

TLT-1 & TLT-2

Target Locating Transponder

Technical Reference Manual



Rev. 3
March 2001

Desert Star Systems
761 Neeson Road, Suite 9
Marina, CA 93933
(831) 384-8000
(831) 384-8062 FAX
<http://www.desertstar.com>

© Copyright 1999, Desert Star Systems

1.0 Introduction	2
2.0 Unpacking	3
3.0 Preparations For Operation	3
3.1 Changing The Internal Batteries	3
3.2 Configuring The TLT-1 / TLT-2	4
3.3 Station Activation	4
4.0 Transponder Mounting	5
5.0 Indicators, Connectors, Switches And Controls	6
5.1 The SONAR Connector	6
5.2 The Status LED	6
5.3 The Configuration Switches	6
5.4 The Immersion Power Switch	7
6.0 TLT-1 / TLT-2 Maintenance	8
7.0 TLT-1 / TLT-2 Specifications	8

1.0 Introduction

TLT-1/TLT-2 target locating transponders are low cost, miniature transponders designed for tracking small ROVs and other underwater targets. The TLT-1 is a self-contained instrument which is housed in a cylinder measuring just 71 mm (2.8") diameter and 156 mm (6.15") long. The transponder is powered by a set of six 'AA' size alkaline cells which are sufficient for about 40 hours of active operation. A magnetic toggle switch activates the transponder and a LED indicates instrument status. TLT-1 is easy to install. Just mount the small cylinder on some opportune part of the ROV using hose clamps or even duct tape. The surface station will track the position and depth of the ROV as soon as it enters the water.

The TLT-2 Target Locating Transponder is identical to the TLT-1 in all respects except it is equipped with a cable mounted sonar transducer rather than hard endcap mounted transducer. The cable mounted transducer allows for more flexible mounting of the transponder.

*Instructions specific to the TLT-2 will be marked with a **TLT-2 ONLY** identifier and italics. All other instructions are valid for both the TLT-1 and TLT-2.*

The TLT-1 / TLT-2 works at depths to 200 meters and distances of up to 500 meters, sufficient for most small ROVs.

TLT-1 / TLT-2 Design Characteristics

- Target Locating Transponder, for tracking of small remotely operated vehicles (ROV) or divers.
- Straightforward installation in minutes.
- Miniature, self-contained, rugged design.
- Operational range up to 500 meters, depth to 200 meters.
- Powered by user replaceable 'AA' size alkaline cells.
- Range measurement accuracy to 0.15 meters, 3D tracking accuracy to 0.5 meters.
- Supports short baseline, long baseline and ultras short baseline tracking.

Figure 1.1 shows the TLT-1 Target Locating Transponder. The cylindrical housing is manufactured from hard-anodized aluminum. An omni-directional sonar transducer along with the power switch, status LED and depth sensor are located on the removable end cap.

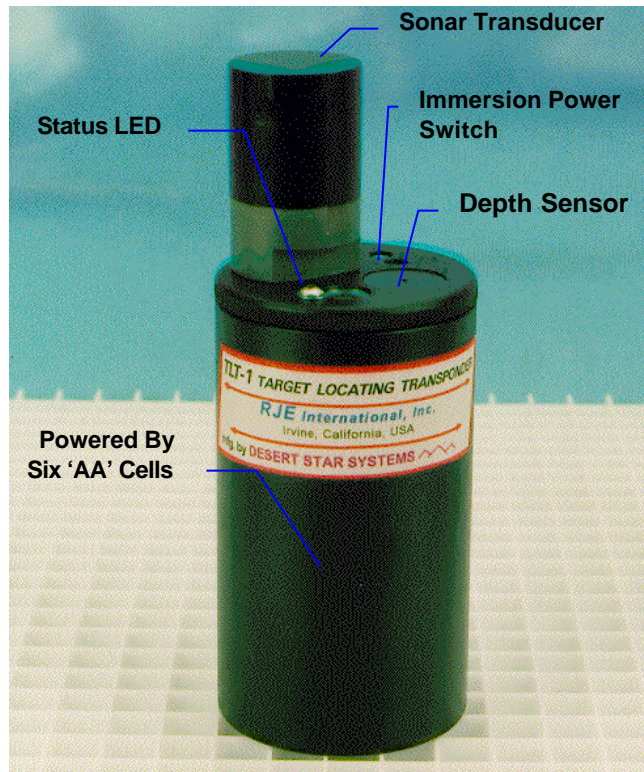


Figure 1.1: TLT-1 Target Locating Transponder

2.0 Unpacking

Please ensure that your shipment does contain these components.

TLT-1 / TLT-2 Component List

- TLT-1 or TLT-2 Target Locating Transponder
- This manual
- For TLT-2 only: One cabled sonar transducer and one terminator plug (dummy plug)

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.

In order to operate your TLT-1 / TLT-2 you will also need a STM-10, STM-1 or other surface station from Desert Star Systems.

3.0 Preparations For Operation

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

Preparations For Operation

- Unpack the transponder and make sure you've got all the parts.
- Install a set of six 'AA' size alkaline cells.
- Configure the TLT-1 / TLT-2 using the internal DIP switches.
- Mount the TLT-1 / TLT-2 on the ROV.
- Switch the transponder on prior to launching the ROV.

3.1 Changing The Internal Batteries

CAUTION!

Installing or changing the TLT-1 / TLT-2 batteries requires opening the transponder. This will expose the electronics and make them vulnerable to damage due to static electricity discharge, contamination, strike etc. Improper re-assembly also risks a leak in the housing and consequential flooding, which will lead to almost certain destruction of your TLT-1. / TLT-2. Always work at a clean, static free work station when opening the transponder. Pay extreme attention to detail. Desert Star Systems will not accept responsibility for transponder flooding, mechanical and static electricity damage.

The transponder is powered by a set of six 'AA' cells. We recommend the use of alkaline cells.

To change the battery, follow these instructions.

Changing The TLT-1 / TLT-2 Battery

- **TLT-2 ONLY:** Remove the transducer cable from the endcap.
- Unthread the end-cap and carefully remove it from the transponder housing.
- The battery pack will now be exposed. Change the six batteries, being careful to watch for proper polarity. Improper installed batteries will not damage the transponder, but will prevent it from operating. Secure the batteries with the supplied Velcro strap.
- Inspect the O-ring and seating area for any contaminants or damage. If necessary, remove the O-ring from the end-cap. Clean or replace the O-ring and groove and apply a thin film of silicon grease. **Do not re-use a damaged O-ring. This will risk flooding the transponder.** Re-install the O-ring.
- Thread the end-cap / electronics assembly back onto the housing until a snug fit is obtained.
- **TLT-2 ONLY:** Reconnect the transducer cable to the endcap.

3.2 Configuring The TLT-1 / TLT-2

Eight configuration 'DIP' switches are located on the TLT-1 / TLT-2 electronics board. Through these switches, the TLT-1 / TLT-2 is adapted to a variety of operating conditions.

Switch settings are indicated by the DiveBase software during the system configuration process. Follow these settings. The function of the switches is also described in section 5.2.

3.3 Station Activation

To activate the transponder, rotate the magnetic power switch to the ON position. This position is marked by a white line. The status LED should come on and eventually settle into a blinking pattern. A short blink once every second indicates that the transponder is ready for deployment. If the battery is low, the LED will blink rapidly. If the LED stays dark, the battery may be dead or missing. Replace the battery and try again whenever you are faced with a low or dead battery.

Refer to section 5.1. for detailed information on the status LED blink patterns.

4.0 Transponder Mounting

The sonar transducer of the TLT-1 and TLT-2 transponders is the antenna of the system. Proper placement and mounting of the transducer is required for good tracking.

Figure 4.1 shows the installation of the cabled sonar transducer of a TLT-2 transponder on the crash frame of a Phantom ROV from Deep Ocean Engineering. Notice the mounting well clear of ROV components which might otherwise obstruct the 'sonar view' of the transducer. Hose clamps, custom brackets, duct tape and other methods are all suitable for transponder or transducer installation. Be sure to keep the black, cylindrical portion of the sonar transducer free of all obstructions. Use only the gray PVC disk as an attachment point.

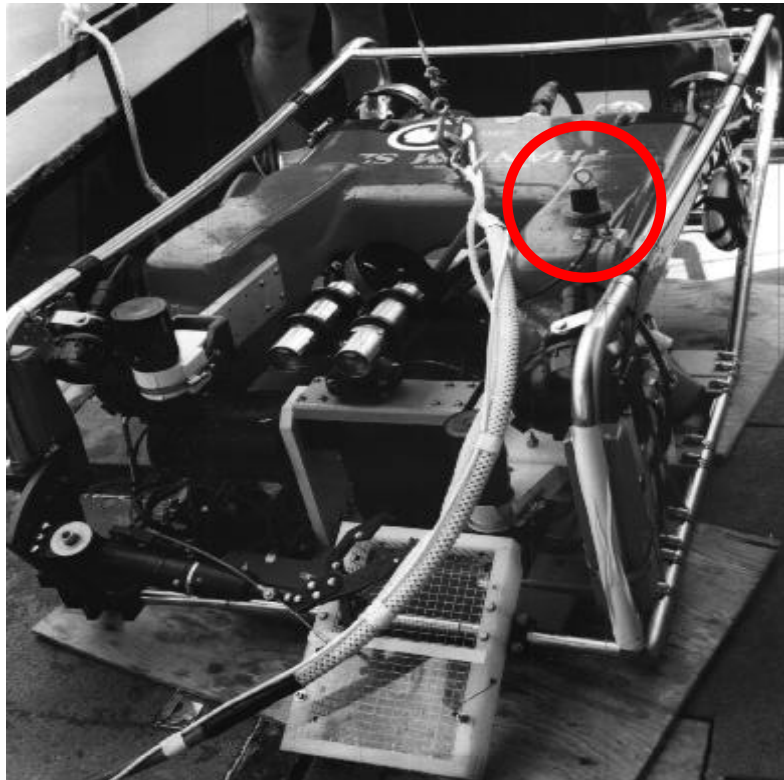


Figure 4.1: Target Locating Transponder Mounted On A ROV

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 and surface station transducers.
- Keep the transponder away from the thrusters as these might generate noise that could interfere with system operation.
- Maximize the space between the TLT-1 / TLT-2 sonar transducer and other sonar transducers on the ROV. Interference may result if transducers are spaced too closely.
- Mount the sonar transducer in an upright or inverted fashion for best results.
- Use a bracket or another rigid structure to secure the transducer. A moving transducer will degrade accuracy of navigation.
- **DO NOT** attach anything to the black cylinder of the sonar transducer. Holes can be drilled into the gray PVC disk at the base of the TLT-2 sonar transducer for mounting purposes.

5.0 Indicators, Connectors, Switches And Controls

Besides the sonar transducer and the depth sensor, the TLT-1 / TLT-2 features a power switch and a status LED on its removable end cap.

5.1 The SONAR Connector

This three-pin waterproof connector is located at the base of the TLT-2 unit, there is no connector on the TLT-1. It is a McArtney type MCBH3F which mates to a model ILMC3M cable connector. The pin out of the connector is shown in figure 9.

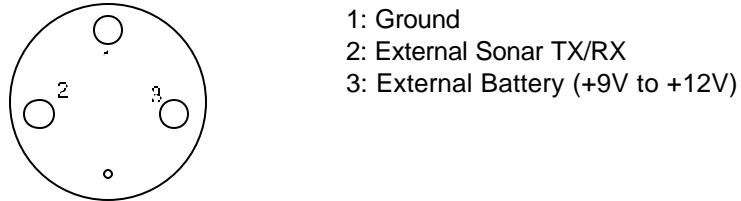


Figure 5.1: Sonar Connector Pin Assignment (Bulkhead)

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.

5.2 The Status LED

The status LED operates under control of the CPU and emits blink patterns that indicate operational status. The following table indicates the meaning of the blink patterns.

Status LED Pattern	Description
LED is OFF	The transponder is OFF or the battery is dead.
LED is always ON	Not a valid blink pattern. A hardware problem may exist, the battery may be discharged.
Single short blink once per second	The transponder is operating fine and waiting for interrogations.
Double blink once per second	An interrogate from the surface station has been received.
Rapid blinking	The battery is low. Change the battery.

Figure 3: TLT-1 / TLT-2 Blink Patterns

During normal operation, the TLT-1 / TLT-2 will emit a short blink once every second. When an interrogate is received, the TLT-1 / TLT-2 will double blink. Watching for the double blink is a good way to trouble shoot tracking problems. If no double blinks are seen despite ongoing interrogations by the surface station, the signal path may be blocked or sound propagation may be poor (excessive range). It is also possible that noise levels are too high.

5.3 The Configuration Switches

Eight configuration 'DIP' switches are located on the TLT-1 / TLT-2 electronics board. Through these switches, the TLT-1 / TLT-2 is adapted to a variety of operating conditions. Switch settings are indicated by the DiveBase software during the system configuration process. Follow these settings. The advanced user may use different settings for specialized purposes.

The TLT-1 / TLT-2 Configuration Switches

- The **Transponder ID** selects the identity of a TLT-1 / TLT-2 as well as the transponder mode of operation. If single transponder mode is selected, only one TLT-1 / TLT-2 can be tracked. In multi-transponder mode, up to seven TLT-1 / TLT-2 can be tracked. Single transponder mode has the advantage of somewhat higher position update rates. When using multi-transponder mode, number your transponders sequentially starting with transponder #0. For example, if you are tracking two transponders, configure them as #0 and #1.
- The **Network Type** switches select the type of tracking system you are using. Options are short baseline with three transducers, short baseline with two transducers and long baseline.
- The **Receiver Sensitivity** switches. A lower sensitivity means greater immunity to noise and echoes but also a lesser tracking range. Generally, reduced sensitivity is used in constricted environments and noisy waters while higher sensitivity is applicable to open waters and low noise environments.
- The **Transmit Speed** switches select the speed of depth telemetry and how fast the transponder replies to an interrogate. High speed is applicable in most cases, but work in pools often requires the low speed setting.

Each configuration switch can either be in the 'up' (U) or the 'down' (D) position. The following table details the switch settings. The factory setting for each group of switches is typed in bold face.

Switch Number	Switch Function	Switch Settings																																				
1-3	Transponder ID	<table border="0"> <tr> <td>S1</td> <td>S2</td> <td>S3</td> <td></td> </tr> <tr> <td>U</td> <td>U</td> <td>U</td> <td>Single Transponder Mode</td> </tr> <tr> <td>U</td> <td>U</td> <td>D</td> <td>Transponder #1</td> </tr> <tr> <td>U</td> <td>D</td> <td>U</td> <td>Transponder #2</td> </tr> <tr> <td>U</td> <td>D</td> <td>D</td> <td>Transponder #3</td> </tr> <tr> <td>D</td> <td>U</td> <td>U</td> <td>Transponder #4</td> </tr> <tr> <td>D</td> <td>U</td> <td>D</td> <td>Transponder #5</td> </tr> <tr> <td>D</td> <td>D</td> <td>U</td> <td>Transponder #6</td> </tr> <tr> <td>D</td> <td>D</td> <td>D</td> <td>Transponder #7</td> </tr> </table>	S1	S2	S3		U	U	U	Single Transponder Mode	U	U	D	Transponder #1	U	D	U	Transponder #2	U	D	D	Transponder #3	D	U	U	Transponder #4	D	U	D	Transponder #5	D	D	U	Transponder #6	D	D	D	Transponder #7
S1	S2	S3																																				
U	U	U	Single Transponder Mode																																			
U	U	D	Transponder #1																																			
U	D	U	Transponder #2																																			
U	D	D	Transponder #3																																			
D	U	U	Transponder #4																																			
D	U	D	Transponder #5																																			
D	D	U	Transponder #6																																			
D	D	D	Transponder #7																																			
4-5	Receiver Sensitivity	<table border="0"> <tr> <td>S4</td> <td>S5</td> <td></td> </tr> <tr> <td>U</td> <td>U</td> <td>Low Sensitivity</td> </tr> <tr> <td>U</td> <td>D</td> <td>High Sensitivity</td> </tr> <tr> <td>D</td> <td>U</td> <td>Very High Sensitivity</td> </tr> <tr> <td>D</td> <td>D</td> <td>Very Low Sensitivity</td> </tr> </table>	S4	S5		U	U	Low Sensitivity	U	D	High Sensitivity	D	U	Very High Sensitivity	D	D	Very Low Sensitivity																					
S4	S5																																					
U	U	Low Sensitivity																																				
U	D	High Sensitivity																																				
D	U	Very High Sensitivity																																				
D	D	Very Low Sensitivity																																				
6-7	Surface Station Type	<table border="0"> <tr> <td>S6</td> <td>S7</td> <td></td> </tr> <tr> <td>U</td> <td>U</td> <td>Three Transducer Short Baseline</td> </tr> <tr> <td>U</td> <td>D</td> <td>Two Transducer Short Baseline</td> </tr> <tr> <td>D</td> <td>U</td> <td>Long Baseline</td> </tr> <tr> <td>D</td> <td>D</td> <td>Not Used</td> </tr> </table>	S6	S7		U	U	Three Transducer Short Baseline	U	D	Two Transducer Short Baseline	D	U	Long Baseline	D	D	Not Used																					
S6	S7																																					
U	U	Three Transducer Short Baseline																																				
U	D	Two Transducer Short Baseline																																				
D	U	Long Baseline																																				
D	D	Not Used																																				
8	Transmit Speed	<table border="0"> <tr> <td>S8</td> <td></td> </tr> <tr> <td>U</td> <td>High Transmit Speed</td> </tr> <tr> <td>D</td> <td>Low Transmit Speed</td> </tr> </table>	S8		U	High Transmit Speed	D	Low Transmit Speed																														
S8																																						
U	High Transmit Speed																																					
D	Low Transmit Speed																																					

TLT-1 / TLT-2 Configuration Switch Settings

5.4 The Immersion Power Switch

To activate the transponder, rotate the magnetic power switch to the ON position. This position is marked by a white line. Switch the transponder OFF after each dive by rotating the lever away from the white line. Make sure the LED is dark before storing the transponder.

6.0 TLT-1 / TLT-2 Maintenance

Your TLT-1 / TLT-2 is a rugged instrument that requires very little maintenance. However, please do observe the following points to ensure long and proper operation.

Maintenance Instructions

- Rinse TLT-1 / TLT-2 with fresh water after each deployment.
- 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 TLT-1 / TLT-2 chassis is sealed by four O-rings. The O-ring rubber has a limited life time. **RETURN YOUR TLT-1 / TLT-2 TO THE FACTORY EVERY THREE YEARS FOR SERVICE AND O-RING REPLACEMENT.**

7.0 TLT-1 / TLT-2 Specifications

Size:	138 mm L x 70 mm D (5.4" L x 2.75" D)
Weight:	.923 kg (2.03 lb.) in air .397 kg (0.87 lb.) in water
Depth Rating:	200 meters (656 feet) max. working depth
Operating temperature:	0-70 degrees Celsius
Configuration:	Through eight internal DIP switches
Status Indicator:	Status LED
Sensors:	Depth sensor for depths of 0-200 meters (0-656 feet), +/- 2 meters (6.5 feet), other ratings available on request
Microprocessor:	MC68HC11, 1 MHz
Memory:	2.5 Kbyte of SRAM 512 Byte of EEPROM for configuration parameter storage 16 Kbyte of permanent EPROM for code storage
Sonar Receiver:	Tuned RF type Single Channel, operating at 34 kHz (other frequencies available on request) RX sensitivity 7 microvolt RMS @ 6 dB S/N 4th order continuous time bandpass filter
Sonar Transmitter:	Multi channel, operating at 34 kHz to 41 kHz 0-40 Watt RMS output Digital frequency synthesis, tunable in 0-100 kHz range
Sonar Transducer:	TLT-1: 34-41 kHz 'omni directional' transducer hard-mounted on end cap TLT-2: 34-41 kHz 'omni directional' transducer cable-mounted. Other frequencies available on request
Sonar Navigation:	Long baseline and short baseline principle supplemented by transducer derived depth information yields 3D position information for ROV stations Navigation range is 100-500 meters, depending on sea conditions. Distance measurements repeatability: +/- 0.15 m (6") typical
Power supply:	Powered by six user replaceable 'AA' size batteries. Approx. 40 hours battery life when using alkaline cells.

Note: all specifications are subject to change without notice