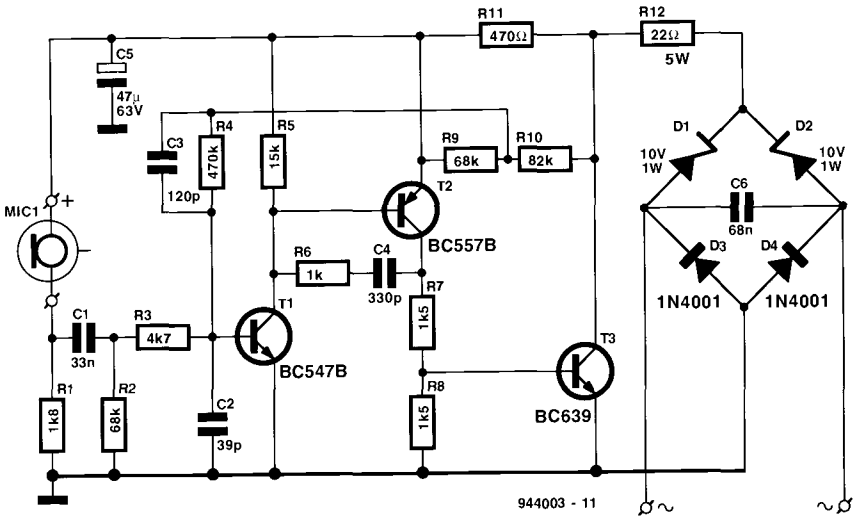
ELECTRET MICROPHONE FOR TELEPHONE MOUTHPIECE

Although many older telephone sets are electrically and mechanically perfectly sound units, their speech quality is poor compared with that of modern, all-electronic, sets (except the cheap types used in domestic intercoms). The reason for this deficiency is the carbon microphone in the mouthpiece. Here, an up-to-date replacement is discussed for the carbon microphone. It takes the form of an electret microphone and an amplifier with a special band-pass characteristic.

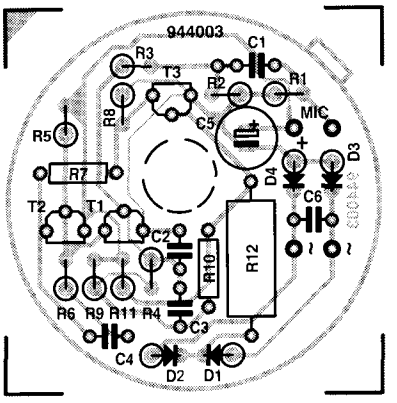


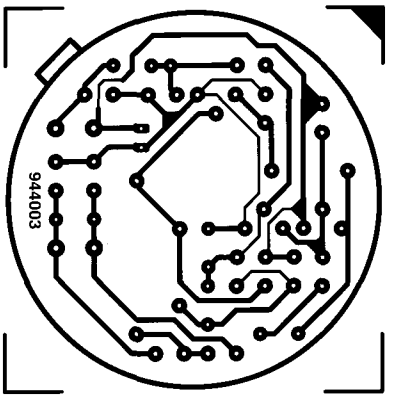
The circuit diagram shows a conventional three-stage direct-coupled transistor amplifier whose output signal is superimposed on the supply voltage. In this way, the amplifier is fully compatible (electrically, that is) with a carbon microphone. Only the sound is much better.

Since an electret microphone has a virtually straight frequency response, the function of pass-band shaping is transferred to the amplifier. Here, the circuit is laid out to give a frequency response suitable for telephony, i.e., about 500 Hz to 4.2 kHz. The microphone signal is first sent through a high-pass filter, C_1-R_2. The high-frequency roll-off is achieved with the aid of capacitor C_3 and resistor R_4 in the feedback circuit between T_2 and T_1. Capacitors C_2 and C_5 serve to suppress r.f. signals which may be picked up by the telephone line, the receiver cord, or the electret microphone. R_6 and C_4 improve the amplifier's stability.

The d.c. behaviour of the amplifier is such that it behaves like a carbon microphone, i.e., as a non-linear resistance. Diodes D_1-D_4 at the amplifier output form a full-wave rectifier which provides an amplifier supply voltage which is sufficiently independent from the telephone line current (which can vary between 15 mA and 150 mA depending on the telephone system, line length, and other factors). Also, the rectifier ensures the correct supply polarity in all cases. For the audio signal, the rectifier is simply not there since the diodes conduct as a result of the line current which flows when the receiver is lifted. The two zener diodes, D_1 and D_2, are included as protective devices — they behave like ordinary diodes as long as the voltage on the line terminals remains below the zener voltage. If a higher voltage occurs on the line, the zeners still conduct, keeping the amplifier supply voltage within safe limits with the aid of resistor R_{12}.

The amplifier is built on the board shown, so that it can actually replace the carbon microphone, which is carefully removed from the mouthpiece. Since many different types of telephone exist, the best way of doing this will have to be figured out carefully. In most cases, it will be necessary to solder wires to the spring terminals provided for the original carbon transmitter. The electret microphone is secured at the solder side of the board, and connected with short wires to the copper tracks that form the amplifier inputs. After trimming it to size, the completed board is mounted upside down into the mouthpiece, and glued into place. The solder side of the board should be sprayed with protective lacquer, or covered with a potting compound to protect it against the heavily corrosive effect of breath. In some cases, you may also use the thin disc originally used to cover the carbon microphone. Every care should be taken to ensure that the amplifier and the electret microphone are securely mounted in the mouthpiece. If they are not, lifting the receiver and moving it about will cause noise, which defeats the use of the circuit because mechanical noise is an inherent disadvantage of the old carbon microphone!





Parts list

Resistors:
R_1 = 1.8 kΩ
R_2;R_9 = 68 kΩ
R_3 = 4.7 kΩ
R_4 = 470 kΩ
R_5 = 15 kΩ
R6 = 1kΩ
R_7;R_8 = 1.5 kΩ
R_{10} = 82 kΩ
R_{11} = 470 Ω
R_{12} = 22 Ω, 5 W

Capacitors:
C_1 = 33 nF
C_2 = 39 pF
C_3 = 120 pF
C_4 = 330 pF
C_5 = 47 µF, 63 V, radial
C_6 = 68 nF, pitch 5 mm

Semiconductors:
D_1;D_2 = 10 V, 1 W zener-diode
D_3;D_4 = 1N4001
T_1 = BC547B
T_2 = BC557B
T_3 = BC639

Miscellaneous:
Mic_1 = CM105-8 electret microphone (dia. 10 mm; Z_o = 2 kΩ)

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