Susceptibility Measurements for Category 5 Copper Cable in the Frequency Range 27-127MHz

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Agenda

Review existing published material on LAN suceptibility

(shows need to be specific about EUT when interpreting conclusions)

Describe measurement equipment and procedure

Results

Conclusions

Previous Work: Example 1

EMC-Characteristics of UTP-Cabling:
Media Filters versus Shield

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Abstract

We compared the Electromagnetic Compatibility (EMC) of 100 Ohm cabling with an overall shield (commonly used abbreviation: S/UTP) with the EMC of unshielded 100 Ohm cabling (commonly used abbreviation: UTP). Furthermore we did tests with and without media filters.
Based on the results of radiated electromagnetic field strength, of unbalanced interference voltage and of immunity against burst noise, we discuss the trade-off between media filters and shielding for different LAN-applications. Thus we show the need of shielding for Open System cabling systems.

Conclusions

For Open System cablings, i.e. customer premises cablings for a wide range of applications, it is necessary to install overall shielded cables. Otherwise neither sufficient low emission, nor sufficient high immunity can be guaranteed. Our measurements show, that for commonly used applications unshielded cabling systems fail due to transient noise. Furthermore we proved, that the shielding is required by law. Thus, a CE-conform system (cabling and active components) can only be realised with an properly shielded cabling. Mediafilters and/or special grounding techniques for 4-pair unshielded cables are not able to solve all EMC-problems.

(11th Annual Conf. Euro. Fibre Optic Comms. and Nets. June 30-July2 1993, The Hague, NL)

Previous work: Example 2

EMC'94 ROMA International Symposium on Electromagnetic Compatibility
September 13-16, 1994, Rome, Italy

EMC PERFORMANCE COMPARISON OF SHIELDED AND UNSHIELDED DATA TRANSMISSION SYSTEMS

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Abstract - EMC emissions and immunity tests were performed on several shielded and unshielded twisted pair cabling systems for data transmission. Results are presented that show a properly designed unshielded system can equal or exceed the performance of shielded systems. Surprisingly, all of the shielded systems tested had immunity problems that were not present at any level of stress achievable by the test equipment for the unshielded system tested.

IV. CONCLUSIONS

The data presented clearly shows that the use of a shielded twisted pair cabling system for data does not necessarily yield advantages over an unshielded system. Also STP systems may even carry significant operational disadvantages in addition to the cost of the cable. The IEC 801-4 results are a case in point. In all of the shielded systems, the LAN crashed at some test level requiring rebooting of the PCs. The unshielded system did not exhibit such behavior even at the highest level obtainable from the burst generator.

The radiated emission results, either in the absorber loaded room or the open field test, indicated that the UTP system passed Class B at all frequencies and in several different configurations. Some of the shielded systems grossly violate even the Class A limits for the 16 Mbit Token Ring System. This significant result helps pave the way for widespread use of UTP systems in Europe and dispels the myth that use of a shield automatically affords electromagnetic compatibility to a data communications system.

It is clear that using a shield in a cabling system for data transmission can give a false sense of security. What really matters for both unshielded and shielded systems is good design. The design of the unshielded system tested was such that it equaled or exceeded the performance of all of the shielded systems tested.

Previous work: Example 3

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The ATM Forum Technical Committee

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TITLE: NRZ BER and Jitter Test Results on Cat. 5 Cabling

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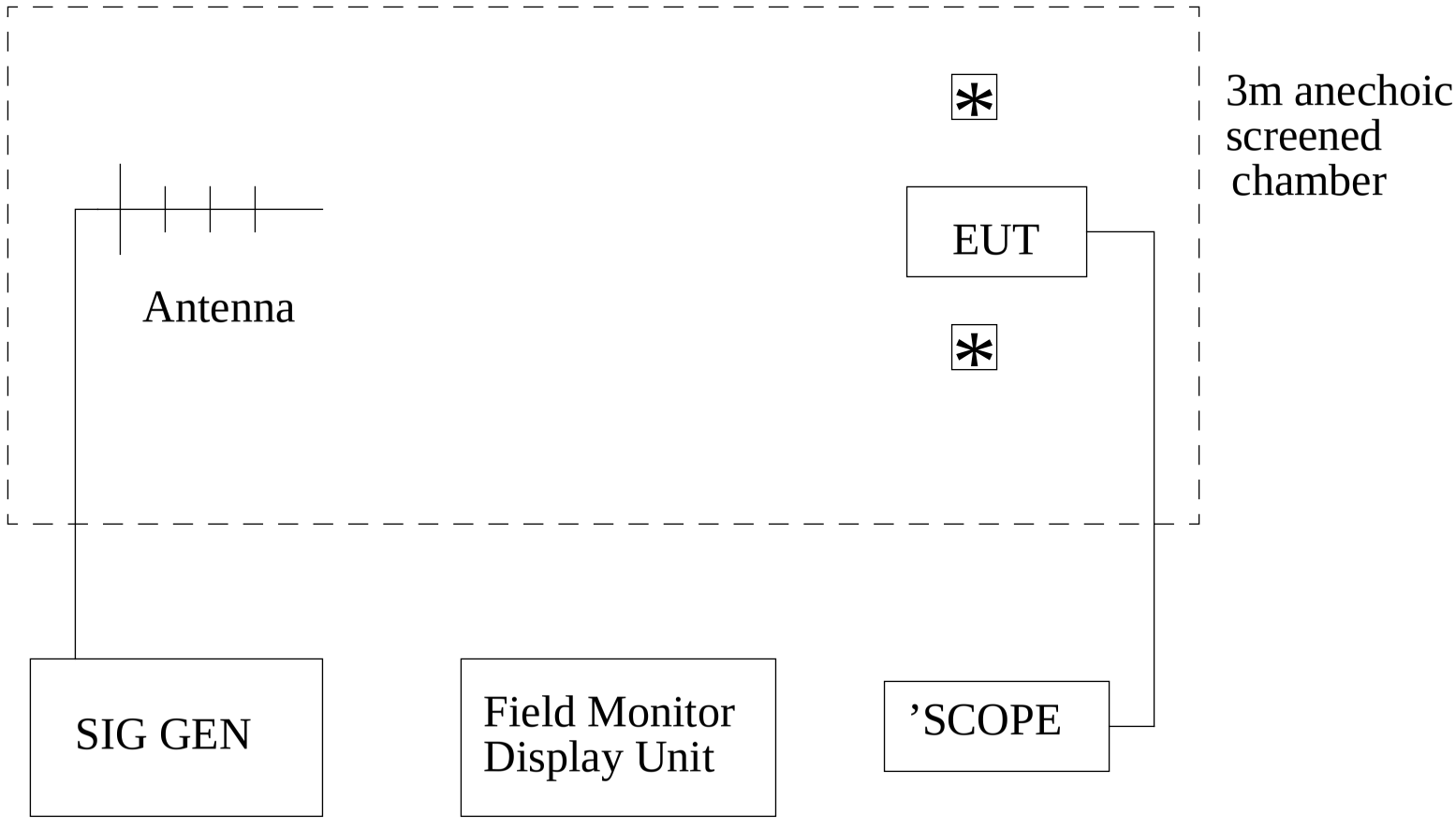
CONCLUSIONS:

- Previously reported results have shown that typical noise levels, coupled onto a cat-5 cable plant from a 3V/Meter 90-100MHz ambient field, measure ~16mVp-p.
- This system exhibits 9.7dB of margin, at the worst case noise sensitivity condition of 100MHz CW noise, to the 3V/Meter coupled noise condition of 16mVp-p.
- Robust operation of this system at noise levels significantly higher than that induced by 3V/M field

Susceptibility Measurements at HPLB - Apparatus



EUT=Equipment under test

*=Field sensor (2 used, optically coupled to display)

Susceptibility Measurements at HPLB - Procedure

For an initial investigation, manual measurements were performed:

Frequency stepped from 27 to 127MHz in increments of 10MHz

Field levelling done at each frequency

The average of the two field meters was used to set 3V/m by adjusting Sig. Gen. level

The peak to peak induced voltage was measured on the oscilloscope via a balun

Three configurations:

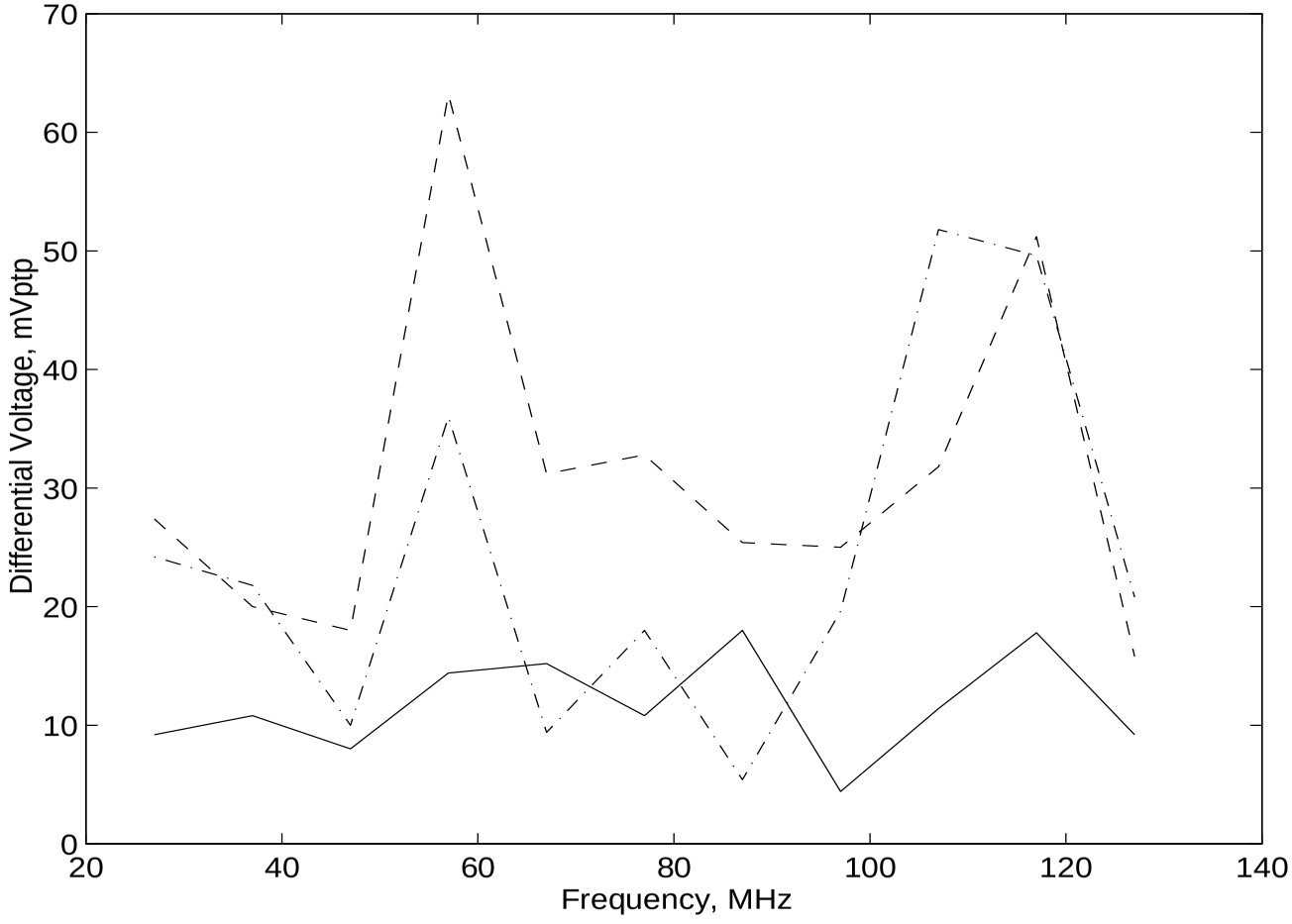
test equipment plus minimal cable (ie a sanity check)

100m cat5 on 1m x 1m rack plus distribution panel (as for emissions tests)

100m cat5 on 1m x 1m rack plus floating shielded connectors

All configurations used differential and common mode terminations on all pairs

Results



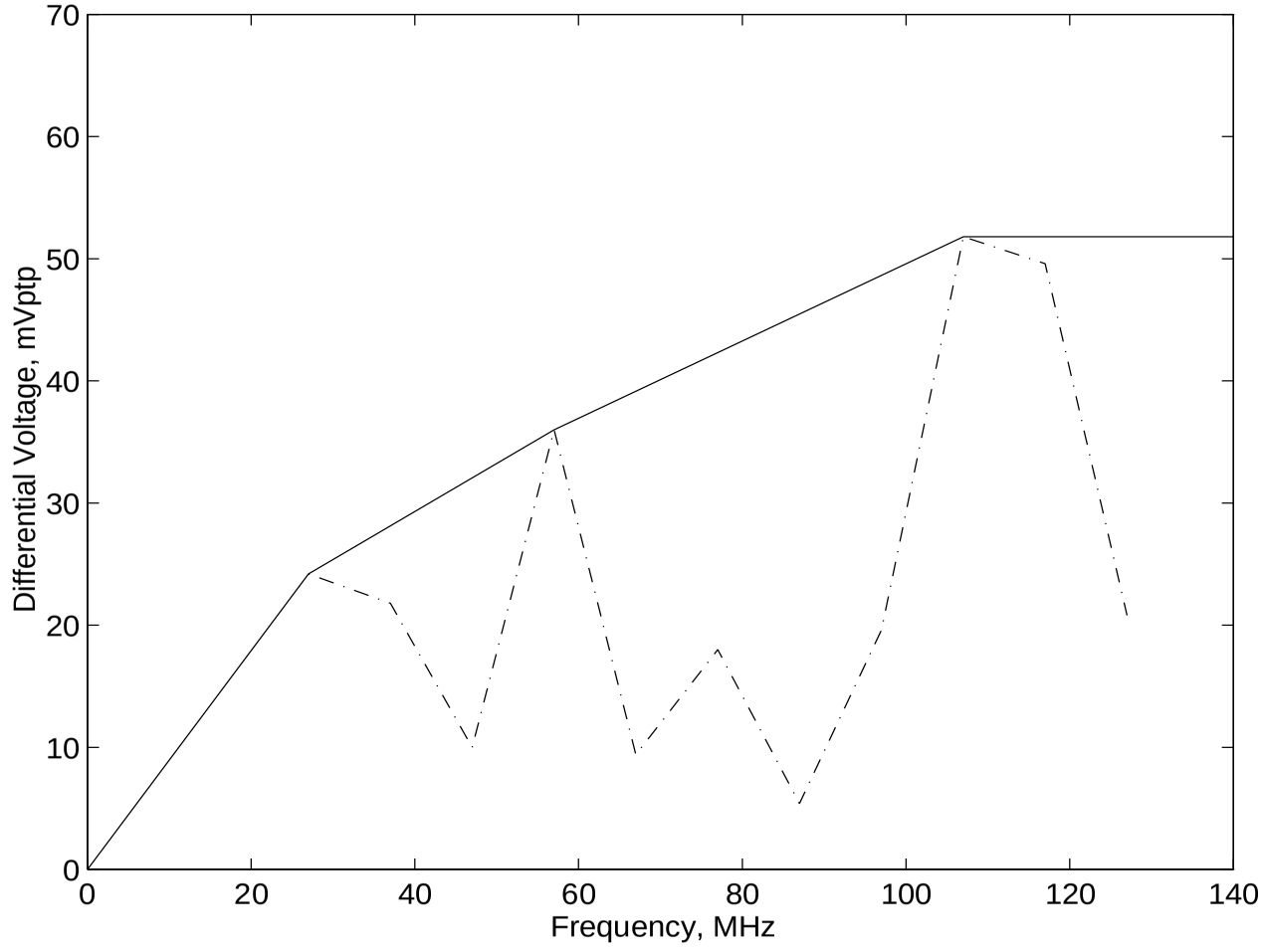
key:

solid=test equipment and minimum cable

dot-dash=cable with distribution panel ← as used for recent emission measurements

dash=cable with floating FTP connectors

Noise Model



The envelope (solid) of the measured noise (dash-dot) was used in later calculations of SNR vs. number of transmitted levels etc.

Breakpoint coordinates are: (27,24.2), (57, 36.0), (107, 51.8)

Conclusions

Previous work shows need to be precise about configuration under test

Results presented here include distribution panel

Initial 3V/m measurements show <40mV ptp induced below 100MHz

Swept measurements are needed ...