

TK Series Guidance System

Operator's Manual



Issue 1.1

053-2832

ORIGINAL INSTRUCTION

Overview



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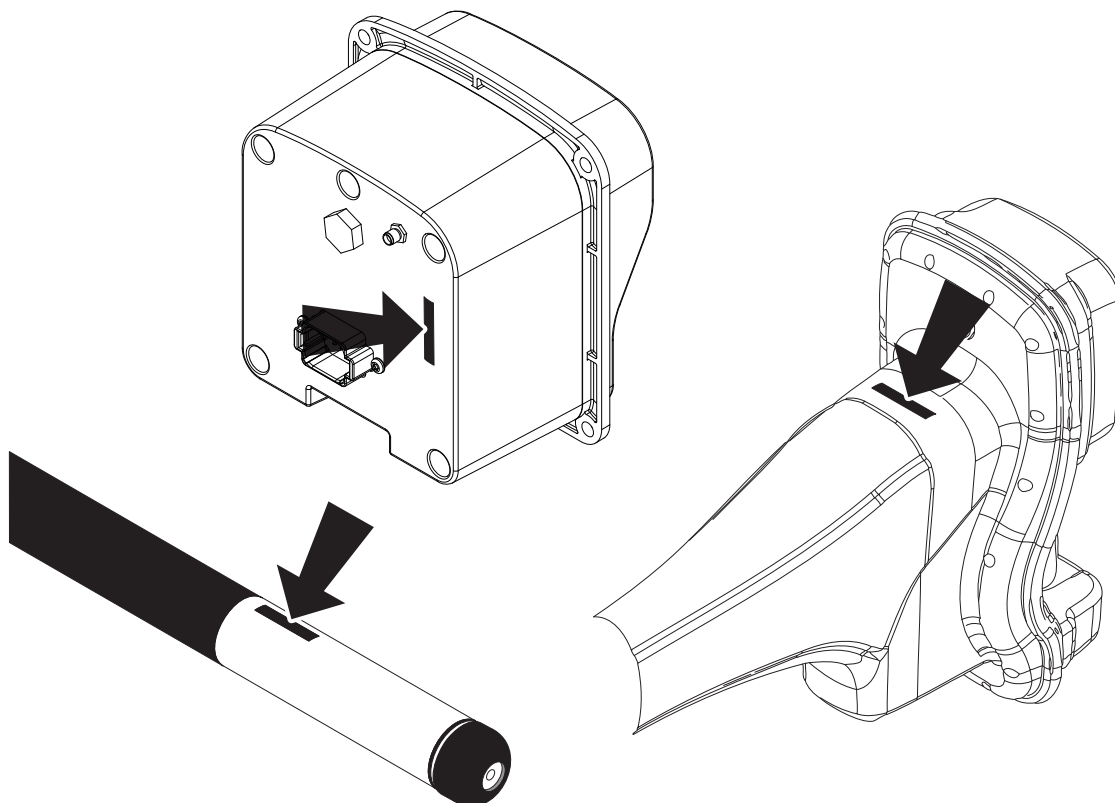
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Serial Number Location

Record serial numbers and date of purchase in spaces provided. Serial numbers are located as shown and displayed briefly in lower left corner of tracker and display screens when units are first powered up.



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Item	
date of purchase:	
tracker serial number:	
display serial number:	
beacon model and serial number:	
beacon model and serial number:	
beacon model and serial number:	

System Components



TK Tracker

Tracker	Available Transmitter Frequencies	Telemetry Radio
TK	29kHz	
TKD	29kHz, 12kHz	UHF Long Range
TKQ	29kHz, 12kHz, 20kHz, 1.5kHz	UHF Long Range

TX Transmitter

Transmitter	Available Transmitter Frequencies	Pitch Resolution	Output Power
TX	29kHz	1%	Low
TXH	29kHz	1%	High
TXQ	29kHz, 12kHz, 20kHz, 1.5kHz	1%	Configurable
TXQG	29kHz, 12kHz, 20kHz, 1.5kHz	0.1%	Configurable

TK Trackers are compatible with Subsite® Electronics 86B series beacons: 86B, 86Bv2, 88B, and 88BAT. However, for the best performance use a TX series transmitter.

TD Remote Display

Remote Display	Mounting Options
TD	In dash
TDR	On-dash, magnetic

TD Displays are compatible with a Subsite Electronics 8500TK tracker of the same region/country model.

Intended Use

The TK Series guidance system consists of a TK tracker, a TD display, and a TX series beacon transmitter. The system provides the location of the transmitter to a depth of 110' (33.53 m). The system provides projected depth information and offers a Drill-To guidance mode. The system can track critical grade bores when using a TXQG transmitter.

The system is designed for operation in temperatures typically experienced in earth moving and construction work environments. Use in any other way is considered contrary to the intended use. The TK Series guidance system should be operated only by persons familiar with its particular characteristics and acquainted with the relevant safety procedures. The system should be serviced only by Subsite® Electronics repair centers.

FCC Statement - Internal Transmitter

TK Series Tracker

Contains FCC ID: ITQ-TR21
Contains FCC ID: QOQWT41
Contains IC: 3598A-TR21
Contains IC: 5213A-BGTWT41

TK Series Display

Contains FCC ID: ITQ-TR21
Contains FCC ID: QOQWT41
Contains IC: 3598A-TR21
Contains IC 5213A-BGTWT41

TK Series Beacon

Contains FCC ID: QOQWT12
Contains IC: 5213A-BGTWT12A

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



N 16819

RF Exposure Statement



In order to comply with RF exposure requirements during normal operation, this device must be held in front of the body horizontally. The antenna must be vertical in line with the body with at least 4" (100 mm) separation distance from the body.

Note: 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 communications. 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 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.

This device complies with Health Canada's Safety Code. The installer of this device should ensure that RF radiation is not emitted in excess of the Health Canada's requirement. Information can be obtained at http://hc-sc.gc.ca/ewh-sem/pub/radiation/radio_guide-lignes_direct-eng.php.

About This Manual

This manual contains information for the proper use of this equipment. Cross references such as "See page 50" will direct you to detailed procedures.

Bulleted Lists

Bulleted lists provide helpful or important information or contain procedures that do not have to be performed in a specific order.

Numbered Lists

Numbered lists contain illustration callouts or list steps that must be performed in order.

Foreword



This manual is an important part of your equipment. It provides safety information and operation instructions to help you use and maintain your Subsite[®] Electronics equipment.

Read this manual before using your equipment. Keep it with the equipment at all times for future reference. If you sell your equipment, be sure to give this manual to the new owner.

If you need a replacement copy, contact your Ditch Witch[®] dealer. If you need assistance in locating a dealer, visit our website at **www.subsite.com**, email info@subsite.com or write to the following address:

Subsite Electronics
Attn: Product Support
1950 W. Fir
Perry, OK 73077
USA

The descriptions and specifications in this manual are subject to change without notice. Subsite Electronics reserves the right to improve equipment. Some product improvements may have taken place after this manual was published. For the latest information on Subsite Electronics equipment, see your Ditch Witch dealer.

Thank you for buying and using Subsite Electronics equipment.

TK Series Guidance System Operator's Manual

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Part number 053-2832

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This product is covered by one or more of the following patents:

US 5,880,680; 7,251,567; 7,786,731; 7,999,551; 8,497,684; **GB** 2439495, UK0846841; other US and foreign applications pending.

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Safety

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Guidelines

Follow these guidelines before operating any jobsite equipment:


- Complete proper training and read operator's manual before using equipment.
- Classify jobsite based on its hazards and use correct tools and machinery, safety equipment, and work methods for jobsite.
- Mark jobsite clearly and keep spectators away.
- Wear personal protective equipment.
- Review jobsite hazards, safety and emergency procedures, and individual responsibilities with all personnel before work begins.
- Replace missing or damaged safety signs.
- Use equipment carefully. Stop operation and investigate anything that does not look or feel right.
- Contact your equipment dealer if you have any question about operation, maintenance, or equipment use.


Safety Alert Classifications


These classifications and the icons defined on the following pages work together to alert you to situations which could be harmful to you, jobsite bystanders or your equipment. When you see these words and icons in the book or on the unit, carefully read and follow all instructions. **YOUR SAFETY IS AT STAKE.**



Watch for the three safety alert levels: **DANGER**, **WARNING** and **CAUTION**. Learn what each level means.

 **DANGER** indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

 **WARNING** indicates a hazardous situation that, if not avoided, could result in death or serious injury.

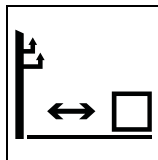
 **CAUTION** indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

Watch for two other words: **NOTICE** and **IMPORTANT**.

NOTICE indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

IMPORTANT can help you do a better job or make your job easier in some way.

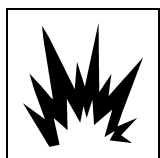
Safety Alerts

**⚠ DANGER**

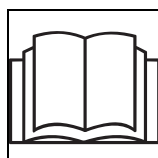
Electric shock will cause death or serious injury. Stay away.

**⚠ WARNING**

Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment. 274-050; 274-724 (2P)

**⚠ WARNING**

Explosion possible. Serious injury or equipment damage could occur. Follow directions carefully.

**⚠ WARNING**

Read operator's manual. Know how to use all controls. Your safety is at stake. 273-475

**⚠ WARNING**

Moving traffic - hazardous situation. Death or serious injury could result. Avoid moving vehicles, wear high visibility clothing, post appropriate warning signs.



Safety Alert

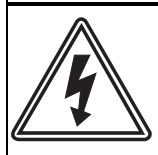
Read and follow all safety precautions.

Do not operate equipment unless you have completed proper training and have read the operator's manual.

Check that equipment is in good condition and that test leads are clean and have no cracked insulation.



⚠ WARNING HIGH VOLTAGE. This device produces electric current that could cause death or serious injury. Electric shock may result if you touch the clips on the HV output cable. Use electrically insulating rubber gloves and proper procedures.



⚠ DANGER Electric shock or equipment damage can result if transmitter is connected to live cable. Have qualified utility personnel disconnect both ends of cable before working.

Turn off transmitter when connecting or moving ground probe.

Jobsite hazards could cause death or serious injury. Use correct equipment and work methods. Use and maintain proper safety equipment.



⚠ WARNING Explosion possible. Do not operate transmitter near explosive devices or blasting operations.



⚠ WARNING Battery cells inside may vent or rupture. Do not crush, do not heat or incinerate, do not short circuit, do not dismantle, do not immerse in any liquid. Observe charging instructions.

Controls

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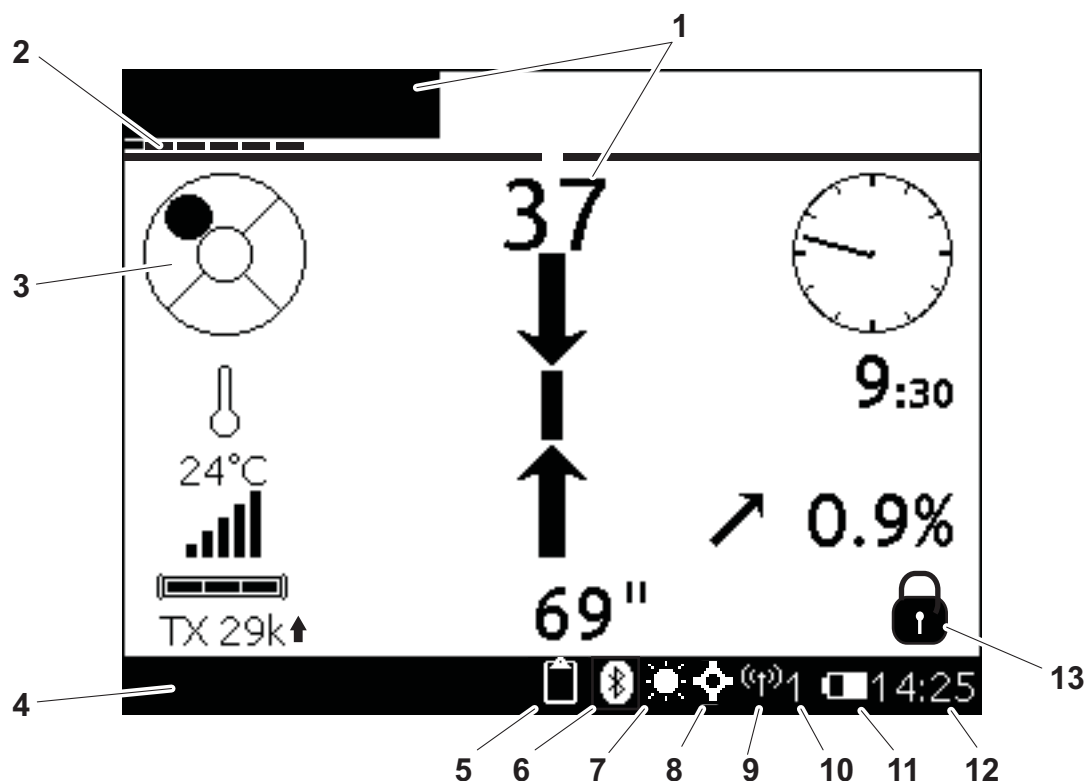
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TK, TKD, TKQ

Tracker Status Icons



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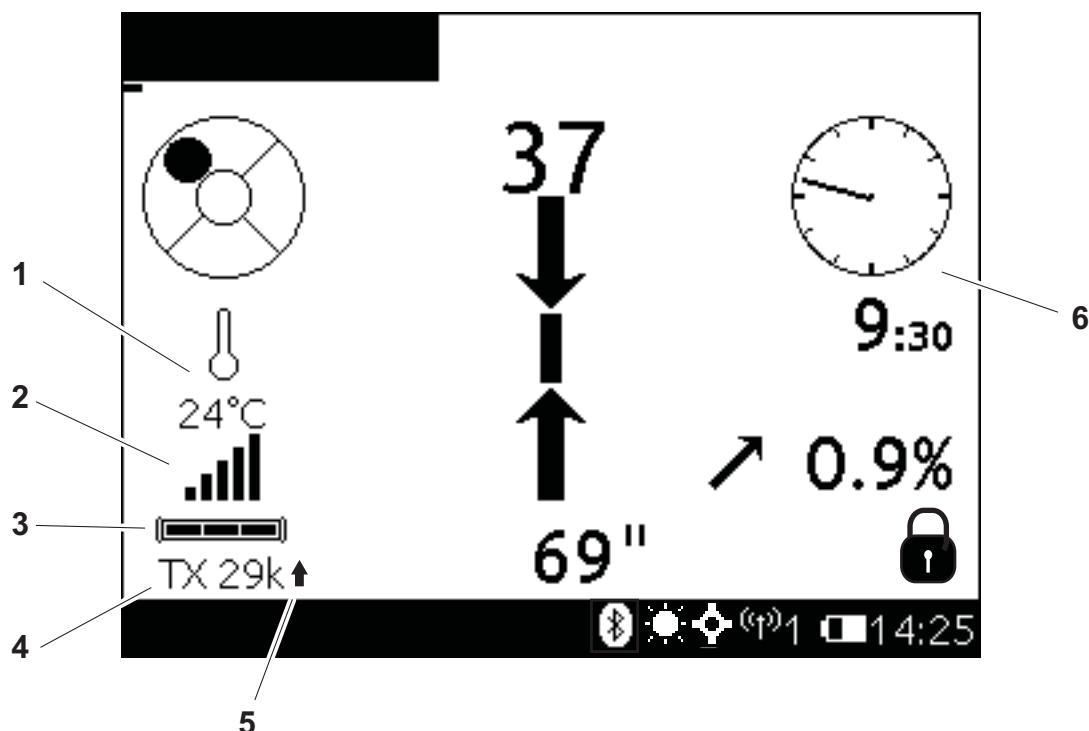
- | | |
|------------------------------------|--------------------------------|
| 1. Signal bar/number | 8. Location active indicator |
| 2. Fine gain/Course gain | 9. Telemetry indicator |
| 3. Bubble level | 10. Telemetry channel |
| 4. Message display | 11. Tracker battery indicator |
| 5. Logging indicator | 12. Clock |
| 6. Bluetooth® connection indicator | 13. DrillLok™ status indicator |
| 7. Backlight indicator | |

Item	Description	Notes
1. Signal strength	Shows signal strength in both bar and numerical form.	

Item	Description	Notes
2. Fine gain	Shows fine gain as a 10-segment bar.	Press up arrow or down arrow to adjust signal gain.
Course gain	Shows course gain as a 2-segment bar: <ul style="list-style-type: none"> One bar displayed indicates shallow mode. Two bars displayed indicates deep mode. 	To change from shallow mode to deep mode, adjust fine gain.
3. Bubble level	Indicates horizontal and vertical tilt of tracker.	
4. Message display	Displays information such as software version, logging status, beacon temperature warning, and low battery alert.	
5. Logging indicator	Lights when logging function is active.	
6. Bluetooth® connection indicator	Lights when Bluetooth connection is established.	
7. Backlight indicator	Lights when backlight is on.	To improve battery life, turn off the backlight. See "Settings Menu" on page 24.
8. Location active indicator	Lights when tracker is connected to a GPS device via Bluetooth wireless technology.	
9. Telemetry indicator	Indicates tracker is transmitting signal.	
10. Telemetry channel	Displays telemetry channel selection.	
11. Tracker battery indicator	Indicates amount of battery power remaining for the tracker.	
12. Clock	Displays time.	To set time, see "System Menu" on page 25.
13. DrillLok™ status indicator	Displays DrillLok status of connected TD display and associated drill.	If equipped. See "DrillLok" on page 41.



Beacon Status Icons



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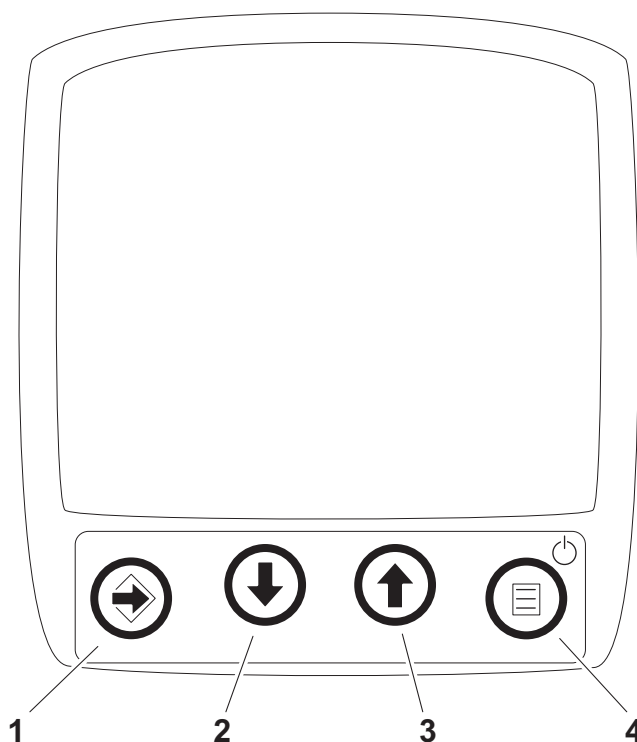
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|---------------------------------|-------------------------------|
| 1. Beacon temperature indicator | 4. Beacon frequency indicator |
| 2. Beacon signal indicators | 5. Beacon mode indicator |
| 3. Beacon battery indicator | 6. Beacon roll indicator |

Item	Description	Notes
1. Beacon temperature indicator	Displays beacon temperature. Operating temperature is between -04°F (-20°C) and 176°F (80°C). Icon darkens as temperature rises and temperature is displayed numerically below the icon.	IMPORTANT: An audible warning is activated when beacon temperature is above 160°F (72°C).
2. Beacon signal indicators	Shows strength of beacon signal received by tracker.	
3. Beacon battery life indicator	Graphically indicates battery life remaining.	

Item	Description	Notes
4. Beacon frequency indicator	Displays active beacon frequency.	
5. Beacon mode indicator	Up or down arrow indicates if beacon is active in Up mode or Down mode. "?" indicates beacon mode is not known and beacon depth readings could be inaccurate.	See "Program Beacon" on page 37 and "Select Beacon Mode" on page 38.
6. Beacon roll indicator	Indicates beacon roll position in degrees, minutes or hours.	



Buttons









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- | | |
|----------------|---------------|
| 1. Select/Send | 3. Up |
| 2. Down | 4. Power/Menu |

Item	Description	Notes
1. Select/Send	<p>In Menu Mode, press to select item shown on screen.</p> <p>In Tracking Mode, press to send depth to remote display.</p>	
2. Down	<p>In Menu Mode, press to move selection down.</p> <p>In Tracking Mode, press to decrease signal gain.</p>	
3. Up	<p>In Menu Mode, press to move selection up.</p> <p>In Tracking Mode, press to increase signal gain.</p>	
4. Power/Menu	<p>To turn unit on, press once.</p> <p>To turn unit off, press for 2 seconds.</p> <p>To access menu or return to a previous menu, press less than 2 seconds.</p>	







Menus


Beacon Menu

Description	Notes
 Calibrate Depth	Sets built-in adjustment of tracker-to-beacon communication to provide accurate depth measurements.
 Frequency	Sets tracker receiving frequency. Available settings: TX1.5K, TX12K, TX20K, TX29K, 86B 12K, 86B 29K.
 Calibrate Roll	Sets roll position for beacon equivalent to bit pointing up (12 o'clock, 0 minutes, 0°).
 Calibrate Pitch	Sets 0.0% pitch position for grade beacon (1.0% limit).
 Configuration	Shows TX series beacon Bluetooth devices available for connection. After connection, shows beacon data. Sets the operating modes of configurable beacons.
 Arrow Lock	Adjusts the range at which the locate arrows lock onto the beacon signal. Select the default setting for shallow bores, use Wide for deep bores, and Widest for extreme cases.









Wireless Menu







Description	Notes
 Telemetry	Selects or disables telemetry mode. Available settings: off, Bluetooth, Long Range (TKD or TKQ only)
 Channel	Sets telemetry channel when using UHF Long Range radio for telemetry. Available settings: 1 (default) through 15 Note: The number of available channels will vary based on region or country configuration.
 Bluetooth®	Scans for and manage Bluetooth device connections.
If equipped with DrillLok™ feature:	
 DrillLok	Enables or disables thrust and rotation of drilling unit. Available settings: Disable Rig (default), Enable Rig
 DrillLok Base	Selects base station code for DrillLok feature corresponding to code on DrillLok-enabled TD display or DrillLok base station.
If not equipped with DrillLok feature (equipped with Tracker Control):	
 Tracker Control	Enables or disables thrust and rotation of drilling unit. Available settings: Disable Rig (default), Enable Rig.

Description	Notes
 Tracker Control code	Selects code for Tracker Control feature corresponding to code on TD display.





Settings Menu

Description	Notes
 Language	Selects user interface language.
 Units	Selects the units for displaying temperature, distance, pitch and roll.
 Backlight	Selects backlight setting. Available settings: Off, On, or Auto. Note: To save battery life, operate with backlight off when possible.
 Clock	Sets the system time.
 Volume	Controls volume of the signal audio volume level. Available settings: mute, low, high (default). IMPORTANT: Beacon temperature warning is always audible.
 Auto Power Off	Enables or disables a five-minute inactivity shutdown. Available settings: enabled (default), disabled.

Logging Menu

Description	Notes
 Logging Mode	Selects or disables the logging mode. Available settings: disable, manual, auto-log
 New Log	Creates a new log file.
 Log Manager	Manages log files. Available settings: select, view, send, send as 750, or delete.
 TMS Plus	Connects to TMS Plus software.
 Delete All Logs	Deletes all log files stored on the tracker.
 Delete Last Pipe	Deletes the last point information from the current log file.

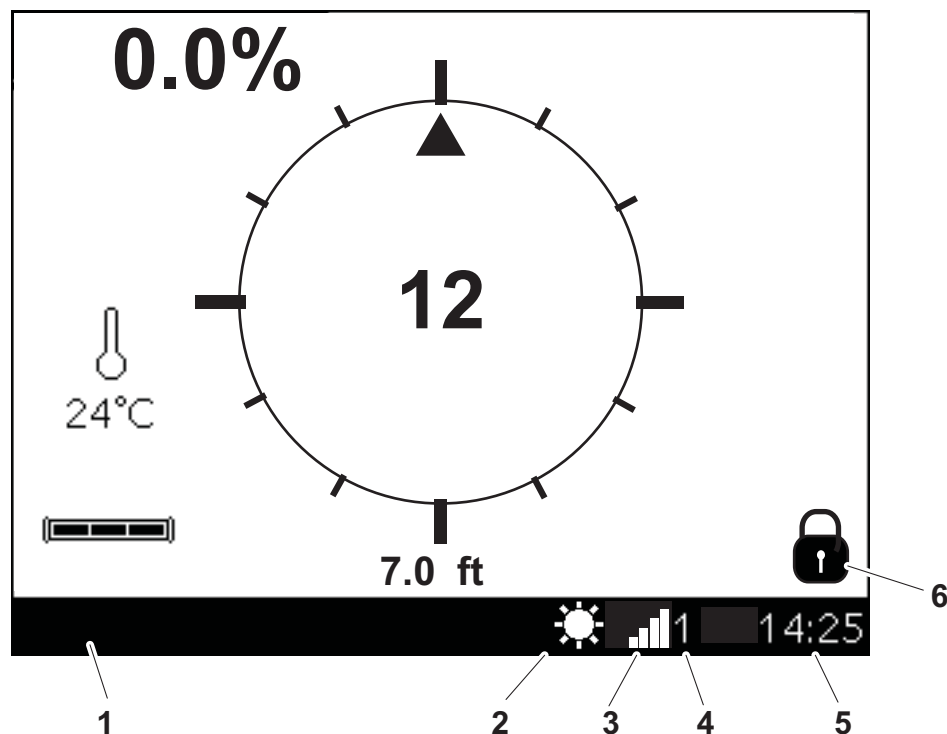
System Menu

Description	Notes
 About	Lists hardware and software versions, serial number, and copyright information.
 Diagnostics	Displays troubleshooting and diagnostic options.
 Software Update	Launches a software update.
 Analyzer	Launches the Bore Path Analyzer.



TD, TDR

Display Status Icons



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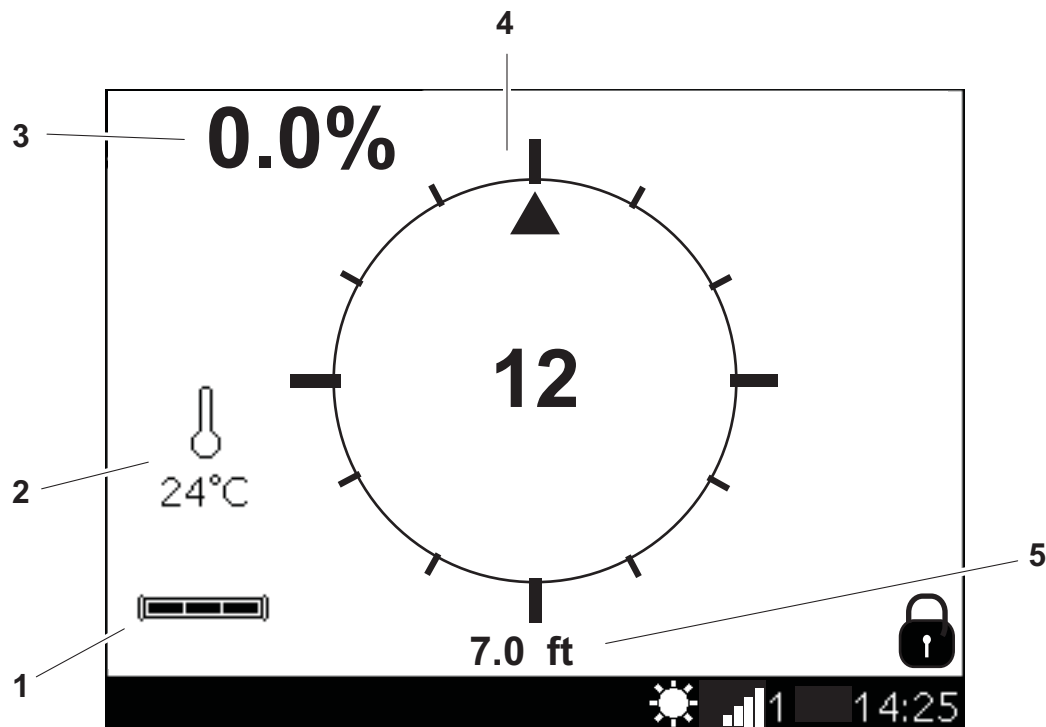
- | | |
|------------------------|-------------------------------|
| 1. Message display | 4. Telemetry channel |
| 2. Backlight indicator | 5. Clock |
| 3. Tracker signal | 6. DrillLok™ status indicator |

Item	Description	Notes
1. Message display	Displays information such as software version, logging status, beacon temperature warning, and low battery alert.	
2. Backlight indicator	Shows if backlight is on.	See "Settings Menu" on page 33.
3. Tracker signal strength	Indicates strength of tracker radio signal received by display.	White bars indicate good reception; hollow or black bars indicate poor reception.
4. Telemetry channel	Displays telemetry channel selection.	

Item	Description	Notes
5. Clock	Displays time.	
6. DrillLok™ status indicator	Displays DrillLok status of connected TD display and associated drill.	If equipped. See "DrillLok" on page 41.



Beacon Status Icons



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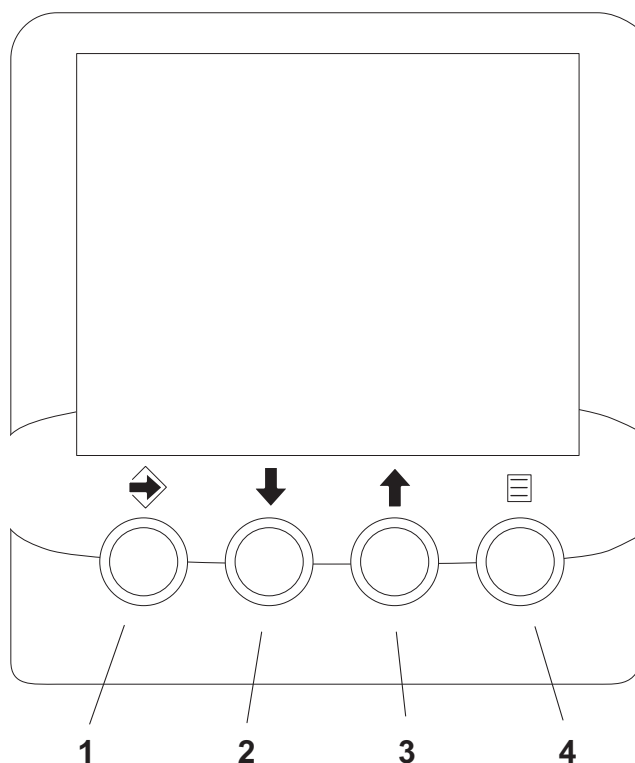
- | | |
|------------------------|-----------------------------|
| 1. Beacon battery life | 4. Beacon roll indicator |
| 2. Beacon temperature | 5. Beacon depth measurement |
| 3. Beacon pitch | |

Item	Description	Notes
1. Beacon battery life	Graphically indicates battery life remaining.	
2. Beacon temperature	Displays beacon temperature. Icon darkens as temperature rises and temperature is displayed numerically below the icon.	
3. Beacon pitch	Displays pitch of beacon in percent grade or degrees. The arrow behind the value indicates whether pitch is positive or negative.	
4. Beacon roll indicator	Graphically and numerically indicates beacon's roll position.	

Item	Description	Notes
5. Beacon depth	Displays beacon depth received from tracker.	



Buttons



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- | | |
|----------------|---------------|
| 1. Select/Send | 3. Up |
| 2. Down | 4. Power/Menu |







Item	Description	Notes
1. Select/Send	Press to select item shown on screen. When connected to TMS Plus or OGMS: Press to send data for current pipe to TMS Plus or OGMS.	
2. Down	In Tracking Mode, press to delete the last stored pipe information. In Menu Mode, press to move selection down.	
3. Up	In Tracking Mode, press to recall the last stored pipe information or to query the next pipe data from TMS Plus. In Menu Mode, press to move selection up.	

Item	Description	Notes
4. Power/Menu	To turn on, press once. To turn off, press for 2 seconds. Press button less than 2 seconds to access menu. Press at any time to return to previous menu.	








Menus





Logging Menu

Description	Notes
 Logging Mode	Selects or disables the logging mode. Available settings: disable, manual, auto-log
 New Log	Creates a new log file.
 Log Manager	Manages log files. Available settings: select, send, send as 750, or delete
 TMS Plus	Accesses TMS Plus tracking software. Available options: Download All, Connect.
 Delete All Logs	Deletes all log files stored on the tracker.
 Delete Last Pipe	Deletes the last point information from the current log file.

Wireless Menu




Description	Notes
 Telemetry	Selects or disables telemetry mode. Available settings: Long Range, Bluetooth, 8500TK.
 Channel	Sets telemetry channel when using UHF Long Range radio for telemetry. Available settings: 1 (default) through 15 Note: The number of available channels will vary based on region or country configuration.
 Bluetooth	Scans for and manages Bluetooth device connections.
If equipped with DrillLok™ feature:	
 DrillLok Remote	Selects remote device code for DrillLok feature corresponding to code on DrillLok-enabled TK or DrillLok remote.
If not equipped with DrillLok feature (equipped with Tracker Control):	
 Tracker Control	Displays control code to pair with tracker to enable or disable thrust and rotation of drilling unit.

Settings Menu

Description	Notes
 Language	Controls user interface language.
 Units	Selects the units for displaying temperature, distance, pitch and roll.
 Backlight	Selects backlight setting. Available settings: Off, On, or Auto Note: To save battery life, operate with backlight off when possible.
 Clock	Sets the system time.



System Menu

Description	Notes
 About	Lists hardware and software versions, serial number, and copyright information.
 Diagnostic	Displays troubleshooting and diagnostic options.
 Software Update	Launches a software update. Options: Continue, Cancel.

System Operation

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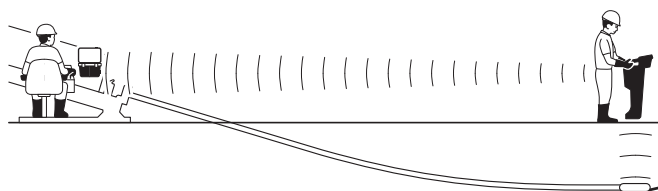
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Tracking Overview

The TK Series Guidance System is designed to function with horizontal directional drilling units. The system is composed of three components: beacon transmitter, tracking unit, and display unit.

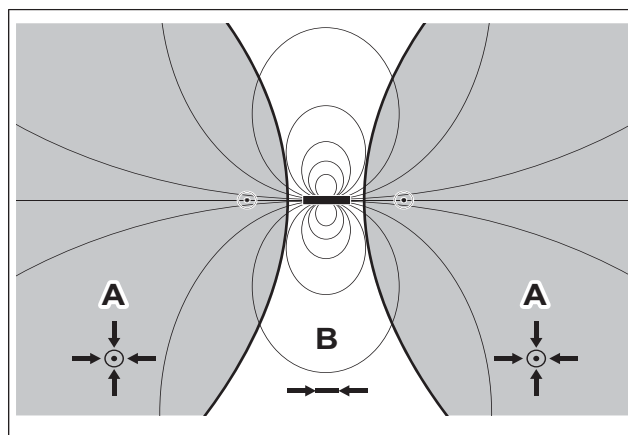


TX, TXH, TXQ, and TXQG beacons transmit roll angle, beacon temperature, beacon battery status, and pitch information and perform best in approved tool housings.

TK trackers detect beacon transmission and relay data to TD displays onboard the drilling unit. The tracking data can be logged and transferred to tracking software.

TX series beacons emit a dipole magnetic field that can be used multiple ways to determine beacon position. The beacon is always located at peak signal strength between two null points (also known as ghost signals). The peak signal strength region (B) is located directly over the beacon. The two null point regions (A) are located in front of and behind the beacon.

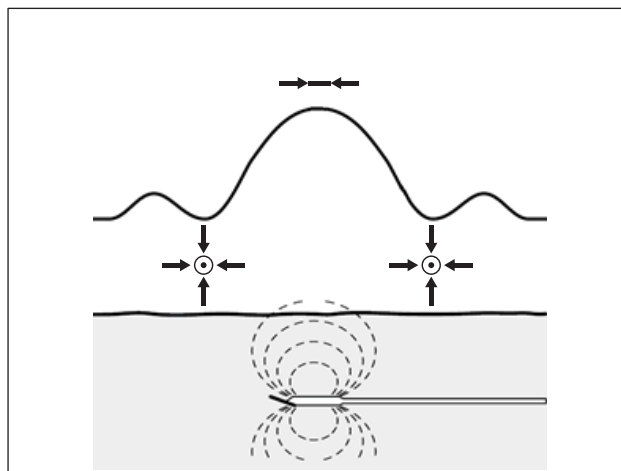
If the TK tracker is in one of the null point regions, the null point icon (A) will be displayed with fore/aft and/or left/right arrow showing the direction to move the tracker to the null point.



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If the tracker is in the peak signal strength region, the beacon icon (B) will be displayed as well as a fore/aft arrow to guide the tracker over the plane perpendicular to the beacon axis.

When the beacon has been correctly located, the depth reading is displayed.



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Setup



WARNING

Potential radio frequency (RF) hazard. Operating this device within 4" (100 mm) of your body may cause RF exposure levels to exceed FCC RF exposure limits and should be avoided.

To help avoid injury, this device must not be co-located with any other radio transmitter.

Analyze Bore Path (TKD and TKQ)

The Bore Path Analyzer analyzes active interference (noise) along the bore path and recommends frequencies that will ensure the best communication for accurate depth and location. Active interference is any magnetic field generated by a source other than the beacon, such as power lines, traffic loops, cable TV, and phone lines that decreases the communication range of the tracker. This feature does not analyze passive interference (fences, metal pipe, and vehicles), which distorts the signal and shape of the beacon dipole field, and thus distorts location and depth.



1. Ensure that no active beacons are operating in the area.
2. Place the TK tracker at the position where the bore will be started.
3. Navigate to **System>Analyzer**
4. To clear any previous readings, press and hold the **Select/Send** button.
5. Press the **Select/Send** button. Tracker will analyze frequency noise at that position.
6. Move tracker to next position along the intended bore path.
7. Repeat steps 3 and 4 until a full noise plot is recorded.
8. At the end of the bore path, press the **Menu** button to display the recommended beacon frequency.

Program Beacon (TXQ and TXQG)

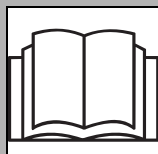
1. On the TK tracker, navigate to **Beacon>Configuration**.
2. Scan for available devices, then select a beacon to connect. Once connected, view the beacon information screen, noting the settings for UP mode and DOWN mode.
3. Select **Set Modes** and follow prompts to program frequency and power level for UP and DOWN modes.

Activate Beacon

Activate beacon by tightening battery cap and rolling it clockwise two times.

Beacon will deactivate (sleep) after 20 minutes of inactivity. To force deactivation, set the beacon to the 5 o'clock roll position and wait 5 minutes.

Select Beacon Mode (TXQ and TXQG)

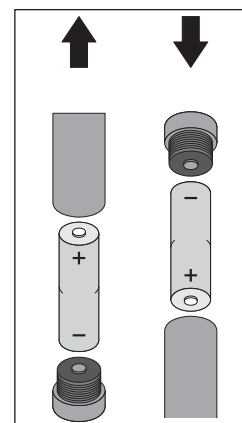


WARNING Read operator's manual. Know how to use all controls. Your safety is at stake. 273-475

To help avoid injury, learn to monitor the beacon mode indicator (see page 20). If the tracker is unsure of the beacon mode, a "?" will be displayed to warn the operator that depth shown could be inaccurate.

TXQ and TXQG multiple frequency beacons are capable of transmitting at multiple frequency/power levels; however, only two frequency/power combinations can be stored to the beacon at one time. This creates two operation modes: UP and DOWN.

1. Unscrew cap.
2. Check for and correct the following conditions:
 - dirty or damaged threads.
 - missing, dirty or worn foam washer on battery cap and bottom of battery chamber.
 - missing, worn or damaged springs.
 - missing, damaged or dirty o-ring. Clean or replace as needed.
3. Insert, positive end first, one Power Stick battery (p/n 222-1369) or one Electrochem CC 3.67 V Lithium.
 - **To select up mode**, hold beacon vertical to the ground with the forward isolator pointing toward the sky.
 - **To select down mode**, hold beacon vertical to the ground with the forward isolator pointed toward the ground.
4. Install batteries. Keep beacon steady while hand tightening cap firmly. Use tracker to confirm beacon is functioning.



Batteries_B.eps

Note: Frequencies may be switched after they are initially set. See "Switch Frequency Downhole" section.

IMPORTANT: For maximum performance, use only Power Stick battery (p/n 222-1369) or Electrochem CC 3.67 V Lithium batteries. Standard "C" cell alkaline batteries can cause intermittent operation and beacon signal errors.

Change Mode Downhole

To change mode downhole, allow beacon to go into sleep mode, then wake beacon within 1 minute.

Install Beacon into Tool Housing

IMPORTANT: Check beacon operation and condition of both isolators before installing beacon into tool housing.

1. Place beacon into tool housing with flat top of isolator toward bit, facing up.
2. Check for proper beacon alignment by rolling housing on the ground and watching for corresponding roll positions on tracker display.

Calibrate Tracker to Beacon

IMPORTANT: Ensure no metal objects including drilling unit and drill pipe are within 20' (6 m) of tracker and toolhead.



Manual Method

TX and TXH beacons have one-way communication with the tracker. To accurately scale depth, calibrate the tracker to the beacon.

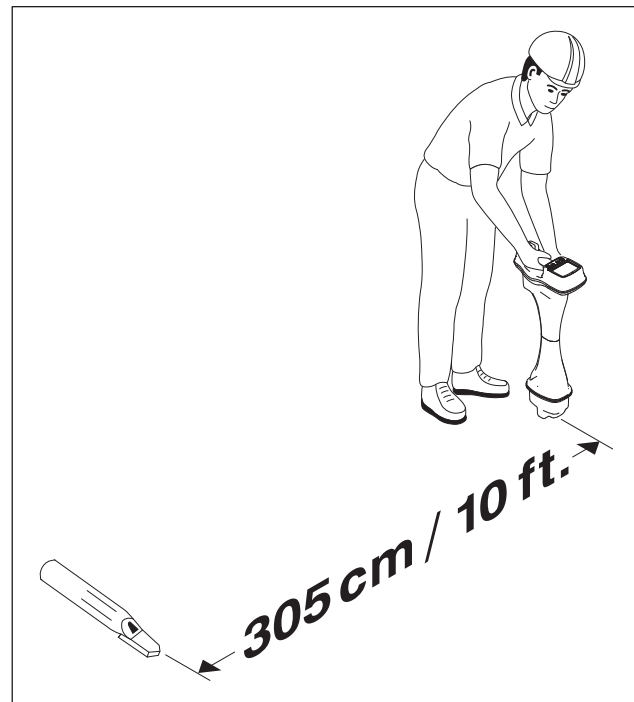
1. Activate beacon and place on ground exactly 10 ft (305 cm) from tracker, as shown.
2. Position tracker parallel to center of beacon.
3. Select **Beacon>Calibrate Depth** and follow prompts.

IMPORTANT: If using a multi-frequency 86 Series beacon or a multi-mode TX series beacon, calibrate each frequency separately.

Bluetooth Method

TXQ and TXQG beacons utilize Bluetooth radios for two-way communication with the tracker. Once the tracker is paired to the beacon, calibration takes place automatically. To pair the tracker with the beacon:

1. Activate the beacon.
2. On the tracker, go to **Wireless>Bluetooth**. Select the correct **TX_0000** beacon to create a connection.
3. Select **Beacon>Calibrate Depth** and follow prompts. This step will calibrate both UP and DOWN modes.



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Roll and Pitch Calibration

Roll calibration is only necessary if using a TX beacon in a non-standard housing. To calibrate roll, install beacon into housing, navigate TK tracker to **Beacon>Calibrate Roll** and follow prompts.

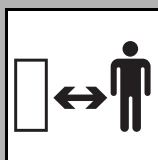
Pitch calibration is only necessary when using a grade beacon (86G or TXQG). To calibrate pitch, install beacon into housing and level housing to 0%. On the tracker, check the beacon pitch reading. If the reading is a value other than zero, navigate to **Beacon>Calibrate Pitch** and follow prompts until the tracker shows a pitch value of 0%.

Test Beacon Operation

Step approximately 15' (4.57 m) from beacon. Turn on tracker, select frequency, check beacon mode, and adjust gain so that signal strength is approximately 50%.

- Roll beacon and look at display for corresponding roll positions.
- Tilt beacon and look at display for corresponding pitch positions.
- Check beacon battery status and temperature.

Activate DrillLok™/Tracker Control



⚠ DANGER

Rotating shaft will cause death or serious injury. Stay away.

To help avoid injury, do not stand or walk over the bore path while drill string is moving during drilling and backreaming.

TK tracker and TD display units that support the DrillLok feature are capable of bi-directional communication between the TK and the TD. Prior units support the Tracker Control feature. If a unit supports the DrillLok feature, the DrillLok logo will appear on the startup splash screen.

DrillLok

DrillLok allows the tracker operator to disable hydraulic thrust and rotation power to a compatible Ditch Witch® drilling unit within 16 seconds. **This mode will not stop thrust and rotation immediately.**

IMPORTANT: In order for the DrillLok feature to work, the TK and TD must both be DrillLok-enabled.

The status of the drilling unit is relayed back to the tracker so the tracker operator has confirmation of the drilling unit state. When the drilling unit is disabled by the tracker operator, green DrillLok/tracker control strobe on the drilling unit will light and thrust and rotation will be disabled within 16 seconds.

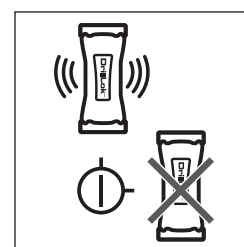
IMPORTANT:

- If thrust and rotation do not work, check to see if green DrillLok/tracker control strobe on drilling unit is on. If it is, the tracker user has selected to disable thrust and rotation. If the drilling unit cannot be enabled, install tracker control key on drilling unit and turn to the deactivated position to override the DrillLok system. Strobe light will go off and thrust and rotation will function.
- The tracker operator cannot stop thrust and rotation from the tracker with the DrillLok/tracker control key installed in drilling unit and turned to the Disable position.
- See the drilling unit operator manual for more information.



Operation


1. Turn on drilling unit, display, and tracker.
2. On tracker, navigate to **System>About**. Note code. (The code is the last four digits of the tracker serial number.)
3. On display, navigate to **Wireless>DrillLok™ Remote**. Enter code from tracker using the **Up** and **Down** arrows for each digit. Press **Select/Send** to save the desired number for each digit.
4. On display, navigate to **System>About**. Note code. (The code is the last four digits of the display serial number.)
5. On tracker, navigate to **Wireless>DrillLok Base**. Enter code from display using the **Up** and **Down** arrows for each digit. Press **Select/Send** to save the desired number for each digit.
6. Turn DrillLok/tracker control key to activated position.
7. Remove DrillLok/tracker control key from drilling unit and keep in tracker operator's possession.
8. Ensure tracker and display are on the same telemetry channel and are communicating.
9. On tracker, navigate to **Wireless>DrillLok** and select **Enable**.
10. Drill and track bore until drill head enters target pit or exits ground.
11. On tracker, navigate to **Wireless>DrillLok** and select **Disable**. After 8-16 seconds, green DrillLok/tracker control strobe on drilling unit will come on and hydraulic power to thrust and rotation will be disabled. The drilling unit status will be updated on the tracker screen to the locked icon.
12. If locked icon appears on tracker, change downhole tools.
13. Navigate to **Wireless>DrillLok** and select **Enable**. After 8-16 seconds, the DrillLok/tracker control light on the drilling unit will go off, the status icon on the tracker will be updated, and thrust and rotation will function.



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If you are not tracking backreamer's path, install DrillLok/tracker control key on drilling unit and turn to the Override position to override DrillLok system. The DrillLok/tracker control light on the drilling unit will go off and thrust and rotation will function.

DrillLok™ Status Icons

Item	Description
	The drilling unit thrust and rotation are locked out. The hydraulic thrust and rotation power is disabled and the green DrillLok/tracker control strobe light on the drilling unit is flashing.

IMPORTANT: If communication is interrupted between tracker and display, drilling unit will remain at its previous state.

Tracker Control

Tracker Control allows the tracker operator to disable hydraulic thrust and rotation power to a compatible Ditch Witch® drilling unit within 16 seconds. **This mode will not stop thrust and rotation immediately.**

When tracker and display communications cease, green DrillLok™/tracker control strobe on drilling unit will light and thrust and rotation will be disabled.

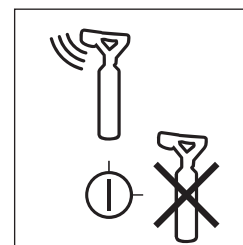
IMPORTANT:

- If thrust and rotation do not work, check to see if DrillLok/tracker control strobe on drilling unit is on. If it is, communication has probably stopped between tracker and display or tracker is set to incorrect code. If communication cannot be restored, install tracker control key on drilling unit and turn to the deactivated position to override tracker control. Strobe light will go off and thrust and rotation will function.
- Tracker operator cannot stop thrust and rotation from tracker with tracker control key installed in drilling unit and turned to disable position.
- See the drilling unit operator manual for more information.



Operation

1. Turn on drilling unit, display, and tracker.
2. On display, navigate to **Wireless>Control Code**. Note code. (The code is the last four digits of the display serial number.)
3. On tracker, navigate to **Wireless>Control Code**. Enter code from display using the **Up** and **Down** arrows for each digit. Press **Select/Send** to save the desired number for each digit.
4. Turn DrillLok/tracker control key to activated position.
5. Remove tracker control key from drilling unit and keep in tracker operator's possession.
6. On tracker, navigate to **Wireless>Tracker Control**. Select **Enable**.
7. Drill and track bore until drill head enters target pit or exits ground.
8. Turn off tracker. After 8-16 seconds, DrillLok/tracker control light on drilling unit will come on and hydraulic power to thrust and rotation will be disabled.
9. Change downhole tools.
10. Turn on tracker and enable code transmission. After 8-16 seconds, DrillLok/tracker control light on drilling unit will go off and thrust and rotation will function.



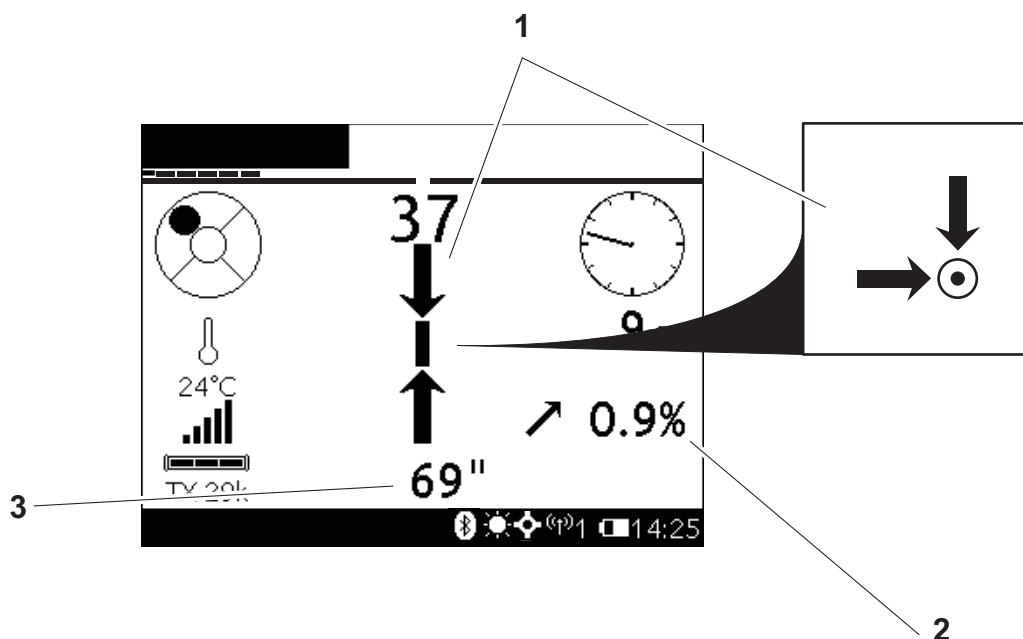
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If you are not tracking backreamer's path, install tracker control key on drilling unit and turn to the Override position to override tracker control. Tracker control light on drilling unit will go off and thrust and rotation will function.

Locate

The tracker has two modes: walkover location and drill-to. Use walkover location to find the position of the beacon. Once the tracker is in or near the beacon plane, view the depth, pitch, and roll position. In drill-to mode, the tracker is placed along the intended bore path and provides steering corrections for the drilling unit operator to drill that path.

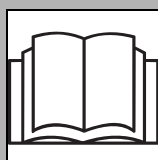
Walkover Location



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- | | |
|------------------|-----------------|
| 1. Locate arrows | 3. Beacon depth |
| 2. Beacon pitch | |

Item	Description	Notes
1. Locate arrows	Indicates direction to move tracker to locate beacon.	
2. Beacon pitch	Displays pitch of beacon in percent grade or degrees.	
3. Beacon Depth	Displays depth of beacon when beacon is properly located.	



Read operator's manual. Know how to use all controls.
Your safety is at stake. 273-475

To help avoid injury, do not stand or walk over the bore path while drill string is moving (during drilling and backreaming).

NOTICE: High temperature is the primary cause of beacon failure. Monitor beacon temperature carefully.

- **If temperature goes above 160°F (70°C)**, stop drilling, pull back 3' (.9 m), and pump fluid into hole until beacon cools.
- Operating beacon at temperatures above 176°F (80°C) will cause beacon overheating and failure and will void beacon warranty. Monitor beacon temperature carefully.
- Operating fluid-assisted drilling system without proper fluid flow will cause overheating and damage to beacon and tool head.



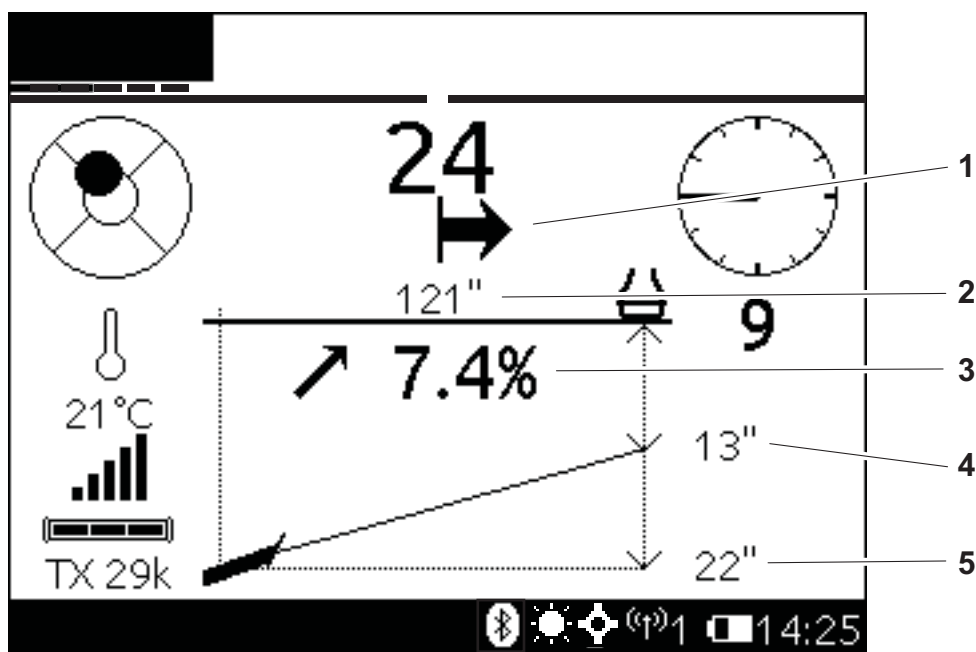
Peak Location

1. Walk bore path with bottom of tracker parallel to beacon. Do not hold tracker at right angle to beacon.
2. Move until beacon icon is shown and both fore/aft arrows are shown. Sweep tracker from side to side and use signal strength display to find lateral location of beacon. The beacon is located at the point where the signal strength number is the highest and the bar graph indicator is highest.
3. Step back until null point icon is shown and sweep tracker side to side until both left/right arrows are on.
4. Move forward until beacon icon is shown and both fore/aft arrows are lit.
5. Press the **Select/Send** button to log depth estimate. Mark location.

Null Point Location

1. Starting from behind the beacon, walk until the null point icon is displayed. Follow arrows and minimize signal strength to find and mark the null point.
2. Walk forward through the beacon region and into the opposite null point region. Find and mark the null point.
3. Walk backwards along the line connecting the two null points until the beacon icon is displayed and fore/aft arrows are lit.
4. Press the **Select/Send** button to log depth estimate. Mark location.

Drill-To Location Mode

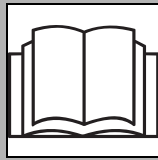


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- | | |
|------------------------|--------------------------------|
| 1. Steering arrow | 4. Approximate projected depth |
| 2. Horizontal distance | 5. Approximate current depth |
| 3. Beacon pitch | |

Item	Description	Notes
1. Steering arrow	Indicates which direction the operator needs to move to correctly align with the tracker.	If the tool head is directly in line with the tracker, the arrow will become a diamond.
2. Horizontal distance	Displays horizontal distance from the tracker antenna to a point directly above the beacon.	
3. Beacon pitch	Displays pitch of beacon in percent grade or degrees. The orientation of the arrow indicates whether the pitch is positive or negative.	
4. Approximate projected depth	Displays projected depth directly below the tracker antenna assuming the beacon proceeds at its current pitch reading.	
5. Approximate current depth	Displays current depth of the beacon from the tracker antenna assuming flat terrain.	

Procedure

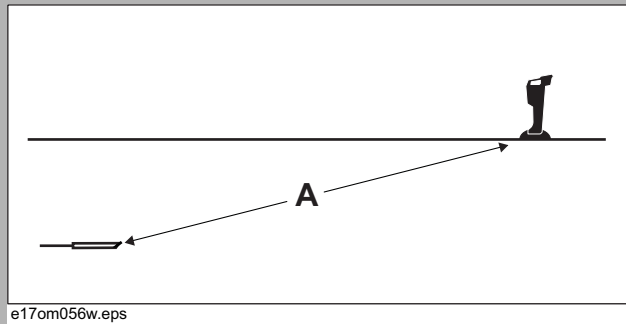


WARNING

Read operator's manual. Know how to use all controls.
Your safety is at stake. 273-475

To help avoid injury:

- If location and depth are critical, confirm by hand-digging.
- Do not stand or walk over the bore path while drill string is moving (during drilling and backreaming).
- If the distance between the tracker and the beacon is greater than 35' (11.7 m), tracker will only display a radial distance estimate (A) and steering correction arrow instead of distance, pitch and depth estimates.



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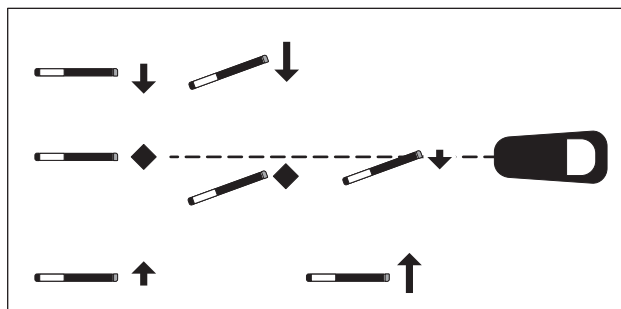
1. Place tracker in tracker stand along intended bore path with the battery caps facing toward the rig. Use the bubble level to ensure tracker is positioned correctly.
2. Drill as usual. Use the TD to monitor steering arrows, current depth, horizontal distance, and projected depth.

IMPORTANT:

- Verify beacon location using walkover mode in critical situations, as accuracy decreases with distance.
- The tracker must be kept in front of the beacon and above the beacon. The beacon must be projecting below the tracker to give correct results.
- Doubleclick the **Select/Send** button to switch between walkover and drill-to modes.

Steer

The steering arrow displays the correction required to guide the beacon back to the bore path defined by the tracker's location and orientation.



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Displayed Information

Beacons send a variety of information to tracker. All Subsite® Electronics beacons send pitch, roll, temperature and battery information.

Roll

Beacon roll information is useful in determining the direction that the drilling tool will tend to travel when pushed without rotation. The following chart shows typical tool face roll indications for directional drilling.

When beacon roll shows . . .	Drilling tool will move . . .
1 or 2 o'clock	up and right
3 o'clock	right
4 or 5 o'clock	down and right
6 o'clock	down
7 or 8 o'clock	down and left
9 o'clock	left
10 or 11 o'clock	up and left
12 o'clock	up



Depth

All tracking and locating systems are subject to interference. To quickly check for interference, raise tracker 1' (0.3 m) and make second depth estimate. If the difference between the two estimates is not 1' (0.3 m), there is interference.

Pitch

Tracker shows pitch (% grade) when used with beacons that provide this information (see specific beacon literature).

Pitch shows beacon grade in percentages from down arrow 99% (45 degrees down) to up arrow 99% (45 degrees up). Tracker displays this information to the left of roll display.

Grade beacons will send pitch in 0.1% increments from 1-45% and in 1% increments from 45-90%.

% of grade	Rise/drop US (metric)	% of grade	Rise/drop US (metric)	% of grade	Rise/drop US (metric)
1	1" (25 mm)	12	1' 2" (356 mm)	45	4' 1" (1.24 m)
2	2" (51 mm)	14	1' 5" (432 mm)	50	4' 6" (1.37 m)
3	4" (102 mm)	16	1' 7" (483 mm)	55	4' 10" (1.47 m)
4	5" (127 mm)	18	1' 9" (533 mm)	60	5' 2" (1.57 m)
5	6" (152 mm)	20	2' (610 mm)	65	5' 5" (1.65 m)
6	7" (178 mm)	24	2' 4" (711 mm)	70	5' 9" (1.75 m)
7	8" (203 mm)	28	2' 8" (813 mm)	75	6' (1.83 m)
8	10" (254 mm)	32	3' 1" (940 mm)	80	6' 3" (1.91 m)
9	11" (279 mm)	36	3' 5" (1.04 m)	90	6' 8" (2.03 m)
10	1' (305 mm)	40	3' 9" (1.14 m)	99	7' (2.13 m)

Finish Locating

When location is complete, remove beacon from tool housing before mud in beacon chamber hardens and seizes beacon into housing.

1. Remove beacon from tool housing.

IMPORTANT: If beacon will not come out, **do not use force**. Try soaking housing in water until dried mud inside housing softens. If beacon still will not come out, contact your equipment dealer for advice.

2. Clean beacon and remove battery.
3. Wash and lubricate tool housing.



Log Data

Tracking data can be saved to a file on the tracker or the display and transferred directly to a personal computer with TSR or TMS PLUS software.

1. Select file to save data:

To create a new log file, navigate to **Logging>New Log**.

To add data to an existing log file, navigate to **Logging>Log Manager**.

Note: All data will be stored to the selected log file until another log file is selected or until logging is disabled.

2. Log data along bore path using Auto-Log or Manual log.

	TK	TD
Auto-Log	Pipe is logged when the Select/Send button is pressed to send depth to display.	Pipe is logged when depth is received from tracker. No user action is required.
Manual log	Pipe is logged after a depth has been sent to the remote display and the Up button is pressed while the depth value is still highlighted.	Pipe is logged when depth has been received from the tracker and the Select/Send button is pressed.

3. When logging is complete, transfer data to a personal computer.

Transfer Data

Using TSR Software

1. Pair the tracker or display and the computer:

On the TK or TD, navigate to **Wireless>Bluetooth** and follow prompts.

Or, on the computer, use the "Add Device" option in the computer's Bluetooth devices menu.

2. Enable the computer to receive files. This procedure varies by manufacturer, but is often done by selecting "Receive File" from the Bluetooth icon in the computer task bar.
3. On the TK or TD, navigate to **Logging>Log Manager**, select the desired log file and press the **Select/Send** button and follow prompts.

Using TMS Plus Software

Use the "Download" option to download log files from the TK or TD. When prompted by TMS Plus, select the virtual COM port assigned to the TK or TD. This port number is stored in the Properties dialog in the Bluetooth Devices folder.

Select **Logging>TMS Plus>Download All** and follow prompts to complete the download. See the TMS Plus operation instructions for more information.

Using Connected Logging

The TD can also connect to the TMS Plus software application and transfer bore data in real time. The TD button functions will change as follows during connected logging:

Button	TMS Live Function
Select/Send	Store/send last depth received from tracker.
Down arrow	Delete last stored pipe
Up arrow	Query next pipe information from TMS Plus.

Service



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General Care

Under normal operating conditions, tracking system components need only minor maintenance. Following these care instructions can ensure longer equipment life:

- Do not drop the equipment.
- Do not expose the equipment to high heat (such as in the rear window of a vehicle).
- Clean equipment with a damp cloth and mild soap. Never use scouring powder.
- Do not immerse in any liquid.
- Inspect housing daily for cracks or other damage. If housing is damaged, contact your equipment dealer for replacement.
- Do not mix new and used batteries.
- Remove battery if storing for an extended period.

As Needed

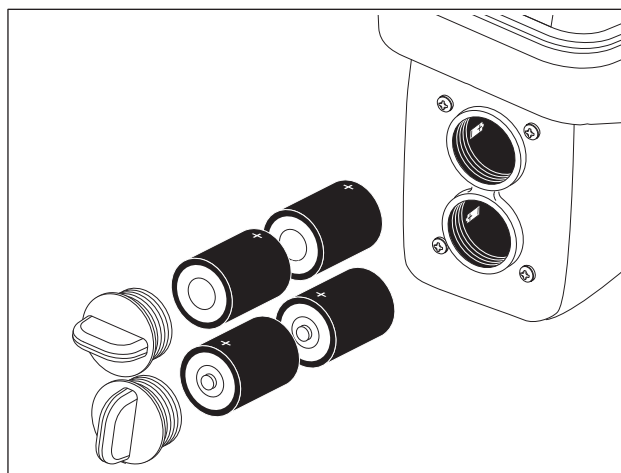
Change Batteries

Tracker

IMPORTANT: Do not mix new and used batteries. Do not mix battery brands or types.

Use four C-cell alkaline or rechargeable Ni-MH batteries in tracker.

1. Remove battery caps.
2. Insert batteries as shown.
3. Install and tighten battery caps.
4. Check operation.

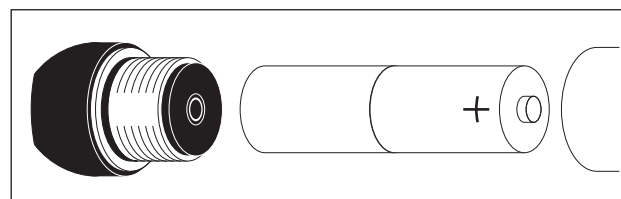


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Beacon

Use one Lithium CC battery or one Power Stick battery (222-1369) in beacon.

1. Remove battery cap.
2. Insert battery as shown.
3. Install and tighten battery cap.
4. Check operation.



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Update Software



Software updates are often available to fix issues, change software behavior, or add software features.

1. Obtain the software update file (TKxxxxxx.TSU for the TK or TDxxxxxx for the TD)
2. Copy the file to a device that supports the Bluetooth OBEX Object Push Profile, such as a computer.
3. Use the **Wireless>Bluetooth** menu to pair the device to the TK or TD unit. Or, use the device to initiate the pairing process.
4. Navigate to **System>Software Update** and press the **Select/Send** button to launch the update process.
5. Once the TK or TD indicates it is waiting for a file, begin the transfer from the sending device. A progress bar will be displayed on the TK or TD and the unit will restart when the update is complete.

Specifications

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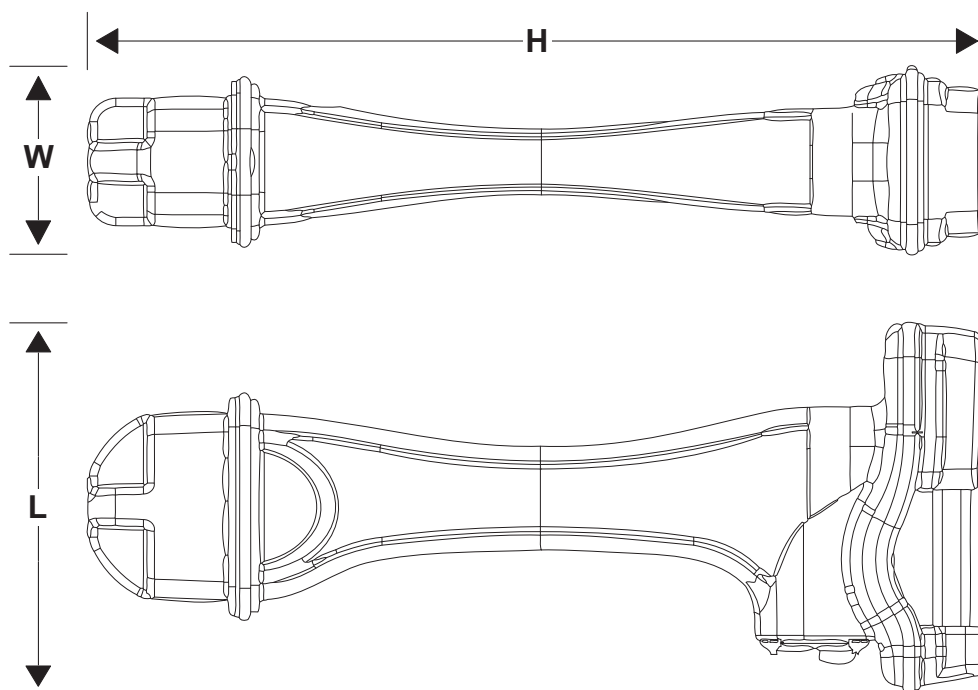
TK Tracker 58

TD Display 60

TX Series Beacons 61



TK Series Tracker



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Dimensions		U.S.	Metric
H	Height	30" max	762 mm max
L	Length	13" max	330 mm max
W	Width	7" max	178 mm max
	Operating weight	9 lb max	4.1 kg max

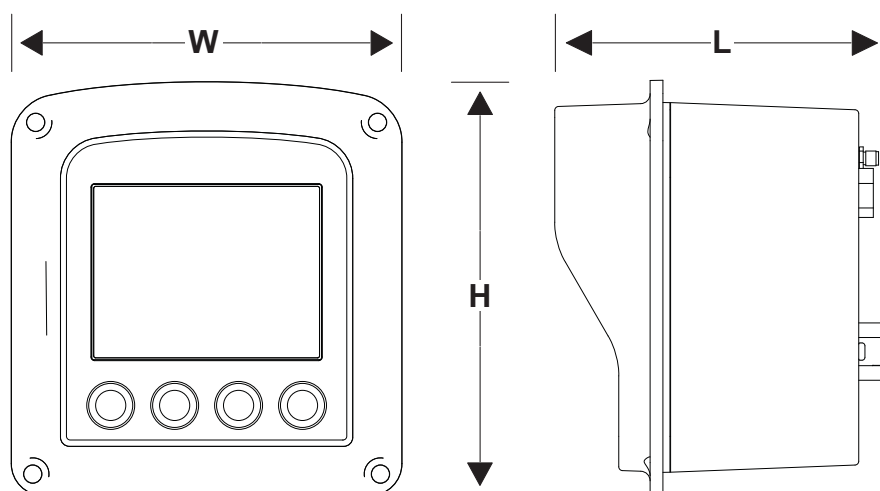
Environmental	U.S.	Metric
Operating temperature	-4°F to 122°F	-20°C to 50°C
Storage temperature	-22°F to 158°F	-30°C to 70°C
IP Rating	IP65	

Performance		U.S.	Metric
TK	Depth distance	>70 ft w/ H power beacon	>18.3 w/ H power beacon
	Depth accuracy	+/- 5% over testable range	
	Telemetry radio range	500 ft	152.4 m
TKD, TKQ	Depth distance	>100 ft w/ H power beacon	>30.5 w/ H power beacon
	Depth accuracy	+/- 5% over testable range	
	Telemetry radio range	2000 ft	610 m

Batteries	
Battery type	C-cell alkaline or C-cell size NiMH rechargeable
Number of cells	4
Battery life	12 hours at room temperature



Universal Display



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Dimensions		U.S.	Metric
TDR (remote version)	Length	6 in. max	152.4 mm max
	Width	6 in. max	152.4 mm max
	Depth	6 in. max	152.4 mm max
TD (in-dash version)	Length	7 in. max	177.8 mm max
	Width	7 in. max	177.8 mm max
	Depth	6.5 in. max	165.1 mm max
Environmental		U.S.	Metric
Operating temperature		-4°F to 140°F	-20°C to 60°C
Storage temperature		-22°F to 158°F	-30°C to 70°C
IP Rating		IP66	
Performance		U.S.	Metric
Telemetry range:	w/ TKD and TKQ	2000 ft	610 m
	w/ TK	500 ft	152.4 m

TX Series Beacons



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Dimensions		U.S.	Metric
L	Length	17.8 in. max	452 mm max
W	Width	1.5 in. max	38 mm max
	Operating weight		

Environmental		U.S.	Metric
Maximum operating temperature		176°F max	80°C max
Maximum fluid pressure		60 psi max	4 bar max
IP Rating		IP67	

Performance

Telemetry Data

	Pitch (TXQG or grade beacons)	1% increments up to 100% (0.1% pitch resolution within 45% of level and 1% pitch resolution at grades between 45% and 100%) Pitch communicated at a minimum rate of 1.5 seconds when a high priority communication does not exist	
	Roll	24 positions (15°) Roll accuracy will be at least 5°, communicated at a minimum of 2.7 rolls per second. Settle time is to be no more than 1 second.	

Depth

TX	with TK	40 ft	12.2 m
	with TKD and TKQ	60 ft	18.3 m
TXH	with TK	70 ft	21.3 m
	with TKD and TKQ	110 ft	33.5 m

Battery

Battery Types: Power Stick (p/n 222-1369); Lithium 'CC' battery



Battery

Battery life in a standard dirt housing: standard power, 60 hrs; H power, 16 hrs.
(Battery life may vary when using a TXQ or TXQG beacon configured to run at high power.)

Support



Procedure

Notify your dealer immediately of any malfunction or failure of Subsite[®] Electronics equipment.

Always give model, serial number, and approximate date of your equipment purchase. This information should be recorded and placed on file by the owner at the time of purchase.

Return damaged unit to dealer for inspection and warranty consideration if in warranty time frame.

All repairs must be done by an authorized Subsite Electronics repair facility. Repairs done elsewhere will void warranty.

Resources

Publications

Contact your Ditch Witch[®] dealer for publications and videos covering safety, operation, service, and repair of your equipment.

Training

For information about on-site, individualized training, contact your Ditch Witch dealer.

Warranty

Electronics Limited Warranty Policy

Subject to the limitation and exclusions herein, free replacement parts and labor will be provided when a unit fails due to a defect in material or workmanship within one (1) year of first commercial use (See Exceptions below for specific products). Defects shall be determined through inspection by Manufacturer or authorized repair centers. An inspection must occur within thirty (30) days of the date of failure of the product or part by Manufacturer or its authorized repair facility. Manufacturer will provide the location of its inspection facilities or its nearest authorized dealer upon inquiry. Manufacturer reserves the right to supply remanufactured replacement parts under this warranty as it deems appropriate. Each warranty repair carries the remainder of the factory warranty or 90 days, whichever is longer, for all repaired components and labor.

Product Warranty Exceptions:

- All Directional Drilling Beacons, Locate Beacons and Accessories carry a six (6) month warranty.
- All Magnetic Locator Products carry an eighty four (84) month warranty.
- All Used (Cosmetic) Electronics products sold from Manufacturer carry a six (6) month warranty from date of sale to dealer.

EXCLUSIONS FROM PRODUCT WARRANTY

- All defects or damages caused by misuse, abuse, improper installation, alteration, neglect, modification, lack of maintenance, or uses other than those for which products were intended.
- All defects, damages, or injuries caused by improper training, operation, or servicing of products in a manner inconsistent with manufacturer's recommendations.
- All batteries, which are considered consumable and therefore not covered under this warranty.
- All damaged plastics are considered to be the result of misuse or neglect unless Manufacturer has determined otherwise.
- All repairs or attempted repairs by non-certified repair facilities or personnel will void the warranty.
- All incoming duties and freight charges.

(Exclusions from Product Warranty, continued)



- Manufacturer reserves the right to make changes in design and/or improvements to products from time to time, and user understands that Manufacturer shall have no obligation to upgrade any previously manufactured product to include any such changes.
- In no event shall Manufacturer or its agents, assigns or parent company be liable for any 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. In no event shall Manufacturer liability exceed the amount user has paid for the Manufacturer product.
- Manufacturer will not be responsible for loss of accessories or loss or erasure of data storage media.
- Should it be determined that applicable law prohibits enforcement of any provision of this Warranty Policy, then to the extent it is necessary to comply with the applicable law, this Warranty Policy shall be deemed amended.
- This Warranty Policy shall be the entire agreement between Manufacturer and the Purchaser. Any statements that purport to be different than or modify or expand the terms set forth in this written policy are not effective for any purpose. ANY IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE ARE EXPRESSLY DISCLAIMED. IN NO EVENT SHALL SUBSITE® ELECTRONICS, THE CHARLES MACHINE WORKS, INC., OR ANY AUTHORIZED SERVICING AUTHORITY BE RESPONSIBLE FOR ANY LOSSES, INCLUDING CONSEQUENTIAL AND INCIDENTAL DAMAGES, EXCEPT AS EXPRESSLY PROVIDED HEREIN.

SERVICE AND REPAIR

All units repaired at Manufacturer's location or an authorized service center will carry a 90 day warranty on all replaced components/parts and labor commencing on the date of repair.

EXTENDED WARRANTY

Consult your local Ditch Witch dealer for extended warranty options.

WARRANTY DETAILS

For information regarding this limited warranty, contact Subsite Electronics Product Support Department, 1950 W. Fir, Perry, OK 73077, or your local dealer.

