Build a Magnetic Field Immunity Tester

Jim Ericson - June 01, 1999
Build the Loop

To construct a 1-m² multturn coil, you need straight PVC water pipe, elbows, and tees joined with liquid plastic-pipe cement. Figure 1 shows a 1-m² PVC pipe frame that contains a two-turn, insulated 18-electrode solid copper wire loop inside. Solid banana jacks to the loop wires where they exit the pipe. Make a flexible twisted pair cable—not longer than 3 m—and connect it to the audio amplifier or other current source.

Make all connections mechanically strong. Solder them well because the total loop resistance at 50 Hz will be about 200 mΩ. To complete the test setup, build a wood frame to support the loop. Place the frame and loop above a non-magnetic, aluminum or copper ground plane with minimum dimensions of 1 m x 1 m x 0.25 mm.

Figure 2 shows how to connect the loop to the audio amplifier through an 8-W, 100-W resistor series with the loop. The resistor approximates the impedance of a speaker. The amplifier must be capable of having the low side of its output connected to safety earth. Connect the "low" side of the loop coil circuit to the ground plane; connect the ground plane to safety earth.

![Figure 1. Use PVC pipe to make a loop for magnetic field immunity testing.](image)

![Figure 2. Connect the loop to a 100-W audio amplifier through an 8-W, 100-W resistor. Connect the amplifier to a signal generator and measure current with an AC ammeter.](image)

You can also measure the loop current. Place a current probe or a DMM (set for ACA) in series with the loop. Verify the meter’s accuracy at the frequencies you plan to use. You also need to verify that the loop current sinusoidal distortion is less than 8%. Do that with a distortion analyzer or visually by monitoring the loop voltage waveform with an oscilloscope as you adjust the signal input level. When you begin to overdrive the amplifier and distortion of the sine wave reaches about 5%, the distortion will start to be visible on the scope pattern.

A 100-W audio amplifier will supply about 2.5 A into an 8-W load without appreciable distortion. This corresponds to a maximum magnetic field at the center of the 2-turn 1-m square loop of 2 x 2.5 x 0.9 turn/m, or 4.5 A/m. If you need higher field intensities, either increase the number of loop turns or drive the loop directly from the AC mains through a variac and stepdown transformer.

Handy Conversions

When measuring the field strength inside the coil, you may have equipment that measures units in units that you don’t use in everyday EMC testing. These conversion factors will help you convert from the somewhat obscure units to the more familiar units:

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H = \text{magnetic field strength (in oersteds)}
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This parameter characterizes the amplitude of alternating magnetic field strength.

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B = \text{flux density (in gauss or tesla)}
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A corresponding parameter for the induced magnetic field in an area perpendicular to the magnetic flux path.

Units:

- 80 A/m = 1 oersted
- 1 T (tesla) = 10⁴ gauss
- 1 A/m = 1.26 x 10⁻⁷ T (in free space)

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