Thank you for purchasing the AWA Heathkit HP-23 Power Supply Upgrade Board.

This board will allow easy upgrading of all diodes, capacitors, and resistors for extended life of your HP-23 power supply.

**Note:** This printed circuit board upgrade is intended only for persons experienced in working with high voltage circuitry. The completed upgrade and associated components produce potentially dangerous voltages. Always install the Heathkit HP-23 perforated metal cover when operating the HP-23.

There were at least five different versions of the HP-23 supply starting with the HP-23 then the A, B, and C models and ending with the PS-23. They all have the same 4 basic outputs: High Voltage, HV, at 700VDC @250ma, B+ at 300VDC @150ma or B+ at 250VDC @100ma, Bias at -100VDC @20ma, filament at 12.6VAC @5.5A. Earlier versions had a switch for Hi or Lo B+, adjustable and fixed Bias voltage, and could supply 6.3VAC and 12.6VAC for filaments, and were 120VAC input only. Later versions eliminated the switch for Hi or Lo B+ and were hard wired, the Bias voltage was fixed, and the filament voltage was only 12.6VAC. The AC input could be wired for 120 or 240VAC. The AWA PCB should be usable in all these versions.

The AWA Upgrade PCB uses diodes in the HV section (D1,D2,D3,D4) upgraded to 1000PIV and 1A (1N4007) or optionally, 1000PIV and 3A(1N5408). Diodes D5,D6,D7 are 1N4007s. The HV and B+ caps C1-C4 were upgraded to 150uF at 500VDC. B+ cap C5, is upgraded to 47uF at 450VDC. Bias caps, C6 and C7 are upgraded to 47uF at 200VDC. The PCB is designed to use modern, snap-in caps with 10mm lead spacing. Leaded (or taller snap-in caps) caps can be used but must be less than approx. 1.7” in height to prevent hitting the filter choke with the PCB mounting suggested. The bleeder resistors specified are TE Connectivity ROX series metal oxide with a flameproof rating. These have a 5 watt rating and are a little smaller than a 2 watt carbon comp resistor. R8, is a 0.33Ω, 3W additional resistor recommended in a HP-23 upgrade article by Mike Bryce, WB8VGE in October, 2003 QST. This resistor in the B+ output is supposed to limit current for a short period of time if the B+ is shorted. This can be jumpered out, if desired. Another option feature to the original circuit is to add a HV fuse (F2). This is a 0.25” x 1.25” (3AG) size fast blow fuse rated 500mA at 1000V. This is a SIBA fuse part# 7017240 widely available as it is used as a multimeter protection fuse. This can be jumpered out, if desired, also.

The PCB board is mounted vertically using the old HV filter cap mounting holes located near the outside edges of the chassis closest to the transformer. The board is mounted using 2 Keystone #614 Angle Brackets and #6 hardware. The 2 screws in the vertical (threaded) leg of the angle bracket can be removed to allow easy board removal for repairs, etc. The board is 4.50” wide and 3.90” tall. Angle bracket mounting holes are 4.10” apart to match the old filter cap mounting hole centers.

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**AWA PCB UPGRADE REPRESENTATIVE PARTS LIST W/Alternate Parts V1.5**
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Note: Only the Digi-Key Parts have been tested in the AWA prototype boards. The alternate parts should be acceptable substitutes but the user should check their usability. Because of the current supply issues, substitutes may be needed. For instance, leaded capacitors could be adapted to this board. The capacitors specified are used because they all have 10mm lead spacing to match the board. The fuse holder can also be found at online auctions sites and has a 1-3/8” lead spacing to match the board holes and is for a type 3AG fuse.
PCB Assembly:

First check that all the PCB parts are available for assembly. Rosin core 60/40 tin/lead solder will be required along with a medium tip soldering iron. Refer to the Assembly and Installation Figures at the end of this manual for the following steps.

[ ] Check the box next to each step after each step is done.

[ ] Position the PCB with the mounting hole, MB1, at the lower left corner.

[ ] Assemble diodes D5, D6 and D7 (1N4007) flat against the board with the white bands on the diodes over the bands on the board. Bend the leads to hold in place. Solder the leads, six places. See Fig. 1

[ ] Bend the lead of diode D1 (1N4007 or 1N5408) next to the white band down along side of the diode body. Do the same for diodes D2, D3, and D4. See Fig. 2

When installing diodes in the following steps, ensure they are vertical and straight.

[ ] Install these four diodes with bent lead towards the top edge of the board. Bend the beads to hold in place. Solder the leads, eight places.

[ ] Install capacitor C1, 150uf 500V by snapping it into board making sure the white capacitor strip (-) is over the white semi-circle on the board. All the following capacitors have the white strip facing the right side of the board. Solder the 2 capacitor pins. See Fig. 3

[ ] Like wise, install capacitors C2, C3, and C4, 150uf 500V by snapping into the board. Solder the 6 capacitor pins.

[ ] Like wise, install capacitor C5, 47uf 450V by snapping into board. Solder the 2 capacitor pins.
Likewise, install capacitors C6 and C7, 47uf 200V by snapping into board. Solder the 4 capacitor pins.

Bend the lead of resistor R1 (100KΩ 5W) down along side of the resistor body. Do the same for resistors R2, R3, and R4 (all 100KΩ 5W). See Fig. 4 When installing resistors in the following steps, ensure they are vertical and straight.

Install resistors R1 and R2 with the bent lead towards the left. Bend leads over on the foil side and solder 4 places. See Fig. 4

Install resistors R3 and R4 with the bent lead towards the right. Bend leads over on the foil side and solder 4 places. See Fig. 4

Bend the lead of resistor R5 (100KΩ 5W) down along side of the resistor body. Do the same for resistors R6 (1KΩ 5W), R7 (27KΩ 5W), and R8 (0.33Ω 3W). See Fig. 5

Install resistor R5 (100KΩ 5W), with the bent lead towards the right.

Install resistor R6 (1KΩ 5W), with the bent lead towards the bottom.

Install resistor R7 (27KΩ 5W), with the bent lead towards the top.

Install resistor R8 (0.33Ω 3W), with the bent lead towards the left. This resistor is optional and may be jumped out, if desired.

Install a HV insulated jumper wire at the F1 Fuse holder location if the HV Fuse will NOT be used. As an alternate, a bare jumper wire can be installed on the back side of the board. If the HV Fuse option is to be used, install the Fuse Holder at the F1 location. See Fig. 6 Install the 500Ma, 1000V fuse in the holder, if used.
Install the “L” mounting brackets at locations MB1 and MB2. The leg with the tapped hole goes on the back side of the board. Use a #6-32 pan head screw ¼” long with a flat washer on the front side of the board. Tighten only loosely in this step. See Fig. 7.

This completes the component assembly of the printed circuit board.

**HP23 Chassis Preparation**

A manual with schematic diagram for your model HP-23 will be useful in the following steps. In the following steps, save any screws, lockwashers, and nuts from the 4 large capacitor mounts that will be removed for future use in mounting the PCB.

Remove the top cover and remove any dust or dirt that may have accumulated. Remove the bottom cover.

When cutting wires that go to the transformer, choke, and 11 pin output socket, leave the length as long as possible. Most wires will be spliced to reach connections on the PCB. On early versions of the HP-23, the transformer wire colors may be faded and hard to determine. After disconnection, the transformer and choke windings should be checked with an ohmmeter for correct value. The approx. values are:

- HV (Red to Red/Yel): 19Ω
- B+ Hi Tap (BRN to BLU): 8.4Ω
- B+ Lo Tap (BRN/YEL to BLU): 6.5Ω
- Filter Choke (RED to BLK): 95Ω

If any of the transformer wires are faded, they can be marked with a short length of colored shrink tubing, a paint pen, or a piece of colored tape.

In the following steps, if you have a HP-23 with the Bias Potentiometer, do not remove resistors R8 & R10 (10KΩ 1W) which are connected to the Potentiometer outer terminals. Also, do not remove the 4 position terminal strip. See Fig. 8.
Referring to Fig. 8, remove all the diodes by clipping their leads close to the body. The parts to be removed are marked by Xs.

Remove the resistors by clipping their leads close to the body. The parts to be removed are marked by Xs.

Remove the 3 capacitors on the left by clipping their leads close to the body. The parts to be removed are marked by Xs.

Remove the 4 large, black capacitors and their mounting plates. Save the hardware. The parts to be removed are marked by Xs.

The AC Input wiring should not have to be disturbed.

Desolder the remaining clipped leads from the terminal strips. Remove 1 of the solder lugs at location “M” and remove any wires on the remaining solder lug.

In the following steps, the Transformer, Filter Choke and 11 Pin Socket wires will be extended to reach connection points on the PCB. They should be extended to provide enough length so the PCB can be removed and worked on. Use 22AWG wire or larger. The HV wire should be rated for 1000V.

Strip and tin the red and black Filter Choke leads about ¼”. Connect the BLK lead to lug #1 of “J” terminal strip. Connect a 6” length of BLK wire to this same lug and solder. Connect the RED lead to lug #2 of “J” terminal strip. Connect a 6” length of RED wire to this same lug and solder. See Fig. 8
The Transformer leads will be extended in the next step.

[ ] Cut and strip 1 BLU 22AWG wire, 2 RD 22AWG wires, and 2 BRN 22AWG wires 6” long. Add yellow markings to 1 of the RED and 1 of the BRN wires.

[ ] Splice the BLU wire to the BLU Transformer wire and insulate the splice with 3:1 (1000V Min Rating) shrink tubing.

[ ] Splice the RED wire to the RED Transformer wire and insulate the splice with 3:1 shrink tubing.

[ ] Splice the BRN wire to the BRN Transformer wire and insulate the splice with 3:1 shrink tubing.

[ ] Splice the RED/YEL wire to the RED/YEL Transformer wire and insulate the splice with 3:1 shrink tubing.

[ ] Splice the BRN/YEL wire to the BRN/YEL Transformer wire and insulate the splice with 3:1 shrink tubing.

[ ] Dress these 5 wires together and secure with 2 wire ties. Pass these 5 wires through the old, lower left capacitor hole. These wires will be connected in a later step. See Fig. 11

[ ] There are 3 ways the Hi Lo B+ voltage can be set.

[ ] Method #1: Install an insulated jumper wire between point E12 and point E14 for 250VDC B+ OR point E12 and point E13 for 300VDC B+.

Method #2: Install a white wire with a male bullet terminal on one end. Connect the other end to point E12, “Select”. Install a BRN/YEL wire with a female bullet terminal on one end. Connect the other end to E14, “250V”. Install a BRN wire with a female bullet terminal on one end. Connect the other end to E13, “300V” See Fig. 9 and Fig. 12.
Method #3: If you have a HP-23A or B model with the voltage select switch, the wires from E12, Select, E13, 300V, and E14, 250V can be wired to that switch. See Wiring Diagram, Fig. 12.

The insulated PCB Output wires will be installed on the PCB in the next steps.
Cut a 12” RED HV wire and strip one end and tin (HV).
Connect this wire to PCB point E8 (+700V) See Fig. 12.
Cut a 12” ORG 22AWG wire and strip and tin one end (B+).
Connect this wire to PCB point E9 (B+).
Cut a 12” YEL 22AWG wire and strip one end and tin (Fixed Bias).
Connect this wire to PCB point E10 (Fixed Bias).
Cut a 12” GRN 22AWG wire and strip one end and tin (GND).
Connect this wire to PCB point E15 (GND).

(GRY wire is used on HP23 and HP23A models only)
Cut a 12” GRY 22AWG wire and strip one end and tin (ADJ Bias).
Connect this wire to PCB point E11 (ADJ BIAS)

Starting at the top of the board, bundle these wires, (E8 E9 E10 E11 E15) with 2 wire ties. These wires will be connected after the PCB is installed.

Feed the 5 bundled transformer wires through the old capacitor mounting hole in the lower left, Fig. 11.

Keeping in mind having some excess wire length for PCB removal, cut the transformer wires so they will reach E1 E2 E3 E4 and E5. Strip and tin these wires.
Connect the RED to PCB point E1.
Connect the RED/YEL to PCB point E2.
Connect the BRN to PCB point E3.
Connect the BRN/YEL to PCB point E4.
Connect the BLU to PCB point E5. Solder 5 connections.

Connect the RED Filter Choke wire to E6 and the BLK to E7.
[ ] Install the PCB as shown in Fig. 7 using the #6-32 hardware shown. Use the 2 outer holes of the old, large capacitor mounting location closest to the transformer as shown in Fig. 7. Tighten the 2 PCB screws in the vertical leg of the Keystone brackets.

[ ] In the following steps, place a wood block under the Filter Choke when working with the chassis upside down to prevent bending the PCB brackets.

[ ] Install the bundled PCB output wires through the old capacitor mounting hole in the upper left, Fig. 11. Connect and splice these wires as follows covering the splice with 3:1 shrink tubing:

[ ] Red HV wire from E8 (700V) to BLU wire from 11 Pin Socket Pin #4, (HV).

[ ] ORG wire from E9 (B+) to ORG wire from 11 Pin Socket Pin #3, (B+).

[ ] YEL wire from E10 (F BIAS) to YEL wire from 11 Pin Socket Pin #1, (F BIAS).

[ ] **HP23 and HP23A models only:** GRY wire from E11 (A BIAS) to Resistor R8 (10KΩ), see Fig. 8.

[ ] GRN wire from E15 (GND) to GND Lug at location M, Fig. 8. Do not solder at this time.

[ ] Cut a 10” BRN 22AWG wire and strip both ends and tin. Connect one end to GND Lug at location M, Fig. 8 and solder 2 wires. Connect, splice, and insulate the other end to BRN wire from 11 Pin Socket Pin #7, (GND).

[ ] This completes the wiring of the HP-23.
The following resistance checks can be made at the 11 pin Output Socket before applying power.
Positive meter lead to pin #4 (HV) and negative meter lead to pin #7 (GND) = 99KΩ
Positive meter lead to pin #3 (B+ 300V) and negative meter lead to pin #7 (GND) = 99KΩ
Positive meter lead to pin #7 (GND) and negative meter lead to pin #1 (F BIAS) 27KΩ

Remember, **HIGH VOLTAGE** is involved in the next steps!
A variable transformer (e.g. Variac) is valuable for first time power up, if available. Be aware that many popular digital multimeters cannot measure voltages higher than 600VDC without damage. The meter should have a 1000VDC range. Below are the typical voltages measured with our test HP-23. A good test method is to start with 12VAC input. Measure the HV, B+, and Bias voltages. They should be roughly 10% of the full output at 120VAC input if things are working correctly. You may want to bring up the voltage slowly at first power-up to check for abnormalities. You may also want to stop raising voltage at 3 or 4 intervals on power-up to allow capacitor forming. Voltages at the 11 Pin Output Socket with 120VAC input: (Measured to GND, pin 7)
HV Pin 4, +846VDC No Load, (NL) 
B+ Pin 3, 369VDC NL, 300V selected 
B+ Pin 3, 275VDC NL, 250V selected 
F Bias Pin 1, -135VDC NL 
Nominal AC Input Amps NL, 0.19A

A PCB Schematic is shown in Fig. 13

Thank you for supporting the Antique Wireless Association.

Bonus HP-23 restoration tip:
Krylon has a spray paint that is a very close match to the dark Heathkit green available at Lowes. This is Krylon Fusion All-in One Paint + Primer 5X in Matte Spanish Moss. This works well on the chassis and cover. Many HP23s have light rusting. A couple of light coats of Krylon Satin Black will make the transformer and Filter choke look like new.
Fig. 1 Diodes D5, D6, D7
Fig. 2 Diodes D1, D2, D3, D4
Fig. 3 Capacitor Assembly

Fig. 4 Resistor Assembly R1, R2, R3, R4
Fig. 5 Resistor Assembly R5, R6, R7, R8
Fig. 6 Fuse Holder

Fig. 7 PCB Mounting Detail
Fig. 8 Chassis, Old Parts Removal

HP-23 & HP-23A Models ONLY:
Leave Pot, 2 10KΩ Resistors, Term Strip L, and Green Wire from Pot to Pin 11 of 11 pin Socket

Fig. 9 B+ Select, 250 or 300VDC

Fig. 10 PCB Installed
Fig. 11 Completed Wiring, Chassis Bottom

Fig. 12 Wiring to PCB

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Fig. 13 PCB Schematic

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5/19/2023