DATA SHEET

Keysight N8827A/B

PAM-4 Analysis Software for Infiniium Oscilloscopes

KEYSIGHT TECHNOLOGIES

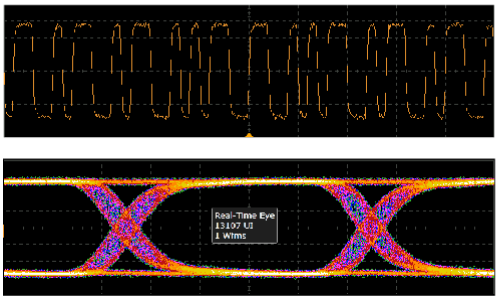
Table of Contents

Introduction 3
N8827A/B PAM Analysis Features 4
Easy Measurement Setup 5
Perform Comprehensive Analysis of Pulse Amplitude Modulation (PAM-4) Signals using the N8827A/B 6
Advanced Analysis Features (PAM) Analysis Using the N8827A/B 7
Conclusion 9

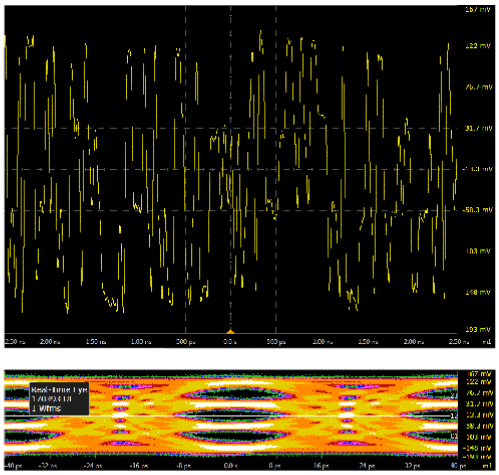
Introduction

Demand for increased network bandwidth in data centers continues to grow. Several industry groups and standards bodies are using or are actively considering multi-level signaling for such as Pulse Amplitude Modulation (PAM) since it enables higher data rates for a given channel bandwidth compared to common Non-Return-to-Zero (NRZ) signaling. However, the switch from NRZ to PAM-4 creates many new design and measurement challenges.

NRZ (PAM-2)



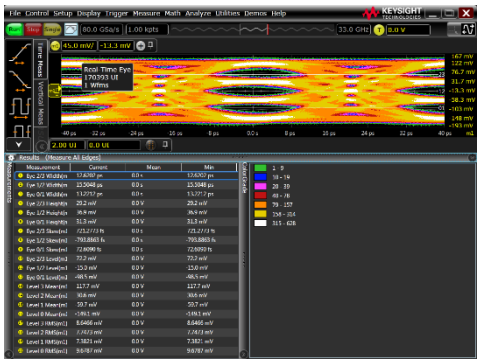
PAM-4



Keysight N8827A/B PAM-4 analysis software for select Infiniium Series real-time oscilloscopes is designed to accurately and quickly characterize electrical PAM-4 designs.

N8827A/B PAM Analysis Features

Comprehensive analysis of Pulse Amplitude Modulation (PAM-4) signals



- Supports 4-level or PAM-4 signaling analysis
- Eye width, eye height, eye skew
- Level amplitude, level noise, level skew
- Linearity measurements and more
- Transition qualified clock recovery
- Bit error ratio (BER) and symbol error ratio (SER) measurements
- BER/SER per acquisition measurements to help identify burst errors
- Unfolding of PAM-4 eye to show waveform location of BER/SER errors found

Flexible, economical

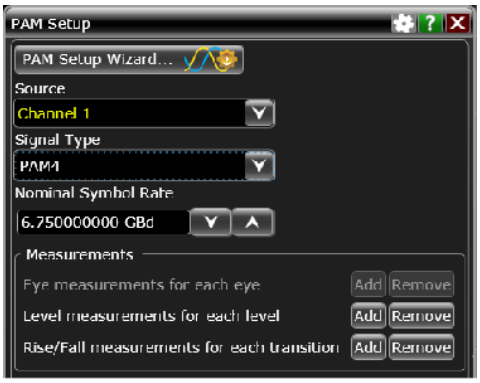
- PAM measurements are supported by all V-Series, Z-Series, 90000A Series, 90000 X-Series, and S-Series oscilloscopes
- PAM features are integrated directly into the Infiniium user interface (not a separate application)
- Offline analysis available on a PC using N8900A Infiniium Offline oscilloscope analysis software plus the N8827A/B PAM analysis software

Powerful advanced analysis features

- PAM-4 equalizers are available (CTLE, FFE/LFE) using the N5461A Infiniium Serial Data Equalization software
- Embedding / de-embedding of channels using N5465A InfiniiSim Waveform Transformation Toolset for Infiniium Oscilloscopes
- Jitter and amplitude analysis on IEEE JP03 patterns using the N5400A EZJIT Plus Jitter Analysis Software

Easy Measurement Setup

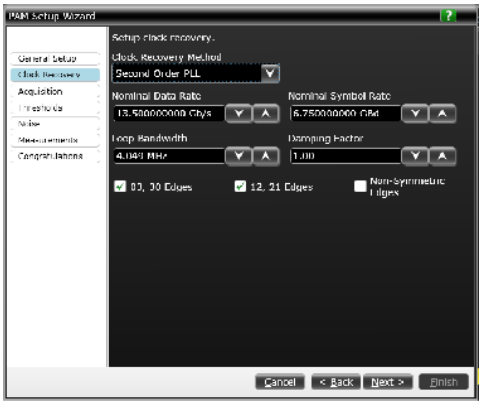
The Keysight N8827A/B PAM analysis software extends the ease-of-use advantages of the Infiniium oscilloscopes to the analysis of PAM-4 signals. A wizard walks you quickly through the steps required to setup measurements for a PAM encoded signal and to select methods for clock recovery and then the measurements you wish to have performed on your PAM-4 signal.

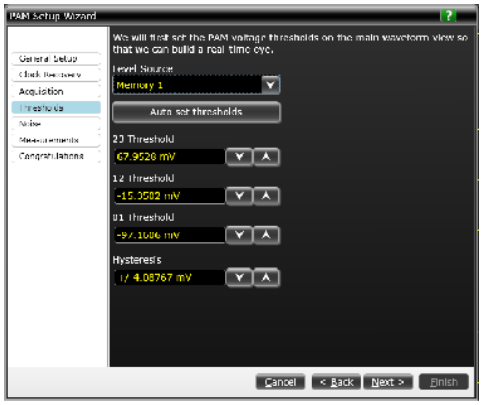


Leveraging the E2688A High-Speed Serial Data Analysis software, the N8827A/B is able to accurately set the individual threshold levels of your PAM-4 signal and render each individual eye.

PAM-4 specific clock recovery

You can choose different, software based clock methods that include first and second order phase -locked loop or constant frequency clock recovery. In addition, if you have a reference clock available, you can route that clock signal to an unused scope channel that you configure as an explicit reference clock for your PAM-4 signal. Transition qualified clock recovery delivers flexible transition-specific reference levels for patterns with low uniform density.



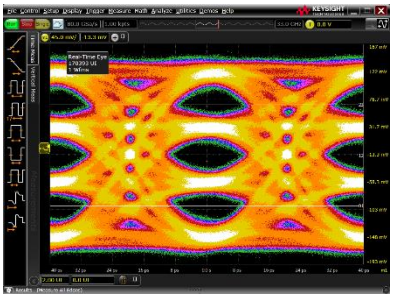


Perform Comprehensive Analysis of Pulse Amplitude Modulation (PAM-4) Signals using the N8827A/B

Accurate analysis of electrical and optical signals

Keysight's N8827A/B PAM software performs accurate analysis on electrical PAM-4 signals using measurements integrated directly into the Infiniium user interface (no external application is required). Communication links using PAM typically operate at much higher Symbol Error Rate (SER) than traditional NRZ links, so the N8827A/B analysis algorithms have been engineered to provide robust measurements on real world waveforms including those from severely degraded signals.

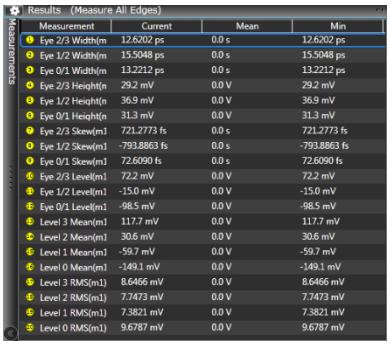
Eye diagram analysis



Analyze eye diagrams using built-in measurements:

- Eye-centric measurements:
  - Level - Skew
  - Eye height - Eye width

- Level-centric measurements:
  - Mean level (voltage or power)
  - Thickness (rms and p-p)
  - Skew



Waveform analysis

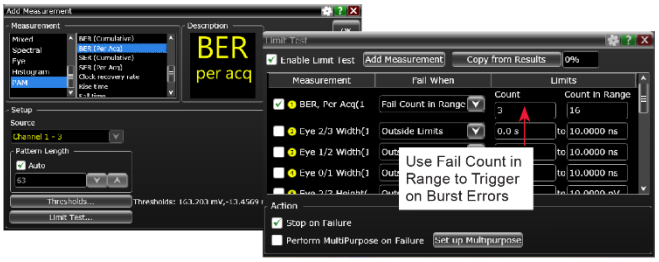
Analyze pattern waveforms including linearity and PRBS patterns.

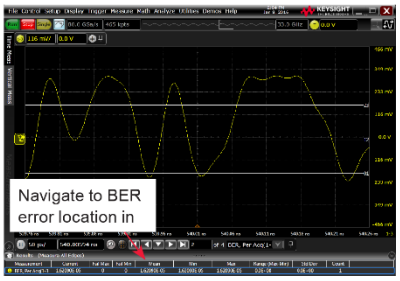
- Level measurements - Noise measurements
- Linearity

Bit error ratio (BER) and symbol error ratio (SER) measurements

Since PAM-4 often uses forward error correction (FEC), it is now possible to use an oscilloscope to perform BER and SER testing. Use the BER/SER measurements to determine error count and to show waveform location of errors for repeating patterns (such as PRBS7 [1]).

- BER/SER cumulative measures statistical BER level
- BER/SER per acquisition helps to identify and locate burst errors
- PAM-4 eye unfolding shows location of BER/SER errors in your actual PAM-4 waveform





1. BER/SER capability requires at least two error free copies of an identical repeating bit pattern in your scope acquisition memory in order to calculate BER/SER.

Advanced Analysis Features (PAM) Analysis Using the N8827A/B

Gain even deeper insights into your PAM signals

The existing library of Infiniium optional software analysis features also support more advanced analysis of PAM signals, providing even more insight into your designs. Using the Infiniium signal processing interface tools for real-time oscilloscopes, you can (for example), cascade S-parameter models and/or equalizers to model your transmission line, or backplane, and receiver.

Equalization

The optional N5461A InfiniiSim Serial Data Equalization Software adds powerful software equalization capability:

- CTLE - Continuous Time Linear Equalizer - FFE/LFE – Linear Feedforward Equalizer

Embedding/de-embedding

The optional N5465A InfiniiSim Waveform Transformation Toolset can simulate PAM signals at the end of a channel (embed) or remove the effects of a cable or channel (de-embedding).

- Embedding of channels
- De-embedding of cables, fixtures

Jitter/noise analysis

The optional N8823A EZJIT Complete software tool can be used to characterize jitter on PAM signals when using patterns such as IEEE JP03B (clock patterns):

- Random jitter
- Periodic jitter
- Vertical Noise

Offline analysis

The optional N8900A Infiniium Offline oscilloscope analysis software along with the N8827A/B PAM-4 option allow you to make PAM-4 measurements without having to work directly with an oscilloscope.

- Use saved or simulated PAM-4 signal

Oscilloscope compatibility

Oscilloscopes	Software
S-Series	5.6 or higher
V-Series	5.6 or higher
90000A Series	5.6 or higher
90000 X-Series	5.6 or higher
90000 Q-Series	5.6 or higher
Z-Series	5.6 or higher

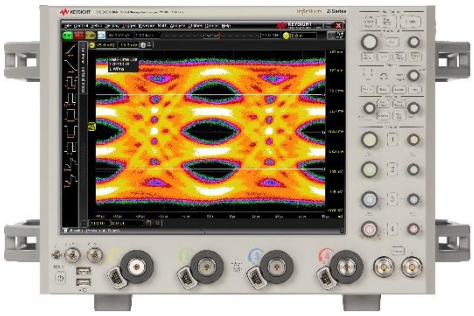
Ordering Instructions

PAM analysis software is available as an option when you order your new V-Series or Z-Series oscilloscope or as a standalone license that is assigned by the user to a single Infiniium oscilloscope, or it may be ordered as a transportable license (-1TP) that can be moved by the user from one instrument (or PC) to another.

To purchase the N8827A/B PAM analysis software with a new Infiniium oscilloscope please order the option indicated in the table.

License type			V-Series	Z-Series	S-Series	90000 X-Series	90000 Q-Series	90000A Series	Infiniium Offline
PAM-4 analysis software	Fixed	Factory-installed	N8827A-1FP	N8827A-1FP	N8827B-1FP	—	—	—	—
		User-installed	N8827A-1FP	N8827A-1FP	N8827B-1FP	N8827A-1FP	N8827A-1FP	N8827A-1FP	—
	Floating	Transportabled	N8827A-1TP	N8827A-1TP	N8827B-1TP	N8827A-1TP	N8827A-1TP	N8827A-1TP	N8900-006
		Server-based	N5435A-077	N5435A-077	—	—	—	—	N8900-006

To add the N8827A/B PAM analysis software to an existing Infiniium oscilloscope please order the following:



Model number	Description
N8827B-1FP	Fixed perpetual PAM-4 software for Infiniium S-Series oscilloscopes
N8827A-1FP	Fixed perpetual PAM-4 software for Infiniium V-Series, Z-Series, 90000 Q-Series, 90000 X-Series, or 90000A Series oscilloscopes

For PC's running the Keysight N8900A Infiniium offline application:

– N8827B-1TP

PAM-N analysis software, transportable perpetual license (move Option 1TP between any computers/PCs).

The N8827A/B requires that the E2688A serial data analysis or N5384A serial data analysis package also be licensed on the platform.

The N8900-006 requires that the N8900-002 also be licensed.

For more information, visit www.keysight.com/find/N8827A or www.keysight.com/find/N8827B

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

KEYSIGHT TECHNOLOGIES