9

Telephone Amplifier

A telephone amplifier can provide very worthwhile advantages, the main one being that it enables more than one person to hear the conversation. Another advantage is the added volume which it provides and which can make a poor connection much more easily understood.

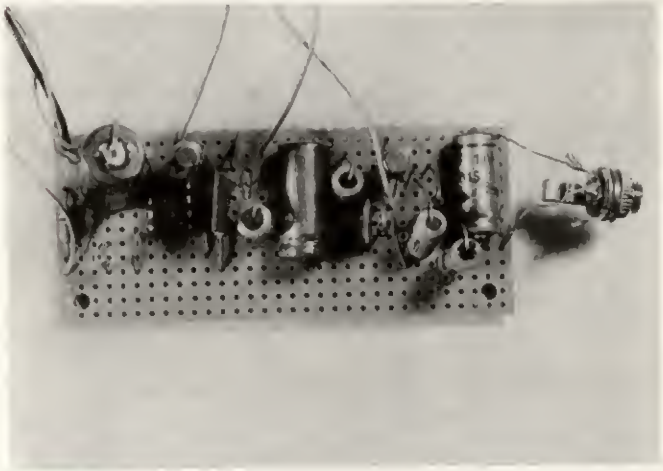

Figure 9.1

Telephone amplifier layout

Extra volume can also be of advantage if the telephone is situated in a noisy environment, such as a factory or workshop.

As was mentioned in the previous section of this book, it is illegal to make a direct unauthorised connection to a Post Office telephone, and this obviously makes it rather difficult to obtain a suitable signal for a telephone amplifier. The obvious method would be to place a

microphone close to the earpiece of the telephone, and then amplify this signal. However, this is likely to produce a rather poor quality output and would probably be rather inconvenient to use in practice.

The more usual way of obtaining a signal is to use an inductor placed near the base part of the telephone. Normal telephones contain inductive components which radiate the signal in the form of magnetic waves. These will induce small electrical signals into any coil which is placed near the telephone, and in this way it is possible to obtain a suitable signal.

Of course, a considerable amount of amplification is needed to boost the small signals from the pick up coil to a sufficiently high level to drive a loudspeaker, but the necessary gain can be achieved reasonably simply using modern components and circuitry.

The circuit

The complete circuit diagram of the Telephone Amplifier appears in Fig. 9.2.

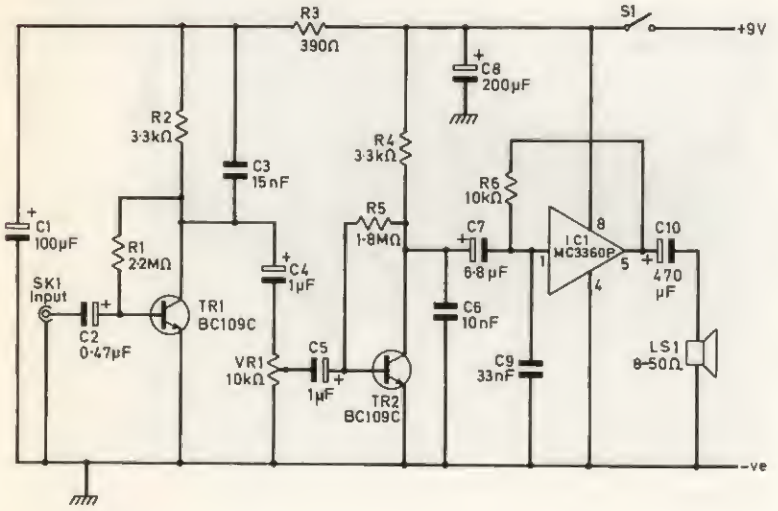

Figure 9.2

Circuit diagram of the telephone amplifier

The input signal is applied to the base of TR1 via d.c. blocking capacitor C2. TR1 is used as a high gain common emitter amplifier which has R2 as its collector load resistor and R1 as the base bias resistor. C3 provides high frequency attenuation and this helps to

maintain the stability of the circuit and attenuates any r.f. signals which are induced into the pick up coil and fed into the amplifier.

C4 couples the output from TR1 to volume control VR1. From here the signal is fed to a second high gain common emitter amplifier by way of C5. This stage is basically the same as the first stage of amplification, and its output is fed to the i.c. audio power amplifier.

The latter is based on IC1, and this is quite a simple audio power amplifier i.c. It consists of a common emitter driver stage followed by a complementary emitter follower output stage. The necessary circuitry to provide a small quiescent current through the output transistors (to minimise cross over distortion) is incorporated in the i.c., but overall biasing of the amplifier is not, this is provided by discrete resistor R6. C7 and C10 provide d.c. blocking at the input and output respectively. C6 and C9 are used to reduce the high frequency response of the circuit in order to ensure good stability and minimise breakthrough of strong radio signals.

Supply decoupling is provided by C1, R3 and C8. S1 is the on/off switch and this can be ganged with VR1 if desired. The quiescent current consumption is typically only a little in excess of 5mA from a 9V supply, but the MC3360P i.c. has a class B output stage and the current consumption rises to about 40mA or so at high volume levels. Ideally the loudspeaker should have an impedance of 16Ω, and the maximum available output power is then about 300mW.

Unfortunately, 16Ω loudspeakers are not very widely available, but in practice the circuit will work well using an 8Ω speaker. Higher impedance loudspeakers are also quite suitable, but their use will result in a loss of maximum available output power. It is not advisable to use a loudspeaker having an impedance of less than 8 ohms.

Construction

All the small components are wired up on a 0.1in pitch stripboard panel which has 13 copper strips by 32 holes using the component layout illustrated in Fig. 9.3. After cutting out a panel of the specified size, the two 3.2mm diameter mounting holes are drilled and the eight breaks in the copper strips are made. The latter can be made using a small drill bit, say about 4mm in diameter, held in the hand, if the special spot face cutter tool is not to hand. The various components and the three link wires are then soldered into position. As the layout is quite compact it is necessary to take great care not to bridge adjacent copper strips with minute blobs of excess solder, and it is a good idea to check the finished board for such short circuits using a continuity tester.

SK1 is a 3.5mm jack socket and this is mounted on the front panel of the case together with S1, VR1 and LS1. The remaining wiring can

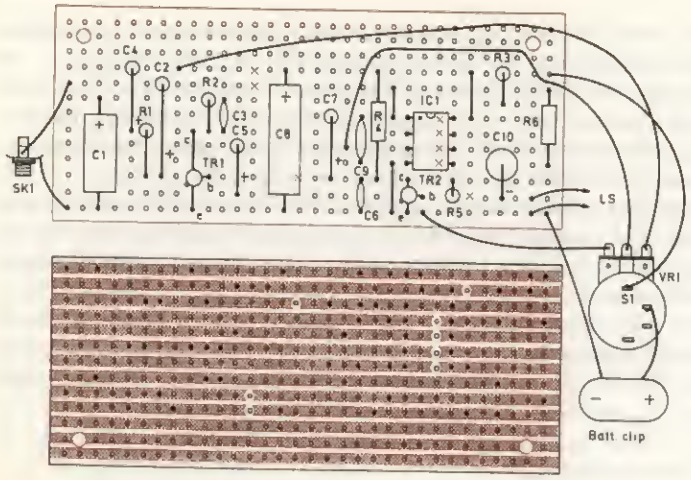

Figure 9.3
Strip board layout of the amplifier

then be completed and finally the component panel is mounted in the case using M3 or 6BA nuts and screws.

Using the unit

When the unit is switched on and VR1 is advanced, there should be quite a high background noise level. If there is not, switch off at once and thoroughly check all the wiring. If a multimeter is available, this can be used to locate the faulty stage or stages. With the unit switched on once again there should be approximately half the supply voltage at TR1 collector, TR2 collector, and IC1 pin 5. Any great departure from such a voltage indicates that there is an error in the wiring to the appropriate stage.

There should be a large reduction in the background noise level when the pickup coil is plugged into SK1. Specially made pickup coils may be obtained, although they are not widely available. These have a rubber sucker which enables them to be secured to the base of the telephone.

An alternative is a ferrite cored r.f. choke having a value of about 5 to 10mH; the exact value is not critical, but should not be much less than about 5mH. This is connected to the telephone amplifier by a piece of screened cable about 1 metre long which is terminated in a 3.5mm jack plug. Make sure the connections to the jack plug are the right way round, with the outer braiding of the cable connecting to the

negative supply rail of the amplifier. For neatness the pickup choke may be mounted in a small plastics (not metal) box.

The pickup must be placed in the position which provides the best signal, and this can only be found with a little experimentation. With an ordinary telephone of the type currently fitted by the Post Office the best pickup point for the coil will probably be somewhere along the

Components list for the telephone amplifier

Resistors (all miniature ¼W, 5 or 10%)

R1	2.2MΩ
R2	3.3kΩ
R3	390Ω
R4	3.3kΩ
R5	1.8Ω
R6	10kΩ
VR1	10kΩ log (may be ganged with switch S1)

Capacitors

C1	100μF, 10V
C2	0.47μF, 10V
C3	15nF, ceramic plate
C4	1μF, 10V
C5	1μF, 10V
C6	10nF, ceramic plate
C7	6.8μF, 10V
C8	200μF, (or 220μF), 10V
C9	33nF, ceramic plate
C10	470μF, 10V

Semiconductors

TR1	BC109C
TR2	BC109C
IC1	MC3360P

Loudspeaker
Miniature type having an impedance of about 8 to 50Ω

Miscellaneous
Case, speaker fret, etc.
Control knob
0.1in matrix stripboard panel
PP6 battery and connector to suit
3.5mm jack socket (SK1)
Telephone pickup coil (see text)
Wire, solder etc.

right hand side of the telephone base. For a Trimphone the best position for the pickup coil is towards the rear of the telephone base on the left hand side.

The equipment is sensitive to any a.f. magnetic field, and so there may be a certain amount of stray pick-up from mains wiring. If this

should occur to a significant degree it should be possible to minimise it by altering the orientation of the pickup coil and (or) the position of the telephone base.

It is quite likely that a howling sound will be produced if the volume control is fully advanced with the telephone handset at all close to the loudspeaker. This is due to acoustic feedback between the loudspeaker in the amplifier unit and the microphone in the handset, and can be avoided by keeping the two reasonably far apart.

It is worth noting that a sensitive amplifier of this type is suitable for uses other than as a telephone amplifier. It can, for example, be used as a baby alarm if a low impedance dynamic microphone (the type used with cassette recorders) is connected to SK1 instead of the pickup coil.