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# SENSIT<sup>®</sup> SPOD

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VOC EMISSIONS & AIR POLLUTANT MONITOR

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## OPERATION & CONFIGURATION GUIDE

READ AND UNDERSTAND INSTRUCTIONS BEFORE USE.



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# GENERAL INFORMATION

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OVERVIEW	PARAMETER
Weight	Base Unit: 6.75 lbs
Dimensions	Fully assembled with anemometer & antenna D x W x H (6" x 8" x 16")
Mounting	Attached mounting flanges
Voltage Requirements	18V – 24V DC Charging (wired adapter or solar panel)
Current Requirements	2A max current draw when charging
Operating Runtime	3-5 days battery backup <sup>1</sup>
Operating Temp	-10°C to 50°C <sup>2</sup>
Data Outputs	<ul style="list-style-type: none"><li>• Digital wired output (3.3V TTL - USB)</li><li>• Wireless (4G IoT Cellular Included) <sup>2</sup></li><li>• Optional analytics on server <sup>4</sup></li><li>• SD card data backup <sup>5</sup></li></ul>

## NOTES:

1. Battery backup time depends on run mode and frequency of transmission.
2. Limited by lithium iron phosphate charging temperature. Lower temperature operation will require external or internal heating to maintain sufficient battery temperature for charge acceptance. Contact the manufacturer for more information.
3. Requires SIM card and suitable data plan on AT&T or T-mobile. Verizon service is pending
4. Cloud based analytics can be developed with additional contract
5. When removing SD card to obtain data, it is recommended to power off the sensor box prior to reinserting the SD card to avoid possible errors. If the system stops responding or any SD errors are observed after inserting an SD card, power down the sensor and turn back on.

## **SENSORS INFORMATION**

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<b>OVERVIEW</b>	<b>PARAMETER</b>
Default PID Detection Range	10 ppb – 2 ppm <sup>1</sup>
Default PID Lamp Energy	10.6 eV <sup>2</sup>
Target PID Accuracy	+/- 20 ppb min or 10% <sup>3,4</sup>
Response Time	5-10 seconds <sup>5,6</sup>
Expected Lamp Life	1 year+

### **NOTES:**

1. VOC range reference to isobutylene. Additional PID sensors available with identical form factors if higher concentrations are necessary.
2. Additional PID sensors available with identical form factors if different lamp energies are required.
3. Factory calibration conducted with 1ppm isobutylene and ultra zero air. This value is a target and cannot be guaranteed for all environments.
4. PID Sensors are sensitive to high amounts of humidity and may rail at the upper output if humidity is excessive. The SPOD contains an internal sensor heater to minimize humidity interference.
5. If the unit has been off for an extended period of time, it could take several minutes to an hour for the PID readings to drop to normal operating conditions depending on storage conditions. This stabilization may temporarily interfere with VOC detection.
6. Exposure to very high levels of VOCs may saturate the detector for several minutes to an hour

# CELLULAR SPECIFICATIONS

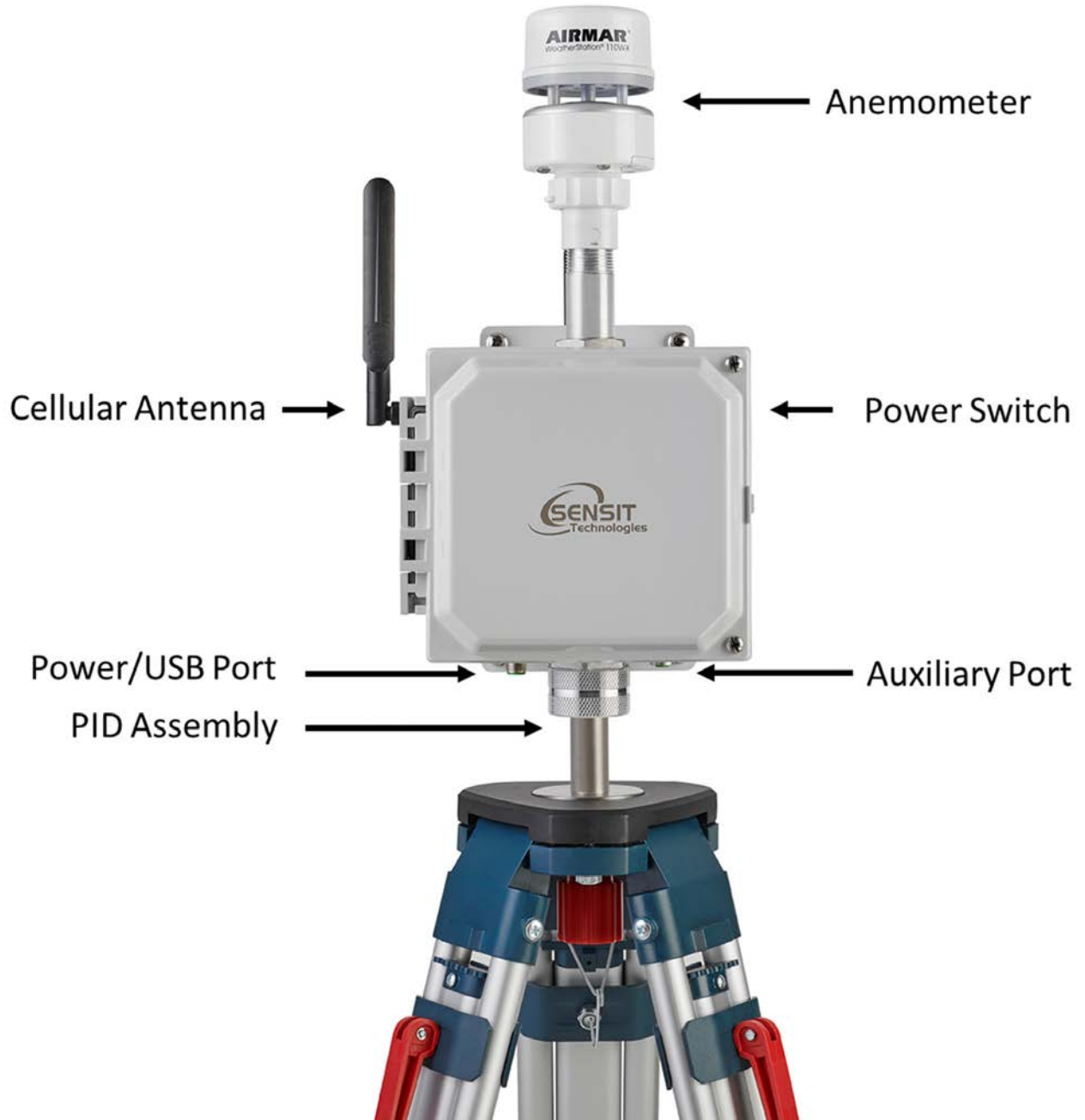
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OVERVIEW	PARAMETER
Network Technology	4G/2G <sup>1</sup>
Carrier	AT&T and T-mobile <sup>2</sup>
Transport Layer	TCP
Internet Layer	IP
Application Layer	HTTP and MQTT
Data Transfer Method	HTTP POST or MQTT Topics
HTTP Content Type	application/x-www-form-urlencoded
HTTP Body Field Identifiers	&ID, &MODULE, &STAT, &DATA
MQTT Content Type	JSON
MQTT Tags	"deviceld", "time", "iodb"
Post Location	Adjustable in Menu
APN	Adjustable in Menu
TLS/SSL	HTTPS and MQTTS with server authentication <sup>3</sup>

## NOTES:

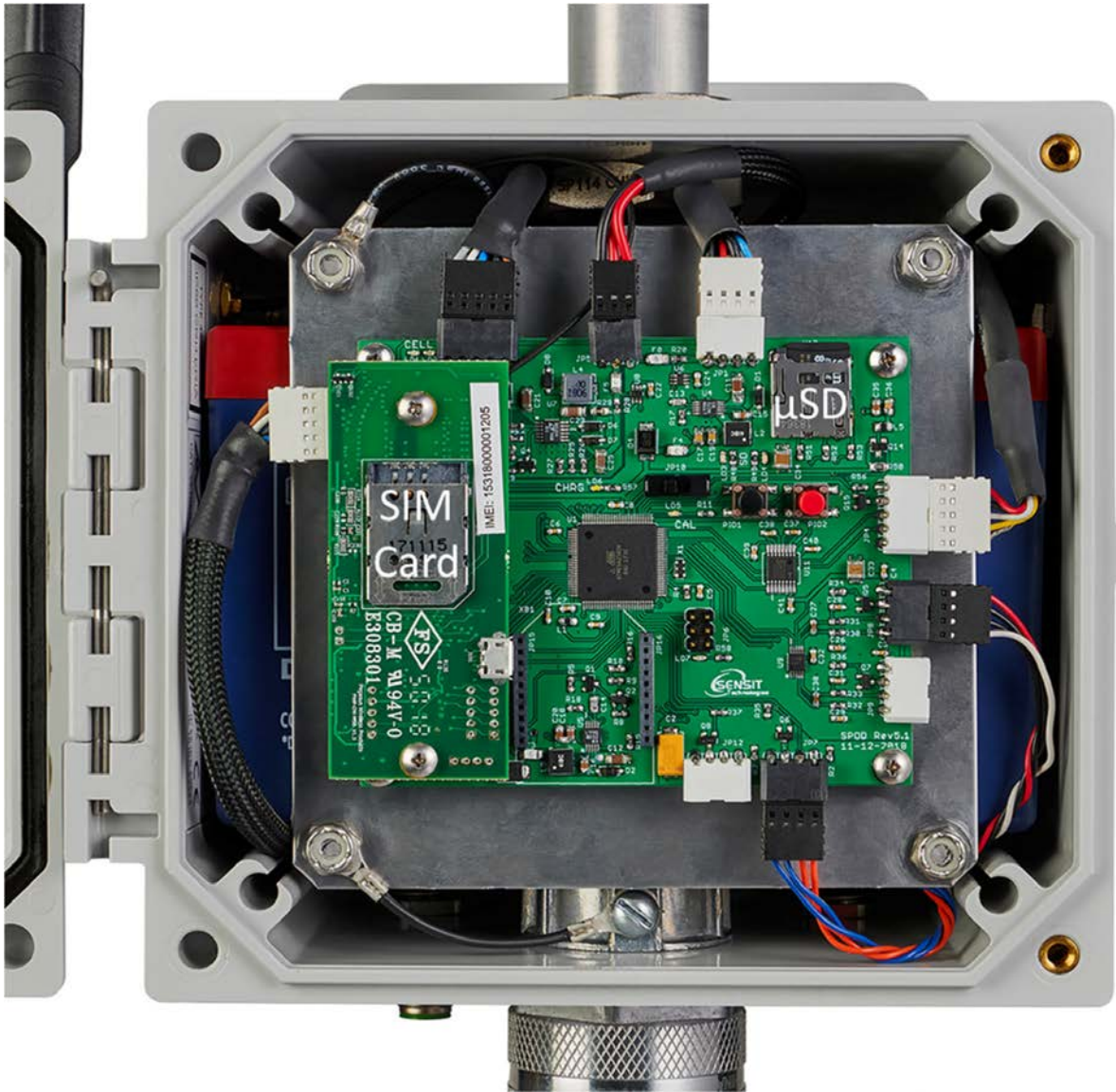
1. 4G CAT M1 and NB-IoT as well as 4G Cat 4 option
2. AT&T is default/preferred
3. Client authentication possible with additional development

# SENSOR EXTERIOR FEATURES (FRONT EXTERIOR)

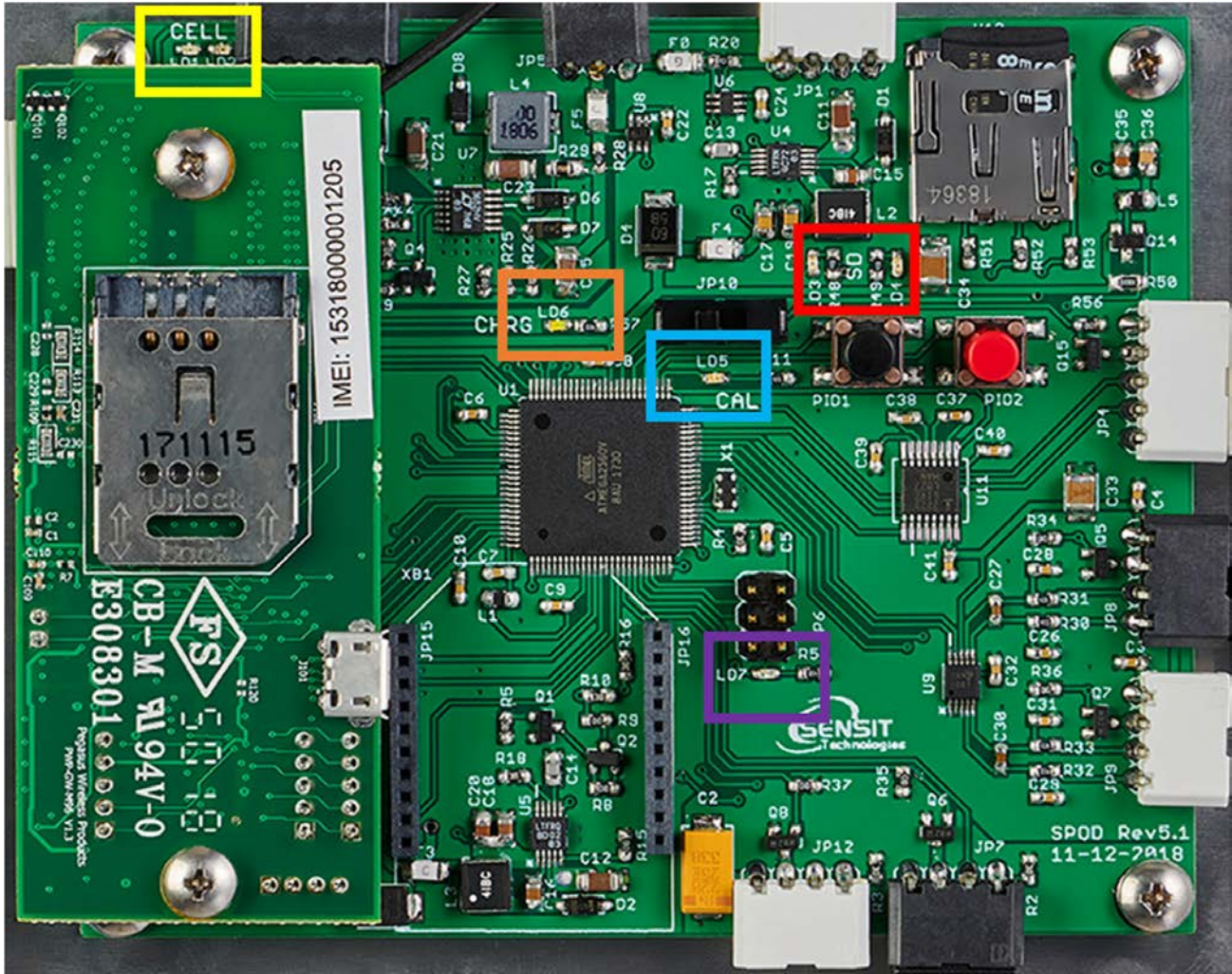


# SENSOR INTERIOR FEATURES (FRONT INTERIOR)

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# SENSOR INTERIOR LED INDICATION



- Cellular Status
- Charging Status
- Calibration Mode
- Sensor Status
- SD Card Status

Cellular Status: Red LED if failure, Green LED if successful

Charging Status: Green LED if Charging

Calibration Mode: Solid/Flashing Blue LED in Calibration

Sensor Status: Red LED if initialization failure (PID or Weather Station)

SD Card Status: Red LED if failure, Green LED if successful



## **QUICK START DEPLOYMENT GUIDE (USB CABLE & COMPUTER)**

It is recommended to use a computer and the supplied USB cable when setting up the sensor unit to verify the operation of the sensors, system output, and cellular data connectivity (if applicable). If no cable and computer are available, please see the next page.

Unpack the sensor unit and check for any physical damage or obstructions at the sensor openings. Open enclosure cover and check for any loose or damaged components. Make sure all wires are securely fastened as shown in the internal sensor view on page 7.

1. Install wireless antenna if equipped with cellular or local wireless module.
2. Hook up sample controller if applicable to the auxiliary port of the SPOD using the provided 5 pin cable.
3. Hook up USB cable sensor and initialize terminal connection. Power on unit and verify that the SD card was detected and initialized.
4. Verify the sensor outputs are reasonable or trending toward reasonable values keeping in mind the stabilization time for sensors that have been powered off or exposed to high VOC concentrations. Additionally, it may take up to 30 seconds for the ultrasonic anemometer to report valid environmental data. For information on USB headings and field identification, please see page 12.
5. When installing orient the weather sensor such that it is pointing North. Failure to do this will result in arbitrary wind direction. The North direction is indicated with a notch on the ultrasonic anemometer base. See page 15 for anemometer instructions. Never rotate the anemometer from the top or severe damage will occur.
6. After verifying functionality remove the USB cable. If planning to run in USB mode, install a power adapter or a solar panel for long term deployment applications. Otherwise, power cycle the SPOD, then install a power adapter or a solar panel for long term deployment applications.

## **QUICK START DEPLOYMENT GUIDE (NO COMPUTER)**

Unpack the sensor unit and check for any physical damage or obstructions at the sensor openings. Open enclosure cover and check for any loose or damaged components. Make sure all wires are securely fastened as shown in the internal sensor view on page 7 and refer to the LEDs indicated on page 8.

1. Install wireless antenna if equipped with cellular or local wireless module.
2. Hook up sample controller if using to the auxiliary port of the SPOD using the provide 5 pin cable.
3. Power on unit. The illuminated switch should turn on. If the switch does not illuminate, inspect all wiring connections and charge battery.
4. Verify that the SD card was detected and initialized with the SD status LEDs
5. Verify the absence of sensor errors with sensor status LED:

**NORMAL STARTUP:** LED solid for 5-10 seconds, brief off period followed by "Normal Flash (see below)"

**SD CARD ABSENT OR ERROR:** 250 msec on/250 msec off (e.g. rapid blink on and off) after the solid LED after pushing power button

**HARDWARE ERROR:** The following flash patterns are indicated for 1 minute following startup. This blink pattern is repeated every 6 seconds and is mirrored on sensor status led inside SPOD housing.

- 1 blink = PID Lamp 1 > 10000 hours
  - 2 blink = PID Sensor 1 Voltage Error
  - 3 blink = PID Lamp 2 > 10000 hours (Only for Dual Sensor Design)
  - 4 blink = PID Sensor 2 Voltage Error (Only for Dual Sensor Design)
  - 5 blink = Ultrasonic Anemometer Error
  - 6 blink = Canister Communication Error (expected canister controller but wasn't found)
6. If HTTP or MQTT protocol is selected verify successful initialization after startup with Cellular status. If cellular connection fails, there will be diagnostic code in the beginning. These codes will be repeated on the cellular status led inside the enclosure. If PERIODIC protocol is used wait for required amount of time before cellular post.
    - 1 blink = General Error, Host Address Error
    - 2 blink = Communication Error
    - 3 blink = SIM card error (missing/not valid)
    - 4 blink = Cellular Registration Error
    - 5 blink = Data Connection Error
    - 6 blink = No response from server
    - 7 blink = MQTT authentication error
  7. If power is hooked up, wait for 1 minute after power up to verify the charging status LED is illuminated. Please note that if the battery is completely full the charging status LED will not illuminate.
  8. When installing orient the weather sensor such that it is pointing North. Failure to do this will result in arbitrary wind direction. The North direction is indicated with a notch on the ultrasonic anemometer base. See page 15 for anemometer instructions. Never rotate the anemometer from the top or severe damage will occur.

9. After initialization is complete the illuminated switch will display the “Normal Flash” (During Operation): Double blink every ~1 second.

**NOTE:** Flash pattern during cellular post is more erratic and is associated with different times to send commands and receive response. If flash pattern looks different and you are concerned, I’d recommend giving the sensor 30-60 seconds and see if the double blink starts again after the cellular post finishes.

## USB OUTPUT HEADINGS AND DESCRIPTION

USB HEADING	DESCRIPTION	UNITS/FORMAT
SPOD	Serial Number	1000-63535
DATE	Local Date and Time	MM/DD/YY HH:MM:SS (24H)
PID1	Field 1, Sensor 1 VOC	PPB
	Field 2, Sensor 1 Raw	mV
PID2 <sup>1</sup>	Field 1, Sensor 2 VOC	PPB
	Field 2, Sensor 2 Raw	mV
T	Temperature	°C
RH	Relative Humidity	%
P	Pressure	mBar
WS	Wind Speed	mph
WD	Wind Direction	Degrees
TC	Field 1, Sensor 1 Temp	Arb Units
	Field 2, Heater 1 Output	0 = Off, 255 = Fully On
	Field 3, Sensor 1 Setpoint	Arb Units
	Field 4, Sensor 2 Temp <sup>1</sup>	Arb Units
	Field 5, Heater 2 Output <sup>1</sup>	0 = Off, 255 = Fully On
	Field 5, Heater 2 Setpoint <sup>1</sup>	Arb Units
BATT	Battery Voltage	Volt
CHRG	Charging Current	mA
RUN	Operating Current	mA
TRIG	Field 1, Port Status	*See Below For All Fields*
	Field 2, Trigger Flag	
	Field 3, Active Flag	
	Field 4, Sample Flag	
LAT <sup>2</sup>	GPS Latitude	Degrees
LON <sup>2</sup>	GPS Longitude	Degrees
CRC	Checksum	Data Integrity Bytes

### NOTES:

1. The control circuit board is designed to support a second sensor. Additional parameters will show up in the output if a dual sensor unit is configured by the factory.
2. GPS is not enabled on all units. Please contact Sensit to enable GPS.

## **FIELD 1 (PORT STATUS)**

<b>BIT NUMBER</b>	<b>DESCRIPTION</b>
7 (MSB)	Port 4: Collected = 1, Not Collected = 0
6	Port 3: Collected = 1, Not Collected = 0
5	Port 2: Collected = 1, Not Collected = 0
4	Port 1: Collected = 1, Not Collected = 0
3	Port 4: Installed = 1, Not Installed = 0
2	Port 3: Installed = 1, Not Installed = 0
1	Port 2: Installed = 1, Not Installed = 0
0 (LSB)	Port 1: Installed = 1, Not Installed = 0

## **FIELD 2 (TRIGGER STATUS)**

<b>BIT NUMBER</b>	<b>DESCRIPTION</b>
7 (MSB)	Not Used
6	Not Used
5	Not Used
4	Wind Only Trigger
3	Combo, High Wind Speed
2	Combo, Med Wind Speed
1	Combo, Low Wind Speed
0 (LSB)	Threshold Trigger

## **FIELD 3 (ACTIVE PORT)**

<b>BIT NUMBER</b>	<b>DESCRIPTION</b>
7 (MSB)	Not Used
6	Not Used
5	Not Used
4	Not Used
3	Port 4: On = 1, Off = 0
2	Port 3: On = 1, Off = 0
1	Port 2: On = 1, Off = 0
0 (LSB)	Port 1: On = 1, Off = 0

## **FIELD 4 (EVENT STATUS)**

<b>BIT NUMBER</b>	<b>DESCRIPTION</b>
7 (MSB)	Event 4: Complete = 1, Not Complete = 0
6	Event 3: Complete = 1, Not Complete = 0
5	Event 2: Complete = 1, Not Complete = 0
4	Event 1: Complete = 1, Not Complete = 0
3	Event 4: Started = 1, Not Started = 0
2	Event 3: Started = 1, Not Started = 0
1	Event 2: Started = 1, Not Started = 0
0 (LSB)	Event 1: Started = 1, Not Started = 0

# ULTRASONIC ANEMOMETER MOUNTING INSTRUCTIONS

## INSTALLING (FIGURE 3)

**CAUTION:** The reflector plate and the waterproof film found in the wind channel of the WeatherStation Instrument are essential to its operation. Be careful not to scratch the plate, puncture the film, or damage them in any way.

**CAUTION:** The WeatherStation Instrument must be installed upright and vertical, not tilted to one side. It must be level and plumb. If the WeatherStation Instrument is tilted from the horizontal plane, it may introduce errors in the compass and wind readings.

**CAUTION:** To accurately measure the wind direction and heacing, the alignment notch on the WeatherStation Instrument must be pointed correctly.

- Moving vehicle/boat-The alignment notch must point forward and be parallel to the centerline of the vehicle/boat.
- Stationary surface-It is recommended that the alignment notch point toward true north

**CAUTION:** Tighten or align the WeatherStation Instrument by grasping the lower housing below the reflector plate. Hand tighten only.

- Do not rotate the cap. Turning It may sever internal connections and void the warranty.
- 1 IOWXS, 150WXR, 150WXS-Oo not grasp the solar-radiation shield. The louvers may break.

**CAUTION:** If you use a thread lock, use Teflon pipe-thread tape. Do not use a liquid thread lock as it may weaken the plastic, causing it to swell and crack.

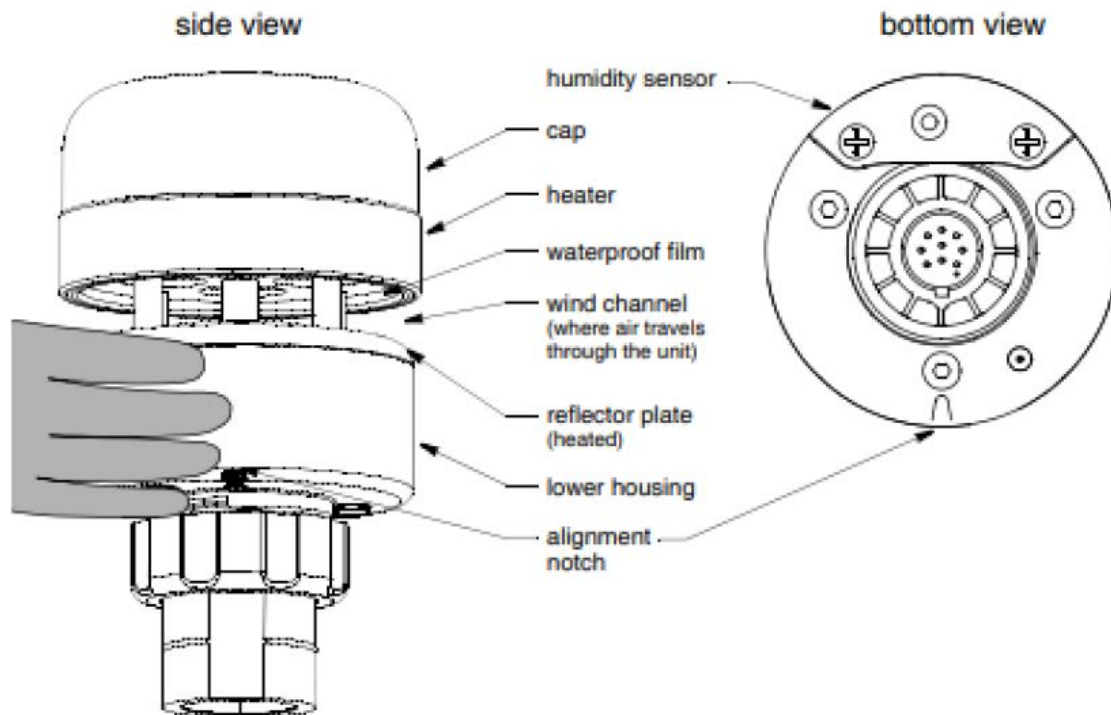


Figure 3. WeatherStation Instrument with heater (120/220WXH shown)

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## **TRIPOD SETUP AND INSTALLATION (OPTIONAL)**

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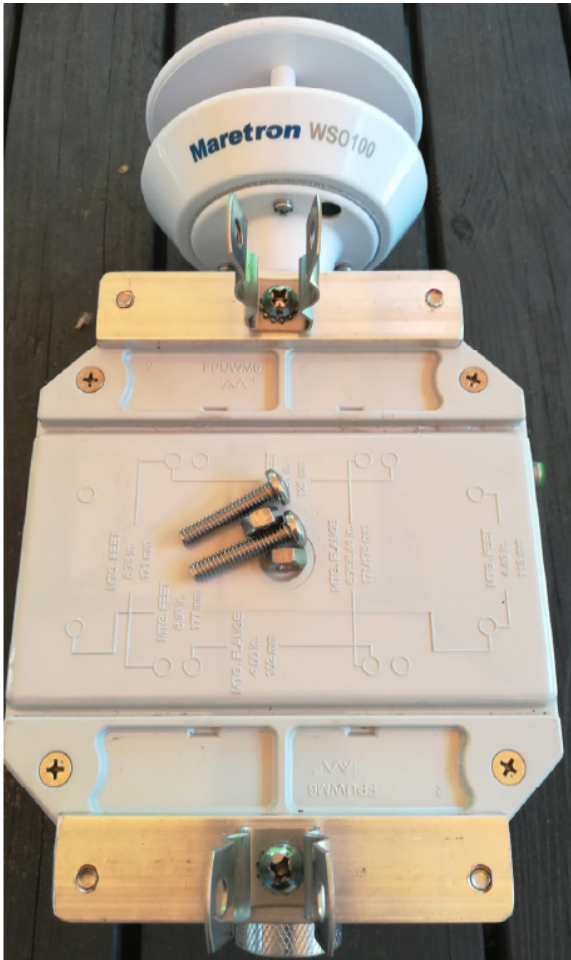
1. Remove protective rubber feet if installing outdoors
2. Install pole on tripod. Pole mounting attachment may differ from image below.
3. Set leg height of tripod and spread legs with a minimum of 30° from perpendicular
4. For added stability in high wind or long-term deployments place sandbags against all legs and step in feet down into the soil.

Catch tab with  
bag to hold down



5. Use the shorter ¼" long screw to attach pole mount to back of SPOD
6. Use the longer 1 ¼" long screw + nut to tighten on pole
7. Tighten sufficiently to prevent rotation
8. Place SPOD as far up as possible on pole to avoid blocking anemometer

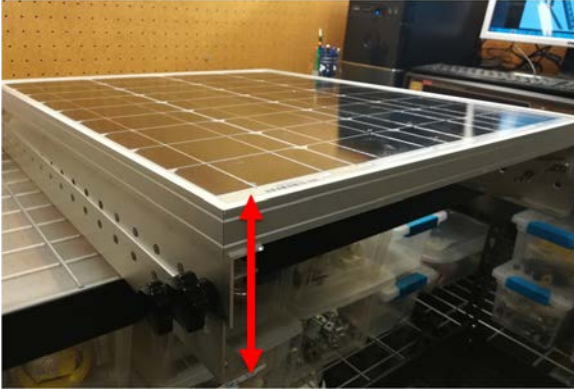
**NOTE:** The images below are used for reference. SPOD appearance will differ slightly from image below.



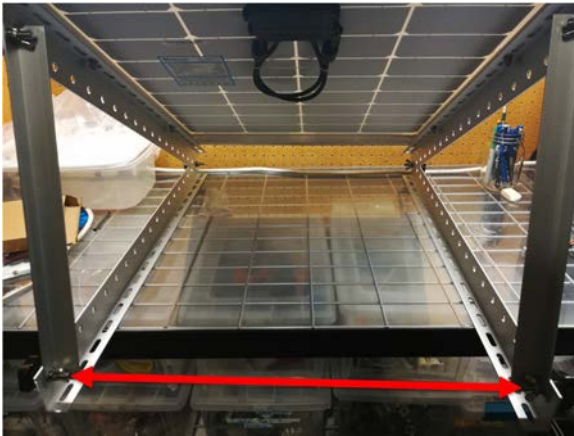
## **SOLAR PANEL SETUP & INSTALLATION (OPTIONAL)**

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1. Lift up on side with 2 knobs to unfold panel
2. Fold down angular supports on both sides and remove 2 knobs on bottom



3. Reattach knobs vertical angular supports on both sides (flat washer, lock washer, wing nut)



4. Place solar panel on ground and fasten to ground or add ballast if possible (recommended to avoid wind damage and theft)
5. Avoid shadowing on panel as much as possible as this will drastically reduce panel output power and efficiency
6. Route cable to SPOD unit
7. Plug cable into SPOD "Power/USB" connection
8. Power on SPOD unit

**NOTE:** Alternative solar mounts and solar panel extension cables can be purchased from Sensit. Please contact Sensit for more information if your application requires an alternative solar mounting setup.



# **POLE MOUNT SOLAR PANEL SETUP & INSTALLATION (OPTIONAL)**

1. Place solar panel on tripod leg or other suitable pole.
2. To place on tripod open worm gear clamps and install as shown below. Note that desired tripod height should be set prior to fully tightening worm gear clamp as adjustments are difficult after the clamp is tightened.



3. Lift panel mount up to keep panel off the ground. If high weeds or deep snow are present consider increasing height off the ground.



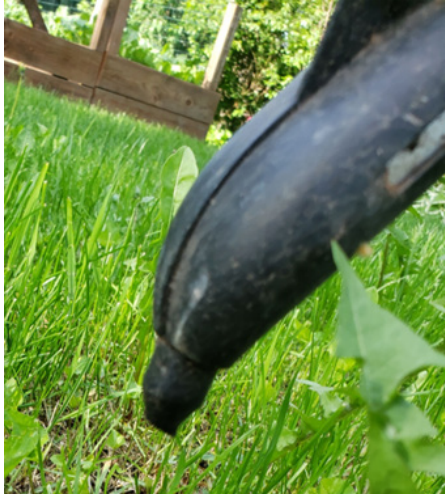
4. Adjust angle according to season and latitude or if heavy snowfall is anticipated. To adjust angle, loosen the 4 bolts until the panel can tilt up and down freely. After the correct angle is set, tighten the 4 bolts fully.



5. Avoid shadowing on panel as much as possible as this will drastically reduce panel output power and efficiency
6. Route cable to SPOD unit
7. Plug cable into SPOD "Power/USB" connection
8. Power on SPOD unit

## **TRIPOD SETUP & ANCHOR KIT INSTALLATION (OPTIONAL)**

1. Adjust tripod to desired height by flipping up red lever and pulling out legs to desired height. The optimal angle for tripod stability is in the range of 60-65 degrees with respect to the ground
2. Remove protective rubber feet from tripod legs



3. Step feet into the ground fully. If setting up a tripod on a hard surface and the legs cannot be stepped into the ground it is necessary to use weights (e.g. sandbags, blocks, etc) to prevent the legs from moving or tipping over. SENSIT is not liable for damage due to improper tripod mounting.



4. Screw in earth anchor in the center of tripod footprint and thread ratcheting rope through anchor as shown. The 2 metal hooks should attach to tripod legs as shown and a loop of rope should go around the remaining leg passing through the eyelet at top of anchor.



# **CANISTER VALVE CONTROLLER INSTALLATION (OPTIONAL)**

The SPOD Canister Valve Controller (CVC) allows the independent or concurrent actuation of up to 4 latching solenoid valves.



1. To use the canister valve controller, hook the valve controller power and TTL comm port up to the auxiliary port of the SPOD.
2. Hook any valves and pressure sensors up to the valve/pressure ports.
3. Power on SPOD and configure sampler as described in the USB configuration settings. Please note that when enabling sampling for the first time, the user must power cycle before attempting to configure the sampler parameters.



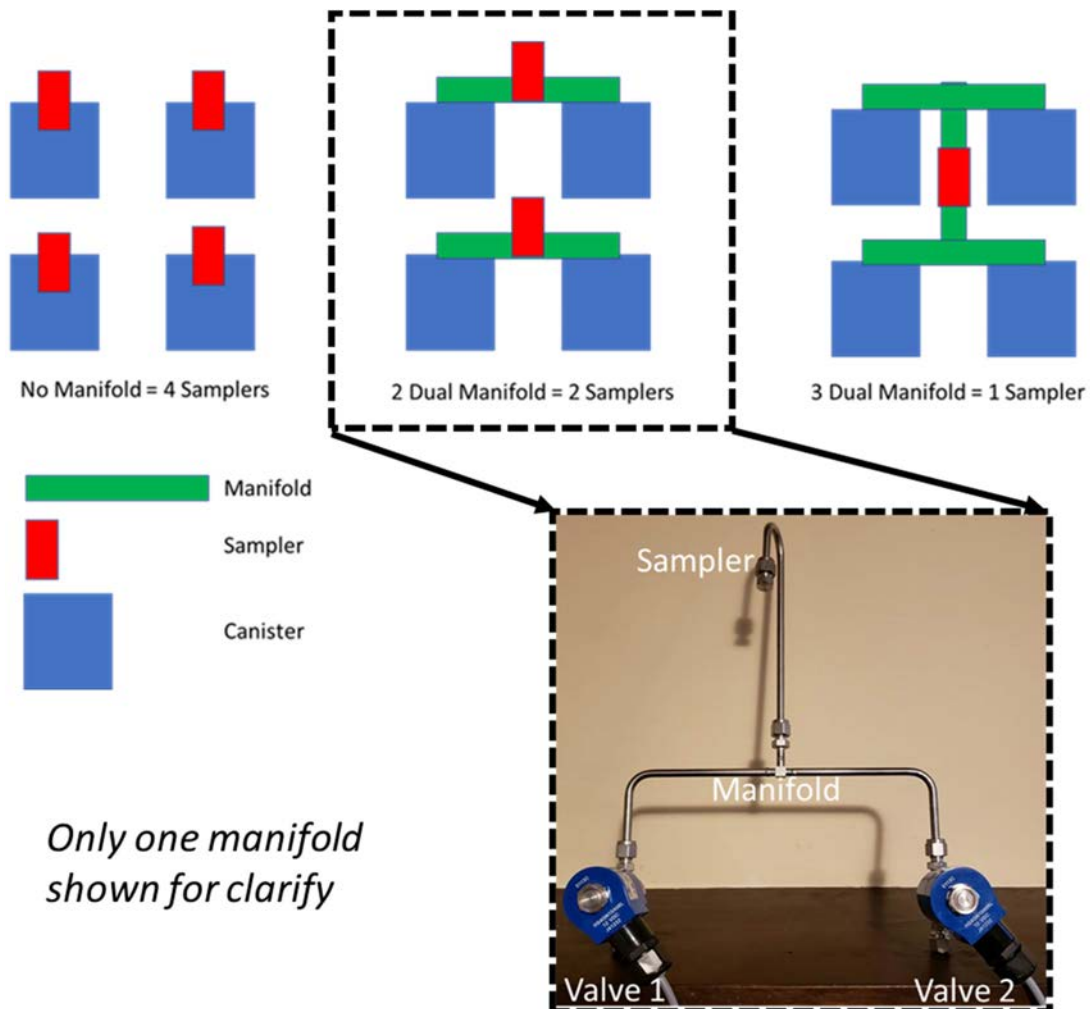
4. The canister valve controller features 4 status indicators for the ports. The color indicates the status.

LED COLOR	DESCRIPTION
BLUE	Not Enabled
GREEN	Enabled and Not Collected
RED	Enabled and Collected
RED-GREEN-BLUE	Currently Collecting Sample

5. The canister valve controller features 4 local buttons for control and testing. The button behavior will depend on the status of port. When the button is pushed, the LED begins to flash RED-GREEN-RED-GREEN. Continue to hold the button until the status LED shows BLUE. Release button and change will occur.

CANISTER STATUS	ACTION
(B) NOT ENABLED	No Action
(G) ENABLED AND NOT COLLECTED	Open Valve
(R) ENABLED AND COLLECTED	Reset Collection Status (Swap Canister)
(RGB) CURRENTLY COLLECTING	Close Valve

6. The configuration of the canister valve hardware is up to the operator. Example setups are discussed here. The CVC can be used with up to 4 cans. The canisters can be connected with manifolds to share a single sampler. This is especially useful when using expensive time integrated samplers. The manifold dead space is negligible when using a 6L can and larger but becomes significant for smaller can sizes.



7. The connection to the canister is shown here both with and without a pressure sensor and no manifold. The inlet of the valve should be the high pressure (atmosphere) side and the outlet of the valve should be the low pressure (vacuum) side of the valve.

Without Pressure Sensor



With Pressure Sensor



8. After hooking everything up, test the valves and pressure sensors described in the USB configuration guide. After testing is complete, be sure to close all the valves and open the manual canister valve. The valves have been leak tested at the factory but final leak testing is the responsibility of the customer.

## **USB COMMUNICATION & CONFIGURATION MODE (SENSOR)**

The SPOD units allow for the reconfiguration of several parameters pertaining to the operation of system. Adjustment of these parameters is only accessible for a short period of time after powering on the sensor (~10s). These parameters are stored in non-volatile memory and are retained during subsequent power cycling. Documentation of these parameters is listed below.

### **REQUIRED COMPONENTS:**

- SPOD Unit
- USB data cable
- Computer with a serial port terminal software program (e.g. CoolTerm)

### **SENSOR QUICKSTART INSTRUCTIONS**

1. Connect the USB cable to the SPOD and computer and establish the communication link in the terminal software.
2. Turn on power switch and observe initialization process. After initializing the micro-controller and printing SPOD information, the system will prompt the user to: **“Enter Configuration Mode? (YES)”**
3. Configuration mode allows access to configuration settings and system settings. To enter configuration mode type Yes at the prompt and hit enter. The menus are all text-based and easy to follow. The following list contains all the adjustable within the menu:

<b>MENU ITEM</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>
Cellular	Common setting	Root Menu
Default	System Default Settings	Root Menu
Display	Prints Current Settings	Root Menu
GPS	GPS Settings	Root Menu
Heat	Sensor Heater Settings	Root Menu*
Baseline	Sensor Offset Setting	Root Menu*
Output	Sensor Output Behavior	Root Menu
Power	Power Settings	Root Menu*
PID	PID Sensor Setting	Root Menu*
Time	Time Setting	Root Menu
System	System Setting	Root Menu*
Sample	Sample Collection Setting	Root Menu
Trigger	Sample Trigger Settings	Root Menu
Exit	Exit Menu	Root Menu

\*To provide more consistency with other product lines, multiple options are moving to a SYSTEM settings menu option starting with Firmware v6.00. Please refer to Detailed System Menu Information for information on these settings and note location within menu may be different or not exist for firmware versions v6.00 and above.

## **DETAILED ROOT MENU INFORMATION**

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**CELLULAR:** Contains all settings associated with the cellular modem. This is required for communication with any online servers.

**DEFAULT:** Resets all options to the factory default. Not recommended without consulting SENSIT. This will remove all custom settings including cellular information.

**DISPLAY:** Displays all current settings in the terminal window. An example print out is shown below. Please note that system settings may differ from device to device depending on the application.

```
Sensor ID: SPOD09005
Without MET
System DATE,03/23/22 15:21:03
Network Time: Enabled, Local
Battery Voltage: 13.81
Power Source: Solar Power
Output Mode: Streaming, Standard SD Rate
Communication Mode: Cellular, Unlocked
Network Selection: LTE
Cellular Protocol: CSV Periodic HTTP Always On with TLS
Output Data Rate: 60
Cellular Output Ratio: 2
Server Address: http://18.222.146.48/SENSIT/TEST/v1/data/sensor_add.php
Access Point Name: zipit.m2m
GPS Mode: Disabled
PID1 Hours: 763
Sensor Heater: Enabled
Temp Set: 30
Dew Point Control: Disabled
PID1 Offset(ppb): 0.00, Constrained
```

Sampling Disabled

**GPS:** "ENABLE" or "DISABLE" the GPS. Depending on the cellular data protocol and output mode, the user may be presented with additional options. If cellular output is disabled or if PERIODIC protocol is selected the GPS mode will default to SINGLE (see below). If cellular output is enabled **and** MQTT or HTTP protocol are enabled the user can select between the following GPS settings:

"CONSTANT": GPS is always on and fixing position (Highest power draw)

"INTERVAL": GPS turns on at an interval determined by "RATIO"x"ODR"

"SINGLE": GPS turns on at power up and remains off until system is reset

**OUTPUT:** This menu contains settings that modify the output characteristics of the sensor.

**SAMPLE:** Control the behavior of the auxiliary port. The port is configured to supply power to a sample collection system if trigger conditions are met.

**TIME:** Set the system date and time. If cellular is available and automatic date and time is enabled, this will happen automatically when the device connects. Note that the initial data may have the wrong date and time until the clock adjusts.

**TRIGGER:** Define the required environmental conditions to trigger sample collection.

**EXIT:** Leave the root menu and starts system operation

## **DETAILED CELLULAR MENU INFORMATION**

---

<b>MENU ITEM</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>
APN	Carrier APN Setting	Cellular Menu
Credentials	MQTT Username and Password	Cellular Menu
Host	Server Location Address	Cellular Menu
Network	Cellular Network Configuration	Cellular Menu
Protocol	Data Transfer Protocol	Cellular Menu
Ratio	Number of Samples to Buffer	Cellular Menu
Signal	Apply settings and check signal	Cellular Menu
TLS	Activate TLS, Load Server Cert	Cellular Menu
Topics	MQTT Topics	Cellular Menu
Exit	Exit Cellular Menu	Cellular Menu

**APN:** Set the required APN for data access on the installed sim card. Please note that the APN text entry might be case sensitive for your network provider.

**BAND:** Select and scan available bands to verify cellular connection and select most suitable band. Also features CARRIER band selection in the United States for AT&T, T-Mobile, and Verizon. This is an advanced feature and is not recommended to be used without guidance of SENSIT.

**CREDENTIALS:** Set the require USERNAME and PASSWORD require for MQTT data access. This menu will prompt the user to type "USERPASS" or "AZUREHUB". To manually configure username and password type "USERPASS". If using Azure IoT hub, type "AZUREHUB" to send SAS token. The SPOD will parse the relevant connection parameters from the SAS token. The SAS token must have the following parameters to be accepted:

**SharedAccessSignature sr=<HOSTNAME>%2Fdevices%2F<DEVICEID> &sig=<URI of the resource being accessed, HASH > &se=<Token Expiry Time, Epoch Time>**

**HOST:** Set the server address to send the data to. The target server must be configured to accept the data.

**NETWORK:** Define network behavior of the cellular module. AUTO mode is enabled by default and under most circumstances will work well. If required it is possible to force the modem to only look for "CAT M1", "GLOBAL", "NB IoT", or "2G" service instead of scanning for all network options. It is required to run "SIGNAL" option after adjusting network settings. Contact Sensit for more information and do not make changes to this parameter unless directed.

**PROTOCOL:** Set the cellular data communication protocol to the following options:

"DATATYPE": Select CSV or JSON data packet to be communicated over wireless data connection. JSON tag delimiters can be provided by SENSIT. JSON datatype not supported by SENSITConnect.

- **"HTTP":** Transfers data using HTTP Post protocol constantly at interval determined by the output data rate (ODR)



- **“MQTT”**: Transfers data using MQTT publish constantly at interval determined by the output data rate (ODR)
- **“PERIODIC”**: Buffers data according to the “RATIO” setting at the output data rate. After the required number of samples has been collected the modem will turn on, post all data, and then turn off. The interval of cellular cycles is determined by “ODR” x “RATIO”

**RATIO**: Set the number of required samples between cellular cycles for the “PERIODIC” cellular protocol. This value also influences GPS signal acquisition interval for certain modes. See information of GPS for more info.

**SIGNAL**: Acquire cellular signal strength and network registration status. This option also programs the modem with any changes to the NETWORK mode. After 10-15 seconds the serial terminal should display “CSQ: A,B REG Status: C,D,E” Data Status: F”

Advanced cellular network information will follow if applicable. A description of A, B, C, D, E, and F follow below.

A: (0-31,99) defines the signal strength  
 B: (0-7, 99) defines the data error rate

C: (0-5) defines the general network registration status  
 D: (0-5) defines GPRS network registration status  
 E: (0-5) defines LTE network registration status

**To form a data connection, D and/or E must show a registration status of 1 or 5**

F: ONLINE/OFFLINE Indicates if unit can make data connection.

**Unit must show ONLINE for it to transmit data via cellular. SIGNAL check should be completed before deployment.**

<b>A VALUE</b>		
<b>CSQ</b>	<b>DBM</b>	<b>MEANING</b>
0	<-113	Absolutely no Signal
1	-111	Very Weak Signal
2-10	-109 to -93	Weak Signal
10-20	-81 to -73	Moderate Signal
21-30	-71 to -53	Strong Signal
31	>-51	Very Strong Signal
99	?	Unknown/Not Detected

<b>B VALUE</b>	<b>MEANING</b>
0-3	Reliable Data Link 4-5
4-5	Occasional Dropped Posts
6-7	Unreliable Data Link
99	Unknown/Not Detected

<b>C, D, E, VALUE</b>	<b>MEANING</b>
0	Not registered, Not Searching
1	Registered Successfully
2	Not registered, Searching
3	Registration Denied
4	Unknown Status
5	Registered Successfully, Roaming

**TLS:** Enable or disable TLS encryption for HTTPS or MQTTS. For TLS authentication the user must load a root certificate file for the server on the microSD card. Prior to version 6.00 it was necessary to load a certificate file on the SD prior to enabling TLS. The certificate file must be named "CACERT.CER". If TLS is enabled the terminal should display:

```
TLS Enabled...Waiting to Load Cert
Deleting Old Files
Loading New Cert From SD
Cert File Found
+QFUPL: 1311,3f41
```

OK

Please note that the values after "+QFUPL" are different for different certificate files. The first number is the number of bytes and the second number is a checksum. The same cert file should always generate the same number of bytes and checksum. If errors are observed verify that the certificate file is loaded on the microSD card and properly named. For versions 6.00 and later it is not necessary to load a certificate file on the SD card and the "Loading" message above is not displayed.

**TOPICS:** Set the publish and subscribe topic used for MQTT cellular protocol.

**EXIT:** Leave the cellular configuration menu and enter the root menu

## DETAILED OUTPUT MENU INFORMATION

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MENU ITEM	DESCRIPTION	LOCATION
Mode	Output Mode Settings	Output Menu
ODR	Data Rate Setting	Output Menu
POLL	Output When Polled (any char)	Output Menu
STREAM	Output Continuously	Output Menu
SD	SD Rate and Format	Output Menu
EXIT	Exit Output Menu	Output Menu

**MODE:** Sets the communication mode of the SPOD. The following options are possible:

“Cellular”: Sends data with cellular modem at ODR and USB/Power port every 1 seconds

“USB”: Sends data with USB/Power Port every 1 seconds and turns of wireless

“WiFi”: Sends data with WiFi modem at ODR and USB/Power port every 1 seconds

“XBEE”: Sends data with XBEE (optional) at ODR and USB/Power port every 1 seconds

**ODR:** Sets the output data rate of the cellular modem or XBEE wireless device. The USB port will always show data output at 1Hz

**POLL:** Disable streaming over USB/Port and XBEE. SPOD will return data when receiving any character from control device.

**STREAM:** Continuous USB and XBEE data output at 1Hz.

**SD:** Select SD data rate and format card.

“RATE”: How fast data is saved to the SD card

‘STD’: Saves SD data at same frequency as cellular data.

‘FAST’: Saves SD data at maximum speeded. **WARNING:** produces very large data files and increases the likelihood of SD corruption.

“FORMAT”: Used to recover from card corruption errors. All data will be lost during format. If card fails to initialize during format it should be replaced.

**EXIT:** Leave the output configuration menu and enter the root menu

## DETAILED TIME MENU INFORMATION

---

MENU ITEM	DESCRIPTION	LOCATION
AUTOTIME	Enable/Disable Autotime	Time Menu
TIMEZONE	Select LOCAL or UTC Timezone	Time Menu
SET	Set Date and Time	Time Menu

**AUTOTIME:** Autotime sync uses the network time provided by the cellular module if available. For some cellular network SIM card combinations, the provided time can be incorrect and should be disabled to avoid time errors.

**TIMEZONE:** "LOCAL" or "UTC" The time can be reported as local time according to the location of the device or UTC time.

**SET:** Allows user to manually set date and time. The indicated format must be followed exactly with no exceptions and all numbers must be padded with 0's as required. The specified format is:

MM/DD/YY HH:MM:SS (e.g. 01/01/20 00:00:01)

## **DETAILED SYSTEM MENU INFORMATION**

---

<b>MENU ITEM</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>
CAL	Adjust Calibration	System Menu
HEAT	PID Heat Settings	System Menu
MET	MET Settings	System Menu
POWER	Set Power Mode	System Menu
SENSOR	Set/Reset Sensor Info	System Menu

**CAL (Previously BASELINE):** Adjustment of the PID sensor zero/baseline up or down by a constant value or automatic baseline adjustment to track baseline downward as sensor ages.

**"AUTOMATIC":** SPOD will detect mV readings below the programmed zero mV and automatically adjust the baseline down to avoid negative voltage readings. This setting will not adjust the baseline upward.

**"CALADJ":** Used to provide offset and/or slope correction to the calculated sensor data.

**"CONSTRAIN":** Used to limit the minimum sensor value to 0 and not allow negative readings.

**"DISPLAY":** View calibration values. This may also reprint all SPOD settings including the PID Offset value/settings for older version of firmware

**"SENSITIVITY":** Program in sensitive value used to convert mV to ppb.

**"ZERO"** (Previously MANUAL): Set new mV value for sensor zero. This is required when replacing the PID with a new or rebuilt PID prior to calibrating the SPAN reading.

**HEAT:** Adjust "CONSTANT" or "HUMID" heat settings. The "CONSTANT" setting means that the sensor heater is on at all times if enabled. The "HUMID" setting means that the sensor heater is on only if humidity exceeds a predefined threshold. If either option is enabled the user will be prompted to adjust the heater setpoints and for the "HUMID" option the user will be prompted to adjust the humidity set point. Both options could be enabled simultaneously to produce different heater setpoints depending on the humidity level. "CONSTANT" heat is enabled by default at 15°C above ambient.

**MET:** Enable, disable, or turn MET detection to AUTOMATIC. If MET detection fails it is recommended to enter this menu, disable MET, enable MET, and then restart SPOD. This menu also provides the ability customize the MET filter period to smooth out wind data.

**POWER:** Select "SOLAR" and "AC" power. If "SOLAR" is selected the unit will try to charge the batteries whenever power is present. If "AC" is selected the system will maintain the battery voltage in the middle of its range to extend battery life. It is very important that "SOLAR" is selected for remote power application.

**SENSOR (Formerly PID):** Allows the user to manually “SET” the number of PID operating hours, “REPLACE” a sensor and reset the hour counter or define the “ERROR” threshold in mV for a sensor error and set the “TYPE” of sensor installed (PID or MOS).

## DETAILED SAMPLE MENU INFORMATION

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MENU ITEM	DESCRIPTION	LOCATION
SAMPCONFIG	Configure Sampler	Sample Menu
SAMPDELAY	Sample Delay Time	Sample Menu
SAMPRESET	Reset Sampler Status	Sample Menu
SAMPTEST	Manually Test Sampler	Sample Menu
SAMPTIME	Sample Acquisition Time	Sample Menu
SAMETYPE	Type of Sampler	Sample Menu
EXIT	Exit Sample Menu	Sample Menu

**SAMPCONFIG: WARNING, this will erase sample configuration and will need to go through programming the following steps.** System will prompt for all canister locations. (e.g. 123 or 1,2,3 or Port 1 Port 2 Port 3, it doesn't matter). It will show the ports that have been selected and will next prompt the user to define sampling events up to the number of canisters present. Please note a single event could be to trigger a single canister or it could be to trigger multiple canisters. Type the canister(s) you want to trigger first and continue until all canisters have been accounted for.  
**NOTE:** You must program events or no sampling can take place.

**SAMPDELAY:** This option is used to program a delay after startup where events are ignored. This is helpful if sensor has been shut down or was exposed to high VOC concentrations. This will let the sensor stabilize before triggering any samples. This will also allow bump tests after powering up and will avoid unintentional sample acquisition.

**SAMPRESET:** This option is used to reset a canister status after changing the canister. The user will be prompted to type the port number that requires a reset. (e.g. 123 or 1,2,3 or Port 1 Port 2 Port 3, it doesn't matter).

**SAMPTEST:** This option is used to verify communication with the valve controller and test valves opening and closing. Recommended prior to any deployment. The system will prompt the user to type “P#:1’ to Open Valve ‘P#:0’ to Close Valve ‘TEST#:1’ for Pressure On ‘TEST#:0’ for Pressure Off (#=1,2,3,4) or EXIT” For example to manually open Port 1 the user would type “P1:1” and to manually close Port 1, the user would type “P1:0”. If a pressure sensor is installed the user can test using the “TEST” command to output the pressure in PSI similar to the port test command.

**SAMPTIME:** Sets the duration of the sample grab. Adjustable between 1-100,000 seconds. This is adjustable for every single port location. This could be due to different canister sizes or sample flow rates.

**SAMPTYPE:** This option defines the type of sampling, “DIRECT, NONE, PRESSURE, or TIME”. “DIRECT” would be a non-latching valve hooked directly up to the auxiliary port. This requires a 12V valve and is switched with a 3.3V digital output. Valve must be isolated from SPOD. “NONE” is no sampler hooked up. This should be selected if not using a sampler to avoid and initialization error upon startup. “PRESSURE” is configured to allow the valve controller to hook up a pressure sensor to monitor canister pressure and stop sampling at a predefined threshold (-2.5 PSI) and is only relevant for deployments with pressure sensors.

For pressure sampling, the SAMPTIME setting becomes a timeout value and the sampling will cease if the timeout is reached. "TIME" is sampling for a given amount of time as defined by SAMPTIME.

**EXIT:** Leave the sample configuration menu and enter the root menu.

## **DETAILED TRIGGER MENU INFORMATION**

---

<b>MENU ITEM</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>
TRIGCONFIG	Configure Trigger Settings	Trigger Menu
TRIGTYPE	Set Trigger Type	Trigger Menu
THRESHTYPE	Set Threshold Behavior	Trigger Menu
EXIT	Exit Trigger Menu	Trigger Menu

**TRIGTYPE:** This option allows the user to define the type of trigger that is used to initiate a sampling event. The most basic trigger is the "THRESHOLD" option which will trigger on a set PPB level for a set time. The "WIND" option triggers using wind direction and wind speed only. The "COMBO" option uses both Wind Direction/Speed and PPB level. Lastly the QUADRANT option (Must have 4 independent canisters. Samples designated canister for North, East, South, and West).

**TRIGCONFIG:** Settings for the given "TRIGTYPE". For THRESHOLD it is ppb value and the time above the threshold. For WIND it is the minimum windspeed and direction range. For COMBO there are 3 Ranges for the combination trigger "LOW", "MED", "HIGH". Every windspeed range can have different direction ranges and concentration thresholds and all ranges must be programmed. Carefully follow the prompts.

**THRESHTYPE:** This menu will first prompt user to enable average array. With average array enabled, the SPOD will calculate a true average of SPOD data. With average array disabled, the SPOD will only count the amount of time the data is above the threshold. If the array is enabled, the array size can be set from 1-60. The measurement averaging time is calculated according to the array size multiplied by the output data rate. For instance if the output data rate (ODR) is set to 60 seconds and the array size is set to 15, the measurement averaging time is  $60 * 15 = 900$  seconds.

After the average array behavior is set, the SPOD will prompt triggering based on RAW or PPB readings. If RAW readings are used the threshold will be in mV and if PPB readings are used the threshold will be in ppb.

Finally, the SPOD will prompt the user to select a STATIC or DYNAMIC threshold. If a STATIC threshold is selected, the trigger level is absolute with respect to zero. If DYNAMIC threshold is selected, the trigger threshold is with respect the background concentration over a user selectable period ranging from 10 – 3600 seconds. This threshold setting allows triggering on small, fast-moving signals while subtracting out slower moving diurnal trends. If DYNAMIC is selected, the user is prompted to set a "Static Limit". The static limit is an absolute limit that disregards the background subtraction.

**EXIT:** Leave the trigger menu and enter the main menu.

# SENSOR MAINTENANCE AND CALIBRATION

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**PERIODIC MAINTENANCE:** The SPOD is a low maintenance device and is designed to operate remotely with no user intervention. Occasional inspections for damage and cleanliness are recommended to maintain optimum performance.

**SENSOR CALIBRATION:** Depending on application requirements and environmental conditions, periodic calibrations may be required to maintain target accuracy. Contact Sensit for ordering calibration gases, calibration hardware, and calibration instructions.

Required Materials:

- Black USB Configuration Cable
- Laptop with Coolterm or other serial terminal program
- Zero gas (Ultra zero air, Low VOC) with constant flow regulator
- Span Gas (1000 ppb Isobutylene) with constant flow regulator
- Rubber calibration cap with Luer connection (Pictured Below)



1. Hook up black USB cable and power on device. The unit must be allowed to run for 3 minutes before any calibration commands will be acknowledged. It is recommended to hook the zero gas up immediately after power on to allow ample time to purge the sensor.

(Optional): Obtain a 4-pin extension cable from Sensit. This extension cable will disconnect the reset line and prevent the computer from resetting the SPOD when plugging in the cable.

2. Hook up the flowing zero air to the SPOD using the SPOD calibration cap. 300-500 sccm is preferred. Moderately higher flow rates (up to 1000 sccm) should work fine, but lower flow rates are not recommended. Push the cap on fully to minimize the dead air space in front of sensor. The calibration cap is not air-tight, air will flow out around the sides of the cap during calibration.
3. Allow the sensor to stabilize in zero air. This could take a several minutes in high VOC background
4. After reading is stable send the command "ZERO1" and the reading will zero.
5. Hook up flowing isobutylene to the SPOD using the SPOD calibration cap
6. Allow the sensor reading to stabilize in isobutylene.
7. After the reading is stable send the command "SPAN1:XXX" where XXX is the concentration of gas is PPB. (e.g SPAN1:500 = 500 ppb, SPAN1:1000 = 1000 ppb, etc).

8. Remove the cap and shut off all gas flow, calibration is now complete

**NOTE: If you do not have zero gas you have several options.**

For firmware version 6.00 and higher, you can apply and OFFSET or ZERO adjust zero level

- Offset the baseline to bring multiple units into better agreement or remove background. To manually offset, enter the MENU → SYSTEM → CAL → CALADJ → OFFSET Enter desired offset in PPB.
- Manually set the zero level based on raw mV data. To manually adjust, enter the MENU → SYSTEM → CAL → ZERO Enter desired zero level in mV.

For firmware version 5.57 to 5.99, you can apply and OFFSET or MANUAL adjust zero level

- Offset the baseline to bring multiple units into better agreement or remove background. To manually offset, enter the MENU → BASLINE → OFFSET → Enter desired offset in PPB.
- Manually set the zero level based on raw mV data. To manually adjust, enter the menu → BASLINE → MANUAL → Enter desired zero level in mV.

For firmware versions 5.56 and lower, you can apply MANUAL offset adjustment

- Offset the baseline to bring multiplier units into better agreement. To manually offset, enter the menu → BASLINE → MANUAL → Enter desired offset in PPB.

**IMPORTANT NOTE: The “MANUAL” option has a different behavior in the newest firmware (5.57 or newer) and is replaced by “ZERO” in versions 6.00 and above. MANUAL/ZERO is used to set the raw mV value corresponding to zero and OFFSET is used to add or subtract a PPB value to the calculated sensor value**

For any firmware version, you can:

1. “zero” in clean background but this could result in a more frequent occurrence of negative or zero concentration readings. To zero in clean air, allow the sensor to stabilize and type “ZERO1” after unit has been running for at least 3 minutes
2. Enable “autobaseline”. This will adjust the sensor baseline down when PPB readings are below zero level. To turn on “autobaseline”, enter the menu SYSTEM → CAL → AUTOMATIC

### **Calibration without computer (Beta and will be removed, Not Recommended)**

**IMPORTANT:** Ensure that SPOD has been running for more than 3 minutes.

1. Hook up ultra-zero air or 1000ppb span gas.

**IMPORTANT NOTE:** Only 1000 ppb +/- 5% span gas can be used as that is the assumed concentration without a computer.

2. Simultaneously press RED and BLACK switch and hold until the blue calibration LED is illuminated (refer to Sensor Interior LED Indication)
3. If zeroing, press and hold the black switch until the calibration LED starts flashing 1 time per second and release the switch. The SPOD will now run for a minimum of 1 minute up to 3 minutes waiting for the reading to stabilize. At the end of this time the calibration LED will stop flashing. For firmware



v5.57 and newer if zero fails, the calibration LED will turn on steady for 5 seconds before turning off.

4. If using span gas, press and hold the red switch until the calibration LED starts flashing 2 times per second and release the switch. The SPOD will now run for a minimum of 1 minute up to 3 minutes waiting for the reading to stabilize. At the end of this time the calibration LED will stop flashing. For firmware v5.57 and newer if calibration fails, the calibration LED will turn on steady for 5 seconds before turning off.

**SENSOR REPLACEMENT:** The PID sensor assembly is designed to be field replaceable. Sensit recommends factory service when replacing the sensor to ensure overall sensor performance. To replace the sensor follow these steps:

1. Remove the threaded aluminum cap at bottom of SPOD. Retain the threaded cap, screen, and black/beige plastic spacer. Inspect for cleanliness. Clean all parts in mild detergent and dry if necessary.



2. Grasp front of sensor and pull straight out. Separate and retain foam thermal insulation from PID sensor. Return sensor for exchange credit.



3. Install new sensor being extremely careful to align all pins. Please note the position of the 3 large sockets on circuit board in relation to the 3 alignment holes on the plastic holder. After reinstalling sensor, reinstall foam. Do not install foam first as it will obstruct the view of the small pins on the perimeter of the sensor. The sensor will insert easily and should be held securely. Do not force the sensor as this will bend the pins and require factory service.



4. Reinstall aluminum cap fully. Ensure spacer is installed with widest diameter flat edge facing the sensor and the conical point facing the screen. The spacer will prevent overtightening and ensure no direct contact with metal screen to prevent wicking of condensed moisture.
5. Power up sensor and observe sensor status during startup with USB cable. Take note of any errors or successful initialization of the PID. The raw millivolt reading should be above 50mV. Any lower readings indicate an error with the sensor.
6. Allow sensor to run for 48 hours before attempting calibration for burn in and stabilization.

## SENSOR FIRMWARE UPDATE

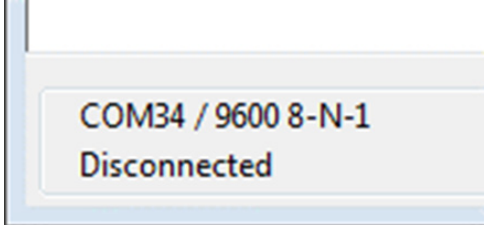
**FIRMWARE UPDATE:** Units connecting to the SENSITConnect platform are capable of updating over the air once updated firmware and bootloader have been installed. Information on manual firmware and bootloader update can be found in this section.

### Main Unit Firmware Upgrade

Required Materials:

- Black USB Configuration Cable
- Laptop with Firmware Tools

1. Power down SPOD and hook up black USB cable. Use coolterm to determine the COM port number of the USB cable. (e.g. COM34). After determining port number make sure coolterm connection is disconnected (i.e. only one program can control serial port)
2. Open firmware folder provided by Sensit. Verify the correct version of the HEX file is found inside the folder.



Name	Date modified	Type	Size
USB Tools	1/21/2020 2:57 PM	File folder	
avrdude.conf	1/17/2017 4:00 AM	CONF File	471 KB
avrdude.exe	1/17/2017 4:00 AM	Application	513 KB
FWUPLOAD.bat	3/20/2018 4:04 PM	Windows Batch File	1 KB
libusb0.dll	10/3/2018 1:44 PM	Application exten...	43 KB
QuickStart Instructions.txt	3/18/2019 10:03 AM	Text Document	1 KB
SPOD_v5.57.hex	5/27/2020 10:07 PM	HEX File	377 KB
UploaderImages SPOD.pdf	3/18/2019 10:00 AM	Adobe Acrobat D...	171 KB

3. Power on SPOD and double click the "FWUPLOAD.BAT" file. A cmd window will open and prompt for a COM port. Type in the com port number determined from coolterm (e.g. "COM34" or "com34")

USB Tools	1/21/2020 2:57 PM	File folder
avrdude.conf	1/17/2017 4:00 AM	CONF File
avrdude.exe	1/17/2017 4:00 AM	Application
<input checked="" type="checkbox"/> FWUPLOAD.bat	3/20/2018 4:04 PM	Windows Batch File
libusb0.dll	10/3/2018 1:44 PM	Application exten...
QuickStart Instructions.txt	3/18/2019 10:03 AM	Text Document
SPOD_v5.57.hex	5/27/2020 10:07 PM	HEX File

4. The cmd window will show the progress of the firmware upload. The program will perform 3 steps:

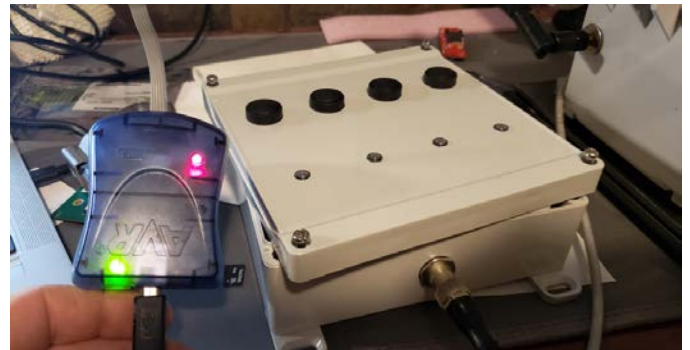
- a. Read device type and configuration ( < 1sec)
  - b. Write new firmware (~40 seconds)
  - c. Verify new firmware (~40 seconds)
5. Program should report all bytes verified and show no errors. If any errors are found verify the following:
    - a. Cable hooked up
    - b. No other programs using serial port
    - c. SPOD turned on
  6. Close cmd window and connect using coolterm. Firmware should report new version number during startup.
  7. Type "YES" to enter menu when prompted
  8. Type "UPGRADE". The SPOD will print out "**Upgrade Parameters Sent**". Any addition UPGRADE commands will result in "**Upgrade Already Performed**"
  9. Follow any other instructions provided by Sensit. There is a quickstart instructions text file found in up-loader folder for easy reference.

### Accessory Unit Upgrade (Or Bootloader Update for OTA Firmware)

Required Materials:

- Blue USB 6 pin Programmer
- Laptop with Firmware Tools

1. Follow the hardware installation guide at the end of this document if using the Blue 6 pin programmer for the first time. The programmer should show 2 lights (generally green and red as pictured but this is not always the color the first time plugging in)
2. Unscrew cover of canister valve controller or sorption tube pump. Do not unplug any cables inside.



3. Hook up accessory to an SPOD that is powered off. Turn on the SPOD. It is recommended to have the SPOD with the USB cable hooked up and enter the Menu when starting up. The accessory should show lights (flashing or steady) to indicate power is received.



4. Plug in the 6 pin programmer to the 6 pin connector on the PCB inside the enclosure. Gently lift the lid edge by the single external male connector enough to plug into the board as shown. The PCB may look slightly different versus photo but 6 pin connector should be located in same/similar place



5. Both LEDs on programmer should be green. If top LED flashing orange than the orientation of the 6 pin connector on programmer needs to be flipped 180 degrees. If the top LED is still red, ensure the accessory has power and should lights on the front panel. If power is verified and led remains red proceed with remaining steps to attempt upload.



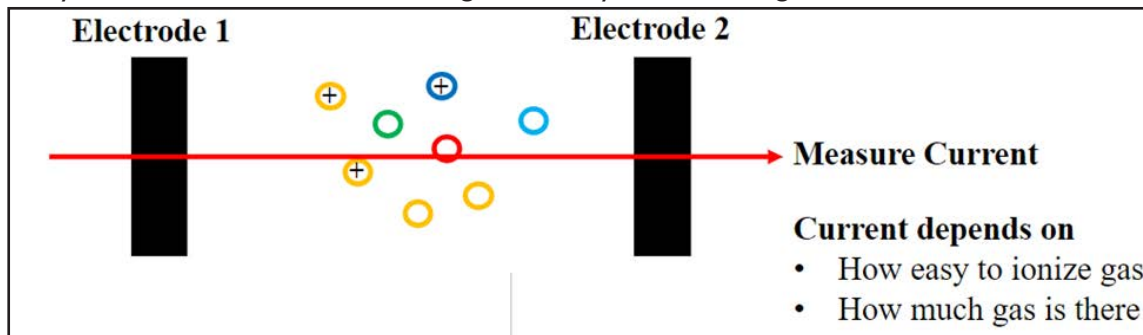
6. Find the upload folder for canister valve controller (CVC) or sorption tube pump (STP) sent by Sensit. Verify that proper version of firmware is in the folder.

<input type="checkbox"/>	Name	Date modified	Type	Size
<input type="checkbox"/>	Tools and Info	5/27/2020 10:52 PM	File folder	
<input type="checkbox"/>	avrdude.conf	1/17/2017 4:00 AM	CONF File	471 KB
<input type="checkbox"/>	avrdude.exe	1/17/2017 4:00 AM	Application	513 KB
<input type="checkbox"/>	AVRUPLOAD.bat	3/20/2018 4:14 PM	Windows Batch File	1 KB
<input checked="" type="checkbox"/>	Canv1.5.hex	5/22/2020 11:28 AM	HEX File	43 KB
<input type="checkbox"/>	libusb0.dll	10/3/2018 1:44 PM	Application exten...	43 KB

7. Double click the "AVRUPLOAD.BAT" file and the tool will start to program immediately. The program should complete without errors. Any warning about fuse setting is normal and not cause for concern. Any errors or flashing red lights on programmer indicates a problem. Please unplug programmer from computer and plug back in and try upload process again. Please send screenshot if errors are found
8. Return to SPOD, enter MENU → SAMPLE → SAMPTTEST. During the beginning of SAMPTTEST the accessory should report the firmware version. Verify this is the correct firmware version. Disregard any gibberish characters as this can occurring during the firmware upgrade process and is not cause for concern.
9. After new firmware version is verified, close cover and screw securely. Make sure no wires are pinched in lid when reinstalling cover.

## PID INFORMATION

Photoionization Detectors (PIDs) respond to a broad range of organic and a few inorganic gaseous and volatile chemicals ('volatiles'). In order for PID to respond to a volatile, the photon energy of the lamp must be greater than its ionization energy (IE). Ion Science PIDs are available with lamps emitting light of maximum energy of 10.0 eV, 10.6 eV, and 11.7 eV. This Technical Article lists the response factors ('RF's') for over 900 volatiles with PID incorporating these lamps. The RF relates the sensitivity of PID to a volatile to the sensitivity to the standard calibration gas isobutylene. The higher the RF, the lower the sensitivity.



For more information on response factors, please visit the 'RESOURCES' tab on the product page on [gasleaksensors.com](http://gasleaksensors.com)

## INITIALIZATION AND STARTUP

1. After powering on the unit, there will be a period of elevated PID readings followed by stabilization at the baseline. If the PID has been powered off for a very short amount of time the stabilization period will be 3-5 minutes typically. If the PID has been powered off for 1 week this stabilization may take up to 1 hour. If the PID has been powered off for 1 month or more and/or stored in a high VOC environment it may take up to 24 hours to stabilize. Avoid any calibration or adjustments during the stabilization period.
2. The use of zero air in PID calibration is not recommended without humidification of the zero gas. Dry zero air produces inaccurate zero levels and should be avoided. Humidification can be achieved using a short (1-2ft) length of Nafion tubing installed in line with the zero gas (available for purchase from SENSIT Technologies) or a water bubbler. An alternative to using zero air is to zero the sensor using a clean air background. The lowest recorded mV reading over the period 3-5 days provides a practical zero level for the environment the sensor is operating in. Typically, the zero level will drop slowly over time except in the case of PID contamination. Typical zero levels for the XF and HS sensor are shown below:  
  
HS: 75 - 200 mV  
XF: 51 - 100 mV  
**NOTE:** Any readings at or below 50mV indicate a sensor error and the sensor should be replaced or service.
3. During calibration, the indicated PPB reading of the sensor may be higher or lower than the calibration gas. After sending the SPAN command, the calculated PPB reading will be approximately equal to the calibration gas. The sensitivity of PIDs decreases over time as the lamp energy output drops and the electrode stack degrades. The PID is a consumable part and will need to be replaced in 6-18-month intervals. Exposure to high amounts of VOC or liquid water may contaminate the PID permanently. Manufacturer reported sensitivity levels for the XF and HS sensors are shown below:

HS: >600mV change per 1 ppm isobutylene (Sensitivity Factor < 1.67 ppb/mV per new device)

XF: > 60 mV change per 1 ppm isobutylene (Sensitivity Factor < 16.7 ppb/mV per new device)

The useful life of the PID will depend on the level of sensitivity required. A general recommendation would be replacing the device if the sensitivity has dropped by more than 50% of the manufacturer specification for a new PID

HS: < 300mV change per 1 ppm isobutylene (Sensitivity Factor > 3.33 ppb/mV per new device)

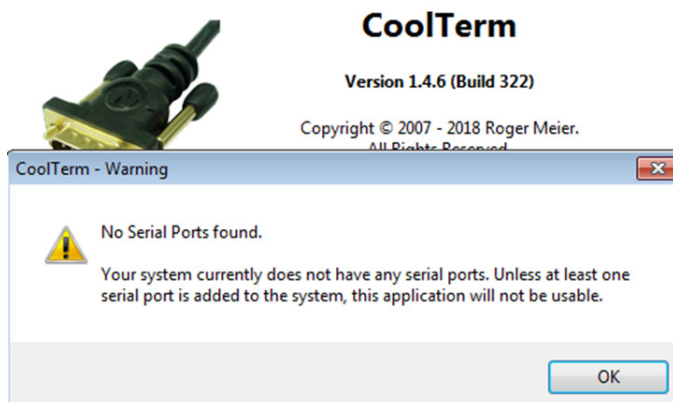
XF: < 32 mV change per 1 ppm isobutylene (Sensitivity Factor > 33.3 ppb/mV per new device)

# **HARDWARE INSTALLATION GUIDE FOR AVR PROGRAMMER**

1. Download firmware tools provided by Sensit
2. Plug in blue USB programmer into computer and let windows attempt to install the driver. Most often, windows either fails to find the driver or installs the wrong driver.
3. Open "Zadig" utility
4. If Windows failed to install a driver, the "mkl" should show up in the drop down list. You will need to select it and click install the "libusb-win32" driver (please note version may be newer).
5. If Windows managed to install some driver, you will need to select "Options" and click "List All Devices". Now the mkl should show up. Select the mkl and replace or upgrade the driver with "libusb-32"(please note version may be newer).
6. It is recommended to unplug the programmer and restart the computer but might not be necessary
7. If installed correctly the programmer should show up as "libusb-win32 devices -> AVRISP mkl" inside the device manager. If you see any error inside device manager or a different name do not proceed until the driver issue is resolved.

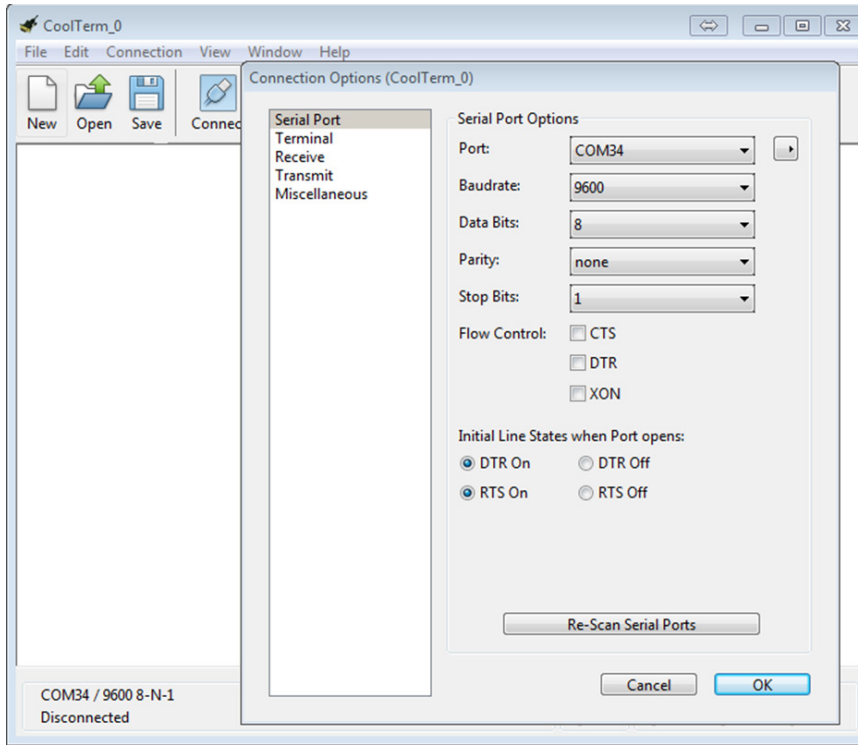
# **HARDWARE AND SOFTWARE INSTALLATION GUIDE FOR USB CABLE**

1. 1) Download drivers for FTDI Serial Adapter and install drivers  
<http://www.ftdichip.com/Drivers/VCP.htm>
2. Open serial terminal program of your choice. CoolTerm is recommended and instructions for using CoolTerm are found below. CoolTerm is available for Windows, Mac, and Linux. CoolTerm can be downloaded for free from here:  
<http://freeware.the-meiers.org/>
1. Extract 'Software\_CoolTerm' to the directory of your choosing. To avoid certain permissions issues do not extract into "Program Files". It is recommended to extract to the desktop if possible.
2. Open the 'CoolTerm' application. You may receive an error indicating that no serial ports are found depending on what is hooked up to the computer. Click okay to continue.

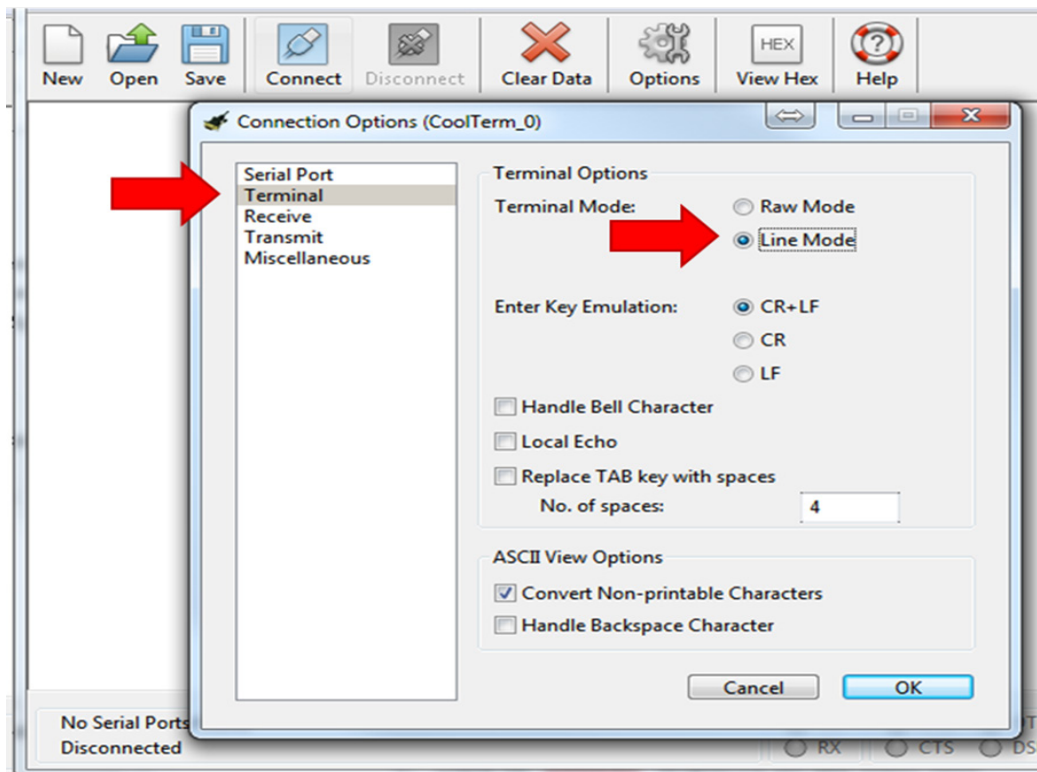


3. Click 'Options' as shown below

- a. 'Serial Port' options should open by default. If not, select Serial Port options from the list of available options as shown below. All default options should be correct but please verify. Click on 'Port' dropdown list and make note of any available ports. Plug in the USB cable and wait for hardware installation to finish. Click "Re-Scan Serial Ports". The newly added port is the USB cable. Select this port.

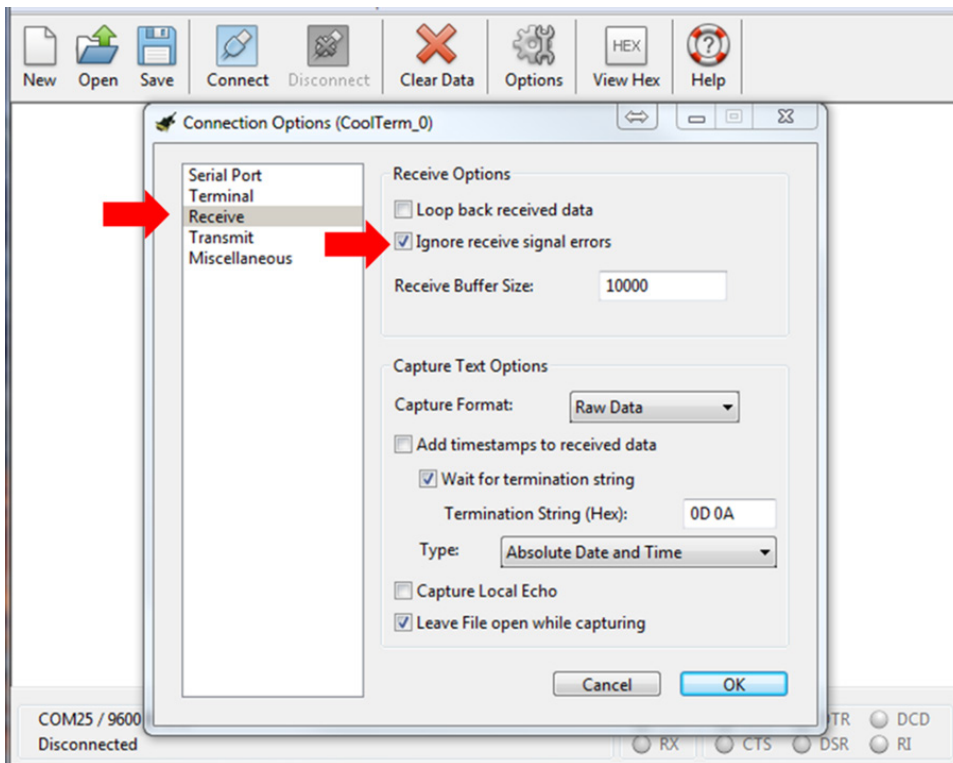


- b. Select 'Terminal' options from list of available options and select 'Line Mode' as shown below. Line mode adds a text entry bar at the bottom of the screen that is useful for sending commands to the connected sensor.

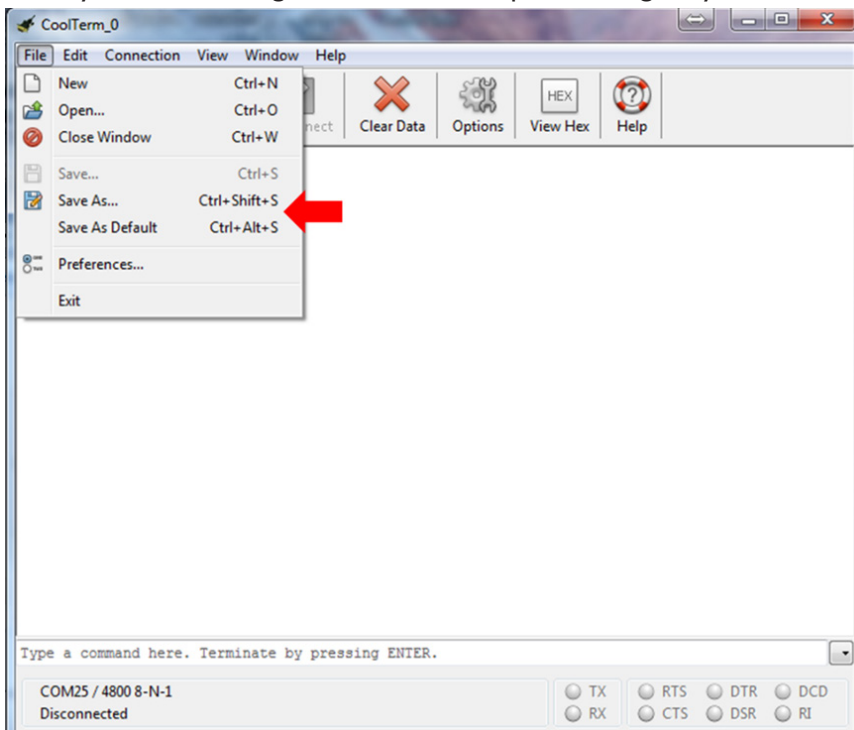




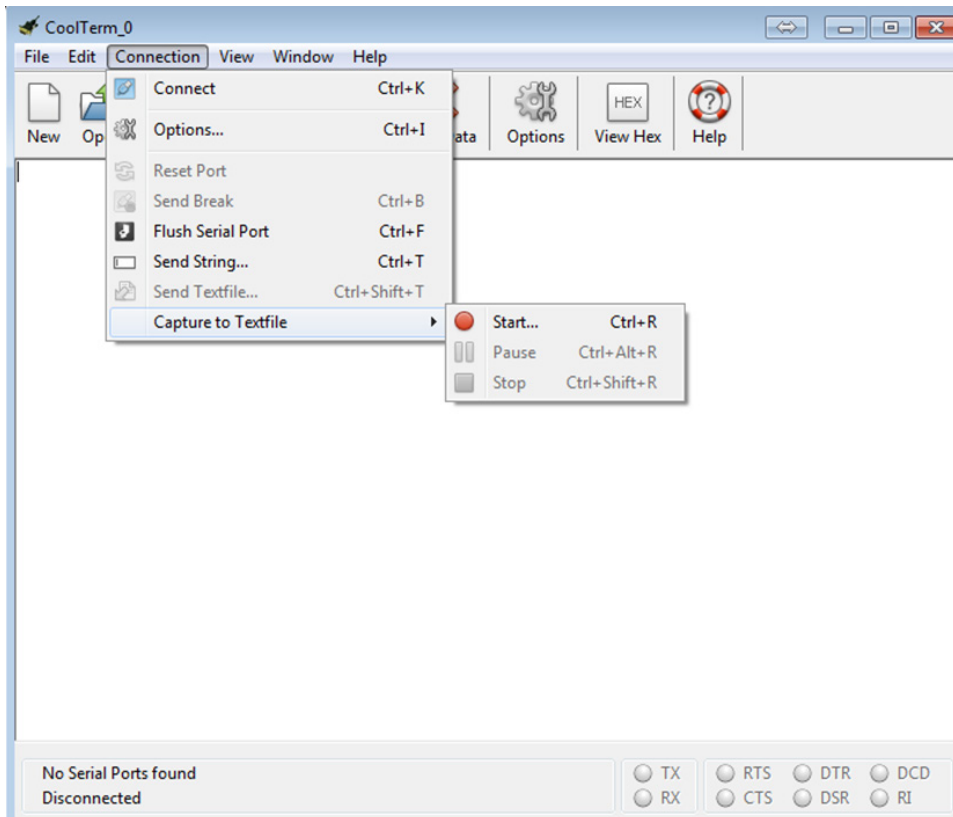
- c. Select 'Receive' options from list of available options and check "Ignore Receive Signal Errors". Selecting this option reduces the possibility of the serial connection closing upon a received serial error such as connecting or disconnecting the cable or power cycling the unit.



4. To avoid having to configure the terminal every time you open it, you have 2 options to save the configuration as shown in Figure 4.
  - a. Click "Save As" and save the connection settings as a file that you can share or store on the computer
  - b. Click "Save As Default" to change these settings to the default settings when starting the program. If you are running off the CD this option will give you an error as there is no default file.



5. Coolterm can be configured to record all data received over serial. This will be useful for evaluation purposes.
  - a. To start a capture go to 'Connection' dropdown menu → Capture to Textfile → Start or hit Ctrl-R (⌘-R). Enter a file name and click save.
  - b. To stop the capture navigate back to the menu entry and click stop or hit Ctrl-Shift-R (⌘-Shift-R)





# WARRANTY

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Your **SENSIT® SPOD** is warranted to be free from defects in materials and workmanship for a period of one year after purchase. If within the warranty period the instrument should become inoperative from such defects the instrument will be repaired or replaced at our option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Proof of purchase may be required before warranty is rendered. Units out of warranty will be repaired for a service charge. Internal repair or maintenance must be performed by a Sensit Technologies authorized technician. Violation will void the warranty. Units must be returned postpaid, insured and to the attention of the service department for warranty or repair.

This warranty gives you specific legal rights and you may have other rights which vary from state to state.

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