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70 CM ATV LINEAR AMP Using the RA30H4047M

This PA5 is built around the Mitsubishi RA30H4047M MOSFET RF power module. The input and output is 50 Ohms and takes just a few milliwatts of drive to get over 25 Watts output. The PC Electronics TXA5-70 series of ATV exciters, Videolynx 434 or Z70A modules, or analog cable TV modulators that output +55 to +60 dBmV and other exciters may be used as long as their output power does not exceed 100 milliwatts pep - exceeding 100 mw can blow the RA30H4047M power module. The power module has excellent modulation linearity, bandwidth and low IM for ATV up to 25 Watts p.e.p. RF output and 40Wpep with a modulator that has adjustable sync stretching. LSB regrowth at 30W was -37dBc when driven by a VSB modulator (>-50dBc lower sound subcarrier, upper set at -18dBc). The RA30H4047M power module is available from RF Parts and a PA5 board from us - specify the power module part number at time of board order.

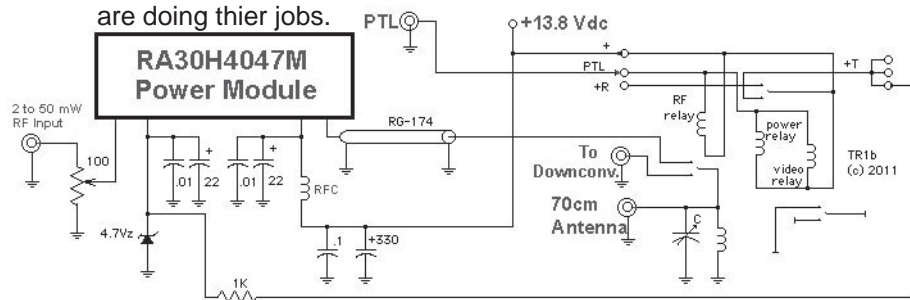
Power supply requirements are a regulated 13.8 Vdc at 6 Amps. For mobile or portable use, a standard 12 Volt car battery may be used, however the output power will vary with the actual voltage between 12 and 14 Vdc. An in-line fuse of 6 Amps must be used to prevent transients or alternator spikes exceeding 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 100 mW before connection to the amplifier input. 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 RA30H4047M is not a direct physical replacement for the SAU4, MHW 710-2, BGY41B or M57716 used in the older PA5 modules or in our TC70 transceivers and TX70 transmitters, although the mounting holes are the same distance, the pin outs and bias voltages are different. The RA30H4047M and board must be mounted in an aluminum chassis for proper heat sinking and shielding. Mount the RA30H4047M low on the chassis for best heat convection upward. Spread a thin layer of heat sink compound on the bottom of the module and mating surface of the chassis. Make sure the chassis surface is clean and flat under the module. The TR-1b T/R relay board can also be mounted inside the chassis.

Running this level of power for more than a few minutes requires getting rid of the heat generated with a good heatsink, keeping all objects at least 2 inches away and a fan for air flow. Heat sinks and fans are available from places like Mouser, Marlin P. Jones, Jameco, MCM Electronics or Radio Shack and can be mounted on top of the amplifier aluminum chassis by drilling and tapping the same pattern as the the power module and PA5 board.

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 50 to 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 and set the amp input 100 Ohm pot to minimum (CCW). Turn on the amplifier 13.8 Vdc regulated supply. With the Videolynx 434, Z70A or cable modulator, momentarily key on transmitter, and slowly turn the input pot to no more than 16 Watts output - current draw will be about 3.8 Amps. This will give about 25Wpep on the sync tip with video connected. If using a TXA5-70 exciter, set the pedestal to maximum and RF out pot to mid-way. Increase the amp input pot to 25 Watts, then the pedestal pot back down to 16 Watts.
4. Now you can plug in the video. While the power reading will now show lower than 16 Watts, this is average power and your actual peak envelope power will be around 25 Watts. Let it run for 5 minutes. The heat sink should not get so hot that you cannot stand to touch it with your finger (135 degrees F) to make sure the chassis, heatsink and fan are doing thier jobs.



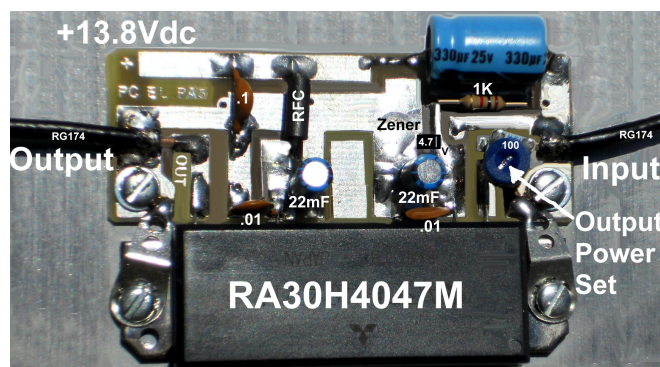
The amplifier can be keyed up by grounding the PTL line. This will apply +13.8V to the 1K bias resistor through a relay. The TR-1b board is optional but is a good way to switch the antenna between the downconverter and amplifier.

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PA5 RA30H4047M Amplifier cont.

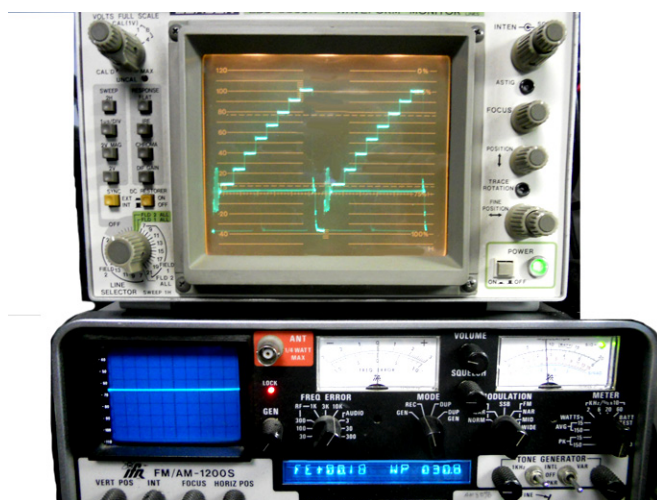
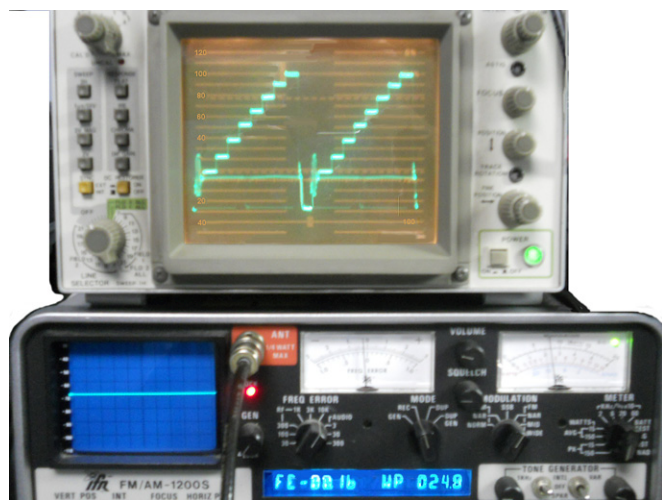
The RA30H4047M RF power module is available from www.rfparts.com phone 800-737-2787. The PA5 board is available from us - specify it is for the RA30H4047M. Mount the board first and solder the +13.8Vdc #18 wire and connect the RG174 input and output coax to the chassis jacks and/or TR-1b board. Before mounting the power module to the chassis or heat sink, clip the leads to .25". Double check the mounting surfaces for flatness and thin layer of silicon heat sink compound. Just snug the first screw, then snug the second screw for the power module. Go back and forth tightening a little at a time to put near equal pressure on the substrate. Solder the RA30H4047M pins to the board and also the two solderlugs.



Solder the braid of the RG174 directly to the top of the shell of the chassis jack connector you choose. Cut the outer insulation back .25" from the end. Fold back the shield braid over the outer insulation and twist. Strip the inner insulation .125" back. Pre-tin the center wire and braid quickly and carefully with no bend in the coax to prevent melting through. Check with an Ohm meter. pre-tin the chassis jack then solder on the coax. Check again with an Ohm meter.

If you wish to drive this brick amp with a transmitter that is capable of more than 100mW, use a good known value series coax attenuator at this frequency and capable of dissipating the power at the input. For example, if driving from our TXA5-RC or KPA5 1W transmitters or Videolynx VM-70X set to 1W, use a Mini-circuits Lab UNAT-15+ (N conn) 15 dB 1W attenuator. Always start with the power set pot at minimum (CCW) and slowly increase while monitoring a RF power meter. Keep the input and output coax leads routed away from each other as this brick has a lot of gain and enough RF leakage radiation from the output could couple to the input and cause the amplifier to go into fatal oscillation. Use a separate regulated DC power supply capable of up to 6 Amps from the driver, and short #18 wire for best linearity.

The 100 Ohm output power set pot will handle inputs from 1 to 100 mWpep. For 20Wpep output at 434 MHz full CW on the power set pot took +2 dBm or less than 2mW. The power module does have a frequency curve - reference 20W at 434 MHz, with same drive, 25W at 426.25 and 15W at 439.25 MHz. At full CCW on the power set pot, 50 mWpep input will still put out a few Watts due to the inductance of the pot leads - therefore, do not be tempted to replace this pot with a panel mounted one. Power gain increases with heat, so always run the fan over the heat sink in transmit.



At 20Wpep, the sync compression is about 2 IRE, but at 25W pep as shown on the Waveform Monitor above left, the sync compression increases to 10 IRE. At this level, some TV's may start to loose sync lock. So those driving this amp with a cable modulator or Videolynx transmitters should keep the peak envelope power below 25 watts, and preferably set for 20Wpep. The Waveform Monitor at right is running at 30Wpep with the sync stretcher in the PC Electronics TXA5-70s exciter adjusted to compensate for the sync compression. The brick was also driven as high as 40W with the sync stretched, but backed down to allow some headroom for the sound subcarrier.



Driving the PA5 Brick Amplifiers 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 an amplifier. See the example in the photo to the right.

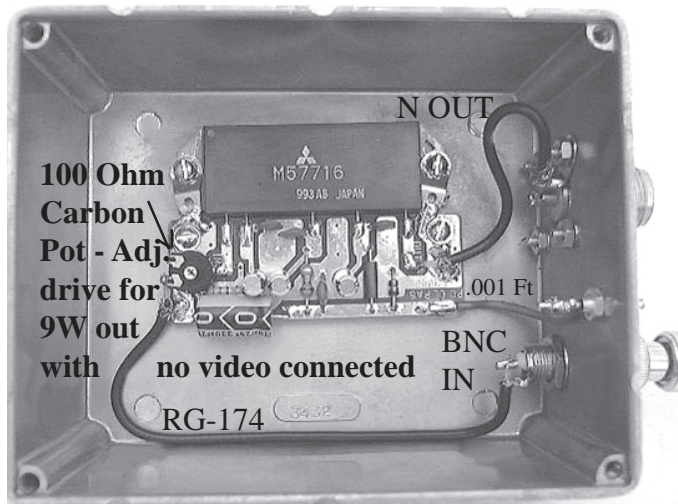
Most power modules used in the PA5 only take about 20 mw pep to give the full power output with 13.8 Vdc applied. The drive power must never exceed the input linear limit otherwise the top of the modulated waveform with flatten out and splatter the band just the same as you might be familiar with when 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 RA30H4047M power module has a 1 dB compression point at about 25 watts output. This peak sync maximum corresponds to a reading on a Bird Wattmeter of about 16 Watts with dirve adjusted and no video plugged in to the Videolynx 434 or Z70A 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 CAB234 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. On the BNC, fold back the shield and solder directly to the end of the shell - no pigtail.. 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. To get rid of the heat, the amp should have nothing around it for at least 2", and a fan blowing air over the heatsink fins if transmit time will exceed 5 minutes.

PARTS LIST

- PA5 board - P. C. Electronics
- Hammond 1590C or 1590DDie Cast Aluminum box - Mouser Electronics
- UG-58 Type N Jack - P. C. Electronics
- .001 mF Feed Through Capacitor - P. C. Electronics
- TR-1b T/R Relay Board - P. C. Electronics
- UG-1094 BNC Jack - Mouser Electronics