24-23 cm PA Assembly Instructions

Rights & Permission

Equipment you'll need

- Surface Mount Device (SMD) soldering kit
  - o Temperature controlled soldering iron with fine tip. Insure the tip is grounded!
  - o Hot air rework tool or hot air gun
  - o Small vise to hold the PCB
  - o Liquid no clean solder flux
  - o SMD Tweezers
  - o Isopropanol 99%
  - o Cotton swabs
  - o Solder wick and solder sucker
- Electrostatic Discharge (ESD) protection - mat - wrist strap
- Needle nose pliers
- Wire cutters
- Small diameter solder suitable for SMD work and larger diameter solder 1mm or so for larger soldering tasks.
- Single pole single throw normally open switch.
- A voltmeter with leads suitable for probing surface mount components.
- Variable regulated power supply with a range of at least 10 to 15V capable of delivering 0.2A.
- Power supply or battery with a voltage greater than 12.5V capable of delivering up to 10A.
- Current meter for the power supply or battery
- Wire and if available Powerpole connectors for temporary power connections
- Screwdriver with very small Philips tip suitable for adjusting the 2mm potentiometer
- Drills and taps for 6:23, 4:40, and 2:56 (or 4, 3, and 2 mm)
- RF signal source suitable for driving the PA input.
- Dummy load and power meter suitable for monitoring the amplifier's output
- RF connecting cables for the PA input and output

Before You Begin

- This assembly document includes an SMA relay in the enclosure. The relay configures the amplifier for use with a transverter that has separate RF output and receive input ports. The SMA relay switches the antenna port between the amplifier's RF output and the connection through the unit to the transverter's receive port. If the configuration wanted doesn't include a relay disregard the assembly sections that refer to it. It may also be useful to eliminate the components associated with the timing that prevent relay hot switching. This would include not installing the following components
  - ☐ C19 0.1nF 0603
  - ☐ R28 39k
  - ☐ D2 1N4148WS or BAV16WS
  - ☐ D9 BZX84C6V8LT1
  - ☐ R28 82k
  - ☐ Q5 2N7002
  - ☐ R30 0R
- Print out the parts list and check that all parts are available.

- Print out this document. To help locate components on the printed circuit board, print out the circuit schematic, and the PCB top component layout
- Perform the functional verification tests after each section of the assembly is complete. Do NOT proceed to the next assembly section until the verification test has been successfully performed. This is especially important for the voltage regulator verification test. It becomes increasingly difficult to trace voltage regulator supply problems if additional circuitry is installed.
- Watch the part sizes. Most resistors are 0805, and most capacitors 0603, however there are size variances so be to use the correct size. Parts sizes other than 0805 are noted beside the part value in the assembly instructions.
- Resistor tolerances are either one or five percent. Resistors are identified by their value and a multiplier. The multiplier R is one; K is one thousand and M one million. So 3k3 would mean 3,300 Ohms, 100R, is 100 Ohms; and 2M0 two mega Ohms. One percent resistors are typically designated with a third digit for example 1k91 is 1910 ohms.
- Temporary leads are soldered to the supply connections for several functional tests. It is useful to have spare Powerpole connectors for this purpose.

Assembly Tips

1. If adhesive does get onto the tweezer's tips parts will stick to them. If this happens wet a cotton swab with isopropyl alcohol. Spread the tweezer tips to clamp around the swab and draw them across the swab to clean the tips.
2. Orient all resistors in the same direction so that they can more easily be read and identified after installation. Use the same orientation as is used on the PCB silk screen.
3. As you install devices check off the component in the square box beside the component identifier.
4. All components on this board mount on the top side. There are no bottom side devices.
5. There are on board power and transmit indicator LEDs. They are noted as optional. I install them as I find them convenient when testing out the circuitry before final assembly. During early testing stages it's not convenient to hook up to the external LED's so having an on board indication of power and transmit status is helpful. Note however that these devices do draw about 2.5 mA each. If you're operating from a power supply the current is incidental, but on batteries if you want to be frugal I suggest initially installing both LEDs then remove the series resistor from the power indicator LED when you're closing in on final assembly. I wouldn't worry too much about the transmit LED as its current use will get lost in the total used during transmit.

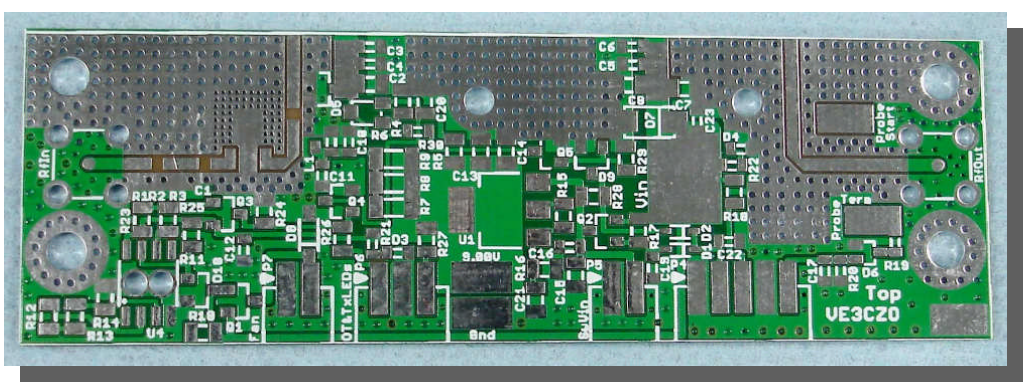


Fig 1 PCB Top Side

1. *Install the power supply LED indicator, PTT switch and associated components.*

☐	C22	1nF 0603	
☐	R18	4k7	
☐	R22	4k7 0603	*Optional*
☐	D4	LO L29k Grn LED 0603	*Optional*

- ☐ D1 1N4148WS or BAV16WS
- ☐ D2 1N4148WS or BAV16WS
- ☐ C19 1nF 0603
- ☐ R17 220k
- ☐ Q2 IRLML9303
- ☐ R28 39k 1206 Note: the PCB silk screen is wrong. Place the resistor as shown in the PCB top view document. It must span from Vin to the track that runs between D9 and D2.
- ☐ R29 828
- ☐ D9 BZX84C6V8LT1
- ☐ Q5 2N7002
- ☐ C23 1nF 0603
- ☐ D1 1n4004
- ☐ C15 10uF 25V
- ☐ C17 1nF

The next steps install connectors P4 and P5. These are JST PH series 2mm connectors designed for through hole mount, and need to be modified for surface mounting. To do this form the pins by bending them 90 degrees toward the side of the connector that has the locking holes in the housing.

- ☐ P4 5 pin JST PH male connector
- ☐ P5 2 pin JST PH male connector

Functional Verification Test 1

This test verifies that the voltage power indicator LEDs work and the PTT switch functions.

a. Solder temporary supply wires to the supply PCB lands Red to Vin and Black to ground.
b. Adjust a variable regulated supply to 13.8V. If possible current limit the supply to about 100mA. Turn it off and connect it to the temporary supply leads
c. Insert J4 and J5 into the PH connectors. Connect a green 5mm LED to J4, anode to pin3 and cathode to pin4. Connect a normally open SPST 'PTT' switch across the PTT leads, J4 pins 1 and 2. Set the PTT switch to the open position.
d. Connect a voltmeter across the P5 leads. Make sure that none of the leads are shorted together.
e. Turn on the power supply. The power LEDs should illuminate. Monitor the voltage across the J5 leads. It should be 0 V.
f. Close the PTT switch. This will turn on Q2. Monitor the voltage across J5. It should be within a few millivolts of the power supply voltage.
   - ☐ J5 voltage. __________ V.
g. Open the SPST PTT switch, turn the power supply off. Disconnect the voltmeter from J5 and unplug both J4 and J5 from the PCB.

2. Install the 1117 LDO voltage regulator and surrounding components

- ☐ C16 1nF 0603
- ☐ R15 1k10
- ☐ R16 6k49
- ☐ C21 10uF 16V
- ☐ C13 10uF 16V
- ☐ C14 10uF 16V
- ☐ U1 1117Adj
- ☐ R5 470R
- ☐ R30 0R 0603
- ☐ C20 10uF 16V
- ☐ R4 470R

- ☐ R6 330R potentiometer
- ☐ D5 MMBZ5232B
- ☐ R7 82R 1206
- ☐ R8 82R 1206
- ☐ R9 82R 1206
- ☐ C10 1nF 0603
- ☐ C9 1uF 16V 0603
- ☐ L1 33nH
- ☐ C11 82pf 0603
- ☐ R27 2k4
- ☐ R21 2k4 0603 *Optional*
- ☐ D3 LOL29k Orange *Optional*
- ☐ P6 3 pin JST PH male connector

Functional Verification Test 2

This test verifies that the voltage regulator provides the correct output voltage over its input voltage range and that some of the connecting components are functional.

a. Solder a 5mm orange LED to the wires of connector P6, anode to pin 3 and cathode to ground, pin2. Plug J6 into P6 and. Make sure none of the leads on J4 or J6 are shorted together.
b. Re-install J4, make sure none of the leads on J4 or J6 are shorted together then turn the power supply on, and close the PTT switch.
c. Check that the PTT LED on J6 and D3 if installed are illuminated
d. Measure the voltage at the regulated 9.00V output at P8 / TP1 to ground. It must be 9.00 +/-.2V (8.9 to 9.2V.)
   - ☐ TP1 voltage. __________ V.
e. If the voltage is within range change the supply voltage over the 10 to 15V input range while monitoring TP1. It must not change from the reading taken when the supply was at 13.8V by more than 20mV.
   - ☐ TP1 voltage at 10V __________ V. then 15V __________ V.
f. Set the power supply voltage back to 13.8V.
g. Turn the R6 pot fully clockwise and measure the voltage at the VBIAS track leading to U3. It should be less than 5.7V.
   - ☐ VBIAS pin voltage. __________ V.
h. Turn the R6 pot fully counter clockwise and measure the voltage at the VBIAS track leading to U3. It should be less than 3.5V.
   - ☐ VBIAS pin voltage. __________ V.

   Leave the pot set to approximately it's mid range value.
i. Measure the voltage at PCB land for the supply pin (pin3) of the SXA-398BZ to ground. It should be at the regulated supply voltage.
   - ☐ SXA-389 pin 3 voltage. __________ V.
j. Turn off the PTT switch and power supply. Disconnect P4, and P6, from the PCB.

3. *Install the LM56 thermostat and associated over temperature components*

- ☐ Q4 2N7002
- ☐ R26 2k4
- ☐ D8 MBR120
- ☐ Q1 IRLML9303
- ☐ D10 BZX84C6V8LT1
- ☐ R10 4k7
- ☐ U1 LM56

- ☐ R14 13k0
- ☐ R13 3k09
- ☐ R12 9k09
- ☐ R24 10k
- ☐ C12 0.1uF
- ☐ Q3 BC857
- ☐ R11 220k
- ☐ R25 10k
- ☐ R23 68k
- ☐ P7 2pin JST PH male connector

Functional Verification Test 3

This test checks the fan thermostat and over temperature function.

a. Insert J7 into P7 and attach a voltmeter to J7's leads.
b. Connect a 5mm red LED to J6. Connect the anode to pin 1 and cathode to pin2 (ground).
c. Re-connect J4 and J6 to the PCB.
d. Make sure none of the leads on J4 are shorted, turn on the power supply and set the PTT switch to transmit.
e. Check that the voltage across J7 is zero volts so that if a fan were attached it would be off.
f. Measure the voltage from the U1 Vbias pin to ground.
   - ☐ U1 Vbias voltage __________ V.
g. Increase the temperature of the LM56 thermostat U4. This can be done by using a hot air rework tool or placing a soldering iron in close proximity to the IC's top surface. Monitor the voltage across J7. The fan switch should turn on and the power supply voltage should be present across J7 once the IC temperature reaches about 40 deg. C. Once J7 has switched monitor the Vbias pin on U4. As the temperature increases past 65 deg. C the over temperature LED should illuminate and the voltage on U3's Vbias pin should be less than 0.1V when Q4 turns on.
   - ☐ U1 Vbias voltage when the OT led is on __________ V.
h. Turn the power supply off, open the PTT switch, and disconnect P4, P6, P7, and the power supply.

4. Install the first stage RF amplifier

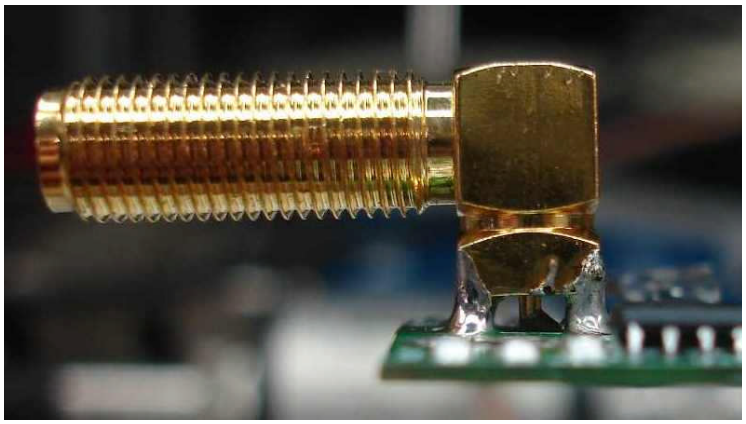
Unless you know the value needed for the RF input pi attenuator don't install R1 or R3 at this time and use a zero ohm jumper for R2.

- ☐ R2 0R 0603
- ☐ C1 68pf 0603
- ☐ C18 68pf 0603
- ☐ U2 SXA-389BZ

The next step installs J1 the right angle SMA connector. This part needs to be modified for surface mounting and this can be a little tricky. Here's how to proceed.

1. Start with a standard through hole mount SMA PCB connector.
2. Cut off the four ground lugs and file them so that they protrude just under 2 mm from the connector body.
3. Cut off the connector center pin and file it flat so that it protrudes 1.5 mm from the connector body. With some connectors the center conductor isn't solidly fixed so as it's filed it will push into the housing. Watch for this and if necessary gently pull the center conductor out of the housing with a set of tweezers.
4. Test for fit by inserting the connector into the PCB, and make sure it rocks freely on the center pin and that the ground pins don't protrude through the board.

5. Remove the PCB solder mask from the portion of the transmission line track that runs from the center conductor dot out to the edge of the connector housing. Lightly Tin the exposed track making sure that there is no excess solder on it.
6. Tin the connector center pin and remove any excess solder.
7. Insert the connector into the PCB and solder any two diagonally opposite ground lugs to secure the connector to the PCB. Make sure it's square and that the threaded barrel is parallel to the PCB.
8. Make sure the center pin is in contact with the PCB. If not gently pull it to meet the PCB with a pair of tweezers. Use a long thin round soldering iron tip capable of reaching the center conductor. A good candidate is the Weller LT1L for the WSP80 pencil. Use solder flux in preparation for soldering in the next step.
9. Solder the center conductor to the PCB track. Visually check the soldering. A solder meniscus should be visible behind the center pin.



10. Test the continuity by measuring the resistance between the center pin and the PCB track
11. Solder the remaining two ground pins.

Functional Verification Test 4

If a low power RF signal source and a power meter is available it's not absolutely essential but a good idea to test the first stage amplifier for gain and any other attributes you wish like P1dB compression before installing the Mitsubishi power amplifier. To do this:

a. Connect a coax to SMA male pigtail or edge launch SMA connector to the 50 ohm transmission line track that runs from C18 to the edge of the PCB (RF in for the RA18H1213G module). If you use a coax pigtail split the ground braid into two and form it either side of the center conductor. Trim and solder the center conductor and two ground braids to the PCB. If you choose to use an SMA edge mount connector solder only the top connections, leave the bottom ground pins unconnected. This won't significantly effect performance measurements and will make the connector easier to remove.
b. Set the signal source for CW, 1270 MHz, with an output power of -10dBm. Turn the RF output off and use an SMA jumper to connect J1 to the source. Connect the output SMA connector to a power meter.
c. Re-connect J4 and the power supply. Turn the power supply on, set the SPST PTT switch connected on J4 closed to transmit.
d. Measure the voltage from collector output of U2, pin 3 to ground. It should be about 5 volts.
    - ☐ VCollector _________V.
e. Turn on the RF source and monitor the output power. It should be in the +3 to +6 dBm range.
    - ☐ Pout _________dBm.
f. Conduct any other measurement you wish

g. Disconnect the RF source, power supply and J4 from the PCB in order to complete the remaining assembly.

5. Install all remaining PCB components

- ☐ C2 22uF 6.3V
- ☐ C4 100pF 0603
- ☐ C3 4.7nF 0603
- ☐ C7 10uF 25V
- ☐ C8 10uF 25v
- ☐ C5 100pF
- ☐ C6 4.7nF
- ☐ R19 0R 0603
- ☐ D6 HSMS-286C
- ☐ R20 10k 0603

The next step installs J2 the SMA RF output connector. Follow the same procedure as outlined in step 4 for installing J1.

- ☐ J2 SMA RF output

This completes the assembly of the PCB. Now let's get onto the initial physical assembly.

6. Prepare the enclosure, RA18H1213G, and PCB for mounting on the Heat Sink

When completed the assembly should look similar to the picture below. Note that the PCB and module assembly first screwed to the heatsink and then the enclosure is fitted around the assembly. A portion of the enclosure's bottom is removed for this assembly.

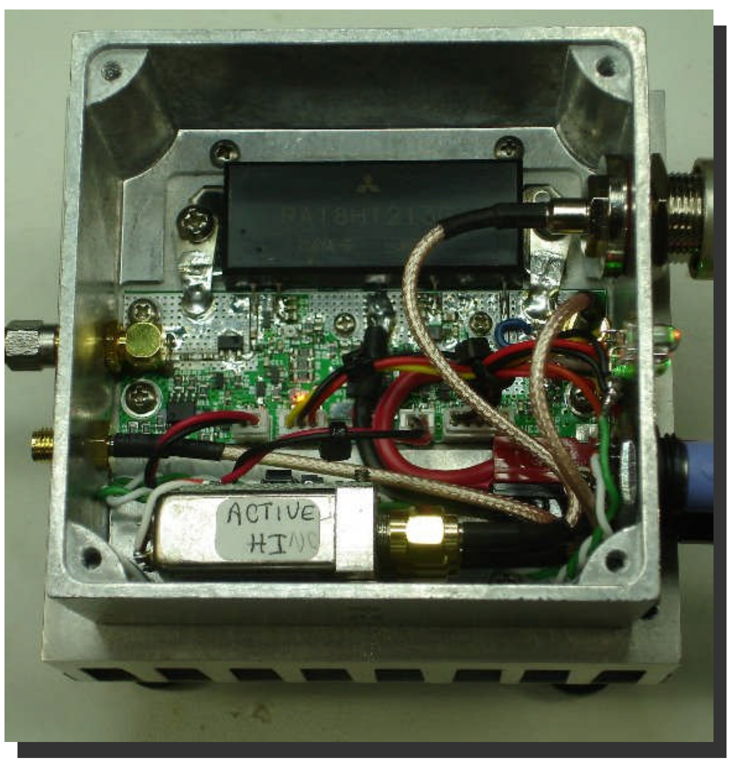


Fig. 2 Completed Assembly in 1590 Enclosure

Start by placing the enclosure, module and PCB on top of the heatsink to determine the relative positioning of these components. The RF PA module and the PCB will be mounted directly against the heatsink. The bottom of the Hammond 1590Y enclosure will be cut open for this as shown in the photo below.

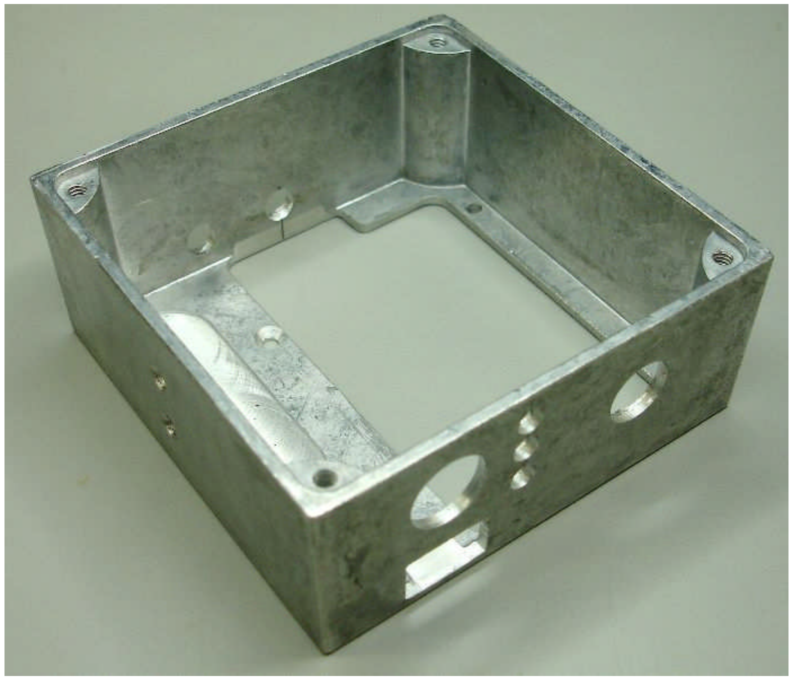


Fig. 3 Machined 1590 Enclosure

If you'd like to follow what was done for the photo above here are some layout guidelines. Regrettably they are NOT to scale. All dimensions are in millimeters.

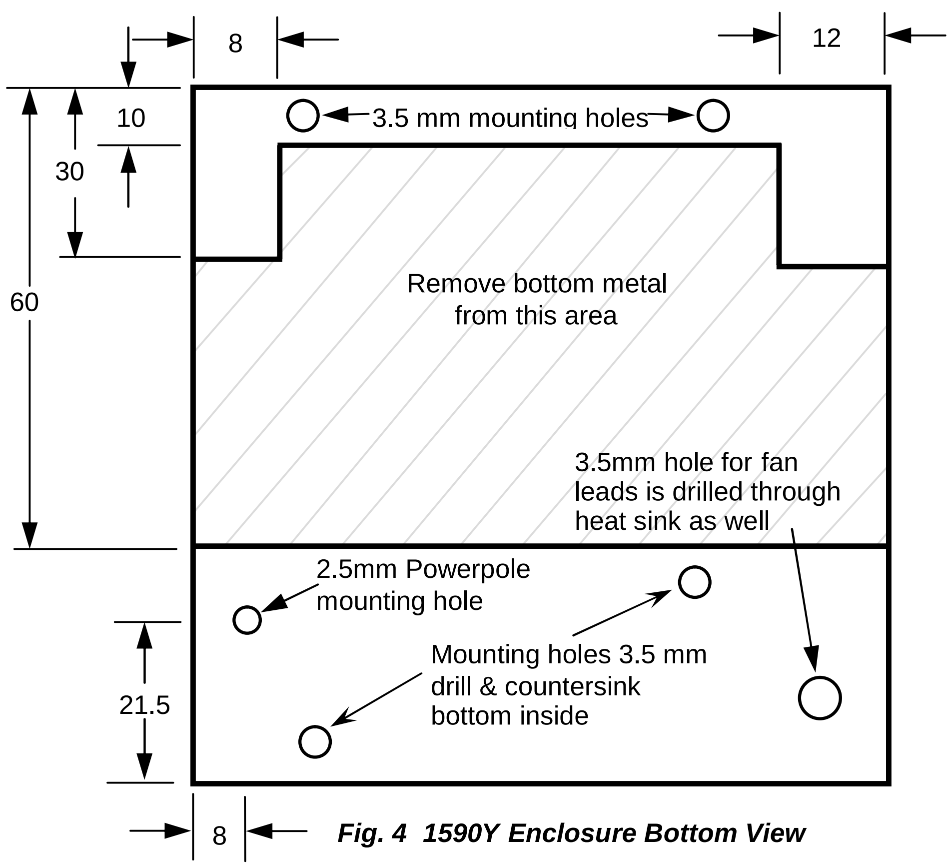


Fig. 4 1590Y Enclosure Bottom View

The location of the four mounting screw holes in the bottom isn't critical just make sure you can reach them when the relay and other components are installed. All screw holes are 3mm for 3mm or 4:40 screws.

1590Y Enclosure RF Output and Power Supply side

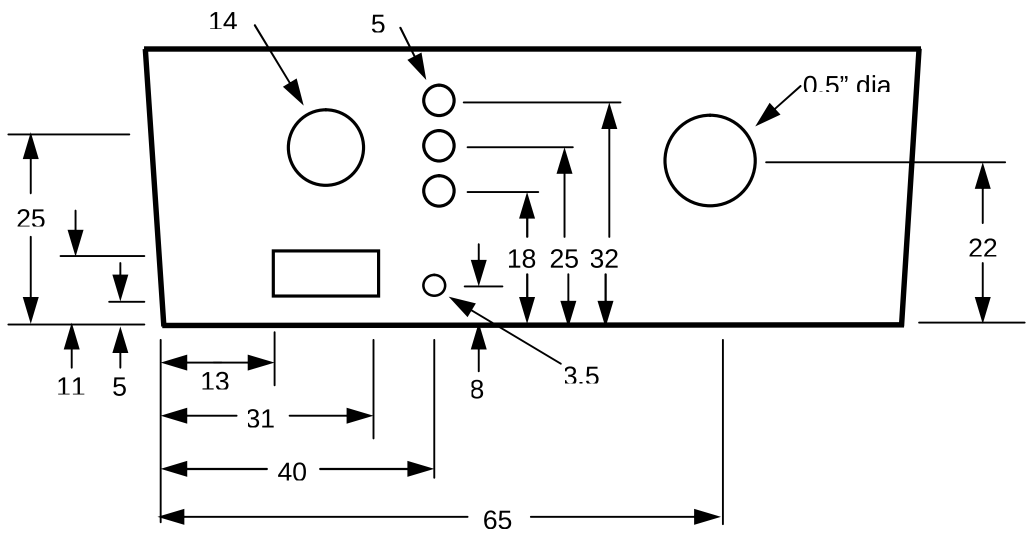


Fig. 5 1590Y Enclosure PA RF O/P & Supply Side

1590Y Enclosure RF Input & Transverter output side

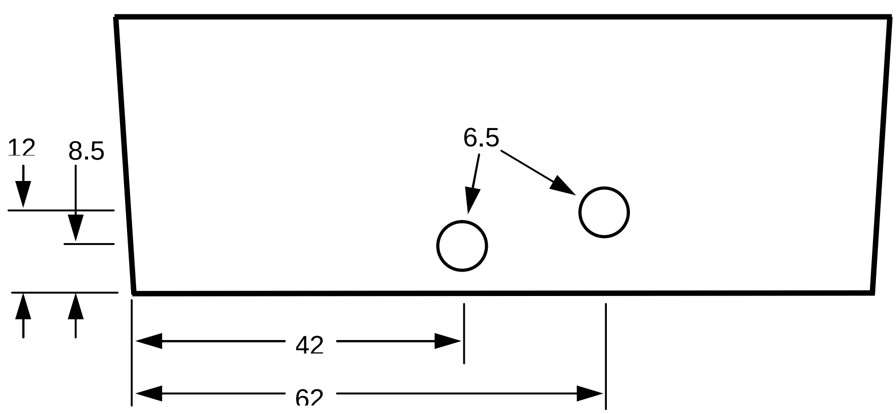


Fig. 6 1590Y Enclosure RF I/P & Rx O/P Side

1590Y Enclosure relay side

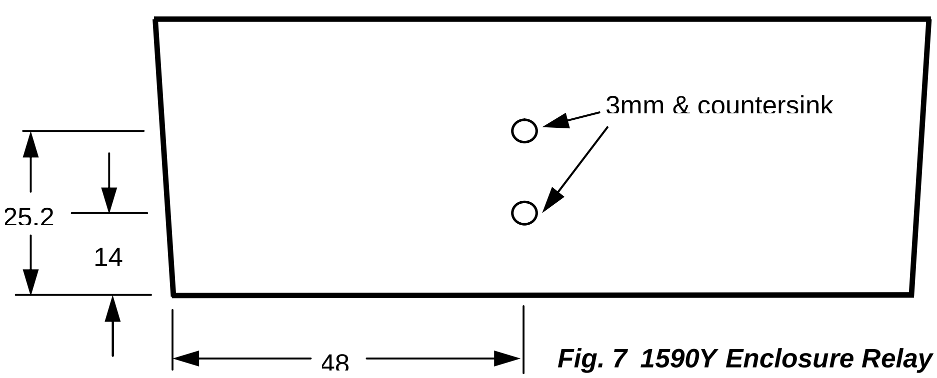


Fig. 7 1590Y Enclosure Relay Side

The hole for RF input jack may need to be filed slightly oblong in order to fit the enclosure over the PCB and RF module assembly.

7. ***Prepare the Heat Sink***

   Begin by making sure the surface is smooth and planar. The RA18H1213G reliability document calls for a 50u surface smoothness / planarity to insure the substrate won't crack when mounted.

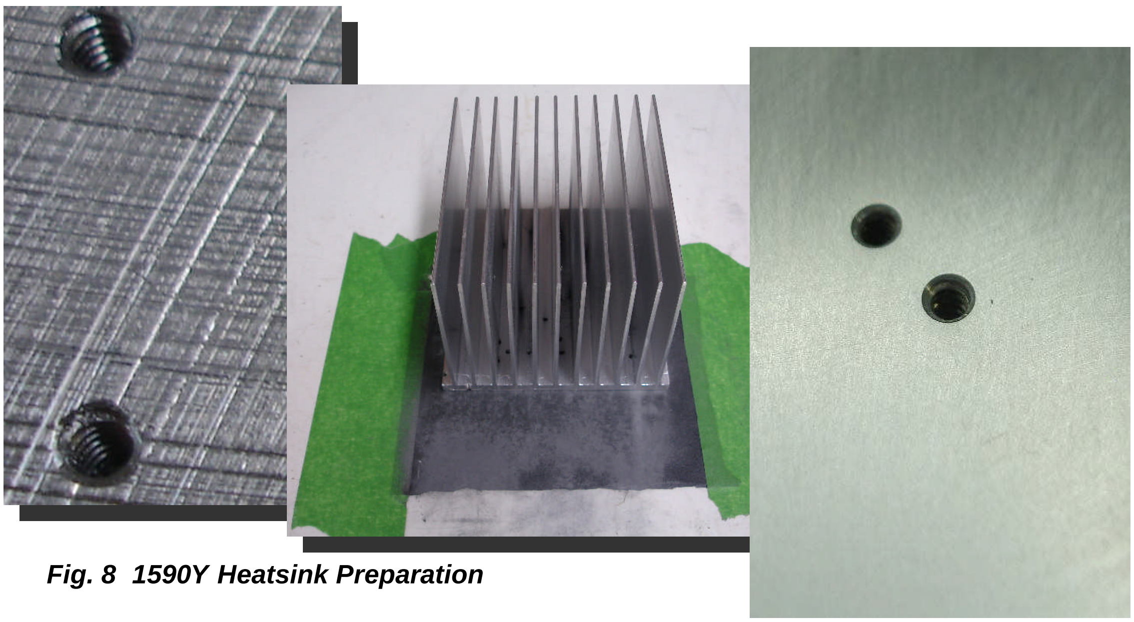


Fig. 8 1590Y Heatsink Preparation

The surface for this heatsink was initially sanded using an orbital sander with 120 grit emery cloth and an orbital sander. To keep the surface as planar as possible a piece of 400 grit (23.6u) paper was taped to a flat surface then the heatsink lapped on the emery paper. The heatsink was finished off by using a piece of 600 grit (16u) emery paper taped to the table.

Next drill and tap the mounting holes for the RA18H1213G module and the printed circuit board. The module uses two 4mm or 6:32 bolts. The PCB uses 4 4:40 or 3mm bolts on the corners and 2 2:56 or 2mm bolts through the ground plane.

Place the 1590Y enclosure with the module and PCB inside on the heatsink surface and orient it correctly. Use the mounting holes as guides to locate the location for the screws. Center punch, drill, and tap the 4 mounting holes for 3mm or 4:40 and the mounting hole for the Powerpole connector at 2:56 or 2mm.

8. ***Mount the RA18H1213G module and Printed Circuit Board on the Heat Sink***

   Make absolutely sure there isn't any debris in the RA18H1213G mounting area it must be absolutely clean, smooth, and planar. Be sure to use either Laird Tgrease or Bergquist Gap Filler 3500S35. Don't substitute unless you know the product will span gaps and has a better thermal conductivity than these products. Spread a layer of the thermal compound on the module.

Fig. 9 RF PA & PCB Mounted to Heat Sink

The thermal compound should be spread between the mounting flanges and there should be enough compound to completely cover the flange. The compound should be spread thick enough so that a small amount out past the edge of the heatsink flange when it's mounted. Wipe away any excess compound. Next mount the PCB. A small dab of heatsink compound can be placed on the holes below the thermostat to improve thermal conductivity to the heatsink.

9. *Solder the module to the PCB*

Gently bend the module leads so that they mate with the PCB and solder the 5 connections. Use two ground lugs under the mounting module mounting bolts and solder these to the PCB ground plane.

Functional Verification Test 5

If an RF signal generator is available, before the unit is assembled in the enclosure, it's useful to test its functionality. To do this:

a. Connect temporary supply leads to the V+ and V- solder points on the PCB. The wires should be heavy enough to supply the unit with several amps.
b. Plug P4 into J4 and make sure that the PTT switch is open.
c. Connect a power meter and dummy load to the RF output
d. Set the output of an RF signal generator to 1270 MHz, CW, with an output power of 0 dBm. If an input attenuator has been installed increase the generator output to compensate. Turn the generator output off. Connect the generator to the RF input.
e. Make sure that R6 is turned fully counter clockwise to set it's wiper at a minimum voltage
f. Connect a battery or power supply through an amp meter to the temporary supply leads. Turn the power supply on and monitor the current. It should be under 5 mA.
g. Turn the supply on or connect the battery and monitor the supply current. It should be less than 5 mA.
   - ☐ Isupply _________mA.
h. Close the PTT switch. Monitor the Vbias pin on U3 and the supply current as you turn R6 clockwise. Stop when the bias current reaches 1.5 A. Record the Vbias pin voltage
   - ☐ Vbias _________Volts.

i. Turn the RF generator output on and measure the output power. It should be about 40dBm.
    - Pout _________mA.

j. Turn off the PTT switch, RF generator, and the power supply or disconnect the battery.

10. Determine the attenuation needed for the Amplifier's input attenuator

It's a good point in the assembly process to populate the input attenuator as it's still easily accessible without the enclosure in place

The amplifier gain can be controlled by changing the value the input attenuator and the PA bias current. These two controls will enable full output power with and input power that ranges from about 0dBm to +23dBm.

Figures 10 through 14 show some characterization data for this amplifier. From the gain versus bias current graph, figure 1, it can be seen that the gain changes rapidly as the bias is increased to about 1 Amp. Then the gain goes into a knee range where it doesn't change as rapidly. Above a bias current of about 3 amps the gain flattens out and increases only gradually until it reaches the recommended maximum Vgg of 5 volts. At that voltage the bias current is about 6 A. And that's the maximum bias current used for the readings taken in graphs 3 to 5. Figure 2 shows the gain relative to 1300MHz. It shows that the gain peaks at about 1270 MHz where it's about 5dB to 6 higher depending on bias current. As the frequency increases the gain reduces until at 1240 MHz it's close to being the same as it was at 1300MHz. Figures 3 through 5 show that the gain is a bit kinky for reasons unknown below bias currents of an amp or so. The gain variation with input level isn't huge but a second attribute of operating with low bias currents comes into play. And that is that the module doesn't have enough gain to reach full output before the maximum input power of 300mW (24.8 dBm). Additionally as the gain versus bias current is quite steep in the low bias currents region I suspect that the gain variation at a given low Ibias is likely to be large if evaluated over a number of amplifiers.

At bias currents at 1.5A and above the device provides good linear gain up to the 1dB compression point and there is enough gain to achieve full output without exceeding the maximum input power. For this reason two bias currents were chosen. If the maximum input power available to drive the amplifier is less than about 8 dBm use the high bias setting. If a higher input power is available set the bias current to 1.5A to conserve overall power.

Only two units have been assembled so it's very likely the full gain variation of this amplifier has been seen. It's best if the overall gain and 1dB compression point can be measured on a unit then use the 24-23 cm attenuator calculator in the calculators folder to determine the input attenuator needed for input power available. If that's not possible from the characterization data the following data points can be derived for bias currents of 1.5 and 6 amps

Overall Amplifier Gain and Power Performance

Frequency	***P1dB***		***Amplifier Gain***		***Pin for 1dB point***		***1st Stage Amp***	
			Ibias	***Ibias***	***Ibias***	***Ibias***	***Gain***	***Pout***
MHz	***dBm***	***Watts***	***1.5A***	***6.2A***	***1.5A***	***6.2A***	***dB***	***dBm***
1240	44.5	28.0	38.5	44.5	6.0	0.0	14	20.0
1270	44.0	25.0	40.0	49.5	4.0	-5.5	14	18.0
1300	42.5	18.0	37.0	43.5	5.5	-1.0	14	19.5

From which the values for the input pi attenuator for available input power can be determined:

Input Pi Attenuator Setting

Pin	***Ibias 1.5A***			***Ibias 6A***		
dBm	***1240 MHz***	***1270 MHz***	***1300 MHz***	***1240 MHz***	***1270 MHz***	***1300 MHz***
-5	---	---	---	---	0.5	---
-4	---	---	---	---	1.5	---
-3	---	---	---	---	2.5	---
-2	---	---	---	---	3.5	---
-1	---	---	---	---	4.5	---
0	---	---	---	---	5.5	1.0
1	---	---	---	1.0	6.5	2.0
2	---	---	---	2.0	7.5	3.0
3	---	---	---	3.0	8.5	4.0
4	---	---	---	4.0	9.5	5.0
5	---	1.0	---	5.0	10.5	6.0
6	---	2.0	0.5	6.0	11.5	7.0
7	1.0	3.0	1.5	7.0	12.5	8.0
8	2.0	4.0	2.5	8.0	13.5	9.0
9	3.0	5.0	3.5			
10	4.0	6.0	4.5			
11	5.0	7.0	5.5			
12	6.0	8.0	6.5			
13	7.0	9.0	7.5			
14	8.0	10.0	8.5			
15	9.0	11.0	9.5			
16	10.0	12.0	10.5			
17	11.0	13.0	11.5			
18	12.0	14.0	12.5			
19	13.0	15.0	13.5			
20	0.0	2.0	0.5	*Bypass the 1st stage amp*		
21	1.0	3.0	1.5	*Bypass the 1st stage amp*		
22	2.0	4.0	2.5	*Bypass the 1st stage amp*		
23	3.0	5.0	3.5	*Bypass the 1st stage amp*		

The attenuator values for 1240 and 1300 MHz are almost identical. If the amplifier is to be used at both ends of the band use the 1240 gain settings. To operate anywhere in the band set the attenuator for the 1240 MHz values and back off the modulation a bit. With input powers of 20 dBm and above the first stage amplifier isn't needed so it can be bypassed and the input attenuator set to the values in the table.

The input attenuator won't take powers higher than 23 dBm. Also the input power should never exceed the power selected for the attenuator by more than about 3 to 5 dB.

These1% 0603 resistors can be used to create attenuation between 0.5 and 16 dB

Atten dB	***R1 ohms***	***R2 ohms***	***R3 ohms***
0.5	1740	2.87	1740
1.0	866	5.76	866
1.5	576	8.66	576
2.0	432	11.5	432
2.5	348	14.7	348
3.0	294	17.4	294
3.5	249	20.5	249
4.0	221	23.7	221
4.5	196	27.4	196
5.0	178	30.9	178
5.5	165	34.0	165
6.0	150	37.4	150
6.5	140	41.2	140
7.0	130	44.2	130
7.5	121	48.7	121
8.0	115	52.3	115
8.5	110	57.6	110
9.0	105	61.9	105
9.5	100	66.5	100
10.0	97.6	71.5	97.6
10.5	93.1	76.8	93.1
11.0	88.7	80.6	88.7
11.5	86.6	86.6	86.6
12.0	82.5	93.1	82.5
12.5	80.6	100	80.6
13.0	78.7	107	78.7
13.5	76.8	113	76.8
14.0	75.0	121	75.0
14.5	73.2	127	73.2
15.0	71.5	137	71.5
15.5	69.8	143	69.8
16.0	68.1	154	68.1

a. Remove the zero ohm R2 jumper.
b. Install selected resistors for R1 to R3
c. Set the bias current by adjusting R6 for the chosen bias current

11. Assemble components on the 1590Y chassis

Figure 8 shows the connections from the PCB connectors to external components

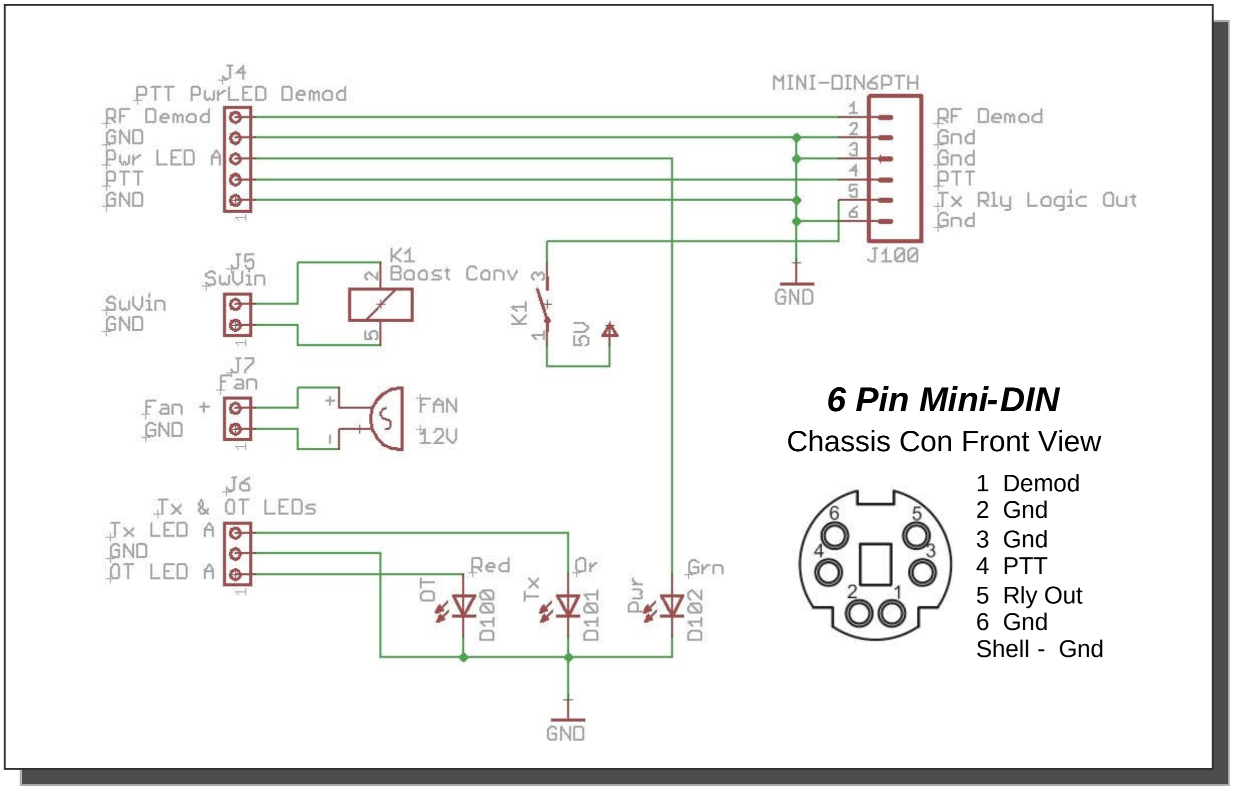


Fig. 15 Amplifier I/O Connections

a. Install the 6 pin mini-DIN chassis mount connector, adjacent ground lug, chassis mount 'N' connector RF out pigtail, and Rx out chassis mount SMA pigtail
b. Install the SMA relay and wire it's relay coil and sense out lines to J7 and pin 5 of the mini-DIN

12. Assemble and wire the 1590Y chassis

a. Place the 1590Y chassis over the module and PCB assembly then secure it to the heatsink with two pan head and two flat head screws
b. Install the 5mm power, transmit, and over temperature indicator LED's.
c. Wire J4, J5, J6 and J7. Plug these jacks into the printed circuit board then wire them to their associated connectors and components.
d. Assemble a Powerpole connector with red and black 16 gage wire leads about 8 cm long
e. Place a flat washer over the 2:56 mounting hole in the 1590Y enclosure used for the Powerpole connector. It may be best to use a small amount of silicone adhesive to keep the washer in place during assembly.
f. Assemble the Powerpole connector then solder the power supply leads to the PCB. Positive to the Vin pad and negative to the adjacent middle section ground plane.
g. Form the leads and screw the Powerpole connector to the heatsink through the 1590Y chassis using a 5/8" 2:56 bolt and washer.
h. Connect the 'N' RF output pigtail to the SMA relay common port. Connect the SMA female bulkhead pigtail to the relay normally closed port. Connect the SMA male to male pigtail between the PCB RF output connector and the SMA relay normally open port

13. *Final Assembly*

a. Drill 4 holes in the 1590Y lid for feet and attach them.
b. Add a label to the lid to describe I/O functions. An example can be found in the 'PCB to I-O wiring for PCB V0.0h.ppt' document

Fig. 16 1590Y Enclosure Bottom Cover

c. Connect the SPST switch that was used on J4 for PTT and connect it between pins 3 and 4 of the male 6 pin mini-DIN cable.

Functional Verification Test 6 – Final Checkout

This last functional verification test provides a check-out for the fully assembled amplifier. An RF signal generator is recommended but if not available use the RF source that was designed to be mated with this amplifier. It's assumed the input attenuator has been selected for the mating signal source.

a. Set the signal source for CW output at 1296 MHz with output amplitude of 0dBm. Keep the generator off for now
b. Verify that the RF path from the Antenna to the Rx out port is functional. Connect the generator to the Antenna 'N' connector. Turn the generator on and monitor the power at the Rx Out port. It should be close to 0 dBm the same as the power at the Antenna port.
   - ☐ Power Rx out _________dBm.
d. Verify that the SMA relay switches correctly. Turn the signal generator RF output off and connect it to the PA in port. Connect an RF power meter and dummy load to the Antenna port. Connect the mini-DIN male, make sure the PTT switch is open and none of the other cable leads are shorted to one another. Connect a voltmeter to the relay sense output mini-DIN leads from pins 5 and 6. connect a current monitor, battery or power supply to the Powerpole connector and turn the power supply on
e. Monitor the power supply current. It should be under 10mA and there should be no RF power at the Antenna port. It not something's wrong, remove power and check connections. The relay sense output voltage should read low.
f. Verify that the power LED is illuminated and that the transmit and over temperature LED's are off.
g. Close the PTT switch. Monitor the power supply current and RF output power at the Antenna port. The power supply current should be less than 2 amps and the output power should remain zero. If not remove the supply voltage immediately and check connections. With the PTT switch closed the transmit LED should illuminate and the relay sense out port should be high.
h. Turn the RF generator on and measure the RF output. It should be close to 40dBm

- ☐ Pout _________dBm.

i. Using a heat gun or rework hot air tool heat the U4 the thermostat. Verify that the fan turns on and as the IC temperature exceeds the over temperature verify that the over temperature LED illuminates and the RF output power drops to near zero.
j. If you need the higher gain offered by the 6 amp bias setting change R6 while monitoring the supply current. Make sure to account for bias current used by the first stage amplifier and fan.

That’s it go out and enjoy the new toy...