

NoLand Engineering, Inc.

MODEL VS52(U)

VESSEL/ENGINE MONITOR

This manual covers version 3.1 Future versions of this product may contain enhancements not covered here.

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1. INTRODUCTION: The VS52(U) is a Windows© based versatile data interface system intended for marine vessel and engine monitoring. The system consists of the following components (ref. Figure 1):

1. VS52(U) Multiplexer/Monitor
2. PC Interface Cable (Serial 9-pin or USB)
3. Interface Unit
4. Interface Unit Cable (Ribbon-14)
5. AS50 Current Shunt Amplifier
6. AD20 Differential Amplifier
7. C-Port Installation CD (for MS Windows©)
8. Mounting hardware

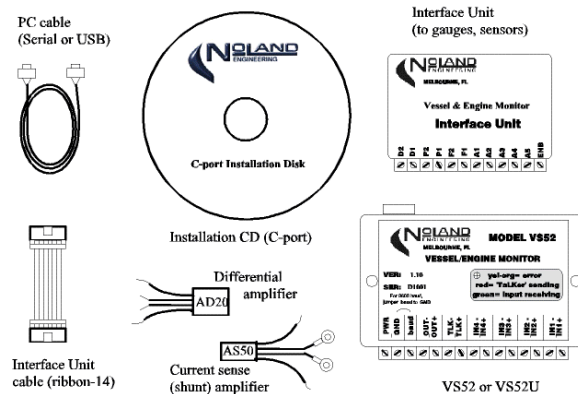


Figure 1 VS52(U) Components

The Vessel/Engine Monitor system is intended to operate with sensors currently onboard the vessel or any added aftermarket sensors. It also accepts NMEA 0183 data from up to 4 other instruments (GPS, depthsounder, etc.) and combines these into a single data interface along with the vessel/engine data. Its measurement capability is summarized in Table 1. The system includes the “C-Port” software program which collects, displays, and replays data as configured by user.

Table 1. Vessel/Engine Monitor Capabilities

TYPE	QTY	RANGE	RESOLUTION	PRIMARY USAGE
Analog	5	0-5 to 0-30v	0.1%	volts, amps, temp, press., ...
Frequency(lo)	1	0-9998 Hz.	2 Hertz	RPM (ignition-sensed)
Frequency(hi)	1	0-99,990 Hz	10 Hertz	RPM (diesel, flywheel-sensed)
Period	2	0-2000 ms	1 millisecc.	Fuel flow, boat speed, ...
Alarm	2	ON/OFF	n/a	Bilge, temp/press alarm, ...

The analog inputs usually connect to a sensor, such as an engine sending unit or current shunt. In the case of battery volts, however, a direct connection is made; no sensor is required. The other inputs, frequency, period, and alarm, can often be directly connected with no sensors needed. In most installations, the sensor connections will be made at the existing gauges on the vessel (see Section 4.)

The VS52(U) collects data from the inputs and sends it as standard and/or proprietary NMEA 0183 sentences to the PC for display and logging. The “C-Port” program included with this system employs a simulated “dash panel” where the various inputs are assigned to gauges and dials per the users preference.

All sensor inputs are connected to the Interface Unit which filters the digital signals and scales the analog inputs to preset full-scale ranges via jumpers. In general, the Interface Unit should be located near the vessel dashboard so as to get all (or most) of its inputs directly from the existing gauges. Data is sensed and updated once per second except for the RPM sentence, which is updated twice per second.

In addition to its engine and vessel monitoring function, the VS52(U) is also a 4-input data multiplexer. As such, it will accept NMEA 0183 sentences from instruments such as GPS, depthsounders, compasses, and others, for combining into a single output along with the vessel/engine data.

The PC connector (USB or serial) provides a computer interface. The computer will receive all of the combined data from the instruments and can also send data back to the instruments via the **TLK** port of the VS52(U). This can be used for downloading waypoints, requesting specific types of data, sending steering commands, and more.

2. BASIC INSTALLATION. A typical installation is shown in Figure 2. All connections to NMEA 0183 instruments are made via a terminal strip. Vessel and engine sensor connections are made to the Interface Unit also via a terminal strip. The Interface Unit connects to the VS52(U) through a 14-pin ribbon cable. The unit begins operating as soon as power is applied. No initialization or setup is required. The PC connector provides 2-way data communication to/from the computer. Some configuration options are programmable (see Appendix A).

To assist in installation and troubleshooting, a multicolor LED is located on top of the VS52(U). The LED will flicker green when valid NMEA sentences are being received on any of the four inputs or when vessel/engine data is being sent. The LED flickers red when valid NMEA sentences are received from the PC interface. It will show a yellow color for about ½ second if an error is detected and simultaneously send an error identification sentence to the outputs, **OUT+/OUT-** and PC connection.

A typical VS52(U) installation with a computer connected might resemble Figure 2. A computer is present to collect all the data from onboard instruments and also to send steering commands to an autopilot and send waypoints to the GPS. The GPS provides position information while the autopilot provides heading. Any other instruments, such as a chartplotter, may obtain the combined instrument data from the **OUT+ / OUT-** terminals.

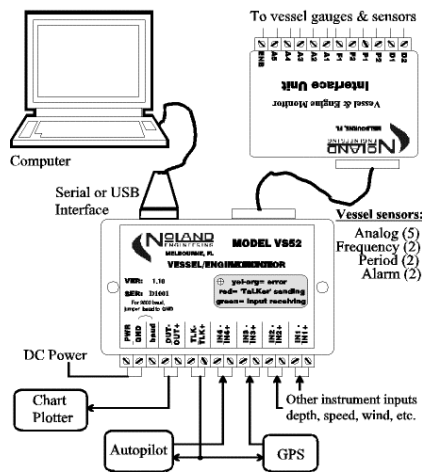


Figure 2. Vessel/Engine Monitor Typical Installation

The VS52(U) is essentially a data collection, conversion, and combining unit. It collects conditioned sensor data from the Interface Unit and converts it into digital (text) data for display by a PC running appropriate software. The VS52(U) also accepts NMEA 0183 data from navigation instruments and combines all into a common output for use by a PC or other instruments.

The VS52(U) must be connected to a Windows PC to run the C-port display software. A PC cable is provided for this purpose. The data conforms to the NMEA 0183 standard and can be viewed by any terminal program such as “HyperTerminal”. The C-port program provided by Noland Engineering can also display the incoming data sentences in a “Data Window.”

3. VS52(U) INSTALLATION: Installation of the VS52(U) requires connection to a power source and to NMEA talkers and listeners. (See Figure 3.) All connections are made via a fifteen position terminal strip. A description of the connections is given in Table 2. Any unused connections may be left disconnected. A PC connector is provided on the rear for connection to a computer. D.C. power to operate the VS52(U) is supplied to the terminal strip. A 14-pin ribbon cable connects the VS52(U) to the Interface Unit.

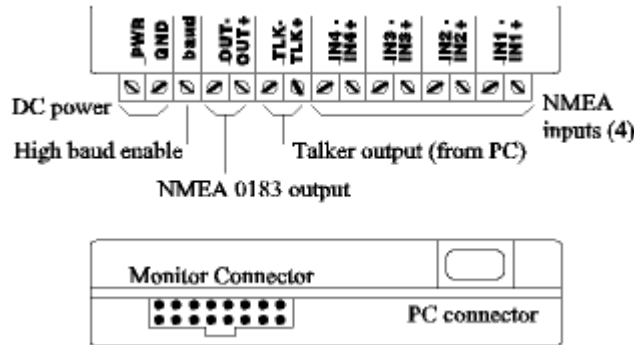


Figure 3. VS52(U) Connections

Table 2. Interface Description

PWR, GND	Ships' power (10-30Vdc), 50 mA. typical current draw.
Baud	Baud rate select terminal. Ground this terminal for HIGH baud. Leave open for 4800 baud (default).
OUT+, OUT-	Combined output (RS-422) from the 4 NMEA 0183 inputs. 4800 – 38,400 baud (selectable).
TLK+, TLK-	Talker output (RS-422) from computer to listeners such as GPS, autopilot, etc. 4800 baud only.
IN1.. 4+, IN1.. 4-	Listener inputs (opto-isolated) from instruments. IN1, IN2 = 4800 or 9600 baud. IN3, IN4 = 4800 baud only.
PC Connector	Serial 9-Pin (VS52) or USB (VS52U)
Monitor Connector	Vessel/Engine Monitor Connection to Interface Unit (14-pin ribbon cable)

Power/Ground Connection: The power (**PWR**) and ground (**GND**) connections are located at one end of the terminal strip. The power source can be anywhere in the 10-30 Vdc range. There is no ON/OFF switch on the VS52(U) due to its low power consumption.

NMEA 0183 Inputs and Output: The four VS52(U) NMEA 0183 input connections are labeled **IN1** through **IN4**, and the output is labeled **OUT**. When connecting NMEA instruments it is important to maintain the proper polarity of the lines. Always connect the “+” terminal of each talker to the corresponding “+” or “A” terminal of each listener. Likewise, connect the “-” terminal of each talker to the corresponding “-” or “B” terminal of each listener. In some cases a device will not have “+/-” or “A/B” connections, but rather only a “Data in” or “Data out” which is referenced to ground. These are known as “single-ended” devices.

For single-ended talkers, connect their “Data out” to an **IN+** connection of the VS52(U). The **IN-** connection must be connected to ground or “common.” For single-ended listeners, however, connect the VS52(U) **OUT+** or **TLK+** terminal to the “Data in” of the listener. Leave the **OUT-** or **TLK-** terminal open. Never connect **OUT-** or **TLK-** to ground or common.

The inputs (**IN1-4**) are configured to operate at 4800 baud. **IN1** and/or **IN2**, however, can be reconfigured at 9600 baud. (See Appendix A.)

NMEA 0183 Talker Connection: The talker (**TLK**) port outputs NMEA 0183 data received from the PC interface. It may be connected to any instrument that is a listener, such as an autopilot or GPS receiver, which requires information from the PC. The **TLK** output baud rate is fixed at 4800 regardless of the baud rate of the PC interface. This port is also differential (RS-422) and follows the same convention as with the **OUT+/OUT-** output. The **TLK-** terminal should never be connected to ground or common. It can be left disconnected where necessary.

Multiple listeners may be connected to this port within the loading limitations of the device (50 mA. max.) The **TLK** output data rate is always fixed at 4800 baud even if the baud terminal is set to HIGH (grounded).

Baud Terminal: This connection is used to increase the output data rate which increases the data throughput of the VS52(U). With the baud terminal disconnected, the data rate is set at 4800 baud, the standard for NMEA 0183. Connecting **baud** to ground and resetting the unit causes the output (**OUT+/OUT-**) data rate to change to the HIGH value. Normally the HIGH baud rate will be 9600 (factory preset) if the unit has not been reconfigured. To reconfigure the HIGH baud for 19,200 or 38,400 see Appendix A. The NMEA inputs (IN1-IN4) and the **TLK** output will remain at 4800 baud even with **baud** grounded. The baud rate detection only takes effect at power-up. Any change to this terminal must be followed by a reset command or by power removal and restoration for the change to take effect.

PC Connector: The PC connector located on the rear of the VS52(U) provides a computer interface. The VS52 has a 9-pin serial connector while the VS52U has a USB connector. The Model VS52U also includes Virtual Com Port drivers for the PC.

The Virtual COM Port drivers (VS52U only) are installed as follows:

- 1) Plug VS52U into USB port of computer
- 2) Insert NoLand Engineering VS52U Drivers Disk into disk drive of computer
- 3) When the "New Hardware Wizard" window appears, select the "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 the "New Hardware Wizard" window appears, select the "Windows recommended option"
- 2) Click "Next"
- 3) Click "Finish"

Software driver installation is complete. To determine which COM port number was assigned to the USB serial port, look under Windows "Device Manager," double click ports (COM and LPT), and look for USB Serial (COM #).

Monitor Connector: This connection accepts the conditioned and scaled data from the Interface Units. The ribbon cable (14-pin) connects this to the Interface Unit. The pinout for this connector is shown in Figure 4.

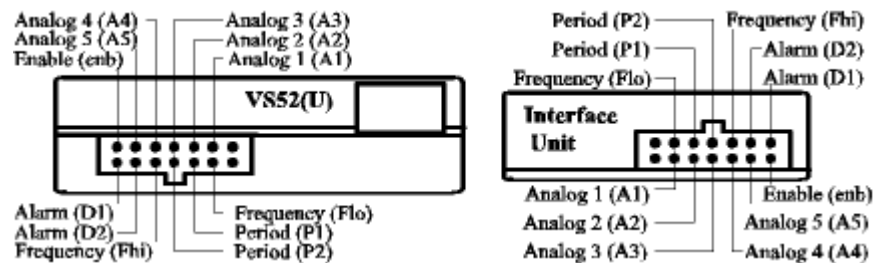


Figure 4. Monitor Connections

4. INTERFACE UNIT INSTALLATION: The Interface Unit provides for connection of the vessel sensors to the VS52(U) monitor input. Signal conditioning, in the form of filtering and scaling, is provided inside the Interface Unit. All analog inputs (A1-A5) must have the appropriate full-scale input voltage set by jumpers within this unit. Figure 5 shows an example of each of the 5 full-scale settings available.

The specific jumper settings of each analog input depend entirely on what each input is measuring. For example, if analog input A1 is measuring a 12V marine battery, the full-scale voltage should be set to 15V. For measuring 24V batteries, the full-scale voltage should be set to 30V. For most other types of sensors, the correct full-scale voltage will usually be either 5V or 10V. To measure very small voltages, such as a 50mV current shunt, the AS50X current shunt amplifier is provided which multiplies the voltage by 50. Thus, a 50mV (0.050V) signal would be boosted to 2.5 volts full-scale by the amplifier. The 5V full-scale setting is the only setting, which works with the AS50 amplifier.

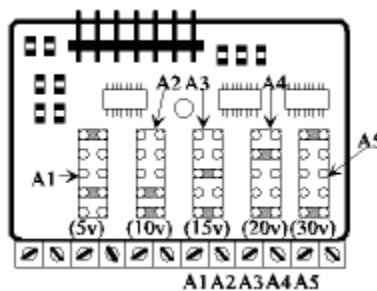


Figure 5. Interface Unit Jumper Settings

Connections to the interface unit can be made at the "sense" terminals of existing gauges. A typical connection diagram is shown in Figure 6. The Vessel/Engine Monitor has several setup (programming) options. These include defining the ON/OFF alarm characters, and setup of the "RPM" sentence. These options are described in detail in Appendix A.

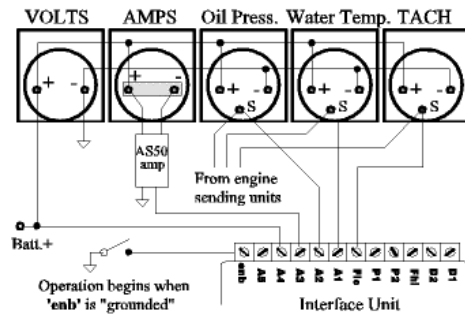


Figure 6. Example Installation with Vessel Gauges

The Vessel/Engine Monitor can measure three different types of inputs as follows:

Analog. The 5 analog voltage inputs (A1-A5) will normally connect to existing sensors or gauges on the vessel. The voltages can be anywhere from 0-30V and must be steady D.C. voltages. Pulsed or rapidly varying signals cannot be measured by these inputs.

Frequency/Period. These inputs are for pulsed or rapidly varying signals such as engine rpm pulses, and pulses from flowmeters or boatspeed paddlewheel sensors. The pulses need to switch from near 0V (ground) to at least 2V to be detected. Two of the pulse inputs, F1 and F2, are dedicated to frequency measurement while two other inputs, P1 and P2, are dedicated to period measurement. Although frequency and period are mathematically related, high frequency signals such as engine RPM are more accurately measured by frequency (pulses/sec), while low frequency signals, such as flowmeters, are more accurately measured by period (time between pulses).

Alarm. Alarm inputs, D1 and D2, are for “on/off” type of indicators, such as bilge pumps, hi-water alarms, etc. Any voltage near 0V (ground) is detected as either an “on” or “off” state (user defined), while a voltage over 2V is detected as the opposite state.

ENB. The ENABLe connection is used to start/stop the Vessel/Engine Monitor function in the VS52(U). When the “ENB” terminal is grounded, the Vessel/Engine Monitor will begin sending the data. If left open or set above 2V, the Vessel/Engine Monitor will cease operation even though the multiplexing function of the VS52(U) continues. If desired, the user may tie this connection permanently to ground, or connect it to ground through a switch to enable/disable operation manually. Another alternative is to use an automatic switch, such as a normally-open engine oil pressure switch. In this way the Vessel/Engine Monitor only operates while the engine is running. (See Figure 7).

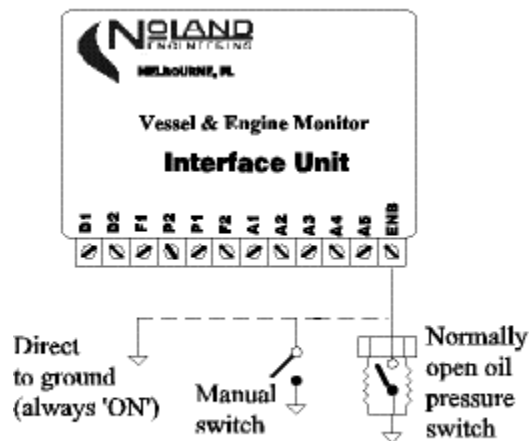


Figure 7. Alternative “ENB” hookups

Analog sensor connection: This section shows how to connect common analog sensors to the Interface Unit. In most installations, the connections can be made directly on the rear panel of the vessel gauges.

Battery volts: Battery voltage can be sensed directly by any of the analog inputs. The voltage, however, must be scaled down to a value below 5v before measurement by the VS52(U). This is done with scaling resistors and user selectable jumpers inside the Interface Unit. The jumper settings allow inputs up to 30v to be measured. For maximum resolution and accuracy, the lowest full-scale setting necessary for the input should be used. Setting a higher full-scale value than necessary will work, but accuracy and resolution will be compromised. For 12V batteries, a 15V full-scale setting is best, while the 30V full-scale setting should be used for 24V batteries.

Battery amps: Sensing of battery amps is usually done with a ‘current shunt’. This is a very small resistor, which develops a small voltage in exact proportion to the current flowing through it. The shunt is usually a short bar of steel or copper attached directly to the rear panel of the Ammeter for lower current applications. For higher current applications, the shunts are too large to mount behind or inside the meter, so they are mounted elsewhere near the meter or battery. Since all the battery current must pass through the shunt for the measurement, the shunt is only allowed to develop a small voltage drop (typically 50mV or 100mV) at full rated current.

For increased resolution, the small voltage across the shunt must be amplified before measurement by the VS52(U). The model AS50X

amplifier, with a gain of 50, is provided for this task. This amplifier is connected directly across the shunt terminals with the output going to one of the analog inputs of the Interface Unit. Whichever analog input is connected to the AS50X must have its jumper setting at '5V' to get a correct reading.

Sending units (temperature, pressure, level, etc.)

There are a variety of sensors, called 'sending units', commonly used on boats and automobiles to sense pressure, temperature, fuel level, etc. The majority of these sensors are resistive, which means their internal resistance changes with the property being sensed. The gauge to which these sending units are attached provides a current that changes the voltage across the sending unit as its resistance changes. Thus, most sending units will act as voltage sensors when attached to their appropriate gauge.

In most cases, sending units can be directly connected to an analog input of the Interface Unit. This is done more conveniently at the "S"(sense) terminal of the gauge itself rather than at the sending unit. Once connected, the appropriate scaling of each analog input must be set inside the Interface Unit. For most 12V systems the sending units rarely go above 10V, so a full-scale jumper setting of 10V is a good start.

Incompatible sensors: There are other types of sensors or transducers commonly used on vessels, which will not interface directly to the VS52(U). An example is rudder position sensors. Some smaller pleasure craft do use simple resistive rudder position sensors, which will connect directly to an analog input of the Interface Unit. Larger vessels, however, use a more sophisticated sensor, which requires a special display unit and will not connect directly to the VS52(U).

Frequency/Period connections: Frequency and Period inputs are used to count pulses within a given time interval or to measure the time interval between pulses. Frequency and period are mathematically related by:

$$\text{frequency} = 1 / \text{period} \text{ or } \text{period} = 1 / \text{frequency},$$

so that one is merely the inverse of the other. If period is expressed in "seconds", then frequency will be in pulses/sec. Both types of inputs are needed because high frequency signals, such as tachometer pulses, are more accurately measured by frequency, whereas low frequency signals, such as paddlewheel sensors, are more accurately measured by period.

RPM measurement: The most common need for frequency measurement onboard vessels is engine RPM. RPM measurement can involve two different frequency ranges depending upon how it is sensed. Gasoline engines generally measure RPM by sensing ignition pulses either directly or via a "TACH" signal in electronic ignitions. Diesel engines, however, must use a special sensor since they have no ignition system. Most diesels use a flywheel sensor, which sends a pulse for every tooth on the flywheel. A very important distinction between these techniques is that a flywheel-sensed diesel engine produces a much higher frequency output than an ignition-sensed gasoline engine. Therefore 'Fhi' should be used to measure RPM in flywheel-sensed diesel engines, while 'Flo' is better suited for measuring ignition sensed gasoline engines.

Another way to state this is in terms of the pulses/revolution (ppr) of the engine. Fhi is used for high ppr (>25 pulses/rev) engines while Flo is used in low ppr (<25 pulses/rev) engines.

For either case, the RPM is calculated by:

$$\text{RPM} = 60 \times (\text{frequency} / \text{ppr}),$$

where **frequency = Fhi or Flo** and **ppr = pulses/rev**. For example, a gasoline engine with ppr =12 and measured Flo =500 pulses/sec would show an RPM of 2500 rev/min.

As with the analog inputs, the frequency inputs, Fhi or Flo, can usually be obtained directly from the "S" terminal on the ships' tachometer. Some diesel engine tachometers do not have a sense terminal. Instead they have two wires coming from a flywheel sensor. To connect to these sensors, NoLand Engineering makes a differential amplifier unit (AD20), which can be connected directly across the sensor terminals. Connecting the AD20 to your sensor will not affect the operation of your vessel tachometer.

Paddlewheel sensors (knotmeters, flowmeters): The period inputs, P1 and P2, are for measuring low frequency sensors such as paddlewheel sensors used for knotmeters and fuel flowmeters. Due to the wide variation of interface differences in these types of sensors, it is often not possible to connect the sensor directly to the Interface Unit. Fortunately, many gauges that use these sensors provide a "remote counter" output, which should connect directly to P1 or P2 of the Interface Unit. In cases where such an output is not available, NoLand Engineering makes a differential amplifier unit (AD20), which can be connected directly across the sensor terminals.

Alarm connections: Inputs D1 and D2 are alarm indicators, which measure a simple "on/off" condition. Examples of this are bilge pump switches, over-temperature or low-pressure switches, etc. Alarms are detected by the VS52(U) by either the presence or absence of voltage. Voltages below 1V are detected as "OFF", while voltages above 2V are detected as "ON". Voltages up to 30V will not damage the alarm inputs.

Bilge pump: An important use of an alarm input is to detect when a bilge pump is running. There are a variety of ways to do this depending upon the type of pump and switch involved. Some examples of this are presented in Figure 8. Where a float or trip switch is involved, it is usually desirable to connect D1 or D2 directly to the switch.

There are some bilge pumps with self-contained float switches. There is no easy way to connect these types to the Vessel/Engine Monitor.

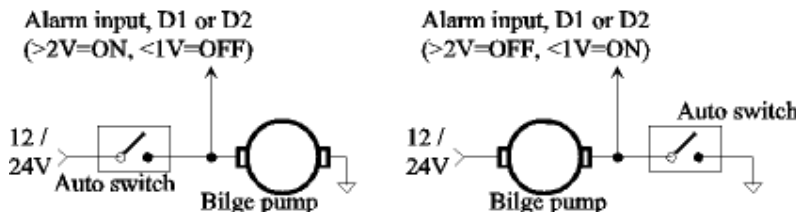


Figure 8. Example hookups of Alarms with Auto Bilge Pumps

5. OPERATION: Once the VS52(U) is installed and power is applied, the unit begins acquiring data automatically. No user intervention is needed unless default settings must be changed. The VS52(U) will also operate without the PC connection.

Status LED: A multicolor LED is situated in a recess on top of the VS52(U). The colors and their meaning are summarized in Table 3. The LED will only show one color at a time as determined by its priority. The yellow color has highest priority to indicate an error has occurred. The red color has next highest priority and will be seen if no error is currently present and data is being sent to the TLK output. The green LED will only be lit if either of the other colors is not displayed. The green and red LED colors flicker as data is being sent. The yellow color is for error notification and remains lit for approximately ½ sec. This makes it easier to discriminate from the red color.

Whenever the yellow LED is displayed, an error message is sent to both the NMEA output (**OUT+/OUT-**) and the PC interface. Refer to “Troubleshooting” (Section 6) for more information about the error messages.

Data Acquisition: Acquiring data from marine navigational instruments is the primary function of the VS52(U). Under the NMEA 0183 Standard, all data is transmitted as ASCII characters assembled into specific sentences. The format of every sentence is defined in the Standard.

Table 3. Status LED Meanings

Color/State	Priority	Meaning
Yellow Steady ~ 1/2 sec	highest	An error has occurred, and an error identification sentence is being sent.
Red Flickering	middle	A valid sentence from PC interface is being sent to the TLK output.
Green Flickering	lowest	A valid sentence from one of the four inputs is being sent to the outputs.

Every sentence begins with a dollar sign (\$) and ends with a carriage return and linefeed, (<CR><LF>). Immediately following the “\$” is a five character identifier which defines the type of instrument and the specific sentence being sent. Following the identifier are data fields separated by commas.

The easiest way to view the data is with a terminal program such as “HyperTerminal” available on most PC’s. The following settings are used to view NMEA 0183 data:

Baud Rate	4800
Data Bits	8
Parity	none
Stop Bits	1
Flow Control	none

NMEA 0183 devices may be either talkers or listeners or both. Data is typically sent once each second.

6. TROUBLESHOOTING: A useful feature of the VS52(U) is the detection and reporting of errors. There are five types of errors which can be detected in any of the five internal channels (4 inputs + talker). An error message identifies both the channels and types of errors that have occurred. It is available at both the PC interface and the **OUT+/OUT-** terminals. The error message is sent simultaneously with the error LED (yellow) being displayed.

The error message identifies the error channels and types with an alphanumeric code. The format is as follows: **\$PNOLE, c, t** where *c* represents an alphanumeric code identifying the error channel(s), and *t* represents an alphanumeric code identifying the error types.

The codes for a single error and their meaning are presented in Table 4. The error message is sent only once each half second when errors are present. The message will contain a summary of all error channels and types which occurred during the previous interval (~1/2 sec).

Table 4. Single Error Codes

CODE	ERROR CHANNEL	ERROR TYPE
1	IN1	synchronization
2	IN2	character
4	IN3	dollar
8	IN4	linefeed
G(16)	TLK	overflow

The meaning of the error types is as follows:

- 1** This is a **synchronization**, or framing, error caused by an invalid START bit or STOP bit, usually from corrupted data.

- 2 This is a **character** error which occurs when an 8-bit ASCII character is detected.
- 4 This is an **dollar** error generated when a “\$” (start of sentence) character is not received when expected.
- 8 This is a **linefeed** error generated by a missing linefeed character or a sentence containing too many characters.
- G This is a **buffer_overflow** error which occurs when more data is coming into the VS52(U) than it can send out.

In most instances only a single channel will have an error, but there may be several errors occurring during the reporting interval. For example, synchronization errors will usually occur simultaneously with character errors and possibly dollar and/or linefeed errors. If an input is connected or disconnected “on-the-fly” while it is sending data, an error will most likely occur. If an input is reverse polarized, it will generate continuous error messages about twice per second.

As an example, the sentence

SPNOLE,4,7

indicates that **IN3** had **synchronization**, **character**, and **dollar** errors. We know this because 7 is the sum of 1(synchronization) + 2(character) + 4(dollar). Each of the five types of errors is assigned a binary power (1, 2, 4, 8, F). The sum of any of these binary powers equals a unique number, which can be decomposed into the simple error types. To accommodate quantities over 9, letters are used to represent the quantities 10(A), 11(B), 12(C), 13(D) ... and so on. The encoding of the error channel follows this same scheme used for error type. Table 4 provides codes which represent multiple error types and multiple error channels.

The “TLK” error code and the “overflow” error code are not shown in Table 5, because they rarely occur in practice. If a “TLK” or “overflow” error occurs with other errors, Table 6 can be used to decipher the codes.

Testing with Status LED: The LED provides a convenient means to test the VS52(U) in place. This is because the VS52(U) will always produce an output whenever any of the five input channels (4 + talker) is stimulated. If valid data is detected, the LED will flash red or green as appropriate and the data will be sent to the output.

Table 5. Multiple Error Codes

CODE	ERROR CHANNEL(S)	ERROR TYPE(S)
3	IN2 + IN1	character + synchronization
5	IN3 + IN1	dollar + synchronization
6	IN3 + IN2	dollar + character
7	IN3 + IN2 + IN1	dollar + character + synchronization
9	IN4 + IN1	linefeed + synchronization
A(10)	IN4 + IN2	linefeed + char
B(11)	IN4 + IN2 + IN1	linefeed + character + synchronization
C(12)	IN4 + IN3	linefeed + dollar
D(13)	IN4 + IN3 + IN1	linefeed + dollar + synchronization
E(14)	IN4 + IN3 + IN2	linefeed + dollar + character
F(15)	IN4 + IN3 + IN2 + IN1	linefeed + dollar + character + synchronization

Table 6. Multiple Error Codes including TLK & ovfl

CODE	ERROR CHANNEL(S)	ERROR TYPE(S)
H(17)	TLK+IN1	overflow+ synchronization
I(18)	TLK+IN2	overflow + character
J(19)	TLK+IN2+IN1	overflow + character + synchronization
K(20)	TLK+IN3	overflow + dollar
L(21)	TLK+IN3+IN1	overflow + dollar + synchronization
M(22)	TLK+IN3+IN2	overflow + dollar + character
N(23)	TLK+IN3+IN2+IN1	overflow + dollar +char+ synchronization
O(24)	TLK+IN4	overflow + linefeed
P(25)	TLK+IN4+IN1	overflow + linefeed + synchronization
Q(26)	TLK +IN4+IN2	overflow + linefeed + character
R(27)	TLK+IN4+IN2+IN1	overflow + linefeed + synchronization
S(28)	TLK+IN4+IN3	overflow + linefeed + dollar
T(29)	TLK+IN4+IN3+IN1	overflow + linefeed + dollar +sync
U(30)	TLK+IN4+IN3+IN2	overflow + linefeed + dollar + character
V(31)	TLK+IN4+IN3+IN2+IN1	overflow + linefeed + dollar + character +sync

If an input has invalid data, the error LED will light and an error sentence will be transmitted identifying the problem. If a computer is connected to the VS52(U), the error message can be observed with a terminal program such as “HyperTerminal.”

These tests are simple, requiring no special equipment. Voltmeter testing of differential signals (RS-422) can produce very confusing results and should not be relied upon to determine proper operation of the VS52(U).

7. VS52(U) TECHNICAL SPECIFICATIONS

Supply Voltage/Current	10-30 VDC/50 mA. max
NMEA Input Drive Voltage (IN1-IN4)	2-14 V (Active State)
NMEA Input Impedance (IN1-IN4)	1K Ohms (Min.)
NMEA Output (TKJ and OUT)	4V Differential (RS-422)
NMEA Output drive (OUT, TLK)	50 mA. (max)
Serial Output Baud Rate	4800-38,400 (selectable)
Analog input range (IN1-IN5)	5V (30V via Interface Unit)
Analog resolution	0.1% (10-bit)
Frequencyhi range (res.)	10-9990 Hz. (10 Hz.)
Frequencylo range (res.)	2-998 Hz. (2 Hz.)
Period, P1,P2 range (res.)	1-2000 ms. (1 ms.)
Size/Weight	3.75" x 3.0" x 1.0"/5 oz.

8. WARRANTY: NoLand Engineering, Inc., provides a two-year replacement warranty against manufacturing defects and component faults. Inquiry for warranty replacement may be made directly to NoLand Engineering via phone, fax, or e-mail. Include the model number and serial number of your unit with any inquiry.

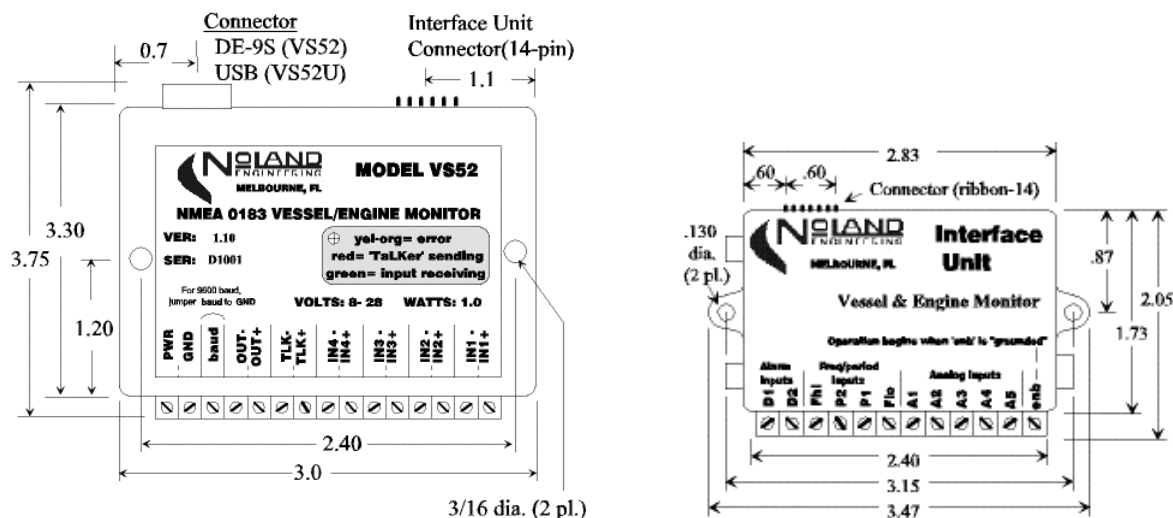


Figure 9. Outline Drawing

APPENDIX A Programming Instructions

Introduction: The VS52(U) is capable of accepting certain commands and taking appropriate action such as a device reset. The commands are also used to configure various options, such as baud rate selection. All programming is done through the PC interface.

Although programming can be done while the unit is operating, it is much easier to stop data flow while programming is being done. This can be done with the “stop device” (@<) command, or all inputs can simply be disconnected or turned off. With the device connected to a computer, a terminal window (e.g., “HyperTerminal”) can be used for programming. To enable viewing of the Vessel/Engine Monitor options, the enable (ENB) terminal of the Interface Unit must be grounded.

Commands typed into the terminal window are sent to the VS52(U), which will check their validity and take appropriate action. All commands begin with an “@” character followed by another character which defines the action to take. Some actions will need additional characters (options) to more specifically define the action. A list of command characters and options is given in Table A-1. If the “R”, “A”, or “V” options are not displayed, it is because the “ENB” terminal of the Interface Unit is not grounded.

TABLE A-1 VS52(U) Commands
Factory presets are shown in **bold**.

Command	Action	Options	Comments
<	Stop device	(n/a)	Stop data for programming
>	Reset (restart) device	(n/a)	Same as power disconnect-reconnect
?	Help / Query configuration	(n/a)	Shows help / Shows current device configuration
B or b	Set HIGH baud rate	1,2,3	9600 , 19200, or 38400 baud available

I or i	Input baud rate select	1,2, 3,4	IN1 = 4800 , 9600 IN2 = 4800 , 9600
E or e	Error report on/off Max sentence length	1,2, 3,4	1 Error report on 2 Error report off 3 = 82 chars 4 = 127 chars
R or r	Set RPM mode	0,1,2	0-off , 1=Fhi or 2=Flo for RPM
A or a	Alarm ON char	(any)	A (default per NMEA 0183 std)
V or v	Alarm OFF char	(any)	V (default per NMEA 0183 std)

Programming Example: An example will demonstrate how to program the VS52(U). With the device connected to a computer and a terminal window open your terminal settings should match those shown in Section 5. When configured for the correct COM port, you are ready to send a command. If the device is currently receiving data, you can stop the data flow by typing

@<

This causes the data flow to stop. If you now type

@?

You will get a list of the current configuration settings as well as a list of commands/options. Most of the options and commands concern the Multiplexer function. Those at the bottom of each list are for the Vessel/Engine Monitor function. If the "RPM" and "ON/OFF character" configuration options are missing from the list, it is because the "ENB" terminal of the Interface Module is not grounded. Ground the terminal and type the query command again.

Note: *The Vessel/Engine Monitor options in the table can be programmed by the user whenever the VS52(U) is powered on and connected to a PC even if the "ENB" terminal of the Interface Unit is not grounded. Display of these options, however, is only possible when the enable (ENB) terminal of the Interface Module is grounded*

Assume we now want to reconfigure the HIGH baud rate for 38400. By typing "@B3" the HIGH baud rate will be reconfigured to 38400. It will remain configured this way unless it is reconfigured sometime in the future. To verify the configuration change was accepted, we can again type "@?" which will show the current configuration. In this particular case, the actual baud rate change does not take effect unless power is removed and reapplied (forced reset) or the 'reset' command "@>" is sent.

The "@I" command is rarely used except by certain specialized users. It is used to increase IN1/IN2 baud rate to 9600.

The "@E" command performs two different actions. It turns error reporting on or off and also sets the maximum sentence length. Turning error reporting off does not affect operation of the error (yellow) LED. The normal sentence length limit is 82 characters per the NMEA standard but can be increased to 127 chars when needed by issuing the "@E4" command.

The "A" and "V" options should be left as is for most users but can be changed for special software needs, if required. These commands merely change the characters which appear in the "\$PNOLD" sentence in response to ON/OFF alarm conditions.

To enable and configure the RPM sentence, the user must know which input, Fhi or Flo, is being used to measure RPM and what the pulses-per-revolution (ppr) value of the engine is (see Section 4, "RPM Measurement). If Fhi is connected for RPM with a ppr value of 48, then the user would type

@r1

and the following prompt would appear;

Pulses/Rev=255, <ENTER> to accept or input new value (025-255)

Type the new desired ppr value (3 digits). For example, if ppr=48, type

0 4 8

The new ppr value will not be accepted until all 3 digits have been typed and the value is within the specified range.

If rejected, the "Invalid Command" message will be displayed. To confirm the ppr value, type the "@r1" command again and the prompt will appear showing the current ppr value.

The setup of RPM for Flo is nearly identical, except that the command is

@r2

the following prompt would appear;

Pulses/Rev=01, <ENTER> to accept or input new value (01,02,03,04,06,08,10,12,16,20,24)

and the valid ppr values are only those shown in parentheses. Typing any other value will result in an "Invalid Command" message.

The user can enter ppr values for both Fhi(RPM) and Flo(RPM), and both will be kept in memory, so that switching between Fhi(RPM) and

Flo(RPM) modes does require re-entering previously assigned ppr values. To turn off the RPM sentence altogether, type the command

@r0

and the RPM mode will revert to the "none" (disable) mode.

APPENDIX B

Vessel/Engine Monitor Sentence Definitions

The NoLand Engineering Vessel/Engine Monitor System is capable of supplying both standard and proprietary data sentences for use by application software. The proprietary sentences are necessary for two reasons. One, the raw data in the proprietary sentences is useful for setup, calibration and troubleshooting of both the hardware installation and the application software. Second, the NMEA 0183 standard has almost no "standard sentences" for the type of data supplied by this system; so proprietary sentences are the most efficient way to send it. In the current version, two proprietary sentences (analog and digital) and one standard sentence (RPM) can be sent.

Analog Sentence: The analog sentence contains the raw data from the five analog inputs. These inputs would generally be used to measure voltages from vessel sensors, such as "amps", "temperature", oil pressure", and others. The format of the sentence is:

SPNOLA,xx.x,xx.x,xx.x,xx.x,xx.x<CR><LF>
(A1 , A2 , A3 , A4 , A5)

As per the NMEA 0183 standard, the above sentence starts with a '\$', then the letter 'P', which indicates a proprietary sentence, and then the 3 letters 'N-O-L' indicating the sentence belongs to NoLand Engineering.

The last letter, 'A', indicates the sentence is for "analog" data. The actual analog data (A1 - A5) is contained in the next five fields, separated by commas. The data is given in % of full-scale volts from 0 - 99.9%. The full-scale voltage is set by jumpers in the Interface Unit. The analog sentence is sent once per second.

Digital Sentence: The digital sentence contains the raw data for two "alarm" inputs, two "frequency" inputs, and two "period" inputs. These inputs are useful for measuring such things as; bilge pumps (on/off), RPM, fuel flow, and more. The sentence format is

SPNOLD,c,c,xxxx,xxxx,xxxx,xxxx<CR><LF>
(D1,D2, Fhi, Flo , P1 , P2)

This proprietary sentence is very similar to the analog sentence above except that the sentence identifier is "D" rather than "A". The first two data fields of the sentence are for the alarm characters (D1, D2). The character in each of these fields indicates whether the alarm is on or off. The NMEA 0183 Standard generally designates the "V" character for an on condition and the "A" character for an off condition. The choice of characters defaults to this standard but can be reprogrammed by the user (see Appendix A).

The next two fields (Fhi, Flo) are the frequency measurements. Fhi measures high frequency inputs such as the pulses from a diesel engine with a flywheel RPM sensor. Conversely, Flo is optimized for lower frequency measurement, such as the ignition pulses from a gasoline engine. Fhi and Flo are both given in pulses/sec (Hertz).

The final two data fields (P1, P2) are period, or interval, measurements. Generally, period is used to measure slower changing events such as fuel flowmeters or paddlewheel knotmeters. Values for P1 and P2 are in milliseconds (1/1000 sec) and leading zero suppression is used. The digital sentence is sent once per second.

RPM sentence

An RPM sentence can also be sent, if configured by the user. This sentence conforms to that specified by the NMEA 0183 Standard as follows:

SERRPM,,,xxxx,,<CR><LF>
RPM

The RPM sentence is only sent when configured by the user, who must assign either Fhi or Flo to the RPM measurement and also enter the pulses-per-revolution (ppr) of the engine. The advantage of the RPM sentence is that it is direct reading and is sent twice per second. Configuring the RPM sentence is covered in Appendix A.

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