



Directional Drilling Locating System

Operator's Manual

403-2300-21-B, Jul 2015

© 2015 by Digital Control Incorporated. All rights reserved.

Trademarks

The DCI logo, DigiTrak[®], F2[®], and Target Steering[®] are U.S. registered trademarks and Aurora[™], *Ball-in-the-Box*[™], F Series[™], DigiTrak Falcon[™], and SuperCell[™], are trademarks of Digital Control Incorporated.

Patents

U.S. and foreign patents apply to the product covered by this manual. For details, please visit www.DigiTrak.com/patents.

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 at the end of this manual; it can also be obtained by contacting your regional office listed on page iii, or DCI U.S. Customer Service at 1.425.251.0559, or at www.DigiTrak.com.

Important Notice

All statements, technical information, and recommendations related to DCI products are based on information believed to be reliable. However, DCI does not warrant or guarantee the accuracy or completeness of such information. Before using 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 for use with horizontal directional drilling in the ordinary course, and do not apply to any user customizations, third-party products, or any usage of the DCI product outside of the ordinary course. Nothing herein shall constitute a warranty by DCI nor will anything herein be deemed to modify the terms of DCI's existing Limited Warranty applicable to all DCI products. DCI may update or correct the information in this manual from time to time. You may find the most recent version of this manual on DCI's website, www.DigiTrak.com. Under **Service & Support**, click **Documentation** and select from the **Manuals** drop-down menu.

Compliance Statement

This equipment complies with Part 15 of the Rules of the FCC and with Industry Canada license-exempt RSS standards and with Australia Class License 2000 for LIPD (low interference potential devices). Operation is subject to the following two conditions: (1) this equipment may not cause harmful interference, and (2) this equipment must accept any interference received, including interference that may cause undesired operation. DCI is responsible for FCC compliance in the United States: Digital Control Incorporated, 19625 62nd Ave S, Suite B103, Kent WA 98032; phone 425.251.0559 or 800.288.3610 (US/CA).

Changes or modifications to any 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.

CE Requirements



DigiTrak receivers are classified as Class 2 radio equipment per the R&TTE Directive and may not be legal to operate or require a user license to operate in some countries. The list of restrictions and the required declarations of conformity are available on DCI's website at www.DigiTrak.com. Under **Service & Support**, click **Documentation** and select from the **CE Documents** drop-down menu.

Contact Us

United States <i>DCI Headquarters</i>	19625 62nd Ave S, Suite B103 Kent, Washington 98032, USA +1.425.251.0559 / 1.800.288.3610 +1.425.251.0702 fax dcj@digital-control.com
Australia	2/9 Frinton Street Southport QLD 4215 +61.7.5531.4283 +61.7.5531.2617 fax dcj.australia@digital-control.com
China	368 Xingle Road Huacao Town Minhang District Shanghai 201107, P.R.C. +86.21.6432.5186 +86.21.6432.5187 fax dcj.china@digital-control.com
Europe	Brueckenstraße 2 97828 Marktheidenfeld Germany +49.9391.810.6100 +49.9391.810.6109 fax dcj.europe@digital-control.com
India	DTJ 1023, 10th Floor DLF Tower A, DA District Center Jasola, New Delhi 110044 +91.11.4507.0444 +91.11.4507.0440 fax dcj.india@digital-control.com
Russia	Molodogvardeyskaya Street, 4 Building 1, Office 5 Moscow, Russia 121467 +7.499.281.8177 +7.499.281.8166 fax dcj.russia@digital-control.com

Dear Customer,

Thank you for choosing a DigiTrak locating system. We are proud of the equipment we have been designing and building in Washington State since 1990. We believe in providing a unique, high-quality product and standing behind it with world-class customer service and training.

Please take the time to read this entire manual, especially the section on safety. Please also register your equipment online at access.DigiTrak.com. Or, fill in the product registration card provided with this equipment and either fax it to us at 253-395-2800 or mail it to DCI headquarters.

Product registration entitles you to free telephone support (in the USA and Canada), notification of product and instruction manual updates, and helps us provide you with future product upgrade information.

Our Customer Service department is available 24 hours a day, 7 days a week in the U.S. to help with problems or questions. International contact information is available in this document and on our website.

As the horizontal directional drilling industry grows, we're keeping our eye on the future to develop equipment that will make your job faster and easier. Visit us online any time to see what we're up to.

We welcome your questions, comments, and ideas.

Digital Control Incorporated
Kent, Washington
2015

Watch our DigiTrak® Training Videos at www.youtube.com/dcikent

For system component name and model information, refer to [Appendix A](#) on page 63.

Table of Contents

Important Safety Instructions	1
General	1
Pre-Drilling Testing	2
Interference	2
Battery Pack Storage	3
Equipment Maintenance.....	3
General Transmitter Care Instructions.....	4
Getting Started	5
Introduction	5
Using This Manual.....	6
Powering On.....	7
Receiver.....	7
Remote Display.....	7
Transmitter	7
Jobsite Setup.....	8
Run Frequency Optimizer	8
Choose a Band.....	8
Calibrate	9
Above Ground Range Check.....	9
Interference Check	9
Receiver	10
General Description.....	10
Trigger Switch	10
Audible Tones.....	11
Startup Screen	11
Adjusting Screen Contrast.....	11
Using a Remote Display	12
Receiver Menus	13
Main Menu	13
Frequency Optimizer	14
Power Off	17
Height-Above-Ground (HAG)	18
Calibration and AGR.....	20
Above Ground Range (AGR)	22
After Calibration.....	23
50 Foot Calibration (Optional).....	23
Settings	24
Depth Units Menu.....	24
Pitch Units Menu	24
Roll Offset Menu.....	25
Transmitter Options Menu	26
Telemetry Channel Menu.....	27
Target Steering	27

Locating Basics	28
Locating Screens.....	29
Locate Screen Shortcuts	29
Locate Screen	29
Depth Screen.....	31
Predicted Depth Screen.....	33
Depth Screen, Invalid Location	34
Interference	34
What is Interference?	34
Checking for Interference.....	35
Roll/Pitch Check	36
Suggestions for Dealing with Interference	37
Locate Points (FLP & RLP) and Locate Line (LL).....	37
Effects of Depth, Pitch, and Topography on Distance Between FLP and RLP	39
Marking Locate Points	40
Locating the Transmitter.....	40
Finding the Front Locate Point (FLP)	41
Finding the Locate Line (LL).....	43
Finding the RLP to Confirm Transmitter Heading and Position	45
Advanced Locating	47
Tracking “On-the-Fly”	47
Off-Track Locating	49
Target Steering	51
Feasible Target Depth	51
Turning Target Steering On	52
Turning Target Steering Off	53
Setting the Target Depth.....	53
Positioning the Receiver as the Target	54
Steering to the Target with the Remote Display	55
Target Steering in Interference Areas	55
Transmitter	56
Batteries and Power On/Off.....	57
Installing Batteries / Power On.....	57
Transmitter Battery Strength	58
Transmitter Current Draw Warning	58
Sleep Mode	59
Transmitter Drill Head Requirements	59
Temperature Status and Overheat Indicator	60
Transmitter Temperature Warning Tones	60
Transmitter Overheat Indicator (Temp Dot).....	61
Changing Frequency Bands	61
Above Ground (Pre-Bore) Tilt Method	61
Below Ground (Mid-Bore) Roll Methods	62

Appendix A: System Specifications	63
Power Requirements	63
Environmental Requirements	63
Storage and Shipping Requirements.....	64
Temperature.....	64
Packaging	64
Equipment and Battery Disposal	64
Transmitter Pitch Resolution	64
Appendix B: Receiver Screen Symbols	65
Appendix C: Projected Depth Versus Actual Depth and the Fore/Aft Offset	67
What Happens When the Transmitter Is Steep and Deep.....	67
Appendix D: Calculating Depth Based on Distance Between FLP and RLP	71
Appendix E: Reference Tables	72
Depth Increase in Inches (cm) per 10-ft. (3-m) Rod	72
Depth Increase in Inches (cm) per 15-ft. (4.6-m) Rod	73
LIMITED WARRANTY	

Important Safety Instructions

General

The following warnings relate generally to the operation of DigiTrak locating systems. This is not an exhaustive list. Always operate your DigiTrak locating system in accordance with the manual and be aware of interference that may affect efforts to retrieve accurate data with this locating system. Failure to do so can be hazardous. If you have any questions about the operation of the system, please contact DCI Customer Service for assistance.



Warning To prevent potentially dangerous conditions, all operators must read and understand the following safety precautions and warnings and must review this operator's manual completely before using the DigiTrak Locating System.



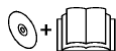
DigiTrak locating systems cannot be used to locate utilities.

Failure to use the front and rear locate points technique described in this manual for locating the transmitter can lead to inaccurate locates.

Serious injury and death as well as substantial property damage can result if underground drilling equipment makes contact with an underground utility, including natural gas lines, high-voltage electrical cable, or other utilities.



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



Work slowdowns 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 proper grounding procedures and techniques for identifying and mitigating interference.
- Ensure all underground utilities and all potential sources of interference have been located, exposed, and accurately marked prior to drilling.
- Wear protective safety clothing such as dielectric boots, gloves, hard hats, high-visibility vests, and safety glasses.
- Locate and track the transmitter in the drill head accurately and correctly during drilling.
- Maintain a minimum distance of 20 cm from the front of the receiver to the user's torso to ensure compliance with RF exposure requirements.
- Comply with federal, state, and local governmental regulations (such as OSHA).
- Follow all other safety procedures.

Remove the batteries from all system components during shipping and prolonged storage. Failure to do so may result in battery leakage, which may lead to risk of explosion, health risks, and/or damage.

Store and transport batteries using a suitable protective case that will keep batteries safely isolated from one another. Failure to do so may result in short circuits, which may lead to hazardous conditions including fire. See [Appendix A](#) for important restrictions on shipping lithium ion batteries.

Use of this equipment is restricted to internal use at a construction site.

Pre-Drilling Testing

Before each drilling run, test your DigiTrak locating system with the transmitter inside the drill head to confirm it is operating properly and providing accurate drill head location and heading 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 the receiver shows the correct depth.
- The transmitter has been located correctly and accurately and the receiver is directly above the transmitter in the drill head underground or at the front locate point.
- The receiver is placed on the ground or held at the correct height-above-ground distance, which has been set correctly.

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

Interference

The Falcon Frequency Optimizer recommends frequency bands based on measured active interference at a given point in time and space. Interference can change, and performance may vary as a result. If performance drops while drilling, consider switching to the other selected band or using Max mode.

Potential Interference Received

Interference can cause inaccuracies in the measurement of depth and loss of the transmitter's pitch, roll, or heading. Always perform a background noise check using your receiver (locator), as well as a visual inspection for possible sources of interference, prior to drilling.

A background noise check will not identify all sources of interference, as it can only pick up sources of active interference, not passive interference. Interference, as well as a partial list of sources of interference, are discussed in the section [Interference](#) on page 34.

Never rely on data that does not display quickly and/or remain stable.

Potential Interference Generated

Because this equipment may generate, use, and radiate radio frequency energy, there is no guarantee that interference will not occur at a particular location. If this equipment does interfere with radio or television reception, which can be determined by powering the equipment off and on, try to correct the interference using one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the receiver and affected equipment.
- Consult the dealer, DCI, or an experienced radio/TV technician for help.
- Connect the equipment to an outlet on a different circuit.

Battery Pack Storage

If you plan to store the battery packs for any period of time, please follow these guidelines.

- Do not store the battery pack at temperatures greater than 45° C.
- Do not store the battery pack in a fully discharged state.
- Do not store the battery pack in the battery charger.
- Do not store multiple batteries together where their terminals or other loose conductive materials may contact one another and cause a short circuit.

If a lithium-ion battery pack will be stored for an extended period of time, pre-charge the battery to a charge level of 30% to 50% (two or three LEDs illuminated on the meter). Do not store the battery pack for more than one year unless it is periodically recharged to the 30% to 50% level.

Equipment Maintenance

Turn off all equipment when not in use.

Store the equipment in cases, away from extremes of heat, cold, and moisture. Test to confirm proper operation prior to use.

Clean the glass screens on the receiver and remote display only with a cleaner specifically formulated to not harm the protective coatings on the glass. If in doubt, use only warm water and a microfiber cloth. Do not use household or commercial window cleaning products that include chemicals such as ammonia, alcohol, or any acidic liquid; these cleaners can contain microscopic abrasive granules that will damage the anti-reflective coating and may cause the display to spot.

Clean equipment cases and housings using only a soft moist cloth and mild detergent.

Do not steam clean or pressure wash.

Inspect the equipment daily and contact DCI if you see any damage or problems. Do not disassemble or attempt to repair the equipment.

Do not store or ship this equipment with batteries inside. Always remove the batteries from the equipment before shipping or periods of non-use.

The battery charger provided with your DigiTrak locating system is designed with adequate safeguards to protect you from shock and other hazards when used as specified within this document. If you use the battery charger in a manner not specified by this document, the protection provided may be impaired. Do not attempt to disassemble the battery charger, it contains no user-serviceable parts. The battery charger shall not be installed into caravans, recreational vehicles, or similar vehicles.

General Transmitter Care Instructions

Periodically clean the spring and threads inside the battery compartment as well as the spring and threads of the battery end cap to ensure a proper power connection with the batteries. Use an emery cloth or wire brush to remove any oxidation that has built up. Be careful not to damage the battery cap O-ring; remove it while cleaning if necessary. After cleaning, use a conductive lubricant on the battery cap threads to keep it from binding in the battery compartment.



Note For better battery performance, all DCI battery-powered transmitters ship with both a special battery contact spring and a nickel-based anti-seize lubricant on the battery end cap to aid in electrical contact.



Before use, inspect the battery cap O-ring for damage that may allow water to enter the battery compartment. Replace the O-ring if the one installed becomes damaged.

Do not use chemicals to clean the transmitter.

Placing tape around the fiberglass tube of the transmitter, if space allows, will keep the fiberglass protected from most corrosive and abrasive environmental wear.

Falcon transmitters have a threaded hole (1/4"-20 thread) in the battery cap to allow the use of an insertion/extraction tool for installing and removing the transmitters in end-load housings. Ensure that this hole remains clear of debris.

Send in the Product Registration Card or register online at access.DigiTrak.com for the 90-day Limited Warranty.

Getting Started

Introduction



Typical DigiTrak Falcon Locating System

Congratulations on your purchase of a DigiTrak Falcon™ F2® walkover locating system, the most advanced method of active interference detection and avoidance available in the HDD industry today.

Historically, locating systems have transmitted the underground signal on a single frequency. DCI pioneered this much-copied approach in the early days of the HDD industry. The inherent challenge has always been that because interference varies from jobsite to jobsite, a single frequency transmitter that performs well on one jobsite might not perform well on the next. This limitation creates variability in performance and compromises the success of the bore in areas with high interference.

The Falcon Frequency Optimizer scans the bore site for interference on multiple frequencies in a matter of seconds. When optimization is complete, it assembles the frequencies with the lowest noise (least amount of active interference) into nine different frequency bands shown on a simple graph. Choose the band best for the job at hand—typically the band with the lowest noise level—pair the transmitter to the receiver with a simple infrared command, and in seconds, the Falcon F2 locating system is ready to drill. Assign a second optimized band as an alternate. At your next bore, re-scan and choose the best bands for the new job site.

Now you can say goodbye to purchasing and keeping track of multiple transmitters—simply optimize your Falcon F2 dual wideband transmitter and drill with the lowest-noise frequencies every time.

DCI's Falcon technology is rated to a 30.5 m depth and nearly 38.1 m data (roll/pitch) range with a standard 15 in. transmitter in a quiet environment. Falcon substantially outperforms all competitors even in noisy environments.

The Falcon system comes standard with the Falcon Compact Display (FCD) shown above. An optional remote display is the advanced Aurora™ touchscreen. Information on the batteries and F Series Battery Charger is located in the FBC Battery Charger manual. The operator's manuals for these devices are located on the flash drive that accompanied your Falcon F2 locating system and also at www.DigiTrak.com.

Using This Manual

This manual is an important tool for you as the operator of a Falcon locating system. You can find it on the flash drive that accompanied your system or at www.DigiTrak.com. We encourage you to load it onto your mobile device and keep it handy so the information you need is always close at hand.



What if I have a question about this topic?

As you read this manual, you may have questions. We've already answered some of them right at the source in boxes like this. If the topic isn't for you, skip it and read on.



You might need this

Page 6

Sometimes it's handy to have some extra information at your fingertips. While it may be discussed in detail elsewhere in the manual, we've extracted and placed some important data right where you need it, with a page link if you want to read more.



Go watch some TV

Subjects with training videos available online will be marked with this icon.

To help find those distant details, the manual includes hyperlinks that will take you right there, like this example:



Prior to use, the receiver must be paired to and calibrated with the transmitter.

[Calibration and AGR](#)

Page 20


Powering On

Receiver


1. Install a fully charged battery pack.
2. Power on the receiver by holding the trigger briefly.
3. Click to accept the “Read the manual before using” statement.
4. Note the regional designation number in the globe  on the receiver startup screen. This number must match the region of the transmitter. If they don't match, contact DCI Customer Service.
5. First time use: from the Settings menu , set the depth units, pitch units, and telemetry channel.
6. From the Main menu, select the Frequency Optimizer, choose a frequency band, power on the transmitter, pair the receiver to the transmitter, and calibrate with the transmitter in the drill head (page 20).
7. On the Main menu, set the optional Height-Above-Ground. [Height-Above-Ground \(HAG\)](#)

Page 18

Remote Display

1. Install a fully charged battery pack in the battery compartment.
2. Press the button to turn on the remote, which defaults to the Remote Locating screen.
3. First time use: from the Settings menu , set the depth units, pitch units, and telemetry channel. Use the same settings as on the receiver. It is also good practice to use the same system of units (English or metric) on both devices.
4. Verify data is being received from receiver. If not, verify proper region is set on both devices.

Transmitter

1. Compare the regional designation number in the globe  on the transmitter with the number in the globe on the receiver startup screen. If they don't match, contact DCI Customer Service.
2. Do not power on the transmitter until after running the Frequency Optimizer (see next section).
3. If you will be using the Frequency Optimizer, transmitter orientation while powering on does not matter. [Batteries and Power On/Off](#)

Page 57

Jobsite Setup

Getting started with Falcon is easy: run the Frequency Optimizer, choose a band, pair the receiver with the transmitter, calibrate, check range, and check for active interference. These tasks are described in detail starting with [Receiver Menu](#) on page 13.




Using the trigger

Page 10



Click the trigger to move between menu options. Hold briefly and release to make a selection. Do nothing in a menu for five seconds to return to the Locate screen.

Run Frequency Optimizer

1. With the transmitter off (batteries not installed), take the Falcon receiver to the point along the intended bore that might create the biggest locating challenge, such as being the deepest point of the bore or an area with obvious active interference such as power lines, railway crossings, traffic lights, or transformers.
2. Power on the receiver and select **Frequency Optimizer (FO)** from the Main menu.  [Frequency Optimizer](#) Page 14
3. With the FO results active, walk the entire intended bore path with the receiver and flag areas of high background noise (active interference). The higher a frequency band's bar is on the graph, the greater the interference. Note which band remains consistently low, since the band with the lowest level of interference will likely be the one you want to use.
 - 90 to -72 dB Low interference levels
 - 72 to -54 dB Moderate interference
 - 54 to -18 dB Interference will become an issue as depth increases

Repeat the above steps as necessary to help determine the lowest-noise frequency band to use.

Choose a Band

1. Insert batteries in the transmitter, positive end first.
2. On the receiver, click to move the selector on the bottom of the Frequency Optimizer graph to the band you want to use and hold briefly to select.
3. Assign as the Up or Down band.
4. Optional: select and assign a second frequency band.
5. Select **Pair** .
6. Align the receiver and transmitter IR windows within two inches of each other and select the check mark to pair. A successful pairing is indicated by a beep and a check mark. 



Are high frequency bands better than low frequency bands?

Different bands are better for different kinds of interference. Lower frequency bands like 7 and 11 are typically better around rebar, passive interference, and salt water. Higher frequency bands can perform better in deeper bores, plus have longer Target Steering capability.

Calibrate

After a successful pairing the receiver continues to the Calibration screen as a reminder that with a new optimized frequency band, calibration is required. Perform a 1-point (**1PT**) calibration in a low-noise area with the transmitter in a housing. Always calibrate after assigning a new frequency band.

[Calibration](#)
Page 20

Above Ground Range Check

Perform an Above Ground Range check on the new optimized frequency band before drilling. The AGR screen displays automatically after calibration.



Perform an AGR test on both frequency bands

Page 22

Calibrate each frequency band separately. Performing an AGR test on both frequency bands at every jobsite is just good practice.

If the above-ground AGR distance at 15 m is not accurate, conduct a **15M** calibration (which also uses only one point) to improve the accuracy of the above-ground distance measurement. A 15 m calibration is *not* necessary for drilling.

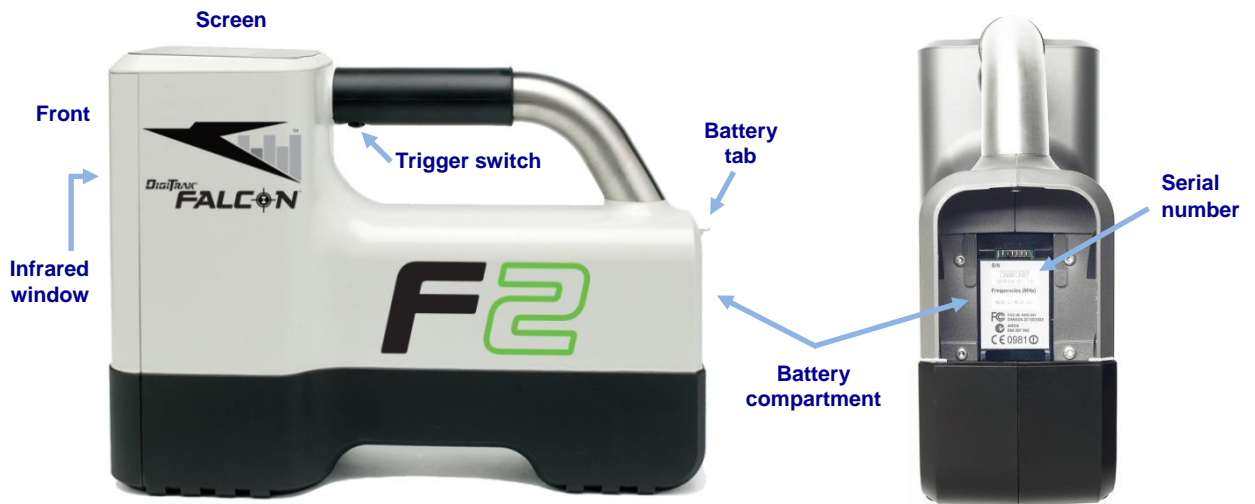
[Calibration](#)
Page 23

Interference Check

Check for active interference on both frequency bands to verify it does not interfere with the transmitter's signal.

[Interference](#)
Page 34

Receiver



Falcon F2 Receiver – Side and Back Views

General Description

The DigiTrak Falcon™ F2 receiver (locator) is a handheld unit used for locating and tracking a DigiTrak Falcon F2 dual wideband transmitter. It converts signals from the transmitter to display depth, pitch, roll, temperature, and battery level, plus sends this information to the remote display on the drill rig.

The receiver and transmitter must meet specific operational requirements for different global regions. A regional designation number is located on the receiver's startup screen. This number must match the one stamped on the transmitter for proper communication.

[Receiver Startup Screen](#)

Figure, Page 11

Prior to use, the receiver must be paired to and calibrated with the transmitter.

[Calibration and AGR](#)

Page 20

Trigger Switch

The Falcon receiver has one trigger switch located under the handle for operating the system. Use it to turn on the receiver, move through menu options, and change the screen view for depth readings. Click to cycle through options or hold briefly and release to make a selection.



I passed the menu option I want; do I have to keep clicking?

After several seconds of inactivity, the display returns to the Locate screen and you can try again.

Audible Tones

The Falcon F2 receiver beeps to signal power on/off, confirm menu changes, and acknowledge the pass/fail status of actions. The receiver also beeps with transmitter temperature increases.

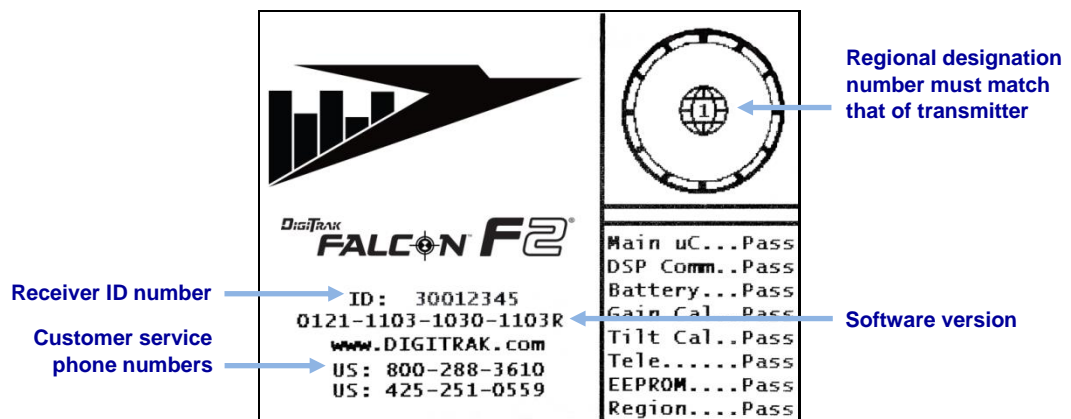
[Transmitter Temperature Warning Tones](#)

Page 60

Two long beeps indicate a problem with the menu option selected and a failure screen will appear until you click the trigger or remove the battery (in the case of a critical failure). Verify your setup and try the operation again or contact DCI Customer Service for assistance.

Startup Screen

Insert a charged battery pack. To power on the receiver, click the trigger. After you have read the warning screen, click again to acknowledge you have read and understand this manual. The receiver displays the startup screen, which includes the results of several startup tests:



Receiver Startup Screen

Click to exit the startup screen. The Falcon F2 receiver proceeds to the Locate screen.

[Locate Screen](#)

Page 29



Note If an item of the self-test fails, a "Fail" warning displays on the startup screen instead of "Pass". If the error is not addressed in this manual, please contact DCI Customer Service.

Adjusting Screen Contrast

To make the screen lighter or darker, hold the trigger while on the locate screen with the receiver held vertical. Release the trigger when the screen contrast reaches the desired level.





The contrast changed way too much, how do I change it back?

Keep holding the trigger; the contrast will adjust completely dark or light, then adjust in the opposite direction.

Using a Remote Display

The Falcon F2 receiver is compatible with the following remote displays:

Remote Display	Minimum Software Version
Falcon Compact Display - FCD	all
Multi-Function Display - MFD	3.0, F2 compatible
F Series Display - FSD	all
Aurora - AP8, AF10	all

If you already own one of the above displays, select "F2" to communicate with your Falcon F2 receiver.

The operator's manual for your remote display is located on the flash drive that accompanied your Falcon F2 locating system and also at www.DigiTrak.com.

Receiver Menus



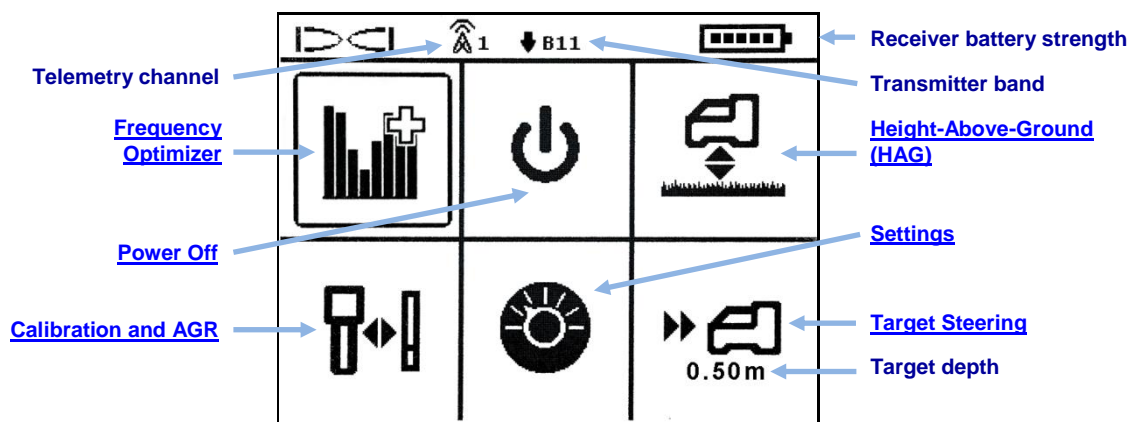
I am already familiar with DigiTrak receiver menus; can I skip this?

Page 28

If you have used a DigiTrak SE® or F2® receiver, you are well on your way to mastering a Falcon. Read the second section on the Frequency Optimizer, then skip ahead to [Locating Basics](#). Come back and visit later as needed for reference.

Main Menu

To access the Main menu from the Locate screen, click the trigger. Click repeatedly to move through the menu, then hold the trigger briefly and release to make a selection. The Frequency Optimizer icon is shown selected below; holding the trigger briefly would start the Frequency Optimizer feature.



Receiver Main Menu

The top of the Main Menu displays the transmitter frequency band, telemetry channel, and receiver battery strength.

If the Target Steering menu has been programmed with a target depth, it displays below the Target Steering icon as shown.

If you open the Main menu accidentally, either click through all the options to return to the Locate screen or wait five seconds for the menu to time out and return automatically.

The Main menu options are described in the following sections.

Frequency Optimizer

The Frequency Optimizer (FO) feature finds the lowest-noise (optimal) group of frequencies available in each of nine bands. When the results display in graph form showing the levels in each band, choose the one or two bands you want to use, pair, and you're ready to calibrate and start drilling.

You can switch the transmitter between the two optimized bands at any time, either pre-bore or mid-bore. Start in the optimized band that works best for the normal-interference portion of the bore and switch to the other band that works better for the portion that has higher interference. Or use one optimized band for the whole bore, or start drilling in one optimized band and switch only if you need to. The choice is yours.



Do I have to optimize every time I power the receiver on?

Page 57

No, the receiver remembers both optimized bands until you pair it to a new band. Power the transmitter on horizontally to use the last active band.


If my optimized band worked great at my last jobsite, can I keep using it at my next one?

Because sources of interference differ at every jobsite, DCI recommends optimizing at every job site to obtain the best selection of frequencies for the current conditions.

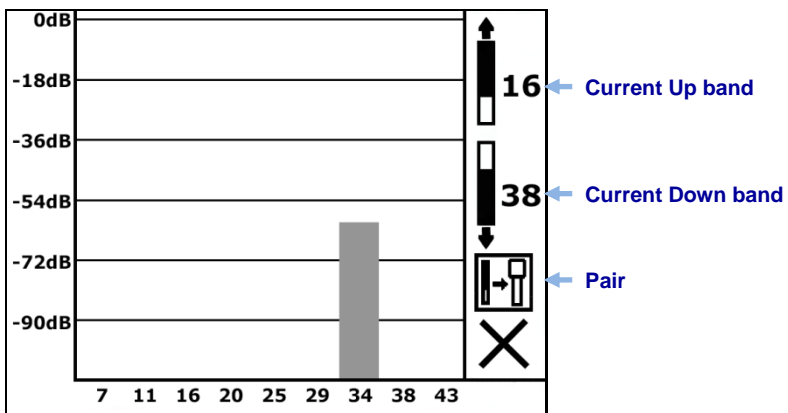
Some of my bands are missing on the optimizer. Is my Falcon F2 broken?

No. A maximum of nine bands are available, but some country regulations limit the number of frequencies and bands available.

To optimize and select a frequency band:

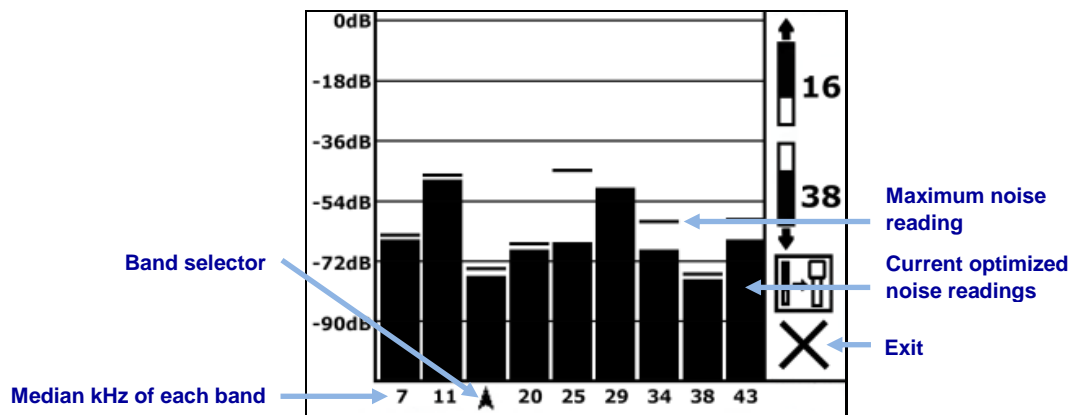
1. Ensure all transmitters are powered off or are more than 30 m away from the receiver.
2. From the Main menu, select **Frequency Optimizer** .

The Falcon F2 receiver scans and measures the background noise (active interference) in multiple frequencies. The display will cycle through each band for about 15 seconds as shown below while it is scanning.



Frequency Optimization Graph while Scanning

When frequency optimization is complete, the receiver shows the background noise currently present in each of the nine frequency bands using an optimized selection of the lowest-noise frequencies within each band. The shorter the bar on the graph, the less interference present in that band.



Frequency Optimizer Results

- To measure noise readings from the entire intended bore, simply walk the bore with the frequency optimization results displayed. As the receiver continues sampling background noise, it marks the maximum noise reading of each band at the top of each bar. Before choosing a frequency band, consider not only which bands remained consistently low, but also which did not experience significant maximum noise readings.



Optimize as often as you want. You can't wear it out.

If you discover a significant source of active interference while walking the intended bore, select a frequency band that was performing well prior to this point, then select and assign the second band for the high-interference area. Or optimize again before assigning the second band. Optimize as often as you want before assigning a band.

- Click to move the selector to the band you want to use and hold briefly to select. Typically this will be a band that remained at a low interference level and did not experience high maximum noise readings while walking the bore path.

Band Number	7	11	16	20	25	29	34	38	43
Range in kHz	4.5–9.0	9.0–13.5	13.5–18	18–22.5	22.5–27	27–31.5	31.5–36	36–40.5	40.5–45


- Select whether to assign this as the Up or Down band (the band the Tx powers on with when facing Up or Down).



Up Down Cancel




Note If the band number you want to use is already displayed at the right edge of the screen, reassign it anyway, as the newly optimized group of frequencies in that band will be different than those in the existing group.

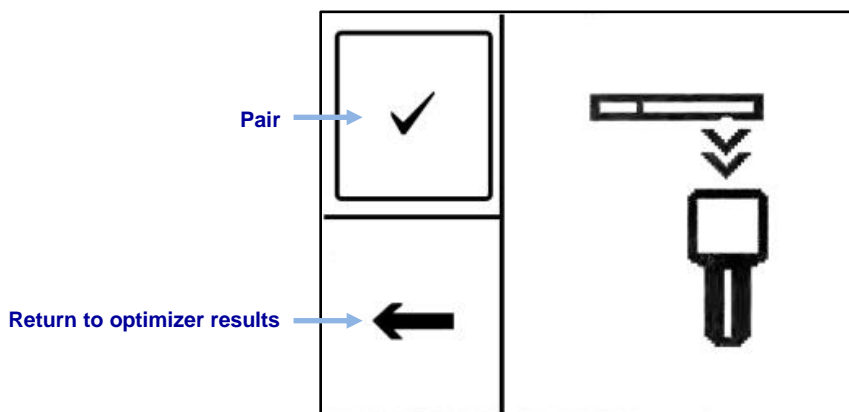
6. Click to select a second band, then assign as the other band (Up or Down); changing both bands is optional. With two new bands, the receiver and transmitter will begin using the Down band first.
7. Select **Pair** . If you assigned two new bands, both will pair at the same time.
8. The receiver displays the transmitter pairing screen. Insert batteries in the transmitter, install the battery cap, and wait 15 seconds for the transmitter to fully power on.
9. Hold the infrared (IR) port of the transmitter within 5 cm of and facing the IR window on the front of the receiver.

[Transmitter](#)

Page 56



10. Select the check mark  to pair the transmitter frequency band to the receiver.







Transmitter Infrared (IR) Pairing Screen

Hold the transmitter in place up to ten seconds for pairing. A circling icon indicates the receiver and transmitter are not yet connected; check alignment and proximity of the IR ports. Moving the transmitter after pairing begins may cause an error code to display on the screen; if this happens, simply restart the pairing process.



Can I exit the pairing screen and go back to the optimizer results without running it again?

Yes. Select **Return**  to go back to the frequency optimization results, erase the maximum readings, and continue observing the noise readings of the last optimized frequency bands. Select **X** to return to the Locate screen.

11. When the pairing is successful, the receiver/transmitter icon briefly changes to a check mark and the receiver beeps. Both the receiver and transmitter are now using the new optimized band you selected. If you assigned two new bands, the system is set to use the Down band first.
 - If the pairing is unsuccessful, the receiver/transmitter icon will briefly change to an **X** and then the Transmitter Pairing screen will reappear. Try pairing a second time. If still unsuccessful, remove and reinstall the transmitter batteries and battery cap, realign the two IR windows, and try again. If still unsuccessful, **Return**  to the FO results and go back to step 4.
 - If the pairing doesn't complete, no new optimized frequency is stored in the receiver. Upon exiting the **Frequency Optimizer** screen, the receiver remains paired to the transmitter at the last optimized band used.
 - The second band can be paired to a completely different optimization. After pairing the first band, simply run the Optimizer at a new location, select a band, and assign as the other (Up or Down) band.
12. The receiver proceeds to the calibration screen as a reminder that with the selection of a new frequency band, the transmitter and receiver need to be recalibrated. After 10 seconds, the calibration failure notice displays. Click to acknowledge the notice, install the transmitter in the drill head, and select Calibration  from the Main menu. Prior to calibration, "Calibration required" is indicated on the Locate screen by an exclamation mark  in the roll indicator in place of the roll value. To change between bands mid-bore, both bands must be separately selected and calibrated prior to drilling.



[Calibration](#)
Page 20

[Main Menu](#)
Page 13


The transmitter is now set to use the new optimized frequency band you just selected (or the Down band, if you assigned both) and is paired to the receiver. Before or during drilling, switch between bands any time if interference is compromising the current band.

[Changing Frequency Bands](#)
Page 61

The orientation of the transmitter when it powers on—up, down, or horizontal—determines the initial frequency band it will use.

[Installing Batteries / Power On](#)
Page 57

Power Off


Select Power Off  from the Main menu to turn the receiver off. The receiver automatically shuts down after 15 minutes of inactivity or after 30 minutes when in Target Steering mode.



Is it okay to power off by just pulling the battery out?

Yes, Falcon F2 can handle it.

Height-Above-Ground (HAG)

Use Height-Above-Ground (HAG)  to set a height measurement on the receiver so you don't have to set it on the ground for a depth reading. Raising the receiver above the ground also provides separation from underground interference that might otherwise reduce the transmitter's range or cause variable readings.

To prevent incorrect readings, Falcon F2 always powers up with the HAG function off (disabled). HAG also automatically shuts off during calibration and when you change depth units, and is ignored during an AGR test and Target Steering. Until you enable HAG, the receiver must be placed on the ground for accurate depth readings.

[Calibration](#)
Page 20

[Depth Units](#)
Page 24

[AGR Test](#)
Page 22

[Target
Steering](#)
Page 51



I use HAG all the time; can I set it to turn on automatically?

No. In the name of safety, HAG must be turned on manually for each use. However, the feature does remember the last height value used.

To determine your desired HAG distance, hold the receiver comfortably at your side, maintaining 20 cm of separation from the front of the receiver to your torso as specified in the Safety section on page 1. Measure the distance from the bottom of the receiver to the ground. HAG may be set from 30 to 90 cm.

The HAG menu has three options: Turn on, Turn off, and Set. Click the trigger to reach the desired option, then hold briefly to select.

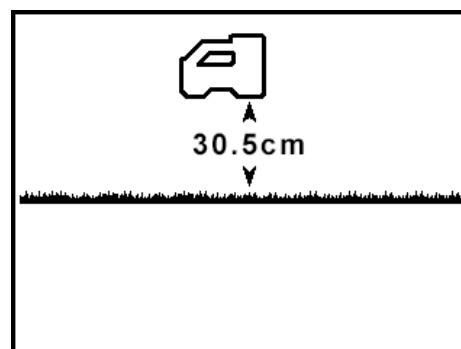
Turn HAG On

The first screen shows either the default HAG value of 30 cm or the value that was most recently set.

To set a different value for HAG or to turn it off, click the trigger to advance to the next screen and skip the rest of this section. Otherwise, continue below.

This **Turn HAG On** screen shows the Falcon F2 receiver 30 cm above the ground. To turn on HAG using the height value displayed, hold the trigger briefly. The receiver beeps and confirms with a checkmark ✓ to indicate HAG is now on, then returns to the Locate screen.

Depth readings (holding the trigger) must now be taken with the receiver held at this height.



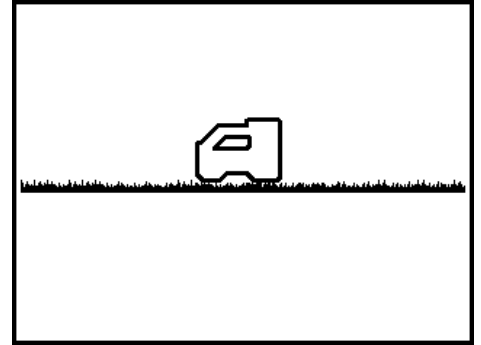
Turn HAG On

Turn HAG Off

To set the HAG distance, click the trigger to advance to the next screen and skip the rest of this section. To turn HAG off, continue below.

The **Turn HAG Off** screen shows the receiver on the ground.

Hold the trigger briefly to turn HAG off. The receiver beeps and confirms with a checkmark ✓ to indicate HAG is now off, then returns to the Locate screen. The receiver must now be placed on the ground to obtain accurate depth readings.



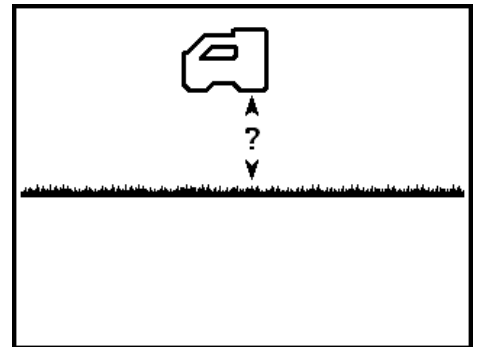
Turn HAG Off

Set HAG Value

Use the **Set HAG Value** screen to input the height at which the receiver will be held above the ground when HAG is on.

A question mark initially appears in place of the HAG value.


Hold the trigger briefly to set the HAG value. The current or default HAG setting displays in place of the question mark. Click to scroll through the available height-above-ground values of 30 to 90 cm, then hold the trigger at the desired HAG value. The receiver beeps and confirms with a checkmark, then enables HAG and returns to the Locate screen.



Set HAG Value


Depth readings (holding the trigger) must now be taken with the receiver held at this height.

Calibration and AGR

Use the Calibration menu  to calibrate the receiver to a transmitter and to verify the Above Ground Range (AGR). Calibration is required prior to first-time use and before using a different transmitter, receiver, drill head, or transmitter band.



Calibrate each optimized band separately

If you select an optimized band that has not been calibrated yet,  appears in the roll indicator. Calibrate and verify Above Ground Range separately for each optimized frequency band prior to each job.

Do not calibrate if:

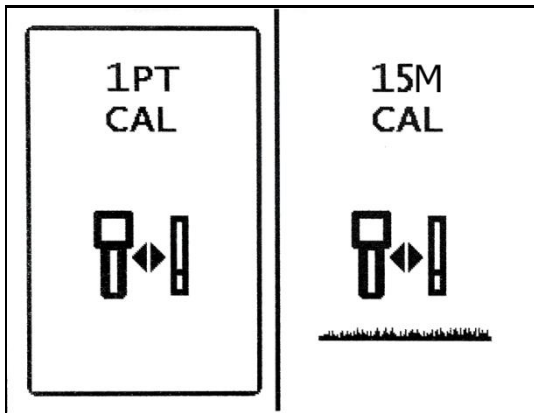
- You are within 3 m of metal structures, such as steel pipe, chain-link fence, metal siding, construction equipment, automobiles, etc.
- The receiver is over rebar or underground utilities.
- The receiver is in the vicinity of excessive electrical interference, as shown by high background noise readings on the Frequency Optimizer results. [Frequency Optimizer Results](#) Page 15
- The transmitter is not displaying transmitter data. [Installing Batteries / Power On](#) Page 57
- The signal strength from the transmitter is less than 300 points (too low) or greater than 950 points (too high). Outside this range, a calibration failure screen will indicate low or high signal strength (see step 6 on page 22).

The transmitter must be installed in a drill head during calibration.

During calibration, HAG is automatically turned off. After calibration, HAG must be turned back on manually.

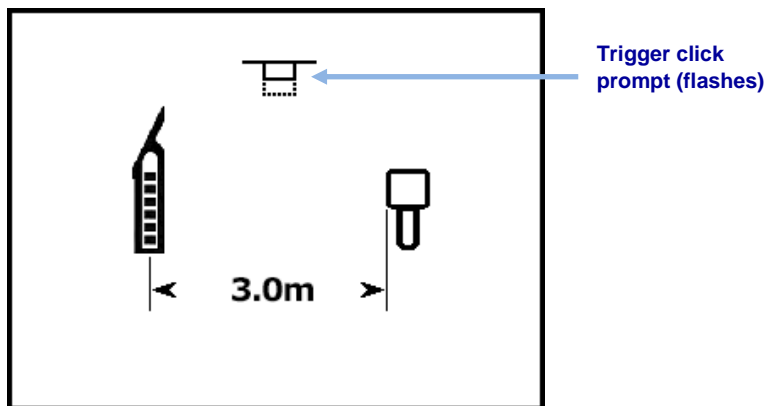
1. Place the receiver and the transmitter (in a drill head) parallel to each other on level ground, with both devices powered on.
2. With the receiver at the Locate screen, verify that roll and pitch values are being displayed and that a steady signal is being received from the transmitter. Record the transmitter's signal strength at the 3 m calibration distance so it can be compared to future signal strength values. A change in signal strength can indicate you are currently in an interference environment or there is a problem with your equipment.

3. At the Main menu, select **Calibration**  and then **1PT** (1-point) calibration.



Receiver Calibration Screen

4. Use a tape measure to ensure the distance from the center of the transmitter to the inside edge of the receiver is 3 m as shown below, then click to begin the calibration.



Calibration Prompt

If you wait longer than about 15 seconds to click the trigger, the calibration terminates and the Above Ground Range (AGR) screen displays (see next section).

5. The display counts down to zero while the receiver records the calibration point. Do not move the receiver.

6. A successful calibration yields a checkmark above the transmitter icon and four beeps. An unsuccessful calibration yields an X above the transmitter icon and two beeps.



The symbol indicates low signal strength, and indicates high (excessive) signal strength. Calibration will fail when the signal from the transmitter is below 300 or above 950 points.



Why do I keep getting calibration errors?

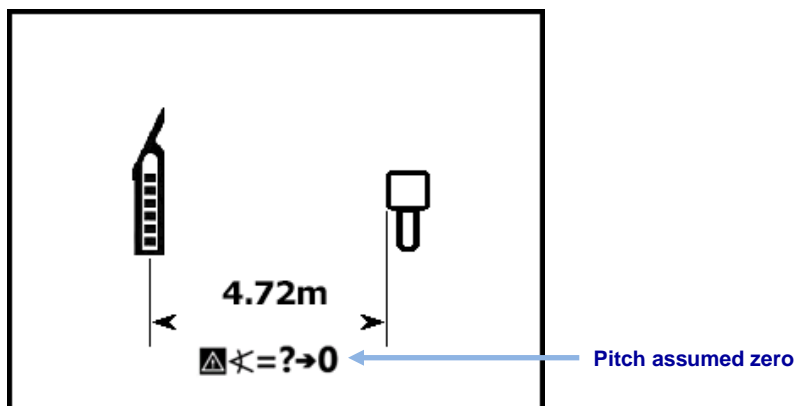
Carefully review the items under "Do not calibrate if" at the beginning of this section. Try calibrating in a different location. Make sure the transmitter is on and paired (data showing on the Locate screen). If you're still having trouble, give us a call, we'll get you going.

Above Ground Range (AGR)

After successfully completing a 1-point calibration, the receiver displays the Above Ground Range screen, an active measurement between the transmitter and receiver. Use this screen along with a tape measure to verify calibration of the transmitter at different distances. With the transmitter level, the depth readings should be within $\pm 5\%$ of the measured distance.



Note To perform an AGR check without re-calibrating the transmitter, follow the 1-point calibration instructions in the previous section up to step 3, but do not click the trigger to perform the calibration . The procedure will time out to the AGR screen after several seconds.



Above Ground Range (AGR)

Note that because AGR intentionally does not consider pitch when calculating range, it displays a symbol indicating "Warning, pitch is unknown, assume zero". It also ignores any HAG setting.

[Locate Screen](#)

Page 29

Use AGR at least daily, and ideally in both frequency bands, to verify proper depth (distance) measurements.

After Calibration

If necessary, turn Height-Above-Ground (HAG) back on.

[Height-Above-Ground \(HAG\)](#)

Page 17

15 m Calibration (Optional)

This feature is only used for verifying above-ground AGR distance measurements beyond 12.2 m. A 15M (15 meter) calibration does not affect depth readings on the Locate screen. Only a 1PT 3 m calibration is necessary for below-ground depth readings.

Above-ground distances beyond 12.2 m may read shorter than normal due to what is known as "surface effects." Varying amounts of conductivity in the surface of the earth make distance readings read shallower than actual, with the amount of error varying with ground conditions.

If you have completed a 1PT 3 m calibration and AGR distances beyond 12.2 m are reading short, perform a 15M calibration (which also uses only one point) to refine the AGR measurement.



Note If the AGR reading at 15 m is less than 13.7 m or greater than 15 m, this calibration will fail.

The 15M calibration does not properly correct for active or passive interference.

1. Follow the same procedure as described for 1PT calibration in [Calibration and AGR](#) on page 20, but at the calibration screen mentioned in step 3, select **15M** instead of **1PT**.
2. Follow the remainder of the procedure, including conducting an AGR test.

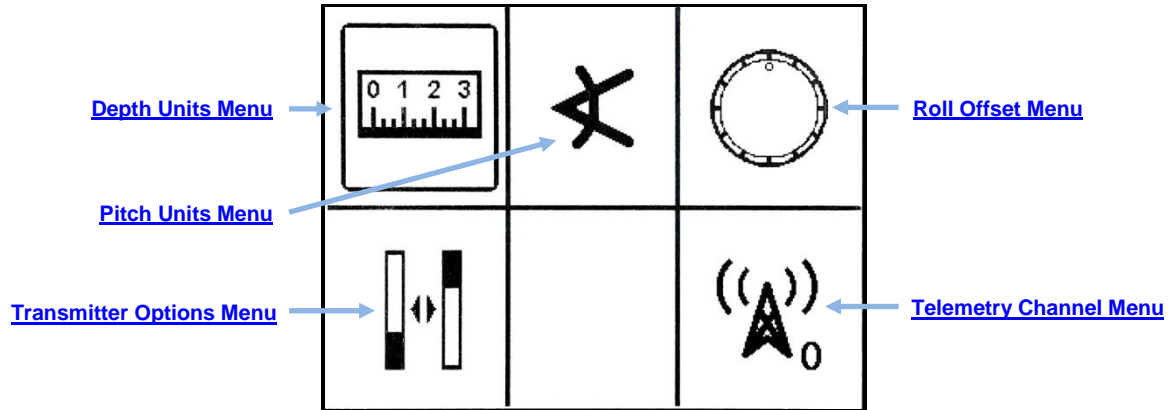


Do I have to do a 15M calibration before I can drill?

No. A 15M calibration only helps with above-ground measurements. Use it if the AGR test reveals shorter than actual distance readings beyond 12.2 m. After the 15M calibration, use the subsequent AGR test to verify the adjusted distance readings.

Settings

Use the Settings menu  to set the following options:



Settings Menu

Click the trigger to move between options, hold briefly to select. DCI recommends that you program the receiver and the remote display Depth and Pitch settings to use the same units of measure.

For each option, an arrow indicates the current setting. Click to switch between options, hold briefly to select. A checkmark confirms the selection and the receiver beeps four times as it returns to the Locate screen. To make no changes, wait four seconds to return to the Locate screen.

Depth Units Menu

Use the depth units menu to choose between **000"** inches, **0'00"** feet and inches, **0.00 M** metric units (meters and centimeters). and **0.00'** decimal feet.

Selecting metric units will cause the temperature to display in °C. All other options will cause the temperature to display in °F.

Changes to depth units will turn the Height-Above-Ground (HAG) setting off and reset the height value to 30 cm. After changing depth units, if necessary, turn HAG back on and reset the height value.

[Height-Above-Ground \(HAG\)](#)

Page 17



Pitch Units Menu

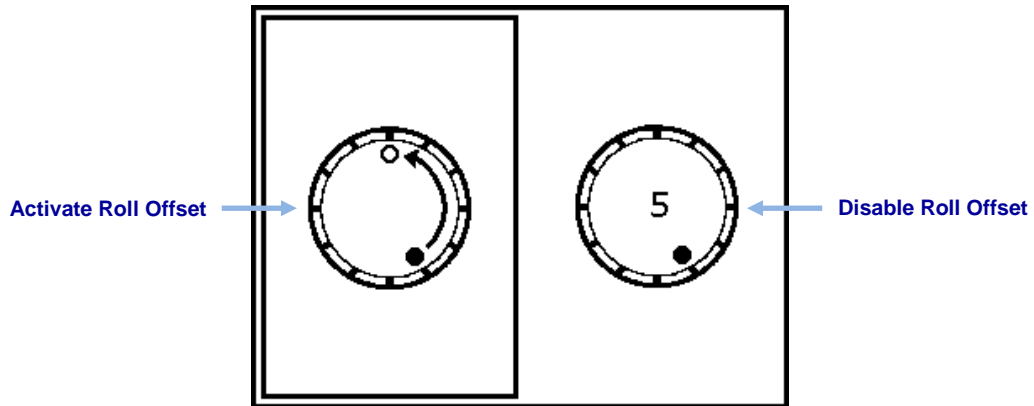
Use the Pitch Units menu to choose between degrees (0.0°) and percent (0.0%).

Typical HDD bores use percent pitch instead of degrees.

Roll Offset Menu

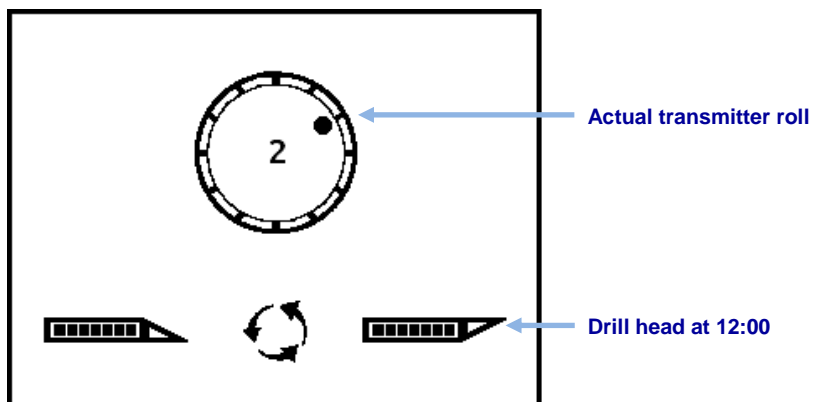
Use Roll Offset to electronically compensate the 12:00 position of the transmitter to that of the drill head. To set and enable roll offset, the receiver must be showing actual clock values.

1. Roll the drill head to the 12:00 position. The transmitter will display its actual roll value.
2. From the **Settings**  menu, select **Roll Offset** .
3. Select **Activate Roll Offset**.



Roll Offset Menu

The receiver activates roll offset, showing the transmitter's actual roll value while the drill head is at 12:00.



Roll Offset Enabled

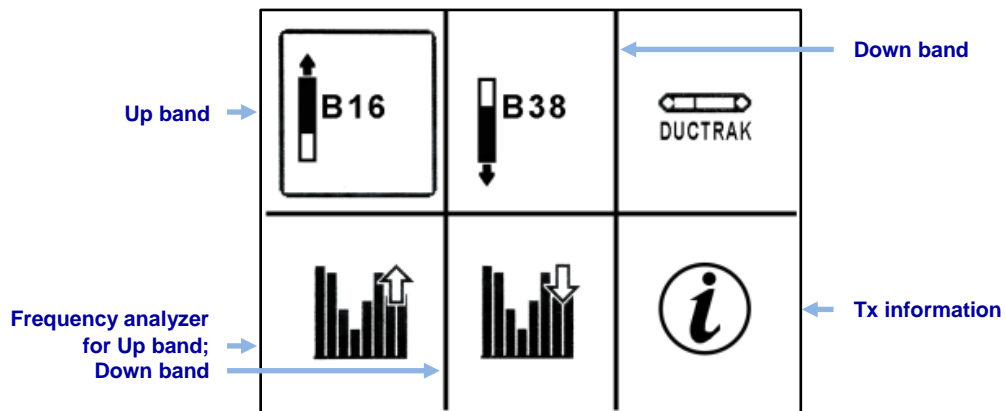
4. With the actual roll showing (in this example, 2:00), hold the trigger briefly to set the offset and correct to 12:00. The receiver beeps four times with a successful roll offset setting or sounds two long beeps if the setting fails.

When the receiver returns to the Locate screen, roll offset is indicated by a hollow dot in place of the solid dot on the roll indicator and the letters "RO" at the bottom right of the roll indicator on both the receiver and remote display.

To disable roll offset, select Disable Roll Offset from the Roll Offset menu. The receiver beeps four times as the screen returns to the Locate screen. The roll value on the Locate screen will now be that of the transmitter, not necessarily the drill head.

Transmitter Options Menu

The Transmitter Options menu lets you select between optimized Up and Down frequency bands. It also lets you select a DucTrak transmitter, view a frequency analyzer that shows the current interference on the band, and view information about a paired transmitter.



Transmitter Options Menu

Select the Up Frequency Band

Sets the receiver to receive transmitter data on the Up optimized band.

To power on the transmitter in the Up band, insert batteries with the transmitter pointing up (battery compartment on the bottom).

[Installing Batteries / Power On](#)

Page 57

Select the Down Frequency Band

Sets the receiver to receive transmitter data on the Down optimized band.

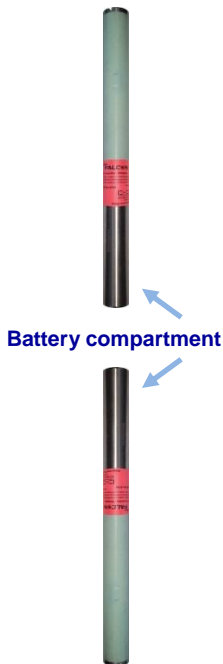
To power on the transmitter in the Down band, insert batteries with the transmitter pointing down (battery compartment on top).

DucTrak

Sets the receiver to use a DucTrak transmitter. DucTrak is used for tracking existing ductwork and piping only, not for drilling. A DucTrak transmitter does not require pairing.

View Transmitter Information

After facing the transmitter and receiver infrared ports toward each other at a distance of 5 cm or less, select this option to view transmitter serial number, region, bands, amperage, voltage, temperature, maximum temperature, and software version. Viewing this data also confirms that the IR pairing capability is functional.




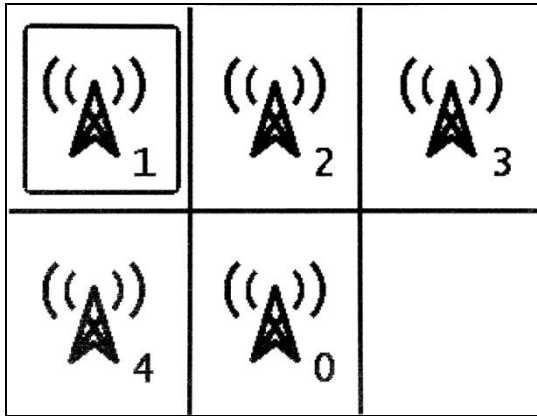
Frequency Analyzer

This function shows the current active interference levels in the optimized Up or Down frequency band. One or more bars in the optimizer graph will be higher if the receiver is near a source of active interference (as an experiment, hold the receiver near a television or computer monitor and watch the bars jump).

You may optionally select a different optimized band from this screen. If so, remember to recalibrate prior to drilling.

Telemetry Channel Menu

The Telemetry Channel menu  has five telemetry channel settings (1, 2, 3, 4, and 0). For communication to occur between the receiver and remote display, both devices must be set to the same telemetry channel.



Telemetry Channel Menu

To turn telemetry off and conserve receiver battery life, select "0". Channel 0 is also used when there are more than four receivers operating in the same area; using more than one receiver per channel within telemetry range of each other will cause conflicting signals to be sent to the remote display on the drill rig.

Click to select the desired telemetry channel on the receiver, hold briefly to set. The receiver beeps four times and confirms with a check mark ✓, then returns to the Locate screen. The current telemetry channel displays next to the Telemetry Channel icon on the Main menu.

Target Steering

The last item on the Main menu is for using the DigiTrak Target Steering[®] locating method, which is discussed later in the Advanced Locating section of this manual.

[Target Steering](#)
Page 51

Locating Basics



Are you ready?

Page 34

If you're new to locating and first want to know everything about the locating screens, you've come to the right place. If you already know locators and want to jump right in and start locating with your Falcon F2 system, skip down to [Interference](#).



Locating in a High-Interference Area

This section covers locating basics:

- Locating screens
- Checking for interference and suggestions for dealing with it
- Performing a roll/pitch check
- Finding and marking front and rear locate points (FLP and RLP) and the locate line (LL) to pinpoint the transmitter
- The geometry of the FLP, RLP, and LL with respect to the transmitter
- Methods to verify depth readings



Note Refer to the DigiTrak YouTube site at www.youtube.com/dcikent for helpful videos on these and many other locating topics.

Locating Screens

The Locate, Depth, and Predicted Depth screens are the primary screens you will use for locating. The type of depth screen that displays depends on the position of the receiver relative to the transmitter at the time of the depth reading.



Do I have to know all this?

Page 40

Get this down first, then you'll be ready to locate like a professional. If you skip to [Locating the Transmitter](#) and feel like you're missing a little background information, come back here for a refresher.

For a description of the icons on the Locate screens, see [Appendix B](#).

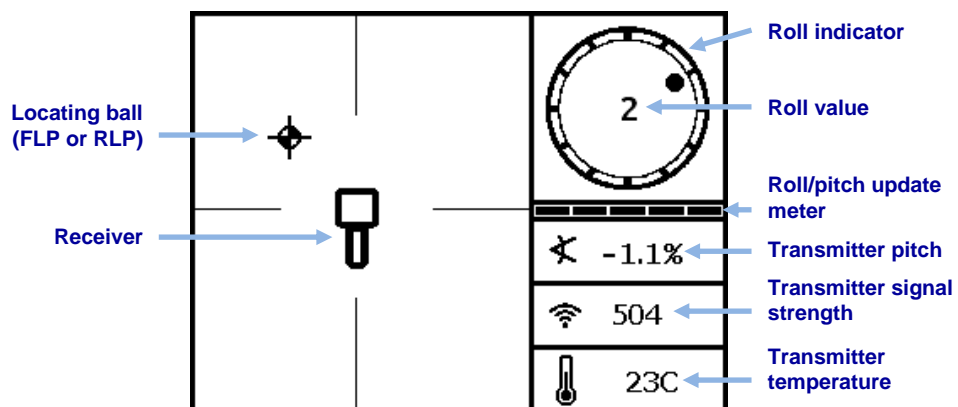
Locate Screen Shortcuts

The following shortcuts are available from the Locate screen.

Task	Operation	Page
Depth Screen	Hold trigger at locate line (LL)	31
Main Menu	Click trigger	13
Max Mode	Hold trigger at least five seconds	31
Predicted Depth Screen	Hold trigger at forward locate point (FLP)	33
Screen Contrast	Hold trigger with receiver vertical	11

Locate Screen

When the receiver is detecting a signal from a transmitter, the Locate screen provides real-time data about the transmitter's location, temperature, pitch, roll, and signal strength.



Typical Locate Screen with Transmitter in Range

If the transmitter is on and there is no roll or pitch data, hold the trigger for 10 seconds to engage Max mode and the data should appear. If not, the transmitter and receiver may not be paired to the same frequency band.

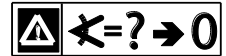


How do I check which frequency bands are assigned?

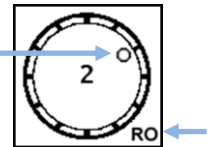
The current band in use is listed at the top of the Main menu [page 13]. Or, From the Main menu, select **Settings > Transmitter Options** [page 26] to see both optimized bands.

The roll/pitch update meter displays the quality of roll/pitch data being received from the transmitter. When the meter is empty, no roll/pitch data is being received, and none will appear on either the receiver or the remote display. Depth and predicted depth readings may still be taken, but the receiver will assume the transmitter has a pitch of zero, as indicated by the image to the right appearing on the Depth or Predicted Depth screen.

When the roll offset function is enabled, the roll indicator ball changes to a circle and "RO" appears at the bottom right of the indicator.



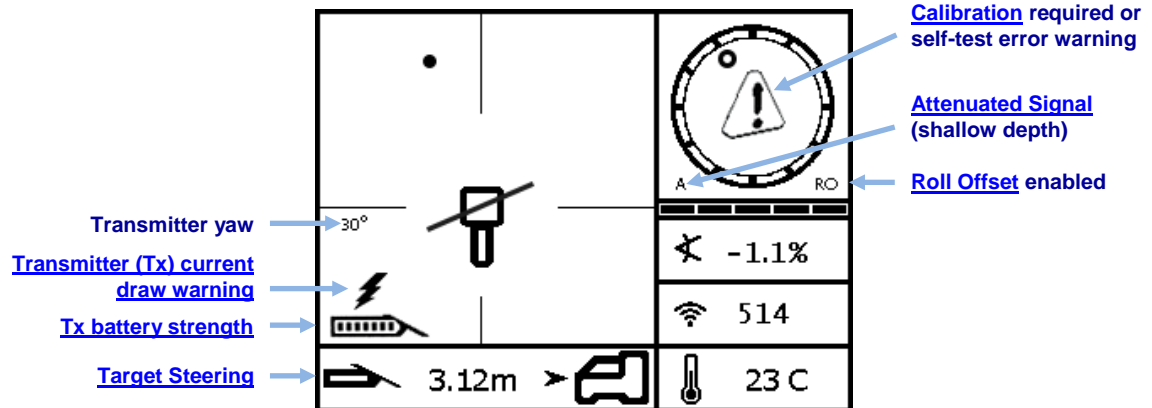
Pitch Assumed Zero



Roll Offset Activated

[Roll Offset Menu](#), page 25

Less Common Icons



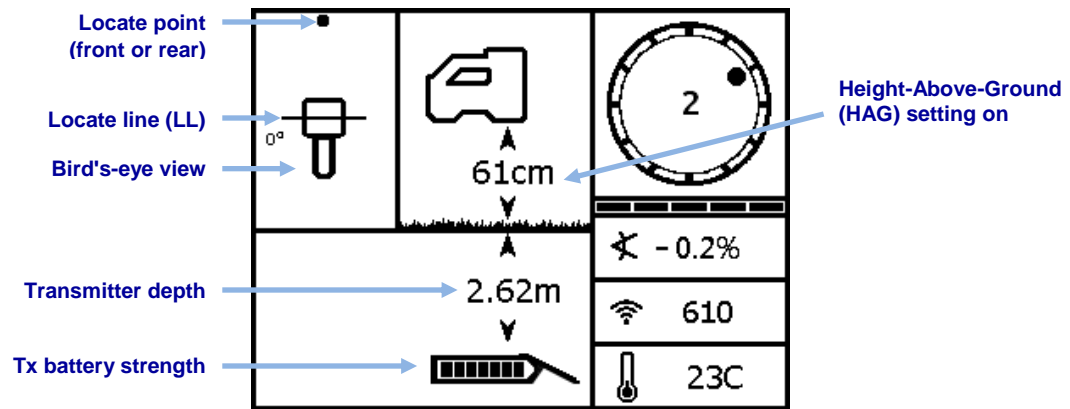
Locate Screen with Less Common Icons

Depth Screen

Hold the trigger with the receiver at the locate line (LL) to display the Depth screen.

[Locate Points \(FLP & RLP\)](#)
[and Locate Line \(LL\)](#)

Page 37



Depth Screen at LL with HAG On

When the HAG setting is disabled, the receiver will be shown on the ground and must be placed on the ground during depth readings.

[HAG function](#)

Page 17


Max Mode Noise Filtering

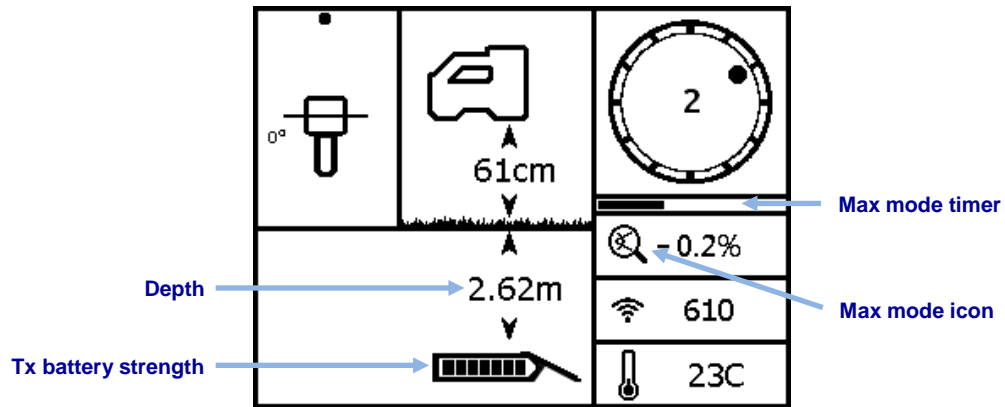


Warning The drill head must be stationary when taking readings using Max mode. If the drill head is moving, data readings will not be accurate.

Due to the nature of the extreme depth and/or high-interference environment where use of Max mode will typically occur, the risk of obtaining unreliable data is increased. Never rely on data that does not display quickly and remain stable. Max mode is never a substitute for prudent operator judgment.

The purpose of Max mode noise filtering is to stabilize erratic roll/pitch data, depths, and locates when drilling at the very limit of the ability of the transmitter due to extreme depth or interference, which will vary by jobsite.

When the roll/pitch update meter shows low signal level or data is erratic, hold the trigger for longer than five seconds to enter Max mode, indicated by a magnifying glass around the pitch icon: .



Depth Screen in Max Mode

Max mode replaces the roll/pitch update meter with the Max mode timer. As you hold the trigger and Max mode gathers data readings, the timer slowly fills up. Greater interference or deeper bores will require a higher number of readings before roll/pitch data displays, or may prevent data from displaying altogether. If the timer is full and data is not yet stable, release the trigger, move to a different location near the drill head, and hold more than five seconds to restart.

Max mode can only provide accurate data when the drill head is not moving. Always take **three** Max readings; all three readings must be identical and stabilize before the Max mode timer is full.

Predicted Depth Screen

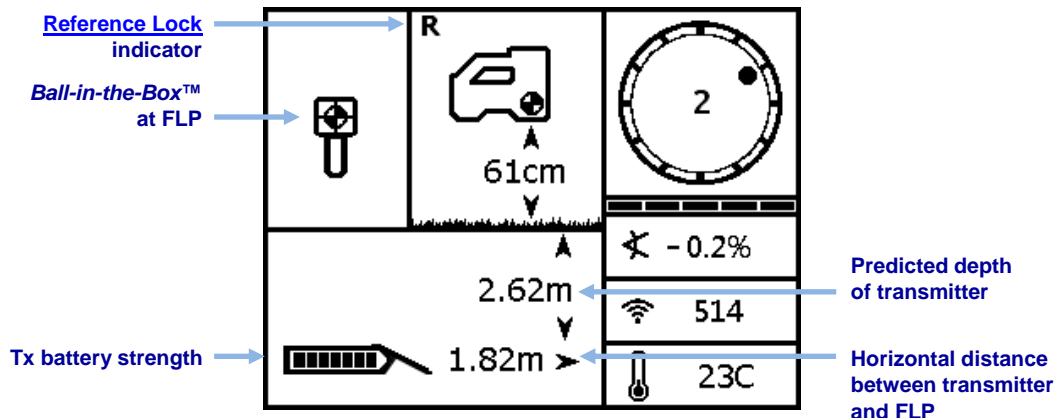


Warning Because both front and rear locate points appear identical to the receiver, an invalid depth prediction can be generated when the receiver is over the rear locate point (RLP). Only a reading at the front locate point (FLP) produces a valid predicted depth.

[Locate Points \[FLP & RLP\]](#)
[and Locate Line \[LL\]](#)

Page 37

Hold the trigger at the front locate point (FLP) to display the Predicted Depth screen. The predicted depth is the depth the transmitter is calculated to be at when it reaches the front locate point if it continues on its current path.



Predicted Depth Screen at FLP with HAG On

Hold the trigger for longer than five seconds to enter Max mode, as described in the previous section.

In this example, if the drill head travels an additional 1.82 m at -0.2% pitch, it will be directly below the locator at 2.62 m.

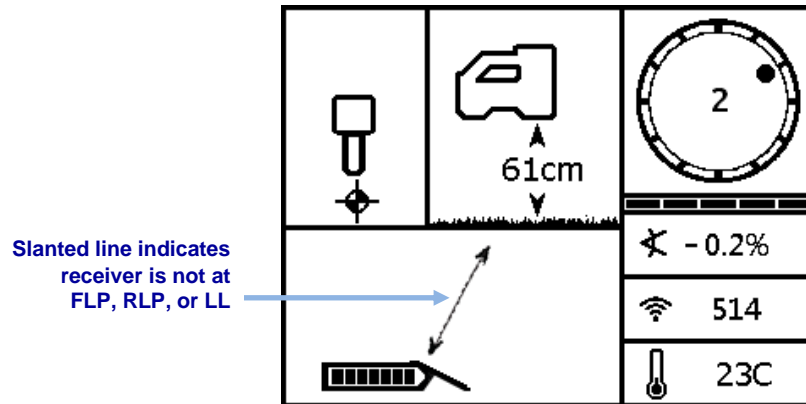
Depth Screen, Invalid Location

Hold the trigger at any time during locating to display the Depth screen. No depth or predicted depth will appear if the receiver is not positioned at the locate line or front or rear locate point. However, holding the trigger more than five seconds to enter Max mode may obtain more stable roll/pitch data (use of Max mode has special requirements and restrictions).

[Max Mode](#)

Page 31

As noted in the previous section, predicted depth can only be obtained with the receiver over the *front* locate point.



**Receiver Depth Screen with HAG Enabled
(not at FLP, RLP, or LL)**

Interference

Interference can compromise a transmitter's signal even when drilling with an optimized frequency band. It is important to the success of your bore that, after pairing your transmitter at a newly optimized frequency, you check how the transmitter's signal will perform along the intended bore path.



Warning To best overcome interference, find and deal with it above ground, before you start drilling.

What is Interference?

Interference can reduce the transmitter's range or cause variable readings and possibly result in job slowdowns. Interference is classified as either *active* or *passive*.

Active interference, also known as electrical interference or background noise, can have varying effects on locating equipment. Most electrical devices emit signals that can inhibit the ability to locate the transmitter accurately or get good roll/pitch readings. Examples of active interference include traffic signal loops, buried dog fences, cathodic protection, radio communications, microwave towers, cable TV, fiber-trace lines, utility data transmissions, security systems, power lines, and phone lines. Interference at the remote display may also occur from other sources operating nearby on the same frequency. The following section describes how to use the receiver to test for the presence of background noise.

Passive interference can reduce or increase the amount of signal received from the transmitter, which results in incorrect depth readings, a completely blocked signal, or locates in the wrong position. Examples of passive interference include metal objects such as pipes, rebar, trench plate, chain-link fence, and vehicles. Two other examples are saltwater/salt domes and conductive earth, such as iron ore. The receiver cannot test for the presence of passive interference. Conducting a thorough site investigation prior to drilling is the best method of identifying passive interference sources.

To familiarize yourself with the interference potential along your intended bore path, check for background noise as discussed in the following section.



Warning A receiver cannot detect sources of passive interference; this can only be accomplished with a visual inspection of the jobsite. A background noise check can only find *active* interference.

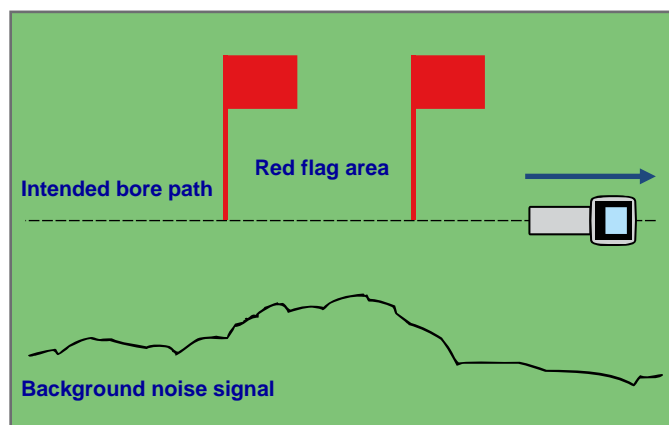


I thought the Frequency Optimizer did all this for me?

The Frequency Optimizer finds the lowest-noise frequencies to use in each band. You choose which bands to use and pair the transmitter. As best practice, now test those bands above ground to ensure the receiver receives data for the intended portion of the bore. A good background noise check is vital to a job free of interference surprises.

Checking for Interference

To check for active interference, walk the intended bore path with the receiver in the frequency band you intend to drill with. Do this with the transmitter off, while taking note of the signal strength on the Locate screen. With no transmitter on, this “signal strength” is in fact background noise (active interference). In the following figure, the red flag area denotes an increase in background noise detected while walking the intended bore path with the receiver.



One-Person Background Signal Strength Check (Transmitter Off)

Now return to the area of highest interference (between the red flags above), turn on the transmitter, and place it the same distance to the side of the receiver as the intended bore depth. Verify that the roll/pitch data is consistent and correct in the flagged area. The transmitter’s signal strength should generally be a minimum of 150 points greater than the

background interference reading. For example, if this area of greatest interference produced a signal strength reading of 175, the reading with the transmitter on at this location, and at a distance from the receiver equal to the maximum intended bore depth, should be a minimum of 325 ($175 + 150$).

Note that the transmitter's signal strength will be slightly higher in this test than while drilling because it is currently not encased in the drill head, which will diminish the signal strength slightly.

Areas where the background noise level is too high may make it difficult to obtain roll and pitch data and accurate locates and depth. If the receiver signal strengths were not strong, conduct a roll/pitch check as described in the following section.

Roll/Pitch Check



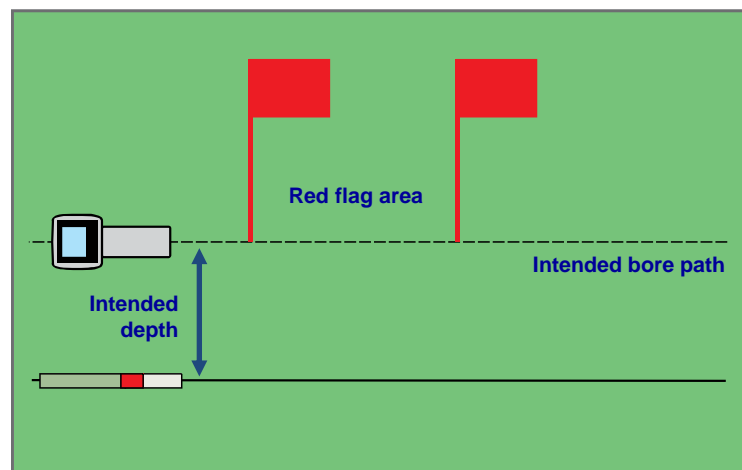
With a strong signal, this test isn't always necessary

If the receiver signal strengths are well above the minimum, a roll/pitch test isn't entirely required. But as best practice, or if sections of the bore produce significantly decreased signal strength, this is an important check prior to drilling.

At the exit end of the bore path, turn the receiver to face the launch point and install batteries in the paired transmitter to turn it on. Have a coworker hold the transmitter and stand beside you. Walk together in parallel back toward the launch point, keeping the receiver over the bore path and the transmitter at a distance of 1 to 1.5 times the current intended bore depth; where the bore is deeper, your coworker will be farther away. Periodically stop and change the transmitter's roll and pitch orientation so you can verify the speed and accuracy of these readings on the receiver. It is good practice to also have a coworker monitor the readings at the remote display at the same time. Note any locations where the receiver or remote display information becomes erratic or disappears. If roll/pitch data or signal strength become unstable, hold the trigger to see if Max Mode can stabilize the data.

[Max Mode](#)

Page 31



Two-Person Roll/Pitch Test with Transmitter

Suggestions for Dealing with Interference

If roll/pitch information becomes erratic or is lost while drilling, try one or more of the following:

- Try Max mode. [Max Mode](#)
Page 31
- Move the receiver away from the interference source while staying within range of the transmitter. [Off-Track Locating](#)
Page 49
- Physically separate the receiver from both passive and active interference to reduce or eliminate interference-related problems. [HAG function](#)
Page 17
- Switch to the transmitter's other frequency band. [Changing Frequency Bands](#)
Page 61
- To overcome interference at the remote display, ensure the telemetry antenna is vertical and that the front of the receiver is facing the remote display. Set the receiver and remote display to use a different telemetry channel. An optional extended-range telemetry antenna may also help overcome some forms of interference.

Never rely on the receiver as the sole means of communication between the receiver operator and drill operator. In cases where data is not available on the remote display, both operators must be able to communicate with each other.

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

The Falcon F2 receiver locates the transmitter by detecting three specific places in the transmitter's magnetic field: the front locate point (FLP) ahead of the transmitter, the rear locate point (RLP) behind the transmitter, and the locate line above the transmitter itself. The locate points are indistinguishable from one another by the receiver as they represent similar points in the transmitter's field in front of and behind the transmitter (see [Appendix C](#) on page 67 for more information about the transmitter's magnetic field).

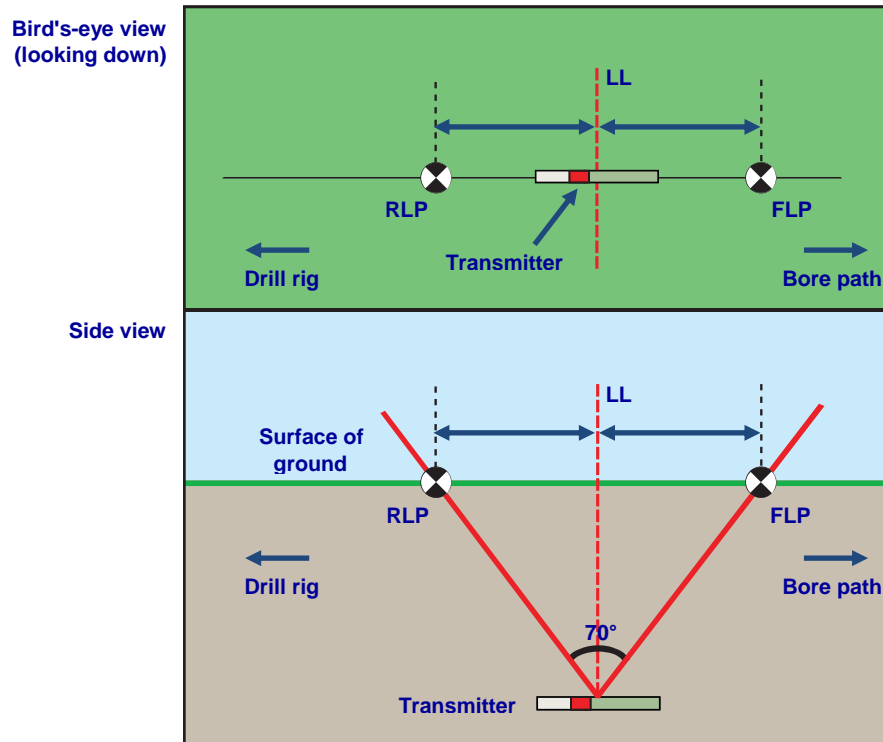
The locate line (LL) extends 90° to the left and right of the transmitter (perpendicular) when the transmitter is at 0% pitch. It represents the location of the transmitter between the FLP and RLP. If you think of the transmitter being the body of an airplane, its wings are the locate line.



Locate line does not equal the location of the transmitter

Being over the locate line does not mean you are over the transmitter, which may be left or right anywhere along the locate line. You must find the front and rear locate points to find the transmitter, as is detailed on the next couple pages.

The most accurate tracking requires the use of all three locations to determine the position, heading, and depth of the transmitter. A line passing through the FLP and RLP reveals the heading and left/right position of the transmitter. The LL determines the position of the transmitter when the receiver is properly aligned between the FLP and RLP (on the line).



Geometry of FLP, RLP, and LL from Top (Bird's-Eye) and Side Views

Note how the RLP and FLP are equal distances from the LL when the transmitter is level.

The line marked LL in the bird's-eye view image suggests the receiver will display a locate line any time it is positioned on this plane. To prevent inaccurate locates and potentially dangerous conditions, it is imperative to first find the front and rear locate points. Do not rely on the peak signal along the locate line.

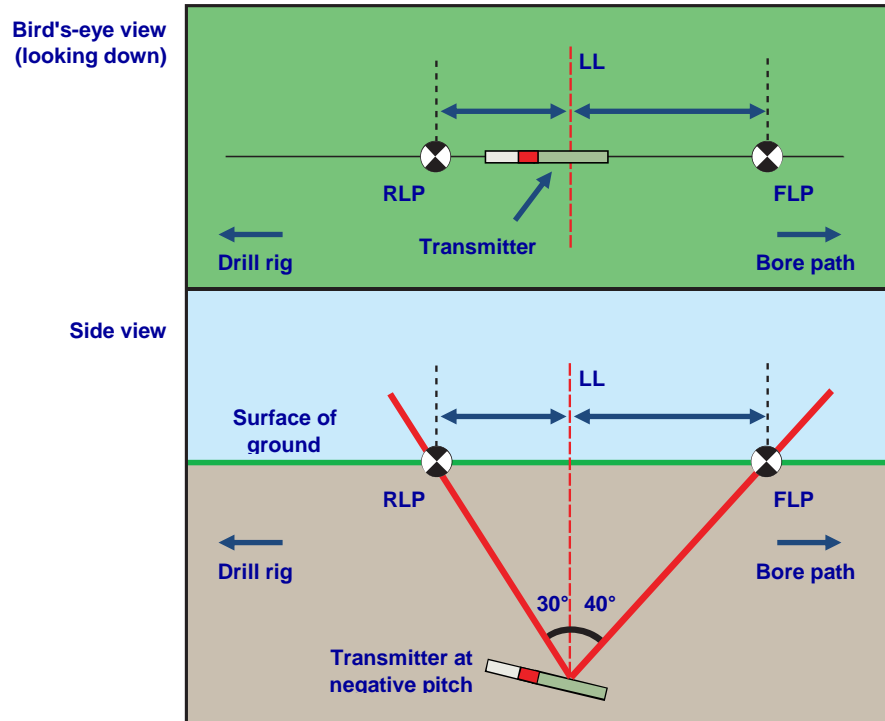


Note Whenever the transmitter is pitched, the position of the locate line will be somewhat slightly ahead of or behind the transmitter's actual position. This slight fore/aft offset will increase with depth (see [Appendix C](#)). In these cases, the depth displayed on the receiver is referred to as the projected depth.

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

The deeper the transmitter is, the farther 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 farther from the LL than the RLP. When the 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 if the transmitter itself is level.



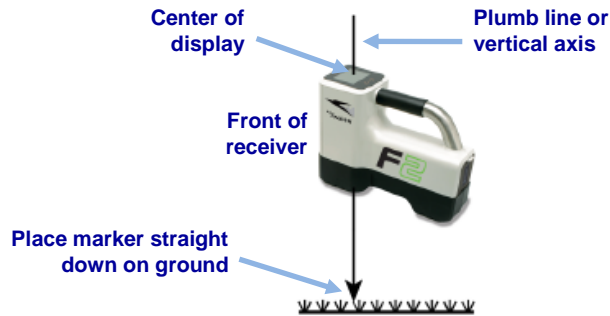
Effect of Pitch on Distance Between FLP, RLP, and LL

For a detailed explanation of how to track the transmitter when it is steep and deep, read the information provided in [Appendix C: Projected Depth Versus Actual Depth and the Fore/Aft Offset](#) on page 67.

To calculate depth (for comparison to the receiver's depth reading) using the distance between the locate points and the pitch of the transmitter, see [Appendix D: Calculating Depth Based on Distance Between FLP and RLP](#) on page 71.

Marking Locate Points

The locate points (FLP and RLP) and the locate line (LL) must be found and accurately marked during the locating procedure. To mark a locate point, stand with the receiver level at the locate point. Look down the vertical axis that runs through the center of the display to project a plumb line to the ground. Mark where this plumb line hits the ground.

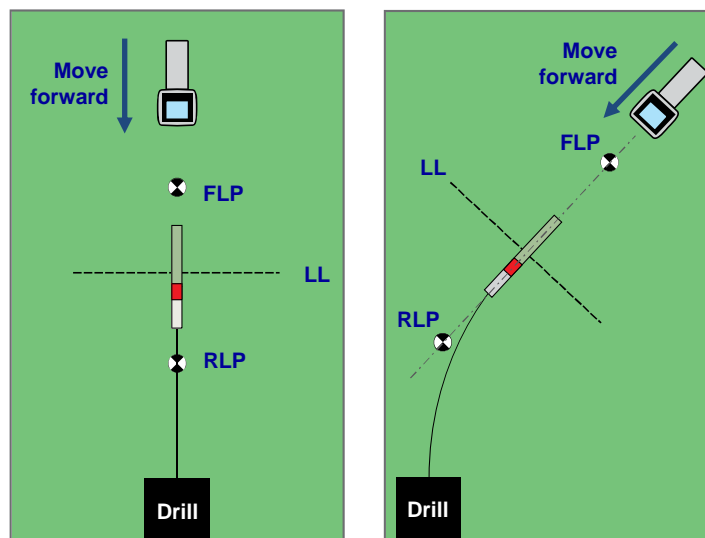


Plumb Line for Marking Locate Points

Locating the Transmitter

Falcon F2 can locate the transmitter *and* its heading while it moves, whether in front of the transmitter, behind it, or beside it. It can locate the transmitter while facing toward or away from the drill rig.

The standard method described in this section guides the receiver to the transmitter while standing 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.



Standard Locating

Curved Path Locating

If necessary, set Height-Above-Ground (HAG) and Roll Offset.

[Height-Above-Ground \(HAG\)](#)

[Roll Offset](#)

Page 18

Page 25




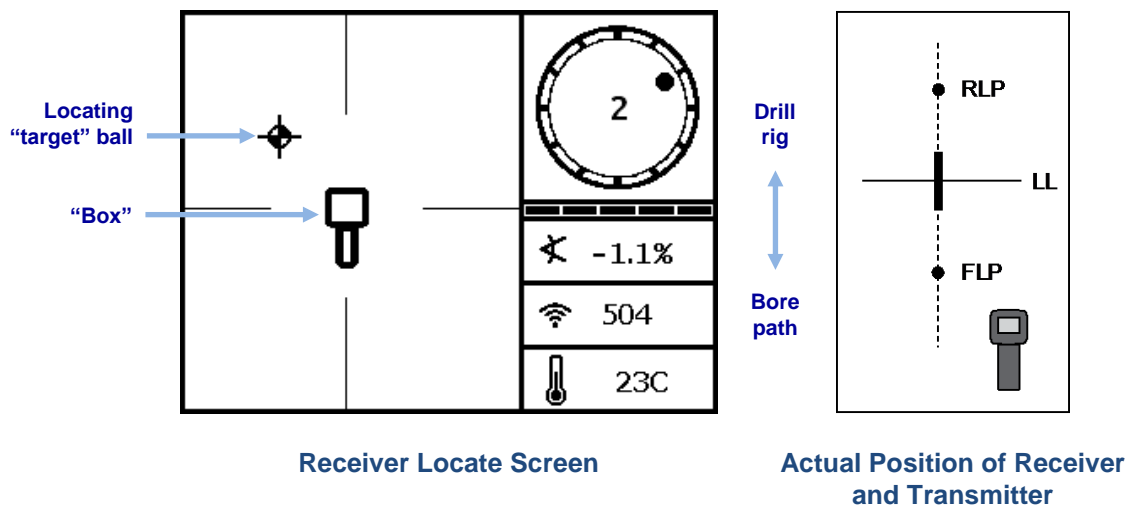
Go watch some TV

You can find a training video on **Basic Locating** at www.youtube.com/dcikent.

Finding the Front Locate Point (FLP)

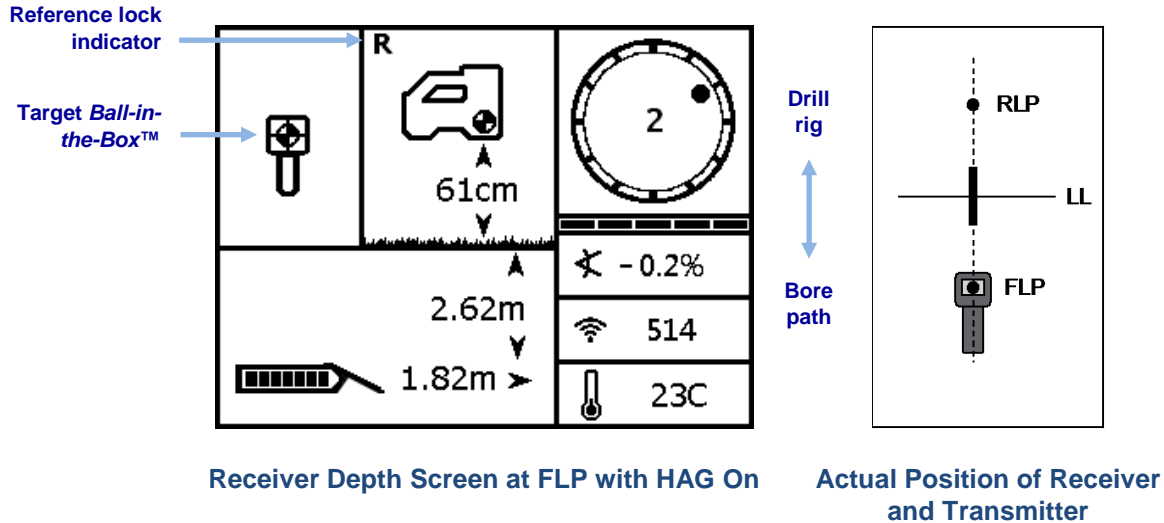
The locating procedure described here assumes that (a) you are facing the drill, (b) the transmitter is below ground and between you and the drill, and (c) the FLP is in front of you.

1. Start with the receiver on and in Locate mode.
2. Stand in front of the drill head at a distance of approximately the drill head depth.
3. Observe the position of the locating ball () relative to the receiver box on the display. The figures below show the FLP ahead of and to the left of the receiver; as the drill head gets deeper, the FLP will be found farther in front of the transmitter.



4. Move the receiver to guide the ball into the box.

- When the ball is centered in the box (*Ball-in-the-Box™*), hold the trigger for at least one second so the receiver can “lock” onto the reference signal. The “R” symbol will appear at the top of the Depth screen. The locate line (LL) will not display later without this reference.



Warning When setting a reference signal, do not hold the trigger unless you are *Ball-in-the-Box™* at the FLP. If you are ahead of the FLP, you could set an incorrect reference that causes a ghost locate line. This typically happens when the head is shallower than 1 m. In this case, you must reference again at the FLP.

If you hold the trigger for longer than five seconds, the receiver will enter Max mode, which performs differently than a normal depth reading.

[Max Mode](#)

Page 31

The depth value given at the FLP is the predicted depth, which is the depth the transmitter is calculated to be at when it reaches the location beneath the receiver. If the pitch or heading of the transmitter changes before it reaches the location under the receiver, the predicted depth reading will no longer be accurate.



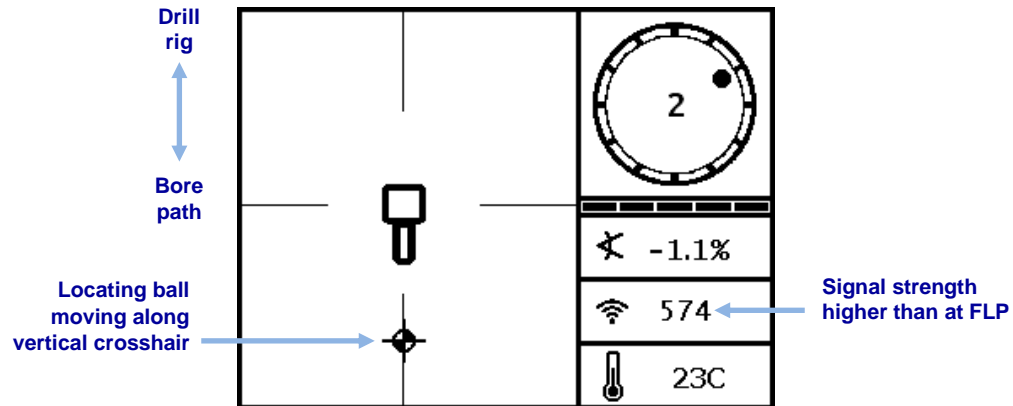
Quick receiver self-check

To verify that the signal is balanced through the receiver's antenna, carefully rotate the receiver 360° about the center of the display while keeping the receiver level. The locating ball should stay centered in the box. If it does not, do not continue to use the receiver and contact DCI Customer Service.

- With the ball centered in the box, mark the ground directly below the receiver's display screen as the FLP.

Finding the Locate Line (LL)

- Continue walking toward the drill rig or the last known transmitter location. Keep the locating ball on the vertical crosshair and observe that the signal strength is increasing.

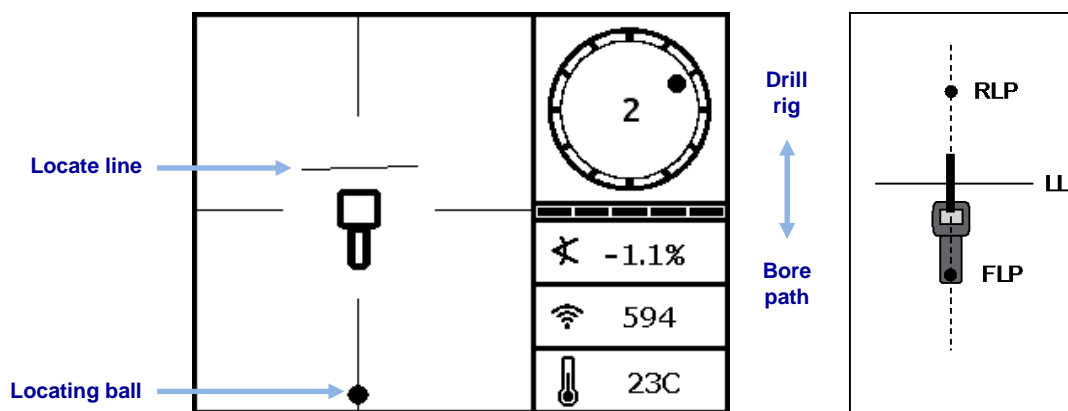


Receiver Locate Screen, Moving Toward LL, FLP Behind

If the signal strength decreases, you may actually have just located the RLP. Position yourself farther away from and facing the drill to locate the FLP.

- When the locating ball reaches the bottom of the screen, the locate line appears and the ball turns solid black to indicate your focus should now be on the LL.

If the locate line does not appear and the ball flips to the top of the screen, hold the trigger while moving the receiver in a forward/backward direction over where the ball flips. This action should re-reference the receiver to the transmitter's signal and bring up the locate line. If it does not, return to the FLP to re-reference (see step 1).

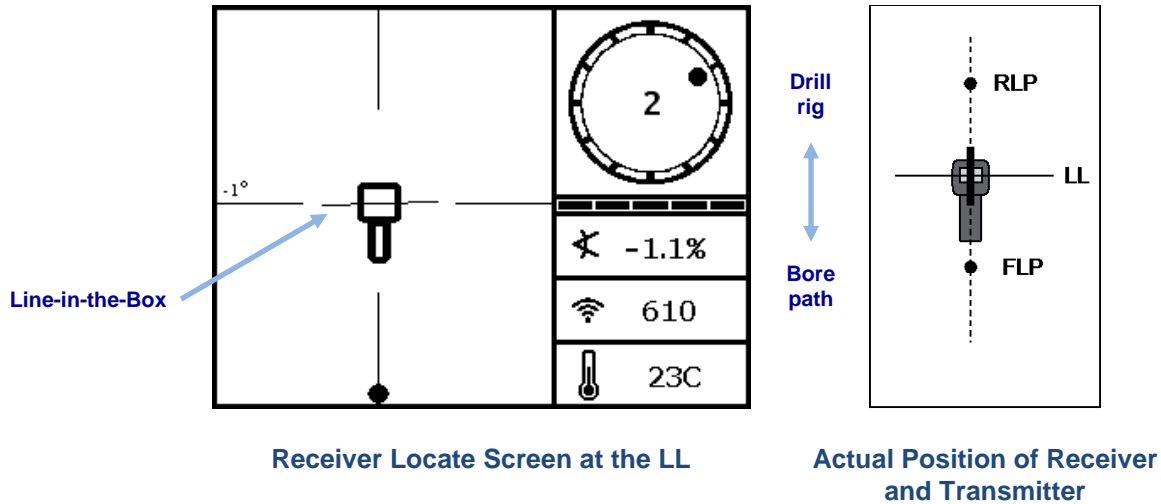


Receiver Locate Screen, Approaching LL

Actual Position of Receiver and Transmitter

Do not rely on the alignment of the ball with the vertical crosshair to identify the left/right position of the transmitter. Accurately locating the front and rear locate points is required to determine the transmitter's lateral position (heading) and take accurate depth readings.

9. Position the receiver so the LL aligns with the horizontal crosshair.



10. Take a depth reading and mark the LL directly below the receiver's display screen. If the FLP is to the left or right of the previous marks—indicating some steering action—locate the RLP as described in the next steps to verify proper positioning of the LL between the Locate Points.



If the bore path is straight, do I have to keep finding the RLP for every rod?

Page 41

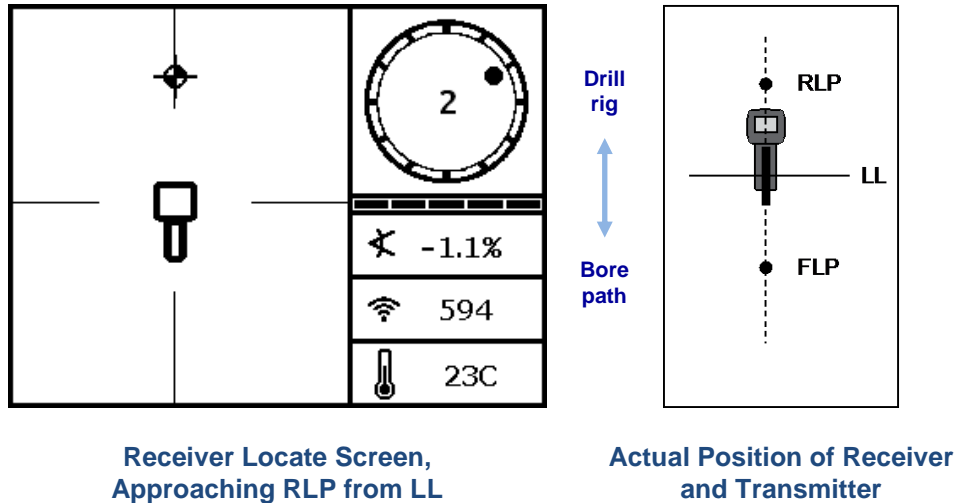
No. If a new FLP is directly in line with the previously marked FLPs (a straight bore line), it is unnecessary to find a new RLP since it will be directly in line with the previous marks. After the drill head moves forward another rod, find the new FLP and then LL.

Finding the RLP to Confirm Transmitter Heading and Position

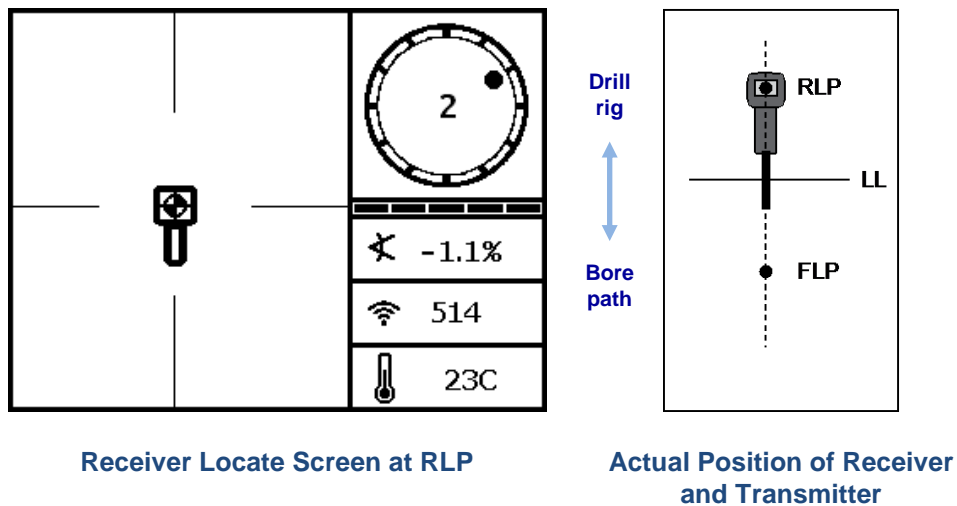
Finding the RLP will allow you to confirm the transmitter's heading and position. Like the FLP, the RLP is represented as a ball (●) on the receiver display.

Continue locating:

11. From the LL, facing toward the drill or last transmitter location, walk forward while keeping the ball aligned on the vertical crosshairs.

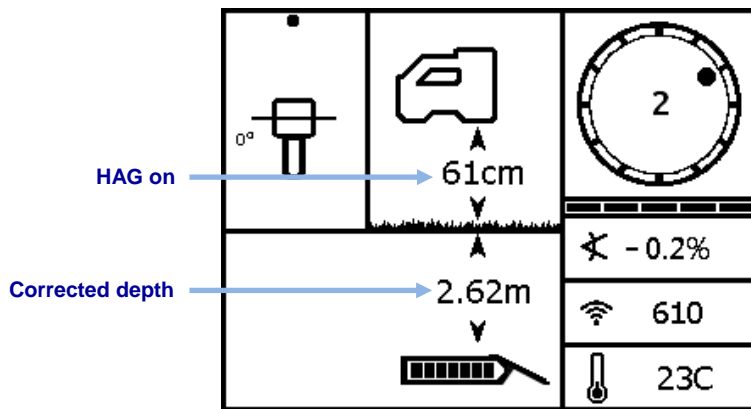


12. Position the receiver so the ball is centered in the box (*Ball-in-the-Box™*).

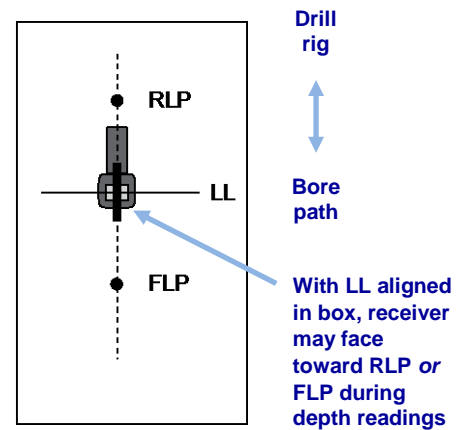


13. Mark the ground directly below the receiver's display screen as the RLP. A line between the RLP and FLP represents the transmitter's heading.

14. Position the receiver at the intersection of this line with the LL passing through the center of the box on the display and hold the trigger to take a depth reading. This is the current location of the transmitter.



Receiver Depth Screen at LL



Actual Position of Receiver and Transmitter

Three Methods to Verify Depth Reading

Disable HAG, set the receiver on the ground, and take another depth reading. This reading should be within 5% of the depth reading obtained with the HAG on and the receiver lifted. In the prior example, the reading should be 2.62 m.

or

With HAG on, set the receiver on the ground and add the HAG to the depth shown. It should also be 2.62 m.

or

If HAG is not being used, note the depth on the ground and then raise the receiver exactly 1 m. The depth reading should increase this same distance. In the example above, the depth would be 3.62 m.

See [Appendix C](#) on page 67 and [Appendix D](#) on page 71 for more information on depth.

Advanced Locating



When you're ready to push the envelope

Here are some techniques that will help you drill more productively and get past the bore that had everyone else scratching their heads and calling the home office.

Tracking "On-the-Fly"



Go watch some TV

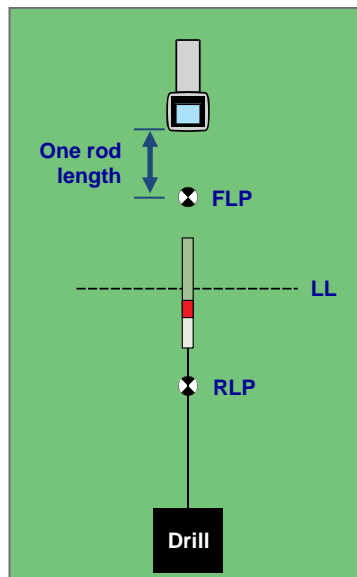
You can find a training video on **Tracking on the Fly** at www.youtube.com/dcikent.

If you are running at 0% (0°) pitch under level ground, the predicted depth will be the actual depth. In this case, all locating can be done at the FLP while the drill head is moving.

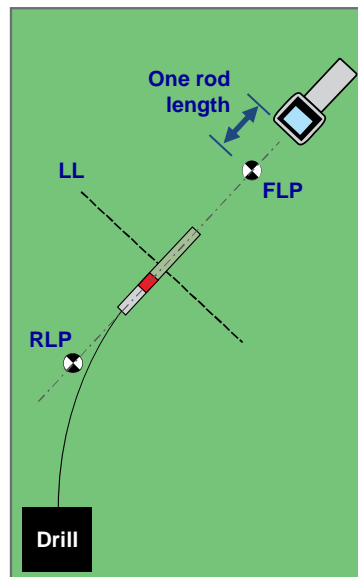
Once the transmitter has been located and it is moving in the correct direction, place the receiver relatively level on the ground one rod length in front of the FLP, in line with the path created by the FLP and RLP. Turn HAG off.

[Height-Above-Ground \(HAG\)](#)

Page 18

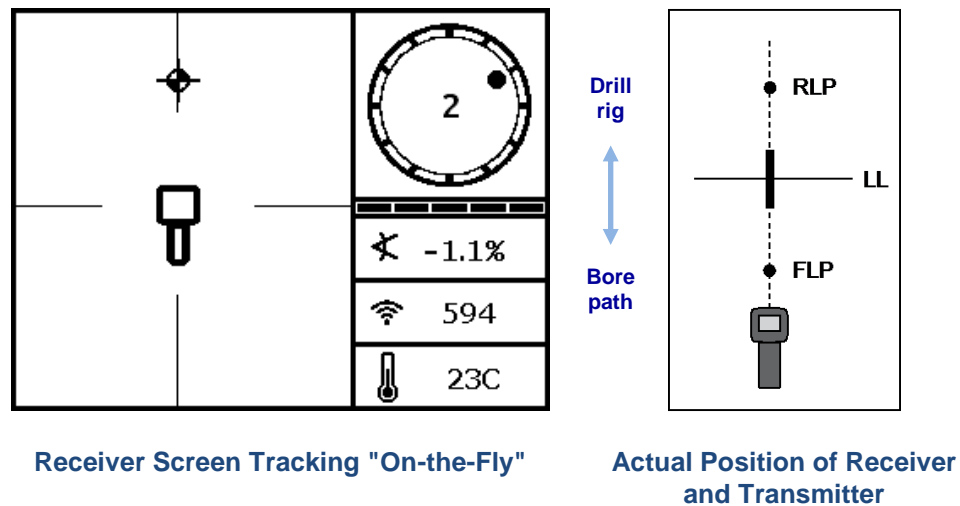


Tracking "On-the-Fly"
with a Straight Path



Tracking "On-the-Fly"
with a Curved Path

As the drill head advances, the FLP should travel along the receiver's vertical crosshairs, indicating the drill head is still on line. Once the FLP is in the box, hold the trigger and confirm that the predicted depth reading is as expected.



Off-Track Locating



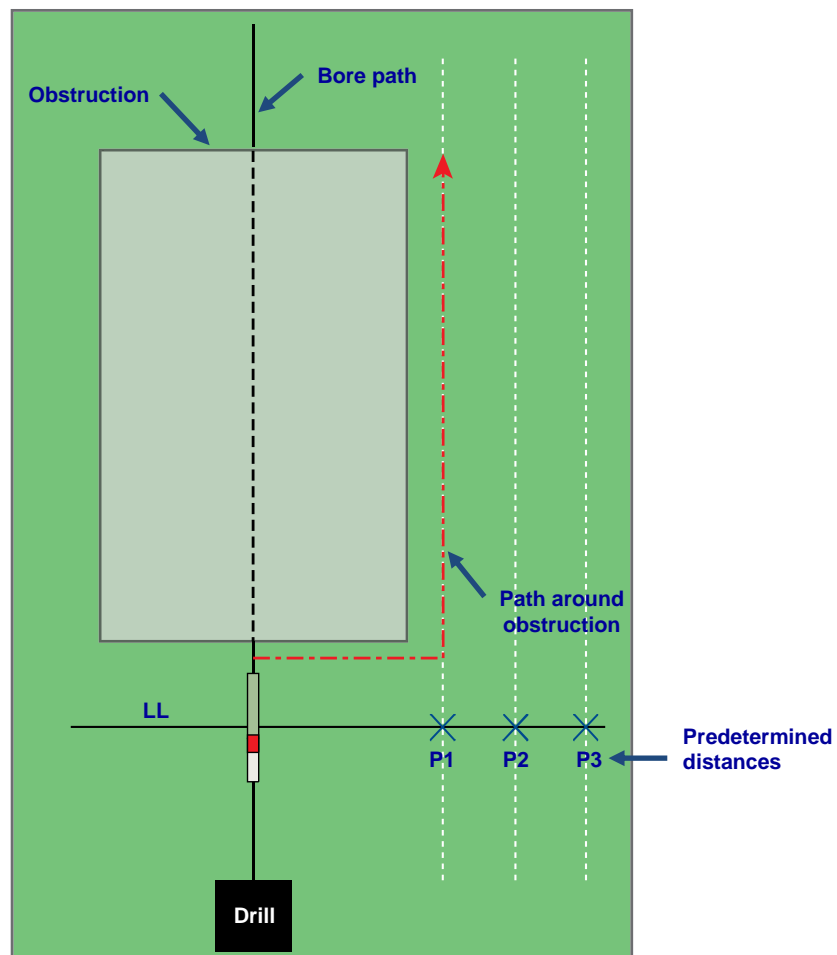
Go watch some TV

You can find a training video on **Off-Track Locating** at www.youtube.com/dcikent.

Use off-track locating when it is not possible to walk above the transmitter due to a surface obstruction or interference. Using the locate line's perpendicular relationship to the transmitter, it is possible to track the transmitter's heading and also determine if it is maintaining its intended depth. The off-track locating method is only effective when the pitch of the transmitter is 0% (0°) and traveling under flat ground.

To explain how the off-track locating method works, consider the example of an obstruction that is on the intended bore path, as shown in the figure below. The transmitter is about to go under the obstruction.

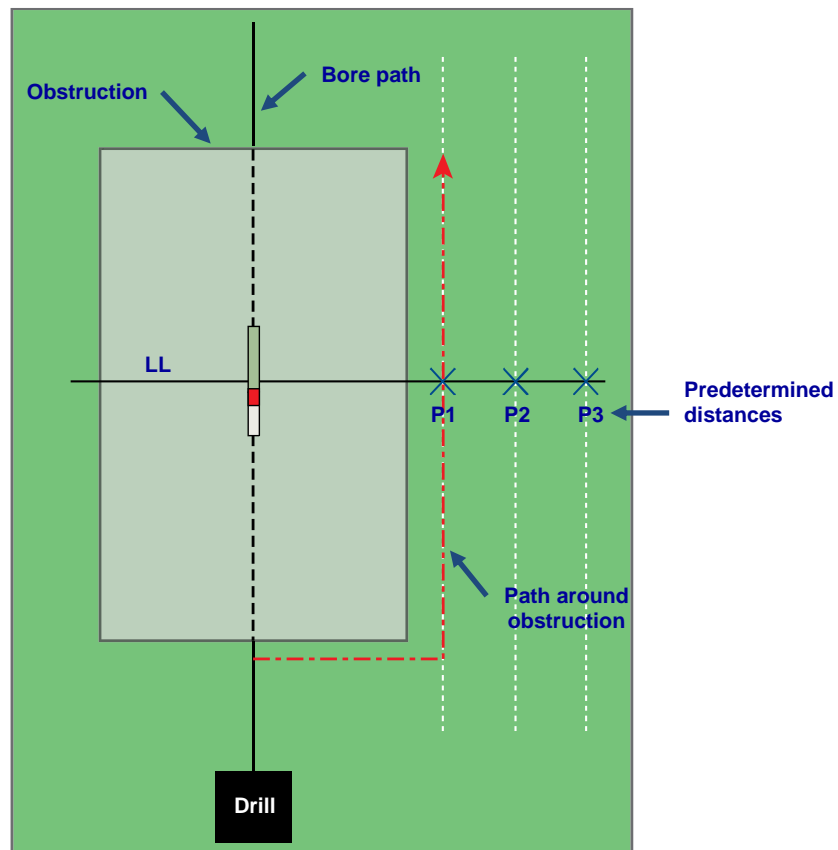
1. Stop drilling and find the locate line (LL) of the transmitter by putting the line in the box.
2. While holding the receiver in the same orientation, step to the side until you reach a predetermined distance (P1). Move the receiver forward and backward until the ball jumps between the top and bottom of the screen, then mark this location.



Preparing for Off-Track Locating

3. While still holding the receiver in the same orientation, step to the side another predetermined distance (P2) farther away. Move the receiver forward and backward until the ball jumps between the top and bottom of the screen, then mark this location.
4. While still holding the receiver in the same orientation, step to the side of the drill head another predetermined distance (P3) farther away. Move the receiver forward and backward until the ball jumps between the top and bottom of the screen, then mark this location.
5. Connect points P1, P2, and P3 with a line. This is the locate line. Because the LL runs perpendicular (at a 90° angle) to the transmitter when the transmitter is level, you can determine the heading of the drill head. By comparing the signal strength at the predetermined distances of P1, P2, and P3, as the drill head progresses, you can verify it is moving away from or maintaining the intended bore path. It is important to monitor the pitch of the transmitter to ensure the drill head is maintaining the desired depth.
6. As drilling continues, steer the drill head to maintain a constant signal strength at each of the points P1, P2, and P3. If the signal strength decreases, the drill head is moving away; if it increases, the drill head is moving toward the side position.

Differences in pitch and topology elevations will also affect the signal strength and LL position as the drill head progresses.



Off-Track Locating

Target Steering

The Target Steering[®] locating method allows the Falcon F2 receiver to be placed ahead of the drill head and used as a steering target.

In general, Target Steering should be used to *maintain* a bore path, not to bring a significantly off-course bore back on track. If needed, use front and rear locate methods to get back on course.

[Locate Points \(FLP & RLP\) and Locate Line \(LL\)](#)

Page 37



Note After learning the concepts of Target Steering, practice its use *before* using on a jobsite where time and money are at a premium. A *Look-Ahead Locating* animation is also available at www.youtube.com/dcikent. If you need further assistance, please contact DCI Customer Service.

The Falcon Compact Display supports Remote Steering, which provides left/right steering guidance but not depth. For Target Steering at the drill, DCI recommends the Aurora touchscreen remote display.

Using the receiver for Target Steering requires a stable signal from the transmitter.

Target Steering will not work properly with passive interference in the vicinity of the bore.

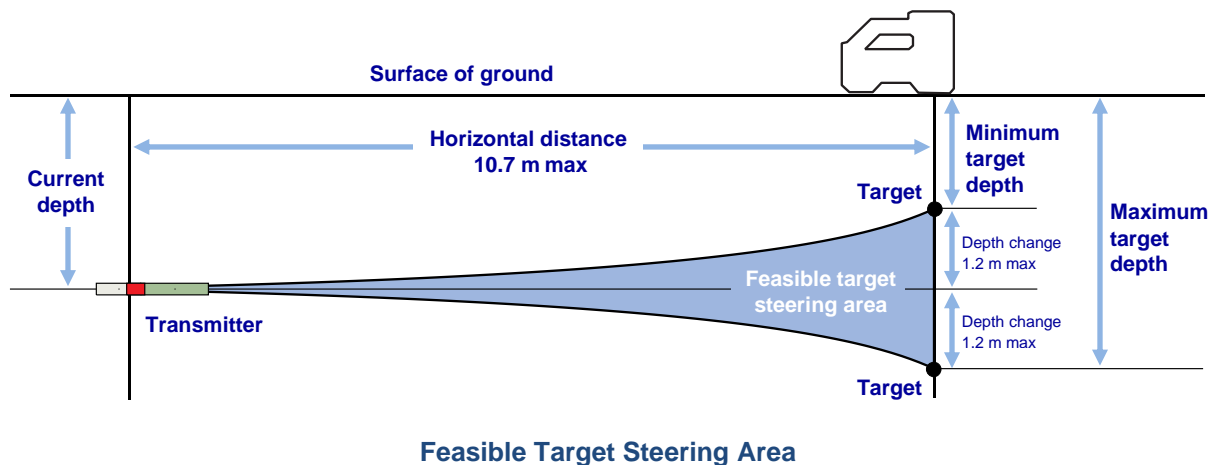
[Interference](#)
Page 34

Feasible Target Depth

The maximum distance the receiver can be placed ahead of the drill head for Target Steering is 10.7 m. Beyond this distance, depth information becomes less accurate. Within this range, starting with the drill head approximately level, the following parameters apply to depth data:


- The maximum depth change is approximately 1.2 m.
- The maximum pitch change is approximately 14%.

For the most conservative Target Steering operation, assume the ideal drill path is a circular arc with a radius that accommodates the bend radius of most drill strings and products being installed. As shown in the diagram below, the feasible steering area is limited to the shaded region bounded by the two circular arcs.



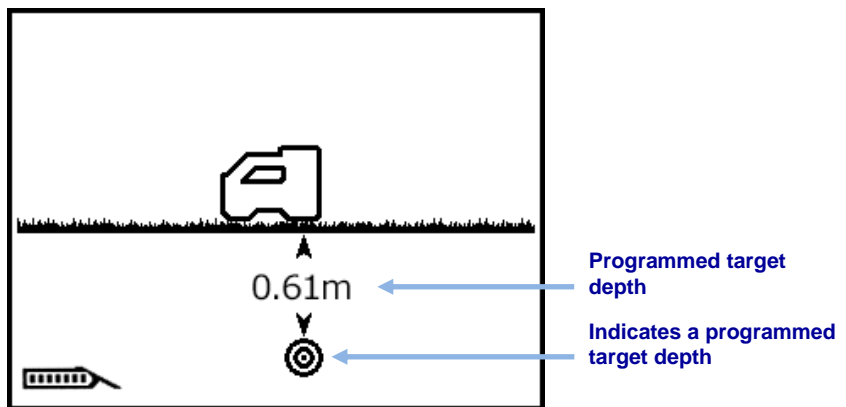
The Target Steering procedure requires correct placement of the receiver at less than 10.7 m in front of the transmitter, on the bore path, with its back end (where the battery pack is inserted) facing the drill.

When used to provide only the right/left Remote Steering signals accepted by the Falcon and Aurora remote displays, the distance between receiver and transmitter is limited only by the range of the transmitter.

Use the three screens in the Target Steering menu  on the receiver to turn Target Steering On, turn Target Steering off, or set the target depth, as described in the following sections.

Turning Target Steering On

Use the first screen in the Target Steering menu to turn remote steering on at the target depth displayed, which is either the default value of 0.50 m or the most recently-set value. The target depth is the depth at which you want the transmitter when it passes under the receiver. To change the target depth, click twice and skip to [Setting the Target Depth](#) on page 53.



Target Steering Menu

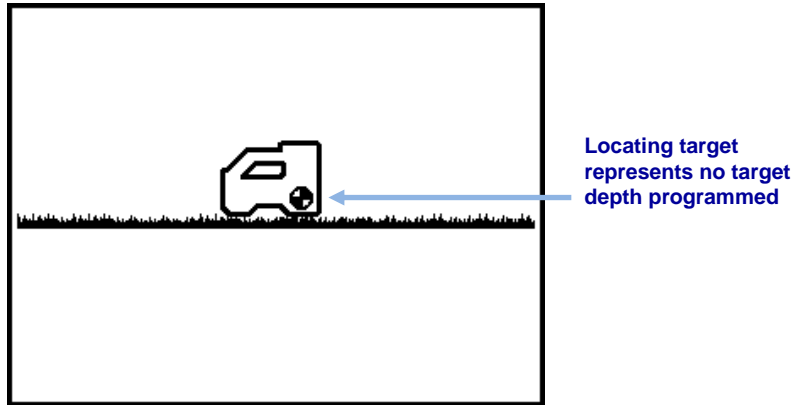
Hold the trigger briefly to turn Target Steering on with the displayed depth value. A checkmark appears briefly next to the receiver icon. The receiver beeps four times to confirm and returns to the Locate screen with Target Steering enabled.

With Target Steering enabled, the Locate screen will now show the horizontal distance from transmitter to receiver (see the first screen in the section [Positioning the Receiver as the Target](#) on page 54).

Any HAG setting in effect is ignored during Target Steering.

Turning Target Steering Off

Use the second screen in the Target Steering menu to turn target steering off.



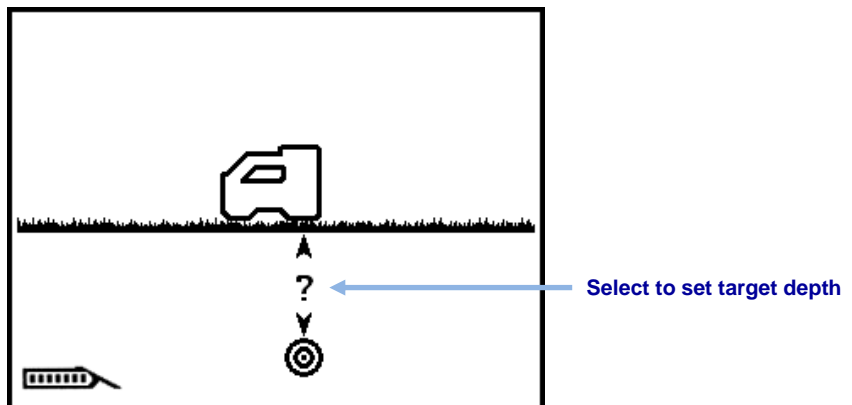
Hold the trigger briefly to turn Target Steering off. A checkmark appears briefly next to the receiver icon. The receiver beeps four times to confirm and returns to the Locate screen.

When the receiver exits Target Steering mode, the remote display automatically returns to the normal Remote Locating screen and the receiver no longer displays horizontal distance from transmitter to receiver.

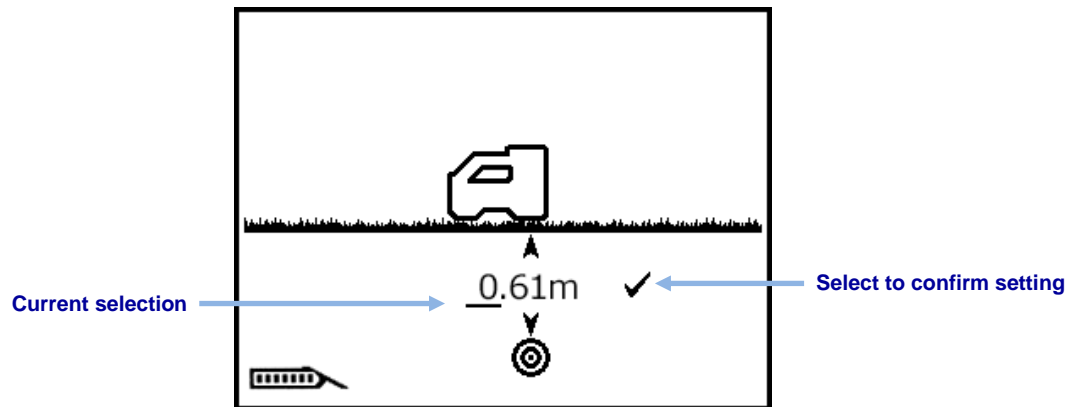
Setting the Target Depth

Use the third screen in the Target Steering menu to set the target depth. This screen is similar to the first screen except that a question mark appears in place of the current target depth value.

1. Hold the trigger briefly to set the target depth value.



2. The first digit is underlined. Click to select the next digit, or hold briefly to change the value.



3. Upon selection, the value becomes boxed. Click to scroll through numeric values, then hold briefly to select. Click to select subsequent values and hold briefly to change.
4. When the target depth is set correctly, select the checkmark to confirm. A checkmark appears briefly next to the receiver icon and the receiver beeps and returns to the Locate screen with Target Steering enabled.

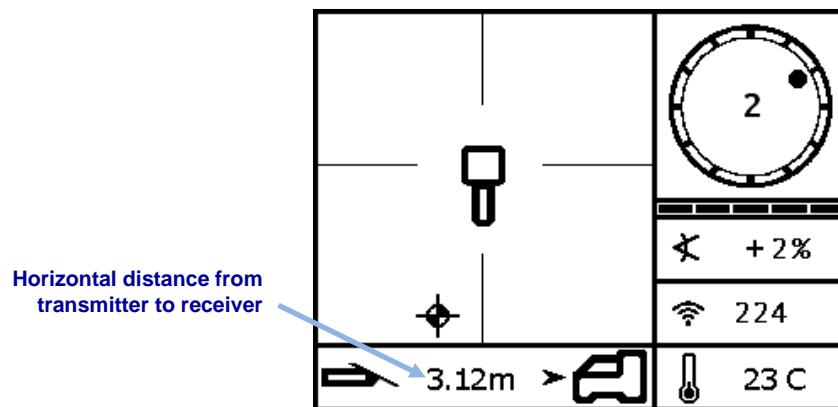
If you click past your desired meter value, either click through the maximum value of 30 m or wait about five seconds to exit without saving and try again.

If you click past 99 cm in the centimeter field, the number in the *m* field will automatically increase.

To maintain the most accurate readings on the remote display, never set the target steering depth more than 1 m from the current depth.

Positioning the Receiver as the Target

Setting a target depth on the receiver activates target steering, and the Locate screen on the receiver now displays horizontal distance from transmitter to receiver. The remote display on the drill automatically changes to Target Steering or Remote Steering mode.



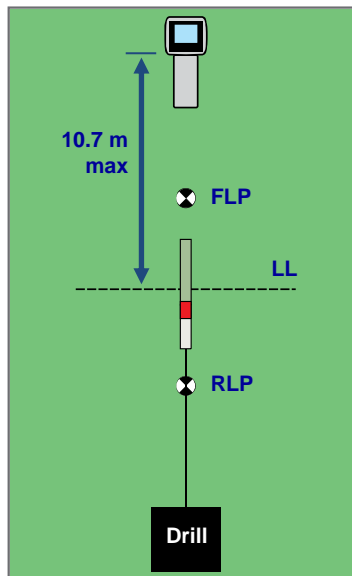
Target Steering Data on the Receiver

Ensure that the location you would like to steer to beneath the receiver is feasible for the bend radius of the drill string and product being installed.

[Feasible Target Steering Area](#)

Page 51

Place the receiver on the intended drill path beyond the FLP but within 10.7 m of the transmitter with its back end (battery pack) facing the transmitter's current location. Position the receiver with the understanding that Target Steering is designed to bring the drill head to the target beneath the receiver so it is perpendicular to the rear of the receiver.



Positioning the Receiver for Target Steering

For the Falcon remote display that supports only Remote Steering, the 10.7 m maximum distance from the transmitter shown below is instead limited only to the maximum range of the transmitter.

Steering to the Target with the Remote Display

Refer to the operator's manual for your remote display for details on its Target Steering or Remote Steering screen. Manuals are located on the flash drive or CD that accompanied the equipment or online at www.DigiTrak.com.

Target Steering in Interference Areas



Warning Interference can cause inaccuracies in the measurement of depth and placement of the locating ball, and loss of the transmitter's pitch, roll, or heading.

In areas of passive and/or active interference, it may help to physically elevate the receiver above the ground. If raising the receiver above the ground, adjust the target depth to include the elevated height.

Transmitter

A transmitter generates a magnetic field detected by the Falcon F2 receiver. The transmitter and receiver must have matching regional designation numbers to communicate with each other and comply with local operating requirements. The transmitter's regional designation number is located inside the globe icon (🌐) near the serial number. The transmitter must be paired to the receiver prior to use.

The Falcon F2 wideband transmitter provides pitch readings in as low as 0.1% or 0.1° increments at level and displays roll in 12 clock positions (CP). The transmitter has a depth range of up to 30.5 m, data range of up to 38.1 m, and broadcasts in nine bands encompassing frequencies from 4.5 to 45.0 kHz.



Falcon F2 Dual Wideband Transmitter

Calibration is required prior to first-time use and before using a different transmitter, receiver, drill head, or transmitter band. Calibration is not necessary, however, when switching between bands on a transmitter that are already paired and calibrated.

[Calibration and AGR](#)
Page 20

A detailed pitch resolution table is located in [Appendix A](#).



Can I use other DigiTrak transmitters with my Falcon?

No. The technology behind Falcon's use of multiple optimized frequencies requires a DigiTrak Falcon F2 dual wideband transmitter.

Can I use DigiTrak transmitters rebuilt by other companies?

Falcon F2 transmitter technology is highly unique and cannot be replicated by any third party vendor. If you think you're getting a great online deal on a substitute Falcon transmitter, you are being scammed for a device that does not exist. Just saying.

If you purchase a "remanufactured" transmitter, do so with the following considerations: (1) You must be willing to bet an entire day's work on thermally abused transmitter components that would likely fail a bench test. (2) You must have a good reason ready for the boss for why DCI customer service will not provide assistance when your transmitter that is registered to someone else fails on your job mid-bore. And, (3) you must be willing to risk bodily harm, property damage, and the potential financial devastation of your company just to save a few bucks on an inferior, potentially dangerous, recycled device that is a lawsuit waiting to happen. If that works for you, we wish you the best of luck, and leave you with this advice from DigiMan: "The inconvenience of poor quality long outlasts the thrill of a good deal."

Batteries and Power On/Off

DigiTrak Falcon F2 dual wideband transmitters require two C-cell alkaline batteries or one DCI SuperCell™ lithium battery providing a maximum of 3.6 VDC. Alkaline batteries will last up to 20 hours, whereas a SuperCell battery will last up to 70 hours.



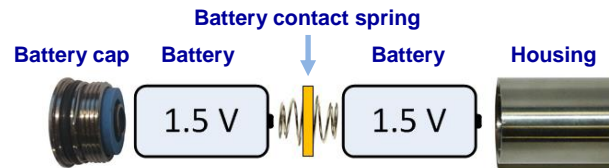
Warning Never use damaged or non-DCI lithium batteries. Never use two C-cell lithium batteries providing a combined voltage above 3.6 VDC.

DCI SuperCell lithium batteries are manufactured to military specifications. The use of damaged or lower-quality lithium batteries may damage the transmitter and/or housing and will void the DCI warranty.

Installing Batteries / Power On

DCI transmitters power on as soon as the batteries and battery cap are properly installed. To install the batteries:

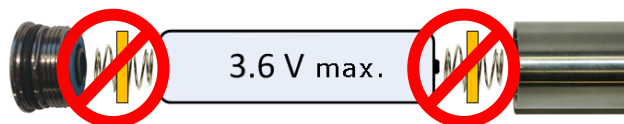
1. Remove the battery cap from the transmitter using a large slotted screwdriver and rotating the cap counterclockwise.
2. Insert the battery or batteries into the transmitter with the positive terminals first. When using two C-cell batteries, include the battery contact spring that came with the transmitter as shown below.



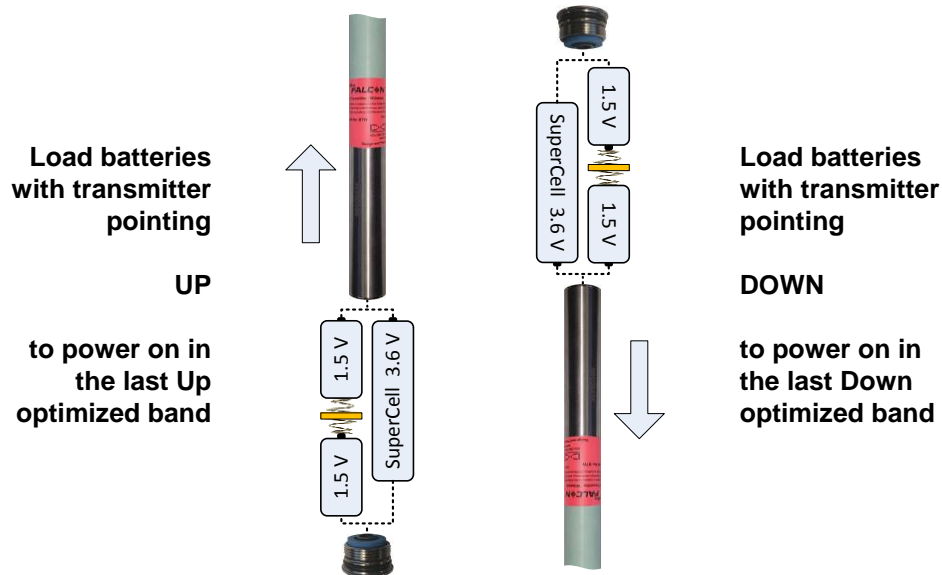
C-Cell Batteries Installed with Battery Contact Spring



Note Do NOT use the battery contact spring at either end of a single SuperCell™ battery.



3. Select the startup frequency of the transmitter by installing the batteries with the transmitter pointing either up or down:



Selecting the Startup Frequency of the Transmitter


To power on the transmitter in the last band used, install the batteries with the transmitter horizontal. The Falcon F2 receiver remembers the last frequency band used, even after a power cycle.

4. Replace the battery cap and maintain orientation for at least 10 seconds.

Starting the **Frequency Optimizer** will not change the transmitter's optimized frequency bands until the receiver and transmitter are paired. Once paired, the transmitter automatically begins using the new optimized frequency band. With two new bands, the receiver and transmitter will begin using the Down band first.



Transmitter Battery Strength

The battery strength icon  at the bottom of the receiver's Depth screen indicates the battery life remaining for alkaline batteries. It also appears at the bottom left of the Locate screen for the first five minutes the transmitter is powered on. Until the transmitter is installed in a housing and therefore drawing normal current, this strength reading will not be accurate.



Warning Because the battery status for a SuperCell battery will appear full until just before it is fully depleted, you must track its hours of use.

Transmitter Current Draw Warning

Transmitter over-current—drawing too much current from the batteries, which shortens battery life—may occur due to weak or used batteries or use of an incompatible drill housing. Excessive current is indicated by a lightning bolt over the transmitter battery strength icon on the Locate screen.



The Falcon F2 transmitter only performs this current draw test for five minutes after powering on. The transmitter must be installed in the drill head for this test to be valid. Different drill heads and slot arrangements will affect current draw and battery life.

Sleep Mode

All battery-powered DigiTrak transmitters go into sleep mode and stop transmitting to conserve battery power if they are stationary for longer than 15 minutes. To awaken the transmitter, rotate the drill string a half turn; a transmitter will not awaken if it lands on the same roll position at which it went to sleep.

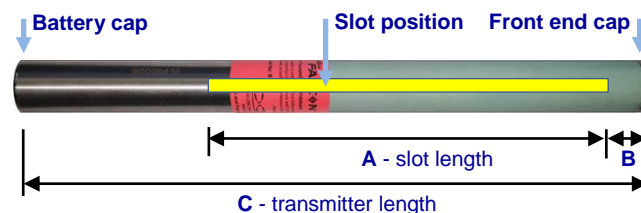
A small amount of charge will continue to drain from the batteries while the transmitter is in sleep mode so it can monitor roll position. To conserve battery life, do not leave batteries in the transmitter when they can be easily removed. Always remove batteries when the transmitter is not being used to turn it off.



Note A transmitter will continue sending data for up to 10 seconds after the batteries are removed. If you have removed the batteries and intend to restart the transmitter in another frequency, wait until data has stopped displaying on the receiver before reinstalling the batteries.

Transmitter Drill Head Requirements

For maximum transmitter range and battery life, the slots in the drill head must meet minimum length and width requirements and be correctly positioned. DCI transmitters work best with three slots that are equally spaced around the circumference of the drill head for optimal signal emission and maximum battery life. The slots must be at least 1.6 mm wide. For accuracy, slot measurements must be taken on the *inside* of the drill head.



	A Minimum	B Maximum	C
Falcon F2 Wideband	22.9 cm*	2.5 cm*	38.1 cm

* Ideal measurement. The DCI standard slot length of 21.6 cm and B distance of 5.1 cm remains acceptable.

A transmitter must fit snugly in its drill head. It may be necessary to wrap the transmitter with tape or O-rings and/or to use a drill head adapter for larger drill heads. Contact DCI Customer Service for more information.


The index slot in the front end cap of the transmitter should fit onto the anti-roll pin (key) in the drill head for proper alignment. Use roll offset if the transmitter's 12:00 position does not match that of the drill head.

[Roll Offset Menu](#)

Page 25


Use only the battery cap that accompanied the Falcon F2 transmitter; other battery caps may look similar but crush the batteries or make the transmitter too long to fit in a standard housing.

Temperature Status and Overheat Indicator

All DigiTrak transmitters are equipped with an internal digital thermometer. The temperature displays on the bottom right of the receiver and remote display screens next to the transmitter temperature symbol . Normal drilling temperatures range from 16 to 40° C. Suspend drilling when temperatures exceed 36° C to permit cooling.






Note Because the digital thermometer is inside the transmitter, temperature increases due to external drilling conditions will take time to transfer to the transmitter. Resolve increases in temperature quickly to avoid irreversible damage.

If the temperature reaches 48° C, the thermometer icon will change to show that the transmitter is becoming dangerously hot . The transmitter must be allowed to cool immediately or it will be damaged.

To cool the transmitter, stop drilling and retract the drill bit a few feet and/or add more drilling fluid.

Transmitter Temperature Warning Tones

The Falcon F2 receiver and remote display emit the following audible tones to indicate increases in the transmitter temperature:

Icon	Temperature	Warning Tones
	Below 16° C	None
	16–36° C	Double-beep sequence (beep-beep) for every 4° C increase in temperature.
	40–44° C	Two double-beep sequences (beep-beep, beep-beep) for every 4° C increase in temperature. Action is required to cool the transmitter.
	48–56° C	Three double-beep sequences (beep-beep, beep-beep, beep-beep) for every 4° C increase in temperature. Cooling is critical to avoid irreversible damage.
 <i>flashing</i>	Above 60° C	Three double-beep sequences every 5 seconds on the remote display, and every 20 seconds on the receiver. This warning signifies dangerous drilling conditions; irreversible damage may have already been done to the transmitter.
	104° C	None: transmitter overheat indicator (temp dot) turns black.

Transmitter Overheat Indicator (Temp Dot)

Each transmitter has a temperature overheat indicator (temp dot) on the front end cap. The temp dot has an outer yellow ring with a 3 mm white dot in the center. The white dot will change color if the transmitter is exposed to excessive heat.



Transmitter Temp Dot

If the temp dot changes to silver or gray, the transmitter has been exposed to heat but not in excess of specifications. If the temp dot is black, the transmitter has been exposed to excessive temperatures (over 104° C) and can no longer be used. The DCI warranty does not cover any transmitter that has been overheated (black dot) or had its temp dot removed.

Avoid transmitter overheating by practicing proper drilling techniques. Abrasive soils, clogged jets, inadequate mud flow, and improperly mixed mud all contribute significantly to the overheating of a transmitter.

Changing Frequency Bands

Use these procedures to switch between the two optimized frequency bands, such as when performing an AGR test in both bands with the transmitter in the drill head prior to drilling.

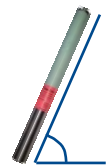
[Installing Batteries / Power On](#)

Page 57

Above Ground (Pre-Bore) Tilt Method

Do not roll the transmitter more than two clock positions (CP) during this procedure.

1. Place the transmitter on an approximately level surface ($0 \pm 10^\circ$) for at least five seconds with the receiver at the Locate screen and transmitter data being displayed.
2. Tilt the transmitter up at approximately 65° (over 100%, or nearly vertical).
3. Hold the transmitter steady for 10–18 seconds.
4. Return the transmitter to level within 10 seconds.
5. After 10–18 seconds, all transmitter data disappears from the receiver's screen, indicating the transmitter frequency has changed.
6. Select the new frequency band in the receiver's Transmitter Options menu. The new band displays at the top of the Main menu. It may take up to 30 seconds for the transmitter to begin sending data on the new frequency; return to the Locate screen and verify that transmitter data appears on the display.



[Transmitter Options Menu](#)

Page 26

Below Ground (Mid-Bore) Roll Methods

Switching between bands on the Falcon F2 transmitter may provide better data results while drilling in a section of the bore with a high level of interference. Use these methods to change the frequency band of a transmitter mid-bore.

Frequency Change, 10-2-7

1. Ensure roll offset is disabled and transmitter roll data is displayed on the receiver. [Roll Offset Menu](#) Page 25
2. Position the transmitter at 10:00 (± 1 clock position, or CP) for 10–18 seconds.
3. Roll the transmitter clockwise to its 2:00 position (± 1 CP) within 10 seconds and remain there for 10–18 seconds.
4. Roll the transmitter clockwise to its 7:00 position (± 1 CP) within 10 seconds.
5. When transmitter data disappears from the receiver, the transmitter frequency has changed. This will take approximately 10–18 seconds.
6. Select the new frequency band in the receiver's Transmitter Options menu. [Transmitter Options Menu](#) Page 26
The new band displays at the top of the Main menu. It may take up to 30 seconds for the transmitter to begin sending data on the new frequency; return to the Locate screen and verify that transmitter data appears on the display.
7. Re-enable roll offset, if applicable.

Frequency Change, Repeating Roll Sequence (RRS3)

1. Remain at any clock position (CP) for at least 40 seconds to clear all timers.
2. Complete one full clockwise rotation (± 2 CP) within 0.5–30 sec., then wait 10–20 seconds.
3. Repeat step 2 two more times, for a total of three rotations (RRS3).
4. After the third rotation, leave the drill string at rest for a total of 60 seconds, after which the transmitter changes frequency.
5. Select the new frequency band in the receiver's Transmitter Options menu. [Transmitter Options Menu](#) Page 26
The new band displays at the top of the Main menu. It may take up to 30 seconds for the transmitter to begin sending data on the new frequency; return to the Locate screen and verify that transmitter data appears on the display.

If any rotation is not completed within the prescribed time, or if any rotation continues for more than one full revolution, the transmitter frequency change is cancelled.



Warning A warning symbol in the roll indicator after changing bands on the receiver means the transmitter has not yet been [calibrated](#) in this band. While locate positions and roll/pitch data will be correct, depth readings will be incorrect.

Appendix A: System Specifications

Power Requirements

Device (Model Number)	Operational Voltage	Operational Current
DigiTrak Falcon F2 Receiver (FAR2)	14.4 V ===	300 mA max
DigiTrak SE NiMH Battery Charger (SBC)	Input 100–240 VAC Output 25 V === (nominal)	350 mA max 700 mA max
DigiTrak SE NiMH Battery Pack (SBP)	14.4 V === (nominal)	2.0 Ah 29 Wh max
DigiTrak F Series Battery Charger (FBC)	Input 10–28 V === Output 19.2 V ===	5.0 A max 1.8 A max
DigiTrak F Series Lithium-Ion Battery Pack (FBP)	14.4 V === (nominal)	4.5 Ah 65 Wh max
DigiTrak Falcon F2 Transmitter (BTW)	1.2–4.2V ===	1.75 A max

Environmental Requirements

Device	Relative Humidity	Operating Temperature
DigiTrak Falcon F2 Receiver (FAR2) and Remote Display with NiMH Battery Pack with Lithium Battery Pack	<90%	-10 to 65° C -20 to 60° C
DigiTrak BTW Transmitter	<100%	-20 to 104° C
DigiTrak Falcon Compact Display (FCD) with NiMH Battery Pack with Li-Ion Battery Pack	<90%	-10 to 65° C -20 to 60° C
DigiTrak SE NiMH Battery Charger (SBC)	<90%	0 to 40° C
DigiTrak SE NiMH Battery Pack (SBP)	<99% for <10° C <95% for 10–35° C <75% for 35–65° C	-10 to 65° C
DigiTrak F Series Battery Charger (FBC)	<99% for 0–10° C <95% for 10–35° C	0 to 35° C
DigiTrak F Series Lithium-Ion Battery Pack (FBP)	<99% for <10° C <95% for 10–35° C <75% for 35–60° C	-20 to 60° C

System working altitude: up to 2000 m.

Storage and Shipping Requirements

Temperature

Storage and transportation temperature must remain within -40 to 65° C.

Packaging

Ship in original carrying case or packaging of sufficient durability to prevent mechanical shock to equipment during transportation.

Approved for transportation by vehicle, boat, and aircraft.

SuperCell batteries are regulated UN3090 lithium metal batteries and F Series FBP batteries are regulated UN3480 and UN3481 lithium ion batteries. Lithium batteries are considered Class 9 Miscellaneous Dangerous Goods under International Air Transportation Association (IATA) regulations; IATA regulation and Ground Transportation regulations 49 CFR 172 and 174 apply. These batteries must be packaged and shipped by trained and certified personnel only. Never ship damaged batteries.

Equipment and Battery Disposal



This symbol on equipment indicates that the equipment must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of such equipment at a designated collection point for the recycling of batteries or electrical and electronic equipment. If the equipment contains a banned substance, the label will show the pollutant (Cd = Cadmium; Hg = Mercury; Pb = Lead) near this symbol. Before recycling, ensure batteries are discharged or the terminals are covered with adhesive tape to prevent shorting. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service, or the shop where you purchased the equipment.











U.S.: Contact the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program at 800.8.BATTERY or visit www.rbrc.org to recycle your used battery.









Transmitter Pitch Resolution

Transmitter pitch resolution decreases with increased grade.

±% Grade	± Degrees Grade	% Resolution
0 – 3%	0 – 1.7°	0.1%
3 – 9%	1.7 – 5.1°	0.2%
9 – 30%	5.1 – 16.7°	0.5%
30 – 50%	16.7 – 26.6°	2.0%
50 – 90%	26.6 – 42.0°	5.0%

Appendix B: Receiver Screen Symbols

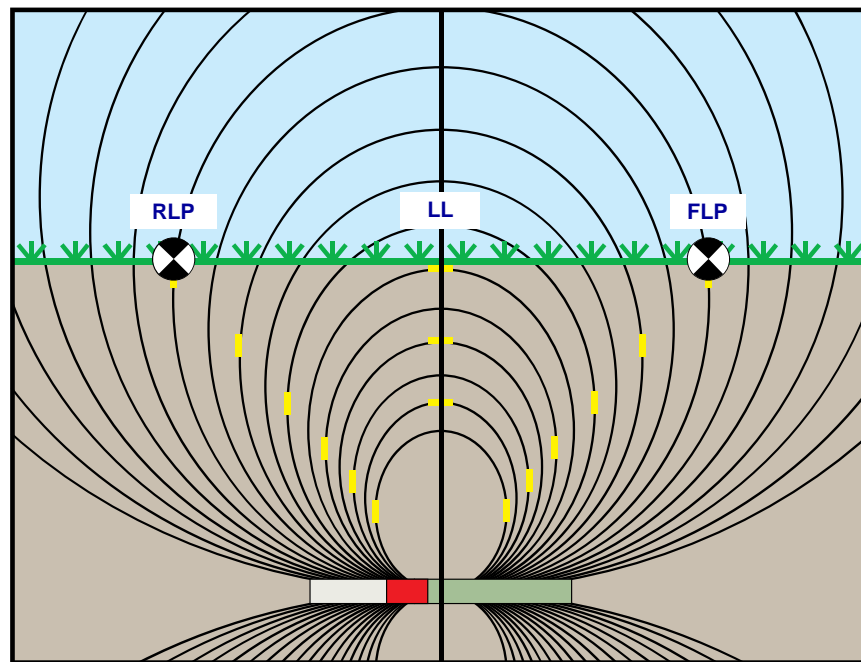
Symbol	Description	
A	<u>Attenuated Signal</u> – The receiver automatically enters Attenuation mode when locating at shallow depths of about 1 m or less to reduce excessive transmitter signal strength. Displays at bottom left of roll indicator.	Page 30
	<u>Globe Icon</u> – Shown on the receiver startup screen, the number inside (shown blank here) identifies the regional designation, which must match that on the transmitter battery compartment.	Page 7
	<u>Ground Level</u> – Represents the ground for the HAG function, depth readings, and the two-point calibration procedure.	Page 31
	<u>Locate Line</u> –The locate line (LL) is found between the front and rear locate points only after a <u>reference lock</u> has been obtained. May also include the transmitter yaw angle in degrees.	Page 31
	<u>Locating Ball</u> – Represents the front and rear locate points (FLP and RLP). When the locate line appears, the locating ball will become a solid circle (ball) representing the approximate locate point.	Page 29
	<u>Locating Icon</u> (Receiver) – Represents a bird's-eye view of the receiver. The square at the top of this icon is referred to as the “box” in the terms <i>Ball-in-the-Box™</i> and Line-in-the-Box locating.	Page 29
	<u>Max mode</u> – Max mode begins when the trigger is held longer that five seconds during a depth reading.	Page 31
	<u>Max mode timer</u> – Provides a visual indication that Max mode is in effect (trigger held). Replaces the roll/pitch update meter.	Page 31
	<u>Pitch Assumed Zero</u> – Indicates that since no pitch data is currently available, the pitch is assumed to be zero for depth and distance calculations.	Page 22
	<u>Receiver Battery Strength</u> – Shows the remaining battery life of the receiver. Appears above the main menu. When battery life is low, the icon will flash on the Locate screen.	Page 13
	<u>Receiver Icon</u> – Indicates the position of the receiver relative to the ground for the HAG function, depth readings, and the Target Steering function.	Page 18
R	<u>Reference Lock</u> – Indicates a reference signal has been obtained for displaying the locate line. Displays at the top of the Locate screen.	Page 33
RO	<u>Roll Offset</u> – Indicates roll offset is enabled. Displays at bottom right of roll indicator.	Page 25
	<u>Roll/Pitch Update Meter</u> – Shows the quality of data reception from the transmitter (specifically, data rate). Five bars is the best signal. Fewer bars indicates the receiver is in an area of interference or you are reaching the range limit of the transmitter.	Page 29

Symbol	Description	
	<u>Transmitter Battery Strength/Drill Head</u> – Depicts the remaining battery life of the transmitter when alkaline batteries are used. Also represents the position of the drill head relative to the receiver in the Depth screen. Appears for five minutes at the bottom left of the Locate screen and also on depth screens.	Page 29
	<u>Transmitter Current Draw Warning</u> – Indicates transmitter over-current, perhaps due to weak batteries or use of an incompatible drill housing.	Page 30
	<u>Transmitter Pitch</u> – The number next to this icon on the Locate screen is transmitter pitch angle.	Page 29
	<u>Transmitter Roll Indicator</u> – Shows the transmitter's roll position. A solid dot indicates the roll position, and the roll value appears in the center of the clock. When roll offset is enabled, the letters "RO" appear at the bottom right and the solid dot becomes a circle.	Page 25
	<u>Transmitter Signal Strength</u> – The number next to this icon on the Locate screen is the transmitter signal strength. During a calibration failure, an up or down arrow with this icon indicates signal strength is too high or too low, respectively. Maximum signal strength is 1283.	Page 29
	<u>Transmitter Temperature</u> – The number next to this icon shows the transmitter temperature. An up or down arrow and a change in the thermometer level will accompany a change in temperature. The icon will display steam and flash when the transmitter becomes dangerously hot, indicating the transmitter must be cooled immediately or it will be damaged.	Page 60
	<u>Trigger Click Prompt</u> – Appears on the calibration screens to indicate that a trigger click is required. Allowing this screen to time out opens the AGR screen.	Page 21
	<u>Warning</u> – Indicates a failure in the self-test or a need to calibrate the receiver to the transmitter.	Page 30

Appendix C: Projected Depth Versus Actual Depth and the Fore/Aft Offset

What Happens When the Transmitter Is Steep and Deep

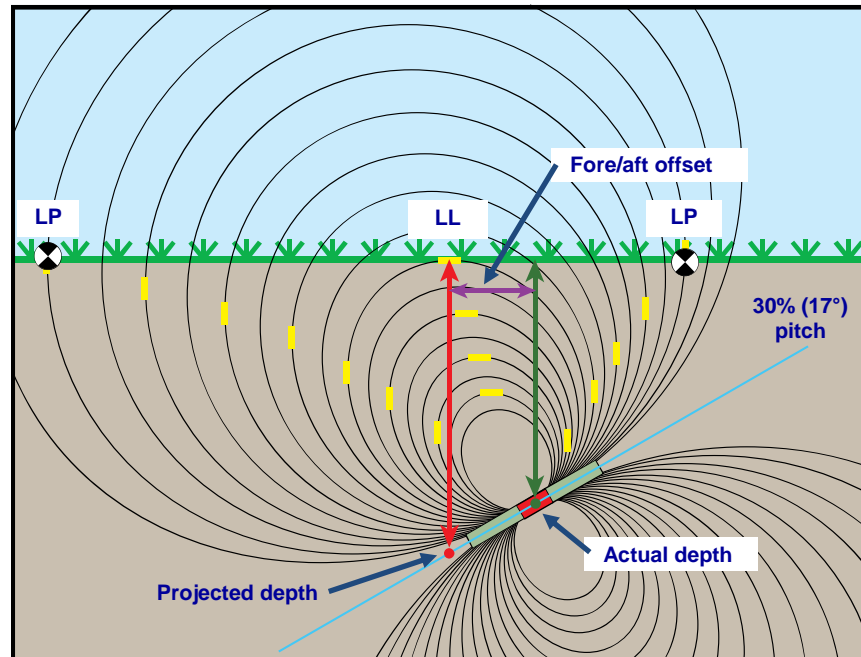
The signal field emitted by the transmitter consists of a set of elliptical signals, or “flux lines”. The flux lines indicate the position of the transmitter. When the transmitter is level with respect to the ground, the locate line (LL) is directly over the transmitter, the depth displayed on the receiver is the actual depth, and the locate points (FLP and RLP) are at equal distances from the transmitter. The location of the LL is found at the intersection of the ground and the horizontal component of the flux field; the FLP and RLP are found where the vertical components of the flux field intersect with the ground. Some of the horizontal and vertical components are identified below by short yellow lines.



Side View of Flux Field and Geometry of FLP, RLP, and LL

Due to the shape of the transmitter’s signal field, when it is at a pitch greater than $\pm 10\%$ ($\pm 5.7^\circ$) and/or a depth of 4.6 m or more, the position of the locate line will be some distance ahead of or behind the transmitter’s actual position. In this case, the depth displayed on the receiver becomes what is called the projected depth. The transmitter’s distance ahead of or behind the locate line is called the fore/aft offset.

The projected depth and fore/aft offset must be accounted for when the transmitter is steep and/or deep. See [Table C1](#) and [Table C2](#) to determine the actual depth and fore/aft offset when you know the displayed (projected) depth and pitch of the transmitter.



Side View of Actual Depth due to Fore/Aft Offset When Steep and Deep

The above figure shows a transmitter positioned in a drill string that is drilling at either a positive or a negative pitch—the pitch is positive if you are drilling left to right, negative if you are drilling right to left. The transmitter's signal field is also pitched at the same angle as the transmitter. The locate line (LL), which is where the depth measurement is taken, is the horizontal component of the transmitter's signal field flux lines. That is, the LL is found where the flux lines are horizontal, illustrated by short horizontal yellow lines above.

The locate points (FLP and RLP) are also shown above. These points are located at the vertical components of the signal field illustrated by short vertical yellow lines above. Note how the locate points are not the same distance from the LL when the transmitter is pitched. Again, this situation requires compensation for the projected depth and the fore/aft offset.

Using the following tables to find:

- **actual depth** based on the receiver's depth reading (projected depth) and the transmitter pitch – [Table C1](#)
- **fore/aft offset** based on the receiver's depth reading (projected depth) and the transmitter pitch – [Table C2](#)
- **projected depth** that you will see on the receiver during drilling if you know the required depth (actual depth) of your installation – [Table C3](#)
- **conversion factors** for determining the projected depth from the actual depth, or the actual depth from the projected depth at various transmitter pitches – [Table C4](#)

These "steep and deep" calculations for projected depth are important when using a bore plan that has specified target depths on steeper and deeper bores.

Table C1. Determining Actual Depth from Displayed (Projected) Depth and Pitch

Pitch→ Displayed Depth ↓	±10% (5.7°)	±20% (11°)	±30% (17°)	±40% (22°)	±50% (27°)	±60% (31°)	±75% (37°)	±90% (42°)	±100% (45°)
1.52 m	1.52 m	1.50 m	1.45 m	1.37 m	1.32 m	1.27 m	1.17 m	1.07 m	0.76 m
3.05 m	3.02 m	2.97 m	2.87 m	2.77 m	2.64 m	2.51 m	2.31 m	2.13 m	1.52 m
4.57 m	4.55 m	4.47 m	4.32 m	4.14 m	3.96 m	3.78 m	3.48 m	3.20 m	2.29 m
6.10 m	6.07 m	5.94 m	5.74 m	5.51 m	5.28 m	5.03 m	4.65 m	4.27 m	3.05 m
7.62 m	7.59 m	7.44 m	7.19 m	6.91 m	6.60 m	6.30 m	5.79 m	5.33 m	3.81 m
9.14 m	9.09 m	8.92 m	8.61 m	8.28 m	7.92 m	7.54 m	6.96 m	6.40 m	4.57 m
10.67 m	10.62 m	10.41 m	10.08 m	9.65 m	9.25 m	8.81 m	8.13 m	7.47 m	5.33 m
12.19 m	12.14 m	11.89 m	11.51 m	11.02 m	10.57 m	10.06 m	9.27 m	8.53 m	6.10 m
13.72 m	13.64 m	13.39 m	12.93 m	12.42 m	11.89 m	11.33 m	10.44 m	9.63 m	6.86 m
15.24 m	15.16 m	14.86 m	14.38 m	13.79 m	13.21 m	12.57 m	11.61 m	10.69 m	7.62 m

Use the projected/displayed depth values in the first column and transmitter pitches in the first row to find actual depth.

Table C2. Determining Fore/Aft Offset from Displayed (Projected) Depth and Pitch

Pitch→ Displayed Depth ↓	±10% (5.7°)	±20% (11°)	±30% (17°)	±40% (22°)	±50% (27°)	±60% (31°)	±75% (37°)	±90% (42°)	±100% (45°)
1.52 m	0.10 m	0.20 m	0.28 m	0.38 m	0.48 m	0.53 m	0.64 m	0.74 m	0.76 m
3.05 m	0.20 m	0.41 m	0.58 m	0.76 m	0.94 m	1.07 m	1.27 m	1.45 m	1.52 m
4.57 m	0.30 m	0.61 m	0.89 m	1.14 m	1.40 m	1.63 m	1.91 m	2.16 m	2.29 m
6.10 m	0.41 m	0.79 m	1.17 m	1.52 m	1.85 m	2.16 m	2.54 m	2.90 m	3.05 m
7.62 m	0.51 m	0.99 m	1.47 m	1.91 m	2.31 m	2.69 m	3.18 m	3.61 m	3.81 m
9.14 m	0.61 m	1.19 m	1.78 m	2.29 m	2.79 m	3.23 m	3.81 m	4.32 m	4.57 m
10.67 m	0.71 m	1.40 m	2.06 m	2.67 m	3.25 m	3.78 m	4.47 m	5.05 m	5.33 m
12.19 m	0.81 m	0.69 m	2.36 m	3.05 m	3.71 m	4.32 m	5.11 m	5.77 m	6.10 m
13.72 m	0.91 m	1.80 m	2.64 m	3.45 m	4.17 m	4.85 m	5.74 m	6.48 m	6.86 m
15.24 m	1.02 m	2.01 m	2.84 m	3.84 m	4.65 m	5.38 m	6.38 m	7.21 m	7.62 m

Use the projected/displayed depth values in the first column and transmitter pitches in the first row to find fore/aft Max mode timer offset values.

Table C3. Determining Projected Depth from Actual Depth and Pitch

Pitch→ Actual Depth ↓	±10% (5.7°)	±20% (11°)	±30% (17°)	±40% (22°)	±50% (27°)	±60% (31°)	±75% (37°)	±90% (42°)	±100% (45°)
1.52 m	1.52 m	1.57 m	1.60 m	1.68 m	1.73 m	1.80 m	1.91 m	1.98 m	2.29 m
3.05 m	3.07 m	3.12 m	3.23 m	3.33 m	3.45 m	3.58 m	3.78 m	3.96 m	4.57 m
4.57 m	4.60 m	4.70 m	4.83 m	5.00 m	5.18 m	5.38 m	5.66 m	5.94 m	6.86 m
6.10 m	6.12 m	6.25 m	6.45 m	6.68 m	6.91 m	7.16 m	7.54 m	7.92 m	9.14 m
7.62 m	7.67 m	7.82 m	8.05 m	8.36 m	8.64 m	8.97 m	9.45 m	9.91 m	11.43 m
9.14 m	9.19 m	9.37 m	9.68 m	10.01 m	10.36 m	10.74 m	11.33 m	11.89 m	13.72 m
10.67 m	10.72 m	10.95 m	11.28 m	11.68 m	11.18 m	12.55 m	13.21 m	13.87 m	16.00 m
12.19 m	12.24 m	12.50 m	12.88 m	13.36 m	13.82 m	14.33 m	15.11 m	15.85 m	18.29 m
13.72 m	13.79 m	14.07 m	14.50 m	15.01 m	15.54 m	15.90 m	16.99 m	17.83 m	11.43 m
15.24 m	15.32 m	15.62 m	16.10 m	16.69 m	17.27 m	17.91 m	18.87 m	19.79 m	22.86 m

Use the actual depth values in the first column and transmitter pitches in the first row to find projected depth values.

Table C4. Conversion Factors for Calculating Exact Projected Depth or Actual Depth

Pitch →	±10% (5.7°)	±20% (11°)	±30% (17°)	±40% (22°)	±50% (27°)	±60% (31°)	±75% (37°)	±90% (42°)
From Actual to Projected Depth	1.005	1.025	1.06	1.105	1.155	1.212	1.314	1.426
From Projected to Actual Depth	0.995	0.975	0.943	0.905	0.866	0.825	0.761	0.701

Table C4 helps calculate the exact projected depth reading as well as the actual depth using a multiplier (conversion factor) at different transmitter pitches.

For example, if you have a required (actual) depth of 7.32 m and want the receiver's projected depth reading at a 30% (17°) pitch, use the first row of conversion factors to select the corresponding value for a pitch of 30%, which is 1.06. Multiply this value by the required depth of 24. The result, 7.75 m, is what the receiver's projected depth reading should be at the locate line.

Using the projected depth displayed on the receiver, you can calculate the actual depth of the transmitter using the second row of conversion factors. For example, if your pitch is 30% and your projected depth reading is 7.32 m, multiply depth 24 by conversion factor 0.943. The result, 6.90 m, is the actual depth of the transmitter.

Appendix D: Calculating Depth Based on Distance Between FLP and RLP

If you know the transmitter pitch, the positions of the front locate point (FLP) and the rear locate point (RLP), and if the ground surface is level, you can still estimate the transmitter depth even if the depth information displayed on the receiver becomes unreliable.

To estimate the transmitter depth, first measure the distance between the FLP and the RLP. The pitch of the transmitter must also be reliably known. Using the Depth Estimation Table below, find the divider that most closely corresponds to the transmitter pitch. Then use the following formula to estimate the depth:

$$\text{Depth} = \text{Distance between FLP and RLP} / \text{Divider}$$

For example, if the transmitter pitch is 34% (or 18.8°) then the corresponding divider value (from the table) is 1.50. In this example, the distance between the FLP and the RLP is 3.5 m. The depth would be:

$$\text{Depth} = 3.5 \text{ m} / 1.50 = 2.34 \text{ m}$$

Depth Estimation Table

Pitch (% / °)	Divider	Pitch (% / °)	Divider	Pitch (% / °)	Divider
0 / 0.0	1.41	34 / 18.8	1.50	68 / 34.2	1.74
2 / 1.1	1.41	36 / 19.8	1.51	70 / 35.0	1.76
4 / 2.3	1.42	38 / 20.8	1.52	72 / 35.8	1.78
6 / 3.4	1.42	40 / 21.8	1.54	74 / 36.5	1.80
8 / 4.6	1.42	42 / 22.8	1.55	76 / 37.2	1.82
10 / 5.7	1.42	44 / 23.7	1.56	78 / 38.0	1.84
12 / 6.8	1.43	46 / 24.7	1.57	80 / 38.7	1.85
14 / 8.0	1.43	48 / 25.6	1.59	82 / 39.4	1.87
16 / 9.1	1.43	50 / 26.6	1.60	84 / 40.0	1.89
18 / 10.2	1.44	52 / 27.5	1.62	86 / 40.7	1.91
20 / 11.3	1.45	54 / 28.4	1.63	88 / 41.3	1.93
22 / 11.9	1.45	56 / 29.2	1.64	90 / 42.0	1.96
24 / 13.5	1.46	58 / 30.1	1.66	92 / 42.6	1.98
26 / 14.6	1.47	60 / 31.0	1.68	94 / 43.2	2.00
28 / 15.6	1.48	62 / 31.8	1.69	96 / 43.8	2.02
30 / 16.7	1.48	64 / 32.6	1.71	98 / 44.4	2.04
32 / 17.7	1.49	66 / 33.4	1.73	100 / 45.0	2.06

Appendix E: Reference Tables

Depth Increase in cm per 3-m Rod

Percent	Depth Increase		Percent	Depth Increase
1	2 cm		28	81 cm
2	5 cm		29	84 cm
3	10 cm		30	86 cm
4	13 cm		31	91 cm
5	15 cm		32	94 cm
6	18 cm		33	97 cm
7	20 cm		34	99 cm
8	25 cm		35	102 cm
9	28 cm		36	104 cm
10	30 cm		37	107 cm
11	33 cm		38	109 cm
12	36 cm		39	112 cm
13	38 cm		40	114 cm
14	43 cm		41	117 cm
15	46 cm		42	117 cm
16	48 cm		43	119 cm
17	51 cm		44	122 cm
18	53 cm		45	124 cm
19	56 cm		46	127 cm
20	61 cm		47	130 cm
21	64 cm		50	137 cm
22	66 cm		55	147 cm
23	69 cm		60	157 cm
24	71 cm		70	175 cm
25	74 cm		80	191 cm
26	76 cm		90	203 cm
27	79 cm		100	216 cm

Depth Increase in cm per 4.6-m Rod

Percent	Depth Increase		Percent	Depth Increase
1	5 cm		28	124 cm
2	10 cm		29	127 cm
3	13 cm		30	132 cm
4	18 cm		31	135 cm
5	23 cm		32	140 cm
6	28 cm		33	142 cm
7	33 cm		34	147 cm
8	36 cm		35	150 cm
9	41 cm		36	155 cm
10	46 cm		37	157 cm
11	51 cm		38	163 cm
12	53 cm		39	165 cm
13	58 cm		40	170 cm
14	64 cm		41	173 cm
15	69 cm		42	178 cm
16	71 cm		43	180 cm
17	76 cm		44	183 cm
18	81 cm		45	188 cm
19	86 cm		46	191 cm
20	89 cm		47	196 cm
21	94 cm		50	203 cm
22	99 cm		55	221 cm
23	102 cm		60	236 cm
24	107 cm		70	262 cm
25	112 cm		80	284 cm
26	114 cm		90	305 cm
27	119 cm		100	323 cm

LIMITED WARRANTY

Digital Control Incorporated ("DCI") warrants that, when shipped from DCI, each DCI product (other than software products) 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") specified below, from material defects in materials and workmanship. In addition, DCI warrants that each DCI software product will perform in substantial accordance with the specifications set forth in the documentation for such software for the Warranty Period specified below. The following limited warranty ("Limited Warranty") is made solely to and for the benefit of 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 not assignable or transferable.

The foregoing Limited Warranty 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 software programs and applications. A Warranty Period of ninety (90) days shall apply to all other new DCI products, including transmitters and accessories. A Warranty Period of ninety (90) days shall also apply to 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. If a DCI product (excluding software products) does not perform as warranted during the Warranty Period, DCI will inspect the product and if DCI determines such product to be defective, DCI will, at its sole option and discretion, either repair or replace the product. If a software product does not perform as warranted during the Warranty Period, DCI will, at its sole option and discretion, either bring the defective software into material compliance with the specifications for such software or refund the purchase price paid for the defective software. **THE FOREGOING ARE USER'S SOLE AND EXCLUSIVE REMEDIES FOR BREACH OF THIS LIMITED WARRANTY.** 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, and be submitted before the end of the Warranty Period.
3. The Limited Warranty shall only be effective if: (i) within fourteen (14) days of receipt of the DCI product, User registers the DCI product with DCI through its product registration website at access.DigiTrak.com; (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.
4. The service period for this equipment is five years from the date of manufacture. During this period, DCI will support the repair or replacement of the products featured in this manual. A fee for repairs and replacements may be charged if the product is outside the warranty period.

What is not covered

This Limited Warranty excludes all damage, including damage to any DCI product, due to: failure to follow DCI's operator's manual and other DCI instructions; use of a DCI product outside the specifications for which the DCI product is designed (including, without limitation, temperature); 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; use of batteries or other products or components not manufactured or supplied by DCI; 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. User 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 from the 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 does not warrant or guarantee the accuracy or completeness of data generated by HDD locating systems. The accuracy or completeness of such data may be impacted by a variety of factors, including (without limitation) active or passive interference (including from salt water) and other environmental conditions, failure to calibrate or use the device properly and other factors. DCI also does not warrant or guarantee, and disclaims liability for, the accuracy and completeness of any data generated by any external source or derived from data generated by any external source that may be displayed on a DCI device, including (without limitation) data received from any HDD drill rig.

DCI reserves the right to make changes in design and improvements upon DCI product 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, IMPLIED WARRANTY OF NON-INFRINGEMENT, AND ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING, OR USAGE OF TRADE, ALL OF WHICH ARE HEREBY DISCLAIMED AND EXCLUDED. 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 or 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 1.800.288.3610 (or, for international markets, the corresponding telephone number for that market) between 6:00 a.m. and 6:00 p.m. Pacific Time and ask to speak with a customer service representative. Prior to returning any DCI product to DCI for service, you must obtain a Return Merchandise Authorization (RMA) number. Failure to obtain an 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 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 an 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.

Product demonstrations

DCI personnel may be present at a jobsite to demonstrate basic usage, features, and benefits of DCI products. User acknowledges that DCI personnel are present only to demonstrate a DCI product. DCI does NOT provide locating services or other consulting or contracting services. DCI does not assume any duty to train User or any other person, and does not assume responsibility or liability for the locating or other work performed at a jobsite at which DCI personnel or equipment are or have been present.