

How to use an eye diagram network analyzer

Article Overview

An eye diagram is used to visualize and analyze the quality of high-speed digital signals, revealing timing, voltage, and noise characteristics to assess signal integrity.

Generating an Eye Diagram

- o Connect the Device Under Test (DUT): Attach the output of your high-speed digital or optical channel to the input of a real-time or sampling oscilloscope, or a network analyzer capable of time-domain measurements .
- o Triggering: Use a system clock or extract the clock from the data signal via hardware or software clock recovery. Each acquisition captures one unit interval, and the oscilloscope overlays multiple cycles to form the eye pattern .
- o Signal Type Consideration: Identify the signaling format:
 - o NRZ (PAM2): Two amplitude levels, one bit per symbol.
 - o PAM4: Four amplitude levels, two bits per symbol, doubling data throughput .
- o Calibration: Ensure the network analyzer or oscilloscope is calibrated to the measurement plane at the DUT to account for losses and reflections .

Key Metrics to Analyze

- o Eye Height: Vertical opening of the eye; indicates noise margin and signal amplitude integrity .
- o Eye Width: Horizontal opening; reflects timing jitter and inter-symbol interference .
- o Jitter: Random variation in signal timing; can be visualized as horizontal eye closure .
- o Bit Error Rate (BER): Probability of incorrect bit detection; lower BER corresponds to a more open eye .
- o Q-Factor: Ratio of signal amplitude to noise amplitude; higher values indicate better signal quality .

Analysis Process

- o Overlay Multiple Cycles: The eye diagram is formed by superimposing thousands or millions of bit sequences, revealing cumulative effects of noise, jitter, and distortion .
- o Compare Against Specifications: Use predefined eye masks or design standards to determine if the signal meets required performance .
- o Identify Issues: Look for closed or skewed eyes, which indicate problems such as crosstalk, reflections, attenuation, or dispersion .
- o Time-Domain Inspection: Switch to time-domain mode to isolate the source of anomalies, such as specific transitions or channel segments .

Tools and Simulation

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- o Oscilloscopes: Real-time or sampling scopes capture eye diagrams directly.
- o EDA Tools: Software like HyperLynx, Ansys SIwave, or Cadence SystemSI can simulate eye diagrams from PCB layouts or channel models, using S-parameters and transmission line models .

Practical Tips

- o Ensure proper termination and impedance matching to avoid reflections.
 - o Use averaging or filtering to reduce random noise for clearer eye visualization.
 - o For optical networks, consider Q-factor and BER alongside eye opening to evaluate system performance .
- By following these steps, you can effectively use an eye diagram with a network analyzer to diagnose signal integrity issues, optimize high-speed channels, and ensure compliance with design specifications.

The Eye Diagram can show the transmission quality of digital signals. It is often used in applications where electronic

Overview PLTS constructs measurement-based eye diagrams (or patterns) by convolving the calculated time domain impulse

This application note reviews basic eye diagram definitions and terminologies, and presents several typical examples of

Generating Eye Diagrams in VectorStar™ VNAs Including PAM-4 Introduction VectorStar vector network analyzers (VNAs) enable

In an ideal world, eye diagrams would look like rectangular boxes. In reality, communications are imperfect, so the

One important methodology is the use of simulated eye diagrams on high-speed communication channels. These eye

TDR Transmission Eye Diagram Measurement in IConnect Eye diagram based on TDR transmission data is computed in IConnect

Performing Eye Diagram Measurements Overview Showing Eye Diagram Displaying Results Scaling the Eye Diagram Injecting Jitter

The video covers how to interpret an eye diagram, common eye diagram anomalies, and how to use eye diagrams to troubleshoot

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Signal Integrity Testing and Network Analysis |Lesson 6 of 9| The eye diagram, a graphical representation of a digital signal that can

With eye diagrams you can see signal quality with one display, you can diagnose problems, such as attenuation, noise, jitter, and

User Manuals 71501D Eye-Diagram Analysis System Users Guide You can configure the 71501D system as a high-speed eye

Eye diagram measurements and eye mask testing with the R&S® ZNB-K20 extended time domain

In order to solve this problem, this paper presents an algorithm of converting S-parameter measured by vector network

Creating Eye Diagrams using VectorStar™ SnP files and AWR Microwave Office®; MS4640B Series Vector Network Analyzer 1

This video discusses what an eye diagram is, and what makes it an invaluable tool for

Web: <https://morwarreconst.co.za>

