Electret microphone replacement for a carbon insert

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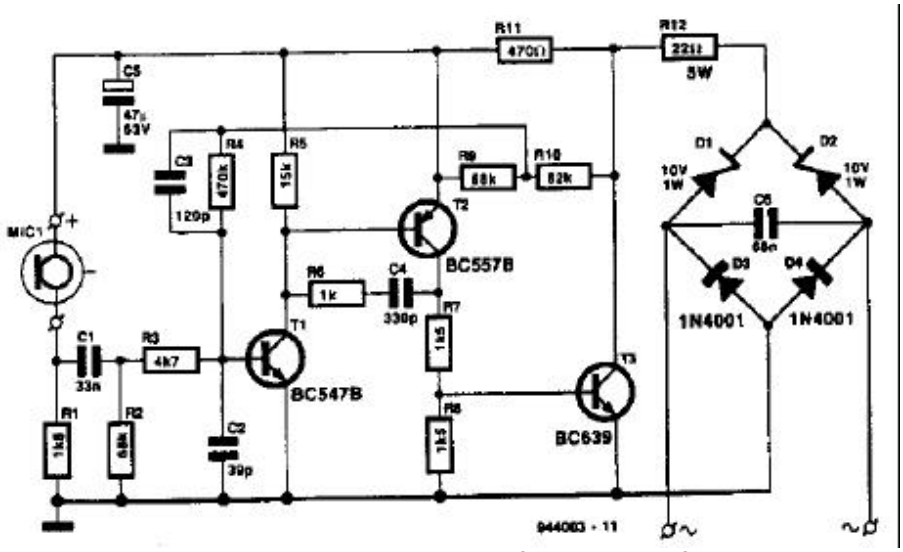
When I found that I had a dud carbon insert in an H33F/PT handset, and I couldn't find another insert that fitted (the original is about 1" diameter) I looked around for an alternative. Trevor Sanderson's excellent article "The RAF Microphone" (Radio Bygones issue 79/80) makes reference to the use of electret inserts with an IC preamplifier in telephones and aircraft headsets, but the information given was too scant to make construction of one of these possible without reference to the IC data sheet, and the IC's are expensive and difficult to obtain. I had a GPO type 21A insert, but the innards of this when dismantled were still too large to fit into the available space. The H33 handset is very slim, and also virtually solid, so there is very little room in which to place a preamplifier. A dig around on the internet turned up the following article written by F. Hueber, originally published in Elektor Electronics December 1994, and is published here with permission from **Elektor Electronics magazine, December 1994, copyright Segment B.V., Beek (Lb.), The Netherlands, www.segment.nl.** The original article included a pcb layout, but I built mine on a strip of veroboard four tracks wide by about 2" (see photo) and mounted it on the back of the ptt switch. The electret insert was acquired from a scrap telephone and all the rest of the components from TV panels. To save space the rectifier and R12 weren't included, care being taken to ensure that the polarity was correct.

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, CI-R2 The high-frequency roll-off is achieved with the aid of capacitor C3 and resistor R2 in the feedback circuit between T2 and T1. Capacitors C2 and C5 serve to suppress r.f. signals which may be picked up by the telephone line, the receiver cord, or the electret microphone. R6 and C4 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 D1 - D4 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, D1 and D2, 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 R12.

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 !



[Components list is on page 16.]

(continued from p. 14) **Components list for Electret Microphone pre-amplifier.**

Resistors:
R1 =1.8 kΩ
R2;R9 = 68 kΩ
R3 = 4.7 kΩ
R4 = 470 kΩ
R5 = 15 kΩ
R6 = 1 kΩ
R7;R8 = 1·5 kΩ
R10 = 82 kΩ
R11 = 470 Ω
Rl2 = 22 Ω , 5W

Capacitors:
C1 = 33 nF
C2 = 39 pF
C3 = 120 pF
C4 = 330 pF
C5 = 47 µF, 63 V. radial
C~ = 68 nF, pitch 5 mm

Miscellaneous :
Mic 1 = CM 105-8 electret microphone
(dia. 10 mm; Z0 = **2 kΩ)**

Semiconductors :
D1;D2 = 10 V· 1 W Zener-diode
D3;D4 = 1N4001
T1 = BC547B
T2 = BC557B
T3 = BC639 (BC548 ok – G4DDI)

The H33F/PT handset