***Important!!! Config Depth sensors for 0-5V output for use with the U30 because this app note scales for 0-5V.

Using the Judd Communications Depth Sensor with the HOBO® U30 Station

This application note describes how to connect and operate the Judd Communications Depth Sensor with the HOBO U30 Station. The Judd Depth Sensor is compatible with any U30 configuration (GSM, Ethernet, or WiFi) that is equipped with the optional two-channel analog input module. It is suggested that a 6-watt solar panel be used to ensure that the battery is kept charged properly. As with any sensor that is connected to the HOBO U30 Station optional analog ports, HOBOware® Pro software should be used to properly scale the analog input. This ensures that both the raw data (the .dtf file) and the data displayed in HOBOlink® represent the data the same way.

Note: Because of the significant load that the Judd device draws from the U30 excitation circuit, any additional analog input device that may be connected to the remaining analog input port will require an independent power source.

Portions of the Judd Technical Manual are used within this application note, but the full manual is available at http://juddcom.com/storage/ds2manual.pdf and should be read and understood before attempting to use this device with the U30 Station. The Judd Depth Sensor is available in both 0-2.5VDC or 0-5VDC analog output configurations. This instruction is based on the 0-5VDC output configuration. In most cases the 0-5VDC version will provide the best accuracy and resolution.

Judd Communications Depth Sensor

SPECIFICATIONS

Power: +12 to 18 VDC, 50 mA
(maximum sample time 2.6 seconds)

Output: 0 to 2.5 or 0 to 5 VDC

Range: .5 to 10 meters (1.6 to 32.8 feet)

Beam width: 22 degrees

Accuracy: ± 1 cm or .4 % distance to target

Resolution: 3 mm (.12 inches)

Temp. range: -40° to + 70°C (-40° to 158°F)

Size: 8 x 8 x 13 cm (3 x 3 x 5 inches)

Weight: .6 kg (1.3 lbs.)

Mounting: 1/2 inch threaded pipe

Cable length: 7.6 meters (25 feet)

Max. cable length: 304 meters (1000 feet)

Temperature Sensor Accuracy: ± .5°C, -40 to +85°C

Temperature Sensor Resolution: .5°C

INTRODUCTION

The Judd Communications Depth Sensor is an inexpensive solution for remotely measuring snow depth or water levels. The sensor measures the distance from the sensor to a target. The sensor works by measuring the time required for an ultrasonic pulse to travel to and from a target surface. An integrated temperature probe with solar radiation shield, provides an air temperature measurement for properly compensating the distance measured. An embedded microcontroller calculates a temperature compensated distance and performs error checking.

Both distance and air temperature can be output as an analog signal between 0 to 2.5 Volts or 0 to 5 Volts. The depth sensor is user configurable by means of internal dip switches. Several configurations are possible and allow the depth sensor to work with as many different type of systems as possible.

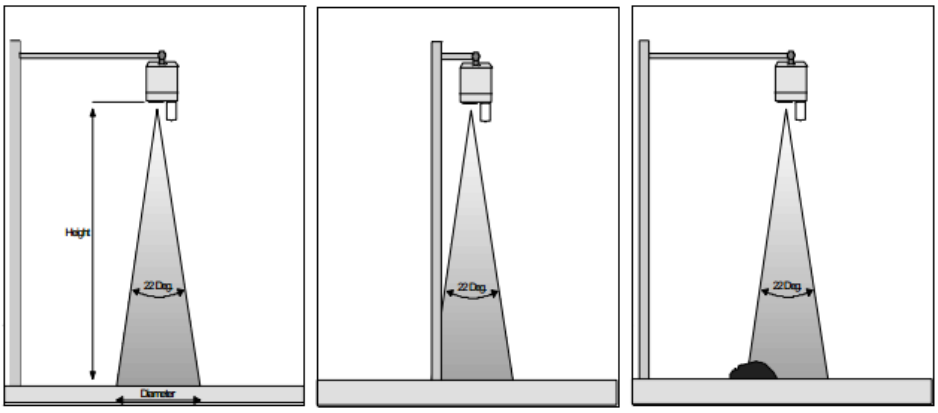
Accurate measurement of snow depth poses many difficult problems. The Judd Communications Depth Sensor has proven very effective in measuring snow depth, which makes it well suited for other various applications.

INSTALLATION

When mounting the sensor pay careful attention to the cone of the ultrasonic beam. The beam width is 22 degrees which means that the diameter of the beam will be 39% of the distance to the target, as shown in Figure 1. This means that after traveling 10 meters the beam diameter will be 3.9 meters. In this example the sensor would need to be mounted at least half the distance of the beam diameter, or 1.95 meters, away from the mast. Be careful to avoid obstructed beam paths.

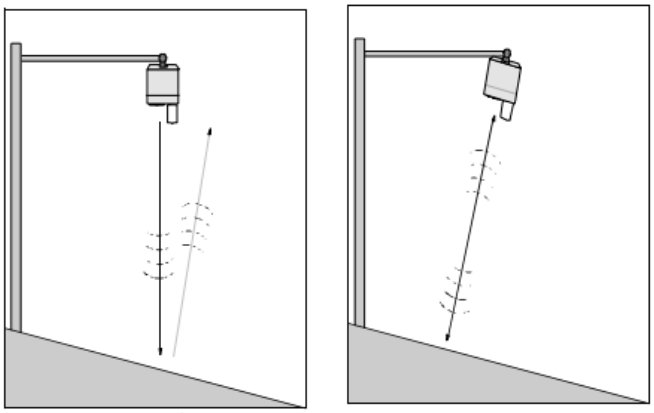
To determine the minimum distance the sensor must be mounted away from the mast use this formula:
Crossarm length = .194 x Height

Depth Sensor Beam Width Examples



Correct, unobstructed path | Incorrect, mast in beam | Incorrect, obstruction in beam

Perpendicular to Surface

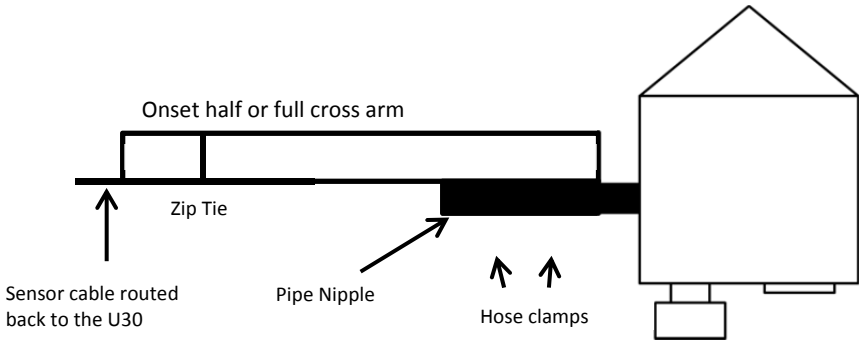


Wrong! | Right

The JC Depth Sensor must be mounted perpendicular to the target surface. Mounting the sensor at an angle will result in erratic and unreliable measurements.

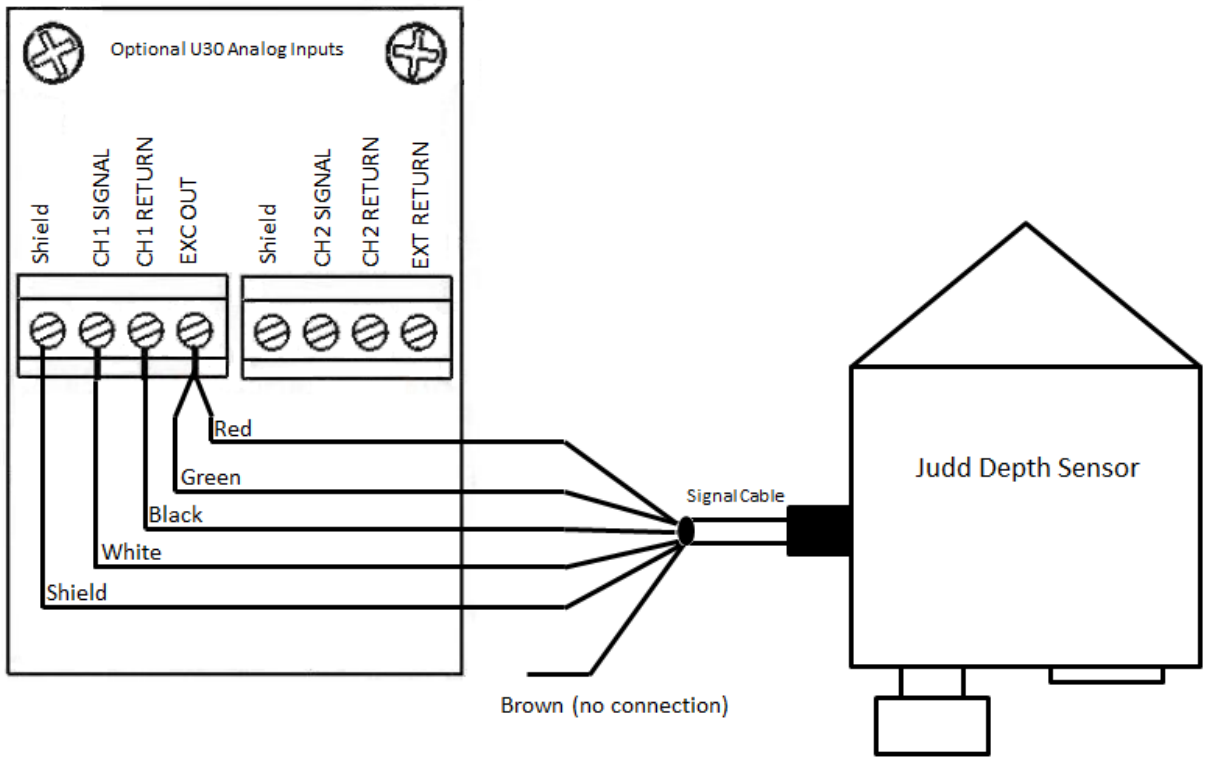
Care should be taken to minimize the distance between the sensor and the snow surface to reduce error caused by temperature stratification through the column of air. The optimal sensor height is the maximum snow depth plus 1.6 feet. For example, if the maximum snow depth expected is 3 feet, then the sensor should be mounted at 3 feet +1.6 feet, or 5 feet (rounding to the closest foot).

The Judd Depth Sensor comes with a 1/2-inch NPT female pipe fitting for mounting and cable egress. Attaching a 4-inch or longer PVC threaded pipe nipple to this pipe fitting allows you to mount the sensor to a horizontal member, such as the Onset half or full cross-arm via the use of two #36 (1 13/16 - 2 3/4 inch) stainless steel hose clamps (not included). Electrician's putty or silicone sealant should be used to seal the end of the nipple where the cable exits to prevent water/snow ingress.



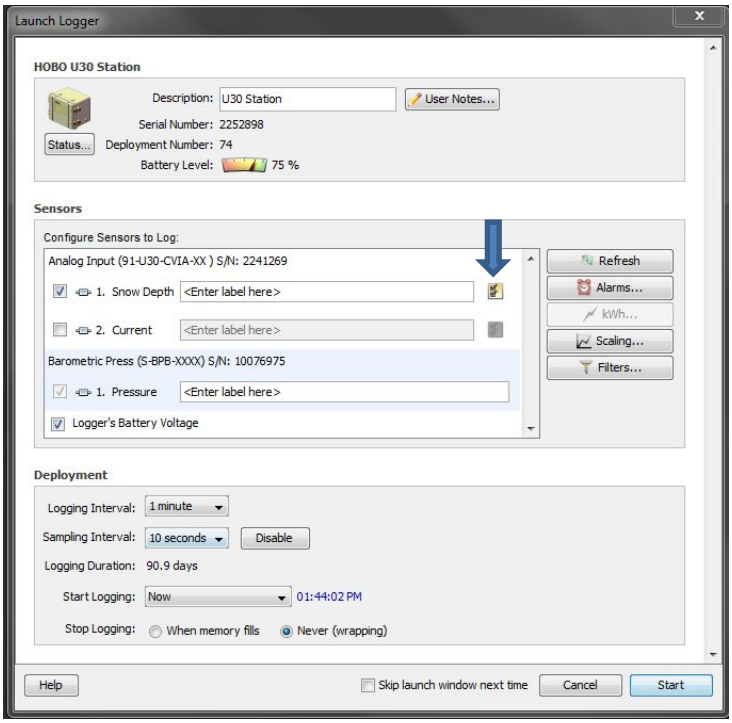
Be sure that the sensor is mounted plumb and level. For more information on mounting, refer to the Judd Depth Sensor manual at http://juddcom.com/storage/ds2manual.pdf.

Wiring to the U30 Station

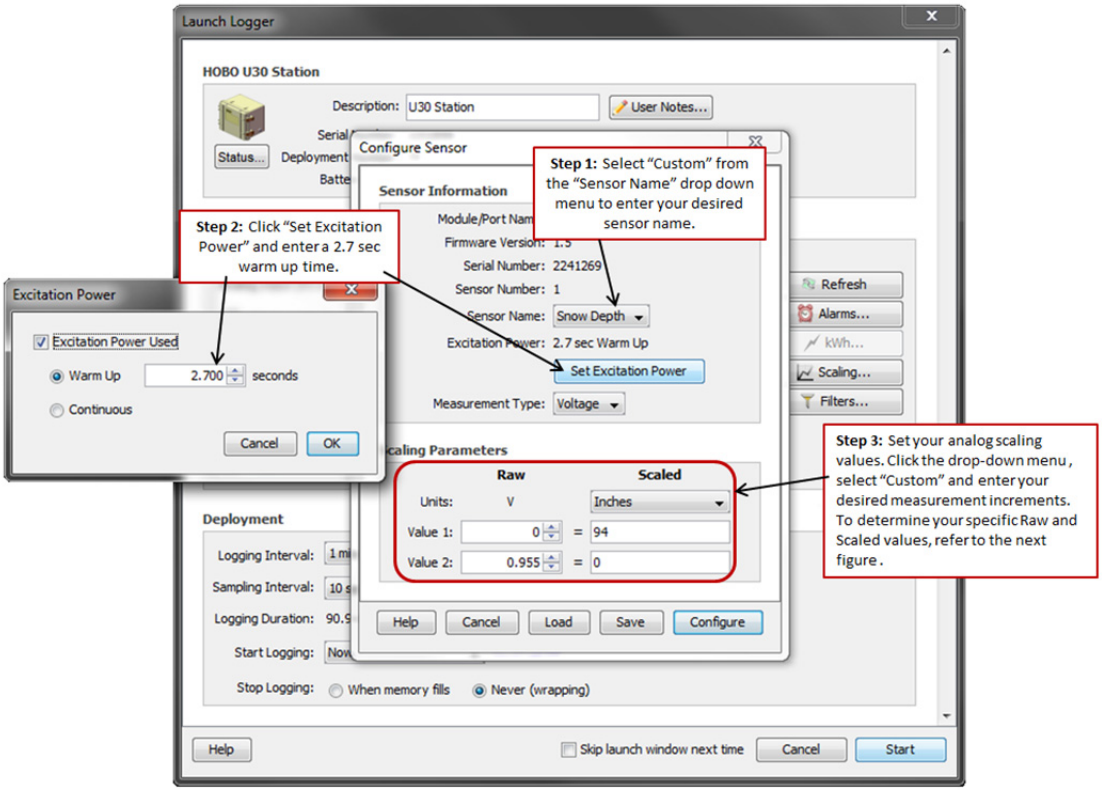


Configuring the U30 Station with HOBOware

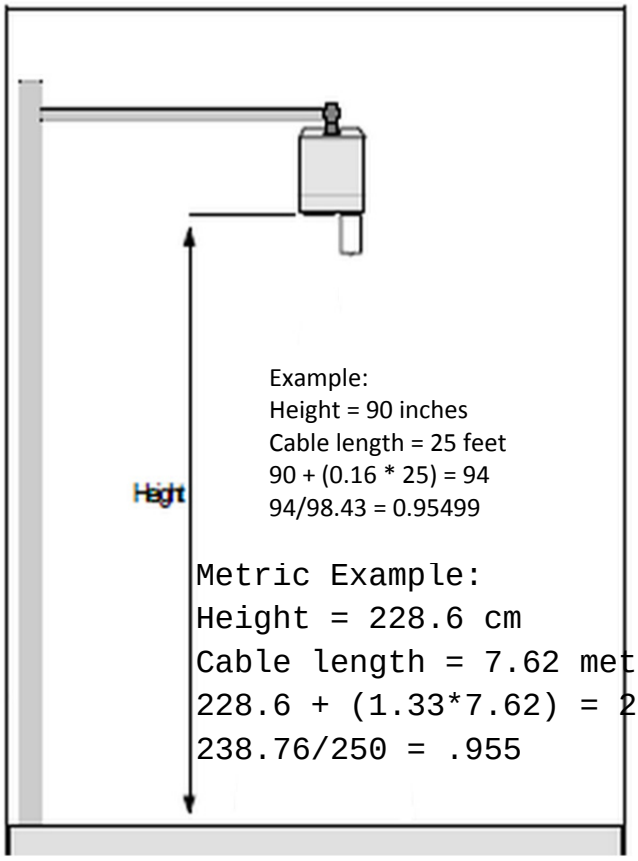
With the U30 connected to your computer via the USB port, select Launch from the Device menu, and then click the button pointed out below to configure the analog port. An alternative method is to select Configure Modules/Ports from the Device menu, then select the sensor and click Configure. **Note:** When setting up the launch configuration for the U30, be sure to select a logging interval 10 minutes or slower to maximize battery life. Logging intervals faster than 10 minutes can significantly impact battery life.



Complete the following steps:



Scaling Calculation



Example:
Height = 90 inches
Cable length = 25 feet
90 + (0.16 * 25) = 94
94/98.43 = 0.95499

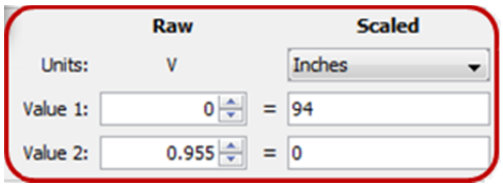
Metric Example:
Height = 228.6 cm
Cable length = 7.62 meters
228.6 + (1.33*7.62) = 238.76
238.76/250 = .955

Height (inches) + 0.16(L)* = Scaled Value 1

*L = length of signal cable in feet

$$\frac{\text{Scaled Value 1}}{98.43} = \text{Raw Value}$$

Enter the calculated values in the Scaling Parameters section of the Configure Sensor window as shown here:

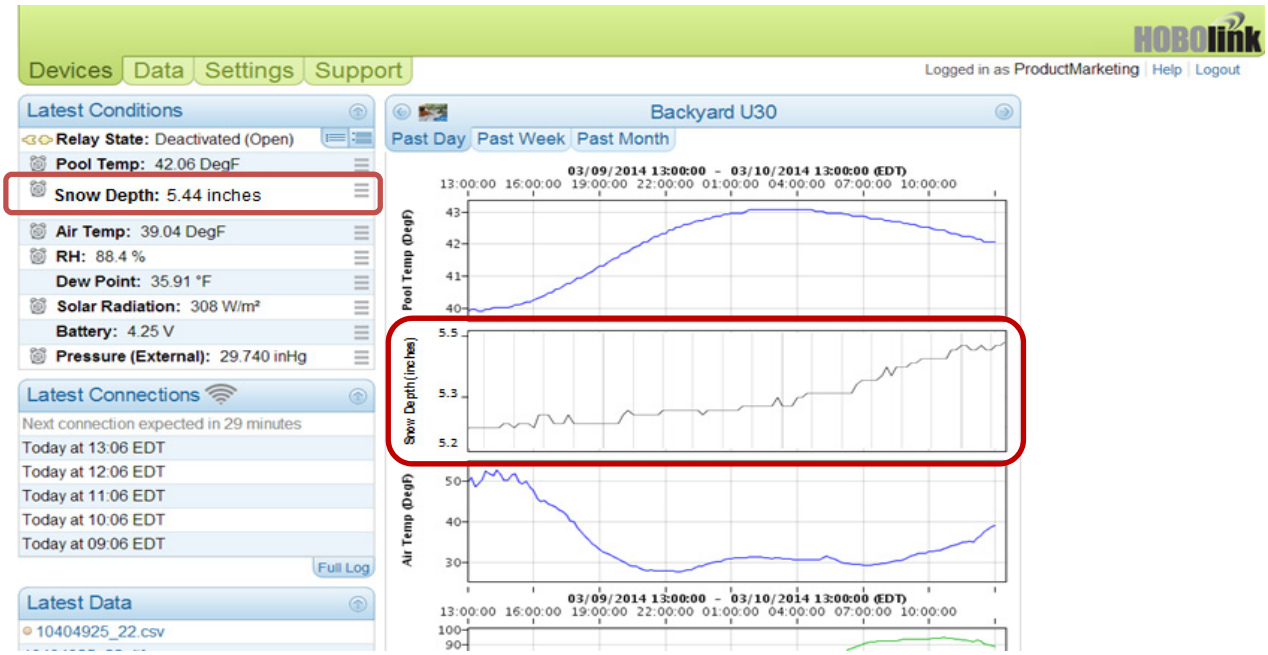


cm
228.6
0

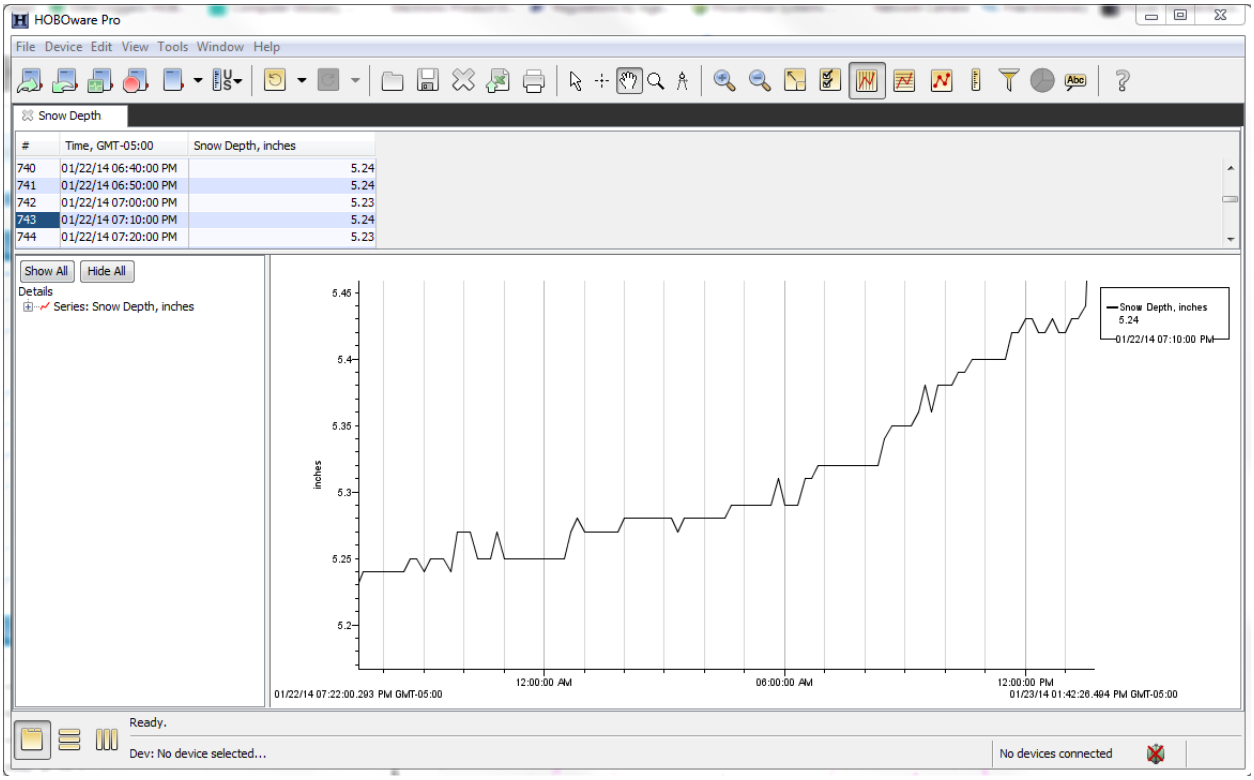
Note that the raw voltage values are the same for imperial or metric. For metric change the unit to cm and value 1 to sensor height.

When done configuring your sensor, click the Configure button at the bottom of the Conifgure Sensor window. Click Start at the bottom of the Launch Logger window if applicable.

Sample HOBOlink data



Sample HOBOware Data



Troubleshooting

When installed correctly and operated within its limitations, the Judd Depth Sensor can provide accurate and reliable distance measurements. The following are the most likely causes of erroneous measurements:

- The sensor is not perpendicular to the target surface.
- The target is small and reflects little sound.
- The target surface is rough and uneven.
- The target surface is a poor reflector of sound, such as low density snow (<5%).
- The transducer is obstructed by ice or debris.
- Strong winds are blowing the echo out from under the sensor.
- The sensor is too close to the target. The minimum distance to the target needs to be kept greater than 1.6 feet (0.5 m).

For more information on this sensor, contact Onset at 1-800-LOGGERS (1-800-564-4377) or loggerhelp@onsetcomp.com. You can also contact Judd Communications at 1-801-424-2889.