Data Sheet LRE/102
Supersedes LRE/400

Encapsulated Differential pH and ORP Sensors

(available in LCP, foreground, or Ryton body materials)

Common Features

■ **Differential Electrode Measurement Technique.**
This field-proven technique uses three electrodes instead of the two normally used in conventional pH sensors. Process and reference electrodes measure the pH differentially with respect to a third ground electrode. The end result is unsurpassed measurement accuracy, reduced reference junction potential, and elimination of sensor ground loops. These sensors provide greater reliability, resulting in less downtime and maintenance. For complete details on the Differential Sensor technology, request GLI Technical Bulletin TB-P5. For general pH measurement information, ask for our Technical Handbook on pH.

■ **Complete Encapsulation.**
Complete encapsulated construction protects the sensor's built-in electronics from moisture and humidity problems, extending the working life of the sensor.

■ **Built-in Preamp or Two-wire Transmitter.**

The built-in preamp produces a strong signal, enabling you to locate the analyzer up to 3000 ft. (914 m) from the sensor. An optional built-in two-wire transmitter is available for applications requiring a 4-20 mA sensor signal. This option requires that the indicating instrument of the measuring system be capable of providing 24 VDC to power the sensor, and have adjustment means to calibrate for zero offset and span.

■ **Versatile Mounting Styles.**
Threads are provided on both ends of the convertible mounting style sensor for either mounting into a pipe tee or attaching to the end of a pipe for immersion. The convertible style enables you to consolidate inventory, and thereby reduce associated costs. A union-mount style sensor and mounting tee are also available to conveniently install and remove the sensor for in-line service. (See page 5 for mounting hardware assemblies offered in a variety of materials.)

LCP Sensor

■ **Chemically-resistant LCP Body.**
The exceptional chemical resistance and mechanical strength of the LCP (liquid crystal polymer) sensor body makes it ideal for most applications. These sensors can be used in aggressive process solutions such as acids, bases, alcohols, hydrocarbons, aromatics, chlorinated hydrocarbons, esters, ketones, and most other chemicals.

■ **Low Heat Distortion.**
LCP sensors are physically stable and will not expand or contract when subjected to the heating and cooling cycles of a process. Furthermore, these sensors may be installed in metal fittings without fear of leakage, normally a problem when dissimilar materials are threaded together.

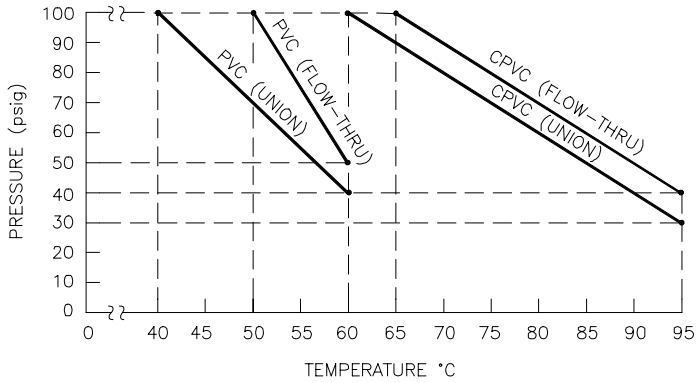
Ryton Sensor

■ **Excellent, Strong Base Chemical Compatibility.**
The Ryton sensor is best suited for measuring strong base solutions of more than 12 pH at elevated temperatures. It can also be used in acidic solutions, but is not recommended when aromatic hydrocarbons are present.

Specifications

Pressure/Temperature Limits:
- Sensor Only (no hardware):
  - LCP Sensor ..... -5°C (23°F) to 95°C
  - Ryton Sensor ..... -5°C (23°F) to 95°C
- Sensor with Hardware* ..... See graph below for specific GLI sensor and mounting hardware combinations

LCP and Ryton Sensor/Plastic Mounting Hardware Ratings



* An LCP or Ryton-encapsulated sensor that is mounted in a plastic flow-through tee has a higher pressure rating at maximum temperature than when it is mounted in a union tee. The temperature rating is increased to 95°C at 100 psig when the sensor is mounted in a stainless steel flow-through or union tee, or a stainless steel cross.

Maximum Flow Rate..... 10 ft. (3 m) per second

	pH Sensors	ORP Sensors
Wetted Materials:	LCP (liquid crystal polymer) body and salt bridge with PVDF (or ceramic) junction, glass process electrode, titanium ground electrode, and Viton O-ring process seals. Union-mount style sensor also has LCP adapter. pH sensor with optional antimony process electrode has stainless steel ground electrode.	LCP (liquid crystal polymer) body and salt bridge with PVDF (or ceramic) junction, glass and platinum (or glass and gold) process electrode, titanium ground electrode, and RTV sealant. Union-mount style sensor also has LCP adapter and Viton O-ring process seals.
Ryton Sensor	Ryton body and salt bridge with PVDF (or ceramic) junction, glass process electrode, titanium ground electrode, and Viton O-ring process seals. Union-mount style sensor also has Ryton adapter. pH sensor with optional antimony process electrode has stainless steel ground electrode.	Ryton body and salt bridge with PVDF (or ceramic) junction, glass and platinum (or glass and gold) process electrode, titanium ground electrode, and RTV sealant. Union-mount style sensor also has Ryton adapter and Viton O-ring process seals.
Measuring Range:		
LCP and Ryton Sensors	0-14 pH (see Note 1)	-2000 to +2000 mV (see Note 2)
Sensitivity	Less than 0.005 pH	Less than 0.5 mV
Stability.....	0.03 pH per 24 hours, non-cumulative	2 mV per 24 hours, non-cumulative

Specifications (continued)

	pH Sensors	ORP Sensors
Output Span ..... (only with 2-wire transmitter)	0.95 mA per pH unit	16 mA per 1000 mV
Output Offset ..... (only w/2-wire transmitter)	12 mA occurs at 7.0 pH, ±0.88 pH (see Note 3)	-500 to +500 mV range: 12 mA occurs at 0 mV, ±40 mV 0 to 1000 mV range: 12 mA occurs at 500 mV, ±40 mV
Load at 20 mA ..... (only with 2-wire transmitter)	450 ohms	450 ohms
Maximum Transmission Distance:		
Sensor with Preamplifier	3000 ft. (914 m)	3000 ft. (914 m)
Sensor with 2-wire Transmitter	Limited only by wire resistance and power supply voltage	Limited only by wire resistance and power supply voltage
Sensor Cable (standard):		
Sensor with Preamplifier	5 conductor (plus shield); 10 ft. (3 m) long	5 conductor (plus shield); 10 ft. (3 m) long
Sensor with 2-wire Transmitter	2 conductor (twisted pair); 10 ft. (3 m) long	2 conductor (twisted pair); 10 ft. (3 m) long

NOTES:

1. Most pH applications fall in the 2.5-12.5 pH range. General purpose pH glass electrodes perform well in this range. For pH applications below 4 or above 10 pH, GLI recommends using an LCP-bodied pH sensor. Some industrial applications require accurate measurement and control below 2 or above 12 pH. In these cases, please contact GLI for further details.

   Repeatability and speed of response of a pH sensor with an optional antimony process electrode is not as good as a sensor with a glass process electrode. Antimony electrodes are only linear between 3 and 8 pH, and should only be ordered when process conditions, such as the presence of hydrofluoric acid, dictate their use.

2. For ORP applications where zinc, cyanide, cadmium, or nickel are present, specify the optional gold electrode instead of the standard platinum electrode.

3. A pH sensor with a built-in two-wire transmitter provides a non-isolated and uncalibrated 4-20 mA output. The indicating instrument of the measuring system must be able to provide 24 VDC to power this sensor, and have adjustment means to calibrate for zero offset and span.

Ordering Information

TYPE OF MEASUREMENT
- **20** ORP, 5-wire (with built-in preamplifier)
- **24** ORP, 2-wire (with built-in two-wire transmitter providing 4-20 mA output)
- **60** pH, 5-wire (with built-in preamplifier)
- **64** pH, 2-wire (with built-in two-wire transmitter providing 4-20 mA output)

MOUNTING STYLE (each style has integral 10 ft./3 m long cable)
- **2** Convertible (immersion or flow-through mount -- see Note A below)
- **5** Union-mount (includes adapter, but requires special 2-inch threaded tee -- Figure 3 on page 5)

BODY MATERIAL
- **2** Ryton (for elevated temperatures in high pH applications)
- **8** LCP (liquid crystal polymer)

ELECTRODE MATERIAL
- **P0** Glass (only for pH -- general purpose)
- **P1** Antimony (only for pH)
- **R0** Platinum (only for ORP -- see Note B)
- **R1** Gold (only for ORP -- see Note B)

Product Number

Choose one from each category.

NOTES: **A.** When immersion mounting a convertible style sensor, it is recommended to order a protector of the same material as the sensor body (LCP protector 60A2F1278 or Ryton protector 60A2F1278-300). The protector, shown in Figure 1 on page 5, threads onto the end of the sensor.

B. Specify the gold electrode material for processes containing zinc, cyanide, cadmium, or nickel which poison a platinum electrode.

Accessories (order separately):

- **Interconnect Cables*:**

  For use with 5-wire sensors -- 1W1055
  For use with 2-wire sensors -- 1W0980

  *Specify required length in whole feet.

- **Spare Union Adapters**:**

  LCP adapter -- 60G9753-101
  Ryton adapter -- 60G9753-301

  **Each adapter includes two Viton O-rings and a retaining ring.

- **pH Buffers (in resealable 1-pint plastic bottles):**

  pH 7 Buffer -- 3A0421
  pH 4 Buffer -- 3A0422
  pH 10 Buffer -- 3A0942

- **Self-contained Air Blast Cleaning Systems:**

  For 115 VAC operation -- 1000A3335-002
  For 230 VAC operation -- 1000A3335-003

  Each system includes a PVDF washer head with 25 ft. (7.6 m) long tubing for air delivery, a quick-disconnect tube fitting, and a compressor housed in a NEMA 4X enclosure.

- **Air/Water Blast Cleaning Washer Head -- 1000A3335-001**

  Only for immersion applications with user-supplied air or water wash system. PVDF washer head includes 1/4-inch barb fitting (see drawing on page 7)

- **Salt Bridges for GLI Differential Sensors**

  The double junction salt bridge on the standard cell of GLI LCP and Ryton Differential Technique sensors is field-replaceable, and includes appropriate O-ring(s). Salt bridges are shipped in specified quantities in a salt solution. Please specify the desired quantity by substituting the corresponding Quantity Code for the "XXX" portion of the salt bridge part number.

Salt Bridge Usage Guide

Type of GLI Differential Sensor	Part Number (XXX = Qty. Code)	Salt Bridge Materials	
		Body	Outer Junction
LCP	60-9765-000-XXX	LCP	Kynar
	60-9765-010-XXX	LCP	Ceramic
Ryton	60-9764-000-XXX	Ryton	Kynar
	60-9764-010-XXX	Ryton	Ceramic

NOTE: Each salt bridge has a ceramic inner junction and Viton O-ring, and contains binary fill solution.

Quantity Code for Salt Bridges

Quantity Code	Number of Salt Bridges
001	1
002	2
003	3
005	5
010	10
050	50

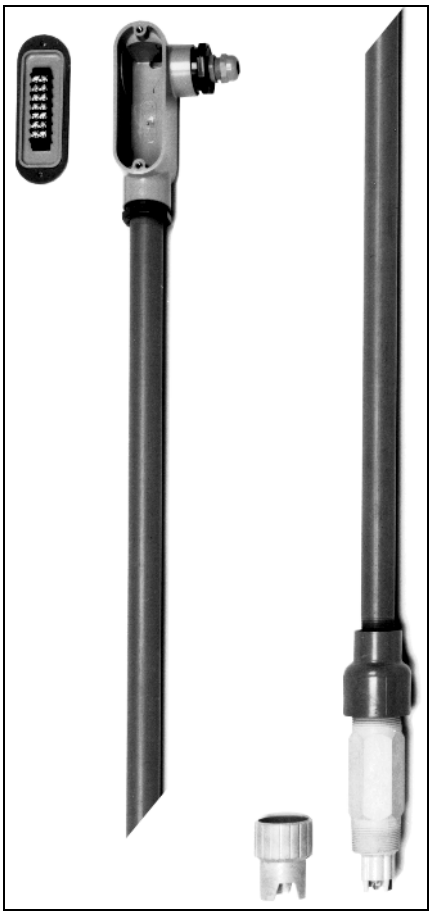
- **Standard Cell Solution for GLI Differential Sensors -- 25M1A1001-115**

  Use this pH 7 solution to replace the solution in the standard cell chamber when replacing the salt bridge. The solution is provided in a resealable 500 milliliter bottle.

Ordering Information (continued)

Sensor Mounting Hardware

FIGURE 1
Immersion Mounting



(LCP sensor pictured)

Part Number	Description
MH474B	PVC pipe (1 inch dia. x 4 ft./1.2 m long) and coupling with PVC pipe-mount j-box
MH434B	CPVC pipe (1 inch dia. x 4 ft./1.2 m long) and coupling with PVC pipe-mount j-box
60A2F1278	LCP protector (order separately)
60A2F1278-300	Ryton Protector (order separately)

NOTE: Hardware does not include the sensor or interconnect cable, which must be ordered separately.

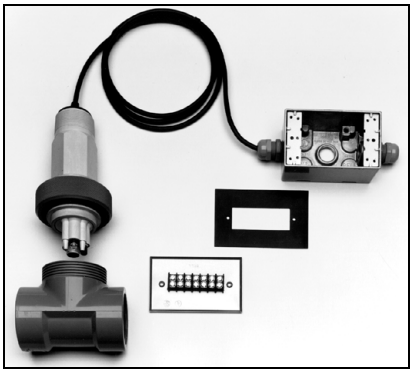
FIGURE 2
Flow-through Mounting

(LCP sensor pictured)

Part Number	Description
MH376	PVC 1-1/2 inch tee and aluminum j-box
MH336	CPVC 1-1/2 inch tee and aluminum j-box
MH316N	316 SS 1-1/2 inch tee and aluminum j-box
MH346X	304 SS 1-1/2 inch cross & aluminum j-box

NOTE: Hardware does not include the sensor or interconnect cable, which must be ordered separately.

FIGURE 3
Union Mounting



(Ryton union-mount sensor pictured)

Part Number	Description
MH578N9A	PVC 2-inch special tee & aluminum j-box
MH538N9A	CPVC 2-inch special tee & aluminum j-box
MH518N9A	316 SS 2-inch special tee & aluminum j-box

NOTE: Hardware does not include the sensor or interconnect cable, which must be ordered separately.

Engineering Specification

LCP Sensor

1. The pH or ORP sensor shall be of Differential Electrode Technique design which uses two electrodes to compare the process value to a stable internal reference standard buffer solution. The standard electrode shall have non-flowing and fouling resistant characteristics.

2. The sensor shall have a hex-shaped body to facilitate mounting, and shall be constructed of liquid crystal polymer for exceptional chemical resistance and mechanical strength. This material shall enable the sensor to be installed in metal fittings without leakage usually caused by heating and cooling cycles when dissimilar materials are threaded together.

3. The sensor's built-in electronics shall be completely encapsulated to protect them from moisture and humidity.

4. The sensor shall have a built-in preamplifier to enable the signal to be transmitted up to 3000 ft. (914 m) with standard cabling, or a built-in two-wire transmitter that provides a non-isolated and uncalibrated 4-20 mA output.

5. The sensor signal shall be automatically temperature compensated by an integral temperature sensor.

6. The sensor shall include a metal ground electrode to eliminate ground loop currents in the measuring electrodes.

7. The sensor shall be GLI International, Inc:

   A. Model 6XX8P-series for pH measurement

   B. Model 2XX8R-series for ORP measurement.

Ryton Sensor

1. The pH or ORP sensor shall be of Differential Electrode Technique design which uses two electrodes to compare the process value to a stable internal reference standard buffer solution. The standard electrode shall have non-flowing and fouling resistant characteristics.

2. The sensor shall have a hex-shaped body to facilitate mounting, and shall be constructed of Ryton for exceptional chemical resistance and mechanical strength. This material shall enable the sensor to be installed in metal fittings without leakage usually caused by heating and cooling cycles when dissimilar materials are threaded together.

3. The sensor's built-in electronics shall be completely encapsulated to protect them from moisture and humidity.

4. The sensor shall have a built-in preamplifier to enable the signal to be transmitted up to 3000 ft. (914 m) with standard cabling, or a built-in two-wire transmitter that provides a non-isolated and uncalibrated 4-20 mA output.

5. The sensor signal shall be automatically temperature compensated by an integral temperature sensor.

6. The sensor shall include a metal ground electrode to eliminate ground loop currents in the measuring electrodes.

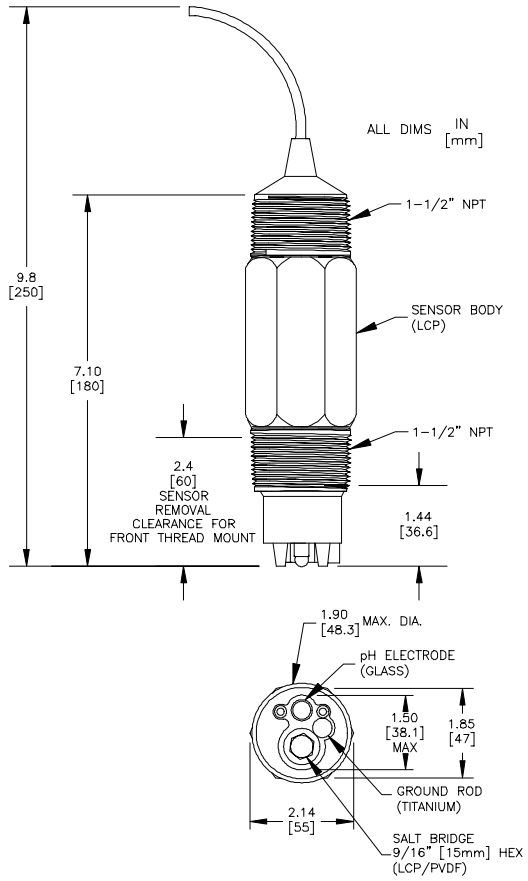
7. The sensor shall be GLI International, Inc:

   A. Model 6XX2P-series for pH measurement.

   B. Model 2XX2R-series for ORP measurement.

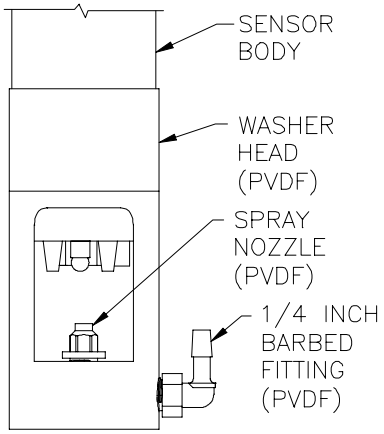
Dimensions

LCP or Ryton Sensor



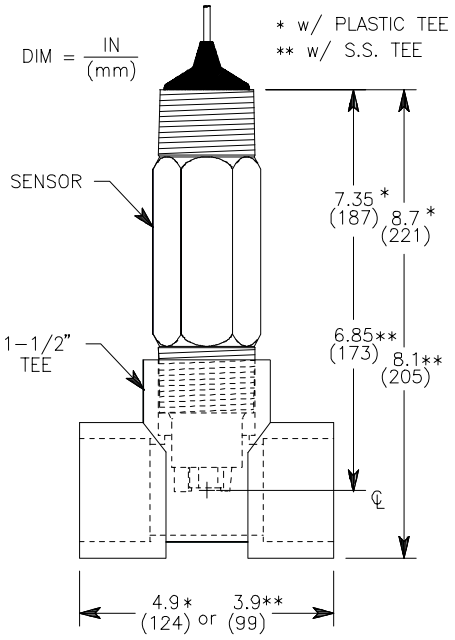
Sensor Cleaning Accessory

Air/Water Blast Cleaning Washer Head 1000A3335-001
(only for immersion applications)

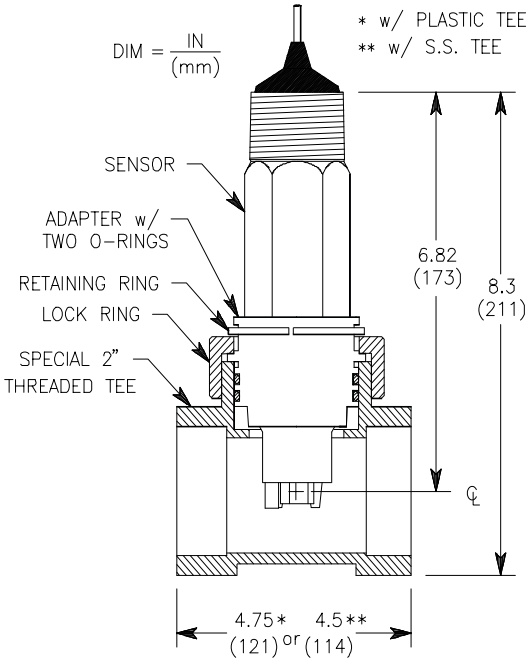


Sensor Mounting Details

Flow-through Tee Mounting



Union Tee Mounting



To complete an exceptional pH measurement system, choose the analyzer that's right for you...

Model P63 pH Analyzer

The advanced **Model P63** pH analyzer features enhanced multi-list menu operation in various languages. During operation, instructional prompts make the analyzer extremely easy to set up, calibrate, and operate.

The P63 can be used with GLI Differential sensors, conventional combination electrodes, or electrode pairs. This premium analyzer has all the capabilities expected of a high-end analyzer, including complete diagnostics. True predictive diagnostics forecast the end of sensor life, while reactive diagnostics alert you to important system changes. A built-in logbook records up to 100 system events with their dates and times of occurrence. **Refer to Data Sheet PR63.**

Model P53 pH/ORP Analyzer

The **Model P53** is a 1/2 DIN, full-featured analyzer with multi-list menu operation in various languages. This versatile, mid-priced analyzer can be used for pH or ORP measurement, and accepts GLI Differential sensors, conventional combination electrodes, or electrode pairs.

The large backlit graphic LCD displays measured pH, process temperature, both analog output values, and the status of up to four relays. The P53 exceeds U.S. and meets European standards for electromagnetic interference and radio frequency interference emissions and immunity. **Refer to Data Sheet PR53.**

Model P33 pH/ORP Analyzer

The **Model P33** is a panel-mount, 1/4 DIN analyzer. This low-priced, full-featured analyzer was specifically designed for OEMs and cost conscious end users.

The P33 can be used for pH or ORP measurement, and accepts GLI Differential sensors, conventional combination electrodes, or electrode pairs. The backlit LCD simultaneously displays measured pH and process temperature. Other features include two analog outputs and two SPDT relays. The P33 uses a simple function menu operation in various languages. It exceeds U.S. and meets European standards for EMI and RFI emissions and immunity. **Refer to Data Sheet PR33.**

Model PRO-P3 pH/ORP Transmitter

The **Model PRO-P3** is a compact, NEMA 4X universal-mount transmitter with menu-guided operation. Screens can be selected for display in English or Spanish. (Different languages such as French or German can also be substituted.)

The PRO-P3 can be used for pH or ORP measurement, and accepts GLI Differential sensors, conventional combination electrodes, or electrode pairs. Its clear display simultaneously shows measured pH and process temperature. Other features include use in a two, three or four-wire hookup arrangement and passcode access. It exceeds U.S. and meets European standards for EMI and RFI emissions and immunity. **Refer to Data Sheet PRO-P3.**