GENERAL PURPOSE AMPLIFIER

A 1 watt output audio amplifier, suitable for equipment testing or for general use.

By F. C. Judd.

A SMALL amplifier has many applications in the electronic construction workshop or in the home generally and can, in fact, be regarded either as a valuable piece of testing equipment or simply as a piece of audio gear. It can be used for testing or using any radio or electronic equipment that normally has no amplifier e.g., a radio tuner or a signal generator and in other ways such as testing microphones, gramophone pick-ups and tape record/replay units etc. or for guitar practice with electric guitars.

The amplifier described here is quite easy to build even though the circuit may look a little complex because of the mixture of *pnp* and *npn* transistors. The amplifier will provide up to 1 watt output into an 8 ohm loudspeaker although any small speaker of say 5 to 15 ohms can be used.

Two inputs are provided one being rated at 5mV which is suitable for low level signal sources such as 200 ohm microphones or guitars whilst the other input, because the impedance is fairly high, can be used for ceramic or crystal pickups, radio tuners or the output from a tape recorder etc.

Both inputs are connected to the first stage of the amplifier via a gain control (VR1) so that signal levels can be adjusted to prevent overloading. The frequency response of the amplifier is −3dB at 100Hz to −3dB at 10,000Hz, not hi fi but certainly very acceptable for many applications.

CIRCUIT

The circuit is shown in Fig. 1. One input (SK1) is taken via R1 which is an attenuator to provide an input sensitivity of about 500mV and also a fairly high input impedance. The other input (SK2) goes straight to the gain control VR1 and has a sensitivity of 5mV for 1 watt output from the amplifier.

The input transistor (TR1) which is an *npn* type, acts as a pre-amplifier and as a d.c. difference amplifier comparing the voltage derived from the potential dividing network R6, R3 and R2 with the voltage appearing between TR4 emitter and the common earth or positive supply rail. The high loop gain of the circuit keeps the small difference between these two voltages constant so that one has a definite relationship to the other regardless of spreads in the charac-

Approximate cost of components £4·20 plus case and loudspeaker

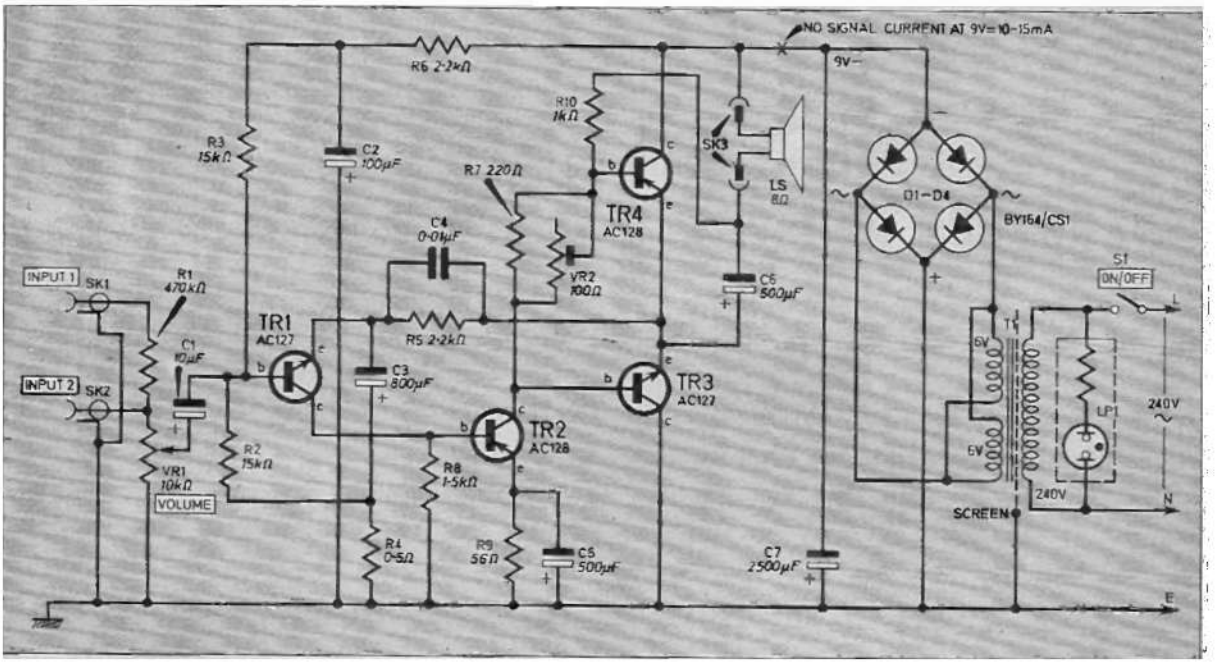


Fig. 1. Complete circuit diagram of the General Purpose Audio Amplifier.

teristics of the transistors and small variations in component values. Negative feedback is taken via R5 and C4 from the output stage to the emitter of TR1.

The amplifier circuit is powered from a 9V positive earth supply provided by transformer T1, the bridge rectifier D1-D4 and smoothing capacitor C7. Note that as the amplifier draws a fairly large current at peak power levels (for a miniature transformer to supply) the transformer chosen has two 6V secondary windings which are connected in parallel to maintain the peak current requirements. If any transformer other than the one specified is used, it must have a 6V winding capable of supplying about 500mA current.

Components....

Resistors

R1	470kΩ	R6	2·2kΩ
R2	15kΩ	R7	220Ω
R3	15kΩ	R8	1·5kΩ
R4	0·5Ω	R9	56Ω
R5	2·2kΩ	R10	1kΩ

All ±10% ¼ W

Capacitors

C1	10μF elect. 12V
C2	100μF elect. 12V
C3	800μF elect. 12V
C4	0·01μF
C5	500μF elect. 12V
C6	500μF elect. 12V
C7	2,500μF elect. 12V

Variable Resistors

VR1	10kΩ log. carbon
VR2	100Ω skeleton preset

Semiconductors

TR1	AC127	germanium *npn*
TR2	AC128	germanium *pnp*
TR3	AC127	germanium *npn*
TR4	AC128	germanium *pnp*

SEE SHOP TALK

D1–D4 BY154/CS1 or similar 50V, 0·5A bridge rectifier.

Miscellaneous

SK1	Single phono socket
SK2	Single phono socket
SK3	Two-way connector for LS1
LS	8Ω 5 to 8 inch moving coil loudspeaker capable of handling 1W. (5 to 15Ω can be used).
T1	240V primary 6V, 500mA secondary (Eagle type MT280 or similar—see text).
S1	Single pole mains on, off switch.
LP1	Mains neon indicator (incorporating resistor)

Case, 7 × 5 × 3 inches—universal chassis parts CU158 (2 off) CU145 (2 off), CU147 (2 off), control knob, heatsink clips, standard TO1 type (2 off), 0·15 inch matrix plain perforated Veroboard, 5 × 4½ inches and 3¼ × 2½ inches, aluminium angle for fixing brackets, connecting wire, 3 core mains lead and fused plug, 4BA fixings.

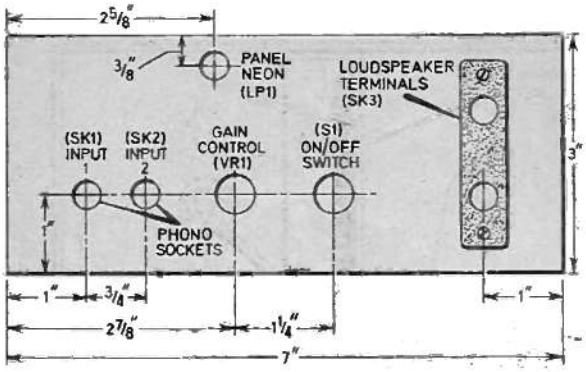
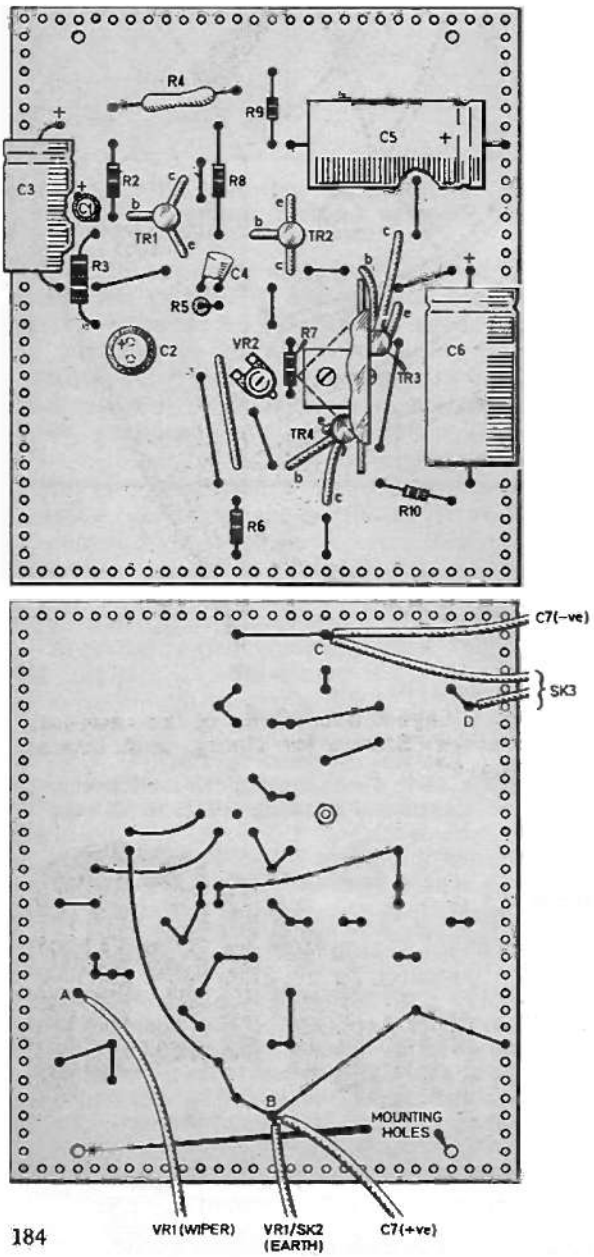


Fig. 2. Front panel details.

Fig. 3. Layout and wiring of the amplifier component board.



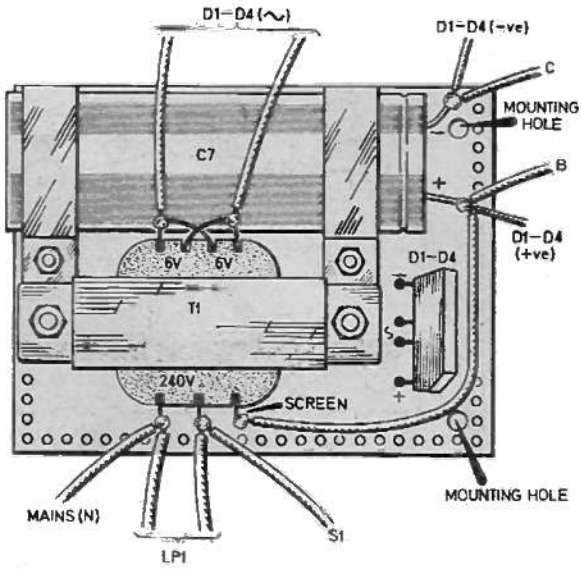


Fig. 4. Layout and wiring of the power supply.

CONSTRUCTION

The prototype, as shown in the photographs, and Figs. 2 to 5, was housed in a box measuring 7 x 5 x 3 inches made from Home Radio universal chassis parts. Any similar size box can be used. The front panel, which carries the amplifier and power supply circuit boards as well as input sockets and gain control should be made up as shown in Fig. 2.

The amplifier itself is arranged on a plain perforated circuit board measuring 5 x 4½ inches, as shown in Fig. 3. Great care must be taken over wiring because of the d.c. coupling used throughout and because two transistors are *pnp* and two are *npn* and can only be differentiated by their type number viz: TR1 and TR3 are *npn* (AC127) and TR2 and TR4 are *pnp* (AC128). Connections are shown in Fig. 3 together with details of the heatsink for TR3 and TR4. Double check the wiring and particularly the position and connection of the transistors.

The small heatsink used on TR3 and TR4 is not suitable for continuous operation when the amplifier is enclosed in the aluminium case. To overcome this a small bracket should be fixed to the heatsink and this bracket screwed to the case by means of a self tapping screw. This will ensure that the unit is kept cool at all times.

The power supply is assembled on a circuit board measuring 3¼ x 2¾ inches as shown in Fig. 4. This is fairly straight forward but note the parallel connection of the two 6V secondary windings of the MT280 transformer T1.

The two circuit boards are positioned as shown in the photographs and wired up as shown in Fig. 5, which also shows the connections to the panel components; VR1 (gain control), the two input sockets, the loudspeaker terminals and mains on-off switch etc.

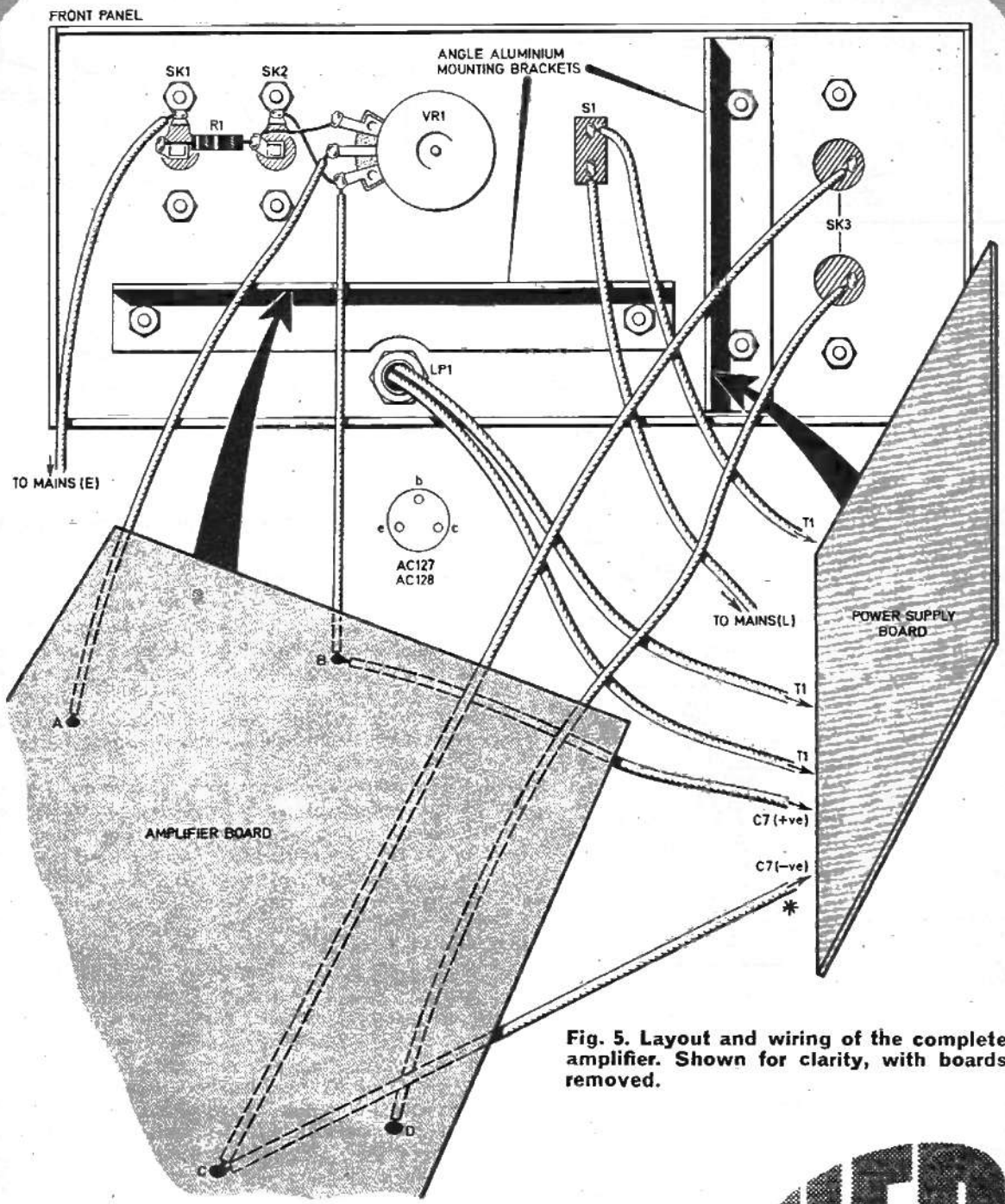


Fig. 5. Layout and wiring of the complete amplifier. Shown for clarity, with boards removed.

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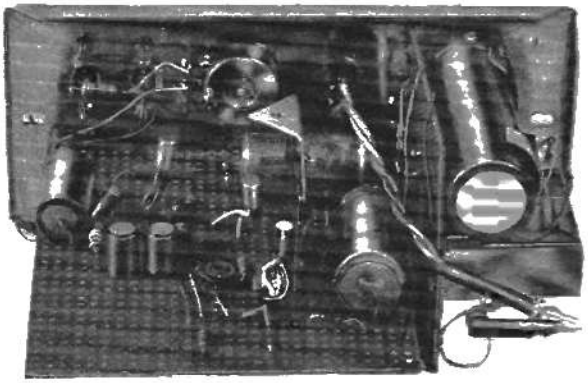

TESTING

It would be best to first check the power supply voltage by disconnecting the negative rail from the amplifier board and measuring the voltage between the power supply negative and positive i.e., across C7. This should be about 9V.

If a milli-amp meter is available connect at the starred point in Fig. 5 i.e., between the power supply negative (C7) and the negative rail of the amplifier board. With the supply on and with VR1 turned off, the current to the amplifier. should be set to about 12mA by adjusting the preset VR2. If no milli-amp meter is available set VR2 with its slider to midway position.

Those able to check voltage and current should be able to obtain readings approximately equal to those shown in Table 1.

Table 1: Amplifier Test Measurements

Measurement	Current
Supply standing current (no input signal)	10– 15mA
Supply current (maximum power output)	100–150mA

Measurement (no input)	Voltage
Supply	9V
TR1 base	4V
emitter	4·2V
collector	0·4V
TR2 base	0·4V
emitter	0·25V
collector	4·8V
TR3 base	4·8V
emitter	4·9V
collector	0V
TR4 base	5·2V
emitter	4·9V
collector	9V

As mentioned earlier the loudspeaker may be any small 5 or 8 inch type of 5, 8, or 15 ohms impedance (preferably 8 ohms for optimum performance) capable of handling 1 watt. It should be housed in a suitable enclosure which may be a plywood box of about 12 by 12 inches (front) by about 6 inches deep and closed in at the back. The amplifier will operate well with the *MW/LW Radio Tuner* (described in September 1972 E.E.) and could be used for monitoring during tape recording as well as the various applications outlined at the beginning of this article.

SAFETY

When operating the amplifier the loudspeaker should not be disconnected, nor should the output be short circuited as this could result in damage to the output transistors.

The amplifier should be connected to the mains supply by way of a three core mains lead and a mains plug fused at $\frac{1}{2}$ amp. The chassis of the amplifier should be earthed as shown and the unit should not be used with any a.c./d.c. equipment such as a television or older type valve record player, unless it is fitted with proper amplifier output socket. ▣