

PS98i/PS9800

Submersible Pressure Transmitter Instructions



For PSIG
sensors, refer
to page 7
regarding
desiccant
use!



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The **PS98i/PS9800** pressure transmitters are rugged and accurate with great noise immunity, transient protection, and thermal performance.

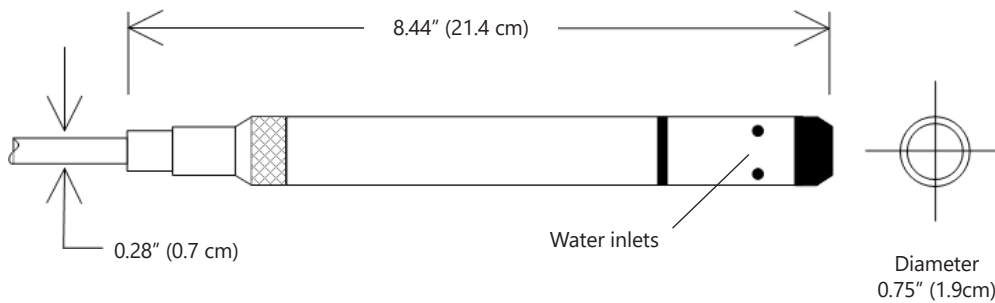
These pressure sensors have been designed to provide trouble-free submersible operation in liquid environments. Pressure is measured with an extremely rugged and stable piezo-electric, media isolated pressure element and calibrated with well established calibration procedures and NIST traceable equipment.

These sensors are thermally compensated, making them great where water temperatures vary, as they are thermally stable (2% over 50 degrees standard).

Both the PS98i and the PS9800 measure pressure, while the PS9800 can optionally be factory configured to measure temperature, also.

These industry standard, 2-wire, 4-20mA devices offer reverse polarity protection, under- and over-current limitation, and built-in transient protection.

Dimensions



Specifications*

Housing	Weight	0.8 lb. (0.4 kg)		
	Length	8.44" (21.4 cm)		
	Diameter	0.75" (1.9 cm)		
	Body Material	Acetal and 316 stainless or optional titanium		
	Wire Seal Material	Fluoropolymer and PTFE		
Cable	Cable	Submersible: Polyurethane, polyethylene, or ETFE available		
	Desiccant	1-3 mm indicating silica gel		
	Field Connector	Available as an option		
Operating Temperature Range		Recommended: -5° to 70°C (23° to 158°F) Requires freeze protection if using in water below freezing.		
Transmitter Voltage		9-24Vdc (100ms warmup)		
Output		4-20mA		
Output Channels	PS98i	PS9800		
		<i>Pressure¹</i>		<i>Temperature (Optional)</i>
	Element	Silicon strain gauge transducer, 316 stainless or Hastelloy	Silicon strain gauge transducer, 316 stainless or Hastelloy	Thermistor
	Accuracy	±0.25% FSO (static, B.F.S.L. 20°C)	±0.1% FSO (static, B.F.S.L. 20°C)	±0.3°C (typical at 25°C) ±0.75°C (max. at 25°C)
	Range	Gauge PSI: 1, 5, 15, 30, 50, 100, 300 FtH ₂ O: 2.3, 12, 35, 69, 115, 231, 692 mH ₂ O: 0.7, 3.5, 10.5, 21, 35, 70, 210 Absolute ² PSI: 30, 50, 100, 300 FtH ₂ O: 35, 81, 196, 658 mH ₂ O: 10, 24, 59, 200	Gauge PSI: 5, 15, 30, 50, 100, 300 FtH ₂ O: 2.3, 12, 35, 69, 115, 231, 692 mH ₂ O: 0.7, 3.5, 10.5, 21, 35, 70, 210 Absolute ² PSI: 30, 50, 100, 300 FtH ₂ O: 35, 81, 196, 658 mH ₂ O: 10, 24, 59, 200	0° to 50°C (32° to 122°F)
Compensated	0° to 50°C (32° to 122°F)	0° to 50°C (32° to 122°F)	---	
Max operating pressure		1.1 x FS		
Burst pressure		3.0 x FS (for >300 psi (650ft, 200m) contact Seametrics representative)		
Regulatory		CE		

*Specifications subject to change. Please consult our web site for the most current data (seametrics.com).

1 Higher pressure ranges available upon request

2 Depth range for absolute sensors has 14.7 PSI subtracted to give actual depth allowed.

How Pressure Sensors Work

Liquids and gasses do not retain a fixed shape. Both have the ability to flow and are often referred to as fluids. One fundamental law for a fluid is that the fluid exerts an equal pressure in all directions at a given level. Further, this pressure increases with an increasing depth of "submergence". If the density of a fluid remains constant (noncompressible...a generally good assumption for water at "normal" pressures and temperatures), this pressure increases linearly with the depth of "submergence".

We are all "submerged" in the atmosphere. As we increase our elevation, the pressure exerted on our bodies decreases as there is less of this fluid above us. It should be noted that atmospheric pressure at a given level does vary with changes in the weather. One standard atmosphere (pressure at sea level at 20° C) is defined to be 14.7 PSI (pounds per square inch).

There are several methods to reference a pressure measurement. Absolute pressure is measured with respect to an ideal vacuum (no pressure). Gauge pressure is the most common way we express pressure in every day life and is the pressure exerted over and above atmospheric pressure. With this in mind, gauge pressure (P_g) can be expressed as the difference between the absolute pressure (P_a) and atmospheric pressure (P_{atm}):

$$P_g = P_a - P_{atm}$$

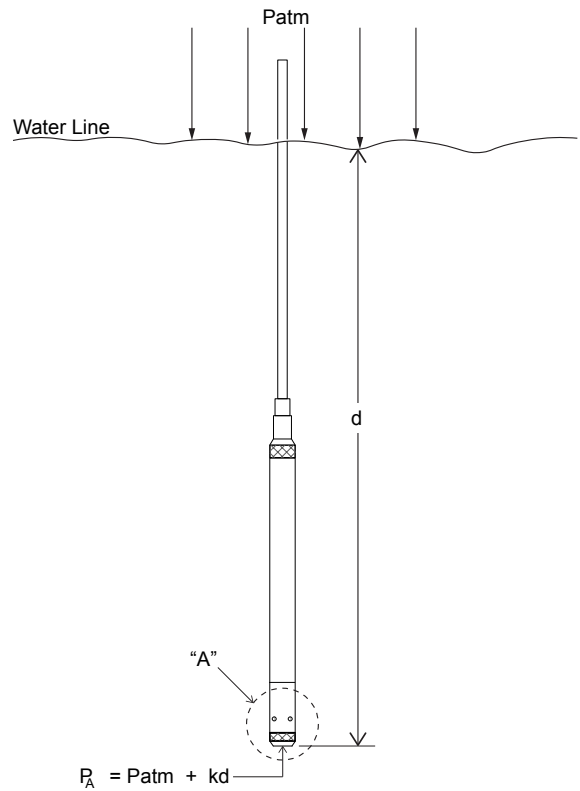
To measure gauge pressure, atmospheric pressure is subjected to one side of the system and the pressure to be measured is subjected to the other. The result is that the differential (gauge pressure) is measured. A tire pressure gauge is a common example of this type of device.

Recall that as the level of submergence increases (in a noncompressible fluid), the pressure increases linearly. Also, recall that changes in weather cause the absolute atmospheric pressure to change. In water, the absolute pressure (P_a) at some level of depth (d) is given as follows:

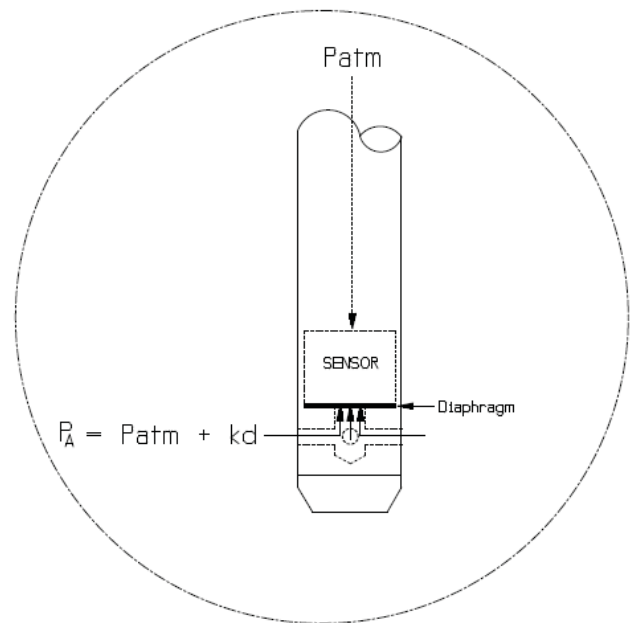
$$P_a = P_{atm} + kd$$

where k is simply a constant
(i.e.: 2.307 feet of water = 1 PSI)

Seametrics' standard gauge submersible pressure devices utilize a vent tube in the cable to allow the device to reference atmospheric pressure. The resulting gauge pressure measurement reflects only the depth of submergence. That is, the net pressure on the diaphragm is due entirely to the depth of submergence.



Pressure Diagram: See Detail A.



DETAIL "A"

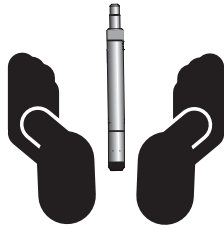
Absolute pressure is given as $P_a = P_{atm} + kd$
(where k is 2.307 feet of water)

Initial Inspection and Handling

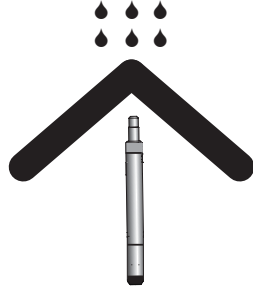
Upon receipt of your smart sensor, inspect the shipping package for damage. If any damage is apparent, note the signs of damage on the appropriate shipping form. After opening the carton, look for concealed damage, such as a cut cable. If concealed damage is found, immediately file a claim with the carrier.

Check the etched label on the sensor to be sure that the proper range and type were provided. Also check the label attached to the cable at the connector end for the proper cable length.

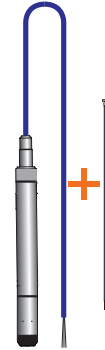
Do's and Don'ts



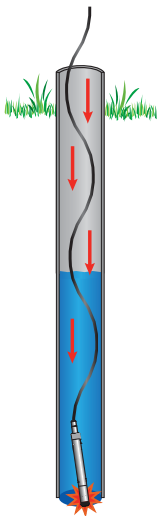
Do handle sensor with care



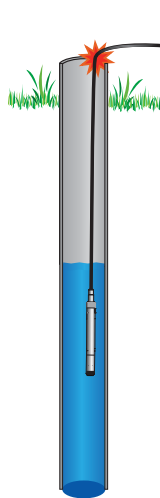
Do store sensor in a dry, inside area when not in use



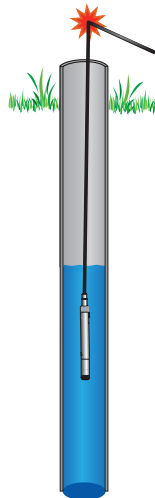
Do install a desiccant tube if using a gauge sensor



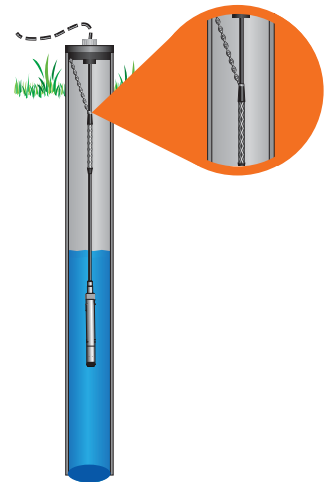
Don't drop into well
Lower gently to prevent damage



Don't scrape cable over edge of well
May nick or fray the cable



Don't bend cable sharply
May close off vent tube and/or weaken internal wires



Don't support sensor with the connector
Use a strain relief device

Installing the Sensor

The PS98i/PS9800 measures pressure. The most common application is measuring liquid levels in wells and tanks. In order to do this, the sensor must be installed below the water level at a fixed depth. The installation depth depends on the range of the sensor. One (1) PSI is equal to approximately 2.31 feet of water. If you have a 5 PSI sensor, the range is 11.55 feet of water and the sensor should not be installed at a depth below 11.55 feet. If the sensor is installed below its maximum range, damage may result to the sensor and the output reading will not be correct.

- Lower the sensor to the desired depth.
- Fasten the cable to the well head using a weather proof strain-relief system. When securing a vented cable, make sure not to pinch the cable too tightly or the vent tube inside the cable jacket may be sealed off.
- Take a measurement to insure the sensor is not installed below its maximum range.
- It is recommended that several readings be taken to ensure proper operation after installation.

If a gauge unit is to be left in the well for a long-term monitoring application, a desiccant tube must be installed to prevent condensation in the cable vent tube. Water in the vent tube will cause inaccurate readings and, in time, will work its way into the transmitter and damage it.

The sensor can be installed in any position; however, when it leaves the factory it is calibrated in the vertical position. Strapping the sensor body with tie wraps or tape will not hurt it. Seametrics can provide an optional 1/4" NPT input adapter which is interchangeable with the standard end cone for those applications where it is necessary to directly attach the sensor to a pipe, tank, or other pipe port. If the sensor is being installed in a fluid environment other than water, be sure to check the compatibility of the fluid with the wetted parts of the sensor.

Cable Wiring

	PS98i <i>Pressure</i>	PS9800 <i>Pressure</i>	PS9800 <i>Pressure & Temperature</i>
Shield	Ground	Ground	Ground
White	V+	V+	V+ (pressure)
Blue	Signal return	Signal return	Signal return (pressure)
Yellow	--	--	V+ (temperature)
Purple	--	--	Signal return (temperature)

Desiccant Use

On vented sensors a desiccant tube prevents moisture in the air from being sucked into the vent tube, which can cause erratic readings and sensor damage.

The desiccant tube is filled with blue silica gel beads. A locking barb and a hydrophobic water filter are attached to the end of the desiccant tube. This filter prolongs the life of the desiccant as much as three times over a desiccant tube without the filter.

Install the sensor so that the desiccant tube will not flood or lie in water.

The desiccant is a bright blue color when active and dry. See Maintenance section for care and changing of desiccant.

Grounding Issues

It is commonly known that when using electronic equipment, both personnel and equipment need to be protected from high power spikes that may be caused by lightning, power line surges, or faulty equipment. Without a proper grounding system, a power spike will find the path of least resistance to earth ground—whether that path is through sensitive electronic equipment or the person operating the equipment. In order to ensure safety and prevent equipment damage, a grounding system must be used to provide a low resistance path to ground.

When using several pieces of interconnected equipment, each of which may have its own ground, problems with noise, signal interference, and erroneous readings may be noted. This is caused by a condition known as a Ground Loop. Because of natural resistance in the earth between the grounding points, current can flow between the points, creating an unexpected voltage difference and resulting erroneous readings.

The single most important step in minimizing a ground loop is to tie all equipment (sensors, data loggers, external power sources, and any other associated equipment) to a single common grounding point. **Seametrics recommends connecting the shield to ground at the top end. This is especially important in a pumping well to avoid failure.**

The PS98i/PS9800 submersible pressure transmitters are industry standard two-wire, 4-20 mA devices, offering improved noise immunity, thermal performance and transient protection. In addition to reverse polarity protection, under-current and over-current limitation are featured on both transmitter channels.

As mentioned above, the PS98i/PS9800 transmitters are current loop devices. This means that changes in pressure imposed on the stainless steel diaphragm result in proportional changes in current. The excitation source (DC supply or data logger) supplies the power but the transmitter actually controls how much current flows as long as the excitation specifications (e.g., voltage level) are met.

For a standard gauge pressure device, there is zero pressure on the diaphragm when above the surface of the liquid. This zero pressure is converted to a current flow of 4 mA. As the transmitter is lowered into the liquid, the amount of current that flows increases linearly (with increasing depth) to 20 mA when the maximum rated pressure (thus depth) is reached. That is, there is a straight line relationship between pressure (thus depth of submergence) and the amount of current that flows. A data logger therefore can apply power, measure the amount of current that is flowing and convert that to the depth of submergence using a multiplier and offset (m and b, respectively, for a $y = mx + b$ straight line) which are preset in the logger by the user.

Compute these m and b values as follows:

$$m = (\text{Total range of measurement in your units}) / 16$$

For example: if you want to measure 0–15 psi:
 $15 / 16 = 0.9375$

$$b = m * 4 * (-1)$$

Using our 0–15 psi example above, this would be
 $0.9375 * 4 * (-1) = -3.75$

Desiccant Tubes

On vented sensors, inspect the desiccant tube at least once every two months. The desiccant tube prevents moisture in the air from being sucked into the vent tube, which can cause erratic readings and sensor damage.

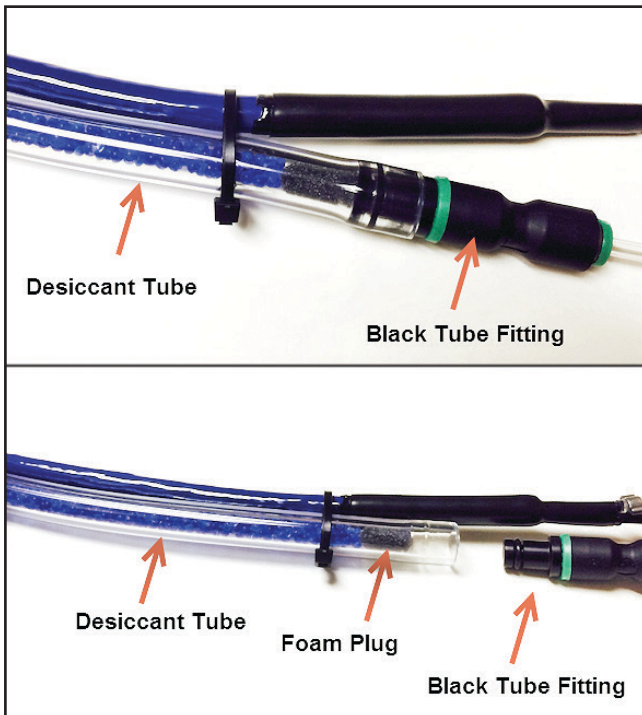
The desiccant tube is filled with blue silica gel beads. A locking barb and a hydrophobic water filter are attached to the end of the desiccant tube. This filter prolongs the life of the desiccant as much as three times over a desiccant tube without the filter.

Install the sensor so that the desiccant tube and cable connector will not flood or lie in water.

The desiccant is a bright blue color when active and dry. As moisture is absorbed the color will begin to fade, becoming a light pink, which indicates full saturation and time to replace. Replacement desiccant and hydrophobic filters can be purchased from Seametrics.

To Change the Desiccant:

- Pulling gently remove the black tube fitting from the clear desiccant tube.
- Using needle-nose pliers, remove the dark gray foam plug. Do not discard the plug.
- Dump out the old desiccant beads and refill with new desiccant beads – tapping desiccant tube frequently during refilling to ensure that the beads are fully seated in tube.
- Push the foam plug back into the tube.
- Reinsert the black fitting.

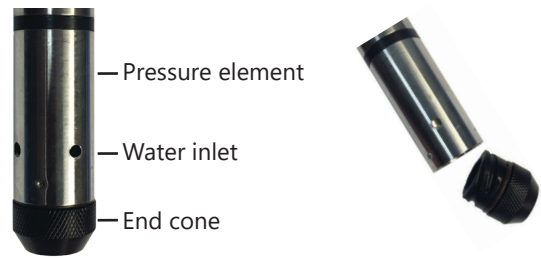


Removing Debris from End Cone

At times mud, silt, or other debris may foul the water inlets to the pressure element. The end cone can be removed to clean out the debris.

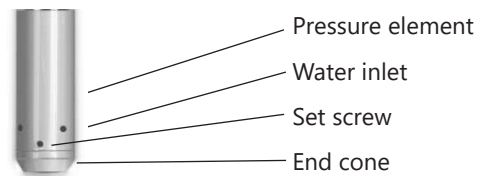
Twist Open Housing

1. Gently twist off end cone portion only - do not twist off pressure element!
2. Remove debris. **Do not poke anything into the sensor.** This can damage the sensor element and void the warranty.
3. Replace and retighten the end cone.



Set Screw Housing

1. Remove the two set screws at the bottom of the housing tube, using a 1/16" allen wrench.
2. Gently remove the end cone.
3. Remove debris. **Do not poke anything into the sensor.** This can damage the sensor element and void the warranty.
4. Replace the end cone and secure with set screws.



Sensor

There are no user-serviceable parts. If problems develop with sensor stability or accuracy, contact Seametrics. If the transducers have been exposed to hazardous materials, do not return them without notification and authorization.

Cable

Cable can be damaged by abrasion, sharp objects, twisting, crimping, crushing, or pulling. Take care during installation and use to avoid cable damage. If a section of cable is damaged, it is recommended that you send your sensor back to replace the cable harness assembly.

Problem	Probable Causes	Things to try...
Erratic readings	<p>Poor connection due to moisture between contacts in connector</p> <p>Loose or connection broken wires</p> <p>Damaged cable, cracked or fraying</p> <p>Moisture in the unit</p> <p>Damaged transmitter</p> <p>Improper grounding</p>	<p>Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).</p> <p>Repair or return for evaluation and repair</p> <p>Replace cable</p> <p>Return for evaluation and repair</p> <p>Return for evaluation and repair</p> <p>See section on grounding on in the Installation section</p>
Oscillating readings over time (usually 0.5 to 1.5 feet of water)	<p>Plugged vent tube (if using a vented unit)</p> <p>Actual water level changes in the aquifer itself in response to barometric pressure changes. This effect can occur in tight formations where the transmitter will immediately pick up barometric changes but the the aquifer will not.</p>	<p>Be sure desiccant tube is installed. Test by gently applying a small amount of pressure to the end of the desiccant tube and seeing if this affect the transmitter reading. If it does not, then the vent tube is plugged. Return for evaluation and repair.</p> <p>You will need to record barometric pressure as well as the water level pressure and compensate the data</p>
Zero readings when pressurized	<p>Poor connection due to moisture between contacts in connector</p> <p>Loose or broken connection wires</p> <p>Damaged cable, broken, cracked, or fraying</p> <p>No apparent damage upon visual inspection</p>	<p>Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).</p> <p>Repair or return for evaluation and repair</p> <p>Replace cable</p> <p>Return for evaluation and repair</p>

The limited warranty set forth below is given by Seametrics, with respect to Seametrics and Seametrics brand products purchased in the United States of America.

Seametrics warrants that products manufactured by Seametrics, when delivered to you in new condition in their original containers and properly installed, shall be free from defects in material and workmanship. **Seametrics products are warranted against defects for a period of two (2) years from date of installation, with proof of install date. If no proof of install date can be provided, warranty period will be two (2) years from date of shipment from Seametrics, as defined on Seametrics' invoice.** Seametrics' obligation under this warranty shall be limited to replacing or repairing the part or parts, or, at Seametrics' option, the products, which prove defective in material or workmanship. The following are the terms of Seametrics' limited warranty:

- a. Buyer must give Seametrics prompt notice of any defect or failure and satisfactory proof thereof.
- b. Any defective part or parts must be returned to Seametrics' factory or to an authorized service center for inspection.
- c. Buyer will prepay all freight charges to return any products to Seametrics' factory, or another repair facility, as designated by Seametrics.
- d. Defective products, or parts thereof, which are returned to Seametrics and proved to be defective upon inspection, will be repaired to factory specifications.
- e. Seametrics will deliver repaired products or replacements for defective products to the buyer (ground freight prepaid) to the destination provided in the original order.
- f. Products returned to Seametrics for which Seametrics provides replacement under this warranty shall become the property of Seametrics.
- g. This limited warranty covers all defects encountered in normal use of Seametrics products, and does not apply to the following cases:
 - i. Loss of or damage to Seametrics product due to abuse, mishandling, or improper packaging by buyer
 - ii. Failure to follow operating, maintenance, or environmental instructions prescribed in Seametrics' instruction manual
 - iii. Products not used for their intended purpose
 - iv. Alterations to the product, purposeful or accidental
 - v. Electrical current fluctuations
 - vi. Corrosion due to aggressive materials not approved for your specific product
 - vii. Mishandling, or misapplication of Seametrics products
 - viii. Products or parts that are typically consumed during normal operation
 - ix. Use of parts or supplies (other than those sold by Seametrics) which cause damage to the products, or cause abnormally frequent service calls or service problems
- h. A new warranty period shall not be established for repaired or replaced material, products, or supplies. Such items shall remain under warranty only for the remainder of the warranty period on the original materials, products, or supplies.
- i. In the event that equipment is altered or repaired by the buyer without prior written approval by Seametrics, all warranties are void. Damage caused by equipment or accessories not manufactured by Seametrics may void the product's warranty.
- j. SOFTWARE: The Seller grants the user a non-exclusive license to use Seametrics' software, according to the following limitations and conditions:
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 - ii. All title and intellectual rights to the software are owned by Seametrics.
 - iii. No copies may be made or distributed except as described above.
 - iv. The user may not modify or reverse-engineer the software.

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SOME STATES DO NOT ALLOW LIMITATIONS ON THE DURATION OF AN IMPLIED WARRANTY, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. SIMILARLY, SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATIONS OF CONSEQUENTIAL DAMAGE, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS; HOWEVER, YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.



Seametrics • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • seametrics.com

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