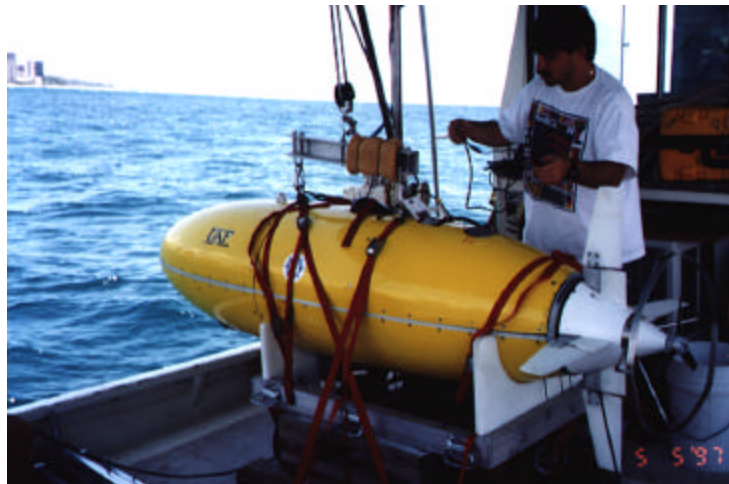


EM-2

DiveTrackerä Electronics Module Technical Reference Manual



An EM-2 Module Supports Automated Docking of Magellan AUV

2nd Edition
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DiveTracker™ model EM-2 (Rev. A) is an electronics module which does not include a housing. The module is designed to be used as a navigation sensor or acoustic modem within a larger subsurface system. Typical applications include AUV navigation, oceanographic instrumentation and ROV tracking.

This module always requires a certain amount of system integration, including the connection of sonar transducer(s) and a power supply. Do not use this module if you are looking for a ‘turn-key’ solution.

- Bare electronics module, no housing.
- Designed for integration into ROVs, AUVs, autonomous instruments, etc.
- Accommodates three external sonar transducers.
- Powered by a 9V to 16V DC source.
- Capable of exchanging data with a ‘host’ computer through an asynchronous serial interface.

DiveTrackerä Model EM-2 Design Characteristics

A DiveTracker™ model EM-2 is depicted in figure 1.

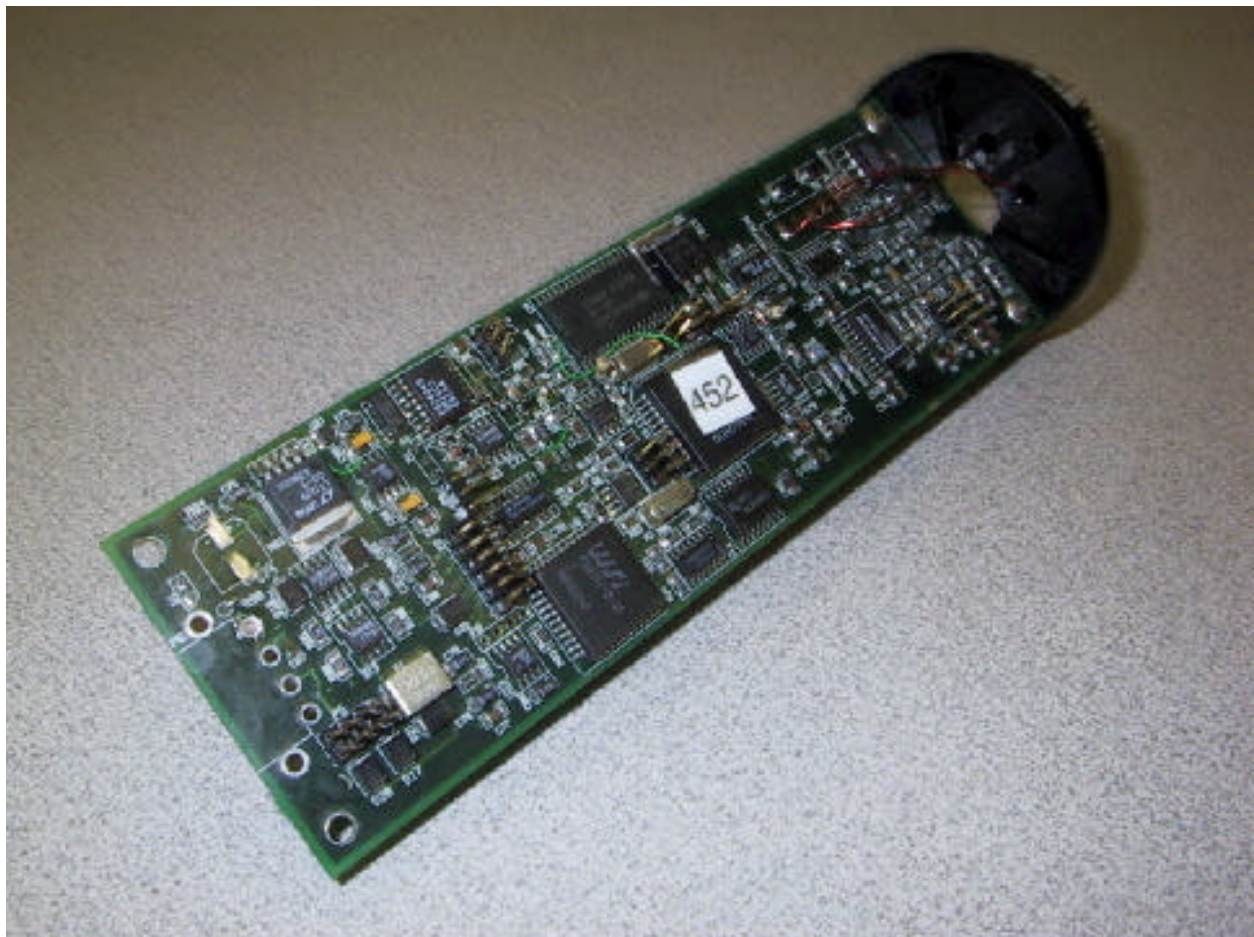


Figure 1: DiveTrackerä Electronics Module EM-2

1. Unpacking

Please ensure that your shipment does contain these components.

- 1 ea. module EM-2
- 1 ea. depth transducer
- 1 ea. two conductor power cable
- 1 ea. sonar transducer hook-up cable with 2-pin modular plug and 2-pin Impulse LPMBH-2-FS waterproof bulkhead connector (only for boards with DTX1 sonar transducer)
- 1 ea. 3-conductor ON/OFF switch cable with 3-pin modular plug
- 1 ea. DT1-M-LINK data exchange cable
- 1 ea. DTX1 (cable mounted) or DTX2 (bulkhead mounted) sonar transducer
- Applicable software. The software is shipped on a set of installation disks. The SmartDive tracking software and the DT-TEST diagnostic software is pre-installed on the EM-2 module. The DiveBase surface station tracking software (if ordered) and the DiveTerm and Convert utilities must be installed on a Windows 95 or Windows NT computer.
- This manual.

DiveTrackerä EM-2 Component List

If a shipment is incomplete, please immediately contact Desert Star Systems. If you are missing any components required for system operation, obtain these components before proceeding.

2. Module Installation

Your DiveTracker™ model EM-2 is an electronics module without housing. It always requires mechanical and electrical installation before it can be used.

Installation of the module involves these steps.

- Mount the DiveTracker™ module in an appropriate location.
- Install the connector for the external sonar transducer and mount of the transducer.
- Mount the depth sensor.
- Wire the power, sonar transducer, depth sensor, ON/OFF switch and data exchange cables.
- Install and configure the software.

DiveTrackerä EM-2 Installation

Once installed, the module can be regarded as a 'black box' which needs no further configuration or 'boot procedure'. Activation and booting will automatically occur whenever power is applied and the ON switch is closed.

Mechanical installation, and wiring is discussed in this section. Chapter three explains the hardware configuration process, and chapter four deals with software installation issues. Refer to figure 2 for the location of the module's jumpers and connectors. A summary of the module's connector functions is listed in figure 3.

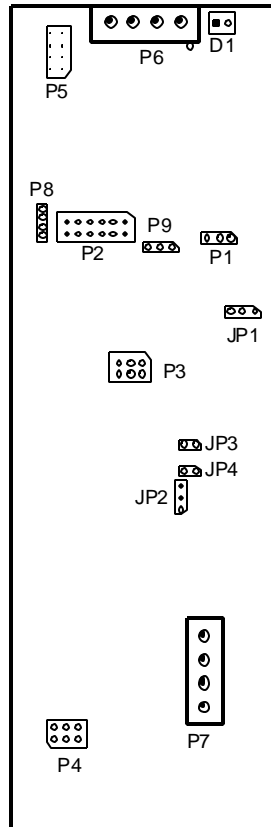


Figure 2: EM-2 Hardware Layout, Connectors And Jumpers

Connector	Function	Refer to
P1	ON/OFF Switch	2.3.3.
P2	Utility Connector	2.3.4, 2.3.7.
P3	Depth Sensor (alternate)	2.3.5.
P4	Sonar Transducers	2.3.1.
P5	Battery Connector	2.3.2.
P6	External Power Connector	2.3.2.
P7	Sonar Power Transformer	2.3.1.
P8	Alternate Serial Port	2.3.4.
P9	Depth Sensor (main)	2.3.5.
JP1	Depth Sensor Select	2.3.5.
D1	Status LED	2.3.6.

Figure 3: EM-2 Connector Summary

2.1. Mounting The EM-2 Module

Start the installation process by selecting a good location for the electronics module and mounting the module following these instructions.

- The module measures 8.25"L x 2.5"D, overall. Additional room may be needed for connector and cable assemblies. The module consists of the printed circuit board. A 2.5" diameter disk is mounted on one end to support the sonar power transformer.
- The mounting area must be free of water and condensation (humidity less than 95%).
- The temperature in the mounting area must be no less than 0 degrees Celsius, and no more than 70 degrees Celsius.
- The module's sonar receiver works with microvolt level signals. Minimize interference by mounting the module well away from electrical noise generators such as switching power supplies, motors, relays, transmitters, processor boards etc. Use a grounded metal shield around the module if interference may be a problem.
- Mount the module such as to minimize the length of the depth and sonar transducer cables.

Mounting The EM-2 Electronics Module

2.2. External Component Mounting

The EM-2 module is designed to be installed inside a pressure (watertight) housing. However, certain components need to be mounted externally and appropriate feed-throughs or connectors must be provided.

WARNING!

Be sure to perform a thorough leakage test after the installation of any through-hole components or connectors. Failure to do so may well result in expensive equipment flooding during operation. The leakage test should repeatedly cycle through pressures ranging from atmospheric to a pressure in excess of the upper operational limit. **Do not deploy a system until you are 100% sure that no leakage will occur. Desert Star Systems is not responsible for equipment leakage or the consequences thereof. The connectors, sensors and other components requiring through-hole fittings which are a part of your system are not tested by us for structural integrity or leakage. Water and pressure tight seals are your responsibility.**

The external components are:

- **The sonar transducer(s)** serve as the antenna of the system. A sonar transducer must be installed whenever you intend to use EM-2 for navigation or communication functions. In most cases only one transducer will be installed. There are some specialized applications where two or three sonar transducers are used. Two sonar transducers are available. The DTX-1 transducer is cable mounted. An underwater is used to make the connection to your pressure housing. The DTX-2 transducer is designed for hard-mounting on the outside surface of your pressure housing. A 3/16-16 UNF threaded hole and an O-ring groove must be machined into the pressure housing. A cage assembly is recommended to protect the transducer.

- **The depth sensor** measures water pressure to determine the depth of the instrument or vessel. Depth measurement is used as a component in navigation. In some applications where depth is not of importance or where depth is measured by other means, the sensor is not needed. The depth sensor requires a 1/4-18 NPT threaded hole in the pressure housing wall.

EM-2 External Components

The following sections provide instructions on how to mount the external and through-hole components.

The Sonar Transducer

The sonar transducer serves as the 'antenna' of the DiveTracker™ module. In most cases, just one transducer will be used. However, for specialized applications you may attach two or three transducers.

The sonar transducers must be mounted in clear water, outside of the housing. The electronics module may be ordered with a DTX1 or a DTX2 transducer.

DTX1 Transducer:

The DTX1 transducer is equipped with a 5' cable. The cable is terminated with a SUBCONN Model MCBH3F waterproof bulkhead connector which mates to a model MCIL3M cable connector. The bulkhead connector is equipped with a 7/16-20 UNF 2A threaded stem. The stem is 3/4" long. Machine a threaded or unthreaded hole into your pressure housing. Provide an O-ring mounting surface with a diameter of no less than 0.81". This surface is used as a seat for the connector O-ring (O-ring size Parker 2-014). The O-ring mounting surface and the connector hole must be concentric. The roughness of the O-ring mounting surface should not exceed 63 micro inch.

Before installing the bulkhead connector in the hole, remove the O-ring at the base of the connector. Inspect it and the O-ring groove for any damage or debris. Remove any debris. Then, apply a thin film of silicone grease to the O-ring and re-install it.

The holes in the gray PVC support disk may be used to secure the transducer. You may also drill additional holes into that disk.

CAUTION!

Do not attach anything, drill into or obscure the black cylindrical part of the transducer. This is the active element which must be able to transmit and receive sonar signals.

CAUTION!

The bulkhead connector must be mated either to a plug or the protective cap before immersion into water. The cable connector (plug) must be mated to a bulkhead connector before immersion.

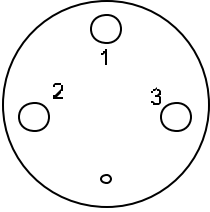
Diagram	Pin Assignment	Connect To EM-2 Con.
	1: Ground 2: External Sonar TX/RX 3: External Battery (+9V to +12V)	P4-1 P4-2

Figure 4: Sonar Connector Pin Assignment (Bulkhead)

Note:

Sonar transducers are wired to pins 1 (ground) and pin 2 (signal) of the connector. The EM-2 can accommodate up to three sonar transducers on connector P4. Pins P4-1, P4-3 and P4-5 are the ground returns for sonar transducers #1, #2 and #3 respectively. Pins P4-2, P4-4 and P4-6 are the signal lines for transducers #1, #2 and #3. Use one Impulse connector for each sonar transducer in multiple transducer applications.

DTX2 Transducer:

The DTX2 transducer is designed for mounting on the outside surface of the pressure vessel. The transducer has a 3/4-16 UNF threaded stem. The stem is 0.75" long. Machine a suitable threaded or unthreaded hole into your pressure vessel. Provide a flat seating area with a diameter of no less than 1.38" around the mounting hole. A size 2-017 O-ring is used to seal the transducer. Two O-rings (one spare) is included in the shipment. Use Parker O-rings for replacement. We recommend compounds E540-80 (Ethylene Propylene) or N674-70 (BUNA N) for sea water applications. Use N674-70 for gasoline, diesel and motor oil applications (fuel tank inspections). Machine an O-ring groove into the pressure vessel. The groove must be concentric with the connector hole. The groove inside diameter must be 0.860", the groove width is 0.095" and the groove depth is 0.052". All tolerances are +/- 0.002". The roughness of the O-ring groove surface must not exceed 63 micro inches.

DANGER!

The DTX2 transducer is machined from plastics. It will break off if knocked hard enough. Transducer breakage will compromise the O-ring seal and cause your pressure vessel to be flooded. We strongly recommend the use of a protective cage if the DTX2 transducer is mounted in an exposed location.

The Depth Transducer:

A MSP-300 series pressure sensor manufactured by Measurement Specialties, Inc. (Fairfield, New Jersey) is shipped with the module. The sensor is used to measure the depth of the instrument or vehicle which carries the module. In navigation applications, a mobile station's depth is transmitted as telemetry to the surface. It is indicated on the DiveBase™ dive site display and is also used in the calculation of the position of the mobile station. In some cases you may not need the depth transducer. This may be the case if you do not use your system for navigation or if you operate over a largely horizontal path where the depth reading has little effect on the horizontal position computation.

The sensor is calibrated for use with the module. Make sure the serial number on the transducer cable matches the serial number of your EM-2 module.

The sensor must be mounted so that the pressure port faces the water. Machine a 1/4-18 NPT threaded hole into the pressure housing. The thread must be tapered such that the sensor can be threaded in from

the inside. Wrap the sensor thread into one to three layers of teflon tape before fitting it. It is preferred to mount the transducer with the pressure port facing down, so that liquid will drain out of the pressure port.

How To Select A Sensor Pressure Rating

The MSP-300 sensor is available in pressure ratings of 100, 250, 500, 1000, 2500, 5000 and 10000 PSI. It is a common mistake to select a high pressure rating in order to allow the vehicle or instrument to dive very deep. This strategy brings with it an accuracy penalty. The depth measurement accuracy is limited to +/- 1% of full scale. For example, a 100 PSI transducer can be used for dives to depths of up to about 224 feet. The depth measurement accuracy is +/- 2.2 feet. The 10000 PSI transducer can be used for dives up to 22400 feet. However, accuracy is +/- 220 feet - even when operating in shallow water. We recommend that you specify a sensor rating that matches or slightly exceeds your maximum realistic operating depth.

CAUTION!

The MSP-300 sensor is manufactured from annealed 17-4 stainless steel. Stainless steel is subject to corrosion when subjected to sea water and other corrosive fluids or gases. We recommend that you flush the pressure port with fresh water and drain it after every dive. Mount the sensor with the pressure port facing down, so that it will be self-draining.

2.3. Electrical Connections

All module installations require at least a sonar transducer hook-up, a power connection, a means to close the module's ON switch and the connection of the data exchange cable. In most cases, you will also install the depth sensor. The following sections describe all electrical connections.

2.3.1. The SONAR Transducer

The sonar transducer serves as the 'antenna' of the DiveTracker module. In most cases, just one transducer will be used. However, for some specialized applications you may attach two or three transducers.

Your EM-2 module may be shipped with the cable mounted DTX1 transducer, or the DTX2 transducer which is designed for mounting on the outside surface of a pressure vessel. Systems shipped with the DTX1 transducer include a cable that is terminated with the Impulse bulkhead connector on one end and a 2-pin modular connector on the other end. A two-conductor cable terminated with a 2-pin modular connector is attached directly to the DTX1 transducer. In either case, the transducer ground or '-' terminal is connected to a black wire, the signal or '+' terminal is hooked up to the red wire.

Plug the 2-pin connector into EM-2A header P4. If only one transducer is used, use pins 1 and 2 of P4. Use pins 3 and 4 for an optional second transducer and pins 5 and 6 for a third transducer.


Diagram	Pin Assignment
	1: Ground, Transducer #1 2: Signal, Transducer #1 3: Ground, Transducer #2 4: Signal, Transducer #2 5: Ground, Transducer #3 6: Signal, Transducer #3

Figure 5: Sonar Connector P4 Pin Assignment

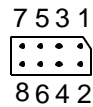
A transformer is used to match the sonar transmitter aboard the EM-2 module to the sonar transducer. This transformer is connected to connector P7. The primary winding of the transformer connects to pins P7-1 and P7-2. The secondary windings connect to P7-3 and P7-4. The transformer is factory installed. However, a transformer change may be necessary if the DiveTracker™ module is to be used with a custom sonar transducer.

2.3.2. Power Hookup

EM-2 requires a power source of 9V to 16V. The module consumes 120 mA in receive mode and - in extreme cases only - up to 2 Ampere in transmit mode. (The module will consume up to 1 Ampere when used for navigation applications using SmartDive. Higher consumption may be seen in telemetry applications). Make sure that your power supply or battery can supply the maximum expected current. The power supply may be unregulated, but you must ensure that there are no noise spikes in excess of about 10 mV on the supply or ground line. Such spikes are common on power supplied by switching regulators. These spikes can induce noise into the sonar receiver section and impede performance. If this is a problem, use an automotive style choke in line with your power and ground lines.

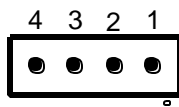
Supply power to pins 1 ('+') and 2 ('-') of P6. Up to four re-chargeable or primary 9V to 12V battery packs may be connected to P5. Use the connections for battery #1 if only one battery is used. Connect additional batteries to the terminals for #2, #3 and #4. The pin assignment of P5 and P6 is listed in the following tables.

CAUTION!
Do not supply more than 16V DC to the power connector. Higher voltages may damage the DiveTracker™ module.



- 1: Battery #1 Negative Terminal
- 2: Battery #1 Positive Terminal
- 3: Battery #2 Negative Terminal
- 4: Battery #2 Positive Terminal
- 5: Battery #3 Negative Terminal
- 6: Battery #3 Positive Terminal
- 7: Battery #4 Negative Terminal
- 8: Battery #4 Positive Terminal

Figure 6: Connector P5 Pin Assignment (Battery)



- 1: Power (+9V to +16V, 2 Amp)
- 2: Ground
- 3: Ground
- 4: Not Assigned

Figure 7: Connector P6 Pin Assignment (Power)

2.3.3. ON and OFF Switches

Two options exist for switching the DiveTracker™ module ON.

- Pins 1 and 2 of connector P1 on the CPU board may be permanently connected using a jumper (shunt). In this mode, DiveTracker™ will power-up and RESET whenever power is applied to the power connector. Similar, the module will shut down whenever power is removed from the power connector. This mode of operation does **not** allow DiveTracker to enter the sleep mode. This option should **not** be used in power sensitive applications (instrumentation buoys, etc.) that rely on the DiveTracker™ sleep mode to conserve power. Short pins 1 and 3 to RESET DiveTracker™ in this mode.
- Power may be ‘permanently’ applied to the DiveTracker™ power connector. The unit is activated whenever power is present and the two contacts of the P1 connector on the CPU board are shorted for about two seconds. After that time, the processor will automatically ‘latch’ the power-on condition and the short on P1 may be removed. In this mode of operation, DiveTracker™ is switched off under software control and may awake automatically through an alarm from the on-board real-time clock. You can also force DiveTracker™ off by shorting pins 1 and 3 of P1. Use this mode of operation whenever you want to make use of DiveTracker's sleep mode and alarm functions. This mode is especially useful in power sensitive long-term deployment applications.

Two Wiring Options For ON, OFF and RESET Functions

An open collector transistor switch which pulls pin 2 of P1 to ground may be used to activate DiveTracker under control of a main computer or another intelligence. A three conductor cable with a 3-pin modular connector is supplied with DiveTracker™ for the wiring of the P1 connector.

The pin assignments of P1 is shown in figure 8.



- 1 (black wire): Ground
- 2 (red wire): Power ON (short to pin 1)
- 3 (green wire): Power OFF or RESET (short to pin 1)

Figure 8: Connector P1 Pin Assignment (ON/OFF/RESET Switch)

2.3.4. The Data Exchange Cable

An asynchronous RS232C serial interface is used by DiveTracker™ to exchange data with a host computer and peripheral devices. The interface is used to download application code and configuration data into the module. Many applications such as SmartDive™ also use the link to exchange commands, status information and various other data. The RS232C asynchronous serial interface is available at the P2 connector. This connector also hosts various other functions.

Plug the data exchange cable into that connector. There is a DB9 connector at the other end of the cable. This connector is wired to be directly compatible with 25-pin serial ports of IBM compatible personal computers.

The cable connection needs not be permanent if the serial port is only used for module configuration.

In some cases it may be useful to make the serial interface accessible on the outside of your vessels or instruments pressure housing. In this case we recommend the use of a SUBCONN model MCBH5F multi-function connector, wired as indicated in figure 10. Use of this connector and wiring will make your installation compatible with DiveTracker accessories.

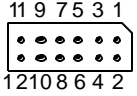
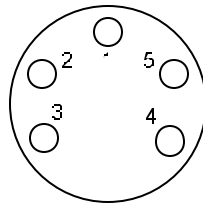
Diagram	Pin Assignment
	1: Ground 2: Transmit Data (TXD) 3: Receive Data (RXD) 4: 12-Bit A/D Ch. 4 5: 12-Bit A/D Ch. 6 6: 12-Bit A/D Ch. 7 7: D/A Channel B 8: Wire Sync. (CPU PA3) 9: Digital I/O (PSD311 PA5) 10: Battery Charge 11: Buzzer 12: Weight Release Trigger

Figure 9: Utility Connector P2 Pin Assignment

The Multi-Function Connector

A SUBCONN model MCBH5F multi-function connector is used to wire the station to the umbilical and to connect a battery charger. The connector must be terminated before the transponder is submerged to prevent corrosion. If the station is not connected to the umbilical, terminate it with the supplied dummy plug.



- 1: Ground (0V)
- 2: Receive Data (RXD)
- 3: Transmit Data (TXD)
- 4: Charger Input
- 5: External Power

Figure 5.1: Multi-Function Connector Pin Assignment

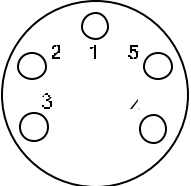
Diagram	SEACON Pin Assignment	Connect To EM-2
	1: Ground 2: RXD or Data '-' (2-Wire Diff.) or Uplink Data '-' (4-Wire Diff.) 3: TXD or Data '+' (2-Wire Diff.) or Uplink Data '+' (4-Wire Diff.) 4: Battery Charger '+' 5: 9V-16V External Power	P2-1 P2-3 (RXD) P2-2 (TXD) P2-8 P6-1

Figure 10: Multi-Function Connector Pin Assignment

The pin assignment on the DB9 connector of the data exchange cable is as follows. The directions are as seen from the device that is connected to the connector, not as seen from the connector itself.

Pin Number	Signal Name (Direction)	Comment
3	Transmit Data (Output)	Data from the PC
2	Receive Data (Input)	Data to the PC
5	Ground	

Figure 11: DB9 Connector Pin Assignment

The EM-2 module includes an alternate connector for serial data. Data is routed by default to connector P2. Alternatively, the data stream can be routed to connector P8. This feature can be useful if the EM-2 module needs to talk to a second serial device - such as a smart sensor


<p>4321</p> 	<p>1: Ground 2: Transmit Data (TXD) 3: Receive Data (RXD) 4: +5V Output</p>
---	--

Figure 12: P8 Connector Pin Assignment (Alternate Serial Data Port)

2.3.5. The Depth Sensor

A MSP-300 series pressure sensor manufactured by Measurement Specialties, Inc. (Fairfield, New Jersey) is shipped with the module. The sensor is used to measure the depth of the instrument or vehicle which carries the module. In navigation applications, a mobile station's depth is transmitted as telemetry to the surface. It is indicated on the DiveBase™ dive site display and is also used in the calculation of the position of the mobile station. In some cases you may not need the depth transducer. This may be the case if you do not use your system for navigation or if you operate over a largely horizontal path where the depth reading has little effect on the horizontal position computation.

The sensor is calibrated for use with the module. Make sure the serial number on the transducer cable matches the serial number of your EM-2 module.

The sensor must be mounted with the pressure port facing the water. Follow the mechanical mounting instructions in section 2.2.

Connect the MSP-300 sensor to connector P9. This connector is designed for amplified sensors with a voltage output of 0V to 5V.


Diagram	P9 Pin Assignment
<p>3 2 1</p> 	<p>1: Ground 2: Sensor Output 3: +12V Supply</p>

Figure 13: Connector P9 Pin Assignment (Depth Sensor)

A second pressure transducer may be connected to P3. P3 is designed for 4-pin or 5-pin 'Whetstone' resistive bridge sensors.


Diagram	P3 Pin Assignment
<p>5 3 1</p>  <p>6 4 2</p>	<p>1: V supply #1 2: V supply #2 3: Output - 4: Ground 5: Output+ 6: No Connect</p>

Figure 14: Connector P3 Pin Assignment (Alternate Depth Sensor)

Jumper JP1 determines which connector is used for depth sensing. Jumper pins 2-3 if the depth sensor is connected to P9 (standard). Jumper pins 1-2 if P3 is used.

Sensor calibration will be necessary if you are using a sensor other than the supplied unit. Contact Desert Star Systems for calibration instructions.

DANGER!

Please be aware that working with high pressure sources is dangerous and can result in your head or other parts of your anatomy being blown off or shredded. For safety, ALWAYS pressurize with water, NEVER pressurize with air or other gases. If your head gets blown off still, immediately see a doctor.

2.3.6. The Status LED

EM-2 is shipped with the red status LED D1 installed next to connector P6. The LED operates under control of the CPU and emits blink patterns that indicate the state of the board. Two brief blinks are emitted when the module is switched on. The LED will remain dark when the module is running the DTOS operating system. Each application has its own unique blink pattern. For example, SmartDive™ uses a 1/8 second blink once every second. A double blink is inserted whenever SmartDive™ receives a sonar command.

If you wish to mount a remote LED on a bulkhead or in a viewing window, unsolder the LED from D1. Connect the remote LED to the two D1 terminals. The LED's anode ('+' terminal) should be connected to the round pad, the cathode ('-' terminal) to the square pad. Nearby resistor R3 limits the LED current. It is set at 330 Ohms. Use a smaller value resistor down to no less than 180 Ohms for a brighter LED or a larger value for dimmer operation. Be careful however to observe the max. current handling capability of the selected LED.

2.3.7. The Data Acquisition And Control Port

Three A/D converters, one D/A converter and two digital I/O lines are available on connector P2. Together, they form the module's 'data acquisition and control port'. You may use these signals to read data from external analog sensors, control external hardware and perform miscellaneous other I/O functions. In most cases, utilizing the port will require the design of custom software. Some off-the-shelf applications for DiveTracker™ may also make use of this port.

P2 Pin	Signal Name	Function
4	ADC4	A/D Channel #4 of MAX186. 12-bit resolution. 0V-4.096V input signal range.
5	ADC6	A/D Channel #6 of MAX186. 12-bit resolution. 0V-4.096V input signal range.
6	ADC7	A/D Channel #7 of MAX186. 12-

		bit resolution. 0V-4.096V input signal range.
7	DAC1	Channel #B of MAX512 D/A converter. 8-bit resolution. 0V-5V output signal range.
8	I/O0	PA3 digital I/O port of 68HC11. Wired as 'SYNC' signal on SEACON connector. Intended primarily for wire-synchronization of EM-2 in some ROV navigation applications. May be used for other functions as well.
9	I/O1	PA5 digital I/O port of PSD311 glue logic chip. For general digital data input and output.
11	BUZZ	Buzzer Output. A piezoelectric element or speaker can be connected here. Variable frequency tones can be generated through the on-board LM555 VCO. An external amplifier may be needed.
12	RELEASE	Weight release control signal. If activated, the battery voltage is available here. Max. continuous current is 1.8 Ampere. Max. peak current is 10 Ampere. Use for acoustic releases, etc.

Figure 15: Data Acquisition And Control Port

3. DiveTrackerä Hardware Configuration

A few DiveTracker™ hardware features are selected through 'jumpers' (also known as shunts). The factory-set jumper settings are appropriate for all but some very specialized applications. We recommend that you do not change the jumper configuration unless you have a good reason to do so and have a thorough understanding of the consequences.

Figure 4-14 summarizes jumper functions.

Jumper	Function	Factory Setting
JP1	Depth Sensor Select	2-3
JP2	RAM type select	1-2
JP3	CPU MODA	OMITTED
JP4	CPU MODB	OMITTED

Figure 16: EM-2 Jumpers

- JP1: Depth sensor selection. If the depth sensor is connected to P9 (standard), this jumper must be in position 2-3. If the depth sensor is hooked up to P3, jumper pins 1-2.

- JP2: RAM type selection. Position 1-2 is used for 1 Mbit RAM chips (standard), position 2-3 for the optional 4 Mbit RAM chip
- JP3, JP4: These two jumpers control the state of the MODA and MODB inputs of the 68HC11. They can be used to place the processor in various special modes of operation. An inserted jumper corresponds to a '0', an omitted jumper stands for a '1'. The jumpers are omitted by the factory and should never be installed during normal operations. Refer to the Motorola MC68HC11E9/D data sheet for details on special processor modes. These jumpers are used by Desert Star during production testing.

Jumper Functions

4. Activating DiveTrackerä

After the installation and hardware configuration is complete, it is time to activate the module. Apply power to the DiveTracker™ module and switch the module ON by shorting pins 1 and 2 of the P1 connector. Make sure pin 3 (OFF switch) is open. You will need to short P1 for only about two seconds. After that, the module will automatically latch the power on state. The status LED should blink twice, confirming the active state (note: boards with DTOS V2.10 will emit one long blink after power up).

The EM-2 module is normally used as a 'black box'. After power-up, it simply starts running a pre-selected application and does it's intended job - be that navigation, communication or data acquisition.

However, in order to download new code to the module, retrieve data from it or configure software, the module must be connected to a PC. If you are using the module for the first time, it's a good idea to hook it up to a PC to make sure the installation was successful and everything is working fine.

Use the data exchange cable to connect the module's P2 connector to a COM port of your PC. Be sure to align the cable's 6-pin connector properly with the 12-pin P2 connector on the module. The black wire of the cable mates with pin 1 of the P2 connector. Pin 1 of P2 is indicated by a beveled corner on the P2 silkscreen (see figure 2).

Install the software provided with the module on a Windows 95 or Windows NT computer. Follow the instructions on the disk label. Now run the DiveTerm™ utility.

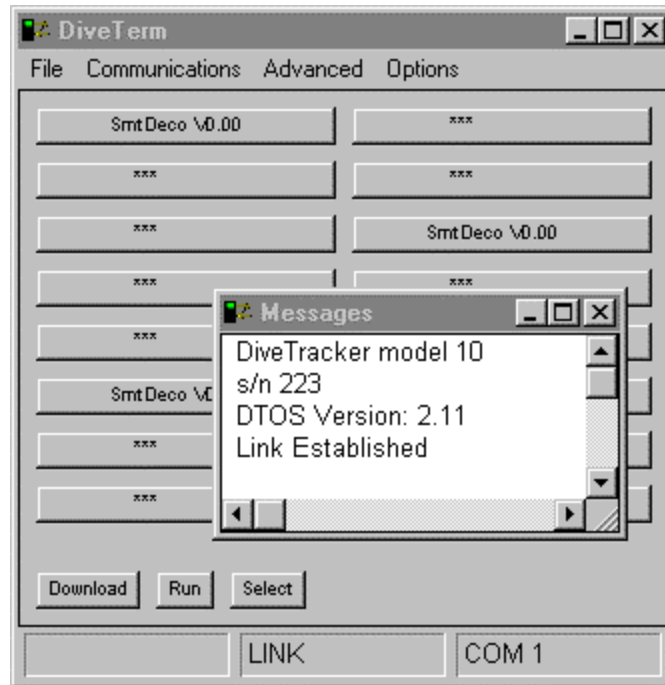


Figure 17: The DiveTerm™ Main Screen

Select the COM port you are using by clicking on the **Communication** sub-menu. Next, power up the EM-2 module.

DiveTerm™ should now recognize the presence of the DiveTracker™ and generate a screen as shown in figure 17. If the link status indicated at the bottom of the DiveTerm™ screen remains 'No Link' or an error message appears, you may have a communication problem. In this case, switch DiveTracker™ off and check all your wiring. Then, try again.

In its normal mode of operation, DiveTracker™ will proceed directly to the 'selected' application. However, whenever the presence of DiveTerm™ is detected at power-up, DiveTracker™ will enter the DTOS operating system and start communicating with DiveTerm™.

At the center of the DiveTerm™ main screen is the DiveTracker™ 'memory map' which lists the contents of the memory pages of the DiveTracker™ module. A factory configured module will contain two applications in its memory.

SmartDive™ is a multi-purpose Mission Control application. It combines navigation, communication, data acquisition and various other functions.

DT-TEST is a DiveTracker™ test utility. DT-TEST checks the DiveTracker™ hardware and can also be used to calibrate pressure transducers and conduct sonar propagation tests.

We recommend that you first run DT-TEST to test the DiveTracker™ hardware. DT-TEST encompasses eight tests. To test the sonar transmitter, select **TX-Test**. You should hear the sonar transducer clicking. To test the sonar receiver, select **Threshold Test**. Two sets of four numbers each reflect the signal seen by the receiver's peak and threshold detection circuits using the receiver's four available gain settings. Higher values indicate a stronger signal. With no signal present, all numbers should read less than 10, and in most cases close to 0. Now repeatedly tap the sonar transducer with a pen. Some of the numbers should briefly increase, indicating the detection of your tapping.

After completing the tests, it's time to select SmartDive™ or whatever application you intend the EM-2 to run. Dismiss the application terminal window by clicking on the cross in the right upper corner. DiveTerm™ will now say 'No Link' and 'Please Reset DiveTracker™'. Power the module down, then switch it on again. Once connection is established, click on the **Select** button, then select the desired application. Now, after each power-up the EM-2 module will proceed to the selected application.

Congratulations! You have now successfully installed and activated your DiveTracker™ EM-2 module. If you are using SmartDive™ as the module's default application, please refer to the DiveTerm™ or DiveBase™ documentation for information on how to configure the software.

5. Module Maintenance

Your model EM-2 DiveTracker requires very little maintenance. Just follow these pointers.

- Inspect all connectors for loose wires and corroded contacts on a regular basis.
- Check all mounting screws periodically for tightness.
- If the module does get exposed to water, rinse it thoroughly in fresh water, shake it dry and inspect for any corrosion.

6. Model EM-2 Specifications

Size:	210 mm L x 64 mm D (8.25" L x 2.5" D) electronics module
Weight:	255 g (9 ounces)
Operating temperature:	0-70 degrees Celsius
Data I/O:	Controlled via IBM compatible PC through RS232 serial data link
Status Indicator:	Status LED
Sensors:	Depth sensor, +/- 1% accuracy. Max. depth from 220 to 22000 feet, per customer spec. Three 12-bit A/D channels available on CPU board for external custom sensors Asynchronous serial interface available on CPU board for external 'smart' sensors
Control:	Control lines for external buzzer, weight release and umbilical synchronization signal
Microprocessor:	MC68HC11, 1 MHz
Memory:	128 Kbyte of battery backed-up SRAM (for user data), 512 Kbyte optional 2.5 Kbyte of volatile SRAM (stack space) 512 Kbyte of permanent FLASH memory (for application) 24 Kbyte of EPROM (firmware storage)
Sonar transceiver:	0-60 Watt RMS output in transmit mode RX sensitivity 7 microvolt RMS @ 6 dB S/N 4th order continuous time bandpass filter Digital frequency synthesis, tunable in 0-100 kHz range, resolution 1.5 Hz
Sonar transducers:	Up to three external transducers. 34-41 kHz standard. Other frequencies available on request
Sonar range:	100-1000 meters communication range, depending on sea conditions Extended range available on special request.
Sonar modulation:	Multi frequency-shift keying (MFSK)
Sonar bitrate:	15 - 150 bits/sec
Sonar Navigation:	Long baseline and short baseline principle supplemented by transducer derived depth information yields 3D position information for mobile stations Navigation range is 100-1000 meters, depending on sea conditions. Extended range available on special request. Distance measurements repeatability +/- 0.15 m (6") (system limit)
Power consumption:	9V to 16V supply voltage 0.01 mA in sleep mode

120 mA in sonar receive mode
Up to 2 Ampere in high-power sonar transmit mode

Note: all specifications are subject to change without notice