# A 160-METER AMPLIFIER

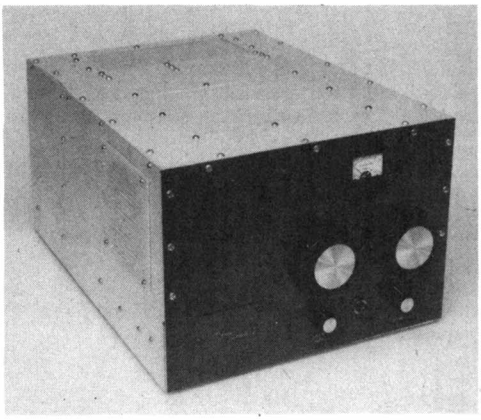


Fig. 1 — Front view of the 160-meter amplifier. Note the use of perforated aluminum stock to permit ventilation of both the rf and power supply compartments. The large front-panel knob on the right controls C3, while the adjacent knob to the left controls C2. The power switch, S1, is controlled by the smaller knob located beneath C3. Both S1 and S2, the meter switch, are mounted below the chassis, and DS1 is mounted between the two switches.

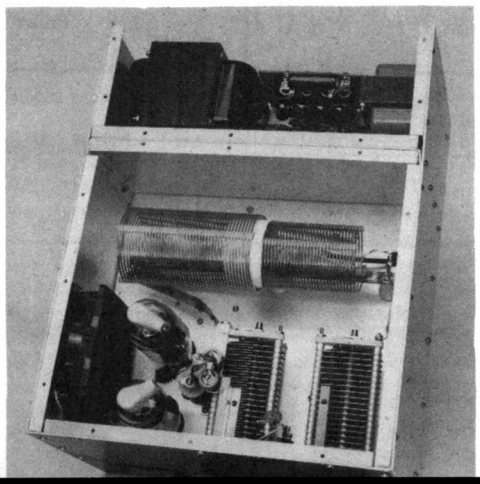
Anyone who has operated in the 160-meter band lately can attest to the fact that interest in the "top band" is on the upswing. With only a handful of manufacturers producing gear for 160, this band is somewhat of a "homebrewers' haven." Most operation takes place during the evening hours, because the high level of daytime ionospheric absorption makes communication (other than strictly local) all but impossible for low powered stations. Summertime static makes things even more difficult. At present, amateurs occupy this band on a shared basis with various radionavigation services, with maximum input power limitations imposed to prevent harmful interference from occuring. These restrictions are greatest between sundown and sunrise, when the potential for interference is at maximum. However, during the daylight hours, amateurs in 29 states are permitted to use up to 1000 watts power input, while in the other 21, the maximum is 500 watts, in selected segments of the band.[1] The amplifier described below is for use with 160-meter exciters in the 50- to 100-watt output class, for ssb and cw operation.

## Circuit Data

A pair of 572B/T160L triodes are used in a cathode-driven, grounded-grid configuration (see Fig. 3). A small amount of operating bias is provided by the 3.9-volt, 10-watt Zener diode in series with the cathode return lead, and the tubes are completely cut off during nontransmitting periods by opening that lead with K1A to reduce unnecessary power consumption and heat generation. The other contacts on K1 perform all necessary antenna switching functions for transceive or separate transmitter/receiver operation. Drive power from the exciter is fed to the directly heated cathodes through a parallel combination of three .01 μF disk capacitors, and a resonant cathode tank circuit helps minimize the amount of drive required. The filament choke, RFC2, isolates the driving signal from the filament transformer. A B&W FC-15A choke was used here. A single power switch, S1, applies 117 V ac to the primaries of both the power and filament transformers simultaneously, as the 572B's require no significant warmup time. S1 also activates the cooling fan, B1, and the front-panel pilot light assembly, DS1. The self-contained high-voltage power supply uses a straightforward voltage doubler circuit. No-load voltage is approximately 3100 V dc, dropping to 2600 V dc under one kilowatt key-down conditions. R2 limits the initial surge current to the filter capacitor bank to prevent exceeding the current handling capability of the rectifier string when the supply is first turned on.

A single 0-1 mA meter is used to monitor either plate voltage or cathode current. To measure plate voltage, a multiplier consisting of five series-connected 1-megohm 1-watt resistors with one end tied to the B plus line is switched in series with the meter to provide a full-scale reading of 5000 volts. A 1000-ohm one-watt resistor between the bottom of the meter multiplier and ground prevents the full B plus voltage from appearing across the meter switch, S2, when it is in the other position. To measure cathode current, the meter is placed in

Fig. 2 — Top view of the amplifier. The rf components occupy the foreground, while the heat-generating power-supply components are visible behind the compartment shield at the rear.



[1] A chart of U.S. and Canadian 160-meter sub-allocations is available from ARRL Headquarters; send a stamped, self-addressed envelope and request form S-15A.

Fig. 3 — Circuit diagram for the 160-meter amplifier. Fixed-value capacitors are ceramic disk unless otherwise indicated. Polarized capacitors are electrolytic. All resistors are 1/2-watt composition unless noted otherwise.

B1 — 117-volt axial fan (Rotron Whisper Fan or equiv.).
C1 — Parallel combination of one 5000, 2000, and 1000-pF silver-mica capacitors.
C2, C3 — 250-pF air variable, .075-inch spacing (E. F. Johnson 154-9 or equiv.).
C4, C5, C6 — Transmitting capacitor, 1000-pF "doorknob" (Centralab 858S or equiv.).
CR1-CR12, incl. — 1000 PRV, 2.5-A silicon (Motorola HEP 170 or equiv.).
DS1 — 117-volt ac neon pilot lamp assembly.
J1 — Phone jack.
J2, J3 — Coax chassis-mounting connector, type SO-239.
K1 — 3pdt, 10-A contacts, 110-V dc coil (Potter and Brumfield KUP14D15 or equiv.).

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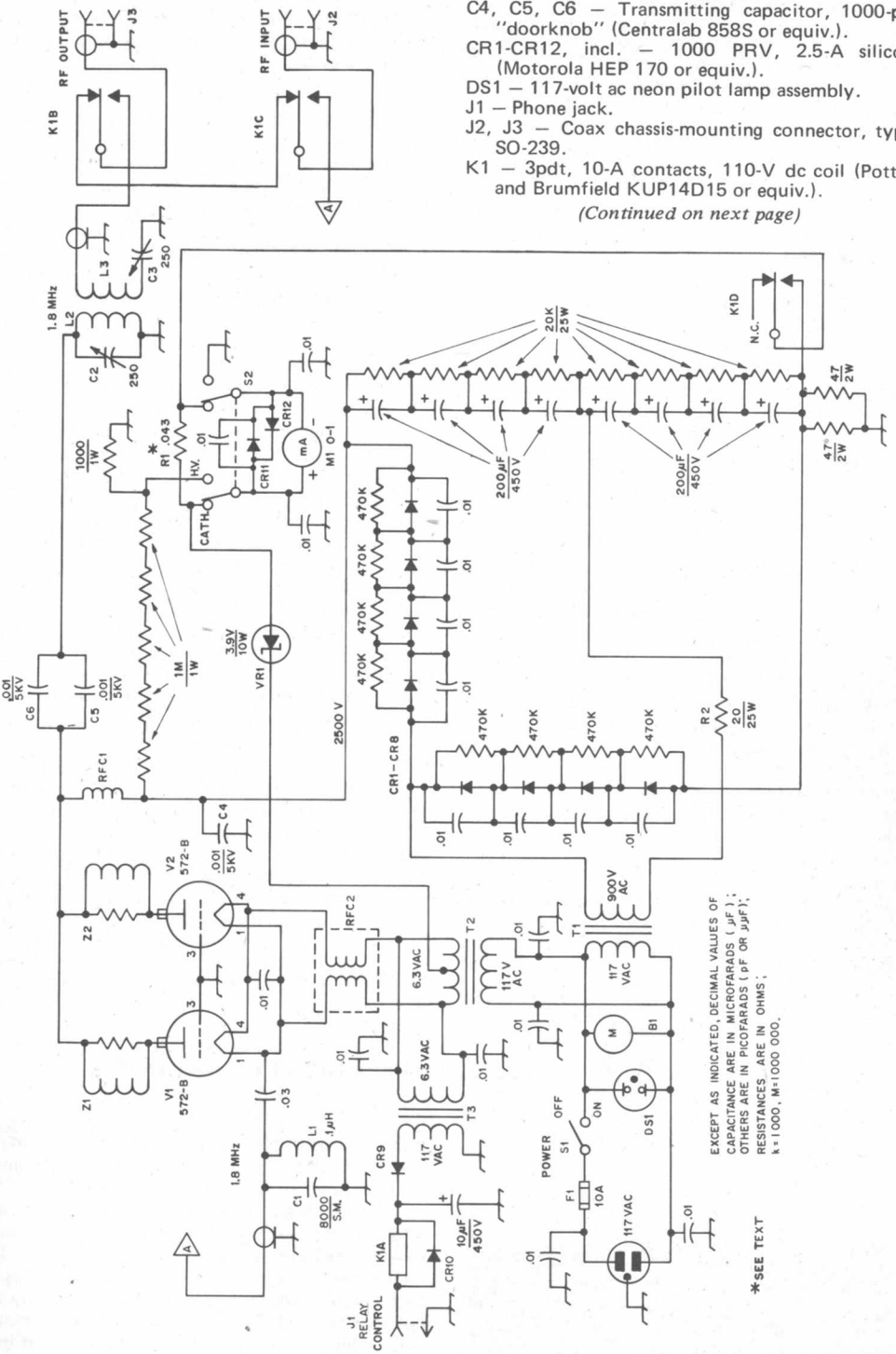

L1 – 1.0 μH
L2, L3 – See text.
M1 – 1-mA dc (Simpson model 2121 or equiv.).
RFC1 – 1.0 mH, 500 mA (E. F. Johnson 102-752 or equiv.).
S1 – Spst rotary switch.
S2 – Dpdt rotary switch.
T1 – 117-volt primary; secondary 625-0-625 volts ac (ct not used) at 450 mA (Hammond No. 720).
T2 – 117-volt primary; secondary 6.3 V ct at 10 A (Stancor P-6464 or equiv.).
T3 – 117-volt primary; secondary 6.3 V ac.
VR1 – Zener, 3.9-V, 10-watt (Motorola HEP Z3500 or equiv.).

parallel with shunt R1, which remains in series with the cathode return lead at all times. To obtain a full-scale reading of one ampere, a shunt resistance of .043 ohms was used with the Simpson model 2121 meter, as it has an internal resistance of 43 ohms (see Chapter 17).

As this amplifier is designed for monoband operation, the mechanical and electrical complexities and compromises involved in the band-switching of an output network are not a factor here. Tuned-link coupling is used in the output circuit. The grid of each 572B is tied directly to chassis ground, using short leads, to avoid problems with instability. Parasitic suppressors Z1 and Z2 also contribute to stability. Neutralization is not necessary.

B&W Miniductor stock is used at L2 and L3. L2 is made from 43 turns of B&W 3034 (No. 14 wire, 8 tpi, 3-inch dia.) and L3 is made from 39 turns of B&W 3030 (No. 14 wire, 8 tpi, 2-1/2-inch dia.). The coils are supported on a 10-inch strip of bakelite which is mounted on three 1-1/2-inch steatite insulating cones. L2 is epoxied into place on the side of the bakelite strip nearest the tubes. L3 will be partially inserted into the cold end of L2, and is epoxied into place after initial adjustments have been made. L3 must be able to slide freely inside L2 without making electrical contact. The first 10 turns of L3 may be covered with a layer of Scotch No. 27 glass insulating tape. Leads from L3 are made with teflon-insulated flexible stranded wire to allow the coil a degree of freedom of movement during initial adjustment. Rf output from L3 is connected to K1B through a short length of RG-58/U coaxial cable.

Meter shunt R1 is made by winding 12-1/2 inches of No. 26 enam. wire around a 1-megohm 2-watt resistor. If the meter used has an internal resistance other than 43 ohms, the appropriate shunt resistance value may be wound by referring to the copper wire resistance table in Chapter 18.

Parasitic suppressors Z1 and Z2 are each made with 3-1/2 turns of No. 14 enam. wire wound around the parallel combination of three 82-ohm, 1-watt composition resistors, mounted right at each plate cap.

### Operation

The power supply should be tested before rf drive is applied to the amplifier. For initial tests, it is desirable to control the power transformer primary voltage with a Powerstat, while leaving the filament transformer primary and fan connected directly to the 117 V ac line. *Remember at all times that lethal voltages exist both above and below chassis.* Do not make any internal adjustments with the power on, or even with the power off until the bleeders have fully discharged the filter capacitors (at least 40 seconds with this particular amplifier). It is good practice to clip a lead from the B-plus terminal to ground after the capacitors have discharged, whenever working inside the amplifier (remember to remove it before applying power!). The tuned-input circuit (L1-C1), should be checked with a grid-dip meter for resonance at the frequency segment of interest. K1 must be closed during transmit; this may be effected by shorting the wire from J1 to ground with a relay inside the 160-meter exciter, or with an external switch. Starting with a plate voltage of about 1500 volts, drive is applied through J2 and C2 is adjusted for maximum rf output as indicated on an external rf wattmeter or relative output indicator. C3 is then adjusted for maximum output. The plate voltage may now be advanced to its normal level. The link may be moved in or out (with power off) and C2 and C3 again adjusted until the highest efficiency is obtained. At that point the link, L3, may be epoxied in place. In the amplifier described here, the optimum position for L3 was when eight of its turns were inside L2. This may be used as a starting point for the adjustment. Normal tune-up procedure involves only the adjustment of C2 and C3 for maximum output, within the maximum legal power limits, of course. During normal operation the 572B anodes may glow with a dull red color. The tubes draw about 50 mA resting current, when K1 is closed and no drive is applied.