SENSIT® RAMP

REMOTE AIR QUALITY MONITORING PLATFORMS

SENSOR OPERATION & CONFIGUATION GUIDE

READ AND UNDERSTAND INSTRUCTIONS BEFORE USE.

SENSIT

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WARNINGS

⚠ WARNING 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.

⚠ WARNING When removing the 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 it back on.

⚠ WARNING When installing the unit, ensure the weather sensor is pointing north. Failure to do this will result in error in the wind direction measured by the anemometer. The north direction is indicated with a notch on the ultrasonic anemometer base. Never rotate the anemometer from the top or severe damage will occur.

⚠ WARNING 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 SENSIT® RAMP, then install a power adapter or a solar panel for long term deployment applications.

⚠ WARNING All accessories are to be used in an area known to be nonflammable.

⚠ WARNING Do not disassemble the unit or change any parts without training or approval by sensit. If you wish to be certified for repairs, please contact sensit so coordination of training can occur.

⚠ WARNING The appliance is not to be used by persons (including children) with reduced physical, sensory, or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction.

⚠ WARNING Pid sensors are sensitive to high amounts of humidity and may rail at the upper output if humidity is excessive. The RAMP contains an internal sensor heater to minimize humidity interference.

⚠ WARNING If the unit has been off for an extended period, 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. Exposure to very high levels of vocs may saturate the detector for several minutes to an hour

RAMP SENSOR OVERVIEW & SPECIFICATIONS

GENERAL

OVERVIEW	PARAMETER
Weight	Base unit: 7.5 lbs
Dimensions	Fully assembled without anemometer or antenna[1] D x W x H (5" x 10" x 12")
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	3-15 days battery backup[2]
Operating Temp	-20°C to 50°C
Data Outputs	• Digital wired output (3.3V TTL - USB) • Cellular 4G IoT with 2G Backup Included[3] • Optional analytics on server [4] • SD card data backup [5]

NOTES:

1. The anemometer is to be mounted separate to a pole. Could be same pole as sensor.
2. Battery backup time depends on run mode, sensor configuration, and frequency of transmission.
3. Requires SIM card and suitable data plan on 2G, 4G CatM1, or 4G NB IoT
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 after inserting an SD card, power down the sensor and turn back on.

SENSORS

OVERVIEW	PARAMETER
CO Detection Range	100 ppb – 25 ppm
CO Accuracy	+/- 100 ppb min or 50%
NO Detection Range	20 ppb – 25 ppm
NO Accuracy	+/- 20 ppb min or 50%
NO_2 Detection Range	20 ppb – 25 ppm
NO_2 Accuracy	+/- 20 ppb min or 50%
O_3 Detection Range	20 ppb – 25 ppm
O_3 Accuracy	+/- 20 ppb min or 50%
CO, NO, NO_2, O_3 Response Times	60-90 seconds [1]
CO, NO, NO_2, O_3 Detection Method	Electrochemical
CO_2 Detection Threshold	100-2000 ppm[2]
CO_2 Accuracy	+/- 200 ppm min or 20%
CO_2 Response Time	15-30 seconds
CO_2 Detection Method	NDIR Optical
PM2.5 Detection Threshold	1 - 1000 µg /m^3
PM2.5 Accuracy	+/- 10 µg /m^3 min or 50%
PM2.5 Response Time	15-30 seconds
PM2.5 Detection Method	Laser Scattering
Periodic Maintenance	Periodic cleaning of sensor openings of dust, offset adjustment, and span adjustment. User replacement of sensors is easily performed as needed.
Additional Included Sensors	Additional sensors can be added (external ports)[3]

NOTES:

1. If the unit has been off for an extended period of time, it will take approximately 12-24 hours for the electrochemical sensors to stabilize completely.
2. There are additional CO_2 sensors available with identical form factors if higher concentrations (e.g. 10,000 ppm) are determined to be necessary.
3. The anemometer that is designed to work with the RAMP is the Davis Vantage Pro 2 Anemometer (https://www.davisinstruments.com/product/anemometer-for-vantage-pro2-vantage-pro/)

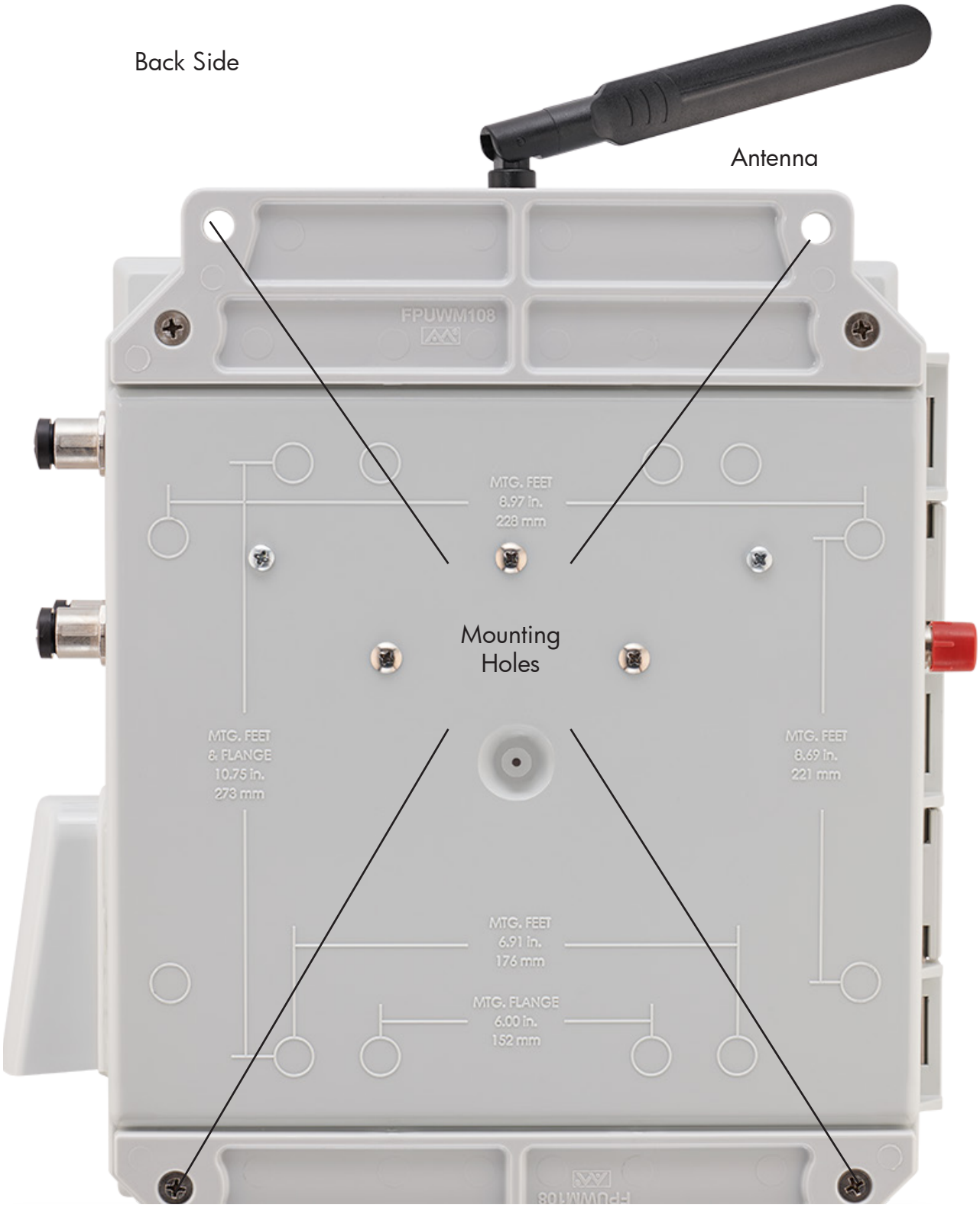
CELLULAR SPECIFICATIONS

OVERVIEW	PARAMETER
Network Technology	4G CAT M1 and Cat 4, and NB-IoT available.
Carrier	AT&T (recommended), Verizon, T-Mobile
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	“deviceId”, “time”, “iodb”
Post Location	Adjustable in Menu
APN	Adjustable in Menu
TLS/SSL	HTTPS and MQTTS with server authentication[3]

SENSOR EXTERIOR FEATURES (FRONT EXTERIOR)

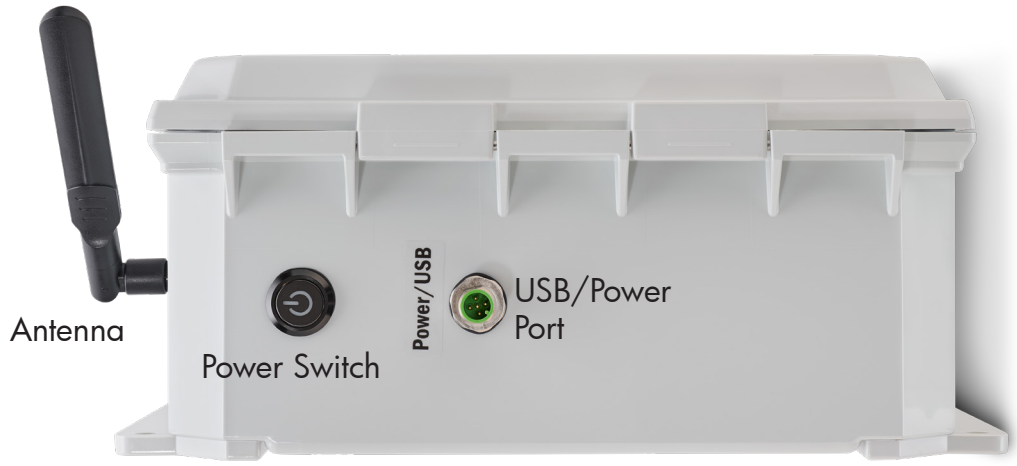
Front View

SENSOR EXTERIOR FEATURES (BACK SIDE EXTERIOR)



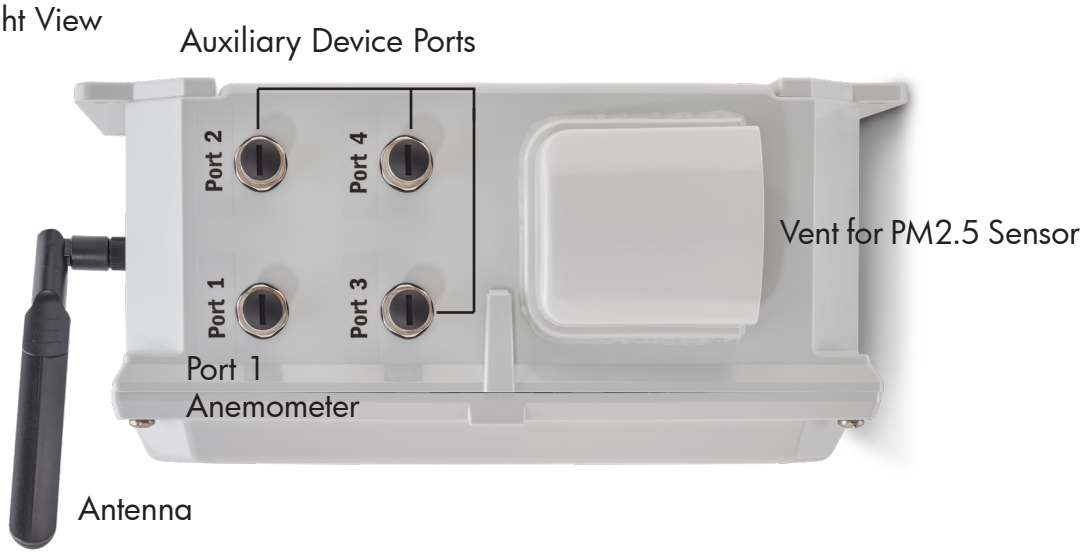
SENSOR EXTERIOR FEATURES (LEFT SIDE EXTERIOR)

Left View

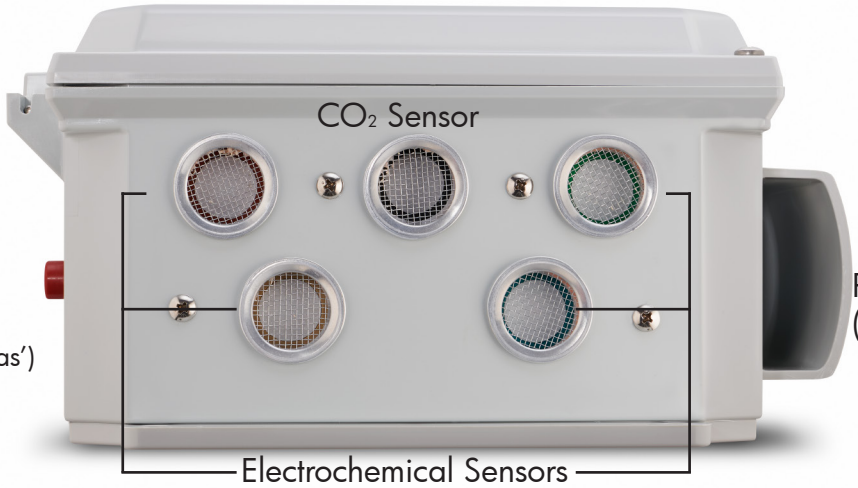


SENSOR EXTERIOR FEATURES (RIGHT SIDE EXTERIOR)

Right View



SENSOR EXTERIOR FEATURES (BOTTOM EXTERIOR)

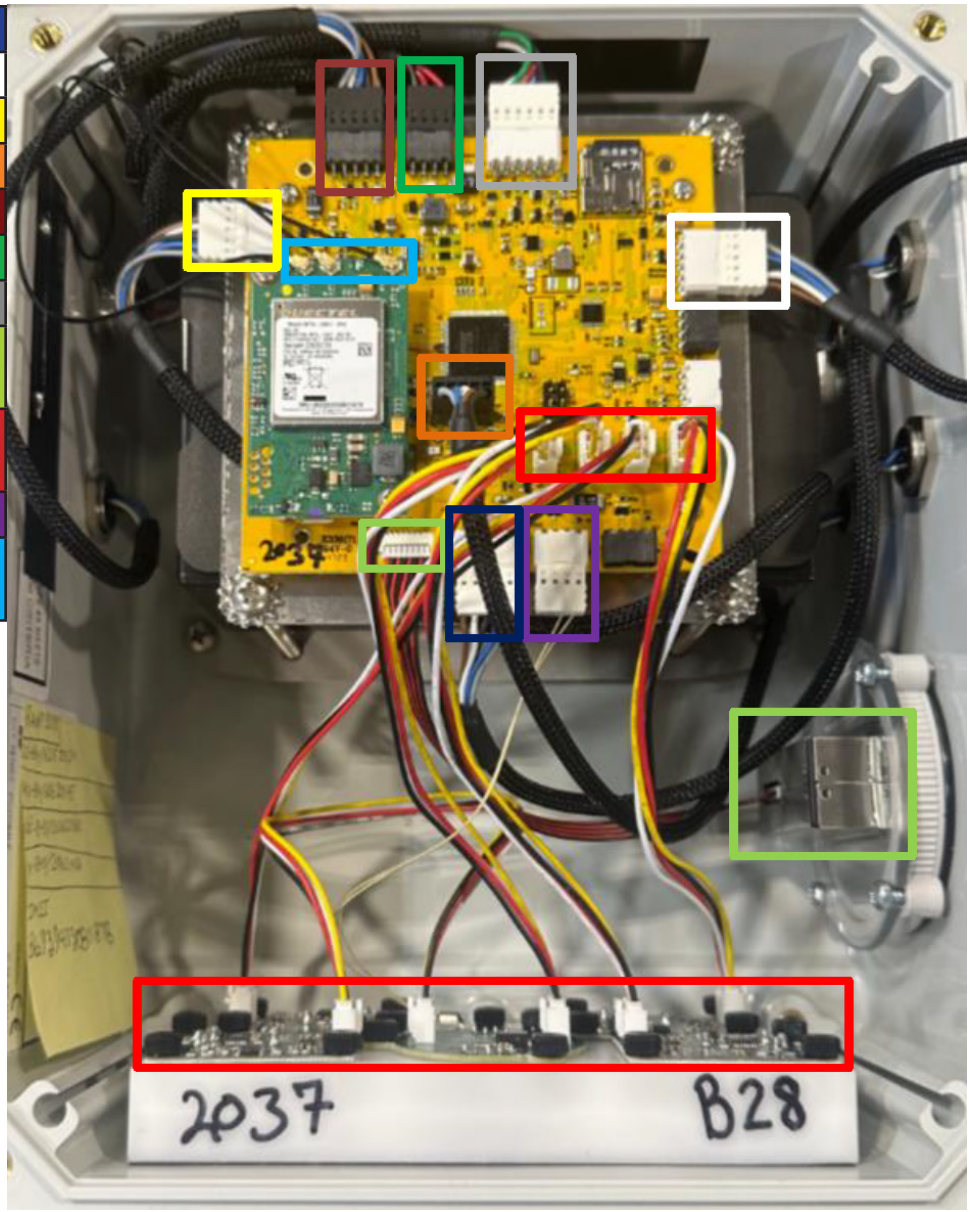


*Alternative sensors exist such as
ENVIR (T, RH, P, 'Gas')
PID (VOC, T, RH)

NOTE: Do not obstruct sensor openings. User must install sensor enclosure with sensor openings facing downward to avoid water and debris accumulation.

SENSOR FEATURES (FRONT INTERIOR)

Dark Blue – Port 1 (Analog MET
White – Port 2 (Ultrasonic MET)
Yellow – Port 3 (Auxiliary)
Orange – Port 4 (External Power)
Maroon – Communication Port
Dark Green - Battery
Gray – Power Button
Light Green – PM Sensor/PM Connector
Red – Sensors/Sensor Connectors
Purple – Sensor Plate Thermistor
Light Blue – uFL Connectors on Moden for Antenna and GPS



International version: (left to right) M – Primary LTE, G - GPS, and D - secondary or directivity.
North American version: (left to right) M – Primary LTE, D - secondary or directivity, and D/G - GPS.

QUICK START DEPLOYMENT GUIDE

It is recommend 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).

1. 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.
2. Hook up USB cable sensor and initialize terminal connection. Power on unit and verify that the SD card was detected and initialized.
3. Enter into USB mode from startup or from configuration menu. Verify the sensor outputs are reasonable or trending toward reasonable values keeping in mind the stabilization time for the electrochemical sensors. The output format is shown below and will depend on RAMP configuration:

HEADING	DESCRIPTION	UNITS/FORMAT
DATE	Local Date and Time	MM/DD/YY HH:MM:SS (24H)
CO	CO	PPB
NO	NO	PPB
SO2	SO_2	PPB
NO2	NO_2	PPB
O3	O_3	PPB
H2S [1]	H_2S	PPB
CO2	CO_2	PPM
VOC	TVOC	PPB
G	TVOC	Uncalibrated MOS (kOhm)
T	Temperature	°C
RH	Relative Humidity	%
P	Pressure	mBar
PM1	PM1.0	µg /m^3
PM2.5	PM2.5	µg /m^3
PM10	PM10	µg /m^3
PM1_2	PM1.0 redundant	µg /m^3
PM2.5_2	PM2.5 redundant	µg /m^3
PM10_2	PM10 redundant	µg /m^3

PORT1 [2]	External Module	Appears only if attached
PORT2 [2]	External Module	Appears only if attached
PORT3 [2]	External Module	Appears only if attached
PORT4 [2]	External Module	Appears only if attached
WD	Wind Dir	Degrees from North
WS	Wind Speed	Mph
BATT	Battery Voltage	Volts (4.2 - 3.4V)
CHRG	Charging Current	mA
RUN	Run Current	mA
SD	SD Status	(1 – OK, 0 – refer to STAT)
RAW	Raw sensor signals	ADC Counts
STAT	System Information	*See Below*
LAT	GPS Latitude	Degrees
LON	GPS Longitude	Degrees
CRC	Checksum	

4. The heading 'STAT' contains diagnostic information detailed below:

STAT = HEX1, HEX2, HEX3, (EXTENDED INFO)

HEX1 BIT	DESCRIPTION
0	SD Init Status (0 – Init Failure, 1 – Init Success)
1	SD Card Presence (0 – Not Installed, 1 – Installed)
2	SD Write Status (0 – No Error, 1 – Write Error)
3	Temp Flag (1 – Normal, 0 – Low Temp)
4	Charge Status (0 – Charge On, 1 – Charge Off)
5	CO_2 Connection Status (0 – Not Installed, 1 – Installed)
6	PTR 1 Connection Status (0 – Not Installed, 1 – Installed)

7	Always Zero

HEX2 BIT	DESCRIPTION
0	CO Read Error (0 – OK, 1 – Error)
1	NO/SO_2 Read Error (0 – OK, 1 – Error)
2	NO_2 Read Error (0 – OK, 1 – Error)
3	O_3 Read Error (0 – OK, 1 – Error)
4	Port 1 Connection Status (0 – Not Installed, 1 – Installed)
5	Port 2 Connection Status (0 – Not Installed, 1 – Installed)
6	Port 3 Connection Status (0 – Not Installed, 1 – Installed)
7	Port 4 Connection Status (0 – Not Installed, 1 – Installed)

HEX3 BIT	DESCRIPTION
0	Port 1 Power Status (0 – Power Off, 1 – Power On)
1	Port 2 Power Status (0 – Power Off, 1 – Power On)
2	Port 3 Power Status (0 – Power Off, 1 – Power On)
3	Port 4 Power Status (0 – Power Off, 1 – Power On)
4	Port 1 Fault Status (0 – No Fault, 1 – Fault)
5	Port 2 Fault Status (0 – No Fault, 1 – Fault)
6	Port 3 Fault Status (0 – No Fault, 1 – Fault)
7	Port 4 Fault Status (0 – No Fault, 1 – Fault)

5. If operating with a weather station, orient the weather sensor such that it is pointing North. Failure to do this will result in arbitrary wind direction.
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 RAMP, then install a power adapter or a solar panel for long term deployment applications.

NOTES:

1. Other sensors not listed here may be possible to configure within the RAMP device. Contact SENSIT for more information.
2. The Heading for the ports will be specific to the device that is connected not 'Port #'

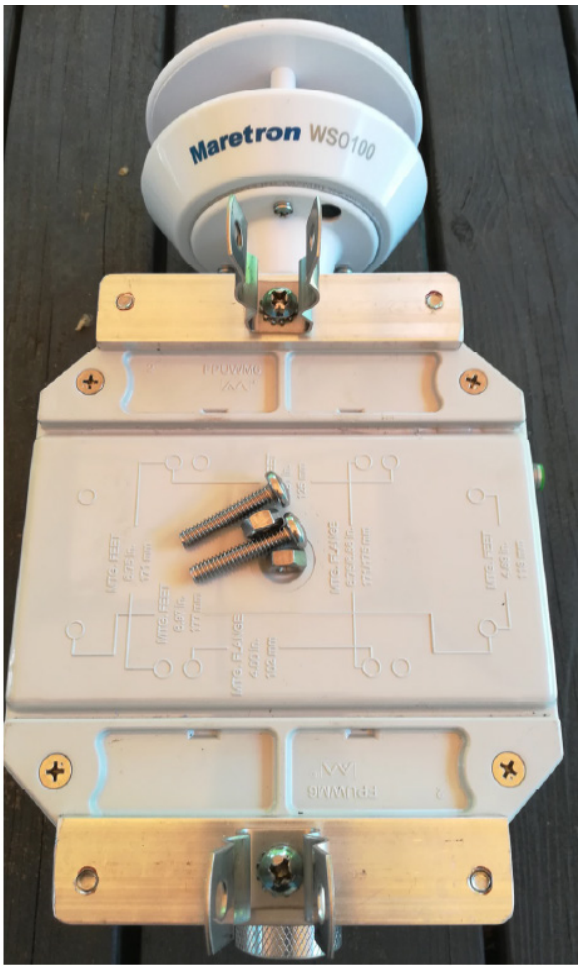
TRIPOD SETUP AND INSTALLATION (OPTIONAL)

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

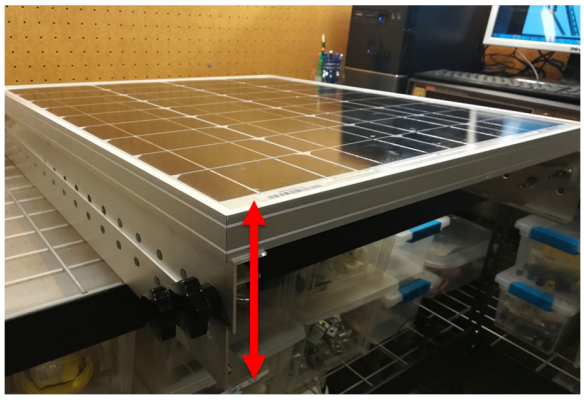
1. Use the shorter ¼" long screw to attach pole mount to back of RAMP
2. Use the longer 1 ¼" long screw + nut to tighten on pole
3. Tighten sufficiently to prevent rotation
4. Place RAMP as far up as possible on pole to avoid blocking anemometer

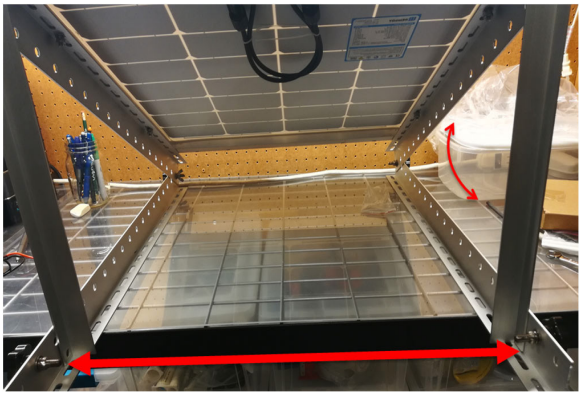
NOTE: The images below are used for reference. RAMP appearance will differ slightly from image below.



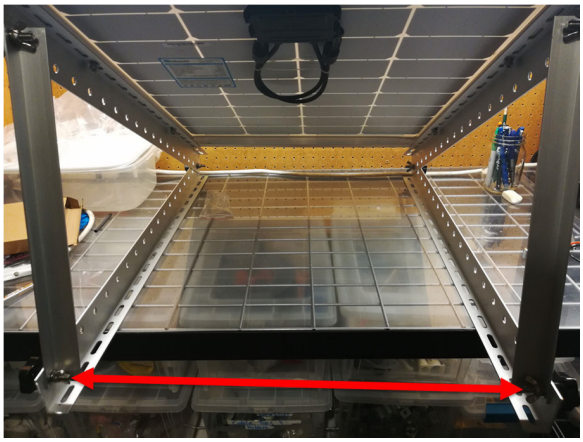
SOLAR PANEL SETUP & INSTALLATION (OPTIONAL)

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 RAMP unit
7. Plug cable into RAMP “Power/USB” connection
8. Power on RAMP 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.

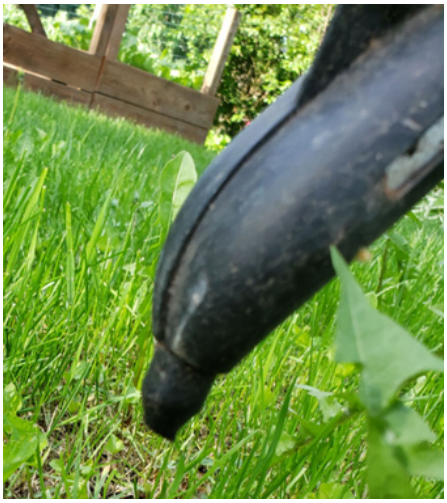
3. Lift panel mount up to keep panel off the ground. If high weeds or deep snow are present consider increasing height off the ground.

4. Adjust angle according to season and latitude or if heavy snowfall is anticipated. To adjust angle, loosen the 4 bolt 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 RAMP unit
7. Plug cable into RAMP “Power/USB” connection
8. Power on RAMP 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.



ANEMOMETER (IF INSTALLED)

1. When installing the unit, ensure the alignment notch of the weather sensor is pointing North (see image below). Failure to do this will result in error in the wind direction measured by the anemometer. The North direction is indicated with a notch on the ultrasonic anemometer base. Never rotate the anemometer from the top or severe damage will occur.

   CAUTION: To accurately measure the wind direction and humidity, the alignment notch on the Weather Station Instrument must be pointed correctly.

   • Moving -The alignment notch must point forward and be parallel to the centerline.

   • Stationary surface-It is recommended that the alignment notch point toward true north.

2. Tighten or align the Weather Station Instrument by grasping the lower housing below the reflector plate. Hand tightens only.

   • Do not rotate the cap. Turning It may sever internal connections and void the warranty.

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

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

Install MET (**Notch** must point North)

3D (left) Analog (middle) Ultrasonic (right)

USB COMMUNICATION & CONFIGURATION MODE (SENSOR)

The RAMP sensors 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:

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

SENSOR QUICKSTART INSTRUCTIONS

1. Connect the USB cable to the RAMP and computer and establish the communication link in the terminal software.

   Turn on power switch and observe initialization process. After initializing the microcontroller and printing RAMP information, the system will system will prompt the user to:

   "Enter Configuration Mode? (YES)"

2. 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:

MENU ITEM	DESCRIPTION	LOCATION
CELLULAR	Cellular settings	Root Menu
DEFAULT	Reset all settings	Root Menu
DISPLAY	Prints device settings	Root Menu
GPS	GPS Settings	Root Menu
OUTPUT	Sensor Output Behavior	Root Menu
TIME	Time Settings	Root Menu
SYSTEM	System settings	Root Menu

NOTE: With the exception of DEBUG option, all changes made within menu are stored in NVRAM and will be retained on power cycling

DETAILED ROOT MENU INFORMATION

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.

Display: Displays all current settings in the terminal window. An example print out is shown below. Please not that system settings may differ from device to device depending on the application.

Sensor ID: 1097
Without MET
Firmware Version: 220224_AQ_v9.70
System DATE,03/23/22 17:29:27
Network Time: Enabled, UTC
Battery Voltage: 3.66
Power Source: Solar Power
Output Mode: Streaming, Standard SD Rate
Communication Mode: Cellular, Unlocked
Network Selection: CATM1
Cellular Protocol: CSV Periodic HTTP Always On with TLS
Output Data Rate: 60
Cellular Output Ratio: 1
Server Address: https://api.sensitconnect.net/sensors- data/addsensorsdata
Access Point Name: zipitwireless.com.attz
GPS Mode: Disabled
Auto-Range Gain: Enabled
Calibration File: 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 and 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.

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.

SYSTEM: Adjustment of system settings of RAMP including ADC configuration, CALFILE generation, constrain limits, sensor calibration settings, and weather station input selection.

EEBACKUP: Start to take backup of EEprom. Preparing new file. Do NOT Turn Off Instrument. EEPROM Backup, Please wait...EEPROM Backup Complete

EERESTORE: Start to retrieve EEprom from SD card. Do NOT Turn Off Instrument. EEPROM Restore, Please wait...EEPROM Restore Complete

EXIT: Leave the root menu and starts system operation

DETAILED CELLULAR MENU INFORMATION

MENU ITEM	DESCRIPTION	LOCATION
APN	Carrier APN Setting	Cellular Menu
BAND	Custom Carrier Band Settings	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 required 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 RAMP 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 "GPRS", "CATM1", "NBIOT", "LTE", or "GLOBAL" service instead of scanning for all network options. It is required to run "SIGNAL" option after adjusting network settings. Note that "GLOBAL" option is no longer recommended for RAMPs using modem based on Quectel BG95.
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 delimeters 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 HTTP 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.

A VALUE		
CSQ VALUE	**DBM**	**MEANING**
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 VALUE	MEANING	
0-3	Reliable Data Link	
4-5	Occasional Dropped Posts	
6-7	Unreliable Data Link	
99	Unknown/Not Detected	
C,D,E VALUE	**MEANING**	
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. The certificate file must be named "CACERT.CER". If TLS is enabled the terminal should display:

TLS Eanbled...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.

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

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 RAMP. The following options are possible:

"Cellular": Sends data with cellular modem at ODR and USB/Power port every 5 seconds
"USB": Sends data with USB/Power Port every 5 seconds and turns of wireless

"Cellular": Sends data with WiFi modem at ODR and USB/Power port every 5 seconds
"XBEE": Sends data with XBEE (optional) at ODR and USB/Power port every 5 seconds

ODR: Sets the output data rate of the cellular modem or XBEE wireless device. The USB port will always show data output every 5 seconds.

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

STREAM: Continuous USB and XBEE data output every 5 seconds.

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

MENU ITEM	DESCRIPTION	LOCATION
AUTORANGE	Automatic ADC Gain Selection	System Menu
CALFILE	Enable continuous file collection	System Menu
CONSTRAIN	Limit sensor readings above 0	System Menu
ECHEM	Sensor Parameters	System Menu
ECHEMPARAM	Display echem parameters	System Menu
OFFSET	Offset and slope settings	System Menu
OFFSETPARAM	Display offset/slope	System Menu
WIND	Wind sensor settings	System Menu

AUTORANGE: Default operation is to leave ADC gain fixed. Higher resolution data may be obtained by enabling autorange gain by reducing the full-scale range of the ADC. This will scale the raw values by the gain multiplier and care must be taken if using the raw values for post data processing if previously using fixed gain.

CALFILE: Enables a continuously running CAL.TXT. This is useful for compiling a continuous set of collocation data but is not recommended to leave on as file size will become extremely large.

CONSTRAIN: Enables or disables a constraint on negative values. It is recommended to disable constrain to allow better indication of offsetting calibration.

ECHEM: This can be used to adjust electrochemical sensor parameters. This should not be edited unless directed by SENSIT. If unintentional changes are made the user should apply the '0: Default' setting

ECHEMPARAM: This shows the current sensors installed and the sensors parameters. If adjustments are made they should be verified here.

OFFSET: This allows the user to adjust the calibration offset and slope correction for all sensors. The user will be prompted to type [SENSORTYPE]: and apply offset and slope corrections. All corrections can be removed by typing RESET within this option.

OFFSETPARAM: This shows the current sensors installed and the offset and slope correction parameters. If adjustments are made they should be verified here.

ACT_SAMPLING: Allows the user to control the fan speed. Enter option to set fan speed: Fan Off: 0%[1], 25%[2], 50%[3], 75%[4], 100%[5]

OFFSETPARAM: This shows the current sensors installed and the offset and slope correction parameters. If adjustments are made they should be verified here.

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.

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

CONSTRAIN: Enables or disables a constraint on negative values. It is recommended to disable constrain to allow better indication of offsetting calibration.

WIND: Select 'Analog' for Cup and Vane style anemometer, 'Digital' for ultrasonic weather station, or NONE

SENSOR MAINTINANCE AND CALIBRATION

Typing 'CAL' instead of 'YES' enter calibration mode. Calibration mode allows the user to observe a continuous sensor output as well as calibrate the zero and slope of the following sensors: CO, NO, NO2, O3, CO2, PM2.5 reading. Calibration mode is temporary and will be lost upon a system power cycle. To enter calibration mode type Cal at the prompt.

- To set new zero level expose the sensor to zero air and type the following: CO:zero, NO:zero, NO2:zero, O3:zero, CO2:zero, or PM25:zero
- To calibrate the sensor to a known level of target gas replace 'zero' with the actual ppb reading for CO, the actual ppm reading for CO2, or the µg / m3 reading for PM2.(e.g. CO:10000 would calibrate to 10000 ppb CO, CO2:1500 would calibrate 1500 ppm CO2, or PM25:20 would calibrate 20 µg / m3)

NOTE: Please allow 1-2 outputs for the sensor reading to update.

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

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)

DETAILED SAMPLE MENU INFORMATION

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 RAMP. "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

MENU ITEM	DESCRIPTION	LOCATION
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 RAMP will calculate a true average of RAMP data. With average array disabled, the RAMP 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.

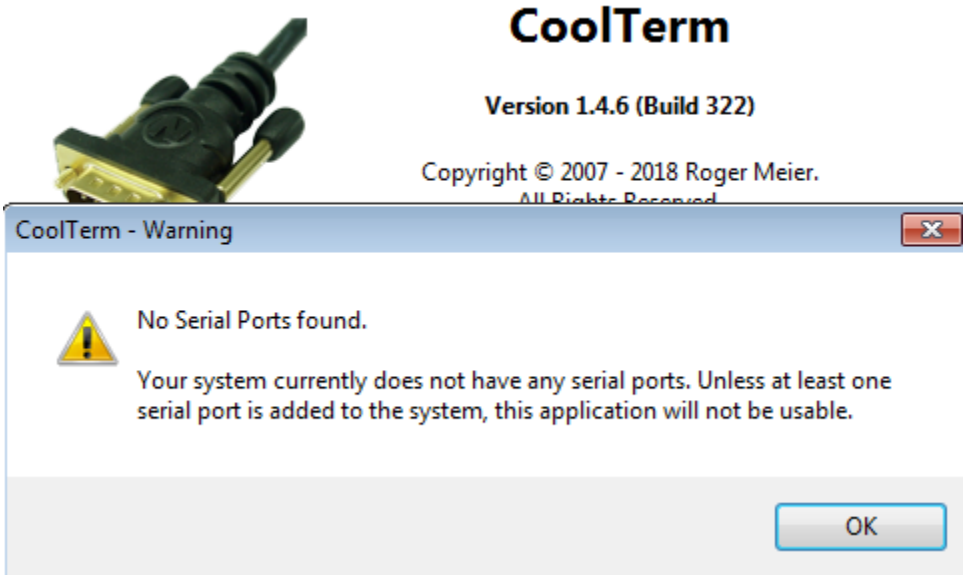
After the average array behavior is set, the RAMP will prompt triggering based on RAW or PPB readings. If RAW readings are used the threshold will be in mV and if PPB readings are used the threshold will be in ppb.

Finally, the RAMP 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.

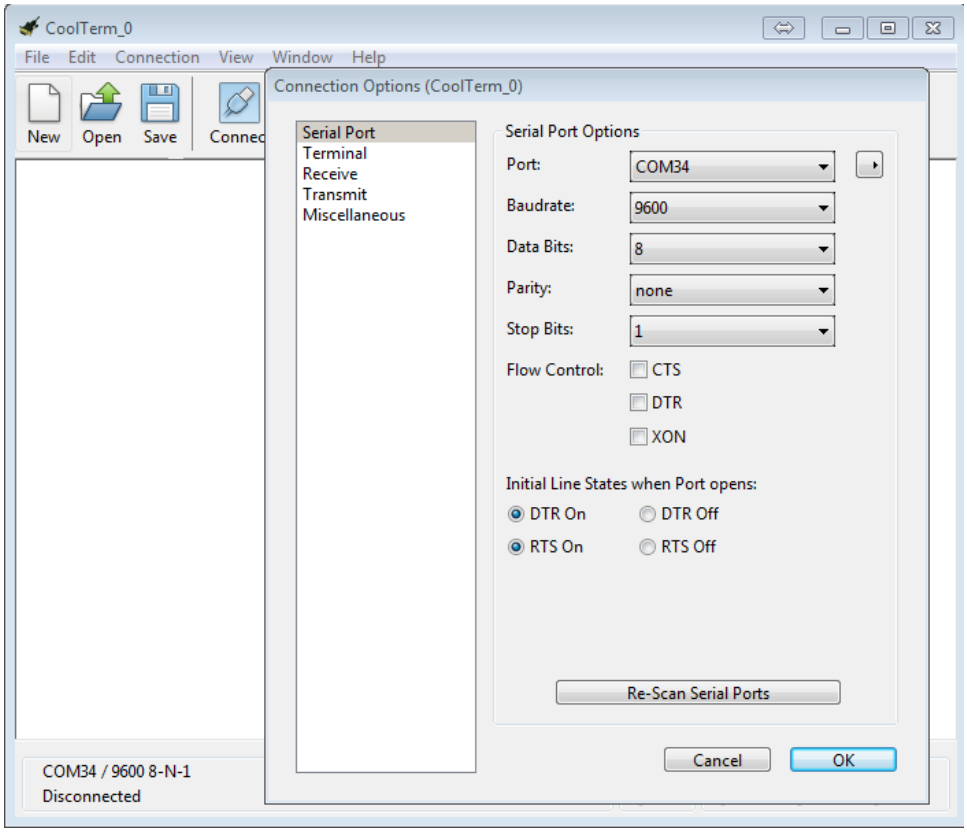
HARDWARE AND SOFTWARE INSTALLATION GUIDE

1. Download drivers for FTDI Serial Adapter and install drivers https://gasleaksensors.com/products/sensit-ramp-air-quality-monitor/ (located in Downloads tab)
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: https://gasleaksensors.com/products/sensit-ramp-air-quality-monitor/ (located in Downloads tab)
    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.

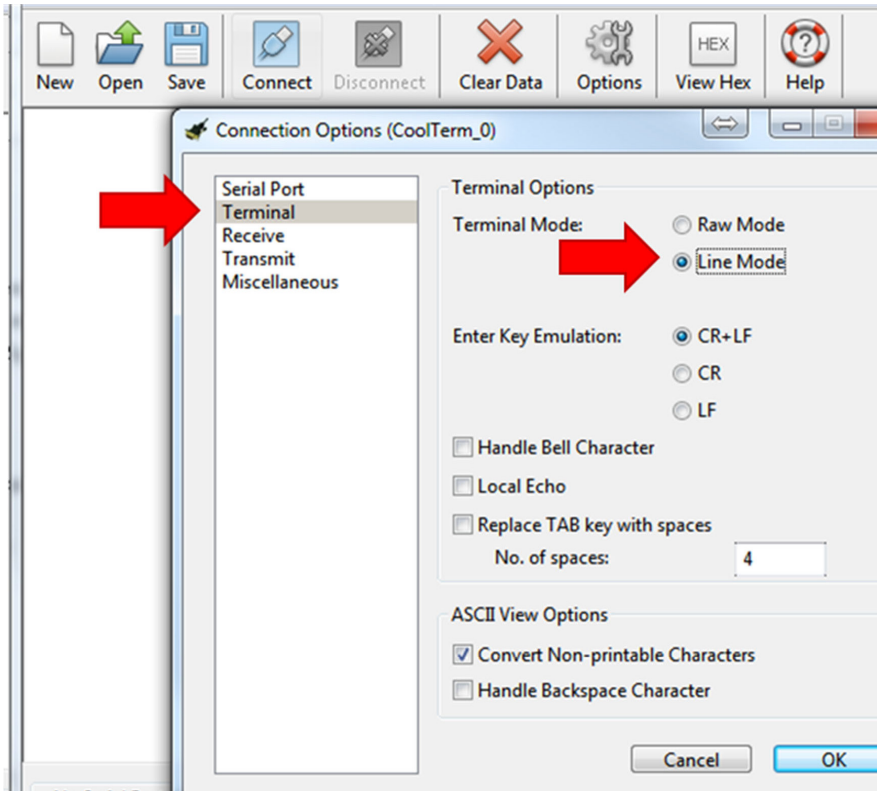


3. Click ‘Options’ as shown below

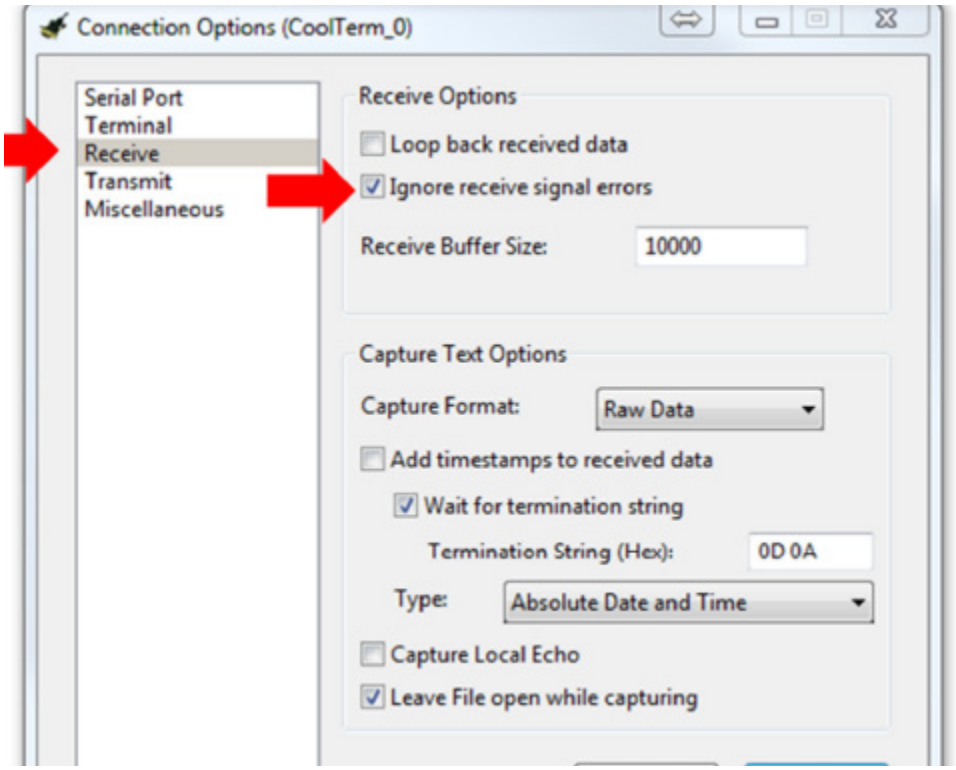
   a. ‘Serial Port’ options should open by default. If not, select Serial Port options from the list of available options as shown below. All default options should be correct but please verify. Click on ‘Port’ dropdown list and make note of any available ports. Plug in the USB cable and wait for hardware 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 connectedsensor.



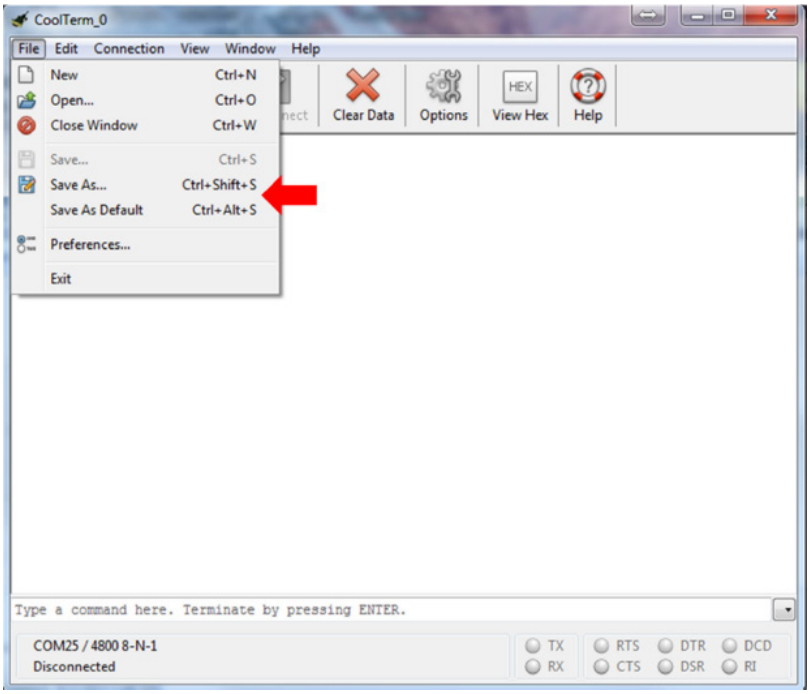
c. Select ‘Receive’ options from list of available options and check “Ignore Receive Signal Errors”. Selecting this option reduces the possibility of the serial connection closing upon a received serial error such as connecting or disconnecting the cable or power cycling the unit.



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

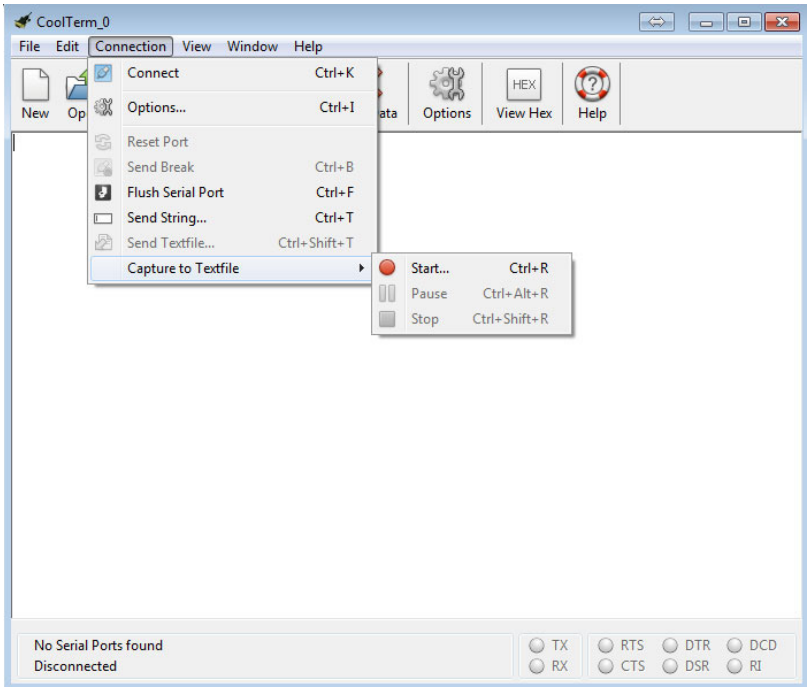
    b. Click “Save As Default” to change these settings to the default settings when starting the program. If you are running off the CD this option will give you an error as there is no default file.



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)



NOTES

WARRANTY

Your **SENSIT® RAMP** 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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SENSIT

MADE IN THE USA
WITH GLOBALLY SOURCED COMPONENTS

SENSIT® RAMP Operation Manual & Configuration Guide
Part Number: 750-00084
Version 2, June 2024