



## ***Twisted Pair for Wiring***

[Ref: Wikipedia]

In this short paper, we briefly discuss how important the twisted pairs of wires play their roles in typical HDMI over CAT5 applications. As there are more and more “zero-skew” LAN cables appear in the market, there are some misunderstandings arouse, which are about that the skew improved cables can boost up the pure digital HDMI transmission over LAN cables.

Let us have firstly a little background why twisted pairs are necessary for differential signaling, and what will be the major side effects if twisted pairs of wires are used.

### **Why twisted in needed?**

In balanced pair operation, the two wires carry equal and opposite signals and the destination detects the difference between the two. This is known as differential mode transmission. Noise sources introduce signals into the wires by coupling of electric or magnetic fields and tend to couple to both wires equally. The noise thus produces a common-mode signal which is cancelled at the receiver when the difference signal is taken. This method starts to fail when the noise source is close to the signal wires; the closer wire will couple with the noise more strongly and the common-mode rejection of the receiver will fail to eliminate it. This problem is especially apparent in telecommunication cables where pairs in the same cable lie next to each other for many miles. One pair can induce crosstalk in another and it is additive along the length of the cable. Twisting the pairs counters this crosstalk effect as on each half twist the wire nearest to the noise-source is exchanged. Providing the interfering source remains uniform, or nearly so, over the distance of a single twist, the induced noise will remain common-mode. Differential signaling also reduces electromagnetic radiation from the cable, along with the attenuation that it causes.

### **What are the downsides of twisted wires?**

Although twisted pairs do bring some advantages to signal transmission, in video, either analog or digital, applications that send information across multiple parallel signal wires, twisted pair cabling can introduce signaling delays known as skew. The cable skew can result in subtle color defects and ghosting due to the image components not aligning correctly when recombined in the display device while analog transmission takes place. For digital transmission, the situation may get even worse, because the sync or control bits may be completely damaged and lead to no video at all. The skew occurs because twisted pairs within the same cable often use a different number of twists per meter so as to prevent common-mode crosstalk between pairs with identical numbers of twists. The skew can be compensated by varying the length of pairs in the termination box, so as to introduce delay lines that take up the slack between shorter and longer pairs, though the precise lengths required are difficult to calculate and vary depending on the overall cable length.

### **Why lower twist rate does matter for digital transmission?**

Twisted wires do bring a lot of difficulties to maintain skews between wires within a very satisfying number. Therefore, cable manufacturers may trade twist rate to gain the close length in wires. However, lowering the twist rate will disfavor the differential signaling. The crosstalk among different pairs of wires may not be canceled out at the receiver because the influence may not be uniform along the transmission path. Lower twist rate introduces noise into the reconstructed video. For typical analog video transmission over LAN cables, the analog video waveforms and syncs are coded into differential formats. The additive noise caused mostly by crosstalk contributes to the shapes of waveform which may not be visually sensitive to human eyes. However, for digital transmission, such as HDMI/DVI, this side effect from lower twist rate will cause bit losses and result in no video! All the important information in digital transmission is coded into a long series of bit stream. The damage of control bits such as video syncs will lead to disastrous outcomes.

### **Wired New Zealand Limited**

Unit B, 2 Centennial Highway, Ngauranga, Wellington

Ph: 04 499 4110, Fax: 04-499 4114

email: [sales@wirednz.co.nz](mailto:sales@wirednz.co.nz) web: [www.wirednz.co.nz](http://www.wirednz.co.nz)