TLT-46, TLT-48, TLT-50

Torpedo Locating Transponders

Technical Reference Manual

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1. Introduction

The TLT-46, TLT-48 and TLT-50 smart torpedo locating transponders are designed specifically for use with the MK46, MK48 ADCAP and MK50 torpedoes. The transponders are installed in a port in the outer shell of the torpedo.

The transponder's function is to aid in the recovery of a torpedo, such as after a test run. The basic mode of operation is straightforward: To locate a torpedo, the search vessel is equipped with a tracking surface station. The surface station emits a sonar ping, which is received and recognized by the torpedo transponder. The transponder replies with a ping of its own, which travels back to the search vessel. By evaluating the reply ping, the surface station can determine both the range and direction of the torpedo. This information is displayed on the surface station's tracking screen. The Trackpoint™ 2 or Trackpoint™ LXT tracking system from ORE, or a PILOT™ or AquaMap™ tracking system from Desert Star Systems may be used as a surface station to locate the transponders.

The TLT series of transponders are equipped with a significant amount of intelligence, which enhances their operation. They can be user configured to operate in a variety of modes to support mission specific search strategies.

- In ***transponder mode***, the TLT replies to interrogations by the surface station. Transponder mode yields precise range and bearing information while at the same time conserving battery power.

- In ***pinger mode***, the TLT emits a continuous series of pings. Pinger mode eliminates the possibility that the torpedo may not 'hear' a faint interrogation pulse. The surface station obtains a precise bearing but only rudimentary range information. Battery life is shorter than in transponder mode. In pinger mode, the TLT functions the same as traditional mini pingers that are used on torpedoes.

- In ***switching mode***, the TLT operates normally in transponder mode with occasional switches to pinger mode. Switches to pinger mode can occur in pre-defined time intervals such as for 15 seconds every five minutes. Alternatively, the transponders can switch to pinger mode at a specific time of day, such as from 1100h to 1130h. Switching mode combines the energy efficiency of transponder mode with the 'faint signal operation' advantage of pinger mode.

The TLT transponders also offer several advanced modes of operation and characteristics which maximize operational benefits.

- **Two interrogation frequencies:** The TLT can be configured to reply either to 16 kHz or 17 kHz interrogation signals. A torpedo can thus be identified, or two torpedoes can be located at the same time.

- **Start-of-life:** The TLT can be instructed to not reply before a certain date and time. This conserves battery power, positively prevents the transponder from interfering with the torpedoes functions during a run and can also be used for stealth purposes.

- **End-of-life operation:** The TLT can switch into a different mode of operation near the end of its life. End-of-life status can be defined by low battery power or a specific date and time.

- **Automatic Gain Control:** The TLT is equipped with an intelligent AGC which optimizes operation for the current sonar environment, thereby maximizing tracking range and minimizing power consumption.

- **Advanced Modes:** The TLT transponders can be programmed for advanced functions such as torpedo status telemetry, acoustic remote control and coded (secure) interrogate operation. Contact Desert Star Systems for details.

Torpedo Locating Transponder Design Characteristics

- Designed for MK46 (TLT-46), MK48 ADCAP (TLT-48) and MK50 torpedoes (TLT-50).
- Compatible with Trackpoint™ 2 and Trackpoint™ LXT tracking systems by ORE and PILOT™ and AquaMap™ tracking systems by Desert Star Systems.
- 2000 meter (3000 PSI) depth rating.
- 16 kHz or 17 kHz interrogate frequency. 23 kHz reply frequency.
- 160 degree beam angle sonar transducer.
- Operates as a transponder or a pinger. Periodic switching between modes available.
- Special start-of-life and end-of-life operating modes.
- Powered by a user replaceable Alkaline battery pack - safe for use aboard submarines.
- Battery life in transponder mode: Over 90 days and 25000 reply pings.
- Battery life in pinger mode: Over 45 days with one ping every 15 seconds.
- Automatic Gain Control.

Figures 1A, 1B and 1C show the three transponders. The transponder housings are manufactured from hard-anodized aluminum. The sonar transducer is sunk into an polyurethane filled cavity in the face of each transponder. The battery, configuration switches, data exchange port and status LED are accessible by removing the transponder back plate.

Figure 1A: The TLT-46 Transponder For MK46 Torpedoes

Figure 1B: The TLT-48 Transponder For MK48 ADCAP Torpedoes

Figure 1C: The TLT-50 Transponder For MK50 Torpedoes

2. Transponder Architecture

Figure 2 shows the transponder architecture. The transponder is built around a Motorola MC68HC708XL36 microcontroller. The microcontroller executes code out of an on-chip EPROM or FLASH chip (depending on chip version). Configuration data is stored in RAM.

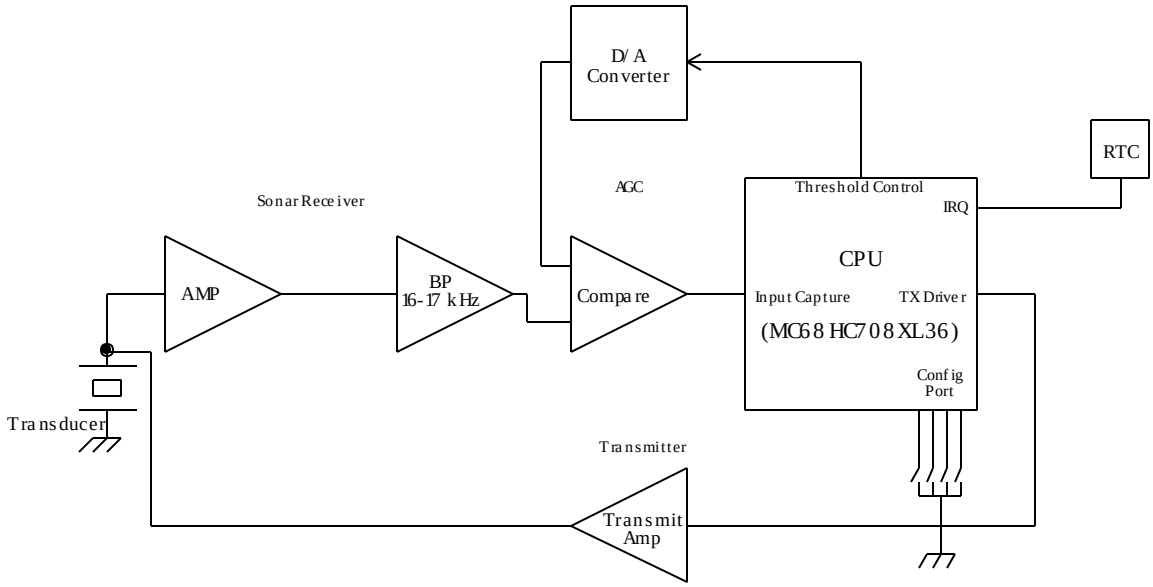

Figure 2: The TLT Series Transponders Are Microprocessor Controlled

Incoming sonar signals are amplified and bandpass filtered. The filtered signal goes to a threshold detector. The processor can control receive sensitivity by setting the detection threshold using an 8-bit D/A converter. Signals that exceed the detection threshold trigger a processor interrupt. The processor wakes up, and measures the frequency of the incoming signal. If a signal is classified as a valid interrogate, the processor generates a reply ping using the processor driven switching amplifier.

The transponders receiver front end consumes just 200 micro amperes, allowing the transponder to operate for 90 days on its alkaline battery pack.

The transponder is also equipped with a real-time clock. The clock is used to switch the transponder between its various mode of operation at user specified times.

The transponder can be configured using either the 4 DIP switches or by configuration data download through its serial data interface. The MicroTerm utility is provided to support this function.

2.1 Transponder Components And Accessories

The following transponder components and accessories are available from Desert Star Systems.

Part Number	Description
TLT-46	Transponder for MK46 torpedo
TLT-48	Transponder for MK48 ADCAP torpedo
TLT-50	Transponder for MK50 torpedo
BAT-T	Alkaline battery pack for TLT-46, TLT-48 and TLT-50
LINK-T	Data exchange cable for TLT-46, TLT-48 and TLT-50
TLT-46/TM	Technical Manual for TLT-46, TLT-48 and TLT-50
TLT-46/OM	Operator's Manual for TLT-46, TLT-48 and TLT-50
EM-10	Spare electronics module for TLT-46
EM-11	Spare electronics module for TLT-48 and TLT-50
MicroTerm	Configuration software for TLT-46, TLT-48 and TLT-50

Figure 3: Transponder Components And Accessories

Transponder	Back Plate Screws	Back Plate O-Ring
TLT-46	18-8 SS 4/40 x 3/8” Socket Cap Screw (4)	Parker 2-137
TLT-48	18-8 SS 4/40 x 3/8” Socket Cap Screw (4)	Parker 2-152
TLT-50	18-8 SS 4/40 x 3/8” Socket Cap Screw (2) 18-8 SS 4/40 x 1” Socket Cap Screw (2)	Parker 2-152

Figure 4: Transponder Screw And O-Ring Specifications

3.0 The Transponder Operation Cycle

The TLT transponders should be serviced after each torpedo run. The first step in getting ready for operation is to install a new battery. Next, the transponder is configured for the new mission. The transponder self-test verifies proper operation. If the transponder is working fine, it is closed and mounted in the torpedo. After torpedo recovery, the transponder is removed from the torpedo and cleaned. The battery is removed and discarded.

The following sections describe each step of the cycle.

3.1. Opening The Transponder & Changing The Battery

CAUTION!

Changing the batteries or configuring the transponder requires opening the housing. 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 the transponder. Always work at a clean, static free work station when opening the transponder. Pay close attention to detail and double-check all your work.

Follow this procedure to open the transponder and change the battery.

1. The TLT transponders are opened by removing the back plate. Unscrew the four back plate screws using an Allen wrench. Lift the back plate off the using by inserting two of the screws into the lift screw holes. Carefully remove the back plate.

2. A two pin connector connects the battery pack to the electronics module. Lift the black connector plug straight from its posts. Be careful not to bend the connector sideways, as this will fatigue and eventually break the gold posts. Discard the battery.

3. Install a new battery pack by placing it in the battery cavity. Slide the battery connector over the gold posts of connector P1 on the electronics module. Make sure to align the black connector wire with pin 1 of P1 which is indicated by a beveled corner in the silkscreen.

4. Dress the cable such that it does not get caught between the back plate and the housing.

5. Before closing the transponder, remove the O-ring from its groove in the back plate. Inspect the O-ring for damage. Replace the O-ring if any nicks, cuts or abrasions are present. Wipe the O-ring, the O-ring groove and the O-ring seating area on the housing free of any debris. Apply a thin film of silicone grease to the O-ring and re-install it.

6. Reassemble the transponder by placing the back plate on the housing, making sure of proper alignment. Using a pin or a small jewelers screwdriver, apply a small amount of silicone grease to each screw. The grease will reduce corrosion. Then, insert and tighten the screws.

CAUTION!

Each battery pack should only be used for one torpedo run. Only by using a new battery pack can the minimum transponder run time be guaranteed. Be aware that battery power is consumed as soon as a new battery is inserted: the transponder is always on. Always install the battery just before getting ready for a new torpedo run.

CAUTION!

Always remove the battery pack as soon as possible after the recovery of a torpedo. Always store the transponder without the battery installed.

3.2 Configuring The Transponder

The transponders can be configured for many different missions. For example, a transponder may be configured to switch to pinger mode for 30 seconds each ten minutes in order to help far-away searchers (in excess of the transponder range) get a fix on the transponder.

The transponders can be configured either by setting the four DIP switches on the inside of the unit or by downloading configuration parameters using the MicroTerm™ download utility.

3.2.1. Transponder Configuration By Switch Setting

Basic transponder modes of operation can be activated by setting the four DIP switches on the inside of the transponder. This method of configuration is fast and does not require the use of a computer. However, only a limited number of operating modes are available.

Follow this procedure to configure a transponder using the DIP switches.

- Open the transponder housing (see section 3.1.).
- Make sure a fresh battery pack is installed in the transponder (see section 3.1.).
- Remove the jumper from location P4 in order to de-activate the transponder.
- Set the four DIP switches to the desired setting, using a jewelers screwdriver.
- Insert jumper P4 in order to activate the transponder.
- The transponder will now conduct a self-test. Watch the LED.
- The LED will blink the READY signal for one minute if the transponder is operating properly.
- Close the transponder housing.

The configuration switches are marked 1, 2, 3 and 4. Slide the white lever of a switch in the direction of the arrow to set that switch to the ON position. Sliding the lever in the opposite direction sets the switch to the OFF position. The following table lists the switch functions.

Switch	Function				
1	Transponder Interrogate Frequency: OFF: 16 kHz ON: 17 kHz				
2, 3, 4	Transponder Mode Of Operation:				
	S2	S3	S4	Description	Battery Life
	OFF	OFF	OFF	Pinger: One Ping Every 5 Seconds	20 days
	OFF	OFF	ON	Pinger: One Ping Every 15 Seconds	45 days
	OFF	ON	OFF	Transponder: One Ping Per Interrogate	107 days
	OFF	ON	ON	Transponder: Ten Pings Per Interrogate	107 days
	ON	OFF	OFF	Switcher: 15 Sec. Pinging Every 2 Min.	26 days
	ON	OFF	ON	Switcher: 30 Sec. Pinging Every 15 Min.	58 days
	ON	ON	OFF	Not Used	
	ON	ON	ON	Use Serial Configuration Data	

notes:
- Transponder reply interval (multiple reply operation) is one second.
- Transponder battery life estimates allow for 25000 transponder replies.
- Pinging interval in switching mode is one second.
- Battery life numbers are estimates only.

Figure 5: The Configuration Switch Functions

3.2.2. Transponder Configuration By Serial Download

To access advanced transponder functions which exceed the scope of the configuration switches, a configuration file must be created (or edited) and downloaded using a PC running Windows 95, Windows 98 or Windows NT and the MicroTerm™ utility.

When using serial configuration, the transponder 'life' is divided into three phases. The configuration file specifies the conditions for switching from one life phase to the next and the transponder mode of operation during each life phase.

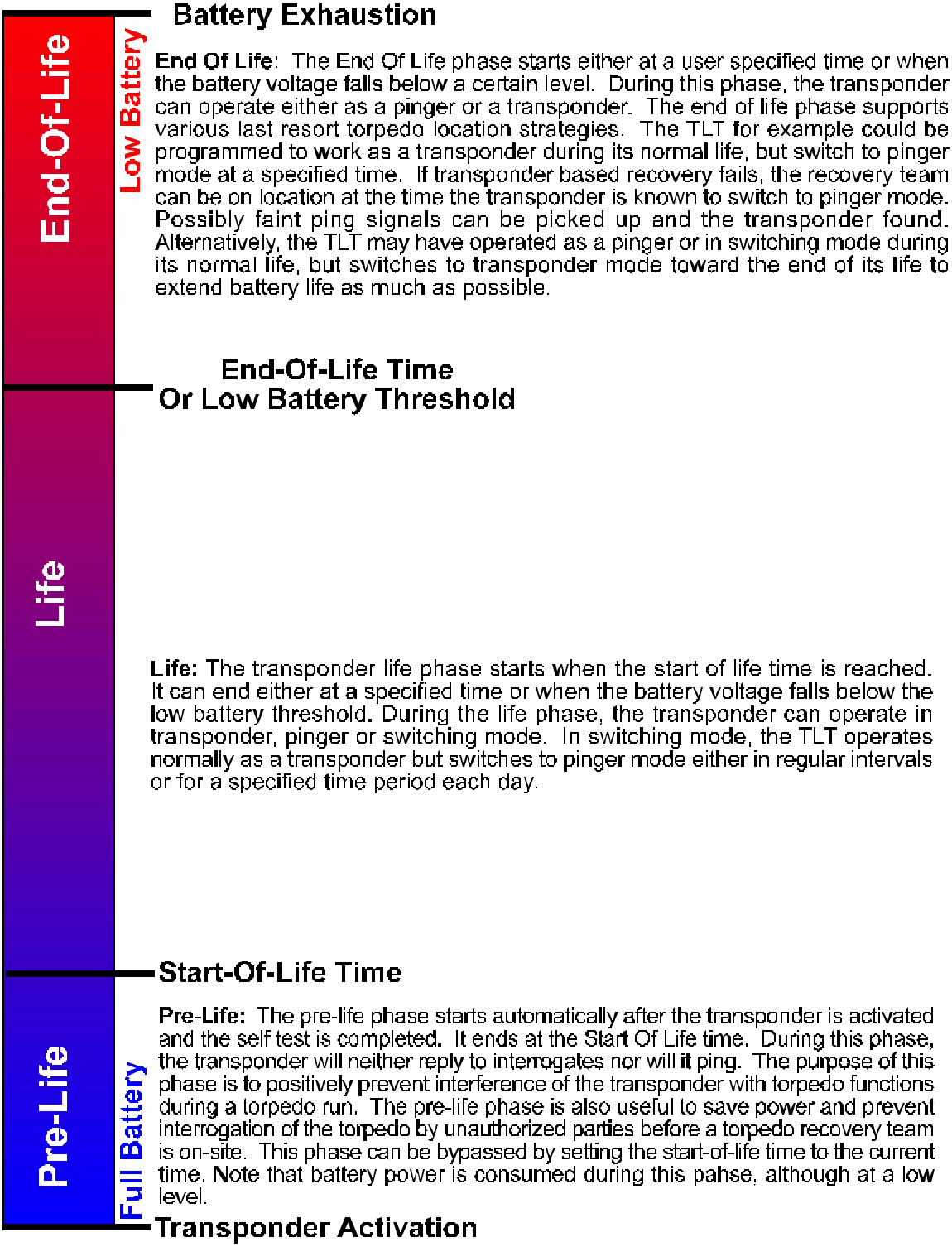

Figure 6: Transponder Life Is Divided Into Three Phases

3.2.2.1. Creating Or Editing A Configuration File

Configuration files are created or edited using a PC running Windows 95, Windows 98 or Windows NT and the MicroTerm™ utility. The MicroTerm™ welcome screen appears after clicking on the MicroTerm™ Icon.

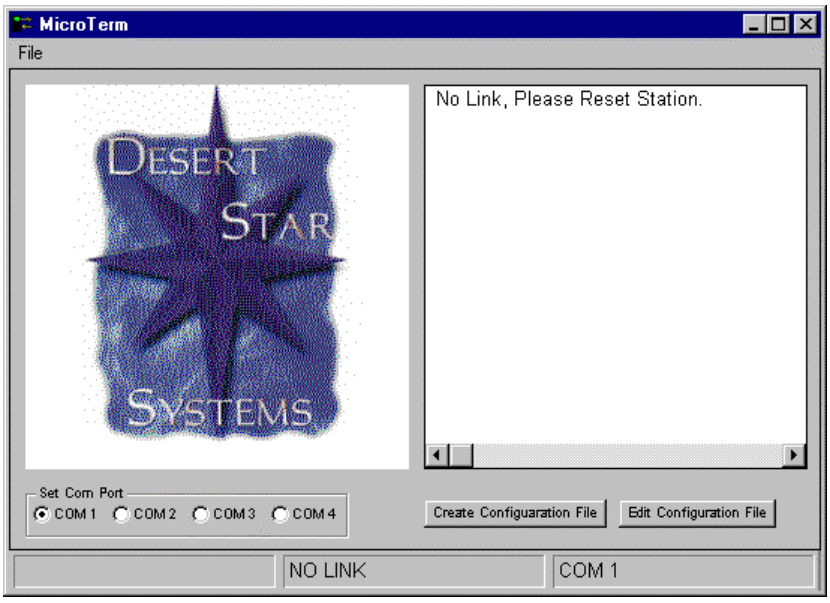

Figure 7: The MicroTerm™ Main Screen

Click on the ***Create Configuration File*** button to start the file creation process. If you wish to modify an existing file, click on ***Edit Configuration File*** and select the file. Configure the transponder by completing the data fields in the three configuration screens. The first screen is shown here. The content of the last two configuration screens depends on your selections in the first and second screen.

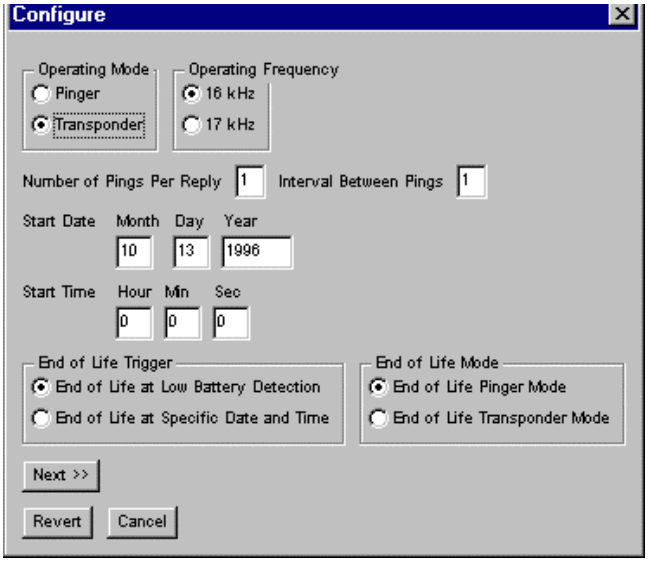

Figure 8: Three Configuration Screens Define Transponder Behavior

Data Field & (Screen)	Applicable Modes	Description
Operating Mode (Configure)	All modes	The primary mode of operation during the life phase can be ***Transponder*** or ***Pinger***.
Operating Frequency (Configure)	Transponder mode	Select ***16 kHz*** or ***17 kHz*** as the transponder interrogate frequency. When locating two torpedoes, each can be identified by its own interrogate frequency. The transponder reply frequency and the pinger frequency is always 23 kHz.
Number Of Pings Per Reply (Configure)	Transponder mode	When operating in transponder mode, this field specifies the number of pings the transponder will issue for each interrogate. A 'normal' transponder will reply only once per interrogate. A single reply is best for obtaining frequent position fixes. However, if sonar conditions are bad or when operating at the edge of the transponder range, the transponder may frequently not receive the interrogates. In this case it can be of advantage for the transponder to reply several times to an interrogate - giving the searcher a better chance to pick up the reply.
Interval Between Pings (Configure)	All modes	This field controls the pinger rate as well as the spacing between reply pings in transponder mode. A slow ping rate provides infrequent position updates but conserves power. A fast pinger may be easier to find, but it also exhausts the battery faster.
Start Date & Start Time (Configure Screen)	All modes	Specify the start date and time of the ***mid-life phase*** here. The current date and time will show up by default. Leave that field unchanged if you do not wish to have an ***initial-life phase***.
End-Of-Life Trigger (Configure)	All modes	The end-of-life phase can start either at a ***specific date and time*** or when the ***low battery detection*** condition appears (about 25% battery power remaining). Select a time trigger and a date and time far in the future if you do not wish to have an end-of-life phase.
End-Of-Life Mode (Configure)	All modes	The TLT can operate as either a ***transponder*** or a ***pinger*** during the end-of-life phase. It cannot operate in switching mode.
Switching Mode (Configure-2)	Transponder mode	This field is only available if the operating mode is as a transponder. It applies only to the mid-life phase. Specify here if you wish to periodically switch to pinger mode: • Select ***No Mode Switching*** if you do not want to switch to pinger mode. • Select ***Switch At Two Specific Times*** if you want to switch to pinger mode for a specific time period of each day. • Select ***Switch After Set Duration*** if you want to switch to pinger mode in regular intervals.
Max. Sensitivity (Configure-2)	Transponder mode	Specify the maximum sensitivity of the transponder's receiver here. Numbers from ***85 dB*** (greatest sensitivity) to ***127 dB*** (least sensitivity) can be selected. Specifying

		a high sensitivity (small number) here will make the transponder more susceptible to noise but will also increase the maximum range that it will hear an interrogation pulse in quiet waters. A low sensitivity (high number) reduces battery power consumption, noise susceptibility and transponder range. Note that the Automatic Gain Control (AGC) will automatically reduce transponder sensitivity in noisy waters if enabled. However, a very high sensitivity will result in greater battery power consumption as the AGC at times tries the most sensitive setting. The transponder will wake up and start processing only to find that a noise event occurred.
AGC On (Configure-2)	Transponder mode	When this box is checked, the automatic gain control is on. AGC should be on during most operations. However, an experienced user may decide to operate the transponder at a certain fixed sensitivity. When AGC is off, the maximum sensitivity field specifies the transponder sensitivity.
End-Of-Life Interval Between Pings		Specify the time between pings during the end of life phase here. If the end of life mode is transponder with multiple replies, this field indicates the time between the transponder replies. A slow pinger may in some missions a good end of life mode.
End-Of-Life Date & End-Of-Life Time		Specify the end of life phase start date and time here if a end of life time trigger is specified.
Use Low Sensitivity At End Of Life		When this box is checked and the end of life mode is transponder, the transponder max. sensitivity during the end of life phase is reduced by 6 dB. This reduces the transponder receive range by about 50%, but also can extend battery life.
Start Ping Mode At & End Ping Mode At		If Switch At Two Specific Times is selected as the switch mode, these fields define the start and end time of pinger mode each day. The start time can be later than the end time, if pinger mode through 0000h is required.
Switch Every X Minutes And Ping For Y Minutes		If Switch After Set Duration is selected as the switch mode, these fields define the length of an interval and the time that the TLT will operate in pinger mode during each interval. Note that pinger mode occurs at the beginning of each interval and that the first interval starts at the beginning of the life phase. Thus, if pinging for five minutes starting at the top of every hour is desired, simply select a start of life time at the top of an hour in the future, a switch interval of 60 minutes and a ping interval of five minutes.

Figure 9: The Configuration Screen Data Fields

3.2.2.2. Downloading A Configuration File

The MicroTerm™ utility is used to download configuration files to the transponder. Follow this procedure:

- Open the transponder (see section 3.1).
- Make sure a fresh battery is installed (see section 3.1.).
- Set all four DIP switches to the ON position. This enables serial download.
- Connect the data exchange cable to P2. Align the black wire with Pin 1. Pin 1 is indicated by a beveled corner on the silkscreen. Connect the other end of the cable to a COM port of your PC.
- Click on the MicroTerm™ Icon on your PC screen to start MicroTerm™. Select the COM port that you are using.
- Reset the transponder by removing and installing P4.
- MicroTerm™ will detect the transponder and a Terminal Window will appear. If this does not happen, check the serial cable connection and verify the COM port setting on the MicroTerm™ screen. RESET the transponder once more by removing and re-installing P4.
- Select ***Configuration Station*** from the ***Command*** menu of the Terminal Window and choose the desired configuration file from the file browser.
- Press the ***Download!*** button on the Download Window.
- The download process now proceeds. After the file download is completed, the transponder will conduct a self test which lasts about one minute (see section 3.3.). If the test succeeds, transponder operation will start immediately afterwards.

Note that configuration files can be downloaded to a transponder independent of the switch setting. However, the configuration parameters will only be used if all four switches are in the ON position.

Beware Of Memory And Time Loss!
The clock and calendar of the transponder is set automatically to the time of the host PC whenever a configuration file is downloaded. The time information and configuration data however is only maintained as long as a battery is connected. Battery disconnects of up to ten minutes are acceptable, as the memory is backed up by a gold capacitor. However, make sure that the transponder passes the self-test once a new battery is connected.

3.3. Transponder Activation And Self Test

The TLT transponders are activated by connecting a battery and inserting a jumper at location P4. Following activation, the transponder will initialize, conduct a self-test and proceed with normal operation. During the self test, the transponder will check its sonar receiver and transmitter, the real time clock, the configuration data and general transponder operation. It will then conduct a one minute transmit endurance test to both check the health of the battery and any stress susceptibility of the transmitter. The self test results are indicated by the status LED.

Following a successful self test, the transponder will start operation. During the first minute of operation, the transponder will remain active. If serial configuration is used, the transponder will assume the ***life phase*** during this first minute. The LED indicates operational status. After the minute has passed, the LED will switch off to conserve power and regular operation will begin.

Watch The Status LED!
The transponder assembler should carefully watch the status LED throughout the self-test and the initial one minute startup period. After the self test is completed, the Transponder Ready pattern should be seen (one brief blink per second). If any other pattern appears instead, do not close the transponder until the problem is fixed.

Status LED Blink Pattern	Description
Three short blinks followed by pause	Transponder self test in progress - please wait

Two long blinks followed by pause	Self test failed: Bad clock and/or configuration data. Reconfigure the transponder and try again.
Three long blinks followed by pause	Self test failed: Faulty electronics module. The transponder electronics module must be replaced.
One short blink followed by pause	Transponder ready. The transponder can be closed and mounted in the torpedo.
Two short blinks followed by pause	Interrogate received. This pattern indicates that a sonar interrogate has been received. It is useful to test the transponder reply capability. If this pattern appears without an interrogate taking place, there may be a problem with the transponder receiver. Do not use the transponder until investigated!
Continuous short blinks	The transponder battery is not fresh. This pattern appears when the battery has less than about 75% capacity. Change the battery.

Figure 10: Transponder Status LED Blink Patterns

Always Activate The Transponder Immediately Before A Mission!
Battery power is consumed as soon as the transponder is activated. Depending on configuration, the transponder batteries may last anywhere from five to 100 days. Always activate and mount the transponder immediately before a mission.

3.5. Mounting The Transponder

Following a successful self test, the transponder is ready to be re-assembled and mounted in the torpedo. Follow the instructions in sections 3.1. to close the transponder.

To mount the transponder in the torpedo, first clean the O-ring groove on the outside of the transponder. Clean the O-ring itself and apply a thin film of silicone grease. Mount the O-ring in the groove.

Place the transponder in the appropriate mounting hole of the torpedo, making sure of proper alignment.

- MK46: Mount the TLT-46 transponder in the scuttling valve port of the exercise section (near the lead weights).
- MK48 ADCAP: Mount the TLT-48 transponder in the hand-hole port.
- MK50: Mount the TLT-50 transponder in the side tracking pinger port.

Secure the transponder using the four mounting screws. The following table summarizes mounting information.

Torpedo	MK46	MK48 ADCAP	MK50
Transponder	TLT-46	TLT-48	TLT-50
Mounting Location	Scuttling Valve Port Of Exercise Section	Hand Hole Cover	Side Tracking Pinger Port
Mounting Screws	4 ea. Socket head cap screws, MS16997-19	4 ea. Socket head cap screws, MS16998-28	4 ea. Socket head cap screws, MS16996-10

	(6-32 UNC-3A x .375”)	or NAS 1351-3-1OP (10-32 UNF-3Ax.625”)	(10-32 UNF-3Ax.5”)
Mounting Torque	10 +/- 1 in-lbs.	18 in-lbs.	25 +/- 5 in-lbs.
Mounting O-Ring	MS28775-145	MS28775-154	MS28775-241

Figure 11: Transponder Mounting Information

3.6. Storing And Maintaining The Transponder

Empty alkaline batteries will often leak. For this reason, the transponder should be removed from the torpedo as soon as possible after a mission.

Rinse the transponder thoroughly with fresh water and wipe it dry or allow it to dry. Then, open it and remove and discard the battery pack (see section 3.1.). Always store the transponder with the back cover in place to prevent corrosion of the electronics module in humid conditions.

Remove the battery from the transponder (see section 3.1.), close the transponder and store it until the next mission.

4. Transponder Specifications

The TLT-46, TLT-48 and TLT-50 transponders vary only in size, shape and weight from each other. The remaining specifications apply to all three transponders.

Size (TLT-46):	5.96” L x 3.375” D at widest points
Size (TLT-48):	2.276” L x 4.996” D at widest points
Size (TLT-50):	2.80” L x 5.140” D at widest points
Weight (TLT-46):	TBD including battery pack
Weight (TLT-48):	TBD including battery pack
Weight (TLT-50):	1160 g (41 oz) including battery pack
Depth Rating:	2000 meters (3000 psig)
Operating temperature:	0-70 degrees Celsius
Storage Temperature:	-20 to 70 degrees Celsius
Configuration:	Through four internal DIP switches or serial data download
Status Indicator:	Status LED
Microprocessor:	MC68HC708XL36
Memory:	1 Kbyte of SRAM 36 Kbyte EPROM (Code Storage)
Clock:	Real Time Clock & Calendar
Sonar Receiver:	Tuned RF receiver with smart automatic gain control Single Channel, operating at 34 kHz (other frequencies available on request) RX sensitivity <= 90 dB re. 1 µPa
Sonar Transmitter:	Microprocessor controlled multi-channel transmitter with switch mode amplifier Source level >= 180 dB re. 1 µPa @ 1 meter for >= 160 degrees cumulative in the XY and XZ planes
Power Consumption:	0.35 mA in sleep mode 2 mA in active processing mode 7000 mA during transmit pulses
Battery:	Battery pack consisting of six ‘AAA’ alkaline cells
Operating Life:	5 days to 100 days, depending on configuration
Operation Modes:	Transponder, Pinger or Switching Mode
Interrogate Freq.:	16 kHz or 17 kHz +/- 100 Hz, User Configurable
Reply & Ping Freq.:	23 kHz +/- 3 Hz
Shock:	Withstands 3 Half-sine shocks on each axis in accordance with MIL-STD-202, method 213 using this schedule: 500g for 0.5 milliseconds and 150g for 8 milliseconds
Vibration:	Meets the standards of MIL-STD-202, method 204