NoLand Engineering, Inc.

MODEL RS11 c4
NMEA2000 Engine Data Converter

This manual covers **version 3.4**. Future versions may contain enhancements not covered herein.

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TABLES & FIGURES

Introduction: The RS11 converts pulse signals (tach or flowmeter) and analog gauge voltages from virtually any engine into CANbus digital messages for the NMEA 2000 (N2K) protocol. It is configurable for either single or dual engine installations. The user must setup the RS11 for the desired data and enter pulse rate and analog scale factors. Configuration is performed via a USB PC interface which also serves as an output data monitor, if desired. Output messages are applied to the N2K bus, which can then be viewed by any compatible display.

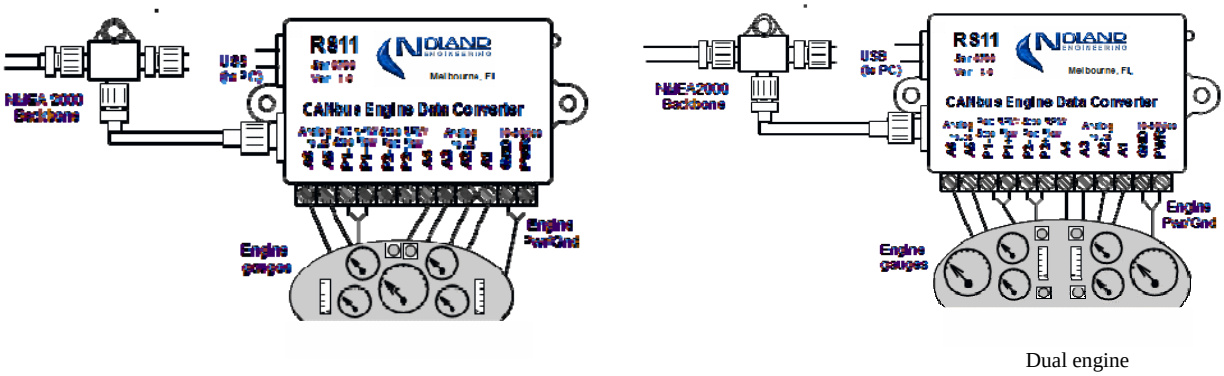
The RS11 is designed for versatile interfacing to almost any type of analog engine sensor or gauge commonly used on marine or automotive engines. It has two pulse (Tach or flowmeter) inputs plus six analog (gauge) inputs and supports both 12 and 24 volt systems. The analog inputs can all be assigned to one engine or split between two engines. Multiple RS11's can be installed on the same CANbus.

Although intended for direct connection to existing gauges, the RS11 can be used directly with resistive senders, where gauges have been eliminated. In such cases the A1-A4 analog inputs will provide “Sender Current” when enabled by the user. The user configures the unit to suit the particular engine(s) by selecting the specific information to be converted and entering calibration factors. A PC-based Setup Utility is included to simplify configuration and calibration .

The RS11 is housed in a weatherproof plastic enclosure. Engine instrument connections are made to a terminal located under a removable cap. A green flashing LED (once/second) on the unit indicates normal operation.

Installation: Typical installations are shown in Figure 1 for a single and a dual engine RS11. For the single engine case, only the ‘Port’ RPM input is used, and all analog inputs are available for that engine. In the dual engine case with only one RS11, the analog inputs must be divided between the two engines. This usually means each engine only gets three analog inputs.

To get six analog inputs from each of two engines, you need two RS11's, one for “Port” instance and another for “Stbd” instance (see Figure 2). The RPM inputs are specifically assigned to Port and Starboard, whereas the Analog inputs can be independently assigned to Port or Starboard, as desired. Note that the unused RPM inputs on each RS11 are available for ‘Fuel flow’ measurement from a flowmeter.



Single engine

Dual engine

Figure 1. Installation Examples

Engine sensor and/or gauge connections are made to a terminal strip on the RS11. N2K bus connection is via the 5-pin “Micro-C” connector. A USB PC cable is supplied for configuring the RS11, but may be left in place for data monitoring (via PC) if desired. The RS11 needs engine power to operate, which is usually the ships’ batteries. Furthermore, it is desirable to have the RS11 power shut off whenever the engines are shut off, so as not to trigger alarms on your displays.

The individual interfaces (CAN, USB, Engine) are all galvanically isolated from USB and NMEA 2000 interfaces are powered by their own respective interfaces, with full data isolation. This means that that your engines can be powered by the ship's batteries, your PC by an AC generator and your N2K bus by a separate isolated supply with no power, ground, or data conflicts.

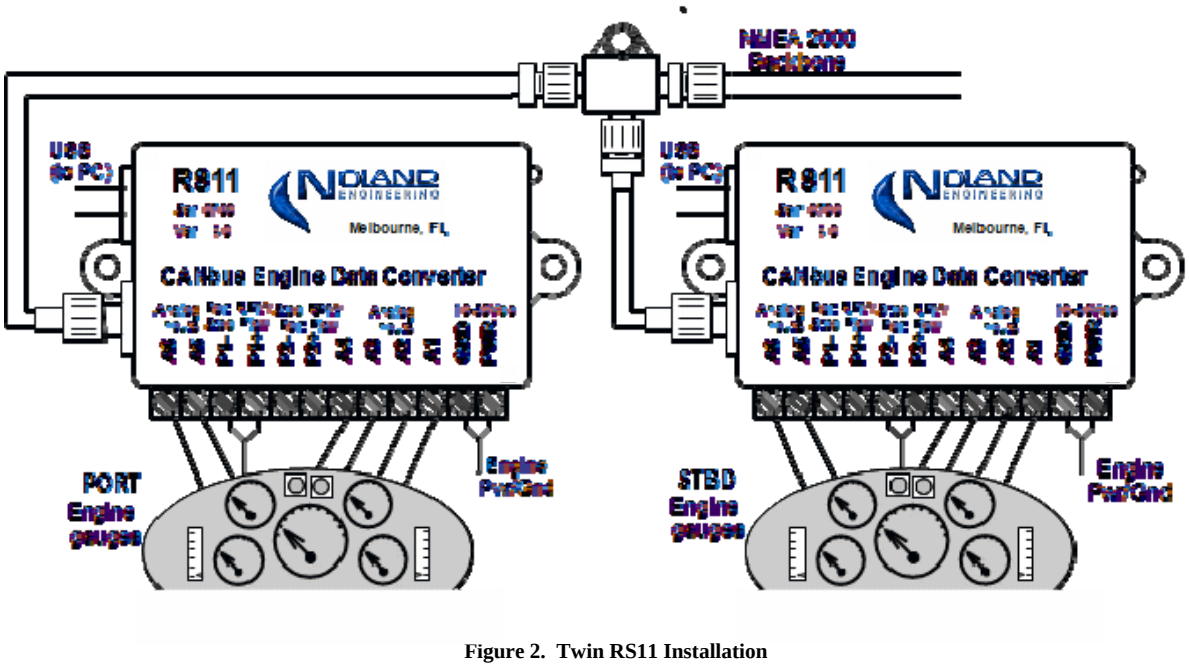


Figure 2. Twin RS11 Installation

Analog (Gauge) inputs: The RS11 A1-A4 inputs accept voltages from 0-20V while A5,A6 accept 0-30V. Normally these connect directly to existing gauges or voltage-based sensors, but A1-A4, can also measure resistive senders directly when no gauges are present. The user must enable internal current sources for this function. Inputs A5 and A6 do not have current sources but can be used for direct 'Battery Volts' measurement up to 30V. They can also be used for other measurements (pressure, temp., …) when gauges are present.

Figure 3 shows typical analog connections. For existing gauges, the 'S' terminal on the back of each gauge is where the connection should be made. For no gauge, the connection is as shown on the 'A1' terminal with the 'Sender Current' for 'A1' enabled.

Figure 3. Analog (Gauge) Connection Example

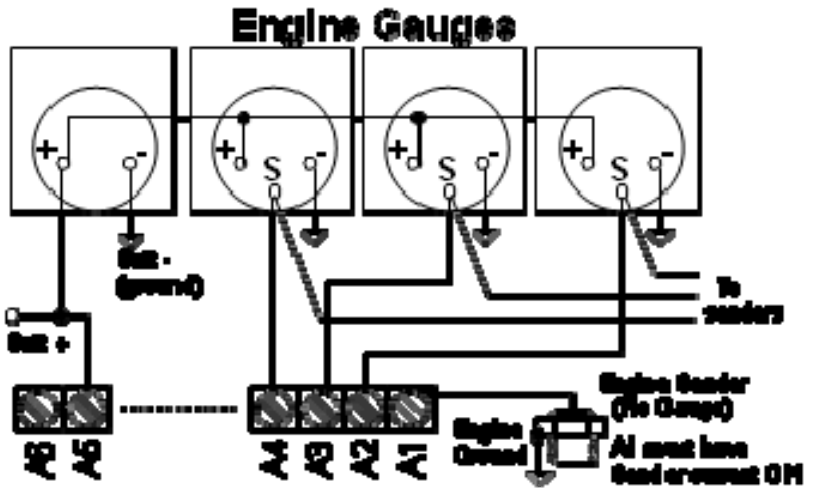


Table 1. Analog Assignment Options

A1 (0-20V)	**A2** (0-20V)	**A3** (0-20V)	**A4** (0-20V)	**A5** (0-30V)	**A6** (0-30V)
Turbo (P)	Tilt/Trim (P)	Turbo (S)	Tilt/Trim (S)	Batt Volt(P)	Batt Volt(S)
Oil Press	Oil Press	Oil Press	Oil Press	Oil Press	Oil Press
Oil Temp	Oil Temp	Oil Temp	Oil Temp	Oil Temp	Oil Temp
Cool Temp	Cool Temp	Cool Temp	Cool Temp	Cool Temp	Cool Temp
Cool Press	Cool Press	Cool Press	Cool Press	Cool Press	Cool Press
Fuel Press	Fuel Press	Fuel Press	Fuel Press	Fuel Press	Fuel Press
Fuel Level	Fuel Level	Fuel Level	Fuel Level	Fuel Level	Fuel Level
Tran Press	Tran Press	Tran Press	Tran Press	Tran Press	Tran Press
Tran Temp	Tran Temp	Tran Temp	Tran Temp	Tran Temp	Tran Temp
Batt Amps	Batt Amps	Batt Amps	Batt Amps	Batt Amps	Batt Amps
Alt Volts	Alt Volts	Alt Volts	Alt Volts	Alt Volts	Alt Volts
Oil Level	Oil Level	Oil Level	Oil Level	Oil Level	Oil Level
Water Lvl	Water Lvl	Water Lvl	Water Lvl	Water Lvl	Water Lvl
Ruddr Pos	Ruddr Pos	Ruddr Pos	Ruddr Pos	Ruddr Pos	Ruddr Pos

Setting up the RS11 for N2K output is done by the user. A software program called “RS11 Setup Utility” is included for this purpose. A Windows PC with USB port is needed to run this utility. The available assignments for each analog input are shown in Table 1. Default assignments for each input are in gray, and the alternative, user selectable, assignments are listed below each default. Most of the analog inputs come from sensors (senders), but “Battery Volts” and “Alternator Volts” are sensed directly.

Battery Amps requires more advanced measurement. It is normally measured with a Current Shunt, which produces a differential voltage (~0-100 mV) which is proportional to current. This differential voltage also usually has the battery voltage (i.e., 12V) biased onto it. Since this small biased differential signal is difficult to measure directly by the RS11, a differential Shunt Amplifier, such as our AD50, is needed to remove the battery bias voltage and amplify the small differential signal (see Figure 4). In some cases, the Current Shunt may exist on the back of an Ammeter, while in other cases it may be a separate unit.

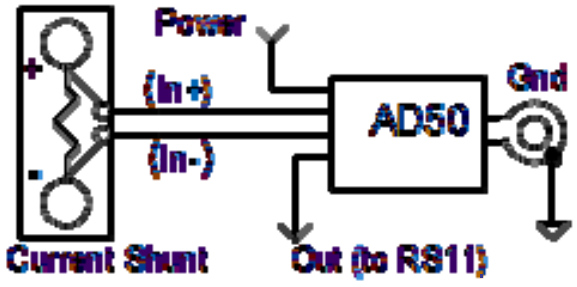


Figure 4 Current Shunt

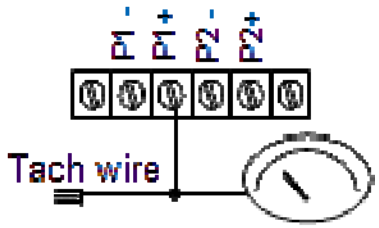
RPM or Fuel Rate (Tach) Connection: The pulse inputs, (P1+/P1-, P2+/P2-) can measure either RPM or fuel rate, as desired. RPM signals come from different sources depending on the engine. They may come from an alternator output, the ignition coil, an ECU (engine control unit), or some type of AC or pulse sender (diesel engines). The RS11 will interface to all of these, but the details vary by type. The RS11 also sends 'Engine Hours' whenever RPM is > 100.

'Fuel Rate'comes from turbine or paddle wheel flowmeters. Connect the wire (s) from the flowmeter to the P+/P– terminals in the same manner as for RPM except that a port (or single engine) flow- meter connects to P2+/P2- (stbd RPM +/-) while a stbd flowmeter connects to P1+/P1- (Port RPM +/-)

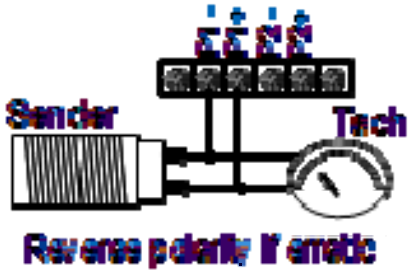
Figure 5a. shows how to connect the RS11 to an ignition coil or alternator output signal or a single wire flow-meter. Since there is only one signal wire, it must connect to the P+ terminal. The P- terminal should usually be left disconnected (open). In some cases the connection of Figure 5(c) may give more stable readings.

Figure 5b. shows how to connect to a sender or generator used on many diesel engines and flowmeters. These senders have 2 signal wires, which should be connected to the P+/P- terminals of the RS11. If the RPM reading is not stable, the polarity may need to be reversed.

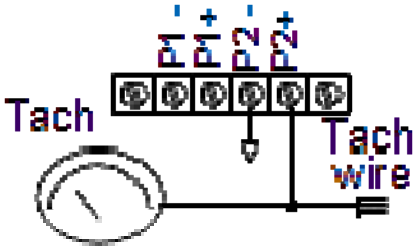
Figure 5c. shows an alternative connection, which works better with some 1-wire senders and also 2-wire senders with one side grounded. The signal (ungrounded) wire of the sender should go to P+ while the P- terminal is grounded. This connection increases the input sensitivity, but is only used when necessary. .



5(a) Most single-wire Tachs



5(b) Most two- wire Tachs



5(c) Some Tachs, incl. 2-wire senders with one wire grounded.

NMEA2000 Connection: The N2K bus is used to output the acquired engine data to appropriate Multi-function Displays. Connection to the bus is via a 'Micro C' connector on the side of the RS11. The connection is normally made to an N2K backbone as shown in the Figure 6 example.

A NMEA2000 backbone typically consists of cables, a power injector, one(or two) terminations, and drop Tee's for connecting each device. Cables and Tee's form the main backbone while devices are connected with short drop cables to each Tee. The backbone provides both a DC Power(8-16V) and Data (250 Kbps) interface for all devices on the bus. Short buses can be terminated with a single 120 ohm termination, but very long buses should have a termination at both ends. Where lots of devices are installed on a bus, Multi-drop boxes are often used rather than Tee's. NMEA2000 Cables, Tee's, and connectors are sealed for operation in harsh marine environments.

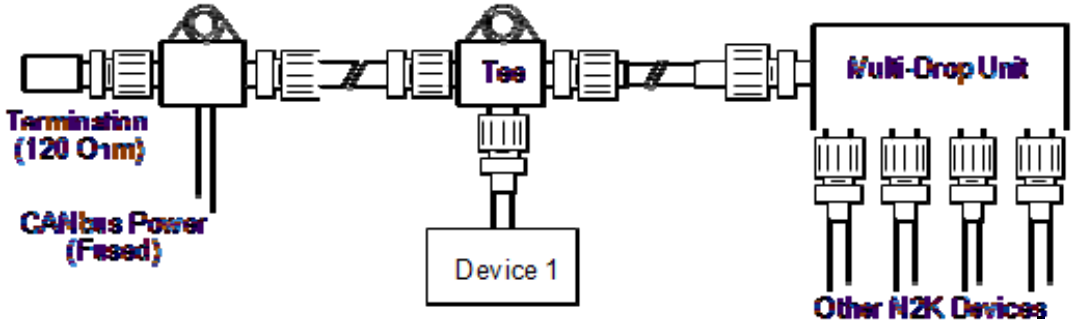


Figure 6. Typical NMEA20000 Backbone

USB Interface: The USB interface is used for setup and calibration of the RS11. It also allows monitoring of the RS11 and updating firmware, when necessary.

When the USB interface is connected to a PC, a 'Virtual COM Port' is created within the PC, which is used by any PC communicating with the RS11. This happens even if the RS11 has no DC power. The first time the RS11 is plugged into your PC, driver installation may be automatic. If not you should get a message that "no driver could be found". You will then need to install the drivers as below. USB Drivers for the RS11are included on the "Installation CD".

To install the RS11 USB drivers, do the following:
1) Plug RS11 into USB port of computer
2) Insert RS11 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"

RS11 Setup Utility: This PC based utility (Figure 7) is used to configure and calibrate the RS11 to send NMEA2000 messages based on the incoming analog and engine data. The Utility allows you to select the data type for each pulse input and enter calibration data. It need only be used once with the RS11 unless changes have to be made later on. It is included on the CD disk supplied with the RS11.

The RS11 connects to this utility through a USB Virtual COM Port. It is interactive in that the Utility can both write to and read from the RS11, so that proper configuration can be verified. The configuration/calibration consists of selecting options from lists and entering numbers in boxes.

Calibration of analog voltages is made simpler because the RS11 provides a direct reading of the voltage on each analog input. A voltmeter may prove useful during calibration, but it is not actually needed since you can read the voltage on any analog input via the Setup Utility. Details of the Setup Utility are contained within the Utility's "Help" section. The next section also provides example calibrations.

RPM or flow rate calibration is done simply by entering the pulses-per-revolution (ppr) of each engine or the pulses– per– liter (or gallon) of the flowmeter. If unknown, it can be done by trial-and-error. The Setup Utility displays the current calculated RPM in the Terminal Window.

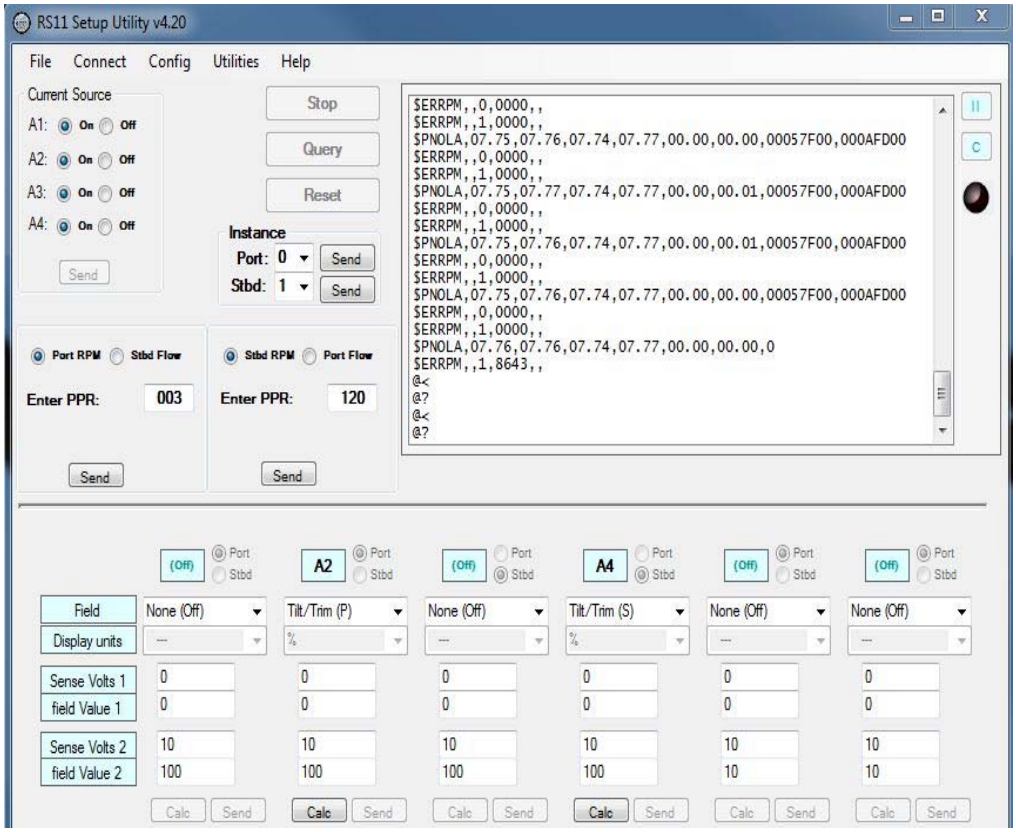
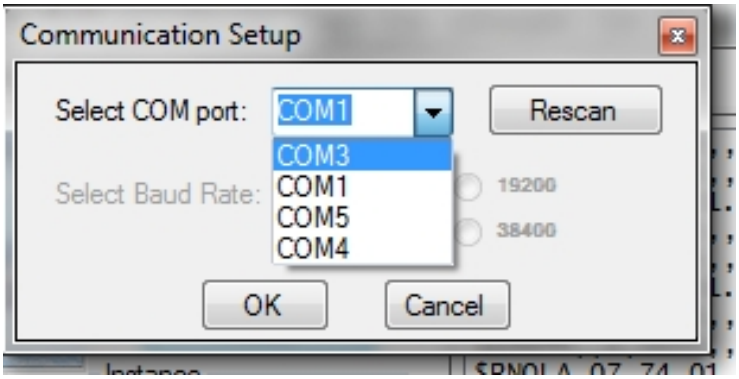


Figure 7. Setup Utility

Figure **8. Com_Port Selection**



Once the USB Drivers are installed you can proceed to select the proper COM port. Under the ‘Config’ menu item of the Setup Utility, select ‘Set COM port.’ This will open the window shown in Figure 8, which contains a pull-down list of all available COM ports. If you know the correct COM port for the RS11, select it and click ‘OK’. To determine the correct COM port, unplug the RS11 USB cable, select ‘Rescan’ and see which COM port disappears from the list. Then plug the USB cable back in, select ‘Rescan’ and select the newly created COM port from the list.

Example Calibration: An example calibration is shown in this section. Assuming this is a single (or Port) RS11, we have selected all analogs as ‘Port’ instance. The example assumes A1, A2, and A3 are being used for Port side Oil Pres., Engine Temp., and Fuel Level respectively. Port "Batt. Volts" is on A5 and its calibration is very simple, where '0v' measured is '0v' displayed and '10v' measured is '10V' displayed, (see Fig 9.)

Before starting calibration, the Setup 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 Setup Utility terminal window and entered into the appropriate boxes as shown in the figure. The corresponding temperature, pressure, and level values are into the boxes below the calibration voltages.

To get the second set of calibration readings we now start the engine. In our example, we assume a gauge Oil Pressure reading of '45 psi' occurs at a new A1 voltage of "4.1" volts (see Figure 9). We enter these values into the lower boxes of A1. Oil pressure calibration is now done and we can select “Send” to send the calibration parameters to the RS11.

To get the second Engine Temperature calibration, we have to wait for the engine to warm up. In our example, we see that when the engine resches 170 degF the A2 voltage has decreased to 4.3V. These values go into the lower boxes for A2. Select “Send” to upload the calibration parameters to the RS11.

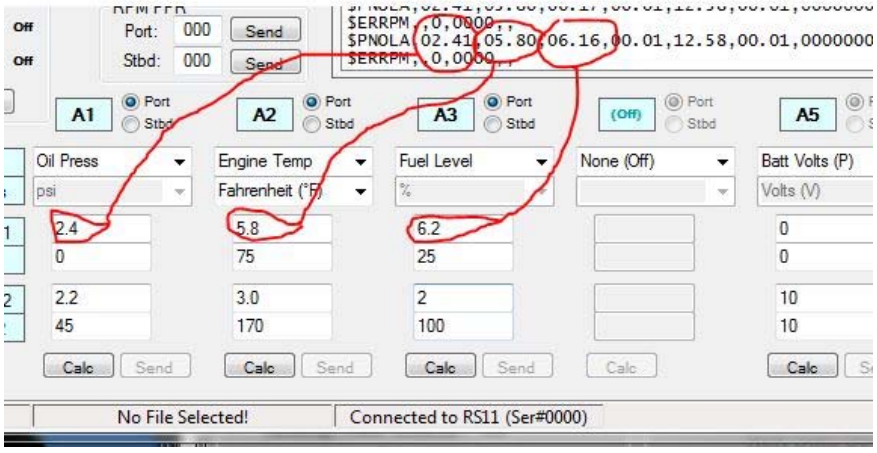


Figure 9. First Data Point Calibration Example

To get a second Fuel Level calibration point, we assume the fuel tank has been filled up (100%) and a new A3 voltage of "2.6" results which is then entered into the lower boxes for A3.

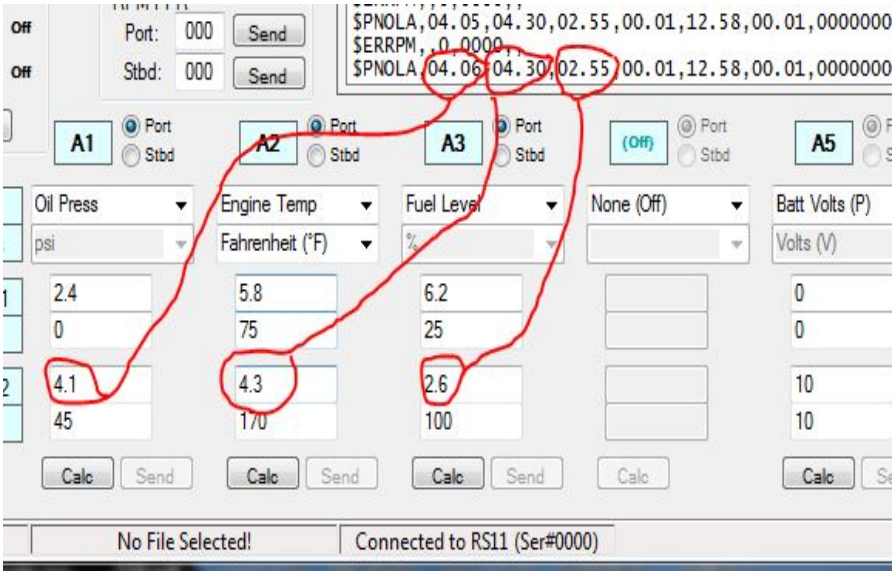


Figure 10. Second Data Point Calibration Example

As each set of calibration values are obtained, select the "Send" button to download these to the RS11. Some calibration sets, such as Oil Pressure, can be obtained quickly while others, such as Engine Temperature, require a time lapse before the second set of values can be obtained. In the case of Fuel Level, it may be days before a second set of values are obtainable.

Finally, the calibration of RPM is a simple matter of entering the “ppr” (pulses-per-revolution) of each engine as shown in Figure 11. Selecting the “Send” button updates the RS11 with the new value and the resulting RPM will display in the Terminal Window in the “$ERRPM, ,. .” sentence. It is therefore fairly quick to calibrate RPM even it is has to be done by trial–and-error. Similarly, calibration of ‘Fuel Rate’ requires entering the ‘ppl’ (pulses/liter) or ‘ppg’ (pules/gal) of the flowmeter.

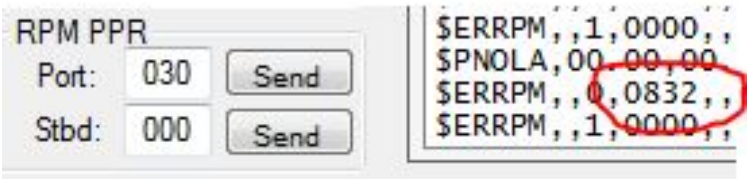


Figure 11. RPM ppr Calibration

If you want to update everything to the RS11 all at once, there is simpler way than pushing every "Send" button in the Utility. Under the "Config" menu item, select "Update All" to send the entire current configuration to the RS11 (see Figure 12). This will erase the entire configuration inside the RS11 and replace it with the current settings of the "Setup Utility”. By using the individual “Send” buttons or the “Update All” command, you can change individual configurations items or the entire configuration, as desired.

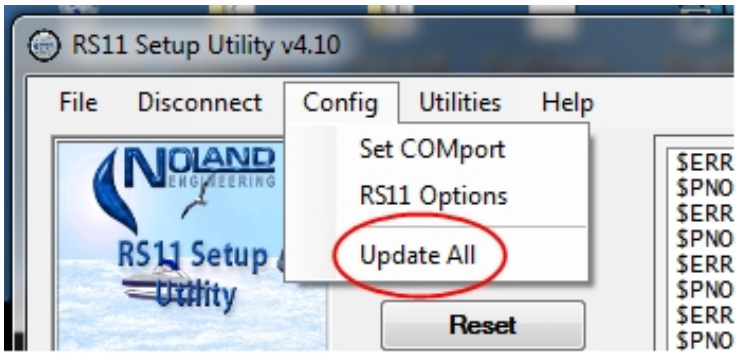


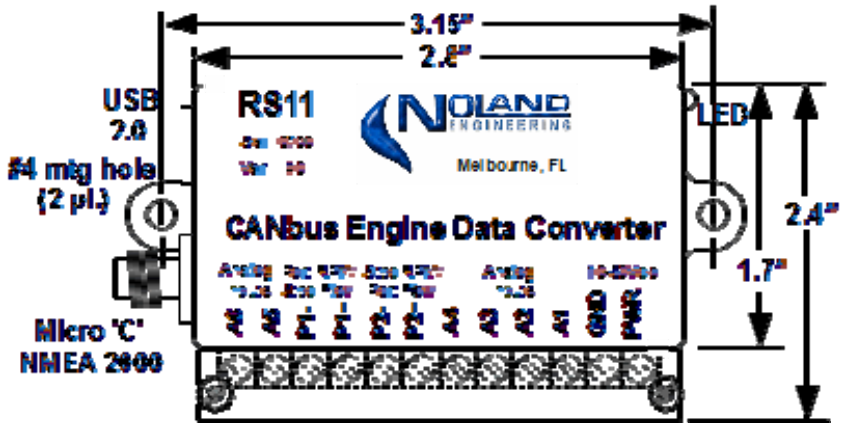
Figure 12. Update all Configuration Command

The RS11 automatically computes, remembers and displays ‘Engine Hours’ whenever RPM > 100. You can set (or reset) the “Engine Hours” to any value from 0-9999.

Figure 13. RS11 Options Settings

Technical Specifications:

RPM resolution	+/-2(ppr=200), +/-4(ppr=60), +/-16(ppr=12)
Analog accuracy	+/- 2%
Tach input impedance	> 100 Kohm
Analog input impedance	> 12 Kohm
Power	10-30 Vdc, 70ma. Max
Temperature, Humidity	0-50 degC, 0-100% (non-condensing)
Size, weight	2.4" x 3.4" x 0.9", 3 oz.
N2K PGN's: 127245	Rudder Angle
127488	Engine Parameters, Rapid Update
127489	Engine Parameters, Dynamic
127493	Transmission Parameters, Dynamic
127505	Fluid Level (Fuel, Oil, Water)
127508	Battery Status (Volts, Amps)



WARRANTY:

Subject to the terms, conditions and limitations herein, NoLand Engineering warranties 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. Such repair or replacement
is the sole remedy to the customer, consistent with local and provincial laws. Any repaired or replaced unit will be warrantied for the balance of the original product's warranty period.

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.

This Limited Warranty does not cover the following:

- products with alterations to the 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, and other rights, which vary from state to state.