BY BONNIE BAKER

EMI problems? Part three: strength of EMI-radiated signals

How far away from radiating sources do you need to be so that the radiated signal does not interfere with your system? As you answer this question, consider both the amount of radiated energy from a source and your system's electromagnetic-interference-protection circuitry. Radiating EMI signals propagate from a source to a receiving element (**references 1** and **2**). The power, or voltage level, of these signals as they hit your sensitive circuits depends on the transmitter's power and antenna gain and the distance between the source and the receiver (**Figure 1**).

Electric-field strength quantifies the magnitude of the interfering voltage at the source. This narrowband or broadband EMI signal unit of measure is in volts per meter. You can modify the units for the electric-field strength to your liking by converting them to decibels referenced to microvolts, where dBμV=20log(V)+120 μV.

A narrowband EMI signal typically is a repetitive signal or pulse train. The **equation** in **Figure 1** allows you to quickly get a worst-case prediction of the radiated voltage, E_R, at a specific distance from the EMI source. A broadband EMI signal typically is a single pulse, such as a lightning strike, an electrostatic-discharge event, or a spark gap. These pulse-type events contain multiple frequencies. Broadband signals are difficult to measure because they are nonrepetitive and fast.

Radiated-power-density units can also describe narrowband events. The unit of measure for the EMI narrowband, radiated-power density is watts per square meter. Communications engineers use the power-density representation of an EMI signal for their narrowband EMI issues. You can convert the radiated-power-density units to decibels referenced to milliwatts, where dBm=10 log(W).

You can use an oscilloscope to observe EMI signals in the time domain and a spectrum analyzer to evaluate EMI signals in the frequency domain. However, FCC- and European CISPR-certified companies must perform all radiated EMI measurements before the release of their products to the market. This requirement ensures that the test results are accurate according to FCC or CISPR regulations. Test methods include environmental conditions, along with calibrated EMI test equipment and antennas. The FCC and CISPR require that the radiated signals that your equipment transmits comply with specified values. FCC- and CISPR-related documents include EN 55011, EN 55013, EN 55014, EN 55015, EN 55022, and EN 50081-1.2.

Figure 2 shows Class A limits for electronic equipment for use in commercial, industrial, or business environments. Class B limits apply to electronic equipment for use in the residential environment. Equipment in residential environments may also be subjected to the Class A limits. Class B limits are more restrictive because of the likelihood of the equipment's close proximity to TV and radio receivers.

We are getting close to the devices in your circuit. Next month's column will discuss EMI-conducted radiation. EDN

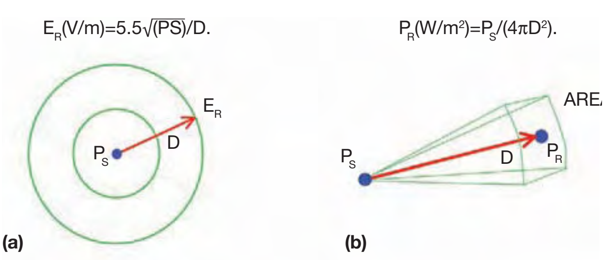

Figure 1 The power, or voltage level, of these signals as they hit your sensitive circuits depends on the transmitter's power and antenna gain, the distance between the source and the receiver, and whether the circuit is using a narrowband EMI signal at electric-field strength (a) or a broadband EMI signal at radiated-power density (b). P_S is the source power in watts, D is the distance in meters, E_R is the receiver's electric-field level, and P_R is the receiver's power in watts.

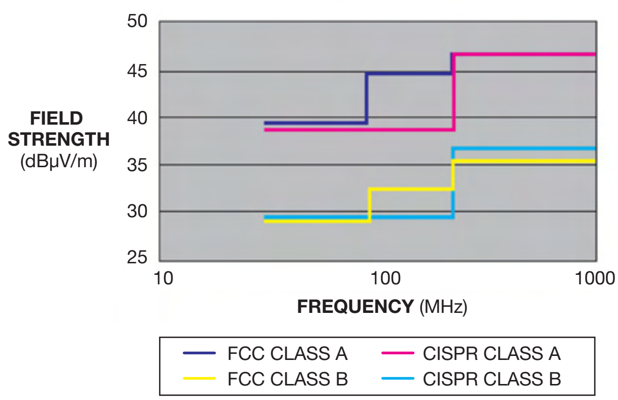

Figure 2 Class A limits are for electronic equipment for use in commercial, industrial, or business environments. Class B limits apply to electronic equipment for use in the residential environment.