Electrodes | Solutions | Instrumentation

ION SELECTIVE MEASUREMENT catalog

featuring our full line of
Ion Selective Electrodes

HANNA® instruments
With Great Products, Come Great Results™

Introduction

HANNA instruments® is an
ISO 9001:2000 Certified company.

Dear Valued Customer,

It is with great pleasure that I introduce HANNA's new line of Ion Selective Electrodes. These electrodes complement our extensive offering of high performance electrochemical products. This catalog features our complete line of half-cell and combination Ion Selective Electrodes as well as meters and accessories to complete this new line.

ISE technology offers considerable advantages to analytical chemistry. These electrodes are ideal in a wide range of industries such as research laboratories, agriculture, education, food processing, biomedical, metal finishing, waste treatment, power generation and water quality monitoring.

Our new Ion Selective line is fully supported with ionic strength adjusters, filling solutions and certified standards. Each electrode has been developed, produced and rigorously tested to confirm high performance, durability and quick response in our state-of-the-art ISO 9001:2000 U.S. production facility.

Thank you for making HANNA instruments® a continuing success for the past 30 years.

Martino Nardo
President

Table of Contents

Overview
ISE Electrode Types 4
Reference
and Combination Electrodes 5

ISE Electrodes
Ammonia
Bromide
Cadmium 6

Calcium
Carbon Dioxide
Chloride 7

Cupric
Cyanide
Fluoride 8

Iodide
Lead/Sulfate
Nitrate 9

Potassium
Silver/Sulfide
Reference 10

Sensors and Accessories
Reference Chart 11

Solutions
ISE Standards
Gas Sensor Fill Solutions
Specific Solutions for ISE Sensors 12

Ionic Strength Adjusters
Silver-free Reference Fill Solutions
Accessories 13

Measurement
Direct Potentiometry
Portable ISE Meters 14-15

Incremental Methods
pH/ISE Bench Meter 16-17

Potentiometric Titrations
Automatic Titrators 18-19

ISE Electrode Types

HANNA's ion selective electrodes can be grouped into three general categories based upon construction.

Solid State Electrodes

are available as both single half-cells or as combination electrodes complete with reference electrode. These electrodes incorporate a solid sensing surface made of compressed silver halides, or solid crystalline material. HANNA's offering includes sensors for the determination of bromide, cadmium, chloride, cupric, cyanide, fluoride, lead and silver ions. Solid body construction is rugged for long life.

Theory: A solid state electrode develops a voltage due to ion-exchange occurring between the sample and the inorganic membrane. An equilibrium mechanism occurs due to the very limited solubility of the membrane material in the sample.

Liquid Membrane Electrodes

are available as single half-cells or as combination electrodes complete with reference electrode. The sensing surfaces of these electrodes are comprised of a homogeneous polymer matrix containing organic ion-exchangers selective for the determined ion. These sensors incorporate easily replaceable membrane modules and are available for measurements of nitrate, potassium and calcium.

Theory: The potassium electrode was one of the earliest liquid membrane sensors developed of this type. The membrane is usually in the form of a thin disc of PVC impregnated with the antibiotic valinomycin. The exchanger, also known an ionophore, is a ring structure that fits potassium ions inside like a lock and key. This type of membrane is not as rugged as the solid state type so they are designed for easy replacement of the sensing module.

Gas Sensors

are combination electrodes that detect dissolved gases in a solution. No external reference is required for these electrodes. The sensing element is separated from the sample solution by a gas permeable membrane. HANNA's offering includes the HI 4101 Ammonia electrode and the HI 4105 Carbon Dioxide electrode.

Theory: A gas sensor works due to the partial pressure of the measured gas in solution. The dissolved gas in the sample diffuses into the membrane and changes the pH in a thin film of unbuffered electrolyte on the surface of the internal pH sensor. Diffusion continues until the partial pressure of the sample and the thin film is the same. The pH change is proportional to the dissolved gas in the sample.

Reference and Combination Electrodes

HANNA's reference electrode is used with our half-cell ISE sensors to provide accurate and repeatable measurements. HANNAs combination electrodes incorporate the measuring electrode with the reference making them ideal for field measurements.

Reference Electrodes are used to provide a stable voltage and electrolytic contact to permit a voltage gradient to be measured across a measurement membrane such as an ISE. HANNA has designed an easy to use, unbreakable plastic, double junction, quick fill, sleeve style reference electrode with a cone style junction to work with the ion selective electrode family of sensors. The design forms the liquid junction with the test solution at the tip of the junction cone and not further up the cone surface. The design produces a highly stable reference electrode with reasonable low flow rates. The model HI 5315 is a silver/silver chloride electrode half-cell with a permanent gel filled internal cell. The outer fill solution is easily replaceable and serves as a buffer zone between the internal chloride ion containing gel and the sample solution. HANNA offers a complete line of silver-free fill solutions to optimize your ion measurement. A fast responding liquid junction, excellent reproducibility, and ease of use will mark this reference as your "best" in the lab.

Combination Electrodes include a sensor and reference electrode in a single electrode body. Our combination ion selective electrodes provide the same selectivity and response as our ISE half-cells, but include our superior double junction reference into the same electrode body. Combination solid state electrodes have a built in solid state sensor and quick refillable reference electrode. Our liquid membrane and fluoride combination electrodes have replaceable module construction and the HANNA double junction reference stability.

Three Methods of Analysis

Potentiometric ion analyses with ISEs are performed by use of one of three methods, each entailing its own advantages: Direct Potentiometry, Incremental Methods, and Potentiometric Titration. HANNA offers a solution for each of these methods, for more details please refer to pages 14-19.

Ammonia • Bromide • Cadmium

PARAMETER	AMMONIA	BROMIDE		CADMIUM	
Code	**HI 4101**	**HI 4002**	**HI 4102**	**HI 4003**	**HI 4103**
Type	Gas-Sensing; Combination	Solid-state; Half-cell	Solid-state; Combination	Solid-state; Half-cell	Solid-state; Combination
Measurement Range	1M to 1X 10^{-6}M 17000 to 0.02 ppm	1M to 1X 10^{-6}M 79910 to 0.08 ppm	1M to 1X 10^{-6}M 79910 to 0.08 ppm	1M to 1X 10^{-7}M 11200 to 0.01 ppm	1M to 1X 10^{-7}M 11200 to 0.01 ppm
Optimum pH Range	>11	2 to 12.5	2 to 12.5	2 to 12.5	2 to 12.5
Temperature Range	0 to 40°C	0 to 80°C	0 to 80°C	0 to 80°C	0 to 80°C
Approximate Slope	-56	-56	-56	+28	+28
Body O.D.	12 mm	12 mm	12 mm	12 mm	12 mm
Insertion Length	120 mm	120 mm	120 mm	120 mm	120 mm
Body Material	Delrin	Epoxy	PEI	Epoxy	PEI
Cable	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial
Connector	BNC	BNC	BNC	BNC	BNC
Possible Applications	Determination of ammonium, ammonia in wine, beer, water, waste water and soil	Determination of free bromide ions in emulsified food products, beverages, plants, soils and as an indicator for titration		Used as an indicator for titrations using chelates	

Calcium • Carbon Dioxide • Chloride

PARAMETER	CALCIUM		CARBON DIOXIDE	CHLORIDE	
Code	HI 4004	HI 4104	HI 4105	HI 4007	HI 4107
Type	Polymer Membrane; Half-cell	Polymer Membrane; Combination	Gas Sensing; Combination	Solid-state; Half-cell	Solid-state; Combination
Measurement Range	1M to 3X 10^{-6}M 40080 to 0.12 ppm	1M to 3X 10^{-6}M 40080 to 0.12 ppm	1X 10^{-2}M to 1X 10^{-4}M 440 to 4.4 ppm	1M to 5X 10^{-5}M 35000 to 1.8 ppm	1M to 5X 10^{-5}M 35000 to 1.8 ppm
Optimum pH Range	4 to 10	4 to 10	4.2 to 5.2	2 to 11	2 to 11
Temperature Range	0 to 40°C	0 to 40°C	0 to 40°C	0 to 80°C	0 to 80°C
Approximate Slope	+28	+28	+54	-57	-57
Body O.D.	12 mm	12 mm	12 mm	12 mm	12 mm
Insertion Length	120 mm	120 mm	120 mm	120 mm	120 mm
Body Material	PVC	PEI/PVC	Delrin	Epoxy	PEI
Cable	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial
Connector	BNC	BNC	BNC	BNC	BNC
Possible Applications	Determination of free calcium in beverages, water, and seawater		Determination of carbonates as CO_2 in water, soft drinks and wine samples	Determination of free chloride ions in emulsified food products, beverages, plants, soils and as an indicator for titration	

Cupric • Cyanide • Fluoride

PARAMETER	CUPRIC		CYANIDE		FLUORIDE	
Code	**HI 4008**	**HI 4108**	**HI 4009**	**HI 4109**	**HI 4010**	**HI 4110**
Type	Solid-state; Half-cell	Solid-state; Combination	Solid-state; Half-cell	Solid-state; Combination	Solid-state; Half-cell	Solid-state; Combination
Measurement Range	0.1M to 1X 10^{-6}M 6354 to 0.06 ppm	0.1M to 1X 10^{-6}M 6354 to 0.06 ppm	10^{-2}M to 1X 10^{-6}M 260 to 0.02 ppm	10^{-2}M to 1X 10^{-6}M 260 to 0.02 ppm	1M to 1X 10^{-6}M Sat. to 0.02 ppm	1M to 1X 10^{-6}M Sat. to 0.02 ppm
Optimum pH Range	2 to 12.5	2 to 12.5	>11	>11	5 to 8	5 to 8
Temperature Range	0 to 80°C	0 to 80°C	0 to 80°C	0 to 80°C	0 to 80°C	0 to 80°C
Approximate Slope	26	26	-57	-57	-56	-56
Body O.D.	12 mm	12 mm	12 mm	12 mm	12 mm	12 mm
Insertion Length	120 mm	120 mm	120 mm	120 mm	120 mm	120 mm
Body Material	Epoxy	PEI	Epoxy	PEI	Epoxy	PEI/Epoxy
Cable	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial
Connector	BNC	BNC	BNC	BNC	BNC	BNC
Possible Applications	Used as an indicator for titrations using chelates		Determination of free cyanide ions in plating baths, waste water and in plant and soil samples		Determination of free fluoride in potable water, soft drinks, wine, plants, emulsified food products, plating and pickling acids	

Iodide • Lead/Sulfate • Nitrate

PARAMETER	IODIDE		LEAD/SULFATE		NITRATE	
Code	**HI 4011**	**HI 4111**	**HI 4012**	**HI 4112**	**HI 4013**	**HI 4113**
Type	Solid-state; Half-cell	Solid-state; Combination	Solid-state; Half-cell	Solid-state; Combination	Polymer Membrane; Half-cell	Polymer Membrane; Combination
Measurement Range	1M to 1X 10^{-7}M 127000 to 0.01 ppm	1M to 1X 10^{-7}M 127000 to 0.01 ppm	0.1M to 1X 10^{-6}M 20700 to 0.21 ppm	0.1M to 1X 10^{-6}M 20700 to 0.21 ppm	1.0M to 1X 10^{-5}M 6200 to .62 ppm	1.0M to 1X 10^{-5}M 6200 to .62 ppm
Optimum pH Range	2 to 13	2 to 13	4 to 7	4 to 7	3.0 to 8	3.0 to 8
Temperature Range	0 to 80°C	0 to 80°C	0 to 80°C	0 to 80°C	0 to 40°C	0 to 40°C
Approximate Slope	-56	-56	+25	+25	-56	-56
Body O.D.	12 mm	12 mm	12 mm	12 mm	12 mm	12 mm
Insertion Length	120 mm	120 mm	120 mm	120 mm	120 mm	120 mm
Body Material	Epoxy	PEI	Epoxy	PEI	PVC	PEI/PVC
Cable	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial
Connector	BNC	BNC	BNC	BNC	BNC	BNC
Possible Applications	Determination of free iodide ions in emulsified food samples (iodized table salt), plants and for titration		Determination of lead ions in plating baths and as an indicator for titrations		Determination of free nitrate in natural waters (fresh and sea), and in emulsified food and plant samples	

Potassium • Silver/Sulfide • Reference

PARAMETER	POTASSIUM		SILVER/SULFIDE		REFERENCE
Code	**HI 4014**	**HI 4114**	**HI 4015**	**HI 4115**	**HI 5315**
Type	Polymer Membrane; Half-cell	Polymer Membrane; Combination	Solid-state; Half-cell	Solid-state; Combination	N/A
Measurement Range	1M to 1X 10^{-6}M 39100 to .039 ppm	1M to 1X 10^{-6}M 39100 to .039 ppm	Ag^+ 1.0M to 1X 10^{-6}M 107900 to 0.11ppm $S^=$ 1.0M to 1X 10^{-7}M 32100 to 0.003 ppm	Ag^+ 1.0M to 1X 10^{-6}M 107900 to 0.11ppm $S^=$ 1.0M to 1X 10^{-7}M 32100 to 0.003 ppm	N/A
Optimum pH Range	1.5 to 12.0	1.5 to 12.0	Ag^+ 2 to 8 $S^=$ 12 to 14	Ag^+ 2 to 8 $S^=$ 12 to 14	N/A
Temperature Range	0 to 40°C	0 to 40°C	0 to 80°C	0 to 80°C	0 to 80°C
Approximate Slope	+56	+56	+56 Ag^+ / -28 $S^=$	+56 Ag^+ / -28 $S^=$	N/A
Body O.D.	12 mm	12 mm	12 mm	12 mm	12 mm
Insertion Length	120 mm	120 mm	120 mm	120 mm	120 mm
Body Material	PVC	PEI/PVC	Epoxy	PEI	PEI
Cable	1m coaxial	1m coaxial	1m coaxial	1m coaxial	1m coaxial
Connector	BNC	BNC	BNC	BNC	Banana
Possible Applications	Determination of potassium ions in wine, waters, soils and biological samples.		As an indicator for titrations using silver nitrate. For the determination of sulfide ions in waters, paper liquors, natural waters and soils.		To complete the electrical circuit and to provide a stable reference voltage for ISE half-cells

Sensors and Accessories Reference Chart

Electrode	Type	Half-cell	Combination	ISA	Filling Solution	Standard 1	Standard 2	Standard 3	Other
Ammonia	Gas	—	HI 4101	HI 4001-00	HI 4001-40	HI 4001-01 0.1 M	HI 4001-02 100 ppm	HI 4001-03 1000 ppm	HI 4000-52 replacement cap HI 4001-51 membrane kit HI 4000-51 replacement pH internal and cap for Ammonia HI 4001-45 conditioning solution HI 4000-47 4 and 7 pH with salt
Bromide	Solid	HI 4002	HI 4102	HI 4000-00	HI 7072	HI 4002-01 0.1 M			HI 4000-70 polishing strip
Cadmium	Solid	HI 4003	HI 4103	HI 4000-00	HI 7072	HI 4003-01 0.1 M			HI 4000-70 polishing strip
Calcium	Polymer membrane	HI 4004	HI 4104	HI 4004-00	HI 7082	HI 4004-01 0.1 M			HI 4004-51 module HI 4104-51 module for combination HI 4004-45 Conditioning Solution
Carbon Dioxide	Gas	—	HI 4105	HI 4005-00	HI 4005-40	HI 4005-01 0.1 M		HI 4005-03 1000 ppm	HI 4000-54 replacement pH internal & cap for CO_2 HI 4005-53 CO2 membrane kit (3 pack) HI 4000-47 4 and 7 pH with salt HI 4005-45 Conditioning Solution
Chloride	Solid	HI 4007	HI 4107	HI 4000-00	HI 7072	HI 4007-01 0.1 M	HI 4007-02 100 ppm	HI 4007-03 1000 ppm	HI 4000-70 polishing strip
Cupric	Solid	HI 4008	HI 4108	HI 4000-00	HI 7072	HI 4008-01 0.1 M			HI 4000-70 polishing strip
Cyanide	Solid	HI 4009	HI 4109	HI 4001-00	HI 7072				HI 4000-70 polishing strip
Fluoride	Solid	HI 4010	HI 4110	HI 4010-00 HI 4010-05 HI 4010-06 HI 4010-30	HI 7075	HI 4010-01 0.1M	HI 4010-02 100 ppm	HI 4010-03 1000 pm	HI 4010-11 1 ppm with TISAB II HI 4010-12 2 ppm with TISAB II HI 4010-10 10 ppm with TISAB II HI 4110-51 module for combination HI 4010-30 Fluoride measurement kit
Iodide	Solid	HI 4011	HI 4111	HI 4000-00	HI 7072	HI 4011-01 0.1 M			HI 4000-70 polishing strip
Lead/Sulfate	Solid	HI 4012	HI 4112	HI 4012-00	HI 7072	HI 4012-01 Lead HI 4012-21 Sulfate 0.1 M			HI 4000-70 polishing strip
Nitrate	Polymer membrane	HI 4013	HI 4113	HI 4013-00	HI 7078	HI 4013-01 0.1 M	HI 4013-02 100 ppm	HI 4013-03 1000 ppm	HI 4013-53 module (3 pack) HI 4113-53 module for combination (3 pack) HI 4013-06 Interferent suppressent ISA
Potassium	Polymer membrane	HI 4014	HI 4114	HI 4014-00	HI 7076	HI 4014-01 0.1 M			HI 4014-51 module HI 4114-51 module for combination
Silver/Sulfide	Solid	HI 4015	HI 4115	HI 4000-00 (Ag^+) HI 4015-00 ($S^=$)	HI 7072	HI 4015-01 0.1 M Silver			HI 4000-70 polishing strip
Reference	—	HI 5315			HI 7072 HI 7075 HI 7076 HI 7082 HI 7078				

HANNA **ISE Standards**

Our wide selection of HANNA ISE Standards are made and bottled in our state-of-the-art solutions facility. ISE Standards are required for direct and incremental measurement techniques and are available with Certificate of Analysis.

Code	Description	Size
HI 4001-01	0.1 M ammonia std.	500 mL
HI 4001-02	100 ppm ammonia std. (as N)	500 mL
HI 4001-03	1000 ppm ammonia std. (as N)	500 mL
HI 4002-01	0.1 M bromide std.	500 mL
HI 4003-01	0.1 M cadmium std.	500 mL
HI 4004-01	0.1 M calcium std.	500 mL
HI 4005-01	0.1 M carbon dioxide std.	500 mL
HI 4005-03	1000 ppm carbon dioxide std. (as $CaCO_3$)	500 mL
HI 4007-01	0.1 M chloride std.	500 mL
HI 4007-02	100 ppm chloride std.	500 mL
HI 4007-03	1000 ppm chloride std.	500 mL
HI 4008-01	0.1 M cupric std.	500 mL
HI 4010-01	0.1 M fluoride std.	500 mL
HI 4010-02	100 ppm fluoride std.	500 mL
HI 4010-03	1000 ppm fluoride std.	500 mL
HI 4010-10	10 ppm fluoride std. premixed with TISAB II	500 mL
HI 4010-11	1 ppm fluoride std. premixed with TISAB II	500 mL
HI 4010-12	2 ppm fluoride std. premixed with TISAB II	500 mL
HI 4010-30	(4) 1 and (4) 10 ppm with (4) TISAB II	500 mL
HI 4011-01	0.1 M iodide std.	500 mL
HI 4012-01	0.1 M lead std.	500 mL
HI 4012-21	0.1 M sulfate std.	500 mL
HI 4013-01	0.1 M nitrate std.	500 mL
HI 4013-02	100 ppm nitrate std.	500 mL
HI 4013-03	1000 ppm nitrate std.	500 mL
HI 4014-01	0.1 M potassium std.	500 mL
HI 4015-01	0.1 M silver std.	500 mL

HANNA **Gas Sensor Fill Solutions**

Code	Description	Size
HI 4001-40	Ammonia filling solution	(4) 30 mL bottles
HI 4005-40	Carbon dioxide filling solution	(4) 30 mL bottles

Specific "Solutions" for ISE Sensors

Code	Description	Size
HI 4000-47	4 and 7 buffer with chloride background Used to check glass internal of gas sensors	10 packages each to reconstitute + 2 beakers
HI 4001-45	Conditioning solution for HI 4101	500 mL
HI 4004-45	Conditioning solution for calcium electrodes	500 mL
HI 4005-45	Conditioning solution for HI 4105	500 mL

HANNA **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.

Code	Description	Size
HI 4000-00	ISA for halide electrodes	500 mL
HI 4001-00	Alkaline ISA for ammonia/cyanide	500 mL
HI 4004-00	Calcium ISA	500 mL
HI 4005-00	Carbon dioxide ISA	500 mL
HI 4010-00	TISAB II (for fluoride)	500 mL
HI 4010-05	TISAB II gallon (for fluoride)	1 gallon
HI 4010-06	TISAB III concentrate (for fluoride)	500 mL
HI 4012-00	Lead or sulfate ISA	500 mL
HI 4013-00	Nitrate ISA	500 mL
HI 4013-06	Nitrate interferent suppressent ISA	500 mL
HI 4014-00	Potassium ISA	500 mL
HI 4015-00	SAOB (sulfide antioxidant buffer)	500 ml, 1pkg (2 components)

HANNA **Silver-free Reference Fill Solutions**

Recommended for our Combination ISE Electrodes and the HANNA HI 5315 reference electrode. Reference electrolytes should be topped off daily with the correct filling solution for optimum measurement performance. These solutions are silver free to eliminate silver preciptates found with standard electolytes.

Code	Description	Size
HI 7072	Electrolyte solution, 1 M KNO_3	(4) 30 mLl bottles
HI 7075	Electrolyte solution with KNO_3 and KCl	(4) 30 mL bottles
HI 7076	Electrolyte solution, 1 M NaCl	(4) 30 mL bottles
HI 7078	Electrolyte solution, $(NH_4)_2SO_4$	(4) 30 mL bottles
HI 7082	Electrolyte solution, 3.5 M KCl	(4) 30 mL bottles

HANNA **Accessories**

HANNA replacement parts and accessories keep your measurements fast and accurate.

Code	Description
HI 4000-50	Liquid membrane sensor handle
HI 4000-51	Gas sensor replacement pH for Ammonia Sensor
HI 4000-52	Gas sensor membrane cap for Ammonia
HI 4000-54	Gas sensor replacement pH for Carbon Dioxide Sensor
HI 4000-70	Halide polishing strip
HI 4001-51	Ammonia membrane kit (20 loose)
HI 4004-51	Calcium module for half-cell
HI 4104-51	Calcium module for combination
HI 4005-53	Carbon dioxide membrane kit (3 caps)
HI 4110-51	Fluoride module for combination electrode
HI 4013-53	Nitrate module 3 pack for half-cell
HI 4113-53	Nitrate module 3 pack for combination
HI 4014-51	Potassium module for half-cell
HI 4114-51	Potassium module for combination
HI 740155P	Capillary pipettes (20 pcs)
HI 740159	Plastic tweezers (1 pcs)

HI 98184 • HI 98185 Portable ISE Meters

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. Our 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 2 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.

Instrument Features

- Waterproof protection
- Direct ISE reading and calibration in ppm
- Exclusive Calibration Check™
- Measure pH, ORP or ISE
- Inductive battery recharging
- 5 point calibration
- Log on demand (up to 300 records)
- Relative mV (for ORP)
- Graphic LCD Display with backlighting
- ºC or ºF unit selection
- Battery charge indication
- USB connectivity
- Contextual help
- Menu driven

pH electrode, pH solutions, carrying case, batteries and inductive recharger included

SPECIFICATIONS		HI 98184	HI 98185
Range	pH	-2.0 to 20.0; -2.00 to 20.00; -2.000 to 20.000 pH	
	mV	±2000 mV	
	ISE	From 1.00 x 10^{-3} to 1.00 x 10^{5} ppm	From 1.00 x 10^{-7} to 9.99 x 10^{10} concentration (choice of units)
	Temperature	-20.0 to 120.0 °C (-4.0 to 248.0°F)	
Resolution	pH	0.1; 0.01; 0.001 pH	
	mV	0.1 mV	
	ISE	3 digits 0.01; 0.1; 1; 10 concentration	
	Temperature	0.1°C (0.1°F)	
Accuracy	pH	±0.01; ±0.002 pH	
	mV	±0.2 mV	
	ISE	±0.5% of reading (monovalent ions), ±1% of reading (divalent ions)	
	Temperature	±0.4°C (±0.8°F) (excluding probe error)	
Calibration	pH	Up to 5 point calibration, 7 standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + 5 custom buffers	
	ISE	Up to 2 point calibration, 6 standard solutions (0.1, 1, 10, 100, 1000, 10000 ppm)	Up to 5 point calibration, 6 standard solutions (choice of units)
	Slope	From 80 to 110%	
Temperature Compensation (pH)		Manual or automatic from -20.0 to 120.0°C (-4.0 to 248.0°F)	
Probes		HI 72911B pH w/BNC and temperature combined	
Logging		Log-on-demand 300 samples (100 each range)	
PC Connectivity		Opto-isolated USB (with HI 92000 software)	
Input Impedance		10^{12} Ohms	
Battery Type/Life		(4) 1.2V AA rechargeable batteries/ approx. 200 hrs continuous use (with backlight off)	
Recharger		Inductive recharger (included)	
Auto-off		User Selectable: 5, 10, 30, 60 min or can be disabled	
Environment		IP67	
Dimensions/Weight		226.5 x 95 x 52 mm (8.9 x 3.75 x 2")/525 g (18.5 oz.)	

ORDERING INFORMATION

HI 98184-01 (115V), **HI 98184-02** (230V), **HI 98185-01** (115V) and **HI 98185-02** (230V) are supplied with HI 72911B combined pH/temperature electrode, pH 4.01 and pH 7.01 buffer solutions, 1.2V AA 1300 mAh rechargeable batteries (4), HI 710042 inductive battery charger with power adapter, rugged carrying case and instructions.

Rechargeable batteries with inductive recharger

These models have up to 200 hour extended battery life to guarantee long operation in the field. When the batteries are low simply leave the meter on the recharger for a few hours and you're ready to go. The recharger can either be plugged to a standard 115V or 230V socket using the included HANNA adapter or into a 12 VDC source such as a car's 12 volt accessory outlet.

More Features

Measurement Screen

Direct ISE readings shown in a choice of units (HI 98185). LCD also displays electrode type used, current temperature, remaining battery life, and time simultaneously.

Soft keys allow quick access to the most used functions.

Setup Screen

HI 98185 allows direct choice of probe type and measurement unit while the HI 98184 requires manual setting of sensor parameters.

ISE Calibration

Up to 5 point calibration with 6 standard solutions between 0.1 to 10000 ppm. Users are guided through the calibration procedure with step-by-step on-screen instructions.

Good Laboratory Practice

Calibration data, date and ID information are stored for retrieval at a later date.

HI 4222 pH/ISE Bench Meter *with Special ISE Features for Ease of Use*

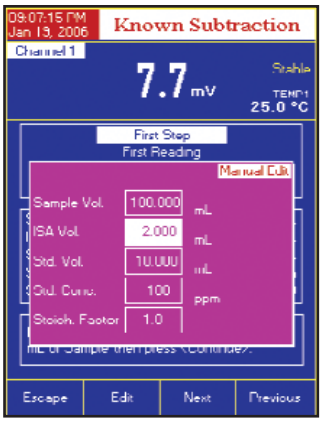
Incremental Methods are useful techniques used to determine ion concentration quickly in samples whose constituents are variable or concentrated. Incremental methods have some inherent advantages over direct potentiometry. The techniques can reduce errors from variables such as temperature, viscosity, 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.

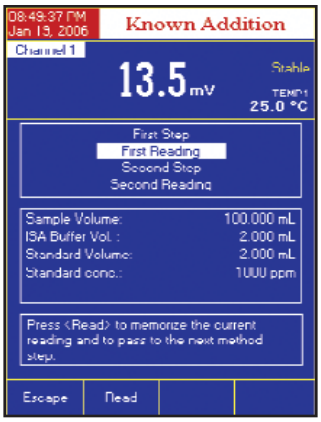
Instrument Features

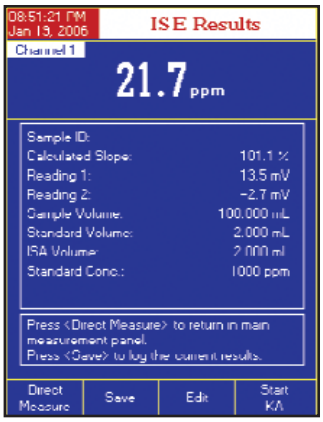
- Incremental methods:
  - Known addition
  - Known subtraction
  - Analyte addition
  - Analyte subtraction
- Direct methods
- pH with Calibration Check™ technology
- Stability indicator
- Calibration information
- Single or dual display
- Colored graphic display
- Dual channel measurement and logging
- Help screens at the touch of a key
- Multi-language interface
- Manual or automatic temperature compensation
- Opto-isolated USB and RS232 outputs
- Data logging

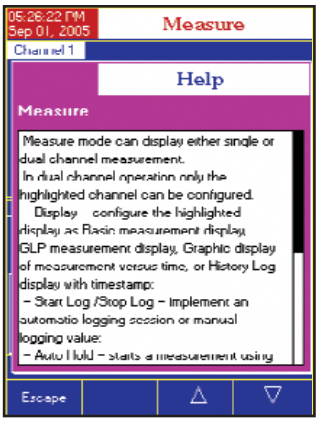
pH electrode, temp. probe, pH solutions and electrode holder included

Large, dot-matrix COLOR LCD w/backlight









First Step

The first step in performing an incremental method analysis is to enter the required parameters including sample, ISA and standard volumes and standard concentration.

When repeating the analysis on another sample, the parameters do not need to be reentered.

Sequence of Readings

Once the variables are entered, the user is guided step-by-step through the measurement.

The initial mV measurement is made before the addition, next is the addition, and then the second measurement is made.

Results

The results are automatically calculated and shown together with all the parameters used.

At this time, results can be saved into a log file. If necessary, the user can edit the parameters without having to redo the entire analysis.

Help Screen

Users can consult the on-screen help from any mode simply by pressing the HELP key.

The instrument will then display the meaning and options available of the current screen.

Dual-graph capability and real-time logging

SPECIFICATIONS		HI 4222
pH	Range	-2.00 to 20.00; -2.000 to 20.000 pH
	Resolution	0.1 pH; 0.01 pH; 0.001 pH
	Accuracy	±0.1 pH; ±0.01 pH; ±0.002 pH
mV	Range	±2000 mV
	Resolution	0.1 mV
	Accuracy	±0.2 mV
ISE	Range	1 x 10^{-7} to 9.99 x 10^{10} concentration (choice of units)
	Resolution	1; 0.1; 0.01; 0.001 concentration
	Accuracy	±0.5% (monovalent ions); ±1% (divalent ions)
Temperature	Range	-20.0 to 120°C; -4.0 to 248.0°; 253.15 to 393.15K
	Resolution	0.1°C; 0.1°F; 0.1K
	Accuracy	±0.2°C; ±0.4°F; ±0.2K
Relative mV Offset Range		±2000 mV
Input Channels		2
Calibration Check		Status of electrode condition and response time; Status of the buffer solutions during calibration
pH Calibration		Automatic, up to 5 points with 8 standard buffers available (pH 1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + 5 custom buffers
ISE Calibration		Automatic, up to 5 points with 5 fixed standard solutions available for each measurement unit + 5 custom solutions
Temperature Compensation		Automatic or manual from -20.0 to 120.0°C (-4 to 248°F)
pH electrode		HI 1131B (optional)
Temperature probe		HI 7669/2W stainless steel probe (optional)
Log-on-demand		100 lots, 5000 samples per lot
Logging Intervals		1, 2, 5, 10, 30 seconds
PC Connection		Opto-isolated USB and RS232
Display		240 x 320 dot-matrix LCD
Menu Languages		English, Italian, Spanish, French
Input impedance		10^{12} ohm
Power		12 VDC adapter (included)
Environment		0 to 50°C (32 to 122°F) 95% RH
Dimensions		160 x 231 x 94 mm (6.3 x 9.1 x 3.7")
Weight		800 g (1.8 lbs.)

ORDERING INFORMATION

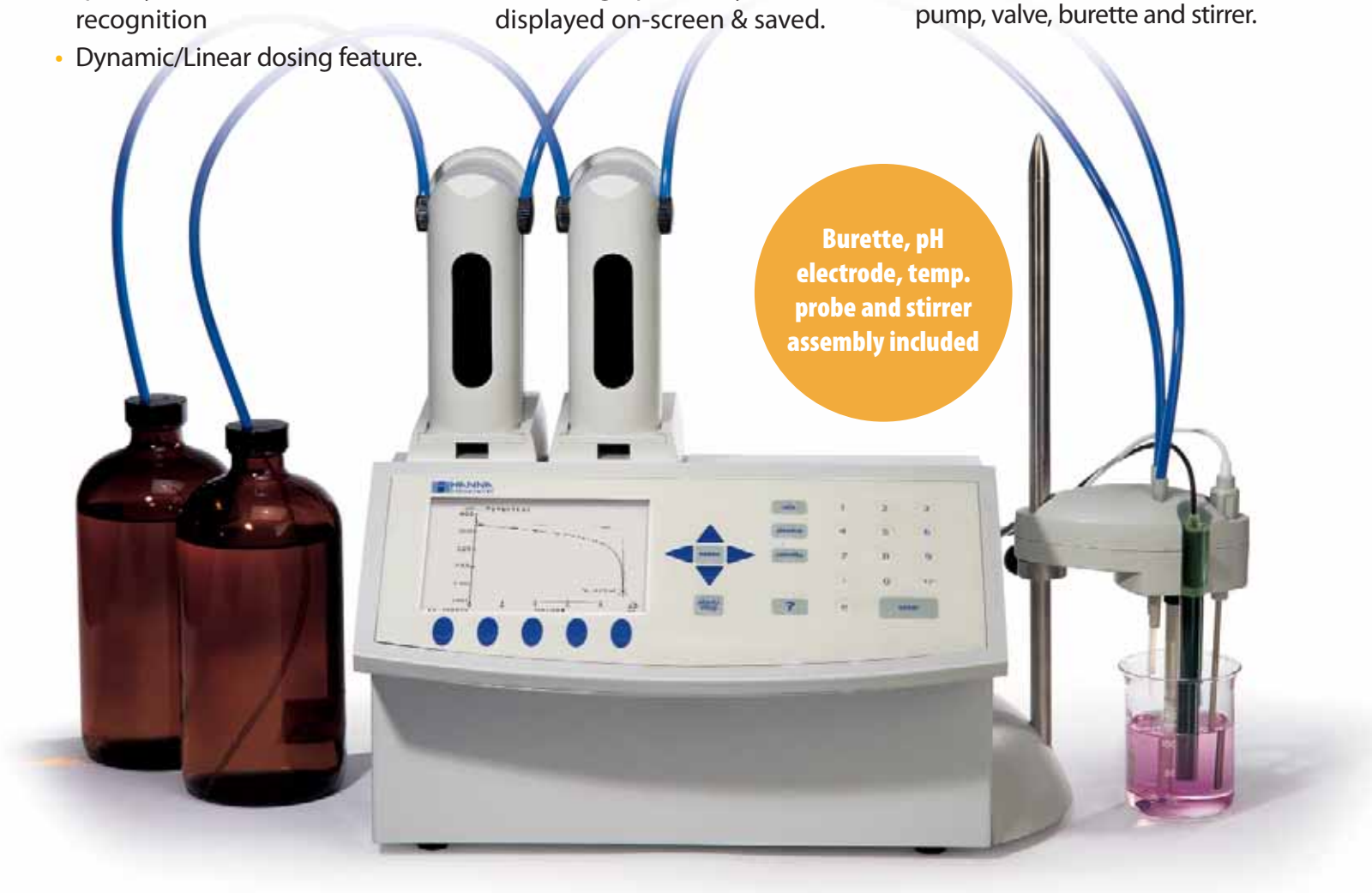
HI 4222-01 (115V) and **HI 4222-02** (230V) are supplied with glass body pH electrode, temperature probe, power adapter, pH 4 and pH 7 buffer solutions, electrode refilling solution, electrode holder and instructions.

HI 901 • HI 902 Automatic Titrators

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 complexation titration. A small change in reactant addition corresponds to a large change in electrode potential at the stoichiometric end point. 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 concentration as more EDTA is added. The end point corresponds to the point when all the Ca^{+2} is complexed. The progress of this titration can be monitored using a calcium ISE.

Instrument Features

- 320 x 240 pixel LCD w/backlight.
- Precise dosing system (accuracy under 0.1% of burette volume).
- Support up to 100 titration methods (standard and user defined).
- Clip Lock™ — change burettes quickly with auto burette recognition
- Dynamic/Linear dosing feature.
- Fixed end point potential or pH.
- Equivalence point detection (first derivative and second derivative).
- The results are displayed directly in the selected units.
- Titration graph can by displayed on-screen & saved.
- User customized reports can be printed, saved on floppy disk or transferred to PC via RS232 interface.
- Reminders for titrant age and standardization expiration.
- Self diagnostic features for peripheral devices including pump, valve, burette and stirrer.



With Clip-Lock™, it only takes a couple seconds to exchange the reagent burettes to perform a different titration.

With conventional titrators, there is the risk of cross contamination of titrants when exchanging reagents. Reconfiguring the titrator for different sample methods also consumes time and reagents. Each method may need different reagents and care must be used when purging and cleaning the burette. To avoid these problems, HANNA provides the Clip-Lock™ exchangeable burette system to prevent cross contamination while reducing loss of time and reagents.

Having several prepared burettes on hand will make the HANNA 900 series the fastest, most versatile titration systems available. 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!

HANNA's burettes feature a threaded screw connection to prevent leakage problems. Burettes are available in 5 mL, 10 mL & 25 mL sizes and are made of chemically resistant material to ensure many years of trouble-free operation. Keep extra HANNA 900 series burettes on hand for quick substitutions without changing the titrant!

SPECIFICATIONS	mV	pH	Temperature
Range	-2000.0 to 2000.0 mV	-2.000 to 20.000 pH	-5.0 to 105.0°C/23 to 221°F/268.2 to 378.2 K
Resolution	0.1 mV	0.1/0.01/0.001 pH	0.1°C/0.1°F/0.1K
Accuracy	±0.1 mV (@25°C/77°F)	±0.001 pH (@25°C/77°F)	±0.1°C/±0.2°F/±0.1K (excluding probe error)
Burette Sizes	5, 10, and 25 mL		
Burette Resolution	1/40000		
Display Resolution	0.001 mL		
Dosing Accuracy	±0.1% of full burette volume		
Display	Graphic LCD, 320 x 240 pixel LCD		
Languages	English, Italian, Portuguese, Spanish		
Methods	Up to 10,000 methods (standard and user-defined)		
Burette Auto-Detection	Burette size is automatically recognized when inserted into the unit		
Programmable Stirrer	Propeller type, 100-2500 RPM, automatically held within 10% of the set value, resolution 100 rpm		
Flow Rate	User-selectable from 0.1 mL/min to 2 x burette volumes/min		
pH/mV Measurement	Titrators can also perform direct pH and mV measurements		
Temperature Compensation	Manual or automatic (ATC)		
pH Calibration	Manual or automatic at 1-5 points with 4 buffer sets or custom buffers		
Potentiometric Titrations	Acid-Base (pH or mV-Mode), Redox, Precipitation, Complexometric, Non-Aqueous, Ion-Selective, Argentometric (in mV-mode only)		
HI 901 Titration Methods	Fixed mV or pH end-point detection & first equivalency point detection (with the 1st or 2nd derivatives)		
HI 902 Titration Methods	Fixed mV or pH end-point detection & multiple equivalency point detection (with the 1st or 2nd derivatives); back titration		
Measurement Units	User specified expression of concentration units to suit specific calculation requirements		
Real Time & Stored Graphs	mV-Volume or pH-Volume titration curve, 1st derivative curve or 2nd derivative curve, in pH-mode or mV-mode; pH/mV values versus time-datalogging results		
Data Storage:	Up to 100 complete titration and pH/mV logging complete reports		
Disk Drive:	Built-in 3.5" floppy disk drive allows storage and transfer of configurations, preprogrammed methods, custom methods, titration reports and bitmap graph files		
Peripherals	Connections for VGA display, PC-keyboard, parallel printer, RS 232 input, interface for future expansion		
GLP Conformity	Instrumentation data storage and printing capabilities		
Operating Environment	10 to 40°C (50 to 104°F), up to 95% RH		
Storage Environment	-20 to 70°C (-4 to 158°F), up to 95% RH		
Power	110V/220 Vac; 50-60Hz		
Dimensions	Width x Depth x Height = 390 x 350 x 380 mm (15.3 x 13.8 x 14.9 in)		
Weight	approx. 10 kg (22 lbs.) with one pump and stirrer assembly		

ORDERING INFORMATION

HI 901-01 (115V) and **HI 901-02** (230V) is supplied with (1) 25 mL glass burette, (1) burette driver assembly, power adapter and instructions.

HI 902-01 (115V) and **HI 902-02** (230V) back titration and multiple end-point titrators are supplied with (1) 25 mL glass burette, (1) burette driver assembly, power adapter and instructions.

HANNA instruments® is an **ISO 9001:2000 Certified** company

For more information or for a distributor near you:

800.504.2662
laboratory@hannainst.com
www.hannainst.com

At HANNA we design and manufacture the most complete range of analytical products. We strive to work with you to develop a HANNA solution to address your specific instrumentation needs —on your budget.

Solid build quality, helpful customer service and competitive pricing place us ahead of the competition. Since 1978, more and more professionals all over the world choose and recommend HANNA for their laboratory testing needs.

Authorized Distributor

HANNA® instruments
With Great Products, Come Great Results™

P/L ISEMEASUREMENT 2.0 PRINTED IN USA

Hanna Instruments® reserves the right to change or modify its products at any time without advance notice.