AVO INTERNATIONAL

Instruction Manual AVTM651070

for

L1070 and L1071 Portable Locator

Catalog No. 651070 and 651071

High Voltage Equipment
Aparato de Alto Voltaje

Read the entire manual before operating.
Antes de operar este producto lea este manual enteramente.

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(215) 646-9200

L1070 and L1071
Portable Locator
Instruction Manual

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Introduction

Receiving Instructions

Check the equipment received against the packing list to ensure that all materials are present. Notify AVO International of any shortage. Telephone (215) 646-9200 and ask for the customer service department.

Examine the instrument for damage received in transit. If damage is discovered, file a claim with the carrier at once. Prepare a detailed description of the damage and notify AVO International.

This instrument has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as indicated in this manual.

General Information

Thanks for purchasing the BIDDLE® L1070 or L1071 Portable Locator. The portable locator will help you locate and trace the routes of buried power cables, cable television cables, gas and water pipes, sewer lines, telephone cables, and fiber-optic cables. When used with the accessory ground return probes, the portable locator will pinpoint faults on most direct buried secondary cables and some direct buried primary cables.

The transmitter transmits a special signal on the cable under test. The receiver receives the signal and indicates how strong it is. Microprocessors in both units process the information and allow you to determine the path of the underground cable.

Supplied Components

1. Receiver unit
2. Transmitter unit
3. Red/black test cord
4. Instruction Manual AVTM651070
5. Eight 1.5 V D-size batteries (for L1070 nonrechargeable transmitter only)
6. Six 1.5 V C-size batteries
7. Ground rod
8. Ac battery charger (for L1071 rechargeable transmitter only)
9. Carrying case

Options

1. Ground return probe
2. Carrying case for the ground return probe
3. Flexible coupler
4. Dc battery charger (automotive)

Preparation for Use

Remove the receiver from the case. Locate the battery compartment. Install the six 1.5-V C-size batteries as marked on the battery holder. Install the battery cover and tighten the retaining screw.

Remove the transmitter from the case. Locate the battery compartment on the bottom of the transmitter. Remove two screws from the battery compartment door. Install the eight D-size batteries as marked on the battery holder. Install the battery cover and tighten the two retaining screws.

Section 2
Safety

Precautions

The L1070 and L1071 Portable Locators and the recommended operating procedures have been designed with careful attention to safety; however, it is not possible to eliminate all hazards from electrical test equipment or to foresee every possible hazard that may occur. It is therefore essential that the user, in addition to following the safety rules in this manual, also carefully consider all safety aspects of the test before proceeding. Safety is the responsibility of the user.

Use suitable barriers, barricades, and warnings to keep people not actually engaged in the test at a safe distance. Make sure that no one can make contact with energized parts of the test equipment and the specimen under test.

Treat all terminals of power equipment as a potential electric shock hazard. There is always the possibility of voltages being induced at these terminals because of proximity to energized high-voltage lines or equipment.

Always turn the transmitter power off before touching any terminals.

Always disconnect test leads from the cable under test before attempting to disconnect them from the portable locator.

Never connect the test leads to a cable that does not have a safety ground strap in place. Never disconnect the test leads from a cable that does not have a safety ground strap in place. The safety ground connection must be the first made and the last removed. Any interruption of the grounding connection can create an electric shock hazard.

Observe all safety warnings marked on the equipment. These warnings identify areas of immediate hazard which could result in personal injury or loss of life.

Do not use this equipment to fault locate on any cable which is likely to be near enough to an energized cable to allow a burn through of the insulation of the energized cable. This situation may occur when the cables are located in a common trench, duct or tray (for example, three-phase systems).

Do not operate the equipment with protective covers removed. Operation without the protective covers presents an electric shock hazard.

Use all practical safety precautions to prevent contact with energized parts of the equipment and related circuits.

Use the recommended grounding and connection procedures. Make sure that the equipment is grounded properly. Any interruption of the grounding connection can create an electric shock hazard.

Refer to IEEE 510-1983 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing" for additional information.

Do not use the portable locator or its accessories with any device or for any purpose other than as specifically described in this manual. Misuse of this equipment can be extremely dangerous.

Never connect the portable locator to energized equipment.

Do not use in an explosive atmosphere.

The L1071 Portable Locator uses rechargeable batteries. Replace only with sealed lead-acid batteries as specified in Section 3, Specifications. Danger of explosion can result if the wrong batteries are used.

If the portable locator is operated in accordance with the safety precautions described, and if all grounds are correctly made, rubber gloves are not necessary. As a routine safety procedure, however, some users require that rubber gloves be worn, not only when making connections to the high-voltage terminals but also when manipulating controls. AVO International considers this an excellent safety practice.

Users of high-voltage equipment should note that high-voltage discharges and other sources of strong electric or magnetic fields may interfere with the proper operation of heart pacemakers. Personnel having heart pacemakers should obtain expert advice on possible risks before using this equipment or being close to equipment while it is in operation.

Warning and Caution Notices

Warning and caution notices are used throughout this manual where applicable. These notices appear in the format shown below and are defined as follows:

WARNING
Warning, as used in this manual, is defined as a condition or practice which could result in personal injury or loss of life.

CAUTION
Caution, as used in this manual, is defined as a condition or practice which could result in damage to or destruction of the equipment or apparatus under test.

Section 3
Specifications

Receiver

Operating frequency:	82.315 kHz (RF), 815 Hz (AF). 50/60~(PASSIVE)
Antenna mode:	Null-responding vertical coil Peak-responding horizontal coil
Audio indication:	Variable pitch response on all frequencies.
Current measurement	Display indicated relative current simultaneously between any two selected cables for target cable verification in a multi-conductor environment.
Operating and storage temperature range:	-4°F to 133°F (-20°C to +55°C)
Battery type:	Six 1.5 V, C-size alkaline
Battery life:	Continuous: 40 hr Intermittent: 82 hr (automatic shutoff after 10 min of nonuse)
Dimensions:	30.3 x 3.7 x 9.4 in. (76.9 x 9.3 x 23.8 cm) (L x W x H)
Weight:	3 lb (1.36 kg)
Signal strength:	Analog LCD bar graph. Absolute Digital Signal Strength readout from 0 to 999.
Gain control:	Up/down button for automatic centering and manual control.
Dynamic range:	126 dB
Depth measurement	
Automatic:	Push-button, three-digit readout to 15 ft (4.6 m) in feet-inches. (optional m-cm)
*Accuracy	
815 Hz:	±(1-6)% under normal conditions ≤5 ft (1.5 m)
82.315 kHz:	±(5-12)% under normal conditions ≤5 ft (1.5 m)
Manual:	Bubble-level triangulation for verification of automatic readout in congested environments.

*Depending upon site conditions, nonconcentric conductor shape, number of nearby conductors, and soil return currents.

Transmitter

Operating frequency:	82.315 kHz (RF), 815 Hz (AF), and BOTH Simultaneous indicators LOADING, LOW BAT, Low Bat warning modulated on output signal every 20 sec.
Load matching:	Automatic from 5 to 2000 Ω

Output power:	**Normal**	**High**
815 Hz(AF)	0.6 W	2.0 W
82.315 kHz(RF)	0.2 W	1.0 W
BOTH	0.12 W(AF)+.06 W(RF)	1.33 W(AF)+0.67 W(RF)

Battery type:

Disposable (used in L1070 Portable Locator transmitter)

Eight 1.5 V, D-size alkaline

Rechargeable (used in L1071 Portable Locator transmitter)

One 12 V, 7 Ah maintenance-free, sealed lead-acid

Battery life:

Disposable

Continuous	8 to 15 hr depending on load, frequency & power setting
Intermittent	40 to 60 hr depending on load, frequency & power setting. 25% duty cycle average

Rechargeable

Continuous	10 to 20 hr depending on load, frequency & power setting.
Intermittent	50 to 70 hr depending on load, frequency & power setting. 25% duty cycle average.

Operating and storage temperature range:	-4°F to +133°F (-20°C to +55°C).
Dimensions:	16 x 6.32 x (5-6) in. (40.6 x 16 x (12.7-15.2) cm) (L x W x H)
Weight:	8 lb (3.6 kg) with disposable alkaline cells 11.5 lb (5.2 kg) with rechargeable sealed lead-acid cells

Battery Charger

Ac battery charger (included with L1071 Portable Locator) charges battery overnight

Input:	120 V ac
Output:	12 V dc @ 500 mA
Output cord:	6 ft (1.82 m) with 2.5 mm x 5.5 mm female power connector

Dc battery charger (available as an option with the L1071 Portable Locator)

Charge rate:	1.0 ±10% A
Automatic cut-off:	14.1 V
Input:	10/15 V dc — negative ground
Input cord:	4 ft (1.2 m) with vehicle cigarette lighter adapter plug with 3 A, fast-blo fuse
Output cord:	12 ft (3.6 m) with 2.5 mm x 5.5 mm coaxial power plug
Dimensions:	4.25 x 3 x 1.75 in. max (L x W x D)

Observe the following precautions when using the dc battery charger.

CAUTION

Not recommended for batteries with less than 2.5 Ah capacity.

Do not use on damaged or shorted batteries.

Allow for air circulation around charger case. Do not cover.

Do not use if circuit is exposed to moisture.

Disconnect immediately if batteries get hot.

Section 4
Transmitter Operation

Controls and Indicators (Fig. 1)

Follow all safety precautions in Section 2 of this manual.

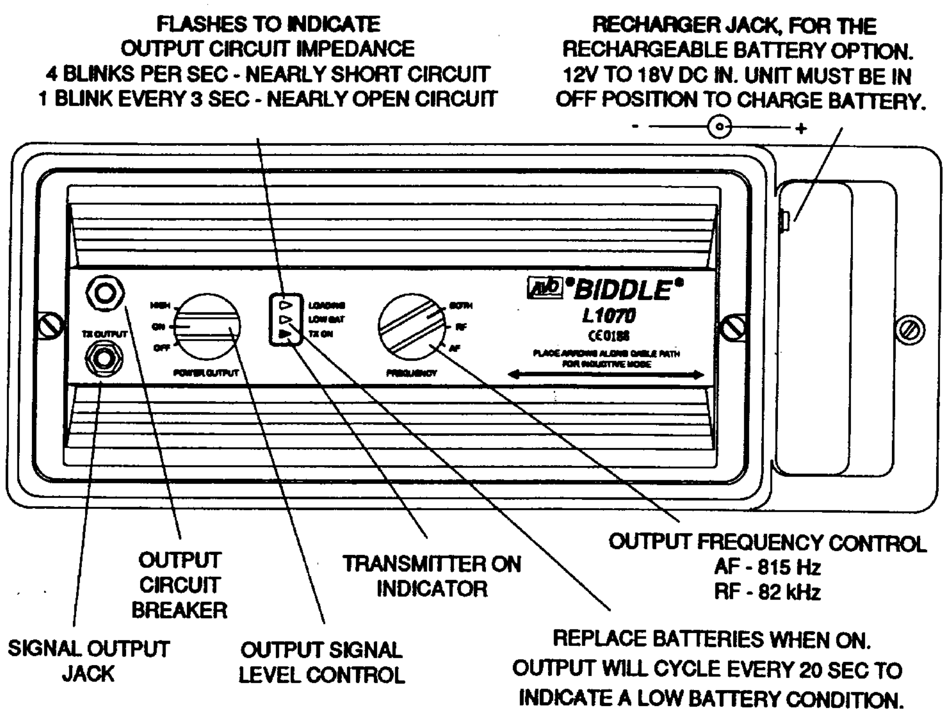

Figure 1: Transmitter Controls and Indicators

Selecting the Locating Method

Identify the application below that matches your job, and then select the locating method. Although the first method listed under each heading will produce results with the simplest connections, we recommend that you use direct connection whenever possible.

WARNING
Never connect the test set to energized equipment.

After selecting the locating method, turn to the page that tells you how to connect the equipment. For the most reliable locate, we recommended that you use low power and low frequency (AF), whenever possible. Refer to the Specifications section for output power information.

POWER CABLE AND CABLE TV
Multiple Grounded Circuit
Flexible Coupler Connection
Inductive Connection
Direct Connection
Passive 50/60 Hz Locating

GAS AND WATER PIPE
Continuously Grounded Circuit
Flexible Coupler Connection
Passive 50/60 Hz Locating

TELEPHONE CABLE
Multiple Grounded Circuit
Telephone Direct Shield Connection
Telephone Direct Pair Connection
Passive 50/60 Hz Locating

FIBER-OPTIC CABLES
Multiple Grounded Telco Circuit
Inductive Connection
Telephone Direct Shield Connection
Passive 50/60 Hz Locating

NOTE: The output will cycle when the LOW BAT indicator is activated to inform you that a LOW BAT condition is present. You must use the 82 kHz (RF) high frequency setting when using the inductive connection method.

Ac Resistance Indications

The LOADING indicator on the transmitter panel blinks as follows to indicate output circuit resistance. If the LOADING indicator does not blink in the AF mode, plug in the red/black cord.

NO. OF BLINKS	CIRCUIT RESISTANCE Ω
4 blinks per sec	5 to 15 Ω circuit
2 blinks per sec	15 to 100 Ω circuit
1 blink per sec	100 to 400 Ω circuit
1 blink every 2 sec	400 to 1800 Ω circuit
1 blink every 3 sec	1800 Ω to open circuit

Transmitter Rechargeable Battery Option

If your transmitter has an optional rechargeable battery, the battery cover will extend past the main transmitter housing shell approximately 1/2 in. (1.27 cm). The recharger jack is situated near the carrying handle on the transmitter housing. To replace the sealed, rechargeable 12 V, 7 Ah lead-acid battery, remove the back cover and four nuts on each side of the battery bracket. Remove the battery, then remove the red wire and the black wire from the battery terminals by pulling off the spade connectors.

An automatic shutdown circuit protects the lead-acid battery from discharging below the safe level of 8.2 V. Reset the automatic shutdown circuit by turning the POWER OUTPUT switch OFF. When the battery voltage is discharged down to 10.5 V, the LOW BAT icon on the LCD is activated. From the time the LOW BAT icon is activated, you will have between 15 and 30 min of operating time before automatic shutdown occurs. Also, when the LOW BAT icon is activated, the transmitter output signal will cycle every 20 sec.

Recharging the Battery/External Power Pack

CAUTION
Set the transmitter POWER OUTPUT switch to OFF before you begin recharging.

Using the ac charger: A fully discharged battery can be fully charged in less than 24 hr using the ac charger. A partially discharged battery requires less recharging time. Use your judgment to decide on a reasonable recharge time. Overcharging shortens battery life.

Using the dc charger: A fully discharged battery can be fully charged in less than 5 hr using the automotive 12-V dc charger. Typically, every 10 min of charge will give you about 20 min of battery usage. Although it is possible to power the transmitter with the automotive charger, the charger will not supply enough energy to charge the battery at the same time.

Power Utility Connection

CAUTION
Turn the transmitter off before connecting or disconnecting the red and black test leads.

This method, which has a range of up to 0.5 mi (0.8 km), uses the ground points that are already exposed and available to you. Make connections as shown in Figures 2 and 3. Because you are only transmitting the signal on the grounding system, it is not necessary to disconnect the service.

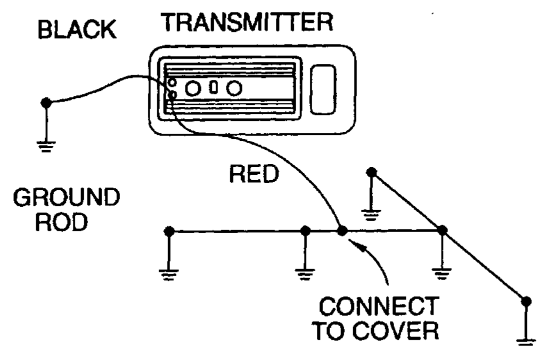

Figure 2: Multiple Grounded Circuit Connection

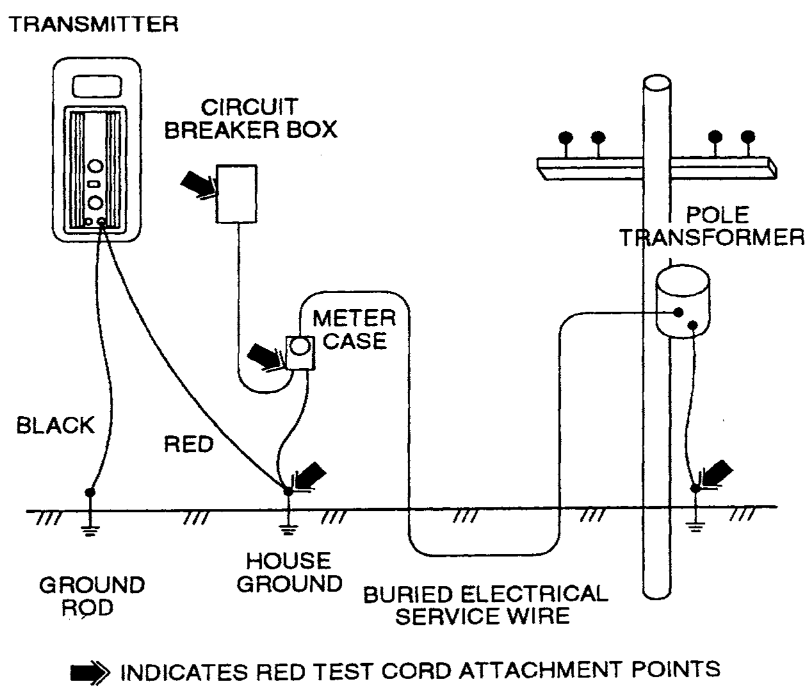

Figure 3: Multiple Ground Power Utility Application

Telco Circuit Connection

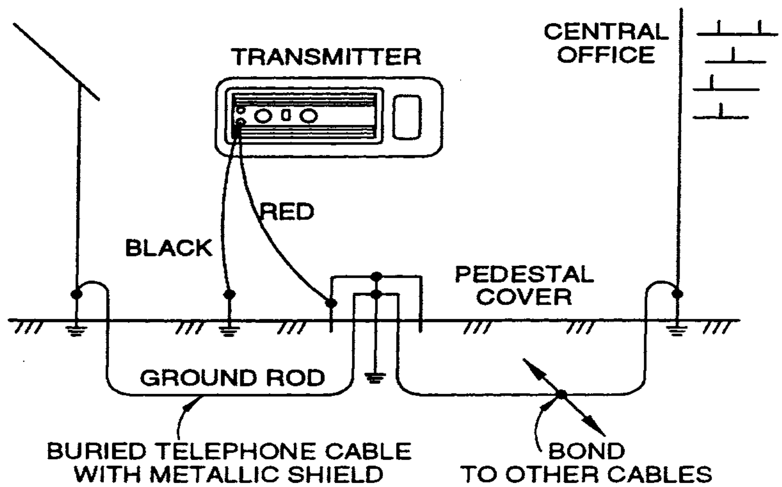

Figure 4: Multiple Ground Telco Application

Connect the red test cord to an existing ground point. Place the ground rod approximately 10 ft (3 m) from this point, at an angle of 90° to the buried cable or pipe. Drive the ground rod into the ground 8 to 10 in. (20.3 to 25.4 cm). Connect the black test cord to the ground rod.

Plug the red/black test cord into the TX OUTPUT jack. Set the FREQUENCY switch to AF. The TX ON indicator will start blinking.

Turn to the Receiver Operation section to begin locating the cable or pipe.

Flexible Coupler Connection

You do not have to interrupt service when you use the flexible coupler, but the operating range is somewhat reduced. Also, more of the tracing signal may leak to neighboring cables and pipes than in the direct connection method.

Ensure that the cable under test is insulated and grounded at both ends. Connect the flexible coupler as shown in Figure 5.

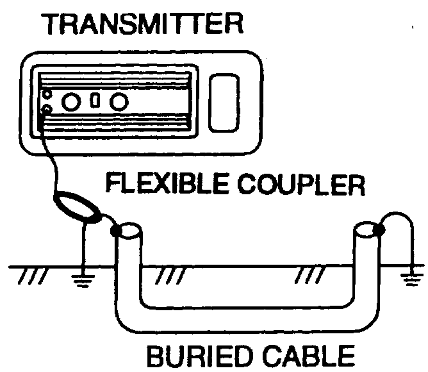

Figure 5: Flexible Coupler Connection

Start by looping the flexible coupler around the cable and connecting the two ends. It is important to connect the flexible coupler around the cable you want to trace, as shown in Figure 5. Remember that when you connect the flexible coupler around the entire cable including the ground conductor that is common to other cables, you will sacrifice some of the benefits you get when using the direct connection method. The transmitted signal in the cable under test will be weaker, the range will be shorter, and you may have trouble telling one cable from another.

Plug the flexible coupler test cord into the TX OUTPUT jack. Set the FREQUENCY switch to RF. The LOADING indicator will start blinking.

Turn to the Receiver Operation section to begin locating the pipe or cable.

NOTE: Set the switch on the flexible coupler test cord plug to the desired locate frequency (either AF or RF). Then set the transmitter FREQUENCY switch to the AF or RF position (same as flexible coupler).

Inductive Connection

This method is convenient because it does not require interruption of service. No test leads are needed. When the cable or pipe has no insulation or nonconductive coating, the operating range will be very short.

Place the transmitter on the ground as close as possible to the path of the cable or pipe. Align the arrows on the transmitter control panel at a small angle to the cable or pipe. Set the FREQUENCY switch to RF. When you turn the transmitter on, the LOADING indicator will start blinking. First locate the broad transmitter null, then move toward the expected cable path while looking for the signal carried by the cable.

Start tracing the path by placing the receiver at least 25 ft (7.6 m) away from the transmitter. Search in the 90° zone as shown in Figure 6. Locate the cable or pipe, and follow the path. When the signal received by the receiver becomes too weak after progressing along the route, move the transmitter to a location no closer than 25 ft (7.6 m) behind the receiver and continue tracing. Note that the transmitter may produce its own null when the receiver is within 25 ft (7.6 m) of the transmitter. When you cannot avoid locating the receiver closer than 25 ft (7.6 m) from the transmitter, place the transmitter at a 30° angle over the target conductor. (See Fig. 7). In this example, two nulls will be present, one transmitter null and one cable/conductor null.

Turn to the Receiver Operation section to begin locating the cable or pipe.

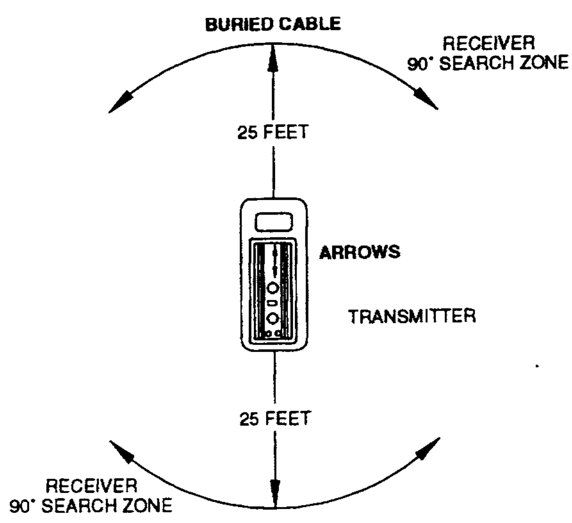

Figure 6: Inductive Connection

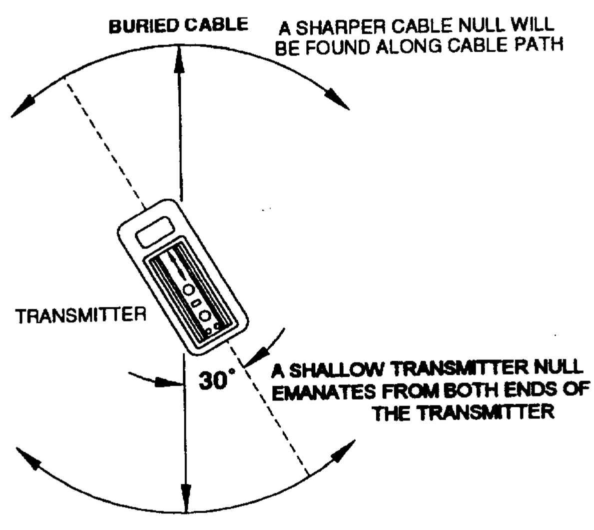

Figure 7: Inductive Connection 30° Angle

Direct Connection

WARNING
The direct-connection locating method shown in Figure 8 requires service interruption, and therefore must only be performed by authorized service technicians

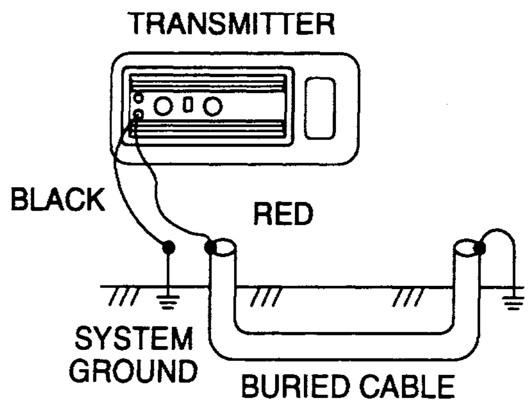

Figure 8: Direct Connection

Direct connection is the most reliable method available. It is less subject to interference, and an additional ground rod is not needed. The range of operation is up to 15 mi (24 km).

Disconnect the cable shield or neutral wire. Connect the red test cord to the cable shield or neutral wire. Connect the black test cord to the system ground, where the cable shield or neutral wire had been connected.

Plug the red/black test cord into the TX OUTPUT jack. Set the FREQUENCY switch to AF. Turn the POWER OUTPUT switch to ON. The LOADING indicator light will start blinking.

Notes on Selecting the Tracing Signal

Because the AF and RF signals have their individual advantages, you can use them in sequence to produce the highest locating success. Begin by selecting the AF signal, and continue using it as long as you are confident in the results. If the signal suddenly becomes very weak, disappears, or takes an unexpected turn, change to the RF signal to correlate your results.

You will probably find that you prefer the AF signal because it is much less susceptible to errors caused by nearby interfering cables or pipes. You can expect the AF signal to travel much farther than the RF signal, for most applications. Unlike the RF signal, however, the AF signal will not travel through disconnected shield bonds and insulated pipe bushings.

The RF signal is better for "jumping" disconnected shield bonds and grounds and for operating more reliably near concrete reinforcing bar. Also, the RF frequency is sometimes better than the AF frequency for locating sharp corners in cables or pipes.

Sudden changes in the tracing signal may be caused by one of the impediments described above. Because the RF signal tends to leak away from the target cable, its locating range is much shorter. Of course, AF is also useful for applying a signal using the flexible coupler. See Figure 5.

Turn to the Receiver Operation section to begin locating the cable or pipe.

Continuously Grounded Circuit

The locating range for bare uninsulated cable and pipe is typically 300 ft (91.4 m). If the locating range on a particular pipe seems unusually short, there may be an insulating bushing in the buried pipe. Try to bypass the insulated bushing by connecting the transmitter to a location on the pipe that is past the bushing.

For pipe — connect the red test lead to the shutoff valve wrench surface or union fittings near the gas or water meter. For cable — connect the red test lead to any point on the bare neutral. See Figure 9.

Place a ground rod approximately 10 ft (3 m) from this point, along a line that is perpendicular to the buried pipe or cable. Insert the ground rod 8 to 10 in. (20.3 to 25.4 cm) into the ground. Connect the black test cord to the ground rod.

Plug the red/black test cord into the TX OUTPUT jack. Set the FREQUENCY switch to AF. The LOADING indicator light will start blinking after the transmitter is turned on.

Turn to the Receiver Operation section to begin locating the cable or pipe.

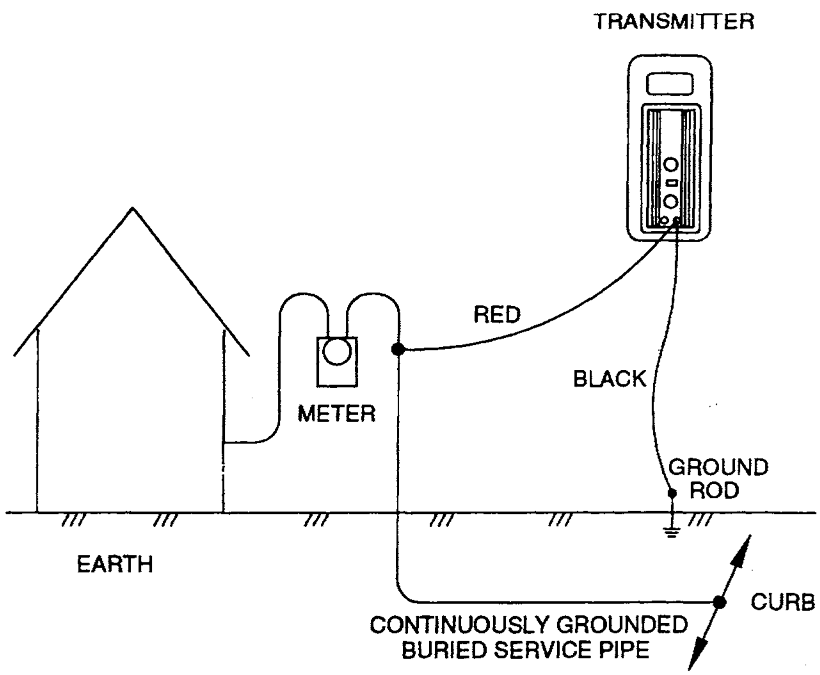

Figure 9: Continuously Grounded Circuit

Telephone Direct Shield Connection

We recommend this method for telephone service because there is usually a ground lug available for making connections, and damage to the cable is unlikely. This method provides reliability, and you do not have to interrupt service. However, all connections must be made by either an authorized telephone company employee or an authorized locator contractor. Readings may be confusing if several cable shields are bonded together.

Disconnect the shield from the system ground. Connect the red test cord to the cable shield. Connect the black test cord to the telephone pedestal or previous shield attachment point. See Figure 10.

Plug the red/black test cord into the TX OUTPUT jack. Set the FREQUENCY switch to AF. The LOADING indicator will start blinking when the transmitter is turned on.

Turn to the Receiver Operation section to begin locating the cable or pipe.

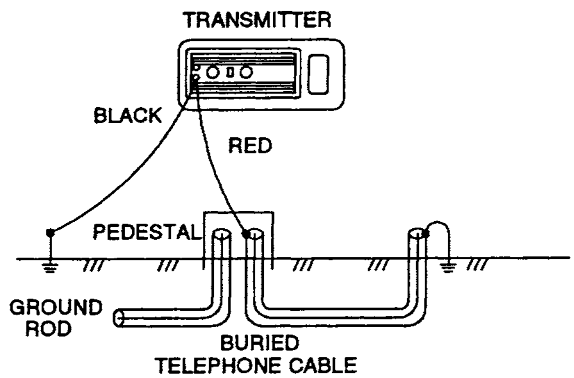

Figure 10: Telephone Direct Shield Connection

Telephone Direct Pair Connection

NOTE: This method will not work with a floating ground ESS #5 office.

Because service is disconnected during the tracing operation, this method requires that either a telephone company employee or other authorized contractor make the connections. You can expect to obtain highest quality results, which more than justifies the extra preparation time and effort.

Connect the red test cord to one of the wire pairs in the cable you want to trace. Do not use insulation piercing clips. Connect the black test cord to the system ground at any convenient point. See Figure 11.

Plug the red/black test cord into the TX OUTPUT. Set the FREQUENCY switch to AF. The LOADING indicator will start blinking when the transmitter is turned on. Proceed to locate with the receiver toward the central office.

Turn to Receiver Operation section to begin locating the cable or pipe.

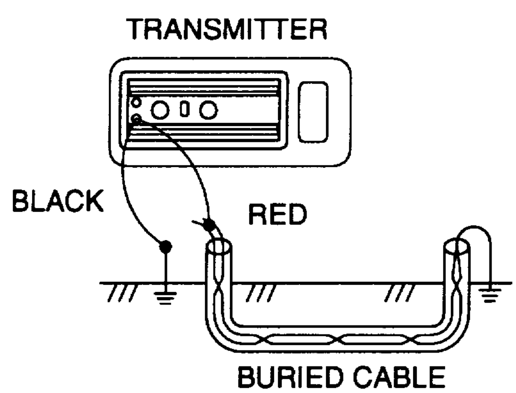

Figure 11: Telephone Direct Pair Connection

Section 6
Receiver Operation

Controls and Indicators

Figure 12 shows the controls and indicators on the receiver.

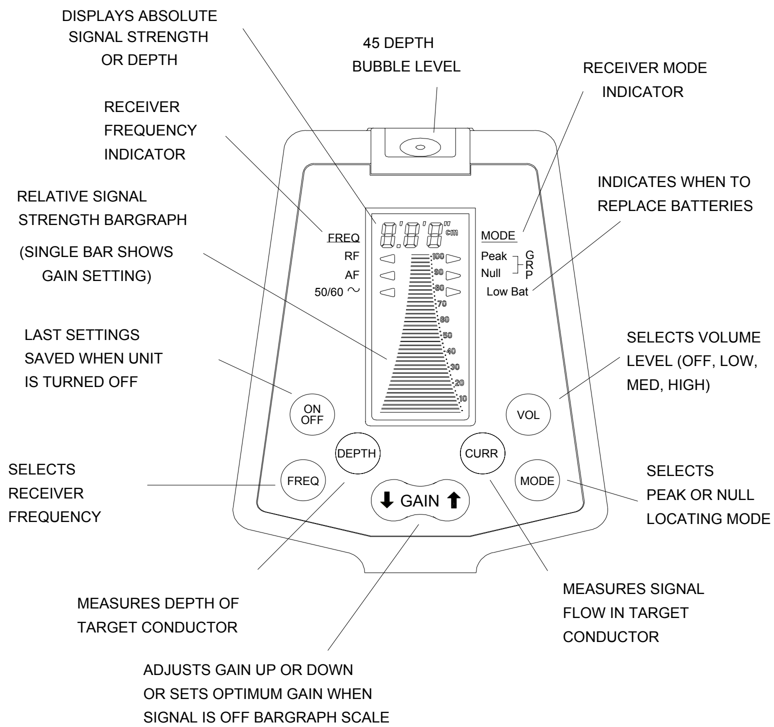

Figure 12: Receiver Controls and Indicators

Locating Cable or Pipe

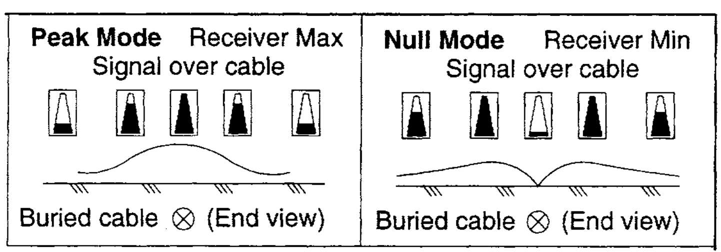

Figure 13: Locating the Cable or Pipe

Make sure that the transmitter is solidly connected to the cable or pipe and turned on. Move about 15 ft (4.6 m) away from the transmitter along the path. For the inductive search method, move about 25 ft (7.6 m). Hold the receiver so that you can see the LCD bar graph and controls easily. Make sure the receiver and transmitter frequency are both set for the same frequency (AF or RF). Press the MODE button to select the desired Peak or Null locating mode.

Peak Mode Locating

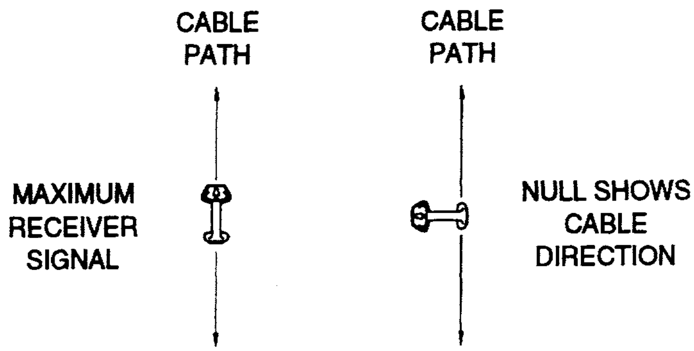

Figure 14: Determine Cable Path in Peak Mode

Keep the receiver approximately vertical. While you are walking along the path of the target cable or pipe, with the receiver in the Peak mode, gently swing the receiver across the path. When the receiver is directly above the cable or pipe, all indicators will be at a maximum. You might occasionally rotate the receiver slightly to confirm that you receive a maximum signal when you are directly over and in line with the target cable (see Fig. 13). As you swing the receiver away from the cable path, the digital strength readout, the relative strength bar graph, and audio frequency response will all drop off. If you rotate the receiver about 90° while over the cable, a sharp null will identify the cable direction, which will be aligned with the flat side of the receiver.

Trace the path by observing the peak indications while walking away from the transmitter at a moderate pace.

As you trace the path in a direction away from the transmitter, the Peak meter reading will slowly fade. Press and release the GAIN buttons as needed to compensate for losses in Peak signal level. If the Peak meter reading suddenly changes in level (higher or lower), you may have found one of the following:

a. A junction where the signal divides (lower)
b. A break in the cable or shield (lower)
c. A change in depth of the cable or pipe (higher or lower)
d. An insulated pipe fitting (lower)
e. A slack loop of cable (lower)

If you can no longer trace the path, even with the gain set to maximum, connect the transmitter to the far end of the cable, and trace back to the point where you lost the signal.

Mark straight sections of the path every few feet. Mark sharp curves, loops, and cable bundles every few inches. Sharp changes in the path cause the receiver Peak and Null indications to behave differently than when tracing a straight path. Practice on a path that you know has turns and laterals in it, so you will recognize these conditions in the field.

Null Mode Locating

When in the Null mode, gently swing the receiver across the cable path as you would when in the Peak mode. However, in the Null mode, all indicators will be at a minimum when the receiver is directly above the cable or pipe. When the receiver is only a small distance to the left or to the right of the target cable, all indicators will be at a maximum. When the receiver is farther away to the left or right of the cable, all indicators will begin to fade.

Trace the path by walking away from the transmitter at a moderate pace. Gently swing the receiver left and right as you walk, following the Null indications.

As you move away from the transmitter, the maximum meter readings may slowly fade as was described for the Peak mode. If the maximum meter reading suddenly changes in level (higher or lower), you may have found one of the following:

a. A junction where the signal divides (lower)
b. A break in the cable or shield (lower)
c. A change in depth of the cable or pipe (higher or lower)
d. An insulated pipe fitting (lower)
e. A slack loop of cable (lower)

If you can no longer trace the path, even with the gain set to maximum, connect the transmitter to the far end of the cable, and trace back to the point where you lost the signal.

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Absolute Signal Strength

The receiver provides a direct measurement of the received signal strength. This measurement is displayed continuously at the top of a three-digit LCD, in a range from 0 to 999 indicating a very weak signal to a very strong signal, respectively. As the receiver nears the buried cable, the numbers increase. As the receiver moves away from the buried cable, the numbers decrease. These numbers indicating signal strength are sometimes referred to as Signal Power Indicators or SPI numbers.

Although signal strength is independent of the gain setting, the gain setting will have an effect. If the gain is adjusted too far above mid-scale, the signal strength indicator will blank out. You will know you have adjusted the gain low enough when the signal strength display reappears.

NOTE: *Do not confuse Signal Strength with Signal Strength Adjusted for Depth (Current Measurement). Signal Strength gives the operator a measurement of how much signal is actually being received from the conductor. For a given amount of current on the target cable, you will measure a higher signal power when the cable is close than when the cable is farther away.*

Signal Strength Adjusted for Depth takes the depth of the conductor into consideration. As the depth of the conductor changes, Signal Strength Adjusted for Depth measurements will remain the same. Signal Strength Adjusted for Depth is actually giving the operator an indication of the amount of signal current through the conductor.

Signal Strength Adjusted for Depth (Current Measurement)

The receiver contains a feature that is very useful in identifying a target cable (the cable that is connected to the transmitter) in a field of various conductors and/or utilities. It is not unusual for the target cable to induce or to leak the transmitted signal into nearby conductors through a common ground system. Consequently, you can receive a stronger signal from nearby conductors close to the surface of the earth than the signal from the target conductor buried deeper. You will find two or more paths and you must somehow determine which is the target conductor. By using the current measurement feature of the receiver, you can determine the amount of transmitted AF or RF current flowing on each conductor. The highest current flow always indicates the target conductor.

To measure the current flow in each cable in the congested area, locate the path of the cables. Mark these paths as accurately as possible (Refer to the sections on Peak Mode Locating and Null Mode Locating). Place the receiver vertically over one of the conductor paths and rest the foot of the locator on the ground. While holding the receiver vertically, press and release the CURR button. When the meter changes from a thermometer-type display to a bar-type display, hold the receiver steady until the measurement stabilizes. The blinking bar indicates the current level on the cable, adjusted for depth. Next, move to the second cable and repeat the measurement. Again, the blinking bar will show the current level on the cable. To help you remember the previous reading, it is shown as a solid bar. The higher of the two readings will represent the target cable.

NOTE: *If the display reads **"Err"** during a current measurement, the receiver has detected a condition that could produce inaccurate readings. Errors can result when conductor signal current flow is too low. Check the transmitter hookup and the far end access point for loose connections. This problem can be identified when you need a high gain setting (80 or greater on the bar-graph display).*

*The receiver may also be detecting adjacent cables or it may not be positioned directly over the target conductor. Verify that the target conductor path is accurate before measuring the current again. If at anytime the display reads **"**CAL," contact the factory for further information.*

Gain Change Indication

Use the GAIN up and down buttons to increase and decrease the gain in small steps to center the meter reading to mid-scale.

Passive 50/60 Hz Locating

The receiver is capable of locating loaded underground primary and secondary utility cables. It can also locate underground water pipes, sewer lines, and other metallic lines such as cable television lines, and telephone lines that are accidentally carrying some utility current. The transmitter is not needed to locate in this mode.

Press the FREQ button to select the 50/60~ (Hz) frequency on the receiver. Press the MODE button to select the Peak Mode. Locate the conductor by using the receiver as previously described for Peak Mode Locating. Passive locating can be faster because of its convenience. Start at a known reference point and keep in mind that other conductors in the area may produce this same locating signal.

Push-Button Digital Depth

You need only push a button on the receiver to measure depth. Depth is displayed digitally at the top of the display window in feet and inches (or meters and centimeters, factory selected).

First locate the path of the cable. Then move to the location where you want to measure depth. Do not measure depth closer than 15 ft (4.6 m) from the transmitter. Pinpoint this location as accurately as possible. (Refer to the sections on Peak Mode Locating, Null Mode Locating, and Absolute Signal Strength). With the foot of the locator resting on the ground, hold the receiver vertically over the conductor. Press and release the DEPTH button. The receiver will briefly indicate that a depth measurement is being calculated, and then it will display the depth.

Note that offset magnetic fields and interfering adjacent conductors can significantly influence depth measurements. You should periodically check for adjacent conductors and offset magnetic fields when you make depth measurements. For information on identifying offset magnetic fields, refer to the following sections on Depth Measurement 45° Angle Method and Offset Magnetic Field Identification.

NOTE: *If the display reads* ***"****Err****"*** *during a depth measurement, the receiver has detected a condition that could produce inaccurate readings. Be especially alert to errors that are caused by inadequate signal current flow. Check the transmitter hookup and far end ground return access point for loose connections. Suspect a low current problem when you have to set the gain to 80 or greater on the bar-graph display. Check to be sure the receiver is directly over the target cable. If at anytime the display reads* ***"****CAL,"* *contact the factory for further information.*

Depth Measurement 45° Angle Method

As a correlation to the depth measurement by push-button method, you can measure depth using a triangulation method as shown in Figure 15. This alternative method will also help you determine whether or not there are interfering nearby cables.

Move to the spot where you want to measure depth and pinpoint and mark the path of the cable. Then place the foot of the receiver on the ground with the meter facing up. Adjust the position of the unit until the bubble level on top of the meter is centered at 45°. Pull the receiver away from the cable path along a line that is perpendicular to the cable. When the locator indicates a null reading, mark the location of the foot of the receiver. Measure the distance between the receiver and the cable path. This distance is the same as the depth of the target cable or pipe.

You can check for a possible false depth reading caused by nearby buried metallic objects such as another cable or pipe, sewer line, fence, or railroad track. To confirm your depth measurement, repeat the above steps on the opposite side of the pipe or cable. A difference of more than 5 in.(12.7 cm) in the two depth measurements can mean that there are interfering cables, pipes, or other objects, and that the accuracy of the depth measurement is less than usual.

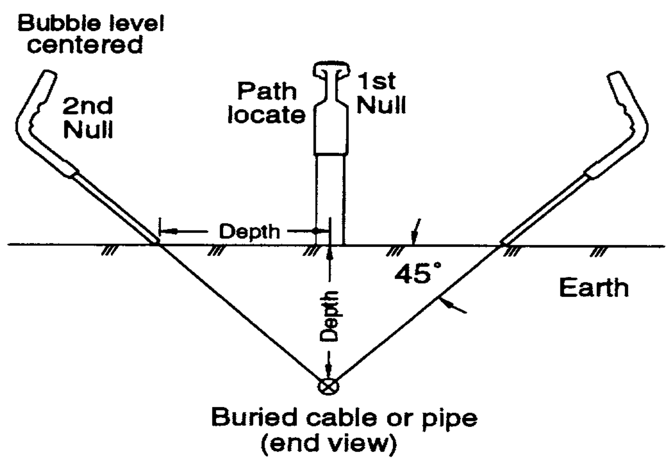

Figure 15: Depth Measurements 45° Angle Method

Offset Magnetic Field Identification

When adjacent cables or pipes are present in the right of way, they will sometimes create locating errors. Some of the transmitted signal is picked up by nearby conductors or pipes and reradiated so that it adds to or subtracts from the original signal. The result is an offset magnetic field that can cause path locating errors.

You can verify the presence of this problem by using triangulation to measure depth, as described in the preceding section on Depth Measurement 45° Angle Method. If the right side and the left side depth readings agree to within about 5 in. (12.7 cm), your path locate is fairly accurate. If the two depth readings do not agree, your path locate is not accurate. You can decrease the error by marking the path as being about halfway between the two outside depth locate marks. This important strategy can be used to obtain the most dependable path location possible. See Figure 15.

Section 6
Fault Locating

Introduction

When cable insulation fails at some location along the route of a direct buried cable, some of the transmitted signal will return to the transmitter ground rod through a break in the insulation, and through the earth, as shown in Figure 16.

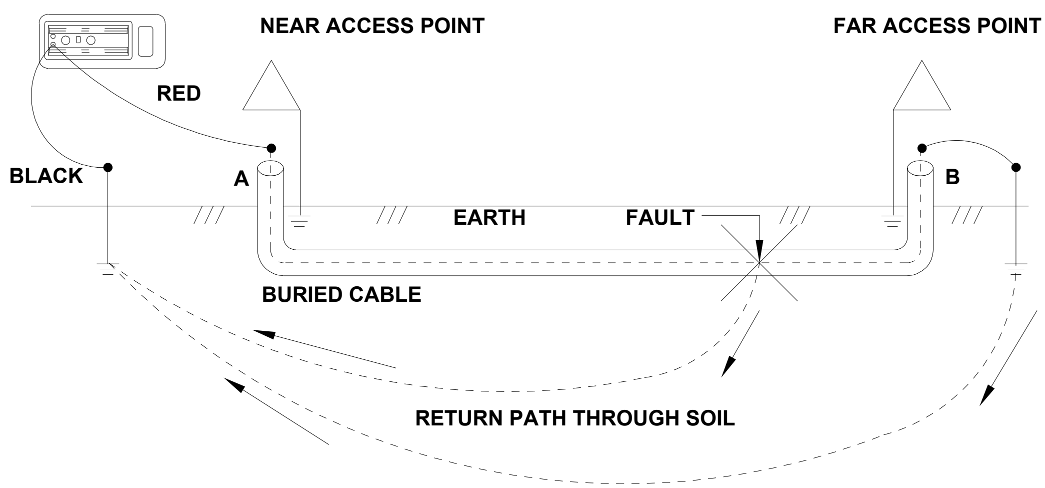

Figure 16: Signal Return Through an Insulation Fault to Earth

After locating the path of a direct buried cable, disconnect the ground at the far end of the cable. Connect the red lead from the transmitter to the conductor of the target cable. Insert the ground rod into the earth at a location off to the side or rear of the red lead connection. Connect the black lead to the ground rod and then turn on the transmitter.

Ground Return Probe

To begin fault locating, open the ground return probe and plug it into the receiver. Plug the black molded cord into the ground return probe handle with the straight connector. The ground return probe is collapsible for easy transport and storage, as shown in Figure 17.

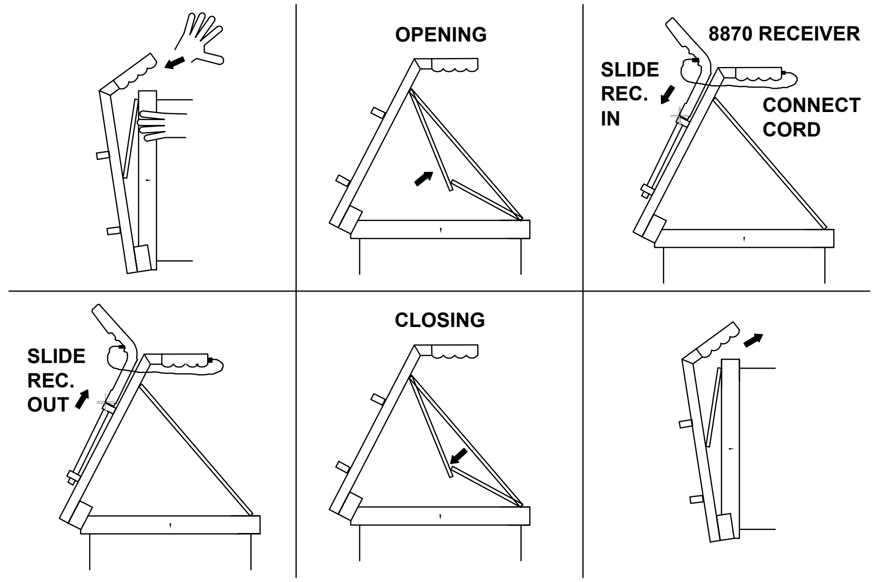

Figure 17: Collapsible Ground Return Probe

Circuitry between the two ground spikes provides a path for the current in the soil returning to the transmitter ground rod. Current enters one spike of the ground return probe and exits the others. Insert the ground return probe into the soil with consistent force and depth (Fig. 18).

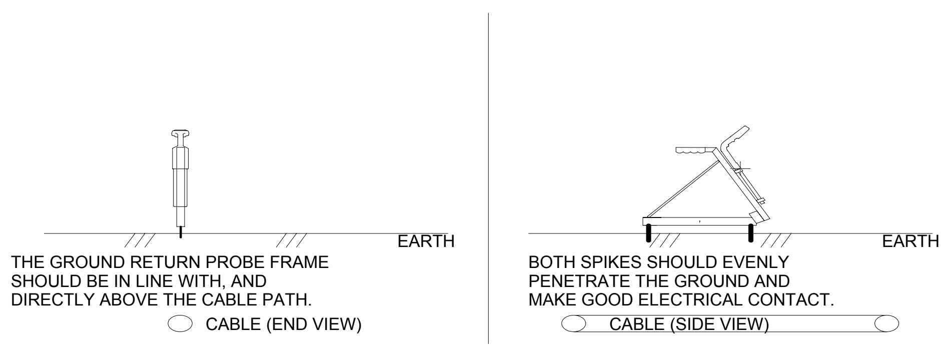

Figure 18: Ground Return Probe Insertion

The current in the soil spreads out from the fault like the spokes of a wheel. The current is highly concentrated in the soil near the fault as it begins its return, and near the transmitter ground rod as it finishes its return. Notice that the current is widely dispersed in the soil between the fault and transmitter ground rod in Figure 19.

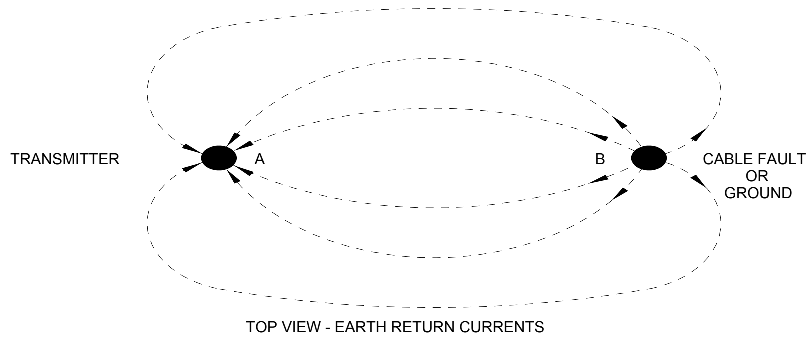

Figure 19: Spoked Wheel Return Paths

The receiver measures the amount of current flowing through the ground return probe. As you walk the path using the ground return probe, drop the probe every three or four steps. As you approach the fault, the receiver will indicate higher and higher readings. You will find it necessary to reduce the receiver sensitivity by pressing the GAIN control button. Once the signal starts to increase, walk more slowly to avoid overrunning the fault.

The receiver will continue to record higher current readings until one spike of the ground return probe passes the fault. When the spikes of the ground return probe are equally spaced on each side of the fault, the currents subtract and produce a null. To record the strongest null, press the GAIN control button to keep the null on the meter scale and move the ground control probe an inch at a time until the strongest null is recorded. The fault will then be in the center of the two spikes (Fig. 20).

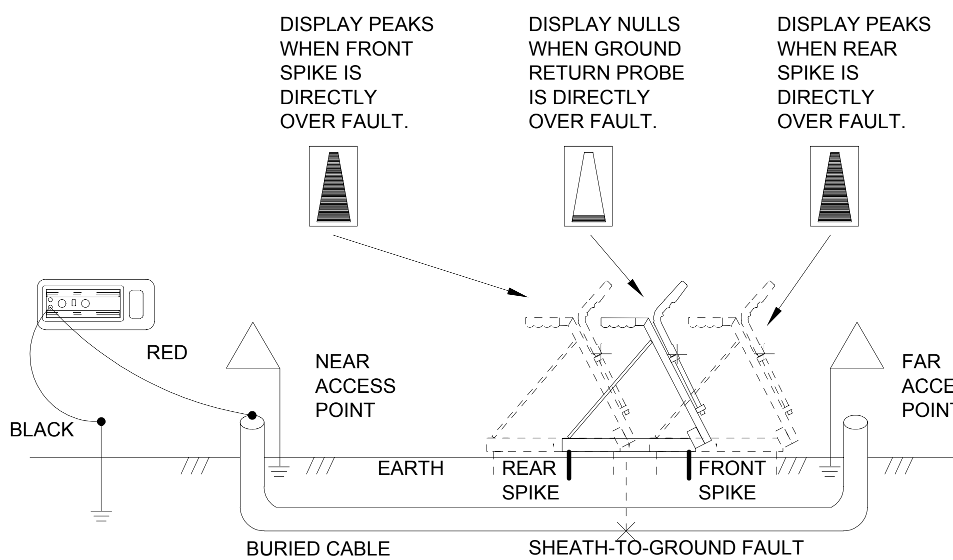

Figure 20: Ground Return Probe Fault Locating

Figure 21 shows that the received signal level increases as the ground return probe approaches a fault, as it moves away from the transmitter. When the cable has no faults, the locating signal will decrease slowly as you increase the distance from the transmitter.

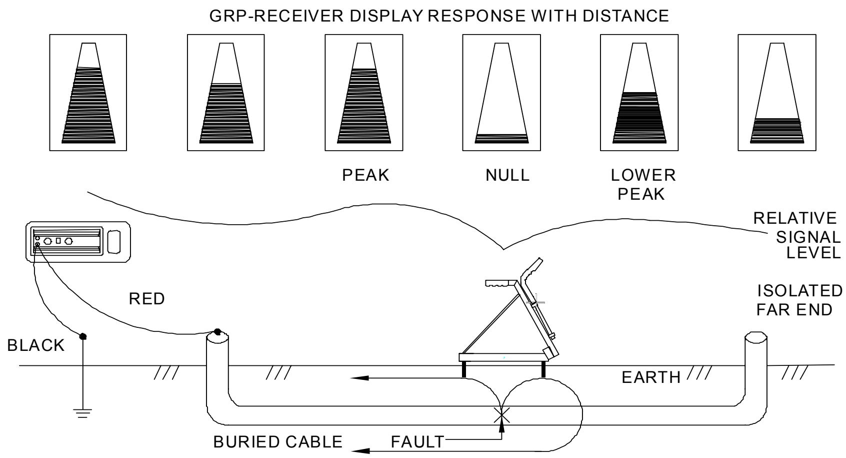

Figure 21: Ground Return Probe-Receiver Meter Response with Distance

When the fault is located under a paved area, insert the ground return probe in the dirt at the side of the paved area as shown in Figure 22. Slightly rotate the ground return probe to find the deepest null at each of two locations. The fault will lie on a straight line projected at a right angle from the center of the probe. Project these two lines over the paved area. The intersection of the two lines is the location of the fault.

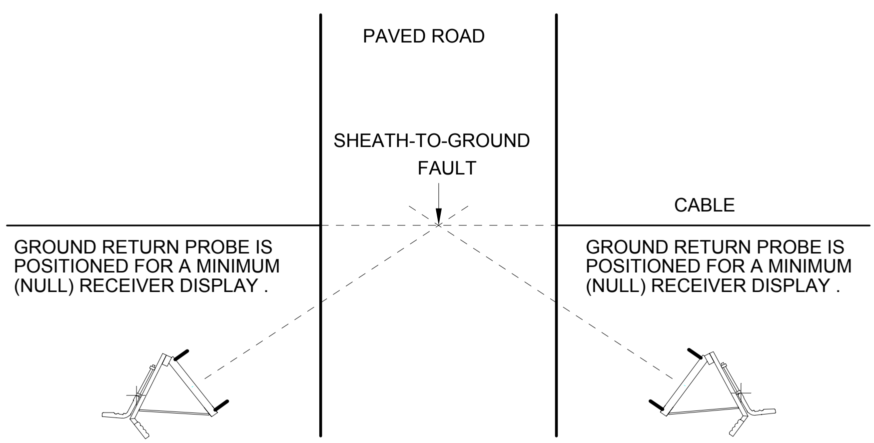

Figure 22: Faults Underneath Paved Surfaces

Section 7
Service

Maintenance

The portable locator is a rugged, durable instrument built to withstand the rigors of day-to-day field use. It requires no periodic adjustments or calibration. It is however an electronic instrument and should be treated as such.

- When not in use, keep the portable locator in its carrying case and store in a safe, dry place, away from extremes in weather conditions.

- Should the unit become dirty, wipe it down with a damp cloth. Do not use cleaning compounds on the transmitter or receiver.

- Periodically inspect the test cord to ensure that it is in good condition.

Repair

If your portable locator is not working properly, please call (800) 641-2349 or (215) 646-9200 for return authorization and shipping instructions.

WARRANTY

Products supplied by AVO International are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair must be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.