DigiTrak® LT™

Directional Drilling Locating System

Operator's Manual

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Patents

The DigiTrak® LT™ Locating System is covered by one or more of the following U.S. Patents: 5,337,002; 5,633,589; 5,764,062; 5,767,678; 5,878,824; 5,926,025; 5,933,008; 5,990,682; 6,002,258; 6,005,532; 6,008,651; 6,014,026; 6,035,951; 6,057,687; 6,160,401; 6,232,780; 6,396,275; 6,525,538; 6,559,646; 6,593,745; 6,693,429; 6,756,784; 6,838,881; 6,838,882; 6,924,645; 7,167,005. Sale of a DigiTrak® LT™ receiver does not convey a license under any patents covering the DigiTrak® transmitter or underground drill housing. Other patents pending.

Limited Warranty

All products manufactured and sold by Digital Control Incorporated (DCI) are subject to the terms of a Limited Warranty. A copy of the Limited Warranty is included with your DigiTrak® LT™ Locating System; it can also be obtained by contacting DCI Customer Service, 800-288-3610 or 425-251-0559, or by connecting to DCI's web site, **www.digitrak.com**.

Important Notice

All statements, technical information, and recommendations related to the products of DCI are based on information believed to be reliable, but the accuracy or completeness thereof is not warranted. Before utilizing any DCI product, the user should determine the suitability of the product for its intended use. All statements herein refer to DCI products as delivered by DCI and do not apply to any user customizations not authorized by DCI nor to any third-party products. Nothing herein shall constitute any warranty by DCI nor will anything herein be deemed to modify the terms of DCI's existing limited warranty applicable to all DCI products.

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the Rules of the Federal Communications Commission. These limits are designed to provide reasonable protection against harmful interference in a horizontal directional drilling 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 communications or inaccurate readings on your DCI locating equipment. 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 DigiTrak® LT™ Receiver.
- Increase the separation between the problematic equipment and the DigiTrak® LT™ Receiver.
- Connect the equipment into an outlet on a different circuit.
- Consult the dealer for help.

Changes or modifications to the DCI equipment not expressly approved and carried out by DCI will void the user's limited warranty and the FCC's authorization to operate the equipment.

Table of Contents

Table of Contents (Continued)

Safety Precautions and Warnings

IMPORTANT NOTE: All operators must read and understand the precautions and warnings given below before using the DigiTrak® LT™ Locating System.

☠ Serious injury and death can result if underground drilling equipment makes contact with an underground utility, such as a high-voltage electrical cable or a natural gas line.

❖ Substantial property damage and liability can result if underground drilling equipment makes contact with an underground utility such as a telephone, cable TV, fiber-optic, water, or sewer line.

🕓 Work slowdown and cost overruns can occur if drilling operators do not use the drilling or locating equipment correctly to obtain proper performance.

- Directional drilling operators MUST at all times:
  - Understand the safe and proper operation of drilling and locating equipment, including the use of ground mats and proper grounding procedures.
  - Ensure that all underground utilities have been located, exposed, and marked accurately prior to drilling.
  - Wear protective safety clothing such as dielectric boots, gloves, hard-hats, high-visibility vests, and safety glasses.
  - Locate and track the drill head accurately and correctly during drilling.
  - Comply with state and local governmental regulations (e.g., OSHA).
  - Follow all other safety procedures.

- The LT System cannot be used to locate utilities.

- Continued exposure to heat, due to frictional heating of the drill head can cause inaccurate information to be displayed and may permanently damage the transmitter. For more information see "Transmitter Temperature" in the *Transmitter* section.

💣 The LT equipment is not explosion-proof and should never be used near flammable or explosive substances.

Safety Precautions and Warnings (Continued)

- Prior to the start of each drilling run, test the LT system with the transmitter inside the drill head to confirm that it is operating properly and check that it is providing accurate drill head location and heading information (see *Receiver* section) and accurate drill head depth, pitch, and roll information.

- During drilling, the depth will not be accurate unless:
  - The receiver has been properly calibrated and the calibration has been checked for accuracy so that the receiver shows the correct depth.
  - The drill head has been located correctly and accurately and the receiver is directly above the transmitter in the tool underground.
  - The receiver is kept level.

- Always test calibration after you have stopped drilling for any length of time.

- Interference can cause inaccuracies in the measurement of depth and the loss of the transmitter pitch, roll, or heading. You should always perform an electrical interference check prior to drilling.
  - Sources of interference include but are not limited to traffic signal loops, invisible dog fences, cable TV, power lines, fiber-trace lines, metal structures, cathodic protection, telephone lines, cell phones, transmission towers, conductive earth, salt water, rebar, radio frequencies, and other unknown sources of interference.
  - Interference with the operation of the remote display may also occur from other sources operating nearby on the same frequency, such as car rental agencies using their remote check-in modules, other directional drilling locating equipment, etc.

- Background noise must be minimal and signal strength must be at least 150 points *above* the background noise during all locating operations.

- Carefully review this manual to ensure you know how to operate the LT system properly to obtain accurate depth, pitch, roll, and locate points. If you have any questions about the operation of the system, please call DCI's Customer Service Department at 425-251-0559 or 800-288-3610 between the hours of 6:00 a.m. and 6:00 p.m. Pacific Time, Monday through Friday, and we will do our best to assist you.

REMEMBER: If you are having difficulty on the job or if you have any questions about the operation of the LT system, call DCI's Customer Service Department at 425-251-0559 or 800-288-3610 between 6 a.m. and 6 p.m. Pacific Time, Monday through Friday, for assistance.

Introduction

DigiTrak LT Locating System

The DigiTrak LT Locating System is used to locate and track the drill head during horizontal directional drilling (HDD) operations. The system consists of a handheld receiver, a transmitter, which is placed in the drill head, and a remote display. The receiver and remote are powered by a NiCad battery pack, and a battery charger is also included with the system.

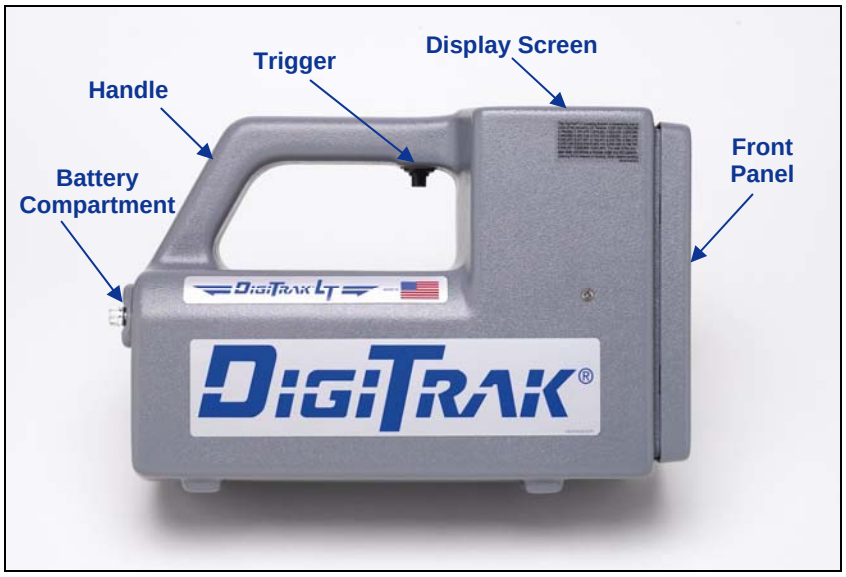
Locating is streamlined using the LT receiver's graphic display and menu system. The real-time graphic display guides you in positioning a target (or a line) in a box on the display window to locate the transmitter in the drill head. You can also locate using the plus/minus signs, as on earlier DigiTrak models produced by Digital Control Incorporated (DCI).

This manual provides information on each LT system component—the receiver, transmitter, remote display, and battery charger—in separate sections following this introduction. These sections are followed by the *Locating Instructions* section, which explains important locating terms and gives step-by-step locating instructions.

If you have any questions about the information in this manual or about the use of the LT system, please call DCI's Customer Service Department at 800-288-3610 or 425-251-0559.

Notes

Receiver



DigiTrak LT Receiver (side view)

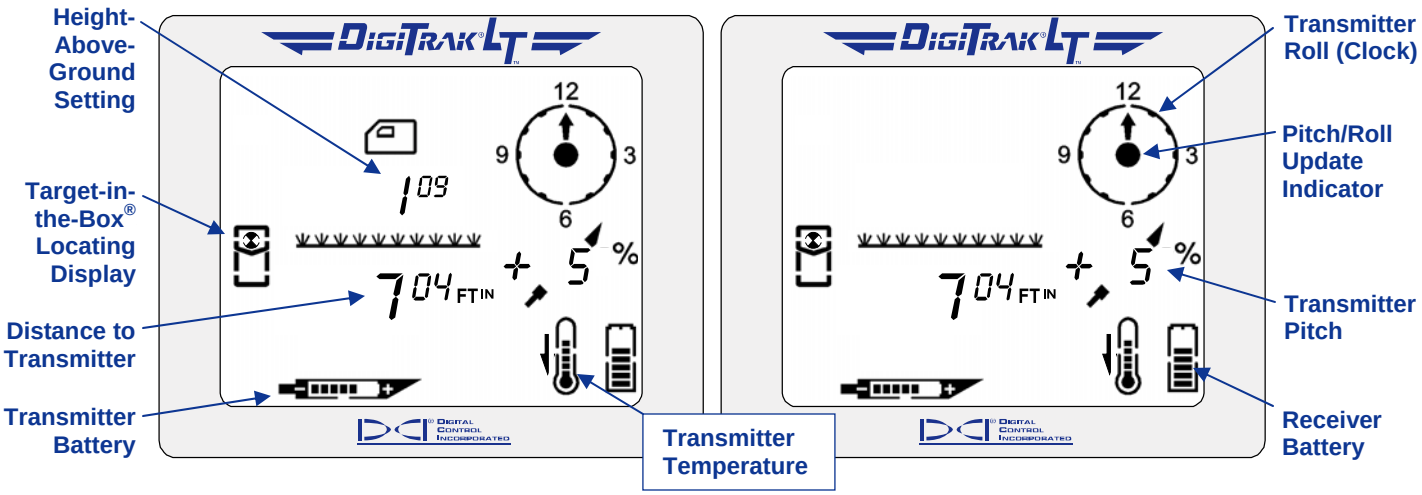
The LT receiver is a hand-held unit used for locating and tracking an LT transmitter emitting a signal at 12 kHz. The receiver converts signals from the transmitter and displays the following information: depth, pitch, roll, and temperature of the transmitter, and battery status of both the transmitter and the receiver. The LT receiver also sends signals to the LT remote display at the drill rig.

The LT system can be used to take depth readings without setting the receiver on the ground. The height-above-ground function allows you to program a comfortable height for holding the receiver for depth readings (see discussion under “Receiver Display Menus” later in this section). Using the height-above-ground feature also allows greater separation, which can decrease the effects of interference.

DigiTrak LT Receiver (top view)

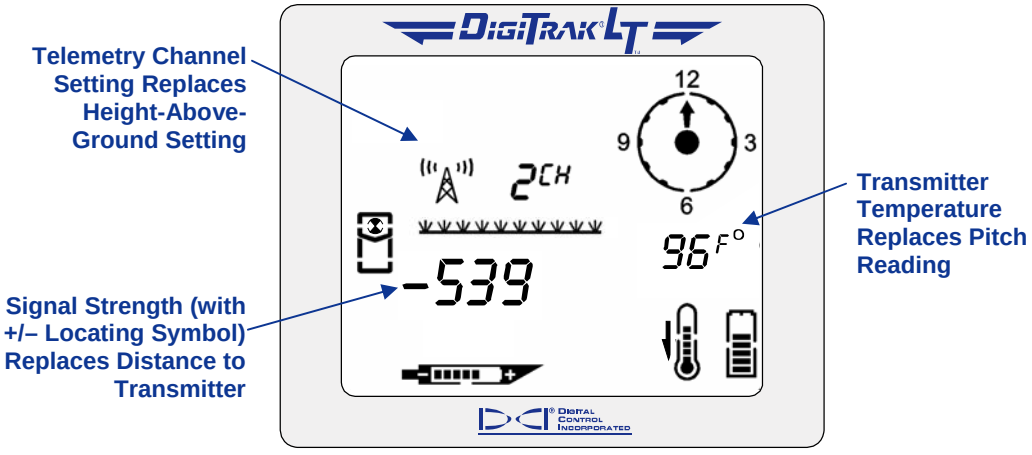
Main Display Screen

When the LT receiver is on, the display screen usually shows the standard locating mode display (see figure below), which is the default display. The display symbols that appear on the locating screen are identified in the figure below and described in the “Standard Display Screen Symbols” table on the next page. Note that the height-above-ground setting will only appear if the height-above-ground function is enabled.



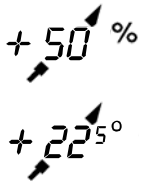
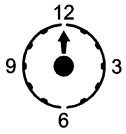
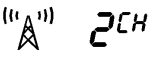
Standard Locating Mode Display with Height-Above-Ground Function Enabled (Left) and Without (Right)

When the operator holds in the trigger, the display changes to show the telemetry channel setting, signal strength, and transmitter temperature (see figure below and table on next page).



Standard Locating Mode Display with Trigger In

Standard Display Screen Symbols

	**Height-Above-Ground Icon** – Appears when the height-above-ground function is on and shows the current height setting.
	**Locating Icon** – Represents a bird's-eye view of the receiver. This icon is referred to as the "box" when using the *target-in-the-box* and *line-in-the-box* locating techniques.
	**Target** – Represents the front and rear locate points (FLP and RLP). When the receiver is positioned directly above a locate point, the target will be in the box.
	Line – Represents locate line (LL). When the receiver is positioned directly above the LL, the line will be in the box. The LL also allows for off-track locating when access over the drill head is limited.
	**Transmitter Battery –** Depicts the battery status of the transmitter.
	**Transmitter Temperature** – Shows temperature status of transmitter. An arrow appears next to the thermometer pointing either up to indicate increasing temperature, or down to indicate decreasing temperature. The three curved lines extending from the top of the thermometer appear if the transmitter has reached a dangerous temperature of 111°F or 43°C and requires immediate attention. The thermometer will flash off and on at 118°F (48°C) to further indicate the need for immediate action to cool the thermometer. The actual temperature can be displayed in place of the pitch by holding the trigger in.
	**Receiver Battery** – Depicts the battery status of the receiver.
	**Transmitter Pitch** – Shows the inclination of the transmitter (drill head), displayed in either percent slope or degrees. The pitch value is shown with a drill head indicator behind it that points up for positive pitch and down for negative pitch. When using percent slope for pitch measurements, a value from 1 to 100 will appear; when using degrees, a value from 0 to 45 will appear, followed by a decimal point and a value of 0 or 5. Pitch measurements are given in 0.5-degree increments.
	**Pitch/Roll Update Indicator** - The dot in the center of the clock should blink 2 times per second, indicating that current pitch, roll, battery, and temperature information is being received from the transmitter.
	**Transmitter Roll** – The clock shows the 12 roll positions of the transmitter.
	**Telemetry Channel Setting** – Shows the current channel setting for the receiver. The receiver must be set to the same channel as the remote display. There are eight channel settings (1, 2, 3, 4, 5, 6, 7, 8) and an Off setting.
	**Plus/Minus Locating Indicator** – The plus or minus sign in front of the signal strength value can be used to guide the operator in finding the locate points (FLP and RLP) and the locate line (LL).
	**Signal Strength** – Displays the amount of signal from the transmitter when the trigger is held in. The signal strength scale ranges from 0 to 999, where 0 indicates no signal and 999 indicates signal saturation (receiver and transmitter are very close). When the trigger is not held in and the receiver is saturated (too close to transmitter), you will see four dashed lines (— — — —) where the distance/depth number should display.

Power On/Off

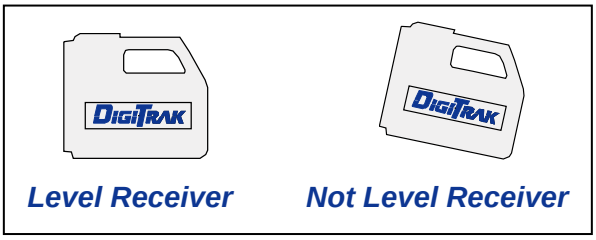
On – To turn the LT receiver on, pull and hold the trigger in for 2 seconds and release. You will briefly see a test screen, followed by a set of numbers that represent the firmware version in the receiver. Then you will go to the standard locating mode display screen.

Off – To turn the unit off, you must first access the menu choices (see "Receiver Display Menus"). Click the trigger until you reach the power on/off menu ⏻, then hold the trigger in during the countdown from 3 to 0 to shut the receiver off.

Note that when the receiver power is turned off, the height-above-ground function is also turned off. If you want to use the height-above-ground function, you must turn it on and reset (if needed) the value after you turn on the receiver.

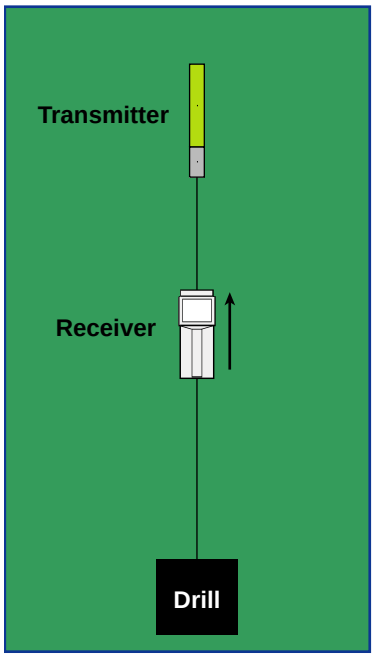
Proper Handling of Receiver

The receiver must always be held correctly to obtain accurate readings. You must hold the receiver **level at all times** and at a **constant height above the ground** (see "Height Above Ground" discussion later in this section).

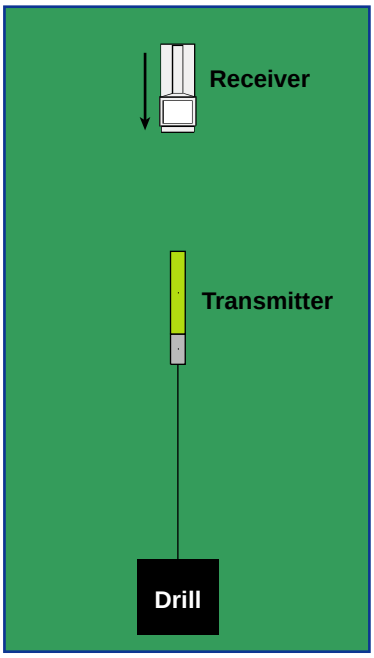


Level Receiver *Not Level Receiver*

You can hold the receiver so that it faces in the same direction as the transmitter (away from the drill) or in the opposite direction, facing toward the drill (see figures below). For an accurate depth reading, you must hold the receiver parallel to the transmitter and directly above it.



Receiver Facing Away from Drill



Receiver Facing Toward Drill

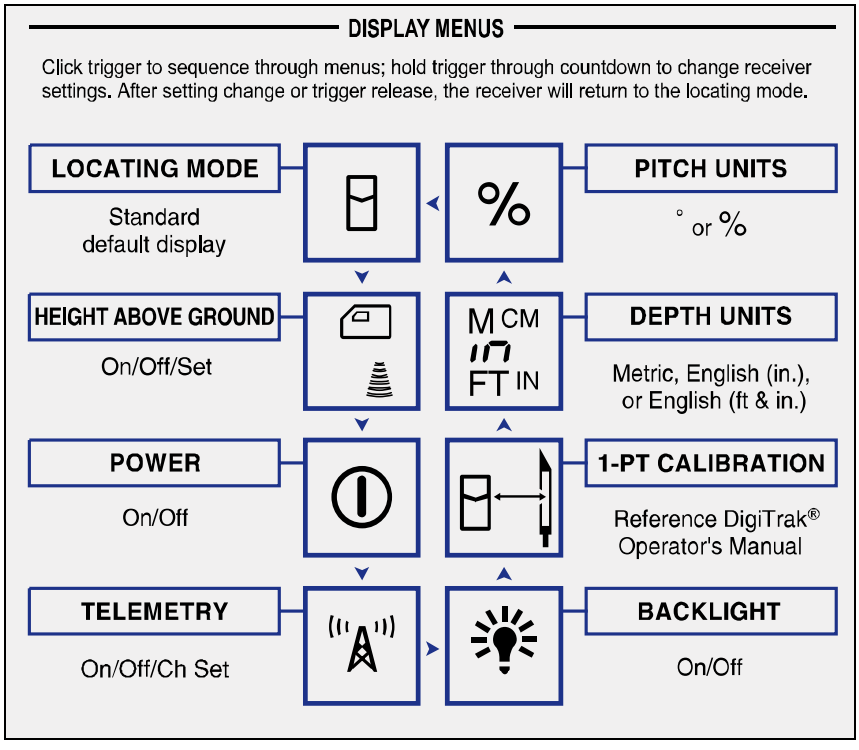
Accessing and Changing Menu Settings

To access the LT menu functions, you simply **click the trigger**. Each trigger click advances you to the next menu item. When you stop at a menu, you will see a number that indicates a countdown sequence. To change a menu setting, you **hold the trigger in** while the counter goes down to 0. Once the counter reaches 0, release the trigger and the menu setting will be changed, which is indicated by a checkmark at the bottom of the screen (✓). If the change was not successful, you will see a checkmark with a slash through it (✓̸). The display will then go back to the standard locating display screen.

When in the standard locating mode, you **hold the trigger in** to display the signal strength in place of the depth reading and the transmitter temperature in place of the pitch value. You will also see the telemetry channel setting in the location where the height-above-ground value is normally shown. When using the standard locating method, you leave the **trigger out** and move the receiver to position the target or line symbol in the box. You can use the standard method of finding the locate points and locate line to find the transmitter, or you can use the plus/minus ("+/–") locating method, which requires you to **hold the trigger in** to locate the transmitter (see *Locating Instructions* section).

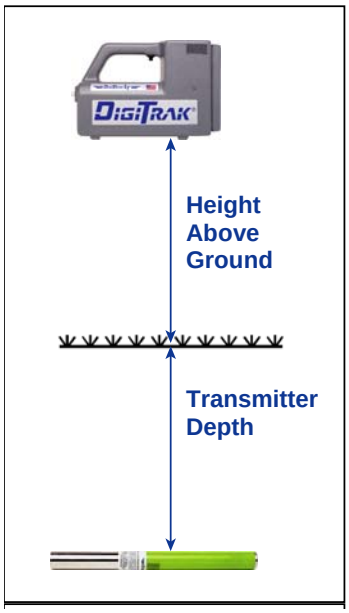
Receiver Display Menus

The front label on the LT receiver shows the display menus (see figure below). This section describes each menu function and gives instructions for how to change the menu settings. The menus are listed in the order that they appear on the front label of the receiver, starting with the height-above-ground menu. The locating mode is the standard default display that you will see when you turn on the receiver.



Receiver Display Menus as Shown on Front Label

HEIGHT ABOVE GROUND

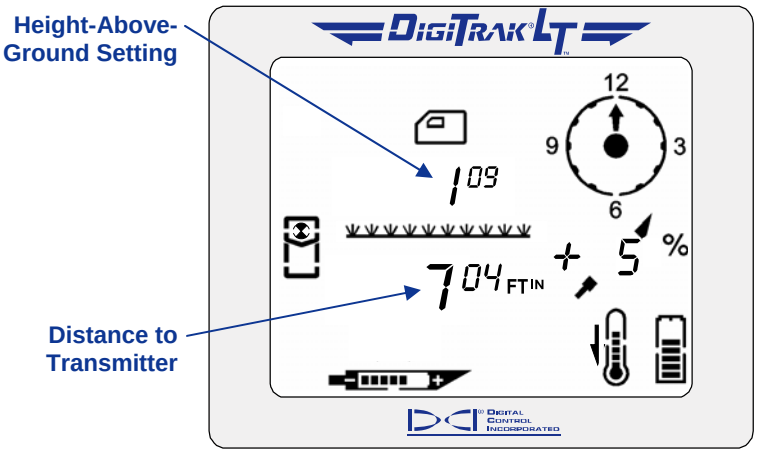


This display menu allows you to enter a height-above-ground measurement so that you can measure the transmitter depth without having to place the LT receiver on the ground. If the height-above-ground function is not on, then you must place the receiver on the ground to take depth measurements.

The height-above-ground value can be set from a distance of 1 ft (12 in. or 30 cm) up to a maximum value of 3 ft (36 in. or 90 cm), depending upon the depth units you selected (FT^{IN} for feet/inches; "in" for inches only; and M^{CM} for meters/centimeters—see discussion of depth units menu later in this section). You will see the default height-above-ground distances for the three depth options as 1^{00} for 1 ft 0 in.; "12 in" for 12 inches; or 0^{30} for 0 m 30 cm. When using the "Set" option described later in this section, the units of measure will increase by 1-in. increments if using English units and by 2-cm increments if using metric units.

The height-above-ground function can also be helpful when the depth of the tool is shallower than 28 in. (71 cm). If the receiver is placed on the ground in this situation, it will be saturated with signal and you will not see a depth number. Instead you will see four dashed lines (— — — —) where the distance/depth number should display.

When the height-above-ground function is enabled, you will see the height-above-ground value on your locating screen, as shown in the following figure. You must hold the receiver at this height to get accurate depth measurements.



Locating Mode Display with 1-ft 9-in. Height Above Ground

NOTE:	When you turn off the receiver, calibrate, or change the depth units, the height-above-ground function automatically turns off and the current height-above-ground setting is deleted.

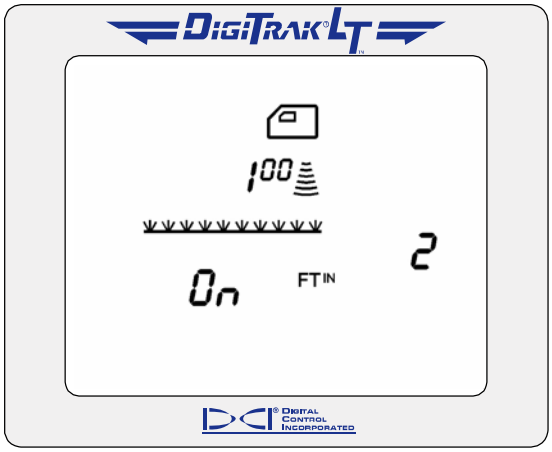
There are three options in the height-above-ground menu:

- "On" turns on the height-above-ground function and sets it to the last value that was used.
- "Off" turns off the height-above-ground function.
- "Set" allows you to set or change the height-above-ground value.

When you enter the height-above-ground menu, the "On" option is the first of the three settings for the height-above-ground function.

To turn on the height-above-ground function:

1. From the locating screen, click the trigger to advance to the height-above-ground menu. You will see the "On" option displayed as the first setting option. You will also see the last height-above-ground number that was entered. If you want that number to remain the same, follow these instructions to turn on the height-above-ground function. If you want to change this number, you must follow the instructions to set or change the height-above-ground value, described later in this section.

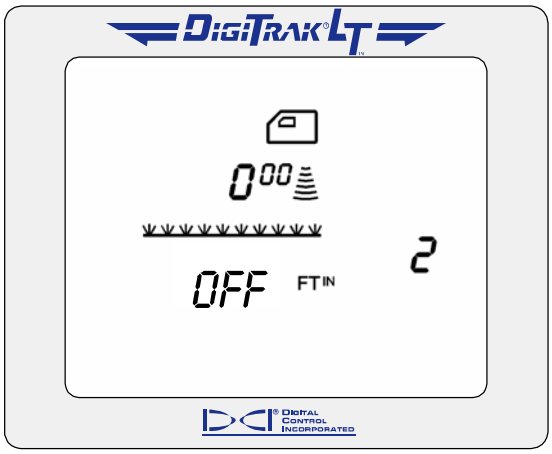


Height-Above-Ground "On" Screen

2. Hold the trigger in through the countdown sequence from 2 to 0.
3. Release the trigger when the 0 is displayed, and a checkmark will briefly appear at the bottom of the screen indicating this option has been selected. You have now turned on the height-above-ground function; note that this value is the number that was last programmed. If you want to change this number, see the instructions below "To set or change the height-above-ground measurement."
4. Release the trigger, and you will be returned to the locating screen.

To turn off the height-above-ground function:

1. From the locating screen, click the trigger to advance to the height-above-ground menu. You will see the "On" option displayed.
2. Continue to hold the trigger in through the countdown from 2 to 0, and you will then see the "Off" option displayed.

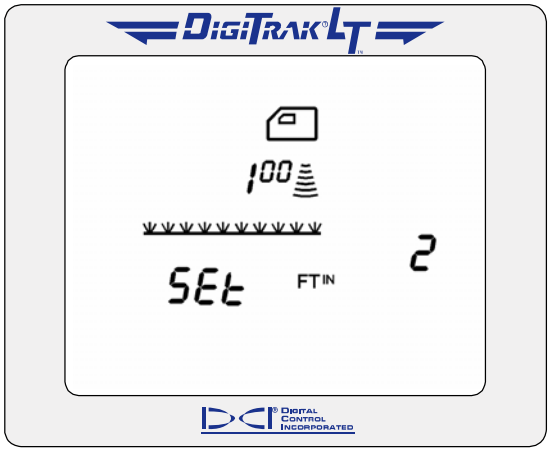


Height-Above-Ground "Off" Screen

3. Continue to hold the trigger in through the countdown sequence from 2 to 0.
4. Release the trigger when the 0 is displayed, and a checkmark will briefly appear at the bottom of the screen indicating this option has been selected. The height-above-ground function has now been turned off, and you will be returned to the locating screen. With the height-above-ground function off, you must place the receiver on the ground for accurate depth readings.

To set or change the height-above-ground measurement:

1. Hold the LT receiver at the height which you intend to hold the receiver.
2. Using a measuring tape, measure the distance from the bottom of the receiver to the ground. This is your desired height-above-ground measurement.
3. From the locating screen, click the trigger to advance to the height-above-ground menu. You will see the "On" option displayed.
4. Continue to hold the trigger in through the countdown from 2 to 0, and you will then see the "Off" option displayed.
5. Continue to hold the trigger in through the countdown sequence from 2 to 0, and you will see the "Set" option displayed.



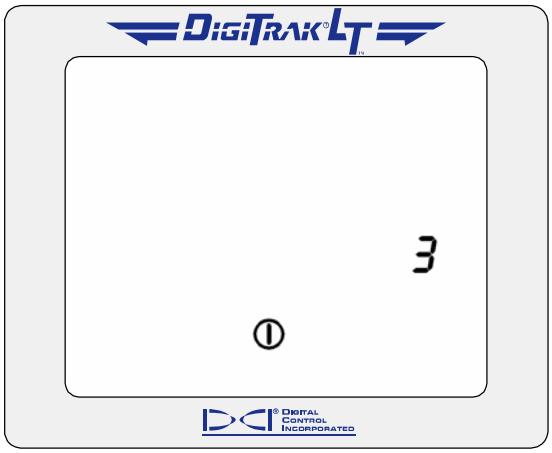
Height-Above-Ground "Set" Screen

6. Continue to hold the trigger in through the countdown sequence from 2 to 0.
7. Continue to hold the trigger in, and the height-above-ground measurement will display starting at 12 in. (30 cm) and then counting up in 1-inch (2-cm) increments.
8. Once you see the desired height, according to the measurement you made in step 2, release the trigger, and a checkmark will appear at the bottom of the screen indicating you have reset the height-above-ground value. You will then be returned to the locating screen.

POWER

This display menu allows you to turn off the receiver.

1. Click the trigger to advance to the power menu.
2. Hold the trigger in through the countdown sequence from 3 to 0.



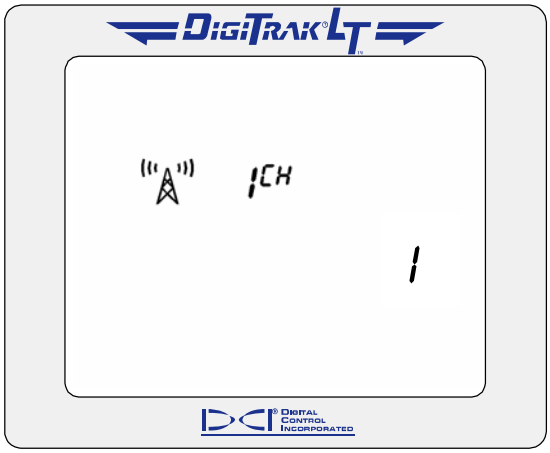
Power Off Screen

3. When the counter reaches 0, you will see a checkmark at the bottom of the display.
4. Release the trigger and the unit will shut off.

TELEMETRY

This display menu allows you to change the telemetry channel setting. This is the channel that the receiver uses to communicate with the remote display. The receiver and the remote display must be set to the same channel. There are eight different telemetry channels (1, 2, 3, 4, 5, 6, 7, 8).

1. Click the trigger to advance to the telemetry menu, where the current channel setting is displayed.
2. Hold the trigger in through the countdown sequence from 1 to 0.



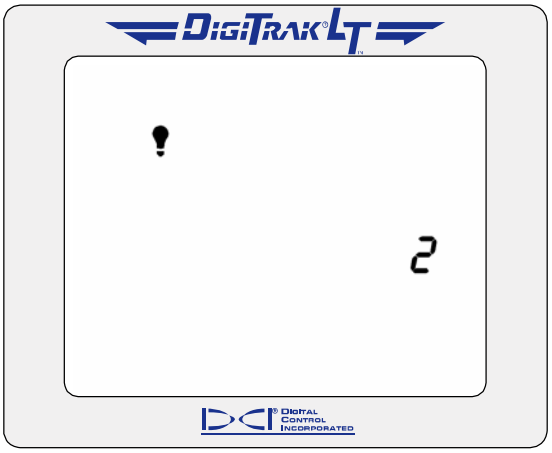
Telemetry Channel Setting

3. When the counter reaches 0, you will see a checkmark at the bottom of the display.
4. While still holding the trigger in, the channel settings will cycle through all nine settings—Off, 1, 2, 3, 4, 5, 6, 7, 8.
5. Release the trigger when the correct setting is displayed, and you will return to the locating mode display screen.

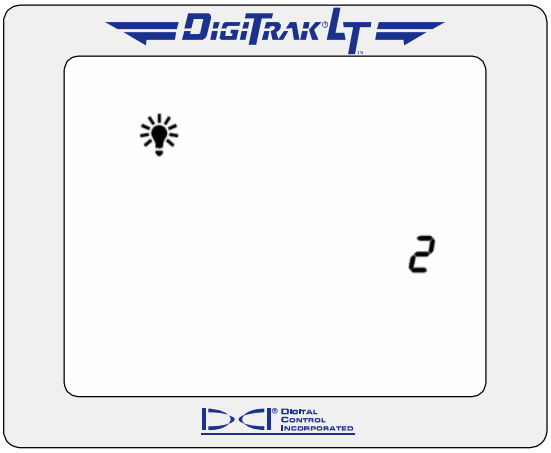
BACKLIGHT

This display menu allows you to turn on or off the display backlight.

1. Click the trigger to advance to the backlight menu; a light bulb will appear on the display. If the backlight is on, the bulb will be lit up; if it is off, the bulb will appear unlit.
2. Hold the trigger in through the countdown sequence from 2 to 0.



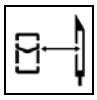
Backlight Is Turned Off



Backlight Is Turned On

3. When the counter reaches 0, the light bulb will either light up as the backlight comes on or it will become unlit and the backlight will turn off.
4. Release the trigger to return to the standard locating mode screen.

NOTE:	The backlight automatically comes on for a few seconds at startup, and then it defaults to the off setting, even if you have reset it previously.

1-PT CALIBRATION 

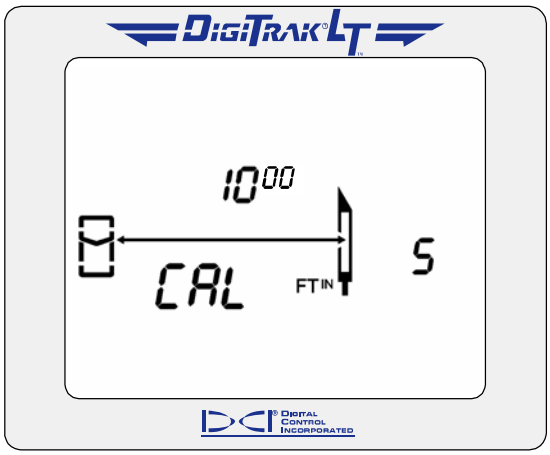
This display menu allows you to calibrate the receiver using the 1-point calibration procedure. The 1-point calibration procedure is performed with the transmitter in the housing, as described later in this section. DCI recommends that you verify that the receiver's depth readings are accurate at several locations using a tape measure before you drill. Calibration is necessary prior to first-time use and whenever a different transmitter, receiver, or housing is going to be used.

Do not calibrate if:

- You are within 10 ft (3 m) of metal structures, such as steel pipe, chain-link fence, metal siding, construction equipment, or automobiles.
- The receiver is over rebar or underground utilities.
- The receiver is in the vicinity of excessive electrical interference.
- The transmitter is not installed in the housing.
- The transmitter is not turned on.

NOTE:	Calibration is necessary prior to first-time use and whenever a different transmitter, receiver, or housing is going to be used.

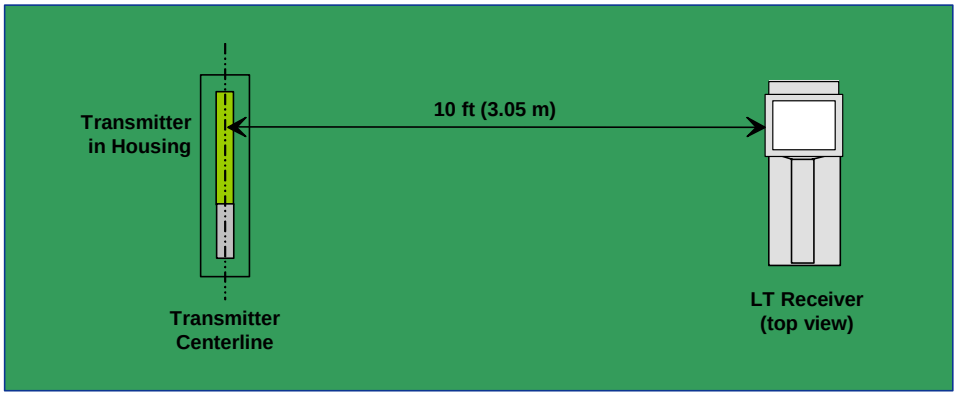
The 1-point calibration menu display appears as follows:



1-Point Calibration Screen

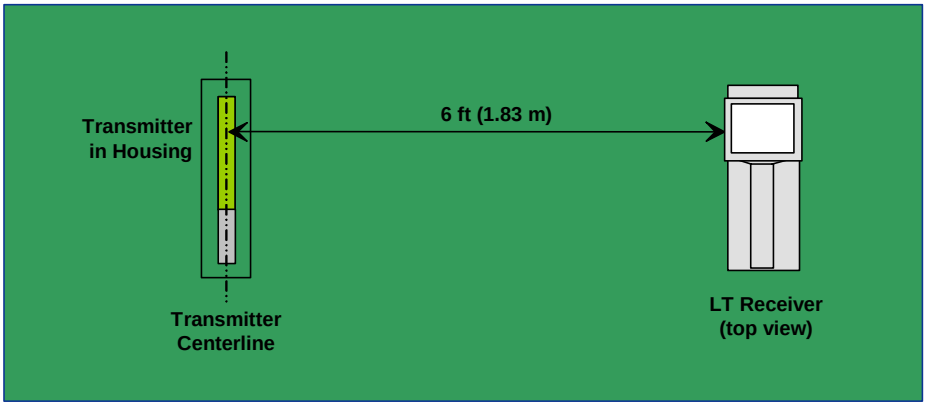
To calibrate the receiver:

1. Using a tape measure, place the receiver on the ground parallel to the transmitter (in housing) so that the distance from the centerline of the transmitter to the inside edge of the receiver is 10 ft (3.05 m), as shown in the figure given below.



Setup for 1-Point Calibration

2. Hold the trigger in on the receiver, and verify that roll and pitch readings are present and that the signal strength is stable. Then, click the trigger to advance to the 1-point calibration screen.
3. Hold the trigger in while holding the receiver steady through the countdown sequence from 5 to 0.
4. When the counter reaches 0, continue holding in the trigger until you see a checkmark at the bottom of the display indicating a successful calibration. If you see a checkmark with a slash, then the calibration has failed, and you must repeat steps 1 through 4.
5. After you have successfully calibrated the receiver, you will be returned to the standard locating mode screen. You must now verify the calibration by checking depth readings at three locations.
6. To verify calibration, place the receiver on the ground parallel to the transmitter so that the distance from the centerline of the transmitter to the inside edge of the receiver measures a given amount on the tape measure; in the example shown in the figure below, a distance of 6 ft (1.83 m) is used.



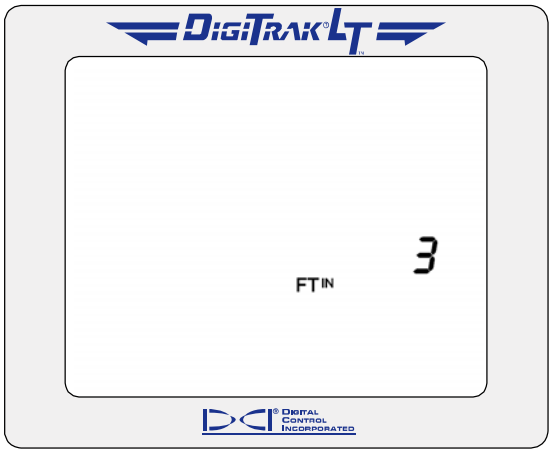
Verifying Calibration

7. You should see a depth reading that matches this measured distance, which in our example would be 6 ft (1.83 m).*
8. Repeat the above two steps in at least two more locations.

DEPTH UNITS

This display menu allows you to set the LT system to display values (depth and temperature) in either English units (FT^{IN} or “in” and °F) or metric units (M^{CM} and °C).

1. Click the trigger to advance to the depth units menu. The display will indicate the current setting.
2. Hold the trigger in through the countdown sequence from 3 to 0.



Depth Units Display Menu

3. When the counter reaches 0, you will see the unit setting change and a checkmark appear at the bottom of the display.
4. Release the trigger to return to the standard locating screen.

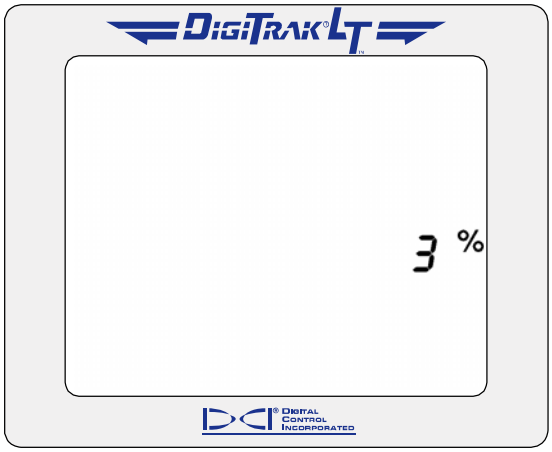
NOTE: The depth units can be set on both the receiver and the remote display. It is recommended that the receiver and the remote display be set to the same depth units.

*Depth tolerance is 5%; thus, at a distance of 6 ft (1.83 m), the error tolerance is 3.6 in. (9 cm).

PITCH UNITS %

This display menu allows you to set the LT system to display pitch values in either degrees or percent of slope.

1. Click the trigger to advance to the pitch units menu. The display will indicate the current setting.
2. Hold the trigger in through the countdown sequence from 3 to 0.



Pitch Units Display Menu

3. When the counter reaches 0, you will see the unit setting change and a checkmark appear at the bottom of the display.
4. Release the trigger to return to the standard locating screen.

NOTE:	The pitch units can be set on both the receiver and the remote display. It is recommended that the receiver and the remote display be set to the same pitch units.

Transmitter

Types of LT Transmitters

The LT transmitter fits inside the drill housing and transmits information regarding the drill head location, position, and heading. The transmitter emits electromagnetic signals at a frequency of 12 kHz that the receiver "hears" and converts into the information shown on the receiver and remote display screens.

DCI manufactures two different battery-operated transmitters for use with the LT system—a long-range transmitter (bright-green tube) and a short-range transmitter (brown tube). The long-range (LX) transmitter provides a depth range of 33 ft (10.1 m). The LX transmitter is the size of a standard transmitter—15 in. (38 cm) long and 1.25 in. (3.125 cm) in diameter. It is powered by two C-cell alkaline batteries.

Long-Range LX Transmitter

The short-range (LS) transmitter provides a depth range of approximately 15 ft (4.6 m). The LS transmitter is 8.0 in. (20 cm) long and 1.0 in. (2.5 cm) in diameter. DCI offers an adapter for this transmitter to fit in a standard-sized housing. The outer dimensions of the adapter with the LS transmitter inside are exactly the same as those of a standard transmitter (15 in. x 1.25 in. [38 cm x 3.125 cm]). It is powered by one AA alkaline battery.

Short-Range LS Transmitter

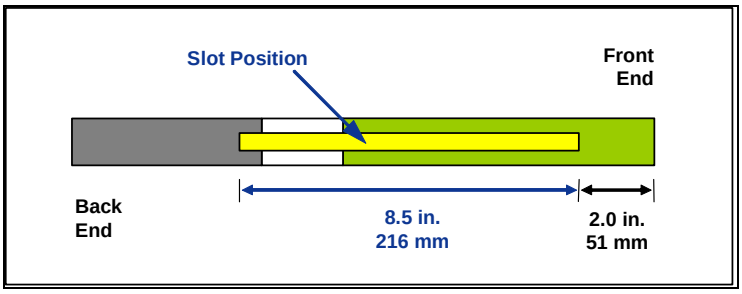
NOTE: The range of any transmitter with any DCI receiver is dependent upon the amount of interference at a job site. The range decreases as interference increases.

An index slot at the front end assists in properly aligning the transmitter in the housing. The slot should be at the 12 o'clock position (with the slot at the top), and the tapered or flattened surface of the drill head should be indexed to this position.

Transmitter Housing Requirements

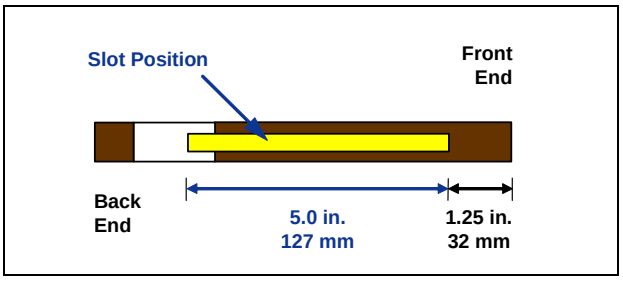
To achieve maximum range and battery life for all of DCI's transmitters, the slots in the housing must be long enough and correctly positioned. Slot measurements should always be taken from the inside of the housing.

DCI recommends at least three slots equally spaced around the circumference of the housing. For the long-range LX transmitter (15 in./38 cm long), each slot should begin at least 2.0 in. (51 mm) from the front of the transmitter and must be at least 8.5 in. (216 mm) long (see figure below).



Long-Range LX Transmitter Housing Slot Requirements

For the short-range LS transmitter (8 in./20 cm long), each slot should begin at least 1.25 in. (32 mm) from the front of the transmitter and must be at least 5.0 in. (127 mm) long (see figure below).



Short-Range LS Transmitter Housing Slot Requirements

DCI offers an adapter so you can run the short-range LS transmitter in a standard-sized housing.

Mini Transmitter Adapter

Transmitter Battery Power

The LT transmitters are battery powered. The long-range LX transmitter is powered by two C-cell alkaline batteries, and the short-range LS transmitter is powered by one AA alkaline battery.

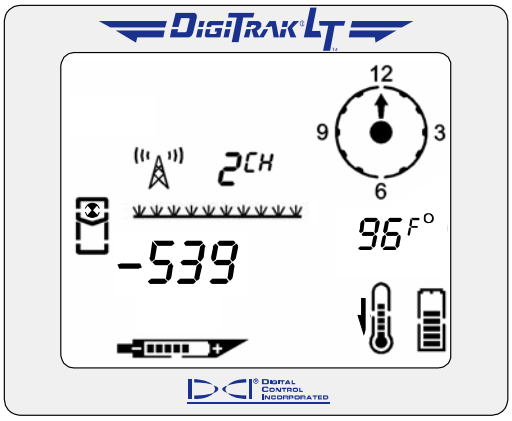
The transmitter battery icon at the bottom of the display screen continuously shows the status of the transmitter battery power using progress bars that decrease as the battery power is used.

Transmitter Battery Status Display Symbol

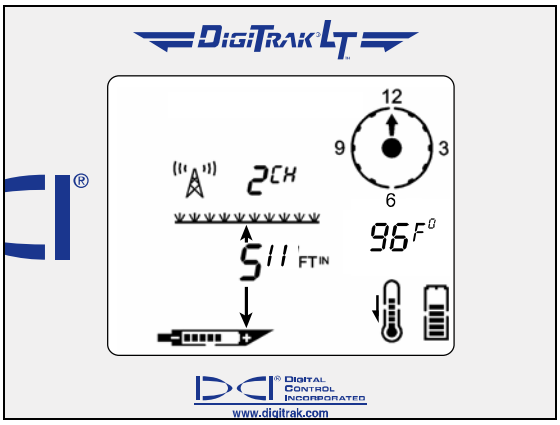
Transmitter Temperature

The transmitter temperature symbol at the bottom of the display gives an indication of the temperature, with progress bars and an up or down arrow. An up arrow indicates the temperature is increasing; a down arrow indicates the temperature is decreasing. A digital temperature reading can be viewed below the clock in place of the pitch by holding in the trigger. The drill rig operator can view the transmitter temperature by holding in the on/off button on the remote display.

Transmitter Temperature Display Symbol

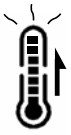


Receiver Display Screen Showing Transmitter Temperature



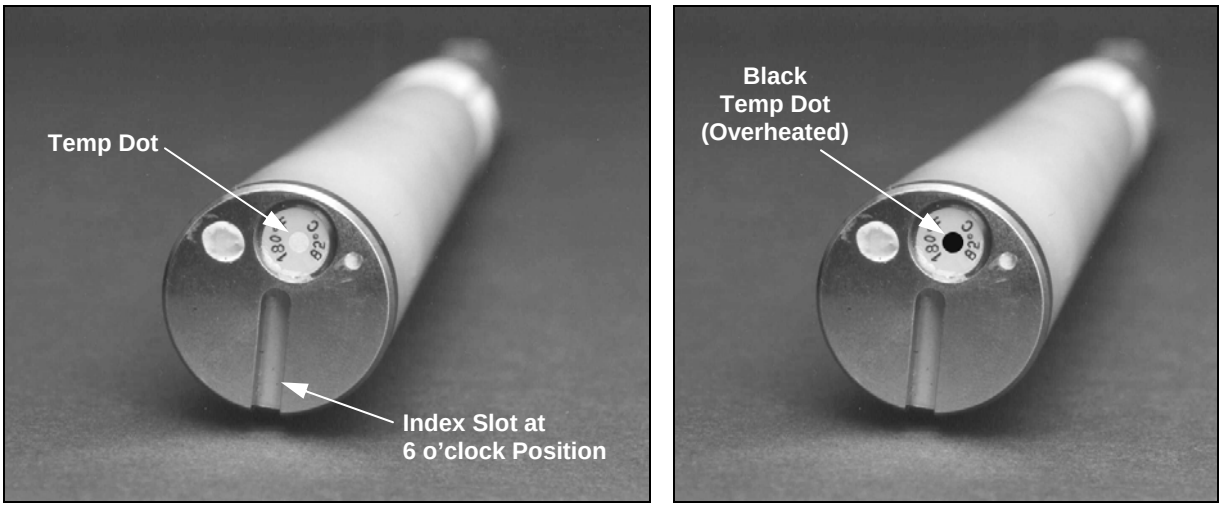
Remote Display Screen Showing Transmitter Temperature

If the transmitter reaches 111°F (43°C), the transmitter temperature symbol will change to indicate the transmitter has reached a dangerous temperature—three curved lines will be seen extending from the top of the thermometer, and the thermometer icon will appear full, as shown in the figure to the right. When the transmitter's temperature reaches 118°F (48°C), the thermometer icon will flash to indicate immediate action is required to cool the transmitter.



Dangerous Transmitter Temperature Indicator

The transmitter also has a temperature overheat indicator (temp dot) that has an outer yellow ring with a 1/8-inch (3-mm) white dot in the center. This temp dot is located on the stainless-steel front end cap. The temp dot should be white if the transmitter has not been exposed to excessive heat. If the temp dot is silver or gray, it indicates the transmitter has been exposed to heat but not in excess of the specifications. A black temp dot indicates the transmitter has been exposed to temperatures in excess of 180°F (82°C). The transmitter will shut off at about 176°F (80°C). Drilling should be suspended when temperatures reach 95°F (35°C) to permit cooling.



Front End Cap of Transmitter Showing Temp Dot, Index Slot, and Black Temp Dot

If the temp dot is black, the transmitter should be considered unreliable. If the transmitter overheats, it may appear to operate normally; however, exposure to excessive temperatures greatly increases the likelihood of inaccurate information and will contribute to premature failure of the transmitter. The DCI warranty does not apply to any transmitter that has been overheated or that has had the temp dot removed.

Avoid transmitter overheating by practicing proper drilling techniques. Abrasive soils, clogged jets, inadequate mud flow, and poorly mixed mud are some of the factors that can contribute significantly to the risk of an overheated transmitter.

Sleep Mode (Automatic Shutoff)

LT transmitters will shut down (go into "sleep" mode) to conserve battery power if they are stationary for 15 minutes. To "wake up" a transmitter, simply rotate the drill string.

General Transmitter Care Instructions

- Clean the springs in the battery compartment and the threads of the battery cap and O-ring. Emery cloth can also be used to remove any oxidation buildup.
- Verify that the transmitter fits snugly in the housing. It may be necessary to wrap the transmitter with tape or O-rings.
- Send in the Product Registration card for the 90-day limited warranty.

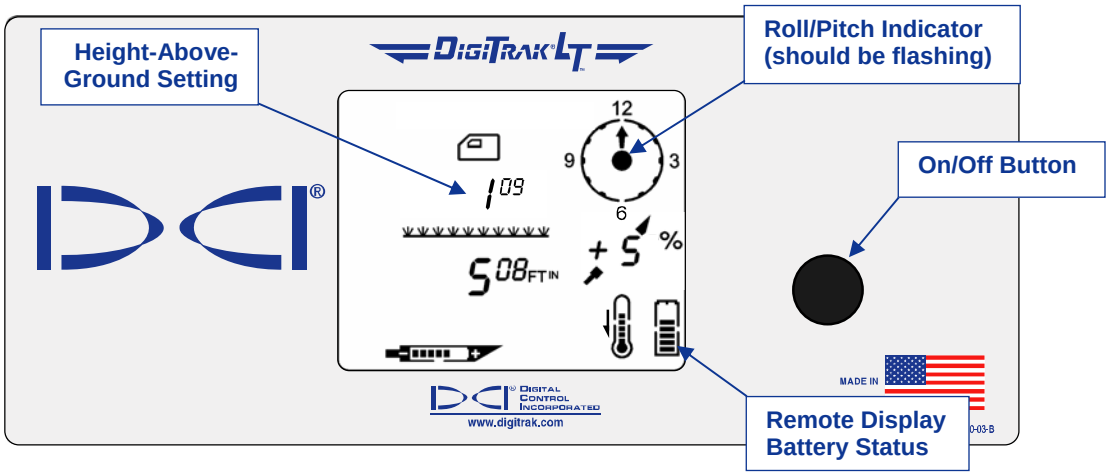
Remote Display

DigiTrak LT Remote Display

The DigiTrak LT remote display, which is located at the drill rig, receives signals from the LT receiver and displays that information on a screen very similar to the receiver display screen. The remote display has a main display screen and five menu options (power on/off, telemetry channel settings, backlight on/off, depth unit selection, and pitch unit selection). The main remote display screen is described below, and then the menu options are explained.

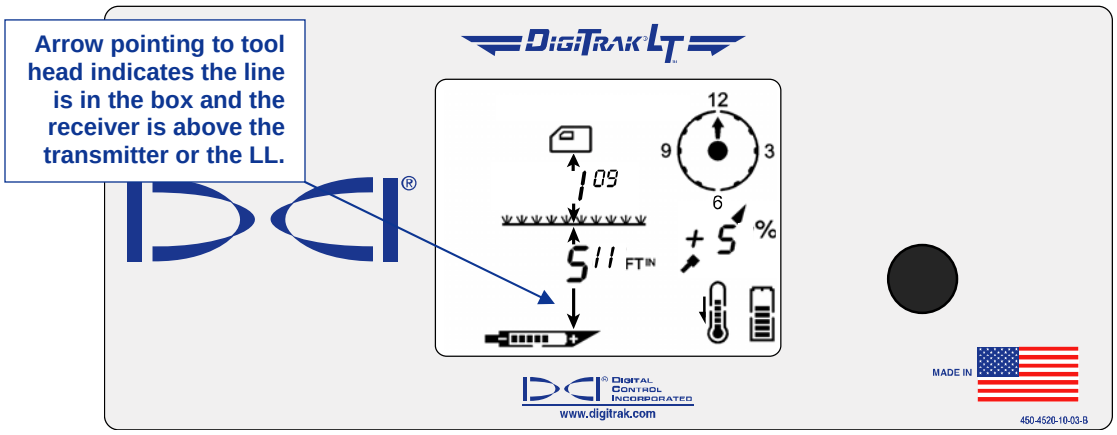
Main Display Screen

The main remote display screen shows information sent from the receiver in a format very similar to the display on the receiver. However, the battery status symbol displays the status of the remote display battery rather than that of the receiver. The on/off button on the remote works similarly to the trigger on the receiver.



Main Remote Display Screen

The main display screen indicates when the receiver is over the transmitter or the locate line (LL) by showing arrows above and below the depth value, as shown below. The receiver display will show the line in the box.

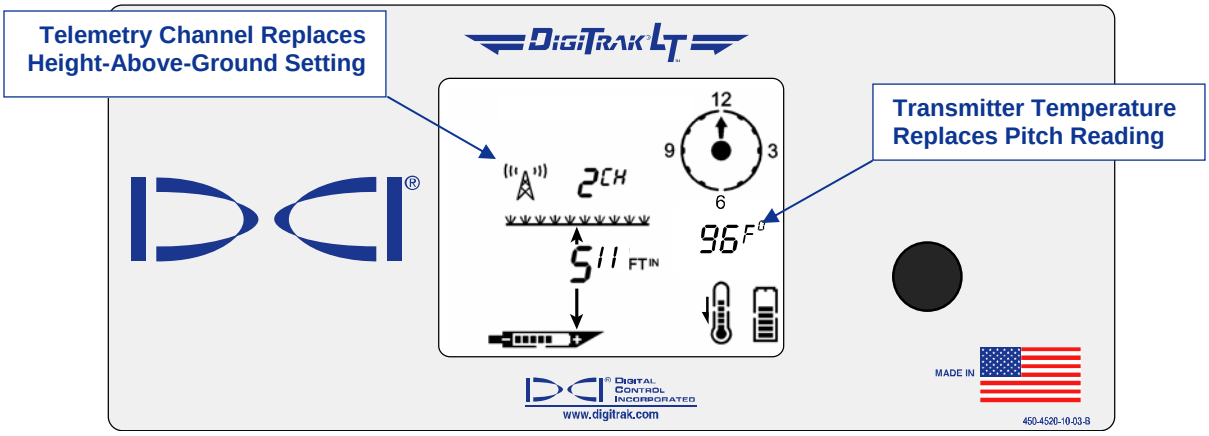


Depth Reading When Receiver Is Above Transmitter or LL

In this display, the downward arrow is pointing to the transmitter to indicate that the reading is the actual depth of the transmitter or LL. If there is not an arrow pointing down from the depth reading, then the depth value shown indicates the slant distance (see *Locating Instructions* section).

NOTE: If you see four dashed lines (— — — —) where the distance/depth number should display, then the receiver is too close to the transmitter and it is getting saturated with signal (see "Height Above Ground" menu discussion in the *Receiver* section).

By holding in the on/off button for 2 seconds or more, the transmitter temperature will display in place of the pitch information and the telemetry channel will display in place of the height-above-ground setting, as shown below.

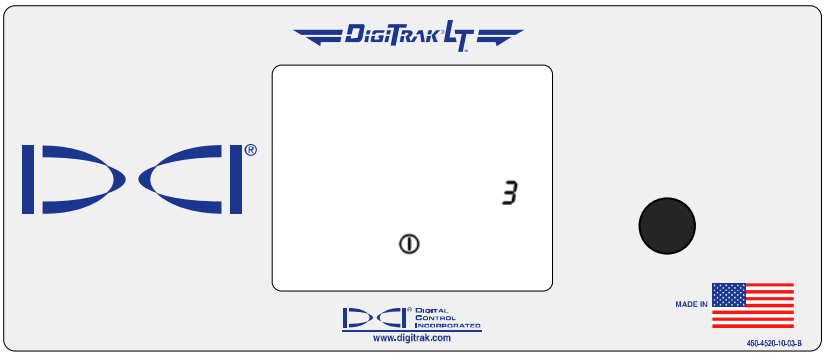


On/Off Button Held In

Remote Display Menus

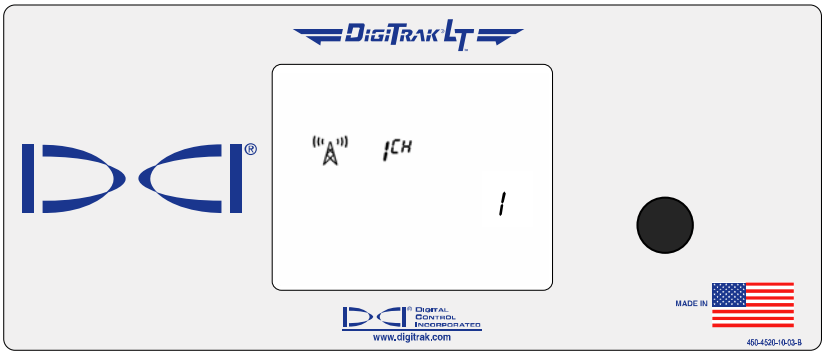
Power On/Off

With the power on/off menu displayed, as shown in the picture below, hold the button in for the countdown sequence from 3 to 0 to turn the unit off.



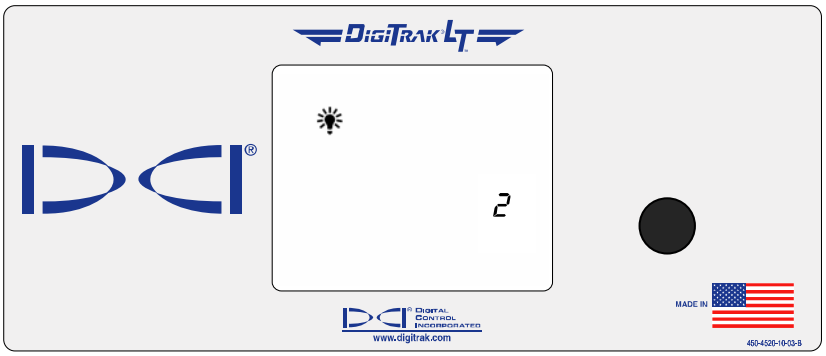
Telemetry Channel Settings

The telemetry channel menu, shown in the picture below, allows you to change the telemetry channel setting. Hold the button in to cycle through the eight channel options (1, 2, 3, 4, 5, 6, 7, 8), and release when the desired setting is selected.



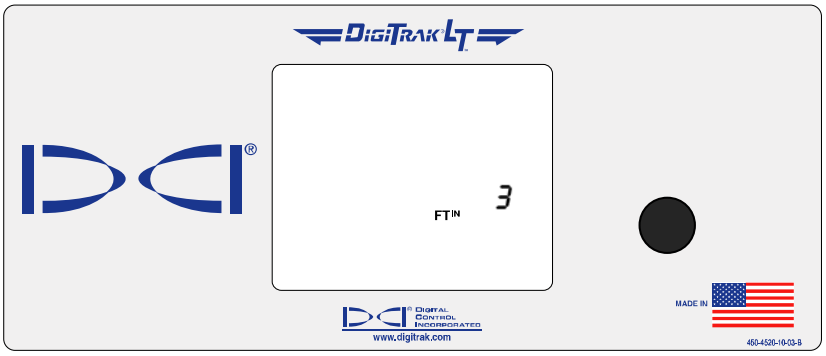
Backlight On/Off

At the backlight on/off menu option, shown in the picture below, hold the on/off button in to turn the display backlight on or off.



Depth Units

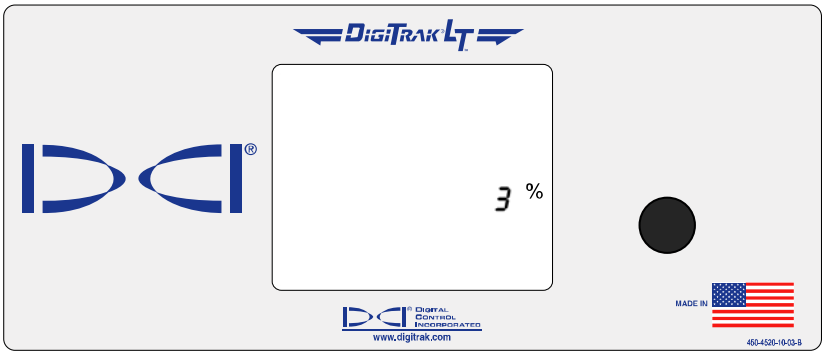
The depth units menu, shown in the picture below, allows you to set the remote display to show values (depth and temperature) in either English (FT^{IN} for feet/inches or “in” for inches only and °F) or metric (M^{CM} for meters/centimeters and °C) units. Hold the on/off button in to see the current unit setting; to change the setting, hold the button in for the countdown sequence from 3 to 0.



NOTE: The depth units can be set on both the remote display and the receiver. It is recommended that the remote display and the receiver be set to the same depth units.

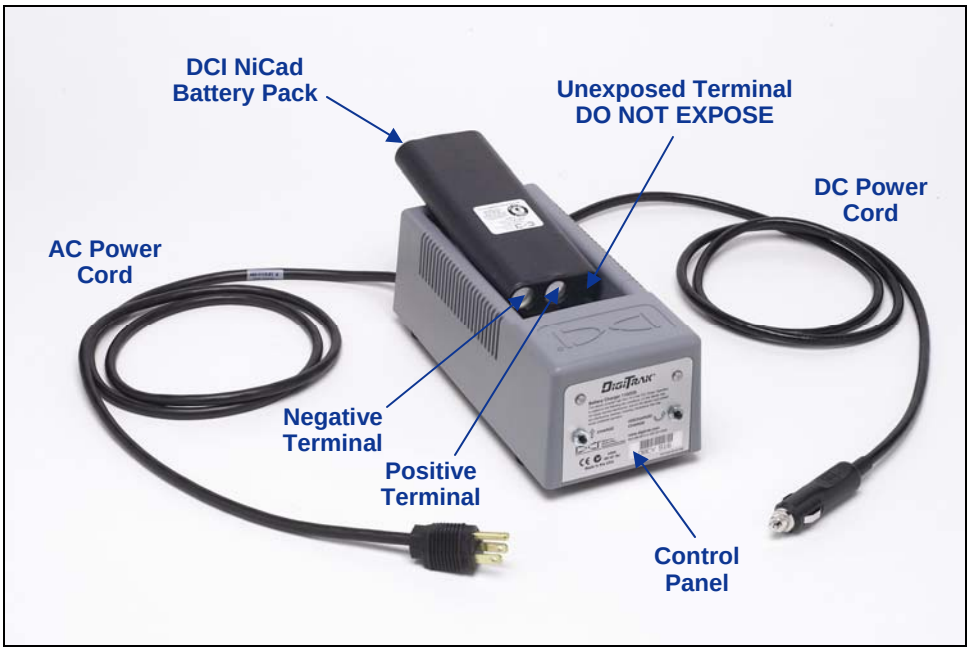
Pitch Units

The pitch units display menu, shown below, allows you to set the LT system to display pitch values in either degrees or percent of slope. Hold the on/off button in to see the current unit setting; to change the setting, hold the button in for the countdown sequence from 3 to 0.



NOTE: The pitch units can be set on both the remote display and the receiver. It is recommended that the remote display and the receiver be set to the same pitch units.

Battery Charger



Battery Charger

Both the LT receiver and the remote display use a rechargeable NiCad battery pack that is provided with the system along with a battery charger. The battery pack should be fully discharged before recharging; this is known as conditioning the battery. A fully discharged battery measures 14.5 V DC or shows low battery status on the receiver or remote display.

The battery charger can be powered from an AC or DC power source and is equipped with a conditioning or discharge cycle designed to remove the “memory effect” from the battery. The charger will operate from any AC voltage (wall outlet) between 85 V and 240 V without modification (you may need to convert the plug). This allows the same battery charger to be used in many different countries. The battery charger is also equipped with an automotive cigarette lighter adapter for 12 V or 28 V DC charging.

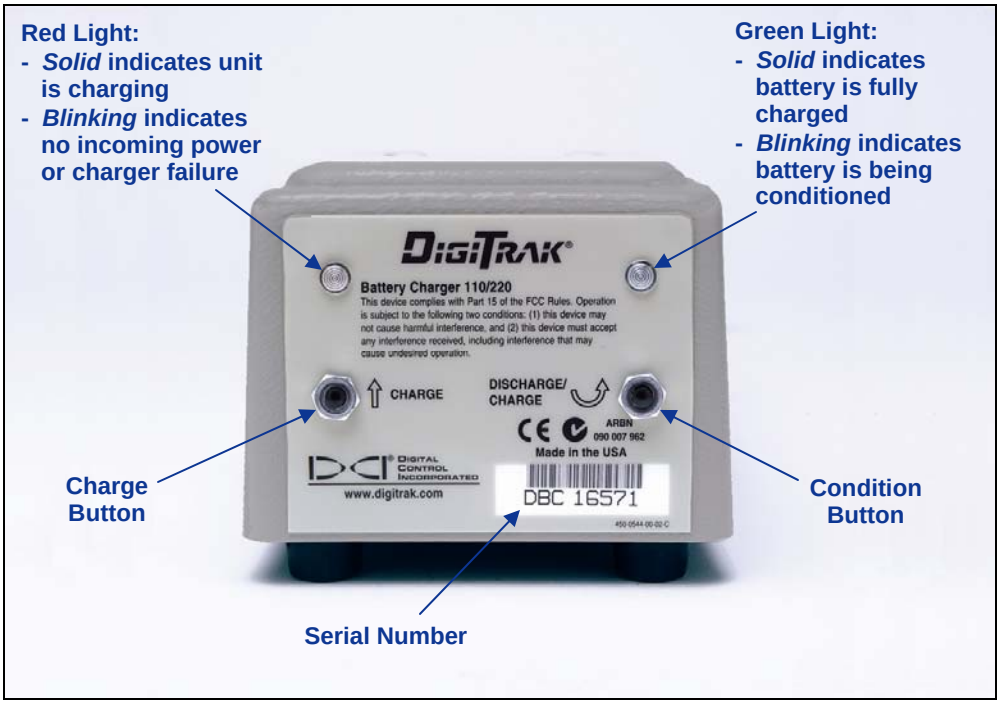
The voltage on a fully charged battery is between 16.5 V DC and 17.1 V DC. A battery is considered discharged at 14.5 V DC.

A fully charged NiCad battery pack should power the LT receiver for approximately 8 hours. A fully charged NiCad battery pack should power the LT remote display for approximately 12 hours.

Only two terminals are exposed on the NiCad battery pack. There is a third terminal under the black insulating material. If the third terminal accidentally becomes exposed, do not try to charge the battery pack or you may damage the battery charger. Such a battery may cause fire or can damage the remote display or receiver.

NOTE:	Charge only DCI NiCad batteries in the battery charger. Charging or using other types of batteries may damage the charger, the receiver, or the remote display and will void the warranty.

To charge a battery, place the battery into the charger with the terminal end making contact with the springs. The red light on the left will illuminate, indicating that the unit is charging (see figure below).



Battery Charger Control Panel

The battery will take between 2 to 3 hours to charge. When the charging cycle has been completed, the green light on the right will illuminate.

NOTE:	If a battery is left in the charger during a power interruption, the red or green light may flash and the battery will begin to discharge on its own. After the power has resumed, simply remove and replace the battery pack and press the desired charge or discharge (condition) button.

Locating Instructions

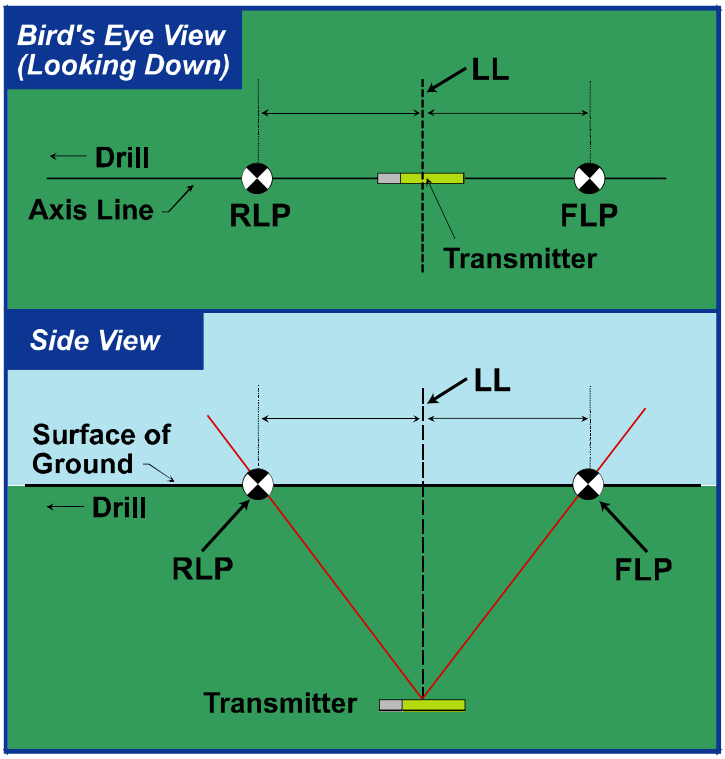
The DigiTrak LT Locating System is easy to use, but there are basic principles that must be understood before you begin to operate the system. This section gives important information regarding the depth or slant distance; the locate points and locate line; the geometry of these elements with respect to the transmitter; and the proper method for marking locate points once they are found. It then describes the standard locating procedure and an alternate technique referred to as the plus/minus method.

Depth or Slant Distance

When the receiver is held directly above the transmitter, the distance to the transmitter is referred to as the depth. At any other location, the distance is referred to as the slant distance. When the depth is displayed, there will always be arrows pointing up and down from the depth reading. If the arrows are not displayed, then the reading is actually the slant distance.

Locate Points (FLP & RLP) and Locate Line (LL)

Two of the three locations used for locating are points that represent extensions of the transmitter. One point is in front of the transmitter (the front locate point or FLP), and the other is behind the transmitter (the rear locate point or RLP). The third location is a line that represents the position of the transmitter. This line, referred to as the locate line or LL, is perpendicular to the transmitter.

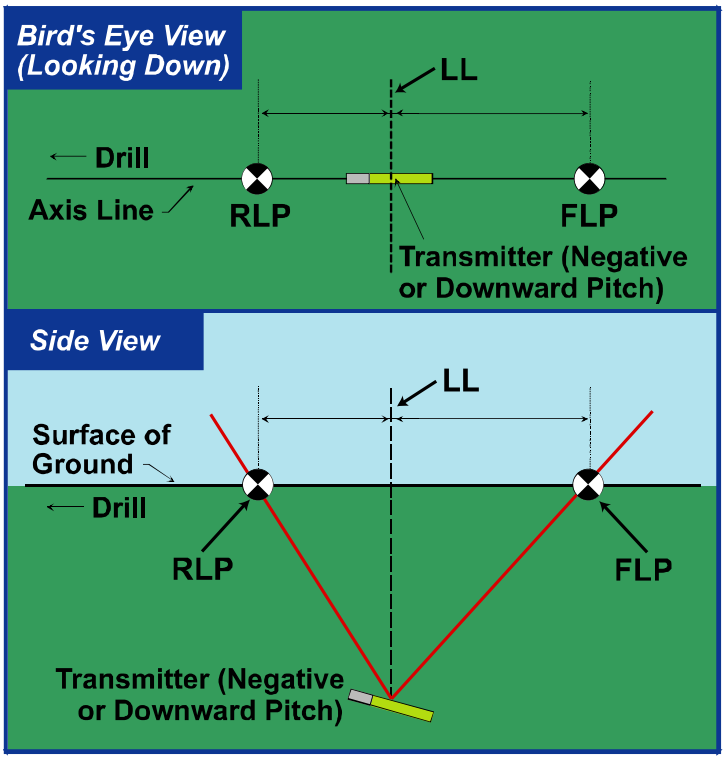


Geometry of FLP, RLP, and LL from Top and Side Views
Note how the RLP and FLP are equal distances from the LL when the transmitter is level.

Effects of Depth, Pitch, and Topography on Distance Between FLP and RLP

Because of the transmitter's field shape, the deeper the transmitter is, the further apart the FLP and RLP will be. The distance between the FLP and RLP with respect to the location of the LL is also a function of the transmitter pitch and the topography.

When the transmitter pitch is negative, the FLP will be further from the LL than the RLP (see figure below). When the transmitter pitch is positive, the RLP will be further from the LL than the FLP. If the ground surface or topography slopes significantly, the locations of the FLP and RLP will also be affected with respect to the LL even though the transmitter itself is level.



Effect of Pitch on Distance Between FLP, RLP, and LL
Note how the RLP and FLP are at different distances from the LL when the transmitter is at a negative pitch (compare with figure on previous page in which transmitter is level).

Marking Locate Points

The front and rear locate points (FLP and RLP) and the locate line (LL) must be found and accurately marked during the locating procedure. To mark a locate position after you have found it, stand with the receiver level directly above the locate point. Look down the vertical axis that runs through the center of the display to project a plumb line to the ground. The point where this plumb line hits the ground is the location that you should mark.

Plumb Line for Marking Locate Points

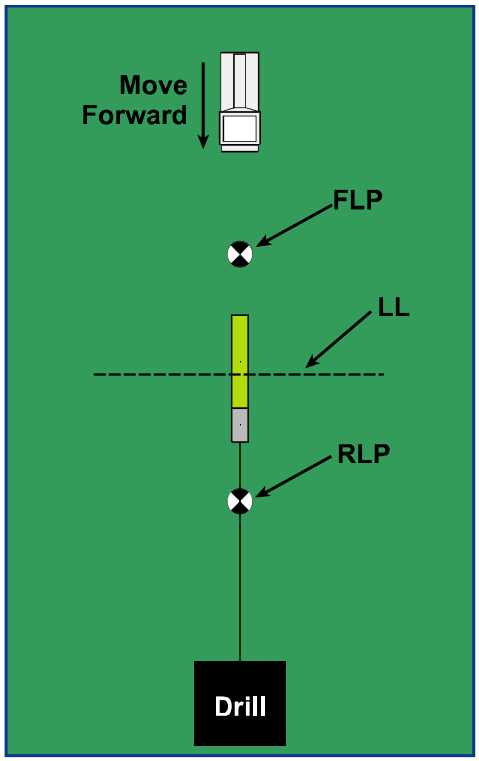
HANDLING THE RECEIVER

NOTE: It is critical that you hold the receiver correctly to obtain accurate readings. You must hold the receiver **level at all times** and maintain a **constant height-above-ground distance**.

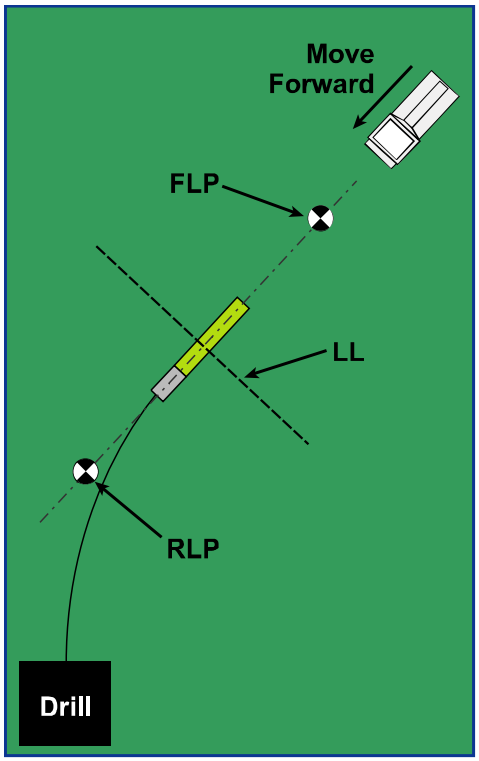
Locating the Transmitter – Standard Method

With the LT system, you can locate the transmitter *and* its heading while it moves, whether standing in front of it, behind it, or toward the side. You can also locate the transmitter facing either toward or away from the drill rig.

The standard method described in this section guides you to the transmitter while standing out in front of it, facing the drill rig. This is the recommended method for locating. As you continue to drill or as the bore path curves, you may be facing the last marked locate point rather than the drill rig.



Setup for Standard Locating Method



Standard Locating Method with a Curved Path

You do not hold the trigger in to view the signal strength when using the standard method. If you want to view the signal strength (with its associated plus/minus symbols) while locating, please refer to the next subsection entitled “Plus/Minus (“+/–“) Locating Method.”

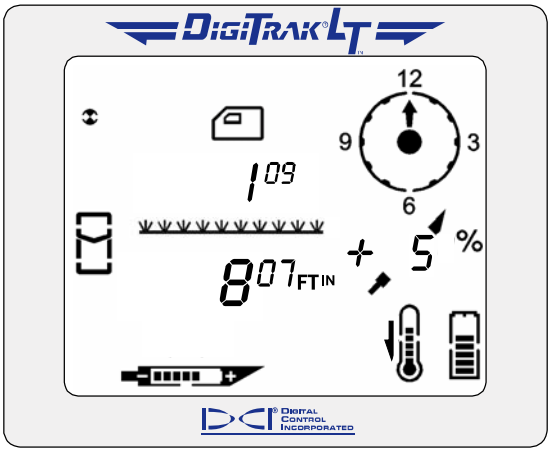
The first position to find is the front locate point or FLP. The FLP gives you the transmitter heading. The FLP’s distance ahead of the transmitter is dependent upon the transmitter depth and pitch; the deeper it is, the further in front the FLP will be. The FLP is represented as a target ( ) on the receiver display.

Once you have found the FLP, then you will find the LL, where you can determine the depth of the transmitter. The LL is represented by a short line (—) on the receiver display. The receiver must be held parallel to the transmitter when over the drill head to obtain an accurate depth reading.

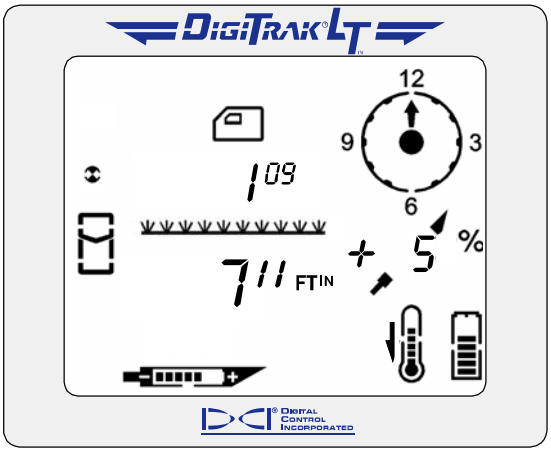
Then you will find the RLP, where you can confirm the transmitter heading and position. Like the FLP, the RLP is represented as a target ( ) on the receiver display.

Finding the FLP

1. Stand out in front of the drill head (facing the drill) at a distance of approximately one drill rod length.
2. As you approach the FLP, the target appears in the top left corner of the display and the depth number decreases.

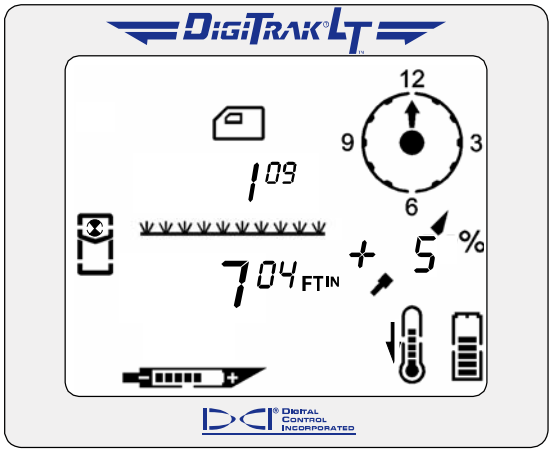


Target in Top Left Corner



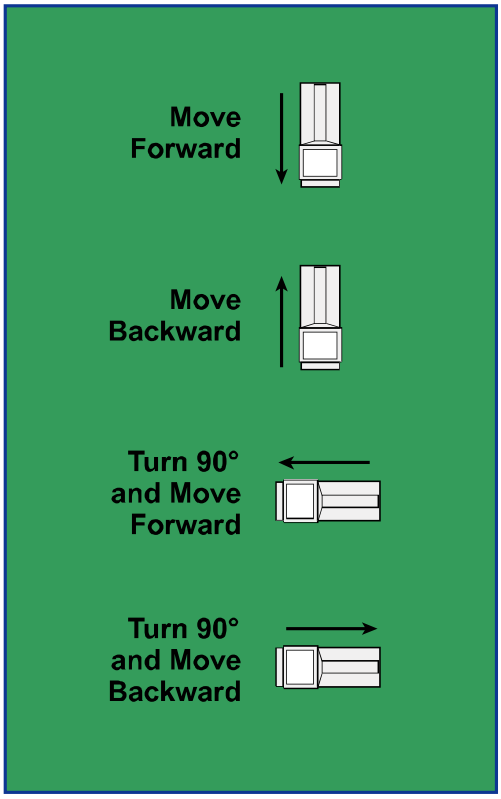
Target Moving Toward the Box

3. Continue to walk forward until the target moves into the locating icon (box).

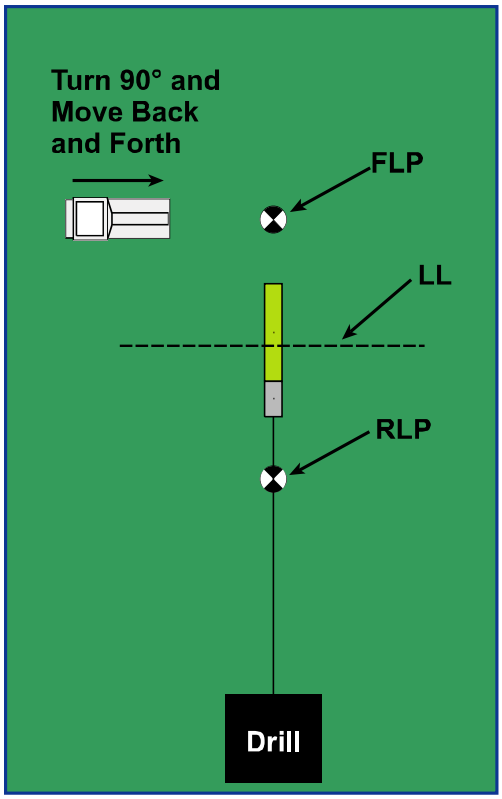


Target in the Box

4. Turn the receiver 90° from the transmitter heading while holding the receiver steady and level, and again center the target in the box by moving the receiver forward or backward as needed. This is the FLP, which is where the transmitter will end up if it does not get a steering command.
5. Mark the location directly below the display screen as the FLP.



Moving Receiver Back and Forth

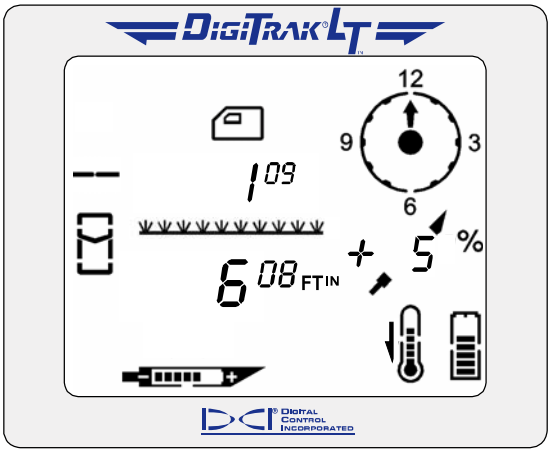


Turn Receiver 90° and Move Back and Forth to Center Target in Box

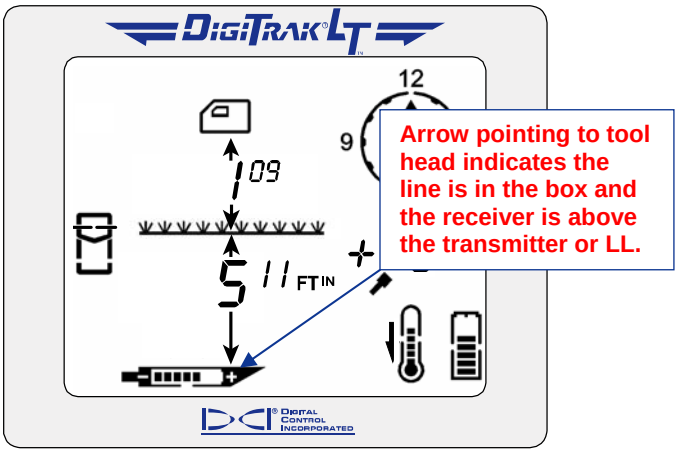
Finding the Transmitter and the LL

1. At the FLP, turn again to face the drill head (and drill) and walk forward toward the last locate point.
2. Note that the LL appears in the top left of the display.
3. Walk forward and the LL moves closer to the box.
4. Center the LL in the box. You should now see an arrow pointing to the transmitter battery icon, which indicates that the value is the actual transmitter depth.

NOTE: If the tool is shallower than approximately 28 in. (71 cm) you will see four dashed lines (— — — —) where the depth should display. This means that the receiver is too close to the transmitter and it is getting saturated with signal (see “Height Above Ground” menu discussion in the *Receiver* section).



LL Moving Toward the Box



Line in the Box

NOTE: The arrow that appears below the depth measurement and that points to the transmitter also appears on the remote display.

5. Mark this location as the LL. You should now be standing above the transmitter.

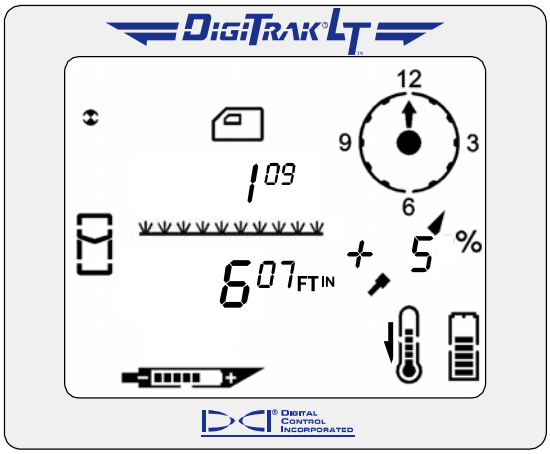
Confirmation of Exact Heading and Transmitter Position

You can confirm the actual transmitter heading by locating the rear locate point or RLP and then drawing a line between the RLP and FLP. That line represents the exact heading. Where this line intersects the LL is the position of the transmitter. Using the locate points and the LL to find the transmitter is more reliable and efficient than using the peak signal or shallowest depth.

NOTE: Both active and passive interference sources can affect the accuracy of the locate points and depth readings.

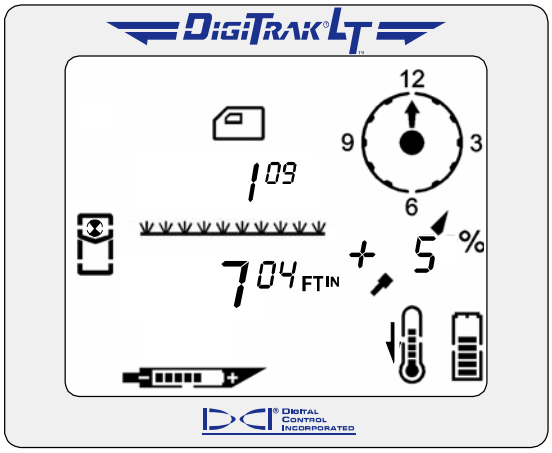
Finding the RLP

1. While standing above the transmitter still facing the drill, continue walking toward the drill; the target will appear in the top left corner of the display and the depth will increase.



Target in Top Left Corner

2. Walk forward until the target moves into the box.

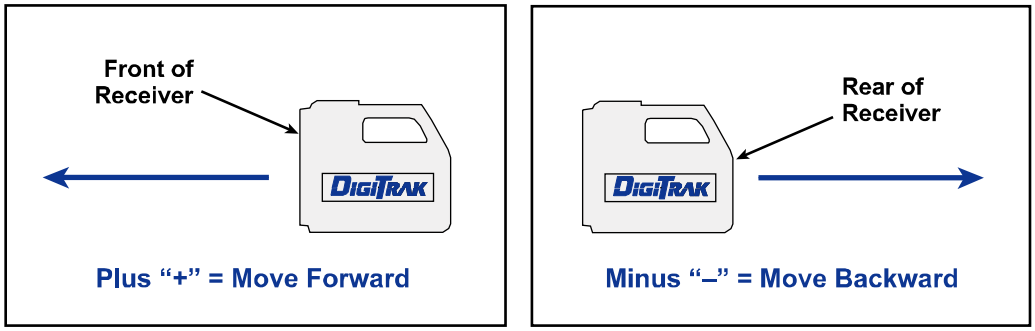


Target in the Box

3. Turn the receiver 90° from the transmitter heading while holding the receiver steady and level, and again put the target in the box by moving the receiver forward or backward as needed.
4. Mark this location as the RLP.
5. Connect the RLP to the FLP by a line. This line represents the actual transmitter heading.

Plus/Minus ("+/–") Locating Method

The plus/minus method is the same as that used in DCI's Mark series receivers for finding the front and rear locate points. This method is similar to the standard locating method except here you hold the trigger in and use the signal strength and plus/minus signs for locating. In general, the plus sign ("+") means move the receiver forward, and the minus sign ("–") means move it backward, to find the locate point.



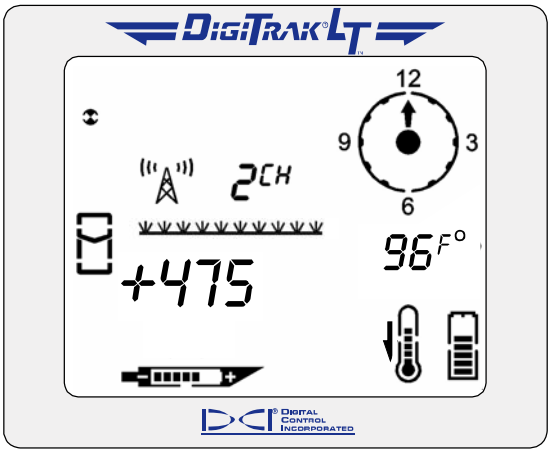
Using Plus/Minus ("+/–") Indicators for Finding Locate Points

The front and rear locate points each represent a *point* where the sign changes from *positive* to *negative*. It doesn't matter if the receiver and transmitter are facing in the same direction or in opposite directions, the "+" sign will change to a "–" sign at either of the locate points.

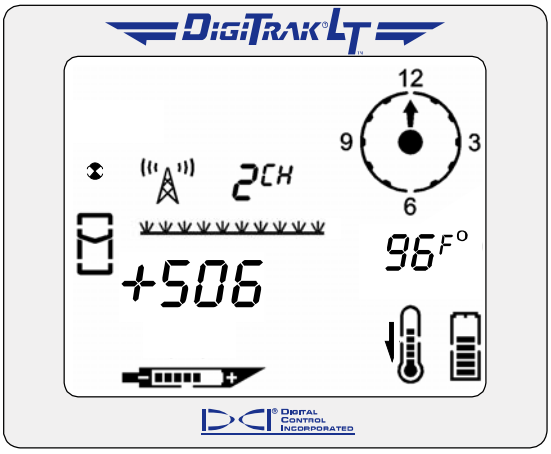
Anywhere along the locate line, when the receiver crosses it, the "–" sign will change to a "+" sign. The position of the transmitter along the LL can be determined by finding the FLP or RLP.

Finding the FLP

1. Stand out in front of the drill head (facing the drill) at a distance of approximately one drill rod length.
2. Hold in the trigger and approach the FLP. The signal strength will be positive and will increase. Note that the target appears in the top left corner of the display, and the target gets closer to the box (locating icon) as you walk toward the FLP.

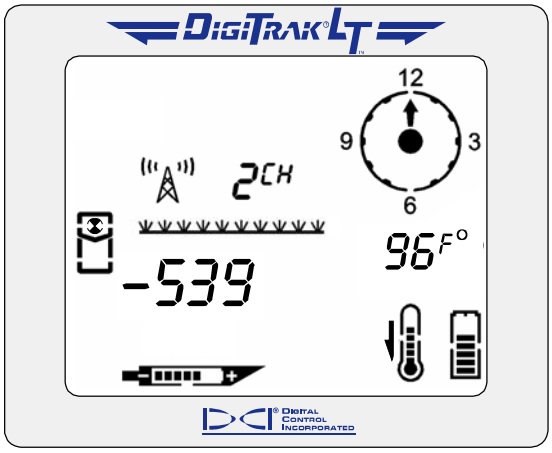


Target in Top Left Corner



Target Moving Toward the Box

3. Continue to walk forward until the "+" sign changes to a "–". Note that the target has moved into the box and the signal strength has increased.

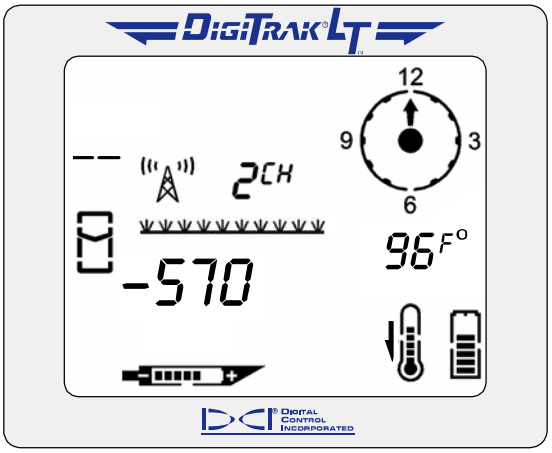


Target in the Box

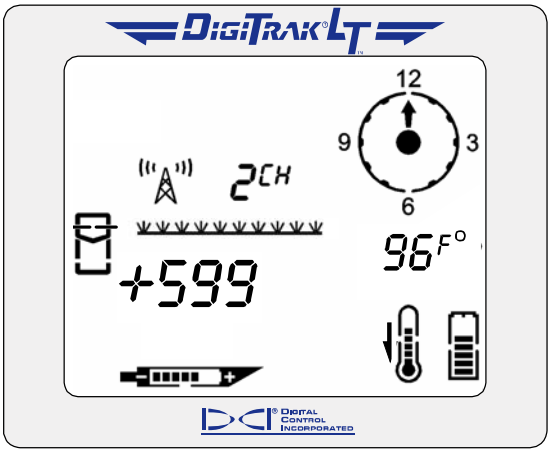
4. Turn the receiver 90° from the transmitter heading while holding the receiver steady and level, and again find the point where the "+" sign changes to a "–" by moving the receiver forward or backward as needed; the target should be in the box. This is the FLP, which is where the transmitter will end up if it does not get a steering command. Release the trigger.
5. Mark the location directly below the display screen as the FLP.

Finding the Transmitter and the LL

1. At the FLP, while continuing to hold in the trigger, turn again to face the drill head (and drill) and walk forward toward the last locate point.
2. Note that the signal strength is negative and the value is increasing. The LL will appear in the top left of the display.
3. Continue to walk forward until the "–" sign changes to a "+" sign. Note that the LL is centered in the box.

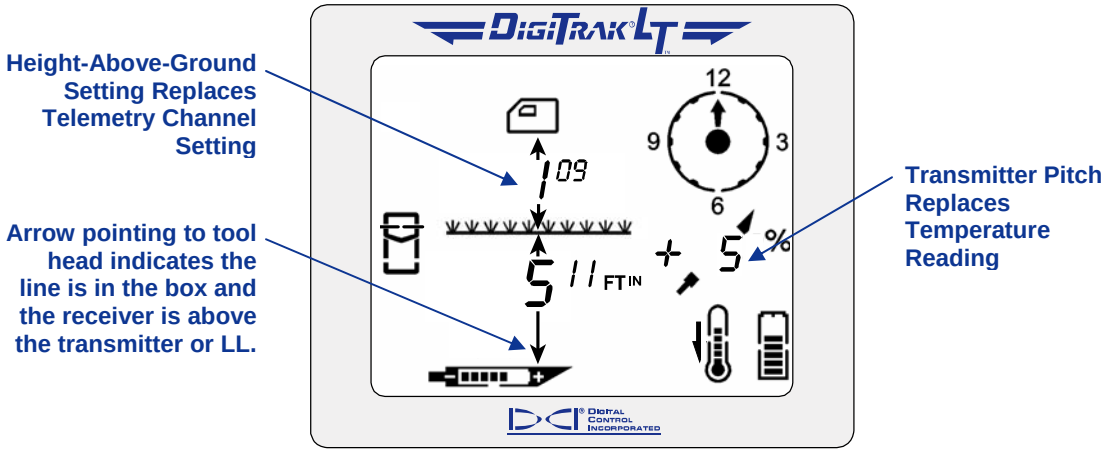


LL Moving Toward the Box



Line in the Box

4. Release the trigger to see the depth display.



Depth Screen

> **NOTE:** The arrow that appears below the depth measurement and that points to the transmitter also appears on the remote display when the line is in the box.

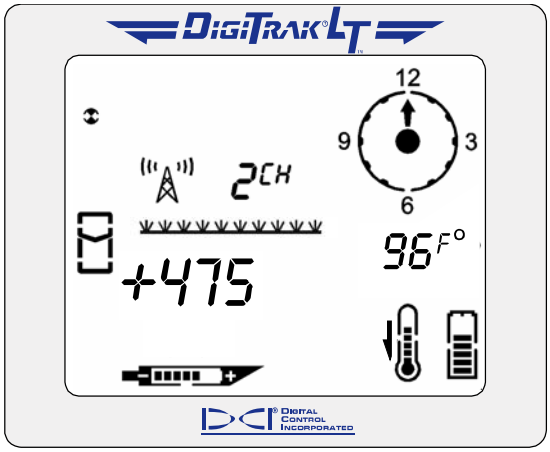
5. Mark this location as the LL. You should now be standing above the transmitter.

Confirmation of Exact Heading and Transmitter Position

Like in the standard locating method, you can confirm the actual transmitter heading by locating the rear locate point or RLP and then drawing a line between the RLP and FLP. That line represents the transmitter heading. Where this line intersects the LL is the position of the transmitter.

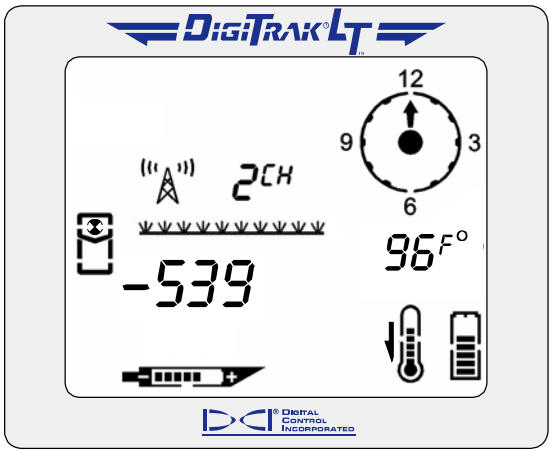
Finding the RLP

1. While standing above the transmitter still facing the drill, hold in the trigger and continue walking toward the drill; the signal strength will decrease and the target will appear in the top left corner of the display.



Target in Top Left Corner

2. Walk forward until the "+" sign changes to a "–" sign. Note that the target has moved into the box.



Target in the Box

3. Turn the receiver 90° from the transmitter heading while holding the receiver steady and level, and find the point where the "–" sign changes to a "+" by moving the receiver forward or backward as needed; the target should be in the box. This is the RLP. Release the trigger.
4. Mark this location as the RLP.
5. Connect the RLP to the FLP by a line. This line represents the transmitter heading.

3-1000-00-B

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www.digitrak.com (Web Site) DCI@digital-control.com (E-mail)

LIMITED WARRANTY

Digital Control Incorporated ("DCI") warrants that when shipped from DCI each DCI product ("DCI Product") will conform to DCI's current published specifications in existence at the time of shipment and will be free, for the warranty period ("Warranty Period") described below, from defects in materials and workmanship. The limited warranty described herein ("Limited Warranty") is not transferable, shall extend only to the first end-user ("User") purchasing the DCI Product from either DCI or a dealer expressly authorized by DCI to sell DCI Products ("Authorized DCI Dealer"), and is subject to the following terms, conditions and limitations:

1. A Warranty Period of twelve (12) months shall apply to the following new DCI Products: receivers/locators, remote displays, battery chargers and rechargeable batteries, and DataLog® modules and interfaces. A Warranty Period of ninety (90) days shall apply to all other new DCI Products, including transmitters, accessories, and software programs and modules. Unless otherwise stated by DCI, a Warranty Period of ninety (90) days shall apply to: (a) a used DCI Product sold either by DCI or by an Authorized DCI Dealer who has been expressly authorized by DCI to sell such used DCI Product; and (b) services provided by DCI, including testing, servicing, and repairing an out-of-warranty DCI Product. The Warranty Period shall begin from the later of: (i) the date of shipment of the DCI Product from DCI, or (ii) the date of shipment (or other delivery) of the DCI Product from an Authorized DCI Dealer to User.

2. DCI's sole obligation under this Limited Warranty shall be limited to either repairing, replacing, or adjusting, at DCI's option, a covered DCI Product that has been determined by DCI, after reasonable inspection, to be defective during the foregoing Warranty Period. All warranty inspections, repairs and adjustments must be performed either by DCI or by a warranty claim service authorized in writing by DCI. All warranty claims must include proof of purchase, including proof of purchase date, identifying the DCI Product by serial number.

3. The Limited Warranty shall only be effective if: (i) within fourteen (14) days of receipt of the DCI Product, User mails a fully-completed Product Registration Card to DCI; (ii) User makes a reasonable inspection upon first receipt of the DCI Product and immediately notifies DCI of any apparent defect; and (iii) User complies with all of the Warranty Claim Procedures described below.

WHAT IS NOT COVERED

This Limited Warranty excludes all damage, including damage to any DCI Product, due to: failure to follow DCI's user's manual and other DCI instructions; abuse; misuse; neglect; accident; fire; flood; Acts of God; improper applications; connection to incorrect line voltages and improper power sources; use of incorrect fuses; overheating; contact with high voltages or injurious substances; or other events beyond the control of DCI. This Limited Warranty does not apply to any equipment not manufactured or supplied by DCI nor, if applicable, to any damage or loss resulting from use of any DCI Product outside the designated country of use. By accepting a DCI Product and not returning it for a refund within thirty (30) days of purchase, User agrees to the terms of this Limited Warranty, including without limitation the Limitation of Remedies and Liability described below, and agrees to carefully evaluate the suitability of the DCI Product for User's intended use and to thoroughly read and strictly follow all instructions supplied by DCI (including any updated DCI Product information which may be obtained at the above DCI website). In no event shall this Limited Warranty cover any damage arising during shipment of the DCI Product to or from DCI.

User agrees that the following will render the above Limited Warranty void: (i) alteration, removal or tampering with any serial number, identification, instructional, or sealing labels on the DCI Product, or (ii) any unauthorized disassembly, repair or modification of the DCI Product. In no event shall DCI be responsible for the cost of or any damage resulting from any changes, modifications, or repairs to the DCI Product not expressly authorized in writing by DCI, and DCI shall not be responsible for the loss of or damage to the DCI Product or any other equipment while in the possession of any service agency not authorized by DCI.

DCI reserves the right to make changes in design and improvements upon DCI Products from time to time, and User understands that DCI shall have no obligation to upgrade any previously manufactured DCI Product to include any such changes.

The foregoing Limited Warranty is DCI's sole warranty and is made in place of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose and any implied warranty arising from course of performance, course of dealing, or usage of trade. If DCI has substantially complied with the warranty claim procedures described below, such procedures shall constitute User's sole and exclusive remedy for breach of the Limited Warranty.

LIMITATION OF REMEDIES AND LIABILITY

In no event shall DCI nor anyone else involved in the creation, production, or delivery of the DCI Product be liable for any damages arising out of the use or inability to use the DCI Product, including but not limited to indirect, special, incidental, or consequential damages or for any cover, loss of information, profit, revenue or use based upon any claim by User for breach of warranty, breach of contract, negligence, strict liability, or any other legal theory, even if DCI has been advised of the possibility of such damages. In no event shall DCI's liability exceed the amount User has paid for the DCI Product. To the extent that any applicable law does not allow the exclusion or limitation of incidental, consequential or similar damages, the foregoing limitations regarding such damages shall not apply.

This Limited Warranty gives you specific legal rights, and you may also have other rights which vary from state to state. This Limited Warranty shall be governed by the laws of the State of Washington.

WARRANTY CLAIM PROCEDURES

1. If you are having problems with your DCI Product, you must first contact the Authorized DCI Dealer where it was purchased. If you are unable to resolve the problem through your Authorized DCI Dealer, contact DCI's Customer Service Department in Kent, Washington, USA at the above telephone number between 6:00 a.m. and 6:00 p.m. Pacific Time and ask to speak with a customer service representative. (The above "800" number is available for use only in the USA and Canada.) Prior to returning any DCI Product to DCI for service, you must obtain a Return Merchandise Authorization (RMA) number. Failure to obtain a RMA may result in delays or return to you of the DCI Product without repair.

2. After contacting a DCI customer service representative by telephone, the representative will attempt to assist you in troubleshooting while you are using the DCI Product during actual field operations. Please have all related equipment available together with a list of all DCI Product serial numbers. It is important that field troubleshooting be conducted because many problems do not result from a defective DCI Product, but instead are due to either operational errors or adverse conditions occurring in the User's drilling environment.

3. If a DCI Product problem is confirmed as a result of field troubleshooting discussions with a DCI customer service representative, the representative will issue a RMA number authorizing the return of the DCI Product and will provide shipping directions. You will be responsible for all shipping costs, including any insurance. If, after receiving the DCI Product and performing diagnostic testing, DCI determines the problem is covered by the Limited Warranty, required repairs and/or adjustments will be made, and a properly functioning DCI Product will be promptly shipped to you. If the problem is not covered by the Limited Warranty, you will be informed of the reason and be provided an estimate of repair costs. If you authorize DCI to service or repair the DCI Product, the work will be promptly performed and the DCI Product will be shipped to you. You will be billed for any costs for testing, repairs and adjustments not covered by the Limited Warranty and for shipping costs. In most cases, repairs are accomplished within 1 to 2 weeks.

4. DCI has a limited supply of loaner equipment available. If loaner equipment is required by you and is available, DCI will attempt to ship loaner equipment to you by overnight delivery for your use while your equipment is being serviced by DCI. DCI will make reasonable efforts to minimize your downtime on warranty claims, limited by circumstances not within DCI's control. If DCI provides you loaner equipment, your equipment must be received by DCI no later than the second business day after your receipt of loaner equipment. You must return the loaner equipment by overnight delivery for receipt by DCI no later than the second business day after your receipt of the repaired DCI Product. Any failure to meet these deadlines will result in a rental charge for use of the loaner equipment for each extra day the return of the loaner equipment to DCI is delayed.