

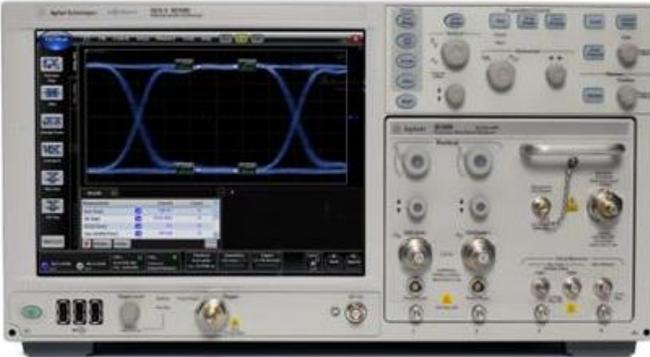
InfiniBand Trade Association

Revision 1.04

2/27/2014

IBTA Receiver MOI for FDR Devices

For Tektronix BERTScope Bit Error Rate Tester and Agilent 86100D with module 86108B and FlexDCA S/W for stressed signal calibration

Tektronix BERTScope Bit Error Tester	Agilent 86100D with module 86108B
 A blue and white Tektronix BERTScope Bit Error Tester. It features a large color LCD screen on the right side displaying a blue and yellow waveform. The front panel has several control knobs and buttons on the left side.	 An Agilent 86100D signal generator with module 86108B. The device is silver and black. The screen shows a blue waveform. The front panel is densely packed with various controls, including knobs, buttons, and connectors.

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Table 1- Modification Record

Revision	Release Date	Author	Comments
1.00	3/4/2013	Alexander Rysin	Initial version of the document
1.01	5/19/2013	Alexander Rysin	Corrected the “calibration of the stressed signal” flow: <ul style="list-style-type: none">• Correct flow for jitter calibration with long pattern (PRBS31)• Corrected the selection of the linear cables section
1.02	10/24/2013	Rupert Dance	Updated MOI to IBTA MOI template and made editorial changes
1.03	1/26/2014	Alexander Rysin	<ul style="list-style-type: none">• Corrected several inaccuracies in the “calibration of the stressed signal” flow• Updated the “calibration of the stressed signal” flow to use the FlexDCA S/W
1.04	2/27/2014	Alexander Rysin	<ul style="list-style-type: none">• Replaced the Agilent 86100D to include the 86108B module• Added the module calibration procedure for the oscilloscope

Purpose

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

Test Procedure

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 BERTScope pattern generator to the oscilloscope channel inputs.
- 3) Configure the BERTScope pattern generator to transmit alternating bits (1010) pattern.
- 4) Select Setup | Mode | Oscilloscope.
- 5) 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.
- 6) Push “Pattern lock” – lower right software button.
- 7) Push “Slot channel setup” (lower left software button), select differential measurement and push D1A software button.
- 8) Push Run – upper right software button.
- 9) Use the Amplitude Tab on the upper left and select Amplitude.
- 10) Adjust the BERTScope generator amplitude to achieve a reading of 800 mV on the oscilloscope amplitude measurement.
- 11) Configure the BERTScope pattern generator to transmit a PRBS9 pattern.
- 12) Switch to the “Stressed Eye” screen of the BERTScope.
- 13) Set the Random Jitter (RJ) amplitude to 15% UI.
- 14) Set the Sinusoidal Jitter (SJ) amplitude to 10% UI and the SJ frequency to 5 MHz.
- 15) On the oscilloscope, select Setup | Mode | Jitter.
- 16) Push “Run” to perform the measurement.
- 17) 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).
- 18) In case the measured DCD value differs from 3.5 %UI (2.49 ps), change slightly the offset of the DATA-signal (in the BERTScope Generator screen), until the desired value is reached.
- 19) In case the measured RJ value differs from 0.107% UI (0.762 ps) RMS, correct the RJ amplitude (in the BERTScope Stressed Eye screen), until the desired value is reached.
- 20) Select Measure | Configure Jitter Mode Measurements... | Advanced
- 21) 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

- 22) Select Setup | Mode | Eye/Mask
- 23) Use the Adv Eye tab on the left and select RJ. Check the “Fix RJ” option.
- 24) Configure the BERTScope pattern generator to transmit a PRBS31 pattern.
- 25) Use the Adv Eye tab on the left and select TJ.
- 26) In case the measured TJ value differ from 28% UI (19.9 ps) RMS, correct the SJ amplitude (in the BERTScope Stressed Eye screen), until the desired value is reached.

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™ 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 σ_{nx}), the calibrated far end crosstalk (denoted as σ_{fx}) and the calibrated ICN noise (denoted as σ_x).
- 6) In case the σ_{fx} and/or σ_x are smaller than the minimal levels, defined by the specification, adjust the “Aft” value, until these levels are reached.

Performing the test

The setup for the FDR RX tolerance test with linear cables is illustrated in Figure 2. The Tektronix BERTScope 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).

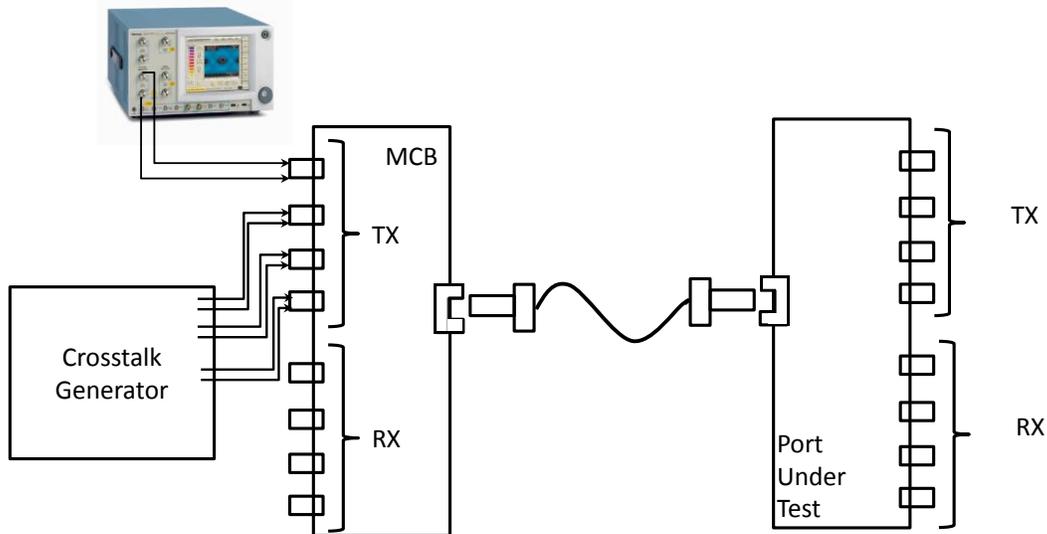


Figure 2. Test setup for FDR RX tolerance testing with linear cables.

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

1. Configure the BERTScope 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 BERTScope 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%