

NoLand Engineering, Inc.

MODEL MD33 Dual-Engine/Vessel Monitor

This manual covers **version 1.3**. Future versions may contain enhancements not covered herein.

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INTRODUCTION:

The MD33 is a versatile data interface system intended for monitoring dual-engine vessels. A variety of common analog, rpm, and alarm signals can be monitored by the MD33 along with Navigation and vessel data from NMEA 0183 and NMEA 2000 (N2K) instruments. The data collected can be sent to a PC for display and logging by the 'C-Port²' software and/or to NMEA displays.

The complete MD33 system consists of the following items:

MD33 Processor Unit 2 ea., AD50 Differential Amplifiers
PC Interface Cable (USB) Installation & Getting Started Guide
CANbus 'Tee' connector Software CD (for MS Windows®)

The MD33 operates with gauges and/or sensors currently onboard the vessel or any added aftermarket sensors. It also accepts NMEA 0183 Navigation data (GPS, depth, etc.) and NMEA 2000 engine data (fuel flow, fluid level, etc.) and combines these into a single PC data interface. With the 'C-Port²' PC software, a complete data acquisition, display, and logging system is provided.

In addition, the MD33 can also be programmed to send NMEA 2000 (N2K) engine messages to compatible Multi-function Displays (MFD's). User configuration and calibration is required for this feature. A PC Calibration Utility for Windows is included with the MD33 to simplify this process.

Although intended for direct connection to existing gauges, the MD33 can be used with resistive senders, where gauges have been eliminated. In such cases "Sender Current" is provided by the MD33 when enabled by the user.

INSTALLATION OVERVIEW:

A typical MD33 installation is shown in Figure 1 with four interface points:

Engine- Accepts inputs from existing engine tachometers, gauges, and alarms.
Separate Port and Stbd inputs are provided.

NMEA 2000- Connects to existing vessel CANbus for sending and receiving NMEA 2000 (N2K) engine/vessel messages.

NMEA 0183- Accepts navigation data input for display by PC's along with converted engine data. Outputs collected data to NMEA0183 displays.

USB PC- Primary PC interface for configuration and calibration of engine data. Also enables display/logging of all received data using 'C-Port²' software.

These interfaces operate independently of each other, but will exchange data as appropriate. Engine input data and NMEA 0183 (navigation) data are sent to the PC-USB interface for display/logging by C-Port² or other software. In turn, the USB interface is used for all configuration and calibration options as well as firmware updates. The NMEA 2000 interface will both send and receive CANbus engine messages on an existing network, once it is configured by the user.

The individual interfaces above are galvanically isolated from each other to prevent “ground” conflicts. Therefore, the user must connect an engine “Power/Ground” source (10-30 Vdc) to the MD33 before it functions. USB and NMEA 2000 interfaces are powered by their own respective interfaces. All other connections are made to the front and rear terminal strips.

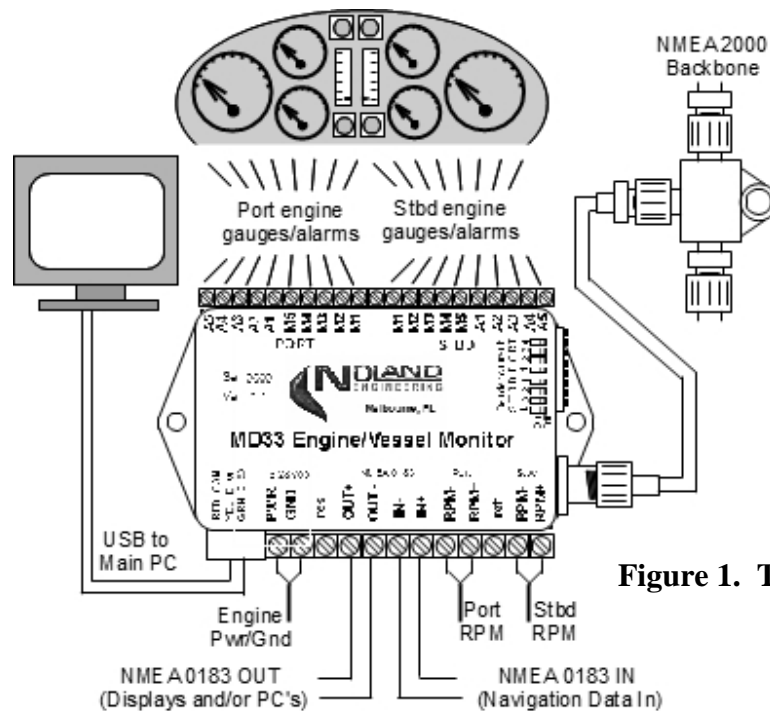


Figure 1. Typical Installation

ENGINE INTERFACES:

A typical MD33 engine hookup is shown in Figure 2. It accepts three inputs:

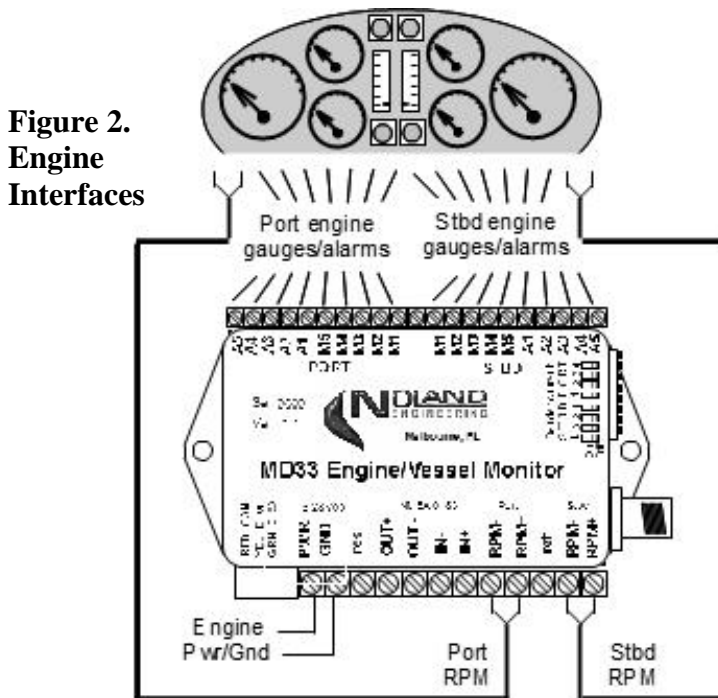
- RPM-** Port/Stbd inputs from existing tachometers, senders or alternators.
- Analog-** Port/Stbd voltage inputs from existing gauges, senders or voltage directly from sensors, batteries, or other instruments.
- Alarm-** Port/Stbd inputs from relays, switches, contact closures, etc., which provide an “on/off” indication.

Besides the two rpm inputs (Port & Stbd), there are 10 analog inputs (5 per engine) and 10 alarm inputs (5 per engine). The user is free to assign each of these to any function supported. The assignment is part of the C-Port² setup. All of these inputs can support voltage levels of 30 Vdc, or more, without damage.

The analog inputs are also capable of powering resistive senders when no gauges are present. Slide switches on the side of the MD33 enable current sources for this function. Any resistive sender less than 500 ohms is compatible.

The MD33 needs a Power/Ground input to operate. This input should be the same Power/Ground as the ships' engine(s), which is usually the ships' batteries. Furthermore, it may be desirable to have the MD33 power shut off whenever the engines are shut off, so as not to trigger alarms on your displays.

There is a 'reset' terminal on the MD33 to reset or shutdown the unit as needed. Momentarily connecting this terminal to Ground resets the MD33. Holding this terminal to ground stops the MD33, which is usually desired if engines are off.



RPM INPUTS:

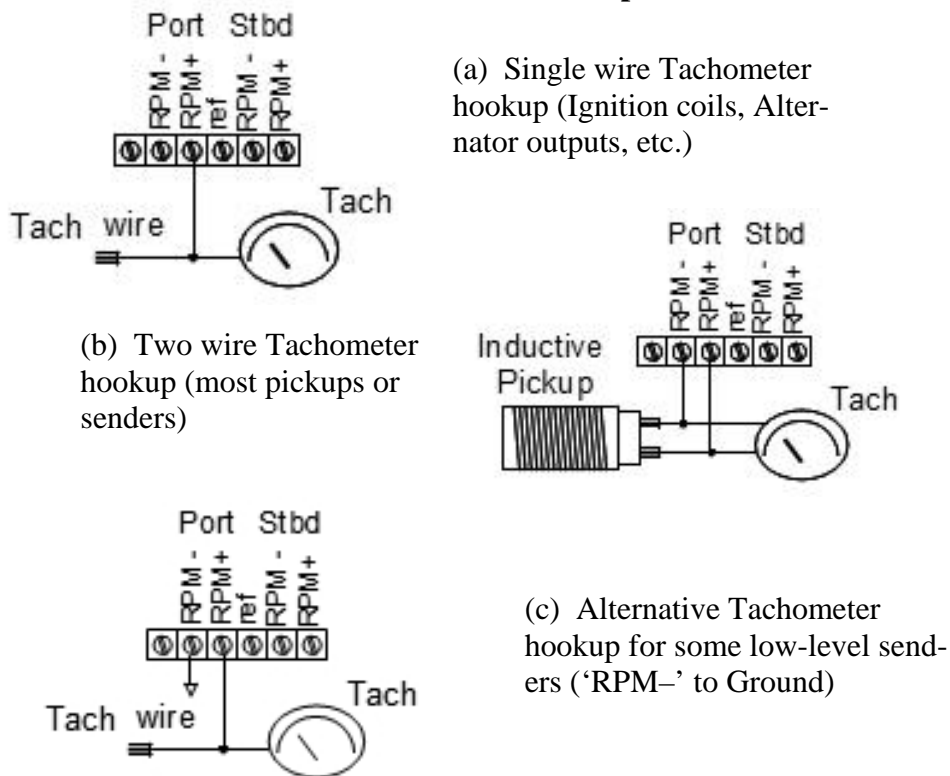
RPM signals come from different sources depending on the engine. They may come from an alternator output, the ignition coil, an ECU (engine control unit), or some type of AC or pulse sender (diesel engines). The MD33 will interface to all of these, but the connection details vary by the type.

Figure 3a. shows how to connect the MD33 to an ignition coil or alternator output signal. Since there is only one Tach signal wire, it must connect to the 'rpm+' terminal. The 'rpm-' terminal should be left disconnected (open).

Figure 3b. shows how to connect to a sender or generator used on many diesel engines. These senders have 2 wires going to the Tachometer which should be connected to the 'rpm+/rpm-' terminals of the MD33. If the RPM reading is not stable, the polarity may need to be reversed.

Figure 3c. shows an alternative connection, which may work better with some senders, especially if one wire of a 2-wire sender is grounded. The ungrounded wire of the sender should go to 'rpm+' while the 'rpm-' terminal is grounded. This connection increases the input sensitivity, but also makes it more susceptible to noise or 'spikes' on the tach signal.

Figure 3. RPM Hookups



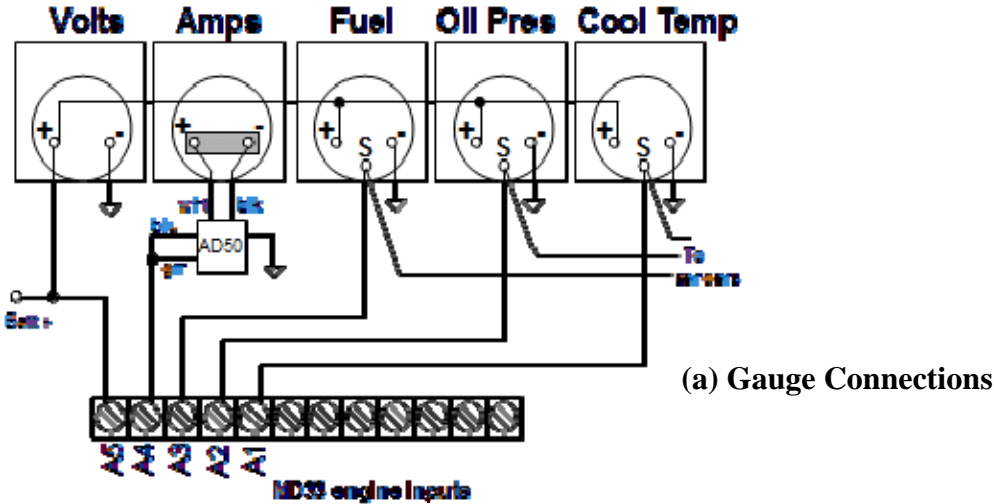
ANALOG INPUTS:

The Analog inputs measure voltage levels from senders, batteries, or other instruments with voltage outputs. The inputs A1-A4 measure 0-20Vdc, while A5 measures up to 40 Vdc for direct measurement of alternator or battery voltage. In addition, the A1-A4 inputs have internal current generators to allow measurement directly from resistive senders where no gauge exists. Slide switches on the side of the MD33 activate the current sources where needed

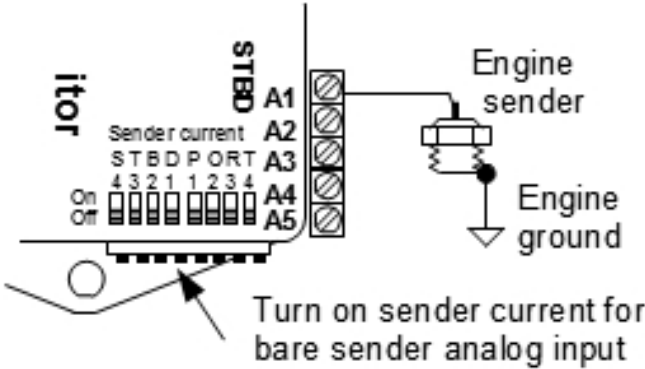
Figure 4(a) shows the typical connection directly to existing gauges. The ‘S’ terminal on the back of each gauge is where the connection should be made. Although the analog inputs can be assigned to any function desired for the C-Port² software, there are limitations to their use if you want to convert the analog data into N2K output. If N2K output of engine data is desired, see “NMEA2000 Interface” for available analog assignments.

Figure 4(b) shows the connection to a resistive sender without a gauge. To energize the sender, the appropriate “Sender Current” switch inside of the MD33 must be activated.

Some sensors such as current shunts and thermocouples, produce voltage levels too small for direct analog input. For these, the AD50 amplifier is available to amplify the sensor voltage to a useful level, as shown in the “AMPS” gauge of Figure 4.



(b) Sender Connection (no gauge)



ALARM INPUTS:

Alarm inputs are “On-Off” indicators such as pressure/temperature alarm switches and door open/closed contacts. The MD33 can detect either the presence or absence of a voltage or the “open or closed” state of contacts (see Figure 5).

The voltage threshold for alarm detection is such that any voltage greater than about 2 volts is detected as “ON”(energized), whereas any level below about 1 volt is “OFF”(un-energized). Voltages between these 2 levels can be detected as either “ON” or “OFF”. The alarm inputs (MI-M5) are protected for voltage levels up to 30V.

Where a switch or contact closure is connected directly to the MD33, the other contact should be grounded. The M1-M5 inputs are ‘pulled-up’ so that open contacts indicate as “Hi”, but will change to “Lo” when contacts are closed to ground. The C-Port² software allows the user to set each alarm ‘Hi/Lo’ state as ‘On/Off’ or vice-versa.

Figure 5 shows example connections of a bilge pump on/off alarm. In the first case the pump is switch actuated and the alarm connection is directly on the switch. In the second case a float switch is the actuator and the condition is sensed directly on the float switch. Note that the logic sense, ON/OFF vs. Voltage/No-voltage is reversed for the two cases.

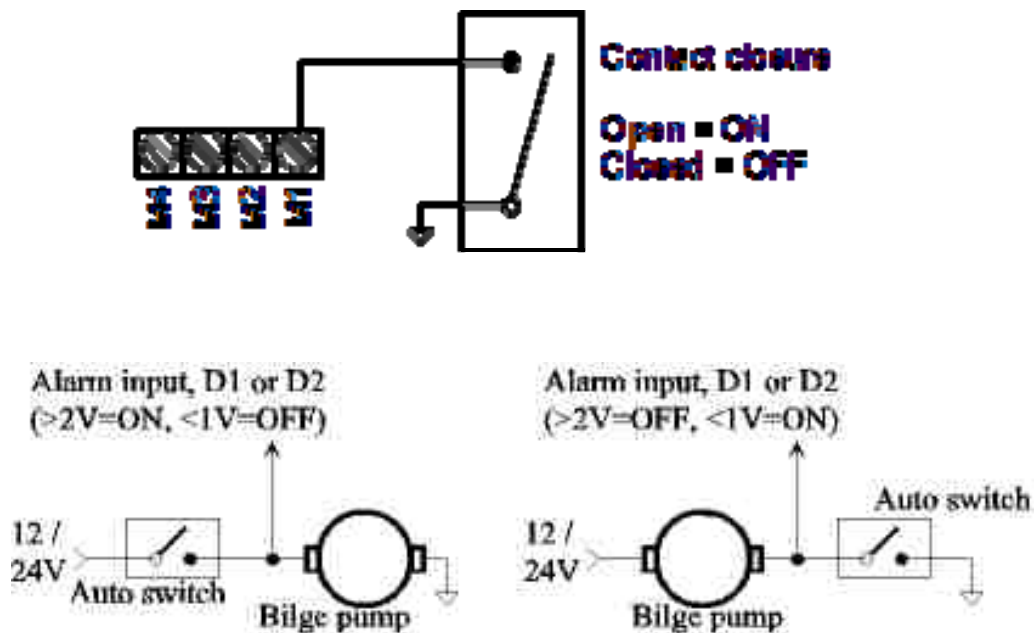


Figure 5. Example Alarm Connections

NMEA 2000 INTERFACE:

The primary purpose of the N2K interface is to output the acquired engine data to appropriate Multi-function Displays. This interface also allows the MD33 to collect data from special N2K sensors which already exist on the vessel, such as flowmeters, level sensors, etc. The collected data can then be used by C-Port² for display and logging along with other engine and navigation data. Connection to the N2K bus is via a ‘Micro C’ connector on the MD33.

Setting up the MD33 for NMEA 2000 output is done by the user. A software program called “N2K Calibration Utility” is included for this purpose. A Windows PC with USB is needed to run this utility. The available assignments for each analog input are shown in Table 1. Default settings are in gray, and alternative assignments are listed below each default. In addition to the analog options shown, the MD33 can also send ‘Engine Hours’, RPM messages and engine alarm messages.

Figure 6 shows a typical connection to an NMEA 2000 CANbus backbone. The backbone consists of cables and “Tee”s which supply both DC power (8-16V) and a data interface to each device. The CANbus must have at least one 120 ohm termination and very long buses should have a termination at each end.

A1 (0-20Vdc)	A2 (0-20Vdc)	A3 (0-20Vdc)	A4 (0-20Vdc)	A5 (0-40Vdc)
Oil Press	Eng Temp	Fuel Level	Tilt/Trim	Batt Volts
Oil Temp	Oil Temp	Oil Temp	Oil Temp	Oil Temp
Cool Press	Cool Press	Cool Press	Cool Press	Cool Press
Fuel Press	Fuel Press	Fuel Press	Fuel Press	Fuel Press
Turbo Boost	Turbo Boost	Turbo Boost	Turbo Boost	Turbo Boost
Tran Press	Tran Press	Tran Press	Tran Press	Tran Press
Tran Temp	Tran Temp	Tran Temp	Tran Temp	Tran Temp
Batt Amps	Batt Amps	Batt Amps	Batt Amps	Batt Amps
Water Level	Water Level	Water Level	Water Level	Water Level
Oil Level	Oil Level	Oil Level	Oil Level	Oil Level
Alt Volts	Alt Volts	Alt Volts	Alt Volts	Alt Volts
Rudder	Rudder	Rudder	Rudder	Rudder

Table 1 N2K Analog assignment (defaults in gray)

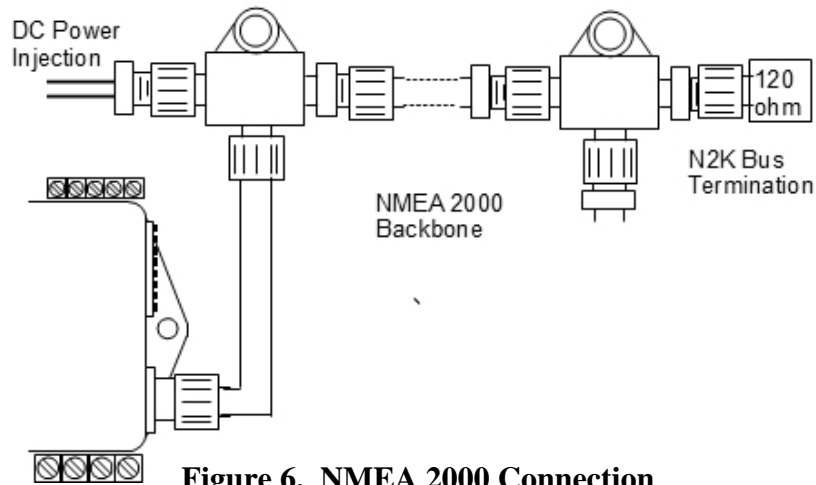


Figure 6. NMEA 2000 Connection

NMEA 0183 INTERFACE:

This interface is used to collect navigation data for display and logging by the C-Port² application software, along with engine data. It also combines all of this collected data for use by other NMEA 0183 displays and/or additional PC's. Separate NMEA 0183 input (listener) and output (talker) terminals are located on the front terminal strip of the MD33.

NMEA 0183 input data is displayed by 'Data Panes' within C-Port². The user selects the particular data for display. Data from both the NMEA 0183 input and the N2K bus can be displayed in the panes.

NMEA 0183 output data is a duplicate of all data sent to the USB output. It contains all the NMEA 0183 input data plus the analog engine data and certain converted data from the N2K bus. This output is therefore useful for running additional PC displays with C-Port² or other display software.

The NMEA 0183 input and output data rates are user selectable. They default to 4800 baud but can be independently increased to 9.6K, 19.2K, or 38.4K baud as desired. Higher baud rates are necessary when large amounts of data are being sent or received. The LED above the USB connector indicates flashes green when receiving NMEA 0183 data and red when receiving certain NMEA 2000 messages. Yellow flashes indicate some sort of data errors.

USB INTERFACE:

The USB interface is used initially for setup and calibration of the MD33. It is also the main data interface for the C-Port² Display/Logging program. This interface also allows updating of the MD33 firmware, when necessary.

When the USB interface is connected to a PC, a 'Virtual COM Port' is created within the PC. This happens even if the MD33 has no DC power. All programs wishing to communicate with the MD33 must use the proper "COM" Port, and only one program can use it at a time. USB Drivers for the MD33 are included on the "Installation CD".

To install the MD33 USB drivers, do the following:

- 1) Plug MD33 into USB port of computer
- 2) Insert MD33 Installation CD into disk drive of computer
- 3) When New Hardware Wizard appears, select 'Windows recommended option'
- 4) Click "Next"
- 5) Click "Finish"

If your computer does not automatically install the "USB Port Drivers," a "New Hardware Wizard" will appear. In this case:

- 1) When New Hardware Wizard appears, select "Windows recommended option"
- 2) Click "Next"
- 3) Click "Finish"

Software driver installation is complete. For problems, refer to the 'Readme.txt' file on the installation disk.

C-Port² APPLICATION SOFTWARE:

This application (see Figure 7) is the display and logging program for the MD33. It employs a simulated 'Dash Panel' for display of the engine and other data received by the MD33. C-Port² can be run on multiple PC's from a single MD33 using both the USB and NMEA 0183 interfaces. Refer to the 'Help' section of this application for details of operation.

Figure 7.
C-Port²
Application



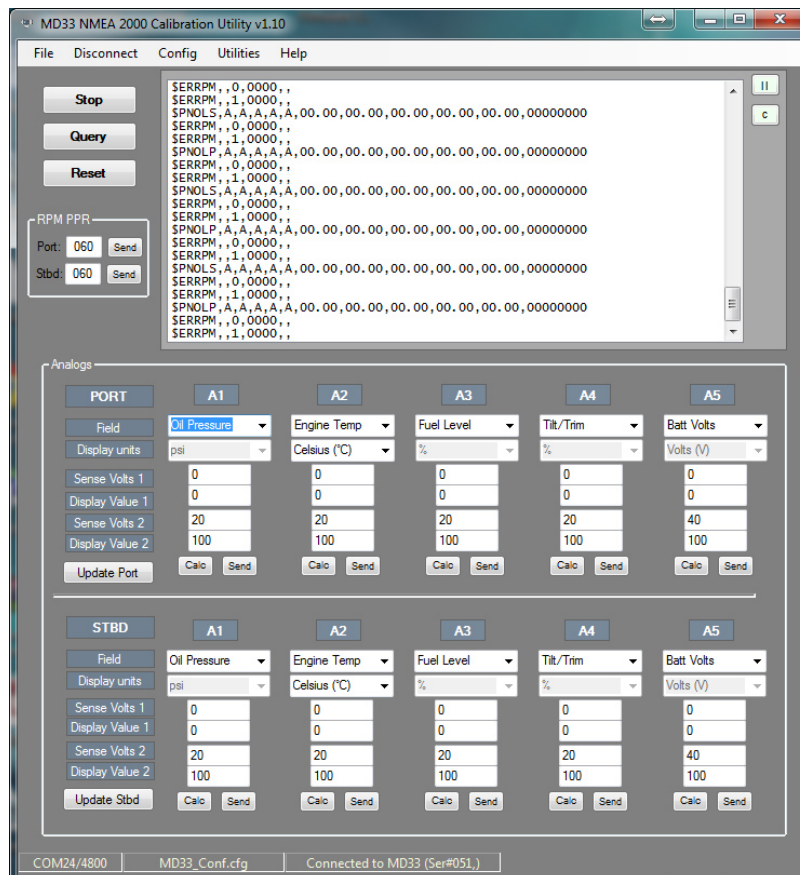
N2K CALIBRATION UTILITY:

This calibration utility is used to configure and calibrate the MD33 to send NMEA 2000 messages from the incoming analog engine data. It only needs to be used if you want the analog engine data from the MD33 to show up on your N2K Multifunction Displays. The utility performs both configuration and calibration of the analog engine data for conversion to NMEA 2000. It need only be used once with the MD33 unless changes have to be made later on. The MD33 must access this utility through the USB Virtual COM Port. The 'Help' section within the application contains details of operation.

Figure 8 is a screenshot of the utility. At the top is a "Terminal Window" for viewing the incoming data from the MD33. The calibration of 'RPM' is also done here by entering Port and Stbd 'ppr' (pulses per revolution) in the boxes. Below that are the calibration sections for the Port and Starboard gauge inputs.

Analog (gauge) calibration is done via a 2-point linear approximation model. Thus, two calibration points for each analog input are required. Each calibration point involves measuring an analog input voltage and its corresponding display value. For example, a fuel gauge might produce a voltage of 3.6 v when the tank is 1/2 (50%) full and 1.95 v when the tank is 100% full. These two measurement points are sufficient to calibrate a "Fuel Level" input. The next section provides additional detail about configuration and calibration.

Figure 8.
MD33 N2K
Calibration
Utility



Example Calibration: An example calibration is shown in this section. The example assumes A1, A2, and A3 are being used for Oil Pres., Engine Temp., and Fuel Level respectively. "Batt. Volts" is on A5 While A4 is unused and therefore set to "None". The 'Batt volts' calibration is very simple, where '0v' measured is '0v' displayed and '10v' measured is '10V' displayed.

Before starting calibration, the Calibration Utility must be "Connected" so that data is scrolling in the Terminal Window. We use this data to assist in calibration. To get the first set of calibration points per Figure 9 , we have assumed the engine is "cold" (75 degF coolant temp), in "key ON" condition to energize the gauges/senders, the Fuel Level is at 25% (1/4 full), and Oil Pressure is 0 psi since the engine is not running. The calibration voltages can be read directly from the "PNOLP,..." (Port) and "PNOLS,..." (Stbd) sentences and typed into the appropriate boxes as shown in the figure. The corresponding temperature, pressure, and level values are typed into the boxes below the calibration voltages.

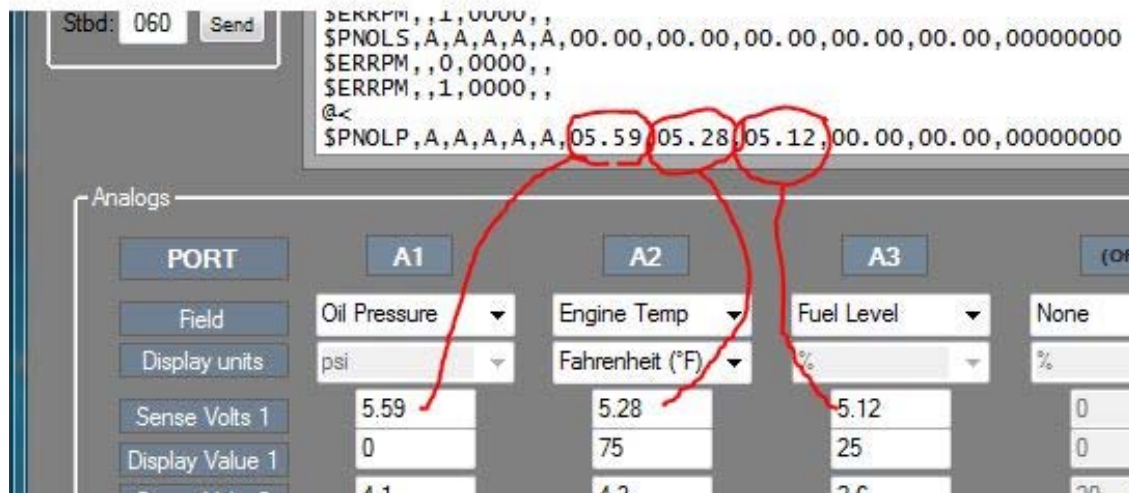


Figure 9. Calibrating 1st Data Point

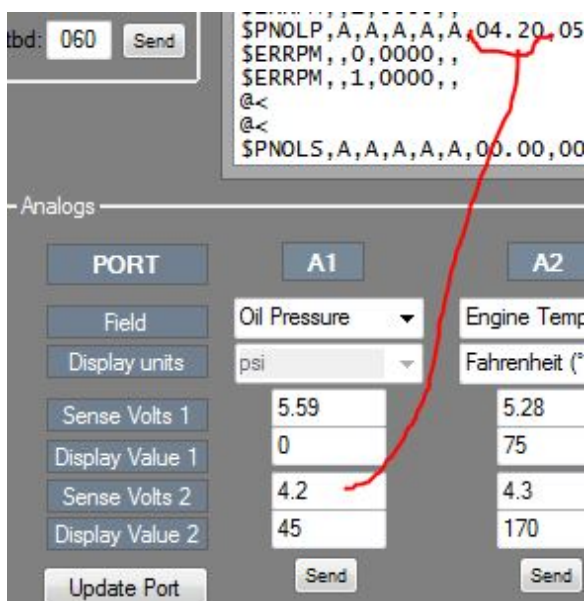


Figure 10. Calibrating 2nd Data Point

To get the second set of calibration readings we now start the engine. In our example, a gauge Oil Pressure reading of '45 psi' occurs at a new A1 voltage of "4.1" volts (see Figure 10). We type these values into the lower boxes of A1. Oil pressure calibration is now done and we can select "Send" to calculate and send the calibration factors to the MD33.

For a second Engine Temp calibration, we must wait for the engine to warm up. Then we can obtain the second voltage and temperature values to enter and "Send" them to the MD33 as before. Similarly, we would obtain a second Fuel Level after filling the tank.

Finally, the calibration of RPM is a simple matter of entering the "ppr" (pulses-per-revolution) of each engine as shown in the left boxes of Figure 11. Selecting the "Send" button updates the MD33 with the new value and the resulting RPM will display in the Terminal Window in the "\$ERRPM, .." sentence (encircled). It is therefore fairly quick to calibrate RPM even it has to be done by trial-and-error.

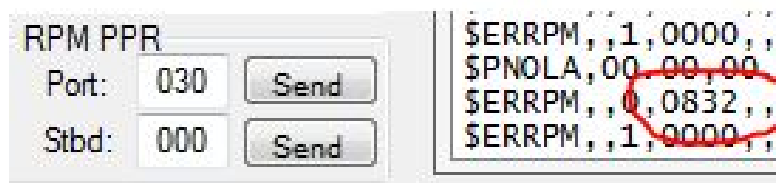


Figure 11. RPM Calibration & Check

Alarm Settings: The MD33 will send NMEA 2000 alarm messages if configured by the user. The alarms correspond to the state of the M1-M5 terminals on the MD33. Table 2 is a list of all available alarms and their corresponding ID number. The calibration utility allows the assignment of individual alarms to the input terminals along with the polarity of each alarm. Figure 12 Shows the alarm configuration window. Any alarm can be assigned to any of the 10 alarm inputs.

Table of Alarms

Check Engine	01
Over Temperature	02
Low Oil Pressure	03
Low Oil Level	04
Low Fuel Pressure	05
Low System Voltage	06
Low Coolant Level	07
Water Flow	08
Water in Fuel	09
Charge Indicator	10
Preheat Indicator	11
High Boost Pressure	12
Rev Limit Exceeded	13
EGR System	14
Throttle Position Sensor	15
Engine Emergency Stop Mode	16
Warning Level 1	17
Warning Level 2	18
Power Reduction	19
Maintenance Needed	20
Engine Comm Error	21
Sub or Secondary Throttle	22
Neutral Start Protect	23
Engine Shutting Down	24
Check Transmission	33
Over Temperature	34
Low Oil Pressure	35
Low Oil Level	36
Sail Drive	37

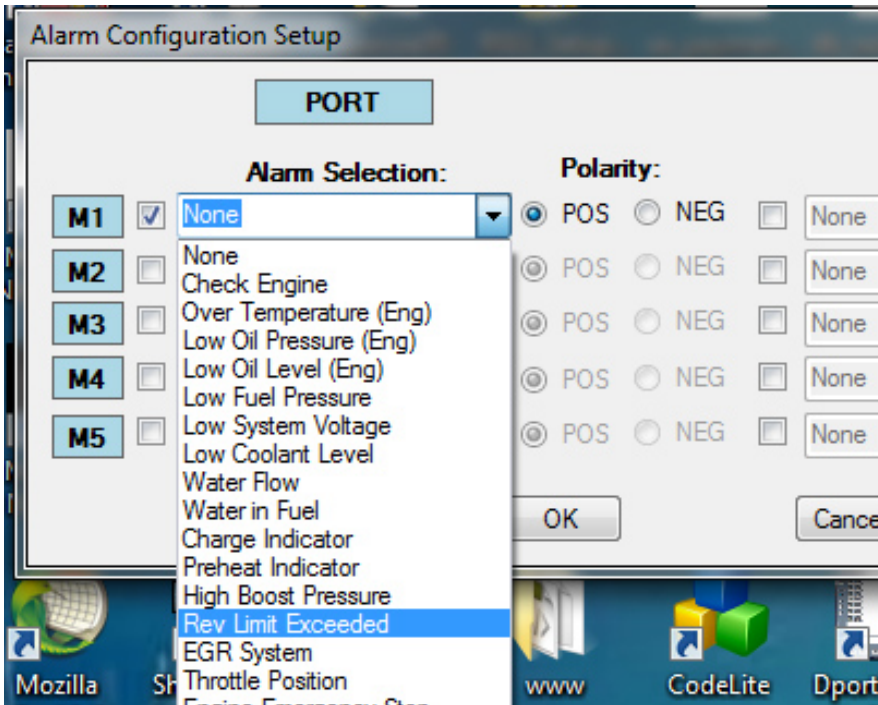
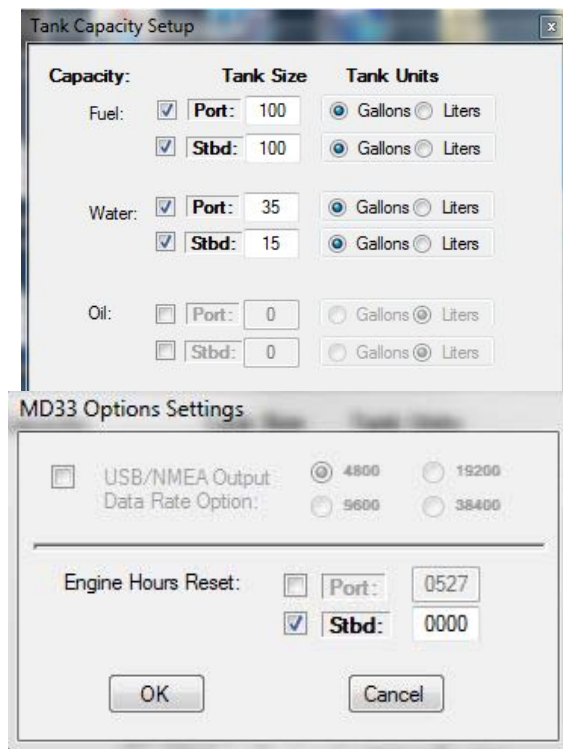


Figure 12. Alarm Configuration Screen

A few optional settings are available for the MD33 as shown in Figure 13. You can set (or reset) the “Engine Hours” to any value from 0-9999. You can also set the fluid capacities to any value from 0-999 in either gallons or liters.

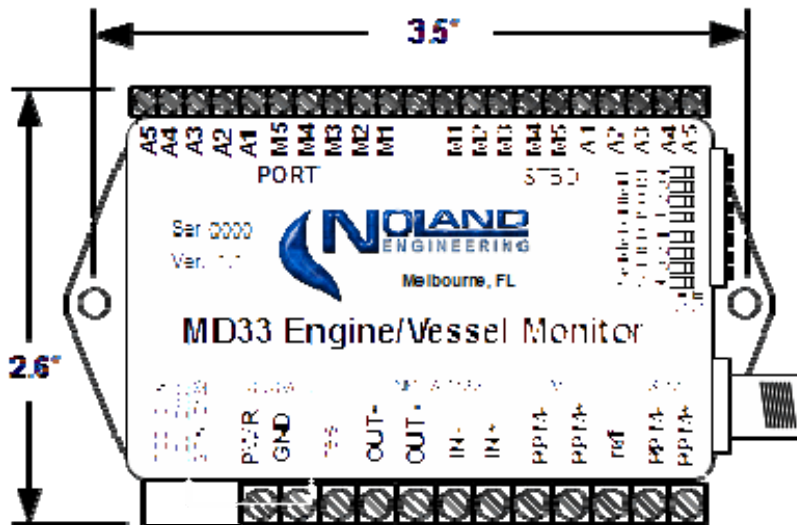


**Figure 13
Capacity and
Option Settings**

Table 3

TECHNICAL SPECIFICATIONS:

RPM accuracy	+/-2 (ppr=60), +/-8 (ppr=12)	
Tach input impedance	> 100 Kohm	
Analog input accuracy	+/-2%	
Analog input impedance	>12 Kohm	
Serial data rate, format	4800-38,400 baud, NMEA 0183	
Power	10-30 Vdc, 100ma. max	
Temperature	0-50 degC	
Humidity	0-100% (non-condensing)	
Size, weight	3.5" x 4.0" x 1.0", 5 oz.	
N2K data PGN's	127245	Rudder Angle
	127488	Engine Parameters, Rapid Update
	127489	Engine Parameters, Dynamic
	127493	Transmission Parameters, Dynamic
	127503	Fluid Level (Fuel, Oil, Water)
	127508	Battery Status (Volts, Amps)



Outline Drawing

WARRANTY:

Subject to the terms, conditions and limitations herein, NoLand Engineering warrants this product against manufacturing and material defects for a period of 24 months from the date of purchase.

NoLand Engineering, at its discretion, will repair or replace the defective unit with new or refurbished parts. There is no other express warranty or representation of any kind that we make concerning this product.

It is customer's responsibility to return products safely to NoLand Engineering. Unless other arrangements are made, the customer must properly pack, ship, and insure the unit for return. If proof of purchase is not provided by the customer, NoLand Engineering will use its own records to determine the date of purchase.

Such repair or replacement is the sole remedy to the customer, consistent with local and provincial laws. Any repaired or replaced unit will be warranted for the balance of the original product's warranty period.

This Limited Warranty does not cover the following:

- products with altered serial number, mutilated labels, or missing labels
- failure from abuse, misuse, accident, over-voltage, unauthorized repair or modification, or improper installation.
- costs incurred from re-installation and testing

This Warranty gives you specific legal rights, which may vary from state to state.