

## UPS Assembly Instructions (Four Resistor Version)

- 1) Prepare the board - 21 traces with 17 holes each (including the two solid edge traces).
- 2) Drill 1/8" mounting holes at D2, R2, G16, & P16.
- 3) Drill 3/32" holes at F8 & P8 for the heat sink. (May need to widen slightly.)
- 4) Drill 5/64" holes at I14 & N14 for the USB connector.
- 5) Cut the traces at the 14 locations indicated in the layout.
- 6) Insert, solder, & snip the leads of the insulated jumper from B10 to N10.
- 7) Insert the insulated jumper from G11 to S11. On the bottom of the board, bend the lead from G11 to F11. Solder the leads at S11 & G11, but **NOT YET** at F11.
- 8) Insert, solder, & snip the leads of the jumper from L7 to O7.
- 9) For the jumper from D15 to H15, cut a 1.5" piece of wire. Near one end of the wire, bend it so that it will span from D15 to H15. Insert the wire so that all the excess lead is at the H15 side. Solder, & snip the lead at D15, (**NOT YET** at H15). Bend the excess length along row 15 on the bottom of the board. (For now, just leave the excess running along row 15.)
- 10) For the jumper from O15 to Q15, cut a 0.7" piece of wire. At one end of the wire, bend it so that it will span from O15 to Q15. Insert the wire into O15 & Q15, with its long end in Q15. Clamp the top section in place. On the bottom of the board, bend and flatten the long piece, so that it extends as shown in the layout (from Q15 to S15). Press down on the bend so that the wire is flat against the trace. Solder the jumper at Q15 (**NOT YET** at O15 or S15).
- 11) Clamp the loose end of the wire that is extending from H15 to O15, and snip it so that it just touches the lead at O15. Along row 15, solder the wires at H15, I15, N15, & O15 (**NOT YET** at K15, M15, & S15).
- 12) Insert the four resistors as shown in the layout. On the bottom of the board, bend, trim, & crimp the leads so that the resistors are connected as shown in the layout. Solder the resistors in place, including the connection to the jumper at F11. On the bottom of the board, locate the resistor lead that extends from C11 to E11. In the middle of that lead, also solder it where it crosses the trace at D11, so that it has a firm connection to the ground lead that was soldered earlier at D15.
- 13) Bend the leads of diode D1 so that it can be inserted into the board as shown. You may want to insulate the diode lead on the left side, so that there is no chance of the lead shorting to ground by contacting the USB connector. Observing the correct polarity (negative lead at L12), insert the diode at L12 & S12. Solder & snip the lead at S12 (**NOT YET** at L12). On the bottom of the board, bend and flatten the lead at L12 so that it extends past L8. Press down on the bend so that the lead is flat against trace L. **DON'T YET** solder the lead at L12; just leave the excess length on the bottom of the board.
- 14) Bend the leads of diode D2 so that it can be inserted into the board as shown. Observing

the correct polarity (negative lead at O6), insert the diode at O2 & O6. Solder & snip the lead at O6, but **NOT YET** at O2. On the bottom of the board, bend and flatten the lead at O2, so that it extends as shown in the layout (in the direction of N2). Press down on the bend so that the lead is flat against the traces. Do **NOT YET** solder anything at O2 or N2.

- 15) Insert cap C1 as shown (negative lead in M5). Solder the lead at L5, but **NOT YET** at M5.
- 16) On the USB connector, carefully bend the two middle pins in the row of four pins, so that they lay flush against the white plastic insulator on the bottom. (Make sure they don't contact the shell of the connector.) Insert the USB connector as shown. Clamp the connector firmly in place at its back end (between the two mounting holes). Solder the two mounting points at I14 & N14. Do **NOT YET** solder the +5V pin at J13, or the ground pin at M13.
- 17) The jumper wire that runs over the top of the USB connector is optional. It's only included to provide additional mechanical support for the connector. If you do want to include the jumper, just cut a 1.5" jumper, bend it so that it fits snugly across the top of the connector, and insert the ends into H17 & O17 as shown. Solder & snip the leads.
- 18) Solder the 2x3 male header in place.
- 19) Observing the correct polarity, insert the battery connector (or leads) as shown. Snip the diode lead so that it just touches the positive battery connection at N2. Solder the connections at O2 & N2, but **NOT YET** at M2.
- 20) On the power connector, we don't need the pin on the side, so rather than drilling a hole in trace U, just snip off that pin. Insert the remaining two pins of the power connector at S13 & S15. (It's a snug fit, but they will go into the holes.) Solder the connection at S13, but **NOT YET** at S15. Snip the loose end of the jumper (that's already installed along row 15) so that it just touches the power connector pin at S15. Solder the jumper and the pin at S15.
- 21) Insert capacitor C2 as shown (negative lead in H3 & positive lead in J3). Solder & snip both leads.
- 22) Finally, we're ready to install the LM2940 regulator and its heat sink! Attach the LM2940 (and thermal pad, if you are using one) to the heat sink as shown in the layout, so that its pins protrude from the bottom of the heat sink (the edge with the mounting pins). Use a small bolt, lock washer, & nut, but **DON'T YET** fully tighten the bolt, so that LM2940 can be slightly adjusted to allow its pins to be inserted into J8, K8, & L8.
- 23) Insert the heat sink and regulator into the board as shown in the layout. When everything is seated correctly, solder the heat sink in place at F8 & P8. Do **NOT YET** solder any of the LM2940 pins. (Also, make sure you don't have an accidental short between P8 & O8.) At this point, fully tighten the bolt connecting the heat sink and the regulator.

Now we can install the four remaining jumpers on the bottom of the board, which "beef-up" the power traces along columns J through M. It's much too difficult to try to bend and crimp the leads around pins, especially the three pins on the LM2940. Those pins are much too wide to wrap a wire around without running the risk of creating an accidental short. The solution is to position the leads so that their ends just touch the regulator's pins, and hold the leads in position as you solder them in place. The easiest way that I found to do this is to stretch a rubber band

around the top and bottom of row 9 or 10, with a small piece of wood trapped between the rubber band and the jumper wire, to hold the wire in place as it is being soldered.

24. For the J8 to J13 jumper, cut a jumper wire just shy of 0.5" & pinch or clamp it in place between the LM2940 pin at J8, & the USB connector pin at J13. Solder both ends, & snip the two pins.
25. For the K8 to K15 jumper, cut a jumper wire just shy of 0.7" & pinch or clamp it in place between the LM2940 pin at K8, & the jumper that runs along row 15. Solder both ends, & snip the pin at K8.
26. For the L8 to L12 jumper, snip the diode lead that runs from L12 (installed earlier) just shy of the LM2940 pin at L8, and pinch or clamp it in place. Solder both ends, & snip the pin at L8.
27. I saved the hardest one for last! For the M2 to M15 jumper, cut a jumper wire just shy of 1.3" & pinch or clamp it in place between the battery connector pin at M2, & the jumper that runs along row 15. Make sure the wire is touching the USB connector pin at M13, & the capacitor pin at M5. Solder the wire at both ends, and at M9 (so the wire can't shift its position). Snip the excess on the battery pin, the capacitor pin, & the USB connector pin.
28. Clean the bottom of the board and inspect both sides for wiring problems, shorts, etc.