A 3CX800A7 Amplifier for 432 MHz

By Steve Powlishen, K1FO

In 1979, I described a 432-MHz power amplifier using a single 8874 tube.[1] The popularity of the amplifier far exceeded my expectations. While stable, linear and efficient, the 8874 amplifier had several drawbacks:

1. Construction required considerable metal fabrication, as the RF enclosure dimensions didn't correspond to a standard chassis size.

2. At 432 MHz, the 8874 requires over 35-W drive for full output—more than current 25-W transceivers can provide.

The introduction of the EIMAC 3CX800A7, essentially an improved 8874, provided the inspiration to build a new and improved amplifier. I wanted higher gain and simplified construction. In addition, this amplifier has TR switching voltages and currents compatible with low-power solid-state transceivers, and tube-protection circuitry.

The IMD performance of this amplifier is almost an order of magnitude better than some 432-MHz exciters! While this point may appear insignificant, operators may have to contend with local signals that are 80 to 100 dB above the noise and only a few kHz away. Any serious 432-MHz operator can attest to near loss-less propagation periods when signals 300 miles away are 80 to 90 dB above the noise. Under such conditions, this amplifier will not aggravate other operators.

While expensive when purchased new, the 3CX800A7 may still be a bargain. When you consider that in intermittent service a properly operated 3CX800A7 still may be cooking long after another operator has gone through several sets of 4CX250-class tubes, the initial price appears more reasonable.

The amplifier described in this article will deliver about 620 W with 25-W drive. At maximum ratings, the 3CX800A7 generates 730 W. Efficiency and maximum power output are better than with the 8874 amplifier.

Construction Details

To minimize metal work, the amplifier uses 4 standard aluminum chassis. The RF plate enclosure is made from a 5- × 13- × 3-in. chassis. The cathode circuit is housed in a 4- × 5- × 2-in. chassis. The RF enclosures are attached to the EIA standard 5¼ in. high, 19-in. rack panel by 2 standard 5- × 7- × 2-in. chassis. Using the smaller chassis in this way makes it unnecessary to fabricate mounting brackets for the RF deck, while also providing space to mount the control circuits. Heavy gauge (0.062-in. or thicker) cover plates are preferred on the RF chassis to assure RF sealing and provide mechanical rigidity.[2]

The construction of this amplifier has the RF deck mounted on its side, relative to the construction of most amplifiers. This mounting method has several advantages. The tuning controls can be positive-actuating lead screws, while still providing front-panel access. Alternately, the fish-line tuning arrangement can be used, as I did. Fish-line actuated controls allow the front-panel knobs to be placed for convenience and esthetics. The mounting arrangement used in this amplifier accommodates a convenient control arrangement while minimizing the length and bends in the fish line. As a result, the plate tuning controls operate smoothly and repeatably. An additional benefit to the mounting method is that tube hot air exhaust exits to the rear of the amplifier. Other equipment can be mounted above or below this amplifier, without leaving cooling space. I built matching 3CX800A7 amplifiers for 50, 144, 222 and 432 MHz. All four amplifiers and their 2200-V power supply can be mounted in a single 28-in. high desktop rack.

I took care to make this amplifier easy to duplicate with readily available parts. Complete metal cutting and drilling drawings are provided for the RF sections. If you accurately follow the drawings and use all parts specified in Table 1, the amplifier should go together and tune up like a commercial kit. I don't discuss the layout of the control circuits as they are not critical, and you may wish to tailor them to your station. Some of the specified parts are priced higher than junk-box substitutes. With some ingenuity you may be able to use cheaper parts, but you do so at your own risk. I'm unable to offer advice about finding and using substitute parts.

Plate Circuit Details

The plate circuit is the now-standard half-wave stripline with the tube located at one end. A "flapper" tuning capacitor is mounted at the other end. The stripline (Fig 1) is larger than

Table 1
Parts List for the Single 3CX800A7 Amplifier

Chassis and Hardware Components

RF deck enclosure: 5×13×3-in. chassis, Bud AC-422 or equiv.
Cathode compartment: 4×5×2-in. chassis, Bud AC-1404 or equiv.
Side chassis (2 req.): 5×7×2-in. chassis, Bud AC-402 or equiv.
Rack panel: 5 1/4×19×1/8-in., Bud SFA-1833 or PA-1103 or equiv.
Tube socket: 11-pin EIA, Eimac SK-1900 or Johnson 124-0311-100.
Grid collet: Eimac 720359 assembly (Eimac 882931 can be used).
Anode collet: Eimac 720829.
Grid collet insulator: Eimac 720518.
Chimney: Eimac SK-1906.
Panel bearings: 1/4-in. diam., Millen 10066 (2 req.).
Reduction drives: Jackson 4511/DAF (2 req.).

Components Referenced On Schematic Diagram

C1—1.5-5 pF miniature air variable (butterfly); Cardwell 160-0205.
C2—1.8-8.7 pF miniature air variable; Cardwell 160-0104.
C3-C5—1000-pF, 300-V feedthrough capacitor; Tusonix 327-005-C5UO-102M.
C6—Plate tuning flapper. See text.
C7—Plate loading flapper. See text.
C8—1000-pF, 4000-V feedthrough capacitor; Tusonix 2498-001-X5UO-102M.
C9-C10—1000 mF, 25-V electrolytic.
C11—0.15 mF, 25-V disk or epoxy.
C12-C19—0.01-mF, 50-V monolytic ceramic; Sprague 1C105Z5U103M050B.
D1—5.6-V, 10-W Zener, mounted on RCA SK122/5178A heatsink.
D2—10-A, 400-PIV.
D3-D4—2.5-A, 1000-PIV; R170 or equiv.
D6-D14—1-A, 1000-PIV; 1N4007 or equiv.
F1—2-A, AGC or 3AG fast-blow.
F2—3/4-A, AGC or 3AG fast-blow.
I1—120-V neon, amber; GC Electronics 38-282.
I2—120-V neon, red; GC Electronics 38-280.
J1—Chassis-mount BNC female, UG-1094/U.
J2—Chassis-mount N female, UG-58A/U.
J3—Chassis-mount MHV female, UG-931/U.
J4—6-pin male chassis mount; Cinch P306AB.
J5—6-pin miniature chassis connector; Waldom Molex 03-06-1061.
J6-J8—Phono connector; Switchcraft 3501FR.
K1—180-sec. thermal time-delay relay, 115-V heater, SPST-NO; Amperite 115NO180B.
K2—Control relay, DPDT, 24-V dc coil; Potter and Brumfield R10-E1-X2-V700.
K3—Control relay, 4PDT, 24-V dc coil; Potter and Brumfield R10-E1-X4-V700.
K4—Coaxial relay, SPST, BNC connectors, 28-V dc coil.
K5—Coaxial relay, SPST, high-power, N connectors, 28-V dc coil.
L1—2 turns no. 16 copper, 1/4-in. diam., 3/4-in. long.
L2—Brass strip 1/4-in. wide × 1/-3/16-in. long.
M1—Dc milliammeter, 600 or 1000 mA fullscale.
M2—0-1 milliammeter with shunt resistors to give full-scale deflections of 60 mA (grid current); 3 kV (high voltage); 30 V ac (filament voltage).
MOT1—54 cfm blower; Dayton 4C012 or equiv.
Q1-Q2—2N2222A, 2N3903 or equiv.
Q3—2N3053 or equiv.
Q4—2N4037 or equiv.
Q5—2N2904, 2N3905 or equiv.
R1—200-Ω, 25-W wirewound.
R2—1000-Ω, 12-W wirewound.
R3—10-kΩ, 25-W wirewound.
R4—1-Ω, 1-W, 1%.
R5-R10—499-kΩ, 1/2-W, 1% metal-film, type RN-60 preferred.
R11—820-Ω, 1/2-W, metal film. Select value to calibrate HV meter.
R12—1.5-kΩ, 1/2-W metal film. Select value to adjust HV relay trip point.
R13—9-Ω, 1/2-W metal film. Select value to calibrate grid meter.
R14—10-Ω, 2-W, metal film
R15—10-kΩ, 1/4-W miniature trimmer.
R16—1200-Ω, 2-W. Select value to set K1 time delay.
R17—50-Ω, 12- or 25-W adjustable slider wirewound.
R18—1-Ω, 5-W wirewound.
R19—12-kΩ, 1/2-W, film.
R20—2-kΩ, 1/4-W, miniature trimmer.
R21, R22, R25, R27—2.7-k, 1/2 W.
R23, R28—10-kΩ, 1/4 W.
R24—4.7-kΩ, 1/4 W.
R26—2.2-kΩ, 1/4 W.
R29—330 Ω, 1/4 W.
R30—500-Ω, 25-W wirewound.
RFC1—8 turns, no. 18 enameled, 1/4-in. diam., closewound.
RFC2, RFC3—8 turns, no. 16 enameled, 1/4-in. diam., closewound.
RFC4, RFC5—7 turns, no. 18, 3/4-in long, 1/4-in. diam.
S1—DPST toggle.
S2—SPST toggle.
S3—2-pole, 4-position rotary.
S4—SPDT miniature toggle.
T1—Filament transformer: 14-V, 2-A secondary, 120-V primary; Stancor P8556 or equiv.
T2—Control transformer: 10-V, 2-A secondary, 120-V primary; Stancor P8653 or equiv.
W1—Plate stripline.
W2—Cathode stripline.

the one used in the 8874 amplifier, both to fill the larger plate compartment and to accommodate the larger (2.5-in.) diameter of the 3CX800A7 anode radiator. The larger stripline allows for better placement of the tuning controls. The preferred material for the stripline is 1/16-in. brass, which is silver plated after the collet is soldered in place. Copper is also suitable, but

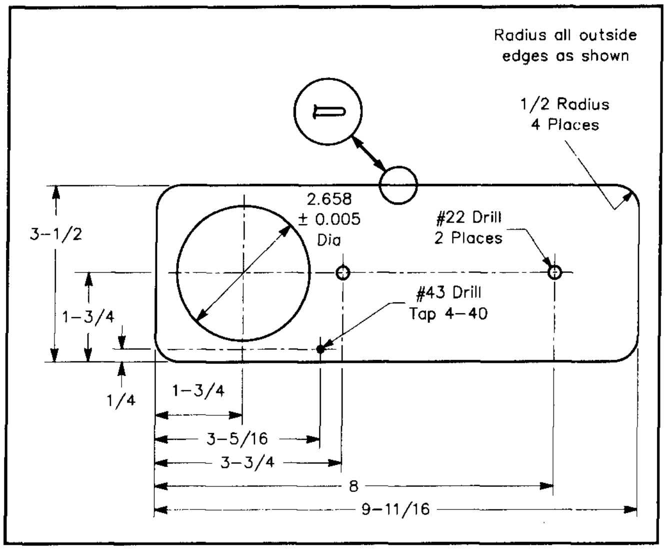


Fig 1—Plate line of the single 3CX800A7 amplifier. Except as noted on the drawing, dimensions are ± 1/32 in. Material is 1/16-in. copper or brass. Anode hole is sized for the EIMAC 720829 collet. Dull-finish (nickle-less) silver plating is recommended after the collet is soldered in place.

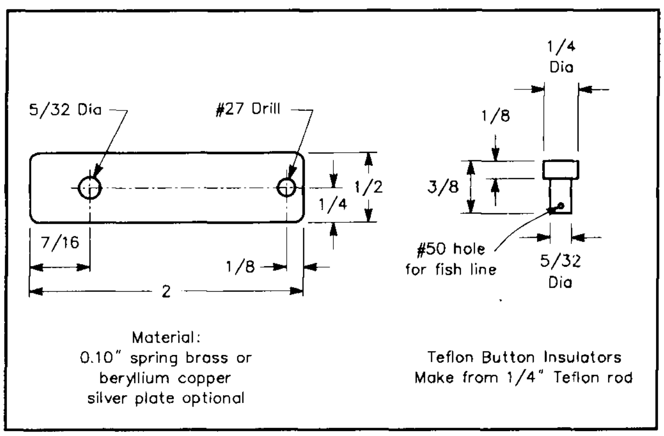


Fig 3—Plate loading capacitor C7 is made from 0.010-in. spring brass or beryllium copper. The button insulator is made of 1/4-in. Teflon rod.

harder to machine. If you have your line professionally plated, specify a "dull" finish; that is, without nickel content. A plater experienced in RF work will know what you mean. He will copper flash the line before plating it. Specify a minimum silver thickness of 0.001 in. In 1986, the cost to silver plate all parts (W1, W2, L2, C6 and C7) was $63, of which $60 was for setup and only $3 was for material. For minimal additional cost, you and other hams can collect a wide assortment of RF parts and have them all plated at once.

Silver plating is *not* necessary for proper operation. The difference in efficiency between a clean, polished but unplated stripline and a silver-plated line was nearly impossible to measure. Experience with the 8874 432-MHz amplifier has shown that an unplated line begins to tarnish after a few years. When the oxidation is heavy enough, the amplifier tuning drifts as it heats up. Polishing the stripline returns the amplifier to

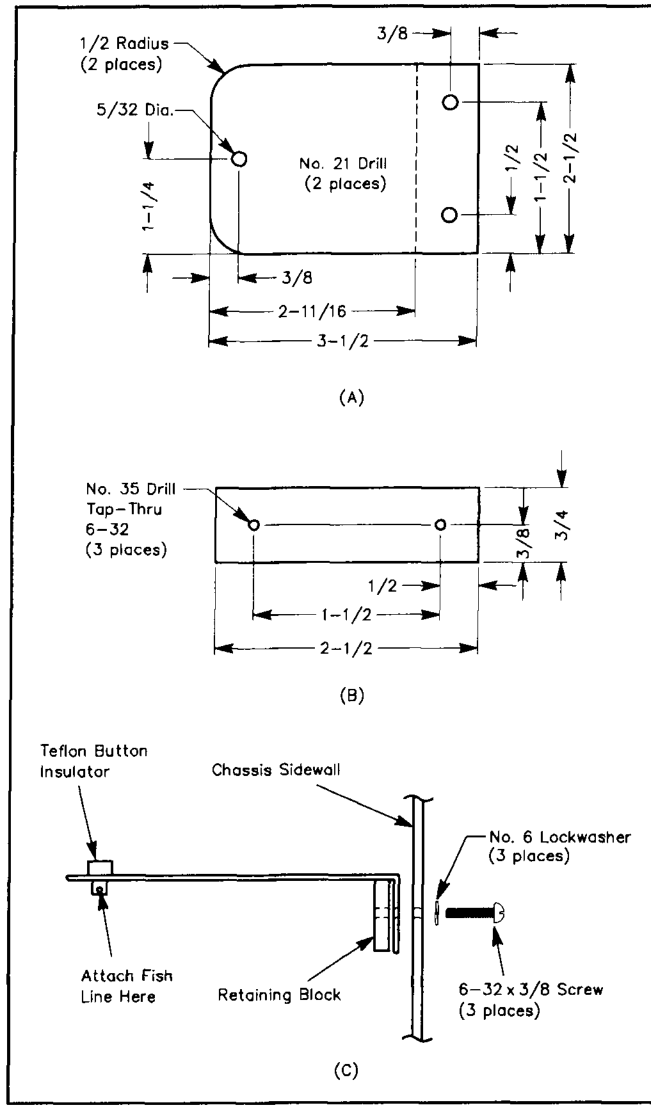


Fig 2—Plate tuning capacitor C6 (A); retaining block (B); mounting of the capacitor and retaining block (C). The capacitor is made from 0.010-in. hard brass or beryllium copper. Silver plating is optional. The mounting block is *made from 1/8-in. aluminum.*

like-new operation with no thermal drift.

The plate line is held in place with two 1½ in. high × ⅜-in. diameter ceramic standoff insulators. Homemade Teflon insulators are even better. They can be made ⅜ or ½ in. diameter. Tap the ends for 6-32 screws. Use brass screws to hold the stripline in place. Steel (and especially stainless steel) can cause unwanted tuning effects. Also use a brass screw to attach the plate RF choke (RFC4). The screws used to attach the standoff insulators to the chassis bottom can be steel. The hole in the plate line for the anode is sized for an EIMAC 720089 collet. Finger stock may be used if you prefer. If you use finger stock significantly larger than the EIMAC collet, the position of the plate-tuning capacitor will be different. Try to obtain finger stock with contacts that are rolled over 180°, sized about ⅛ to 3/16 in. high, with the fingers rolled over about ⅛ in. Be careful to size the anode hold in the plate line correctly.

The tuning and loading capacitors are made from 0.010-in. thick brass shim stock. This material has a spring temper

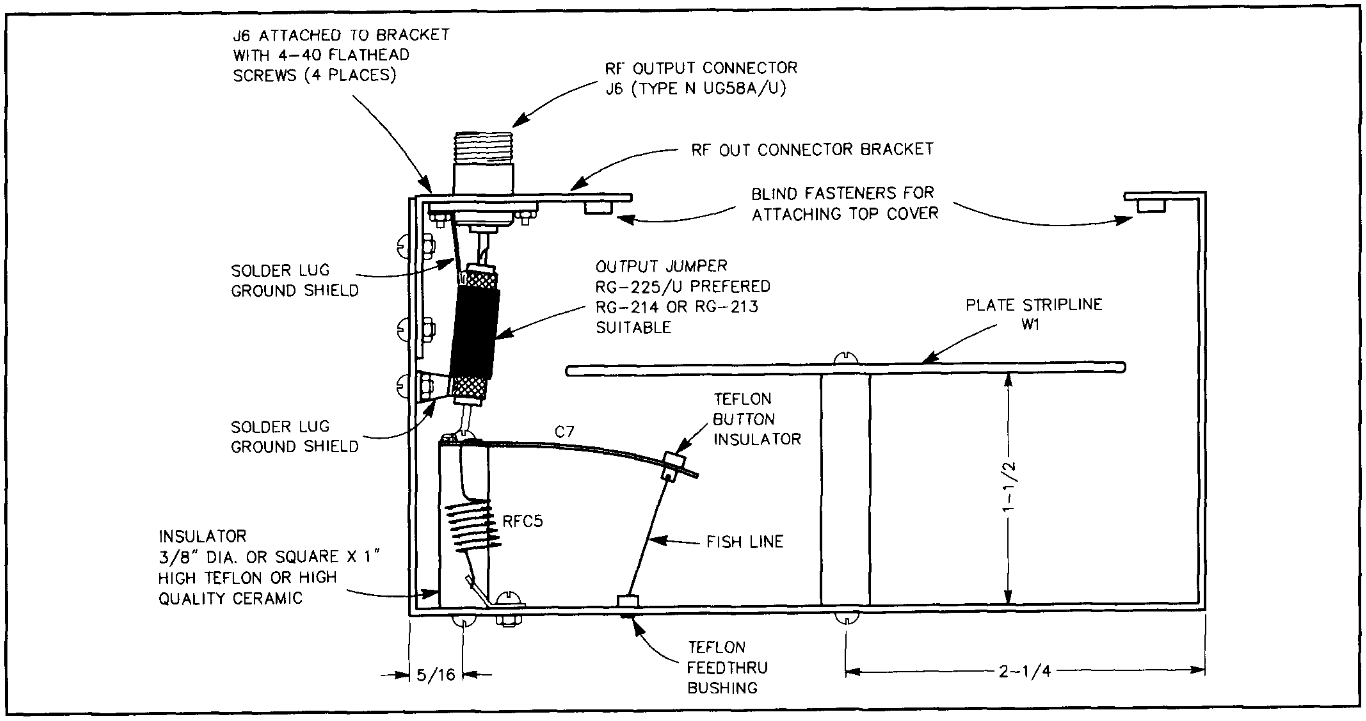


Fig 4—RF output compartment details. The plate line is not centered in the enclosure. See Fig 5 for construction details of the RF output jumper.

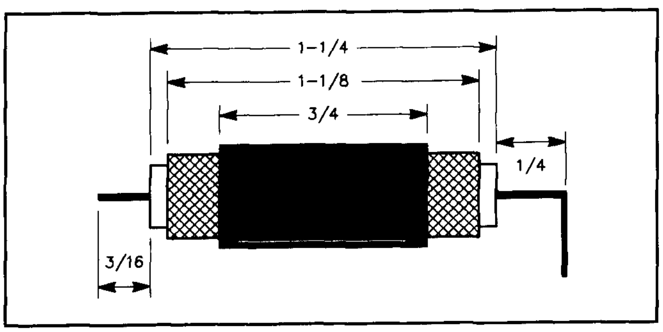


Fig 5—RF output jumper details. RG-225 Teflon-dielectric cable is preferred, but RG-214 or RG-213 cable may be used. Alternately semi rigid solid copper sheathed cable such as UT-141 or UT-250 may be used.

and works well. You can also use beryllium copper. Don't use material thicker than 0.010 in. Thicker stock is more likely to take a set and not spring back to its original position. In addition, thicker material may place too great a load on the fish line and tuning controls. The strain may stretch the fish line or move the tuning control positions, affecting tuning.

The plate flapper (Fig 2) is held in place by an aluminum block ¾-in. wide × 2½ in. long × ⅛-in. thick. Tap the holes for 6-32 thread, for easy installation and removal. The loading flapper (Fig 3) is mounted on a 1-in. tall, ⅜-in. dia. Teflon or ceramic insulator. Both flappers use small Teflon button insulators to secure the fish line. These homemade insulators serve the dual purpose of providing an attachment point for the fish line and preventing the flappers from accidentally contacting the plate stripline.

The preferred fish line is braided Dacron fly line. I used Specialist 18-lb Fly Line Backing, made by Berkley. Be sure

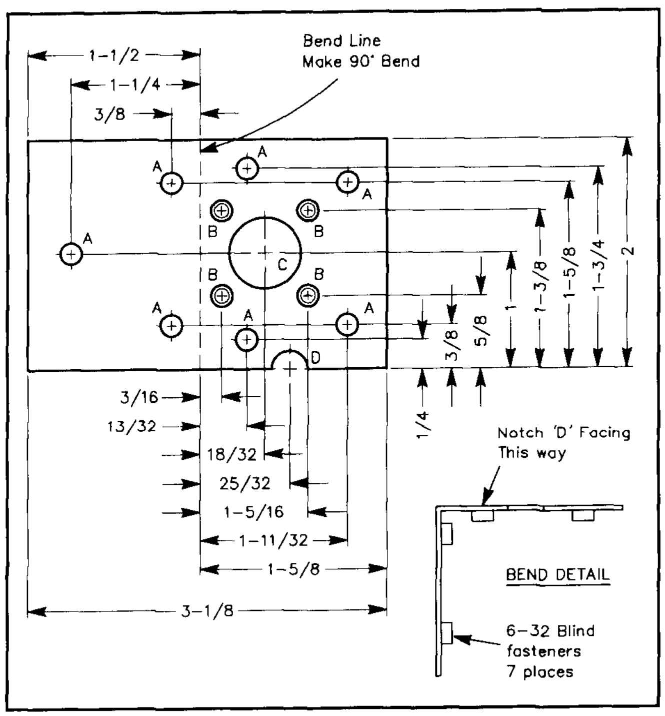


Fig 6—RF-output connector bracket is made from 0.062.-in. aluminum. Holes marked A are 3/16-in. diam., for 6-32 blind fasteners. Asterisks (*) indicate holes that should be located using the top cover as a template when the bracket is mounted. Holes marked B are No. 30, countersunk for flush mount with 4-40 screws. The connector mounting holes may also need to be countersunk. Hole C is 5/8 in. diam. Hole D is a 5/16-in. diam. notch to clear the blower mounting plate.

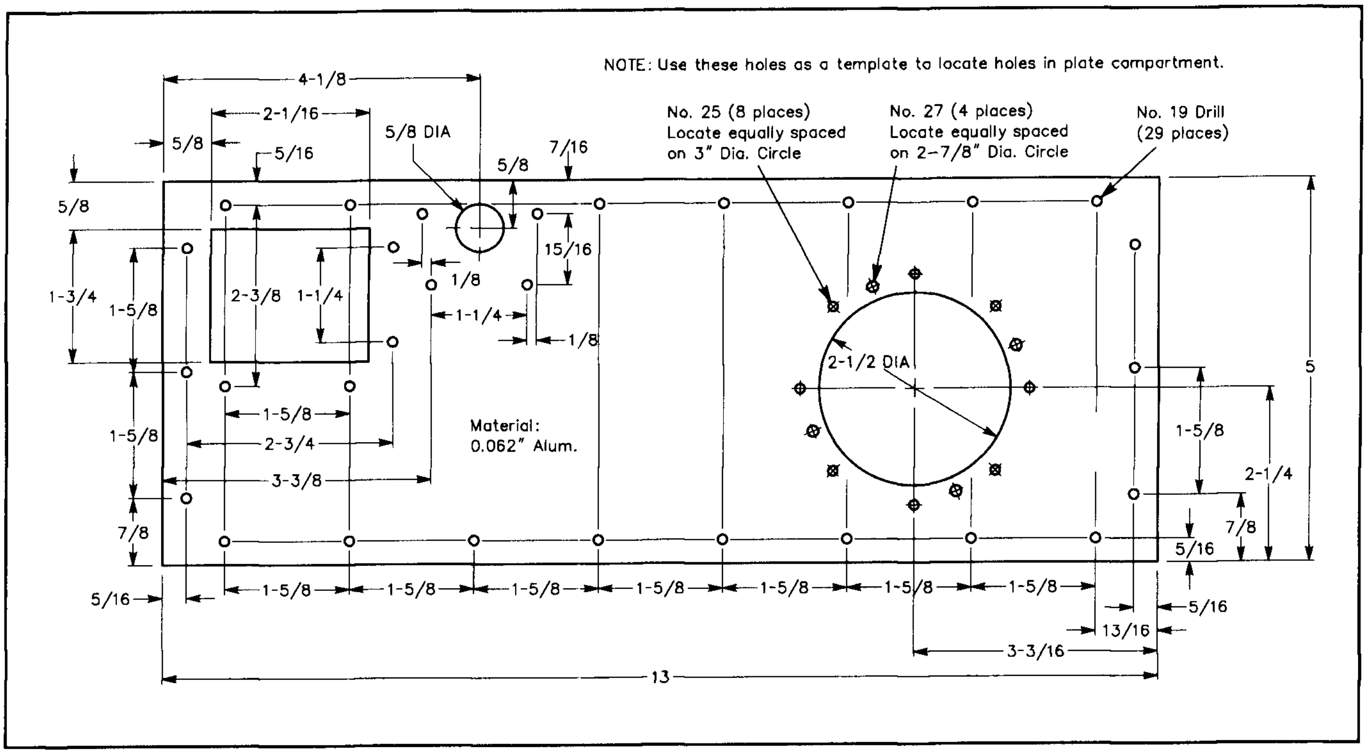


Fig 7—Top cover of the amplifier is made from 0.062-in. aluminum. Use the cover as a template to mark holes in the chassis.

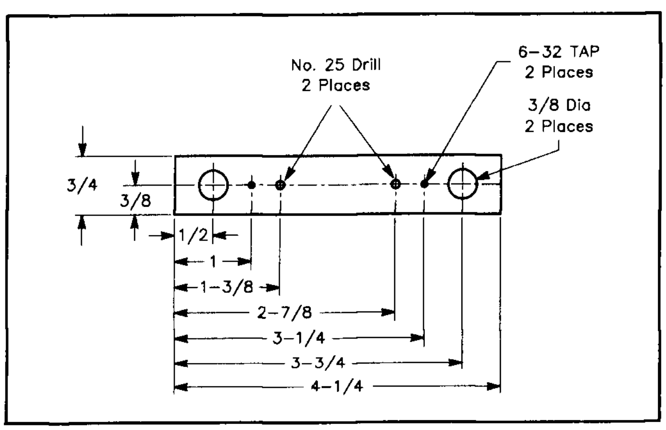


Fig 8—Plate tuning control bracket is made from 0.062-in. aluminum.

all edges on the flappers are smooth and free from burrs. Also make sure the flappers are mounted parallel to the stripline. These precautions assure RF or dc doesn't arc from the plate line to the flappers.

A small piece of RG-225 coax connects the loading capacitor to the RF-output Type-N connector (J2). Fig 4 details assembly of the loading capacitor (C7) and Fig 5 gives dimensions for the coax jumper. RG-225 is similar to RG-214, but uses Teflon dielectric and jacket, along with double silver-plated shields. You can also use RG-213 or RG-214 if you're careful not to melt the dielectric while soldering it in place. Both ends of the shield are grounded through solder lugs. Be sure that the jumper is mounted close to the chassis wall and away from the stripline. The output connector is mounted on a small bracket to allow for rear-panel RF-output connection, while not requiring any disassembly when the plate-compartment cover is removed. Fig 6 gives the layout of the output connector bracket.

Be very careful when notching the plate chassis for the RF- output-connector bracket. Once the lip is cut out it is very easy to bend the chassis if the bracket is not secured in place. The top cover (Fig 7) should be drilled first. Then you can use it as a template to locate the holes in the chassis that will hold the top cover in place. Next, install the blind fasteners (PEM nuts). Once the fasteners are in place, you can notch the chassis for the output-connector bracket. Cut the bracket to size and bend it 90°, as shown in Fig 6. Drill the 3 holes for the bracket mounting screws and install the bracket. Now use the top cover again as a template to locate the output-connector hole and the 4 top-cover mounting holes. You can use the UG-58 output connector as a template to locate its mounting holes.

The plate tuning and loading fish lines are brought through the chassis through small homemade Teflon bushings. The lines run over small pieces of ¼-in. Teflon rod, giving nearly friction-less 90° transition of the tuning controls. Brass shafts, which run through panel bearings that are mounted on a support bracket (Fig 8), control the tuning lines. This bracket is supported by standard 1¼ in. long steel standoffs. To impart a slow, smooth feel to the plate tuning and loading controls, 6:1 ball-reduction drives are used. The drives I used are Jackson Bros. 4511/DAF, and is available from Radiokit or Surplus Sales of Nebraska.[3] The ball drives are

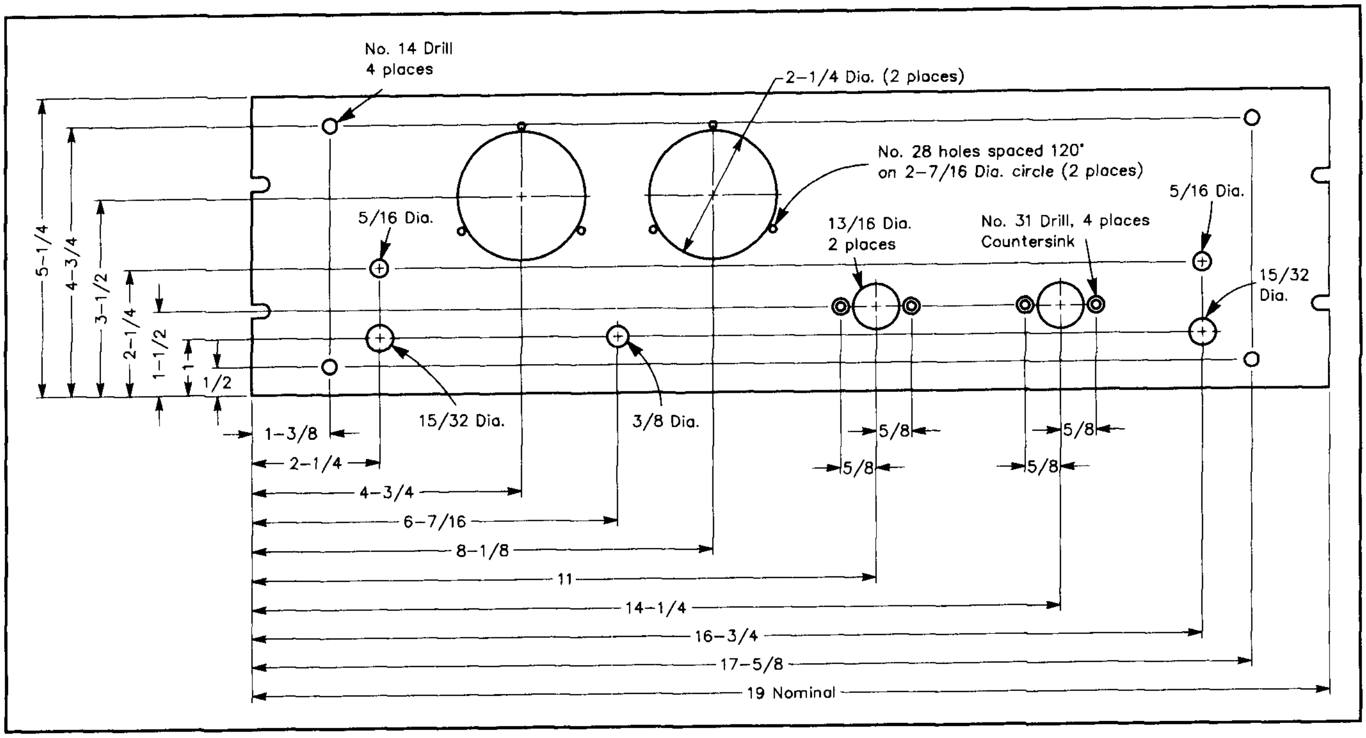


Fig 9—Front-panel layout. The panel is made from a standard 5-1/4 in. aluminum EIA rack panel.

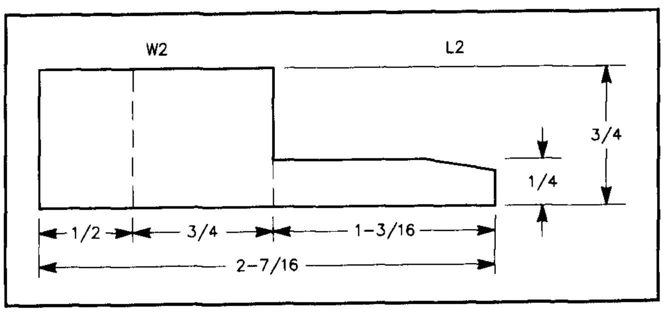


Fig 10—Cathode stripline is made from 0.015-in. brass. Silver plating is optional.

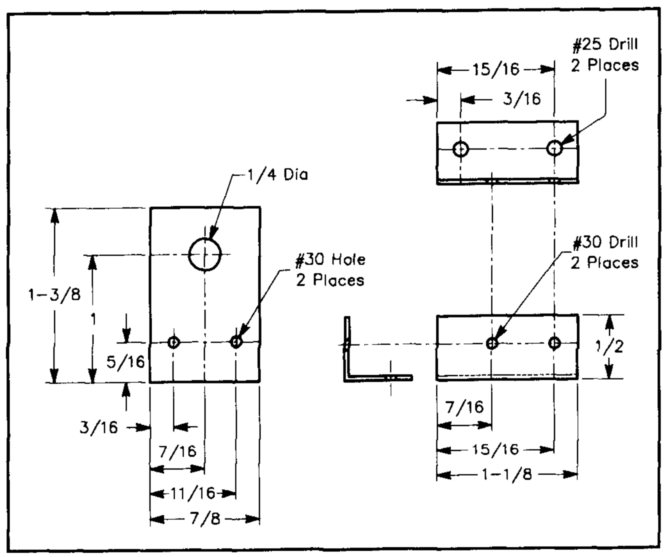


Fig 11—C1 mounting bracket is made from 0.062 X 1/2-in. aluminum angle or 0.062-in. aluminum sheet. The mounting insulator is made from 1/16-in. G10 circuit-board material from which the copper has been removed.

mounted to the front panel with 4-40 flat-head screws. Fig 9 shows the front rack-panel hole sizes and locations for the ball drives and other holes. Use 4-40 nuts to secure the screws, so they act as mounting studs for the ball drives. The nuts also serve as spacers to position the ball drives nearly flush with the front panel. Homemade pointers attached to the ball drives serve as control position indicators.

The specified high-voltage feedthrough capacitor may be hard to find. It may be available from Microwave Components of Michigan.[4] You can also construct a bypass capacitor from 1/16-in. thick brass plates and 0.005-in. Teflon or Kapton sheets. A two-plate capacitor with one plate inside the RF enclosure and another plate on the outside is recommended. Plates sized approximately 2½ × 3¼ in. are suitable. The plates should be flat, polished so they are smooth and free from any burrs, and have rounded edges. If you use Teflon, spread silicone grease on the Teflon to fill in any imperfections. You don't have to coat Kapton, as it doesn't have the porosity or cold-flow characteristics of Teflon.[5]

Cathode Circuit Assembly

The cathode circuit consists of a quasi-half-wave line, similar to that used in the original 8874 amplifier. Changes have been made, due to the higher input capacitance of the 3CX800A7 and to make the circuit more repeatable when duplicated. Fig 10 gives the layout of W2 and L2. Most of the first quarter wave of the half-wave input line is actually inside the tube and socket. W2 forms the rest of the first quarter wave and part of the second quarter wave. L2 completes the second

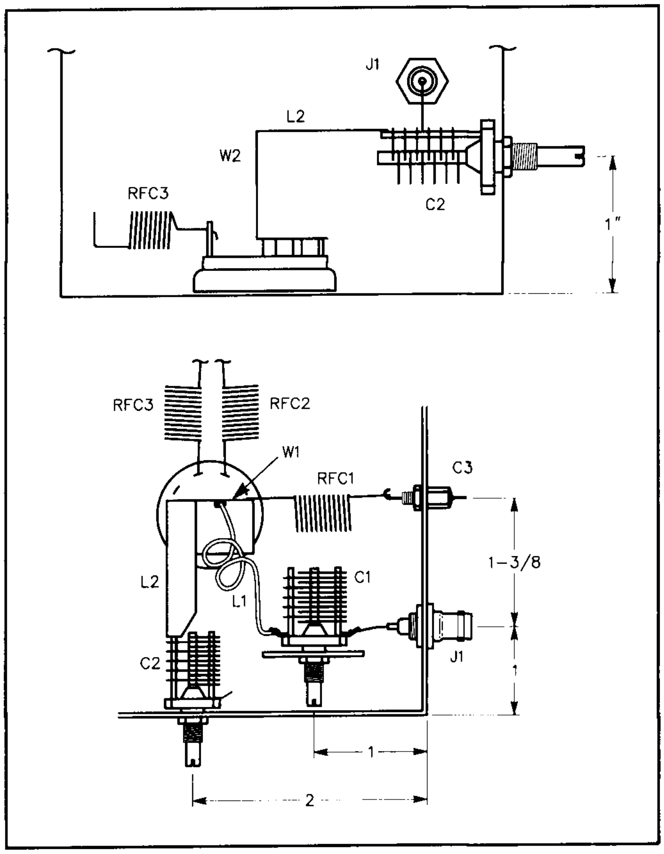


Fig 12—Side and bottom views of the cathode circuit.

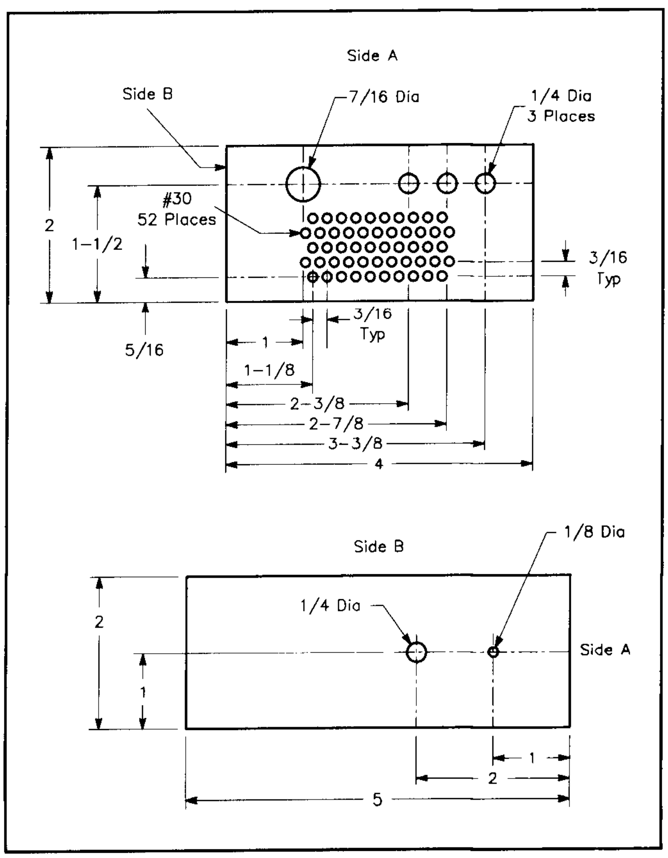


Fig 13—Cathode compartment details. The compartment is made from a 5 X 4 X 2-in. chassis.

half of the line. C2 is simply used to tune the line to resonance. L1 is a series inductance to match the 50-Ω input impedance to the input impedance of the tube. L2 has slightly too much inductance so the series capacitor C1 is used to adjust the total reactance for a proper match. Note that the rotor of C1 must be insulated from ground. A small piece of G-10 epoxy PC board material serves as a mounting insulator. The circuit board is held in place by a small aluminum bracket (Fig 11).

To assemble the cathode circuit, first remove the unused grid pins (4, 7, 11) from the tube socket. Next bend the 6 cathode pins (1, 2, 3, 8, 9, 10) in toward the center of the socket, forming a 90° angle. The bend is made just above the dimple that keeps the pins in place in the socket. The socket is then mounted in place on the grid collet. Note how the 2 filament pins point to the top of the amplifier and the 6 cathode pins point toward the bottom. Mount the rest of the cathode components, C1, C2 and J1. If the layout has been followed, when W2 is soldered to the 6 cathode pins, L2 should line up right on the stator wires of C2. Fig 12 gives 2 views of the cathode-circuit layout. Fig 13 covers the hole-drilling patterns in the cathode compartment. If you follow the layout, the input circuit should tune up easily and you'll obtain an input SWR less than 1.2:1.

Tube Socket Mounting

The recommended EIMAC 720359 grid-collet assembly simplifies construction. It consists of an EIMAC 882931 collet that has been soldered to a 1/16 in.-thick brass mounting ring. The mounting ring has three 4-40 studs that are positioned to match the mounting holes of the 11-pin tube socket. An alternate method of construction is to use the 882931 collet and attach it to a homemade mounting ring. Although the 720359 collet assembly is more expensive, it will save you considerable construction time.

To cut the hole for the tube socket, first punch a 1¼ in. diameter hole in the chassis bottom, located as shown in Fig 14. Next use the tube socket to locate 3 no. 28 holes, orienting the socket per the hole layout in Fig 14. Put the EIMAC 720359 collet in place and use it as a template to drill its 4 mounting holes in the chassis with a no. 27. Remove the collet and socket. Next, drill out the 3 #27 holes with a 9/32-in. drill. Then file out the holes until they form one hole that matches the shape shown in Fig 14. The socket should be able to pass through the hole. Drill a series of 6 no. 43 holes in the collet, matching the pattern shown in Fig 22. Again use the collet as a template to drill 6 no. 42 holes in the chassis. These holes are for bleeding air into the cathode compartment for cooling the tube base. The tube socket may then be mounted to the collet, using 4-40 nuts and lock washers. The collet is then mounted to the chassis with 4 6-32 screws. With everything properly assembled the tube socket will mount flush with the collet.

Additional air is let into the cathode compartment through a series of cooling holes. A metal plate (Fig 15) is used to make an RF filter to prevent leakage from the plate compartment into the cathode compartment. The cathode box is perforated on the side away from the cooling holes. In this way, the air passing into the cathode box is forced across the tube base, to maximize its cooling effect.

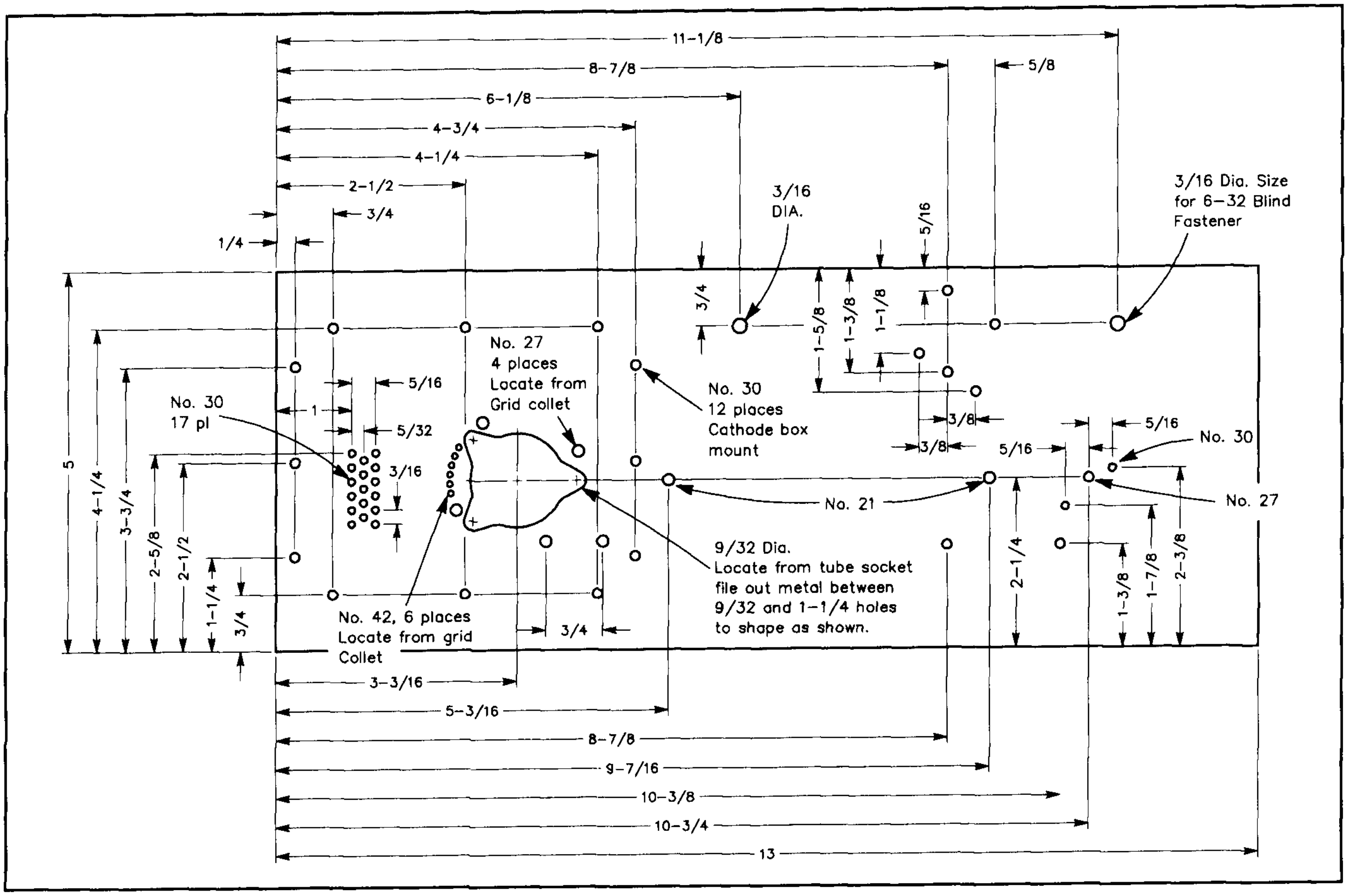


Fig 14—Bottom cover of the plate RF enclosure is made from 0.062-in. aluminum.

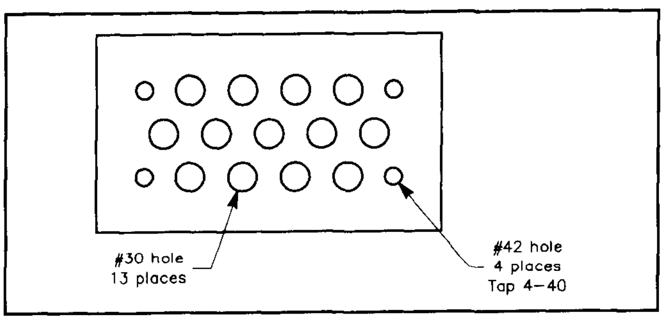


Fig 15—Cathode air vent waveguide is made from 3/16-1/4 in. aluminum.

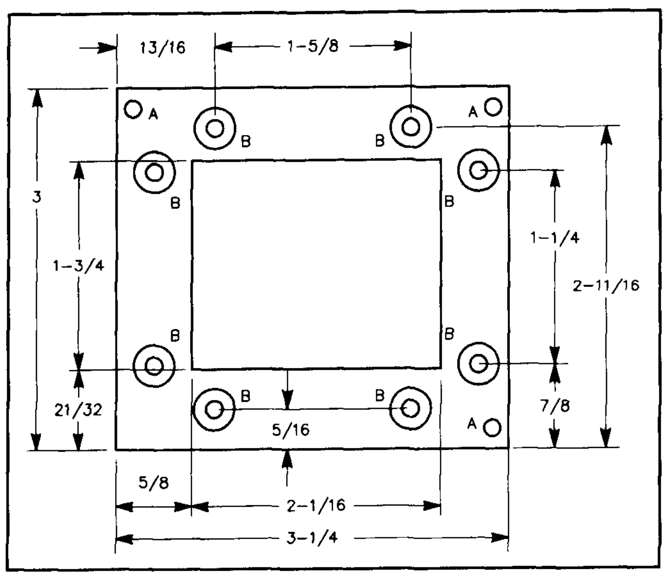


Fig 16—Air inlet retaining plate is made from 3/16-1/4 in. aluminum. Hard alloys, such as 6061-T6 or 2024-T6 are preferred. Holes marked A are No. 7, tapped 1/4-20. Use the blower itself as a template to locate the holes. Holes marked B are No. 25, countersunk for 6-32 flathead screws. Use the top cover to locate these holes.

Cooling Considerations

The air inlet and outlet are RF shielded by means of aluminum cooling screen, sandwiched between the RF deck top cover and ¼-in.-thick retaining plates. Matching hole patterns are cut in the top cover and the retaining plates. For best alignment, use the top cover as a template for drilling the plates. Although these plates may look complicated to make, they were fabricated with hand tools. The large air inlet and outlet holes were first scribed. Then, a series of small holes was drilled along the inside of the marks. The holes are then drilled out with a larger drill so the hole slug can be knocked out. The holes are then simply filed to shape. Fig 16 gives the inlet plate layout and Fig 17 shows details of the outlet plate.

The air-outlet plate is mounted on the inside of the chassis sandwiching the screen between it and the cover plate. The plate also serves to space the chimney down to the plate line. The EIMAC SK-1906 chimney is held in place with 4, ½-in.-

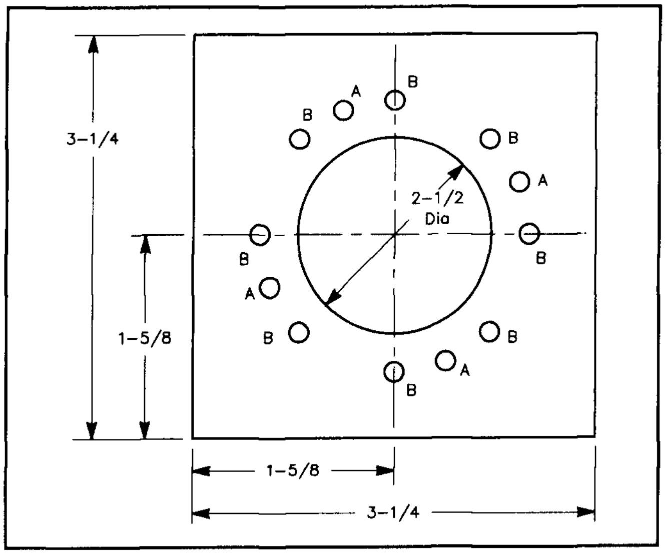


Fig 17—Air outlet retaining plate is made of 1/4-5/16 in. aluminum. Hard alloys, such as 6061-T6 or 2024-T6 are preferred. Holes marked A are No. 27. Locate the 4 holes equally spaced on a 2-7/8 in. diam. circle. Holes marked B are No. 35, tapped 6-32. Locate the holes equally spaced on a 3-in. diam. circle.

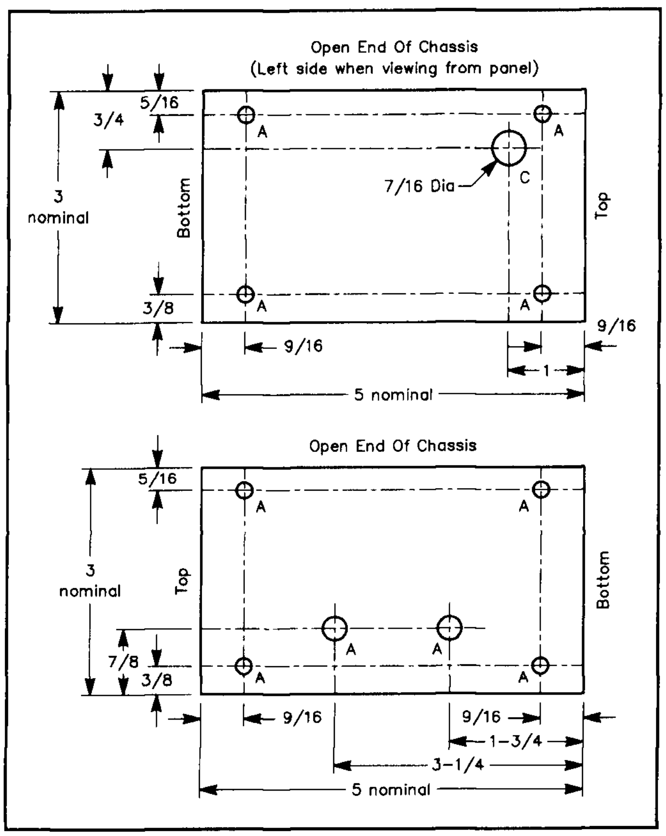


Fig 18—RF deck. At top, tube end; at bottom, flapper end. Holes marked A are chassis mounting holes, No. 23.

long 4-40 screws, which pass through the cover plate and retaining plate. The threaded metal inserts in the chimney should be removed from the plate line side of the chimney. Alternately, you can use a homemade Teflon chimney. The air-inlet

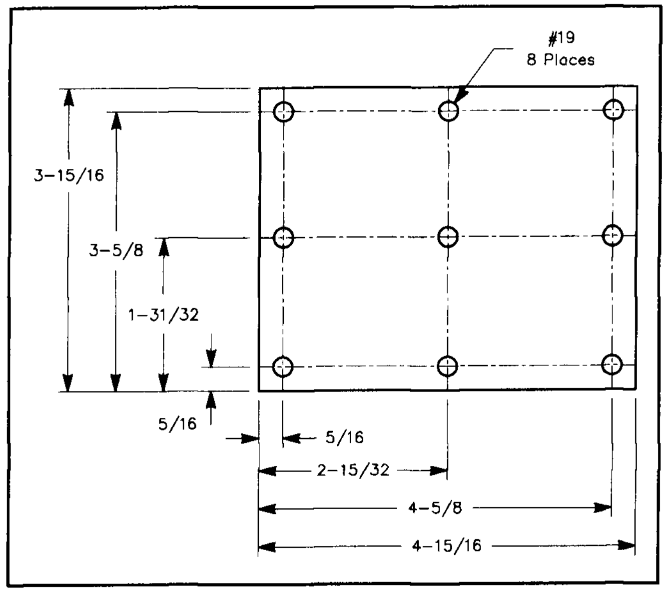


Fig 19—Cathode compartment cover plate is made from 0.062-in. aluminum. Use the finished cover as a template to locate holes in the cathode compartment.

plate and screen are mounted on the outside of the top cover. Tap three ¼-20 blower-mounting holes in the plate. Note that 4 of the inlet plate hold-down screws also secure the top cover. Since the blower covers all 8 of the mounting screws, their holes are countersunk and flat head screws are used. The blower must be removed to take the plate compartment top cover off.

To ensure that adequate RF shielding is maintained, the air inlet retaining plate and the top cover must be fastened tightly. The 5- × 13- × 3-in. chassis is made from 0.040-in.-thick soft aluminum. Sheet-metal screws will easily strip out the thin aluminum after being removed and replaced several times; it's essential to use blind fasteners (PEM nuts or Rivnuts). They are readily available from Small Parts Inc. I used 6-32 fasteners. When installing the fasteners, be very careful not to distort the chassis lip. It is easy to make ripples in the metal, which will cause RF leakage.

The amplifier operates quietly with the specified blower, in combination with effective shock mounting. A ⅛-in.-thick gasket made from high-density foam rubber is placed between the blower and its mounting plate. The blower is attached with three ¼-20 nylon screws, ½-in. long. Rubber grommets are placed on the screws before they are installed. This arrangement assures that there are no solid mechanical contacts to transmit blower noise and vibration.

Metal Finishing

The professional finish on the amplifier is gold-irridite applied by a plating company. Irridite provides a hard and conductive finish. Don't confuse irridite, which is sometimes known as chromate finish, with anodizing. Anodize is not a conductive finish and may contribute to RF leakage and improper operation of the amplifier. All aluminum was wet sanded with 320-grit wet-sanding paper. Sand in one direction in a straight motion. You are sanding the aluminum to remove

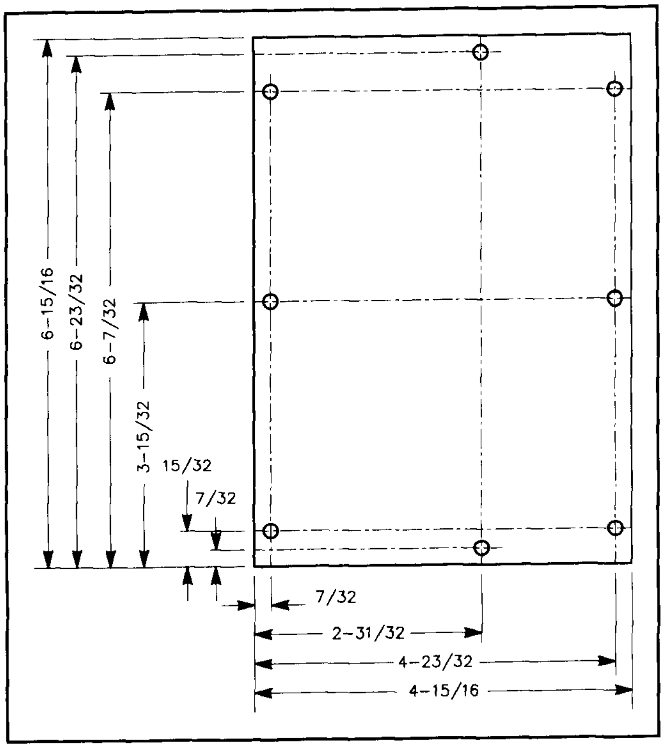


Fig 20—Side-chassis cover plates (2 required). Holes are No. 19. Use cover plates as templates to drill side chassis.

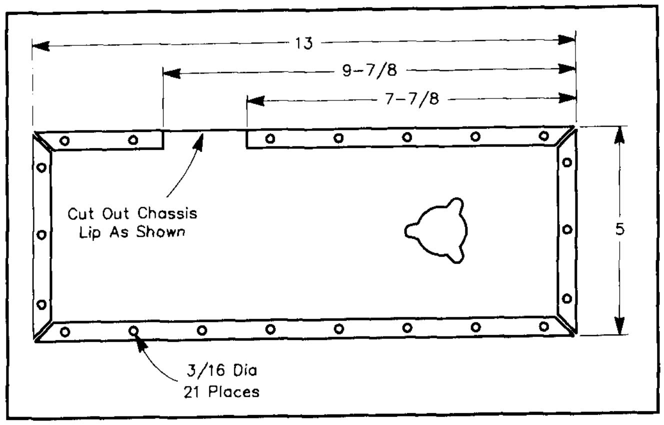


Fig 21—RF plate enclosure. Install blind fasteners in the 21 3/16-diam. holes.

scratches and burrs made during construction. At the plater's specify a deep etch, which will remove any remaining scratches, unless they are very deep. While you can apply irridite at home, I don't recommend you try, though. The aluminum must be absolutely free of contaminants, and the chemicals necessary to ensure it is are not readily available and are dangerous to use. I paid only $32 to have all the amplifier parts irridite plated, in 1986.

The drill work done to make the various air-vent holes (cathode compartment and side chassis) may look as if it was done by magic, to achieve their near-perfect patterns. In truth, these vent holes are simple to create. A piece of standard perforated steel was used as a drilling template, so the many holes do not even have to be marked! After drilling, the burrs are sanded smooth to create the clean, sharp holes. Figs 18 to 21 give additional metalwork drilling and cutting information.

Protection Circuits

The specified filament warm-up time for the 3CX800A7 is 3 minutes. Follow this specification to obtain maximum tube life. As the cathode is heated, the areas directly in front of the filament wires get hot first, and become the first areas to emit cathode current. If you operate the amplifier in this condition, the cathode hot spots will emit all the cathode current, and may vaporize.

An Amperite thermal time-delay relay is used to prevent operation of the amplifier for 3 minutes. A solid-state timing circuit was considered, but the thermal time-delay was chosen because it is simple and heats just like the tube filament. There's no need to wait another three minutes if filament power is only interrupted momentarily. Brief interruptions may be caused by power failures or HV arcing. This kind of flexibility is hard to design into a solid-state circuit.

A 120-second time-delay relay was used because it is the longest delay available in the 9-pin miniature size. I extended its turn-on time to 180 seconds by placing a resistor in series with the heater element. Even if you obtain a 180-second unit, you should check the turn-on time. Most units are specified for use on a nominal 115-V ac circuit. With US line voltage now typically 118 to 120 V, some timers will warm up 15 to 20% faster than the specified time. If necessary, use a series resistor to adjust the warm-up time. Since I built this amplifier, the Amperite 115NO120T (9-pin) and 115NO180 (octal) have become hard to get and very expensive. An inexpensive sealed-plastic-case model (115NO180B) can be used instead.

A small but significant point is the use of a 14-V transformer for the filament. Since the filament voltage is backed off to 13.0 V for operation, you may be tempted to use a commonly available oversized 12.6-V transformer. Doing so will be detrimental to the life of the tube. A well-cared-for tube used in intermittent service may first fail with an open filament. A cold filament has very low resistance (1.5 Ω for the 3CX800A7). Unless some protection is used, the turn-on surge may be as high as 10 A. By using a higher-voltage transformer and series resistors, automatic surge limiting is easily achieved. I used a 1-Ω resistor in series with the secondary of the transformer. A 50-Ω, 12-W variable resistor is used in the primary circuit to set operating filament voltage.. This combination limits turn-on surge to just over 2 A.

To achieve high gain and efficiency, the 3CX800A7 uses a grid structure constructed of small wires. This construction limits grid dissipation to 4 W. It is common practice for HF amplifier designers to include a circuit to sense excessive grid current. Such sensing circuits are not always useful at UHF, as transit-time effects may cause negative grid currents vastly different from real grid absorption and secondary emission. In testing the 3CX800A7 at 432 MHz, the grid current was found to behave predictably, that is positive current which corresponded directly to drive levels was observed. Because of this desirable behavior, a grid-current-sensing circuit was included in this amplifier. R14, in combination with grid shunt R4 develops a voltage sufficient to switch on the grid-trip relay K3, through switching transistor Q2. Contacts on K3 lock in the over-current relay and turn off the OPERATE pilot lamp. No reset switch is used. The circuit is reset by setting STANDBY/OPERATE switch (S2) to STANDBY, then back to OPERATE.

An additional protection circuit senses high voltage. It consists of Q1, which senses the presence of high voltage through the HV metering circuit. Q1 allows the T/R relays to switch on transmit. This circuit prevents the amplifier from keying should plate voltage not be present. While just the grid-trip circuit may seem adequate, the absence of plate voltage will cause the tube to draw excessive grid current when drive is applied. The HV sensing circuit protects against such an occurrence.

Many high-performance 432-MHz stations use a single T/R relay at the array, in combination with an antenna-mounted receive preamplifier. In these stations, in-out RF relays are not used at the amplifier. This could cause a problem if the amplifier ac fuses blow. Since the grid-trip circuit requires that power be present to operate, ac-power loss to the amplifier but not the exciter can result in damage to the tube, unless a driver-to-amplifier interlock is provided. The HV-sensing circuit will protect the tube. Simply unshorting the cathode-bias resistor (R3) will provide sufficient protection for the tube from drive power, but it is better to remove all drive power when plate voltage isn't present.

Another feature of the switching circuitry is provided by S4. This switch, located on the rear panel, allows the operator to determine whether the RF relays actuate every time he transmits, or lock in when the amplifier is switched from standby to operate. This feature can be used if the station includes a tower-mounted preamp with a separate feed line. It eliminates the noise generated by switching the relays in the shack. If an in-out tower preamp is used (with a single transmission line) or a transceiver without an external preamp, this locking feature is not usable. Note though, even if the RF relays are locked in, either an excessive grid-current trip or loss of plate voltage will still drop out the RF relays.

Metering Circuits

The metering circuit has one anomaly: The resistor string is used both for the high-voltage meter and for the high-voltage sensing circuit. Since the HV sensing circuit is referenced to ground, the current from the circuit will return to the HV supply B– lead through the grid-meter shunt. The grid meter will read this current. At idle conditions, the grid-current meter will read negative by about 0.8 mA. If you find this to be a problem, use separate resistor strings for the HV meter and HV sensing. The HV meter would then be connected to the B– line, not to ground.

Note also that the HV meter also reads plate voltage relative to ground. Since the actual power input is determined by plate-to-cathode voltage, the bias voltage must be subtracted to obtain the true plate voltage and power input. As the bias voltage on the 3CX800A7 is only 5.6 V, so the correction is only 0.2%. To obtain a true plate-to-cathode voltage reading, you must reference the HV meter circuit to the tube side of the Zener bias diode. This would again require separate HV meter and sensing resistor strings. Arranging the meter circuit in this way also causes the plate meter to indicate the metering string resistor current.

Many operators will want to build 3X800A7 amplifiers for other bands, and share a common HV supply. This would place the grid shunts in parallel. Grid-current meters on the unused amplifiers will indicate a portion of the operating amplifier's plate and grid currents, uncalibrating all the metering circuits. There are two methods to reduce this problem. One is to place a resistor in series with the grid-sensing resistor (R21). Alternately, you can install a resistor in series with the B– line. T/R relay K2 would short out these resistors on transmit. Use the lowest-value resistors which eliminate the problem. This value depends on the number of amplifiers connected to the same power supply, but a value of 500 Ω is typical. A word of warning: These resistors increase the possibility of damage to the metering circuits when a HV arc occurs. Also note that the 11-Ω effective grid-shunt value (due to the grid over-current sensing circuit) causes a portion of the grid current to flow through the B– safety resistors (R1 on the amplifier and any similar resistors at the HV power supply). R13 can be adjusted to make the grid meter read the correct value when connected to the power supply.

Keying Circuits

A transistorized relay-switching scheme is used. The circuit can be switched by either grounding J6 or by supplying +12 V to J8. Current sinking or supplying capability is only 15 mA, which should be compatible with current 432-MHz exciters. If you are using conventional switching circuits, make sure your relays will reliably contact at only 15 mA of current. As described in the protection-circuit section, a loss of high voltage will prevent the relays from switching, or drop them if they have already switched.

The coaxial relays you use should have dc coils. Dc coils switch faster, have less contact bounce and run cooler than ac types. The coils don't have to be 28 V, as are most available military surplus relays. Several types of suitable coax relays with 12-V coils are available. The switching circuitry can be made to work with 12-V coils but you'll have to change T2. If you have relays with 120-V ac coils, don't despair. Many 120-V ac relays work better on 12 to 28 V dc, so try them on a dc supply.

Amplifier in-out switching relays don't need high isolation. If you use separate input and output relays, the input relay can be a low-power type.

Power Supply Considerations

The high performance of the 3CX800A7 at VHF and UHF is partially a result of the close internal spacings of the tube elements. These close spacings increase the possibility of a plate-to-grid arc over. To protect the tube, power supply, metering circuits and the operator, a 50-Ω 50-W resistor is connected in series with the HV power lead. This resistor substantially reduces the energy dissipated in the tube during an arc over, yet only reduces the full-load plate voltage by 30 V. EIMAC specifies that idle plate voltage should not exceed 2500 V.

I built a modern capacitor-input power supply, which uses a solid-state bridge rectifier in combination with a low-resistance plate transformer. My supply uses a Peter Dahl Hypersil transformer (1800 V at 700 mA, CCS). The electrolytic-capacitor string has a total capacitance of 22 µF. An oil-filled capacitor is preferred. Adequate regulation and ripple filtering can be obtained with less than 25 µF of filter capacitance. No-load voltage is approximately 2510 V. At 600 mA, the plate voltage is 2250 V. Out of the 259-V drop, over 100 V is due to line-voltage sag and the protection resistor. In no case should you use more than 50 µF of filter capacitance. Higher values will not significantly improve regulation, but will greatly increase the possibility of damage during an arc over.

Avoid choke-input filters. I have seen many improperly designed amateur supplies that were made from surplus components haphazardly cobbled together. These supplies can have bad transient-voltage-spike problems, induced from the chokes. These transients will blow rectifier diodes and cause tube arcs. They can also severely reduce the IMD performance of the amplifier. Finally, be sure to use MOV transient suppressors on the ac-input leads.

I highly recommend MHV-type HV connectors. The most dangerous condition to the operator is when high voltage is present and the power-supply-to-amplifier ground connection open. If this happens and you touch the amplifier and power supply (or any other grounded object if the power supply was grounded), you become the ground return. MHV connectors prevent this possibility as the shield makes contact along with the center conductor. RG-59 cable can comfortably handle the 2500-V power that this amplifier uses.

Amplifier Stabilization

Many amateurs mistakenly believe that neutralization of a grounded-grid amplifier is not required. Although operation of this amplifier is possible without neutralization, the simple neutralization procedure used provides for improved tuning, more stable operation and greater apparent efficiency. In addition, tube life may be increased due to the elimination of unwanted higher frequency circulating currents. The amplifier was neutralized by adjusting the grid inductance until the plate current dip matched the maximum output point. The amplifier operates so well that it can be tuned up without a power-output indicator. By dipping the plate current and adjusting the loading for proper grid current one can obtain output power that will be within a few watts of tuning it up for maximum output on a directional wattmeter!

Since the 3CX800A7 is operating below its self-neutralized frequency, neutralization is easily accomplished by breaking off grid collet fingers. The so-called self-neutralizing frequency of a tube is simply the frequency at which the combination of tube and socket have the right combination of feedback capacitance and inductance as to create the maximum input-to-output isolation. It should be noted that not all tube and socket combinations have any frequency where their isolation will be acceptable.

By breaking off some of the grid-collet fingers, the effective grid inductance is raised and the maximum reverse isolation point is lowered to 432 MHz. Fig 22 shows the proper pattern for breaking off the grid-collet fingers. Tube characteristics appear to be close enough among different 3CX800A7 tubes such that neutralization for a specific tube is not required. If you want to be safe, however, break off every other

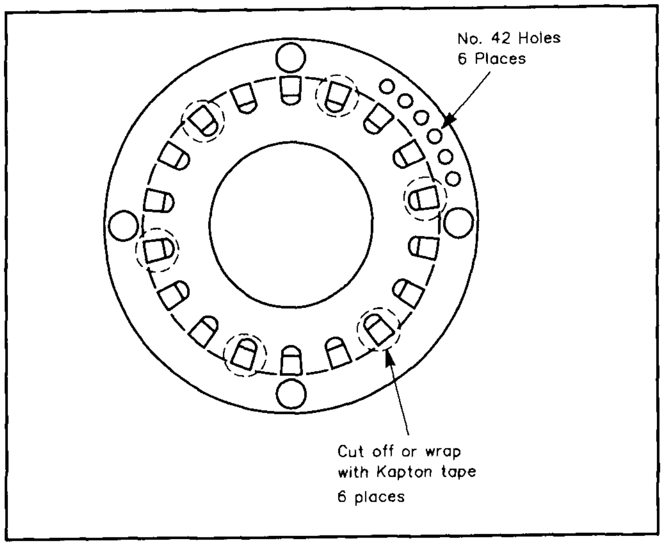


Fig 22—Grid collet modification. The EIMAC 720359 collet is supplied with 36 fingers. Break off every other finger. Wrap 6 of the remaining fingers (as shown) with Kapton tape or break them off. Removing the fingers adjusts grid-circuit capacitance and helps neutralize the amplifier.

finger on the grid collet. There will be 18 remaining fingers. Tape over 6 of them with Kapton tape, spacing the taped fingers equally around the tube. These taped fingers will then allow future tuning adjustments without replacing the grid collet.

An even more scientific approach to neutralization is to look at the reverse isolation of the amplifier. This is done by connecting the output of a signal generator or network analyzer to RF-output connector and measuring the fed-through power with a power meter, spectrum analyzer or network analyzer. Ideally, this test is performed after tuning up the amplifier with all voltages in place. If isolators are not available, there is a danger that the amplifier can oscillate during the test procedure and put out enough power to destroy your signal generator.

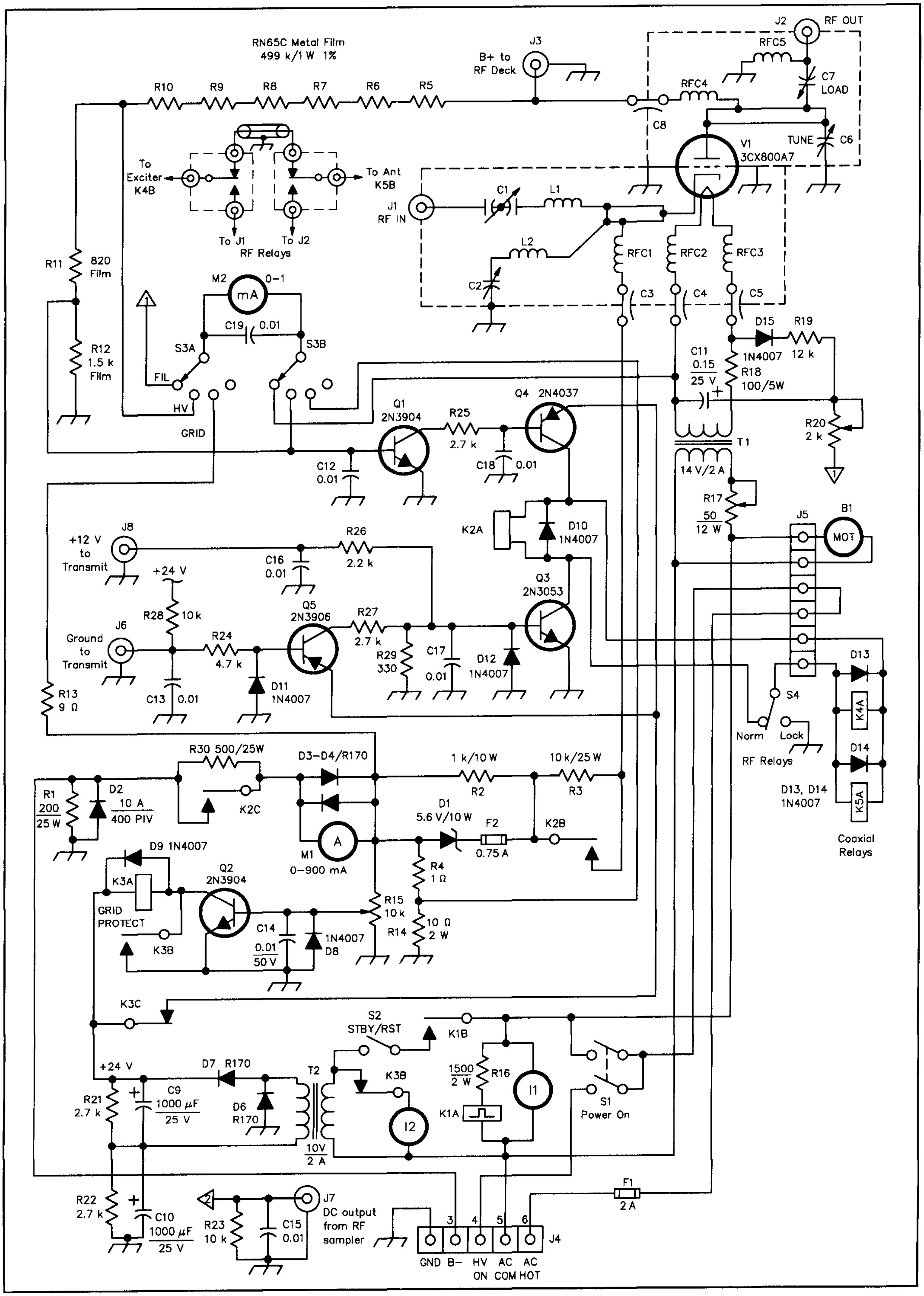
The reverse isolation of the amplifier should be a minimum of 20 dB greater than its power gain. Since the 3CX800A7 amplifier has a gain of 14.2 dB, you should see over 34-dB reverse isolation when it is neutralized. This amplifier had less than 20-dB reverse isolation before neutralization and over 30 dB after the collet was modified.

After neutralization, power drift became almost nonexistent. Power output will slowly rise by only 20 to 30 W from a cold start to full operating temperature. This represents a less than 0.2 dB of power drift, certainly an acceptable amount.

Initial Tuning Adjustments

Tune up of the amplifier is quite straight forward. If the dimensions and layout of the amplifier have been closely followed, the following initial settings will place the amplifier very close to optimum tuning at 432 MHz and full power output.

C1: Plates approximately 50% meshed


RN65C Metal Film
499 k/1 W 1%
R10
R9
R8
R7
R6
R5
B+ to
RF Deck
J3
J2
RF OUT
RFC5
C7
LOAD
RFC4
C8
TUNE
C6
V1
3CX800A7
To
Exciter
K4B
To Ant
K5B
To J1
To J2
RF Relays
J1
RF IN
C1
L1
L2
C2
RFC1
RFC2
RFC3
C3
C4
C5
D15
R19
1N4007
12 k
R11
820
Film
M2
mA
0–1
C19
0.01
S3A
S3B
R12
1.5 k
Film
FIL
HV
GRID
C11
0.15
25 V
R18
100/5W
Q4 2N4037
Q1
2N3904
R25
2.7 k
C18
0.01
C12
0.01
R20
2 k
T1
14 V/2 A
R17
50
12 W
J5
B1
MOT
K2A
D10
1N4007
J8
+12 V
to
Transmit
C16
0.01
R26
2.2 k
+24 V
Q3
2N3053
R28
10 k
Q5
2N3906
R27
2.7 k
J6
Ground
to
Transmit
R24
4.7 k
R29
330
C17
0.01
D12
1N4007
D13
D11
1N4007
R13
9 Ω
C13
0.01
S4
K4A
Norm
Lock
RF Relays
D14
R30 500/25W
D3–D4/R170
1 k/10 W
10 k/25 W
R2
R3
D13, D14
1N4007
K5A
R1
200
25 W
D2
10 A
400 PIV
K2C
D1
5.6 V/10 W
F2
0.75 A
K2B
M1
0–900 mA
Coaxial
Relays
D9 1N4007
Q2
2N3904
K3A
R4
1 Ω
GRID
PROTECT
R15
10 k
K3B
C14
0.01
50 V
1N4007
D8
R14
10 Ω
2 W
K3C
S2
STBY/RST
K1B
+24 V
D7 R170
T2
K3B
1500
2 W
R16
I1
R21
2.7 k
C9
1000 µF
25 V
D6
R170
I2
K1A
S1
Power On
10V
2 A
F1
2 A
R22
2.7 k
C10
1000 µF
25 V
J7
DC output
from RF
sampler
R23
10 k
C15
0.01
J4
GND B– HV AC AC
ON COM HOT

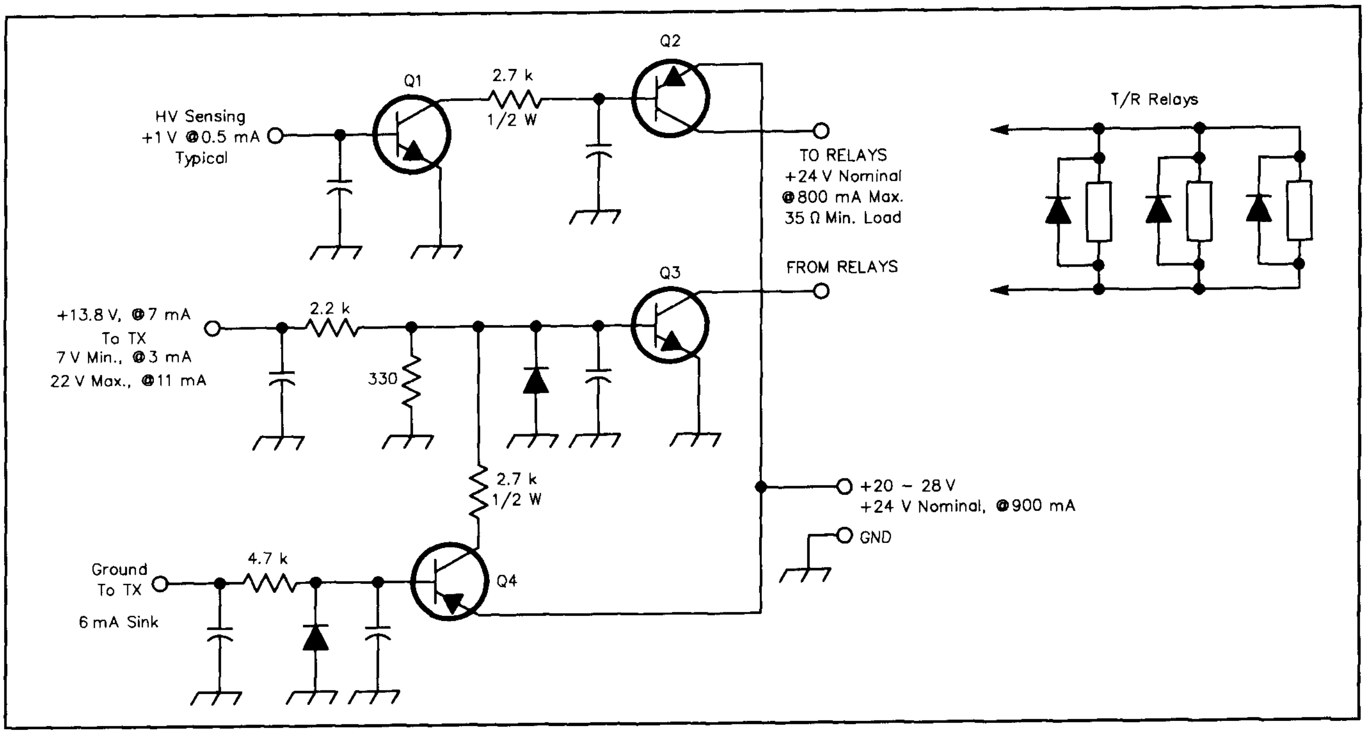


Fig 24—TR switching circuits for use with 24-Vdc relays. These components are mounted on the PC board shown in Fig 25.

←

Fig 23—Schematic diagram of the amplifier. Control circuits protect the tube and amplifier from potentially catastrophic events, such as overdrive, loss of high voltage or loss of heater voltage.

C2: Plates approximately 25% meshed
C6: Fixed end of flapper 1¼ in. above bottom of chassis
Moving end of flapper ¾ in. above bottom of chassis
C7: Fixed end of flapper 1 in. above bottom of chassis
Moving end of flapper ⅞ in. above bottom of chassis

After all wiring has been checked, set R17 (filament adjust) to maximum resistance. Attach an accurate RMS voltmeter to the filament feed-through capacitors. After the filament has warmed up for 3 minutes, adjust R17 until the filament voltage is 13.0 V. Next, adjust R29 such that the filament meter indicates 13.0 V. If the meter cannot be calibrated, change R19.

Apply high voltage and verify the tube draws proper idling current when J6 is shorted to ground (approximately 55 mA at 2400 V). Remove high voltage. Short out cathode resistor R3. Apply a very small amount of drive, increasing drive until the grid current reads 60 mA. Adjust R15 so the grid overcurrent trips at 60 mA. If you are unable to obtain 60 mA of grid current, adjust the cathode tuning controls (C1 and C2) for maximum grid current. After adjusting the grid-trip, reduce drive power and peak C1 and C2 for maximum grid current, being sure not to exceed 60 mA.

Remove the shorting jumper from R3 and turn the high voltage back on. Apply drive power so the plate meter reads 200 to 300 mA. Start adjusting C6 and C7 (plate tuning and loading) maximum power output. As the power output comes up you can increase drive until you are operating at the desired power level. If the amplifier cannot be driven to full power, C1 and C2 may need to be adjusted.

Final adjustments to the cathode circuit must be made at full power. With an in-line power meter connected as close to J1 as possible, alternately adjust C1 and C2 for minimum SWR. You may find that there are combinations of the cathode capacitors that allow the amplifier to be driven but the input SWR is poor. There will be a unique combination of the capacitors that will adjust the amplifier such that the lowest input SWR (less than 1.2:1) corresponds to maximum plate current (lowest drive-power requirement). To obtain this condition will require alternately adjusting C1 and C2 several times. If you cannot obtain a good input SWR, check to see if C1, C2 or both are at minimum or maximum capacitance. If C1 is at minimum capacitance, shorten L1. Lengthen L1 if C1 is at maximum capacitance. If C2 is at minimum or maximum capacitance, it is most likely because you didn't follow the cathode-circuit layout. Using a Bird 43 wattmeter with a 50D element (50 W, 200 to 500 MHz), I can completely null out the reflected power, so that with 30-W drive the wattmeter indicates no reflected power. (This only indicates that reflected power is lower than the directivity of the element, not that I have obtained a perfect match.)

With the input circuit properly adjusted, final adjustments to the plate tuning and loading controls may be made. There will be many settings of C6 and C7 that will deliver lots of power output. There will be a unique combination that will deliver that power output at maximum efficiency. Grid current is an excellent indicator of proper tuning. At full power output the grid current will range from 15 to 30 mA (varies from tube to tube). If the amplifier is properly tuned, grid current should increase as you increase drive. The plate-current dip should

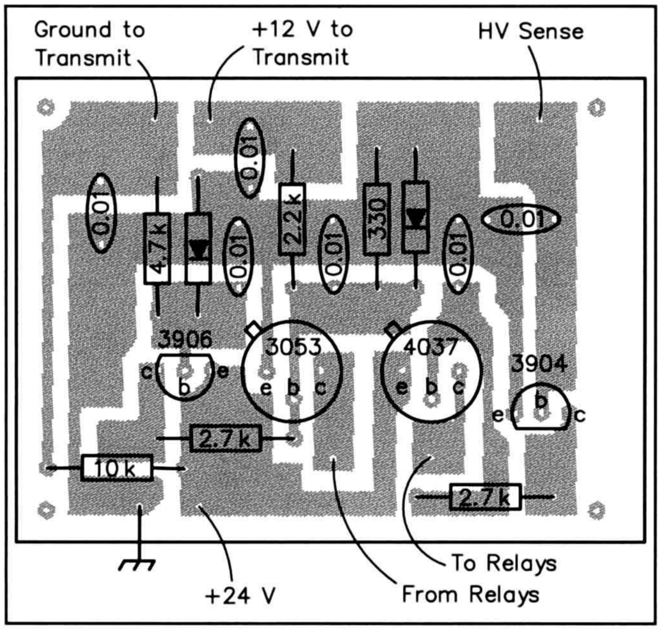


Fig 25—TR switching PC board, component side. While board layout is not especially critical, the board itself must be 1.75 X 3.25 in. or smaller in size.

Table 2
Full Power CW Operating Conditions
Keyed CW and SSB PEP Operation

Plate voltage, full load:	2250 V
Plate current:	600 mA
Dc Input power:	1350 W
RF Output power:	730 W
Apparent efficiency:	54%
Power gain:	14.2 dB
Grid current:	26 mA (will vary from tube to tube)
Drive power:	28.5 W
Input VSWR:	1.16:1
Filament voltage:	13.0 V
Idling current:	55 mA (@ 2400 V; will vary tube to tube)
Bias voltage:	5.6 V

Note: These conditions are for SSB and keyed CW service. Key-down time not to exceed 1 minute. For maximum continuous duty ratings, see text.

also match very closely (within 20 W) of maximum power output. There should also be minimum thermal drift. After letting the fish lines stretch for a few days, power should drift less than 30 W from a cold start.

Amplifier Operation

Efficiency of the amplifier is about 54%. If you are measuring higher efficiency you either have an inaccurate power meter or your high voltage and plate meters aren't calibrated. Use a Bird 1000D element with the Bird 43 wattmeter; 1000E elements typically read about 10% high at 432 MHz. An antenna or dummy load with a high SWR can cause inaccurate power meter readings. This can be verified by placing ¼-wavelength coax sections in series with your feed line, and checking to see if the SWR or indicated power change. Power measurements were made with a directional coupler in combination with a microwave power meter. The directional coupler was measured on a network analyzer to verify the amount of coupling it has at 432 MHz. If your efficiency is below 50%, you may have any of the previously mentioned measurement accuracy problems, a bad tube or just a mistuned amplifier.

At full rated output (about 730 W) the 1-dB bandwidth of the amplifier is 1.3 MHz. The 3-dB bandwidth is 3.9 MHz. The amplifier was designed to operate between 430 and 440 MHz. With the specified plate line and tuning capacitor sizes, the amplifier will operate efficiently at output levels from 300 to 730 W over that frequency range. If operation is desired at higher or lower frequencies, you'll have to adjust the length of W2 or C6.

Maximum CCS ratings of the 3CX800A7 are 2250 V at 600 mA. The specified highest frequency for maximum ratings is 350 MHz. No problems have been experienced running the tube at those ratings in keyed CW and SSB service at 432 MHz. I recommend, however, limiting CW key-down tuneup time to under 1 minute. If the amplifier is to be used in continuous-duty service, such as FM repeater or ATV, limit maximum plate current to 500 mA and reduce full-load plate voltage to 2000 V or less. In continuous service the filament voltage should be reduced to 12.2 V during transmit. A switching circuit should be added to raise the filament voltage to 13.5 V during warmup and standby periods. Maximum CCS output will be 500 W at a drive level of 22 W and 50% efficiency (2000 V at 500 mA). Continuous-duty service at elevations above 2000 feet may also require a larger-capacity blower. When shutting off the amplifier, be sure to let the tube completely cool down. The amplifier should be left powered up (blower running) for at least 5 minutes after the last transmission. The cathode compartment can still be warm after the anode air exhaust is blowing cool air.

Note that in addition to the grid dissipation value of 4 W, the maximum grid current is 60 mA. Under linear service the grid dissipation will be far under the rated value (less than 0.5 W). The grid-current restriction therefore becomes a matter of a total limit of cathode current, which is normally 600 mA of plate current and 60 mA of grid current. At 432 MHz, transit time effects, secondary emission by the grid and back bombardment of the cathode start to occur. The amplifier can be loaded so that negative grid current will be indicated. These conditions require that you be even more careful about grid and cathode current. In general, the amplifier should never be operated with an indicated grid current over 40 mA. An indication of these back-heating effects is grid-current drift. If you are seeing the grid current drift upward at a constant drive and plate-current level, you are running the amplifier too hard (or you may have a bad connector or cable in the system).

You should also be very careful not to overdrive the amplifier. Cathode-driven triodes such as the 3CX800A7 will not exhibit the gain-compression phenomena shown by solid-state amplifiers. That is, the power gain of the tube is just as high at full power as it is at low power. The station should have an exciter that has stable output power. In addition, make provisions to limit the available drive power to 35 W or less.

Table 2 gives full power operating conditions. For SSB operation the conditions represent the PEP point. There is little

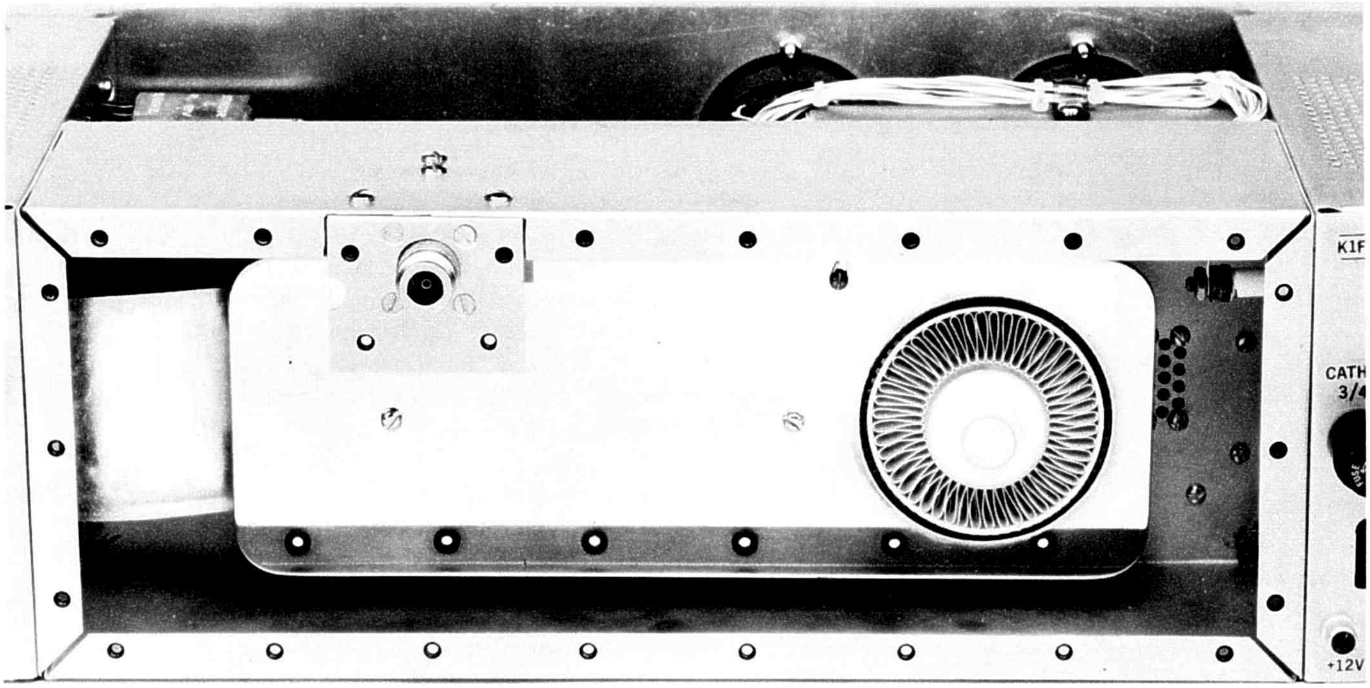
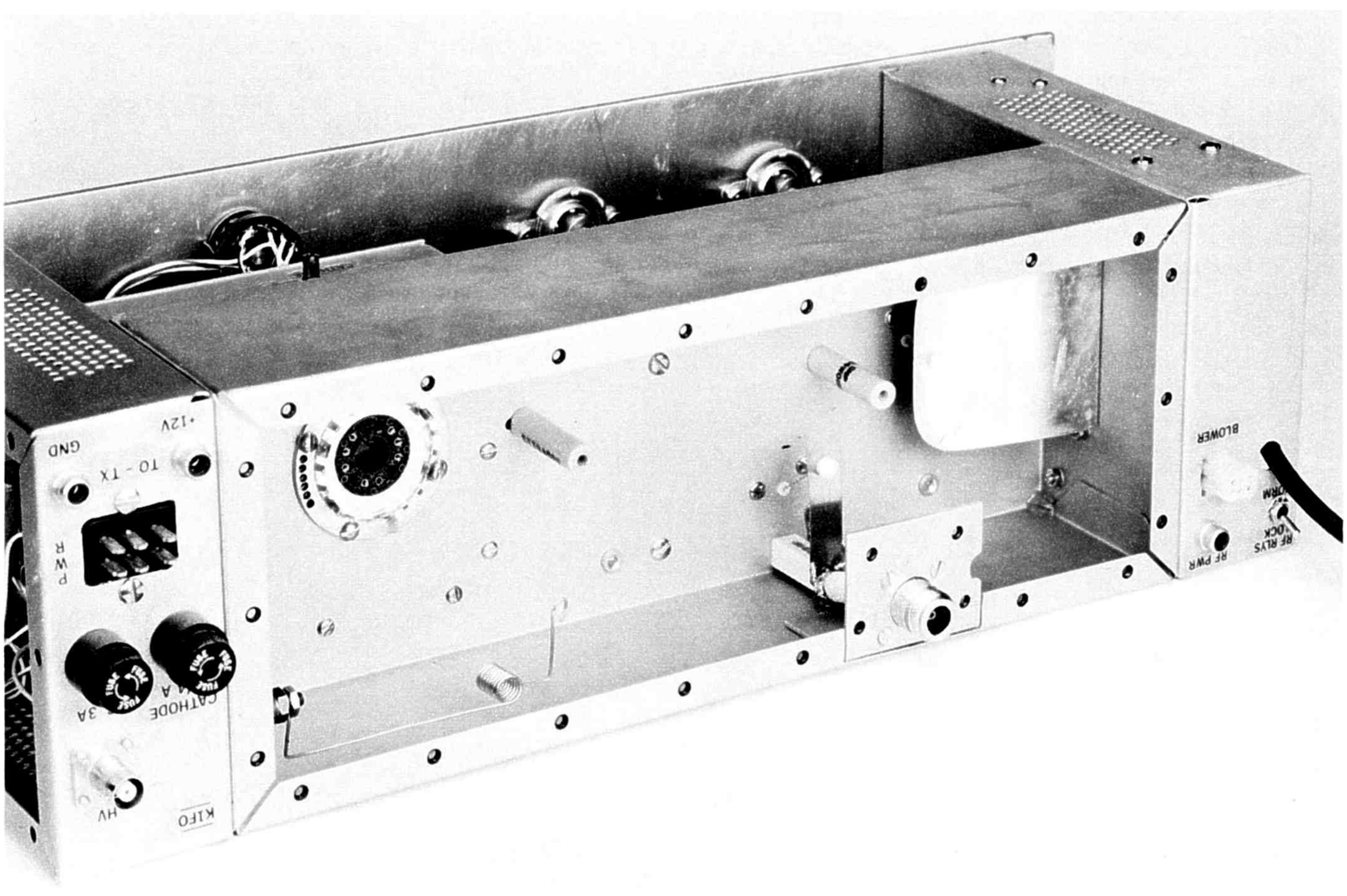
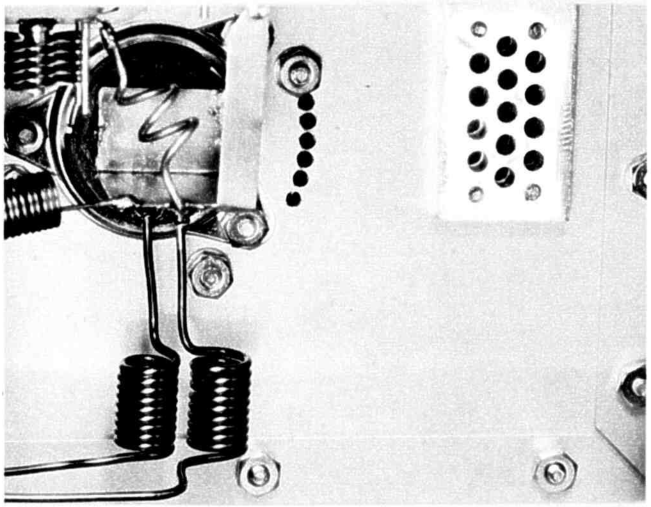


Plate compartment of the single 3CX800 amplifier. Plate tuning capacitor is shown to the left. The RF-output connector is at top.



This inverted view of the plate compartment shows the output loading capacitor, which is adjusted by means of a non-conducting cord fastened to its lower edge.



Interior of the cathode compartment. The filament RF chokes are at bottom.

sense in investing in a tube of this quality if you are going to overdrive or mistune the amplifier. During proper SSB operation, without speech processing, indicated plate current on *voice peaks* should be less than 250 mA. Power output as indicated on a slow-responding average-power meter (such as the Bird 43) should be less than 200 W on peaks. If an effective RF peak clipper is used (10 dB of compression and clipping), indicated plate current on voice peaks can approach 400 mA. Average-power watt meters may indicate up to 325 W on peaks. While driving the amplifier harder may give you the satisfaction of seeing higher meter readings, the additional power will be transmitted primarily as distortion products, and won't make your on-frequency signal any stronger.

Pay attention to the cable, connectors and relays you use. All high-power connections should use Type-N connectors. Assemble each connector properly so the shield has good contact and the center pin is aligned and at the proper depth. This much power at 432 MHz will destroy poorly assembled connectors. Use ½-in. or larger Hardline for the antenna feed line. For flexible jumpers, use RG-225 coax.

Using An 8874

This amplifier will also work with an 8874 tube. To use an 8874, set the filament voltage to 6.0 V RMS. Substitute a 6.3-V, 3-A transformer for T1 and eliminate R18. Make the hole in the plate line (W1) 1.75-in. diameter. An EIMAC 008294 collet makes for a simple connection between the plate line and the 8874 anode radiator. Make the air-outlet hole 1⅝ in. diameter, You'll have to make a chimney (sheet Teflon). In the input circuit, L1 and L2 may need to be made longer. Neutralization of an 8874 is slightly different.

The maximum ratings of an 8874 are 2200 V at 500 mA, in intermittent amateur service (keyed CW and SSB). Peak power output will be 570 W. Drive power for that output level will be 35 to 38 W. In continuous duty, limit the 8874 plate current to 350 mA.

Conclusion

This amplifier is easy to build and requires minimal special metal fabrication. Performance is excellent. The investment in parts and careful assembly time will pay off with years of trouble-free operation.

Notes

[1]The 8874 432-MHz amplifier appears in ARRL *Handbook* editions from 1981 through 1986.

[2]Aluminum sheet cut to size is available from Chassis Kit. Charles Byers, K3IWK, 5120, Harmony Grove Road, Dover, PA 17315. Tel 717-292-4901.

[3]Surplus Sales of Nebraska, 1315 Jones St., Omaha, NE 68102. Tel. 402-346-4750.

[4]Microwave Components of Michigan, P.O. Box 1697, Taylor MI 48180. Tel 313-753-4581.

[5]S. Powlishen, "Improving the K1FO 8874 432-MHz Amplifier," *QST,* Jun 1987, pp 20-23.