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PA5-20 20 WATT 70 CM ATV LINEAR AMP

The PA5-70 is built around the Mitsubishi M57716 all mode hybrid RF power module. The input and output is 50 Ohms and matches to the 50 to 80 milliwatts of drive from the 420-450 MHz TXA5-70b exciter. Other exciters may be used as long as their output power does not exceed 200 milliwatts pep - exceeding 200 mw can blow the M57716 power module. The power module has excellent modulation linearity and bandwidth for video up to 20 Watts p.e.p. RF output. See the next page for additional system and use information.

Power supply requirements are a regulated 13.8 Vdc (14 Vdc max) at 3 Amps. For mobile or portable use, a standard 12 Volt car battery may be used, however the output power will vary with the actual voltage between 12 and 14 Vdc. An in-line fuse of 4 Amps must be used to prevent transients or alternator spikes exceeding 16 volts or accidental reverse polarity connection from blowing the module. Take care when connecting and using the module as the manufacturer does not warranty the device once it has been soldered in. The modules are quite hardy, however, if you get no output, check the TXA5-70 output test point, coax interconnections, etc. first. Insert a good UHF 50 Ohm attenuator if driven from a higher power exciter, and verify that the output does not exceed 200 mW before connection to the PA5-20. If the power supply leads are over a few feet long, a 4700 mF 25V cap may have to be added in the power supply line in the mobile installation to prevent line impedance ripple. Use #18 or larger hook up wire.

The M57716 is not a direct physical replacement for the Toshiba SAU4,Motorola MHW 710-2 or Amprex BGY41B used in the older PA5 modules, although the mounting holes are the same distance. The pin outs are different: input and output is reversed, and there are 3 power connections instead of 2. The module can be put in the same location as the other modules, but two new holes must be drilled for the PC board mounting, and new coaxes run to the respective input and output pins. The M57716 and board must be mounted in an aluminum chassis for proper heat sinking and shielding. Do not operate the M57716 with just the heatsink. Mount the M57716 low on the chassis for best heat convection.

If even higher power is desired, set the power out of the PA5-20 with the RF out pot on the end of the TXA5-70 board. Other exciters without a RF power pot must use some inline attenuation. Ie: the Mirage D1010N-ATV with 4 - 9 dB of in-line coax attenuation (RG 174 has 1 dB per 4 feet) between the exciter output set to give 8 Watts p.e.p. maximum drive. Never detune the exciter trimmer caps to lower power output. However do not attempt to drive any other Amplifier with a maximum RF input rating of less than 15 Watts. The sync stretcher in the TXA5-70 insures maximum power on the sync tip regardless of the pedestal pot setting or video gain, which could damage Amplifiers made for 1 to 3 Watts input. Also, for a stronger signal, it is suggested that all effort should be put into the antenna and coax system first because each DB gain there pays off in both receive and transmit.

SET UP: ATV is a complex AM modulation, therefore the video swing must be set for the linear portion of the Amplifier input/output curve. To do this, the blanking pedestal (blacker than black) is set to between about 60% of the sync tip power. The sync tip power is the peak envelope power of the system (p.e.p.) and like the blanking pedestal, must be constant as set in the video modulator no matter what contrast is in the picture. Therefore every video transmitter must go thru this setup to insure stable video pictures. If you add another Amplifier later or applied voltage is changed .5 V, the same set up is done with the RF power meter always in the antenna line.

1. Connect RF output into a 50 Ohm dummy load or antenna with a VSWR less than 1.5 :1.
2. Connect a RF power meter (such as aDiamond SX-1000 RF power meter or Bird with 25E slug) in the antenna line.
3. Make sure that no video source is plugged in, pedestal pot and RF power pot at maximum power out. Turn on the PA5 13.8 Vdc regulated supply. Momentarily turn on transmitter, and turn the RF power pot on the TXA5-70 to no more than20 Watts. If less, repeak the TXA5-70 and connections. If a TXA5-RC 1.5W transmitter is used, place a good 20 dB 50 Ohm 2W attenuator like the Mini-Circuits Lab (718-934-4500) S20W2 in series to the PA5 input.
4. Note power output on RF meter (this is the sync tip power-p.e.p.). Reduce the power to 60% on the power meter (pep X .6, ie. 20 watts pep X .6 = 12 pedestal), with the TXA5 Pedestal pot (this is the blanking level). Let it run for 5 minutes. If the bottom of the heat sink gets so hot that you cannot stand to touch it with your finger (135 degrees F), the aluminum chassis is not conducting the heat enough.
5. Take RF power meter out of the line, further readings are meaningless since it is an average reading meter responding to modulation only under 50 kHz and varies with video modulation level and picture contrast. Do not touch pedestal pot during video modulation, it is now set to maintain proper video to sync ratio independent of video gain setting.
6. Connect camera and slowly increase video gain pot to the point of white smearing in the picture, and then back off a little. White level is about 10% of sync tip power. If exceeded, the RF is shut off during extreme white periods resulting in a smear and a buzzing sound in the audio. You can try monitoring your own received picture on another cable ready TV on ch 58-60, but better to have a ham a few miles away talk it in back to you on 2 meters.

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Putting together the Basic 20 Watt ATV Module System

There are many ways to construct and package your ATV system to suit your application and tastes. This is presented as an example with notes on some of the considerations .

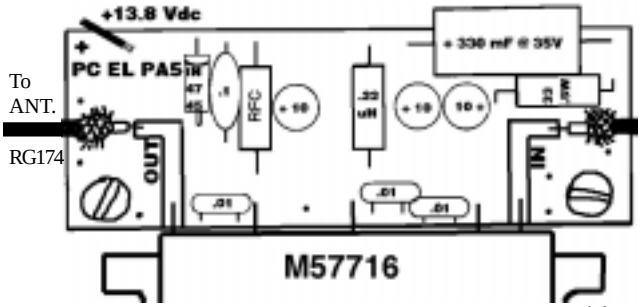
The modules must be put inside an aluminum enclosure for RF shielding and heat sinking. A 2.5x7x7" or larger aluminium chassis and bottom cover will make a nice transceiver. The Hammond 1590F die cast aluminum box makes a nice RF tight enclosure and is the same one used for the TC70-20 ready to go transceiver, or 1590E as with the TX70-10. Mount the PA5-20 and TR-1b on the back panel, with the M57716 as low as possible for best heat convection. Unscrew the Power module & its board from the heatsink & poke through the 4 mounting holes and a piece of paper with a pencil. Use this as a template from the opposite side to center punch the drill locations on the chassis. Make sure the Heatsink will mount at least 1/8" above the bottom edge of the chassis. Drill the holes 3/16 dia and *carefully debur on each side*. The M57716 must be on a perfectly flat surface or you could crack the ceramic substrate inside when you bolt it down. Use a *thin* layer of heatsink compound under both the M57716 and the Heatsink. Mount the M57716 and its board inside the chassis, and the heatsink outside by running the 4 screws from the M57716 side thru the chassis into the heatsink.

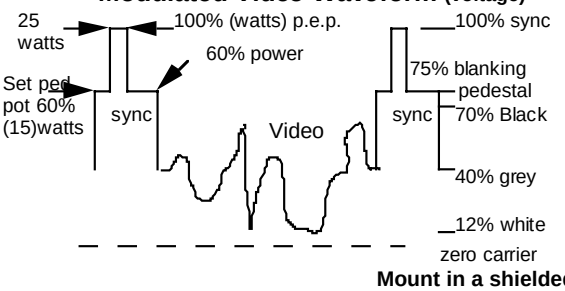
See the TR-1b sheet for mounting that module. A type N UG58 chassis connector is suggested, and RG174 small 50 Ohm coax carefully run to the PA5-20 and TVC-2G modules. To keep the VSWR from running around inside the chassis, carefully dress the coax braid back over its outer insulation no more than 1/4" and directly solder to the board ground planes. When soldering, make sure there are no bends or stress on the coax. Do not pig tail the braid at these UHF frequencies.

A four pin power input connector is wired thru a 4 amp fast acting fuse to the spst power on switch. The other two unused pins can be used to control or power external devices. The TVC-2G downconverter, TXA5-70 exciter, and FMA5 subcarrier generator can be mounted inside the chassis with 4-40x1/2 screws and double nuts for spacers (see board mounting detail). Again, keep the length of the center conductor of the interconnecting coax out of the braid no more than 1/4". Solder the coax carefully and check with an Ohmmeter for shorts. Use #18 wire for the PA5-20 +13.8 Vdc connection, and #22 solid for all the rest. Dress all wires away from the RF coaxes and the power module. The video and audio leads & panel pot connections can be twisted pair up to 6" long. Use coax or shielded cable for longer runs.

You may want to remove & change some of the board trimpots for panel types to make adjustments easier. These would be the video gain on the TXA5-70, the mic and line gain on the FMA5, & the frequency tuning on the TVC-2G. Remove these pots and run three wires from the holes made by the removed pots to their respective carbon (no wire wound) panel pot. 100 Ohm carbon panel pots for the video gain are hard to find, but are available from us.

For RF purposes, bypass each video and audio input connector with a 100 pF disc ceramic capacitor , directly at the connector with short leads. Do not put any other boards inside the chassis that might be RF susceptible. RCA phono jacks are suggested for video, monitor and line audio inputs. A toggle or rotary switch can be used to switch between multiple video and audio sources.





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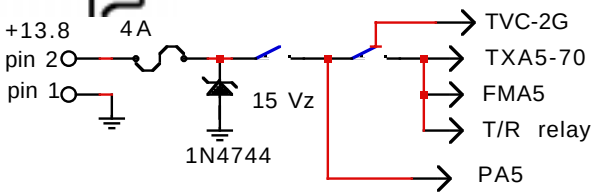
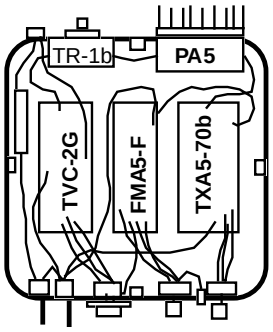
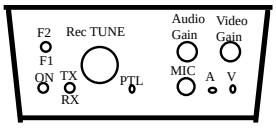




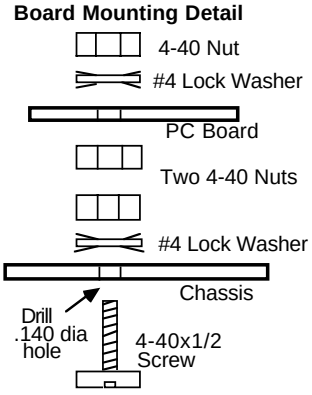
Hammond 1590F



See TR-1b or DMTR T/R Relay board sheet for power connections if that board is used - PA5 may be switched through a 5A contact or better relay or left on in receive. TXA5 and FMA5 power is switched by the T/R board power relay.

Mount in a shielded box.

Board Mounting Detail



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

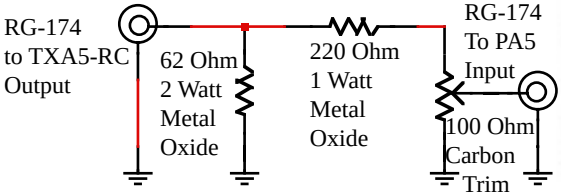
There are many applications where having the flexibility of easily switching from 1.5 Watts to 20 Watts without having a completely separate ATV transmitter system is desireable. If 1.5 Watt is not enough for a public service event, or in a long range balloon, rocket or R/C application, but there are other times when you dont 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-RC just by turning the peak envelope power down with C7. The answer is maybe; but you had better be able to accurately measure the TXA5-RC output power. If you dont 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-RC may not want to be turned down that far and still be able to set the pedestal as well as get good stable video.

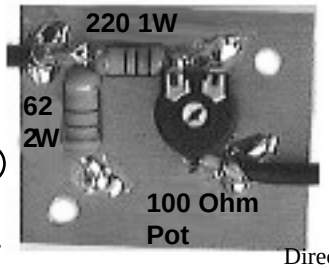
If you want to switch back and forth between 1.5W and 20Wpep the easiest answer is to put a good, known, 15 or 20 dB 2 watt inline attenuator in the coax line between the TXA5-RC and PA5. Mini-Circuits Lab makes a 50 Ohm 2 watt inline coax attenuator with SMA connectors, model S20W2, for $30 (718-934-4500 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-RC on 426.25 MHz in my tests. Dropping the DC voltage down to 12.0 Volts to the TXA5-RC as one might do in an R/C aircraft, rocket, portable, or engine off mobile, the TXA5-RC 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.

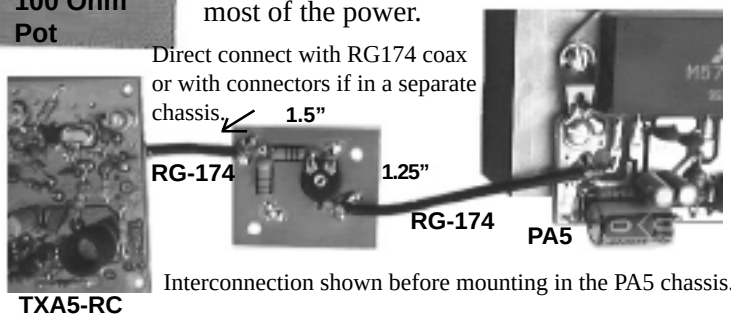


Mouser Electronics (800-346-6873) Part Numbers
62 Ohm 2 Watt Metal Oxide Resistor - 282-62
220 Ohm 1 Watt Metal Oxide Resistor - 281-220
100 Ohm Carbon Trim Pot - 531-PT10V-100

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.



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-RC side 62 Ohm needs to be a 2 Watt as it dissipates most of the power.



Interconnection shown before mounting in the PA5 chassis.

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-RC 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.

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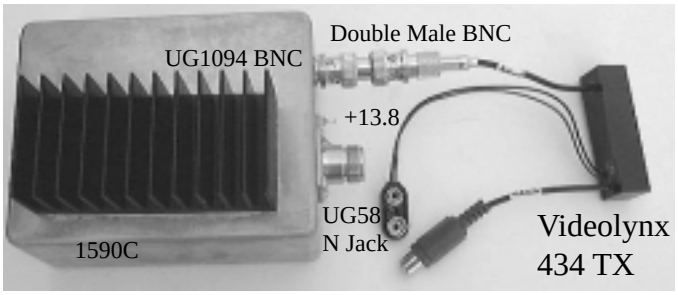
Driving the PA5 20 Watt Amplifier from the Videolynx 434 or Z70A Mini ATV Transmitters

The Videolynx 434 and Z70A Mini ATV transmitters are great for short range applications up to 1/2 mile dipole to dipole or ground plane to ground plane. But there may be times that you need to extend the range but cant use higher gain antennas and need a linear amplifier. Also, if you do not have a higher power ATV transmitter for the home station, and want to get some additional use out of your Videolynx, then you can add the PA5 20 watt amplifier. See the example in the photo to the right.



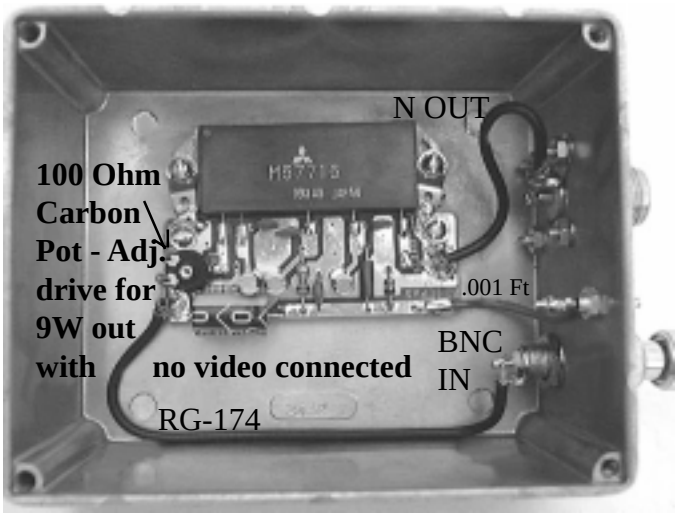
The 20 watt power module in the PA5 only takes about 20 mw pep to give the 20 Watts pep output with 13.8 Vdc applied. The drive power must never exceed the input linear limit otherwise the top of the modulated waveform with flatten out and splatter the band just the same as you might be familiar with when running SSB voice.

Generally, linear amplifiers will list the 1 dB compression point and is a good reference to set the peak sync at for ATV. This is the power where the straight line input vs output departs from the actual gain line and bends over toward less gain by 1 dB as the output power increases. The PA5 20 watt power module has a 1 dB compression point at about 14 watts output. This peak sync maximum corresponds to a reading on a Bird Wattmeter of about 9 Watts with dirve adjusted and no video plugged in to the Videolynx transmitter.

Since the Videolynx transmitters do not have a peak power output pot, video gain pot, or blanking pedestal (sync stretcher) pot like the TXA5-70 transmitter boards that were designed to drive this amplifier, you must reduce the peak power low enough so that the sync and color burst do not get compressed so far that the TV set will not lock up the sync and/or produce color. Over driving a linear amplifier will also clip the 4.5 MHz sound riding on the video waveform with the Z70A at each sync tip resulting in sync buzz in the received audio.

The amount of attenuation to put between the Videolynx transmitter and the amplifier input will vary from unit to unit. So on the surface, the easiest way to impliment the added amplifier is to add a 100 Ohm carbon pot. However, leads that are outside the coax are very significant inductors on the 70cm band. So one cannot use a panel pot like the video gain pot but must use a small carbon trimpot and make sure the connections are very short. Besides affecting the actual attenuation, the leads outside of the coax can radiate and get into other parts of the circuit.

The example below shows the PA5 module packaged in a 1590C die cast aluminum box which serves to both shield the circuit and dissipate heat. Note that the placement of the power module must be on a very flat surface and so is off set to one side to avoid a raised manufacturers logo in the middle of the box. RG174 50 Ohm coax is used between the connectors and the board with short direct connections. The Radio Shack 278-105 BNC has a solder tab on the end which is best for keeping the coax ground short. A solder lug is used under one of the N Jacks holes and pointed toward the center socket - coax center goes through a lug hole and the braid soldered to it. The TR-1b T/R relay board could be mounted on the N Jack if you wanted to switch the Antenna between the amp in transmit and the downconverter as well as DC power switching. Bend the 100 Ohm pot CW lead 180 degrees to keep it isolated from ground and solder the coax center conductor to it. The wiper solders to the PA5 IN pad and the CCW lead to the ground plane - bend leads 90 degrees.



The 13.8 Vdc is fed in through a .001 mF feed through cap. The Videolynx BNC antenna jack can be connected to the amp with a double male BNC adaptor.

PARTS LIST

PA5 20Watt power module, includes heat sink and 1 ft of RG-174 coax - P. C. Electronics

1590C Hammond Die Cast Aluminum box - Mouser Elect.

UG-58 Type N Jack - P. C. Electronics

.001 mF Feed Through Capacitor - P. C. Electronics

100 Ohm Carbon trim pot - Mouser Electronics

UG-1094 BNC Jack - Radio Shack 278-105