

# Mag 3 System

## Operator's Manual



**Underground Magnetics**

[www.undergroundmagnetics.com](http://www.undergroundmagnetics.com)



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# 1: Introduction

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MAG 3 is a locating system designed to assist horizontal directional drill machine operators in locating and tracking underground drill head locations and orientations. The system consists of a transmitter, a receiver, and a remote display.

- The transmitter sends digital information of the transmitter's pitch, roll, temperature, and battery status through an FM modulated RF signal.
- The receiver receives this information and uses RF signal to identify the transmitter's status and location.
- The receiver transmits the locating information to a remote display through a radio telemetry system. A horizontal directional drill machine operator can use the information from the display to guide the drill head to the desired path.







The FM communication between the transmitter and the receiver provides more noise suppression than the traditional AM modulation widely used in this industry. The receiver offers a very simple and clear method to locate an underground drill head.

This locating system also offers four channel license free radio telemetries between the receiver and remote display. The user can easily register any two receivers and displays so that communications between the "pair" will not be interfered by other "pairs".

This manual is intended to provide information and instructions on how to use this locating system properly. Underground Magnetics reserves the right to improve the locating system and the user manual at any time without notice.

## 2: Caution

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-  The user must understand safety procedures and correct operation methods before operating the HDD and the locating system.
-  HDD machines can cause property damage and personal injury upon striking underground power lines, gas lines, phone lines, television cables, fiber optic cables, or sewage lines. Make sure to confirm and mark all underground utilities before beginning operations.
-  Do not use the locating system near flammable or explosive substances.
-  Wear proper personal protective equipment including steel-toed boots, safety gloves, helmets, reflective vests, and safety goggles.
-  Obey all local safety regulations.
-  This locating system is only a tool to assist the operator to locate the drill head. It is the operator, not the Mag 3 locating system that is responsible for identifying the drill head location. Underground Magnetics is not responsible for any damage or loss caused by using the Mag 3 system. Users should operate the Mag 3 system according to the manual. If there are any questions, please contact Underground Magnetics.

### 3: System Highlights

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- High precision and high anti-interference Faraday shield 3D antenna structure
- Industrial rated, gold-plated electronic modules
- High-performance DSP
- Dual locating system, functioning as two locators independently tracking to provide better accuracy and reliability
- Up to 160ft depth range and up to 200 hours continuous usage



## 4: Receiver






### 4.1: Specifications

#### Mag 3



<b>System frequency</b>	4kHz, 19kHz, 30kHz
<b>Water proof</b>	IP65
<b>Temperature range</b>	-4° to 140°F
<b>Telemetry</b>	4 radio channels with range up to 3000 feet
<b>Rechargeable lithium battery</b>	12.5V
<b>Battery life</b>	Up to 50 hours
<b>Dimensions</b>	27" by 5" by 12"
<b>Weight</b>	6.5 pounds

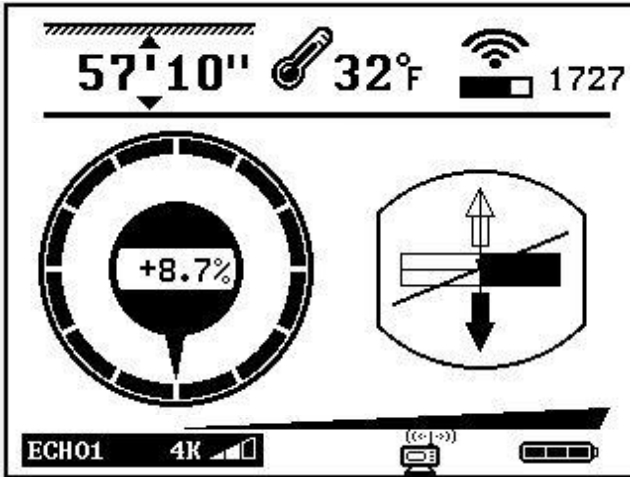
### 4.2: Receiver Operation

-  Power key: Press and hold to turn on or off. Tap to turn backlight on or off.
-  Up key: Move to previous cursor selection.
-  Down key: Move to next cursor selection.
-  Confirm key: Tap to confirm cursor selection. Press and hold to enter secondary page.
-  Setup key: Tap to enter calibration page/ return to main page. Press and hold to enter setup page.



## 4.3: Icons

### 4.3.1: Main Page Icons



ECHO1 4K

- Transmitter model and frequency



- Transmitter signal strength

1727

- Signal to noise ratio bar



- Transmitter battery status



- Transmitter temperature (Flashing indicates transmitter is over-heating)



- Receiver and display connection status


57' 10"

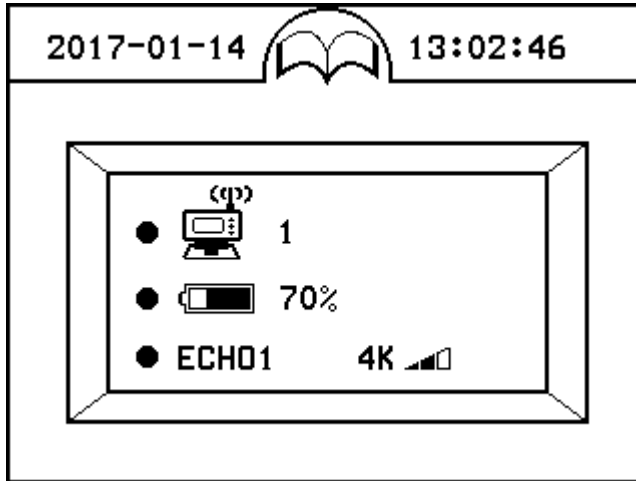
- Distance between transmitter and receiver




+8.7%

- Transmitter pitch

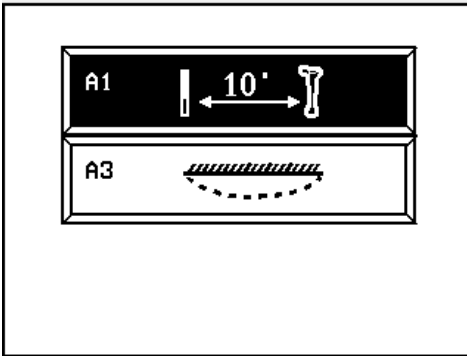
### 4.3.2: Secondary Page Icons

To enter the secondary page, press and hold 



- ECHO1**      **4K**       Transmitter model and frequency
-       **70%**      Receiver battery status
-       **1**      Telemetry channel

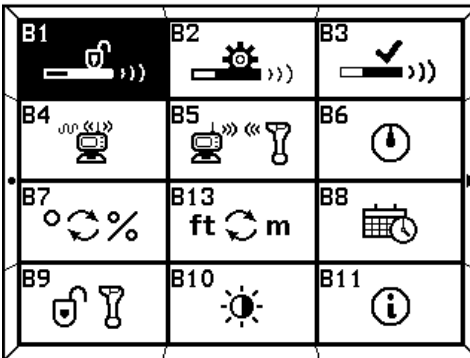
### 4.3.3: Calibration and Depth Forecast Page Icons



A1: 10ft calibration

A3: Depth prediction

### 4.3.4: Setup Page Icons



B1: Transmitter activation

B2: Transmitter settings

B3: Receiver settings

B4: Telemetry selection

B5: Receiver and display pairing

B6: Roll calibration

B7: Pitch unit selection

B8: Time setting

B9: System lock/unlock

B10: Visibility control

B11: System info

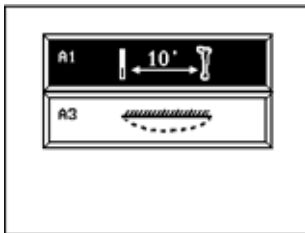
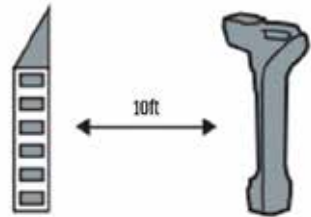
B13: Depth unit selection

## 4.4: Calibration

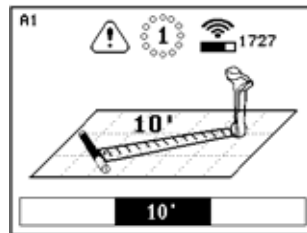
### 4.4.1: Depth Calibration (10ft)


**Warning:** Even if the transmitter's roll, pitch, battery status and temperature are displayed correctly, calibration may not be reliable due to a distorted magnetic field.

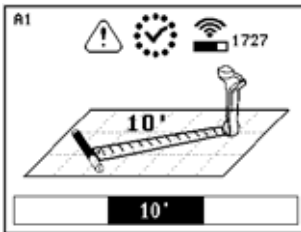
1. Make sure that the transmitter is working properly. Place it in the housing.
2. Place housing containing the transmitter in a location away from interference.
3. Set transmitter 10 feet apart from center of housing to center of receiver as shown.




4. Tap  to enter calibration page.



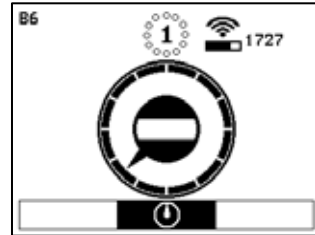
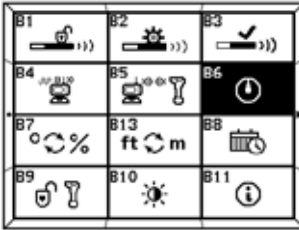
5. Tap  three times to start 10ft calibration and wait for calibration to complete.






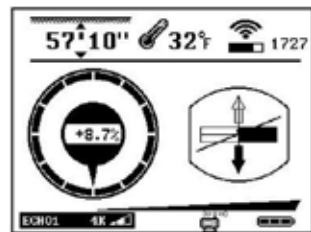
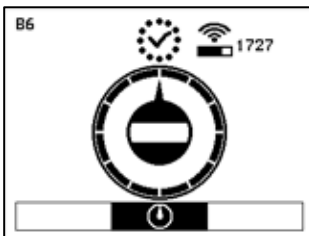
7. Calibration complete.
8. Tap  to return to main page.


## 4.4.2: Roll Calibration

1. Place transmitter housing in a 12 o'clock position.



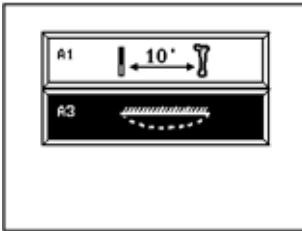
2. Press and hold  to enter setup page and tap  to select B6 icon.
3. Tap  three times to enter and start roll calibration and wait for calibration to complete.





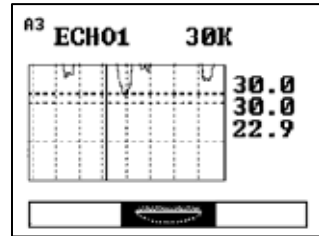
4. Calibration complete.
5. Tap  to return to main page.



## 4.5: Operation

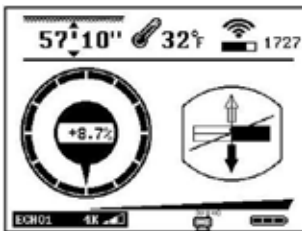
### 4.5.1: Depth Forecast



1. Tap  to enter calibration page and tap  to select A3 icon.



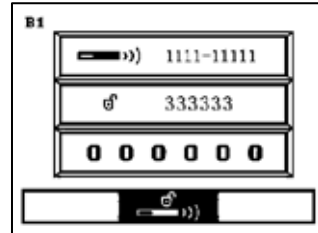
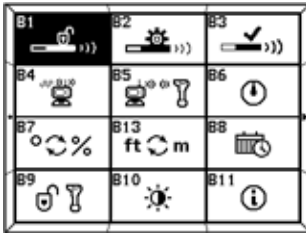
2. Tap  to enter depth forecast page. Maximum, projected, and minimum depth forecast values are listed on the right while transmitter model and frequency are listed at the top. Tap  to reset forecast



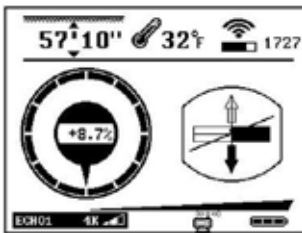
3. Tap  to return to main page.

## 4.5.2: Transmitter Activation

(Process must be started within 10 minutes after batteries have been placed in the transmitter.)



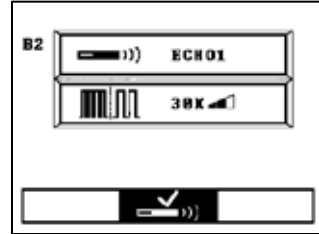
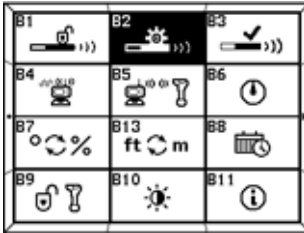
1. Press and hold to enter setup page. Tap to enter transmitter activation page.
2. 1111-1111 is the transmitter identification number and 3333-3333 is the prompt code in the diagram. Send the transmitter identification number and the prompt code to the dealer. The dealer will give you an activation password. Use and to input password, tap to confirm activation.



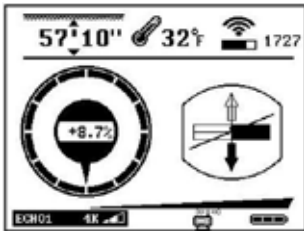
3. Tap to return to main page.

### 4.5.3: Transmitter Settings

(Process must be started within 10 minutes after batteries have been placed in the transmitter.)



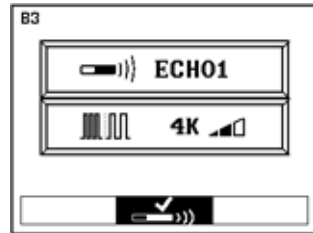
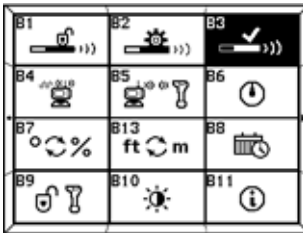
1. Press and hold to enter setup page and tap to select B2 icon.
2. Tap to enter transmitter settings page. The receiver and Echo transmitter will automatically pair. Then tap or and to select frequency.









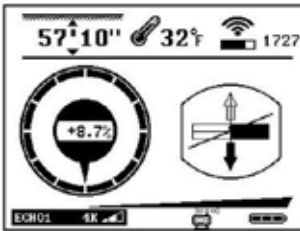
3. Tap to return to main page.



## 4.5.4: Receiver Settings

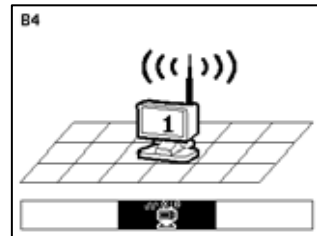
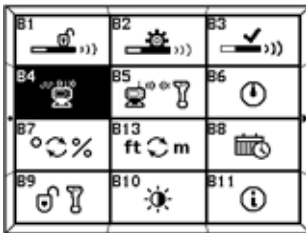







1. Press and hold  to enter setup page. Tap  to select B3 icon.
2. Tap  to enter receiver settings page. Tap  or  and  to select Transmitter model and frequency.

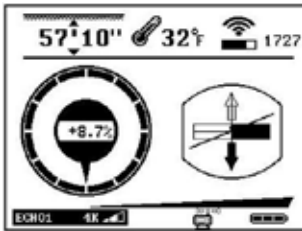


3. Tap  to return to main page.

## 4.5.5: Radio Channel Selection

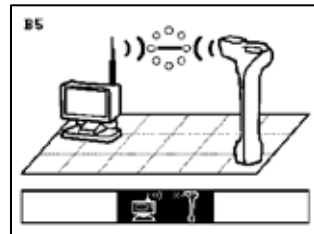
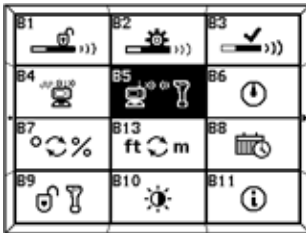


1. Press and hold  to enter setup page. Tap  to select B4 icon.
2. Tap  to enter radio channel page. Use  or  to select radio channel.

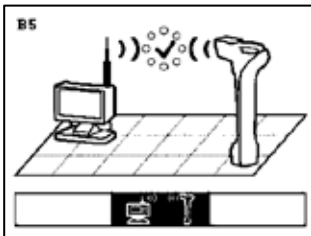


3. Tap  to return to main page.

## 4.5.6: Radio Registration

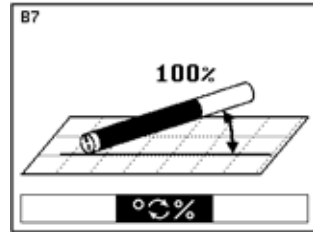
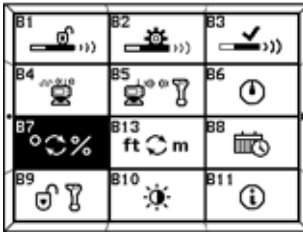






1. Press and hold to enter setup page. Tap to select B5 icon.
2. Tap to enter radio registration page. Tap to start radio registration. (It is required that these last two steps are performed on the display at the same time.)

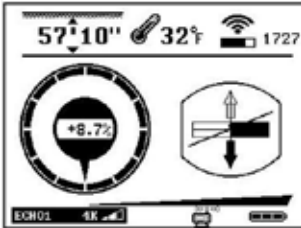


3. Radio registration complete.
4. Tap to return to main page.

## 4.5.7: Pitch Unit Selection

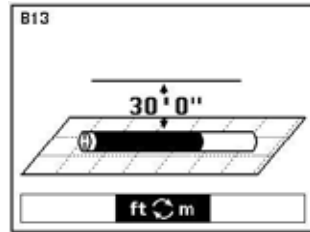
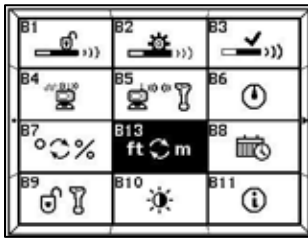







1. Press and hold  to enter setup page and tap  to select B7 icon. Tap  to enter pitch unit selection page.
2. Tap  to switch pitch mode.

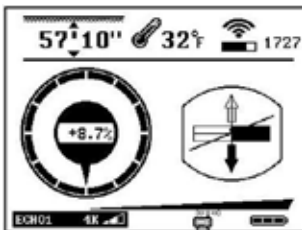


3. Tap  to return to main page.

## 4.5.8: Depth Unit Selection

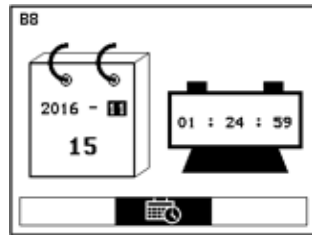
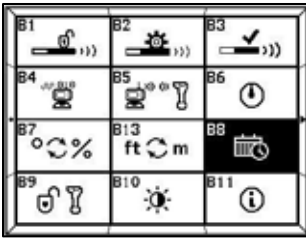


2. Press and hold  to enter setup page. Tap  to select B13 icon.
3. Tap  to enter Depth Unit Selection. Tap  or  to select unit and format.

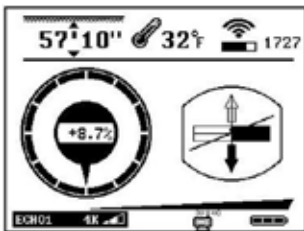


4. Tap  to return to main page.

## 4.5.9: Time Setting

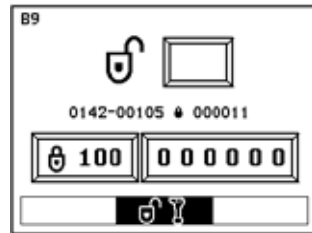
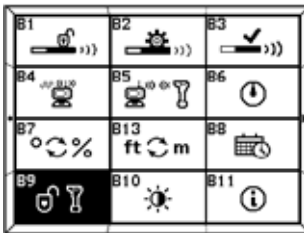


1. Press and hold to enter setup page. Tap to select B8 icon.
2. Tap to enter Time Settings. Tap to select year, month, day, hour, or minute. Tap or to set time.



3. Tap to return to main page.

## 4.5.10: System Unlock

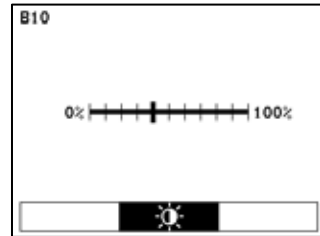
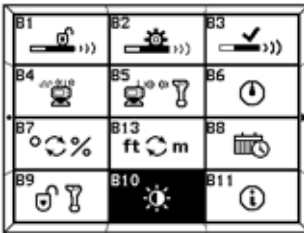


1. Press and hold to enter setup page and tap to select B9 icon. Tap to enter system unlock page.
2. Tap or and to input password. (To get the password, please contact your dealer)

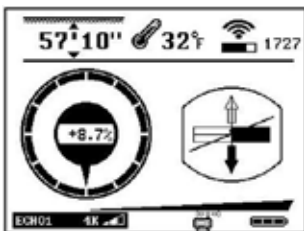


4. Tap to return to main page.

## 4.5.11: Visibility Control



1. Press and hold to enter setup page and tap to select the B10 icon. Tap to enter Visibility Control.
2. Tap and to adjust.



3. Tap to return to main page.



## 4.6: Receiver Maintenance

- The receiver uses rechargeable lithium batteries. The receiver will automatically shut off if no key is pressed for over a period of 20 minutes or if there is no information received from the transmitter. It is strongly recommended that the batteries are taken out of the receiver if it is not being used for a long period of time to avoid potential corrosion.
- The receiver is an electronic measurement device. Severe shock and impact can damage the housing and the electronics inside the housing.
- Keep the receiver away from excessive heat to avoid damages to the plastic housing and the electronics inside the housing.
- Do not soak the receiver in excessive amounts of water.

## 5 Display






### 5.1: Display Specifications

#### Mag D



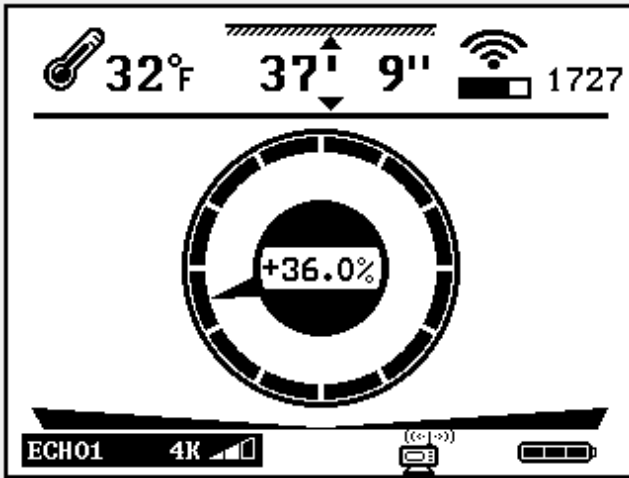
<b>Radio frequency</b>	915MHz
<b>Water proof</b>	IP65
<b>Temperature range</b>	-4° to 140°F
<b>Telemetry</b>	4 radio channels with range up to 3000 feet
<b>Power</b>	Rechargeable lithium batteries
<b>Battery life</b>	Up to 50 hours
<b>Screen</b>	Industrial rated LCD graphic display
<b>Dimensions</b>	7.5" by 5" by 7.5"
<b>Weight</b>	3.3 pounds

### 5.2: Display Operations

-  Power key: Press and hold to turn on or off. Tap to select level of backlight.
-  Up key: Move to previous cursor selection.
-  Down key: Move to next cursor selection.
-  Confirm key: Tap to confirm cursor selection. Press and hold to enter secondary page.
-  Setup key: Tap to return to main page. Press and hold to enter setup page.

## 5.3: Icons

### 5.3.1: Main Page Icons



ECHO1 4K

- Transmitter model and frequency



- Transmitter signal strength

1727

- Signal to noise ratio bar



- Transmitter battery status

32°F

- Transmitter temperature (Flashing indicates transmitter is over-heating)



- Receiver and display connection status


37' 9"

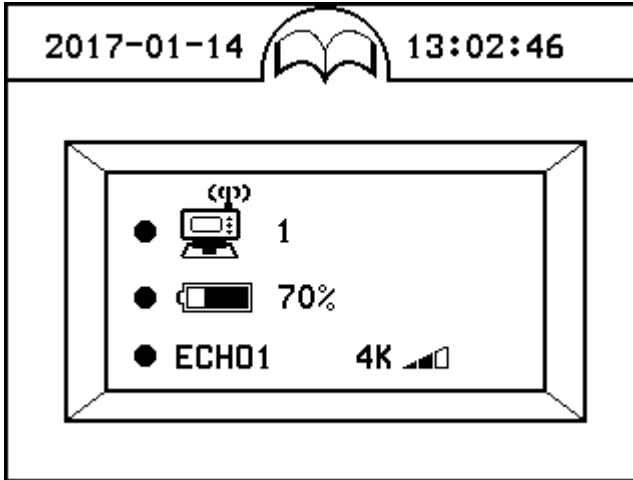
- Distance between transmitter and receiver

+36.0%

- Transmitter pitch

### 5.3.2: Secondary Page Icons

To enter the secondary page, press and hold 

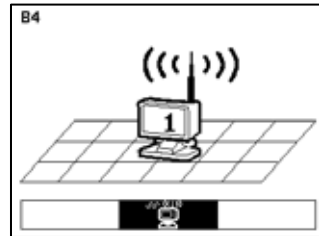
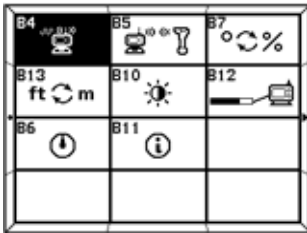


ECHO1      4K       Transmitter model and frequency

 70%      Receiver battery status

 1      Telemetry channel

### 5.3.3: Display Telemetry Selection

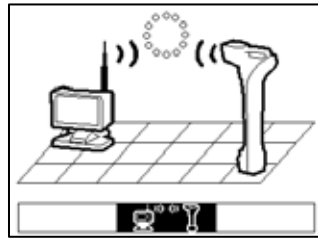
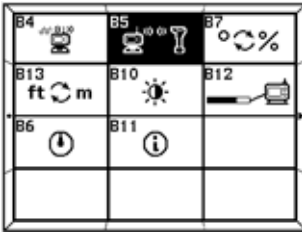


1. Press and hold to enter setup page. Tap to enter radio channel page.
2. Use to select radio channel.

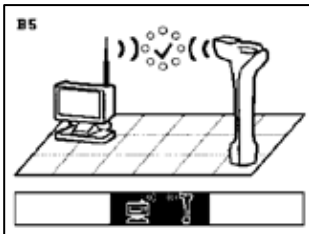


3. Tap to return to main page.

## 5.3.4: Radio Register

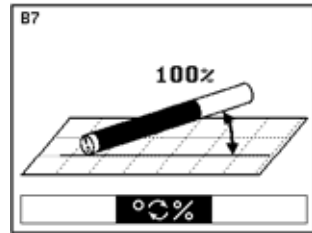
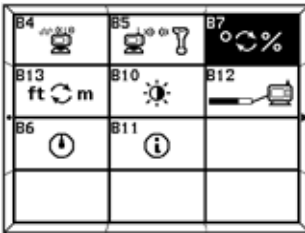






1. Press and hold to enter setup page and tap to select B5 icon. Tap to enter Radio Registration.
2. Tap to start radio registration. (It is required that the following procedure is performed on the receiver at the same time)



3. Radio registration complete.
4. Tap to return to main page.

## 5.3.5: Pitch Unit Selection



1. Press and hold  to enter setup page and tap  to select B7 icon. Tap  to enter Pitch Unit Selection.
2. Tap  to switch pitch mode.



3. Tap  to return to main page.

## 5.4: Display Maintenance

- The display uses rechargeable lithium batteries. The display will automatically shut off if no key is pressed for over a period of 20 minutes or if there is no information received from the receiver. It is strongly recommended that the batteries are taken out of the display if it is not being used for a long period of time to avoid potential corrosion.
- The display is an electronic measurement device. Severe shock and impact can damage the housing and the electronics inside the housing.
- Keep the display away from excessive heat to avoid damages to the plastic housing and electronics inside the housing.
- Do not submerge the display in excessive amounts of water.



# 6: Transmitter

## 6.1: Introduction

The transmitter provides drill head temperature, clock position, pitch, battery status and locating signal. The transmitter transmits signals at 4kHz, 19kHz or 30kHz. The transmitter will enter a “sleep” mode after 15 minutes without rotation. It takes 10 seconds to “wake up” when the transmitter is rotated.

## 6.2: Specifications

### Echo 1



Weight	1.5lbs	
Dimensions	1.25" x 15" length	
Frequency	4kHz/19kHz/30kHz	
Depth Range	100ft/130ft/130ft	
Power	2 C-cells or Lithium Battery	
	C-cell	3V, 12 hours of continuous usage
	Lithium	3V, 48 hours of continuous usage
Roll	24 transmitter roll positions	
Pitch	.01% resolution	
Temperature	Under 185°F	

### 6.3: Digital Information

- Pitch: From -100% to +100% with 0.1% resolution within the range of -45% to +45% and 1.0% resolution outside of that range.
- Roll: 24 transmitter roll positions
- Battery: Battery full, 2/3 full, 1/3 full and flash warning
- Temperature: When the transmitter is overheating, temperature indication in the receiver's display flashes. If temperature reaches over 185°F (85°C), transmitter may be permanently damaged. If this happens, the dot temperature indicator on the front of transmitter will turn black.

### 6.4: Transmitter Maintenance

- Do not place the transmitter near excessive temperature (over 185°F/85°C).
- Do not apply excessive pressure, shock or vibration on the transmitter.
- Take the battery out of the transmitter after use.
- Clean the spring and cap on the battery compartment when necessary.
- Regularly check the sealing ring on the battery cover. Replace if necessary.

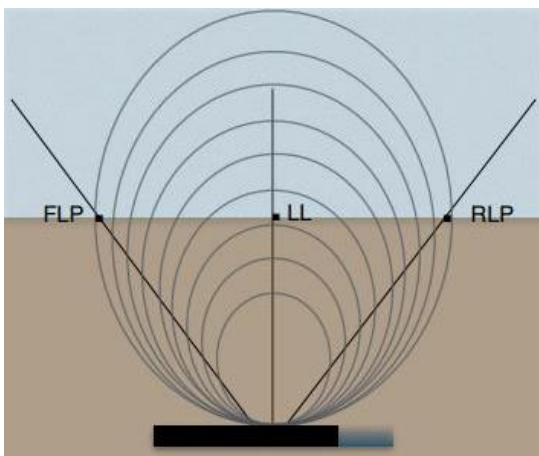
## 7: Locating Methods

One major advantage of the Mag 3 system is its simplicity. Once the receiver and transmitter are paired, the operator is not required to push any buttons to pinpoint the location, direction or depth of the transmitter.

### 7.1: Locate Points and Locate Line

The Mag 3 receiver locates the transmitter by pinpointing three specific locations along 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 (LL) above the transmitter.

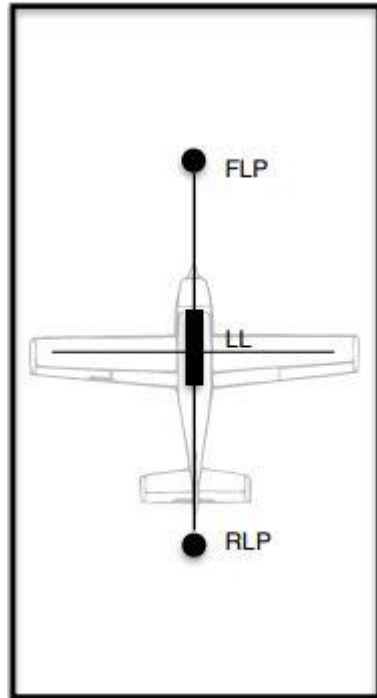
For the most accurate location and depth of the transmitter, both the FLP and the RLP should be located before locating the LL. The front and rear locate points, when lined up, indicate the exact direction of the transmitter. If the transmitter is level, the locate line will be located directly in-between the two points.



The Locate Line does not equal the location of the transmitter. The Locate Line extends left and right of the transmitter.

Think of the transmitter as an airplane. The FLP is the nose and the RLP is the tail. You can locate the LL left and right of the body, but that is not the center of the transmitter.

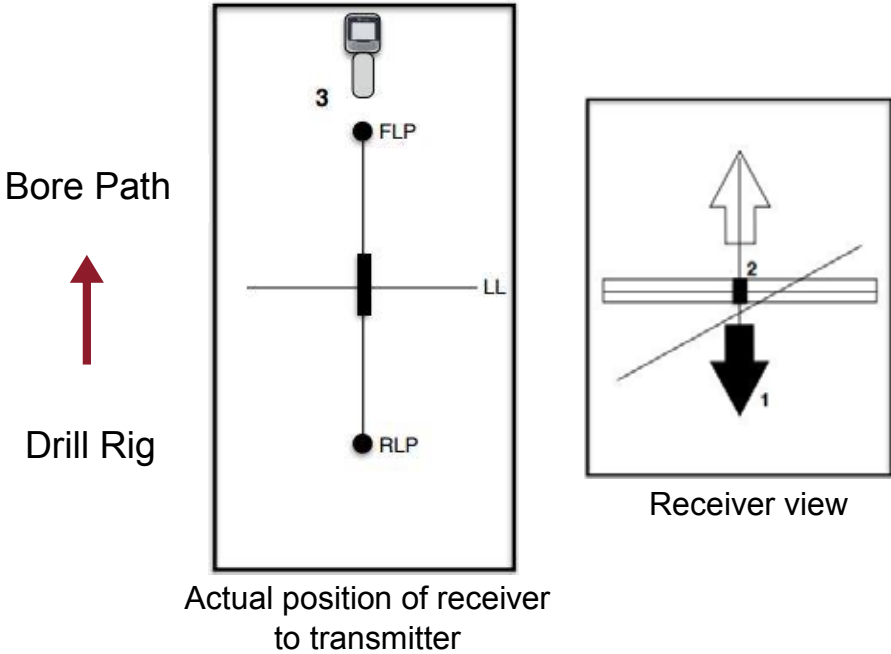
This is why you must locate both the FLP and RLP before the LL to get the most accurate depth and location.



Top view

## 7.2: Finding the Front Locate Point

Scenario:



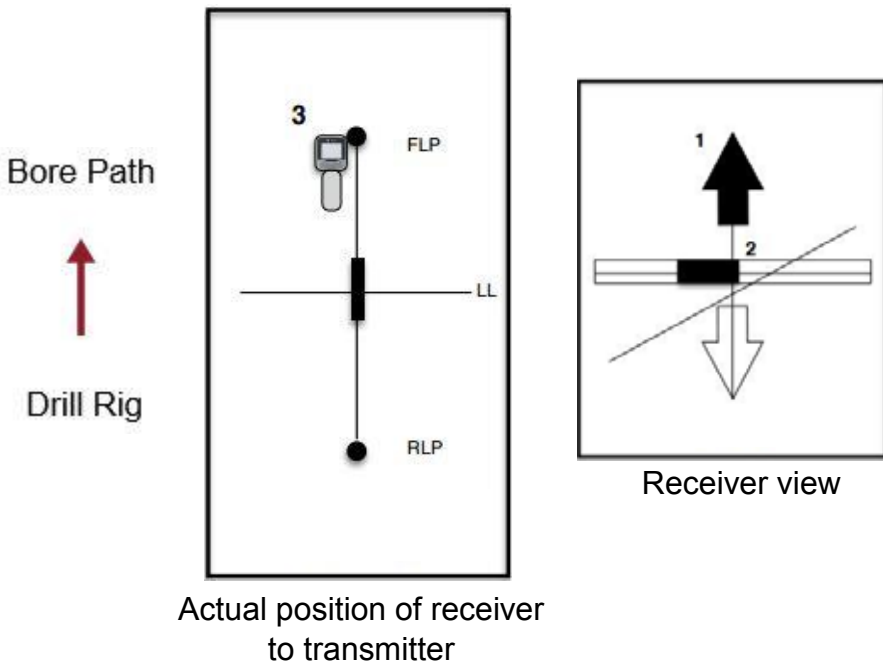
Actual position of receiver to transmitter

The locating procedure described here assumes you are (a) facing away from the drill rig, toward the bore path, (b) the transmitter is below ground and between you and the drill rig and (c) the FLP is behind you.

The arrows in the receiver screen indicate the direction of the closest locate point (1). The right-left bar (2) is used to fine tune the location of the locate point. In the above illustration, the FLP is the closest locate point and it is behind the operator (3).

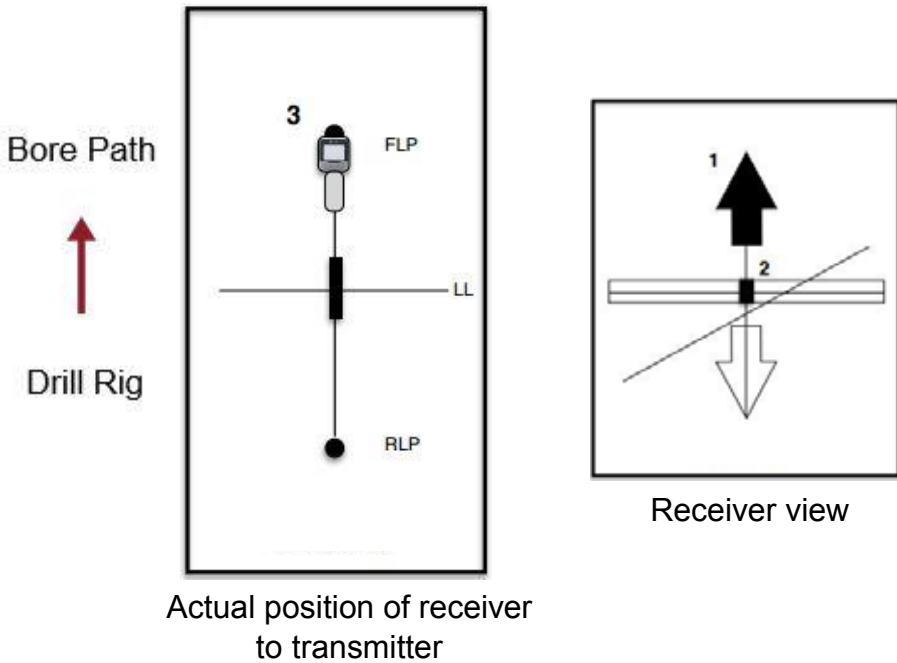
## Steps to locate FLP

1. Move the receiver (3) back toward the drill until the arrows (1) flip as shown in the receiver view below. The flip indicates that you have just crossed the front locate point.



2. Notice the location of the receiver (3) and its position to the FLP and the corresponding relationship to the right-left bar (2) in the figures above.

- To fine tune the FLP, simply move the receiver to the right and center the right-left bar (2) as shown in the figures below. You are now at the FLP. Mark the location on the ground.



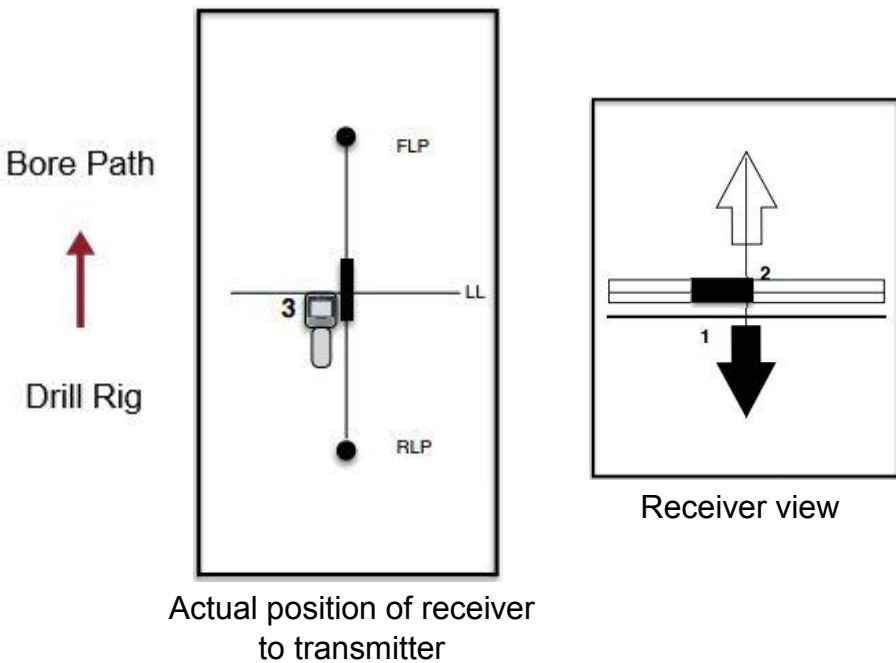
Notice that the highlighted arrow indicates the direction of the nearest locate point, while the highlighted section of the left-right bar indicates the position of the receiver relative to the locate point.

For example, a highlighted portion of the bar to the right indicates that the receiver is on the right of the locate point and that you must move to the left to fine tune the location of the LP.

### 7.3: Finding the Rear Locate Point

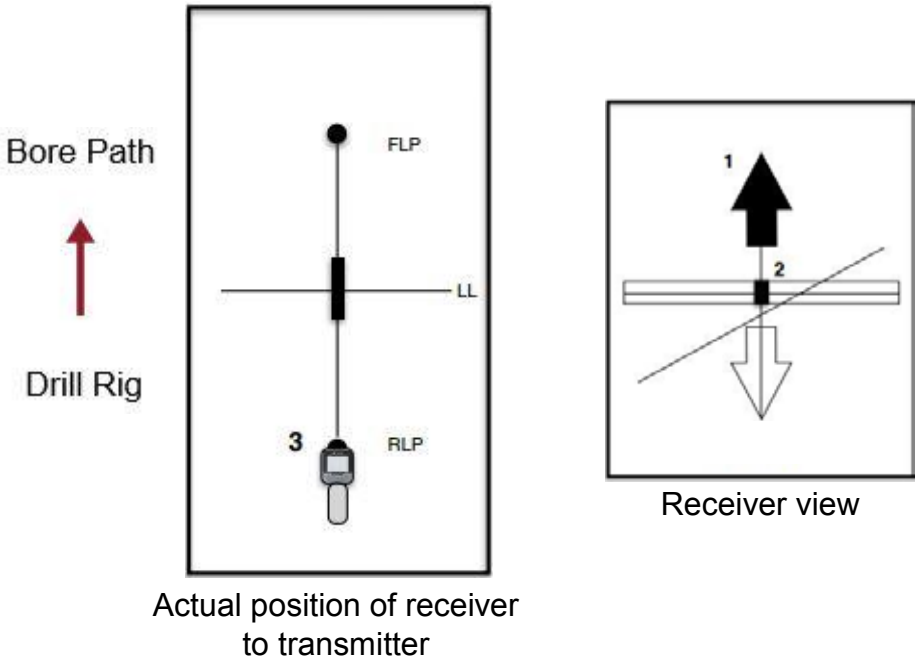
#### Steps to locate RLP

1. Move the receiver (3) back toward the drill until the arrows (1) flip as shown in the receiver view below. The flip indicates that you have just crossed the LL.





2. Continue to move back toward the drill until the arrows flip as shown in the receiver view below. The flip indicates that you have just crossed the RLP.
3. Fine tune the left-right bar and mark the location on the ground.

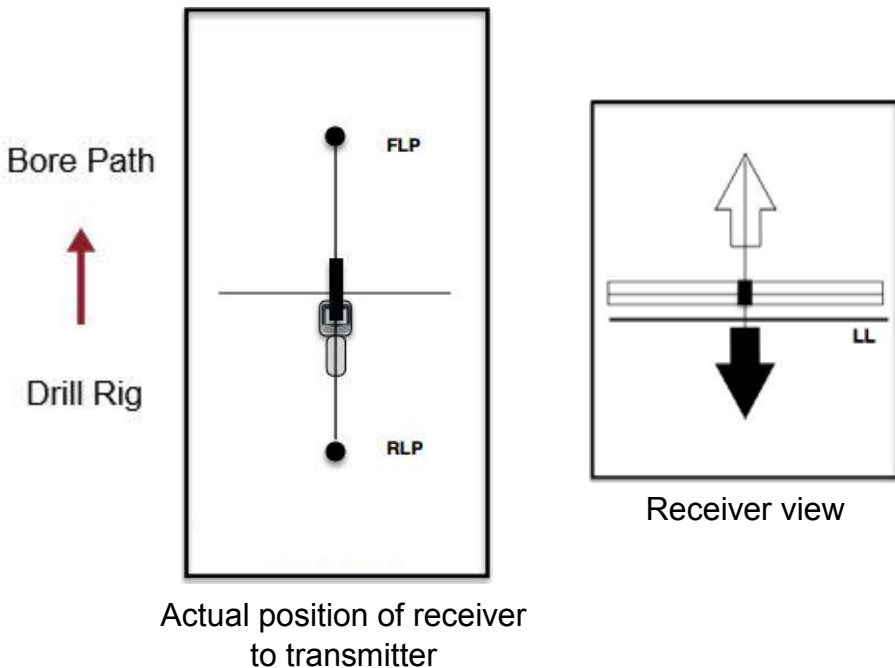


## 7.4: Finding the Locate Line and Transmitter

Now that the FLP and RLP have been marked, you're ready to locate the transmitter.

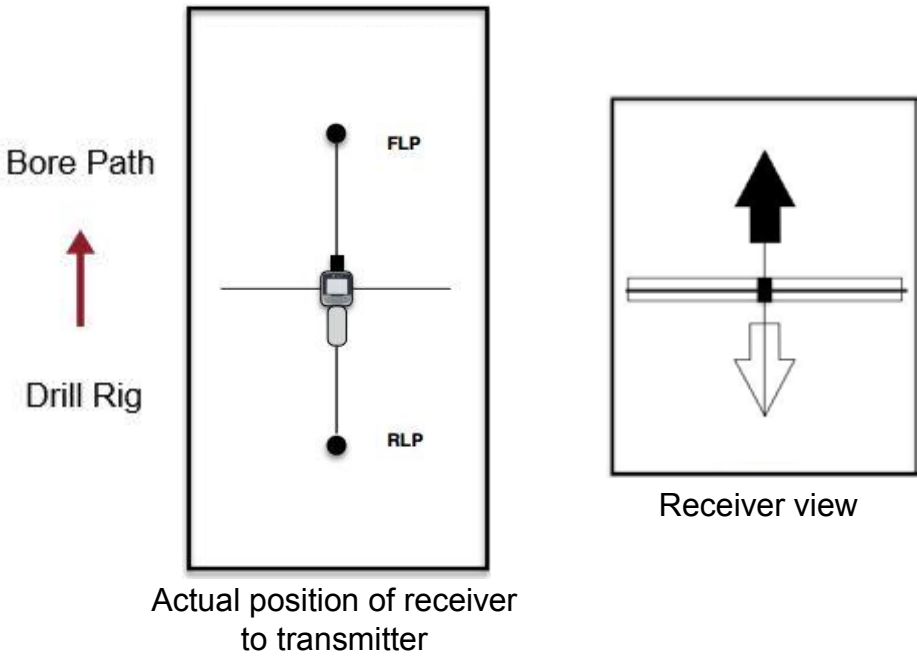
### Steps to Locate LL

1. From the RLP walk toward the FLP. The LL will start to center as shown on the receiver view below.



2. Once the LL is centered as shown below, you are directly over the head and you may mark the location and note depth.

(Note: the left-right bar should not be used over the head)



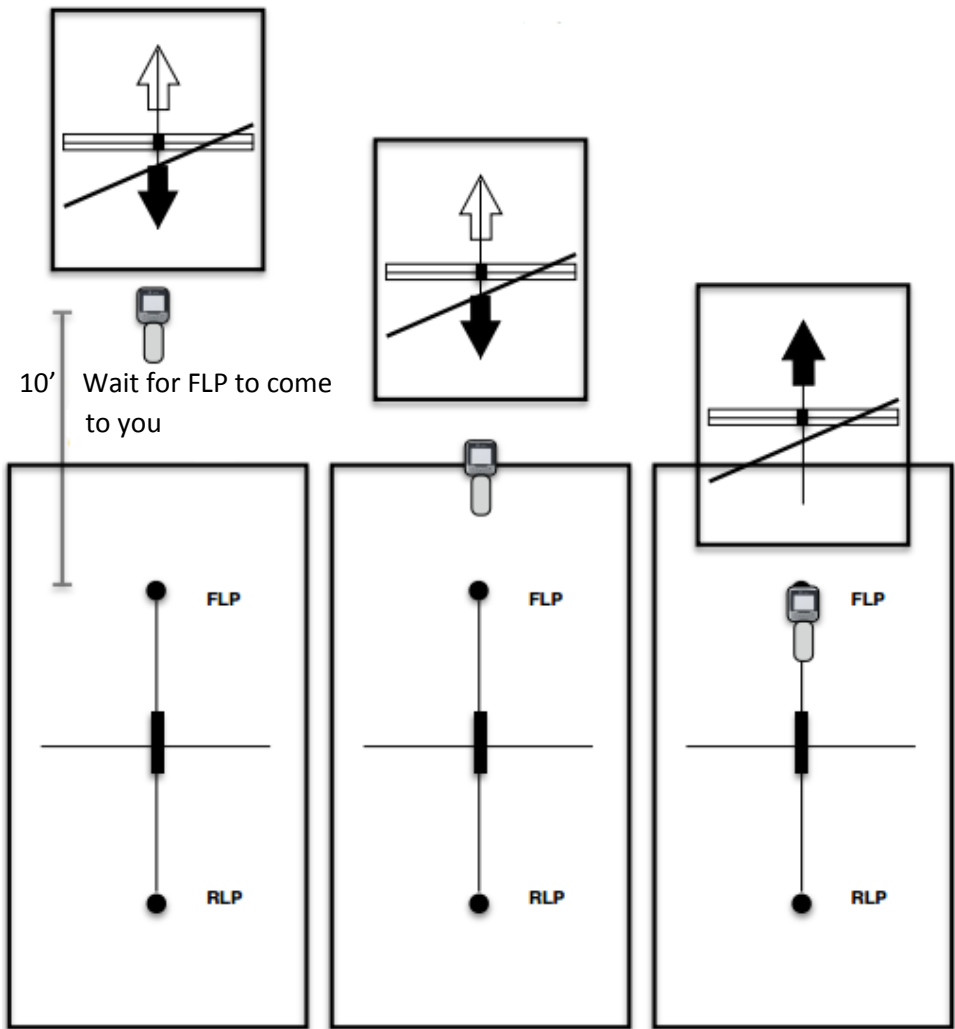
## 7.5: Tracking on the Fly

Tracking on the fly may be used once the bore path is established and level. This tracking method will increase locating speed and in turn the speed at which the bore can be completed.

As long as the FLP remains on target, there is no need to find the RLP on every rod. If steering is required, a quick look at both the RLP and the FLP will ensure the transmitter is still on target.

While tracking on the fly using 10' drill pipes the operator should walk forward from the last FLP approximately 10' and place the receiver down in line with the path created by the RLP and the FLP. While the drill operator is drilling toward the receiver, wait for the arrow to flip. You are within inches of the new FLP, fine tune the left-right bar and mark the new FLP. Now simply walk back to the LL being careful to stay in line with your last FLP and mark the new location of the transmitter and record the depth.

Refer to diagram on the next page.



## 8: Battery and Charger

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- Mag receivers use lithium rechargeable batteries.
- This lithium rechargeable battery comes with a special charger. Any use of other lithium rechargeable battery or charger for the receiver may cause fire, explosion, leaking or other damages.
- Store the battery at the room temperatures; 59-77°F (15-25°C). Extreme high or low temperatures will shorten the battery life.
  - Do not submerge the battery in water or any other liquids.
  - Do not throw the battery into fire.
  - Do not disassemble the battery.
  - Avoid any kind of damage to the battery.
  - Please dispose of lithium properly.
- When charging the battery, the red light will shine. When charging is complete, a green light will shine.

## 9: Warranty

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Underground Magnetics offers standard warranty on parts and labor of the Mag 3 series locating system under normal usage. The warranty period is one year for the receiver and display and one year for the transmitter. Warranty time is from the date of transaction.

## 10: Product List

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<b>Description</b>	<b>Quantity</b>
Receiver	1
Display	1
Transmitter	1
Lithium rechargeable batteries	3
Battery charger	1
Long range antenna	1
Tape measure	1
Carrying Case	1
C-Cell battery	2



**Underground Magnetics**

515-329-4243

[www.undergroundmagnetics.com](http://www.undergroundmagnetics.com)

[support@undergroundmagnetics.com](mailto:support@undergroundmagnetics.com)