Instruction Manual

Model MAC-51B
Magnetic and Cable Locator

The Foldout Cover is a MAC-51B Applications Diagram

Manufactured By
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Section I
General

Introduction

The MAC-51B Magnetic and Cable Locator is a light-weight, dual-mode instrument designed for detecting buried iron and steel objects and tracing underground cables and pipes. The system consists of two major units: a transmitter and a dual-function receiver. Both units use C-cell batteries that provide up to 50 hours of operation.

Figure 1-1. MAC-51B Magnetic and Cable Locator

Cable Locator Mode

When used in the cable locator mode, the transmitter generates a distinctive ac signal which is applied to the cable or pipe. The receiver is used to detect and trace the signal as it travels along the cable/pipe. A siren-like tone from the receiver is easily identified as the tracing signal. The approximate depth of an underground cable can be determined using the 45° null-point triangulation method. Operation of the MAC-51B in the cable locator mode is explained in Sections IV and V.

Magnetic Locator Mode

The receiver is the only unit required for operation in the magnetic mode. Set the receiver M/C function switch to "M", adjust the sensitivity control, and you have the best magnetic locator available. Operation of the magnetic locator mode is explained in Sections II and III.

Switching from cable locator mode to magnetic locator mode while tracing a cable is a unique method for unscrambling ground clutter. Gas and water pipes in the immediate vicinity of a cable can emit parasitic signals that distort the identification null. In the magnetic mode cast-iron water pipes and gas lines can be identified quickly and even classified as to type by the conventional spacing of joints, which provide the strongest signals.

Standard Accessories

Basic accessories supplied with the MAC-51B include an earphone jack, a spare batteries holder and a conductive cable assembly with ground stake. An inductive signal clamp and earphones are available as options.

Receiver Compatible with Metrotech* Model 480

The 82.5 kHz tracing signal detected by the MAC-51B receiver in the cable locator mode is the same frequency used by the Metrotech* Model 480 Pipe and Cable Locating System. The MAC-51B receiver, available from Schonstedt Instrument Company as a separate unit, can be used as a direct replacement for the Metrotech 480 receiver in conjunction with the Model 480 transmitter.

*Metrotech is a registered trademark of Metrotech Corporation

SPECIFICATIONS

TRANSMITTER

Operating Voltage	12 Volts (eight C-Cell batteries)
Battery Life	50 hours intermittent operation at 70° F
Output Frequency	82.5 kHz modulated at 382 Hz, pulsed at 4.8 Hz (inductive or conductive)
Audio Indicator	2.58 kHz pulsed at 4.8 Hz
Weight	Approximately 5.5 lb.(2.5 kg.)
Operating Temperature	0° F to 120° F (-18° C to 49° C)
Overall Size	43.5 in. x 7 in. x 5 in. (110.5 cm. x 17.8 cm. x 12.7 cm.)

RECEIVER

Operating Voltage	6 Volts (4 C-Cell batteries)
Battery Life	50 hours intermittent operation at 70° F
Output Frequency	Approximately 40 Hz idling tone from speaker. Frequency of pulsing tone increases (or decreases) with signal intensity.
Weight	Approximately 3 lb. (1.36 kg.)
Operating Temperature	0° F to 120° F (-18° C to 49° C)
Overall Length	42.3 in. (107.4 cm.)

SPECIFICATIONS (cont.)

RECEIVER (cont.)

Waterproof Length	34.5 in. (87.6 cm.)
Nominal Sensor Spacing	20 in. (50.8 cm.)

(Specifications subject to change without notice)

PATENTS

Manufactured under the following patents: United States: 2,916,696; 2,981,885; 3,894,283; 3,909,704; 3,961,245; 3,977,072; 4,110,689; 4,161,568; 4,163,877; 4,258,320 and Design 255552. Canada: 637,963; 673,375; 1,006,915; 1,037,121; and 1,141,003. Great Britain: 1,446,741; 1,446,742 and 1,494,865. France: 2,205,671. Germany: 25 51 968.0-09; 23 55 630; and 29 01 163. Other United States and foreign patents pending.

Section II
Magnetic Locator Operation

Theory of Operation

In the magnetic locator mode, the MAC-51B receiver responds when the magnetic field strength at the two sensors, which are 20 inches apart, is different. This response consists of a change in the idling frequency of the signal emitted from the speaker.

Figure 2-1 illustrates an application of the locator in which it is used to detect an iron marker of the type used for property line identification. The magnetic field of the marker is stronger at sensor **A** than it is at sensor **B**. As a result, the frequency of the signal on the speaker is higher than the 40 Hz idling frequency which exists when the field strength is the same at both sensors.

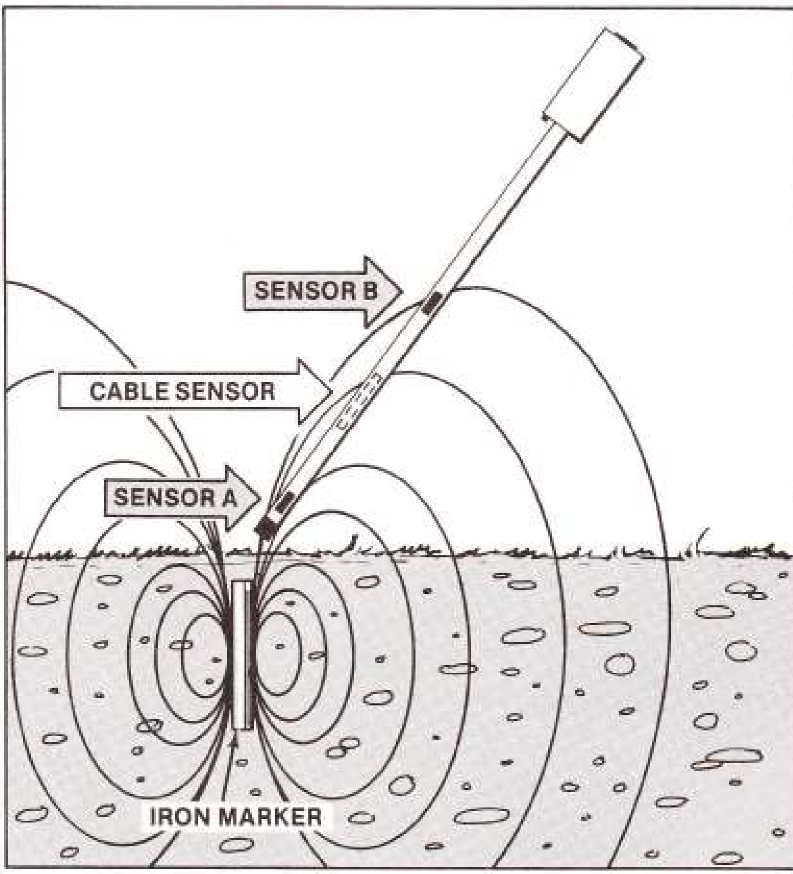


Figure 2-1. Detecting Magnetic Field of an Iron Marker

Function Selection, Turn-On and Initial Sensitivity Setting

Set the M/C Function switch to M and adjust the ON/OFF-Sensitivity control for mid-position as shown in Figure 2-2. With the knob in this position, the sensitivity is set for what is referred to as the Normal Range.

In most areas the locator can be oriented in any direction without producing a significant change in the frequency of the tone from its idling rate. However, in some areas where magnetic disturbances are encountered from nearby structures, rocks, sand or trash, the control should be adjusted for lower sensitivity as illustrated in Figure 2-3.

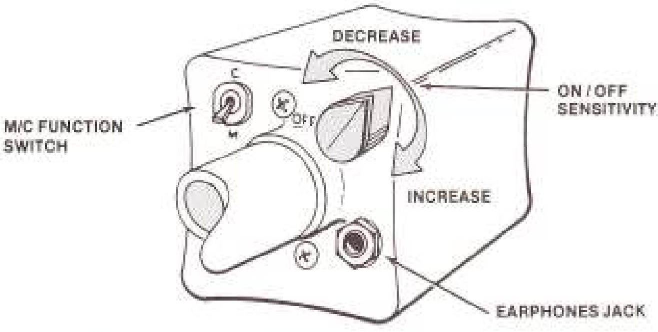


Figure 2-2. Sensitivity Set for Normal Range

Low Sensitivity Operation

Unwanted background signals due to nearby magnetic objects may require that the effective range of the locator be reduced. This is accomplished by turning the sensitivity knob in a counter-clockwise direction. Reduced range is useful for pinpointing the location of a strongly magnetized marker.

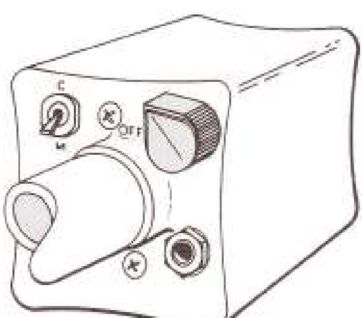


Figure 2-3. Sensitivity Set for Low Range

High Sensitivity Operation

The sensitivity of the locator is increased by turning the sensitivity knob in a clockwise direction. A high sensitivity setting imposes some constraints on operating methods. The locator tone will vary in frequency depending on the instrument's orientation relative to the Earth's magnetic field.

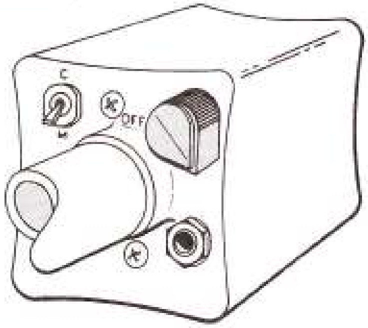


Figure 2-4. Sensitivity Set for High Range

Search Procedure

Set the sensitivity control for normal operation and hold the locator just below the large end as illustrated in Figure 2-5. Because the upper sensor is located near the area where the locator is usually held, wrist watches may produce unwanted changes in the signal frequency. Therefore, a watch worn on the the wrist of the hand holding the locator should be removed. Avoid bringing the locator close to your shoes, since they might contain magnetic material.

To obtain maximum area coverage, the locator should be swept from side-to-side with the small end of the instrument kept close to the ground. A higher frequency tone from the speaker will be heard when the locator is within range of an iron or steel object.

When using a high sensitivity setting, avoid turning the locator about its long axis. This may produce tonal variations in the output signal because of sensor misalignment.

The presence of a ferromagnetic object will be indicated by a change in the tone of the output frequency.

Figure 2-5. Searching with the Locator

Section III
Magnetic Locator Application Notes

Basic Signal Patterns

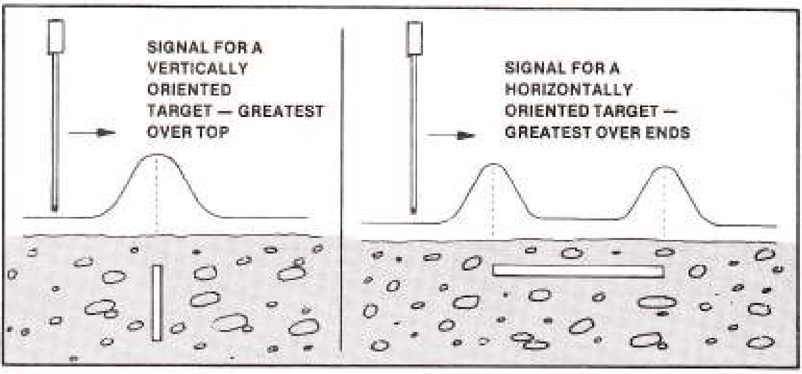


Figure 3-1. Signals from Vertical and Horizontal Targets

After you have detected the presence of a target, hold the locator vertically and move it back and forth in an "X" pattern. The peak signal occurs directly over a vertical target, and over the ends of a horizontal target.

The "X" pattern is ideal for pinpointing small objects. A 1-1/4-inch PK nail buried up to 8 inches can be located so precisely with this technique that it can be uncovered using a 1/2-inch star drill.

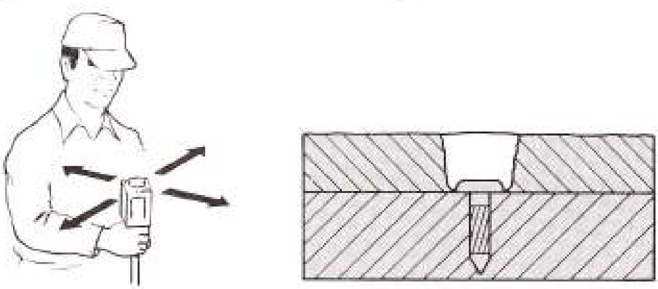


Figure 3-2. "X" Pattern Provides Precision Locating

If you find more then one signal in the vicinity of a target, just raise the locator several inches higher. Any signal that disappears when the locator is raised is probably not coming from the actual target. The signal from a rusty bolt or other small item will decrease much faster with distance than the signal from a larger target such as a corner marker. An 18-inch length of ¾-inch pipe can be located at depths up to 7 feet.

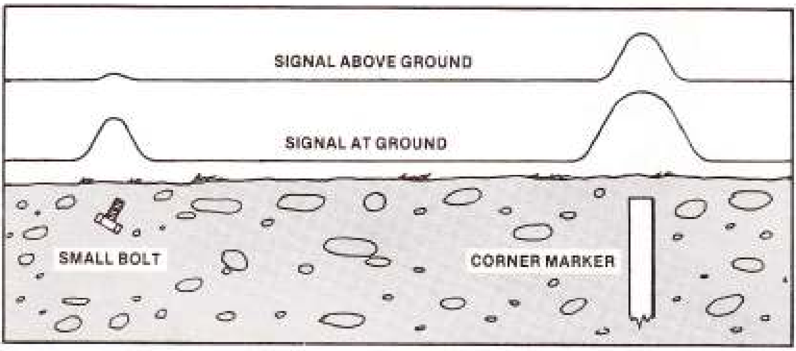


Figure 3-3. Raising the Locator Eliminates Unwanted Signals

Strongly Magnetized Markers

A strongly magnetized marker at or near the surface may provide location information that is misleading.

The heavy line in Figure 3-4 represents the variation in tone frequency when the locator is moved over the marker. When moving the instrument from **A** to **B**, the frequency of the tone increases and then suddenly decreases at **B**. From just beyond **B** the frequency of the tone increases sharply, becomes very high directly over the marker and decreases just before reaching **C**. From **C** to **D** the pattern is the reverse of that from **A** to **B**. It is obvious that the locator must enter the **B-C** region. Otherwise the marker might be assumed to be between **A** and **B** or **C** and **D**.

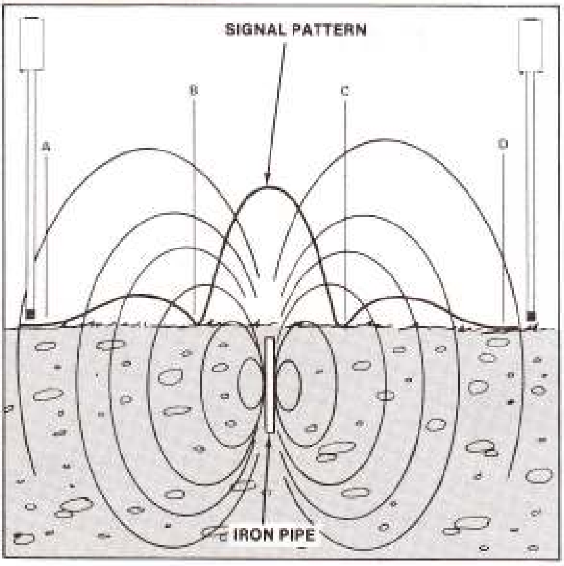


Figure 3-4. Signal Pattern From a Strongly Magnetized Marker

This phenomenon is explained by the fact that the locator is sensitive to the magnetic field components parallel to its long axis. At points **B** and **C** the field is perpendicular to the locator so no high frequency is produced at these points.

Locating Manholes, Septic Tanks and Water Wells

The magnetic field is strongest at the edge of a shallow manhole cover. Turn the sensitivity down all the way and you can easily trace the edge of covers near the surface. Locating depth ranges up to 8 feet.

The great length of a well casing provides a strong field at the surface that makes it easy to locate casings buried up to 15 feet deep.

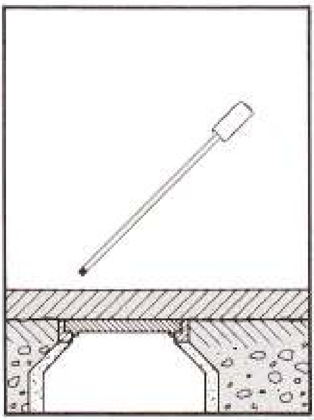


Figure 3-5. Locating Manhole Covers

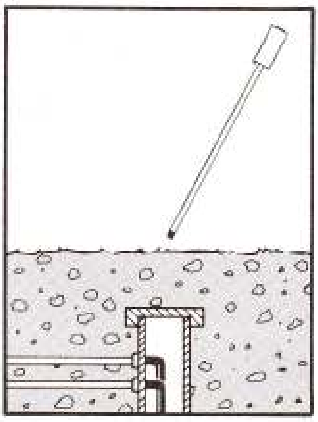


Figure 3-6. Locating Water Well Casings

The MAC-51B receiver can be used to precisely locate the metal handles or reinforcing bars on septic tank covers at depths up to 4 feet.

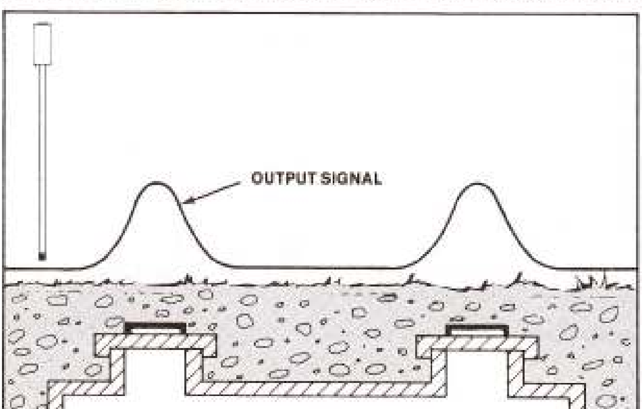


Figure 3-7. Signal Pattern Provided by Septic Tank Handles

Locating Objects under Snow or Water and Tracing Barbed Wire

The locator can be used in flooded areas—just keep the electronic unit out of the water.

Snow poses no problem. Thrust the locator into the snow as deep as necessary to locate the target.

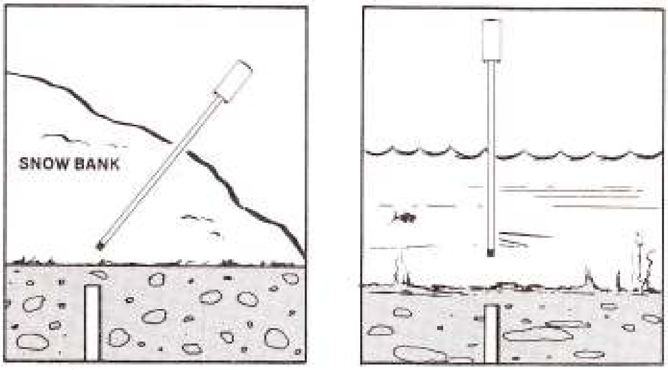


Figure 3-8. Locating Objects under Snow or Water

You can often trace barbed wire (from old fence lines) buried just beneath the surface. Even if the wire is only a trail of rust, it can still be detected near the surface. Tip the locator a little lower than usual—but not parallel with the ground.

First, examine trees for bench marks and bits of embedded barbed wire. Then hold the locator parallel with the direction of the wire.

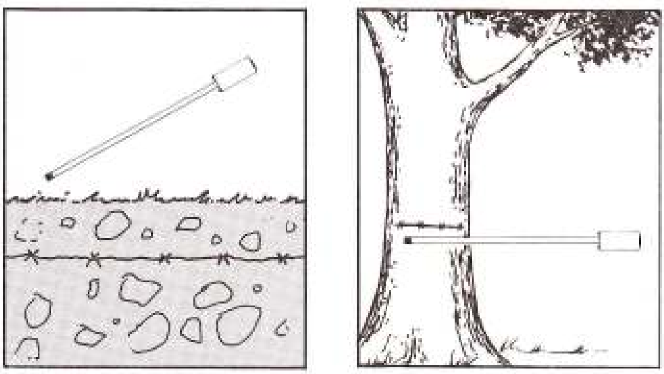


Figure 3-9. Tracing Barbed Wire from Old Fence Lines

Searching Areas Along a Chain Link Fence

Searching in the vicinity of a chain link fence requires a reduced sensitivity setting and also some control over the orientation of the locator. As illustrated in Figure 3-10, position the locator horizontally with its long axis perpendicular to the fence. This ensures that the upper sensor is kept away from the fence.

Figure 3-10. Searching in the Vicinity of a Chain Link Fence

Perform the search by moving along the fence, keeping the end a constant distance from the fence. **When a point 1-5/8 inches from the end of the locator is directly over the stake, the signal will drop abruptly as shown in Figure 3-11.** Any variation in the position of the locator will produce an abrupt rise in the frequency of the tone.

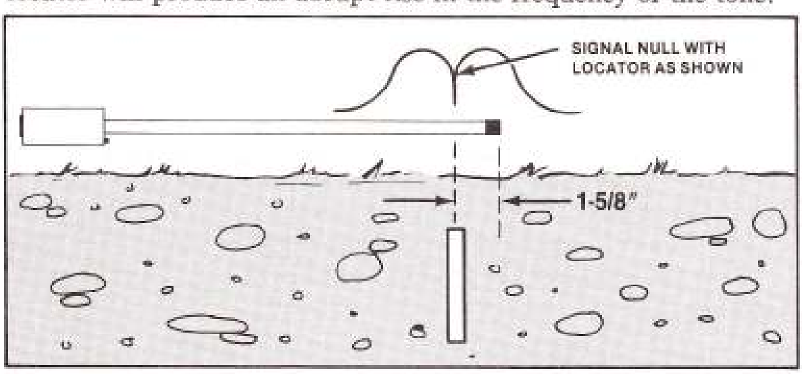


Figure 3-11. Placement of Locator While Searching Along a Chain Link Fence

Locating Valve Boxes

Both the valve and its casing, when iron, provide strong magnetic fields which make them easy to locate. Plastic enclosures containing magnets are easily located at depths of 6 feet or more.

Figure 3-12. Locating Valve Boxes and Casings

Locating Cast-Iron Pipes

As illustrated in Figure 3-13, cast-iron pipes produce the strongest magnetic signals at their joints.

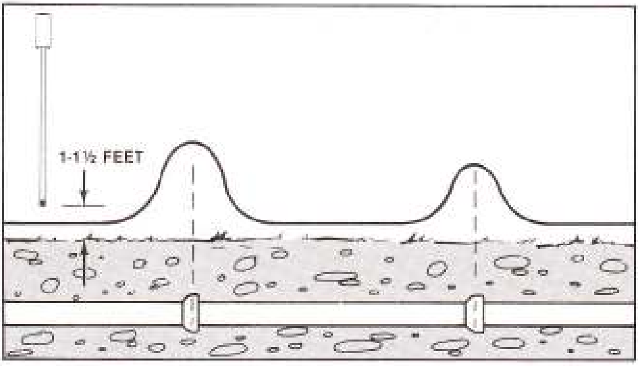


Figure 3-13. Signal Pattern Provided by Cast-Iron Pipes

The initial search should be performed as follows:

1. Adjust the sensitivity level for maximum.
2. Hold the locator vertically approximately 1 to 1-1/2 feet above the surface.
3. Walk along without turning or tilting the locator.
4. Mark the locations where the maximum signal levels occur.
5. Return to an area of maximum signal strength and hold the locator several inches above the surface. The sensitivity will probably have to be reduced during this second pass. Four-inch pipes can be located at depths up to 8 feet.

Other Notes

1. A burbling sound indicates the presence of an energized power line.
2. The instrument will not detect nonmagnetic materials such as gold, silver, copper, brass and aluminum.

Section IV
Cable Locator Operation

Theory of Operation

In the cable locator mode, the receiver must be used in combination with the transmitter which is housed in the carrying case.

As illustrated in Figure 4-1, the transmitter is placed over and in line with the target cable/pipe. An alternating current induced into the cable/pipe produces a signal that is detected with the receiver. The transmitter emits a steady beeping sound to indicate that it is operating, and the receiver emits a siren-like sound that is easily identified as the induced tracing signal.

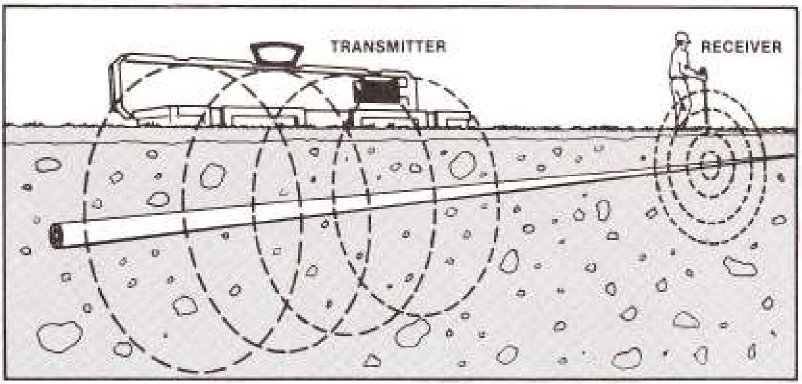


Figure 4-1. Transmitter and Receiver Placement

The tracing current generates an alternating circumferential field around the cable. This alternating field induces a signal into the receiver's sensor. As the receiver is moved back and forth across the cable in a search pattern, the pitch of the audio output from the receiver increases and decreases.

The heavy line in Figure 4-2 represents the increase and decrease in pitch of the audio signal as the receiver is moved back and forth over an energized cable. Moving from **A** to **D** causes the pitch to increase to a maximum at **B** and decrease to a minimum directly over the target. At **C** the pitch again increases and then decreases at **D**.

The MAC-51B can be used to trace any long conductive element such as an anode string or metalized warning tape as well as cable and pipe.

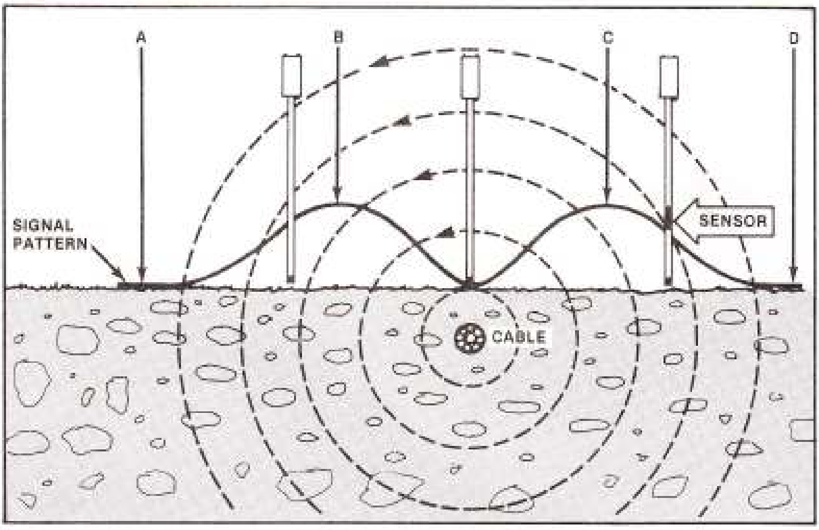


Figure 4-2. Signal Pattern from a Tracing Signal

NOTE
For convenience, all targets will be referred to as lines throughout Sections IV and V.

Transmitter, Turn-On and Battery Check

Set the ON/OFF switch to ON and listen for a steady beeping sound. If a beeping is not heard, the batteries must be replaced as described on page 6-3.

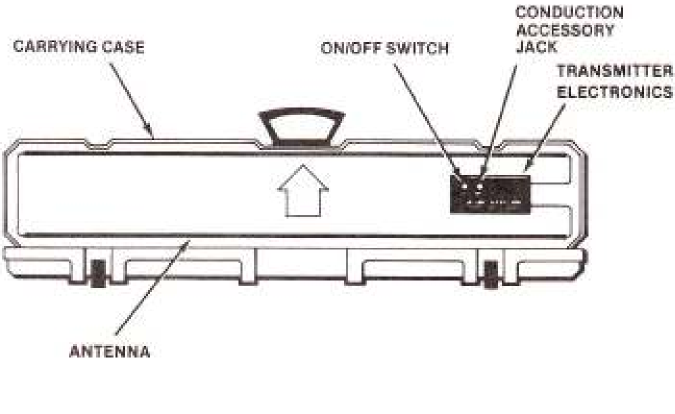


Figure 4-3. Transmitter Controls

Transmitter, Inductive Mode

The most common line excitation mode is inductive. With the cover open and the arrow pointing up, place the transmitter over the line as illustrated in Figure 4-4. The cover must be pointing up. Turn the transmitter ON/OFF switch to ON and you will hear a steady beeping sound. If not, replace the batteries.

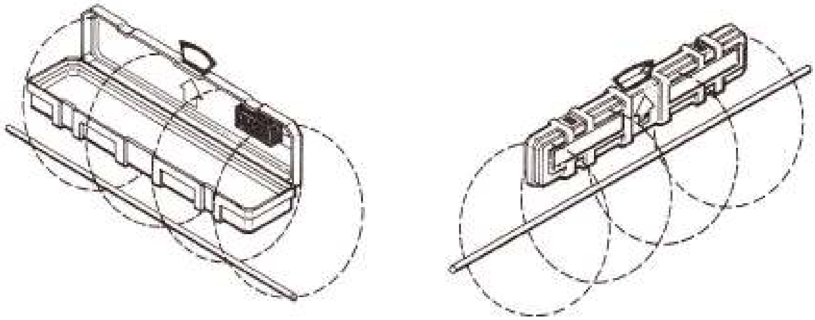


Figure 4-4. Transmitter Operating Positions

Transmitter, Conductive Mode

If an exposed section of a target gas or water pipe is accessible, the tracing signal can be applied directly to the target line.

Plug the conductive cable assembly into the transmitter accessory jack and turn the power switch to ON. (Inserting the plug automatically disables the inductive transmitter and applies exciting current to the cable clips.) Connect one cable clip to a conductive portion of the line. Drive the ground stake into the soil off to the side of the line and attach the other clip to the stake. A good electrical contact between the clips, the line, and the ground stake is very important.

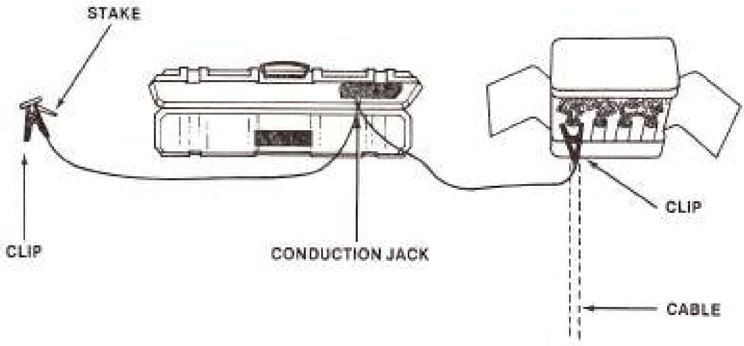


Figure 4-5. Transmitter Hookup for Conductive Operation

Transmitter, Inductive Signal Clamp Mode

The inductive signal clamp (optional) provides a convenient method of applying the tracing signal to electrical cables covered with nonmetalic insulation. Plug the clamp lead into the transmitter accessory jack, turn on the transmitter and close the clamp around the cable. No ground connection is required. It can be applied to cables up to three inches in diameter.

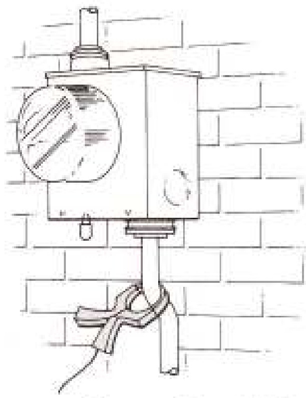


Figure 4-6. Inductive Signal Clamp Hookup

Receiver, Function Selection and Turn-On

Set the M/C switch to C and adjust the ON/OFF-Sensitivity control for mid-position as shown in Figure 4-7. The volume level is preset. If the receiver is turned on when located within 15 feet of the transmitter, the receiver's speaker will emit a siren-like sound indicating that the receiver is picking up the tracing signal directly from the transmitter through the air.

The sensitivity will have to be increased as the distance between the receiver and transmitter increases. Higher sensitivity is required when operating in the inductive mode.

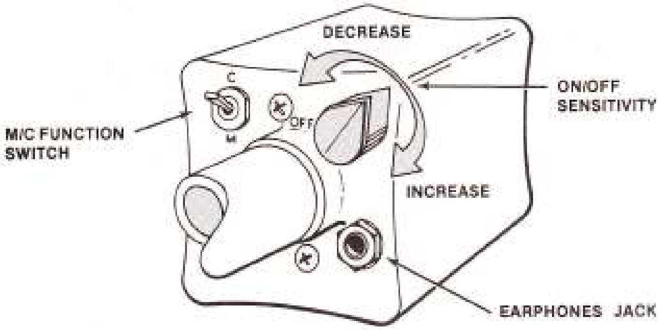


Figure 4-7. Sensitivity Set for Normal Range

Receiver, Sensitivity Settings

The right sensitivity level must be used to obtain a proper null. A null is the audio signature that lets the operator know when he is positioned directly over the target line. If the sensitivity level is set too low, the null between the two signal peaks (highest audio pitch) will cover too large an area, making it difficult to trace the line. If the sensitivity is set too high, the null will be too short and not heard. Setting the sensitivity to get the null width as illustrated by the medium sensitivity curve in Figure 4-8 is the secret to successful tracing.

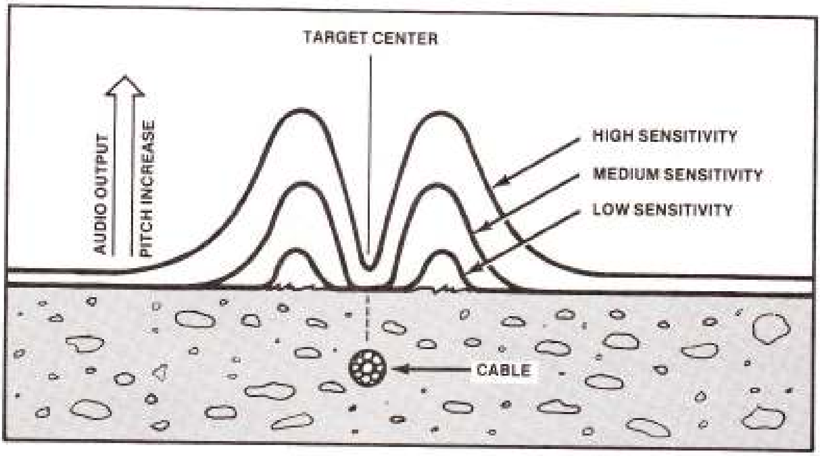


Figure 4-8. Null Shape Versus Sensitivity Setting

Tracing, Inductive Mode

Position the transmitter over the target line and turn the power switch to ON. A steady beeping will be heard that indicates the transmitter is operational. Move approximately 30 feet away from the transmitter along the suspected target line before turning on the receiver. This will ensure that the receiver is not receiving the signal through the air directly from the transmitter. Set the receiver function switch to C and adjust the sensitivity control to obtain a medium pitch signal. Hold the receiver just below the large end as illustrated in Figure 4-9.

NOTE

Do not swing the receiver. The null appears over the target only when the receiver is held in a vertical position. If it is held at an angle, the null will not indicate the true location of the target line.

Holding it in a vertical position with the sensor end close to the ground, move it back and forth across the line. Readjust the sensitivity until a sharp null (minimum pitch) is obtained. The null occurs directly over the line. As you move away from the transmitter the sensitivity level will have to be increased.

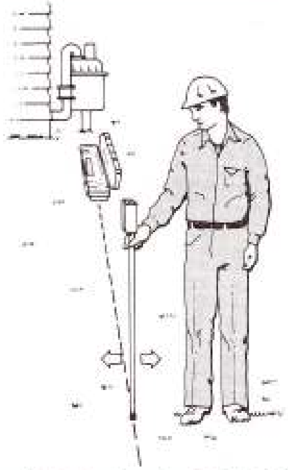


Figure 4-9. Inductive Mode Tracing

Tracing, Conductive Mode

In this mode the transmitter is physically connected to an exposed conductive section of the target line using the conductive cable assembly and the ground stake. After the two clips are connected to the line and to the ground stake (good electrical contacts are essential), the procedure for using the transmitter and the receiver is the same as for the inductive mode except that tracing can be started right next to the transmitter.

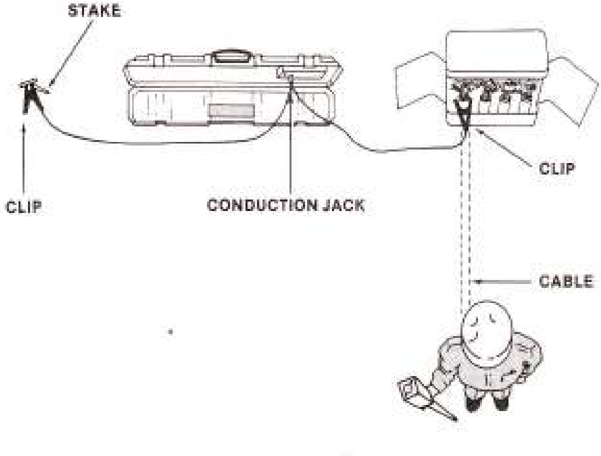


Figure 4-10. Conductive Mode Tracing

Section V
Cable Locator Application Notes

Inductive Coupling

Induction is the easiest and quickest way of applying the tracing signal to a conductor and provides a signal strong enough to trace most lines. Induction does not require access to an exposed section of the line which very often is not available. However, an induced signal is not as strong as a conductively applied signal and will fade quickly as distance from the transmitter increases when electrically poor or leaky conductors such as gas and water pipes are being traced. Any time a tracing signal is induced on a target line, the same signal will be induced on nearby utility lines which may cause some confusion when trying to identify the null.

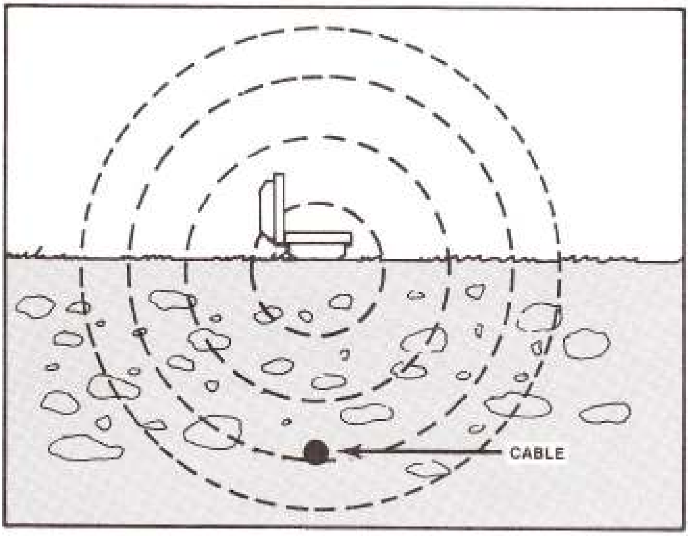


Figure 5-1. Inductive Coupling Setup

Conductive Coupling

This is the most reliable way of applying the tracing signal. A good electrical contact between the clip and the conductive portion of the target line is essential. If necessary, use a file to clean off rust or paint to ensure a good electrical connection. Electrical contact must also be made to the ground using the supplied stake. For the best results, drive the stake into the ground as far off to the side of the line as the connecting cable will permit. (See Figure 5-2)

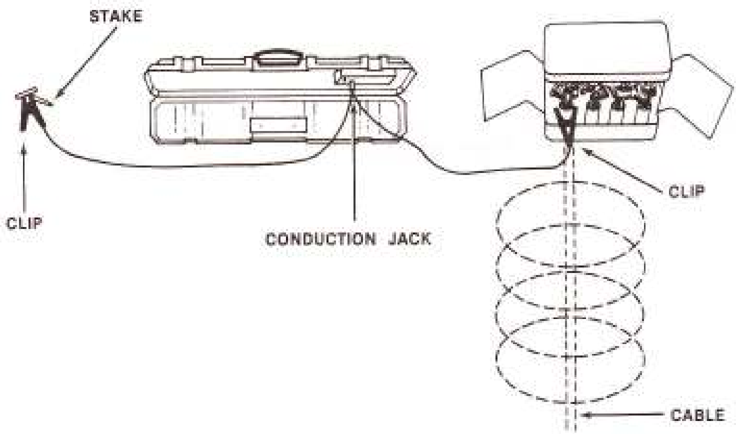


Figure 5-2. Conductive Coupling Setup

Dealing with Clutter Signals

When operating in the inductive mode, an effective method of reducing interference caused by parasitic signals from an adjacent line is to find a second spot on the line that has a good clean null (equal strength lobes on both sides). Move the transmitter to this spot. Confirm that this is the target line by back-tracking with the receiver to the first site of the transmitter and checking for a null. This procedure of leapfrogging the transmitter is also the standard method for extending the tracing range on electrically poor or leaky lines.

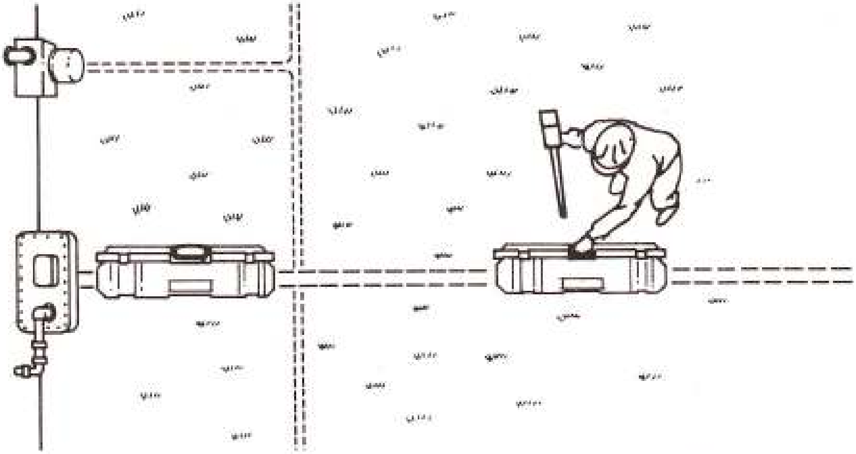


Figure 5-3. Repositioning Transmitter to Reduce Interference

Single-Lobe Identification

A second line parallel to the line being traced will emit a parasitic signal but at a reduced strength. Interaction of these signals results in unequal side lobes, which cause a large null off to one side of the target line as indicated by signal pattern curve A in Figure 5-4. To accurately trace a line under this condition will require practice. An alternate method is to hold the receiver in a horizontal position perpendicular to the line and listen for a single high pitch audio signal that occurs directly over the line as indicated by signal pattern B.

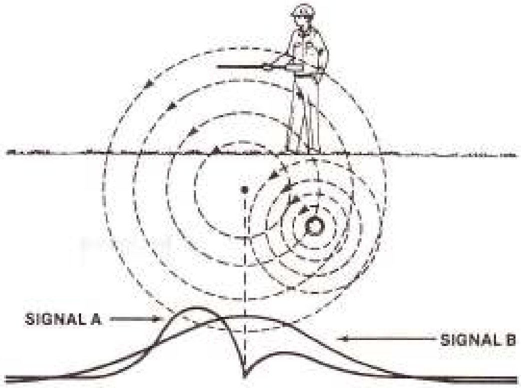


Figure 5-4. Single Lobe Identification Technique

Bends and Junctions

A variation of the two-line, single-lobe identification problem just described occurs when the line being traced has a bend or junction. As the receiver is brought near a bend or junction, the tracing signal becomes difficult to interpret. When this occurs, walk a 20-foot circle around the spot where the signal becomes confusing to detect the null that will indicate the line's new direction. However, to be certain that it is the new direction and not a junction, complete the circle to check for a second null that will indicate if the line has a branch.

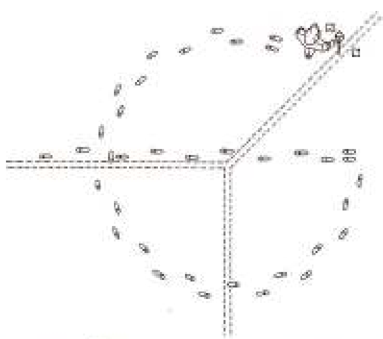


Figure 5-5. Identification of Bends and Junctions

Signal Spreading

Target lines that are poorly insulated from ground such as gas pipes, water pipes and anode strings may cause signal spreading to occur over long distances from the transmitter, even when using the conductive mode. This condition is prevalent when ground water is present. The signal also spreads to nearby lines and into the soil itself. When this situation is encountered, the transmitter must be moved closer to the section of the line to be traced and the conductive mode used if possible.

Signal spreading can also occur even when lines are well insulated. The tracing signal can travel into buildings via the ground or the shield of a line and transfer to the shields of other lines leaving the building. Signal spreading can be minimized by placing the transmitter as far as possible from the building.

Magnetic Locator Function

The MAC-51B has a unique feature designed to help the operator unscramble underground clutter. It is the option of switching to the magnetic mode for a second indication of what category of targets are in the immediate vicinity. In this mode cast-iron water and gas pipes can be readily identified and even classified as to type by the conventional spacing of joints. Power mains and some 60 Hz service drops can also be identified by a burbling sound that peaks when the receiver is directly over the power line. As the operator becomes more familiar with the MAC-51B System, switching between the M and C functions when clutter is encountered will become an invaluable tracing aid.

Isolators and Signal Path Continuity

The tracer current must travel in a closed loop. When it leaves the line being traced, it loops back, one way or another, to the beginning of the line. If the current cannot complete its loop the locating system will not operate. The operator should be aware of this system requirement when tracing lines that have electrical isolators installed.

Electrical isolators are sometimes placed in a gas line at the meter to provide an electrically open circuit which stops the flow of galvanic current and reduces corrosion. To inductively excite this type of line by placing the transmitter close to the meter, a shorting wire must be placed on the pipe to bypass the isolator. This allows the tracer current to return to the pipe through the earth ground of the building. An alternate method is to move the transmitter down the line a few yards away from the building to a point where the gas pipe riser provides a current return path.

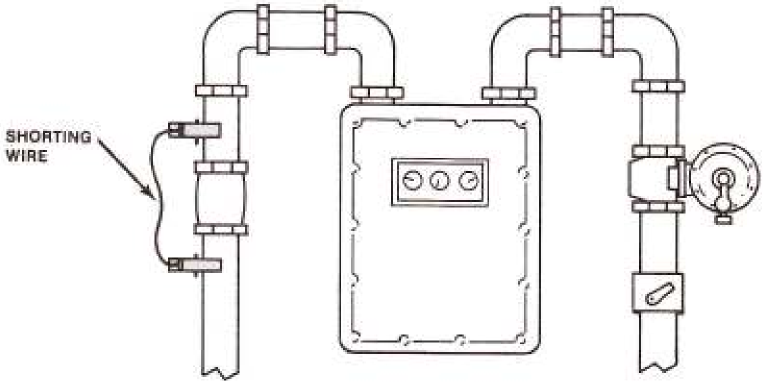


Figure 5-6. Gas Line Isolator Bypassed with Shorting Wire

Isolators and Inductive Excitation

Electrical isolation sometimes occurs inadvertently on phone cables entering a pedestal because the cable's shield is not grounded. In most jurisdictions, grounding the shield inside the pedestal is not required unless the cable shares a trench with power cables. If there is no ground wire, it is recommended that a wire and clips, as shown in Figure 5-7, be connected from the cable shield to the pedestal before using the inductive mode to excite the target cable. This will greatly improve the strength of the inducted tracing signal.

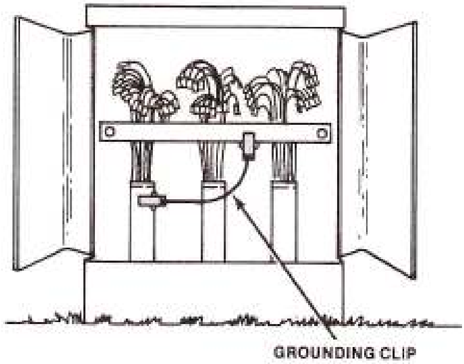


Figure 5-7. Pedestal with Grounding Clip Installed

Isolators and Conductive Excitation

When using the conductive mode to trace a phone cable from a pedestal, electrical isolation of the shield is an advantage. If a ground wire is providing a good path from the shield to earth ground through the pedestal, the trace current will use it to complete the return loop to the transmitter grounding stake instead of going down the target line. So if there is a ground wire in place, disconnect it from the pedestal before connecting the conductive cable clip to the shield to ensure that a strong tracer current is applied to the cable.

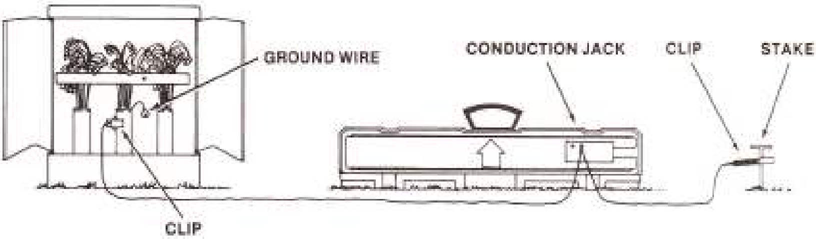


Figure 5-8. Pedestal with Groundwire Removed

Determining Target Depth by Triangulation

The receiver can be used in the traditional triangulation method to determine the approximate depth of a target as illustrated in Figure 5-9. However, when using this method it is necessary to take into account the fact that the center of the cable-sensor is located 11 inches up the receiver tube from the black tip.

When the position of the target has been determined by the null, mark the spot (#1) on the ground. Hold the receiver tip on the ground at this spot, slant the instrument at a 45° angle and slowly move directly back, to one side, from the target until a second null is obtained. Now mark a spot (#2) on the ground that is directly below a point 11 inches up the receiver tube from the black tip. Measure the distance between spot # 1 and spot #2. This measurement indicates the approximate depth of the target.

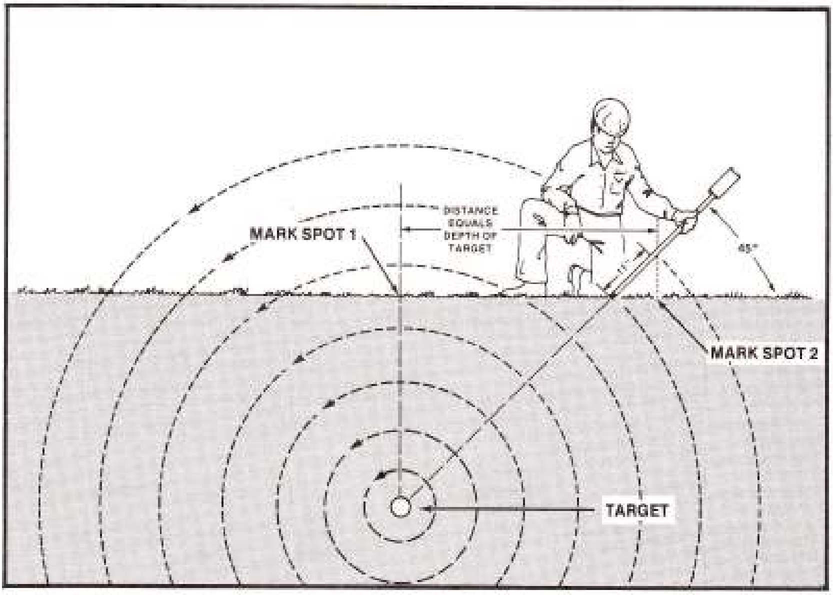


Figure 5-9. Determining Approximate Depth of Target

NOTE

Depth readings should be taken on both sides of the line at a spot where the lobes have the same signal strength. This procedure will help reduce any error in depth estimation caused by a distorted tracing signal due to interference.

Section VI
Maintenance

The MAC-51B system is built to give trouble-free operation. Normally, maintenance is limited to the occasional replacement of batteries. In the event that a malfunction does occur, refer to the appropriate trouble-shooting guide on page 6-4. They list a few possible problems that can generally be corrected in the field so that you will be able to continue using the locator without interruption.

Replacement of Receiver Batteries

The receiver is powered by four C-cell batteries carried in a battery holder illustrated in the exploded view of the electronic assembly. Access to the batteries is obtained by removing the two knurled nuts and sliding off the cover.

The four batteries are connected in series. The proper polarities for the batteries are shown on the battery holder. **Batteries must be removed and installed as shown in Figure 6-2.**

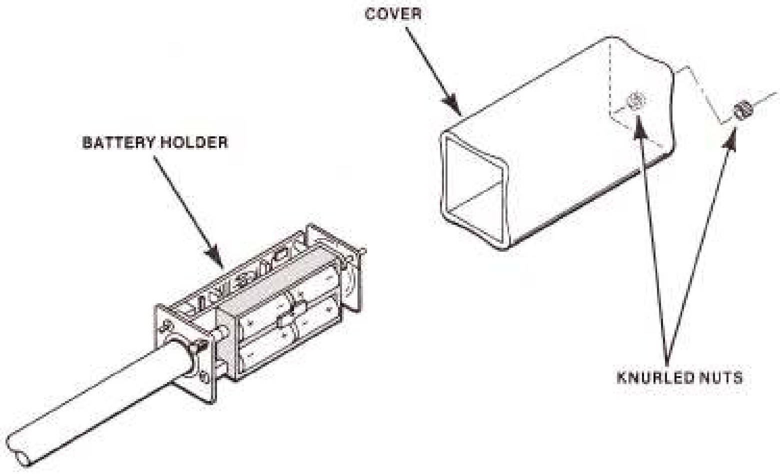


Figure 6-1. Exploded View of Receiver Electronic Unit

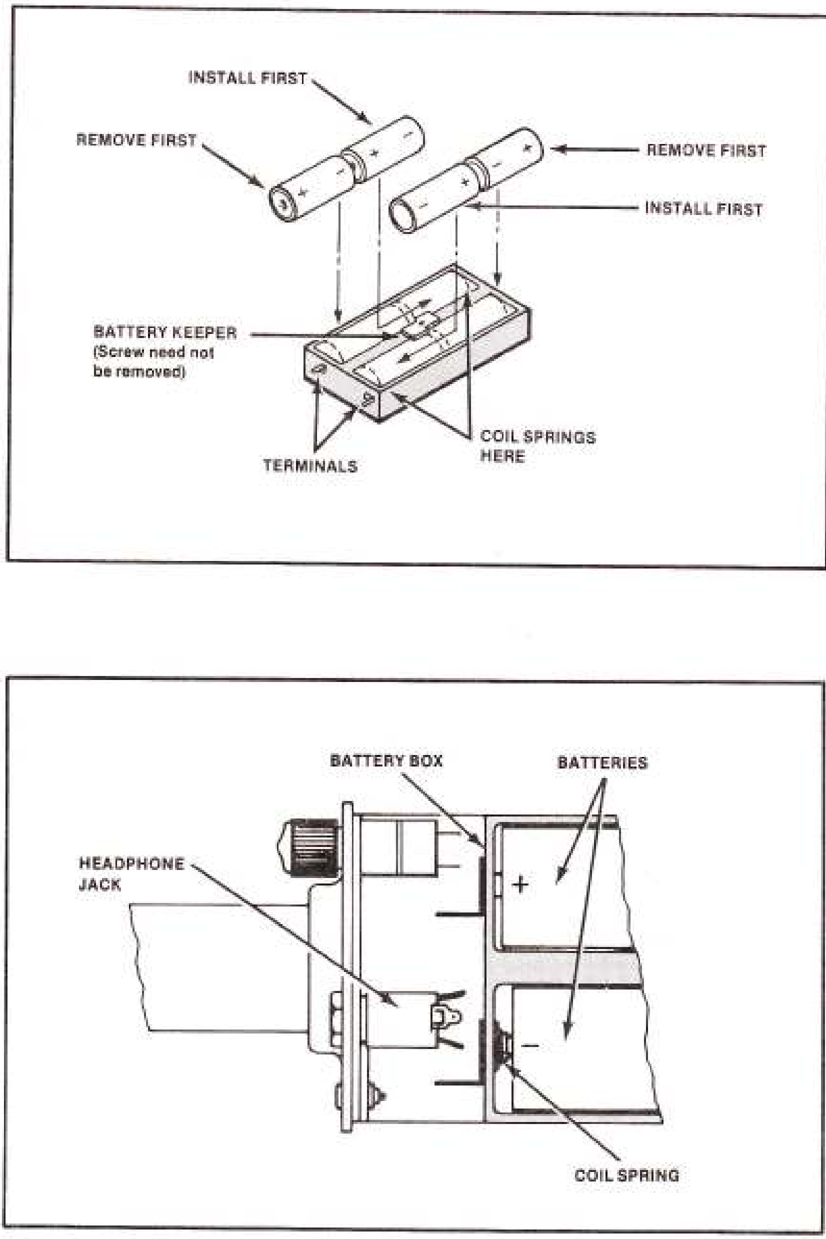


Figure 6-2. Replacement of Receiver Batteries

Replacement of Transmitter Batteries

The transmitter is powered by eight C-cell batteries located in a battery holder. Access to the batteries, as illustrated in Figure 6-3, is obtained by removing the two knurled nuts, the battery holder cover, and the spare battery holder. The eight batteries are connected in series. The proper polarities for the batteries, their removal, and installation sequence are indicated below. **Batteries must be removed and installed in the order shown.**

In very cold weather, alkaline batteries should be used.

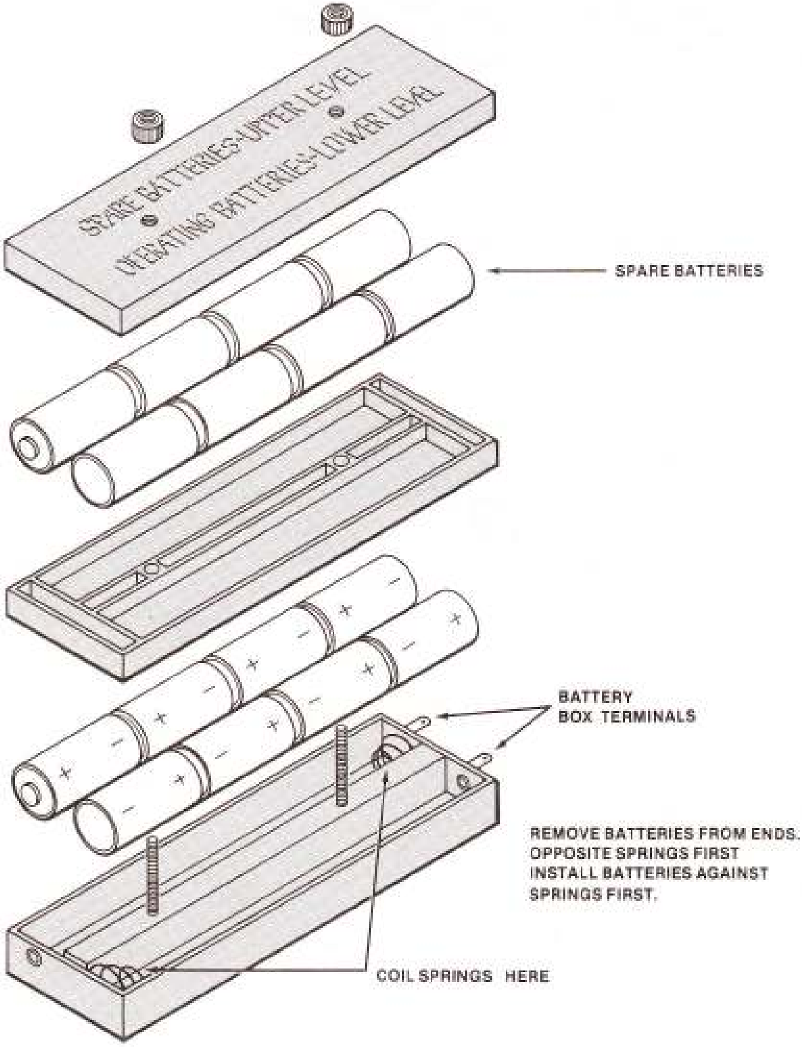


Figure 6-3. Replacement of Transmitter Batteries

RECEIVER TROUBLESHOOTING GUIDE

Symptom	Possible Cause	How to Check	How to Fix
Dead	Dead Batteries.	Replace.	Replace.
	Batteries not making contact.	Check for contact corrosion.	Clean Contacts.
	Broken Wires.	Visually inspect.	Resolder.
Intermittent	Batteries not making good contact.	Check for corrosion.	Clean Contacts.
No sound	Speaker terminals shorted to cover.	Visual.	Bend terminals.

TRANSMITTER TROUBLESHOOTING GUIDE

Sympton	Possible Cause	How to Check	How to Fix
No Sound	Dead Batteries.	Replace.	Replace.
	Batteries not making contact.	Check for contact corrosion.	Clean Contacts.
	Broken wires.	Visually inspect.	Resolder.
Intermittent Sound	Batteries not making contact.	Check for corrosion.	Clean contacts.

Service Information

If your locator needs service, you may return it to the dealer from which it was purchased or return it to the factory along with the following information: Name, Address, Where Purchased, Date and Description of Trouble(s).

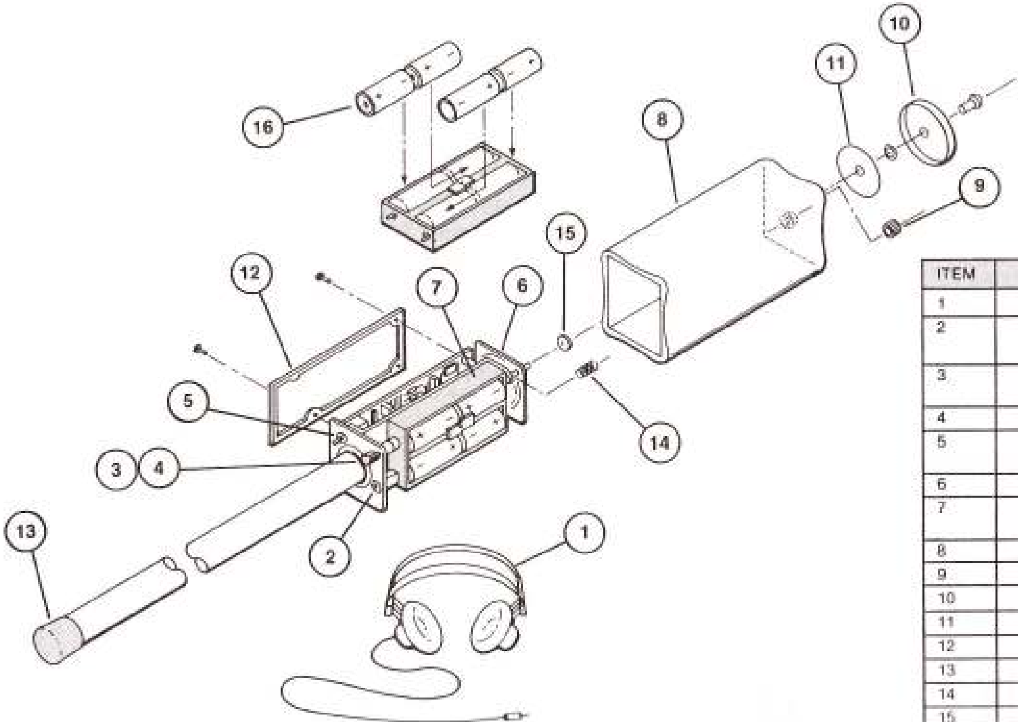
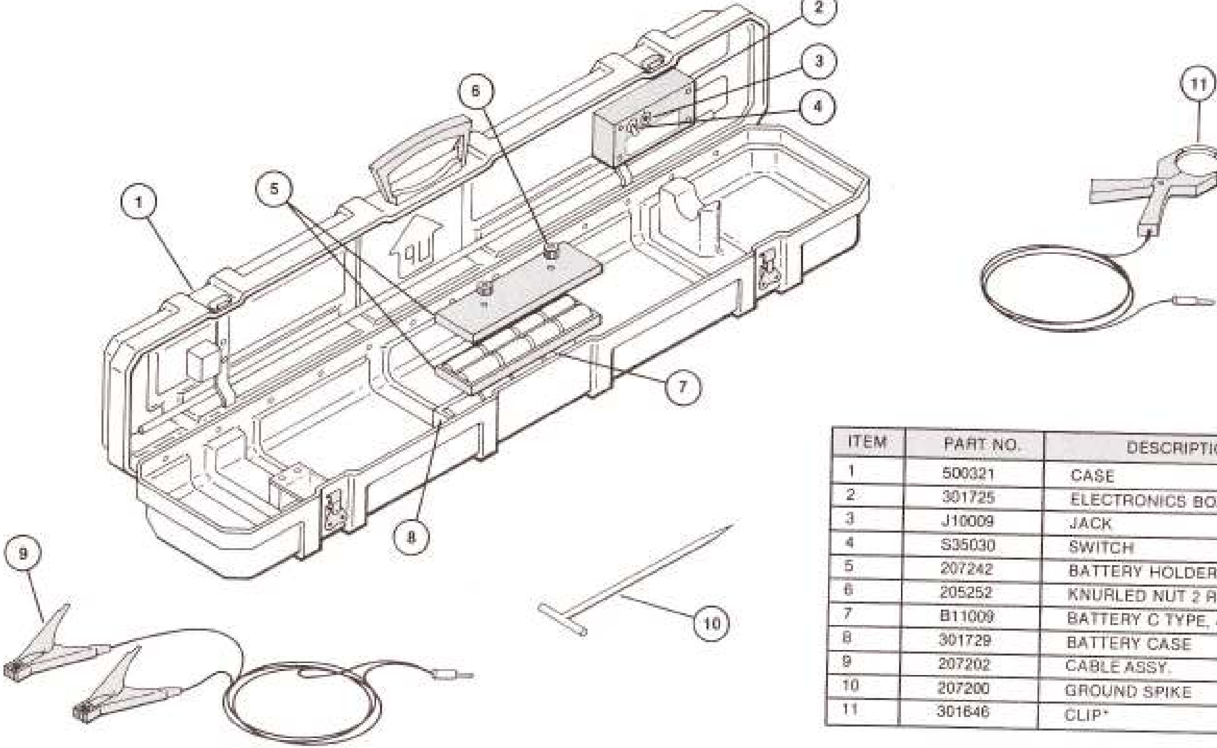


Figure 6-4. MAC-51B Receiver Repair Parts

ITEM	PART NO.	DESCRIPTION
1	H30005	HEADSET*
2	207245	PHONE JACK J10012 WITH WIRES
3	207179	SENSITIVITY CONTROL S35065 WITH WIRES
4	K20011	KNOB
5	207269 B55004	OPTION SWITCH BUSHING BUSHING EXTENDER
6	206003	SPEAKER MOD.
7	207173	BATT. HOLDER AND CHASSIS ASSY.
8	207271	COVER
9	K20021	KNURLED NUT (2 REQ'D)
10	207215	CAP
11	202006	SCREEN
12	301655	PROTECTOR
13	T60003	TIP
14	S56002	SPRING (2 REQ'D)
15	R40016	"O" RING (2 REQ'D)
16	B11009	BATTERY ("C" SIZE, 4 REQ'D)

*OPTIONAL



ITEM	PART NO.	DESCRIPTION
1	500321	CASE
2	301725	ELECTRONICS BOX
3	J10009	JACK
4	S35030	SWITCH
5	207242	BATTERY HOLDER
6	205252	KNURLED NUT 2 REQ'D
7	B11009	BATTERY C TYPE, 4 REQ'D
8	301729	BATTERY CASE
9	207202	CABLE ASSY.
10	207200	GROUND SPIKE
11	301646	CLIP*

*OPTIONAL

Figure 6-5. MAC-51B Transmitter Repair Parts

WARRANTY

The Schonstedt Instrument Company warrants each instrument of its manufacture to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for this purpose and to replace any defective part thereof. Batteries, lamps and fuses are specifically excluded under this warranty. This warranty is effective for one year after delivery to the original purchaser. As a condition of this warranty, the instrument must be returned by the orginal purchaser, transporation charges prepaid, and prove to our satisfaction to be defective. If fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. Prior to repair in this instance, a cost estimate will be submitted.

Service or shipping information will be furnished upon notification of the difficulty encountered. Model and serial number must be supplied.