Proposed Draft

Serial ATA International Organization

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Title : Cable ISI Test Source Risetime

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Document History

Version	Date	Comments
0	6 June 2007	Initial Draft.
1	10 July 2007	Added ECN number
2	2 August 2007	Changed Tolerance method to Min., after group input. Added fall time.

1 Introduction

1.1 Problem Statement

The cable ISI test procedure does not have sufficient information to produce repeatable data. The procedure also contains conflicting instructions resulting in a measurement that produces data that is not used.

More detail is provided in the paragraphs that follow:

A) The present cable ISI tests, do not specify the rise time of the pattern source used for the testing. The resulting ISI (DJ) measured after the cable includes the ISI effects of the pattern source and the cable. Since the measured ISI is a function of the rise time of the pattern source, and it is not clear what rise time to use, correlation between cable ISI tests is poor.

B) The cable ISI test procedure (P9) in step 1) requires one to measure and record the cable fixtures RJ and DJ. Step 3) correctly states “As incident (test system induced) DJ may not be de-convolved from the end results, it’s critical one use a high quality (low jitter) fixture and stimulus system when performing this measurement.” Step 3) makes the exercise of measuring and recording the RJ and DJ of the fixtures useless, since this data is not used.

C) No means of generating a Gen2 LBP is included in the Test Equipment list.

1.2 Solution

A) Add the rise time requirement for the pattern source to cable ISI procedure (P9). This would be the slowest rise time allowed for a Gen2 pattern such that the ISI is not under reported. Using the slowest rise time preserves the margin in the jitter budget.

B) Combine the information from Step 1) and Step 3) related to the Jitter of the test system into an initial note in the (P9) procedure. Make the testing of the test system jitter informative in nature.

C) Add an entry in the test equipment list (section 6.5.2.1) for a test pattern source for the Gen2 LBP used for cable ISI testing. (P9)

1.3 Background Information

When measuring the DJ of a combined system of a pattern source and a cable, as is done in the cable ISI test, the jitter of the pattern source and the cable induced jitter are combined. DJ components in the pattern source and jitter introduced in the test fixtures should be minimized in order to better qualify the ISI introduced by the cable.

Since the rise time of the pattern source affects the ISI of the combined pattern source and cable system, the rise time of the pattern source needs to be specified for the testing. The test pattern is the Gen2 LBP. Gen2 20%-80% rise and fall time specifications are 67ps minimum to 136 ps maximum. Since the jitter budgets allow for 50ps of DJ due to the cable, and the DJ measured at the cable output increases as the rise time of the pattern source increases, the cable must be tested at the maximum rise time or slower to insure that the cable will not exceed the 50 ps budget when in use at slower rise times allowed by the spec.

Since the control of rise time is difficult to control precisely, a tolerance on the pattern source rise time is required. In order to provide the most accurate measurement, the pattern source should be at 136 ps. With practical rise time control methods, it is not always possible to control the rise time to 136 +/- 0.49 ps as would be inferred by the precision of a fixed value of 136 ps. Since the slowest end of the allowable Gen2i TX rise time range needs to be tested, the tolerance will be specified as a minimum. Requiring an absolute range (136ps to 136ps + delta) may infer to some that the higher number must be also used for testing. This is not the intent. It is desirable to be as close to 136ps as is practical, but not less than 136 ps.

Since the need of this clarification of the cable ISI test is based on the fact that increasing the rise time of the pattern source increases the DJ at the output of the cable, the following data has been collected on three cables from three different manufacturers to demonstrate this characteristic. All are 1 meter internal cables. The same pattern source, fixtures, and Jitter Measuring Device were used for all measurements. The test pattern is a Gen2 LPB. The source rise times selected are close to the ends of the Gen2i rise time range.

CABLE 1:
Tr = 70 ps, The resulting DJ = 11.6 ps
Tr = 132 ps. The resulting DJ = 24.4 ps

CABLE 2:
Tr = 70 ps, The resulting DJ = 11.1 ps
Tr = 132 ps. The resulting DJ = 21.9 ps

CABLE 3:
Tr = 70 ps, The resulting DJ = 9.2 ps
Tr = 132 ps. The resulting DJ = 25.2 ps

It can be seen that in all cases the DJ level increased as the pattern source rise time increased. Although the ratio of the increase is dependant on the cable characteristics, in all cases the significant increase of DJ was observed with an increase of rise time. The rise times were measured before the test fixtures (Input rise time), into a lab load.

2 Technical Specification Changes

2.1 Test Definition / Methodology

[**Editor's Note:** The changes marked in red (and underlined/strikethrough) will be incorporated in section 6.5.2.4]

P9	Inter-Symbol Interference
	Note: As incident (test system induced) DJ may not be de-convolved from the end results, it's critical one use a high quality (low jitter) fixture and stimulus system when performing this measurement. ~~1. Observe and record the cable fixtures intrinsic RJ and DJ for this setup through a 2X cal/reference trace which should be present on all SMA to cable break-out boards.~~ ~~2.~~ 1. Connect a differential pattern source at the input of the test fixture. The 20%-80% rise time and fall time of the pattern source shall be 136 ps minimum. The rise and fall times should be as close to 136 ps as is practical, to minimize the resulting DJ and produce the most accurate results. Generate the LBP ~~a lone bit~~ pattern at 3.0 Gbps through the fixture. The lone bit pattern ~~more accurately~~ emphasizes ISI. ~~3.~~ 2. Using a JMD, evaluate the Deterministic Jitter (DJ) introduced at the end of the cable~~. Bear in mind the deterministic contribution from test fixtures and stimulus systems. As incident (test system induced) DJ may not be de-convolved from the end results, it's critical one use a high quality (low jitter) fixture and stimulus system when performing this measurement.~~

2.2 Test Equipment

[**Editor's Note:** The changes marked in red (and underlined/strikethrough) will be incorporated in section 6.5.2.1]

6.5.2.1 Test Equipment

The following list identifies the type and performance of suggested equipment to perform the characterization procedures outlined in **Error! Reference source not found.** and **Error! Reference source not found.**.

- High Bandwidth Sampling Oscilloscope
- TDR Module – < 35 ps (20% - 80%) Edge Rate Step Response
- Vector Network Analyzer – 4 port, 13.5 GHz BW
    - Suggested 20 GHz BW
- High Performance Coaxial Cables – = 20 GHz BW
- Low Jitter 3.0 Gb/s Pattern Source – 20%-80% rise time of 136 ps minimum. (The rise time should be as close to 136 ps as is practical.)