



## D-pHi Series™ Device Manual

4-20 mA Differential pH/ORP Sensors

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## INTRODUCTION

This sensor is designed to work in combination with a receiver (datalogger, PLC, SCADA, transmitter, etc.) to provide accurate measurements of pH/ORP (depending on the model) in water via 4-20 mA signals. Two types of backends are available depending on the mounting requirements:

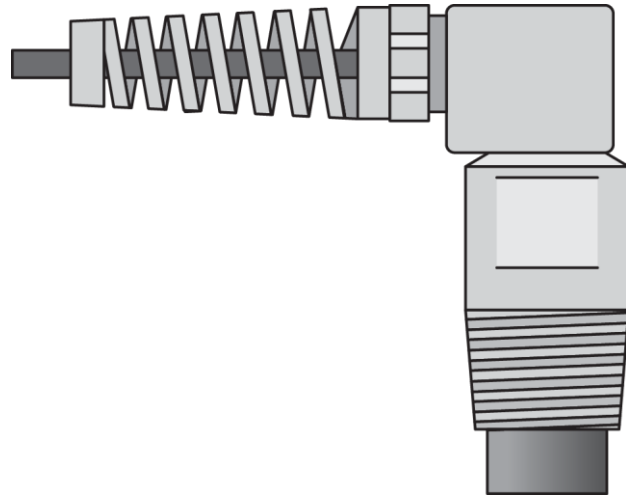
### D-phi-s

For submersion and standpipe mounting



### D-phi-i

For inline mounting



## FEATURES

- **Linear 4-20 mA output**
  - Simple to understand
  - Easy to calibrate
  - Accurate over long distances
  - Compatible with wide variety of dataloggers, PLCs, SCADA, and IoT systems.
- **Differential electrode technology**
  - No reference electrode poisoning
  - No electrode replacement required (10+ year sensor life)
  - Prevents ground loops\*

- Easily refillable reference chamber
- **Rugged glass bulbs**
  - Quickly clean the electrode with a soft brush or automated system without worries of damage
- **Chemical-resistant titanium and Delrin® housing (PVDF available)**
- **Built-in 0-50°C temperature sensor (secondary 4-20 mA output)**
- **¾" or 1" NPT backend (depending on model)**
- **Fully submersible to 100 psi and 150°F**
- **Dry storage**
- **Automatic Temperature Compensation (ATC)**
- **600 VDC Electrical isolation**
- **2-wire connection with Reversible Input Protection**

\*In combination with built-in electrical isolation

## SPECIFICATIONS

| <b>pH Sensor</b>                          |  |
|---|--|
| <b>pH Range</b>                           | 0-14 pH  |
| <b>Response Time</b>                      | 95% < 5 seconds  |
| <b>Output</b>                             | 4-20 mA   2-wire   |
| <b>Electrode Type</b>                     | Differential   |
| <b>Wetted Materials</b>                   | Delrin®, titanium, glass, Viton™   |
| <b>Thread Type</b>                        | 3/4 inch MNPT or 1 inch MNPT   |
| <b>Cable Type</b>                         | Polyurethane, Kevlar® reinforced, water blocked, shielded, twisted-pair wiring |
| <b>Max. Flow Rate</b>                     | 10 ft per second   |
| <b>Storage Temperature</b>                | 40-80°F (4-27°C)   |
| <b>Operating Temperature</b>              | 32-155°F (0-70°C)  |
| <b>Operational Pressure Range</b>         | 0-100 psi  |
| <b>Automatic Temperature Compensation</b> | Included from 32-155°F (0-70°C)  |
| <b>Electrical Isolation</b>               | Up to 600 VDC  |
| <b>Power Supply Requirements</b>          | 8-40 VDC, ≥20mA  |
| <b>Linearity</b>                          | ±0.05 pH   |
| <b>Accuracy</b>                           | ±0.05 pH   |
| <b>Sensitivity</b>                        | 0.01 pH  |
| <b>Weight (No cable)</b>                  | 0.5 lbs  |

| <b>Dimensions</b>               | <b>Units (inches [cm])</b> |
|---------------------------------|----------------------------|
| <b>Length</b>                   | 9.25 [23.50]               |
| <b>Diameter</b>                 | 1.00 [2.54] (max)          |
| <b>Minimum Submersion Depth</b> | 1.25 [3.18]                |

| <b>Temperature Sensor</b>   |           |
|-----------------------------|-----------|
| <b>Output</b>               | 4-20 mA   |
| <b>Temperature Range</b>    | 0-50°C    |
| <b>Accuracy</b>             | +/- 1°C   |
| <b>Linearity</b>            | +/- 0.5°C |
| <b>Power Supply Voltage</b> | 7-40 VDC  |

## SAFETY INFORMATION

pHionics accepts no responsibility for the misuse of this unit or the failure to identify critical safety risks to equipment or users.

Some applications may have critical safety hazards including, but not limited to, chemical exposure, pressure, temperature, overflow, that the user must be responsible for. The user is also responsible for installing appropriate safety mechanisms and providing safety procedures to protect the process and users. pHionics is not responsible for any direct, incidental, or consequential damage due to misapplication or misuse of this product. Please read the entire manual before unpacking, installing, or use of this product, paying careful attention to all warning statements. Failure to do so may result in serious injury of the user or equipment. Follow all manufacturer recommendations for upkeep of safety equipment. Do not use this product in any manner contradicting the ways specified in this manual.



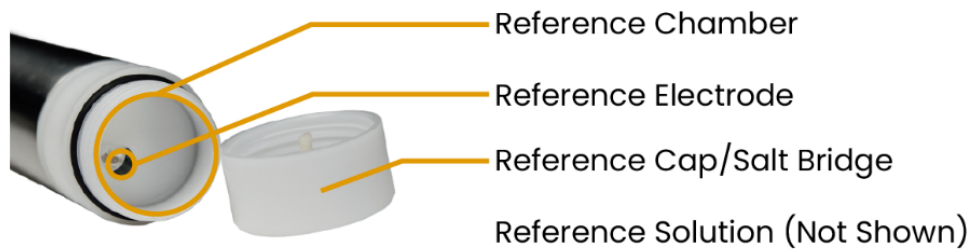
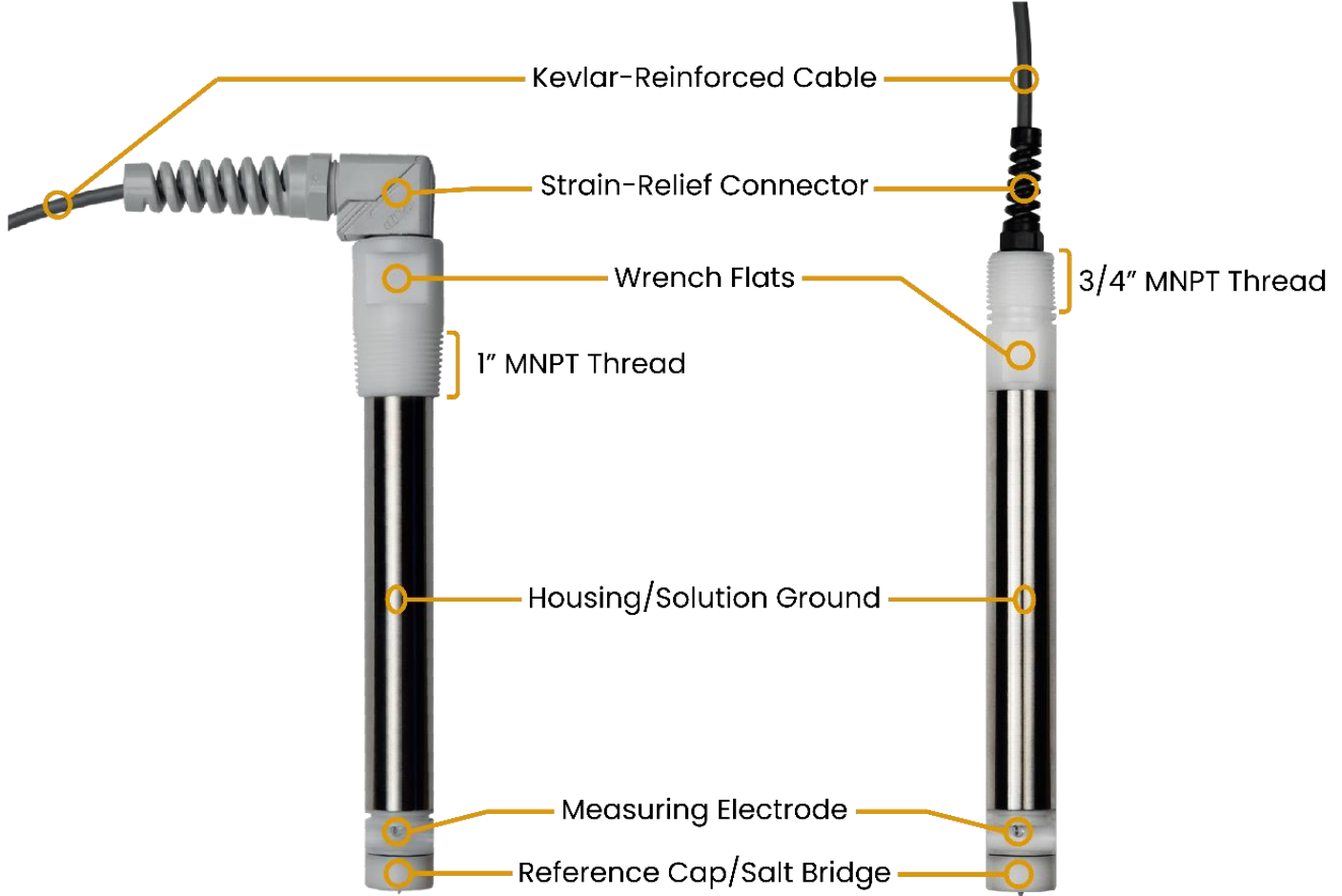
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# PRODUCT DESCRIPTION

## D-phi Series™ Sensor Models

### D-phi-i In-Line Mounting

### D-phi-s Standpipe Mounting/Submersion



## Parts

- **Wires**
  - Two reversible wires for loop-powered sensor that are stripped and tinned. One additional tinned wire for shielding.
- **Cable**
  - Kevlar™ reinforced, shielded, water-blocked, polyurethane jacketed cable built for tough applications.
- **Strain-Relief Connector**
  - This part prevents extreme angles that would otherwise shorten the lifespan of the sensor. It should always be tightly screwed in to ensure adequate compression of the O-ring seals.
- **Wrench Flats**
  - A place to position a wrench for tightening the sensor during installation.

| Model   | Wrench Flat Size (inches [cm]) |
|---------|--------------------------------|
| D-phi-i | 1 [2.5]                        |
| D-phi-s | 0.75 [1.9]                     |

- **Mounting Threads**
  - Area that provides options for pipe mounting of sensor.

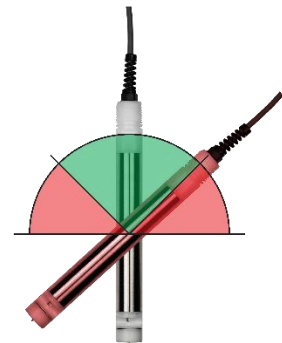
| Model   | Thread Type    |
|---------|----------------|
| D-phi-i | 1-inch MNPT    |
| D-phi-s | 0.75-inch MNPT |

- **Housing/Solution Ground**
  - This part contains the electronics, helps shield them, and is made of chemical-resistant titanium. It also acts as the solution ground, which conducts stray electrical currents in the water and prevents them from interfering with measurements.
- **Measuring Electrode**
  - The outer sensing element that reacts to the pH/ORP of the water.
- **Reference Cap/Salt Bridge**
  - The part that screws onto the end of the sensor. It contains the Reference Solution and allows salt ions to move between the Reference Solution and the sample for measurement.

- **Reference Chamber**
  - The area that holds the reference solution.
- **Reference Electrode**
  - The sensing element with a stable output that is compared to the Measuring Electrode to produce the pH/ORP value.
- **Reference Solution**
  - A stable, long-lasting buffer in the Reference Chamber that surrounds the Reference Electrode. The Solution must be periodically replaced to ensure accuracy and reliability. The product code for replacement Reference Solution is ref-12.

## SYSTEM/APPLICATION REQUIREMENTS

- The system must be able to supply 8-40 VDC and at least 20 mA for the loop-powered sensor. Some systems may not supply power, in which case a power supply may be purchased and added in series with the sensor.
- The system must accept at least one (1) 0-20+ mA input, or two (2) if the temperature sensor is also used.
- The application should not exceed 100 psi or 155°F (70°C).
- The application should be within 2-12 pH for most of the time to lengthen sensor life.
- The sensor should be installed at an angle no greater than 45° from vertical.
- The sample must touch the metal sensor housing during measurements.



## SENSOR ASSEMBLY AND DISASSEMBLY

The only removable or replaceable part is the Reference Cap. Attempts to disassemble the sensor voids the product warranty and will result in damage.

If the sensor stops working or damage occurs, please fill out the [RMA Form](#) and send it to [support@pHionics.com](mailto:support@pHionics.com). A representative will assist in determining the best course of action.



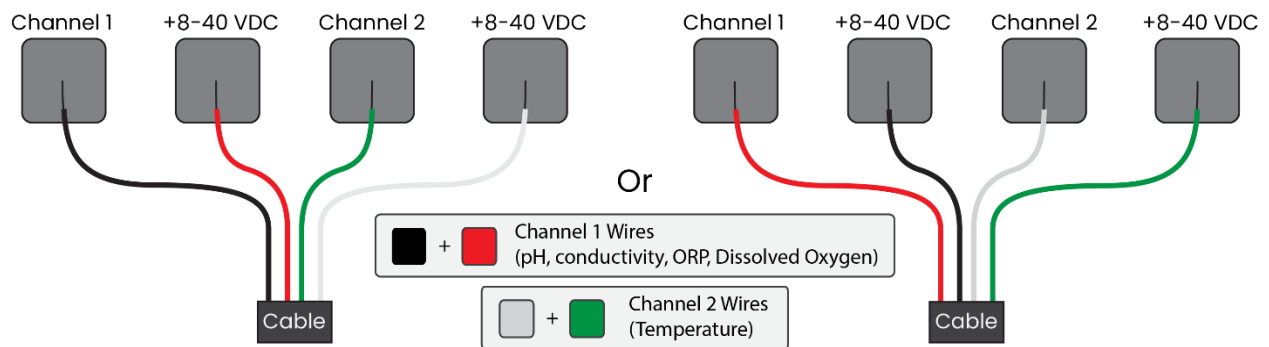
## SENSOR INSTALLATION

### Sensor Mounting

For mounting ideas, [click here](#).

For inline or standpipe mounting examples, [click here](#).

### Sensor Wiring



D-phi Series™ sensors have Reversible Input Protection (RIP). This means that the red and black wires function interchangeably as the power and output. RIP prevents damage occurring to the receiver or sensor due to improper wiring and simplifies the wiring process.

#### WARNING - Potential Electrocutation Hazard

Always disconnect power from receiver when connecting the product. In addition, take proper precautions to avoid conduction of high voltage through liquids that may shock or harm users.

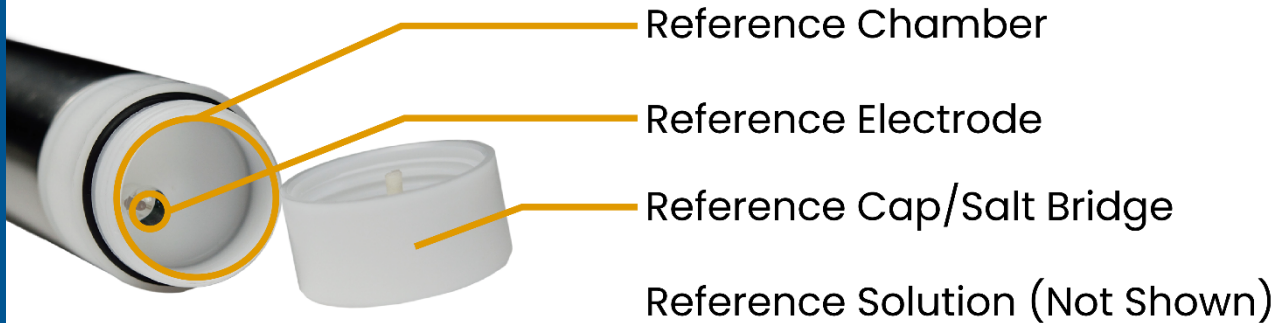
Conduction of stray electrical currents may damage sensitive electrical components, resulting in degraded performance or failure.



## ELECTRODE REFERENCE FILLING, REPLACEMENT, AND CLEANING

The Reference Solution becomes diluted over time, resulting in more frequent calibration to maintain accuracy. To avoid drops in performance, we recommend replacing the Reference Solution every 1-2 months. Ideal replacement frequency depends on the application and must be determined empirically through calibration checks. Applications with high flow rate,

temperature, pressure, alkalinity, or acidity dilute the reference faster and may require more frequent replacement.



*In these instructions, “water” refers to RO/DI/distilled water, although other relatively clean water sources may be used when RO/DI/distilled water is not available.*

### Supplies

- D-phi Series Sensor
- Reference Refill Kit
- RO/DI water

*Please skip to Step 5 if a Reference Refill Bottle has already been filled with water.*

### [Companion Instruction Video](#)

1. Open the Reference Refill Kit (included with sensor and available for purchase) and pull out a Reference Refill Bottle, along with the funnel.
2. Unscrew the cap of the Reference Refill Bottle.
3. Place the provided funnel into the top of the Bottle and fill the Bottle to the top of the white label with RO/DI water.
  - a. The funnel is narrow so surface tension can block the water from going through. Tilt the funnel to one side and pour slowly to avoid this problem.
  - b. Relatively clean tap water also works but may lead to lower performance.
  - c. **Alternately, you may fill the empty unlabeled bottle in the Reference Refill Kit with RO/DI water**



**then squirt that into a Reference Refill Bottle. This may provide more control over how much liquid is added.**

4. Screw the cap back on and put the rubber stopper over the needle nose then shake the Reference Refill Bottle 30-60s until there is little or no remaining powder that settles on the bottle of the Bottle.
  - a. The bottle will heat up slightly due to an exothermic reaction.
5. Unscrew sensor Reference Cap and pour out Reference Solution.
  - a. The reference solution does not meet the hazardous criteria set forth by the 2012 OSHA Hazard Communication Standard (CFR 1910.1200). Please see [page 6 of the SDS](#) for disposal information.
6. Rinse Reference Chamber out with water. If the interior is extremely dirty, you may use soap, water, and a soft brush to scrub away debris. Do the same with the Reference Cap.
  - a. If the sensor has been in storage for more than a few days, then we recommend scrubbing both Electrodes with soap, water, and a soft brush, then rinse with water. This revitalizes the glass to improve response time and accuracy.
7. Remove the rubber stopper from the Reference Refill Bottle.
8. Hold the sensor upright then fill the Reference Well to the top with the newly-made Reference Solution in the Reference Refill Bottle.
9. Screw the Reference Cap onto the upright Sensor.
  - a. Some of the Reference Solution will be pushed out of the pointed junction in the Reference Cap if the sensor was filled completely.
10. Recalibrate the sensor before use.
11. The Reference Refill Bottle has up to three (3) remaining refills in it. Store the Reference Refill Bottle in a refrigerator to prolong the life of the remaining solution.

## SENSOR CALIBRATION

Follow all local laws and regulations regarding proper handling and disposal of the chemicals used during calibration.

Metal housing must be in contact with sample for accurate measurements.

Reading is considered stable after change of less than 0.1 mA per minute is observed. It is common that measurement devices do not have greater than 0.01 mA resolution, so the reading may change back and forth (example: 12.07-12.08 mA over and over).

Shield wire should be connected when possible for highest accuracy.

## Required Equipment

- D-pHi Series pH or ORP Sensor
- Device for measuring mA output (Digital voltmeter, programmable logic controller, distributed control system, etc.)
- Calibration Buffer 1
  - pH Sensor: 7 pH Buffer
  - ORP Sensor: +256 mV Buffer
- Calibration Buffer 2
  - pH Sensor: 4 pH Buffer
  - ORP Sensor: +92 mV Buffer

*These calibration solutions are the most commonly available but other options are available. Zobell ORP solutions are recommended for ORP calibration as they are more shelf-stable than others. 10 pH buffers are another common pH calibration option but be aware that they are more prone to dilution and drift over time.*

## Calibration Instructions

1. Rinse Sensor with distilled water.
2. Submerge the sensor in Calibration Buffer 1. Wait 1-5 minutes for output to stabilize.
  - Always ensure solution is in contact with the metal housing for proper readings.
3. Record mA output for Calibration Buffer 1.
4. Rinse electrode with distilled water.
5. Submerge sensor in Calibration Buffer 2. Wait 1-5 minutes for output to stabilize.
6. Record mA output for Calibration Buffer 2.
7. Input Calibration Buffer values and sensor outputs to system software if using automatic scaling.
8. Rinse Sensor with distilled water.

Calibration is now complete. The sensor will require periodic calibration and replacement of Reference Solution due to Reference Solution dilution over time. Calibration frequency depends on many factors, including required accuracy, flow rate, temperature, pressure, debris, alkalinity, or acidity. Applications requiring high accuracy should perform calibration checks more frequently.

Calibration checks are performed by either placing the sensor in a calibration buffer and comparing the measurement to the previous calibration, or by placing a second (calibrated) pH sensor into the same sample and comparing the measurements.

## TEMPERATURE SENSOR CALIBRATION

Temperature will be within 1°C without calibration if the sensor is fully submersed in the solution of interest for at least 10 minutes so does not require calibration.

Using the applicable software or interface to scale a PLC, datalogger, or DCS, setting 4.0 ma to = 0.0°C. Set 20.0 ma = 50°C. To connect the sensor to an RTU or datalogger for temperature measurement – connect the WHITE and GREEN wires to the terminals of the device. Wires are reversible so it does not matter which is connected to power or output.

## SENSOR STORAGE

1. Remove sensor from use.
2. Unscrew Reference Cap and dump out Reference Solution.
3. Remove all debris from Sensor Housing, Electrodes, Reference Well, and Reference Cap. Rinse with RO/DI water to remove loose debris. For tougher debris, scrub with a soft brush, soap, and water, then rinse with RO/DI water.
4. Dry exterior of Sensor, Reference Well, and Reference Cap with a towel.
5. Replace Reference Cap and store in a cool, dry place where the Sensor cannot fall or roll.

## TROUBLESHOOTING STEPS

1. Check the wiring for a loose connection or signs of water damage.
2. Check the cable for signs of damage.
3. Check that the metal housing is in contact with the sample solution.
4. Check the Measuring Electrode for scratches or cracks.
5. Replace calibration buffers and recalibrate.
6. Scrub the Measuring Electrode and outside of the Reference Cap with soap and a soft brush, then recalibrate.
7. Dump the reference, clean the Reference Cap, Reference Chamber, and Outer Electrode, then follow the steps in Electrode Reference Replacement.

If none of these steps solve the problem being experienced, then please contact the pHionics Support Team at [support@phionics.com](mailto:support@phionics.com). In the email, please include any supporting data, along with detailed notes about the issue and the steps taken while trying to fix it.

## WARRANTY

pHionics warrants its instruments to be free from defect in material and workmanship under normal use for a period of twenty-four months from date of purchase (the warranty excludes the electrode). Please test the unit before using it in your application. We cannot accept the return of a sensor after use for reasons other than warranty. Nor do we warrant the sensor or sensor for any specific application. Determination of application compatibility is the sole responsibility of the procurer. pH, ORP, dissolved oxygen, and similar electro-chemical electrodes are not warranted against failure. If the sensor or sensor is stained or disfigured in such a manner as to preclude it from being sold as new -- the unit cannot be accepted as a return and the procurer will remain responsible for any monies owed.

Warranty does not cover defects caused by abuse or electrical damage. pHionics will not cover under warranty any instruments damaged during shipment to the factory improperly packed. Repair attempts by other than authorized service personnel will void warranty.

If within the warranty period, the equipment does not meet the specifications at time of purchase, pHionics shall correct any such defect or non-conformance by (at our option) repairing any defective part or parts that are returned to us, or by making available at your facility (via lowest freight rate) a repaired or replacement part, or by crediting your account, if we deem it appropriate.

Items returned for warranty repair must be prepaid and insured for shipment. Warranty claims are processed on the condition that prompt notification of a defect is given to pHionics within the warranty period. pHionics shall have the sole right to determine if in fact a warranty situation exists.

pHionics' warranty does not cover travel, travel time, mileage, removal, reinstallation, or calibration expenses.

The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral, or implied, and we make *no warranty of merchantability or fitness for a particular purpose*.

pHionics' liability to you arising out of supplying of this equipment or its use whether based on warranty, contract or negligence shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of the applicable warranty period as aforementioned, all such liability shall terminate. The foregoing shall constitute your sole remedy and our sole liability. *In no event is pHionics liable for special or consequential damages.*

## RETURN OF MATERIALS

Material returned for repair, whether in or out of warranty (**please read warranty section regarding types of material which cannot be accepted back for environmental and/or safety reasons**), should be shipped prepaid, insured to:

**pHionics Inc.  
6680 Alhambra Avenue, #504  
Martinez, CA 94553**

RMA No: (call for return of merchandise authorization number -- material cannot be accepted without an RMA number – merchandise returned for credit may be subject to a twenty percent restocking fee – at the discretion of pHionics).

The returned material should be accompanied by a letter of transmittal that should include the following:

Subject: Return of Materials for Repair

1. Location, type of service, and length of time in service of device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name, telephone, and email of the person to contact if there are questions regarding the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete instructions as to how you would like any problems resolved, etc.
6. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device. If the material is returned for out of warranty repairs, a purchase order for repairs should be enclosed with the letter of transmittal.

### **Statement of pHionics product policy**

It is a primary objective of pHionics, Inc. to provide a product and/or service to our customers of outstanding value, safety, reliability, and quality. In our concern for the world that we share, we will attempt to package and design our products in an environmentally conscious manner.

## PROPER END OF LIFE DISPOSAL

To comply with the Waste Electrical and Electronic Equipment Directive in the EU, this product must not be disposed of in unsorted municipal waste. Please check with your EU distributor to find out more about proper disposal of this product.



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