LARCAN HI BAND AMPLIFIER CONVERSION TO 222 MHZ

By Terry Price, W8ZN

With the demise of analog TV several years ago, many high quality, highly linear solid state amplifiers became available on the surplus market. The first ones to gain notoriety were the Harris Platinum Channel 2 SSPAs, which were converted for 6M use. I saw an email from Warren Stone, VO1KS (vo1ks@eastlink.ca), for Larcan 1KW and 1.5KW amplifiers that would operate on 222 MHz.

Since I was already in the process of converting all of K8GPs tube amps to SSPAs, I decided to give one of the 1.5KW units a try. While the amp really doesn't require any "modifications", this article covers areas which I felt needed to be changed for amateur service. There is more info on Warren's site at:

http://members.rennlist.org/warren/larcanamps.html

Both the 1KW and 1.5KW models utilize 50 volt MRF-151G FETs. The 1KW model utilizes 4 devices; the 1.5KW model utilizes 6 devices, which by the specs should yield up to 1800 watts output, although operating above the 175 MHz spec would reduce that rating. I have built several SSPAs utilizing W6PQL pallets, and while they work very well, they only put out the rated 1200 watts. When using the amp for contesting, WSJT or EME, I wanted a little more headroom – plus, the price was right! First things first . . unpacking the monster. If Warren ever needs a career change, Santa Claus could use him for packing Christmas gifts! The amp comes in a custom made wooden crate that protects the amplifier during its trip across the border. To remove the amp from the carrier, you must first remove the tape around the perimeter to expose a large number of square-drive wood screws. You will need about a 1/8" square drive bit. I HIGHLY recommend a drill driver for this operation to avoid your wrist falling off from fatigue.



Once free from the shipping container, a quick look of the layout shows just how nicely built these amplifiers are. Each side of the Gemini FETs are individually fused and each side has its own bias adjustment. There is a small printed circuit board on the rear that provides protection and bias control.



Design Layout

- > 19 inch rack mountable
- Completely self contained with antenna changeover relays
- > W6PQL (www.w6pql.com)LPF and directional coupler board
- Capable of handling 12V, 24V or 48V antenna relays
- High current DC disconnect
- Voltage and current monitoring on front panel
- Future FWD and REV power metering

First, I removed the front panel, disconnecting the power LED and the BNC power monitoring connections. I discarded this since I was ordering a new front panel from Front Panel Express (www.frontpanelexpress.com). Next, I wanted to add some physical protection for the top of the circuit board, since they were designed to be vertically mounted on end and slid into a rack.

I happened to have a large quantity of $1\frac{1}{2} \times \frac{3}{4} \times \frac{1}{8''}$ thick aluminum angle that I could use to replace the original rail guides. That would allow the top of the new rails to stick above the circuit board and all of its components and provide protection for them. I simply removed the first rail and used it as a template to mark the new replacement rail that measured 26" long. The extra length would allow me to add the LPF, antenna relays and DC connections to the rear.

A word of caution here --- DO NOT remove both rails at the same time. The heat sink is in two pieces and the rails keep the heat sink from putting stress on the pc board and components. Don't discard the old rail guides as the material will be used later in the mod. Once both side rails are replaced, the amp can now be flipped over on the bench without danger of damaging any of the components. Once the amp is complete, an aluminum plate measuring 15" x 26" will be affixed to the new side rails.







View with new side rails installed



Power connector removal. The main 50V input bus is a long silver bar that runs the entire length of the amplifier. Remove the seven screws attaching the bar to the amplifier, careful not to lose the flat or lock washers. Remove the four screws holding the large quick disconnect power connector on the rear of the amp, which will also allow two large aluminum spacers to be removed.

Cut the single white wire from one of the smaller pins and the entire DC feed connector and power distribution bar can now be removed. Remove the power bus bar from the large quick disconnect power connector. Also remove the aluminum stand-off block from the ground side of the connector. Save both aluminum stand-off blocks for later use. Cut the power bus bar just behind the last screw slot, eliminating the 90 degree bend. Reinstall the power bus bar.



Next is RF connector removal. Since the amp was designed for slide in/slide out operation, a non-locking BNC and 7/16" DIN connectors were used for the input and output. I carefully removed both connectors. After connector removal, I wanted to replace the input connector with a standard female Type N and the output required no connector since I planned on putting the LPF board right at the output. I drilled and tapped two #4-40 holes using a #43 drill bit removing the side rail makes the operation easier. Once this operation is complete, reattach the side rail.



For the amplifier output, I used a slightly modified W6PQL LPF/dual directional coupler pc board. The awl marks where I cut the PC board. To mount the pc board, I utilized one of the old side rails, cutting a piece 4" long and mounting it to the new side rail.



I then added a 2" piece of angle to the rear of the heat sink just below the output trace on the printed circuit board. Removal of the side rail makes the operation easier. As seen in the picture, I added a couple of access holes in the new rail.



Last, I fabricated a rear support for the LPF that goes between the two side rails. Cut a piece of the original side rail to 147/8" in length. Bring this rail underneath the LPF and mark two mounting holes that correspond to the holes in the LPF. Drill and mount LPF. This rear bar will also be used for the 75A Anderson power poles and the RCA

connector for PTT.



Use the aluminum blocks removed from the DC power connector and mount them to the side rails bar to provide stable mounting for the rear bar. To accomplish this, thread the two holes in each block with an 8-32 tap. Note that the holes are a bit large, but you still get decent thread penetration. Drill a #28 hole through the rear of the block and through the 14 7/8" rear bar. The 6-32 x 1 ¹/₄" screws from the original power connector mounting can be used here. Likewise, mount the other block to the other side.



After the LPF and brackets are completed, I jumpered between the output trace of the amp to the input trace of the LPF with a small piece of brass strip.



Cooling

The amp had metal covers over the heat sink so I removed them and using a hole saw, I cut $4 \frac{1}{2}$ holes and mounted four 12v muffin fans and wired them in series so they could run from 50v. The area in the K8GP bus where the amps mount got to over 100 degrees in June, yet the amp stayed just warm to the touch - and this was running the CQ'er pretty hard!



Electrical Connections

There were several electrical items that needed addressing. First, since these amps were designed for continuous transmit, the minute power is applied and the protection circuits reset, the amp is drawing idling current. I broke the main bias input and routed it through a relay for PTT. The amp runs off a single 50V HP 3000 watt power supply, with the large number of 12, 24 and 48 volt coax relays available, I made the amp so it would handle any voltage relays. Remove wire connected to this and connect to one side of bias relay. Other side of bias relay, reconnects here.

50v buss



Most all the IC regulators will only handle 37V input so I added a TIP102 series pass regulator with a 33v volt zener on the base to set the voltage the regulators will see, which is about 32 volts or so. I made a small PC board from Express PCB to handle the power supplies and the PTT relay. I've not installed the new power supply board yet but it's designed so the two regulators and the TIP102 will bolt to the rear heat sink. Make sure you don't forget to insulate the TIP102!





I added a RCA jack for PTT and mounted it to the rear angle bar added to support the LPF.

Using 75A Anderson power pole connectors and the matching locking brackets, I mounted these to the rear angle bracket. The positive goes directly to the power bus bar. The 50v to the power supply board comes off the main PC board.



Performance

OK, so I saved the best for last! Performance was OUTSTANDING! I only had 25 watts available for initial testing and it immediately pegged the 1000 watt scale on the Bird wattmeter. After I installed it in the K8GP bus and connected the DEMI 222 transverter, the 30 watt yielded just over 1300 watts out with no signs of compression, and onair audio reports were excellent. Once I get the DEMI HP transverter connected, I'm sure 1500 watts will be no problem.

The Good, the Bad and the Ugly

We used the amp for the first time in the June VHF contest and we had a new 222 operator. As with any new amp, "things" happen. I used some surplus DowKey 60 series 48y relays for RF switching and shortly after the start of the contest, one of the coil caps popped off causing the relay to fail. Keeping with Murphy's Laws, "anything that can go wrong will go wrong, and at the worst possible time" and "if there is a possibility of several things going wrong, the one that will cause the most damage will be the FIRST to go wrong!" Of course it was the output relay and the operator didn't notice it for 10 minutes! @#*\$@\$*#!~@

Well, thanks to the protection circuit, it set the bias back and after repairing the relay, 1300 watts happily made it's way out the coax again!!

SWR protection is the next addition!!!

Total cost was under \$1000 and that includes the new custom front panel that has not been installed yet.

The full mod will be available at <u>www.k8gp.net</u> or <u>www.directivesystems.com</u> I will also make the PC boards available and I will prepare the custom side rails.