

HB ROSS MANUFACTURING CO.
ROSS METER™

THE ACVGD® ROSS METER®

USER MANUAL

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1.0 DIRECTIONS FOR USING THE ACVGD®

1.1 BACKGROUND – The alphabetic characters of the trademark, ACVGD®, form an abbreviation, a symbol, for our use to more simply name the instrument which was originally known as the 60 Hz A.C. Voltage Gradient Detector. The ACVGD® ROSS METER® is an instrument designed to locate the point along an underground cable path where a "fault to the surrounding earth" is occurring. The ACVGD® makes use of the existing 60 hertz A.C. voltage that is still energizing the faulted cable. The ACVGD® does not require that any secondary voltage service cables be disconnected in order to use it. The operator merely walks out to where the cable is buried and begins to probe along the path of the cable as described below. Since the instrument does not put a signal onto the faulted cable the instrument is **"Passive in Nature"** both in its design and in its use in locating the fault. Because of this passive nature the instrument does not introduce any additional risk to the job site nor to the operator/user than was present prior to arrival at the job location.



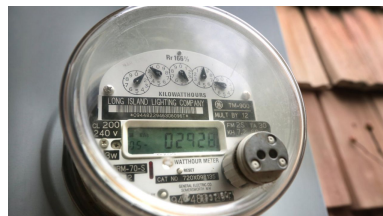
1.2 ON THE JOB SITE – The ACVGD® is easy to use and its application to the job of locating the precise location of the fault can be mastered in just a few times of use. The following discussion explains the techniques used to locate secondary voltage (less than 600 VAC) service cable faults with the ACVGD®. Please refer to the attached drawings throughout this discussion on the use of the ACVGD®. Figure 1 (pg 11) shows a typical layout of facilities in a customer's yard. There

is a chain link fence, underground water pipes, and the underground secondary service. There is an earth ground at the customer's meter base and there is another at the pad-mount transformer. These grounds may be solidly (electrically) connected to the underground pipes and possibly even to the chain link fence.

1.3 TAKING READINGS – Let's look at Figure 2 (pg 11) for the basic method of taking readings with the instrument. Here the readings are represented as circular shapes, each being a specific voltage's pattern that is generated at the surface of the ground. You also see there is an area that is labeled the transformer zone on the left and the fault zone to the right. Of course, you cannot know immediately where the fault zone is, but you do know where the source transformer is and where the customer's meter base or street light is. With this in mind the following rule was developed (by user experience in the field) as a time saving approach to finding the point of the fault.

THE 2/3's RULE

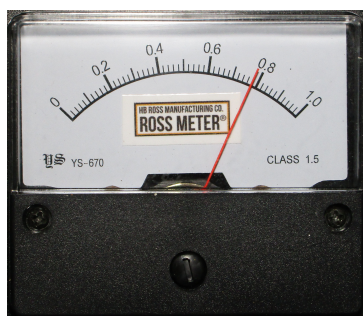
Observe the relative locations of the metered service point (that is experiencing problems) and the source transformer. Walk to a position that is approximately 2/3's of the way from the transformer toward the metered service point. Position yourself along what you would consider the probable path of the underground service. This is where you should begin to take readings with the ACVGD®.



With the SCALE ADJUST knob turned fully **Clock Wise** (CW; ie, ☻) place the probes at a comfortable distance from your sides and push them into the ground enough to establish a firm contact with the soil. It is not necessary to try to stick the probe tips deep into the soil in order for the instrument to detect the presence of an A.C. voltage in the soil. However, it is important to *try and maintain a similar amount of depression into the soil, and a consistent distance between the probes*, from one reading to the next. This will help you to make the "comparisons" of the readings (from one sample reading to the next) more meaningful. In other words, if the probes will easily penetrate two inches into the soil then try to take all the readings by sticking them into the soil about two or three inches deep. If you go five or six inches

deep, after taking readings at two inches deep, the A.C. voltage, at the deeper point, will likely provide a significantly higher reading, which could temporarily mislead you into thinking the fault point is closer than it actually is. Also, when you hold the probes 'comfortably' at your sides if they are about 3 to 3.5 feet from each other then you should try to maintain about that same distance between them as you probe for the voltage reading.

Let's assume that the first location of your probes is represented by position #1 as shown in Figure 2. Assuming that there is sufficient A.C. voltage signal from the fault to cause the instrument's meter to give an up-scale indication, you can make a mental note of how high the reading is at that position. Leave one of the probes in place and move the other one about 45 degrees **C**ounter **C**lock **W**ise (CCW; ie, ☺) around from its original position. This brings you into position #2 and you can see a higher reading than you had in position #1.



Successive readings, moving the one probe CCW (☺) will bring you to the point of "highest" relative reading. This "highest" reading position establishes the 'general direction' of the fault. This is the path indicated by the dashed line that is drawn between the probe tip positions on the ground. Next, you will have to determine which way you should move along the dashed line shown in Figure 2. Move along the line in either direction you choose. If the reading you get after moving is higher than the previous then continue to move along the line in that direction. If the reading is lower than the first then go the other direction along the line and follow that procedure until you approach the point of the fault.

1.4 – THE ZERO READING POINT – As you move closer to the fault, you will have to turn the SCALE ADJUST knob counterclockwise (CCW; ☺) in order to keep the indicating needle of the panel meter from staying pegged solidly at the right side of the scale. Again, what you will observe is a pattern of increasing readings as you move toward the fault. Then as you pass one probe just beyond the point where the fault actually is you will notice a decline in the relative reading. Moving the probes in football chain fashion in the same direction will again result in a lower relative reading. If you go too far the readings will rise sharply at first; but, as you continue moving in that direction the readings will become lower and lower. However, you can find a point shown as position #5 in Figure 2 where the reading is essentially **ZERO**. At this point you will be standing directly above the fault. Why does a ZERO reading indicate the point of the fault? Realizing that the voltage patterns in the soil are in the shape of concentric circles around the point of the fault, note the diagram of dashed lines in Figure 2. Thus, when you have both probes on the same "voltage pattern circle" there is no difference for the instrument to read, hence it will indicate ZERO. ***It is this ZERO reading position that you are looking for.***



1.5 – OTHER READING TECHNIQUES

Two other techniques you may choose to use in locating the point of the fault are:

1.5.1 - THE TRIANGULATION TECHNIQUE

Now let's look at Figure 3 (pg 12). You will notice that it is essentially the same as Figure 2 but another set of readings is shown. Here you see that the 'general direction' indicated by position #C establishes a second line of direction and this second line intersects the one that was established in Figure 2. It is at this point of intersection that you would *expect to find the fault*. This is referred to as the triangulation technique for locating the point of the fault. You probably see already how to achieve this but let's run through it briefly;

- (1) Take your first set of readings as shown in position #1 through #3 and note the 'general direction' line the probes establish;
- (2) Next, pick another position about 12 to 15 feet to the side (along the 90 degree line) of position #3;
- (3) Determine the 'general direction' as shown in position #C. Observe the indicated point of intersection of the two 'general direction' lines.
- (4) Probe along this second line in football chain fashion in the direction of the intersection point.



The closer to the fault that these initial indications are found the better the accuracy of determining the intersection point. If you appear to be 15 to 20 feet from the intersection point you should take several more readings along both of the direction lines established above. When you work the readings of both direction lines to within 4 to 6 feet of the intersection point you can "literally" draw two lines in the soil for the direction lines you have been following and the point where they cross will be very close to the point of the fault. It is recommended, however, that you confirm the actual point by finding the ZERO reading point (described previously) along both direction lines. If the ZERO reading points, as determined along both direction lines, coincide *then you can be confident* that there is A.C. voltage present from some source at that point in the soil.

Some users prefer to begin their probing with the ACVGD[®] after they assure themselves of the exact path of the underground service cables, because (for them) this adds an element of certainty that they are probing in the correct area(s). This technique we shall refer to as:

1.5.2 - THE CABLE-PATH TECHNIQUE

With this approach you would simply use any "path finding" equipment, that you may already have, that can sense the presence of the electromagnetic field emitted by the energized service wires. After marking or mentally noting the path of the conductors, you would then go to the location (along this path) about 2/3's of the distance from the pad-mount transformer toward the metered service point. There you would begin to take readings in football chain fashion (in your choice of direction) along the actual path of the conductors. Depending upon where the fault is from this initial point, you may find;

- (1) that you have no readings even at the full clockwise (CW; ie, ⌚) setting of the SCALE ADJUST knob, in which case you have to decide which direction to move along the cable path

to continue taking readings. If you go far from the starting location without getting any readings you probably should go back to the 2/3's point, to start again, and probe in the other direction.

Remember that as you get close to the source transformer (into the transformer zone) you will begin to get readings due to the AC current flowing back to the transformer's grounding rod. As was pointed out in the opening discussion, the voltage patterns will make a more concentrated pattern at both the point of the fault **and at the pad-mount transformer's ground rod.** You need to be mindful of this since you will almost always find strong readings within 6 to 8 feet of the pad-mount transformer, or near the ground rod at the base of the overhead transformer pole, that serves underground secondary service conductors. Of course there are times when the fault is within the area of the transformer and the hunt for the exact spot of the fault is more difficult, but still possible.



- (2) that you have readings and so you move the probes in football chain fashion, in either direction you choose, to get your next comparison reading. Then if the next reading is higher you can be reasonably confident that you should continue moving along the cable's path in that direction. However, if the readings seem to be getting lower then you should go in the opposite direction.

Once you have determined the direction that produces higher readings you simply continue, in football chain fashion, along the cable's path until the readings drop off sharply and you can find the ZERO point as described in the **ZERO POINT** paragraph above.

The technique that you may use is a personal choice, it depends on what you feel comfortable with. In either approach it may be of some help if you take a sample reading about 8 feet from the source transformer (within the "transformer zone") to determine how high the reading may actually be when you begin to come close to the point of the fault (within the fault zone).

1.6 – TYPICAL USERS ACTUAL PRACTICE



The football chain technique of probe movement described in the previous paragraph(s) is what you can use once you come near to the fault location. However, as reported by most users, the real-world user technique for getting into the general area of the fault is a bit more like using two walking sticks as seen in this photo on the left. Football chain movement is rather clumsy and it is more comfortable to be able to walk straight ahead as one is probing for the fault. Whenever the "seasoned user" begins to probe at a new job site; instead of initially moving the probes in football chain fashion, the operator positions himself/herself such that they have the probes stuck in the ground, one at each side of their body, and they are facing in the direction they wish to walk to begin the probing process. Then the operator keeps one probe in the ground (we will call it probe "A") as he/she steps forward one step moving the other probe (probe "B") ahead of probe "A" and then sticks probe "B" into the ground. At this position the operator looks to see whether there is any change in the panel meter reading, either higher or lower, from the previous position where probes "A" and "B" were both stuck in the ground. If there is an increased reading then the operator

keeps probe "B" in the ground and then steps forward again but this time moving probe "A" ahead of probe "B" by one step and sticks probe "A" in the ground to see if the reading increases again. Repeating this

process until the panel meter reading reaches a maximum value and **then begins to decline** will bring the operator within range of the fault point. This technique allows the user to move along the cable path by walking in a straight ahead manner while moving the probes alongside their body. Once the operator observes the PEAK reading and then sees a declining value on the ACVGD[®] panel meter he/she can then utilize the football chain technique to move the probes to locate the exact point of the fault by determining the ZERO reading point as described above.

2.0 GENERAL INFORMATION ABOUT THE ACVGD®

2.1 – WARRANTY

- The ACVGD® instrument, and the probes, are guaranteed to be free from material and manufacturing defects for a period of one (1) year from the date of shipment to buyer. The probe tips are not warranted against normal wear and tear.
- The ACVGD® instrument is guaranteed self-protected for 60HZ A.C. voltages up to 300 Volts-RMS. Application of voltages higher than 300 Volts-RMS may result in failure of the circuit's electronics and in such event the warranty is void.
- The newer model storage cases are guaranteed against defects in materials and craftsmanship for a period of one (1) year from the date of shipment to buyer. Cases that have been modified are not covered under this guarantee. The case is guaranteed to be watertight when properly closed with an undamaged O-ring in place. Any liability, either expressed or implied, is limited to replacement of the case and not its contents. This guarantee is void if the case has seen excessive abuse or blatant neglect beyond normal and sensible wear and tear.
- Batteries are not guaranteed and will not fall under this warranty.
- Any attempts to modify, repair, or tamper with the meter or the probes by individuals other than the Manufacturer will result in the Warranty being voided.

2.2 – BATTERY REPLACEMENT

It is recommended that you use alkaline type, 9 volt batteries of a type similar to the Duracell Plus Power DuraLock MN1604 or the UltraLife U9VL-BP Lithium batteries. NOTE: For very cold weather conditions (which cause most batteries to lose their charge more rapidly, especially when stored outdoors) lithium batteries, such as the UltraLife U9VL-BP, will hold their charge longer and maintain their output closer to the 9 volt level better than any other type of battery currently available; however, they are more expensive than the Alkaline batteries.



There are two batteries in the instrument and **you must replace both at the same time**, otherwise the instrument will soon begin erratic operation. If this happens, the first items to check are the batteries. Remember, when in doubt, remove both batteries and check them with a voltmeter. You should replace them whenever either read less than 7.5 volts.

To replace the batteries you must first remove the four screws that secure the faceplate to the box. Then you can lift the faceplate up until you see the batteries inside. Use your finger to lift each battery out of the metal clip. Set the faceplate and the two batteries next to the top edge of the instrument. Now you simply unsnap the old batteries from their connectors and then reverse the process to install the new batteries.

Regarding Needed Repairs - If after you have replaced the batteries the unit continues to act erratic, contact the HB Ross Manufacturing Company on next steps to have the unit diagnosed and repaired.

2.3 – PROBE CONSTRUCTION

The probe body is made of industrial quality **Isophthalic Polyester Resin**, reinforced with fiberglass, that has excellent electrical, thermal, and mechanical properties for this application. It is similar to the “hot-sticks” used by utility crews. The probe wiring is 18 AWG test probe wire rated at 5,000 volts d.c. When the banana jack plugs are plugged flush into the terminals of the instrument no electrical contact points exist anywhere along the length of these wires. This is a **safety feature** that is designed into the probes.

The probe tips are made of stainless steel (1/4 inch solid rod) for added strength and durability. One end of the rod is threaded using a 1/4-20 NC die. The wire is secured to the end of the probe tip, within the probe's handle, by two 1/4-20 NC finished (zinc coated) hex nuts.

2.4 – DISCLAIMER



Working with electricity can be dangerous. Responsibility lies with you, the user of the ACVGD[®], to act safely when using this device. Inspect the instrument before each use. Be sure that the probe wires are not damaged, exposing any conductor. The instrument must be used in accordance with the manufacturer's instructions and only for the purpose in which it was designed. The manufacturer of this product shall neither assume nor accept any liability or responsibility for consequential damages or injury resulting from the use or misuse of this product or any of its component parts. When using this product, the user of the Ross Meter[®] assumes the responsibilities of ownership, use and operation and the user agrees to hold harmless the manufacturer and employees for any incident or action involving the use or misuse of this product.

TYPICAL LAYOUT OF FACILITIES

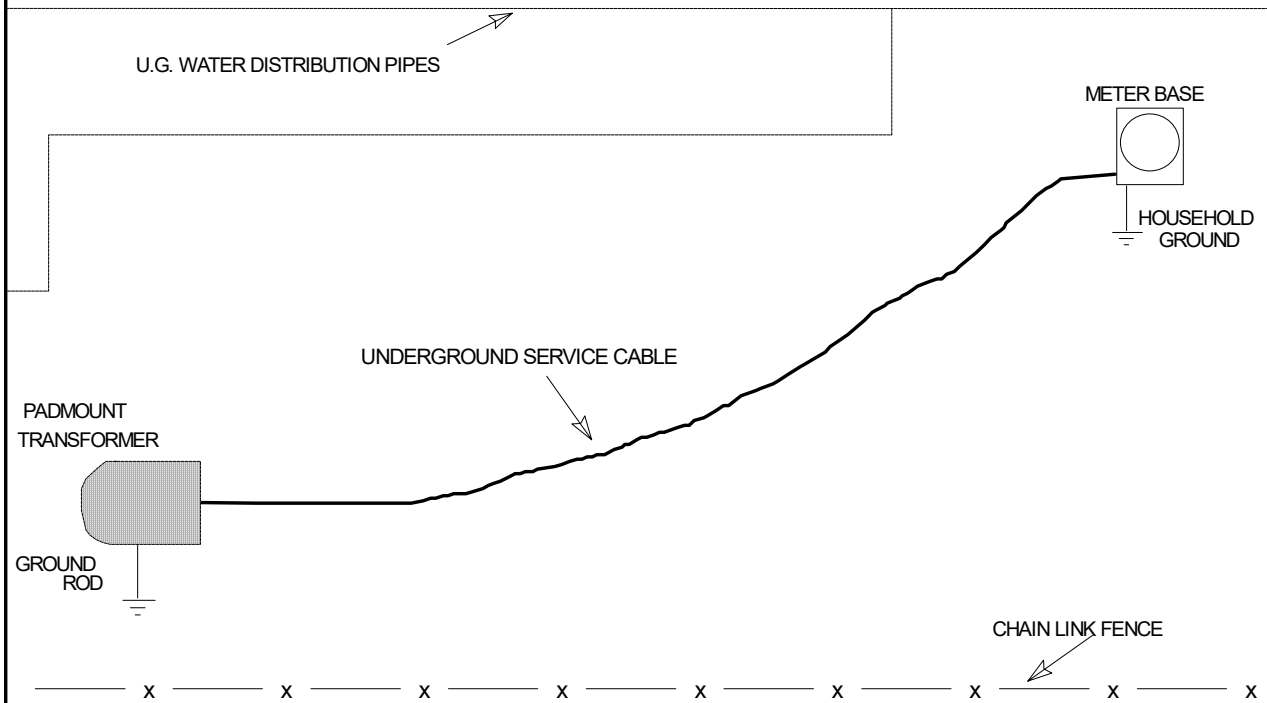


Figure 1

TYPICAL PATTERN OF VOLTAGE CIRCLES NEAR THE SURFACE

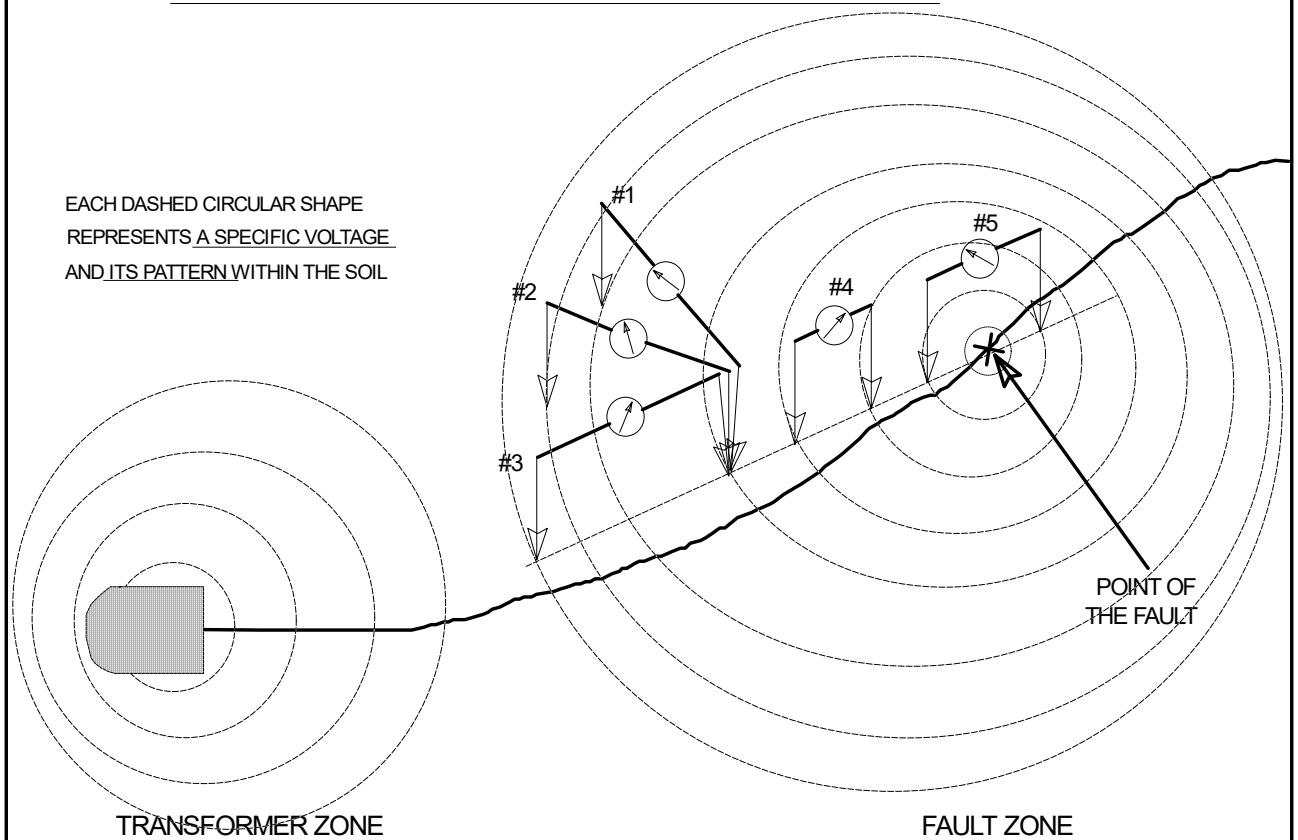


Figure 2

TRIANGULATION METHOD OF LOCATING THE FAULT POINT

EACH DASHED CIRCULAR SHAPE
REPRESENTS A SPECIFIC VOLTAGE
AND ITS PATTERN WITHIN THE SOIL

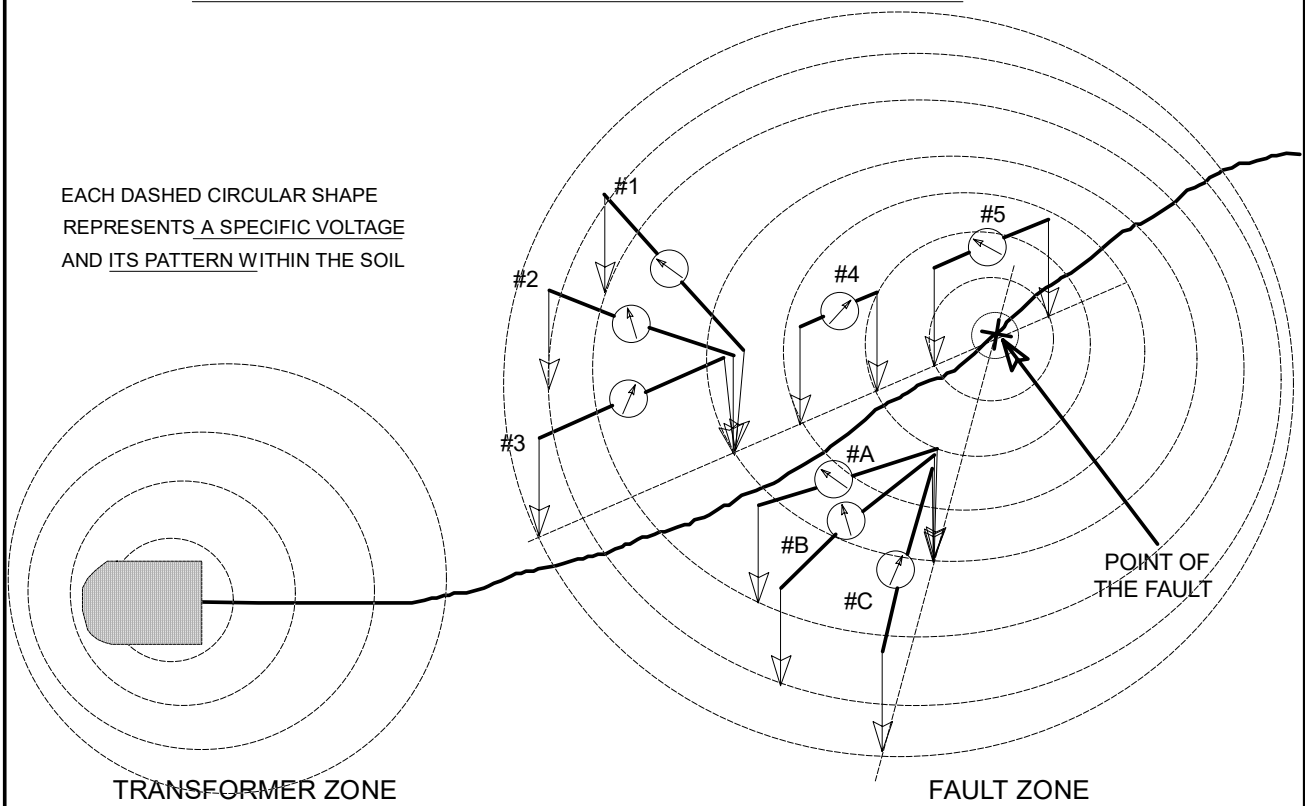
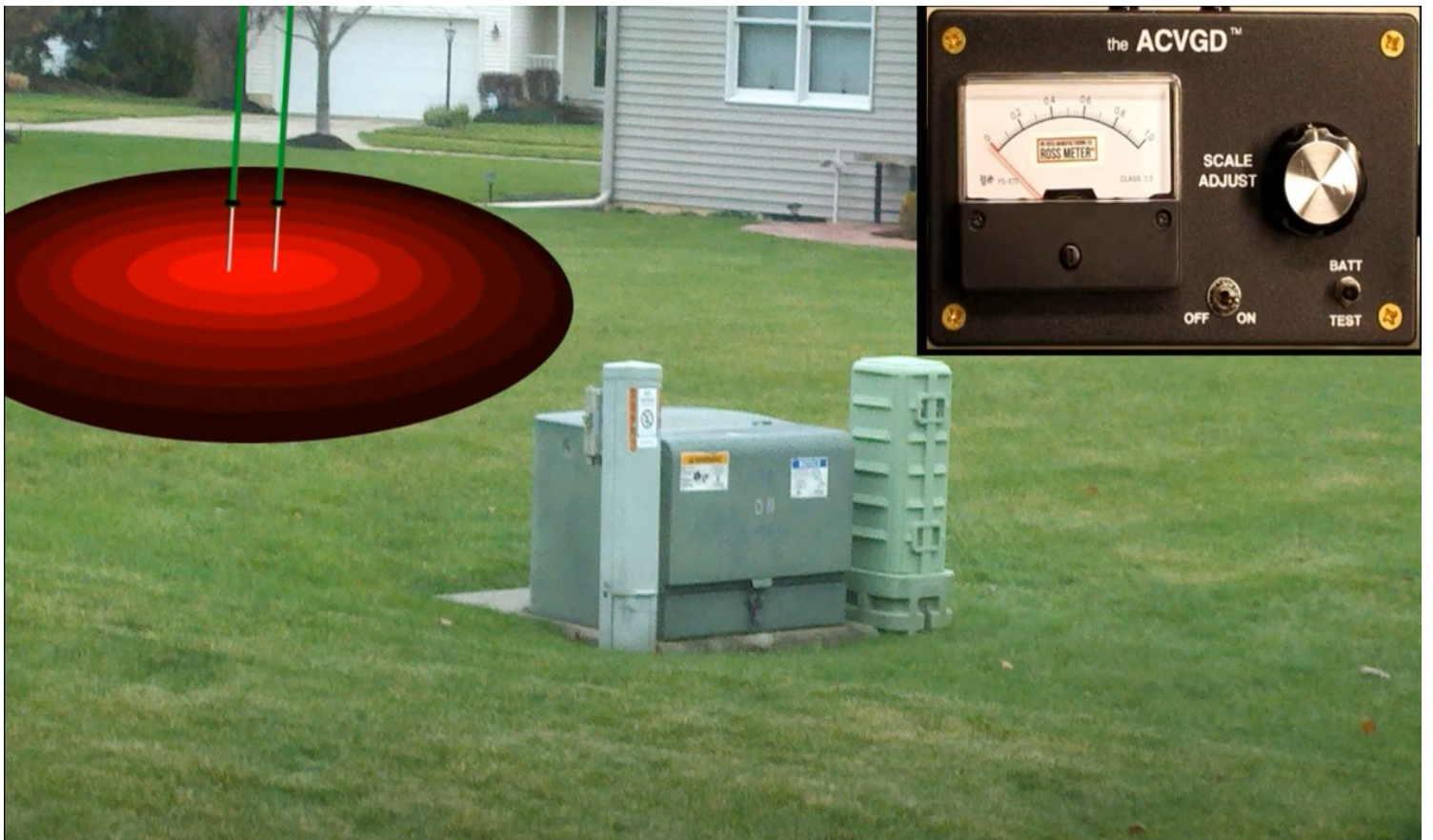
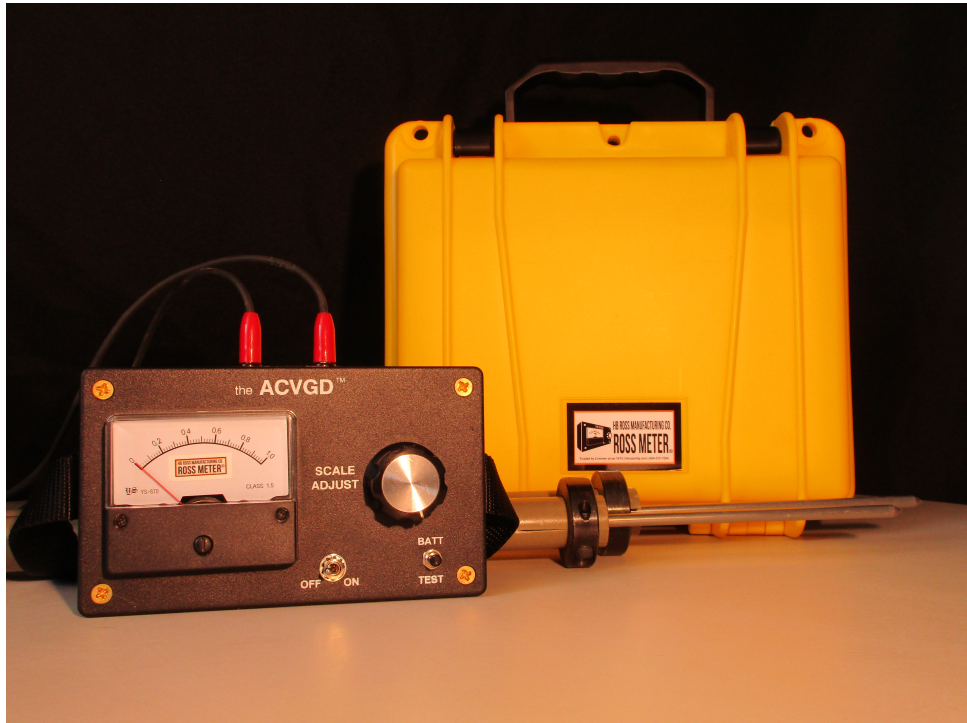


Figure 3



WHAT IS INCLUDED IN THE ACVGD® ROSS METER® KIT?



1. Instrument Storage Case – our military grade storage case provides maximum protection for your meter. You can rest assured it is safe and secured. It is designed to be waterproof (IP67 or better) and have automatic pressure equalization valves to prevent damage to the interior contents. The case includes safety latches, padlock holes and multilayer protective cubed matrix accuform foam as standard equipment. The dimensions are (length 10.8" x width 9.9" x height 4.9").
2. The Ross Meter® – includes two 9 volt batteries already installed in the unit. Its case is made of thermoplastic ABS which is mar and scratch resistant, chemical resistant and heat resistant to 475 degrees. The handy neck strap is made of light weight nylon webbing which is military spec and has a breaking strength of 1200 pounds.
3. Probes – each Ross Meter® includes two probes which are constructed of Isophthalic Polyester Resin reinforced with fiberglass. Each probe includes 18 AWG wiring which is rated at 5,000 volts D.C. Banana jack plugs are also included which are used to connect the probes to the meter. The probe tips are made of stainless steel T304 and are 1/4" diameter (standard specification ASTM A276, QQS-763, T304/304L). Each probe tip is secured with a black oxide steel clamp that can handle typical axial loads during proper use.
4. User Manual and Training Videos – a printed user manual is included and a digital PDF manual is available online along with training videos via computer or smart phone using the QR code sticker attached to the storage case.



This manual as well as instruction and training videos are available online on our website, located at <https://therossmeter.com>

Quickly access our website & training videos on your phone using this handy QR Code below:



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