Digital Instrument / Accessory Installation And Troubleshooting Guide

Easy Quick-connect System

BorgWarner Automotive | Air/Fluid Systems Instrumentation

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Before The Installation

We suggest you take some time to get acquainted with our digital instrument system.

The first few pages of this manual will introduce BorgWarner digital instruments and accessories.

We will recommend a few tools and provide a general wiring plan to give you a framework for understanding the system and working with it in the installation process.

- Gauges

Message Center

- Depth Indicator
- Air/Sea Temperature
- GPS System

Introduction

BorgWarner Automotive's Instrumentation Division (formerly Kysor Medallion) has pioneered the development of this series of digital instruments and accessories for the marine industry.

Going Digital

Digital instruments and accessories are more accurate, more dependable, and easer to install and maintain than traditional instruments. That's a big help in manufacturing and in dealerships where accessory upgrades are added after the sale.

It will be helpful to clear up the basic difference between traditional or analog instruments and the new digital instruments and accessories.

The Digital Difference

THE MDC
(Marine Data Concentrator)

and its big brother

THE MMDC
(Multiple Module Data Computer)

Before this, traditional Instruments displayed voltages and mechanical pressures.

The MDC supports digital instruments only. It does not support the Message Center and Accessories.

The heart of our digital system is this small, hand-size computer. It receives sensor data and converts it to repeated bursts of digital messages that tell the instruments and accessories what to display.

Traditional (analog) instruments work through a combination of electricity and mechanical linkages. The sensors for most traditional instruments produce a DC voltage. This voltage increases and decreases according to the amount of whatever is measured. The instruments are essentially little volt meters where the pointer is moved by magnetic torque created by the amount of voltage on a core winding of wire at its base. The more the voltage in the core of wire the higher the pointer moves.

Traditional speedometers are all mechanical. Essentially, they are barometers with a bellows that expands and contracts according to the amount of air pressure in the hose connected to the pitot tube. A mechanical linkage to the expanding and contracting bellows moves the pointer.

Other pressure readings, such as oil pressure, come from senders that convert pressure to a voltage on a wire.

Messages Replace Voltages

Digital instruments are completely different. Instead of displaying a voltage, the pointers are moved by a coded message that tells a small motor to turn to a certain point on an arc of the dial. This "stepper motor," is similar to the small motor in an electric watch.

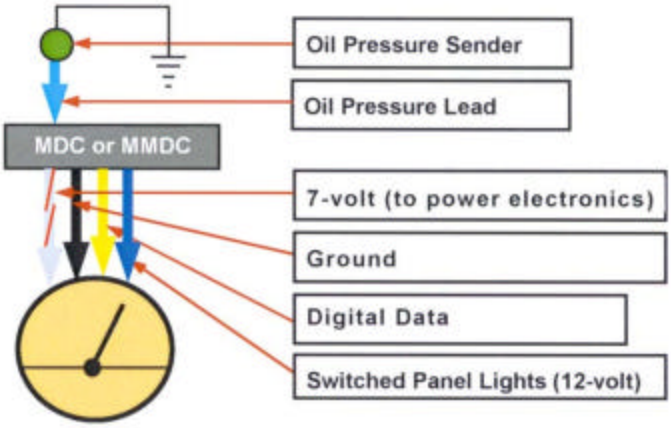
The computer converts voltages from the sensors, digital and analog information from the engine, and pressures from the pitot tubes into messages the instruments and message center are programmed to understand.

The digital instrument system writes and reads messages about the performance of the engine and other aspects of the boat and its environment.

The computer monitors the sensors and converts the information from each into a series of digital messages in a string with an address line that says "fuel", "oil", "pressure", "speedometer", etc. All of these messages travel on a single yellow wire in the harness that connect to the instruments in daisy chain fashion. Each instrument receives all of the messages, but each single instrument displays only the message addressed to it.

For example, in one fraction of a second, the speedometer would receive dozens of different messages and recognize only the one that said, "display 31 MPH." The electronic circuit on the speedometer knows just what to do with that message. It directs the stepper motor to turn to the point of arc that corresponds to 31 mph on the dial. With several such messages arriving each second, the motor moves the pointer smoothly to show the speed on the dial face to within 1/3rd of a degree.

Oil Pressure Example



(These four leads are used in each instrument.)

In the example above, the oil sender transmits a voltage to the MDC or MMDC where it is converted to a digital message that may say "60.0 PSI." Inside the digital oil pressure instrument, this is rewritten as a stepper motor instruction to display a point on the arc of the dial that corresponds to 60.0 PSI.

Remember, The instruments can be hooked up in any order because they only use the messages addressed to them as individual instruments.

Tools Needed For Installation

The easy Quick-connect System provided requires only a few simple hand tools. With the exception of mounting the MDC or MMDC computer, the Digital Instruments, and the Message Center, most of the work involves making connections on the easy Universal Harness System with their mistake-proof connectors. You just snap them together.

Additional work involves making butt splices using crimp connectors. At least one accessory , the GPS, requires a hole for mounting the antennae on the deck.

A Screwdriver

This will be needed for the screws selected to attach the black boxes to a fiberglass wall.

Nut Driver 1/4" and 5/16"

This will be needed to attach the MDC connector and to mount instruments to their brackets if not already done.

Snipping Pliers

You always need snipping pliers.

Electrical Crimping Pliers

Aside from joining connectors, it will be necessary to butt splice wires using crimp connectors. This special tool is best for the job.

Wire Stripper

Wires are already stripped. You may find one that needs additional stripping.

Wire Ties

These are helpful to dress the wiring and to tie back unused leads in the harness elements.

A Hand Drill With 3/8 and 7/16" Bits

You may need to make a hole for the GPS antennae.

Wire Color Codes

The wires in the BorgWarner wiring harnesses are color coded according to standards established in August 2000.

Older harnesses are described in the footnotes below.

In most cases your wiring will be in place in the harness. The most important point to check is the AMP 12-pin connector where the main harness from your sensors comes into our Universal Bridge Harness.

Note:

The repeated green and orange colors in the Universal-Out harness carry two bands of digital data. Yellow is for the Instruments, green and orange are for the Message Center.

Black	Ground
Red	12-Volt Battery
Purple	Ignition
White / Red [1.]	7-Volt
Gray / Black [2.]	7-Volt Ground
Orange	Digital Data
Gray	Tachometer
Pink	Fuel
Light Blue	Oil Pressure
Tan	Engine Temperature
Brown	Transmission Pressure
Brown / White	Trim
Green	Water Tank Level
White	Transmission Pressure
Blue	Panel Lights
Blue / White	MC only Backlight
White /Black	Transmission Pressure

Only in the 10-pin

Green	DIB-CANL
Orange	DIB-CANH
Yellow	Analog AIB Bus

Former colors: 1. 2.

The MMDC-In Harness

This harness is to the MMDC what a large vein is to the heart. It brings in the work.

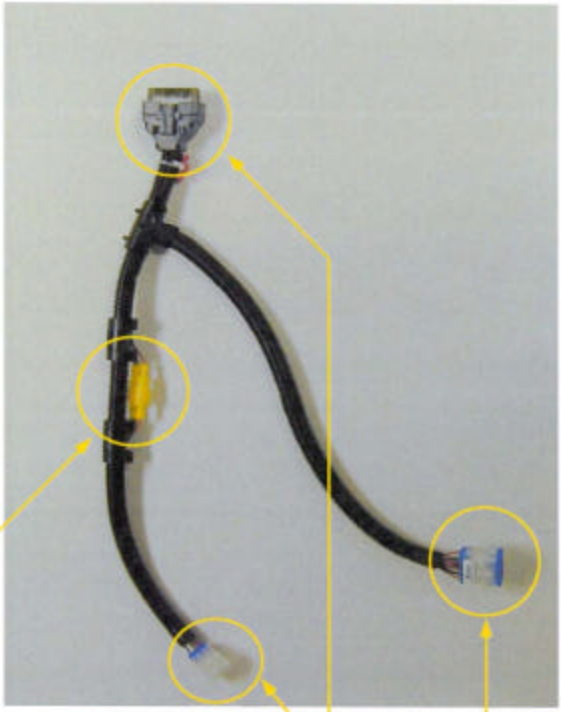
It carries all of the analog and digital information from the sensors to the MMDC.

The branch at the right is actually a two-way line. It carries AccuSki information from the MMDC and the Message Center and out to the servo on the engine.

The **red** clip tied to the harness just above the Packard 24-pin connector is a locking pin.

3 Amp fuse for the Battery
3/4 Amp fuse for Ignition

The MMDC-in Harness is the largest of two principal connections to the MMDC.



These fuses are placed on the battery and ignition wires to protect the MMDC and other components against shorts. 3 amp for Battery and 3/4 amp for Ignition.

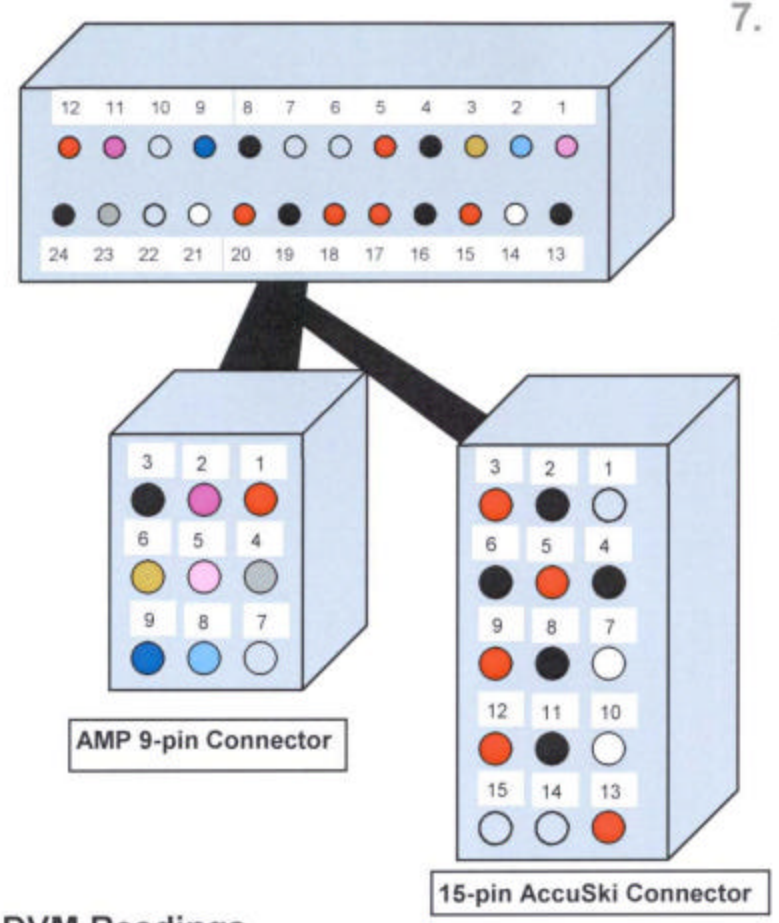
This is the AccuSki system connector. This branch of the harness brings data in and out through the Bridge Harness.

This large 24-pin connector joins plugs into the largest socket in the MMDC. It carries all of the sensor input information to the computer.

The AMP 9-pin connector here connects all of the sensor input, Power, and Accuski lines to the MMDC.

MMDC-IN Harness Pin Detail

Pin	Function	Ohms	Voltages	Next Connector	Notes
1	Fuel Sender	33 to 240	0 to 7 vdc	9-pin 5	1, 4
2	Oil Pressure Sender	33 to 240	0 to 7 vdc	9-pin 8	1, 4
3	Temperature Sender	25 to 600	0 to 7 vdc	9-pin 6	1, 4
4	Safety Switch GRND	0		15-pin 4	
5	Safety Switch	0 or open	0 to 5 vdc	15-pin 5	2, 4
6	Blank				
7	Blank				
8	Servo GND	0		15-pin 11	
9	Panel Lights	N/A	0 to 12 vdc	9-pin 9	4
10	Blank				
11	Ignition	N/A	9 to 16 vdc	9-pin 2	3, 4
12	Battery	N/A	9 to 16 vdc	9-pin 1	3, 4
13	Increase/Decrease GND	0	0	15-pin 8	
14	Decrease Switch	0 to open	0 to 5 vdc	15-pin 10	2, 4
15	Increase Switch	0 to open	0 to 5 vdc	15-pin 9	2, 4
16	Foot SW GND	0	0	15-pin 2	
17	Foot Switch	0 to open	0 to 5 vdc	15-pin 3	2, 4
18	Horn 12 vdc	N/A	12 vdc	15-pin 13	
19	Horn Control	N/A	5 to 11 vdc	15-pin 6	
20	Servo Power	N/A	9 to 16 vdc	15-pin 12	3, 4
21	Servo Control)	N/A	0 to 16	15-pin 7	
22	Blank				
23	Tachometer	N/A		9-pin 4	
24	Boat GND	0	0	9-pin 3	



DVM Readings

Note 1: Instrument reads low when sender is open and 7 vdc will be measured on the pins. Instrument reads high when sender is shorted and 0 vdc will be measured on the pins. A normal reading is between 0 and 7 vdc.

Note 2: Voltage will read 0 vdc when the switch is closed or the button is pressed. Voltage will read 5 vdc when switch is open or button is not pressed.

Note 3: This will read the same as Ignition or Battery voltage

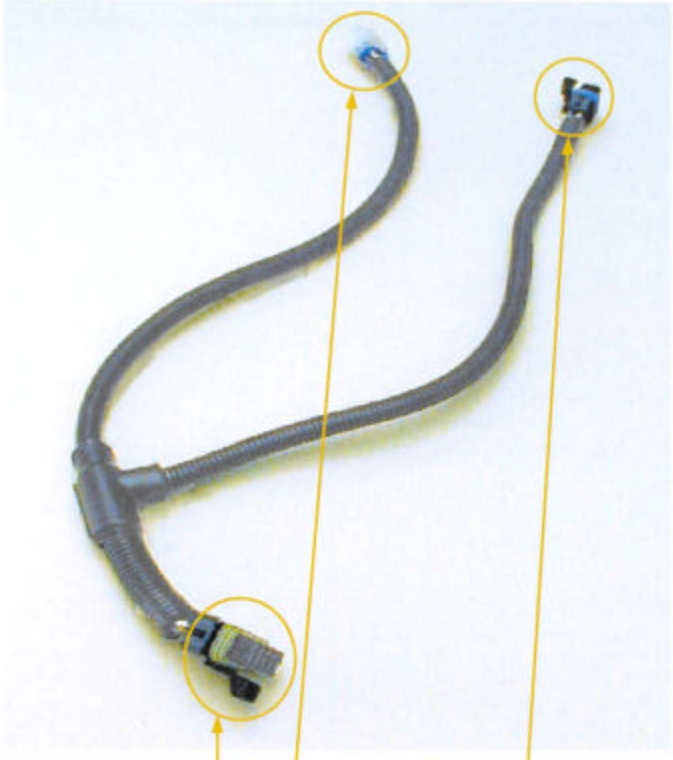
Note 4: All voltage readings are not exact use +/- 1.0 vdc

The MMDC-out Harness

This is the artery of the two main MMDC harnesses. With two branches, it carries digital messages bound for the instruments up to the Universal Bridge Harness and directly to the Message Center.

Notice the black, square-face, Packard 6-pin connector is exactly like those on the accessory system kits for GPS, Air & Sea Ambient Temperature, and the depth sounder.

The Universal-Out Harness carries all of the data and support wiring for each instrument on the panel. See your model sheet for the panel layout that fits your job.



This Packard 10-pin connector taps the digital output of the MMDC for the instruments and the Message Center.

The white, AMP 6-pin MMDC Instrument Bus Connector here joins the Universal Bridge to pass on wiring for each of the digital instruments on the panel.

This Packard 6-Pin, blue-faced, Option Bus Connector joins the Message Center. It is the same type found on the extended hook-ups for all of the digital accessories including the Depth Sounder, Sea & Ambient Temperature, GPS, etc.

MMDC-Out Harness Connector

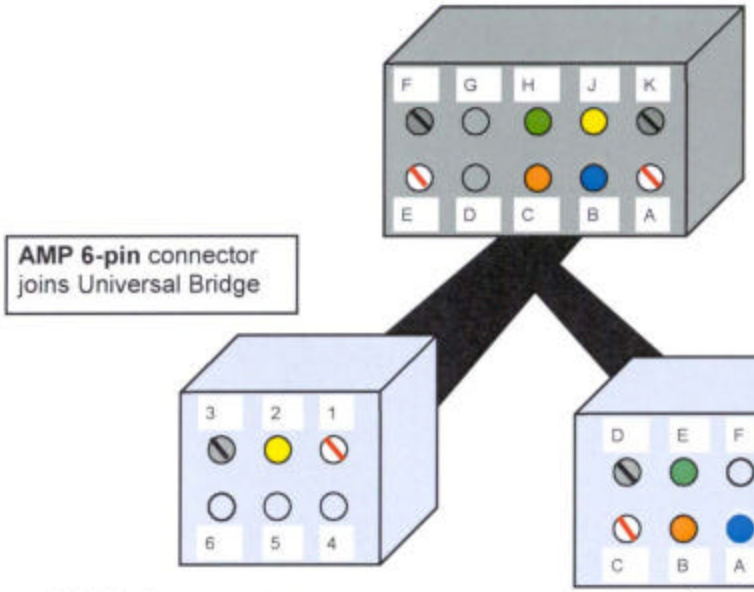
Packard 10-pin Out Connector

Pin	Function	Voltages
A	7V Reg	7 vdc
B	Display Backlight	0 or 12 vdc
C	DIB_CANH	2.5 vdc
D		
E	7V_Reg	7.0 vdc
F	7B_Reg GND	0 vdc
G		
H	DIB_CANL	2.5 vdc
J	AIB_DATA	1.5 to 5.5 volts
K	7V_Reg GND	0 vdc

Packard 6-pin Connector

Pin	Function	from	Notes
A	Display Backlight	B on 10 pin	1
B	DIB_CANH	C on 10 pin	1
C	7V Reg	E on 10 pin	1
D	7B_Reg GND	F on 10 pin	1
E	DIB_CANL	H on 10 pin	1
F			

Packard 10-pin Out Connector



AMP 6-pin connector joins Universal Bridge

Packard 6-pin Connector To Message Center

AMP 6-pin connector

Pin	Function	from	Notes
1	7V Reg	A on 10 pin	1
2	AIB_DATA	J on 10 pin	1
3	7B_Reg GND	K on 10 pin	1
4			
5			
6			

Note 1: All voltage readings are not exact use +/- 1.0 vdc

Note 2: Voltage will read 0 vdc when the switch is closed or the button is pressed. Voltage will read 5 vdc when switch is open or button is not pressed.

The Accessory Wiring Plan

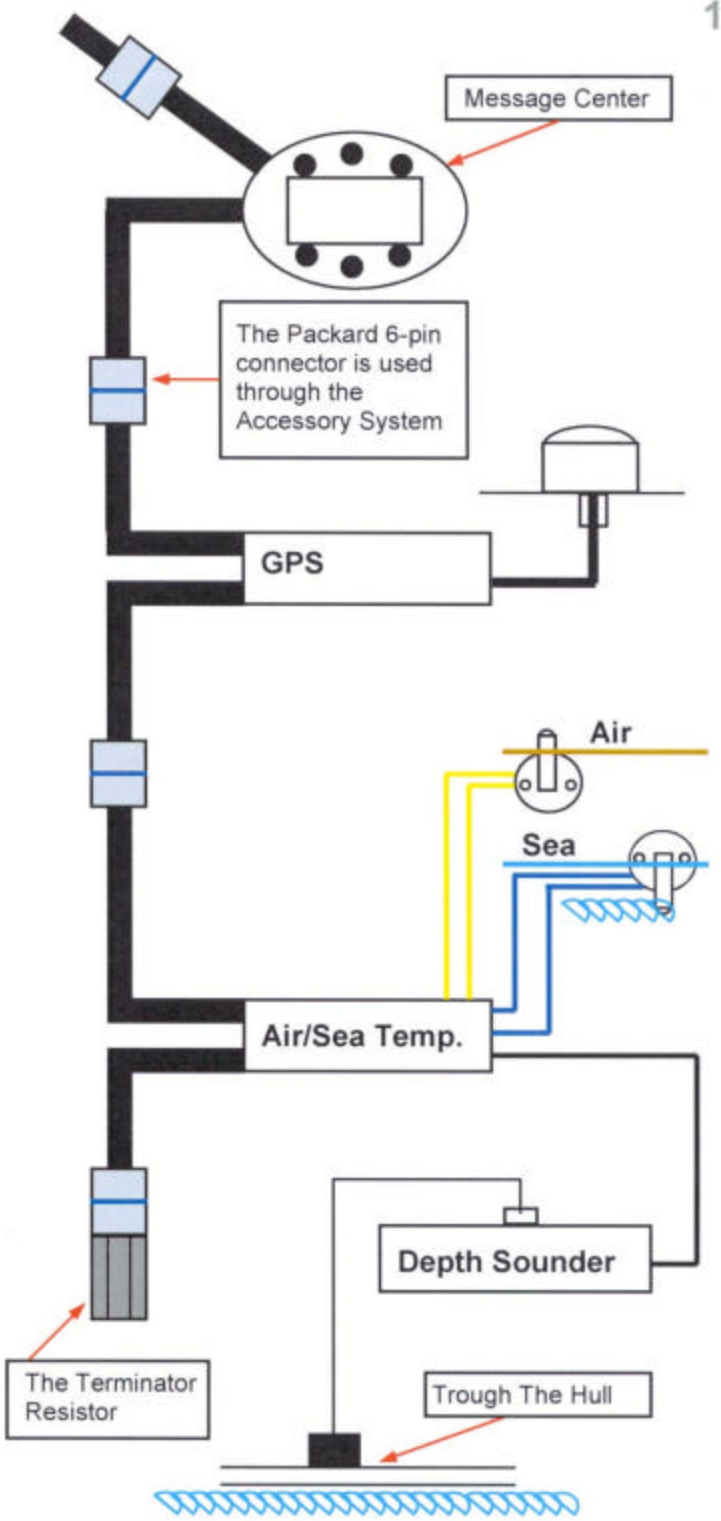
The Accessory System is the easiest component set to install. The elements simply clip together in a daisy-chain of modules and sensors.

Wherever the daisy chain ends, it is necessary to clip in a terminator resistor to place a dummy load on the circuit. This keeps the electronic system in equilibrium.

The GPS antennae is installed on the deck through a 5/16" hole placed in the most favorable position as judged by the factory or the customer in the case of a dealer's retrofit.

The temperature sensors are butt spliced to like colors: the two black wires on temp. go to two yellows or two blues, and so forth. The order does not matter because the system will recognize the difference.

More details on each system follow.



Install GPS

This amazing accessory can pinpoint your position on the earth, Indicate your direction of travel, and accurately indicate your speed and distance traveled.

For all that, the installation is very simple. The most difficult task is selecting the positions for the antenna and the module. Since the lead lengths are limited, it is necessary to plan your locations carefully and also play to store any excess cable securely with wire ties to avoid a wiring mess.

Remember to cap the last output connector in the chain with the Terminator resistor.

The GPS system module may be located on a vertical wall within the pod or any convenient place which is out of sight yet easy to access if service is every required.

Choose bolts or self-tapping screws best suited for the location.

This connects to the Packard 6-pin connector on the MMDC-Out harness.

If Air & Sea Ambient Temperature and Depth are not to be added, be sure to install the Terminator resistor at the end of the line.

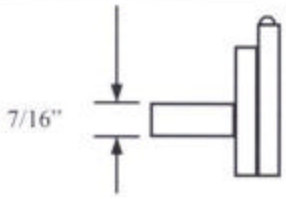
Drill the hole for this stem at 15/16". The bottom of the dome will seal to the deck.

Install Depth Sounder plus Air and Sea Ambient Temperature

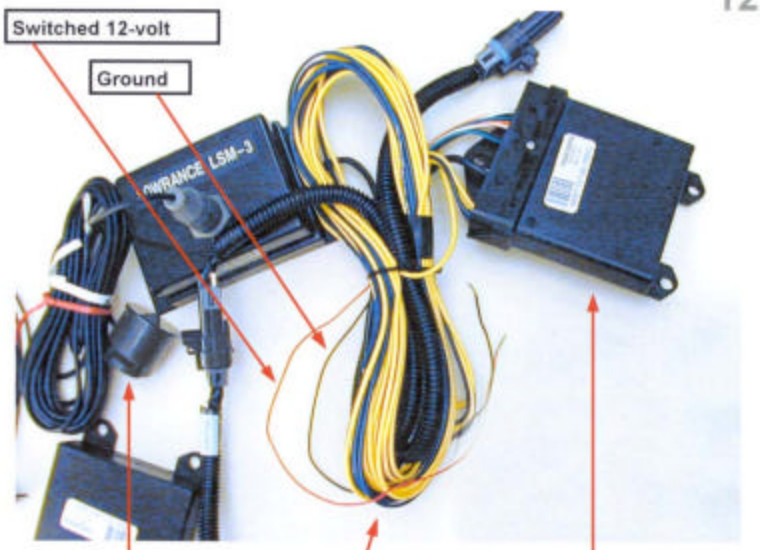
These two accessories are slightly more difficult to install than GPS. The system hook-ups are easy, but sensor placement and wiring are more complex here.

Follow the steps outlined at the right to install the Air & Sea Ambient system.

See details on page 20 for installing the depth transducer.



Sea Temp. Sensor: Drill a 7/16" hole below waterline at the base of the transom. Run wires through and seal with silicone similar to mounting a pitot tube.



See next page (page 20) for details on mounting the through-the-hull transducer.

Mount the modules for both depth and temperature in the pod area.

There is plenty of hook-up wire for the air and sea temperature sensors. The air sensor is usually placed onboard in the pod area and the sea temperature sensor is normally placed below the water line at base of the transom.

Drill two holes for an appropriate mounting screw as you would in mounting a pitot tube.

Use a **butt splice** to connect the black sensor wires to yellow and blue after cutting and stripping.