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**DISCLAIMER – YOU WORK ON YOUR AMPLIFIERS AT YOUR OWN RISK!!!
THIS INFORMATION IS FOR EDUCATIONAL PURPOSES ONLY, WITH *NO* WARRANTY.
YOU ASSUME *FULL* RESPONSIBILITY FOR *ALL* ASSOCIATED RISKS!!!
HIGH POWER RF AMPLIFIERS CAN BE DANGEROUS. IF YOU DON'T KNOW EXACTLY
WHAT YOU ARE DOING, PLEASE FIND A QUALIFIED TECHNICIAN FOR YOUR REPAIRS.
AGAIN, YOU ASSUME *FULL* RESPONSIBILITY FOR *ALL* ASSOCIATED RISKS!!!**

Section 1 – Diagnosis

Symptom: Amp goes into Fault 8 immediately after warm-up completes, without even attempting to transmit. Fault 8 is "Transmit PIN diode back bias below minimum required value key up." Alpha guru AE0Q says "*Fault 8 is a problem with the -109vdc PIN diode bias voltage, usually caused by the PIN diodes, or sometimes the power supply.*" In my case (which was the second PIN diode failure for this particular amp) the problem progressed over time. For a solid year+, I was able to revive the amplifier simply by turning it off and then back on again. Eventually, June 2023, it would not clear fault 8 with a power cycle. It turned out to be another TX PIN diode failure. This time, both TX PIN diodes failed. I used a simplified troubleshooting procedure, gleaned from comments by AE0Q and N4UQ. Below are the steps that I followed:

- 1) Unplug amplifier, and allow bleeder resistors to drain HV supply caps.
- 2) Remove cover. 15 screws total. Do NOT remove tube anode insulated post screws. Inspect and clean out the dust and cobwebs. Use an air duster and vacuum cleaner if necessary.
- 3) WITH POWER OFF, measure resistance between the plate tank coil and chassis ground. It should NOT be zero. I am seeing around 82k ohms to ground. This measurement also verifies that the blue capacitor above the small safety choke board is not shorted. If you measure close to zero ohms, then there is something shorting to ground in the RF section of the amplifier.
- 4) Check D1 on Safety Choke board, and make sure it is OK. I used diode check mode.
- 5) Defeat both safety interlocks. I used a plastic pen cap over the HV shorting screw, and a small book to hold down the LV micro switch.
- 6) Connect a voltmeter between ground and the large chassis mounted resistor (or resistor pair) next to the Safety Choke board. Either side of the resistor is fine.
- 7) Plug the amplifier in. ***BE VERY CAREFUL. There is 3000V in the power supply and on the tubes!!! Safety Interlocks are DISABLED. Use caution!! PROCEED AT YOUR OWN RISK!!***
- 8) Measure the bias voltage (nominally -109V) at either end of the large resistor pair mounted on the chassis at the left side of the RF section. If it measures above -89 volts when receiving, that is causing the Fault 8. For example, I measured -49 volts on a faulty amplifier.

Section 1 – Diagnosis - continued

- 9) Turn the amplifier off, and make sure the HV caps have discharged.
- 10) Remove the coax center conductor from the “fork pin” connector on the Safety Choke board.
- 11) Measure bias voltage again. If the bias is -89 volts (or greater) with the coax disconnected, you have found the problem. I measured -100 volts after disconnecting the coax. This indicates a bad Power TX PIN diode on the ABX-X220 board in the T/R Module. The bad diode(s) is(are) pulling the -100 volts up to -49 volts, and that is what triggers the Fault 8 after warmup finishes.
- 12) Resolder the coax center conductor to the Safety Choke board fork pin connector.

Sidebar – Measuring PIN Diodes

There are two different types of PIN diodes in the 87A. One type is the “receive” PIN diode, original P/N KS1001. This is an axial lead diode, usually tan with black markings. Alpha now recommends replacing the KS1001 with 1N4007 silicon PIN diodes, available practically anywhere.

The second type is the transmit PIN diode, original P/N MA4P4006D. These are the expensive stud-mounted diodes that were supposedly becoming un-obtainium. The closest thing that I can find to a replacement for the MA4P4006D TX PIN diodes is the MicroSemi UM4006D. It works as a drop-in replacement for the MA4P4006D. The following info is from AE0Q:

To check the PIN diodes, one end must be lifted from the circuit. The multimeter must be in the NORMAL resistance measuring range, NOT the "diode check" function.

The forward resistance will vary a bit depending on the voltage that the meter puts across the leads in the resistance measuring function. We usually use Fluke 77 meters, and they use 0.750vdc when measuring resistance, and 2.5vdc in the diode check range. I have another meter here that uses only 0.25vdc in the resistance function, and it reads a good diode ever higher (about 1.5 megohm) in forward bias. Measure your meter in the normal resistance check function with another in the volts range to check the bias voltage that is used (leads connected together).

The tan/yellow diodes in the T/R module are KS1001 types, and with one end lifted and 0.75vdc from the meter used to forward bias it, they read 1.5 megohm. If yours are reading 10k and your meter uses a similar voltage on the test leads, then it is leaking too much.

There is also a KS1001 PIN diode under the tube deck that should be checked if others are OK.

I used a Siglent SDM3045X which uses a 1.0 volt bias in resistance mode. With the SDM3045X, I measured about 224k ohms in forward bias, and infinity ohms in reverse bias on a GOOD TX PIN diode. On a BAD TX PIN diode, I measured about 220k forward and 46 Megohms in reverse bias. As AE0Q stated, readings may vary, depending on your test equipment.

Section 1 – Diagnosis - continued

After going through the troubleshooting procedure above, I determined the following:

No short from tank to ground.

Blue cap from Safety Choke board to ground is not shorted.

D1 (1N5404) on Safety Choke board tests OK.

After removing the coax center conductor from the Safety Choke board, I measured -100 volts on the resistor. This indicates a bad Power PIN diode, which is located on the ABX-X220 board in the T/R Module.

Following a suggestion from N4UQ, I snipped one side of the brown resistors R1 and R2, one at a time, to see which transmit PIN is leaky. It is pretty easy to solder back that connection, and is much easier than trying to unsolder the PIN diodes from the assembly. With the leaky PIN diode disconnected, the amp will operate normally with only one transmit PIN diode (at reduced power for the safety of the good diode.)

I decided to replace both diodes while inside the unit, in case the other diode was on the verge of failing. Getting access to the diodes is not trivial, and requires considerable patience. There might be a better method than I have described below. Comments are welcome. The diodes are MicroSemi UM4006D. These are drop-in replacements. The studs mount perfectly using the original 87A 3/16" brass hardware.

Once the diodes arrived, I proceeded with the replacement procedure outlined below.

Listed screw lengths are for the entire fastener, and were measured with calipers for a quick reference. The main key is to take your time, and keep all parts sorted and documented. Take photos before and while disassembling, especially if you don't plan to do the entire repair at one sitting.

Required tools:

3/16" nut driver

Phillips driver – large and medium

Pliers – small curved needle nose best

Diagonal cutters

Soldering station, de-soldering braid, etc.

Bic pen cap

Digital multimeter

Parts organizer

