3M

Dynatel™ 573A Earth Return Fault and Cable Locator

Operators Manual

July 1993
78–8093–0604–2 Revision A

Dynatel™
573A
Earth Return Fault and Cable Locator

Operators Manual

Table of Contents

Section 1 Description

Section 2 Locating Earth Faults

Section 3 Cable And Conductor Location

Section 4 Special Applications

Section 5 Care and Maintenance

This manual has been prepared to provide the most important written instruction material to date for this product. It assumes a basic understanding of the commonly used terms in telephone transmission and switching.

Whenever this manual is reissued, the reason(s) for reissue will be listed here.

Comments concerning the contents or organization of this document, as well as suggestions for improvement are welcomed. Direct comments to:

3M Telecom Systems
Lab – Technical Communications
6801 River Place Boulevard
Austin, Texas 78726–9000

For Technical Service call: 800/426 8688
(outside the U.S.A. call 512/984–2575)

Section 1 Description

1. Introduction

1.1 The Dynatel 573A Earth Return Fault and Cable Locator is a portable, battery-powered test set. It detects and pinpoints sheath and conductor faults, and locates the path of buried or underground (UG) cables. The test set indicates the presence of dangerous voltage on a test section, and detects RF (radio frequency) and audio frequencies applied to a conductor by the transmitter. The receiver alone detects 60 Hz AC current, and the receiver and earth frame together detect sections of substantial AC power influence. Other applications include locating butt-splices, slack-loops, unknown laterals, cut service drops, and encapsulated closures. The locator accurately indicates the depth of buried or UG cables, and it finds clear or severed cable ends. It provides a high-frequency (RF) tone for positive conductor or cable identification, and an audio frequency tone for coiling solid resistive faults.

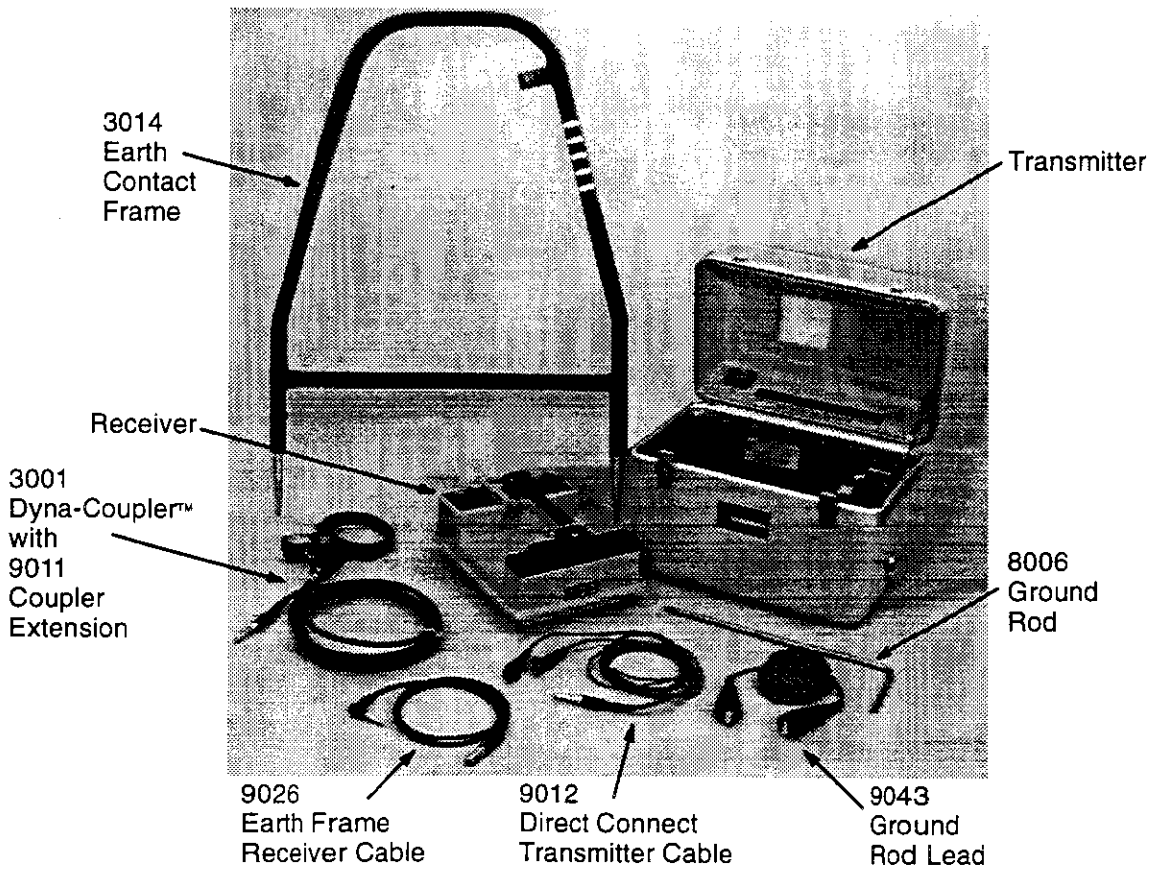


Figure 1 573A Test Set with Accessories

1.2 The 573A locates cables without taking them out of service. A high-frequency RF tone is put on the cable or conductor for most cable locating of less than one mile. This tone does not create noise on the circuit and does not interfere with signals or conversation on the cable. There is a low- or audio-frequency tone provided for long tracing distances, or for cables with continuously grounded shields such as lead sheath. This mode pushes tone farther than the RF mode, but it can create noise on the circuits. When locating a working power cable, or a cable that has 60 Hz AC voltage induced on it, you can use the receiver alone to trace the 60 Hz signal path.

1.3 The receiver is very sensitive to the tracing tones and you can adjust the sensitivity to prevent error due to overdriven tone. The test set indicates received tone strength through the loudspeaker and on the meter. The sensitivity control adjusts loudspeaker volume and meter deflection. The meter's deflection to the red or green zone indicates direction to a sheath fault.

1.4 The receiver is physically independent of the transmitter in all tracing modes.

1.5 The 573A consists of a transmitter, a receiver, and accessory items. The transmitter and receiver cases are made of high-density polyethylene for light weight and high durability. Both are water resistant for wet-weather operation. For compact storage and carrying, the receiver and accessories fit into the transmitter case. To preserve battery life, both transmitter and receiver power switches automatically turn off when you place the receiver into the transmitter case.

2. Transmitter

2.1 The transmitter has two selector switches - output level and locate mode. It also has an output-test meter that indicates transmitter output level and voltmeter/ohmmeter test conditions.

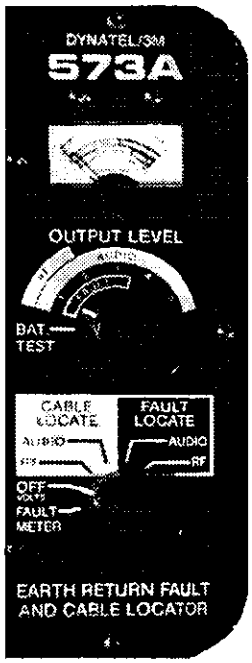


Figure 2 Transmitter Control Panel

2.2 The output level switch selects RF or audio tone output level and test. The positions are as follows.

- **BAT/TEST** is a spring-return, momentary-contact switch that places a load on the transmitter batteries for test.

- **RF/1** sets the transmitter output to radio-frequency (300,000 Hz) mode at normal power level for cable location. This level is used for most short locates and provides maximum battery life.

- **RF/2** sets the transmitter output to radio-frequency mode at high level for cable location. This provides a tracing tone for distances up to one mile.

- **AUDIO/1, 2, 3, 4, 5** selects the audio frequency (577.5 Hz) and signal level for tracing long distances, or through cables with continually grounded outer shields, such as lead sheath.

- **1, 2, 3/FAULT** sets the output for earth fault location in either RF or audio mode.

2.3 The locate mode selector tests voltage and fault conditions on a cable section and selects locate type and transmission frequency. The positions are as follows.

- **FAULTMETER** is a momentary-contact, spring-return position that tests sheath integrity. Sheath condition is indicated by needle deflection in the resistance band of the output-test meter. This position also indicates ground or conductor integrity of the signal return circuit when tracing and coiling in the audio mode (refer to paragraph 4.1 on page 26).

- **OFF/VOLTS** turns off the transmitter battery power. When attached to a conductor with the 9012 Direct Connect Transmitter Cable, the test set acts as a voltmeter. It indicates the presence of AC and DC voltage up to 600 volts. It also indicates the presence of C. O. battery on a cable shield.

- **CABLE LOCATE - RF** sets the transmission to RF for cable location.

- **CABLE LOCATE - AUDIO** sets the transmission to audio frequency for cable location.

- **FAULT LOCATE - AUDIO** sets the transmission to audio frequency for earth fault location.

- **FAULT LOCATE - RF** sets the transmission to RF for earth fault.

2.4 The output-test meter has four indicator bands to show test conditions.

- **OUTPUT REFERENCE** is calibrated left to right from 0 to 10 and shows optimum output transmission through the test positions of the output level selector.
- **VOLTS/DANGER** indicates voltages when metallic attachment is made to a shield or conductor and the transmitter is in the off/volts position. Up to 50 volts present is acceptable for test. If more than 50 volts are indicated (the red zone), dangerous voltages are present that could damage equipment and cause operator injury.
- **GOOD/HI RES./FAULT** tests sheath condition and indicates the degree of resistance in a fault when the locate mode selector is in the faultmeter position.
- **BAT. OK** indicates acceptable battery level when the output level selector is turned to bat/test.

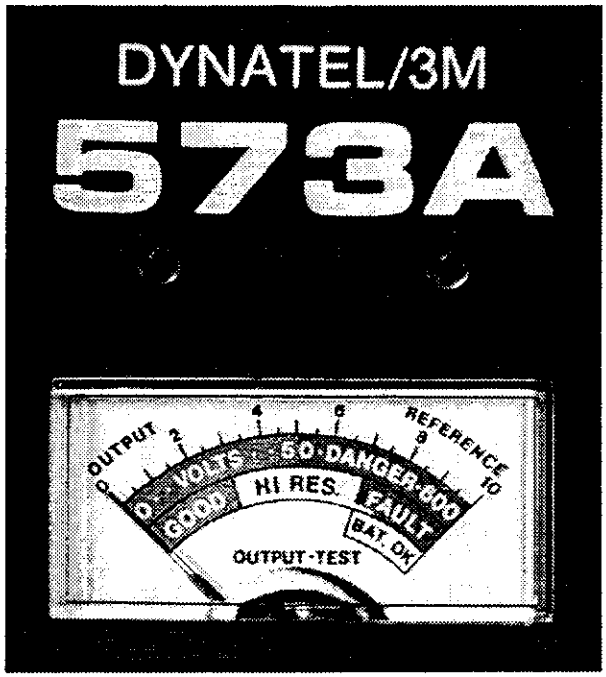


Figure 3 Output-Test Meter

2.5 The transmitter output jack is a standard telephone jack for direct connection or inductive coupling with the Dyna-Coupler (refer to paragraphs 2.2 and 2.3 on page 16). Note that when no cable is plugged into this jack, RF output is directed to the internal radiating loop.

3. Receiver

3.1 The receiver operating panel has two selector switches, a signal level reference meter, and a sensitivity control knob. The tone select switch selects the system frequency, and the receiver mode switch controls the receiver operating modes.

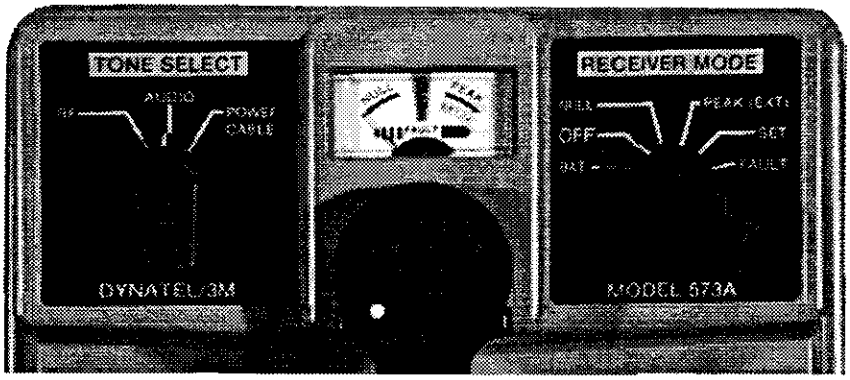


Figure 4 Tone Select and Receiver Mode Switches

3.2 The three-position tone select switch sets the receiver to detect RF or audio system tones generated by the transmitter, or power cable current flow in the area.

3.3 The sensitivity control knob adjusts the loudspeaker volume. Except in fault mode, it also adjusts meter sensitivity.

3.4 The loudspeaker provides an audible indication of tone level. It is protected from weather by an overlapping cover.

3.5 The receiver mode selector is a six-position switch that controls the following receiver operating modes, clockwise from the left.

- **BAT** is the battery test position. It is a momentary-contact, spring-return switch that puts a test load on the receiver batteries.
- **OFF** turns off the receiver power.
- **NULL** selects the null operation mode for cable location. In null mode, the loudspeake tone sharply decreases and the needle deflects to the null (left) side of the meter when t receiver is directly over the cable. Refer to paragraph 5.1 on page 19 for more information null operation.
- **PEAK (EXT)** selects the peak operation mode for cable location. It also sets the oper of the receiver to the external jack for use with the Dyna-Coupler, the 3011 Indu Probe, the 3013 Direct Probe, or other accessories. In peak mode, with the receiver h parallel to the cable path, the loudspeaker tone is at its highest and the needle deflects peak (right) side of the meter when the receiver is directly over the cable. Refer to pa 5.2 on page 19 for more information on peak operation.

Note: Peak is not as sharp (well-defined) an indication as null, but it is more reliable if curves or branches. Always check and locate in both modes.

- **SET** sets a reference on the meter for use in cable depth determination.
- **FAULT** sets the receiver to the sheath fault locate mode.

3.6 Except in the fault mode, the receiver signal level reference meter indicates the strength of the tone being received. The needle deflects to the right (peak) at strongest volume. The needle deflects to the left (null) for weak or canceled tone. The yellow center zone (set) provides a reference for cable depth location. In fault mode, the red striped and green solid fault arrows indicate the leg of the Earth Contact Frame closest to a sheath fault. The bat ok zone shows acceptable battery condition.

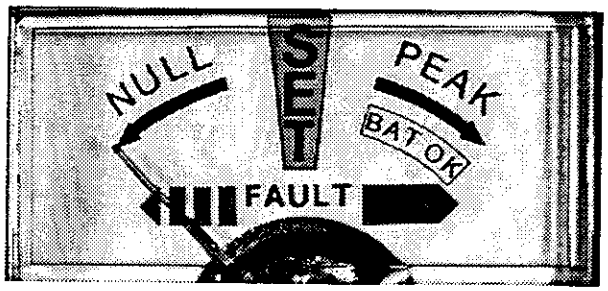


Figure 5 Receiver Signal Level Reference Meter

3.7 The ext jack is a signal input jack for accessories such as the Dyna-Coupler and the 3011 Inductive Probe Head (available separately). This jack is energized with the receiver mode switch in peak (ext) mode and the accessory plugged in.

3 The tone/coil jack is an input connector for use in the audio mode with an accessory coil for toning solid faults up to 50,000 ohms.

The fault jack connects the receiver to the 3014 Earth Contact Frame, using the 9026 cable.

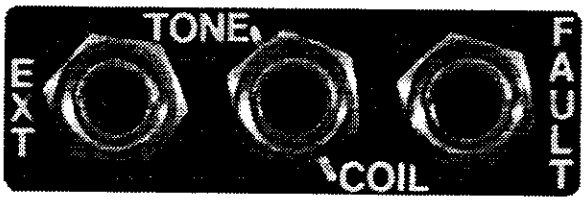


Figure 6 Receiver Unit Accessory Jacks

Section 2 Locating Earth Faults

1. Introduction

1.1 The 573A checks cables for sheath integrity by testing shield-to-earth or conductor-to-earth. If an earth fault exists, you can pinpoint its exact location with the 3014 Earth Contact Frame. Tone transmission is operator selectable using either RF or audio frequency.

- RF mode is preferred for locates of less than one mile on plastic sheathed cable.
- Audio mode is for fault locates longer than one mile. Audio sometimes locates sheath damage in such continuously-grounded conductors as lead-sheath, or armor-jacketed cable.

2. Checking for Sheath Damage

Warning

Make all metallic test connections with the transmitter output selector in the off/volts position and check the meter for voltage indications. 50 volts or higher is dangerous and can damage the test set.

Note: *With the black clip to ground, test the shield with the red clip. A meter reading showing C. O. battery on the shield indicates sheath integrity, but water is in the section. Since there is no earth fault on the section, you must locate the trouble by an alternate method, such as using the Dynatel 710B Resistance Fault Locator.*

2.1 Remove bonds at both ends and isolate the shield of the test section. With the cable isolated, plug in the 9012 Direct Connect Transmitter Cable and connect the red clip to the shield or a faulted conductor. Connect the black clip to the ground rod. You can use the 9043 Ground Rod Lead to extend either lead for operating convenience.

2.2 Place the ground rod in good soil in line with the faulted cable path behind the transmitter. For some applications on continuously-grounded cable such as lead sheath, connect the red clip to the faulted conductor or shield and the black clip to ground. Attach the 9043 Ground Rod Lead between the stud below the transmitter output jack and a separate through connector.

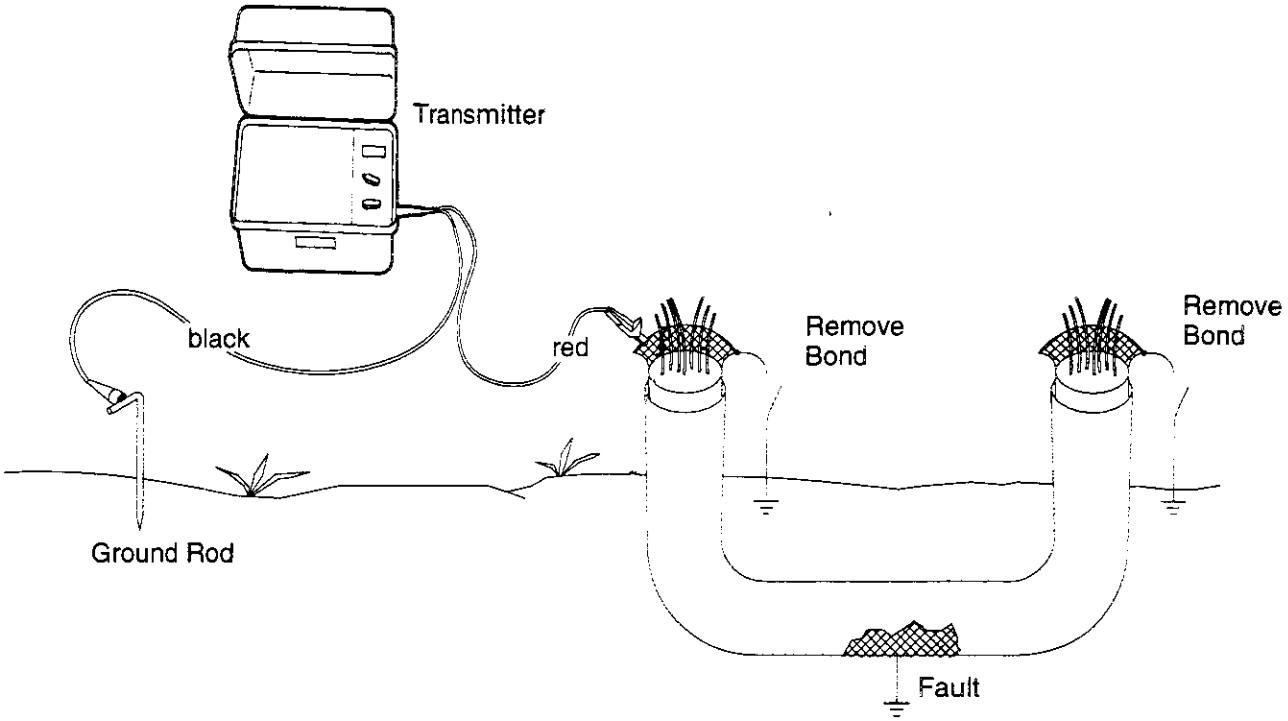


Figure 7 Transmitter Ground Placement

2.3 Turn the transmitter locate mode selector to the fault meter position. The meter needle deflects into either the good, hi res. or fault zone.

1. The green good zone indicates that there is no fault with resistance to ground greater than 1.5 million ohms in the cable sheath.

2. The white hi res zone indicates a sheath fault of 50,000 ohms to 1.5 million ohms. This value could be due to one fault, or a combination of several faults.

3. The red fault zone indicates a heavy fault of less than 50,000 ohms.

Note: *Failure to disconnect the pedestal splice bonds produces a heavy fault reading.*

3. Fault Location Setups

3.1 With the transmitter output selector in either the RF or audio mode, switch the output level selector through positions 1, 2, and 3. Leave the selector set to the position that shows the highest reading as the meter deflects to the right.

3.2 When locating an earth fault in plastic insulated cable, the transmitter attachment remains the same as for the fault test mode (refer to "Checking for Sheath Damage" on page 7). Select RF (preferred) or audio frequency on the receiver tone select switch to match the transmitter output frequency.

3.3 With the receiver tone select switch set to match the transmitter output tone, set the receiver mode switch to fault. It may take several seconds before the test set gives a proper receiver indication.

3.4 Connect the 9026 Earth Frame Receiver Cable between the socket on the 3014 Earth Contact Frame and the receiver fault jack. The test set is now ready for locating an earth fault.

4. Locating an Earth Fault

4.1 Use the following procedure to locate an earth fault.

1. Trace and mark the cable path, holding the receiver in one hand and the Earth Contact Frame in the other with the green-banded leg to the front.

2. At the location of the ground rod, insert the frame probes fully into the ground in line with the cable path while facing the section under test. The receiver meter needle deflects into the green (solid) zone, indicating that the fault is ahead of the operator in the direction of the green-banded leg.

3. Continue along the cable path, reinserting the frame probes every few steps while watching the receiver meter. When the needle deflects into the red (striped) zone, you have passed the fault.

4. Back up slowly, inserting the frame every few inches until the needle returns to the green zone. The fault is located beneath the center of the frame when the needle changes from one zone to the other.

5. To verify the fault location, rotate the frame, still centered over the fault, 90 degrees to the cable path. Repeat the above procedure to locate the point of meter reversal; this pinpoints the exact location of the fault.

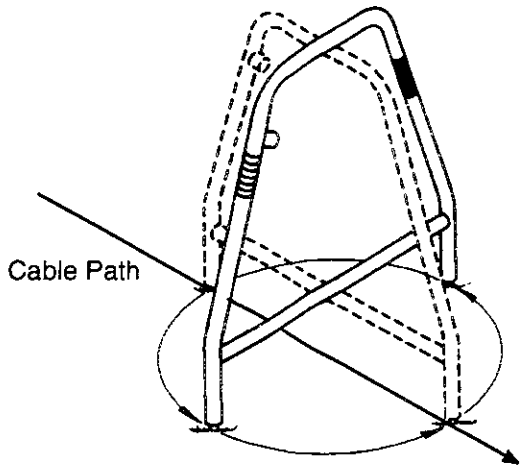


Figure 8 Frame Positions to Pinpoint a Fault

Note: *In the case of a high resistance or distant earth fault, the meter needle movement may become very small or even undetectable; however, the meter indication increases as you get closer to the fault. This is because the gradient signal is highest at the ground rod and at the fault, but drops off in between. If the meter needle shows movements, or is erratic to the end of the test section, there is no fault on the section.*

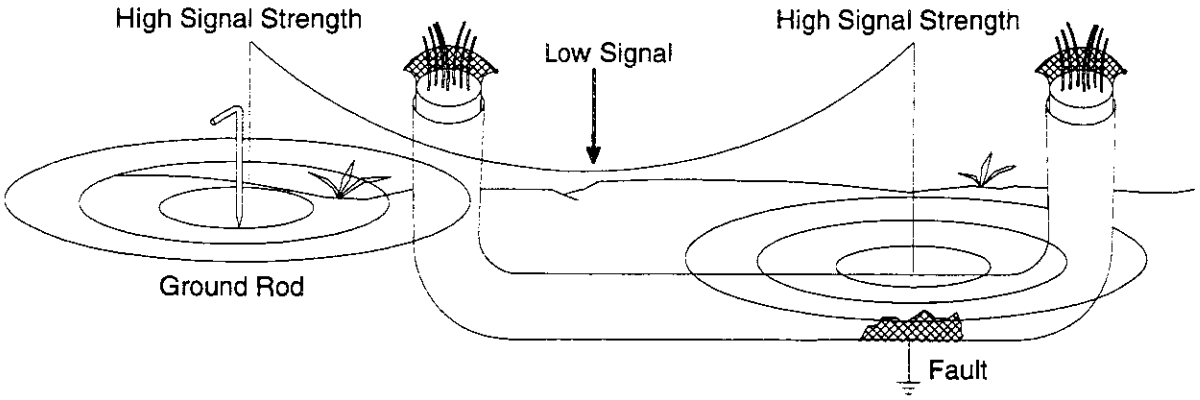


Figure 9 Gradient Signal Strength

5. Locating Earth Faults Under Pavement

5.1 When a cable is routed beneath, and in line with, a paved surface, you can locate the fault using either the perpendicular method, the triangulation method, or the extended frame method as follows.

Perpendicular Method

5.2 Hold the frame parallel to the cable path as shown below. Meter reversal occurs when the frame is directly perpendicular to the sheath fault.

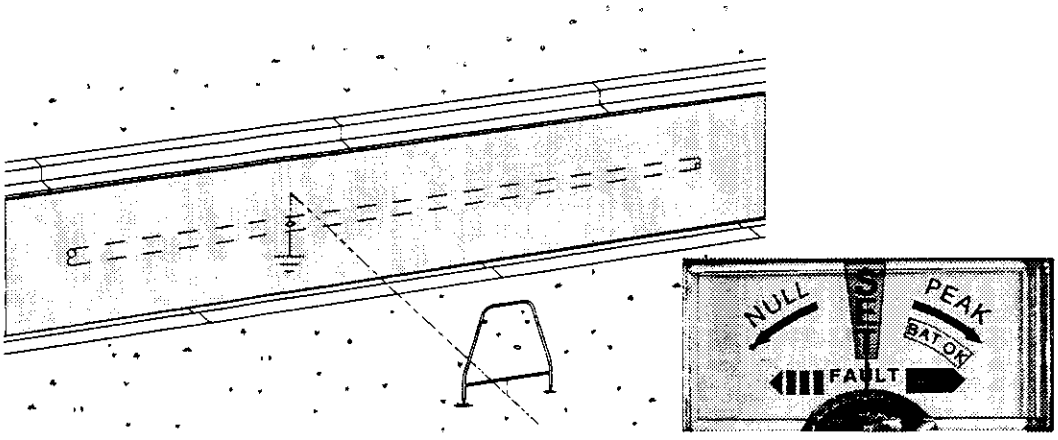


Figure 10 Perpendicular Fault Location

Triangulation Method

5.3 To check the accuracy of a perpendicular locate, move back several yards from the point of meter reversal. Probe in one spot with the frame, rotating it a few degrees between inserts, until the meter reverses after less than one inch of frame movement. A line marked perpendicular to the frame intersects the cable path at the fault. Repeat this procedure a few yards ahead of the perpendicular locate to triangulate and confirm the location.

Note: If the cable is routed under a large area of asphalt, such as a parking lot, you can penetrate the surface with nails long enough to reach two to three inches into the dirt. You can space the nails to accommodate the Earth Contact Frame probes, or use them with the 9028 Earth Contact Cord (available separately).

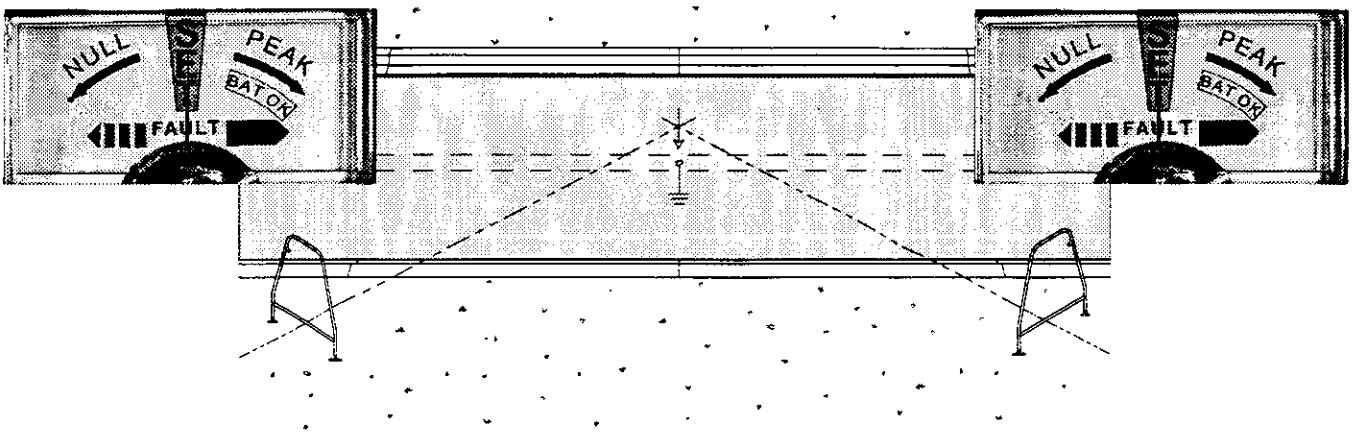


Figure 11 Triangulated Fault Location

Extended Frame Method

5.4 Use the following steps to get an accurate location of a fault when it passes under a narrow length of pavement.

1. Insert the green leg in earth on the far side of the fault, but do not insert the red leg. Strip about ten inches of an insulated conductor such as cross-connect wire and wrap it around the red probe. Pull out enough wire to equal twice the width of the pavement. Strip another ten inches of insulation from the far-end and wrap it around a screwdriver. Ground the screwdriver at a point in line with the cable path across the pavement from the receiver. The screwdriver acts as an extension of the frame's red probe.

2. Return to the receiver, making sure the red probe of the frame is held clear of the ground, and note the meter deflection. If the meter deflects to the red (striped) side, the fault is nearest the grounded wire side. If you are working alone, it helps to reverse the positions of the frame and the screwdriver at this reading.

3. If the needle deflects to the green (solid) side of the meter, move the frame forward along the cable path, probing with the green leg and keeping the red probe clear, until the meter reverses.

4. When you establish the reversal point, pull the wire tight between the two contact points. The fault lies exactly half the distance between the green probe and the screwdriver as measured by the tight wire. Fold the wire in half above the cable path for an exact fault location from either contact point.

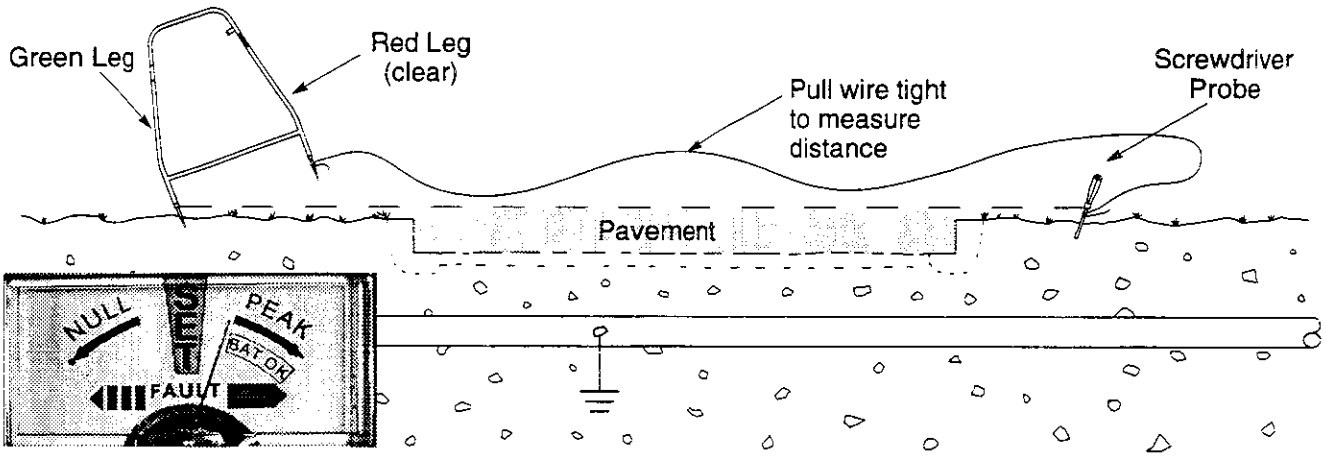


Figure 12 Frame Extension with Screwdriver Probe

6. Locating Substantial AC Power Influence

Identifying a Section with Open Bonds

6.1 Induced 60 Hz AC is greater on a cable with an isolated shield than on one with the shield grounded on either end. If a bond is open, the 573A receiver (with the tone select switch turned to power/cable) detects a sudden increase in the AC field when in the vicinity of the poorly bonded section.

6.2 Set the receive mode switch to peak (ext) and plug the frame into the tone coil jack. The transmitter is not used for this test. While probing along the section of cable in question, continually adjust the sensitivity control to set. If a portion of the shield is carrying more 60 Hz AC, the receiver suddenly peaks when the you encounter the AC field.

Note: The probes must penetrate the earth equally for this test. Different soil consistencies and conductivity affect the indication given by the receiver.

Open Power Neutral

6.3 If a nearby power neutral is open, AC current induces to the telephone shield, which serves as the power neutral until the fault is bridged. AC signal is evident in this area.

6.4 Trace the field as in paragraph NO TAG. The signal will be similar to those on an unbonded section.

Note: Use extreme caution when working near induced voltages. Always test a conductor with the transmitter in the off/volts position to assure safe conditions before performing further tests.

Section 3 Cable And Conductor Location

1. Tracing Tones

1.1 The 573A transmitter places either an RF or audio tone on a conductor. The receiver detects and traces the tone. In addition, when AC voltage energizes a conductor, the receiver detects the current flow without the aid of tone broadcast by the transmitter.

RF (Radio Frequency) Tone

1.2 RF tone is used in most locates. RF transmission is a high frequency tone that provides good accuracy in congested service areas. This mode offers a variety of ways to tone a conductor, and it is less susceptible than other frequencies to power and induced interference. It will not produce noise on a circuit, and it does not require metallic contact or far-end grounding.

Audio Tone

1.3 Audio transmission is a low-frequency tone that carries for long distances in PIC and continuously-grounded conductors, such as lead- or armor-sheathed cable. Audio tone requires direct connection to a conductor and the far end must be grounded. Ground integrity is checked with the locate mode switch in the faultmeter position. During a test, the meter needle must be well into the red fault zone (less than 50,000 ohms).

Note: Audio tone is best for long traces in relatively congested areas. It may produce noise on working lines, and it may also be susceptible to power lines and induced interference.

Power Cable

1.4 In power cable mode, the receiver detects and traces 60 Hz AC current along a conductor. The transmitter is not used in this mode.

Note: In the Power Cable setting, the receiver only detects current flow. It does not detect potential in a non-working, energized conductor.

2. RF Transmitter Setup

2.1 The transmitter places RF tone on a cable in three ways: direct connect, inductive coupling, and general induction.

Direct Connect

2.2 The direct connect method requires access to the cable shield or conductors. Plug the 9012 Direct Connect Transmitter Cable into the transmitter output jack at the side of the transmitter and use the following proceedure.

1. Connect the red clip to any conductor, or to the isolator shield.
2. Set the transmitter on the ground. If you need a strong tone, place the ground rod in the ground several feet away from, and perpendicular to, the cable path. Attach the transmitter to the ground rod with the black clip.

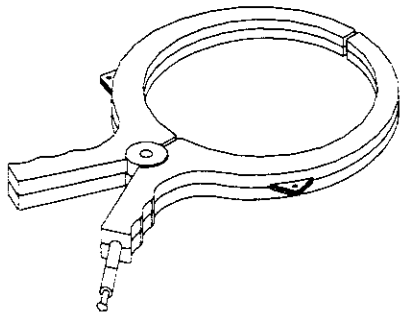
Note: Never ground to a water pipe, or other service in the area because the returning signal may create an out-of-phase condition that can mislead the trace.

3. Turn the output level selector to RF/1 for most locates. Use RF/2 only for extended distance locates up to one mile.

Inductive Coupling

2.3 The Dyna-Coupler places tone selectively on a cable by clamping around it. This eliminates the need to disconnect bonds, or make direct connection to a conductor, but it does require access to the cable. Follow these steps to connect the Dyna-Coupler.

Figure 13 The 3001 Dyna-Coupler



Warning

A potential for electrical shock exists when you are using the Dyna-Coupler on cables energized with electrical power. Use appropriate safety procedures. DO NOT USE ON CABLES CARRYING IN EXCESS OF 600 VOLTS RMS.

1. Connect the 9011 Coupler Extension cable between the coupler and transmitter output jack. Clamp the coupler around the cable. There is no minimum conductor size, but the jaws of the coupler must fully close for good tone transmission.

Note: Do not use the Dyna-Coupler on cables that are clear on both ends.

2. Turn the output level selector to RF/1 for most short traces. Use RF/2 only for extended distance traces up to one mile.

General Induction

2.4 General induction broadcasts tone over a general area. You should only use this method when there are no other conductors present, or if you must locate all conductive buried services in the area. If other services, such as gas pipes, CATV, etc., are in the same area, you must find access to the cable and use direct connection or inductive coupling.

2.5 For this method, access to the cable is not necessary. Set the transmitter on the ground over the cable and turn the output level switch to RF/1 for short locates. Use RF/2 for longer distances up to one mile. Place the transmitter case handle parallel to the cable path.

Note: Do not use the receiver within 50 feet of the transmitter because it will receive the tone and mislead the locate.

2.6 Be certain the transmitter is directly over the cable to be located. You can do this by setting the receiver on the ground near the cable 50 feet from the transmitter. Move the transmitter across the cable path and listen for the strongest tone from the receiver.

3. Audio Frequency Transmitter Setup

3.1 Audio tone requires direct connection to the cable shield or conductors. You should isolate the cable section at both ends and ground the conductor at the far end. To set up the transmitter, follow these steps.

1. Plug the 9012 Direct Connect Transmitter Cable into the transmitter output jack and attach the red clip to the conductor or shield.

2. Connect the 9043 Ground Rod Lead to the black clip and attach it to the ground rod at least 15 to 20 feet from the set and perpendicular to the cable path. If necessary, extend the ground lead with any insulated wire.

3. Turn the locate mode selector to faultmeter. The meter needle must register well into the red fault zone (0 to 50,000 ohms). If the needle goes to the white or green zone, you must ground the far end of the conductor or shield so the meter shows the ground as a fault.

Note: When tracing on the shield, a white or green indication may be due to high resistance or broken bonds at intermediate splices.

4. Turn the output level to audio 1, 2, 3, 4, and 5 in order. Use the setting that deflects the meter needle farthest to the right.

4. Receiver Mode Selection

4.1 The receiver signal level meter indicates the strength of the tone being received. The needle deflects to the right for strong tone (peak), and deflects to the left for weak or canceled tone (null). The yellow center zone (set) is for cable depth locating. The bat ok zone is for battery testing. The red (striped) and green (solid) fault arrows are used in sheath fault locating.

4.2 The sensitivity control knob adjusts both meter sensitivity and speaker volume. As you trace the cable, adjust the receiver sensitivity as required so that the meter is not overdriven.

RF Tone Mode

4.3 With the tone select switch at RF, turn the receiver mode switch to null or peak.

Audio Tone Mode

4.4 With the tone select switch at audio, set the receiver mode switch to null or peak.

Power Cable Mode

4.5 You do not need the transmitter for this method. Turn the tone select switch to power cable and locate in peak or null. The cable you are locating must be transmitting a 60 Hz AC current. Tone strength may vary and the receiver sensitivity should be continually adjusted to keep the meter needle in the normal range.

Note: Because of complex electrical fields, power cable locates may not be as definite as those with transmitted tone. Also, you cannot detect a power cable that is energized, but not transmitting power.

5. Receiver Mode Selection (Null and Peak)

Null

5.1 In this mode, tone cancels when the receiver is directly over the cable. The meter needle deflects to the null zone and the speaker is silent. As the receiver moves away from the cable, the audio tone increases and the needle returns to the right. Null gives a more precise center point than peak, but it is not as accurate when other conductors are in the area. In null, the cable is located at the point of minimum needle deflection and tone.

Peak (Ext)

5.2 In this mode, tone increases to a maximum as the receiver passes over the cabl, and diminishes as the receiver moves off the cable path. The meter needle deflects to the peak zone and then returns as the receiver passes over the cable. Peak is less sensitive than null, but it is more reliable when locating changes in cable direction because the tone decreases rapidly if the receiver is not in line with the cable.

Note: Use the sensitivity control knob to adjust reception on peak for meter needle action in the mid-scale area. For maximum accuracy, check the trace in both peak and null modes.

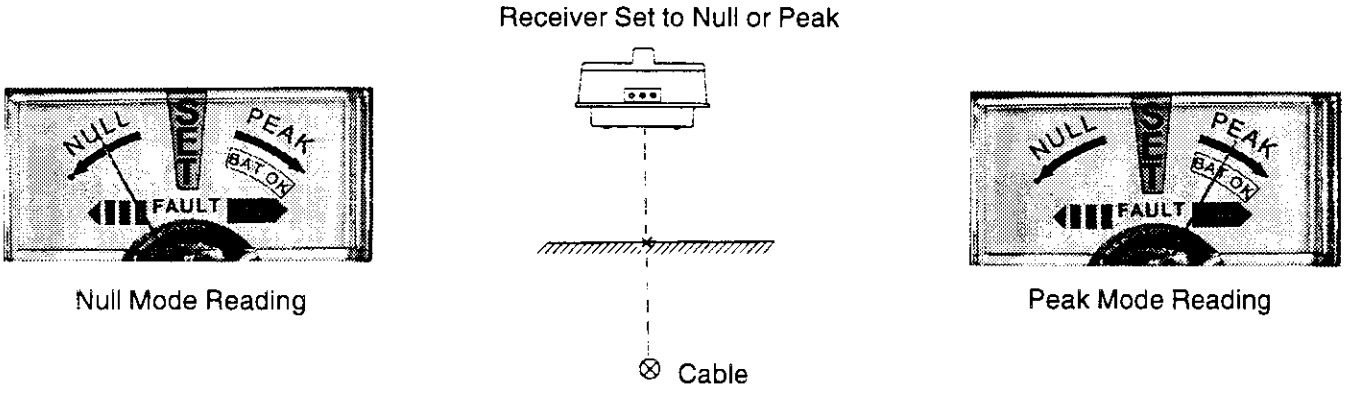


Figure 14 Signal Indications in Peak and Null Modes

6. Determining Cable Depth

Direct Measurement

6.5 After you have located and marked the cable path, follow these instructions to determine the depth with direct measurement.

1. Place the receiver on the ground directly above the cable with the handle parallel to the path.
2. Turn the receiver mode selector switch to set. Adjust the volume control so the meter needle is centered in the yellow area labeled set.
3. Turn the receiver mode switch to peak. Note that the meter reading and the loudspeaker tone both increase.
4. Raise the receiver straight up from the ground until the meter needle returns to the set area of the meter.
5. Measure the distance from the bottom of the receiver to the ground. This distance is equal to the depth of the cable below the surface at this point.

Note

You can turn the receiver mode switch to power to use the direct measurement method to measure depth on conductors with 60 Hz AC current. The measurement accuracy, however, may be affected by other power conductors in the area, including overhead lines.

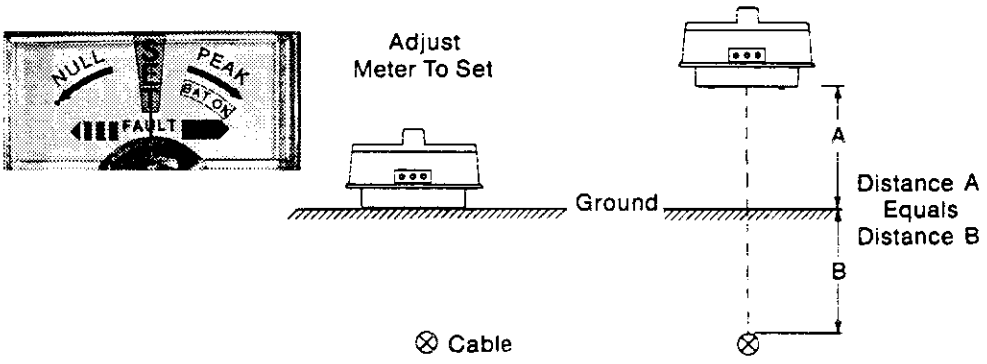


Figure 15 Measuring Cable Depth with Direct Measurement

Triangulation Method

6.6 The triangulation method, unlike the direct measurement method, is not limited to the height that you can hold the receiver. Use the following steps to measure the depth of cables buried deeper than this limit.

1. Use the null mode and mark a point on the cable path.
2. Hold the receiver so the handle is parallel to the cable path and tilt it so the bottom is at a 45-degree angle relative to the ground.
3. Maintaining the receiver angle, move to the side of, and perpendicular to, the cable path until the receiver again indicates a null.
4. Mark the ground at the point a perpendicular line would project from the bottom of the angled receiver.
5. The distance between the first mark and the second mark equals the depth of the cable below the first mark.

Note: *The accuracy of this measurement depends on the accuracy of the 45-degree angle at which you hold the receiver. For best results, hold the receiver close to the ground while performing this measurement.*

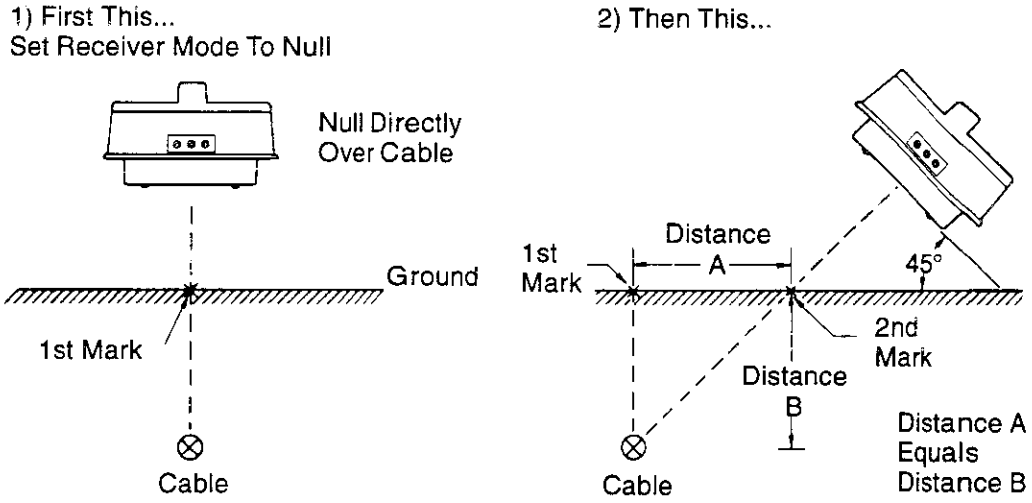


Figure 16 Measuring Cable Depth with the Triangulation Method

Section 4 Special Applications

1. Identifying Cables with RF Tone

1.1 Use the following procedure to identify a single cable in a group of similar cables.

1. At an access where you know the cable identity, place a tone on the cable you want to locate. Use either direct connection or a Dyna-Coupler.
2. At an access point at the far end of the cable group, connect a Dyna-Coupler to the receiver ext jack with the 9011 Ground Rod Lead (available separately).
3. Set the receiver mode selector to peak (ext) and adjust the meter needle to about half-scale deflection. Do not overdrive the receiver.
4. Check each cable in the group. The cable with a significantly higher reading than the others is the one you are trying to locate.

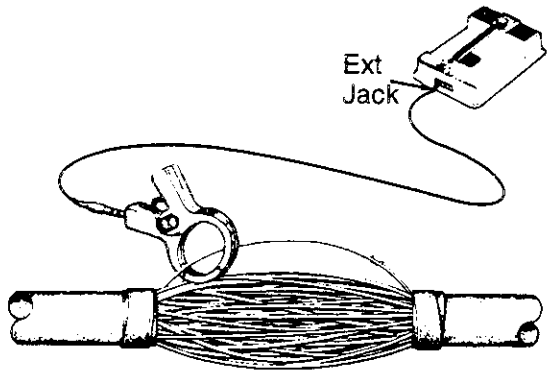


Figure 1 Receiver Setup for Cable Identification with the Dyna-Coupler

2. Identifying Individual Conductors with RF Tone

2.1 Using this procedure, you can identify individual conductors in a cable.

1. At a splice or access, place tone on the conductor you want to identify with a direct connection or Dyna-Coupler. If you use the Dyna-Coupler, apply tone to only one conductor of the pair.
2. At the far end access, connect a 3013 Direct Probe Head to the ext jack of the receiver using the 9023 6 ft. Probe Cable. Both of these items are available as optional accessories.
3. Set the receiver mode selector to peak (ext) and adjust the meter needle to about half-scale deflection. Do not overdrive the receiver.
4. Tone is loudest when the 3013 Direct Probe Head contacts the pair you are trying to locate.

Note: This RF tone frequency will not pass through load coils. If a load coil is present in the test section, use audio tone frequency (refer to paragraph 4.1 on page 26).

3. Identifying Common-Ground Conductors with RF Tone

3.1 Use the following procedure to identify common-ground conductors in a wet pulp section.

1. Open enough shield in the wet cable to gain access to all pairs for tagging.
2. Place the Dyna-Coupler around a single conductor (either tip or ring) of the pair to be identified.

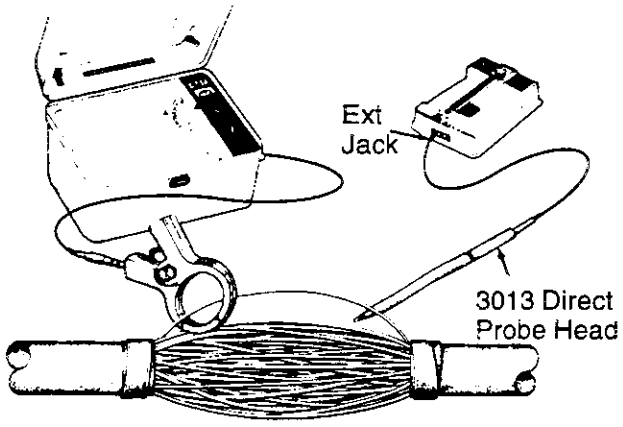


Figure 2 Setting a Reference for Conductor Identification

3. Turn the transmitter mode selector to rf normal.
4. Connect the 3011 Inductive Probe Head (available separately) to the receiver ext jack using the 9023 6 ft. Probe Cable.
5. In the same splice, place the toned wire in the groove of, and perpendicular to, the 3011 Inductive Probe Head. Adjust the volume to set a reference for that conductor. Do not overdrive the receiver.
6. With the probe, test for tone on conductors throughout the splice. If tone on other wires is louder than the reference, you must apply tone directly. Cut a single conductor of the test pair and apply tone directly with the 9012 Direct Connect Transmitter Cable. Adjust the volume to set a reference for that conductor. Do not overdrive the receiver.

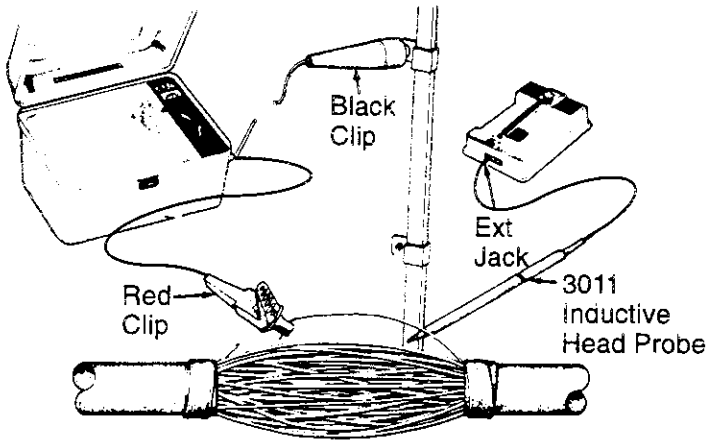


Figure 3 Direct Connect to Single Conductor

7. With the probe, again test for a tone on conductors throughout the splice that is louder than the reference. If tone on other wires is louder than the reference, apply metallic tone to the pairs. Cut the remaining conductor of the test pair and connect the black lead of the 9012 Direct Connect Cable. Adjust the volume to set a reference for that conductor. Do not overdrive the receiver.

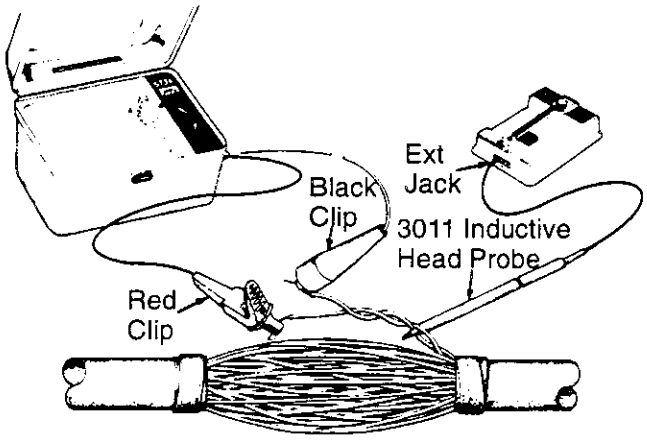


Figure 4 Direct Connect for Metallic Tone

8. On other conductors in the cable, again test for tone louder than on the reference. If you locate a louder tone on other conductors, the 573A will not tone through the wet section. Move the transmitter to the far end of the section and retest through the wet section.

9. Once you have correctly adjusted the tone, and the best current is on the conductor or pair, take the receiver to an access beyond the wet section and probe the conductors with the 3011 Inductive Probe Head. Do not change the volume control. The loudest tone identifies the test conductor or pair.

4. Identifying a Cable with Audio Tone

4.1 Using this procedure, you can identify a single cable in a group of similar cables.

1. At an access point, short or ground a vacant pair.
2. At a far end access point, connect the 573A transmitter across the shorted or grounded pair.
3. Turn the locate mode selector to the faultmeter position. The meter needle must go into the red fault zone.
4. Next, turn the output level selector to audio 1, 2, 3, and 4 in order. Use the setting that deflects the meter needle farthest to the right.
5. Move to an access point where you can identify the cable. Connect an exploring coil to the tone coil jack of the receiver. Select audio on the tone select switch and peak (ext) on the receiver mode selector.
6. Test each cable in the access with the exploring coil. The cable you are trying to locate will be the only one with tone on it.

5. Identifying Individual Conductors with Audio Tone

5.1 Using this procedure, you can identify individual conductors in a cable.

1. At an access point, apply either metallic or grounded audio tone.
2. At the location where you are trying to locate the cable, attach the 3013 Direct Probe Head to the receiver using the 9023 6 ft. Probe Coil.
3. Explore the conductor group with the probe. The conductor with the most tone is the one you are trying to locate.

Note: You can use a banana probe or a 147-type amplifier instead of the 573A receiver.

6. Locating Faults using the Exploring Coil with Audio Tone

6.1 Using this method, you can locate shorts, grounds, or crosses on a pair.

1. Connect the transmitter either across the faulted pair, or from one side to ground.
2. Turn the locate mode selector to faultmeter. The meter needle should go into the red fault zone. If the needle falls in the white or green zone, you cannot tone the fault. Return the switch to cable locate audio.
3. Turn the transmitter output level selector to 1. Connect the exploring tone coil to the receiver and listen for tone on the cable. If you do not hear a tone, increase the selector setting until you do. Use just enough tone to locate the fault. Overdriving may push the tone past the fault causing you to mislocate the trouble.

4. Follow the cable with the exploring coil. The fault is located at the point where the sound stops (a short), or drops off sharply (grounds present).

5. To locate a point of low insulation due to moisture in the pulp cable, use the above procedures to locate a short or ground. To locate the fault as a cross, select a number of pairs having the lowest resistance, divide them into two groups and connect each group to the tracing current. You will hear tone on one side of the cross and reduced tone on the other side.

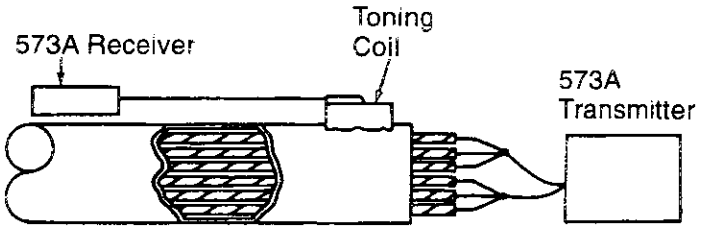


Figure 5 Locating a Point of Low Insulation as a Cross

6. To locate the point of a split in a cable, attach tone to one pair of the split and strap both pairs together at the far end (first attachment, below). The exploring coil detects a weak tone from the transmitter to the split, and a strong tone from the split to the far end. Check the locate by attaching the transmitter to one conductor of each pair (second attachment, below). The tracing tone will be strong from the transmitter to the split, and weak from the split to the strap.

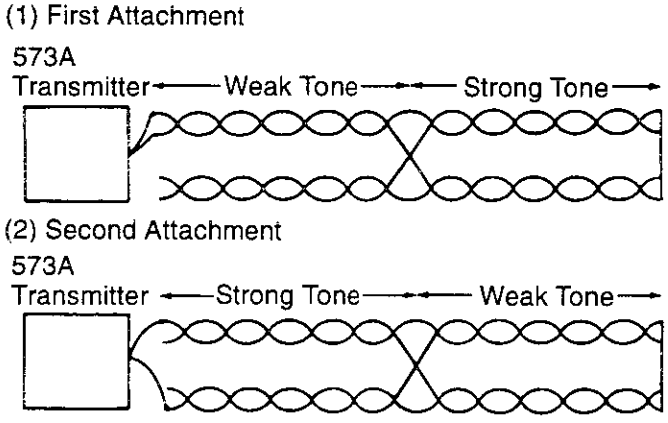


Figure 6 Attachments for Split Location

7. Slack-Loops and Butt-Splices

7.1 To identify the presence of a slack-loop or butt-splice in a cable path, first locate and mark the cable path using RF or audio tone. Retrace the path following these steps.

1. Set the receiver mode selector to peak.

2. Hold the receiver so the handle is perpendicular (across) the cable path. The tone from the receiver should be minimum. Next, retrace the cable path.

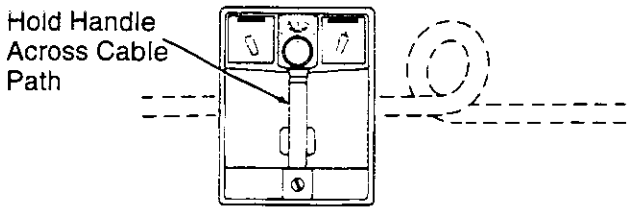


Figure 7 Locating a Slack-Loop or Butt-Splice

3. When the receiver passes over a slack-loop or butt-splice, the tone increases and the meter needle deflects to peak. This indicates a sudden change in signal caused by a turn in the cable path.

Note: *The receiver senses slack-loops and butt-splices only if you hold the handle perpendicular to the cable path. When you hold the handle parallel to the path, tracing tone remains constant.*

4. Mark each occurrence of increased tone. Whenever you encounter such a condition, check to see if an unknown lateral exists (refer to paragraph 8.1).

8. Unknown Laterals

8.1 To check for unknown laterals from a closure, first mark the cable path and then retrace the cable, marking any butt-splice or slack-loop using the following steps.

1. Switch the receiver to peak mode and walk 10 to 25 feet off the path, away from the mark. Hold the receiver so the meter end of the handle points directly away from the mark. Walk in a circle around the mark with the receiver pointing outward.

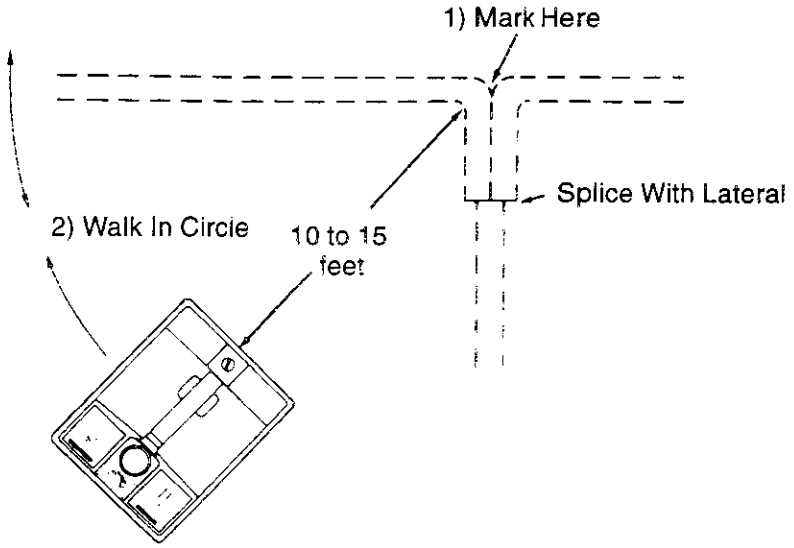


Figure 8 Locating Unknown Laterals

2. The receiver remains relatively quiet until it crosses a lateral, or the actual cable path. The tone peaks when you are directly over a lateral. Since there may be several laterals radiating from the closure, mark each occurrence of tone around the circle. After you have located each lateral, trace and mark the cable path.

9. Locating Cables from Pedestals or Accessible Closures

9.1 To locate cables from pedestals or accessible closures, first place tracing tone on the cable or conductor using either direct connection (RF or audio), or the Dyna-Coupler (RF tone only) and then follow these steps.

Note: When using RF tone and the Dyna-Coupler, be sure to place the coupler between the common bond and the point where the cable goes underground. The bond actually backstops the tone and directs it down the cable.

1. Switch the receiver to peak mode and walk 10 to 25 feet away from the access. Hold the receiver so that the meter end of the handle points directly away from the pedestal or closure. Walk in a circle around the pedestal or closure with the receiver pointing outward.

2. The receiver remains relatively quiet until it crosses a cable. Tone is loudest when the receiver is directly over the cable with tone on it. There may be several cables radiating out from the closure, so mark each occurrence all the way around the circle. After you have located each cable, apply tone to each one and trace and mark the path.

10. Service Drop Location

10.1 When locating the path of a service drop, use RF tone and standard cable locating procedures. It may be more convenient to use a direct connection to the drop at the protector.

1. Connect the red clip of the transmitter output cable to the protector and place the transmitter on the ground (or connect the black clip to the ground rod).

2. Locate the cable using null or peak mode.

11. Locating a Clear or Severed End

11.1 This procedure locates the unterminated or open end of a cable drop. Normally, it can only be performed in the RF tone mode, but if the severed end of the cable is grounded, you can use audio signal. Check for ground as a fault in the faultmeter setting on the locate mode selector.

1. If the cable is bonded or connected at one end, use the Dyna-Coupler to put RF tone on the cable. Attach the coupler between the bonding, or connecting point, and the point where the cable goes underground.

2. Use direct connection for audio tone if the cable is grounded at the far end, or RF tone if the cable is clear at both ends.

3. Set the receiver to peak and trace the cable path. The tone decreases suddenly at the site of the clear or severed end.

12. Cable Connection Tips

Risers

12.1 When locating a cable going underground from a riser, use RF tone and the Dyna-Coupler. Reach above the U-guard, pull the cable away from the pole, and attach the coupler around the cable. You can now trace the path of the cable.

Pressurized Cables

12.2 To place tone on pressurized buried or toll cable, locate a pressure valve and connect the transmitter's red clip directly to the valve assembly. For best results, place the transmitter as far away from the valve assembly as possible. Use the 9043 20 ft. Extension Cable. Test for ground continuity as a fault with the locate mode selector at faultmeter to assure continuity between the valve and the cable. Use either RF or audio tone. Audio is preferred for toll cable because of its longer range.

Section 5 Care And Maintenance

1. Battery Tests

1.1 Use the following procedure to check the batteries in the transmitter and receiver.

1. The transmitter's output level selector has a momentary-contact bat/test battery test position. Hold the output level switch fully counter-clockwise for 5 to 10 seconds. The batteries are good if the meter needle remains in the bat ok position. As the batteries age, the meter needle will not deflect as far into the ok range. When the needle is at the low end of the scale, replace the batteries.

2. On the receiver, hold the receiver mode selector fully counter-clockwise to batt for 5 to 10 seconds. The meter should indicate bat ok. If not, replace the batteries.

2. Battery Replacement

Transmitter

2.1 The transmitter uses four standard 6-volt carbon-zinc lantern cells. Refer to Table A for replacement types. Follow these steps to replace the batteries.

1. For access to the transmitter battery compartment, remove the receiver from the case. The batteries are located in the bottom of the case beneath a plastic storage tray. Remove the four screw fasteners and lift out the storage tray. Remove the battery cover clamp and cover.

2. Disconnect each battery and replace with new ones using the following diagram.

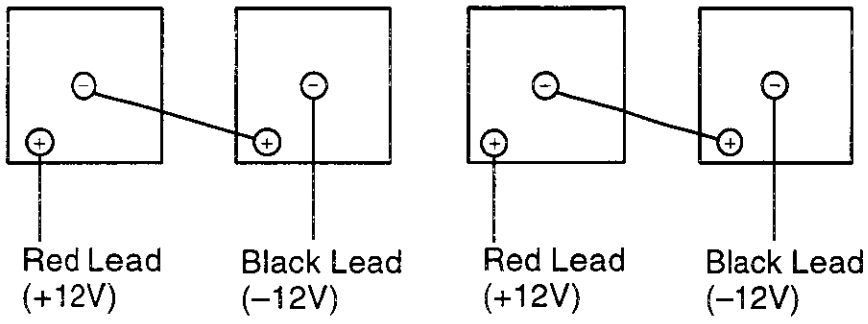


Figure 1 Transmitter Battery Connection

Note: The transmitter has a protection circuit that prevents damage if the leads are incorrectly connected. The transmitter, however, will not operate in this condition.

3. After replacing the batteries, verify proper operation with the battery test procedure. When you are finished, replace the cover, clamp, and storage tray and tighten the screw fasteners.

Receiver

2.2 The receiver uses four 9-volt carbon-zinc transistor batteries located under the access cover at the end opposite the controls. Refer to Table A for replacement types. Use the following procedure to change the batteries.

1. Remove the access cover located at the end of the handle opposite the meter. Replace the batteries and verify proper operation with the battery test procedure.
2. Replace access cover and tighten the cover screws.

Table A
Battery Types

Unit	Number of Batteries	Voltage	NEDA	Eveready	Burgess	Rayovac
Transmitter	4	6V	915	510S	F4BP	954
Receiver	4	6V	1064D	1222	2MN6	D-1604 Long life

3. Battery Life

3.1 Battery life should exceed 100 hours of use under average field conditions.

4. Fuses

4.1 To test the transmitter fuse, insert the Direct Connect Cable into the transmitter output jack. Set the locate selector to faultmeter and hold the fuse between the red and black clips. The meter needle should deflect into the red fault zone to show low resistance. If not, the fuse is bad and must be replaced.

5. Accessories

5.1 Following is a list of optional connection cables and accessories.

1. 3005 Dyna-Coupler (1 inch)
2. 3011 Inductive Probe Head (1/2 inch)
3. 9023 Extension Cable (6 feet)
4. 1196 Dyna-Coupler (6-inch)
5. 3013 Direct Probe (1/2-inch)

3M

Telecom Systems

6801 River Place Blvd.
Austin, Texas 78726–9000

This literature was printed in the U.S.