# BABBITT ULTRASONIC TRANSMITTERS

# INSTRUCTION MANUAL



**B**ABBITT
**I**NTERNATIONAL
Level Controls & Systems

**P.O. Box 70094**
**Houston, TX 77270**
**(713) 467-4438**

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure that you thoroughly understand the contents before installing, using or maintaining this product.

For equipment service or support needs:

**Customer Service:** 1-800-835-8012 or 713-467-4438 (8:00 a.m. to 5:00 p.m. CST US)

⚠ **WARNING**

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

- Do not perform any services other than those contained in this manual unless you are qualified.

Explosions could result in death or serious injury.

- Verify the operating environment of the Babbitt Ultrasonic is consistent with the appropriate location certifications.

- Do not remove the housing cover in explosive atmospheres when the circuit is alive.

- To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.



High voltage that may be present on leads could cause electrical shock.

Make sure the main power to the Ultrasonic is off and the lines to any other external power source are disconnected or not powered while wiring the instrument.

## TABLE OF CONTENTS

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## ULTRASONIC LEVEL TRANSMITTER

### 1. DESCRIPTION

Babbitt Ultrasonic Transmitters provide simple and reliable non-contact level measurement of fluids in plastic, metal or concrete tanks, sumps or other containers. Babbitt ultrasonics are designed to be used in liquid applications that do not contain fumes, vapor or gases. These units feature high efficiency, narrow beam design technology using a wide frequency bandwidth to enhance operation in difficult applications. The transmitter performs particularly well in harsh environments where vessel temperatures vary.

Babbitt Ultrasonics utilize SmartSonic Technology, which uses smart signal processing to help eliminate unwanted echoes from tank walls, standpipes and other tank structures that often cause error readings by other ultrasonic devices. The unit's transducer uses a built-in, self-cleaning operation to eliminate buildup or condensation.  The SmartSonic sensors are designed to adapt to the internal tank conditions, automatically adjusting power and receiver sensitivity to any distance and reflecting surface.  This technology ensures the same echo is maintained over the entire operating range which enhances measurement accuracy.

The transmitter can be programmed to simply send a 4/20mA analog signal directly to an existing control system or send data by RS-232, RS-485 or HART (2 Wire Units) to a PC running the SmartSonic calibration/data logging software program.

## 2. SPECIFICATIONS

| | |
|---|---|
| **Conduit Entry:** | 1/2" NPT (PVC conduit only) |
| **Enclosure:** | PVC-94VO |
| **Enclosure Rating:** | NEMA 6 (IP 68) |
| **Temperature:** | Standard - PVC -40° to +140° F (-40° to 60° C) |
| | Optional - High Temp Teflon De-Coupler -40° to +266° F (- 40° to 130° C) |
| **Pressure:** | 1 bar |
| **Approvals:** | Entela—CSA/UL; |
| | General Approvals CSA and FM; must have Aluminum enclosure |
| **Accuracy:** | +/- 0.25% of maximum range |
| **Beam Angle:** | 6°-12° conical at –3dB |
| **Loss of Echo:** | Hold 30 seconds, 22 mA |
| **Temperature Compensation:** | Continuous in transducer |
| **Temperature Sensor failure:** | 23 mA |
| **Calibration:** | Push-button or programmable via optional communication port |
| **Diagnostics:** | Via communication port (echo profile, echo stability, operation errors) |
| **Power AC:** | AC units 115 VAC 60Hz or 230 VAC 50Hz, 1.7 VA |
| **Power DC:** | DC units 12 to 30 VDC, 0.07 A max @ 24 VDC |
| **Output:** | 4-20 mA, optional RS-232, RS-485, Modbus or HART (2 Wire Only) |
| **4 to 20 mA Max. Loop Resistance** | 110 VAC @ 750 Ohms (isolated)<br>12 VDC @ 250 Ohms<br>24 VDC @ 750 Ohms |

## 3. COMMUNICATION WIRING
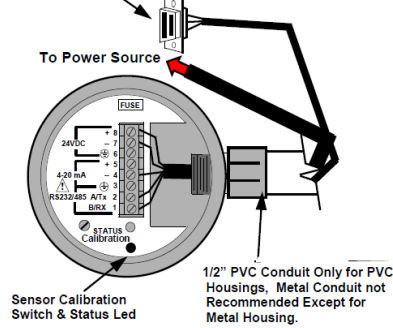
### 3 & 4 Wire Ultrasonic

**Fig. 1 RS232 Connection**

**Fig. 2 RS485 Connection**
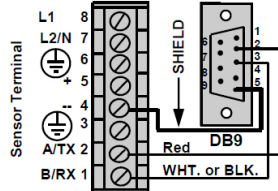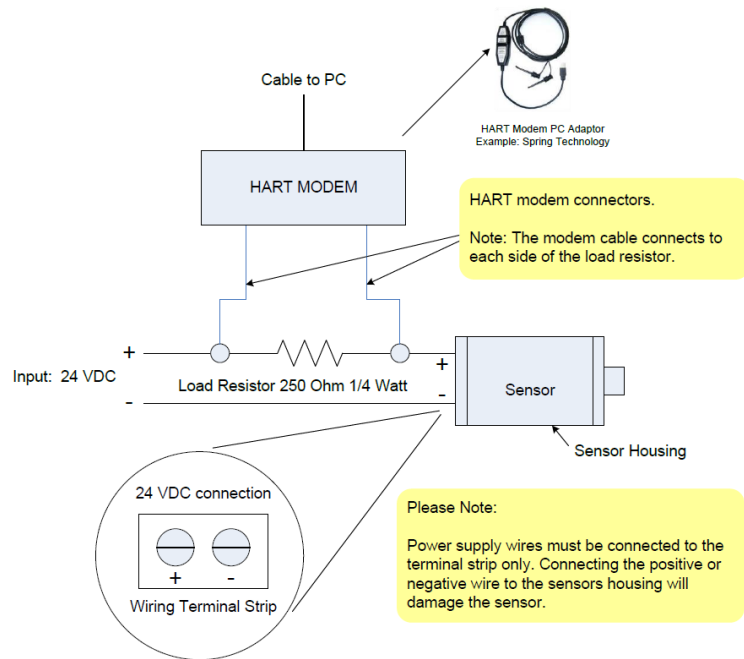


Note – Connect the shield to Terminal #4.
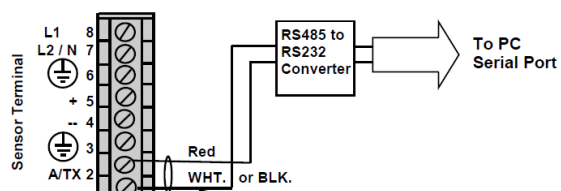
Note – Connect the shield to Terminal #3.

Connect to Serial Port of PC, use Extension Cable length as required, Refer to Fig.# 1 or # 2 For Wiring Dtl.

To Power Source

1/2" PVC Conduit Only for PVC Housings, Metal Conduit not Recommended Except for Metal Housing.

Sensor Calibration Switch & Status Led

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### 2 Wire Ultrasonic



Cable to PC

HART Modem PC Adaptor
Example: Spring Technology

HART MODEM

HART modem connectors.

Note: The modem cable connects to each side of the load resistor.

Input: 24 VDC

Load Resistor 250 Ohm 1/4 Watt

Sensor

Sensor Housing

24 VDC connection

+    −

Wiring Terminal Strip

**Please Note:**

Power supply wires must be connected to the terminal strip only. Connecting the positive or negative wire to the sensors housing will damage the sensor.

PDF 2 Wire HART Software Instruction Manual can be downloaded from the bottom of webpage:
https://www.babbittinternational.com/ultrasonic-level-transmitters.html

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**4. COMMUNICATION SOFTWARE**

Communication software is provided with all ultrasonic orders.  It is important to note that 3 & 4 Wire Units use a different software than 2 Wire Loop Power Units.

> If lost or not found, software for each can be downloaded from the bottom of webpage:
>
> https://www.babbittinternational.com/ultrasonic-level-transmitters.html
>
> The instructions below are for 3 & 4 Wire Ultrasonic Sensors. For 2 Wire Ultrasonic Sensors, users should follow the instructions located in the 2 Wire HART Instruction Manual PDF, which can be downloaded from the bottom of webpage:
>
> https://www.babbittinternational.com/ultrasonic-level-transmitters.html

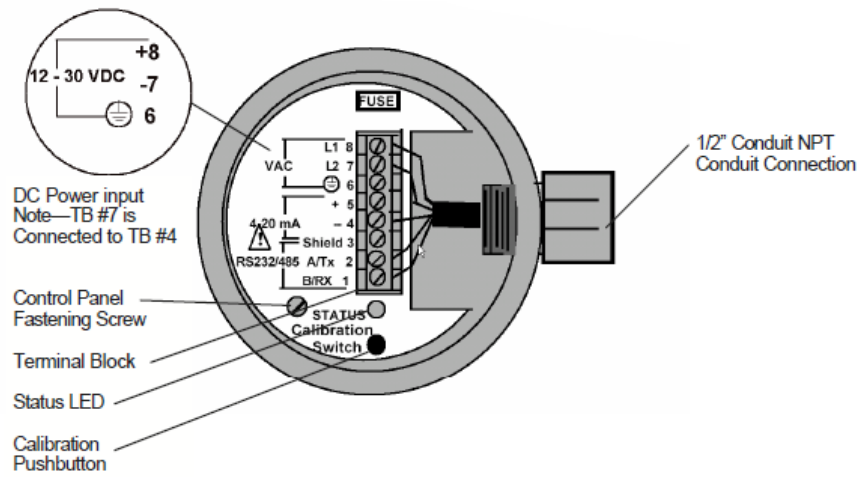### HOW TO START THE GATEWAY PC COMMUNICATION PROGRAM – 3 & 4 WIRE ULTRASONIC

1.) Install Level device Gateway PC by selecting SETUP.EXE from the factory provided disc or by downloading the software from the webpage.

2.) Click on START Windows button and select "probe_GatewayPC"

3.) Choose save an available serial communication port; Click on Select_COM_Port (Click STOP data link)

4.) After selection of communication port, save port number to avoid going through the same process next time.

5.) Click on Start data link, you will see two bar graphs that display last 8 echoes and tank level in %.

6.) When communication is working, you should see a smiling face and green light at the bottom of screen.

7.) 4mA and 20mA distance calibration, go to TOOLS and click on 4mA Distance Calib. and 20mA Distance Calib. In the 4mA (20mA) dialog box, click OK and in the next box enter distances.

For information about the communication program, please go to **HELP** and click on **OPERATING INSTRUCTIONS.**
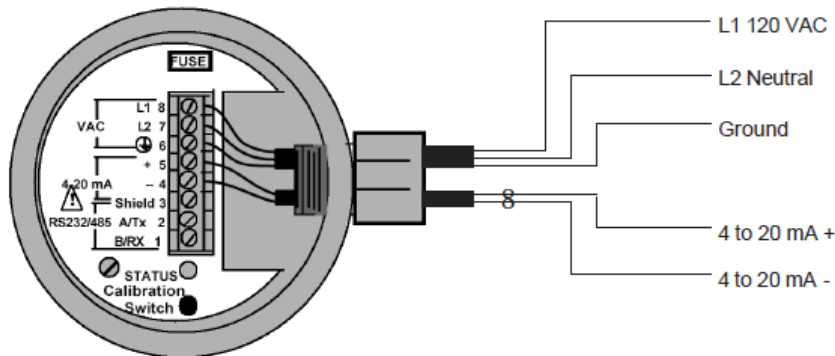
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### IMPORTANT NOTE:

Ultrasonic sensors with RS-485 communication ports can be used in Daisy Chain Network. BEFORE INSTALLATION, please assign new sensor ID to each sensor starting from 4 and up.  The default ID for a single sensor is 2.  Please read HELP file in the Gateway PC Software. In points 20-22 you will learn how to change the sensors ID.
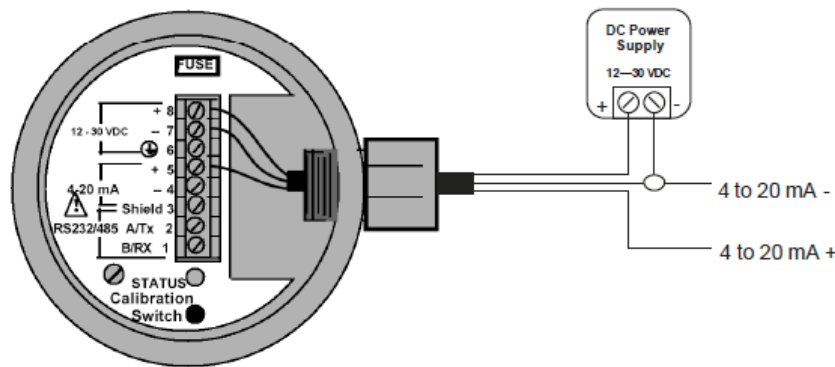
## 5. INTERCONNECTING WIRE DIAGRAM



+8
12 - 30 VDC  -7
6

DC Power input
Note—TB #7 is
Connected to TB #4

Control Panel
Fastening Screw

Terminal Block

Status LED

Calibration
Pushbutton

1/2" Conduit NPT
Conduit Connection

**AC Wire Diagram**

L1 120 VAC
L2 Neutral
Ground
4 to 20 mA +
4 to 20 mA -

**DC 3—Wire Diagram**
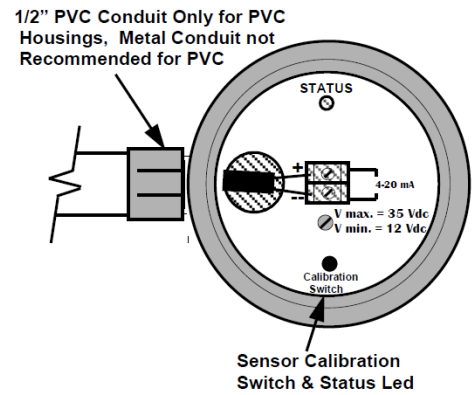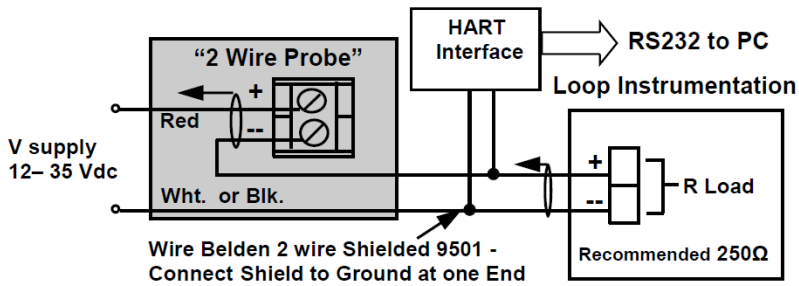
DC Power Supply
12—30 VDC
4 to 20 mA -
4 to 20 mA +

**Wire/Cable for A/C Units**
115/230 VAC……………….. 3 wire unshielded, 22AWG (7X30), 300V
4/20mA…………………... 1 pair shielded, 24AWG (7X32), 300V

**Wire/Cable Recommendation for 3 Wire 24VDC Units**
24 VDC + 4/20mA …………. 3 wire shielded, 24AWG (7X32), 300V

**DC 2 Wire Diagram**



## Wiring Information

- Ground shield at one end only.
- All terminal block wiring must be rated for 250V.
- Terminal is for use only with equipment which has no live parts that are accessible.
- Terminal is for use with equipment which maintains basic insulation from hazardous voltage under normal and single fault conditions.
- Connection used at the remote end of external circuit.

## Recommended Wiring

AC Sensor
-    Power                3 Wire unshielded 22 AWG, 300V
-    Current Output       1 Pair shielded 24 AWG, 300V
-    Communication        1 Pair shielded 24 AWG, 300 V

DC Sensor
-    Power                3 Wire shielded 24 AWG, 300V
-    Current Output       3 Wire shielded 24 AWG, 300V
-    Communication        1 Pair shielded 24 AWG, 300 V

2 Wire Sensor
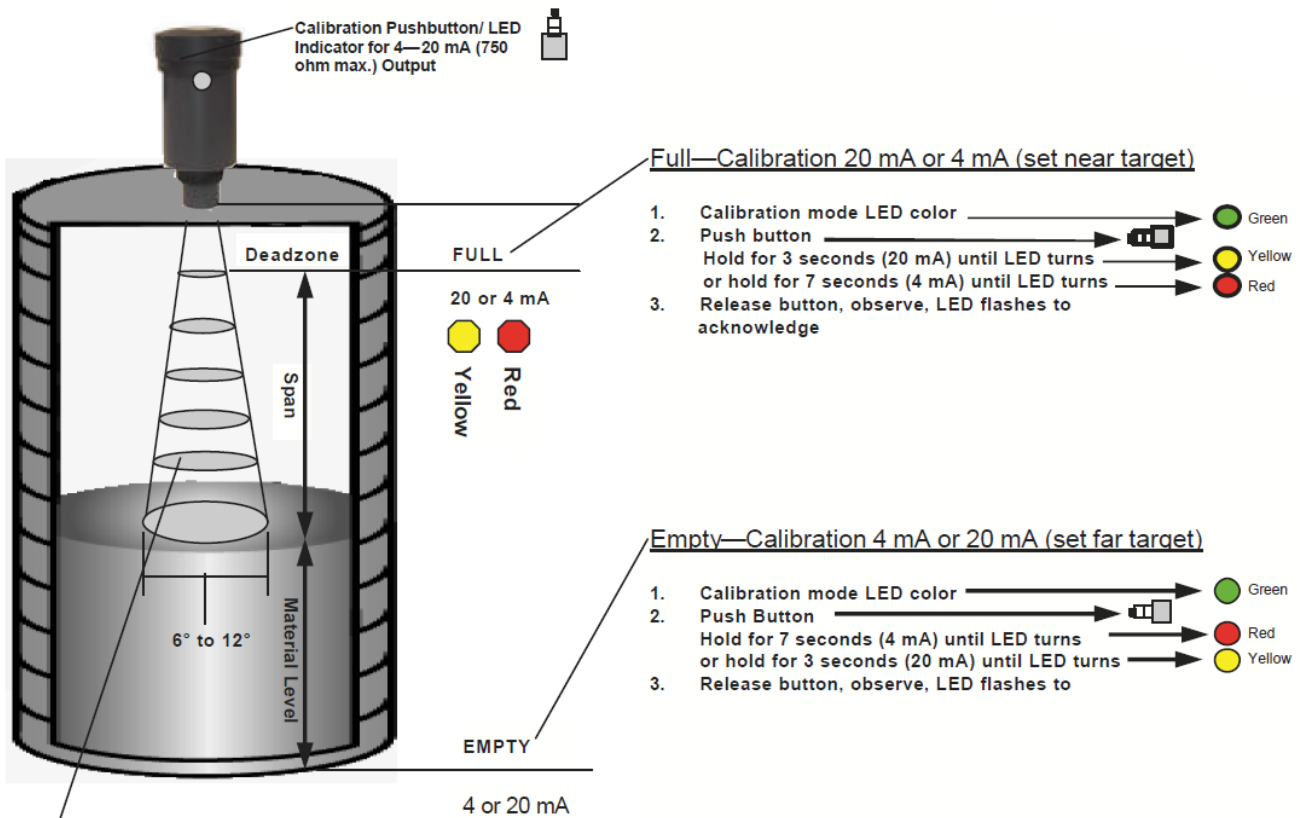-    2 Wire shielded 24 AWG, 300 V

## 6. CALIBRATION (4/20mA or 20/4mA Output)

All Babbitt Ultrasonics feature single push button calibration, allowing the user to manually calibrate the unit inside the tank or off a flat surface.  The Ultrasonic can also be calibrated using the factory provided software.  In addition, the factory software provides access to advanced features, settings and diagnostics.

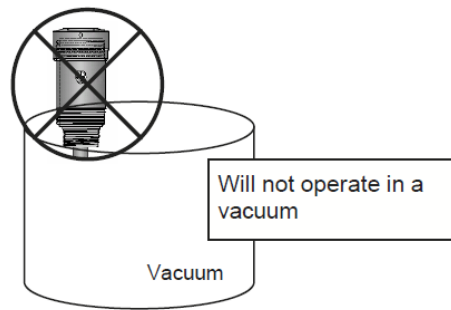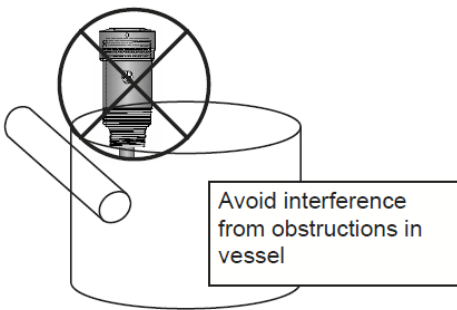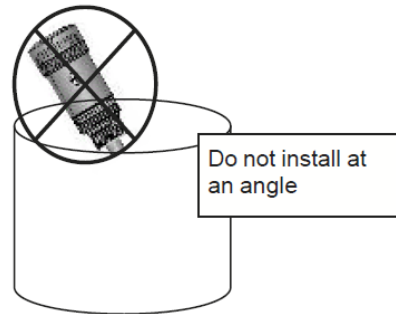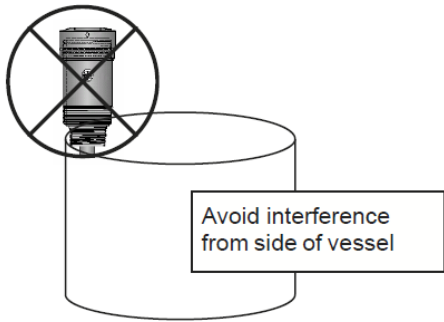NOTE: 3 & 4 Wire Units use a different software than 2 Wire Loop Power Units.

Software for each can be downloaded from the bottom of webpage:
https://www.babbittinternational.com/ultrasonic-level-transmitters.html

2 Wire HART Instruction Manual PDF can be downloaded from the bottom of webpage:
https://www.babbittinternational.com/ultrasonic-level-transmitters.html

Calibration Pushbutton/ LED Indicator for 4—20 mA (750 ohm max.) Output

Deadzone

FULL

20 or 4 mA

Yellow    Red

Span

6° to 12°

Material Level

EMPTY

4 or 20 mA

Full—Calibration 20 mA or 4 mA (set near target)

1. Calibration mode LED color ⟶ Green
2. Push button ⟶
   Hold for 3 seconds (20 mA) until LED turns ⟶ Yellow
   or hold for 7 seconds (4 mA) until LED turns ⟶ Red
3. Release button, observe, LED flashes to acknowledge

Empty—Calibration 4 mA or 20 mA (set far target)

1. Calibration mode LED color ⟶ Green
2. Push Button ⟶
   Hold for 7 seconds (4 mA) until LED turns ⟶ Red
   or hold for 3 seconds (20 mA) until LED turns ⟶ Yellow
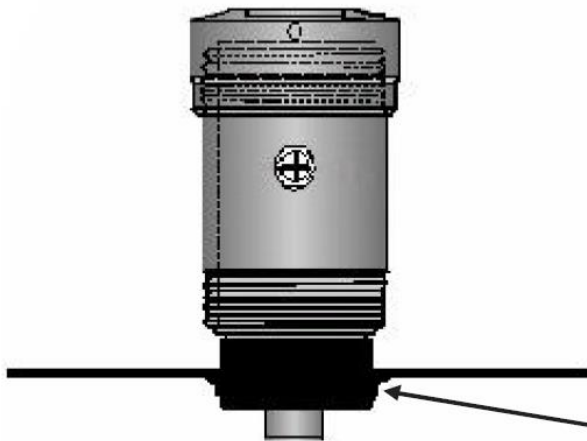3. Release button, observe, LED flashes to

Operation – An acoustic pulse is transmitter from the ultrasonic sensor face.  The pulse travels to the surface being monitored and is reflected off the surface back to the sensor face.  The round trip time of flight is divided by 2 and converted to an analog output signal directly proportional to the material level.

## 7.  POSITIONING

Avoid interference from side of vessel

Do not install at an angle

Avoid interference from obstructions in vessel

Will not operate in a vacuum

Vacuum

## 8. MOUNTING

Mounting:

Mounting of the Ultrasonic Transmitter is critical to the proper operation of the unit.  The unit can be directly mounted by simply threading the sensor directly into a metal or plastic mounting flange.  If an extended standpipe is used for mounting, please consult the factory for assistance.  The thread size of the unit is dependent upon the specific model (see specifications).

Threaded Mounting Flange (1", 1 1/2", 2", or 3" NPT)

The Ultrasonic should not be mounted in the center of a tank that has a domed top.  The domed top acts like a satellite dish and magnifies the first echo.  This echo becomes stronger than the first received echo, creating a false echo that the software locks onto.  This echo is typically twice the distance of the actual level.

Refer to Section 9 for proper mounting location.

If the unit must be mounted in the center of a domed top tank, a stilling well will need to be used.  Refer to section 10.

**WRONG**

**RIGHT**

— = First burst and received echo

— = A BAD MAGNIFIED ECHO FROM DOMED TOP.
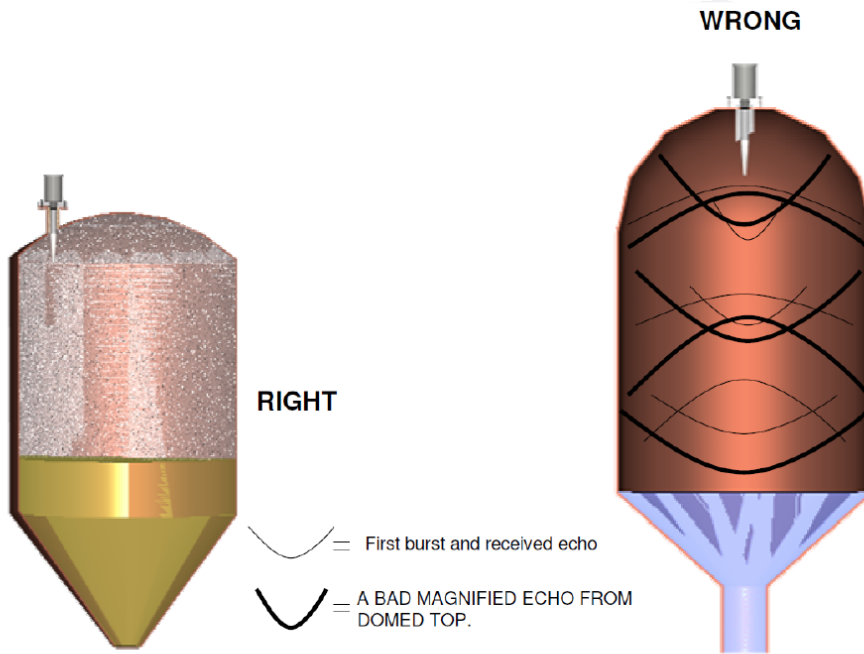
## 9. DISTANCE FROM TANK WALL
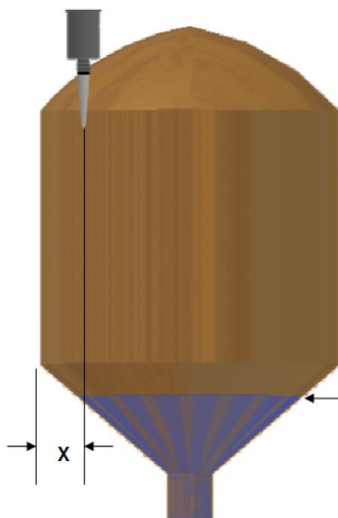
The distance from the wall after using the formula is the minimum distance allowable from the side wall based on the height of the tank.
To prevent the bouncing of the echo from the tapered bottom a **Minimum Level** can be set so there is a perpendicular reflection.

If it's not possible to have a minimum level in a tank then you can use the **Loss Of Echo** function found in the **TOOLS** menu.  Either set the Loss of Echo for 2 mA or 22 mA depending on the full tank calibration setting.

← **Minimum Level**

X

**Minimum distance to Wall can be calculated from the equation:**

X= tan (ALFA/2) x height

**Where: ALFA is a radiation beam angle**

For Ultrasonic: Tan(12/2) = 0.1

## 10. STAND PIPE AND STILLING WELL MOUNTING

NOTE: Depending on model, PIPE ON may need to be enabled in TOOLS section of software.

No termination required for pipes shorter than 6" and ID of Pipes must be greater than OD of the transducer nozzle

If a pipe is submerged in liquid, a vent hole is required

Plastic or Metal pipes with Smooth inside

Transducer nozzle can't have Physical Contact

45°

Remove sharp edges

•If pipe is longer than 6" a 45° cut is required
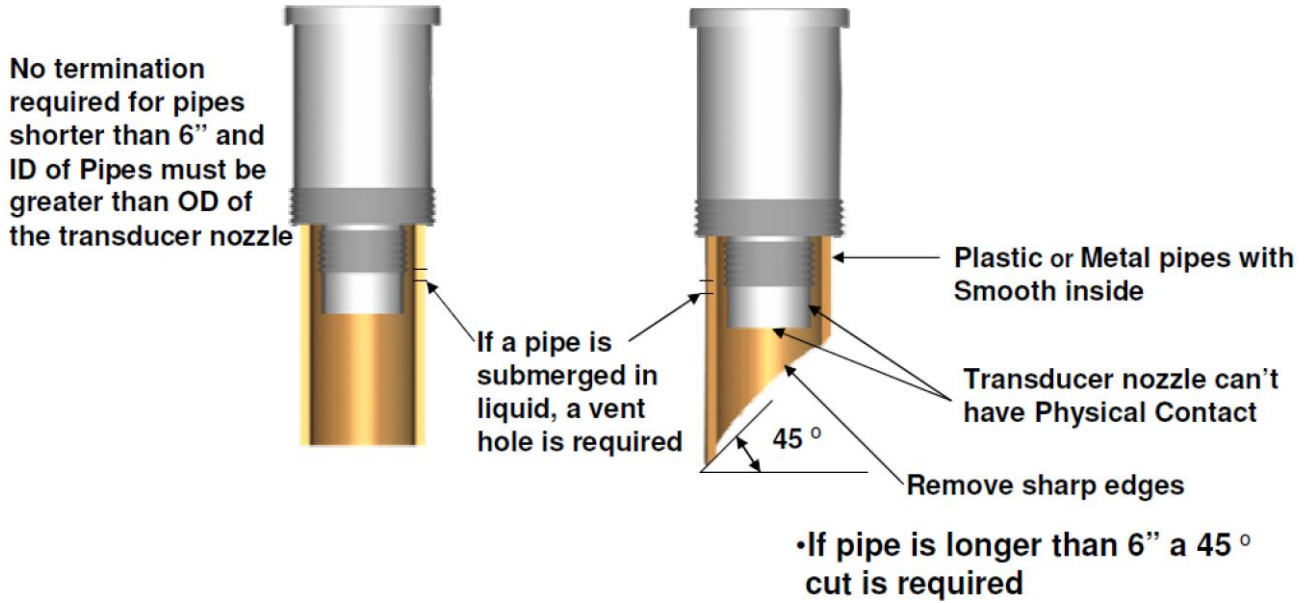
## 11. TECHNICAL SPECIFICATIONS

**3 & Wire Ultrasonic**
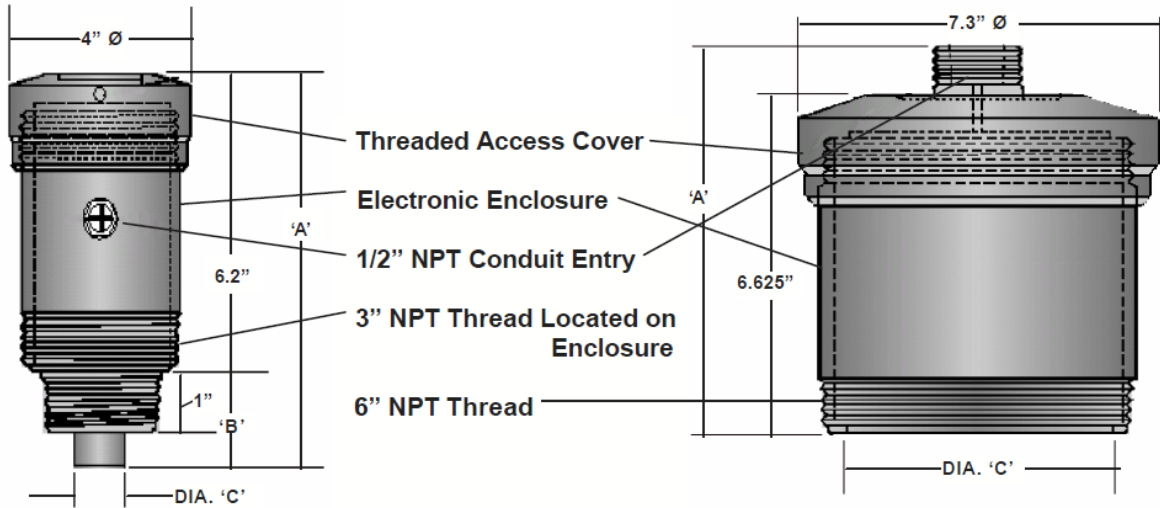


Models BAB300/400-45U,52U,70U,80U,81U,and 148U

Model BAB300/400-25U Only

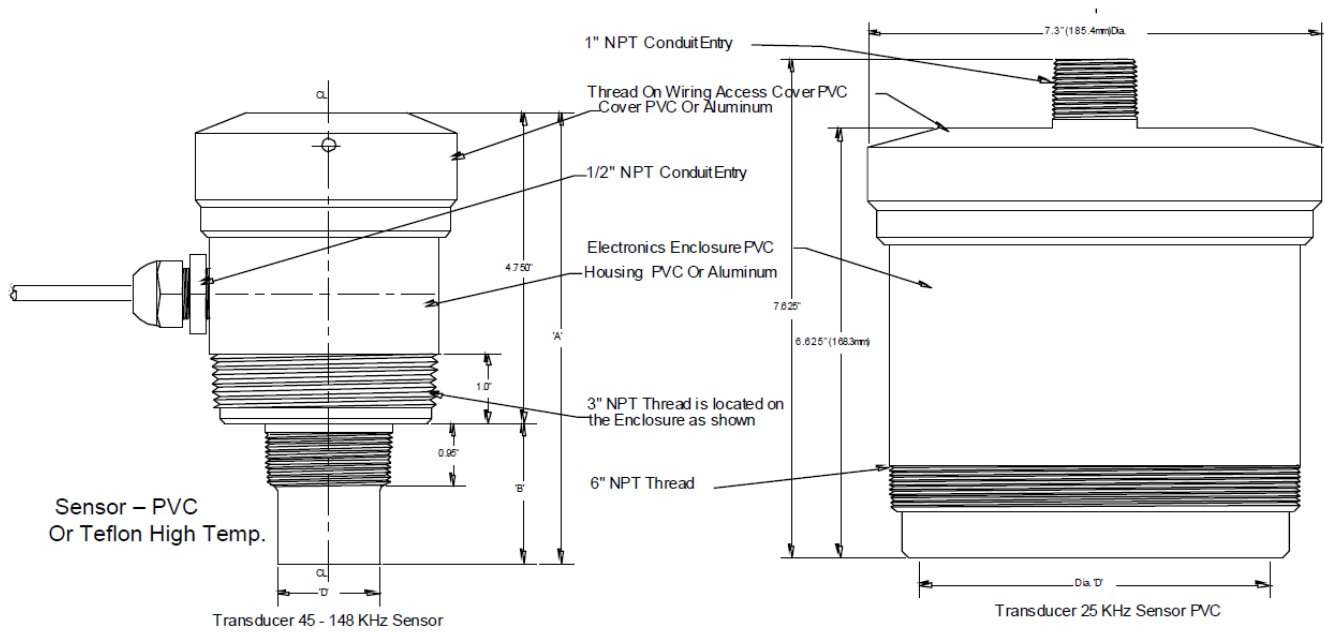| | MODEL | RANGE | RESOLUTION | OPERATING FREQUENCY | MOUNTING | DIMENSION 'A' | DIMENSION 'B' | DIMENSION 'C' |
|---|---|---|---|---|---|---|---|---|
| 110/230 VAC—4 Wire | BAB400-25U | 1.4-90 ft<br>0.40-27.4 m | 0.41"<br>10 mm | 25 KHz | 6.0"/1.0"<br>NPT | 7.625" | N/A | 5.75" |
| | BAB400-45U | 1.0—60 ft<br>0.30—18.2 m | 0.19"<br>5 mm | 45 KHz | 3.0"<br>NPT | 8.9" | 3.0" | 3.0" |
| | BAB400-52U | 0.9—50 ft<br>0.27—15.2 m | 0.16"<br>4 mm | 52 KHz | 3.0" or 2.0"<br>NPT | 9.3" | 3.05" | 2.2" |
| | BAB400-70U | 0.8—30 ft<br>0.24—9.1 m | 0.12"<br>3 mm | 70 KHz | 3.0" or 2.0"<br>NPT | 8.5" | 2.25" | 1.8" |
| | BAB400-80U | 0.7—20 ft<br>0.21—6.1 m | 0.08"<br>2 mm | 80 KHz | 3.0" or 2.0"<br>NPT | 8.5" | 2.25" | 1.8" |
| | BAB400-81U | 0.6—16 ft<br>0.18—4.9 m | 0.08"<br>2 mm | 81 KHz | 3.0" or 1.5"<br>NPT | 8.4" | 2.1" | 1.5" |
| | BAB400-148U | 0.4—9 ft<br>0.12—2.7 m | 0.04"<br>1 mm | 148 KHz | 3.0" or 1.0"<br>NPT | 8.25" | 2.0" | 1.1" |
| 12 to 30 VDC—3 Wire | BAB300-25U | 1.4-90 ft<br>0.40-27.4 m | 0.41"<br>10 mm | 25 KHz | 6.0"/1.0"<br>NPT | 7.625" | N/A | 5.75" |
| | BAB300-45U | 1.0—60 ft<br>0.30—18.2 m | 0.19"<br>5 mm | 45 KHz | 3.0"<br>NPT | 8.9" | 3.0" | 3.0" |
| | BAB300-52U | 0.9—50 ft<br>0.27—15.2 m | 0.19"<br>5 mm | 52 KHZ | 3.0"<br>NPT | 9.3" | 3.05" | 2.2" |
| | BAB300-70U | 0.8—30 ft<br>0.24—9.1 m | 0.12"<br>3 mm | 70 KHZ | 3.0" or 2.0"<br>NPT | 8.5" | 2.25" | 1.8" |
| | BAB300-80U | 0.7—20 ft<br>0.21—6.1 m | 0.08"<br>2 mm | 80 KHz | 3.0" or 2.0"<br>NPT | 8.5" | 2.25" | 1.8" |
| | BAB300-81U | 0.6—16 ft<br>0.18—4.9 m | 0.08"<br>2 mm | 81 KHz | 3.0" or 1.5"<br>NPT | 8.4" | 2.1" | 1.5" |
| | BAB300-148U | 0.4—9 ft<br>0.12—2.7 m | 0.04"<br>1 mm | 148 KHz | 3.0" or 1.0"<br>NPT | 8.25" | 2.0" | 1.1" |

## 2 Wire Ultrasonic



1" NPT Conduit Entry

Thread On Wiring Access Cover PVC
Cover PVC Or Aluminum

1/2" NPT Conduit Entry

Electronics Enclosure PVC
Housing PVC Or Aluminum

3" NPT Thread is located on
the Enclosure as shown

6" NPT Thread

7.3"(185.4mm)Dia.

7.625"

6.625"(168.3mm)

Dia. 'D'

Sensor – PVC
Or Teflon High Temp.

4.750"

1.0"

0.95"

'A'

'B'

'D'

Transducer 45 - 148 KHz Sensor

Transducer 25 KHz Sensor PVC

**Models BAB200-45U, 52U, 70U, 80U, 81U and 148U**          **Model BAB200-25U ONLY**

| Model # | Operating Range | Operating Frequency | Mounting Thread NPT | Dimension 'A' | Dimension 'B' | Dimension 'D' |
|---|---|---|---|---|---|---|
| BAB200-025UL | 90' (27.4m) | 25 KHz | 6"/1" | 7.625"(194mm) | N/A | 5.75"(146mm) |
| BAB200-045UL | 60' (18.2m) | 45 KHz | 3" | 7.75"(197mm) | 3.0"(76.2mm) | 3.0"(76.2mm) |
| BAB200-052UL | 50' (15.2m) | 52 KHz | 3"/2" | 7.8"(198mm) | 3.05"(77.5mm) | 2.2"(55.9mm) |
| BAB200-070UL | 30' (9.1m) | 70 KHz | 3"/2" | 7.0"(178mm) | 2.25"(57.2mm) | 1.8"(45.7mm) |
| BAB200-080UL | 20' (6.1m) | 80 KHz | 3"/2" | 7.0"(178mm) | 2.25"(57.2mm) | 1.8"(45.7mm) |
| BAB200-081UL | 16' (4.9m) | 81 KHz | 3"/1.5" | 6.85"(174mm) | 2.1"(53.3mm) | 1.5"(38.1mm) |
| BAB200-148UL | 9' (2.7m) | 148 KHz | 1" | 6.75"(172mm) | 2.0"(50.8mm) | 1.1"(27.9mm) |

Call one of the following numbers if you have installation or application questions.

| | |
|---|---|
| 1-800-835-8012 | 8:00 am – 5:00 pm CST |
| (713) 467-4438 | Voice |
| (713) 467-8736 | Fax |
| www.babbittinternational.com | |

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