

Using the Judd Communications Depth Sensor with the HOBO® RX3000 Station

This application note describes how to connect and operate the Judd Communications Depth Sensor with the HOBO RX3000 station. The Judd Depth Sensor is compatible with any RX3000 configuration (cellular, Ethernet, or Wi-Fi) that is equipped with the optional four-channel analog input module. It is suggested that a 6-watt solar panel be used to ensure that the battery is kept charged properly.

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 RX3000 station. The Judd Depth Sensor is available in both 0-2.5VDC or 0-5VDC analog output configurations.

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: $\pm .5^\circ\text{C}$, -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.

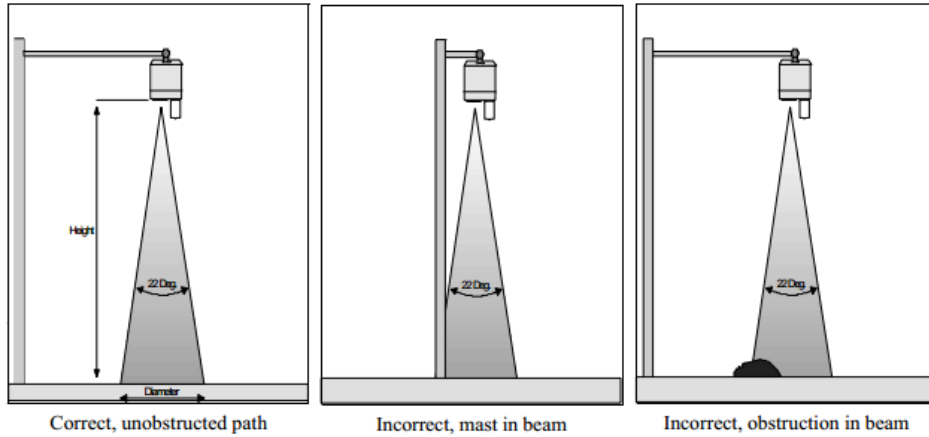
Accurate measurement of snow depth poses many difficult problems. The Judd Communications Depth Sensor has proven very effective in measuring snow depth, which makes it well suited for other various applications.

INSTALLATION

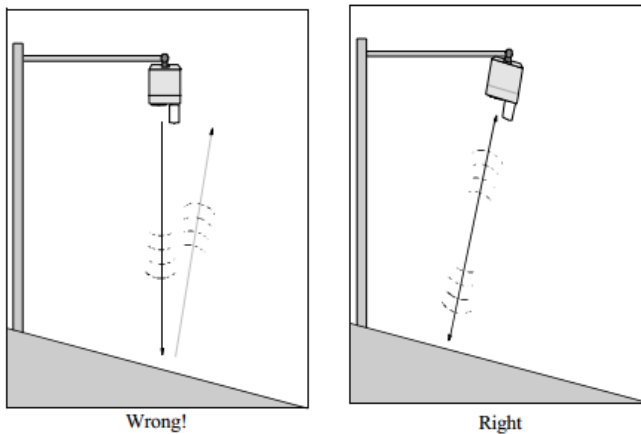
When mounting the sensor pay careful attention to the cone of the ultrasonic beam. The beam width is 22 degrees which means that the diameter of the beam will be 39% of the distance to the target, as shown in Figure 1. This means that after traveling 10 meters the beam diameter will be 3.9 meters. In 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 = $.194 \times \text{Height}$

Depth Sensor Beam Width Examples



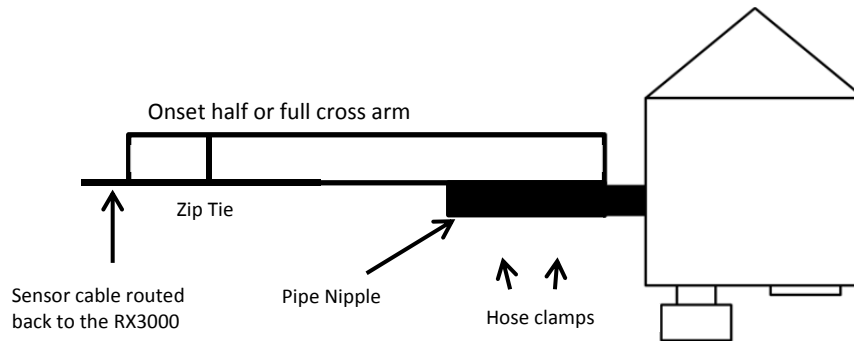
Perpendicular to Surface



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.

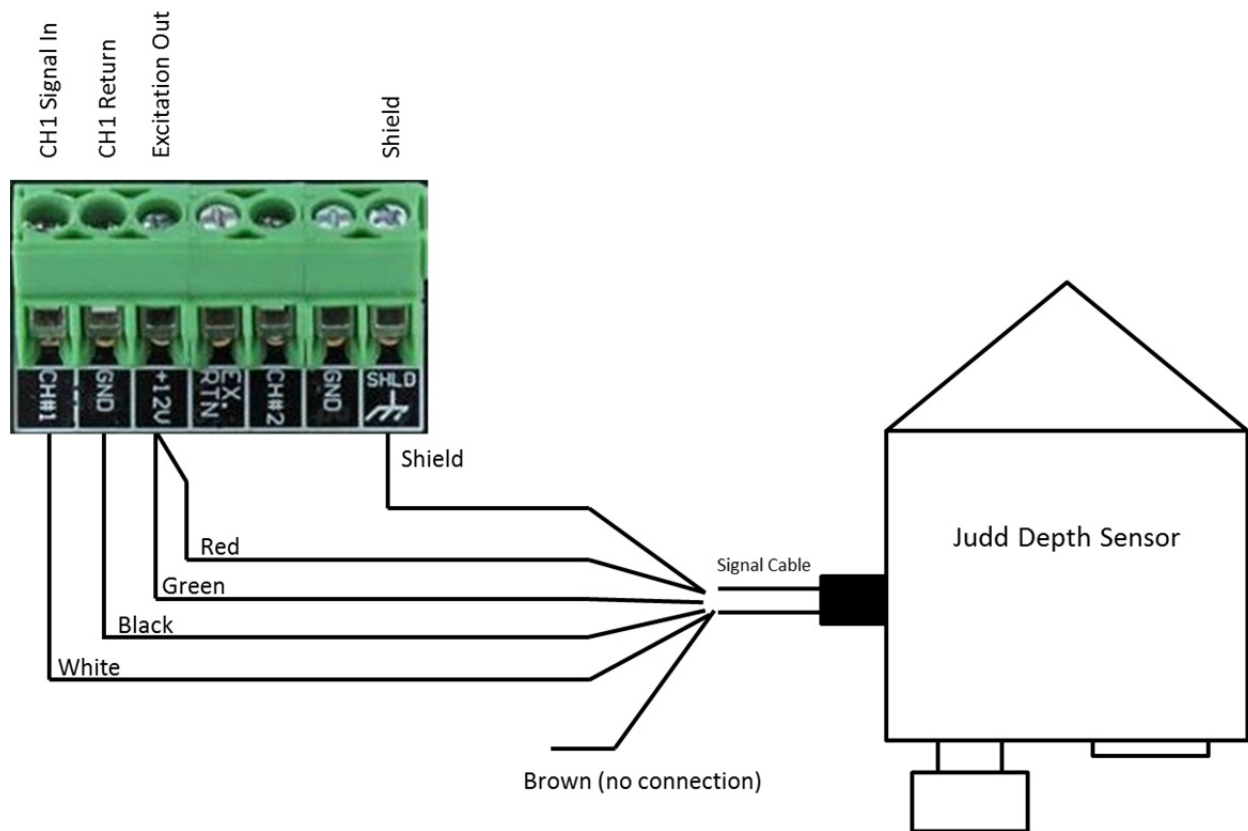
Care should be taken to minimize the distance between the sensor and the snow surface to reduce error caused by temperature stratification through the column of air. The optimal sensor height is the maximum snow depth plus 1.6 feet. For example, if the maximum snow depth expected is 3 feet, then the 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 RX000 Analog Sensor Module (RXMOD-A1)



Configuring the RX3000 Station with HOBOLink

In HOBOLink®, click Configure and select Module/Sensor Configuration.

The screenshot shows the HOBOLink® interface for an RX3000 Weather Station. The 'Configure' dropdown menu is open, showing options: General Configuration, Readout Configuration, Module/Sensor Configuration (highlighted with a blue arrow), Start/Stop, and Alarm Configuration. The main dashboard shows current conditions (Temperature: 41.60 °F, RH: 97.40 %, Dew Point: 47.65 °F, Rain: 0.00 in, Wind Direction: ENE 77 °, Wind Speed: 3.4 mph, Gust Speed: 15.3 mph, Solar Radiation: 41 W/m²) and three line graphs for Temperature, RH, and Dew Point over the past day. The left sidebar shows 'Module 1: Analog Sensors' selected.

Select the Analog Sensor Module from the menu on the left (Module 1 in this example). Set the logging interval, sampling interval (if desired), and enable the “Use excitation power” checkbox. Select Warmup and enter 2 seconds and 400 milliseconds. Click Save.

The screenshot shows the 'Module Configuration' dialog box. The left sidebar shows a tree view with 'Module 1: Analog Sensors' selected. The main area shows configuration options: Logging Interval (0 hours, 30 minutes, 0 seconds), Sampling Interval (checked, 3 minutes, 0 seconds), Statistics (Average selected), Use excitation power (checked, Warmup selected, 2 seconds, 400 milliseconds), and Serial Number (10707194). A usage summary shows 'Actual usage to date 1% of plan' and 'Estimated usage with this configuration 1% of plan'.

Select the channel with the Judd sensor from the menu on the left (Channel 1 in this example) to configure the sensor scaling. Select the "Enable this channel" checkbox. Type a label for the snow (such as Judd Snow Depth). Select the sensor/input type and select the "Enable Scaling" checkbox. Type the scaled units, values, and scaled measurement type. Click Save. To determine specific raw and scaled values, refer to the next section.

✕

General

Readout

Smart Sensors

- Logging
- Temperature
- RH
- Dew Point
- Rain
- Wind Direction
- Wind Speed
- Gust Speed
- Solar Radiation

Module 1: Analog Sensors

- Logging
- Channel 1 - depth (Judd Sno
- Channel 2: Select Analog Sens
- Channel 3: Select Analog Sens
- Channel 4: Select Analog Sens

Battery

Start/Stop

Alarms

Sensor Configuration

Latest Value: 0.920 Inches Back Save Next

Enable Graph

Enable this channel

Label:

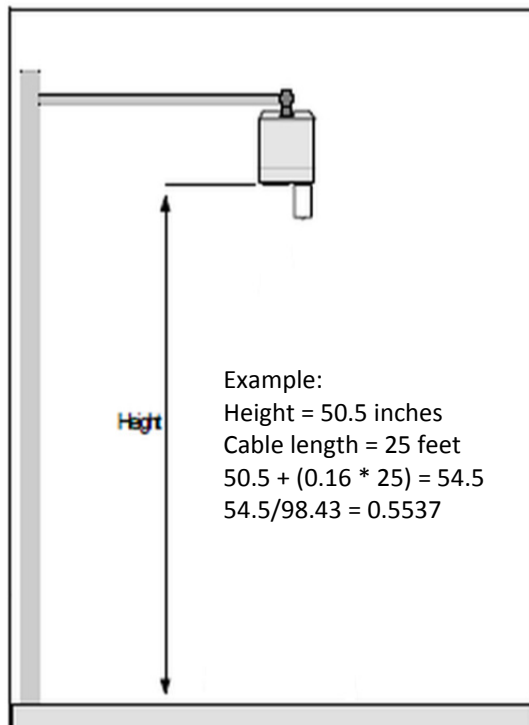
Sensor/Input Type:

Enable Scaling Help

Raw	Scaled Units
*Units: <input type="text" value="V"/>	<input type="text" value="Inches"/>
*Value 1: <input type="text" value="0.0"/>	= <input type="text" value="54.5"/>
*Value 2: <input type="text" value="0.5537"/>	= <input type="text" value="0.0"/>

*Scaled Measurement Type:

Scaling Calculation



$$\text{Height (inches)} + 0.16(L)^* = \text{Scaled Value 1}$$

*L = length of signal cable in feet

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

Enter the calculated values in the scaling fields in the HOBOLink Sensor Configuration screen as shown here.

Raw	Scaled Units
*Units: <input type="text" value="V"/>	<input type="text" value="Inches"/>
*Value 1: <input type="text" value="0.0"/>	= <input type="text" value="54.5"/>
*Value 2: <input type="text" value="0.5537"/>	= <input type="text" value="0.0"/>

*Scaled Measurement Type:

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.