EMI SUSCEPTIBILITY GENERATORS

What is an EMI Susceptibility Generator? It is a signal generator, a power amplifier, a broadband power source, a spark gap and coil, or any device with a power output of sufficient magnitude to determine the susceptibility or vulnerability of an object under test.

Susceptibility is a term used in the Interference Technology to describe an equipment or systems' undesirable response to externally applied energy. This energy can be applied to an antenna to establish a radiation environment, and is commonly called radiated susceptibility test. It is also applied to power and other lines through coupling capacitors or current probes, and is commonly referred to as conducted susceptibility test.

Radiated Susceptibility

Radiated susceptibility tests are usually performed to assure that the test specimen will operate in its intended radiated environment. The irradiation levels are either specified by a standard, or determined through a study or prediction of the intended environment. For instance, if you know that your equipment has to operate near a microwave oven, a radio or TV antenna installation, or close to communications equipment, the equipments' response to these fields should be tested in the laboratory. A measurement or calculation can define the field intensity (volts per meter) or power density (watts per square meter), and frequency of the environment. Then, by obtaining the proper antennas and power sources, it can nearly be duplicated in the laboratory.

Military and other specifications define the fields which must be generated and imposed on electronic equipment. The earlier specifications merely defined the type of antenna to use as a function of frequency, specified the open circuit voltage into the antenna terminal, and the distance between the antenna and the test specimen. The frequency ranged from 150KHz to 106Hz. The Signal Corps was the only service to specify field intensity rather than antenna applied voltage.

The most widely used modern-day Government specification, MIL-STD-461A, specifies the required frequencies, test distances, field intensities and test antennas. However, considerable flexibility is allowed by the statement, "Antennas other than those specified can be used if described in the test plan and approved by the procuring activity." For several years, the standard required a susceptibility field strength of 1 volt/meter from 14kHz through 10GHz. However, in its Notice 3 and 4 revision the levels were changed as shown in Table 1 in the "Military EMI Specifications" section of this book.

Obviously, radiated levels of this order of magnitude cannot be generated using standard laboratory equipment. The military has found these levels to be realistic of intended environments. The consumer product manufacturer may also be surprised to learn the environments in which his products are operated.

A major drawback of the EMI specifications, and a trap that many product manufacturers may fall into, is the unchallenged application of a single modulated CW frequency. Often, there are two or more radiators generating the severe intended environment, and the combined effects on products or systems can be considerably different from that of a single CW signal. An undesirable response to a single CW signal can be referred to as a spurious response, but multiple signals produce intermodulation and cross-modulation products which can result in an undesirable response of the equipment under test. Also, a CW signal cannot realistically simulate the radiated environment of a fluorescent light, commutator noise from a motor, or automotive engine noise.

When considering the purchase of an EMI susceptibility generator, you should look for features which could provide considerable time savings in the performance of tests. For instance, the peaking of the signal at each test frequency could take enough labor costs to pay for an expensive broadband source which is commercially available after one lengthy test. Some of the important features you should look for are:

1. Protection against damage under any magnitude or phase of source and load VSWR;
2. No tuning or band-switching (broadband);
3. Reproduction of AM or FM modulation appearing on the input signal;
4. Compatibility with reactive antennas;
5. Suppression of harmonic products;
6. Versatility in use for other purposes; and
7. Bandpass ripple.

Conducted Susceptibility

The application of a susceptibility signal to a power line may not be as simple as it may first seem. The use of a current probe will provide impedance isolation between the line and the power source. However, the probe which inductively couples the energy into the line may have losses. There is a danger of burning out the impedance matching resistors in the probe when applying high levels of energy. The lines must be monitored to determine the amount of energy pick-up by the line.

When susceptibility voltages are specified, capacitors are often used as the coupling device. The impedance of the capacitor must be small at the frequency of operation to avoid significant voltage drops across the device. Although the capacitor provides isolation between the source and line at low and power line frequencies, no isolation is present at the test frequency. Thus, when the line impedance is low, it will tend to load down the power source making it difficult to develop the desired voltage level. With an unlimited power source, it may be possible to burn out the equipment under test without ever reaching the desired or maximum safe voltage level.

For frequencies below 50 KHz, an isolation transformer is used as the coupling device. The secondary winding of the transformer is connected in series with the line under test, and must have a negligible impedance at the test frequency. The power is then applied to the primary winding and "modulates" the line. At power line frequencies, there is some danger of power being fed back to the power source causing damage to the source.

Test Facilities

Conducted susceptibility tests may be performed in the open laboratory. However, the susceptibility signal may propagate through the laboratory's power lines and interfere with other equipment. The power lines also have the capability of radiating the energy. To protect the rest of your laboratory, power line filters should be used. An inductor should be placed between the filter and the coupling device so that the filter will not load down the susceptibility signal source or in other ways effect the results of the test.

A shielded anechoic chamber would probably provide the best facility in which to perform radiated susceptibility tests. The anechoic material is absorbative usually above 100MHz (depending upon size and shape of the anechoic material), and reflections from the walls are 30 dB or more down at the point of the test sample. Significant reflections and perhaps standing waves will be present at frequencies below the cut-off frequency of the anechoic material. However, the FCC, OTM, other laboratory users and the general public would greatly appreciate the containment of these high signal levels. Many cities and towns have ordinances to this effect, especially when your signals may interfere with police and fire communications.