HF Technology - Technical Newsletter

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HF TECHNOLOGY

An introduction to the different ways of

Grounding cable braids in the EMC field of engineering

It is common practise in the EMC field of engineering to ground a cable braid at least at one side. It is preferred to do this at both ends if the situation permits. The way this is done differs a lot in practise.

Some use dedicated EMC glands, which is the perfect way to go, others prefer dedicated shield clamps. Some prefer to use multicable feedthroughs. The main question remains what to take into consideration. This article discusses some of the used methodologies and their countereffects.

Example

Figure 1 shows an example from a practical situation.

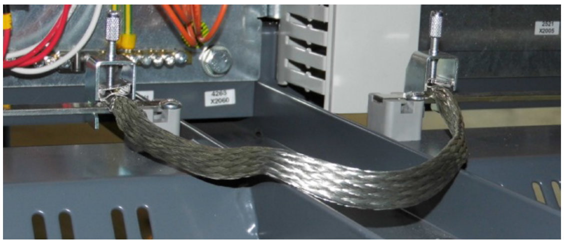

Figure 1: Mounting rail for cable braid bonding.

The situation of figure 1 shows an elevated rail that is interconnected with another rail using a flat woven cable. The mounting spacers are made of an insulating material as figure 2 shows in detail.

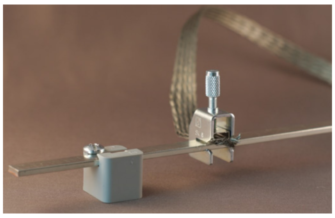

Figure 2: Detail of the rail with spacer.

Cable braid mounting effects

The so-called paigtail is a way of bonding cable braids that is known for its devastating effect. The transferimpedance Z_{tr} will rise. Consequently an improper terminated but inherently good cable can thus prove to be a worse connection than a proper terminated but poorer cable. This also applies to connectors. Figure 3 shows two versions of the BNC connector.

Figure 3: BNC Connectors, crimped version (left) and soldered (right).

The right BNC connector that is shown in figure 3 shows a braid connection that closely resembles a pigtail. The connectors are compared using a test setup that measures the transferimpedance (fig. 4).

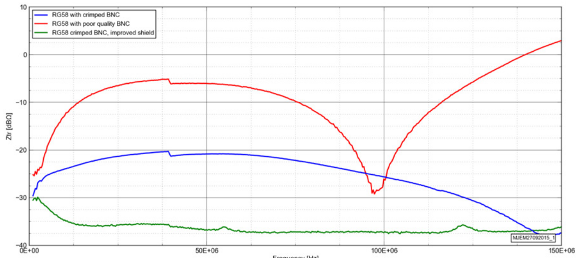

Figure 4: Transferimpedance of RG58 cable using different BNC connectors.

About the author

"Mathieu Melenhorst is working at Alewijnse Marine Nijmegen as Designer at the department Conceptual Design & Consultancy with focus on EMC, Lightning and Power Quality". Together with Dr. Ir. Mark van Helvoort Melenhorst co-wrote the book "EMC van Installaties – Op weg naar elektromagnetische compatibiliteit", issued by BIM Media, The Netherlands (ISBN 978-90-125-8552-1).

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The transferimpedance of the connection is defined as given in equation 1.

$$Z_{tr} = \frac{U_{DM}}{I_{CM}}$$

Figure 4 shows that the red curve is signicantly higher than the blue curve. In fact, the red curve is the cable that is terminated using the rightmost BNC connector that is shown in figure 3. The blue curve is the crimped BNC connector, the leftmost connector, of figure 3. The lowest curve is taken using the crimped BNC connector yet the entire connection is wrapped in aluminum foil. This lowers the entire transferimpedance.

The conclusion is drawn that the lower the transferimpedance, the better. The transfer-impedance is a function of the frequency. This can only be achieved avoiding the pigtail-like connection that was shown in figure 3 for the right BNC connector.

The mounting rail

An elevated mounting rail was mounted on an aluminum plate as figure 5 shows.

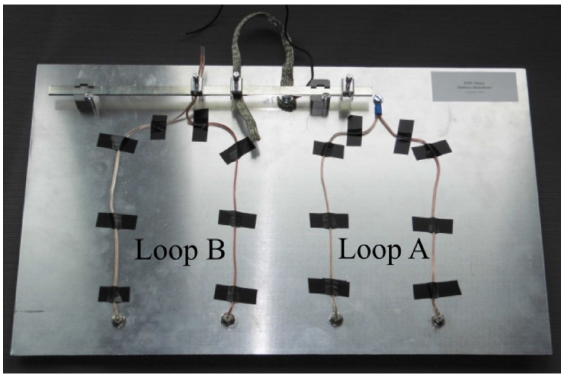

***Figure 5:** Two wire loops, mechanical differently terminated.*

Figure 6 shows the schematic overview of one wireloop, inspired by the measurement report by Pitsch/Both. Transmitting and receiving loops are equal in size and shape.

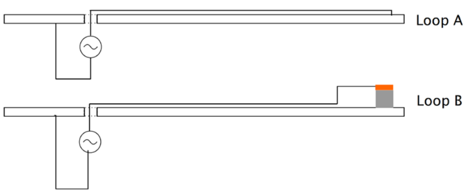

***Figure 6:** Schematic overview of the transmitting loops.*

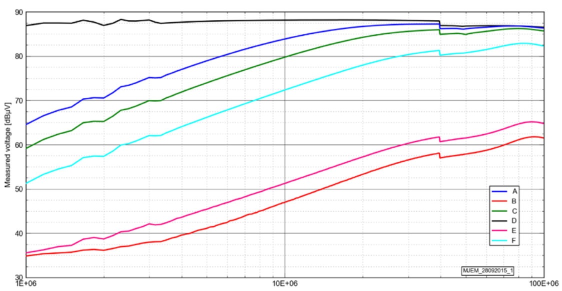

***Figure 7:** Measurement results of figures 5 and 6*

Wire loop A in figure 6 is terminated using a lug that is screwed directly onto the aluminum plate. Wire loop B represents the termination at the mounting rail. This rail is bonded to the aluminum plate using dierent connections. The signal sources are connected to the wire loops using BNC chassismounted connectors.

The measurement results are shown in figure 7. Note that the relative differences are of main importance as the test setup is not calibrated.

Designation	Loop	Description
A	B	Rail bonded using bicycle lighting wire
B	A	Loop wires close to the aluminum plate
C	B	Rail connected using thick flexible braid
D	B	No bonding between the rail and aluminum plate
E	B	Aluminum foil between rail and aluminum plate underneath wires.
F	B	Aluminum foil between rail and aluminum plate at left-end of the rail.

The graphs of figure 7 show that it is mandatory to keep the loop area as small as possible. Using the braided connection instead of the bicycle lighting wire provides some improvement. The largest improvement is to have the connection between the rail and the aluminum plate as close as possible to the currentcarrying wires. This implies underneath the wires.

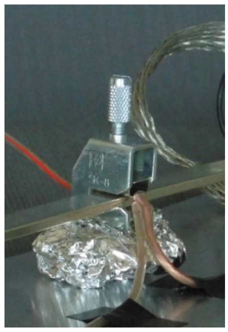

***Figure 8:** Connection close to wires.*

Conclusions

This article shows that proper cables that are terminated in the wrong way, of which a pigtail is an example, deteriorate the EMC characteristics in terms of its transferimpedance. The termination of cable braids on an insulating rail can in some ways be considered as a pigtail termination. Loop areas must be kept small at all times.

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075 - 628 37 17

Postbus 343 - 1560 AH Krommenie