# 260-700-D

User Manual

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260-700-D

Ultrasonic Snow Depth Sensor

Digital Output

**Phone** (530) 823-7185
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DOC 260-700-D UM 20230407

## Receiving and Unpacking

Carefully unpack all components and compare to the packing list. Notify NovaLynx Corporation immediately concerning any discrepancy. Inspect equipment to detect any damage that may have occurred during shipment. In the event of damage, any claim for loss must be filed immediately with the carrier by the consignee. Damages to equipment sent via Parcel Post or UPS require the consignee to contact NovaLynx Corporation for instructions.

## Returns

If equipment is to be returned to the factory for any reason, call NovaLynx between 8:00 a.m. and 4:00 p.m. Pacific Time to request a Return Authorization Number (RA#). Include with the returned equipment a description of the problem and the name, address, and daytime phone number of the sender. Carefully pack the equipment to prevent damage or additional damage during the return shipment. Call NovaLynx for packing instructions in the case of delicate or sensitive items. If packing facilities are not available take the equipment to the nearest Post Office, UPS, or other freight service and obtain assistance with the packaging. Please write the RA# on the outside of the box.

## Warranty

NovaLynx Corporation warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment from the factory. NovaLynx Corporation's obligations under this warranty are limited to, at NovaLynx's option: (i) replacing; or (ii) repairing; any product determined to be defective. In no case shall NovaLynx Corporation's liability exceed product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by NovaLynx Corporation, or that has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

# Address

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# 1 FORWARD

Thank you for purchasing NovaLynx products. NovaLynx has been designing and manufacturing weather instruments since 1988. NovaLynx represents several well-known brands of quality manufacturers, including Gill Instruments, RM Young, Kipp & Zonen, and Vaisala. It is our hope that our products will meet all your monitoring requirements.

# 2 INTRODUCTION

The **260-700-D Ultrasonic Snow Depth Sensor** is a low cost, non-contact, rugged sensor for reliable snow depth or water level measurement. Ultrasonic sensors measure the time of flight for sound transmitted to and reflected back from nearby objects within a defined area. Based upon the time of flight, the sensor outputs a range reading. Temperature compensation is applied to every reading using an integrated temperature sensor. Multiple sensor readings are analyzed using algorithms optimized for snow measurement, ensuring accurate results. The 260-700-D outputs the measurement results in an ASCII data string that can be recorded by a computer or logger.

Accurate measurement of snow depth poses many difficult problems. The **260-700-D Ultrasonic Snow Depth Sensor** has proven very effective in measuring snow depth, which makes it well suited for other various applications.

# 3 SPECIFICATIONS

| **Digital Ultrasonic Snow Depth Sensor** | **260-700-D** |
|---|---|
| Serial output | RS232, 1200 baud (8N1), ASCII characters |
| Range | 0.5 to 10 meters (1.6 to 32.8 feet) |
| Range accuracy | 1 cm or 0.4% distance to target |
| Range resolution | 3 mm (0.12 inches) |
| Temperature range | -40°C to +70°C ( -40°F to +158°F ) |
| Temperature sensor accuracy | 1°C, -40°C to +85°C |
| Temperature sensor resolution | 0.5 °C |
| Beam angle | ~22 degrees |
| **Electrical** | |
| Power | +12 to +24 Vdc, 50 mA (maximum sample time 2.6 seconds) |
| Cable | 25 feet (7.6 meters). Maximum cable length 250' (76 meters) |
| **Environmental** | |
| Enclosure | Enclosure rating IP66 |
| Mounting | 1/2" NPT female pipe coupling |
| Operating temperature range | -40°C to +70°C ( -40°F to +158°F ) |
| **Shipping** | |
| Dimensions | 3" x 3" x 5" (8 x 8 x 13 cm) |
| Weight of sensor with 25' cable | 1.70 lb (0.77 kg) |
| Weight of additional cable (25') | 0.55 lb (0.25 kg) |

# 4 OPERATING PRINCIPLES

The 260-700-D operates at a frequency of 49.4 kilohertz, which is above the human range of hearing. For each measurement cycle two measurements are made and compared. If the difference is less than one centimeter, then the last measurement is saved and output. If the difference is greater than one centimeter, the oldest sample is discarded and a new measurement and comparison made. This retry algorithm will continue up to a maximum of ten times. If a valid measurement cannot be made, or no echo is returned, a value of zero is returned.

The speed of sound in air varies proportionally with the air temperature. In order to make an accurate measurement of distance, the air temperature is measured and the speed of sound calculated. The resulting correction factor is applied to the measured time-of-flight of the pulse to calculate the distance. The built-in temperature sensor on the 260-700-D provides the necessary data for these calculations.

A measurement cycle begins when the green Sensor Enable wire is toggled high (>2.5 volts). The time to complete the measurement varies from 1.5 to 3.5 seconds, depending on how many retries are needed. At the end of the measurement cycle, four values are output: temperature, time of flight, distance, and number of retries. Each value is separated by a tab character (ASCII 09). The message is terminated with a carriage return (ASCII 13) and line feed (ASCII 10).

Example: **595 1674 2904 0**

Value 1: Air temperature in degrees Kelvin * 2. Example: ( 595 = 297.5 * 2 )
Value 2: The time in tens of microseconds that it took for the ultrasonic pulse echo to return.
Value 3: The distance measurement in millimeters, calculated from the first two parameters.
Speed of sound, 346.27 meters/second = (331.4 + (0.607 * ( Temp K – 273 ))
Distance to target, ~2.904 meters = ( 0.01674 seconds / 2 ) * 346.27 meters/second
Value 4: The number of tries the retry/error checking algorithm was used beyond the first pass.

NOTE: If Sensor Enable is held high, the sensor will start a new measurement cycle and continue to output data.

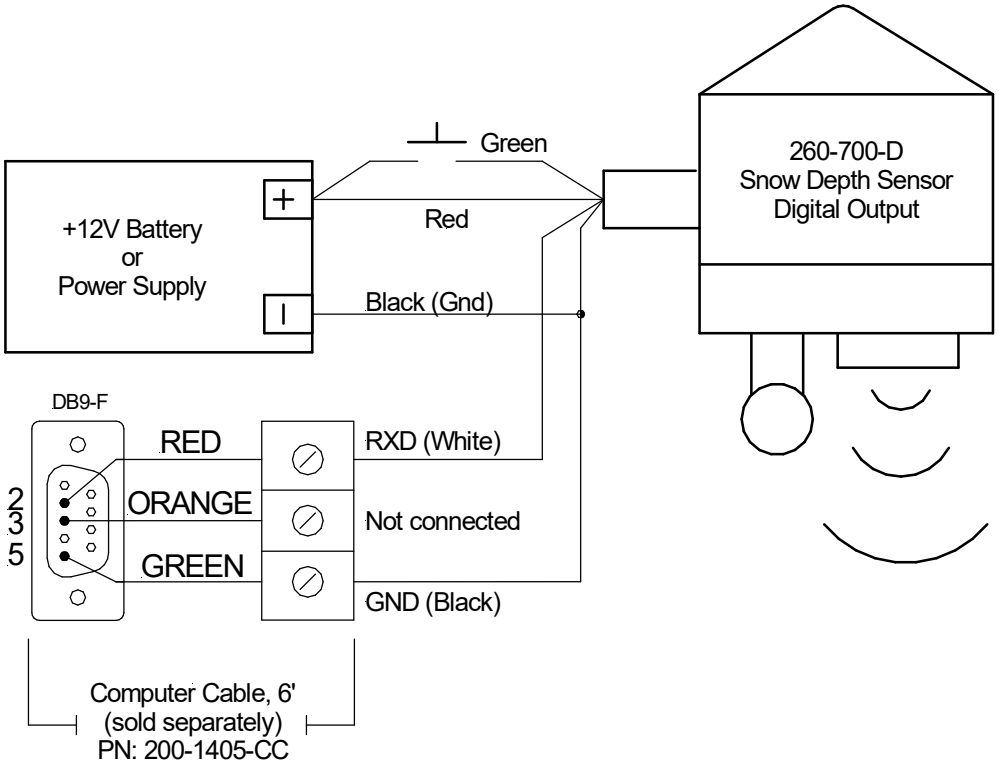
# 5 CONNECTIONS

**CAUTION: Make sure the power is turned off before connecting to your computer or logger.**

| Color | Function | Computer/Data Logger Connection |
|---|---|---|
| Red | Power | +12 to +24 Vdc |
| Black | Ground | Ground |
| Clear | Shield | Ground |
| Green | Sensor Enable | +2.5 to +24V Control Port* |
| White | Transmit | RS232 input, 1200 baud, 8N1 |
| Brown | Not used, insulate | Not connected |
| * Continuous Mode: Connect green Sensor Enable to red Power wire. | | |

The data is in ASCII format and can be displayed on a computer running a terminal emulator program such as TeraTerm, HyperTerminal, or Putty.

To collect data on a computer, run the terminal emulator software and configure it to the correct COM port, 1200 baud, 8 bits, no parity, 1 stop bit, no handshake. Use a battery or power supply to power the sensor. The green wire is shown with a momentary switch which is closed to start a measurement cycle. The switch can be omitted and the green wire simply connected to battery + for continuous operation.



# 6 SITE SELECTION

The location of the snow depth sensor is very important to the successful operation of the instrument. The most accurate measurements are made in relatively open areas away from trees or buildings and sheltered from wind effects. The site should be level and not subject to snow drifts.

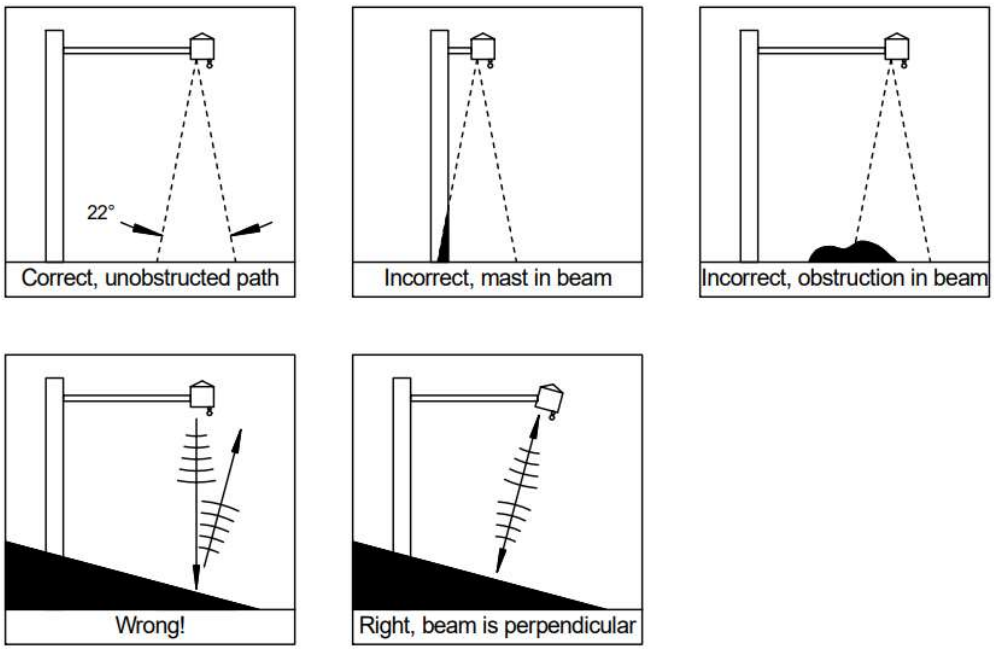
Snow fencing is not recommended because it can create problems if it is not regularly maintained, and some types tend to accumulate extra snow in the area of interest. A better alternative is chain link fencing to keep out unwanted animals.[1]

The sensor should not be located under power lines or any structures where snow might accumulate and then fall onto the area being measured, as this will create an uneven surface below the sensor.

Place a white-painted square of waterproof plywood below the sensor or purchase a "snow board" made for the purpose. In some areas it may be helpful to create a frame under the board to raise it slightly to reduce the effects of heaving caused by freeze / thaw cycles. Calculate the size of snow board needed by multiplying the height of the sensor by 0.4. The sensor must be centered over and perpendicular to the target for best results.

It is good practice to make reference marks on the support mast that are visible from a distance. These marks can be compared with the sensor readings to verify the operation of the sensor once snow has accumulated.

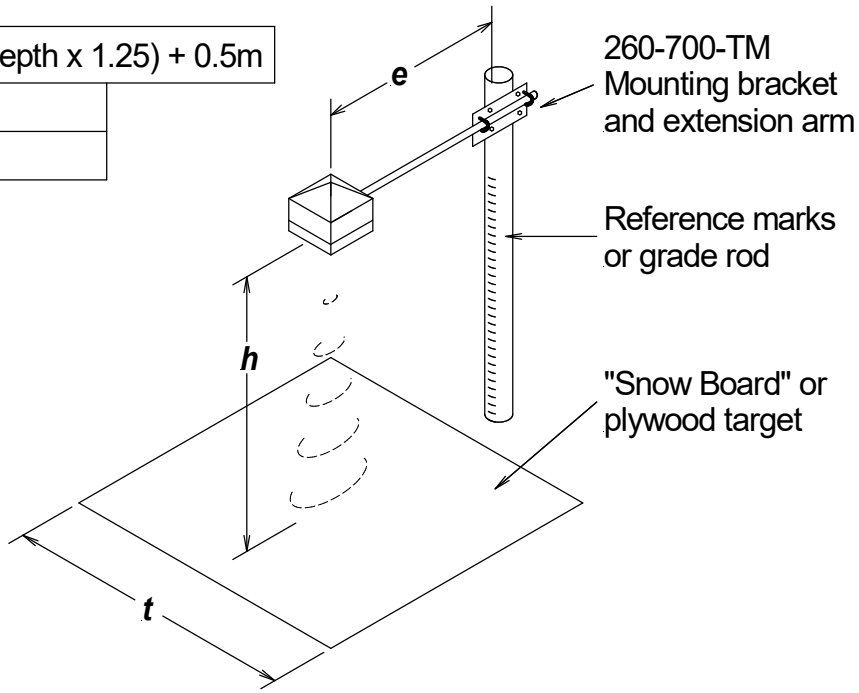
Good locations do not always remain obstruction free. Vegetation can grow quickly, changing an excellent exposure into a poor one. Sites should be inspected regularly in order to properly maintain the exposure of the sensor.



# 7 INSTALLATION

The support structure (tower or mast) must be sturdy to keep the sensor from vibrating when there are high winds. It must be tall enough for the expected snow accumulation, and the pipe extension that holds the sensor must be long enough so that the sound pulses do not reflect from the mast.

| |
|---|
| ***h*** = (maximum snow depth x 1.25) + 0.5m |
| ***t*** = ***h*** x 0.4 |
| ***e*** = 0.194 x ***h*** |




*not to scale*

**Determine the Sensor Height (*h*)**

*NOTE: The lower the sensor can be mounted the stronger the echo from the snow.*

The sensor should be mounted at least 1.64 feet (0.5m) above the highest expected snow level, to a maximum of 32.8 feet (10m).

Sensor height = (max observed snow level x 1.25) + 1.64 feet (or 0.5m)

**Determine the Extension Length (*e*)**

*NOTE: If the sensor is too close to the mast or tower the sound pulses may reflect from the mast and confuse the distance measurement.*

Calculate the minimum extension length using this simple formula:

Extension length = 0.194 x Sensor height

The 260-705-TM kit (sold separately) contains parts for mounting the sensor to a mast or tower. If you purchased the kit then follow the installation instructions that came with the kit. Otherwise, a suitable mounting structure can be made with parts from a local hardware store.

The 260-700-D Ultrasonic Snow Depth Sensor is provided with a 1/2" NPT female coupler so that it is easily installed on a threaded 1/2" galvanized pipe of suitable length. A reducer may be used to adapt to larger pipe if needed for rigidity. Apply Teflon tape to the pipe threads, feed the cable through the pipe and then screw the pipe into the coupler on the sensor, taking care that the cable does not become twisted. Attach the pipe to your mast or tower and secure the cable with cable ties so that the wind cannot cause it to whip around. Close off any openings in the pipe so that water cannot collect inside.

# 8 MAINTENANCE

A properly installed sensor will require little maintenance. However, harsh conditions and freeze/thaw cycles can cause problems that should be addressed.

1. The pipe that supports the sensor should be sealed so that snow melt and condensation do not accumulate inside. If water has collected in the pipe, drain it and let it dry before sealing up any openings.
2. If the sensor must be opened for any reason, check the condition of the desiccant pack and replace it as required.
3. Secure the cable so that it does not whip around in the wind. Check for signs of wear.
4. Look up into the horn and make sure insects have not built a nest inside. Clean it out carefully so as not to damage the transducer. Also check the PVC tee where the temperature sensor is mounted, and clear out any insect nests.
5. Clean the target surface (the white-painted waterproof plywood piece below the sensor) and remove any weeds from around the area. Repaint the board when necessary.
6. Aim the sensor perpendicular to the target.
7. Verify the calibration by checking the readings at two points at least.

# 9 TROUBLESHOOTING TIPS

Please refer to the following checklist if there are any problems with the functionality of the sensor.

- Ensure the sensor is perpendicular to the target surface. If the sensor is off-axis then the reflected sound waves will be weak or miss the sensor.
- Check the target surface. If it is rough or uneven the sound waves will be scattered. A piece of white-painted waterproof plywood laid on the ground below the sensor makes a suitable target.
- Check the opening of the sound horn to ensure it is free of ice or insect nests.

- Low density snow (<5%) is a poor reflector of sound. The snow depth measurement may be uncertain in these conditions.
- Strong winds may mask the echo, causing uncertain measurements. Discount anomalous readings in high winds.
- Do not operate other ultrasonic sensors near the snow depth sensor, as the signals may confuse the measurement.

# 10 REFERENCES

1 Wendy A. Ryan, Nolan J. Doesken and Steven R. Fassnacht, (2006) Evaluation of Ultrasonic Snow Depth Sensors for U.S. Snow Measurements. *JOURNALS ONLINE* Section 5a, Online publication date 1 May 2008