White paper: <u>The use of a drain wire in shielded "data" cables</u>

1. introduction

1.1. In the new requirements for category cables as are defined in the TIA and IEC standards, EMC performance as well as EMI/RFI requirements of the cables may be evaluated for the system level definition.

1.2. High ground impedance is one of the major high-frequency problems, whether they relate to emissions, self-compatibility, or immunity.
These are neither low-frequency ground loop issues, nor earth grounds. These are problems caused by local ground impedances such as are found on circuit boards or in cables.
High-impedance ground paths are the principal contributor to cable shielding failure and common-mode currents.
How high is a "high frequency"? That depends on the application. But, with a wire or trace, the inductive impedance is higher than the resistance of the path already at audio frequencies, and it is significant at 1 MHz. At that point, designers should avoid using wires or pigtails for grounds.
A good rule of thumb is that the inductance of a wire is about 20 nH per in. of length. A 1-in. wire or trace has an impedance of Z = 2pfL = 12 Ω at 100 MHz—hardly a short circuit

1.3. Ground impedance, as just discussed, plays a key role in cable termination performance. The best cable termination is the circumferential wrap, where the cable connector is grounded around the entire perimeter.
Wire or pigtail termination is unacceptable at any frequencies above audio frequencies range.

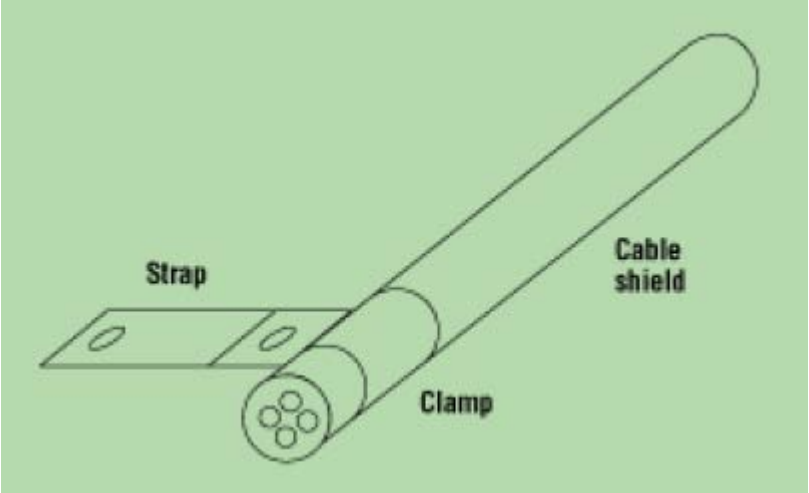
1.4. To summarize, a good termination should ensure zero voltage drop in the circular section of the shield and a low impedance earth connection.

1.5. A drain wire which is used in parallel to the braid shield as an earth connection (pigtail) acts opposite to the EMC practice as described in this document. In other words, a cable shield which is grounded through the drain wire causes a problem if the drain wire is attached to a pin in the connector, making it almost completely ineffective, or to a screw post inside the connector, in which case shielding effectiveness is reduced. It is important to note here that this creates a pigtail.

1.1. EMC tests performed in independent laboratories (i.e.Delta, 3P) shows that EMC performance of braid shielded cable is worse when using a drain wire compared to the same cable without the drain wire.

2. Teldor Wires & Cables recommendation and activities

2.1. In case of horizontal type cables the preferred grounding method is by using a ground clamp and strap as illustrated in the drawing:



2.2. In case of F/UTP or U/FTP cables where a drain wire is almost a must due to the aluminum tapes used for screening, the best practice is to "coil" the drain wire on the tape(s) below the ground clamp. This way the earth connection is done in a circular form, thus the wire inductance and the earth impedance are reduced to very small values.

2.3. In the case of SF/UTP or S/FTP cables the recommendation is to use cables which do not contains drain wire.

2.4. To help our customers reach the EMC requirements for the braided shield cables (SF/UTP and S/FTP structures), TELDOR Cables & Systems standard cables does not contain drain wire (since 2004).

2.5. A drain wire may be added upon a specific request.

2.6. It is suggested for already installed/used braided shielded cables which contain drain wire to perform the earth connection as is recommended and leave the drain wire un-connected inside the braid "cage".

For any further information please feel free to contact the author.

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