THE MINI-FI

A mono amplifier for \$10... stereo for \$15! Two tubes, 20 db of feedback, direct coupling and Ultra-Linear output produce the cleanest two watts you've ever heard!

By Dave Gordon



UDIOPHILES usually prefer 15 A watts or more per channel for living room hi-fi, but there are times when an amplifier that puts out a clean couple of watts will do a specific job more efficiently. For instance, a small, high-quality amplifier is well suited for use with a tape deck, or it can feed the center-channel speaker in a stereo

The EI Mini-Fi is just such an amplifier. Simple and easily built, it delivers an exceptionally clean 2 watts and fills the bill where power requirements are low but fidelity requirements are high. And it can be constructed in either of two versions-mono or stereo. Building cost runs about \$10 for the mono model, about \$15 for stereo.

With the Mini-Fi, an inexpensive FM tuner and EI's Duoflex speaker (July '62 issue) or similar system, you can have a top-quality FM radio at a fraction of the cost of commercial equivalents. Or if you want an outstanding phonograph at minimum cost, you can feed the output of a high-quality ceramic cartridge directly into the Mini-Fi's input jack.

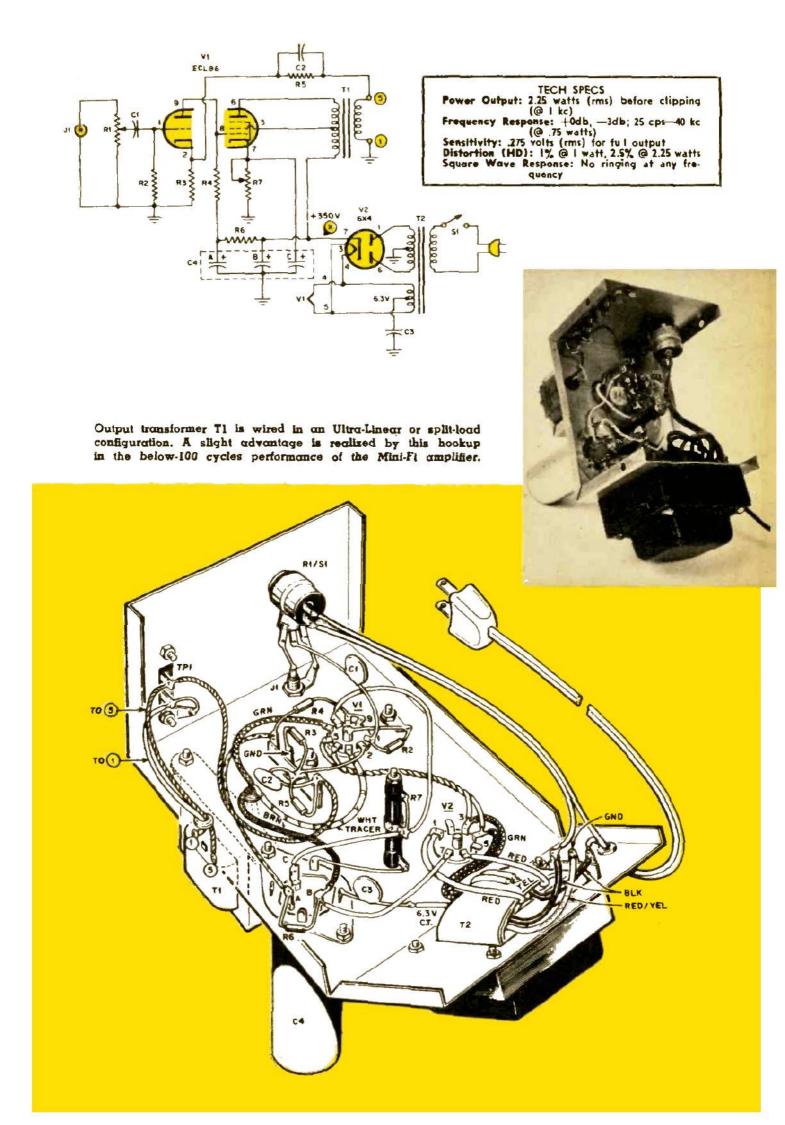
Two keys to the Mini-Fi's quality are a carefully selected output transformer

and a new tube, the ECL86, which combines a high-gain triode with a sensitive output pentode.

The Mini-Fi's circuit has several offbeat aspects (see schematic). Starting at input jack J1, control R1 establishes the level of input signal. If the associated equipment has a built-in volume control, R1 may be omitted. Capacitor C1 is necessary to prevent the grid bias achieved by the 10-megohm grid resistor (R2) from being shorted out by the input load. The 68-ohm cathode resistor (R3) does not function as a bias resistor but simply lifts the cathode off ground

PARTS LIST

Resistors: ½ watt, 10% unless otherwise indicated R1—500,000 ohm or 1 megohm pot. w/switch \$1 R2—10 megohm R4—470,000 ohms R3-68 ohms R6-680,000 ohms R5-1,200 ohms R7—Any value 7,500 to 10,000 ohms, 10 watt adjustable Capacitors: -,01 mf ceramic disc C2, C3-.02 mt ceramic disc C4-40 mf @ 450 V; 10 mf @ 450 V; 80 mf @ 200 V triple-section can-type electrolytic (see text) TI-Universal output transformer (Lafayette TRI3) see text T2—Power transformer. Secondaries: 6.3 V @ 1.5 a. 750 V @ 40 ma, centertapped (see text)
TP1—2-screw terminal strip JI-Phono jack Misc.--7-pin tube socket, 9-pin socket, 4-lug terminal strip, wire, etc.



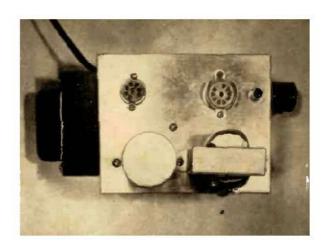
sufficiently to allow feedback to be applied to the cathode. Resistor R4 serves as both the plate load resistor of the triode and the grid return of the pentode. This means that the pentode grid is operating with a voltage on it equal to the plate voltage of the triode. Since the ECL86 pentode requires about 8.75 volts bias on the grid, an over-large cathode resistor (R7) provides a voltage drop equal to 8.75 volts plus the triode's plate voltage.

For optimum results, the bias on the output tube must be adjusted critically with R7. It's not possible to specify an exact resistance for R7 because with a direct-coupled circuit, in which one tube's plate voltage is another tube's grid voltage, the normal voltage variations tend to add up. As measured with respect to the cathode (in other words, with the positive lead of your meter on pin 7 and the negative on pin 8), R7 should be adjusted for 8 volts. With respect to ground, both pins 7 and 8 will show anywhere from 100 to 150 volts positive, but pin 7 will be 8 volts more positive than pin 8. The grid voltage on the output tube should be measured with a VTVM (preferably) or a 20,000 ohms/volt VOM.

If the equipment is available, a better way to determine the correct bias on the pentode is to use an audio generator and oscilloscope. Connect an 8-ohm load resistor to the output terminals of the amplifier, feed a 1-kc signal into J1 and, with R1 on full, adjust R7 for maximum undistorted output as viewed on the scope. The level of the 1-kc signal fed into J1 and R7 should be adjusted with respect to each other, so maximum signal output with minimum clipping is obtained.

Since the cathode of V1's pentode section is operating with over 100 volts on it (to compensate for the high grid voltage), the plate and screen grid must be raised above their normal 250 volts by an additional 100 volts to insure proper current flow. This accounts for the high plate and screen voltages on the ECL86.

Parts Substitutions. Certain parts changes are permissible. Wired as shown, the Mini-Fi has an input sensitivity of .25 volts. In other words, .25 volts applied to J1 (with R1 wide open)

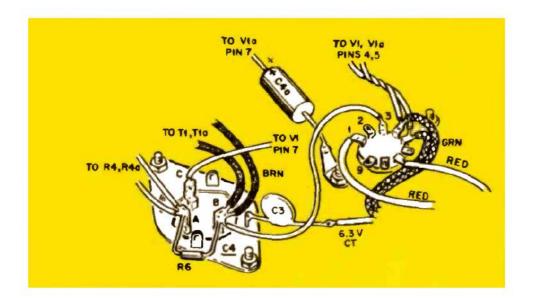


Top chassis view of Mini-Fi shows socket and component placement. Keep V2 away from filter C4.

will drive the Mini-Fi to full output. However, if more gain is desired, feedback resistor R5 can be *increased* in value. Capacitor C2 should be decreased in the same ratio. Input control R1 may be 500,000 ohms to 2 megohms.

Output transformer T1 was selected on a price vs. quality basis. There's no point in substituting another transformer unless it's in the \$6-or-overrange. If a better quality transformer is used, feedback components R5 and C2 will have to be readjusted. Select R5 so that approximately .25 volts input drives the amplifier to full output. The value of C2 will have to be established experimentally as follows. Set R1 half open and use the smallest value of C2 that eliminates the resulting supersonic oscillation as viewed on a scope. As an alternative, feed in a 10-kc square wave and adjust C2 for the flattest tops.

Power transformer T2 may be a surplus or junkbox component. Its highvoltage secondary can range from 600 volts center-tapped to 750 volts centertapped (300-0-300 to 375-0-375) with at least a 40 ma rating. If the high-voltage secondary is in the 600-650 volts centertapped range, no additional parts are required. However, if the DC voltage at the 6X4 cathode (pin 7) exceeds 380 volts, install a resistor between pin 7 of V2 and C4B. This point is marked X on the schematic. The value of the resistor is determined experimentally, but should be a 4-watt job at 500 ohms or higher. In any case, select the resistor to provide about 350-375 volts at C4B.



Pictorial of the power supply for the stereo version shows the revised power supply wiring. All other components are doubled for stereo. Note that a metal mounting plate is used for the filter capacitor in both mono and stereo versions.

If the filament winding of transformer T2 has a center-tap as shown, do not connect it to ground because the high cathode voltage on the pentode section may arc over to the filament. Connect capacitor C3 to the center-tap as shown. If the filament winding has no center-tap, connect C3 to pin 4 of V1. C3 is not critical and values from .002 mf to .05 mf will serve.

Filter capacitor section C4A may be anywhere from 10-50 mf at 450 volts, C4B should be 40 mf or higher at 450 volts and C4C can be 20-80 mf at 150 volts rating. If a resistor is installed at X, an additional 8-20 mf capacitor at 450 volts may be installed from pin 7 of V2 to ground. If desired, separate capacitors instead of the multiple-section can type shown may be used.

The stereo version of the Mini-Fi requires little redesign. All components are duplicated except those in the power

supply. A power transformer capable of suplying at least 80 mais required and a heavyduty rectifier tube, the 6CA4 is substituted for the 6X4. The 6CA4 re-

quires a 9-pin socket instead of the 7-pin type used by the 6X4. All other components not shown in the partial schematic and pictorial of the stereo model are duplicated. The new or

additional power supply components are indicated by the letter a in the diagrams. Capacitor C4Ca is a tubular electrolytic with the same specifications as C4C.

A larger chassis will have to be used. No size is specified here, because the physical size of the larger power transformer will determine the overall chassis dimensions.

The Mini-Fi is designed for an 8-ohm speaker load. With either a 16- or 4-ohm load there will be a slight loss of power, but the high level of feedback will keep distortion low.

If desired, the stereo version may be operated monophonically by feeding the same signal into both input jacks and paralleling the outputs for a 4-ohm output impedance.

In listening tests, the Mini-Fi is impressive. It appears to be able to drive any speaker system except suspension types.

For the stereo version of the Mini-Fi, the power supply is redesigned. A new rectifier tube, a 9-pin socket a heavier-duty transformer, and an additional filter are required.

