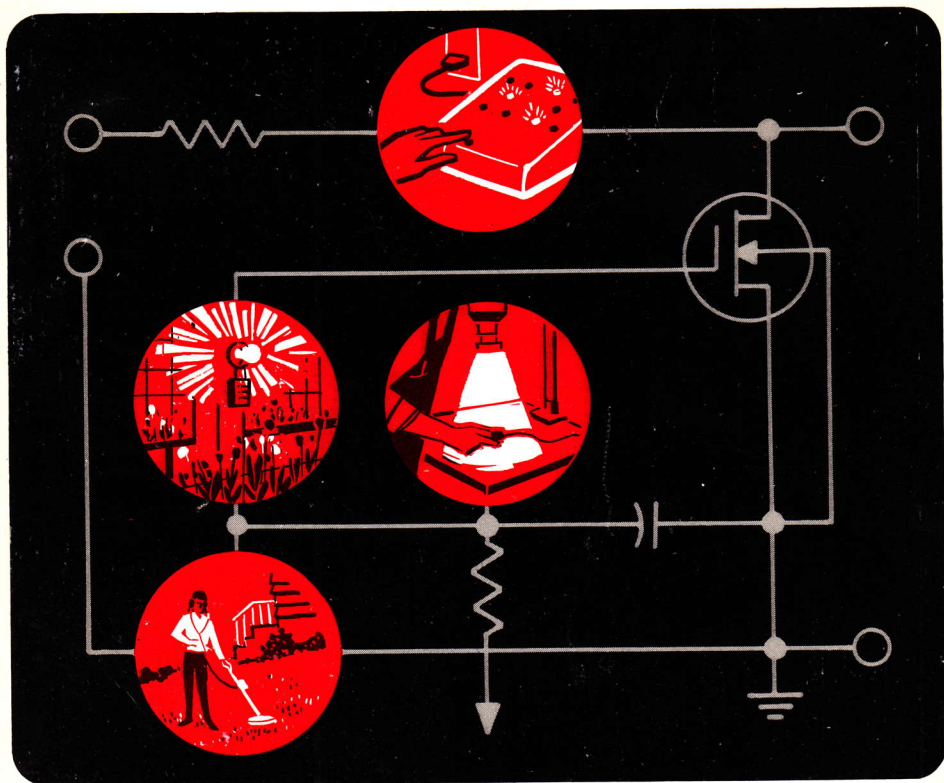


Technical Series HM-90

\$1⁷⁵

Suggested Price

RCA SOLID-STATE Hobby Circuits Manual



RCA

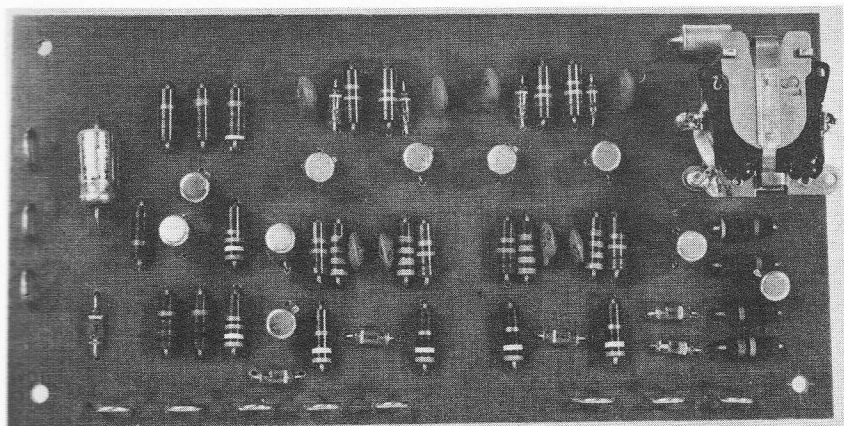


Fig. 71 - Completed circuit board for the automatic keyer.

CIRCUIT NO. 7 — MICROPHONE PREAMPLIFIER

The microphone preamplifier is capable of boosting the output of a dynamic microphone to a 0.5- to 1-volt level. This level is compatible with the mixer, volume compressor, and line amplifier (Circuit No. 8) and the audio power amplifier circuit (Circuit No. 17) described in this Manual.

Circuit Operation

The schematic diagram and parts list for the microphone preamplifier are shown in Fig. 72. The circuit consists of a two-stage direct-coupled amplifier that is stabilized by the use of dc feedback. The circuit works well with dynamic microphones having impedances from 200 ohms to 30,000 ohms.

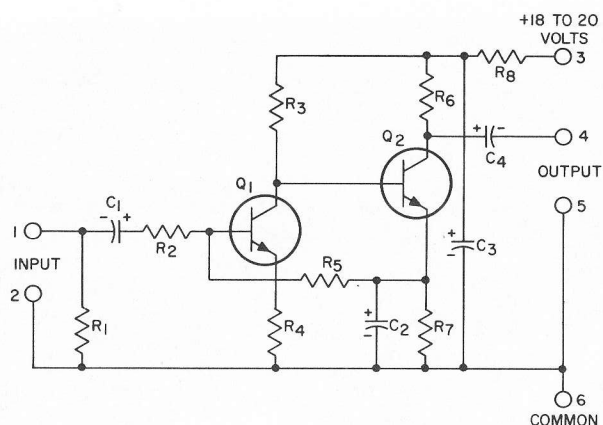
When the circuit is in operation, base bias current for the input transistor Q_1 is obtained from the emitter of output transistor Q_2 through R_5 . Q_2 obtains its base bias current through the collector resistor of Q_1 , R_3 . This unique bias circuit provides dc feedback for stabilization of the operating points of the transistors. For example,

if the operating current of Q_1 increases, the collector voltage of Q_1 decreases and reduces the voltage of the base of Q_2 . This lower voltage causes a reduction in the operating current of Q_2 . When the operating current of Q_2 decreases, the voltage at the emitter of Q_2 also decreases. This voltage decrease is reflected back to the base of Q_1 , which undergoes a current reduction that offsets the initial increase.

This preamplifier circuit is designed to operate from an 18- to 20-volt source; voltage in this range can be obtained from batteries or from a power supply. The power circuit can be common to the power amplifier. The preamplifier circuit can tolerate voltages greater than 20 volts if R_8 is increased about 400 ohms for every volt above 20 volts. The current drain of the preamplifier is approximately 2.5 milliamperes; the voltage gain is about 1700.

Special Considerations

When the preamplifier is used with a low-impedance dynamic microphone



Parts list

- | | |
|---|--|
| C_1 = 25 microfarads, 6 volts, electrolytic | microphone 270,000 ohms for high-impedance microphone, 1/2 watt, 10% |
| C_2 = 300 microfarads, 6 volts, electrolytic | R_2 = 10,000 ohms, 1/2 watt, 10% |
| C_3 = 100 microfarads, 25 volts, electrolytic | R_3 = 27,000 ohms, 1/2 watt, 10% |
| C_4 = 20 microfarads, 25 volts, electrolytic | R_4 = 100 ohms, 1/2 watt, 10% |
| $Q_1 Q_2$ = transistor, RCA SK3020 | R_5 = 120,000 ohms, 1/2 watt, 10% |
| R_1 = 220 ohms for low-impedance | R_6 = 3900 ohms, 1/2 watt, 10% |
| | R_7 = 680 ohms, 1/2 watt, 10% |
| | R_8 = 1500 ohms, 1/2 watt, 10% |

Fig. 72 - Schematic diagram and parts list for the microphone preamplifier.

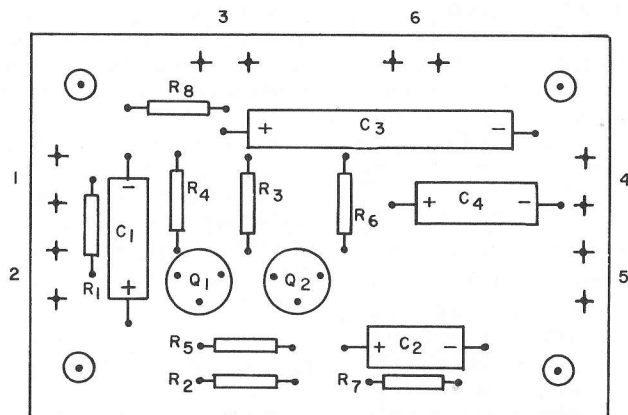


Fig. 73 - Component placement diagram for the microphone preamplifier.

(such as the RCA-HK97 in the low-impedance mode), R_1 should be 220 ohms; when a microphone with an impedance of about 30,000 ohms is used (such as the RCA-HK97 in the high-impedance mode), R_1 should be 270,000 ohms.

Construction

The drilling template for the microphone preamplifier is shown at the back of this Manual; a component

placement diagram and a photograph of the completed circuit board are shown in Figs. 73 and 74, respectively. A single preamplifier circuit fits on a 3-by 2-inch circuit board; two can be built on a 3-by 4-inch board, and three on a 3-by 6-inch board. If the circuit is not constructed on a board, a ground bus should be used to ground the preamplifier to the circuits that follow it at one point only, preferably at the input to the circuits.

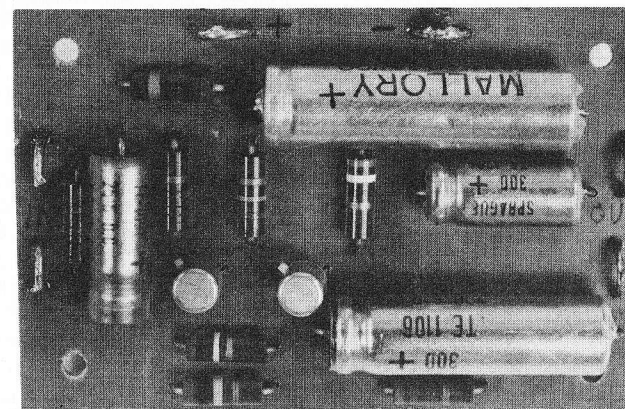


Fig. 74 - Completed circuit board for the microphone preamplifier.

CIRCUIT NO. 8 — AUDIO MIXER, COMPRESSOR, AND LINE AMPLIFIER

The audio mixer, compressor, and line amplifier is an indispensable piece of equipment for the audio enthusiast

who requires uniform audio levels such as are necessary in the production of very-high-quality tape recordings. Fig.

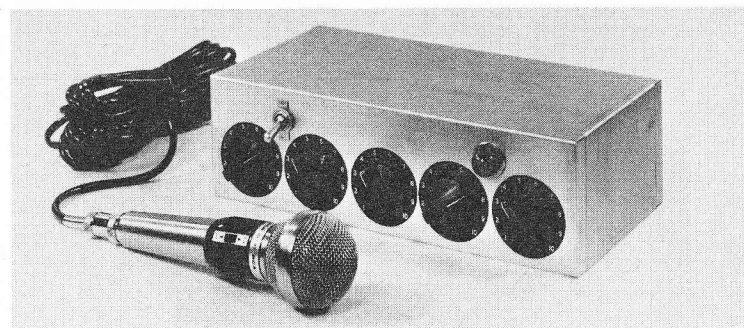


Fig. 75 - A suggested enclosure for the audio mixer, compressor, and line-amplifier circuit.

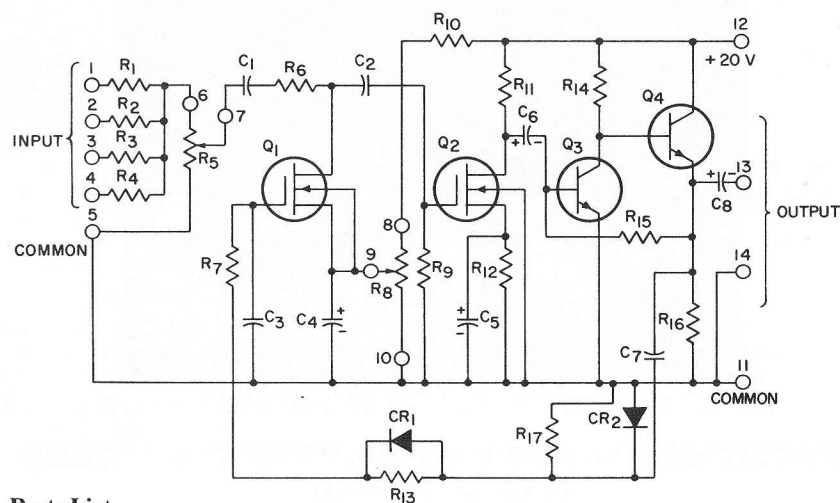
75 is a photograph of a suggested enclosure for this circuit.

Circuit Operation

The schematic diagram and parts list for the audio mixer, compressor, and line amplifier are shown in Fig. 76. The circuit consists of a four-channel resistive mixer, an MOS transistor (Q_1) that acts as a voltage-variable resistor, a high-impedance MOS transistor amplifier (Q_2), and a two-stage bipolar line driver.

of an MOS field-effect transistor that make it useable as a voltage-variable resistor are discussed in the section on **Theory and Operation of Solid-State Devices**; Q_1 operates as described and, with R_6 , forms an incoming-signal voltage divider.

Circuit inputs are designed to be driven by the preamplifier circuit described in Circuit No. 7 or from any source capable of providing a 50- to 1000-millivolt signal. The gain of each input can be controlled by use of a



Parts List

- | | |
|---|---|
| $C_1 C_2 C_3 C_7$ = 0.1 microfarad, paper | $R_1 R_2 R_3 R_4 R_7$ = 100,000 ohms, 1/2 watt, 10% |
| C_4 = 10 microfarads, 12 volts, electrolytic | R_5 = potentiometer, 10,000 ohms, audio taper |
| C_5 = 15 microfarads, 6 volts, electrolytic | R_6 = 180,000 ohms, 1/2 watt, 10% |
| C_6 = 5 microfarads, 25 volts, electrolytic | R_8 = potentiometer, 5000 ohms, straight taper |
| C_8 = 50 microfarads, 25 volts, electrolytic | $R_9 R_{13}$ = 1 megohm, 1/2 watt, 10% |
| $CR_1 CR_2$ = silicon rectifier, type 1N270 | R_{10} = 15,000 ohms, 1/2 watt, 10% |
| $Q_1 Q_2$ = MOS field-effect transistor, type 3N128 | R_{11} = 10,000 ohms, 1/2 watt, 10% |
| $Q_3 Q_4$ = transistor, RCA SK3020 | R_{12} = 1500 ohms, 1/2 watt, 10% |
| | R_{14} = 1200 ohms, 1/2 watt, 10% |
| | R_{15} = 100,000 ohms, 1/2 watt, 10% |
| | R_{16} = 470 ohms, 1/2 watt, 10% |
| | R_{17} = 2 megohms, 1/2 watt, 10% |

Fig. 76 - Schematic diagram and parts list for the audio mixer, compressor, and line amplifier.

50,000-ohm potentiometer between the output of the preamplifier or other source and the input of the mixer stage. Potentiometer R_5 is the master gain control; it controls all channels simultaneously.

The initial bias voltage for Q_1 is set by adjustment of potentiometer R_8 . When Q_1 is biased off, it has an effective drain-to-source resistance of several megohms. This high resistance allows nearly all of the signal voltage appearing at the potentiometer arm of R_5 to appear at the gate of Q_2 . The signal is amplified by Q_2 and passed to the output-amplifier and line-driver transistors Q_3 and Q_4 . The output signal of Q_4 is rectified by CR_2 and the resultant dc signal is fed back to the gate of Q_1 . The rectified output signal is polarized in such a way that its application to Q_1 reduces the drain-to-source resistance of that transistor. The result is a reduced input to Q_2 and an over-all reduction in amplifier gain. CR_1 is inserted in the feedback line so that the rectified dc signal can be applied very rapidly to the gate of Q_1 and to C_3 . During this application, C_3 is charged at a very fast rate. The discharge time of C_3 is slow because CR_1 forces the discharge current to flow through R_{18} . The product of this

arrangement of CR_1 , R_{18} , and C_3 is a circuit that has a fast attack time and a relatively slow release time. A fast attack time is a very desirable characteristic in a circuit of this type because it provides for immediate reduction in system gain and consequent prevention of the overload that could occur with a loud passage of speech or music. The delayed release time helps to maintain a constant level of output during small pauses in speech or music.

Q_4 is connected as an emitter-follower to provide the amplifier with a low output impedance. The line driver is designed for operation at approximately 1 volt rms into a line of 250 ohms. The circuit can be adjusted so that any input signal level between 50 millivolts and 1 volt will result in an output of approximately 1 volt. Circuit current drain is about 23 milliamperes at 20 volts.

Construction

The drilling template for the audio mixer, compressor, and line amplifier is shown at the back of this Manual; a photograph of the completed circuit board and a component placement diagram are shown in Figs. 77 and 78, respectively.

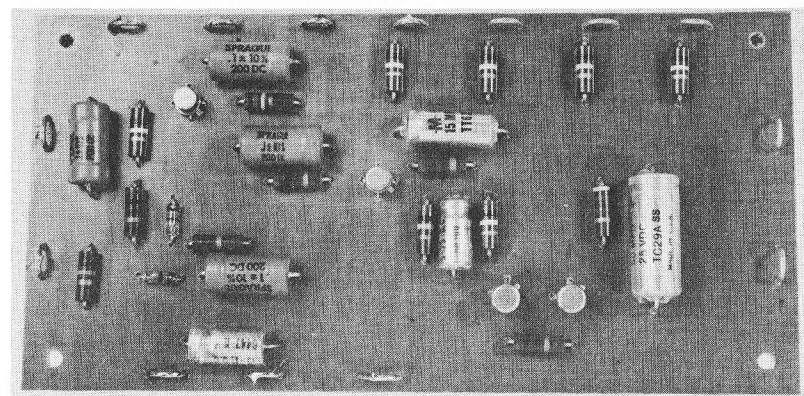


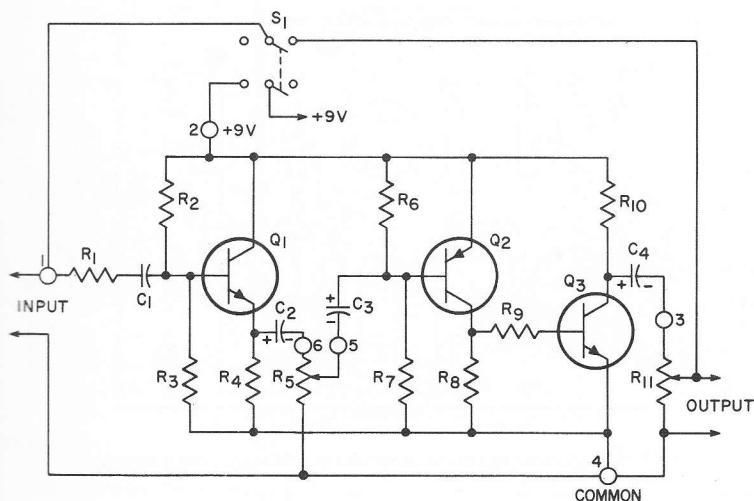
Fig. 77 - Completed circuit board for the audio mixer, compressor, and line amplifier.

CIRCUIT NO. 15- ELECTRONIC FUZZ BOX

The fuzz box is intended to be used with a guitar; however, it may be used with any instrument whose musical output is electrically amplified. It can be used with the audio power amplifier circuit described in this Manual. The fuzz box changes the character of the sound produced by an instrument and makes possible the generation of a variety of sounds of which the instrument alone is not capable.

Circuit Operation

The schematic diagram and parts list for the electronic fuzz box are shown in Fig. 97. The output of transistor Q_1 , a basic emitter-follower that gives the fuzz box a high-impedance input, is applied to the base of Q_2 . Q_2 is biased at almost cutoff and, therefore, amplifies only half the input signal. Potentiometer R_5 is used to adjust the



Parts List

C_1 = 0.01 microfarad, 25 volts or greater

C_2, C_3, C_4 = 5 microfarads, 15 volts, electrolytic

Q_1, Q_3 = transistor, RCA SK3020

Q_2 = transistor, RCA SK3005

R_1, R_2, R_3, R_7 = 100,000 ohms, 1/2 watt, 10%

R_4 = 3300 ohms, 1/2 watt, 10%

R_5 = potentiometer, 5000 ohms, linear taper

R_6 = 15,000 ohms, 1/2 watt, 10%

R_8, R_{10} = 2700 ohms, 1/2 watt, 10%

R_9 = 47,000 ohms, 1/2 watt, 10%

R_{11} = potentiometer, 10,000 ohms, linear taper

S_1 = switch, double-pole, double-throw

Fig. 97 - Schematic diagram and parts list for the electronic fuzz box.

input signal level to Q_2 (to approximately 1 volt) and the amount of "fuzz." Transistor Q_3 receives the output from Q_2 through R_9 ; Q_3 is biased in such a way that the top half of the signal input to it is clipped; this clipping action tends to create a square wave. Potentiometer R_{11} is used to vary the output level of the circuit.

The input voltage of this circuit should be approximately 1 volt. The current drain for this circuit is approximately 5 milliamperes.

Construction

In operation, the fuzz box is normally cut in and out as music is being played. When the fuzz box is cut out the musical instrument is connected directly to the amplifier.

The drilling template for the electronic fuzz box is shown at the back of this Manual; a component placement diagram and a photograph of a completed circuit board are shown in Figs. 98 and 99 respectively.

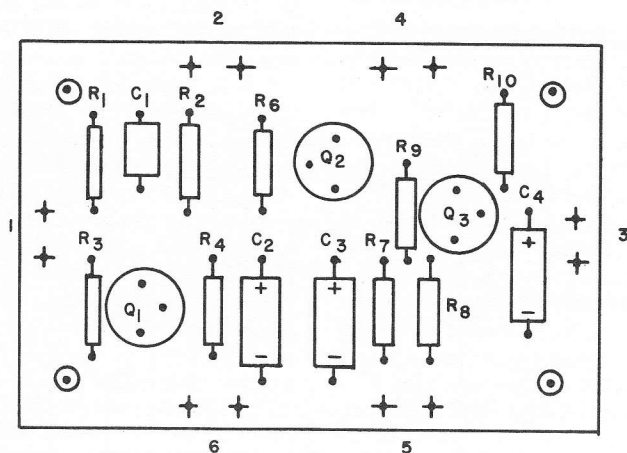


Fig. 98 - Component placement diagram for the electronic fuzz box.

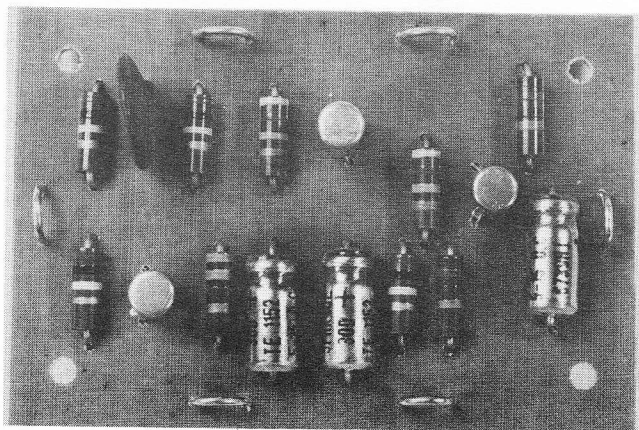


Fig. 99 - Completed circuit board for the electronic fuzz box.