

User Manual

Overview

This is the user's manual for the TriSonica Mini (TSM) family of products from Anemoment. It provides the information that users need to mount, orient, connect, receive data, and configure the TSM. This document covers all versions of the TSM including the TriSonica Mini Wind Sensor (TSM-WS), TriSonica Mini Wind and Weather Sensor (TSM-WWS), and the TriSonica Mini Wind and Weather Sensor Pipe Mount (TSM-PM).

Mounting the TriSonica Mini

TriSonica Mini Wind Sensor and TriSonica Wind and Weather Sensor

TSM-WS and the TSM-WWS have a flat base with four mounting points for connecting to a user-supplied mounting platform. The user-supplied mounting platform should be a flat plate having a 5-mm hole in the center for the connecting wires. For the TSM-WWS a 5.5 mm hole is needed over the Gortex Vent to allow for water vapor and air pressure exchange. Figure 1 shows a dimensioned drawing of the TSM-WS and TSM-WWS mounting.

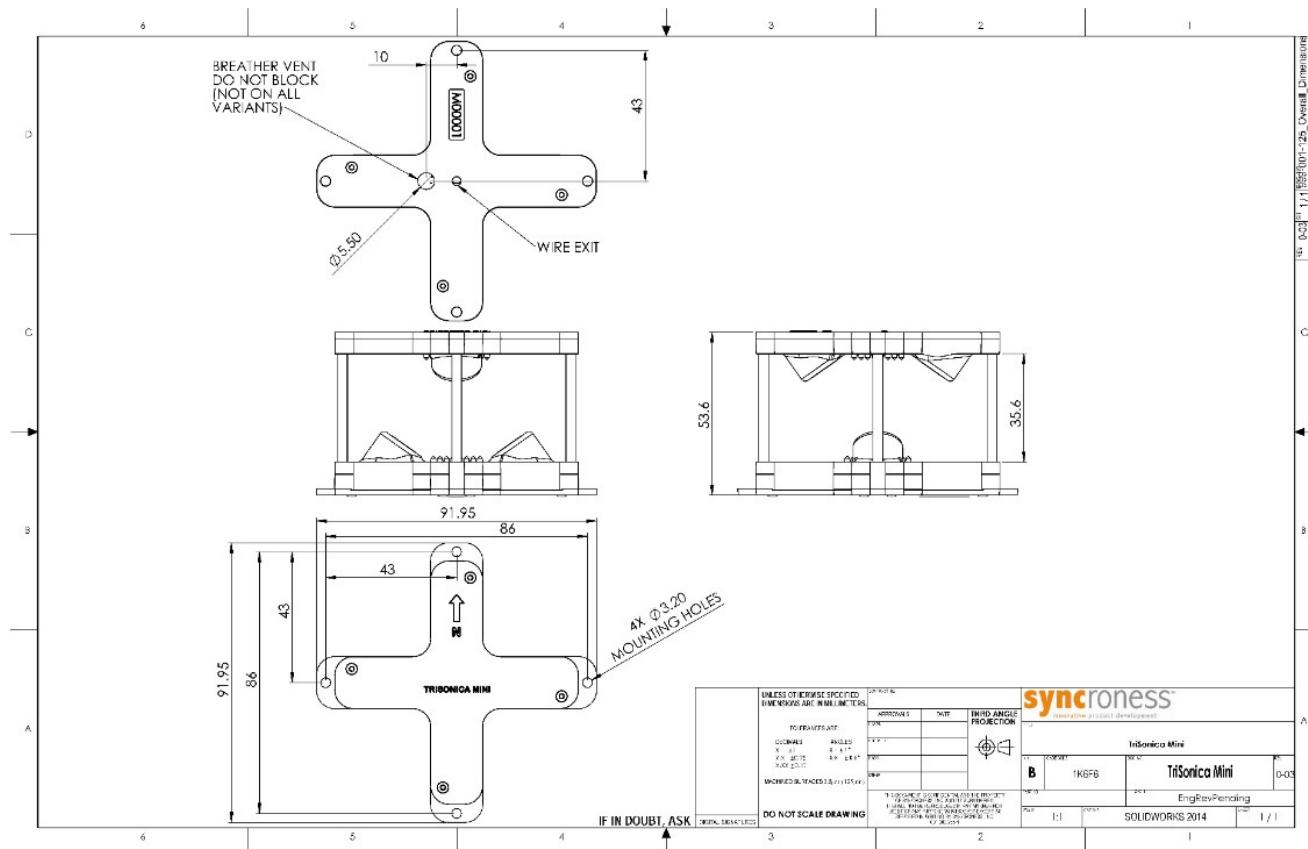


FIGURE 1: TRISONICA MINI FLAT BASE DRAWING

TriSonica Mini Wind and Weather Sensor Pipe Mount

The TSM-PM version has a circular connector designed to mount over a standard $\frac{1}{2}$ " DIN15 Schedule 10 pipe. The pipe must be a thin wall type, specified by the Schedule 10 designation, in order to allow an inside diameter wide enough for

the mating cable connector to pass through the pipe. Once fitted over the pipe a single set screw secures the TSM-PM to the pipe. Figure 2 shows a dimensioned drawing of the TSM-PM mounting.

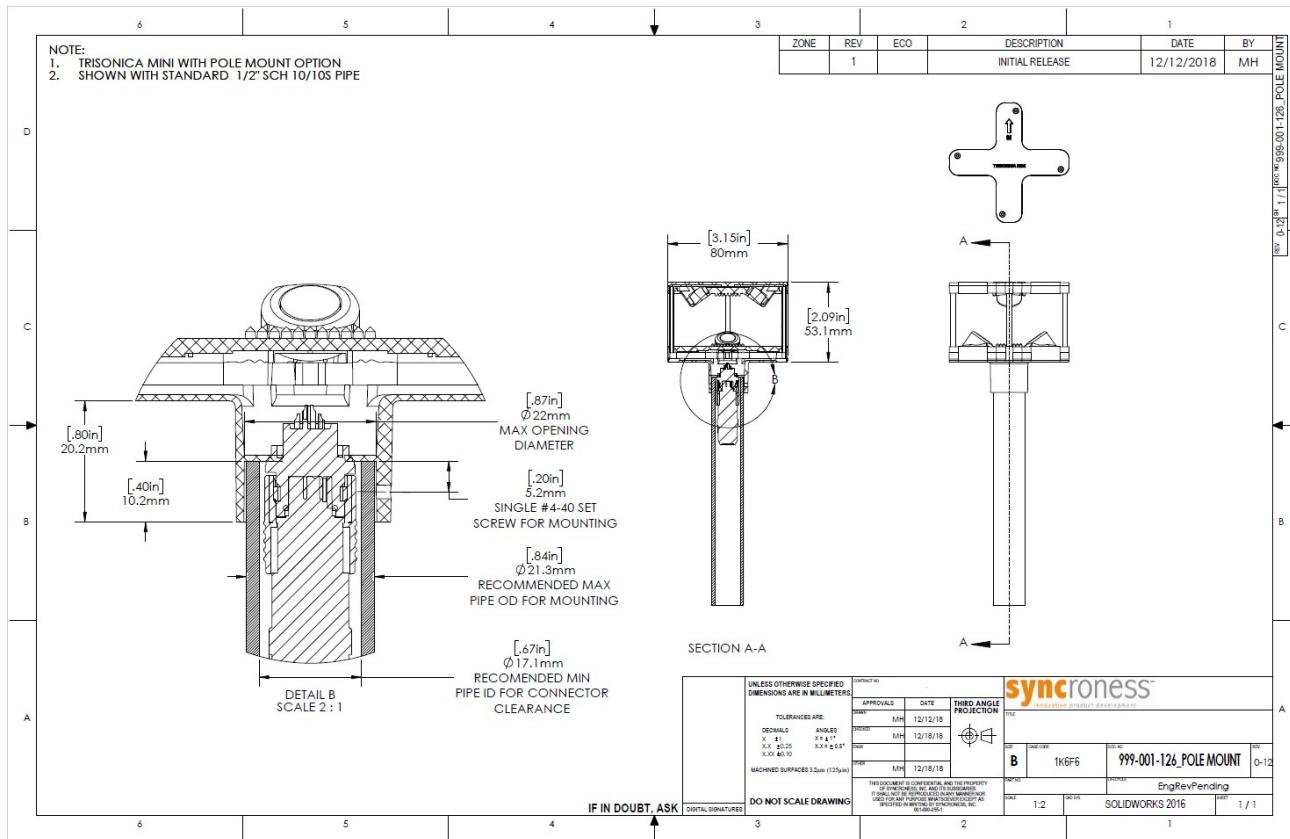


FIGURE 2: TRISONICA MINI PIPE MOUNT DRAWING

Orientation

A north indicator 'N' is marked on one of the upper arms of the TriSonica Mini. Airflow going into the 'N' or flowing from north to south will return zero degrees for wind direction. On the TSM-PM the connector mating indicator and the set screw are aligned with the 'N' indicator on the top.

Connecting

TriSonica Mini Wind Sensor and TriSonica Wind and Weather Sensor
TriSonica Mini provides four un-terminated wires for user hookup.

- **Yellow** is 9V to 36V.
- **Red** is RS-232 TxD.
- **Green** is RS-232 RxD.
- **Black** is Ground (and the serial connection return).

TriSonica Mini Wind and Weather Sensor Pipe Mount

THE TSM-PM USES A 12 PIN CIRCULAR IP67 CONNECTOR. FIGURE 3 SHOWS THE SIGNAL CONNECTIONS AND POSITIONS WHEN LOOKING AT THE CONNECTOR ON THE BOTTOM OF THE TSM-PM.

Table 1 show the connector pin out. Table 2 shows the signal name and wire color match of a TSM-PM cable with a blunt cut end.

TriSonica Mini Connector

| | | | |
|-----------|----------|-------------|---------|
| 1 - VIN | 2 - GND | 3 - Trigger | |
| 4 - TX+ | 5 - TX- | 6 - RX+ | 7 - RX- |
| 8 - Rsvd | 9 - GND | 10 - 232 | |
| 11 - Rsvd | 12 - GND | | |

FIGURE 3: TRISONICA MINI PIPE MOUNT PIN OUT

TABLE 1: TRISONICA MINI PIN DESCRIPTIONS

| Pin Number | Signal Name | Description |
|------------|-------------|--|
| 1 | VIN | Voltage Input of 9V to 36V |
| 2 | GND | Ground connection. Only one of the GND connections are required for proper operation. The multiple GND connections are provided as a convenience for wiring. |
| 3 | Trigger | Synchronizing Trigger input. This input allows multiple instruments to synchronize their sampling. |
| 4 | TX+ | Transmit data output in EIA232 Mode and TX+ data output in EIA422 mode. |
| 5 | TX- | TX- data output when in EIA422 mode. Not used in EIA232 mode. |
| 6 | RX+ | Receive data input in EIA232 Mode and TX+ data output in EIA422 mode. |
| 7 | RX- | RX- data output when in EIA422 mode. Not used in EIA232 mode. |
| 8 | Rsvd | Reserved – Not connected internally. |
| 9 | GND | Ground connection. See the description for Pin #2 |
| 10 | 232 | Force EIA232 mode. When this pin is connected to GND the TSM will start in EIA232 mode with the setting of 115200,8,N,1 regardless of the software settings of the instrument. |
| 11 | Rsvd | Reserved – Not connected internally. |
| 12 | GND | Ground connection. See the description for Pin #2 |

TABLE 2: TRISONICA MINI PIPE MOUNT CABLE SIGNAL AND WIRE COLOR FOR BLUNT CUT CABLES

| Color | Signal Name |
|-------------|-------------|
| Brown | VIN |
| Red | GND |
| Orange | Trigger |
| Yellow | TX+ |
| Green | TX- |
| Blue | RX+ |
| Violet | RX- |
| Gray | Rsvd |
| White | GND |
| Black | 232 |
| Green/Black | Rsvd |
| Tan | GND |

Data Output

Serial Data Format

The data output is an ASCII character string ending with carriage return and line feed characters. Each line is a single record containing all the measured parameters contained in a single sample. The parameters on an output line are separated by two spaces, or a single space and a negative sign. Optional data tags indicate the measurement associated with the value and can be turned on or off for each individual measurement.

A couple of samples of the output without tags:

05.2 112 -01.9 04.7 01.1 22.6

05.3 107 -01.5 04.9 01.3 22.2

The columns in this example in order are Wind Speed, Wind Direction, U-Vector, V-Vector, W-Vector, and Temperature.

A sample of the output data with tags:

S 05.2 D 112 U -01.9 V 04.7 W 01.1 T 22.6

S 05.3 D 107 U -01.5 V 04.9 W 01.3 T 22.2

S= Wind Speed

D= Wind Direction

U= U-Vector

V= V-Vector

W= W-Vector

T=Temperature

Error Codes

When the TriSonica Mini firmware detects an error, it puts out an error code in the data stream in all of the parameters that are affected by the error. All error codes are in the format of “-99.x”. The decimal value of the error code is a 1 or a 5 and simply indicates an error in the ultrasonic sampling (1), or the humidity sensor (5). When an error code is in the output, use the “diagnostic” command to get information about the error.

One of the most common reasons for an error is an ultrasonic pathway blockage. Ice, snow, or some other physical material is preventing the ultrasonic signal reception. Clearing the blockage returns the unit to normal operation.

TriSonica Mini Configuration

Serial Communication

The TriSonica Mini is configured by default to these serial parameters:

- Baud Rate: 115,200
- Data Bits: 8
- Parity: None
- Stop Bits: 1

The TriSonica Mini starts generating data about 1.5 seconds after power up, and outputs data continuously when in sampling mode.

Command Interface

To enter command line interface (CLI) mode, press Ctrl+C. The TSM stops sampling and provides a user prompt: ">".

Details of all available commands and their parameters are accessed within the Command Line interface by typing "help" at the user prompt. For reference, some of the commands are listed below. Parameters are indicated with "<" and ">" characters, replace the angle brackets and the text with the parameter value. Parameters shown within square brackets "[" and "]" are optional.

NOTE: We attempt to make the TSM CLI self-documenting, so the detailed help for each command may be more current than the information in the following table.

TABLE 3: SERIAL COMMANDS IN THE COMMAND LINE INTERFACE

| COMMAND | DESCRIPTION |
|--|---|
| help | Displays a list of CLI commands. |
| help <command> | The command word "help" followed by the name of another command displays detailed help for that command. |
| exit | Leave the CLI and return to sampling. |
| acclimate <temp> | Acclimate the TSM to an abrupt change in operating conditions or when it does not seem to be reading correctly. |
| baudrate [<baud> [now]] | Show or set the current baud rate |
| calibrate <temp> [<rh>] | Start an anemometer calibration cycle. See the anemometer calibration section of this document for more details about the anemometer calibration procedure. |
| compasscalibrate YES | Start a compass calibration cycle. (Not available on TSM-WS) See the compass calibration section of this document for more details about the compass calibration procedure. |
| decimals [<param>] | Set the number of decimal places of a Display Parameter or a Group of Parameters. See the Show, |

| | |
|--------------------------------------|---|
| | Hide, Tag, Untag, and Decimal Commands section in this document. |
| declination [<value>] | Set/Read the true heading declination offset |
| diagnostic | Performs a self-diagnostic and reports problems found with the TSM |
| display | Show the current Display Mode settings. See the Display Commands section in this document. |
| expert enable disable | Enable or Disable Expert Menu Command Items. See the section on Expert Mode |
| hide [<param>] | Hide Display Parameter Groups. See the Show, Hide, Tag, Untag, and Decimal Commands section in this document. |
| levelcalibrate YES | Start a level calibration cycle. (Not available on TSM-WS) See the compass calibration section of this document for more details about the compass calibration procedure. |
| nvwrite | Writes parameter data to non-volatile memory. See the section about Non-Volatile Parameters. |
| outputrate [<value>] | Set or Show the data output rate of the sampled data |
| parity [odd even none [now]] | Set or Show the current parity setting |
| programupdate [YES] | Use the TriSonica Mini Program Update Utility provided by Anemoment. |
| show [<param>] | Show Display Parameter or Groups. See the Show, Hide, Tag, Untag, and Decimal Commands section in this document. |
| systemreset | Software Reset. |
| tag [<param>] | Display the ID Tag of a Display Parameter or a Group of Parameters. See the Show, Hide, Tag, Untag, and Decimal Commands section in this document. |
| triggertype [<type>] | Set or Get the sampling trigger type |
| trisonicaid <id> | Set or Show TriSonica User Defined ID |
| units [<param> [units]] | Sets or Displays the units value for all adjustable parameters |
| untag [<param>] | Remove the ID Tag of a Display Parameter or a Group of Parameters. See the Show, Hide, Tag, Untag, and Decimal Commands section in this document. |

| | |
|------------------------------|--|
| version | Displays software version and build numbers |
| wd540 [<value>] | Set or Show the Wind Direction 540 Degree Mode |

Expert Mode

The TriSonica Mini has an expert mode in the Command Line Interface. When expert mode is enabled, these extra commands are present in the help menu. It is recommended that you understand the effects of these commands before you use them.

TABLE 4: SERIAL COMMANDS IN EXPERT MODE

| COMMAND | DESCRIPTION |
|--|--|
| averagesize [<size>] | Set or Show the size of the average of samples. This command specifies the number of internal samples to average before generating an output, when combined with the samperate command below it affects the output data rate. For simplicity, it is better to use the outputrate command in the basic menu. |
| digitalgain [<gain>] | Get or Set the digital gain. Digital, or software, gain is set by the calibration command. Changing digitalgain can affect the stability of your output data. |
| distance [<value>] (x1 or x4) | Set or Show the distance between transducers. This is one of the calibration factors set during the calibration cycle. If you enter the value as a single number, it will be applied to all four distances. If you enter four values, they will be applied respectively to the four distance values. The mechanical distance between transducers of a TSM is 0.03486. |
| offset [<value>] (x1 or x4) | Set or Show the offset value for all paths. This is one of the calibration factors set during the calibration cycle. If you enter the value as a single number, it will be applied to all four distances. If you enter four values, they will be applied respectively to the four distance values. The offset value compensates for variations in manufacturing. |
| orientuv [std ati otsm] | Set or View the UV Wind Vector Output coordinate system. There are some different definitions for the meanings of the U and V axis. The “std” setting defines positive U as being from the West, and positive V as being from the South. The “ati” setting defines the positive U as being from the North, and positive V as being from the West. The “otsm” setting matches the original TriSonica Mini output definition of positive U |

| | |
|----------------------------------|--|
| | as being form the North, and positive V as being from the East. |
| protocol [232 422 [now]] | Show or set the current serial protocol setting. The command only works for the TSM-PM, where the EIA422 signals are brought out to the connector. This is the software command to select between EIA232 and EIA422 modes. The “now” parameters makes the change immediately, otherwise the change happens after a system reset. |
| rawaverage [<size>] | Set or Show the size of the average of samples. This is a deprecated command and will be removed in a future version of the firmware. Do not use this command. |
| recordnoise YES | Sample and record system noise while acoustic paths are blocked. This is a deprecated command and will be removed in a future version of the firmware. Do not use this command. |
| samplerate [<Hz>] | Set or Get the internal sample frequency. This command changes the internal sampling rate and when combined with the averagesize command above affects the output data rate. For simplicity, it is better to use the outputrate command in the basic menu. |
| usenoise enable disable | Enable or Disable the Use Noise Mode. This is a deprecated command and will be removed in a future version of the firmware. Do not use this command. |
| viewnoise | View the recorded system noise captured by the recordnoise command. This is a deprecated command and will be removed in a future version of the firmware. Do not use this command. |

Display Command

The ‘display’ command prints a table indicating the name and description of each signal available, whether it is tagged or not, what the tag value is, how many decimals are displayed, whether the signal is enabled to be added to the serial output string, and the units for each measurement.

| Display Value List: | | | | | | |
|---------------------|----------------------|--------|-----|----------|---------|---------|
| Name | Description | Tagged | Tag | Decimals | Enabled | Units |
| S | Wind Speed 3D | | S | 1 | Yes | m/s |
| S2D | Wind Speed 2D | | S2 | 1 | Yes | m/s |
| D | Horiz Wind Direction | | D | | Yes | Degrees |
| DU | Vert Wind Direction | | DU | | Yes | Degrees |
| U | U Vector | | U | 1 | Yes | m/s |
| V | V Vector | | V | 1 | Yes | m/s |
| W | W Vector | | W | 1 | Yes | m/s |
| T | Temperature | | T | 1 | Yes | C |
| Cs | Speed of Sound | | C | 1 | Yes | m/s |

FIGURE 4: DISPLAY COMMAND OUTPUT EXAMPLE OF A TRISONICA MINI WIND SENSOR

Show, Hide, Tag, Untag, and Decimal Commands

The ‘show’, ‘hide’, ‘tag’, ‘untag’, and ‘decimal’ commands operate similarly. They enable a measurement, disable a measurement, display the tag for a measurement, remove the tag for a measurement, or adjust the number of decimals for an output; respectively.

When invoked without a parameter, they display the options available. The ‘show’ command only lists the values that are available to be shown, similarly the ‘hide’ command only lists the values that are can be hidden. (The ‘hide’ command provides a convenient list of all values currently being displayed.) The ‘tag’ and ‘untag’ commands show only the values available to be tagged and untagged, and the ‘decimal’ command only lists the values that allow changing their decimal resolution.

Calibration Procedure

Anemometer Calibration

Place the TSM inside a small container to reduce the airflow to as close to zero as possible. Care must be taken to eliminate acoustic reflections from hard sides and to not block the acoustic pathways. There should be some sound absorbing material on any flat walls that could reflect sound back towards the TSM. A small box with acoustic absorption foam is ideal. However, you can successfully calibrate a TSM by loosely wrapping coat or towel around it. You need to provide a zero-wind environment, and you need to know the temperature, and optionally the humidity, of the air volume where the TSM is enclosed.

Type “calibrate <temp> [<rh>]”

Where the <temp> = xx.x in °C temperature and <rh> = xx.x in % relative humidity. If humidity is not supplied, then 50% is assumed.

The calibration cycle takes ten seconds. You will see dots printed on the serial console indicating progress, and the serial prompt will return when the calibration is completed. Enter “nvwrite” to store the values in non-volatile memory.

Level Calibration

The calibration function of the level is simply an offset adjustment for the accelerometer contained in the TSM. Place the TSM on a known level surface such that the bottom surface of the TSM is parallel with the level surface. The wires of the TSM will prevent placing the TSM directly on the level surface. With the TSM in a known level configuration execute the “levelcalibrate” command. Enter “nvwrite” to store the values in non-volatile memory.

Compass Calibration

The compass calibration acclimates the compass module in the TSM to the local magnetic field. Start the compass calibration by using the “compasscalibrate” command. The compass calibration is active for ten seconds, during this time tilt and rotate the TSM into as many orientation as possible using a three dimensional figure eight pattern. Enter “nvwrite” to store the values in non-volatile memory.

Wind Direction Scale Command (wd540)

Wind direction can be displayed in a 0 to 360 degree format or in a 0 to 540 degree format for strip chart type displays. The 540-degree mode prevents full scale shifting of data when the wind direction is around 0, where it moves from 359 to 0 to 359. The data makes a single large transition once at 540 degrees and again at 180 degrees to display data otherwise.

Non-Volatile Parameters

The TriSonica Mini operates with a copy of its configuration parameters in volatile memory (RAM). When changes are made using the CLI, the parameters are updated in the volatile memory. These changes will be lost when the unit restarts

and pulls the parameters out of Non-Volatile Memory (Flash). To copy the parameter changes made in volatile memory to the non-volatile memory use the “nvwrite” command. The changes will then be remembered during a restart.

TriSonica Mini Wind and Weather Sensor Additional Outputs

The TSM-WWS and TSM-PM are equipped with extra sensors that are not present on the wind sensing version of TriSonica Mini. These additional sensors add humidity, absolute pressure, accelerometer (tilt), and magnetometer (compass).

Humidity

The humidity sensor is located inside the TriSonica Mini and depends on the water vapor transfer membrane (white Gortex dot) to keep the humidity inside the same as outside the unit. This causes a delay in the humidity reading when the humidity change. This delay can be up to an hour for very large humidity changes, such as moving the unit from a 90% environment to a 30% environment. Normal environmental humidity changes that happen more slowly experience a shorter latency.

The Humidity is determined by calculating the dew point inside the anemometer, it is assumed then that the dew point is the same inside and out. The average of the ultrasonic temperature is used to calculate the humidity from the dew point.

An issue seen during testing happened when the TriSonica Mini was removed from a warm 90% humidity environment to a cooler 30% environment. The quick change caused condensation inside the unit and it displayed humidity greater than 100% until the condensation evaporated and equalized through the vent.

Absolute Pressure

The absolute pressure sensor is located inside the TriSonica Mini and depends on the water vapor transfer membrane to keep the pressure inside the same as outside the unit.

Tilt

The accelerometer is located inside the TriSonica Mini. Since the mounting of the TriSonica Mini affects the tilt measurement, the offsets have not been set during manufacturing. The “levelcalibrate” command is provided to record the accelerometer values and use them to offset the measurement for level. The raw accelerometer outputs are also available.

Compass

The magnetic sensor, or compass, is located inside the TriSonica Mini. Since the heading reading of the magnetic sensor is very dependent on the magnetic effects of the environment around it, the heading is not calibrated during manufacturing. The “compasscalibrate” command is provided for the user to calibrate the compass in the environment where it will be used. The raw magnetometer outputs are also available.

To calibrate the heading, the user invokes the “compasscalibrate” command, then rotates and tilts the unit in a three-dimensional figure eight, similar to how you calibrate the compass of other handheld devices.

Wind Tunnels

Ultrasonic anemometers operate using ultrasonic pulses and measuring the time of flight between transducers. The time of flight measurements can be disturbed by external noise sources in the same frequency band that the ultrasonic anemometer operates within. Some wind tunnels generate ultrasonic noise that can cause erroneous readings from the anemometer. This is not an indication of failure of the anemometer, but an artifact of using the anemometer in an ultrasonically noisy environment.

Compact Fluorescent Lamps

Many compact fluorescent lamps operate at ultrasonic frequencies that interfere with the operation of a TriSonica Mini. If the instrument is operated near compact fluorescent lamps, erroneous and erratic readings may result. Turning off the compact fluorescent lamps or moving the TSM away from the CFL should result in proper instrument operation.