USER GUIDE

Trimble® TDL 450L Radio

Version 1.00
Revision A
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Trimble

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Legal notices

Release notice

This is the September 2009 release (Revision A) of the *Trimble TDL 450L Radio User Guide*. It applies to version 1.00 of the Trimble TDL 450 radio.

One-year limited warranty

This warranty gives you specific legal rights. You may also have other rights which vary from state to state or area to area.

Trimble Navigation Limited warrants TDL family products, inclusive of cables and batteries, against defects in materials and workmanship for a period of one year from receipt by the end-user.

Exclusions

Should Trimble Navigation Limited be unable to repair or replace the product within a reasonable amount of time, a refund of the purchase price may be given upon return of the product.

The warranty on your TDL 450L radio shall not apply to defects resulting from:

- Improper or inadequate maintenance by the customer
- Unauthorized modification, negligence or misuse
- Operation outside of the environment specifications

Warranty limitations

This warranty set forth above is exclusive and no other warranty, whether written or oral, is expressed or implied. Trimble Navigation Limited specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Notices

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Canada

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Europe

This product has been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 1999/5/EC on R&TTE, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment, and to ensure that the equipment is safe

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications and Media Authority (ACMA) EMC framework, thus satisfying the requirements for C-Tick Marking and sale within Australia and New Zealand.

Notice to Our European Union Customers

For product recycling instructions and more information, please go to www.trimble.com/ev.shtml.

Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:
Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

Safety Information

This manual describes the Trimble® TDL 450 radio. Before you use your radio, make sure that you have read and understood this publication, as well as all safety requirements.

CAUTION – A license is required before operating radio communication equipment.

Warnings and Cautions

An absence of specific alerts does not mean that there are no safety risks involved.

Always follow the instructions that accompany a Warning or Caution. The information they provide is intended to minimize the risk of personal injury and/or damage to the equipment. In particular, observe safety instructions that are presented in the following formats:

WARNING – A Warning alerts you to a likely risk of serious injury to your person and/or damage to the equipment. A warning identifies the nature of the risk and the extent of possible injury and/or damage. It also describes how to protect yourself and/or the equipment from this risk. Warnings that appear in the text are repeated at the front of the manual.

CAUTION – A Caution alerts you to a possible risk of damage to the equipment and/or loss of data. A Caution describes how to protect the equipment and/or data from this risk.

Exposure to radio frequency radiation

The TDL 450L radio complies with the following national and international standards and guidelines regarding exposure of human beings to radio frequency electromagnetic energy, in addition to protection against harmful interference of neighboring electrical equipment:

- FCC Report and Order FCC 96-326 (August, 1996)
- American National Standards Institute (C95.3-1992)
- National Council on Radiation Protection and Measurement (NCRP - 1986)
- International Commission on Non-ionizing Radiation Protection (ICNRP - 1986)
- European Committee for Electrotechnical Standardization (CENELEC)
- FCC CFR47 Part 15
- FCC CFR47 Part 90
- Industry Canada RSS 119

- ETSI EN 300 113-2
- ETSI EN 300 489
- ACA AS/NZS 4295
- iDA Spec 111
- OFTA STD-1E
- SRRC CMII

Contact your sales representative for model-specific country approval.

To ensure optimal radio performance, and that exposure to RF energy is within the guidelines in the above standards, follow these operating procedures:

- Do not operate a transceiver when someone is within the distance shown below of the antenna (unity gain).
  - 120 cm (approximately 4 feet) for TDL 450L @ 4 W
  - 30 cm (approximately 12 inches) for TDL 450L @ 2 W
  - 15 cm (approximately 6 inches) for TDL 450L @ 0.5 W
- Do not operate the transceiver unless all RF connectors are secure and any open connectors are properly terminated.
- Avoid contact with the antenna while operating the transceiver.
- Do not operate the transceiver with a damaged antenna. If a damaged antenna comes in contact with the skin, a minor burn may result.
- Do not operate the equipment near electrical blasting caps or in an explosive atmosphere.

Compliance cautions

CAUTION – Always obey local licensing requirements and restrictions. It is illegal to transmit in the United States while Carrier Sense Multiple Access (CSMA) is turned off.

CAUTION – If you are in conflict with a co-channel user, select another frequency to avoid formal FCC actions. In most cases you are required to vacate a frequency if a shared channel voice user complains.

CAUTION – Failure to transmit your station identification is in violation of FCC regulations.

Rechargeable batteries

The TDL 450L radio uses a 12 V, 8 AHr, deep-discharge, lead-acid battery.

CAUTION – Storing batteries for an extended time in a discharged state damages them.

Note – For specific safety information, refer to the documentation included with your battery.

WARNING – Do not damage the battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage.
To prevent injury or damage:
– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.
To prevent injury or damage:
– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING – Charge and use the rechargeable battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.
To prevent injury or damage:
– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in Trimble equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

Other alerts

WARNING – Changes or modifications not expressly approved by the FCC could void the user's authority to operate the equipment.

WARNING – Operating or storing the radio outside the specified temperature range can damage it. For more information, see Specifications, page 15.

CAUTION – Radio communication equipment is susceptible to damage from shock or environmental extremes.

CAUTION – Never operate the radio outside the operating specifications shown in Specifications, page 15.

Contents

CHAPTER

1

Introduction

The *Trimble TDL 450L Radio User Guide* describes how to install, set up, and use the Trimble® TDL 450L radio with your survey system.

Trimble strongly recommends that you read this manual completely before you set up your system.

For information about Trimble and GPS, go to www.trimble.com.

Licensing requirements

It is the responsibility of the owner to comply with applicable rules and regulations concerning the operation of a radio transmitter. In the United States, the FCC regulates the licensing of this equipment.

To apply for a license, submit FCC Form 600, along with evidence of frequency coordination (if required) and applicable fees. Similar licensing requirements exist worldwide. Penalties for broadcasting without a license can be severe, and may include the confiscation of your radio.

For more information, contact our customer service department.

CAUTION – Always obey local licensing requirements and restrictions. It is illegal to transmit in the United States while Carrier Sense Multiple Access (CSMA) is turned off.

Equipment compliances

TDL 450L radios have been tested and found to comply with Parts 15 and 90 of Title 47 of the Code of Federal Regulations. The radios have also been tested and found compliant for type certification and approval in many other countries worldwide.

For more information about worldwide compliances, contact Trimble Support.

The Radio Frequency community

Operation of a licensed radio product makes you a member of the Radio Frequency (RF) community. Virtually all frequencies licensed are provided on a shared basis with other users. Each frequency dedicated specifically to RTK surveying activities has certain restrictions and limitations. For complete information, refer to Part 90, Title 47, of the Code of Federal Regulations.

Most frequencies sharing data transmissions and voice transmissions give priority to voice users. Be mindful of the persistent nature of a GPS RTK data transmission and always limit your RF transmission output power when performing close-in survey situations to avoid interference with co-channel users. Trimble recommends that you use the low RF power setting for construction site and other line-of-site surveys with baselines less than two miles (depending on terrain).

CAUTION – If you are in conflict with a co-channel user, select another frequency to avoid formal FCC actions. In most cases you are required to vacate a frequency if a shared channel voice user complains.

Most survey operations are itinerant—the system is moved on a frequent basis. For fixed system installations, do not use frequencies set aside for itinerant operations; coordinate a frequency based on the fixed area operation.

Regulations differ from country to country, so be aware of the local regulations before you use radio equipment.

Automatic station identification

For operation in the United States, the FCC requires that radio transmitters used for GPS RTK applications periodically broadcast a ***station identifier***—the call sign assigned to you on the station license.

The TDL 450L radio supports the broadcast of station identification in a manner that meets the requirements of the FCC. Upon receipt of equipment, use the configuration software to program your FCC call sign into your radio. This is required only for transmitters.

CAUTION – Failure to transmit your station identification is in violation of FCC regulations.

Carrier Sense Multiple Access

Carrier Sense Multiple Access (CSMA) is a technology implemented in TDL 450L base radios to meet the United States FCC transmitter requirements. It is illegal to transmit on any UHF radio within the United States without CSMA enabled. CSMA prevents radio transmission if the frequency is currently being used by a co-channel user, so you may occasionally notice that a radio broadcasts stop for short periods of time.

GPS RTK equipment functions with intermittent gaps in the data. Heavy co-channel use may limit the ability of the TDL 450L base radio to transmit the required information. In areas of heavy co-channel usage, try changing channels to a less used frequency.

Related information

An electronic copy of this manual is available in portable document format (PDF) on the receiver CD. Use Adobe Reader to view the contents of this file.

Other sources of related information are:

- Release notes – the release notes describe new features of the product, information not included in the manual, and any changes to the manual. They are provided as a PDF on the CD. Use Adobe Reader to view the contents of the release notes.
- Registration – register your receiver to automatically receive email notifications of receiver firmware upgrades and new functionality. To register, do one of the following:
  - Run the receiver CD.
  - Register electronically at www.trimble.com.
  - Print the registration form that is on the CD, fill it in, and fax or mail it to the address shown.

Contact your local Trimble Dealer for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.

- Trimble training courses – consider a training course to help you use your GPS system to its fullest potential. For more information, visit the Trimble website at www.trimble.com/training.html.

Technical assistance

If you have a problem and cannot find the information you need in the product documentation, *contact your local Dealer*. Alternatively, request technical support using the Trimble website at (www.trimble.com/support.html).

Your comments

Your feedback about the supporting documentation helps us to improve it with each revision. Email your comments to ReaderFeedback@trimble.com.

CHAPTER

2

Overview

The TDL 450L radio is an advanced, high speed, wireless data link that is designed specifically for GNSS/RTK applications.

The radio provides excellent value and performance. Trimble provides this equipment in complete turnkey systems that include everything necessary for operation with your GPS system.

You may have purchased your TDL 450L radio from a third party. On occasion, the bundled product provided by these sources may differ from the kits provided directly from Trimble. If this guide does not accurately reflect the equipment that you received, please contact your supplier for specific instructions concerning the setup of items that differ.

Features

Compatibility

GNSS equipment mix and match:

- Interoperable with Pacific Crest RFM and PDL, SATEL, and Trimble radio products
- All models support 12.5 kHz and 25 kHz channel bandwidth communications
- 40 MHz-wide channel tables (390-430 MHz and 430-470 MHz models)
- An upgrade path for existing installations

Enhanced user interface

Backlit LCD display and five-button navigation interface:

- View and change radio channel, modulation and protocol types
- Monitor signal levels, baud rates, and other parameters

See also User Interface, page 34.

Fast over-the-air data rate

19,200 bits per second:

- Reduced latency provides better GPS position information
- Lower power consumption allows longer field operation

User-selectable RF output

Select between 0.1, 0.5, 1, 2, or 4 W:

- Increase range by switching to 2 or 4 W (where permitted)
- Increase battery life by reducing output power when you do not need the range

Rugged construction

Designed specifically for real-world working environments:

- All metal construction and shock-mounted electronics ensure highest reliability and EMI-resistance
- Watertight, corrosion-resistant connectors stand up to bad weather conditions

Casing

The TDL Sentry casing is tough, impact-resistant, aluminum. It is protected with a chemical- and scratch-resistant polyurethane coating.

Elastomer end caps provide the first level of shock protection for the internal components.

An internal isolation system reduces the effects of vibration on the radio receiver board.

Software compatibility

Current versions of the following software were tested and verified for compatibility with Windows® XP and the Microsoft® Business Edition of the Windows Vista® operating systems:

- TDLCONF
- PCC Range Estimator

Specifications

Commutation and interface

Communication	1 RS-232 port, 115.2 kbps maximum
User interface	2-row, 16-character LCD display with 5 navigation buttons

Power

External	9.0 – 30.0 VDC, 2 Amp maximum
During RX	0.6 W nominal @ 12.0 VDC
During TX	7 W nominal @ 12.0 VDC, 1 W RF output 13.4 W nominal @ 12.0 VDC, 4 W RF output

Modem

Link rate/modulation	19,200 bps/4FSK 9600 bps/4FSK 19,200 bps/GMSK 16,000 bps/GMSK 9600 bps/GMSK 8000 bps/GMSK 4800 bps/GMSK
Link protocols	Transparent EOT/EOC, Packet-switched, TRIMTALK™, TRIMMARK™, TT450S (HW), SATEL
Forward error correction	Yes

Radio

Frequency bands	390-430 MHz 430-470 MHz
Frequency control	Synthesized 12.5 kHz tuning resolution Frequency stability +/- 1 PPM
RF transmitter output	Programmable to 0.1 – 4 W (where permitted)
Sensitivity	-110 dBm BER 10-5
Type certification	All models are type accepted and certified for operation in the U.S., Europe, Australia, New Zealand, Russia, and Canada

Environmental

Enclosure	IP67 (Dustproof and watertight to depth of 1 meter for 30 minutes)
Operating temperature (receiver)	-40 °C to +85 °C (-40 °F to +185 °F)
Operating temperature (transmitter)	-40 °C to +65 °C (-40 °F to +149 °F)
Storage temperature (receiver/transmitter)	-55 °C to +85 °C (-67 °F to +185 °F)
Vibration	MIL-STD-810F

Mechanical

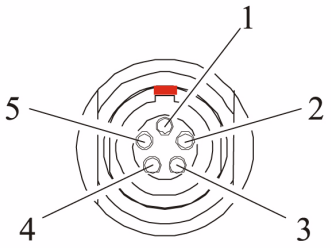
Dimensions	8.89 cm L x 4.6 cm W x 16.0 cm H (3.5” L x 1.809” W x 6.3” H)
Weight	690 grams (1.52 lbs.)
Data/power connector	5-pin, #1-shell LEMO
RF connector	50 Ohm, TNC-female

Pin-outs and connectors

The TDL 450L data receptacle is an 0-shell, 5-pin circular connector. For a mating plug, Trimble recommends LEMO P/N FGG.1B.305.CLAD.72Z.

For pin assignments and orientation, see below.

The following figure shows a rear view of the data/power connector (looking from behind the connector).



Pin number	Description
1	Power: 9-30 VDC Input
2	Ground for Power
3	RX (DTE)
4	Signal Ground
5	TX (DTE)

User interface

The TDL 450L user interface includes three LEDs, an On/Off button, a two-row LCD screen, four scrolling buttons marked with arrows, and a central **Enter** button.

LCD screen

The LCD screen has a backlight that stays on for 20 seconds. The backlight must be on for the **Enter** or arrow buttons to function. If the backlight is off, press any button to turn it on. To set the backlight to stay on, refer to the *TDLCONF Software User Guide*.

The top LCD row shows the name of the currently-selected radio configuration function.

The bottom LCD row shows the parameters you can select for the displayed function.

- Press the left or right arrows to scroll through the functions.
- Press the up or down arrows to scroll through options for the displayed function.

Functions

The following functions are available. The default parameters, where applicable, are in **bold**.

Function	Description	Parameter choices
Device Status	Displays radio status and identification information	Battery status
		Frequency of selected channel
		Serial number
		Owner name
		Call sign
		Modulation type
		Channel bandwidth
		Transmitter status
		Firmware version
Channel / Freq	Displays/selects channel number & receive frequency	**Channel 01 and frequency (MHz)**
		Channel 02 and frequency (MHz)
		Channel 03 and frequency (MHz)
		Etc.
Ch TX Freq	Displays TX frequency (if different from the channel's RX frequency)	Channel No. & frequency (MHz)
Data Protocol	Displays/selects data protocol type	**Trans EOT (End of Transmission)**
		Trans EOC (End of Character)
		Packet Switched
		TRIMTALK 450S
		TRIMMARK II/IIE
		TT450S (HW)
		TRIMMARK 3
		SATEL
Radio Link Rate	Displays/selects bit rate for radio transmission/reception	4800
		8000
		9600
		16000
		19200
Repeater Mode	Sets the radio to be a repeater (non-Trimble protocols)	**Not a repeater**
		Is a repeater

Function	Description	Parameter choices
Operation Mode	Sets the radio to be a repeater (Trimble protocols)	**Base/Rover**
		Base + 1 Repeater
		Base + 2 Repeaters
		Repeater 1
		Repeater 2
Sensitivity	Displays/selects radio squelch level	**Low (Base)**
		Moderate
		High (Rover)
Transmit Power	Displays/selects transmitter power level	**100 mW**
		500 mW
		1 W (where permitted)
		2 W (where permitted)
		4 W (where permitted)
RX LED Meaning	Displays/selects what it means when the RX LED flashes	**Signal Received**
		Data Received
CSMA	Displays/selects Carrier Sense Multiple Access setting	**On**
		Off
Serial Baud	Displays/selects serial baud rate of the radio's data port	2400
		4800
		9600
		19200
		38000
		115200
Signal Strength	Displays strength of the received signal (RSSI) in dBm	Press Enter
		Weak
		Moderate
		Strong
Error Code	Displays current error status	**No Error**
		01: Voltage High
		02: Voltage Low
		08: Temp High
		11: Memory Error
		15: Tx Frequency Not Locked
		16: Rx Frequency Not Locked

Radio settings

The TDL 450L LCD shows radio settings that are determined:

- In the factory: serial number, firmware version, transmitter status (enabled/disabled)
- By the radio: battery status, signal strength and error codes
- By your dealer: channel tables (including frequency and bandwidth) and maximum transmit power
- In the office: using the configuration software (everything else)

In addition, you can configure the following parameters in the field through the user interface:

- Channel number
- Data protocol
- Radio link rate
- Repeater Mode (called "Operation Mode" when using a Trimble protocol)
- Sensitivity
- Transmit power
- Meaning of RX LED flashing
- CSMA

CAUTION – It is illegal to transmit in the United States while CSMA is turned off.

- Serial baud

Field-configurable functions

For the field-configurable functions, the available choices appear on the bottom LCD row. The currently-selected parameter is marked with an asterisk. To select a different choice for the displayed function, use the arrows to scroll up or down and then press the Enter button when the required choice appears.

There are two ways to move to a different function screen:

- When viewing a display-only function such as Device Status or Signal Strength, press the left or right arrow.
- When viewing a display-and-select function such as Channel/Freq or Data Protocol, press the up or down arrows to view the currently-selected parameter in the second row. Then press the left or right arrow to move to a new function screen.

Note – *If the currently-selected parameter is not visible on the LCD, and the backlight is off (that is, you have not pressed a button for more than 20 seconds), you can press the left or right arrow once to scroll directly to the selected parameter. To move to a new function screen, press the left or right arrow again.*

To speed up field configuration and to prevent the selection of unsupported radio configurations, the TDL 450L user interface shows only function parameters that make sense based on the parameters chosen for previously-displayed functions. What you choose for the data protocol determines your options for radio link rate and repeater mode. For example, if your channel table is set to 12.5 kHz channel spacing, and you select *TT450S(HW)* on the *Data Protocol* screen, you cannot select a radio link rate (the *Radio Link Rate* screen does not appear) because the TT450S(HW) protocol works with 12.5 kHz channel spacing only at 4800 bps. And because TT450S(HW) is a Trimble protocol, Trimble-specific *Operation Modes* are available for selection. If you decide to undo any of these selections, press the left arrow to return to the *Data Protocol* screen and then select a different protocol.

Although the TDL 450L radio modem supports both GMSK and 4FSK modulation, you cannot select the modulation type through the user interface. The radio automatically selects the appropriate modulation based on the channel bandwidth of the radio channel table (shown on the *Device Status* screen as *BW: 12.5 or 25 kHz*), the data protocol, and the radio link rate. To select a modulation type first and then an appropriate channel bandwidth, protocol, and link rate, use the TDLCONF software to configure the radio.

Indicator LEDs

LED	Description
TX	Shows that the radio is broadcasting. In most GPS RTK applications, the TX LED flashes approximately once per second.
PWR	Shows the power status and a low external voltage supply indicator. When lit, power is turned on. The PWR LED blinks if the external voltage supply is nearing the minimum value. If the PWR LED does not respond to the On/Off button, inspect the level of the external voltage supply.
RX	Flashes to show that the radio is receiving signals from another radio or from a source of interference. The default is *Signal received*, but you can reset the radio so that when the RX LED flashes, it means *Data packets received*. Reset the meaning through the user interface or in the configuration software. During normal operation, the RX LED flashes once per second rate to show reception of transmissions from the transmitting radio. If the RX LED is on continuously, a source of interference may be affecting the radio's ability to receive data. To reduce or eliminate the interference, reposition the antenna or change to another channel at both the transmitter and receiver.

Antenna

The TDL 450L antenna connector is a TNC female. For a mating plug, Trimble recommends Amphenol-brand connectors. Use only high-quality 50 impedance cable for the antenna connection.

Most TDL 450L antennas use industry-standard NMO connectors. The impedance of all TDL 450L antennas is 50 Ω .

Connector Manufacturer Contacts:

- LEMO - http://www.lemo.com
- Amphenol - http://www.amphenol.com

Antenna mount

The integrated antenna mount provides an industry-standard TNC-female RF connector that is compatible with a wide range of mobile whip antennas.

Batteries

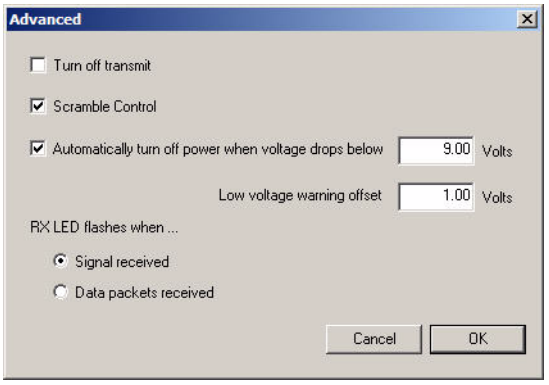
WARNING – Read the battery safety instructions in the Safety chapter, page 5.

Battery care

The TDL 450L battery/charger kit (P/N 64450-14) includes a 12 V, 8 AHr, deep-discharge, lead-acid battery that provides all-day operation for the radio, and may be recharged approximately 300 times over a period of 3 years.

If you use your own battery, select a deep-discharge battery with a minimum capacity of 8 AHr. If necessary, you can use an automotive battery but it will be damaged by repetitive discharge/charge cycles; Trimble does not recommend this practice.

By default, the battery status appears on the bottom row of the *Device Status* screen. This appears as Normal until the battery voltage falls below the level that you set in the configuration software:



You can change the value in one or both of these fields:

- *Automatically turn off power when voltage drops below*: To protect the battery, the radio automatically shuts down when the input voltage from the battery drops below the level set in this field. The default value is 9.00 V.
- *Low voltage warning offset*: Contains a value that is higher than the value in the *Automatically turn off power when voltage drops below* field. The default value is 1.00 V. When the battery voltage falls below this level, the radio battery status level appears as Low.

For example, to make the radio show the Low warning when input voltage falls to 11 V, change the *Low voltage warning offset* value to **2 V** (above 9 V).

Note – *A copy of the TDLCONF User Guide is included on the installation CD; you can also download a free copy from www.trimble.co.*

Charging the battery

CAUTION – Storing batteries for an extended time in a discharged state damages them.

The charger supplied with the TDL 450L Battery/Charger kit (P/N 64450-14) provides two-stage charging. The first stage quickly charges the battery to capacity; the second stage trickle-charges the battery to maintain a full charge.

To ensure good battery life and performance, recharge the battery after every full day of operation, and for 24 hours every 3 months during periods of non-use.

To recharge a user-supplied battery, select a charger of an appropriate type.

Caring for the equipment

Routine care prolongs the life and reliability of your TDL 450L radio.

CAUTION – Radio communication equipment is susceptible to damage from shock or environmental extremes.

CAUTION – Never operate the radio outside the operating specifications shown in Specifications, page 15.

CHAPTER

3

Setup and Operation

In this chapter:

This chapter explains how to set up and operate the TDL450L radio.

The TDL 450L radio accessory kit

The kit contains the following items:

- A/C power supply
- Wall plug with adaptor set
- Programming cable
- *TDL 450L CD* containing:
  - *TDL 450L Radio User Guide* (this document)
  - *TDLCONF Software User Guide*
  - TDLCONF Software
  - PCC Range Estimator

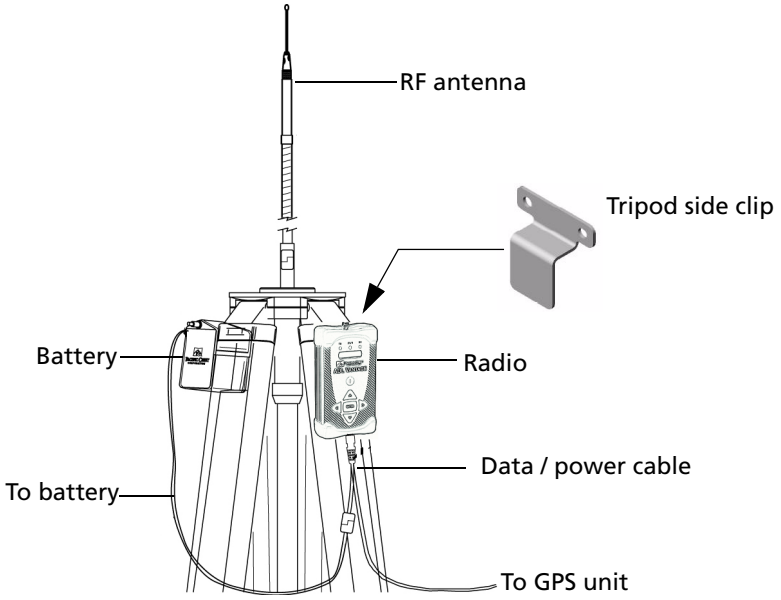
To configure the radio with TDLCONF software, see Chapter 4, Configuration Software.

Operating the radio in the field

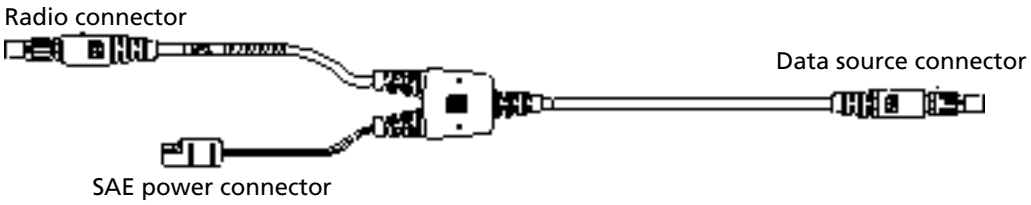
To operate the radio in the field, you need an antenna, a portable power supply, and a cable to connect to a data source such as a GNSS receiver. Trimble and its authorized dealers can provide everything you need including a tripod accessory kit and a battery/charger kit. For more information, see Chapter 5, Operations.

Setting up the radio for use in the field

1. Before you connect any cables, screw the radio tripod clip (P/N F01003) onto the back of the radio and then insert the clip into the slot on the tripod.



2. Use a data/power cable to connect the TDL 450L radio to a data source, such as a GNSS receiver. This cable is available with different connectors for attaching to a large variety of data sources. Contact your Trimble sales representative for help to select the best cable for your needs.



Note – *Each TDL 450L data/power cable also connects the radio (and in some cases the data source) to external power through an SAE-type connector. Trimble strongly recommends that you use the TDL external battery (P/N 51866-00), which includes an SAE connector. This is sold separately and as part of the Battery/Charger Kit (P/N 64450-14).*

3. To mount the antenna, do one of the following:

   – If the antenna has a male TNC connector, you can attach it directly to the RF connector on the top of the TDL 450L radio.

   – However, Trimble strongly recommends that you elevate your RF antenna as much as possible. The most common set up is similar to the following:

   a. Attach an antenna cable with a male TNC connector to the TDL 450L radio.

   b. Attach the other end of the cable to a tripod or elevated section of range pole.

   c. Attach the RF antenna to the end of the cable.

Note – *Trimble offers an antenna cable that attaches to standard 5/8-inch threaded tripods and range poles, and antennas with NMO connectors.*

   d. To ensure good system performance, make sure that the antenna center push-pin makes good contact with the antenna mount.

CAUTION – Transmitting without an antenna does not damage the radio but it is not recommended. Use a gained antenna to raise the radio Effective Isotropic Radiated Power (EIRP): Make sure that the resulting EIRP does not exceed your licensed limit.

Placing the antenna

Antenna placement is critical for good performance. Range and coverage is directly proportional to the height of the transmitting and receiving antennas, in addition to antenna gain. Where possible, select a reference station location that takes advantage of terrain to get the transmitting antenna as high as possible.

Always use the telescoping antenna mast and raise the antenna as high as is practical and safe, given terrain and wind conditions.

Do not use a gained antenna if doing so increases the radio EIRP beyond the limit of your license.

Line loss

Line loss, produced by RF or antenna cables that connect the radio and antenna, decreases the output power (Wattage) transmitted by the antenna, thereby decreasing the signal range. To minimize line loss, check the loss-per-length of the cable you use.

For every 3 dB of line loss, the output power decreases by half. For example, with 35 W radio and a line loss of 3 dB in the cable, the output power is be 17.5 W. Every 6 dB of loss reduce the effective radio range by 50%.

Turning on the radio

Apply power to the radio through one of the following:

- The programming cable (attached to A/C power supply)
- The data/power cable (attached to the battery)

Once it detects power on its data connector, the radio turns on automatically and shows the radio modem firmware version and the owner's name. The radio is ready for communication within five seconds.

If the A/C power supply is interrupted, the radio automatically turns on and resumes transmitting data within five seconds of power restoration.

Turning off the radio

Do one of the following:

- Disconnect the power cable.
- Press the On/Off button for three seconds.

Error codes

The TDL 450L radio performs several power-up and run-time tests to ensure optimal operation. Tests include environmental and electrical measurements designed to prevent damage to the radio while maintaining adequate operation.

In the event of an error condition, an error code appears on the LCD screen and the PWR LED flashes the number of the error code (for example, two flashes for Error Code 02, followed by a pause and then two more flashes). Possible error conditions and their required actions are as follows:

Code	Description	Actions
01	Input voltage is too high	• Check the battery or power supply voltage level. • Check power cables. • Recharge or replace the battery. • Check the charger.
02	Input voltage is too low	
08	Internal temperature exceeds limit for operation	• Place the radio in the shade. • Check the antenna and antenna cables for damage or disconnection. • Set the radio link rate to 19200 to reduce the duty cycle. • Select a lower RF power.
E11	Memory error	• Contact customer service. • If the radios shows Code 15, turn off the radio as it may be transmitting at an unprogrammed frequency for which you are not licensed.
E15	Transmit Frequency Lock error	
E16	Receive Frequency Lock error	

If the radio continues to show the error code after you take the suggested action:

Press and hold the On/Off button for 3 seconds to turn off the radio.

Wait one minute.

Press the On/Off button to turn on the radio.

If the error warning persists, contact a Trimble authorized dealer or Trimble Support.

CHAPTER

4

Configuration Software

In this chapter:

This chapter introduces the TDLCONF configuration software.

For full details, refer to the *Trimble TDLCONF Software User Guide*.

TDLCONF configuration software

TDLCONF is a suite of software utilities for configuring and troubleshooting the Trimble line of digital communication radios and modems.

Use a serial cable to attach a computer to the radio and then run the software to check the status of the radio, input receive-only channel tables, and set radio parameters such as channel bandwidth and output power. Channel tables for transmitting data must be obtained from authorized Trimble dealers. If your radio did not have a channel table pre-installed, you can obtain one from your dealer and import it using the configuration software.

TDLCONF software is available on the *TDL 450L CD*. The latest version is available for free download from www.trimble.com.

To access the *TDLCONF Software User Guide*, run the software and then select *Help* / *User Guide*. The User Guide describes how to configure the TDL 450L radio. The User Guide is also available from the Trimble website.

Configuring the radio

Connect the programming cable to:

- the power supply
- the TDL 450L radio
- the computer

Turn on the radio.

Launch the software.

4. For instructions on how to connect the software to the radio, refer to the *TDLCONF Software User Guide*.

Factory default settings

Use the configuration software to return the TDL 450L radio to its factory default configuration:

1. Click **Restore Factory**.

   Click **Program**.

The factory default settings are as follows:

Setting	Value
Radio Link Rate	9600
Modulation type	GMSK
Sensitivity	Low (Base)
Transmit Power	100 mW

Setting	Value
Scramble Control	On
CSMA	On
Forward Error Correction	Yes
Transmit Retries	10
TX ACK Timeout	10
Modem Address	0
Destination Address	255
RX Delay	0
TX Delay	2
RX LED Meaning	Signal received
Call Sign	“OFF”
Owner	“OWNER”
Low Voltage Turn Warning	10 V
Low Voltage Turn Off	9 V
Turn Off LCD Backlight	No
Turn Off LCD Delay	After 20 seconds
Serial interface	
PC Baud Rate	38400
Parity	None
Soft Break Disabled	Yes
Protocol Mode	Transparent with EOT Timeout
EOT Timeout	50
EOT Character	No default
Security Code	00000000