

Keysight Technologies, Inc.

# Overcome PCB Loss and Deliver a Clean Eye to Your DUT Using Multi-tap De-emphasis

Application Brief

## Introduction

Keysight Technologies, Inc. announces a new 32 Gb/s pattern generator with integrated 5-tap de-emphasis to augment the popular 32 Gb/s BERT platform. The video demonstrates the value of a pattern generator with integrated 5-tap de-emphasis when dealing with cable, connector, PCB board material, and other losses. With de-emphasis, the frequency-dependent loss can be compensated for and the test equipment can deliver a clean open eye to the DUT – even a chip-in-board or chip-on-board ceramic substrate separated from the test equipment by many inches of PCB traces and connectors.

## Test Setup

The test board shown in the test setup below represents the undesirable lossy connection to your latest chipset. It could be the backplane connecting your transceiver to your ASIC, or perhaps it's the switch fabric between your device and the PHY. The board material has frequency-dependent loss that degrades broadband data transmission.

By using de-emphasis to pre-distort the amplitude of certain bits, we can overcome the lossy characteristic of the board and deliver a clean eye at the test point you define. The test setup shows an N4951B-D32 (32 Gb/s) Pattern Generator with integrated 5-tap de-emphasis, connected to the test board, connected to a 60 GHz high-speed sampling oscilloscope.

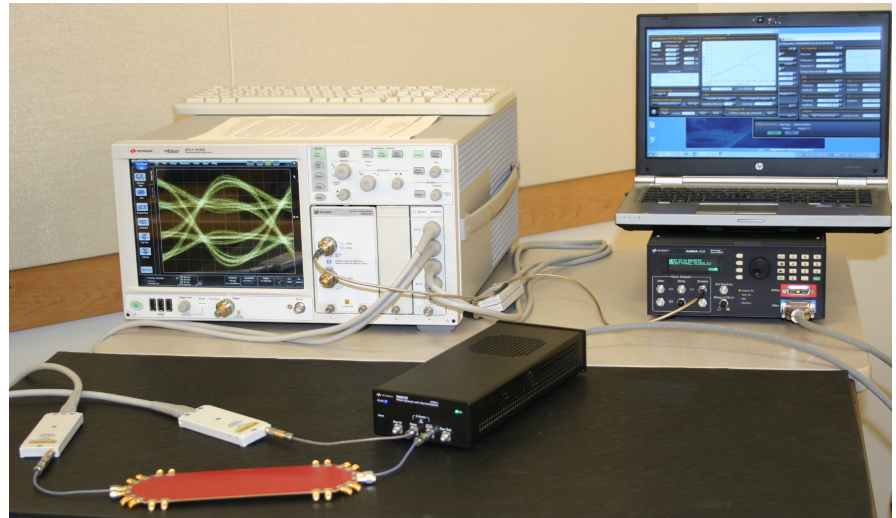


Figure 1. Test setup

## Procedure

First we turn on our pattern generator without de-emphasis. The waveform coming from the pattern generator is very clean as shown below.

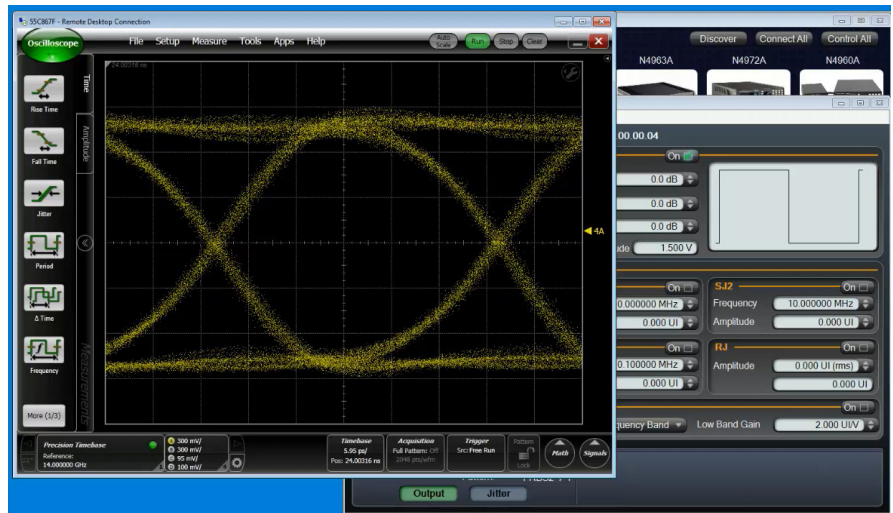


Figure 2. Waveform at pattern generator output.

However, you can see that this 28 Gb/s bitstream is totally degraded by the test board loss. The eye at the other end of the board is closed as shown below.

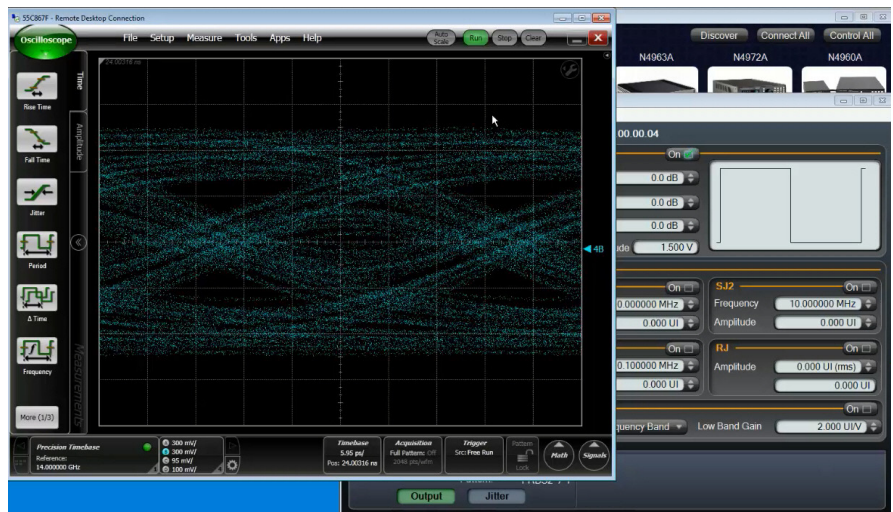


Figure 3. Waveform at test board output.

Using two- or four-port s-parameter files, generated from measurements or simulation as shown below, we can automatically determine the optimal de-emphasis cursor values to remove most of the degradation caused by our lossy backplane.



Figure 4. S-parameters.

We import the s-parameter files, indicate the data rate we are testing, invert the frequency response, and the program automatically determines the best tap weight values.

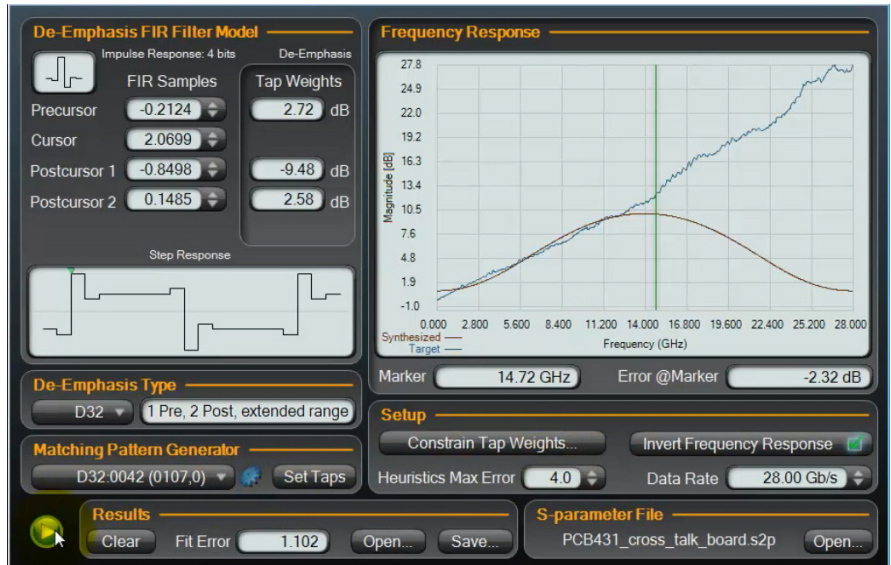


Figure 5. Determining optimal tap weight values.

The de-emphasis head is programmed with these values, and you can clearly see the results as shown below. The output from the pattern generator is pre-distorted and the output from the backplane is much cleaner.

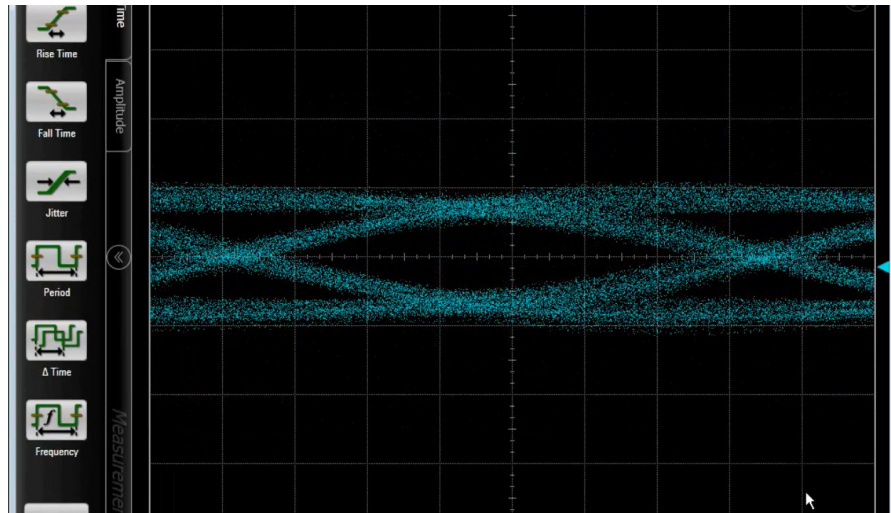


Figure 6. Waveform at test board output with de-emphasis applied

## Key Features

### N4960A Serial BERT 17 and 32 Gb/s

- Operation from 2.5 to 16 GHz (32 Gb/s system)
- Operation from 2 to 8.5 GHz (17 Gb/s system)
- Two independent sinusoidal jitter injection sources (one for N4960A-CJ0)
- True Gaussian random jitter stress (N4960A-CJ1 only)
- Spread spectrum clock (N4960A-CJ1 only)
- Fully programmable clock output parameters
- Low intrinsic jitter
- Jittered, non-jittered, and divided outputs
- Remote control through GPIB (IEEE 488.2) or USB2.0
- User interface along with SCPI command set for easy automation and test system integration

## Key Features (continued)

### **N4951B-D17/-D32 Pattern Generator Remote Head**

- N4951B-D32 data rate from 5 Gb/s to 32 Gb/s
- N4951B-D17 data rate from 4 Gb/s to 17 Gb/s
- 5-tap de-emphasis
- 1.5 V (p-p) output data amplitude (single-ended)
- Single ended or differential AC coupled data output with integrated bias tee
- User definable offset and termination voltage
- Family of PRBS patterns and predefined sample patterns
- User programmable patterns (up to 8 Mbit memory depth)

### **N4980A Multi-Instrument BERT Software**

- Software is Windows-based controlling equipment through USB or GPIB
- Simple and fast setup
- Full instrument remote control
- Test single and multi-lane BER with active aggressor signals
- Monitor instantaneous BER over time or measure BER over a specific period
- Fast and efficient parallel jitter tolerance testing (N4980A-JTS)
- View BER-measured BERT scan (often called bathtub curve, a horizontal slice through eye)
- De-emphasis tap weight calculator
- Intuitive pattern editor

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