Care and Feeding of Icom PW1 1,000-Watt Solid State Power Amplifiers
W6DE, July 2022

Use the following information at your own risk. No warranty is offered, implied or expressed. I make no warranty as to correctness or completeness of the following information. I am not associated with Icom, nor has the information contained herein been approved by Icom. Modifying, repairing and/or following these procedures may void Icom's original Manufacturer's warranty. If you undertake any repairs and/or adjustments to your PW1 amplifier based on this information you do so at your own risk.

This is a compilation of replies I have made to the Groups.io PW1 on-line forum. This is loosely organized around the causes of why PW1s fail, how to protect PW1s and how to repair some PW1 failures.

Setting up a PW1 with an Icom Radio:

Some folks find the ALC Level adjustment confusing. I drive my PW1 with an Icom 7300 and a 7600 radio which I'll refer to as exciter and/or radio. I adjust my ALC level on 20 or 40 meters. I use the Icom supplied cable to connect the radio ACC2 connector to the PW1 ACC1 connector. The Icom supplied cable routes the ALC and PTT signals between the radio and amplifier.

The following advice about setting the ALC level is not the Icom recommended method. While I believe this is a safer method to adjust the PW1 ALC, you follow this advice at your own risk. Here is how I adjust the ALC:

--#1 rule: Never use the radio/exciter's antenna tuner when operating into a PW1!
--#2 rule: Everybody should have a dummy load. If you don't have one, borrow or buy one—tuning and adjusting into an antenna is just looking for trouble. A good dummy load is always on the right frequency and always has low SWR.

For the following steps do not engage the PW1's "TUNER" you should be operating into a matched load of 1:1 SWR!
--PW1 should be connected to the mains power. The PW1 power can be on, but the "TUNER" and "AMP/PROTECT" LEDs should be off. That is; the amp should not be amplifying and is in "by-pass" mode. The PW1 RF output should be connected to your dummy load.
--When setting ALC, set the PW1 meters to read PO (on the left meter), and ALC (on the right meter).
--Set your radio's meter on Power Out. Set your exciter power out to its lowest position. Set your exciter to CW mode and use a hand key to transmit; a second way to generate the correct amount of RF is to select FM and the press TRANSMIT key on the radio front panel. DO NOT use or connect the hand mic to the radio, the mic may pick up sounds and affect the readings.
--In contrast to Icom directions: start setting ALC with lowest exciter power and then slowly turn up the exciter's drive.
--When you get to around 100 Watts out of the exciter (remember the amp is off), Stop raising the exciter's power, stop transmitting.

--On the PW1 meter, switch the right meter from ALC to SWR, transmit again. Look at SWR. If it isn't below 1.2 or 1.3, stop and find out why it isn't closer to 1:1. Do not continue until you fix the SWR.
--If your SWR is ok, stop transmitting, return the PW1 right meter to read ALC.
--On the exciter turn the power down to its lowest level.
--Power up the PW1 and depress "AMP/PROTECT" once and the "AMP/PROTECT" light is on and green. The PW1 is now on and will amplify the RF fed to it.
--With the exciter's power at its lowest level, resume setting the ALC level. Start transmitting again. Increase the exciter power out until: 1) the PW1 Power out shows 1000 Watts, OR 2) you reach 35-50 Watts output from your exciter, OR 3) ALC level reaches mid-scale (where the red band starts).
--If your PW1 power gets to 1000 Watts before the ALC meter gets to midscale—turn down the ALC adjustment on the back of the PW1. [Getting to a KW before reaching midscale ALC is bad because it would allow you to overdrive the PW1 and exceed the power limits of the PW1.]
--If you get to midscale ALC before you get 1000 Watts of PW1 power, then turn up the ALC adjustment on the back of the PW1. [Not getting to a KW before midscale ALC, will keep the PW1 from reaching its full power capabilities.]
--Perfect ALC adjustment is when you reach 1000 Watts of PW1 power out, the ALC meter will be at midscale and your exciter power lever is around 35 to 40 watts out (ok, maybe 50+ watts on six meters).
--If you can't get 1000 Watts out of your PW1 with 35 to 40 Watts drive, something is misadjusted or broken.
--There is no reason you should need turn the exciter drive level to more than approximately halfway up when driving a PW1. Reason defined as: safe from errors that will blow up your PW1.
--Now that you have the ALC set correctly; when adjusting the exciter's power knob, you will find lowest exciter power when the knob is pointing to a 7:00 o'clock position; then normal PW1 driver level setting should be around 11:00 o'clock on 40 and 20 meters. For 6-meters the driver power level setting will be around 1:00 o'clock. And when the PW1 is OFF, you will find 100 watts of maximum exciter power is at 5:00 o'clock.

I leave my 7600-power level set at 11:00 o'clock. I almost always transmit through the PW1. When I want to run 100 Watts, I turn the drive level down to somewhere between 7:00 and 8:00 o'clock. That way, I never have the exciter running full power and when I walk away from the radio, there is no chance of forgetting to turn down the power at the next operating session.

What causes PW1s to blow up?

I have found no inherent failure modes in the PW1. However, it is my opinion that some of the PW1's protection circuitry may not act fast enough for self-protection from some common operator errors.

PW1 amplifiers blow up because of these operator errors:
You use a computer to control your radio and PW1 without CI-V arbitration**,
The ALC is set wrong,
The PW1 is set to the wrong band,
The PW1 is operated into the wrong antenna,
The PW1 is intentionally operated into a high SWR antenna,
The PW1 'Antenna Tuner' is operated with the PW1 at high power in an attempt to tune out a high SWR,
The operator forgot to turn off Split when he/she change bands,
The operator failed to disconnect the PW1 from the mains during a lightning storm.

Here are some details on operator errors that can cause your PW1 to FAIL.

One: CI-V control collisions:
This is the noted CI-V collision problem that leaves the PW1 on the wrong band. See: K8UT's "Riding the CI-V Bus" at:
http://www.k8ut.com/download/documents/Riding%20the%20CI-V%20Bus%20by%20K8UT.pdf
K8UT describes the problem and several cures. I use the k9jm solution. http://k9jm.com/CIV_Router/CI-V%20Router.html

If you have a computer, PW1 and earlier Icom radio** connected to each other, all on the CI-V buss, you are just marking time until you have a PW1 failure. Icom specifically states in their documentation NOT TO DO THIS. Please note: this is WHEN will the failure occur not an IF the problem can occur! Yes, this means if you have a (1) PW1, (2) an Icom radio** and (3) a computer on the same CI-V buss you are just waiting for the problem to happen! This is how an "Automatic" system transmits into the wrong band or antenna!

** Later Icom radios: e.g., 7300, 7610, 7851/7851 (and possible other Icom HF transceivers produced after this 2022 write-up) can isolate the CIV buss within the radio, with this isolation done the CIV phono jack on the radio can be connected to a PW1, while the computer control is connected to the radio via the USB port. This setting is in The Icom manuals in the MENU function under SET, Connectors, CIV. Make sure "CI-V USB Port" is set to "Unlink."

Two: The next possible source of problem is you were operating your radio split (Listening on VFO-A and transmitting on VFO-B) and you requested/made a band change, and you did not cancel split. On the new band your VFO-A and the PW1 went to the new frequency, but your radio was still in split and transmitted on VFO-B, which remained on the previous band. There is a 50% chance you will then transmit into a band pass filter that will try to eliminate your 1 KW signal all by itself or the other 50% chance is you will transmit full power into an antenna on the 'old' frequency. On occasion the protection circuits don't operate fast enough and the High SWR reflected voltage will arc across the isolation relay contacts and blow out a clamp diode and the driver chip.

Note: DXLab suite logging and control software has a solution that I use. DXLab's Commander, the radio control module, has an option in its Configuration | General tab | General panel | select: Switch to simplex on 1 MHz QSY. With this option selected Commander will cancel split when you change bands.

Three: Mismatched antennas. The PW1 antenna "tuner" will not match your wire antennas for all bands. At best, the built-in "tuner" can be used to help you extend the bandwidth of an antenna. E.g., if your antenna is resonant on the bottom of a band (CW/Digital) and you want to operate higher in the band (Phone). For these cases the PW1 "Tuner" will successfully force a match a SWR of no more than 1.5 for down to SWR limit of no more than 1.2.
The PW1 Instruction (operator's) manual on page 13 states:
"The built-in antenna tuner automatically tunes the antenna.
- SWR reading on meter-2 should be less than 1.2:1."
And later in the manual on page 14 it says:
"When the tuner cannot tune the antenna (SWR 1.5:1 or greater), the tuning circuit is bypassed automatically after 20 sec."
If you intend to use a non-resonant, multi-band antenna, e.g., G5RV, buy a heavy-duty antenna tuner advertised to handle higher SWR ratios.

Automatic antenna tuner failure: To prevent tuner run-away, you should only make the automatic tuner adjustments at reduced power—100 watts or less. Use exciter power only or turn down the power on the exciter. I have not had to repair a tuner, but accidentally using full a KW into a miss-matched antenna caused my auto tune function to go wild as described above and take out a PA board. Arced tuner capacitors in the tuner and failed tuners are also a result of allowing the tune function to be performed at High Power with the PW1.
If you are trying to use a mismatched antenna anyway, allow the tuner to find a match at low power and then slowly increase the exciter's power and watch the PW1 SWR meter. If the SWR starts creeping up or the tuner starts to initiate another tune—tuner light blinks—immediately roll the power back and start the process all over again. It may be that you can find a match at a lower PW1 power level that still works without tuner run-away.

Four: PW1s do not always survive an Electric Company/Utility power failure and subsequent power restoration. Sometimes upon power restoration the power surge overwhelms the power supply's power input protection circuitry.

The "Power" button on the PW1 is a misnomer. The PW1 is on whenever the mains power is connected. The "Power" button more or less acts like a standby/operate button.

Because the PW1 is always powered, folks living in areas of lightning activity with the accompanying power spikes and failures, it is wise to unplug the power cord during these events. If you have a weather forecast predicting a Storm with Lightning and Thunder or a notice from your Electric Utility announcing a power outage; disconnect your PW1 from the power mains until the storm or outage is over.

One way to increase the survivability of a PW1 through a power fail and restoration is to remove the capability of the amplifier to operate on 120 Volts. This will make the PW1 always require a 240 Volt power connection. Removing the 120 Volt capabilities allows the amp to survive higher voltage surges. See this nice write up from AK2F: http://www.ab4oj.com/icom/pw1/psu_repair.html for more information.

Repairing your PW1:

Use the following information at your own risk. I make no warrantee as to correctness or completeness of the following information. If you undertake any repairs and/or adjustments to your PW1 amplifier based on this information, you do so at your own risk.

Not all problems have the same source. So, while I've may have seen the same symptoms, it doesn't mean you have the same problem and the same fix.

First, do a Google search to find and then down-load the PW1 Service Manual.

If you have technician skills and/or are a good tinkerer you can repair a PW1 yourself. However, one extremely important and needed skill is soldering. Soldering will require judgement about what size and type of tip on your controlled temperature soldering iron to use. And, if you need to replace the MRF-150 finals you need to know what type/size of soldering gun/iron to use. If you do not have significant electronics soldering skills—this is not a project for you.

The daunting part of a repair is the disassembly. Take pictures of the unit before disassembly and at stages as you disassemble the PW1. Take pictures of screw locations, cable routing and general layout. I've taken about 30 or so pictures and even then, I missed a few screw locations. First time disassembly for either the PA/RF side or the Tuner/Controller/Power supply side will take about 4 to 6 hours per side. With experience it goes a lot faster. After removal of the sheet metal cabinet and plastic front panel, take pictures of the left side and be sure to have pics of all the shouldered screw fasters—after disassembly it is not obvious where the shouldered screws go.

A repair will take about a week or two as you figure out: what to do, what to fix, order parts and repair.

Be sure to work in a static free area. Don't do the repair in a house where you are standing on a carpet, a synthetic floor, or a plastic carpet protector. I have a shop with a concrete floor and a wood table to work on, i.e., low static. Put ***cotton*** towels (NO synthetic material!) under the amp to help slide it around. In the end, you will scratch whatever you have the PW1 sitting on—don't use the dining room table. Have a space with about an extra 12" to 18" around all sides of the amp while you work on it. You'll need another similar amount of space to safely place the assemblies/parts as you remove them from the chassis.

Icom did a good, sturdy, mechanical design on the PW1. A complete disassembly will have you dealing with 40 to 50 small parts and fasteners. To keep from having left over parts, have several small containers to separately place fasteners and small parts in as you disassemble the PW1 in stages. That is: put all the fasteners in one container for the cabinet disassembly, then another container for the first part of the left side (filter/combiner) then another container for the PA if you need to take that out too. And so on . . . You get the idea.

Any project is an excuse for another tool:

--A good quality digital multimeter will be required for diagnosis.
--Any PA work will require a good quality multimeter that can read milliamps to set the idle current—I used the 300-ma scale on my multimeter.
--A clamp-on ammeter will be nice to compare the individual idle draw of all four power modules without disconnecting the power leads. A suspected PA problem may require this to determine which of the four PA boards is bad.
--Hemostats (6" and 8") will be needed to pick up the screws that will fall into impossible to get to places.
-- To get to some screws, a long blade 6" Phillips screwdriver will also be needed. Always use the largest size Phillips screwdriver blade that will fit into the screw head slots.
--For soldering work rosin clean up, a Pen type Fiberglass Scratch Brush will help clean up boards. It is also good for general PC board clean up. Do a google search for → Pen Fiberglass Scratch Brush ← and something will show up for an Amazon purchase.

PC Board Repair

--Any PC board work will require a static-free work bench area. I recommend a grounded anti-static pad and grounded wrist strap.
--A PANA-VISE with a PC card holder makes pc board component replacement a lot easier.
--Narrow point solder-sucker.
--Use copper braid .050-inch wick along with rosin flux from a "pen" to help remove solder around SMD components.
--It seems difficult to remove surface mount devices and I've assumed that is because Icom uses lead free solder as per European rules. Use what solder you feel is appropriate. I'm in the USA so I use 60/40 solder.
--Use .031-inch diameter solder for mounting the PC board components, including the MRF-150 fins. Thicker diameter solder will flow too much solder. Thinner solder will work ok but you will feed more solder length into the solder joints—which can sometimes be hard to manage.
TIP: to remove a component, it is sometimes easier to remove the lead-free solder if you dilute the joint with 64/40 solder first. Then paint the joint with rosin and then solder-suck or use braid to lift the now diluted solder from the solder joint.
--A long, very thin, sharp point, stainless steel solder tool will be needed to clean out PC card through-holes for thru-hole components. Heat the holes, clean up as much solder as possible with a solder sucker and/or braid. Then re-heat the hole, remove soldering iron tip and quickly push the tool through the hole to keep the hole open for part insertion—do not use force to push trough the hole!

Symptom: The Tuning Light changes from Steady on to Flashing when increasing the power level in the PW1

The tuning light flashes when the tuner is trying to find a match. In the PW1 Instruction (operator's) manual on page 13 it says:
"The built-in antenna tuner automatically tunes the antenna.
- SWR reading on meter-2 should be less than 1.2:1."
And later in the manual on page 14 it says:
"When the tuner cannot tune the antenna (SWR 1.5:1 or greater), the tuning circuit is bypassed automatically after 20 sec.."
The first comment is telling you the amplifier wants less than a 1.2 SWR in order to operate.
The second comment is telling you that the tuner may not be able match an antenna if the starting point is greater than 1.5 SWR.

I can attest that continued operation with the Tuning Light flashing can cause damage to the PW1 before the 20 seconds is up. If you continue operation long enough (not recommended) with the blinking tuning light, you will see the SWR meter vary up and down and eventually peg at full scale as the tuner hunts for and fails to find a match. The PW1 tuner is only intended for slight mismatches. I now only operate with matched antennas (under 1.5:1 SWR). If your only antennas are so-called multiple bands, non-resonant, antennas, then my recommendation is to buy an external high power/heavy duty antenna "tuner" that is advertised to handle higher SWR.

Automatic antenna tuner failure: To prevent tuner run-away, you should only make the automatic tuner adjustments at reduced power—100 watts or less. Use exciter power only or turn down the power on the exciter. I have not had to repair a tuner, but accidentally using full a KW into a miss-matched antenna caused my auto tune function to go wild as described above and take out a PA board. Arced tuner capacitors in the tuner and failed tuners are also a result of allowing the tune function to be performed at High Power with the PW1.
If you are trying to use a multiband antenna, anyway, allow the tuner to find a match at low power and then slowly increase the exciter's power and watch the PW1 SWR meter. If the SWR starts creeping up or the tuner starts to initiate another tune—tuner light blinks—immediately roll the power back and start the process all over again. It may be that you can find a match at a lower PW1 power level that still works without a tuner run-away.

Symptom: On the PW1's Control Panel, the AUTO indicator is Flashing and the protection circuit cutting in.

In the PW1 Operator manual, page page 14, "Protection circuit", "Linear amplifier protection circuit" is a description of the various fault indications and faults. It says AUTO** flashing means PA Boards have become unbalanced. This means one of the four PA boards may be bad.
** AUTO is the left most indicator in the row of band indicator lamps at the bottom of the control head.

There are four PA boards, two boards on each side of the heat sink. The two PA boards on each side of the heat sink are paired together. Then each side of the heat sink are paired in the Combiner Board.

Icom service centers do not repair boards, they replace them. The reason they might recommend replacing all four of the PA boards is that there at least three versions of the PA board. The difference between the boards that I've seen is the value and quantity of the power source swamping resistors (R11, R12 and if it exists 12a) feeding the pair of MRF-150s. If you replace a board, it is likely the new board will have different resistor values. Thus, you also need to replace the mate board on that side of the heat sink. To be comfortable you should also replace the pair of boards on the other side of the heat sink. If you repair your own PA board(s), then you don't need to replace all the PA boards.

The PA boards are sold by Icom for about $250 to $300. They are listed as a single item, but they come as pairs—thus, for a purchase of the Icom PA board item you get two identical boards. However, the PA boards do NOT come with the MRF-150 devices. Two MRF-150 devices are needed per PA board.

If you smelled a component cooking it could be on one of the PA boards and/or on the Combiner Board.
--The failure point on the PA boards is likely the power source swamping resistors R11 & R12 and if it exists R12a (in later PA boards). If they are cooked, you'll probably have to replace the MRF-150 devices on that board. Be careful replacing R11 & R12, it is very easy to lift the PCB trace on the bottom of the card.
--If you need to repair a PA board it is also likely that you will have to replace or repair the Combiner Board. The power imbalance that occurred when the PA board failed is likely to have cooked the balance resistor R6 on the Combiner Board. If R6 has cooked, it will likely char the PCB under the resistor. You must remove all this char, doing so will also remove several layers of the Fiberglas PCB itself—reseal the PCB with MG Chemicals Super Corona Dope. When installing a new R6, I elevated the resistor slightly above the PCB (between 1/8 and ¼ inch). The Combiner Board is around $150 from Icom.

If you can't find a cooked resistor, a clamp-on ammeter will tell you which pa board is bad by its idle current being different than the others. Separate the four RED DC power lines at the front of the cabinet just after you remove the case sheet metal and measure there. The red power lines loop left down behind sheet metal where they pass through a toroid, then loop up, right and then pass toward the back between brackets and then to the four PA boards. The four red wires are B+ for the PA units. Note carefully how your wiring gets from the front to the back—take pictures. I had to disassemble and reassemble this several times to get the PA power wires routed without pinching them or pulling on sharp corners.

To remove the PA assembly, you must take out the Filter assembly and Combiner Board assembly out first. NOTE: the black two wire (red and black wires inside a black casing) termination on the Combiner

Board looks likes it is a connector on the Combiner Board. That is NOT a connector attached to the Combiner board—it won't remove.
On the left side, you also need to remove both the center and bottom cross bars and a lateral bar across the PA assembly. When assembled the lateral bar is partially hidden by the combiner cables. In addition, there are a lot of screws on the back panel. You also need to remove the back left corner foot from the bottom of the chassis to slide the PA assembly forward. Removing the foot is required in order to slide the PA forward because the foot's screw protrudes through the cabinet floor. You don't have to disassemble the Ground connection on the back panel; it does not pass through the back panel to the PAs.

Make sure you mark every cable and take lots of cable routing and placement pictures first. Also note where the shouldered screws go to hold the Filter assembly on the left side (a picture taken before disassembly will help here).

Regarding: The MRF-150s on one of My PW1 final boards are bad. Should I buy a matched pair of MRF-150 devices or just buy two from stock?

You can replace a set of finals on one board of the four PA boards in a PW1. That is, you only have to replace the finals on the bad board. You should replace both finals on a board as a set.

A matched pair of MRF-150 devices is cheaper than two non-matched devices. Get the matched pair at mouser.com (part number: 937-MRF150MP). When replacing the MRF-150 devices you will need some thermal paste. You can use some computer CPU chip thermal paste if you have it. It is also available at a computer shop/store. Or go ahead and order some thermal paste when you order the MRF-150 devices.

Without specialized equipment it is difficult to separate the MRF-150 devices from the PC board without damaging the PC board.
1) While the board is still mounted on the PA heat sink, with an X-ACTO knife carefully cut all the fins on both MRF-150 devices in order to protect the board.
2) Remove the board from the heat sink and
3) Then remove the remnants of the two MRF-150 devices from the heat sink.
4) Remove all traces of thermal paste from the heat sink.
5) With the now removed PA board, clean up the board by unsoldering and removing the fin remnants.
6) If necessary, perform any other required repairs to the board [e.g., cooked resistors].
7) Prepare the MRF-150 devices for mounting. One-at-a-time, apply a very thin paste of thermal conducting material to the base of each MRF-150 device and test fit it to the heat sink. Gently and firmly push the MRF-150 onto the heat sink. Remove the MRF-150 device and inspect both the device and heatsink. If you see peaks in the thermal paste, you have used too much. Wipe off the MRF-150 device; leave the paste on the heat sink. Then repeat the mounting process and removal again. When you have a slight wave like appearance on the device and heat sink, you have the correct amount of paste—do not mount the device yet! Carefully set aside the devices, protect them from dust.
8) Re-install the board onto the heat sink. Mounting the board before the MRF-150 will allow the MRF-150 fins to lie on top of the board where they are supposed to be.
9) Then install the MRF-150 devices.
10) Finally solder the MRF-150 fins to the pc board.

There are two potentiometers to set the bias on each board, one for each MRF-150. These pots are used to balance the pair of devices on each board.

I've found the Icom factory settings for the MRF-150 bias settings to be different from what the Service Manual calls for. You must make a choice to either: 1) measure what the other PA boards have their idle current set to and then match the replaced MRF-150 to be the same value; or 2) to set all four of the PA boards as per the Service Manual. I found enough variance between all the boards to cause me to set the bias on all four boards, eight MRF-150 devices, to the 100ma per MRF-150 (which equals 200ma per board) as stated in the service manual. Note: There are four PA boards total, two boards on each side of the heat sink.

The instructions in the service manual seem incomplete to me. Icom has you set bias on one MRF-150 first by biasing the 2nd side to cut off. Then the Service Manual has you set the 2nd side by turning both sides on and doubling the value you set the first one to. I found this didn't always get each side to a

close match. So, I did my bias adjustments by adjusting each side separately with the other side biased off and then checked the current draw for both.

The balance potentiometer is very, very touchy, only about 2% or 3% of the entire range of the pot is used to adjust the bias. And, the pots have high friction, so it's difficult to set. I tried using a plastic "tuning" wand/screwdriver and it would wind up and snapped the adjustments too far when the friction broke. I gave up and used a small blade metal screwdriver--much better than the plastic but still very difficult to adjust to the desired value. To help reduce the friction a little:

1) With the power on.
2) Very carefully try to set the bias for the MRF-150 you are adjusting. Make note of which direction you turn to potentiometer to reduce the bias current.
3) Turn the potentiometer to the end stop with the minimum bias current. Risk**
4) Disconnect the PW1 from the AC mains, turn the potentiometer stop to stop five or six times.
5) Return the potentiometer to its minimum bias end stop position.
6) Reconnect the AC power, turn the power back on.
7) Proceed with the bias adjustment.
8) Repeat the process on the second MRF-150.

**Accidentally moving the bias potentiometer to the maximum bias risks burning out the MRF-150 device. Adjust the bias slowly; avoid rapid or large adjustments when the power is on.

Regarding: My PW1 won't tune up on 6 meters even into a dummy load. All other bands will put out 1000 watts but not on 6 meters. Note: This is symptom can also apply to other bands not working.

To diagnose, on the Main Unit board at connector J8 measure the voltage for each band filter selection as you manually go through each band. There is not a filter for each band, some bands are combined—check the service manual. When engaged the voltage for each band filter will be ~13 Volts.
You will likely find one of the band filter voltages to be significantly lower than the others. I don't remember exactly what they were; I found one at zero volts and others at low but not zero volts. If you find filter select voltage too low, then you need to repair two separate boards in the PW1!

Required Fix 1: Filter Unit, remove the filter unit. It is in the left front side of the chassis assembly. The combiner assembly is attached to the filter, and they will come out together. NOTE: the black two wire (red and black wires inside a black casing) termination on the Combiner Board looks likes it is a connector on the Combiner Board. That is NOT a connector attached to the Combiner board—it won't remove! After removal of the Filter/Combiner, separate the combiner from the filter assembly. Then remove the circuit board from the filter assembly sheet metal.

Then (for 6 meters) replace diode D18. Other bands will have a corresponding diode across the relay coil. You won't find this diode in any standard catalog. It is a general-purpose diode being used as a clamp diode. I used a fast recovery diode P/N 1N5602. Mouser Electronics P/N 610-1N5062.
It is not always the 50MHz filter relay clamp diode that fails, other band relay clamp diodes fail. On other band fail to select problems, there is a corresponding clamp diode for each band filter relay. The failed bands have been indicated by reading the band filter select voltages on the Main Board connector J8.
Note: it is likely you won't be able to detect a failed clamp diode while it is in place on the circuit board. Furthermore, this is a 50-cent device protecting a $300 board and it took you 2 to 3 hours to get to it—just replace it. Be sure to observe polarity markings.

Required Fix 2: On the Main Unit, replace Integrated Circuit IC19. It is a Display driver used as a relay driver. Original, now obsolete part is Toshiba P/N TD62783AFG(O,S,EL) has been replaced by: Toshiba TBD62783AFG,EL, Mouser Electronics part number 757-TBD62783AFGEL. Replacing the SMT driver chip is a delicate operation but doable using a CHIPQUIK SMD Removal Kit. Do a Google search CHIPQUIK and watch a video or two.

However, if you don't want to mess with the SMT chip removal you can buy, from ICOM Service Center Parts, a 98415169 "Main Unit New Version circuit board". But—WARNING: this is a complicated set up to perform, read the service manual before deciding. You will have to set a bunch of finicky potentiometers on the replacement board to get proper power, SWR and ALC readings. If you choose to replace the board carefully pre-set the potentiometers and switches to the same position as you can see on the original board—this will save a lot of time. As I recall this board is in the $200 to $300 range. "New Version" means it is for later versions of the PW1s that can still select bands with the PW1 power off. It can probably be used to upgrade and repair your original PW1 too—I haven't done this upgrade, so you are on your own. CAUTION: you still have to repair the appropriate blown Clamp diode on the filter board or you are going to blow up the new board too!

Regarding: **The Tuner in the amp has stopped working. With the Tuner off, the amp works fine.**

This information is reprinted with permission from Jeff Mazur, WA8ZZZ. Thank you, Jeff! When the Tuner is on the amp attempts to tune, even into a dummy load, it cannot find a match. Input SWR as seen by the radio swings wildly and the amp SWR meter is all over the place including pegged high. I opened the amp expecting to possibly find one of the tuning caps C1 or C2 arced or damaged. Instead, they looked good but motor MF1 that drives C1 was bad. I ordered the motor from Icom. The service manual lists the part number as 2710000460 this item was replaced with part number 2710000800. and a different part (cable 8900015420) to connect the new motor to the connector board. Apparently, they switched to this new motor a few years ago, so if anyone is repairing an older unit with motors that have attached wires, make sure to get the connector cable as well. Motor cost was around $26 plus another $2.50 for the cable.

After replacing the motor, both caps would now move but the initial problem remained. While doing some more testing and measuring I noticed something strange. The ground plane of the H-NET board was not stable and several ohms above ground. This was weird since the board is mounted to the chassis with three of its four screws in contact with both the board's ground and tabs on the frame. The screws were all tight. But an ohmmeter confirmed that NONE of the connections were good. Yes, I could read 0 ohms at the metal tab but up to 10 ohms on the screw that was threaded into it! And that may have just been from the ground connection via the control connector J1.

One of the screws did show some discoloring on part of the threads. But I just decided to clean the surfaces on the component side of the board and tabs. [W6DE note: you can use a pen type Fiberglass Scratch Brush to clean the surfaces.] On the solder side, there are little solder bumps around the screw hole which the screw is supposed to dig into for a good connection. I put #4 star lock-washers under the screws for good measure. This restored the ground connections and the amp now tuned slightly better on 1.8-7MHz but still wouldn't operate correctly. The output SWR that fluctuated between 1.2 and 1.9 even after the tuner stopped. So, I then turned my attention to the L-NET board and found the grounding issue was even worse on this board.

While getting to the L-NET board requires complete removal of the Tuner assembly, I repeated the clean-up process for the mounting screws on this board as I did on the C-NET board.

BOTTOM LINE: After replacing motor MF1 and cleaning up the mounting hardware for the H-NET and L-NET boards, the Tuner is now working correctly!

For additional information on diagnosing and repairing PW1s; ZS6KR provides this excellent advice: http://www.ab4oj.com/icom/pw1/zs6kr_pw1_repair.pdf