PatternPro®
32GB/S PAM-4 BERT SYSTEM
### PRODUCT INFORMATION

32Gb/s PAM-4 BERT and *25Gb/s PAM-4 Eye Diagram*

Picosecond Pulse Labs' PAM-4 BERT is a **multi-level source** and **measurement** system that creates and analyzes PAM-4 data signals. The unique capabilities of PSPL's PatternPro instruments enable programmable control over the generation and measurement of PAM-4 signals.

Programmable user data, fine/coarse phase adjustment, and programmable amplitude enable a great deal of flexibility in generating PAM-4 data. Similarly, precision control of error measurement phase and voltage threshold adjustments allows the measurement and characterization of each level of the PAM-4 signal. The PSPL PAM-4 BERT configuration and the basic concept of the PAM-4 data signal (in terms of LSB and MSB) are shown below.

PAM-4 BERT Setup with PG, ED,
and PAM-4 combiner kit.
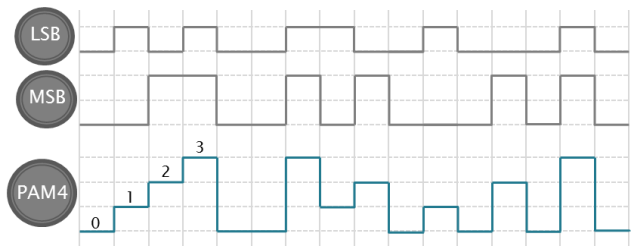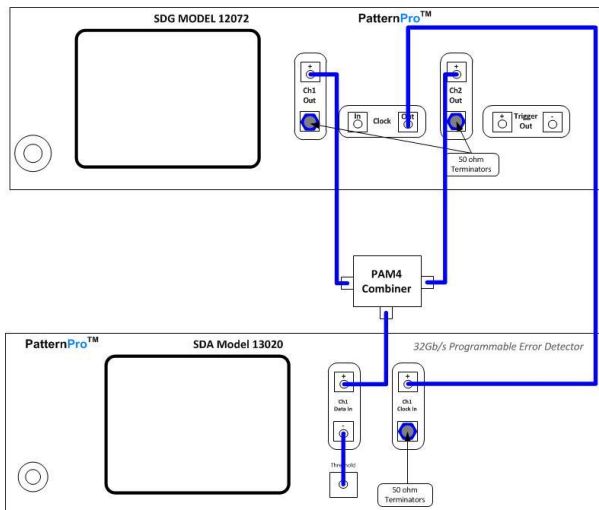
LSB: Ch1 data signal (1V)
MSB: Ch2 data signal (2V)
PAM4: Sum of the two signals

PAM4 Signal Creation with LSB and MSB.
LSB is typically set to ½ amplitude of MSB.

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PAM-4 data signals require different measurement capabilities than standard NRZ data signals. PSPL's BERT system utilizes instruments, components, and control software to address these requirements. The PAM-4 BERT system equipment and software is shown in the table below:

| Tool	Description
Programmable PG plus PAM-4 component kit	Generates PAM-N signal. Two channels are used to create each programmable PAM-4.
Programmable ED	Measures errors of each PAM-N signal level.
PAM-N Analysis Software	Uses programmable PG and ED to capture a series of data and produce BER, bathtub, and contour measurements

The PAM-4 data signal may be thought of in terms of a two bit binary system with an LSB and an MSB. The four signal levels are created by the four possible combinations of LSB and MSB values per the PAM-4 truth table shown below. As with traditional NRZ data signals, an eye diagram of the PAM-4 data may be captured using a sampling oscilloscope. The resulting eye diagram will have three eye openings compared with one for NRZ data (see diagram below). Measured PAM-4 Eye diagrams at 25 and 32Gb/s are also shown below.

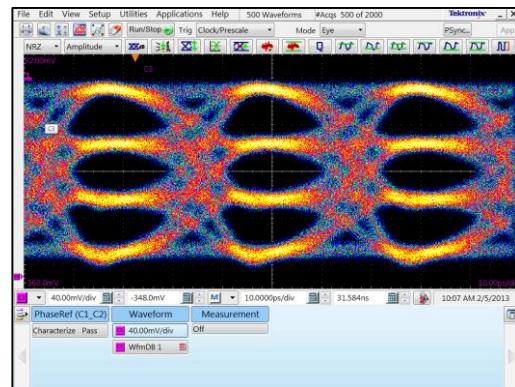| MSB	LSB	PAM4 LEVEL
0	0	0
0	1	1
1	0	2
1	1	3

PAM-4 Truth table
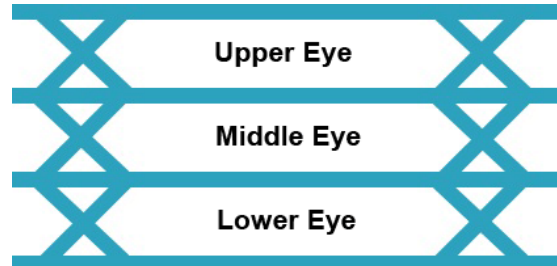
PAM-4 Voltage thresholds
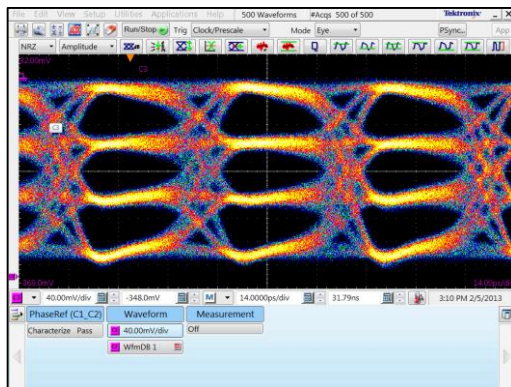
25Gb/s PAM4 Signal

32Gb/s PAM-4 Signal

PSPL's software tools are used to make PAM-4 BER measurements and analyze the data signal. Bathtub curves (both horizontal and vertical) are used to characterize the jitter and noise characteristics of the PAM-4 signal. In addition, the PAM-4 software can produce contour plots of the signal that show both the noise and jitter characteristics to low BER rates.

This can be a valuable PAM-4 analysis tool to identify signal issues and low BER performance. This is very important since PAM-4 applications will utilize Forward Error Correction (FEC) and accurate knowledge of the BER is critical. By comparison a sampling scope measures only a small number of samples and cannot see deeply into the PAM-4 contour. Example PAM-4 bathtub curves and contour plots are shown below.
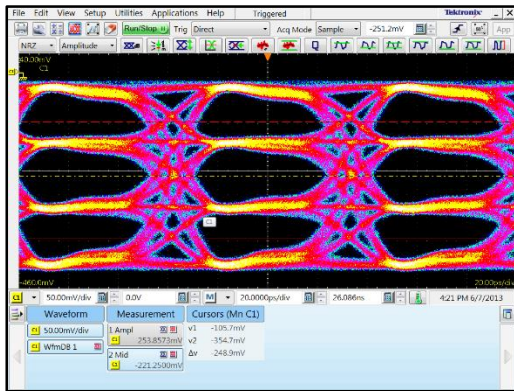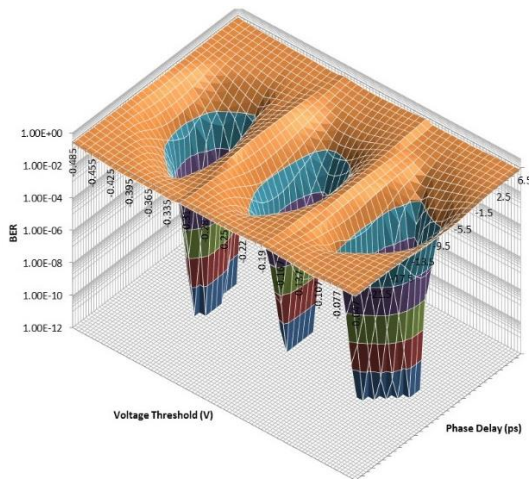

PAM-4 Eye Diagram
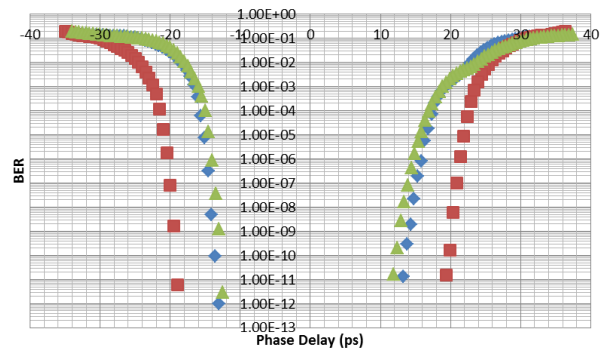
Resulting PAM-4 Bathtub Curves
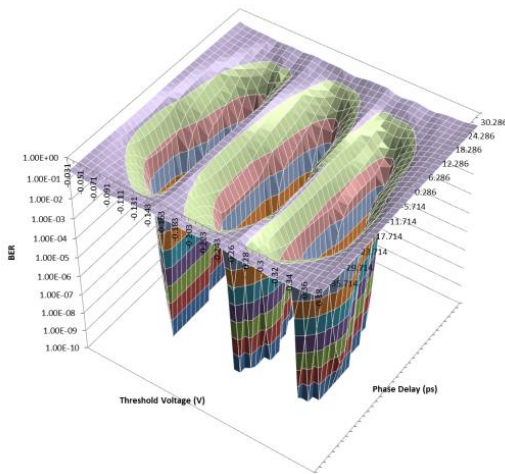
14Gb/s PAM-4 Bathtub Curves

25Gb/s PAM-4 Contour Plot

Contact Information

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