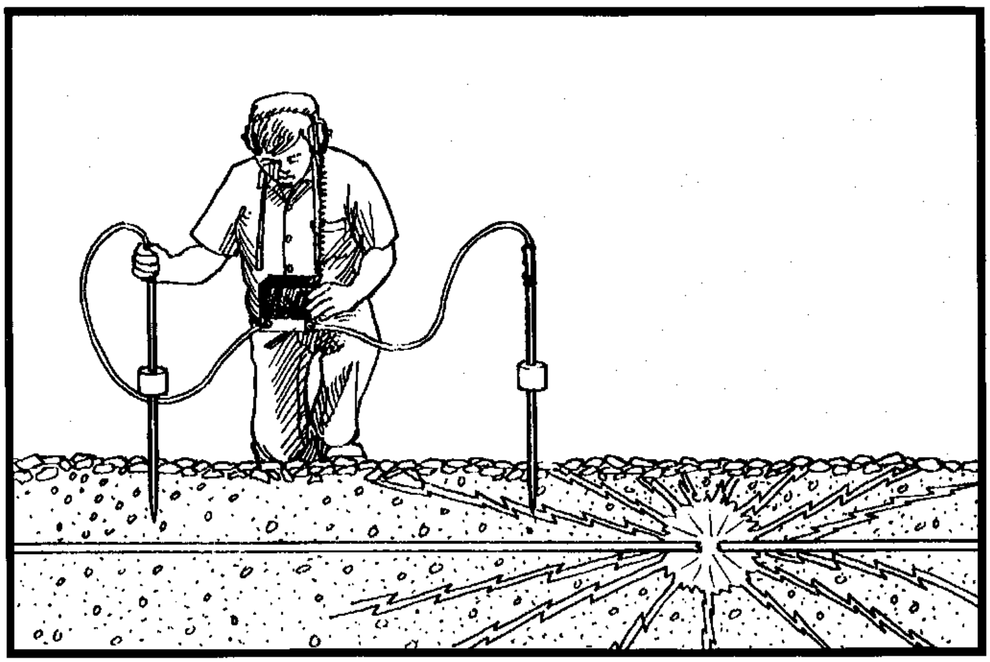
OPERATOR'S MANUAL

SUPER-D.A.D.
Directional Acoustic Detector
by Aqua-Tronics



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TIME TO FAULT MODE

In the TIME = ----MSEC mode, one time can only relate to another location's time if the "Acoustic Sensitivity Control" is at the same setting for all of the microphone listening points being compared.

When the electronics deliver microphone information to the trip logic circuit, the signal must be large enough to overcome the built-in background noise suppression threshold.

Note in FIG. A that on a very large signal, the microphone out put signal will arrive at the trip threshold sooner than it will on a small signal. This means the "TIME TO FAULT" will decrease if the acoustic sensitivity is increased and longer if the control is decreased and the microphone is not being moved. Because the signal amplitude is being controlled by the acoustic sensitivity control, it will be important to leave this control at one setting if two or more location times are being compared with each other.

FIG. A

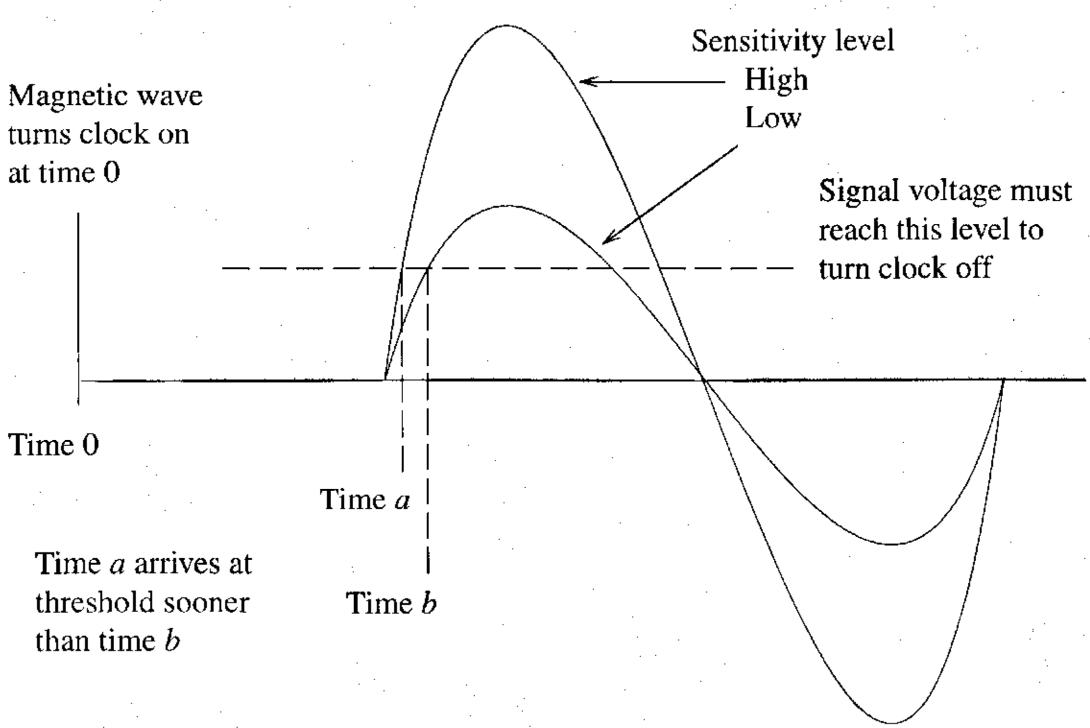

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TABLE OF CONTENTS

Directional Acoustical Detector
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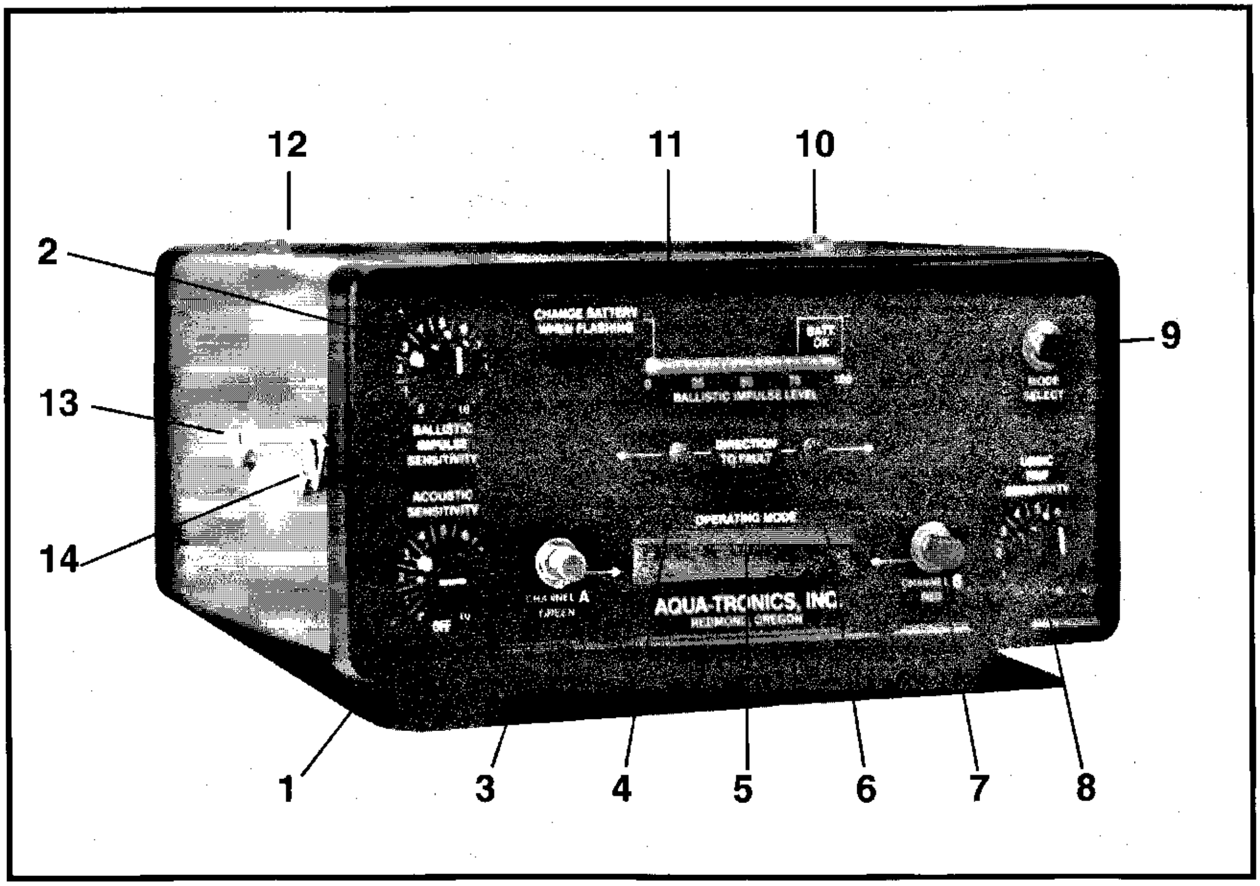
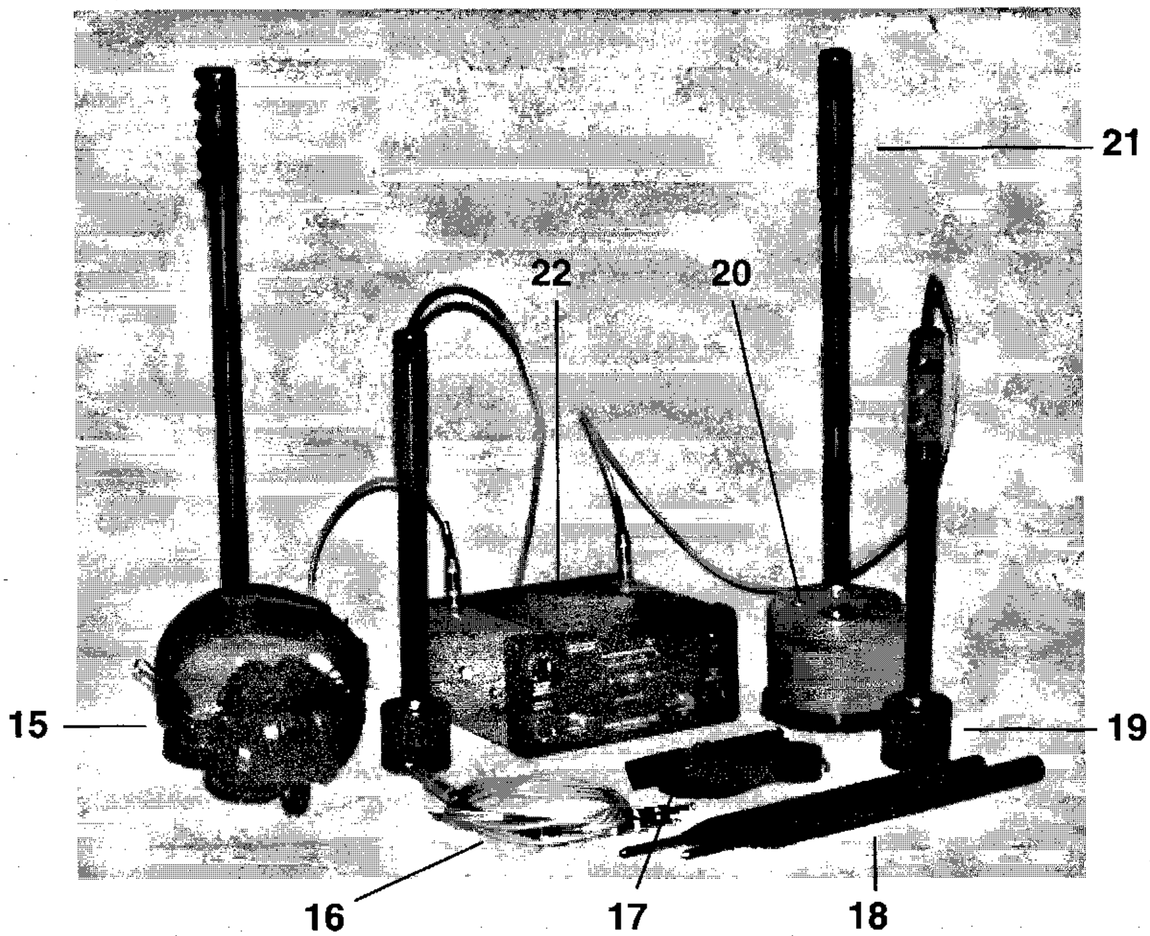
Instrument Controls and Connectors



1. OFF - ON, and acoustic sensitivity control.
2. BALLISTIC IMPULSE SENSITIVITY CONTROL
3. GREEN CHANNEL ON-OFF PUSH BUTTON
4. GREEN DIRECTION TO FAULT LED
5. LCD - LIQUID CRYSTAL DISPLAY
6. RED DIRECTON TO FAULT LED
7. RED CHANNEL ON-OFF PUSH BUTTON
8. LOGIC TRIP SENSITIVITY CONTROL
9. MODE SELECTION PUSH BUTTON
10. RED CHANNEL MICROPHONE INPUT
11. BALLISTIC IMPULSE LED BAR GRAPH AND BATTERY TEST INDICATOR
12. GREEN CHANNEL MICROPHONE INPUT
13. HEADPHONE JACK
14. NECK STRAP "D" RING

ACCESSORIES



15. STEREO HEADPHONE

16. GROUND CONTACT MICROPHONE CABLES (2 each)

17. NECK STRAP

18. EARTH PROBE MICROPHONE SPIKES (2 each)

19. EARTH PROBE MICROPHONE (2 each)

20. GROUND CONTACT MICROPHONE (2 each)

21. GROUND CONTACT MICROPHONE HANDLE (2 each)

22. SUPER D.A.D. ELECTRONICS

BATTERIES

Testing

Rotate the "OFF-ON" control (acoustic sensitivity control) to "ON". The ballistic impulse level light bar will move to the right indicating the battery condition. If the light bar indicates at any position below the "BATT. OK" window, replace all six (6) of the "AA" batteries.

When the computer has completed its battery test, the light bar will move back to the left leaving one LED (light emitting diode) on. This will allow the computer to do two things.

1. Tell the operator if the instrument is "ON" or "OFF".

2. Allows the computer to monitor the batteries during actual operation. If the LED starts flashing, the batteries are near their end life and should be replaced.

Replacement

The batteries are located behind the door on the back cover. To replace batteries, remove the small plastic nut to open the battery compartment door. 6 each "AA" batteries are required. Alkaline batteries are recommended because of their longer life, however any type or brand of "AA" battery could be used.

SOUND

GENERAL CHARACTERISTICS OF SOUND

Sound Waves

Sound is mechanical energy in the form of pressure waves. You can't see sound waves, but you can form a mental picture of how sound works by comparing it to what happens when a rock is dropped into a quiet lake. Sound waves leaving the sound's source would look like ripples on the surface leaving the spot where the rock was dropped. As the ripples move away in all directions, they get smaller and gradually lose their energy. If any of the ripples strike a solid object, they reflect off the object and start traveling back in the direction they came from. Sound waves act very much like these ripples in the lake. They radiate out in all directions from the source of the sound; they grow weaker and lose more energy the farther they travel; and they bounce off objects and reflect back in the direction they came from.

Thumpers used to locate cable faults create sound waves which radiate out from the fault in all directions. When the high voltage thumper pulse reaches the fault and arcs from the conductor to the neutral, it creates an "explosion" or rapid ionization of air. If this occurred in open air, it would sound like a large caliber rifle discharging. Since the explosion caused by the thumper pulse occurs under ground, the sound waves are muffled and what the operator will hear is most often a soft "thump". Thus, the name for the high voltage impulse generator = "Thumper".

Most of the time, the sound of the thump is loud enough in the area of the fault that the operator can hear it without using any equipment to amplify the sound. Sometimes, the voltage arc at the fault releases enough energy to actually move soil at the ground level. In these cases, the thump can be felt with the operator's foot or hand.

Sound Traveling in Different Materials

Sound travels at different speeds, and with greater ease or difficulty, in different materials. This can have an effect on the operator's efforts to accurately locate a cable fault. The operator should keep in mind some basic facts about how sound travels in different materials.

(1) Speed of Sound & Sound Resistance. Sound waves travel at different speeds in different materials. In open air, sound travels at about 1,100 feet per second (750 mph). In steel, sound travels at about 16,000 feet per second (11,000 mph). In general, sound travels faster in hard or dense materials. Sound waves also travel "easier" in dense or hard materials. For example, sound waves will travel farther in steel than they will in air before losing enough energy that they can no longer be heard. For the same reason, sound travels better in water than it does in air.

Like water running downhill or lightning darting through the sky, sound prefers to take the "path of least resistance". If sound has more than one material to use in moving away from a point, it will travel faster and with less loss in sound level (amplitude) through the material that is more dense. If you tap on the bottom of a boat sitting on a lake, someone on shore would hear the sound faster and louder with their head under water than they would standing on the shore.

(2) Sound Reflections. Sound waves are reflected when the run into any object. Like ripples on a lake surface reflecting off a floating log, sound waves traveling through soil will reflect off building foundations, underground pipes, sidewalks, or even off the cement base of a pad mount transformer.

(3) Sound in Air. Compared to many other materials, air is a very poor conductor of sound waves, or sound energy. Water, metals, compact or moist soil all conduct sound better than air. Place your ear on a railroad track and you will hear the train several miles away. Stand up and you will see the train before you hear it.

FACTORS AFFECTING SOUND IN FAULT-LOCATING EFFORTS

Soil Types

Some types of soil can muffle the sound created by a "thump" more than other types. This muffling can be so severe that an operator standing near the fault may not be able to hear the thump. Dry, porous soil like sand is a good example. Even though grains of sand by themselves are dense and would be good conductors of sound if they were packed together very tightly, sand is filled with tiny air pockets that are poor conductors of sound. After a rain storm, the tiny air pockets are filled with moisture and the overall sound conducting ability will improve.

Temperature

Frozen soil is generally quite easy to locate in because the ground is quite hard with ice frozen around the grains of soil and ice is a very good conductor of sound. This will not always be the case. Repeated freezing and thawing of soil tends to create air pockets due to the soil's movement during the freezing and thawing process. Air pockets can reduce the operators ability to hear.

Asphalt & Concrete Surfaces

How well a thump sound can be heard above an asphalt or concrete surface depends on how firm this material is in contact with the soil, or how much air space is between the soil and the bottom side of the material the microphone is set on. Dead air spaces can be created under these surfaces by soil settling or by soil-surface movements caused by freezing and thawing. Even if a thumper's sound travels well through the soil itself, the sound may be lost or greatly reduced if it runs into a dead air space underneath a road or sidewalk. Further, how well any one area of road or sidewalk surface conducts sound may change with temperature. A hard freeze may cause an asphalt surface to separate from the soil beneath it, but that same spot my "relax" and make good contact with the soil on a hot day.

Buried Ducts & Pipes

Because sound travels best along the path of least resistance, trying to hear a "thump" on a cable in a duct can be a problem. When the sound leaves the cable fault, the duct will act like a rifle barrel and instead of the sound going out in all directions with equal force, most of it will travel in both directions and emerge at both ends of the duct.

In a quiet locating area, try listing for the thump over the cable route even though it is in a duct. IF THE BACK GROUND NOISE EXCEEDS THE SOUND OF THE THUMP, YOU WILL NOT BE ABLE TO HEAR THE THUMP. If it is a quiet area, higher acoustic sensitivity and logic trip settings can be attempted. The settings explained later are for normal areas that do have some back-ground noise. The operator will know because of false tripping if the controls are set higher than they should be for the area being searched.

Submarine Cables

Sound travels well in water with very little amplitude loss, so a thump can be heard at great distance from the fault if a microphone is placed beneath the water's surface. If the microphone is placed above the surface, no sound will be heard. When the sound waves change from water to air, the surface cannot vibrate or reproduce the noise.

Fault locating submarine cables in a small lake are normally very easy because microphones under water do not have a current (water flow) passing by the microphone. The friction of the water moving over a microphone can create loud noises. This noise can be very disturbing to the operator when trying set up the correct acoustic sensitivity and logic trip sensitivity.

Surface Reflection

Like water, the top layer of soil has a tougher "skin" that can reflect sound waves back down into the earth. The surface layer of soil can become more dense than the soil beneath it due to rain compaction, sun baking, wind erosion and the filling of soil voids by dust and other sediments. The harder or more dense the soil surface is, the more reflection of sound waves there will be.

To a sound wave, a change from soil to air, water to air, soil to concrete, soft soil to hard soil, and even hard soil to soft soil looks like a surface. Any surface will cause sound waves to be reflected and sound energy (amplitude) to be lost. This happens because each material has its own unique physical characteristics which determine how fast sound will travel through it, so each material has its own "speed of sound".

When a sound wave runs into a material with a different speed of sound than the one through which it has been traveling, the sound wave acts like this is a "surface" and part of the wave is reflected. The more difference there is in the speed of sound between the new material and the old material, the more energy the sound wave will lose in getting through this surface.

MICROPHONES

GROUND CONTACT MICROPHONES

Ground contact microphones pick up sound waves when they are placed in direct physical contact with the a solid material. They work well on a hard surface such as concrete and asphalt because sound waves will make these materials resonate like the skin on a drum or like a guitar string. sound waves traveling through the earth strike the bottom side of these materials and are reflected. When the sound wave bounces off these surfaces, they lose energy and the energy lost is transmitted into the harder material and causes the concrete or asphalt to vibrate, or resonate. The ground contact microphone detects this vibration and creates a corresponding sound in the headphones. The pickup element in the microphone acts like a phonograph needle on a record.

Ground contact microphones will allow good detection of the "thump" at a long distance from the cable fault. However, background noise can be a problem on concrete and asphalt because background noise is also a mechanical energy wave just like the sound waves from a "thump". It is easy for background noises from cars, machinery, people, dogs, birds and wind to reach the microphone. Sound waves from these background noise sources can strike the concrete or asphalt at some distance away and will travel quickly to the microphone. In some cases, this could hide or cover up the sound of the "thump".

<u>Test</u>

Set a ground contact microphone on a table top, a concrete or asphalt surface. Turn up the acoustic sensitivity control and listen in the headphones while someone is talking. Notice how clear their voice is. While they are talking, lift the microphone in the air so it is not making contact with what ever it was setting on. Notice the voice waves have gone away. The microphone was not picking up the voice waves going through the air. The hard surface was being vibrated by the voice waves like a phonograph record and this vibration was what the microphone reproduced. Now that the microphone is in the air, no vibration is present so the voice waves are not being picked up.

Ground contact microphones do not work in soil, snow, sawdust, barkdust, sand or grass. Since the top of the soil surface is not bonded together like cement, the soil cannot vibrate when sound waves reflect from its surface and if it cannot vibrate, the ground contact microphone has nothing to reproduce. Sound does not travel as well laterally on the soil surface as it does below the surface.

EARTH PROBE MICROPHONES

To solve the types of problems encountered with ground contact microphones on surfaces that are not solid, Aqua-Tronics, Inc. developed an earth probe microphone for use in soil, water and other soft materials. By stabbing the earth probe microphone through the surface skin, or top layer of soil, sound waves from the thump can be detected before they have a chance to reflect from the soil's surface or disperse into the air.

Earth probes also eliminate many background noise problems. Sound waves originating at the cable fault travel directly through the soil to the earth probe microphone. Sound waves from above ground noise sources have to travel through the air, which has the slowest speed of sound and through the air-to-soil surface before they can reach the earth probe microphone. Thus, many background noises lose their energy and are filtered out before reaching the microphone.

Because they pick up much less background noise, earth probe microphones should be used whenever possible. If a cable route lies under a sidewalk, using an earth probe microphone off to one side of the sidewalk will allow the operator to hear the thump more clearly. With less background noises entering the microphone, a higher acoustic sensitivity setting can be used. This will allow the operator to hear the "thump" from a greater distance.

STIRRUP PROBE FOR EARTH PROBE MICROPHONES

The earth probe microphone could be damaged if it is driven into hard soil, gravel, or frozen ground.

Cantilever damage can occur where the earth spike screws into the electronic bulb if the earth probe is not being inserted into the soil in vertical (straight up & down) direction. Damage can also take place if the earth probe spike is not screwed up solid to the electronics bulb.

To eliminate the above possibilities as well as someone trying drive or beat a microphone into the ground, a unique stirrup probe has been developed to use with the earth probe microphones. The operator can push the microphone into the ground with his/her foot, using as much force as needed. The angle the microphone is entered into the soil will not place a stress on the microphone bulb itself.

Tricks & tips

a. Wind problems: Try placing the microphone inside a traffic cone.

b. Cable was under dirt, now its under concrete and its two miles back to the truck: Set the electronics down on the concrete. Place the metal tip of the earth probe microphone on the concrete with the handle resting on the electronics. Let go of the microphone and listen. If the thump can be heard, set the second microphone down in the same manner, over the route of the cable but in the opposite direction. This will provide the 30" or more separation between the metal tip and by not touching the microphones, the only vibration they pick up should be the thump. If used correctly, the earth probes can be used on hard surfaces.

FAULT LOCATION - PROCEDURES & OPERATION

TRACE THE CABLE ROUTE

Before the fault locate can begin, the route of the cable must be located and marked. While tracing the route of the cable, watch for signs of construction or digging near the route. This could be an indication of where the cable fault is located.

FINDING THE GENERAL AREA OF THE FAULT

There are two methods that can be used to quickly find the general area of the cable fault. (a) The ballistic impulse level drop off. (b) Using one microphone to listen for the "thump". In either case, the ballistic impulse level light bar plays an important roll.

Ballistic Impulse - How It Works

The ballistic impulse level light bar allows the operator to "see" the output pulse from the thumper as it travels down the cable route. The light bar provides a "reference signal" each time the thumper pulse occurs. It also provides the rate at which the thumper is pulsing the cable.

The ballistic impulse circuitry is independent from the acoustic circuitry so the headphone and microphones are not needed for the "Setting The Ballistic Impulse Level" or "Quick Search With Ballistic Impulse Only" as listed in the following section of this manual.

Setting The Ballistic Impulse Level

At full gain, the ballistic light bar can see the thumper pulse at a considerable distance from the route of the cable. When pre-locating a fault, the lowest sensitivity that will provide a very small light bar level should always be used.

1. Move 10 to 20 feet away from the thumper and 5 to 10 feet off to one side of the cable path. Adjust the "Ballistic Impulse Sensitivity" control for a light bar level between 20% and 50% when the thumper output is recorded.

2. Walk the cable route keeping the same approximate distance from the cable path as used in setting the ballistic sensitivity control for the 20% to 50% light bar reading.

THIS SAME METHOD OF PRE-LOCATION CAN BE MADE FROM INSIDE A PICK UP AND DRIVING THE ROUTE OF THE CABLE. SET THE ELECTRONICS ON THE FRONT SEAT OR HOLD IT OUT OF THE WINDOW. SET THE SENSITIVITY FOR THE SAME 20% TO 50% LIGHT BAR READING WHEN THE THUMPER PRODUCES A THUMP PULSE.

The above adjustment can be made 20 to 30 feet off to one side of the cable path providing this same distance of 20 to 30 feet is maintained during the search for magnetic wave fall off.

NEVER SET UP A MAGNETIC ADJUSTMENT OR SEARCH DIRECTLY OVER THE CABLE PATH. THIS CAN ONLY BE ACCOMPLISHED IF THE OPERATOR IS OFF TO ONE SIDE OF THE CABLE PATH.

Quick Search With Ballistic Impulse Only

With the correct setting on the Ballistic Impulse Level Light Bar, the general vicinity of the fault may be located without the use of a microphone.

When a thump pulse arrives at the fault, the voltage will arc to the neutral. Most of the current at the fault will try to go back to the thumper neutral connection, but not all of it. A small portion of the current will be lost into the soil around the fault and a small portion will travel to the far end of the cable because it can see a ground rod connection. Most of the current is between the cable fault and the thumper neutral connection, so a very large magnetic wave is present between the cable fault and the thumper. A small magnetic wave will be between the cable fault and the ground rod at the far end of the cable. AS A RESULT, THE OPERATOR SHOULD SEE A REDUCTION OR A COMPLETE LOSS IN BALLISTIC IMPULSE LEVEL WHEN THE FAULT HAS BEEN PASSED.

Isolating the neutral at the far end of the cable on a jacketed primary will remove that current path and the magnetic fall off will be much more abrupt at the fault. Isolating the grouind rod on a direct buried primary may help, but not as much as on a jacketed primary because the neutral is still in contact with the soil even though the ground rod has been removed at the far end.

A direct buried primary (single phase) in a duct would act like a jacketed primary and magnetic signal loss should be very abrupt at the fault with the far end ground rod removed. Keep in mind that neutrals are touching each other on a three phase so the removal of the neutral under test will not remove the neutral ground from the other cables touching the test cable over its entire length.

3. When an abrupt signal loss has been found as the pre-located spot, mark that spot and move past this spot another 30 to 40 feet. If the ballistic impulse signal does not come back, a microphone placed at the marked spot is probably close enough to hear the "thump".

IF THE BALLISTIC IMPULSE RETURNS AT SOME SHORT DISTANCE PAST THE PRE-LOCATED SPOT, THE SPOT MARKED MAY NOT BE THE CABLE FAULT. A GROUND ROD AT A CABLE JUNCTION POINT, A CATHODIC ANODE, OR ANY KIND OF TIE POINT CAN BREAK UP THE MAGNETIC WAVE IN THAT AREA. AN OPEN NEUTRAL CAN ALSO BREAK UP THE MAGNETIC WAVE IN THE AREA OF THE OPEN. KEEP MOVING DOWN THE CABLE ROUTE. WHEN THE REAL FAULT HAS BEEN PASSED, THE BALLISTIC IMPULSE WILL NOT COME BACK TO ITS ORIGINAL LEVEL.

LOCATING IN A NETWORK, OR ON A "Y" SPLICE

With all of the conductors on one feed isolated, the thumper pulse can only travel in the conductor between the thumper and the fault. As a result, the large magnetic wave (ballistic impulse) can only be in the cable between the thumper and the fault.

Walk or drive the cable route. If the magnetic wave is lost when a vault has been passed, go back to the vault and travel that portion of the cable where the magnetic wave is present. Keep in mind that magnetic waves are broken up around ground rods and tie points so move past a vault 30 to 40 feet before the determination is made that magnetic wave is not on this leg or portion of the cable.

USING ONE MICROPHONE

CONNECTING AND USING 1 MICROPHONE

Once the general area of the fault has been located using ballistic impulse, it is time to use a microphone.

1. Connect one microphone. When the Super D.A.D. is turned on, the two acoustic channels will always power up in the "OFF" mode. Push the RED or GREEN channel button being used. The LCD display should now show that channel as "ON".

Since direction to fault will require two microphones, the second microphone needs to be with the operator during the search. Keep that channel turned off until the second microphone is used.

2. Logic Trip Sensitivity is set to "O" since direction to fault is only used when two microphones are in operation at the same time.

3. Install headphone into side mount phone jack. Make sure the Mono/Stereo switch is set to "Mono". The cord side of the headphones should be on your LEFT ear.

<u>Setting The Acoustic Sensitivity Control</u>

The LCD display should read "TIME & DEPTH OFF". In this mode, direction to fault using two microphones can be achieved. However, background noise could provide false tripping.

In general, the lower the acoustic (sound) sensitivity that can be used, the less background noise you will have on the fault locate. Until an actual "thump" is heard and direction to fault is needed with a second microphone installed, the acoustic sensitivity control can be set to "MAXIMUM".

With one microphone in place listen for a "thump". Once a "thump" can be heard at the same time the ballistic impulse light bar indicates a thump pulse has taken place, push the "Mode Select" button. The LCD display should now read "TIME = ----MSEC.

The next ballistic impulse passing the instrument will turn on a clock. When the thump is heard, the clock will be turned off. A time to fault will be displayed on the LCD. If a new microphone is moved in either direction over the route of the cable, the next thump will display new time as a shorter or a longer time depending on the microphones proximity to the fault at the new listening spot.

In the "TIME = ----MSEC" mode, the ballistic impulse must be present to activate direction to fault. The ability to pick up an acoustic impulse can only happen during the time the ballistic impulse is present. This could help reduce random background noise. A constant background noise could still create problems when the ballistic impulse passed by.

As you get closer to the fault, the thump will get louder. Turn down the sensitivity control. When the acoustic sensitivity control can be reduced to a #5 or less on the control dial and the "thump" can still be heard, a second microphone can now be used.

FINDING THE EXACT AREA OF THE FAULT

CONNECTING AND USING 2 MICROPHONES

a. Connect the second microphone to the electronics.
b. The RED microphone should be connected to the right side of the electronics and the Green microphone connected to the left side. This will correspond with the Direction To Fault LED's.
c. Switch the headphone Mono/Stereo switch to Stereo.
d. Turn on the second channel microphone. The LCD should show both channels as "ON".
e. Set both microphones over the route of the cable.

If earth probe microphones are being used in dirt, sand, snow etc., they should be separated 24" or more during use. If ground contact microphones are being used on a hard surface like concrete or asphalt, they should be separated 30" or more during use.

With experience, the operator may find that microphones can be placed much closer together than indicated. Until the operator is familiar enough with the instrument to know where the limitations are in the different soil or ground conditions in his/her area, it is recommended that the suggested microphone spacing be followed. The microphones need to be spaced far enough apart so the computer can measure the time difference between the arrival of the thump sound at each microphone.

<u>Setting The Logic Trip Sensitivity</u>

NOTE: The following adjustment can be made in the "TIME & DEPTH OFF" mode or the "TIME = ----MSEC" mode. It will be easier to adjust the Logic Trip Sensitivity in the "TIME & DEPTH OFF" mode because the ballistic impulse is not needed to operate the Direction To Fault LED's. If Logic Trip is adjusted in the "TIME = ---MSEC" mode, the trip level can only be checked when the thump pulse is present and this does not allow the operator to see the difference in thump sound and background noise.

When both microphones are set up over the route of the cable and the "thump" sound can be heard in the headphones at the same time the "ballistic impulse level" light bar flashes, the "Logic Trip Sensitivity" can be adjusted.

Slowly increase the control knob clockwise (from "O" towards "10") until one of the red or green direction to fault LEDs lights up. If the Logic Trip is too high, or if the Acoustic Sensitivity is too high, false tripping could occur. False tripping is easy to see because the direction to fault LED's are not always providing the same direction.

When the Logic Trip is set to the correct spot, the direction to fault LED will always be in one direction.

If the back ground noise is high, it may require a different acoustic sensitivity setting to find the correct logic trip sensitivity setting. These two controls interact and one is very much dependent on the other.

IF THE ABOVE ADJUSTMENTS WERE MADE IN THE "TIME & DEPTH OFF" MODE, RETURNING TO "TIME = ----MSEC" COULD HELP REDUCE BACKGROUND NOISE.

"ZEROING IN" ON THE FAULT

When a direction to fault LED lights up at the same time the ballistic impulse light bar indicates a "thump" has take place, a time will be displayed on the LCD. This number is clocked from when the "thump" pulse passed the instrument until the first microphone heard the sound and it will be listed as "TIME" in MSEC.

If the LCD time is a large number, the operator can move 10 to 15 feet for the new reading. If the LCD time is a small number, the fault is very close and the movement of microphones should be very short. This will vary greatly depending on conditions. (How far to move the microphones with different times being listed on the LCD will come with experience, and will vary greatly depending on soil conditions.)

When the direction to fault LED tells the operator the direction to the fault, the operator should move the microphones accordingly in that direction. How far to move will be dependent on the time listed on the LCD.

At this new location, wait until the next thump pulse passes. Record the direction to fault and the time. The time should be getting shorter. Keep moving in the direction of the fault.

When the direction to fault LED indicates the fault is in the reverse direction, the fault has been passed and the operator needs to reverse his/her direction. In the reverse direction, move the microphones the same approximate distance as the microphones are separated. (If the microphones are 24" apart, move both microphones approximately 24" in the reverse direction) The trailing microphone should be setting where the lead microphone was. This will keep the operator from leap-frogging over the fault. Make these small movements until the direction to fault LED again indicates a reversal in direction.

The trailing microphone is now very near the fault and should be left where it is. Moving the lead microphone back and forth 1/4" at a time will soon locate the fault half way between the two microphones. When the fault is at an exact half way point, both direction to fault LED's will light up indicating a "NULL".

The fault is equal distance from each microphone, but it could be off to one side.

VERIFYING THE FAULT'S LOCATION

The final step needed to verify the fault location is a "90 degree WALK AROUND". Keep in mind that "DEAD INCH" accuracy can only be obtained if "NULL" readings are taken in both the IN-LINE locate and the ACROSS THE CABLE locate.

The acoustic ability of the instrument is such that the sound of the thump can be detected from a long distance away. This distance could be off to one side of the cable.

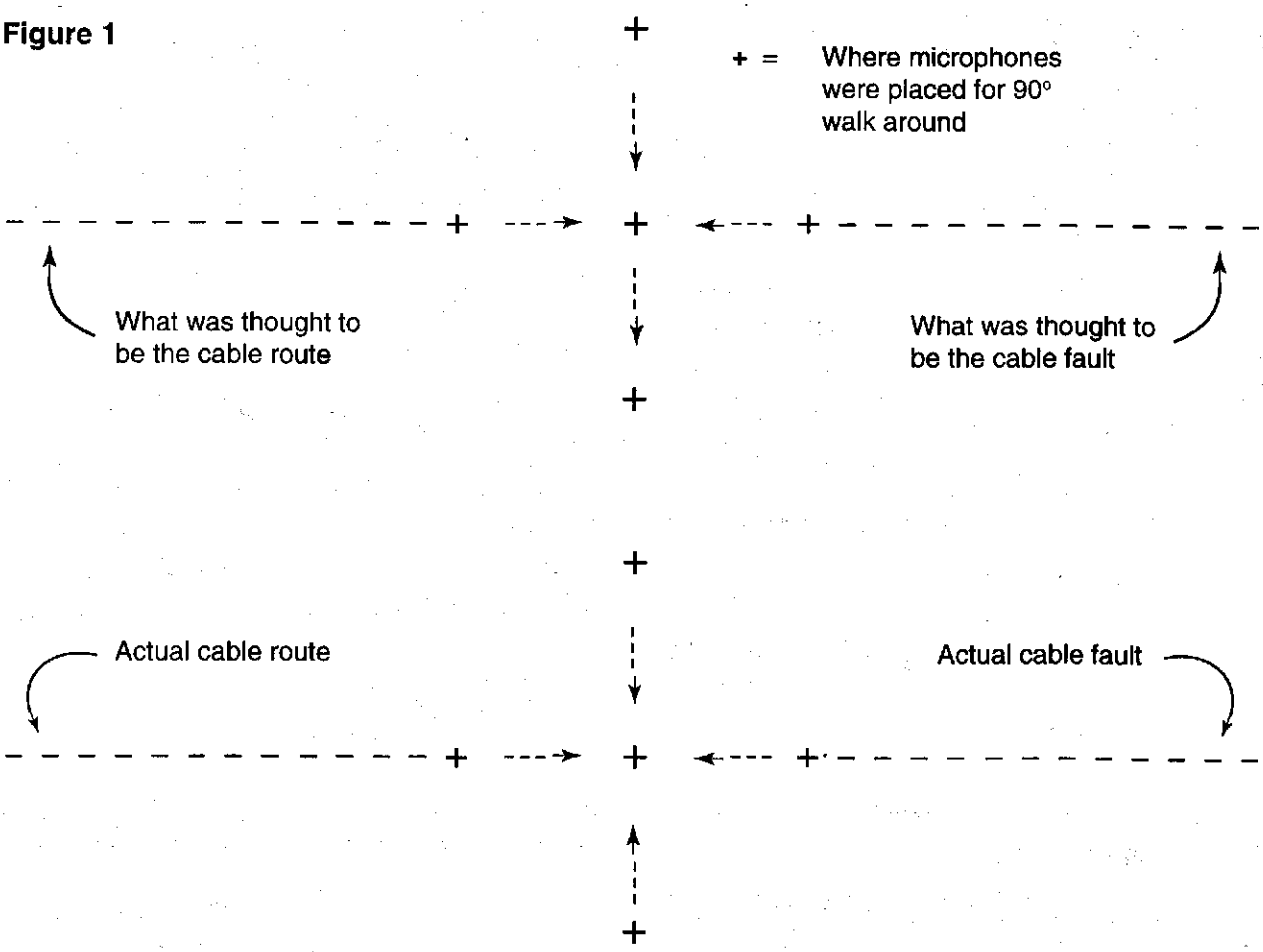
With one microphone directly over the "NULL" point (position of the fault), we will call this the pivot microphone, move the other microphone around the pivot microphone and take four (4) readings. Position the second microphone approximately 30" apart.

a. 30" up the cable route.
b. 30" down the cable route.
c. 30" off to one side of the cable route.
d. 30" of to the other side of the cable route.

This will provide readings on all four sides of the fault at 90 degree intervals. Avoid crossing the microphone cables or confusing readings could be taken. The color of the LED will show which microphone received the sound first.

If the cable route was off to one side of where the operator thought it was, the fault locate would be made off to one side of the cable route. The 90 degree walk around would allow the correction to be made because the direction to fault would have reversed if the fault locate had been off to one side. THE LED FOR THE PIVOT MICROPHONE WILL LIGHT AT EACH OF THE FOUR READINGS IF THE FAULT IS UNDER THE PIVOT MICROPHONE ON THE 90 DEGREE WALK AROUND. See Fig. 1.

Figure 1



WAGON WHEEL - LOCATE FROM OFF TO ONE SIDE

Sometimes a microphone can not be placed directly over the fault because of an obstacle of some type. The approximate position can be located by triangulation.

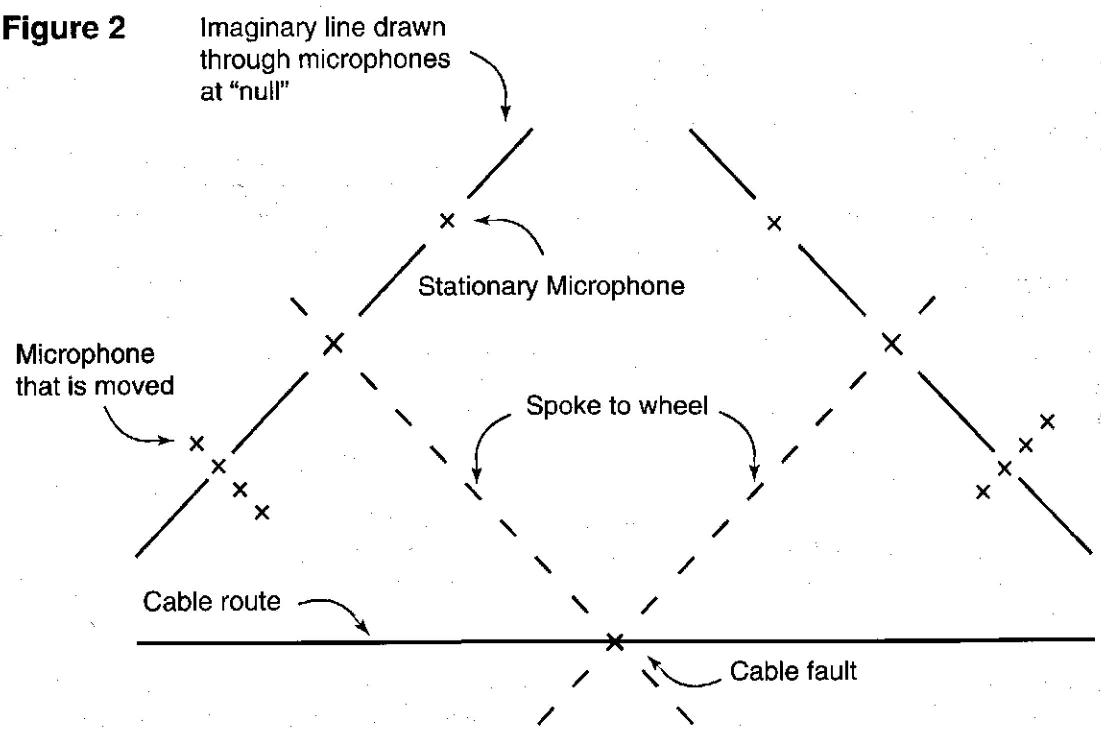
One microphone is set in place. The second microphone is placed 30" away from the first microphone, but closer to the fault. The direction to fault LED for the closest microphone will indicate when a thump takes place.

The second microphone is now moved in a half circle away from the fault keeping the 30" separation. At some point, the first microphone will be closer and its LED will flash.

Move the second microphone back in very small increments until the two microphones are at equal distance from the fault. At that time both direction to fault LEDs will turn on when the thump takes place. Draw an imaginary line from one microphone to the other. Half way between the two microphones, draw a spoke to the wagon wheel leaving the imaginary line at 90 degrees. In other words, if microphone 1 was to the North and microphone 2 was South, the spoke to our wagon wheel would be traveling East or West.

Move to a new location and repeat the above locate with a new spoke. Where these two spokes cross will be the cable fault. Note: Always try to provide a third spoke. If one of the spokes do not cross where the other two cross, the operator will know an error has been made in one of the readings . See Fig. 2

Figure 2



DEPTH OF THE FAULT

When the position of the fault has been marked, place the RED microphone at that exact spot. The GREEN microphone is placed 28.5 inches from the red microphone and in-line with the cable. Push the mode switch for a "DEPTH = -ft --in" to appear on the LCD display. The next "thump" to be heard will triangulate the sound being received and provide the depth from the red microphone to the fault.

When using the Earth Probe Microphone, the depth accuracy will be + or - 1.5 inches, depending on how deep the rod tip is in the ground. The depth is being measured from where the rod first picks up the sound, not at ground level.

With the red microphone over the fault, measure the 28.5 inches with the green earth probe microphone.

28.5 inches on an Earth Probe Microphone using front spike is from the "tip of the spike to the top edge of the grip handle".

28.5 inches on an Earth Probe Microphone, if a Stirrup Probe is being used, is from the "top edge of the foot bar to the top edge of the grip handle".

Another method that can be used to establish 28.5 inches is to use a tape measure. Place your two feet heel to toe until the 28.5 inch mark can be found as an approximate mark on one of your shoes. You can then step off the 28.5" mark from the red microphone when a depth needs to be taken.

WATER FILLED VAULTS

DO NOT PUMP OUT A VAULT FULL OF WATER UNTIL YOU CHECK IT

When a thump takes place in a duct, the sound will travel both directions to the end of the duct. When the sound leaves the duct into air or water, it will not re-enter a new duct on the other side of the vault. By listening inside each vault, the operator can pin point the fault between two vaults.

The earth probe microphones are sealed and can be placed under water. By placing one microphone in the water, the thump will be heard in that vault. If the vault is not full of water, the sound will enter the vault into air. As indicated earlier, air does not transmit sound to a microphone so contact of some type must be made. If the duct is plastic, the tip of the earth probe can touch the duct and then listen for the thump.

IF THE DUCT IS METAL, DO NOT TOUCH THE DUCT WITH THE MICROPHONE OR ANY OTHER OBJECT WHILE THE THUMPER IS IN OPERATION. WHEN THE THUMP VOLTAGE ARCS TO THE NEUTRAL, ANY CONDUCTOR TOUCHING THAT NEUTRAL WILL RISE TO THE THUMPER VOLTAGE OUTPUT. THE METAL DUCT IS A CONDUCTOR OF ELECTRICITY AND COULD HAVE HIGH VOLTAGE IMPULSES ON IT. THE MICROPHONE CAN TOUCH THE WALL OF THE VAULT NEAR THE DUCT, BUT NEVER THE DUCT.

SERVICE AND WARRANTY INFORMATION

WARRANTY

All of Aqua-Tronics, Inc. products are warranted against defective materials and workmanship.

The Super D.A.D. is covered by a one-year warranty

Aqua-Tronics, Inc. will repair or replace all products which prove defective during the warranty period. All repairs will be performed at our manufacturing plant or at one of our field service centers. Aqua-Tronics, Inc. retains sole and exclusive right to determine where repairs are to be made and to determine if defects are covered by warranty or are the result of misuse and/or abuse of the instrument and, thus, not subject to warranty repair or replacement.

ANY ATTEMPTS BY UNAUTHORIZED PERSONNEL TO REPAIR ANY AQUA-TRONICS, INC. INSTRUMENT WILL AUTOMATICALLY VOID THE WARRANTY COVERING THAT INSTRUMENT.

SERVICE

If you have trouble with this or any other instrument, or require assistance for any reason, contact the nearest Aqua-Tronics, Inc. sales outlet. You may also call or write directly to Aqua-Tronics, Inc. to explain your problem, or the type of assistance you need.

All instruments shipped to the factory must be sent prepaid. No collect or C.O.D. shipments will be accepted.