Modifications to the TS-930 Power Supply

Ken Grant, VE3FIT

My TS-930 has a serial number in the 5 million and uses a +21.7 Volt low-current regulator as well as the normal +28.5 V high current supply. The power supply was becoming problematic in that you had to press the POWER button two or three times before the rig would turn on.

I purchased a Phoenix Quint model 2938604 from an eBay vendor and verified that it would deliver 28.5 Volts at 10 Amps in NORMAL mode and 15 Amps in POWER BOOST mode. It's also worth noting that this supply will deliver 15 Amps into a short-circuit (!). Unfortunately, there's no fold-back current limiting.

I've tried to use the best ideas put forth in the previous articles in this series and thrown in a few of my own, as well.

I started by removing all the existing power supply components, including the large heat sink, AVR board, filter capacitors, wiring to/from the front panel POWER switch LINE VOLTAGE SELECTOR switch and both fans from the TS-930 chassis. Save all of the hardware and tag all of the disconnected wires. I re-used many of the domed-head self-tapping screws to mount different pieces.

Kenwood wired the AC primary circuit all wrong. I rewired mine in the proper CSA/UL approved manner: LINE (black) wire to the fuse holder, to the switch, to the load and back to NEUTRAL (white).

Note that the fuse-holder terminal furthest from the rear panel is its input. Wired properly, you will avoid touching a live circuit while changing a fuse.

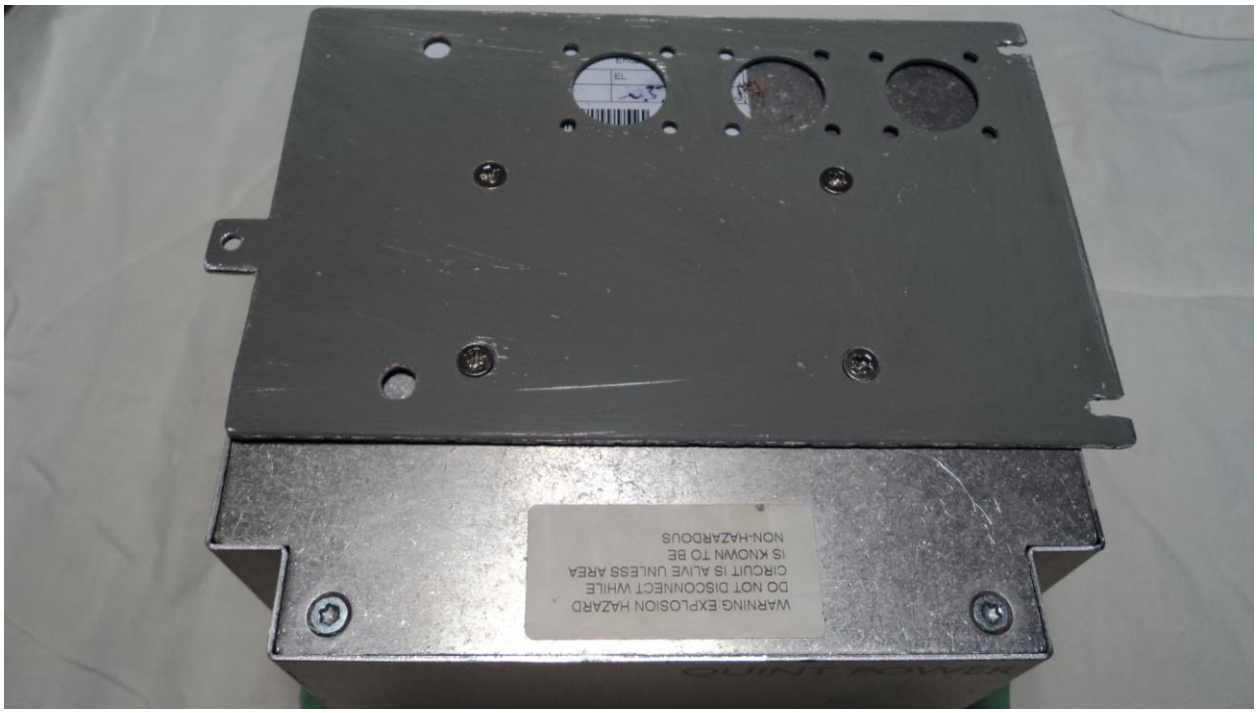
A line voltage relay was never installed in my rig, as it was in earlier production runs.

The wiring to the front panel switch is a 20 AWG twisted pair routed underneath the left side of the chassis. Parallel the two poles of the POWER switch. Cover the exposed terminals on the top of the switch with cardboard or tape. No 'AC hum' on receive or transmit has been noted as a result of this routing scheme.

I wanted a secure mechanical mount for the Quint, so I fashioned an adapter plate out of a piece of scrap aluminum. It's attached to the existing tapped attachment points on the side of the Quint using the four counter-sunk screws which originally secured the DIN using two of the existing power transformer bracket screw holes and one hole drilled at the rear edge of the TS-930 chassis. See Photos 1 and 2.

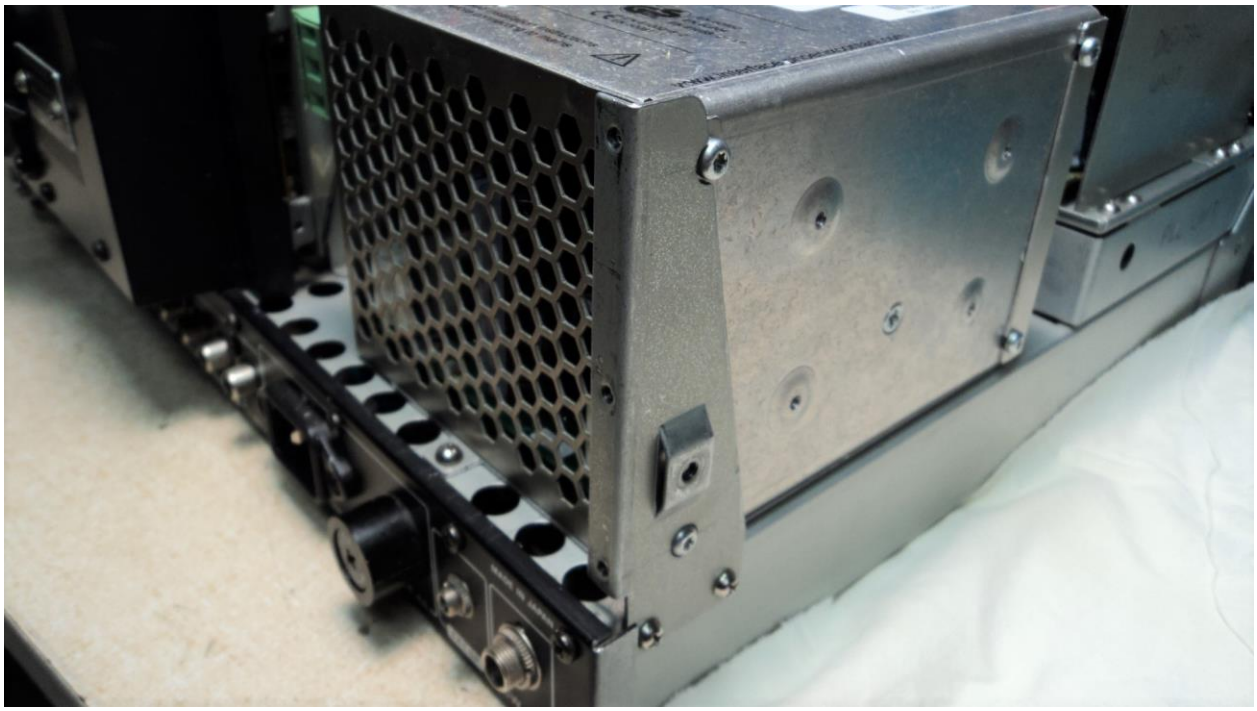
Measure carefully and move any existing under-chassis wiring out of the way. I used a Dremel tool with a cut-off disc to remove the ends of several existing screws that were protruding upwards through the chassis.

Photo 1



The original case-mounting bracket on the left-rear of the chassis has to be modified slightly so as to clear two of the Quint case screws. See Photo 2.

Photo 2



Re-use the upper case-half mounting bracket originally attached to the PS heat-sink by flattening it and pop-riveting it to the top of the fan case. See Photo 3.

Photo 3

I decided to let the two fans run continuously, but changed them to a pair of very quiet NOCTUA NF-R8 redux-1200 units (available from Amazon). The PA fan blows cool air inward and the power supply fan draws warm air outward. Each is in series with an 82Ω resistor to the +15V source. See Photo 4.

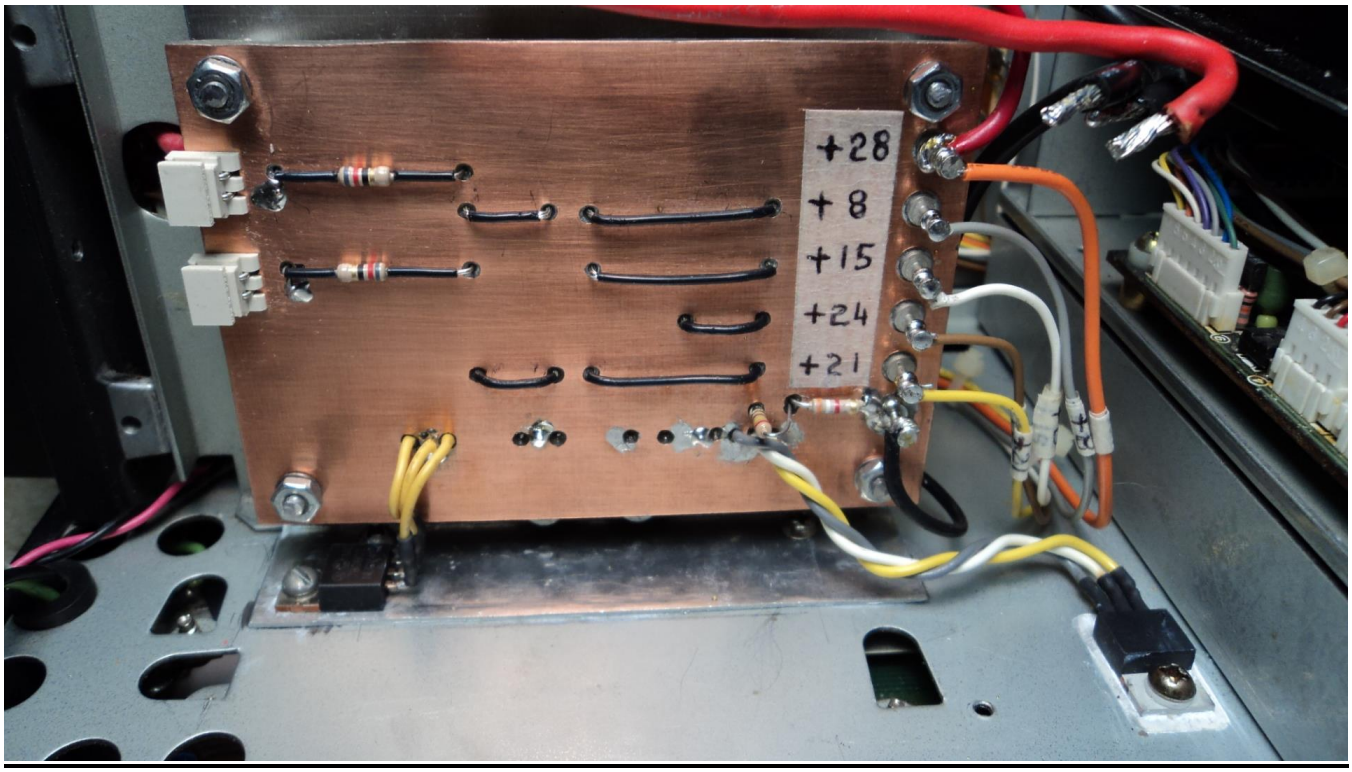
Photo 4

I had already done the 'W6NL mods' (www.kkn.net/~k5tr/ts930fix/**w6nl**930.pdf)
which, amongst other things, replace the mess of under-rated resistors and Zener diodes in the power-supply fan case with 7815 and 7808 three terminal regulators bolted to the original power supply heat-sink.

This idea was carried a little further by replacing the 33Ω, 2W resistor R10 (originally found inside the fan case, on the right-hand side) with a TO-220 thick-film unit and using an LM338T three-terminal adjustable regulator for the +21.7 Volt supply. This part is mounted to the TS-930 chassis using an existing tapped screw hole. Use one of the self-tapping screws (cut down to 7mm) from the original AVR board stand-offs, an insulating shoulder washer, mica insulator and a very thin layer of thermal grease. The LM338 has to dissipate about 8 Watts so it and the surrounding chassis get noticeably hot

The bits and pieces for the previous two steps are accommodated on a simple printed-circuit board. See Photo 5.

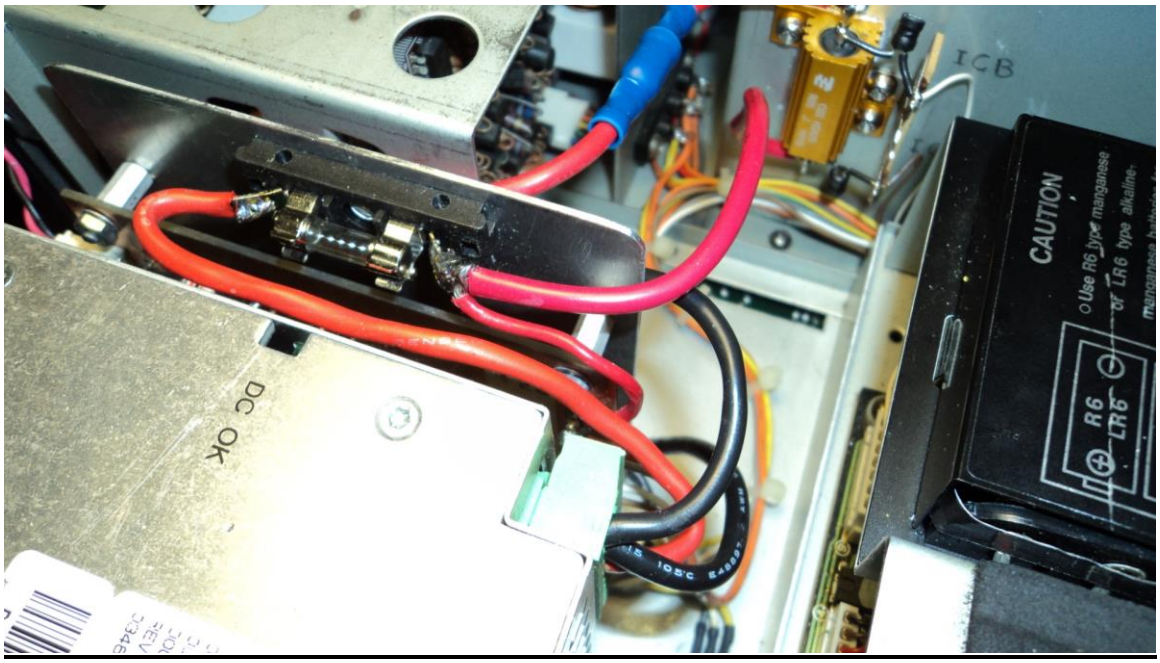
Photo 5



This board is mounted on stand-offs to a bent-aluminum bracket. The bracket attaches to the chassis using the old AVR board bracket mounting holes. The fan wires plug in to mating headers on the circuit board.

The Quint output *is* short circuit proof but it *will* dump 15 Amps into a short. Therefore, I decided to fuse it with an 8 Amp fast-blow fuse. See Photo 6.

Photo 6



The collector current for the finals is measured using a .05Ω, 25 Watt, metal-clad resistor and 150 µH filter chokes soldered to a terminal strip and mounted to the wall of the Antenna Tuner unit using self-tapping screws. See photo 6. The ATU must be removed in order to drill the mounting holes. Cut off the ends of the self-tapping screws inside the ATU case or they will get *very* close to the variable capacitors.

I used duct-tape to seal off the air gaps around the exterior edges of the PS fan case. Between the top edge of the P.S. fan case and the back edge of the Quint, I installed a piece of reclaimed air-duct sheet metal secured with duct-tape (of course!). This helps to channel the air flow a bit better. See photo 7.

Photo 7

The rear case-half attachment screws on the left-hand side must be shortened by 2mm in order to avoid bottoming out against the case of the Quint.

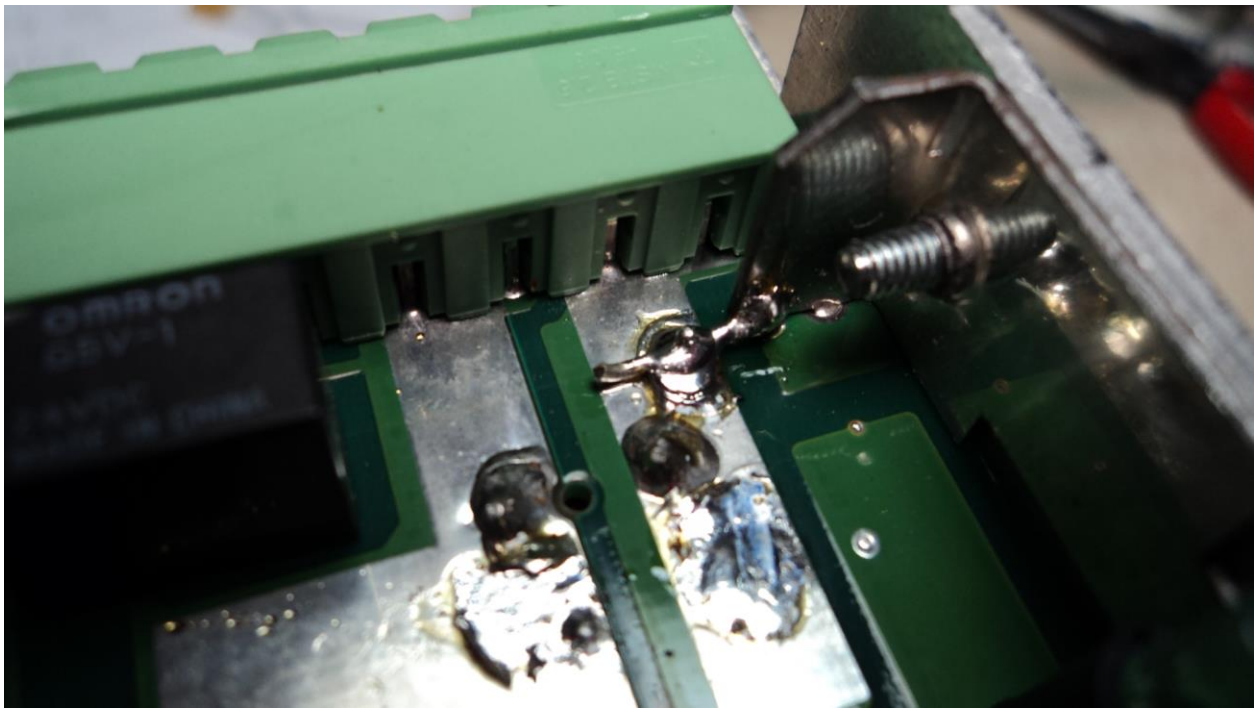
These mods all seemed to work quite well. The TS-930 is *somewhat* lighter than it was originally (by 8 lbs), although this beast will never be mistaken for a light-weight.

There is very little on the case of the Quint to indicate when it was made. Only Sno. :52988840 (serial number?) and REV 06 and 0346 (46th week of 2003?). I think that it's an earlier unit.

Anyways, I started tuning around (in AM mode with no antenna connected) for power supply hash showing up in the receiver, and soon found it. The Quint switching frequency appeared (loudly) at 365 KHz and showed up at various harmonic frequencies up through 5 MHz. It sounds like buzzing accompanied by clicking sounds.

The Quint Negative and Positive outputs are floating with respect to the case. I opened it up and connected the Negative output to the case. See Photo 8.

Photo 8



This made a very big difference. I then bypassed the +28 V and +21V terminals on the circuit board with 1 µF ceramic capacitors. Power supply noise is now almost completely inaudible on any frequency within the receiver's range.

73

Ken, VE3FIT