VLT-1 & VLT-3

Vehicle Locating Transponders

Technical Reference Manual

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1.0 Introduction

The VLT-1 and VLT-3 transponders are based on the same design and are referred to in this manual as the VLT. Anywhere there is a difference between the two models it is pointed out. The main difference is that the VLT-1 uses **RS-232** data transfer and VLT-3 uses a differential data transmission format designed for data transmission over a single twisted wire pair.

The VLT vehicle locating transponder is a rugged instrument which is designed for tracking ROV's and other underwater vehicles. The VLT is housed in a cylinder measuring 76 mm (3") diameter and 324 mm (12.75") long. A high power version of the transponder, the VLT-1H/VLT-3H is available for extended range or high noise operations. The instrument is powered either by the internal nickel cadmium battery or by an external (ROV) supply. VLT is activated through a rotary power switch. A LED indicates instrument status.

The VLT is specifically optimized for use as a ROV transponder in an AquaMap ROV long baseline survey system. It is outfitted with a short-haul modem that allows it to communicate with the surface station PC through a single twisted wire pair in the ROV umbilical.

VLT Design Characteristics

- Vehicle Locating Transponder, for use with AquaMap ROV long-baseline survey systems.
- VLT-3: Short-haul wire modem for umbilical communication through a single twisted wire pair.
- Housed in a rugged hard-anodized aluminum cylinder rated for use at depths up to 1000 meters.
- Operational range up to 1000 meters.
- Cable mounted, omni-directional sonar transducer.
- Powered by internal re-chargeable nickel cadmium battery and / or external (ROV) power source.
- Range measurement accuracy to 0.15 meters, 3D tracking accuracy to 0.5 meters.
- Advanced capabilities including acoustic telemetry and AUV navigation support.
- Supports short baseline, long baseline and ultra short baseline tracking.

Figure 1.1: VLT-1 Vehicle Locating Transponder with Two Transducer Mounting Options

2.0 Unpacking

Please ensure that your shipment does contain these components.

VLT Component List

- 1 ea. VLT Vehicle Locating Transponder
- 1 ea. Hard mounted sonar transducer on end-cap or optional cable mounted sonar transducer.
- 1 ea. ROV power & data cable
- 1 ea. RS-485 to RS-232 converter (VLT-3 only)
- 1 ea. SONAR transducer on 5' cable (optional)
- 1 ea. protective cap for multi-function connector
- 1 ea. cable adapter
- 1 ea. battery charger
- This manual

3.0 Preparations For Operation

Follow these simple steps to get your vehicle locating transponder ready for operation.

Preparations For Operation

- Unpack the transponder and make sure you've got all the parts.
- Charge the VLT internal battery.
- Install and configure appropriate application software (if different from factory installed software).
- Mount the VLT on the ROV and wire it to the umbilical.
- Activate the transponder.
- You're ready to go

3.1 Station Activation

All that is needed to activate the VLT is to rotate the power knob, which is located on the end cap of the housing. The power knob has three settings.

Switching The VLT ON and OFF

- To activate the VLT rotate the power knob to the ON position. Wait until the status LED lights up. Now, rotate the knob to one of the two half-way positions between ON and OFF. The half-way positions allow the transponder to switch itself ON and OFF under software control. This 'sleep mode' is used by VLT software to save battery power. Sleep mode will not work when the knob is in the ON position.

- To shut down the VLT, rotate the power knob to the OFF position. If the transponder has been in sleep mode, activate it by turning the knob to the ON position and wait until the status LED starts blinking.

- Now, turn the knob to the OFF position. This action will clear any pending wake-up calls.

3.2 Charging The Internal Battery

Your VLT is equipped with a re-chargeable nickel cadmium battery. The battery is re-charged using a sophisticated fast-charge algorithm which is implemented as a part of the SmartDive™ application. The SmartDive™ application is factory implemented on your DiveTracker™ and selected as the default application.

To charge the battery on a factory new VLT, follow these instructions.

Battery Charging Procedure

- Remove the protective cap from the multi-function connector.

- Connect the connector adapter to the VLT. Connect the battery charger to the connector adapter. Plug the battery charger power cable into a power outlet.

- Activate the VLT by rotating the power knob to the ON position.

- After a few seconds, the VLT status LED will enter a slow blink mode, in which the LED is on for one second and the off for one second, etc. This indicates that battery charging is taking place.

- The charge cycle itself may take up to 3.5 hours. Following this period, VLT will enter the standby mode. The LED will now be on for one second, followed by three seconds off, etc.

- The battery is now fully charged. Disconnect the charger.

3.3 Configuring, Installing And Selecting New Software

While Desert Star Systems pre-configures all stations before shipping, you may at times find the need to change configuration parameters, install new software or perform a variety of other 'system administration' functions. This section explains how it's done.

System administration functions generally require that the VLT be connected to a personal computer. This is done using the supplied data exchange cable and connector adapter. Connect the adapter to the multi-function connector on one end-cap. Then, link the instrument to a COM port of the personal computer using the data exchange cable.

Next you will have to run one of two utilities on the PC.

- To configure the VLT for your operation, run DiveBase™.

- Use DiveTerm™ to download new application software, upload data that has been collected by the station, select a new default application, set the instrument's real-time clock, interact with DT-TEST and other DiveTracker™ applications and perform various other system administration tasks.

After the job at hand is completed, switch the instrument OFF, disconnect the connector adapter and re-seal the multi-function connector by applying the terminator.

Application configuration, software download and other system administration tasks are explained in detail in the DiveTerm™ and DiveBase™ manuals.

4.0 Transponder Mounting

The VLT is easily installed on remotely operated vehicles.

Figure 4.1 shows the installation of a transponder on a Phantom ROV from Deep Ocean Engineering. The sonar transducer has been secured to the top of the crash frame of the ROV. In this configuration the VLT has its SONAR transducer on a 4' cable instead of an endcap mounting. The transponder housing itself is mounted on the base platform of the ROV and is not visible here.

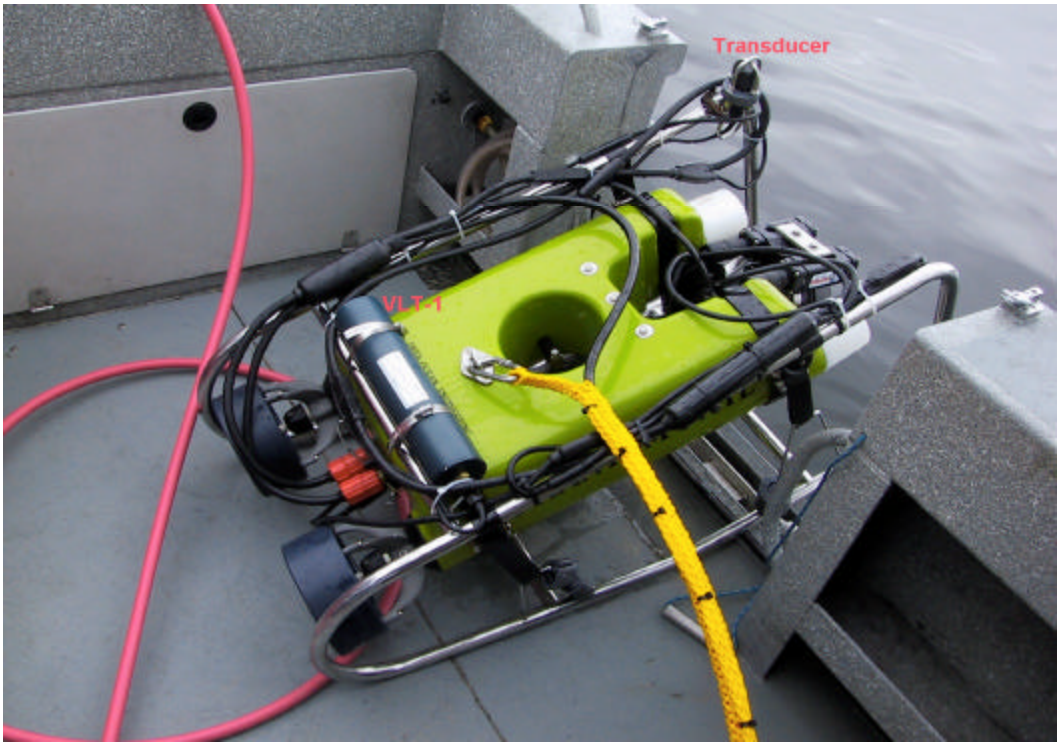


Figure 4.1: Vehicle Locating Transponder Mounted On A Phantom ROV

VLT Installation On An ROV

- Secure the VLT cylinder to the ROV using appropriate brackets, hose clamps or even duct tape. Make sure you retain access to the power knob, status LED and multi-function connectors.

- Wire the VLT power and data cable to the umbilical junction box.

- Connect the power and data cable to the VLT connector.
- Connect the sonar transducer to the connector on the other end of the VLT (if you purchased that option).
- Mount the sonar transponder or transducer in an 'exposed' location on the ROV. The transducer should have an unobstructed view of the environment and in particular the baseline and surface station transducers. Secure the transducer cable.

The VLT is designed to exchange data with the surface through an umbilical. It can also be powered by an external (ROV) power source. Both data exchange and external power supply takes place through the power/data cable that is supplied with the transponder. Further, the power conductors of the cable are marked for easy identification. Follow the instructions in the box below to wire the VLT to the umbilical. The cable components you recieve from the factory will depend on which VLT you have. Along with the standard multi-purpose connector cables the VLT-1 comes with a standard RS-232 data cable and the VLT-3 comes with an RS-485 converter.

Wiring the VLT to the Umbilical

Communication Test

Before wiring the VLT to the umbilical, we recommend that you test the communication between the VLT and your PC. For the test, connect one end of the VLT power/data cable to the VLT. Connect the other end to COM1 your PC. Next, start DiveTerm™ on your PC. Once DiveTerm™ is running, switch the VLT on. After a few seconds, you should see a message 'Trying to Link' at the bottom of the DiveTerm™ window. About 30 seconds later, the message should change to 'LINK' and a map showing the contents of the FLASH memory pages of the VLT will appear. If this happens, communication between the VLT and the PC is working. You can now start wiring the umbilical. If no link is established, make sure that you are connected to COM1, or select a different COM port in DiveTerm™. Then, try again. Watch the LED on the VLT after activation. If it never blinks, the battery may be dead. Charge the battery and try the communication test again.

Umbilical data wire & power requirements

You will need a single twisted wire pair to establish communication between the VLT and the surface station PC. The maximum umbilical length depends on the gauge of the twisted wire pair. 26 gauge (AWG26) wire will support a maximum length of 2000 meters. 22 gauge (AWG22) wire allows use of umbilicals up to 4000 meter long. The VLT can also be powered by a ROV power source. The VLT operates on 9V to 25V DC, while the VLTH (High Power) can use voltages up to 25V DC. Both versions of the transponder consume about 100 mA in receive mode. Peak currents during transmit reach 0.7 Ampere for the VLT and 3.5 Ampere for the VLTH. These peaks persist for up to 0.1 seconds.

Wiring instructions

Disconnect the Telebyte 203F modem from the data/power cable by loosening the two screw terminals. Wire the data/power cable to the umbilical junction box as follows:

Negative supply rail (0V): Pin 1 (black conductor)
Positive supply rail: Pin 5 (orange conductor)
Data+ (RS-485) or TXD (RS-232): Pin 3 (red conductor)
Data- (RS-485) or RXD (RS-232): Pin 2 (white conductor)

Pin 4 of the data/power cable connector (green conductor) is the charge line to the VLT. This is not normally wired in the ROV system. However, it is possible to connect this line through a 2 Ohm resistor to a regulated 15V / 2A power source. Whenever the charge power is applied, the VLT will enter battery charge mode.

The surface end of the umbilical twisted wire pair must be wired to the RS-485 converter (VLT-3 only). Connect the 'Data+' wire to the '+' screw terminal of the converter. Connect the 'Data-' wire to the '-' screw terminal.

Checking the wiring

Repeat the communication test, this time with the umbilical forming a part of the link between the VLT ands the surface station PC. Do the initial test with all ROV systems switched off, then repeat the test while the ROV is under power. If the initial test fails, check the wiring with an ohm meter. If communication fails only when the ROV is powered up, there may be interference between a ROV system and the VLT. Switch ROV systems off until communication works again.

The power wiring can be checked with an ampere (current) meter. Whenever the ROV supply voltage exceeds the VLT internal battery voltage, the VLT will draw power from the ROV. With a fully charged battery, this will happen at ROV supply voltages of approximately 12V or more. Switch the VLT on. You should see a consumption of about 100 mA. If no current flow is noted, ROV supply voltage may be less then battery voltage or the power wiring may be reversed. While reversed power wiring does not harm the VLT, be aware that connecting power to the data lines could cause damage.

The transponder's sonar transducer is used for underwater communication and navigation tasks. The sonar transducer is the antenna of the system. Just as is the case with radio and TV antennas, proper placement is required to obtain good reception. The standard VLT is equipped with an end cap mounted sonar transducer that is protected by a cage. A transducer mounted on a 1 meter cable is available as an option.

For best results, follow these guidelines when mounting the transducer.

Guidelines For Sonar Transducer Mounting on a ROV

- The transducer should not be shielded by any part of the ROV. It is preferred to mount it near the top of the ROV to obtain an unobstructed view of the baseline station transducers.
- Keep the transducer away from the thrusters as these might generate noise that could interfere with system operation.
- Maximize the space between the VLT sonar transducer and other sonar transducers on the vessel or instrument. Interference may result if transducers are spaced too closely.
- The performance of the standard VLT transducer is strongest in and near the horizontal plane. Mount the transducer in an upright (transponder housing or cable end points down) or inverted (transponder housing or cable end points up) fashion for best results.
- Use a bracket or another rigid structure to secure the transducer. A moving transducer will degrade accuracy of navigation.
- When using the optional cable mounted sonar transducer, use the holes in the gray PVC support disk to mount the transducer. You may also drill other holes into that disk. **DO NOT** secure or attach anything to the black cylinder. This is the active element of the transducer.

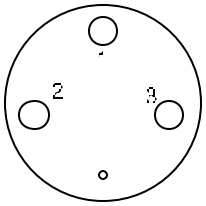
5.0 Connectors, Indicators And Controls

The VLT features a power knob, a status LED and a multi-function connectors. A hard mounted sonar transducer or a connector for a cabled sonar transducer is located on the other end cap.

5.1. The SONAR Connector

An external SONAR transducer is optional on the VLT. If you have one it uses the following connector.

This three-pin waterproof connector is a McArtney type MCBH3F which mates to a model ILMC3M cable connector.



1: Ground
2: External Sonar TX/RX
3: External Battery (+9V to +12V)

Figure 5.1: Sonar Connector Pin Assignment (Bulkhead)

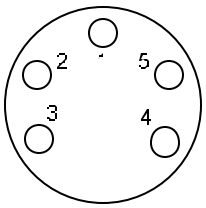
The SONAR connector is normally used to connect the station to the sonar transducer. An external battery pack can also be switched in-line between the station and the sonar transducer.

CAUTION!

Before entering the water, make sure that either a cable or a connector cap (supplied) is inserted in all connectors. Submerging the unit with open connectors will damage the connectors and can result in flooding of the unit.

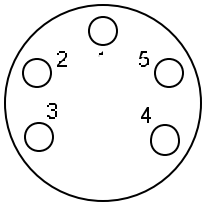
5.2 The Multi-Function Connector

The multi function connector is a SUBCONN model MCBH5F. This connector is used to wire the VLT to the umbilical and to connect a battery charger. The connector must be terminated before the transponder is submerged to prevent corrosion. If the VLT 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 5.2: VLT-1 Multi-Function Connector Pin Assignment (RS-232 ready)



1: Ground (0V)
2: Data-
3: Data+
4: Charger Input
5: External Power

Figure 5.3: VLT-3 Multi-Function Connector Pin Assignment (RS-485 ready)

5.3 The Status LED

A status LED is located on the main end cap.

The LED operates under control of the CPU and emits blink patterns that indicate operational status. The blink patterns used by SmartDive™ are listed below.

Once a station is active, observe the status LED. After a few seconds, the LED should settle into a pattern of one short blink every second. If you don't see this pattern, the station may indicate a special condition or it may not be running SmartDive. Refer to the following table.

Status LED Pattern	Description
LED is OFF	The station is OFF, the battery is dead or it is not running any application software (no application software installed, baseline station is connected to DiveTerm for maintenance functions)
LED is always ON	Not a valid blink pattern. A hardware problem may exist, the baseline station battery may be discharged.
Single short blink once per second	Station is operating fine.
Double blink once per second	A position fix has been received.
Triple blink once per second	Station self test failed. Run DiveTerm on the PC and start SmartDive from DiveTerm. Watch the error code. Look in next table to interpret the error code.
1/2 sec ON, 1/2 sec OFF	The station is not configured, configure the station (see next section for details). This signal may also indicate that a different application is running. Use DiveTerm to verify that SmartDive is running.
1 sec ON, 1 sec OFF	Charging of the station battery is under way.
1 sec ON, 3 sec OFF	Battery charging is complete.
Other blink patterns	A different application is running on the station. Use DiveTerm to select SmartDive as the active application.

Figure 5.4 : SmartDive Blink Patterns

5.4 The Power Knob

The power knob is located on the connector end cap. It has three settings.

The Three Settings Of The VLT Power Knob

- When the knob is in the ON position, VLT is forced ON. Use this setting to activate a VLT that is either OFF or asleep. The ON function is absolute, i.e. when the knob is in the ON position, the transponder will not be able to fall asleep. This mode can be used on the VLT.

- Alternatively, switch the power knob ON and then to one of the settings half way between ON and OFF. The VLT can now fall asleep in case the umbilical is cut, to preserve power for a recovery operation.

- When the knob is in the OFF position, VLT is forced OFF. Use this selection to manually force the instrument OFF. If a sleeping station, which is awaiting an alarm, is switched OFF, the station will not be able to wake up. However, as soon as the knob is turned into any position other than OFF, a pending alarm will take effect and the station will activate itself.

6.0 VLT Maintenance

Your VLT is a rugged instrument that requires only little maintenance. However, please do observe the following points to ensure long and proper operation.

Maintenance Instructions

- Rinse VLT with fresh water after each deployment. Pay special attention to the area around the connectors and transducers on the end caps. The transponder chassis is made out of aluminum, the transducers and connectors, screws, mounting ring and other hardware are brass and stainless steel. Even though the housing is hard anodized to minimize corrosion, some will still occur at the points where the two metals meet. This corrosion can be minimized through proper rinsing. Corrosion around this area will rarely be severe enough to affect operation. It may however be a cosmetic consideration.

- Make sure that the hole in the depth transducer on the connector end cap does not get blocked by debris. If this should happen, rinse the transducer with a strong stream of water in order to dislodge the debris. **DO NOT USE A SHARP OR POINTY OBJECT TO PENETRATE THE TRANSDUCER HOLE. THIS MAY WELL RESULT IN DAMAGE TO THE TRANSDUCER MEMBRANE.**

- The VLT chassis is sealed with a number of O-rings. The O-ring rubber has a limited life time. **RETURN YOUR VLT TO THE FACTORY EVERY THREE YEARS FOR SERVICE AND O-RING REPLACEMENT.**

7.0 VLT Specifications

Size:	324 mm L x 76 mm D (12.75” L x 3” D)
Weight:	1.75 kg (3.85 lb.) in air
	0.4 kg (0.88 lb.) in water
Depth Rating:	1000 meters (3280 feet) max. working depth
Operating temperature:	0-70 degrees Celsius
Data I/O:	RS232 serial data link available on two identical multi-function connectors
Status Indicator:	Status LED
Sensors:	Depth sensor for depths of 0-670 meter (0-2200 feet), +/- 6.7 meter (22 feet), other ratings available on request
	Two 8-bit A/D channels available on multi-function connector
	Smart sensors may be connected via RS232C link
Microprocessor:	MC68HC11, 1 MHz
Memory:	128 Kbyte of battery backed-up SRAM (for user data)
	2.5 Kbyte of volatile SRAM (stack space)
	256 Kbyte of permanent FLASH memory (for DiveCode)
	24 Kbyte of EPROM (firmware storage)
Sonar transceiver:	Transmit power 182 dB for VLT on battery power (full battery), up to 188 dB on external power (16V)
	Transmit power 192 dB for VLT with high power option (VLT-1H) on battery or external power
	Receiver sensitivity <= 90 dB
	4th order continuos time bandpass filter
	Digital frequency synthesis, tunable in 0-100 kHz range, resolution 1.5 Hz
Sonar transducers:	34-41 kHz standard ‘omni directional’ transducer hard-mounted on end cap or cable mounted (optional)
	Other frequencies available on request
Sonar range:	100-1000 meters communication range, depending on sea conditions and power settings
	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”) typical
Power supply:	Internal re-chargeable NiCd battery, 3 Ah capacity, 6 (high power) to 15 (normal power) battery life.
	External 9V to 12V DC power supply (ROV power)
Power consumption:	9V to 16V supply voltage for VLT; 9V to 25V for VLTHP
	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