Never use pigtails on cable shields

Martin Rowe - August 18, 2014

Ask any EMC engineer to name the most common problems associated with system-level emissions and all of them will include poor cable shielding and terminations. Often, the poor terminations occur because someone takes a cable's shield, twists it into a single wire (often called a "pigtail"), and connects it to "ground." Let the emissions begin. In the videos below from the 2014 IEEE EMC Symposium, NASA engineer John McCloskey demonstrates how pigtails compromise shielding.

While at the Symposium, I heard a great analogy that describes what happens when you use pigtails. It went something like this:

*Imagine you need to walk 100 m in the pouring rain. The good news is you can walk under a canopy. The bad news is that the canopy is 10 m too short. The result? You get soaked anyway.*

That's essentially what happens with a pigtail and why shields need to completely cover not only the cable, but go 360° around the cable's connectors as well.

**Figure 1**—originally published in *EDN's Designers Guide to Electromagnetic Compatibility* by Kimmel and Gerke—shows how the pigtail termination results in becoming an effective radiator.

![Figure 1. Pigtails transform cable shields into sources of radiated emissions.](image)

Assisted by summer intern Jennifer Roberts, McCloskey showed the differences in emissions that arise from using pigtails of different lengths. The test setup consisted of both an unshielded wire (used for a worst-case baseline of emissions) and a shielded coax cable. Using a BNC adapter, Roberts added pigtails of different lengths to the cable's shield while McCloskey showed the results. In the video below, McCloskey noted that the adapter alone resulted in some 40 dB loss in shielding effectiveness.

Next, Roberts added a 2-in. pigtail. That resulted in further losses in shielding effectiveness shows in the video below.
Figure 2 shows frequency plots of the different pigtails. The black line represents the coax cable with proper shield termination (no pigtails).

![Frequency plots of different pigtails](image)

Figure 2. As pigtail length increases, so do the emissions radiated from a shielded cable.

The final word from the demonstration.

**PIGTAILS ARE EVIL.**

(They degrade shielding effectiveness.)

**DO NOT USE THEM.**

EVER.

Also see
- [EMC questions answered (Part 4)](link) Pre-compliance testing for radiated emissions
- [EMI and emissions: rules, regulations, and options](link)
- [Control conditions of EMI measurements](link)
- [Designing External Cabling for Low EMI Radiation](link)
- [Troubleshooting EMI on your bench top](link)

[Design enclosures to meet EMC requirements](link)