InfiniBand Trade Association

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3/30/2014

IBTA Receiver MOI for FDR Devices

For Anritsu MP1800A Signal Analyzer and Agilent 86100D with module 86108B and FlexDCA S/W for stressed signal calibration

Anritsu MP1800A Signal Analyzer	Agilent 86100D with module 86108B

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Table 1- Modification Record

Revision	Release Date	Author	Comments
1.00	2/18/2014	Alexander Rysin	Initial version of the document
1.01	2/27/2014	Alexander Rysin	• Replaced the Agilent 86100D image to include the 86108B module • Added the module calibration procedure for the oscilloscope
1.02	3/30/2014	Alexander Rysin	Several corrections, following comments by James Morgante: • Page 4, step 2: Phase-matched RF cables have to be used for connection between the BERT and the oscilloscope/tested device. • Page 4, step 4: added "Enable "Tracking" between "P" and "N" signals". • Added numbering to the Test Procedure sections.

Purpose

Verify that the receiver under test meets the required bit error ratio when tested using stressed input signals.

Test Procedure

A. Calibration of the stressed signal

1) In case the 86100D oscilloscope is turned off and/or not calibrated, calibrate the 86100D oscilloscope and the 86108B module:
   a) Turn on the oscilloscope and let warm up for at least 30 minutes.
   b) On the oscilloscope calibrate the module by going to Tools > Calibrate, selecting all calibrations for the 86108B and following the prompts.
2) Connect the Data Output ports of the Anritsu signal analyzer PPG Module to the oscilloscope channel inputs by phase-matched RF cables.
3) Push the physical button with the number of the PPG module on the Anritsu MP1800A Mainframe.
4) Use the "Output" tab in the Anritsu MP1800A to set the bitrate (14.0625 Gb/s) and the data amplitude (400 mV single-ended). Enable "Tracking" between "P" and "N" signals.
5) In the "Pattern" tab in the Anritsu MP1800A select "Data" test pattern and use the data editor to transmit alternating bits (1010) pattern.
6) In the "Output" tab, push the "Calibration" button in the lower right corner.
7) Make sure that the "Output" indicator LED on the Anritsu MP1800A mainframe is on. If not, push on the "Output" physical button.
8) In the oscilloscope, select Setup | Mode | Oscilloscope.
9) Clock recovery procedure:
   a) Click on CDR (Clock recovery).
   b) Make sure Nominal Data Rate is set to the desired rate (for example 14.0625 Gb/s).
   c) Click on Relock – if the button is red and says lock, then you are not in synch.
10) Push "Pattern lock" – lower right software button.
11) Push "Slot channel setup" (lower left software button), select differential measurement and push D1A software button.
12) Push Run – upper right software button.
13) Use the Amplitude Tab on the upper left and select Amplitude.
14) If necessary, adjust the Anritsu MP1800A PPG amplitude to achieve a reading of 800 mV on the oscilloscope amplitude measurement.
15) In the "Pattern" tab in the Anritsu MP1800A select "PRBS" test pattern and choose Length of 2^9-1.
16) Push the physical button with the number of the Jitter Modulation Source module on the Anritsu MP1800A Mainframe.
17) Set the Random Jitter (RJ) amplitude to 0.15 UI p-p.
18) Set the Sinusoidal Jitter (SJ) amplitude to 0.1 UI and the SJ frequency to 5 MHz.
19) On the oscilloscope, select Setup | Mode | Jitter.
20) Push "Run" to perform the measurement.
21) Verify that the measured RJ value is 0.107% UI (0.762 ps) RMS and the measured DCD value is 3.5 %UI (2.49 ps).
22) In case the measured DCD value differs from 3.5 %UI (2.49 ps):
   a) Push the physical button with the number of the PPG module on the Anritsu MP1800A Mainframe

b) Disable "Tracking".

c) Change slightly the offsets of the Data and XData in opposite directions (i.e. 45% for Data and 55% for XData) until the desired value is reached.

23) In case the measured RJ value differs from 0.107% UI (0.762 ps) RMS, correct the RJ amplitude (in the Anritsu MP1800A Jitter Modulation Source module screen) until the desired value is reached.

24) Select Measure | Configure Jitter Mode Measurements… | Advanced

25) In the Random Jitter/Interference (RJ/RN) section, go to the "Stabilization" tab, select "Fix RJ at" and push the "Get Measured RJ" button. Make sure that the measured RJ value is displayed in the text box, as it can be seen in Figure 1.

Figure 1. Locking the RJ value for long pattern measurements

26) Select Setup | Mode | Eye/Mask

27) Use the Adv Eye tab on the left and select RJ. Check the "Fix RJ" option.

28) In the "Pattern" tab in the Anritsu MP1800A select "PRBS" test pattern and choose Length of 2^31-1.

29) Use the Adv Eye tab on the left and select TJ.

30) In case the measured TJ value differ from 28% UI (19.9 ps) RMS, correct the SJ amplitude (in the Anritsu MP1800A Jitter Modulation Source module screen) until the desired value is reached.

B. Selection of the linear cables

The linear cables are used in the RX tolerance testing in order to induce distortion in the form of inter-symbol interference (ISI) and crosstalk noise on the propagating signals. The InfiniBand[TM] Architecture Specification Volume 2 defines two test channels – a low loss channel, introducing moderate levels of insertion loss and therefore moderate levels of ISI, but high level of crosstalk noise and a maximal loss channel, introducing high levels of insertion loss and therefore high levels of ISI, but moderate level of crosstalk noise.

Insertion Loss

The minimal insertion loss levels of the cables, used for RX tolerance testing, are 15 dB at 7.03 GHz for the high-loss cable, and 5.79 dB at 7.03 GHz for the low-loss cable.

Crosstalk Noise

The minimal induced RMS crosstalk noise should be 10 mV, out of which 5.5 mV should be the far-end crosstalk noise, for the maximum loss cable and 6.4 mV, out of which 4.1 mV should be the far-end crosstalk noise, for the low loss cable. The following steps should be taken to verify these requirements:

1) Measure the near end and far end crosstalk noise of the selected cables, using a vector network analyzer (VNA). The frequency range of the measurements should be 10 MHz – 15 GHz.
2) For each RX lane, create a CSV worksheet arranged in the following manner:
   a) The first column will contain the frequency points of the VNA measurements in GHz.
   b) Columns B-E will contain the measured near end crosstalk values, in dB.
   c) Columns F-H will contain the measured far-end crosstalk values, in dB.
3) Save the attached Matlab (Octave) script **icn.m** in the directory of the created CSV worksheets.

icn.m

4) Open the saved Matlab (Octave) script **icn.m.** Adjust the following parameters:
   a) The filename of the CSV worksheet.
   b) "Ant" value should be set to the output amplitude of the tested device's transmitters in mV.
   c) "Tnt" value should be set to the rise time of the tested device's transmitters in ns.
   d) "Tft" value should be set to the rise time of the signal source for the aggressor lines (crosstalk generator) in ns.
5) Run the Matlab (Octave) script. Its outputs are the calibrated near end crosstalk (denoted as sigma_nx), the calibrated far end crosstalk (denoted as sigma_fx) and the calibrated ICN noise (denoted as sigma_x).
6) In case the sigma_fx and/or sigma_x are smaller than the minimal levels, defined by the specification, adjust the "Aft" value, until these levels are reached.

C. Performing the test

The setup for the FDR RX tolerance test with linear cables is illustrated in Figure 2. The Anritsu MP1800A PPG output is connected to the tested lane and the signal to the other 3 lanes of the tested port is supplied from another signal source, preferably with controllable output amplitude. In case the tested device has numerous ports, any other port of the tested device can be employed to supply the signal to the other 3 lanes of the tested port (for far end crosstalk generation).
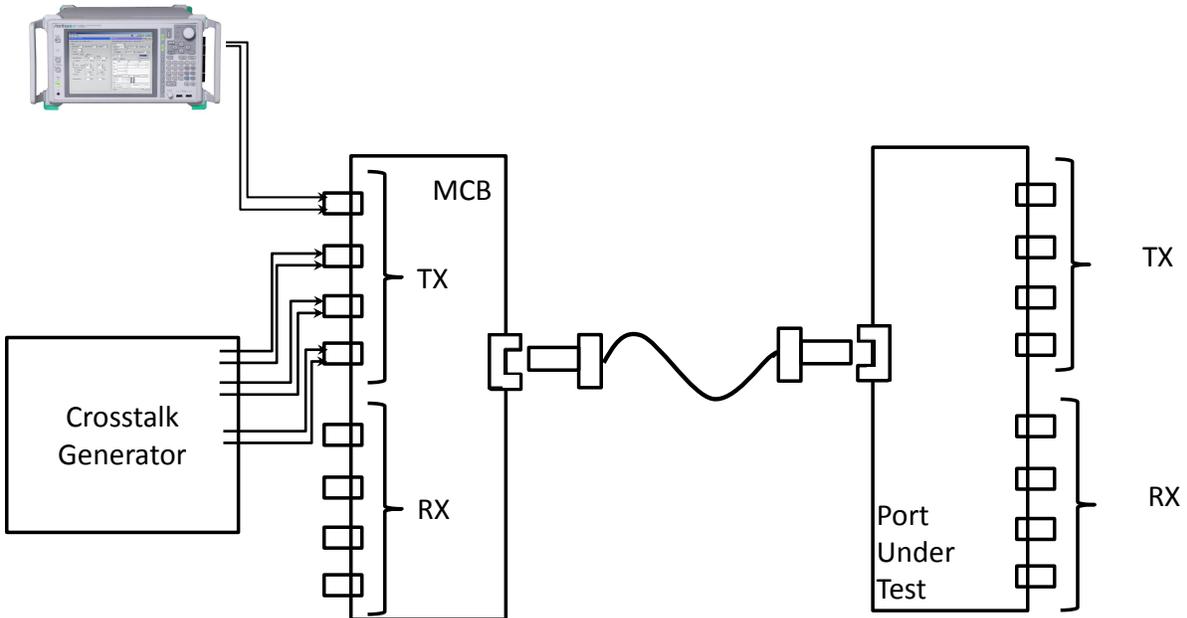

Figure 2. Test setup for FDR RX tolerance testing with linear cables.

After connecting the test setup, the test flow will be as follows:

1. Configure the Anritsu MP1800A PPG output signal as described in section (A) of this document.
2. Configure the amplitude of the crosstalk generator outputs to the "Aft" value, found in section (B) of this document.
3. Configure the transmitters of the tested ports to transmit data in order to generate near end crosstalk noise.
4. Check the data, recovered by the tested receiver, for bit errors. This can be done either by employing an on-die bit error counter, or by configuring the tested device in loopback mode (driving the recovered data from a transmitter) and employing the Anritsu MP1800A error detector.
5. The tested receiver is considered compliant if no bit errors are recorded for 214 seconds (to achieve a BER of 10^{-12} with a confidence level of 95%.