



# Well Watch 660

## Sonic Water Level Meter



# User Manual

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# WELL WATCH 660 USER MANUAL

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## PRODUCT OVERVIEW

The Well Watch 660 is a simple to use self-contained acoustic ranging instrument designed specifically to find the distance through a closed pipe (well casing or sounding tube as small as 1/2") from one closed end to the to the other. The Well Watch works by sending a low frequency sound pulse into the pipe, then measuring the time it takes for the echo to return from the opposite end, which could be a plug or water surface. The distance is calculated using the sound speed and the time. The low frequency sound can follow the pipe around corners and in any direction up/down or horizontally. It can be used to measure any closed pipe, straight or crooked with a constant diameter.

The Well Watch 660 consists of a control unit and a probe which are connected by a latching hinge. The control unit contains the driver electronics, processor, display, and keypad, while the probe contains a speaker, a microphone and a threaded spout to connect to the test pipe.

When the unit powers, it immediately begins sending sound pulses into the well and attempts to characterize the well. After a few seconds, the depth is calculated and output for the user. The data will also be sent in a variety of formats through the several outputs provided.

The 660 is also available in an upgraded model, the Well Watch 670 which allows the data to be accessed through RS232, RS485, 4-20ma, and 0-5v analog outputs, as well as the internal RF transmitter. A 0-5vdc alarm output is also provided. This model also has an internal data logger with a realtime clock/calendar, memory for over 25 million data points, and a USB interface for data downloading.

Both models require 7-16vdc external power. A power adapter is supplied with the unit to supply the dc power from a standard ac power outlet, but a battery pack or solar panel could also be used.

Several accessories are available for the Well Watch units which can be found on our website at [www.enoscientific.com](http://www.enoscientific.com).

## QUICK START GUIDE

The Well Watch is nearly ready to go right out of the box. Follow the few steps below to find the depth to water. If depth to the water is all you are interested in, then this is all you need to read. To learn about the more advanced features continue reading the operation section of this manual.

1. **Attach spout to well.** Insert the probe end into the vent hole on the well. If the casing is open, it should be covered with anything solid such as rigid plastic with a hole in it for the probe. The cover does not need to be air tight, but the tighter it is, the stronger the signal will be.
2. **Turn meter on.** Apply power to turn the meter on. You should hear a popping sound coming from the probe.
3. **Measure well.** Read the measured depth on the display. If the measured distance is not as expected, then proceed to the next step to change the initial settings.
4. **Change initial settings.** Press the SET button repeatedly to show the various settings to be changed. Press the UP or DOWN button to change setting. When set as desired, press SET again to change another setting or press DISP to return to read the measured depth. For best depth results, the **range min**, **range max**, and the **well temperature** should all be set.
5. **Read other information.** While reading the depth display, press the UP or DOWN buttons to read other information.

We encourage you to read the frequently asked questions section. They really are frequently asked. Also, visit our website [www.enoscientific.com](http://www.enoscientific.com) for the latest manual and installation tips.

# CAUTIONS

## **The Well Watch is not water proof!**

It is weather resistant, rain and splashing but not submersion. The unit will be damaged if submerged under water. Caution must also be used if the water level in the well reaches the surface.

## **Both sides of the probe must be near atmospheric pressure!**

The probe cannot be used on a well which is significantly above or below atmospheric pressure. A vent port must be provided in these cases. Applying pressure to either side of the probe will damage the pulse generator.

## **External power cannot exceed 16 volts DC!**

When supplying external power to the Well Watch, care must be taken to insure that voltage spikes or induced transients are not conducted into the unit. Over voltage and surge protectors and proper grounding should be used if this is a possibility.

## **Use surge suppressors and grounding on signal lines!**

When connecting the Well Watch to remote equipment through the RS232 port or analog outputs, care is required to prevent ground loops, lightning induced transients etc from reaching the Well Watch. Over voltage and surge protectors and proper grounding should be used if this is a possibility.

## **FCC Warning Statement.**

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRE OPERATION.

NOTE: THE GRANTEE IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

## Industry Canada.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.



## BACKGROUND – HOW IT WORKS

The Well Watch works by pushing an air pressure wave or low frequency sound wave into the well. For this reason, it is important that the probe be connected to a closed end of the pipe to prevent the air pressure from just escaping the open end. After the Well Watch sends its sound pulse, it listens for the pulse to return. And since sound travels at a predictable rate, it can tell where in the well the pulse was reflected by timing the returning pulse.

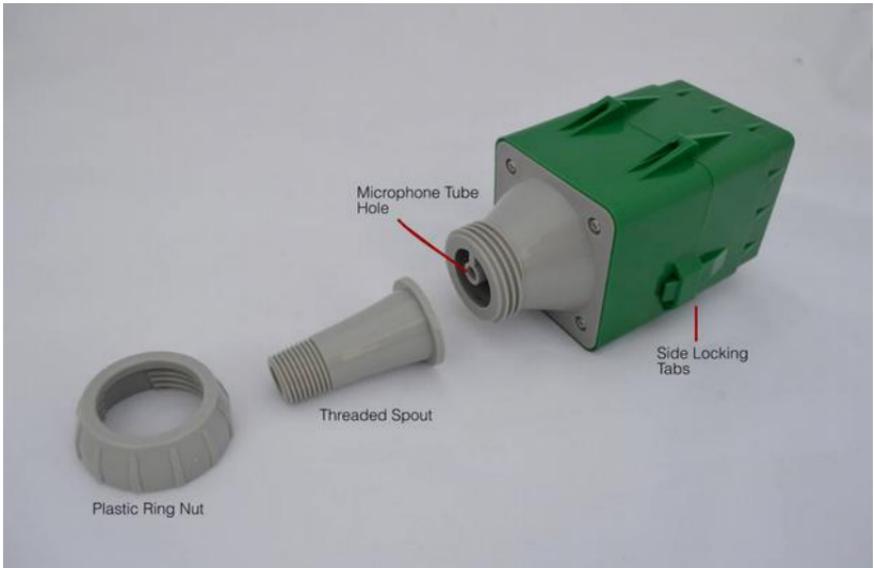
The pressure wave generated by the probe will continue to travel into the well until something disturbs it. Every imperfection in the well will disturb the wave, and every time it is disturbed, some of the wave changes direction and is reflected back to the Well Watch leaving the main wave a little weaker. A complete obstruction like the surface of the water, reflects the entire remaining wave. Most common obstructions like wires and tubes and pipe couplings do not reflect enough of the wave to cause a problem, provided that the remaining part of the main wave is relatively big enough to be obviously the one of interest.

Some imperfections like a change in casing diameter can cause a significant part of the wave to be reflected. Where the water may be very far away and its reflected pulse very weak, the reflection from the imperfection could be the largest wave returning to the Well Watch. In this case, the Well Watch would lock in on the erroneous reflection and tell you that the water was at the end of the casing. The Well Watch therefore offers settings to limit the range in which it will look for reflections. If for example the casing in your well ended at 40 feet and the water was around 80 feet, then the minimum range could be set to 60 feet so that the Well Watch would ignore any reflection from the casing.

The sound wave traveling through the well also loses energy as it travels, more as the surface of the well casing gets rough or porous. To compensate for this, the Well Watch increases its gain with time to listen for fainter signals. This can cause problems if the Well Watch listens for too long. The gain will get so high that the pump noise or even noise from outside the well will outweigh the desired pulse. Therefore, the maximum range setting is available to tell the Well Watch how long to listen. If for example the pump is mounted at 200 feet, then there is no reason to set any more than 250 ft as a maximum range.

The strength of the sound pulse generated by the probe depends on how much space it needs to fill. A 12" pipe is 4 times larger than a 6" pipe in volume and therefore the pulse will be 4 times smaller. A weaker pulse becomes more susceptible to pump noise and loss with depth. While the Well Watch is being used in wells up to 30", many of these installations do not get reliable results with running pumps etc. These wells usually require a sounding tube installed in the well which reaches into the water and provides a tight connection to the probe at the top. A 3/4" or 1" tube is adequate.

Something to keep in mind, especially for shallow wells, is that the sound wave bounces off the top and bottom of the well. So it is possible for the pulse to bounce back and forth many times. In a well where the water level is at 6 feet, the Well Watch would hear a reflection at 6 feet, then again at 12 feet, then 18 etc, until the pulse gets weak enough to ignore. In this example, you would be able to see the multiple reflections by increasing the min range. When set to 9ft, the depth would read 12. When set to 14ft, it would read 18 etc. In this case, it may be helpful to leave a small leak at the probe to help dissipate the pulse.

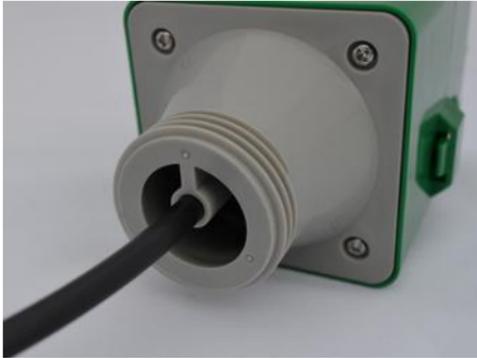


## SETUP

1 - Connect the spout to the well. 3 spouts are supplied with the well watch with standard male pipe threads 1/2", 3/4", and 1". The spouts are designed to be threaded into vent holes near the end of the well. It is not required that the spout be vertical or near the center of the well. It is also permissible to use adapter fittings to clear obstructions. Assemble the fittings from the well to the spout remembering to place the plastic ring nut on the spout before screwing it in place. The spout should not be more than hand tight.



2 - Press the microphone tube into the small hole where the spout attaches. The tube should be long enough to reach through all of the fittings and reach approximately 1" into the well cavity. The tube can be extended up to 6ft. The tubing is 1/4" OD PE and is available at most hardware stores if additional tubing is required.



3 - Slide the microphone tubing into the spout and connect the Well Watch to the spout with the plastic ring nut.



4 – Open the well watch to expose the electrical terminals by squeezing the locking tabs on the side of the unit.



5 – Attach 7-12 volt power to the PWR IN terminal with the positive on the PWR IN terminal and negative on the GND terminal. The included adapter cable provides a connector for the included AC power adapter. The adapter cable can be extended up to 500 ft using #24AWG wire. The adapter wire with the white stripe is positive.



7 – Route the wires opposite the hinge and close the unit so that the wires come through the opening.

8 – Protect unit to avoid damage and direct weather exposure. Accessory Well Watch caps are available on at [www.enoscientific.com/estore/](http://www.enoscientific.com/estore/)

## OPERATION

**POWER ON:** Apply power to start the Well Watch. The probe will pulsate and the LCD screen will display a product information screen for a few seconds then go to the default DISPLAY mode screen. The depth is displayed on the top line once the unit adjusts to the well and calculates a stable reading. While the unit adjusts to the well the display will read “DEPTH SEARCHING.”

*Note: If error conditions exist, line two of the display will be replaced by an alternating error message. See the ERROR CODES section for details.*

The Well Watch has two different operating modes, DISPLAY mode and SET modes. The DISPLAY modes are accessed by pressing the DISP button, and the SET modes are accessed by repeatedly pressing the SET button. The DISPLAY modes are used to show measurement data, and the SET modes are used to change operating parameters of the Well Watch.

There are several primary user SET modes which advance with each press of the SET button. A complete description of the SET modes can be found in the SET MODE section of this manual. While in any SET mode, pressing the DISP button will return to the default DISPLAY mode. Similarly when in a DISPLAY mode, pressing the SET button puts the Well Watch in the first SET mode.

**DEFAULT DISPLAY:** While the display shows depth on the top line, press the UP or DOWN button to scroll through additional information on the second line. The following information may be available depending on options installed and enabled:

1. Probe – temperature measured in the control unit.
2. Bat – measured voltage of the external power supply.
3. Diagnostic Data – information about the quality of the measurement.

**SET MODES:** Press the SET button while the depth is displayed to view and change any of the system settings. Continue to press SET to scroll through all of the settings. Sounding stops while in a SET mode. After 30 seconds of inactivity sounding will automatically resume or press the DISP button at any time to return to the depth reading instantly. While viewing a SET screen, press the UP or DOWN button to change the value. Rapid scrolling is activated by holding the up or down button for about a second. Scrolling gets faster and faster while the button is held down. When the value is as desired, press the SET button to go to the next setting or the DISP button to return to operation. The new settings are saved automatically as they are changed so there is no need to press ENTER.

The new settings will be remembered while power is maintained, but will be reset to factory defaults when the unit is turned off, unless the settings are saved. Press the SET button to find the Save Settings page. Press ENTER to permanently save the new settings.

There are 9 main system settings screens (SET MODES) as follow:

1. Product Info – displays model number, version and serial number.
2. Unit ID – user settable well ID number.
3. Range Min – sets the minimum range to detect.
4. Range Max – sets the maximum depth to be measured.
5. Well Temp – sets the well deep temperature.
6. Units – changes display units, decimal feet, feet & inches, or metric.
7. Contrast – adjusts the contrast level on the LCD screen
8. Save Settings – Press enter to save new settings after power off.
9. Factory Reset – Press enter to set all settings back to factory defaults.

## **DISPLAY MODE DESCRIPTIONS**

**DEPTH DISPLAY** – The default display mode after power-up. While this display is active, the unit is operational, sending pulses and timing the echoes. The depth is displayed on the top line and additional user selectable information is displayed on the second line. The depth is displayed as “searching” when the unit is turned on and adjusting to the well. Once the signal is locked and stable, the depth is displayed in the units selected. Occasionally a spurious depth reading will be calculated due to random noise in the well. Software in the Well Watch identifies the anomaly and holds the last good data through a few bad data points while a good depth is obtained. An asterisk is displayed before the depth while holding. If a stable depth is not found in several tries, the depth is replaced with “searching” until one can be found.

Data displayed on the second line can be changed by pressing the UP or DOWN arrow. Data available varies depending on options enabled on each unit. If there are any error conditions, such as when the probe is not on the well, or when the battery low, an error message will alternately be displayed on the second line.

**PROBE TEMP**– displays the temperature measured in the controller unit.

**BAT** – displays the measured voltage of the external power supply. The Well Watch maintains calibration down to 6.5 volts. An alarm message is displayed when the voltage drops below 6.5 volts. The unit will continue to operate, but with reduced signal strength down to about 5.5 volts.

**DIAGNOSTIC DISPLAY** – This display provides diagnostic data for each pulse for technical support. While on this display page, press the ENTER key to set the pulse width. It will be displayed as PW=nnn in the lower right corner, where nnn is the pulse width ranging from 0 to 100. Lower numbers are shorter (higher frequency) pulses which are more directional and more sensitive to imperfections in the well, but tend to work better in larger diameter wells (larger than 6"). Higher numbers (lower frequency) pulses work better following irregular wells and getting past partial obstructions.

## **SET MODE DESCRIPTIONS**

**PRODUCT INFO** – displays the product type, configuration and the software version number. The unit serial number is displayed by pressing the UP or DOWN button.

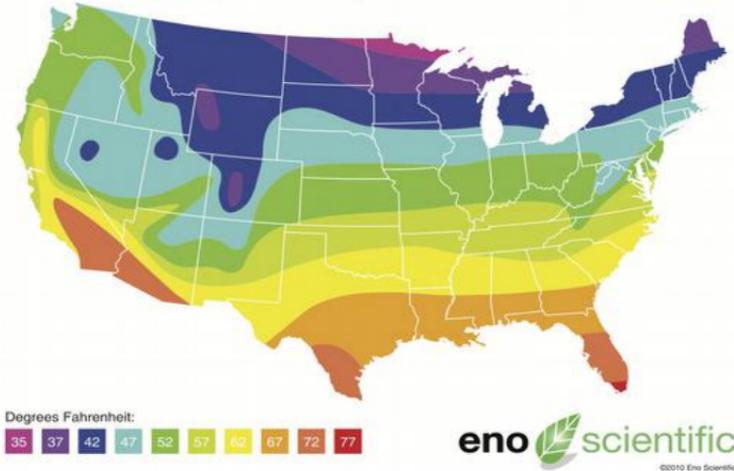
**UNIT ID** – sets a user selectable ID number in the range 0-255 to identify the source of logged data. Set the unit ID number by pressing the UP or DOWN button.

**RANGE MIN** – sets the minimum distance to start detecting in feet (M). This is used where there may be a known defect in the well such as a step down in bore diameter. This kind of defect will reflect some of the pulse which could compete with the desired reflection from the water surface. If for example this transition occurred at 42 feet, then set the range min to 45 feet or more.

**RANGE MAX**– sets the maximum distance in feet (M) the Well Watch will listen for a returning pulse. A shorter range means more frequent pulses and faster updates. A longer range gives less frequent updates and increases the possibility of collection spurious noise.

**WELL TEMP** – sets the deep temperature in the well. If you do not know the well temperature, reference the Water Temperature chart included with your unit. The temperature near the surface is automatically sensed by the probe. These two temperatures are used to calculate the sound speed and in turn, the distance. The distance error is fairly small for variations in temperature, about 1% for a 10 °F (5.6 °C) temperature error.

Groundwater Temperature Map



**UNITS** – selects the measurement system for the data. Press the UP or DOWN button to scroll through the options: English for decimal feet, degrees Fahrenheit and gallons; English ft-in for distance displayed as feet and inches; Metric for meters, degrees Celsius, and liters, or Imperial for feet, degrees Fahrenheit and imperial gallons.

**CONTRAST** - sets the contrast level on the LCD screen from 0 (brightest) to 20 (dimnest).

**SAVE SETTINGS** – settings changed on the set screens will remain until the power is turned off, unless they are saved. Press ENTER on this screen to make the current settings the power on defaults.

**FACTORY RESET** – allows the user return the unit to the factory default configuration. Press the ENTER button to make the selection. All user settings will be set to the Factory default values.

## **MAINTENANCE**

There are no user serviceable components in the Well Watch.

## **FREQUENTLY ASKED QUESTIONS**

**Q:** Can I use the Well Watch on an open well?

**A:** The Well Watch was designed to work on a closed well. A simple piece of rigid card board or plastic held tight against the opening is enough to meet this requirement. In many cases it will work on the open well but may be off by a couple feet.

**Q:** Does the Well Watch work on wells with the pump installed?

**A:** Yes. The sound pulse used for measuring is not disturbed by the presence on pump wiring or piping.

**Q:** What if there are guard rings or torque arresters on the pump line?

**A:** The Well Watch will read past most guard rings and torque arresters with little signal attenuation. Some torque arresters may block more than 90% of the well opening and may cause problems.

**Q:** Will the Well Watch work with the pump running?

**A:** Generally, yes. If however the pump is exceptionally noisy and or the water level is near or below the pump, it is possible that the noise from the pump could interfere with the depth measurement.

**Q:** Does the Well Watch work on larger diameter wells?

**A:** The Well Watch, with the standard probe, works on wells up to 18" in diameter. However, as the well diameter increases, the signal strength weakens and becomes more susceptible to pump noise and imperfections in the well. It is recommended that on wells larger than 8" that a sounding tube be used.

**Q:** How deep will the Well Watch measure?

**A:** The maximum range is 2000 feet. This may not be achievable on all wells however. On a good 6" well with tight clean casing all the way down to the water and little or no

obstructions along the way, maximum range can be achieved. On uncased wells drilled through porous stone or with irregular walls, or any obstructions such as spacer rings or couplings the range will be reduced.

Q: Does the Well Watch work in wells with perforated casing?

A: If the perforations are exposed (above the water line) and the exterior of the casing is very porous like crushed stone, then the perforations will dampen the sound pulse and there will be no reflection for the Well Watch to detect. In this case, the Well Watch will track the descending water level until it gets to the perforations and then stick at the start of the exposed perforations as the water level continues to descend.

Q: Does the Well Watch work in crooked wells?

A: Yes. The sound pulse used to measure the depth will even go around corners and obstructions which block less than 90% of the well opening.

Q: What if the well contains a constant pressure pump system with the accumulator tank in the well?

A: The in well accumulators tend to block the well shaft entirely. If this is the case then the Well Watch will be unable to find the distance to the water past the accumulator.

Q: Can the Well Watch measure past a pit-less adapter?

A: Yes. The common side mount pit-less adapter typically does not block a significant portion of the well opening and will not interfere with the depth sensing. Some pit-less adapters, however, are recessed into the well and do block most of the opening. These installations may be more difficult. There are two ways to handle these cases: The probe spout can be extended into the well and seated on the access hole through the pit-less adapter. When this is done, the microphone tube must also be extended to reach into the well cavity.

Q: Can the Well Watch be used on hand dug wells?

A: Hand dug wells are often fairly large and irregular, and as such may cause problems for the Well Watch due to multiple or weak reflections. Some work and some do not. However, in any difficult to measure well, a small tube can be installed specifically for measurement. A 3/4" PE pipe can be used for up to 1000' provided splicers do not restrict the ID.

Q: Can I use the Well Watch to measure the water level in a tank?

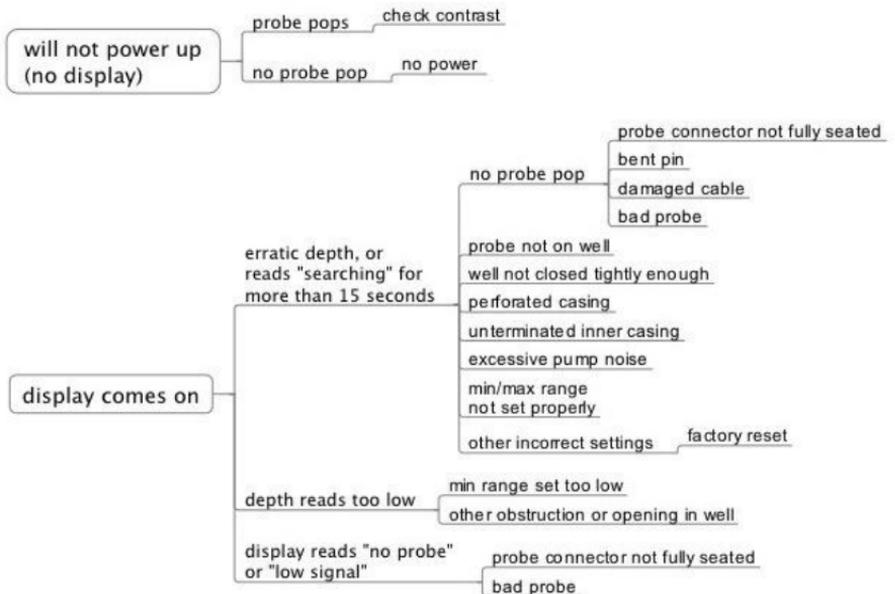
A: There are three issues here. First, the Well Watch is designed to be used in a constant diameter pipe. Tank measurement is generally into a large opening which would create multiple reflections and hence an uncertain reading. Second, the minimum measurement distance is about 15 feet, so unless the sounder is mounted at

least 15 feet from the maximum water level, it would not be useful. And third, the sensing probe is not designed for use with any pressure. Both sides of the probe must be maintained at atmosphere. This being said, it is possible to install the sounder on a sensing tube above the tank extending 15 feet above the maximum water level and down to the lowest level to be measured.

Q: My sounding tube is 3/4" PVC schd 80 with threaded couplings every 20ft. The Well Watch reads the depth at 20'. Why?

A: The pocket created at each joint is significant compared to the inside diameter of the PVC pipe, and therefore causes the pulse to reflect at each coupling. You will notice that if the min range is increased to 25ft, the depth will jump to 40ft. And when increased to 45ft, the depth will jump to 60ft etc. In many cases, after the the pulse has passed the nearby stronger reflections, the stronger reflection from the water will dominate and the depth will jump up to the water level.

## TROUBLESHOOTING



# SPECIFICATIONS

## POWER:

External Power (optional): 6.5 to 12VDC at 80ma max. Do not exceed 16V. Screw terminals and adapter with 5.5mm x 2.1mm center post positive connector.

## MEASUREMENT:

Units: Selectable English(ft, gal, °F), Metric(M, L, °C), Imperial(ft, Imp gal, °F)

Resolution: .05 ft

Accuracy: .1 ft (see notes)

Range: 15 to 4000 feet. (see notes)

## ENVIRONMENTAL:

Temperature: -10 to 110 F

Humidity: 10 to 90% non-condensing.

## PHYSICAL:

Dimensions: 3.5x3.5x6" exclusive of the removable spout

Unit Weight: ~16 oz.

## FEATURES:

Display: 2x16 character LCD

RF Wireless Port: Proprietary for communication with the Eno Scientific remote display.

## ADDITIONAL NOTES

The specified accuracy is achieved provided certain conditions are met. Since the distance calculation is determined by timing the returned echo, it is important that a free path is available for the pulse to travel to the water surface and return. It is possible that an obstruction such as torque arrester or centering ring on a pump pipe can cause a premature echo or distort the pulse causing the effective pulse to shift one way or the other. It is also possible that a breakout or large fracture opening can also cause a false echo. Ordinary pump piping and wiring will not interfere with the measurements.

The accuracy is also dependent on the sound speed in the well. Since the sound speed is determined by the temperature, the average temperature must be specified correctly. The error is approximately .1%/°F.

The maximum range is limited by the maximum time during which the echo is monitored, and the strength of the echo signal. Uncased wells drilled through porous material can attenuate the signal faster than the rated distance, making detection impossible.

## WARRANTY AND SERVICE

Eno Scientific warrants to the user that all products manufactured by Eno Scientific, will be free from defects in workmanship and materials for 1 year from the date of shipment.

Eno Scientific warrants to repair or replace any such defective equipment or part (determined to our satisfaction to have a defect in workmanship or original material) upon receipt and inspection of such defective equipment to Eno Scientific with all shipping pre paid by the user.

In no event shall Eno Scientific be liable for any direct, indirect or consequential damages, abuse, acts of third parties (rental equipment), environmental conditions or other expenses which may arise in connection with such defective equipment. This warranty shall not apply to damage of equipment caused by incorrect installation, usage, lightning, storage, alteration or inadequate care.

This warranty does not apply to parts, assemblies or devices not manufactured by Eno Scientific which are covered by other manufacturers' warranties. There are no warranties except as specifically provided in writing herein.

Contact Eno Scientific with any warranty or service questions.

For additional information, please visit our website at [www.enoscientific.com](http://www.enoscientific.com).



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