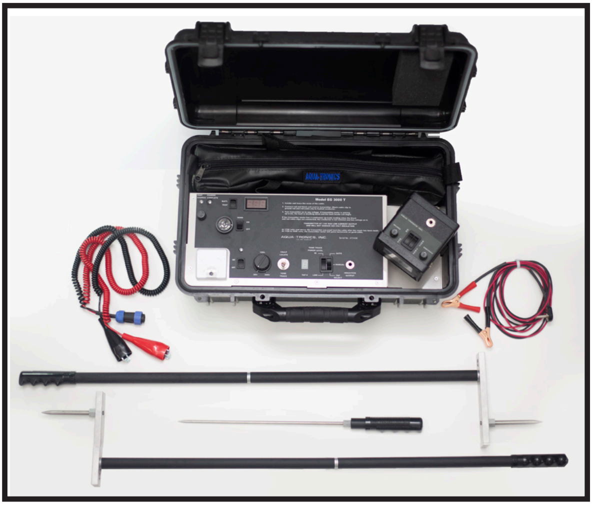
EG 3000 | EG 3000T INSTRUCTION MANUAL

EG 3000
Earth Gradient
Cable Fault
Locator

EG 3000 T
Includes
Cable Locating
with Automatic
Impedance
Matching



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

Plus:

- *Cable Tracing*
  - *-Direct*
  - *-Inductive*
  - *-Inductive Coupler*

AQUA · TRONICS, INC.
SETTING THE STANDARD FOR SERVICE

U.S. Patents #4,697,137
and #4,233,561

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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 "nonlinear" fault.

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.

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.

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.

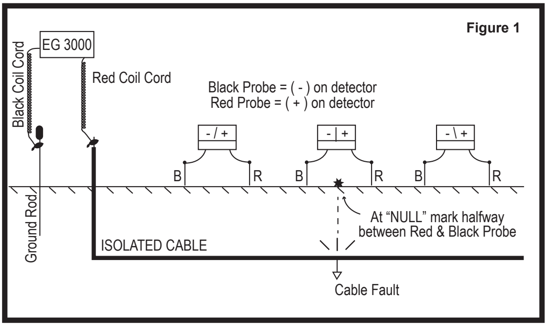
The detector used to detect the fault consists of a high gain amplifier and a direction to fault indicator. The input to the detector comes from two probes that are pushed into the ground, which pick up the voltage gradient present.

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 direction indicator toward that probe. As the detector passes beyond the fault, the direction indicator 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 direction indicator will remain at center, 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 indicator pulse on the detector near the ground rod. As the detector moves down the cable, the amount of signal (indicator 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 drop-off is more pronounced if the fault is a long distance from where the transmitter is connected to the cable or if the ground cover is asphalt or concrete.

EARTH GRADIENT FAULT LOCATING PROCESS (CONTINUED)

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 to verify that the operator has indeed gone past the fault. A reverse pulse on the indicator should be present. (See Figure 1)



DESCRIPTION OF THE EG 3000

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.

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.

DESCRIPTION OF THE EG 3000 (CONTINUED)

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 apples 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. 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.

2. 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 transmitter 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.

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 actuate any switch or 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 switch to TONE TRACE, or FAULT LOCATE before the output connection is made. If the function switch is in TONE TRACE position, also turn the transmitter on and set the Auto / Manual Tap select switch to Manual Tap # 2 on the Tap Selector Display before any output connection is made.

2. If the transmitter is in the fault locate mode and 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 present on the cable. A fault locate can be made, but do not change any of the transmitter control settings if the transmitter function meter has a constant reading of any type.

DESCRIPTION OF THE EG 3000 (CONTINUED)

The transmitter meter will pulse even though the fault may not be 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 or transformer.

> ***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.*

3. If connected into a live 120 volt circuit, a high 60 Hz current can be entering the ground at the cable fault. A high 60 He current in the soil can flood the detector and cause the detector direction indicator to oscillate under some conditions.

   If the detector direction indicator 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.

THE EG 3000T HAS A BUILT-IN TONE FOR TRACING THE CABLE

When the Fault Locate-Tone Trace function switch is in the TONE TRACE position, the Fault location 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 two methods:

1. 120 volt line (60 Hz) 110/230 universal input 90 - 264
2. Internal 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 being charged from a 120 volt wall outlet and will remain on until disconnected from the outlet. The Green LED will turn on when the battery is fully charged. 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.

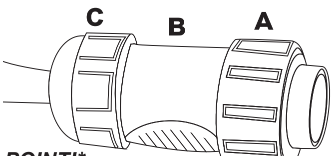
OPERATION Do's AND DON'TS

1. Never use this instrument without using rubber gloves. 3000 volts at 10 milliamps will get your attention, but 300 volts at 200 milliamp 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 of this manual 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.

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 some times 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, or the internal battery.
5. Make sure the Tone Trace / Fault Locate Function Switch is set to Fault Locate. If the transmitter does not have tone tracing abilities, this switch is not present and the transmitter is always in the fault locating mode.
6. Turn on the transmitter.
7. Setting the transmitter to 3000 volts will do two things to help in making a fault locate.
   a. It will proof test the cable. If connected to a good cable at 3000 volts, the transmitter meter will try to pulse backward.
   b. At 3000 volts the transmitter will allow a little more fault current to flow and this can help when locating a fault in dry soil or under asphalt or concrete.

Note: When connecting the output cable assembly to the transmitter, care should be used to avoid rotation/twisting of parts B & C. The locknut, Part A can be rotated to tighten the H.V. cord to the transmitter.



The H.V. output cable assembly IS NOT A LIFTING POINT!*

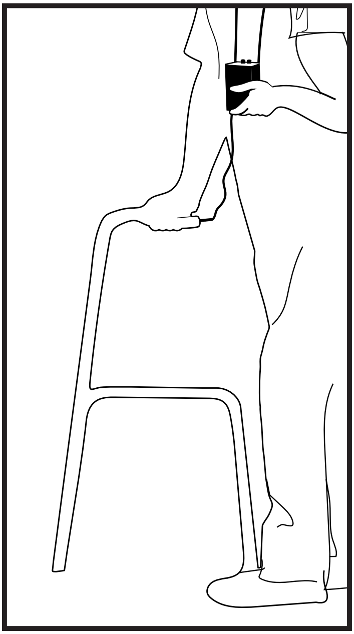
WHEN A GOOD EARTH GROUND IS NEEDED

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.

ANALOG 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 to 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 Direction to Fault Indicator provides direction to the fault from where the operator is standing.

The sensitivity control adjusts the amount of signal being fed to the meter. Lower sensitivity levels are better to use and easier to work with. This will also help reduce any meter backlash present on the Direction to Fault Indicator.

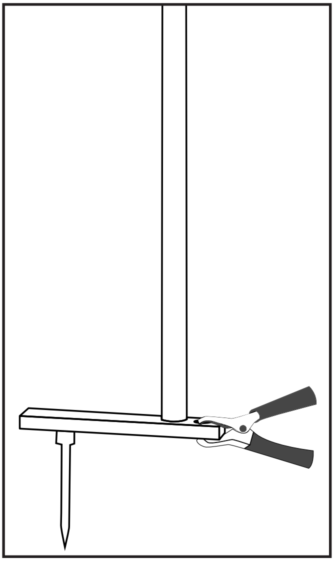
Placing the two probes farther apart can also help in the dead area of no signal. Fault currents are present, but they are spread out, and the weak or reduced amount of fault current creates the dead spot. By placing the two probes farther apart, a greater difference of voltage can be found, allowing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

To set the Balance Control, turn the detector on with the probes in the ground and the cord plugged in to the detector. Turn the Sensitivity control to full scale and set the Balance Control for a “0” center on the Direction Indicator. The Sensitivity Control can then be adjusted to the level needed to perform the locate. The Balance Control Should Not be adjusted again on that locate.

The battery compartment located on the side of the detector uses one # 216 9-volt battery or equivalent (NEDA #1604).

CONNECTING THE DETECTOR FOR USE

Plug the detector cable assembly into the jack on the top side of the detector. The two small cable clips should be connected to the hole in the foot probes behind the attached handle.



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 source (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.

The face of the direction indicator has a battery test mark on the right hand side of center.

The upper portion of the analog meter face has a (+) Red on the right and a (-) Black on the left. The (+) Red on the analog meter is the red wire probe input and the (-) Black on the analog 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 directional indicator is getting a small kick in the (+) or (-) direction. If the two probes are over the route of the cable, the direction the indicator kicked is the direction the fault will be from that point. In other words, if the indicator 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

CONNECTING THE DETECTOR FOR USE (CONTINUED)

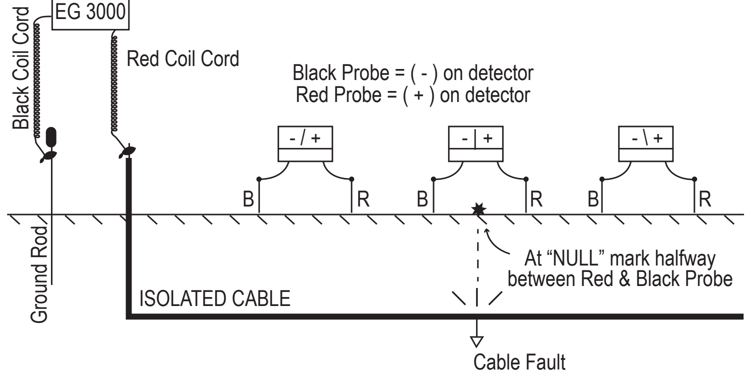
direction indication could reduce to a very small kick. It could die out to where you are not picking up direction indicator kick even at full gain. This means the fault is some distance from this point, and the fault currents are spread out over a large area on their way back to the ground rod. **The fault currents may have collected on some 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 direction indicator kick. He could then travel in that direction until the fault is found. 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 direction Indicator starts pulsing off scale, and then receives a large reverse kick, the sensitivity should be reduced for a clear indicator reading. Shortening up the distance between the two probes will also reduce the amount of signal. or indicator 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 direction indicator 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 indicator 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 direction indicator will start reducing. When the indicator 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 direction indicator, the fault will be half way between the two probes, if the probes are over the route of the cable. (See Figure 2)

Figure 2



CONNECTING THE DETECTOR FOR USE (CONTINUED)

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 Indicator always kicks toward the center probe, you have located the fault.

If on one side of the center probe, the indicator 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 indicator kick until the indicator again kicks in the reverse direction. When you find the spot where a probe can be rotated around the center probe and the indicator will always kick toward the center probe, the center probe will be directly over the fault. (See Figure 3)

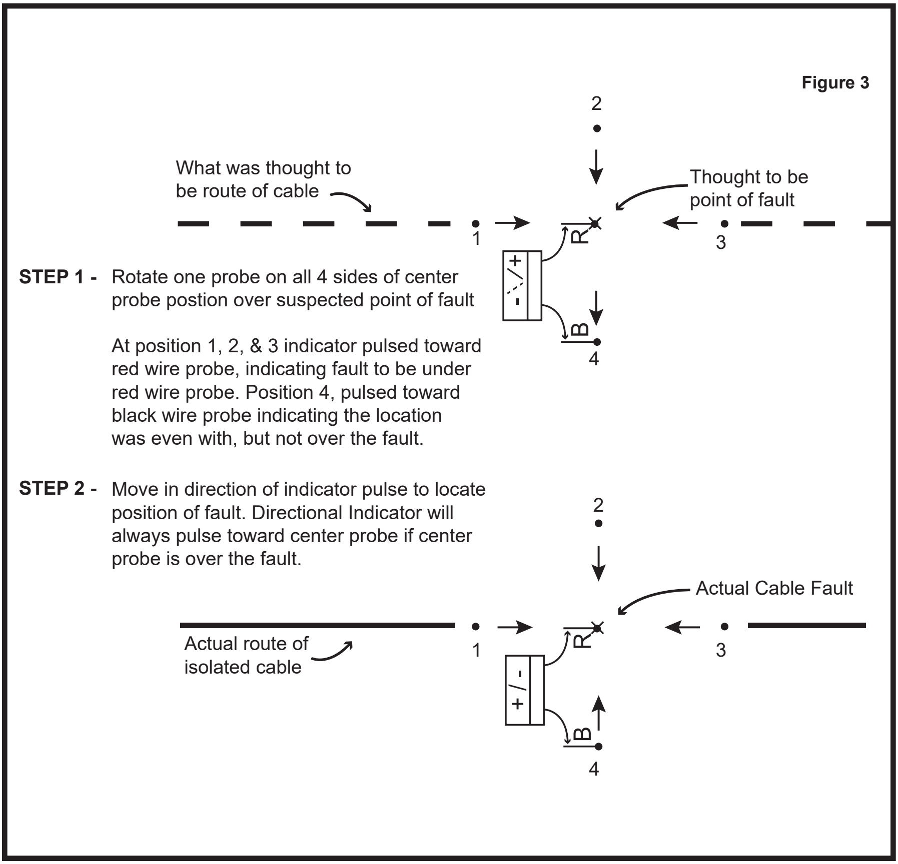


Figure 3

HELPFUL LOCATING TECHNIQUES

1) A problem some people have experienced operating the EG 3000 detector occurs when they preset the sensitivity control to full gain, without testing lower settings first. The Aqua-Tronics 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. 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 their hands from the probes. Even a small movement caused by wind to the metal-to-earth contact can produce an Indicator reading

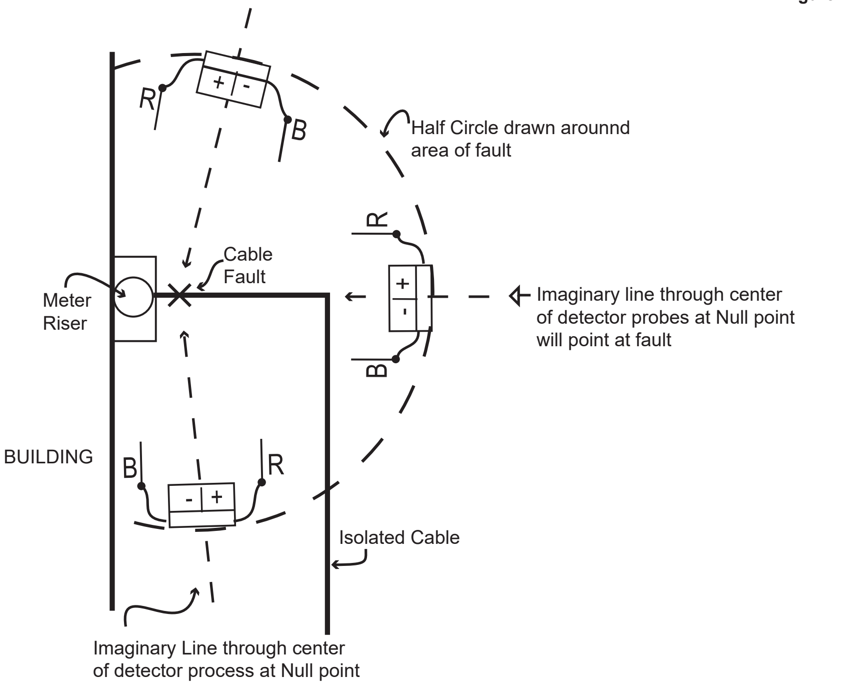
2) In some ground conditions, it is not possible to insert the probes into the ground. Rock, cement, or asphalt can be a problem. In this condition, do not use the two probes. The two cable clips can be clipped to two household sponges that are soaked in water (approximate size 4 x 4 x 1). Two good size sponges in a wide mouth picnic cooler filled with water is an item every truck should have as a back-up tool.

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 (approximately 6 x 6 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.

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 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 Figure 4 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.

Figure 4



FEATURES AND 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 needed to flash over a high impedance faults up to 10 Mohm.**
- **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 gradient current is low.

The EG 3000 does not do this. Most cable faults can be flashed at 300 volts. 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? Even at a 3000 Volt setting, 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.

CABLE LOCATING

CONNECTING THE TRANSMITTER FOR TRACING THE ROUTE OF THE CABLE

Make sure the EG 3000 is turned "OFF" before any connections are made.

DIRECT TRACING:

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. Connect the Red clip to the cable under test. (Pouring water on the ground rod in dry soil can improve a cable trace.)

1. The FAULT LOCATE - TONE TRACE switch should be set to TONE TRACE.
2. The AUTO - MANUAL - TAP SELECT switch should be set to AUTO.
3. The tone trace power switch should be set to LOW.
4. Turn on the transmitter.

The transmitter will go through a self test on the numerical display window. This will take several seconds. When the self-test is complete, the automatic impedance matching will set the transmitter to the correct output tap and this number will then be displayed. The line is now ready to be traced.

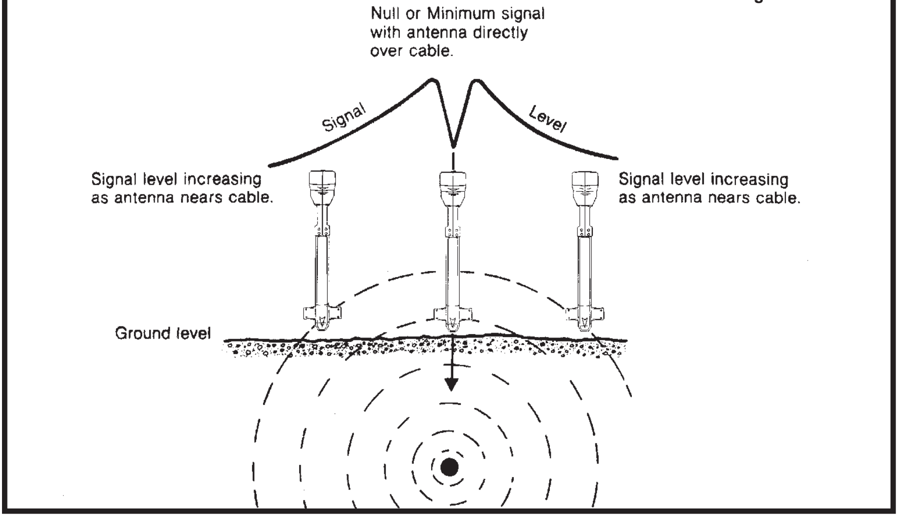
WARNING: A switch contact making or breaking 120 volts can arc and this will produce a high voltage transient spike of 500 volts or more. This high voltage spike can reflect back into the transmitter and create problems. Thus, the transmitter should be placed in manual/mode, TAP#2 before a direct connection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

NULL TRACING METHOD

DEFINITION OF A NULL

A high signal reading is found on both sides of the conductor, and a loss of signal is found directly over the conductor. The sensitivity control setting will determine how sharp or broad the null will be.

Figure 5



LOCATING BY THE NULL METHOD - A-700 RECEIVER

With the transmitter connected to the conductor and turned on, move out away from the transmitter 5 to 10 feet. Push ***the*** NULL/ PEAK button, between the handle and the meter, to NULL. Turn on the receiver by rotating the sensitivity control knob under the handle grip from the off position. Adjust the sensitivity control for a mid scale meter reading. Walk a half circle around the transmitter in the direction the meter starts to increase. When a location is found where the meter drops to "0" and an increase in signal is found on both sides of the "0" location, this will be a locate to mark. When two positions or NULLS have been found, the operator knows the direction of the run.

THE OPERATOR CANNOT SEE THE LOWEST READING IF THE METER IS AT 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 LOCATE AND NOT SEE THE NULL; HOWEVER, A SMALL LOSS OF TONE MIGHT BE HEARD. **THE** SENSITIVITY SHOULD BE REDUCED TO WHERE A SHARP NULL CAN BE SEEN ON THE METER.

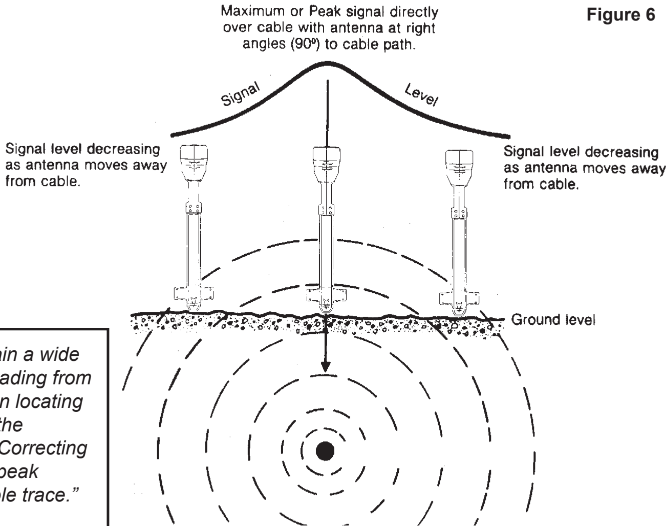
Now that two null points have been found, the route of the conductor can be walked by moving the receiver back and forth over the line being traced. NEVER SWING THE LOCATOR. The receiver should be moved back and forth over the line being traced with the bottom of the antenna area remaining approximately the same distance from the ground at all times.

MAXIMUM OR PEAK TRACING METHOD

DEFINITION OF MAXIMUM OR PEAK

A maximum meter reading will be found directly over the line being located and with the receiver antenna at right angles to the conductor's path, the meter will decrease to lesser readings as the instrument moves away from either side. When the locator is directly over the line and at right angles to the line, the locate has been made. IN THE PEAK METHOD, THE RECEIVER PROVIDES THE DIRECTION OF THE LINE BEING TRACED FROM ONE LOCATING POINT. THE LINE BEING LOCATED WILL BE AT RIGHT ANGLES TO THE RECEIVER. In other word, if the operator would lay an arrow on top of the receiver handle with the shaft crossing #5 on the meter dial, the arrow head would be pointing down the route of the locate. Unlike the null mode that can be made with the receiver pointing at any axis of a compass, the peak mode cannot. In the peak mode, no reading can be taken if the instrument is parallel to the. direction of the conductor run. See Figure 6

Figure 6



Note: *If you obtain a wide or broad peak reading from the receiver when locating your cable near the transmitter see "Correcting a wide or broad peak reading on a cable trace." See page 18.*

LOCATING BY THE MAXIMUM OR PEAK METHOD A-700 RECEIVER

With the transmitter connected and operating, move out 5 or10 feet from the transmitter. Turn on the receiver and push the NULL/PEAK button to the PEAK position. Adjust the sensitivity control for a mid scale meter reading. Walk a half circle around the transmitter in the direction the meter indication starts to increase. If the meter goes off-scale or past 10, reduce the sensitivity to where the meter movement can be seen increasing or decreasing. Meter movements cannot be seen if the meter movement is at "0" or at "10".

When a location has been made, the meter will show its highest point directly over the spot to be marked and the receiver is at right angles to the line being located. A movement of the receiver to the right or left side of this highest meter reading will produce a meter reading that is decreasing from the high point.

Now that the conductor has been located, turn the sensitivity down to a very small meter movement above "0" on the meter dial when the antenna is directly over and at right angles to the line being located. Keep moving the instrument from one side of the peak reading to the other. Each time a peak reading is found, the ire will be directly below the center of the receiving antenna. Do not swing the antenna from side to side.

*Note: More detailed instructions of the Digi-7 Receiver can be found by visiting:
www.aquatronics.com/links/pdfs/DIGI7_Manual.pdf, or scan the code below:

More detailed instructions or the A-700 Receiver can be found by visiting:
www.aquatronics.com/links/pdfs/A700_Manual.pdf, or scan the code below:

LOCATING BY THE NULL METHOD - DIGI-7 RECIEVER

DIGI-7 RECEIVER AUTOMATIC MODE

The receiver will always power up in the AUTOMATIC PEAK MODE OF OPERATION. Turn on the receiver and rotate the large knob until the desired level of sound is being heard. In the Auto Mode, the knob is a "Volume" control. Push the Null button for NULL operation. A small flag at the lower left corner of the LCD display will point to NULL.

Move 5 to 10 feet from the transmitter and walk a half circle around the transmitter until the bar-graph display starts to increase. At some point, the bar-graph will drop to a small value and then increase. Directional arrows are also present and will indicate what direction is needed to find the conductor. As the receiver moves past the NULL point, the directional arrow will change, and a different tone will be heard. Each time the conductor is crossed, the directional arrow will change, and the sound being heard will also change. The numerical signal strength meter will read 'Absolute signal' and it will be at a maximum even though the receiver is in the NULL mode of operation. In the Automatic NULL Mode, the receiver will provide direction to the conductor with LEFT/RIGHT arrows on the display so the receiver must be at right angles to the conductor path.

DIGI-7 RECEIVER MANUAL MODE

Locating in the manual mode allows the operator to take control of the receiver sensitivity. The large knob that was the loudness control in Auto Mode is now the sensitivity control.

Change the receiver to Manual Mode and push the NULL switch for NULL operation. A flag will point to the word NULL on the lower left corner of the LCD display. In the upper left corner, a numerical read out will appear. This 0-100 reading will indicate the position of the sensitivity control. The manual mode will operate the same as the A-700 analog receiver.

LOCATING BY THE PEAK METHOD - DIGI-7 RECEIVER

DIGI-7 RECEIVER AUTOMATIC MODE

When the receiver is turned on, it will power up in the Automatic Peak Mode. The volume control knob can be adjusted for sound desired.

Move 5 to 10 feet from the transmitter and walk a half circle. Record all of the peak signals found in the half circle and notice the absolute signal display number at each peak signal found. Depending on the Depth, the strongest signal may not be the utility being traced, but the strongest signal is a good starting point. When a location has been made, the bar-graph and absolute signal reading will both provide the highest value. A down arrow will replace the LEFT/RIGHT guidance arrows directly over the located cable. No audio output will be present. Moving the receiver from side to side will produce the directional arrows and tone change each time the receiver passes over the conductor.

DIGI-7 RECEIVER MANUAL MODE

Locating a peak in the manual mode is the same as the A-700 Receiver. No LEFT/RIGHT guidance arrows are present, and the loudness control becomes a sensitivity control. Sensitivity percentage will be displayed in the upper left corner of the LCD display. The tone will no longer change pitch as the receiver passes from one side of the conductor to the other.

TRACING WITH THE INDUCTIVE COUPLER

CAUTION: ALWAYS USE RUBBER GLOVES WHEN INSTALLING AN INDUCTIVE COUPLER ON PRIMARY CABLES.

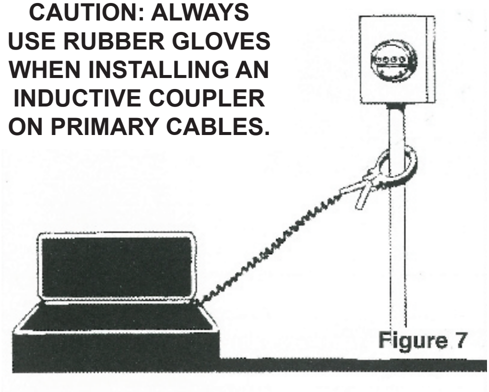


Figure 7

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 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 neutral 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 into the inductive output phone jack. The TONE TRACE TAP SELECTOR 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 is placed around one cable, very poor results will be obtained because all three cables are grounded to each other along the cable route. (See Figure 7)

CORRECTING A WIDE OR BROAD PEAK READING ON A CABLE TRACE

When using the Inductive Coupler or the Direct Output mode of tracing, there may be times when a wide or broad peak reading is found near the transmitter. If this occurs, the receiver is being flooded with too much signal. Reducing the signal on the line being traced can be accomplished by setting the transmitter Auto-Manual-Tap Select switch to Manual. The tap select switch will allow the direct output impedance to be set at number 4 or 5 in the numerical display window. This will be the wrong impedance tap for a long or deep trace, but the reduced signal will un-flood the receiver and a sharp crisp reading can be found near the transmitter.

The tone trace power control just to the right of the tap switch should be set to 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.

DETERMINING DEPTH

On a right 45˚ triangle, two of the sides are equal. The receiver positioned at 45˚ and off to either side of the marked cable route can determine the cable depth.

The receiver antenna decal has black arrows pointing down the antenna housing. When the receiver is positioned at a 45˚ angle to either side of the marked cable route and the lines of the arrow are vertical, the receiver is at a 45˚ angle to the ground surface.

Move away from the marked cable route with the receiver at 45˚ until the locate is made. Mark that spot. The distance from that spot to the actual cable route mark is the depth of the cable.

When possible, the depth should be taken from both sides of the cable route. If the two depths agree, the depth measurement is assumed to be fairly accurate. If the two depths do not agree, the radio field pattern is probably distorted which indicates the depth is wrong and the actual locate is also in question.

NOTE: With a distorted field pattern situation, the actual cable route will be between the marked route and the longer depth dimension.

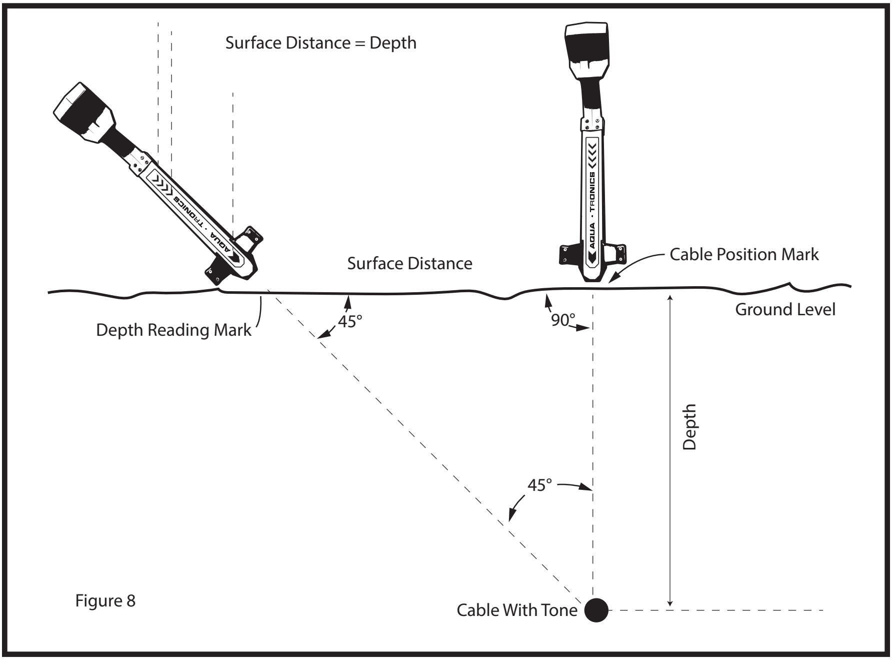


Figure 8

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.
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 with the case lid open 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 an 8Ah, 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.

SERVICE

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

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.

WARRANTY

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

Aqua-Tronics, Inc. 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 warrant defects from abuse or breakage, lies with Aqua-Tronic, Inc. 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.