

Installation Instructions

USM 4 Sensor Input Vnet Module
Racepak PN: 230-VM-USM



Racepak Data Systems
30402 Esperanza Rancho Santa Margarita, CA 92688
949-709-5555
www.racepak.com



Table of Contents

PRODUCT DETAILS	3
ITEMS INCLUDED	3
DATA LOGGER COMPATIBILITY	3
TECHNICAL SPECIFICATIONS.....	3
INSTALLATION.....	4
MOUNTING LOCATION	4
SENSOR CABLE STRAIN RELIEF INSTALLATION	5
SENSOR CABLE TERMINATION.....	6
<i>Sensor to Sensor Cable Termination</i>	6
<i>Sensor Cable to USM Terminal Strip</i>	6
CONNECTING THE USM TO THE VNET CABLE	7
PROGRAMMING THE USM.....	8
SERIAL COM PORT SETTINGS.....	8
<i>USB to Serial Adapter COM Port Number Setting</i>	9
ADDING USM SENSOR CHANNELS TO DATALINKII SOFTWARE.....	10
<i>Programming Individual Sensor Channels</i>	11
<i>Sampling Rate</i>	12
<i>Calibration of Travel (Movement) Sensors</i>	13
<i>Zeroing Sensor Calibration</i>	14
<i>Adding New Sensors to the Real Time (Live View) List</i>	15
<i>Programming the COM Port for Real Time (Live) Viewing</i>	15
SENSOR SPECIFICATIONS FOR USE WITH USM MODULE	16
0-5V SENSOR INPUTS - LINEAR (TYPICAL PRESSURE AND TRAVEL SENSORS).....	17
0-5V SENSOR INPUTS – NON LINEAR.....	17
TEMPERATURE SENSOR INPUTS – RACEPAK/GM	17
TEMPERATURE SENSOR INPUTS – NON RACEPAK / GM	18
RPM SENSOR INPUTS –PROGRAMMING PULSE PER REVOLUTION	18

Product Details

Items included

Quantity	Part Number	Description
1	230-VM-USM	USM 4 Channel Programmable Vnet sensor module
1	280-CA-VM-T009	9" Vnet T Connector

Data Logger Compatibility

LDX	V300	V300SD	V500	G2X	G2X Pro	IQ3
-----	------	--------	------	-----	---------	-----

Technical Specifications

The USM is a fully programmable, four sensor input Vnet module. Each of the four sensor inputs of the USM can be programmed to accept data from four different types of sensors. Connection of each sensor is by means of an internal terminal strip.

Total sensor inputs	4
Sensor input type per channel	Analog, RPM or resistive temperature
Maximum logging rate per channel	100HZ (programmable by user)
Terminal strip specifications	Power / Ground (Earth) / Signal / 5V or 12V power
Housing	Injection Molded / O ring lid / water resistant cable strain reliefs
Sensor cable specifications	Multi-conductor with OD 0.114" to 0.250" / 2.9mm to 6.35mm.
Weight	6.4 ounces / 181 grams

The DatalinkII software regards a single USM as four individual Vnet sensors channels. The USM can be used in conjunction with any Vnet sensor, Racepak Intelli-Gauge or other USM modules, as long as the total number of sensor inputs does not exceed the maximum sensor channel capabilities of the data logger.

Installation

Mounting Location

The rugged nature of the USM housing enables mounting in a variety of locations. As with any electronic device, care should be taken to avoid certain mounting locations.

The bulkhead should be mounted in a manner that avoids:

1. Excessive heat and vibration (exhaust or engine)
2. Excessive electrical interference (ignition systems)
3. Abuse from track or vehicle debris (rubber, rocks, etc)
4. Avoid direct spray from water (such as when washing vehicle)

Mounting Tip

1. The mounting location determines the exiting route for each sensor cable. Try to pre-plan the route that each sensor cable will take as this allows for proper orientation of the module, to best accommodate the connection of the sensor cables to the module
2. The USM is equipped with a 9" Vnet T cable. Insure the mounting location provides easy access to the data logger Vnet cable



The USM housing includes four mounting pads, with each pad containing a #8 (.164" dia. / .416 cm) mounting hole. Insure the housing is securely mounted, utilizing all four mounting pads.

Sensor Cable Strain Relief Installation

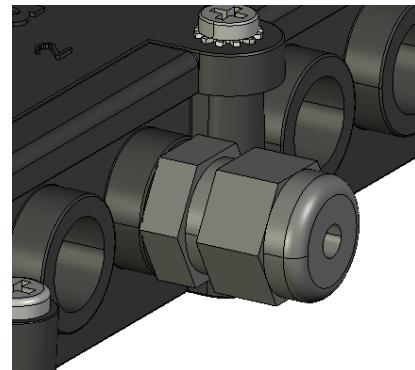
The sensor cable strain relief is designed to provide pull-out protection for the cable, along with providing a water resistant cable entry. Therefore, it is required that the diameter of the cable used is within the range of 0.114 in. to 0.250 in. or 2.9mm to 6.35mm.



The strain relief consists of three components.

1. Threaded insert with wrench flats
2. Cable compression bushing
3. Cable Nut

1. Disassemble the strain relief into the individual components
2. Screw the threaded insert into the appropriate IQ3 sensor input port. Do not over tighten
3. Slide the Cable nut over the sensor cable with the threaded end facing the threaded insert
4. Slide the cable compression bushing over the sensor cable.
5. Insure the tapered end is facing the threaded insert and not the cable nut



At this time, the sensor cable can now be slid through the Threaded Insert and connected to the appropriate terminal strip connectors, as outlined in the following section.

Repeat this process for all other sensor cables.

Sensor Cable Termination

Following installation of the USM housing and external sensors, the sensor cables may now be routed and connected. The USM lid contains molded numbers 1- 4 which correspond with the sensor channel numbers in the USM software. It will be important to remember which input number each sensor is connected to, for software setup purposes.

Sensor to Sensor Cable Termination

If a Racepak sensor is utilized, the appropriate sensor cable and connector can be ordered with the sensor. If a customer supplied sensor is utilized, terminate the sensor cable to the sensor with the appropriate connector. Refer to page 3 of this manual for sensor cable specifications.

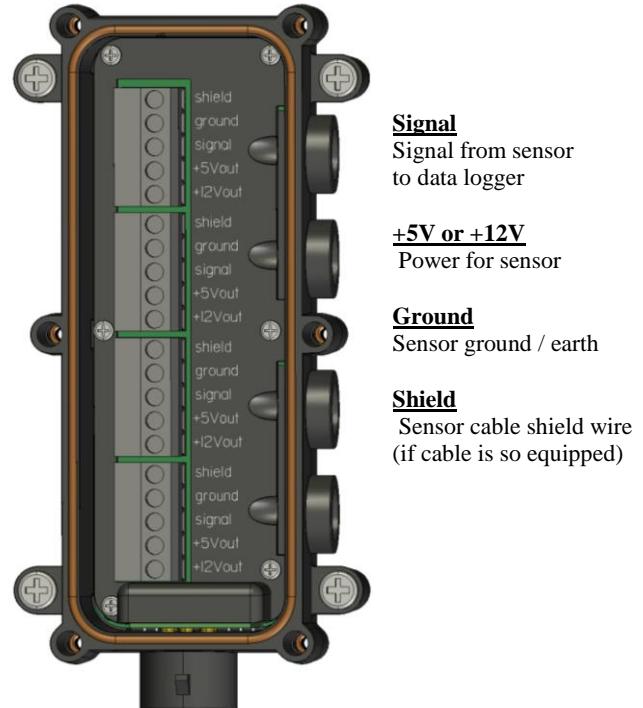
Sensor Cable to USM Terminal Strip

After connecting the sensor cables to the sensors, we can now terminate the sensor cables to the USM terminal strip.

Remove the 6 screws from the lid of the USM. Inside are four terminal strips, corresponding to the numbered housing lid and channels 1-4 in setup software.

Strip approximately .250" / .635cm of jacket from each sensor wire.

1. Determine the power requirements of the sensor (5V or 12V)
2. Insure the strain relief is slid over the sensor cable, then loosen the appropriate screws on each terminal strip
3. Connect the appropriate sensor wires and tighten each terminal strip wire screw
4. Install the strain relief cable nut and bushing
5. Reinstall the housing lid and screws



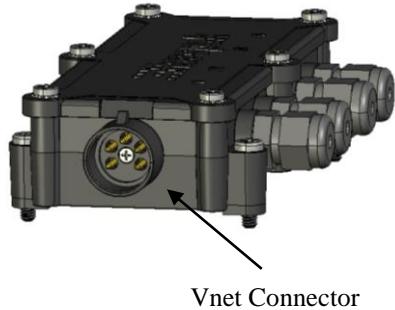
Channel 1	Channel 2	Channel 3	Channel 4
0-5V Sensor Input	0-5V Sensor Input	0-5V Sensor Output	0-5V Sensor Output
Racepak Coolant Temp	Racepak Coolant Temp	Racepak Coolant Temp	Racepak Coolant Temp
GM Air/Coolant Temp	GM Air/Coolant Temp	GM Air/Coolant Temp	GM Air/Coolant Temp
Square Wave RPM	Square Wave RPM	Square Wave RPM	No Square Wave RPM
Voltage Event	Voltage Event	Voltage Event	Voltage Event
Ground Event	Ground Event	Ground Event	Ground Event

Connecting the USM to the Data Logger Vnet Cable

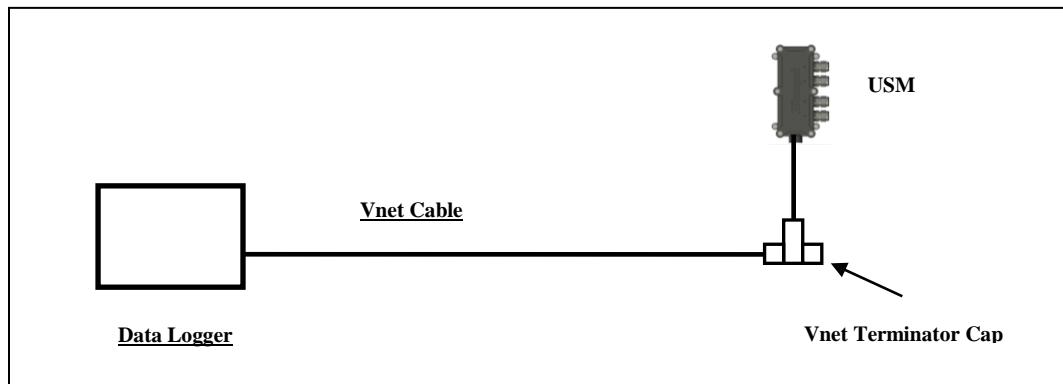
Much the same as any other Racepak Vnet sensor, the USM connects to the data logger by means of the main Vnet sensor cable which in turn is connected to the Vnet port of the data logger.

At this time, locate the 9" Vnet T cable that is included with each USM. The male end of the T cable is connected to the 5 pin Vnet connector located on the end of the USM module.

The opposite end (male/female portion) of the Vnet T can now be connected to the main Vnet cable. The below image provides an example installation.



Vnet Connector



Each USM Vnet T connector is equipped with a terminator cap. This cap must always be installed after adding sensor(s) to the Vnet cable. If additional sensors are added, the terminator cap is removed, the additional sensors added and the terminator cap replaced at the last sensor in line.

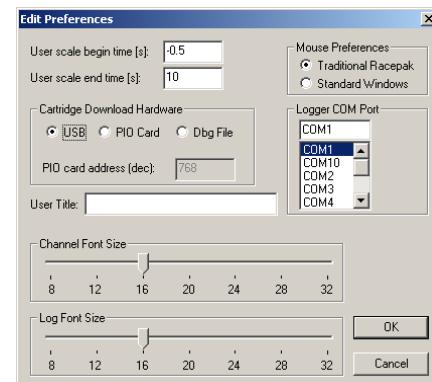
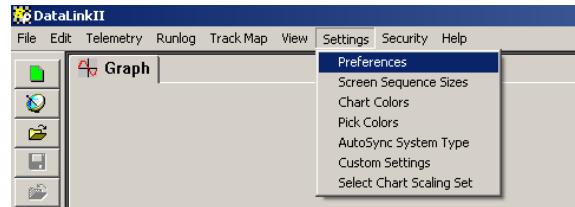
Programming the USM

When all sensors are connected to the USM and the USM is connected to the data logger Vnet cable, the individual sensor channels may now be programmed.

Serial Com Port Settings

When programming the USM, it is necessary to connect the user's PC to the data logger by means of the Racepak Serial Communication Cable. The DatalinkII software is defaulted to communicate through COM1 (standard serial port com number). If your PC is using a different com port number, it will be necessary to match the DatalinkII and PC com port settings.

1. Open the DataLink II program. The Racepak serial cable connects to the 9 pin serial port, located on the rear of the PC. In order for your PC to communicate with the data logger, we will now set COM 1 as the correct port number.
2. Select the Preferences menu item located in the Settings main menu selection.
3. Locate the section on the dialog box labeled Logger COM Port. Select COM 1 from the list to be used by clicking on the name of the port.
4. If you are unable to determine the com port setting of your serial port, refer to the following instructions or if your PC does not have a serial communications port and you are using a USB to serial port adapter you will need to refer to following instructions.



USB to Serial Adapter COM Port Number Setting

If you are utilizing a USB to serial port adapter, insure the adapter is correctly installed by following the manufacturer's instructions. It will then be necessary to determine the com port number assigned by the USB to Serial adapter. Since a variety of Microsoft© operating systems are in use, the following directions may vary, depending upon your operating system.

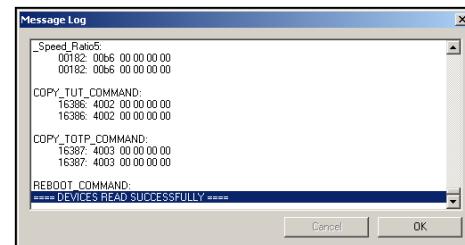
1. Minimize the Datalink II program and select the Start button located in the bottom left area of your computer display
2. Select the Control Panel icon located in the small window
3. Select System in the small window
4. Vista users will need to select the Device manager, found under Tasks in the upper left corner
5. Select the Hardware tab located in the just opened Systems Properties window
6. Select the Device Manager button located in the center/right of the Hardware page
7. Locate the Ports (COM & LPT) in the currently opened list and double left click
8. You will now see Communications Port (COM 1) or the appropriate com number for your system
9. If you disconnect and re-connect the USB adapter, you will see the com port number momentarily disappear, then re-appear thus verifying the com number

Note the com port number, return to the Datalink II program and set the appropriate number in the software, following the previous instructions.

The above instructions may be followed to verify any com port number, such as needed in the previous Serial Com Port Setting.

Adding USM Sensor Channels to DatalinkII Software

1. Connect the Racepak serial communication cable between your PC and the data logger
2. Power up the data logger
3. Open the DatalinkII software and the Configuration file using the command File / Open Car Configuration from the main menu
4. Select Edit, then Read Vnet Config located in the main menu selection
5. When selected a Message Log dialog box will be displayed and the read Configuration process will be started. When completed the following Message Log dialog box will be appear as shown
6. The message Devices Read Successfully should appear at the bottom of the dialog box indicating the read was successful.
7. Select OK
8. Select Save in the DatalinkII Main Menu



This action will automatically add the four sensors channels from the USM, to the Configuration file, as shown. The AMod Chan numbers correspond with the numbers molded in the USM lid, above each cable input.

AMod Chan #1	N/S
AMod Chan #2	N/S
AMod Chan #3	N/S
AMod Chan #4	N/S

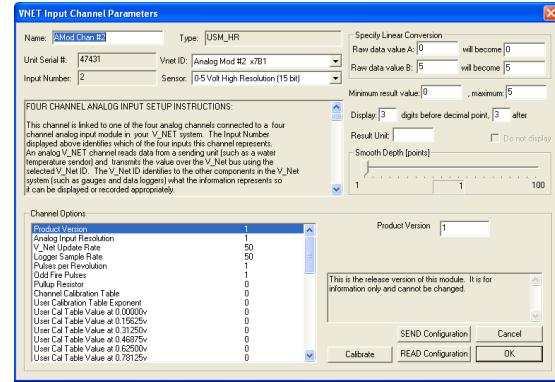


Note that the Read function adds the 1-4 Channel Buttons regardless if any sensors are connected to the USM.

Programming Individual Sensor Channels

As indicated on page 6 of this manual, each of the four sensor channels may be programmed for a variety of sensor usage. Following the Read function completed in the above section, Channel Buttons are added to the Configuration file. Each button represents an individual sensor input.

Access to each sensor channel programming is gained by placing the mouse cursor over the desired Channel Button and right clicking, which opens a Vnet Input Channel as shown.



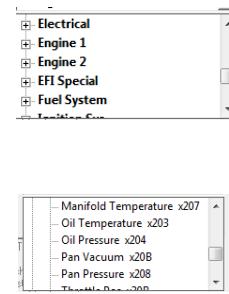
While this window appears to contain a large amount of information, there are two areas used for sensor programming.

- A. **Vnet ID:** This input box assigns the sensor Channel Name and ID used for data transmission. Since we are transmitting all sensor data over the same two wires, it is necessary to assign a unique ID to each sensor. The sensor channel names are grouped according to their type and location on the vehicle.
- B. **Sensor:** This input box defines the type of sensor, which in turn automatically programs the calibration, graph scaling values and number of digits to display.

Programming Sensor Channel Name / Vnet ID

At this time, locate the sensor Channel Button which corresponds with the sensor to be programmed. For the following example, we are going to suppose a 0-150 psi pressure sensor was installed on Channel 1. We will program this sensor as an Oil Pressure sensor.

1. Right click over AMod Chan #1. This will open the Vnet Input Channel Parameter window
2. ▼ Using the pull down arrow found in the Vnet ID input box, locate Engine 1, then select Engine 1
3. This will expand Engine 1 to reveal a large list of engine sensors
4. Continue to use the pull down arrow to scroll through the list until Oil Pressure X204 is located
5. Note that Oil Pressure is automatically assigned as Name



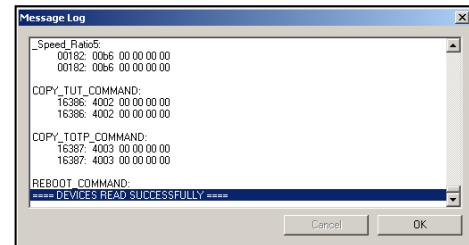
Programming Sensor Type

The final action is to select the type of sensor. For this demonstration, we are supposing a 0-150 PSI pressure sensor was installed.

1. ▼ Using the pull down arrow found in the Sensor input box, scroll down and locate and select the 0-150PSI Pressure Sensor
 2. Note this action inserts the type of sensor in the Sensor input area and automatically assigns calibration (Raw Data Values A/B) and the graph scaling values (Minimum / Maximum Values) along with value before and after decimal point



The last action is to update the changes to the data logger by use of the Send button. This button is found in the lower right corner of the Vnet Input Channel Parameters window. Following selection of the Send button and progress window will open. When the send action is complete, as indicated by the Devices Read Successfully, select the OK button.



Insure power to the data logger is on, before the Send process. If the PC will not communicate with the data logger, turn the data logger power off / on. If a USB to serial adapter is in use, disconnect the adapter from the PC and reconnect.

To program additional sensors, repeat the entire process for each individual sensor channel.

Sampling Rate

The sampling (logging rate) for each sensor is automatically set during the selection of the sensor. However, this rate can be manually changed by the user.

1. Scroll to the bottom of the Channel Options area found in the Vnet Input Channel Parameters window. The final selection in the list is Logger Sample Rate
 2. ▼ Select the Logger Sample Rate text line. An input box will open up and to the right. Using the pull down arrow select the desire sample rate
 3. Repeat the Send Configuration action as outline above

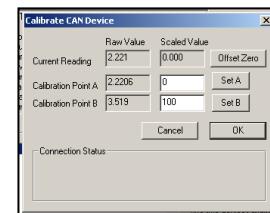
Calibration of Travel (Movement) Sensors

As indicated in the previous section, a variety of two point calibration values are predefined in the USM software. In typical applications, pressure/temperature/rpm sensors do not require additional calibration action. However, sensors that monitor travel or movement, such as throttle position, require additional calibration action. This action will enable the user to apply custom two point calibration values to travel sensors, resulting in graphically correct data.

For example, the default calibration for a 0-5V travel sensor would graph data between 0 and 5" (12.7cm). However, if we were adding a throttle position sensor, it is preferred the calibrated data to graph as throttle closed = 0% and throttle wide open = 100%. The software then computes all data points, to provide smooth graphical display of data between 0 and 100%.

Access to the Calibrate button is gained by right clicking over the desired sensor Channel Button. As reviewed in the previous section, a Vnet Input Channel Parameters window will open. Located in the lower right corner is a Calibrate button.

1. Insure the data logger is powered up and the user's PC is connected to the data logger via the Racepak serial cable
2. Select the Calibrate button
3. The system will connect to the sensor and open a CAN Calibrate Device window



To assign calibration values, we will use the Set A and Set B buttons. Set A will be our first calibration point and is entered with the throttle in a closed position. (0 % throttle).

1. Insure the throttle is in a closed position and the Scaled Value is at 0. If so, click the Set A button. The system will reassign the current output voltage reading to the Set A box
2. Open the throttle to wide open position. Insert 100 into the Set B Scaled Value input box and select the Set B button. When the system places the current voltage reading in the Set B box, the throttle can be closed
3. Select the OK button
4. Change the Minimum Result Value to -5 and the Maximum to 110. These numbers are found in the upper right corner of the VNET Input Channel Parameters dialog window
5. Select the SEND Configuration button, located in the lower right corner of the VNET Input Channel Parameters box, then select OK when completed
6. Power the data logger off and back on. Calibration is now complete

The above provides a demonstration of calibrating a 0-5V sensor for throttle sensor usage. However, the procedures can be applied to any 0-5V travel sensor. The first calibration point of the sensor is Set A, while the second calibration point is Set B.

Zeroing Sensor Calibration

On occasion, it is necessary to zero a sensor, following the initial calibration action as outlined on the previous page. This action “offsets” or moves the current value of the sensor to 0, while still retaining the calibration values.

To begin the procedure, insure the PC is still connected to the data logger, by means of the Racepak serial cable and the data logger is powered up.

The Offset Zero button is located in the Calibrate CAN Device window, which is accessed as outlined on the previous page.

Current Reading	2.221	0.000	Offset Zero
Calibration Point A	2.2206	0	Set A
Calibration Point B	3.519	100	Set B

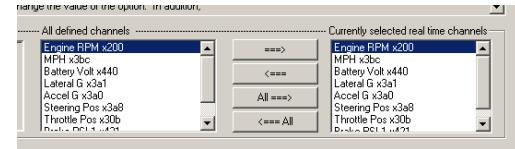
1. When the sensor is at the desired zero point, select the Offset Zero button
2. The software will re-assign the zero value as indicated in the Current Reading window
3. Select the OK button
4. The Calibrate CAN Device window will close.
5. Select the Send button located at the bottom right off the currently open Vnet Input Channel Parameters window
6. Select OK

Only one sensor can be zeroed, per procedure. At the end of all actions, power the data logger off and on, in order to record the changes within the data logger memory.

Adding New Sensors to the Real Time (Live View) List

Each channel may be viewed live, or in real time, by connecting the user's PC to the data logger via the serial communication cable. However, each time new sensors are added, it will be necessary to add the new sensor channels to the list of channels available for real time viewing: To perform this procedure:

1. Insure the Configuration file is open. Place the mouse cursor over the Module channel button and right click.
2. In the center of the currently open dialog window is a list of All Defined Channels. To the right of this list is a Currently Selected Real Time Channel list.
3. Select the desired channels to be viewed in real time from the All Defined Channels and place each channel (one at a time) in the Currently Selected Real Time Channel list by use of the > arrow, located between the two input areas. Channels maybe be removed from the Real Time list by using the < arrow. Complete this procedure for all desired channels.
4. Select the Send button, located in the bottom, right corner of the open dialog Window and select OK when the process is complete. Select the Save icon in the toolbar or select the Save menu item located in the File main menu selection to save the modified Configuration file to disk.



Programming the COM Port for Real Time (Live) Viewing

The default COM setting for Real Time viewing of data is Com 1. To change this to match the COM port setting of the user's PC.

1. Open the DatalinkII software and the Configuration file
2. Right click over the Module Channel Button
3. Locate the Real Time Port selection in the System Options window
4. Select the Real Time Port text line, the enter the Real Time Port number in the Real Time Port input box to the right of the Customer Programming Options window
5. Select the OK button

Sensor Specifications for Use with USM Module

As a convenience to the user, the programming software for the USM contains an extensive list of pre-calibrated sensor data, each containing Channel Name and Calibration values for each.

Pressure	Temperature	Linear Travel	RPM	Event	Analog Input Using Calibration Tables
0-30in HG Absolute Pressure	Racepak Temp Sensor 0-300F	0-5V High Resolution (15 bit)	Tach Signal 50% Duty Cycle/Square Wave/ 5-18V	Voltage Triggered	See information in following section
0-30in Hg Gauge Pressure	Racepak Temp Sensor 150C	0-5V Standard Resolution (10 bit)	Hall Effect Ferrous or Magnetic	Ground Triggered	
30PSI – 30 in Hg Gauge Pressure	GM Coolant Sensor 0-300F GM PN: 12146312	4 Inch Linear Travel			
0-15 PSI Sensor	GM Coolant Sensor 150C GM PN: 12146312	8 Inch Linear Travel			
0-75 PSI Sensor	GM Manifold Temp Sensor 0-300F GM PN: 25036751				
0-150 PSI Sensor	GM Manifold Temp Sensor 150C GM PN: 25036751				
0-300 PSI Sensor					
0-500 PSI Sensor					
0-1500 PSI Sensor					
0-3000 PSI Sensor					

The following section will review programming specifications for each type of sensors.

0-5V Sensor Inputs - Linear (Typical Pressure and Travel Sensors)

The pre-defined pressure and linear travel sensor calibration values are for use with three wire (power/ground/signal) 0-5V sensor signal type sensors. Any type of sensor that outputs a 0-5V sensor signal and requires either 5V or 12V power, can be utilized by the USM. For user supplied sensors, it is often necessary to manually insert two point calibration values. For this action, The Raw Data Value A and Raw Data Value B input areas as shown below are utilized.

1. Raw Data Value A and Raw Data Value B are the beginning and ending voltage values for the sensor
 2. Will Become provides input for the two calibration values

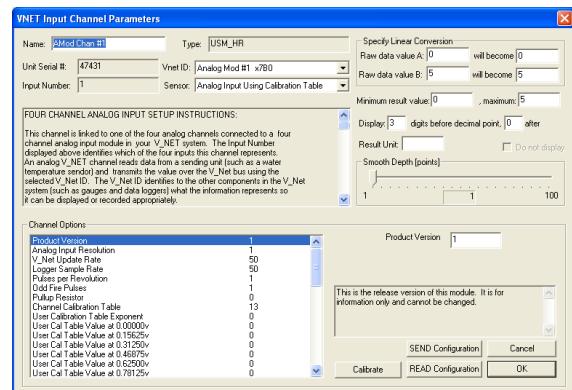
For example, a user supplied pressure sensor requires a two point calibration value of: 0 volts = 0 PSI / 4.5 volts = 1000 PSI. Simply insert the values into the appropriate input areas, and follow steps 3 and steps 4 as shown below.

0-5V Sensor Inputs – Non Linear

For customers desiring to utilize non-linear 0-5V sensor data, a User Calibration Table is provided to input the multiple calibration point information. It is first necessary to select Analog Input Using Calibration Table from the Sensor input box.

Following this, note the Calibration Table Exponent tables in the lower left corner of the Vnet Input Channel Parameters window.

1. Select the Pullup Resistor text line. Note the Pullup Resistor text input window to the right. Select Pullup Resistor Off
 2. Starting by selecting Calibration Table Exponent. Note that a set of instructions will be displayed in the bottom right corner. Follow the instructions for each Calibration Table Element input area. All 32 calibration points must be entered
 3. Insure the PC is connected to the data logger by the Racepak serial cable
 4. Select the Send Configuration button



Temperature Sensor Inputs – Racepak/GM

The pre-defined temperature sensor calibration values are for use with Racepak or General Motors two wire, resistive type temperature sensors. Note that as the desired sensor is selected from the Sensor input window, the appropriate pull up resistor value is selected in the right, middle section of the Vnet Input Channel Parameters window.

Temperature Sensor Inputs – Non Racepak / GM

For customers utilizing other non-linear forms of two wire resistive (non thermocouple) type temperature sensors, a User Calibration Table is provided to input the multiple calibration point information. It is first necessary to select Analog Input Using Calibration Table from the Sensor input box.

Following this, note the Calibration Table Exponent tables in the lower left corner of the Vnet Input Channel Parameters window.

1. Select the Pullup Resistor text line. Note the Pullup Resistor text input window to the right. Select the appropriate pull-up resistor for the resistance range of the sensor to be used
2. Next, set the Calibration Table Exponent for the values you are about to enter. Note that a set of instructions will be displayed in the bottom right corner. Follow the instructions for each Calibration Table Element. All 32 calibration points must be entered
3. Insure the PC is connected to the data logger via the Racepak serial cable
4. Select the Send Configuration button.

RPM Sensor Inputs –Programming Pulse per Revolution

By default, the calibration values loaded for RPM sensors will be 1 pulse = 1 RPM (Raw Data Value B). To simplify the programming process, the actual number of pulses per revolution can be programmed by the user, utilizing the Channel Options area of the Vnet Input Channel Parameters window. Engine RPM or Hall Effect sensors triggered by a passing ferrous object (bolt head) or magnet may be utilized.

To program the pulse per revolution of the sensor in use.

1. Determine the type of sensor (ferrous or magnet triggered) and provide the appropriate trigger target.
2. Determine the number of trigger targets (pulses) per revolution.
3. Using the pull down bar in the Channel Options window, move down to the bottom of the input window and select Pulses Per Revolution.
4. An input window will open up and to the right. Enter the correct number of pulses
5. Select the Send Configuration button.



Engine RPM signals must be a 50% Duty Cycle/Square Wave/ 5-18V signal. Do not connect any USM RPM sensor wire to any part of the coil (+ or -) as this will damage the unit.



Odd Fire Engines will need to utilize the Odd Fire Pulses per Revolution selection