



SmartBoat[®] Module

Patent <http://www.airmar.com/patent.html>

User Manual

NMEA 2000[®] Certified



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2 Introduction

Airmar's SmartFlex™ system products support multiple network standards and are highly configurable for a wide range of applications. They share a common set of features including built-in wireless networking support and browser-based configuration and management.

SmartBoat® modules are certified for use with NMEA 2000® networks and designed specifically for marine applications.

Basic models provide programmable device interfaces for parameters including voltage, current loop sensors, resistive senders, thermistor, and thermocouple temperature sensors, run detection, switch detection, flow metering, and relay control.

Advanced models add support for multi-network bridging and management including multiple NMEA 2000 networks, NMEA 0183 support, and SAE J1939 engine interface features. Unique alerting features provide customizable messages and task automation capabilities.

All SmartBoat modules are designed to operate in harsh marine environments and are rated for water ingress to IP66 (water jet) and IP67 (submersion).

3 Specifications

3.1 General specifications

PARAMETER	VALUE	COMMENT
Operating Voltage	9 to 16 VDC	NMEA 2000 interface
Input Current	475 mA (maximum)	From NMEA 2000 interface
Load Equivalence Number	10	NMEA 2000: 1 LEN = 50 mA Measured at a supply voltage of 9 V
Isolation	1,500 VDC: power input 2,500 Vrms: signals	
Reverse Voltage Protection	Yes	Indefinitely
Load Dump Protection	Yes	
Over-current Protection	Yes	2A Auto-resettable electronic fuse
Size	221 mm x 145 mm x 61 mm (8.7" x 5.7" x 2.4")	Including mounting flanges
Weight	675 gm (1.5 lb.)	Maximum for all models
IEC 60945 Classification	Exposed	
Water Ingress Rating	IP66 (water jet)	IEC 60529
Operating Temperature	-25°C to +55°C (-13°F to +130°F)	
Storage Temperature	-40°C to +70°C (-40°F to +158°F)	
Electromagnetic Emission	Conducted/Radiated emission per IEC/EN 61000- 2/3	
Electromagnetic Immunity	Conducted/Radiated, supply, and ESD per IEC 61000-4	
Flammability Rating	UL94V-0	Printed circuit board
	UL94-5VA	Enclosure
Compass Interference	None	EN 60945:2002
Certifications	NMEA 2000 standard	v1.200, Level A
	Maritime navigation and radio communication equipment & systems	IEC 61162-3 IEC 60945
Manufacturing	ANSI/IPC-A-610C class 2	
RoHS/REACH Compliance	Yes	

3.2 Monitored parameters



Accuracy parameters are exclusive of sensor/transducer accuracy.

3.2.1 Voltage measurement

CHARACTERISTIC	VALUE	COMMENT
Range	0 to 75 VDC	
Accuracy	+/- 100 mV	
Resolution	0.0031 V	
Input Resistance	> 15 K Ω	
Configuration Inputs	Damping period	None to 25 seconds 0.1 second steps

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
DC Voltage	127751, 130840

3.2.2 Thermistor temperature sensor

CHARACTERISTIC	VALUE	COMMENT
Range	-40°C to +125°C	Dependent on thermistor used
Accuracy	+/- 2%	
Resolution	0.0076°C	
Configuration Inputs	Thermistor parameters	Dropdown selection for standard devices. You may also specify a custom thermistor by providing the R25 value (1 to 100 K Ω) and one of the following: <ul style="list-style-type: none"> • Thermistor beta • Three resistance-temperature curve points • Steinhart-Hart coefficients
	Minimum temperature	
	Maximum temperature	
	Damping period	None to 25 seconds 0.10 second steps

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Temperature	130310, 130311, 130312, 130316

3.2.3 Current-loop sensor

CHARACTERISTIC	VALUE	COMMENT
Range	4 to 20 mA	Allowable range 0 to 22 mA
Accuracy	+/- 1% full scale	
Resolution	0.0013 mA	
Excitation Voltage	12 to 14 VDC	Type II only
Configuration Inputs	Type	Type II (2-wire) Type III (3-wire) Type IV (4-wire)
	Minimum value	4 mA value
	Maximum value	20 mA value
	Damping period	None to 25 seconds 0.1 second steps

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Temperature	130310, 130311, 130312, 130316
Pressure	130310, 130311, 130314
Humidity	130311, 130313, 130840
Fluid Level	127505
Flow Rate	065286
Linear Velocity	130840
Rotation Rate	130840
Acceleration	130840
Angular Velocity	130840
Angular Acceleration	130840
Angle	130840
Force	130840
Decibels	130840
Resistance	130840
Distance	130840
DC Voltage	127751, 130840
DC Current	130840

3.2.4 Thermocouple temperature sensor

CHARACTERISTIC	VALUE	COMMENT
Range	-100°C to +1275°C	Dependent on thermocouple used
Accuracy	+/- 2%	
Resolution	0.0778°C	
Configuration Inputs	Type of thermocouple	J, K, T, E
	Minimum temperature	
	Maximum temperature	
	Damping period	None to 25 seconds 0.1 second steps

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Temperature	130310, 130311, 130312, 130316

3.2.5 Resistive sender

CHARACTERISTIC	VALUE	COMMENT
Range	10 to 300 Ω	US: 30 to 240 Ω Europe: 10 to 180 Ω Custom: 10 to 300 Ω
Accuracy	+/- 1% full scale	
Resolution	0.0183 Ω	
Configuration Inputs	Sensor standard	US, European, or custom
	Sensor type	e.g. rudder angle
	Minimum resistance: R_{min}	In Ohms
	Maximum resistance: R_{max}	In Ohms
	Sensor value at R_{min}	e.g. R_{min} = minimum angle
	Sensor value at R_{max}	e.g. R_{max} = maximum angle
	Damping period	None to 25 seconds 0.1 second steps

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Fluid Level	127505
Rudder Angle	127245

3.2.6 Switch detector

CHARACTERISTIC	VALUE	COMMENT
Configurations	Unsupervised (no EOL resistor) One EOL resistor Two EOL resistor	EOL = End of Line
Fault Detection	Supervised: One EOL resistor: open line Two EOL resistor: open or shorted line	
Configuration Inputs	Number of EOL resistors	0, 1, or 2
	EOL resistor value <i>Note: If 2 EOL resistors, they must be the same value</i>	Dropdown menu selection: 25 K Ω , 20 K Ω , 15 K Ω , 10 K Ω , 8 K Ω , 2 K Ω , 1 K Ω , 680 Ω
	Invert value	Select "ON" state as closed or open.

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Binary Switch	127501

3.2.7 Run detector

CHARACTERISTIC	VALUE	COMMENT
"OFF" Voltage (switch open)	9 to 240 VAC RMS 9 to 240 VDC	Terminals connected across switch
"ON" Voltage (switch closed)	< 3 V: AC or DC	
"ON" Voltage (switch closed)	9 to 240 VAC RMS 9 to 240 VDC	Terminals connected across load
"OFF" Voltage (switch open)	Not applicable	
Configuration Inputs	Connection mode	Across switch or load

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Binary Switch	127501

3.2.8 Relay control

CHARACTERISTIC	VALUE	COMMENT
Maximum Switching Current	10 A resistive 5 A inductive	DC Only (Use external relay for AC)
DC Switching Voltage	32 VDC maximum	
Contact Resistance	100 m Ω maximum	
Configuration Inputs	None	

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Binary Switch	127501

3.3 SmartBoat module supported devices

The following table outlines the device types supported by each model.

FEATURE/FUNCTION	ASM MODEL	
	ASM-XXX-T1	ASM-XXX-T2
PROGRAMMABLE SENSOR INPUTS (Total)		
Thermistor (NTC) ⁽¹⁾	8	4
Current Loop (2, 3, or 4-wire interface) ⁽¹⁾	8	
Resistive Senders (US or European) ⁽¹⁾	8	
Binary Switch (0, 1, or 2 EOL resistors) ⁽¹⁾	8	4
Voltage (0 to 75 VDC) ⁽¹⁾		4
⁽¹⁾ Maximum inputs are shared in a module		
FIXED SENSOR INPUT/OUTPUT		
Thermocouples (J, K, T, E) ⁽²⁾	2	
Relays (10 A resistive, 5 A inductive) ⁽²⁾		4
Run Detector (9 to 240 VDC/VAC rms) ⁽²⁾		4
⁽²⁾ Dedicated: all can be used at the same time		

3.4 Common and advanced features

	SMARTBOAT MODULE FUNCTION	
	ALL MODELS	ADVANCED MODELS
MULTI-NETWORK FEATURE/FUNCTION		
NMEA 2000 BRIDGING		
NMEA 2000 primary/secondary bridging		✓
NMEA 2000 traffic bridging over Wi-Fi	✓ #	✓
NMEA 2000 traffic bridging over Ethernet		✓
SmartFlex Network View provides a complete picture of NMEA 2000 traffic at device/PGN level	✓	✓
SmartFlex Filter provides "whitelist" and "blacklist" filtering by bus, device, or PGN	✓	✓
SmartFlex Alert provides customized alerting and task automation		✓
NMEA 2000 LOGGING		
Network traffic logging and download	✓	✓
Supports USB memory for nearly unlimited log storage		✓
NMEA 2000 WI-FI/ETHERNET		
Unlimited client connections in multiple formats	✓	✓
Network advertising and automatic connection	✓	✓
NMEA 0183 SUPPORT		
Duplex operation		✓
Listener interface with NMEA 0183 to NMEA 2000 conversion gateway		✓
Talker interface with NMEA 2000 to NMEA 0183 conversion gateway		✓
Simple "click to set" conversion selection and control		✓
Smart conversion gateway reduces redundant and incomplete messages		✓
Wi-Fi/Ethernet gateway with unlimited client connections and talker multiplexing		✓
SAE J1939 SUPPORT		
SAE J1939 bus monitoring with automatic or manual configuration		✓
Two Engine status monitor with DTC reporting and DTC reset		✓
Support for separate engine/transmission ECU addressing		✓
SAE J1939 to NMEA 2000 conversion		✓
Simple "click to set" conversion selection and control		✓
View and clear engine DTC alerts		✓
Detect and display SAE J1939 PGNs present on the NMEA 2000 bus	✓	✓
WI-FI/ETHERNET NETWORK INFRASTRUCTURE		
Wi-Fi router with DHCP support	✓	✓
Wi-Fi/Ethernet bridge function		✓
Wi-Fi access point functions	✓	✓

4 Physical Interfaces

4.1 Network and device connectors



Figure 4-1 Pluggable terminal blocks for device connections



Figure 4-2 USB and Ethernet connectors



Figure 4-3 NMEA 2000 and DB-9 connectors

4.2 User interface

4.2.1 LED indicators

There are four LED indicators on the top of each SmartBoat module.

- **Power:** This orange LED lights to indicate that the module is receiving power through the primary NMEA 2000 bus connection. In normal operation, it will remain on. This LED will flash during configuration, diagnostic testing, and during a low-level firmware update.
- **Status:** This green LED lights to indicate that the module is operating normally. When first starting, this LED will flash as diagnostics are performed and the initialization process is underway. The web configuration interface will be available when it remains on.
- **NMEA 2000:** This blue LED will flash when there is NMEA 2000 PGN traffic on either the primary or secondary physical NMEA buses. A fully configured module will begin processing NMEA 2000 PGN traffic as soon as possible after power-on.
- **Network:** This yellow LED will flash when there is web server Wi-Fi or Ethernet traffic received or sent by the module.

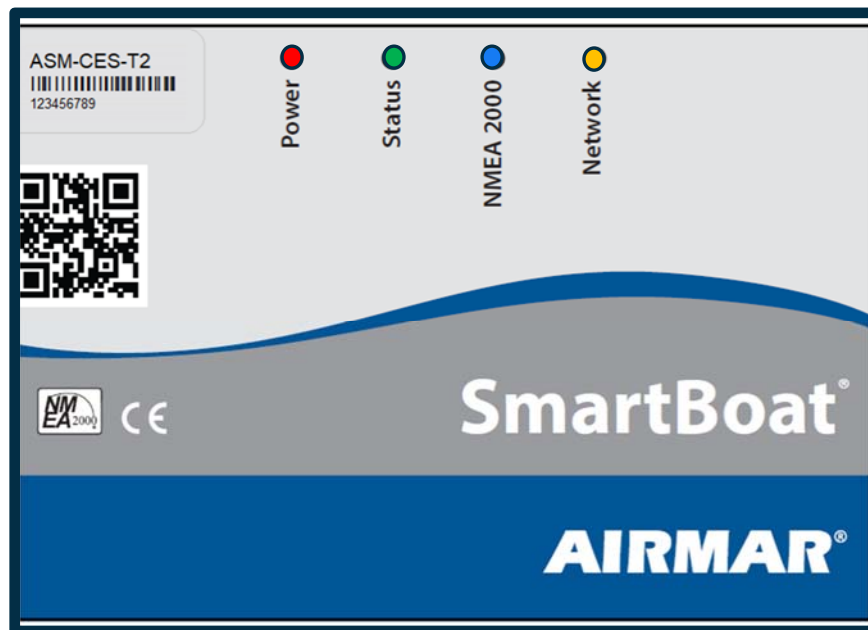


Figure 4-2 Label with LED indicators

4.2.2 Reset switch

If you forget the password for a SmartBoat module or there is an issue with the Wi-Fi network configuration that prevents access to the configuration web server, you may need to reset the configuration of the module. This switch may also be used after a firmware update to return to the previous firmware version.

On the end of the module enclosure opposite the primary NMEA 2000 bus connector (above the ethernet connector on an advanced SmartBoat module) is a recessed switch. It may be used to reset the module. This recessed switch is covered by a small adhesive label to prevent water ingress.

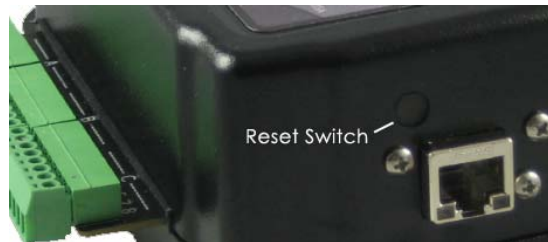


Figure 4-3 Reset switch location

To reset the system, remove the adhesive label cover. Gently activate the reset switch by inserting a paper clip or similar implement.

- **Reset configuration:** Press and hold the reset switch. After approximately 5 seconds, the LEDs will begin to flash. Release the reset switch and the configuration will be reset to the factory default.
- **Restore firmware:** Continue to hold the reset switch for an additional 5 seconds after the LEDs begin flashing. The system will revert to the previous firmware version. This is only applicable after a firmware update has been performed.



The reset switch is recessed and *not* visible through the opening. Always press gently.



Replace the adhesive label after performing the reset to prevent water ingress.

4.3 Primary NMEA 2000 bus

Each SmartBoat module is attached to the NMEA 2000 bus through a standard drop cable. This cable must also provide the power to operate the module. Each module has a bus termination resistor that may be enabled through the user interface. The interface to the primary NMEA 2000 bus. It is fully isolated according to the NMEA 2000 standard.

4.4 DB-9 connector

Each advanced SmartBoat module has an industry-standard DB-9 connector for access to a second CAN bus and NMEA 0183 RS-422 serial data. The CAN bus may be configured as a secondary physical NMEA 2000 bus, an SAE J1939 bus, or used with a SmartFlex digital sensor.

4.4.1 Pinout and accessory connector

The pinout of this connector is shown below.

PIN	FUNCTION	SIGNAL NAME
1	RS-422	RXD+
2	RS-422	RS-422 shield
3	NMEA 2000	CAN +12 V
4	RS-422	TXD-
5	NMEA 2000	CAN ground
6	RS-422	TXD+
7	NMEA 2000	CAN H
8	RS-422	RXD-
9	NMEA 2000	CAN L

Figure 4-4 DB-9 connector pinout

An optional accessory cable is available: Airmar part-number ACC-YCBL-ASM-01. This cable provides a standard NMEA 2000 connector for attaching the module to a secondary physical bus, plus wires for NMEA 0183 talker and listener functions. It is strongly recommended that only an Airmar cable be used to prevent damage to the SmartBoat module.

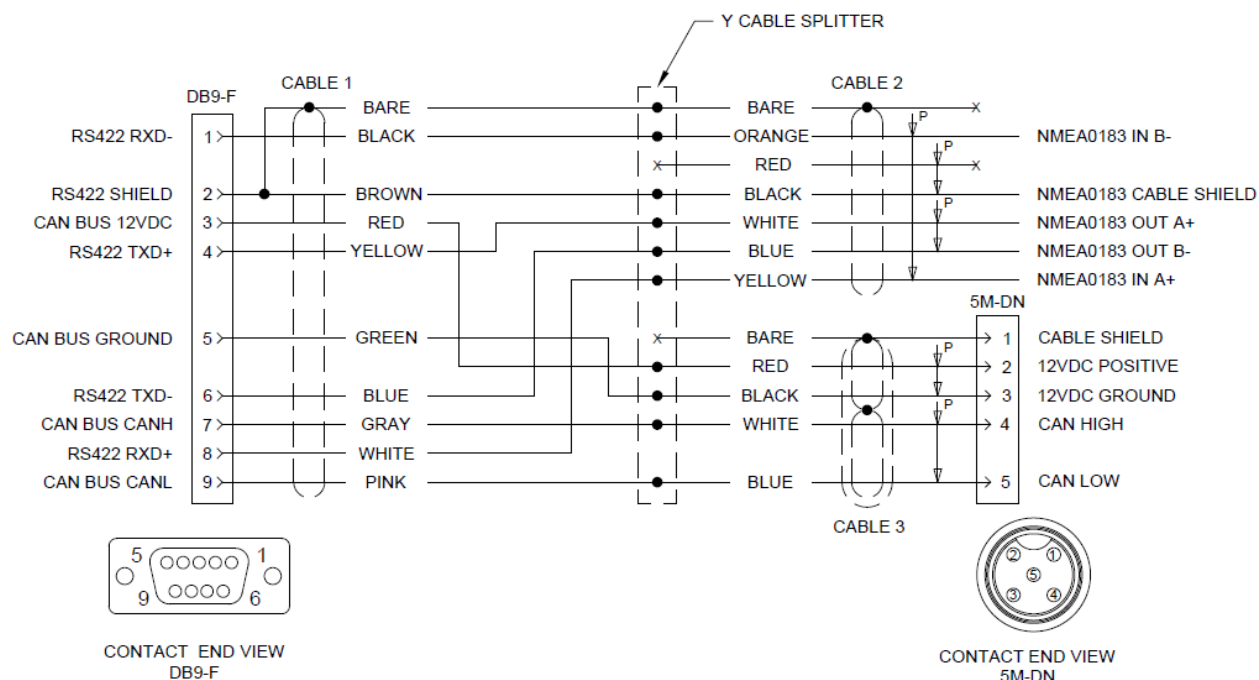


Figure 4-5 DB-9 adapter cable: Airmar part-number ACC-YCBL-ASM-01

4.4.2 Secondary NMEA 2000 / SAE J1939 bus / digital sensor interface

Using the DB-9 adapter cable, a SmartBoat module may be attached to a second NMEA 2000 bus through a standard drop cable. This cable must also provide the power (LEN 1) to operate the bus interface. An advanced SmartBoat module has a 120 Ω bus termination resistor for a second NMEA 2000 bus that may be enabled through the user interface. The interface to the secondary NMEA 2000 bus is fully isolated.

This same interface may be configured for other devices that use the Controller Area Network (CAN) bus interface for the physical layer. This includes J1939 engine gateway functions and SmartFlex digital sensors.

4.4.3 NMEA 0183 serial interface

The serial interface follows the TIA/EIA-422 technical standard originated by the Electronic Industries Alliance that specifies electrical characteristics of a digital signaling circuit. It provides independent listener (RXD+, RXD-) and talker (TXD+, TXD-) functions according to the NMEA 0183 standard.

4.5 USB 2.0 ports

There are two USB 2.0 ports. In the current software release, these ports may be used for a USB storage drive for extended NMEA 2000 bus logging functions only.

4.6 Ethernet port

A standard RJ-45 Ethernet port allows connection to a wired Ethernet network. Network speeds of 10, 100, or 1000 Mbps are supported.

4.7 Installation

The SmartBoat module can be mounted in any orientation. If mounted to a vertical wall or bulkhead, it is recommended that the terminal blocks face downwards. The injection molded ABS enclosures are designed to be secured with self-tapping screws or screws with lock washers or locknuts. There are two keyhole mounting holes and four additional holes available for mounting. Airmar recommends using #8 screws. To avoid cracking the enclosure, **do not overtighten** the mounting screws.

Appendix D contains a *scaled* template that can be used for marking or drilling mounting holes. Be sure to print the template in "Actual Size."

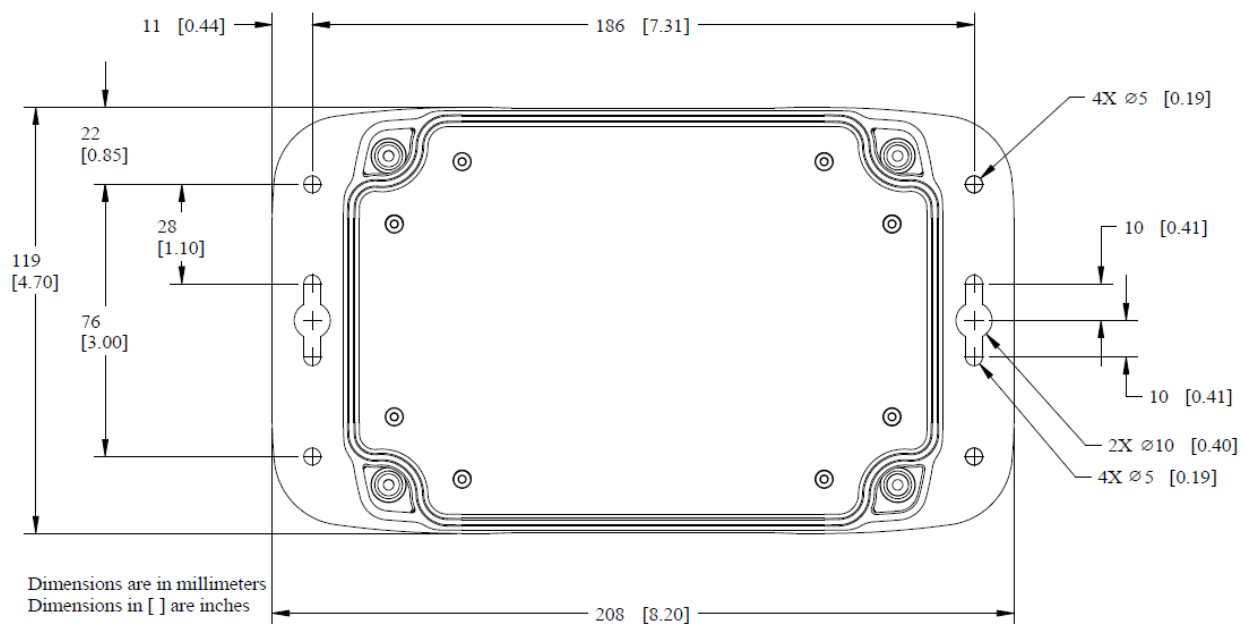


Figure 4-6 Module enclosure dimensions



Do not open the module enclosure. Breaking the seal may allow water and contaminants to enter the module. This will void the warranty.

4.8 Connecting devices

SmartBoat modules with device interfaces have pluggable terminal blocks for connecting switch, sensor, and transducer inputs and relay outputs. Connections are made to terminal pairs grouped into sections A, B, and C. Terminal-pair configurations are as shown in the following tables.

TERMINAL PAIR	THERMISTOR	THERMOCOUPLE	SWITCH	CURRENT LOOP	RESISTIVE	VOLTAGE	RUN DETECT	RELAY
A:1-2	✓	-	✓	✓	✓	-	-	-
A:3-4	✓	-	✓	✓	✓	-	-	-
A:5-6	✓	-	✓	✓	✓	-	-	-
A:7-8	✓	-	✓	✓	✓	-	-	-
B:1-2	✓	-	✓	✓	✓	-	-	-
B:3-4	✓	-	✓	✓	✓	-	-	-
B:5-6	✓	-	✓	✓	✓	-	-	-
B:7-8	✓	-	✓	✓	✓	-	-	-
C:1-2	-	✓	-	-	-	-	-	-
C:3-4	-	✓	-	-	-	-	-	-

Figure 4-7 ASM-XXX-T1 terminal-pair configurations

TERMINAL PAIR	THERMISTOR	THERMOCOUPLE	SWITCH	CURRENT LOOP	RESISTIVE	VOLTAGE	RUN DETECT	RELAY
A:1-2	-	-	-	-	-	-	-	✓
A:3-4	-	-	-	-	-	-	-	✓
A:5-6	-	-	-	-	-	-	-	✓
A:7-8	-	-	-	-	-	-	-	✓
B:1-2	✓	-	✓	-	✓	✓	-	-
B:3-4	✓	-	✓	-	✓	✓	-	-
B:5-6	✓	-	✓	-	✓	✓	-	-
B:7-8	✓	-	✓	-	✓	✓	-	-
C:1-2	-	-	-	-	-	-	✓	-
C:3-4	-	-	-	-	-	-	✓	-
C:5-6	-	-	-	-	-	-	✓	-
C:7-8	-	-	-	-	-	-	✓	-

Figure 4-8 ASM-XXX-T2 terminal-pair configurations

Polarity is to be observed on terminal pairs for specific input types. In all cases, the lower number of the terminal-pair designation is the positive connection (e.g., for B: 5-6, 5 is positive and 6 is negative).

DEVICE TYPE	POLARITY	COMMENT
Thermistor	None	-
Thermocouple	Yes	Thermocouples have color coded leads.
Switch	Yes	Series EOL resistor is positive. Install parallel EOL resistor across switch and before series EOL resistor
Current Loop	Yes	Type II: current into negative terminal Type III / IV: current into positive terminal
Resistive	None	-
Voltage	Yes	Positive to positive
Run Detect	Yes	If DC input, positive to positive AC: no polarity
Relay	None	-

Figure 4-9 Device polarity

After connecting and configuring your SmartBoat module, apply the included foam tape over the terminal screws to prevent water intrusion or corrosion.



There is substantial protection circuitry included in your SmartBoat module, but it is not possible to protect against every situation. Ensure your connections are correct before plugging the terminal blocks into their sockets.

5 Configuring Your SmartBoat Module

Every SmartBoat module incorporates a web server that may be used to configure and manage the module.

5.1 Connecting through the Wi-Fi access point

For the best experience, download and run the Airmar SmartFlex app. Scan the QR code on the module.

A new module, or one that has been reset to the factory configuration, is initially configured through the built-in Wi-Fi access point. Use the wireless settings on your electronic device to connect to the access point. It is identified by an SSID that looks something like ASM-XXX-YY-ABCDEFGH where XXX-YY indicates the module version and ABCDEFGH is the full serial number. For example, a model ASM-C-T1 module with a serial number of 55081F7E would advertise an SSID of ASM-C-T1-55081F7E.

Once connected, direct your browser to <http://192.168.2.1>, the default IP address of the module. You will see the Status screen and can continue with configuration. The Status screen for an unconfigured module is shown in the figure below.

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FE9BF74F Log Out

ASM-CES-T1

SmartBoat® Module Status

Module Information	
Serial Number	FE9BF74F
Hardware Version	ASM-CES-T1
Firmware Version	1.0.0
Running Time	0 Days : 0 Hours : 0 Minutes
Total Running Time	1262.8 Hours
USB Storage	2410MB available (61% free)
Installation Description	

Networking	
Access point	SSID: ASM-CES-T1-FE9BF74F, Enabled
Wifi status	Disabled
Ethernet	Connected, IPV4: 10.10.10.10

NMEA 2000	
Disabled	Not configured

Device configuration	
No devices configured	

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Figure 5-1 Status screen

5.2 Configuration steps

Airmar recommends using the Guided Setup screen to complete the initial configuration of your SmartBoat module, but it is not required.

Guided Setup is reached by clicking on the link in the sidebar of the Status screen.

ASM-CES-T1

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TECHNOLOGY CORPORATION

FE9BF74F Log Out

SmartBoat™ Module Guided Setup

Security Settings

☐ Set a username and password

☐ Set WiFi Access Point passphrase

Configure Devices and Sensors

☐ Set up attached devices and sensors

NMEA Network

☐ Set up NMEA network connections

WiFi/Ethernet Connections and Servers

☐ Connect to a WiFi network

☐ Connect other SmartBoat modules

Network Conversions

☐ Setup NMEA 0183

☒ Set up SAE J1939 connection **Not configured for J1939**

☒ Set up Digital Sensors **Not configured for Digital Sensors**

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Figure 5-2 Guided setup screen

Each of the configuration steps may be completed in any order. You may go back to modify each setting at any time. As each step is completed, the checkbox to the left of the step will be marked.

5.2.1 Security settings

Airmar strongly recommends activating the security settings of each SmartBoat module to control access to your devices and data.

5.2.1.1 Set a username and password

You may establish user accounts to control access to each module. Select "Add User" to create a new account.

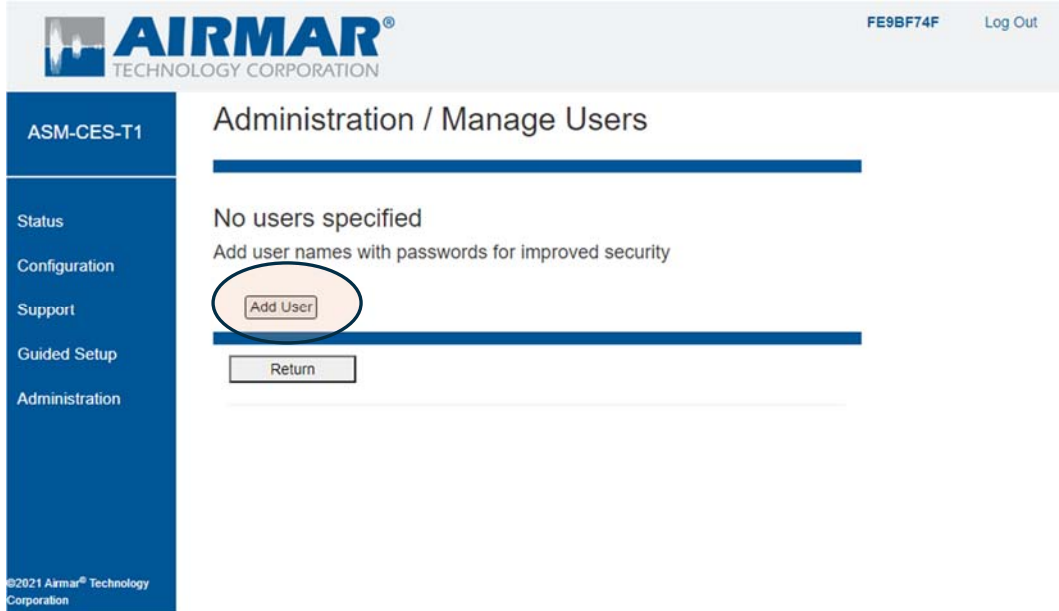


Figure 5-3 Setting the username and password

After entering the username and password, select if this user will have “Administration” access. There must be at least one administrator if user IDs are enabled for the module. Click on the “Update” button to save these settings.

Be sure to remember your username and password. If they are forgotten, you will need to reset your module to the factory configuration to obtain access.

Note that screen images throughout this manual represent the options available to administrators. Users without administrator access will be able to view status and settings but cannot make changes to the configuration of the module.

5.2.1.2 Set a Wi-Fi access point passphrase

Setting a WPA-2 security passphrase is strongly recommended. The Access Point Settings screen is shown below and includes other important settings.

The screenshot displays the Airmar Technology Corporation web interface for the ASM-CES-T1 module. The main heading is 'Wireless Configuration'. Below it, the 'Access Point Settings' section is highlighted. The settings include a 'Disabled' checkbox, a 'Timeout (mins)' field set to '0', an 'SSID' field with the value 'ASM-CES-T1-FE9BF74F', a 'WPA2 Passphrase' field, and an 'IPv4' field with the value '192.168.2.1'. At the bottom of the settings are 'Update' and 'Cancel' buttons. The top of the interface shows the Airmar logo, the module name 'ASM-CES-T1', and a 'Log Out' link.

Figure 5-4 Wi-Fi Access point settings screen

Access point Settings include the following:

- **Disabled:** Only check Disabled if you have already set up a Wi-Fi or wired Ethernet connection to another device and can use that connection to access this module. ***You may lose access to the configuration interface if the access point is disabled and there is no other connection.***
- **Timeout:** This is a security feature that allows configuration through the access point for a limited period of time. It also reduces the number of active Wi-Fi routers on the vessel during normal operation. The Timeout feature can be set to automatically turn OFF the module after a specified number of minutes following power-on. Setting this value to zero (default) will keep the access point active at all times.
- **SSID:** The default access point SSID is generated using the model name and serial number of the SmartBoat module. Changing the SSID may be helpful to identify the correct wireless connection from your electronic device when working with multiple units.
- **IPv4:** The IP address for each SmartBoat module access point must represent a unique subnet if it will be connected to another SmartBoat module access point. The default IP address is 192.168.2.1. Airmar recommends selecting addresses such as 192.168.xxx.1 using a unique number for xxx in the range 1 to 250. Refer to Section 10.0 for additional information about TCP/IP connectivity.

Click on the “Update” button when all settings are complete. If you are connected wirelessly, you will need to reconnect after the module resets.

5.2.2 Configure devices

SmartBoat models with a “-Tx” suffix may be configured to support a range of devices. Each device is connected through a pluggable terminal block to a terminal pair and is configured through the web interface. See section 3 for information on connection devices.

5.2.2.1 Device Configuration screen

The Device Configuration screen shows the current function assigned to each terminal pair. Users can change the function and configure the device. For a new SmartBoat module or one that has been reset to the factory default configuration, all device functions are initially *disabled*. To configure a device, use the Selected Function dropdown menu to choose the desired operation. Click on “Configure Device.”

Only the functions supported by a particular terminal pair are available in the dropdown menu.

If you wish to make changes to a previously configured device, click on “Configure Device.” Select “No Change” as the device function.

The figure below shows a typical device configuration screen for a SmartBoat ASM-CES-T1 module. The available terminal pairs and functions will depend upon the model of the module you are configuring.

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FE9BF74F Log Out

ASM-CES-T1

Configuration / Devices

Terminals A: 1-2

Selected Function

Terminals A: 3-4

Selected Function

Terminals A: 5-6

Selected Function

Terminals A: 7-8

Selected Function

Terminals B: 1-2

Selected Function

Terminals B: 3-4

Selected Function

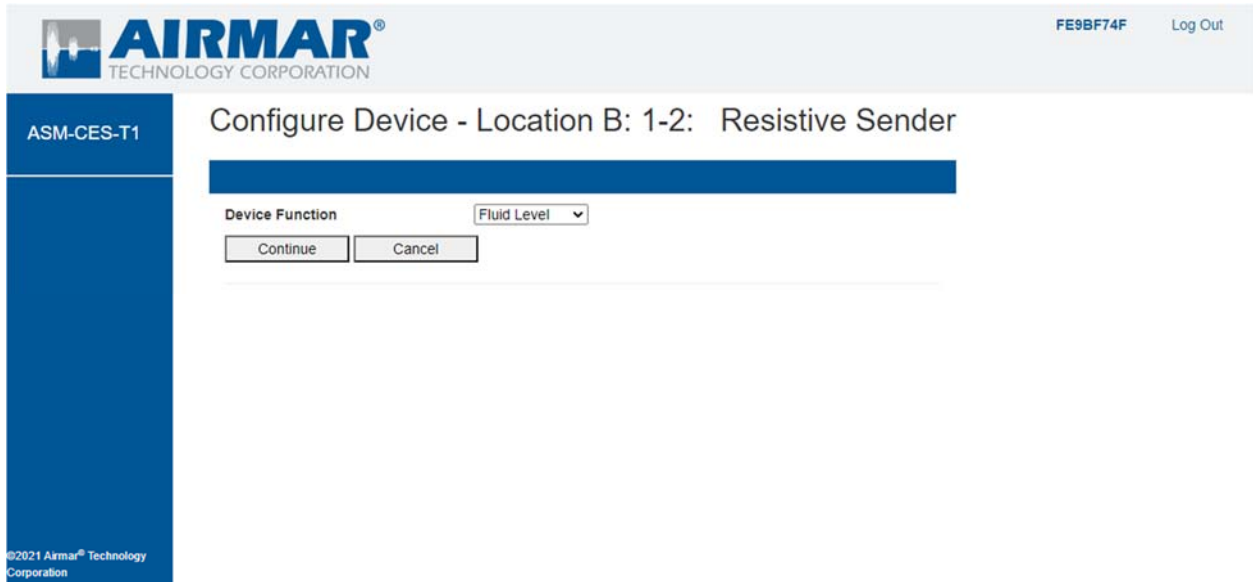
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Figure 5-5 Typical device configuration screen

5.2.2.2 Detailed configuration options

The configuration options available for each terminal pair depend upon the device type. A device description field is provided as an installer convenience, and pre-populated with the device type. All other configuration options are specific to the device being configured.

As an example, if "Resistive Sender" is selected on the Device Configuration screen, the next step would be to specify the intended function of the sender.



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ASM-CES-T1

Configure Device - Location B: 1-2: Resistive Sender

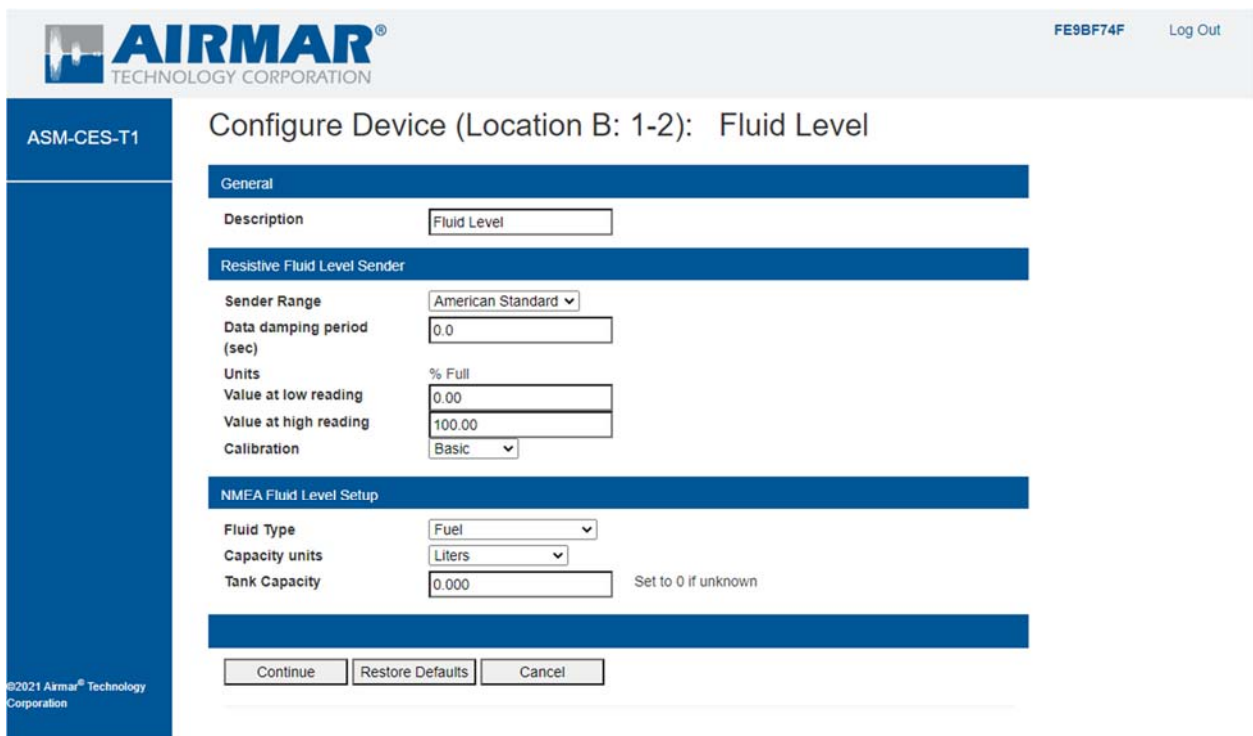
Device Function Fluid Level ▼

Continue Cancel

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Figure 5-6 Example: Resistive sender configuration

Continuing this example, if the resistive sender input is to be configured to measure fluid level, the next screen would show the available configuration options for that function.



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ASM-CES-T1

Configure Device (Location B: 1-2): Fluid Level

General

Description Fluid Level

Resistive Fluid Level Sender

Sender Range American Standard ▼

Data damping period (sec) 0.0

Units % Full

Value at low reading 0.00

Value at high reading 100.00

Calibration Basic ▼

NMEA Fluid Level Setup

Fluid Type Fuel ▼

Capacity units Liters ▼

Tank Capacity 0.000 Set to 0 if unknown

Continue Restore Defaults Cancel

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Figure 5-7 Example: Fluid level measurement function

These settings include the following:

- **Description:** This field is pre-populated with a generic description of the device function but can be customized as a memory aid for future maintenance. This field is only used in the SmartBoat module interface.
- **Sender range:** The resistance range of the sender is selected from the dropdown menu.
 - **US Standard:** 240 to 30 Ohms
 - **European Standard:** 10 to 180 Ohms
 - **Custom range:** Enter custom values in the provided fields.
- **Data damping period:** The values read, may be “smoothed” by averaging multiple readings. Enter the period of time in seconds for averaging, or zero to disable damping.
- **Calibration:** Select “Basic” or “Advanced” calibration. These features are described in section 5.2.2.3.
- **Other fields:** Other configuration values are unique to the function of the device. In the example shown, this includes the fluid type and the capacity of the tank being measured. These values are used to either adjust the measurement being performed or to complete the required fields for NMEA 2000 messages.

5.2.2.3 Device calibration

Resistive Sender and Current Loop devices support optional calibration settings.

5.2.2.3.1 Basic calibration


Basic calibration is the default for supported sensors and transducers. This is set initially to the full range of the device but may be adjusted to match the actual performance. The operation of the device is assumed to be linear within the specified range.

5.2.2.3.2 Advanced calibration

Advanced calibration may be enabled for sensors and transducers that do not operate linearly. For example, a fuel tank may be shaped in a way that causes the device readings to change less rapidly as the fluid level drops.

A maximum of ten calibration entries may be used. For each entry, you must provide the reading and the corresponding value at that reading.

A typical Advanced Calibration screen is shown below.



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FE9BF74F Log Out

ASM-CES-T1

Advanced Calibration (Location B: 1-2): Fluid Level

Sensor Range

Minimum Value: 0.00 %
 Maximum Value: 100.00 %

Calibration Entries

Entry	Reading (%)	Value (%)	
1	0.00	0.00	Delete
2	100.00	100.00	Delete
3			Delete
4			Delete
5			Delete
6			Delete
7			Delete
8			Delete
9			Delete
10			Delete

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Figure 5-8 Example: Advanced calibration

5.2.2.4 NMEA 2000 PGN configuration

The final Device Configuration screen is used to specify the NMEA 2000 PGNs that will be generated for the device function. In the example shown below, the only PGN available is 127505. Other functions such as Temperature Measurement may generate several different PGN messages.

ASM-CES-T1

Configure Device (Location B: 1-2): Fluid Level

General

Device is Active ☒

Fluid level instance

NMEA 2000 PGNs

Fluid Level

PGN 127505

PGN Send interval (sec)

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Figure 5-9 Example: Fluid level PGN configuration

The “Device is Active” checkbox must be checked to generate PGN messages. Other settings include the following:


- **Fluid level instance:** The instance value to be used in the PGN.
- **PGN send interval:** How often to send the PGN. This field is prepopulated with the default value specified in the NMEA 2000 standard.

5.2.2.5 Completing configuration

You may continue configuring additional devices or return to this step to complete configuration at any time. *Note that it is possible to choose settings for devices that cause PGN message conflicts.* The SmartBoat module will identify these conflicts and display a warning message on the device configuration screen.

Figure 5-10 shows an example of these messages when two devices are configured to use the same switch position for the selected NMEA 2000 PGN.

Simply return to the PGN Configuration screen of the devices to select an alternate value to resolve the conflict.



FE9BF74F Log Out

ASM-CES-T1

Status

Configuration

View Devices

Support

Guided Setup

Administration

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Configuration / Devices

Terminals A: 1-2

Current Function	Current Loop Sensor	Fluid Level
Status	Active PGNs: 127505 Instance: 0	Current value: 0.0 % No Errors

Selected Function No Change
Configure Device
PGN Conflicts A: 3-4 (127505)

Terminals A: 3-4

Current Function	Resistive Sender	Fluid Level
Status	Active PGNs: 127505 Instance: 0	Current value: 0.0 % No Errors

Selected Function No Change
Configure Device
PGN Conflicts A: 1-2 (127505)

Terminals A: 5-6

Selected Function Disabled
Configure Device

Terminals A: 7-8

Selected Function Disabled
Configure Device

Terminals B: 1-2

Selected Function Disabled

Figure 5-10 Example: PGN conflict notice

5.2.3 Set up NMEA network connections

- **Enable NMEA network:** Until this box is checked, the SmartBoat module will *not* communicate on the NMEA 2000 bus. The network must be enabled after completing configuration.
- **Secondary CAN bus function:** For modules that support a second physical NMEA 2000 bus, you may configure in one of three ways.
 - for NMEA 2000 PGNs as a secondary bus
 - as an SAE J1939 bus for gateway operation
 - to attach SmartFlex digital sensors, such as fuel flow meters
- **Bus termination:** Each SmartBoat module has built-in NMEA 2000 bus termination resistors (120 Ω) that may be activated by selecting the checkbox for each bus.
- **Product information:** The system instance, device instance, and installation description fields may be completed for each SmartBoat module. If multiple modules are used on the same network, it is important to provide a unique instance number for each module. Both the NMEA device instance and system instance may be changed through this setting or through NMEA system PGN 126208 using another NMEA device. The installation description fields are optional.
- **Extend NMEA network:** SmartBoat modules implement TCP/UDP servers to provide access to NMEA 2000 data over Wi-Fi/Ethernet. SmartBoat modules that are connected by Wi-Fi/Ethernet can use that network to bridge NMEA 2000 message traffic.
- **NMEA 2000 bus logging:** A log of recent NMEA 2000 message traffic is maintained and may be downloaded. SmartBoat modules with USB ports may also log bus activity to a formatted USB memory device.

The SmartBoat module will not begin processing NMEA messages until “Enable NMEA Network” has been selected and the configuration saved.

The links available in the sidebar of each top-level screen are determined by some of these configuration options. For example, the View Network link is not available until the NMEA network is enabled. In addition, the J1939 options are only available if the secondary bus function has been set to J1939.



Internal termination resistors must only be used after careful consideration of the implications for the network if the SmartBoat module is removed from the bus. The use of internal termination is not recommended by NMEA.

The NMEA 2000 Network Configuration screen is shown below.

The screenshot displays the 'Configuration / NMEA 2000' screen for the ASM-CES-T1 module. The header includes the AIRMAR TECHNOLOGY CORPORATION logo and the user ID 'FE9BF74F' with a 'Log Out' link. The left sidebar shows 'ASM-CES-T1' and a copyright notice for 2021 Airmar Technology Corporation.

The main configuration area is divided into several sections:

- Enable NMEA network:** A checkbox is currently unchecked. A red note states 'Select after configuration is complete'.
- Secondary CAN bus function:** A dropdown menu is set to 'Disabled'.
- NMEA 2000 bus termination:**
 - Primary bus termination: Unchecked checkbox.
 - Secondary bus termination: Unchecked checkbox.
- Product Information:**
 - Model serial code: FE9BF74F
 - Product code: 8302
 - Model ID: ASM-CES-T1
 - System instance: Input field with '0'.
 - Device instance: Input field with '0'.
 - Installation description: Two empty text input fields.
- Extend NMEA Network:**
 - Enable ethernet servers: Checked checkbox.
 - Current Connection: Disabled.
 - Select server: Dropdown menu set to 'Disabled'.
 - A 'Server ports' button is visible.
- NMEA 2000 Bus Logging:**
 - Log primary bus to USB storage: Unchecked checkbox.
 - Log bridged bus to USB storage: Unchecked checkbox.

At the bottom, there are 'Save changes' and 'Cancel' buttons.

Figure 5-11 NMEA network configuration screen



The NMEA network must be “enabled” with the checkbox at the top of the configuration screen to activate some SmartBoat module functions.

An advanced SmartBoat module can save NMEA 2000 traffic logs to a USB storage device. This is enabled or disabled using the checkbox in the NMEA 2000 bus logging section. When a compatible USB storage device is attached, the Status screen will show the utilization and available storage space as shown in the figure below.

AIRMAR® TECHNOLOGY CORPORATION FE9BF74F Log Out

ASM-CES-T1

SmartBoat® Module Status

Module Information	
Serial Number	FE9BF74F
Hardware Version	ASM-CES-T1
Firmware Version	1.0.0
Running Time	0 Days : 0 Hours : 9 Minutes
Total Running Time	1262.9 Hours
USB Storage	2410MB available (61% free)
Installation Description	

Networking	
Access point	SSID: ASM-CES-T1-FE9BF74F, Enabled
Wifi status	Disconnected

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Figure 5-12 USB Storage status

NMEA 2000 log data is stored to a directory named N2Klogs, which will be created on the USB drive if necessary. A separate subdirectory is used for the primary and secondary (bridge) bus traffic. Each time the SmartBoat device is powered ON it will begin a new log file with the traffic in that section. Log files will be named xxx.N2K, with xxx indicating the sequence number for that section.

You may also download an abbreviated log of traffic in the most recent session by clicking on the “Save Current” button. The file will be downloaded to your connected device. This option is only available when the NMEA network is enabled.

5.2.4 Wi-Fi/Ethernet connections and servers

The following steps are optional and apply if you wish to connect the SmartBoat module to a Wi-Fi network or extend the NMEA 2000 network to other SmartBoat modules wirelessly.

5.2.4.1 Connect to another Wi-Fi network or access point

The Wireless Configuration screen may take a few seconds to load as the SmartBoat module scans for available wireless connections. Choose the desired access point from the SSID dropdown menu. Enter the WEP/WPA passphrase if it is a secured network. After clicking on “Update” you may need to reconnect to the SmartBoat module to continue configuration.

The following figure shows the Wireless Configuration screen after a wireless connection has been established using the access-point feature of another SmartBoat module.

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FE9BF74F Log Out

ASM-CES-T1

WiFi/Ethernet / WiFi Network

Current Wireless Network	
Network Status	Connected
SSID	ASM-CES-74C08C64
IP Address	192.168.2.108
Link Quality	70/70
Signal level	-39 dBm

Change Wireless Network	
SSID	Disabled ▼
WEP/WPA passphrase	<input type="text"/>
<input type="button" value="Update"/>	

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Figure 5-13 Wireless configuration

This screen can also be used to check the IP address assigned to the SmartBoat module and see the quality of the connection.

5.2.4.2 Wired Ethernet configuration (advanced SmartBoat module only)

An advanced SmartBoat module may be connected to a wired Ethernet network. This can be helpful in situations requiring high bandwidth or when the installation makes wireless connectivity difficult. In most cases, it is simply a matter of plugging a Category 5E or better cable from the router/switch into the Ethernet port of the module. If there is a good connection established with a router that supports DHCP, the Wired Ethernet Configuration screen will be similar to what is shown in the figure below.

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FE9BF74F Log Out

ASM-CES-T1

WiFi/Ethernet / Ethernet

Ethernet Status

Network Status	Connected
IP Address	10.10.10.10
Link Speed	1000 Mbps

Ethernet Configuration

Static IP ☐

Update

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Figure 5-14 Wired ethernet configuration

If you do not wish to use DHCP for address assignment, or if there is no DHCP server on the wired network, the SmartBoat module supports the use of a fixed static IP address. Select the “Static IP” checkbox. Figure 5-15 shows the fields available for static IP configuration.

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FE9BF74F Log Out

ASM-CES-T1

WiFi/Ethernet / Ethernet

Ethernet Status

Network Status	Connected
IP Address	10.10.10.10
Link Speed	1000 Mbps

Ethernet Configuration

Static IP ☒

IPv4

Netmask

Gateway

DNS server 1

DNS server 2

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Figure 5-15 Wired ethernet configuration with static IP address

The key fields for configuring a static IP address are the address for the module and the gateway address. The DNS server addresses are pre-populated with public DNS servers but may be changed.

5.2.4.3 Connect other SmartBoat modules by Wi-Fi or Ethernet

SmartBoat modules that are connected to a wired or wireless Ethernet network can extend the NMEA network across that interface. Each module “advertises” its presence on available networks so that it may be discovered by other SmartBoat modules. This means that a module can connect to another without knowing the IP address or any information other than the serial number.

As described in Section 6.0, connected SmartBoat modules share traffic on the secondary NMEA 2000 bus (either virtual or physical).

There are several configuration options for this feature.

- **Extend NMEA network:** Ethernet servers are implemented to support distribution and bridging of NMEA 2000 messages.

- **Enable Ethernet servers:** This box must be checked to enable Wi-Fi/Ethernet bridging and remote access. Several types of TCP and UDP servers are supported. Selecting this option will enable all TCP servers.
- **Server ports:** The TCP/UDP port used for each server type may be specified in case of network conflicts. Figure 5-16 shows the TCP and UDP Server Ports configuration screen. There is usually no need to change the default settings. TCP servers do not use network bandwidth unless there is an active client connection. In contrast, UDP servers “broadcast” messages whether there is an active listening client or not, and so it is recommended that only servers that will be used are enabled.
- **Select server:** Each SmartBoat module uses network discovery to establish connections for NMEA 2000 network extension. In this dropdown menu, you can select from a list of available SmartBoat modules for Wi-Fi/Ethernet bridging. The *Current Connection* field shows the status of the currently selected module.

Configuration / NMEA Network / Server Ports

IPv4 Server Type	TCP Port	UDP Port / Broadcast
NMEA 0183	10110	10110 <input type="checkbox"/>
Raw CAN	10120	10120 <input type="checkbox"/>
ASCII Format CAN	10121	10121 <input type="checkbox"/>
SmartFlex Log	10130	10130 <input type="checkbox"/>

Update Cancel

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Figure 5-16 Wi-Fi/Ethernet server-port configuration

6 SmartBoat Module Operation

When the SmartBoat module has been fully configured, several screens may be used to review the status of the module and your NMEA network.

6.1 Status screen

The Status screen is the “home page” for the SmartBoat module configuration interface. It provides an overview of the operation of the module. An example Status screen is shown below.

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FE9BF74F Log Out

ASM-CES-T1

SmartBoat® Module Status

20 NOV 2021
15:44 UTC

Module Information		
Serial Number	FE9BF74F	
Hardware Version	ASM-CES-T1	
Firmware Version	1.0.0	
Running Time	0 Days : 0 Hours : 22 Minutes	
Total Running Time	1263.2 Hours	
USB Storage	2410MB available (61% free)	
Installation Description		

Networking		
Access point	SSID: ASM-CES-T1-FE9BF74F, Enabled	
Wifi status	Disabled	
Ethernet	Connected, IPV4: address not available	

NMEA 2000		
Primary network	NMEA 2000	
Secondary network	Enabled: NMEA 2000	
Ethernet server	Enabled	
Ethernet extension	Disabled	
Active NMEA sources	Direct: 4, Bridged: 2	

Device configuration		
A: 1-2	Switch Input	Active PGNs: 127501, 127502
A: 3-4	Thermistor	Active PGNs: 130316
B: 1-2	Fluid Level	Active PGNs: 127505
C: 1-2	Thermocouple	Active PGNs: 130316

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Figure 6-1 Status screen

The Status screen shows the following:

- **Device information**
 - **Serial number:** A unique 8-character hexadecimal serial number.
 - **Hardware version:** The model number.
 - **Firmware version:** The current version of the operating firmware.
 - **Running time:** The elapsed time since the module was last restarted.
 - **USB storage:** For advanced SmartBoat modules, the used and available memory space.
- **Networking**
 - **Access point:** The SSID of this module and the current status.
 - **Wi-Fi status:** Connection status to a Wi-Fi access point.
 - **Ethernet:** Connection status over wired Ethernet.
- **NMEA 2000**
 - **Primary network:** The status of the primary NMEA 2000 bus.
 - **Secondary network:** For an advanced SmartBoat module, the status of the secondary bus. This may be configured for either NMEA 2000 or SAE J1939 message traffic.
 - **Ethernet server:** The status of the embedded TCP/IP servers.
 - **Ethernet extension:** Connection status to other SmartBoat modules for bridging NMEA 2000 traffic over TCP/IP.
 - **Active NMEA sources:** Status of any devices connected either directly over the NMEA 2000 bus or through the TCP/IP servers.
- **Device configuration:** Displays the current status of each configured SmartBoat device.

6.2 Viewing connected devices

The View Devices screen is reached by clicking on the link in the sidebar of the Status screen. From this screen, you can see the current values for each configured device.

The following figure shows a typical display on an ASM-CES-T1 module with three configured devices.

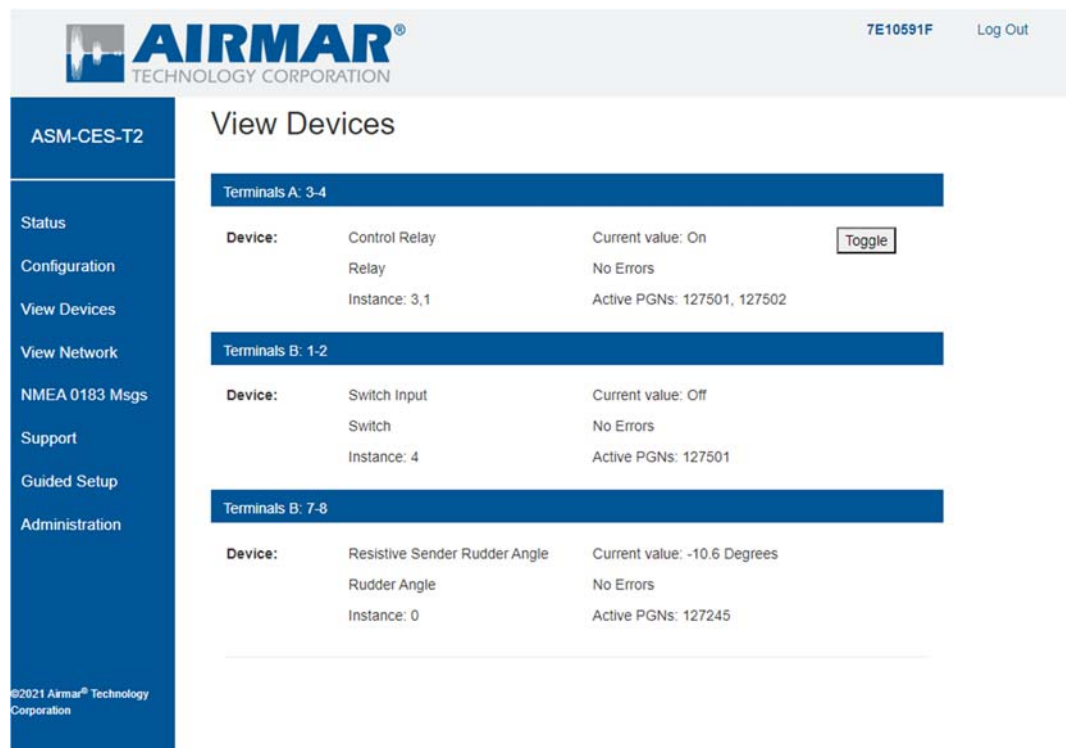


Figure 6-2 Typical device status display

On the Device Status screen, the units for each measured value match what was specified when the device was configured. You can also see the active PGNs that will be sent and the PGN instance numbers.

For Relay devices, you may manually change the relay state by clicking on the "Toggle" button to the right.

This screen helps to ensure that each device has been properly configured and connected to the correct terminal pair. It is important to verify that the Current value is accurate and that there are no detected errors. Figure 6-3 shows an example of detected errors.

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7E10591F Log Out

ASM-CES-T2

View Devices

Terminals A: 3-4

Device:	Control Relay	Current value: Off	<input type="button" value="Toggle"/>
	Relay	No Errors	
	Instance: 3,1	Active PGNs: 127501, 127502	

Terminals B: 1-2

Device:	Switch Input	Current value: Undetermined
	Switch	Line-open fault
	Instance: 4	Active PGNs: 127501

Terminals B: 7-8

Device:	Resistive Sender Rudder Angle	Current value: 45.0 Degrees
	Rudder Angle	Under range
	Instance: 0	Active PGNs: 127245

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Figure 6-3 Device status with errors

In this example:

- The binary-switch input on terminals B:1-2 has been configured for a single end-of-line resistor and a line-open fault has been detected.
- The resistive sender on terminals B:7-8 has been configured to the US standard but is currently less than 30 Ohms.

Any device in a detected error state will result in NMEA 2000 PGN messages not being generated. Check the connected device.

6.3 Viewing NMEA 2000 network information

The SmartFlex network view feature provides a summary of NMEA 2000 bus activity. The View Network link is selected from the sidebar and is only available when the NMEA 2000 bus has been enabled. The figure below shows an example of the NMEA Network information screen for a module with six other devices, three on the primary NMEA 2000 bus and three on the secondary NMEA 2000 bus.

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FE9BF74F Log Out

ASM-CES-T1

View Network

NMEA 2000 Devices - Primary bus

Source	Model ID	Unique#	SW Version	Model Version
7	ASM-CES-T2	22815	1.0.0	7E10591F
8	ASM-CES	35940	1.0.0	74C08C84
9	ASM-CES-T1	784207	1.0.0	FE9BF74F
35	W7 Series Weather Station	57418	2.005.2.301.2.00	44-854-1-01,HW11.13,OEM0

NMEA 2000 Devices - Remote or Secondary bus

Source	Model ID	Unique#	SW Version	Model Version
7	ASM-CES-T1	556897	1.0.0	91167F61
17	ASM-CES-T1	784207	1.0.0	FE9BF74F

NMEA 2000 PGN Messages - Primary bus

PGN (Instance)	Source : Dest	Category / Description	Interval
127245	7	Steering / Rudder	0.10 sec
127250	35	Steering / Vessel Heading	0.10 sec
127251	35	Steering / Rate of Turn	0.10 sec
127252	35	Steering / Shift/Rate	1.00 sec

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Figure 6-4 NMEA network information



This example uses an advanced SmartBoat module with an active secondary physical NMEA 2000 bus. A SmartBoat module without a second physical bus available and configured will have a “virtual” secondary bus.

For each active device detected on the bus, the following information is displayed:

- **Source:** The NMEA 2000 source address used by the device. This is a unique value on each bus.
- **Model ID:** The value reported by the device.
- **Unique #:** The value reported by the device.
- **Software version:** The version reported by the device.
- **Model version:** The value reported by the device.

The SmartBoat module appears on the list for each bus because it operates as an active device on each bus. The two entries may have the same or different source address, according to the results of the NMEA 2000 address claiming process. The entries for the SmartBoat module we are working with are highlighted in Figure 6-4.

Below the device sections is a list of the active PGNS observed on each bus. For each PGN, the following information is displayed:

- **PGN (Instance):** The NMEA 2000 PGN number along with up to three values used along with the source to identify each unique PGN. The most common of these values is the PGN instance number.

- **Source:Dest:** The source address of the sending device and the destination address for the device intended to receive the PGN. If the PGN is "broadcast" on the bus, then no destination address is shown.
- **Category/Description:** The general category and description of the PGN as specified by NMEA.
- **Interval:** The average time between sequential PGNs. If this field is blank, then the PGN has not been observed frequently enough to calculate the interval.

The instance values are used to differentiate between messages with the same PGN number. For some PGNs, this is not needed, and the source address is sufficient.

Appendix C describes the identifying values used for each PGN. In the highlighted example shown below, PGN 130316 (Temperature, Extended Range) shows (3, 14) for the instance values. As described in Appendix B, the instance number is "3", and the Temperature Source is "14" which corresponds to Exhaust Gas Temperature.


 FE9BF74F Log Out				
ASM-CES-T1 Status Configuration View Devices View Network Support Guided Setup Administration	NMEA 2000 PGN Messages - Primary bus			
	PGN (Instance)	Source : Dest	Category / Description	Interval
	127245	7	Steering / Rudder	0.10 sec
	127250	35	Steering / Vessel Heading	0.10 sec
	127251	35	Steering / Rate of Turn	0.10 sec
	127257	35	Steering / Attitude	1.00 sec
	127258	35	Steering / Magnetic Variation	1.00 sec
	127501 (3)	7	Power / Binary Switch Bank Status	0.50 sec
	127501 (3)	9	Power / Binary Switch Bank Status	0.50 sec
	127501 (4)	7	Power / Binary Switch Bank Status	0.50 sec
	127502 (3)	7	Power / Switch Bank Control	46.11 sec
	127505 (0)	9	Power / Fluid Level	2.50 sec
	129025	35	Navigation / Position, Rapid Update	0.20 sec
	129026	35	Navigation / COG & SOG, Rapid Update	0.20 sec
	129029	35	Navigation / GNSS Position Data	1.00 sec
	129033	35	Navigation / Time & Date	1.00 sec
	129044	35	Navigation / Datum	6.67 sec
	129539	35	Navigation / GNSS DOPs	1.00 sec
	129540	35	Navigation / GNSS Sets in View	1.00 sec
	130306	35	Environmental / Wind Data	0.25 sec
	130311 (193)	35	Environmental / Environmental Parameters	0.50 sec
	130312 (0,1)	35	Environmental / Temperature	2.00 sec
	130314 (0,0)	35	Environmental / Actual Pressure	2.00 sec
	130316 (0,0)	9	Environmental / Temperature, Extended Range	2.00 sec
	130316 (3,14)	9	Environmental / Temperature, Extended Range	2.00 sec
	130323	35	Environmental / Meteorological Station Data	1.00 sec
	130945	35	Fast-Packet / Proprietary	
	NMEA 2000 PGN Messages - Remote or Secondary bus			
	PGN (Instance)	Source : Dest	Category / Description	Interval

Figure 6-5 NMEA 2000 PGN message

There are several options at the bottom of the NMEA network information screen for specifying which PGNs will be included.

- **Show PGNs for this device:** Include any PGNs generated by this SmartBoat module. The default for this setting is *enabled*.
- **Show PGNs bridged by this device:** Include PGNs that originate from one of the NMEA 2000 buses and are bridged by this SmartBoat module to the other bus. The default for this setting is *disabled*.
Note that any bridged PGNs will appear in each bus listing.
- **Show general/mandatory PGNs received:** By default, PGNs that fall in the general/mandatory category as defined by NMEA will *not* be shown. Checking this box will include PGNs in this category.
- **Show PGN message data:** Show all data values contained in the PGN message in hexadecimal format. The default for this setting is *disabled*.

After making any changes to these settings, you must click "Apply" for the display to be updated.

There is also a button labeled "Reset List" at the bottom of the screen. Clicking this button will cause the list of devices and PGNs to be cleared. This may be helpful if you have made network configuration changes and want to only see current data. All interval values will be recalculated.

Use these preference settings to customize the display of NMEA 2000 devices and messages.

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ASM-CES-T2

PGN (Instance)	Source : Dest	Category / Description	Interval
130312	(0,1)	35 Environmental / Temperature	2.00 sec
130314	(0,0)	35 Environmental / Actual Pressure	2.00 sec
130316	(0,0)	9 Environmental / Temperature, Extended Range	2.00 sec
130316	(3,14)	9 Environmental / Temperature, Extended Range	2.00 sec
130323		35 Environmental / Meteorological Station Data	1.00 sec

NMEA 2000 PGN Messages - Remote or Secondary bus

PGN (Instance)	Source : Dest	Category / Description	Interval
----------------	---------------	------------------------	----------

Display options

- Show PGNs for this device ☒
- Highlight matching instances ☐
- Show PGNs bridged by this device ☐
- Show general / mandatory PGNs received ☐
- Show PGN message data ☐

Apply Reset list

Figure 6-6 NMEA network information display options

Selecting “Highlight matching instances” will indicate potential bus conflicts caused by instancing issues. Identical instances of the same PGN message sent from different devices on the NMEA 2000 bus are not conflicts but may not be interpreted properly by all NMEA 2000 devices and are highlighted in yellow. If identical instances of a single PGN are sent by the same device, results may be unpredictable. In this case, the PGNs are highlighted in red. This situation may be the result of bus bridging, and the SmartFlex filter feature described in Section 7 should be used to resolve the conflict.

The following figure shows the same example as above but with the “Show PGNs bridged by this device” option selected.

AIRMAR® TECHNOLOGY CORPORATION 7E10591F Log Out

Device	PGN	Source	Description	Rate
ASM-CES-T2	129033	17 [35]	Navigation / Time & Date	1.00 sec
	129044	17 [35]	Navigation / Datum	
	129539	17 [35]	Navigation / GNSS DOPs	1.00 sec
	129540	17 [35]	Navigation / GNSS Sats in View	1.00 sec
	130306	17 [35]	Environmental / Wind Data	0.25 sec
	130311 (193)	17 [35]	Environmental / Environmental Parameters	0.50 sec
	130312 (0,0)	17 [35]	Environmental / Temperature	2.00 sec
	130314 (0,0)	17 [35]	Environmental / Actual Pressure	2.00 sec
	130316 (0,0)	17 [9]	Environmental / Temperature, Extended Range	2.00 sec
	130316 (3,14)	17 [9]	Environmental / Temperature, Extended Range	2.00 sec
Support	130323	17 [35]	Environmental / Meteorological Station Data	1.00 sec
	130945	17 [35]	Fast-Packet / Proprietary	

Display options

- Show PGNs for this device ☒
- Highlight matching instances ☐
- Show PGNs bridged by this device ☒
- Show general / mandatory PGNs received ☐
- Show PGN message data ☐

Apply Reset list

Figure 6-7 Bridged PGNs

In this example, you can see that PGN 130311 on the primary NMEA 2000 bus is being bridged to the secondary bus.

In the source field for the bridged PGNs, there is additional information shown in brackets. For PGN 130311 on the secondary bus (highlighted above) the source is shown as 17 [35]. This indicates that while the PGN is being sent from source 17 (the SmartBoat module address on the secondary bus), it originated from source 35 on the other bus and is being bridged.

If the value shown in brackets is [R], then the PGN originated from a remote SmartBoat module and was bridged through the TCP/IP server.

The general/mandatory PGNs are used for NMEA 2000 network management and are never bridged from one network to another. Some of these messages such as PGN 60928 are required for all NMEA 2000 devices. Others, such as 126998 (configuration information) are used by devices such as a SmartBoat module to gather information from other devices. There is an option to enable display of these messages.

The "Show PGN message data" option is generally only used for network debugging and requires knowledge of the NMEA 2000 message data formats.

If you wish to view the details of a PGN, the view network feature can decode most NMEA 2000 messages. In the sidebar, click on the "View Network" link to see the NMEA network information screen. If the PGN number is in a green box, clicking on the box will display a window with the PGN field values as shown in Figure 6-8.

NMEA 2000 PGN Detail: 129029
GNSS Position Data
Source: 35 Destination: Broadcast

01	SID	148
02	Date	2021-05-16
03	Time	13:35:58
04	Latitude	40.6336°N
05	Longitude	-79.6894°W
06	Altitude	315.800000
07	GNSS type	3 (GPS+SBAS/WAAS)
08	Method	1 (GNSS fix)
09	Integrity	0 (No integrity checking)
10	Reserved	---
11	Number of SVs	7
12	HDOP	1.10
13	PDOP	2.00
14	Geoidal Separation	-33.30
15	Reference Stations	---
16	Reference Station type	---
17	Reference Station ID	15
18	Age of DGNS Corrections	0.00

Close

Figure 6-8 PGN message details

For this example, PGN 129029 and GNSS Position Data were selected. The window displays the various PGN message fields and their values. A field with no data available is indicated with "---" as shown above.

7 NMEA 2000 Network Bridging and Filtering

All SmartBoat modules implement a common system for bridging between networks. They control the flow of NMEA 2000 messages across the bridging interface. This section describes the key features of this implementation.

It is helpful to understand some of the key terms used to describe SmartBoat module NMEA 2000 network bridging and filtering features.

- **Primary NMEA 2000 bus:** This is always a physical NMEA 2000 bus for PGN traffic.
- **Secondary NMEA 2000 bus:** This operates as a *virtual bus*.
- **Bus connection:** Each function is connected to *only one* NMEA 2000 bus.

For an advanced SmartBoat module, you may configure the second hardware NMEA 2000 bus to carry the secondary bus PGN traffic.

- **Connected to the primary NMEA 2000 bus are the following:**
 - Any external devices attached to the physical bus.
 - Any internal SmartBoat module devices configured to one of the terminal pairs.
 - NMEA 0183 gateway function. PGNs on the primary bus may be mapped to NMEA 0183 sentences and received NMEA 0183 sentences send the resulting PGNs on the primary bus.
 - The bridge to the secondary bus.
- **Connected to the secondary NMEA 2000 bus are the following:**
 - Any external devices attached to the second physical bus when a second physical bus is available and configured.
 - Wi-Fi / Ethernet TCP / IP servers.
 - Bus extension client used to connect to another SmartBoat module.
 - SAE J1939 gateway function, if configured for this operation. PGNs generated by the J1939 gateway are sent on the secondary bus.
 - The bridge to the primary bus.

The figure below shows how various SmartBoat module functions are connected to each other.



Figure 7-1 SmartBoat module block diagram

7.1 Bridging operations

The term *bridging* is used to describe when a PGN received or generated by one SmartBoat module function is then provided to a different SmartBoat module function. The configuration of each function controls what PGNs will be generated or processed by that function.

When a PGN is bridged from one function to another or from one SmartBoat module to another, it always appears to the receiving device as if it originated from the bridged device. For this reason, NMEA 2000 general/mandatory PGNs for functions such as address claiming are never bridged.

When Wi-Fi/Ethernet bridging is used between two or more SmartBoat modules, the result is functionally as if the secondary NMEA 2000 buses are directly connected. For this reason, each implementation must be configured so there is only a **single connection** between modules. If two SmartBoat modules are connected on the same physical NMEA 2000 bus, they must *not* also be connected wirelessly.

Figure 7-2 illustrates the connection of two physical NMEA 2000 buses. The SmartBoat module labeled B must be an advanced SmartBoat module with secondary NMEA 2000 bus support.

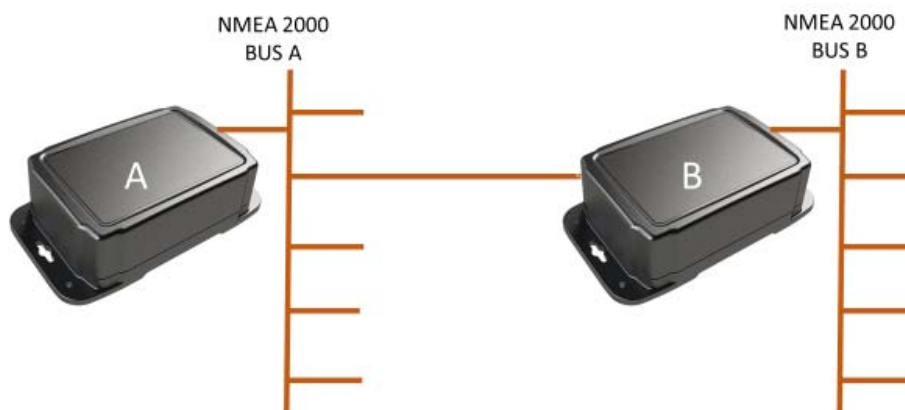


Figure 7-1 Physically bridging NMEA 2000 buses

In this example, both module A and module B are active on NMEA 2000 bus A. Only module B is active on the NMEA 2000 bus B. Module B is bridging NMEA 2000 PGNs between the two buses.



SmartBoat modules must not be connected in a way that can create multiple paths to the same device. "Loops" will generate high levels of network traffic.

7.2 Using SmartFlex filter

The SmartFlex filter function is used to control PGN message traffic between the primary and secondary NMEA 2000 buses. For each PGN, the filter determines if a PGN from one bus is bridged to the other.

The SmartFlex filter is configured using an allow list/block list approach. There are three possible settings for each PGN.



Allow: This PGN will always be bridged.



Block: This PGN will never be bridged.



Default: The action for this PGN depends upon a higher-level setting.

These same three settings are available at the **device** level, and at the **bus** level.

At the device level, the setting is used to determine the action for all PGNs generated by that device that are set to *default* and *not* specifically allowed or blocked.

At the bus level, the setting is used to determine the action for all devices that are set to *default* and *not* specifically allowed or blocked.

Finally, there is a **global** setting that is used if all lower levels are set to *default*.

The final filter setting is shown at each level with one of two icons.



Allowed: The PGN will be bridged.



Blocked: The PGN will *not* be bridged.

7.3 SmartFlex filter example

The SmartFlex NMEA Network Filter Setup screen can be reached through the Configuration option in the sidebar. An example is shown below.

The screenshot displays the AIRMAR Configuration / SmartFlex® Filter interface. The sidebar on the left shows 'ASM-CES-T2' and '2021 Airmar® Technology Corporation'. The main content area is titled 'Configuration / SmartFlex® Filter' and includes the following sections:

- Global:** A section with a green checkmark icon and the text 'Global default setting'.
- Primary Network:** A section with a green checkmark icon and the text 'Default for bridging from primary network'.
- Local NMEA 2000 Devices:** A section containing two device configurations:
 - ASM-CES-T2 (ID: 22816):** Lists three PGNs: PGN 127245 (Steering / Rudder), PGN 127501 (3) (Power / Binary Switch Bank Status), and PGN 127501 (4) (Power / Binary Switch Bank Status).
 - WX Series Weather Station Sensor (ID: 67412):** Lists 15 PGNs: PGN 127250 (Steering / Vessel Heading), PGN 127251 (Steering / Rate of Turn), PGN 127257 (Steering / Attitude), PGN 127258 (Steering / Magnetic Variation), PGN 129025 (Navigation / Position, Rapid Update), PGN 129026 (Navigation / COG & SOG, Rapid Update), PGN 129029 (Navigation / GNSS Position Data), PGN 129033 (Navigation / Time & Date), PGN 129044 (Navigation / Datum), PGN 129539 (Navigation / GNSS DOPs), PGN 129540 (Navigation / GNSS Sats in View), PGN 130306 (Environmental / Wind Data), PGN 130311 (193) (Environmental / Environmental Parameters), PGN 130312 (0,1) (Environmental / Temperature), PGN 130314 (0,0) (Environmental / Actual Pressure), PGN 130323 (Environmental / Meteorological Station Data), and PGN 130945 (Fast-Packet / Proprietary).
- Bridged Networks:** A section with a green checkmark icon and the text 'Default for devices not on primary network'.
- Bridged NMEA 2000 Devices:** A section with a dropdown menu and the text 'Apply Filter'.
- Buttons:** 'Reset' (Reset to defaults) and 'Return' (Discard changes not yet applied).

Figure 7-2

Example: Default SmartFlex filter settings

In this example, there are two devices sending NMEA 2000 PGN messages. An Airmar WX series WeatherStation® instrument and another SmartBoat module are on the primary bus. Each PGN, each device, and each of the two buses is set to *default*. To bridge all PGNs from one bus to the other, click the “allow” checkbox in the Global default setting at the top of the screen.

This example continues in the figure below. Some of the settings have been changed.

AIRMAR®
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7E10681F Log Out

ASM-CES-T2

Configuration / SmartFlex® Filter

Global

☒ ☐ ☐ ☐ Global default setting

Primary Network

☒ ☐ ☐ ☐ Default for bridging from primary network

Local NMEA 2000 Devices

Device	ID	PGN	Description
A BM-CES-T2	ID: 22816	PGN 127245	Steering / Rudder
		PGN 127501 (3)	Power / Binary Switch Bank Status
		PGN 127501 (4)	Power / Binary Switch Bank Status
WX Series WeatherStation Sensor	ID: 67418	PGN 127250	Steering / Vessel Heading
		PGN 127251	Steering / Rate of Turn
		PGN 127257	Steering / Attitude
		PGN 127258	Steering / Magnetic Variation
		PGN 129025	Navigation / Position, Rapid Update
		PGN 129026	Navigation / COG & SOG, Rapid Update
		PGN 129029	Navigation / GNSS Position Data
		PGN 129033	Navigation / Time & Date
		PGN 129044	Navigation / Datum
		PGN 129039	Navigation / GNSS DOPs
		PGN 129540	Navigation / GNSS Sats in View
		PGN 130306	Environmental / Wind Data
		PGN 130311 (193)	Environmental / Environmental Parameters
		PGN 130312 (0,1)	Environmental / Temperature
		PGN 130314 (0,0)	Environmental / Actual Pressure
		PGN 130323	Environmental / Meteorological Station Data
		PGN 130945	Fast-Packet / Proprietary

Bridged Networks

☒ ☐ ☐ ☐ Default for devices not on primary network

Bridged NMEA 2000 Devices

Reset to defaults

Discard changes not yet applied

Figure 7-3

Example: SmartFlex filter configuration

In this example, the default for bridging from the primary bus to the secondary bus has been set to *block*, with exceptions to *allow* the WeatherStation PGN 129033 (Navigation/Time & Date) as well as any PGN messages generated by the ASM-CES-T1 module with ID 784207.

The PGNs and devices listed on the SmartFlex Filter configuration screen (NMEA network) will include all devices and messages that have been detected by the SmartBoat module. Any newly observed PGNs will follow the default settings. Using the example above, if a new NMEA 2000 device is added to the primary bus, any PGNs it sends will *not* be bridged to the secondary bus. Similarly, if a new NMEA 2000 device is added to the secondary bus, any PGNs it sends will be bridged according to the bus default. This also applies at the device level. If the WeatherStation instrument's configuration was changed to add a new measurement and PGN message, that new message would *not* be bridged because the default has been set to *block*.

After making changes to the filter settings, you must click on the "Apply" button near the bottom of the screen for the changes to take effect. Clicking on "Return" will discard any unapplied changes.

The results of the filter operation may be seen by clicking on the "View Network" link in the sidebar. The following figure shows the result of the example used for this description.

AIRMAR®
TECHNOLOGY CORPORATION

7E10591F Log Out

ASM-CES-T2

PGN (Instance)	Source : Dest	Category / Description	Interval
129026	35	Navigation / COG & SOG, Rapid Update	0.20 sec
129029	35	Navigation / GNSS Position Data	1.00 sec
129033	35	Navigation / Time & Date	1.00 sec
129044	35	Navigation / Datum	1.00 sec
129539	35	Navigation / GNSS DOPs	1.00 sec
129540	35	Navigation / GNSS Sats in View	1.00 sec
130306	35	Environmental / Wind Data	0.25 sec
130311 (193)	35	Environmental / Environmental Parameters	0.50 sec
130312 (0.1)	35	Environmental / Temperature	2.00 sec
130314 (0.0)	35	Environmental / Actual Pressure	2.00 sec
130316 (0.0)	9	Environmental / Temperature, Extended Range	2.00 sec
130316 (3.14)	9	Environmental / Temperature, Extended Range	2.00 sec
130323	35	Environmental / Meteorological Station Data	1.00 sec

NMEA 2000 PGN Messages - Remote or Secondary bus

PGN (Instance)	Source : Dest	Category / Description	Interval
127505 (0)	17 [9]	Power / Fluid Level	2.50 sec
129033	17 [35]	Navigation / Time & Date	1.00 sec

Display options

- Show PGNs for this device ☒
- Highlight matching instances ☐
- Show PGNs bridged by this device ☒
- Show general / mandatory PGNs received ☐
- Show PGN message data ☐

Apply Reset list

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Figure 7-4 Example: filter results

As shown in this figure, the only message generated by the WeatherStation instrument that is being bridged is PGN 129033 (Navigation/Time & Date). All other WeatherStation instrument messages are only available on the Primary NMEA 2000 bus.

8 Alerting (advanced SmartBoat module only)

An advanced SmartBoat module supports a highly configurable alerting system. Alerts can be defined based upon NMEA 2000 message-field values, timers, and counters. Also, they can be combined as needed. In addition to displaying an alert status, binary-switch values may be set and NMEA 2000 bus alert messages may be generated for display on a wide range of multifunction displays (MFDs).

8.1 Alert variables

There are four types of alert variables.

- **PGN value:** Determined from a PGN message field.
- **Calculated:** Logic equation from other alert variables.
- **Timer:** Resettable timer.
- **Event counter:** Resettable counter.

The SmartFlex Alert configuration screen is reached by clicking on the “Status” link in the sidebar. From the alert screen, you can add, delete, or modify alert variables and define any actions.

Figure 8-1 shows the SmartFlex Alert configuration screen without any variables defined. To add a new condition, select the type from the dropdown menu and click “Configure.”

An alert value can be in one of three different states.

- **True:** Condition is met.
- **False:** Condition is *not* met.
- **Unknown:** PGN data is not available for one or more values.

Actions can be defined for each alert variable based upon its status.

Variable names may only contain letters, numbers, and a few special characters, including underscore (_), hyphen (-), and period (.). If you enter a variable name with spaces, they will be replaced by underscore characters.

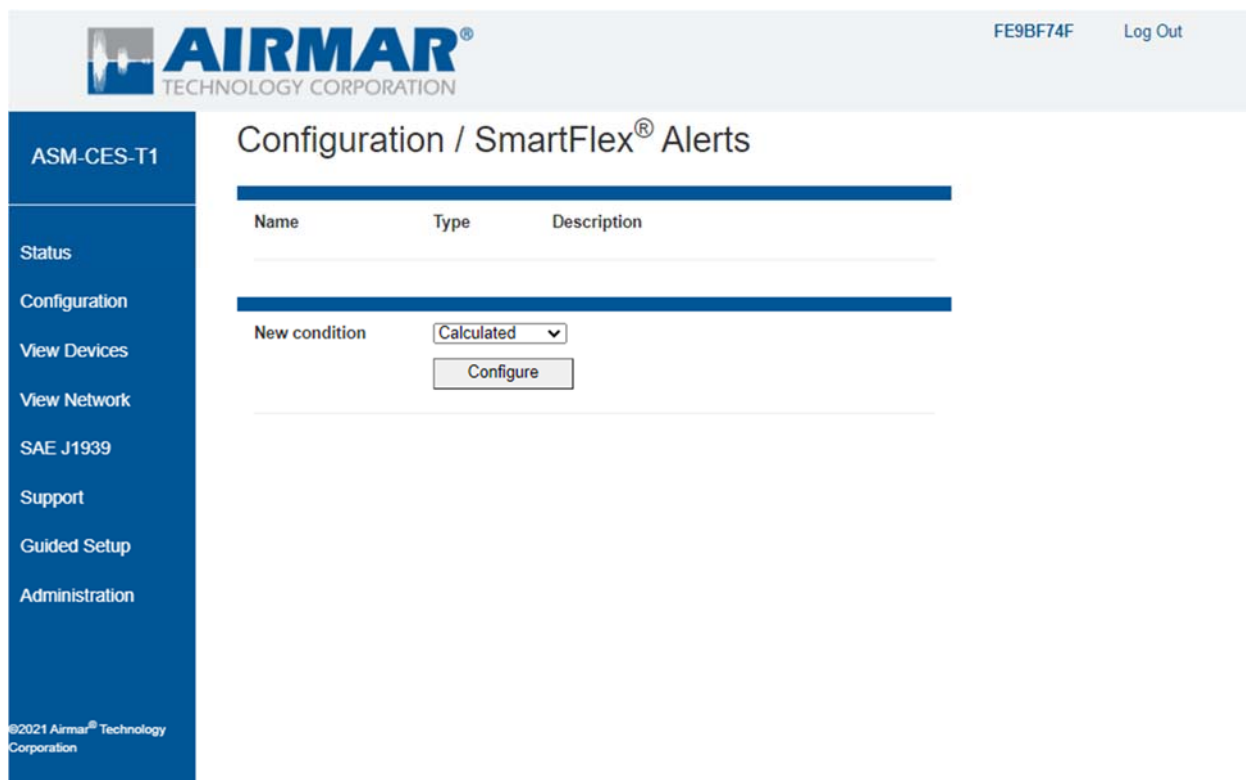


Figure 8-1 SmartFlex alert configuration screen

8.1.1 PGN value variables

PGN value variables are defined using the View Network PGN message decoding feature in the sidebar. Section 6.3 describes how to view the PGN message detail on the NMEA Network Information screen. This example uses PGN 127488 (Engine Parameters, Rapid Update) generated by the J1939 interface function. If a field number is shown with a light-green color, it may be clicked to define the variable thresholds. Figure 8-2 shows the NMEA 2000 PGN Detail window. To create a variable, click on field “02” (Engine Speed). A condition window will open. Enter the name for the condition variable and the minimum and maximum threshold values. Clicking on the “green checkbox” will save the settings. Figure 8.3 shows two conditions set for the Engine Speed of this PGN.

- **Engine Normal:** True if the engine RPM is between 1000 and 8000 RPM.
- **Engine Running:** True if the engine RPM is over 300 RPM.

You may add another condition by entering the name and values and clicking the green checkbox. Clicking the red checkbox next to a defined condition will delete that variable.

For each field, you may set as many conditions as needed. This procedure may be used to establish thresholds for warnings and actions. When a variable has been defined, the field number and PGN numbers in the NMEA Network Information screens will be blue.

NMEA 2000 PGN Detail: 127488
Engine Parameters, Rapid Update
Source: 9 Destination: Broadcast

01	Engine Instance	0
02	Engine Speed	4016.0
03	Engine Boost Pressure	0.4 psi
04	Engine Tilt/Trim	---
05	Reserved	---

Close

NMEA 2000 Devices - Remote or Secondary bus

Source	Model ID	Unique#	SW Version	Model Version
17	ASM-CES-T1	784207	1.0.0	FE9BF74F

NMEA 2000 PGN Messages - Primary bus

PGN (Instance)	Source : Dest	Category / Description	Interval
127245	7	Steering / Rudder	0.10 sec
127250	35	Steering / Vessel Heading	0.10 sec
127251	35	Steering / Rate of Turn	0.10 sec
127257	35	Steering / Attitude	1.00 sec
127258	35	Steering / Magnetic Variation	1.00 sec
127488 (0)	9	Propulsion / Engine Parameters, Rapid Update	0.10 sec
127489 (0)	9	Propulsion / Engine Parameters, Dynamic	1.00 sec
127501 (3)	9	Power / Binary Switch Bank Status	0.50 sec
127501 (3)	7	Power / Binary Switch Bank Status	0.50 sec
127501 (4)	7	Power / Binary Switch Bank Status	0.50 sec

Figure 8-2 NMEA 2000 PGN detail for 127488

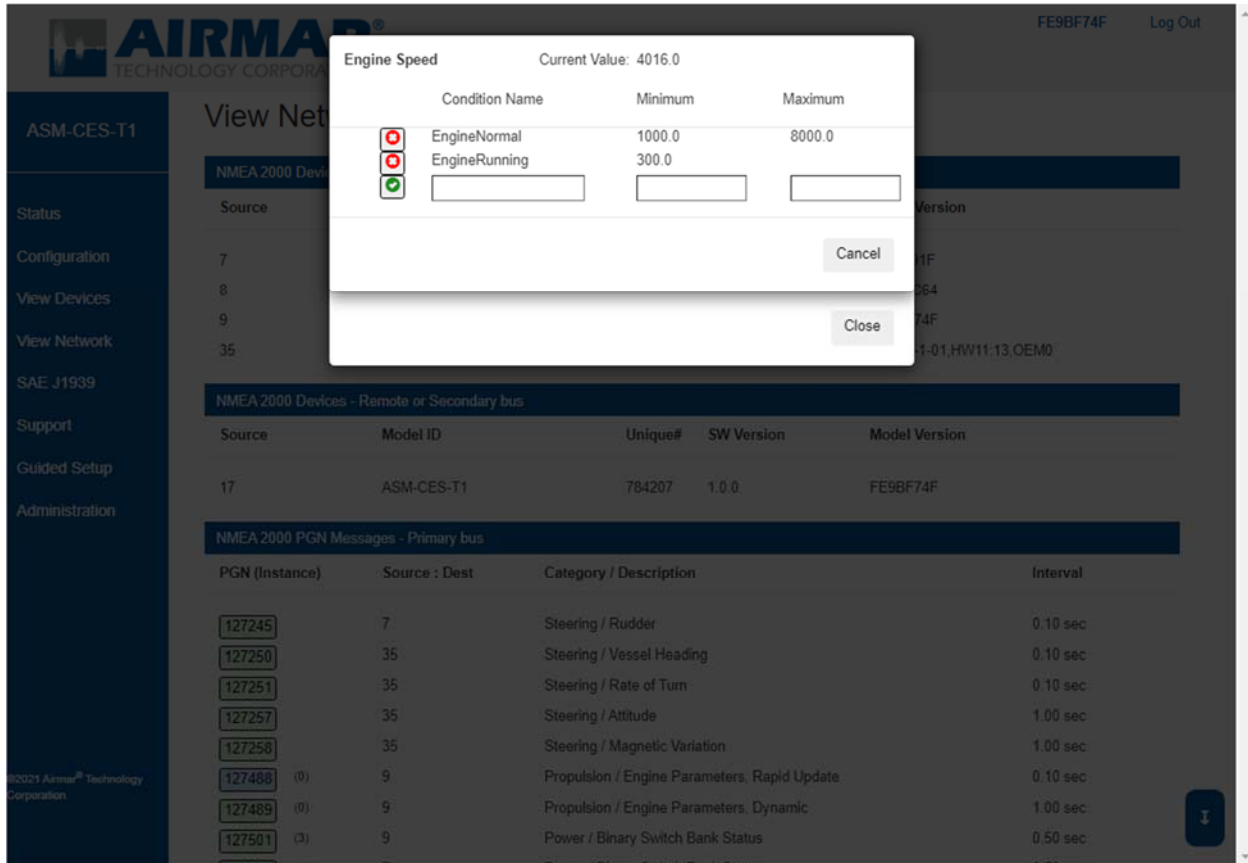


Figure 8-3 PGN value variables

8.1.2 Calculated variables

Calculated variables uses an equation and the values of other variables. An arbitrary expression may be defined that uses the names of the other variables and logic operators. The figure below shows the Change Alert Definition screen for a calculated variable. In this example, a voltage measurement called "Good Battery" is combined with the previously defined "Engine Running" variable to indicate alternator status. Voltage must be more than 11.5 V if the engine is charging the battery.

AIRMAR
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FE9BF74F Log Out

ASM-CES-T1

Change Alert Definition

Calculated

Name: AlternatorOK

Description: Battery voltage good when ru

Expression:

EngineRunning and GoodBattery

Insert

Save Changes Cancel Delete

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Figure 8-4 Calculated alert variable

Click on the “Insert” button below the Expression field to select and insert variables used to build an expression. There is also a description of the allowable operators. Figure 8-5 shows an example of the selection window. The name of the variable is followed by its description.



*Each valid operator has synonyms that may be used interchangeably. For example, the AND operation may be entered using AND, *, or &. Brackets may be used to control the order of operations.*

The value of a calculated variable will be set according to the expression and the other variables used. If any of these variables are Unknown, the calculated variable will also be Unknown.

In some cases, it may be useful to define an action to be taken when a variable is Unknown. For example, you may wish to trigger an alert when a device is offline and not communicating. The special operator “?” results in a value of True if applied to an Unknown value.

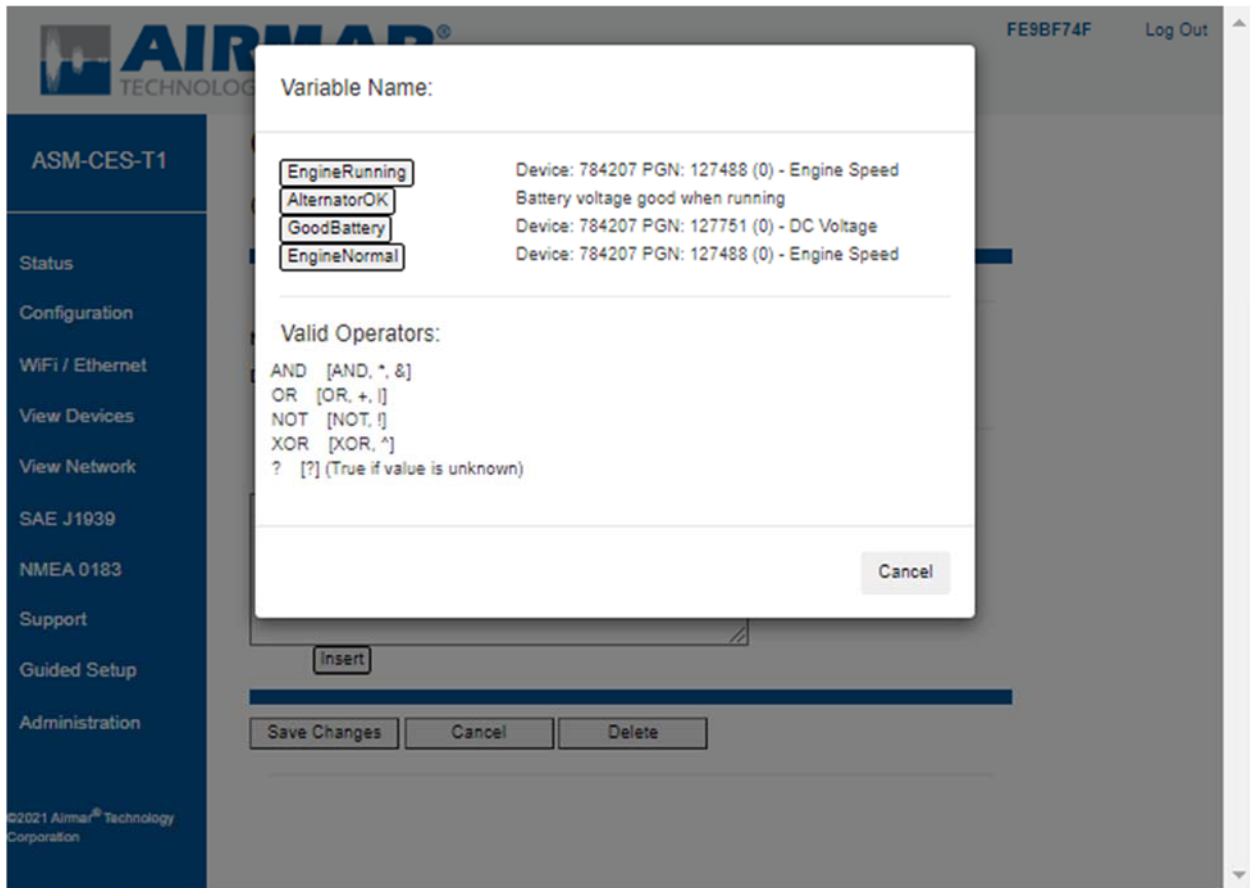


Figure 8-5 Inserting a variable name

8.1.3 Timer variables

Timer variables are used to delay an action. Just as with a calculated variable, an expression may be provided for evaluation. When the result of that expression is True for the specified amount of time, the variable will then become True.

In the example shown below, a timer named "Alternator Not OK" is implemented that will become True if "Alternator OK" is False or Unknown for more than 30 seconds.

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FE9BF74F Log Out

ASM-CES-T1

Change Alert Definition

Timer

Name:

Description:

Delay Seconds:

Expression:

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Figure 8-6 Timer alert variable

8.1.4 Event-counter variables

Event counters are defined using two expressions: one to increment a counter each time it changes from False to True, and a second to reset the counter to zero. Figure 8-7 illustrates the screen used to define an Event Counter variable. In this example, the Count Threshold is set to 1. This means that the first time "Alternator Not OK" becomes True, this Event Counter variable will also become True. It will remain True even if the counting expression subsequently becomes False. There is a reset expression that becomes True when the engine is turned OFF. When that happens, the counter will reset, and the Event Counter variable will become False.

These counters can be used to "latch" a value as in this example, or to count events and trigger an alert when a threshold is exceeded.



A loss of power or a reset of the SmartBoat module will reset the counter to zero.

The screenshot shows the AIRMAR Technology Corporation web interface. The top header includes the AIRMAR logo and the text 'FE9BF74F Log Out'. The left sidebar contains a navigation menu with the following items: ASM-CES-T1, Status, Configuration, WiFi / Ethernet, View Devices, View Network, SAE J1939, NMEA 0183, Support, Guided Setup, and Administration. The main content area is titled 'Define New Alert Value' and 'Event Counter'. It contains several input fields: 'Name' with the value 'AlternatorError', 'Description' with the value 'Latch Alternator Failure', and 'Count Threshold' with the value '1'. Below these are two text areas for expressions: 'Counting Expression' with the value 'AlternatorNotOK' and 'Reset Expression' with the value 'NOT EngineRunning'. Each text area has an 'Insert' button below it. At the bottom of the form are three buttons: 'Save Changes', 'Cancel', and 'Delete'. The footer of the sidebar shows '©2021 Airmar® Technology Corporation'.

Figure 8-7 Event-counter variable

8.2 Alert actions

There are several possible actions that may be defined for each alert variable.

- Display the alert in the Show Alerts window in a browser.
- Report a binary status (like a switch) using PGN 127501.
- Control a binary device (like a relay) using PGN 127502.

Note that some devices use PGN 127501 for control.

To configure actions for the Browser Alert window, select the "Action" button to the right of each Alert Display Text entry on the Configure Alert Actions screen.

You may specify both the text to be shown and the highlight color for each condition.

Configuring the Binary-switch Bank Status PGNs is very similar to configuring switch and relay devices on the Device Configuration screen.

The following figure shows the Configure Alert Actions screen.

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Configure Alert Actions

EngineRunning:

Browser alert window

Alert Display Text

When True	<input type="text" value="EngineRunning"/>	Color	<input type="text" value="Green"/>
When False	<input type="text" value="EngineRunning"/>	Color	<input type="text" value="Red"/>
When Unknown	<input type="text" value="EngineRunning"/>	Color	<input type="text" value="Grey"/>

NMEA 2000 PGNs

Switch bank instance

Switch position

Binary Switch Bank Status

PGN 127501

PGN Send interval (sec)

Binary Switch Bank Control

PGN 127502

NMEA Bus alert

PGN 126983

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Figure 8-8 Configuring alert actions

It is also possible to configure NMEA 2000 bus alert messages which may be displayed on an MFD. To configure bus alerts, enable PGN 126983. Then click “update”. The Configure NMEA 2000 Bus Alert screen will be presented to set up the alert.

8.3 NMEA 2000 bus alerts

The following figure shows the screen presented to configure a new NMEA 2000 bus alert.

The screenshot displays the 'Configure NMEA 2000 Bus alert' web interface. At the top, the Airmar Technology Corporation logo is on the left, and the user ID 'FE9BF74F' and 'Log Out' link are on the right. The left sidebar shows the user 'ASM-CES-T1'. The main content area has the title 'Configure NMEA 2000 Bus alert' and the variable 'EngineRunning:'. Below this, there is a section for 'Alert Description' with a dropdown menu for 'Alert system' currently set to '--- SELECT ALERT SYSTEM ---'. A 'Cancel' button is visible at the bottom left of the form area. The footer indicates '©2021 Airmar Technology Corporation'.

Figure 8-9 Configure a new NMEA 2000 bus alert

The name of the variable used to trigger the alert is shown at the top of the screen. The Alert Description fields are used to specify the NMEA 2000 alert to be sent. These alert messages use specific fields from dropdown menus. The Alert Description includes the following.

- **Alert system**
- **Alert subsystem**
- **Alert category**
- **Alert description (Name)**

Each standard alert has a specific index value for each field, which is shown to the right of the field value. For standard alerts, the alert category is determined by the alert system and alert subsystem selected. The available choices for each field are determined by the previous selection.

There are additional alert message options on this screen.

- **Alert type:** This field is used to specify the severity of the alert. The dropdown menu options include the following:
 - **Emergency alarm:** (Field value = 1)
 - **Alarm:** (Field value = 2)
 - **Warning:** (Field value = 5)
 - **Caution:** (Field value = 8)
- **Alert instance**
- **Location name:** This identifies the place in the vessel that is causing the alert, such as the engine room.
- **Time to resend:** If the alert variable remains True, then the alert message will be resent with an interval specified in this field. If set to zero, the alert message will be sent only once when the alert variable first becomes True.

The figure below illustrates a bus alert configured using a standard NMEA 2000 alert.

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Configure NMEA 2000 Bus alert

AlternatorNotOK:

Alert Description		
Alert system	Propulsion	5
Alert subsystem	Engine	0
Alert Category	Technical	1
Alert name	Alternator Potential - Low	57

Alert Message	
Alert type	Warning
Alert instance	0
Location name	Engine Room
Time to Resend (sec)	300 0 to disable resend

Cancel Save

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Figure 8-10 Standard NMEA 2000 bus alert configuration

In this example, after 30 seconds a warning will be sent for display on an MFD. When the alert criteria are met, the engine is running, but the battery is low. This message will be resent to the MFD every 5 minutes until corrected.

There are twenty defined alert systems with a total of 894 alert definitions in the NMEA 2000 standard. If none of these alerts match the alert you wish to send, or if you would like to customize the text sent with an alert, a customized alert message may be defined. Figure 8-11 illustrates a bus alert configured with a custom subsystem and custom name within the Propulsion alert system.

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Configure NMEA 2000 Bus alert

AlternatorNotOK:

Alert Description	
Alert system	Propulsion 5
Alert subsystem	Custom Definition 0
Custom subsystem	SmartFlex 5
Alert category	Technical
Custom name	Alternator Alarm 79

Alert Message	
Alert type	Warning
Alert instance	0
Location name	Engine Room
Time to Resend (sec)	300 0 to disable resend

Cancel Save

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Figure 8-11 Custom NMEA 2000 bus alert

The configuration screens for a custom alert require that the combination of fields do not overlap an existing standard NMEA bus alert. This example is defining a custom alert in the Propulsion alert system (5). Because there are already alert subsystems defined from 0 to 4, the first available subsystem index is 5.

Select "Save" to save the configuration and return to the SmartFlex Alert Configuration screen.

9 NMEA 0183 Support (advanced SmartBoat module only)

Each advanced SmartBoat module supports an isolated EIA-422 serial port for both input (listener) and output (talker). There is also a TCP/UDP internet protocol server for NMEA 0183 messages that supports both listener and talker operation. An NMEA 2000 to NMEA 0183 gateway may be enabled to convert messages between these standards.

Access the NMEA 0183 Configuration screen by clicking on “Configuration” in the sidebar and choosing the “NMEA 0183” link.

The screenshot displays the Airmar Configuration / NMEA 0183 interface. The top header shows the Airmar logo and the user ID FE9BF74F with a Log Out link. The left sidebar identifies the user as ASM-CES-T1. The main content area is titled 'Configuration / NMEA 0183' and is divided into three sections:

- NMEA 0183 Gateway:**
 - Enable gateway:** A checked checkbox.
 - Sentence Prefix:** A text input field containing 'SB', with a note 'Used for gateway messages'.
 - Listener conversions:** A 'Configure' button, with a note 'Convert to NMEA 2000'.
 - Talker conversions:** A 'Configure' button, with a note 'Convert from NMEA 2000'.
- NMEA 0183 Serial functions:**
 - Serial port:** A dropdown menu set to 'Disabled'.
 - Listener:** A dropdown menu set to 'Disable', with a note 'NMEA 0183 → Input'.
 - Talker:** A dropdown menu set to 'Disable', with a note 'Output → NMEA 0183'.
 - Echo Messages:** A dropdown menu set to 'Disable', with a note 'Listener → Talker'.
- Extend NMEA Network:**
 - Enable ethernet servers:** A checked checkbox, with a 'Server ports' button next to it.

At the bottom of the configuration area are two buttons: 'Save changes' and 'Cancel'.

Figure 9-1 NMEA 0183 gateway configuration

There are several configuration options for the NMEA 0183 features.

- **Enable NMEA 0183 gateway:** This box must be checked to convert supported NMEA 2000 PGNs to NMEA 0183 sentences, and NMEA 0183 sentences to NMEA 2000 PGNs. When the gateway is enabled, there are additional settings available.
 - **Sentence corresponds prefix:** This must be a two-character value. The talker ID sentence prefix is used for any NMEA 0183 sentence generated by the gateway function.

- **Listener conversions:** Allows the selection of NMEA 0183 to NMEA 2000 conversions.
- **Talker conversions:** Allows the selection of NMEA 2000 to NMEA 0183 conversions.
- **Serial port:** Used to enable serial communications.
- **Listener:** This dropdown menu must be set to *enable* to process received serial sentences.
- **Talker:** This dropdown menu must be set to *enable* to send serial sentences.
- **Echo messages:** If this dropdown menu is set to *enable*, any sentences received by the listener function will be sent unchanged to the talker function.

When enabled, the EIA-422 serial port is configured according to the NMEA 0183 standard.

Baud Rate	4800	Standard Rate
	38400	High Speed
Bits	8	
Parity	None	
Stop Bits	1	
Handshake	None	

Figure 9-2 NMEA 0183 serial port configuration

9.1 Talker and listener support

Each advanced SmartBoat module implements an NMEA 0183 TCP/UDP IP server in addition to the serial-port function. The figure below shows an advanced SmartBoat module with an active NMEA 2000 bus, an NMEA 0183 serial connection enabled for both talker and listener support, an active NMEA 0183 TCP/IP server connection with incoming sentences, and echo messages enabled.

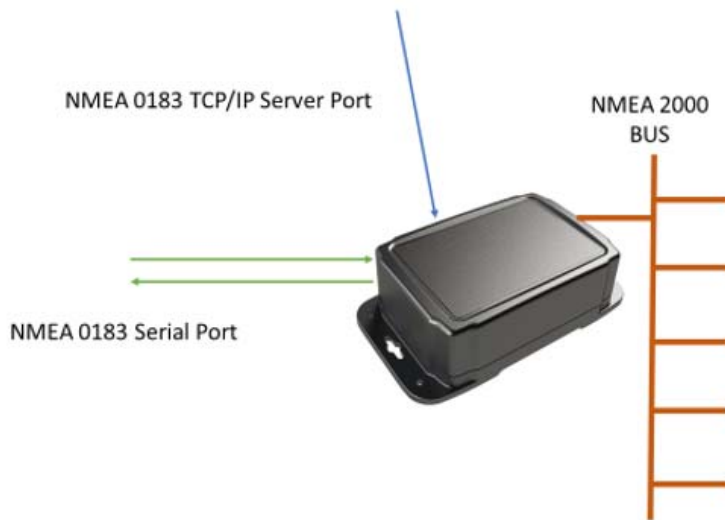


Figure 9-1 NMEA 0183 talker and listener

In this example, NMEA 0183 serial talker would multiplex the NMEA 0183 sentences received by the listener port along with sentences generated by the NMEA 2000 conversion gateway and any sentences received by the TCP/IP server.

9.2 NMEA 0183 conversions

After the NMEA 0183 conversion gateway has been enabled, the desired conversion functions must be enabled using the Configure Gateway Conversions screens. This process is similar to using the SmartFlex filter. There is a *global* setting that sets the default, a *group* setting for each source message, and a *conversion* setting for each supported conversion.

- ☒ **Enable:** Convert the selected message.
- ☐ **Disable:** Do *not* convert the selected message.
- ☐ **Default:** The action for this message depends upon the higher-level setting.


The final setting is shown at each level with one of two icons.

- ☒ **Enabled:** The message will be converted.
- ☐ **Disabled:** The message will *not* be converted.

The figures below show the configuration screens for NMEA 0183 sentence to NMEA 2000 PGN conversion in each direction. Because of the large number of supported conversions, the entire list is *not* shown in each figure.

After making changes to the conversion settings, you must click on the "Apply" button near the bottom of the screen for the changes to take effect. Clicking on "Return" will discard any unapplied changes.

Because there is not one-to-one mapping between NMEA 2000 PGNs and NMEA 0183 sentences, the conversion gateway function maintains a database of values that have been received. When a message is created, this database is used to complete the message with all information available to the advanced SmartBoat module.



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Configure / NMEA 0183 / Listener Conversions


Serial port or Ethernet server

☐ ☒ ☐

Default for all conversions





<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	APB	Heading/Track Controller (Autopilot) Sentence "B"
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	127237	Heading/Track Control
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129283	Cross Track Error
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129284	Navigation Data
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DBT	Depth Below Transducer
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	128267	Water Depth
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DPT	Depth
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	128267	Water Depth
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DTM	Datum
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129044	Datum
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GGA	Global Positioning System Fix Data
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	126992	System Time
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129025	Position, Rapid Update
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129029	GNSS Position Data
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	129033	Time & Date









↓




















FE9BF74F
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ASM-CES-T1

				129029	GNSS Position Data (Requires additional data)
---	---	---	---	--------	---

				XTE	Cross Track Error, Measured
				129283	Cross Track Error

				ZDA	Time & Date
				126992	System Time
				129029	GNSS Position Data
				129033	Time & Date



Apply changes

Reset

Return


Reset to defaults

Discard any changes not yet applied



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Figure 9-2 Configure NMEA 0183 to NMEA 2000 listener conversions



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ASM-CES-T1

Configure / NMEA 0183 / Talker Conversions

Serial port or Ethernet server

☐ ☒ ☐

Default for all conversions

<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	126992 ZDA GGA GLL RMC	System Time Time & Date Global Positioning System Fix Data (Requires additional data) Geographic Position/Latitude/Longitude (Requires additional data) Recommended Minimum Specific GNSS Data (Requires additional data)
<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	127237 APB	Heading/Track Control Heading/Track Controller (Autopilot) Sentence "B"
<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	127245 RSA	Rudder Rudder Sensor Angle
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	127250 HDG VHW RMC	Vessel Heading Heading, Deviation & Variation Water Speed and Heading Recommended Minimum Specific GNSS Data (Requires additional data)

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ASM-CES-T1

☐ ☒ ☐ ☐

<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	130312 MDA MTW	Temperature Meteorological Composite Water Temperature
<input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	130316 MDA MTW	Temperature, Extended Range Meteorological Composite Water Temperature

Reset

Reset to defaults

Return

Discard any changes not yet applied

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Figure 9-3

Configure NMEA 2000 to NMEA 0183 talker conversions

9.3 Viewing NMEA 0183 sentences

To see the active NMEA 0183 sentences, in the sidebar select “NMEA 0183”. Then click “View Messages”.

The screenshot shows the AIRMAR Technology Corporation web interface. The top header includes the AIRMAR logo, the user ID 'FE9BF74F', and a 'Log Out' link. The left sidebar contains a navigation menu with the following items: ASM-CES-T1, Status, View Alerts, Configuration, View Devices, View Network, SAE J1939, View NMEA 0183 (highlighted), Support, Guided Setup, and Administration. The main content area is titled 'NMEA 0183 / View Messages'. It features two sections: 'NMEA 0183 Sentences Received' with a status of 'None', and 'NMEA 0183 Sentences Sent' which contains a table of messages. The table has two columns: 'Message' and 'Interval'. The messages listed are: \$SBDTM,,,87.61,N,,,W84*7F (0.00), \$SBGGA,212721.40,4038.0076,N,7941.3360,W,1.8,1.40,326.00,M,-33.30,M*6E (0.60), \$SBGLL,4038.0076,N,7941.3360,W,212721.40,A*22 (1.00), \$SBGSA,A,3,,,,,,,,,2.10,1.40,1.50*06 (0.75), \$SBGSV,3,01,10,03,38,251,01,04,43,311,01,09,08,313,01,16,58,203,02*4A (1.00), \$SBGSV,3,02,10,22,28,227,01,26,74,067,02,27,08,167,32,29,14,043,02*40 (1.00), \$SBGSV,3,03,10,31,40,068,02,32,08,135,01*4B (1.00), \$SBHDG,4.94,0.00,E,9.50,W*7F (1.00), \$SBMDA,28.82,I,97600.00,B,22.70,C,-273.15,C,,,,,4.06,T,,,,,0.10,N,0.05,M*3D (0.34), \$SBMTW,-273.15,C*2D (1.00), \$SBMWD,232.49,T,,,0.10,N,0.05,M*0C (0.28), \$SBMWV,232.49,T,0.05,M*4F (0.28), \$SBRMC,212721.40,A,4038.0076,N,7941.3360,W,0.10,273.39,211121,9.50,W*5D (0.22), \$SBROT,-1.05,A*2E (0.10), \$SBRSA,,,44.98,A*13 (1.02), \$SBVHW,273.39,T,282.89,M*44 (0.47), and \$SBZDA,212721.40,21,11,2021*63 (1.00). A note at the bottom states: 'Sentences processed by the NMEA 2000 conversion gateway are shown in blue'. At the very bottom, there is a 'Clear all' button.

Message	Interval
\$SBDTM,,,87.61,N,,,W84*7F	0.00
\$SBGGA,212721.40,4038.0076,N,7941.3360,W,1.8,1.40,326.00,M,-33.30,M*6E	0.60
\$SBGLL,4038.0076,N,7941.3360,W,212721.40,A*22	1.00
\$SBGSA,A,3,,,,,,,,,2.10,1.40,1.50*06	0.75
\$SBGSV,3,01,10,03,38,251,01,04,43,311,01,09,08,313,01,16,58,203,02*4A	1.00
\$SBGSV,3,02,10,22,28,227,01,26,74,067,02,27,08,167,32,29,14,043,02*40	1.00
\$SBGSV,3,03,10,31,40,068,02,32,08,135,01*4B	1.00
\$SBHDG,4.94,0.00,E,9.50,W*7F	1.00
\$SBMDA,28.82,I,97600.00,B,22.70,C,-273.15,C,,,,,4.06,T,,,,,0.10,N,0.05,M*3D	0.34
\$SBMTW,-273.15,C*2D	1.00
\$SBMWD,232.49,T,,,0.10,N,0.05,M*0C	0.28
\$SBMWV,232.49,T,0.05,M*4F	0.28
\$SBRMC,212721.40,A,4038.0076,N,7941.3360,W,0.10,273.39,211121,9.50,W*5D	0.22
\$SBROT,-1.05,A*2E	0.10
\$SBRSA,,,44.98,A*13	1.02
\$SBVHW,273.39,T,282.89,M*44	0.47
\$SBZDA,212721.40,21,11,2021*63	1.00

Sentences processed by the NMEA 2000 conversion gateway are shown in blue

Clear all

Figure 9-4 Viewing NMEA 0183 sentences

Under NMEA 0183 Sentences Received, each line represents a sentence that has been received by the listener function. NMEA 0183 Sentences Sent, lists messages using the talker function. Any sentences that have been processed by the NMEA 0183 gateway are highlighted in blue. The interval between sentences either received or sent is shown.

If you wish to see the most recently sent or received sentences only, click on “Clear all” at the bottom of the screen to reset the list.

10 SAE J1939 Gateway (advanced SmartBoat module only)

An advanced SmartBoat module provides an SAE J1939 Gateway Configuration function that will receive J1939 PGN messages and create NMEA 2000 PGN messages containing the engine status. NMEA 2000 and SAE J1939 are both based upon the Controller Area Network (CAN) bus and are compatible at the physical level.

The SAE J1939 bridge operates using the secondary bus connection. If you connect J1939 devices to this bus without enabling the J1939 bridge function, you will see J1939 engine-status messages identified in the secondary bus section of the NMEA Network Information screen. Access this screen by clicking on "View Network" in the sidebar.

The first step to configuring the SAE J1939 gateway is to select J1939 as the secondary bus function on the NMEA Network Configuration screen. When this step is complete, the options for SAE J1939 will be available as a configuration option in the sidebar.

10.1 Interface configuration

When the SAE J1939 option is selected from the sidebar under Configuration, you will see the SAE J1939 Gateway Configuration screen shown below.

The screenshot displays the Airmar Technology Corporation web interface for SAE J1939 Gateway Configuration. The top header includes the Airmar logo and the user ID 'FE9BF74F' with a 'Log Out' link. The left sidebar shows 'ASM-CES-T1' as the selected module. The main content area is titled 'SAE J1939 Gateway Configuration'. It features a blue bar at the top, followed by the 'Enable J1939 gateway' checkbox which is checked. Below this is a section for 'Select after configuration is complete' showing 'Detected J1939 source addresses: 1'. A 'General' section contains the 'Engine Configuration' dropdown menu set to 'Automatic'. At the bottom of the configuration area are 'Continue' and 'Cancel' buttons. The footer of the sidebar indicates the copyright '©2021 Airmar Technology Corporation'.

Figure 10-1 Automatic SAE J1939 gateway configuration

This screen allows you to see any J1939 addresses detected on the secondary bus, and provides the following options:

- **Enable J1939 gateway:** This checkbox must be selected after the J1939 gateway has been fully configured. Until this box is checked, J1939 messages will be received, but no NMEA 2000 PGNs will be generated.
- **Engine configuration:** There are 3 options for this dropdown menu.
 - **Automatic:** Attempt to automatically discover and configure detected Engine/Transmission sources.
 - **Single engine:** Manually configure a single engine source.
 - **Dual engine:** Manually configure the gateway for two engines.

If you choose to manually configure the J1939 gateway, there are additional options. The example below shows the choices for a dual-engine bus.



Dual-engine support requires that both engines are using the same physical J1939 CAN bus. If each engine is on its own bus, then two SmartBoat modules are required.

ASM-CES-T1

SAE J1939 Gateway Configuration

Enable J1939 gateway ☒

Detected J1939 source addresses: 1

General

Engine Configuration

Static PGN Query Some data only sent by request

DTC Format Used to decode faults

Engine 1 Addressing

Engine address Primary ECU address

Secondary ECU address

Engine instance For NMEA 2000 PGNs

Engine 2 Addressing

Engine address Primary ECU address

Secondary ECU address

Engine instance For NMEA 2000 PGNs

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Figure 10-2 Manual SAE J1939 gateway configuration

Additional options include the following:

- **Static PGN query:** If this option is disabled, then the J1939 gateway function will operate “listen only” and will not transmit any queries for additional data. Some engines will periodically transmit static information such as the VIN code, while others only transmit this information on request. Enabling this function allows the SmartBoat module to request static information.
- **DTC format:** The standards for Diagnostic Trouble Codes (DTC) have evolved over time. The most recent is Version 4, but if DTC codes are not properly interpreted, an older standard may be selected.
- **Engine address:** Because there may be a separate transmission ECU on the J1939 bus, up to two ECU addresses may be specified for each engine. The data from the two addresses will be consolidated.
- **Engine instance:** This is the instance number that will be used for generated NMEA 2000 PGN messages.

After entering any changes required to communicate with the engine(s), select “continue” to configure the NMEA 2000 PGNs that will be generated from the engine data.

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SAE J1939 Gateway Configuration

NMEA 2000 PGNs

Engine Parameters, Rapid Update	
PGN 127488	Enable ▼
PGN Send Interval (sec)	0.10
Engine Parameters, Dynamic	
PGN 127489	Enable ▼
PGN Send Interval (sec)	1.00
Transmission Parameters, Dynamic	
PGN 127493	Enable ▼
PGN Send Interval (sec)	1.00
Engine Parameters, Static	
PGN 127498	Disable ▼
PGN Send Interval (sec)	60.00

Save Changes Cancel

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Figure 10-3 NMEA 2000 PGNs generated by the SAE J1939 gateway

The default values will create all NMEA 2000 PGNs at the recommended intervals. You may individually enable or disable each PGN or adjust the transmission interval as needed.

10.2 Viewing engine/transmission data

When the J1939 gateway function is active, you may view engine data. Click “SAE J1939” in the sidebar to access the J1939 Engine Information screen as shown in figure 10-4 below.



The display units dropdown menu is used to select US or metric units of measure.



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Status

Configuration

WiFi / Ethernet

View Network

SAE J1939

NMEA 0183

Support

Guided Setup

Administration

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J1939 Engine Information

Display units US ▼


Engine 1

Status: Healthy

SPN 190	Engine Speed	4016.0 RPM
SPN 102	Engine Turbocharger Boost Pressure	36.26 PSI
SPN 513	Actual Engine – Percent Torque	0.0 %
SPN 168	Electrical Potential (Voltage)	24.00 Volts
SPN 109	Engine Coolant Pressure	36.26 PSI
SPN 110	Engine Coolant Temperature	184.7 Fahrenheit
SPN 94	Engine Fuel Delivery Pressure	72.52 PSI
SPN 183	Engine Fuel Rate	424.366 Gal/hour (US)
SPN 100	Engine Oil Pressure	72.52 PSI
SPN 175	Engine Oil Temperature	1347.5 Fahrenheit
SPN 92	Engine Percent Load at Current Speed	62.0 %
SPN 247	Engine Total Hours of Operation	0.10 Hours
SPN 189	Engine Rated Speed	3000.0 RPM
SPN 237	Vehicle Identification Number	VINLintestSystems

Figure 10-4 J1939 engine information

The J1939 Engine Information screen also reports the status of any faults. The figure below shows Engine 1 with a DTC alert detected.



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Status

Configuration

WiFi / Ethernet

View Network

SAE J1939

NMEA 0183

Support

Guided Setup

Administration

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J1939 Engine Information

Display units US ▼

Engine 1

Status: DTC Alert

DTC 1	SPN 1208	FMI 3	OC 10
Engine Pre-filter Oil Pressure (Voltage Above Normal)			
<div style="border: 1px solid #0056b3; display: inline-block; padding: 2px 10px;">Clear DTC</div>			

SPN 190	Engine Speed	4016.0 RPM
SPN 102	Engine Turbocharger Boost Pressure	36.26 PSI
SPN 513	Actual Engine – Percent Torque	0.0 %
SPN 168	Electrical Potential (Voltage)	24.00 Volts
SPN 109	Engine Coolant Pressure	36.26 PSI
SPN 110	Engine Coolant Temperature	184.7 Fahrenheit
SPN 94	Engine Fuel Delivery Pressure	72.52 PSI
SPN 183	Engine Fuel Rate	424.366 Gal/hour (US)
SPN 100	Engine Oil Pressure	72.52 PSI
SPN 175	Engine Oil Temperature	1347.5 Fahrenheit
SPN 92	Engine Percent Load at Current Speed	62.0 %
SPN 247	Engine Total Hours of Operation	0.10 Hours
SPN 189	Engine Rated Speed	3000.0 RPM
SPN 237	Vehicle Identification Number	VINIntestSystems

Figure 10-5 Example: J1939 engine DTC alert

The details of the DTC alert are shown below the blue bar, along with the decoded description. Up to three unique DTCs may be displayed. Clicking the “Clear DTC” button will notify the ECU to clear the alerts.

11 SmartFlex Digital Sensors (advanced SmartBoat modules only)

Advanced SmartBoat modules can be used with SmartFlex digital sensors. These sensors are compatible with NMEA 2000 at the physical level. Airmar DFM series diesel-fuel flow sensors are supported.

SmartFlex digital sensors operate using the secondary bus connection. If you connect a SmartFlex digital sensor to a bus configured for NMEA 2000 you will see “Unknown” messages identified on the NMEA Network Information screen, as well as a warning on the SmartBoat Module Status screen.

The first step to configuring a SmartFlex digital sensor is to select Digital Sensors as the Secondary Bus Function under Network Interfaces on the NMEA Network Configuration screen. When this step is complete, the links for digital sensor functions will be available in the sidebar.

11.1 Diesel fuel-flow meters

SmartFlex diesel fuel-flow meters are compatible with advanced SmartBoat modules only. Visit www.airmar.com for details on these sensors, which cover the complete range of fuel-flow rates.

There are two versions of fuel-flow meters.

- **Single:** Measures either supply or return flow. Two sensors may be configured together by the SmartBoat module to measure differential fuel flow.
- **Dual:** Measures both supply and return flow to perform differential fuel-flow measurement with a single device.

11.1.1 Fuel-flow configuration

When the Digital Sensors option is selected in the sidebar under Configuration, you will see the Digital Fuel-flow Meter Configuration screen shown below.

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FE9BF74F Log Out

ASM-CES-T1

Digital Fuel Flow Meter Configuration

Enable digital sensors ☒

Detected digital flow meters:

DFM-250-SA-L	65003300135
DFM-250-DA	33002301299

Sensor Assignment

Number of engines

Engine 1 Flow Meters

Engine instance	<input type="text" value="0"/>	For NMEA 2000 PGNs
Supply sensor	<input type="text" value="33002301299"/>	
Return sensor	<input type="text" value="Single"/>	Used if separate sensor

Engine 2 Flow Meters

Engine instance	<input type="text" value="1"/>	For NMEA 2000 PGNs
Supply sensor	<input type="text" value="65003300135"/>	
Return sensor	<input type="text" value="Single"/>	Used if separate sensor

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Figure 11-1 Assigning digital fuel flow meters to engines

This screen shows the model and serial numbers for any fuel-flow meters detected, and provides the following options:

- **Enable digital sensors:** This checkbox must be selected after connected digital sensors have been fully configured. Until this box is checked, no NMEA 2000 PGNs will be generated.
- **Number of engines:** Specifies the number of engines on the vessel.

For each engine:

- **Engine instance:** The NMEA 2000 instance number assigned to the engine.
- **Supply sensor:** From the dropdown menu, select the serial number of the single or differential sensor used to measure fuel supply, or select "Disabled".
- **Return sensor:** From the dropdown menu, select the serial number of the single sensor used to measure fuel return, or select "Single" if a second flow meter is not used for this engine.

After assigning fuel flow meter(s) to the engine(s), select "Continue" to configure the NMEA 2000 PGNs that will be generated from the measured data.

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ASM-CES-T1

Digital Fuel Flow Meter Configuration

NMEA 2000 PGNs

Engine Parameters, Dynamic
PGN 127489 Enable ▾
PGN Send interval (sec)

Trip Fuel Consumption, Engine
PGN 127497 Disable ▾
PGN Send interval (sec)

Proprietary PGN - Flow Rate
PGN 065286 Disable ▾
Manufacturer code Airmar ▾
PGN Send interval (sec)

Proprietary PGN - Fluid Volume
PGN 065287 Disable ▾
Manufacturer code Airmar ▾
PGN Send interval (sec)

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Save changes Cancel

Figure 11-2 Configuring NMEA 2000 PGNs for digital fuel-flow meters


The default values will create all standard NMEA 2000 PGNs at the recommended intervals. You may individually enable or disable each PGN or adjust the transmission interval as needed. Select “Save Changes” to complete the configuration process.

11.1.2 Viewing fuel flow sensor information

When a digital sensor is active, you may view the configuration and measured values. Click on “Digital Sensors” in the sidebar to access the Digital Fuel-flow Sensor Information screen.



The display units dropdown menu is used to select US or metric units of measure.



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ASM-CES-T1

Status

Configuration

WiFi / Ethernet

View Network

Digital Sensors

NMEA 0183

Support

Guided Setup

Administration

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Digital Fuel Flow Sensor Information

Display Units Metric ▼


Model: DFM-250-DA	Serial Number: 33002301299
Engine: 1 (Differential)	Engine Instance: 0
Flow Rate:	0.000 Liters/hour
Total Volume:	2.08 Liters

Model: DFM-250-SA-L	Serial Number: 65003300135
Engine: 2 (Supply)	Engine Instance: 1
Flow Rate:	0.000 Liters/hour
Total Volume:	2.09 Liters

Figure 11-3 View digital fuel- flow meter information

11.1.3 Viewing digital sensor status

After SmartFlex digital sensors are configured, the SmartBoat Module Status screen will include an additional section at the bottom to display a summary of the current flow-meter status as shown below.



FE9BF74F [Log Out](#)

ASM-CES-T1

Status

Configuration

WiFi / Ethernet

View Network

Digital Sensors

NMEA 0183

Support

Guided Setup

Administration

SmartBoat® Module Status

25 JUL 2021
13:12 UTC

Module Information

Serial Number	FE9BF74F
Hardware Version	ASM-CES-T1
Firmware Version	1.0.0
Running Time	0 Days : 0 Hours : 2 Minutes
Total Running Time	439.3 Hours
USB Storage	3121MB available (69% free)
Installation Description	

Networking

Access point	SSID: ASM-CES-T1-FE9BF74F, Enabled
Wifi status	Disabled
Ethernet	Connected, IPV4: 10.10.10.10

NMEA 2000

Primary network	NMEA 2000
Secondary network	Enabled: Digital Sensors
Ethernet server	Enabled
Ethernet extension	Disabled
Active NMEA sources	Direct: 3, Bridged: 1

Device configuration

No devices configured

Digital sensors

Fuel Flow: DFM-250-DA	Engine: 1 (Differential)
Fuel Flow: DFM-250-SA-L	Engine: 2 (Supply)

Figure 11-4 Fuel flow meter status

12 Wi-Fi/Ethernet Connectivity

Each SmartBoat module can operate as either a wireless access point (AP) or as a client. The role of the module in establishing connectivity does not affect the capabilities of the module for wireless bridging.

A wireless **subnet** consists of all devices with the same values for the first three octets of their IPv4 network address. The default IP address for the access point is 192.168.2.1. If other devices are connected to that AP, the SmartBoat module will assign IP addresses to those devices starting at device address 192.168.2.100. In the example below, all devices connected with addresses 192.168.2.XXX will be on the same subnet and be able to communicate.

The default IP address range for SmartBoat modules corresponds to the range reserved for Class C private networks. Any of the following IP address ranges may be used.

CLASS	PRIVATE IP ADDRESS RANGE	SUBNET MASK
A	10.0.0.0 to 10.255.255.255	255.0.0.0
B	172.16.0.0 to 172.31.255.255	255.240.0.0
C	192.168.0.0 to 192.168.255.255	255.255.0.0

Figure 12-1 IP address ranges

If the network is established using a wireless router, IP addresses will be assigned by that router to the connected SmartBoat modules.

Because SmartBoat modules will “advertise” their presence on the network, there is generally no need for fixed IP addresses. However, it is possible to assign a fixed address if communicating modules are placed on the same subnet.

12.1 Configuring the Wi-Fi/Ethernet network

The figure below shows a typical configuration with three SmartBoat modules that are connected wirelessly. One of the modules is acting as the access point and the other two modules are connecting to it as clients.

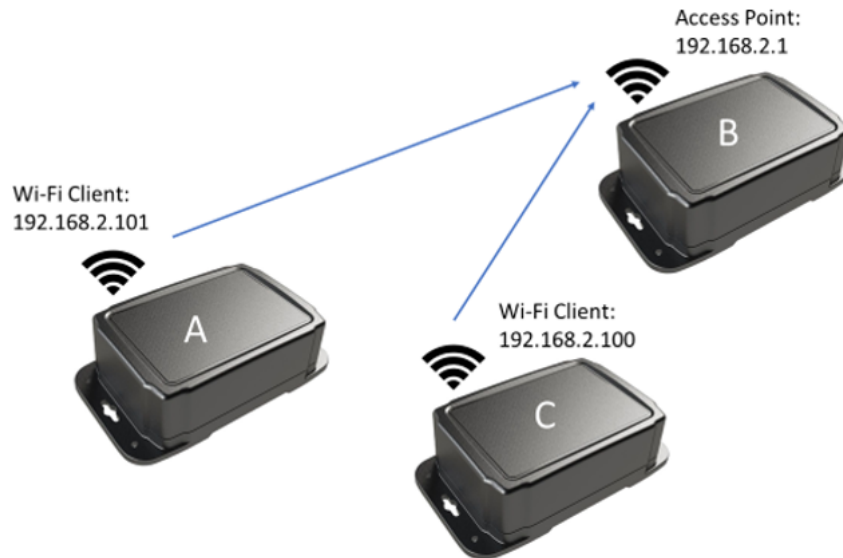


Figure 12-2 Example: Simple Wi-Fi configuration

In some cases, it may be useful to have multiple access points in a network. The next example shows a configuration with four SmartBoat modules.

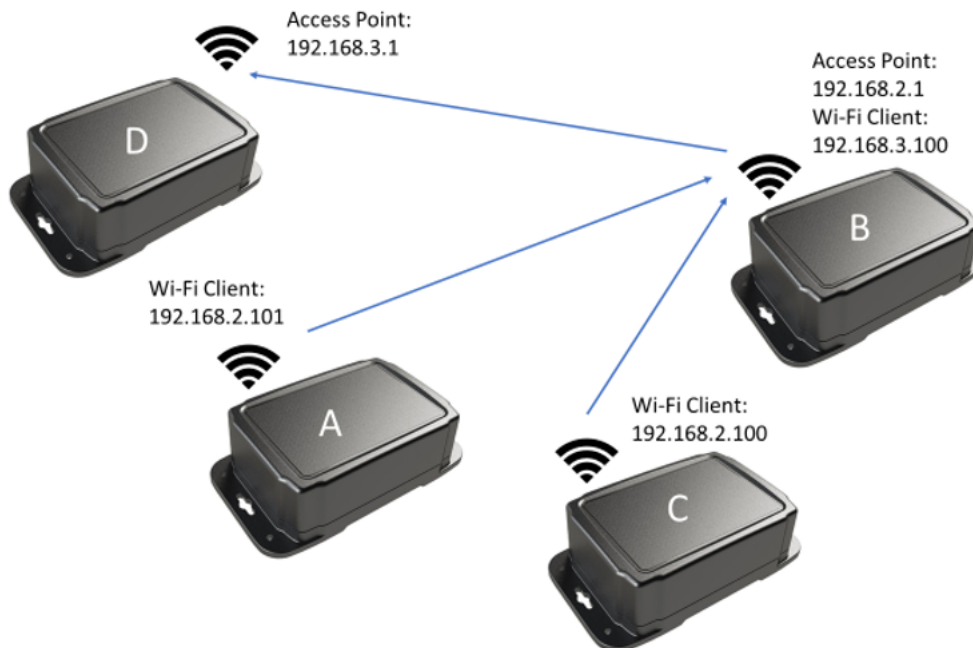


Figure 12-3 Wi-Fi configuration with multiple access points



When two SmartBoat modules are being used as access points and connected to each other, the IP address for one of the modules must be changed to a different subnet.

In this example, module D has been set to subnet 192.168.3. The result is that module B is active on two separate subnets.

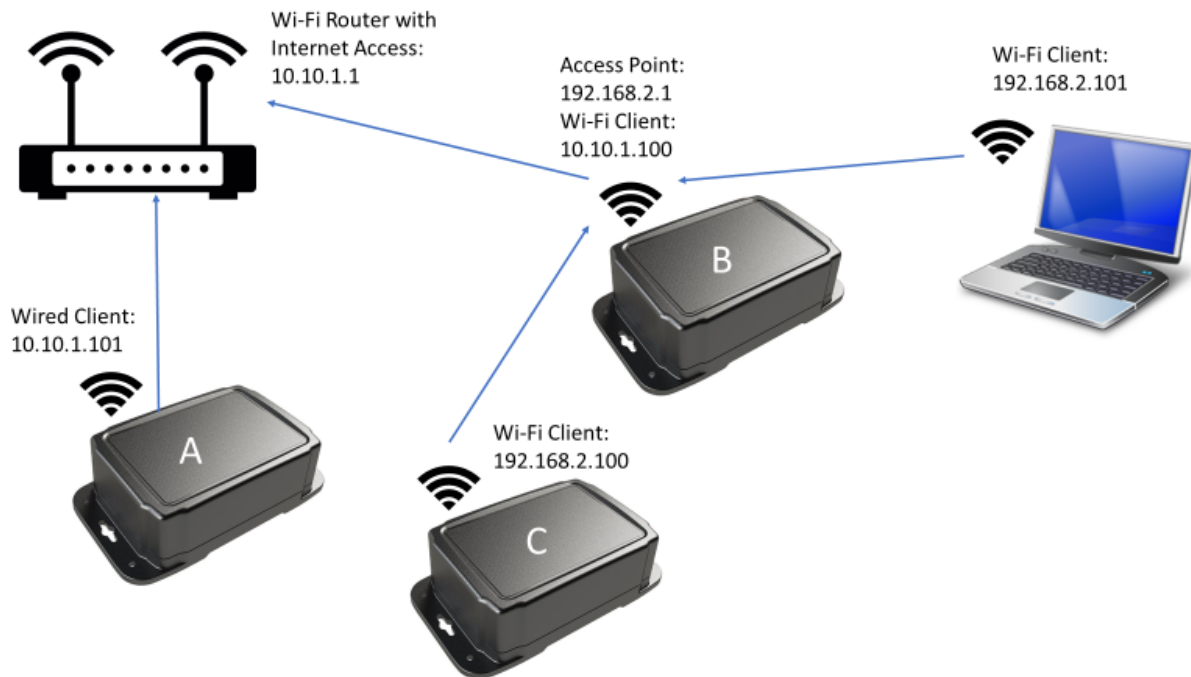


Figure 12-4 Complex network configuration

12.2 Extending the NMEA 2000 bus

The secondary bus of any two SmartBoat modules that are connected by Wi-Fi or Ethernet on the **same subnet** may be connected. This is called “network extension.”

When two modules are linked using network extension, all NMEA 2000 PGN messages on the secondary bus will be also available on the secondary bus of the other module. This may be a second physical bus or a virtual bus depending upon the capabilities of the module and the configuration selected.

It does not matter which module is configured as the client. An extension connection simply requires that they be able to communicate.

Using network extension, it is possible to “daisy chain” any number of SmartBoat modules together, and the secondary buses for all modules will act as one. For example, if module A was extended to module B, and module B was extended to module C, and module C was extended to module D, all secondary bus PGN traffic for all four modules will be available to all four modules. The SmartFlex filter function can then be used to control which PGNs are bridged to the primary NMEA 2000 bus of each module, and which PGNs from the primary bus will be bridged and available to the other three modules.

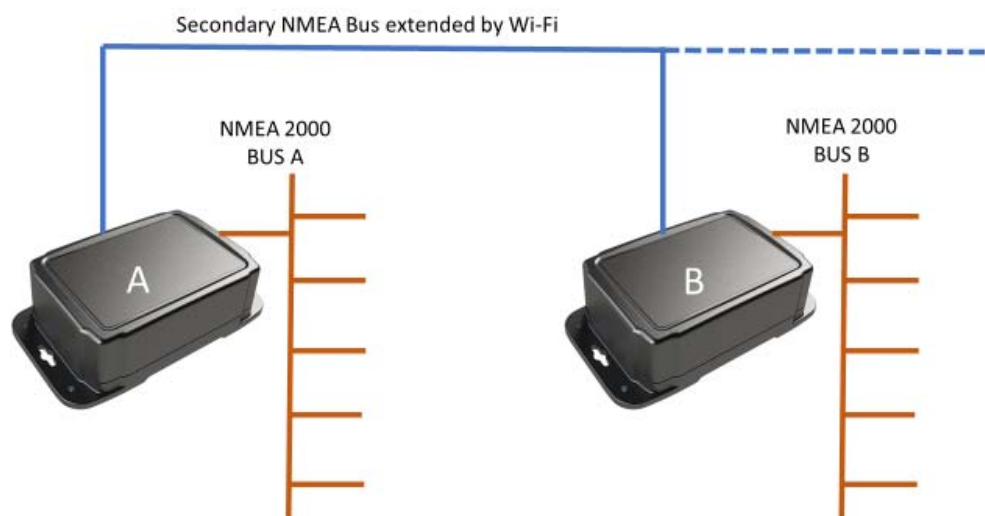


Figure 12-5 Bridging over Wi-Fi/Ethernet

13 Administrative Features

The SmartBoat module Administration screen is reached by selecting the “Administration” link in the sidebar. Figure 13-1 shows a typical screen.

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FE9BF74F Log Out

ASM-CES-T1

Status

View Alerts

Configuration

View Devices

View Network

SAE J1939

View NMEA 0183

Support

Guided Setup

Administration

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Administration

Authorized Users

Usernames and Passwords

Module Nickname

Licensed Features

Add or remove license keys

System Update

Update system firmware:

No file chosen

System Log

Clear the system log

Save system log to a file

System Functions

Restart the system

Restore factory configuration

Save module configuration file

Restore saved module configuration file:

No file chosen

Figure 13-1 Administration screen

This screen provides options for managing the SmartBoat module.

- **Authorized users:** Manage usernames and passwords. Set an administrative username and password for improved security.
- **Change module nickname:** Each SmartBoat module may be assigned a nickname to help identify individual modules. The nickname will be displayed at the top of each configuration screen. Nicknames may only consist of letters, numbers, spaces, and limited punctuation (period, comma, dash, underscore, question mark, and exclamation point). Nicknames will also be displayed when you click on “View Network” to bring up the NMEA Network Information screen. If a nickname is not set, the 8-character serial number will be used.
- **Licensed features:** Manage the license keys for optional SmartFlex system features.
- **System update:** The system firmware may be updated from a connected computer.
- **System log:** The System Log may be saved to your connected computer or cleared. The logging level may also be changed to a value between 1 (minimum) and 99 (maximum) to select the level of detail in the log.
- **System functions:**
 - **Restart:** Restart the system as if the power were cycled on the module.
 - **Reset:** Restore the default factory configuration. ***Note that the current configuration settings will be lost permanently.*** Saving the current configuration settings before a reset is recommended.
 - **Save config:** The current configuration file may be saved to a connected device.
 - **Restore config:** A saved configuration file may be used to restore a module to previous settings. This function may also be used to “clone” SmartBoat modules when configuring multiple systems.

13.1 Change username and password

The factory default for each SmartBoat module has *no* username or password set. Airmar recommends setting a username and password to provide additional security for your network.



This username and password are not the same as the Wi-Fi SSID and passphrase used for wireless security.

If no username and password have been set, then the module may be accessed directly, bypassing the Login screen. Otherwise, when first connecting to the module a correct username and password must be entered.

ASMCES-T1

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FE9BF74F Log Out

Administration / Manage Users

Username	Role	Actions	
user1	Administrator	Change	Remove
user2	Administrator	Change	Remove
user3	User	Change	Remove

[Add User](#)

[Return](#)

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Figure 13-2 Manage users screen

It is important to remember the assigned username and password for each module. If this information is lost, it will not be possible to access the configuration interface. The only recovery is to reset the module to the factory configuration, using the Reset switch as described in section 4.

Administrators have full access to the SmartBoat module settings and may make configuration changes. Non-administrator users cannot access the configuration pages, and may only view device and message information.

You may log out of the module configuration interface at the end of a session by clicking the "Log Out" link at the top of the screen.

13.2 Change module nickname

Each SmartBoat module may be assigned a nickname that will be displayed at the top of each screen. This is optional. It is only used to simplify identification and management of the module. This name is not available on the NMEA 2000 network. If a module nickname is not assigned, the serial number of the module will be used.

13.3 Manage licensed features

Each SmartBoat module requires a system license, included with purchase. Some additional SmartFlex features are optional, requiring a separate software license key. You may view currently active keys, remove them, or add a new license key as shown below.

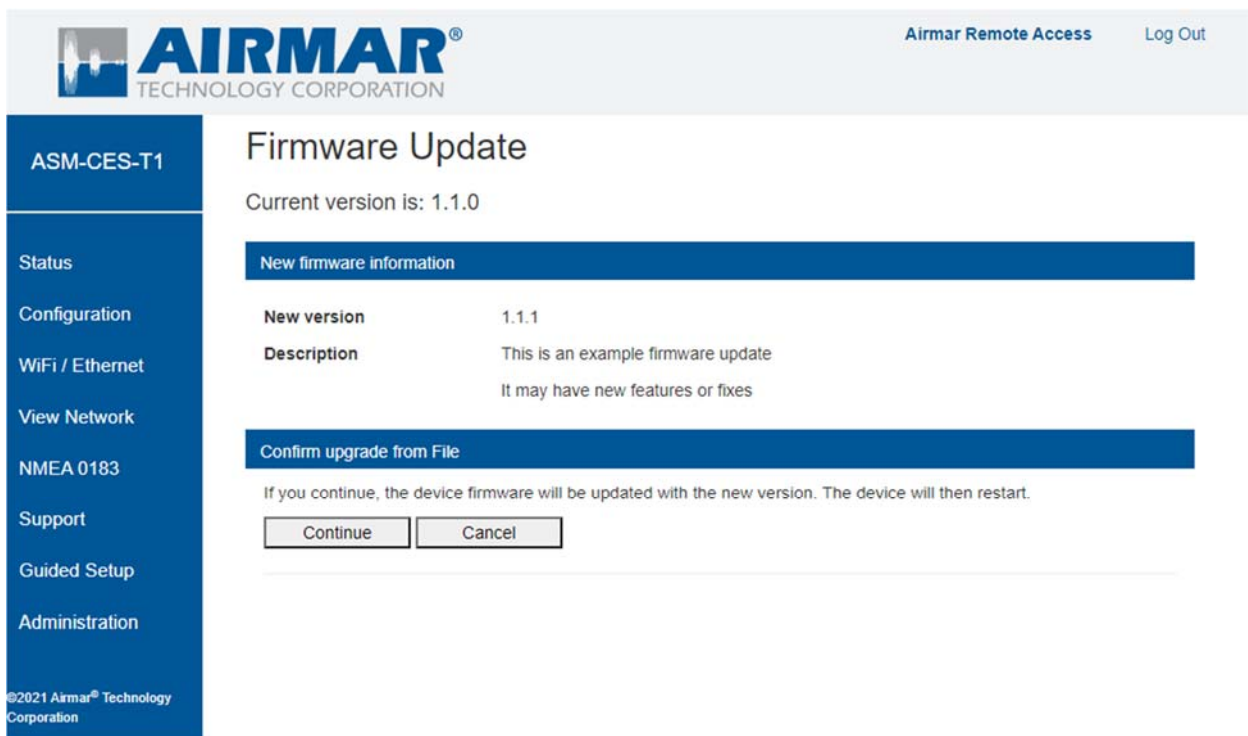
The screenshot displays the Airmar Technology Corporation web interface. At the top, the Airmar logo and the text 'TECHNOLOGY CORPORATION' are visible. To the right of the logo, the text 'FE9BF74F' and 'Log Out' are displayed. The sidebar on the left contains the following navigation items: 'ASM-CES-T1', 'Status', 'Configuration', 'WiFi / Ethernet', 'View Network', 'SAE J1939', 'NMEA 0183', 'Support', 'Guided Setup', and 'Administration'. The main content area is titled 'License Keys'. It features a table with one row containing the license key 'BEBX5-UES2M-78PC9-S5D2G-7L2U9' and a 'Remove' button. Below this, there is a text input field for a 'New License Key' and an 'Add' button. At the bottom of the main area, there is a 'Return' button and the text 'Changes take effect after restarting'. The footer of the sidebar shows the copyright notice '©2021 Airmar® Technology Corporation'.

Figure 13-3 Manage license keys

13.4 Updating the SmartBoat module firmware

SmartBoat module firmware may be updated from your connected computer or mobile device. In most cases, configuration settings will be preserved through the update process.

Firmware update files have the extension “.ASM”. They must be downloaded to your connected SmartBoat module. Select “Choose File” and navigate to the new firmware file. The selected file name will be shown on the Administration screen. After selecting “Update Firmware”, this file will be transferred to the SmartBoat module. You will be presented with the Firmware Update screen shown below.



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Airmar Remote Access Log Out

ASM-CES-T1

Firmware Update

Current version is: 1.1.0

New firmware information	
New version	1.1.1
Description	This is an example firmware update It may have new features or fixes

Confirm upgrade from File	
If you continue, the device firmware will be updated with the new version. The device will then restart.	
<input type="button" value="Continue"/>	<input type="button" value="Cancel"/>

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Figure 13-4 Firmware update screen

The actual screen will be different from the example shown. The current firmware version is displayed at the top of the screen. Information about the new firmware file, including a description of changes, is shown below. If there are any issues with the update file, an error message would be displayed. Selecting “Continue” will complete the firmware update process, and the module will restart.



If you are connected wirelessly, it is necessary to reconnect before the system can restart. Selecting "Cancel" or navigating away from this screen will mean that no changes to the system are made.

The version number and description are provided to help ensure that the update represents the changes you wish to make. It is possible to revert to a previous version of the system firmware by applying an older update file. You may also revert to the previous firmware after an update using the "Reset" button as described in section 4.

The first time you log into the administrative web server after performing a firmware update, the status screen will show a banner similar to the example below.

The screenshot displays the Airmar SmartBoat Module Status web interface. At the top, the Airmar Technology Corporation logo is on the left, and 'Airmar Remote Access' and 'Log Out' links are on the right. The main header shows 'ASM-CES-T1' on the left, 'SmartBoat™ Module Status' in the center, and the date/time '16 MAY 2021 15:12 UTC' on the right. A prominent orange banner at the top of the main content area reads 'Firmware update from version 1.1.0 complete'. Below this, the 'Module Information' section lists details: Serial Number (97187F61), Hardware Version (ASM-CES-T1), Firmware Version (1.1.0), Running Time (0 Days : 0 Hours : 0 Minutes), and USB Storage (Not available). The 'Networking' section shows Access Point (SSID: ASM-CES-T1-97187F61, Enabled), Wifi Status (Connected: SSID Linder, IPV4: 10.10.8.113), and Ethernet (Connected, IPV4: 10.10.10.11). The 'NMEA 2000' section lists Primary Network (NMEA 2000), Secondary Network (Virtual), Ethernet server (Enabled), Ethernet extension (Disabled), and Active NMEA sources (Direct: 2, Bridged: 1). A 'Device Configuration' section is partially visible at the bottom. A left sidebar contains navigation links: Status, Configuration, WiFi / Ethernet, View Network, NMEA 0183, Support, Guided Setup, and Administration. The footer on the left shows '©2021 Airmar® Technology Corporation'.

Figure 13-5 Example: Completed firmware update



The firmware update banner will appear until additional configuration changes are made.

Firmware updates also include the latest version of this user manual. The manual is available by using the “Support” link in the sidebar.

13.5 System log

In most situations, there is no need to access the system log. The logging function improves customer support when problems are encountered.

The log file may be saved to your connected device by selecting “Save Log.” The file name will include the model number and serial number of the SmartBoat module and have the file extension “.LOG”.

The system logging level may be changed to record more or less information about system performance. The maximum logging level is 99. Airmar recommends a logging level of 8 during normal operation.

13.6 System functions

System management features include the following:

- **Restart:** This is equivalent to powering your device OFF and ON again.
- **Reset:** Remove all user configuration information.
- **Save config:** Save the current SmartBoat module configuration to a file.
- **Restore config:** Set the configuration using a saved configuration file. Only restore configuration files saved from the same model SmartBoat module.

14 Appendix A: NMEA 2000 PGNs

14.1 Table of generated PGNs

GENERATED FROM DEVICES		
PGN	CATEGORY	DESCRIPTION
065286	Proprietary	Fluid Flow Rate
065287	Proprietary	Trip Flow Volume
127245	Steering	Rudder
127489	Propulsion	Engine Parameters, Rapid Update
127497	Propulsion	Trip Fuel Consumption
127501	Power	Binary Switch Bank Status
127505	Power	Fluid Level
127508	Power	Battery Status
127751	Power	DC Voltage
130310	Environmental	Environmental Parameters
130311	Environmental	Environmental Parameters
130312	Environmental	Temperature
130313	Environmental	Environmental Parameters
139314	Environmental	Actual Pressure
130316	Environmental	Temperature, Extended Range
130840	Proprietary	Generic Sensor
GENERATED BY SMARTFLEX ALERT FUNCTION		
PGN	CATEGORY	DESCRIPTION
126983	General/Mandatory	Alert
126985	General/Mandatory	Alert Text
127502	Power	Binary Switch Bank Control
GENERATED BY SAE J1939 GATEWAY		
PGN	CATEGORY	DESCRIPTION
127488	Propulsion	Engine Parameters, Rapid Update
127489	Propulsion	Engine Parameters, Dynamic
127493	Propulsion	Transmission Parameters, Dynamic
127498	Propulsion	Engine Parameters, Static
GENERATED BY DIGITAL SENSORS		
PGN	CATEGORY	DESCRIPTION
065286	Proprietary	Fluid Flow Rate
065287	Proprietary	Trip Flow Volume
127488	Propulsion	Engine Parameters, Rapid Update
127489	Propulsion	Engine Parameters, Dynamic

GENERATED BY NMEA 0183 GATEWAY		
PGN	CATEGORY	DESCRIPTION
126992	General/Mandatory	System Time
127237	Steering	Heading/Track Control
127245	Steering	Rudder
127250	Steering	Vessel Heading
127251	Steering	Rate of Turn
127258	Steering	Magnetic Variation
127259	Propulsion	Speed
128267	Navigation	Water Depth
128275	Navigation	Distance Log
129025	Navigation	Position, Rapid Update
129026	Navigation	COG & SOG, Rapid Update
129029	Navigation	GNSS Position Data
129033	Navigation	Time & Date
129044	Navigation	Datum
129283	Navigation	Cross Track Error
129284	Navigation	Navigation Data
129291	Navigation	Set & Drift, Rapid Update
129539	Navigation	GNSS DOPs
129540	Navigation	GNSS Satellites in View
130306	Environmental	Wind Data
130310	Environmental	Environmental Parameters
130311	Environmental	Environmental Parameters
130312	Environmental	Temperature
130316	Environmental	Temperature, Extended Range

14.2 Proprietary PGN definitions

PGN 130840: Generic sensor

This PGN provides a regular transmission of various parameters that are not otherwise available in the NMEA Network messages. The default transmission rate is once every two seconds. The transmission of this PGN must be configured by the user.

Field Definitions

- **Manufacturer code:** This defaults to the Airmar manufacturer code which is 1008.
- **Reserved:** All bits are set to 1.
- **Industry group:** This field contains the marine industry group code which is 4.
- **Data instance:** This identifies a particular measurement.
- **Data format:** This indicates the format of the parameter value that appears in field 6. This number refers to the DF (data format) value as defined by the NMEA 2000 specification.
- **Data value:** This field contains the parameter value being transmitted. Its size is defined by the data format specified in field 5.

PGN 65286: Fluid-flow rate

This PGN provides a regular transmission of fluid flow rates not available in the NMEA network messages. The default transmission rate is once every 0.5 seconds. The transmission of this PGN must be configured by the user.

Field Definitions

- **Manufacturer code:** This defaults to the Airmar manufacturer code which is 1008.
- **Reserved:** All bits are set to 1.
- **Industry group:** This field contains the marine industry group code which is 4.
- **SID:** This is the Sequence ID.
- **Flow-rate instance:** This identifies a particular measurement.
- **Fluid type:** This indicates the liquid being measured. Possible values for this field include fuel, fresh water, wastewater, live well, oil, and black water. (4 bits)
- **Reserved bits:** All bits are set to 1. (4 bits)
- **Fluid-flow rate:** The flow rate of the liquid in units of $1 \times 10^{-4} \text{ m}^3/\text{hour}$. (3 bytes)

PGN 65287: Trip flow volume

This PGN provides a regular transmission of trip fluid volume. The default transmission rate is once every 0.5 seconds. The transmission of this PGN must be configured by the user.

Field Definitions

- **Manufacturer code:** This defaults to the Airmar manufacturer code which is 1008.
- **Reserved:** All bits are set to 1.
- **Industry group:** This field contains the marine industry group code which is 4.
- **SID:** This is the Sequence ID
- **Volume instance:** This identifies a particular measurement.
- **Fluid type:** This indicates the liquid being measured. Possible values for this field include fuel, fresh water, wastewater, live well, oil, and black water. (4 bits)
- **Reserved bits:** All bits are set to 1. (4 bits)
- **Trip Volume:** The volume of liquid in units of $1 \times 10^{-3} \text{ m}^3$. (3 bytes)

15 Appendix B: NMEA 0183 Gateway Conversions

15.1 NMEA 0183 sentence to NMEA 2000 PGN conversions

NMEA 0183 SENTENCES	DESCRIPTION	NMEA 2000 PGNS GENERATED
APB	Heading/Track Controller (Autopilot) Sentence B	127237, 129283, 129284
DBT	Depth Below Transducer	128267
DPT	Depth	128267
GGA	Global Positioning System Fix Data	126992, 129025, 129029, 129033, 129539
GLL	Geographic Position Latitude / Longitude	126992, 129025, 129029, 129033
GSA	GSA GNSS DOP and Active Satellites	129029, 129539
GSV	GSV GNSS Satellites in View	129540
HDG	Heading, Deviation & Variation	127250, 127258
HDM	Heading, Magnetic	127250
HDT	Heading, True	127250
HSC	Heading Steering Command	127237
MDA	Meteorological Composite	130306, 130310, 130311, 130312, 130316
MTW	Water Temperature	130310, 130311, 130312, 130316
MWD	Wind Direction & Speed	130306
MWV	Wind Speed and Angle (Relative & Theoretical)	130306
RMB	Recommended Minimum Navigation Information	129283, 129284
RMC	Recommended Minimum Specific GNSS Data	126992, 127250, 127258, 129025, 129026, 129029, 129033
ROT	Rate Of Turn	127251
RPM	Revolutions	127488
RSA	Rudder Sensor Angle	127245
VBW	Dual Ground / Water Speed	130578
VDR	Set and Drift	129291
VHW	Water Speed and Heading	127250, 128259
VLW	Dual Ground / Water Distance	128275
VTG	Course Over Ground and Ground Speed	129026, 129029
VWR	Relative (Apparent) Wind Speed and Angle	130306
XTE	Cross Track Error, Measured	129283
ZDA	Time & Date	126992, 129029, 129033

15.2 NMEA 2000 PGN to NMEA 0183 sentence conversions

NMEA 2000 PGN	DESCRIPTION	NMEA 0183 SENTENCE GENERATED
126992	System Time	ZDA, GGA, GLL, RMC
127237	Heading/Track Control	APB
127245	Rudder	RSA
127250	Vessel Heading	HDG, VHW, RMC
127251	Rate of Turn	ROT
127258	Magnetic Variation	HDG, RMC
128259	Speed, Water referenced	VHW
128267	Water Depth	DBT, DPT
128275	Distance Log	VLW
129025	Position, Rapid Update	GGA, GLL, RMC
129026	COG & SOG, Rapid Update	RMC, VTG
129029	GNSS Position Data	GGA, GLL, GSA, RMC, ZDA
129033	Time & Date	ZDA, GGA, GLL, RMC
129044	Datum	DTM
129283	Cross Track Error	APB, RMB, XTE
129284	Navigation Data	APB, RMB
129291	Set & Drift, Rapid Update	VDR, GGA
129539	GNSS DOPs	GSA
129540	GNSS Satellites in View	GSV
130306	Wind Data	MDA, MWD, MWV, VWR
130310	Environmental Parameters	MDA, MTW
130311	Environmental Parameters	MDA, MTW
130312	Temperature	MDA, MTW
130316	Temperature, Extended Range	MDA, MTW

16 Appendix C: PGN Identifying Fields

PGN	Description	Identifying Field		
		1	2	3
65286	Proprietary Flow Rate	Manufacturer ID	Instance	Type
65287	Proprietary Trip Volume	Manufacturer ID	Instance	Type
127488	Engine Parameters, rapid update	Instance		
127489	Engine Parameters, dynamic	Instance		
127493	Transmission Parameters, dynamic	Instance		
127498	Engine Parameters, Static	Instance		
127501	Binary Status Report	Instance		
127502	Switch Bank Control	Instance		
127503	AC Input Status	Instance		
127504	AC Output Status	Instance		
127505	Fluid Level	Instance / Type		
127506	DC Detailed Status	Instance		
127507	Charger Status	Charger Instance	Battery Instance	
127508	Battery Status	Instance		
127509	Inverter Status	Instance		
127510	Charger Configuration Status	Charger Instance	Battery Instance	
127511	Inverter Configuration Status	Inverter Instance	AC Instance	DC Instance
127514	AGS Configuration Status	AGS Instance	Generator Instance	
127744	AC Power / Current – Phase A	Connection		
127745	AC Power / Current – Phase B	Connection		
127746	AC Power / Current – Phase C	Connection		
127747	AC Voltage / Frequency – Phase A	Connection		
127748	AC Voltage / Frequency – Phase B	Connection		
127749	AC Voltage / Frequency – Phase C	Connection		
127750	Converter Status	Connection		
127751	DC Voltage / Current	Connection		
130311	Environmental Parameters	Temperature Instance	Humidity Instance	
130312	Temperature	Instance	Source	
130313	Humidity	Instance	Source	
130314	Actual Pressure	Instance	Source	
130315	Set Pressure	Instance	Source	
130316	Temperature, Extended Range	Instance	Source	
130840	Proprietary	Manufacturer ID	Instance	Format

17 Appendix D: Mounting Template



18 Appendix E: Warranty

LIMITED 2-YEAR WARRANTY

Airmar covers this Product with a standard two-year (2) warranty in accordance with the language contained below. Coverage is provided for the period of two years from the date-of-manufacture on the product label.

LIMITED 3-YEAR WARRANTY

Airmar will cover this Product for a period of three (3) years from the date-of-installation, when the installation has been completed by an Airmar Certified Installer (ACI). Post-install warranty submission shall be done by the ACI in accordance with the Type 3 Warranty procedure outlined in Airmar's general warranty policy.

WHAT IS COVERED BY WARRANTY

Except as specified below, the Airmar warranty covers all Product defects in material and workmanship. The following are NOT covered: damage caused by accident, misuse, abuse, or Product modification (including opening the unit); neglect; damage occurring during shipping; damage from failure to follow instructions contained within the user's manual; damage resulting from the performance of repairs by someone not authorized by Airmar Technology; damage caused by installation of parts that do not conform to Airmar specifications; any claim based on misrepresentation by the seller; Product sold on an "as-is" or final-sale basis; or the cost of installing, removing, or re-installing the Product.

Airmar Technology's liability is limited to the repair or replacement, at our option, of any defective product and shall not include incidental or consequential damages. Airmar reserves the right to replace a discontinued model with a comparable model. Any replacement Products or parts may be new or rebuilt.

PROCESS FOR SUBMITTING WARRANTY CLAIM

Airmar must be notified in writing of any non-conformance during the warranty period, including the quantity of products considered to be non-conforming. A Return Material Authorization (RMA) must be obtained from Airmar for the non-confirming Product. An RMA number may be obtained by calling one of the following:

Gemeco Marine Accessories (Airmar subsidiary): 803-693-0777

Airmar EMEA (Europe, Middle-East, Asia, Africa): +33 (0) 2 23 52 06 48

Any non-conforming Product must be returned to Airmar, freight prepaid, within thirty (30) days of receipt of the RMA with a statement describing in reasonable specificity the non-conformity. Airmar will only accept returned Products with the original Cable Label affixed and legible. Except with regard to onboard support as set forth herein, with regard to Type 2 and Type 3 warranties, Airmar's exclusive obligation with respect to any non-conforming Product shall be, at Airmar's option, to repair or replace the Product, if Airmar determines it is defective in accordance with the terms of the relevant warranty, or to issue a credit to buyer, within thirty (30) days after receipt by Airmar of the returned Product. All transportation charges on Products returned to Airmar must be prepaid by the Buyer. Return surface transportation charges for Products covered by warranty will be prepaid by Airmar.

Based on the circumstances of the claim, Airmar may choose to waive the requirement to have warranty items returned.