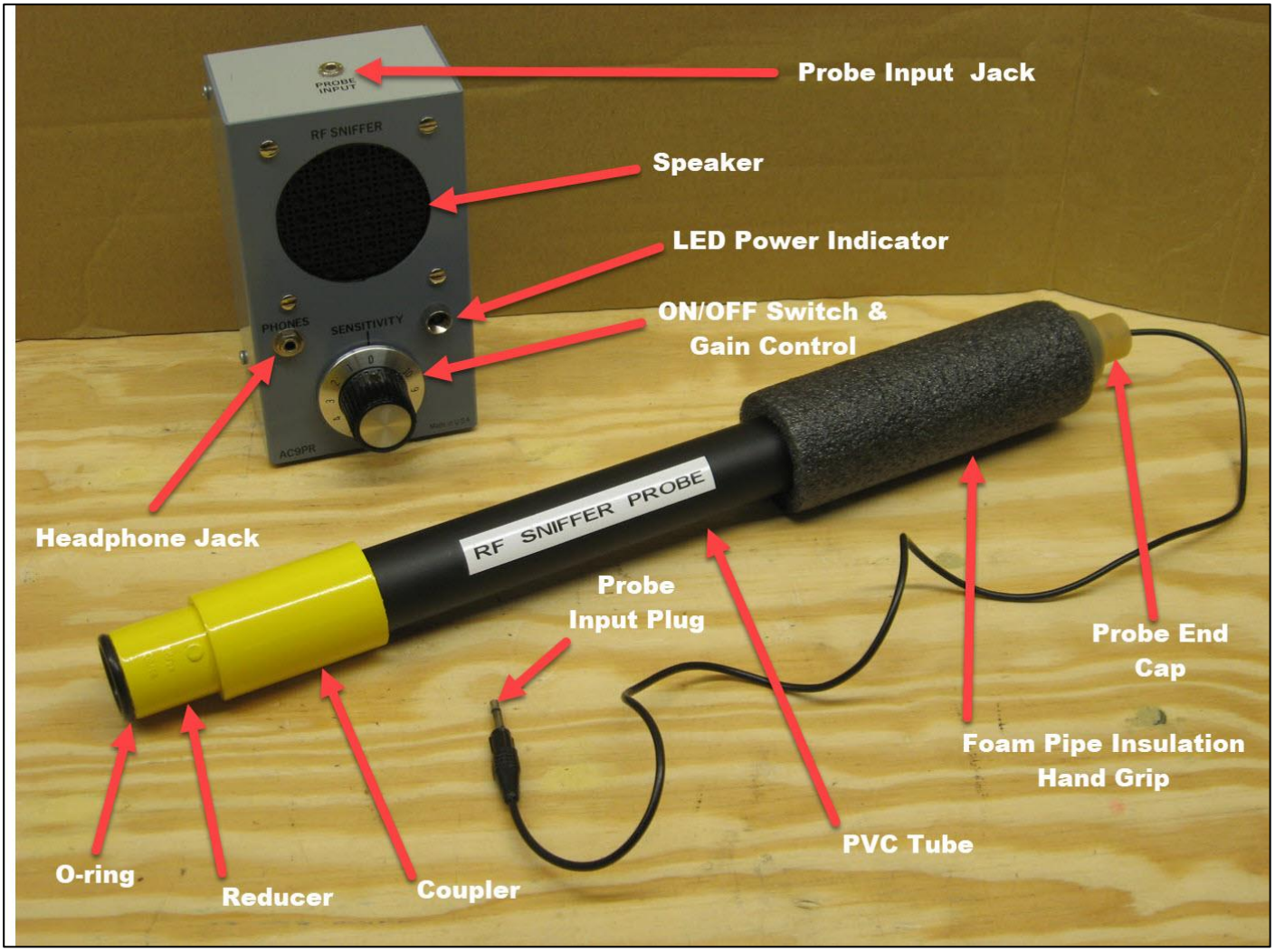
RF Sniffer Construction Notes

Submitted by AC9PR – May 2019



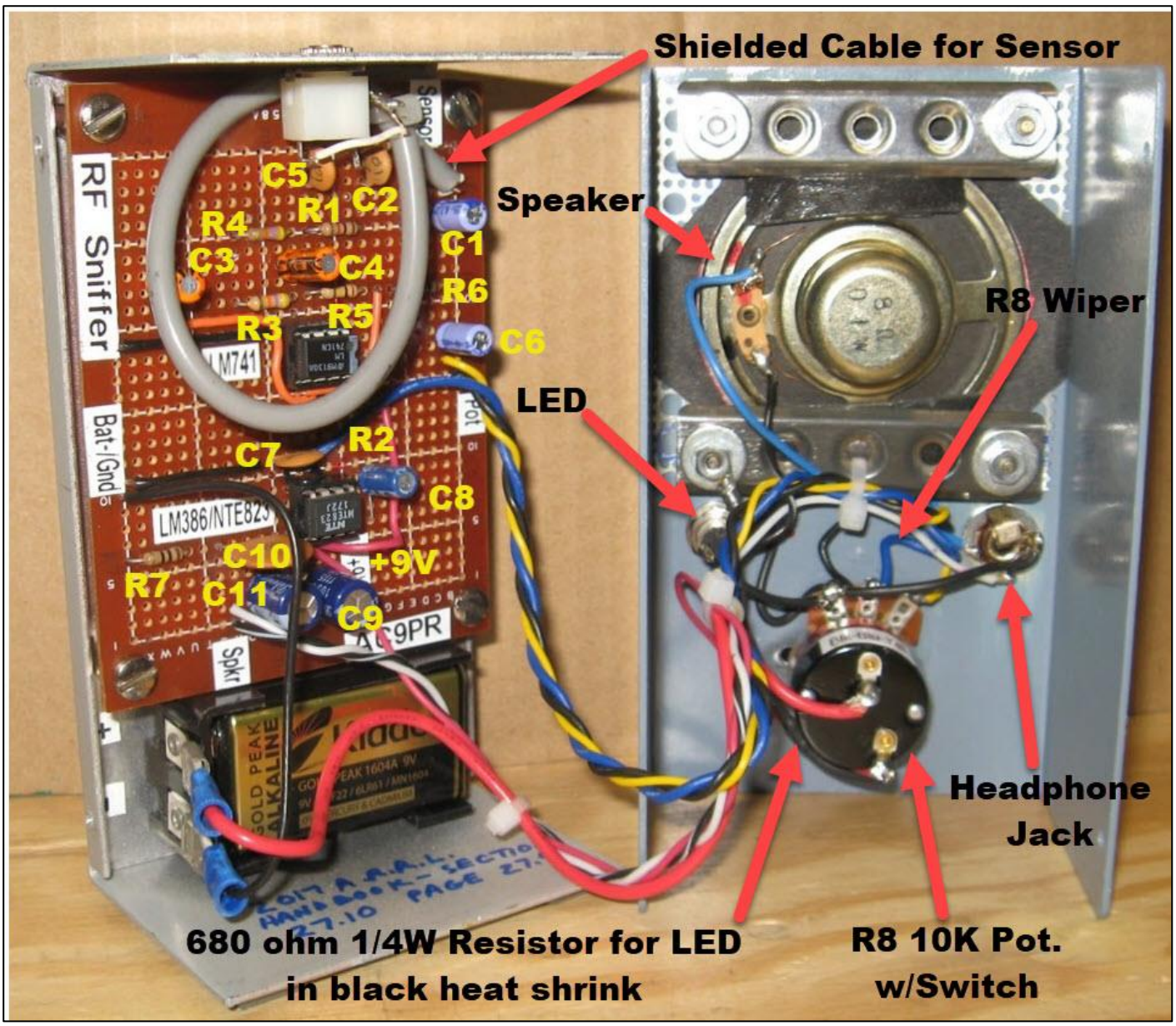
The completed units.

RF Sniffer Unit

Front view of the main unit.

1. Enclosure shown is a 3” X 5” X 2” (WHD) aluminum box. The size is not critical, but needs to be metallic (i.e. – shielded), and be able to be hand-held.
2. Note the metallic (aluminum) grill material covering the speaker. Although it is painted black and has a layer of cloth material behind it, the grill itself is grounded to the aluminum case. The grill cloth material was sourced from Hobby Lobby in the fabrics section. It is a very thin, almost translucent black crepe paper-like material. Double-back tape was used to secure it in place. The speaker is secured by compression – the four hex stand-off screw posts and their screws, flat washers, and two short pieces of old Erector Set metal strips. Between the metal strips and the speaker’s frame is a piece of self-stick rubberized padding material.
3. Several parts I already had on-hand, those that I did not have I ordered from Cable & Connectors (see enclosed Invoice copy for reference).
4. Recommend using IC sockets for both ICs – preferably ones with *machined pins* (more expensive but EASIER to insert and replace the ICs if needed, and much better quality (gold plated). I did not use them, as I had others already on-hand, but it was rather difficult to insert the ICs into the sockets.
5. The LM741CN is equivalent to an ECG #941M
6. The LM386 is equivalent to an NTE823
1. Be sure to install the ICs after all of the other components and wiring is done (except for testing purposes). When laying out where/how to install the components on the board, be sure to allow adequate room to install/remove the ICs. It is also recommended to put a mark on the perf board that corresponds to Pin 1 of each IC.
7. On that note, during the component layout phase, be sure there is no interference between board components, the grounded chassis, the speaker, potentiometer, and other components that may have protruding leads or a wiring harness, no pinched wires, etc. Also be sure to allow enough room to remove and install the 9V battery.
8. Add four rubber feet to the bottom of the chassis.

9. The perf board I used was one obtained from Radio Shack many years ago, part number 276-158A. Radio Shack part number 276-154A is similar but larger, and could be made to work. You need to obtain a perf board that has rows of individual or paired solder pads on the reverse side. If you try and use one that has solid copper traces running back and forth and in long runs, you will need to be cutting a lot of traces to try and install/connect the various parts.
10. Misc. hardware and supplies as needed (1/8" cable clamp, 6-32 X 1/2" pan head screw, 6-32 hex nut, #6 external tooth lock washer, black tape, painters' tape, spray paint, 91% alcohol, PVC cleaner & cement for white PVC, end cap for ¾" PVC tube, etc.). Read down through the Construction Notes for additional items and supplies.
11. Press-on lettering applied and coated with clear Acrylic spray to prevent damage. Be sure to apply the Acrylic spray *before* mounting the components on the chassis, and allow it to dry completely.
12. If the metallic enclosure that you use is painted on the inside, be sure to remove the paint <u>for any and all</u> ground connections! Use a file, rasp, sandpaper, steel wool, etc., as necessary to ensure a good ground connection is made. Be sure to remove all filings, dust, etc.
13. I added a green super-bright LED power indicator (long lead is Anode [+]) with a 680 ohm ¼ W resistor in series to limit the current draw to approx. 10 mA. This item is not shown on the schematic.
14. I also added a 3.5 mm (1/8") shorting jack for using a pair of headphones *with an inline volume control*. The shorting feature will mute the loud speaker on the unit when the headphone plug is inserted into the jack. You will want to use a pair of mono headphones, or insert a stereo-to-mono converter jack in series with the headphone jack. A converter jack used to be available from Radio Shack (I just happened to have one). Another option may be to modify a stereo jack by installing a wire jumper between the left side and the right side. The added jack is not shown on the schematic.
15. One the page with the schematic, in Figure 27.32, along the top of the illustration, I ran a red jumper wire from the "9V via S1" shown on the left, to the "9V via S1" shown on the right. Doing this eliminates running a second red power wire to/from the power switch which is incorporated on R8, the 10K ohm pot.
16. I have also penciled in the wire colors on page 27.41 that I used in the event you may want to reference the photos to better match up the wiring on the schematic. This was done only for reference. On this note, I do remember noticing a wiring discrepancy during my construction process between the point-to-point wiring (Figure 27.32), and the schematic (Figure 27.31), but I don't remember exactly what it was. I believe the discrepancy was in the point-to-point wiring diagram. As I recall, *I followed the schematic and was careful to identify all jumpers and wiring connections by color*. Another assembly technique that I use, is to *put a check mark on or by each component and each connection on the schematic (or on a copy of the schematic) as each component or connection is completed*.

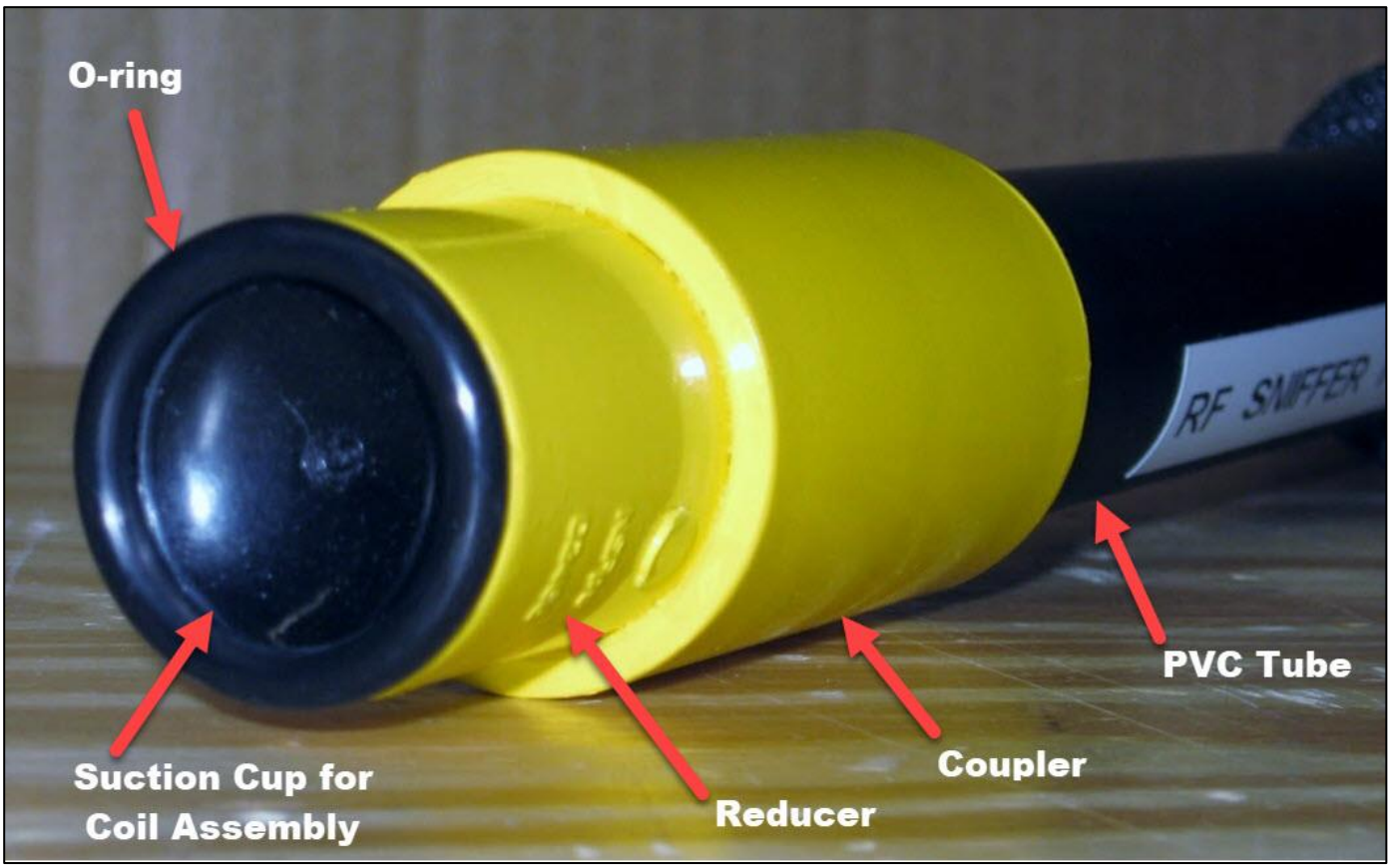


Inside view of the main unit.

RF Sniffer Probe

NOTE: The following is for the assembly of the PVC probe parts. It is to help provide you with the parts needed, should you decide to assemble a probe similar to mine. All PVC parts were obtained from the local MENARD'S store. Do **NOT** cement any of the parts together until after you read <u>all</u> of the probe assembly notes!

NOTE: Be sure to read and heed all manufacturer's WARNINGS, Cautions, Notes, and Instructions before following the PVC and painting steps. Additionally, be sure to have adequate ventilation, and wear safety glasses/goggles and appropriate safety garments for the various machining and assembly procedures listed below.



Close-up of the business end of the probe.

Parts list for the probe assembly (one each of the following):

- ¾" X 5' PVC Schedule 40 pipe (PVC Tube), #689-8517
- ¾" Pipe Insulation, #679-2723
- ¾" to ¾" Female Adapter (Coupler), #689-6810
- ¾" to ½" Adapter (Reducer), # 689-6580
- 6-32 X ½" Pan head machine screw
- 6-32 hex nut
- #6 External tooth lock washer
- 1/8" Plastic cable clamp
- 13/16" I.D. X 1 1/16" O.D. O-ring with a 1/8" cross section
- Rubber or plastic end cap for bottom end of probe

NOTE: All of the above part numbers are Menard's stock numbers. Due to sourcing their stock from multiple suppliers, the appearance of a given part may be different than what is shown in this document. However, they do not change stock numbers between the various suppliers. Case in point – the adapter (Reducer) that I used was smooth, and was sourced from LASCO. I recently checked this item at the same local Menard's store where I purchased my supplies for this project, and now the item is sourced from NIBCO and includes a molded hex configuration rather than a smooth surface. Although I provide part numbers for certain items shown above, I am also including additional descriptions of each of those items for reference, as other hardware stores may have identical items in stock, but under their part number system.

1. The main body of the probe is approx. 12" of ¾" Schedule 40 PVC, a NIBCO ¾" Coupler with the following markings on the end: PVC-1 ¾" SCH 40 D-2466 NSF UPC. Inserted into the coupler is a reducer that is threaded on the end that is inserted into the coupler. It contains the following markings: ¾ X ½" LASCO PVC1 MHT-101 NSFpw? 02466. In order for the reducer to fit well into the coupler, I had to file down the threads until I could twist the reducer into the coupler snugly, then to assemble all three parts, I used the appropriate cleaner and adhesive for white PVC fittings.
2. **First**, carefully file down the threads on the reducer to allow assembly of the reducer into the coupler. Since they are pipe threads, the diameter of the threads increases with depth. So, the first several turns will be easy, but will become tighter with greater insertion of the reducer into the coupler. File the threads only enough to allow complete assembly. Remove the reducer from the coupler.
3. The telephone pick-up coil typically has about a 36" long cable terminated by a 1/8" 2-conductor plug. Carefully feed the cable into the end of the reducer with the smooth bore, using caution so as not to cause damage to the cable where it exits the coil assembly. If the coil is like the one that I had, I used a Dremel tool to remove some of the PVC material near the center of the reducer to allow enough clearance for the cable where it exits the coil. Grind out just enough PVC material so as not to kink or damage the cable when the coil assembly is inserted into the end of the reducer. The coil should be positioned so that the suction cup of the coil assembly is flush with the edge of the reducer.
4. Once you are satisfied with the fit of the coil, remove the coil assembly. Prep the PVC tube and fittings for painting them, if desired. Remove all sharp edges, and clean both the insides and the outsides to remove all debris and coatings. Use 91% rubbing alcohol for this task. Use masking or painters' tape to cover the areas that will end up being cemented together when the unit is assembled. Place a cotton ball just inside the tube and just inside the fittings to help keep paint out of the bores, but still allow the ends of the fittings to be painted. Paint as desired.
5. After the paint has dried completely, carefully remove the masking or painters' tape that you applied in the previous step.
6. Assemble the coil assembly into the reducer until the outer edge of the suction cup is flush with the edge of the reducer. Make sure there is no damage to the cable where it exits the coil assembly. Set the reducer on a flat surface so the suction cup end is facing down on the flat surface. Very carefully, pull some cotton off of a cotton ball, and put it down and around the coil assembly so that it is wrapped around the back side of the suction cup. This will help prevent damage to the suction cup in the next step.
7. During this step, *do NOT apply any hot glue to the coil's cable, nor allow any hot glue to drip down onto the suction cup of the coil assembly. Doing so may cause damage to the cable, or damage or disfigurement to the suction cup*. Carefully hot glue the coil assembly in several places, taking care not to apply too much. Also consider that at some point in time, you may need to replace the coil assembly. Allow the glue to completely cool.
8. Obtain a plastic straw, and slit it down its length. Slip the slit straw over the cable and slide it until it is against the back of the coil assembly. Secure the straw in place with a short piece of masking or painters' tape. This will prevent the cable from being damaged during the PVC cementing process.
9. Measure and mark with a pencil where the tube will be cemented inside of the coupler. *Use painters' tape to cover the painted surface of the tube, and prevent damage from the cleaner and the cement.* You will need to work fast, and *CAREFULLY*, as the cleaner is watery and will run and drip everywhere you don't want it to, and it will immediately destroy your paint job! In addition, the PVC cement sets up FAST!

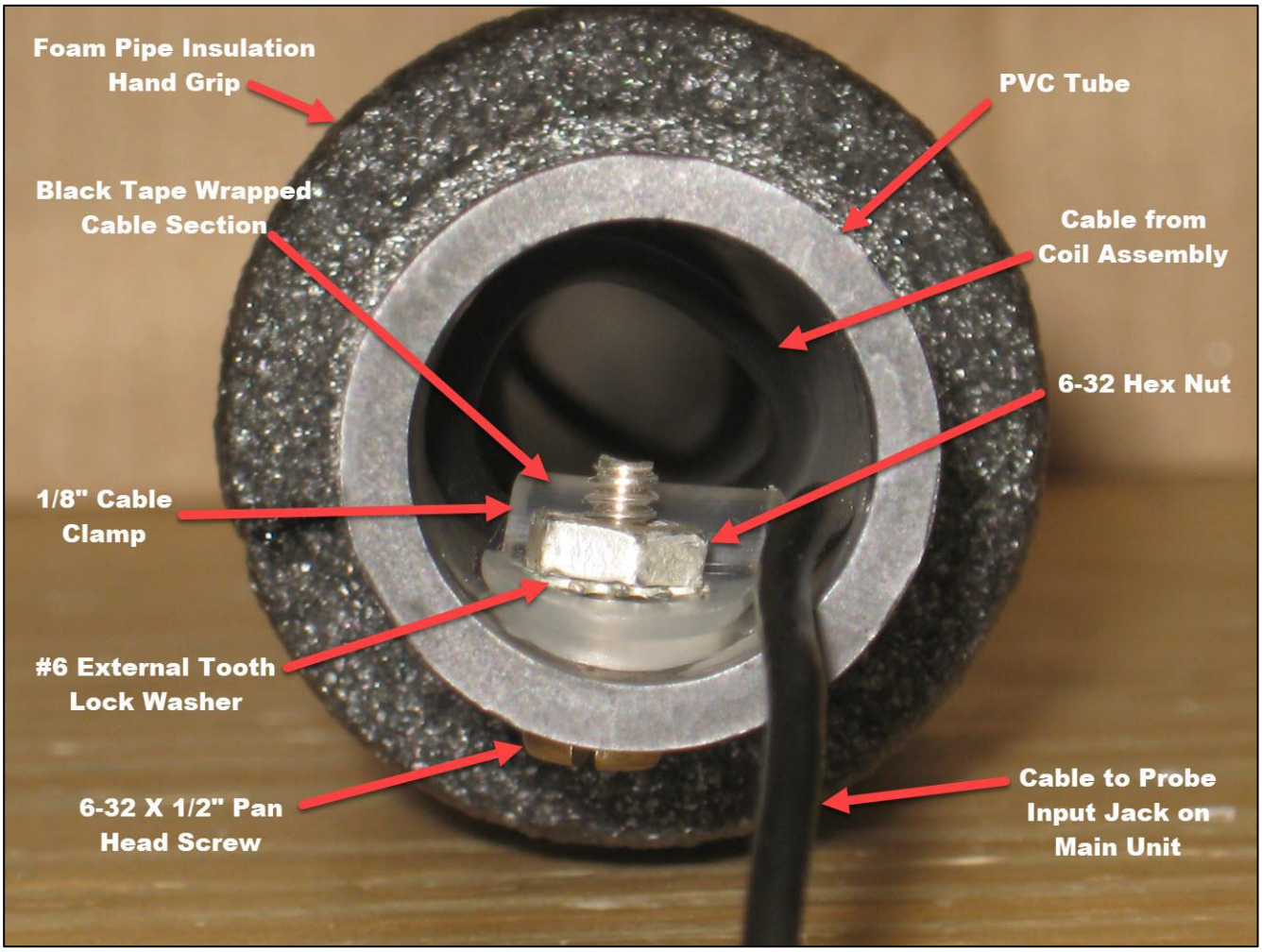
NOTE: Be sure to follow the manufacturer's WARNINGS and instructions prior to the PVC cleaning and cementing steps that follow.

10. Apply the PVC cleaner SPARINGLY to the threads of the reducer and the bore of the coupler.

NOTE: Due to the fluid consistency and short curing time of the PVC cement, timing of the cementing/assembly process is ***CRITICAL*** during the following two steps.

11. Apply the cement sparingly to the threads of the reducer and the bore of the coupler. Quickly but CAREFULLY, slip the cable into the coupling, making sure the straw protects the cable from damage, and quickly insert the reducer into the coupler until fully assembled. Immediately clean up as needed while allowing the cement to cure.
12. Remove the straw and the tape from the cable, and feed the cable down into the length of tubing until the end of the cable is hanging out of the tube. Repeat the cleaning and cementing process for assembling the tube into the bore of the coupling, avoiding getting either product on the cable. Be sure to use a twisting motion as you insert the tube into the coupling until the tubing is fully seated into the coupling. When the cement is cured, *carefully* remove the painters' tape from the tubing that you installed in Step 9.

Strain relief for the cable:



Close-up of the cable strain relief inside of the tube.

13. Measure 5/8” of an inch from the end of the tube end where the cable exits, and drill a 9/64” diameter hole through one side of the tube. Right at where the cable exits the end of the tube, wrap a short piece of black tape around the cable several times so that when you slip the cable into a 1/8” plastic cable clamp and secure the clamp closed, the cable will not slip through the tightened clamp. Be sure to put just enough black tape around the cable to do its job.
14. Install the 1/8” cable clamp around the cable where the tape is wrapped around the cable, and rotate the clamp 90 degrees, so the clamp is perpendicular to the exiting cable. Secure the clamp in place with a 6-32 X 1/2” pan head screw, #6 external lock washer, and a 6-32 hex nut. Tighten securely. Install a cap over the cable and the end of the tube assembly. (I happened to have a translucent rubber cover I believe I obtained from a new automotive battery terminal.
15. Cut and install about a 5” length of foam pipe insulation over the end of the tube assembly for a handle grip. You may need to apply additional glue along the lengthwise slit of the foam pipe insulation and use rubber bands to hold the insulation together until the glue sets. I used black E6000 adhesive sourced from Hobby Lobby for this purpose.
16. Glue the rubber O-ring onto the end of the probe to prevent damage to the probe and the suction cup portion of the coil assembly.

Operational Testing

1. If you haven’t done so already, install both ICs. Be sure they are installed in their correct socket, and are correctly oriented in the socket. Pin #1 on each IC is typically indicated with a small dot on the top of the IC. Use caution when inserting the pins of the ICs into their socket … *they bend easily*.
2. Make sure the power switch on the potentiometer is in the OFF position. Install a new Alkaline battery.
3. Insert the plug for the probe into the probe’s jack.
4. If you installed the optional headphone jack, do not plug in the headphones at this time. Turn the unit ON. If you installed the optional LED power indicator, check to see if it is illuminated. With the Sensitivity/Gain control in its lowest setting, you should hear a faint hiss emanating from the speaker.
5. If successful with the previous step, assemble and secure the housing closed.
6. Rotate the potentiometer clockwise to increase the amount of Sensitivity/Gain to the mid-range. Holding the main unit in one hand, and the probe in the other hand, move the tip of the probe to some sort of working electrical device. Examples may include a fluorescent or LED lighting fixture, a digital telephone, computer, router, TV, etc. You should hear an assortment of buzzing, hissing, squeaks, squawks, thumping, ticks, noise pulses, humming, etc., depending on where you point the tip of the probe on a particular item. If you incur feedback, rotate the potentiometer counterclockwise to reduce the amount of Sensitivity/Gain.
7. If the headphone option was installed, plug the headphones into the headphone jack on the main unit and make sure the external speaker mutes when the headphones are plugged in. Move the probe around to ensure the sounds can be heard through the headphones alright. Adjust the inline volume control on the headphones to an acceptable level.
8. If the unit is not to be used for an extended period of time, be sure to remove the battery to prevent potential damage to the unit from battery leakage.