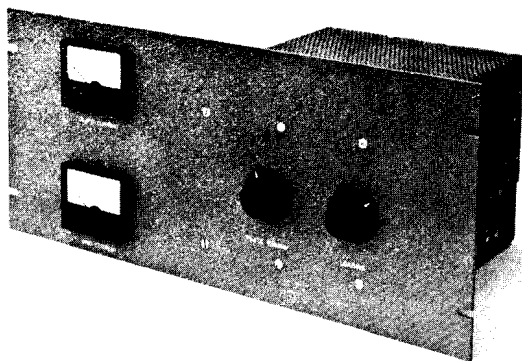




amateur service newsletter
W6SAI



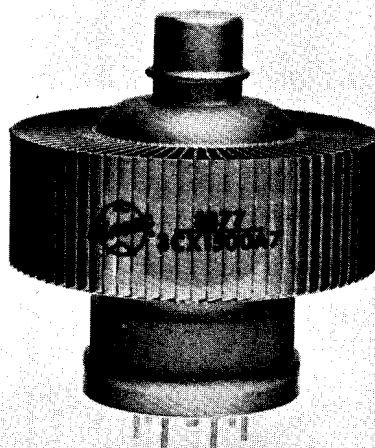
two-kilowatt linear amplifier for six meters

This high performance
six-meter linear
features the new
Eimac 8877
and provides
excellent stability,
good reliability
and minimum
harmonic output

The serious six-meter operator needs a high power amplifier that will function reliably over extended periods of time and have minimum harmonic radiation. Such amplifiers seem to be commonplace for the "dc bands" but are rather rare for 50 MHz and above. Many six-meter amplifier designs are cranky, hard to neutralize or otherwise unstable or tricky to adjust.

The amplifier described in this article has none of these undesirable attributes. It will run key-down on a 24-hour basis, if need be, and is stable and easy to adjust. I have used it over a period of months and it has proven to be a valuable

The new high-mu 8877/3CX1500A7 triode recently announced by EIMAC.



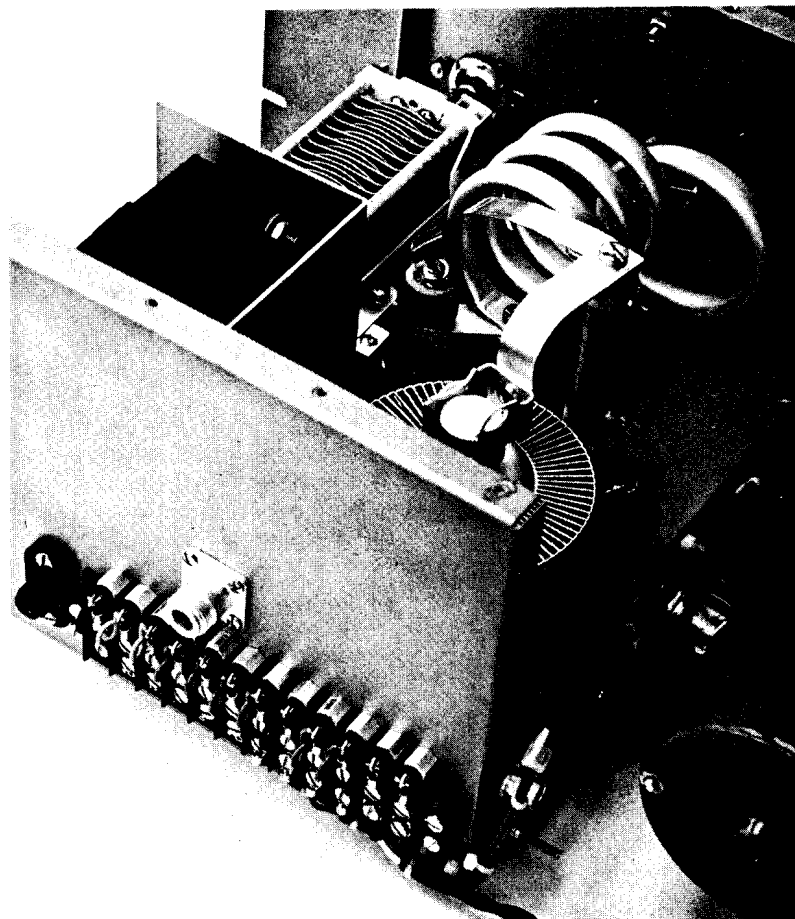
Robert I. Sutherland, W6UOV, EIMAC Division of Varian, San Carlos, California 94070

adjunct to the spread of six-meter equipment in my station.

This amplifier uses a grounded-grid circuit with a new high-mu triode just announced by Eimac: the

plate current of 750 milliamperes, power output will be about 1200 watts. This represents an amplifier efficiency of 61% and a power gain of 14.8 dB.

A schematic of the amplifier is shown



Top view of the plate circuit of the linear amplifier showing the shorted-turn tuning scheme. The shorted-turn is hard-soldered to shaft coupler to allow front panel tuning. The "anti-inductance" strap can be seen connecting the top of the plate choke to the plate blocking capacitor. Note that the position of the plate blocking capacitor can be changed by loosening one screw and rotating the capacitor around the screw.

8877/3CX1500A7. This ceramic/metal triode is intended for linear service in the high-frequency and vhf range. The amplifier is intended for the maximum legal power input, 1000 watts dc, and can develop up to 2000 watts peak envelope power input during ssb operation. The amplifier requires a driver that can supply approximately 40 watts PEP at 50 MHz. Using a plate potential of 2600 volts and

in fig. 1. The control grid is operated at dc ground with a minimum of inductance between the tube and the chassis. The plate and grid currents are measured in the cathode return lead. A 12-volt 50-watt zener diode is placed in series with the cathode return lead to set the desired idling plate current. No special neutralization scheme is needed to attain completely stable operation.

A 10,000-ohm 25-watt resistor in the cathode lead of the 8877/3CX1500A7 is

fig. 1. Complete circuit diagram of the 2000-watt PEP input amplifier for 50 MHz.

- | | |
|---|--|
| L1 6 turns no. 18 on a CTC 1538-4-3 form; coil length 7/8" | L4 54 turns no. 20 enameled on 1/2" diameter Teflon rod; winding length 1-13/16" |
| L2 6 turns no. 18, 1/2" diameter, 5/8" long, self-supporting | L5 3 turns 3/8" diameter copper tubing; inside diameter 1-7/8"; coil length 2-3/8"; shorted turn 2-1/4" diameter 3/8" copper tubing 1/4" from main coil |
| L3 Bifilar wound choke, 1/2" diameter core, 3" long, each coil 12 turns no. 10 Formvar; core is Indiana General CF-503 | FT Erie 327 1000-pF feedthrough capacitors |

used to reduce standby current through the tube to a low value. When the exciter is turned on, a set of contacts on the vox relay (or other control relay) shorts out the 10,000-ohm resistor, causing the tube to operate at its normal idling plate current. The 200-ohm 10-watt resistor from the negative terminal of the plate supply to ground makes certain the nega-

The cathode input circuit consists of a simple T-network. The network was calculated so that a 50-ohm cable from the driver would be matched to the input impedance of the 3CX1500A7 at full

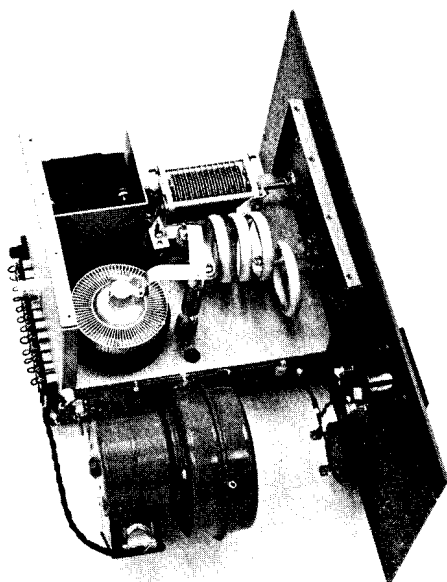
tive terminal does not soar to the value of the plate voltage if the positive side of the power supply is accidentally shorted to ground.

The two 1N2071 diodes across the 200-ohm resistor limit any transient surges under the shorted condition which might cause insulation breakdown. Also, these diodes afford some transient protection of the two meters by providing a path around the meters. Additional protection could be obtained by putting two back-to-front parallel connected diodes across each meter. The 200-ohm resistor around the zener provides a load for the zener and prevents the cathode voltage from becoming quite high if the zener should burn open.

the plate circuit

Top views of the amplifier chassis are shown in the photographs. The closed ring near the front panel is the shorted

Another view of the plate circuit. The air variable across the top edge of the chassis is the adjustable part of the loading capacitor. Two ceramic barrel capacitors are mounted in parallel with the air capacitor and can be seen at the end of the variable capacitor near the filament transformer shield.



turn used for tuning; it is made of 3/8-inch diameter tubing, hard soldered to a brass shaft coupler with copper-silver solder. Soft solder would not be advisable in this application because of the high circulating current in the shorted turn. The "anti-inductance" strap is used to set the tank circuit to the desired tuning range. This strap runs from the top of the plate rf choke to the plate blocking capacitor. The position of the blocking capacitor can be moved to allow the strap to be flexed and set to the proper position. Note that the current through the strap is going in the opposite direction from the current in the coil at any instant and therefore causes field cancellation.

To set the amplifier to the low-frequency end of the band, the shorted turn is completely decoupled and the position of the blocking capacitor and the anode strap adjusted to resonate the plate circuit to 50 MHz. As the shorted turn is coupled tighter, the total inductance in the plate tank circuit will be reduced, causing the resonant frequency to increase. When the shorted turn is fully coupled, the resonant frequency of the plate tank circuit will be about 51 MHz.

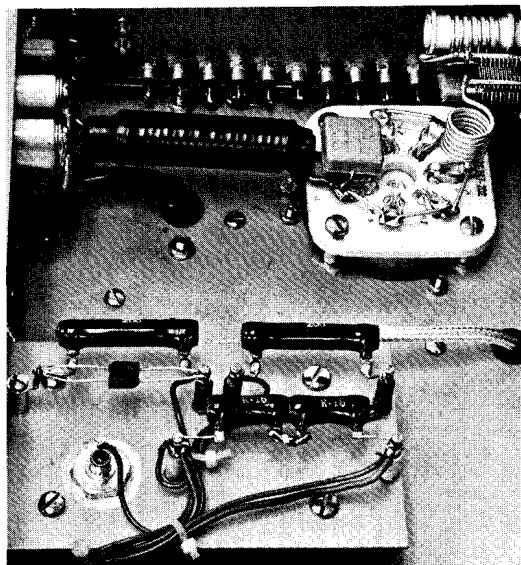
Amplifier loading is accomplished in the same manner as in a typical pi-network amplifier. The loading capacitor is the air variable along the top right edge of the chassis. The two ceramic fixed capacitors are at the left end of the air capacitor and at the end of the coaxial cable coming from the type-N coaxial receptacle mounted on the back panel.

The plate choke is made of 54 turns of no. 20 enameled wire closewound on a one-half inch diameter Teflon rod. The winding length of the coil is 1-13/16 inches. The choke is mounted on top of the ceramic capacitor which is used to by-pass the B-plus end of the choke.

Visible on the back of the front panel are the *Jackson* ball-drive assemblies. These handy devices provide a very smooth and slow "feel" to the tuning. The 5.0-volt 12-ampere filament transformer is visible inside its aluminum shield at the top left end of the chassis.

the input circuit

The input matching network is a standard T-design consisting of two series coils and one shunt capacitor. One coil and the shunt capacitor are variable. With these two adjustments it is possible to



View of the underside of the chassis showing the input circuit and the location of the zener diode and resistors. The T matching network is in the upper right hand side of the chassis. The heater-cathode choke is mounted between the socket and the ceramic stand-offs at the left side of the picture. Note that the socket is mounted below the chassis to allow passage of the cooling air. The straps grounding the grid to the chassis can also be seen under the threaded brass spacers used to sub-mount the socket.

cover a wide range of impedance transformations. The controls for the variable elements are brought out the left rear side of the chassis. Once the adjustments have been made, no tuning is required over the first megahertz of the band.

The input matching network can be seen in the top right corner of the under chassis photograph. The cathode-heater rf choke is near the tube socket. The choke is bifilar wound with twelve turns on each

* Available from Newark Electronics Corporation, 500 North Pulaski Road, Chicago, Illinois 60624. Order catalog number 59F1521.

coil using no. 10 Formvar insulated wire. The core material is *Indiana General CF-503*, one-half inch in diameter.* The core permeability is a little high for this application, but the material was available and has not given any trouble. The Johnson 122-247-202 socket is mounted one-half inch below the chassis using threaded brass spacers. Four pieces of brass shim stock, or beryllium copper, are formed into an "L" shape to mount between the brass spacers and the chassis and make contact to the control grid ring.

the tube

The 8877/3CX1500A7 is a new ceramic triode having good division between the plate current and the grid current. It has EIA base no. E7-2 which can be used with the standard septar sockets. The tube has a plate dissipation rating of 1500 watts, and has a μ of approximately 200. The cathode is indirectly heated, and the filament requirements are 5.0 volts at 10 amperes.

performance data

Many different operating conditions were tried with this amplifier. The conditions most suitable for amateur ssb operation at 2000 watts PEP input are:

Plate voltage	2600 Vdc
Plate current (single-tone)	750 mA
Plate current (idling)	40 mA
Grid voltages	-12 Vdc
Grid current (single-tone)	58 mA
Power input	1950 W
Power output	1200 W
Efficiency (apparent)	61 %
Drive power	40 W
Power gain	14.8 dB

The intermodulation distortion products at full peak envelope power input under the above operating conditions are:

3rd order	-44 dB
5th order	-37 dB
7th order	-64 dB
9th order	-68 dB

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