APPENDIX

CONTENTS

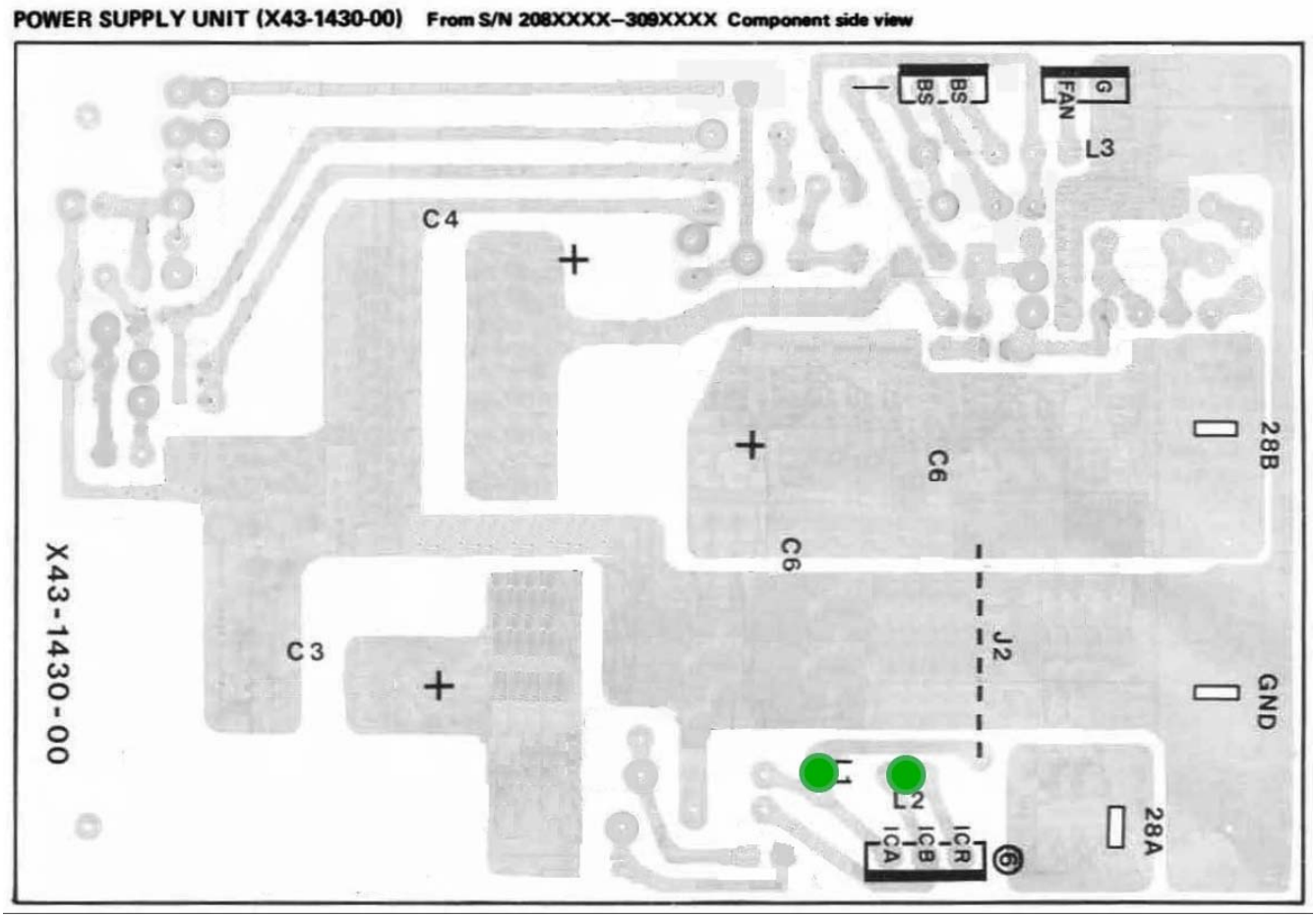
HOW OTHERS REPAIRED THEIR RIGS – PLEASE CLICK THE APPROPRIATE BUTTON AT W3AFC.COM

Stripping and rebuilding the AVR Boards

I've received some requests for suggestions on stripping the AVR boards and populating them with the 250-ohm resistor, and other parts. So, here's some info!

Single-voltage AVR Boards – Radio serial numbers 3,100,000 and earlier

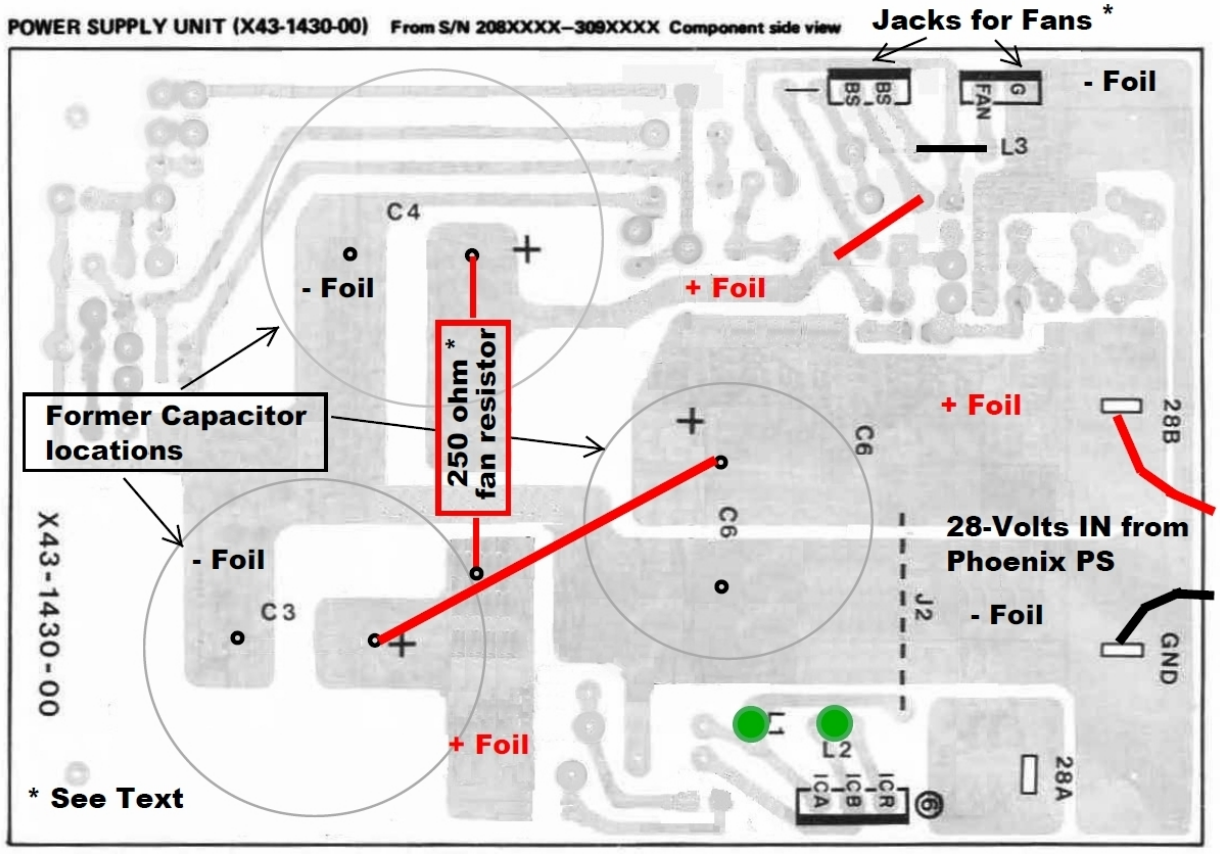
Remove everything except the two green inductors that provide power to the meter circuits, and three jacks for the existing plugs. One of the two-pin jacks, labeled "BS" will be used for one of the cooling fans. Your board should look like this once it's stripped. The two green inductors at the 3-pin meter drive jack and the jumper J2 will restore the voltage and Ic measurement functions on your meter. J2 is actually a piece of plain wire with a ferrite cover on it ("ferrite bead").



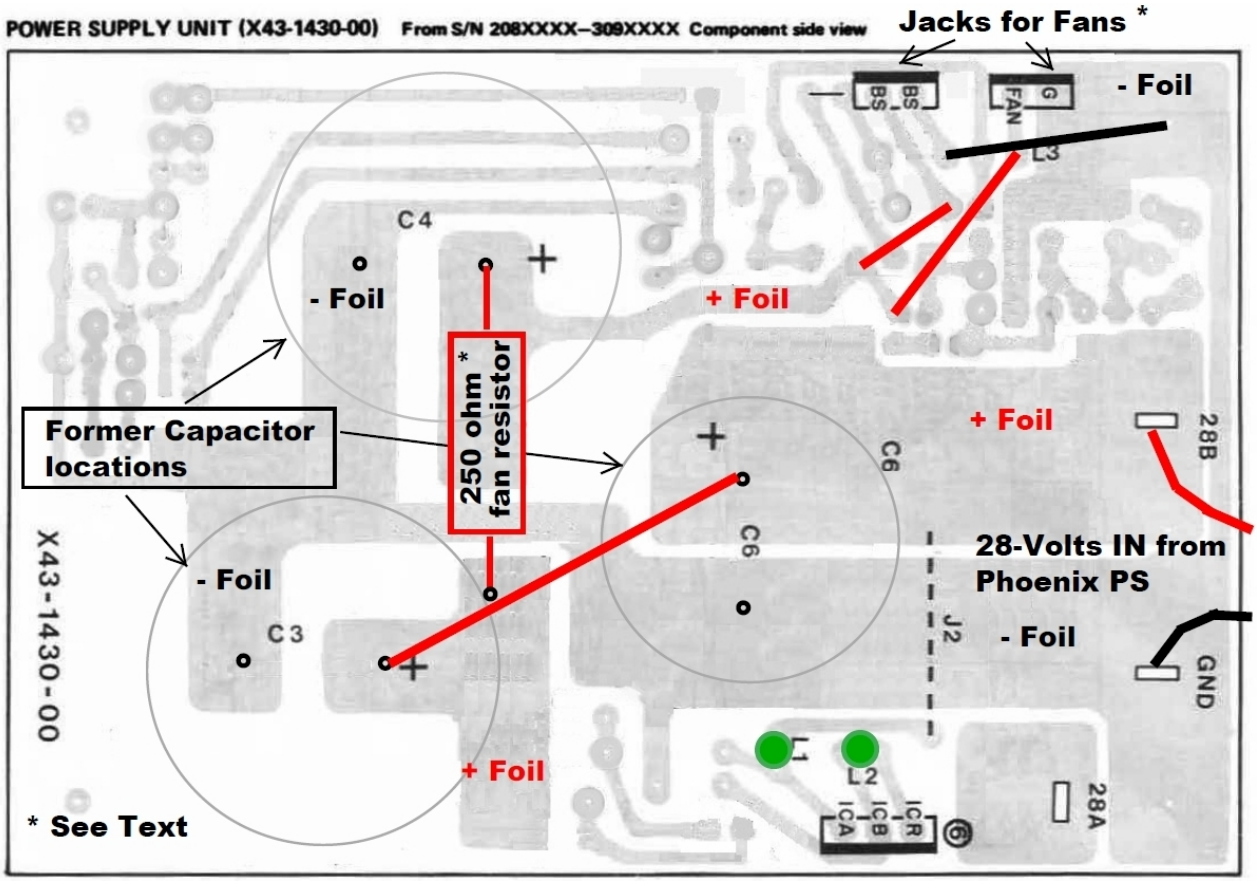
With all those foil traces, there are many different ways to wire the board. I connected the three main power foils that were for electrolytic capacitors C3, C4, and C6, so I could add other circuits later. One such circuit is an 8-9 volt Zener diode regulated supply for pin 5 of the 8-pin microphone connector so that I can use later model condenser microphones with my early model rig. The TS-940S and some later versions of the 930S already have that feature.

By the way, the procedure describe above works with the split-voltage AVR board used on the later Kenwood rigs. The ONLY difference is that you will have a small-signal transistor and a small electrolytic capacitor next to the two green inductors for the meter, and of course, the power tab regulator shown in the section that follows on rebuilding the later model board. But again, jumper J2 will do all the work for you once you feed the 28-volts from your Quint to the positive foil that once connected to C6. Plus, your board will have the jack next to the meter jack for the regulator plug. The procedure is outlined in the next section.

This is how I wired my AVR board. The red lines represent positive jumpers with red insulation, and the black ones are negative. I only had to connect the positive foils, because the negative ones for C3, C4, and C6 are already linked together. I needed one piece of black wire for the second fan. Note that I wired my fans in series. My logic was that if one fan jammed the other would run faster and I would notice. Or if one opened, the silence would catch my attention.



Another way of wiring the fans is in parallel. That way if one fan jams or the motor winding opens, both won't be disabled. The fans will be louder and faster, so you might want to increase the resistor to 270-300 ohms. Here's the parallel wiring:



You COULD save time by connecting the fan resistor across the positive foils for C4 and C6, leaving C3 out of the picture. But as I said, I plan to create a drive circuit for a condenser mike some day, using my AVR board. Right now, I'm using a little Chinese-made regulator as a test (plus I can adjust the voltage to see what works best)

If you look at the way I did the later model AVR board (next section), you will see that I used the C4 and C6 foils, so the resistor sits an angle, which makes no difference electrically.

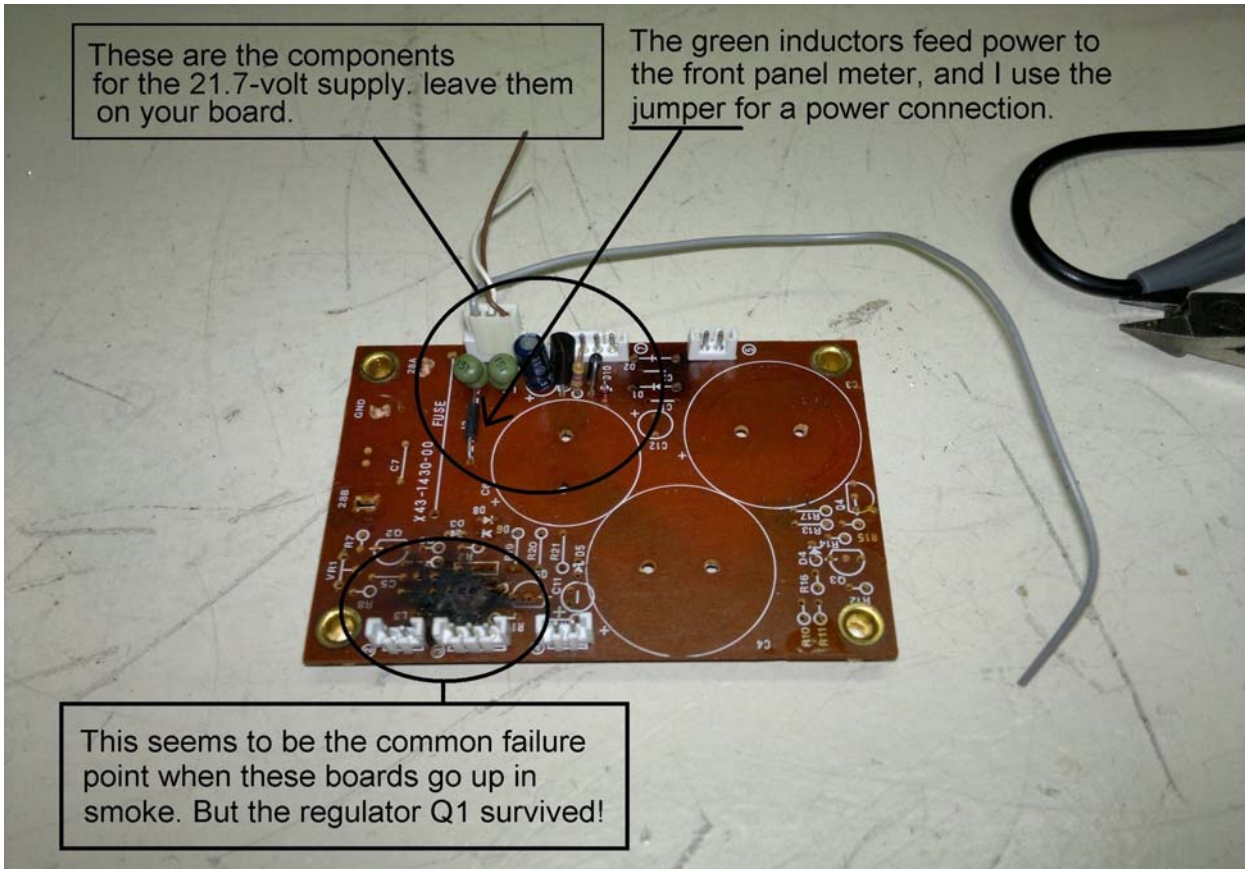
One issue to address right now is this: If you plug the fans into the connectors on the AVR board the way they were keyed, both fans will be blowing out. I prefer to have my PA fan blowing IN against the heat sink, but my PS cooling fan pulling air OUT. That way, power supply heat, if any, will not be blown back into my rigs' case. The only way to make that work is to slide the plastic retainer for the PA fan jack on the AVR board off and reverse it, trim off the plastic tabs on the plug so you can insert the plug in either direction, or pop out the little pins on the plug and reverse the leads. I chose the last solution, because the plastic jack piece was stuck down firmly to the AVR board, possibly because the pins hold it in place, or the heat from my AVR board catching fire melted the bottom of the retainer to the board.

Rebuilding a TS-930S with the 28.5 & 21.7-volt AVR Board

If you have a later model 930S with the dual-output AVR board and you don't want to use the board, eBay sellers offer solutions: Small adjustable converter boards that typically reduce 3-40 volts down to 1.5-35 volts. I used one to provide 9 volts to my mic connector so I can use condenser microphones. There are some that resemble scaled-down versions of the Phoenix Quint. Many can handle 4-5 amps without a heat sink.

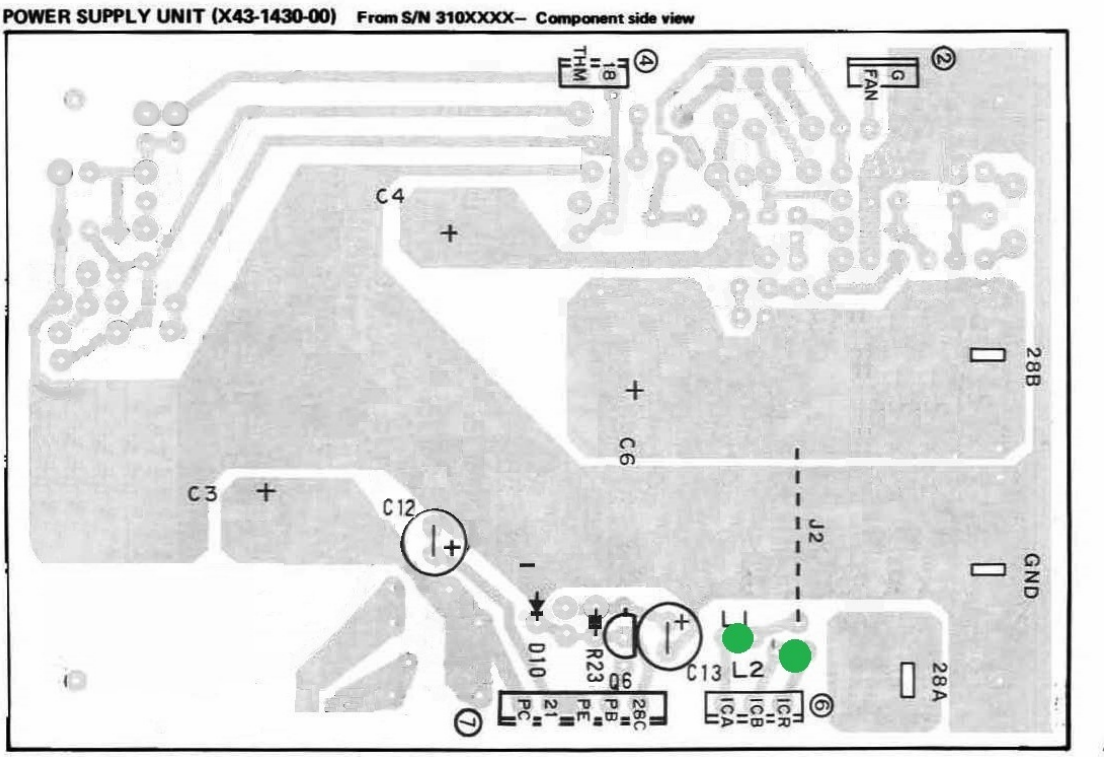
Phoenix Contact even sells a Quint-Series DC-DC converter that has the same 125mm x 130mm length and width as either of the Quint power supplies discussed above. Its depth is 32mm, so if you mount a "big Quint" directly to the 930S chassis using the 3M snap-lock fastener system, the smaller Quint could sit on top using 3M double-sided tape and you could even line the terminals up so that the two could be removed as a package for service. The Phoenix Quint converter handles 5 amps. The part number for it is 2320034. It lists for $267, but no doubt you could find it on eBay for a lot less.

Or, you can do what I did and strip the original AVR board down, and reuse it. The strip-down procedure for this board is pretty much the same as with the older AVRs. You just need to leave on Q6 and its associated components, and keep the TO-220 regulator Q3. If you toss the OEM PS heat sink, you will need to mount Q3 to the chassis or some other heat sink using a mica insulator and shoulder washer. THIS is what your board will look like after it's stripped.

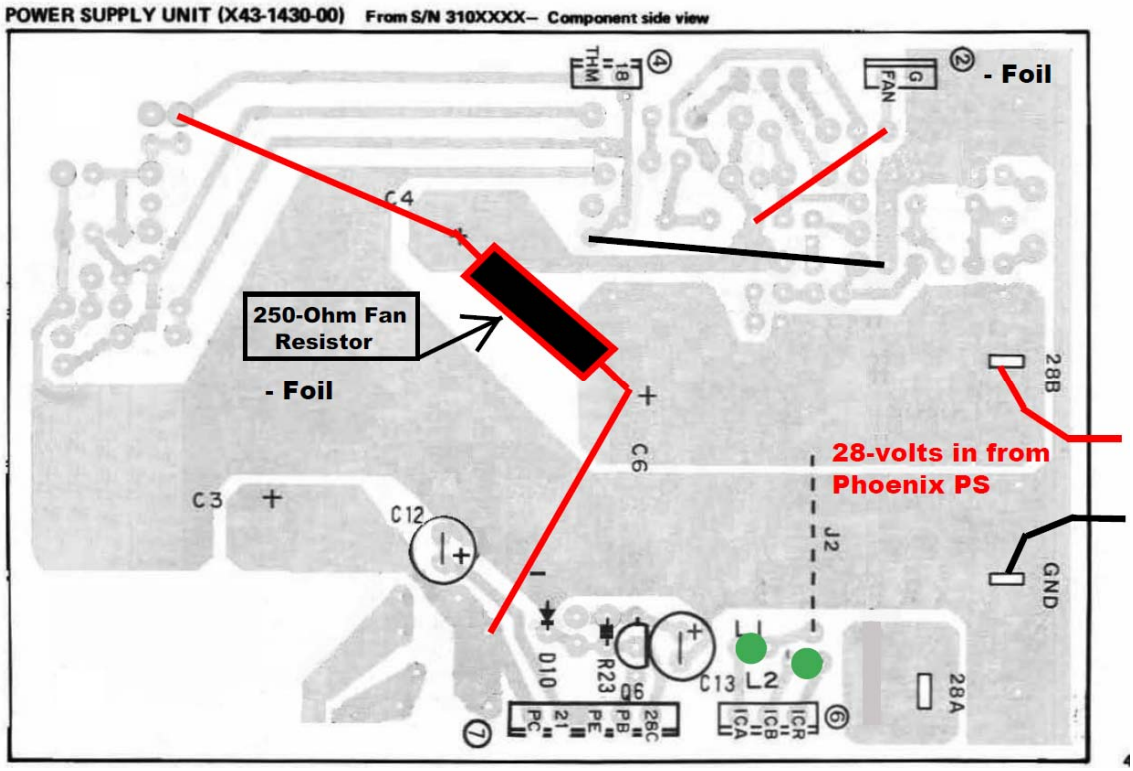


The jumper mentioned in the above picture is actually a "ferrite bead" - basically a piece of wire with a tight-fitting ferrite covering to block RF from reaching a DC circuit. It's labeled "J2" on the board.

From a diagrammatic standpoint, your board will look like the "Pre-3,100,XXX AVR board, except for the connector and parts for the 21.7-volt sub-system. (next page). Again, there are many ways to wire the AVR board since you have so many holes to choose from. My way is not necessarily the best, but it works.



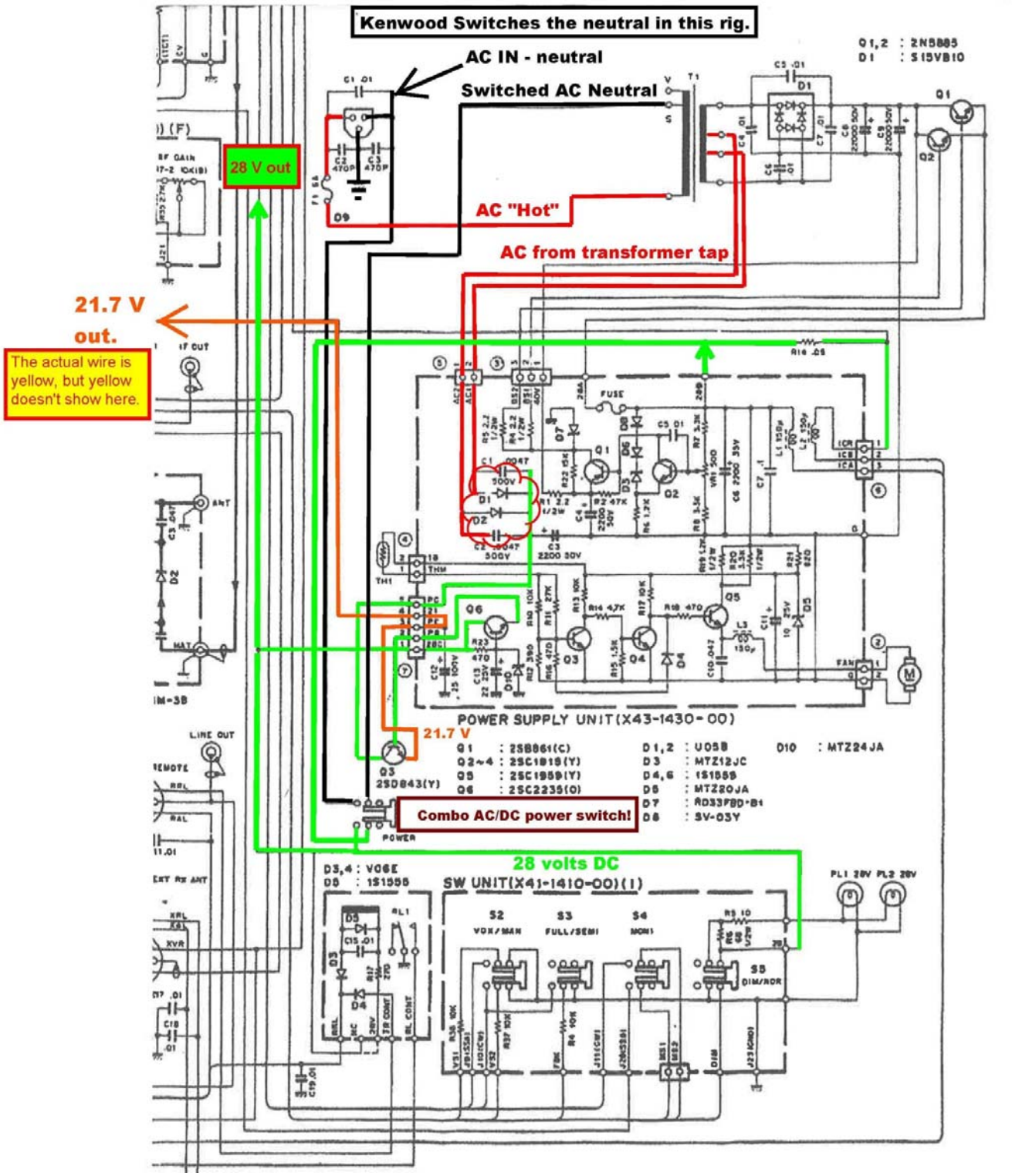
You will need to jumper the foil that was used for C3 to the C6 foil to provide power to Connector 7, and the 21.7-volt sub-system components, as shown below:



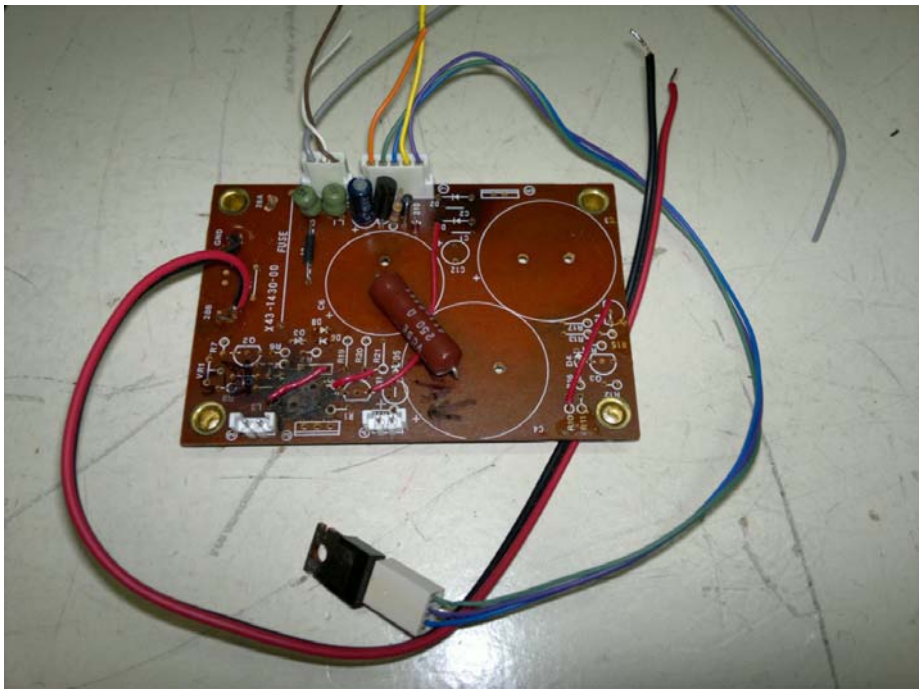
Note from the schematic on the next page that the 21.7-volt sub-system is literally stand-alone. It's fed 28-volts DC through the power switch from terminal 28B into pin 1 of the connector, while pin 5 receives 28 volts DC from a separate circuit via diodes D1 and D2. I used jumpers to the 28-volt line from the Quint instead of D1 and D2, and everything works fine. Be sure to leave on the ferrite bead jumper and the green inductors for the panel meter circuit.

The Dual-Voltage AVR Board with the pertinent circuits highlighted.

(Note that this model does NOT have the AC power relay that the older models have)



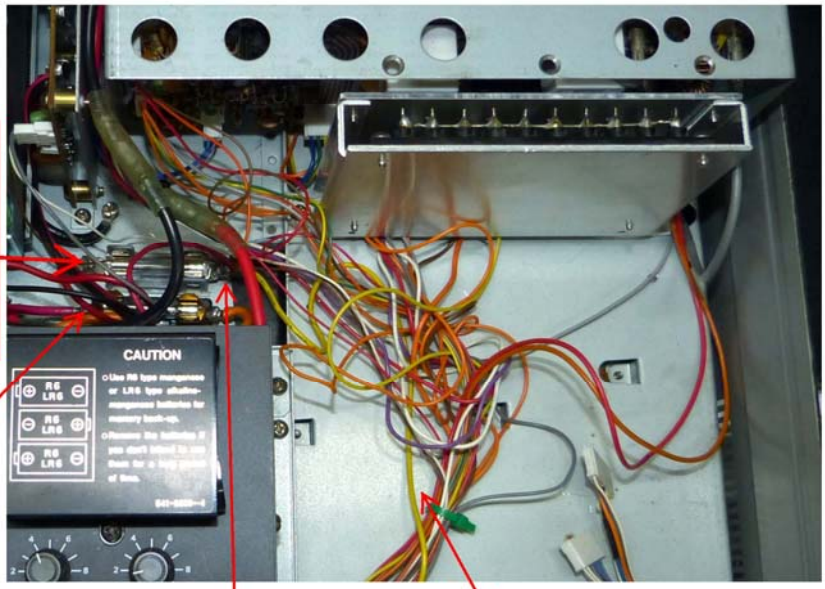
Here is the later model AVR board, ready to reinstall. For this conversion, I ran the 250-ohm resistor directly from the C4 foil to the C6 one. Remember to install the regulator transistor using an insulating mica washer or the original rubber piece, and use a shoulder washer to insulate the screw. Otherwise, you will short the 28 volt B+ line right to ground.



It doesn't hurt to test everything before putting the board back in the rig. A load resistor will be needed or the voltage will "float" up to 22 or 23 volts. I used a 70-ohm resistor for this test.

ADDITIONAL PHOTOS WITH NOTES, SHOWING MY POWER SUPPLY CONNECTIONS

(Remember, my radio is an older "Pre-3,100,xxx model)

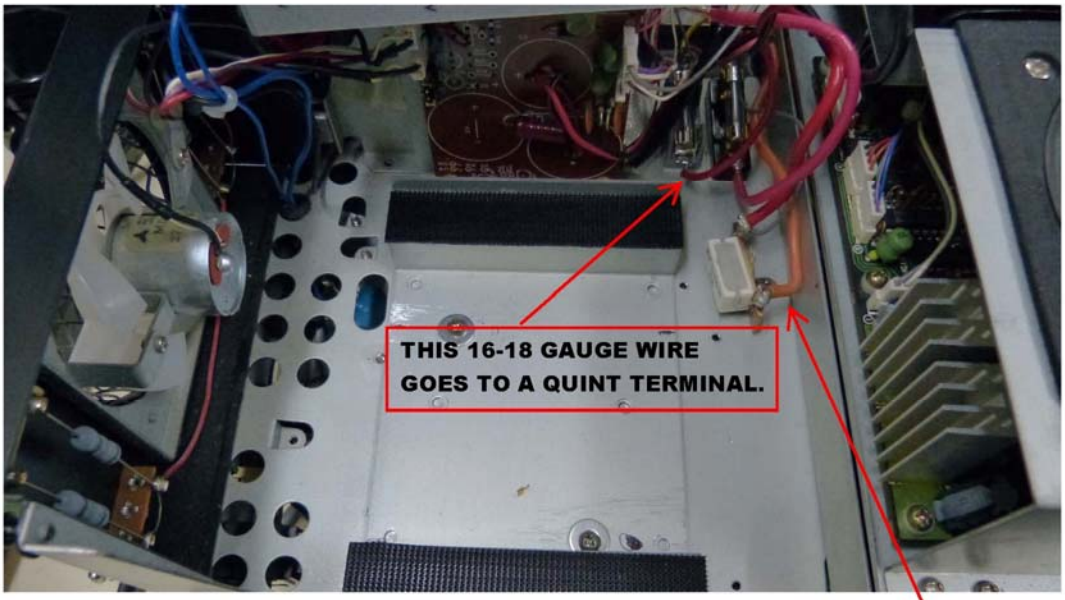


THIS FUSEHOLDER IS FOR THE RECEIVER\ AND AVR BOARD. RUN A 16 OR 18-GAUGE WIRE FROM IT TO A + TERMINAL ON YOUR QUINT.

THIS FUSEHOLDER IS FOR THE PA ALONE. USE A 10-AMP SLOW BLOW FUSE HERE.

THIS "HEAVY" YELLOW WIRE GETS 28 VOLTS.

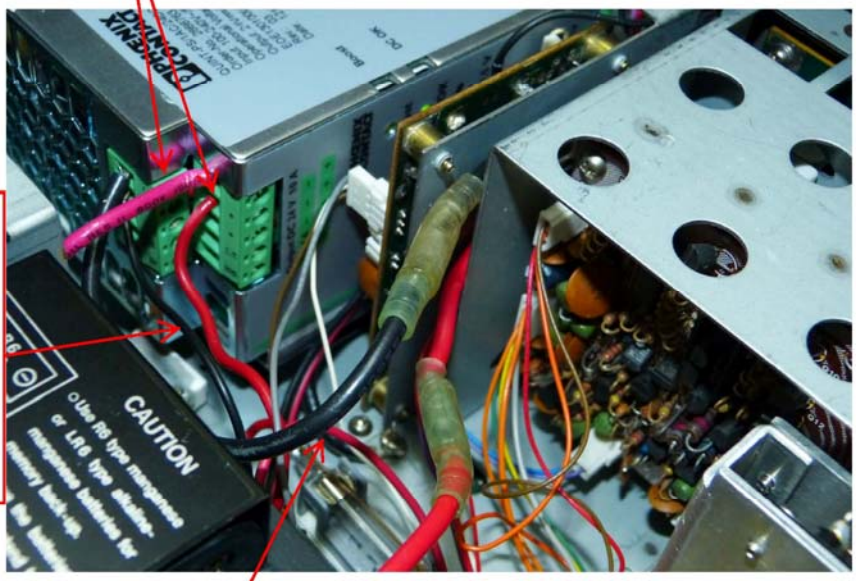
CONNECT THE "HEAVY" YELLOW WIRE HERE.



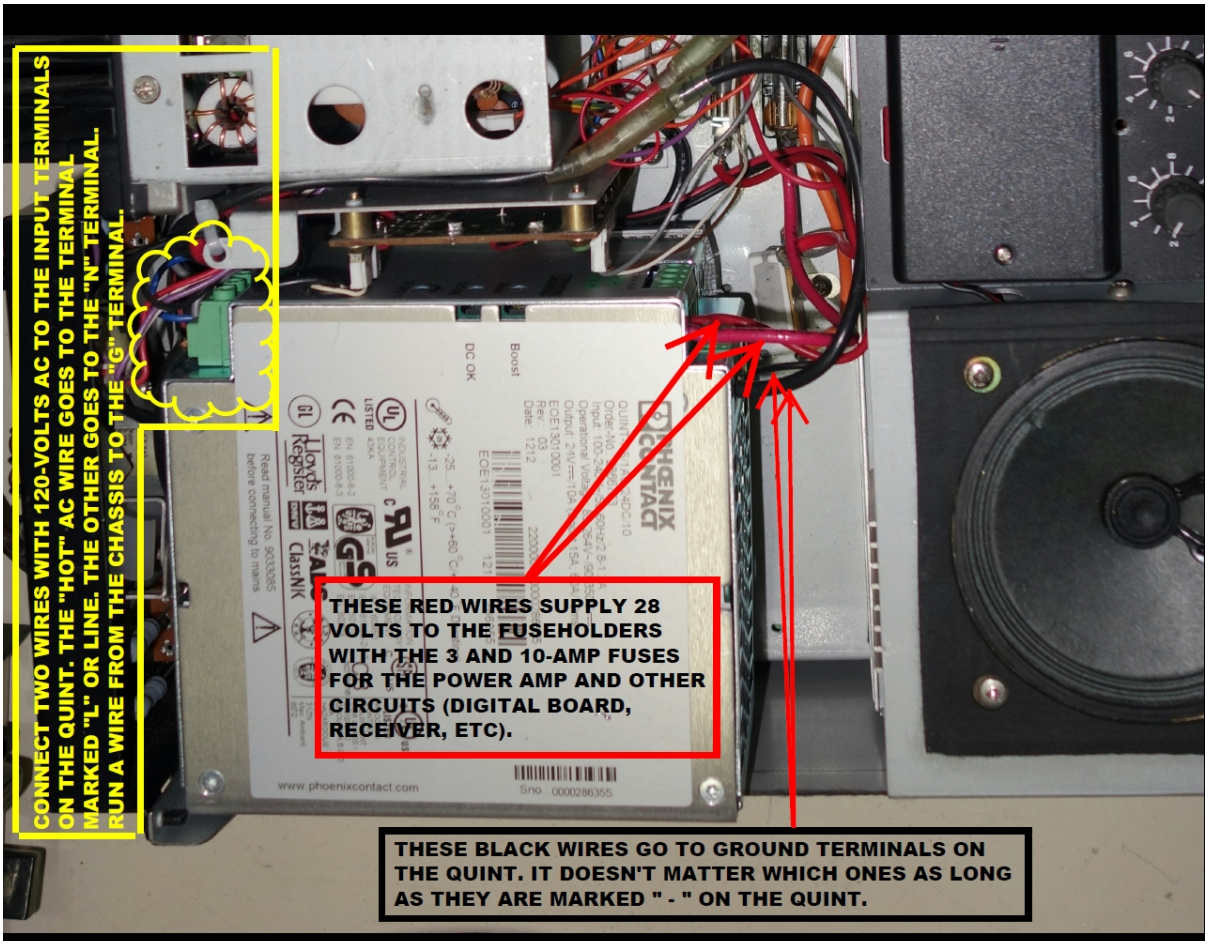
THIS 10-GAUGE ORANGE LEAD ONCE WENT TO THE AVR BOARD. TAKE THE FREE END FROM THE BOARD AND SOLDER IT TO THE FUSED SIDE OF THE FUSEHOLDER. USE A 10-GAUGE STRANDED WIRE (RED ON MINE) TO CONNECT THE POWER END TO THE QUINT.

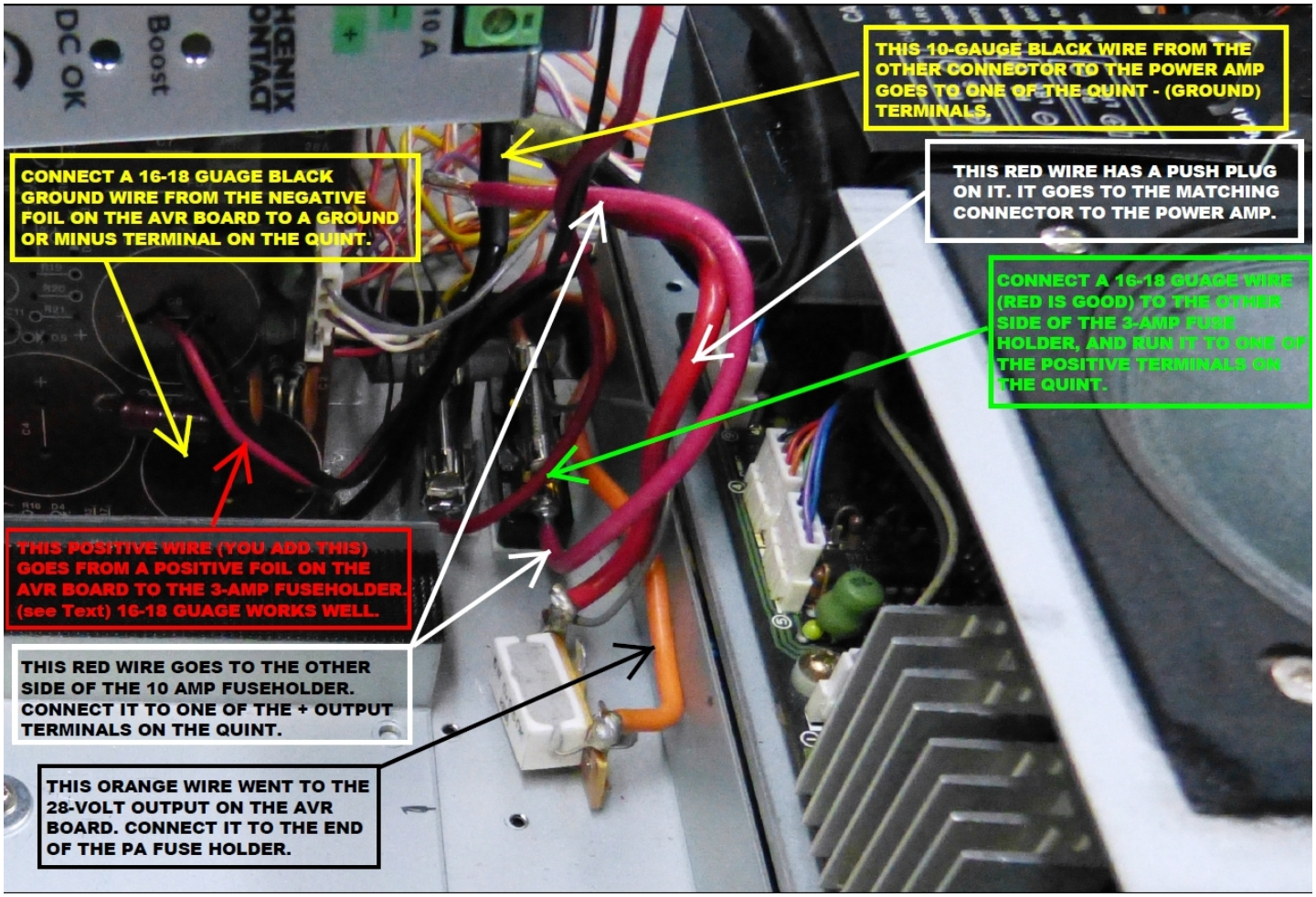
THESE TWO WIRES WERE ADDED BY ME. THE THICK ONE GOES TO THE PA FUSEHOLDER. THE OTHER GOES TO A FUSEHOLDER FOR THE HEAVIER YELLOW WIRE AND THE RED WIRE FROM THE AVR BOARD.

I "SPLIT" THE RED AND BLACK WIRES FROM THE AVR BOARD AND RAN THE BLACK ONE TO THE QUINT. THE RED GOES TO THE SAME FUSEHOLDER AS THE YELLOW RECEIVER WIRE.



THIS THICK BLACK WIRE GOES TO A NEGATIVE TERMINAL ON THE QUINT.



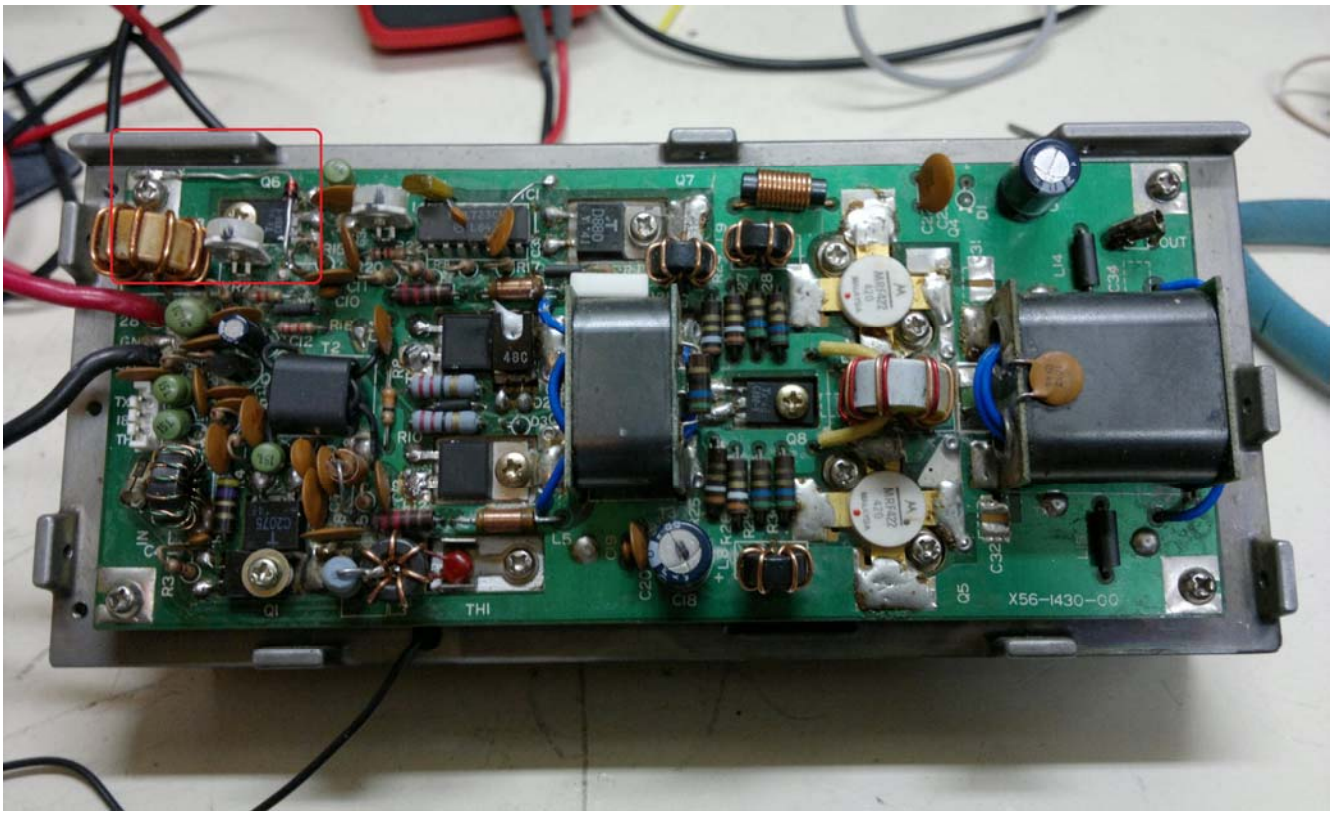

THIS 10-GAUGE BLACK WIRE FROM THE OTHER CONNECTOR TO THE POWER AMP GOES TO ONE OF THE QUINT - (GROUND) TERMINALS.
CONNECT A 16-18 GUAGE BLACK GROUND WIRE FROM THE NEGATIVE FOIL ON THE AVR BOARD TO A GROUND OR MINUS TERMINAL ON THE QUINT.
THIS RED WIRE HAS A PUSH PLUG ON IT. IT GOES TO THE MATCHING CONNECTOR TO THE POWER AMP.
CONNECT A 16-18 GUAGE WIRE (RED IS GOOD) TO THE OTHER SIDE OF THE 3-AMP FUSE HOLDER, AND RUN IT TO ONE OF THE POSITIVE TERMINALS ON THE QUINT.
THIS POSITIVE WIRE (YOU ADD THIS) GOES FROM A POSITIVE FOIL ON THE AVR BOARD TO THE 3-AMP FUSEHOLDER. (see Text) 16-18 GUAGE WORKS WELL.
THIS RED WIRE GOES TO THE OTHER SIDE OF THE 10 AMP FUSEHOLDER. CONNECT IT TO ONE OF THE + OUTPUT TERMINALS ON THE QUINT.
THIS ORANGE WIRE WENT TO THE 28-VOLT OUTPUT ON THE AVR BOARD. CONNECT IT TO THE END OF THE PA FUSE HOLDER.

Repairing your PA with the circuit board screwed to the heat sink.

This is the fastest and easiest way to fix your PA and get your rig back on the air. Some judgment is needed here. If your board looks clean and the heat sink compound under the blown drivers isn't all dried up, then this is a good way to go. However, if your circuit board is a mess, I would remove it so that you can clean it up and check solder joints, etc. One big benefit of fixing yours without removing the board is that you don't have to worry about things like the mica insulators for the regulators and drivers falling off the heat sink, etc. Also, it's easier to bend the driver leads into position when the drivers are already mounted to the heat sink. In fact, that's how I install mine whether or not I remove the circuit board or not. Just bend all three leads up at a 30 to 45-degree angle and then mount the driver. The Collector (middle) lead gets cut off, and you will end up cutting ½ inch off the other two leads. Be quick about soldering the leads down, but one advantage to doing this with the drivers mounted is that some of the heat that reaches the transistor junction will be dissipated by the heat sink.

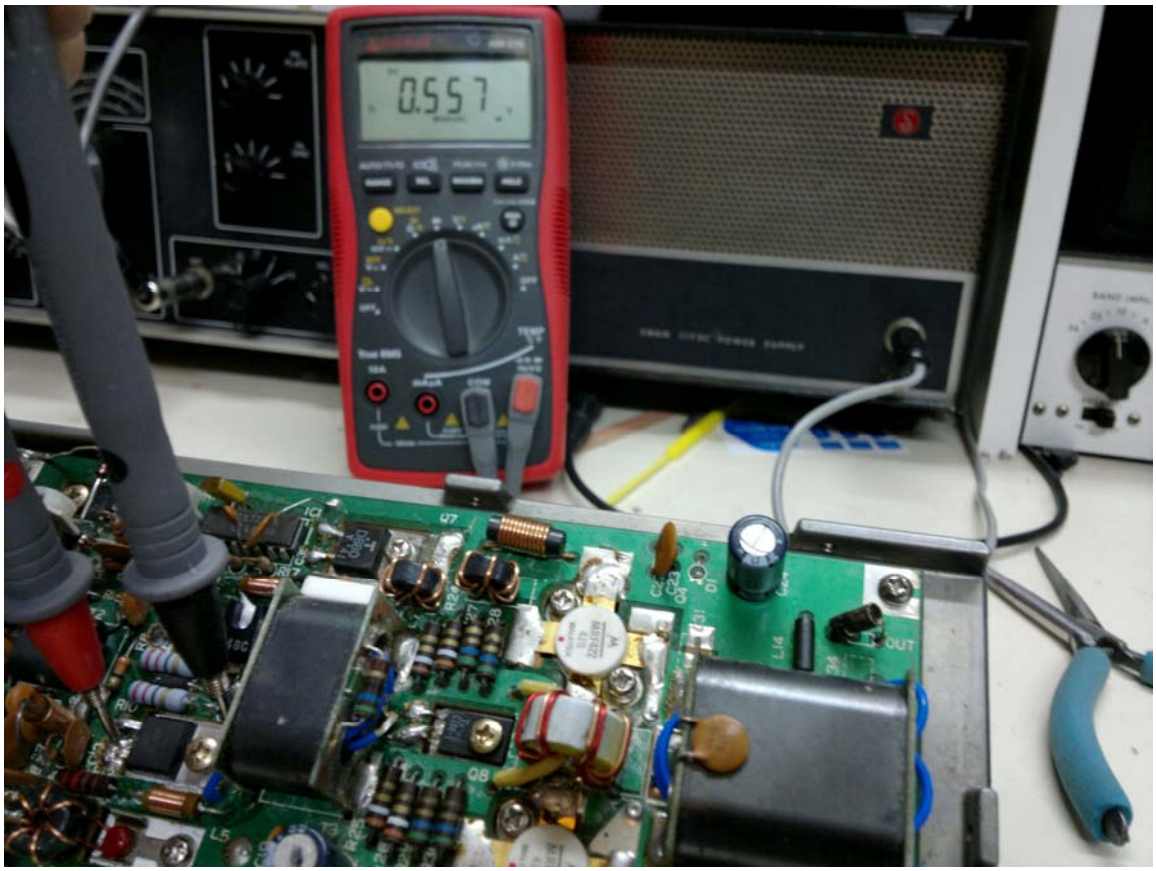
The most common components that fail when the PA blows are the drivers, and the 36-volt "protection" zener diode D1. Once you pitch the OEM power supply, D1 can be simply cut off the board and left off. D5 also shorts, and it is also somewhat optional. It limits the bias to the drivers to 19 volts or less. It was shorted, on both of my PA's. If your D5 is shorted, and you want to replace it, you can still add it without removing the board. The solution will just LOOK a little funny.

The photo below shows the blown PA that I bought on eBay and repaired without removing the circuit board. I have since removed D5. Over time, I have discovered that it's worthless after you switch over to the Quint power supply.

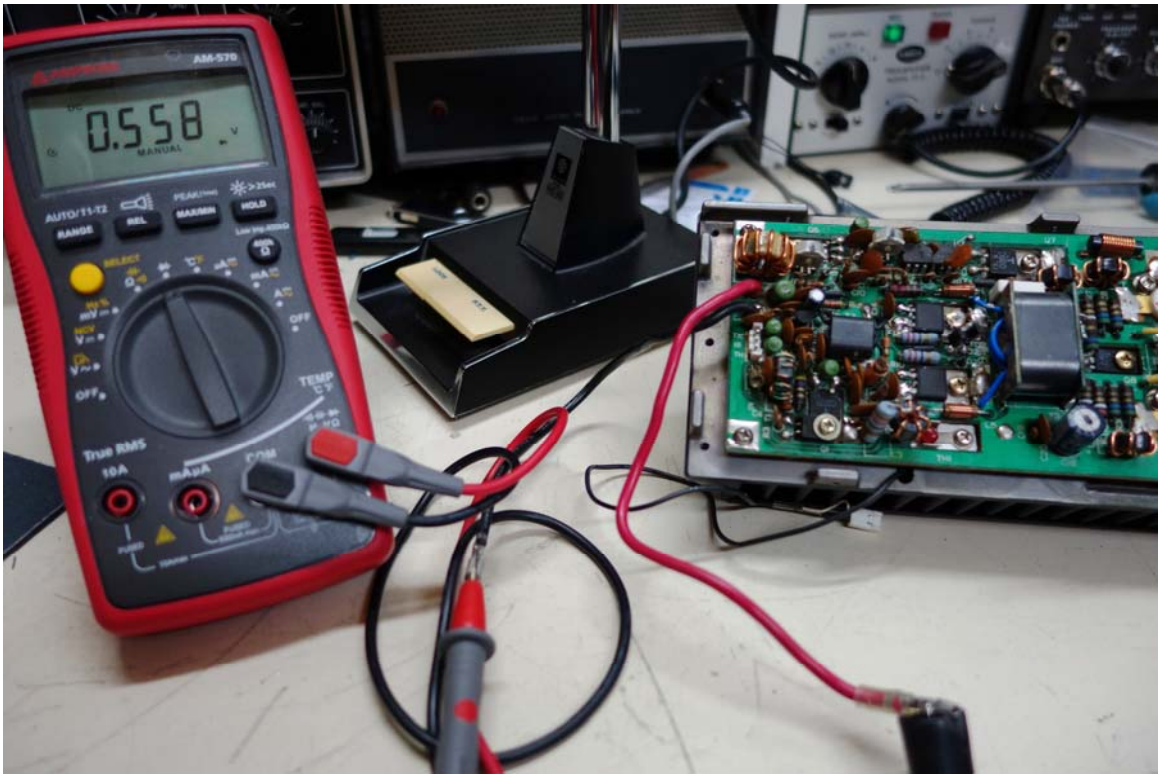


"PRE-FLIGHT" TESTS

It's a good idea to perform some basic tests before you apply power to your newly-rebuilt PA. After the new drivers are mounted and soldered in, they should show a diode relationship between their collectors, and base and emitters. Remember the collector tabs are electrically insulated from the mounting screws.

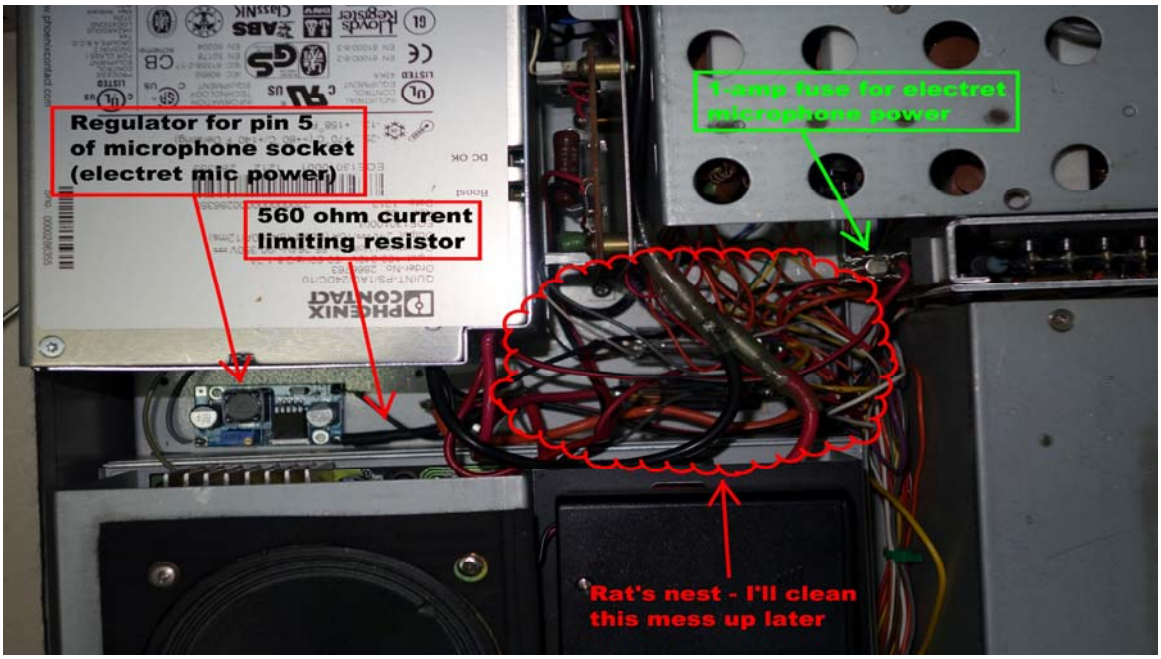


A diode relationship must exist between the main power leads also. If it doesn't, something is wrong.

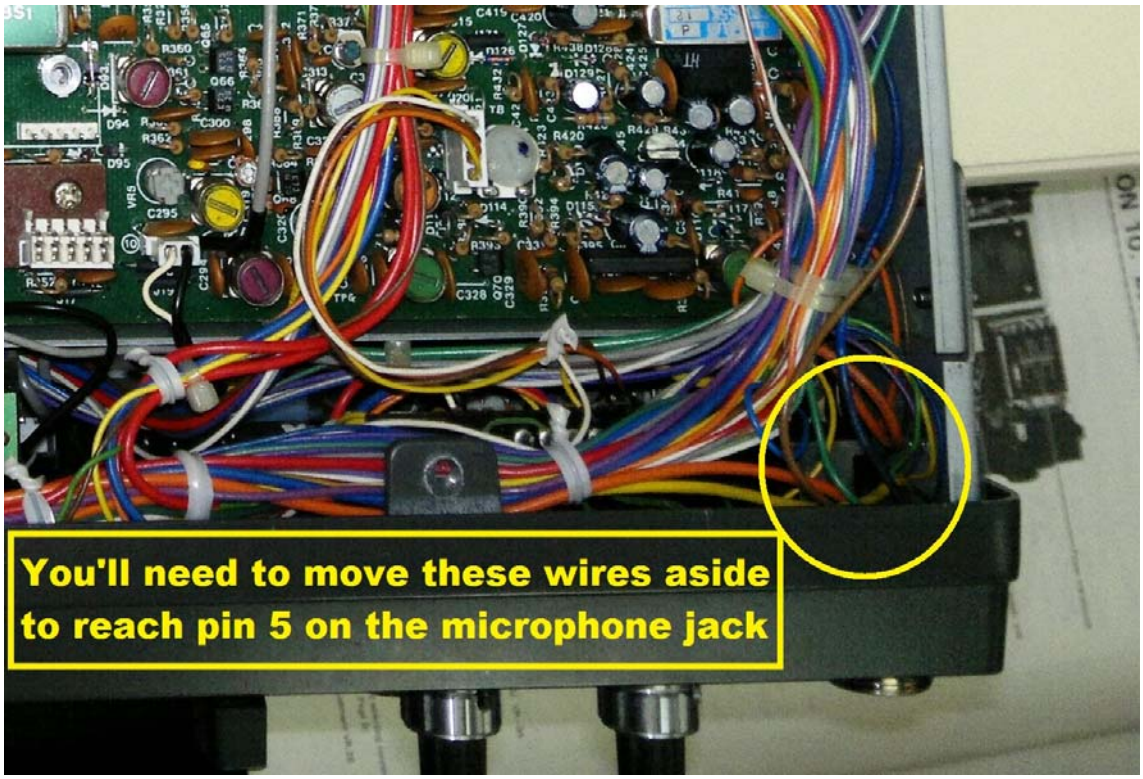


ADDING ELECTRET (CONDENSER) MICROPHONE CAPABILITY TO YOUR TS-930S

If you've ever bought a 940S hand mic for your 930S only to find that it doesn't work, it may be because the 930S lacks a 9-volt, 10 mA connection to pin 5 of the microphone connector. There are lots of ways to add this. You can use a battery holder with a 9-volt battery, a resistor & zener diode on your reworked AVR board, you could connect a wire to the 8.5-volt resistor tap (gray lead) in the PS fan shroud. OR, you could install a small voltage regulator with a fuse. I wanted to try out one of the Chinese-made regulators that Gary (N6BIZ) sent to me, so I chose the last option.



Pin 5 requires 8-9 volts at 10 mA to drive a condenser mike element, so I used a current-limiting resistor to provide 16 mA. That way, if I short pin 5 to ground, the current will be below the damage threshold. And it works well, so the 560-ohm resistor was a good choice. The microphone connector is fairly easy to reach from the bottom without tearing the rig apart. Electret microphones are MUCH more sensitive than dynamic models, so turn your mic gain way down or you and everyone on that frequency might be greeted by a loud squeal the second you hit the "transmit" button. In some cases, additional resistive attenuator circuitry may be needed to match the condenser mike to your 930S. I recommend placing that circuitry inside the mike housing rather than attenuating the input for all mikes. I'm still working on this.

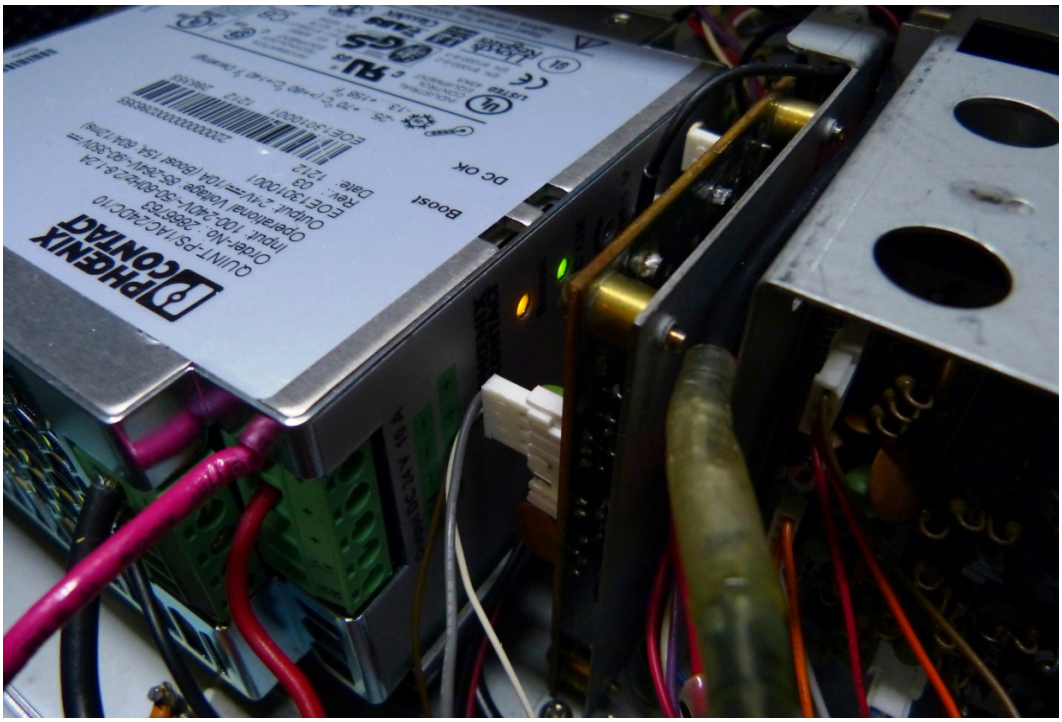

You'll need to move these wires aside
to reach pin 5 on the microphone jack

BOOST MODE

After operating my 930S for a few days, I had to see if the Quint power supply was entering boost mode when operating at full power, so I pulled the cover and watched while I talked. I was most interested in SSB, but I also tried AM and CW modes. This is what I discovered:

On strong SSB voice peaks where the PEP reached 100W or more, the yellow boost light came on. (See photo below) On CW it came on full brightness every time I keyed down. But it stayed dark on AM, probably because AM output is limited to 30W. This suggests that the Nao Tech 28-volt, 10.7 amp power supply that I was considering in the beginning would not have had enough power to run this radio. But the Acopian 14-amp supply should have worked perfectly, had it fit.

The Yellow BOOST Mode Light on the Quint Power Supply



One year later: How does it compare?

Since performing this mod, this has been my everyday "go-to" rig for everything from ragchewing to all-day contesting. Even after a full day of contesting or other use, the top of the rig is barely warm. The only part that generates any heat is the resistor bank assembly in front of the Low Pass Filter assembly. If I buy another 930S, or even a 940S, I'll install a Phoenix supply immediately, even if the OEM power supply still works.

PARTS INFORMATION

Phoenix Quint Power Supplies: eBay. They are on there all the time. You can find them NOS or surplus with a 14-30 day return period for $50-$100. Don't pay much more unless you're really in a rush.

Eleflow MRF-485: Eleflow is out of the low-gain 485's, so if you want to buy from them, you will literally HAVE to rebuild your PA using Solution 2 or 3. I strongly suggest you use 3 (circuit board changes to the negative feedback loops)

Eleflow will sell to individuals but their minimum purchase is $60.00 including shipping. They want $14.50 each plus $12.00 S&H, so you will end up with four drivers for $70.00. That's really not bad, because you have will have two spares. They say they can get approximately 2000 units of their MRF-485 drivers.

Here is the contact information that was good as of the above date:

Roger Huang
Eleflow Tech
www.eleflow.com
Phone: 86-755-86329083
Fax: 86-755-86329019
roger_huang@163.comhide

TESTIMONIALS

So, how does it work? Here's what Mike, who tore two of his working 930S radios apart to modify the power supplies, had to say. He installed the Phoenix supply in one.

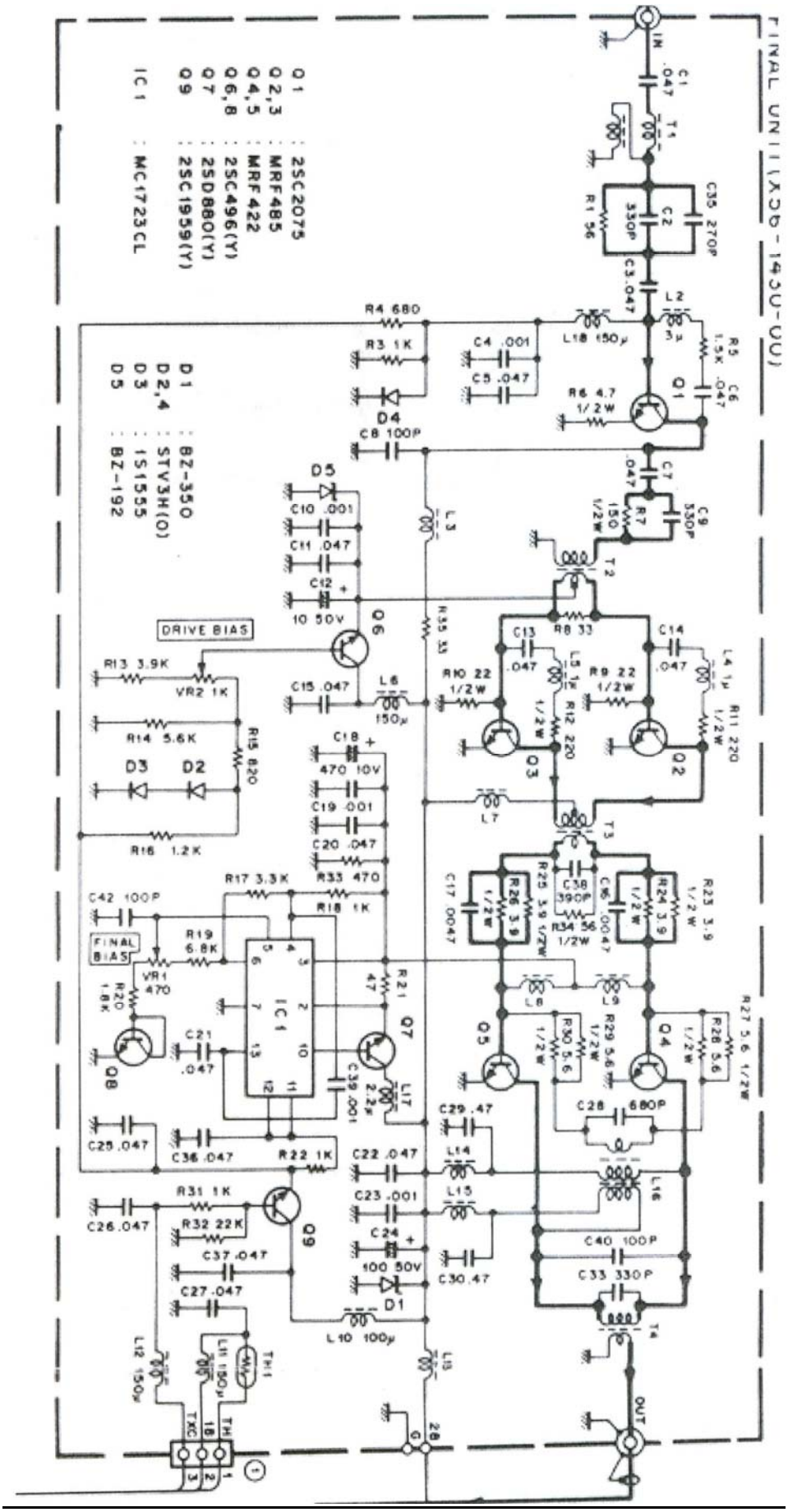
"Hi John - yesterday I finished my VK4AMZ power supply & put into my number three 930 & all is fine! I wired the whole power unit, heat sink & fan casing, so I can remove the 3 parts & lay them all behind the rig for checks etc., without unsoldering anything. I changed the rearmost transformer mounting clamp from a 'U' to a flat, this gave enough space to mount a 2-way connector (we call them 'chocolate blocks', guess you know what I mean!) on top of the rearmost transformer windings, with the transformer secondary into the block & flexible wires coming out to the rectifier.

To be honest, I regard the mod using the 'Quint' to be quicker & tidier, and I can't see any performance differences between the 3. Plus, like you said before, the 930 with the quint is a LOT easier to lift!!!

Hope all is well at your end!
73 de Mike, zl1mh."

W3AFC: Here's my testimonial – it's my baby, back in full service. I run it all weekend during contests without a glitch. It doesn't even get warm. I wouldn't use a 930S with the old power supply. I like fireworks, but not in my shack!

TS-930S PA Schematic


FINAL UNIT (X36-1430-00)
Q1 : 2SC2075
Q2,3 : MRF485
Q4,5 : MRF422
Q6,8 : 2SC496(Y)
Q7 : 2SD880(Y)
Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : 8Z-350
D2,4 : STV3H(O)
D3 : 1S1555
D5 : 8Z-192
IN
OUT
DRIVE BIAS
FINAL BIAS
IC 1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
T1
T2
T3
T4
D1
D2
D3
D4
D5
TH1
VR1 470
VR2 1K