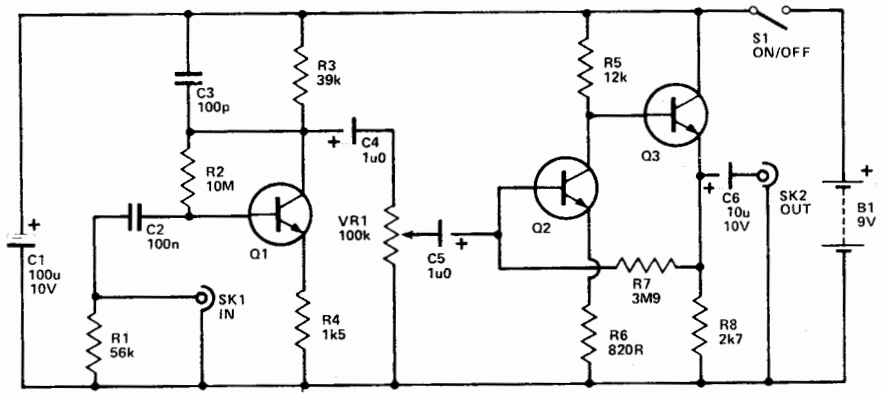
Designer Circuits

TWO MICROPHONE PREAMPLIFIERS



Q1, Q2 2N3904
Q3 TIS97, MPSA18

Microphones provide only a minute output signal and cannot be used successfully with many items of equipment unless their output is augmented by a suitable preamplifier. For example, few stereo Hi-Fi amplifiers have an input that is an acceptable match for a microphone (a magnetic pickup input is unsuitable as it has RIAA equalisation with consequent bass boost and treble cut). Many simple mekers have only high level inputs and require separate preamplifiers for use with low level sources.

The first preamplifier circuit shown here is for use with low impedence (200 or 600 ohms) dynamic microphones. Most electret type microphones have an integral source follower JFET buffer stage which gives a low output impedence, and these should also work well with this circuit. Low impedence microphones have an extremely small output voltage which in normal use is unlikely to ever exceed 1 mV. RMS. This means that the preamplifier must have a high level of voltage gain and a very low noise input stage as well if a high signal to noise ratio is to be achieved. This circuit requires only about 200 uV. RMS at the input for an output level of 1 V. RMS, and the unweighted signal to noise ratio (input open circuit) is a little under —66 dB.

A common base input stage is used, and it is based on Q1 which is an ultra low noise — high gain device. Although the common base configuration is not often encountered in audio circuits it is ideal for this application as it gives the required low input impedance and high voltage gain. In order to obtain a really low noise level Q1 is operated at a collector current of only about 180 uA. C4 is an RF filter capacitor, and this reduces the risk of radio signals picked up by the input wiring breaking through to the output. With high gain circuits such as this RF breakthrough is not an uncommon problem, and ideally the unit should be built into a metal case so that the circuit is screened from RF signal sources.

The output from Q1 collector is fed by way of gain control RV1 and coupling capacitors C5 and C6 to a two stage amplifier circuit. Q2 is a common emitter amplifier and it provides the additional voltage gain that is required. Q3 is used as an emitter follower output stage and gives the circuit a low output impedance. Power is obtained from a 9 volt battery supply and the current consumption is only about 3 mA.

Many dynamic and electret microphones have an integral step up transformer which gives increased output voltage, but the available output current is of course decreased and so a preamplifier having a higher input impedance (usually 50k) is required. Although on the face of it there may seem to be no point in incurring the additional expense of the transformer plus the small loss of performance it inevitably gives, indirectly it gives improved performance. This is simply because a preamplifier designed to match the higher voltage, higher impedance signal tends to have superior performance to an equivalent circuit designed to match the direct output of the microphone.

The high impedance microphone preamplifier shown here requires an input level of approximately 5 mV. RMS for an output of 1 V RMS, and the unweighted signal to noise ratio (input short circuited) is well over —70dB. With reference to this output level. Apart from the input stage the circuit is virtually identical to the previous design, the only difference being that the emitter resistor for Q2 has been increased in value. This has been done because the circuit only needs to have a moderate amount of voltage gain, and the increased negative feedback produced by raising the value of the resistor gives the necessary reduction in voltage gain.

The input stage is again run at a fairly low collector current (about 250 uA.) in order to give a low noise level. Only a moderate voltage gain and medium input impedance are required from this stage, and so Q1 is employed in the common emitter mode with non-bypassed emitter resistor R4 being used to introduce negative feedback to give increased input impedance and reduced voltage gain. The input impedance to Q1 is actually somewhat higher than is required, and so R1 is used to shunt the input and reduce the input impedance to approximately the required figure of 50k.

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