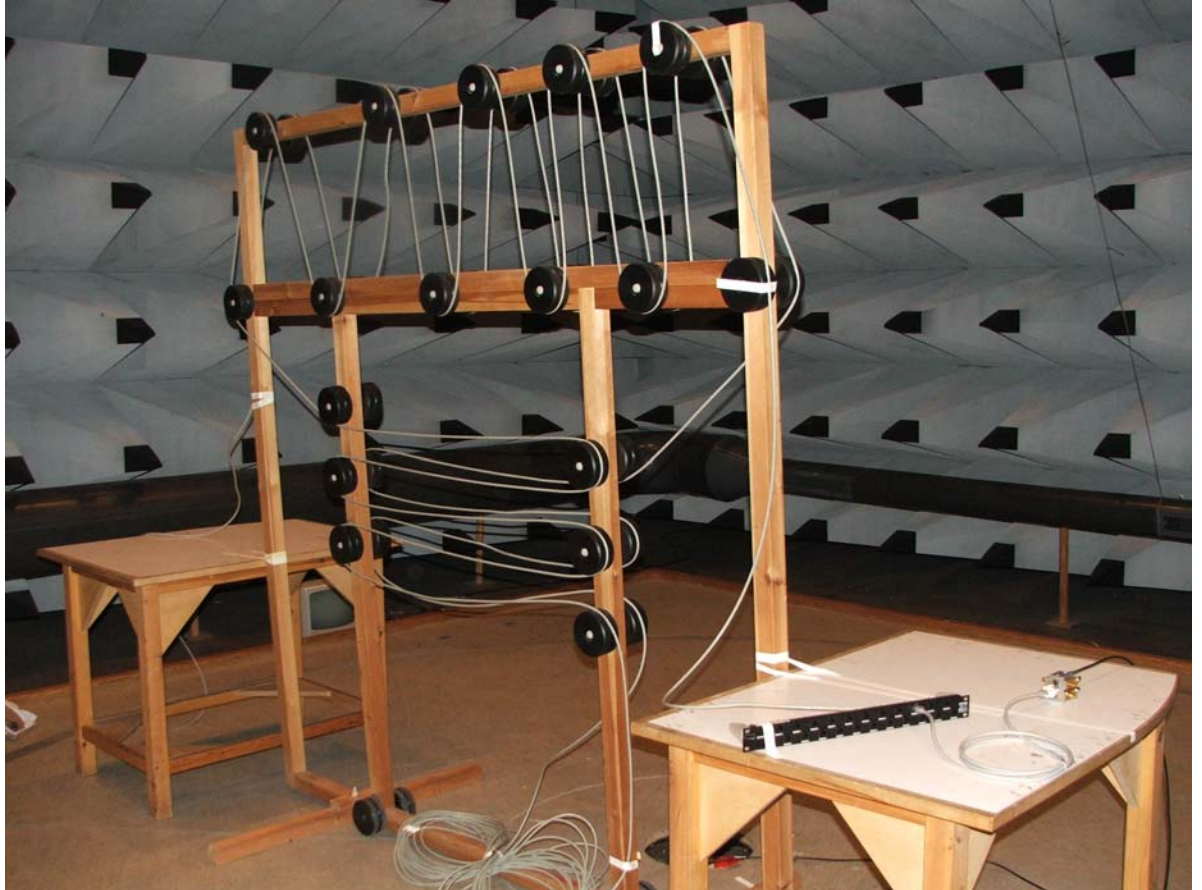


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A Novel Approach for 10 GbE (10 GBase-T) Cables

Alien Crosstalk Attenuation by Floating Ungrounded Shielding

Introduction

When it comes to 10G-Base-T cabling, today's information technology world for is divided. While some are staunch supporters of unshielded cabling, shielding is almost mandatory for full compliance with IEEE 802.3an cabling requirements as well as attaining ease of installation.

This white paper focuses on the effects of alien crosstalk attenuation on cable and structured cabling and suggests the novel approach of the U/STP (Ungrounded Screened Twisted Pair) design.

1. What is alien crosstalk (how to reduce the effect)?

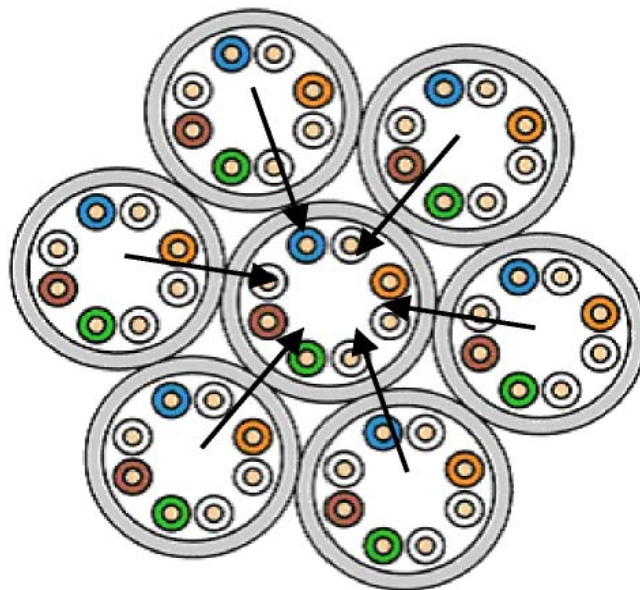
The source of the problem can be explained in following diagram. Each conductor pair in a cable induces crosstalk in the adjacent pairs of both its own as well as adjacent cables. The reason for this is the capacitive and inductive coupling between the current carrying conductors.

Crosstalk as the sum of partial capacitances can be reduced via constructive measures. One is to twist the pairs of balanced cables by using different twist lengths. Further, decoupling of crosstalk between cables is achieved by shielding the individual pairs (STP) and/ or the four pairs together (FTP) or by increasing the distance between the cables in the case of fully unshielded UTP cables.

Crosstalk between two pairs that are not separated by a metal shield basically depends on the pairs' twist lengths. By choosing appropriate twist lengths, high crosstalk attenuation can be achieved. The twist lengths of any two-pair combination within the cable must be different to avoid harmonic resonance (peaks).

This requirement cannot be achieved in real installations using cables from the same vendor (see Fig 1.). In those instances, the option of increased distance between cables must be used..

Theoretically the preferred approach is the STP, where we obtain a gain of alien and internal crosstalk attenuation.



2. EMC and Related Uncertainties

The EMC cabling criteria of IEEE 802.3an clause 55.1.1. is defined as "Meet CISPR/FCC Class A EMC requirements".

Electromagnetic compatibility, EMC for short, deals in general with electromagnetic interference and interference immunity.

The most important component of the cabling is the cable itself. Authoritative standards specify test situations that yield comparable parameters.

The test method required by **CISPR/FCC** is based on injection of RF energy into the cable pairs and measuring the emitted RF energy. This test method can be used for comparing cables and for determining EMC suitability of a particular cable.

2.1. Un-Grounding of Balance Cable Shield

The primary reason for shield grounding (connect to earth) is safety. In general any metal part of electrical equipment which can be directly touched by a human and the body current exceeds the safety limit must be grounded.

A second reason for grounding may be the theory that a floating shield may behave as an "antenna" for RF energy.

LAN systems are defined as low voltage systems, typically having the rated common voltage about 30 V, although in some cases it can be higher. In any case the body current shield to earth can not exceed the safety limit because the shield is not part of the electrical circuit as it is in unbalanced systems. We can say that for safety shield grounding is not a mandatory requirement, and that ungrounded shielded LAN cables behave like regular UTP cables.

A special **Un-Grounded** individual screened four pair cable designed and structured for complete compliance with all 10GbE (10 GBase-T) cabling requirements was tested in an independent third-party EMC laboratory (Delta), and compared with a regular Cat-6 UTP cable for compliance with CISPR/FCC Class A EMC requirements. The test conclusion is that the U/STP cable behaves similarly to the UTP cable and fully complies with the EMC requirements for 10GbE cabling. We can say that for this specially designed cable the ungrounded screen does not act as an antenna.

Note: for the full test report please contact the author.

2.2. Termination of U/STP (Ungrounded Screened Twisted Pair)

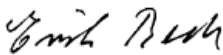
Standard RIT Technologies Cat-6 UTP connecting hardware was used in the test. We can say that the use of the Teldor 83U horizontal series cables and 9828U working area series cables with matched UTP connecting hardware complies with the 10GbE EMC cabling requirements.

In general the use of the of U/STP cables with matched UTP connecting hardware can be defined as UTP cabling which fully complies with the CISPR/FCC Class A EMC requirements of IEEE 802.an.

2.3. EMC test summary

2.3.1. front page

DANAK-19J1544
DELTA-N312136
Page 2 of 19

Title	Measurement and comparison of electromagnetic radiation from two cabling systems.
Product description	1. Unscreened, UTP cabling channel, class E 2. Screened ¹ , U/STP cabling channel, class E
Product identification	1. UTP cable type 750AZ04129, Patch cord, UTP cable type 720KS, Connecting hardware, RIT type R3010392, Patch panel, RIT type SMARTen 24 UTP Panel. 2. U/STP cable type 83U1204129, Patch cord, U/STP cable type 9828U, Connecting hardware, RIT type R3010392, Patch panel, RIT type SMARTen 24 UTP Panel.
Report no.	DANAK 19J1544
Project no.	N312136
Test object received	7 March 2006
Test period	7 March 2006
Client	Teldor Wires and Cables Ltd. Ein-Dor 19335 Israel
Contact	Jacob Ben Ary
Prepared by	Erik Bech
Reviewed by	Claude Videt
Date	14 March 2006
Responsible	 <hr/> Erik Bech, Test Manager DELTA LAN Components and Systems Testing

¹ The horizontal cable is screened, but the screens are not connected.

2.3.2. Summary

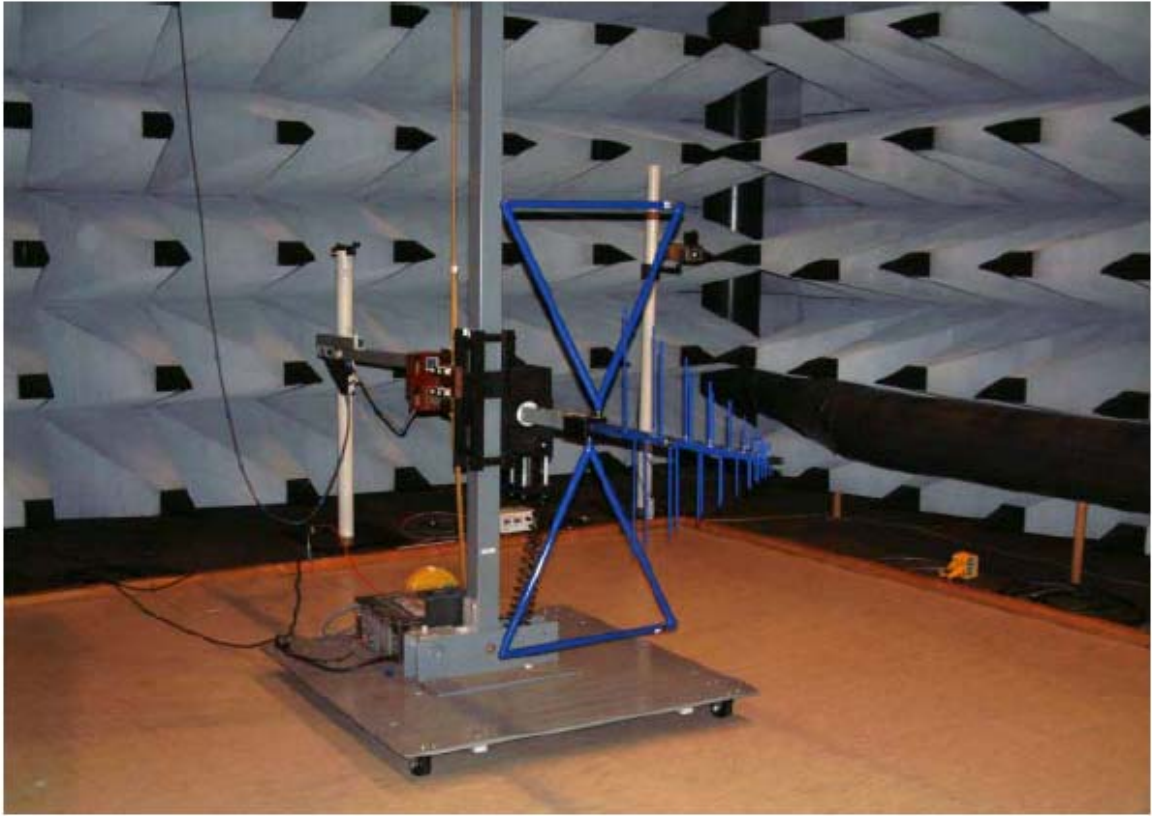
Two communication channels have been tested for electromagnetic radiation in an anechoic chamber test facility. The one channel is a conventional unscreened channel while the other is a channel, which uses a horizontal cable with unterminated screens.

The objective of the testing is to compare electromagnetic radiation from the two channels and investigate if the channels are able to support the new 10 GBASE-T application maintaining compliance with the CISPR 22 class A limits for electromagnetic radiation.

The testing shows that the two channels have similar performance for radiation and that CISPR 22 class-A limit can be met.

2.3.3. Test setup





3. U/STP cables Alien Crosstalk attenuation

Teldor 83U and 9828U cables were tested for alien crosstalk attenuation as defined in IEC 61156-1 (new 2006 draft) using the "6 around 1" method.

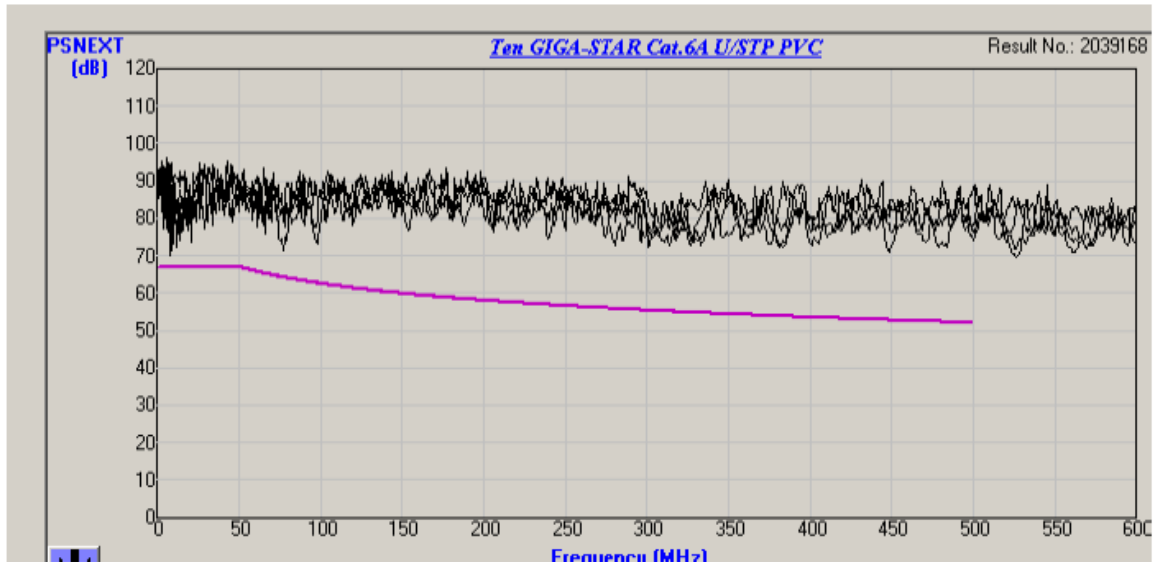
3.1. Teldor 83U Horizontal Cables - Test Result

Teldor P/N: 83U1204XXX

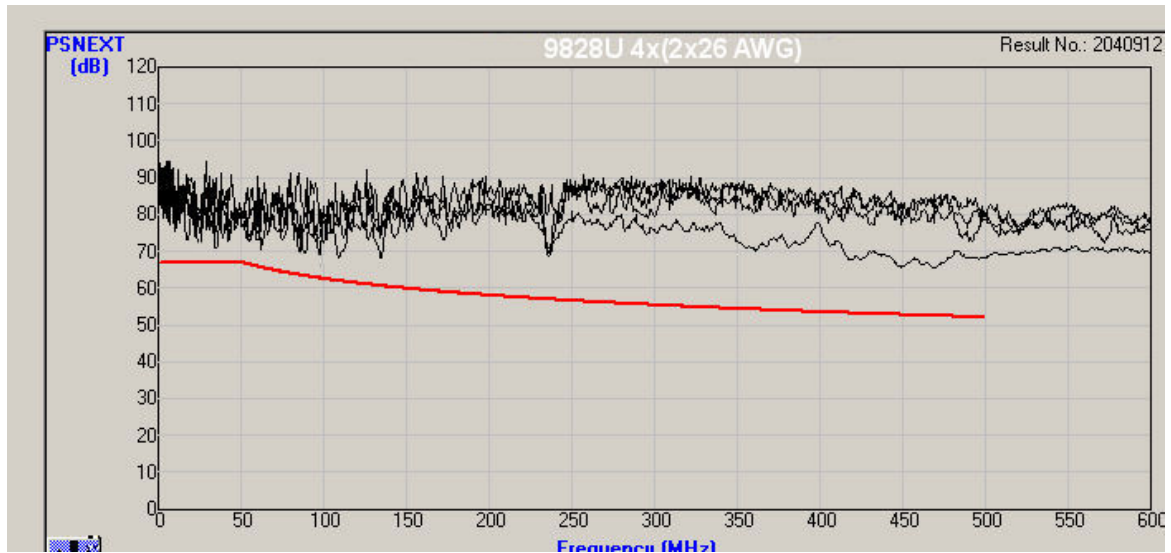
Test Specification: TIA/EIA 568B.2-10 draft 3

Testing Date: 01/01/2006

PowerSum Alien Cross-Talk



3.2. Teldor 9828U Work Area Cables - Test Result



As a summary we can say that the cables fully comply with the most demanding PSAXT requirements.

4. Summary

The novel approach of U/STP (Ungrounded Screened Pairs) cables terminated with UTP connecting hardware can be used as fully a compliant UTP cabling system for the most demanding requirements of any 10GbE cabling system.

The advantages of Teldor's 83U and 99828U cable series over other UTP designs presently in the market include:

- Vastly enhanced EMC and Alien Crosstalk performance
- Fully meets all requirements of the IEEE 802.3an (10 G Base-T) standard as tested by an independent 3rd Party Laboratory
- Does not require Alien Crosstalk testing in the field (defined as Type I in table 3 of IEC 61156-5/6, therefore "proven by design")
- Smaller outer diameter (~8 mm as compared to 12mm) therefore more economical, flexible and takes up less conduit space
- Can use shielded or unshielded work area cables and connecting hardware

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