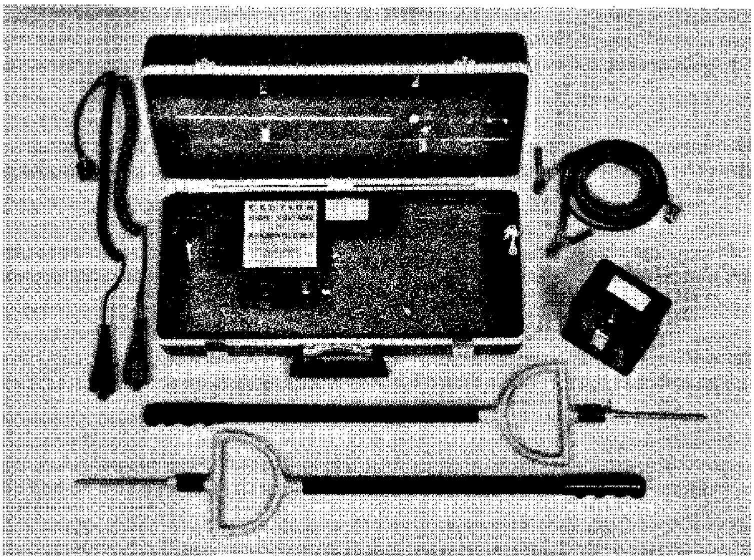
INSTRUCTION MANUAL



EG 3000 Earth Gradient cable
cable Fault Locator

and

EG 3000T includes Cable Locating with Impedance Matching

To Locate All Unshielded Cable Faults and Sheath-to-Ground Faults

Plus:
Cable Tracing
- Direct
- Inductive
- Inductive Coupler

INSTRUCTION MANUAL

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I. When to Use Earth Gradient Fault Locating

Earth gradient techniques can only be used on "unshielded, insulated" cables and can only locate a "short" or a "nonlinear" fault.

A. Short

A short occurs when direct metallic contact has been made between two or more conductors, such as a phase-to-phase, phase-to-neutral, or phase-to-ground. A high fault current will flow and the voltage will collapse. This causes the fuse or breaker to blow. The fault resistance will measure less than a few ohms

B. Nonlinear

A nonlinear fault occurs where the cable has an insulation failure. An arc will form at the fault at some voltage level equal to, or less than, the normal operating voltage of that cable. The fault resistance can measure several thousand ohms. This same fault can change to almost a dead short at the correct operating voltage, or the cable might still be in service with some lower-than normal voltage present. In other words, the cable fault is leaking current to ground, but the fault resistance is high enough to keep from blowing a fuse or breaker.

II. Earth Gradient Fault Locating Process

To begin the locating process, the faulted cable is isolated at both ends and then a pulsed voltage is applied between the faulted cable and a ground rod. When the voltage pulse flashes through the fault to ground, fault currents travel from the fault back to the transmitter ground rod. These fault currents set up a "voltage gradient" in the earth that can be measured.

The detector used to detect the fault consists of a high gain amplifier and "0-center" meter. The input to the detector comes from two probes that are pushed into the ground, which pick up the voltage gradient present.

The detector and the probes are moved down the route of the faulted cable. The input probes are set some distance apart, much like the chain used in football to mark yardage. The input probe that is closest to the fault will deflect the "0" reading meter toward that probe. As the detector passes beyond the fault, the "0" reading meter will deflect in the opposite direction, because the opposite input probe is now closer to the fault. When the two probes are at an equal distance on each side of the fault, the meter will remain at "0", or in a "NULL" position.

The gradient field will be very strong near the ground rod and the point of fault. The fault current will spread out over a wide area as it travels from the point of fault to the ground rod, so the detector may see a reduced amount of signal in the area between the fault and the ground rod. In other words, the operator will see a large meter pulse on the detector near the ground rod. As the detector moves down the cable, the amount of signal (meter pulse) will reduce. It may fall off to a very small reading, or no reading at all, until the general area of the fault is reached. The dropoff is more pronounced if the fault is some distance from where the transmitter is connected to the cable or if the ground cover is asphalt or concrete.

As the probes are moved along the route of the cable, readings should be taken every few feet. Being in a hurry and moving the probes too far between readings allows the operator to leap past the fault without finding its location. This is especially true in very dry sand or over asphalt or concrete. Until the operator becomes an experienced fault locator, he should move the lead probe 5 to 10 feet down the route of the cable. The back or trailing probe, should be placed where the lead probe was before it was moved. Once the fault is located, further readings should be taken some 10 to 20 feet past it to verify that the operator has indeed gone past the fault. A reverse pulse on the meter should be present. (See Figure A).

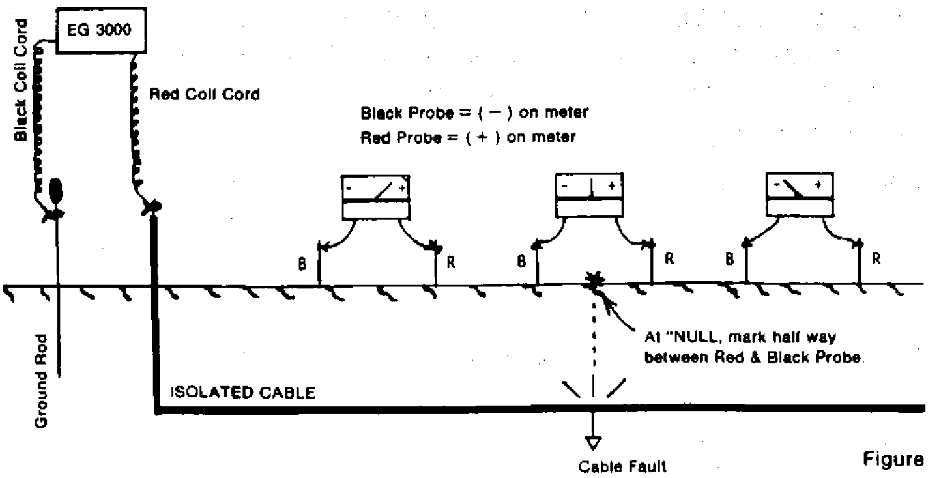


Figure A

III. Description of the EG 3000

A. Transmitter

The transmitter produces a negative square wave pulse into the faulted cable. This pulse will be approximately 1/2 second long, every 4 seconds. (On 1/2 second, off 4 seconds, on 1/2 second, off 4 seconds, etc.) The output voltage can be controlled by the operator.

The on/off switch is also the voltage control, so the transmitter must be reduced to 300 volts to turn the instrument off. This ensures that the transmitter will start up at the 300 volt level the next time it is used. At 3000 volts the transmitter produces 10 milliamps; at 300 volts the transmitter produces 200 milliamps.
The voltage control allows the operator to adjust the transmitter output to the voltage level needed to "flash" the fault, and no more. When the fault voltage level is sufficient to break down the fault, the transmitter automatically takes control of the output voltage control and reduces its voltage to the lowest level required to keep the fault alive. The output voltage level required to flash the fault is stored in the electronics so that if the ground conditions change, the transmitter output will track the fault resistance and keep enough voltage at the fault to keep the fault alive. Into a one ohm fault, the transmitter will produce approximately 2.2 volts, or just over 2 amps of fault current. This high current produces a good strong gradient field and the low voltage protects low voltage cables from voltage stress.

CAUTION:
Always use rubber gloves when operating the EG 3000. Between 300 and 3000 volts can be present* on *the transmitter output.

The fault resistance can change during the fault locating process. For example, soil can dry out and raise the fault resistance level because of the fault current present from the transmitter, or rain can moisten the soil and reduce the fault resistance level. Regardless of the conditions, the transmitter automatically tracks the fault resistance and applies only the voltage needed to keep the fault alive. However, if the fault resistance increases beyond the original voltage level set by the operator when the fault first flashed, the adjustment process takes the voltage no higher. In other words, the voltage control sets the upper limit of the transmitter output voltage. The transmitter's automatic voltage tracking and adjustment functions work only below this limit.
A loud horn (86 db) is placed on the front panel, along with an on/off switch. In fault location conditions where the operator wants to know when the transmitter is pulsing, turning the horn switch to "ON" will pulse the horn every time the transmitter pulses.

The output meter on the transmitter is used for several functions.
1. When making a battery test.
2. To tell the operator when the fault "breaks over" from the voltage applied by the transmitter, allowing the fault to be located. When the fault breaks over and sets up a gradient field that can be measured, the meter pulses. Until the transmitter fires at a level that makes the meter pulse, there is no earth gradient field to detect. Fault location with the detector should not begin until the meter pulses. If the meter does not pulse when the transmitter fires, increase the voltage control until the fault breaks over and the meter starts to pulse.
3. To proof test the cable (to see if the transmitter is connected to a good cable that is not faulted). This is useful after the repair has been made, or to make sure that the transmitter is not connected to a good cable in error. If the meter tries to pulse backwards at a voltage control setting of 1500 to 1700 volts, the cable is not faulted. The cable has been repaired. or the transmitter is not connected to the faulted cable.

B. Connecting to a live 120 volt line

This transmitter can be connected to a live 120 volt circuit (120 volts maximum), which can lead to three problems:

1. Never rotate the function control when the output is connected to a live 120 volt circuit. If a switch contact makes or breaks with voltage present, the contact will draw an arc. This arc can create a voltage spike of over 500 volts, which is large enough to damage the instrument under some conditions.
   Place the function control on TONE TRACE, tap #2, for a cable locate, or on FAULT LOCATE before the output connection is made. Shut the transmitter off and then disconnect the output leads, before another tap position is made.

2. If the transmitter is connected to a live 120 volt circuit, the meter on the transmitter will produce a constant mid-scale deflection. If the transmitter meter registers a constant reading of any type, the cable is not isolated and voltage of some type is on the cable. A fault locate can be made, but do not rotate the function control if the meter has a constant reading of any type.

   The transmitter meter will pulse even though the fault is not breaking over. The neutral ground rod will be seen through the transformer windings and this will provide a conductive path to the soil. These earth currents will be received by the transmitter and will cause the transmitter meter to pulse.
   If the transmitter is connected to a cable that is not isolated at both ends, the voltage control should be set at 3000 volts to insure the fault will break over. When the fault breaks over, the voltage will automatically reduce to a low level and fault currents will automatically increase. This will not damage the cable.
3. If connected into a live 120 volt circuit, a high 60Hz current can be entering the ground at the cable fault. A high 60Hz current in the soil can flood the detector and cause the detector meter to oscillate under some conditions.

   If the detector meter starts to oscillate or produce erratic readings that cannot be corrected with the balance control, stop the fault locate and isolate the cable. A high 60 Hz current can prevent the detector from responding to the transmitter's fault current.

Note: The meter is not useful for measuring actual fault resistance. Claims made to the contrary for any such instrument overlook one item: The resistance of the earth is also involved. The output circuit is from the transmitter output, through the cable, through the fault, and through the earth back to the ground rod and back into the transmitter. This total circuit is the total resistance and each component can vary. In other words, instruments using a meter to measure fault resistance tell the operator only what the total loop resistance is, which includes, but is unlikely to represent, the actual fault resistance.

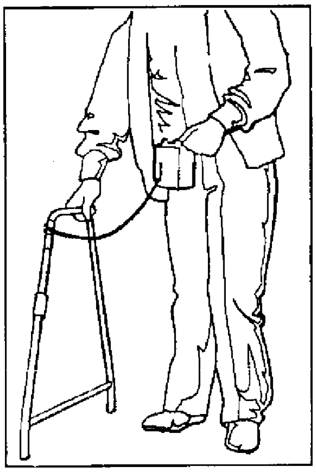
The EG 3000 T has a built-in tone for tracing the cable
When the function control is placed on one of the direct output taps, the fault locator portion of the transmitter is automatically turned off, allowing the same leads used for fault locating to be used for placing a tone on the cable for cable tracing. Even if the cable location and route can be described, the operator should always use a good cable locator and trace out the actual route of the cable to be tested. If the operator is not following the correct route of the faulted cable, a lot of time and energy can be spent without much success.

The transmitter is powered by any of three methods:
1. 120 volt line (60 Hz)
2. Cigar lighter of car or truck with a 12 volt battery (negative ground)
3. Rechargeable 12 volt battery

A good rule of thumb is to charge at least two hours for each hour of operation. A Red LED on the face of the transmitter front panel indicates when the battery is low and on fast charge. The Red LED will go out and the Green LED will turn on when the battery is charged. The cigar lighter or the 120 volt line operation will automatically recharge the rechargeable battery, but the two LED lights operate only when the battery is being charged from the 120 volt power cord (not from the cigar lighter). A 3/4 amp slow blow fuse is also used in the power supply from the AC 120 volt line cord. If the battery cannot be charged from the AC line cord, this fuse should be checked.

C. Detector

When the transmitter is operating and the transmitter meter indicates the fault is being flashed by pulsing up-scale, the EG 3000 Detector is walked down the route of the cable. The two probes can be used, or the operator can use a fixed distance between the probe rods by using the "A" frame probe (picture left) offered as an accessory with the instrument. If the soil is very dry or the operator is a long distance from the fault, a dead spot may be found where the detector will not pick up any pulse. As the detector nears the fault, the pulse can be detected and will increase in strength the closer to the fault the detector gets. The built-in "0-center" meter provides direction to the fault from where the operator is standing.



A sensitivity control, a balance control, and an on/off/battery test switch is found on the front panel of the detector. The battery test switch is momentary and the detector will return to an "off" position when the battery test switch is released. The same switch is used to turn the detector "on" by pushing it down toward the bottom of the detector. The sensitivity control adjusts the amount of signal being fed to the meter. A very small signal is better to use and easier to work with. Even though the transmitter sends a square wave signal to the fault, the earth and cable capacitance will reshape the pulse, creating a reverse kick on the meter if it picks up a large signal. By reducing the sensitivity to a small pulse, the reverse kick can be reduced.

Placing the two probes farther apart can also help in the dead area of no signal. Fault currents are present, but they are spread out, and the weak or reduced amount of fault current creates the dead spot. By placing the two probes farther apart, a greater difference of voltage can be found, allowing detection of a pulse that may go undetected if the two probes are close together.

The balance control is needed to keep the meter near the "0" Center. DC voltages are naturally present in the earth, even when the transmitter is not operating. This DC voltage will enter the detector by way of the two input probes. The balance control is used to offset this spurious DC voltage, so that only the desired transmitter voltage is shown on the meter.

The battery compartment located on the back side of the detector uses two #216 9-volt batteries or equivalent (NEDA #1604). The two batteries are used in parallel to provide longer operation between battery changes. Both batteries should be changed when a change is required. (Since the two batteries are in parallel, one battery would work, but a shorter life can be expected since only half the normal current capacity would be present).

IV. Operation Do's & Don'ts

1. Never use this instrument without using rubber gloves, 3000 volts at 10 milliamps will get your attention, but 300 volts at 200 milliamps could create a serious problem. The only way to make sure the operator is safe is to never violate a safety rule. Rubber gloves are required for safe operation.
2. Install a safety zone with signs, tape, rope, cones, and any other warning tools available to ensure no one can enter the area. Small children, adults, and animals have been injured because a proper safety zone was not installed to keep them out of the area. The price we pay for safe working conditions is very small compared to the price we pay when we overlook it.
3. Locate the cable under test with a good cable locator and mark the route. See the back section for cable locating.
4. Establish a good, solid ground for the transmitter or much time can be lost in the actual fault locating process. Do not move the ground probe while the transmitter is on.

V. Connecting the EG 3000 to the faulted cable

1. After the route of the cable to be worked is located and marked, isolate the cable at both ends. If the cable is on a tap feed, make sure that each meter being fed from this cable is pulled. Also check and make sure any and all street lights are disconnected. Street lights are sometimes tap fed from a transformer to house cable. The cable is not ready to fault locate until ALL ends are isolated.
2. Connect the black high-voltage coil cord from the transmitter to the ground rod.
3. Connect the red high-voltage coil cord from the transmitter to the faulted cable.
4. Choose the method of operation: AC Line, 12-volt cigar lighter, or the internal battery.
5. Make sure the function control is set at Fault Locate. If the transmitter does not have tone tracing abilities, the function control is not present and the transmitter is always in the fault locating mode.

6. Turn on the transmitter.
7. Keep the voltage control at 300 volts. If the meter pulses when the transmitter fires, the fault has flashed. The automatic voltage reduction has already taken place and any increase of the voltage control would serve no purpose. The detector can now be used to walk the cable in search of the fault.

When a good earth ground is needed

If the cable is properly isolated at both ends, the fault location can be started from either end in most cases. System ground or neutral can be used instead of the ground rod in the earth, but this can also create problems in the fault locate. Whenever possible, the ground rod should be used and positioned as far away from the system ground rod as possible. Some fault locates may require the neutral to be removed from the system ground rod. This would be true if fault currents are finding a way to the neutral cable. The system ground rod would then look like a ghost fault..

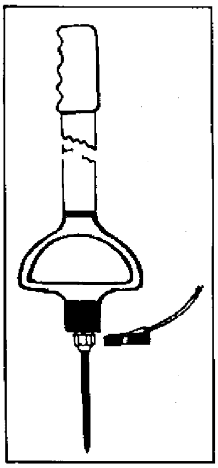
The ground rod should be off to one side of the cable route and as far away from the cable as possible. Never place the ground rod over the route of the cable under test.

If the ground rod is placed over the route of the faulted cable, and the fault is either near the rod or between the rod and the transmitter, the fault can be hidden by ground currents between it and the ground rod. If the ground rod can be placed on the opposite side of the connection from the route of the cable, even those faults within a few feet of the cable connection can be found in a very short time.

VI. Connecting the Detector for Use

The plug with a long black wire and a short red wire is connected to the top side of the detector. The two small cable clips should be connected to the HEX-NUT between the probe rod and the black plastic insulator just below the stirrup. The plastic insulator will protect the operator from the earth connection when the rods are in the ground, if the operator does not make contact with the metal portion of the probe below the black plastic insulator. (See Fig. B).

Figure B



The voltage being picked up by the probe is very small and could not hurt anyone, unless the probe tip was in contact with a high voltage (electric fence, a live cable in the ground, or the cable fault when the transmitter fires).

The detector is worn around the neck with a neck strap. All controls are on the front panel, and the battery compartment is recessed, so the detector can be placed on the ground as needed.

The face of the meter has a battery test mark on the right hand side of "0". If the meter shows the battery to be OK, the detector can be turned on by pushing the switch down. If the battery test falls below the Battery OK area of the meter, both batteries should be replaced.

The upper portion of the meter face has a (+) Red on the right and a (-) Black on the left. The (+) Red on the meter is the red wire probe input and the (-) Black on the meter is the black wire probe. The operator should carry the red wire probe in the right hand and the black wire probe in the left hand during fault location.

Insert the two probes into the ground and let go of them. Turn the sensitivity control up or down so that the meter is getting a small kick in the (+) or (-) direction. If the two probes are over the route of the cable, the direction the meter kicked is the direction the fault will be from that point. In other words, if the meter kicks to the (+) Red side on the meter, the red wire probe is closer to the fault than that of the (-) Black wire probe.

If the operator is near the ground rod being used, a large kick may be found. The kick could be a large one if the probes are far apart, or if the sensitivity is turned up to some high setting. The ground rod being used is the collector of fault currents making their way back to the transmitter, thus, the concentration of fault current could appear strong enough to indicate you are near the fault when you are not. As you move down the cable route away from the transmitter, the fault current indication could reduce to a very small kick. It could die out to where you are not picking up any meter kick even at full gain. This means the fault is some distance from this point, and the fault currents are spread out over a large area on their way back to the ground rod. The fault currents may have collected on some other conductor in the area like a water pipe near the ground rod. In theory, the fault current should travel from the fault to the ground rod in a straight line. This is not always the case when other utilities are in the area..

If this were always true, the operator could rotate around the cable ground rod until he found the strongest meter kick. He could then travel in that direction until he found the fault. In some cases this would work, but the rule of thumb will always be to follow the route of the cable. Sooner or later, serious problems will arise by taking the easy way out.

Separating the probes will help produce larger readings. Move down the route of the cable and insert the probes into the ground every 5 to 10 feet. As you approach the fault, the detector will start receiving larger and larger pulses with the same sensitivity setting. If the meter starts pulsing off scale, and then receives a large reverse kick, the sensitivity should be reduced for a clear meter reading. Shortening up the distance between the two probes will also reduce the amount of signal, or meter pulse, when the transmitter is firing.

When you start your fault locating, the red or black probe can be toward the fault. Regardless of which probe is toward the fault, you should keep that probe as the lead probe. Proceed down the route of the cable in a "football chain" like method. At some point, the meter will kick in the reverse direction, or toward the opposite probe. You have now passed the fault. Move back to the point where this reversal took place and place one probe on each side of the suspected position of the fault. If the meter is kicking toward the red probe, move the black probe a few inches at a time toward the red probe. At some point, the pulse, or meter kick will start reducing. When the meter starts kicking toward the black probe, this will indicate the black probe was moved too far. When a spot is found where no kick, or meter deflection is found (a null point), and the movement of either probe will provide a meter pulse, the fault will be halt way between the two probes, if the probes are over the route of the cable. (See Fig. A, page 4).

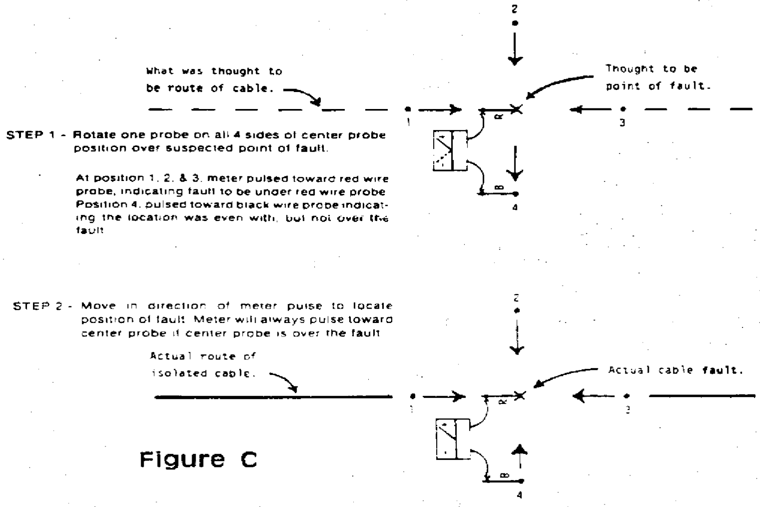


Figure C

Place one of the probes directly over the point marked as the fault (center). Move the other probe around all four sides of the center probe, keeping the probe being rotated an equal distance from the center probe at each of the four side locations. If the meter always kicks toward the center probe, you have located the fault.

If on one side of the center probe, the meter kicks in the opposite direction, this means the probe to that side is now closer to the fault. You were probably off to one side of the cable route. Move the two probes in the direction of the meter kick until the meter again kicks in the reverse direction. When you find the spot where a probe can be rotated around the center probe and the meter will always kick toward the center probe, the center probe will be directly over the fault. (See Fig. C, this page).

VII. Helpful Locating Techniques

1. A problem some people have experienced operating the EG 3000 occurs when they preset the sensitivity control to full gain, without testing lower settings first. The A-Tronics-Europe detector is a very high gain amplifier that registers extremely small currents. Operating at full gain can slow the locating process, because stray currents can be seen that did not come from the fault and constant use of the balance central will be required. This problem has occurred, we have found, because operators were used to other brands of detectors with less sensitive systems.
   Use only enough gain to see the pulse. At 5 or 6 on the sensitivity scale and below, we have the same gain as Brand X, Y & Z and our detector is very stable. The only time you can use the high portion of the sensitivity control is if the probes can be inserted in the ground and the operator removes his hands from the probes. Even a small movement caused by wind in the metal-to-earth contact can produce a meter reading. This detector is as high as one should ever go on an earth gradient detector.
   Stray voltages in the ground from an outside source can trip the electronics into a solid signal in one direction. The balance control can over-ride this outside influence. Set the balance control for a meter "0"; the operator can then see a meter kick, or pulse, when the transmitter fires.
2. In some ground conditions, it is not possible to insert the probes into the ground. Rock, cement, or asphalt can be a problem. In this condition, do not use the two probes. The two cable clips can be clipped to two household sponges that are soaked in salt water (approximate size 4x4x1). Two good size sponges in a wide mouth picnic cooler jar filled with salt water is an item every truck should have back up tool. Two cups of rock salt in two or three galloons of water is a good mix.

   With the two cable clips connected to the wet sponges, move the sponges down the route of the cable under test. If it is not possible to use the two wet sponges, soaking the area with a garden hose can provide good results with the two probes. Two large copper plates (approx. 6x6 inches each) could also be used, if water cannot be applied to the area. Nails driven through the road cover is another method often used. Touching the two probe tips to nails that are driven into the road cover will most often produce the results needed to locate a fault.

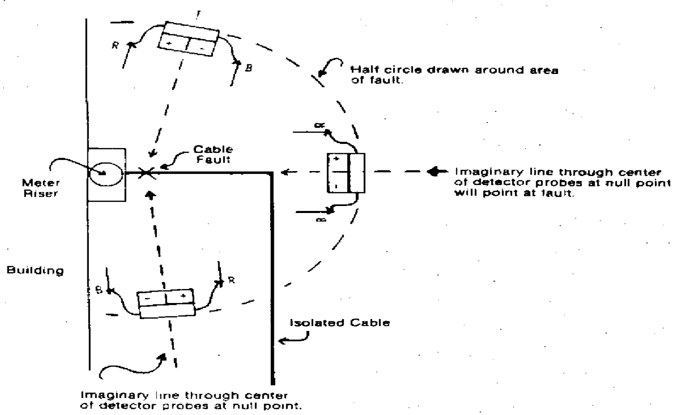


Figure D

3. If the transmitter is connected to a meter riser, and the fault is at the riser, locating the fault can be a problem. The fault current leaving the cable at the point of fault is so close to the ground rod that the area is flooded with a very strong gradient field, creating a confusion in readings on the detector. If you suspect the fault to be near the transmitter or ground rod, move the transmitter to the other end of the cable. You will not want the ground rod anywhere near the fault to be located. As mentioned earlier, the ground rod is the collector of fault currents for the transmitter and this concentration of fault currents, if placed near the point of fault, can obscure detection of the desired fault current. Much time can be wasted trying to read through the large mass of currents the detector sees if the ground rod is nearby.

4. When you have any fault in a position (like at a meter riser) where the probes cannot be set on each side of the fault, draw a half circle around the area of location. (See Fig. 0 on page 11). Notice that if the probes are rotated until a "NULL" is found, an imaginary line drawn through the center spacing of the two probes is aimed at the fault. The lines through several NULL points all converge on the same spot, which is the fault location. You can test this method on any fault. Move off to one side of the fault and place the two probes in the ground so that each probe is an equal distance from the fault. Notice that in each case, the detector will see a null and at that point, an imaginary line through the center of the two probes will point at the fault.

VIII. Features & Advantages of the EG 3000

- The EG 3000 detector has as much gain as any detector on the market.
- The EG 3000 transmitter can produce up to 3000 volts of signal if that is what it takes to flash over a high impedance fault.
- Only that amount of voltage needed to flash the fault is used to solve the problem.

Aluminum hydroxide and copper sulfate are both insulators. When moisture comes in contact with aluminum or copper, this oxide forms and what was a low impedance fault can become a very large resistance. This resistance allows a leakage path to earth, and a low voltage can result on the line because current is going to ground.

All other earth gradient fault locators place a high voltage on the cable to flash the fault. A couple of the locators will reduce down to some lower voltage, after the fault has flashed, to some lower resistance value, but even on a low resistance fault, their first few pulses into the cable are at the high voltage limits of their instrument and their gradient current is low.

The EG 3000 does not do this. A voltage control is mounted to the ON-OFF switch so the voltage must be reduced to turn the instrument off. Most cable faults can be flashed at 300 volts, where the EG 3000 starts when first turned on. If 300 volts does not break down the fault, you know it is a high impedance fault and a little more voltage is needed. The operator gradually turns up the voltage control while watching the meter on the face of the EG 3000 transmitter. When the voltage level is high enough to flash this high impedance fault, the transmitter will automatically reduce itself to the lowest voltage needed to keep the fault alive, and the meter on the transmitter will pulse.

How does this differ from the other locators on the market? The EG 3000 will not place any more voltage on the cable than is required to flash the fault. The operator has control of what the instrument is doing. In this way a low voltage cable will never have a voltage that is higher than needed to complete the fault locating job. Stressing low voltage cables with a high voltage and high current at the same time is of some concern to all utilities. By placing excess voltage even briefly on a low voltage cable, as other locators do, you can create as many problems as you solve.

IX. Cable Locating

A. Connecting the Transmitter for Tracing the Route of the Cable

Make sure the EG 3000 is turned "off" before any connections are made. Isolate the cable at all ends and connect the EG 3000 as follows:

1. Connect the large cable clip with the black coil cord to a good solid earth ground. A 19" ground probe supplied with the instrument can be used.
2. When the ground probe is in the ground, connect the black cable clip to the little hex nut at the top end of the 1/4" rod.
3. Connect the large cable clip on the red coil cord to the cable. Make sure the cable is stripped and the clip is on clean bare metal.
4. The 3 pin connector on the other end of the red and black coil cord should be plugged into the left side of the EG 3000 transmitter.
5. Set the "Fault Locate-Tone Trace Tap Switch" to anyone of the out tone trace taps. Do not set it on the fault locate.
6. Turn the EG 3000 transmitter on.
7. Turn the receiver on and set it down 5 to 10 feet from the red or black coil cord.
8. With the receiver set so the meter can be seen from the transmitter, adjust the sensitivity for a mid-scale meter reading.
9. Adjust the transmitter tap switch through the tone trace taps and find the tap position that will provide the highest meter reading on the receiver. When the tap switch is at the position where the highest reading on the meter is obtained, the transmitter output impedance is most closely matched to the cable being traced, and the cable tracing can begin.
10. The tone trace power control just to the right of the tap switch should be set at low. For greater tracing range and deep locations, a higher power level may be required, but most locations can be made with a low setting.

WARNING:
A switch contact making or breaking 120 volts can arc and this will. produce a high voltage transient spike of 500V or more. This high voltage spike can reflect back into the transmitter and create problems. Thus, the Function Control should be on TAP#2 of Tone Trace and the transmitter should be "OFF" before a direct connection is made on a live 120-volt circuit.

B. Null Tracing Method

With the Sensitivity control adjusted for an on-scale meter reading and the antenna vertical to the ground (parallel to the extension arm), walk in the direction that the meter reading increases. The meter reading will increase as the antenna approaches the cable (see Fig. E). Directly over the cable, a loss of signal will be found and the meter will decrease to a zero or minimum level. The signal will return to a high level and then start falling off as the antenna leaves the exact center of the cable. On both sides of the cable, a high meter reading is available, but a loss of signal occurs when the antenna is directly over the cable.

The center of the cable will be directly below the "null" or minimum meter reading. The Sensitivity control will determine how sharp or how broad the null will be. The operator cannot see the lowest reading if the meter is below a "0" reading. If the null is broad, increase the sensitivity control until a sharp null is found. If the null is so sharp that the meter does not have time to respond, the operator could walk over the cable and not see a null; however, he might hear a small loss of tone. The sensitivity should be reduced to the point where a sharp null can be found.

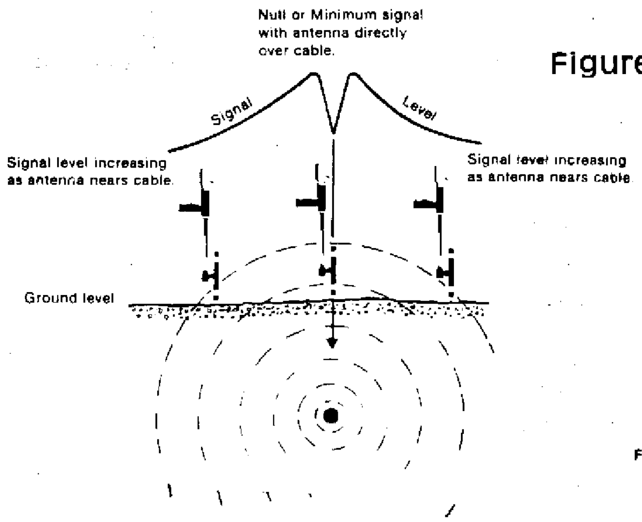


Figure E

The cable can now be traced by finding two (2) null points. This will give the operator the direction of the cable run at that point. By walking in the direction to be traced, move the instrument (receiving antenna) from side to side, keeping the receiving antenna vertical to the ground at all times (do not *swing* the antenna). A higher meter reading will be found on each side of the cable with a null occurring directly over the center of the cable.

The signal being radiated from a single cable will be round and the null will be easy to find. If more than one utility is in the same trench, or area, the signal being radiated from each utility can add together producing a distorted field. This distorted field can wash out a null to a point where the receiver cannot produce a distinct null. If the null cannot be found, go to the maximum method of locating.

C. Maximum or Peak Tracing Method

With the Sensitivity adjusted for an on-scale meter reading and the antenna horizontal and close to the ground, walk in the direction that the meter reading increases (see Fig. F page 15) to some on-scale reading. The meter reading will increase as you near the cable. If the meter goes off-scale (above 10), reduce the Sensitivity control to an on-scale reading again (the operator cannot see a maximum meter reading if the meter is off-scale). By keeping the meter reading on scale as the operator walks in the direction the meter reading is increasing, a maximum meter operator crosses the cable. As the operator continues past the cable, the meter reading will start decreasing. Hold the receiving antenna directly over the maximum or peak reading and slowly rotate the instrument until a new peak reading is found. When the antenna is directly over and at right angles (90°) to the direction of the cable path, the highest reading will be found. The cable will be directly below the center of the antenna.

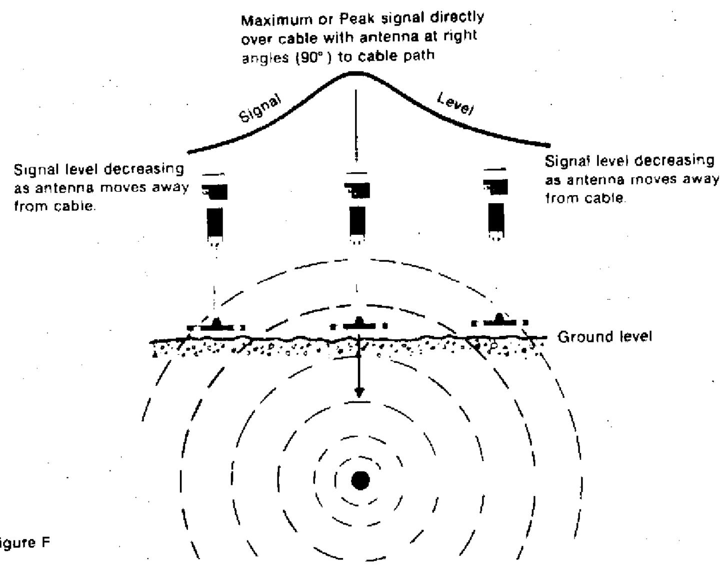


Figure F

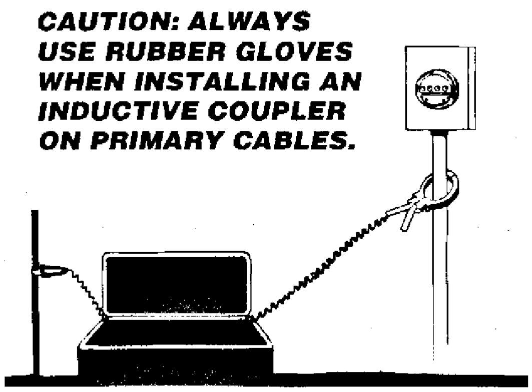
Now that the cable has been located, the cable path can easily be traced. With the antenna directly over and at right angles to the cable path, walk in the direction to be traced. Keep moving the instrument from one side of a maximum reading to the other. Each time a maximum reading is found, the cable will be directly below the receiving antenna. Do not swing the antenna from side to side.

When the cable has been found and the exact position is needed, turn down the Sensitivity control until a very small movement of the meter can be seen as the antenna passes over the cable (the lowest reading the operator can detect on the meter). This will help insure that other cables in the area are not influencing the location

NOTE: If you obtain a *wide or broad peak reading from the receiver when locating your cable near the transmitter, see "Correctinq a wide or broad peak reading on a cable trace".*

D. Tracing with the Inductive Coupler

The Inductive Coupler can only be used on a cable or conductor that is grounded at both ends. This ground can be through a low impedance load of some type such as a transformer or appliance. The soil is the signal return path on a closed loop and, if the cable is not grounded, the circuit loop is open and no signal current can flow.



A street light in the day time could not be traced with an Inductive Coupler because the photo-cell is open. At night when the photo-cell is closed, the cable could be traced with the Inductive Coupler. A jumper cable and a screw driver could be used on a cable to ground one or more ends. A secondary service can be located even if the meter is pulled because the ground will still be in place, provided the cable is still grounded at the transformer and at the meter base.

The Inductive Coupler is plugged into the EG 3000 T transmitter by way of the phone jack just to the right of the battery test switch. The TONE TRACE TAP SWITCH should be set to TAP #1. This will set the impedance of the transmitter to the impedance of the Inductive Coupler for the best trace.

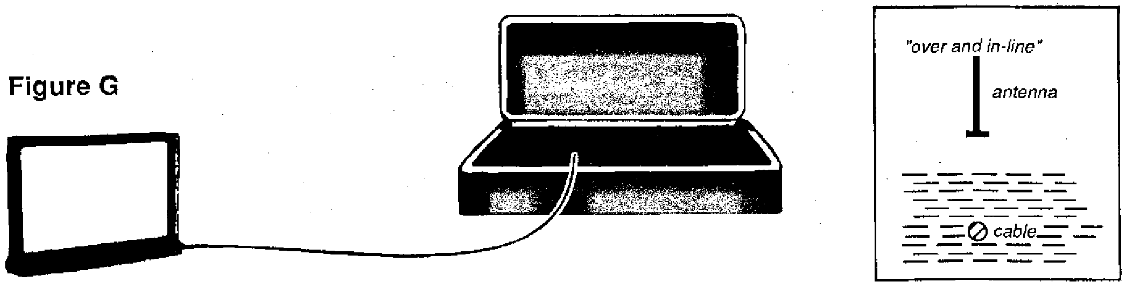
On primary cables, the Inductive Coupler should always be placed around the neutral, or over neutral and cable. The Inductive Coupler should never be used on the elbow side of the neutral break away point. On a direct buried 3-phase cable, place the Inductive Coupler around all three cables. If it's placed around one cable, very poor results will be obtained because all three cables are grounded to each other along the cable route.

E. Inductive Tracing

The Inductive Antenna is plugged into the EG 3000 T transmitter by way of the phone jack just to the right of the battery test switch. The TONE TRACE TAP SWITCH should be set on TAP #2.

Set the Inductive Antenna *'over and in-line"* with the cable to be traced. The antenna is not only placing Signal into the ground, but it is also radiating into the air around the antenna. If the receiver is used too close to the antenna, the receiver will pick up the antenna instead of the cable that is to be traced. The receiver must be 20 feet or more from antenna before a cable trace can be made. (See Figure G).

Figure G



F. Correcting a Wide or Broad Peak Reading on a Cable Trace

When using the Direct Output mode of tracing, there may be times when a wide or broad peak reading is found even though a low power setting is being used. This can be true when you are very close to the transmitter. The transmitter is placing enough tone on the cable that it is flooding the receiver.

Reducing the amount of signal the transmitter is placing on the cable can be accomplished by mismatching the TONE TRACE TAP SWITCH. Switch the tap switch to a tap position that is farthest away from the correct tap switch position. The impedance matching will be wrong and the transmitter will reduce the amount of tone being placed on the cable. On that tap, a long or deep trace cannot be made, but the reduced signal will allow a sharp peak reading to be obtained.

G. Determining Depth

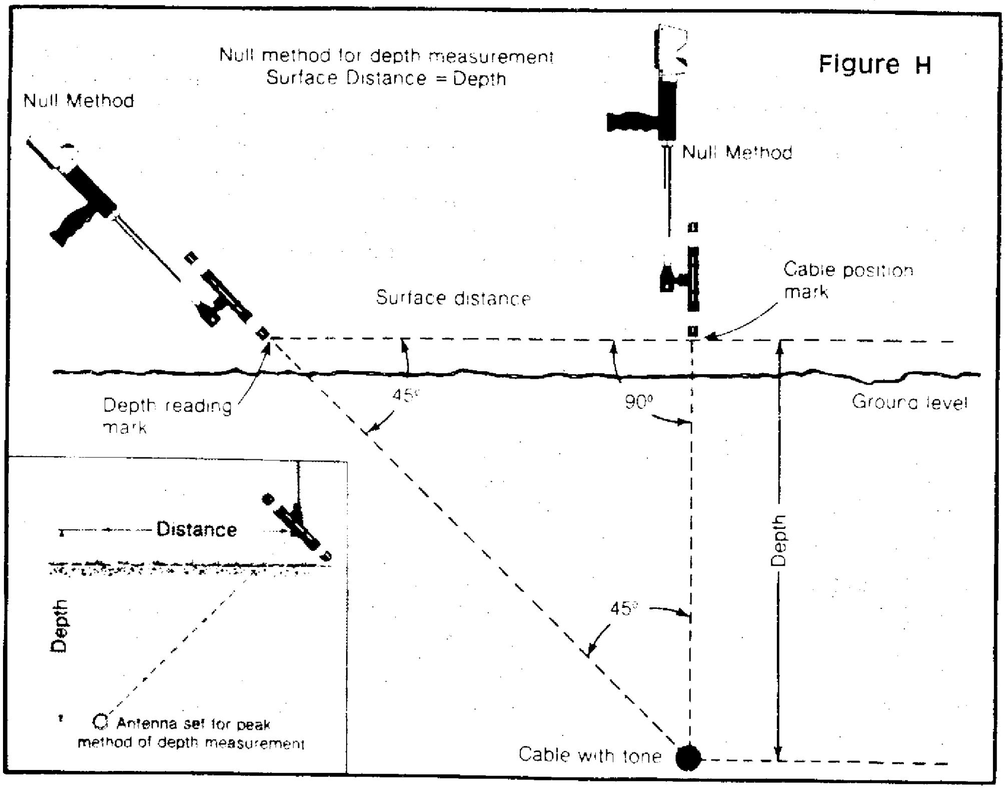
The null or maximum methods will locate the depth of a cable. While this manual only explains the null method, the maximum method can be used if the operator positions the receiving antenna for a maximum signal at 45°.

On a 45° triangle, two of the three sides will always be equal. The true 45° angle for the null method will be when the bubble is center or shows level on the depth gauge. (See Fig. H page 17).

The receiving antenna should be adjusted to the vertical position for a null reading. After the cable has been located and its exact position marked, the receiver should be tilted to a 45° angle with the antenna close to the ground. With the operator facing the cable and off to one side, move away from the cable at a right angle. (See Fig. H) When the receiving antenna is again pointing at the cable, a new null will be found. Mark this depth null on the ground. Measure the distance between the depth mark and the cable position mark. The distance between these two marks will be the depth of the cable.

The Sensitivity control may have to be adjusted while making a depth reading. The null found should be sharp enough to pinpoint the spot you want marked. Also, bear in mind that the distance is calculated at a 45° angle from the receiving antenna. The calculations will have to take into account any slope of the terrain, or the height that the receiving antenna was held above the ground when making the depth measurement.

When possible, a depth reading should be made from both sides of the cable. If both depth measurements agree with each other, the operator can assume a good depth measurement has been made. If the two depth readings do not agree with each other, the operator should again locate the position of the cable and then repeat the two depth measurements. If the two readings still are not the same, care should be used when digging up the cable, Other cables in the area, or other utilities that have signal on them could be distorting the field being radiated from the cable under location. If this distortion is present, the located position and depth could be off.



X. Care of the EG 3000

The EG 3000 can be used in almost any type of weather or operating conditions. However, a few steps taken in care of the instrument can prevent needless down time.

1. In rain or snow the transmitter lid should be closed, or the entire transmitter can be placed inside a large plastic bag.
2. No electronic instrument of any type should be left in a truck overnight if it is wet. Prolonged exposure to moisture will shorten the life of any instrument, so the EG 3000 should be placed in a warm, dry room for the night if it has been exposed to moisture.
3. A rechargeable battery will provide a much longer life if it is not used in a complete discharged condition. The EG 3000 battery should be recharged after each use to ensure that the battery is ready to use on the next cable fault. The battery used in the EG 3000 is a 6.5 Ah, 12-volt sealed lead-acid type and provides well over 8 hours of continuous use when fully charged.
4. Keep the instrument clean. Mud, dust, moisture, and chemicals are all corrosive materials when they contact metal parts. A little time taken in keeping the instrument clean will insure the EG 3000 is ready to work when you are.

XI. Service

If for any reason you have trouble, or require assistance with your instrument, contact the nearest A-Tronics-Europe sales outlet. You may, if you so desire, write or call directly to A-Tronics-Europe, manufacturing plant and give full details of your problem or needs.

Service can be performed at any authorized service center; however, our factory will respond much faster to your needs. We have stock on all components used and have the test equipment needed to keep your down time to a minimum. We recommend that all service be performed at our manufacturing plant.

XII. Warranty

All A-Tronics-Europe, products are warranted against defective materials and workmanship. The EG 3000, EG 3000T and EG 3000TP Cable Fault Locators have a one year warranty period from date of purchase.

A-Tronics-Europe will repair or replace all products which prove to be defective during the warranty period. All repair on warranty items will take place at our manufacturing plant. The decision of determining warranty defects from abuse or breakage, lies with A-Tronics-Europe or with the authorized manufacturing representative servicing your area.

If you send your instrument in for factory service, please send it pre-paid. All C.O.D. shipments will be refused. If the instrument is covered by warranty, the return shipping cost will be included under the warranty, at no cost to you. If the instrument is not covered by warranty, the return shipping cost will be added to the repair invoice.

Please provide a return address and a purchase order for all instruments sent in for service. UPS will not deliver to a post office box number.