INTERFERENCE AND SCREENING

Interference is one of the most serious as well as most common problems in audio electronics. We encounter interference when it produces effects like noise, hiss, hum or cross-talk. If a radio engineer faces such problems, good theoretical knowledge as well as experience is required to overcome them.

However, it should be considered, that interference is always present. All technical remedies only aim at reducing the effect of interference to such a degree, that it is neither audible nor disturbing. This is mainly achieved by different ways of screening. This paper will explain the technical background of interference and provides some common rules and hints which may help you to reduce the problems.

TYPES OF INTERFERENCE.

Theoretically, the effects and mechanism of a single interference can well be calculated. But in practice, the complex coupling systems between pieces of equipment prevent precise prediction of interference. The following picture shows the different types of interference coupling. The different types of interference between the components of an electric system. If we consider all possible coupling paths in the diagram above we will find 10 different paths. This means a variety of 1024 different combinations. It should be noted, that not only the number of paths, but also their intensity is important.

SYMMETRICAL AND ASYMMETRICAL INTERFERENCE.

Having a closer look at the interference of cable, we find that hf-interference currents cause measurable levels on signal (audio) lines and on supply lines. A ground-free interference source would produce signals on a cable which spread along the line. These voltages and currents can be called symmetrical interference. In practice this rarely occurs.

Through interference, asymmetrical signals are produced in respect to the ground. The asymmetrical interference current flows along the two wires of the symmetrical line to the sink and via the ground back to the source. These interference signals are cancelled at the symmetrical input.

GALVANIC COUPLING OF INTERFERENCE.

Galvanic coupling of interference occurs if the source and the sink of interference are coupled by a conductive path. As can be seen from the equivalent circuit diagram, the source impedance of the interference consists of the resistance RC and the inductance LC of the conductor, which are common to the two parts of the circuit. From these elements the interference source voltage can be calculated.

CAPACITIVE COUPLING OF INTERFERENCE.

The capacitive coupling of interference occurs due to any capacitance between the source and sink of interference.

Principle of capacitive coupling of interference.

The current in the interference sink can be calculated as the interference voltage in the sink is proportional to its impedance. Systems of high impedance are therefore more sensitive to interference than those of low impedance. The coupled interference current depends on the rate of change of the interference and on the coupling capacitance CC.

INDUCTIVE COUPLING OF INTERFERENCE.

Inductive coupling of interference occurs if the interference sink is in the magnetic field of the interference source (e.g. coils, cables, etc.)

Principle of the inductive coupling of interference.

GROUNDING (OR EARTHING).

This is one of the simplest but most efficient methods to reduce interference. Grounding can be used for three different purposes:

1. Protection Ground

Provides protection for the operators from dangerous voltages.

Widely used on mains-operated equipment.

2. **Function Ground**

The ground is used as a conductive path for signals.

Example: in asymmetrical cables screen, which is one conductor for thesignal, is connected to the ground.

3. Screening Ground

Used to provide a neutral electrical path for the interference, to prevent that the interfering voltages or currents from entering the circuit. In this chapter we will only consider the third aspect. Grounding of equipment is often required for the cases 1 or 2 anyhow, so that the screening ground is available "free of charge". Sometimes the grounding potential, provided by the mains connection, is much "polluted". This means that the ground potential itself already carries an interfering signal. This is especially likely if there are big power consumers in the neighborhood or even in the same building. Using such a ground might do more harm than good. The quality of the ground line can be tested by measuring it with a storage scope against some other ground connection, e.g. a metal waterpipe or some metal parts of the construction.