

Innovation for the next generation



ML4039EML

4-Channel | 56 Gbaud PAM4 & NRZ | Bit Error Ratio Tester 400G | Integrated EML Laser Driver |

SSPRO, PRBS13Q & PRBS31Q | TX and RX Equalizers | Signal SNR and Histogram | High Voltage Amplitude |

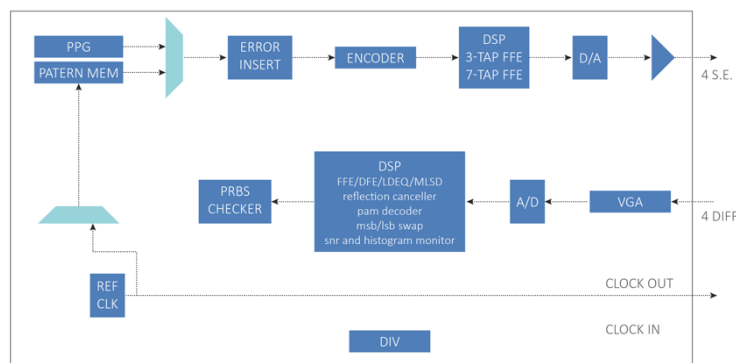
Summary

With the accelerated growth of hyperscale datacenters, the performance demands on Ethernet network infrastructure is increasing exponentially, and customer expectations for high-speed data throughput is at an all-time high. As a result, Bit Error Rate Testers (BERT) have become a cornerstone for physical layer testing, from qualifying bit transmission for fiber optic and copper-wire digital data transmission lines to testing signal integrity.

A BERT generates a sequence of bits through a communication channel and the received bits are then compared against the transmitted bits. A Bit Error Ratio (BER) evaluates the full end-to-end performance of a connectivity system and assures communication reliability.

ML4039EML

4x 56 GBd BERT



Introduction

The ML4039EML is a full feature 400G BERT that can be configured as a four-channel PAM4 56 GBaud or four-channel NRZ 56 Gbps lanes. Also, half rates around 28 GBd are supported.

The transmitters Support all standard test patterns mandated by IEEE and OIF such as PRBS13Q, SSPRQ, PRBS31Q, etc...

It is also possible to program the TX to output a user-defined pattern of 16384 UI maximum size. The transmitters are single-ended with swing up to 1800 mVpp to enable driving EML-based optics.

The error detectors are differential pairs with adaptive front-end signal conditioning.

Key Features

Transmit:

Data Rates: 23 – 29 & 46 – 58 Gbps
 Ability to tune the bit rate in steps of 100 kbps and find the RX PLL locking margin.
 Independent control of inner eye levels
 Up to 1.8 Vpp output swing single ended
 supports Gray coding and polarity inversion

Available patterns are:

- PRBS 7/9/11/13/15/16/23/31/58 and their inverses
 - PRBS13Q, PRBS31Q
 - SSPRQ
 - Square wave
 - Error injection
- 3-tap LUT-based Pre- and Post-emphasis
 7-tap linear FFE-based de-emphasis

Receive:

Adaptive DFE and FFE with reflection canceller and MLSD.

AGC

SNR monitoring over time.

PAM histogram monitor.

PAM slicer threshold adjustable.

Error-detection on following patterns:

- PRBS 7/9/11/15/16/23/31
 - PRBS13Q and PRBS31Q
- LOS indicators
 Adaptive 10-tap FFE monitor

General:

API libraries with documentation.

LabView driver and Python wrapper available.

Same product available in ATE format for Verigy 93K and Teradyne.

Target Applications

Production testing of transceiver drivers and TIAs.

Functional and SI testing.

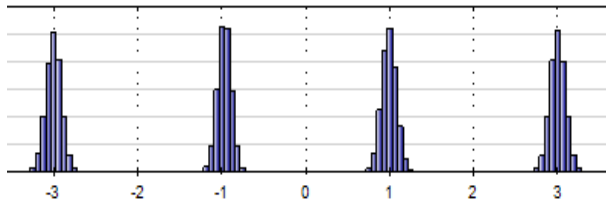


Figure 1: PAM eye histogram

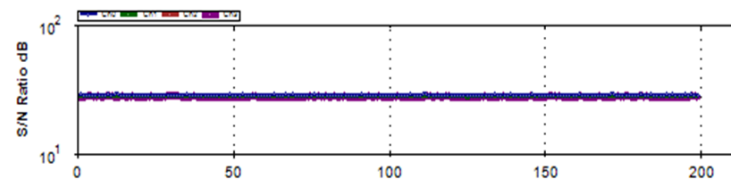


Figure 2: S/N Ratio over 200 captures

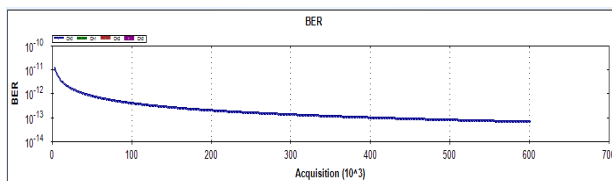


Figure 3: BER curves for one channel with 1 error inserted at the MSB and LSB respectively

Electrical Specifications

Parameter	Specifications
Bit Rates	23 – 29 GBaud and 46 – 58 GBaud
TX Amplitude	0 - 1800 mV
Patterns	PRBS 7/9/11/13/15/16/23/31/58 - PRBS13Q, 31Q and SSPRQ Square wave
TX Amplitude Adjustment	Steps of 1 mV
Pre- / Post-emphasis	6 dB
Pre-Emphasis Resolution	1000 steps
Equalizing Filter Spacing	1UI
Random Jitter RMS	230 fs
Rise/ Fall Time (20–80%) ¹	10 ps
Coding	DFE Pre-coding and Gray coding supported
Output Return Loss up to 10GHz	< -15dB
Output Return Loss (16-25GHz)	< -10dB
Error Detector input range	50 mV– 800 mV diff.

¹ With appropriate pre and post emphasis settings and 50 GHz scope

Total DFE/FFE/CTLE Equalization	Up to 13 dB
Error-detector VGA dynamic range	± 2 dB
TX/RX connectors	2.92 mm or 2.4 mm Connectors
Reference clock Output	Rate div 16/32/128/256
Diff. Input Return Loss	Better than 10 dB
Histogram	160 levels. Reports Counts/level based on 2^{20} bits
Clock Input Range	Up to 4.4 GHz
Clock Input Amplitude	200 - 1000 mV
Input Impedance	50 Ω
Temperature range	0-75 °C
Power	110V, 1.4A or 220V, 0.9A – 50/60 Hz
Power (ATE version only)	12 V, 1.5A

PRBS Pattern	Polynomial
7	$x^7 + x^6 + 1$
9 variant 1	$x^9 + x^4 + 1$
9 variant 2	$x^9 + x^5 + 1$
11	$x^{11} + x^9 + 1$
13Q	$x^{13} + x^{12} + x^2 + x + 1$
15	$x^{15} + x^4 + 1$
16	$x^{16} + x^5 + x^3 + x^2 + 1$
23	$x^{23} + x^{18} + 1$
31	$x^{31} + x^{28} + 1$
58	$x^{58} + x^{39} + 1$

Mechanical Dimensions

The ML4039EML is a benchtop instrument that fits in a 19-inch 2U rack. TwoBERTs arranged side by side comprise one 2U slot in the rack. Multilane supplies the needed brackets.



Ordering Information

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