MAG 6 SYSTEM

Manual





Underground Magnetics

www.undergroundmagnetics.com

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1: Introduction

The MAG 6 & 8 are locating systems 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 s ignal to identify the transmitter's status and location.

T he receiver transmits the locating information to a remote **display** through a radio telemetry system. A h orizontal directional drill machine operator can use th e information from the display to guide the drill head to the desired path.

These locating systems also offer four channel license free radio telemetries between the receiver and remote display. The user can easily "pair" 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 these locating systems properly. Underground Magnetics Inc. (UM) reserves the right to improve the locating systems and the Operator's Manual at any time without notice.

2: Caution

⚠ The operator 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 locating system that is responsible for identifying the drill head location. UM is not responsible for any damage or loss caused by using the Mag system. Operators should operate the Mag system according to the manual.

⚠ If there are any questions, please contact Underground Magnetics.

3: System Highlights

- High precisionand high anti-interference Faraday shield 3D antenna structure
- Industrial rated,gold-plated electronic modules
- High-performance DSP
- Dual locatingsystem, functioning as two receivers independentlytracking to provide better accuracy and reliability
- Up to 110m depth range and up to 120 hours continuous usage

4: Receiver

4.1: Specifications

Mag8



11 System frequencies	4kHz – 31kHz
Water resistant	IP65
Temperature range	-20° to 60°C
Telemetry	4 radio channels with range up to 0.9km (900m)
Rechargeable lithium battery	12.5V
Battery life	Up to 50 hours
Dimensions	68.5cm * 13cm * 30cm
Weight	3kg
Compatibility	XNeedle-M, Echo 1, Echo 2S, Echo 50, Echo60,Echo 70, Echo 90, Echo110

Mag 6

11 System frequencies	4kHz – 31kHz
Water resistant	IP65
Temperature range	-20° to 60°C
Telemetry	4 radio channels with range up to 0.9km (900m)
Rechargeable lithium battery	12.5V
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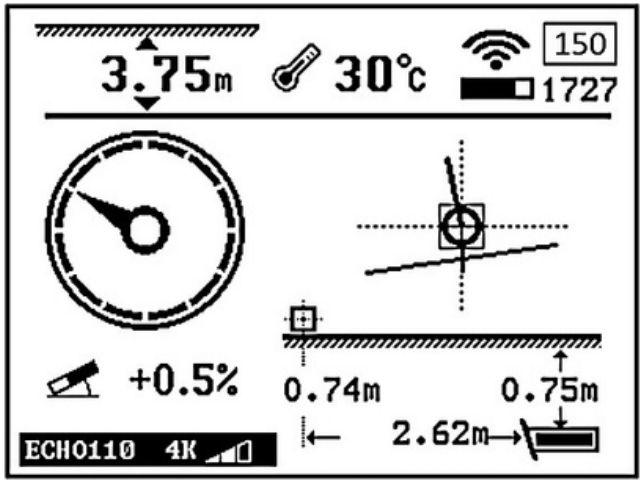


4.2: Receiver Operation

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. Tap from main page to enter Bore-To mode.
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





- Trans mitter model, frequency, and power



- Noise



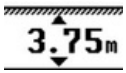
- Signal strength



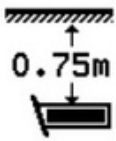
- Visual representation of signal to noise



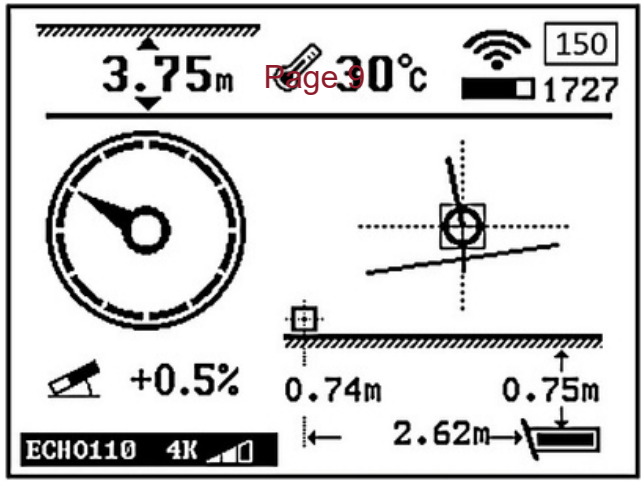
- Transmitter temperature (Flashing indicates transmitter is over-heating)



- Direct distance between transmitter and receiver

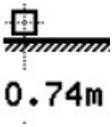


- Vertical distance between receiver and transmitter

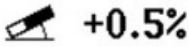




- Estimated horizontal distance between transmitter and receiver



- Estimated transmitter depth



- Transmitter pitch



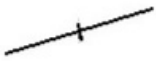
- Roll indicator



- 24 clock positions



- Single Point: direction of transmitter



- Locate Line

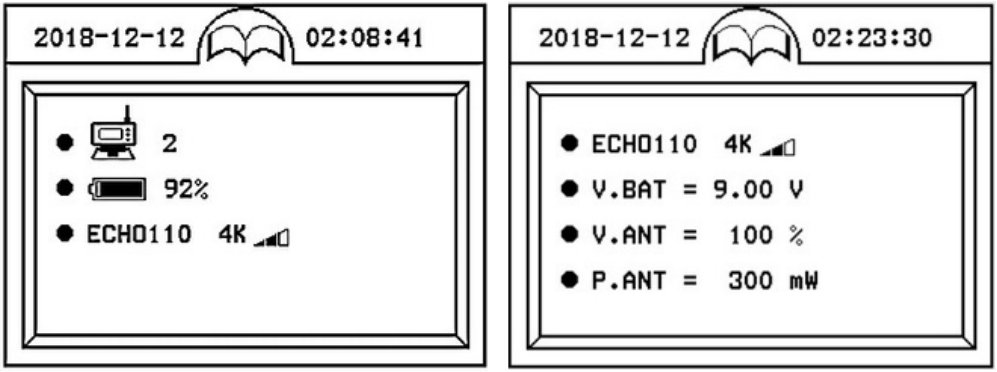


- Receiver

4.3.2: Secondary Page Icons

To enter Secondary Page part I, press and hold .

To enter Secondary Page part II, tap from Secondary Page part I.



ECHO110 4K Transmitter model, frequency, and power

92% Receiver battery status

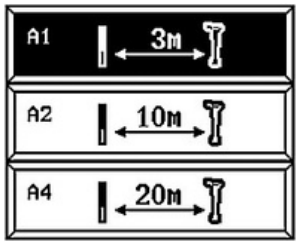
2 Ra d io channel

V.BAT = 9.00 V Batter y v oltage

V.ANT = 100 % Antenna voltage:
Normal range: 95% - 105%

P.ANT = 300 mW Antenna power:
Normal power mode: 500mW – 800mW
High power mode: 2000mW – 3000mW

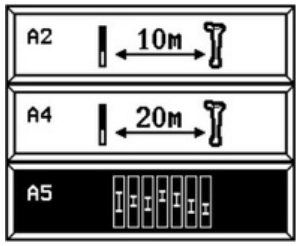
4.3.3: Calibration and Depth Forecast Page Icons



A1： 3m calibration

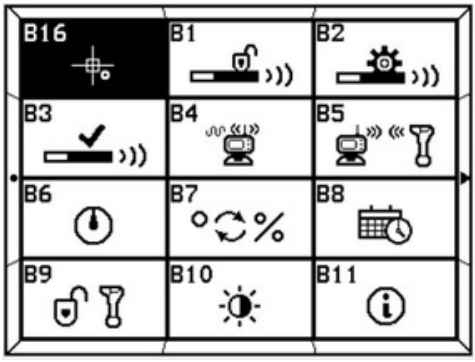
A2: 10m calibration

A4： 20m calibration



A5: Depth forecast

4.3.4: Setup Page Icons



B1: Transmitter activation

B2: Transmitter settings

B3: Receiver settings

B4: Radio channel selection

B5: Receiver and display pairing

B6: Roll calibration

B7: Pitch unit selection

B8: Time & date setting

B9: System lock/unlock

B10: Visibility control

B11: System info

B16: Speed Control

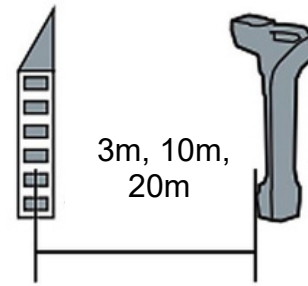
4.4: Calibration

4.4.1: Depth Calibration (3m, 10m, 20m)

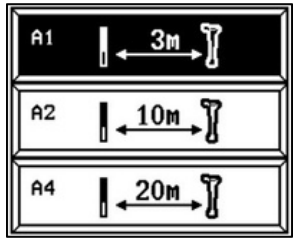
Warning: Even if the transmitter's roll, pitch, battery status and temperature are displayed correctly, calibration may not be reliable due to a distorted magnetic field. **Always do the 3m calibration first.**

1. Make sure that the transmitter is working properly. Place it in the housing.

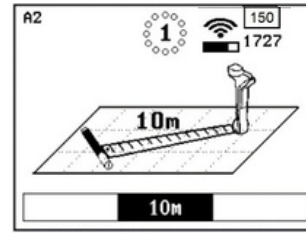
2. Place housing containing the transmitter in a location away from interference.



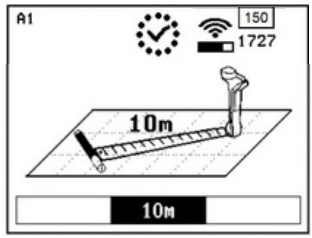
3. Set transmitter and receiver 3m, 10m, or 20m apart from center of transmitter to inside edge of receiver's base, as shown.



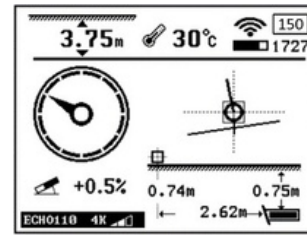
4. Tap ⚙ to enter Calibration Page.



5. Tap ▲ and ▼ to highlight desired distance for calibration. Tap ⚙ to start calibration and wait for calibration to complete.



6. Calibration complete.

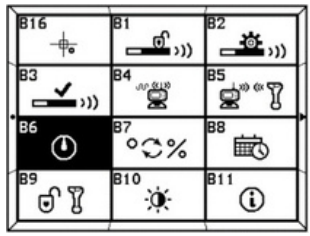


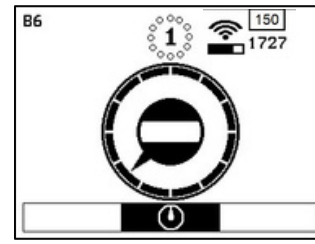
7. Tap ⚙ to return to Main Page.

4.4.2: Roll Calibration

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

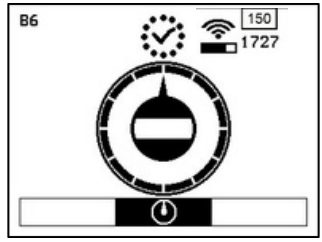


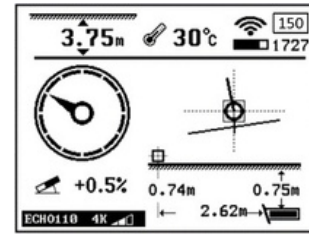




2. Press and hold to enter Setup page and tap to select B6 icon.

3. Tap three timesto enter and start roll calibration and waitfor calibration to complete.



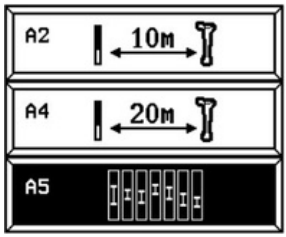


4. Calibration complete.

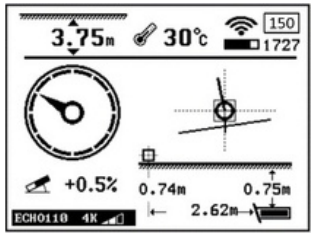
5. Tap to return to Main Page.

4.5: Operation

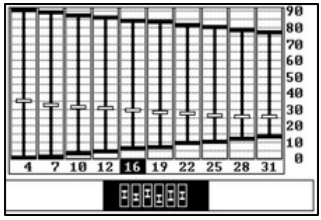
4.5.1: Depth Forecast



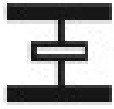
1. Tap ◎ to enter calibration page and tap ▲ to select A5 icon.



3. Tap ◎ to return to Main Page.



2. Tap ↵ to enter DepthForecast Page.



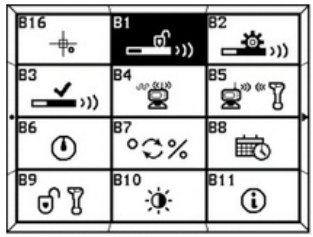
…. Highest depth
…. real-time depth
…. lowest depth

Tap ↵ to reset forecast.

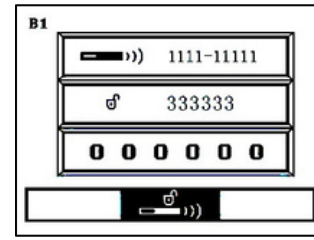
> Note: The highest depthforecast value is a conservativevalue and will be the main valueused when determining interference.

4.5.2: Transmitter Activation (For dealer or factory use)

(Process must be started within10 minutes after batteries have been placed inthe transmitter.)

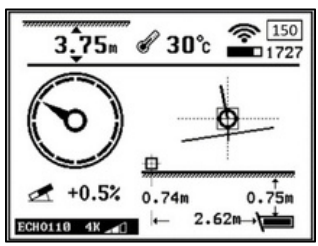


1. Press and hold ⚙ to enter Setup Page and tap ▲ to select B1 icon.



2. Tap ↵ to enter Transmitter Activation Page.

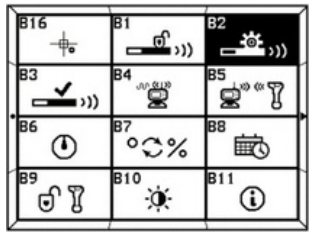
   1111-1111 is the transmitter identification number and 3333-3333 is the prompt code in the diagram. Send the transmitter identification number and the prompt code to the dealer. The dealer will give you an activation password. Use ▲ and ▼ to input password, tap ↵ to confirm activation.



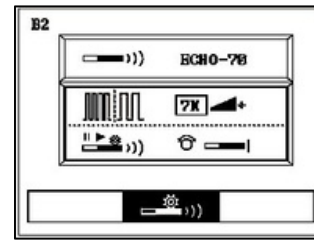
3. Tap ⚙ to return to Main Page.

4.5.3: Transmitter Settings

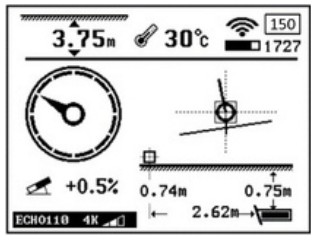
(Process must be started within 10 minutes after batteries have been placed in the transmitter.)



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 and power level. Tap ▲ to highlight Wake Up Mode and tap ↵ to enter. Then tap ▲ or ▼ to select desired mode.



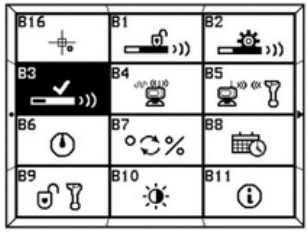
3. Tap ◎ to return to Main Page.

Instant
(rotate the transmitter 4 degrees or change the pitch by 1 degree)

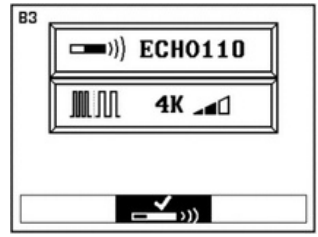
360 degrees
(rotate the transmitter a full 360° several times)

Always on

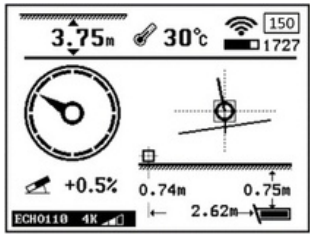
4.5.4: Receiver Settings



1. Press and hold to enter Setup Page. Tap to select B3 icon.

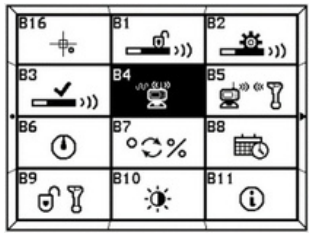


2. Tap to enter Receiver Settings Page. Tap or and to select transmitter model, frequency, and power.

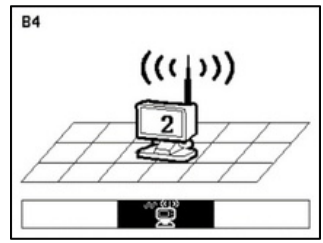


3. Tap to return to Main Page.

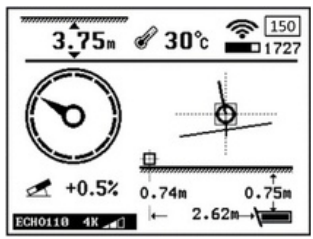
4.5.5: Radio Channel Selection



1. Press and hold ⚙ to enter Setup Page. Tap ▲ to select B4 icon.

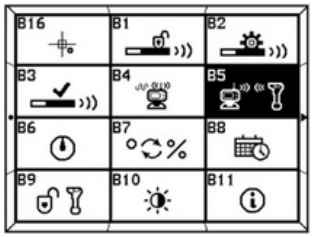


2. Tap ↵ to enter Radio Channel Page. Use ▲ or ▼ to select radio channel.

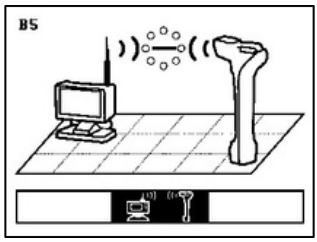


3. Tap ⚙ to return to Main Page.

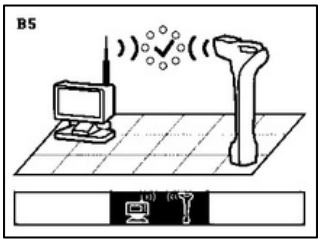
4.5.6: Pairing



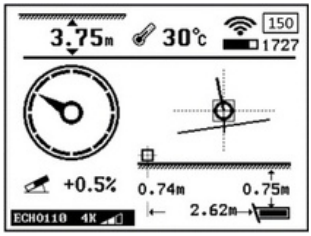
1. Press and hold to enter Setup Page. Tap to select B5 icon.



2. Tap to enter Pairing Page. Tap to start pairing. (It is required that these last two steps are performed on the display at the same time.)

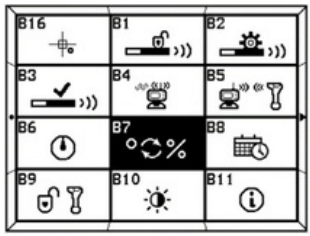


3. Pairing complete.

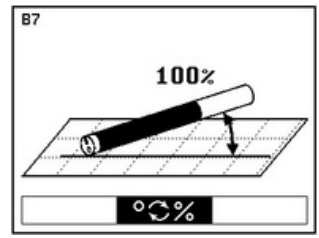


4. Tap to return to Main Page.

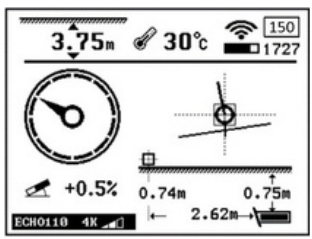
4.5.7: Pitch Unit Selection



1. Press and hold ◎ to enter Setup Page and tap ▲ to select B7 icon. Tap ↵ to enter Pitch Unit Selection Page.

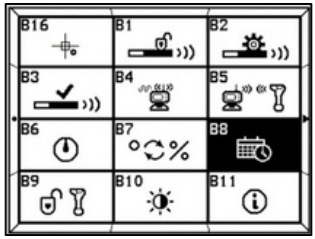


2. Tap ▲ to switch pitch mode.

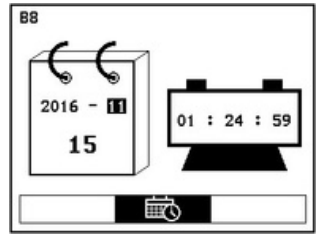


3. Tap ◎ to return to Main Page.

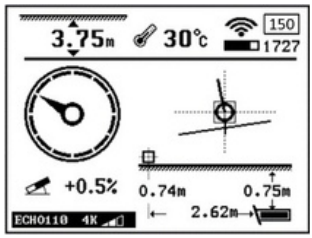
4.5.8: Time Setting



1. Press and hold ◎ to enter Setup Page. Tap ▲ to select B8 icon.

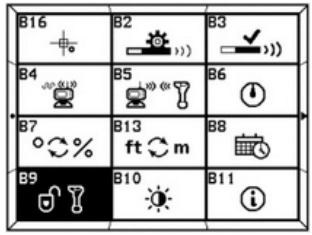


2. Tap ↵ to enter Time Settings Page. Tap ↵ to select year, month, day, hour, or minute. Tap ▲ or ▼ to set time.

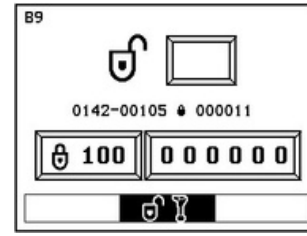


3. Tap ◎ to return to Main Page.

4.5.9: System Unlock (To obtain password, please contact your dealer)

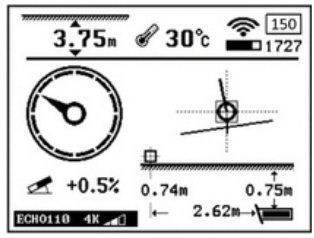


1. Press and hold ⚙ to enter Setup Page and tap ▲ to select B9 icon. Tap ↵ to enter System Unlock Page.



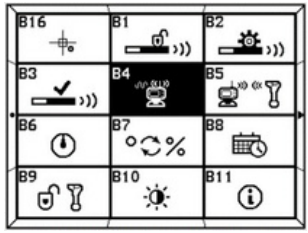
2. Tap ↵ and ▲ or ▼ to change number of days (default is 100). Tap ↵ again to select password. Tap ▲ or ▼ and ↵ to input password.

   Tap ↵ a final time and number of days unlocked will appear in the top box.

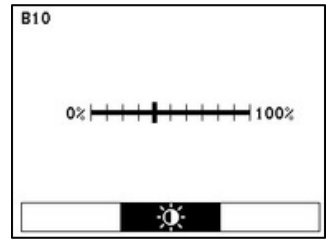


3. Tap ⚙ to return to Main Page.

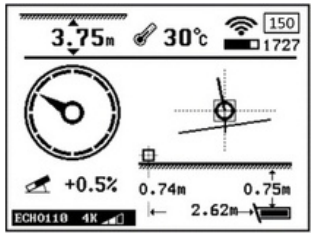
4.5.10: Visibility Control



1. Press and hold to enter Setup Page and tap to select the B10 icon. Tap to enter Visibility Control.



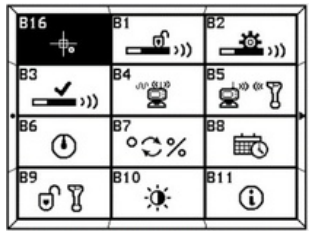
2. Tap and to adjust.



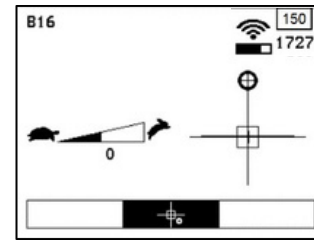
3. Tap to return to Main Page.

Note: By holdingboth and atthe sametimewhile turningthe receiveron,the visibilitycontrol will resettonormal visibility.

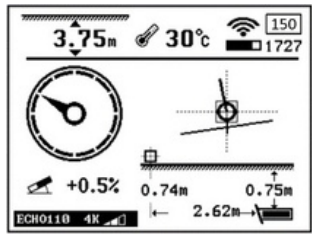
4.5.11: Speed Control (Adjusting speed control of the ball)



1. Press and hold to enter Setup Page and tap to enter the Speed Control Page.



2. Tap and to adjust speed.



3. Tap to return to Main Page.

Note:

0to100 is the indexfor speeding up(suitable for shallow depths)

-100 to 0 s the index for slowing down (suitablefor deeper depths)

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

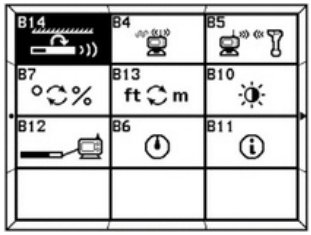


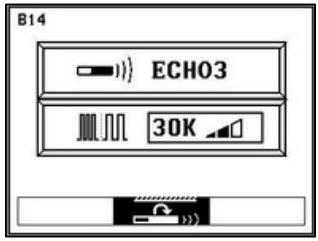
Mag D6	
Radio frequency	867MHz
Water resistant	IP65
Temperature range	-20° to 60°C
Telemetry	4 radio channels with range up to 0.9km (900m)
Power	Rechargeable lithium batteries
Battery life	Up to 50 hours
Screen	Industrial rated LCD graphic screen
Dimensions	19cm x 13cm x 19cm
Weight	1.5kg

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.

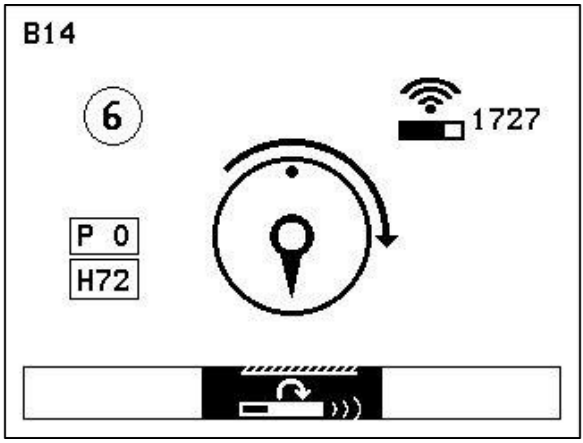
5.2.1: Down Hole Echo Mode Change (Echo 2S and Echo 3)





1. Press and hold to enter Setup Page. Tap to enter Down Hole Echo Mode Change Page.

2. Use or to select desired frequency and power levels. Tap to begin mode change process.



Roll indicator
Target dot

Ho ld: hold this roll position until it counts down to 0

H72

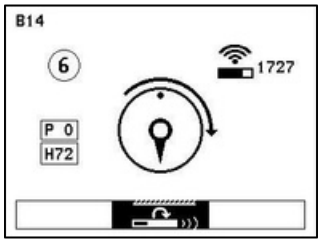
6

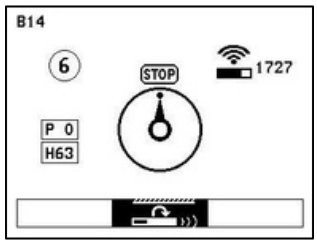
Steps remaining
Instructions

STOP

P 0

Proceed: time left to proceed in process by rotating to new roll position in sequence

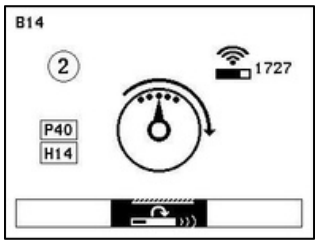


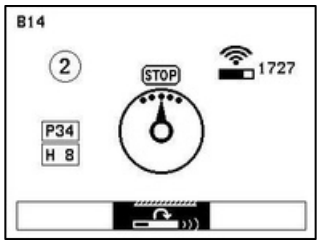


Rotate drill head until roll indicator points toward target dot. Instructions will change from the clockwise arrow to “STOP”.

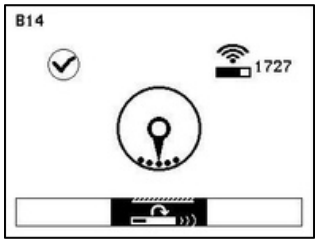
Hold this position until “H” counts down to 0.

Rotate drill head to next position in sequence before “P” counts down to 0 or the sequence will be canceled.



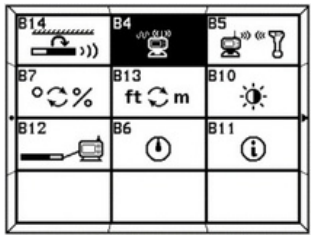


If the next step has the target dots in the same place as the previous step, rotate the drill head one entire rotation until the roll indicator lines up with the target dots again.

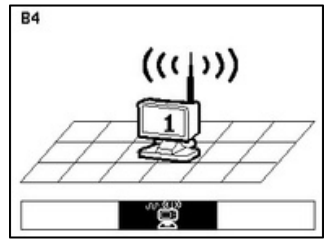


Once all six steps of the sequence are complete, change the Transmitter Settings on the receiver to match the new frequency and power levels.

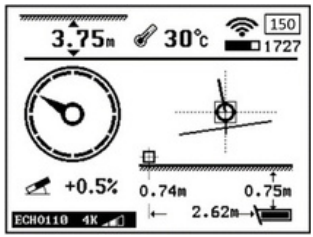
5.2.2: Radio Channel Selection



1. Press and hold to enter Setup Page and tap to select B4 icon. Tap to enter Radio Channel Page.

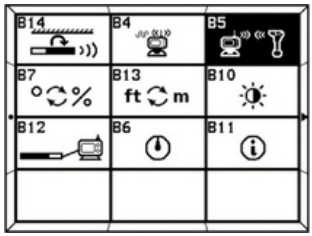


2. Use to select radio channel.

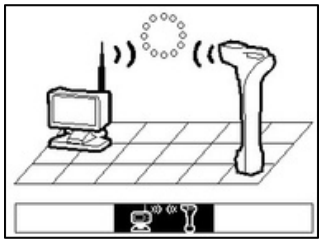


3. Tap to return to Main Page.

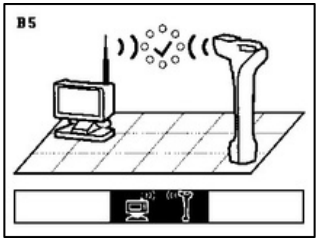
5.2.3: Pairing



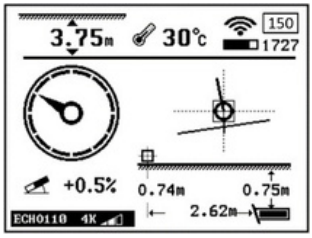
1. Press and hold ⊙ to enter Setup Page and tap ▲ to select B5 icon. Tap ↵ to enter Radio Registration Page.



2. Tap ↵ to start pairing. (It is required that the following procedure is performed on the receiver at the same time)

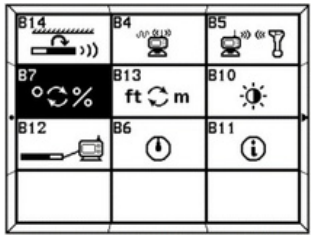


3. Pairing complete.

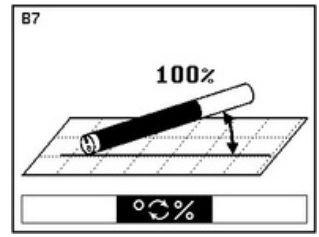


4. Tap ⊙ to return to Main Page.

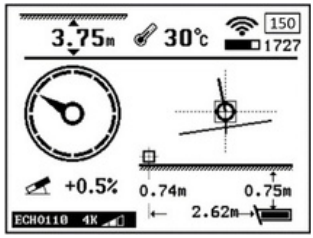
5.2.4: Pitch Unit Selection



1. Press and hold ◎ to enter Setup Page and tap ▲ to select B7 icon. Tap ◎ to enter Pitch Unit Selection Page.

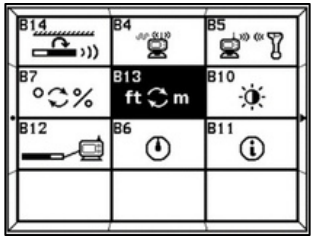


2. Tap ▲ to switch pitch mode.

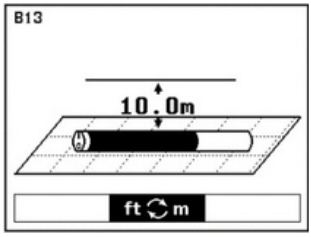


3. Tap ◎ to return to Main Page.

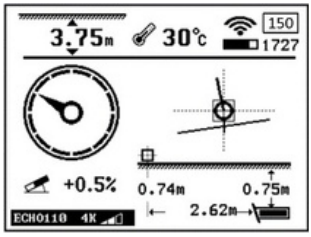
5.2.5: Distance Unit Selection



1. Press and hold ◎ to enter Setup Page. Tap ▲ to select B13 icon.

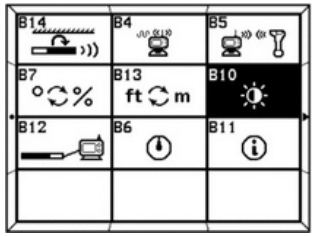


2. Tap ↵ to enter Distance Unit Selection Page. Tap ▲ or ▼ to select unit and format.

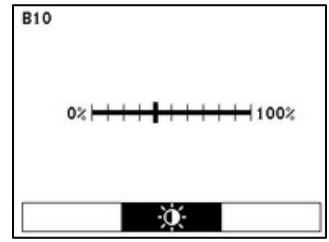


3. Tap ◎ to return to Main Page.

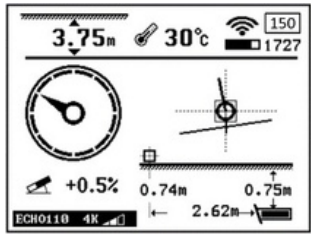
5.2.6: Visibility Control



1. Press and hold to enter Setup Page and tap to select the B10 icon. Tap to enter Visibility Control Page.



2. Tap and to adjust.



3. Tap to return to Main Page.

Note: By holding both and at the same time while turning the display on, the visibility control will reset to normal visibility.

5.3: 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, 7kHz, 10kHz, 12kHz, 16kHz, 19 kHz, 22kHz, 25kHz, 28kHz, 30kHz, or 31kHz. The transmitter will enter a “sleep” mode after 15 minutes without rotation. It takes 10 seconds to “wake up” once the transmitter is rotated.

Note: If drilling in adverse soil conditions (i.e. rock), normal C cell batteries will experience battery chatter. This can greatly reduce battery life. To prevent this, use your provided double C lithium cell battery instead.



6.2: Specifications

Echo 1



Dimensions		3.2cm x 38cm
Frequency		4kHz/19kHz/30kHz
Depth Range		25m/40m/40m
Power		2 C cells, Echo Cell Kit, or Lithium Battery
	C cell	3V, 12 hours of continuous usage
	Echo Cell Kit	3V, 20 hours of continuous usage
	Lithium*	3V, 48 hours of continuous usage
Temperature		Under 121°C

Echo 2S



Dimensions		3.2cm x 38cm
Frequency		4kHz/19kHz/30kHz
Depth Range		25m/40m/40m
Power		Echo Cell Kit or Lithium Battery
	Echo Cell Kit	3V, 20 hours of continuous usage
	Lithium*	3V, 48 hours of continuous usage
Temperature		Under 121°C
High Power Modes		• 19kHz and30kHz depth range of 50m • Operating time is 5 hours for Echo Cell Kit and 12 hours for lithium battery

Echo 50



Dimensions		3.2cm * 38cm
Frequency		10 frequencies: 4kHz – 31kHz
Depth Range		Normal power: 40m High power: 50m
Power		18650 rechargeable lithium battery 261020 lithium battery
	18650 (3.7V)	Normal power: 20 hours High power: 5 hours
	261020 (3.7V)	Normal power: 60 hours High power: 15 hours
Temperature		Under 121°C
BatteryVoltage		2.8V – 4.2V

Echo 60



Dimensions		3.2cm * 48cm
Frequency		10 frequencies: 4kHz – 31kHz
Depth Range		Normal power: 40m High power: 60m
Power		(2) 18650 rechargeable lithium batteries (2) 261020 lithium batteries
	18650 (3.7V)	Normal power: 50 hours High power: 12 hours
	261020 (3.7V)	Normal power: 160 hours High power: 40 hours
Temperature		Under 121°C
Battery Voltage		5.6V – 8.4V

Echo 70



Dimensions		3.6cm * 39.3cm
Frequency		10 frequencies: 4kHz – 31kHz
Depth Range		Normal power: 50m High power: 70m
Power		(3) 18650 rechargeable lithium batteries
	18650 (3.7V)	Normal power: 60 hours High power: 15 hours
Temperature		Under 121°C
Battery Voltage		8.4V – 12.6V

Echo 90



Dimensions		3.6cm * 45.5cm
Frequency		10 frequencies: 4kHz – 31kHz
Depth Range		Normal power: 70m High power: 90m
Power		(2) 18650B2 rechargeable lithium batteries
	18650B2 (3.7V)	Normal power: 80 hours High power: 20 hours
Temperature		Under 121°C
Battery Voltage		5.6V – 8.4V



Echo 110

Dimensions		3.6cm * 60.5cm
Frequency		10 frequencies: 4kHz – 31kHz
Depth Range		Normal power: 90m High power: 110m
Power		(3) 18650B2 rechargeable lithium batteries
	18650B2 (3.7V)	Normal power: 120 hours High power: 30 hours
Temperature		Under 121°C
Battery Voltage		8.4V – 12.6V

XNEEDLE-M



Dimensions		2cm * 16cm
Frequency		30kHz (19kHz)
Depth Range		25m
Power		16340 rechargeable lithium battery
	Battery Life	Up to 12 hours
	Lithium*	6V, 160 hours of continuous usage
Temperature		Under 121°C

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: Install batteries positive side down and install battery cap with provided battery cap tool.
  - C cell: Battery full, 2/3 full, 1/3 full and flash warning
  - Lithium: Will show battery full then flash warning
- Temperature: When the transmitter is overheating, temperature indication on the receiver's screen flashes. If temperature reaches over 121°C, transmitter may be permanently damaged. If this happens, the dot temperatureindicator on the front of transmitterwill turn black. (Echo 70,Echo90, andEcho110donothavea temperature indicator)

6.4: Transmitter Maintenance

- Do not place the transmitter near excessive temperature (over 121°C).
- Do not apply excessive pressure, shock or vibration to 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

7.1: Locating Basics

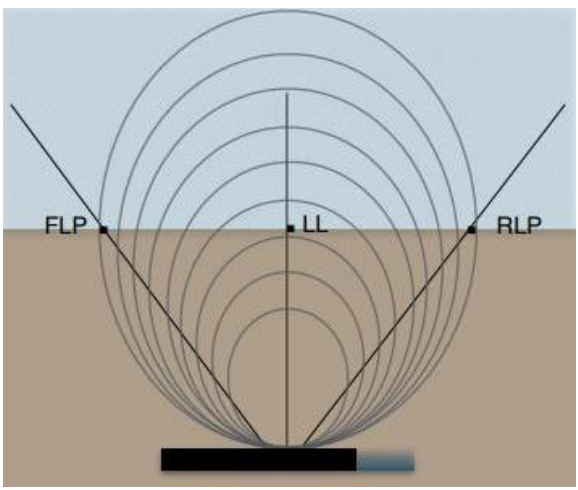
There are two main methods of locating a transmitter.

- Three Point Locating
- Single Point Locating

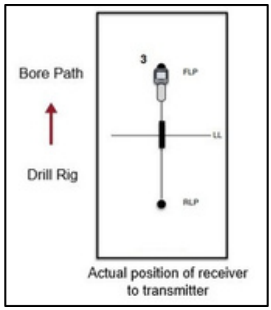
7.1.1: Three Point Locating

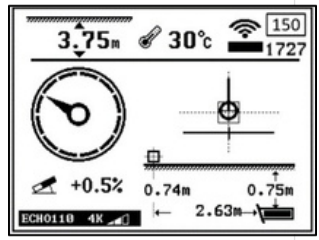
Three Point Locating is the industry standard method for locating. It locates the transmitter by pinpointing three specific locations along the transmitter's magnetic field. The front locate point (FLP) ahead of the transmitter, the rear locate point (RLP) behind the transmitter and the locate line (LL) 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.

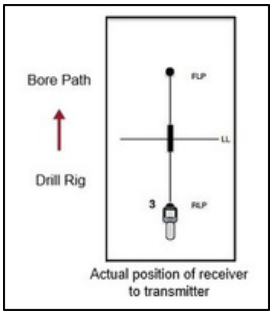


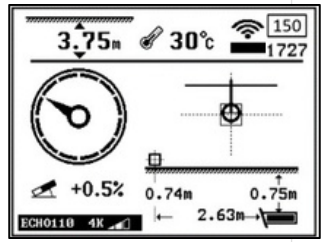
Side view



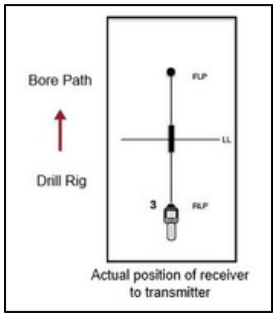


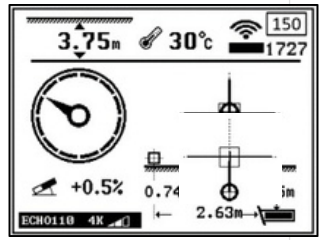
The FLP is a point in front of the transmitter. Locate it by putting the ball in the box.





Next, find the RLP. The RLP is a point behind the transmitter. Locate it by putting the ball in the box.





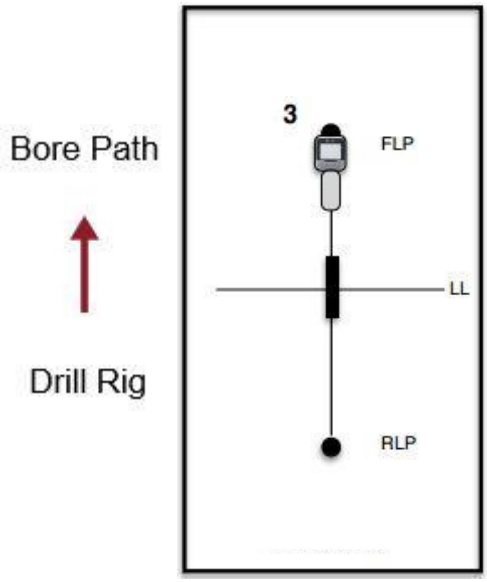
Then, imagine a line that runs through the FLP and RLP. Walk along that line until the LL indicator on the receiver screen enters the box. You are now above the LL.

7.1.2: Single Point Locating

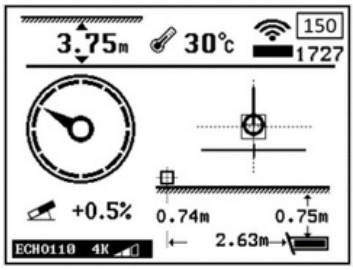
Single Point Locating is the newest and most efficient locating method, which is available with the Mag 6 and Mag 8.

Simply locate the front locate point (FLP).

When the ball falls into the box, you are above the FLP. Then continue drilling and locating the FLP to steer.

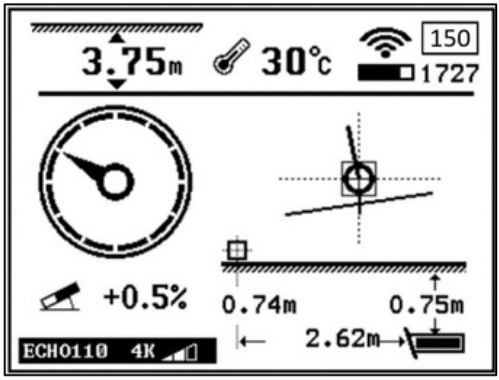


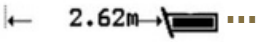
Actual position of receiver to transmitter



Receiver view

7.2: Bore-To

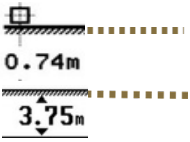




Estimated horizontal distance between transmitter and receiver



Vertical distance between receiver and transmitter
Projected transmitter depth

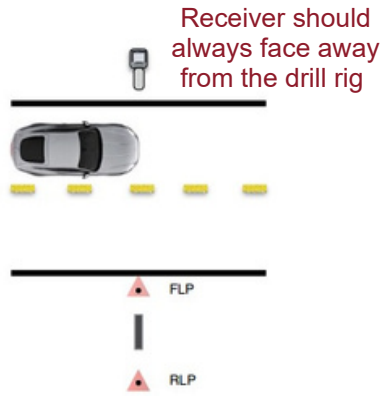


Direct distance between transmitter and receiver



Hold

To switch between Bore-To and Walkover mode, tap from the main page or point the bottom of the receiver upward and hold for 2 seconds as shown.



To use Bore-To, place the receiver ahead of the transmitter along the drill path.

Using pitch, depth, and left/right information, put the ball in the box.

Projected Depth

Projected depth tells you what depth the head is estimated to be at when it reaches the receiver if the operator maintains the indicated pitch.

8: Battery and Charger

- 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 room temperatures (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

Underground Magnetics offers standard warranty on parts and labor of the Mag 6 and 8 series locating system under normal usage. The warranty period is one year for the receiver and display and six months for the transmitter. Warranty time is from the date of transaction for receiver and display, and from the date of unlock for the transmitter.