

Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

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Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

Two topics to be presented

- 1. Alien PSNEXT from Cat 5e and Cat 6 installations compared with the bundled/hybrid requirements in 568B.2**
- 2. Alien PSNEXT from prototype Cat 6 UTP cable compared to Cat 6 channel NEXT extended to 500MHz**

Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- **Cat 5e and Cat 6 installations are evaluated for Alien PSNEXT**
- **Bundled and unbundled solutions are investigated**
- **Results are compared to bundled/hybrid, link, and channel specs**
- **Determine if installation has margin to various specs for bound and unbound cases**

Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- All cables exhibited positive margin to appropriate internal Pr-Pr NEXT spec:
 - Cat 5e NEXT: $67-15\log(f/0.772)$ dB
 - Cat 6 NEXT: $76-15\log(f/0.772)$ dB

Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- Cat 5e Bundled/Hybrid PSNEXT cable only spec

$$67-15\log(f/0.772)+3 \text{ dB} = 70-15\log(f/0.772) \text{ dB}$$

Cat 5e Bundled/Hybrid PSNEXT includes only external (Alien) NEXT

- Cat 6 Bundled/Hybrid PSNEXT cable only spec

$$76-15\log(f/0.772)-3.2 \text{ dB} = 72.8-15\log(f/0.772) \text{ dB}$$

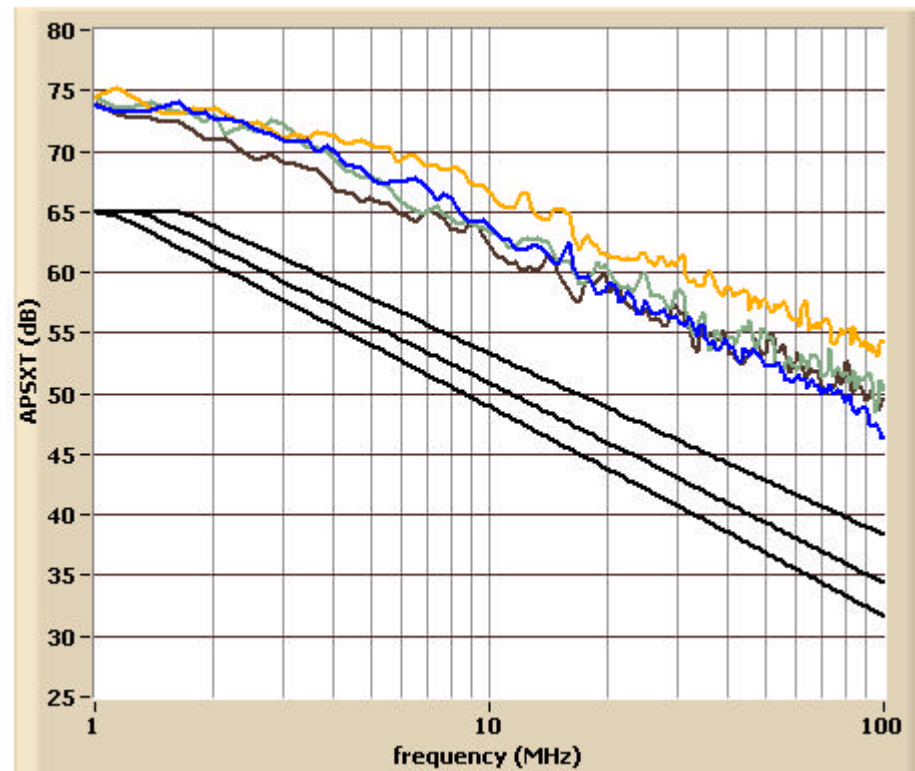
Cat 6 Bundled/Hybrid PSNEXT includes both external (Alien) and internal NEXT

Both specs revert to 65dB for XT values higher than 65dB

Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- 24 Cat 5e cables
- Bound configuration
- Permanent links (2 connector channel)
- 6.8dB margin to cable spec
- 7.8dB to link spec
- 8.4dB margin to Cat 5e channel spec

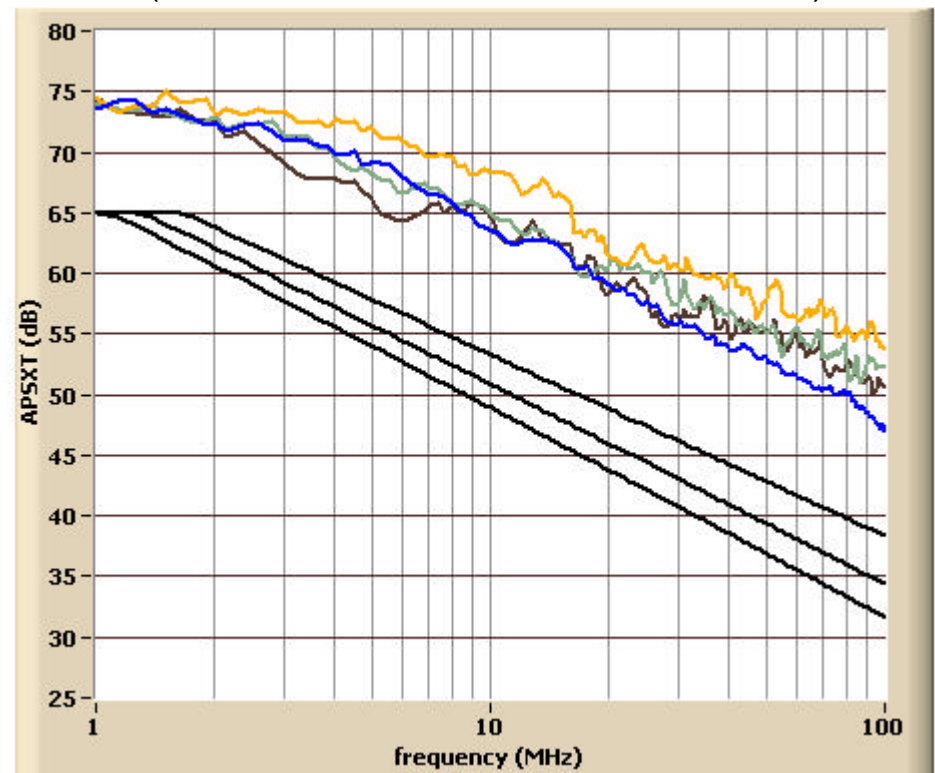
Alien PSNEXT into Cable 1 from Cables 2-24
(does not include Cable 1 Internal NEXT)



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- Same 24 cables
- Removed Velcro binding straps
- Permanent links (2 connector channel)
- 7.4dB to cable spec
- 8.2dB to link spec
- 8.6dB to Cat 5e channel spec

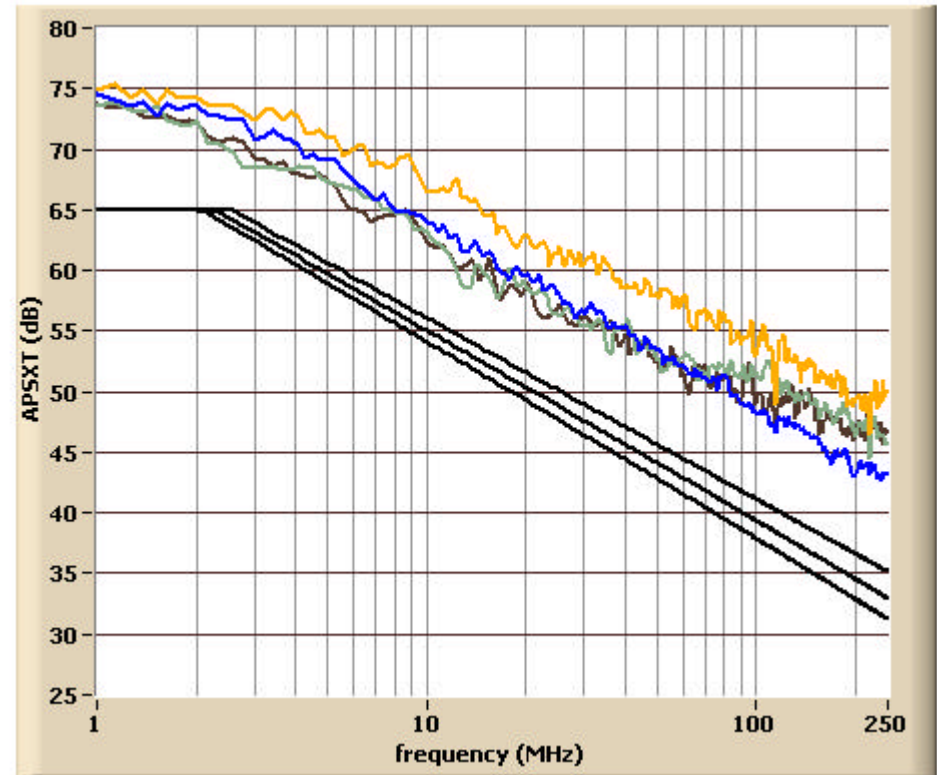
Alien PSNEXT into Cable 1 from Cables 2-24
(does not include Cable 1 Internal NEXT)



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- **24 Cat 6 cables**
- **Bound configuration**
- **Permanent links (2 connector channel)**
- **4.1dB margin to cable spec**
- **4.8dB to link spec**
- **5.5dB margin to Cat 6 channel spec**

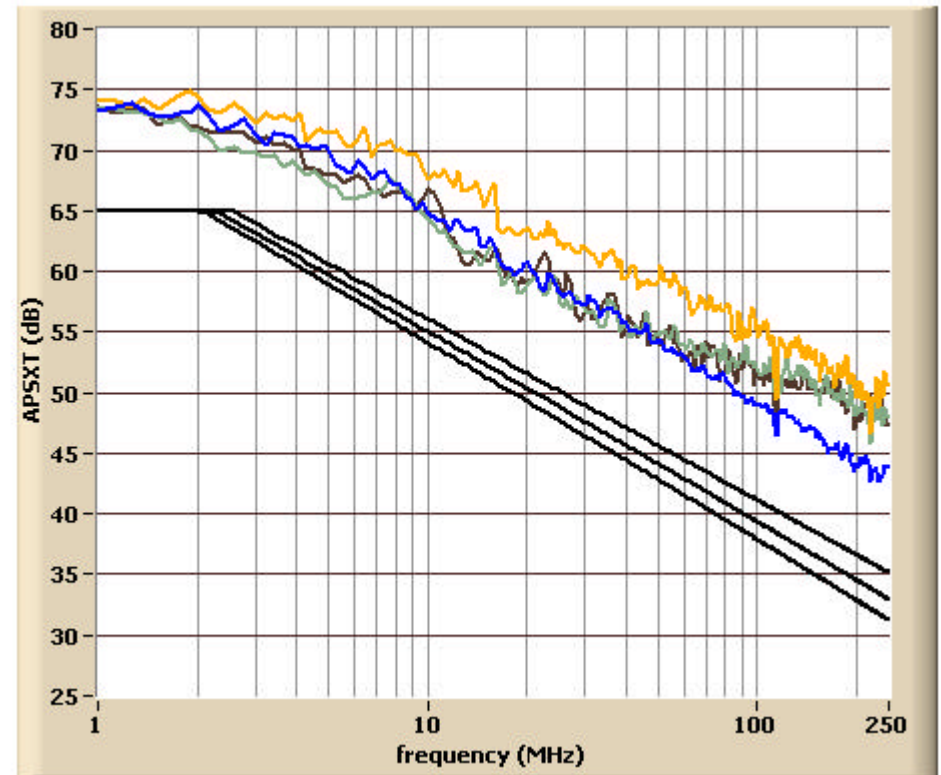
Alien PSNEXT into Cable 1 from Cables 2-24 (also includes Cable 1 Internal NEXT)



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

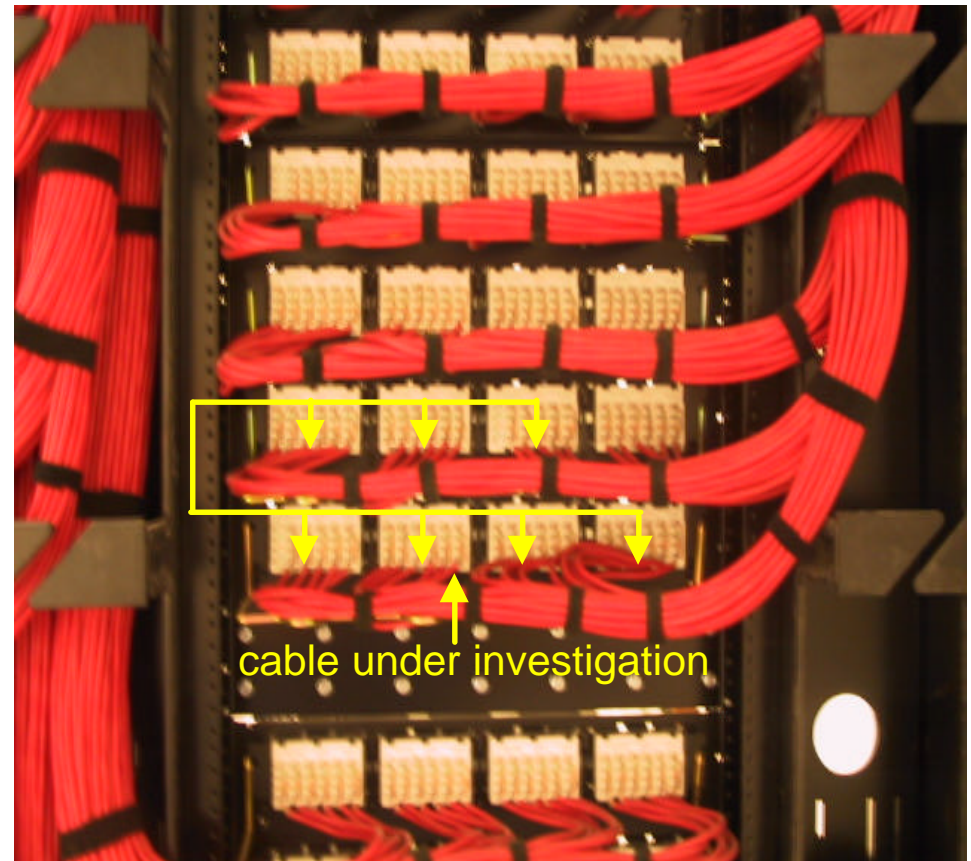
- Same 24 cables
- Removed Velcro binding straps
- Permanent links (2 connector channel)
- 5.0dB to cable spec
- 5.2dB to link spec
- 5.9dB to Cat 6 channel spec

Alien PSNEXT into Cable 1 from Cables 2-24 (also includes Cable 1 Internal NEXT)



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- Real world installation on existing network
- 35 cables tightly bound
- Cable of interest at center of bundle



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

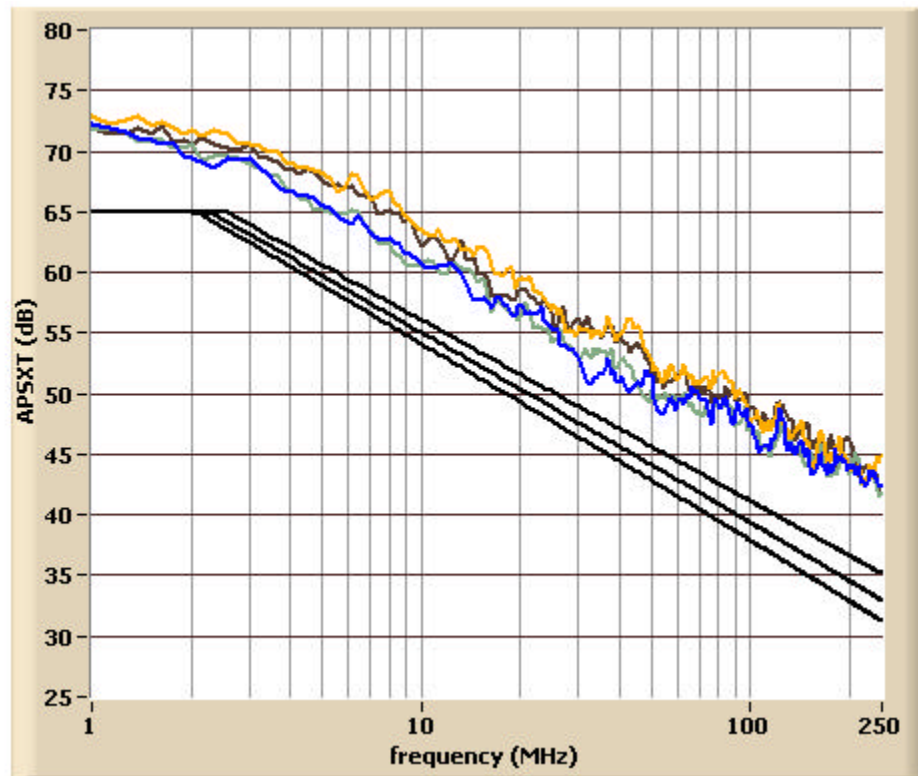
- **Bundle leading into ceiling on cable runway**
- **Tight bundle configuration for entire length to consolidation point**



Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- 35 Cat 6 cables
- “Real world” installation
- Permanent links (2 connector channel)
- 2.4dB margin to cable spec
- 3.8dB to link spec
- 4.4dB margin to Cat 6 channel spec

Alien PSNEXT into Cable 1 from Cables 2-35 (also includes Cable 1 Internal NEXT)



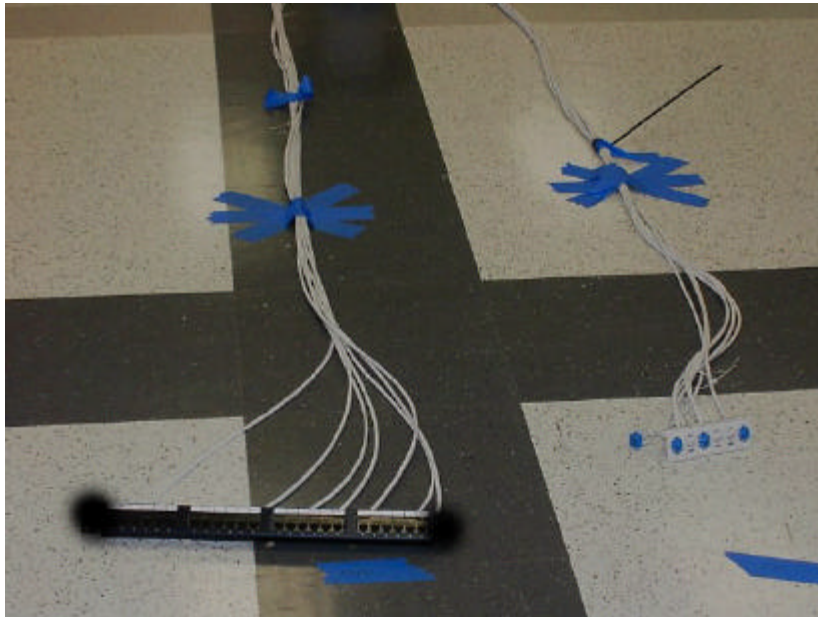
Evaluation of Alien Crosstalk in Cat 5e and Cat 6 Installations

- **Cat 5e and Cat 6 installations were evaluated for Alien NEXT**
- **All installations comply with bundled/hybrid, link and channel specs**
- **Additional margin was realized by not employing bundling or removing bundling during installation**
- **In all cases positive margin to current TIA/EIA specifications for Cat 5e and Cat 6 cable, link, and channel measurements were demonstrated**

Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

- **Prototype Cat 6 UTP cable with improved Alien PSNEXT developed**
- **Alien NEXT Measured in permanent link configuration (2 connector channel)**
- **Cables maintain close proximity and longitudinal organization**
- **Alien PSNEXT results are compared to channel specs**

Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

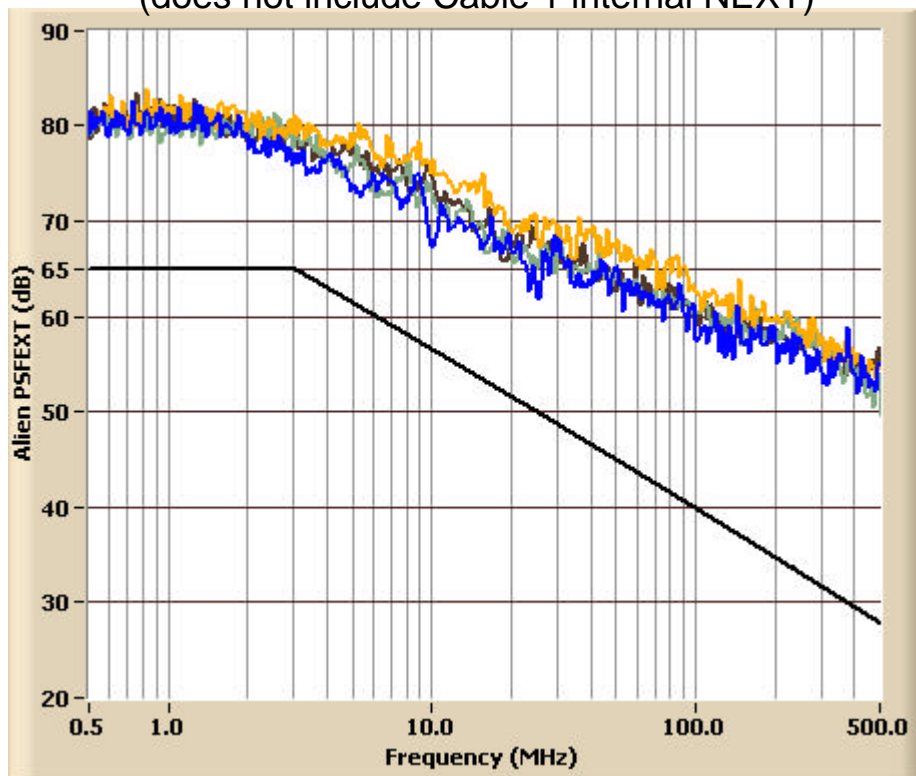


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Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

Alien PSNEXT into Cable 1 from Cables 2-7
(does not include Cable 1 internal NEXT)



Alien PSNEXT minimum margins versus the
Cat 6 channel spec:
Computed from 1, 10, 50, 100, 250 through
500 MHz

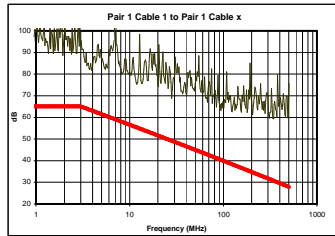
start f	stop f	min margin	min freq	pair	pair margin	pair freq
1	500	10.73	3.37	1	10.73	3.37
				2	13.54	2.55
				3	12.56	2.98
				4	12.40	3.55
10	500	11.73	10.34	1	11.73	10.34
				2	17.05	20.11
				3	13.48	16.30
				4	13.67	18.75
50	500	16.10	53.59	1	16.10	53.59
				2	20.53	72.17
				3	18.25	67.29
				4	17.91	61.65
100	500	17.69	102.43	1	17.69	102.43
				2	21.05	106.08
				3	19.78	117.83
				4	19.49	104.24
250	500	21.45	268.30	1	21.45	268.30
				2	23.89	314.09
				3	22.22	478.12
				4	23.07	298.02

Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

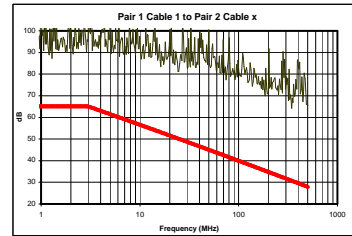
- **The following 6 pages include all the individual pair to pair NEXT combinations for Cable 1 Alien PSNEXT**
- **A matrix of sixteen NEXT graphs is shown on each page**
- **The row number = pair number in cable 1**
- **The column number = pair number in cable x**
- **The margins shown are computed from the Cat 6 Channel spec from 1 - 500 MHz and 250 - 500MHz**

Spec = TIA/EIA-568B.2-1 Cat 6 Channel NEXT

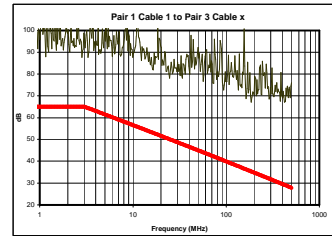
Cable 1 to Cable 3



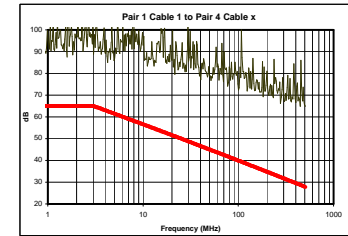
Min: 1-500 250-500
18.56 28.02



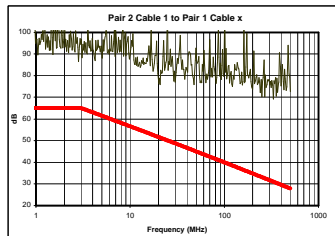
Min: 1-500 250-500
22.27 33.43



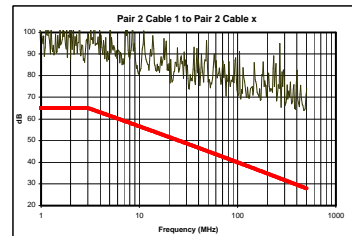
Min: 1-500 250-500
22.60 36.47



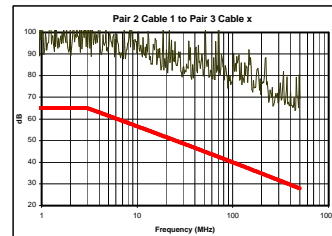
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22.35 33.95



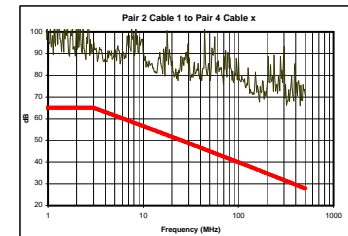
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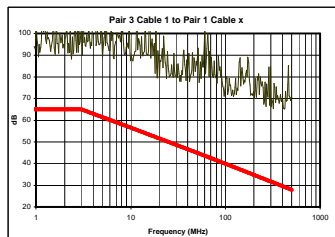
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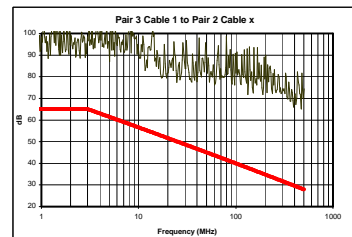
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24.16 33.23



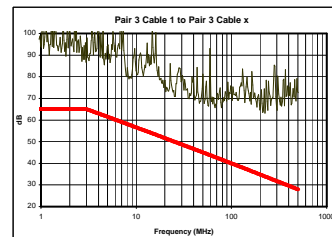
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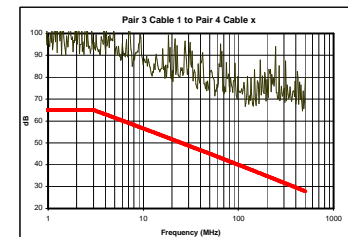
Min: 1-500 250-500
23.19 33.82



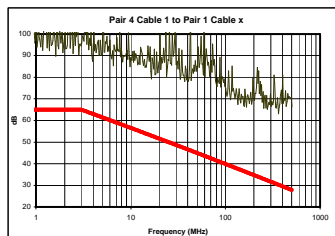
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23.51 36.27



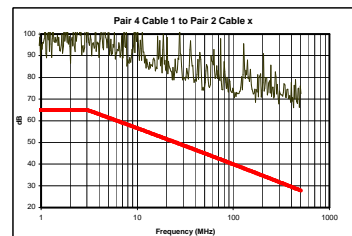
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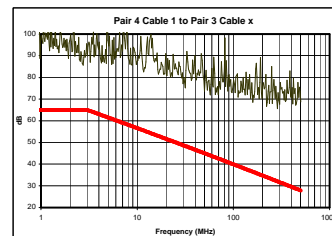
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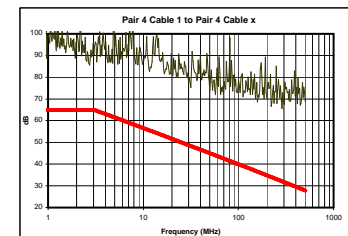
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24.26 32.60



Min: 1-500 250-500
21.60 35.94



Min: 1-500 250-500
20.65 33.47



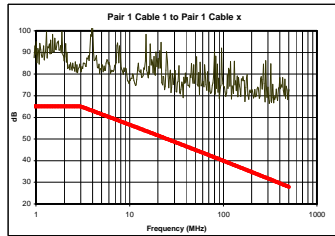
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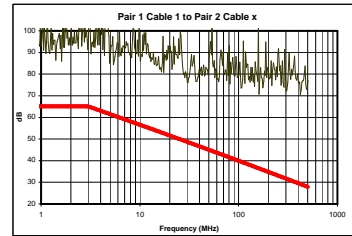
IEEE 802.3 10GBASE-T
Study Group

Spec = TIA/EIA-568B.2-1 Cat 6 Channel NEXT

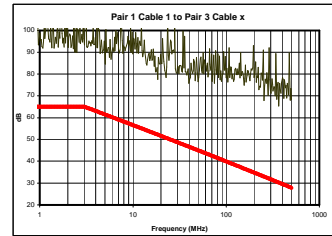
Cable 1 to Cable 4



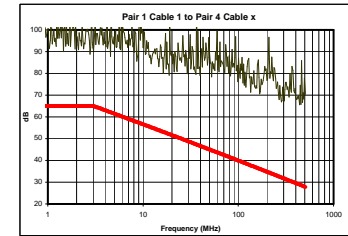
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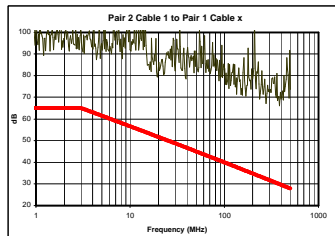
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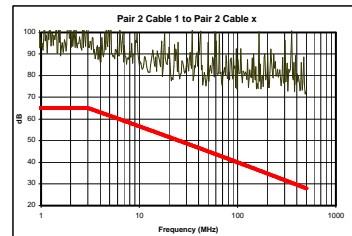
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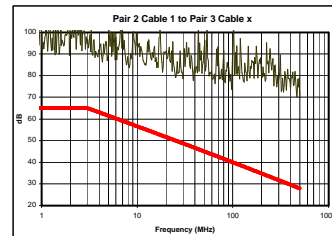
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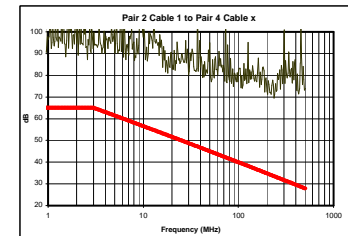
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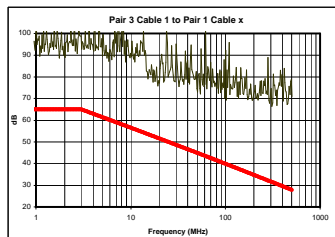
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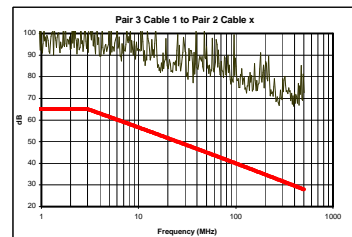
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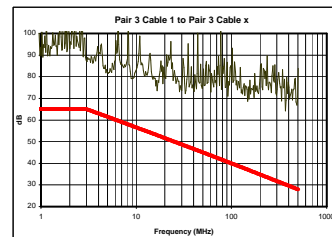
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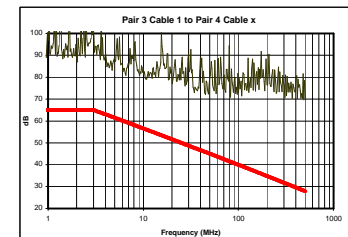
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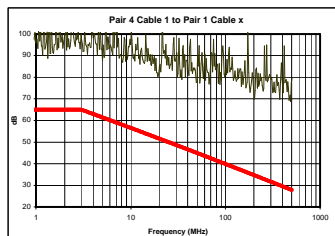
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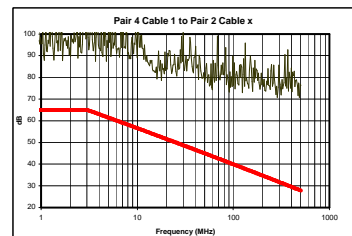
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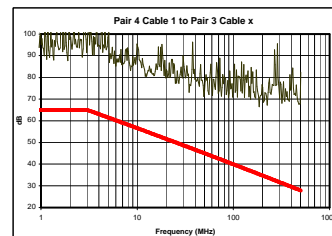
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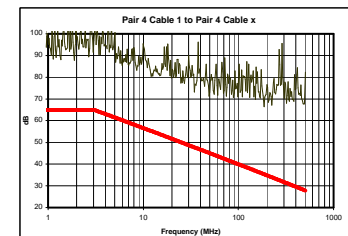
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Min: 1-500 250-500
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22.69 36.83



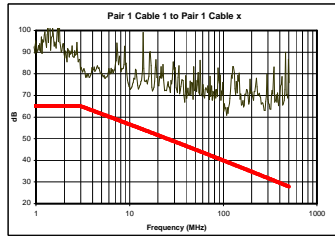
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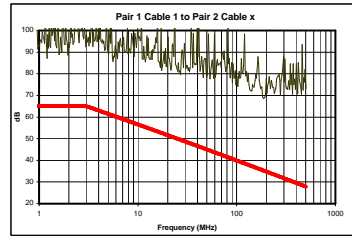
IEEE 802.3 10GBASE-T
Study Group

Spec = TIA/EIA-568B.2-1 Cat 6 Channel NEXT

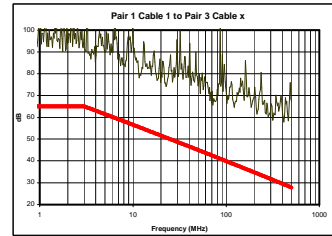
Cable 1 to Cable 5



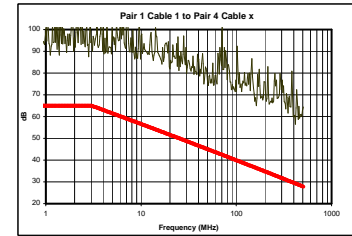
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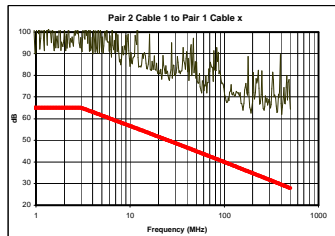
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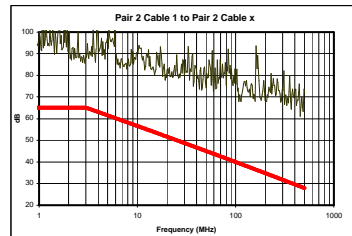
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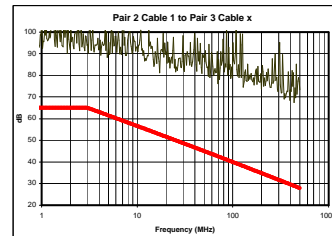
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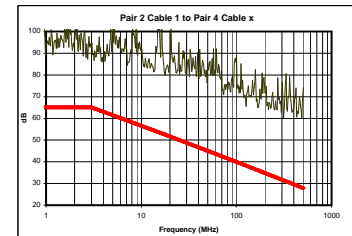
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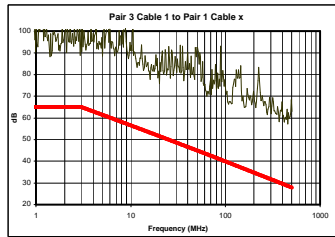
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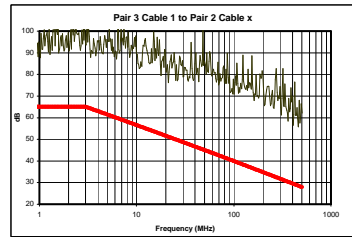
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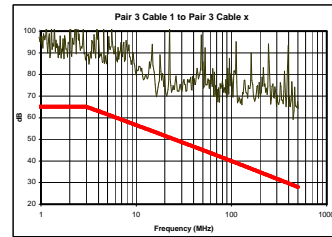
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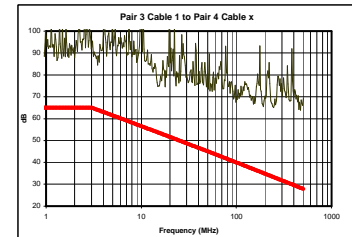
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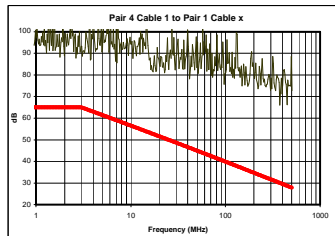
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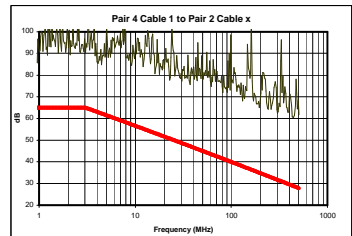
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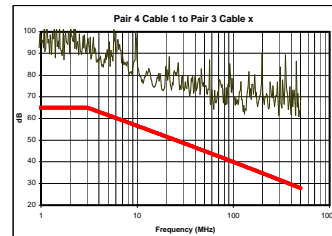
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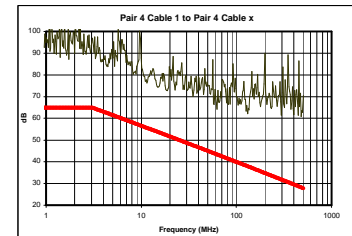
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Min: 1-500 250-500
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Min: 1-500 250-500
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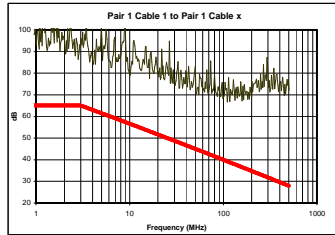
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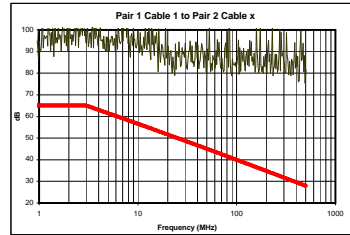
IEEE 802.3 10GBASE-T
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Spec = TIA/EIA-568B.2-1 Cat 6 Channel NEXT

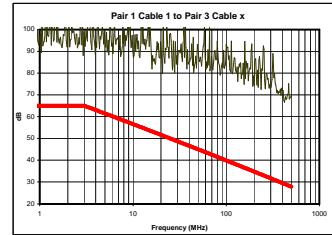
Cable 1 to Cable 7



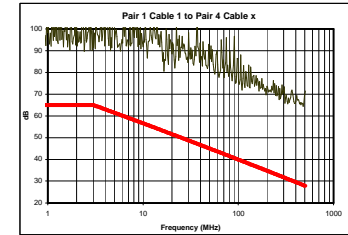
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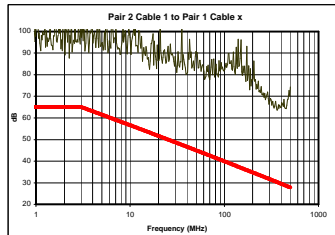
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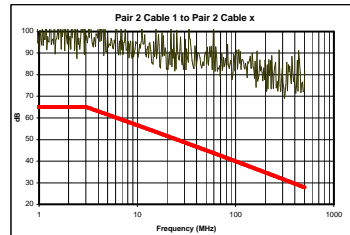
Min: 1-500 250-500
22.98 37.46



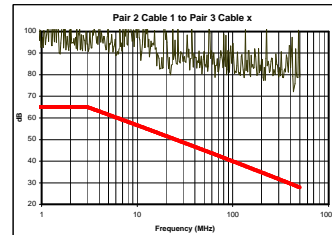
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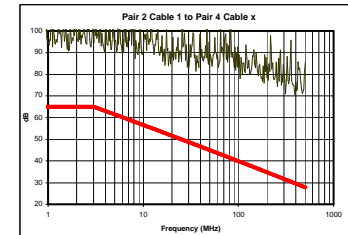
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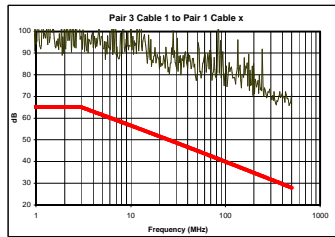
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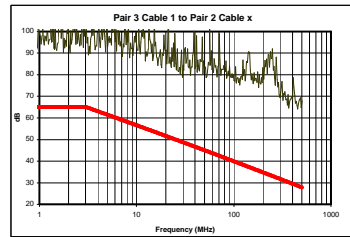
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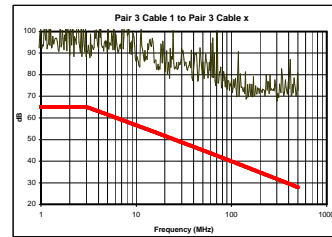
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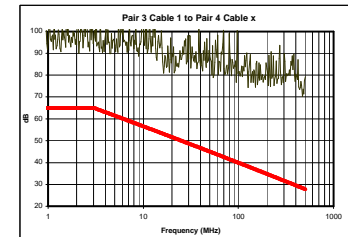
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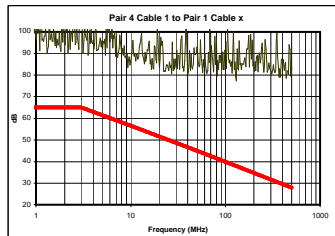
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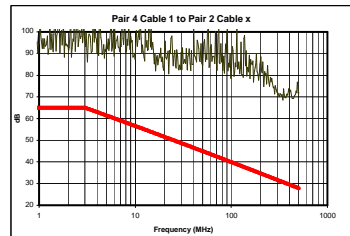
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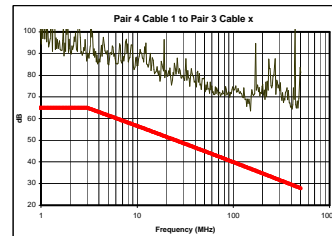
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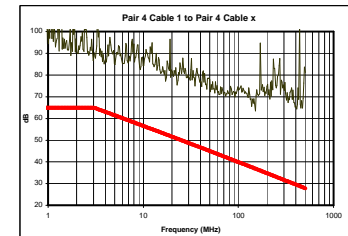
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Min: 1-500 250-500
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Min: 1-500 250-500
21.66 34.98



Min: 1-500 250-500
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March 2003

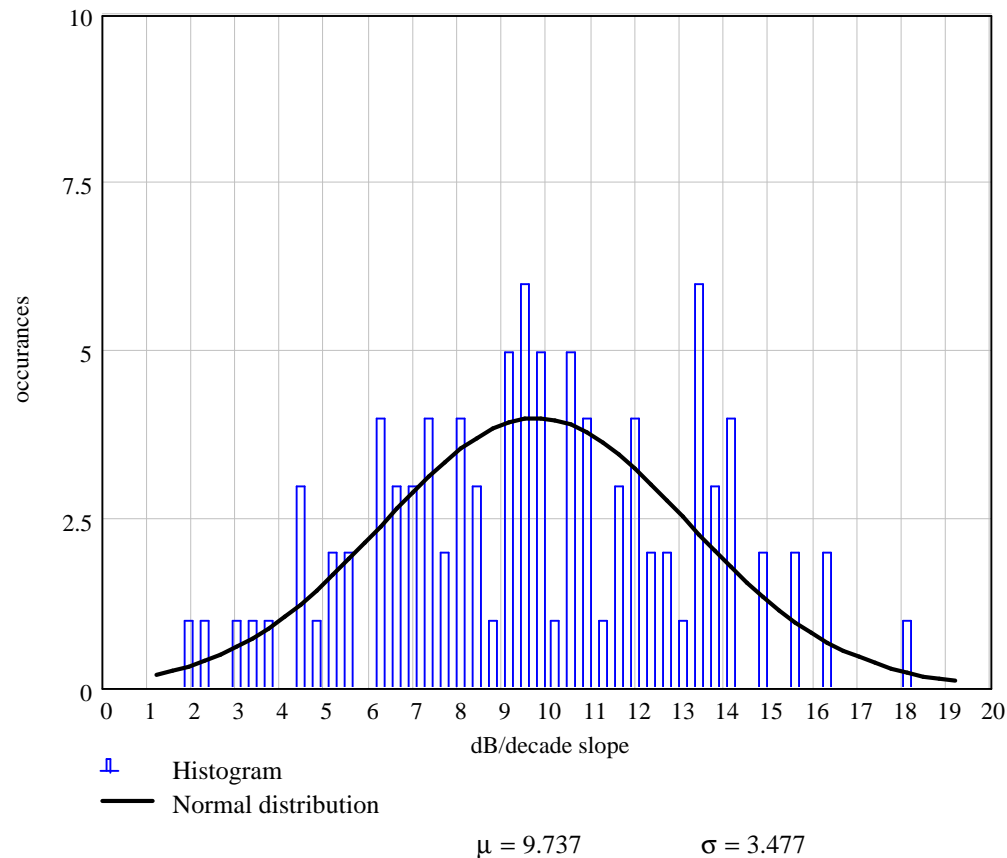
IEEE 802.3 10GBASE-T
Study Group

Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

- The Pair to Pair NEXT slopes were computed for the 96 pair combinations
- The margin versus the Cat 6 channel spec tends to increase with increasing frequency in these cables due to:
 - noise floor measurement limitations
 - the lesser slope of Alien NEXT
 - the physics of between cable crosstalk in this design

Experimental Cat 6 UTP Cable Developed with Improved Alien NEXT

Histogram of Alien NEXT slope in experimental Cat 6 Cable



Conclusions

- **Alien NEXT can be improved with focus**
- **Currently TIA Cat 6 only has limits on the combined Internal+Alien NEXT for bundled and hybrid cables**
- **There are currently no Alien NEXT requirements for non-bound cables**
- **IEEE Should provide guidance on the needed level of Alien-only NEXT**
- **The Cabling Industry will develop Alien NEXT requirements and installation practices to meet IEEE's recommendations**