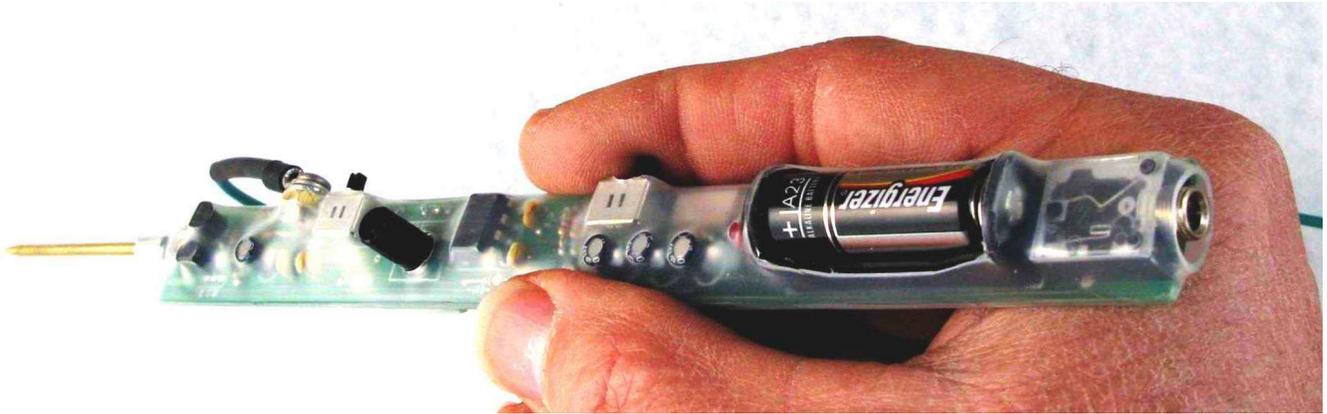


Hendricks Signal Injector/Tracer Assembly Instructions



First off, check to see if the parts match the parts list...

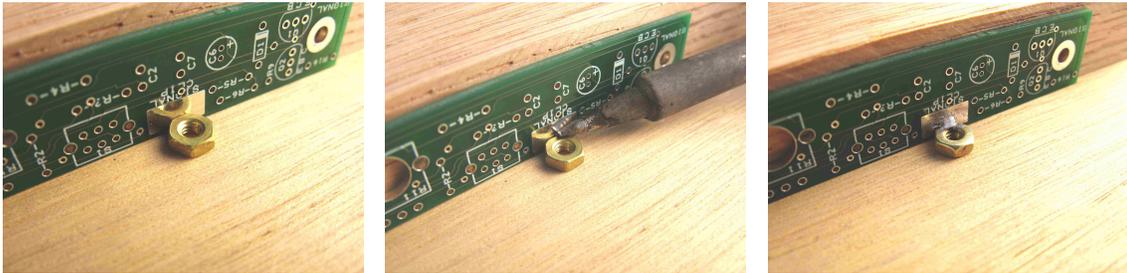
Electrical components:

R1, 2	100K, 1/8W (BRN, BLK, YEL, GLD)
R3, 9, 15	10K, 1/8W (BRN, BLK, ORN, GLD)
R4	180K, 1/8W (BRN, GRY, YEL, GLD)
R5	6.8K, 1/8W (BLU, GRY, RED, GLD)
R6	100 Ohm, 1/8W (BRN, BLK, BRN, GLD)
R7	220K, 1/8W (RED, RED, YEL, GLD)
R8	4.7K, 1/8W (YEL, VIO, RED, GLD)
R10	1K, 1/8W (BRN, BLK, RED, GLD)
R11	100K Potentiometer
R12	47K, 1/8W (YEL, VIO, ORN, GLD)
R13	2.7K, 1/8W (RED, VIO, RED, GLD)
R14	3.9K, 1/8W (ORN, WHT, RED, GLD)
R16	220 Ohm, 1/8W (RED, RED, BRN, GLD)
C1	.001uF marked (102)
C2, 3, 7	.1uF marked (104)
C4, 5, 6, 8	10uF-16v
U1	LM358N DIP
Q1	2N5172
Q2	2N3904
D1	1N5234B, 6.8V Zener
D2	Red LED
S1,2	DPDT Slide Switch
J1	Phone Jack
LEAD	Alligator clip and lead
PCB	Printed circuit board

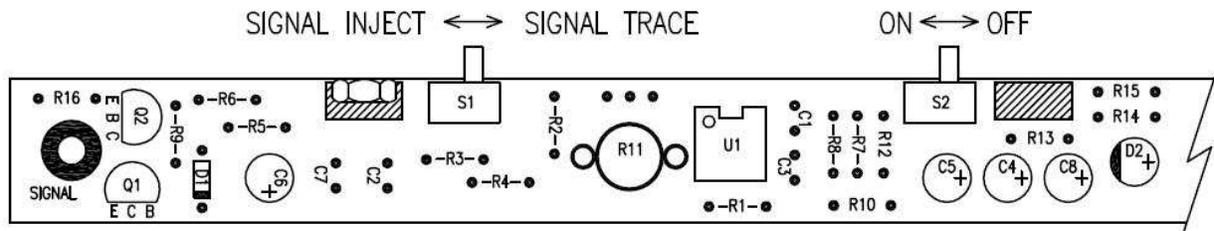
Mechanical components:

N size battery holder
Size 23A alkaline battery
4-40 Brass nut
4-40 Steel nut
2 ea. #4 Internal tooth lock washers
2 ea. 4-40 x 1/4" L. Pan head screws
2 ea. 14-16ga., #4 Ring terminals
3/32" dia. x 2" L. Brass rod
3/16" x 1" L. Heat shrink tubing
3/4" dia. x 8" L. Clear heat shrink tubing

The first item to assemble will be soldering the 4-40 brass nut to the correct pad on the pcb.



- Solder the nut, flush to the side of the board, at the forward pad, (the one near S1), as shown. Use something square to position the board up against, I used a small piece of wood, and lie the nut down 90 degrees to the board. This will be the alligator lead connection point used later. The pad near S2 is for another nut, for those wanting to mount the probe in their own custom container. That will not be addressed here.



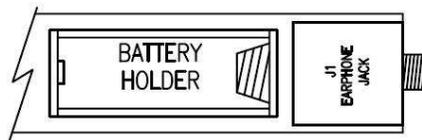
Next, solder all the 1/8 watt resistors in place, following the above guide and the silk screened locations. Bend the leads 90° and lay the resistors down flat, there are no vertically mounted resistors. Trim all leads after soldering. These 1/8 watt resistors, and color bands are extremely small. If you have any doubt as to the correct value, double check them with your VOM.

- R1, 2 - 100K, 1/8W (BRN, BLK, YEL, GLD)
- R3, 9, 15 - 10K, 1/8W (BRN, BLK, ORN, GLD)
- R4 - 180K, 1/8W (BRN, GRY, YEL, GLD)
- R5 - 6.8K, 1/8W (BLU, GRY, RED, GLD)
- R6 - 100 OHM, 1/8W (BRN, BLK, BRN, GLD)
- R7 - 220K, 1/8W (RED, RED, YEL, GLD)
- R8 - 4.7K, 1/8W (YEL, VIO, RED, GLD)
- R10 - 1K, 1/8W (BRN, BLK, RED, GLD)
- R12 - 47K, 1/8W (YEL, VIO, ORN, GLD)
- R13 - 2.7K, 1/8W (RED, VIO, RED, GLD)
- R14 - 3.9K, 1/8W (ORN, WHT, RED, GLD)
- R16 - 220 OHM, 1/8W (RED, RED, BRN, GLD)

Install and solder all the capacitors. Be sure to observe the polarity on the four 10uF electrolytic capacitors. Trim all leads after soldering.

- C1 - .001uF (marked 102)
- C2, 3, 7 - .1uF (marked 104)
- C4, 5, 6, 8 – 10uF-16V

- Solder D1, 1N5234B, Zener Diode to the circuit board. Note the banded end of the diode must match the silk screened band legend on the surface of the pcb.
- Solder U1, the LM358P Integrated Circuit, onto the board. Be careful to insert all the pins into the holes, it is easy to fold one underneath. Note the dot, designating pin 1, and insert it in the end with the silk screened notch in the outline.
- Correctly identify Q1, 2N5172 transistor, match the flat to the silk screen, and correctly solder it to the designated place on the board, near the signal connector.
- Correctly identify Q2, 2N3904 transistor, match the flat to the silk screen, and correctly solder it to the designated place on the board, near the signal connector.
- Solder D2, the red LED to the designated place on the board. The **long** lead is positive, and must go into the “+” hole on the silk screened legend.
- Solder the mode switch S1, and power switch S2, to the designated places on the board. The operating levers go to the outside of the board.



- Solder the earphone jack to the end of the board, where marked, J1
- Solder the battery holder, where marked on the board. Be sure to observe the correct alignment. The spring end, (-),of the holder is next to J1, the earphone jack.

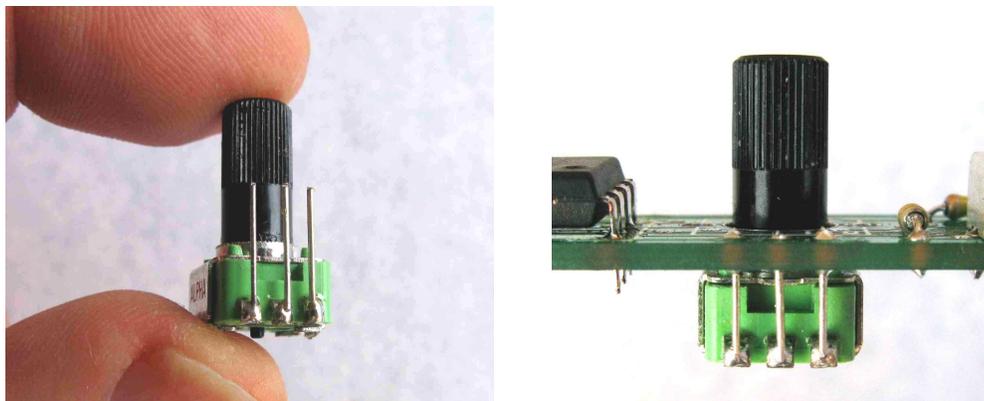
Mounting R11, the 100K potentiometer

For those that want to mount the finished probe in their own fabricated container, the potentiometer can be mounted entirely above the pcb using the standard mounting lugs, as both sets of holes are provided. Here, we will only address the compact method.

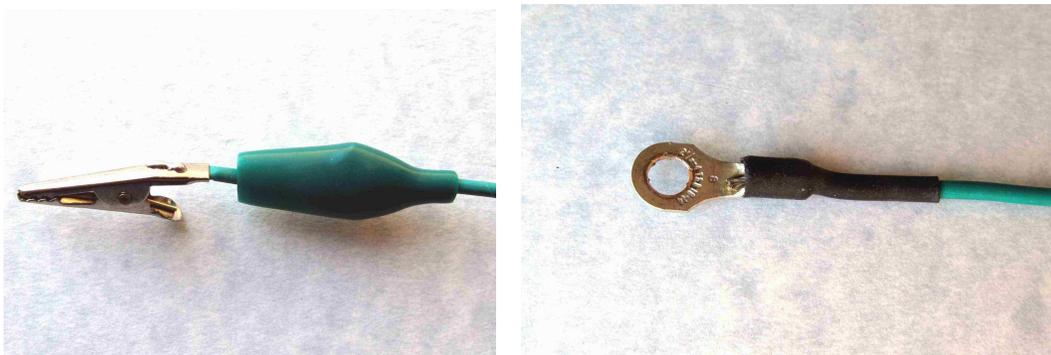
In order to keep the probe as compact as possible, and make final assembly easier, you will be mounting R11, the 100K pot, below the top surface of the pcb, with the adjustment shaft passing through the board. The following modification is required.



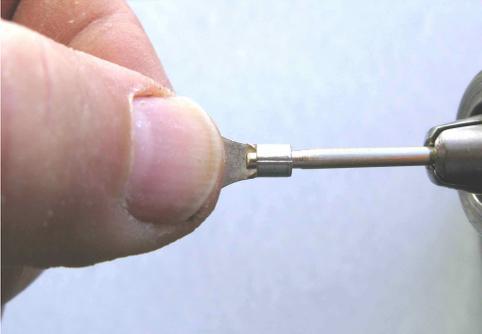
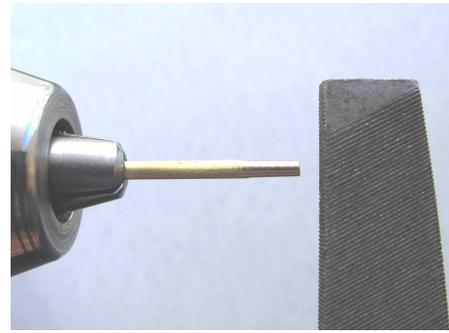
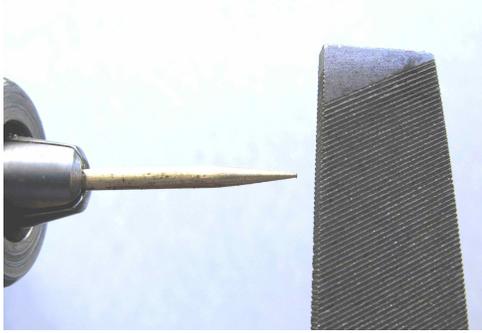
- With your side cutters, trim off the two mounting tabs, the four green plastic standoff buttons on the bottom of the pot, and three leads, leaving about 1/16", of the larger width of the terminals. Trim all down flush with the bottom of the pot. The trimmed pot, should look like the picture on the right.



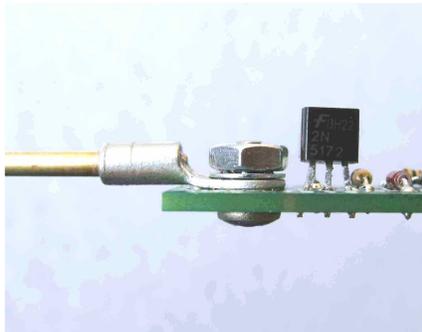
- Solder three of previously trimmed component leads to the modified pot. If necessary, re-trim the component leads flush with the bottom of the pot. Place the modified potentiometer, shaft up, through the bottom of the board. The small metal collar around the shaft, will fit into the .275" dia. hole in the pcb. Solder the leads to the pcb. Trim off the excess leads flush with the top of the board. The completed operation should look like the picture on the right.



- Slide the plastic boot back from the alligator clip and solder the lead to the clip. Sometimes these are crimped only, and can lose conductivity. Replace the boot. Place the 3/16" dia. x 1" L. heat shrink tubing over the loose end of the clip lead. Solder the lead assembly to one of the #4 ring terminals, and shrink the tubing to the transition from the ring terminal to the lead. Color may vary from picture. Set it aside for later assembly.



- File a contact point on one end of the 2" long, 3/32" brass rod as shown. File down the other end of the brass rod to accept the other #4 ring terminal, and solder it in place. An electric drill makes it easier, but you can do it by hand as well.



- Secure the contact point and ring terminal assembly to the signal pad of the pcb using the 4-40 x 3/16" L. pan head screw, lock washer, and steel nut in the order shown. The screw head should be on the bottom of the pcb, then the board, ring terminal, lock washer, and finally the steel nut. Temporarily attach the alligator clip assembly to the brass nut. It will be required for testing, but removed for final packaging.
- Insert the battery, with the negative side towards the spring and earphone jack. You are ready for testing.

Darwin (Dar) Piatt – W9HZC has written the testing and troubleshooting procedures. Also, look for his detailed application and usage documents in the files area.

Testing

Testing the QRPKits.com Injector/Tracer is fairly simple. Always the first thing you check is for soldering or wiring errors. Next, make sure you install the little 12V battery first. Turning the Injector/Tracer on (S2) should make the red LED up. Now, clip the alligator lead to the probe tip and plug an earphone to the jack. You should hear a tone in the earphone. Vary the gain control and the tone should vary in amplitude.

Next, find either a small, working, battery operated AM radio or a battery operated audio amplifier. Set the probe slide switch (S1) into the inject position (toward the tip). Connect the alligator clip to the output of the amplifier or the radio. Touch the probe tip either to the input of the last stage of the amplifier or just to the speaker. If the Injector/Tracer is working, the tone should be heard in the earphones (or in the speaker).

You can continue moving the tip from stage to stage. (input then output of each). Be careful and vary the gain of the tester so as not to over drive either the device or your ears. If you are using an AM radio, try injecting the signal into the IF and RF stages. You should be able to hear the harmonics of the injector's 1 kHz signal.

Now put the switch (S1) to the tip tracer position (S1 should be in the 'back' position, farthest from the tip). Now, connect the alligator lead to the input of one of the stages on the device you are testing, either the AM radio or the Audio Amplifier. The probe tip now is used to pickup the signal. Start with the first stage and continue to the last stage. This procedure will be helpful determining which at which stage the signal is getting lost.

If your signal tracer fails to perform as expected, refer to the troubleshooting Tips for help in solving the problem.

Troubleshooting Tips

Again, check for soldering or wiring errors.

If the LED does not light, check to insure the battery is secure and is in the correct direction. If that seems OK, then check the LED, it may be in backwards or open. Lastly, check that the switch (S2) is wired correctly.

Next, check the voltage at the emitter of transistor Q1. It should measure between 4.5 to 5.5 volts. If you do not measure between 4.5 and 5.5 then check the zener diode D1, transistor Q1, and capacitors C5 and C6 to see if one of them is installed backwards. Insure that R9 and R10 are not switched.

If the Injector audio is weak or there is no sound in earphones with alligator clip connected to probe tip, and the LED is **ON** then check to see if the IC is in backwards.

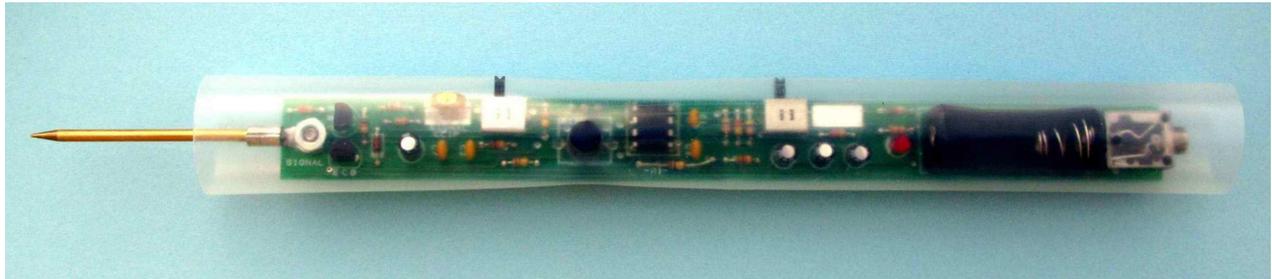
To determine if the oscillator or amplifier is at fault, and an oscilloscope is available, look at the output of the op-amp (pin 1). There should be 3 to 5V of a 1 kHz square wave. If no scope is available, put the switch to tip receive position and remove the alligator clip from the tip, then touch the tip with your finger. The earphone should buzz with 60Hz response when the gain control is fully clockwise and the amplifier is operational. If the oscillator is at fault: Check the LM-358 op-amp (pins 1, 2, 3, 4, and 8), resistors R1 to R6 and capacitors C1 and C2 for soldering or wiring errors. Replace the LM-358 op-amp if there are no solder or wiring errors.

If the amplifier is at fault: Check the LM-358 (pins 4 to 8), trim pot R11, resistors R7, R8, and capacitors C3 and C4, for soldering or wiring errors. Replace the LM-358 op-amp if you find no solder or wiring errors.

As a last item also check switch S1.

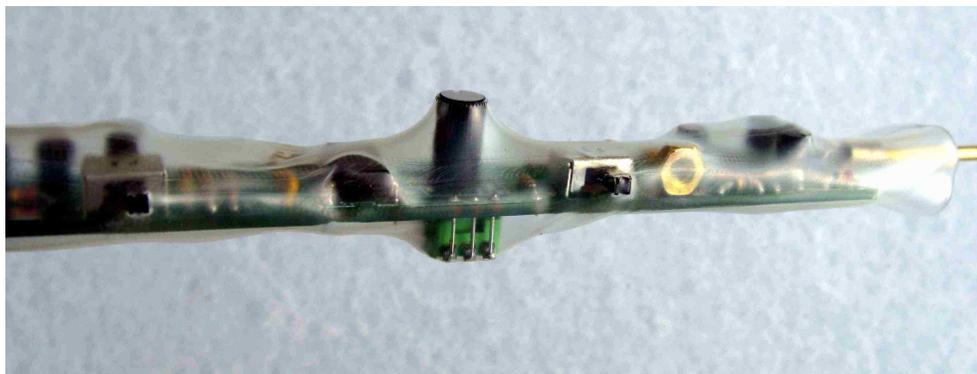
After you have tested and verified all is assembled and operating correctly,

the probe assembly is encapsulated in the 3/4" diameter clear heat shrink tubing. All the operating access to the controls, earphone, alligator clip, and battery will be provided for. The shrink tubing is a one time shot, so make sure you are completed before this final operation. Make a final check that all components are trimmed on the bottom of the pcb, and remove the alligator clip assembly used in testing. It will be re-attached later.

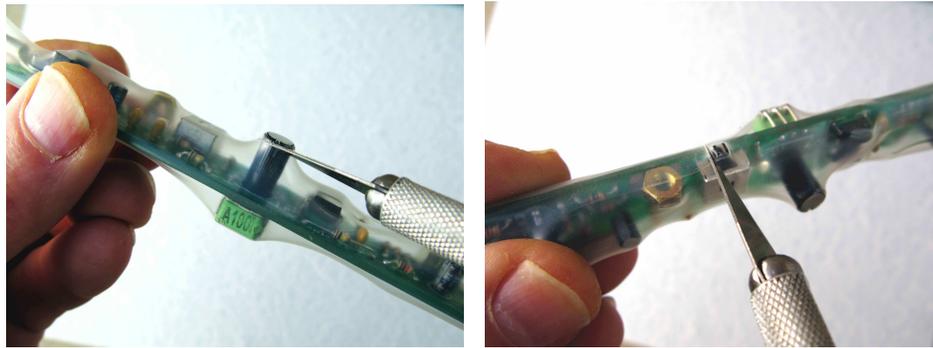


- Slide the complete assembly into the shrink wrap, battery end first. Center it into the piece provided. It gets a little tight after going over the top of the potentiometer shaft and past the mode switch. Take your time, it will fit.

Using an appropriate heat source, eg. heat gun, or one of the small craft hot air sources for doing embossed cards, start to shrink the tubing. Take your time. **Some heat guns are extremely hot, and can strip paint, so be careful, go slowly.** I prefer the craft hot air gun, it does a gradual shrink, and it's difficult to damage components.



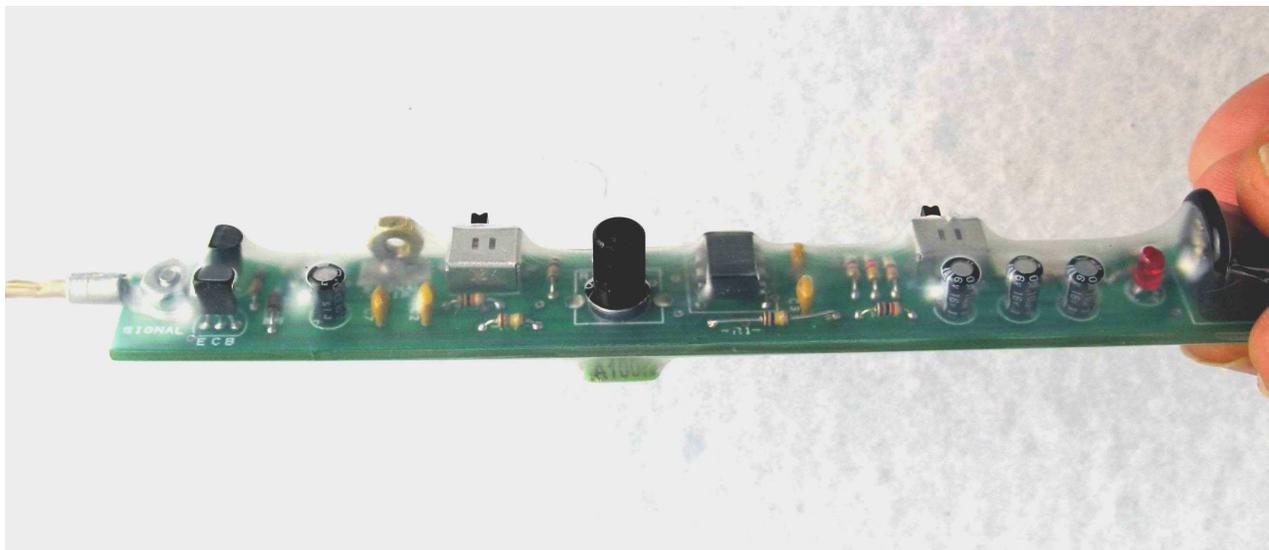
This picture shows what it looks like about 50% through the process. At this point you want to stop



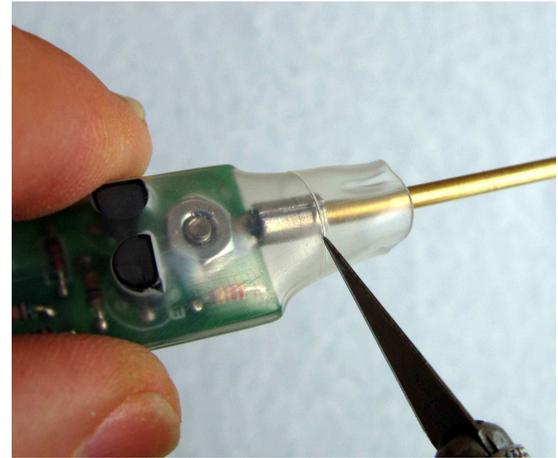
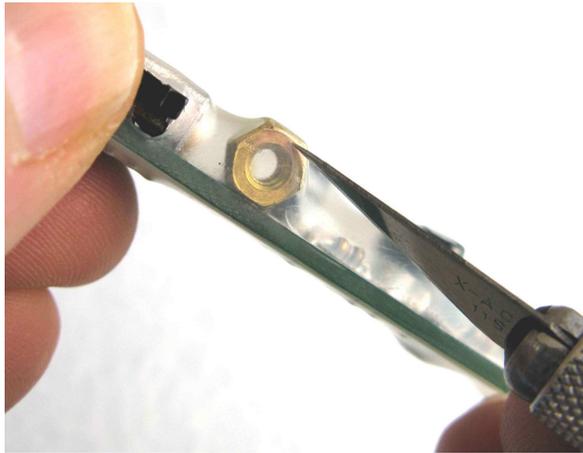
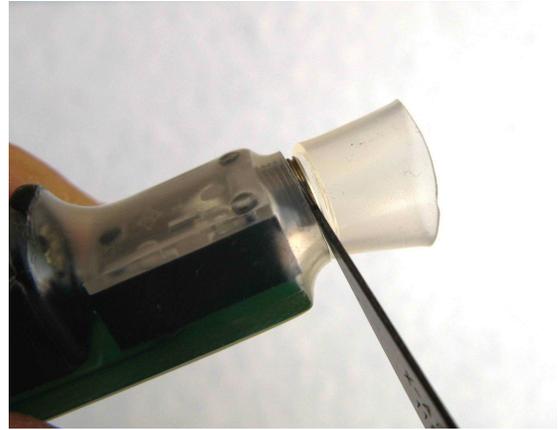
- Use an Xacto knife, and trim around the potentiometer shaft and both slide switches as shown.



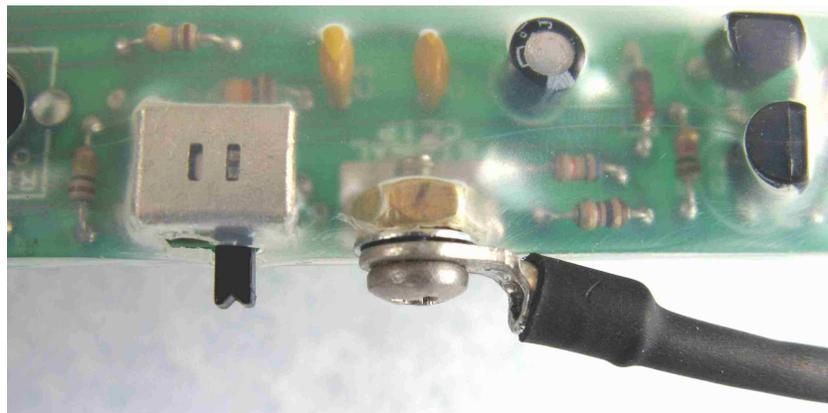
- This picture shows after the trimming. This will provide for a nice finished look when complete.



- Continue and finish shrinking the tubing until it pulls down to touch the surface of the components and the bottom of the pcb. Be careful around the battery holder, it is especially sensitive to overheating. You are just looking to insulate and protect the components and pcb! **Do not overheat.**



- After the shrink tubing has cooled, use the Xacto knife to carefully trim around the switches, so they have full travel. Carefully trim the access to the battery compartment, earphone jack, and alligator clip connection point, and excess around the probe end as needed.



- Attach the alligator lead assembly with the remaining 4-40 x 3/16" pan head screw, and lock washer. The proper order is, 4-40 screw, ring terminal, internal tooth lock washer, attached to the brass nut. **Do not over tighten or you will break the brass nut off the pcb.**



- Install the battery, and you are ready for use. In order for this tool to be self contained, certain allowances had to be made concerning the battery. The 12v battery was selected for it's small size, not longevity. It is important that you do not leave the power switch on, when not in use. It is an inexpensive, readily available battery, used in devices like garage door openers, etc. The battery life will be typically 90 minutes of total "on" time. Walmart has a 2 pk. for less than \$2.

