METEOROLOGICAL INSTRUMENTS

INSTRUCTIONS

Snow Depth Sensor

MODEL 54000

SNOdar

CE

R.M. YOUNG COMPANY 2801 AERO PARK DRIVE, TRAVERSE CITY, MICHIGAN 49686, USA
TEL: (231) 946-3980 FAX: (231) 946-4772 WEB: www.youngusa.com

PN: 54000-90
REV: A011426

MODEL 54000
SNOdar SNOW DEPTH SENSOR

SPECIFICATIONS

Durability

Input Voltage:	6-24 Volts
Operating Temperature:	-40 to 60°C
Storage Temperature:	-40 to 85°C
Mechanical Vibration:	20g MIL-STD-883D
Mechanical Shock:	500g MIL-STD-883D
Ingress Protection:	IP67
Corrosion Resistance:	Type II: MIL-A-8625

Measurements

Accuracy:	±1 cm to 2 m
	±2 cm to 4 m
	±4 cm to 8 m
Resolution:	1 cm
Range:	0.09 to 9 m *
Measuring Interval:	1 to 60 min

Power Usage

Current Consumption:	0.04 to 0.26 amps
Power Consumption:	0.42 to 3.24 watts
Avg Power Consumption:	0.5 watts

Dimensions

Weight with bracket:	375 grams
Weight w/o bracket:	265 grams
Size:	6.3 x 6.3 x 9.5 cm

ESD Ratings

Human-Body Model:	±2500V
Charged-Device Model:	±1000V

FEATURES

- Real-time, accurate data during storms
- User-friendly app for setup and live data
- Bluetooth Low Energy (BLE) enabled
- Seasonal internal data logger
- Snow depth (compaction)
- New snowfall
- Seasonal snowfall
- Optional estimated SWE (Snow Water Equivalent)
- SDI-12 data logger & RS-232 output
- Sensor orientation monitoring
- Oblique or normal angle mounting on tower or structure

* As measured indoors to a 90% reflective target. Note that signal to noise ratio decreases as distance from sensor to target increases or as the target surface is partially obscured by objects such as vegetation. As such, measurement and calibration timeouts are more likely to be experienced at installation heights approaching 9m and at sites with uncleared groundcover when no snow is present.

INTRODUCTION

The SNOdar is a highly accurate, reliable snow depth sensor designed to deliver real-time data—even in the middle of a snowstorm. Its mobile app makes setup effortless while providing instant access to live snow depth measurements from anywhere in the world.

SNOdar is one of the only snow depth sensors that utilizes LIDAR (Light Detection and Ranging) technology to provide accurate snow depth measurements. This high-precision method allows the SNOdar to create detailed, real-time snow depth data, ensuring reliable and efficient snow monitoring for a variety of applications.

The SNOdar can output data via RS-232 or SDI-12 to a range of commercially available data loggers. It also features an internal, non-volatile data logger capable of storing an entire season's worth of data, eliminating the need for separate data loggers for each sensor—resulting in significant cost savings during deployment. Its compact, lightweight design is built to withstand frigid temperatures while consuming very little energy.

APPLICATIONS

- SNOTEL Snow Monitoring
- Stormboard Snow Measurement
- Avalanche Monitoring & Forecasting
- DOT Road Conditions
- Ski Resort Snow Monitoring
- Scientific Snow Monitoring
- Snow Management
- Solar Panel Control Systems

OVERVIEW

Welcome to the SNOdar User Manual, your comprehensive guide to setting up, installing, and using your SNOdar snow depth sensor. This manual will walk you through every step, from mounting the sensor in an optimal location to configuring the app for seamless data collection. Whether you're a first-time user or an experienced weather enthusiast, this guide ensures you get the most accurate and reliable measurements from your SNOdar system.

You'll start with installation and mounting, including best practices for securing the sensor in an unobstructed area to maximize performance. Next, you'll learn how to connect and configure the SNOdar app, enabling real-time monitoring and alerts. Once your system is up and running, the manual will guide you through reviewing and interpreting data logs, helping you track snow accumulation trends over time. Finally, you'll find troubleshooting steps for common sensor errors, ensuring smooth operation even in challenging weather conditions. With this manual, you'll have everything you need to confidently set up, use, and maintain your SNOdar sensor. Your SNOdar package includes the SNOdar sensor, mounting clamp, and the preassembled cable.

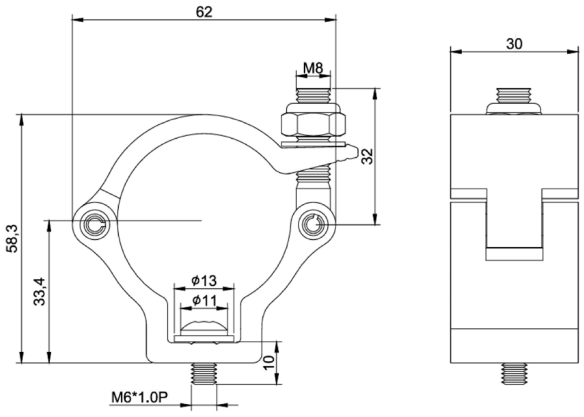
54000-90(A)

Cable:
The cable supplied with the SNOdar features a straight over molded connector designed for durability in harsh environmental conditions.

- Operating Temperature: −40°C to 105°C
- Power Rating: 300 V
- Connector Rating: IP67 (outer jacket is UV- and water-resistant)
- Wire Gauge: 20 AWG
- Compliance: UL Recognized, CSA Certified, RoHS Compliant
- Length: 10 meters
- Termination: Blunt-cut for installation flexibility
- Additional Documentation: Cable pinout and cable datasheet provided

Mounting Clamp:
The included mounting clamp is manufactured from high-strength materials to ensure reliable installation in demanding environments.

- Material: Aluminum 6061-T6 with 304 SS hardware
- Intended Tube Size: 1.5" OD (1.49–1.58 in / 38–40 mm)
- Minimum Tube Size: 38 mm
- Maximum Tube Size: 40 mm
- Load Capacity: 100 kg (220 lbs)
- Type: Medium-duty clamp
- Custom Options: Contact RM Young if a different clamp size is required



POWER AND BOOT SENSOR

Unbox the device and locate the 6-pin power cable. Apply the supplied grease to the connector on the device prior to connecting the cable. Ensure proper alignment with the directional key, and secure the connection by engaging the bayonet locking mechanism.

Supply a power input of 6–24 VDC (min of 3.5 W) to the cable leads.

SNOdar Pin Name	SNOdar Pin No.	Cable Pin No.	Wire Color
GND	1	1	BLACK
+12 to 24VDC	2	2	WHITE

Note: The wiring used for communication depends on whether the sensor is operated using RS-232 or SDI-12. Refer to the appropriate interface section later in this manual for detailed wiring diagrams.

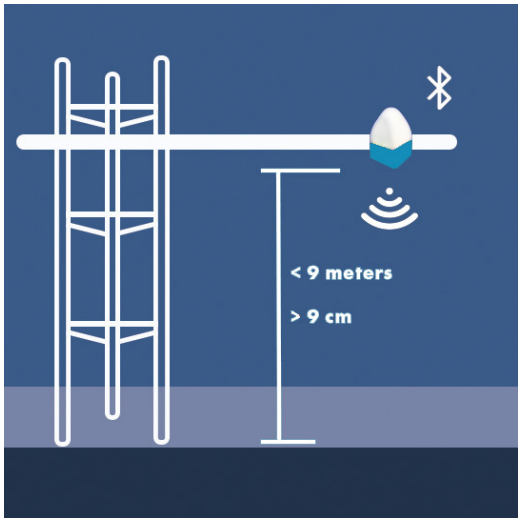
Once the device is powered on, the green LED will flash 20 times at 5 Hz, indicating the sensor has booted successfully and is actively broadcasting a Bluetooth Low Energy (BLE) signal.

If installing in the field, proceed to Installation and Mounting. Otherwise, set the sensor aside and install the SNOdar mobile application.

INSTALLATION AND MOUNTING

MOUNTING HEIGHT

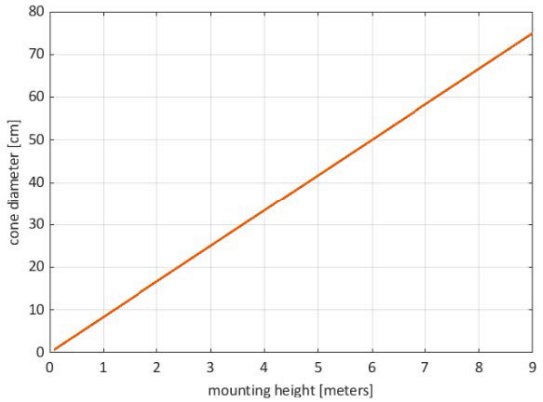
Mount the sensor less than 9 meters from the ground and more than 9 cm from the ground or Stormboard fixture.



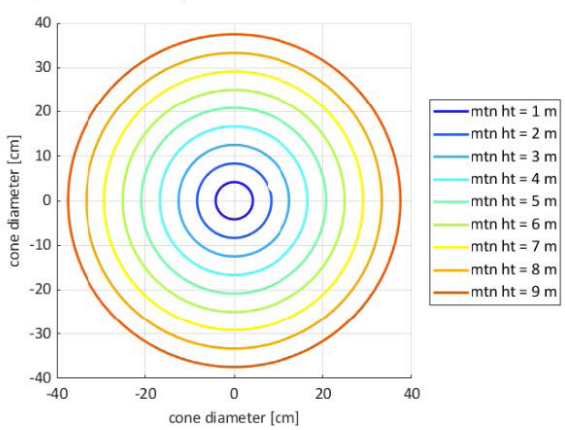
Field-of-View:

The approximate cone projection field-of-view (FOV) of the SNOdar is shown in the diagram below. This visualization indicates the size and shape of the measurement zone on the ground or snowpack, offering guidance for proper mounting height and clearance.

SNOdar Field of View: Mounting Ht vs. Cone of Influence



SNOdar Field of View: Mounting Ht vs. Cone of Influence

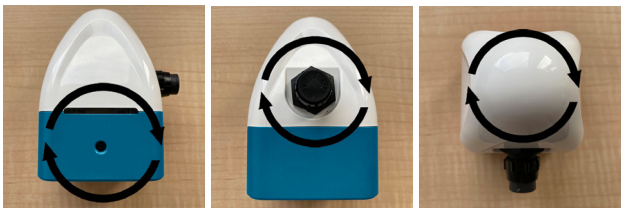


OBLIQUENESS

For best performance, when mounting the sensor, rotate it so that it is normal to the ground, i.e. measuring perpendicular to the ground surface; however, it does have the ability to be mounted at angles or on hillsides, up to 30 degrees from normal. Note that if mounted at an angle, max mounting height will be reduced.

IMU DIRECTIONALITY

Roll: Rotation about the axis running through the clamp mount (this is the rotation monitored in Stormboard mode, 20 degrees is ideal)
Pitch: Rotation about the axis running through the connector
Yaw: Rotation about the axis running through the top dome peak



Roll Pitch Yaw

GROUND PREPARATION

Before setup and calibration, ensure the area beneath the sensor is free of any debris, such as sticks, rocks, or uneven ground clumps. Additionally, remove any large foliage or tall grass surrounding the sensor. Debris and vegetation will increase measurement noise and may result in calibration or measurement time-outs until fully buried in snow. For optimal accuracy in seasonal measurements, it is recommended to prepare a level dirt pad beneath the sensor.

ELECTRICAL INTERFACES

The SNOdar Snow Depth Sensor provides both wired and wireless communication interfaces to support a wide range of deployment scenarios. These options allow for rapid integration with commercial off-the-shelf (COTS) telemetry equipment, as well as convenient wireless access for setup, configuration, and data monitoring.

Wired Interfaces

The SNOdar sensor includes industry-standard wired communication ports to ensure compatibility with common data acquisition systems:

- RS-232: A standard serial interface widely used among commercial Satcom and LTE modem platforms. This connection supports straightforward integration in remote monitoring installations.
- SDI-12: A low-power digital interface commonly used by environmental sensors and commercial data loggers. SDI-12 enables seamless integration into existing hydrological, meteorological, and environmental monitoring networks.

Wireless Interfaces

In addition to wired communication, the SNOdar sensor includes a robust Bluetooth® Low Energy (BLE) 5.x wireless interface for convenient local access:

- 2 Mbps PHY: Supports high-speed communication at distances up to 50 meters line-of-sight (LOS).
- Long-Range 125 Kbps PHY: Provides extended connectivity up to 250 meters LOS.
- The wireless interface enables quick and efficient setup, calibration, data monitoring, and data sharing using compatible mobile devices without the need for direct cable connection.

RS-232

The SNOdar includes a dedicated RS-232 port for direct serial communication with commercial Satcom/LTE modems and other data acquisition devices. This interface provides full diagnostic information, system temperatures, inertial sensor data, and all calculated snow-related measurements in a single serial output string.

Connect power and RS-232 signal wires through the 6-pin connector as shown below.

SNOdar Pin Name	SNOdar Pin No.	Cable Pin No.	Wire Color
GND	1	1	BLACK
+12-24 VDC	2	2	WHITE
TX: RS-232	5	5	BLUE
RX: RS-232	6	6	VIOLET

Serial Port Settings

The SNOdar RS-232 interface operates using the following fixed communication parameters (configured in firmware):

- Baud Rate: 19200
- Data Bits: 8
- Parity: None (N)
- Stop Bits: 1
- Hardware Flow Control: Disabled / None
- Timeout: 10 ms

Ensure your logging or telemetry device is configured with these settings to properly receive serial output.

RS-232 Data Output

Each RS-232 transmission contains a sequence of data fields describing device status, internal temperatures, inertial sensor readings, and real-time snow depth measurements. The table below defines each field within the serial output string:

Field #	Name	Units	Comments
1	unix_time	Seconds	
2	power_current	mA	
3	power_voltage	Volts	
4	soc_temp	Deg C	
5	pcb_temp	Deg C	
6	imu_temp	Deg C	Inertial sensor temperature
7	imu_q0,	Radians	Inertial sensor
8	imu_qx,	Radians	Inertial sensor roll axis rotation
9	imu_qy,	Radians	Inertial sensor pitch axis rotation
10	imu_qz,	Radians	Inertial sensor yaw axis rotation
11	snodar_soc_temp	Deg C	Internal temperature
12	snodar_pcb_temp	Deg C	Internal Temperature
13	snodar_tc_distance	In. or m	Calibration distance
14	heater_en		Heater On or Off
15	outside_temp	Deg C	-1 means no temperature sensor in use.
16	current_snow_depth	In. or m	The height of the current snow pack.
17	seasonal_snow_fall	In. or m	The sum of each daily snow fall.
18	daily_snow_fall	In. or m	The 24 hour snowfall based on the "daily reset time
19	doy_swe	In. or m	The estimated SWE value eSWE.
20	snodar_temp_swe	Deg C	-1 means no temperature sensor in use.

SDI-12

The SNOdar Model 54000 supports communication using the SDI-12 v1.4 protocol. This section provides an overview of the commands and data returned by the sensor. For full protocol details, refer to the official SDI-12 Specification.

Connect power and the SDI-12 data line through the 6-pin connector as shown below.

SNOdar Pin Name	SNOdar Pin No.	Cable Pin No.	Wire Color
GND	1	1	BLACK
+12-24 VDC	2	2	WHITE
SDI-12	4	4	RED

Measurement Data and Overview

Each measurement sequence returns 9 data values, in the order shown below. Measurement units (meters or inches) depend on the device configuration.

Sensor Data

1. System Current (mA)
2. System Voltage (V)
3. Internal Temperature (°C)
4. Orientation Flag (see description below)
5. Distance (m or in)

DSP - Processed Data

6. Seasonal Snow Depth (m or in)
7. Seasonal Snowfall (m or in)
8. Daily New Snowfall (m or in)
9. Day-of-Year SWE (m or in)

Start Measurement

To initiate a measurement, send the following SDI-12 command:
aM!

After receiving the aM! command, the sensor immediately responds with: atttn!<CR><LF>

Where :

- a = sensor address
- ttt = time in seconds required to complete the measurement
- n = number of data values available (n is always 9, corresponding to the nine data values listed in Measurement Data Overview)

Example Response: 00109<CR><LF>
This response indicates that 9 data values will be available in 10 seconds.

Measurement duration depends on the physical installation and operating conditions of the SNOdar.

- The default initial measurement time is 30 seconds.
- After each completed measurement, the sensor automatically updates the reported measurement time to the actual measured duration, rounded to the nearest second plus one additional second.
- If the measurement completes earlier than the reported time, the sensor issues a service request to indicate that data is ready.

Retrieve Measurement Data

Once the measurement is complete, retrieve the data using the D commands.

Because SDI-12 messages have a limited length, the SNOdar returns its 9 data values across two data requests:

aD0!
aD1!

Example Data Retrieval

First data request: aD0!

Response:0+46.700+11.072+27.938+0.000+1.487<CR><LF>

This response contains 5 data values. To retrieve the remaining values, issue a second data request.

Second data request: aD1!

Response: 0+0.027+1.320+0.047+0.007<CR><LF>

Data Output Definitions

46.700	System current (mA)
11.072	System voltage (V)
27.938	System temperature (°C)
0	Orientation flag
1.487	Distance measurement (m)
0.027	Seasonal snow depth (m)
1.320	Seasonal snowfall (m)
0.047	Daily new snowfall (m)
0.007	Day-of-year Snow Water Equivalent (SWE) (m)

Non-Measurement Commands

Name	Command	Response
Address Query	?!	a<CR><LF>
Acknowledge Active	a!	a<CR><LF>
Change Address	aAb! a = Sensor address b = New sensor address	b<CR><LF>
Send Identification	aI!	a14RMYOUNG 54000 1202P0210504<CR><LF>

Send Identification, where:

a	= sensor address
14	= SDI-12 compatibility number
RMYOUNG	= company name
54000	= sensor model number
120	= firmware version
2P0	= hardware version
210504	= serial number

Orientation Flag Description

The Orientation Flag reports whether the sensor's current pitch and roll angles differ from the orientation used during setup calibration. A value of 0 indicates normal operation with no significant orientation change.

The flag is a bit-encoded integer, where each bit corresponds to a threshold being exceeded. Each bit has an associated value that contributes to the final Orientation Flag number.

Bit Definitions:

Bit	Value	Condition
0	1	Δ pitch > 5°
1	2	Δ pitch > 20°
2	4	Δ roll > 5°
3	8	Δ roll > 20°

Accumulation Rule

The Orientation Flag value is formed by adding together the values of all bits whose conditions are met. Because the threshold levels are hierarchical, exceeding a larger threshold automatically includes the smaller one.

For pitch, if Δ pitch > 20°, then both pitch thresholds are exceeded:

- Bit 0 (value 1) for Δ pitch > 5°
- Bit 1 (value 2) for Δ pitch > 20°

So the pitch contribution becomes: 1 + 2 = 3

For roll, if Δ roll > 20°, then both roll thresholds are exceeded:

- Bit 2 (value 4) for Δ roll > 5°
- Bit 3 (value 8) for Δ roll > 20°

So the roll contribution becomes: 4 + 8 = 12

Example: Δ pitch > 5° and Δ roll > 20°

Δ pitch > 5° → Bit 0 set (value 1)
Δ roll > 20° → Bits 2 and 3 set (values 4 + 8 = 12)

Total Orientation Flag value: 1 + 12 = 13

DOWNLOAD THE APP

Depending on your mobile device of choice:

Download on the App Store

https://apps.apple.com/us/app/snodar/id1584974884

GET IT ON Google Play

https://play.google.com/store/apps/details?id=com

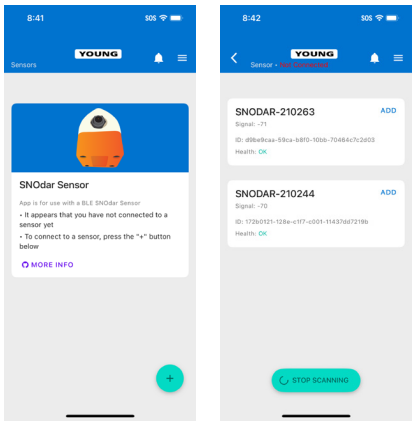
RUN THE APP

PERMISSIONS

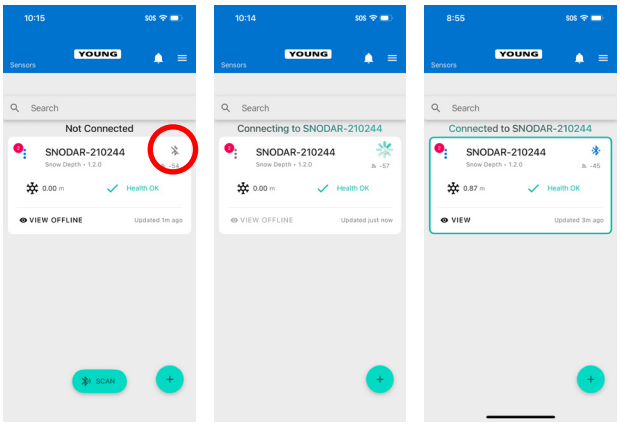
To run the fully featured App, Bluetooth and Location services (i.e. GPS) *MUST* be enabled.

CONNECT

1. To connect to a sensor, tap the + sign in the lower right corner of the screen.
2. From the **Add Sensor** screen, connect to the desired sensor by tapping on the **Connect** button by the sensor's name.
3. When prompted, enter the default passkey `123456` and tap the pair button.



4. Devices that have already been added will be listed on the home screen and can be connected to by tapping the **Bluetooth** button to the right of the device's name.



PAIRING AND BONDING SECURITY

The mobile device will now have to pair and bond to the SNOdar device. This is an encryption-based security feature to protect the device and its data from nefarious and/or unintentional actions. Therefore, it is highly important to **change the default passkey** and note, somewhere safe, where it can be recalled if forgotten.

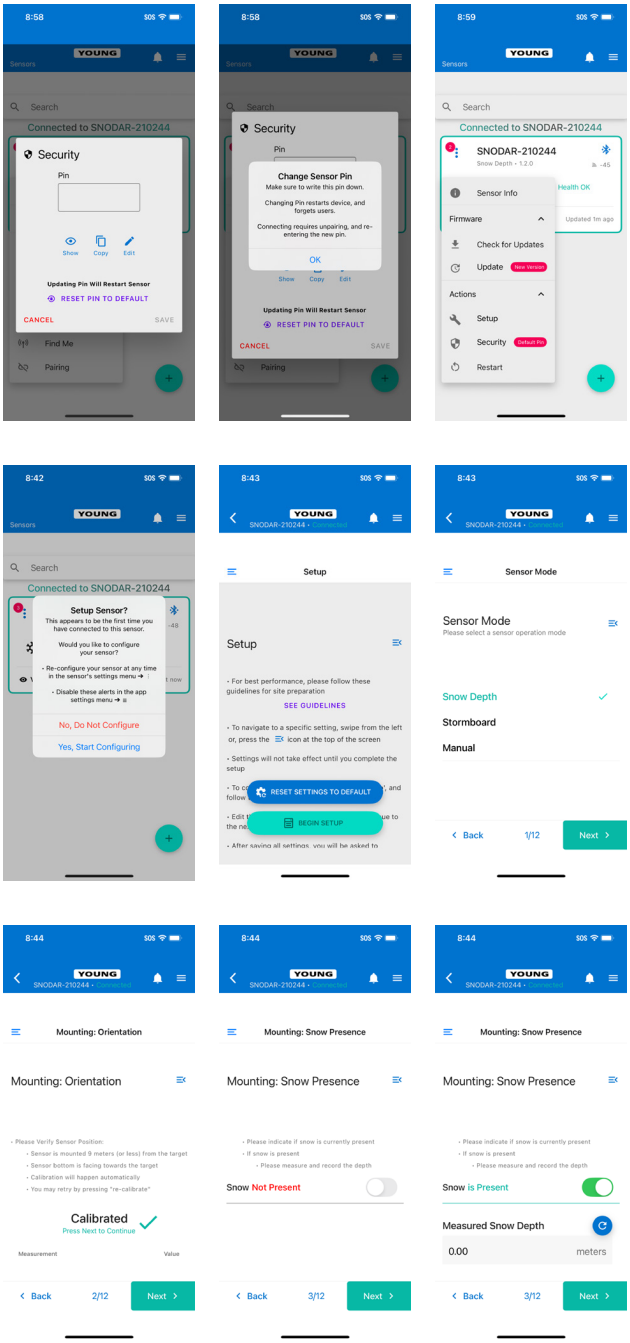
CHANGE PASSKEY

1. From the home screen, tap on the Kebab Menu beside the name of the desired sensor.
2. Select Security from the menu items.
3. Tap the edit button and change the default passkey to a six digit, numeric passkey of your choice.
4. Tap the Save button to update the passkey.

NOTE: Updating the passkey will restart the device.

SENSOR SETUP

Upon SNOdar sensor field installation, it is imperative to run the Sensor Setup located in the Kebab Menu on the home screen.



SENSOR MODE

The Sensor Mode Page allows for different sensor operation modes to be selected.

- The **Snow Depth** sensor mode is standard automated snow depth measurement. The unit needs to be calibrated at the beginning of each season (preferably when NO snow is present) for accurate, settled snow depth measurements.
- The **Stormboard** sensor mode is a manual calibration mode for storm snowfall measurements. This mode will calibrate to 'zero' accumulation after the user wipes the stormboard clean of snow. A manual calibrate after each clear will help the accuracy remain high.

• The **Distance** sensor mode is used for basic distance measurements. This will be the default mode when NO Bluetooth setup can be done. The sensor will measure distance to the snow every 5 minutes and send data out the SDI-12.

• The **Manual** sensor mode has no automated operation only user interactions. This mode is used exclusively for testing and in lab scenarios.

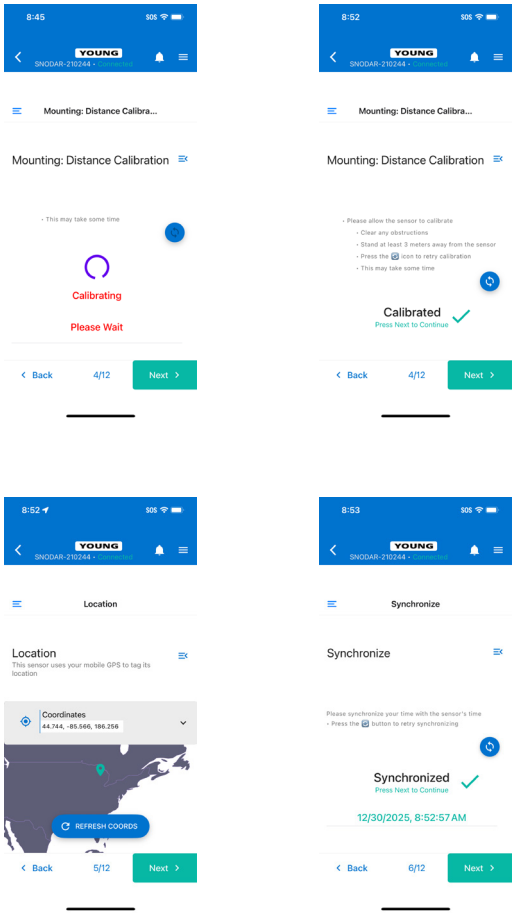
MOUNTING: ORIENTATION

The Mounting Orientation page verifies that the sensor is mounted in the proper orientation—less than 9 meters above ground and with the sensor bottom facing towards the ground.

Once the sensor has been mounted, press the **Calibrate** button in the bottom middle of the screen. If the sensor is properly oriented, this **Calibrate** button will turn green.

MOUNTING: SNOW PRESENCE

The Snow Presence Page records if snow is present when sensor is set up. If snow is present, the depth of the snow in meters must be entered.



MOUNTING: DISTANCE CALIBRATION

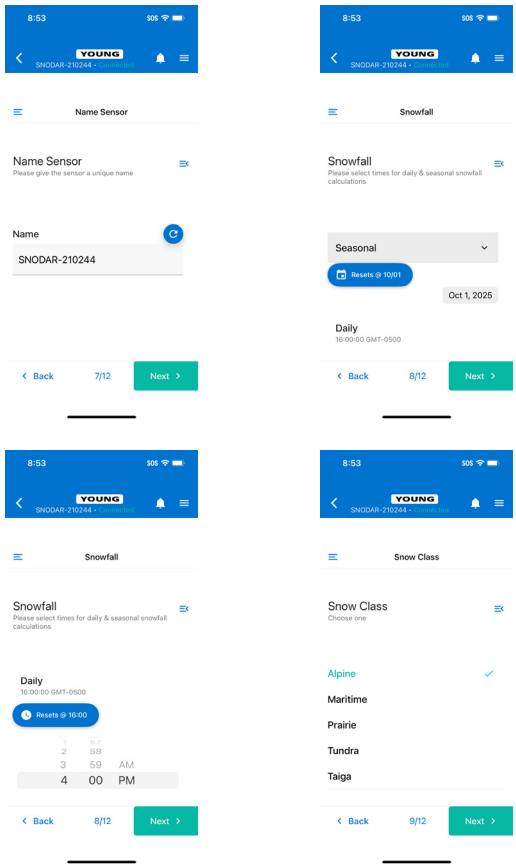
The Sensor Calibration Page allows the sensor to calibrate. To do so, clear any obstruction from below the sensor, press the Calibrate button, and stand at least 10 meters away from the sensor.

LOCATION

The Location Page uses your mobile device's GPS to determine the sensor's location. To update the location tap the **Refresh Coords** button.

SYNCHRONIZE

The Synchronize Page synchronizes the sensor's time with the time and time zone of your mobile device. To do so, press the Synchronize button. When the time has been synchronized, the newly set time will be displayed.



NAME SENSOR

The Name Sensor Page allows for the sensor to be given a unique name. The name can be reverted back to the original sensor name by pressing the **Refresh** icon to the right of the text input field.

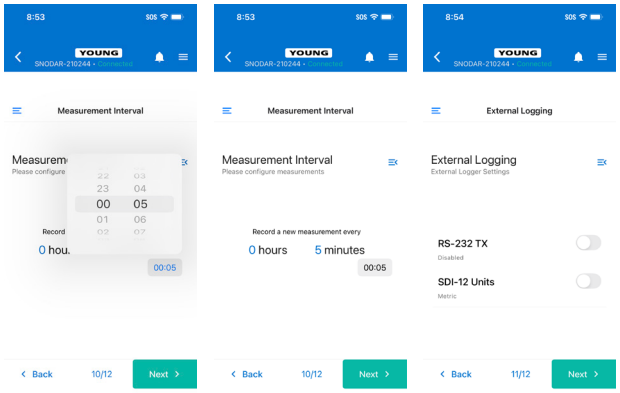
SNOWFALL

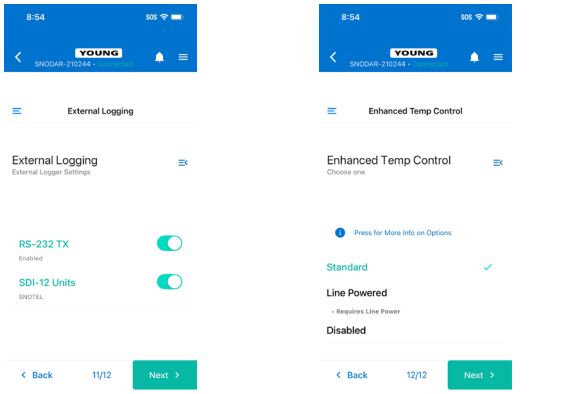
The Snowfall page allows for a time to be set at which the snowfall calculations for the day and the season will start over. To set the seasonal reset date, tap the date icon under the **Resets @** button and scroll through the year, month, and date. To set the daily reset time, scroll through the time options under the **Resets @** button. Both values are set according to the local time of the mobile device.

SNOW CLASS

The Snow Class Page allows for the type of snow to be specified. Choose a snow class that best describes the snow in your region:

- Alpine
- Maritime
- Prairie
- Tundra
- Taiga





MEASUREMENT INTERVAL

The Measurement Interval Page allows for the interval at which measurements are taken to be set. The minimum allowable time interval is 1 minute.

To set the interval, tap anywhere on the current hours and minutes listing. Then tap the time button that appears. To increase the time, drag the hours (left) or minutes (right) up. To decrease the time, drag the hours (left) or minutes (right) down. Tap anywhere outside of the time input to exit.

EXTERNAL LOGGING

The logging mode for data acquisition can be set to a combination of RS-232 TX, RS-232 Format, and SDI-12 Units. RS-232 TX must be enabled in order to enable SDI-12 Units.

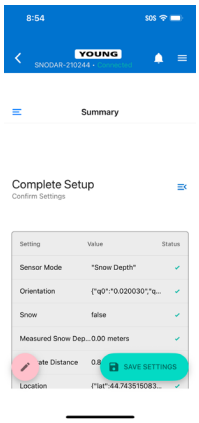
ENHANCED TEMPERATURE CONTROL

While the SNOdar has a standard temperature control, the Enhance Temperature Control page allows for the temperature control to be disabled or set to Line Powered control. Detailed information about each of these options can be found by tapping the more info button.

COMPLETE SETUP

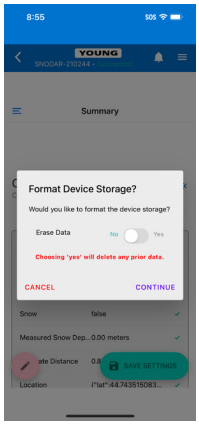
Lastly, the Complete Setup Page provides a summary of the settings. Any setup steps that were skipped or are incomplete will have a red x next to them. To go back to these steps, press the menu button in the right corner of the setup page and choose the desired setup step from the menu.

To confirm the settings and complete the sensor setup, press the Save Settings button.



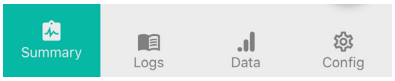
ERASE DATA FLASH

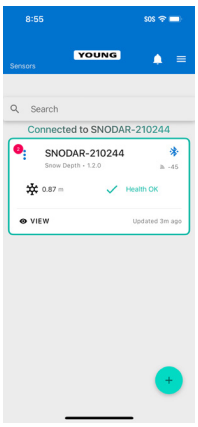
Once you press the Save Settings button, you will be asked if you would like to format the device storage. By choosing yes the device storage will be formatted and any recorded data will be deleted. By choosing no, the device storage will not be formatted and any recorded data will be preserved.



VIEW

To view a sensor and its associated data, press the View button on the desired sensor's tab. You can return to the home page via the back arrow in the top left corner.

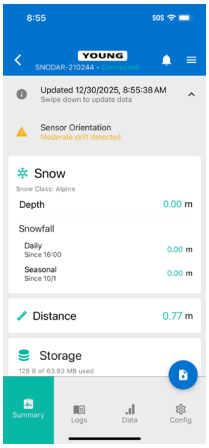




SUMMARY

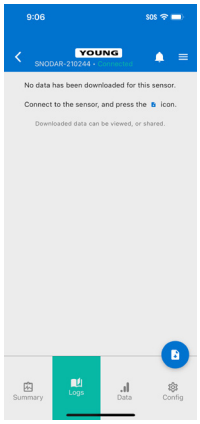
The Summary Page provides an overview of the sensor's data as well as displays any errors with the sensor. For more information on sensor error notifications see the Sensor Error Notifications section of the user guide.

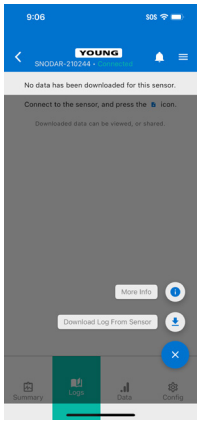
The Summary Page contains information on snow depth, sensor storage, measurement information, sensor power, internal sensor temperature including potential heater failure, and sensor orientation including potential sensor drift.

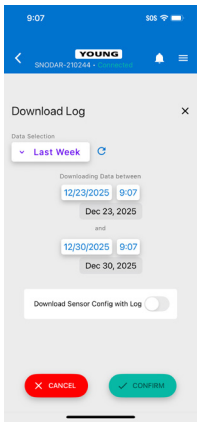


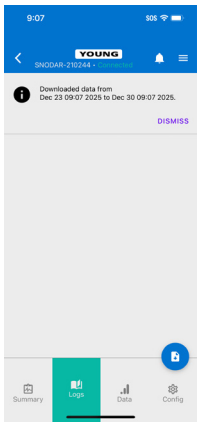
LOGS

The Logs Page displays data that has been downloaded for the sensor. To download data, press the **Download** button in the lower right hand corner of the page. Then press the **Download Log from Sensor** button. You will be prompted to choose data from either the last day, the last week, or the last month. A custom range can also be selected by tapping on the first displayed date or time and setting a unique time then doing the same for the second displayed date or time. Once downloaded, the logs page will display all logs that have been downloaded to your mobile device.

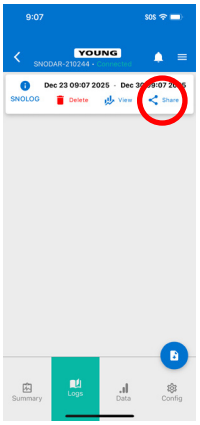


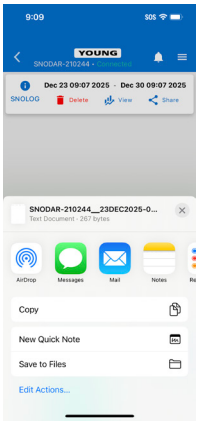






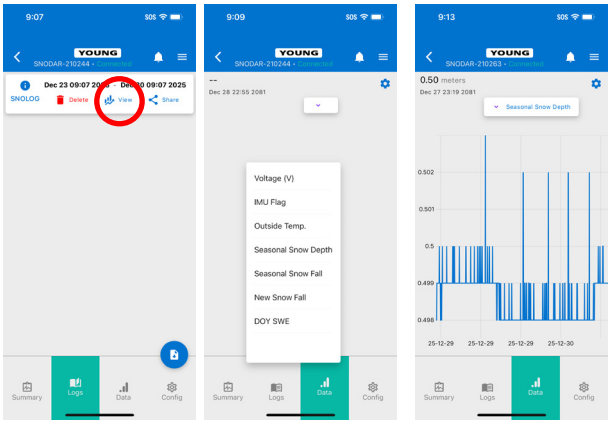
More information about each log can be found under the **SNOLOG Information** button. To view a graph of the log, tap the **View** button. Tapping the **Share** button will bring up options for sharing the log or uploading to your cloud storage of choice.





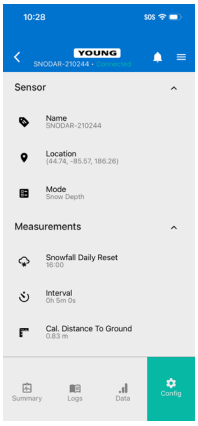
DATA

The Data Page displays an interactive depiction of the downloaded data. To plot data, select a log and press the **View** button for that log. Once the log has been plotted, different collections of data can be displayed by tapping the **Dropdown menu** above the plot. The chart settings can also be altered by tapping the **Settings** icon beside the dropdown menu.



CONFIGURATION

The Config Page allows for quick edits of some of the sensor's settings. These settings can only be edited after the Unlock button in the bottom corner of the screen is tapped. The Lock button should be tapped after edits are made.

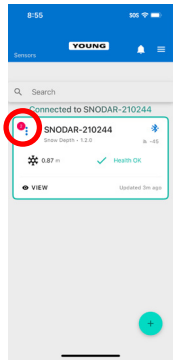


54000-90(A)

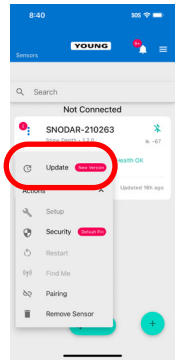
APPENDIX

DEVICE FIRMWARE UPDATE (DFU)

The App has the ability to update the sensor firmware over-the-air (OTA). Toggle the main **Kebab** menu in the upper left corner of the sensor card on the Home page. If there is an available update, a red-encircled + alert will appear by the Update action. Initiate the update and the unit LEDs will quickly flash Magenta, then hold Cyan while it is updating. **DON'T** power down the sensor or quit the App while updating. The unit will reboot and flash Green when updated and ready.



Sensor Card Kebab Menu Location



Available Firmware Update

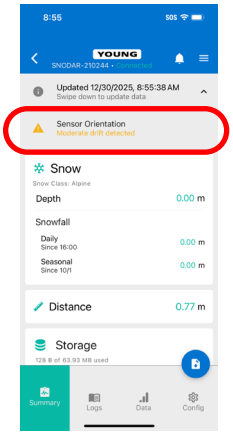
LED LEGEND

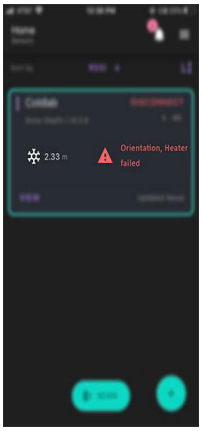
- Upon Boot
  - . 4 secs @ 5 Hz Green: Health Diagnostics Passing
  - . 4 secs @ 5 Hz Red: Health Diagnostics Failure
- Measurement
  - . Solid Yellow for length of measurement
  - . Solid White for length of calibration
- BLE Connect
  - . Fade Blue -> Cyan -> White for 2 seconds
- BLE Disconnect
  - . Fade White -> Cyan -> Blue for 2 seconds
- Device Firmware Update (DFU) via Mobile device
  - . Magenta for 2 seconds preparing update into Cyan for the length of the upload, up to 60 seconds. The unit will reboot when updating is finished.
- 'Find Me' Feature on the _Home_ Kebab menu
  - . Blue <-> White ping-pong for 4 seconds
  - . Useful to identify units when there are multiple sensors to configure

SENSOR ERROR NOTIFICATIONS

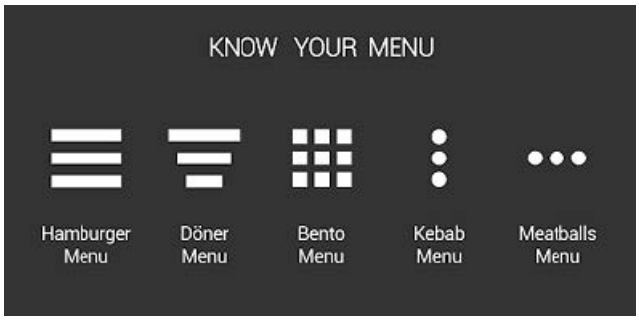
Orientation Drift: This sensor orientation notification will appear if considerable drift has been detected in the sensor's orientation. This error can be resolved by adjusting the sensor back to the correct orientation.

Heater Failure: This notification will be seen if the sensor's internal heater fails.

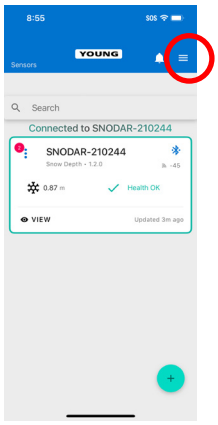


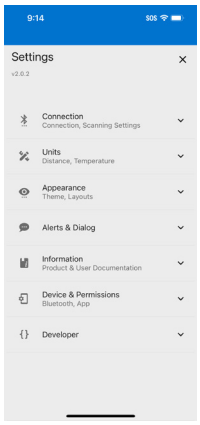


UNDERSTANDING THE MENUS



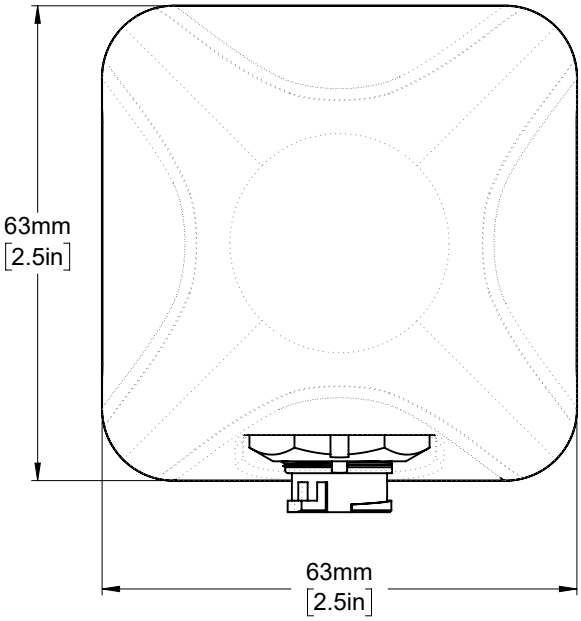
General App Info is contained in the upper right Hamburger Menu.

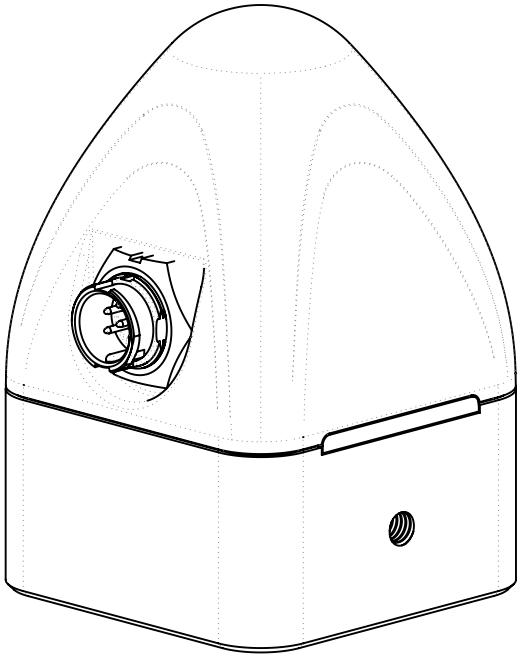


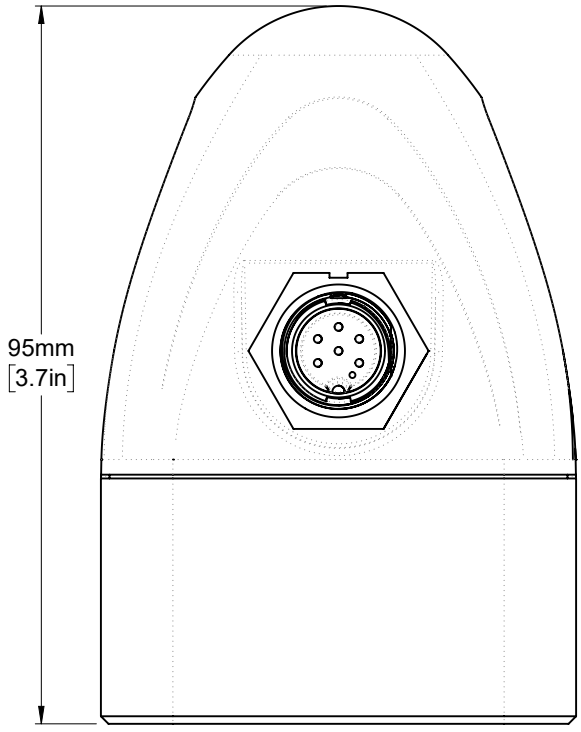


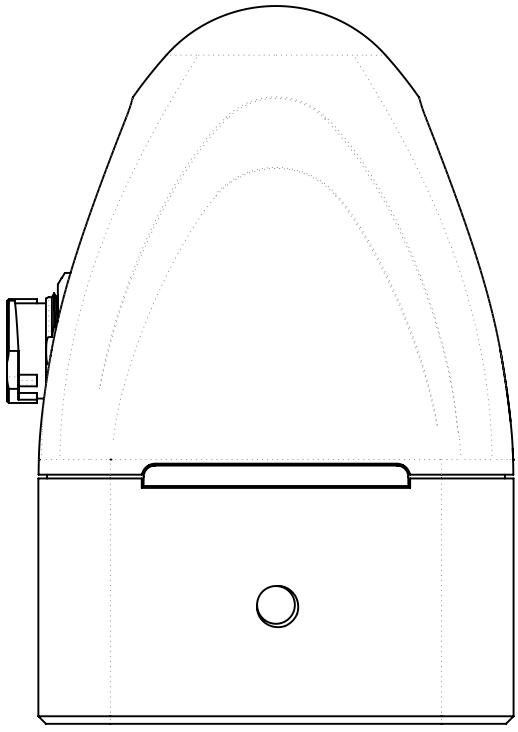
HARDWARE DIMENSIONS

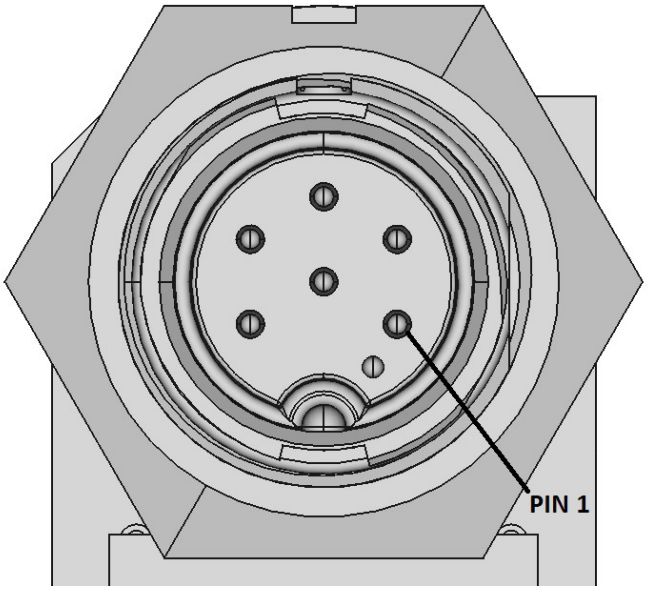
SNOdar



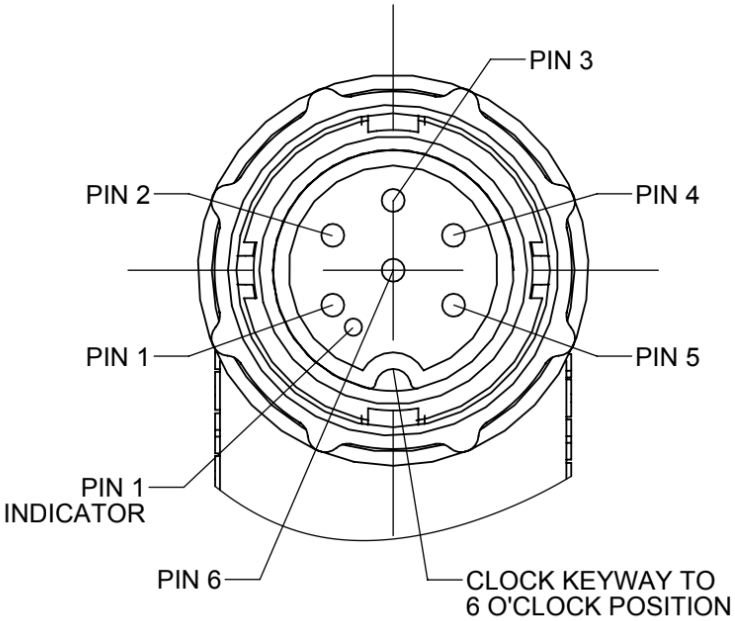








VIEW OF SENSOR SOCKET



PIN CALLOUT VIEW FROM MATING SIDE OF CONNECTOR
SCALE=3:1