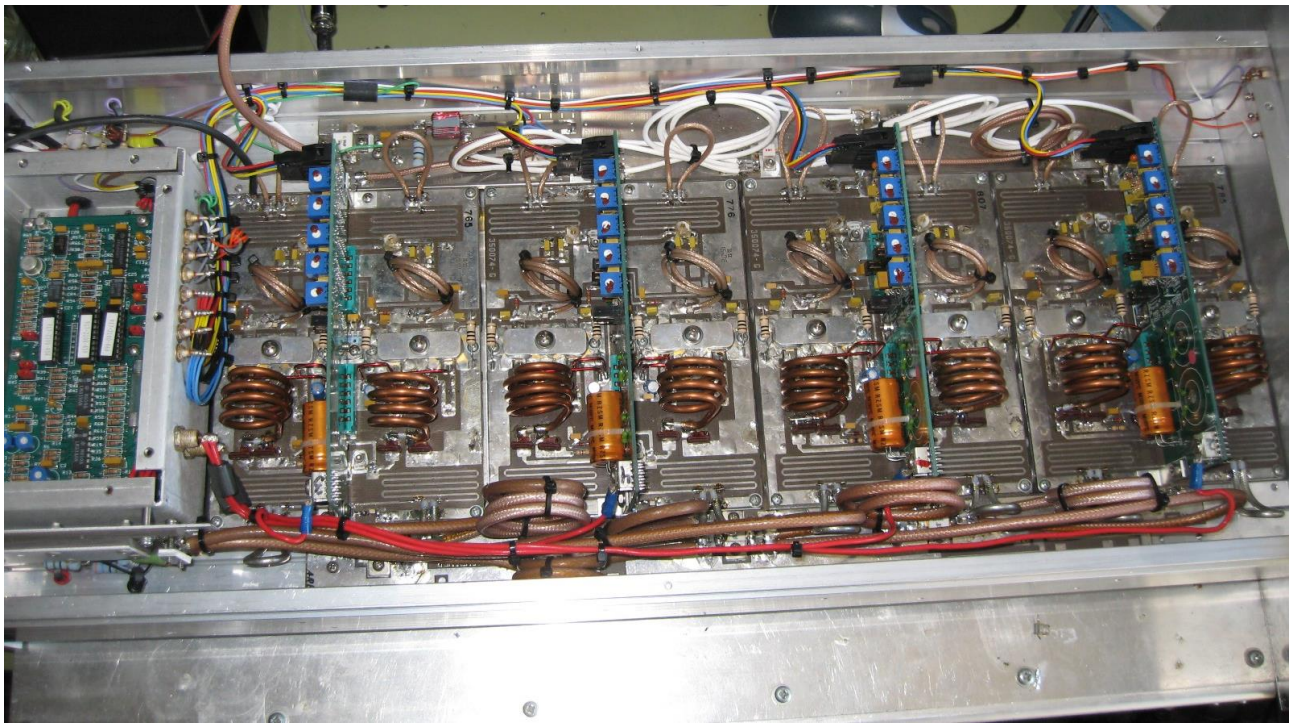
# MODIFICATIONS ON HARRIS PLATINIUM BAND III SERIES

## By OZ1LPR 2011

**REV 2 2013**



# Modifications on Harris platinium TV transmitter

After the shutdown of the old analouge TV system alot of TV transmitters became available for Hams. I have used many hours to find a possible way to get those amplifiers work on 144MHz.

The following text describes how to modify the VHF band III TV amplifier module.
Each amplifier drawer is a 4 module Unit containing 16 pieces of 100W mosfets. It was intended for the analogue TV system, which is being scrapped all over the world. The amplifier drawer makes 1100W in TV service at -54dB third order inter-modulation. They will make some very nice amplifiers for 144Mhz once converted.
They run on 50Vdc and will need a power supply of 60A. To make sure they will survive being used for ham radio I will recommend to use them at a reduced voltage 48VDc.
This will make the amp being able to withstand more before the Fets burn out.
I can only STRONGLY recommend to work with caution as those fets cannot be found anywhere and no replacements are known to me.
The amplifier modules have a gain that varies from amp to amp, but I have seen modules having from 14,5-17,5dB gain.
The saturated power is around 400W pr module. When those 4 modules are combined around 1500W is to expect on 144Mhz at an efficiency of almost 68% in class AB.

On the module several things need to be modified to get it working on 144Mhz.

On Fig 1 it is shown a 400W CH7 module is shown before modifications.

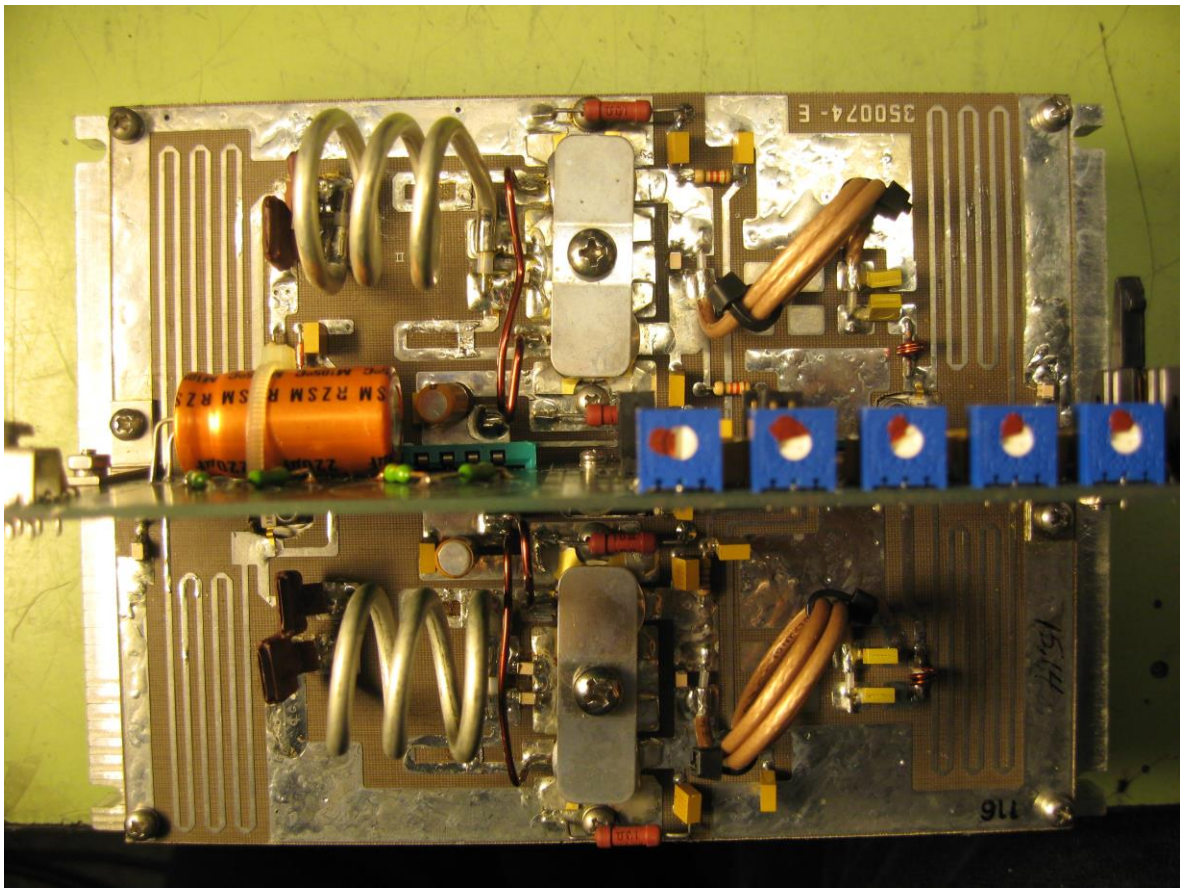


Fig 1 unmodified module CH7
These modifications are strait forward as long as you are really carefully and work in an antistatic environment. And NEVER try to solder on the amplifier with any supply voltage on.
I will not recommend this modifications to be carried out by persons not familiar with SMD components and High power RF amplifiers.

**All modifications are done at your own risc and I take no responsibility about errors or burned amplifiers. This description is made as help and guide how to get those amplifiers work on 144Mhz**

## *This description is made in Steps.*

**Step 1:**
Take off the lid of the amplifier by removing all the screws and look inside.
Make some high resolution pictures of the inside before disassembly of unit. This makes it more easy to put it back together after mods.

**Step 2:**
Remove the 4 modules. The input/output connection is done by a small copper strip. Remove that before unscrewing the heatsinks from the drawer. Remove the DC connector on the bias board.

**Step3**:
The heatsink compound is old and needs replacement. So unscrew all the screws that holds the Teflon board against the heatsink. Also remove the large spring over the Fets. Remember to remove the screws holding the small 100ohms resistor in the combiners. Now with the help of a screwdriver loosen the board from the heatsink, use no real force. The PCB is glued to the heatsink with silicone. After the board has been removed use some alcohol to remove the old white heatcompound both on the heatsink and on the Fets. Be sure NOT to leave anything: burrs or old compound. The surface needs to be real clean. No add some new compound in a very thin layer. It needs to be a very thin layer. If available use some of the better compounds used for Computers they have much better data. Fig 2 shows the backside of the PCB.

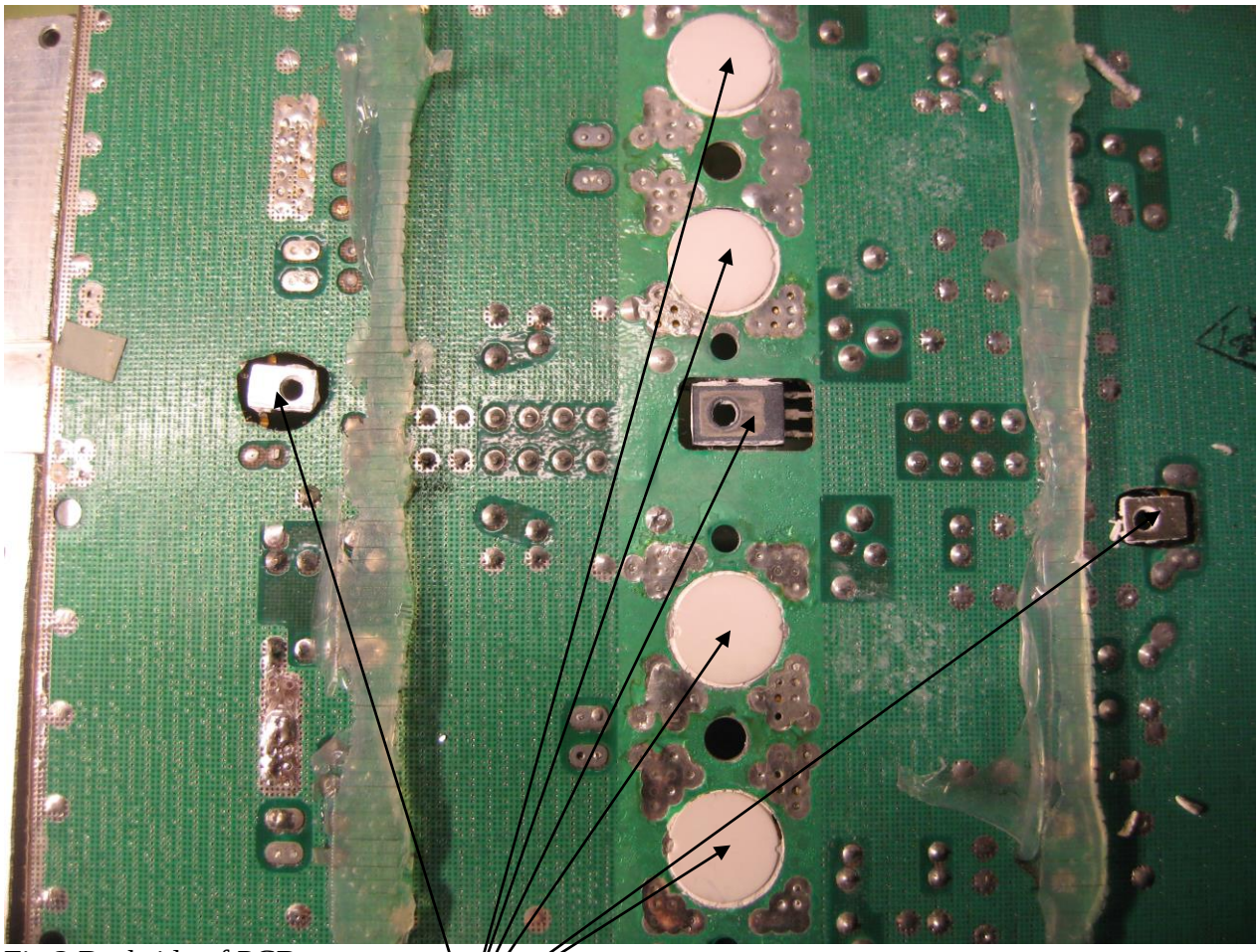


Fig 2 Backside of PCB

After the Compound has been renewed just mount the PCB back on the heatsink rembemer to mount all screws. The large screws for the Fets must be tightened real good.

**Step 4:**
The Drain coil must be altered a little to get the transformation of impedance correct. This is done very easy by moving the small shortening bar on the hairpin. Se Fig 3 for the right placement. Leave no old solder to make shorts on the hairpin

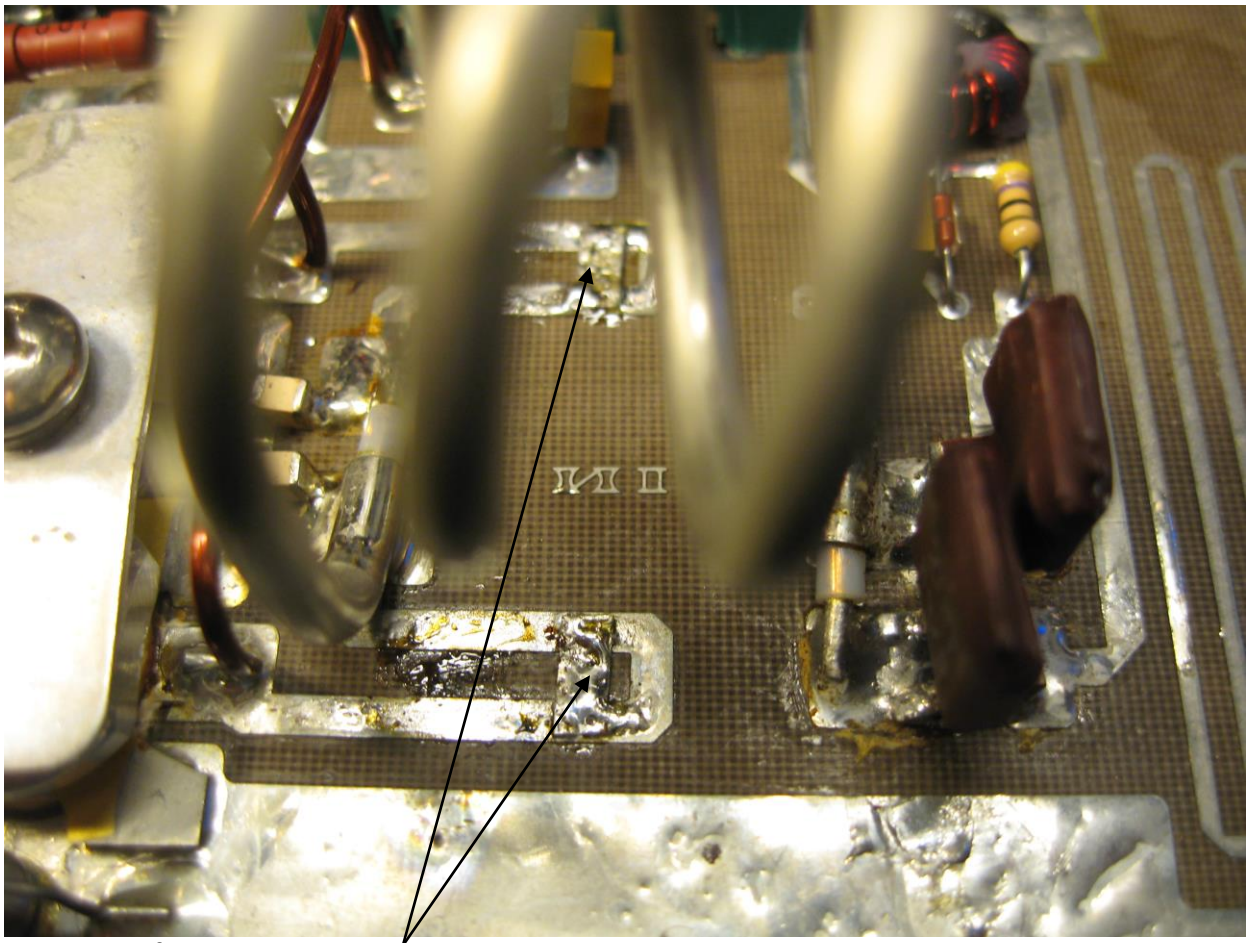


Fig 3 Transformer

Remember this must be done both sides of the amplifier module.

**Step 5:**
On the input side remove the 2 coils (this is the case on channel 7 modules). Harris CH8 does not have the coils. If the module has no coils to remove we need to break the PCB track. Fig shows the place where the coils where mounted or where to break the PCB.

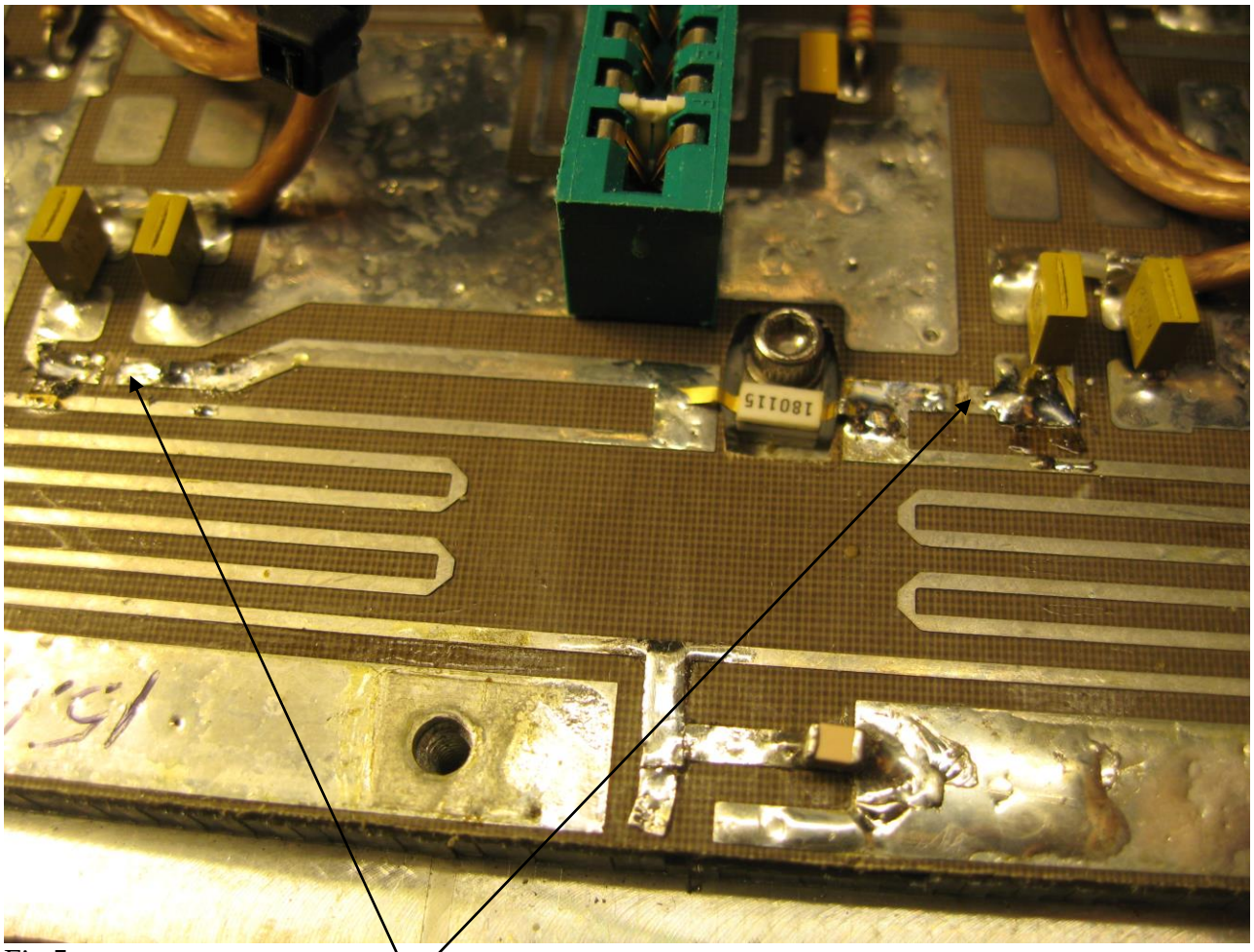


Fig 5

Place where coils where removed. If no coils in the module. Break the PCB track with a sharp scalpel. Be careful not to cut to deep. The PCB is only 0,8mm and Teflon is easy to cut in.

Over the gap in the PCB mount a 2-10pf variable capacitor (MUST BE TEFLON). Fig 6 shows the details.

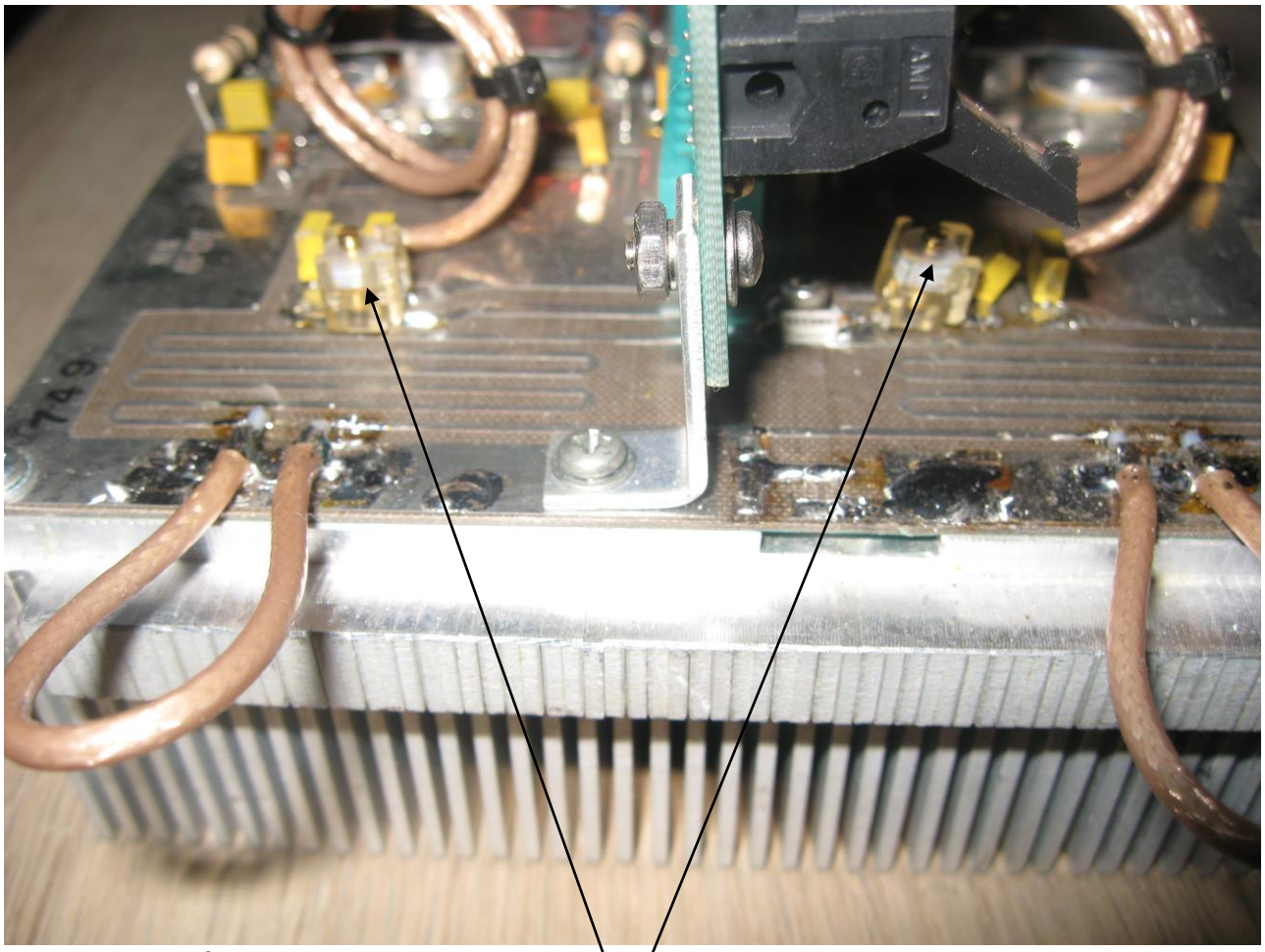



Fig 6 capacitor for input

**Step 6:**
Mounting of an additional capacitor input side. You need to mount a 47Pf capacitor between the 2 gates on each side. Se Fig 7 for details.

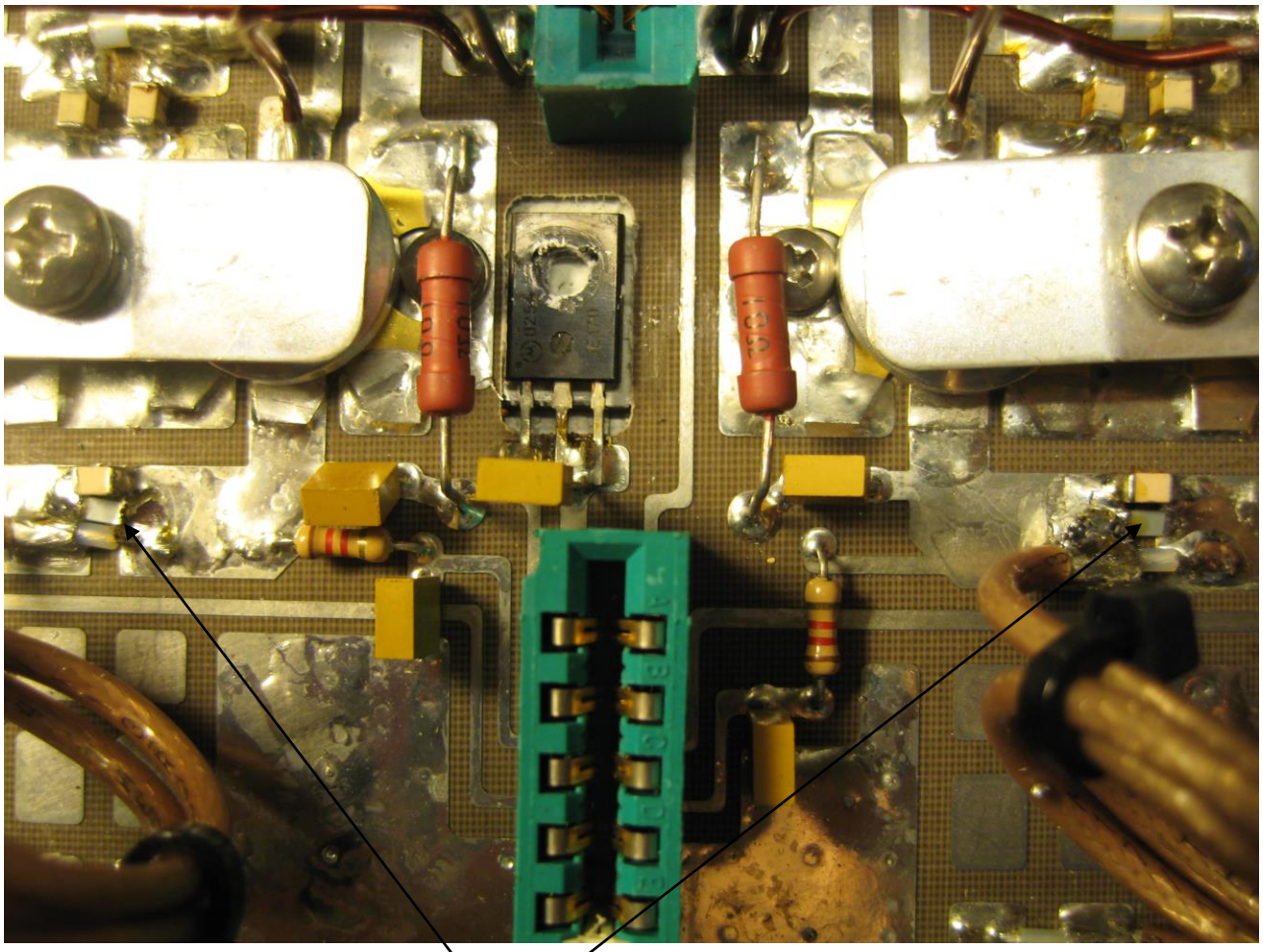


Fig 7 Details input capacitor

Placement of the 47pF capacitors. 1 each side

**Step 7:**

Removal of an optional capacitor.
CH5 has a 39pF
CH6 Have not seen value but if any remove it.
CH7 has no capacitor
CH8 has a 18pF capacitor.
CH10 has a 18pF capacitor

The module when used on 144MHz needs no capacitor mounted. So if there is capacitors please remove them. Se fig 8 for details. Remember this is both sides.

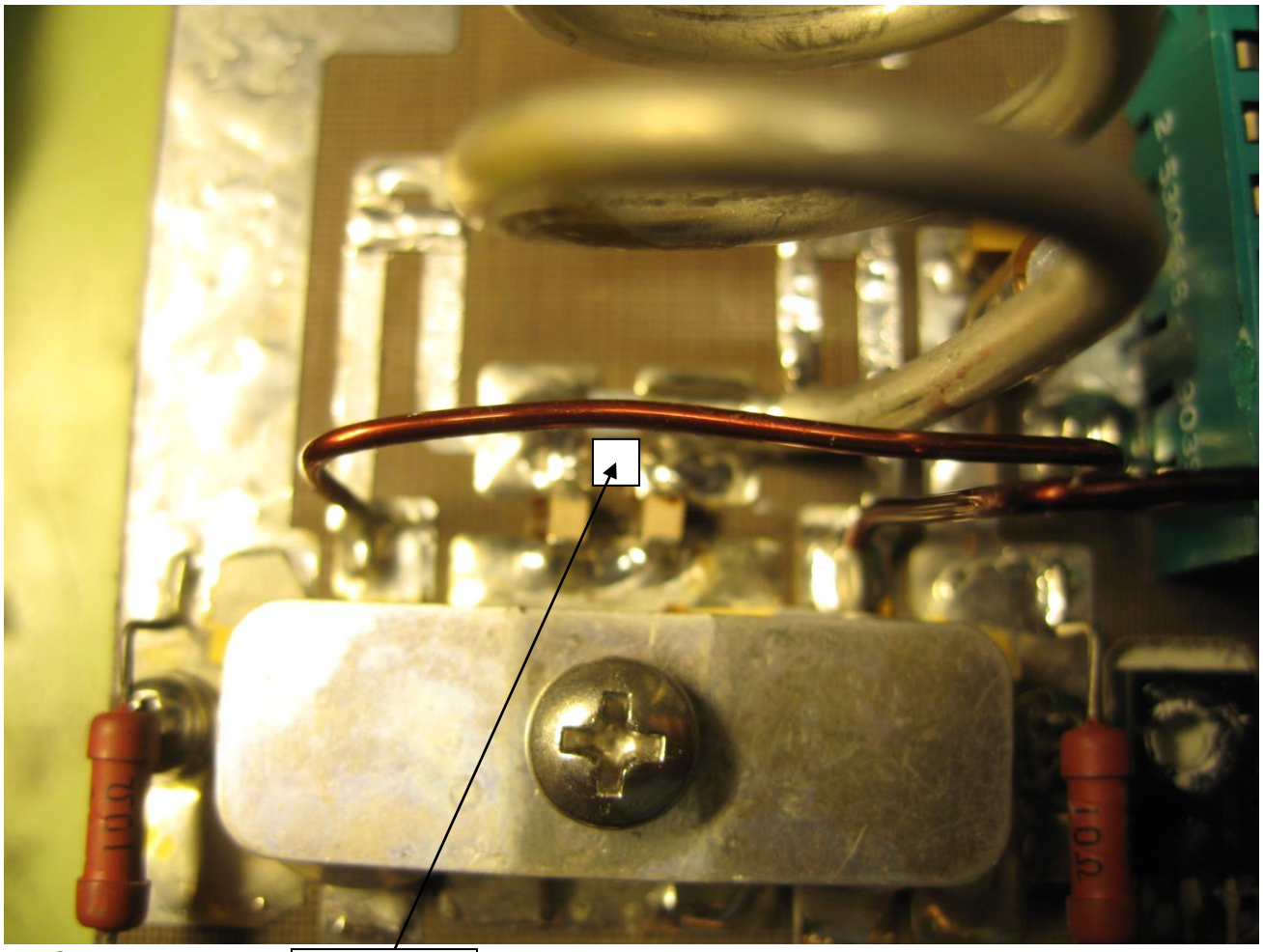



Fig 8

**Step 8**.
Optional replacement of the output balun. The Balun is a 25Ohm coax cable of 26cm length. This should ideally be 31cm.
Changing the 25ohm to longer version does not give more output power but it enables a much higher efficiency. If not changed the efficiency is around 50% and around 68% with them changed.
There are several places to buy the 25ohms coax but it is rather expensive 18-25euro pr meter and you need almost 3meter to complete a complete Amplifier drawer. (8x31cm)
It is very important that they are wound the same way both sides.
Se Fig 9 for details.
The copper ones are homemade.

CH5 and 6 needs a length of 29cm instead. So same procedure is used for those but at shorter length.

**All the pictures in this description shows a larger balun of 4 windings. This is older pictures and length need to be 3 windings only.**

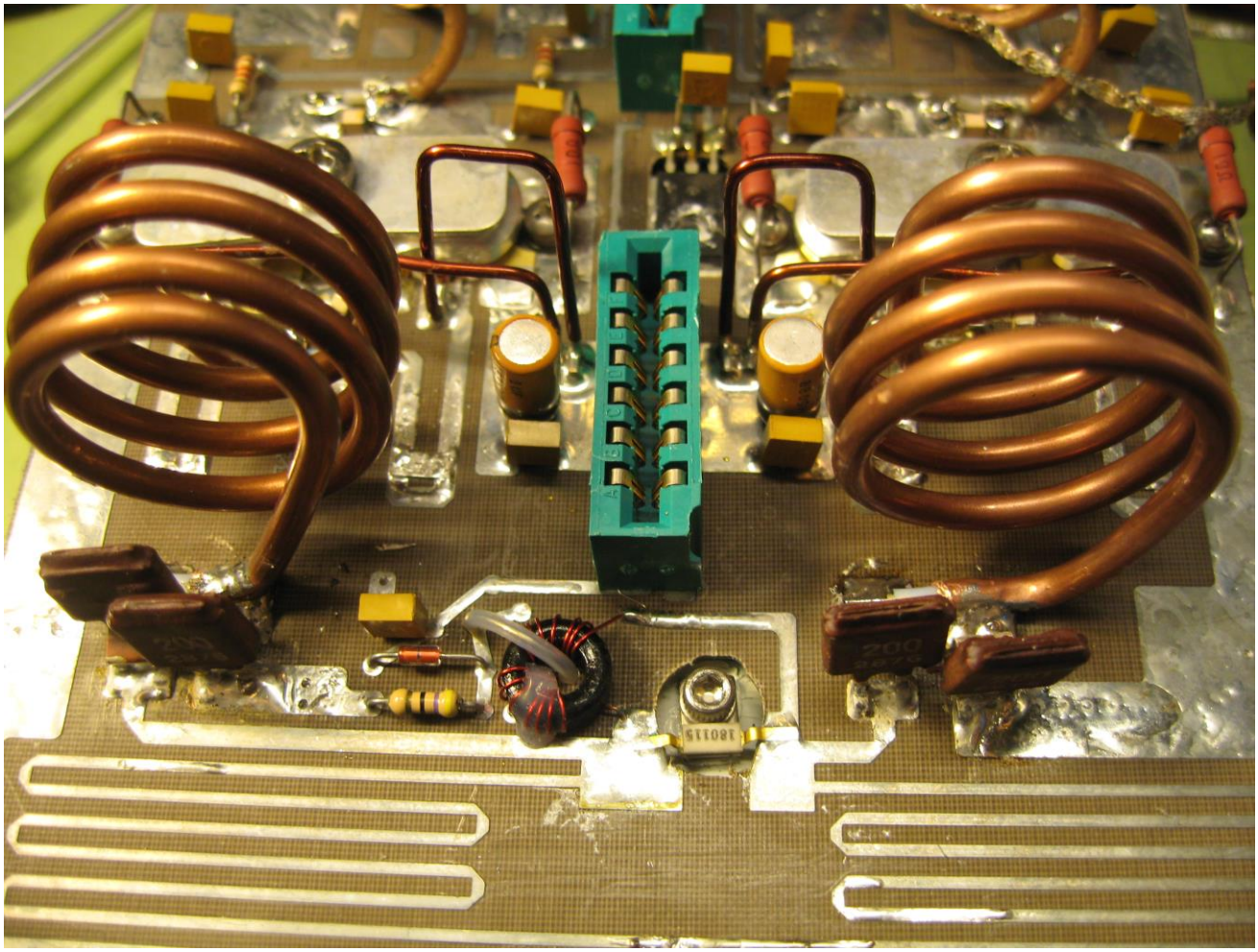
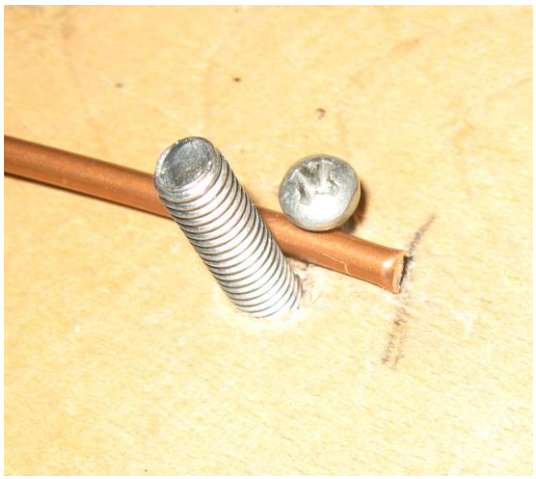


Fig 9 Balun details

Step 9
Making of the Baluns is quite easy. First find a tube with a diameter where the coax fits inside. Then cut the length of the coax balun needed to made. The 31cm for CH7 and CH8 is the cutting length of the coax. Same is true for the CH5 and CH6 balun of 29cm.
Now when you cut many baluns you simply put inside the 25ohm coax and trim cable to is has same length as the tube. Then you can make very equal length each time. This is quite important.
For making the coils find a tube of aprox. 24mm for winding the baluns on. Find 2 6mm bolts and mount them with 4mm distance on a piece of wood. Then you can bend the ends of the baluns perfectly without breaking the 25ohm coax. When you wind the baluns be sure to wind them the same orientation as the old ones.
Se the picure for details of the balun



**Step 10:**
The input/output combiners needs to be extended to match use on 144MHz. The cables that must be used needs to have 75ohms impedance. On the input side RG179 is used. And on the output side 3.58mm flexible semirigid is used in 75ohms impedance. But any other 75ohm cables can be used assuming, that they can carry the power.
To extend the combiners on the input/output simply cut the PCB track and solder in the piece of 75ohms coax. The Coax must be 100mm long.
Needless to say all cables must be made accurately in length. Tip: use a small tubing again to cut them perfectly equal
Se Fig 10 how to extend the length of the combiners.

INPUT SIDE

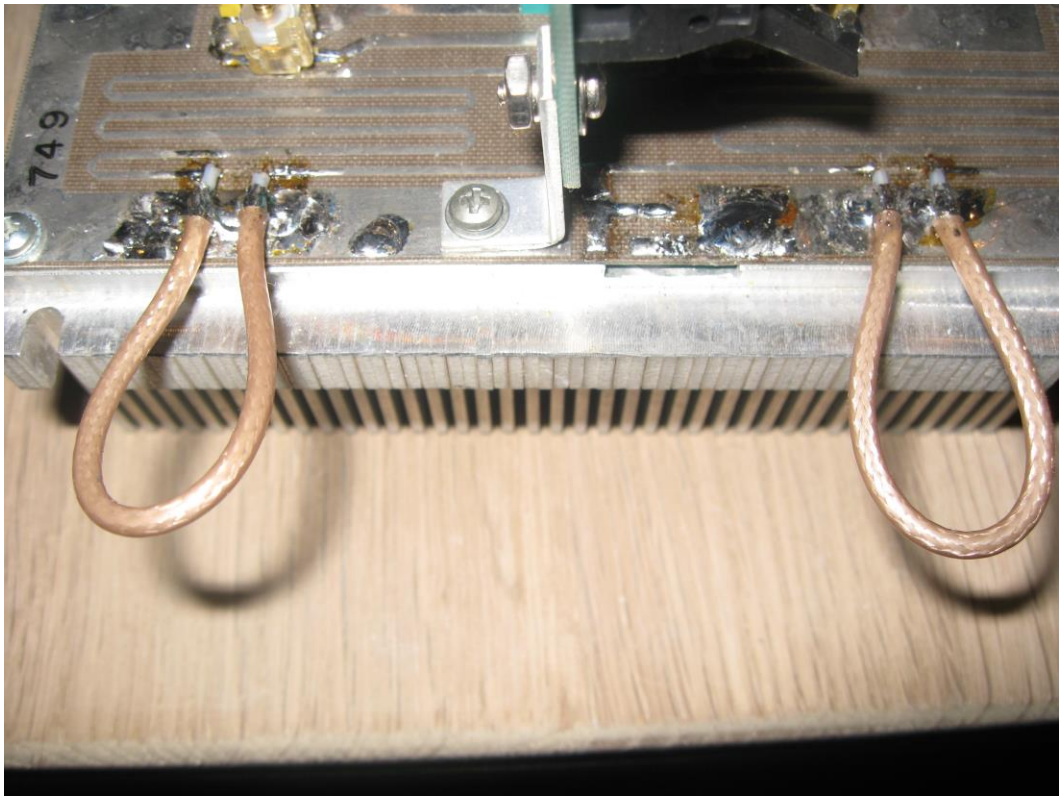



Fig10

OUTPUT SIDE

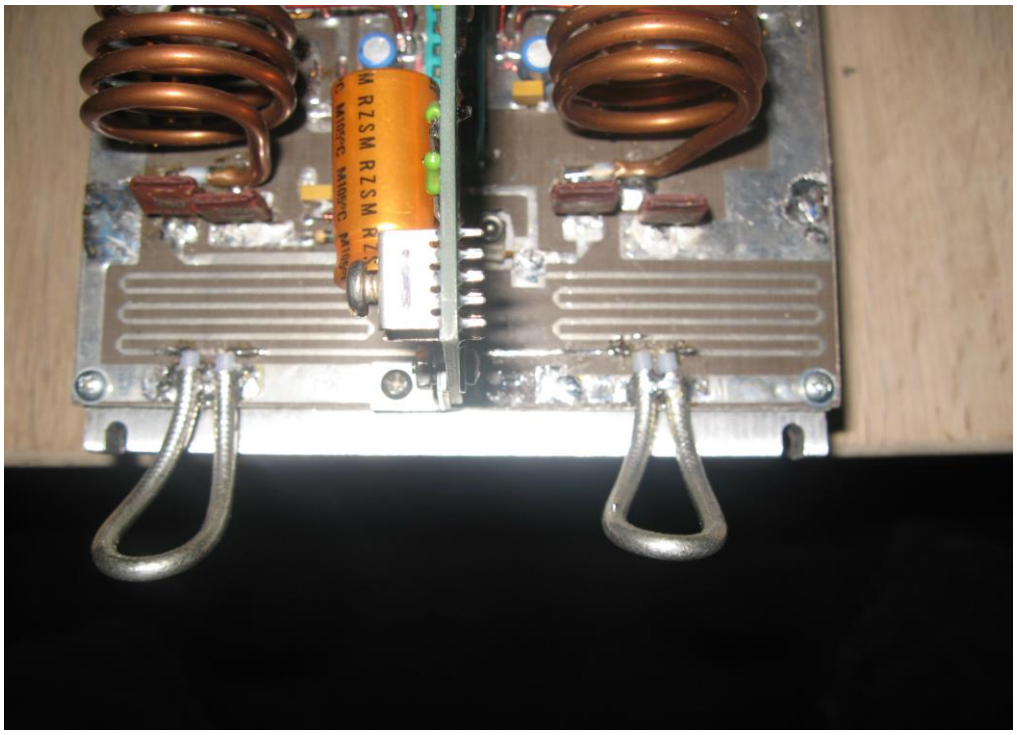


Fig 10

**Step 11**:
**Soldering of the Bias board. (optional)**
There have been reported many problems on bad connection in the green connectors carrying the bias board. That can result in burned Fets. One way to avoid that is by soldering the board directly to the connectors. We will never in ham operation need to change a bias board. If any component need changing it is still easy without removing the board.
The best way to solder the board to the connector is to put solder on the Bias PCB tracks (the golden pads) and also add some solder with a long solder tip into the connector pins directly. You need to remove most of that solder again with some solder-wick. Also on the pins only a thin layer is needed.
Press down the board and mount the screws for holding the bias board. Once mounted take the long solder tip and carefully warm up each connection. You can add a small amount of solder in each connection pin to be sure it gets a good connection. Remember you need to warm the pin as long as it takes to let the solder flow correctly. Both connectors both sides need to be soldered that way.

**Second option you can clean the connector very good with isoprohyl alcohol.**

**Step 12:**
**Tip!!!**
**For testing I will recomend to use the amplifier drawer and mount the amplifier module. Connect the DC line +48V and the bias connector. Do not connect the input/output to the combiners but solder in a coax cable to the input and output side. If you test like that you will use the buildin security in the amplifier. But this requires you have made a connector for feeding the complete amp described in the last part of the document. During trimming it will protect your module. You can se later in this document how the security works. If you have no amplifier box or don´t want to mount the modules you can follow the tekst just below here. if you use your box for test takeout the module after test and mount another. You might need to unsolder the 75ohms extensions to be able to get the module mounted.**

Now all modifications has been done.
Now it is time to check bias settings and adjust the input trimmers.
Add a coax cable for outputside to a dummyload. NEVER OPERATE those modules without load. Connect the driver coax to the inputside. Add a +48VDC power supply of min 15A. GND from the supply is to be mounted on the ground on the PCB. +15V is used for Bias supply. This must be added to the EC1 connecor PIN1. Gnd from the supply is to be soldered to the ground on the PCB. Se Fig 11 for details

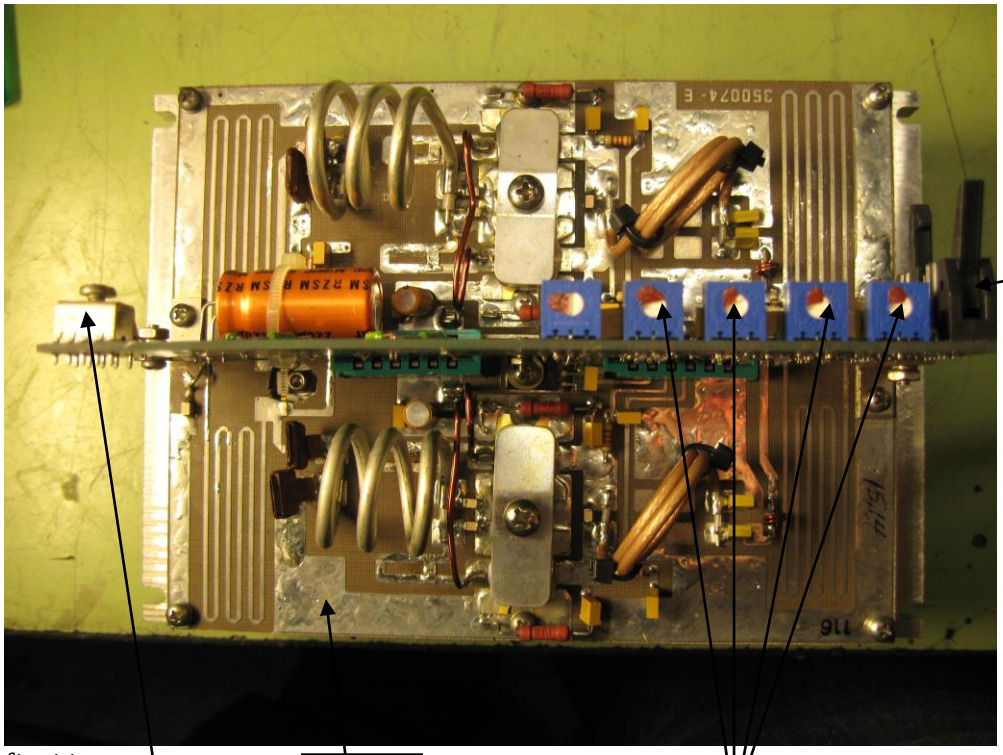



fig 11

**Step 13:**
Before powerup adjust both input trimmers so that they are around half way in se Fig 6 for placement of the trimmers.

Now slowly bring up the powersuppy to the desired 48Vdc. Add the +15Vdc and watch the current on the 48Vdc. During first Bias checkup limit the 48V to a max of 3A.

There is supposed to flow a current of 1,6Ain idle . If not correct take a screw driver adjust the Bias potmeters to 400mA each potmeter. All 4 Fets in a module will then take around 1,6A in idle.
Make sure external fans to keep the heatsink within temperature limits.
After Idle adjustment add some RF drive. Start with 1W drive. There should happen something on the output meter. Adjust slowly the 2 trimmers back and forth. Make small steps. If bigger steps are taken most likely the 100Ohm Wilkinson resistors will die. On the EC1 connector pin 3 there is a signal that states if the balance is not ok. This reading is also to be minimalized with adjusting the trimmers. You need to adjust this to a maximum of 700mV. If you cannot reach that level you have made an error. Typical you will reach <50mV approximately if mods are done correctly. DO NOT GO ABOVE 2VDC on the isolation port, or you need a need 100ohm resistor change.

When you have optimized the amplifier at 1W drive add some more drive and readjust the trimmers but make sure you do optimize at high level also. Use extreme caution and only very small steps on the trimmers
Around 6-7W is needed to make the amplifier make 400W.
Let the amp run hot first time to make sure that all is ok.
Sat power can be as much as 600W depending on the active devices. But I recommend keep it at 400W maximum. This will happen at around 13A.
This is what is needed for modification of the module.
Conclusion: 7-8w drive makes 400W output on a modified module at an efficiency. Gain can even increase a little. Efficiency is around 68% (if you change the 25ohms baluns).
It is important all amplifier modules gives the same power and have almost the same gain. Otherwise there will be problems when combining all 4 modules.
Write the details on each modules and trim for giving the same gain and power. If errors in the power out look for errors smaller differences can be corrected by moving the hairpins in steps of maybe 0,2mm and it is done on all devices on the module. 20W is acceptable difference in the performance on the different modules. (Tip if you have many modules you can match them to get best performance).

## The next section tells what to change in the Amplifier drawer

In the amplifier drawer all the needed combiners are for combining the modules together. They do also need to be renewed to work efficient on 144MHz.

The change is quite simple but will take some time to finish. All the cables are around 26cm long but need to be changed to 36cm. There are on the output side used RG302 Teflon 75ohms coax and RG400 50ohms coax. On the input side RG316 50ohms Teflon and RG179 75ohms Teflon is used. Specially on the output side it is very important to use Teflon material as it will carry high Power.

Note on the pictures shown (fig 12) is only containing 2 amplifier modules, but those will be modified and mounted later.

**Inputside**

Fig 12 shows the input side of the renewed combiner. On this case the white coax is the RG179 75ohms coax. The 2 brown one is 50ohms.

Be very careful not to change any placement of the different impedance. Good tip is to remove one coax at a time and solder in the new one to avoid errors. Another tip the 75ohms Teflon coax always have thinner inner conductor. Please be careful in this section. Failures or faults will make fets burn out. Also be sure not to make any short circuits with solder etc this will make your fets die. Simply find a suitable way to roll up the coax and strip it together with tie-wraps. On the input side there is a 150W attenuator. It is seen on the extreme left on the picture below. This attenuator is together with the module gain set to deliver 13,dB gain in all amplifier modules. You can remove this attenuator and reduce the drive needed and reuse this 150w attenuator in other applications.

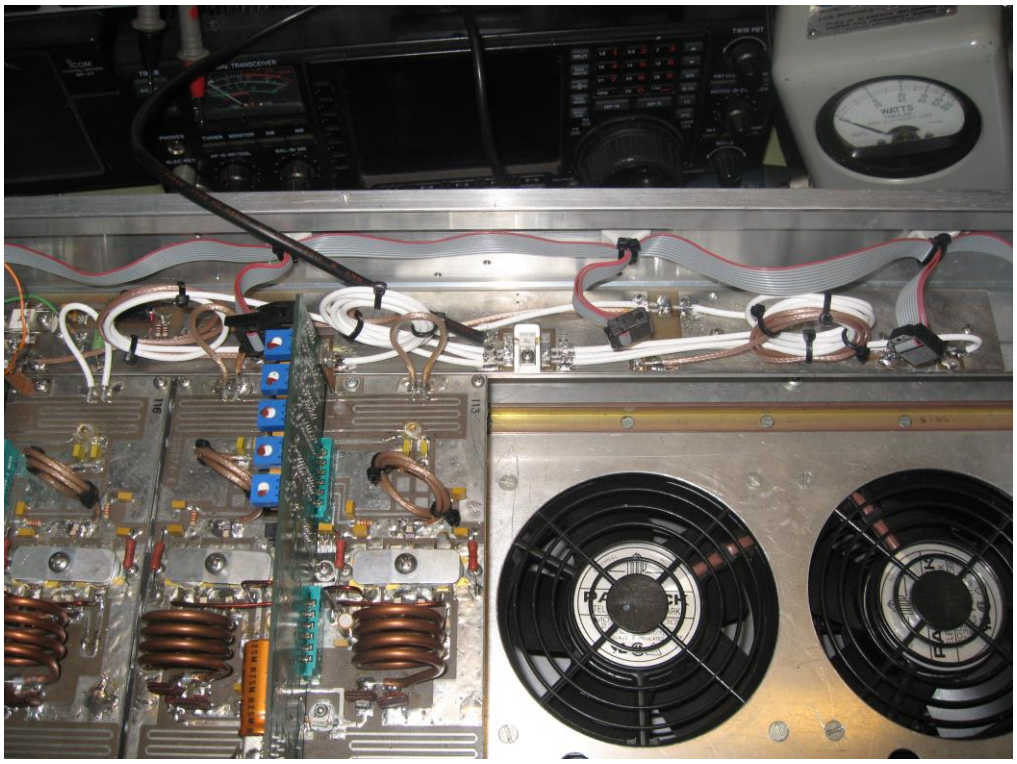


Fig 12 input combiners

**Outputside**
Fig 13 shows the output side of the renewed combiner. In this case all coax is brown Be very careful not to change any placement of the different impedance. Good tip is to remove one coax and solder in the new one to avoid errors. Another tip the 75ohms Teflon coax always have thinner inner conductor. Please be careful in this section. Failures or faults will make fets burn out. Also be sure not to make any short circuits with solder etc this will make your fets die. Simply find a suitable way to roll up the coax and strip it together with tiewraps

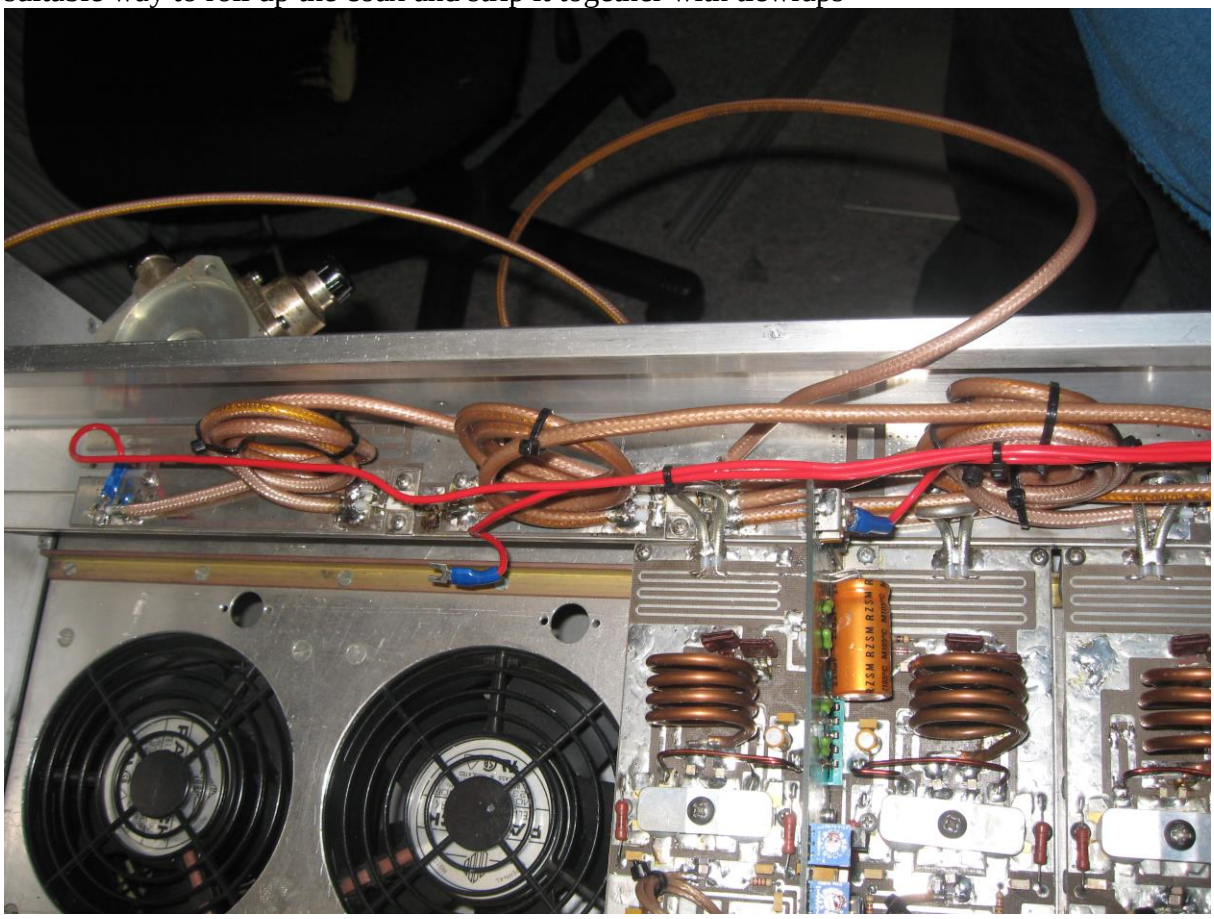


Fig 13 output combiner

When all combiners are finished all 4 amps can be mounted in the ampflier drawer again. Of course remember to solder the input/output strips on all 4 amplifier modules .
Remount the +48V and the flat cable on all units.

**Security circuits**
There is a PCB in the end of the Amplifier drawer. This takes care of all security.

The module is secured against

- SWR
- TOO LOW DC VOLTAGE
- TOO HIGH VOLTAGE
- TOO HIGH INPUT DRIVE
- BALANCE IN THE AMPLIFIER.
- TEMPERATURE OVERLOAD

On the Front of the amplifier drawer there is 2 LED. One Green and one Red. The Red one lights red when the PTT is not enabled and the green one lights green when the PTT is on. The green led flashes also when drive is applied.

The red one also tells if there are faults around the module. It will blink and you can tell from the number of blinks what is wrong.

1 Blink is: SWR fault
2 Blink is: Input overdrive
3 Blink is: Fet unbalance
4 blink is: Powersupply out of range 44-52V
5 Blink is: Overtemperature Fault

No changes are needed to this module. Fig 14 shows a picture of the security board.

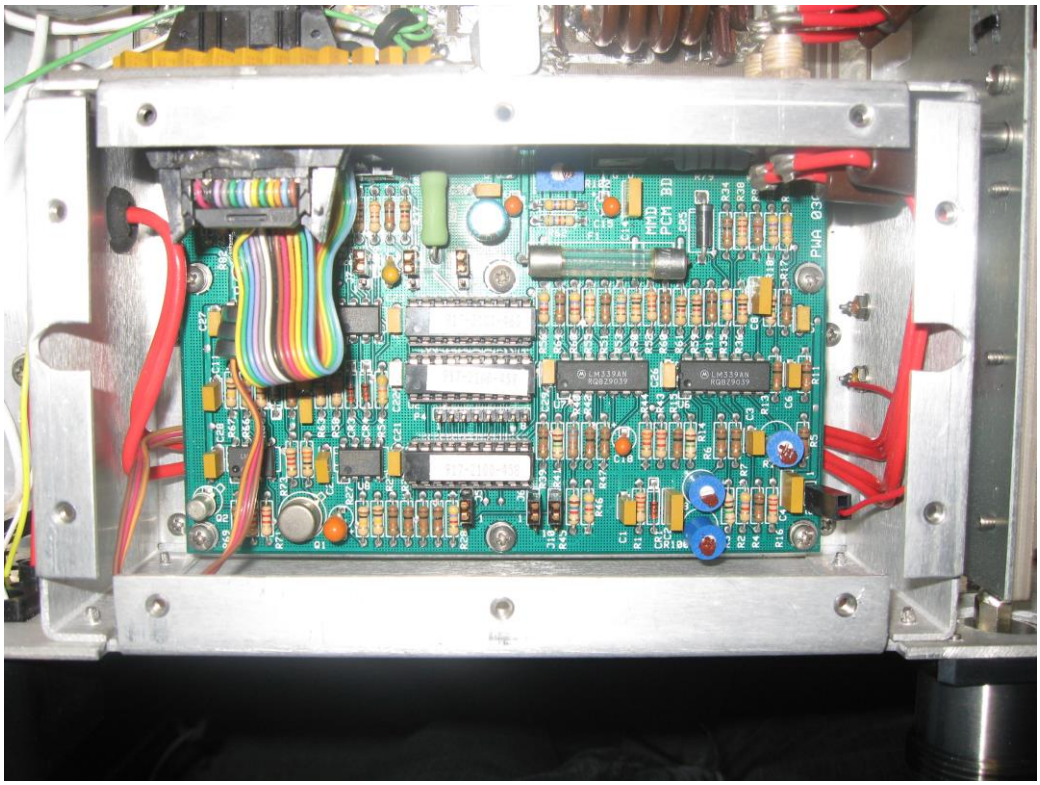


Fig 14

**Change of output connector**

Output connector is a special one as the amplifier was a hot plug unit. I have changed mine to a Din 7/16 connector. Fig 15 shows how I did it but you can use any connector wanted. Just make sure you get a good connector and use only Teflon connectors and NO SO239 PL.

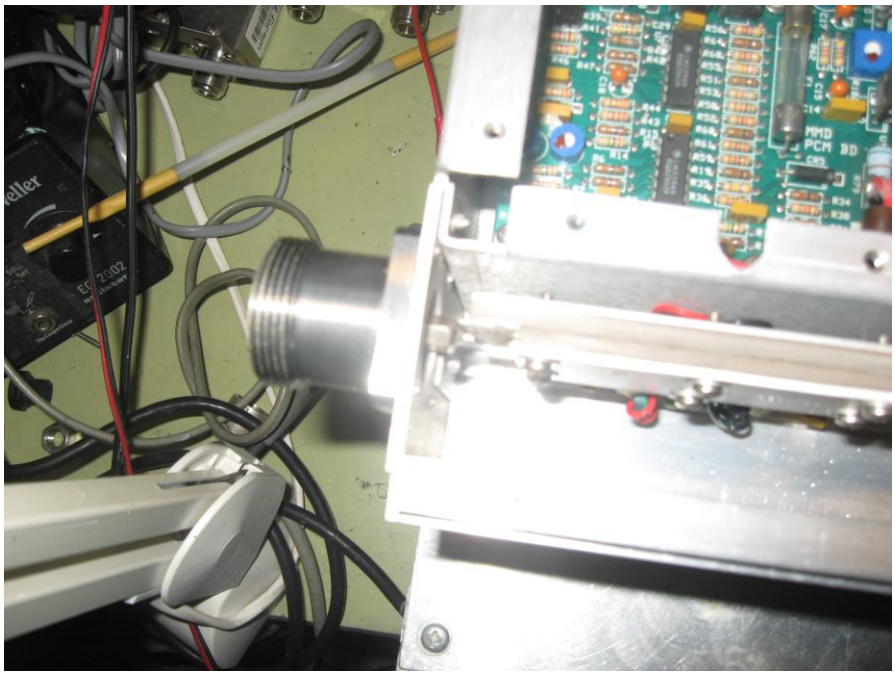


Fig 15

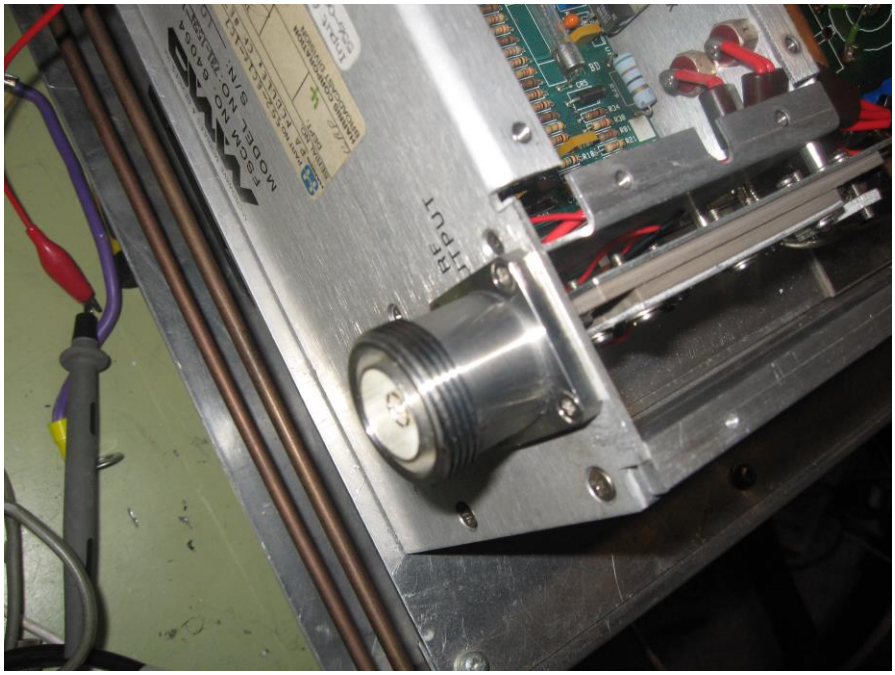
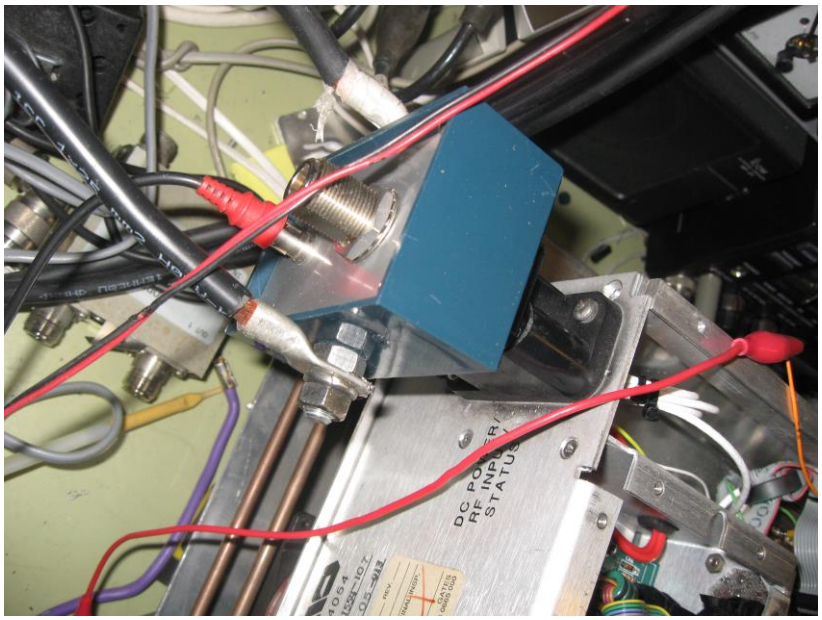


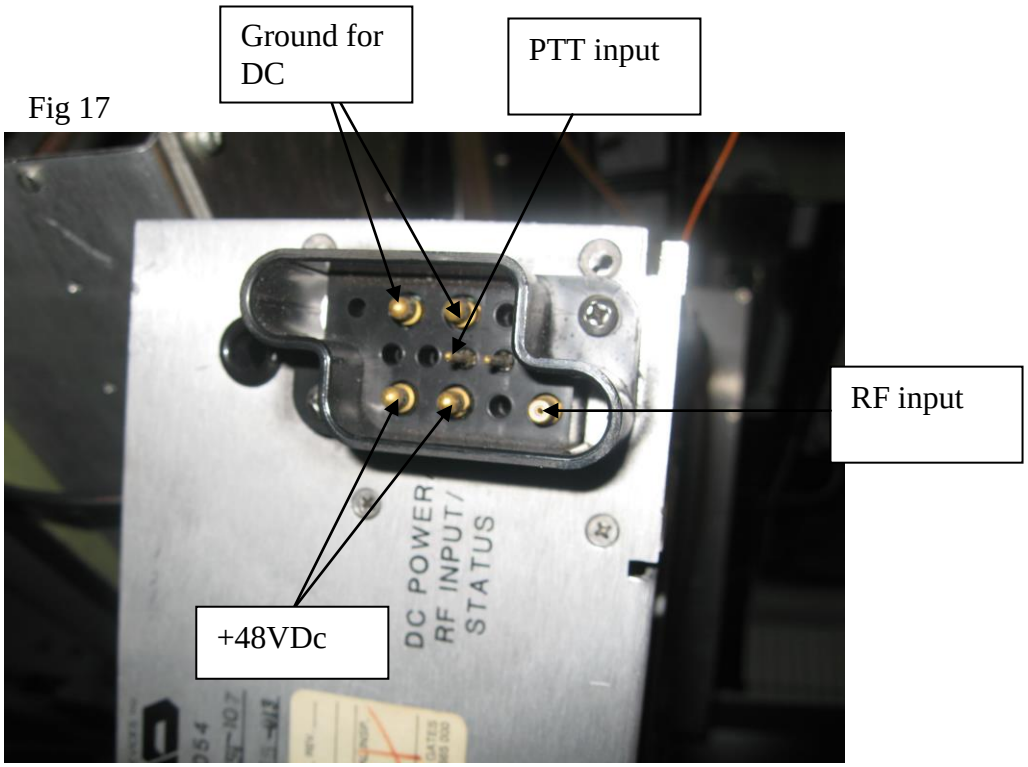
Fig15

**Input connector, DC supply and PTT**
The input connector is rather special.
Depending on if you got the mating part with your amplifier you can make a box like this
It contains input RF connector and 2 pieces 8mm stud for the DC power supply. Use 16mm2 at least for supply lines. PTT is the small phono connector. We are lucky the enable line on the amplifier can be used for PTT. Signal is to be grounded for PTT of the amplifier. Last pin is not be used. Se Fig16 for details.



Pinout in the connector is like Fig 17 shows.

Fig 17



Cooling of the complete amp
Suitable cooling of the amp is a Muffin fan 100x100mm pr module. I have use the old service box for cooling my amps. But build your own design. Important is only to keep the temperature low at all operation conditions.

Fig 18 shows one way to make the cooling.
You can imagine a fan below each module. This forces the air through the heatsink.

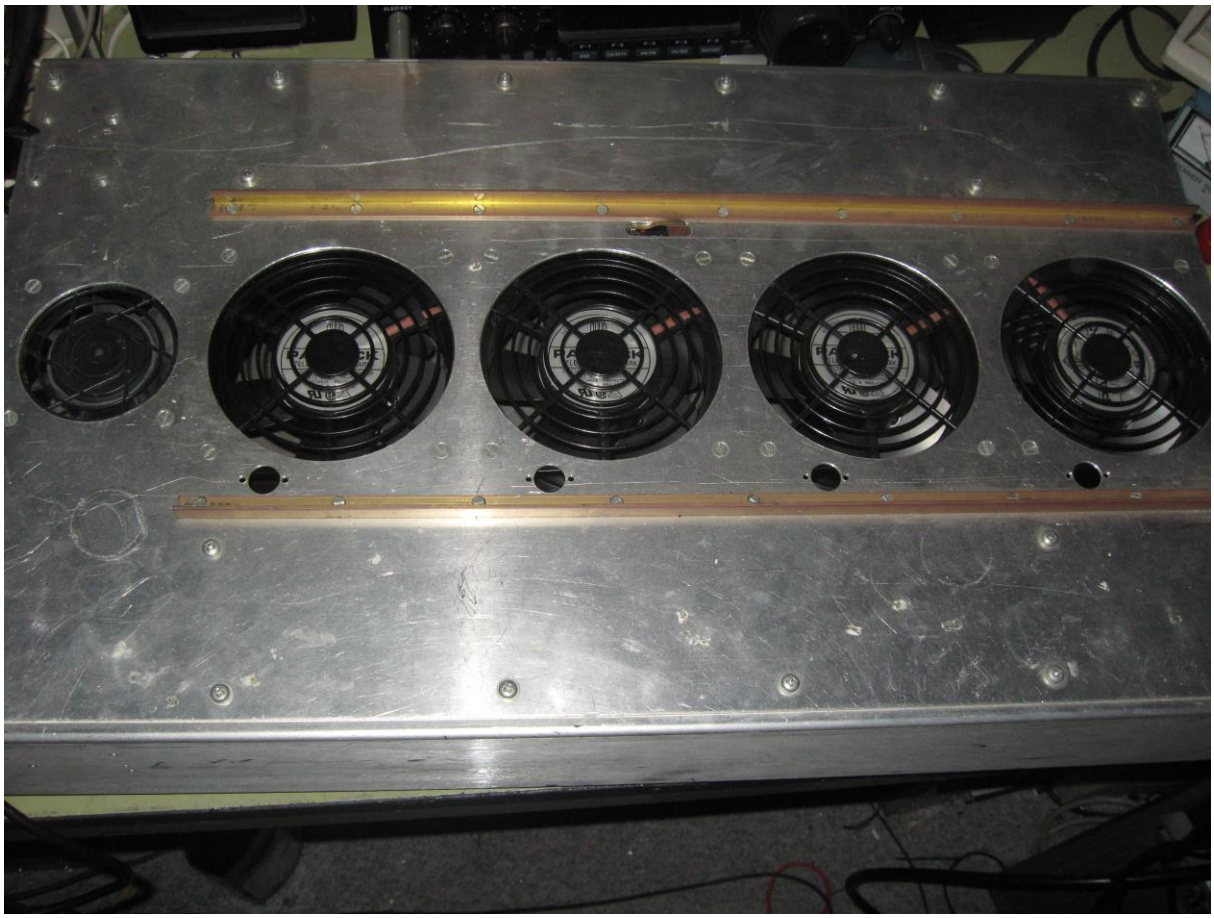


Fig 18 fan arrangement

## Final test

Now you finished all the rebuilding and have a load connected and proper cooling it is time to try to put the amplifier to a test.

Start with 5W drive and se what the output meter shows. This should be in the 250W range. Let the amp run for 1-2 min and feel under the Combiner resistors on the outputside combiner. They should be rather cool. If not cool there is a fault in the modification somewhere.
If all ok add some more drive. You can go to 40-50W at that level the amplifier should saturate at 1600W-1800W level depending on the gain in the amplifier. That varies a lot in those "older" Fet amps.
If you reach that level you have succeded to modify the amp. Let it run for some minutes and observe if anything gets warm. Specially feel the combiner resistors again.

Congratulation now you have a complete amplifier that can run WSJT FM SSB or what you like.

Hope these amps will be put into service and that they will make you a happy user.

VY 73 Peter OZ1LPR

## ADDITIONAL INFO

If you need a power supply I can inform you that there are some nice HP 3kw power supplies for sale on Ebay. They are listed as a 51,4Vdc 3kw but only a small inside resistor change will make the supply do 48V at 60A. This is a lightweight way to get a stable amp. Search on Ebay for "48V 3000W" I will make a change procedure later for the supplies. One thing about them is that they are used in Server racks with heavy filtering on the AC inlet but NOT on the 48V supply as it was internal. So some ferrite and screen DC lines is needed to make sure no qrm will kill your rx performance.