



# TXA5-RCb ATV TRANSMITTER BOARD

The TXA5-RCb was designed for R/C model and Rocket applications, but can be used for any Amateur Radio ATV set up. The 3.5 x 1.8 is size should fit standard model rocket packages and accommodate most model aircraft. The board comes wired and tested and crystal controlled to your specified 70 CM frequency. 426.25 MHz is suggested for R/C to stay away from FM and ATV repeater inputs normally found on 434.0 or 439.25 MHz. Check with local ATVers.

The video modulator contains an adjustable sync stretcher circuit that accurately sets the 70% / 30% video to sync voltage ratio to compensate for any non-linearities in the video source, exciter or add on amplifiers, regardless of average picture level changes or video gain control adjustments.

The RF section has a crystal controlled oscillator around 106 MHz that operates at 1/4 the output frequency. This keeps crystal fundamental or harmonics out of the range of the R/C receivers below 75 MHz and 2 meter voice coordination channels. The oscillator is followed by two doublers and a modulated driver and final. Frequency range is 425 to 440 MHz with a selected crystal tolerance of .005%. Power output is adjustable from 1.5 Watts p.e.p. @ 13.8 Vdc to as low as 100 mW. Maximum power drops to about the 1 Watt legal limit for radio control (Part 97.99) with a 12.6 V battery.

**DC POWER INPUT:** Power requirement is 12.0 to 14.0 Volts DC at up to 350 MA with maximum RF output and 225 MA at 100 mW. Do not exceed 14.0 Volts, and make sure of supply polarity before applying. A small 1/2 to 1 Amp fast blow fuse is suggested in the + supply line. Run #22 wires from the battery or regulated power supply to the solder pad marked "+" and the negative lead to an adjacent pad in the ground foil. It is necessary to have a separate power ground lead that goes directly from the board to the power source. The power source must be very stable as any ripple on the supply voltage shows up as noise modulation in the picture.

**VIDEO INPUT:** The board accepts any composite video source (1 volt peak to peak, negative going sync into 75 Ohms). This is standard from most all US cameras. Twisted #22 hook up wire can be used for runs up to 6 inches long, otherwise use small coax of any kind for up to 10 ft, or 75 Ohm coax for anything longer. The center conductor goes to the "V" pad and shield to the adjacent ground foil.

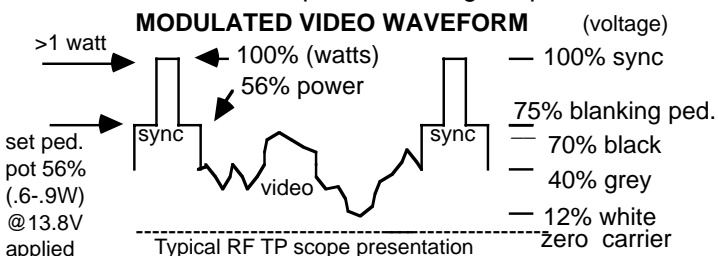
**AUDIO SUBCARRIER INPUT:** This is optional if you also want sound. Use a short direct length of coax from the FMA5-F Sound Subcarrier Board with the center lead to the TXA5-RC "S" solder pad and braid to the ground foil. Keep all audio leads away from RF leads as possible.

**RF OUTPUT:** The board comes set up by us for a nominal 1.5 Watts p.e.p. RF output (sync tip power -.9 Watts blanking pedestal) into a 50 Ohm dummy load with a regulated 13.8 Vdc power supply. Less power can be set with C7.

It is very important for normal operation as well as preventing the final or modulator transistor from blowing, to have a low VSWR antenna/load. No more than 10% reflected power is acceptable. Take special care with all RF cable, connectors and the antenna. Small RG174 coax center conductor can be directly soldered to the RF output "A" pad and it's shield to the adjacent ground foil, and the other end to the antenna or chassis connector as shown on page 2.

**MOUNTING:** The board must be put in a shielded enclosure to prevent stray RF from getting into the camera, R/C receiver or interference, and to provide a heat conduction/radiation path. See the app note using a 1590C box for base or portable. Other applications can use the Eagle box, Sescom SB-6 or Radio Shack 270-238 Aluminum box. For heat conduction and grounding, mount with all 4-40-1/2" screws and nuts as illustrated, or tack solder at the four corners if you make a brass or copper enclosure. Keep power, video and sound leads away from the antenna output or any part of the RF section.

**BLANKING PEDISTAL:** This control must be reset any time the the power supply voltage is changed more than .5 Volts, C7 is changed, or an external amplifier is connected. Only adjust this control with no video connected. Turn the 1K blanking pedestal pot to full counter-clockwise - max indicated power on a RF Wattmeter or dc Voltmeter on the output test point. With an external amplifier, a Wattmeter must be placed on the amp output. This level is the peak envelope power or sync tip power. Make a note of it's value. Next slowly rotate the blanking pedestal pot (clockwise) for 56% of the Wattmeter reading, or 75% of the output test point voltmeter reading. If you have a calculator, multiply the Watts by .56 or the Volts by .75 for the proper blanking pedestal power level. Again, do not touch the trimmer caps after setting the pedestal.



**POWER OUTPUT REDUCTION:** C7 can be rotated up to 90 degrees to decrease the power to as low as 100 mW, if desired, but do not touch the other trimmer caps; they will change the video linearity and could become unstable. Reducing RF power out may help R/C receiver overload, but shielding the R/C receiver, adding the low pass filter and shielding the transmitter to reduce the 100 MHz crystal oscillator radiation into the receiver will have more effect. See the R/C app note before flying the ATV transmitter.





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## Packaged TXA5-RCb 1.5 Watt 70cm ATV Transmitter

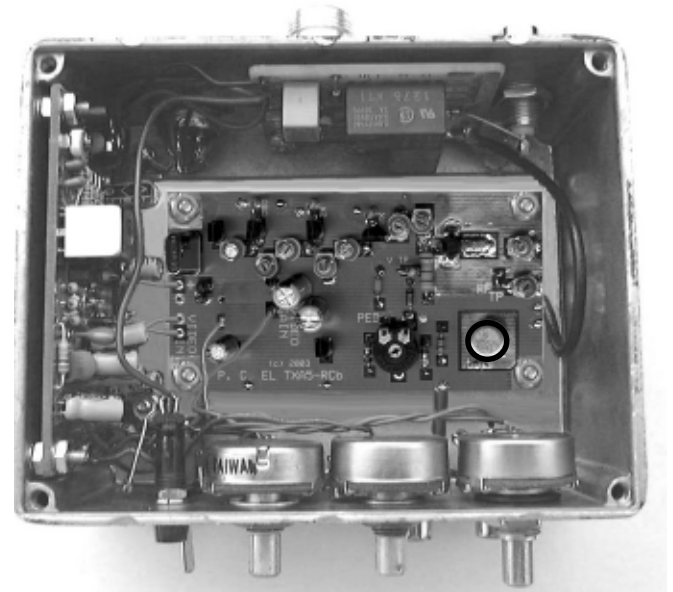


The TXA5-RCb 1.5 Watt 70cm ATV transmitter board, along with the FMA5 sound subcarrier generator and TR-1b T/R relay boards can be packaged in a small 4.7x3.7x2.1" CAB234 die cast aluminium box for base or portable use. At the home shack, it may be used with the TVC-4G downconverter with its 13.8 Vdc and antenna input switched by the TR-1b in this box. The small box also makes it perfect for public service events, field day, etc., it can easily be externally battery powered and clipped to a belt or back pack for portable operation.

### Construction procedure:

Yes, it's tight but worth it. All the boards and parts listed will fit within the Hammond 1590C die cast aluminum box if care is taken and the mounting sequence followed.

1. Drill out the box using the templates. Check that all parts fit properly in the holes. Clean box with isoprophyl alcohol then paint and letter the outside surfaces.
2. Mount the lower row of front panel connectors, toggle switch, rear panel BNC and N jacks. Put in the board mounting screws (but use a single nut instead of two). A ground lug is used under each of two of the TXA5-RCb nuts closest to the FMA5 instead of a lock washer.
3. Before mounting the DC power jack, prewire the leads:  
Sockets 1 and 3 1" #22 buss - solder to gnd lug  
Sockets 2 and 4 2" #22 red
4. Solder 1" buss wires (4) on the RCA jack center & ground lug.
5. Solder a 3" #22 green wire to the Mic jack center lug
6. Solder a 1" buss wire from the bottom lug of the toggle switch to the adjacent ground lug. Also solder one side of a 100 ohm 1/4 watt resistor to this same ground lug -long ground lead
7. Solder 6" & 1.5" black #22 wires to toggle switch center lug  
Solder, other end of the 1.5" lead to the PTL jack center lug..
8. Remove 100 ohm video gain pot from TXA5-RCb, 50K mic gain pot and 10K line audio gain pot on FMA5 board.
9. Solder the RG174 coax between the boards:  
4" from TXA5RCb A antenna output top side to TR-1b T pad.  
5.5" from TXA5RCb S sound input to FMA5 out bottom pads.
10. Solder twisted 4" long yellow and blue #22 wires from top of TXA5-RC center (blue) and CW (yellow) pads to the respective 100 ohm video gain panel pot terminals.
11. Solder 3.5" #22 green wire from 10K line audio panel pot center lug to respective solder pad on FMA5 board.
12. Solder 3" green twisted pair from 50K mic gain pot center and CCW lugs to respective solder pads on FMA5 board.
13. Solder on TR-1b board +TX pads: 3" #22 red to FMA5 +, 5" #22 red to TXA5-RCb + and a 4" #22 red. Solder 1" buss to R pad. Solder the black lead from the toggle switch to the PTL pad. Solder the red lead from pin 4 of the DC power jack to the +R solder pad and then mount the board. Solder the N center pin to the board and the R buss wire to the BNC center - carefully angle the iron so as not to melt the relay cases.
14. Solder wire from the mic jack to the M pad on the FMA5 board.
15. Mount the TXA5-RCb board then the FMA5 - no top nuts necessary on the bottom two FMA5 mounting screws, no room.
16. Mount the transmit lamp and connect the 4" red wire from the TR-1b board +TX to one side, 100 ohm resistor to the other.
17. Mount the panel pots. Solder the 4 buss wires from the RCA jacks to their respective CW and CCW (gnd) lugs.
18. Dress the wires and check everything for shorts.
19. Make DC power cable - use a fuse holder in + lead from pin 2.





## Packaged TXA5-RCb 1.5 Watt 70cm ATV Transmitter cont.

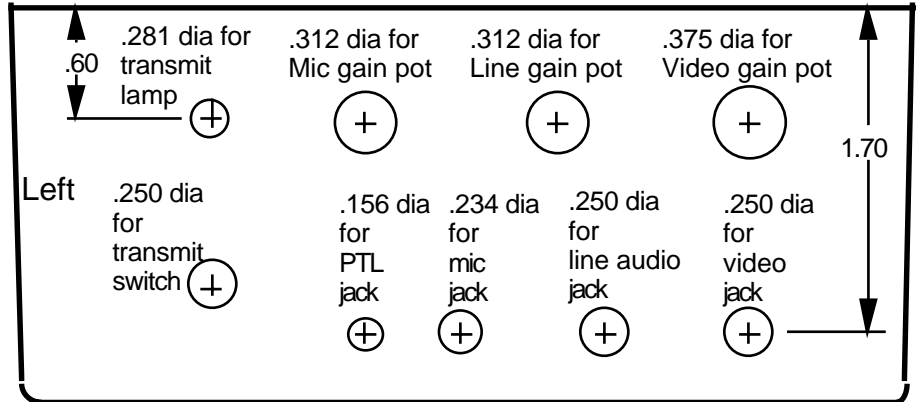
### Chassis Layout

Cut out the drill templates here and on the next page, and place over the respective Hammond 1590C aluminum box sides. Align with the edges and hold in place with tape or a rubber cement. Center punch through the paper, or poke a hole through the paper, then place on the box and mark with a pencil. Measure the distances to the alignment reference holes and correct if necessary before drilling.

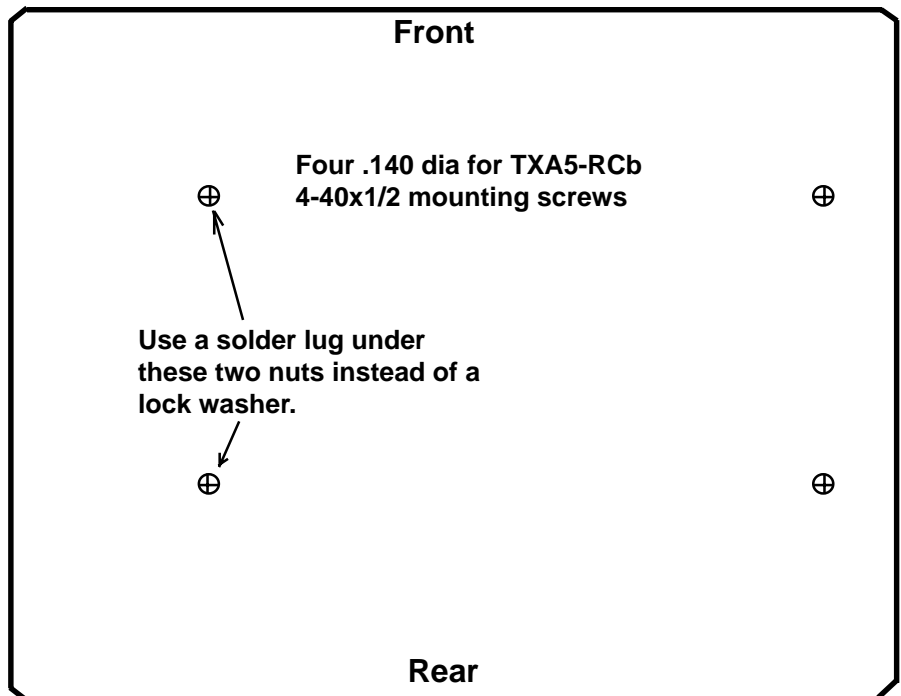
Drill all holes with a .140 dia drill first, check alignment again, then finish with the larger drills. Debur all holes.

Check all parts for fit, then clean the box with isopropyl alcohol prior to painting. Spray paint the outside surfaces of the box and cover. After drying, rub on letters can be applied and then a coat of clear paint. Again, after complete drying, assemble all the parts and wire per the sequential procedure on the previous page.

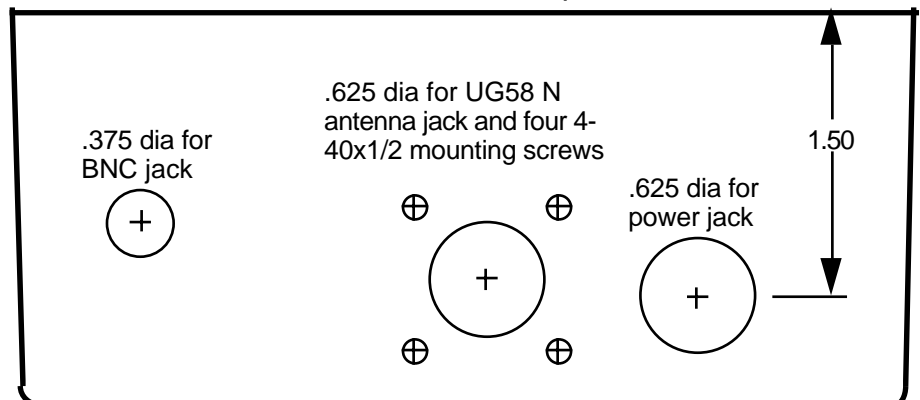
Front view from outside, top cover removed



Bottom view from outside



Rear view from outside, top cover removed





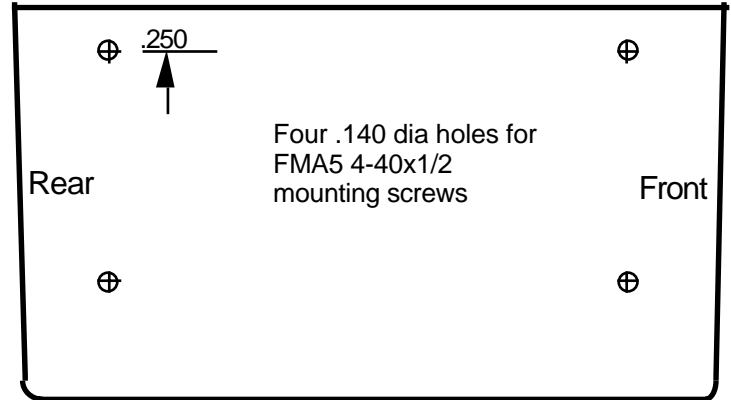
## Packaged TXA5-RCb 1.5 Watt 70cm ATV Transmitter cont.

### Parts list for packaging the ATV transmitter:

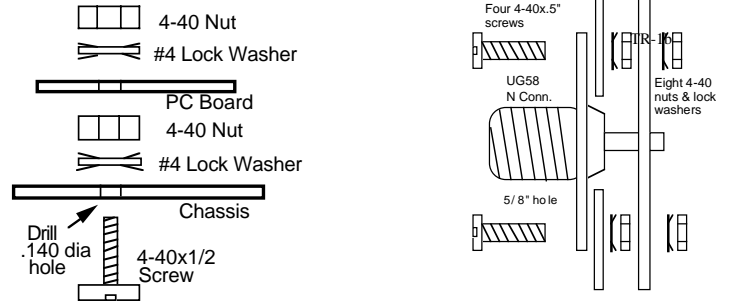
RS part numbers = Radio shack, the alternates after are from Mouser - call: 1-800-346-6873

- 1 TXA5-RCb ATV transmitter board, P. C. Electronics
- 1 FMA5 sound subcarrier board, P. C. Electronics
- 1 TR-1b T/R relay board, P. C. Electronics
- 1 UG-58 N chassis jack, P. C. Electronics
- 1 100 Ohm carbon pot, P. C. Electronics
- 1 Hammond 1590C die cast aluminum box, 546-1590C
- 1 10K line audio pot, RS 271-1715, 31VA401
- 1 50K mic gain pot, RS 271-1716, 31VA405
- 1 UG1094 BNC chassis jack, RS 278-105
- 1 4 pin chassis power jack, RS 274-002
- 1 4 pin power plug, RS 274-001
- 1 Inline fuse holder, RS 270-1217
- 1 1 Amp 3AG fuse, RS 270-1005, 504-AGC-1
- 2 RCA phone jack, 161-1052
- 1 Mini mic jack, 16PJ012
- 1 Sub-mini PTL jack, 16PJ100
- 3 Knob, builders choice, ME 450-6015 - shown in pix
- 1 Toggle switch, RS 275-612, ME 108-MS550K
- 1 Lamp, RS 272-331
- 1 100 Ohm 1/4 watt resistor, RS 271-1311, 29SJ250-100
- 12 4-40x1/2" pan head screws, RS 64-3011, 5721-440-1/2
- 22 4-40 nuts, RS 64-3018, 5721-440
- 20 #4 internal tooth lock washers
- 2 #4 solder lug, 534-7311
- 4 Rubber bumpers, RS 64-2346, 517-SJ-5007BK
- Misc #22 hookup and buss wire, #18 for DC power leads

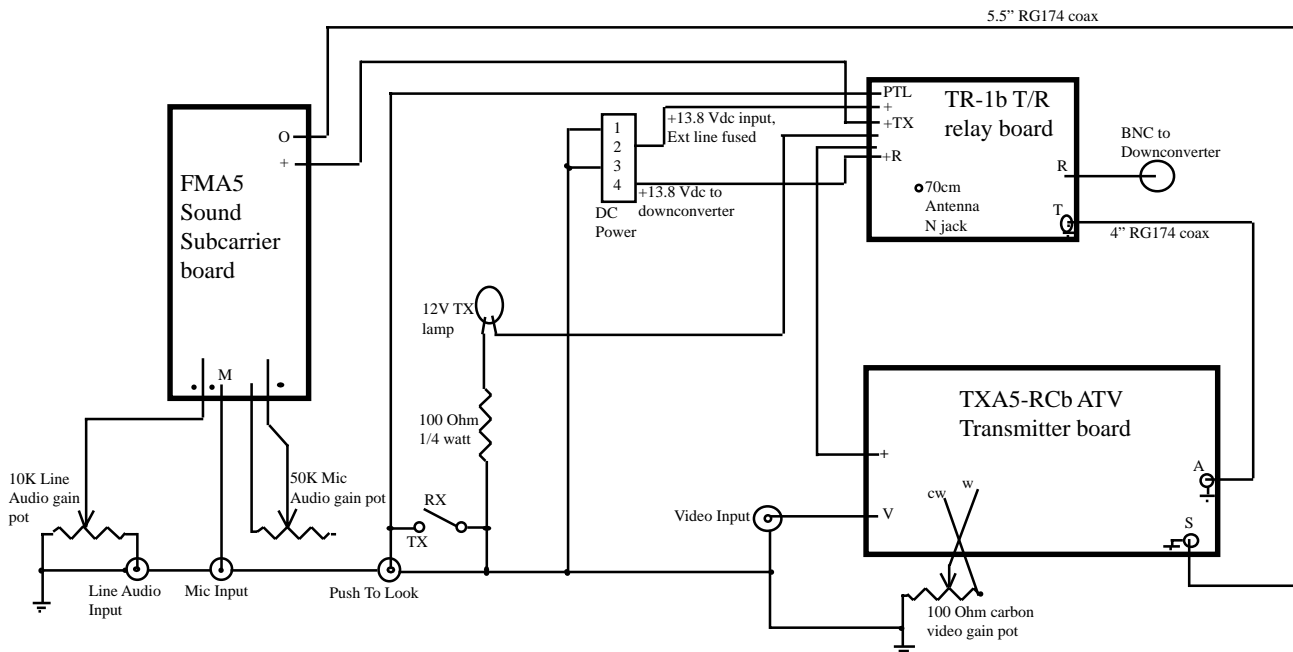
Left Side view from outside, top cover removed



### Board Mounting Detail



Place screw through hole in chassis, drop on lock washer or solder lug, then finger tighten the nut. Then place the PC board on the nuts and check for fit. Push down on the board near the mounting hole while tightening with a screwdriver to lock in the alignment. Then put on the final lock washer and nut.





## Driving the PA5 20 Watt Amplifier from the 1.5 Watt TXA5-RCb ATV Transmitter Board

There are many applications where having the flexibility of easily switching from 1.5 Watts to 20 Watts without having a completely separate ATV transmitter system is desirable. If 1.5 Watt is not enough for a public service event, or in a long range balloon, rocket or R/C application, but there are other times when you don't need 20 Watts, then you can drive the PA5 20 Watt peak envelope power amplifier through a RF attenuator.

I often get asked if the PA5 20 watt amp can be driven by the TXA5-RCb just by turning the peak envelope power down with C7. The answer is maybe; but you must be able to accurately measure the TXA5-RCb output power. If you don't verify before connecting to the PA5 that the power is less than the 200 milliwatt's, you will blow the first stage of the power module. Most do not have a RF power meter that will accurately go down that far.

Secondly, the 20 watt power module in the PA5 only takes about 20 mw to give the 20 Watts out at 13.8 Vdc applied. The TXA5-RCb may not want to be turned down that far (adjusting C7) and still be able to set the pedestal as well as get good stable video.

If you want to switch back and forth between 1.5W and 20W pep the easiest answer is to put a good, known, 15 or 20 dB 2 watt inline attenuator in the coax line between the TXA5-RCb and PA5. Mini-Circuits Lab makes a 50 Ohm 2 watt inline coax attenuator with SMA connectors, model S20W2, for \$30 (718-934-4500 www.minicircuits.com).

Using a 13.8 Vdc supply, the 20 dB Mini-Circuits Lab S20W2 attenuator, gave 16.5 watts pep out with 1.7 watts out of the TXA5-RCb on 426.25 MHz in my tests. Dropping the DC voltage down to 12.0 Volts to the TXA5-RCb as one might do in an R/C aircraft, rocket, portable, or engine off mobile, the TXA5-RCb put out 1.3 watts pep and the PA5 9.6 watts. If the PA5 is also run at 12.0 Vdc then you could use the 15 dB model S15W2 attenuator for higher power output.

You can also build a Pi attenuator using non-inductive resistors (no wire wounds), but the wire leads are very significant inductors, especially the 62 Ohm resistor. The TXA5-RCb side 62 Ohm needs to be a 2 Watt as it dissipates most of the power.

Direct connect with RG174 coax or with connectors if in a separate chassis.

Interconnection shown before mounting in the PA5 chassis.

Mouser Electronics (800-346-6873) Part Numbers  
 62 Ohm 2 Watt Metal Oxide Resistor - 282-62  
 220 Ohm 1 Watt Metal Oxide Resistor - 281-220  
 100 Ohm Carbon Trim Pot - 531-PT10V-100

Use a small piece of copper PC board as a ground plane and heatsink to mount the attenuator parts. Bend the pot CW and wiper pins up 180 degrees and connect directly to the 220 Ohm resistor and to the RG174 coax center. CCW pin to ground. Make sure that the CW and wiper pins do not touch ground when adjusting. With TXA5-RC pedestal pot at max CCW, no video plugged in, start attenuator pot at CCW and slowly increase to 20 Watts. Then reset the pedestal pot for 11 to 12 W.

The attenuator shown varies from about 18 dB to 33 dB with the pot, and gave 25 Wpep max to 2 Wpep minimum when driven with 1.7 Wpep from the TXA5-RC. Construct on a 1.5 x 1.25" piece of copper PC board. Note there are practically no leads so as to minimize inductance. Two holes are drilled to mount on the chassis with screws to help pull away some of the heat. Check for shorts before applying power with an Ohm meter.

Another solution, if you have room, is to coil up 80 feet of RG174 coax to give the 20 dB of attenuation at 420 MHz between the two modules. RG-174 has 25 dB/100 ft. of insertion loss at 420 MHz or 1 dB/4 feet. The coax length can then be reduced little by little until the full 20 watts p.e.p. is reached out of the PA5. No matter which method of attenuation you use, you would need to have a good RF power meter in the PA5 output to verify that the peak envelope power does not exceed 20 Watts and to reset the TXA5-RCb pedestal pot for 60% of what ever the p.e.p. reading is. The PA5 will put out more p.e.p., some as high as 30 watts, but the video linearity and color burst start to degrade and the signal strength between 20 and 30 watts is hardly noticeable at the receive end.

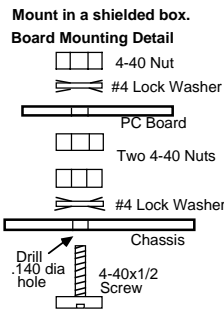
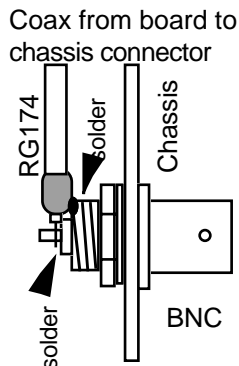


## Packaging the 1W ATV Transmitter Board for R/C

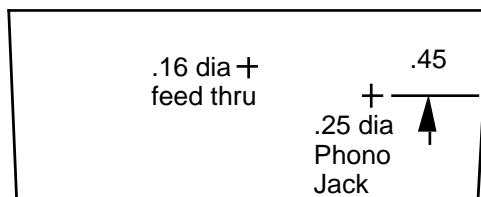
One might be tempted to not package the TXA5 transmitter for placement in a R/C vehicle in order to save weight, but it is necessary to minimize radiation from the crystal oscillator between 105 and 110 MHz and other stages through to the final output from getting into the close by R/C receiver. A 72 or 75 MHz R/C receiver does not have a lot of rejection at 105 MHz, a 50 MHz R/C receiver will do best but still might not be enough depending on how close the transmitter is to the receiver and also the respective antenna separation. The die cast aluminum box shown here only takes the weight from 2 oz. to 6.5 oz but provides great shielding.

The Eagle 4591 4.5x2.5x1.2" die cast aluminum box is slightly larger than the similar size in LMB, Bud or Hammond and will accommodate the TXA5-70S or TXA5-RCb transmitter boards. Place the board centered in the box, mark and drill four .140 holes. Drill templates are shown below for the connector ends. A BNC UG88 or gold plated SMA jack is used for the RF output with RG174 braid soldered to the shell. RG58 or RG174 coax cable with a BNC or SMA plug on the end can be made or purchased from Nema Electronics (305 893-3924) to connect to the antenna. A .001 mF feedthrough cap is used for the DC input and a RCA jack with a 33 pF disc cap for RF bypassing on the camera video input.

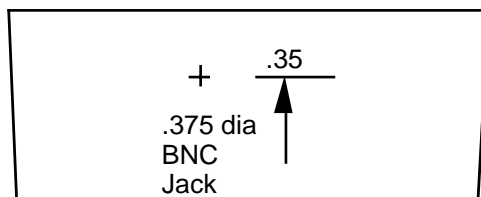
Before mounting the board, solder in a 1" video lead, 1" ground lead and 1.5" DC power lead to the respective board solder pads. Finger tighten the 4-40x1/2 screws, lock washer and double nuts. Mount the board, and while holding the board down in place with your hand, tighten the screw heads. Then put the lock washer and



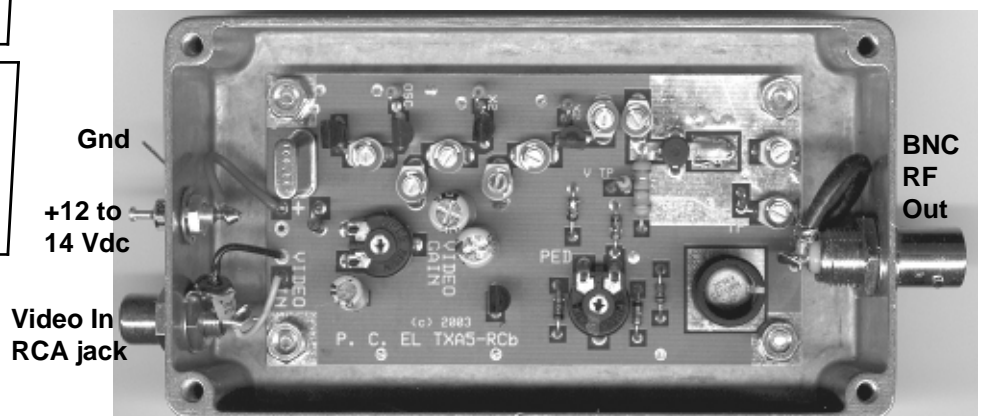
nuts to hold the board. Mount the RCA jack and bend the ground solder tab so that the 33 pF disc cap has practically no leads when attached. Connect and solder the video and ground leads to the RCA Jack, then the DC power lead to the feed thru cap. Mount the BNC or SMA jack. Cut the RG174 coax to 2", strip the outer insulation off to 1/4" and fold it back. Strip the center conductor 1/8" and carefully solder to the connector as shown. This is necessary to prevent a VSWR current flowing all through the inside of the box. Verify with an Ohm meter that the coax is not shorted - >4K to ground.



Cut out drill template and center punch indicated hole locations. Check .35" and .45" dimensions from open edge with cover removed before drilling.



- Parts List;  
 TXA5-RCb ATV TX, P. C. Electronics  
 Eagle 4591 box, P. C. Electronics  
 .001 Feedthru cap, P. C. Electronics  
 RCA Jack, Mouser 161-1052  
 BNC Jack, Radio Shack 278-105  
 Mouser call 800-346-6873



TXA5-RCb in a Eagle die cast aluminum box