Application Note

What can you do when cabling links fail compliance with the 10GBASE-T standard?

The first step is to follow the test and measurement procedures that deliver reliable test results. All the links that are to transmit 10GBASE-T should be tested in the conventional certification method against the "in-channel" specification of 10GBASE-T or of one of the equivalent cabling industry standards (TIA TSB-155; currently in draft 5). The Fluke Networks DTX-1800 fully supports these standards and can be used "as is" to execute the first step. Consult the Fluke Networks website to ensure that you have the latest version of the software and the test standard library in your unit. This first test ensures that each installed cabling link meets the transmission requirements outlined in the standards from 1 through 500 MHz. Second, we must test that the "between-cable" coupling which is called *Alien Crosstalk* meets the required specifications. The DTX-10GKIT contains all the hardware and software accessories to perfrom the Alien Crosstalk measurements in the field with the DTX-1800.

In-Channel Mitigation

It is of course possible that some of the installed links do not pass the in-channel tests. If this is the case, all channels must be inspected and upgraded to meet this first requirement for 10GBASE-T transmission. Use the diagnostics features of the DTX Series testers to guide you to the problem area and the corrective action. When an Autotest fails, press the fault Info key on the tester to obtain more information. This information may be inconclusive if the failures occur in the higher frequency ranges of the test spectrum. Therefore, we would like to add some guidelines for troubleshooting. It is very likely indeed that most of the failures not identified by the diagnostics will relate to improper performance of link connections in the higher frequency ranges. The following corrective action recommendations may best be executed in the sequence we state them below:

1. Replace the work area, patch, and/or equipment cords with Cat 6A cords
2. Reconfigure the cross-connect as an interconnect.
3. Replace the interconnect with a Cat 6A interconnect
4. Replace the consolidation point connector with a Cat 6A consolidation point connector.
5. Replace the work area outlet connector with a Cat 6A work area outlet connector.

To see the effect of each upgrade step, we recommend that you retest the link. Obviously when it passes the test, your corrective action has been successful.

Between-Channel Mitigation or Alien Crosstalk Mitigation Procedures

The Alien Crosstalk testing is typically executed for a selected sample of links. For more information on this sampling technique as well as the actual Alien Crosstalk measurements, please see the white paper "How to Certify or Re-certify Twisted-Pair Cabling for 10 Gb/s Ethernet: And testing guidelines for Alien Crosstalk (AXTalk)," on the Fluke Networks 10 Gig solution center at **www.flukenetworks.com/10gig.**

To summarize some of the basic Alien Crosstalk testing rules: The longest links should be tested first. The tested link is referred to in the standards as the "*disturbed link*." To make the distinction between disturbed and disturber links easier, we will refer to the disturbed link as the *victim* link. All the links in the same bundle as the victim link should be included as disturber links for the Alien Crosstalk tests. In addition, you should make sure that you have included in the list of disturber links those links that are terminated in adjacent positions in the Telecommunication Room patch panel.

See how far the right tool can take you - from 10 Meg to 10 Gig.

Interpreting the test results

The Alien Crosstalk tests are executed under control of the AxTALK Analyzer™ software which executes on a Windows-based personal computer or laptop. The computer connects to the DTX-1800 main unit using a USB connection. The AxTalk Analyzer software controls the DTX-1800, uploads all of the measurement results and processes this data in real time to produce the power sum test results for the wire pairs in the victim link. As the crosstalk effects of wire pairs in additional disturber links are measured, the AxTALK Analyzer software automatically adds and displays their effect by calculating the power sum AXTalk test result for all the disturbers included in the test so far on each victim wire pair. Figure 1 shows the AxTALK Analyzer result screen after five disturbers have been added to the test results. The list of disturbers included in the displayed test result is shown in the top right hand side of the AxTALK Analyzer screen. You can see in Figure 1 that the crosstalk effects of five disturbers have been measured and included in the graphical results.

The individual pair-to-pair Alien Crosstalk measurements from which the power sum parameters are calculated are stored in the PC's memory. You can at any time investigate the effect of one disturber onto the four wires pairs of the victim link. Figure 2 illustrates this by showing the PS ANEXT results of one disturber (ID: 1A/8A-A.02) on the wire pairs in the victim link (ID: 1A/8A.A05). The checks in the disturber list have all been cleared except for the disturber we want to investigate.

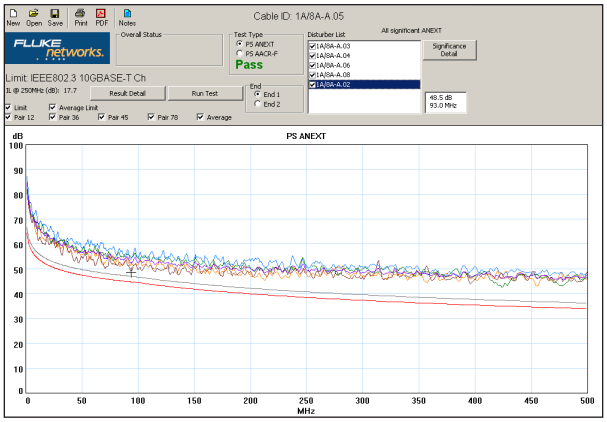

Figure 1 - Power Sum ANEXT test results for five disturbers

View the worst case PS ANEXT margin for each wire pair in the victim link by clicking on the "Result Data" button (towards the left of the screen, just left of the button labeled "Run test") and the display shown in Figure 3 pops up. We see that, for instance, wire pair 7,8 in the victim link displays the worst case margin of 9.60 dB (and this occurred at 118 MHz).

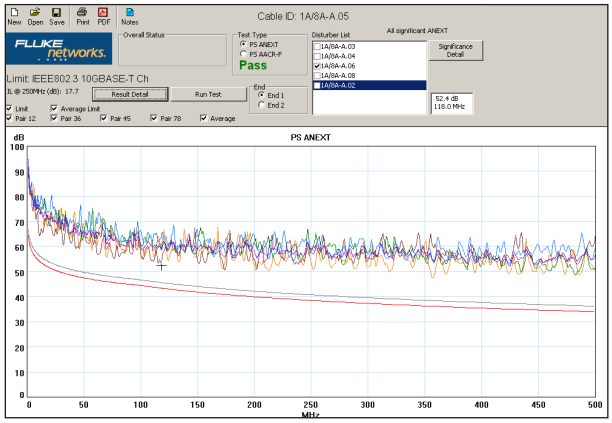

Figure 2 - Power Sum ANEXT for each wire pair in the "victim" link from the four wire pairs of one disturber link

It should also be observed that the margin of the test results for one disturber is significantly better than the margin for the combined effect of five disturber links. This should be evident. Just compare the distance above the limit lines of the measurement values in Figure 2 (only one disturber) versus that distance in Figure 1 (the combined effect of five disturbers). When we investigate the worst case margin for PS ANEXT including all five disturbers shown in Figure 1, wire pair 7,8 remains the worst pair and the margin has dropped to 4.08 MHz (not shown in a figure). As more disturbers are added the margin of the PS ANEXT measurement values will slowly decrease. If the measurement values remain above the limit lines after the last disturber has been added, the victim link passes the requirements for PS ANEXT. The tests should then be repeated for AFEXT and the results data can be investigated as described here for PS ANEXT.

Result (End 1)

PS ANEXT

Pair	Frequency	Value	Limit	Margin	Status
12	70.0 MHz	55.76 dB	46.04 dB	9.72 dB	Pass
36	482.0 MHz	48.65 dB	34.25 dB	14.40 dB	Pass
45	164.5 MHz	55.81 dB	41.25 dB	14.55 dB	Pass
78	118.0 MHz	53.02 dB	43.42 dB	9.60 dB	Pass
Average	101.5 MHz	58.58 dB	46.65 dB	11.94 dB	Pass

Figure 3- Summary Test Results data (Worst case margin) for the PS ANEXT results shown in Figure 2

Identify the disturber contributing the worst amount of ANEXT

In case the PS ANEXT test fails, we want to know which disturber links are contributing the most amount of ANEXT in order to arrive at a strategy to correct the problem(s). We can investigate the contribution made by individual disturber links as we have shown above. Disturber links yielding the smallest worst case margin numbers (or negative numbers) are the worst offenders (biggest contributors to PS ANEXT). You can rank order the links from worst to least amount of ANEXT coupling.

For each of the worst contributors, we can consider the corrective actions (alien crosstalk mitigation) listed below in order of priority:

1. Reduce the alien crosstalk coupling by separating the equipment cords and the patch cords and un-bundling the horizontal cabling.
2. An alternative to separating equipment cords is to utilize equipment cords sufficiently specified to mitigate the alien crosstalk coupling such as Category 6 ScTP and Augmented Category 6.
3. Reconfigure the cross-connect as an interconnect
4. Replace connectors with Augmented Category 6
5. Replace the horizontal cable with augmented Category 6

After applying one of the mitigations, you should re-test the interaction between the victim link and the modified disturber to see whether a noticeable improvement has been achieved in the worst case margin of the offending test parameter.

Interested in learning more about 10 Gig testing?

Visit our 10 Gig Solution Center at **www.flukenetworks.com/10gig** to get up to date on the latest 10 Gig standards updates. Some of the resources you'll find on our solution center include whitepapers, webcasts, virtual demonstrations, and much more.