Avoiding Interference to Nearby Domestic Electronic Equipment

Purpose of the Leaflet

This leaflet is for RSGB members, to assist in good radio housekeeping practice. A fairly common problem in amateur radio is interference caused by the fundamental transmission getting into nearby electronic equipment. The term 'breakthrough' is normally used to describe this phenomenon; emphasising the fact that it is really a shortcoming on the part of the equipment being interfered with, and not a transmitter fault.

Good radio housekeeping

The main object of *good radio housekeeping* is to minimise breakthrough, by making sure that as little as possible of the precious RF energy finds its way into neighbouring TVs, videos, telephones, and the multitude of electronic gadgets which are part and parcel of the modern home.

In some cases it might be argued that the immunity of the domestic equipment is inadequate, but this does not absolve the amateur from the responsibility of keeping his/her RF under reasonable control. Many of the features which contribute to minimising breakthrough also help in reducing received interference, so that the virtue of good neighbourliness has the bonus of better all-round station performance

Antennas

By far the most important factor in preventing both breakthrough and received interference problems is the antenna and its siting. The aim is to site the antenna as high as you can and as far as possible from your own house and from neighbouring houses (Fig 1). If there is any choice to be made in this regard give your neighbours the benefit of the increased distance - it is usually much easier to deal with any problems in your own home. It is a sad fact that many amateurs are persuaded by social pressures into using low, poorly sited antennas, only to find that breakthrough problems sour the local relations far more than fears of obtrusive antennas would have done.

HF antennas

The question of which antenna to use is a perennial topic and the last thing that anyone would want to do is to discourage experimentation, but there is no doubt that certain types of antenna are more likely to cause breakthrough than others. It is simply a question of “horses for courses”. What you can get away with in a large garden, or on HF field day, may well be unsuitable for a confined city location.

Where EMC is of prime importance, the antenna system should be:

(a) *Horizontally polarised.* TV down leads and other household wiring tend to look like an earthed vertical antenna so far as HF is concerned, and are more susceptible to vertically polarised radiation.
(b) *Balanced.* This avoids out-of-balance currents in feeders giving rise to radiation which has a large vertically polarised component. Generally, end-fed antennas are unsatisfactory from an EMC point of view and are best kept for portable and low power operation. Where a balanced antenna is fed with coaxial feeder, a balun should be used.

(c) *Compact.* Ideally neither end should come close to the house and consequently to TV down leads and mains wiring.

On frequencies of 14MHz upwards it is not too difficult to arrange an antenna fulfilling these requirements, even in quite a small garden. A half-wave dipole or small beam up as high as possible, and 15m or more from the house is the sort of thing to aim for. At lower frequencies compromise becomes inevitable, and at 80m most of us have no choice but to have one end of the antenna near the house, or to go for a loaded vertical antenna which can be mounted further away. A small loop antenna is another possibility, but in general any antenna which is very small compared to a wave-length will have a narrow bandwidth, and a relatively low efficiency. Many stations use a G5RV or W3DZZ trap dipole for the lower frequencies, but have separate dipoles (or a beam) for the higher frequencies, sited as far down the garden as possible.

VHF antennas

The main problem with VHF is that large beams can cause very high field strengths. For instance 100W fed to an isotropic transmitting antenna in free space would give a field strength of about 3.6V/m at a distance of 15m. The same transmitter into a beam with a gain of 20dB would give a field strength, in the direction of the beam, of 36V /m the same distance away. If you want to run high power to a high-gain beam, the antenna must be kept as far from neighbouring houses as possible, and of course, as high as practical.

Operation in adverse situations

First of all, and most importantly, don't get discouraged - many amateurs operate very well from amazingly unpromising locations. It is really a question of cutting your coat according to your cloth. If there is no choice but to have antennas very close to the house, or even in the loft, then it will almost certainly be necessary to restrict the transmitted power. It is worth remembering that it is good radio operating practice not to use more power than is required for satisfactory communication. In many cases relations with neighbours could be significantly improved by observance of this simple rule.

Not all modes are equally “EMC friendly” and it is worth looking at some of the more frequently used modes from this point of view.

SSB is one of the least EMC-friendly, particularly where audio breakthrough is concerned.

FM is an EMC-friendly mode, mainly because in most cases the susceptible equipment sees only a constant carrier turned on and off every minute of so.

CW is the old faithful for those with EMC problems, because it has two big advantages. First, providing the keying waveform is well shaped, with rise and fall times of about 10ms or so, the rectified carrier is not such a problem to audio equipment as SSB. The second is that it is possible to use lower power for a given contact. Of course, low-power CW is not everybody's favourite mode but it does provide a way of staying on the air, even in the most difficult circumstances.

Data modes are more EMC-friendly than SSB. Amateurs who live in locations where running high power is impractical might consider PSK31. This is a mode in which the transceiver is driven from a PC and sound card. It easy to use, and rivals CW in its ability to get through with minimum power.

Earths

From the EMC point of view, the purpose of an earth is to provide a low-impedance path for currents which would otherwise find their way into household wiring, and hence into susceptible electronic equipment in the vicinity. In effect, the earth is in parallel with the mains earth path (Fig 2). Good EMC practice dictates that any earth currents should be reduced to a minimum by making sure that antennas are as balanced as possible. An inductively coupled ATU can be used to improve the isolation between the antenna/RF earth system and the mains earth. The impedance of the mains earth path can be increased by winding the mains lead supplying the transceiver and its ancillaries, onto a suitable ferrite core (or cores).

Traditional end-fed wires tuned against earth at the transmitter end should be avoided, since these inevitably involve large RF currents flowing in the earth system and hence into the mains wiring (fig 2). In recent years the availability of automatic remotely-tuned ATUs has made it possible to feed the antenna at the far end. While this is not ideal from an EMC point of view, it is much better than the traditional arrangement.

The minimum requirement for an RF earth is several copper pipes 1.5m long or more, driven into the ground at least 1m apart and connected together by thick cable. The connection to the station should be as short as possible, using thick cable or flat copper strip/braid.

Where the shack is in an upstairs room, the provision of a satisfactory RF earth is a problem. Sometimes it may be found that connecting an RF earth makes interference problems worse. In such cases it is probably best to avoid the need for an RF earth, by using a well-balanced antenna system, but don't forget lightning protection.

PME

An increasing number of houses are being wired on the Protective Multiple Earthing (PME) system. Electricity organisations usually refer to this as TN-C-S. This system has a common neutral/earth conductor from the sub-station to the consumer's premises. For safety reasons special regulations apply to earthing in a PME installation. If in doubt consult a qualified electrician or contact your electricity company for advice. Leaflet EMC07 gives further information on PME

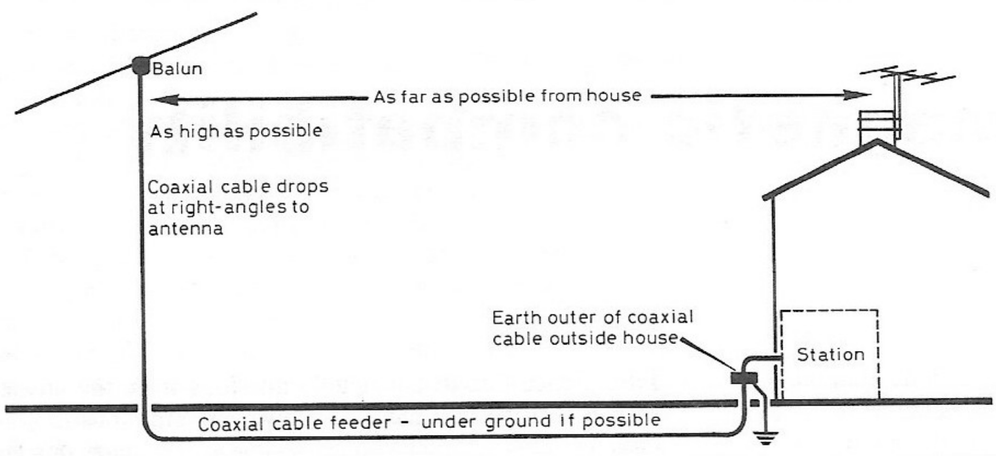

Fig 1 An antenna Installation with EMC in Mind

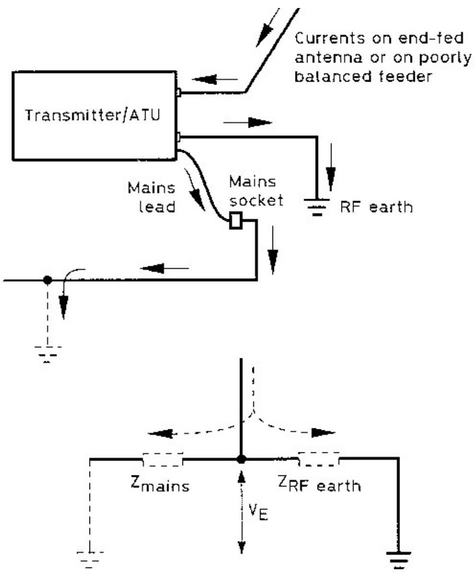

Fig 2 Earth current divides between RF earth and the mains. The current down each path will depend on the impedances. The earth terminal will be at V_E relative to "true" earth

Figures from "The Radio Amateurs Guide to EMC"

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