

## **Alpha 87A - Transmit PIN diode troubleshooting and replacement. K4RO July 8, 2015**

*Symptom:* Amp goes into fault 8 immediately after warm-up, without even attempting to transmit. Fault 8 is "Transmit PIN diode back bias below minimum required value key up." 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." I followed Glenn's troubleshooting instructions below:

*With the POWER OFF, remove the amplifier cover and measure the resistance from chassis to the tank coil, there should NOT be a short. If there is, that will cause a Fault 8 because the -109 goes through the two resistors mounted on the left side of the chassis. Check the small blue capacitor from bandswitch to the chassis located near the little circuit board on the chassis, left side. This should NOT be shorted, it should be a high resistance. If it is close to zero ohms, then there is something shorting to ground in the RF section of the amplifier.*

*Defeat BOTH interlocks. Put the plastic cap of a Bic pen on the screw of the HV shorting spring to insulate it.*

*Connect the 87A to AC power and turn it on. Be VERY CAREFUL, there is 3000v in the power supply and on the tubes!*

*Measure the -109vdc at either end of the large resistor mounted on the chassis at the left side of the RF section. If it is below 89 volts when receiving, that is causing the fault.*

*To test bias check -109*

*1) Pull connector J12 (5 pin connector) at edge of Low Voltage Power Supply and measure for -109 on J5-2,3, if OK put back on and ---*

*2) measure -109 on connector in T/R module J2-2,3). If low check PIN diodes.*

*3) Pull connector J1 on Input T/R board (under tube deck), measure -109v there (J1-3).*

*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 the other 4 are OK.*

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As an aside, 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, and Alpha now recommends replacing the KS1001 with 1N4007 silicon PIN diodes, available in most junk boxes.

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, available at the link below. It works as a drop-in replacement for the MA4P4006D.

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 on Safety Choke board tests OK.

With the coax connected to the Safety Choke board, I measure only -33 volts on the chassis-mounted resistor. No where near the -109 volts that it should be.

After removing the coax center conductor from the Safety Choke board, I measure -105 volts on the resistor. This indicates a bad Power PIN diode (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.) After checking both, I quickly determined that the bottom TX PIN diode was the leaky one.

I decided to replace both diodes while in there, in case the other diode was on the verge of failing. I ordered new TX PIN diodes from Verical / Arrow Electronics. The diodes are MicroSemi UM4006D. These are drop-in replacements, and the studs mount with the original 87A 3/16" hardware. Cost is \$41.70 ea. Total including shipping for a pair was \$96.00. Here is the link:

[https://www.verical.com/part/660830-UM4006D#landingPage=catalogItemView&searchCriterion=mpnIDs&searchName=&searchTerm=660830&\\_i=1](https://www.verical.com/part/660830-UM4006D#landingPage=catalogItemView&searchCriterion=mpnIDs&searchName=&searchTerm=660830&_i=1)

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

Listed screw lengths are for the entire fastener, and were just 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 disassembling, especially if you don't plan to do the entire repair at one sitting.

## Alpha 87A Transmit PIN diode replacement procedure. K4RO July 8, 2015

- 1) Remove cover  
15 black screws  
8mm
- 2) Remove T/R unit screen cover  
2 pan head screws  
plus Lock Washers  
9.5mm
- 3) Remove screws next to fuse holders, above 20A/220V markings  
2 pan heads & LW  
10mm
- 4) Remove two screws to right of PIN diode studs. Screw plus flat washer outside. Nut plus LW inside, up against ABX X220 PIN diode board.  
Screws  
14.4mm
- 5) Remove coax tie-down clip. Large pan head screw outside. Inside: plastic clip, flat washer, lock washer, nut.  
Screw & HW  
11.5mm
- 6) Remove 1.25A fuse  
1.25A fuse  
n/a
- 7) Remove two screws holding power plus and fuse sub-assembly on back panel.  
Screws  
9.5mm
- 8) Gently nudge power/fuse sub-assembly, and remove two screws behind fuse. Order is:  
screw -> lock washer -> flat washer -> chassis captive nut  
10mm
- 9) Remove screw on outside of green choke, with strap and two solder lugs  
screw only, no lock washer  
12.3mm
- 10) Remove screw holding green horizontal plate choke from inside the T/R module.  
Sharp angle; tough. screw and lock washer.  
12.3mm
- 11) Label and then unplug five (5) white Low Voltage wire connectors inside T/R module.
- 12) Gently tip green choke out of the way until you can remove the T/R module. Tricky.
- 13) With T/R module removed, loosen and remove PIN diode mounting nuts using 3/16" nut driver. There is a 3/16" nut and split ring washer - both are made of brass.
- 14) Loosen top left screw of coax connector in T/R module just enough to allow ABX X220 board to be extracted. Was not necessary to remove ABX X190 wattmeter board SO-239 jack screws.
- 15) Desolder and remove old diodes.
- 16) Correctly orient and mount new diodes with 3/16" brass split washers and nuts.
- 17) Solder new diodes into place.
- 18) Reassemble in reverse order.