



Commander HF-2500 Linear Amplifier

Time Honored Powerhouse

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Durable "Commander" legend

I believe the HF-2500 Commander may be the longest in-production Ham Radio HF amplifier model utilizing indirectly heated cathode, metal-ceramic tubes. It has been on the market since 1990 and has developed a grand reputation over time as a reliable, compact, lightweight desktop legal limit++ powerhouse that doesn't break. Pat Stein of [Command Technologies](#) says the Commander is in-use in hundreds of countries, Worldwide.

Over the years I have heard many Hams on the air make casual comment that they were using a "Commander", when asked. In the 90s I learned that "Commander" was some sort of an established Ham Radio linear amplifier legend for power, reliability and quality. Command Technologies also produces amplifiers for 6 and 2 meters.

I believe the Commander HF-2500 was first to use the proven voltage doubler power supply design, made famous by the legendary Heathkit SB220, in a modern legal limit++ amplifier utilizing the metal-ceramic external anode triodes. After talking several times to Command Technologies owner Patrick Stein, we arranged for an HF-2500 to be Browned to HRM for review. The current going price for this amplifier is \$3,295.00.



OK, follow along as I examine this mother of light weight legal limit++ amplifiers, up real close, to see if it's legendary reputation is warranted.

Too small

Seven boxes arrived from Brown Truck Company today but no amplifier. Wait a minute - - here's a box from Command Technologies, Inc., but it's too small to be a legal limit ++ amplifier. Well, two boxes, one small and heavy and one not large enough for an amplifier, but it is an amplifier. Huh!

Out of the box and on the bench. With plastic off I noticed it has a two piece cover similar to the Titan II, nice. Since the first thing is photography in the light tent it's off with the top cover, but this is different. The cover is secured with stainless steel socket head machine screws with clear plastic washers. This gives a professional appearance to the product.

The proper size allen driver for my screw gun seems to have been "loaned" out of my tool collection so I clamped the short end of the allen wrench that came with the amplifier in the vice and scored it with the edge of a file. I then snapped it off and chucked it in my nice screw gun. Off with the top and bottom covers. Everything inside is orderly, neat and well laid out. No acres of wasted space in this amplifier.

OK, it's light tent duty for the Olympus camera

This is the fun part. Neat and orderly makes good product pictures. Open frame T/R relay behind the tubes, under the tuned input housing, control circuit board on the right side panel and another board under the meters, but wait a minute - - - there are some parts missing, the rectifier/filter section. Where's the rectifier/filter section?

RF section

The big robust band switch and coil are mounted on top of a backward and upside down L shaped



plenum chamber. The load capacitor is mounted under the tune capacitor and both are beside the plenum. The rectifier/filter circuit board is inside the plenum. Huh? Yes, inside the plenum, in the breeze. Components will stay cool there for sure. This design certainly makes efficient use of space. The only other amplifier I have reviewed with major components inside the plenum is the Ten Tec Titan II. It has all circuit boards *except* the rectifier/filter components inside the air chamber.



From an old article I found: The tank circuit here is a pi network on all bands that transforms plate impedance from 1400 ohms to 200 ohms. A 4:1 ferrite core transformer provides the final 50 ohms impedance. In the event the anode dc blocking capacitor should short, this arrangement provides a dc shunt path to ground instead of to the RF output connector.

Centrifugal squirrel cage type blower?

Well yes, one can only move the required air into the plenum, swirl some around the rectifier diodes and filter capacitors and force it up through the radial/axial heat exchangers surrounding the external anodes with a centrifugal blower. A fan just won't cut it here. The blower AC circuit has a resistor to slow the blower some as it has more than enough capacity for the job.

Noise?

No, no noise at all, quiet as a mouse -- kidding, of course it makes noise. However, Command has recently altered the design to reduce the blower noise to the outside of the case. Normally, air flow is through the large air intake area on the right side of the amplifier, into the right side chamber, around the transformer and circuit board and into the blower.



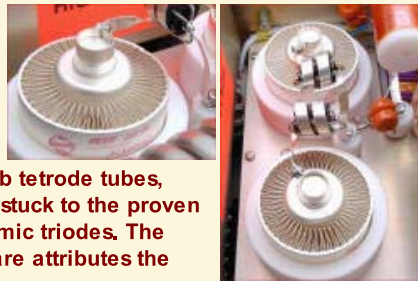
There is a bottom pan, front to back central panel, front and rear panels and side panels with large windows as found in many amplifiers. A bottom/sides cover with lotsa holes for air circulation on right and left side has been standard with the HF-2500. This arrangement provides two bottoms, pan and outer, bottom cover with about 3/4" space between.

Pat's new design has air circulation inlets holes in the bottom pan under the blower and similar air inlet holes in the bottom cover. No air inlet holes on the right side at all. Air is sucked from under the amplifier, into the space between the pan and cover, into the right side chamber and into the blower. With no holes on the right and double bottom with 3/4" air space, blower sound is better trapped inside and less noise makes its way outside to the user's ear bulbs.



The Eimac tubes

Yes, beautiful, high performance, shiny Eimac 3CX800A tubes with the external, in-the-breeze anodes. Well, --- not really beautiful, well, maybe beautiful in design, but not beautiful like the big, warm, glowing glass tubes. While other makers of this legal limit++ class of amplifier have switched to the non-glowing, Svetlana 4CX800A/GU74b tetrode tubes, mainly for economic reasons, Command Technologies has stuck to the proven and more expensive Eimac 3CX800A7 premium metal-ceramic triodes. The Eimac tube specifications, consistency and quality control are attributes the Rusky makers are hard-pressed to match.



With triode vacuum tubes a tuned input is require for each band to match the impedance of the exciter output. The tuned input circuits are mounted in the box on the rear panel, behind the tubes. Adjustment holes in the rear are available for each band, if ever needed.

The manual

Well done as most are today. Good diagrams. Final test sheet furnished with starting tune and load settings for all bands.

Meters

Left is the full time grid current meter. Right is the switchable plate current/plate voltage meter. Forward and reflected power is measured with external equipment, not supplied.



And the power supplies?

The rectifier circuit is the proven full wave doubler rectifier/filter arrangement utilizing 10 N5408 3 amp, 1000 PIV diodes and 8 270 uf, 450 v. premium computer grade capacitors. This text book circuit provides about 33 uf of smoothing for the measured 2,990 VDC B+. Much less total filter capacitance is required here because of the smoother DC form the full wave doubler rectifier circuit provides.



Upon removing the transformer from the box I noticed it is the premium core type Hypersil. Transformers in all other amplifiers I have examined, except for the Alpha 87A, are shell types having one winding segment and usually two steel cores banded together with steel strapping. This one has two winding segments and one steel core. Of course, this premium core type transformer has a premium cost.

Mating is good, reduces the weight

By using more than one winding with secondaries in series, the total length of wire in the secondary is less, resulting in less weight and less resistance. Transformers used in full wave voltage doubler rectifier circuits have half the voltage of transformers used in full wave bridge rectifier circuits and a lot less copper wire in the secondary. When the voltage doubler rectifier circuit is mated with the light weight core type plate transformer and it's reduced amount of copper wire, you have the most efficient arrangement available today. This is why the Commander HF-2500 weights only 65 lbs. but still has a 4KW+ power supply. An amplifier of this capacity 25 years ago weighed 2 to 3 times as much as the Commander.



Two more transformers, a filament transformer right next to the blower and the control transformer mounted on the circuit board, right side, rear. The control power supply provides power for all



other functions such as relays, lamps, trip circuits, etc. The QSK version of the HF-2500 has more circuits mounted here. By the way, the vacuum relay QSK option adds couple of hundred dollars to the price.

Mains power control is handled by a single 20 amp fuse. A pair of robust solid state relays handle the switching and soft start or surge control during start up.

Some assembly required

The box with the tubes comes in the plate transformer space. Each Eimac tube, not like a real tube, no glass, just shiny metal, has a small notch on the outer ring that correlates with the gap in the pin index of the tube socket. This gives somewhat of a head start in feeling when the pins are aligned and ready for seating pressure. I don't install the transformer, I just set it in, after the picture session, and mate the one plug. Assembly done.

Will the "Commander" confirm it's grand reputation?

Let's see if it will light up. Let's run it. Well, the tubes don't really *light up*, but the meters do.

The Commander manual says never operate this amplifier without ALC connected, but I will ignore the warning. In all my years in ham radio I have never met or had knowledge of a Ham that actually used or connected ALC. If our exciter was capable of somewhat more than 90 - 100 watts I would consider using ALC. As with most of these high gain amplifiers, 90 to 100 watts is overdriving and tuning without exceeding grid current maximums is important.



Bench

Our test bench is equipped with a 2000+ watt fan cooled dummy load, *wrecked by a QRO Mark III and repaired*, 3,500 watt low pass filter, Bird 43 and Coaxial Dynamics watt meters cabled in series. Bird with 5,000 watt slug and Coaxial Dynamics with 2,500 slug for this test. The bench has a superb 7,500 w. antenna switch utilizing Jennings vacuum relays, designed and built by this writer for access to 75M & 40M dipoles, 20M, 17M and 15M verticals and the dummy load. Various putt-putt watt meters are used between exciter and amplifier to measure drive power and SWR. Mains voltage during this test was averaging 245 VAC.

Accuracy of measurement

We use the average of the two watt meters mentioned above. Both manufacturer's spec, an available inaccuracy of + or - 5% of slug rating at a mid-scale reading. This works out to be an error factor of + or - 125 watts at mid-scale for the 2,500 watt slugs and + or - 250 watts for the 5,000 watt slugs. The maker's don't even mention accuracy at close to full meter right deflection. Remember, these watt meters are the bottom of their line, most inexpensive of the manufacturer's offerings.



Exciter signal is CW.

Freq.	Loafing Column 50W. Drive Grid/Plate/Power	Bad Boy Column 90 - 100W. Drive Grid/Plate/Power
1.950 Mhz	30/1100/1,800W	50/1600/2,300W
3.925 Mhz	20/1050/1,750W	50/1600/2,500W
7.245 Mhz	30/1050/1,800W	65/1600/2500W
14.250 Mhz	45/1100/1,800W	40/1600/2,500W
18.140 Mhz	35/1150/1,850W	60/1600/2,300W
21.350Mhz	45/1200/1,750W	50/1600/2,450W
24.950 Mhz	15/1150/1650W	50/1400/2,300W
28.400 Mhz	40/1100/1,700W	60/1550/2,300W

The grid current protection circuit appears to be set to trip at about 125ma. Using the starting numbers from the test sheet that came with the amplifier, tuning was a snap. I tuned just like the manual says. A few times, until I got the feel, the grid over-current tripped, but the trip is reset by releasing the PTT. Tuning with 50 watts *loafing* drive is a snap. Tuning with 90 to 100 watts requires more care while watching the grid current. There is no way to exceed max. safe grid current in this amplifier, over current trip works well.

Conclusion

OK, if you've got this far you've been following along to see if the "Commander" reputation is warranted - right? To see if it truly *is* the mother of light weight legal limit++ Ham Radio linear amplifiers. Well, the reputation is *real and warranted* and, based on the age and longevity of the legend and reputation, the "Commander" *is* the mother of light weight legal limit++ Ham Radio amplifiers.

If you're looking for a compact amplifier that is a tower of reliability and stamina and, perhaps seeking to quickly power your way up and out of the noise mire to a real presence on the bands, the "Commander HF-2500" legend will do the grand job for you *and* your Ham Radio heirs or future owners.



Quieting the blower

See the article about [quieting the centrifugal blowers](#) in amplifiers. Hopefully, we will see some automatic blower speed control circuits in amplifiers one day. Until then, I'm afraid you will have to do-it-yourself. The Commander will be an easy one to convert because everything is accessible.

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