AIRMAR TECHNOLOGY CORPORATION
An Amphenol Company

SmartFlex™ System

SmartBoat® Module

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

User Manual

NMEA 2000® Certified

D-20189-rev.7 05/23/2025

Contents

1 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).

2 Specifications

2.1 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 V_{rms}: 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	

2.2 Monitored Parameters

Accuracy parameters are exclusive of sensor/transducer accuracy.

2.2.1 Voltage Measurement

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

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
DC Voltage	127751, 130840
Fluid Level	127505

2.2.2 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 KΩ) and one of the following: • 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

2.2.3 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

2.2.4 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

2.2.5 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

2.2.6 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 resistors: open or shorted line	
Configuration Inputs	Number of EOL resistors	0, 1, or 2
	EOL resistor value *Note: If 2 EOL resistors, they must be the same value*	Drop down menu selection: 25 KΩ, 20 KΩ, 15 KΩ, 10 KΩ, 8 KΩ, 2 KΩ, 1 KΩ, 680 Ω
	Invert value	Select "ON" state as closed or open.

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Binary Switch	127501

2.2.7 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

2.2.8 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 mΩ maximum	
Configuration Inputs	None	

MEASURED PARAMETER	AVAILABLE NMEA 2000 PGN
Binary Switch	127501

2.3 SmartBoat Module Supported Devices

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

	ASM MODEL	
	ASM-XXX-T1	ASM-XXX-T2
FEATURE/FUNCTION		
PROGRAMMABLE SENSOR INPUTS (Total)		
Thermistor (NTC) (1)	8	4
Current Loop (2, 3, or 4-wire interface) (1) (2)	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 (2) 2- and 3-wire interfaces supported on terminal block A		
FIXED SENSOR INPUT/OUTPUT		
Thermocouples (J, K, T, E) (3)	2	
Relays (10 A resistive, 5 A inductive) (3)		4
Run Detector (9 to 240 VDC/VAC rms) (3)		4
(3) Dedicated: all can be used at the same time		

2.4 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 Values, with customized logging, 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 ENGINE GATEWAY		
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	✓	✓
SAE J1708/J1587 ENGINE GATEWAY		
SAE J1587 to NMEA 2000 conversion		✓
Simple "click to set" conversion selection and control		✓
WI-FI/ETHERNET NETWORK INFRASTRUCTURE		
Wi-Fi router with DHCP support	✓	✓
Wi-Fi/Ethernet bridge function		✓
Wi-Fi access point functions	✓	✓

3 Physical Interfaces

3.1 Network and Device Connectors

Figure 3-1: Pluggable terminal blocks for device connections

Figure 3-2: USB and Ethernet connectors

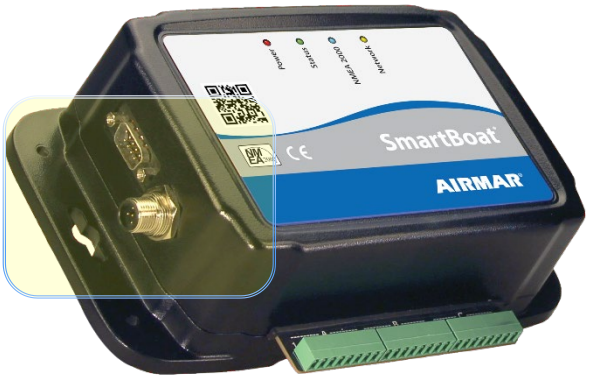


Figure 3-3: NMEA 2000 and DB-9 connectors

3.2 User Interface

3.2.1 LED Indicators

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

- **Power:** This orange LED light indicates 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 light indicates 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 flashes 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 flashes when there is web server Wi-Fi or Ethernet traffic received or sent by the module.

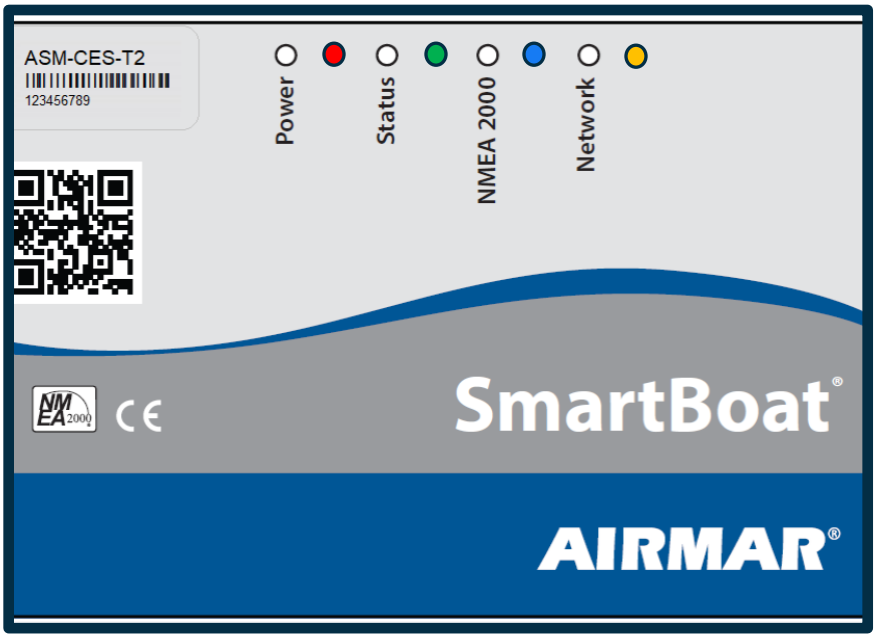


Figure 3-4: Label with LED indicators

3.2.2 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.

At 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.

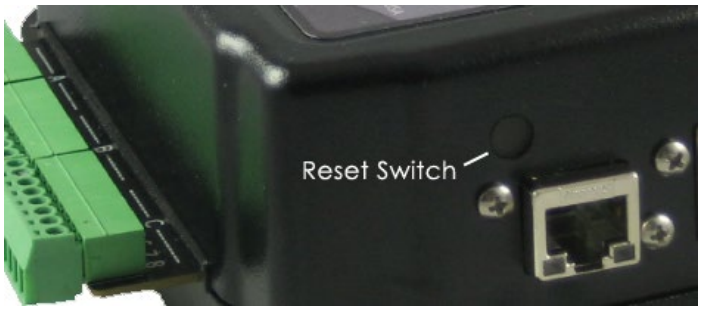


Figure 3-5: Reset switch location

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.

3.3 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.

3.4 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.

3.4.1 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 3-6: 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.

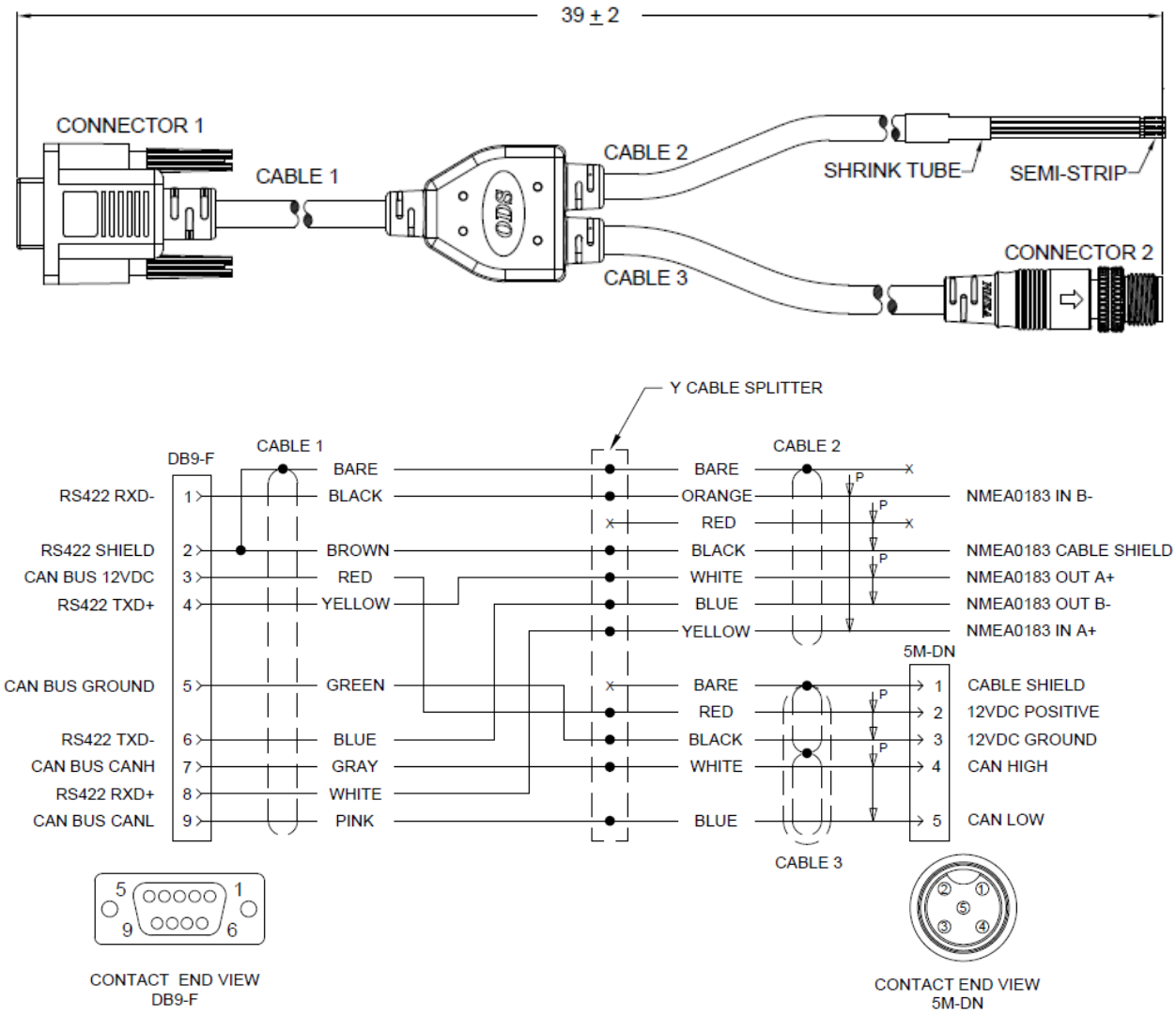


Figure 3-7: DB-9 adapter cable and Wiring Diagram – Airmar part-number ACC-YCBL-ASM-01

3.4.2 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.

3.4.3 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.

3.5 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. USB sticks must be formatted in FAT32 format.

3.6 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.

3.7 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.

Refer to Appendix D: Mounting Template for a *scaled* template that can be used for marking or drilling mounting holes. Be sure to print the template in "Actual Size." Measure printed template and compare dimensions to the following dimensions *prior to use*.

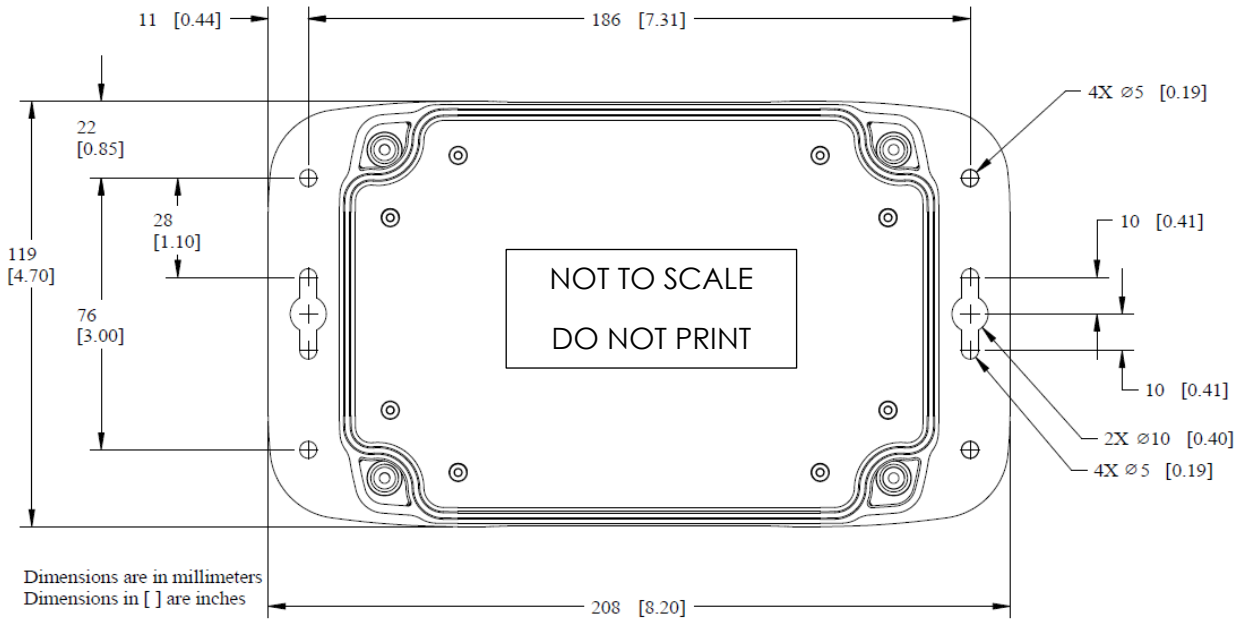


Figure 3-8: Module enclosure dimensions – not to scale

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

3.8 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 3-9: 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 3-10: 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 3-11: 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.

4 Configuring Your SmartBoat Module

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

4.1 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-ABCDEFGH where 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-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 Figure *4-1*.

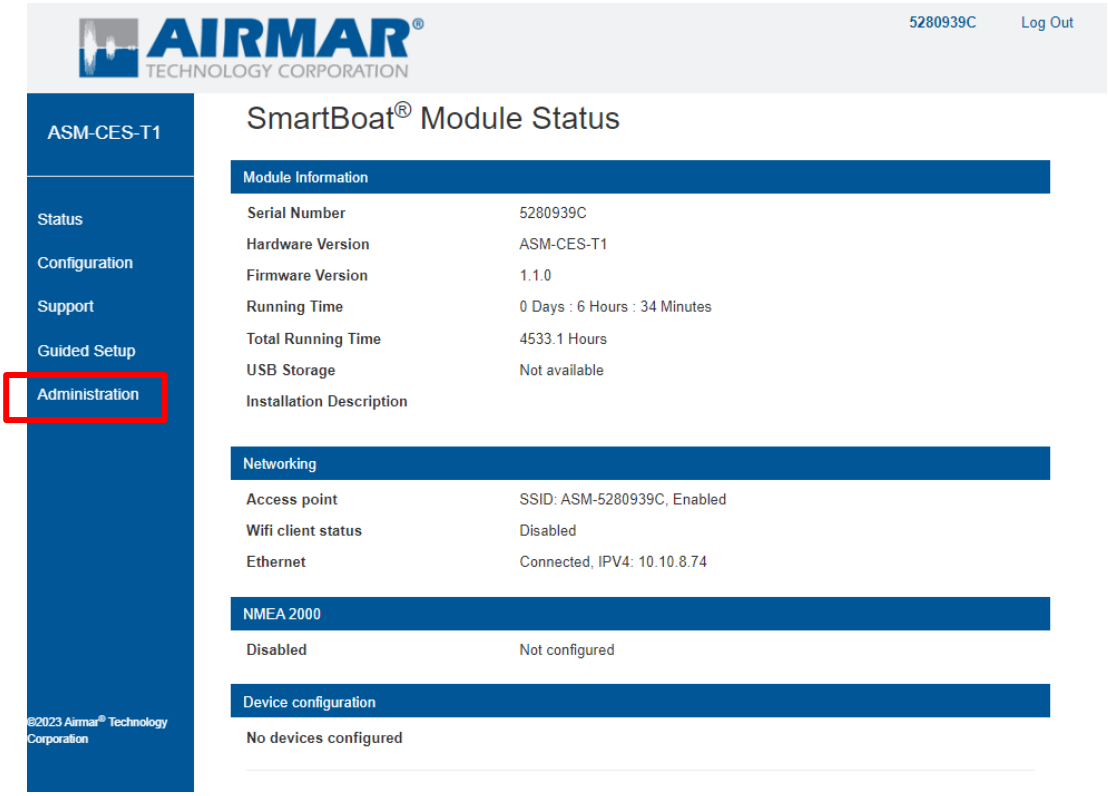


Figure 4-1: Status screen

4.2 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, shown above.

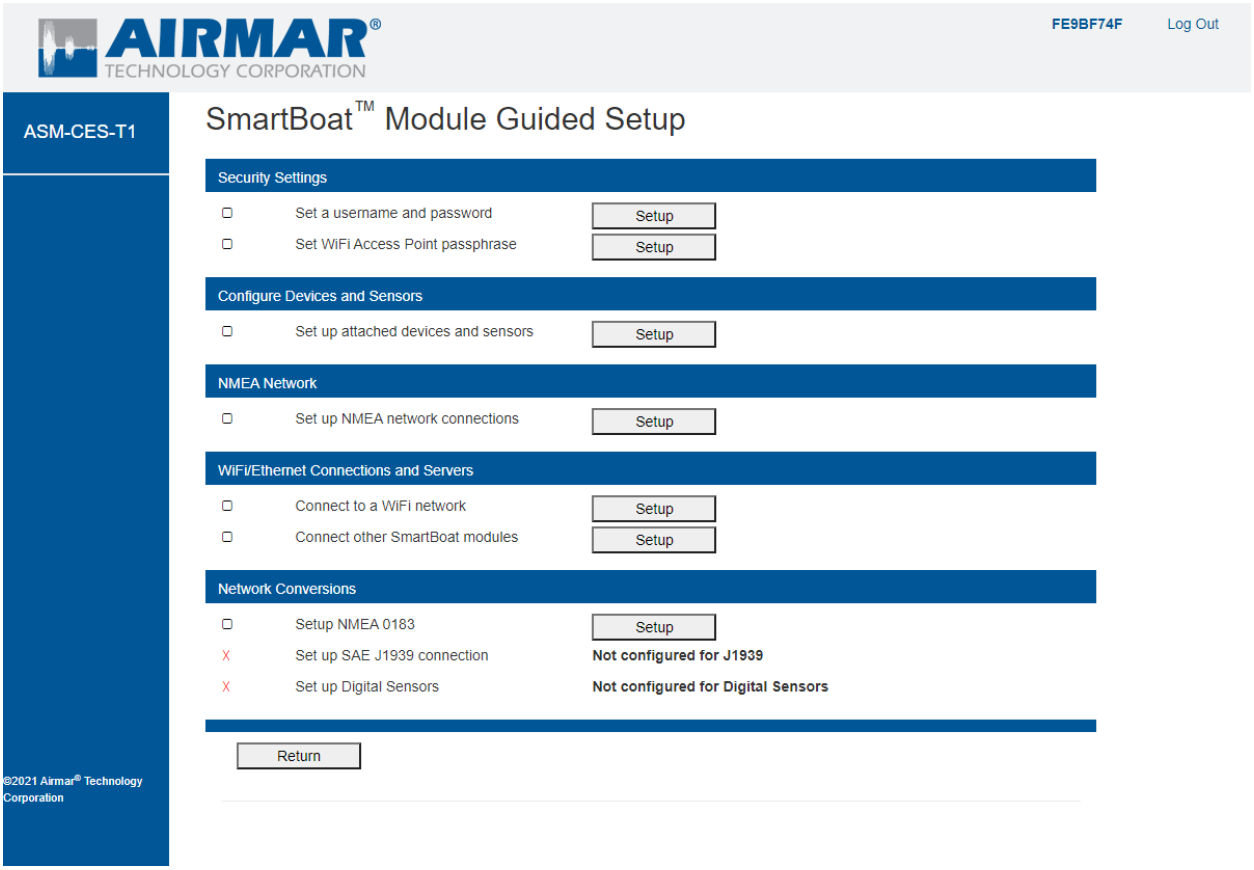


Figure 4-2: Guided setup screen

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.

4.2.1 Security Settings

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

4.2.1.1 Set a Username and Password

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

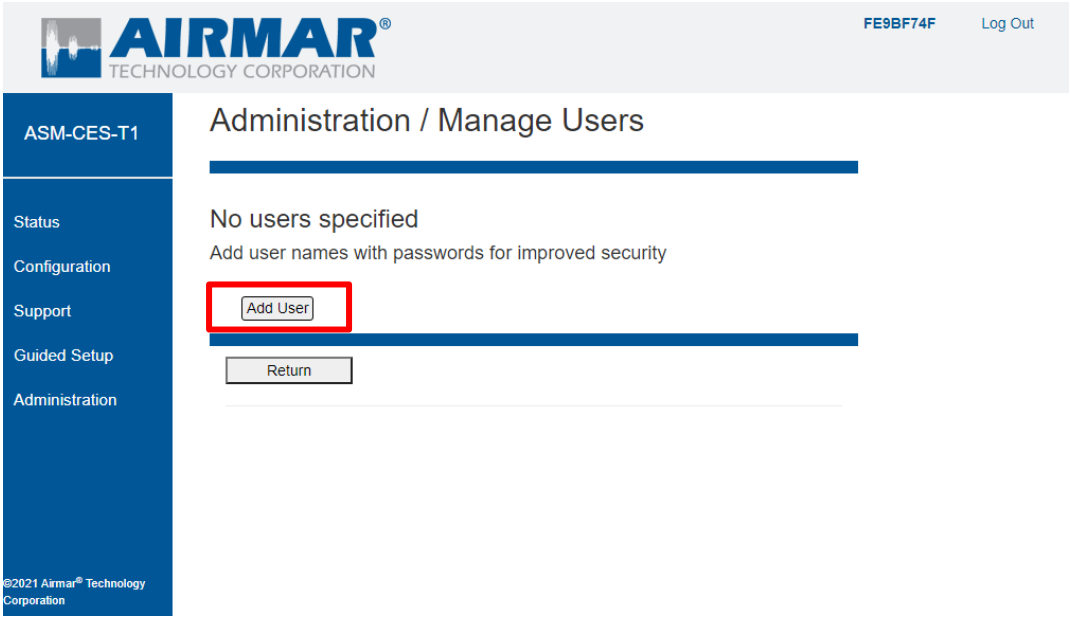


Figure 4-3: Add User/Setting the username and password

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 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: 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.

4.2.1.2 Set a Wi-Fi Access Point Passphrase

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

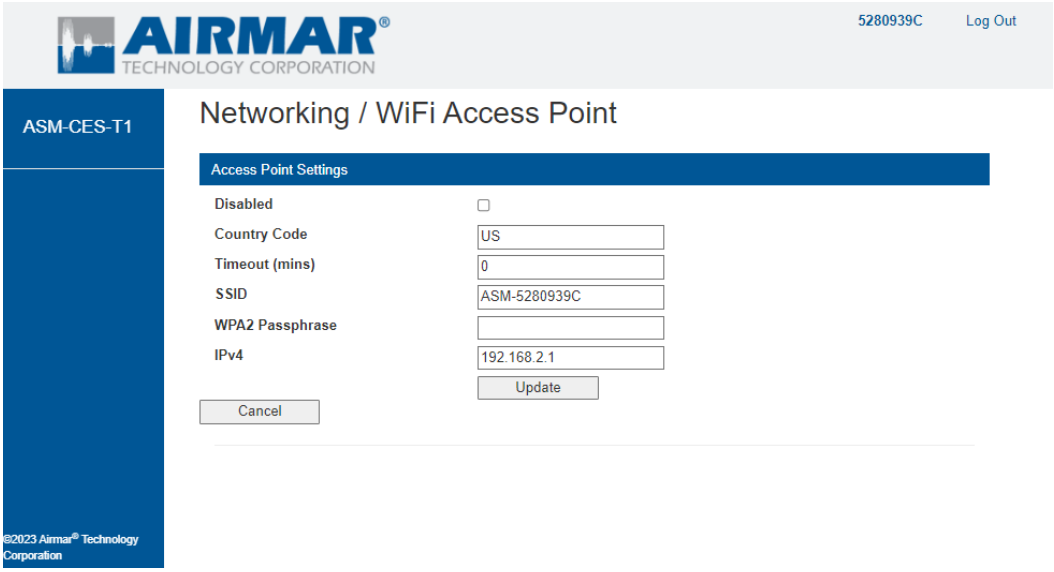


Figure 4-4: Wi-Fi Access point settings screen

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.***
- **Country Code:** The Internet Assigned Numbers Authority (IANA) assigned two-letter country code for the location of operation.
- **Timeout:** This is a security feature that allows configuration through the access point for a limited time period. 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 always keep the access point active.
- **SSID:** The default access point SSID is generated using the model's 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 is 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 6 for additional information about TCP/IP connectivity.

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

4.2.2 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 2 for information on connection devices.

4.2.2.1 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.

To make changes to a previously configured device, click on **Configure Device**. Select **No Change** as the device function.

Figure 4-5 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.

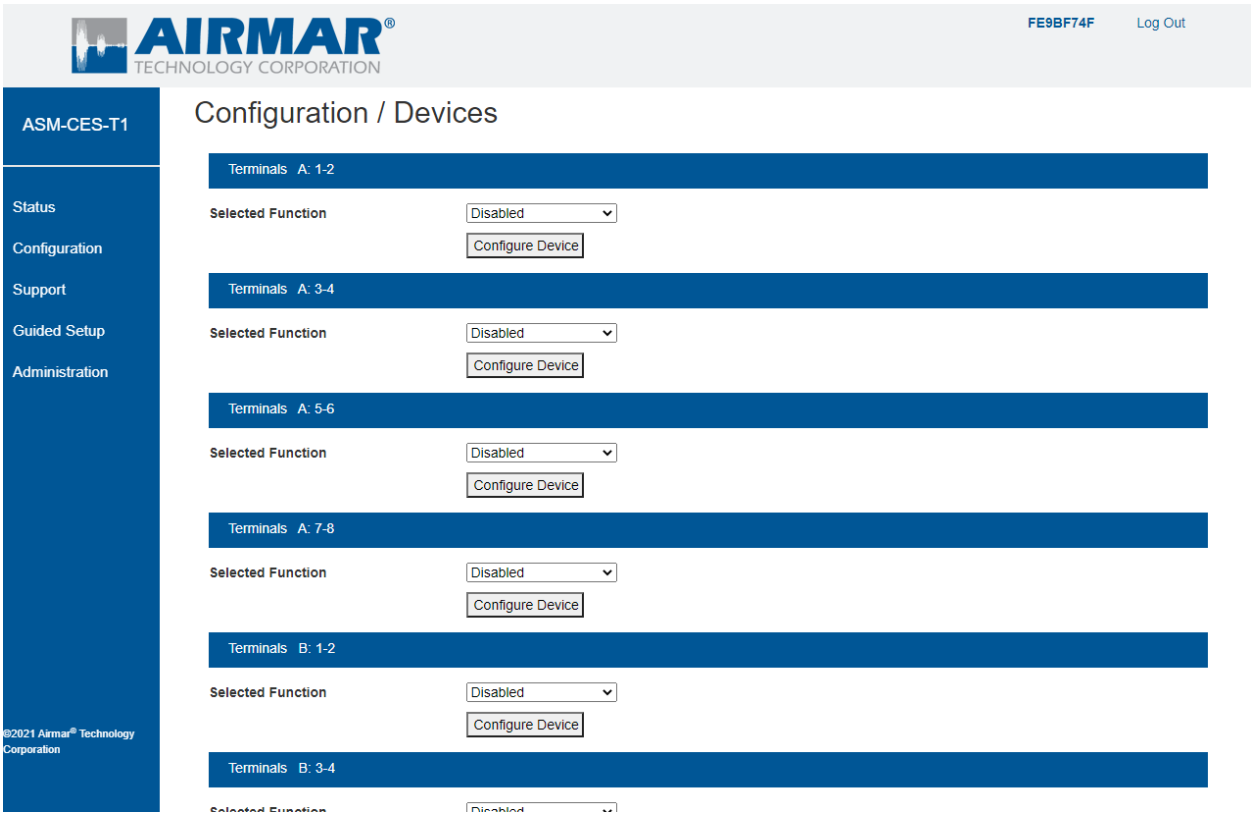


Figure 4-5: Typical device configuration screen

4.2.2.2 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.

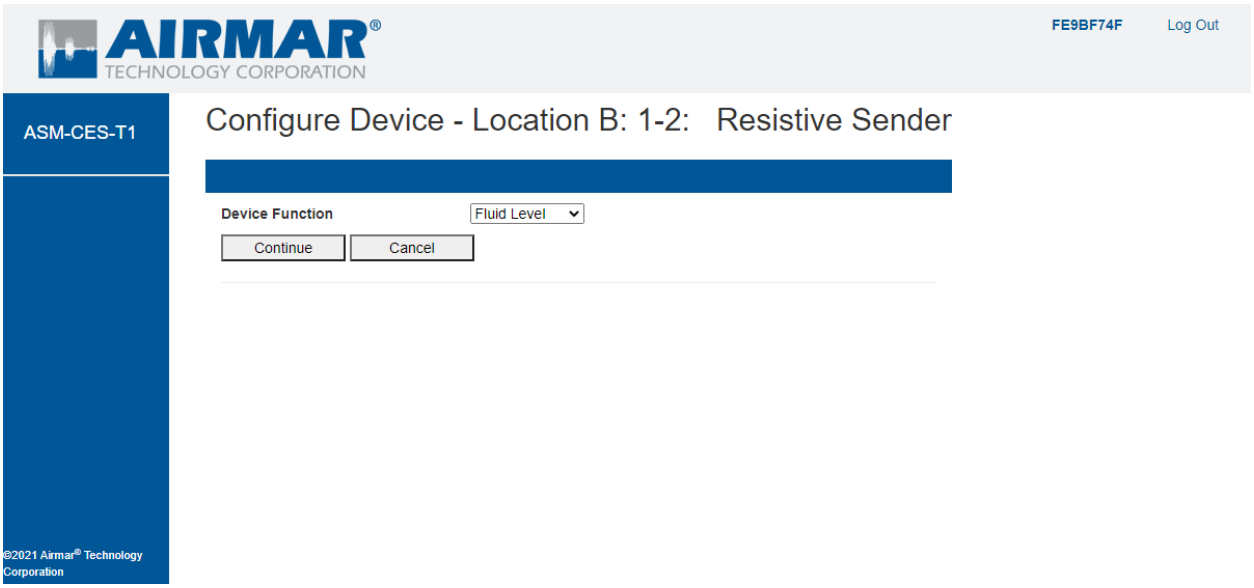


Figure 4-6: Example – Resistive sender configuration

Continuing with 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.

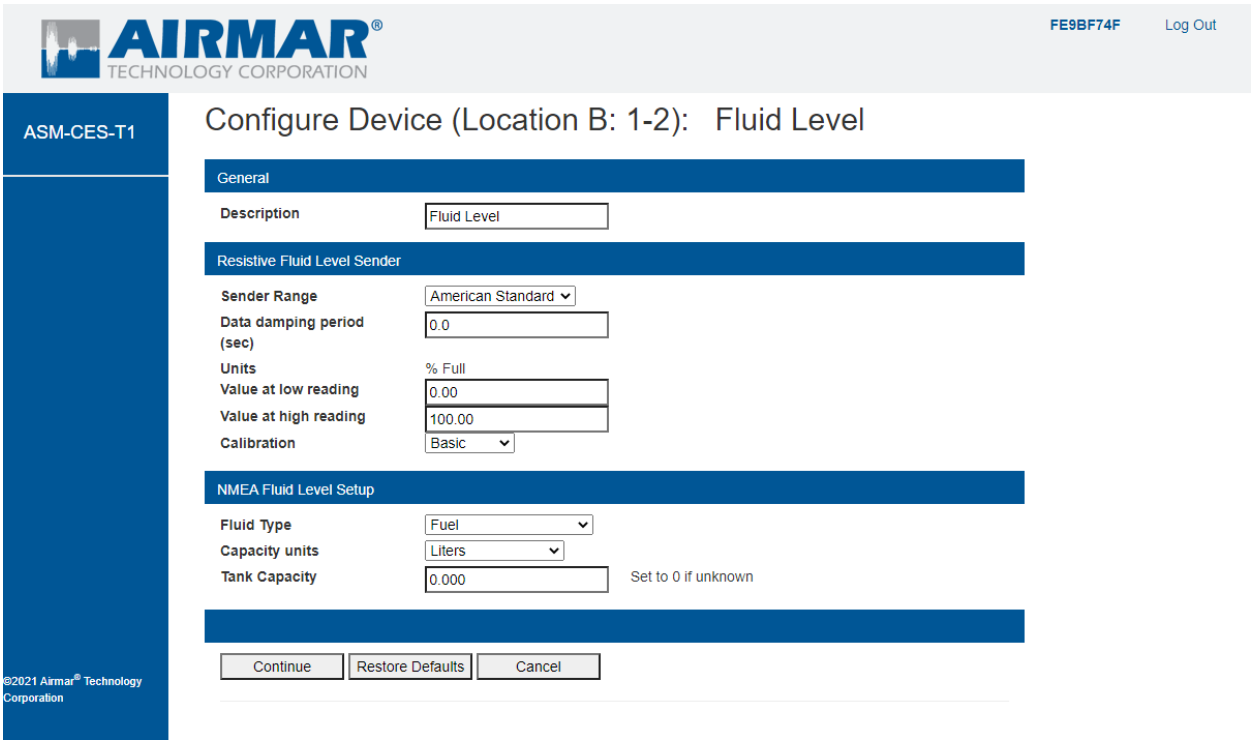


Figure 4-7: Example: Fluid level measurement function

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 the next sections.
- **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.

4.2.2.3 Device Calibration

Resistive Sender and Current Loop devices support optional calibration settings.

4.2.2.4 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.

4.2.2.5 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 next.

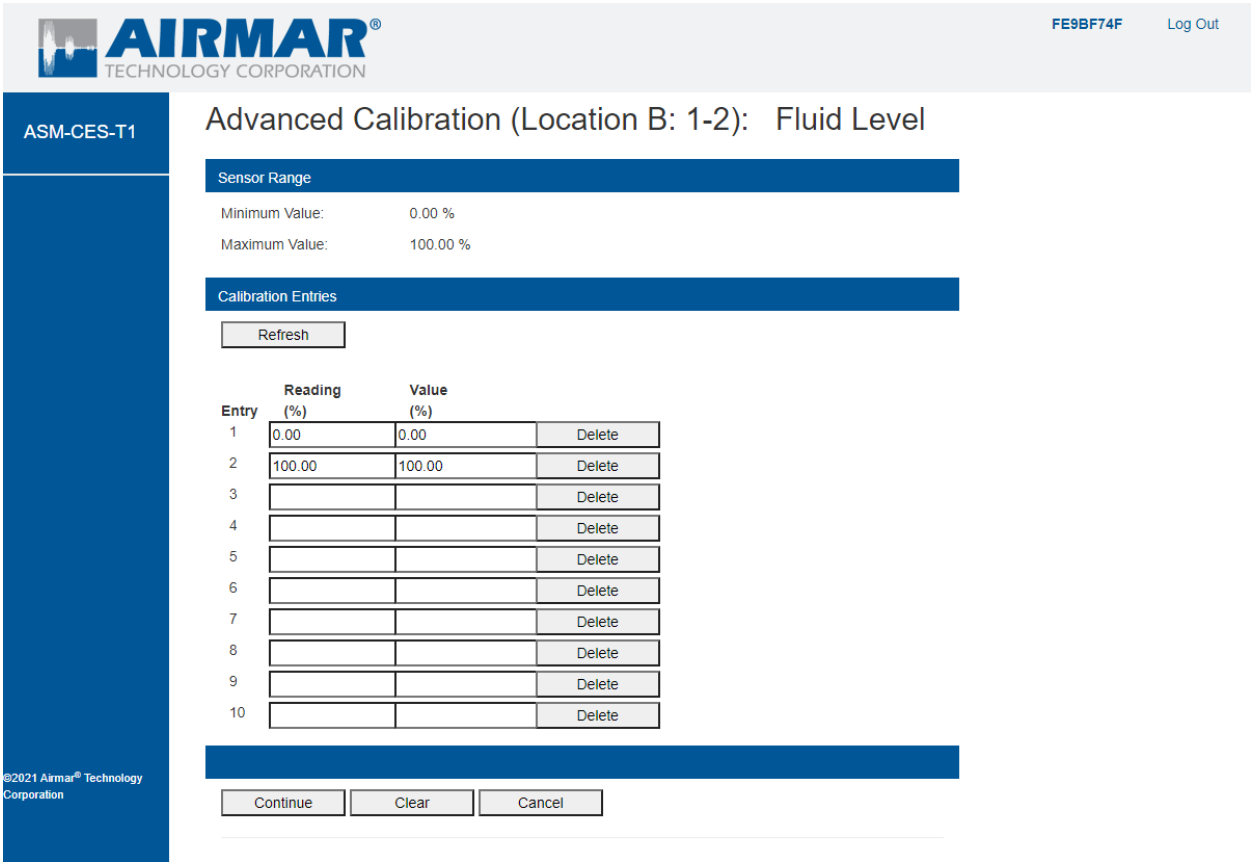


Figure 4-8: Example – Advanced calibration

4.2.2.6 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 next, the only PGN available is 127505. Other functions such as Temperature Measurement may generate several different PGN messages.

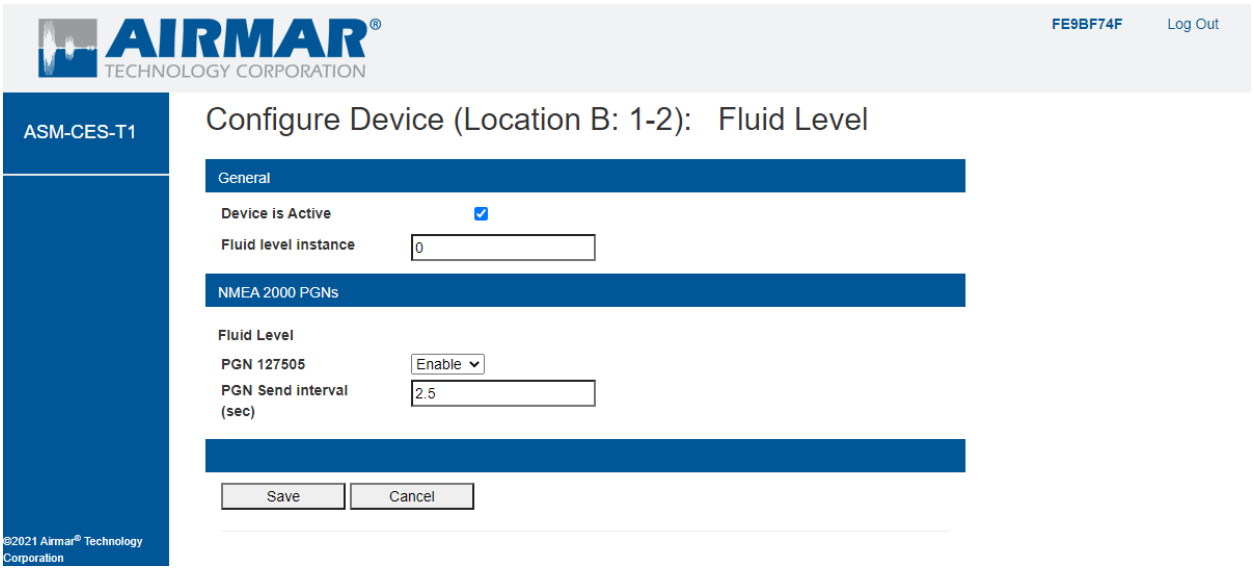


Figure 4-9: Example – Fluid level PGN configuration

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:** The interval to send the PGN. This field is prepopulated with the default value specified in the NMEA 2000 standard.

4.2.2.7 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 4-10 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.

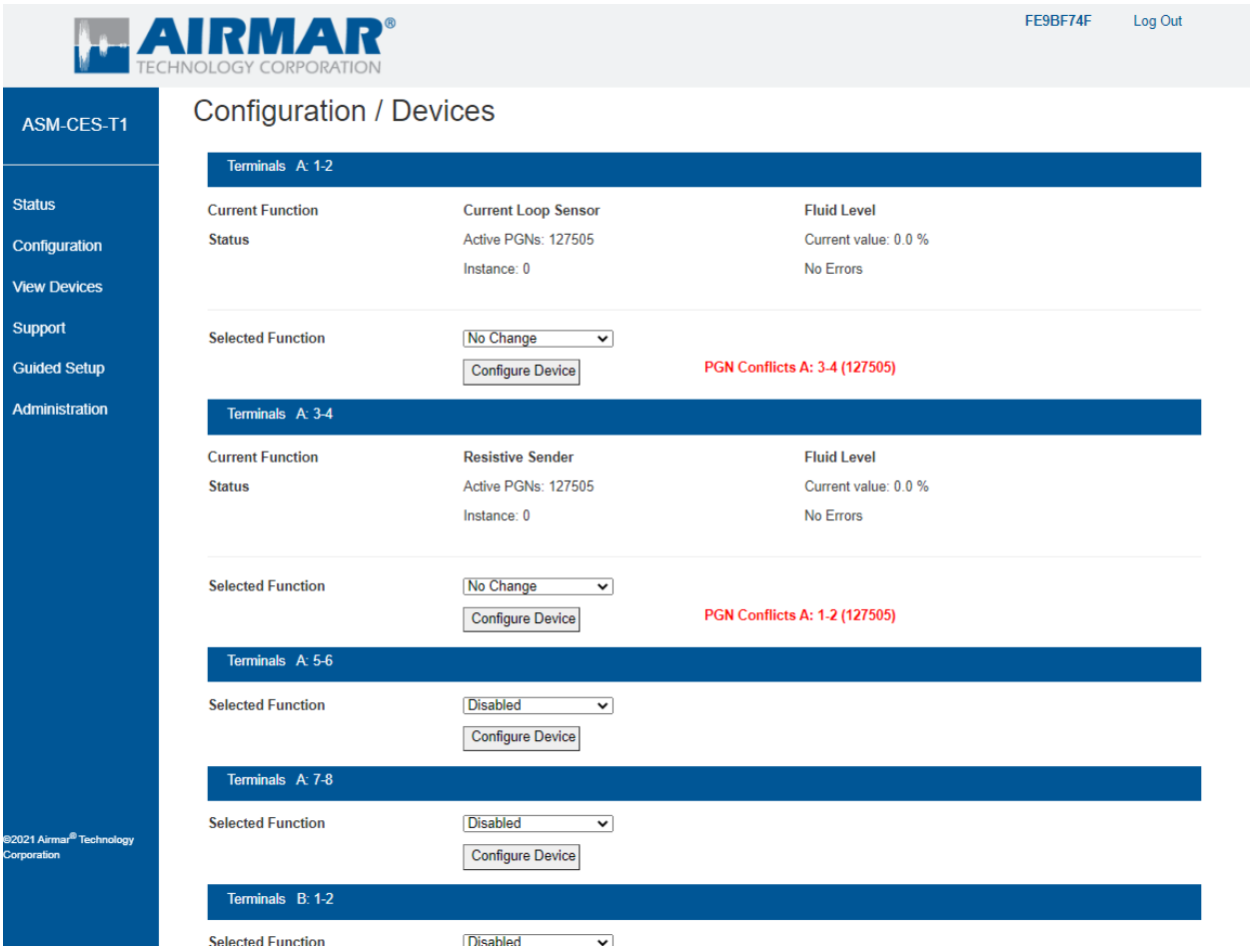


Figure 4-10: Example – PGN conflict notice

4.2.3 Configuring a Windlass Using ASM-CES-T2/ASM-C-T2 Smart Boat Module

4.2.3.1 Windlass Requirements

The Smart Boat T2 device can be used to monitor an anchor windlass device. The windlass must have a reed switch sensor installed below it and must have a magnet installed in the gypsy.

4.2.3.2 Terminal Wiring

Three terminal pairs on the Smart Boat are required for operation:

- A switch terminal pair(on the B block) to connect the reed switch.
- 2 Run Detect terminal pairs (on the C Block) to connect to the windlass motor deployment terminal and the retrieval terminal.

Example:

- B1-2 – Connect to reed switch.
- C1 – Connect to Deployment terminal on the windlass motor switch.
- C2 – Connect to ground.
- C3 – Connect to Retrieval terminal on the windlass motor switch.
- C4 – Connect to ground.

4.2.3.3 Software Configuration of the Windlass Devices

The following Windlass Configurations are based on 4.2.3.2 Terminal Wiring. You will need to modify the configuration if you use different terminals.

4.2.3.3.1 Configure the Windlass Counter Input

1. Go to **Device configuration** for B1-2. Select **Binary Switch** and click **Configure Device**.
2. Click the dropdown menu and select **Windlass Counter**, then click **Continue**.

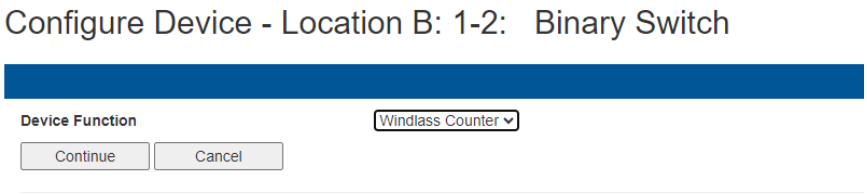


Figure 4-11: Configure Device

3. The **Windlass Counter** screen displays:

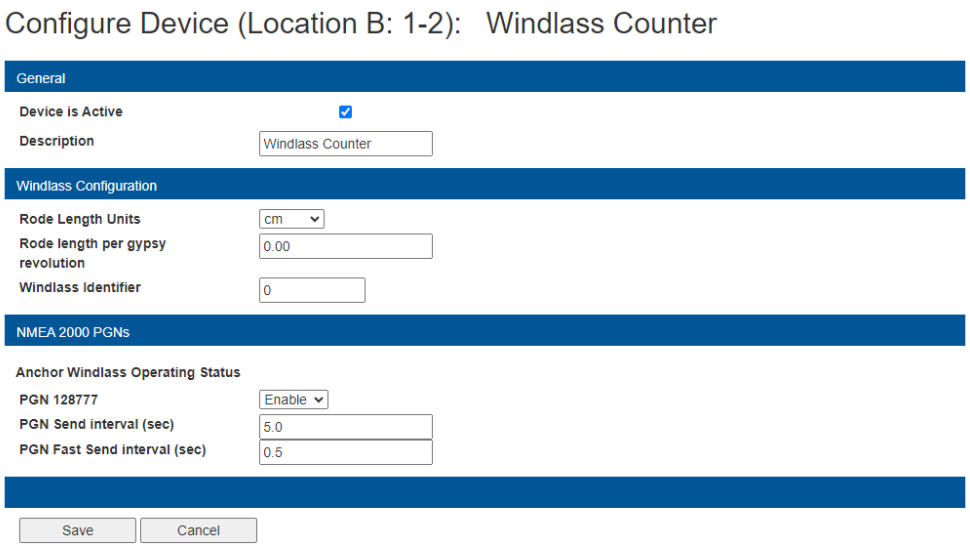


Figure 4-12: Windlass Counter

4. Under **Windlass Configuration**, enter the units of measurement you will use to set the **rode** length.
5. Next enter the **rode length per gypsy** revolution.
6. Select the **Windlass identifier** value (default 0).
7. Under the **NMEA2000 PGNS** section, **Enable** PGN128777 for transmission on the NMEA2000 bus. Select different timing intervals as required or leave the default values(5 sec, 500ms fast send).
8. Click **Save**.

NOTE:

The recommended method for calculating the chain length per revolution is as follows:

1. Use tape to place a mark on the top of the windlass. Note the position.
2. Use tape to place a mark on the chain coming out of the windlass.
3. Use tape to place a mark on the deck just below the chain tape mark.
4. Release the windlass to allow manual movement and rotate it 1 full turn until the tape is back to its original position. Be sure to rotate in the direction to place chain on the deck.
5. Measure the length of chain from the tape on the deck to the tape on the chain.
6. Enter this value in the **Configuration** page.

4.2.3.3.2 Configure the Windlass Direction Inputs

Following wiring example:

1. Configure Device C:1-2 as a **Run Detector** device.

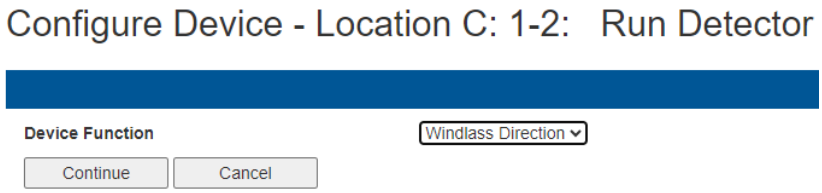


Figure 4-13: Example – Run Detector

2. Next select **Windlass Direction** from the drop-down menu. The **Windlass Direction** screen displays:

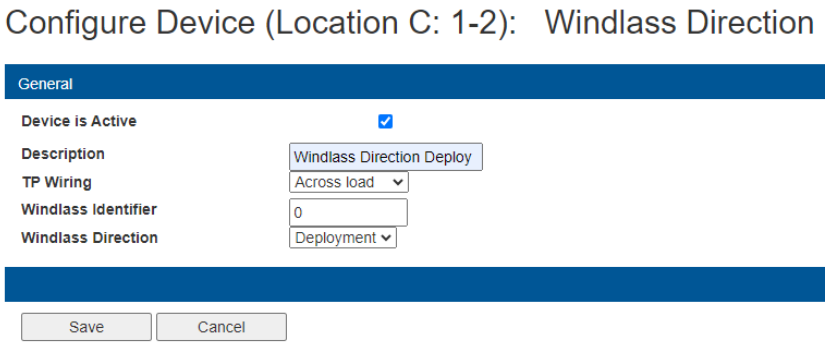


Figure 4-14: Example – Windlass Direction

3. Enter a **Description**, select the **Wiring** type, enter the same **Windlass identifier** you used with the **Windlass counter device**, and enter a **Windlass direction** this input will monitor. Click **Save**. In the example this device is the windlass deployment sensor.
4. Repeat this configuration for terminals C:3-4 and configure it as a windlass retrieval device.

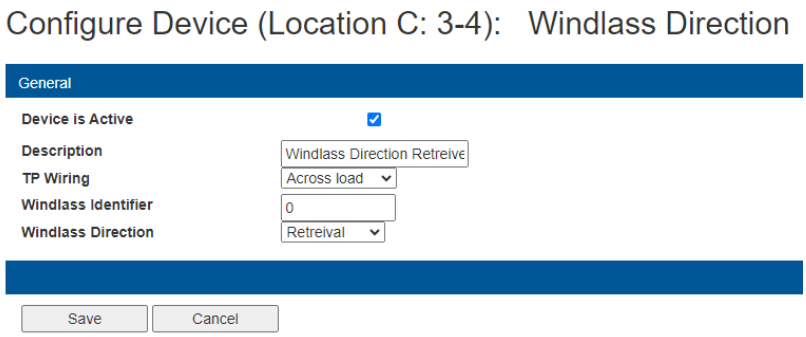


Figure 4-15: Example – Save settings

5. Click **Save**. Your windlass monitor is now configured.

4.2.3.3.3 Displaying the Windlass Output Data

1. Click **View Devices** in the menu to show configured devices.

Figure 4-16: Example – View Devices

The Counter will show the rode distance. When the rode is being deployed, the counter will count up; when retrieved, it will count down to zero. The direction values will show On or Off indicating which way the motor is moving. You may reset the rode counter by clicking the **Reset** button next to the counter.

4.2.3.3.4 NMEA 2000 PGN 128777 Information

In PGN 128777 only fields 1, 2, 3, and 6 are supported. A command group set using PGN 128777 field 6 will be allowed to reset field 6 using a value of 0.

4.2.4 Setup 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 it 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
- **Device Tunnelling:** This feature is used to make devices available on both primary and secondary NMEA 2000 buses. This may be used to configure devices when the programming device is attached to a different physical bus, or in very large installations when selective bus segmentation is required.
- **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.

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 **Configuration/NMEA 2000** network screen is shown next.

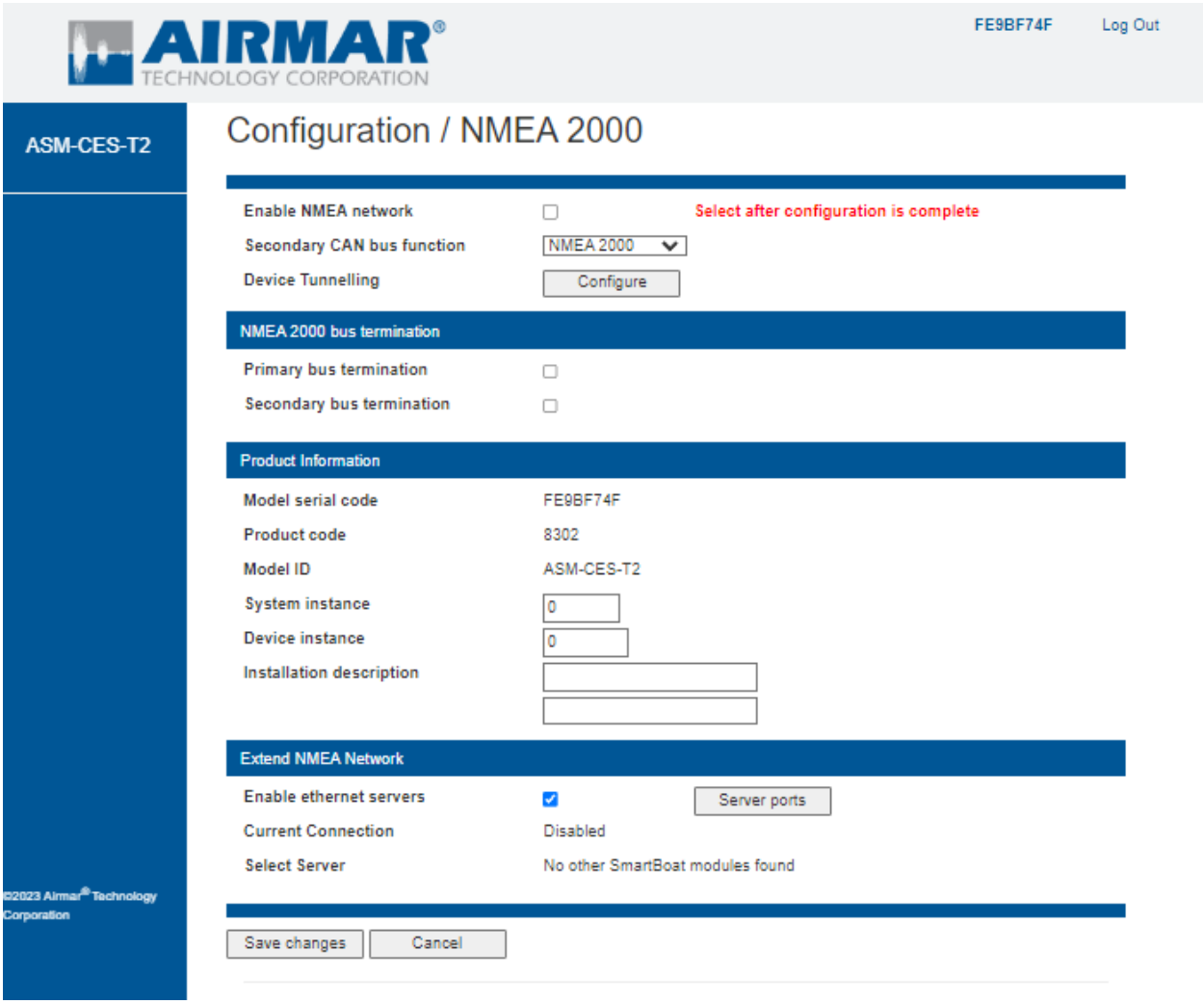


Figure 4-17: NMEA Network configuration screen

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

4.2.5 Wi-Fi/Ethernet Connections and Servers

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

4.2.5.1 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.

1. Choose the desired access point from the SSID dropdown menu.
2. Enter the WEP/WPA passphrase if it is a secured network.
3. After clicking on **Update** it may be necessary to reconnect to the SmartBoat module to continue configuration.

Figure 4-18 shows the Wireless Configuration screen after a wireless connection has been established using the access-point feature of another SmartBoat module.

*Wi-Fi SSIDs should contain only alphabetic characters and should not contain any special characters. Note: iPhone device hotspots often use SSIDs such as **Ryan's iPhone**. This will not work with SmartBoat. Remove the apostrophe in your device's name for this to function correctly.*

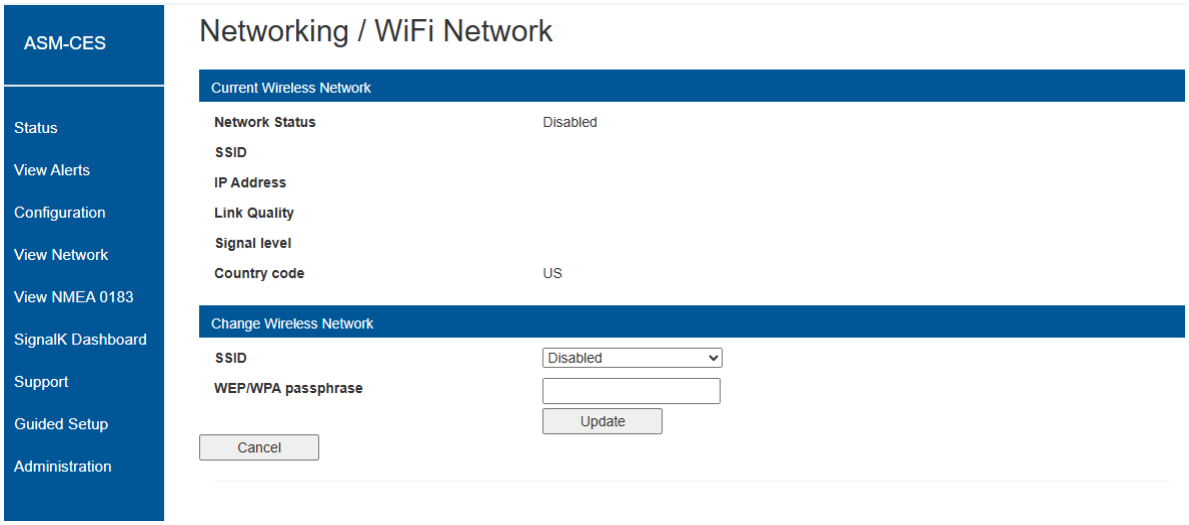


Figure 4-18: Wireless configuration

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

4.2.5.2 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, plugging a Category 5E or better cable from the router/switch into the Ethernet port of the module is sufficient. If there is a good connection established with a router that supports DHCP, the **Wired Ethernet Configuration** screen displays as **Connected**, Figure 4-19.

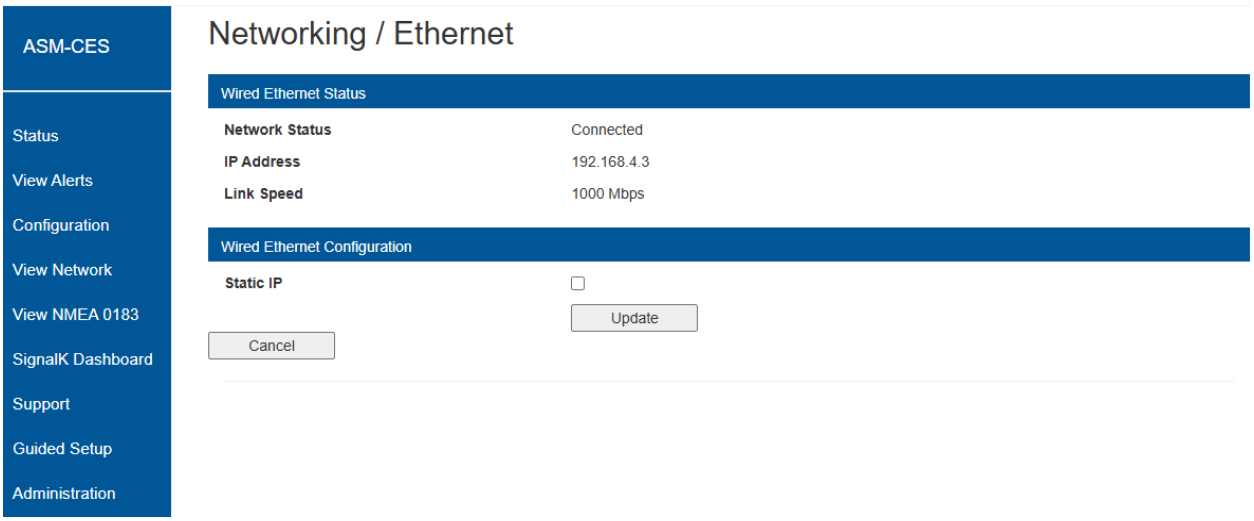


Figure 4-19: Wired Ethernet configuration

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 4-20 shows the fields available for static IP configuration.

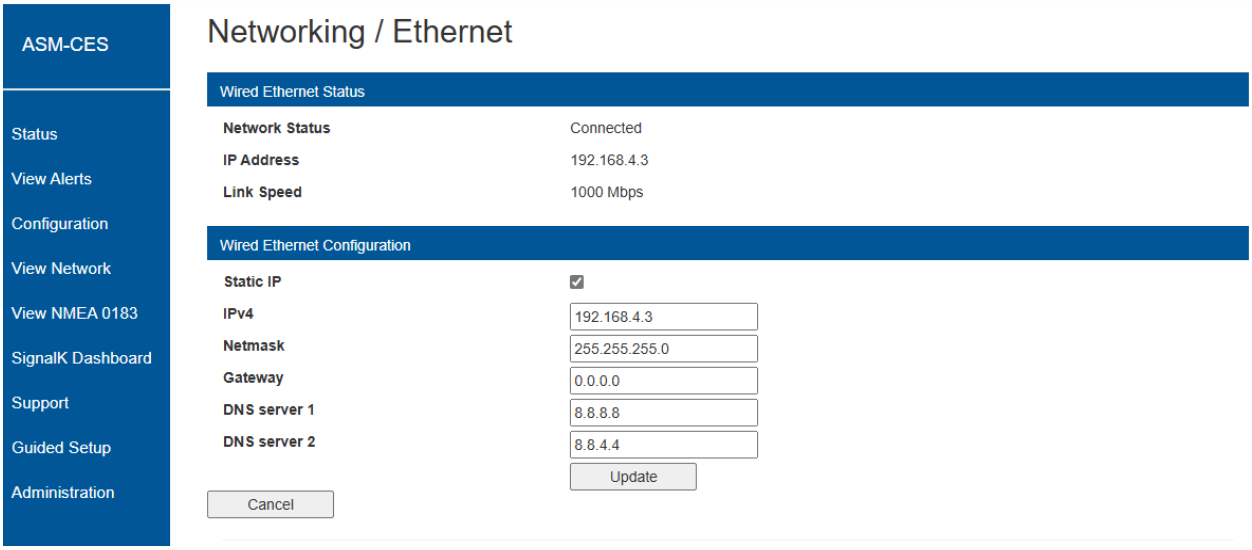


Figure 4-20: Wired Ethernet configuration with static IP address

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.

4.2.5.3 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 SmartBoat Module Operation, 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 4-21 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.

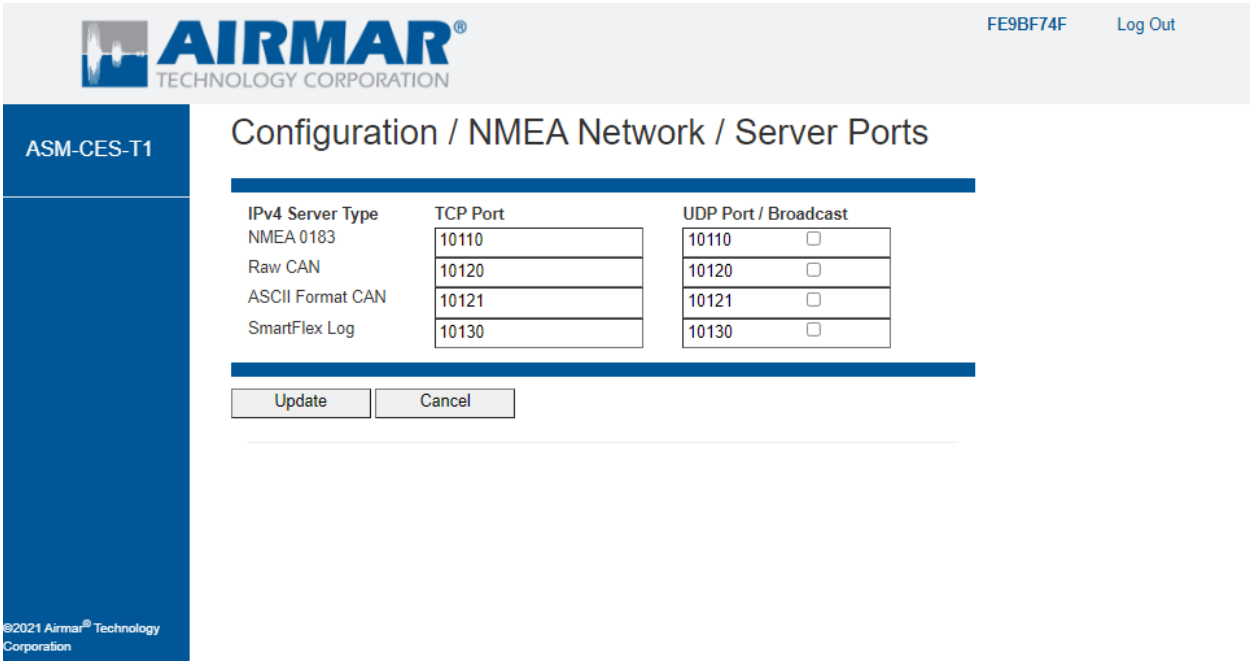


Figure 4-21: Wi-Fi/Ethernet server-port configuration

5 SmartBoat Module Operation

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

5.1 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 next.

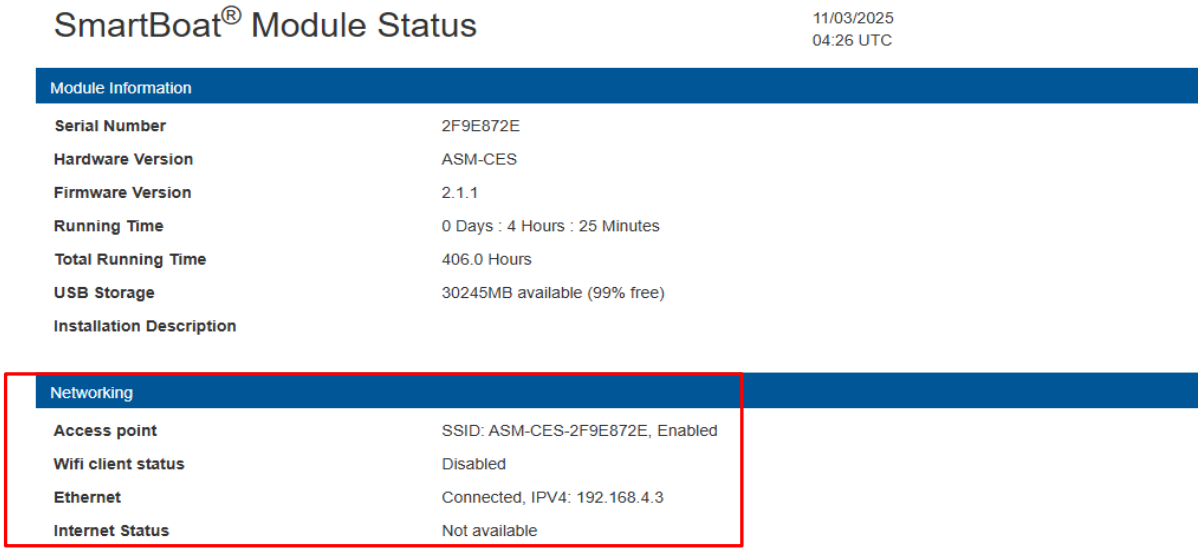


Figure 5-1: Status screen

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 status.
  - **Wi-Fi status:** Connection status to a Wi-Fi access point.
  - **Ethernet:** Connection status over wired Ethernet.
  - **Internet:** Connection status to the Internet.
- **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 status of each configured SmartBoat device.

5.2 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.

Figure 5-2 shows a typical display on an ASM-CES-T2 module with three configured devices.

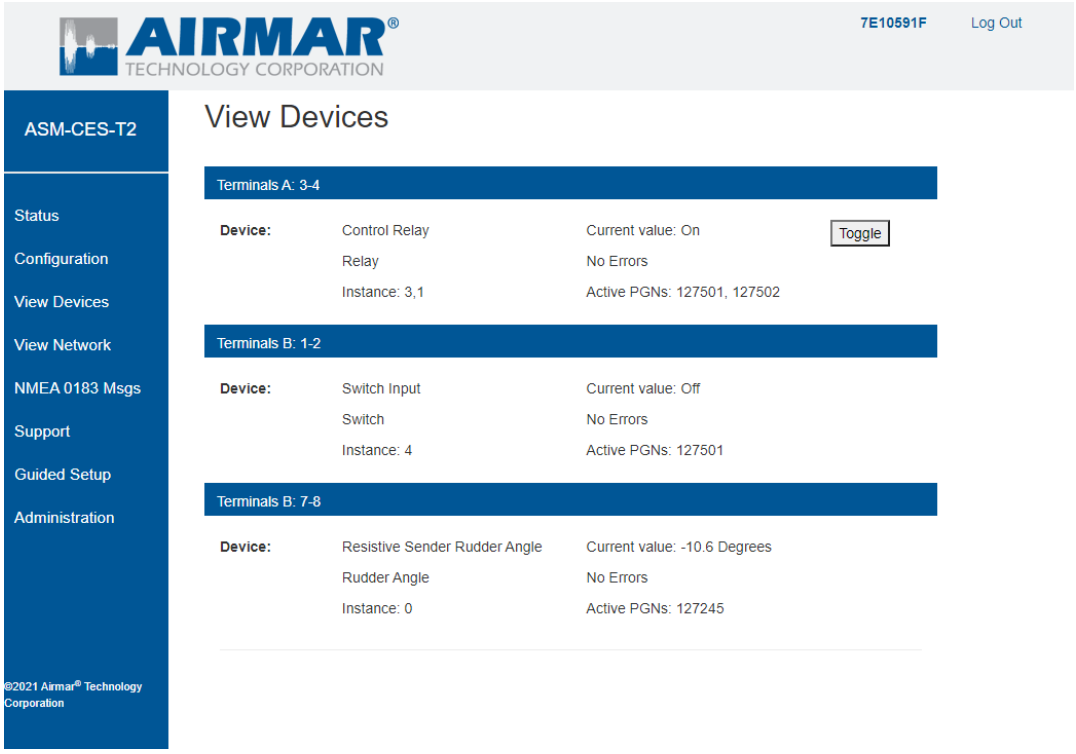


Figure 5-2: Typical device status display

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 the **Toggle** button.

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 5-3 shows an example of detected errors.

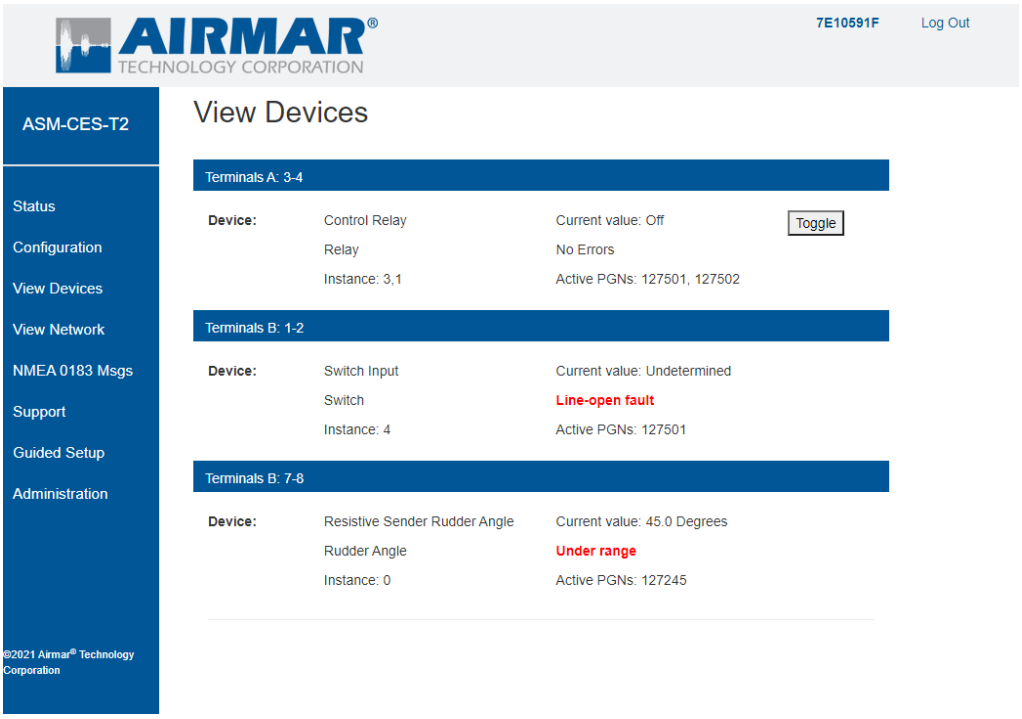


Figure 5-3: Device status with errors

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.

5.3 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. Figure 5-4 shows an example of the NMEA Network information screen for a module with two other devices on the primary NMEA 2000 bus and three on the secondary NMEA 2000 bus, and a total of 18 periodic NMEA 2000 PGNs displayed.

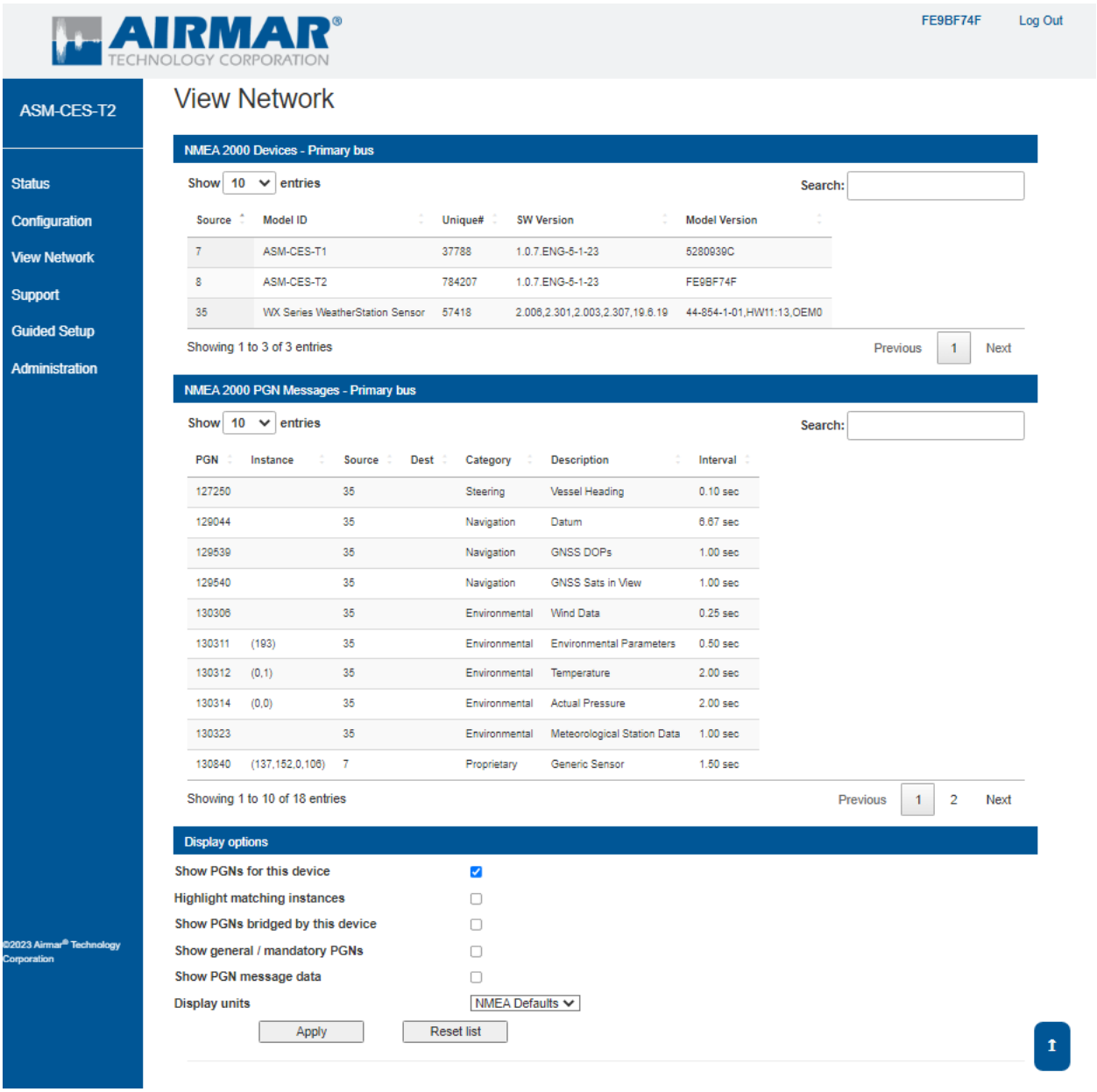


Figure 5-4: NMEA network information

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 5-4.

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

- **PGN:** The NMEA 2000 PGN number
- **Instance:** 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:** The source address of the sending device.
- **Destination:** 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:** The general category of the PGN as specified by NMEA.
- **Description:** A 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.

There are several options at the bottom of the NMEA network information screen for specifying which PGNs will be included. Use these preference settings to customize the display of NMEA 2000 devices and messages.

- **Show PGNs for this device:** Include any PGNs generated by this SmartBoat module. The default for this setting is *enabled*.
- **Highlight matching instances:** 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 6 should be used to resolve the conflict.
- **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 when the PGN detail is displayed. The default for this

setting is *disabled*. This option is generally only used for network debugging and requires knowledge of the NMEA 2000 message data formats.

- **Display Units:** Used to select the preferred units of measure for PGN values.

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

Selecting **Highlight matching instances** indicates 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 6 should be used to resolve the conflict.

There is also a button labeled **Reset List** at the bottom of the screen. Clicking this button causes 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.

When there are more devices or messages than can be displayed on a single screen, paging through the list or changing the number of entries will allow you to view them all. If you click on one of the message lines, the details of the NMEA 2000 message including the current value of each available field displays. You may also sort the list of messages by clicking on the heading above each column. Multiple clicks will change the sort order from low -> high to the reverse.

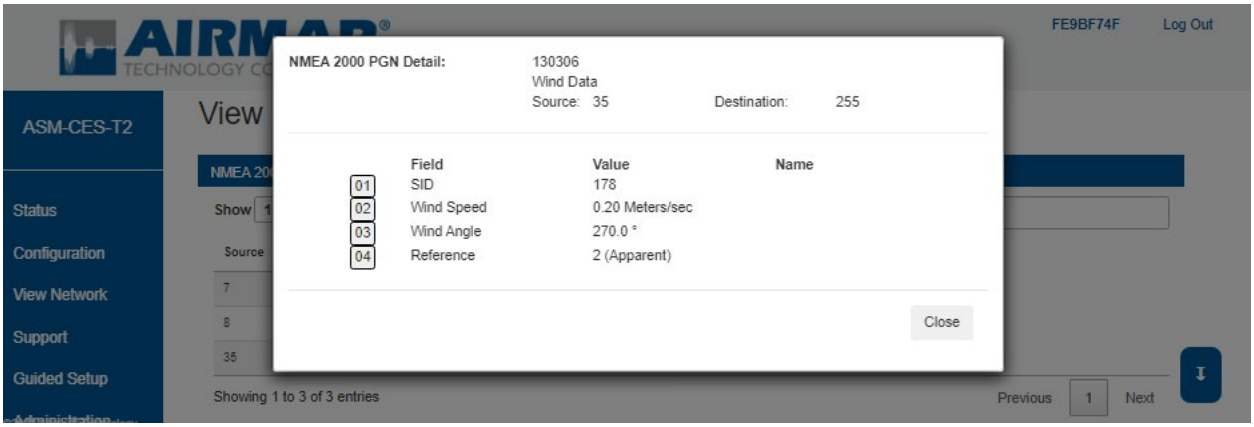


Figure 5-5: NMEA 2000 PGN Details Display

If a name has been assigned to any of the fields as described in Section 7 of this manual, the value name will also be displayed.

6 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 following figure shows how various SmartBoat module functions are connected to each other.

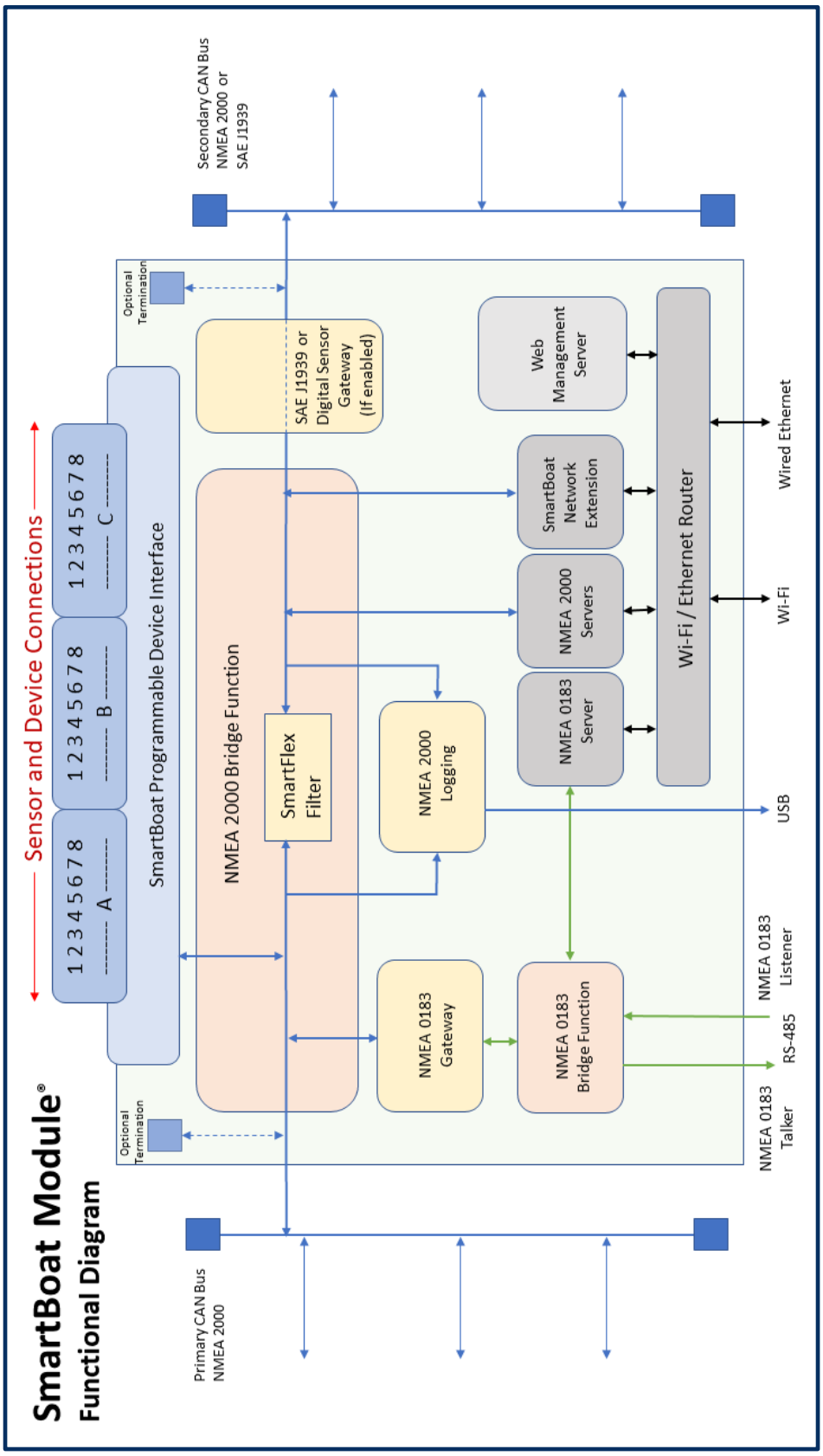


Figure 6-1: SmartBoat module block diagram

6.1 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 also *not* be connected wirelessly.

Figure 6-2 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.

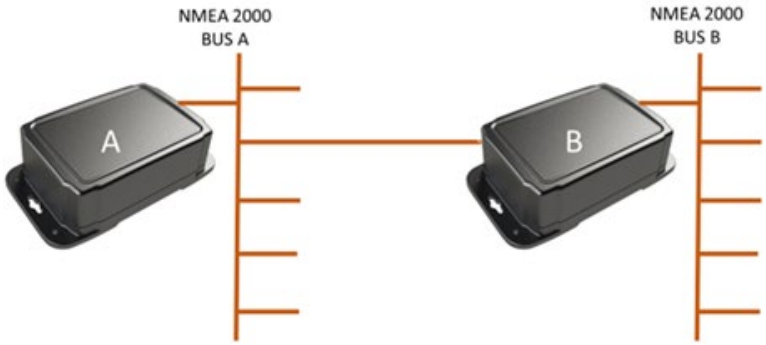


Figure 6-2: Physically bridging NMEA 2000 buses

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.

When bridging is enabled, the **View Network** page will display information about both the primary and secondary NMEA 2000 bus. The figure below shows an example with two bridged PGNs on the secondary bus.

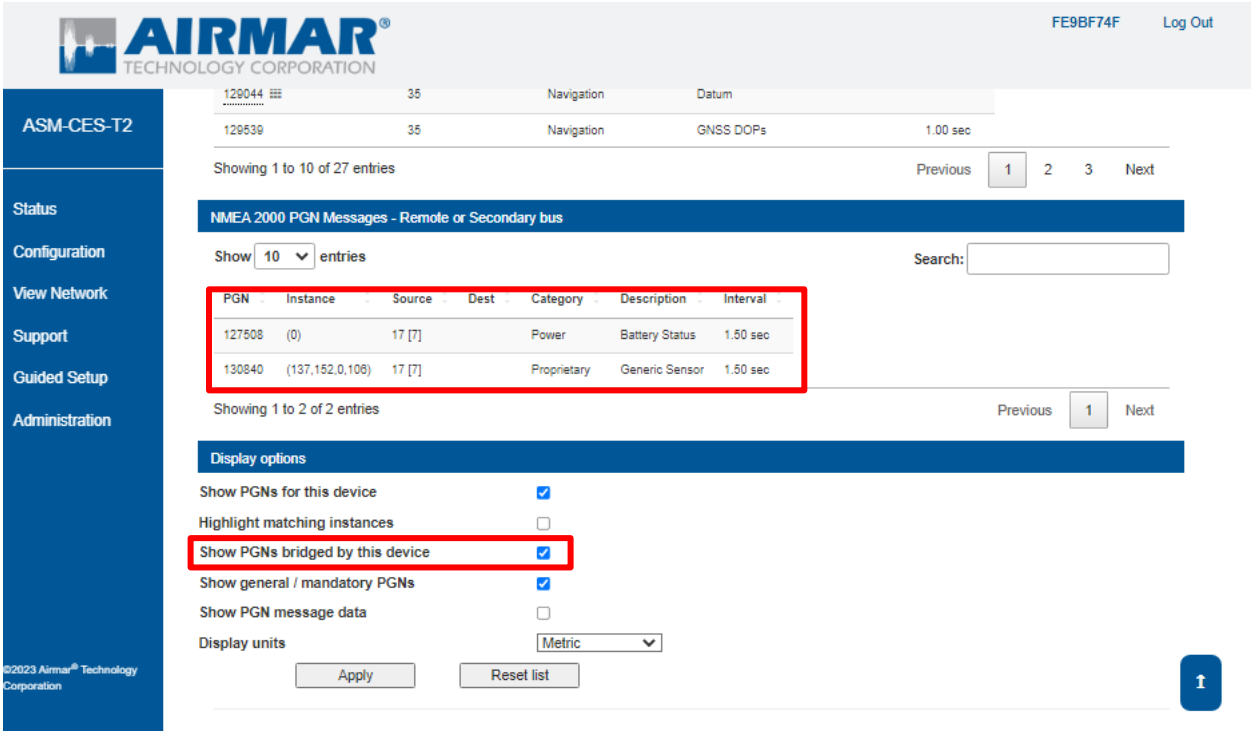


Figure 6-3: Bridged messages on the secondary NMEA 2000 bus

The **Show PGNs bridged by this device** option must be selected to view these messages.

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 [7]. This indicates that while the PGN is being sent from source 17 (the SmartBoat module address on the secondary bus), it originated from source 7 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.

6.2 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 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.

6.3 SmartFlex Filter Example

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

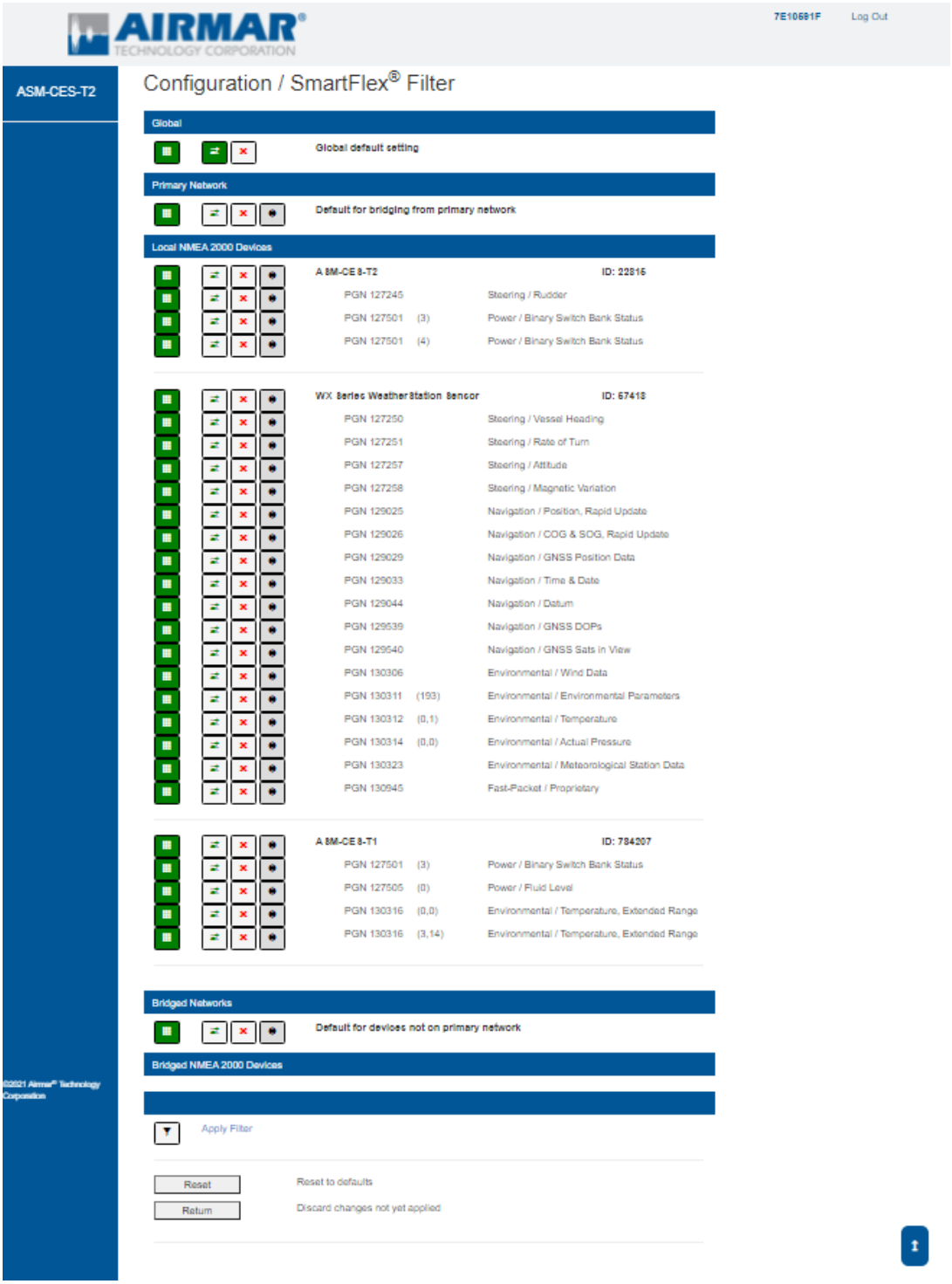


Figure 6-4: Example – Default SmartFlex filter settings

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.

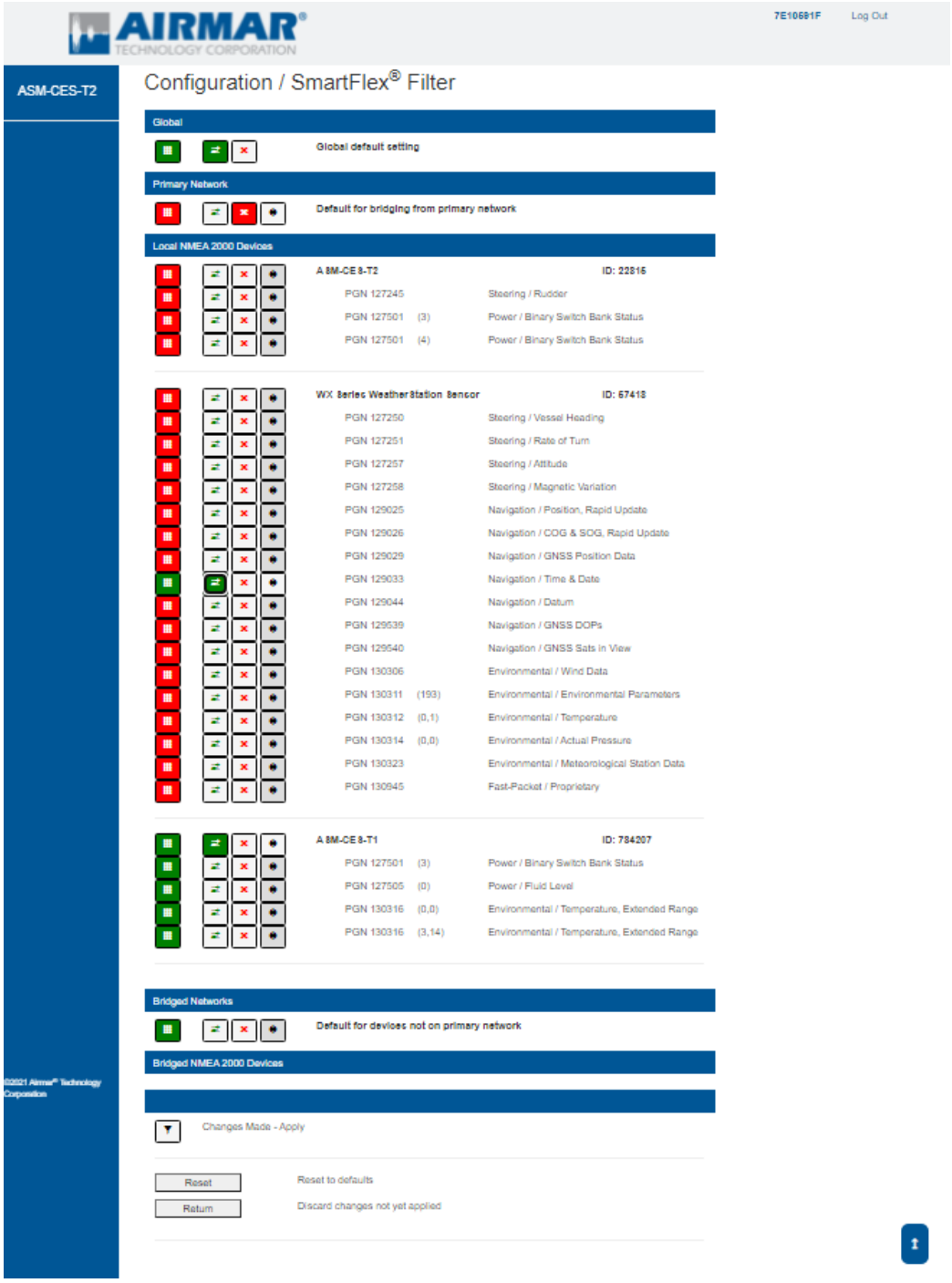


Figure 6-5: Example – SmartFlex filter configuration

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 **Return** discards any unapplied changes.

The results of the filter operation may be seen by clicking on the **View Network** link in the sidebar.

6.4 Device Tunnelling

For most installations, network bridging using the SmartFlex filter feature is the best way to make NMEA 2000 PGN information available to devices on separate NMEA 2000 busses. In some cases, it may be important that a single device is directly accessible on both busses. For example, it may not be possible to attach the programming device to the same physical bus for configuration, or it may be necessary for other devices to detect presence on both primary and secondary busses. Device Tunnelling may be used to solve these challenges.

Device Tunnelling may be selected from the NMEA 2000 configuration page and is shown in the following figure:

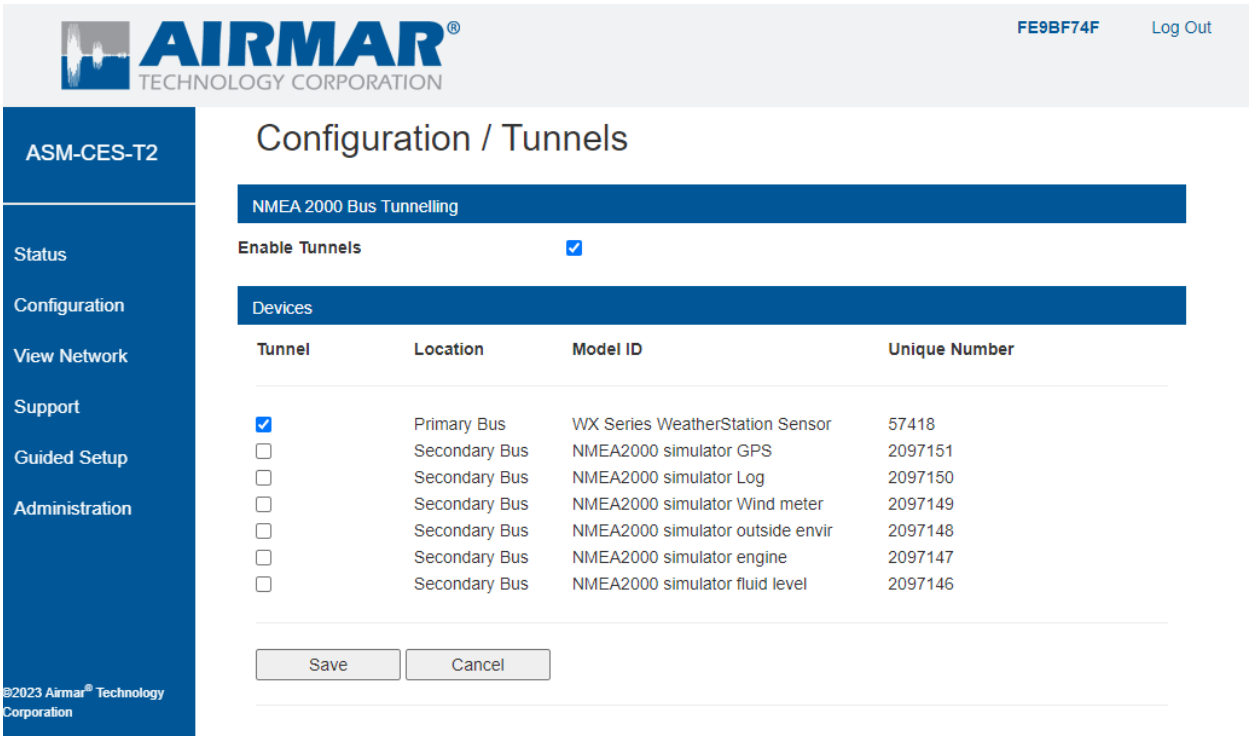


Figure 6-6: Example – Default SmartFlex filter settings

Each of the devices currently attached to either the primary or secondary NMEA 2000 bus is shown on this list. To activate or deactivate tunneling, use the checkbox for that device and click **Save**.

The following figure illustrates the changes to the network with tunnelling enabled for an Airmar WeatherStation device:

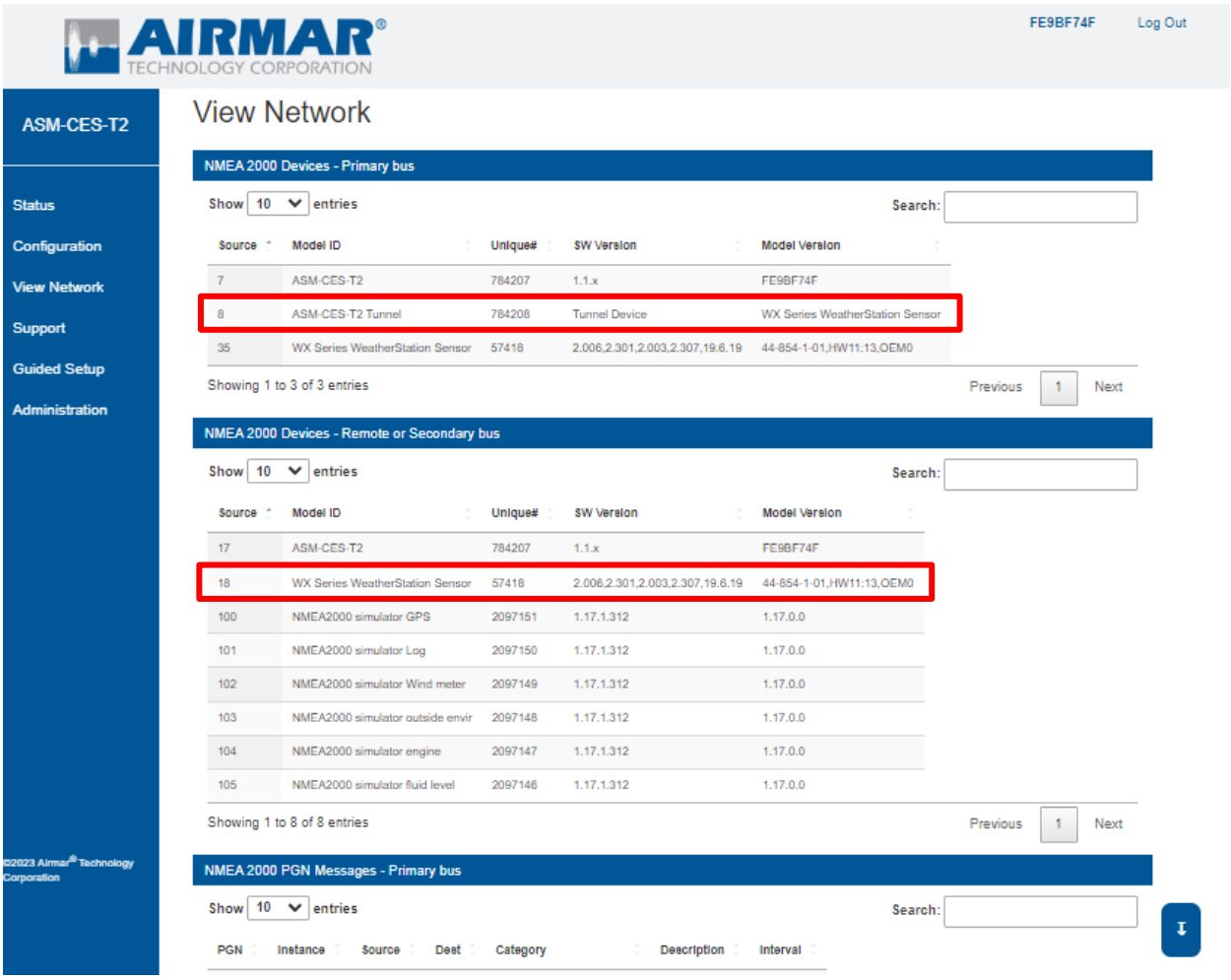


Figure 6-7: Example – Tunnelling Feature

As shown in this example, the Airmar WeatherStation device that is attached physically to the primary NMEA 2000 bus also appears "virtually" on the secondary NMEA 2000 bus. All NMEA 2000 PGNs that are generated by the WeatherStation will be transmitted on each bus. These PGN messages cannot be managed through the SmartFlex filter feature. The "virtual" device may have a different NMEA 2000 source address.

Note that the SmartBoat module will create a second virtual "Tunnel Device" on the same bus as the actual device being tunneled. This tunnel device is used to handle direct communication between the actual tunneled device and devices on the secondary bus and is shown to identify the associated NMEA 2000 source address.

7 SmartFlex Values (Advanced SmartBoat Module Only)

An advanced SmartBoat module supports a range of features for reviewing and logging sensor and system values. These features provide insight into system operation and can be used as part of a comprehensive alerting and automation solution.

The SmartFlex Values and Automation screen is reached by clicking on the link in the configuration section of the sidebar of the Status screen.

7.1 Available Values

The following figure shows the default screen displayed before configuring the module.

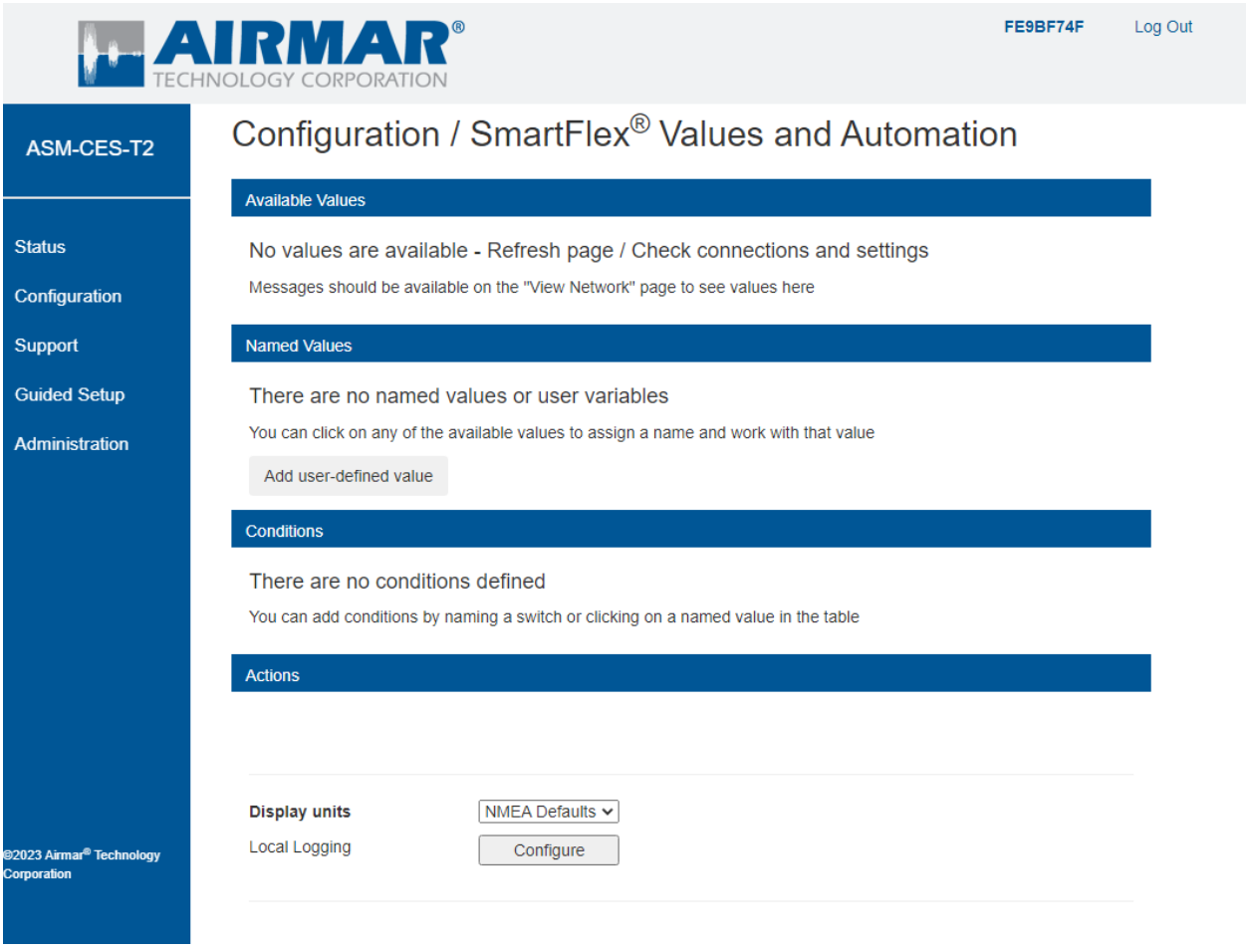


Figure 7-1: Uninitialized Values and Automation Screen

At the bottom of the page is a drop-down selection for the **Display Units** that will be used when presenting values.

When the NMEA 2000 network is enabled and devices are attached to the network, all the available NMEA 2000 message values will be listed in the **Available Values** section at the top of the page as shown in the following figure.

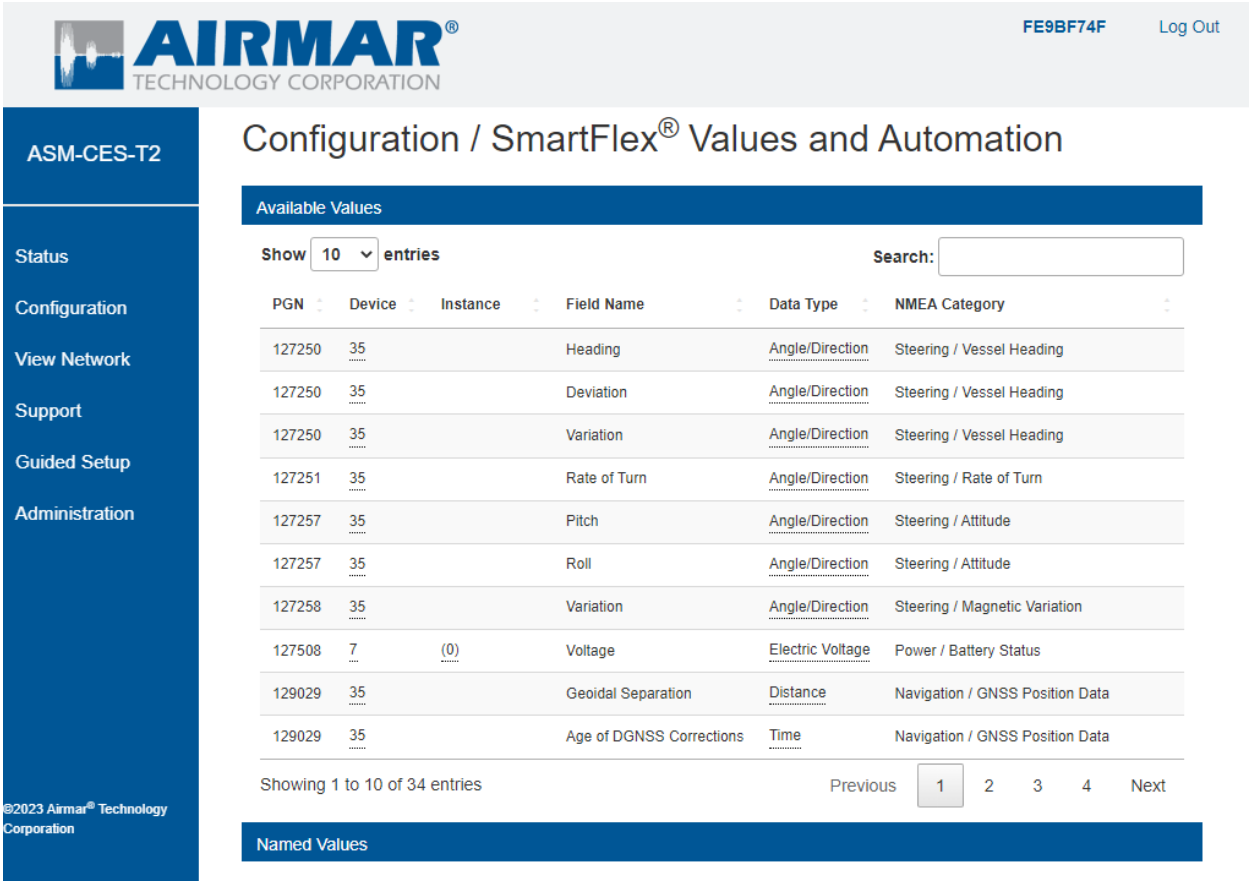


Figure 7-2: Available Values

This view is based upon the same PGN message information used for the **View Network** page but is organized to show all the individual field values transmitted within the message.

Additional information is available by hovering over entries with a dotted underline:

- **Device source address:** Complete device name and unique number for the origin device.
- **Instance:** Additional information about the source instance
- **Data Type:** The current value contained in the field, displayed using the units selected at the bottom of the page. Note that the current value is not updated in real time and represents the value at the time this page was loaded.

7.2 Named Values

The first step in working with SmartFlex Values is to assign a name to NMEA bus values of interest. Simply click on the table entry for that value to enter and name and optional description using the dialog box as shown below.

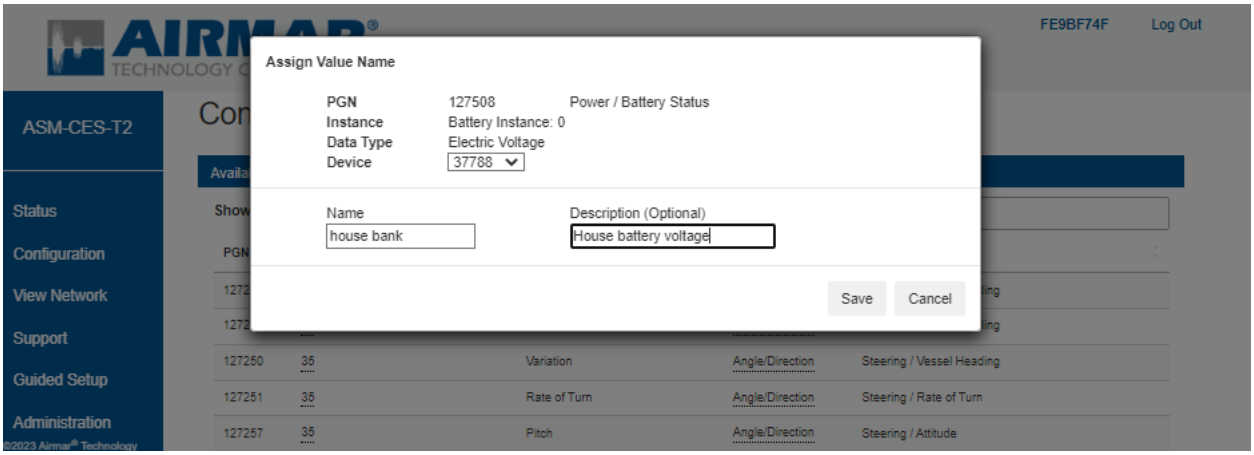


Figure 7-3: Naming a value

In this example, we have named the voltage reading provided by device 37788 to be "house_bank" and provided a description of the value for reference. Although the description is optional, providing this information is helpful when working with defined values in the future.

Value names must be unique, and are limited to letters, numbers, dash, underscore, and period. An underscore will be automatically substituted for any blanks. You will not be able to save a name that does not satisfy these requirements.

Note that there is a drop down selection box with the unique number of the source device. The default for this value is the source device that generated the available value entry. It is possible to change this selection to "any" or to specify a different device if the same value including the same instance is being sent by other devices. This feature is helpful if there are changes to the NMEA 2000 network configuration that cause devices to be added or removed.

The **Named Values** section of the SmartFlex Values and Automation page will show all values with assigned names as shown next.

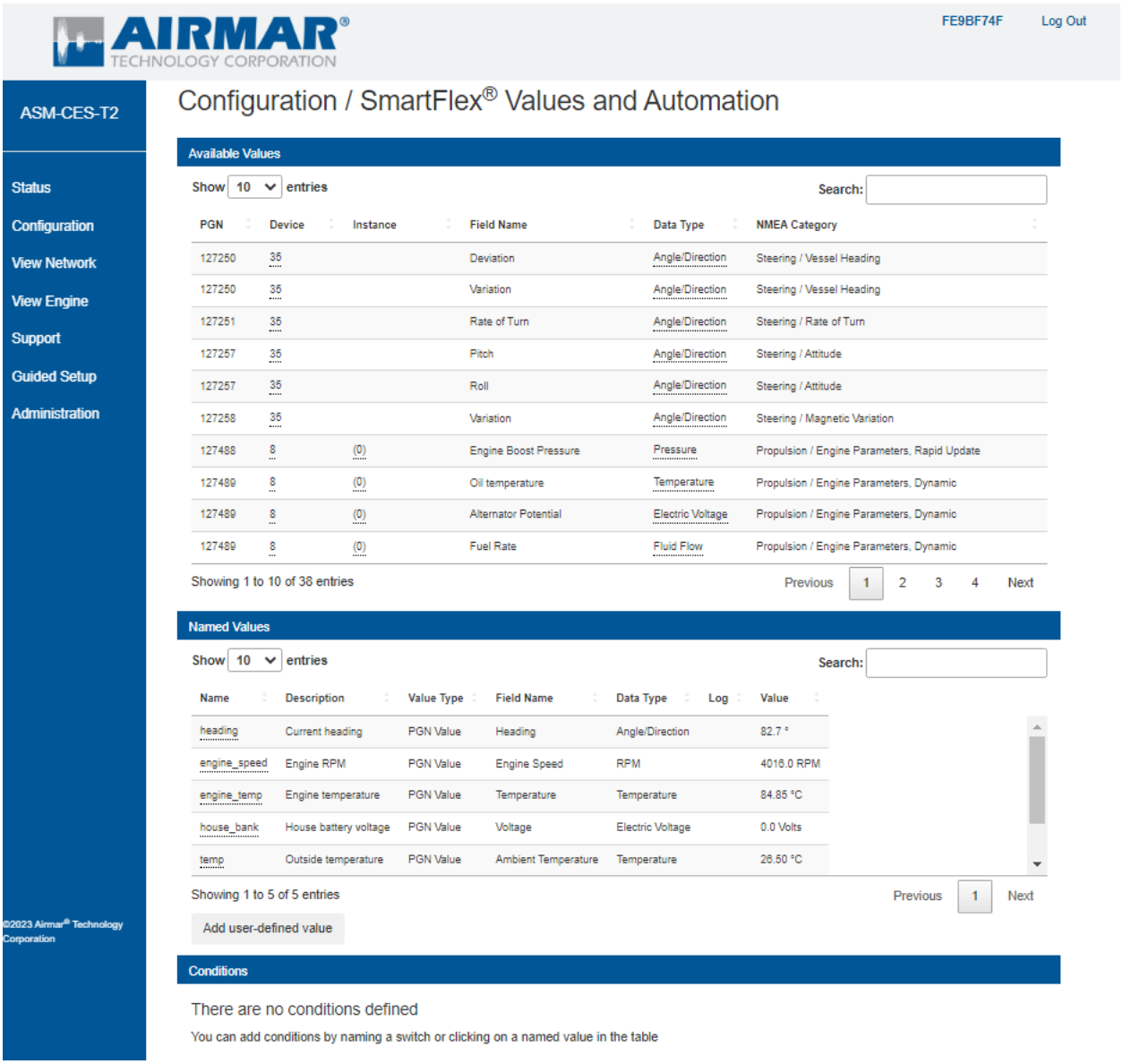


Figure 7-4: Viewing Named Values

In this example, we have named five different values available from the NMEA 2000 PGN messages and provided a description for each value. The value type **PGN Value** indicates that the source is the NMEA 2000 bus, **Field Name** displays the NMEA assigned name for that data, and the **Data Type** indicates the nature of the value that has been named.

Now that these values have been named, the **Value** column displays that current actual reading and may change as the PGN field values change. The units used for showing these values are selected using the **Display Units** dropdown at the bottom of

the page. For example, selecting **US** display units would cause temperatures to be displayed in Fahrenheit.

Note that when PGN values have been named they are no longer displayed as an **Available value** on this page and are only shown in the **Named Values** section.

7.3 Conditions

A SmartFlex "condition" is a named value that can have three values: **True/On**, **False/Off**, or **Unknown**. Some PGN values such as a binary switch status or a relay setting have a data type of **Binary** and are always considered to be "conditions." It is also possible to define condition settings that can be applied to analog values such as temperature or engine speed.

To define a condition based on a PGN value, begin by clicking on the named value entry in the table and selecting **Add Condition** in the dialog box. A set of questions will lead through the process of setting a condition using the value, starting with the figure below.

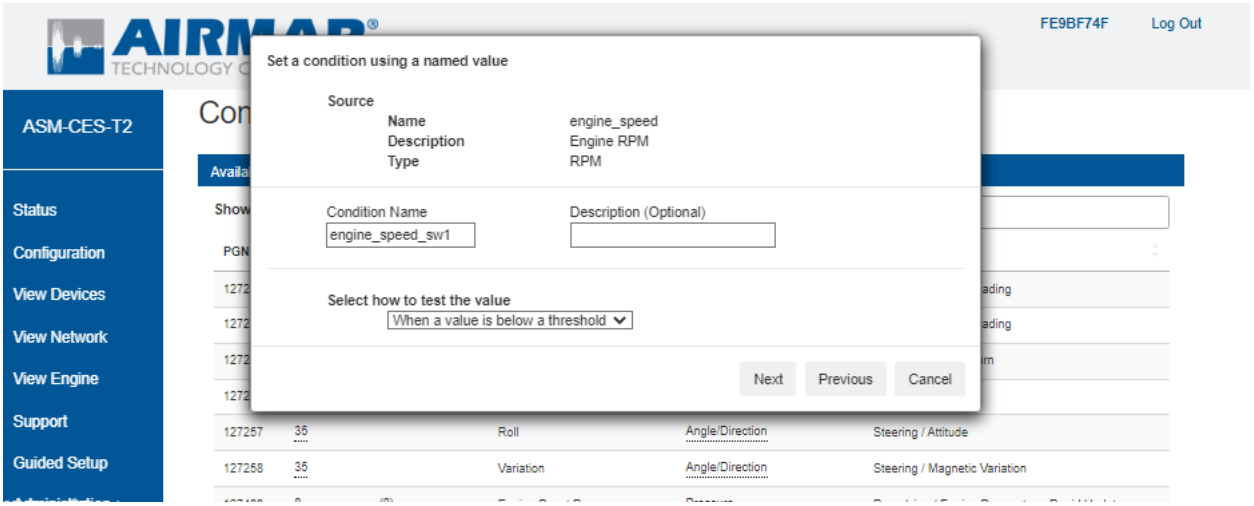


Figure 7-5: Setting a condition with a named value

Each condition must be assigned a unique name. The SmartFlex module will suggest a name based upon the value being used, but this may be changed to any unique value desired. A description of the condition may also be entered and is recommended.

The condition may be defined in several ways:

- **When a value is below a threshold: True** if the named value is under a setting.
- **When a value is above a threshold: True** if the named value is over a setting.
- **When a value is within a range: True** if the named value is between two settings.
- **When a value is outside a range: True** if the named value is outside two settings.
- **According to a formula:** A formula may be provided to set the condition. This can be used to combine information from several named values.

For the example shown below, we have defined a condition called **engine_is_running** that is true if the detected engine RPM (**engine_speed**) is greater than 100 RPM.

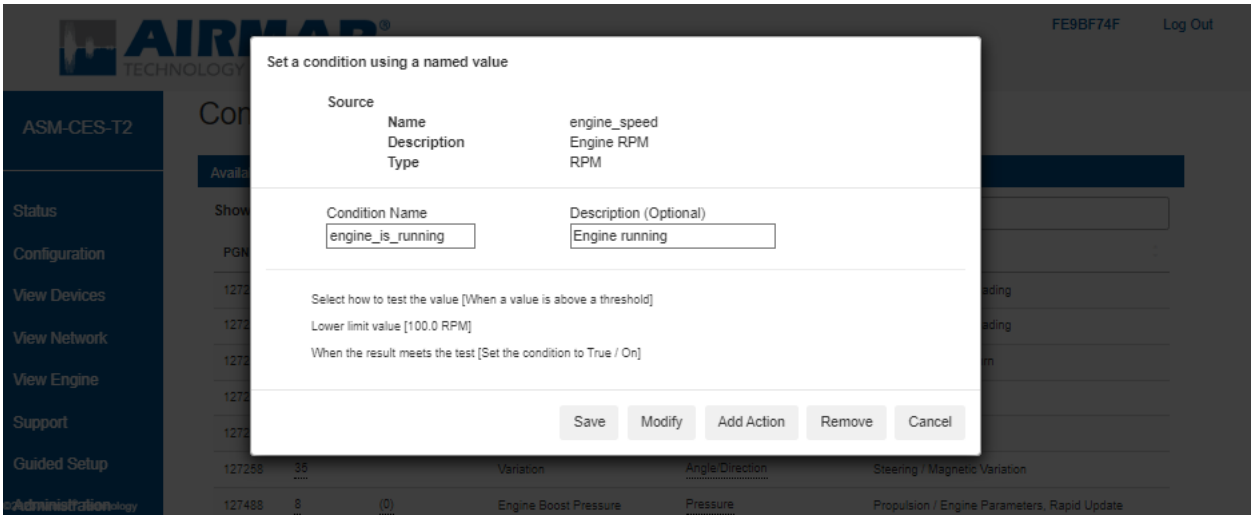


Figure 7-6: Completed condition

Figure 7-7 shows the SmartFlex Values and Automation page with several defined conditions.

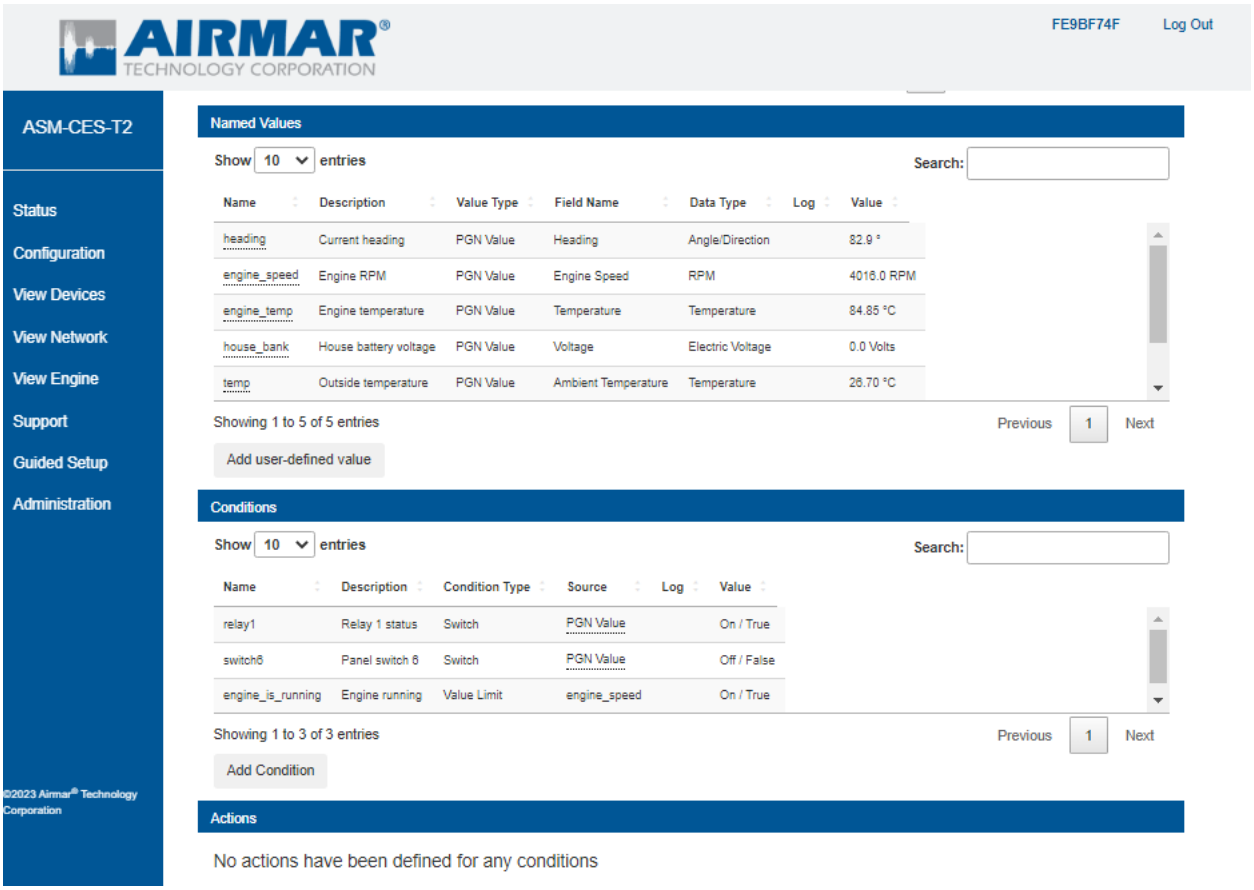


Figure 7-7: Conditions Display

Please note that there are two types of conditions that have been defined in this example. In addition to the **engine_is_running** condition based upon RPM, we have named two binary values: **relay1** and **switch6** that are supplied from NMEA binary switch bank PGN messages.

The **Value** column shows the current value for the condition. A condition is considered **Unknown** if the source supplying the condition is not available. This could happen if a condition is established using a PGN that is not being transmitted.

7.4 User-Defined Values

In addition to the PGN message field values, SmartBoat supports a set of "user-defined" variables. These values enable complete control of a wide range of alerting and automation features. Click on **Add user-defined value** in the **Named Values** section of the page to define any number of these values. A unique name is required for each value, and an optional description is recommended.

Each value has an assigned **data type** which is used to convert and present the value with the appropriate units. Some values may be "unitless," and no conversions are performed. When possible, the SmartFlex module will set or recommend the data type for each value.

7.4.1 Constant or Stored Value

This type of value is like the "memory" function of a calculator. It can be used to save a value for use in logging, alerting, or other calculations. The data type must be set when creating the value.

7.4.2 Calculated Value

A formula is provided to calculate the value using any other constants, conditions, or values. Care should be taken to ensure that the calculation is reasonable for the data types of the values. All calculations are performed using NMEA units.

When entering a formula, you may 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 7-7 shows an example of the selection window. The name of the variable is followed by its description.

Some operators have 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.

A binary condition value is either "0" (False) or "1" (True) when included in a calculation. Similarly, if a numerical expression evaluates to zero it is considered "False" and a non-zero result is considered "True."

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.

7.4.3 Timer

A timer value is used for measuring duration and to control periodic events. The resolution of SmartFlex timers is 1 second. When a timer is created, it appears in both the **Named Value** and **Condition** sections of the page. A timer condition is **True** when the timer reaches its limit value.

7.4.4 Counter

A counter is a special case of a unitless stored value that may be incremented or decremented to track events and control actions. Limit conditions may be established for a counter value.

A loss of power or a reset of the SmartBoat module will reset all user values to their initial value.

7.5 Actions

A SmartFlex "Action" is used to define a specific alerting or automation task that is performed when a particular condition is met. There are a wide range of actions, including:

- **Display a message on the alert page:** An alert message may be displayed in a user-specified color.
- **Control a timer:** Start, stop, or reset a timer.
- **Control a counter:** A counter may be incremented, decremented, or cleared.
- **Control a relay output:** The relay functions of SmartBoat -T2 modules may be controlled directly.
- **Send an NMEA 2000 binary message:** Provide status of a condition to other modules on the NMEA 2000 bus or control a relay or other binary function in another device.
- **Send an NMEA 2000 alert message:** Display a standard or custom alert message on a multi-function display (MFD). A sortable and searchable list of NMEA-defined alert messages is available.
- **Send a notification message:** Use the SmartFlex cloud services to send an email or SMS text message.

- **Store a value to a named variable:** Set a user-defined value using a constant or another value.
- **Garmin custom field:** Display a value in a user-defined field of a Garmin display.

An action may be assigned to any condition by clicking on the table entry for that condition and selecting **Add Action** from the choices presented. Any number of actions may be assigned to a single condition. The **Specify an action** wizard displays to guide you through the process of defining the actions as shown next.

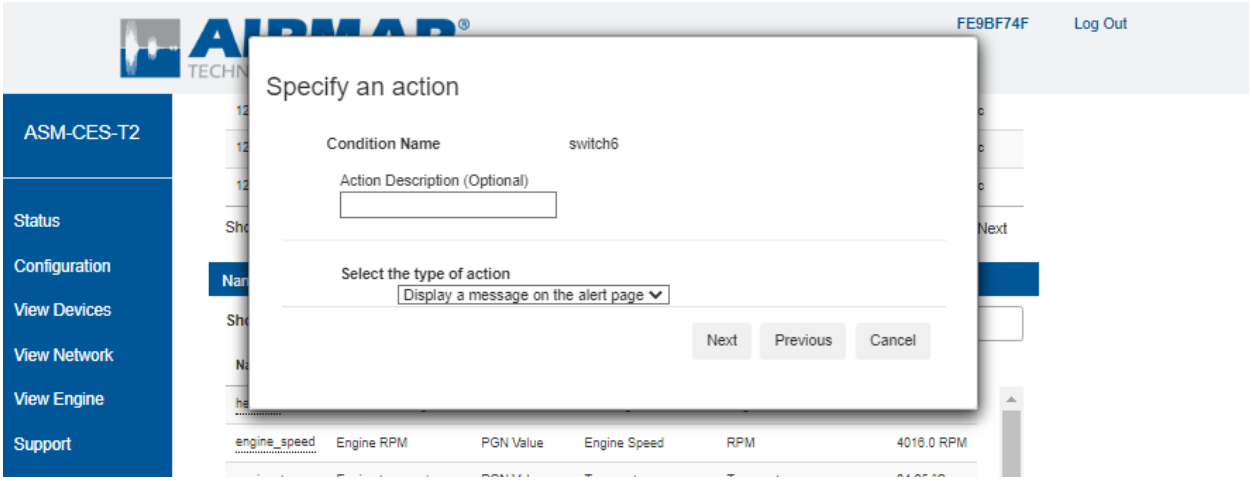


Figure 7-8: Adding an action

An optional description of the action may be entered and is recommended. Step through the series of questions provided, and when the action is fully defined you will be shown all the answers provided and given the option to modify the action or save the settings. The action becomes active immediately.

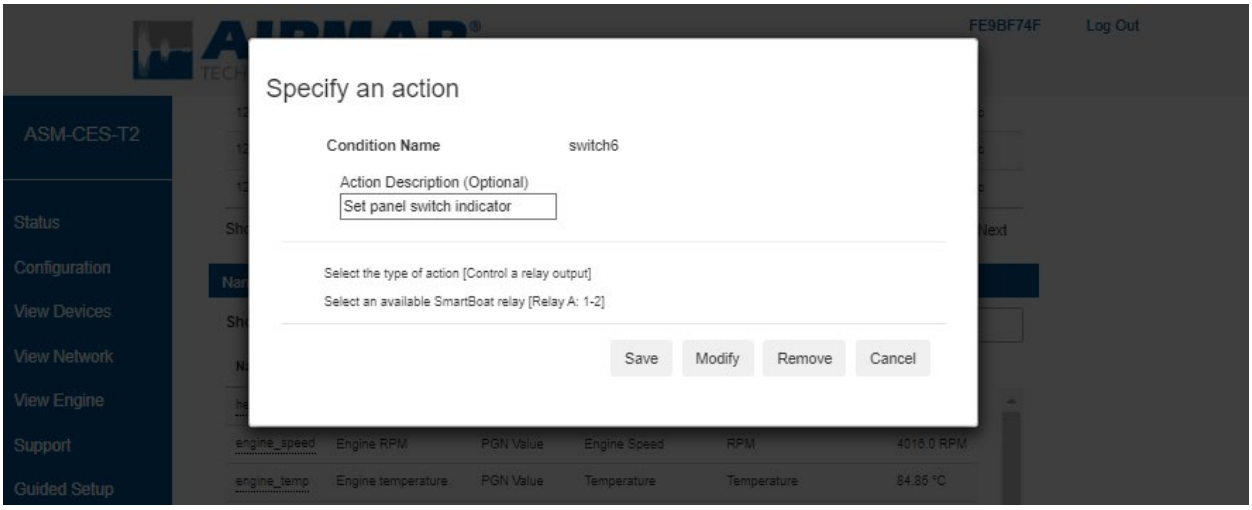


Figure 7-9: SmartFlex action summary

Once an action has been saved, it is displayed in the **Actions** table of the SmartFlex Values page. Figure 7-10 shows an example with three different actions defined.

Figure 7-10: SmartFlex Actions

An action may be modified or removed by clicking on the table entry.

8 SmartFlex Logging

SmartBoat modules provide support for logging both NMEA 2000 bus activity and named values and conditions. This capability is a powerful tool for managing devices and data, diagnosing, and resolving issues, and providing insight into the operation of the various electronic systems.

SmartFlex logging is available through the Configuration option on the side menu bar.

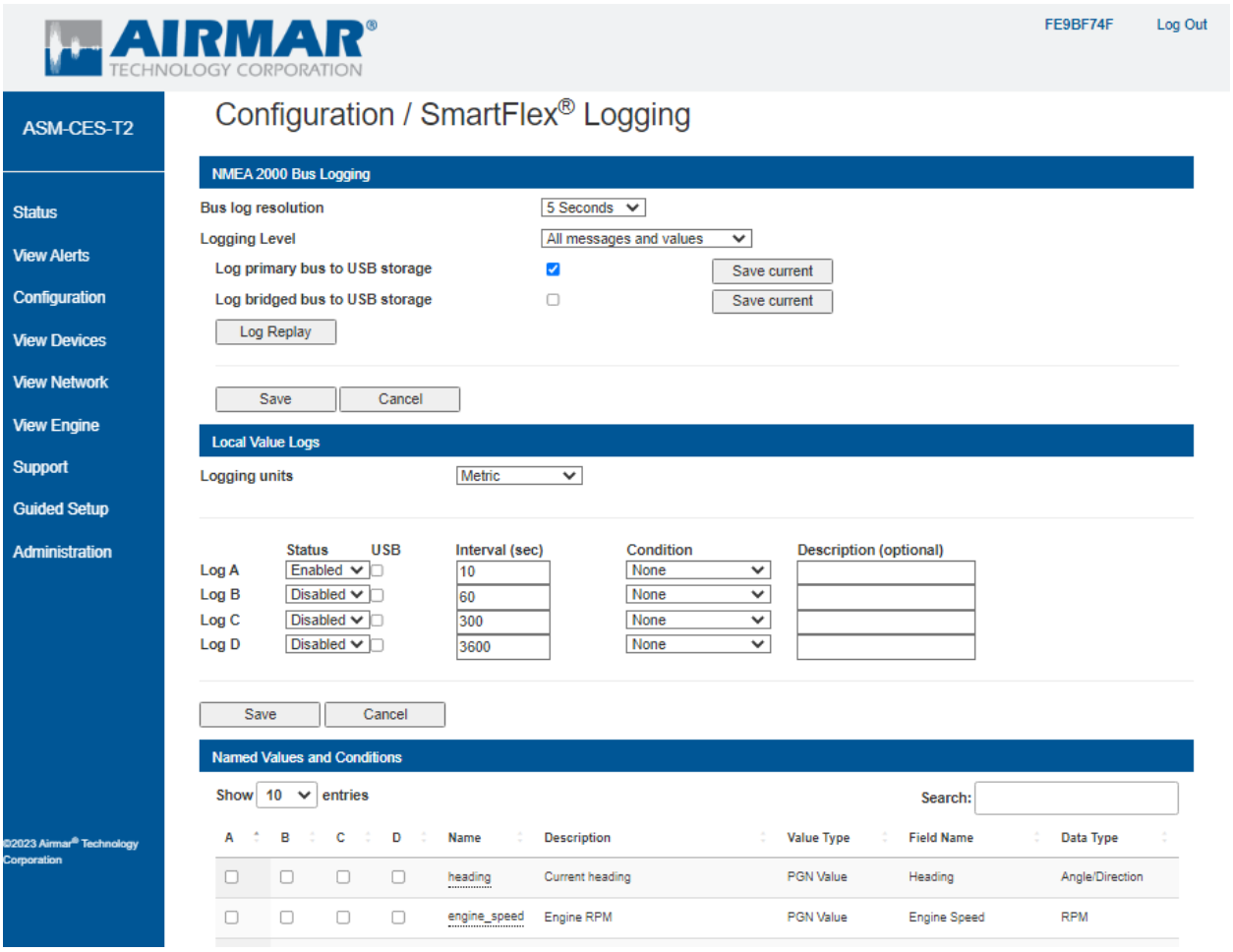


Figure 8-1: SmartFlex Logging Configuration

8.1 NMEA 2000 Bus Logging

Each advanced SmartBoat module implements an NMEA 2000 bus logging feature that can be used to preserve a record of the PGN message traffic on both the primary and secondary NMEA 2000 bus.

There are several configuration settings for this feature:

- **Bus log resolution:** This setting can be used to manage the amount of information recorded. When set to **Unlimited**, every PGN message will be saved. Other settings will limit the frequency of recording. For example, the default of "5 seconds" will set a minimum interval of 5 seconds between PGN records. For a PGN message with a send interval of 0.5 seconds this would mean that every tenth message is saved.
- **Logging Level:** Controls the content of the bus log
  - **Messages only:** Only the PGN messages are saved.
  - **Messages and device details:** Additional records are saved to identify the devices present on the bus. This allows the sender of each PGN message to be identified.
  - **All messages and values:** All SmartFlex values and condition status information is saved.
- **Log to USB storage:** The logs will be saved to a USB memory stick if available. This allows nearly unlimited log storage.

NMEA 2000 log data saved to a USB memory stick is stored in 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.

A button labeled **Save Current** may be used to download the most recent logged values. At a bus log resolution of 5 seconds, over an hour of message information is available for download without USB storage.

A time stamp is recorded for each entry in the bus log. If "real time" is available from the NMEA bus (GPS time) or from the Internet, the date and time of the timestamp will be accurate. If a source of "real time" is not available, the time will start at "00:00:00" when the module is powered on.

See NMEA 2000 Log Replay for additional information.

8.2 Local Value Logs

In addition to bus logs, selected SmartFlex values and conditions may be logged for later review and analysis. Up to four local value logs may be saved. Each log is formatted as a CSV (Comma Separated Values) file that may be loaded into any spreadsheet or database program. A timestamp is recorded for each entry.

Unlike NMEA 2000 bus logging, all values will be presented using the selected logging units. For example, a temperature might be logged in metric units (Celsius), US units (Fahrenheit), or NMEA units (Kelvin). This is a global setting for all local value logs and may be different from the "display units" specified for other features.

In addition to the "Logging units" setting, each local value log has several individual settings:

- **Status:** Enable or disable the value log
- **USB:** Save the value log to USB storage if available. A separate directory is created on the USB memory stick for value logs.
- **Interval:** The amount of time between log records in seconds. Lower settings will increase the amount of memory required and capture additional intermediate values for rapidly changing values.
- **Condition:** A SmartFlex condition value that is used to control the local log. The specified condition must be "true" to enable logging. This feature can be used to manage storage requirements for data that is only relevant at certain times. For example, a condition that detects "Engine running" could be used to manage a log that tracks fuel and engine performance data.
- **Description:** An optional description of the contents or purpose of the log may be provided and is included in the created log file.

For each named value or condition to be logged, the checkbox corresponding to the log must be selected. A given value or condition may be included in more than one local log.

When a local value log is active, the most recently saved values are available for download by selecting the button to the right. This button is not shown if no data is available.

8.3 NMEA 2000 Log Replay

A SmartBoat module can "replay" recorded NMEA bus log information. This feature is available by selecting **Log Replay** from the NMEA bus logging section of the Logging configuration page.

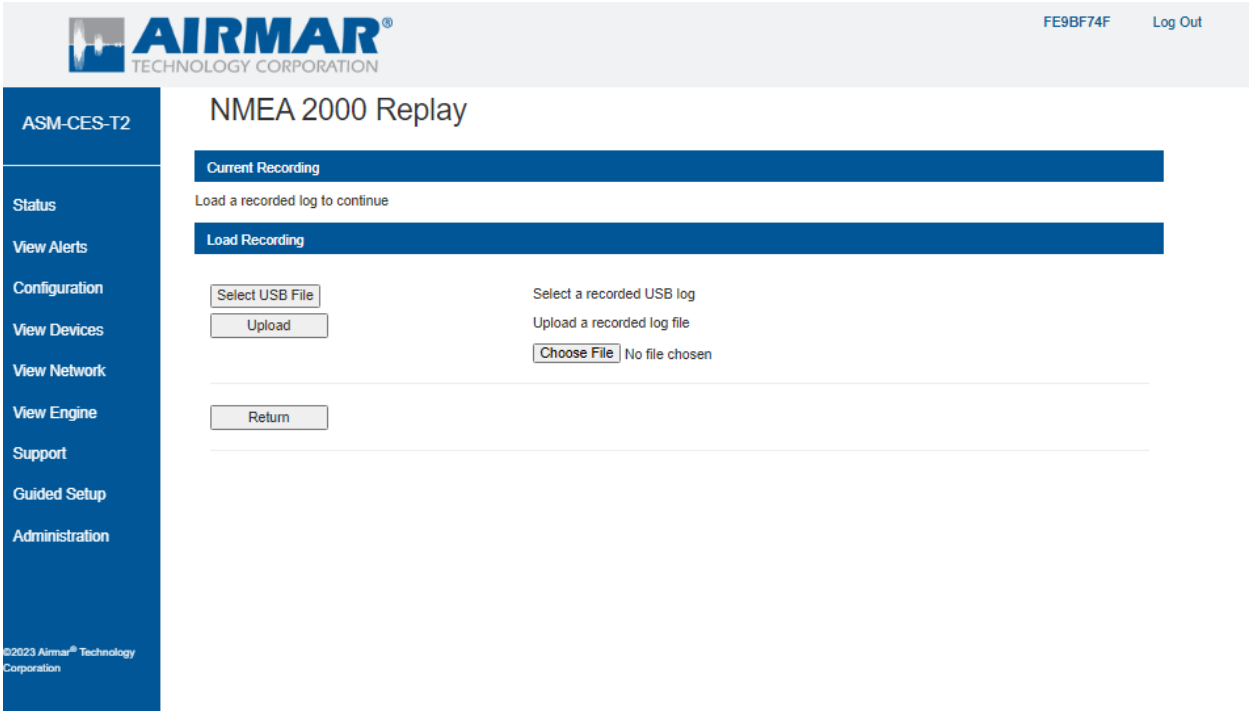


Figure 8-2: NMEA 2000 Replay

Previously saved logs may be uploaded to the SmartBoat device for replay. Logs may also be selected from a list of saved logs on an attached USB storage device, as shown in Figure 8-3. The source of the data (Primary or Secondary NMEA 2000 bus), size of the log file, and the date are provided for each file. These fields are sortable and searchable to locate the log of interest.

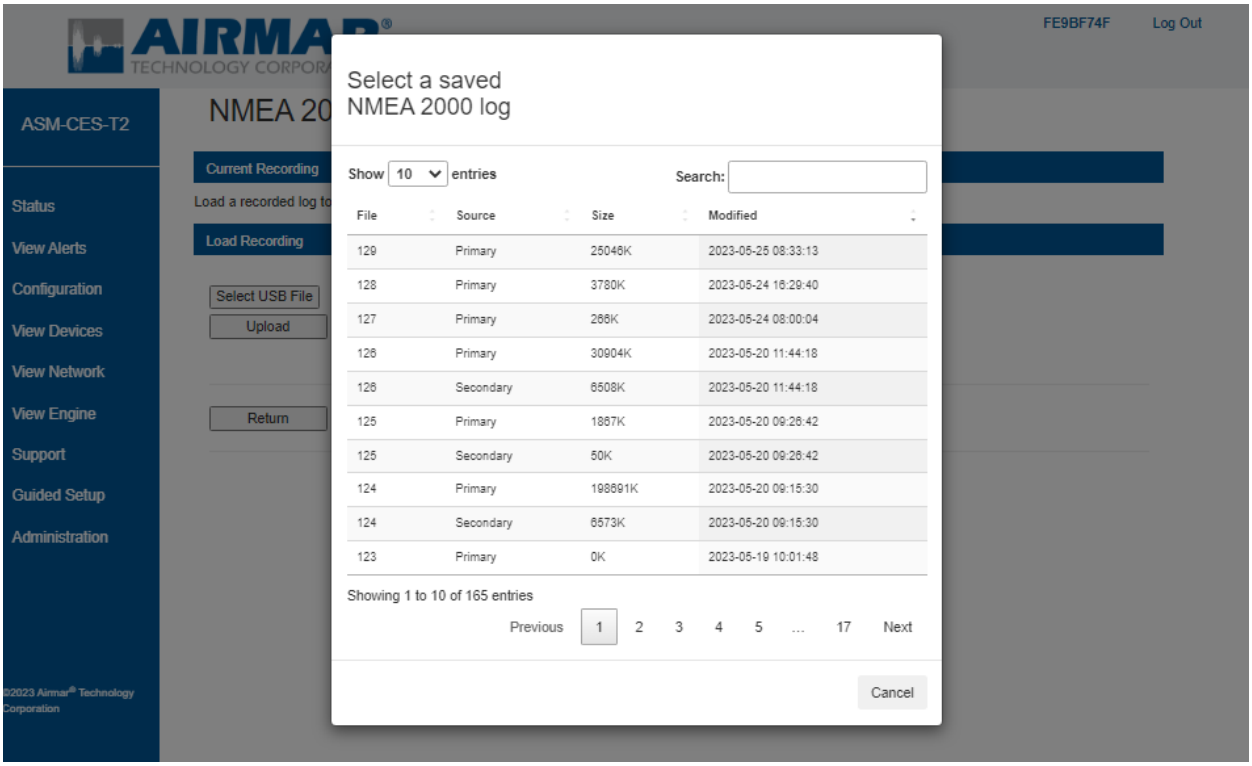


Figure 8-3: Log replay selection

When a log is selected, it will be shown in the **Current Recording** section of the NMEA 2000 Replay page.

There is an additional option called **Log Replay** on the sidebar menu. This option is available whenever a log file has been uploaded or selected from USB storage and can be used to return to this page at any time.

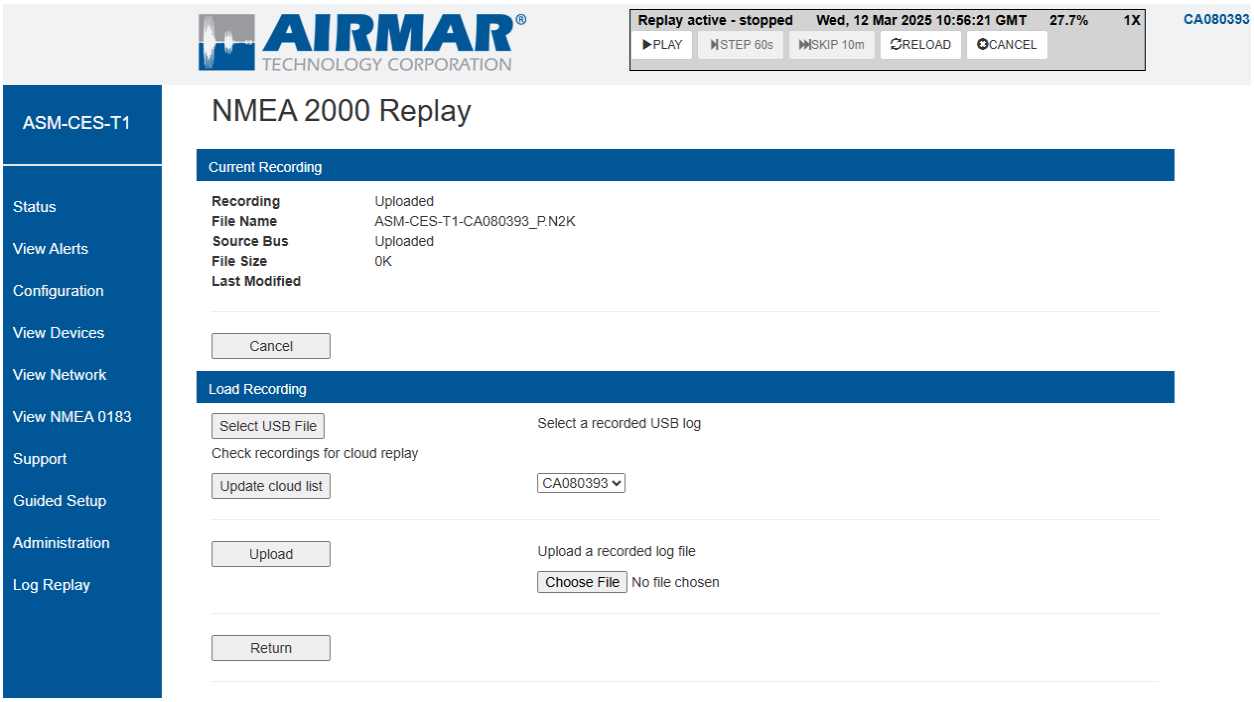


Figure 8-4: Replay recording ready

To begin replay, click the **Start** button on this page. A replay control bar appears at the top of the page and will be present on every page for as long as replay remains active.

When replay is active, pages that display messages and values will no longer be displaying current information. Cancel replay to return to normal display operation.

The actual operation of the SmartBoat module is unaffected by replay, and all functions and features of the device will continue to work normally. Only the user interface and display functions are changed.

The replay control bar displays the current replay status, the current **Replay Time** the current replay position as a percentage of the total file size, and the current replay speed. There are also several options which may be selected:

- **PLAY:** Begin the replay playback.
- **RELOAD:** Reset the replay to the beginning
- **CANCEL:** Cancel replay operations and return to normal operation.

When **Play** is selected, the options available in the replay control bar will change as shown next.

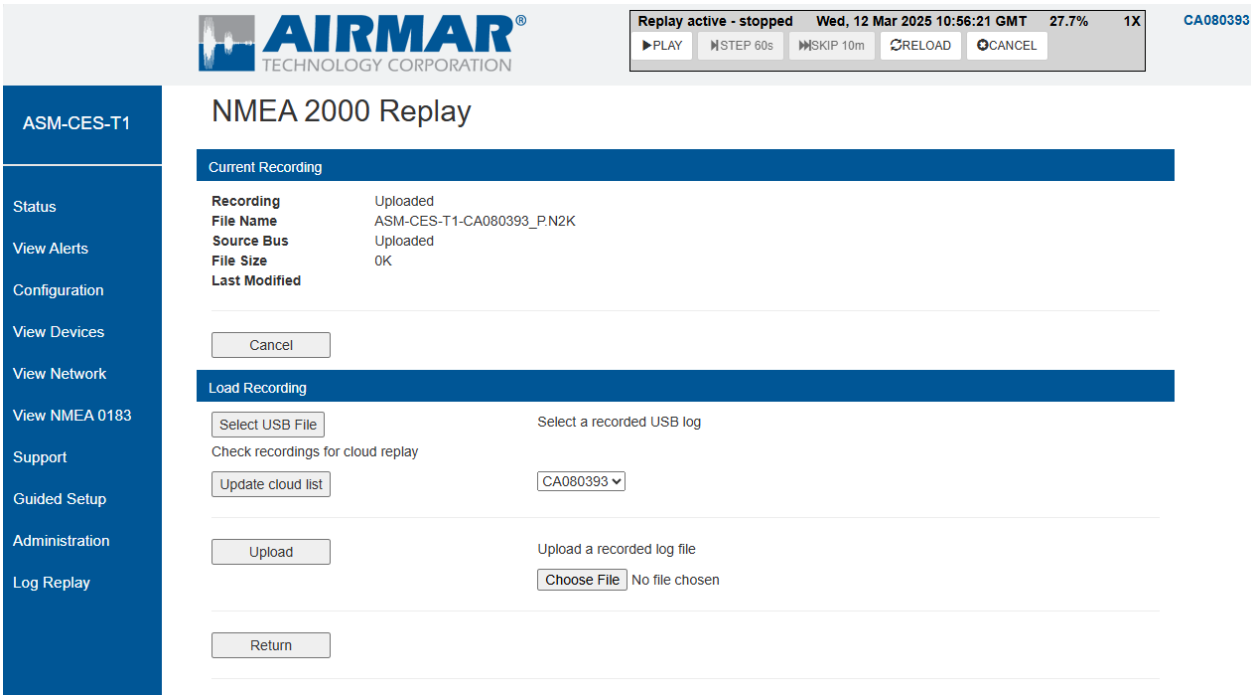


Figure 8-5: Replay running

These options apply to the Replay operation while it is running.

- **PLAY:** Will be selected.
- **RELOAD:** Reset the replay to the beginning.
- **CANCEL:** Cancel replay operations and return to normal operation.

During replay, the **View Network** page displays the current values for all PGN messages. If network devices were included in the log, they are also displayed on the **View Network** page. If SmartFlex values and conditions were included in the log, the **SmartFlex Values** page can be used to view them.

9 SmartFlex Cloud Data Services (Subscription Required)

Each advanced SmartBoat module may be enabled for Cloud Data Services including:

- **Notification Services:** Send email or SMS alert messages as an automation action.

  This level of service also includes the ability to backup and restore SmartFlex Module configuration files to the cloud.

- **Cloud Value Logging:** Save selected named values to a cloud database.

  These values may be accessed using a variety of query and visualization tools.

- **Cloud Bus Logging and Replay:** NMEA 2000 bus logs may be sent to a cloud database and accessed remotely.

  This feature also supports near real-time monitoring of a remote network using the SmartBoat **View Network** feature and other included management tools and is the most complete level of cloud data logging.

Internet access is required for all Cloud Data Services features. For dock-based operation, this could be provided by using the Wi-Fi capabilities of the SmartBoat module. For remote operation, any 3rd party cellular and satellite data solution may be used.

SmartFlex cloud data services provide several methods for managing the amount of data being transferred, providing a high degree of control over the content and resolution of the stored data.

9.1 Configuring Cloud Services

Cloud services credentials must be entered for each enrolled SmartFlex module to enable the cloud data features.

- **Account ID:** This value is unique for each customer but may be the same for any number of customer SmartFlex modules. All modules enrolled using the same account ID have access to the data from other modules. Multiple account IDs may be created for a single customer account to separate or group data from a set of modules.

- **Access Key:** This value is unique for each SmartFlex module and will be provided when the cloud services subscription is activated for use on the module.

The Cloud Services configuration screen is available on the left menu under **Configuration** for any SmartBoat module with cloud capability. Prior to configuration, each of the cloud services features will display that status **Not Available**. Select **Configure** to enter the access credentials as shown next.

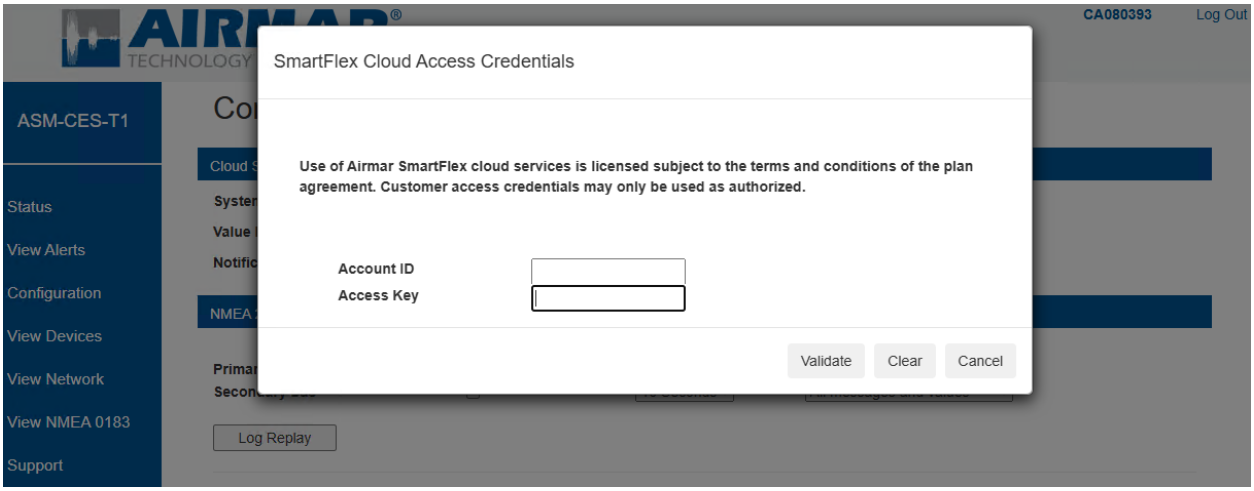


Figure 9-1: Cloud Services Credentials

The Account ID and Access Key must be entered exactly as they are provided, and it is recommended that you copy and paste each value from the email confirming your credentials for the specific module you are setting up.

Internet access must be available to activate cloud services. Press **Validate** to confirm the entries, and the registered credentials will be accessed and saved to the SmartBoat module. You will then return to the Cloud Services Configuration page with the enabled features available for detailed configuration as shown in the following figure.

Once cloud services features have been activated, continuous Internet connection is not required.

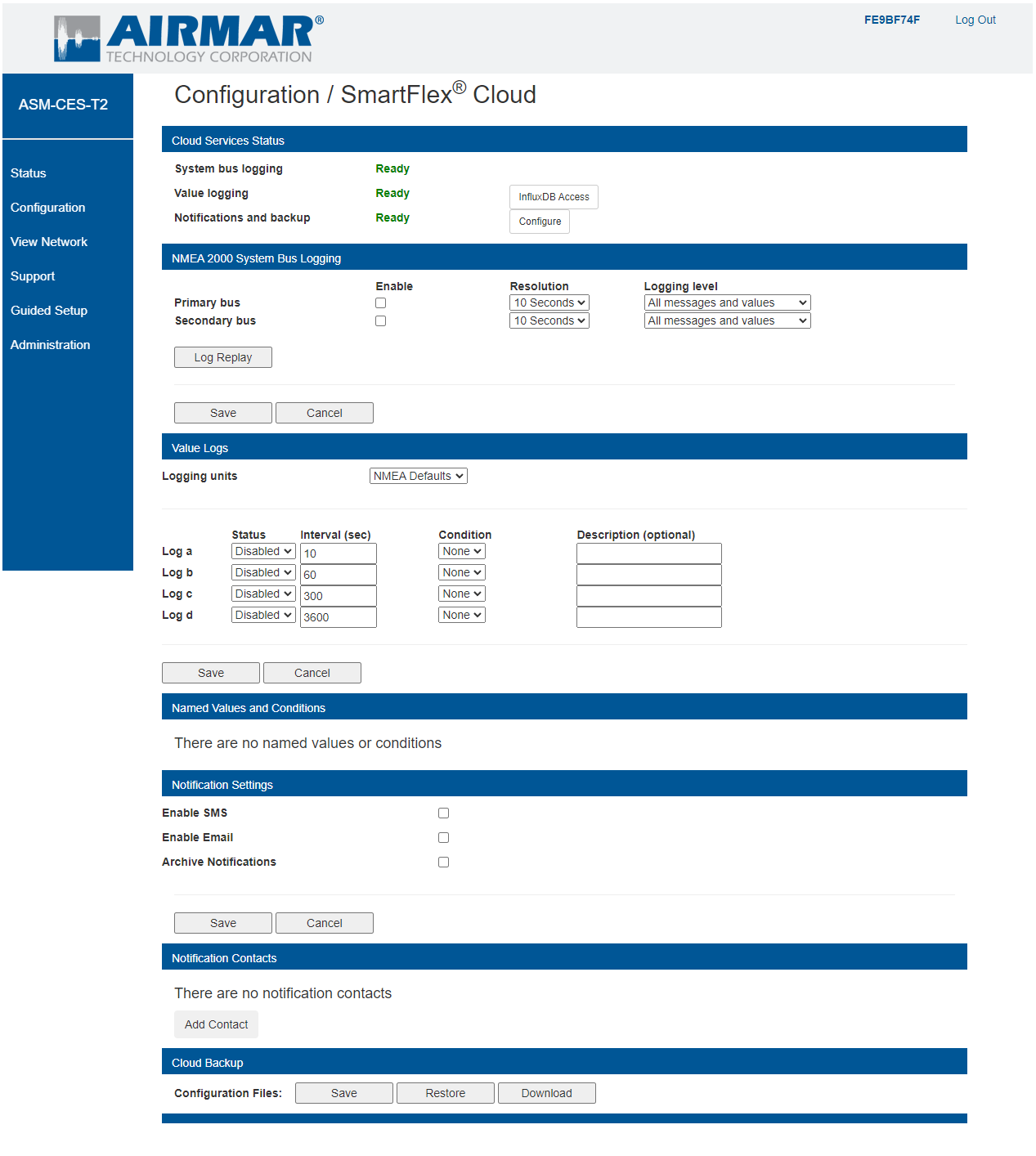


Figure 9-2: Cloud Services Credentials

In this example all cloud services features have been enabled and are available.

9.2 NMEA 2000 Bus Cloud Logging

Logging the NMEA 2000 bus traffic to the cloud is very similar to the local NMEA 2000 bus logging features described in section 8.1. Please refer to that section for a detailed description of the bus logging features. Bus logging settings may be different for local and cloud logs.

It is important to remember that bus logging can generate a high volume of data and should be used with care when using metered Internet connections. For this reason, the default bus log resolution for cloud storage is set to 10 seconds. To capture transient or quickly changing values the resolution may be increased to 1x/second.

Just as with local logging, a SmartBoat module can "replay" recorded NMEA bus log information when connected to the Internet. This feature is available by selecting **Log Replay** from the NMEA bus logging section. When cloud logging features are activated, an option to **Select cloud recording** will be available in addition to the local replay options.

An Internet connection is required to access the list of available logs that have been saved to the cloud. Each recorded log is identified with the serial number of the SmartBoat module that stored the log along with a start time and the duration of the recording as shown in the following figure:

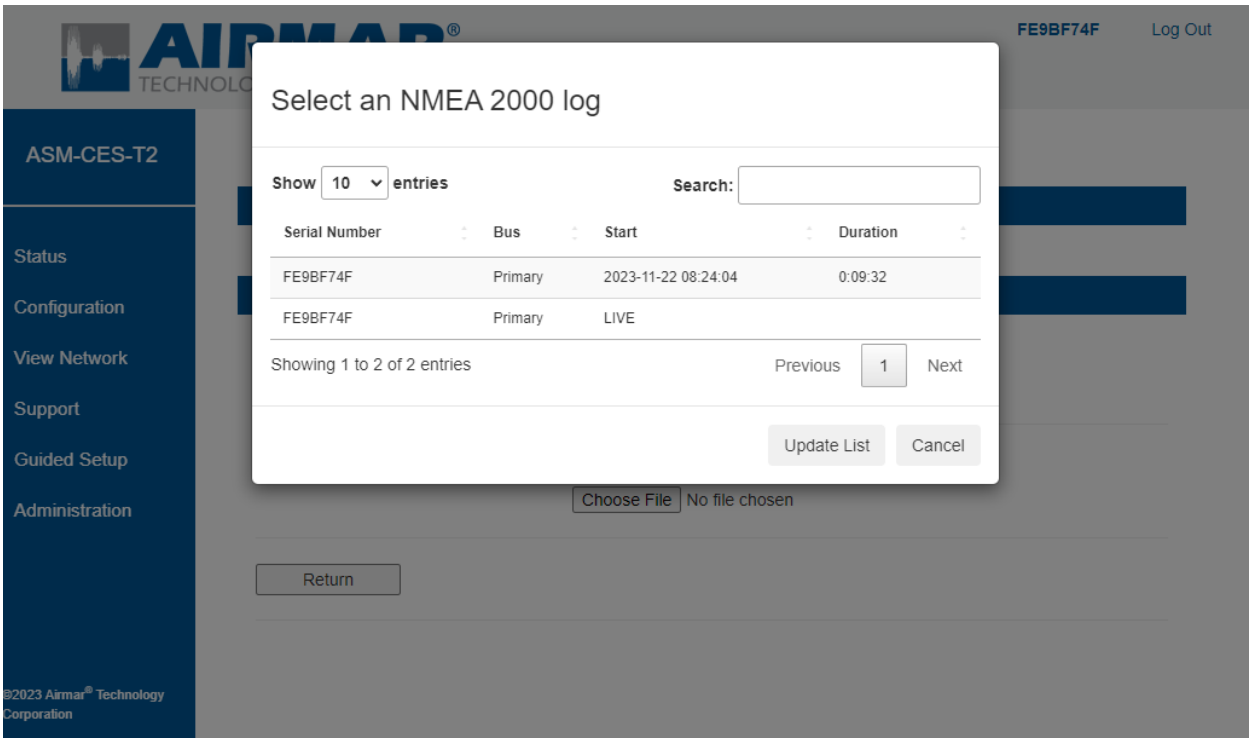


Figure 9-3: NMEA 2000 Cloud Replay

Any entry with a start time "LIVE" indicates that the SmartBoat module is currently sending bus information to the cloud database. Selecting this entry will begin a replay session that shows the current NMEA 2000 bus activity for the selected module. This data will be delayed slightly from the local view. The amount of delay depends upon the selected logging resolution and the Internet connection speeds for the modules. When a **LIVE** replay is selected replay controls such as **Slow** or **Fast Forward** are not available.

9.3 Cloud Value Logs

As with local logging, selected SmartFlex values and conditions may be logged to the cloud database for later review and analysis. Up to four independent value logs may be saved. The setting for these logs is independent of the local logging settings, but the process is the same as described earlier

Cloud value logs are saved in an InfluxDB database. InfluxDB is an open-source time series database developed by the company InfluxData. It is widely used for storage and retrieval of time series data such as the logs produced by the SmartFlex System. Because InfluxDB is an open source database solution, it may be hosted on either local or cloud based servers. Stored data may be accessed directly by writing custom software for your application, or by using a data visualization tool such as Grafana or Google Data. These tools generally have both free and subscription-based features.

When a SmartFlex Cloud Services subscription is activated on a SmartBoat module, the information required to access the database is provided using the access key supplied for that module. The data stored using cloud value logs may be accessed using the URL and access key for the InfluxDB server. This information is available from an activated SmartFlex module by selecting **InfluxDB Access** from the cloud services configuration screen. This option will display the information for access as shown in the following figure:

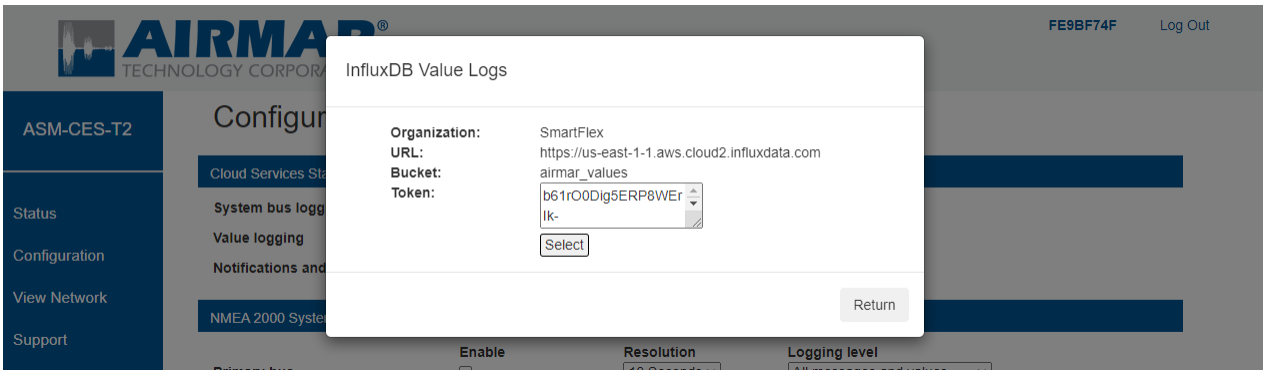


Figure 9-4: NMEA 2000 Cloud Replay

It is recommended that **Copy** and **Paste** be used to transfer this information exactly when linking to the InfluxDB database.

Please refer to the documentation supplied with the chosen visualization software for instructions for linking and using these tools. Publicly available InfluxDB documentation provides the details needed for custom software applications.

9.4 Cloud Notifications

SmartFlex Cloud supports both email and SMS notifications, which may be customized as required for the application.

To send a notification, a "contact" must be entered for each destination. Select **Add Contact** from the Cloud Services configuration screen to create a contact entry, as shown next:

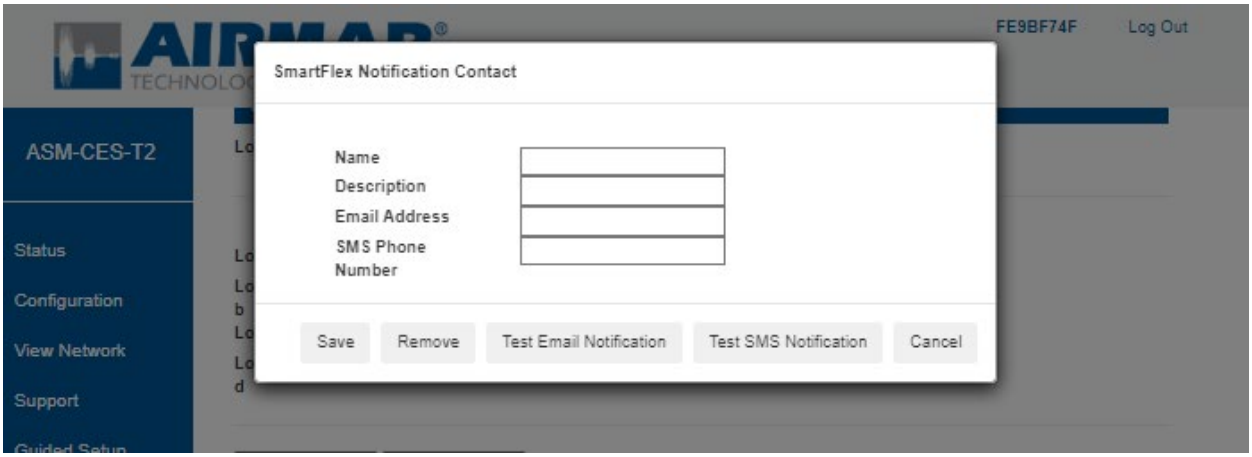


Figure 9-5: InfluxDB Access Information

Enter the required information and select **Save** to add to the list of contacts:

- **Name:** The name is required and must be unique
- **Description:** An optional description for the contact
- **Email Address:** A valid email address, required for email notifications
- **SMS Phone Number:** A valid phone number required for SMS text message notifications.

This window is also displayed if a previously entered contact is selected, so that the contact information may be edited.

It is strongly recommended that the **Test Email Notification** and **Test SMS Notification** be used to ensure that the contact destination can be reached. An active Internet connection is required to test notifications.

Corporate email policies or mail filters may prevent receipt of an email notification. If a test email notification is not received, check your "spam" folder or contact your IT support team.

Notification messages are handled as "Actions" as described in section 7.5. An example of a user-defined SMS text notification is shown in the following figure:

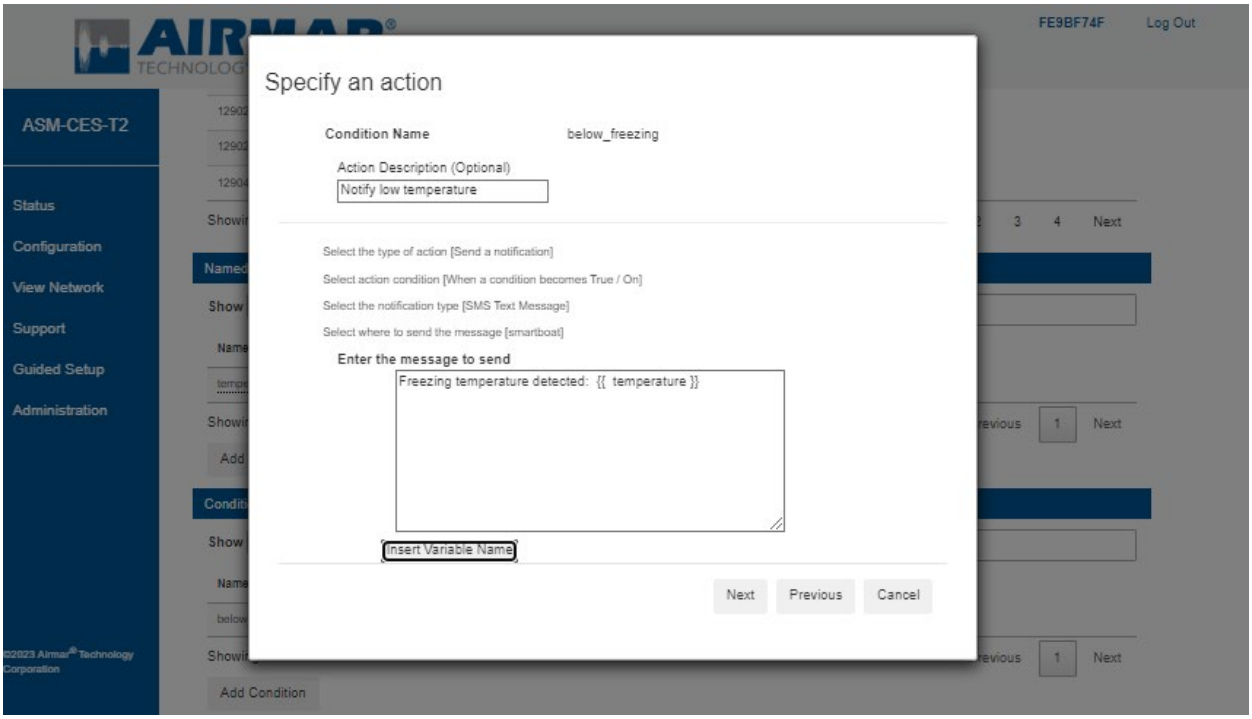


Figure 9-6: Example SMS notification action

For this example, a condition has been defined using an outside temperature value that will become "true" when the temperature is below freezing. This condition will trigger an SMS notification message action with the text shown in the entry box. Note that the actual temperature in the named value "temperature" will be included in the message by substituting the actual value for the named value in curly brackets "{{ }}".

Email notifications may be defined using the same steps.

10 NMEA 0183 (Advanced SmartBoat Modules 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.

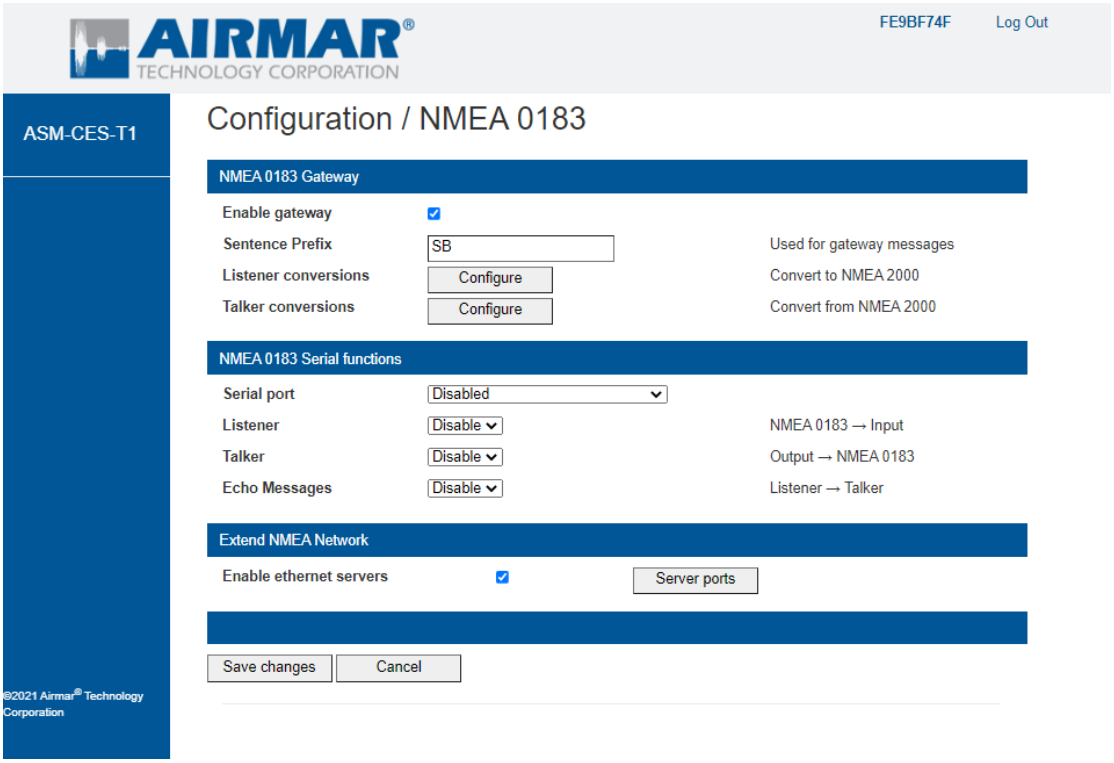


Figure 10-1: NMEA 0183 gateway configuration

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 10-2: NMEA 0183 serial port configuration

10.1 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.

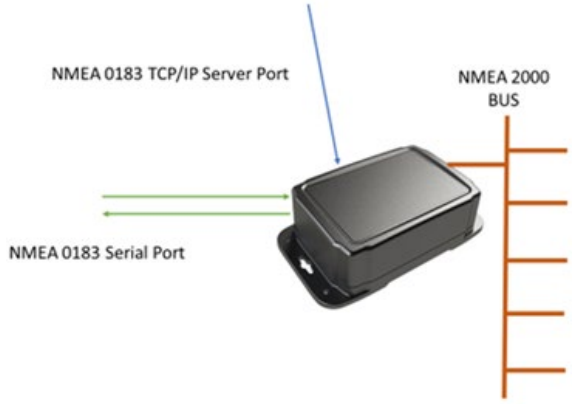


Figure 10-3: NMEA 0183 talker and listener

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.

10.2 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, click **Apply Changes**,  screen bottom, for changes to take effect. Clicking **Return** discards 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.

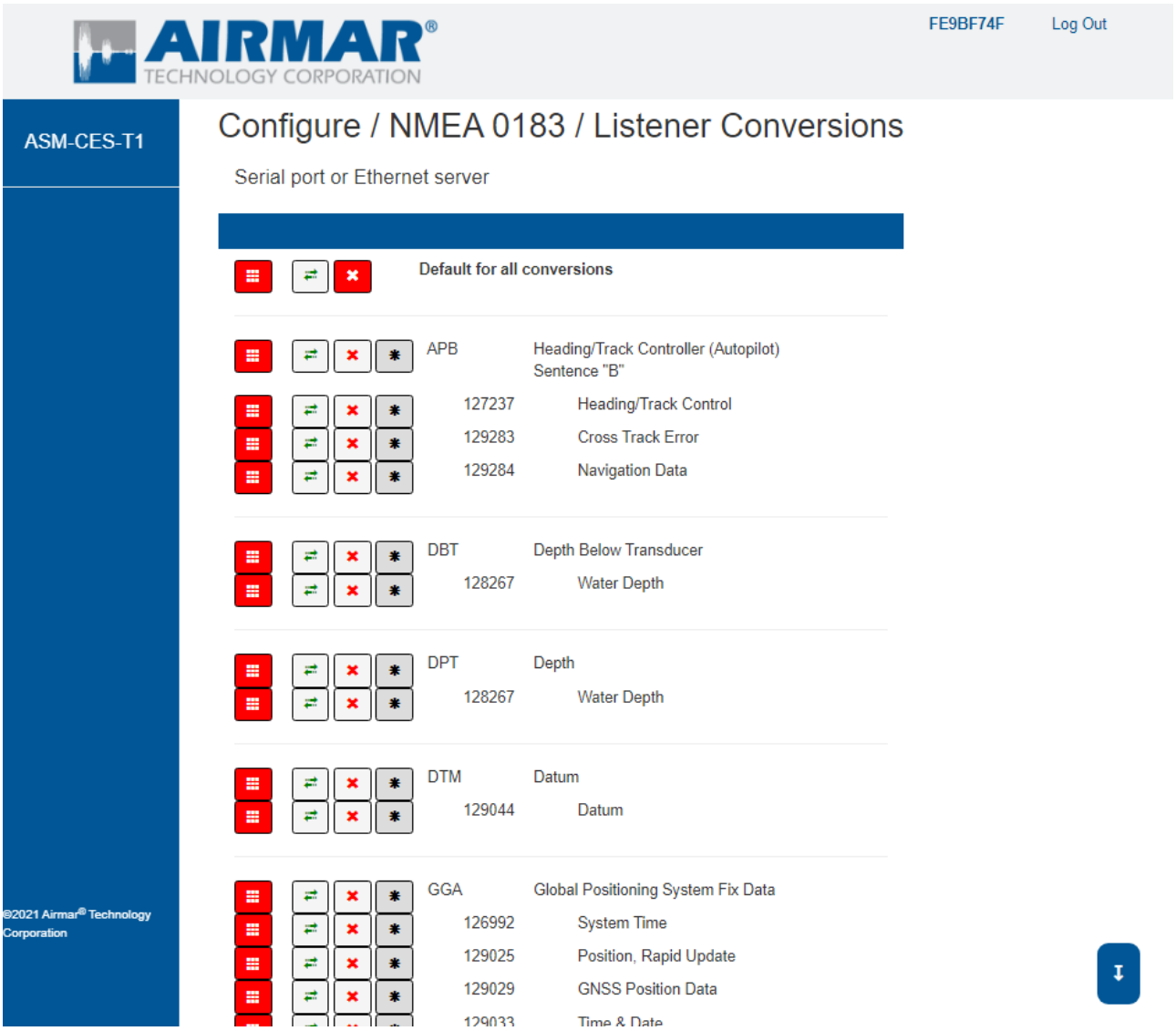


Figure 10-4: Configure NMEA 0183 to NMEA 2000 listener conversions – Data

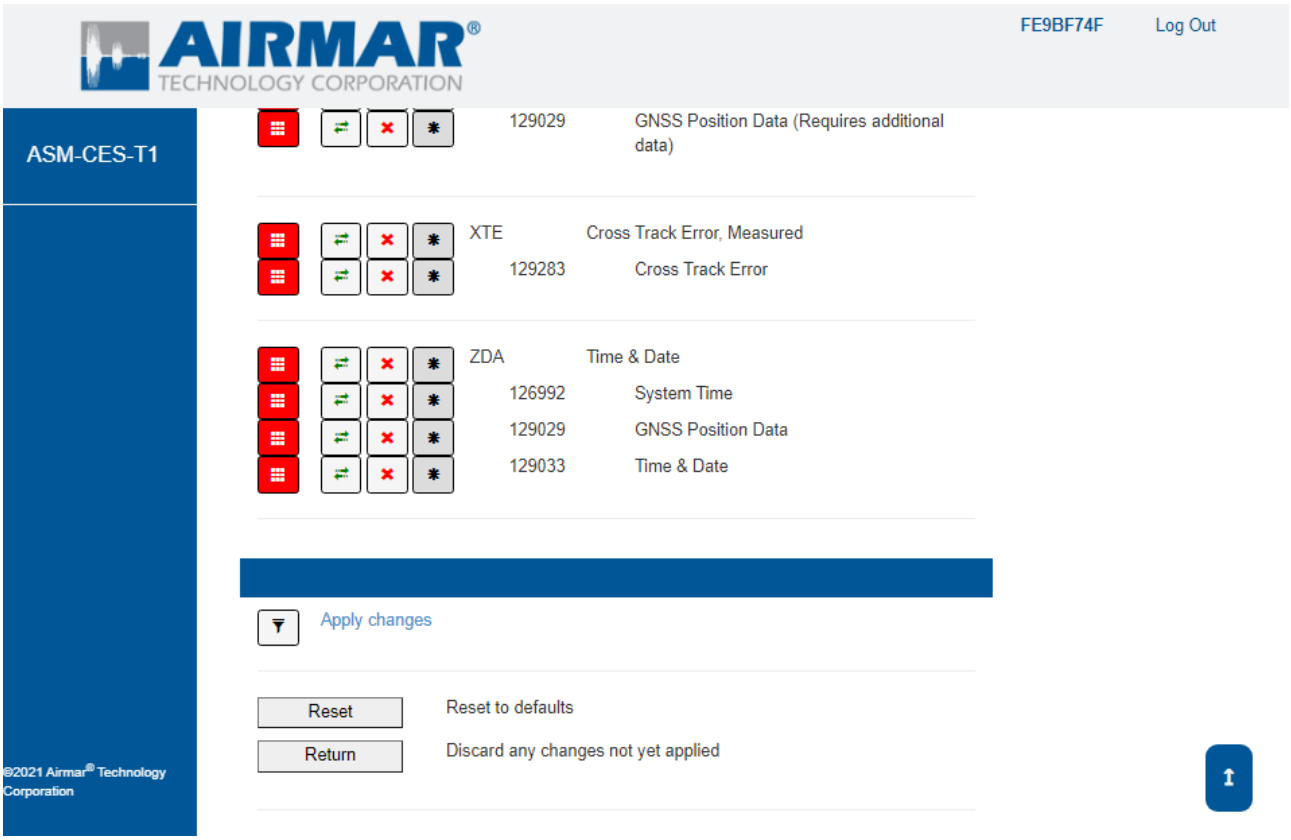


Figure 10-5: Configure NMEA 0183 to NMEA 2000 listener conversions (continued)

Figure 10-6: Configure NMEA 2000 to NMEA 0183 talker conversions

10.3 Viewing NMEA 0183 Sentences

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

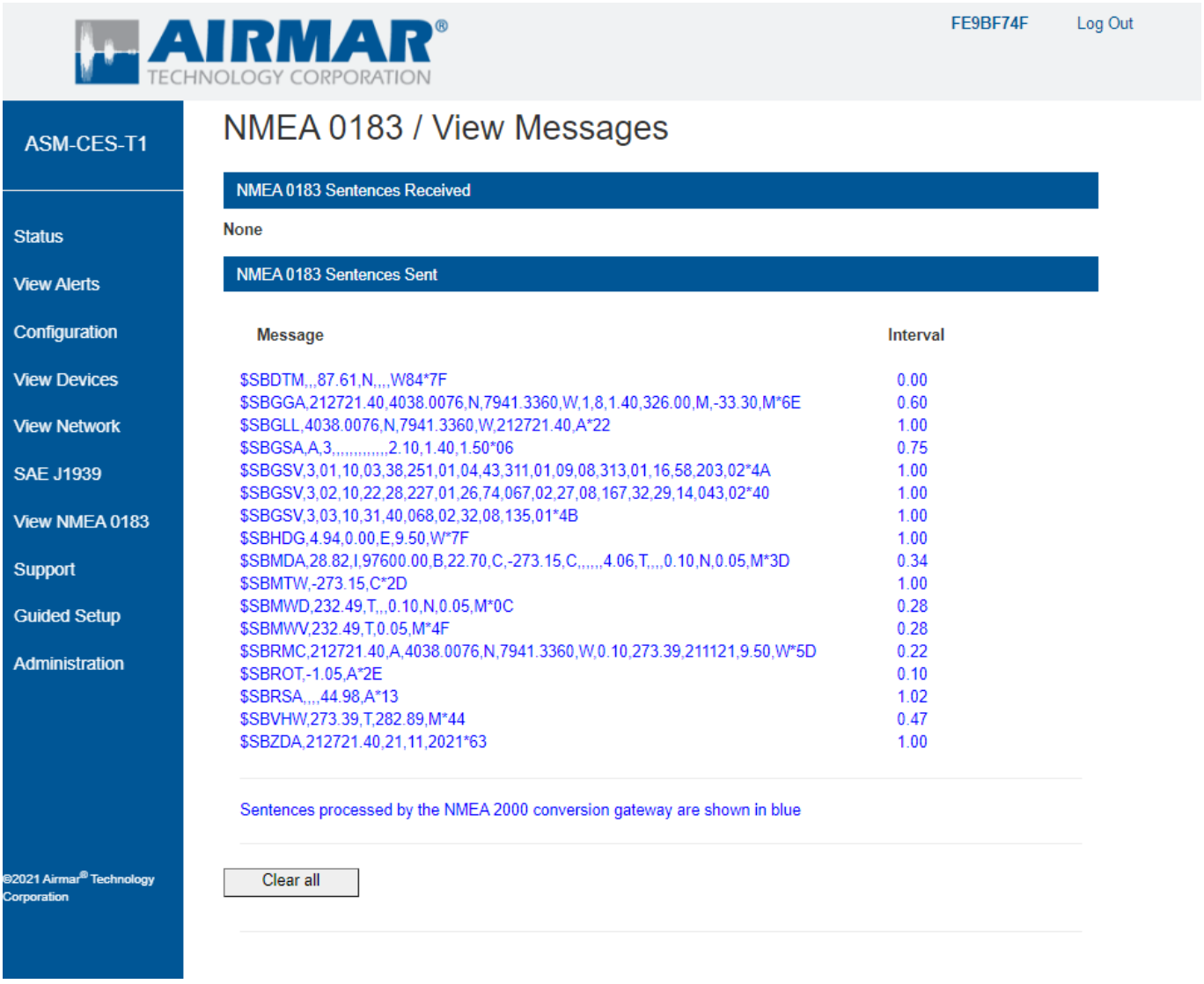


Figure 10-7: Viewing NMEA 0183 sentences

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 **Clear All** at the bottom of the screen to reset the list.

11 Engine Gateway (Advanced SmartBoat Modules Only)

An advanced SmartBoat module provides an Engine Gateway function that can receive information provided by the engine/transmission ECUs and create NMEA 2000 PGN messages containing the engine status. There are two gateway types available:

- SAE J1939

  The SAE J1939 bridge operates using the secondary bus connection. NMEA 2000 and SAE J1939 are both based upon the Controller Area Network (CAN) bus and are compatible at the physical level. 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.

- SAE J1708/J1587

  SAE J1708 uses a serial data interface, and messages are transmitted from the engine ECU using the SAE J1587 message protocol. The engine data signals must be connected to the RX+ and RX- lines of the advanced SmartBoat module serial interface using the DB-9 adapter cable. When this gateway is configured, NMEA 0183 talker/listener interfaces are not available.

The first step to configuring the engine gateway is to select the gateway type.

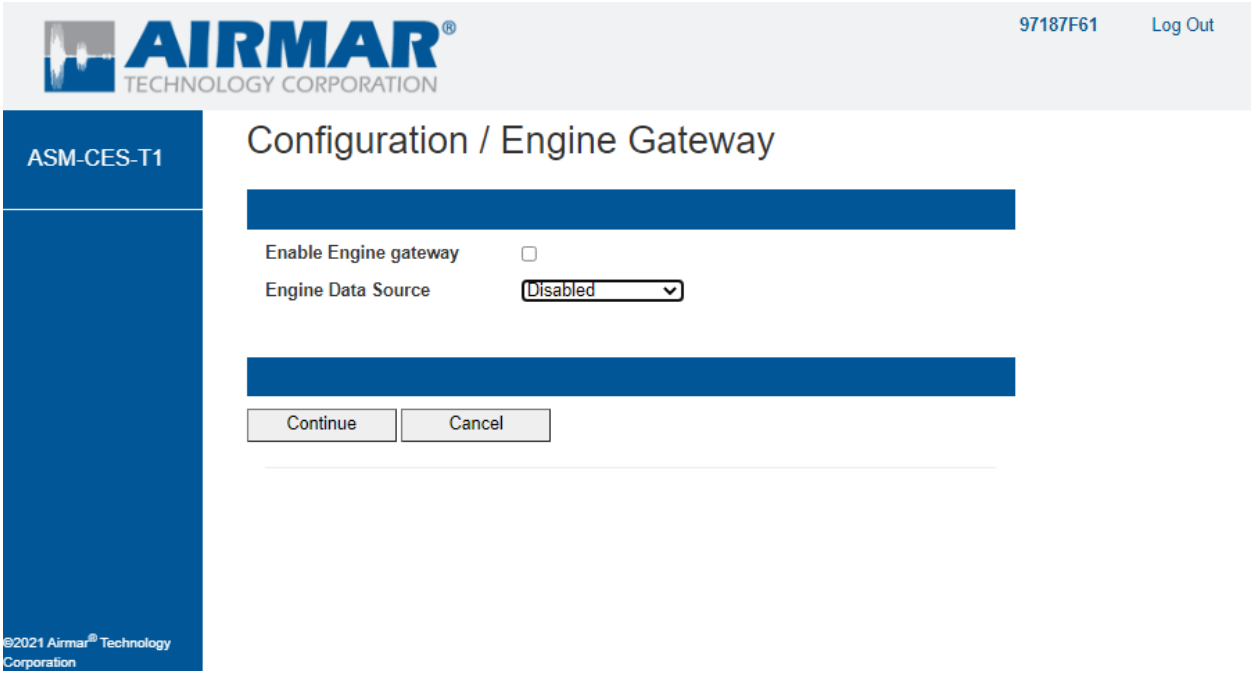


Figure 11-1: Engine Gateway Selection

You will see an error message if the required interface is already configured for a different function and not available for the gateway.

The **Enable Engine gateway** checkbox should be selected once the gateway function is fully configured to begin gateway operation. Until this box is checked, engine data will be received, but no NMEA 2000 PGNs will be generated.

11.1 SAE J1939 Interface Configuration

When the SAE J1939 option is selected as the gateway data source, you will see the SAE J1939 Gateway Configuration screen shown below.

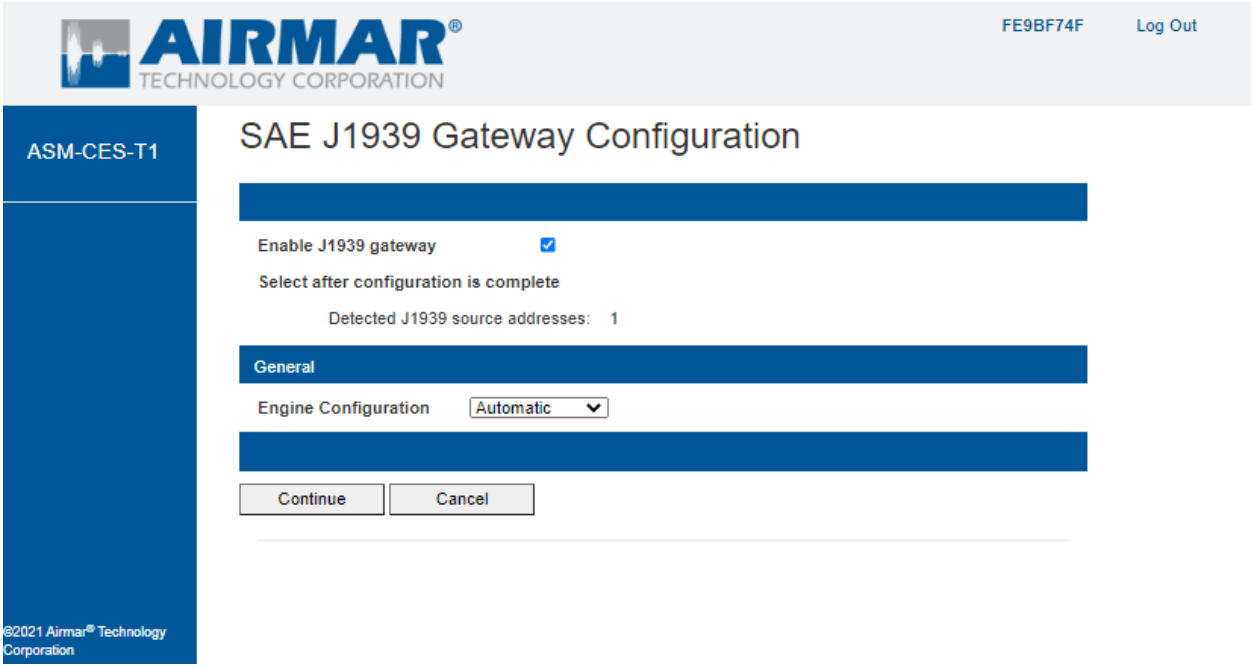


Figure 11-2: Automatic SAE J1939 gateway configuration

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

- **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.

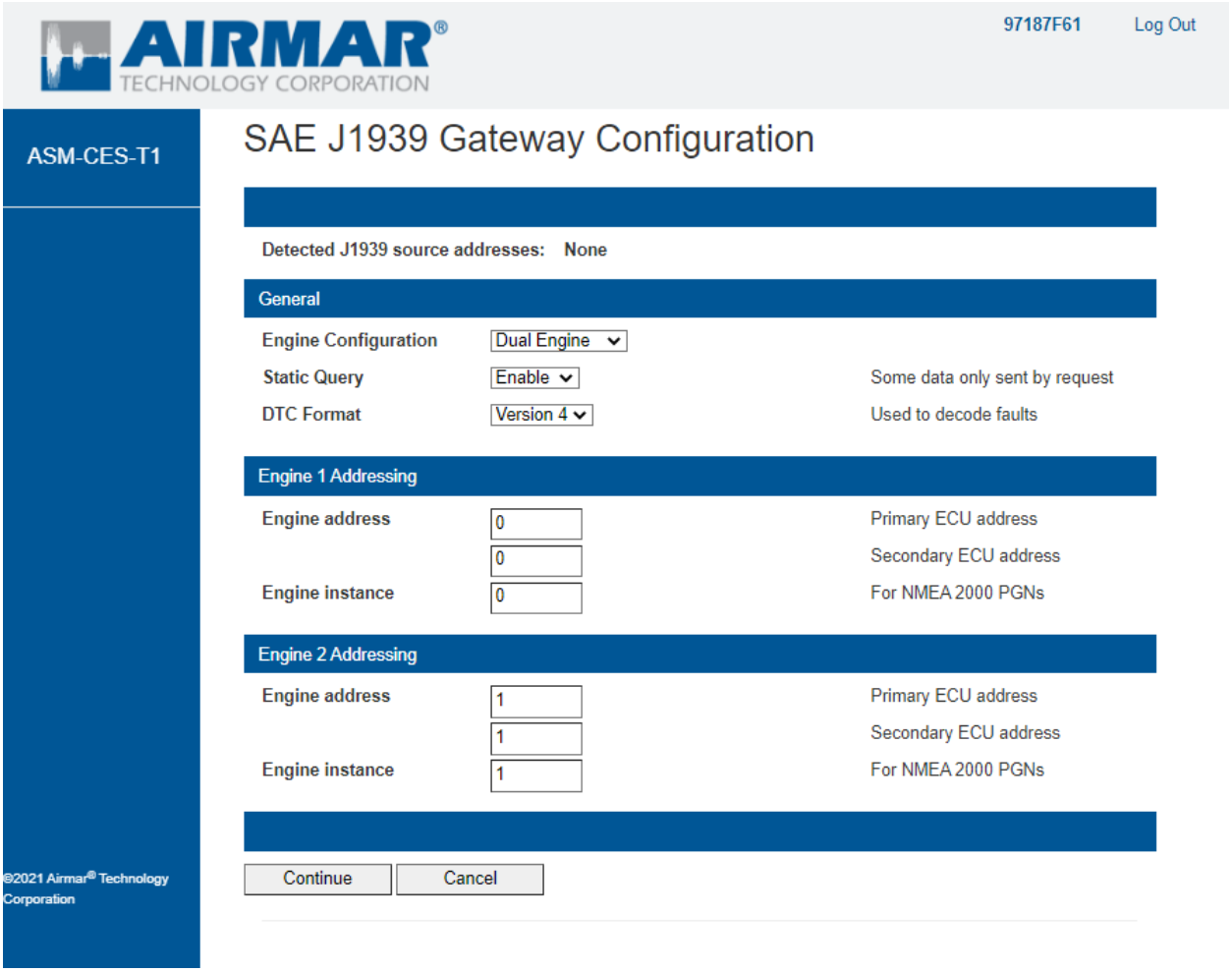


Figure 11-3: Manual SAE J1939 gateway configuration

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), click **Continue** to configure the NMEA 2000 PGNs that will be generated from the engine data.

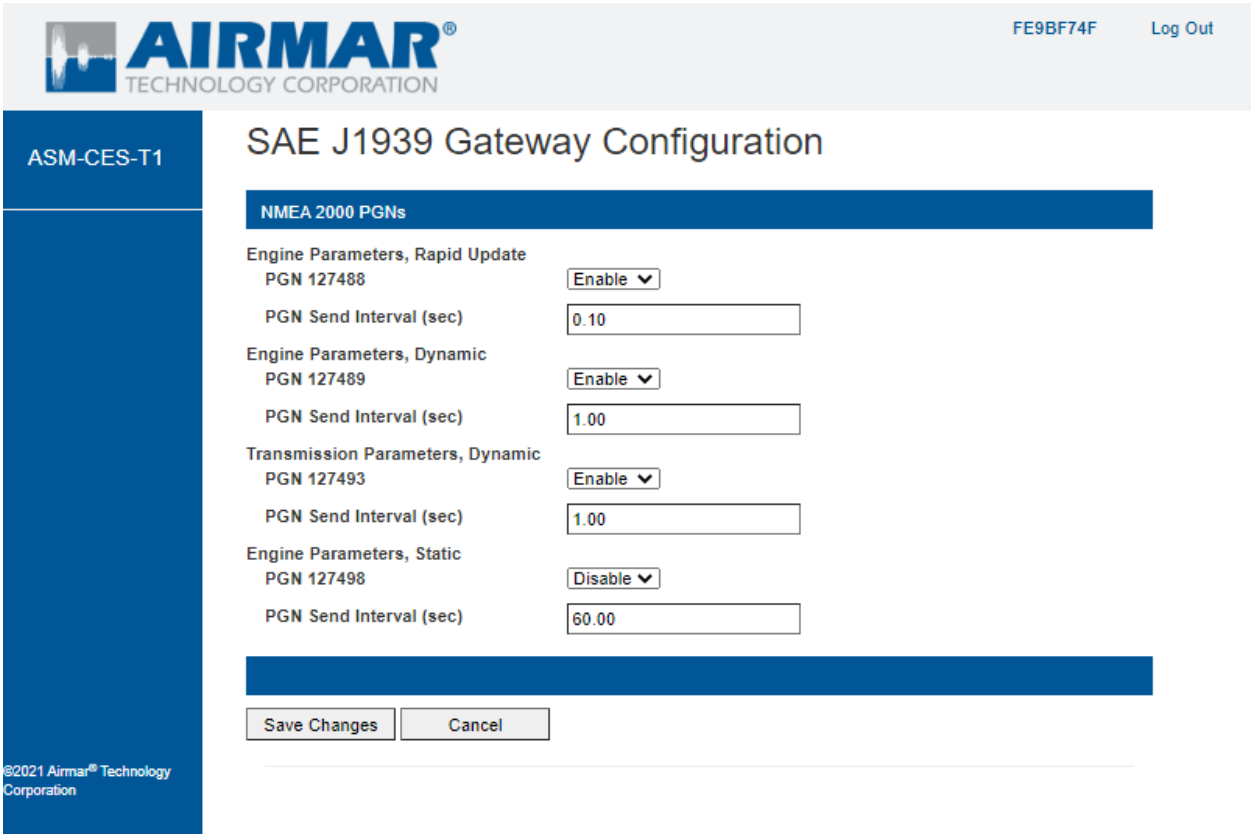


Figure 11-4: NMEA 2000 PGNs generated by the SAE J1939 gateway

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.

11.2 SAE J1708/J1587 Interface Configuration

When the SAE J1708/1587 option is selected as the gateway data source, you will see the engine Gateway Configuration screen shown below.

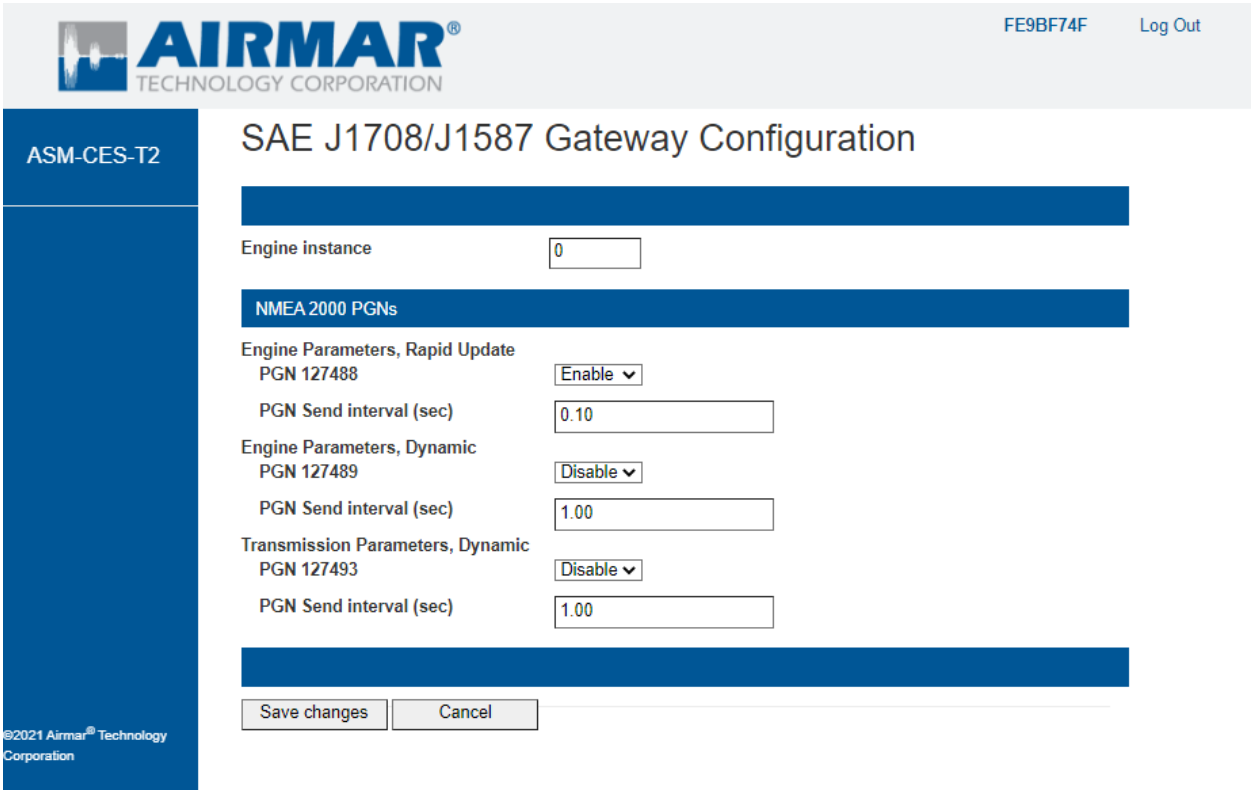


Figure 11-5: SAE J1708/J1587 Engine Gateway Configuration

The Engine instance used for NMEA 2000 PGNs must be specified, and defaults to 0.

The default settings 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.

11.3 Viewing Engine/Transmission Data

When the engine gateway function is active, you may view engine data. Click **View Engine** in the sidebar to access the Engine Information screen as shown in the figures below.

*The **Display units** dropdown is used to select US or metric units of measure.*

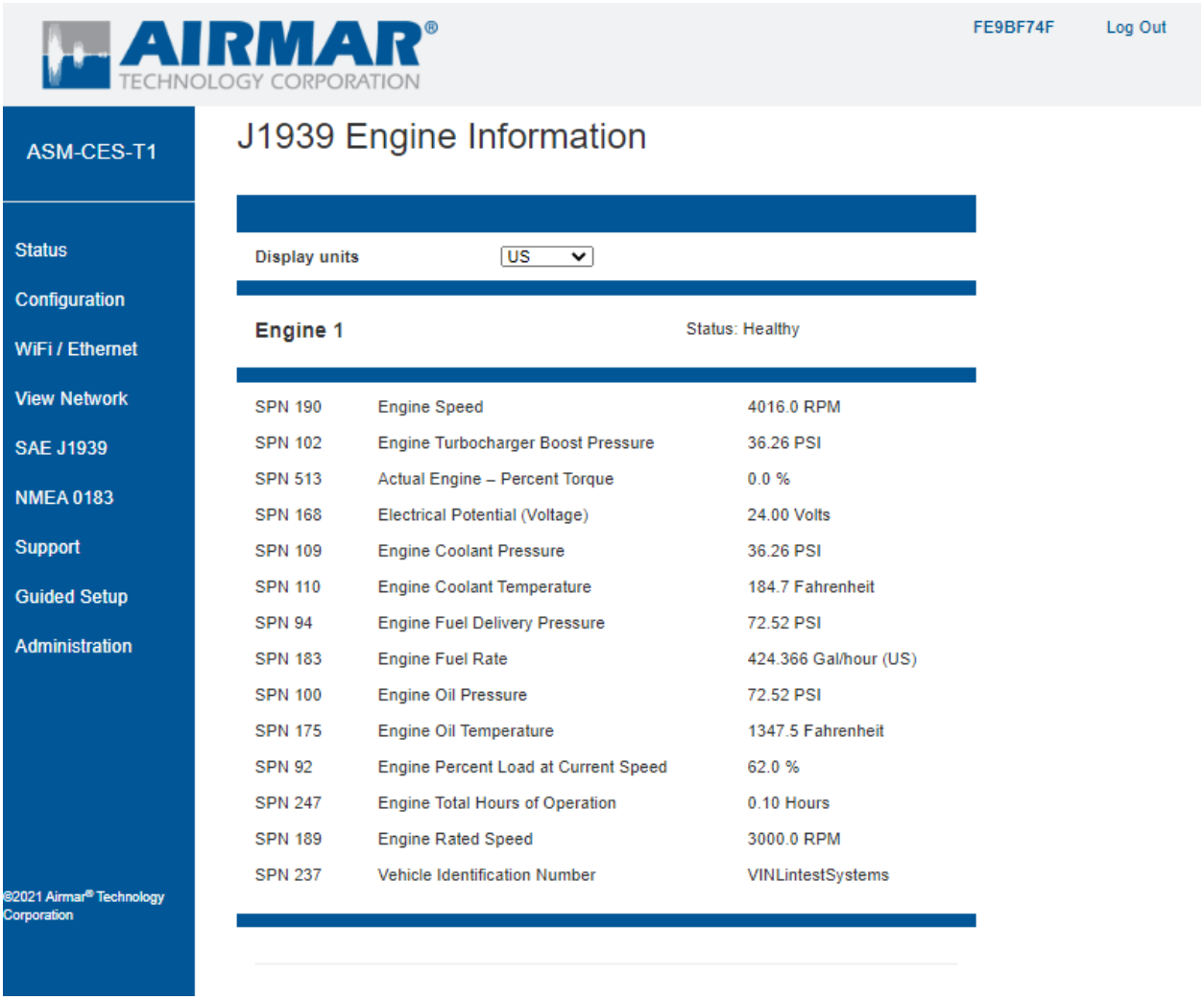


Figure 11-6: J1939 engine information

The J1939 Engine Information screen also reports the status of any faults. Figure 11-7 shows Engine 1 with a DTC alert detected.

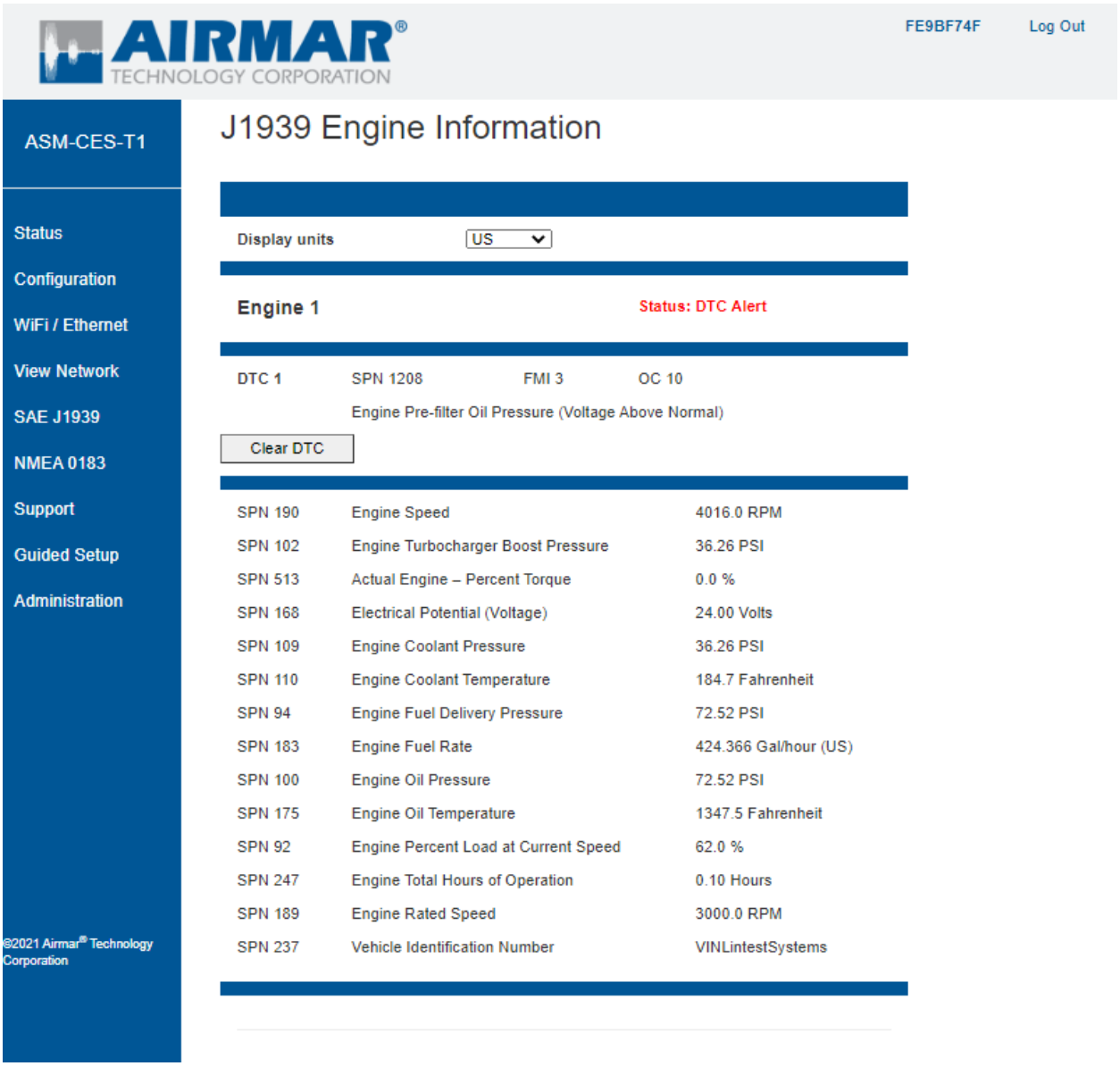


Figure 11-7: Example – J1939 engine DTC alert

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 notifies the ECU to clear the alerts.

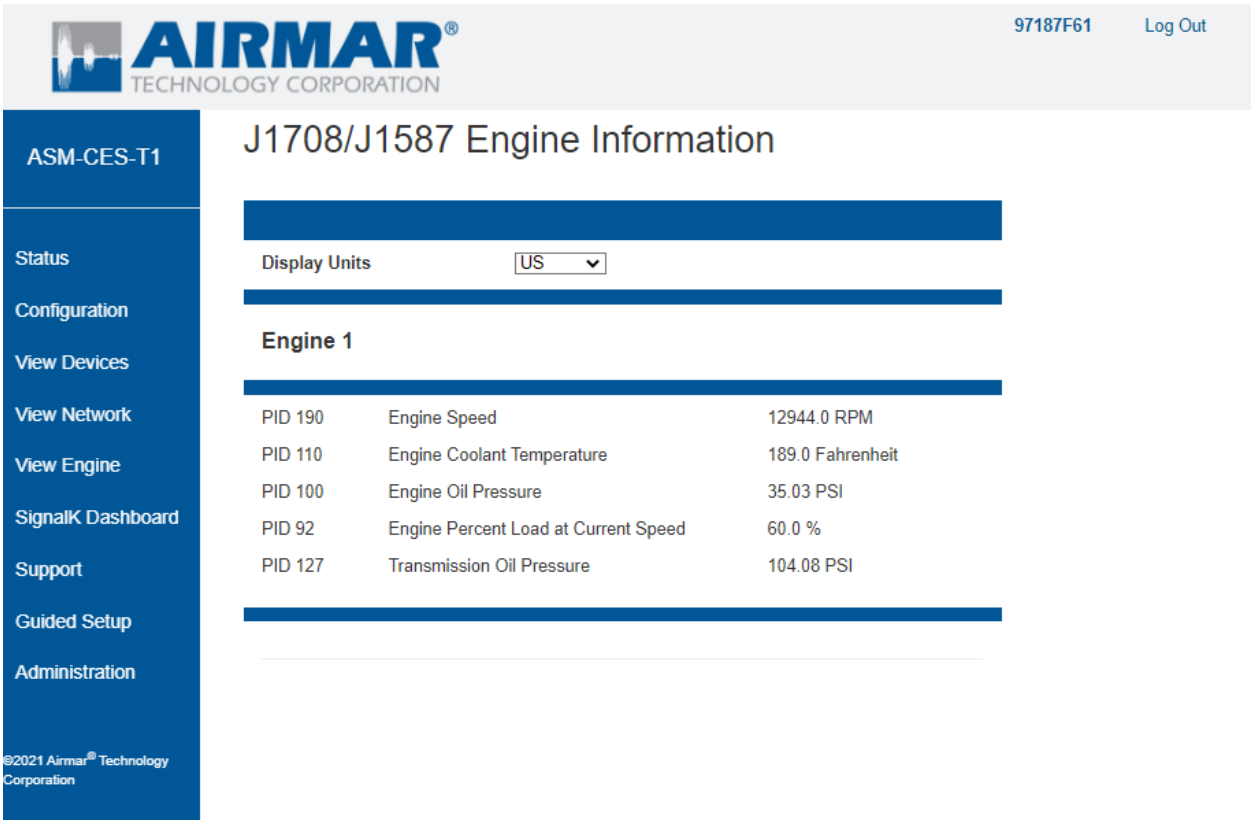


Figure 11-8: Example – J1708/J1587 engine information

12 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.

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.

When the Digital Sensors option is selected in the sidebar under Configuration, you will see a list of the detected sensors and the configuration status. Select **Configure** to begin the process.

12.1 Diesel Fuel-flow Meters (DFM)

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.

12.1.1 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, Figure 12-1.

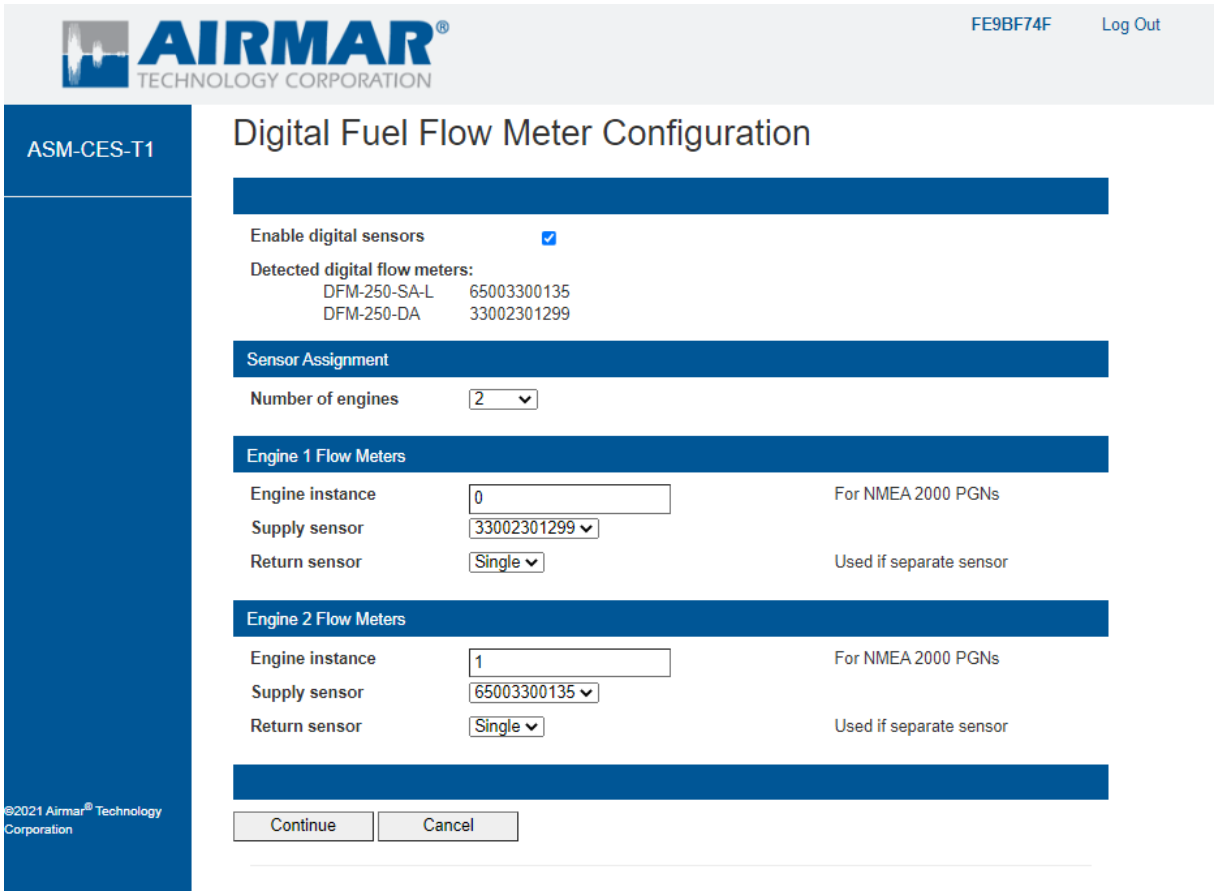


Figure 12-1: Assigning digital fuel flow meters to engines

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 meters(s) to the engine(s), select **Continue** to configure the NMEA 2000 PGNs that will be generated from the measured data.*

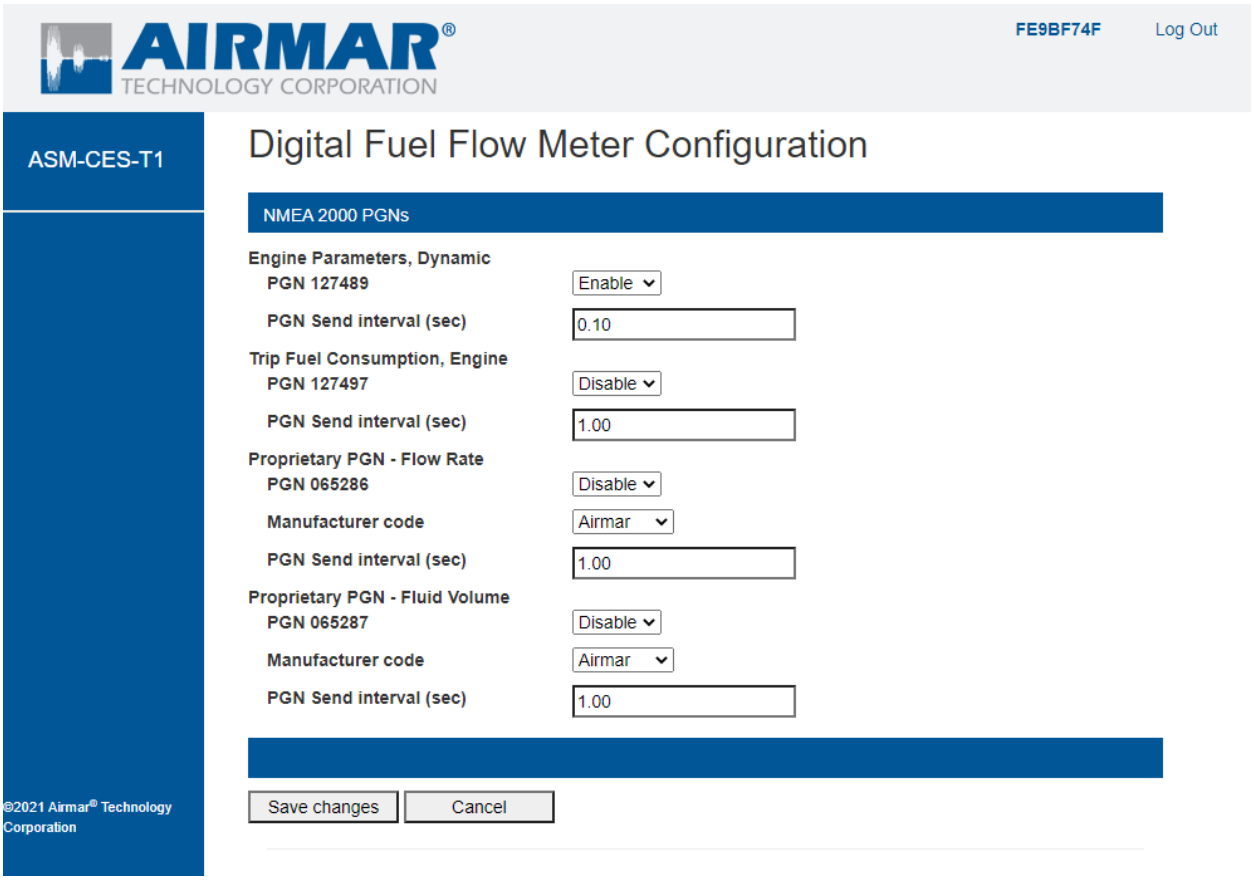


Figure 12-2: Configuring NMEA 2000 PGNs for digital fuel-flow meters

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.

12.1.2 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 drop down menu is used to select US or metric units of measure.

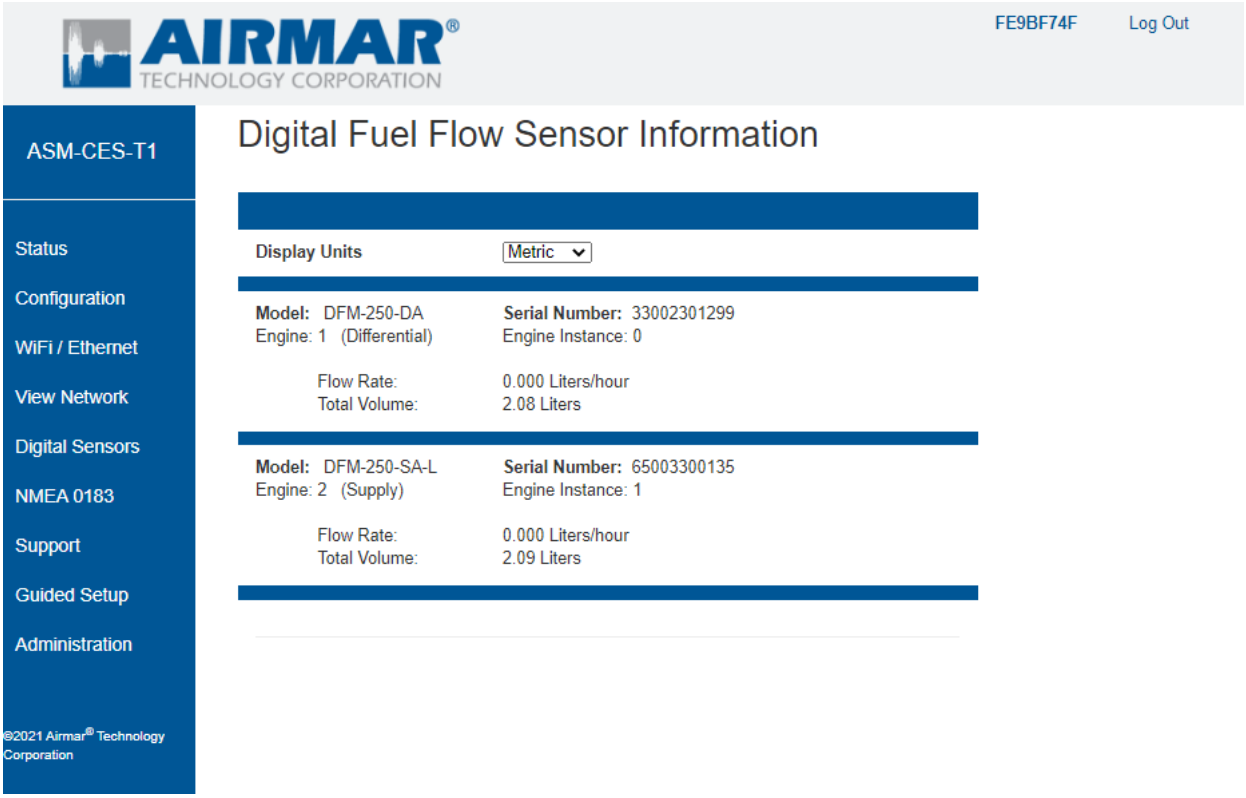


Figure 12-3: View digital fuel flow meter information

12.1.3 Viewing Digital Sensor Status

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

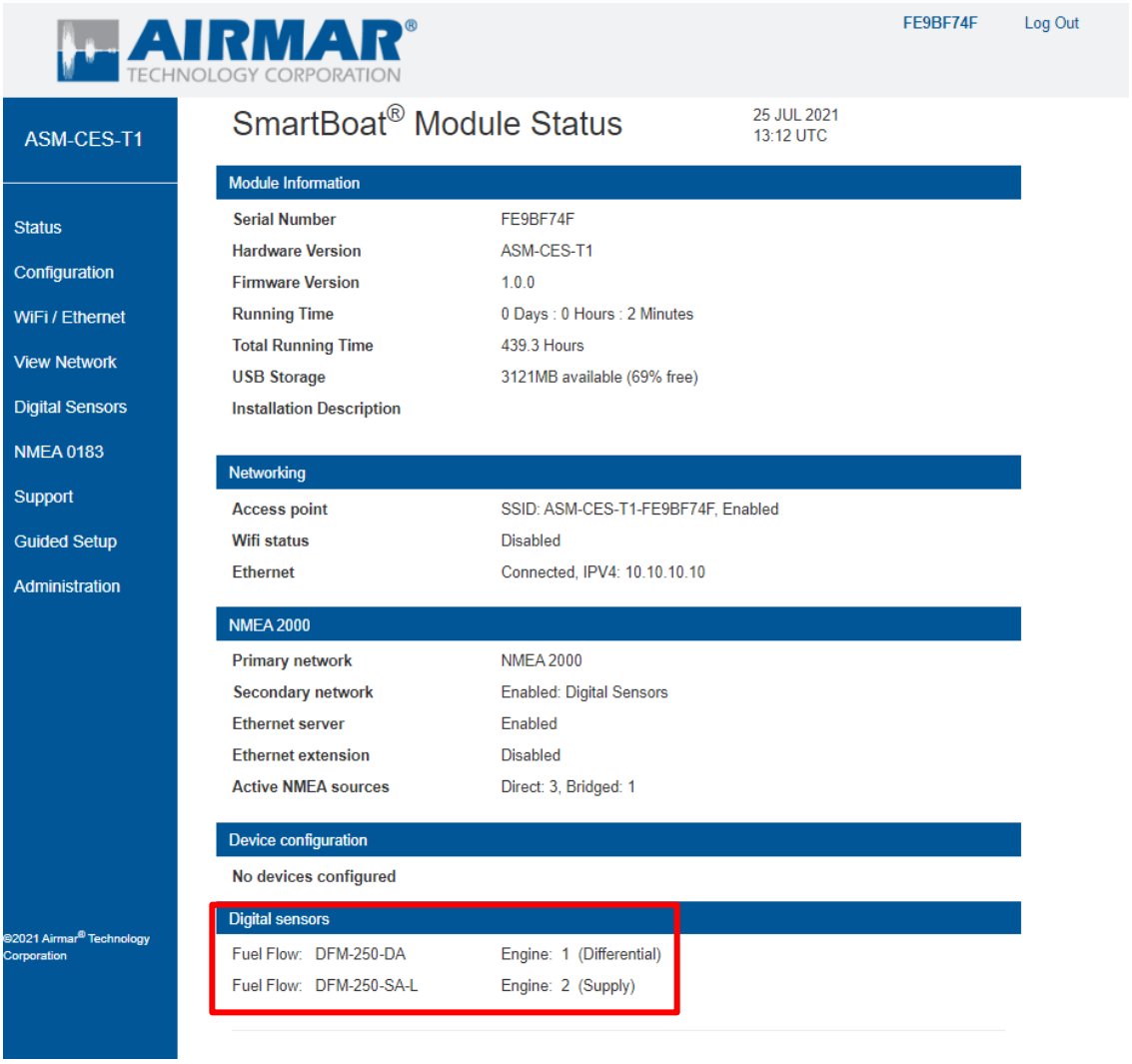


Figure 12-4: Fuel flow meter status

13 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 13-1: 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.

13.1 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 acts as the access point and the other two modules are connecting to it as clients.

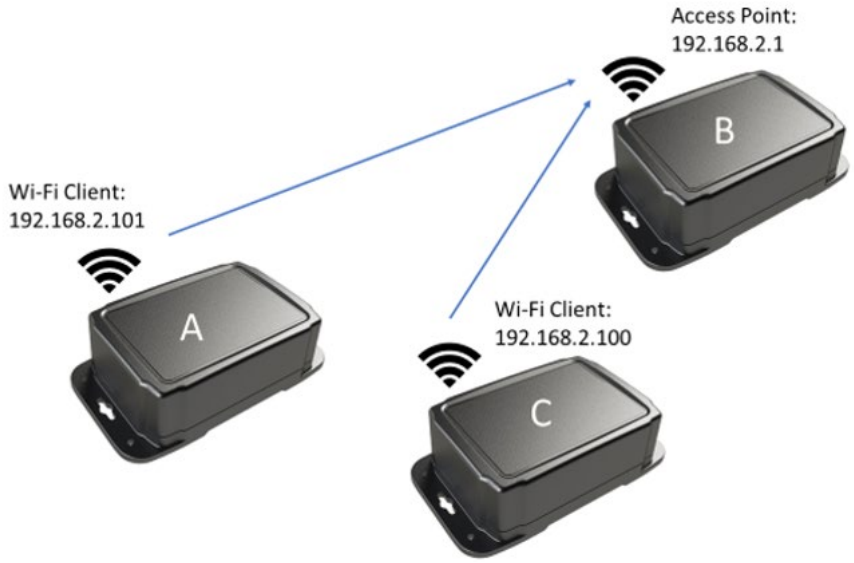


Figure 13-2: Example – Simple Wi-Fi configuration

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.

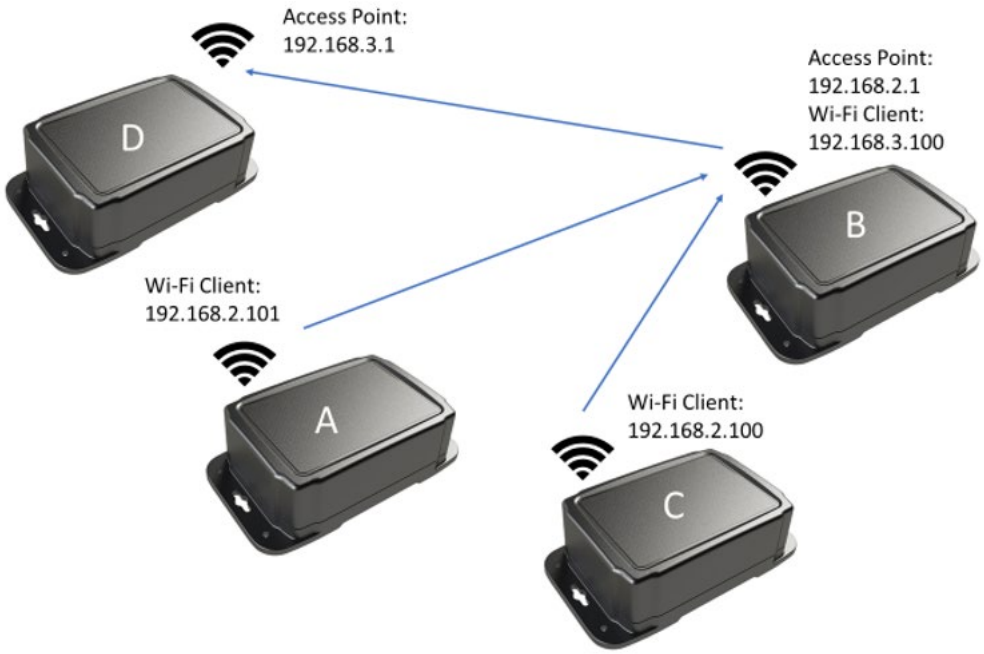


Figure 13-3: Wi-Fi configuration with multiple access points

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.

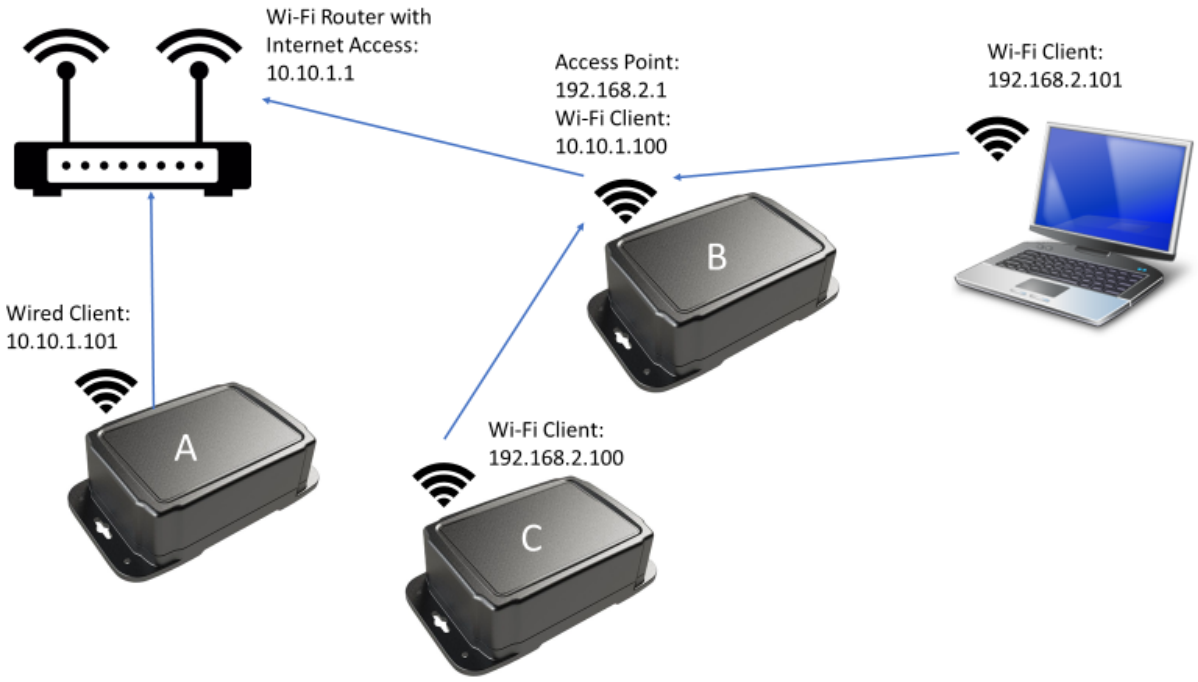


Figure 13-4: Complex network configuration

13.2 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.

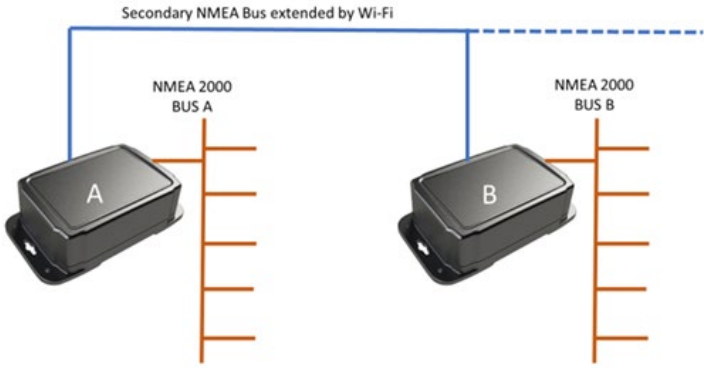


Figure 13-5: Bridging over Wi-Fi/Ethernet

14 Administrative Features

The SmartBoat module Administration screen is reached by selecting the **Administration** link in the sidebar. Figure 14-1 shows a typical screen.

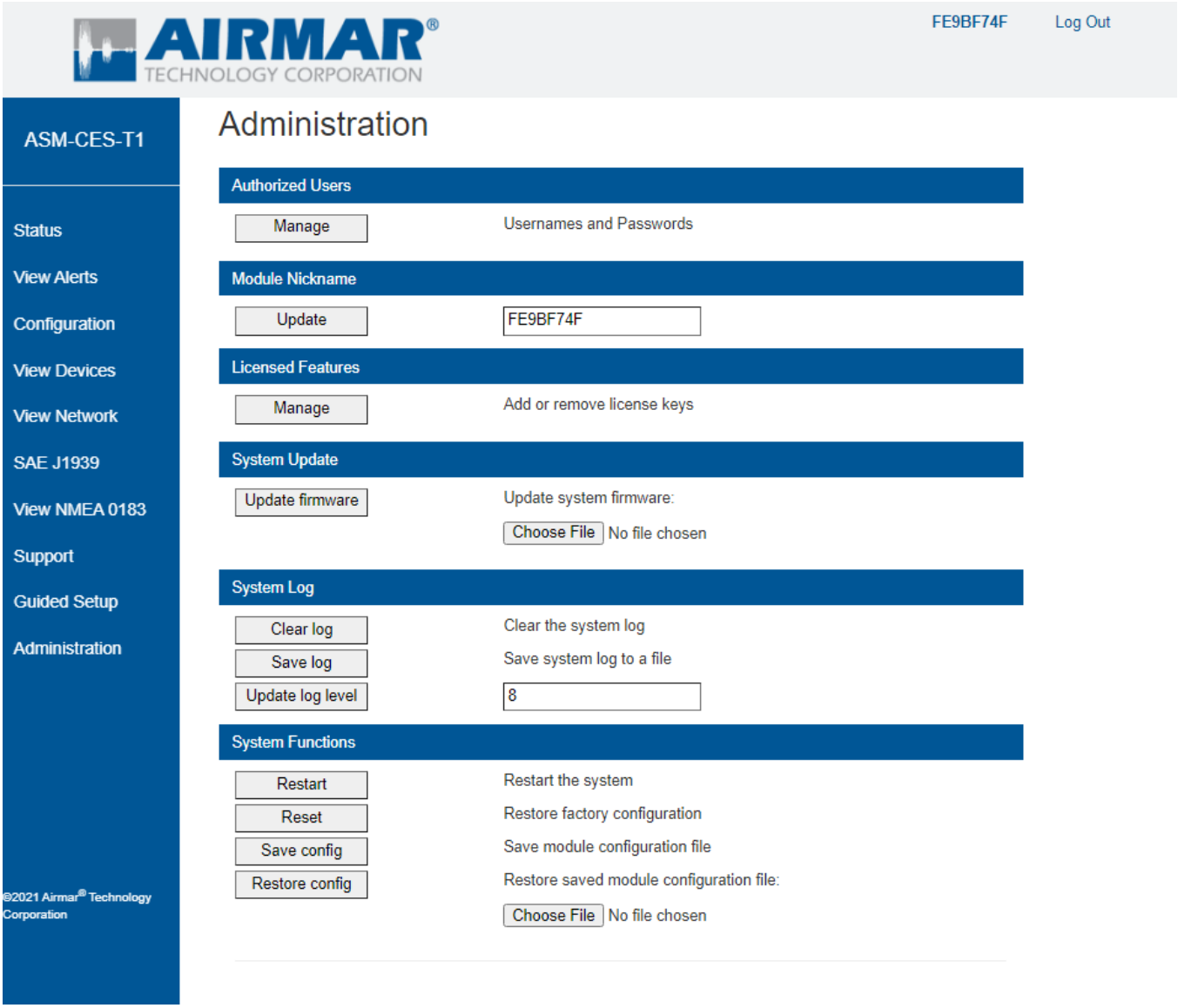


Figure 14-1: Administration screen

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 displays at the top of each configuration screen. Nicknames may only consist of letters, numbers, spaces, and limited punctuation (period, 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.

14.1 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 different from 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.

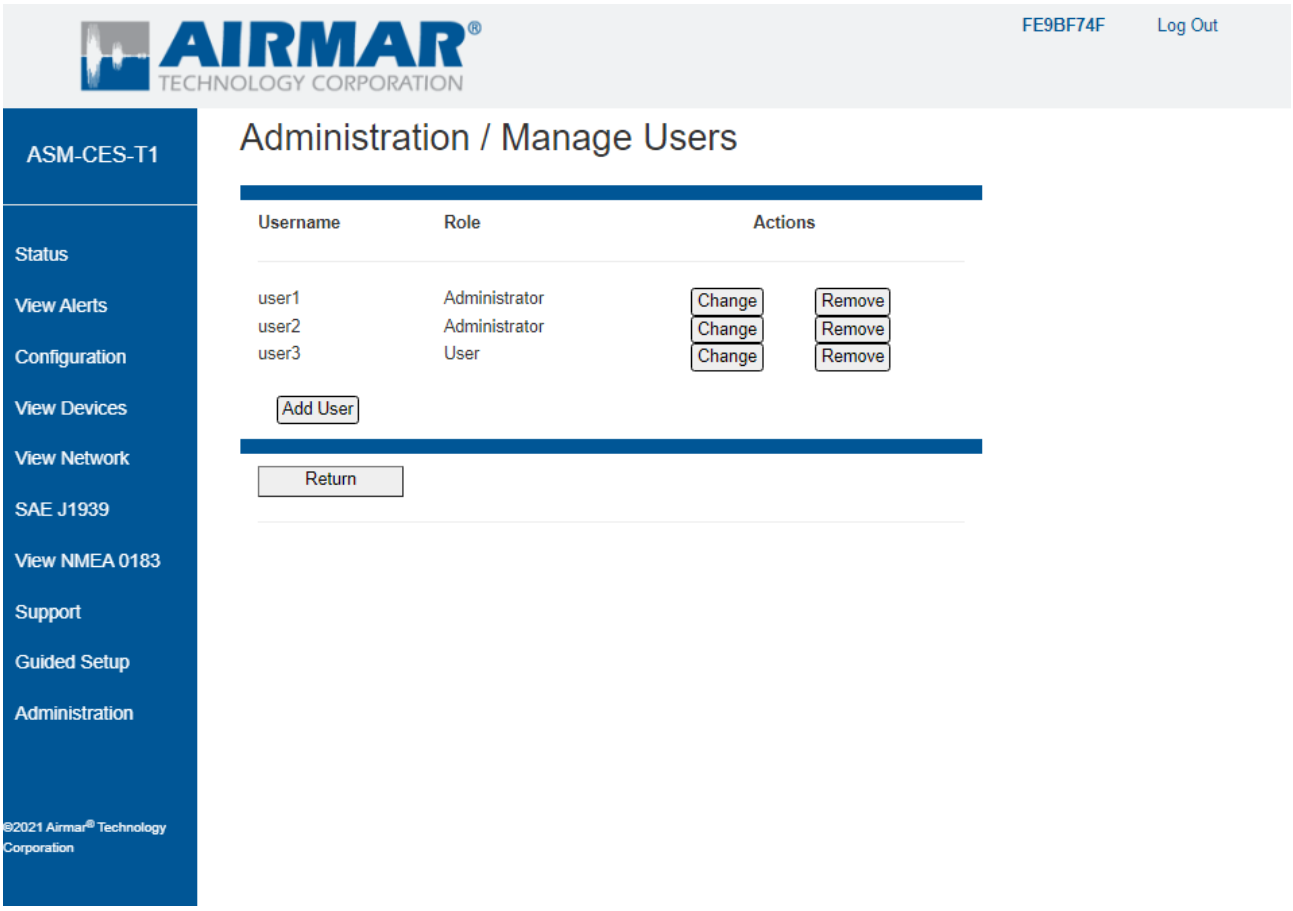


Figure 14-2: Manage Users screen

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 3.2.2 Reset Switch.

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** at the top of the screen.

14.2 Change Module Nickname

Each SmartBoat module may be assigned a nickname that displays 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.

14.3 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 next.

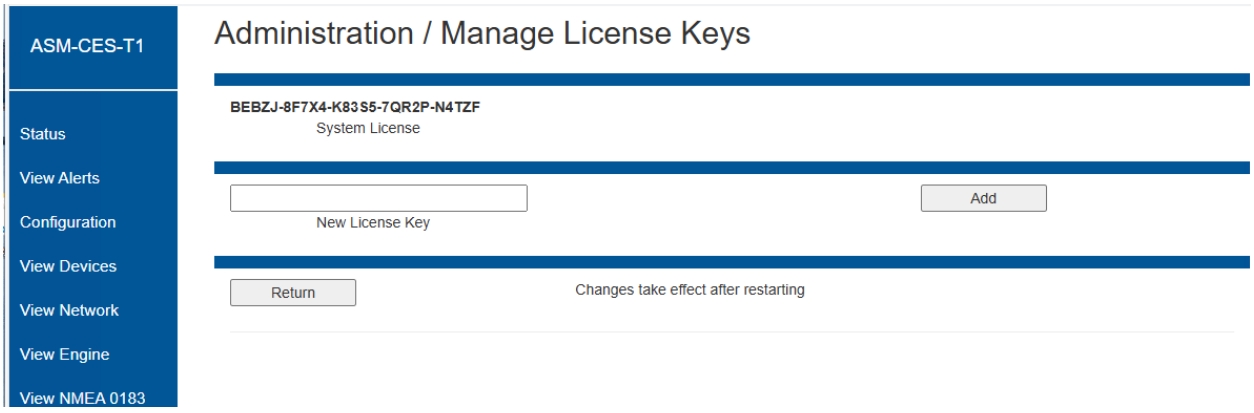


Figure 14-3: Manage License Keys

14.4 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 next.

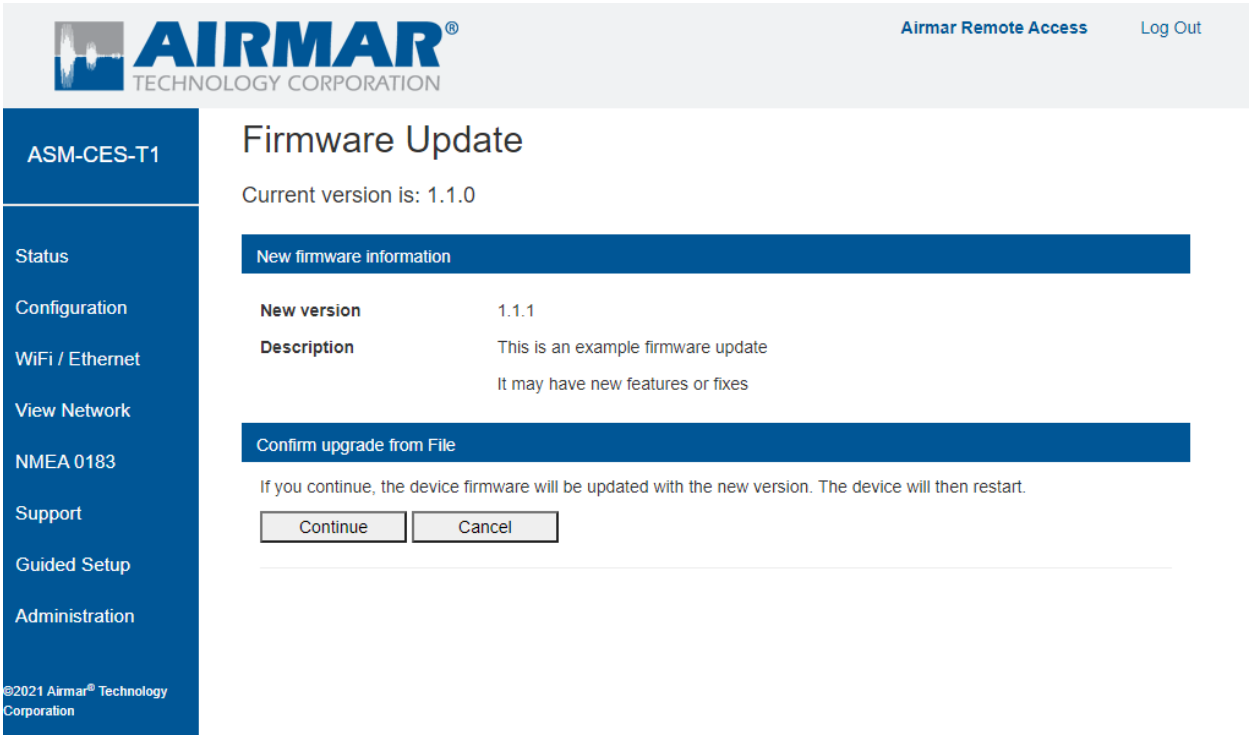


Figure 14-4: Firmware update screen

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** completes the firmware update process, and the module restarts.

*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 3.

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

Figure 14-5: 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.

14.5 Adding or Updating Feature Packages

The **System Update** function also enables the installation and update of **Feature Packages** to expand the capabilities of the SmartBoat module. Feature Package files have the extension **.PKG**. They must be downloaded to your connected SmartBoat module. Select **Choose File** and navigate to the update 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.

The **Configuration** tab will show options for managing supported features after installation.

Firmware upgrades including Feature Packages can be very large and may take several minutes to transfer and install. Please be patient.

14.6 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.

14.7 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.

15 Appendix A: NMEA 2000 PGNs

15.1 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
127751	Power	DC Voltage
128777	Power	Anchor Windlass Operating Status
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 ACTIONS		
PGN	**CATEGORY**	**DESCRIPTION**
126983	General/Mandatory	Alert
126985	General/Mandatory	Alert Text
127502	Power	Binary Switch Bank Control
126720	Proprietary	Garmin Custom Field
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
127506	Power	DC Detailed Status
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

15.2 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 x 10^{-4} m^3/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 $1x10^{-3}$ $m^{3\cdot}$ (3 bytes)

16 Appendix B: NMEA 0183 Gateway Conversions

16.1 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

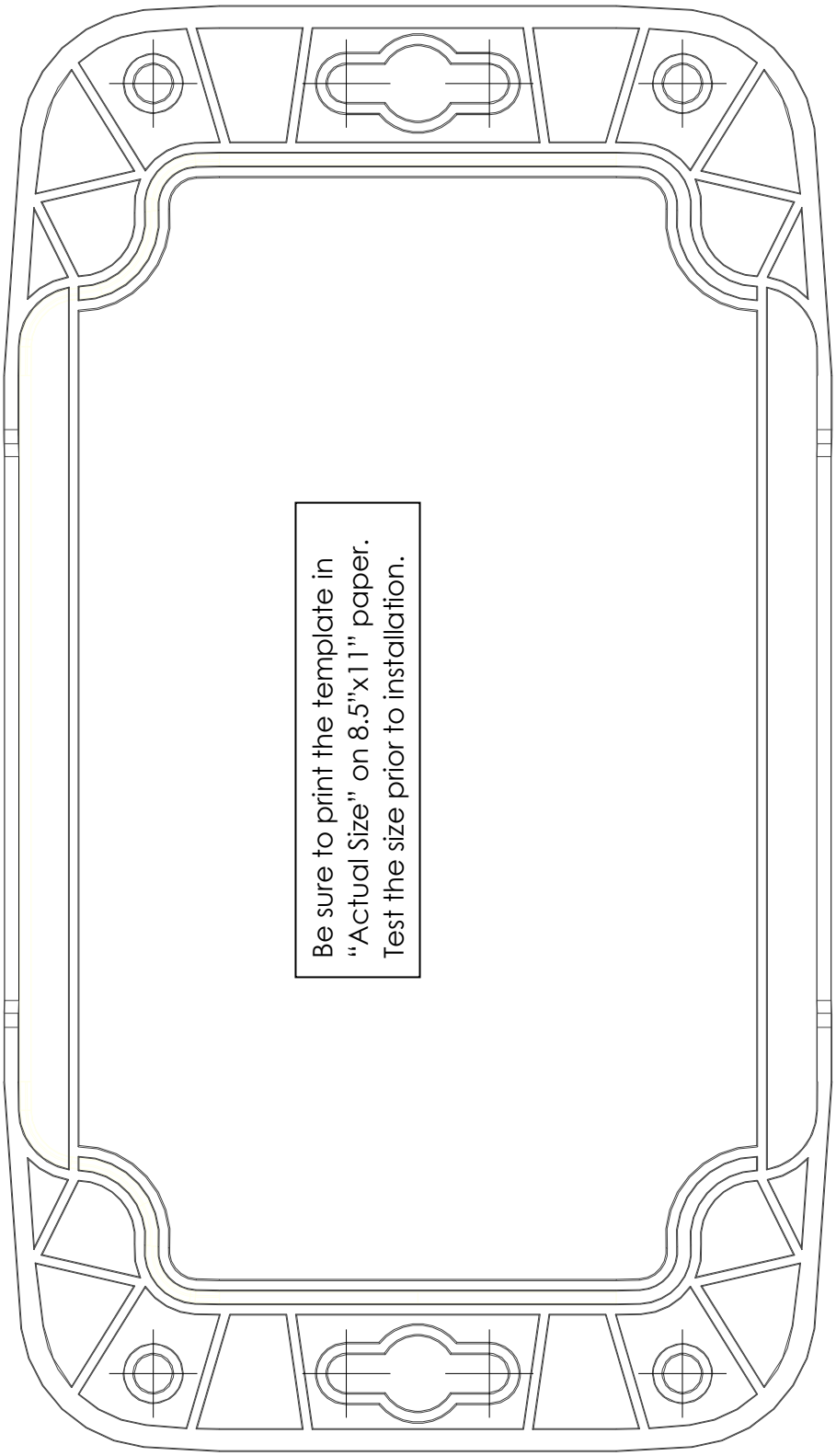
16.2 NMEA 2000 PGN to NMEA 0183 Sentence Conversions

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

17 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		
127500	Load Controller Connection	Connection		
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		
127509	Inverter Status	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

18 Appendix D: Mounting Template



19 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.

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