

Alien Crosstalk Testing Methods and Standards

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Abstract

The new cabling structure network and standards demand the higher speed and low latency network Datacom copper cables which requires compliance of the Alien crosstalk. The Power Sum Alien Crosstalk has been introduced to international standards ISO/IEC 11801 Ed. 2.2, ANSI/TIA 568C.2 and it is mandatory parameter for Category 6A and above copper LAN Cables. Alien Crosstalk is the interference caused by a pair of insulated copper conductors in one cable inducing noise into other pairs of insulated conductors in adjacent cables. Power Sum Alien Crosstalk (PSANEXT) is an unwanted disturbing signal transferred from one balanced twisted pair of cable to twisted pair of another cable. The Alien Crosstalk is time consuming and usually takes 4 hours to prepare testing set up and test. It was demand on us to compare the different test method of the measurement and find a reliable conclusion about this form of crosstalk between different cables in a group or bundle, rather than between individual pairs or circuits within a single cable.

In our situation the same cable construction of Cat6a U/UTP was desired and our expectation was to find the different test results based on the different method of the alien crosstalk testing.

By finding the most significant parameter we have saved significant amount of financial part for another development. The second factor behind carrying out this correlation study was to avoid the repeated alien crosstalk testing which is a destructive testing in nature. Without more destructive testing we needed to ensure the alien crosstalk compliance in all produced cables.

Keywords: LAN Cable; Alien Crosstalk; Data Copper Cable; Margin; Performance; Cat6A; Network analyzer; Field analyzer, lay out, flared,

1. Introduction

The Power Sum Alien Crosstalk has been introduced to international standards ISO/IEC 11801 Ed. 2.2, ANSI/TIA 568C.2, IEC 61156-5 and it is mandatory for category 6A and above copper LAN Cables. Alien Crosstalk is the interference caused by a pair of insulated copper conductors in one cable inducing noise into other pairs of insulated conductors in adjacent cables as shown in Figure 1- Alien Crosstalk. Alien Crosstalk is an unwanted disturbing signal transferred from one balanced twisted pair of cable to twisted pair of another cable. The Alien Crosstalk measurement results depends on the test method being followed for testing, type of test instrument and handling of cable during the testing.

In this paper we have studied Alien Crosstalk Results with three different scenario of testing like,

1. Different test method according to different International standards

2. Different test instrument
3. Sample Preparation for testing

Results are recorded for these different scenarios and then studied for variation.

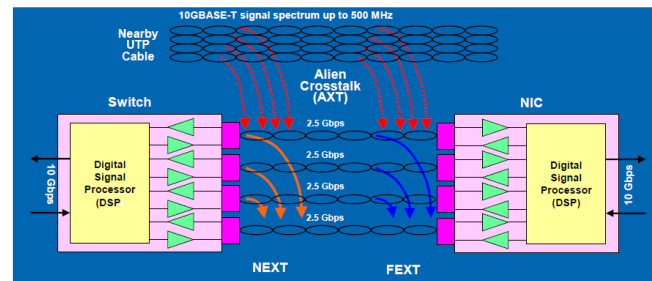


Figure 1 Alien Crosstalk

2. Study of Alien crosstalk using different standard test methods and equipment

2.1 Different Standards to Measure Alien Crosstalk

2.1.1 ANSI/TIA 568 C.2

ANSI/TIA 568C.2 Standard is for balanced twisted pair telecommunications cabling and components standard. This standard specifies the required for Horizontal cables, Permanent link and channel performance for different categories of Copper data cables like Category 6A, Category 6, Category 5e. According to this standard Alien Crosstalk compliance is mandatory for Category 6A and above all copper data cables. The test configuration to test Alien crosstalk is described in figure 2 – 6 Around 1 Cable configuration for Alien Crosstalk Measurement.

At our test laboratory, we prepared 7 samples of 100 meter Cat6A U/UTP Cable in reels. These cables are rolled out from the reel and passed through a special face plate to form a bunch in 6 around 1 configuration as shown in Figure 2. As specified in the standard nonmetallic binding shall be used to tie up the cable. At our laboratory we have used Velcro tape at every 200 mm (8 in) distance. Then this cable bunch is laid on nonmetallic rods for testing. Distance between each of the bunch in layers shall be maintained at 100 mm. The stranding lay length of all 7 cable was consistent. In our cable bunch lay length was 800 mm. Figure 2. Cable Alien Crosstalk test set up describes the final test set up at our laboratory. Cable is connected to high frequency Network Analyzer at both ends to test the Alien Crosstalk. Results are recorded in 100 meter horizontal cable standard.

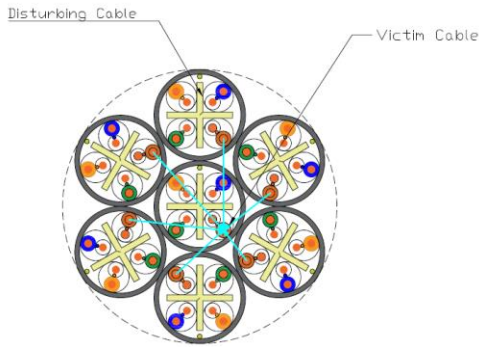


Figure 2 6 Around 1 Cable configuration for Alien Crosstalk Measurement

2.1.2 ISO/IEC 11801 & IEC 61156 Standard

ISO/IEC 11801 Standard is for Information Technology – Generic Cabling for customer Premises. This standard refers to IEC 61156-5 Standard for Horizontal cable and Permanent Link testing of Category cables. Test method to test Alien Crosstalk is described in IEC 61156-1 Standard. Preparation of the cable sample bunch of six around one configuration is similar as mentioned in 2.1 of this paper. There is no specific distance between two cable ties, is mentioned for the cable while bunching. After completion of bunching in six around one configuration it is laid up in a Serpentine shape as shown in Figure 3 on non-metallic floor to test the alien cross talk. Here the care is taken that the distance between two layers is minimum 10cm.

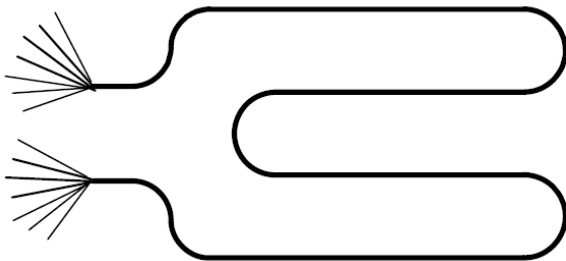


Figure 3 – Test Assembly lay out, six cables around One Cable (Reference IEC 61156-1)

Cable Test Results are shown in Table 1 below.

Test Method (Network Analyzer 100 M Horizontal Cable Spec)	PSANEXT (Near End) (dB)	PSANEXT (Far End) (dB)	PSAACRF (dB)
TIA 568C.2 Test Method	2.9	2.5	6.6
IEC 61156-1 Test Method	3.2	3.0	7.0

Table 1 – Test Result Comparison between two test Standards Test Method

Test results graphs for ANSI/TIA 568C.2 Test method is shown in figure 4 and IEC 61156-1 is shown in Figure 5 below

Alien CrosTalk Worst Case Summary

Test Type	Specification	High Frequency			Test Result
		Measured (Pair)	Margin	@ Frequency (MHz)	
Power Sum Alien NEXT (PSANEXT)	66.1 (dBm)	69.0 (Pair 2)	2.9	48.03	Passed
Power Sum Alien NEXT (PSANEXT-Far End)	57.8 (dBm)	57.8 (Pair 2)	2.3	308.59	Passed
Power Sum Alien ACNCF (PSAACRF)	60.8 (dBm)	67.4 (Pair 4)	6.6	7.46	Passed

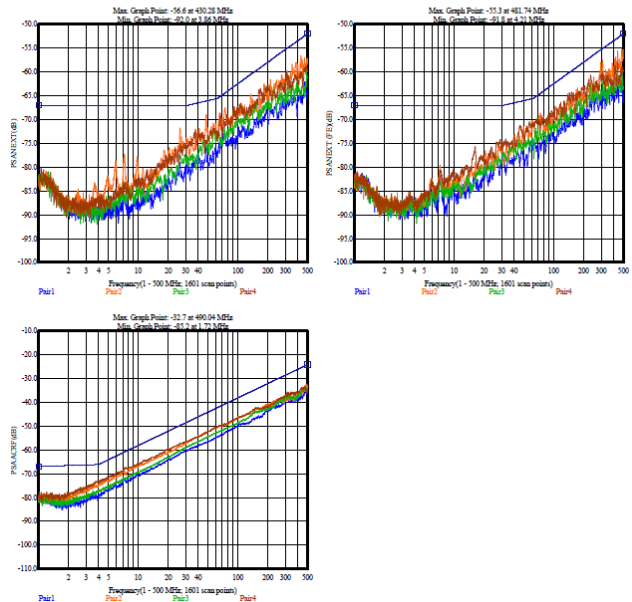


Figure 4 – Alien Crosstalk graph as per ANSI/TIA 568C.2 Test Method

Alien CrosTalk Worst Case Summary

Test Type	Specification	High Frequency			Test Result
		Measured (Pair)	Margin	@ Frequency (MHz)	
Power Sum Alien NEXT (PSANEXT)	61.2 (dBm)	66.4 (Pair 2)	5.2	66.86	Passed
Power Sum Alien NEXT (PSANEXT-Far End)	53.9 (dBm)	53.9 (Pair 2)	3.0	492.24	Passed
Power Sum Alien ACNCF (PSAACRF)	66.2 (dBm)	73.2 (Pair 4)	7.0	4.01	Passed

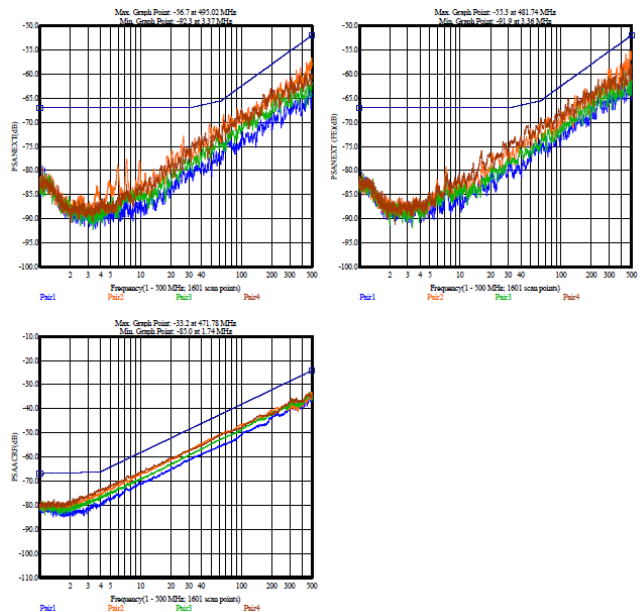


Figure 5 – Alien Crosstalk graph as per IEC 61156-1 Test Method

2.2 Testing with two different Test Instrument

The other factor which can impact the test results is the test equipment used for alien crosstalk testing. At our end cable under study was tested with two different type of instrument which was the

cable network analyzer and the field analyzer. Here we kept the test standard constant which was ANSI/TIA 568C.2. Cable alien crosstalk testing bunch with six around one configuration was tested as shown in Figure 6 and 7 with Network analyzer and field analyzer respectively.

The cable was tested in 90 meter length against Permanent link table as per ANSI/TIA 568C.2 and results from two different test equipments were compared for achieved margins which are given in Table 2.

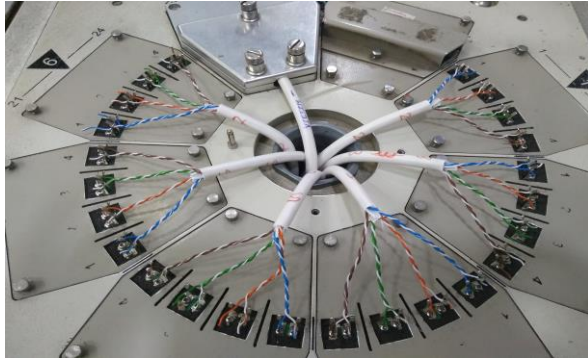


Figure 6 – Alien Crosstalk Measurement with Network Analyzer



Figure 7 – Alien Crosstalk Measurement with Field Analyzer

Test Equipment	PSANEXT (Near End) (dB)	PSANEXT (Far End) (dB)	PSAACRF (dB)
Network Analyzer	5.60	5.60	7.10
Field Analyzer	5.59	4.84	5.81

Table 2 – Comparison between Test Results from different Test Equipment

Test results graphs for a network analyzer and a field analyzer are shown in figure 8 and 9 below

Alien CrossTalk Worst Case Summary

High Frequency					
Test Type	Specification	Measured (Pair)	Margin	@ Frequency (MHz)	Test Result
Power Sum Alien NEXT (PSANEXT)	66.8 (dB)	72.4 (Pair 2)	5.6	21.09	Passed
Power Sum Alien NEXT (PSANEXT Per End)	73.0 (dB)	81.0 (Pair 2)	8.6	210.96	Passed
Power Sum Alien ACPR (PSAACRF)	34.2 (dB)	41.3 (Pair 4)	7.1	130.49	Passed

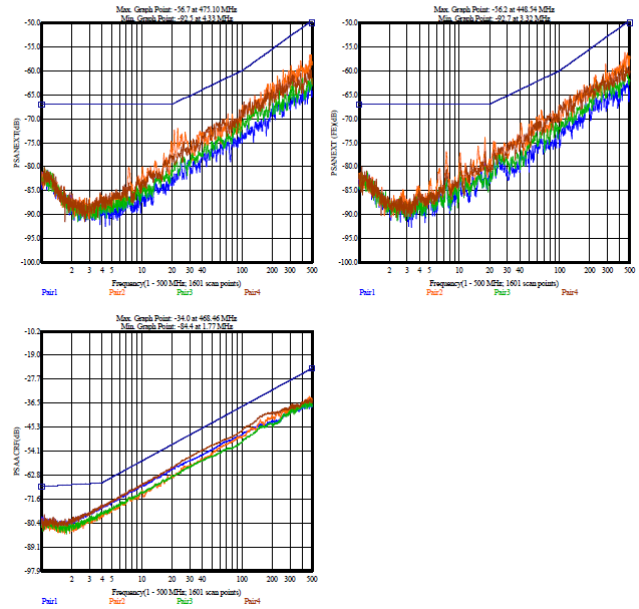
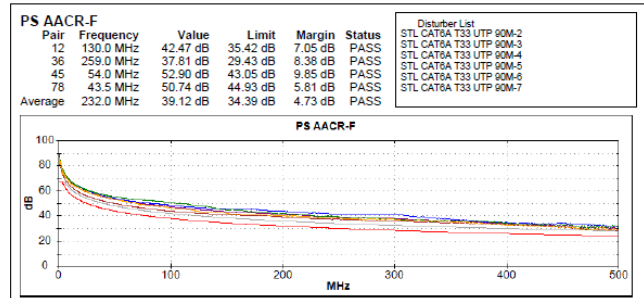
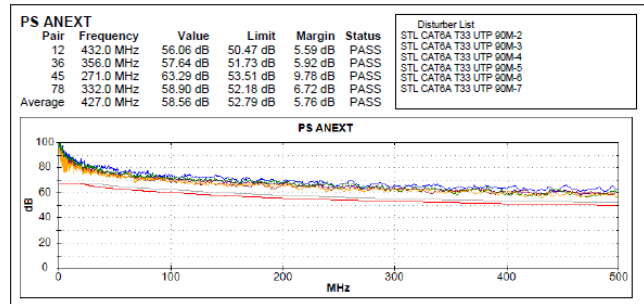


Figure 8 – Alien Crosstalk graph – Network Analyzer



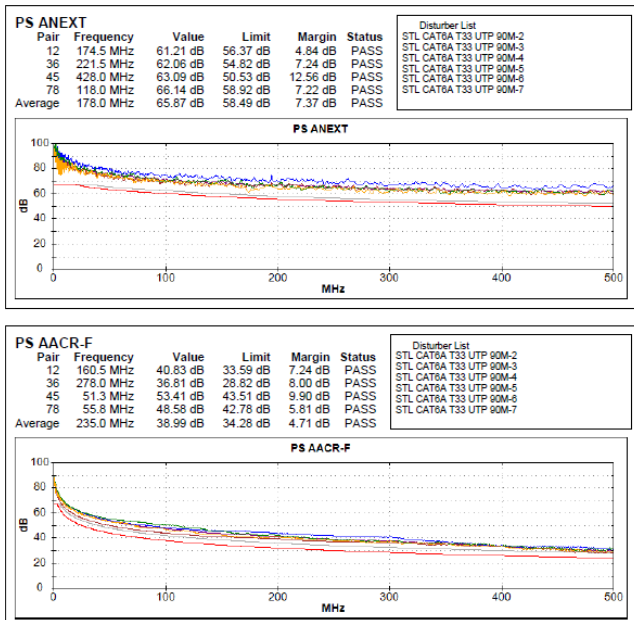


Figure 9 – Alien Crosstalk graph – Field Analyzer

2.3 Testing with different interpretation of Standard Test Method

In this scenario the cable bunch preparation was same as mentioned in ANSI/TIA 568C.2 with distance between cable tie 30 cm and cable bunch laid on non-metallic floor. Results were recorded. After the first test set the cable were flared from the middle of the loop without disturbing the distance between two cable ties which is 30cm. First and second test set are as shown in figure 10 and 11 respectively. A group of 3 and 4 cables were departed approximately 7 mm from each other to study the difference in Alien crosstalk result without deviating from the test procedure defined in the Standard ANSI/TIA 568C.2. After completion of test the results were recorded and compared with each other as shown in Table 3.



Figure – 10 Alien Crosstalk Bunch with No gap

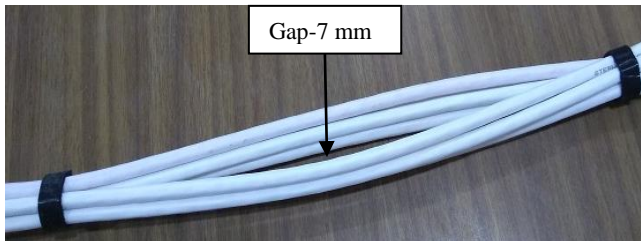


Figure – 11 Alien Crosstalk Bunch with gap

Test Method (ANSI/TIA 568C.2 90 M PL Network Analyzer)	PSANEXT (Near End) (dB)	PSANEXT (Far End) (dB)	PSAACRF (dB)
No gap between bunched cable , Cable Tie at every 30 cm	5.6	5.6	7.1
Gap between bunched cable, Cable Tie at every 30 cm	6.4	5.6	6.4

Table 2 –Comparison between Test Results from Different interpretation of Test Method

Test results graphs for network analyzer and field analyzer are shown in figure 12 and 13 below

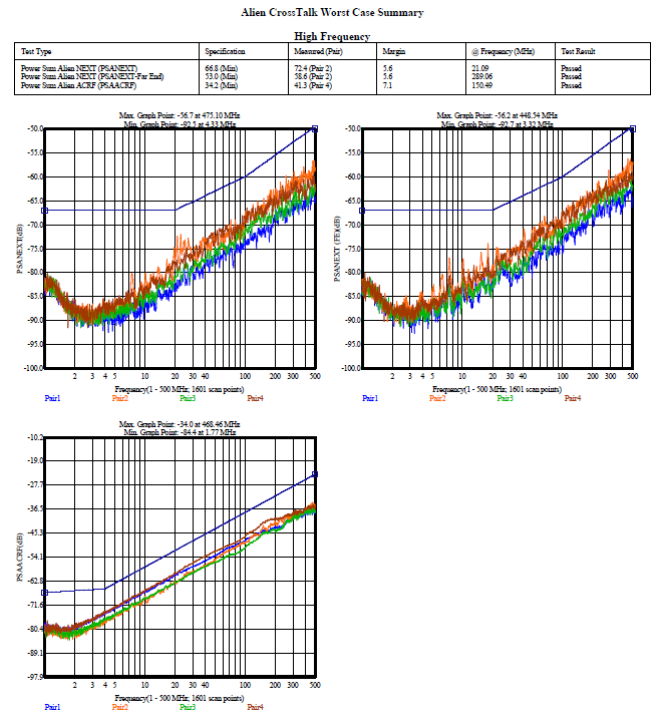


Figure – 12 Alien Crosstalk graph – No gap in loop between two cable ties

Alien Crosstalk Worst Case Summary

High Frequency					
Test Type	Specification	Measured (Pair)	Margin	@ Frequency (MHz)	Test Result
Power Sum Alien NEXT (PSANEXT)	-18.8 (Min)	61.2 (Pair 4)	8.4	120.35	Passed
Power Sum Alien NEXT (PSANEXT Star End)	-16.4 (Min)	62.9 (Pair 2)	1.8	172.35	Passed
Power Sum Alien ACRF (PSAACRF)	-61.6 (Min)	72.0 (Pair 4)	8.4	4.02	Passed

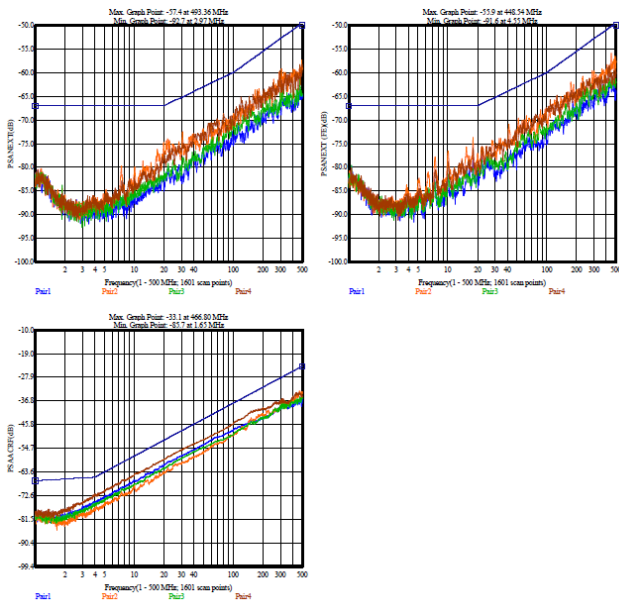


Figure – 13 Alien Crosstalk graph – Gap in loop between two cable ties

This study was carried out on one design of Sterlite Cat6a U/UTP Design cable keeping one victim constant for all different scenario testing. Difference between the alien crosstalk margins obtained from different test scenarios were then compared with statistical method at different frequencies and conclusion was made.

3. Conclusions

1. Different standards, test instruments and sample preparation methods impact on the test results
2. Our calculations are showing that we achieve the different test method of Alien cross talk test with same cable construction shows different results from 2.5 dB to 6.4 dB.
3. As per our findings the stringent test method is ANSI/TIA 568C.2 with the network analyzer. If our cable is passing with good margin with this scenario then the other scenarios are met.

4. Acknowledgments

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7. Pictures and Biography of Authors



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Andrew has over 24 years of experience in optical and copper network development, installation and management with international producers and exporters. Furthermore, he has reviewed network design, installation, innovations, technical back up and several patents. In his capacity as the manager, he has built direct relationships with customers, installers and has been consulted on a number of projects up to \$2B. He has played a key role in the development and introduction of FTtx systems. He has developed a training structure for cabling, building automation and security, and assisted in putting data sheets and catalogues. He holds Master’s and Bachelor’s Degree in electronics.



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Darshana has over 12 years of experience in Design and Development of Power Cable, Jelly Filled Telecommunication cables, Structured Data Cables and Fiber Optic Cables. In her tenure as the manager, she has built direct relationships with customers, suppliers and has been consulted on a number of projects up to \$100K. She has played a key role in the development and introduction of High end Data cables and FTTH Premise cables. She has developed a training structure for cabling design, testing and Management. She has participated in several patents and catalogues development. She holds Bachelor's Degree in Electrical.



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Abhishek has over 10 years of experience in Optical Fiber manufacturing ,Process, Structured Data Cables and Fiber Optic Cables. In his tenure as the Officer , He has built direct relationships with customers, suppliers and has been consulted on a number of projects like as Six sigma,5S, Lean ,Improvement of Head room ,Scrap Reduction, Quality tools, Testing methodology of Fiber as well as Data cable . He has played a key role in the development and introduction of High end Data cables and Optical Fiber. He has developed a training structure for testing and management. He has participated in several patents. He holds Master Degree in Chemical Science.



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