

## I. Introduction.

Thank you for purchasing the Scotty's Sled Shed Custom Probe Modification Kit for Heathkit HP-23(A, B, C) and PS-23 series power supplies.

The HP-23B/C and PS-23 are identical in circuitry. The HP-23 and 23A are different only in that it contains also a 6VAC Filament, a switch for the 250/300V low voltage and an adjustable negative bias. All the capacitors, resistors and diodes are the same except for the 27K ohm on the HP-23B, C and PS-23 series.

The two 20uF (C6, C7) for the HP-23 and 23A will be upgraded to 47uF as it was for the rest of the models.

Capacitor C5 will be replaced with 47uF.

Replacement capacitors for C5, C6, C7 may be Axial or Radial in the kit (Depending on supply chains). Axial lead capacitors tend to be more expensive and harder to find in voltages greater than 100V.

Capacitor C1, C2, C3, C4 will be replaced with 150uF 450V.

Resistors R1, R2, R3, R4 will replace the 100kohm 2W with 200Kohm 2W(minimum) resistors.

Resistors R5, R6, R7, R8 will differ slightly from the HP-23A version but the kit will be provided with enough resistors to restore all versions of the HP-23 and PS-23.

Diodes 1-7 will be replaced with 2A 1KV rectifier diodes with the kit. This is optional as the original diodes seldom fail under normal conditions.

This kit was developed to help fellow vintage electronic enthusiasts. The Heathkit HP-23/PS-23 Power supplies are plentiful to find in restorable condition.

The difference between this kit and those that include an entire circuit board, is the ability to upgrade one component at a time, in the original locations of the power supply.

The Scotty's Sled Shed HP-23 restoration kit alleviates the issues of transformer wires not long enough to reach an aftermarket circuit board and having to drill holes in the chassis, install standoffs and expose high voltages. It also does not require the customer to completely gut the power supply just to perform an upgrade service.

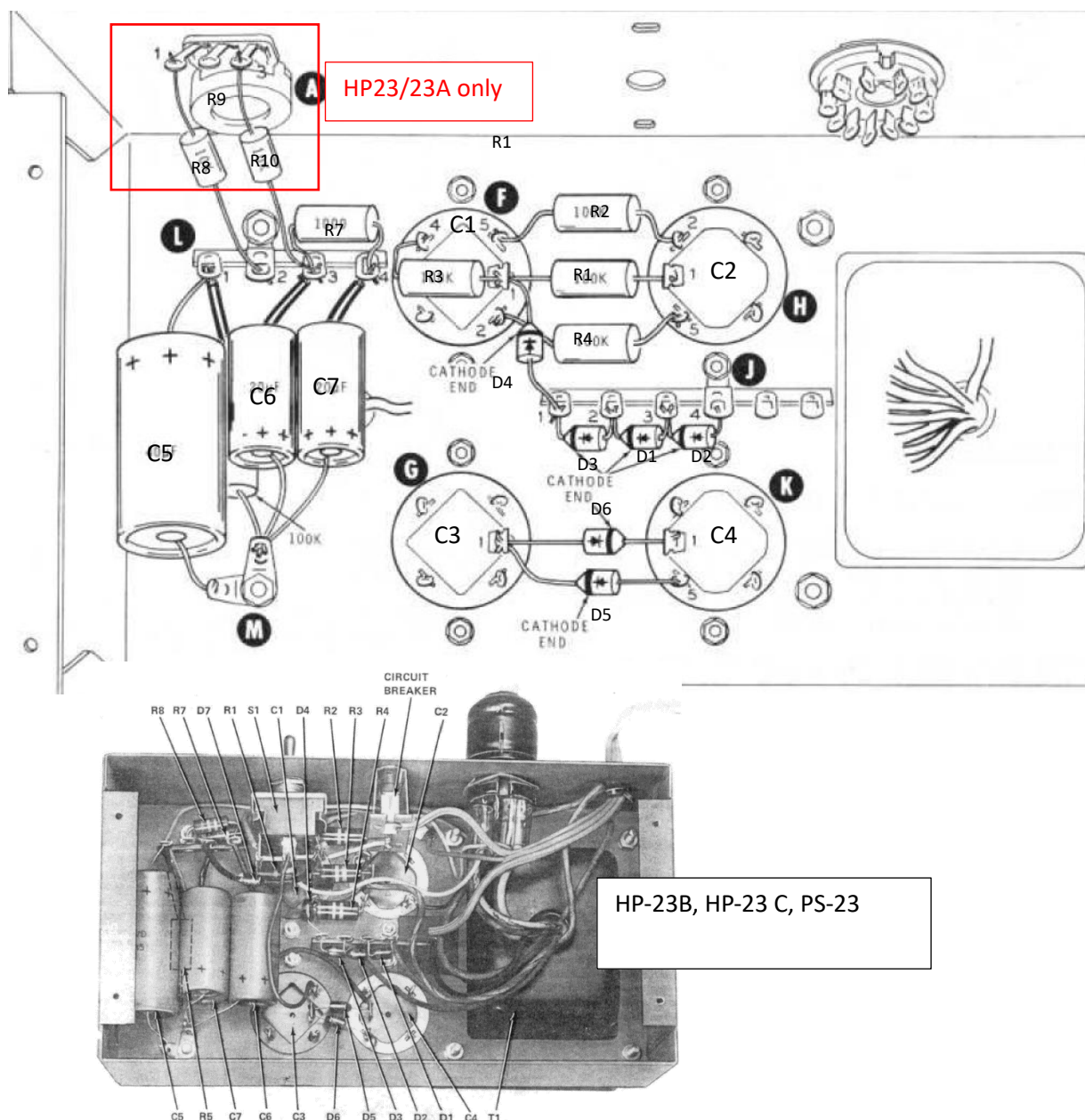
Before you get started there is a list of items to be aware of.

1. Due to constant supply chain challenges, Scotty's Sled Shed reserves the right to substitute component OEMs. If there is an orange bodied resistor in installation guide images and you receive a blue bodied resistor, it is due to component substitutions.
2. You may see a blue capacitor in one picture and a yellow capacitor in another picture. Multiple pictures may have been taken over various kits with different capacitor values or manufacturers.
3. Scotty's Sled Shed LLC is only providing you with components for a DIY installation.
4. The following instructions are only a guide. Experienced users may have a preferred method of installation.
5. **CAUTION: Lethal voltages are present in these devices.** If you are not aware of that by now, you should NOT be doing this upgrade.
6. If you do not feel comfortable working around voltages more than 800V DC, please do not perform the upgrade. Find an experienced technician to perform or assist you.
7. Scotty's Sled Shed LLC is NOT liable for any damage caused to your equipment, bench, house, Power supply or that your spouse is mad at you for working on this 50-year-old piece of equipment. You are ON YOUR OWN.
8. The customer assumes all responsibilities and agrees to check all resistance, capacitance, and voltages before and after installation.
9. Customer assumes all responsibility to know how to read a schematic and perform the task this kit requires.
10. Customer assumes all responsibility to perform procedures by following the Heathkit OEM manual.
11. You get the point; you are responsible for yourself.
12. Please be sure to download the manual if you do not have it. They are readily available online at: <https://www.vintage-radio.info/heathkit>
13. Read the original Heathkit manual. The process for replacing components will be nearly identical to the original installation.
14. References are made in this guide to component numbers associated with the original manufacturer manual. Customers should familiarize themselves with what the components are. IE C4, C5, D7, R8
15. The HP-23/PS-23 power supplies were sold in DIY kits back in the 1960's and 70's. Some original components were pre 1970 (when the EPA was established). DO NOT CUT OPEN THE ORIGINAL CAPACITORS. There may be toxic chemicals inside. Since these were sold as kits, the installations may vary unit to unit. The power supply you have may have been modified.
16. Protect yourself and remember to wear protective eyewear, use a fume extractor, and have a fire extinguisher nearby.

## Heathkit HP-23A, B, C, PS-23 Power Supplies

## II. Preparation

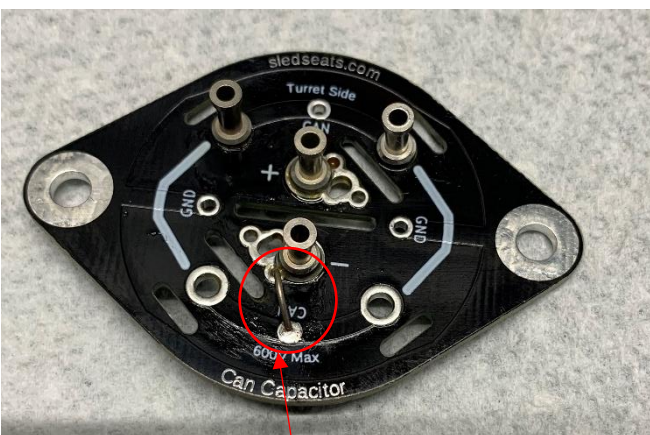
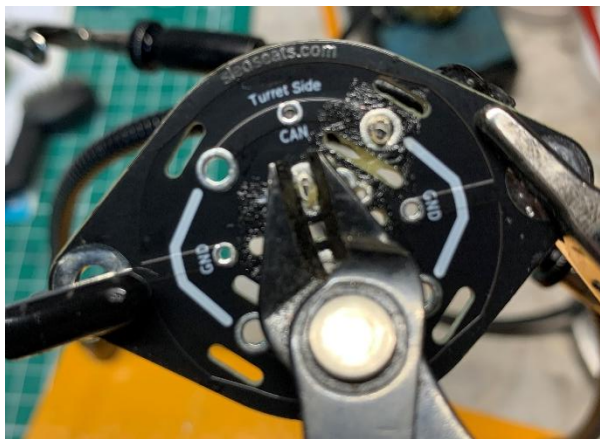
1. Take lots of pictures and video if you need to, of the original assembly for future reference.
2. Print out/copy an additional copy of the schematic.
3. Ability to label wires/components as needed-tape, label maker, etc.
4. On the extra schematic, it may help to write down where each lead of Capacitors C5, C6, C7 and associated resistors are connected to the 5-lug terminal strip. Example C5 (+) to lug 1, (-) to chassis ground.
5. Be sure that all capacitors are discharged.
6. READ THE HEATHKIT OWNER/INSTALLATION MANUAL!
7. Solder paste will improve the efficiency of soldering and de-soldering.



**III. Assemble the Scotty's Sled Shed High Voltage Capacitor Board**

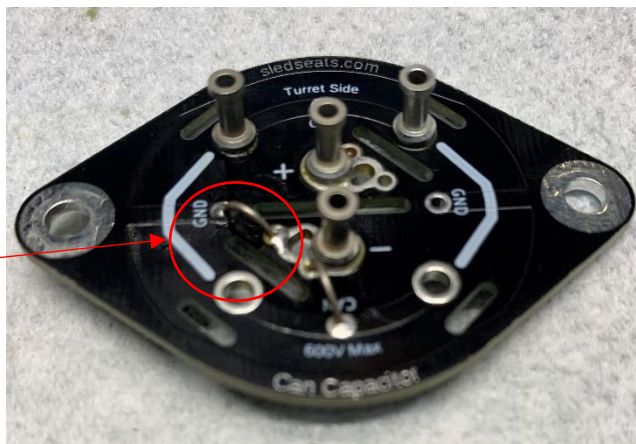
1. Familiarize yourself with the Sledseats.com 600V capacitor board orientation, spacers, and insulator boards. NOTE: New release of the PCB will be branded with "W8AOR.COM" vs my old "sledseats.com" brand from when I first developed the kit.
  - a. The Solder Posts are called "Turrets" (Keystone brand name).
  - b. Review the document for the HV board that comes with this kit.
  - c. There is a "Cap Side" and a "Turret Side" to each board. The long end of the turrets mounts on the "Turret Side". The turret will stick up about 1mm above surface of the board on the "Cap Side".
  - d. The "Can" solder holes tie the 4 outer turrets mounting to simulate the can common mounting tabs of the original capacitors. The "Can" ring does not connect to ground.
  - e. To connect the negative lead of the capacitor to chassis ground you will need to install a jumper from one of the holes next to the Negative (-) turret, to the GND hole. This ties both flange mounting holes and outer ring (CAN) to chassis ground. The GND will be connected to chassis ground on only C2 and C4.
  - f. C1 and C3 will use the insulator boards, and the negative (-) will get a jumper only to "Can". C1 and C3 will NOT use a jumper installed ground.
2. Apply solder paste to both sides of the board around all the holes, except the outer mounting flange holes.
3. Install and solder a turret at (+) and (-) on each board. Slightly squeezing the turret on the "Cap" side after the turret is installed, will make the turret oblong, and stay in place while soldering. DO NOT CLOSE THE OPENING. The capacitor legs will feed through the inside of the turret.
4. Solder a jumper (not included) on the "Turret" side (jumper on turret side, solder on cap side) for all 4 boards from "CAN" to the hole next to the turret. I use leads from an old capacitor or leads from a resistor to make the jumpers (see images below).
5. Add two turrets on each board on the "CAN" ring that are closest to the + side.
6. On two of the boards, add a jumper from "GND" to the hole closest to the - (neg) turret.
7. Snip the extra length of jumper on the "Cap" side as flush as you can to the board.
8. Each board assembly should now look like the following images. All four with jumpers between CAN and Neg (-), and two with jumpers from GND to Neg (-).



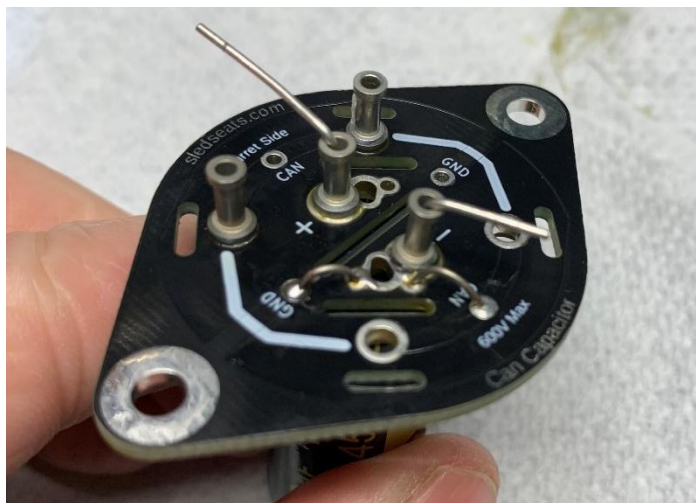


All 4 boards will get jumper from Neg (-) to "CAN". Snip excess lead on "CAP SIDE" as close to the board as possible

Only 2 boards (C2, C4) will get jumper from Neg (-) to "GND"



9. Place a spacer (provided with the kit) on one of the boards. Be sure the orientation matches the + and – of the board, on the “Cap” side. All the holes should line up.
10. Install a 150uF 450V radial capacitor on the cap side with a spacer board between the capacitor and the cap board. The legs of the capacitor go through the inside of the hollow turret. Positive to Positive, Negative to Negative.
11. Bend the leg over each turret to hold the capacitor in place. Do not solder yet.
12. Repeat for the other three boards.
13. Mark the 2 board assemblies with the jumper to the GND as C2 and C4.
14. Mark the board assembly with only the jumper as C1 and C3 and put an insulator board next to each C1 and C3. Set all the capacitors aside.
15. Your assembly should look like the following pics.



#### IV. Component replacements C3, C4, C5, C6, C7

The replacement of the components is now as simple as one for one swap, one piece at a time. The following is only a suggestion in sequence. An experienced technician may have their preference for process.

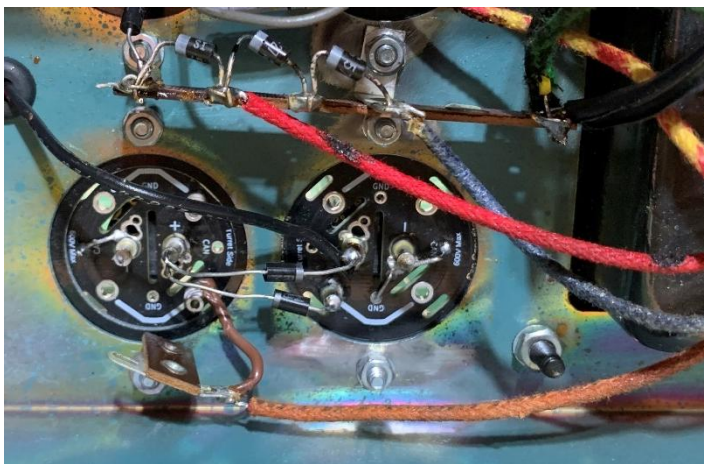
1. Replace capacitors C5, C6, C7. Noting that C6 and C7 are reversed polarity. Positive lead of C6 and C7 goes to ground for the negative bias (fixed, or fixed+adjustable) supply. Typically, the + of C5 is connected at Lug 1 (far left) and negative to ground. The center Lug is ground. C6 negative is lug 4, C7 negative is Lug 5. C6, C7 positive is to chassis ground. For Radial capacitors, use the center grounded lug of the 5-lug terminal strip near the bias control (HP-23A). #6 ground lug is included with the kit to replace the existing.
2. Ensure that anywhere you are attached to chassis ground you remove the bolted assembly and clean the chassis surface, bolt, nut, lug surface, and tooth washer with a wire brush.
3. Replace resistors for bias circuit (optional):
  - a. HP-23A: R5, R6, R7, R8, R10.
  - b. HP-23B/C, PS-23: R5, R7, R8
  - c. Replace D7
4. Remove the bolt holding the 6-lug terminal strip and clean, bolt, nut, washer, and lug connections with wire brush to create a good chassis ground connection. Reinstall assembly.
5. Optional-Replace Diodes D1, D2, D3 on the 6-lug terminal strip that runs between C1/C2 and C3/C4.
6. Remove Capacitor C4.
  - a. Unsolder black lead from filter choke from positive terminal.
  - b. Unsolder (or cut) D6 cathode side from C4 positive terminal.
  - c. Unsolder (or cut) D5 anode side from the ground tab of C4 (some supplies may tie to a different chassis ground point).
  - d. Unbolt and remove the capacitor.
  - e. Clean the surface around chassis holes on the terminations side of the chassis.
7. Install new C4 using one of the two assembled boards that has both jumpers from negative to CAN and GND. The three solder turrets that form an "arrow" shape with + in the middle, will face toward C4.
8. Remove Capacitor C3.
  - a. Mark the wire from transformer connected to the negative terminal of C3.
  - b. For the HP-23B/C/PS-23 300V configurations it will be a brown wire direct to transformer. For 250V, there will be a jumper from Brown Yellow (transformer) that connects to cathode of Diode D7 which connects to C6 on the bias circuit.
  - c. For the HP-23A, the lead to the center of the On/Off/250v/300V switch will connect to one mounting tab of C3.
  - d. Remove the two bolt assemblies holding the flange for C3 and remove C3.
9. Install the new Capacitor assembly C3.
  - a. C3 is isolated from chassis ground. The football shaped insulator board mounts between the chassis and the new circuit board capacitor assembly.



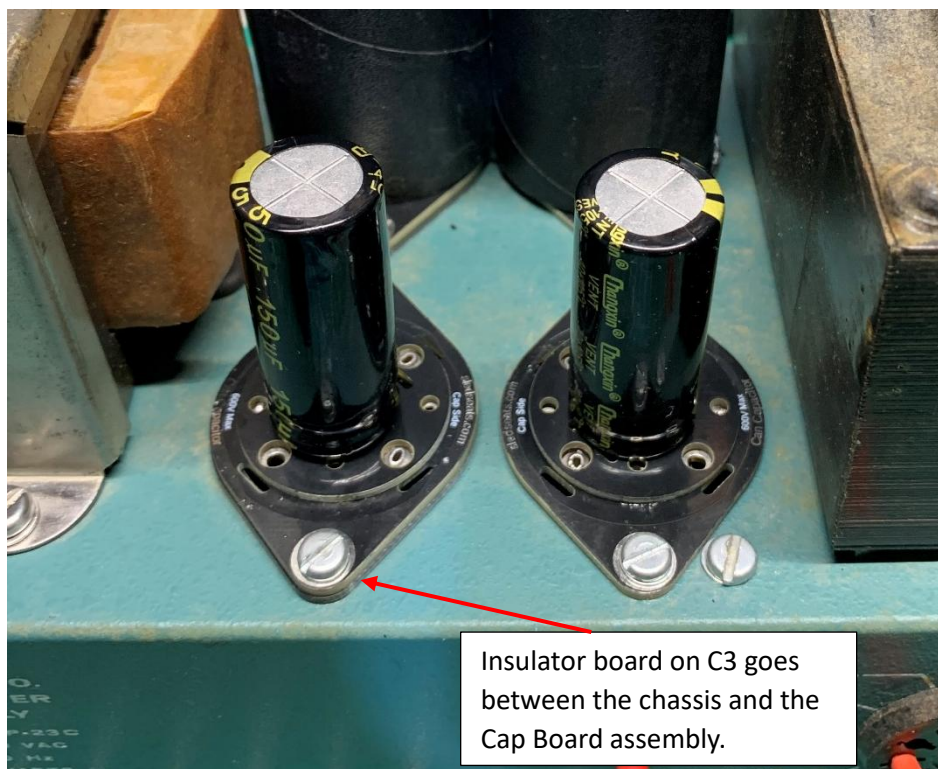
Heathkit HP-23A, B, C, PS-23 Power Supplies

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- b. Install one of the two capacitor board assemblies that only has jumper from ground to “CAN” with the football shaped insulator between the board and the chassis. Tighten the bolts.
- c. Add solder paste to one of the outer turrets of C3 that the Brown/Brown-Yellow or lead to On/off switch will connect. Solder the LV transformer lead. Do not solder the transformer wire to the + center turret.
- d. Use two diodes that came with the kit to replace Diodes D5 and D6. Anode of D6 to + of C3, cathode to + of C4. Cathode of D5 to + of C3, and Anode to chassis ground (usually one of the outer turrets of C4).
- e. Solder black lead from isolation transformer to the + turret of C4.
- f. Solder the negative terminals of the 150uF capacitor leads to the negative turret of C4 and C3. Cut excessive lead length off from both + and – of the 150uF capacitor leads on C3 and C4 assembly.
- g. C3 and C4 installation complete and should look like the picture below.



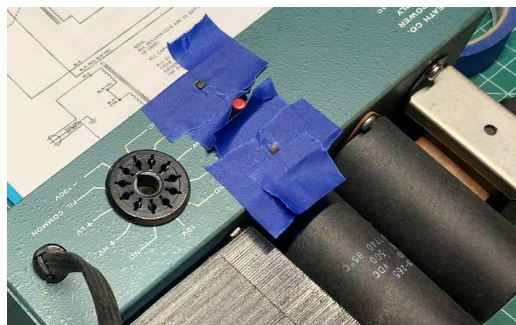




#### V. Component replacements C1, C2

Capacitors C1 and C2 require a few more steps for replacement as there are 4 resistors, 1 diode, 2 capacitors, a jumper, and one transformer tap. Additionally, the breaker switch and the On/Off switch (HP-23A) are in the way of working on C1 and C2.

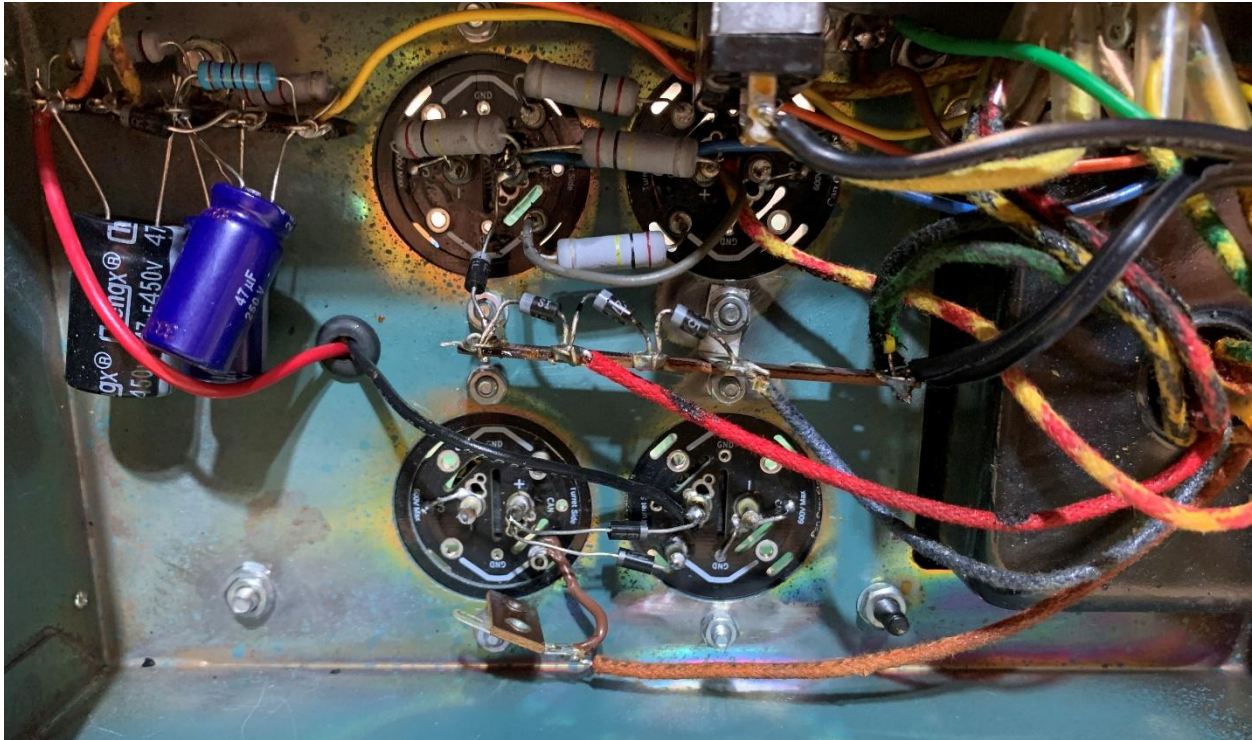
1. To remove the breaker switch without damaging the paint, use blue painters' tape to protect the chassis paint and tape around the two folding tabs.
2. Carefully, and slowly with a flat blade, pry up the folding tabs enough so the breaker can be removed.
3. Move the breaker switch out of the way. I use painters' tape to hold it in place out of the way.



4. The On/Off switch will most likely require you to unsolder some of the wires to allow enough slack to move it out of the way.

5. Be sure to take multiple pictures and mark the wires before un-soldering from the switch.
6. You can also use painters' tape around the outside nut to protect the paint while removing the switch. Secure it out of the way so you can work on C1 and C2.
7. Mark and unsolder the Red with Yellow Stripe transformer wire from the **(+)** tab of C2.
8. If there is a wire connected to one of the twist lock tabs of C2 (usually brown to pin 7 of the octal plug), mark as GND and de-solder.
9. There will be three (3) 100k ohm 2watt resistors, R2, R3, R4 between C1 and C2. Cut out all three of those resistors.
10. De-solder the jumper wire from **(+)** of C2 to one of the twist tabs of C1.
11. Remove capacitor C2. Clean the mounting hole locations.
12. If there is a ground lug to the chassis near C2, remove, clean, and reinstall.
13. Install the remaining Capacitor board assembly that has both GND and CAP jumpers into the open slot where C2 was removed. Test with DMM that there is continuity from chassis to the negative **(-)** lug of C2.
14. Solder the lead from Pin 7 of octal plug to the **(-)** negative turret of the C2 capacitor assembly board, or solder direct to chassis ground (a #8 ground lug is included in kit).
15. Desolder or cut D4 that connects the 6-lug terminal strip to the Positive **(+)** tab of C1.
16. Mark and desolder the wire (blue) connected to the positive **(+)** tab of C1 (connects to pin 4 of octal plug).
17. Remove C1.
18. Install the remaining capacitor board with the insulator flange in the same way you installed C3.
19. If the jumper you removed between C1 and C2 will not reach **(+)** of C2 to one of the outer turrets of C1, then make a new jumper and connect the jumper.
20. Install a 200k 3W resistor between each of the two turrets on the outside of C1 and C2 of the Positive **(+)** turret of each capacitor. Simulating the 100K ohm resistors you just removed.
21. Solder the two resistors (R2, R4).
22. Connect (or put in new) diode D4 with the cathode to Positive **(+)** of C1.
23. Connect the blue jumper (from Pin 4 of octal plug) to Positive **(+)** of C1.
24. Cut lead lengths and insert a 200K ohm 2W resistor between the **(+)** and **(-)** turrets of C1. Solder the negative but not the positive side yet.
25. Connect the Red-Yellow transformer tap to the Positive **(+)** of C2.
26. Install 200K ohm 2W resistor between the two Positive **(+)** terminals of C2 and C1.
27. Solder the connections and check the connections.
28. Double check all your connections, review the original pictures and double check wiring against the assembly manual. Final assembly should look like the pictures below.
29. Reinstall the on/off switch (HP-23A) and solder any removed wires.

30. Reinstall the breaker switch.



## VI. Final testing.

1. Follow the "Initial Tests" section of the Heathkit Assembly Manual. Noting that the 100K ohm resistors have been substituted with 200K ohm resistors.
2. To test the power supply by itself, a jumper from AC SW and AC Common needs to be installed at the round octal plug.
3. Connect a high impedance multimeter to GND and LV of the round octal plug.
4. Plug the power supply into a VARIAC, turn the Power switch to 250V (HP-23A only) and slowly bring up the AC voltage from the VARIAC. This is in case you installed something incorrectly (IE backwards capacitor), and to slowly give the new capacitors an initial charge.
5. Plugging the supply in directly to full 120VAC may cause the breaker to trip for initial surge current to the capacitors. Once the new capacitors have an initial charge, you can use it as normal for the remaining life of the unit.
6. Measure the DC voltages at the LV, HV, -bias and adjustable bias (HP-23A) ports on octal plug as you slowly bring up the VARIAC.
7. **NOTE!** Ground the positive lead to chassis ground between each port test to discharge any standing voltage on the test leads. If a + 250V charge is still on the leads when you move the probe from LV to -bias, you could create a spark or damage the bias supply.
8. Continue bringing the VARIAC to full power and validate the HV, LV (250 and 300-HP23A), negative (-) bias, adjustable bias (HP23A).
9. Validate the AC filament voltage with multi-meter, measuring between Filament Common and 12V (HP-23B/C, PS-23) and check the 6V (H-23A).
10. Congratulations, your upgrade is complete.



11. Optional: To keep the original look of the Can capacitors, the black tubing is just glued to the original capacitors and will usually just come off with some twisting. You can set that tubing over the new capacitor board assemblies and tack it in place with some hot glue.

I welcome feedback on any tips or tricks you find to make the project go faster.

Customer pics of final installations are always welcome.

If you find an error in this document, please kindly let me know at [mysledshed@yahoo.com](mailto:mysledshed@yahoo.com)

Please be professional in your communicate.

Thank you, and good luck!

73's

Scott

W8AOR