



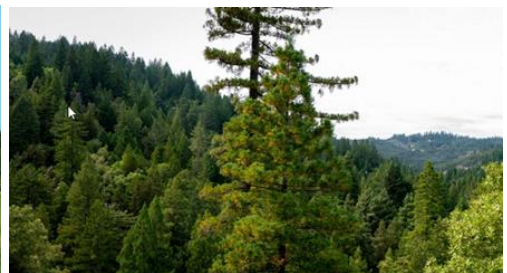
Sensor Environmental Monitoring in Remote Zones

By John Sonnenberg Raveon Technologies Corp

Overview

Raveon's Remote Autonomous Zone Node (RAZN) can connect up to many sensors for *Sensor Environmental Monitoring (SEM)* in remote areas. The integrated long-range wireless link communicates over many miles so sensors can be monitored, calibrated, and trigger alerts to save many things.

Boats, Greenhouses, Forests, and many places could be monitored.



Save boats from sinking or being stolen, ensure farms grow all plants, and spot fires in forests to save valuable resources. Here is a list of the sensors that this *Environmental Monitoring System* works with that can trigger alerts, alarms, operate valves, control pumps, or show you current status.

List of Sensor Types this SEM can monitor:

- Water level sensors
- Spot-Fire
- Carbon monoxide
- Methane
- Temperature
- Power/Voltage
- Angle position of the device, and detect changes in angle
- In-ground water sensors or humidity
- Vibration sensor

Save BOATS

A *SEM* system can prevent sinking by instantly alerting the ship crew members and boat owners if leakage occurs, the power fails, batteries fail, temperature rises unsafely high, heavy vibration occurs, the boat shifts over or falls over, and the boat is stolen by taking away.

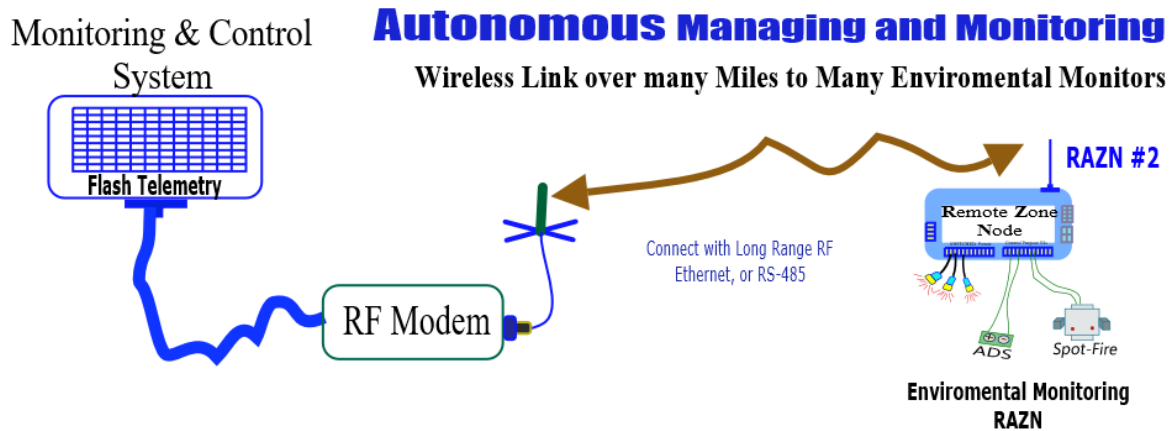
Save Farms or Greenhouses

A *SEM* system can stop plants from dying. It can make sure timely watering happens. If water is in the ground. Water is not too heavy/full that will kill a plant. Monitor temperature in the area, spot snow, and let you know the temperature and humidity to properly control your irrigation and frost tolerance.

Save Woods and Forests

A *SEM* system with a Spot-Fire sensor can remotely spot a fire and quickly report it to local organizations or fire departments. The RAZN can also autonomously trigger local Fire alarm lights, sirens, and turn things on to help stop the fire, such as irrigation, water valves, pumps, and turn AC power off.

How does this Sensor Environmental Monitoring SEM Work:



Along with sensor monitoring, other features here will make this *Sensor Environmental Monitoring (SEM)* work very safe and reduce the probability of the risk happening. These extra features make this system work remotely.

List of additional features this RAZN SEM has:

- Real Time Clock (RTC)
- RTC battery backed up.
- Up to 18 IO interfaces.
- Ultra-high-resolution ADCs
- Ethernet Interface for networks
- RS-485 interfaces and mesh multiple SEMs
- Long-range wireless data modems built-in.
- Autonomous features to do whatever you want.
- Calibrate the sensors to output formats as desired.

Using Great Sensors to Monitor your Environment, and keep it safe.

There are many great sensors that will work with Raveon's wireless data links and the Remote Autonomous Zone Nodes (RAZNs) so this *SEM* can keep your system as safe as you want.

Spot-Fire

A fire spotting sensor is optimized to detect even small flames from early stage fires. The RAZN's flexible digital IO can monitor this and wirelessly connect it remotely to other master controllers. There are sensors for monitoring low levels of carbon monoxide to detect fire.



Temperature Sensors

There are so many ways to measure temperature. Internally, the RAZN has 3 IC chips with temp sensors. The ADS terminal inputs can measure any type of sensor: Thermistor, Thermocouples, Infrared sensors, Silicon Diode, RTD. For reliable long-range, connect a sensor to a Multi-Range Temperature sensor transmitter to pass the signal to the RAZN or to Raveon's GPIO data radios.



Carbon Monoxide or Methane

Gas detectors can detect and quantify industrial and environmental gases like Carbon Monoxide, Carbon Dioxide, and Methane. This vital role ensures the safety and efficiency of a wide variety of processes and applications. Carbon dioxide is an energetic molecule which diffuses quickly throughout an area. Many different types of sensors can be connected to the RAZN to monitor Industrial, Commercial, or Hazardous areas.

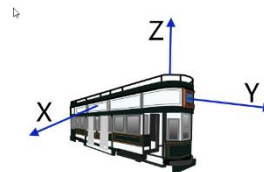


Power/Voltage

The ADS terminal input measures the “differential” voltage input. For AC power, you could add a diode and resistor to measure it, For Large Voltages, add a large resistor in series to the inputs, so you can measure even thousands of volts. Add capacitors, resistors, and diodes to measure AC power.

Angle of the Device

Inside the RAZN is an accelerometer to measure X, Y, Z angles and vibration. The RAZN on a boat or anything can monitor and alert based any or all of the X, Y, Z angle level changes. If it tips over to the side, the X can trigger. If front goes up or down, the Y will trigger, and if it just moves up or down, the Z will trigger.



Vibration Sensor

The same accelerometer can monitor and measure vibration rates, so if the RAZN is vibrating, the system can monitor it and be alerted. A boat (ship, car, truck, bicycle, person...) that is moving does vibrate and the RAZN will detect it is moving. And if it vibrates much too large, a large alert can take place.

Gas Sensor

To detect many different gas types, a gas sensor can warn you remotely with a beeper or flash a light, or turn on other safety equipment autonomously, or have your master software controller recognize the gas.



Calibrate the Sensors

The smart CPU in the RAZN has lots of math for calibration processes. Commands or SCADA messages can specify the math or execute calibration functions for the analog inputs. The 24 bit can be converted to any other size. Inside the RAZN are registers holding the calibrated input values in whatever range you want. The Master controller can tell the RAZN what the input level is, and the RAZN will setup the input math to ensure the current calibrated input is read correctly.

Oxygen Sensor

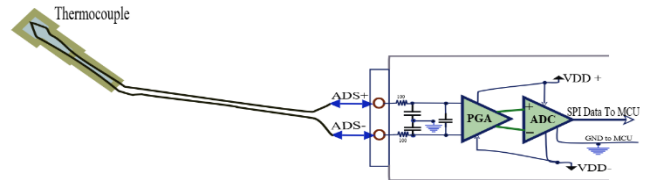
Monitor oxygen to protect buildings and occupants from injury due to oxygen deficiency or excess. In remote areas of mines, ships, tunnels, vaults, sewers, or tanks, monitoring oxygen over long-range areas can protect people and these areas. The Master can monitor remotely and the RAZN can autonomously do something, such as (beep a siren or open a door) to help save lives.



Sensor input terminals on the RAZN monitor the perfect sensors for the system.

Thermocouple Sensors

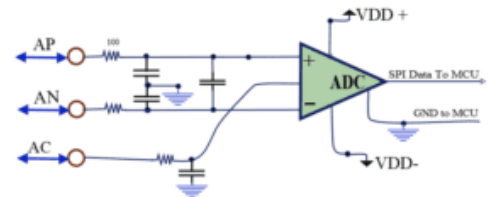
Thermocouples cover a wide temperature range, are self-powered, and have a fast response time. Their simple construction make them inexpensive and durable. A thermocouple consists of two wires of dissimilar metals joined together at the end. The delta-sigma analog-to-digital converters (ADCs) are 34 bit ultra-high resolution ADCs, ideal data converters for measuring, monitoring, and reporting thermocouples and analog sensors.



A programmable Gain Amplifier (PGA) is also within the RAZN, so gain can be from 0.125 to 128. Large gain for small signals, or low gain for large signals, is configurable. Most Thermocouples types have low output so high gain PGA are correct for this type of sensor.

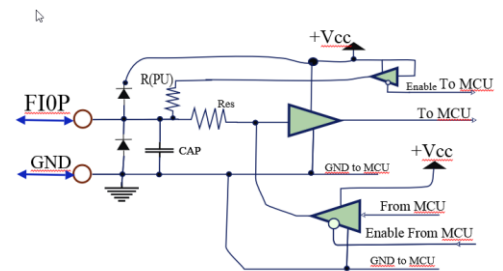
Temperature Sensors

Internal to the RAZN is a local temperature sensor, and the Analog Delta-Sigma Differential ADS input can measure most any type of temp sensor. 4-20mA, 0-5mA, -5 to +5V, -1V to +1V, or almost any other type of sensor can be measured. A resistor that changes by temperature can be measured, and the RAZN will convert measured inputs to temperature and report the temperature.



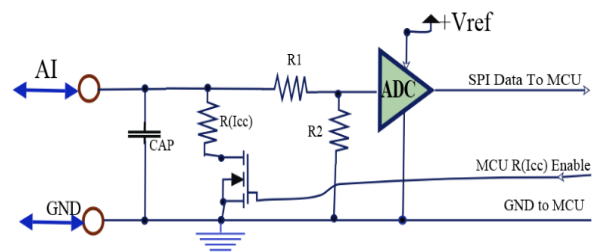
FIOP Flexible Digital Input / Output with Pullup option.

IOPIN: A(In) B(Out) is the character used to specify the IO mode.
 User configurable TTL digital IO pins configurable as **In or Out**.
 Max DC input Voltage: Vcc
 "ON" DC input voltage Range: $(0.8 \times V_{cc})$ to Vcc
 "OFF" DC input voltage Range: 0V – $(0.12 \times V_{cc})$
 Input Current: <2uA
 CAP: 220pF Res: 1K Diodes for ESD protection.
 Default IO mode from factory: **A** (digital Input).
 100K pull up resistor R(PU) can be enabled by CPU.



AI Analog Input. Voltage Input or 4-20mA current Input

IOPIN: E (Volt) or F (Current) is the character to use to specify this type of GPIO Input Configuration. That MOSFET turns on R2 to measure 4-20mA.
E: Input impedance: 10K-15K
F: Input Impedance: 120 ohm
 A to D resolution: 12 bit
 Input Sampling Time: 50mS - 2S configurable.
 Smoothing: Selectable averaging: 1-8 samples.
 Maximum Input voltage: 5V, R1 can be changed.



Internal Technology Features

All these Technologies are working on RAZN Prototypes. For more details, see the user manual or our web page: <https://www.raveon.com/remote-zone-nodes/>

- RTC** Real Time clock with internal back-up battery that keeps clock accurate for months without power input.
- ACCL** Accelerometer chip to read X, Y, and Z angles of the RAZN. It also can monitor vibration.
- EEPROM** To store permanently information settings and information. It could be used to store historical data.
- TEMP** Temperature sensor in the enclosure, but near the box so close to the outside temperature.
- LPM** Low Power mode. We can run the system at much lower DC power consumption, with periodic things to do.
- MODBUS** The RAZN can process and send MODBUS TCP and RTU messages.
- MIMIC** MIMIC mode is like our Radio Modem MIMIC mode. One master RAZN sends its inputs to a slave RAZN that outputs the same modes, and then responds back to the master MIMIC device so the master can display that actual slave status.
- MESH Nets.** For Daisy Chaining or Mesh Networking many RAZNs together, every RAZN monitors messages and can route them appropriately to: wireless, Ethernet, or wired interfaces. Messages can be multiple-meshed over many different RAZNs in the system to Mesh Networks over large areas.
- IO Boards** The Input/Output interface boards can plug into the main motherboard. The interface is generic, flexible, and hardware detectable so the CPU can run based on the type of board plugged in.

Remote Autonomous Zone Node (RAZN) Sensor Monitoring

Use Raveon's RAZN to remotely monitor temperature. Over a large areas, do whatever you want based on temperature monitored via this long range communication technology the RAZN has.

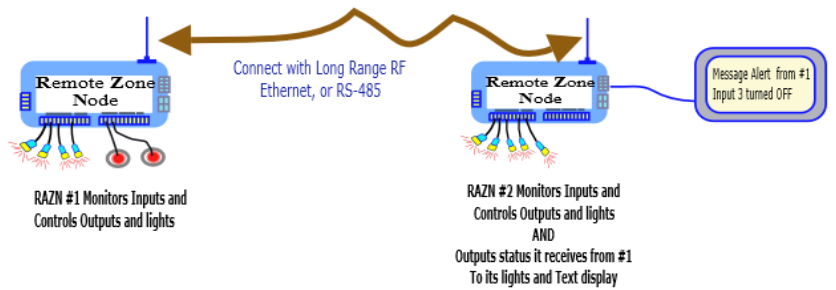
In remote areas, the RV-N55-7 RAZN can accurately monitor sensors with the ultra-high precision Analog to Digital Converter is has within it. The [ADS](#) input terminals are analog differential inputs to measure the different voltage or current between two input pints.

Using Raveon's Daisy Radios for daisy chaining your network or your system, the RAZN can work across many miles

Daisy chaining RAZN together can also monitor things remotely and then send messages to other remote areas to control what you need.

RAZN can autonomously use the [ADS](#) information to remotely control things, and report temperatures into remote computers, Master controllers, IoT servers, or simple to a graphical display. Many different versions of the RAZN have analog inputs, and the RV-N55-7 version has the ultra-high resolution ADC in it that is the ideal device to monitor a Thermocouple Sensor.

Autonomous Text Messaging and SCADA Messaging



Here is an overview of the RV-N55-7 RAZN Input and Output Terminals with many IO features. The [ADS](#) terminals IO# 3 and IO# 4 are perfect for analog Sensor monitoring.

RV-N55-7 8 FIO and 2 high-res Differential ADCs

The RV-N55-7 has 2 Ultra-High Resolution ADC inputs, 8 Flexible digital IO terminals, and one Relay Driver output to drive a relay or electronics device On or Off.

The RV-N55-7 interface terminal connector pin-outs are as follows:

Terminal A Analog Inputs, Relay Driver, and voltages.

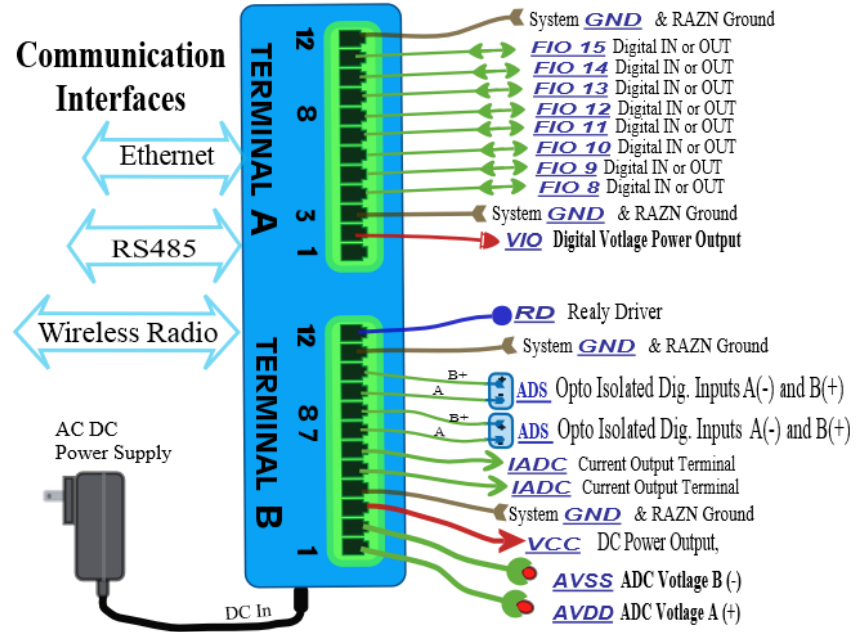
Pin #	1	2	3	4	5	6	7	8	9	10	11	12
Function	AVDD	AVSS	VCC	GND	IADC	IADC	ADS+	ADS-	ADS+	ADS-	GND	RD
IO#					1	2	3	3	4	4		7

Terminal B Configurable FIO pins: 8

Pin #	1	2	3	4	5	6	7	8	9	10	11	12
Function	NC	VIO	GND	FIO	FIO	FIO	FIO	FIO	FIO	FIO	FIO	GND
IO#				8	9	10	11	12	13	14	15	

Pin # is the Terminal Port Pin Number. IO# is the software reference and register code for this port.

RAZN RV-N55-7 Terminal Interfaces



ADCG x gg command sets the Programmable Gain Amplitude (PGA). Index for input terminal number IO# is **x** to set **gg** as the gain value.

The **ADS** inputs are a signed 24 bit register for high resolution ADC. $2^{23} = 8,288,608$ so with 8 million bit resolution this has the highest resolution ADC in the world. The ADC data is stored in SCADA registers 6040-6055 for IO terminals IO#0 – IO# 15.

Commands **GVOLT x** can read the voltage in IO terminal **x**.

Command **TEMC X** can read the calculated Celsius Temperature of the thermocouple connected to RAZN terminal IO# **X**.

Command **TEMF X** can read the calculated Fahrenheit Temperature of the thermocouple connected to RAZN terminal IO# **X**.

RAZN IO Boards (Raveon has created many IO option boards for the RAZN)

Internally, every RAZN has a **CPU board** on it, and an **IO board**. There are many different IO boards Raveon has created for many different industries and input/output features. Each **IO board** has a detection interface, and is plugged into the CPU board. **IO board** are detected by the **CPU board**, so when an **IO board** is plugged into it, the CPU knows how to talk to it and what IO features it has.

The dash after their RV-N55 part number is a number specific to the internal IO board. Here is a list of the IO boards, their IO architecture and board numbers.

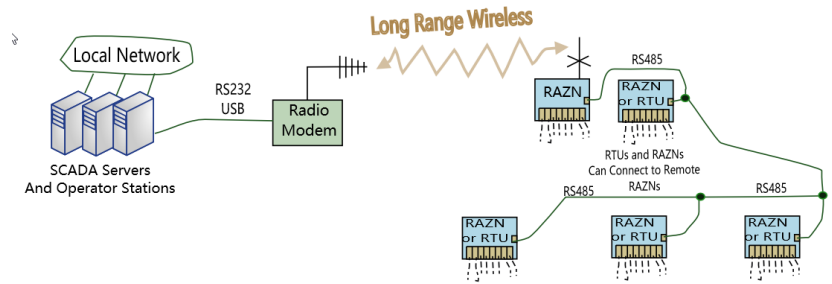
- RV-N55-2 (5A510)** 8 **SV** DC&AC power output switches to control things.
8 **GPIO**
- RV-N55-3 (5A515)** 8 **SV** DC&AC power terminals
8 **BM** switch inputs terminals for 8 buttons.
8 status LEDs on top show the status of this devices SV outputs,
Ethernet Interface.

- RV-N55-5 (5A511)** 8 **LI** LED optically isolated digital inputs.
4 **AI** Analog Inputs.
- RV-N55-7 (5A517)** 8 **FIO** input terminals for 8 button inputs.
2 **ADS** Differential Analog Inputs.
1 **RD** MOSFET relay driver.
- RV-N55-8 (5A512)** 16 **GPIO** input terminals for 8 button inputs.
4 **AI** Analog Inputs
1 **RD** MOSFET relay driver.
- RV-N55-6 (5A513)** 4 **AI** 12 bit ADC.
8 **OIDI** optically isolated digital inputs, 3000V isolation.
1 **RD** MOSFET relay driver.

Each of the IO board versions (5Axxx) above have many sub-version with some IOs included, and some turned off, and some setup differently in pre-set ways. After the dash number, there is a character related to the version. A,B,C,D,E,F,G... are used after the number. If your industry would ever like an IO board with different features, Raveon can easily make it for you with every feature would like, and it will work with all RAZN features, communication, and Raveon data radio modems.

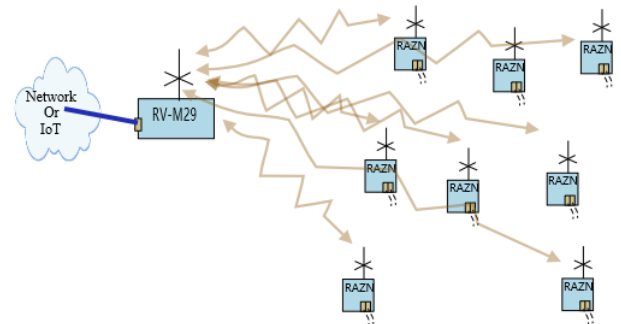
SEM systems with RAZN RTU meshed over to many more low-cost RAZN RTUs up to 20 extra

SCADA Server is the Master Controller. Masters Connects directly to Radio Modem serial port. RAZN RTU has built-in long-range Radio Modem. The RS485 RAZNs meshed to the Main RAZN, and are low cost because they have no RF and no Ethernet.



SEM systems with RAZNs in remote areas are wireless connected up to thousands.

And in remote areas, it is often better to not use wires between the sensors. Using long-range private Data Radios, the system can communicate between all RAZNs using RF links. This SEM system can wirelessly monitor thousands of sensors with monitoring software on a Network connected to the master data radio. Raveon’s RV-N29 Hub, or RV-M21 and RV-M22 data radio modems can be used to connect your network to thousands of sensors connected to many RAZNs.



Ways to Monitor Sensors with a RAZN

Traditional SCADA Method Monitoring

1. Query the input voltage with a MODBUS message from a Master controller.

2. Query the input voltage with a MODBUS message from a PLC.
3. Program the Logic in the RAZN to control outputs based on temperature sensors.
4. Communicate via: RS-485, Ethernet, or long-range Wireless data radio built in the RAZN.

Innovative RAZN Technologies for Monitoring Sensors

1. Wide variety of communication interface options and Long Range wireless features.
2. Autonomous actions to make your system safe and reliable with no communications.
3. Locally trigger outputs based on temperature measured.
4. Locally trigger outputs based on temperature measure and combination of:
 - a. sensor levels (As you want),
 - b. The time and date(as you want),
 - c. Local inputs from buttons, other sensors, temperature, and input status.
 - d. RAZN monitored input events (# on, # off, pulse rate, Time ON, time OFF,...)
5. Remotely trigger outputs by a RAZN
 - a. From a RAZN monitor locally and communicates wirelessly to remote RAZNs.
 - b. Use the RS-485
 - c. The outputs triggered from temperature can be many different kinds of outputs.
 - d. Many different RAZN models have many IO features. See the list of RAZNs.

Communication Methods to and from RAZNs

Ethernet Connect an Ethernet Cable or Wi-Fi adaptor to the RAZN's 10/100mbps Ethernet connector. This is a *Terminal Server* with 1-3 TCP/IP ports for 1-3 simultaneous client connections.

RS-485 Serial Connect an RS-485 serial cable to a RAZN or dozens of RAZNs that share this differential serial communications port connection.

Narrow Band RF The RAZN can have Raveon's RV-M6, or RV-M8 data radio modem installed inside for ultra long range RF data 1-50 miles in VHF or UHF RF bands.

LoRa RF The RAZN can have Raveon's RV-M50 LoRa data radio modem installed inside for long range license-free RF data 1-10 miles.

RS-232 Serial Connect an RS232 serial cable to a RAZN. This is an optional feature on all versions of the RV-N55 RAZN.

Wi-Fi The Ethernet connection can connect to a Wi-Fi modem to use Wi-Fi.

Monitoring and Control Systems

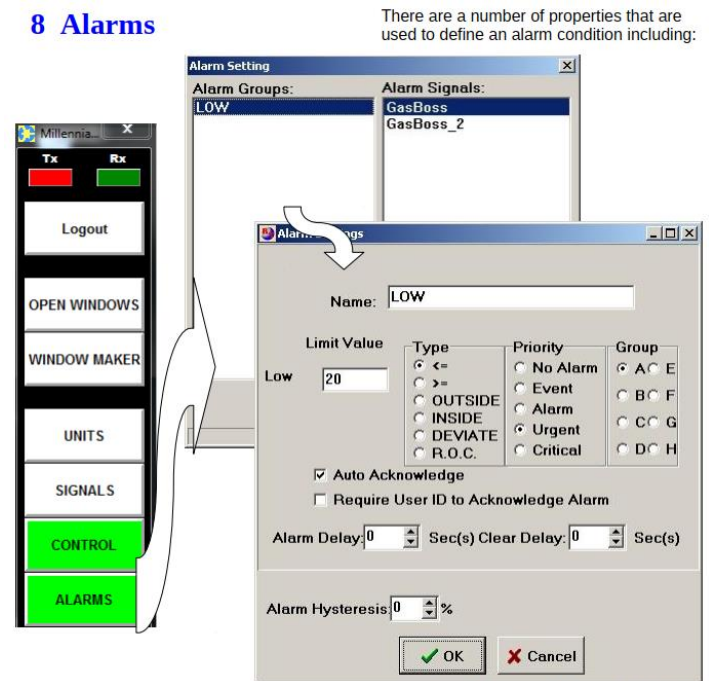
SEM can be monitored and controlled with Master Controller software. Monitoring is done by sending messages to the RAZN to query the sensors. Each sensor is assigned to registers that contain their voltage, current, and temperature calculations. The RAZN can be setup to autonomously remote register values.

Real-Time monitoring and controlling can be done with compatible Windows software applications. The **Millennia-FT** software from Rel-Tek is a reliable tool to view the alarm events, sensor data, and backup your data.

Look at [Rel-Tek's website](#) to see this monitoring software.

A PC Master Controller can do remote viewing of your stations. While monitoring, the PC can show you all status information of the sensors connected to the system. Any number of sensors can be seen and you can touch the PC to view the data. On the PC, setup your alarm thresholds, and the PC can send our messages or trigger remote alarms. An alarm can be a light, siren, text messages, or whatever you want. And these alarms can also be wirelessly be sent out to remote areas.

8 Alarms



Data Radio Modems with GPIO Interfaces

Raveon's **Tech Series** enclosures incorporate all versions of our data radio modems, and they have a myriad of IO terminals available on their front panel.

- RS-232 [S] 5A835
- USB [U] 5A837
- RS-485 [T] 5A836-1
- RS-422 [F] 5A836-2
- GPIO [G] 5A833
- Analog [A] 5A838
- FIO [D] 5A832



These are ideal for Environmental Monitoring in Remote Zones because they have the right serial interface for all RTUs and PLCs. And the GPIO and FIO interfaces are IO terminals with serial ports.

The GPIO interface front panel with the 5-pin terminal as ideal for Monitoring sensors. It has 3 input pins to measure voltage or 4-20mA currents. Users can setup the GPIO the way they need IO pins to work. IOs can be configured as: A: *Digital TTL Input*, C: *Open Drain MOSFET output*, D: *DC Power switch output*. E: *Analog Input Monitoring*.

The RV-M22 miniature Radio Modem is a rugged, modular data radio modem available in 902-928 MHz and 868 MHz license free bands, as well as the FCC USA license free MURS bands, VHF and UHF bands. Raveon's RV-M21 large Tech Series enclosure uses higher-power RF radio modems.

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Modbus is a registered trademark of MODICON, Inc.

Daisy Radio is a registered trademark of Raveon Technologies.

Millennia-FT is a trademark of Rel-Tek corporation. Rel-Tek is a trademark of Rel-Tek corporation.

Thanks for Looking Into this great Technology

All this RAZN technology was designed and manufactured here in America by Raveon. Most of these sensors and software mentioned herein were also made in America.

Raveon also teams up with Sensor companies and Software solution suppliers, so if you need a perfect solution to for *Environmental Monitoring Sensors*, we want to work with you and our partners to make the perfect reliable systems.

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