DESIGN IDEAS

# ACTIVE AERIAL WITH SMDS

*Now that surface-mount devices — SMDs — are becoming available, many readers will, no doubt, want to gain practical experience with these new components. What better way to start than with this tiny active aerial?*

As stated in *Surface-mount Technology (Elektor India*, January 1986), all major semiconductor manufacturers are heavily engaged in the development and production of surface-mount components. These components are much smaller than conventional ones and have no or very short connecting terminals, since they are intended to be soldered direct to the copper tracks of a circuit board. In general, these boards no longer have holes drilled in them, other than for fixing purposes.
It should be noted that, although all major manufacturers have a good range of SMDs in production, these devices may not yet be available from all distributors and stockists.

## Circuit description

The active aerial presented here is a very simple circuit, which is primarily intended as a practical introduction to working with surface-mount devices. It has been designed as an add-on unit for a car aerial and for portable receivers where a 12 V supply is available. The aerials used with these receivers usually have a fairly high resistance, whereas the receiver input impedance is typically of the order of 50 to 100 ohms. The resulting mismatch has a detrimental effect on the noise figure of the receiver.

The present circuit provides a large degree of correct impedance matching via a dual-gate MOSFET, $T_1$. The aerial signal is applied to gate 1 of the device, while the potential at gate 2 is arranged at half the supply voltage, i.e., 4.5 to 6 volts. The MOSFET amplifier is coupled to the receiver input via a short length of screened 75-ohm cable (as normally used in car radios). The conductor in this cable also serves to connect the supply voltage to $T_1$. The chokes present a high impedance to frequencies in the receiver range, so that they cannot enter the receiver via the supply line. The 560 pF capacitor isolates the receiver input circuits from the DC supply.
Note that the MOSFET has a typical mutual conductance of 20 mS, so that it performs best with output impedances greater than 50 ohms. As the medium- and long-wave input circuits of car radios are normally high impedance, the present circuit will work well on those wavebands. FM receiver inputs are generally low-impedance, so that the circuit will not be so effective on the VHF bands.

## Construction

Note that the circuit board is not available ready made through our Readers Services. It is best made from the pattern on page 44 or from a piece of prototyping board. Soldering should be carried out with an iron rated at no more than 18 watts and fitted with a subminiature tip to prevent damage to the fragile surface-mount devices. The tip may be made from a length of SWG20 (1 mm dia) bare copper wire wound around the heating element of the iron. Useful tips on mounting the devices are given in *Surface-mount Technology* in the January 1986 issue of *Elector India*.
The component layout is shown in Fig. 2. In portable radios it is advisable to solder the aerial termination direct to $C_1$. Note, however, that the present circuit can only be used if the portable radio has a separate aerial input that bypasses the built-in ferrite aerial.

## Finally

Since it is impossible to achieve absolutely correct impedance matching, the cable between the present circuit and the receiver may radiate. If the resulting signal is picked up by the aerial, the MOSFET stage may oscillate. All this can be prevented by winding the initial length of the connecting cable around a ferrite toroid or rod as shown in Fig. 3. JB:BL

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*Fig. 1. Circuit diagram of the proposed active aerial in which all electrical components — except the chokes — are surface-mount devices.*

*Fig. 2. Circuit board showing a possible layout of the active aerial circuit. This board is not available ready made, but may be made from a piece of prototyping board. Its dimensions are about 250 × 250 mm.*

*Fig. 3. Any tendency of the connecting coaxial cable to radiate may be suppressed by winding its initial length around a ferrite rod or toroid.*

The aerial resistance is the ratio of the power supplied to it and the mean square value of the current at its feed point. This resistance takes into account the energy consumed by the aerial system as a result of radiation and other losses.

The noise factor, $F$, of a receiver is the ratio of the input power, $P_o$, and the noise output power, $N_o$: $F = P_o/N_o$. The noise figure is often expressed in decibels: $F_{dB} = 10\log_{10}F$.

Mutual conductance, $g_m$, is the ratio of a change in output current to the causative change in input voltage when the output voltage is held constant. It is expressed in siemens —S— which has replaced, and is equivalent to, the mho (reciprocal of ohm)

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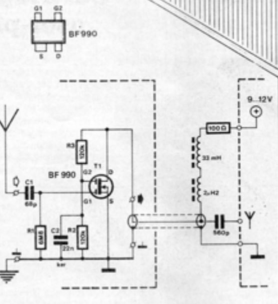


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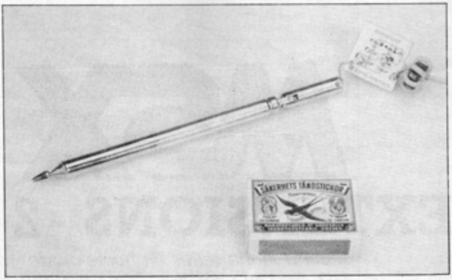


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