

# **ULTRASONIC-MEGASONIC MONITORING TRANSMITTER**

## **INSTALLATION AND OPERATIONAL MANUAL**

# BX-502

## ULTRASONIC-MEGASONIC MONITORING TRANSMITTER

*"Continuous monitoring of your cleaning tanks"*

Continuously monitors cavitation energy and frequency in Ultrasonic and Megasonic cleaning tanks.

- ◆ 4-20 mA & 0-10 Vdc Energy Outputs
- ◆ 4-20 mA & 0-10 Vdc Frequency Outputs
- ◆ 0 to 2.5 MHz (2500 kHz) Frequency Range
- ◆ Din Rail and Wall Mountable



### TABLE OF CONTENTS

#### Safety Considerations

- 1.0 General Information
- 2.0 Transmitter Specifications
- 3.0 Probe Specifications
- 4.0 Mechanical Assembly and Installation
- 5.0 Power and Signal Connection
- 6.0 Calibration Procedure
- 7.0 Product Limited Warranty

## SAFETY CONSIDERATION

It is important to read this manual before installing or commissioning this device as it contains important information relating to Safety.

### Unpacking & Inspection

Unpack the instrument and inspect for obvious shipping damage. Do not attempt to operate the unit if damage is found. Qualified personnel should do installation of this instrument. In order to ensure safe operation, the following instructions should be followed:

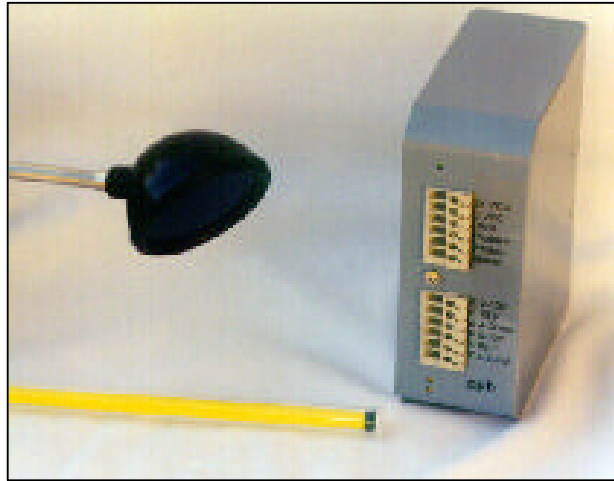
This instrument has no power-on switch. An external switch or circuit breaker shall be included in the building installation as a disconnecting device. It shall be marked to indicate this function, and it shall be in close proximity to the equipment within reach of the operator. The switch or circuit breaker shall not interrupt the Protective Conductor (Earth wire) marked "GND" on the instrument case, and it shall meet the relevant requirements. The switch shall not be incorporated in the mains supply cord.

Furthermore, to provide protection against excessive energy being draw from the mains supply in case of a fault in the equipment, and overcurrent protection device shall be installed.

The Protective Conductor must be connected for safety reasons. Check that the power cable has the proper Earth wire, and it is properly connected. It is not safe to operate this unit without the Protective Conductor.

- 
- Do not exceed a voltage rating of 20 to 30 V dc. 24 V dc input is recommended as marked on the label located on the front of the instrument housing.
  - Always disconnect power before changing signal and power connections.
  - Do not open the instrument case under any circumstance.
  - Do not operate this instrument in flammable or explosive atmospheres.
  - Do not expose this instrument to rain or moisture.
  - Unit mounting should allow for adequate ventilation to ensure instrument does not exceed operating temperature rating.
  - Use electrical wires with adequate size to handle mechanical strain and power requirements. Install without exposing bare wire outside the connector to minimize electrical shock hazards.
  - Whenever EMC (Electromagnetic Compatibility) is an issue, always use shielded cables.

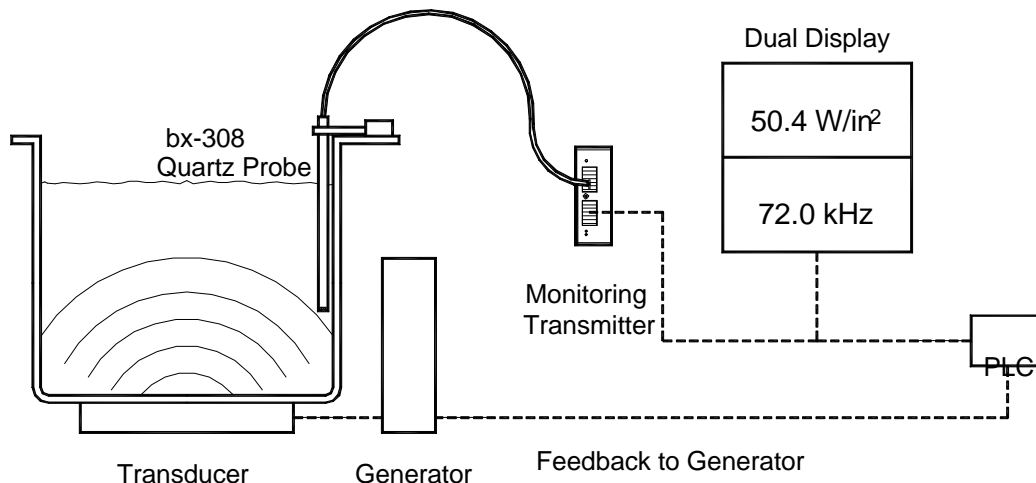
## 1.0 GENERAL INFORMATION



The bx-502 is a panel-mount-ready unit designed to continuously monitor cavitation energy and frequency in your ultrasonic and megasonic cleaning tanks. It is designed to provide a non-isolated 4 to 20 mA current output and a 0 to 10 V dc output which are proportional to the cavitation and the ultrasonic/megasonic energy density present within a cleaning tank. The output signal may be scaled by the user to meet a specific energy range. The unit also provides a non-isolated 4 to 20 mA current output and a 0 to 10 V dc output which are proportional to the Ultrasonic-Megasonic frequency.

The transmitter may be connected to a PLC or external dual LCD, to display both energy and frequency, measured from a probe that is mounted to the tank. The transmitter accommodates both the ppb bx-208 or bx-308 probes. Any of these probes can easily mount within any cleaning tank for continuous monitoring. In addition to passive monitor capabilities, the transmitter may also be used to maintain and control the tank energy levels by including a feedback to the transducer generator.

The bx-502's unique design makes it a very stable and reliable monitoring tool for most ultrasonic and megasonic cleaning applications.



## **2.0 TRANSMITTER SPECIFICATIONS**

**2.1 SIGNAL INPUT** Single probe input

### **2.2 POWER INPUT**

**Supply-voltage range:** 20 to 30 V dc (24 V dc recommended)  
**Overvoltage protection:** 50 V dc  
**Reverse polarity protection:** 50 V dc  
**Current drain:** 36 mA dc

### **2.3 OUTPUT**

#### **2.3.1 CAVITATION ENERGY**

**4-10 mA output:**

**Linear range:** 4 mA to 20 mA dc  
**Isolation:** non-isolated  
**Loop Resistance:**  $R_{max} = 650$  ohms  
**Supplied Voltage:**  $V_s = 15$  V dc (internal supply, +15 V dc from E REF)

**0-10 V dc Output**

**Linear range** 0 to 10 V dc  
**Range** 0 to 250 W/in<sup>2</sup>, Scalable  
**Formulas:** (V dc) x (25) = Energy (W/in<sup>2</sup>)  
(mA dc - 4) x (25) x (10) / 16 = Energy (W/gal)

#### **2.3.1 FREQUENCY**

**4-10 mA output:**

**Linear range:** 4 mA to 20 mA dc  
**Isolation:** non-isolated  
**Loop Resistance:**  $R_{max} = 650$  ohms  
**Supplied Voltage:**  $V_s = 15$  V dc (internal supply, +15 V dc from E REF)

**0-10 V dc Output**

**Linear range** 0 to 10 V dc  
**Operating Range:** 0 to 2.56MHz (2560 kHz)  
**Formulas:** (V dc) x (256) = Frequency (kHz)  
(mA dc - 4) x (256) x (10) / 16 = Frequency (kHz)

### **2.4 ENVIRONMENTAL**

**Operating temperature:** -40° to 85° C  
**Storage temperature:** -55° to 125° C  
**Mounting position:** Any

**NOTE:** *NOT WATER-RESISTANT*

### **2.5 MECHANICAL**

**Case material:** Aluminum with polyurethane baked enamel paint  
**Dimensions:** 4.375" W x 5.125" L x 1.938" H  
(2.938" H with DIN Rail Mount)  
**Connections:** 12-22 AWG, 10 mm wire strip length

### 3.0 PROBE SPECIFICATIONS

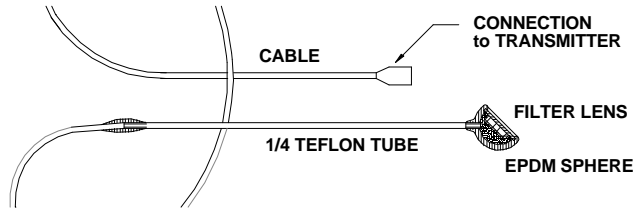
#### 3.1 PROBE MATERIALS

**bx-208** This is the standard probe for both ultrasonic and megasonic solutions, including Alcohols, NMP, SC1 and SC2. The probe has three components that come in contact with solutions:

**Half Sphere:** made of Ethylene Propylene (EPDM), angled at 45° with the probe tube, 2" diameter, black.

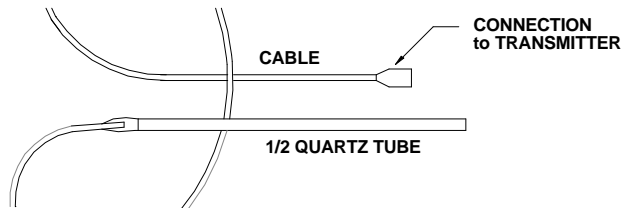
**Tube:** made of 1/4" OD 316 stainless steel with an optional Teflon wrapping, custom length.

**Lens:** made of Quartz (optional sapphire for HF).



**bx-308** This is an all Quartz probe for ultrasonic and megasonic cleaning solutions. The probe has only one component that comes in contact with solutions:

**Rod:** made of Quartz, 1/2" OD, custom length, sealed.



#### 3.2 ENVIRONMENTAL

##### Operating temperature:

**bx-208:** -20° C to 80° C (dependent on solution)

**bx-308:** -20° C to 200° C

##### Chemical Resistivity:

**bx-208:**

**Quartz lens:** Recommended for all solution except HF (Optional sapphire lens available for HF)

**316 s.s tube:** Recommended for all non-acidic solutions.

**Teflon® wrapped tube:** Recommended for all solutions

**EPDM Sphere:** Recommended for most solutions. Please refer to the Chemical Resistivity charts on our internet address at: [www.megasonics.com/chemical.html](http://www.megasonics.com/chemical.html)

**bx-308**

**Quartz tube:** Recommended for all solutions except HF

## **4.0 MECHANICAL ASSEMBLY AND INSTALLATION**

### **4.1 UNPACKING AND INSPECTION**

Your bx-502 was systematically inspected and tested, then carefully packed before shipment. Unpack the instrument and inspect for shipping damage. Notify the freight carrier immediately if damage exists.

Each package includes an assembled transmitter, a probe, and owners' manual. If any items are not according to your order, contact your local distributor or ppb, Inc.

### **4.2 SAFETY CONSIDERATIONS**

As delivered from the factory/distributor, this instrument complies with required safety regulations. To prevent electrical or fire hazard and to ensure safe operation, please follow the guidelines below.

**VISUAL INSPECTION:** Do not attempt to operate the unit if damage is found.

**MOUNTING** - Observe the mounting instructions in the following pages as applicable.

**POWER VOLTAGE** - Verify that the instrument is connected for the power voltage rating that will be used (24-36 V dc).

**POWER WIRING** - This instrument has no power-on switch; it will be in operation as soon as the power is connected.

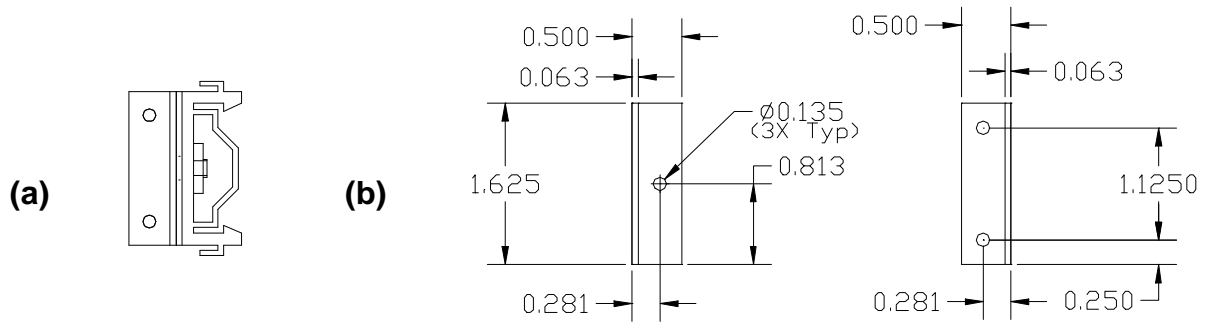
**SIGNAL WIRING** - Do not make signal wiring connections or changes when power is on. Make signal connections before power is applied. If connection changes are required, first disconnect the power.

**EXERCISE CAUTION** - As with any electronic instrument, high voltage may exist when attempting to install, calibrate, or remove parts of the transmitter.

### 4.3 OPTIONAL ADAPTERS FOR MOUNTING

The following optional adapters provide various mounting choices:

- a. 35 mm DIN Rail clamp with bracket.
- b. Bracket for wall mounting.

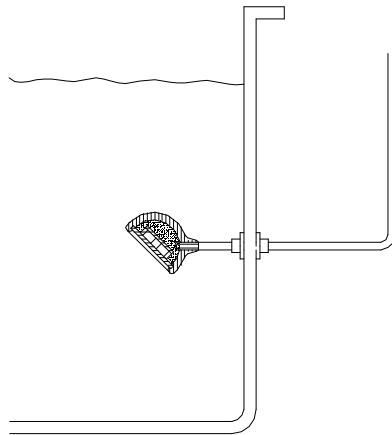


### 4.4 PROBE MOUNTING OPTIONS

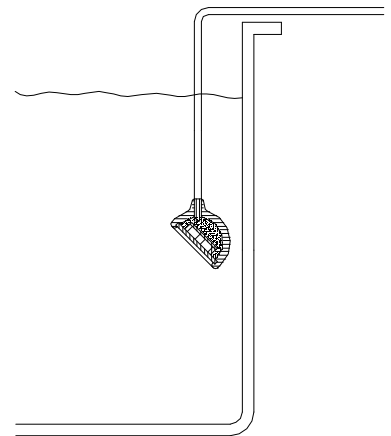
Additional hardware may be required to mount the probe to the tank. As most tanks vary from one to the other, a universal bracket is not possible. If the specifications of the tanks are available, we can assist you in attaining the proper mounting bracket for your system.

The following figures describe various mounting choices:

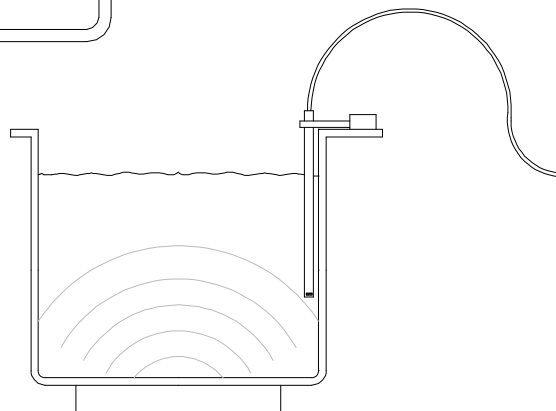
(a) bx-208 bulk head mount.



(b) bx-208 tank wall mount.

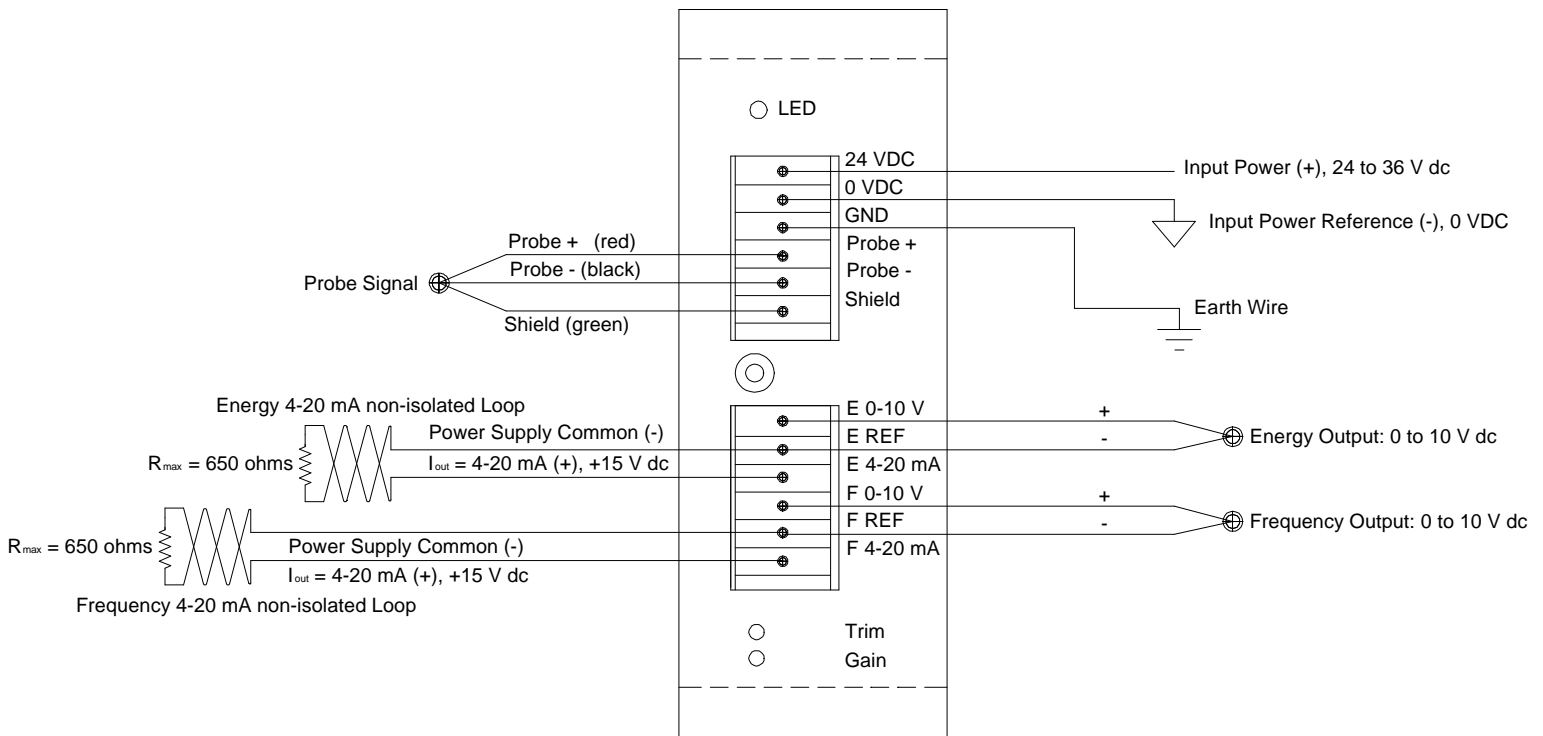


(c) bx-308 tank wall mount.





## 5.0 POWER AND SIGNAL CONNECTION

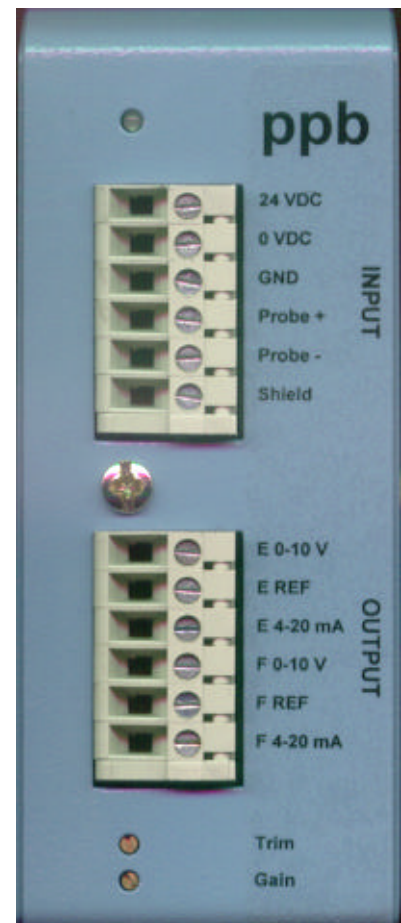


### 5.1 GENERAL

Terminals accept 12-22 AWG wire, 10 mm wire strip length.  
Grounding to GND will ground case. Input range is 24-36 V dc.

### SCREW-TERMINAL PIN ASSIGNMENT

<b>24 VDC</b>	Power Input (+), 24 to 36 V dc
<b>0 VDC</b>	Power Input (-), reference
<b>GND</b>	Earth wire
<b>Probe +</b>	Probe signal (+), RED WIRE
<b>Probe -</b>	Probe signal (-), BLACK WIRE
<b>Shield</b>	Probe shield wire, GREEN WIRE
<b>E 0-10 V</b>	Energy signal (+ V dc)
<b>E REF</b>	Energy reference (voltage or current)
<b>E 4-20 mA</b>	Energy signal ( $I_{out}$ mA), +15 V dc internal supply
<b>F 0-10 V</b>	Frequency signal (+ V dc)
<b>F REF</b>	Frequency reference (voltage or current)
<b>F 4-20 mA</b>	Frequency signal ( $I_{out}$ mA), +15 V dc internal supply
<b>Trim</b>	Scale down energy level
<b>Gain</b>	Scale up energy level (Trim clockwise fully)



## **6.0 CONFIGURATION**

The bx-502 is normally configured with the following settings:

**Energy:** 0 to 10 V dc = 4 - 20 mA = 0 to 250 W/in<sup>2</sup> (W/gal)

Formulas:  $(V \text{ dc}) \times (25) = \text{Energy (W/in}^2)$   
 $(\text{mA dc} - 4) \times (25) \times (10) / 16 = \text{Energy (W/in}^2)$

**Frequency:** 0 to 10 V dc = 4 -20 mA = 0 to 2560 kHz

Formulas:  $(V \text{ dc}) \times (256) = \text{Frequency (kHz)}$   
 $(\text{mA dc} - 4) \times (256) \times (10) / 16 = \text{Frequency (kHz)}$

### **6.1 CALIBRATION PROCEDURE**

The unit is shipped calibrated to read cavitation energy in Watts per square inch. This is the default setting for Ultrasonic systems. The unit may also be delivered calibrated to a W/in<sup>2</sup> for Megasonic systems, which includes a different multiplier than the 25 shown above. An NIST Traceable calibration certificate can be provided for an additional charge. The unit is calibrated and the certificate provided by an independent testing laboratory. Please contact us for additional information.

An alternative to the W/in<sup>2</sup> output, the transmitter might be calibrated to an alternative reference, such as the W/gal of your system, or an arbitrary baseline. **WARNING**, you will lose the calibration to W/in<sup>2</sup> when you adjust the calibration screw.

To proceed with a user calibration of the transmitter in W/gal, it is necessary to use an Ultrasonic or Megasonic tank for which both the volume of water in the tank, as well as the total watts coming from the Ultrasonic or Megasonic generators are known. The transmitter can be calibrated by scaling the energy reading in an iterative fashion until the energy displayed coincides with the watts/gallon of the tank.

$$E \text{ (Watts/Gallon)} = \frac{\text{Power (watts)}}{\text{Volume (gallons)}}$$

The transmitters have two screws located on the bottom of the unit's front face. The locations of the screws are shown on the figures on page 12, labeled as **Trim** and **Gain**. The procedure to calibrate the transmitter with these adjustments is as follows:

#### **ULTRASONIC**

1. Turn **Gain** and **Trim** counter-clockwise all the way (the transmitter terminals should be facing forward towards you, with the LED at the top)
2. The unit should read only 0 V dc and 4 mA for Energy.
3. Turn **Trim** clockwise until the energy being read converges to you baseline calculated above.  
Note: The maximum energy that can be read is 250 W/gal according to the formulas defined. Any energy above that is not permitted. If the energy is reading above 250 W/gal, you need to turn **Trim** counter-clockwise. You may define an alternative formula to attain reading greater than 250 W/gal.

## **MEGASONIC**

1. Turn **Gain** counter-clockwise all the way and **Trim** clockwise all the way.
2. Turn **Gain** clockwise until the energy being displayed is approximately 50 W/gal. Note: The maximum energy that can be read is 250 W/gal according to the formulas defined. Any energy above that is not permitted. If the energy is reading above 250 W/gal, you need to turn **Gain** counter-clockwise. If the energy is still greater than the baseline you are targeting, turn **Trim** counter-clockwise. You may define an alternative formula to attain reading greater than 250 W/gal.

Please note that ultrasonic energy is an order of magnitude larger than megasonic energy. Therefore, it is unlikely that you be able to display both ultrasonic and megasonic energy with the same **Trim** and **Gain** adjustment.

### **7.0 PRODUCT LIMITED WARRANTY**

The bx-502 is warranted to the original purchaser to be free from defects in materials and workmanship under normal installation, use and service for a period of one (1) year from the date of shipment as shown by the shipping package or invoice.

The obligation of ppb under this warranty shall be limited to the repair or replacement (at our option), during the warranty period of any part which proves defective in materials or workmanship under normal use and service, provided the product is returned to ppb (address below) or to one of our authorized service centers transportation charges prepaid. Products returned to us or to an authorized service center.

This one (1) year warranty is in lieu of all other expressed warranties, obligations, or liabilities. Any implied warranties, obligations, or liabilities, including but not limited to the implied warranties of fitness for a particular purpose, shall be limited in duration to the one (1) year duration of this written limited warranty. Local state laws will apply.

In no event shall we be liable for any special, incidental or consequential damages for breach of this or other warranty, expressed or implied whatsoever.

This warranty gives you specific legal rights.

#### **Company information:**

ppb, Inc.  
236 Stanford S Center  
PMB 236  
Palo Alto, CA 94304  
Phone: (650) 851-4387  
Fax: (650) 851-4388

[www.megasonics.com](http://www.megasonics.com)