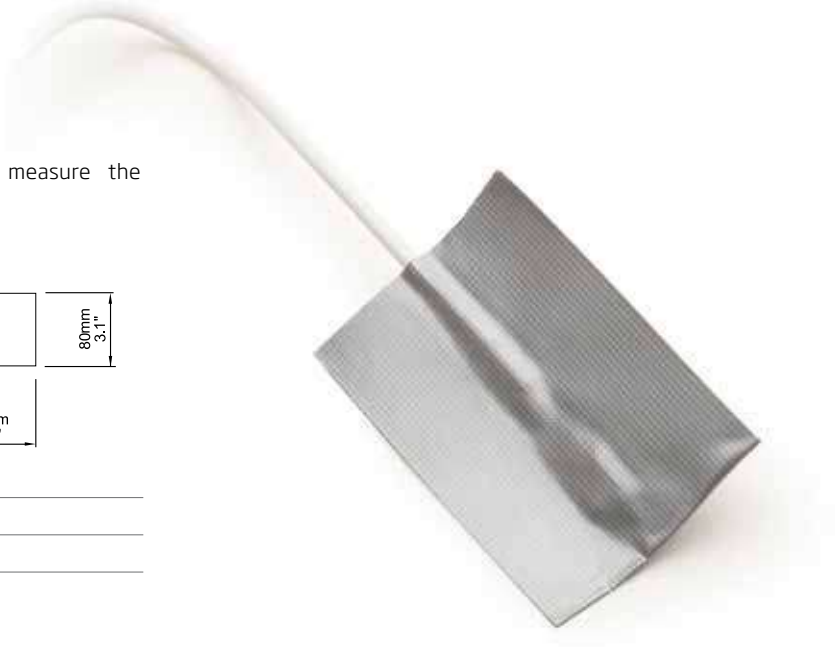
1 m (3.3') Cable	10 m (32.8') Cable
HI765W1	**HI765W/10**

HI765 Thermistor Probes

HI765BP

Thermistor probe without handle, designed to measure the temperature of stacked goods.





Specifications

1 m (3.3') Cable	2 m (6.6') Cable
HI765BP1	–

Calibration Test Keys for Thermistor Thermometers

For measurements that are always reliable, thermometers must be calibrated periodically.

Hanna test keys offer a fast and simple way of checking the accuracy of your instruments.

Connect the key to the probe input. If the reading on the display differs more than 0.4°C (0.8°F) from the key rated value, your thermometer should be recalibrated at our technical service center.

Test Keys for Thermometers Using HI762 Probes

HI762-18C	Test key at -18°C	**HI762-004F**	Test key at -0.4°F
HI762000C	Test key at 0°C	**HI762032F**	Test key at 32°F
HI762070C	Test key at 70°C	**HI762158F**	Test key at 158°F

For periodic verification of your thermometer's calibration, it is recommended to check at least two points. Choose the test keys with the nominal values closest to the temperature usually measured.

Test Keys for Thermometers Using HI765 Probes

HI765-18C	Test key at -18°C	**HI765-004F**	Test key at -0.4°F
HI765000C	Test key at 0°C	**HI765032F**	Test key at 32°F
HI765070C	Test key at 70°C	**HI765158F**	Test key at 158°F

For periodic verification of your thermometer's calibration, it is recommended to check at least two points. Choose the test keys with the nominal values closest to the temperature usually measured.

HI99551 · HI99556

Infrared Thermometers for the Food Industry

- HOLD
  - HOLD Feature
- Battery indicator
  - Battery life indicator on startup
- Optional external probe can also be used (HI99556)

The HI99551 and HI99556 thermometers employ infrared technology to measure surface temperatures. Infrared readings are extremely fast, with a response time typically around one second.

One big advantage of these meters is the non-intrusive nature of measurements. This feature is particularly attractive for food distribution, retailing and markets, since it translates practicality into savings by leaving products intact, especially those sealed or pre-wrapped.

In order to measure the temperature, simply turn on the meter and point to the product or target. Readings are displayed on the LCD. This type of non-intrusive measurement is also useful when the surface temperature is too high to approach, for difficult to reach places or for hygiene requirements.

If you must check the core temperature in addition to surface measurement, the HI99556 is the ideal solution for you. Simply attach an optional external probe to the meter and you have a 2-in-1 infrared-thermistor thermometer.

A HOLD function freezes the display to allow the user time to record readings.

Specifications		HI99551-00 / HI99556-00	HI99551-10 / HI99556-10
Range	IR	-10 to 300°C	-20.0 to 199.9°C
	Probe (HI99556 only)	-40 to 150°C	-40 to 150.0°C
Resolution	IR	1°C	0.1°C
	Probe (HI99556 only)	1°C	0.1°C
Accuracy	IR	±2% of reading or ±2°C	±2% of reading or ±2°C
	Probe (HI99556 only)	±0.5°C (-20 to 120°C); ±0.5°C +1% reading (outside)	±0.5°C (-20 to 120°C); ±0.5°C +1% reading (outside)
IR Sensor Response Time		1 second	
IR Sensor Optic Coefficient		3:1 (ratio of distance to target diameter)	
Minimum Distance		30 mm (1.2")	
Probe (HI99556 only)		HI765PW general purpose/penetration, stainless steel thermistor temperature probe with white handle and 1 m (3.3') cable (included)	
Battery Type / Life		9V / approximately 150 hours of continuous use	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		143 x 80 x 38 mm (5.6 x 3.2 x 1.5")	
Weight		320 g (11.3 oz.)	
Ordering Information		**HI9955 x – y** **x = 1** meter with IR sensor **x = 6** meter with IR sensor and HI765PW probe (40 to 150°C range) **y = 00** IR range from -10 to 300°C **y = 10** IR range from -20 to 199.9°C	
Probes		**HI765PW** General purpose/penetration, stainless steel thermistor temperature probe with white handle and 1 m (3.3') cable	

Thermistor probes begin on page 14.36; calibration test keys begin on page 14.38

HI955501 · HI955502

4-Wire Pt100 Thermometers

- Auto-ranging
- Available with interchangeable or fixed probe
- Economical
- Missing probe indictor (HI955501)
- Optional protective boot

Pt100 models are widely recognized as the most accurate, with the best stability, repeatability and linearity among thermometers. Add to this the 4-wire system that is practically impervious to lead-wire length error, and you have a powerful tool to measure temperature accurately.

The HI955501 works with the HI768 series of Pt100 temperature probes, while the HI955502 model is supplied with a fixed general-purpose probe.

The HI955501 also features a missing probe indicator to alert the user if no temperature probe is detected.

Both the HI955501 and HI955502 measure temperatures with 0.1°C resolution in the -199.9 to 199.9°C range and then automatically switch to 1°C from 200 to 850°C. Press RANGE and the resolution switches to 1°C at any time.

A compact, ergonomic design and a wrist-strap make it easy to carry them anywhere in the lab or plant. To protect the meter during field measurements, a Hanna shockproof boot is recommended.

Specifications	HI955501	HI955502
Range	-199.9 to 199.9°C; -200 to 850°C	
Resolution	0.1°C (-199.9 to +199.9°C); 1°C (-200 to 850°C)	
Accuracy	±0.2°C and ±1 digit (-120.0 to 199.9°C); ±1°C and ±1 digit (-170 to 119.9°C and 200 to 450°C); ±1% f.s. and ±1 digit (outside) (excluding probe error)	
Probe	HI768 series stainless steel Pt100 temperature probe with 1 m (3.3') cable (not included)	HI768P fixed general purpose/penetration, stainless steel Pt100 temperature probe with 1 m (3.3') cable (included)
Battery Type / Life	9V / approximately 150 hours of continuous use	
Environment	0 to 50°C (32 to 122°F); RH max 95%	
Dimensions	143 x 80 x 38 mm (5.6 x 3.2 x 1.5")	
Weight	320 g (11.3 oz.)	
Ordering Information	**HI955501** is supplied with battery and instructions.	
	HI955502 is supplied with HI768P fixed temperature probe, battery and instructions.	
Probes for HI955501	**HI768A**	Air/gas, stainless steel Pt100 temperature probe with 1 m (3.3') cable
	HI768L	Air/liquid, stainless steel Pt100 temperature probe with 1 m (3.3') cable
	HI768P	General purpose/penetration, Pt100 stainless steel temperature probe with 1 m (3.3') cable

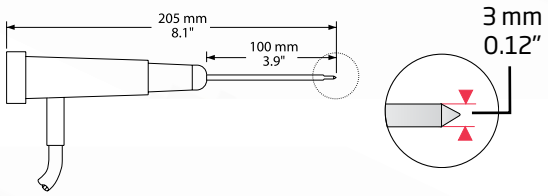
See page 14.41 for Pt100 probes

HI768 Series: Pt100 Probes

The HI768 series of temperature probes is provided with a Pt100 sensor and features the following specifications:

HI768 Specifications

Range	-30 to 350°C (-22 to 622°F)
Sensor	Pt100
Accuracy	±0.25°C (±0.5°F) ±3% of reading
Probe Handle	Carilon®
Interchange Error	±0.2°C (±0.4°F)
Probe	AISI 316 stainless steel
Response Time	30 seconds

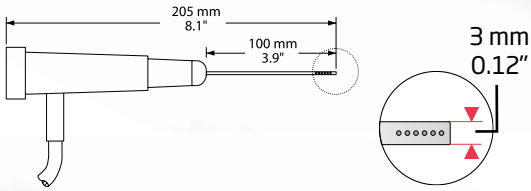


HI768P, General Purpose/ Penetration Probe

Pt100 probe for applications, such as air measurement and penetration of semi-solids.

Specifications

Code	Application	Probe Dimensions	Handle Color	Cable Length
HI768P	general purpose/ penetration	L 205 mm x dia 3 mm (0.12")	green	1 m (3.3')

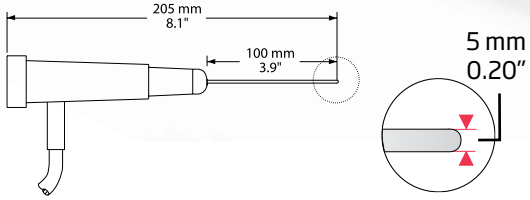


HI768A

Pt100 probe for measuring the temperature of air and gases.

Specifications

Code	Application	Probe Dimensions	Cable Length
HI768A	air, gases	L 205 mm x dia 3 mm (0.12")	1 m (3.3')



HI768L

Pt100 probe for applications, such as liquid and air.

Specifications

Code	Application	Probe Dimensions	Cable Length
HI768L	liquid, air	L 205 mm x dia 5 mm (0.20")	1 m (3.3')

HI141

Temperature Dataloggers

The HI141 dataloggers are housed in a smooth, yet tough ABS casing that is sealed against ingress of dust and water. They can be placed with goods on the move, on supermarket shelves and in warehouses. They record the temperature at a given interval to make sure that perishable goods are not left unattended, such as on a loading dock on the other side of the world. These dataloggers can provide that extra guarantee that goods never ventured out of limits of public safety.

HI141 models offer users many alternatives, including one or two channels, internal or external temperature sensors, and an optional LCD display. External temperature sensor models feature one or two stainless steel sensors on a 1 m (3.3') cable for direct insertion.

HI141 can store up to 16,000 temperature samples in a protected, non-volatile EEPROM memory. The logging interval can be set from once per second to once per 24 hour period, and logging delay can be set anywhere up to 199 hours. The MIN or MAX temperature between logging intervals can also be stored. All of your collected data is tamper-proof and stored into serial numbered lots. All parameters can be set through our Windows® compatible software (for 32-bit systems) through RS232 communication and an infrared transmitter (software and transmitter not included). HI141 models also feature programmable alarms and logging intervals and Hanna's Battery Error Prevention System (BEPS) that will shut the meter off when the battery power is too low for an accurate measurement.

- Waterproof
  - The case of the HI141 dataloggers is waterproof rated IP67. A convenient hanging hook is also located at the top of the housing on all models that end in "H".
- °C/°F Ranges
  - Through the PC application software, all HI141 models can be programmed to read in Celsius or Fahrenheit.
- One or Two Channels
  - HI141 dataloggers offer the option of one or two measurement channels. Users can opt for one internal channel, one external channel, one internal and one external channel, or two external channels.
- Internal/External Sensors
  - HI141 models that allow for an external temperature sensor feature one or two stainless steel probes on a 1 m (3.3') cable for direct insertion.
- LCD Display
  - The optional LCD is divided into 3 areas: the top displays the status of the datalogger; the middle displays the temperature reading, units, and active channel; the bottom displays useful information regarding alarms, battery, sample number, and indicating icons.
- Data Logging
  - The HI141 can store up to 16,000 measurements at selectable intervals from 1 second to 24 hours. Users can also program a delayed logging start time up to 199 hours.
- Magnetic Start Key
  - Once all the settings are programmed using the PC software (for 32-bit systems), a convenient and portable magnetic start key can be used to initiate when data logging begins. This helps users to quickly begin logging, preventing the need to access and start via the computer software.
- PC Connectivity
  - Logged data can be transferred to a PC by simply placing the instrument on the HI141001 infrared cradle (not included). The infrared cradle eliminates the need to put a connector on the meter - an undesirable dirt-trap in the food market and source of problems due to wear and tear over time. Using the cradle and software, users need just one PC interface to handle all HI141 dataloggers, each identified by a unique ID code. A security password is also able to be set to ensure collected data is tamper-proof.
- Programmable Alarms
  - High and low alarm thresholds can be programmed to alert users if the temperature readings go outside of the acceptable range. The PC software (for 32-bit systems) can also indicate the length of time that temperatures remained unacceptable.

- Status Indicator Lights
  - There are 4 LED lights located on the face of all HI141 dataloggers. The bottom top LEDs are used for communication with the infrared transmitter, while the logging status is indicated by the 2 top LEDs that are green and red.
- Enhanced Battery Life
  - The HI141 series uses AA batteries to achieve a long battery life of about 4 years at 25°C.
- Battery Error Prevention System (BEPS)
  - The Battery Error Prevention System will shut the meter off when the battery power is too low for an accurate measurement.

Specifications	Model	Display	Molded Eye for Hanging	Sensor(s)	Cable Length (if applicable)	Range
Model Specific	**HI141AH**		•	1 internal	–	-40.0 to 80.0°C / -40.0 to 176.0°F
	HI141BH		•	1 external	1 m (3.3')	-40.0 to 125.0°C / -40.0 to 257.0°F
	HI141CH	•	•	1 internal	–	-20.0 to 70.0°C / -40.0 to 158.0°F
	HI141DH	•	•	1 external	1 m (3.3')	-40.0 to 125.0°C / -40.0 to 257.0°F
	HI141EH		•	1 internal 1 external	1 m (3.3')	-40.0 to 80.0°C / -40.0 to 175.0°F -40.0 to 125.0°C / -40.0 to 257.0°F
	HI141FH		•	2 external	1 m (3.3')	-40.0 to 125.0°C / -40.0 to 257.0°F
	HI141GH	•	•	1 internal 1 external	1 m (3.3')	-20.0 to 70.0°C / -40.0 to 158.0°F -40.0 to 125.0°C / -40.0 to 257.0°F
	HI141JH	•	•	2 external	1 m (3.3')	-40.0 to 125.0°C / -40.0 to 257.0°F

All Models	Resolution	0.1°C (-40.0 to 100.0°C); 0.2°C (> 100.0°C) 0.1°F (-40.0 to 190.0°F); 0.3°F (> 190.0°F)
	Accuracy	±0.5°C (-40.0 to 0.0 and 70.0 to 100.0°C); ±0.4°C (0.0 to 70.0°C); ±1.0°C (> 100.0°C); ±1.0°F (-40.0 to 32.0 and 158.0 to 212.0°F); ±0.8°F (32.0 to 158.0°F); ±2.0°F (> 212.0°F)
	Battery Type / Life	3.6V lithium AA battery / approx. life of 4 years at 25°C
	Environment	RH 100%
	Diameter	86.5 mm (3.4")
	Height	35 mm (1.4")
	Weight	150 g (5.5 oz.)
Ordering Information	All HI141 models are supplied with 3.6V Lithium AA battery, magnetic key and instructions.	
Accessories	**HI141000**	Windows® compatible software (required)
	HI141001	infrared transmitter (required)
	HI740033	3.6 V AA lithium battery
	HI740221	key for HI141 magnetic start

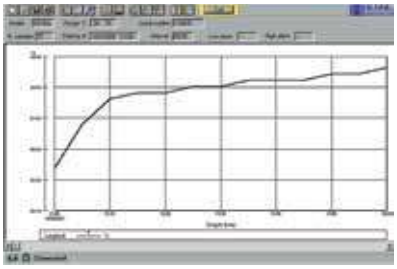
HI140

Temperature Dataloggers

The HI140 dataloggers represent the most economical and secure way of monitoring temperature continuously over long periods of time. These models are housed in a rugged, waterproof ABS casing that seals against the ingress of dust and water. HI140 dataloggers feature different temperature ranges to make them more accurate for your specific needs. They can be placed with goods on the move, on supermarket shelves and in warehouses. These dataloggers can provide that extra guarantee that goods never ventured out of limits of public safety.

All parameters can be set through our Windows® compatible software via RS232 communication and an infrared transmitter (software and transmitter not included).

- Waterproof
  - The case of the HI140 dataloggers is waterproof rated IP67.
- °C/°F Ranges
  - Through the application software, all HI140 models can be programmed to read in Celsius or Fahrenheit.
- Data Logging
  - The HI140 can store up to 7600 measurements at selectable intervals from 1 minute to 24 hours. Users can also program a delayed logging start time from 0 minutes to 24 hours.
- Programmable Alarms
  - High and low alarm thresholds can be programmed to alert users if the temperature readings go outside of the acceptable range. The PC software can also indicate the length of time that temperatures remained unacceptable.
- Status Indicator Lights
  - The two external LEDs are used for communication with the infrared transmitter. A green LED on the front of the meter notifies users of the logging status, while a red LED serves as an alarm indication when undesired temperatures have been encountered.
- Enhanced Battery Life
  - The HI140 series uses AA batteries to achieve a battery life of about 4 years at 25°C.
- Battery Error Prevention System (BEPS)
  - BEPS shuts the meter off when the battery power is too low for an accurate measurement.
- PC Connectivity
  - Logged data can be transferred to a PC by simply placing the instrument on the HI90140 infrared cradle (not included). Using the cradle and software, users need just one PC interface to handle all HI140 dataloggers, each identified by a unique ID code.



Specifications	Model	Range	Resolution	Accuracy
Models Specific	**HI140AH**	-30.0 to 70.0°C / -22 to 158°F	0.5°C / 0.5°F	±1.5°C / ±3°F
	HI140BH	-10.0 to 30.0°C / 14 to 86°F	0.2°C / 0.4°F	±0.5°C / ±1°F
	HI140CH	-30.0 to 10.0°C / -22 to 50°F	0.2°C / 0.4°F	±0.5°C / ±1°F
	HI140DH	20.0 to 60.0°C / 68 to 140°F	0.2°C / 0.4°F	±0.5°C / ±1°F
	HI140GH	-5.0 to 15.0°C / 23 to 59°F	0.1°C / 0.2°F	±0.3°C / ±0.6°F
	HI140HH	10 to 120°C / 50 to 248°F	1°C / 2°F	±2°C / ±4°F
All Models	Battery Type / Life	3 x 1.5V AA batteries / approx. life of 4 years at 25°C		
	Environment	RH 100%		
	Diameter	86.5 mm (3.4")		
	Height	35 mm (1.4")		
	Weight	150 g (5.5 oz.)		
Ordering Information	All HI140 models are supplied with batteries and instructions.			
Accessories	HI92140	Windows® compatible software		
	HI90140	infrared transmitter		

All loggers have the following features: programmable high and low alarm thresholds; programmable logging interval from 1 min. to 23 hours and 59 min; logging delay start selectable from 0 min. to 23 hours and 59 min; programmable ID number; infrared communication with PC interface; programmable real time clock; 3 x 1.5V AA batteries (included) with approx. life of 4 years at 25°C; dimensions: dia 86.5 mm x h 35 mm; / weight: 150 g

HI143

T-Logger with Locking Wall Cradle

The HI143 T-Logger temperature dataloggers are housed in a smooth, yet tough watertight casing that is sealed against ingress of dust and water jets. They can be placed with goods on the move, on supermarket shelves and in warehouses. They record the temperature at a given interval to make sure that perishable goods are not left unattended, such as on a loading dock on the other side of the world. These dataloggers can provide that extra guarantee that goods never ventured out of limits of public safety.

- Locking Wall Cradle
  - A convenient wall cradle holds the HI143 T-Logger in place, whether it be on a truck or in a warehouse. A supplied lock and key help to further prevent tampering.
- °C/°F Ranges
  - Through the PC application software, the HI143 can be programmed to read in Celsius or Fahrenheit.
- LCD Display
  - The LCD clearly displays the status of the datalogger, the temperature reading and units, information regarding alarms, and battery level.
- Data Logging
  - The HI143 can store up to 4,000 measurements at selectable intervals from 1 minute to 24 hours. Users can start logging through the PC software, the button on the face of the datalogger, or at a set time.
- PC Connectivity
  - The HI143 can be controlled through a PC by simply placing the instrument on the supplied RS232 or USB communication cradle. A security password is able to be set to ensure collected data is tamper-proof when transferring and organizing logged data.
- Programmable Alarms
  - High and low alarm thresholds can be programmed to alert users if the temperature readings go outside of the acceptable range.
- Status Indicator Light
  - The LED light located on the cradle blinks to indicate that communication with the PC is active during data transfer.
- Enhanced Battery Life
  - The HI143 series uses CR2032 3V lithium ion batteries to achieve a long battery life of about 2 years at 25°C.

Specifications	HI143
Range	-30.0 to 70.0°C/-22.0 to 158.0°F
Resolution	0.1°C/0.1°F
Accuracy	±0.4°C (-20 to 60°C); ±0.6°C (outside); ±0.7°F (-4 to 140°C); ±1.1°F (outside)
Calibration	factory-calibrated
Data Logging	up to 4000 samples
Logging Interval	user selectable, from 1 minute to 24 hours
Battery Type / Life	CR2032 3V lithium ion / approximately 2 years
Protection	IP65 (water-resistant)
Dimensions	60 x 37 x 17 mm (2.4 x 1.5 x 0.7")
Ordering Information	**HI143** is supplied with CR2032 lithium battery, wall cradle, lock and instructions. **HI143-00** is supplied with HI143 logger, HI143001 RS232 communication cradle, Windows® compatible application software, CR2032 lithium battery, wall cradle, lock and instructions. **HI143-10** is supplied with HI143 logger, HI143002 USB communication cradle, Windows® compatible application software, CR2032 lithium battery, wall cradle, lock and instructions.

HI97500

Portable Lux Meter

- Waterproof
  - Rugged, waterproof case
- Battery indicator
  - Low-battery indicator

A lux meter can be used to measure illuminance, or the luminous flux in a given area. The HI97500, is a portable lux meter designed to perform light measurements simply and accurately. The instrument is supplied with a light sensor connected by a fixed 1.5 m coaxial cable to allow measurements to be taken from a distance without any interference from the operator.

By simply pressing the RANGE key, users can switch among three ranges to choose the best resolution according to the environment being tested. The HI97500 lux meter has a rugged and water-resistant body for frequent outdoor use.

The HI97500 features a low battery indicator and automatic shut-off that turns the meter of after 7 minutes of non-use.

Specifications	HI97500
Range	0.001 to 1.999 Klux 0.01 to 19.99 Klux 0.1 to 199.9 Klux
Resolution	0.001 Klux 0.01 Klux 0.1 Klux
Accuracy	±6% of reading ±2 digits
Sensor	human-eye-response silicon photodiode with 1.5 m coaxial cable (fixed)
Battery Type / Life	9V / approximately 200 hours of continuous use; auto-off after 7 minutes of non-use
Environment	0 to 50°C (32 to 122°F); RH 100%
Dimensions	164 x 76 x 45 mm (6.5 x 3.0 x 1.8")
Weight	180 g (6.3 oz.)
Ordering Information	**HI97500** is supplied with battery, protective case and instructions.

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BL983320			•				•		•		15.50
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BL983327			•				•			•	15.51
BL983315				•			•		•		15.52
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Comparison Guides

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BL7917		•	•	1	1	•	15.60

Wall Mount Controllers

	pH	ORP	Conductivity	TDS	Temperature	Digital	Alarm	(S)ingle or (D)ual setpoint	ON/OFF control	Proportionall control	PID control	Digital output	Password protection	Boiler and colling tower applications	Agriculture applications	Page
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HI22		•			•	•	•	S	•	•		RS485	•			15.64
HI23			•		•	•	•	D	•		•	RS485	•			15.65
HI9913	•		•				•	S		•			•		•	15.66
HI9935	•			•			•	S		•			•		•	15.67
HI9910	•						•	S		•			•			15.68
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HI98143-01	•		•	0-1 V		•		IP54		15.72
HI98143-04	•		•	0-4 V		•		IP54		15.72
HI98143-20	•		•	4-20 mA		•		IP54		15.72
HI98143-22	•		•	4-20 mA		•		IP54	•	15.72
HI8614N	•			4-20 mA	•	•		IP65		15.73
HI8614LN	•			4-20 mA	•	•	•	IP65		15.73
HI8615N		•		4-20 mA	•			IP65		15.73
HI8615LN		•		4-20 mA	•		•	IP65		15.73
HI8936 series			•	4-20 mA	•	•		IP65		15.74

BL120/BL121

pH/ORP Swimming Pool Controllers with Built-In Chemical Feed Pump

The BL120 and BL121 are an all-in-one solution for automatic control of pH and chlorine levels in swimming pool, hot tub, and spa water.

See page 15.16

PCA340

Chlorine, pH, and Temperature Analyzer

PCA340 analyzer is the newest addition to the PCA family and features two analog outputs. PCA340 features built in data logging, RS485 digital output, dosing relays, and alarm relays packaged in a wall mount Nema 4x enclosure.

See page 15.10

HI8000 Series

Fertigation Control Systems

A wide variety of models are available to cover the requirements of specific fertigation applications.

HI8000 series models can be selected based on the irrigation and fertilization type.

Up to 10 irrigation programs can be set by the user with different irrigation parameters: irrigation periods, type of irrigation control, irrigated sectors and volume or irrigation time specified for each sector, conditions to start irrigation such as time, accumulated solar radiation, low level in tanks (hydroponic crops), temperature variations, linked to another program, priority of program, number of repetitions. For irrigation water, each program has a defined pH set point, EC set point (if the quantity of fertilizer is dosed according with conductivity), and receipt of fertilizers. Control of agitators is specified by programs according with the irrigation periods

See page 15.6

HI8000 Series

Fertigation Control Systems

- Connectivity
  - PC compatible
- Alarm
  - Alarm and warning system
- Backlight
  - Backlit, LCD display

Wall Mount

Variety and customization of models

A wide variety of models are available to cover the requirements of specific fertigation applications. The HI 8000 series are fully customizable and upgradable on the hardware and program level.

HI8000 series models can be selected based on the irrigation and fertilization type of control along with the additional features that are proper for the specific application.

Some of the most important criteria in selection of controller type are: number of irrigated sectors: 8, 16, 24, 32; type of irrigation control: in volume or in time; type of fertilizer control: by EC, by Volume, ratiometric; type of pH correction: acid or alkaline; control of incoming water: one, two or three sources of water; control of dosing with venturi or motorized electrovalves; redundancy of the conductivity or pH probes; mounting solution: panel or wall mounted.

Panel Mount

Irrigation control

Irrigation control differs based on the type of control: by irrigation water volume or by irrigation time; the number of sectors that have to be irrigated, the available sources of water for irrigation – one or more with or without reusing the irrigation drain water.

Irrigation control is started by opening the irrigation valves and starting the main irrigation pump. The control of all these elements is performed by the controller based on concepts of irrigation programs.

Irrigation programs

Up to 10 irrigation programs can be set by the user with different irrigation parameters: irrigation periods, type of irrigation control, irrigated sectors and volume or irrigation time specified for each sector, conditions to start irrigation such as time, accumulated solar radiation, low level in tanks (hydroponic crops), temperature variations, linked to another program, priority of program, number of repetitions. For irrigation water, each program has a defined pH set point, EC set point (if the quantity of fertilizer is dosed according with conductivity), and receipt of fertilizers. Control of agitators is specified by programs according with the irrigation periods.

Irrigation water

The quality of irrigation water is assured by proper control of pH and the quantity of nutrients (fertilizers) present in irrigation water.

Fertilization control

Fertilizer can be dosed during irrigation using the Venturi tubes principal or with motorized valves. The control of the quantity of dosed fertilizer can be performed using the volume counters. The system supports dosing from up to 4 fertilizer tanks with specific receipts.

The concentration of the fertilizer in irrigation water can be controlled based on the conductivity reading, proportional with irrigation water based on the receipt or ratiometric, in which case the certain quantity of fertilizers are added with the amount of programmed water.

pH control

The pH control is performed in order to adjust the pH of water to the irrigation program set point.

The pH correction can be performed with alkaline or acid solution based on the characteristic of the incoming water.

The control of pH and EC is performed with PID, PI or proportional control. The tuning of the PID control can be accomplished by the user manually, or automatically by the PID auto-tuning feature.

Agitators and filter cleaning

The automatic control of agitators used in fertilizers tanks and filter cleaning system complete the needs of a standard fertigation system.

In order to keep the fertilizer concentration constant before and during the irrigation program, the fertilizers are mixed in their tanks based on the agitators program. The system can manage up to two filters mounted to protect the probes and in-line dosing elements.

With differential presostates, the filters are monitored and when necessary, the irrigation programs are automatically suspended and washer filter cleaning is started. This process removes any deposits and sediments that may appear on filters to increase the systems life.

Redundancy of EC and pH probes

For safety reasons, the systems can be equipped with 2 conductivity probes and two pH electrodes in redundancy so that the system can generate an alarm in the case of reading differences between them. A third conductivity probe can be mounted to verify and compensate the incoming water conductivity.

Logging system

The logging of the controller can be selected on three levels: input reading variations, statistics of reading (average of pH and EC) or events (start of programs, opening valves, ...).

Alarm system

The alarms of these systems are related to measured water quality parameters like conductivity and pH: out of range, differential reading between redundant probes; over dosing of conductivity or acid or alkaline correction solution, tanks at low level or no dosing detected by counter movement. Similar alarms can be generated after the units self-diagnostic tests are run.

Sensor connections

All the sensors: EC, pH, temperature are connected to the controller via transmitters.

pH and EC are temperature compensated on the transmitter level. The output of analog transmitters can be calibrated at two points for pH and conductivity. Also, the controller offers a calibration in two points for pH and one point for conductivity.

User interface and digital connection

The user interface is based on an 4 x 20 character line LCD, organized for settings and consultancy. The UI has multi-language support.

The RS232 connection permits the connection to a PC.

Internal back-up system

The systems internal back-up power system offers a special feature; in the case of losing external power, the controller will stop the irrigations and memorize the irrigation programs that were not performed. The controller will start from the uncompleted programs after power has been restored. The programs will be executed based on their priority level with full respect of the quantity of irrigation water, pH level, and concentration of fertilizers.

Additional features that can be found are control of the external power supply and control of mixing of different water sources (clean water, drain irrigation water).

Two panel mount units used in a fertigation system

HI8001 (panel mount) and HI8002 (wall mount) models

The HI8001 and HI8002 fertigation controllers provide up to 10 programs to irrigate up to 32 sectors using time or volume irrigation control. Each irrigation program has one pH and one EC setpoint. The start condition of the program, the irrigation sectors and the time or volume for each sector are user defined. The irrigation water is pH corrected based on the pH control, with acid or alkaline solution and can contain nutrients for crops based on up to 4 fertilizer receipts. Correction of time or volume of irrigated water can be based on accumulated solar radiation or can be manually requested by user. Agitator control and filter cleaning control are performed automatically. The instruments read up to 3 EC probes, one to verify the incoming water EC, and the other two are in-line redundant for safety to measure the current irrigation water EC. The two pH electrodes are mounted in-line redundant for safety to read the irrigation water pH. The instruments provide an alarm system and logging organized on user selectable three levels.

HI8051 (panel mount) model

The HI8051 fertigation controller provides up to 10 irrigation programs to irrigate up to 24 sectors using time or volume control. Each irrigation program has one pH and one EC setpoint. The start condition of the program, the irrigation sectors and the time or volume for each sector are user defined. The irrigation water is pH corrected based on the pH control with acid or alkaline solution and can contain nutrients for crops based on up to 4 fertilizer receipts. Fertilizer dosing is performed based on the EC, volumetric or ratiometric control. Another important feature is the correction of irrigated water volume or time based on accumulated solar radiation or manually requested by user. Agitator control and filter cleaning control is performed automatically. The instrument reads up to 3 EC probes, one to verify the water incoming EC, and the other two redundant in-line for safety, to measure the current irrigation water EC. The two pH inputs are mounted in-line redundant for safety to read the irrigation water pH. This instrument provides an alarm system and logging organized on three user selectable levels. An important added feature is this models ability to mix 3 sources of incoming water. Fresh water, reused water and all dosing are performed based on the motorized valves that are activated by motors that allow different flows of the fertilizers, acid and alkaline solutions used for pH correction.

HI98143 pH/EC Transmitter

Models	HI8001/HI8002	HI8051
Irrigation control	Time/volume control, 10 programs/5 priority levels with up to 99 repetition	Time/volume control, 10 programs/5 priority levels with up to 99 repetition
Irrigation start condition	By Time, by solar radiation, by 5 external tank low level	By Time, by solar radiation, by 5 external tank low level
Fertilization control	By EC	By EC, By volume, Ratiometric
Fertilizers	Up to 4 valves	Up to 4 motorized valves
pH control/correction	Acid or alkaline	Acid or alkaline, motorized pump
Agitators control	Yes	Yes
Filter control/cleaning	2 differential presostate/2 filter cleaning relays	2 differential presostate/2 filter cleaning relays
Fertilizer tank levels/ counters control	Level	Level and counters
Irrigation counter	Yes	Yes
Acid/Alkaline tank level/ counter control	Level	Level and counter
EC inputs	Up to 3, 0.0 to 10 mS/cm	Up to 2, 0.0 to 10 mS/cm
pH inputs	Up to 2, 0.0 to 14.0 pH	1, 0.0 to 14.0 pH
Temperature Compensation	EC, pH	EC, pH
Solar radiation input	1; 0 to 2000 W/m2	No
Temperature	No	1
Wind speed	No	No
Engine power back-up	No	No
Irrigated sectors	Up to 32	Up to 24
Mixing source of water	No	Yes, 3 sources
PC connectivity	RS 232	
Alarms	Yes, user selectable levels	
Logging	Yes, three level	
Power Supply	115V/220V ±10% 50Hz/60Hz	
Environment	wall mounted: NEMA 4X specifications	
Dimensions	wallmounted: 280 x 330 x 165 mm (11.2 x 13.2 x 6.6"); panel mounted: 178 x 260 x 116 mm (7.1 x 10.4 x 4.6")	
Weight	wall mounted: 4.95 Kg (11 lb.); panel mounted: 3.4 Kg (7.5 lb.)	

Ordering Information

Each HI8000 Series model is supplied instructions.

Choose your configuration:

HI8001-0100U Fertigation controller with priority for pH and EC, panel mount, 8 sectors, English, 115V.

HI8001-0200D Fertigation controller with priority for pH and EC, panel mount, 16 sectors, English, 230V.

HI8001-0400U Fertigation controller with priority for pH and EC, panel mount, 32 sectors, English, 115V.

HI8002-0100U Fertigation controller with priority for pH and EC, wall mount, 8 sectors, English, 115V.

HI8002-0100D Fertigation controller with priority for pH and EC, wall mount, 8 sectors, English, 230V.

HI8002-0401D Fertigation controller with priority for pH and EC, wall mount, 32 sectors, English, 230V.

HI8051-0300D Acid based fertigation controller with dual pH control, differential EC control, actuator control, multiple dosing and irrigation pump control, panel mount, 24 sectors, English, 230V.

Required Accessories	**HI98143-22** pH/EC isolated transmitter, 4-20 mA sourcing current output *1 transmitter is needed in configuration with 1 EC probe and 1 pH probe (no probe redundancy feature)* *2 transmitters are needed in configuration with 2 EC probes and 2 pH probes (for probe redundancy feature)* *3 transmitters are needed in configuration with 3 EC probes and 2 pH probes (for probe redundancy feature and EC water incoming compensation)*
Recommended Accessories	**HI1001** "flow-thru", double junction pH electrode with BNC connector and 3 m (10') cable. *1 or 2 electrodes are needed (2 electrodes for probe redundancy feature)*
	HI3001 "flow-thru", 4 platinum ring EC probe with built-in temperature sensor & 3 m (10') cable. *1, 2 or 3 probes are needed (2 for probe redundancy feature; 3 for probe redundancy feature and EC water incoming compensation)*
	HI60542 Electrode Holder for Direct Pipe (Order according with the total amount of ordered probes)
	HI710005 115 VAC to 12VDC power adapter
	HI710006 230 VAC to 12VDC power adapter

pH electrodes begin on page 2.122; pH and ORP solutions begin on page 2.142;
EC solutions begin on page 5.34

PCA300 Family

Chlorine, pH, ORP and Temperature Analyzers

- Backlit LCD display
- Nema 4X protection
- DPD chlorine measurement method
- Colorimeter diagnostics
- Reagent reminder
- Amplified pH/temperature probe
- Data logging of up to 3500 measurements
- GLP data for review of calibration information
- Digital RS485 output
- Two analog outputs for recording or dosing devices (PCA340)
- Two dosing relays
- SPDT alarm relay
- SPDT system error relay
- Warning messages

The PCA family are process analyzers for the continuous measurement of chlorine, pH (PCA320, PCA330, PCA340) and temperature. These analyzers feature built in data logging, RS485 digital output, dosing relays, and alarm relays packaged in a wall mount Nema 4x enclosure. The PCA340 also features two analog outputs.

This family uses DPD Colorimetric method in which N, N-Diethyl-p-phenylenediamine indicator and a buffer are mixed together with the sample. The resulting chemical reaction causes a magenta color to form in the presence of chlorine. The color intensity is proportional to the concentration. The color intensity is measured photometrically (light source at a specific wavelength and a photodetector) and converted to chlorine concentration, in mg/L, which is displayed on the front panel. The sampling interval for chlorine measurement is adjustable from 3 to 90 minutes. These analyzers have a dosing relay for the addition of chlorine by a dosing pump or chlorine generator when a reading is below the programmable set point. The technology used by this family for chlorine measurement is the same as that found in portable and benchtop colorimeters providing for consistent results when performing process verification with one of those types of meters.

The PCA320, PCA330 and PCA340 also utilize the HI1005 amplified pH electrode with a built in pt100 temperature sensor and matching pin to measure both pH and temperature. The built in amplifier and matching pin provide for exceptional performance against any electrical noise generated by pumps and motors. These analyzers have a programmable dosing relay for the adjustment of pH. The dosing relay can be activated by either on/off or proportional control.

The PCA340 features two selectable 0-20 or 4-20 mA signal output that are scalable for the transmission of readings to external recording devices. The analog outputs can also be set for dosing and used with dosing pumps that accept a 4-20 mA analog input. The analog outputs can be used for any of the three measured parameters.

Through the system setup menu, users have the ability to enable or disable the low and high level of alarms for all parameters. The PCA family also offers overdosing protection that generates an alarm if something within the system is not working properly. The system will stop processes until the user corrects the error.

Backlit LCD Display

The PCA family has a backlit display that is easy to read from a distance and allows for up to three parameters to be displayed at a time.

Nema 4X Protection

These analyzers are enclosed in waterproof casing for superior protection against the elements. The front door of the case has a window for the measurement display while also shielding the DPD reagents from UV light to prevent premature degradation.

DPD Chlorine Measurement Method

The DPD colorimetric method is one of the most common and reliable methods to measure chlorine. The PCA family can use either free or total chlorine reagents and allow for 16,000 measurements to be performed.

Reagent Reminder

The PCA family has a reagent reminder feature to alert the user when the reagents are running low. When the reagents are changed the counter is reset and the meter automatically tracks the number of readings performed.

Colorimeter Diagnostics

Advanced diagnostics allow for easy troubleshooting of the colorimeter. In the setup menu it is possible to select an option that allows the user to determine the difference between a dark read (LED off) and a blank read (LED on). These analyzers also automatically perform this check in order to determine when to alert the user that the sample cell needs to be cleaned.

Amplified pH/Temperature Probe (PCA320, PCA330, PCA340)

An integrated pt100 temperature sensor allows for automatic temperature compensation of pH measurements and allows for monitoring temperature as well. The built in amplifier and matching pin provides for exceptional performance where other probes fail when placed in line with pumps and motors.

Data Logging

The analyzers can store up to 3500 readings (at least 7 days worth of records when set to a a3 minutes sampling interval) that can be reviewed or downloaded to a Windows compatible PC using the HI92500 software and the RS485 serial port. Logged records contain the date time and reading of all parameters measured along with any alarm status.

GLP Data

The GLP data allows for the user to review the data and time for the last Chlorine and pH calibration.

Digital RS485 Output

These analyzers have a RS485 digital output that allows for connection to a Windows compatible PC running the HI92500 software. The software allows for remote monitoring, review of logged data, events and errors, and executing setup options.

Two Analog Outputs (PCA340)

The PCA340 features two selectable 0-20 or 4-20 mA signal output that are scalable for the transmission of readings to external recording devices. The analog outputs can also be set for dosing and used with dosing pumps that accept a 4-20 mA analog input. The analog outputs can be used for any of the three measured parameters.

Two Dosing Relays

The dosing relays of these analyzers can be connected to a pH and/or chlorine dosing pumps. The chlorine relays are proportionally controlled while the pH relay can be set for on/off or proportional control. The proportional control offers very fine control of doing to prevent any overshoot and wastage of chemicals.

Alarm Relay

One SPDT alarm relay is provided that can be activated by adjustable upper and lower chlorine, pH and temperature limits.

Error Relay

One SPDT error relay is provided and is activated when an error is present including a problem with the colorimeter such as when the reagent counter has reached zero, or when a reading is outside the range for a measured parameter.

Warning Messages

Error messages are displayed when the reagents are expired or low and if the colorimeter cell needs to be cleaned.

Specifications		PCA310	PCA320	PCA330	PCA340
Free and Total Chlorine	Range	0.00 to 5.00 mg/L (ppm)	0.00 to 5.00 mg/L (ppm)	0.00 to 5.00 mg/L (ppm)	0.00 to 5.00 mg/L (ppm)
	Resolution	0.01 mg/L (ppm)	0.01 mg/L (ppm)	0.01 mg/L (ppm)	0.01 mg/L (ppm)
	Accuracy	± 8% or ±0.05 mg/L whichever is greater	± 8% or ±0.05 mg/L whichever is greater	± 8% or ±0.05 mg/L whichever is greater	± 8% or ±0.05 mg/L whichever is greater
	Calibration	one-point process calibration			
	Minimum Detectable Level	0.05 mg/L			
	Sampling Rate	adjustable from 3 to 90 minutes			
	Dosage	proportional relay or 4-20 mA output			
	Delta (Δ)	selectable from 0.1 to 5 mg/L (ppm)			
pH	Range	–	0.00 to 14.00 pH	0.00 to 14.00 pH	0.00 to 14.00 pH
	Resolution	–	0.01 pH	0.01 pH	0.01 pH
	Accuracy	–	±0.05 pH	±0.05 pH	±0.05 pH
	Calibration	–	one or two points or in line calibration		
	Dosing Rate	–	adjustable from 3 to 120 seconds		
	Dosage	–	ON/OFF or proportional, relay or 4-20mA output		
	Delta (Δ)	–	selectable from 0.10 to 2.00 pH		
	Hysteresis		selectable from 0.05 to 2.00 pH		
ORP	Range	–	–	0 to 2000 mV	–
	Resolution	–	–	1 mV	–
	Accuracy	–	–	±1 mV	–
Temperature	Range	–	5.0 to 75.0°C (41.0 to 167.0°F)	5.0 to 75.0°C (41.0 to 167.0°F)	5.0 to 75.0°C (41.0 to 167.0°F)
	Resolution	–	0.1 °C (0.1°F)	0.1 °C (0.1°F)	0.1 °C (0.1°F)
	Accuracy	–	±0.5°C (±1.0°F)	±0.5°C (±1.0°F)	±0.5°C (±1.0°F)
Additional Specifications	Analog Output (Dosing)	(1) 4-20mA			(2) 4-20mA
	Recorder Output	(1) 0-10 mV, 0-100 mV, 0-1 V, 4-20mA			(2) 4-20mA
	PC Connectivity	RS485 port, galvanically isolated			
	Baud Rate	1200, 2400, 4800, 9600 bps			
	Data Logging	up to 3500 data points			
	GSM Alarm	2 numbers, alarm SMS, info SMS, warning SMS			
	Alarm Relay	SPDT contact with 5A, 230V resistive load			
	Dosing Relay	SPDT contact with 5A, 230V resistive load			
	System Error	SPDT contact with 5A, 230V resistive load			
	Sample Inlet Pressure	0.07 to 4 bar with no external pressure regulator (for pressure exceeding four bar an external pressure regulator is required)			
	Sample Flow	100 to 300 mL/min			
	Sample Temperature	5 to 40°C (41 to 104°F)			
	Sample Inlet/Outlet Connection	12mm (1/2") male NPT fitting			
	Drain Connection	10mm (3/8") barb			
	Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz; 20 VA			
	Enclosure	NEMA-4X standard, molded fiberglass polyester with transparent Lexan window			
	Dimensions / Weight	318 x 267 x 159 mm (12.5 x 10.5 x 6.25") / 5 kg (11 lb.) without reagents			

Ordering Information

Each PCA300 series model is supplied with reagent bottles (2), reagent caps (2), 1 DPD compound powder, tubing and instructions.;

PCA310-1 Free & total chlorine analyzer/control (115V);

PCA310-2 Free & total chlorine analyzer/control (230V);

PCA320-1 Free & total chlorine analyzer/control, pH control, temperature (115V);

PCA320-2 Free & total chlorine analyzer/control, pH control, temperature (230V) ;

PCA330-1 Free & total chlorine analyzer/control, pH control, ORP monitoring, temperature (115V);

PCA330-2 Free & total chlorine analyzer/control, pH control, ORP monitoring, temperature (230V)

PCA340-1 Free & total chlorine analyzer/control, pH control, temperature with dual analog outputs (115V);

PCA340-2 Free & total chlorine analyzer/control, pH control, temperature with dual analog outputs (230V)

Recommended Probes

HI1005	Flow-thru Monitoring pH electrode
HI2008	Flow-thru Monitoring ORP Electrode

See page 15.15 for spare parts and solutions

Swimming Pools and Chlorine for Disinfection

In regards to swimming pool treatment, disinfection or sanitizing basically means to rid the pool of bather contamination, destroy bacteria, and control nuisance organisms like algae, which may occur in the pool, filtration equipment, and piping. Of the many techniques used (chlorine, bromine and iodine dosing systems), chlorine is the most common.

Chlorine

Chlorine is a strong oxidizing agent that destroys mostly organic pollutants and bacteria and can combine with nitrogen containing compounds, forming chloramines. When dosing chlorine for disinfection, only a portion of the dosed chlorine remains active to actually continue the disinfection process.

When free chlorine combines with a nitrogen containing compound it becomes a less efficient disinfectant called chloramines. The addition of these two parts gives total chlorine. The target is to keep free and total chlorine equal, and thus to maintain the combined chlorine concentration chloramines) near zero. The presence of chloramines is not desired because of the distinctive 'swimming pool' smell caused by combined chlorines like di-chloramines. Beside this unpleasant odor, chloramines can irritate the eyes and the mucous membranes.

Commercial chlorine for disinfection may be available as a gas (Cl_2), a liquid like sodium hypochlorite or bleach (NaOCl) or in a solid state like calcium hypochlorite, chloro-hydantoins or chloro-cyanuric acid compounds. These compounds, once dissolved in water do establish equilibrium between the hypochlorous acid (HOCl) and the hypochlorite ions (OCl^-). Although both forms are considered free chlorine, it is the hypochlorous acid that provides the strongest disinfecting and oxidising characteristic of chlorine solutions; the amount of hypochlorous acid in chlorinated water dependends upon the pH value of the solution. Changes in pH value will affect the HOCl equilibrium in relation to the hydrogen and hypochlorite ion; HOCl decreases and OCl^- increases as pH increases. At a low pH, almost all the free chlorine is in the molecular form HOCl and at a pH of around 7.5, the ratio between HOCl and OCl^- is 50:50. Since the ionic form OCl^- is a slow acting sanitizer while the molecular HOCl is a fast acting, it is important to regularly measure the pH. As a general rule a pH of about 7.2 is recommended to maintain fast acting disinfection conditions.

PCA Parts and Solutions

Graphic display with backlight

LED indicators for different working modes

Keyboard for all parameter settings

Peristaltic pump for accurate reagent dosage

Incoming pressure regulator

Buffer and indicator reagents for DPD method

Hinged cover with window for easy maintenance

Measurement cell with LCD light source

Port to quickly drain the measurement cell at the end of the cycle

External enclosure according to NEMA 4X standard for best protection

PCA Parts and Solutions

Parts

HI70473	PCA tubing kit, pressure regulator to drain (2). Each kit includes: transparent Tygon tubes 86L x 3.2ID mm (3.4 x 0.1") (Length x Internal Diameter) **(1, 2)** and 105 x 9.5 mm (4.1 x 0.4") **(3)**
HI70474	PCA peristaltic pump tubing kit (6). Each kit includes: non-transparent C-flex tubes 55L x 0.8ID mm (2.1 x 0.03") **(5)**
HI70475	PCA peristaltic pump tubing kit (2). Each kit includes: non-transparent C-flex tubes 55L x 0.8ID mm (2.1 x 0.03") **(5)**
HI70476	PCA reagent bottle tubing kit (6). Each kit includes: non-transparent C-flex tubes 155L x 0.8ID mm (6.1 x 0.03") **(11)**
HI70477	PCA tubing set for measuring cell (2). Each set includes: non-transparent C-flex tube 50L x 0.8ID mm (2.0 x 0.03") **(8)** and Y strainer **(7)**
HI70478	PCA tubing kit, bottle to pump (6). Each kit includes: non-transparent C-flex tube 150L x 0.8ID mm (5.9 x 0.03") **(4)**
HI70479	PCA tubing kit, pump to Y strainer (6 pcs). Each kit includes: non-transparent C-flex tube 150L x 0.8ID mm (5.9 x 0.03") **(6)**
HI70482	PCA filters. The kit includes 0.5 µm and 50 µm filters **(13)**
HI70496	Replacement filter, 0.5 µm **(15)**
HI70497	Replacement filter, 50 µm **(16)**
HI70483	PCA complete tubing kit. The kit includes: non-transparent C-flex tubes **(4, 6)** 150L x 0.8ID (5.9 x 0.03") (4 pcs), non-transparent C-flex tubes **(5)** 55L x 0.8ID (2.1 x 0.03") (2 pcs), non-transparent C-flex tubes **(8)** 50L x 0.8ID (2.0 x 0.03") and Y strainer **(7)**
HI70484	PCA complete tubing kit (3). Each kit includes: non-transparent C-flex tubes **(4, 6)** 150L x 0.8ID (5.9 x 0.03") (4 pcs), non-transparent C-flex tubes **(5)** 55L x 0.8ID (2.1 x 0.03") (2 pcs), non-transparent C-flex tubes **(8)** 50L x 0.8ID (2.0 x 0.03"), Y strainer **(7)**
HI70485	PCA stirrer motor
HI70486	PCA stirring bar **(2)**
HI704871	Measuring cell **(9)**
HI70488	Electrovalve, 24VAC/60Hz **(12)**
HI70489	Electrovalve, 24VAC/50Hz **(12)**
HI70492	Electrode holder (PCA330)
HI70493	Closing cap for electrode holder

Electrodes

HI1005	Amplified pH electrode with Matching Pin and Pt100 **(14)** (PCA320/330 only)
HI2008	Amplified ORP electrode with Matching Pin **(17)** (PCA330 only)

Reagent Sets

HI70431	Total Chlorine reagent set for PCA (buffer citrate), 500 mL (2)
HI70481	Total chlorine reagent set for PCA, 500 mL (2) + 5 powder sachets (DPD)
HI70491	Total chlorine reagent set for PCA, 500 mL (2) + 5 poweder sachets (DPD)
HI70430	Free chlorine reagents set for PCA (the most stable), recommended for long term measurements, 500 mL (2) + 6 g powder
HI70480	Free chlorine reagents set for PCA, recommended for short term measurements, 500 mL (2) + 5 sachets (DPD)
HI70490	Free chlorine reagents set for PCA, 500 mL (2) + 5 sachets (DPD)
HI70452	DPD reagent,5 sachets

Solutions

HI70460	Total chlorine indicator solution for PCA, 500 mL*
HI70461	Total chlorine buffer solution for PCA, 500 mL
HI70450	Free chlorine indicator solution for PCA, 500 mL*
HI70451	Free chlorine buffer solution for PCA, 500 mL
HI7004L	pH 4.01 buffer solution, 500 mL
HI7006L	pH 6.86 buffer solution, 500 mL
HI7007L	pH 7.01 buffer solution, 500 mL
HI7009L	pH 9.18 buffer solution, 500 mL
HI7010L	pH 10.01 buffer solution, 500 mL
HI7020L	200-275 mV buffer solution, 500 mL
HI7091L	Pretreatment reducing solution, 500 mL
HI7092L	Pretreatment oxidizing solution, 500 mL
HI70300L	Storage solution, 500 mL
HI7082	3.5M KCL electrolyte, 30 mL
HI7061L	Electrode cleaning solution, 500 mL

Software

HI92500	Windows® compatible software

* After addition of 5 powder sachets (HI70452-0)

BL120 and BL121

pH/ORP Swimming Pool and Spa Controllers with Built-In Chemical Feed Pumps

The BL120 and BL121 are an all-in-one solution for automatic control of pH and chlorine levels in swimming pool, hot tub, and spa water.

The BL120 and BL121 Swimming Pool Controller is a complete system designed for maintaining swimming pool, hot tub, and spa disinfection water quality. These controllers are available in two configurations. The basic version is the in-line model which allows for direct installation of probe and chemical injection fittings into existing piping. A panel mounted version with a bypass flow cell is also available. The bypass flow cell allows for calibration and maintenance of the probe without having to shut down the recirculation pump.

The BL120 and BL121 use a multiparameter digital HI1036-1802 probe that incorporates pH, ORP, and temperature sensors along with a matching pin. All readings are measured within the probe and the data transferred to the controller by a digital connection. Both a digital connection and matching pin provide for stable, reliable measurements. Without these two components, electrical noise from recirculation pumps and ground loops can interfere, causing erratic readings and premature probe failure.

These controllers have two built-in peristaltic chemical feed pumps that are proportionally controlled with adjustable flow rates. One of the pumps is used to dose acid while the other is used to dose chlorine. The effectiveness of the available chlorine, as determined by ORP, is inversely related to the water's pH value. A pool with a fixed concentration of chlorine will show a decrease in ORP as the pH of the water increases. The BL120 and BL121 utilize a dosing consent feature that will not dose chlorine until the pH value is first corrected, since it is possible to have a low ORP value even though there is sufficient chlorine. The dosing consent feature will prevent chemical wastage and having a higher chlorine concentration level than desired.

For compliance monitoring, BL120 and BL121 have a built-in datalogger. Measurement readings are logged every 10 seconds with a new log starting for each new day or when the instrument is calibrated. Logged data include pH, ORP, and temperature values, last calibration data, setup configuration, and any event data.

For BL121 models, three 4-20 mA analog outputs are available for users that wish to connect to an external chart recorder or datalogger to monitor any of the three measured parameters. The outputs are scalable, offering increased flexibility and better resolution as needed.

Additional features of the BL121 include LED indicators for dosing, meter status and service, real-time graph display, programmable alarms, and password protection.

These controllers are an all-in-one solution for automatic control of pH and chlorine levels in swimming pool, hot tub, and spa water.

Three Display Modes

The versatile display of the BL120 and BL121 allows for three display modes. The LCD can display all three parameters at one time, a 3-second cycle of single parameters, or a real-time plot screen with options for parameter selection, zooming, and log recall.

Peristaltic Dosing Pumps

BL120 and BL121 are equipped with two peristaltic dosing pumps with replaceable chemical resistant tubing. A problem that occurs with chlorine dosing pumps is the formation of chlorine gas. When using a diaphragm pump, chlorine gas can collect in the pump head and cause the pump to lose prime; the buildup of chlorine gas is not a problem with peristaltic pumps that use rollers and tubing.

Automatic Proportional Pump Control

BL120 and BL121 feature proportionally controlled dosing pumps. Based on the sensitivity of the process to chemical addition, these controllers allow the user to adjust a proportional band. This setting determines the amount of time that the pumps are dosing as a percentage of the deviation from the set point. For example, a large body of water will use a small proportional band; having a small band (e.g., 0.1 pH) will ensure the pumps are dosing more often when the reading is close to the set point. For smaller bodies of water such as hot tubs or spas, it is more useful to set a larger proportional band (e.g.,1.0 pH); when the reading is close to the set point, the amount of time that the dosing pump is on is minimal to avoid large swings of pH or ORP. This valuable feature allows for very fine control in maintaining the desired set point.

Adjustable Flow Rate

The flow rate from the dosing pumps is adjustable from 0.5 to 3.5L/h. Larger bodies of water require more chemical to be dosed than small bodies since it takes more chemical to see a change in the reading. The adjustable flow rate, like the proportional band, allows for better control in maintaining a desired set point.

ORP (Chlorine) Dosing Consent

Both pH and ORP meters are commonly used with swimming pools. With chlorine disinfection there is an inverse relationship between pH and ORP. As the pH level increases, the ORP level decreases. The BL120 and BL121 utilize a dosing consent feature that will not dose chlorine until the pH value is first corrected since it is possible to have a low ORP value even though there is sufficient chlorine. The dosing consent feature prevents wastage of chemicals and avoids a higher than necessary chlorine concentration.

Acid and Chlorine Tank Level Inputs

The BL120 and BL121 allow for a connection to an optional level controller. This input is used to disable the dosing pumps when there is no chemical left in the reservoir tank.

Hold Input

It is possible to connect a flow switch mounted in-line or a mechanical relay that is connected to the recirculation pump power source to the hold input of these controllers. With no flow or when no power is applied to the recirculation pump, the hold circuit will disable the dosing pumps. This will prevent any dosing of chemical when there is no movement of water in the system.

Programmable Alarm System

These controllers allow users to enable or disable the low and high level of alarms for all parameters: pH, ORP, and temperature. When an alarm is activated, all dosing will stop. The alarm system also offers overdosing protection in that if the value is not corrected within a specified time interval then the meter will go into alarm status.

Multicolored LED Indicators

BL120 and BL121 offers multiple LED indicators for status, servicing, and pump operation. The STATUS LED changes color based on operational state; a green LED means the water is within the desired parameter ranges, a yellow LED means that the controller needs attention, and a red LED identifies a problem in the system such as high and low pH, ORP and/or temperature readings. The SERVICE LED indicates any alarms and process errors experienced by the controller.

BL121 Analog Outputs

The BL121 controller offers three 4-20 mA outputs. Each output can be disabled or connected to an external recording device. Each of the three measured parameters (pH, ORP, and temperature) can be assigned to an analog output where the current signal will be proportional to the measured value. For more flexibility and better resolution, the analog output can be scaled; users can define any two points within a parameter range to correspond to the analog output span. For example, the controller assigns 0 pH to 4 mA and 14 pH to 20 mA as a default. The user can adjust the pH range to assign pH 6 to 4 mA and pH 8 to 20 mA. This adjustment allows better resolution in the range of interest.

Automatic Logging

The readings for each parameter are automatically logged every 10 seconds. A new log is started each time the instrument is calibrated or at the start of a new day. Logged data include pH, ORP, and temperature values, last calibration data, setup configuration, and any event data.

USB Connectivity

For review and storage the users can easily transfer data to a PC using a flash drive and the USB port.

Password Protected

BL120 and BL121 controllers feature a password protection solution that offers restricted access to calibration, setup, and review of logged data. The password can be set and enabled/disabled during general setup of the instrument.

Multiple Configurations

BL120 and BL121 swimming pool controllers are available in one of two configurations. The basic version is the in-line model which allows for direct installation of the probe and chemical injection fittings into existing piping.

A panel mounted version of these controllers with a bypass flow cell is also available. The bypass flow cell allows for calibration and maintenance of the probe without having to shut down the recirculation pump.

BL120-410
Flow Cell for
BL120-20 and
BL121-20

HI1036-1802 Multiparameter Digital pH, ORP, Temperature Probe

The HI1036-1802 is a digital combined probe that measures pH, ORP, and temperature. This probe also incorporates a potential matching pin. The matching pin is considered the "earth ground" connection and is used to prevent ground loop effects from causing erratic readings and damage to the system.

The pH glass has been chosen to produce stable quick equilibration even in low conductivity waters. Additionally, the pH sensor is designed to produce a mV value near pH 4 (not pH 7 like typical pH sensors) should it stop working. A broken pH electrode that produces a mV value near pH 7 would produce an alarm state and disable any pump activated.

The ORP sensing surface is a large smooth surfaced platinum band that encircles the circumference of the temperature probe. It is referenced to Ag/AgCl reference electrode (3.5M KCl).

The ORP and pH sensors and reference electrode use a differential measurement technique which is known to stay in service and provide accurate measurements under adverse conditions that may cause conventional pH probes to produce erroneous measurements. The HI1036-1802 probe with its differential amplifiers greatly reduces inaccuracies caused by ground loops which may exist between process and instrument grounds. With the differential technique, a ground loop current will flow through the low impedance path of the matching pin thus providing immunity to the measurement signals. Additionally the probe converts these measurements to a digital signal to eliminate noise and static due to high impedance signals carried by cable.

The HI1036-1802 with the BL120 or BL121 pool controller helps to promote the health and safety of pool and spa water.

Specifications		BL120/BL121
pH	Range	0.00 to 14.00 pH
	Resolution	0.01 pH
	Accuracy (@25°C/77°F)	±0.05 pH
	Calibration	pH buffer calibration: automatic, two-point (4.01, 7.01, 10.01 pH) pH process calibration: one-point, manual input
	pH Dosing	proportional with adjustable set point and proportional band; delay to start at power-on and overdosing protection
mV	Range	±2000 mV
	Resolution	1 mV
	Accuracy (@25°C/77°F)	±5 mV
	ORP (mV) calibration	one-point, manual input
	ORP Dosing	proportional with adjustable set point and proportional band; delay to start at power-on and overdosing protection; pH dosing interlocked
Temperature	Range	-5.0 to 105.0°C (23.0 to 221.0°F)
	Resolution	0.1°C (0.1°F)
	Accuracy (@25°C/77°F)	±1°C (±1.8°F)
Additional Specifications	Temperature Compensation	automatic, -5.0 to 105.0°C (23.0 to 221.0°F) for pH
	Pump Control	automatic and manual modes; adjustable flow rate from 0.5 to 3.5 L/h
	Log Feature	automatic logging of pH, ORP, and temperature measurements, GLP and events including alarms, errors and power failure; capacity for 60 days with 10 second sampling interval; all data .csv files are transferred by USB flash drive
	Alarms	high and low with enable/disable option for all parameters; alarm is triggered when 5 consecutive readings are over/under threshold
	Alarm System	intuitive alert system based on LEDs; alarm filtering options; alarm relay control based on user setup
	Password Protection	setup, calibration and log recall options features are password protected
	Storage Interface	USB
	GLP	pH/ORP calibration information including date and time for pH/ORP sensors
	Alarm Relay Output (1)	SPDT 5A/230 VAC; activated by pH/ORP/temperature selectable alarm conditions
	BL121 Analog Outputs (3)	4 to 20 mA, sourcing, configurable; output impedance ≤ 500 Ohm; accuracy < 0.5 % FS; galvanically isolated up to 50 V relative to earth ground
	Auxiliary Inputs (3)	low level in acid/base tank (contact open); low level in chlorine tank (contact open); hold input (contact open)
	Digital Probe Input (1)	galvanic isolated digital input HI1036-1802 pH/ORP/temperature/matching pin combined probe with DIN waterproof connector
	Power Supply	100 – 240 VAC
	Power Consumption	10 VA
	Environment	0 to 50°C (32-122°F); max 95% RH non-condensing
	Dimensions	245 x 188 x 55 mm (73 mm with pumps); 9.6 x 7.4 x 2.2" (2.9" with pumps)
	Weight	1700 g (60 oz.)

Ordering Information

In-Line Configuration

BL120-10 pH/ORP/Temperature Pool Controller is supplied with HI1036-1802 pH/ORP/temperature digital probe with matching pin, 50 mm probe saddle (1), fitting for probe, chemical injectors (2), 50 mm saddle for injectors (2), peristaltic tubing (2), 5 m of injection tubing, aspiration filter (2), 20 ml sachets containing pH 7.01 buffer (3), 20 ml sachets containing pH 4.01 buffer (3), 250 ml bottle of 470 mV test solution, power cable and instruction manual.

BL121-10 pH/ORP/Temperature Pool Controller with analog output is supplied with HI1036-1802 pH/ORP/temperature digital probe with matching pin, 50 mm probe saddle (1), fitting for probe, chemical injectors (2), 50 mm saddle for injectors (2), peristaltic tubing (2), 5 m of injection tubing, aspiration filter (2), 20 ml sachets containing pH 7.01 buffer (3), 20 ml sachets containing pH 4.01 buffer (3), 250 ml bottle of 470 mV test solution, power cable and instruction manual.

User Panel Flow Cell Configuration

BL120-20 pH/ORP/temperature pool controller with flow cell is supplied with panel mounted flow cell, HI1036-1802 pH/ORP/temperature digital probe with matching pin, 50 mm probe saddle (1), fitting for probe, chemical injectors (2), 50 mm saddle for injectors (2), peristaltic tubing (2), 5 m of injection tubing, aspiration filter (2), 20 ml sachets containing pH 7.01 buffer (3), 20 ml sachets containing pH 4.01 buffer (3), 250 ml bottle of 470 mV test solution, power cable and instruction manual.

BL121-20 pH/ORP/temperature pool controller with flow cell and analog output is supplied with panel mounted flow cell, HI1036-1802 pH/ORP/temperature digital probe with matching pin, 50 mm probe saddle (1), fitting for probe, chemical injectors (2), 50 mm saddle for injectors (2), peristaltic tubing (2), 5 m of injection tubing, aspiration filter (2), 20 ml sachets containing pH 7.01 buffer (3), 20 ml sachets containing pH 4.01 buffer (3), 250 ml bottle of 470 mV test solution, power cable and instruction manual.

pH and ORP solutions begin on page 2.142

Process Instrumentation

The Hanna line of process instrumentation offers different solutions to control processes in which parameters like pH, ORP, Conductivity, TDS are important. Digital controllers offer a full package of features for process control with high levels of configuration for control and measurement parameters. Hanna solutions are designed for both accuracy of the reading and safety of the control process. The matching pin, sensor check, cleaning programs, auto-diagnostics, hold mode, alarm and warning system are all solutions to the same problem: measurement and control of processes has to be performed in safety from the process control point of view.

Typical feedback systems are based on a control loop, including sensors, controllers with control algorithms and actuators. The purpose of this system is to try to regulate a variable parameter at a set point or reference value. Different types of feedback control algorithms are available: on/off, linear, proportional or PID controllers. Open-loop control systems do not make use of feedback, and run only in preset ways.

Closed-loop control systems typically operate at a fixed frequency. The frequency of changes to the drive signal is usually the same as the sampling rate. After reading each new sample from the sensor, the controller reacts to the controlled system changed state by recalculating and adjusting the actuators drive signal. The controlled system responds to this change, another sample is taken, and the cycle repeats. Eventually, the controlled system should reach the desired state and the controller will cease making changes. The above frequency is fixed based on a setting of the time cycle according with the time necessary to the controlled system to react to the actuator adjustment .

An on-off controller is a feedback controller that switches the actuators drive signal between two states. They are often used to control an actuator that accepts a binary input, for example an on/off valve. A common issue in most applications of on-off feedback control is the wear of actuators such as relays and control valves when the measurement is closed to the set point and the system is starting a continuous on/off switching on each cycle (similar with a continuous oscillation around the set point).

Therefore, practical on-off control systems are designed to include hysteresis, usually in the form of a dead-band, a region around the set point value in which no control action occurs. The width of dead-band may be adjustable or programmable.

Linear control

Linear control is the first solution to on/off control issues. Linear control systems use linear negative feedback to produce a control signal mathematically based on other variables, with a view to maintaining the controlled process within an acceptable operating range. The output from a linear control system into the controlled process may be in the form of a directly variable signal, such as a motorized valve that may be 0 or 100% open or anywhere in between. Sometimes this is not feasible and so, after calculating the current required corrective signal, a linear control system may repeatedly switch an actuator, such as a pump, motor or heater, fully on and then fully off again, regulating the duty cycle inside the time cycle using pulse-width modulation.

Proportional control

Proportional negative-feedback systems are based on the difference between the required set point and measured value. This difference is called the error. Correction is applied in direct proportion to the current calculated error, in the correct sense so as to tend to reduce the error. The amount of corrective action that is applied for a given error is set by the gain or sensitivity of the control system. At low gains, only a small corrective action is applied when errors are detected: the system may be safe and stable, but may be low in response on large changing conditions; errors will remain uncorrected for relatively long periods of time. If the proportional gain is increased, such systems become more responsive and errors are dealt with more quickly. There is an optimal value for the gain setting when the overall system is said to be critically damped. Increases in loop gain beyond this point will lead to oscillations in the process. To resolve the two problems of low response time on one side or system oscillation on the other side, many feedback control schemes include mathematical extensions to improve performance. The most common extensions lead to proportional-integral-derivative control, or PID control. The PID control is formed from three controllers that treat the error in different way: proportional, derivative and integrative.

Derivative action

The biggest problem with proportional control is to reach new desired outputs quickly and to avoid overshoot and minimize ripple once you get there. Responding quickly imposes a high proportional gain, but minimizing overshoot and oscillation requires a small proportional gain. Achieving both at the same time may not be possible in all systems.

The derivative part is concerned with the rate-of-change of the error with time: If the measured variable approaches the set point rapidly, then the actuator is backed off early to allow it to coast to the required level; if the measured value begins to move rapidly away from the set point, extra effort is applied—in proportion to that rapidity—to try to maintain it. If derivative action is over-applied, it can lead to oscillations as well.

Integral Action

The integral term magnifies the effect of long-term steady-state errors, applying ever-increasing effort until they reduce to zero. If the actuator action being applied does not bring the controlled parameter up to set point, for whatever reason, integral action increasingly moves the proportional band relative to the set point until the error is reduced to zero and the set point is achieved.

PID Tuning

PID control is a very powerful and high quality solution for many control processes. The biggest problem of PID controllers is the tuning of the controller in accordance with the controlled system/parameter. Tuning control is not an easy operation and the controller and controlled system have to permit this. High level instruments offer the auto-tuning of controllers that is oriented to the automation of the controller reaction and do not request common PID tuning.

Input of the Controllers

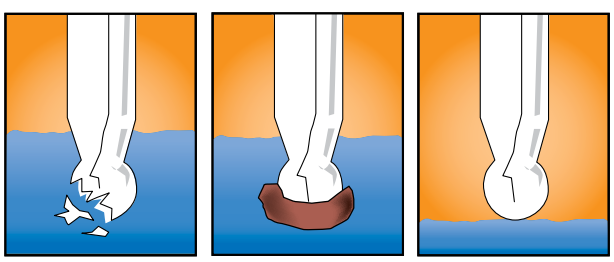
Controllers are in contact with the process based on the sensors and actuators. The sensors are the inputs of the controller, the actuators are the outputs of the controller. In Hanna controllers, the common inputs are the pH, ORP, conductivity, TDS along with temperature for temperature compensation. The probes are connected directly to the controller, or in case of extreme distances between controller and probe, through the transmitters (analog/digital).

Sensor Check™

A pH control system consists of a pH electrode in contact with a test solution, a connection cable, and a meter for measurements and adjustments. The instrument is typically set to control acid or alkaline dosage for the purpose of maintaining a desired pH value. Many efforts have been devoted to such functions as dosage in pipes or tanks, on/off or proportional control, Automatic Temperature Compensation, the use of amplifiers for distances exceeding 15 meters, panel or wall-mounted models, etc. However, little effort has been applied to determining when and what occurs when an electrode fails.

For example, let's assume a process electrode is installed in a tank of wastewater containing hexavalent chromium. The set point pH value is 3.0 and, every time this value rises, pumps or solenoid valves are activated to dose sulfuric acid to maintain the set point. Let's also assume that the process electrode becomes damaged and the pH bulb is broken. Under normal conditions, the electrode will produce a potential equal to the difference between the buffer inside the glass bulb (pH 7.0) and the liquid being tested (pH 3.0), i.e. pH (7.0-3.0) x approx. 59.16 mV = 236.64 mV (value not compensated for temperature variations).

Problems Detected by the Sensor Check™ System



Broken electrode | Dirty electrode | Electrode not immersed

Once the glass bulb is broken, a short circuit occurs between the reference wire of the glass electrode (bulb) and the reference electrode; as a result the complete electrode potential is 0 mV. When the instrument receives a 0 mV signal, it will read approximately pH 7.0 and will immediately start to dose sulfuric acid in order to lower the pH level of the tank. If the controller does not possess a timed override function to shut down automatically, the system will keep dosing in an attempt to reach the 3.0 pH set point. This will continue until the acid container becomes empty by which time the process stream will be dangerously contaminated. Even if a timed override is programmed into the controller, this will only limit the contamination. If the electrode fails near to the set point, the controller could dose for several minutes before the override shuts down the system.

This is just one of many possible examples of overdosing and contamination as a result of an undetectable electrode failure.

In any given application, costly damage can be avoided by automatically and continually monitoring the condition of the process sensors. Hanna has devised such a system. **The Sensor Check™ system automatically checks the condition of the process electrode every 5 seconds to ensure proper function.**

A pH glass electrode is a high impedance device (tens of MΩ at high temperatures, and up to 1,000 MΩ for temperatures close to zero). The Sensor Check™ system repeatedly checks the impedance of the cable and electrode to ensure it does not fall below the average value of the system (at least 10 MΩ). If a lower value is detected, indicating electrode failure, the instrument stops all dosage and activates an alarm that alerts the operator. By doing so, the Sensor Check™ system makes over dosage and contamination as a result of electrode failure a thing of the past.

Additionally, the Sensor Check™ system monitors the condition of the reference electrode. The pH measuring half cell may be intact and work normally, but problems may occur related specifically to the reference portion of the electrode. The purpose of the reference half cell portion of the electrode is to supply a consistent and stable potential that is independent of the liquid being tested. This stable potential is the reference value by which the measuring portion of the electrode is compared. As a result the potential difference between the measuring half cell and the reference is the value used by the instrument to produce the pH reading. The reference electrode must make contact with the test solution to complete an electrochemical connection. Unlike the measuring cell which is hermetically separated by means of a glass bulb, the reference cell contains a permeable membrane (reference junction) which allows electrolyte to diffuse into the solution. This creates an ionic connection between the internal silver reference and test solution, completing the circuit.

As with any electrochemical connection, the possibility of contamination is always a concern. When contamination occurs, the potential of the reference electrode changes and the pH reading is no

longer reliable. In addition, exposure to dirt and particles in the process stream may clog the porous reference junction, isolating the reference from the test liquid. If this occurs the electrochemical connection is broken and the electrode is essentially "unplugged" from the test solution making a correct pH reading impossible. This is why regular cleaning of the electrode system is a necessity. As with the pH bulb, the reference junction produces a measurable resistance value which under normal conditions is approximately 1,000Ω.

The Hanna Sensor Check™ system monitors the reference junction every 5 seconds to ensure that the proper resistance is maintained. Users can program a maximum value for the resistance similar to setting the pH set point. When the resistance of the clogged junction exceeds the set value, the instrument can stop dosage, trigger an alarm or automatic cleaning cycle. These features are present in the HI504 series of process pH/ORP controllers.

Ground loop current effect on process pH/ORP electrodes

An electrochemical (combination) cell, such as a pH or ORP electrode, is comprised of 2 half cells; the measuring cell and the reference.

Both are essential for the cell to function and each has a specific purpose. The entire cell is considered galvanic in that no external power is supplied to the solution. In many respects, the electrochemical cell is very much like a "wet cell" battery. In order for the measuring half cell to produce a readable measurement of a test solution, it must be compared to a stable reference potential. It is absolutely crucial that the potential produced by the reference half cell is consistent and stable (approx. 210 mV) regardless of the properties of the test solution and the working conditions. The only changing potential, as a result of the solution under test, is produced by the glass bulb of the measuring cell. The reference electrode must also make contact with the test solution to complete an electrochemical connection. Unlike the measuring cell which is hermetically separated by means of a glass bulb, the reference cell contains a permeable membrane (reference junction) which allows electrolyte to leach out into the solution. This creates an ionic connection between the internal silver reference and test solution completing the circuit. Hence the reference is now electrochemically connected to the solution which makes it vulnerable to transient electrical currents that may be present in the process.

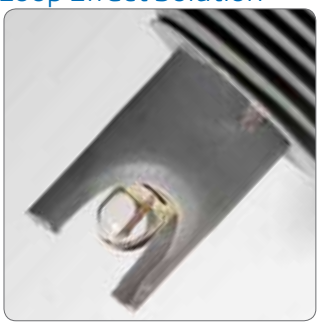
Unlike with a portable battery powered pH meter and electrode, the process system is not isolated from potential difference and the resulting current flow. It is possible, given that unwanted potentials exist in the process, that the silver/silver chloride wire of the reference is exposed to current flow thousands of times higher than normal. In theory, this should not happen since most process instruments are powered at low voltage and the transformer inside the instrument will galvanically isolate the two potentials between the "process" and ground of the electrical system. This depends, therefore, on the quality of the instrument's input transformer. Even with the best isolation, capacitance may be generated between the instrument and the process stream. In this case, the reference electrode influenced by the resulting EMF can no longer function properly and as a result, the pH reading is lost.

By introducing the matching pin, which acts as a ground connection, the EMF is rerouted through the pin and galvanically isolated from the internal mass of the instrument. The instrument must be equipped electrically to perform this function. Hence, the matching pin can only be used with controllers provided with a differential input and circuit.

Few electrode and instrumentation manufacturers have paid the necessary attention to the matching pin and as a result it has been up to the user to devise makeshift ground connections that may or may not work correctly.

Hanna has responded to this problem by designing a complete series of process electrodes, each equipped with an integrated potential matching pin.

Matching Pin: The Ground Loop Effect Solution



In process applications utilizing controllers and electrodes installed in-line or in tank, the potential matching pin is considered the "earth ground" connection and is used to prevent ground loop effects from causing erratic readings and damage to the system. In fact, it is a grounding device with a pin made of a material (usually stainless steel or titanium) inert to chemical attack. The matching pin essentially redirects the current from the reference cell of the process electrode (i.e. pH or ORP sensor). Potentials and transient current flow can be caused by "leakage" of improperly insulated electrical equipment (pumps and stirrers), electrostatic charges introduced by the motion of mixer blades, or the existence of electric fields (electrolysis) present in plating baths.

Calibration of a Typical Process Meter

In industrial applications, the calibration of a meter often poses difficulties due to the distance between the electrode and the instrument. In addition, accessing the electrode for calibration may prove to be a challenge if it is installed in a pressurized line or large tank in a continuous process. Stopping a process frequently for the purposes of regular calibration may prove inconvenient and costly.

In laboratory applications, the task of calibration is significantly different because the electrode and the instrument are close together and easily manageable. To provide the same level of manageability in a process application, Hanna has developed a remote calibration method which allows the maintenance technician or operator the capability to calibrate the process controller without having direct access to it or without removing the electrode from the installation.

Analog or digital transmitters

In order to increase the distance between the sensor and the controller, different solutions were implemented: to amplify the sensor signal, to transform the signal into another type of signal in current or voltage using the analog transmitters, or to convert the signal from analog to digital and to transfer the reading in digital format. Based on this consideration Hanna supports all of these solutions on the sensor level and input of the controllers.

Controller Output

As mentioned earlier, actuators are the outputs of the controllers. The output to actuators on the controller side can be performed using a relay or analog output. Each of them is driven by the controller in accordance with the control method used. For example, an on/off control is common to be performed with a relay, a linear control with an analog output, and a duty cycle command using a solid state relay. Hanna controllers feature all of these options.

Alarms and warning

Controllers are designed to keep the controlled system/parameter within a certain area of values. In the event that parameters have gone out of range, the controller signals an alarm on the user interface and on an output such as an on/off relay according with the alarm status. The status of the controller and the process can be monitored using the analog output connected to a recorder or on the controller LCD.

Due to the complexity and importance of the controlled systems, the controllers incorporate a self-diagnostic feature. With this feature, the controller has the ability to check the most important functions, and in the event of failures, to take the actions that are necessary to minimize the effects of the problems. Hanna controllers have implemented both levels of protection: self-diagnostic and control of output in the event of failures.

Hold feature

The Hold feature suspends the measurement and control of functions of the instrument. The control and control relays are also disabled. If the meter is in idle or control mode and displaying measurements, then the last measured value (both for temperature and pH, ORP or conductivity/concentration) is frozen on the display. The LCD displays the "Hold" message.

The instrument enters Hold mode during the calibration, setup, in progress cleaning or every time when this function is started by: calibration, setup, cleaning in place, the hold digital insulated input (there are two digital insulated inputs: one for hold mode and one for the advanced cleaning) when it is on; normally the signal level is polled at least every 4 seconds, the proper key combination (CFM and up arrow keys together) for service; the same key combination is used both to start and stop the hold mode (the key combination acts in the same way as the hold digital input, the daily programmable control timing, an error event, the hold start/stop RS485 command.

The display will show dashes if the meter is put into the Hold mode before any readings have taken place.

After the Hold mode expires, the meter exits the hold mode, but control and alarms remain disabled for a user-selectable delay (0 to 99 seconds). In this situation, measurements are normally acquired, displayed and recorded through the analog or RS485 output.

Analog output

Hanna controllers feature settable analog outputs. The analog output can be linked to the measured input or to the output of the PID controller. In the first case the analog output will be connected to a recorder and in the second case it will be used to drive external devices such as actuators in a control system. A feature of the recorder output configuration is the ability to zoom a specific measurement range, to offer a higher resolution on the recorder output. Additionally, values that are out of the defined analog output range can be used to signal the alarm condition that appears.

The analog output is communally working in current and the standard ranges are 0 to 20 mA or 4 to 20 mA. The measured range is divided proportional with the analog output range. In some conditions the analog output can be set in voltage with commune ranges between 0 to 5V or 0 to 2V. The voltage is not commonly to be used for long distances due to the drop in voltage on the connection and wires.

Password protection

The controllers can be mounted to monitor and control important processes where unqualified personnel intervention is not accepted. Hanna digital controllers feature a password protection solution that offers restricted access to important features like calibration, setup and consultancy of logged data. The password can be set and enabled/disabled during the normal operations.

Panel Mount or Wall Mount Instruments

Most process instruments for measuring and controlling pH, ORP and conductivity are designed for installation in panel enclosures. Panel configurations are necessary when installing a variety of control devices in a confined space.

Almost the entire range of Hanna panel mount instrumentation is available in stand alone wall mountable versions for quick and easy "plug and play" installation.

HI504

pH/ORP Digital Controller

with Sensor Check™

- Sensor Check™
  - Tells the user if there is something wrong with the electrode
- CAL Check™
  - Alerts users of calibration status
- Alarm
  - Fail Safe Alarm System
- ATC
  - Automatic temperature compensation
- Logging
  - Loging of up to 100 system events

HI504 Overview

HI504 is a PID, PI, proportional or on/off pH/ORP controller with one or two set points. The measurement configuration settings and control of pH and ORP are saved separately and permits users to switch between pH and ORP without losing settings. The pH channel can be calibrated in 2 calibration points. The instrument has a full auto diagnostic procedure. Sensor Check™ is also available for pH and ORP probes.

The temperature is continuously monitored using a temperature sensor (Pt100 or Pt1000 type) with automatic temperature compensation of pH.

One or two analog controller outputs (0-20 or 4-20 mA) can be configured for pH/ORP recording or controlling (only for models with PID), and relays can be used to control the process or be connected with alarm status.

Controller status is visable with LED's on the front panel and on the LCD display.

The controllers logging feature can save up to 6000 samples pH/°C or ORP and last 100 error, configuration, calibration and cleaning events. This information is accessible from a PC through RS485 and HI92500 software. The powerful HI92500 software has graphing capabilities and can print graphs directly or can be saved as a bitmap. Data can be exported in common spreadsheet formats.

Analog Output: Data Logging or PID Dosage Control

Models are available with one or two analog outputs. These outputs can be connected to a recorder for the catalogging of process data (pH/mV and temperature), or can be used for controlling dosing systems (pumps or electrovalves) using PID control.

Sensor Check™ pH/ORP

Sensor Check™ performs self-diagnostic and troubleshooting functions by continuously verifying the electrode status based on impedance movement of the glass and reference measurement. The internal circuit of the instrument executes two independent tests, one for the probe and one for the reference chamber, measuring the respective impedance values every 5 seconds. These tests last for a very short period to avoid electrolysis and polarization, which can be caused by a prolonged exposure to an electric current. The types of problems identified by Sensor Check™ are: pH electrode broken, reference electrode dirty, reference electrode or matching pin not immersed, clogged or dirty electrode junction, short-circuit between cables of pH and reference electrodes, signal problems from the cable or connector due to humid or dirty environments. The test is not limited to a simple signal that indicates an error in progress, but it reports the nature of the problem with a specific error code.

Programmable Cleaning Cycles

Heavy-duty applications often require almost continuous probe maintenance. Elements such as suspended solids, fat, oils, pigments and microorganisms can quickly deposit and soil the glass bulb of a pH probe, the sensor of an ORP probe or the reference junction. To solve these problems, the HI504 series has been equipped with an automatic cleaning system (simple or advanced, depending on model) with programmable cycles. The cleaning cycle is a simple wash with either water or detergent, programmed by setting the rinse time and the pause length. The advanced cleaning uses both water and detergent, and allows the user to program three stages, with the possibility to vary the sequence, the time, and the number of cycles. The advanced mode can also be triggered at any time from a remote control or through the isolated digital input on the rear panel, which can be connected to an external switch.

The controllers can also automatically activate both cleaning modes whenever Sensor Check™ reveals a soiled probe. A delay time can be set before restarting the reading after a cleaning cycle has taken place; this allows the probe to adjust to new operating conditions.

Logging of the Last 100 Events

With the HI504 series, it is possible to recall the sequence of the last 100 occurred events at any time: errors, calibrations performed, set parameter changes and cleaning cycles. Every code shown on the display corresponds to a certain type of event, error, or operation.

Programmable Hold System

The hold function allows the user to stop the regulating action of the controller for programmable time periods. It is possible to activate the hold periods in correspondence to programmed operations, such as plant maintenance and cleaning procedures.

Fail Safe Alarm System

Hanna's exclusive Fail Safe Alarm System protects against problems caused by power supply failure or signal interruption, which are typical risks in industrial environments. The system acts both on a hardware and a software level. The alarm relay functions in a normally closed condition, and is tripped when there is a power failure if, for example, the power cable is accidentally cut. This function is very important in industrial plants where alarms are usually not activated if there is a power supply interruption, which can cause serious damage due to a loss of control of the process plant. At the software level, the Fail Safe Alarm System function activates an alarm in case of abnormal circumstances, for example if the dosing contacts remain closed for an excessive period. The alarm condition is also indicated by a red LED, located directly on the front panel of the controller.

Specifications	HI504
Range	-2.00 to 16.00 pH; -2000 to 2000 mV; -30 to 130.0°C
Resolution	0.01 pH; 1 mV; 0.1°C (above -10 °C); 1°C (below -10°C)
Accuracy (@25°C/77°F)	±0.02 pH; ±2 mV; ±0.5°C (-9.9 to 130.0°C); ±1°C (-30 to -10°C)
Input Impedance	10^{12} Ohm
Digital Input for the pH/ ORP/°C Transmitter	RS485
Other Digital Insulated Inputs	two digital insulated inputs: one for hold and one for the advanced cleaning; ON state: 5 to 24 VDC
Digital Insulated Output	a digital insulated contact closed upon hold mode
Temperature Compensation	automatic or manual, -30 to 130°C
Temperature Probe	with three-wire or two-wire Pt100/Pt1000 sensor (with automatic recognition and damage test)
Power Supply (depending on model)	24 VDC/AC, 115 VAC ±10%, 230 VAC ±10% or 100 VAC ±10%; 50/60 Hz
Power Consumption	10 VA
Over Current Protection	400 mA 250V quick blow fuse
Max. Oscillation Frequency	8 MHz
Relays 1, 2, 3, 4	electromechanical relay SPDT contact outputs, 5A-250 VAC, 5A - 30 VDC (resistive load); fuse protected: 5A, 250V quick blow fuse
Alarm Relay	electromechanical relay SPDT contact output, 5A - 250 VAC, 5A - 30 VDC (resistive load) fuse protected: 5A, 250V quick blow fuse
Analog Output	two independent outputs, 0 - 22 mA (configuring as 0-20 mA or 4-20 mA)
Analog Output Resolution	0.1% f.s.
Analog Output Accuracy	± 2% f.s.
Data logging	6000 pH/°C or ORP samples
Environment	0 to 50°C (32 to 122°F); RH max 85% non-condensing
Casing	IP20 (housing); IP54 (front panel)
Weight	1.6 kg (3.5 lb.)
Ordering Information	Each HI504 model is supplied complete with mounting brackets and instructions. **Choose your configuration** **HI504222-1** dual setpoint, on/off and PID control, single analog output, 115V **HI504222-2** dual setpoint, on/off and PID control, single analog output, 230V **HI504224-0** dual setpoint, on/off and PID control, dual analog output, 24VDC/AC **HI504224-1** dual setpoint, on/off and PID control, dual analog output, 115V **HI504224-2** dual setpoint, on/off and PID control, dual analog output, 230V **HI504924-1** dual setpoint, advanced cleaning, on/off and PID control, dual analog output, 115V **HI504924-2** dual setpoint, advanced cleaning, on/off and PID control, dual analog output, 230V
Probes	**HI7610** Stainless steel Pt100 probe with front and back 1/2" NPT thread and 5 m (16.4') cable
	HI7611 Glass Pt100 probe with front and back 1/2" NPT thread and 5 m (16.4') cable

pH and ORP solutions begin on page 2.142

HI720

Conductivity Process Digital Controller

with Inductive Probe

- ATC
  - Automatic temperature compensation
- Logging
  - Logging of up to 100 system events

HI720 Overview

HI720 is a PID, PI, proportional or on/off EC/TDS controller with one or two set points and includes an inductive conductivity probe.

The measurement configuration settings and EC and TDS control are saved separately and permits users to switch between EC and TDS without losing settings. TDS or a specific user defined curve can be used for concentration.

Temperature is continuously monitored using a temperature sensor (Pt100 or Pt1000 type) with ATC of conductivity. Conductivity temperature compensation parameters are fully customizable: linear or non-linear temperature compensation, reference temperature and temperature coefficient. Users can define the specific curve of temperature compensation.

The working conductivity range is user selectable and the conductivity calibration in one point is performed in a value that corresponds to the measurement range.

One or two analog controller outputs (0-20 or 4-20 mA) can be configured for recording or controlling (only for models with PID), and up to 4 relays can be used to control the process or be connected with alarm status. Controller status is visable with LED's on the front panel and on LCD.

The controller logging feature can save the last 100 error, configuration, calibration and cleaning events. This information can be accessible from a PC through RS485 and HI92500 software. The controller also has a full auto diagnostic procedure. A cleaning procedure of the EC inductive probe is also available.

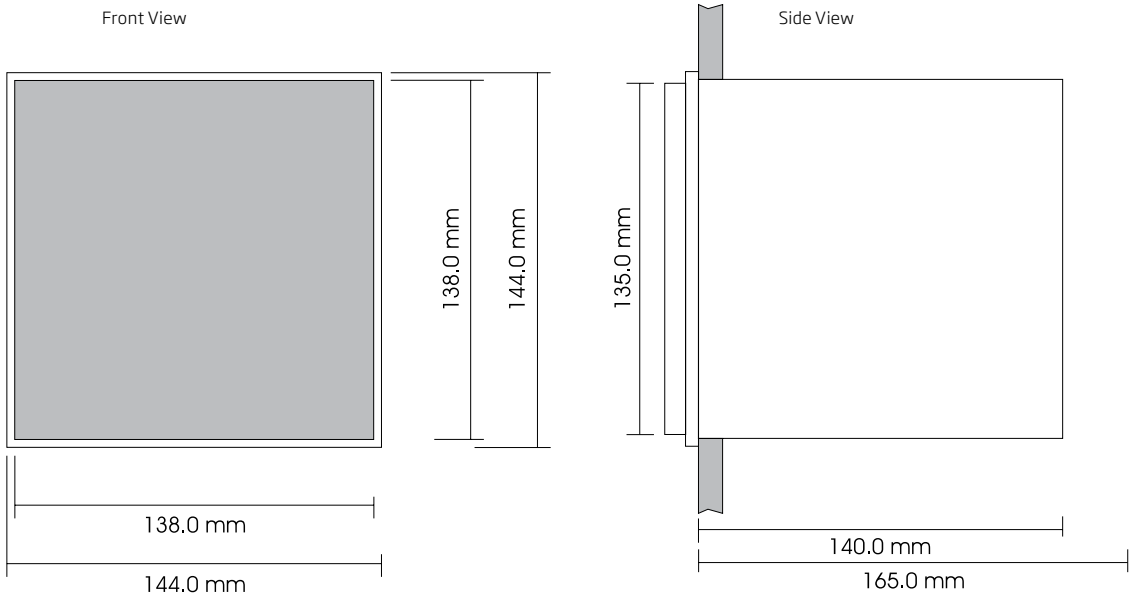
In-Line Cleaning

The cleaning feature allows an automatic cleaning action of the probe. To perform cleaning, the controller activates an external device (pump). Cleaning actions never take place if no relay is configured for cleaning. Cleaning can be of two types:

1. **Simple cleaning:** with water only, it can be triggered only by a timer (periodical cleaning) or by an error for which a cleaning action can be configured.
2. **Advanced cleaning (optional):** with water and detergent, it can be triggered by the following events:

Timer: Digital input or RS485 command (external trigger); Timer and digital input or RS485 command (external trigger); Timer masked by the digital input (i.e. disabled when the digital input is on); Error for which a cleaning action can be configured

Mechanical Dimensions



Specifications	HI720
Range	0 to 2000 mS/cm (autoranging); -30 to 130°C / -22 to 266°F
Resolution	1 µS/cm (0 to 1999 µS/cm); 0.01 mS/cm (2.00 to 19.99 mS/cm); 0.1 mS/cm (20.0 to 199.9 mS/cm); 1 mS/cm (200 to 2000 mS/cm); 0.1°C / 0.2°F
Accuracy (@25°C/77°F)	±2% f.s. (conductivity) / ±0.5°C / ±1°F
Temperature Compensation	automatic or manual, -30 to 130°C
Temperature Probe	three-wire or two-wire Pt100 or Pt1000 sensor with automatic recognition and damage test
Digital Input	digital transmitter, hold and advanced cleaning inputs
Digital Output	one digital insulated contact closed upon hold mode
Analog Output	one or two independent outputs; 0-22 mA (configuring as 0-20 mA or 4-20 mA)
Digital Serial Output	RS485
Dosing Relay	1, 2, 3 or 4 electromechanical relays SPDT; 5A-250 VAC, 5A-30 VDC (resistive load); fuse protected: 5A, 250 V fuse
Alarm Relay	1 electromechanical relay SPDT; 5A-250 VAC, 5A-30 VDC (resistive load); fuse protected: 5A, 250 V fuse
Installation Category	II
Power supply (depending on model)	24 VDC/ac, or 115 VAC or 230 VAC or 100 VAC ±10%, 50/60 Hz; fuse protected: 400 mA, 250 V fast fuse
Power Consumption	10 VA
Max Oscillation Frequency	8 MHz
Environment	0 to 50°C (32 to 122°F); RH max 85% non-condensing
Enclosure	single case 1/2 DIN
Weight	approximately 1.6 kg (3.5 lb.)
Ordering Information	Each HI720 model is supplied complete with mounting brackets and instructions. **Choose your configuration:** **HI720122-1** single setpoint, on/off and PID control, single analog output, 115V **HI720122-2** single setpoint, on/off and PID control, single analog output, 230V **HI720224-1** dual setpoint, on/off and PID control, dual analog output, 115V **HI720224-2** dual setpoint, on/off and PID control, dual analog output, 230V
Probes	**HI7610** Stainless steel Pt100 probe with front and back 1/2" NPT thread and 5 m (16.4') cable
	HI7611 Glass Pt100 probe with front and back 1/2" NPT thread and 5 m (16.4') cable
	HI7620 Stainless steel Pt1000 probe with PG 13.5 thread and 5 m (16.4') cable
	HI7621 Glass Pt1000 probe with PG 13.5

EC solutions begin on page 5.34

HI7650

Inductive Conductivity Probe

for HI720

EC Inductive Probe Theory of Operation

This instrument allows conductivity measurements without any electrical contact between electrodes and process fluid. The measurement is based on inductive coupling of two toroidal transformers by the liquid.

The instrument supplies a high frequency, reference voltage to the "Drive Coil", and a strong magnetic field is generated in the toroid.

The liquid passes through the hole in the toroid and can be considered as one turn secondary winding. The magnetic field induces a voltage in this liquid winding, the current induced in the flow is proportional to this voltage, and the conductance of the liquid one-turn winding is in accordance to Ohm's law.

The conductance is proportional to the specific conductivity and a constant factor determined by the sensor geometry and installation.

The liquid also passes through the second toroid and therefore the liquid turn can be considered as a primary winding of the second toroidal transformer. The current in the liquid will create a magnetic field in the second toroid, and the induced current can be measured as an output.

The output current of this "receive coil" is therefore proportional to the specific conductivity of process liquid.

For an inductive cell, the cell constant is defined as the measured conductivity, obtained by making a loop through the sensor with a resistor R, multiplied by that R value.

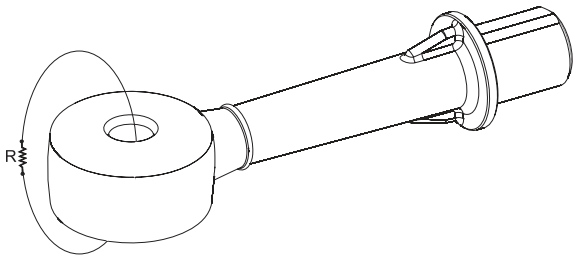
The cell constant depends only on the sensor geometry. However, when the probe is immersed in a liquid, the induced current in the solution is affected by the piping or any other container where the probe is inserted. This effect is negligible when there is an area of at least 3 cm of liquid around the cell.

Otherwise, it is necessary to multiply measurements by the installation factor: Conductivity = (cell constant)(installation factor)/(measured resistance).

The installation factor is < 1 for conductive piping/containers, and > 1 for nonconductive piping/containers.

Since this type of sensor has no electrodes, common problems such as polarization and contamination are eliminated and will not affect the performance of the electrodeless sensor.

Specifications	HI7650 Inductive Conductivity Probe	
Measuring Range	0 to 2000 mS/cm	
Accuracy	±2% f.s.	
Cell Constant	approx. 2.4 cm-1	
Protection Class	IP67	
Temperature Sensor	Pt100 to Pt1000 (depending on model)	
Temperature Response	90% of the final value, approximately 10 minutes	
Required Pipe Diameter	>80 mm (consider installation factor for pipe with diameter < 125 mm)	
Dimensions (probe only)	40 x 190 x 55 mm (1.57 x 7.48 x 2.16") ; head: 32 x OD 55 mm (1.25" x OD 2.16"n)	
Weight (probe only)	approximately 330 g (11.64 oz.)	
Ordering Information	**Choose your configuration**	
	HI7650-1105	PVC body, Pt100, 5 m cable
	HI7650-1110	PVC body, Pt100, 10 m cable
	HI7650-1115	PVC body, Pt100, 15 m cable



pH502

pH Digital Controllers

with Matching Pin and PID Control

- ATC
  - Automatic temperature compensation
- 3 Point Calibration
  - Up to three point calibration

The pH502 series of controllers offer many features to increase the level of control available in your plant. These instruments can be configured to utilize P, PI, PID controlling. With this feature, the pH502 takes the place of three instruments that only allow one configuration each. The pH502 line includes models that incorporate control through analog output to drive any compatible device, such as an electrovalve or pump. The solid state relay is available to ensure maximum life of the switching device. Each model has a differential input for a grounding bar to extend electrode life.

Fail Safe Alarm System protects against power interruption or line failure. 1, 2 or 3 point automatic calibration and manual or Automatic Temperature Compensation complete the features of this controller.

Specifications	pH502
Range	0.00 to 14.00 pH; -9.9 to 120°C
Resolution	0.01 pH; 0.1°C
Accuracy (@25°C/77°F)	±0.02 pH; ±0.5°C
Input Impedance	10^{12} Ohm
pH Calibration	automatic, one, two or three point, at pH 4.01, 7.01, 10.01
Temperature Compensation	automatic (with Pt100 probe) or manual from -9.9 to 120°C
Outputs	digital: RS485 bi-directional opto-isolated; or analog, galvanically isolated: 0-1 mA, 0-20 mA and 4-20 mA, 0-5 VDC, 1-5 VDC and 0-10 VDC
Set Point Relay	1 or 2 contact outputs SPDT 5A-250 VAC, 5A-30 VDC (resistive load) or 1 or 2 Solid State Relay (SSR), 1A, 250 VAC (resistive and inductive load), fuse protected (2A, 250V fast fuse)
Alarm Relay	one contact output SPDT, 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fuse)
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
Power Consumption	15 VA
Over Current Protection	400 mA 250V fast fuse
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	panel cutout:140 x 140 mm, instrument: 144 x 144 x 170 mm
Weight	1.6 kg (3.5 lb.)
Ordering Information	Each pH 502 model is supplied complete with mounting brackets and instructions. **Choose your configuration** **pH502421-1** Dual setpoint with SSR relay, on/off and PID controls, analog output, 115V **pH502421-2** Dual setpoint with SSR relay, on/off and PID controls, analog output, 230V

pH solutions begin on page 2.142

pH500

pH Digital Controllers

with Matching Pin

- Alarm
  - Fail Safe Alarm System
- ATC
  - Automatic temperature compensation
- 3 Point Calibration
  - Up to three point calibration

pH500 series of controllers are simple to operate, microprocessor-based process meters packed with features. For more flexibility and better resolution for chart recorders, any two points between 0 and 14 pH can be chosen to correspond to the analog output spans. Several pH500 models are equipped with a bi-directional RS232 port. Push button password programming prevents tampering.

The Fail Safe Alarm System protects the pH500 against the pitfalls of process control, like power interruption or line failure. With pH500 quick one, two or three point calibration at pH 4.01, 7.01 and 10.01 comes standard. The temperature can be manually or automatically compensated for. Models with RS232 output allow computer compatibility, a necessity for process control instrumentation. You can also choose from ON/OFF or proportional dosage to save on chemicals.

Specifications	pH500
Range	0.00 to 14.00 pH; -9.9 to 120°C
Resolution	0.01 pH; 0.1°C
Accuracy (@25°C/77°F)	±0.02 pH; ±0.5°C
Input Impedance	10^{12} Ohm
pH Calibration	automatic, one, two or three point, at pH 4.01, 7.01, 10.01
Temp. Compensation	automatic (with Pt100 probe) or manual from -9.9 to 120°C
Outputs	digital: RS232 bi-directional optoisolated; or analog, galvanically isolated: 0-1 mA, 0-20 mA and 4-20 mA,0-5 VDC, 1-5 VDC and 0-10 VDC
Set Point Relay	1 or 2 contact outputs SPDT 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse)
Alarm Relay	1 contact output SPDT, 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse)
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
Power Consumption	15 VA
Over Current Protection	400 mA 250V fast fuse
Max. Oscillation Frequency	4 MHz
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	panel cutout: 140 x 140 mm, instrument: 144 x 144 x 170 mm
Weight	1.6 kg (3.5 lb.)
Ordering Information	Each pH 500 model is supplied complete with mounting brackets and instructions. **Choose your configuration** **pH500111-1** single setpoint, on/off control, analog output, 115V **pH500111-2** single setpoint, on/off control, analog output, 230V **pH500121-1** single setpoint, proportional control, analog output, 115V **pH500121-2** single setpoint, proportional control, analog output, 230V **pH500211-1** dual setpoint, on/off control, analog output, 115V **pH500211-2** dual setpoint, on/off control, analog output, 230V **pH500221-1** dual setpoint, proportional control, analog output, 115V **pH500221-2** dual setpoint, proportional control, analog output, 230V **pH500222-1** dual setpoint, proportional control, RS232 output, 115V **pH500222-2** dual setpoint, proportional control, RS232 output, 230V

pH solutions begin on page 2.142

mV600

ORP Digital Controller

with Matching Pin

- Alarm
  - Fail Safe Alarm System
- ATC
  - Automatic temperature compensation
- 2 Point Calibration
  - Up to two point calibration
- Connectivity
  - PC compatible

The mV600 controllers have been engineered with the same outstanding features as the pH500 meters. The Fail Safe Alarm System protects these meters against the pitfalls of process control. User selectable timing capability safeguards against overdosing.

These instruments have a differential input, extending electrode life by eliminating ground loop current through the reference. Users can choose between ON/OFF and proportional control as well as selectable current and voltage output. For more flexibility and better resolution for chart recorders, choose any two points between 0 and 2000 mV to correspond to the analog output spans.

RS232 capability makes two mV600 models PC compatible. Wiring the controllers is simple with extractable terminal modules. A host of self-testing features and user friendly functions make mV600 a great value.

Specifications	mV600
Range	±2000 mV; -9.9 to 120°C
Resolution	1 mV; 0.1°C
Accuracy (@25°C/77°F)	±2 mV; ±0.5°C
Input Impedance	10^{12} Ohm
ORP Calibration	automatic, two point, at 0 and 350 or 1900 mV
Outputs	digital: RS232 bi-directional optoisolated; or analog, galvanically isolated: 0-1 mA, 0-20 mA and 4-20 mA, 0-5 VDC, 1-5 VDC and 0-10 VDC
Set Point Relay	1 or 2 contact outputs SPDT 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse)
Alarm Relay	1 contact output SPDT, 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse)
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
Power Consumption	15 VA
Over Current Protection	400 mA 250V fast fuse
Max. Oscillation Frequency	4 MHz
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	panel cutout: 140 x 140 mm, instrument: 144 x 144 x 170 mm
Weight	1.6 kg (3.5 lb.)
Ordering Information	Each mV 600 model is supplied complete with mounting brackets and instructions. **Choose your configuration** **mV600111-1** single setpoint, on/off control, analog output, 115V **mV600111-2** single setpoint, on/off control, analog output, 230V **mV600121-1** single setpoint, proportional control, analog output, 115V **mV600121-2** single setpoint, proportional control, analog output, 230V

ORP solutions begin on page 2.142

HI700 · HI710

Conductivity and TDS Digital Controllers

with Four-ring Potentiometric Probe

- ATC
  - Automatic temperature compensation
- 2 Point Calibration
  - Up to two point calibration
- Backlight
  - Backlit, LCD display

The HI700 series of controllers offer state of the art specifications for your process control. They can be configured for ON/OFF, proportional, PI or PID control. Thanks to our exclusive technology, they can be customized to best fit your application. Bright LED's show the current status even from a distance. A menu-driven display aids the user throughout the operations with running messages and clear prompts. All relevant parameters can be simply adjusted and will remain memorized until overwritten.

With self-diagnostic features and extractable terminals, installation and maintenance are fast and simple. Password protection guarantees that the calibration and predetermined parameters cannot be altered unnecessarily. The controllers can operate with four-ring probe or 4-20 mA signal. They accept probes with or without a built-in Pt100 temperature sensor. HI710 includes all of the features of the HI700 and adds TDS measurement.

Specifications		HI700	HI710
Range	EC	0.0 to 199.9 µS/cm; 0 to 1999 µS/cm; 0.00 to 19.99 mS/cm; 0.0 to 199.9 mS/cm	0.0 to 199.9 µS/cm; 0 to 1999 µS/cm; 0.00 to 19.99 mS/cm; 0.0 to 199.9 mS/cm
	TDS	–	0.0 to 100.0 mg/L (ppm); 0 to 1000 mg/L (ppm); 0.00 to 10.00 g/L (ppt); 0.0 to 100.0 g/L (ppt)
	Temperature	-10.0 to 100.0°C	-10.0 to 100.0°C
Additional Specifications	Resolution	**EC:** 0.1 µS; 1 µS; 0.01 mS; 0.1 mS; 0.1 °C –	**EC:** 0.1 µS; 1 µS; 0.01 mS; 0.1 mS; 0.1 °C **TDS:** 0.1 ppm; 1 ppm; 0.01 g/L (ppt); 0.1 g/L (ppt)
	TDS Conversion Factor	–	adjustable from 0.00 to 1.00
	Accuracy (@25°C/77°F)	±0.5% f.s. (EC / TDS); ±0.5°C (0 to 70°C); ±1°C (outside)	
	EC Calibration	automatic or manual at 1 point	
	Temperature Compensation	automatic or manual, -10 to 100°C with adjustable temperature coefficient from 0.00 to 10.00%/°C	
	Outputs	analog: isolated 0-1 mA, 0-20 mA and 4-20 mA; 0-5 VDC, 1-5 VDC and 0-10 VDC or digital: RS485 bi-directional opto-isolated	
	Analog Input	4-20 mA	
	Set Point Relay	two contact outputs SPDT 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse)	
	Alarm Relay	contact output SPDT 5A-250 VAC, 5A-30 VDC (resistive load), fuse protected (5A, 250V fast fuse	
	Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
	Power Consumption	15 VA	
	Over Current Protection	400 mA 250V fast fuse	
	Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing	
	Dimensions	panel cutout: 140 x 140 mm, instrument: 144 x 144 x 170 mm	
	Weight	1.6 kg (3.5 lb.)	
Ordering Information	Each HI700 and HI710 model is supplied with mounting brackets and instructions.		
	Choose your configuration		
	HI700221-1	dual setpoint, on/off and PID controls, analog output, 115V	
	HI700221-2	dual setpoint, on/off and PID controls, analog output, 230V	
	HI710221-1	dual setpoint, on/off and PID controls, analog output, 115V	
	HI710221-2	dual setpoint, on/off and PID controls, analog output, 230V	
	HI710222-1	dual setpoint, on/off and PID controls, RS485 output, 115V	
	HI710222-2	dual setpoint, on/off and PID controls, RS485 output, 230V	

EC and TDS solutions begin on page 5.34

Analog Process Controllers

Panel Mounted Controllers

Hanna panel mounted pH, ORP and conductivity controllers are designed to meet your most demanding process control requirements. Our controllers come equipped with a relay operating at a maximum of 2 A (240V). Where a direct electrode input is not suitable, the controller is available with a 4-20 mA input from a transmitter. This feature greatly improves the safety of your instrumentation and plant. Accurate measurements are displayed on a large LCD, enabling the operator to check the controller readings easily. These units have sophisticated, built-in, self-diagnostic functions that allow the operator to check whether a malfunction has originated in the instrument itself, or in the outside connection (electrode, transmitter or cables). This saves valuable time and money, particularly in the monitoring of critical processes. In the event of a malfunction, the operator can determine the origin and rectify the situation before any costly errors occur. This Self-Diagnostic Error Prevention System makes these process instruments superior to conventional controllers.

Alarm Feature

Hanna controllers incorporate an alarm warning system. When the measured value of the meter is out of the user-specified range, the alarm is activated. When activated, the alarm contacts close, triggering the mechanism of your choice, whether a buzzer, light or any other electrical connection. The alarm feature is a necessity when the installation is in a remote location and corrective action must be taken immediately in the event of an out of range condition.

Recorder Output

The ability to record data from the process you are monitoring greatly enhances process troubleshooting. By simply connecting a recorder to the controller's output terminals (choose between 0 to 20 mA or 4 to 20 mA according to your needs), users are able to acquire a hard copy for demonstrative or analytical purposes.

Low or High Impedance Input and Analog Inputs

Hanna pH and ORP controllers come in two different models to meet user requirements. These models, have a high impedance 10^{12} Ohm direct input from an electrode, ideal for connections with a distance of up to 10 m (33'). However, if the distance is greater than 10 m (33') then a 4 to 20 mA transmitter should be used. The greater the distance between the controller and the sample, the greater the chance you have of line noise causing erroneous readings. Using a transmitter greatly enhances the input signal, thus allowing high accuracy at distances of up to 300 m (1000').

Consent Feature

The consent contact allows you to be sure that the ORP dosing occurs only when the pH value is correct. This assures that the pH is within a specified range before any dosing of oxidizing or reducing agents occurs. This will prevent any overdosing of chemicals, a very important cost-effective feature in many applications, especially in pools, spas and hot tubs.

Quality Construction

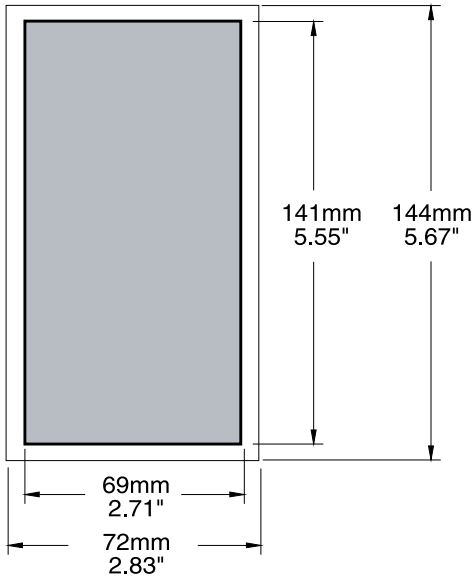
The controllers are housed in sturdy aluminum casings with ABS plastic front panels. The mounting brackets that are supplied with the meter, can be installed securely and quickly. When in operation, and with the transparent protective cover installed, the units comply with IP42 standards (see chart in section 20 for IP codes). The use of this design protects the unit from the conditions associated with industrial environments, ensuring a long and trouble-free operation.

LED Indicators

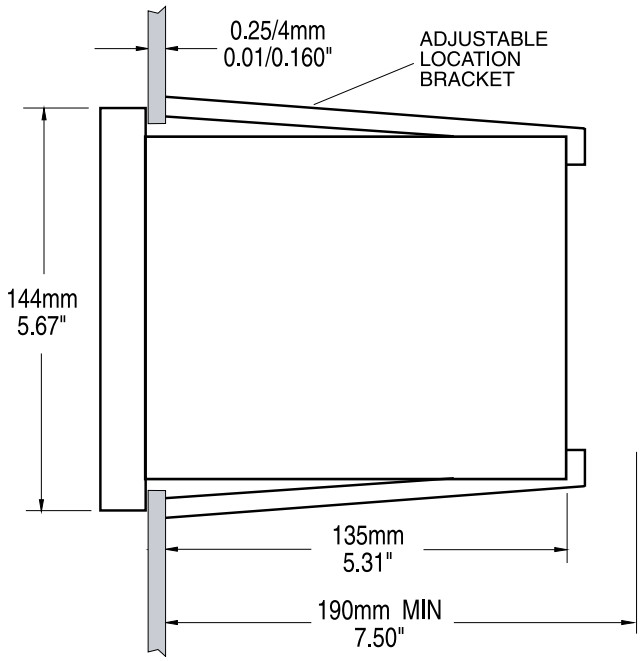
The LEDs on the front panel light up to indicate the current operational mode. The LEDs also blink at different rates to indicate multiple modes occurring simultaneously. This feature allows the user to evaluate the controller from a distance and clearly read which mode it is in.

Mechanical Dimensions for Panel Mounting

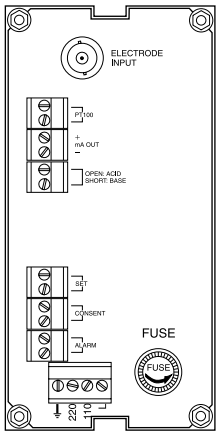
Analog Indicators and Controllers
HI8510 / HI8710 / HI8711 / HI8720 /
HI8931AN / HI8931BN / HI8931CN / HI8931DN / HI943500



Front View
Dimensions show the cutout size for installation and also the outside dimensions of the instrument panel.



Side View
Adjustable location brackets allow the instrument to slide into the cutout and will hold the unit securely in place. 190 mm (7.50") is the minimum amount of room required to install the indicator with the cables connected.



Rear View
Rear view of the HI8710 shows the typical electrical connections.

HI8510

pH Analog Indicator

with Self Diagnostic Test

- ATC
  - Automatic temperature compensation Backlight
- Backlit, LCD display

HI8510 is ideal for monitoring pH in process control. It can provide highly accurate pH measurements and display values on the easy to read LCD. BNC input, amplified probe input and input from transmitter are supported.

Designed for easy and fast installation, the HI 8510 is provided with membrane keypads on the front panel, large display, and auto-diagnostic functions to check pH electrode and instrument status. These instruments also provide ±5V power output and input terminals for amplified electrodes.

A removable, transparent splash-proof cover protects the front panel.

Specifications	HI8510	
Range	0.00 to 14.00 pH	
Resolution	0.01 pH	
Accuracy (@25°C/77°F)	±0.02 pH (0 to 100 °C); ±0.05 pH (-20 to 0 °C); ±0.5% (input transmitter)	
Input	high impedance 10^{12} Ohm; reference and matching pin inputs are available; 4-20 mA	
Power Output	±5 Vcc; 150 mA max load for amplified electrodes	
Calibration	offset: ±2 pH with OFFSET trimmer; slope: 80 to 110% with SLOPE trimmer	
Temperature Compensation	fixed or automatic with Pt100, from -20 to 100°C (-4 to 212°F)	
Recorder Output	0-20 mA or 4-20 mA (isolated)	
Backlight	continuous on	
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover	
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing	
Panel Cutout	141 x 69 mm (5.6 x 2.7")	
Weight	1 kg (2.2 lb.)	
Ordering Information	The **HI8510** is supplied complete with mounting brackets and instructions.	
Accessories	**HI8427**	pH / ORP electrode simulator
	HI931001	pH / ORP electrode simulator with display
	HI8614N	pH transmitter
	HI8614LN	pH transmitter with display

pH solutions begin on page 2.142

HI8710

pH Analog Controller

with Self-Diagnostic Test

- Alarm
  - 0.2 to 3.00 pH alarm tolerance range
- ATC
  - Automatic temperature compensation
- Backlight
  - Backlit, LCD display

HI8710 is a panel mounted pH controller with self-diagnostic test capabilities. Users can set: the setpoint for acid or alkaline dosage, the tolerance of the setpoint before an alarm is activated, the dosage mode: automatic, continuous on or OFF and the over dosage control by setting the overtime dosage knob.

When used in conjunction with the HI8720 ORP controller, the ODCD* function will ensure that the ORP dosage will start only when the pH level is correct.

"Overtime dosage" function with selection knob and jumper for disable on the rear panel. If the dosing relay remains continuously activated for more than selected dosing time the alarm relay is activated, the alarm LED is blinking and the dosing relay is deactivated.

A removable, transparent splash-proof cover protects the front panel.

* ORP dosing consent device

Specifications	HI8710	
Range	0.00 to 14.00 pH	
Resolution	0.01 pH	
Accuracy (@25°C/77°F)	±0.02 pH (0 to 100 °C); ±0.05 pH (-20 to 0 °C); ±0.5% (input from transmitter)	
Input	high impedance 10^{12} Ohm; reference and matching pin inputs are available 4-20 mA	
Power Output	±5 Vcc; 150 mA max load for amplified electrodes	
Calibration	offset: ±2 pH with OFFSET trimmer; slope: 80 to 110% with SLOPE trimmer	
Temperature Compensation	fixed or automatic with Pt100, from -20 to 100°C (-4 to 212°F)	
Recorder Output	0-20 mA or 4-20 mA (isolated)	
Set Point Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Set Point Range	0.00 to 14.00 pH	
Alarm Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Alarm Range	0.2 to 3.00 pH	
Consent Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Dosing Control	OFF/AUTO/ON with selection switch	
Over Dosing Control	adjustable, from 5 min to 60 min with knob or disable by wire strap - on rear panel	
Backlight	continuous on	
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover	
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing	
Panel Cutout	141 x 69 mm (5.6 x 2.7")	
Weight	1 kg (2.2 lb.)	
Ordering Information	The **HI8710** is supplied complete with mounting brackets and instructions.	
Accessories	**HI8427**	pH / ORP electrode simulator
	HI931001	pH / ORP electrode simulator with display
	HI8614N	pH transmitter
	HI8614LN	pH transmitter with display

pH solutions begin on page 2.142

HI8711

pH Analog Controller

with Dual Output and Self-Diagnostic Test

- Alarm
  - 0.2 to 3.00 pH alarm tolerance range
- ATC
  - Automatic temperature compensation
- Backlight
  - Backlit, LCD display

HI8711 allows the selection of two set points with two independent outputs for acid and alkaline dosages.

Each model accepts either a direct input from a pH or ORP electrode or from a transmitter through 4-20 mA input. The instrument also provides ±5V power output and input terminals for amplified electrodes. In addition, you can choose the output configuration for connecting a recorder or a PLC, between 0-20 or 4-20 mA.

The HI8711 incorporates adjustable overtime dosing protection from 5 to 60 minutes. If dosing exceeds selected time, the alarm will be triggered and the dosing contact will deactivate. This feature can be activated or deactivated.

A removable, transparent splash-proof cover protects the front panel.

Specifications	HI8711	
Range	0.00 to 14.00 pH	
Resolution	0.01 pH	
Accuracy (@25°C/77°F)	±0.02 pH (0 to 100 °C); ±0.05 pH (-20 to 0 °C); ±0.5% (input from transmitter)	
Input	high impedance 10^{12} Ohm; reference and matching pin inputs are available; 4-20 mA	
Power Output	±5 Vcc; 150 mA max load for amplified electrodes	
Calibration	offset: ±2 pH with OFFSET trimmer; slope: 80 to 110% with SLOPE trimmer	
Temperature Compensation	fixed or automatic with Pt100, from -20 to 100°C (-4 to 212°F)	
Recorder Output	0-20 mA or 4-20 mA (isolated)	
Set Point Relay	2, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Set Point Range	alk. set: from 0.00 to 14.00 pH; acid set: from 0.00 to 14.00 pH	
Alarm Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Alarm Range	0.2 to 3.00 pH	
Dosing Control	OFF/AUTO/ON with selection switch	
Over Dosing Control	adjustable, from 5 min to 60 min with knob or disable by wire strap - on rear panel	
Backlight	continuous on	
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover	
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing	
Panel Cutout	141 x 69 mm (5.6 x 2.7")	
Weight	1 kg (2.2 lb.)	
Ordering Information	The **HI8711** is supplied complete with mounting brackets and instructions.	
Accessories	**HI8427**	pH / ORP electrode simulator
	HI931001	pH / ORP electrode simulator with display
	HI8614N	pH transmitter
	HI8614LN	pH transmitter with display

pH solutions begin on page 2.142

HI8720

ORP Analog Controller

with Self-Diagnostic Test

- Alarm
  - 10 to 300 mV alarm tolerance range
- Backlight
  - Backlit, LCD display

This instrument allows the selection of a set point for oxidizing or reducing dosage.

When used in conjunction with the HI8710 pH controller, the ODCD (ORP dosing consent device) function (featured by the HI8710) will ensure that the ORP dosage will start only when the pH level is correct.

These instruments have been designed for easy and fast installation and are provided with membrane keypads on the front panel, large display, and autodiagnostic functions.

Each model accepts either a direct input from an ORP electrode or from a transmitter through 4-20 mA input. The instrument also provides ±5V power output and input terminals for amplified electrodes.

Moreover, you can choose the output configuration for connecting a recorder or a PLC, between 0-20 or 4-20 mA.

A removable, transparent splash-proof cover protects the front panel.

Specifications	HI8720	
Range	±1999 mV	
Resolution	1 mV	
Accuracy (@25°C/77°F)	±5 mV; ±0.5% (input from transmitter)	
Input	high impedance 10^{12} Ohm; reference and matching pin inputs are available; 4-20 mA	
Power Output	±5 Vcc; 150 mA max load for amplified electrodes	
Calibration	offset: ±200 mV with CAL trimmer;	
Recorder Output	0-20 mA or 4-20 mA (isolated)	
Set Point Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Set Point Range	±1999 mV	
Alarm Relay	1, isolated, 2 A, max 240 V, resistive load, 1000000 strokes (not fuse protected)	
Alarm Range	10 to 300 mV	
Dosing Control	OFF/AUTO/ON with selection switch	
Over Dosing Control	adjustable, from 5 min to 60 min with knob or disable by wire strap - on rear panel	
Backlight	continuous on	
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover	
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing	
Panel Cutout	141 x 69 mm (5.6 x 2.7")	
Weight	1 kg (2.2 lb.)	
Ordering Information	The **HI8720** is supplied complete with mounting brackets and instructions.	
Accessories	**HI8427**	pH / ORP electrode simulator
	HI8615N	ORP transmitter
	HI8615LN	ORP transmitter with display

ORP solutions begin on page 2.154

HI8931AN · HI8931BN
HI8931CN · HI8931DN

EC Analog Controller

with Input from Probe or Transmitter

- ATC
  - Automatic temperature compensation
- Backlight
  - Backlit, LCD display

HI8931 is a panel mounted conductivity controller designed for simplicity of use. For in-line applications, use the HI7635 probe, while for tanks the HI7638 with external threads is recommended. These probes are provided with a built-in NTC sensor for temperature compensated conductivity measurements.

HI8931 also features a direct connection up to 20 m (67'), without needing to amplify the signal to the conductivity probe.

Using the HI8931 in conjunction with a 4-20 mA output transmitter (HI8936 or HI8936L series) will assure a strong, interference free signal at distances up to 300 meters (1000').

A removable, transparent splash-proof cover protects the front panel.

Specifications	HI8931AN	HI8931BN	HI8931CN	HI8931DN
Range	0.0 to 199.9 mS/cm	0.00 to 19.99 mS/cm	0 to 1999 µS/cm	0.0 to 199.9 µS/cm
Resolution	0.1 mS/cm	0.01 mS/cm	1 µS/cm	0.1 µS/cm
Accuracy (@25°C/77°F)	±2% F.S. (excluding probe error)	±2% F.S. (excluding probe error)	±2% F.S. (excluding probe error)	±2% F.S. (excluding probe error)
Input from Transmitter	HI8936A / AL	HI8936B / BL	HI8936C / CL	HI8936D / DL
Set Point Range	0.0 to 199.9 mS/cm	0.00 to 19.99 mS/cm	0 to 1999 µS/cm	0.0 to 199.9 µS/cm
Alarm Range	0.0 mS and 100.0 mS	0.00 mS and 10.00 mS	0 µS and 1000 µS	0.0 µS and 100.0 µS
Temp. Compensation	automatic, 0 to 60°C with β=2%/°C; see also transmitter HI8936			
Inputs	DIN (probe) or 4-20 mA (transmitter)			
Conductivity Probe	HI7635 for in-line applications or HI3001D for flow-thru (not included)			
Calibration	manual, two point, through offset and slope trimmers			
Recorder Output	0 to 20 mA or 4 to 20 mA (isolated)			
Set Point and Alarm Relay	1, Isolated, 2A, max. 240V, resistive load, 1,000,000 strokes			
Dosing Control	OFF/AUTO/ON with selection switch			
Over Dosing Control	adjustable, from 5 min to 60 min with knob or disable by wire strap - on rear panel			
Backlight	continuous on			
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz			
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover			
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing			
Panel Cutout	141 x 69 mm (5.6 x 2.7")			
Weight	1 kg (2.2 lbs.)			
Ordering Information	The **HI8931** series is supplied with mounting brackets and instructions.			

EC solutions begin on page 5.34

HI943500A · HI943500B
HI943500C · HI943500D

EC Analog Controller

with Direct Input from Potentiometric Probe

- ATC
  - Automatic temperature compensation
- Backlight
  - Backlit, LCD display

These controllers allow direct connection of a potentiometric conductivity probe (HI7638) with a cable up to 20 m long, without needing a transmitter to amplify the signal.

The output configuration for connecting a recorder or a PLC can be chosen between 0-20 or 4-20 mA.

The LED on the front panel indicates the operating status of the controller.

The Automatic Temperature Compensation (ATC) is performed directly by the HI7638 probe with built-in temperature sensor.

A removable, transparent splash-proof cover protects the front panel.

Specifications	HI943500A	HI943500B	HI943500C	HI943500D
Range	0.0 to 199.9 mS/cm	0.00 to 19.99 mS/cm	0 to 1999 µS/cm	0.0 to 199.9 µS/cm
Resolution	0.1 mS/cm	0.01 mS/cm	1 µS/cm	0.1 µS/cm
Accuracy (@25°C/77°F)	±2% F.S.			
Calibration	manual, two point, through offset and slope trimmers			
Temperature Compensation	automatic, 0 to 60°C (32 to 140°F), with β=2%/°C			
Recorder Output	4-20 mA (isolated)			
Set Point Relay	1, isolated, 2A, max. 240 V, resistive load, 1,000,000 strokes			
Alarm Relay	1, isolated, 2A, max. 240 V, resistive load, 1,000,000 strokes			
Power Supply	115 or 230 VAC ±10% (user selectable); 50/60 Hz			
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover			
Environment	-10 to 50°C (14 to 122°F); RH max 95%			
Panel Cutout	141 x 69 mm (5.6 x 2.7")			
Weight	1 kg (2.2 lb.)			
Ordering Information	The **HI943500** series is supplied complete with mounting brackets and instructions.			
Probes	**HI7638**	PEI/glass body, 75 mm conductivity probe with internal temperature sensor and 3/8" NPT thread (immersion)		
	HI3001	PEI/PVDF body, 20 mm conductivity probe with internal temperature sensor, 1/2" NPT front thread (flow-thru) and 3/4" NPT back thread (submersion/pipe) mounting and 3 m (9.9') cable		
	HI3002	PEI/PVDF body, 60 mm conductivity probe with internal temperature sensor, 1/2" NPT front thread (flow-thru) and 3/4" NPT back thread (submersion/pipe) mounting and 3 m (9.9') cable		

EC solutions begin on page 5.34

HI8410

Dissolved Oxygen Controller

with Extended Range and Analog Output

- Alarm
  - 0.5 to 5.0 mg/L (ppm) O_2 alarm range
- ATC
  - Automatic temperature compensation

The HI8410 is a panel mounted dissolved oxygen controller that is used to maintain and monitor the concentration of DO in a wide range of industrial process applications. The HI8410 uses a Galvanic probe that typically requires less maintenance than a Polarographic style making it ideal for long term monitoring.

The set point for controlling the activation of a relay is adjusted manually by the user. An alarm relay is also manually adjustable and is based upon a tolerance from the programmed setpoint. This controller features single set point calibration in zero oxygen solution.

The dosage mode: automatic, continuous ON or OFF and over dosage control by setting the overtime dosage trimmer. If the dosing relay remains continuously activated for more than the selected dosing time, the alarm relay is activated, the alarm LED will start blinking and the dosing relay will be deactivated. A jumper located on the controller's rear panel can disable the "over time dosage" function.

"Automatic/Off/manual" dosing selection switch and LED on the front panel. In Automatic mode all the relays are controlled based on the measurement set point and alarm values. In OFF mode, the dosing and alarm relays are always deactivated. In ON (Manual) mode, the dosing relay is always on. The alarm relay is still enabled. If an alarm occurs the dosing relay remains activated. If the over dose time exceeds the setting during manual mode, the alarm relay remains activated.

The D.O. probe is provided with a membrane covering the galvanic sensor and a built-in thermistor for temperature measurement and compensation.

Specifications	HI8410	
Range	0.0 to 50.0 mg/L (ppm) O_2; 0 to 600 % O_2; -5.0 to 50.0°C	
Resolution	0.1 mg/L (ppm) or 1% (O_2) / 0.1°C	
Accuracy (@25°C/77°F)	±1% of reading (O_2) / ±0.2°C	
Calibration	manual, one point, in saturated air	
Temp. Compensation	automatic, from -5 to 50°C (23 to 122 °F)	
Salinity Compensation	0 to 51 g/L (resolution 1 g/L)	
Probe (not included)	HI76410/4 with 4 m (13.1') cable or HI76410/10 with 10 m (32.8') cable	
Recorder Output	0 to 20 mA or 4 to 20 mA (isolated)	
Set point and Alarm Relay	1, isolated, 2A, max. 240V, resistive load, 1,000,000 strokes	
Set point Range	5 to 600 % O_2; 0.5 to 50.0 mg/L (ppm) O_2	
Alarm Range	0.5 to 5.0 mg/L (ppm) O_2	
Hysteresis Range	0.5 to 2.4 mg/L (ppm) O_2	
Dosing Control	OFF/AUTO/ON with selection switch	
Over Dosing Control	adjustable, from 5 min to 60 min with knob or disable by wire strap - on rear panel	
Backlight	continuous on	
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz	
Enclosure	flame retardant ABS body and front panel; transparent splash-proof front cover	
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-conndensing	
Panel Cutout	141 x 69 mm (5.6 x 2.7")	
Weight	1 kg (2.2 lb.)	
Ordering Information	The **HI8410** is supplied complete with mounting brackets and instructions.	
Probes	**HI76410/4**	Galvanic DO probe (fixed) with internal temperature sensor, DIN connector and 4 m (13.1') cable
	HI76410/10	Galvanic DO probe (fixed) with internal temperature sensor, DINconnector and 10 m (32.8') cable

See page 6.26 for DO solutions

Any system can be cost effectively monitored 24/7

BL mini controllers are the perfect solution for water analysis and control

pH Mini Controllers

Monitoring and controlling pH in water conditioning and industrial applications is essential for water quality and maintaining infrastructure (piping and equipment). In the case of industrial effluent, neutralization of acidic waste is vital for environmental safety and public health. In boiler feed water conditioning, a pH of 8.5 is necessary to prevent scaling and corrosion of critical components. Maintaining a pH of 7.4 is fundamental for proper and efficient sanitization in swimming pools and spas. The efficacy of sanitizers, such as chlorine, is dependent on a controlled pH value.

ORP Mini Controllers

ORP (oxidation reduction potential) is the most dependable and consistent indicator of the sanitizing effectiveness of your pool, spa, or water treatment. As oxidizers, chlorine, peroxide, and ozone are added, the ORP value increases, providing a clear indication of the cleansing power of the water. Typically, an ORP value of 650 to 700 mV at a pH of 7.2 indicates that your water is properly treated and all harmful bacteria are killed in less than 1 second. ORP is also essential in chemical processing where reducing agents are used and a negative ORP value indicates proper neutralization.

Conductivity Mini Controllers

In water, an increase in conductivity indicates an increase in water hardness and a decrease in purity. Conductivity monitoring and control is essential in reducing water hardness and maintaining water quality. Water with a conductivity value of 0 to 140 µS/cm is considered "very soft," while 640 to 840 µS/cm is considered "hard" water. An increase in conductivity indicates an increase in the amount of damaging dissolved solids (salts) present in water. Conductivity monitoring and control is essential in industrial applications such as feed water control, blow down activation in cooling towers and water management. In these applications, high conductivity will cause scaling and corrosion of piping and damage to critical components.

TDS Mini Controllers

A TDS (total dissolved solids) measurement is an important indicator of water quality. An increase in TDS indicates an increase in the amount of dissolved solids (salts) present in the water. TDS monitoring and control is imperative in industrial applications such as feed water control, blow down activation in cooling towers and water management. In these applications, high TDS will cause scaling and corrosion of piping and damage to critical components.

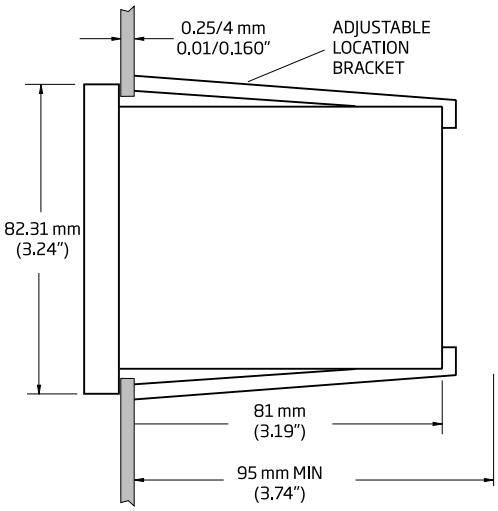
A TDS measurement is also an important indicator of the effectiveness of water conditioning, an increase in TDS indicates an increase in water hardness and a decrease in purity. This will affect the quality of drinking water, feed water and rinse water. TDS monitoring and control is crucial in reducing water hardness and maintaining water quality and usability.

Resistivity Mini Controller

Resistivity, measured in Ω•M, is the optimal way to measure the quality of water produced by high purity systems, such as reverse osmosis (RO) systems and water conditioning equipment. As resistivity is the inverse of conductivity, it provides a more accurate characterization of water with very low conductive ability. As filter systems become less effective, the resistivity value will decrease, indicating a need for maintenance and/or replacement of filters and critical components. Properly functioning RO and water conditioning systems will consistently produce water with resistivity readings in the range of 16 to 18 MΩ•cm.

Hanna Mini Controllers

BL Series Mechanical Dimensions

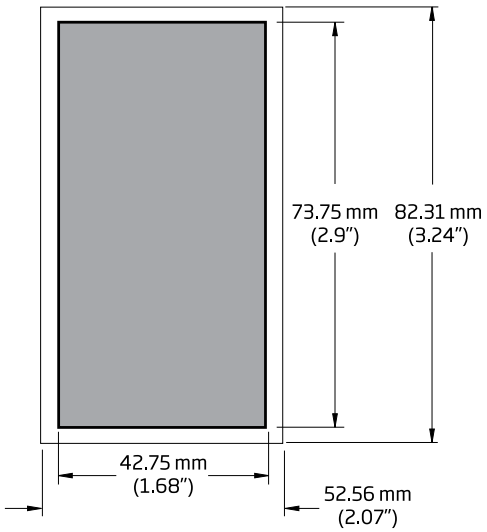


Side View

Side view of panel-mounted controllers.

Adjustable location brackets allow the controller to slide into the cutout and will hold the unit securely in place.

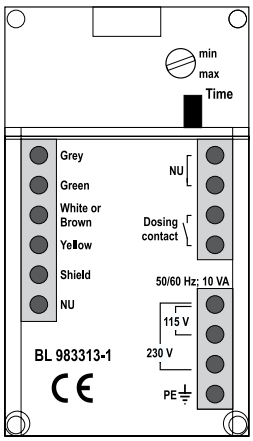
130 or 87 mm (depending on model) is the minimum amount of room required to install the meter with all wiring.



Front View

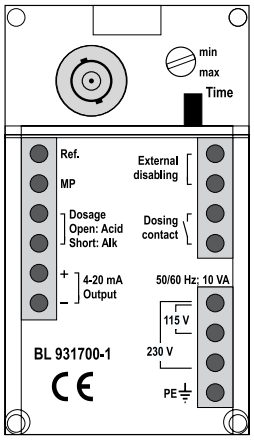
Front view of the panel-mounted units.

Dimensions show the cutout size for installation and also the outside dimensions of the panel.



Rear View

Rear view of the BL983313-1 with electrical connections.



Rear View

Rear view of the BL931700-1 with electrical connections.

BL981411

pH Mini Controller

- Easy to handle
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL981411 pH controller has been designed for easy, affordable installation in tight spaces, ideal for simple and effective process control. The unit is provided with high impedance pH input and can be used with any pH electrode with a standard BNC connector. Measurements are clearly displayed on the LCD, while the status LED indicates operating mode.

The BL981411 is also provided with a dosing relay. Selecting acid dosing will cause the relay to activate when the pH reading is higher than the setpoint. If the basic dosing is selected, the relay is activated when the pH reading falls below the setpoint.

Setpoint adjustment (from 0 to 14 pH) and calibration procedures are easily performed with trimmers on the front panel. Users can choose from automatic or manual dosing modes with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need. An overtime control system advises users when the relay is active too long, to help prevent overdosing.

Specifications	BL981411
Range	0.0 to 14.0 pH
Resolution	0.1 pH
Accuracy (@25°C/77°F)	±0.2 pH
Calibration	manual, through CAL (offset) trimmer
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC
Dosing Selection	acid or alkaline contact open=acid dosage=relay ON if measurement > setpoint contact closed=alkaline dosage=relay ON if measurement < setpoint
Setpoint	adjustable from 0 to 14 pH
Overtime	adjustable, typically from 5 to approximately 30 minutes
Input Impedance	10^{12} Ohm
Power Supply	BL981411-0: 12 VDC adapter (included); BL981411-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL981411-0: 200 g (7.1 oz.); BL981411-1: 300 g (10.6 oz.)
Ordering Information	**BL981411-0** (12 VDC) and **BL981411-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI1001** PVDF body pH electrode with 1/2" NPT thread, BNC connector and 3 m (9.8') cable for continuous flow-thru monitoring (not included).

pH solutions begin on page 2.142

BL931700

pH Mini Controller

with 4-20 mA Recorder Output

- Easy-to-handle
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL931700 mini pH controller has been designed for easy, affordable installation in tight spaces to perform simple, yet effective process control. Thanks to its compact size, BL931700 can be installed right next to tanks or vats.

This versatile controller is ideal for a wide variety of applications, such as textiles, papers, photographic solutions, plating baths, chemicals and water treatment.

The BL931700 is provided with a selectable setpoint for acid or basic dosage.

Accuracy is ensured by two-point calibration, performed manually through trimmers on the front panel.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need. The overtime control system advises users when the relay is active for too long, helping to prevent overdosing.

In addition, this model features a 4-20 mA analog output for recorder connection.

Specifications	BL931700
Range	0.00 to 14.00 pH
Resolution	0.01 pH
Accuracy (@25°C/77°F)	±0.02 pH
Calibration	manual, through offset and slope trimmers
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC
Dosing Selection	acid or alkaline contact open=acid dosage=relay ON if measurement > setpoint contact closed=alkaline dosage=relay ON if measurement < setpoint
Setpoint	adjustable from 0 to 14 pH
Overtime	adjustable, typically from 5 to approximately 30 minutes
Recorder Output	4 to 20 mA, accuracy ±0.20 mA, 500 Ω maximum load
Input Impedance	10^{12} Ohm
Power Supply	BL931700-0: 12 VDC adapter (included); BL931700-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL931700-0: 200 g (7.1 oz.); BL931700-1: 300 g (10.6 oz.)
Ordering Information	**BL931700-0** (12 VDC) and **BL931700-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI1001** PVDF body pH electrode with 1/2" NPT thread, BNC connector and 3 m (9.8') cable for continuous flow-thru monitoring (not included).

pH solutions begin on page 2.142

BL982411

ORP Mini Controller

- Easy to handle
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL982411 is an ORP mini controller for panel mounting, specially designed for swimming pools and spas. Thanks to its compact size, the BL982411 can be installed in small spaces. This controller is the ideal solution for those who have always checked ORP manually. With its automatic dosing, this mini controller will significantly reduce maintenance time.

The BL982411 can be used with any ORP electrode with a standard BNC connector. The status LED continuously indicates if the controller is in measurement, dosing or alarm mode.

The BL982411 is also provided with a relay for selecting the dosing direction, oxidizing or reducing.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need. The overtime control system advises users when the relay is active for too long, helping to prevent overdosage.

Specifications	BL982411
Range	0 to 1000 mV
Resolution	1 mV
Accuracy (@25°C/77°F)	±5 mV
Calibration	manual, with CAL trimmer
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC
Dosing Selection	reducing or oxidizing, selectable on the back panel contact open=reductant dosage=relay ON if measure > setpoint contact closed=oxidant dosage=relay ON if measure < setpoint
Setpoint	adjustable, from 0 to 1000 mV
Overtime	adjustable, typically from 5 to approximately 30 minutes
Input Impedance	10^{12} Ohm
Power Supply	BL982411-0: 12 VDC adapter (included); BL982411-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL982411-0: 200 g (7.1 oz.); BL982411-1: 300 g (10.6 oz.)
Ordering Information	**BL982411-0** (12 VDC) and **BL982411-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI2001** PVDF body ORPelectrode with 1/2" NPT thread, BNC connector and 3 m (9.8') cable for continuous flow-thru monitoring (not included).

ORP solutions begin on page 2.154

BL932700

ORP Mini Controller

with 4-20 mA Recorder Output

- Easy to handle
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL932700 is an ORP mini controller that has been designed for easy, affordable installation in tight spaces, ideal for simple yet effective process control. As a result of its compact size, the BL932700 can be installed right next to tanks or vats.

This versatile controller is ideal for many applications, such as ORP monitoring of bleaching processes, wastewater treatment and swimming pools. the BL932700 permits automatic control of installations that were previously checked manually.

The instrument can be set for reducing or oxidizing dosage. Setpoint adjustment and calibration are simply performed through trimmers on the front panel. Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need.

The overtime control system advises users when the relay is active too long, helping to prevent overdosage. In addition, this model features a 4-20 mA analog output for recorder connection.

Specifications	BL932700
Range	±1000 mV
Resolution	1 mV
Accuracy (@25°C/77°F)	±5 mV
Calibration	manual, with CAL trimmer
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC
Dosing Selection	reducing or oxidizing, selectable on the back panel contact open=reductant dosage=relay ON if measure > setpoint contact closed=oxidant dosage=relay ON if measure < setpoint
Setpoint	adjustable from -1000 to 1000 mV
Overtime	adjustable, typically from 5 to approximately 30 minutes
Recorder Output	4 to 20 mA, accuracy ±0.20 mA, 500 Ω maximum load
Input Impedance	10^{12} Ohm
Power Supply	BL932700-0: 12 VDC adapter (included); BL932700-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL932700-0: 200 g (7.1 oz.) BL932700-1: 300 g (10.6 oz.)
Ordering Information	**BL932700-0** (12 VDC) and **BL932700-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI2001** PVDF body ORPelectrode with 1/2" NPT thread, BNC connector and 3 m (9.8') cable for continuous flow-thru monitoring (not included).

ORP solutions begin on page 2.154

BL983313 • BL983320 • BL983322

EC Mini Controllers

Measuring in µS/cm

- Adjustable setpoint
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

These Hanna mini controllers have been specially designed for water conditioning and growing applications. Compact in size, they can be mounted in confined spaces or even right next to the vat or barrel containing the chemicals. These meters permit automatic control of installations previously checked manually.

EC measurements are shown on the display and the multi-colored LED continuously indicates if the mini controller is in measurement, dosing, or alarm mode.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need. The overtime control system advices users when the relay is active for too long, helping to prevent overdosage.

Specifications	BL983313	BL983320	BL983322
Range	0 to 1999 µS/cm	0.0 to 199.9 µS/cm	0.00 to 19.99 µS/cm
Resolution	1 µS/cm	0.1 µS/cm	0.01 µS/cm
Accuracy (@25°C/77°F)	±2% F.S.	±2% F.S.	±2% F.S.
Setpoint	adjustable from 0 to 1999 µS/cm	adjustable from 0 to 199.9 µS/cm	adjustable from 0 to 19.99 µS/cm
Temperature Compensation	automatic from 5 to 50°C (41 to 122°F) with β =2%/°C		
Calibration	manual, with CAL trimmer		
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC contact closed when measure > setpoint		
Overtime	adjustable, typically from 5 to approximately 30 minutes		
Power Supply	models "-0": 12 VDC adapter (included) models "-1": 115/230 VAC; 50/60Hz		
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")		
Weight	models "-0": 200 g (7.1 oz.) models "-1": 300 g (10.6 oz.)		
Ordering Information	**BL983313-0** (12 VDC), **BL983313-1** (115/230V), **BL983320-0** (12 VDC), **BL983320-1** (115/230V), **BL983322-0** (12 VDC) and **BL983322-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.		
Recommended Probe	**HI7634-00** EC/TDS probe with internal temperature sensor and 2 m (6.6') cable (not included).		

EC solutions begin on page 5.34

BL983317 • BL983327

EC Mini Controllers

Measuring in mS/cm

- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL983317 and BL983327 are panel-mounted mini controllers with output relays that have been designed for easy, affordable installation in tight spaces, ideal for simple yet effective process control.

Both instruments are provided with automatic compensation for variations in temperature. The probe (not included) is easy to clean and requires very little maintenance. The calibration is performed manually at one point, through a trimmer.

All wiring and connections to external devices are done through the terminals on the rear panel. The multi-color LED continuously indicates if the controller is in measurement, dosing, or alarm mode.

Users can choose automatic or manual dosing mode by a switch on the front panel. Manual control is particularly useful during maintenance operations because it permits operators to enable or disable the dosing relay according to need. To help prevent overdosing, the overtime control system advises users when the relay is active too long.

Specifications	BL983317	BL983327
Range	0.00 to 10.00 mS/cm	
Resolution	0.01 mS/cm	
Accuracy (@25°C/77°F)	±2% F.S.	
Temperature Compensation	automatic from 5 to 50°C (41 to 122°F) with β =2%/°C	
Calibration	manual, with CAL trimmer	
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC	
	contact closed when measure < setpoint	contact closed when measure > setpoint
Setpoint	adjustable from 0 to 10 mS/cm	
Overtime	adjustable, typically from 5 to approximately 30 minutes	
Power Supply	models "-0": 12 VDC adapter (included) models "-1": 115/230 VAC; 50/60Hz	
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")	
Weight	models "-0": 200 g (7.1 oz.) models "-1": 300 g (10.6 oz.)	
Ordering Information	**BL983317-0** (12 VDC), **BL983317-1** (115/230V), **BL983327-0** (12 VDC) and **BL983327-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.	
Recommended Probe	**HI7632-00** EC/TDS probe with internal temperature sensor and 2 m (6.6') cable (not included).	

EC solutions begin on page 5.34

BL983315 • BL983319
BL983321 • BL983329

TDS Mini Controllers

- Adjustable overtime control
- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

These instruments have been designed for TDS control in hydroponics, horticulture and water conditioning. Compact in size, they can be mounted in confined spaces or even right next to the vat or barrel containing the chemicals. These meters permit automatic control of installations that were previously checked manually.

Readings are shown on the display and the multi-colored LED continuously indicates if the mini controller is in measurement, dosing, or alarm mode.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to your need.

The overtime control system advises users when the relay is active too long, helping to prevent overdosage.

Specifications	BL983315	BL983319	BL983321	BL983329
Range	0.0 to 199.9 mg/L (ppm)	0 to 1999 mg/L (ppm)	0.00 to 19.99 mg/L (ppm)	0 to 999 mg/L (ppm)
Resolution	0.1 mg/L (ppm)	1 mg/L (ppm)	0.01 mg/L (ppm)	1 mg/L (ppm)
Accuracy (@25°C/77°F)	±2% F.S.	±2% F.S.	±2% F.S.	±2% F.S.
TDS Conversion Factor	0.5	0.65	0.5	0.5
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC Contact close when measure:			
	> setpoint	< setpoint	> setpoint	> setpoint
Setpoint	adjustable from 0 to 199.9 mg/L (ppm)	adjustable from 0 to 1999 mg/L (ppm)	adjustable from 0 to 19.99 mg/L (ppm)	adjustable from 0 to 999 mg/L (ppm)
Temperature Compensation	automatic from 5 to 50°C (41 to 122°F) with β =2%/°C			
Calibration	manual, with CAL trimmer			
Overtime	adjustable, typically from 5 to approximately 30 minutes			
Power Supply	models "-0": 12 VDC adapter (included) models "-1": 115/230 VAC; 50/60Hz			
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")			
Weight	models "-0": 200 g (7.1 oz.) models "-1": 300 g (10.6 oz.)			
Ordering Information	**BL983315-0** (12 VDC), **BL983315-1** (115/230V), **BL983319-0** (12 VDC), **BL983319-1** (115/230V), **BL983321-0** (12 VDC), **BL983321-1** (115/230V), **BL983329-0** (12 VDC) and **BL983329-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.			
Recommended Probe	**HI7634-00** EC/TDS probe with internal temperature sensor and 2 m (6.6') cable (not included).			

TDS solutions begin on page 5.37

BL983318

TDS Mini Controllers

0 to 10,000 ppm

- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL983318 is a mini controller that has been designed for easy, affordable installation in tight spaces, ideal for simple yet effective process control.

The BL983318 features automatic temperature compenstion and simple one-point calibration performed through the trimmer.

The multi-colored LED continuously indicates if the controller is in measurement, dosing, or alarm mode.

Wiring and external device connections are extremely simple to perform through the terminals on the rear of the instrument.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations because it permits operators to enable or disable the dosing relay according to need.

The overtime control system advises users when the relay is active too long, helping to prevent overdosage.

Specifications	BL983318
Range	0.00 to 10.00 g/L (ppt)
Resolution	0.01 g/L (ppt)
Accuracy (@25°C/77°F)	±2% F.S.
TDS Conversion Factor	0.5
Temperature Compensation	automatic from 5 to 50°C (41 to 122°F) with β=2%/°C
Calibration	manual, with CAL trimmer
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC contact closed when measure > setpoint
Setpoint	adjustable from 0 to 10 ppt (g/L)
Overtime	adjustable, typically from 5 to approximately 30 minutes
Power Supply	BL983318-0: 12 VDC adapter (included) BL983318-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL983318-0: 200 g (7.1 oz.) BL983318-1: 300 g (10.6 oz.)
Ordering Information	**BL983318-0** (12 VDC) and **BL983318-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI7632-00** EC/TDS probe with internal temperature sensor and 2 m (6.6') cable (not included).

TDS solutions begin on page 5.37

BL983324

TDS Mini Controllers

- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL983324 is a panel-mounted TDS controller, designed for easy installation, configuration and maintenance.

The meter is provided with a dosing relay that is activated when the TDS reading exceeds the setpoint value.

Measurements are compensated for temperature variations and are shown on the display automatically.

A multi-colored LED on the front panel continuously indicates if the mini controller is in measurement, dosing, or alarm mode.

Wiring and external device connections are extremely simple to perform through the terminals on the rear of the instrument.

Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need.

The overtime control system advises operators when the relay is active too long, helping to prevent overdosage.

Specifications	BL983324
Range	0.0 to 49.9 mg/L (ppm)
Resolution	0.1 mg/L (ppm)
Accuracy (@25°C/77°F)	±2% F.S.
TDS Conversion Factor	0.5
Temperature Compensation	automatic from 5 to 50°C (41 to 122°F) with β=2%/°C
Calibration	manual, with CAL trimmer
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 VDC contact closed when measure > setpoint
Setpoint	adjustable from 0 to 49.9 mg/L (ppm)
Overtime	adjustable, typically from 5 to approximately 30 minutes
Power Supply	BL983324-0: 12 VDC adapter (included) BL983324-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL983324-0: 200 g (7.1 oz.) BL983324-1: 300 g (10.6 oz.)
Ordering Information	**BL983324-0** (12 VDC) and **BL983324-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI7634-00** EC/TDS probe with internal temperature sensor and 2 m (6.6') cable (not included).

TDS solutions begin on page 5.37

BL983314

Resistivity Mini Controllers

- Fire-retardant casing
- Selectable overdose protection system
- Splash-resistant cover

The BL983314 is a simple to operate resistivity controller designed for ultra pure water, reverse osmosis, and water conditioning applications. The BL983314 resistivity controller is also ideal for continuous monitoring of process solutions. Setpoint and calibration are manually adjusted with a trimmer and the alarm relay allows for simple control.

Readings are automatically temperature compensated, with three different coefficients (β=2.4, 3.5 or 4.5 %/°C). The alarm contact can be used for connection to an alarm, pump, solenoid or dosing system.

The relay contact is open when readings are higher than the setpoint, while for measurements lower than setpoint, the relay contact is closed. The hysteresis is typically 0.20 MΩ•cm from the setpoint.

Measurements are displayed on the LCD and the multi-colored LED continuously indicates if the controller is in measurement, dosing, or alarm mode. Users can choose automatic or manual dosing mode with a switch on the front panel. Manual control is particularly useful during maintenance operations, because it permits operators to enable or disable the dosing relay according to need.

The overtime control system advises users when the relay is active for too long, helping to prevent overdosage.

Specifications	BL983314
Range	0.00 to 19.90 MΩ•cm
Resolution	0.10 MΩ•cm
Accuracy (@25°C/77°F)	±2% F.S.
Temperature Compensation	automatic and linear from 5 to 50°C (41 to 122°F)
Temperature Coefficient	β=2.4 ; 3.5 ; 4.5 %/°C selectable through jumper on the rear panel
Calibration	factory calibrated
Dosing Relay	maximum 2A (fuse protected), 250 Vac, 30 Vdc contact closed when measure < setpoint
Setpoint	adjustable from 0 to 19.90 MΩ•cm
Overtime	adjustable, typically from 5 to approximately 30 minutes
Power Supply	BL983314-0: 12 VDC adapter (included) BL983314-1: 115/230 VAC; 50/60Hz
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")
Weight	BL983314-0: 200 g (7.1 oz.) BL983314-1: 300 g (10.6 oz.)
Ordering Information	**BL983314-0** (12 VDC) and **BL983314-1** (115/230V) are supplied with mounting brackets, transparent cover and instruction manual.
Recommended Probe	**HI3314** resistivity probe with 2 m (6.6') cable (included)

HI7871 • HI7873

Mini Level Controllers

The HI7871 and HI7873 mini level controllers are ideal for liquid level control over distances of up to 100 m (330'). These instruments are highly compact and will fit in tight spaces.

These easy-to-use controllers are suited for nearly any liquid level application, such as industrial and municipal water treatment, nutrient tank control in farming, hydroponics, aquaculture and plating rinse baths.

The HI7871 features high and low level control, while the HI7873 includes an overflow alarm. Both instruments are connected to a two-wire transmitter (HI7874), which is ideal for level monitoring in remote applications.

A complete liquid level measuring system requires:

1) A controller (HI7871 or HI7873)
2) A bar holder with amplifier circuitry (HI7874)
3) A package of measuring bars (HI731324)
4) An undecal connector (HI7164)

HI7874
Level Transmitter with
HI 731324 Stainless Steel
Measuring Bars

Specifications	HI7871	HI7873
Transmission	max 100 m (330')	
Electrical Connection	HI7164 undecal connector (not included)	
Level Adjustment	high and low	high, low and overflow
Level Indication	high and low	high, low and overflow
Sensor Bars	three*	four **
Transmitter	HI7874 (not included)	HI7874 (not included)
Output Contact	one relay (2A/250 VAC, 30 VDC)	two relays (2A/250V, 30 VDC)
Power Supply	models "/115": 110/115 VAC; 50/60Hz models "/220": 220/240 VAC; 50/60Hz	
Environment	0 to 50°C (32 to 122°F); RH max 85% non condensing	
Dimensions	83 x 53 x 99 mm (3.3 x 2.1 x 3.9")	
Weight	250 g (8.8 oz)	
Ordering Information	**HI7871/115** (115V) is supplied with mounting brackets and instructions. **HI7871/220** (220V) is supplied with mounting brackets and instructions. **HI7873/115** (115V) is supplied with mounting brackets and instructions. **HI7873/220** (220V) is supplied with mounting brackets and instructions. **HI731324** measuring bar set for level controller	

*HI7871 requires 3 bars, one each for low and high levels and the third as a consent sensor.
**HI7873 requires 4 bars with the additional bar used for overflow measurement.

HI7874

Level Transmitter

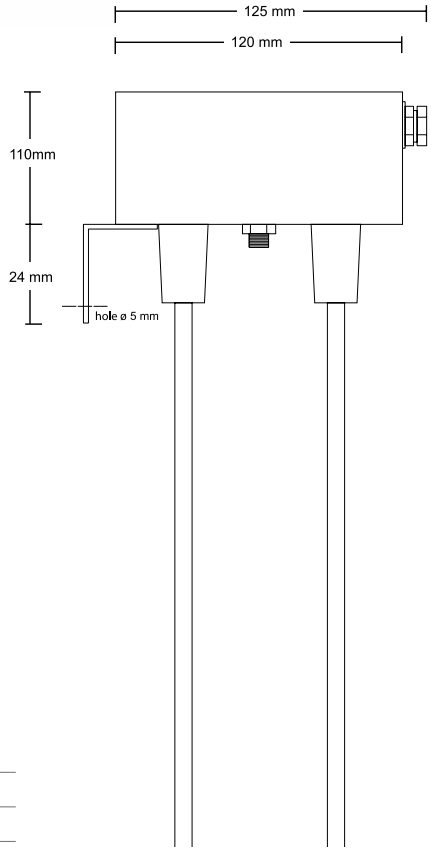
Accurate level control is critical to many industrial applications, especially for process adjustments using aggressive chemicals. Our sensor bars are built with stainless steel for long life, even in harsh conditions. These transmitters are easy to install and ideal for monitoring tanks and water conditioning plants.

The HI7874 transmitter was designed in conjunction with the HI7871 and HI7873 level controllers. The transmitter is housed in a durable and waterproof ABS body and allows the user to easily adjust the length of the sensor bars according to the specific need.

The HI7874 is supplied with a sturdy mounting bracket for quick and easy installation.

HI7874

Level Transmitter with HI731324
Stainless Steel Measuring Bars



Specifications	HI7874
Transmission	max 100 m (330')
Electrical Connection	two-wire terminal
Level Adjustment	high, low and overflow
Sensor Bars	three or four (not included)
Power Supply	from level controller
Environment	0 to 50°C (32 to 122°F); RH max 100%
Weight	550 g (1.2 lbs.)
Ordering Information	**HI7874** is supplied with mounting bracket and instructions. **HI731324** measuring bar set for level controller

MEADOS pH and ORP Measuring and Dosing System

Black Stone by Hanna

Two Advanced Instruments in One

MEADOS pumps combine the powerful Blackstone dosing pumps with Hanna pH/ORP controllers. This latest innovation eliminates the need for multiple units by combining a pH controller and chemical feed pump into one. No more complicated installations, wiring and compatibility problems. This compact unit features accurate regulation, proportional dosing, alarm and recorder signals and much more, all in one meter.

Easy Installation

Designed with mounting holes built into a rugged base, Blackstone pump/controllers are simple to install. They use a standard pH probe with a BNC connector to eliminate the need for any additional hardware. All of the controls and pump assemblies are conveniently located on the front of the unit. There is no need to uninstall the unit to access the pump head or control panel.

Rugged Construction

Blackstone pump/controllers are housed in rugged, fiber-reinforced polypropylene IP55 rated casings to prevent the ingress of liquids. The material used for the housing resists corrosion caused by most chemicals, protecting the unit from hazardous spills and splashes.

Superior Materials

Blackstone pumps use PVDF, FPM/FKM and PTFE materials for all components in contact with the chemicals being dosed. These materials have properties which enable them to resist even the most corrosive chemicals in the industry. The chemical resistance chart on page 17.54 shows how well PVDF, FPM/FKM and PTFE resist the harmful effects of different products.

Simple Pump Action

A positive displacement solenoid with few moving parts makes Blackstone pumps more reliable than motor driven pumps since there is no rotating parts, gears or cams; drastically reducing any chance of mechanical failure.

Proportional Dosing

The Blackstone controller/pump strokes at full capacity when the measured value deviates by more than 1.5 pH or 150 mV from the set value. A proportional control slows down the stroke rate as the measured value approaches the user selectable set points, avoiding overdosage of chemicals. This feature makes the pump's dosing more accurate, saves chemicals and eliminates unnecessary and costly corrections to your process, especially with slow reacting chemicals.

Isolated Recorder Output

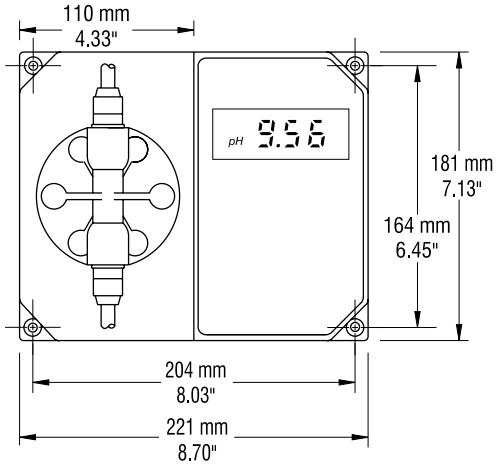
To enhance troubleshooting and the ability to record data while monitoring, Blackstone controller/pumps provide a recorder output. By simply attaching a recording device to the instrument's 4 to 20 mA output contacts, conveniently located on the front panel, you can obtain a hard copy of the results on demand.

Alarm Output

When monitoring and controlling pH and ORP levels in a process, it is very important that any potential problem does not go unattended. The Hanna MEADOS units incorporate an alarm system that will alert the user if the reaction is not within certain guidelines. The alarm of the BL7916 will be activated if the measured pH value is 2 pH units lower than the set point (if dosing acid, this indicates overdosage, a common symptom of siphoning). The alarm will also activate if the value is 2 pH higher than the set point (if dosing acid, this is an indication of insufficient dosage, a common symptom of the lack of chemicals). The BL7917's alarm will activate if the mV value is 200 mV lower than the set point (if dosing reducing chemicals, this indicates overdosage). The alarm will also activate if the value is 200 mV higher than the set point (if dosing reducing chemicals, this is an indication of lack of chemicals).

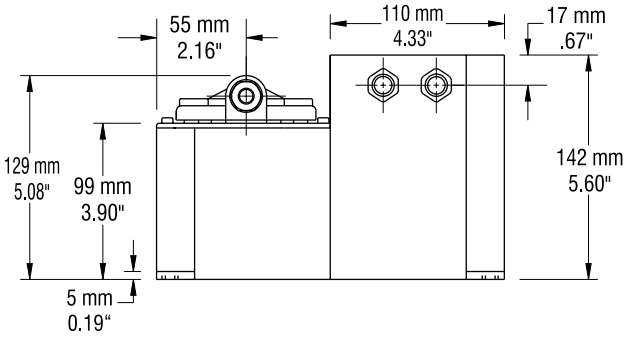
Auxiliary Dosing Contacts

The auxiliary dosing contacts of the MEADOS units are closed whenever the pump is dosing. This solution offers considerable advantages, especially for small plants, where these pumps need to be the only equipment left running. This will spare other equipment such as mixers, priming pumps etc. With this feature activated, a mixer can be automatically started, when the pump is dosing.



Front View

This series of instruments will mount easily in your plant using a minimum of wall space. The controls and pump head are located in the front to allow easy access.



Bottom View

The controller/pump series of instruments are enclosed in a modular housing for maximum protection. These illustrations show the layout of the controller/pumps and how they utilize the one-piece polypropylene, injection-molded housing for rigidity.

Black Stone
by Hanna

BL7916

pH Controller and Pump

- pH controller and dosing pump
- ±0.01 pH accuracy
- Isolated 4 to 20 mA recorder output.
- Proportional dosing
  - Slows the pump down when the measured pH level approaches the set value, which ensures precise dosage and avoids costly waste of chemicals due to overdosage.
- Alarm contact
  - Activated whenever the pH value varies more than 2 pH units from the set point.
- Auxiliary contacts
  - Allow the user to attach a mixer or priming pump that is activated only when the pump is dosing.
- PVDF, FPM/FKM and PTFE materials
  - Used for all parts that come into contact with liquid.

Specifications	BL7916
Range	0.00 to 14.00 pH
Resolution	0.01 pH
Accuracy (@25°C/77°F)	±0.01 pH
Flow Rate	see table
Input Impedance	10^{12} Ohm
Dosage	proportional, acid or base, user selectable
Dosing Contact	1 isolated, 2A, max. 240V, resistive load, 1,000,000 strokes
Alarm Contact	1 isolated, 2A, max. 240V, resistive load, 1,000,000 strokes
Calibration	offset: ±1 pH with trimmer; slope: 85 to 115% with trimmer
Recorder Output	4-20 mA (isolated)
Power Supply	BL 7916-1: 115V ±15%; 50/60Hz (40W); BL 7916-2: 230V ±15%; 50/60Hz (40W)
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	221 x 142 x 181 mm (8.7 x 5.6 x 7.1")
Weight	5 kg (11 lb.)
Ordering Information	**BL7916-1** is supplied with discharge and suction valves, polyethylene tubing, 115V power cable and instructions **BL7916-2** is supplied with discharge and suction valves, polyethylene tubing, 230V power cable and instructions

BL7916 PRESSURE/FLOW

BAR (PSI)	LPH (GPH)
0.5 (7.4)	13.3 (3.46)
1.0 (14.7)	11.7 (3.04)
2.0 (29.4)	10.1 (2.63)
3.0 (44.1)	9.0 (2.33)
4.0 (58.8)	7.8 (2.03)

pH solutions begin on page 2.142

BL7917

ORP Controller and Pump

- ORP controller and dosing pumps
- ±5 mV accuracy
- Isolated 4 to 20 mA recorder output.
- Proportional dosing
  - Slows the pump down when the measured ORP level approaches the set value, to avoid over dosage of oxidizing or reducing agents.
- Alarm contact
  - Is activated whenever the ORP reading varies more than 200 mV from the setpoint.
- Auxiliary contacts
  - Allow users to attach a mixer or priming pump that is activated only when the pump is dosing
- PVDF, FPM/FKM and PTFE materials
  - are used for all parts that come into contact with liquid.

Black Stone by Hanna

Specifications	BL7917
Range	-999 mV to +999 mV
Resolution	1 mV
Accuracy (@20°C/68°F)	±5 mV
Flow Rate	see table
Input Impedance	10^{12} Ohm
Dosage	proportional, oxidizing or reducing, user selectable
Dosing Contact	1 isolated, 2A, max. 240V, resistive load, 1,000,000 strokes
Alarm Contact	1 isolated, 2A, max. 240V, resistive load, 1,000,000 strokes
Recorder Output	4-20 mA (isolated)
Power Supply	BL 7917-1: 115V ±15%; 50/60Hz (40W) BL 7917-2: 230V ±15%; 50/60Hz (40W)
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	221 x 142 x 181 mm (8.7 x 5.6 x 7.1")
Weight	5 kg (11 lb.)
Ordering Information	**BL7917-1** is supplied with discharge and suction valves, polyethylene tubing, 115V power cable and instructions. **BL7917-2** is supplied with discharge and suction valves, polyethylene tubing, 230V power cable and instructions.

BL7917 PRESSURE/FLOW

BAR (PSI)	LPH (GPH)
0.5 (7.4)	13.3 (3.46)
1.0 (14.7)	11.7 (3.04)
2.0 (29.4)	10.1 (2.63)
3.0 (44.1)	9.0 (2.33)
4.0 (58.8)	7.8 (2.03)

ORP solutions begin on page 2.154

Reliable, High Performance Wall Mounted Controllers

Hanna wall mounted pH, ORP, and conductivity controllers are specifically designed to meet your process control requirements. The controllers come equipped with power relays operating at a maximum of 2A (240V). Electrodes can be installed quickly and easily. Simply plug the universal BNC or DIN connector over the socket and twist it into a secured position. This feature greatly improves the reliability of your instrumentation by assuring a positive connection. Accurate measurements are displayed on a large LCD, enabling the operator to check the controller readings easily.

Alarm Feature

The Hanna wall mounted series of controllers incorporate a triple contact alarm system that allows the user to select whether the alarm contacts will be in a normally open or normally closed position. When the measured value of the meter is out of range, the alarm is activated. The alarm will also be activated if the unit loses power. When activated, the alarm contacts will open or close, triggering the mechanism of your choice, whether a buzzer, light or any other electrical device. The alarm is a necessity when the installation is in a remote location and corrective action must be taken immediately in the event of an out of range condition.

Isolated Recorder Output

The ability to record the data from the process you are monitoring greatly enhances process troubleshooting. By simply connecting a recorder to the controller's output terminals you are able to acquire a hard copy of the readings for demonstrative or analytical purposes. The recorder output terminals are isolated from the controller circuitry to avoid any interference and are user switchable between 0 to 20 mA or 4 to 20 mA.

High Impedance Input

The pH and ORP controllers come with high impedance 10^{12} Ω direct input from the electrode, ideal for applications with distances of up to 10 m (33'). The greater the distance between the controller and the sample, the greater the chance that line noise will occur, causing faulty readings. Use an AmpHel® pH electrode (available also with external battery) to greatly enhance the input signal allowing high accuracy at distances of up to 50 m (165').

Quality Construction

These controllers are housed in a rugged, modular, fiber-reinforced polypropylene housing. Polypropylene has properties that will resist the harmful effects of most chemicals. When in operation, and with the transparent protective cover installed, the units comply with the IP54 standards. The modular design isolates the controller circuitry from all contacts, assuring that there is no noise interference. The use of this rugged design protects the unit from the tough conditions associated with industrial environments, ensuring long periods of trouble-free operation.

HI2X Advanced Controllers

This line of industrial microprocessor controllers offers a wide range of features and functions such as single and dual set points, ON/OFF, proportional and PID control, relay outputs, bi-directional isolated RS485, isolated recorder outputs in mAmps and volts, differential input, control through analog output and Fail Safe features.

Wall-Mounted Process Controllers

Simple to Use

The large, dual-level LCD shows both primary measurement and temperature and guides operators through calibration and programming with step-by-step prompts. The choice of ON/OFF, proportional and PID control provides extra versatility and makes it possible to pick the process controller that best fits your application. Keeping track of multiple controllers in different plants is made easy. These advanced controllers can be identified with both a factory and process ID.

Save Money with Custom Programs

HI2X help to prevent overdosing or costly system failures. You can set your high and low set point hysteresis bands independently to fine tune dosing processes with the ON/OFF controllers. Similarly, the proportional band and time period are user-programmable to save on slow reacting chemicals which are commonly overdosed.

All models offer an adjustable overdosing timer from 10 minutes to 7 days as the maximum time that the relay contacts may remain closed. An important feature in case of sudden chemical depletion, truncated intake or discharge tubing and other calamities.

Fail Safe Protection

The Fail Safe Alarms protect processes against critical errors arising from power interruptions, surges and human errors. The sophisticated yet easy to use system resolves these problems on two fronts: hardware and software. To eliminate blackout and line failure problems, the alarm function operates in a "normally closed" state and goes off if the wires are accidentally tripped, or when the power is down. This is an important feature since with most meters the alarm terminals close in abnormal situations, but no alarm is sounded with a line interruption, causing extensive damage. With our controllers, software is employed to set off the alarm in abnormal circumstances, for example, if the dosing terminals are closed too long a red LED will provide a visual warning signal.

Differential Input (Matching Pin)

All Hanna controllers in this family come with a differential input to prevent problems due to ground loop current. With this new feature, the life of the electrodes will be greatly extended.

Password Protection

The Hanna password protection feature keeps these controllers safe from tampering. Only users with the proper password can change the settings of these controllers.

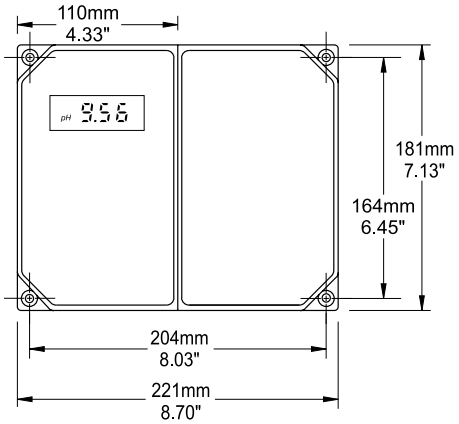
Simple Installation

These wall mounted controllers have mounting holes molded into the housing to assure simple, quick and secure installation without the need for additional hardware. Once all electrical connections are made, the protective cover can be installed over the front panel, making it possible to perform all adjustments without disassembling any part of the unit. Temperature probes can also be installed. Pumps to be used in conjunction with the controller simply plug into the controller's input and will be powered up through the unit's internal power supply.

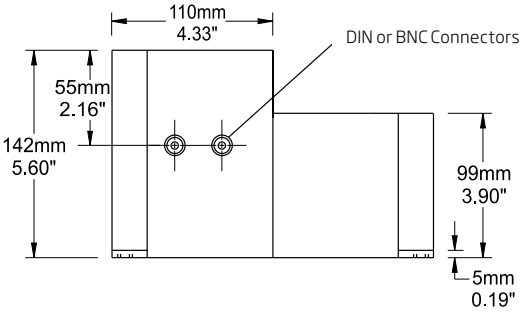
Mechanical Dimensions

The modular design isolates electrical connections in a closed compartment, while the control settings are accessible and can be made through the adjacent compartment.

Front View



Bottom View



HI21

Industrial Grade pH Digital Controllers

Wall Mounted with Matching Pin

- Alarm
  - Fail Safe Alarm System
- ATC
  - Automatic temperature compensation
- 3 Point Calibration
  - Up to three point calibration at

The HI21 controllers are simple to operate, microprocessor-based pH process controllers packed with features. With HI21, a quick one, two or three point calibration at pH 4.01, 7.01 and 10.01 comes standard and you can choose from ON/OFF, proportional and PID control to save on chemicals. These instruments have a differential input, extending electrode life by eliminating ground loop current through the reference.

Password protection prevents unauthorized modifications in settings or calibration. The Fail Safe Alarm System protects the HI21 against the pitfalls of process control, like power interruption or line failure.

Extractable terminal modules make wiring simple. A host of self-testing features and user-friendly functions make the HI21 a great value.

For more flexibility and better resolution for chart recorders, any two points between 0 and 14 pH can be chosen to correspond to the analog output spans. HI21 models are equipped with a bi-directional RS485 port, which allows remote control of the instrument from a PC.

Specifications	HI21
Range	0.00 to 14.00 pH; -9.9 to 120°C
Resolution	0.01 pH; 0.1°C
Accuracy	±0.02 pH; ±0.5°C
Input Impedance	10^{12} Ohm
pH Calibration	automatic, one, two or three point, at pH 4.01, 7.01, 10.01
Temperature Compensation	automatic (with Pt100 probe) or manual from -9.9 to 120°C
Analog Output	0 to 1 mA, 0 to 20 mA, 4 to 20 mA; 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC
Digital Output	RS485
Relays 1 and 2	electromechanical relay SPDT contact outputs, 5A-250 VAC, 5A - 30 VDC (resistive load) (HI211YZ and HI212YZ), fuse protected: 5A, 250V fast fuse
Alarm Relay	electromechanical relay SPDT contact output, 5A - 250 VAC, 5A - 30 VDC (resistive load) fuse protected: 5A, 250V, 250V fast fuse
Power Supply Input	±5V (for amplified electrodes)
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
Power Consumption	15 VA
Over Current Protection	400 mA, 250V, fast fuse
Environment	0 to 50°C (32 to 122°F); RH max. 85% non-condensing
Protection	IP 54
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.4 kg (3.1 lb.)
Ordering Information	Each HI21 model is supplied with instructions. **Choose your configuration** **HI21211-1** dual setpoint, on/off control, analog output, 115V **HI21211-2** dual setpoint, on/off control, analog output, 230V

pH solutions begin on page 2.142

HI22

Industrial Grade ORP Digital Controllers

Wall Mounted with Matching Pin

- Alarm
  - Fail Safe Alarm System
- Connectivity
  - PC compatible

The HI22 has been engineered with the same outstanding quality and features as the HI21 meters.

The Fail Safe Alarm System protects these meters against the pitfall of process control, like power interruption or line failure. User selectable timing capability safeguards against overdosing and saves money while protecting the environment. RS485 capability makes this model PC compatible. The microprocessor memory is fully programmable and has a 3-month backup power supply.

These instruments have a differential input, extending electrode life by eliminating ground loop current through the reference. Users can choose between ON/OFF and proportional control as well as selectable current and voltage outputs. For more flexibility and better resolution for chart recorders, choose any two points between 0 and ±2000 mV to correspond to the analog output spans.

Wiring the controllers is simple with extractable terminal modules. A host of self-testing features and user-friendly functions make HI22 a great value.

Specifications	HI22
Range	±2000 mV; -9.9 to 120°C
Resolution	1 mV; 0.1°C
Accuracy (@25°C/77°F)	±2 mV; ±0.5°C
Input Impedance	10^{12} Ohm
ORP Calibration	automatic, at 0 and 350 or 1900 mV
AnalogOutput	0 to 1 mA, 0 to 20 mA, 4 to 20 mA; 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC
Digital Output	RS485
Relays 1 and 2	electromechanical relay SPDT contact outputs, 5A-250 VAC, 5A - 30 VDC (resistive load) (HI221YZ), fuse protected: 5A, 250V fast fuse
Alarm Relay	electromechanical relay SPDT contact output, 5A - 250 VAC, 5A - 30 VDC (resistive load) Fuse protected: 5A, 250V, 250V fast fuse
Power Supply Input	±5V (for amplified electrodes)
Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
Power Consumption	15 VA
Over Current Protection	400 mA, 250V, fast fuse
Environment	0 to 50°C (32 to 122°F); RH max. 85% non-condensing
Protection	IP 54
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.4 kg (3.1 lb.)
Ordering Information	Each **HI22** model is supplied complete with instructions. **Choose your configuration** **HI22111-1** single setpoint, on/off controls, analog output, 115V **HI22111-2** single setpoint, on/off controls, analog output, 230V

ORP solutions begin on page 2.154

HI23

Industrial Grade EC Digital Controllers

Wall Mounted with Four-ring Potentiometric Probe

- ATC
  - Automatic temperature compensation

HI23 is a wall mounted, microprocessor conductivity controller that provides very accurate measurements due to the four-ring EC probe and Automatic Temperature Compensation (ATC) feature.

Users can choose among models featuring ON/OFF or PID control, analog input and output, double set point. The relay contacts can drive external devices such as pumps or electrovalves.

The input signal can come from a probe or a 4-20 mA transmitter. Models with the RS485 output option are also available. This option allows the user to insert the controller into a 2-wire RS485 network.

Specifications		HI23
EC	Range	0.0 to 199.9 µS/cm; 0 to 1999 µS/cm; 0.00 to 19.99 mS/cm; 0.0 to 199.9 mS/cm
	Resolution	0.1 µS/cm, 1 µS/cm; 0.01 mS/cm, 0.1 mS/cm
Temperature	Range	-10.0 to 100.0°C
	Resolution	0.1 °C
Additional Specifications	Accuracy	0.5% f.s. (EC); ±0.5 °C (0 to 70°C); ±1 °C (outside)
	Calibration	automatic, 1 point
	Temperature Compensation	automatic or manual from -10 to 100°C with Pt100 probe; β adjustable from 0.00 to 10.00%/°C
	Probe	four-ring conductivity probe with built-in 3-wire Pt100 temperature sensor or conductivity probe + external Pt100 (not included)
	Analog Input	4-20mA
	Analog Output	0-10 VDC, 0-5 VDC or 1-5 VDC; 0-1mA, 0-20 mA or 4-20mA
	RS485 baud rate	1200, 2400, 4800 and 9600
	Relays 1 and 2	electromechanical relay SPDT contact outputs, 5A-250 VAC, 5A - 30 VDC (resistive load) (HI211YZ and HI212YZ), fuse protected: 5A, 250V fast fuse
	Alarm Relay	electromechanical relay SPDT contact output, 5A - 250 VAC, 5A - 30 VDC (resistive load) fuse protected: 5A, 250V, 250V fast fuse
	Power Supply	115 VAC ±10% or 230 VAC ±10%; 50/60 Hz
	Power Consumption	15 VA
	Over Current Protection	400 mA, 250V, fast fuse
	Environment	0 to 50°C (32 to 122°F); RH max. 85% non-condensing
	Case Material	fiber-reinforced, self-extinguishing ABS
	Protection	IP54
	Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
	Weight	1.6 kg (3.5 lb.)
Ordering Information	Each **HI23** model is provided with dual set point and is supplied complete with instructions.	
	Choose your configuration	
	HI23211-1	dual setpoint, on/off control, analog output, 115V
	HI23211-2	dual setpoint, on/off control, analog output, 230V

EC solutions begin on page 5.34

HI9913

Industrial Grade pH and Conductivity Controller

with Proportional Control of Fertilization

- Alarm
  - The alarm is activated if pH falls below the set point by the user selectable interval (0.5 to 2.5 pH), or conductivity exceeds the set point by more than the user selectable interval (0 to 2.0 mS/cm) or due to overdosage
- ATC
  - Automatic temperature compensation

HI9913 is a 2-in-1 pH and conductivity controller engineered for dosage of fertilizer solutions in hydroponics and agriculture.

HI9913 measures pH from 0 to 14 and EC from 0 to 10 mS/cm. Two separate set points can be user adjusted from 4 to 7 pH and 0 to 6 mS/cm. The relays are activated when pH exceeds the set point or conductivity falls below the desired value. Two pumps or electrovalves can be wired directly to the controller and be powered through the terminal. The operator can adjust two independent proportional settings for pH and conductivity. The time cycle is adjustable from 0 to 90 seconds, while the proportional band is 0 to 2 for both pH and EC. A matching pin/ground probe can be connected to the appropriate terminals to eliminate interference and prolong the pH electrode's life.

HI9913 provides for an alarm relay which is activated in several circumstances. These include when the pH is below the set point by the operator-adjustable threshold of 0.5 to 2.5 pH, or EC exceeds the set point by a value in the 0.5 to 2.5 mS/cm range. The alarm goes off if the pH and/or conductivity are not corrected within the operator-determined time frame of 1 to 10 minutes. The alarm can be turned off during maintenance.

Fertilization status can be ascertained from a distance through dosage and alarm LED's.

HI9913 accepts pH electrodes with BNC and conductivity probes with DIN connectors.

Specifications	HI9913
Range	0.00 to 14.00 pH; 0.00 to 10.00 mS/cm
Resolution	0.01 pH; 0.01 mS/cm
Accuracy (@25°C/77°F)	±0.02 pH; ±2% f.s. EC
Input Impedance	10^{12} Ohm
Calibration	through "OFFSET" and "SLOPE" trimmers for pH, and "ZERO CAL" and "SLOPE CAL" for EC
Set point	from 4.0 to 7.0 pH and 1.0 to 4.0 mS/cm (EC)
EC Temperature Compensation	automatic, 0 to 50°C (32 to 122°F) with β=2%/°C
Proportional Control	two independent controls: pH from 0.0 to 2.0 and conductivity (EC) from 0.0 to 2.0 mS/cm with two separate time cycles from 0 to 90 seconds
Alarm Contact	terminals can be configured as normally open or normally closed (isolated output max. 2A, max. 240V, resistive load, 1,000,000 strokes). The alarm is activated if pH falls below the set point by the user selectable interval (0.5 to 2.5 pH), or conductivity exceeds the set point by more than the user selectable interval (0.5 to 2.5 mS/cm) or due to overdosage
Dosing Terminals	two sets of independent terminals (115 to 240V, Max.2A, 1,000,000 strokes) are activated whenever pH exceeds the pH set point and/or conductivity falls below the EC set point
Probe	any combination pH electrode with a universal BNC connector and Hanna conductivity four-ring potentiometric probe with built-in temperature sensor and DIN connector (not included)
Power Supply	±10% 115 VAC or 230 VAC ; 50/60 Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Case Material	fiber-reinforced, self-extinguishing ABS
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.6 kg (3.5 lb.)
Ordering Information	**HI9913** is supplied complete with instructions.

pH solutions begin on page 2.142; EC solutions begin on page 5.34

HI9935

Industrial Grade pH and TDS Controller

with Proportional Control of Fertilization

- Alarm
  - The alarm is activated if pH falls below the set point by the user selectable interval (0.5 to 2.5 pH),or TDS exceeds the set point by more than the user selectable interval (0 to 400 ppm) or due to overdosage
- ATC
  - Automatic temperature compensation

HI9935 is a pH and TDS controller for fertilizer solution dosage in hydroponics.

HI9935 measures pH from 0 to 14 and TDS from 0 to 1999 mg/L (ppm). Two separate set points can be adjusted from 4 to 7 pH and 900 to 1800 ppm (mg/L). The relays are activated when the pH exceeds the set point or TDS falls below the desired value. Two pumps or electrovalves can be wired directly to the controller and be powered through the terminals. Independent proportional settings for pH and TDS can be adjusted from 0 to 90 seconds, 0 to 2.0 for pH and 0 to 400 mg/L (ppm) for TDS. A matching pin/ground probe can be connected to the appropriate terminals to extend electrode life and eliminate interference.

HI9935 provides for an alarm relay which is activated in several circumstances. These include when the pH is below the set points in the operator adjustable threshold of 0.5 to 2.5 pH, or similarly, TDS exceeding the set point by a value in the 50 to 450 mg/L (ppm) range. The alarm also goes off if the pH and/or TDS are not corrected within the operator determined time frame of 1 to 10 minutes. Moreover, the alarm configuration is switchable from a normally-closed to a normally-open state or turned off during maintenance. The fertilization status can be ascertained from a distance through dosage and alarm LED's.

HI9935 accepts pH electrodes with a BNC connector and TDS probes with a DIN connector.

Specifications	HI9935
Range	0.00 to 14.00 pH; 0 to 1999 ppm (mg/L)
Resolution	0.01 pH; 1 ppm (mg/L)
Accuracy (@25°C/77°F)	±0.02 pH; ±2% f.s. TDS
Input Impedance	10^{12} Ohm
Calibration	through "OFFSET" and "SLOPE" trimmers for pH, and "ZERO CAL" and "SLOPE CAL" for TDS
Set point	from 4.0 to 7.0 pH and 900 to 1800 ppm (mg/L)
TDS Conversion Factor	0.65 mg/L (ppm) = 1 µS/cm
TDS Temperature Compensation	automatic, 0 to 50°C (32 to 122°F) with β = 2%/°C
Proportional Control	two independent controls: pH from 0.0 to 2.0 and TDS from 0.0 to 400 ppm (mg/L) with two separate time cycles from 0 to 90 seconds
Alarm Contact	terminals can be configured as normally open or normally closed (isolated output max. 2A, max. 240V, resistive load, 1,000,000 strokes). The alarm is activated if pH falls below the set point by the user selectable interval (0.5 to 2.5 pH),or TDS exceeds the set point by more than the user selectable interval (0 to 400 ppm) or due to overdosage
Dosing Terminals	two sets of independent terminals (115 to 240V, max. 2A, 1,000,000 strokes) are activated whenever pH exceeds the pH set point and for the TDS falls below the TDS set point
Probe	any combination pH electrode with a universal BNC connector and Hanna TDS four-ring potentiometric probe with built-in temperature sensor and DIN connector (not included)
Power Supply	±10% 115 VAC or 230 VAC; 50/60 Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Case Material	fiber-reinforced, self-extinguishing ABS
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.6 kg (3.5 lb.)
Ordering Information	**HI9935** is supplied complete with instructions. **Choose your configuration:** **HI9935-1** 115V **HI9935-2** 230V

pH solutions begin on page 2.142; TDS solutions begin on page 5.39

HI9910

Industrial Grade pH Controller

with Single Set point and Proportional Dosage

- Alarm
  - The alarm is activated if pH varies by more than user selectable interval (0.5 to 2.5 pH) from set point or due to overdosage
- ATC
  - Automatic temperature compensation

HI9910 is a pH controller with a single set point for proportional dosage of acid or alkaline solutions. Any pH electrode ending in a BNC connector can be directly attached to the controller. The proportional control can be fine tuned through two dials on the front panel. The time cycle is adjustable from 0 to 90 seconds and the proportional band from 0.0 to 2.0 pH. Coarse and fine as well as offset and slope trimmers make accurate setting and calibration easy and convenient. A pump or electrovalve can be wired directly to the controller and be powered through the terminals.

The HI9910 also provides for an alarm relay. The alarm is activated when the measurements stray away from the set point by a predetermined value in the 0.5 to 2.5 pH range. A maximum dosing time from 1 to 10 minutes can also be set, after which the alarm is activated to warn of an abnormality. The alarm can be configured in either normally-closed or normally-opened state. HI9910 also provides an isolated output signal which is user selectable between 0-20 or 4-20 mA. A dial on the front panel renders manual temperature compensation fast and easy.

For automatic temperature compensation, hook up a three wire Pt100 to the controller. To speed up wiring, the HI9910 comes with extractable terminal modules. Once wired up, the compartment containing the connections is protected behind a fire-retardant ABS panel. Several LED's show whether the set point or alarm relays are activated from a distance.

Specifications	HI9910
Range	0.00 to 14.00 pH
Resolution	0.01 pH
Accuracy (@25°C/77°F)	±0.02 pH
Calibration	through "OFFSET" and "SLOPE" trimmers (max. ±1.5 pH for offset and 80% to 110% for slope)
Temperature Compensation	automatic from 0 to 50°C with Pt100 probe or manual from -10 to 80°C
Set point	from 0.00 to 14.00 pH with "COARSE" and "FINE" trimmers with "ACID" or "ALK" (alkaline) selection
mA Output	user selectable 0 to 20 mA or 4 to 20 mA over the 0-14 pH range with isolated output
Proportional Control	pH is user adjustable from 0.0 to 2.0 and time cycle from 0 to 90 seconds
Alarm Contact	terminals can be configured as normally open or normally closed (isolated output max. 2A, max. 240V, resistive load, 1,000,000 strokes). The alarm is activated if pH varies by more than user selectable interval (0.5 to 2.5 pH) from set point or due to overdosage
Dosing Terminals	relay terminals (115 to 240V, max.2A,1,000,000 strokes) are activated when pH exceeds the set point with "ACID" dosage or falls below the set point with "ALK" selection (alkaline dosage)
Power Supply	±10% 115 VAC or 230 VAC; 50/60 Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Case Material	fiber-reinforced, self-extinguishing ABS
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.6 kg (3.5 lb.)
Ordering Information	**HI9910** is supplied complete with instructions. **Choose your configuration** **HI9910-1** 115V **HI9910-2** 230V

pH solutions begin on page 2.142

HI9931

Industrial Grade EC Controller

with Proportional Fertilizer Dosing for Hydroponics Applications

- Alarm
  - The alarm is activated if conductivity exceeds by more than the user selectable interval (0.5 to 2.5 mS/cm) from the set point or due to overdosage
- ATC
  - Automatic temperature compensation

HI9931 is a wall mounted meter that measures and controls conductivity in the 0 to 10 mS/cm range. A single set point allows for proportional dosage of fertilizer solutions. The proportional settings can be fine tuned through two conveniently positioned dials on the front panel. The time cycle is adjustable from 0 to 90 seconds and the proportional band from 0 to 1.6 mS/cm. Calibration and set points have a coarse and fine tuning trimmers. A pump or electrovalve can be wired directly to the controller and be powered through the terminals.

HI9931 also provides for an alarm relay which is activated when the measurements exceed the set point by a user selectable margin from 0.5 to 2.5 mS/cm. The alarm also triggers if, due to a malfunction, the continuous dosing time exceeds the operator adjustable period of 1 to 10 minutes. The alarm can be configured in either normally closed or open position and turned off during maintenance. HI9931 also provides an isolated output signal which is user selectable between 0-20 or 4-20 mA.

Hanna four-ring conductivity probes ending in a DIN connector can be quickly attached to the HI9931. Readings are automatically compensated for the effects of temperature in the 0 to 50°C (32 to 122°F) range. For quick and easy wiring, HI9931 comes with extractable terminal modules. Several LED's show whether the set point or alarm relays have been activated.

Specifications	HI9931
Range	0.00 to 10.00 mS/cm
Resolution	0.01 mS/cm
Accuracy	±2% f.s.
Calibration	through "ZERO CAL" and "SLOPE CAL" trimmers
Set point	from 0 to 10.00 mS/cm
Temperature Compensation	automatic, 0 to 50°C (32 to 122°F) with β= 2%/°C
Recorder Output	selectable at 0-20 mA or 4-20 mA (isolated)
Proportional Control	conductivity from 0.0 to 1.6 mS/cm and time cycle from 0 to 90 seconds
Alarm Contact	terminal can be configured as normally open or normally closed (isolated output max. 2A, max. 240V, resistive load, 1,000,000 strokes). The alarm is activated if conductivity exceeds by more than the user selectable interval (0.5 to 2.5 mS/cm) from the set point or due to overdosage
Dosing Terminals	relay (115 to 240V, max.2A, 1,000,000 strokes) is activated whenever conductivity falls below the setpoint
Probe	four-ring potentiometric with built-in temperature sensor and DIN connector (not included)
Power Supply	±10% 115 VAC or 230 VAC; 50/60 Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Case Materials	fiber-reinforced, self-extinguishing ABS
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.6 kg (3.5 lb.)
Ordering Information	**HI9931** is supplied complete with instructions. **Choose your configuration** **HI9931-1** 115V **HI9931-2** 230V

EC solutions begin on page 5.34

HI9934

Industrial Grade TDS Controller

with Proportional Fertilizer Dosing for Hydroponics Applications

- Alarm
  - Fail Safe Alarm System
- ATC
  - Automatic temperature compensation

HI9934 is a wall mounted meter that controls TDS in the 0 to 1999 ppm (mg/L) range through a single set point for dosage of fertilizers. The proportional control can be fine tuned through the time cycle between 0 to 90 seconds and the proportional band from 0 to 400 ppm. Coarse and fine as well as a slope trimmer make for an accurate setting and calibration. A pump or electrovalve can be powered through the terminal. In addition to the set point relay, HI9934 also provides for an alarm relay. The alarm is activated when the measurements exceed the set point by a user selectable margin in the 50 to 450 ppm range. The alarm also triggers if, due to a malfunction, the continuous dosing time exceeds the operator adjustable period of 1 to 10 minutes. The alarm can be configured in either normally-closed or normally-open position and turned off during maintenance.

HI9934 also provides an isolated output signal which is user selectable between 0-20 or 4-20 mA.

Hanna instruments four-ring TDS probes with incorporated temperature sensor and DIN connector can be quickly attached to the controller. Readings are automatically compensated for temperature variations in the 0 to 50°C (32 to 122°F) range.

The extractable terminal wiring is through the side of the meter with washers and grommets. The compartment containing the connections is enclosed behind a fire-retardant ABS panel.

Specifications	HI9934
Range	0 to 1999 ppm (mg/L)
Resolution	1 ppm (mg/L)
Accuracy	±2% f.s.
Calibration	through "ZERO CAL" and "SLOPE CAL" trimmers
Set point	from 0 to 1999 ppm (mg/L)
TDS Conversion factor	0.65 mg/L (ppm) = 1 µS/cm
Temperature Compensation	automatic, 0 to 50°C (32 to 122°F) with β = 2%/°C
Recorder Output	selectable at 0-20 mA or 4-20 mA (isolated)
Proportional Control	TDS from 0 to 400 ppm and time cycle from 0 to 90 seconds
Alarm Contact	terminals can be configured as normally open or normally closed (isolated output max. 2A, max. 240V, resistive load, 1,000,000 strokes). The alarm is activated if TDS exceeds by more than the user- selectable interval (50 to 450 ppm) from the set point or due to overdosage
Dosing Terminals	relay (115 to 240V, max.2A, 1,000,000 strokes) are activated whenever TDS falls below the set point
Probe	four-ring potentiometric with built-in temperature sensor (not included)
Power Supply	±10% 115 VAC or 230 VAC; 50/60 Hz
Environment	-10 to 50°C (14 to 122°F); RH max 95% non-condensing
Case Material	fiber-reinforced, self-extinguishing ABS
Dimensions	221 x 181 x 86 mm (8.7 x 7.1 x 3.4")
Weight	1.6 kg (3.5 lb.)
Ordering Information	**HI9934** is supplied complete with instructions. **Choose your configuration** **HI9934-1** 115V **HI9934-2** 230V

TDS solutions begin on page 5.39

Analog Transmitters for pH, ORP and Conductivity

Two-Wire pH & ORP Transmitters

Two-wire transmitters are widely used for process control in industry. These instruments are particularly useful in industrial conditions where electrical interference is an important factor. By galvanically isolating the signals, any interference created is prevented from reaching the transmitter. Industrial environments are often associated with corrosive conditions, therefore any instrumentation used must be resistant to liquids and corrosion. Hanna transmitters meet all of these criteria and they only use two wires which reduces costs and eliminates the need for an expensive coaxial cable. Two-wire transmitters are ideal when used in remote applications that do not have AC power available.

As technology advances it is becoming more important to monitor certain processes closely, particularly from remote locations. Computers are commonly used to receive signals from transducers that have travelled a great distance (up to 300 meters, 1000'). When transmitting signals over such a distance, it is likely that a substantial portion of the signal will be absorbed by the resistance of the lines. Considerable differences in ground potentials and between the signal source and load, are inherent to long lines.

Powering the system with an AC supply is beneficial in eliminating this problem. One of the two wires is power ground return, while the other is the power supply. The power supply line acts in a dual manner, as a power supply, and as a signal carrier. This allows the transmitter to operate with 2 wires.

The signal current from the process controller is normally 4 to 20 mA. When the load is connected with the power supply return line, the signal current will be proportional in the range of 4 to 20 mA.

The ability to use a thinner gauge of wire greatly reduces the costs associated with the wiring of remote transmitters. Typically, a heavy gauge of shielded cable is required in order to minimize the ambient electrical noise from AC power sources, interference from electrical equipment, or various other sources of noise.

Thin wire will also provide better operation when the transmitter current output is a 4 to 20 mA signal. All of these features and many more, give Hanna transmitters the versatility to be used over long distances in almost any process control application.

Conductivity, Four-Ring Technology

Hanna conductivity transmitters use four-ring Potentiometric probes. As opposed to the more widely used 2-electrode Amperometric method, the four-ring Potentiometric method provides the highest accuracy and repeatability attainable. When measuring liquids that have a high conductivity, the 2-electrode system is susceptible to polarization. This condition makes it exceptionally difficult to obtain measurements with any accuracy. The polarization is directly related to the electrode's current load, and will cause a considerable, nonlinear drop in the voltage. As a result, the solution around the electrode simulates a low conductivity condition.

Four-ring electrodes eliminate the polarization effect by splitting the four rings into 2 current and 2 voltage electrodes. When placed in a conductive liquid, the 2 current electrodes take the alternating voltage and create a current. This alternating current produces a buffer field from which polarization is absent. The voltage is then measured in this field assuring no altered readings.

HI98143

pH and EC Transmitter

with Galvanic Isolated Output

- ATC
  - Automatic temperature compensation Connectivity
- PC compatible

The HI98143 series is designed to accept signals directly from a pH electrode and a conductivity probe at the same time.

Direct connection of the probes to the transmitter assure a positive electrical connection with no signal loss. This transmitter is ideal for remote process control applications.

Four models are available, transmitting a 0-1 V, 0-4 V or 4-20 mA signal. The output signals are proportional to the input signals but independent of changes in load or cable capacitance. Compensation for the effects of temperature for EC measurements are performed by the transmitters' Automatic Temperature Compenstion circuitry.

The transmitter can be connected to any pH or conductivity controller, recorder, PC or any data monitoring device that accepts 0 to 1 V, 0 to 4 V or 4 to 20 mA input. HI 98143 is an ideal tool for applications that require the monitoring of both pH and conductivity at the same time.

Specifications	HI98143-01 • HI98143-04 • HI98143-20 • HI98143-22
Range	0 to 14 pH; 0 to 10 mS/cm
Accuracy (@25°C/77°F)	±0.5% f.s. pH; ±2% f.s. EC
Calibration	manual, 2 point, through trimmers: pH: offset and slope trimmers; EC: 0 and 5 mS/cm trimmers
EC Temp. Compensation	automatic, 0 to 60°C (32 to 132°F) with β=2%/°C
pH Electrode	HI1001 pH electrode (suggested, not included), HI1283 matching pin (not included)
EC Probe	HI3001 (not included) with cell constant 2.1
Casing	IP54
Power Supply	12-24 VDC
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	160 x 105 x 31 mm (6.3 x 4.1 x 1.2")
Weight	280 g (9.9 oz.)
Ordering Information	All **HI98143** models are supplied with instructions. **Choose your configuration** **HI98143-01** pH/EC transmitter with 0-1 V isolated output **HI98143-04** pH/EC transmitter with 0-4 V isolated output **HI98143-20** pH/EC transmitter with 4-20 mA isolated output **HI98143-22** pH/EC transmitter with 4-20 mA isolated output (specific for HI8000 controllers)

pH solutions begin on page 2.142; EC solutions begin on page 5.34

HI8614N · HI8614LN · HI8615N · HI8615LN

pH and ORP Transmitters

with 4-20 mA Galvanically Isolated Output

- ATC for pH models
  - Automatic temperature compensation
- Waterpoof
  - Water resistant
- Backlight
  - Backlit, LCD display for "L"models

HI8614LN with LCD

The HI8614N and HI8614LN are a water-resistant pH transmitters designed to be used with a standard high impedance pH probe with BNC connector. The signal is then processed by a special high impedance amplifier, which transmits an output current directly proportional to the input signal but independent of changes in load or cable capacitance.

These transmitters can be connected to Hanna controller HI8510, HI8710 or HI8711, recorders, computers or any data monitoring device that accepts 4 to 20 mA input.

HI8615N and HI8615LN have been designed for transmitting ORP measurements from remote locations. These transmitters features two controls (one for 4 mA and one for 20 mA) to compensate for electronic drift and ambient temperature.

These transmitters can be connected to Hanna HI8512, HI8720, or any recorders, computers or any data monitoring device that accepts 4 to 20 mA input.

"L" versions allow easy verification and monitoring of measured values and is easier to calibrate and maintain.

HI8614N without LCD

Specifications	HI8614N • HI8614LN	HI8615N • HI8615LN
Range	0.00 to 14.00 pH; 4-20 mA	±1000 mV; 4-20 mA
Resolution (for "L" models)	0.01 pH; 0.01 mA	1 mV; 0.01 mA
Accuracy (@20°C/68°F)	±0.02 pH; ±0.02 mA	±5 mV; ±0.02 mA
Calibration	offset: ±2 pH; ±2.2 mA; slope: 86 to 116%; ±0.5 mA	offset: ±100 mV; ±0.8 mA slope: 90 to 110%; ±0.8 mA
Temperature Compensation	fixed or automatic from 0 to 100°C (32 to 212°F) with Pt100 probe	–
Input Impedance	10^{12} Ohm	
Recorder Output	4-20 mA (isolated)	
Protection	IP65	
Power Supply	HI8614N: 18-30 VDC; HI8614LN: 20-36 VDC	HI8615N: 18-30 VDC; HI8615LN: 20-36 VDC
LCD display	only for HI8614LN	only for HI8615LN
Load	max 500 Ohm	
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing	
Dimensions	165 x 110 x 71 mm (6.5 x 4.3 x 2.8")	
Weight	1 kg (2.2 lb.)	
Ordering Information	**HI8614N** and **HI8614LN** (with display) is supplied with instructions.	**HI8615N** and **HI8615LN** (with display) is supplied with instructions.

pH and ORP solutions begin on page 2.142

HI8936 Series

Conductivity Transmitters

to use with Four-ring Probe

- ATC
  - Automatic temperature compensation
- Backlight
  - Backlit, LCD display

HI8936 is a conductivity transmitter that utilizes a four-ring potentiometric probe. This probe is virtually immune to contamination by unclean solutions. This allows the transmitterto operate at peak performance at all times.

Temperature effects are compensated for by utilizing both the built-in temperature sensor on the probe and the transmitter's ATC circuitry with a d of 2%/°C.

Direct connection of the probe to the transmitter assures a positive electrical connection with no signal loss over long distances.

HI8936 "L" versions allow easy verification and monitoring of measured values and is easier to calibrate and maintain.

The HI8936 series requires external power to the 4-20 mA current loop.

The HI8936 series should be used in conjunction with the HI7635 in-line probe or HI7638 platinum probe (see Process Electrodes and Probes).

AN, BN, CN, and DN without LCD

ALN, BLN, CLN, and DLN with LCD

Specifications	HI8936AN HI8936ALN	HI8936BN HI8936BLN	HI8936CN HI8936CLN	HI8936DN HI8936DLN
Range	0.0 to 199.9 mS/cm	0.00 to 19.99 mS/cm	0 to 1999 µS/cm	0.0 to 199.9 µS/cm
Resolution	0.1 mS/cm	0.01 mS/cm	1 µS/cm	0.1 µS/cm
Accuracy	±2% f.s. (excluding probe error)			
Calibration	manual, two point, with offset and slope trimmers			
Temperature Compensation	fixed or automatic with NTC sensor from 0 to 50°C (32 to 122°F) with β=2%/°C			
Conductivity Probe	HI7635 for in-line applications (not included)			
Recorder Output	4-20 mA, not isolated, max 500 Ohm			
Protection	IP65			
Power Supply	without LCD: 12-30 VDC; with LCD: 17-36 VDC			
LCD Display	HI8936AN: no HI8936ALN: yes	HI8936BN: no HI8936BLN: yes	HI8936CN: no HI8936CLN: yes	HI8936DN: no HI8936DLN: yes
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing			
Dimensions	165 x 110 x 71 mm (6.5 x 4.3 x 2.8")			
Weight	1 kg (2.2 lb.)			
Ordering Information	All **HI8936** models are supplied complete with instructions.			

EC solutions begin on page 5.34

HI931002

4-20 mA Amperometer

Simulator and Calibrator

HI931002 is a portable instrument designed by the Plant Repair and Maintenance Operator for the MRO! This portable simulator can monitor and regulate 4-20 mA from practically any process meter with or without a voltage generator. The communication bus from process instrumentation can be simulated in any of the following modes:

- Passive drive/Calibrator mode:
  - HI931002 can set the 4-20 mA current values and the user can then adjust the process meter accordingly.
- Active drive/Simulator mode:
  - HI931002 simulates the correct current values as above in addition to providing power to the bus communication. Power is provided through an external adapter (included) which is connected to the simulator. This mode is ideal to calibrate chart recorders, pressure transducer or current indicators.
- Passive measurement/Tester mode:
  - HI931002 practically becomes an Amperometer. It measures and displays the mA (or pH) values transmitted by the process meter.
- Active measurement/Tester mode:
  - Same as above in addition to providing voltage to the 4-20 mA bus.

HI931002 can measure incoming current, provide power, and simulate 4-20 mA output to calibrate your process meter. A large LCD shows values on the display. You can select between drive and measurement modes through a switch on the front panel and two dials allow for quick adjustment of the current.

Specifications		HI931002
Ranges	Active Drive	2.00 to 19.99 mA; -1.50 to 14.00 pH
	Passive Drive	2.00 to 19.99 mA; -1.50 to 14.00 pH
	Active Measure	0.00 to 19.99 mA; -3.50 to 14.00 pH
	Passive Measure	0.00 to 19.99 mA; -3.50 to 14.00 pH
Additional Specifications	Resolution	0.01 mA; 0.01 pH
	Accuracy (@20°C/68°F)	±0.01 mA; ±0.01 pH
	Input Resistance	20Ω
	Fuse	5 x 20 mm, 200 mA, 250V
	Power Supply	9V; approximately 1600 hours of continuous use; or 12 VDC adapter (included)
	Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
	Dimensions	180 x 83 x 40 mm (7.1 x 3.3 x 1.6")
	Weight	320 g (11.3 oz.)
Ordering Information	**HI931002** is supplied with 1 m (3.3') connection cable, battery, 12 VDC adapter and instructions.	

BlackStone Chemical Dosing Pumps

Versatility

BlackStone pumps have been designed to meet the ever changing needs of industry. With their broad, flat base and mounting holes for tank, shelf or floor mounting (horizontal), the pumps can be easily mounted anywhere in your plant. The rear of the pump housing also provides mounting holes to facilitate vertical mounting: wall, tank or machine. Since the pump valve assembly and controls for the unit are located on the front of the pump, there is never a problem with installation or flow adjustments.

Simple Operation

BlackStone pumps are equipped with a single control for pump output. The external flow rate control (potentiometer) on the face of the pump allows you to adjust the percentage of flow from 0 to 100% of the pump's rated capacity. This feature eliminates the need to worry about stroke lengths and power settings. An LED indicator lights up each time a stroke begins, allowing the user to assess the stroke rate from a distance.

High Quality Materials

BlackStone pumps have been manufactured with the highest level of mechanical precision from materials chosen for their inherent ability to resist the effects of aggressive chemicals. When you select a Blackstone pump, you are eliminating the time consuming effort involved in picking the right material for your application. Blackstone pumps are supplied with the highest quality material as standard equipment–not optional. The diaphragm utilizes one-piece construction of PTFE, which unlike conventional laminated diaphragms, will stand up to the test of time and wear. Ball valves are constructed in glass.

The pumphead and O-rings are made of PVDF, PTFE and FPM/FKM which offer unsurpassed resistance. The chemical resistance chart (right) shows how well PVDF and PTFE stand up to some of the most aggressive chemicals.

Chemical Resistance Guide*

Chemical	PVC	PP	Hypalon	FPM/ FKM	PVDF	PTFE
Acetic Acid, 80%	D	B	A	E	A	A
Bleach	A	B	A	A	A	B
Citric Acid	A	A	A	A	A	A
Copper Cyanide	A	A	X	B	A	A
Copper Sulfate	A	A	B	B	A	A
Ferric Chloride	A	A	B	B	A	A
Ferric Sulfate	A	A	B	B	A	A
Hydrazine	X	X	B	B	A	A
Hydrochloric Acid (concentrated)	A	A	B	B	A	A
Hydrochloric Acid (diluted)	A	A	B	B	A	A
Hydrofluoric Acid (diluted)	D	B	D	A	A	A
Hydrogen Sulfide	C	A	B	B	A	A
Magnesium Nitrate	A	A	A	A	A	A
Magnesium Sulfate	A	A	A	A	A	A
Nitric Acid, 50%	A	C	E	A	A	A
Phosphoric Acid	B	B	A	B	A	A
Plating Baths	A	A	C	A	A	A
Potassium Cyanide	A	A	B	B	A	A
Potassium Nitrate	A	A	B	B	A	A
Propyl Alcohol	C	X	B	B	A	A
Soaps	A	A	B	B	A	A
Sodium Bicarbonate	A	A	A	A	A	A
Sodium Bisulfite	A	A	A	A	A	A
Sodium Hydroxide, 50%	A	A	B	E	A	A
Sodium Hypochlorite, 18%	A	A	A	D	A	A
Sulfuric Acid (concentrated)	A	A	B	A	A	A
Tanning Reagents	A	A	A	X	A	A
Trichloretane	E	C	E	A	A	A

* PARTIAL LISTING

Symbol Key

A - Excellent	B - Good	C - Fair	D - Acceptable (limited use)	E - Not recommended	X - Unknown

BL Series Dosing Pumps

BlackStone's positive displacement solenoid driven pumps use a minimum number of moving parts, therefore reducing the chance of mechanical failure. Part wear and oiling associated with motor driven pumps (ball-bearings, gear drives and cams) are not a concern with these pumps. Blackstone pumps are more accurate than standard pumps due to the positive displacement design ensuring each stroke is identical to the strokes before and after it, thus keeping the flow rate consistent.

A wide range of BlackStone pumps with different dosing capacities are available for your specific dosing needs. Each pump is supplied with discharge and suction valves.

Part Number	Max Output	Rated Pressure	Dosing Frequency strokes/min
With Large Diaphragm			
BL20	18.3 lph (4.8 gph)	0.5 bar (7.4 psi)	120
BL15	15.2 lph (4.0 gph)	1 bar (14.5 psi)	120
BL10	10.8 lph (2.9 gph)	3 bar (43.5 psi)	120
BL7	7.6 lph (2.0 gph)	3 bar (43.5 psi)	120
With Small Diaphragm			
BL5	5.0 lph (1.3 gph)	7 bar (101.5 psi)	120
BL3	2.9 lph (0.8 gph)	8 bar (116 psi)	120
BL1.5	1.5 lph (0.4 gph)	13 bar (188.5 psi)	120

Specifications	BL Series
Max Output	see table above
Pump Casing	fiber-reinforced polypropylene
Materials	pumphead in PVDF, diaphragm in PTFE, glass ball valves and O-rings in FPM/FKM, polyethylene 5 x 8 mm tubing
Self-priming	max height: 1.5 m (5 feet)
Power Supply	110/115 VAC or 220/240 VAC, 50/60Hz
Max Power Consumption	approximately 200 W
Protection	IP65
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions	194 x 165 x 121 mm (7.6 x 6.5 x 4.8")
Weight	approx. 3 kg (6.6 lb.)

Ordering Information

BL1.5-1	1.5 LPH flow rate
BL1.5-2	1.5 LPH flow rate
BL3-1	2.9 LPH flow rate
BL3-2	2.9 LPH flow rate
BL5-1	5.0 LPH flow rate
BL5-2	5.0 LPH flow rate
BL7-1	7.6 LPH flow rate
BL7-2	7.6 LPH flow rate
BL10-1	10.8 LPH flow rate
BL10-2	10.8 LPH flow rate
BL15-1	15.2 LPH flow rate
BL15-2	15.2 LPH flow rate
BL20-1	18.3 LPH flow rate
BL20-2	18.3 LPH flow rate

-1 = 110/115 VAC power supply
-2 = 220/2400 VAC power supply

Accessories

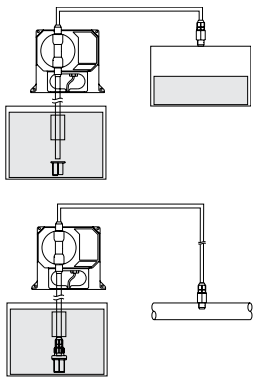
HI721004**	Injection valve assembly
HI721005**	Foot valve assembly
HI721101	Pumphead, O-ring, screws and washer
HI721102	Discharge valve assembly
HI721103	Suction valve assembly
HI721008	Ceramic weight (4)
HI720011D	Magnet and coil for BL pumps (230VAC)
HI720011U	Magnet and coil for BL pumps (115VAC)
HI720025	Pump body
HI720034	Magnet pump head assembly for BL pumps
HI721001	Complete pumphead with valves
HI72001	Tube nut. 5 x 8 mm dia. (100 pcs)
HI721009	Diaphragm
HI721010	PTFE coated O-ring for pump head
HI721011	Aluminum piston, insulation disk, washer and springs replacement kit for BL pump
HI721013	Piston set for BL pump
HI721014	Bottom housing and housing seal
HI721104	Small diaphragm for BL pumps
HI721105	BlackStone spare pump head
HI721106	BlackStone pump head assembly

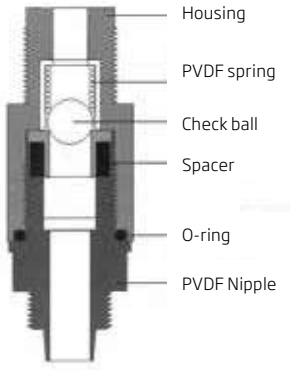
** Required for operation

Rugged Design

Blackstone pumps are completely sealed during assembly and offer IP65 protection against splashes and spills providing excellent protection even in hostile environments. The fiber-reinforced polypropylene housing stands up to aggressive chemicals while offering superior strength under tough industrial conditions.

Typical Installations

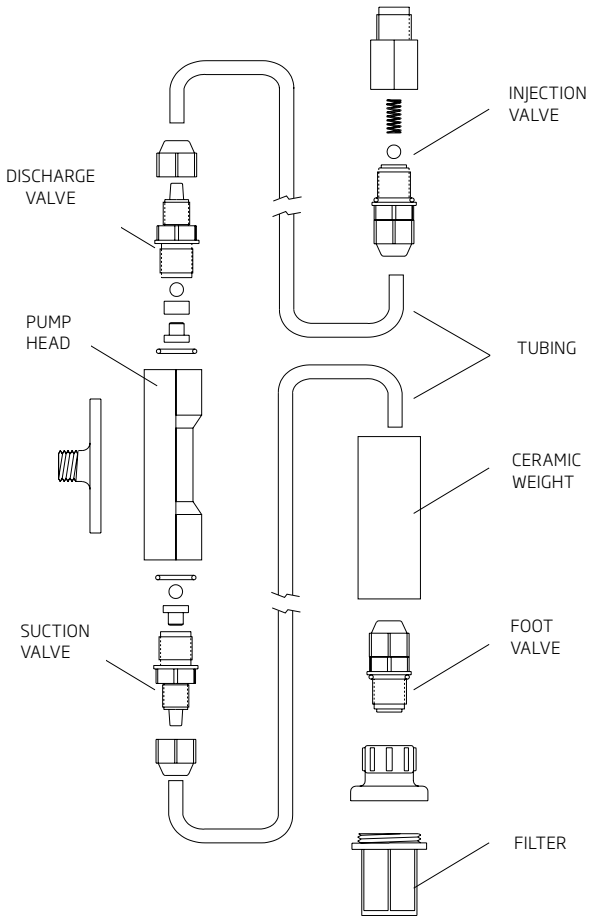


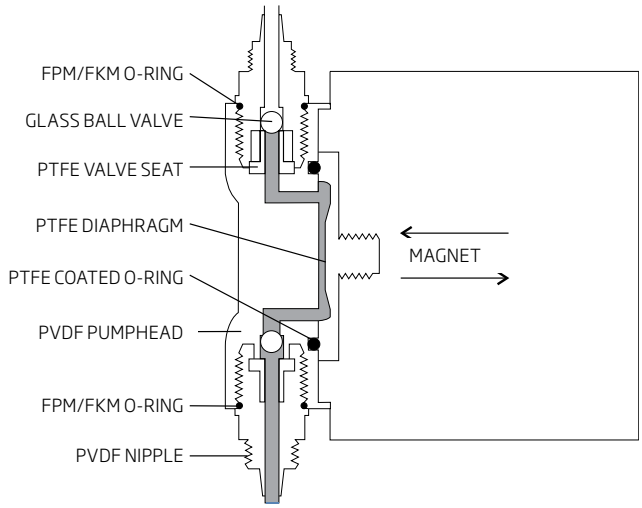


Replacement Parts

for BlackStone Chemical Dosing Pumps

Assembly Diagram

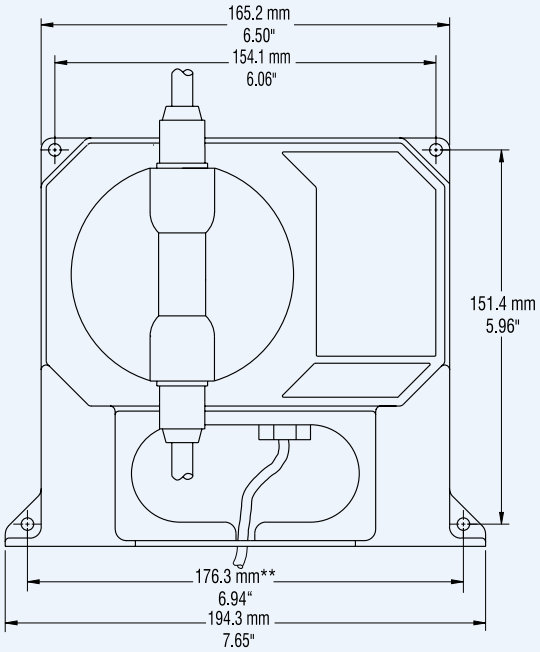




Mechanical Dimensions

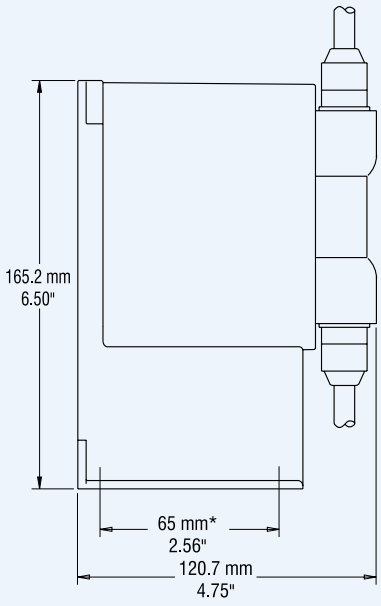
for BlackStone Chemical Dosing Pumps

Front View



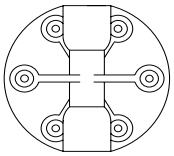
** Dimensions for floor and wall mounting

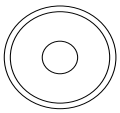
Side View

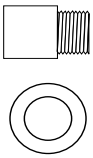


* Dimensions for floor mounting

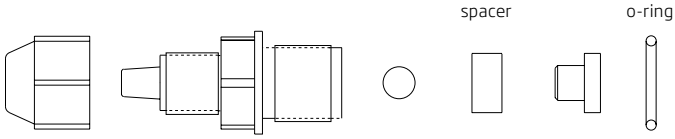
HI721101


pumphead

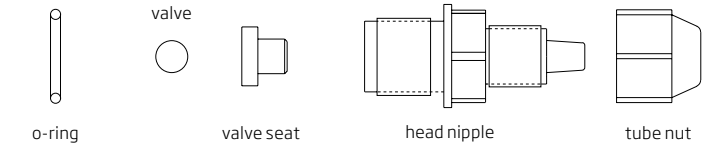

PTFE coated o-ring


6 screws and washers

HI721102



HI721103



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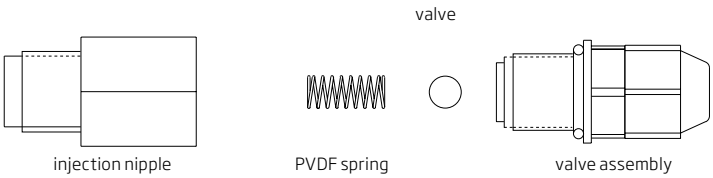

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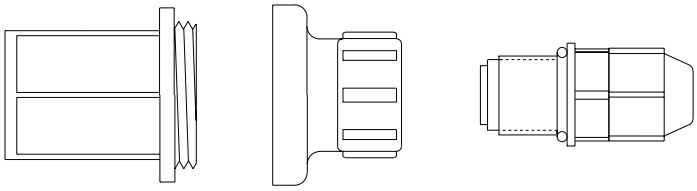
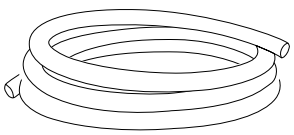


HI721003

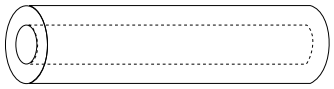
HI721006


PVDF spring

HI720032


LDPE hose

HI721008


ceramic weight

Ordering Information

HI721101

This kit contains the PVDF pumphead, PTFE coated O-ring, 6 screws and washers.

HI721102

This kit contains all the necessary replacement parts for your discharge valve assembly. Complete with a FPM/FKM O-ring, glass valve ball, the valve spacer and seat, head nipple and the tube nut to secure the assembled parts.

HI721103

Suction valve assembly, complete with a FPM/FKM O-ring, glass valve ball, the valve spacer and seat, head nipple and the tube nut to secure the assembled parts.

HI721004

Complete with an injection nipple, PTFE coated spring, glass valve ball and a valve assembly.

HI721005

This kit contains a filter with a filter holder and a valve assembly.

HI721003

This kit contains 10 glass balls and 10 valve O-rings.

HI721006

This kit contains 4 PVDF springs.

HI720029

LDPE hose, 3 m (9.9').
Inside diameter 4.71 mm
Outside diameter 7.87 mm

HI720030

LDPE hose, 10 m (33').
Inside diameter 4.71 mm
Outside diameter 7.87 mm

HI720031

LDPE hose, 50 m (165').
Inside diameter 4.71 mm
Outside diameter 7.87 mm

HI720032

LPDE hose, 100 m (333').
Inside diameter 4.71 mm
Outside diameter 7.87 mm

HI721008

This kit contains 4 ceramic weights.

HI740156

This kit contains 3 valve seats.

Electrodes Designed and Manufactured by Hanna

Process Electrodes

A Worldwide Leader in Electrode Manufacturing

Since the beginning of the 1990's Hanna has been a leader in the research & development of pH and ORP electrodes. Today, Hanna is proud to present the latest family of industrial electrodes, the Flat Tip Series, which completes the wide range of Hanna probes for any process application. All Hanna industrial pH and ORP electrodes are combination type, i.e. the reference half cell and the measurement half cell are assembled in the same body.

Industrial Electrodes and Probes


HI1000/HI2000 Series


Standard


AmpHel®


Flat Tip

Reference Half Cell

The reference half cell provides a known and stable reference potential. During the normal electrode life span, this potential can vary, possibly signaling the end of the electrode's life.

- The main causes of reference potential variation are:
  - Electrolyte contamination
  - Dilution
  - Electrochemical reaction
  - Junction clogging

As a result of many years of experience and electrode testing in industrial applications, Hanna has found the solutions for all these challenges.

Electrolyte Contamination

The contamination of the reference half cell is linked to the diffusion of external substances into the reference chamber (strong oxidants, reductants, complexing agents).

The combination of Hanna double junction technology with a polymer reference electrolyte, reduces the diffusion process rate and keeps the reference potential stable for long periods of time.

Dilution

When the reference cell containing concentrated 3.5M KCl electrolyte comes in contact with a less concentrated aqueous sample, diffusion of the electrolyte into the sample will occur. This process causes a progressive dilution of the reference electrolyte with a consequent variation of the reference potential.

Hanna double junction technology and the use of a large electrolyte volume (up to three times greater than traditional electrodes) makes this dilution effect negligible.

Electrochemical Reaction

In many industrial applications, it is possible to get a potential difference between the measuring point and the instrument. This inconvenience originates from electrical currents that destroy the Ag/AgCl element of the reference half-cell and also creates non-stable, interfering potentials.

Hanna's simple and effective solution to this challenge is the matching pin built-in to each industrial electrode. The matching pin is a stainless steel or titanium element that is connected to the instrument to prevent grounding problems, and to prolong electrode life.

Junction Clogging

Typical industrial applications require continuous monitoring of pH and ORP. Periodic cleaning and maintenance of the electrode junction ensure a stable and repeatable contact between sample and junction. The frequency of these cleaning procedures depends on the shape of the junction and material.

Hanna industrial electrodes are provided with different types of junctions. In particular, the porous PTFE junction used for the flat tip electrodes, which can provide optimum performance for months without requiring any maintenance.

Measurement Half Cell

All Hanna industrial pH electrodes include a measurement cell with a glass sensor. A glass sensor is the only answer for most industrial requirements. Below is a list of the main causes of shortened glass sensor life, for which Hanna has developed different types of specialized glass:

- High temperature
- Low temperature
- Acid samples containing fluoride

Electrodes Designed and Manufactured by Hanna

Process Electrodes

Built for Everyday, Demanding Use

Hanna provides glass sensors that are able to withstand the previously listed industrial environmental challenges.

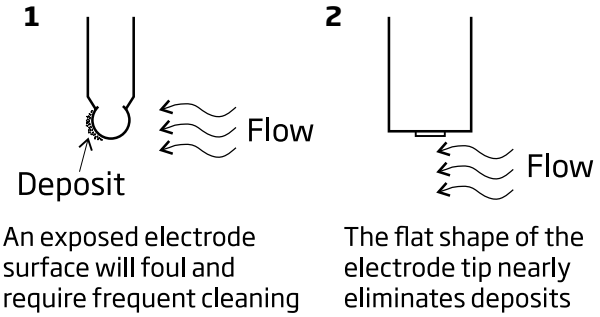
Glass Type	Application	pH Range	Temperature Range
LT	low temperature	0 to 12	-10 to 80°C
HT	high temperature	0 to 14	0 to 100°C
HF	acid samples with fluoride	0 to 10	-5 to 60°C

Mechanical Stress

In a continuous in-line installation, the glass sensor of the pH electrode can be physically damaged by solution streams containing suspended solids.

Our Flat Tip electrodes are the best answer to this problem. The flat tip virtually eliminates deposits that can foul the electrode, significantly reducing necessary maintenance.

Flat Tip Advantages



An exposed electrode surface will foul and require frequent cleaning

The flat shape of the electrode tip nearly eliminates deposits

Electrode Body Material: Glass, PVDF or PEI

Glass

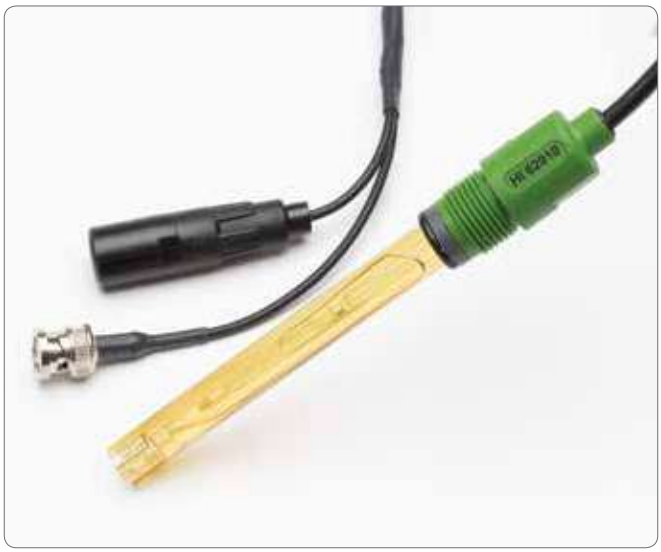
The glass body electrode can withstand high pressure and high temperature applications. The glass body also offers high resistance to aggressive chemicals (only fluoridic acid and strong alkaline solutions can damage glass).

PVDF

The PVDF body used for the Flat Tip Series withstands high pressure and high temperature applications, and guarantees a high chemical and mechanical resistance. These characteristics makes the PVDF material the most recommended for many industrial applications. PVDF is also non-toxic and compatible with food applications.

PEI

PEI is a special plastic material used first to produce electrodes by Hanna. PEI electrodes proved to be ideally suited to field applications, as well as industrial environments. An electrode with a PEI body represents a very good combination of chemical, mechanical, and thermal resistance which can be used in non-critical applications (e.g. swimming pools), or with portable meters for routine field monitoring and control, such as wells, lakes and rivers, and discharges of tanks and reservoirs.



AmpHel®: Why and Where to Use It

pH electrode glass sensors have a high impedance of typically 100 Mohm, but can reach 800 Mohm depending on the temperature. This is a very weak signal available for accurate measurements. Impedance this high is difficult to handle especially between the electrode and the instrument. Normally this distance is covered by special cables with very high shielding and electrical insulation. Even with these cables, distances cannot be longer than 5 meters.

In industrial installations it is not easy to limit the distance between the electrode and the measuring instrument to 5 meters . Quite often, the recording instruments are located in separate areas from where the pH is measured. To avoid this limitation, a pH amplifier can be used.

Amplifiers are usually available with water-tight casings and can be used under extremely harsh conditions. The pH amplifier needs a power supply and usually must also provide for galvanic insulation between the power supply and the amplification circuit. At times it is difficult to have a power supply close to the measuring electrode. In such a case, 2-wire amplifiers and a 4-20 mA output can solve the problem (see HI8614 and HI8614L produced by Hanna).

Such amplifiers need instruments with 4-20 mA input in place of, or in parallel with, the BNC connector (some instruments are not provided with this option).

To overcome the instrument limitation, in 1988, Hanna produced the AmpHel® electrode (Amplified pH electrode). The AmpHel® electrodes feature an internal, high impedance pH amplifier with the required batteries.

An AmpHel® electrode has a life of approximately 3 years from the day it was produced. Taking into consideration that an average life for a pH electrode is one year, this should not be considered a limitation.

The output is still with 2 wires, as in the case of the typical coaxial cable, but it has a low impedance, and allows connections up to 75 meters long without delays in the measurements.

Cable Leakage

A high impedance coaxial cable, when installed more than 5 meters away from the electrode, could also be subject to current leakage. Quite often the installers place it in underground ducts as done with any other electric cable. During the installation of the cable, the insulation may become scratched by rubbing against the pipes or sharp corners. Underneath the insulation there is a screen connected to the reference electrode.

If the cable is in an underwater duct, it could happen that, sometime during the year, the reference electrode (the screen) could come into contact with the humid environment and, thus, with the grounding circuit of the electrical installations. Under these conditions, the pH electrode cannot take reliable measurements and can give erroneous readings. Without any reference to the measurement, the actual reading can be many pH units off. This is another solid reason for avoiding cables longer than 5 meters.

Electrode-Cable Connection

Some German manufacturers have produced pH electrodes with a coaxial connector mounted directly at one end of the electrode, i.e. without cable. The intention was to replace the electrode, without having to replace the connecting cable which remains attached. But as time passed, such an intention has proven to be harmful.

In fact, in many cases, the electrode is placed inside an electrode holder, which protects it from test liquid (tank measurement). Moisture forms inside the holder because of temperature changes from day to night. This moisture reduces the connector insulation, and the signal to the electrode drops.

When an electrode leaks, the generated emf drops and the reading drifts toward the pH 7 value. Therefore, for example, instead of pH 3, the measurement can be pH 3.5 or 4. This reading may result in a dosage that is harmful to the system.

Electrodes Designed and Manufactured by Hanna

Process Electrodes

Potential Matching Pin

In many industrial applications, especially in plating baths, grounding loop current is a very common problem.

When a traditional electrode/controller system is used with the electrode reference connected both to the electrode and to the instrument, a current flow occurs through the reference half cell, causing fluctuations in reading and serious damage to the Ag/AgCl element. The potential matching pin shields the reference from external electrical fields. Shown above, the matching pin allows the measurement to stabilize and ensures effective process regulation. In order to function properly, the matching pin has to be continuously immersed in the measured solution and for this reason is placed near the electrode junction.

Temperature Effect

Sample temperature is an important parameter for solutions with a pH different from 7.0. In fact at pH 7.0, temperature compensation is not required.

Due to a built-in temperature sensor, there is only one electrode to install. Also due to its proximity to the pH sensor, the built-in temperature sensor ensures fast, accurately compensated readings even during sudden temperature fluctuations.

A Specific Electrode for Each Application

The table to the right lists the most common industrial applications with the corresponding, recommended Hanna electrodes.

For each application, several models are available, with different options for the following characteristics:

- Electrode dimensions
- Connection type
- Installation requirement
- Optional configurations (matching pin, Pt100 or Pt1000 sensor)

Hanna produces a wide range of industrial electrodes, for any specific application need.

Common Industrial Applications

Application	pH Electrode Series	Code
Domestic Wastewater Sewage, Septic Tank Treatment	easy	**HI1090B/5**
Industrial Wastewater	flat tip	**HI1006-2005**
	HI1000	**HI1003/5**
	easy	**HI1210B/5**
Food Industry (Beer, Jam, Diary Products)	flat tip	**HI1006-2005**
	easy	**HI1090B/5**
Chemical Neutralization	flat tip	**HI1006-2005**
	easy	**HI1210B/5**
Potable Water (>400µS/cm)	flat tip	**HI1006-2005**
	HI1000	**HI1001**
	easy	**HI1210B/5**
Cooling Towers	AmpHel®	**HI6291005**
	HI1000	**HI1002/5**
	easy	**HI1210B/5**
Water Softening	flat tip	**HI1006-2005**
	AmpHel®	**HI6291005**
	HI1000	**HI1001/5, HI1002/5**
	easy	**HI1210B/5**
Demineralization	flat tip	**HI1006-2005**
	easy	**HI1090B/5**
Low Conductivity Solutions	flat tip	**HI1006-2005**
Swimming Pools	flast tip	**HI1006-2005**
Sea Water	easy	**HI1090B/5**
Galvanic Baths	flat tip	**HI1006-3005**
	AmpHel®	**HI8299505**
	HI1000	**HI1003/5**
	easy	**HI1210B/5**
Sugar Industry, Paper Industry	flat tip	**HI1006-2005**
	easy	**HI1090B/5**
Textile Industry, Tanneries	flat tip	**HI1006-3005**
	AmpHel®	**HI8299505**
Acid Samples with Fluoride Ions	flat tip	**HI1006-4005**

Application	ORP Electrode Series	CODE
Oxidation of Cyanide and Nitrite	flat tip	**HI2004-2005**
Ozonization & Oxidant Products	AmpHel®	**HI6493005**
Reductant Products (Chromate Reduction)	AmpHel®	**HI6293005**
	HI2000	**HI2003/5**
	easy	**HI3210B/5**
Swimming Pools	HI2000	**HI2001, HI2003/5**
	easy	**HI3210B/5**

Flat Tip Industrial Electrodes

Select the flat tip electrode that best fits your process requirements by choosing from the following technical characteristics:

1. Junction

Three junction types are available:

- Annular non-clogging PTFE junction, for testing solutions with high content of suspended solids or for high pressure installation
- Open junction, ideal for wastewater analysis
- Ceramic junction

2a. pH Electrodes

Hanna has developed four types of specialized glass. First is a durable sensor glass for general purpose, industrial use. This glass can withstand the stress of daily use. The remaining types of electrode glass allow continuous monitoring in highly acidic solutions containing fluoride ions, as well as high or low temperature process and streams significantly increase the electrode life.

2b. ORP Electrodes

ORP electrodes are provided with a platinum sensor for most applications, while a gold sensor is required for measurement of cyanide or highly oxidative environments.

3. Temperature Sensor

The pH electrodes with built-in 3-wire Pt100 or Pt1000 temperature sensor allow for the temperature compensation of pH readings as well as temperature measurements.

4. Connection Type

Electrodes are wired for direct connection to a transmitter or process controller, or with the standard BNC connector.

5. Built-in Amplifier

Models with a built-in amplifier are necessary for long distance measurements, where it is not possible to install a transmitter.

The internal amplifier can be powered directly from select Hanna process controllers or a power source that supplies the appropriate voltage.

6. Cable Length

Non-amplified electrodes are provided with a 5, 10 or 15 m cable (16', 33' or 49'), while the amplified models are provided with a 15, 25, 50 or 75 m cable (49, 82, 164 or 246').

- Self-cleaning flat tip sensor
- Significantly reduced maintenance requirement
- Models especially designed for plating baths
- PVDF body
- Three junction types: ceramic, PTFE and open
- Built-in potential matching pin
- Three different glass type pH sensors
- ORP electrodes with platinum or gold sensor
- Models with built-in Pt100 or Pt1000 temp. sensor
- Internal amplifier models powered by the process controller
- 3/4" NPT external thread on both ends for easy installation

Hanna presents a series of combination pH and ORP electrodes, including more than 300 models, incorporating over 20 years of electrode manufacturing experience.

The most advanced feature of this series is the electrode shape with a flat tip, virtually eliminating deposits that can foul the electrode, significantly reducing necessary maintenance. This characteristic makes flat tip electrodes ideal for continuous in-line monitoring and for solutions containing aggressive chemicals.

The PVDF body offers a higher level of mechanical and temperature resistance. Moreover, the PVDF material is non-toxic and compatible with food applications.

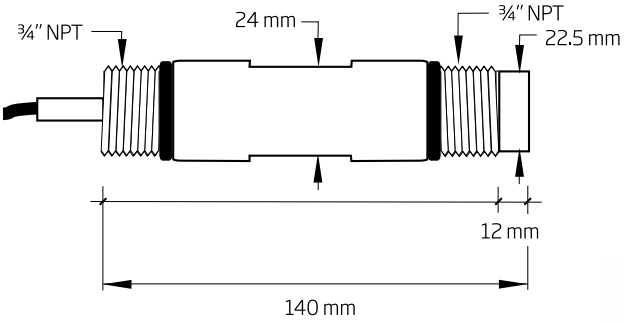
Each pH and ORP electrode is provided with an internal matching pin that can avoid typical problems caused by grounding loop current, such as:

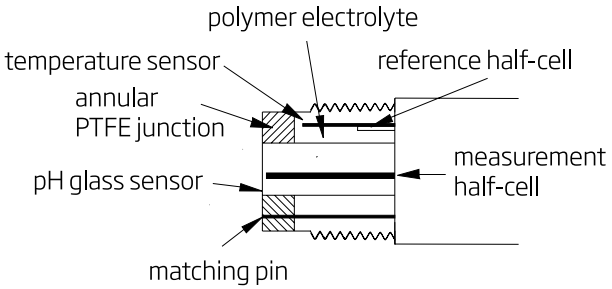
- progressive damage of the electrode
- fluctuating measurements
- poor process regulation

Glass Type	Application	pH Range	Temperature Range
LT	low temperature	0 to 12	-10 to 80°C
HT	high temperature	0 to 14	0 to 100°C
HF	acid samples with F- (*)	0 to 10	-5 to 60°C

(*) F- max 2 g/L, temperature max 60°C, pH >2

Flat Tip Industrial pH Electrodes





Flat Tip pH Electrodes: Ordering Information

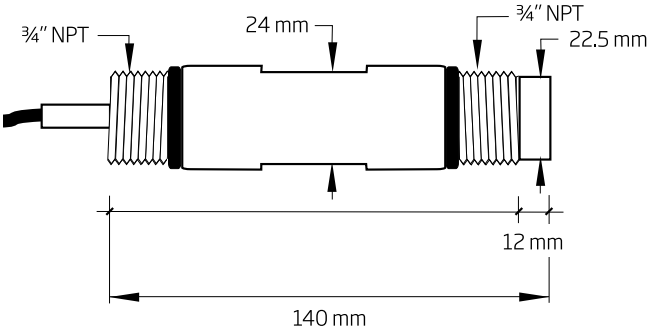
Choose your configuration:		
w =	**06**	PTFE junction
	16	ceramic junction
	26	open junction*
x =	**1**	LT (Low Temperature) glass sensor
	2	GP (General Purpose) glass sensor
	3	HT (High Temperature) glass sensor; titanium matching pin
	4	HF (Fluoride resistant) glass sensor
y =	**0**	BNC connector
	1	direct wire connection
	2	BNC connector + Pt100
	3	direct wire connection + Pt100
	4	BNC connector + Pt1000
	5	direct wire connection + Pt1000
	6	amplified electrode with BNC connector
	7	amplified electrode with BNC connector + Pt100
z =	**05, 10, 15** Cable length (meters); for non-amplified electrodes	
	15, 25, 50, 75 Cable length (meters); for amplified electrodes	

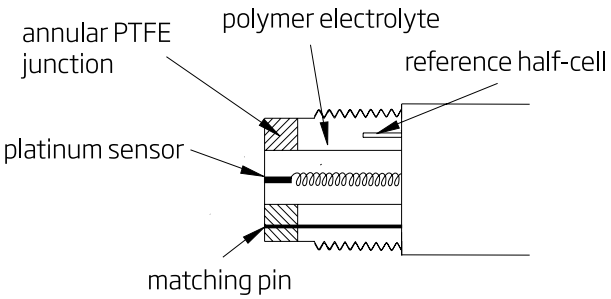
HI10 [w] – [x] [y] [z]

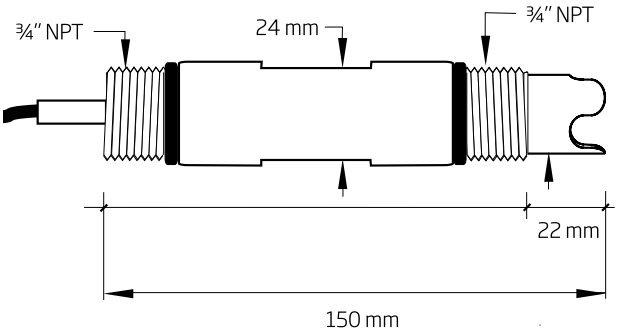
* Open junction is available only with GP glass sensor.

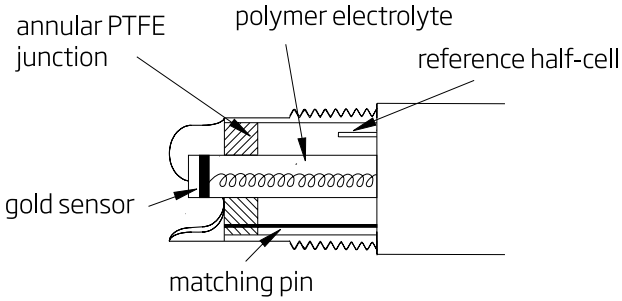
Note: The internal amplifier can be powered directly from select Hanna process controllers or a power source that supplies the appropriate voltage.

Flat Tip Industrial ORP Electrodes









Flat Tip ORP Electrodes: Ordering Information

Choose your configuration:		
w =	**04**	PTFE junction
	14	ceramic junction
	24	open junction
x =	**1**	platinum sensor
	2	gold sensor
y =	**0**	BNC connector
	1	direct wire connection
	6	amplified electrode with BNC connector
z =	**05, 10, 15**	Cable length (meters); for non-amplified electrodes
	15, 25, 50, 75	Cable length (meters); for amplified electrodes

HI20 [w] – [x] [y] [z]

Note: The internal amplifier can be powered directly from select Hanna process controllers or a power source that supplies the appropriate voltage.

AmpHel® Flat Tip Industrial Electrodes

- AmpHel® amplified
- Matching pin
- Flat tip
- PVDF body

AmpHel® Flat-tip pH Electrodes

General Purpose pH Electrodes

Code	Range	Body	Junction	Electrolyte	Glass Type	Temperature	ATC	Max Pressure	Connector	Cable
HI6100405	0-13	PVDF	double, PTFE	polymer	GP	-5 to 80 °C	–	6 bar (87 psi)	BNC	5 m
HI6101405	0-13	PVDF	double, PTFE	polymer	GP	-5 to 80 °C	Pt100	6 bar (87 psi)	BNC + lead	5 m
HI6101415	0-13	PVDF	double, PTFE	polymer	GP	-5 to 80 °C	Pt100	6 bar (87 psi)	BNC + lead	15 m

Low Temperature pH Electrodes

Code	Range	Body	Junction	Electrolyte	Glass Type	Temperature	ATC	Max Pressure	Connector	Cable
HI6100605	0-12	PVDF	double, PTFE	polymer	LT	-10 to 80 °C	–	6 bar (87 psi)	BNC	5 m
HI6101605	0-12	PVDF	double, PTFE	polymer	LT	-10 to 80 °C	Pt100	6 bar (87 psi)	BNC + lead	5 m

High Temperature pH Electrodes

Code	Range	Body	Junction	Electrolyte	Glass Type	Temperature	ATC	Max Pressure	Connector	Cable
HI6100805	0-14	PVDF	double, PTFE	polymer	HT	0 to 100 °C	–	6 bar (87 psi)	BNC	5 m
HI6101805	0-14	PVDF	double, PTFE	polymer	HT	0 to 100 °C	Pt100	6 bar (87 psi)	BNC + lead	5 m

pH Electrodes for Acid Samples with Fluoride Ions (F- max 2 g/L, Temperature Max 60 °C, pH >2)

Code	Range	Body	Junction	Electrolyte	Glass Type	Temperature	ATC	Max Pressure	Connector	Cable
HI6100205	0-10	PVDF	double, PTFE	polymer	HF	-5 to 60 °C	–	6 bar (87 psi)	BNC	5 m
HI6101205	0-10	PVDF	double, PTFE	polymer	HF	-5 to 60 °C	Pt100	6 bar (87 psi)	BNC + lead	5 m

AmpHel® Flat-tip ORP Electrodes

Platinum Type ORP Sensors

Code	Range	Body	Junction	Electrolyte	Temperature	ATC	Max Pressure	Connector	Cable
HI6200405	±2000 mV	PVDF	double, PTFE	polymer	-5 to 100 °C	–	6 bar (87 psi)	BNC	5 m

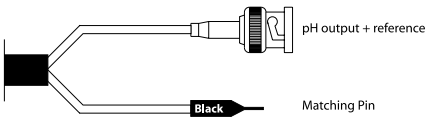
Gold Type ORP Sensors

Code	Range	Body	Junction	Electrolyte	Temperature	ATC	Max Pressure	Connector	Cable
HI6200505	±2000 mV	PVDF	double, PTFE	polymer	-5 to 100 °C	–	6 bar (87 psi)	BNC	5 m

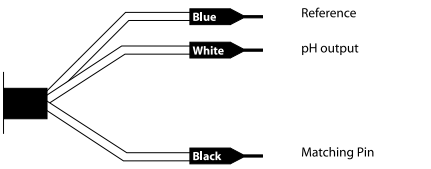
Flat Tip Industrial Electrodes Electrical Connections and Installation

Electrical Connections

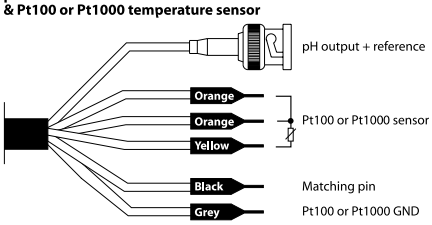
pH & ORP electrodes with BNC connector



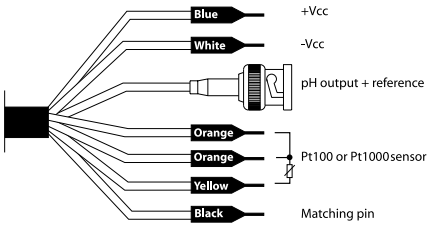
pH & ORP electrodes with direct wire connection



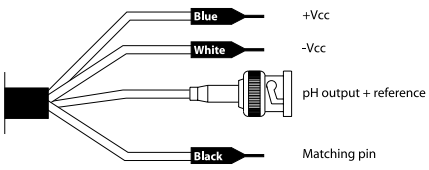
pH electrodes with BNC connector & Pt100 or Pt1000 temperature sensor



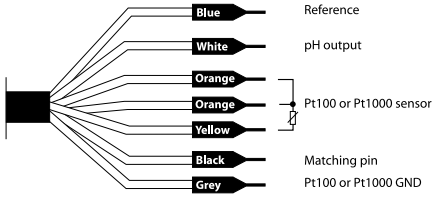
pH electrodes with BNC connector & Pt100 or Pt1000 temperature sensor, amplified



pH & ORP electrodes with BNC connector, amplified



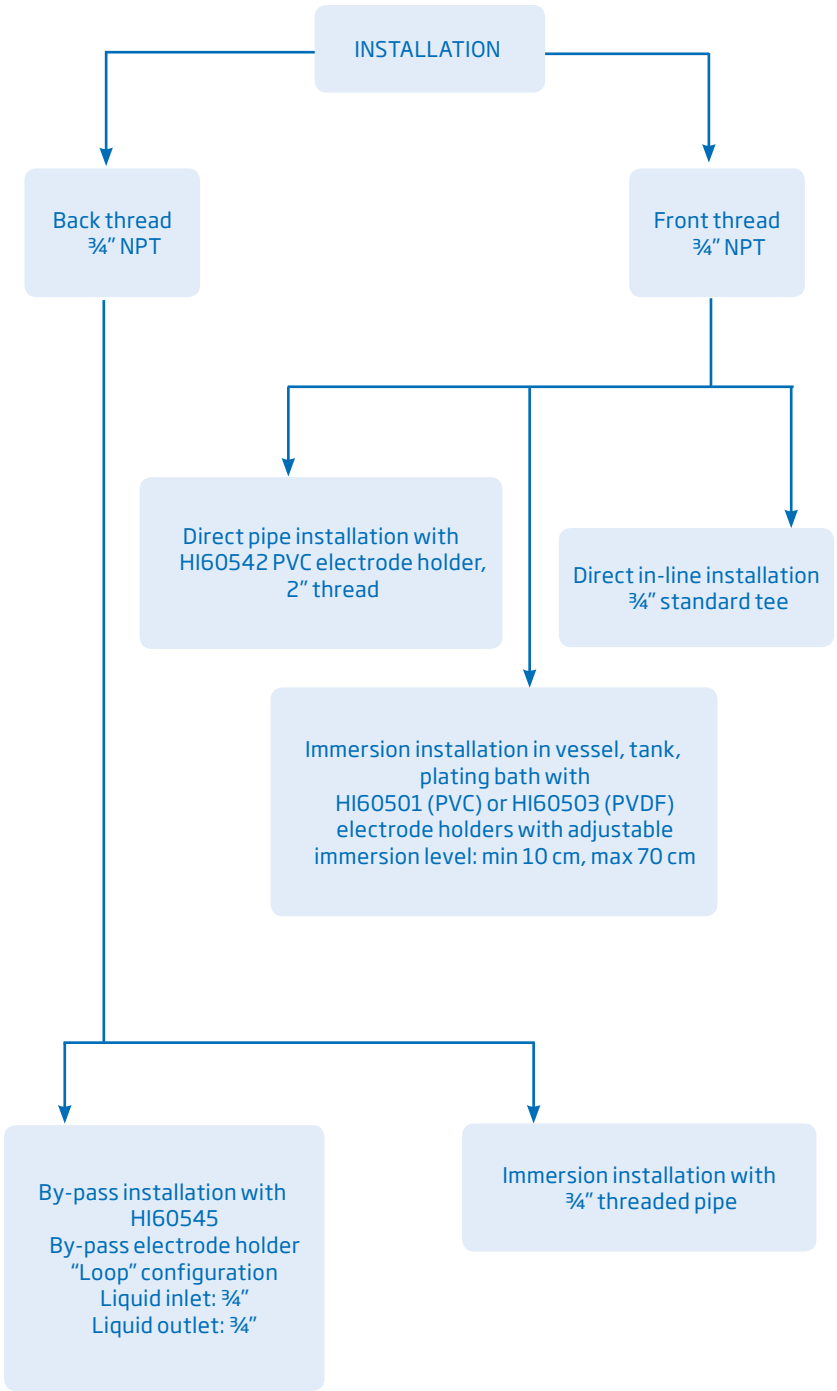
pH electrodes with direct wire connection & Pt100 or Pt1000 temperature sensor



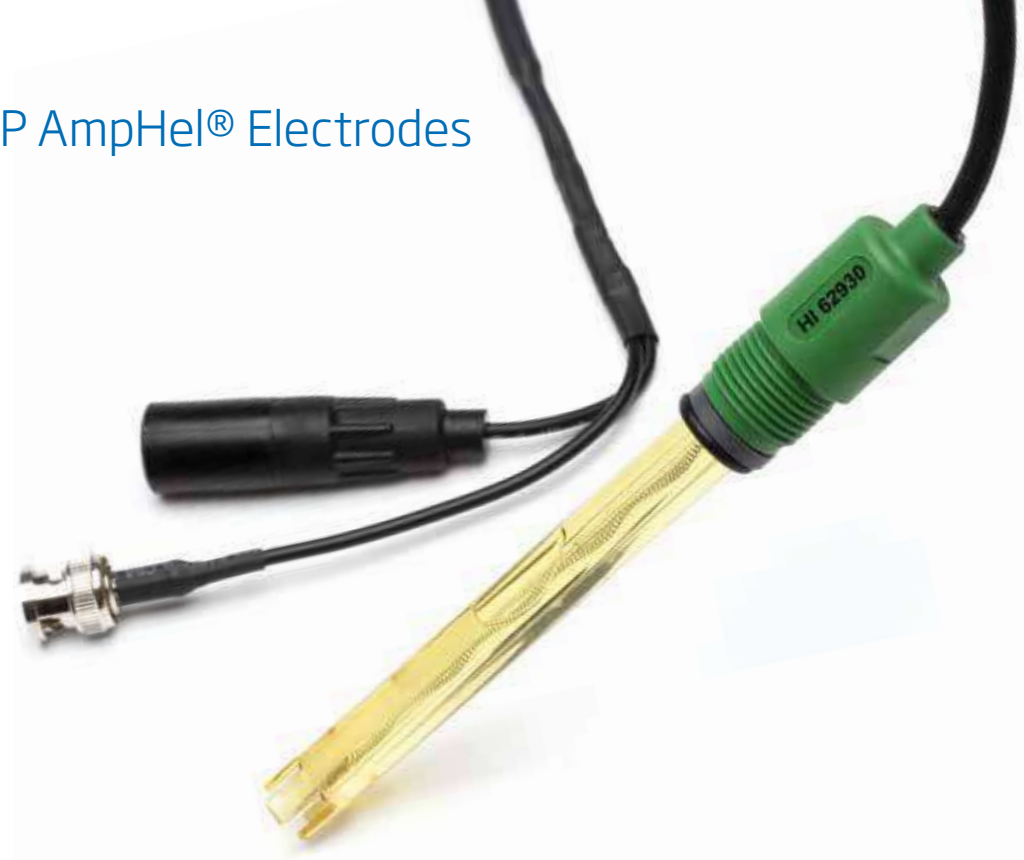
Installation

These electrodes have been designed with ¾" external thread on both ends for easy installation.

Hanna also provides a series of probe holders for in-line, tank or by-pass installations for these electrodes, as shown below.



Amplified pH and ORP AmpHel® Electrodes



- Strong signal up to 75 meters (246')
- Low noise coaxial cables are no longer required
- Measurements in unclean samples and high humidity conditions
- Models with external replaceable battery, for longer electrode life
- Glass sensor for specific applications

Due to the high resistance of the glass membrane, conventional electrodes require a high impedance measurement system. Inadequate insulation of the connectors and cables results in erroneous readings due to leakage or noise. For conventional electrodes, the lead is therefore limited to typically less than 15-20 meters. Hanna AmpHel® electrodes incorporate a miniaturized amplifier which resolves most of the problems associated with high impedance signals. The amplifier circuitry is located right on top of the electrode and is completely sealed. As a result, a strong, low impedance signal is emitted and ordinary connectors with long unshielded cables can be used. This breakthrough technology provides a stable signal for industrial monitoring as well as a major saving in low noise coaxial cable costs. In some cases, the need for a transmitter is also eliminated, resulting in further cost reductions.

For those applications that have been proven particularly hostile to electrodes, Hanna has developed four types of specialized glass. First is an extremely durable sensor glass for general purpose and industrial use. This glass can withstand the stress of daily use. The remaining types of electrode glass allow continuous monitoring in highly acidic solutions containing fluoride ions, as well as high or low temperature process streams, without significantly reducing the life of the electrode.

The electrode body material is glass or PEI, while the junction is cloth or PTFE.

Hanna Glass Sensors for Process Electrodes

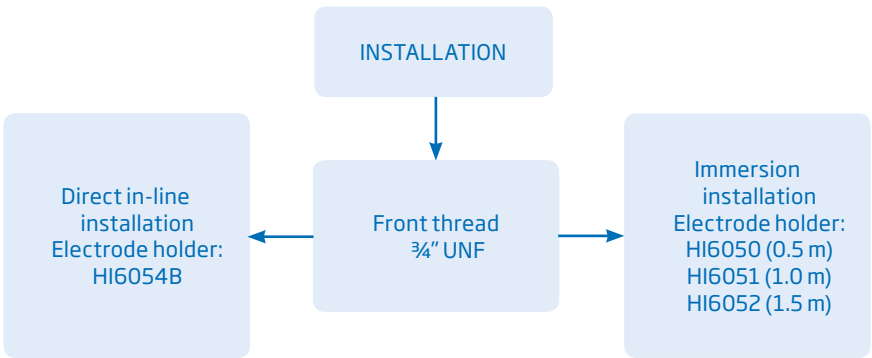
Glass Membrane	Application
GP	General Purpose
HT	High Temperature
LT	Low Temperature
HF	Samples with Fluoride

- Extend Electrode Life
  - With the AmpHel® replaceable battery model, it is no longer necessary to throw away an electrode when the battery is exhausted.

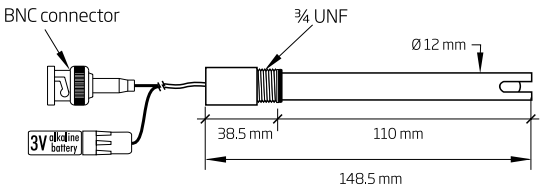
Easy Installation

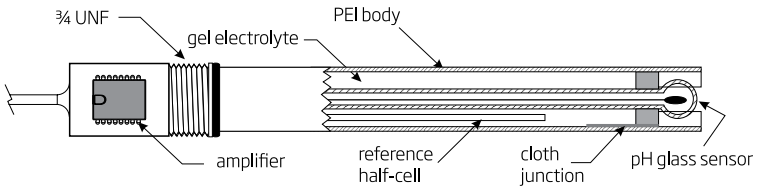
Models with glass body and PTFE junctions are recommended for in-line installations.

Models with an PEI body and cloth junction are suitable for tank monitoring or for use with portable meters, where the electrode can be easily accessed for maintenance.



Amplified pH and ORP AmpHel® Electrodes





AmpHel® pH Electrodes with Replaceable Battery - General Purpose pH Electrodes

Code	Body	Junction	Electrolyte	Glass Type	Temperature	Max Pressure	Connector	Cable
HI6291005	PEI	cloth	gel	GP	-5 to 70 °C	3 bar	BNC	5 m
HI6291010	PEI	cloth	gel	GP	-5 to 70 °C	3 bar	BNC	10 m

AmpHel® pH Electrodes with Replaceable Battery - High Temperature pH Electrodes

Code	Body	Junction	Electrolyte	Glass Type	Temperature	Max Pressure	Connector	Cable
HI8299505	glass	PTFE	polymer	HT	0 to 100 °C	3 bar	BNC	5 m


HI2911


HI2931

AmpHel® pH Electrodes with Internal Battery

Code	Body	Junction	Electrolyte	Glass Type	Temperature	Max Pressure	Connector	Cable
HI2910B	PEI	cloth	gel	GP	-5 to 70 °C	3 bar (43.5 psi)	BNC	1 m
HI2910B/5	PEI	cloth	gel	GP	-5 to 70 °C	3 bar (43.5 psi)	BNC	5 m
HI2911B/5	PEI	PTFE	polymer	GP	-5 to 80 °C	3 bar (43.5 psi)	BNC	5 m

AmpHel® ORP Electrodes with Replaceable Battery

Code	Body	Junction	Electrolyte	PIN Type	Temperature	Max Pressure	Connector	Cable
HI6293005	PEI	cloth	gel	platinum	-5 to 80 °C	3 bar (43.5 psi)	BNC	5 m
HI6493005	PEI	cloth	gel	gold	-5 to 80 °C	3 bar (43.5 psi)	BNC	5 m

AmpHel® ORP Electrodes with Internal Battery

Code	Body	Junction	Electrolyte	PIN Type	Temperature	Max Pressure	Connector	Cable
HI2930B/5	PEI	cloth	gel	platinum	-5 to 80 °C	3 bar (43.5 psi)	BNC	5 m
HI2931B/5	PEI	PTFE	gel	platinum	-5 to 80 °C	3 bar (43.5 psi)	BNC	5 m

HI1000 and HI2000 Series

pH and ORP Electrodes for Continuous Flow-thru Monitoring

Specifically Built for Industrial Applications

- ½" NPT external thread for in-line installation
- pH electrode with exclusive PTFE non-clogging membrane
- Double-junction technology
- PVDF body
- Models with built-in matching pin and amplifier

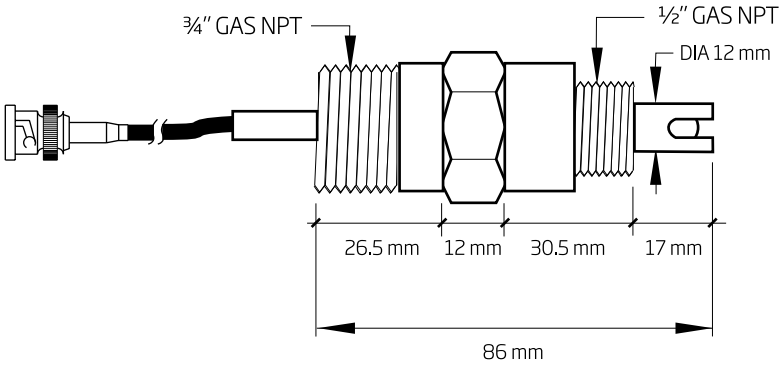
Matching pin with differential input for grounding

In order to reduce normal contamination coming from industrial use, these electrodes combine a polymer reference and double-junction technology. With this technology, no refilling is required and the electrode can be used in samples such as organic compounds, proteins and heavy metals. In addition, the pH electrodes use a unique annular PTFE junction that minimizes clogging.

These industrial probes have a glass body electrode for use in aggressive chemicals and are easy to clean. A PEI protective sleeve gives the electrodes resistance against mechanical stress. Operating limits are -5 to 80°C (23 to 176°F) and pressure up to 6 bar (87 psi).

Both pH and ORP models are available, many of which include a built-in matching pin. Some models also feature a built-in amplifier, which allows for measurements to be taken far from the location of the instrument without requiring a transmitter.

HI1000 and HI2000 series incorporate a BNC connector that enables connection to any pH/ORP meter quickly and easily. Models with 3 or 5 meters (9.8 or 16 feet) cable are available.



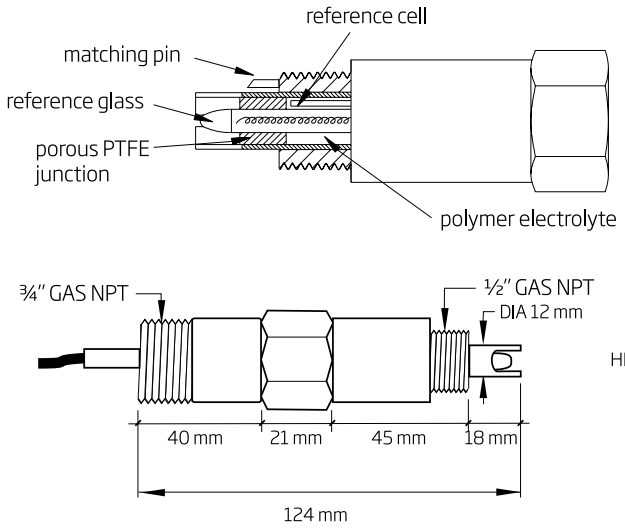
HI1000 and HI2000 series

HI1001 and HI 1005 (pH Electrodes) and HI2001 (ORP Electrode with Pt sensor)

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector	Cable
HI1001	double, PTFE	polymer	-5 to 80°C - HT	6 bar (87 psi)	BNC	3 m
HI1005	double, PTFE	polymer	-5 to 80°C	6 bar (87 psi)	DIN	0.5 m
HI2001	double, PTFE	polymer	-5 to 80°C	6 bar (87 psi)	BNC	3 m

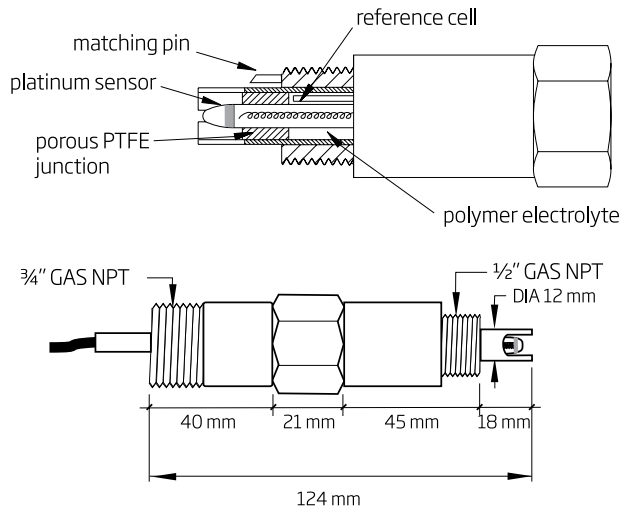
pH and ORP Electrodes for Continuous Flow-thru Monitoring

Specifically Built for Industrial Applications



HI1000 Series: pH Electrodes

Code	Junction	Electrolyte	Matching Pin	Amplifier	Temperature	Max Pressure	Connector	Cable
HI1002/3	double, PTFE	polymer	–	–	-5 to 80°C - HT	6 bar (87 psi)	BNC	3 m
HI1002/5	double, PTFE	polymer	–	–	-5 to 80°C - HT	6 bar (87 psi)	BNC	5 m
HI1002/10	double, PTFE	polymer	–	–	-5 to 80°C	6 bar (87 psi)	BNC	10 m
HI1003/3	double, PTFE	polymer	yes	–	-5 to 80°C - HT	6 bar (87 psi)	BNC	3 m
HI1003/5	double, PTFE	polymer	yes	–	-5 to 80°C - HT	6 bar (87 psi)	BNC	5 m
HI1004/15	double, PTFE	polymer	yes	yes	-5 to 80°C	6 bar (87 psi)	spade lug	15 m



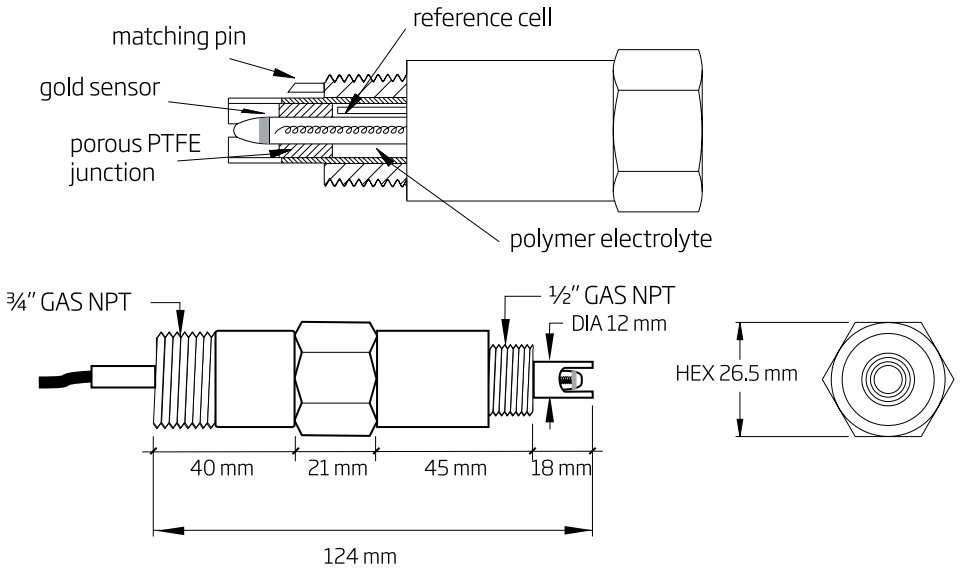
HI2000 Series: ORP Electrodes with Platinum Sensor

Code	Junction	Electrolyte	Matching Pin	Amplifier	Temperature	Max Pressure	Connector	Cable
HI2002/3	double, PTFE	polymer	–	–	-5 to 80°C	6 bar (87 psi)	BNC	3 m
HI2002/5	double, PTFE	polymer	–	–	-5 to 80°C	6 bar (87 psi)	BNC	5 m
HI2003/3	double, PTFE	polymer	yes	–	-5 to 80°C	6 bar (87 psi)	BNC	3 m
HI2003/5	double, PTFE	polymer	yes	–	-5 to 80°C	6 bar (87 psi)	BNC	5 m

HI1000 and HI2000 Series

pH and ORP Electrodes for Continuous Flow-thru Monitoring

Specifically Built for Industrial Applications

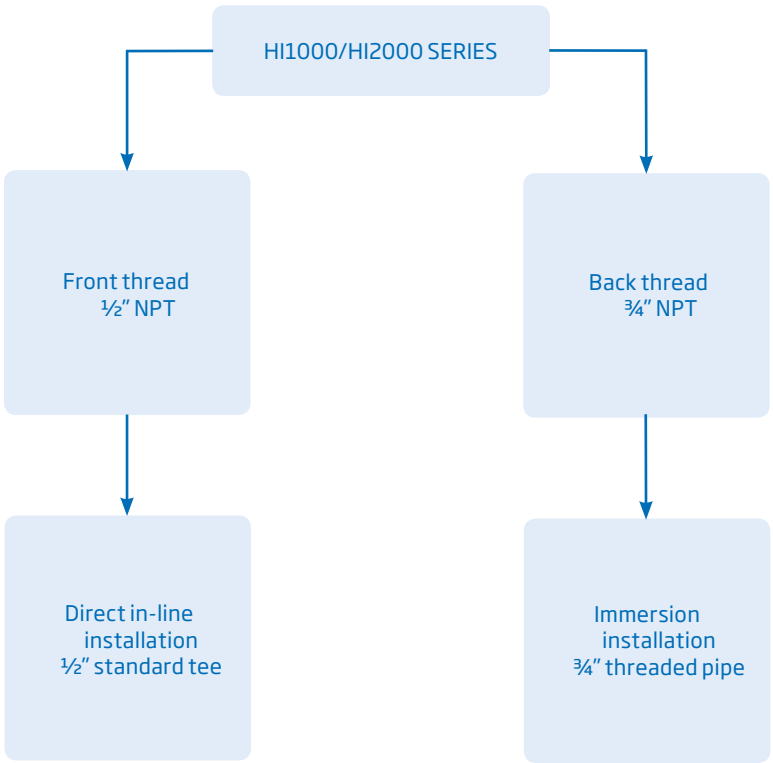


HI2000 Series: ORP Electrodes with Gold Sensor

Code	Junction	Electrolyte	Matching Pin	Amplifier	Temperature	Max Pressure	Connector	Cable
HI2008	double, PTFE	polymer	yes	yes	-5 to 80°C	6 bar (87 psi)	DIN	0.5 m

Installation

These sensors have a hex-shaped body for easy installation, requiring no special tools. Continuous in-line mounting is possible due to the ½" external thread. No special holders are required: HI1000 and HI2000 series can be used with any standard ½" pipe tee available on the market. On the opposite end, these probes are provided with a ¾" thread so that they can be attached to a pipe for dip applications.



Easy pH and ORP Electrodes

with Quick and Easy BNC Connection

- BNC connector
- Submersion and in-line installation capability
- PEI and glass body

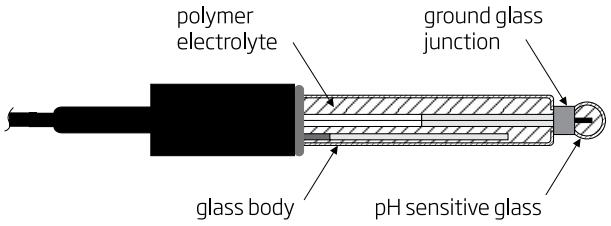
Hanna offers a wide range of combination pH and ORP electrodes specifically designed for the needs of industrial users.

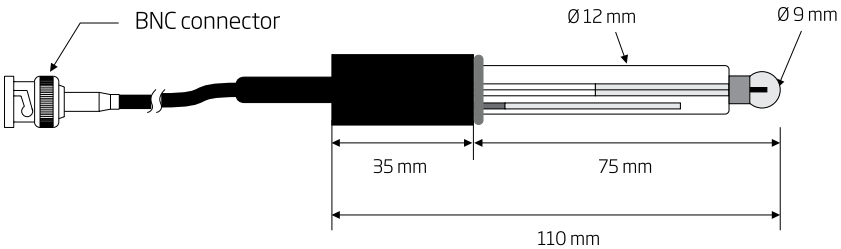
In order to reduce contamination problems, all electrodes are gel or polymer filled and feature double-junction technology.

The BNC connector allows quick and easy connection to any pH/ORP meter or transmitter. In addition to this type of connection, select models offer a ¾" UNF thread for secure in-line installation.

PEI and glass body electrodes are available. PEI bodied electrodes are rugged and suitable for applications in which the capability to resist stress is needed. Glass body electrodes are easier to clean and recommended for use in aggressive chemicals.

All Hanna pH and ORP electrodes can be mounted with the Hanna in-line and submersion assemblies.



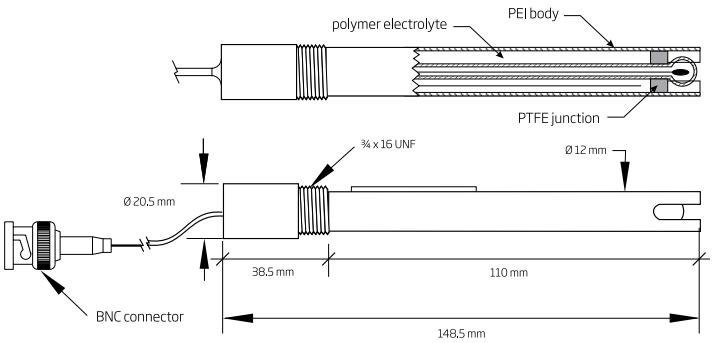


Combination Glass-body pH Electrode

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector	Cable
HI1090B/5	double, ground glass	polymer	-5 to 95°C (23-203°F) - HT	3 bar (43.5 psi)	BNC	5 m

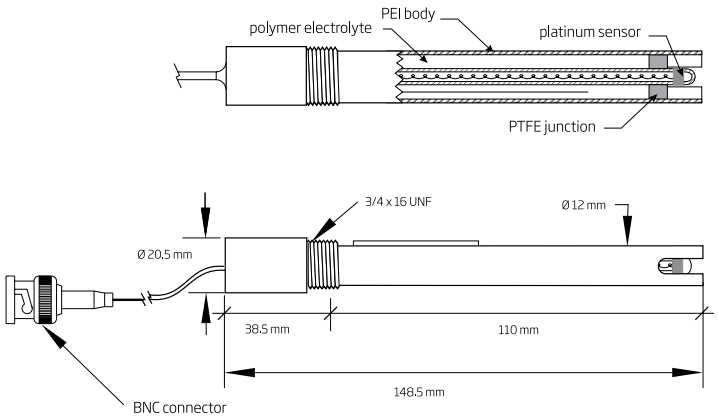
Easy pH and ORP Electrodes

with Quick and Easy BNC Connection



Combination PEI-body pH Electrode

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector	Cable
HI1210B/5	double, PTFE	polymer	-5 to 80°C - GP	3 bar (43.5 psi)	BNC	5 m



Combination PEI-body ORP Electrode with Platinum Sensor

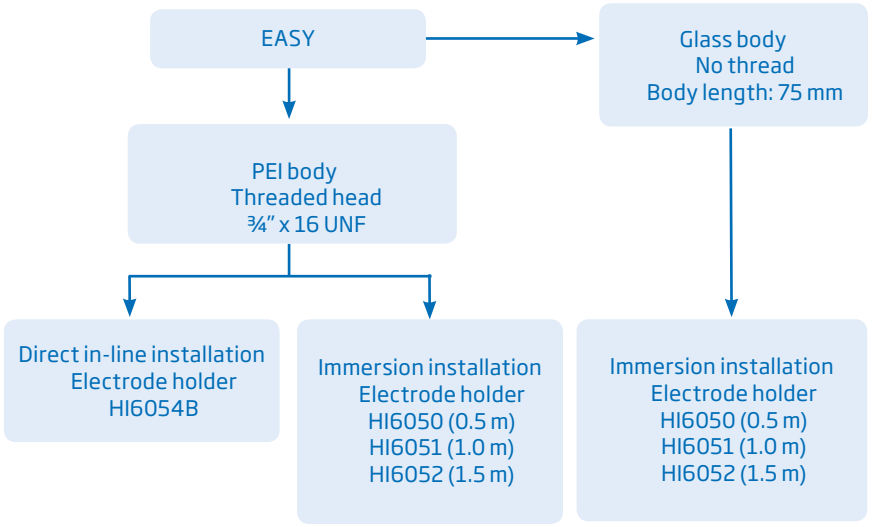
Code	Junction	Electrolyte	Temperature	Max Pressure	Connector	Cable
HI3210B/5	double, PTFE	polymer	-5 to 80°C	3 bar (43.5 psi)	BNC	5 m
HI3130B	single, ceramic	gel	0 to 80°C	3 bar (43.5 psi)	BNC	1 m

Installation

These electrodes feature flexible installation, with different mounting configurations available

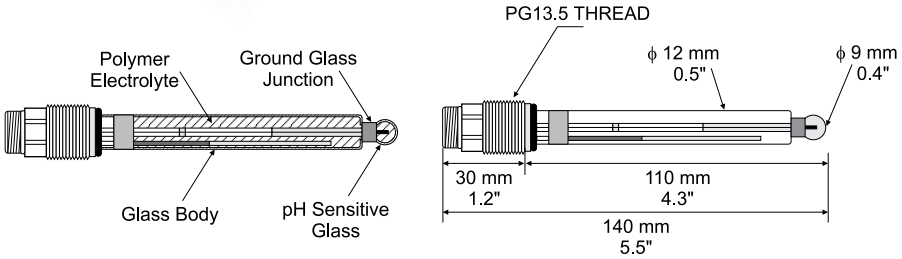
Models with a glass body and no external thread can be installed on tanks using the HI6050 electrode holder with sealing O-ring.

Models with a PEI body and ¾" UNF thread or glass body and no thread can be easily installed directly in-line, using a T-shaped electrode holder, such as HI6054B.



pH and ORP Electrodes

with T-type Connection



- Screw cap connector and PG 13.5 thread
- Easy operation
- Double-junction technology
- Pressure up to 3 bar (43.5 PSI)

Electrodes featuring a T-connector have been designed by Hanna to take advantage of both PG 13.5 thread and screw cap. The PG 13.5 thread ensures proper in-line installation; furthermore, the user can quickly and easily perform all servicing and maintenance procedures. The screw cap allows for maximum versatility making it possible to connect a cable of different lengths. Easily detacheable cables make electrode replacement simple.

Many models are available to choose from, all of which feature a double junction of gel polymer filling to ensure long electrode life and reliability in harsh environments. In addition, users can select from ground-glass or cloth junction technology to meet the needs of their specific application.

Electrodes featuring a PEI body are ideal for use in moderately aggressive liquids, such as in wastewater, while electrodes featuring glass bodies are recommended with more aggressive chemicals, such as in galvanic applications.

These sensors are suitable to be operated with moderate pressure up to 3 bar (43.5 psi) and operating temperature limits of -5 up to 95°C (23 to 203°F).

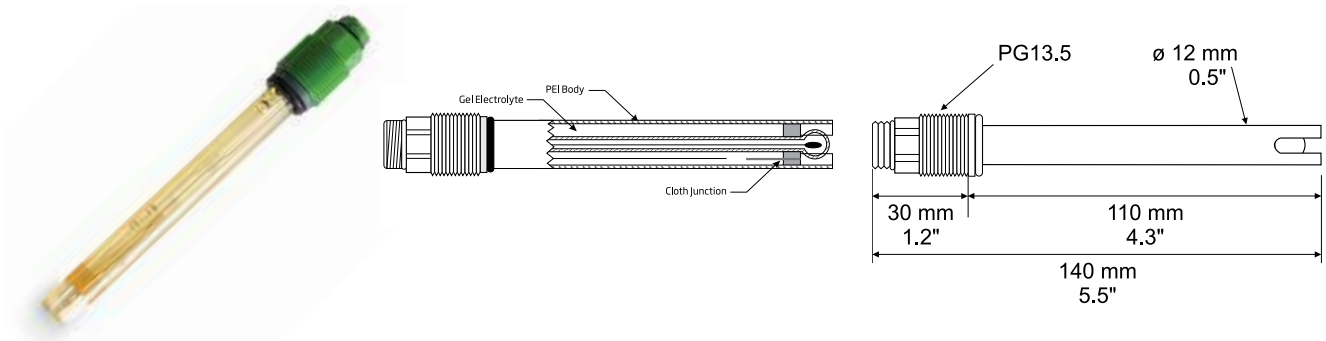
Hanna electrode holders and assemblies are featured at the end of this section for in-line and submersion applications. These optional accessories can be dismantled and reassembled easily without requiring any special tools.

Combination Glass-body pH Electrode

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector
HI1190T	double, PTFE	polymer	-15 to 80°C (5 to 176°F) - LT	6 bar (87 psi)	T-type
HI1191T	double, PTFE	polymer	-15 to 80°C (5 to 176°F) - LT	8 bar (116 psi)	T-type
HI1192T	double, PTFE	polymer	-15 to 80°C (5 to 176°F) - LT	8 bar (116 psi)	T-type

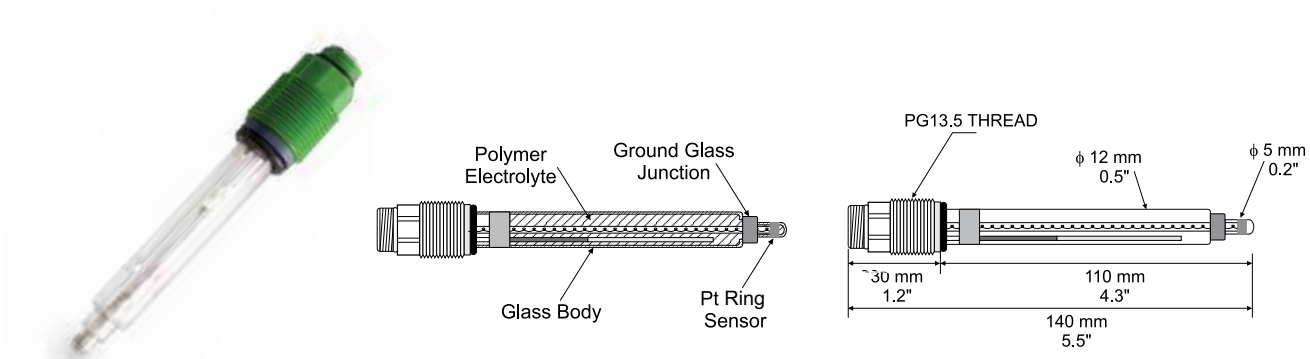
pH and ORP Electrodes

with T-type Connection



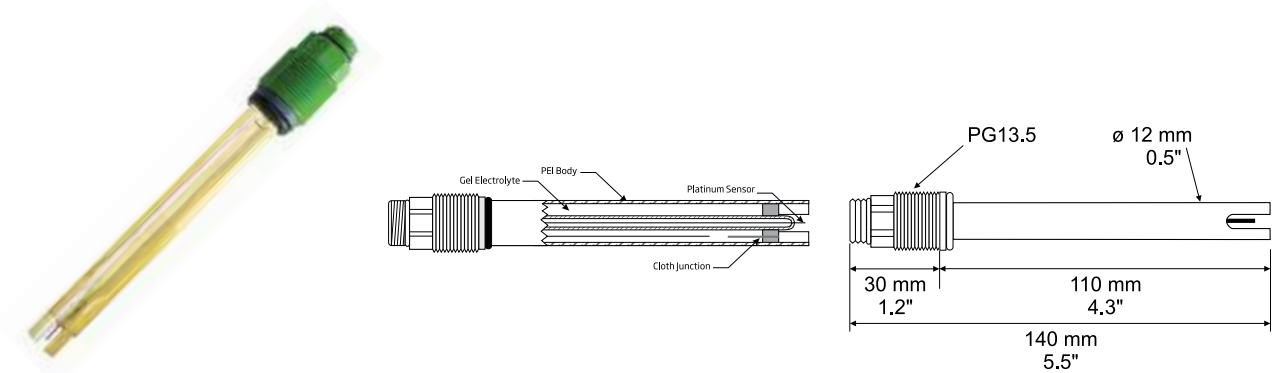
Combination PEI-body pH Electrode

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector
HI1210T	double, cloth	gel	-5 to 80°C (23 to 176°F) - GP	3 bar (43.5 psi)	T-type
HI1211T	double, PTFE	polymer	-5 to 80°C (23 to 176°F) - HT	3 bar (43.5 psi)	T-type



Combination Glass-body ORP Electrode with Platinum Sensor

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector
HI3090T	double, ground glass	polymer	-5 to 95°C (23 to 203°F)	3 bar (43.5 psi)	T-type
HI3190T	double, PTFE	polymer	-15 to 100°C (5 to 212°F)	6 bar (87 psi)	T-type
HI3211T	double, cloth	gel	-5 to 80°C (23 to 176°F)	3 bar (43.5 psi)	T-type

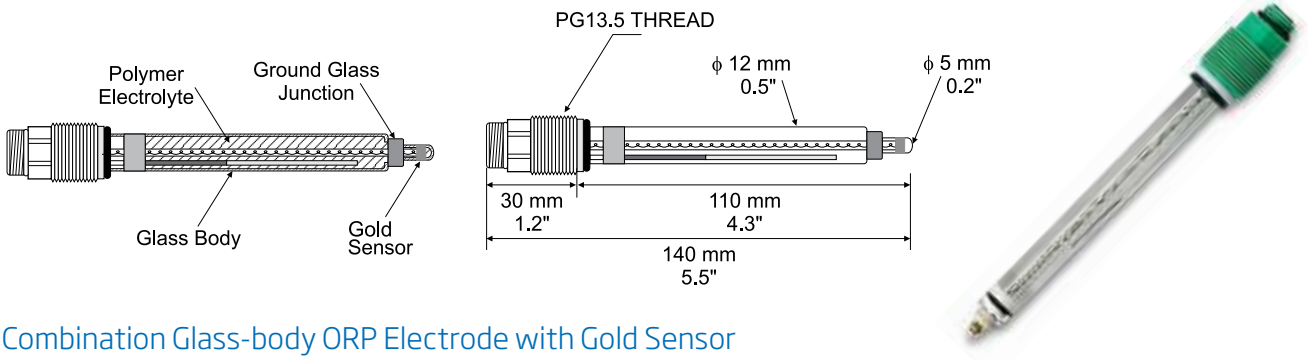


Combination PEI-body ORP Electrode with Platinum Sensor

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector
HI3210T	double, cloth	gel	-5 to 80°C (23 to 176°F)	3 bar (43.5 psi)	T-type

pH and ORP Electrodes

with T-type Connection



Combination Glass-body ORP Electrode with Gold Sensor

Code	Junction	Electrolyte	Temperature	Max Pressure	Connector
HI4190T	double, PTFE	polymer	-5 to 80°C (23 to 176°F)	3 bar (43.5 psi)	T-type
HI4290T	single, ground glass	polymer	-5 to 80°C (23 to 176°F)	3 bar (43.5 psi)	T-type

pH and ORP Immersion and In-Line Electrodes

Code	HI101	HI102	HI201
Description	submersible pH electrode	in-line pH electrode	submersible ORP electrode
Reference	double, Ag/AgCl	double, Ag/AgCl	double, Ag/AgCl
Junction / Flow Rate	PTFE	PTFE	PTFE
Electrolyte	polymer	polymer	polymer
Max Pressure	6 bar (25°C)	6 bar (25°C)	6 bar (25°C)
Range	pH: 0 to 13	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F) - GP	20 to 40°C (68 to 104°F) - GP	20 to 40°C (68 to 104°F)
Tip /Shape	flat	flat	flat, platinum
Temperature Sensor	no	no	no
Amplifier	no	no	no
Body Material	PVC	PVC	PVC
Connector	BNC female	BNC female	BNC female
Connection Cable	HI101/3 adapter with 3 m (9.9') cable	HI101/3 adapter with 3 m (9.9') cable	HI101/3 adapter with 3 m (9.9') cable
Recommended Use	Immersion	In-line	Immersion

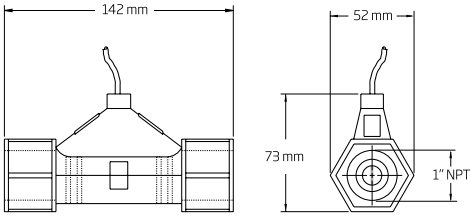
HI7635

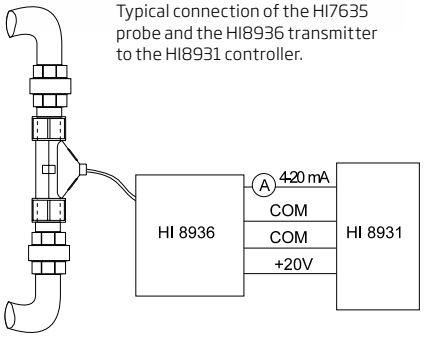
In-line Conductivity Probes

These conductivity probes combine the proven four-ring potentiometric method of measuring conductivity with platinum sensors. The universally acclaimed four-ring method provides an exceptionally stable measurement over a wider range. These probes do not suffer polarization, nor do they need frequent calibration or cell changes.

The built-in temperature sensor (select models) allows automatically temperature compensated measurements and features easy operation and maintenance.

The majority of probes are provided with a 4 m cable incorporating color coded wires for easy connection to HI8936 transmitters while others provide a DIN connection.





Typical connection of the HI7635 probe and the HI8936 transmitter to the HI8931 controller.

Code	Temperature Compansation	Body	Operating Temperature	Max Pressure (@25°C/77°F)	Cable/ Connection
HI7635	automatic, 0 to 50°C with NTC sensor	polypropylene	0 to 80°C (32 to 176°F)	5 bar	4 m (13.1')/Color coded wires

HI7638 · HI7639

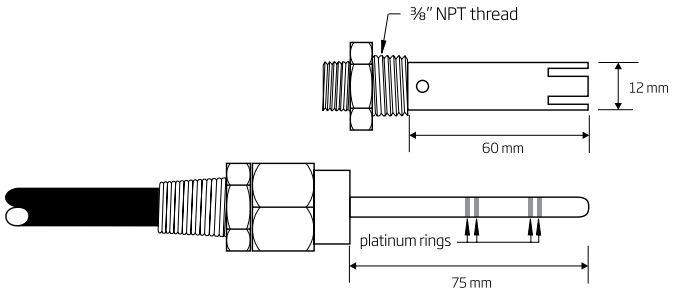
In-line Conductivity Probes

with Platinum Ring

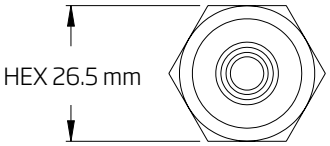
These conductivity probes combine the proven four-ring potentiometric method of measuring conductivity with platinum sensors. The universally acclaimed four-ring method provides an exceptionally stable measurement over a wider range. These probes do not suffer polarization, nor do they need frequent calibration or cell changes.

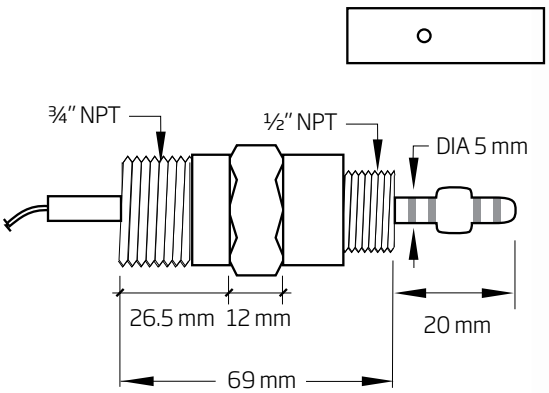
HI7638 and HI7639's built-in temperature sensor allows automatically temperature compensated measurements and features easy operation and maintenance.

HI7639



Code	Temperature Compensation	Body	Operating Temperature	Max Pressure (@25°C/77°F)	Cable/Connection
HI7638	automatic, 0 to 50°C with NTC sensor	PEI and glass	0 to 120°C (32 to 248°F)	5 bar (72.5 psi)	3 m (9.9')/Color coded wires
HI7638/10	automatic, 0 to 50°C with NTC sensor	PEI and glass	0 to 120°C (32 to 248°F)	5 bar (72.5 psi)	10 m (32.8')/Color coded wires
HI7638/20	automatic, 0 to 50°C with NTC sensor	PEI and glass	0 to 120°C (32 to 248°F)	5 bar (72.5 psi)	20 m (65.6')/Color coded wires
HI7639	automatic, 0 to 50°C with Pt100 sensor	PEI and glass	0 to 120°C (32 to 248°F)	5 bar (72.5 psi)	3 m (9.9')/Color coded wires






HI3001

HI3001 · HI3001D · HI3011

Flow-thru Conductivity Probes

These four-ring probes measure conductivity with platinum sensors. They come with standard ½" external thread on the front for flow-thru mounting and ¾" threads on the back for submersion or pipe mounting.

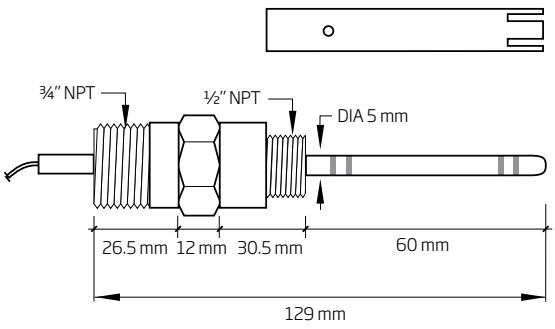
These probes feature 3 m (9.9') of cable and the protective cover is made of PEI and can be removed for quick maintenance. These probes can withstand temperatures up to 80°C (176°F) and 6 bars (87 psi) of pressure.

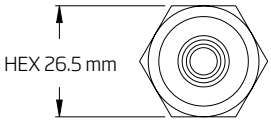
In addition, HI3001 houses an NTC sensor for Automatic Temperature Compensation.

Model HI3001D with DIN connector is to be used with the HI99xx series of wall-mounted controllers.

Code	Temperature Compensation	Body	Operating Temperature	Max Pressure (@25°C/77°F)	Connector	Cable
HI3001	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	–	3 m (9.9')
HI3001D	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	DIN	3 m (9.9')
HI3001D/5	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	DIN	5 m (16.4')
HI3001D/10	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	DIN	10 m (32.8')
HI3003/D*	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	DIN	3 m (9.9')
HI3011	–	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	–	3 m (9.9')

*for HI9914 only






HI3002

HI3002

Submersion Probes

The HI3002 four-ring probe measure EC with platinum sensors. It comes with standard ½" external thread on the front for flow-thru mounting and ¾" threads on the back for submersion or pipe mounting. Probes incorporate 3 m (9.9') of cable.

The protective probe cover is made of PEI and can be removed for quick maintenance. These probes can withstand temperatures up to 80°C (176°F) and 6 bars (87 psi) of pressure. HI3002 also houses an NTC temperature sensor for automatically temperature compensated measurements.

Code	Temperature Compensation	Body	Operating Temperature	Max Pressure (@25°C/77°F)	Connector	Cable
HI3002	automatic, 0 to 60°C with NTC sensor	PEI and PVDF	0 to 80°C (32 to 176°F)	6 bar (87 psi)	–	3 m (9.9')

HI7610 · HI7611

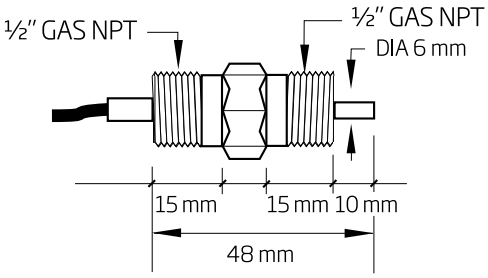
Stainless Steel Temperature Probes

- Flow-through and immersion mounting
- High accuracy
- Stainless steel model with ½" GAS NPT external thread
- Glass version with high chemical resistance and PG 13.5 external thread

HI7610 and HI7611 are temperature probes with 3-wire Pt100 or Pt1000 sensors. These probes provide accurate and effective temperature compensation. They can be used with a vast array of industrial pH, ORP and conductivity controllers on the market, as well as our pH 500, mV 600, HI700 and HI504 series.

HI7610 and HI7611 are constructed of stainless steel for additional ruggedness. They incorporate ½" external threads on both ends to facilitate inline and immersion installations.


HI7610, HI7611



HI7610 and HI7611 Industrial Temperature Probes

Code	Temperature Sensor	Body	Max Pressure	Cable Length
HI7610	Pt100	stainless steel	8 bar	5 m (16.4')
HI7611	Pt1000	stainless steel	8 bar	5 m (16.4')

HI7620 • HI7621

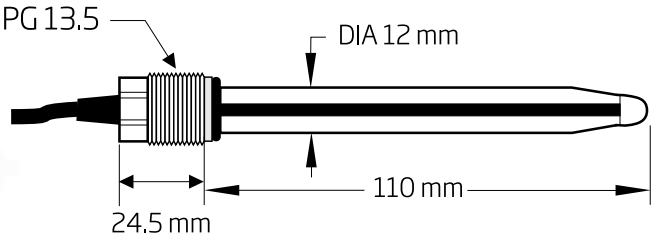
Glass Body Probes

- Flow-thru and immersion mounting
- High accuracy
- Glass body with high chemical resistance and PG 13.5 external thread

HI7620 and HI7621 are temperature probes with 3-wire Pt100 or Pt1000 sensors. These probes provide accurate and effective temperature compensation. They can be used with a vast array of industrial pH, ORP and conductivity controllers on the market, as well as our pH500, mV600, HI700 and HI504 series.

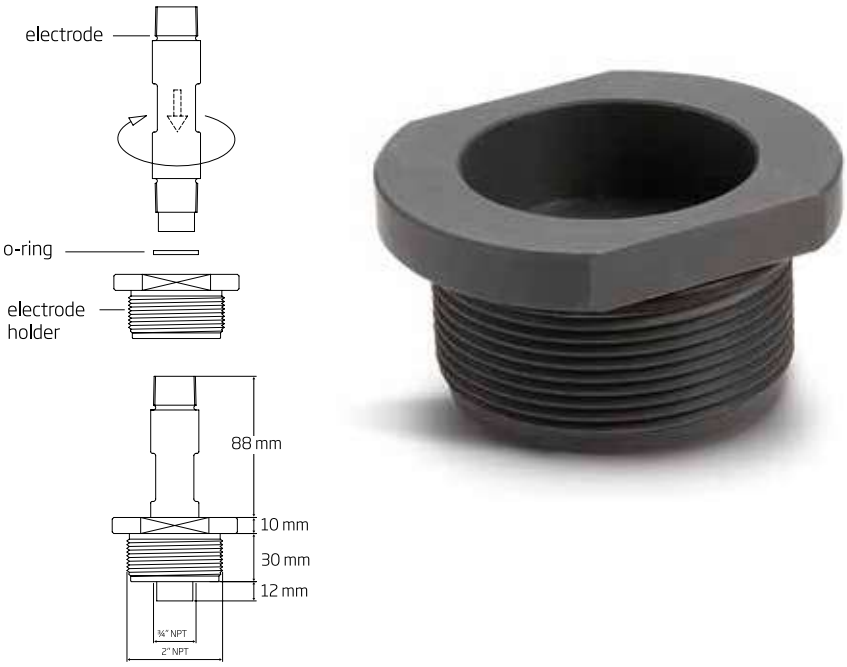
HI7620 and HI7621 are made with a glass body in order to provide greater resistance against aggressive chemicals. They also come with a standard PG 13.5 external thread so that they may be used with our HI6054T holder as well as other common probe holders.


HI7621



HI7620 and HI7621 Industrial Temperature Probes

Code	Temperature Sensor	Body	Max Pressure	Cable Length
HI7620	Pt100	glass	3 bar	5 m (16.4')
HI7621	Pt1000	glass	3 bar	5 m (16.4')



HI60542

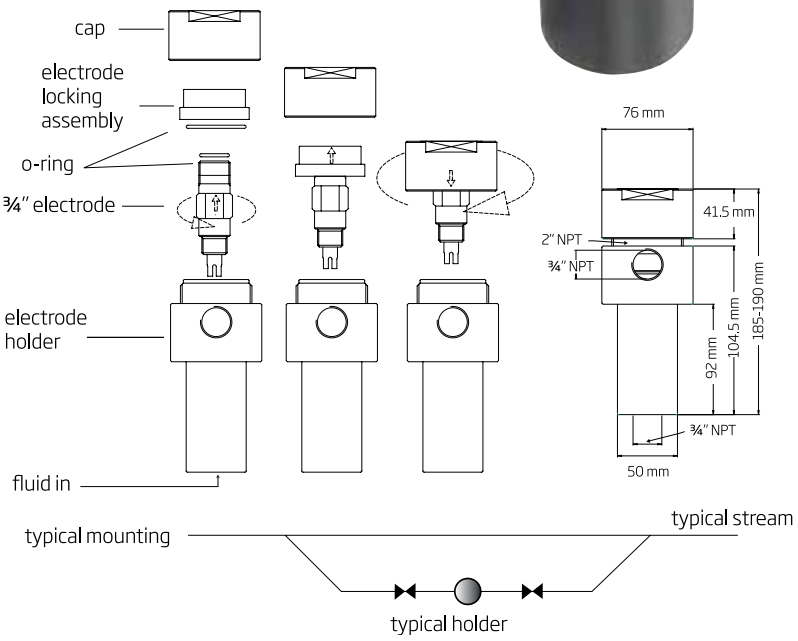
In-line Electrode Holder

for Direct Pipe Installation

HI60542 is a two inch NPT in-line PVC electrode holder ideal for direct pipe installation.

HI60542 has been designed specifically to be used with Hanna ¾" NPT process electrodes with built-in temperature sensor and matching pin.

Specifications	HI60542
Electrode Holder Material	PVC
O-ring Material	NBR (Buna N)
Minimum Temperature	-10 °C
Maximum Temperature	+60 °C
Maximum Pressure	8 bar @25°C or 3 bar @50°C



HI60545

By-pass Loop Electrode Holder

No Downtime

HI60545 is an electrode holder designed for use in a bypass loop configuration.

HI60545 allows easy maintenance and calibration without shutting down the process. The design of HI60545 assures that the glass sensor remains wet even when system is not under pressure.

HI60545 is only for use with Hanna 1006 series probes that have a ¾" NPT fitting.

Specifications	HI60545
Electrode Holder Material	PVC
O-ring Material	NBR (Buna N)
Minimum Temperature	-10 °C
Maximum Temperature	+60 °C
Maximum Pressure	8 bar @25°C or 3 bar @50°C

HI6050

Submersible Electrode Holder

These electrode mounting systems are constructed in rugged PVC and will resist most of the chemicals associated with wastewater treatment.

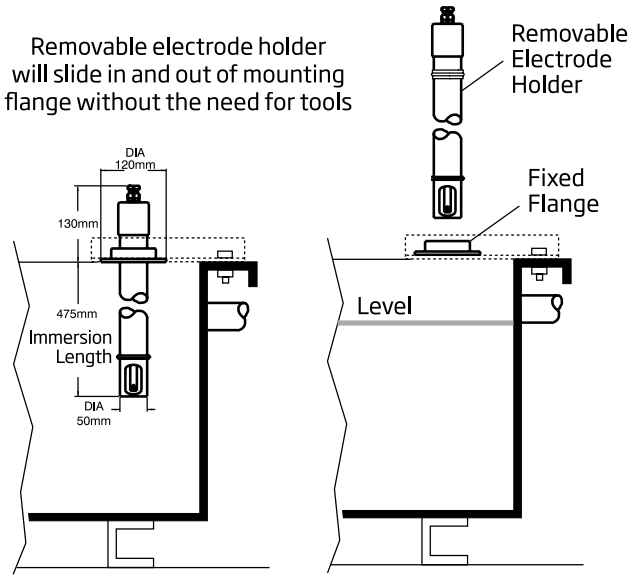
They are easy to install and require no tools for maintenance, making weekly electrode inspection and meter calibration a quick and easy task.

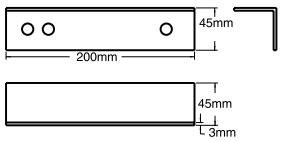
The mounting flange is a rugged PVC piece that mounts directly to the stainless steel brackets on tanks.

The figure illustrates the suggested bracket dimensions used for mounting. Once mounted to the tank, the electrode holder is a sturdy, protective housing that will extend the life of the electrodes.

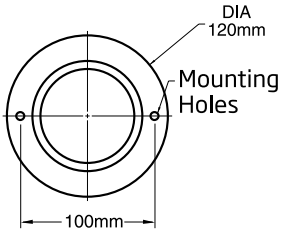
The electrode slides into the holder and is hand tightened into place. The cable from the electrode will lead up through the holder and out through the cap on top. The cable is also shielded inside the holder to prevent any damage to the insulation. The protective cap is removable to allow for quick and simple electrode maintenance and replacement.

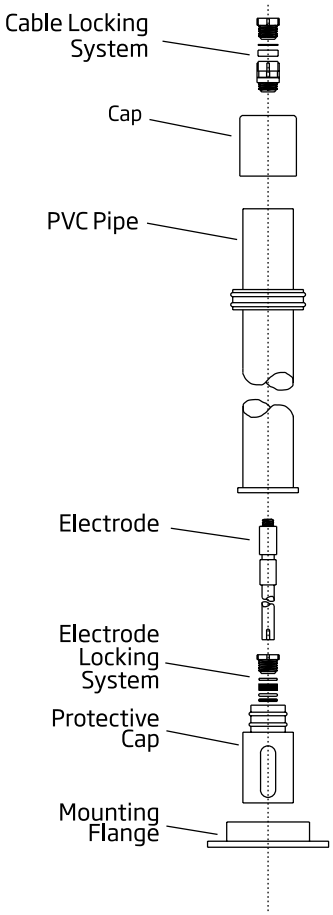
Removable electrode holder will slide in and out of mounting flange without the need for tools





Suggested dimensions of stainless steel mounting brackets to mount the flange onto the tank





Specifications	Total Length	Weight	Submersion Length
HI6050	605 mm (23.8")	0.8 kg (26 oz.)	475 mm (18.7")
HI6051	1105 mm (43.5")	1.2 kg (44 oz.)	975 mm (38.4")
HI6052	1605 mm (63.2")	2.0 kg (71 oz.)	1500 mm (59.1")

HI6054B · HI6054T

Electrode Holders

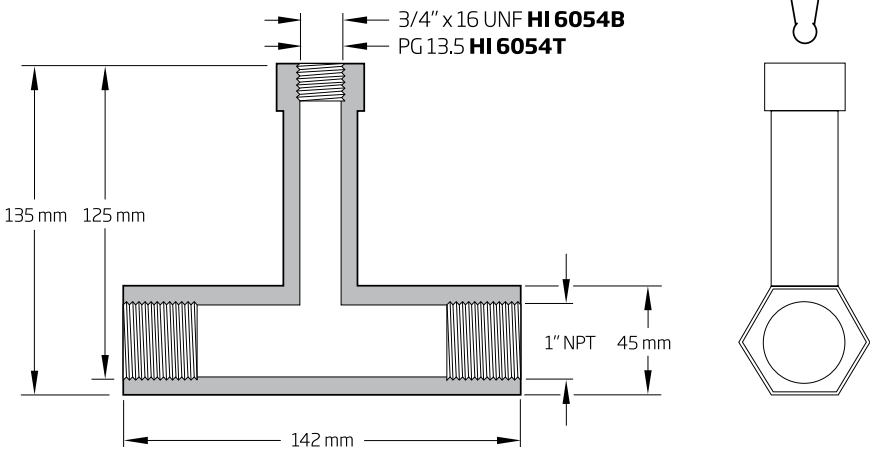
for In-line Applications

The HI6054 is a rugged, fiber-reinforced polypropylene in-line electrode holder.

Simply install the holder in the line so that liquid will always be present inside of it.

Once installed, the electrode will remain in contact with the fluid at all times, allowing the most accurate readings possible.

The HI6054B and HI6054T are designed specifically to work with Hanna electrodes with external thread of ¾" x 16 UNF and PG 13.5 respectively.



Actual Installation Examples

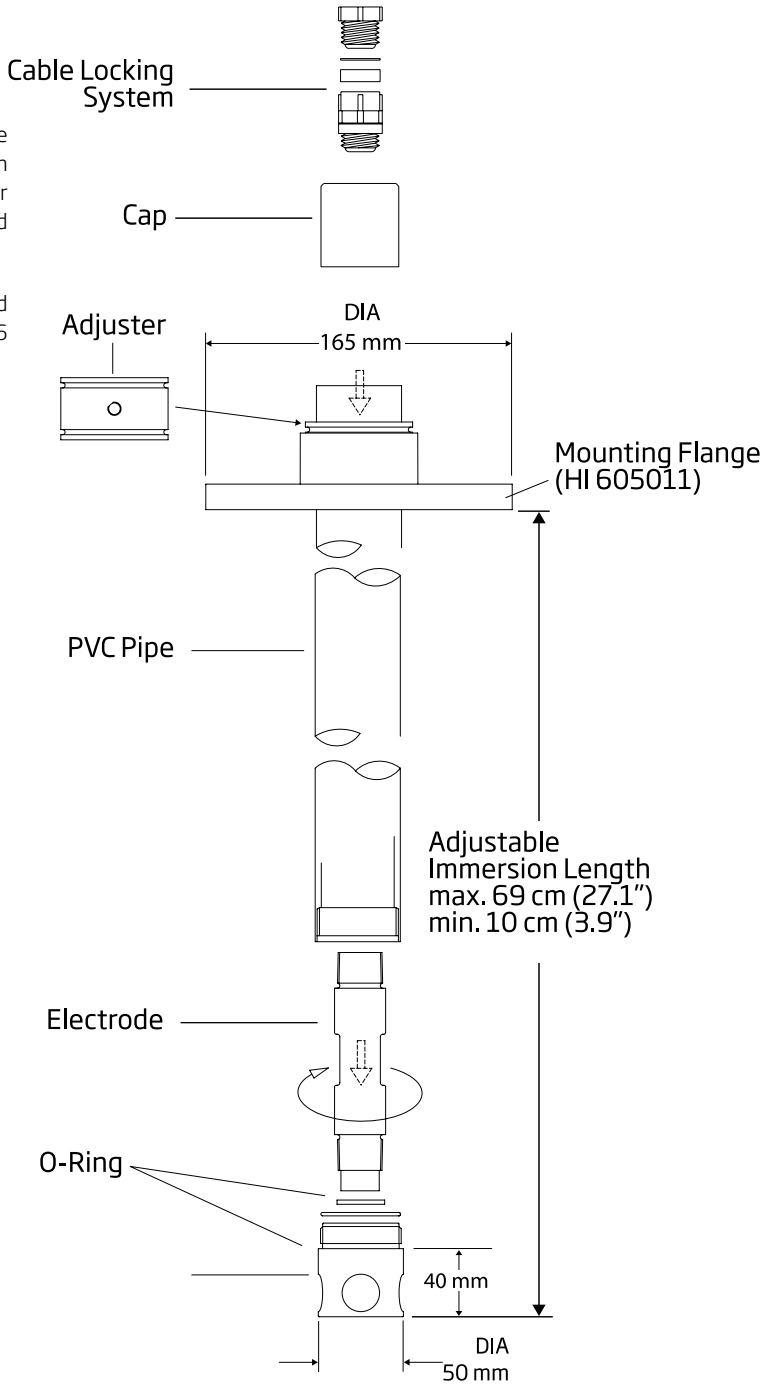
HI60501 · HI60503

Immersion Electrode Holders

for Tanks, Vessels, Baths and Open Channels

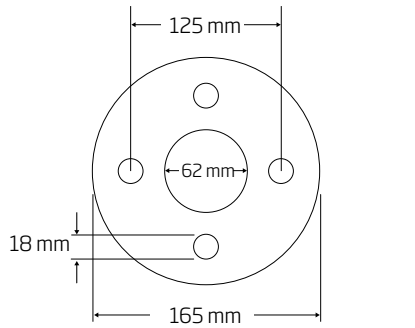
These electrode holders have an adjustable length and have been designed for immersion applications. Simply set the flange adjuster and the flange (HI605011) to the required length and install.

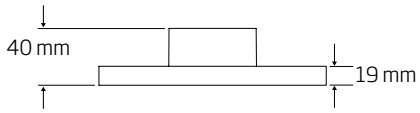
These holders have been designed specifically to be used with Hanna 1006 series probes that have a ¾" NPT fitting.



HI60503

HI 605011
mounting flange





Specifications	HI60501	HI60503
Electrode Holder Material	PVC	PVDF
O-ring Material	NBR (Buna N)	NBR (Buna N)
Minimum Immersion Level	10 cm (3.9")	10 cm (3.9")
Maximum Immersion Level	69 cm (27.1")	69 cm (27.1")
Minimum Temperature	-10°C (14°F)	-15°C (5°F)
Maximum Temperature	+60°C (140°F)	+100°C (212°F)

Table of Contents

IP67 Protection

IP67: The Waterproof Advantage

Hanna waterproof meters comply with the IP67 standards that classify them dust-tight and protected against the effect of temporary immersion in water.

This enables the units to operate in the harshest of environments, protected against spills, dust, high humidity and severe weather conditions. This makes them ideal for outdoor measurements and the most severe industrial applications such as mines, food processing, plating, foundries, etc. Hanna waterproof meters are built to last.

IP67 Protection

IP Codes

This standard describes a system for classifying the degree of protection provided by the enclosure of electrical/electronic equipment. Developed by the European Committee for Electro-Technical Standardization (CENELEC), these standards are designed to numerically rate an electrical product on the level of protection its enclosure provides. By assigning different number codes, the degree of protection of the product can be quickly and easily identified. In the IP67 code, for example, IP signifies International Protection, the first digit 6 indicates the level of protection from solid objects, and the second digit 7 denotes the level of protection from liquids. See the tables below for the details.

DEGREE OF PROTECTION (First Number in the Code)

First #	Description
0	No special protection
1	Protected against solid foreign objects of 50 mm diameter and greater, e.g. human hands
2	Protected against solid foreign objects of 12.5 mm diameter and greater, e.g. human hands
3	Protected against solid foreign objects of 2.5 mm diameter and greater, e.g. tools, thick wire
4	Protected against solid foreign objects of 1.0 mm diameter and greater, e.g. wires, screws
5	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety.
6	No ingress of dust, complete protection

DEGREE OF PROTECTION FROM LIQUIDS (Second Number in the Code)

Second #	Description
0	Not protected
1	Protected against vertically falling water drops
2	Protected against vertically falling water drops tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water, up to 1 m
8	Protected against the effects of continuous immersion in water, beyond 1 m

CE Mark Definition and Compliance

All industries make use of electronic instrumentation for their daily operations. The increased use of electronic equipment in many industries means that more instruments are used together and in conjunction with each other, often in a very restricted area.

Proximity of equipment has increased the likelihood of interferences between various instruments, as well as the instruments and the environment surrounding them. Improper operation of the equipment may result from these undesired Electromagnetic Interferences (EMI).

Electromagnetic Interferences (EMI)

Electromagnetic Interferences are generated by currents which flow into the electronic circuitry of instrumentation. Some electromagnetic interferences originate in nature through atomospheric phenomena, such as lightning and static electricity.

Electromagnetic Compatibility (EMC) Directives define two categories (illustrated below).

Susceptibility

Directives which sets standards for the amount of EMI a device can withstand and still operate normally and without incurring any damage.

Emission Directives

Restrict the amplitude of the signals emerging from a device.

Each category is further sub-divided into:

- Conducted EMI propagated by wires (such as power or connection cables)
- Radiated EMI spread through the air

The effects of these electromagnetic interferences are the main cause for:

- Incorrect equipment operation and therefore, inaccurate measurements
- Damage to the equipment, itself

International Governing bodies have defined the EMI tolerance limits for electronic instruments. The aim is to limit EMI effects and to reach an Electromagnetic Compatibility (EMC) that permits all electronic devices to operate normally, and in proximity with each other, without having an adverse effect on their operation.

Electromagnetic Compatibility

Electromagnetic Compatibility of an instrument means that electromagnetic interferences will not compromise its functionality, and at the same time, the meter itself will not generate interferences which may affect other equipment. In Europe, the CE mark on a product means compliance with the EMC Directives. The products must meet the directives before they can be legally sold. The CE Directive referring the the "Conducted and Radiated Emissions" is designated as EN 50081-1, while EN 50082-1 defines the prerequisites for "Susceptibility to the Conducted and Radiated EMI".

The "Mission Statement" of Hanna's Research and Development is "a complete dedication in designing electroanalytical instruments to monitor and safeguard the environment, in compliance with the CE Directives". The following provides a short list of the significance of CE Norms and how we comply with them.

- Radiated Susceptibility
  - Our instruments are not susceptible to radiation generated by other equipment that in turn can cause improper operation, such as, automatic switching off and/or inaccurate measurements.

- Radiated Emissions
  - The Hanna meters do not emit radiation that might cause improper functioning of other equipment in their proximity (such as switching off and/or inaccurate measurements).

- Susceptibility to Conducted Interferences
  - This is caused mainly by power leads or signal/control cables connecting different devices, which could result in malfunctioning or permanent damage. Hanna products come with this protection

- Electrostatic Discharges
  - Hanna equipment is not susceptible to static electricity from users or objects, whether due to direct contact or proximity. This kind of discharge can cause severe damage to other equipment.
  - Compliance with the CE Directives, ensures reliability and accuracy for products manufactured by Hanna.

Hanna Meter Vs. Meter without CE

To show how susceptible instruments are to outside interference, we had a pH meter without the CE Mark tested against HI 98240 from Hanna (shown below). Both meters had a purported 0.01 pH margin of error.

Both meters were subjected to the effects of an external electro-magnetic field, in accordance with the procedures established by the CE Directives. The graphs show the measurements taken at different frequencies.

As you can see from the histograms, at 3 V/meter and 100 MHz frequency, the Hanna meters stayed within the stated tolerance, wheras the non-CE model displayed an erroneous reading of almost 5 pH! The rest of the graph also demonstrates that the readings from the Hanna meter remained practically unvaried throughout the test.


HANNA instruments

CE

DECLARATION OF CONFORMITY

We

Hanna Instruments Italia Srl
via E.Fermi, 10
35030 Sarmeola di Rubano - PD
ITALY

herewith certify that the pH & temperature meters

HI 98127 and HI 98128

have been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normatives:

EN 50082-1 Electromagnetic Compatibility - Generic Immunity Standard
IEC 801-2 Electrostatic Discharge
IEC 801-3 RF Radiated

EN 50081-1 Electromagnetic Compatibility - Generic Emission Standard
EN 55022 Radiated, Class B

EN61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use

Date of Issue: 19/07/2000

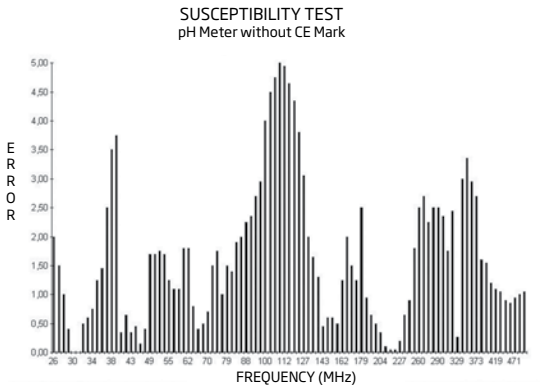
A. Marullo - Technical Director
On behalf of
Hanna Instruments S.r.l.

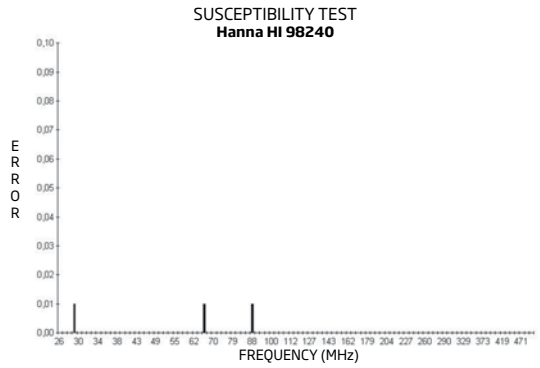
Our commitment to provide quality products for our customers has resulted in instruments manufactured by Hanna, complying with the European Directives

EN 61000-6-1,

EN 61000-6-3 and

EN 61010-1.





ISO 9001:2008 Compliance

ISO Standards

ISO 9000 standards were adopted in 1978 by the International Organization of Standards in Geneva, Switzerland, as a uniform standard of excellence for use in the European Economic Community. The standards were an immediate success and have since been adopted in more than 90 countries around the world, including the USA.

In order to obtain an ISO 9001:2008 Certification, each of the following departments need to comply with rigorous ISO standards:

1. Design/Development: Hanna products are designed, developed and engineered under ISO 9001:2008 standards.
2. Production: Every instrument undergoes stringent Quality Control tests at different stages of manufacturing.
3. Quality Assurance: All meters undergo 100% quality control checks prior to shipment.
4. Installation and Servicing: Hanna provides unsurpassed level of customer service, technical support and after sales assistance.

Hanna is an ISO 9001:2008 certified company. Our production system is certified to guarantee our customers a quality product every time.

With Hanna, you receive products manufactured to the most stringent quality standards.

ABS

Acrylonitrile butadiene styrene is a common thermoplastic.

ABS/LAS

Alkyl benzene sulfonate / Linear alkyl sulfonate (detergents)

Absorbance

Absorption of light is a typical phenomenon of interaction between electromagnetic radiation and matter. When a light beam crosses a substance, some of the radiation may be absorbed by atoms, molecules or crystal lattices.

Accuracy

The accuracy of an analytical procedure expresses the closeness of agreement between the value which is accepted either as a conventional true value or an accepted reference value and the value found.

AISI

The American Iron and Steel Institute.

Alkalinity

The quantitative capacity of a water sample to neutralize an acid to a set pH.

Analytical Procedure

The analytical procedure refers to the way of performing the analysis. This may include but is not limited to: the sample, the reference standard and the reagents preparations, use of the apparatus, generation of the calibration curve, use of the formula for the calculation, etc.

Amphel®

Hanna AmpHel electrodes incorporate a miniaturized amplifier which resolves most of the problems associated with high impedance signals. The amplifier circuitry is located right on top of the electrode and is completely sealed. As a result, a strong, low impedance signal is emitted and ordinary connectors with long unshielded cables can be used. This breakthrough technology provides a stable signal for industrial monitoring as well as a major saving in low noise coaxial cable costs. In some cases, the need for a transmitter is also eliminated, resulting in further cost reductions.

AOAC

Association of Official Analytical Chemists

ASBC

American Society of Brewing Chemists.

ASTM

American Society for Testing and Materials.

ATC

Automatically Temperature Compensation.

Auto-feedback

With a Hanna magnetic stirrer incorporating auto-feedback, any change in viscosity or volume of the solution is automatically compensated for to keep the speed constant.

Backlight

A form of illumination used in LCD's; backlights illuminate the LCD from the side or back of the display panel.

Backpack Lab®

Backpack Lab from Hanna are portable student laboratories that include a collection of well constructed lessons and activities, testing instruments, and kits for use by educators and students of environmental science.

°Baumé

The Baumé scale is used to measure density of various liquids. Notated variously as degrees Baume, degrees Baumé, B°, Be°, Bé, Baume.

BEPS

Battery Error Prevention System. Alerts the user in the event that low battery power could adversely affect readings

BNC Connector

Bayonet Neill-Concelman connector is a common type of radio-frequency connector used for the coaxial cable which connects various devices; usually is applied for frequencies below 3 GHz.

BOD

Biochemical Oxygen Demand (BOD) gives an indication of the biodegradable organic material present in a sample of water. The dissolved oxygen concentration is measured before and after an incubation period of 5 days and the BOD is calculated in mg/L from the difference.

% Brix

Degrees Brix is a unit representative of the sugar content of an aqueous solution. One degree Brix corresponds to 1 gram of sucrose in 100 grams of solution (% w/w).

°C

Celsius temperature degree; °C = (°F-32) / 5/9

CAL Check™

With the Hanna exclusive CAL Check validation function, users are able to verify the performance of the instrument at any time. Taking just a few short steps, the validation procedure is extremely user friendly and ensures that the meter is properly calibrated.

Calibration

Calibration is the validation of specific measurement techniques and equipment.

The bias is the difference between the mean of the measurements and the reference value. The procedure that establishes and corrects the bias is the calibration.

At the simplest level, calibration is a comparison between measurements – one of known magnitude or correctness made or set with one device and another measurement made in as similar a way as possible with a second device.

Calibration is often regarded as including the process of adjusting the output or indication on a measurement instrument to agree with the value of the applied standard, within a specified accuracy.

CAL Check™ System

When used in tandem with a CAL Check™ meter, CAL Check™ equipped electrodes permit users to be informed if they have performed a proper calibration. In the event of a dirty or broken electrode or contaminated buffer solution, the system alerts the user to either check the electrode, replace the buffer solution or both. The system also reminds users when the instrument should be recalibrated.

Calibration Curve

In analytical chemistry, a calibration curve is a general method for determining the concentration of a substance in an unknown sample by comparing the unknown to a set of standard samples of known concentration. A calibration curve is one approach to the problem of instrument calibration; other approaches may mix the standard into the unknown, giving an internal standard.

The calibration curve is a plot of how the instrumental response, the so called analytical signal, changes with the concentration of the analyte (the substance to be measured). The operator prepares a series of standards across a range of concentrations near the expected concentration of analyte in the unknown. The concentrations of the standards must lie within the working range of the technique (instrumentation) they are using. Analyzing each of these standards using the chosen technique will produce a series of measurements. For most analyses, a plot of instrument response vs. Analyte concentration will show a linear relationship. The operator can measure the response of the unknown, and using the calibration curve, they can interpolate to find the concentration of analyte.

Candela

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 × 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

CaT

Calcium tartrate

CE Mark

See page 17.4

Checker®

Hanna pocket-sized electronic meter.

Checkfridge™

Hanna temperature monitor with magnetic backing and remote thermistor sensor on a 1 meter cable.

Checktemp®

Hanna Electronic Digital Thermometer with sharp-tip probe

CIS

Commonwealth of Independent States

Cleaning Solution

The solution used for cleaning the glass bulb of the electrode/probe once a day or at least once a week to maintain accuracy and to prevent junction clogging.

Clip-Lock™

Interrupting an important cycle of analysis due to a malfunctioning burette is a thing of the past. With the Hanna Clip-Lock™ system you can simply substitute the burette and complete all your tests with the same titrant!

The Clip-Lock™ exchangeable burette system prevents cross contamination while reducing loss of time and reagents. Burettes simply slide out for quick exchanges, and detaching the aspiration and dispensing tubes from the titrant bottles is easy.

COD

Chemical Oxygen Demand is a measure of the oxygen equivalent of the organic matter in the sample that is susceptible to oxidation by a strong oxidizing agent.

Colorimeter

(see Photometer)

Colorimetry

Colorimetry is concerned with the determination of the concentration of a substance by measurement of the relative absorption of light with respect to a known concentration of the substance. In visual colorimetry, natural or artificial white light is generally used as a light source, and determinations are usually made with a simple instrument termed a photometer, or color comparator. When the eye is replaced by a photoelectric cell (thus largely eliminating the errors due to the personal characteristics of each observer) the instrument is termed a photoelectric colorimeter, or photometer.

Conditioning Solution

A specialized solution in which the electrode must be immersed in to activate the glass selective membrane.

CPS™

Clogging Prevention System. Conventional pH electrodes use ceramic junctions that may clog quickly when used in biological samples such as wine. When the junction is blocked, the entire electrode will not function properly. Electrodes that feature CPS™ technology utilize a ground glass/PTFE sleeve junction which controls a steady, predictable flow of fill solution thus keeping the junction open. The hydrophobic property of PTFE sleeve repels wetness and coatings.

CYAC

Cyanuric Acid

°Dornic

Determined by titrating a 100 mL sample with N/9 sodium hydroxide to a phenolphthalein end point.

Delrin

A plastic made from Acetal Homopolymer; a crystalline plastic that offers an excellent balance of properties that bridge the gap between metals and plastics.

Detection Limit

In analytical chemistry, the detection limit LOD of an individual analytical procedure is the lowest amount of analyte in a sample which can be detected but not necessarily quantitated as an exact value; or the lowest quantity of a substance that can be distinguished from the absence of that substance (a blank value) within a stated confidence limit (generally 1%).

The detection limit is estimated from the mean of the blank, the standard deviation of the blank and some confidence factor. Another consideration that affects the detection limit is the accuracy of the model used to predict concentration from the raw analytical signal. There are a number of different “detection

limits" that are commonly used. These include: the instrument detection limit (IDL), the method detection limit (MDL) and the limit of quantitation (LOQ).

Even when the same terminology is used, there can be differences in the LOD, according to nuances of what definition is used and what type of noise contributes to the measurement and calibration.

Most analytical instruments produce a signal even when a blank (matrix without analyte) is analyzed. This signal is referred to as the noise level.

The IDL is the analyte concentration that is required to produce a signal greater than three times the standard deviation of the noise level.

Many times there is more to the analytical method than just doing a reaction or submitting it to direct analysis. For example it might be necessary to heat a sample that is to be analyzed for a particular metal with the addition of acid first (this is called digestion). The sample may also be diluted or concentrated prior to analysis on an instrument.

Additional steps in an analysis add additional opportunities for error.

Since detection limits are defined in terms of error, this will naturally increase the measured detection limit. This detection limit (with all steps of the analysis included) is called the MDL.

Dew Point

The dew point is defined as the temperature to which air must be cooled in order for condensation (saturation) to occur. The dew point is dependent on the concentration of water vapor present, and therefore, the relative humidity.

DIN Connector

A circular connector for consumer electronics, originally standardized by the Deutches Institut für Normung (DIN) for analog audio signals.

Direct Potentiometry

Direct Potentiometry is a widely used method of performing ion analysis with ISEs. This method is highly effective when the user must quickly measure large batches of samples at many concentrations. Hanna direct reading meters such as the HI 98184 and HI 98185 display concentration of the unknown sample by a direct reading after calibrating the instrument with two or more standards. Ionic strength adjustments are made to both samples and standards. In some applications quick and reliable measurements can be made on-site, without taking samples back to the laboratory.

DiST®

Hanna Dissolved Solids Testers are widely used for monitoring EC/TDS in water conditioning, reverse osmosis, cooling towers, drinking water, wastewater, laboratories, agriculture, aquaculture and aquariums, hydroponics and the printing industry.

dKH

Degrees of carbonate hardness.
In case of alkalinity: 1 dKH = 0.36 meq/L = 17.86 mg/L $CaCO_3$

DO

Dissolved Oxygen. A relative measure of the amount of oxygen that is dissolved or carried in a given medium.

DPD

N,N-diethyl-p-phenylenediamine

EBC

European Brewery Convention.

EC

Electrical conductivity is a measure of how well a material accommodates the transport of electric charge. Its SI derived unit is the Siemens per meter, (A2s3m-3kg-1) (named after Werner von Siemens). It is the ratio of the current density to the electric field strength. This applies also to the electrolytic conductivity of a fluid.

EDTA

Edetic acid; etylenediaminetetraacetic acid

EES

Sodium exchangeable (in meq/100 g soil)

Electromagnetic Compatibility

See page 17.4

Electromagnetic Interferences (EMI)

See page 17.4

EPA (U.S. EPA)

United States Environmental Protection Agency

°F

Fahrenheit temperature degree; °F = °C x 9/5 + 32

FAO

Food and Agriculture Organization

Fast Tracker™–Tag Identification System

Hanna's Fact Tracker™–Tag Identification System simplifies test logging. iButton®s with a unique ID can be installed at various sampling sites. When the matching connector on the meter contacts the location button, measurements are logged and labeled with the alphanumeric user-entered location ID. Location, date, time and measurements are logged into the meter which can be transferred to a PC.

FDA

US Food & Drug Administration.

FDA bottle = bottles that meet FDA Standards.

Filling Solution

Solution containing the anion to which the reference electrode of the operational pH cell is reversible, eg. Chloride for Ag-AgCl electrodes.

FNU

Formazin Nephelometric Unit.

FTU

Formazin Turbidity Unit.

F.S. (or f.s.)

Full scale

Glass Membrane

Hanna utilizes four different types of pH sensitive glass to cover a vast number of applications. Our manufacturing processes are specific for each pH electrode design. For instance, some electrodes with low impedance glass are particularly suited at performing measurements in solutions with low conductivity or cold solutions. For industrial grade electrodes, Hanna produces a specific range of sensitive glass that guarantees a linear response over a wide pH range as well as being resistant to harsh environments.

To optimize a pH measurement for a particular application, the pH glass characteristics are considered, as well as materials of construction including reference junctions, wetted materials and internal seals. Hanna provides the best materials and performance for a particular application to ensure reliable measurements.

GP	General Purpose
HT	High Temperature
LT	Low Temperature
HF	Samples with Fluoride

GLP

Good Laboratory Practice. The phrase good laboratory practice especially refers to a Quality System concerned with the organizational process and the conditions under which non-clinical health and environmental safety studies are planned, performed, monitored, recorded, archived and reported.

GP Glass

Hanna's GP (general purpose) hydrogen sensitive glass provides the best response over the entire pH range and can be used for a wide range of applications. Great results are obtained with sphere geometry with diameter of 9.5 mm (0.37"). This achieves a system with 100 MΩ, impedance. The GP glass is also used on smaller diameter spheres.

GPS

Global Positioning System

GR

Gypsum Requirement (metric ton/ha or ton/acre).

H_2T

Tartaric Acid.

HACCP

Hazard Analysis and Critical Control Points.

HC

Handheld Colorimeter.

HF Glass

Hydrofluoric acid can dissolve glass rapidly. Hanna uses HF resistant glass for aggressive applications that have fluoride ions. Electrodes manufactured with this glass live ten times longer than electrodes made with standard pH glass formulations (from 10 days to 100 days). The alkaline error is very high for this glass so it is not suited for pH measurements above pH 10. The recommended pH range with this glass is 2-10 pH.

High Input Impedance Meter

It is the measurement device that processes the voltage from the electrochemical cell and converts it into a meaningful measurement unit (pH). The measurement is done with virtually zero current flow to prevent polarization of the electrodes. Modern pH meters also may provide sensor diagnostics, automatic buffer recognition, calibration reminders and user prompts.

HOLD Function

Function that lets the user know when to take readings and freezes the readings on display for easy and accurate recording.

HPLC

High Performance Liquid Chromatography.

HR

High Range.

HT Glass

Designed for extended use at elevated temperature. The glass impedance has a temperature coefficient of about 14.3% per degree Celsius. HT sensitive glass has an impedance of 400 MΩ at approximately 25°C (77°F). At extremely high temperatures, the impedance drops significantly. This glass makes it possible to obtain accurate, high temperature pH measurements for extended periods of time 90°C (194°F) and for a few weeks at 100°C (212°F). At room temperature, the response time may increase so additional time for equilibration in buffers should be allowed. This glass is clear.

HVAC

Heating, Ventilating, and Air Conditioning - refers to technology of indoor or automotive environmental comfort.

Hygrometer

The hygrometer is an instrument used to measure relative humidity (RH), that is, the quantity of water vapor present in the air. Hygrometers are often available in versions that also measure temperature–these are normally called thermohygrometers.

IARC

International Agency for Research on Cancer

iButton® Tags

Install the optional TAGs near your sampling points for quick and easy iButton® readings. Each TAG contains a computer chip with a unique identification code encased in stainless steel. Users can order and install a virtually unlimited amount of TAGs to meet any need of traceability requirements.

ICUMSA

International Commission for Uniform Methods of Sugar Analysis

Incremental Method

Incremental Methods are useful techniques used to determine ion concentration quickly in samples whose constituents are variable or concentrated. Incremental Methods have some inherent advantages over direct potentiometry. The techniques can reduce errors from variables such as temperature, viscosity, pH or ionic strength. The electrodes remain immersed throughout the process thus reducing sample carry over and possible liquid junction changes in the reference and analysis steps are reduced. Known addition, known subtraction, analyte addition, and analyte subtraction methods are four of these incremental techniques. All techniques involve adding a standard to the sample, or sample to the standard and the meter calculates the sample's ion concentration directly.

IR

Infrared. Electromagnetic radiation with a wavelength longer than VIS (according to CIE the IR band is 700 nm to 1 mm).

ISA

Ionic Strength Adjusters (ISA) are formulated to provide a constant ionic strength in sample and standards alike, thus permitting concentration rather than activity measurements to be made. In some cases ISA's adjust pH and eliminate matrix effects.

ISE

Ion Selective Electrode, also known as a specific ion electrode. ISE's are sensors that convert the activity of a specific ion dissolved in a solution into an electrical potential, which can be measured by a pH meter or a voltmeter.

ISO Standards

See page 18.5

ISOPOTENTIAL pH

Is the pH at which the cell voltage does not change when the temperature changes.

ISSS

International Society of Soil Science.

ITS

International Temperature Scale.

Junction

The junction (the part in contact between the two liquids) is typically made with inert materials that will not increase a junction potential or be chemically attacked by the measured solutions.

JTU

Jackson Turbidity Unit.

KEY®

The KEY is a thermometer with an interchangeable probe for quick spot measurements. With a response time of less than 20 seconds in water, KEY is ideal for QC and industrial temperature monitoring.

KHT

Potassium Bi-Tartrate.

°KMW

°Klosterneuburger Mostwaage is used in Austria to measure the sugar content of must. °KMW is also known as °Babo.

°KMW is related to °Oe by the following equation: °Oe = °KMW x [(0.022 x °KMW) + 4.54]

1 °KMW is roughly equivalent to 1 %Brix or 5 °Oe.

% l.a.

Percent lactic acid is determined by titrating a 20 mL or 20 g sample diluted with twice its volume of deionized or distilled water with 0.1 M sodium hydroxide to a phenolphthalein end point.

LCD

Liquid Crystal Display.

LDL Cholesterol

Low-density lipoprotein cholesterol.

LED

Light-emitting diode; a semiconductor light source.

LI

Langelier Index is a saturation index developed by Dr. Wilfred Langelier and is widely used to predict the balance of swimming pool waters. It is an estimation of the solutions ability to dissolve or precipitate calcium carbonate deposits.

Linearity

The linearity of an analytical procedure is its ability (within a given range) to obtain test results which are directly proportional to the concentration of analyte in the sample.

LOAEL

Lowest-observed-adverse-effect level.

LR

Low Range.

LSD

Low Significant Digit.

LT Glass

This glass is used on our flat and conical shaped membranes as well as sensors used at cold temperatures, because the glass has lower impedance. If an electrode has very high impedance, the measurement response will be sluggish, and a voltage drop causing error can occur. At temperatures below -8°C (17°F) the internal buffer may freeze and expand and cause the mechanical destruction of the sensor. This glass has a more limited pH range and is dark green.

Lux (lx)

The SI unit of illuminance and luminous emittance measuring luminous power per area.

Matching Pin

A matching pin is a differential measurement technique used to eliminate ground loops and common mode perturbations for the measurement system. In a system without a matching pin, electrical currents in the sample can affect the reference half cell voltage that is connected via the liquid junction with the sample.

In this case, the reference electrode picks up the electromagnetic fields and the measurement of the pH is altered. The matching pin isolates these current/magnetic fields from the reference electrode. Hanna manufactures a number of models with the matching pin design for safe precise pH measurements.

MEADOS

Measuring and Dosing System.

MEBAK

Central European Brewing Commission.

meq/L

Milliequivalents per liter.

In case of alkalinity: 1 meq/L = 50 mg/L $CaCO_3$ = 2.8 dKH.

Mho/cm

see S/cm.

Millesimal pH Buffer

This line of buffers with millesimal accuracy (±0.002 pH), has been prepared to meet the increasing need for assured accuracy in pH measurements. Each bottle is provided with a certificate of analysis, prepared by comparison with NIST standards.

MR

Medium Range.

MTC

Manual Temperature Compensation. The temperature value, shown on the LCD, can be manually set. The compensation is referenced at the selected temperature.

mV

1/1000 of a volt, a measure of electrical potential (voltage).

NIST

National Institute of Standards and Technology.

nm

Nanometer. Unit of measurement for length in the metric system, equal to one billionth of a meter.

NoTC

No Temperature Compensation. For actual conductivity or TDS measurement, the temperature value shown on the LCD is not taken into account.

NPK

Nitrogen, phosphorus, and potassium.

NPT

National Pipe Thread. A U.S. standard for tapered threads used on threaded pipes and fittings.

NTU

Nephelometric Turbidity Unit.

°Oechsle (°Oe)

°Oechsle is mainly used in the German, Swiss and Luxenburgish winemaking industry to measure the sugar content of must. The °Oe scale, one degree Oechsle corresponds to one ram of difference between the mass of one liter of must at 20°C and 1 kg (the mass of 1 liter of water at same temperature).

Open Junction

This type junction, found in reference half-cells, is filled with a special gel which comes into direct contact with the solution to be measured. An advantage of an open junction is low contact resistance and it is virtually impossible to clog.

Opto-isolator

In electronics, an opto-isolator is an electronic device designed to transfer electrical signals by utilizing light waves to provide coupling with electrical isolation between its input and output.

ORP

Oxidation Reduction Potential. Solutions can be graded as oxidizing or reducing based on measurement of ORP values.

OSHA

The Occupational Safety and Health Administration.

OUR

Oxygen Uptake Rate. Used to determine the oxygen consumption or respiration rate; is measured in mg of oxygen consumed per liter per hour.

PAN

1-(2-pyridylazo)-2-naphtol (indicator)

PCU

Platinum Cobalt Unit.

PD Controller

Proportional Derivative controller.

PEI

Polyetherimide.

PELs

Standards for the length and intensity of exposure to certain elements.

Pfund Scale

The Pfund scale is a color grader used to provide readings of the range of honey colors. There are seven color classifications for processed honey; water white, extra white, white, extra light amber, light amber, amber and dark amber. Traditionally, the Pfund color grader works by visually comparing a wedge-shaped glass container of honey with an amber glass wedge.

pH [NIST]

The negative logarithm of the hydrogen ion activity has been given the symbol pH. The original definition was in terms of hydrogen ion concentration. The present definition of pH is associated with the "effective" concentration of hydrogen ion.

pH Glass Electrode [IUPAC]

Hydrogen ion responsive electrode usually consists of a bulb, or other suitable form of special glass attached to a stem of high-resistance glass complete with internal reference electrode and internal filling solution system. Other geometrical forms may be appropriate for special applications.

Photometer

An instrument used for measuring of photometric quantities by means of a photoreceptor.

PID Controller

Proportional-Integral-Derivative controller.

PLC

Programmable Logic Controller.

Potentiometric Titration

A Potentiometric Titration can increase the precision of ISE measurements and also the number of ionic species that can be determined. ISEs are commonly used as indicators for the titrant or sample species to follow the progress of a precipitation or complexometric titration. A small change in reactant addition corresponds to a large change in electrode potential at its stoichiometric endpoint. An example of a precipitation titration is the determination of chloride using silver nitrate. A silver ISE can be used to follow this titration. A complexometric titration is used for the determination of calcium. A calcium solution is titrated with the complexing reagent EDTA. During the titration, there is a gradual decrease in the free Ca^{2+} ion concentrations as more EDTA is added. The endpoint corresponds to the point when all the Ca^{2+} is complexed. The progress of this titration can be monitored using a calcium ISE.

Pre-amplified Electrode

Hanna electrode containing an internal pre-amplifier. The pre-amplifier converts the high impedance signal from the pH glass to a low impedance signal thus allowing the user to use long runs of sensor cable with ordinary connectors without noisy or voltage drops resulting in erroneous measurements.

Precision

The precision of an analytical procedure expresses the closeness of agreement (degree of scatter) between a series of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions. Precision may be considered at three levels: repeatability, intermediate precision and reproducibility.

Precision should be investigated using homogeneous, authentic samples. However, if it is not possible to obtain a homogeneous sample it may be investigated using artificially prepared samples or a sample solution.

The precision of an analytical procedure is usually expressed as the variance, standard deviation or coefficient of variation of a series of measurements.

Intermediate precision expresses within-laboratories variations: different days, different analysts, different equipment, etc.

ppb

parts per billion; as concentration: 1 ppb = 1 µg substance /L solution.

ppm

parts per million; as concentration: 1 ppm = 1 mg substance /L solution; 1% = 10000 ppm.

ppt

parts per thousand; as concentration: 1 ppt = 1 g substance /L solution.

Pt100

Platinum sensors with means a resistance of 100Ω 0°C with a temperature coefficient of 0.00385Ω per degree Celsius. Similar for Pt1000.

PTFE

PolyTetraFluoroEthylene. Porous PTFE is a hydrophobic material that is available with different porosities. Because of its chemical advantages, PTFE is widely used in industrial applications.

PVC

Polyvinyl chloride.

PVDF

Polyvinylidene Fluoride–a highly non-reactive and pure thermoplastic fluoropolymere.

PWT

Pure Water Test.

QC

Quality Control.

Range

The range of an analytical procedure is the interval between the upper and lower concentrations of analyte in the sample (including these concentrations) for which it has been demonstrated that the analytical procedure has a suitable level of precision, accuracy and linearity.

RDT

Resistance Temperature Detectors.

Reference Electrode

Half cell of the electrochemical cell that supplies a stable voltage that is known, constant and completely insensitive to the measurement solution. Changes in voltages generated from the pH sensor are measured versus this electrode's voltage.

Refractive Index

Refractive Index is defined as the ratio of the speed of light in empty space to the speed of light in the substance.

Repeatability

Repeatability expresses the precision under the same operating conditions over a short interval of time. Repeatability is also termed intra-assay precision.

Reproducibility

Reproducibility expresses the precision between laboratories collaborative studies, (usually applied to standardization of methodology).

Resistivity

Electrical resistivity (also known as specific electrical resistance) is a measure indicating how strongly a material opposes the flow of electric current. A low resistivity indicates a material that readily allows the movement of electrons. The SI unit for electrical resistivity is the ohm meter.

RH

Relative humidity is expressed as the ratio of the quantity of water vapor present in the air to the quantity at which the air would reach saturation (100%) at a given temperature.

Robustness

The robustness of an analytical procedure is a measure of its capacity to remain unaffected by small, but deliberate variations in method parameters and provides an indication of its reliability during normal usage.

rpm

Revolutions per minute.

RS

Reducing Sugars.

RS232

In telecommunications, RS-232 (Recommended Standard 232) is traditional name for a series of standards for serial binary single-ended data and control signals.

RS485

In telecommunications, RS-485 (Recommended Standard 485) is a standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems. RS-485 can be used effectively over long distances and in electrically noisy environments.

S/cm

The siemens (S) unit is named after Werner von Siemens, the 19th century German inventor and entrepreneur in the area of electrical engineering. Previously to the siemens per meter unit, mho/cm was used to measure conductivity, where the unit "mho" is a reciprocal ohm. The "mho" is "ohm" spelled backwards. Because of the history of conductivity, µmho/cm and mmho/cm is commonly translated to µS/cm and mS/cm because they correspond one-to-one.

The unit of measurement commonly used is one millionth of a Siemens per centimeter (micro-Siemens per centimeter or µS/cm).

When measuring more concentrated solutions, the units are expressed as milli-Siemens/cm or mS/cm (thousandths of a Siemens). For ease of expression, 1000 µS/cm are equal to 1 mS/cm.

Salinity

Salinity is a measurement without the unit corresponding to the weight of dissolved salts in seawater. Salinity is calculated from an empirical relationship between the conductivity and the salinity of a seawater sample. Oceanographic Tables and Standards endorsed by UNESCO/SCOR/ICES/IAPSO are used for the calculation.

Salinity measurements are performed with no direct temperature correction. The salinity range is calibrated using a standard sea water solution.

SAR

Sodium Absorbtion Ratio (meq/L).

Sensor Check™

Allows users to check electrode status at any time.

°SH

Soxlet Henkel degrees is determined by titrating a 50 mL sample with 0.1 M sodium hydroxide to a phenolphthalein end point.

SHE

Standard Hydrogen Electrode.

SMART electrode

With models that feature our SMART circuitry, an exclusive microchip embedded inside the electrode retains the calibration data and assigns an identity code to the host unit. As soon as the electrode is connected to a pH meter in the SMART series, it is recognized and its characteristics retrieved. The meter then uses the accessed calibration data as a reference for future measurements. Once each SMART electrode is calibrated, these electrodes can be used in succession without requiring new calibration. Hanna's intelligent electrodes help eliminate errors and will save time when working with more than one electrode.

SOP

Standard Operating Procedures means documented procedures which describe how to perform tests or activities normally not specified in detail in study plans or tests guidelines.

SOUR

Specific Oxygen Uptake Rate. This is used to determine the oxygen consumption or respiration rate; SOUR is measured in mg of oxygen consumed per gram of volatile suspended solids per hour.

SPDT relay

Single Pole Double Throw relay.

Specificity

Specificity is the ability to assess unequivocally the analyte in the presence of components which may be expected to be present. Typically these might include impurities, degradants, matrix, etc.

Speedsafe™

Each Hanna stirrer is equipped with a speed sensing device (opto-sensor) coupled with an FVC (frequency voltage converter), which monitors the speed. As the speed reaches a preset maximum level, the speed limiter shuts down the VCO to slow down the motor speed. This ensures that when the load is suddenly removed from the stirrer, the motor will not accelerate to such a high speed that will be hazardous to both the user and the stirrer; a feature not commonly found in conventional stirrers.

SPST Relay

Single Pole Single Throw relay.

SRM

Standard Reference Material (CRM of National Institute of Standards and Technology).

Storage Solution

Solution used to keep the electrode moist when not in use.

TDS

Total Dissolved Solids (often abbreviated TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in: molecular, ionized or micro-granular (colloidal sol) suspended form.

TDS Factor

When a solution does not have a similar ionic content to natural water or salt water, then a TDS conversion factor is needed to automatically adjust the readings. TDS = CF x conductivity (CF is TDS Conversion factor).

TFPC

Thin Film Polymer Capacitance.

TEA

Total Exchangeable Acidity - A measure of the amount of acidic cations (hydrogen, aluminum, iron and manganese) present in soil. It is expressed in Milliequivalents per 100 grams (meq/100 g) of soil.

°Th

Degree Thörner is determined by titrating a 10 mL sample diluted with twice its volume of deionized or distilled water with 0.1 M sodium hydroxide to a phenolphthalein end point.

Timer Function

Counts down to appropriate time interval before a reading is displayed. This feature ensures consistency in measurements.

TPTZ

2,4,6-tri-(2-pyridyl)-1,3,5-triazine (iron indicator)

Traceability [IUPAC]

Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties. The concept is often expressed by the adjective traceable. The unbroken chain of comparisons is called a traceability chain.

Turbidity

Turbidity of water is an optical property that causes light to be scattered and absorbed, rather than transmitted. The scattering of the light that passes through a liquid is primarily caused by the suspended solids. The higher the turbidity, the greater the amount of scattered light. Because even the molecules in a very pure fluid scatter light to a certain degree, no solution will have zero turbidity.

UPW

Ultra Pure Water.

USB

Universal Serial Bus is a application to establish communication between various devices and a host controller (usually a PC).

USDA

United States Department of Agriculture.

USP

US Pharmacopoeia. USP <645> with Stage 1, 2 and 3 compliance is required for purified water and WFI (water for injection). Hanna offers instruments that are able to perform all three stages required by this standard. Some of these requirements are: Resolution of 0.1 µS/cm or better, accuracy at 1.3µS/cm of 0.1µS/cm, to be able to read with or without automatic temperature compensation, the cell constant be known with an uncertainty better than ±2%.

UV

Ultraviolet–electromagnetic radiation with a wavelength shorter than that of VIS, but longer than X-rays (10-400 nm).

VCO

Voltage Controlled Oscillator.

VIS

The visible spectrum - is the portion of the electromagnetic spectrum that is visible (can be detected by) to the human eye (390 - 750 nm for typical human eye).

WHO

World Health Organization.

Relative Humidity in air as a function of temperature of some saturated salt solutions

Temperature °C	Lithium Chloride	Potassium Acetate	Magnesium Chloride	Potassium Carbonate	Magnesium Nitrate
0	11.23 ± 0.54		33.66 ± 0.33	43.13 ± 0.66	60.35 ± 0.55
5	11.26 ± 0.47		33.60 ± 0.28	43.13 ± 0.50	58.86 ± 0.43
10	11.29 ± 0.41	23.28 ± 0.53	33.47 ± 0.24	43.14 ± 0.39	57.36 ± 0.33
15	11.30 ± 0.35	23.40 ± 0.32	33.30 ± 0.21	43.15 ± 0.33	55.87 ± 0.27
20	11.31 ± 0.31	23.11 ± 0.25	33.07 ± 0.18	43.16 ± 0.33	54.38 ± 0.23
25	11.30 ± 0.27	22.51 ± 0.32	32.78 ± 0.16	43.16 ± 0.39	52.89 ± 0.22
30	11.28 ± 0.24	21.61 ± 0.53	32.44 ± 0.14	43.17 ± 0.50	51.40 ± 0.24
35	11.25 ± 0.22		32.05 ± 0.13		49.91 ± 0.29
40	11.21 ± 0.21		31.60 ± 0.13		48.42 ± 0.37
45	11.16 ± 0.21		31.10 ± 0.13		46.93 ± 0.47
50	11.10 ± 0.22		30.54 ± 0.13		45.44 ± 0.60
55	11.03 ± 0.23		29.93 ± 0.16		
60	10.95 ± 0.26		29.26 ± 0.18		
65	10.86 ± 0.29		28.54 ± 0.21		
70	10.75 ± 0.33		27.77 ± 0.25		
75	10.64 ± 0.38		26.94 ± 0.29		
80	10.51 ± 0.44		26.05 ± 0.34		
85	10.38 ± 0.51		25.11 ± 0.39		
90	10.23 ± 0.59		24.12 ± 0.46		
95	10.07 ± 0.67		23.07 ± 0.52		
100	9.90 ± 0.77		21.97 ± 0.60		

Relative Humidity in air as a function of temperature of some saturated salt solutions

Temperature °C	Sodium Chloride	Potassium Chloride	Potassium Nitrate	Potassium Sulfate
0	75.51 ± 0.34	88.61 ± 0.53	96.33 ± 2.90	98.77 ± 1.10
5	76.65 ± 0.27	87.67 ± 0.45	96.27 ± 2.10	98.48 ± 0.91
10	75.67 ± 0.22	86.77 ± 0.39	95.96 ± 1.40	98.18 ± 0.76
15	75.61 ± 0.18	85.92 ± 0.33	95.41 ± 0.96	97.89 ± 0.63
20	75.47 ± 0.14	85.11 ± 0.29	94.62 ± 0.66	97.59 ± 0.53
25	75.29 ± 0.12	84.34 ± 0.26	93.58 ± 0.55	97.30 ± 0.45
30	75.09 ± 0.11	83.62 ± 0.25	93.21 ± 0.60	97.00 ± 0.40
35	74.87 ±0.12	82.95 ± 0.25	90.79 ± 0.83	96.71 ± 0.38
40	74.68 ± 0.13	82.32 ± 0.25	89.03 ± 1.20	96.41 ± 0.38
45	74.52 ± 0.16	81.74 ± 0.28	87.03 ± 1.80	96.12 ± 0.40
50	74.43 ± 0.19	81.20 ± 0.31	84.78 ± 2.50	95.82 ± 0.45
55	74.41 ± 0.24	80.70 ± 0.35		
60	74.50 ± 0.30	80.25 ± 0.41		
65	74.71 ± 0.37	79.85 ± 0.48		
70	75.06 ± 0.45	79.49 ± 0.57		
75	75.58 ± 0.55	79.17 ± 0.66		
80	76.29 ± 0.65	78.90 ± 0.77		
85		78.68 ± 0.89		
90		78.50 ± 1.00		
95				
100				

Thermoelectric Voltage in milliVolts

Thermocouple Reference Tables

Reference Tables
N.I.S.T Rev. ITS-90

K-type thermocouple - Temperature in degrees "C" with reference junction at 0°C

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°C
-270	-6.458											-270
-260	-6.441	-6.444	-6.446	-6.448	-6.450	-6.452	-6.453	-6.455	-6.456	-6.457	-6.458	-260
-250	-6.404	-6.408	-6.413	-6.417	-6.421	-6.425	-6.429	-6.432	-6.435	-6.438	-6.441	-250
-240	-6.344	-6.351	-6.358	-6.364	-6.370	-6.377	-6.382	-6.388	-6.393	-6.399	-6.404	-240
-230	-6.262	-6.271	-6.280	-6.289	-6.297	-6.306	-6.314	-6.322	-6.329	-6.337	-6.344	-230
-220	-6.158	-6.170	-6.181	-6.192	-6.202	-6.213	-6.223	-6.233	-6.243	-6.252	-6.262	-220
-210	-6.035	-6.048	-6.061	-6.074	-6.087	-6.099	-6.111	-6.123	-6.135	-6.147	-6.158	-210
-200	-5.891	-5.907	-5.922	-5.936	-5.951	-5.965	-5.980	-5.994	-6.007	-6.021	-6.035	-200
-190	-5.730	-5.747	-5.763	-5.780	-5.797	-5.813	-5.829	-5.845	-5.861	-5.876	-5.891	-190
-180	-5.550	-5.569	-5.588	-5.606	-5.624	-5.642	-5.660	-5.678	-5.695	-5.713	-5.730	-180
-170	-5.354	-5.374	-5.395	-5.415	-5.435	-5.454	-5.474	-5.493	-5.512	-5.531	-5.550	-170
-160	-5.141	-5.163	-5.185	-5.207	-5.228	-5.250	-5.271	-5.292	-5.313	-5.333	-5.354	-160
-150	-4.913	-4.936	-4.960	-4.983	-5.006	-5.029	-5.052	-5.074	-5.097	-5.119	-5.141	-150
-140	-4.669	-4.694	-4.719	-4.744	-4.768	-4.793	-4.817	-4.841	-4.865	-4.889	-4.913	-140
-130	-4.411	-4.437	-4.463	-4.490	-4.516	-4.542	-4.567	-4.593	-4.618	-4.644	-4.669	-130
-120	-4.138	-4.166	-4.194	-4.221	-4.249	-4.276	-4.303	-4.330	-4.357	-4.384	-4.411	-120
-110	-3.852	-3.882	-3.911	-3.939	-3.968	-3.997	-4.025	-4.054	-4.082	-4.110	-4.138	-110
-100	-3.554	-3.584	-3.614	-3.645	-3.675	-3.705	-3.734	-3.764	-3.794	-3.823	-3.852	-100
-90	-3.243	-3.274	-3.306	-3.337	-3.368	-3.400	-3.431	-3.462	-3.492	-3.523	-3.554	-90
-80	-2.920	-2.953	-2.986	-3.018	-3.050	-3.083	-3.115	-3.147	-3.179	-3.211	-3.243	-80
-70	-2.587	-2.620	-2.654	-2.688	-2.721	-2.755	-2.788	-2.821	-2.854	-2.887	-2.920	-70
-60	-2.243	-2.278	-2.312	-2.347	-2.382	-2.416	-2.450	-2.485	-2.519	-2.553	-2.587	-60
-50	-1.889	-1.925	-1.961	-1.996	-2.032	-2.067	-2.103	-2.138	-2.173	-2.208	-2.243	-50
-40	-1.527	-1.564	-1.600	-1.637	-1.673	-1.709	-1.745	-1.782	-1.818	-1.854	-1.889	-40
-30	-1.156	-1.194	-1.231	-1.268	-1.305	-1.343	-1.380	-1.417	-1.453	-1.490	-1.527	-30
-20	-0.778	-0.816	-0.854	-0.892	-0.930	-0.968	-1.006	-1.043	-1.081	-1.119	-1.156	-20
-10	-0.392	-0.431	-0.470	-0.508	-0.547	-0.586	-0.624	-0.663	-0.701	-0.739	-0.778	-10
0	0.000	-0.039	-0.079	-0.118	-0.157	-0.197	-0.236	-0.275	-0.314	-0.353	-0.392	0
°C	0	1	2	3	4	5	6	7	8	9	10	°C
0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397	0
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798	10
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.163	1.203	20
30	1.203	1.244	1.285	1.326	1.366	1.407	1.448	1.489	1.530	1.571	1.612	30
40	1.612	1.653	1.694	1.735	1.776	1.817	1.858	1.899	1.941	1.982	2.023	40
50	2.023	2.064	2.106	2.147	2.188	2.230	2.271	2.312	2.354	2.395	2.436	50
60	2.436	2.478	2.519	2.561	2.602	2.644	2.685	2.727	2.768	2.810	2.851	60
70	2.851	2.893	2.934	2.976	3.017	3.059	3.100	3.142	3.184	3.225	3.267	70
80	3.267	3.308	3.350	3.391	3.433	3.474	3.516	3.557	3.599	3.640	3.682	80
90	3.682	3.723	3.765	3.806	3.848	3.889	3.931	3.972	4.013	4.055	4.096	90
100	4.096	4.138	4.179	4.220	4.262	4.303	4.344	4.385	4.427	4.468	4.509	100
110	4.509	4.550	4.591	4.633	4.674	4.715	4.756	4.797	4.838	4.879	4.920	110
120	4.920	4.961	5.002	5.043	5.084	5.124	5.165	5.206	5.247	5.288	5.328	120
130	5.328	5.369	5.410	5.450	5.491	5.532	5.572	5.613	5.653	5.694	5.735	130
140	5.735	5.775	5.815	5.856	5.896	5.937	5.977	6.017	6.058	6.098	6.138	140
150	6.138	6.179	6.219	6.259	6.299	6.339	6.380	6.420	6.460	6.500	6.540	150
160	6.540	6.580	6.620	6.660	6.701	6.741	6.781	6.821	6.861	6.901	6.941	160
170	6.941	6.981	7.021	7.060	7.100	7.140	7.180	7.220	7.260	7.300	7.340	170
180	7.340	7.380	7.420	7.460	7.500	7.540	7.579	7.619	7.659	7.699	7.739	180
190	7.739	7.779	7.819	7.859	7.899	7.939	7.979	8.019	8.059	8.099	8.138	190
200	8.138	8.178	8.218	8.258	8.298	8.338	8.378	8.418	8.458	8.499	8.539	200
210	8.539	8.579	8.619	8.659	8.699	8.739	8.779	8.819	8.860	8.900	8.940	210
220	8.940	8.980	9.020	9.061	9.101	9.141	9.181	9.222	9.262	9.302	9.343	220
230	9.343	9.383	9.423	9.464	9.504	9.545	9.585	9.626	9.666	9.707	9.747	230
240	9.747	9.788	9.828	9.869	9.909	9.950	9.991	10.031	10.072	10.113	10.153	240
250	10.153	10.194	10.235	10.276	10.316	10.357	10.398	10.439	10.480	10.520	0.561	250
260	10.561	10.602	10.643	10.684	10.725	10.766	10.807	10.848	10.889	10.930	10.971	260
270	10.971	11.012	11.053	11.094	11.135	11.176	11.217	11.259	11.300	11.341	11.382	270
280	11.382	11.423	11.465	11.506	11.547	11.588	11.630	11.671	11.712	11.753	11.795	280
290	11.795	11.836	11.877	11.919	11.960	12.001	12.043	12.084	12.126	12.167	12.209	290
300	12.209	12.250	12.291	12.333	12.374	12.416	12.457	12.499	12.540	12.582	12.624	300
310	12.624	12.665	12.707	12.748	12.790	12.831	12.873	12.915	12.956	12.998	13.040	310
320	13.040	13.081	13.123	13.165	13.206	13.248	13.290	13.331	13.373	13.415	13.457	320
330	13.457	13.498	13.540	13.582	13.624	13.665	13.707	13.749	13.791	13.833	13.874	330
340	13.874	13.916	13.958	14.000	14.042	14.084	14.126	14.167	14.209	14.251	14.293	340
350	14.293	14.335	14.377	14.419	14.461	14.503	14.545	14.587	14.629	14.671	14.713	350
360	14.713	14.755	14.797	14.839	14.881	14.923	14.965	15.007	15.049	15.091	15.133	360
370	15.133	15.175	15.217	15.259	15.301	15.343	15.385	15.427	15.469	15.511	15.554	370
380	15.554	15.596	15.638	15.680	15.722	15.764	15.806	15.849	15.891	15.933	15.975	380
390	15.975	16.017	16.059	16.102	16.144	16.186	16.228	16.270	16.313	16.355	16.397	390
400	16.397	16.439	16.482	16.524	16.566	16.608	16.651	16.693	16.735	16.778	16.820	400
410	16.820	16.862	16.904	16.947	16.989	17.031	17.074	17.116	17.158	17.201	17.243	410
420	17.243	17.285	17.328	17.370	17.413	17.455	17.497	17.540	17.582	17.624	17.667	420
430	17.667	17.709	17.752	17.794	17.837	17.879	17.921	17.964	18.006	18.049	18.091	430
440	18.091	18.134	18.176	18.218	18.261	18.303	18.346	18.388	18.431	18.473	18.516	440
450	18.516	18.558	18.601	18.643	18.686	18.728	18.771	18.813	18.856	18.898	18.941	450
460	18.941	18.983	19.026	19.068	19.111	19.154	19.196	19.239	19.281	19.324	19.366	460
470	19.366	19.409	19.451	19.494	19.537	19.579	19.622	19.664	19.707	19.750	19.792	470
480	19.792	19.835	19.877	19.920	19.962	20.005	20.048	20.090	20.133	20.175	20.218	480
490	20.218	20.261	20.303	20.346	20.389	20.431	20.474	20.516	20.559	20.602	20.644	490
500	20.644	20.687	20.730	20.772	20.815	20.857	20.900	20.943	20.985	21.028	21.071	500
510	21.071	21.113	21.156	21.199	21.241	21.284	21.326	21.369	21.412	21.454	21.497	510
520	21.497	21.540	21.582	21.625	21.668	21.710	21.753	21.796	21.838	21.881	21.924	520
530	21.924	21.966	22.009	22.052	22.094	22.137	22.179	22.222	22.265	22.307	22.350	530
540	22.350	22.393	22.435	22.478	22.521	22.563	22.606	22.649	22.691	22.734	22.776	540

K-type thermocouple - Temperature in degrees "C" with reference junction at 0°C

°C	0	1	2	3	4	5	6	7	8	9	10	°C
550	22.776	22.819	22.862	22.904	22.947	22.990	23.032	23.075	23.117	23.160	23.203	550
560	23.203	23.245	23.288	23.331	23.373	23.416	23.458	23.501	23.544	23.586	23.629	560
570	23.629	23.671	23.714	23.757	23.799	23.842	23.884	23.927	23.970	24.012	24.055	570
580	24.055	24.097	24.140	24.182	24.225	24.267	24.310	24.353	24.395	24.438	24.480	580
590	24.480	24.523	24.565	24.608	24.650	24.693	24.735	24.778	24.820	24.863	24.905	590
600	24.905	24.948	24.990	25.033	25.075	25.118	25.160	25.203	25.245	25.288	25.330	600
610	25.330	25.373	25.415	25.458	25.500	25.543	25.585	25.627	25.670	25.712	25.755	610
620	25.755	25.797	25.840	25.882	25.924	25.967	26.009	26.052	26.094	26.136	26.179	620
630	26.179	26.221	26.263	26.306	26.348	26.390	26.433	26.475	26.517	26.560	26.602	630
640	26.602	26.644	26.687	26.729	26.771	26.814	26.856	26.898	26.940	26.983	27.025	640
650	27.025	27.067	27.109	27.152	27.194	27.236	27.278	27.320	27.363	27.405	27.447	650
660	27.447	27.489	27.531	27.574	27.616	27.658	27.700	27.742	27.784	27.826	27.869	660
670	27.869	27.911	27.953	27.995	28.037	28.079	28.121	28.163	28.205	28.247	28.289	670
680	28.289	28.332	28.374	28.416	28.458	28.500	28.542	28.584	28.626	28.668	28.710	680
690	28.710	28.752	28.794	28.835	28.877	28.919	28.961	29.003	29.045	29.087	29.129	690
700	29.129	29.171	29.213	29.255	29.297	29.338	29.380	29.422	29.464	29.506	29.548	700
710	29.548	29.589	29.631	29.673	29.715	29.757	29.798	29.840	29.882	29.924	29.965	710
720	29.965	30.007	30.049	30.090	30.132	30.174	30.216	30.257	30.299	30.341	30.382	720
730	30.382	30.424	30.466	30.507	30.549	30.590	30.632	30.674	30.715	30.757	30.798	730
740	30.798	30.840	30.881	30.923	30.964	31.006	31.047	31.089	31.130	31.172	31.213	740
750	31.213	31.255	31.296	31.338	31.379	31.421	31.462	31.504	31.545	31.586	31.628	750
760	31.628	31.669	31.710	31.752	31.793	31.834	31.876	31.917	31.958	32.000	32.041	760
770	32.041	32.082	32.124	32.165	32.206	32.247	32.289	32.330	32.371	32.412	32.453	770
780	32.453	32.495	32.536	32.577	32.618	32.659	32.700	32.742	32.783	32.824	32.865	780
790	32.865	32.906	32.947	32.988	33.029	33.070	33.111	33.152	33.193	33.234	33.275	790
800	33.275	33.316	33.357	33.398	33.439	33.480	33.521	33.562	33.603	33.644	33.685	800
810	33.685	33.726	33.767	33.808	33.848	33.889	33.930	33.971	34.012	34.053	34.093	810
820	34.093	34.134	34.175	34.216	34.257	34.297	34.338	34.379	34.420	34.460	34.501	820
830	34.501	34.542	34.582	34.623	34.664	34.704	34.745	34.786	34.826	34.867	34.908	830
840	34.908	34.948	34.989	35.029	35.070	35.110	35.151	35.192	35.232	35.273	35.313	840
850	35.313	35.354	35.394	35.435	35.475	35.516	35.556	35.596	35.637	35.677	35.718	850
860	35.718	35.758	35.798	35.839	35.879	35.920	35.960	36.000	36.041	36.081	36.121	860
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.484	36.524	870
880	36.524	36.564	36.604	36.644	36.685	36.725	36.765	36.805	36.845	36.885	36.925	880
890	36.925	36.965	37.006	37.046	37.086	37.126	37.166	37.206	37.246	37.286	37.326	890
900	37.326	37.366	37.406	37.446	37.486	37.526	37.566	37.606	37.646	37.686	37.725	900
910	37.725	37.765	37.805	37.845	37.885	37.925	37.965	38.005	38.044	38.084	38.124	910
920	38.124	38.164	38.204	38.243	38.283	38.323	38.363	38.402	38.442	38.482	38.522	920
930	38.522	38.561	38.601	38.641	38.680	38.720	38.760	38.799	38.839	38.878	38.918	930
940	38.918	38.958	38.997	39.037	39.076	39.116	39.155	39.195	39.235	39.274	39.314	940
950	39.314	39.353	39.393	39.432	39.471	39.511	39.550	39.590	39.629	39.669	39.708	950
960	39.708	39.747	39.787	39.826	39.866	39.905	39.944	39.984	40.023	40.062	40.101	960
970	40.101	40.141	40.180	40.219	40.259	40.298	40.337	40.376	40.415	40.455	40.494	970
980	40.494	40.533	40.572	40.611	40.651	40.690	40.729	40.768	40.807	40.846	40.885	980
990	40.885	40.924	40.963	41.002	41.042	41.081	41.120	41.159	41.198	41.237	41.276	990
1000	41.276	41.315	41.354	41.393	41.431	41.470	41.509	41.548	41.587	41.626	41.665	1000
1010	41.665	41.704	41.743	41.781	41.820	41.859	41.898	41.937	41.976	42.014	42.053	1010
1020	42.053	42.092	42.131	42.169	42.208	42.247	42.286	42.324	42.363	42.402	42.440	1020
1030	42.440	42.479	42.518	42.556	42.595	42.633	42.672	42.711	42.749	42.788	42.826	1030
1040	42.826	42.865	42.903	42.942	42.980	43.019	43.057	43.096	43.134	43.173	43.211	1040
1050	43.211	43.250	43.288	43.327	43.365	43.403	43.442	43.480	43.518	43.557	43.595	1050
1060	43.595	43.633	43.672	43.710	43.748	43.787	43.825	43.863	43.901	43.940	43.978	1060
1070	43.978	44.016	44.054	44.092	44.130	44.169	44.207	44.245	44.283	44.321	44.359	1070
1080	44.359	44.397	44.435	44.473	44.512	44.550	44.588	44.626	44.664	44.702	44.740	1080
1090	44.740	44.778	44.816	44.853	44.891	44.929	44.967	45.005	45.043	45.081	45.119	1090
1100	45.119	45.157	45.194	45.232	45.270	45.308	45.346	45.383	45.421	45.459	45.497	1100
1110	45.497	45.534	45.572	45.610	45.647	45.685	45.723	45.760	45.798	45.836	45.873	1110
1120	45.873	45.911	45.948	45.986	46.024	46.061	46.099	46.136	46.174	46.211	46.249	1120
1130	46.249	46.286	46.324	46.361	46.398	46.436	46.473	46.511	46.548	46.585	46.623	1130
1140	46.623	46.660	46.697	46.735	46.772	46.809	46.847	46.884	46.921	46.958	46.995	1140
1150	46.995	47.033	47.070	47.107	47.144	47.181	47.218	47.256	47.293	47.330	47.367	1150
1160	47.367	47.404	47.441	47.478	47.515	47.552	47.589	47.626	47.663	47.700	47.737	1160
1170	47.737	47.774	47.811	47.848	47.884	47.921	47.958	47.995	48.032	48.069	48.105	1170
1180	48.105	48.142	48.179	48.216	48.252	48.289	48.326	48.363	48.399	48.436	48.473	1180
1190	48.473	48.509	48.546	48.582	48.619	48.656	48.692	48.729	48.765	48.802	48.838	1190
1200	48.838	48.875	48.911	48.948	48.984	49.021	49.057	49.093	49.130	49.166	49.202	1200
1210	49.202	49.239	49.275	49.311	49.348	49.384	49.420	49.456	49.493	49.529	49.565	1210
1220	49.565	49.601	49.637	49.674	49.710	49.746	49.782	49.818	49.854	49.890	49.926	1220
1230	49.926	49.962	49.998	50.034	50.070	50.106	50.142	50.178	50.214	50.250	50.286	1230
1240	50.286	50.322	50.358	50.393	50.429	50.465	50.501	50.537	50.572	50.608	50.644	1240
1250	50.644	50.680	50.715	50.751	50.787	50.822	50.858	50.894	50.929	50.965	51.000	1250
1260	51.000	51.036	51.071	51.107	51.142	51.178	51.213	51.249	51.284	51.320	51.355	1260
1270	51.355	51.391	51.426	51.461	51.497	51.532	51.567	51.603	51.638	51.673	51.708	1270
1280	51.708	51.744	51.779	51.814	51.849	51.885	51.920	51.955	51.990	52.025	52.060	1280
1290	52.060	52.095	52.130	52.165	52.200	52.235	52.270	52.305	52.340	52.375	52.410	1290
1300	52.410	52.445	52.480	52.515	52.550	52.585	52.620	52.654	52.689	52.724	52.759	1300
1310	52.759	52.794	52.828	52.863	52.898	52.932	52.967	53.002	53.037	53.071	53.106	1310
1320	53.106	53.140	53.175	53.210	53.244	53.279	53.313	53.348	53.382	53.417	53.451	1320
1330	53.451	53.486	53.520	53.555	53.589	53.623	53.658	53.692	53.727	53.761	53.795	1330
1340	53.795	53.830	53.864	53.898	53.932	53.967	54.001	54.035	54.069	54.104	54.138	1340
1350	54.138	54.172	54.206	54.240	54.274	54.308	54.343	54.377	54.411	54.445	54.479	1350
1360	54.479	54.513	54.547	54.581	54.615	54.649	54.683	54.717	54.751	54.785	54.819	1360
1370	54.819	54.852	54.886									1370

Thermoelectric Voltage in milliVolts

Thermocouple Reference Tables

Reference Tables
N.I.S.T Rev. ITS-90

K-type thermocouple - Temperature in degrees "F" with reference junction at 32°F

°F	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	°F
-450							-6.458	-6.457	-6.457	-6.456	-6.456	-450
-440	-6.456	-6.455	-6.454	-6.454	-6.453	-6.452	-6.451	-6.450	-6.449	-6.448	-6.446	-440
-430	-6.446	-6.445	-6.444	-6.443	-6.441	-6.440	-6.438	-6.436	-6.435	-6.433	-6.431	-430
-420	-6.431	-6.429	-6.427	-6.425	-6.423	-6.421	-6.419	-6.416	-6.414	-6.411	-6.409	-420
-410	-6.409	-6.406	-6.404	-6.401	-6.398	-6.395	-6.392	-6.389	-6.386	-6.383	-6.380	-410
-400	-6.380	-6.377	-6.373	-6.370	-6.366	-6.363	-6.359	-6.355	-6.352	-6.348	-6.344	-400
-390	-6.344	-6.340	-6.336	-6.332	-6.328	-6.323	-6.319	-6.315	-6.310	-6.306	-6.301	-390
-380	-6.301	-6.296	-6.292	-6.287	-6.282	-6.277	-6.272	-6.267	-6.262	-6.257	-6.251	-380
-370	-6.251	-6.246	-6.241	-6.235	-6.230	-6.224	-6.218	-6.213	-6.207	-6.201	-6.195	-370
-360	-6.195	-6.189	-6.183	-6.177	-6.171	-6.165	-6.158	-6.152	-6.146	-6.139	-6.133	-360
-350	-6.133	-6.126	-6.119	-6.113	-6.106	-6.099	-6.092	-6.085	-6.078	-6.071	-6.064	-350
-340	-6.064	-6.057	-6.049	-6.042	-6.035	-6.027	-6.020	-6.012	-6.004	-5.997	-5.989	-340
-330	-5.989	-5.981	-5.973	-5.965	-5.957	-5.949	-5.941	-5.933	-5.925	-5.917	-5.908	-330
-320	-5.908	-5.900	-5.891	-5.883	-5.874	-5.866	-5.857	-5.848	-5.840	-5.831	-5.822	-320
-310	-5.822	-5.813	-5.804	-5.795	-5.786	-5.776	-5.767	-5.758	-5.749	-5.739	-5.730	-310
-300	-5.730	-5.720	-5.711	-5.701	-5.691	-5.682	-5.672	-5.662	-5.652	-5.642	-5.632	-300
-290	-5.632	-5.622	-5.612	-5.602	-5.592	-5.581	-5.571	-5.561	-5.550	-5.540	-5.529	-290
-280	-5.529	-5.519	-5.508	-5.497	-5.487	-5.476	-5.465	-5.454	-5.443	-5.432	-5.421	-280
-270	-5.421	-5.410	-5.399	-5.388	-5.377	-5.365	-5.354	-5.343	-5.331	-5.320	-5.308	-270
-260	-5.308	-5.296	-5.285	-5.273	-5.261	-5.250	-5.238	-5.226	-5.214	-5.202	-5.190	-260
-250	-5.190	-5.178	-5.166	-5.153	-5.141	-5.129	-5.117	-5.104	-5.092	-5.079	-5.067	-250
-240	-5.067	-5.054	-5.042	-5.029	-5.016	-5.003	-4.991	-4.978	-4.965	-4.952	-4.939	-240
-230	-4.939	-4.926	-4.913	-4.900	-4.886	-4.873	-4.860	-4.847	-4.833	-4.820	-4.806	-230
-220	-4.806	-4.793	-4.779	-4.766	-4.752	-4.738	-4.724	-4.711	-4.697	-4.683	-4.669	-220
-210	-4.669	-4.655	-4.641	-4.627	-4.613	-4.599	-4.584	-4.570	-4.556	-4.542	-4.527	-210
-200	-4.527	-4.513	-4.498	-4.484	-4.469	-4.455	-4.440	-4.425	-4.411	-4.396	-4.381	-200
-190	-4.381	-4.366	-4.351	-4.336	-4.321	-4.306	-4.291	-4.276	-4.261	-4.246	-4.231	-190
-180	-4.231	-4.215	-4.200	-4.185	-4.169	-4.154	-4.138	-4.123	-4.107	-4.091	-4.076	-180
-170	-4.076	-4.060	-4.044	-4.029	-4.013	-3.997	-3.981	-3.965	-3.949	-3.933	-3.917	-170
-160	-3.917	-3.901	-3.885	-3.869	-3.852	-3.836	-3.820	-3.803	-3.787	-3.771	-3.754	-160
-150	-3.754	-3.738	-3.721	-3.705	-3.688	-3.671	-3.655	-3.638	-3.621	-3.604	-3.587	-150
-140	-3.587	-3.571	-3.554	-3.537	-3.520	-3.503	-3.486	-3.468	-3.451	-3.434	-3.417	-140
-130	-3.417	-3.400	-3.382	-3.365	-3.348	-3.330	-3.313	-3.295	-3.278	-3.260	-3.243	-130
-120	-3.243	-3.225	-3.207	-3.190	-3.172	-3.154	-3.136	-3.119	-3.101	-3.083	-3.065	-120
-110	-3.065	-3.047	-3.029	-3.011	-2.993	-2.975	-2.957	-2.938	-2.920	-2.902	-2.884	-110
-100	-2.884	-2.865	-2.847	-2.829	-2.810	-2.792	-2.773	-2.755	-2.736	-2.718	-2.699	-100
-90	-2.699	-2.680	-2.662	-2.643	-2.624	-2.605	-2.587	-2.568	-2.549	-2.530	-2.511	-90
-80	-2.511	-2.492	-2.473	-2.454	-2.435	-2.416	-2.397	-2.378	-2.359	-2.339	-2.320	-80
-70	-2.320	-2.301	-2.282	-2.262	-2.243	-2.223	-2.204	-2.185	-2.165	-2.146	-2.126	-70
-60	-2.126	-2.106	-2.087	-2.067	-2.048	-2.028	-2.008	-1.988	-1.969	-1.949	-1.929	-60
-50	-1.929	-1.909	-1.889	-1.869	-1.850	-1.830	-1.810	-1.790	-1.770	-1.749	-1.729	-50
-40	-1.729	-1.709	-1.689	-1.669	-1.649	-1.628	-1.608	-1.588	-1.568	-1.547	-1.527	-40
-30	-1.527	-1.507	-1.486	-1.466	-1.445	-1.425	-1.404	-1.384	-1.363	-1.343	-1.322	-30
-20	-1.322	-1.301	-1.281	-1.260	-1.239	-1.218	-1.198	-1.177	-1.156	-1.135	-1.114	-20
-10	-1.114	-1.094	-1.073	-1.052	-1.031	-1.010	-0.989	-0.968	-0.947	-0.926	-0.905	-10
0	-0.905	-0.883	-0.862	-0.841	-0.820	-0.799	-0.778	-0.756	-0.735	-0.714	-0.692	0

°F	0	1	2	3	4	5	6	7	8	9	10	°F
0	-0.692	-0.671	-0.650	-0.628	-0.607	-0.586	-0.564	-0.543	-0.521	-0.500	-0.478	0
10	-0.478	-0.457	-0.435	-0.413	-0.392	-0.370	-0.349	-0.327	-0.305	-0.284	-0.262	10
20	-0.262	-0.240	-0.218	-0.197	-0.175	-0.153	-0.131	-0.109	-0.088	-0.066	-0.044	20
30	-0.044	-0.022	0.000	0.022	0.044	0.066	0.088	0.110	0.132	0.154	0.176	30
40	0.176	0.198	0.220	0.242	0.264	0.286	0.308	0.330	0.353	0.375	0.397	40
50	0.397	0.419	0.441	0.463	0.486	0.508	0.530	0.552	0.575	0.597	0.619	50
60	0.619	0.642	0.664	0.686	0.709	0.731	0.753	0.776	0.798	0.821	0.843	60
70	0.843	0.865	0.888	0.910	0.933	0.955	0.978	1.000	1.023	1.045	1.068	70
80	1.068	1.090	1.113	1.136	1.158	1.181	1.203	1.226	1.249	1.271	1.294	80
90	1.294	1.316	1.339	1.362	1.384	1.407	1.430	1.453	1.475	1.498	1.521	90
100	1.521	1.543	1.566	1.589	1.612	1.635	1.657	1.680	1.703	1.726	1.749	100
110	1.749	1.771	1.794	1.817	1.840	1.863	1.886	1.909	1.931	1.954	1.977	110
120	1.977	2.000	2.023	2.046	2.069	2.092	2.115	2.138	2.161	2.184	2.207	120
130	2.207	2.230	2.253	2.276	2.298	2.321	2.344	2.367	2.390	2.413	2.436	130
140	2.436	2.459	2.483	2.506	2.529	2.552	2.575	2.598	2.621	2.644	2.667	140
150	2.667	2.690	2.713	.736	2.759	2.782	2.805	2.828	2.851	2.874	2.897	150
160	2.897	2.920	2.944	2.967	2.990	3.013	3.036	3.059	3.082	3.105	3.128	160
170	3.128	3.151	3.174	3.197	3.220	3.244	3.267	3.290	3.313	3.336	3.359	170
180	3.359	3.382	3.405	3.428	3.451	3.474	3.497	3.520	3.544	3.567	3.590	180
190	3.590	3.613	3.636	3.659	3.682	3.705	3.728	3.751	3.774	3.797	3.820	190
200	3.820	3.843	3.866	3.889	3.912	3.935	3.958	3.981	4.004	4.027	4.050	200
210	4.050	4.073	4.096	4.119	4.142	4.165	4.188	4.211	4.234	4.257	4.280	210
220	4.280	4.303	4.326	4.349	4.372	4.395	4.417	4.440	4.463	4.486	4.509	220
230	4.509	4.532	4.555	4.578	4.601	4.623	4.646	4.669	4.692	4.715	4.738	230
240	4.738	4.760	4.783	4.806	4.829	4.852	4.874	4.897	4.920	4.943	4.965	240
250	4.965	4.988	5.011	5.034	5.056	5.079	5.102	5.124	5.147	5.170	5.192	250
260	5.192	5.215	5.238	5.260	5.283	5.306	5.328	5.351	5.374	5.396	5.419	260
270	5.419	5.441	5.464	5.487	5.509	5.532	5.554	5.577	5.599	5.622	5.644	270
280	5.644	5.667	5.690	5.712	5.735	5.757	5.779	5.802	5.824	5.847	5.869	280
290	5.869	5.892	5.914	5.937	5.959	5.982	6.004	6.026	6.049	6.071	6.094	290
300	6.094	6.116	6.138	6.161	6.183	6.205	6.228	6.250	6.272	6.295	6.317	300
310	6.317	6.339	6.362	6.384	6.406	6.429	6.451	6.473	6.496	6.518	6.540	310
320	6.540	6.562	6.585	6.607	6.629	6.652	6.674	6.696	6.718	6.741	6.763	320
330	6.763	6.785	6.807	6.829	6.852	6.874	6.896	6.918	6.941	6.963	6.985	330
340	6.985	7.007	7.029	7.052	7.074	7.096	7.118	7.140	7.163	7.185	7.207	340

K-type thermocouple - Temperature in degrees "F" with reference junction at 32°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
350	7.207	7.229	7.251	7.273	7.296	7.318	7.340	7.362	7.384	7.407	7.429	350
360	7.429	7.451	7.473	7.495	7.517	7.540	7.562	7.584	7.606	7.628	7.650	360
370	7.650	7.673	7.695	7.717	7.739	7.761	7.783	7.806	7.828	7.850	7.872	370
380	7.872	7.894	7.917	7.939	7.961	7.983	8.005	8.027	8.050	8.072	8.094	380
390	8.094	8.116	8.138	8.161	8.183	8.205	8.227	8.250	8.272	8.294	8.316	390
400	8.316	8.338	8.361	8.383	8.405	8.427	8.450	8.472	8.494	8.516	8.539	400
410	8.539	8.561	8.583	8.605	8.628	8.650	8.672	8.694	8.717	8.739	8.761	410
420	8.761	8.784	8.806	8.828	8.851	8.873	8.895	8.918	8.940	8.962	8.985	420
430	8.985	9.007	9.029	9.052	9.074	9.096	9.119	9.141	9.163	9.186	9.208	430
440	9.208	9.231	9.253	9.275	9.298	9.320	9.343	9.365	9.388	9.410	9.432	440
450	9.432	9.455	9.477	9.500	9.522	9.545	9.567	9.590	9.612	9.635	9.657	450
460	9.657	9.680	9.702	9.725	9.747	9.770	9.792	9.815	9.837	9.860	9.882	460
470	9.882	9.905	9.927	9.950	9.973	9.995	10.018	10.040	10.063	10.086	10.108	470
480	10.108	10.131	10.153	10.176	10.199	10.221	10.244	10.267	10.289	10.312	10.334	480
490	10.334	10.357	10.380	10.402	10.425	10.448	10.471	10.493	10.516	10.539	10.561	490
500	10.561	10.584	10.607	10.629	10.652	10.675	10.698	10.720	10.743	10.766	10.789	500
510	10.789	10.811	10.834	10.857	10.880	10.903	10.925	10.948	10.971	10.994	11.017	510
520	11.017	11.039	11.062	11.085	11.108	11.131	11.154	11.176	11.199	11.222	11.245	520
530	11.245	11.268	11.291	11.313	11.336	11.359	11.382	11.405	11.428	11.451	11.474	530
540	11.474	11.497	11.519	11.542	11.565	11.588	11.611	11.634	11.657	11.680	11.703	540
550	11.703	11.726	11.749	11.772	11.795	11.818	11.841	11.864	11.887	11.910	11.933	550
560	11.933	11.956	11.978	12.001	12.024	12.047	12.070	12.093	12.116	12.140	12.163	560
570	12.163	12.186	12.209	12.232	12.255	12.278	12.301	12.324	12.347	12.370	12.393	570
580	12.393	12.416	12.439	12.462	12.485	12.508	12.531	12.554	12.577	12.600	12.624	580
590	12.624	12.647	12.670	12.693	12.716	12.739	12.762	12.785	12.808	12.831	12.855	590
600	12.855	12.878	12.901	12.924	12.947	12.970	12.993	13.016	13.040	13.063	13.086	600
610	13.086	13.109	13.132	13.155	13.179	13.202	13.225	13.248	13.271	13.294	13.318	610
620	13.318	13.341	13.364	13.387	13.410	13.433	13.457	13.480	13.503	13.526	13.549	620
630	13.549	13.573	13.596	13.619	13.642	13.665	13.689	13.712	13.735	13.758	13.782	630
640	13.782	13.805	13.828	13.851	13.874	13.898	13.921	13.944	13.967	13.991	14.014	640
650	14.014	14.037	14.060	14.084	14.107	14.130	14.154	14.177	14.200	14.223	14.247	650
660	14.247	14.270	14.293	14.316	14.340	14.363	14.386	14.410	14.433	14.456	14.479	660
670	14.479	14.503	14.526	14.549	14.573	14.596	14.619	14.643	14.666	14.689	14.713	670
680	14.713	14.736	14.759	14.783	14.806	14.829	14.853	14.876	14.899	14.923	14.946	680
690	14.946	14.969	14.993	15.016	15.039	15.063	15.086	15.109	15.133	15.156	15.179	690
700	15.179	15.203	15.226	15.250	15.273	15.296	15.320	15.343	15.366	15.390	15.413	700
710	15.413	15.437	15.460	15.483	15.507	15.530	15.554	15.577	15.600	15.624	15.647	710
720	15.647	15.671	15.694	15.717	15.741	15.764	15.788	15.811	15.834	15.858	15.881	720
730	15.881	15.905	15.928	15.952	15.975	15.998	16.022	16.045	16.069	16.092	16.116	730
740	16.116	16.139	16.163	16.186	16.209	16.233	16.256	16.280	16.303	16.327	16.350	740
750	16.350	16.374	16.397	16.421	16.444	16.468	16.491	16.514	16.538	16.561	16.585	750
760	16.585	16.608	16.632	16.655	16.679	16.702	16.726	16.749	16.773	16.796	16.820	760
770	16.820	16.843	16.867	16.890	16.914	16.937	16.961	16.984	17.008	17.031	17.055	770
780	17.055	17.078	17.102	17.125	17.149	17.173	17.196	17.220	17.243	17.267	17.290	780
790	17.290	17.314	17.337	17.361	17.384	17.408	17.431	17.455	17.478	17.502	17.526	790
800	17.526	17.549	17.573	17.596	17.620	17.643	17.667	17.690	17.714	17.738	17.761	800
810	17.761	17.785	17.808	17.832	17.855	17.879	17.902	17.926	17.950	17.973	17.997	810
820	17.997	18.020	18.044	18.068	18.091	18.115	18.138	18.162	18.185	18.209	18.233	820
830	18.233	18.256	18.280	18.303	18.327	18.351	18.374	18.398	18.421	18.445	18.469	830
840	18.469	18.492	18.516	18.539	18.563	18.587	18.610	18.634	18.657	18.681	18.705	840
850	18.705	18.728	18.752	18.776	18.799	18.823	18.846	18.870	18.894	18.917	18.941	850
860	18.941	18.965	18.988	19.012	19.035	19.059	19.083	19.106	19.130	19.154	19.177	860
870	19.177	19.201	19.224	19.248	19.272	19.295	19.319	19.343	19.366	19.390	19.414	870
880	19.414	19.437	19.461	19.485	19.508	19.532	19.556	19.579	19.603	19.626	19.650	880
890	19.650	19.674	19.697	19.721	19.745	19.768	19.792	19.816	19.839	19.863	19.887	890
900	19.887	19.910	19.934	19.958	19.981	20.005	20.029	20.052	20.076	20.100	20.123	900
910	20.123	20.147	20.171	20.194	20.218	20.242	20.265	20.289	20.313	20.336	20.360	910
920	20.360	20.384	20.407	20.431	20.455	20.479	20.502	20.526	20.550	20.573	20.597	920
930	20.597	20.621	20.644	20.668	20.692	20.715	20.739	20.763	20.786	20.810	20.834	930
940	20.834	20.857	20.881	20.905	20.929	20.952	20.976	21.000	21.023	21.047	21.071	940
950	21.071	21.094	21.118	21.142	21.165	21.189	21.213	21.236	21.260	21.284	21.308	950
960	21.308	21.331	21.355	21.379	21.402	21.426	21.450	21.473	21.497	21.521	21.544	960
970	21.544	21.568	21.592	21.616	21.639	21.663	21.687	21.710	21.734	21.758	21.781	970
980	21.781	21.805	21.829	21.852	21.876	21.900	21.924	21.947	21.971	21.995	22.018	980
990	22.018	22.042	22.066	22.089	22.113	22.137	22.160	22.184	22.208	22.232	22.255	990
1000	22.255	22.279	22.303	22.326	22.350	22.374	22.397	22.421	22.445	22.468	22.492	1000
1010	22.492	22.516	22.540	22.563	22.587	22.611	22.634	22.658	22.682	22.705	22.729	1010
1020	22.729	22.753	22.776	22.800	22.824	22.847	22.871	22.895	22.919	22.942	22.966	1020
1030	22.966	22.990	23.013	23.037	23.061	23.084	23.108	23.132	23.155	23.179	23.203	1030
1040	23.203	23.226	23.250	23.274	23.297	23.321	23.345	23.368	23.392	23.416	23.439	1040
1050	23.439	23.463	23.487	23.510	23.534	23.558	23.581	23.605	23.629	23.652	23.676	1050
1060	23.676	23.700	23.723	23.747	23.771	23.794	23.818	23.842	23.865	23.889	23.913	1060
1070	23.913	23.936	23.960	23.984	24.007	24.031	24.055	24.078	24.102	24.126	24.149	1070
1080	24.149	24.173	24.197	24.220	24.244	24.267	24.291	24.315	24.338	24.362	24.386	1080
1090	24.386	24.409	24.433	24.457	24.480	24.504	24.527	24.551	24.575	24.598	24.622	1090
1100	24.622	24.646	24.669	24.693	24.717	24.740	24.764	24.787	24.811	24.835	24.858	1100
1110	24.858	24.882	24.905	24.929	24.953	24.976	25.000	25.024	25.047	25.071	25.094	1110
1120	25.094	25.118	25.142	25.165	25.189	25.212	25.236	25.260	25.283	25.307	25.330	1120
1130	25.330	25.354	25.377	25.401	25.425	25.448	25.472	25.495	25.519	25.543	25.566	1130
1140	25.566	25.590	25.613	25.637	25.660	25.684	25.708	25.731	25.755	25.778	25.802	1140
1150	25.802	25.825	25.849	25.873	25.896	25.920	25.943	25.967	25.990	26.014	26.037	1150
1160	26.037	26.061	26.084	26.108	26.132	26.155	26.179	26.202	26.226	26.249	26.273	1160
1170	26.273	26.296	26.320	26.343	26.367	26.390	26.414	26.437	26.461	26.484	26.508	1170
1180	26.508	26.532	26.555	26.579	26.602	26.626	26.649	26.673	26.696	26.720	26.743	1180
1190	26.743	26.767	26.790	26.814	26.837	26.861	26.884	26.907	26.931	26.954	26.978	1190

Thermoelectric Voltage in milliVolts

Thermocouple Reference Tables

Reference Tables
N.I.S.T Rev. ITS-90

K-type thermocouple - Temperature in degrees "F" with reference junction at 32°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
1200	26.978	27.001	27.025	27.048	27.072	27.095	27.119	27.142	27.166	27.189	27.213	1200
1210	27.213	27.236	27.259	27.283	27.306	27.330	27.353	27.377	27.400	27.424	27.447	1210
1220	27.447	27.471	27.494	27.517	27.541	27.564	27.588	27.611	27.635	27.658	27.681	1220
1230	27.681	27.705	27.728	27.752	27.775	27.798	27.822	27.845	27.869	27.892	27.915	1230
1240	27.915	27.939	27.962	27.986	28.009	28.032	28.056	28.079	28.103	28.126	28.149	1240
1250	28.149	28.173	28.196	28.219	28.243	28.266	28.289	28.313	28.336	28.360	28.383	1250
1260	28.383	28.406	28.430	28.453	28.476	28.500	28.523	28.546	28.570	28.593	28.616	1260
1270	28.616	28.640	28.663	28.686	28.710	28.733	28.756	28.780	28.803	28.826	28.849	1270
1280	28.849	28.873	28.896	28.919	28.943	28.966	28.989	29.013	29.036	29.059	29.082	1280
1290	29.082	29.106	29.129	29.152	29.176	29.199	29.222	29.245	29.269	29.292	29.315	1290
1300	29.315	29.338	29.362	29.385	29.408	29.431	29.455	29.478	29.501	29.524	29.548	1300
1310	29.548	29.571	29.594	29.617	29.640	29.664	29.687	29.710	29.733	29.757	29.780	1310
1320	29.780	29.803	29.826	29.849	29.873	29.896	29.919	29.942	29.965	29.989	30.012	1320
1330	30.012	30.035	30.058	30.081	30.104	30.128	30.151	30.174	30.197	30.220	30.243	1330
1340	30.243	30.267	30.290	30.313	30.336	30.359	30.382	30.405	30.429	30.452	30.475	1340
1350	30.475	30.498	30.521	30.544	30.567	30.590	30.613	30.637	30.660	30.683	30.706	1350
1360	30.706	30.729	30.752	30.775	30.798	30.821	30.844	30.868	30.891	30.914	30.937	1360
1370	30.937	30.960	30.983	31.006	31.029	31.052	31.075	31.098	31.121	31.144	31.167	1370
1380	31.167	31.190	31.213	31.236	31.260	31.283	31.306	31.329	31.352	31.375	31.398	1380
1390	31.398	31.421	31.444	31.467	31.490	31.513	31.536	31.559	31.582	31.605	31.628	1390
1400	31.628	31.651	31.674	31.697	31.720	31.743	31.766	31.789	31.812	31.834	31.857	1400
1410	31.857	31.880	31.903	31.926	31.949	31.972	31.995	32.018	32.041	32.064	32.087	1410
1420	32.087	32.110	32.133	32.156	32.179	32.202	32.224	32.247	32.270	32.293	32.316	1420
1430	32.316	32.339	32.362	32.385	32.408	32.431	32.453	32.476	32.499	32.522	32.545	1430
1440	32.545	32.568	32.591	32.614	32.636	32.659	32.682	32.705	32.728	32.751	32.774	1440
1450	32.774	32.796	32.819	32.842	32.865	32.888	32.911	32.933	32.956	32.979	33.002	1450
1460	33.002	33.025	33.047	33.070	33.093	33.116	33.139	33.161	33.184	33.207	33.230	1460
1470	33.230	33.253	33.275	33.298	33.321	33.344	33.366	33.389	33.412	33.435	33.458	1470
1480	33.458	33.480	33.503	33.526	33.548	33.571	33.594	33.617	33.639	33.662	33.685	1480
1490	33.685	33.708	33.730	33.753	33.776	33.798	33.821	33.844	33.867	33.889	33.912	1490
1500	33.912	33.935	33.957	33.980	34.003	34.025	34.048	34.071	34.093	34.116	34.139	1500
1510	34.139	34.161	34.184	34.207	34.229	34.252	34.275	34.297	34.320	34.343	34.365	1510
1520	34.365	34.388	34.410	34.433	34.456	34.478	34.501	34.524	34.546	34.569	34.591	1520
1530	34.591	34.614	34.637	34.659	34.682	34.704	34.727	34.750	34.772	34.795	34.817	1530
1540	34.817	34.840	34.862	34.885	34.908	34.930	34.953	34.975	34.998	35.020	35.043	1540
1550	35.043	35.065	35.088	35.110	35.133	35.156	35.178	35.201	35.223	35.246	35.268	1550
1560	35.268	35.291	35.313	35.336	35.358	35.381	35.403	35.426	35.448	35.471	35.493	1560
1570	35.493	35.516	35.538	35.560	35.583	35.605	35.628	35.650	35.673	35.695	35.718	1570
1580	35.718	35.740	35.763	35.785	35.807	35.830	35.852	35.875	35.897	35.920	35.942	1580
1590	35.942	35.964	35.987	36.009	36.032	36.054	36.076	36.099	36.121	36.144	36.166	1590
1600	36.166	36.188	36.211	36.233	36.256	36.278	36.300	36.323	36.345	36.367	36.390	1600
1610	36.390	36.412	36.434	36.457	36.479	36.501	36.524	36.546	36.568	36.591	36.613	1610
1620	36.613	36.635	36.658	36.680	36.702	36.725	36.747	36.769	36.792	36.814	36.836	1620
1630	36.836	36.859	36.881	36.903	36.925	36.948	36.970	36.992	37.014	37.037	37.059	1630
1640	37.059	37.081	37.104	37.126	37.148	37.170	37.193	37.215	37.237	37.259	37.281	1640
1650	37.281	37.304	37.326	37.348	37.370	37.393	37.415	37.437	37.459	37.481	37.504	1650
1660	37.504	37.526	37.548	37.570	37.592	37.615	37.637	37.659	37.681	37.703	37.725	1660
1670	37.725	37.748	37.770	37.792	37.814	37.836	37.858	37.881	37.903	37.925	37.947	1670
1680	37.947	37.969	37.991	38.013	38.036	38.058	38.080	38.102	38.124	38.146	38.168	1680
1690	38.168	38.190	38.212	38.235	38.257	38.279	38.301	38.323	38.345	38.367	38.389	1690
1700	38.389	38.411	38.433	38.455	38.477	38.499	38.522	38.544	38.566	38.588	38.610	1700
1710	38.610	38.632	38.654	38.676	38.698	38.720	38.742	38.764	38.786	38.808	38.830	1710
1720	38.830	38.852	38.874	38.896	38.918	38.940	38.962	38.984	39.006	39.028	39.050	1720
1730	39.050	39.072	39.094	39.116	39.138	39.160	39.182	39.204	39.226	39.248	39.270	1730
1740	39.270	39.292	39.314	39.335	39.357	39.379	39.401	39.423	39.445	39.467	39.489	1740
1750	39.489	39.511	39.533	39.555	39.577	39.599	39.620	39.642	39.664	39.686	39.708	1750
1760	39.708	39.730	39.752	39.774	39.796	39.817	39.839	39.861	39.883	39.905	39.927	1760
1770	39.927	39.949	39.970	39.992	40.014	40.036	40.058	40.080	40.101	40.123	40.145	1770
1780	40.145	40.167	40.189	40.211	40.232	40.254	40.276	40.298	40.320	40.341	40.363	1780
1790	40.363	40.385	40.407	40.429	40.450	40.472	40.494	40.516	40.537	40.559	40.581	1790
1800	40.581	40.603	40.624	40.646	40.668	40.690	40.711	40.733	40.755	40.777	40.798	1800
1810	40.798	40.820	40.842	40.864	40.885	40.907	40.929	40.950	40.972	40.994	41.015	1810
1820	41.015	41.037	41.059	41.081	41.102	41.124	41.146	41.167	41.189	41.211	41.232	1820
1830	41.232	41.254	41.276	41.297	41.319	41.341	41.362	41.384	41.405	41.427	41.449	1830
1840	41.449	41.470	41.492	41.514	41.535	41.557	41.578	41.600	41.622	41.643	41.665	1840
1850	41.665	41.686	41.708	41.730	41.751	41.773	41.794	41.816	41.838	41.859	41.881	1850
1860	41.881	41.902	41.924	41.945	41.967	41.988	42.010	42.032	42.053	42.075	42.096	1860
1870	42.096	42.118	42.139	42.161	42.182	42.204	42.225	42.247	42.268	42.290	42.311	1870
1880	42.311	42.333	42.354	42.376	42.397	42.419	42.440	42.462	42.483	42.505	42.526	1880
1890	42.526	42.548	42.569	42.591	42.612	42.633	42.655	42.676	42.698	42.719	42.741	1890
1900	42.741	42.762	42.783	42.805	42.826	42.848	42.869	42.891	42.912	42.933	42.955	1900
1910	42.955	42.976	42.998	43.019	43.040	43.062	43.083	43.104	43.126	43.147	43.169	1910
1920	43.169	43.190	43.211	43.233	43.254	43.275	43.297	43.318	43.339	43.361	43.382	1920
1930	43.382	43.403	43.425	43.446	43.467	43.489	43.510	43.531	43.552	43.574	43.595	1930
1940	43.595	43.616	43.638	43.659	43.680	43.701	43.723	43.744	43.765	43.787	43.808	1940
1950	43.808	43.829	43.850	43.872	43.893	43.914	43.935	43.957	43.978	43.999	44.020	1950
1960	44.020	44.041	44.063	44.084	44.105	44.126	44.147	44.169	44.190	44.211	44.232	1960
1970	44.232	44.253	44.275	44.296	44.317	44.338	44.359	44.380	44.402	44.423	44.444	1970
1980	44.444	44.465	44.486	44.507	44.528	44.550	44.571	44.592	44.613	44.634	44.655	1980
1990	44.655	44.676	44.697	44.719	44.740	44.761	44.782	44.803	44.824	44.845	44.866	1990
2000	44.866	44.887	44.908	44.929	44.950	44.971	44.992	45.014	45.035	45.056	45.077	2000
2010	45.077	45.098	45.119	45.140	45.161	45.182	45.203	45.224	45.245	45.266	45.287	2010
2020	45.287	45.308	45.329	45.350	45.371	45.392	45.413	45.434	45.455	45.476	45.497	2020
2030	45.497	45.518	45.539	45.560	45.580	45.601	45.622	45.643	45.664	45.685	45.706	2030
2040	45.706	45.727	45.748	45.769	45.790	45.811	45.832	45.852	45.873	45.894	45.915	2040

K-type thermocouple - Temperature in degrees "F" with reference junction at 32°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
2050	45.915	45.936	45.957	45.978	45.999	46.019	46.040	46.061	46.082	46.103	46.124	2050
2060	46.124	46.145	46.165	46.186	46.207	46.228	46.249	46.269	46.290	46.311	46.332	2060
2070	46.332	46.353	46.373	46.394	46.415	46.436	46.457	46.477	46.498	46.519	46.540	2070
2080	46.540	46.560	46.581	46.602	46.623	46.643	46.664	46.685	46.706	46.726	46.747	2080
2090	46.747	46.768	46.789	46.809	46.830	46.851	46.871	46.892	46.913	46.933	46.954	2090
2100	46.954	46.975	46.995	47.016	47.037	47.057	47.078	47.099	47.119	47.140	47.161	2100
2110	47.161	47.181	47.202	47.223	47.243	47.264	47.284	47.305	47.326	47.346	47.367	2110
2120	47.367	47.387	47.408	47.429	47.449	47.470	47.490	47.511	47.531	47.552	47.573	2120
2130	47.573	47.593	47.614	47.634	47.655	47.675	47.696	47.716	47.737	47.757	47.778	2130
2140	47.778	47.798	47.819	47.839	47.860	47.880	47.901	47.921	47.942	47.962	47.983	2140
2150	47.983	48.003	48.024	48.044	48.065	48.085	48.105	48.126	48.146	48.167	48.187	2150
2160	48.187	48.208	48.228	48.248	48.269	48.289	48.310	48.330	48.350	48.371	48.391	2160
2170	48.391	48.411	48.432	48.452	48.473	48.493	48.513	48.534	48.554	48.574	48.595	2170
2180	48.595	48.615	48.635	48.656	48.676	48.696	48.717	48.737	48.757	48.777	48.798	2180
2190	48.798	48.818	48.838	48.859	48.879	48.899	48.919	48.940	48.960	48.980	49.000	2190
2200	49.000	49.021	49.041	49.061	49.081	49.101	49.122	49.142	49.162	49.182	49.202	2200
2210	49.202	49.223	49.243	49.263	49.283	49.303	49.323	49.344	49.364	49.384	49.404	2210
2220	49.404	49.424	49.444	49.465	49.485	49.505	49.525	49.545	49.565	49.585	49.605	2220
2230	49.605	49.625	49.645	49.666	49.686	49.706	49.726	49.746	49.766	49.786	49.806	2230
2240	49.806	49.826	49.846	49.866	49.886	49.906	49.926	49.946	49.966	49.986	50.006	2240
2250	50.006	50.026	50.046	50.066	50.086	50.106	50.126	50.146	50.166	50.186	50.206	2250
2260	50.206	50.226	50.246	50.266	50.286	50.306	50.326	50.346	50.366	50.385	50.405	2260
2270	50.405	50.425	50.445	50.465	50.485	50.505	50.525	50.545	50.564	50.584	50.604	2270
2280	50.604	50.624	50.644	50.664	50.684	50.703	50.723	50.743	50.763	50.783	50.802	2280
2290	50.802	50.822	50.842	50.862	50.882	50.901	50.921	50.941	50.961	50.981	51.000	2290
2300	51.000	51.020	51.040	51.060	51.079	51.099	51.119	51.139	51.158	51.178	51.198	2300
2310	51.198	51.217	51.237	51.257	51.276	51.296	51.316	51.336	51.355	51.375	51.395	2310
2320	51.395	51.414	51.434	51.453	51.473	51.493	51.512	51.532	51.552	51.571	51.591	2320
2330	51.591	51.611	51.630	51.650	51.669	51.689	51.708	51.728	51.748	51.767	51.787	2330
2340	51.787	51.806	51.826	51.845	51.865	51.885	51.904	51.924	51.943	51.963	51.982	2340
2350	51.982	52.002	52.021	52.041	52.060	52.080	52.099	52.119	52.138	52.158	52.177	2350
2360	52.177	52.197	52.216	52.235	52.255	52.274	52.294	52.313	52.333	52.352	52.371	2360
2370	52.371	52.391	52.410	52.430	52.449	52.468	52.488	52.507	52.527	52.546	52.565	2370
2380	52.565	52.585	52.604	52.623	52.643	52.662	52.681	52.701	52.720	52.739	52.759	2380
2390	52.759	52.778	52.797	52.817	52.836	52.855	52.875	52.894	52.913	52.932	52.952	2390
2400	52.952	52.971	52.990	53.010	53.029	53.048	53.067	53.087	53.106	53.125	53.144	2400
2410	53.144	53.163	53.183	53.202	53.221	53.240	53.260	53.279	53.298	53.317	53.336	2410
2420	53.336	53.355	53.375	53.394	53.413	53.432	53.451	53.470	53.490	53.509	53.528	2420
2430	53.528	53.547	53.566	53.585	53.604	53.623	53.643	53.662	53.681	53.700	53.719	2430
2440	53.719	53.738	53.757	53.776	53.795	53.814	53.833	53.852	53.871	53.890	53.910	2440
2450	53.910	53.929	53.948	53.967	53.986	54.005	54.024	54.043	54.062	54.081	54.100	2450
2460	54.100	54.119	54.138	54.157	54.176	54.195	54.214	54.233	54.252	54.271	54.289	2460
2470	54.289	54.308	54.327	54.346	54.365	54.384	54.403	54.422	54.441	54.460	54.479	2470
2480	54.479	54.498	54.517	54.536	54.554	54.573	54.592	54.611	54.630	54.649	54.668	2480
2490	54.668	54.687	54.705	54.724	54.743	54.762	54.781	54.800	54.819	54.837	54.856	2490
2500	54.856	54.875	54.894									

Resistance Values of HANNA Thermistor Sensors

HI 765 Series

The following table shows various ambient temperatures and the corresponding resistance values of our HI765 sensor series in the -50.0 to +170.0°C range

Ambient Temperature (°C)	Resistance (ohm)	Ambient Temperature (°C)	Resistance (ohm)
-50.0	537.2	60.0	1275.3
-40.0	588.2	70.0	1361.9
-30.0	641.9	80.0	1450.2
-20.0	699.5	90.0	1542.0
-10.0	760.9	100.0	1637.2
0.0	825.0	110.0	1734.9
10.0	891.9	120.0	1835.9
20.0	962.4	130.0	1939.4
25.0	999.1	140.0	2045.2
30.0	1036.7	150.0	2154.3
40.0	1112.6	160.0	2267.5
50.0	1193.1	170.0	2380.2

HI 762 Series

The following table shows various ambient temperatures and the corresponding resistance values of our HI762 sensor series in the -50.0 to +140.0°C range

Ambient Temperature (°C)	Resistance (ohm)	Ambient Temperature (°C)	Resistance (ohm)
-50.0	670100	50.0	3603
-40.0	336500	60.0	2488
-30.0	177000	70.0	1752
-20.0	97070	80.0	1258
-10.0	55330	90.0	917.7
0.0	32650	100.0	680.0
10.0	19900	110.0	511.2
20.0	12490	120.0	389.3
25.0	10000	130.0	300.9
30.0	8057	140.0	234.8
40.0	5327		

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Limited Warranty, Return and Exchange

Limited Warranty

Hanna products are manufactured in our ISO 9001:2008 facilities, meeting the highest quality standards in the industry. Hanna's high standards also apply should a product be returned due to defects in material or workmanship. Our extensive warranty extends up to five years on some products.

Limitations: Warranted products may be returned for repair or replacement only at the discretion of Hanna. In some circumstances, remedy may constitute refund for the price paid for the product.

The warranty period commences from the original date of sale to the user or a maximum of 18 months from factory ship date. Warranty is valid only when the product is used under normal conditions and in accordance with operating limitations and prescribed maintenance procedures. The express warranty stated previously is the only express warranty given by Hanna to the end-user buyer. Hanna expressly disclaims any warranties implied by law, including but not limited to warranty of merchantability of fitness for a particular purpose. Hanna shall not be liable for any individual or consequential damages of any kind for breach of any warranty, negligence, on the basis of strict liability or otherwise. Hanna's warranty periods differ across our range of instrumentation, please visit us on the web at: www.hannainst.com or contact your local Hanna representative for specific warranty information.

Instrument Service:

Warranty and non-warranty service, replacement, recalibration and repairs are performed by factory trained service technicians at one of Hanna's Technical Service Centers worldwide. All items must have a Return Goods Authorization (RGA) number that can be obtained by contacting the Hanna Technical Service Department. The RGA number should be clearly marked on the outside of the box and the unit shipped prepaid and insured. Any product not bearing an RGA number will be refused. All products returned for warranty repair or replacement MUST be preceded or accompanied with proof of purchase, such as the original invoice or packing slip. Under special circumstances it may be deemed necessary by Hanna to issue a Return In Advance (RIA). In such cases, the defective materials must be returned to Hanna within 30 days. Materials not returned within 30 days become chargeable. Materials must be packed properly to avoid damage during transport, which would render the warranty null and void. The sender is responsible for expediting any damage claims placed against the carrier.

In most cases, a flat minimum service charge applies to non-warranty repairs or recalibration. Please contact your local Hanna Technical Service Department for current rates. Any materials returned for repair which are considered non-warranty may be serviced at hourly cost (excluding parts) following subsequent notification and approval of such.

Product Return and Exchange

Returning Merchandise:

Should an instance occur when a product may need to be returned for exchange or credit, or should a discrepancy occur in a packing slip, Hanna must be contacted to obtain a Return Goods Authorization Number (RGA). Please follow these steps:

1. Within 30 days of receipt of merchandise call Hanna's Technical Service Department to obtain a Return Goods Authorization Number.
2. Hanna will issue a Return Goods Authorization Number.
3. The number must be clearly marked on the outside of the package being returned. Shipments not bearing a Return Goods Authorization Number will be refused.
4. Credit returns may be subject to a 25% restocking fee.

Terms and Conditions

Return shipments must meet the following requirements to be accepted for credit:

1. Products must be returned in the original packaging with labeling not defaced. All items returned will be inspected for credit worthiness. Credit will only be issued for product returned in like-new condition. No credit will be issued for product, which is not received in like-new condition.
2. All freight charges are the responsibility of the customer.
3. All chemicals and reagents being returned must be packaged in accordance with the laws and regulations of the governing country. Only unopened chemicals and reagents may be returned.

HANNA® instruments

GCGENCATV32 1.0 01/18 PRINTED IN USA