multiLane

Innovation for the next generation

ML4039EML

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

SSPRQ, 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.

The ML4039EML is a 4x56 GBaud BERT that supports PAM4 & NRZ signal generation required for 400 Gb measurements. It is ideally suited for the production testing of systems, components, and Electro-Optical Modules. It supports the required test patterns defined by IEEE and OIF. It works as a single ended PPG. Other features include signal-to-noise ratio (SNR) and histogram measurements, as well as transmitter and receiver equalizers.

ML4039EML

4x 56 GBd BERT

Introduction

The ML4039EML is a full featured 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 1400 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 1.4 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.
- 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.
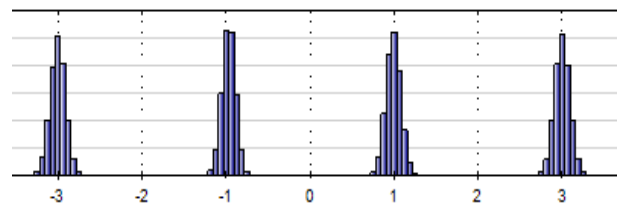- Same product available in ATE format for Verigy 93K and Teradyne.
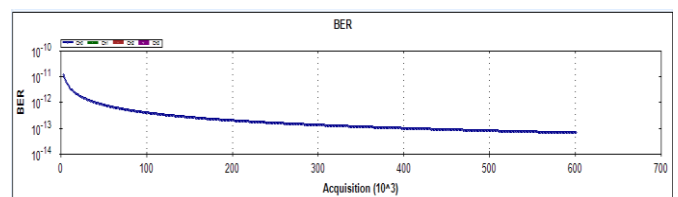

Figure 1: PAM eye histogram

Figure 2: BER curves for one channel with 1 error inserted at the MSB and LSB respectively
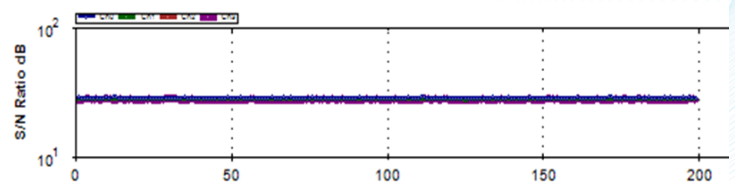

Figure 3: S/N Ratio over 200 captures

Target Applications

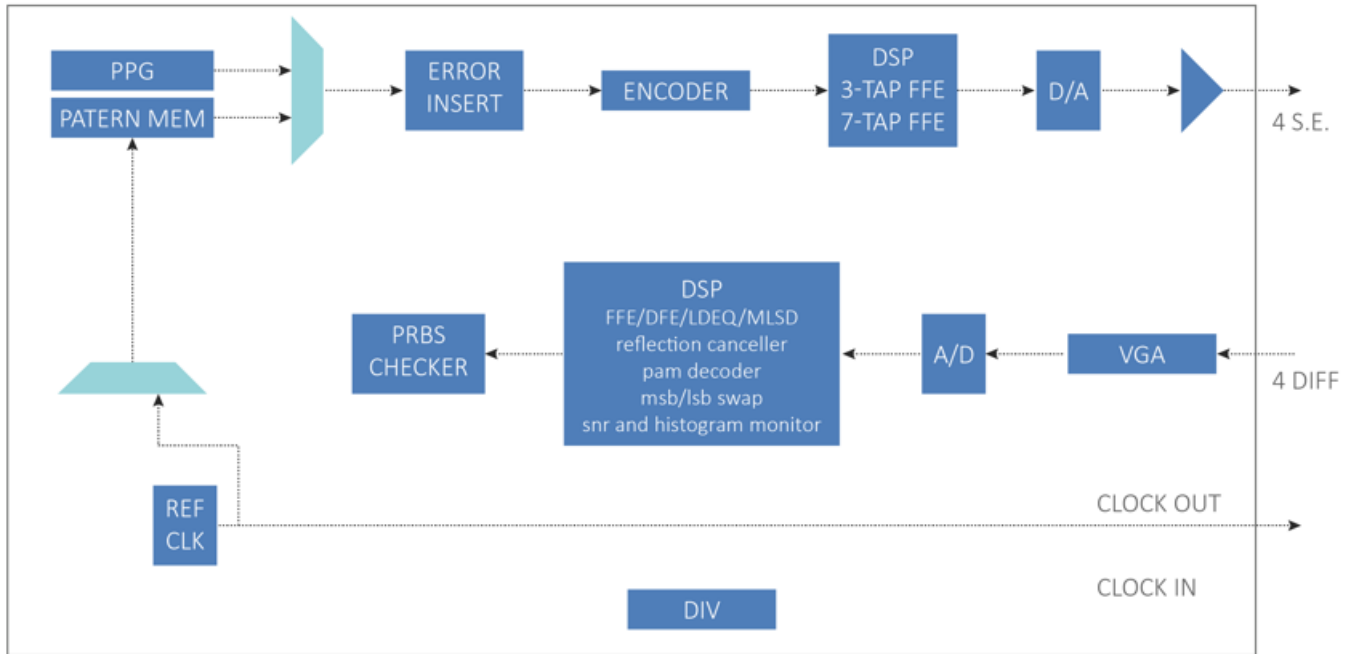- Production testing of transceiver drivers and TIAs.
- Functional and SI testing.

Figure 4: ML4039EML Block diagram

Electrical Specifications

Parameter	Specifications
Bit Rates	PAM4: 23 – 29 GBaud and 46 – 58 GBaud NRZ: 23 – 29 Gbps and 46 – 58 Gbps
TX Amplitude	0 - 1400 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	1 UI
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	< -15 dB
Output Return Loss (16-25GHz)	< -10 dB
Error Detector input range	50 mV– 800 mV diff.
Total DFE/FFE/CTLE Equalization	Up to 13 dB
Error-detector VGA dynamic range	± 2 dB
TX/RX connectors	2.4 mm connectors (2.92 mm optional)
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	110 V, 1.4 A or 220 V, 0.9 A – 50/60 Hz
Power (ATE version only)	12 V, 1.5 A

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

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

Mechanical Dimensions

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

Ordering Information

Option	Description
ML4039EML	400G BERT (4 CH 56 GBd NRZ)
3YW	Total 3-year warranty
CAL	Single calibration
3YWC	Total 3-year warranty with 3 annual calibrations
Option 29	2.92 mm connectors

Recommended Accessories

Instruments	Recommended *Phase matched cable pairs*	Alternative *Phase matched cable sets*	Comments
ML4039EML standard	6x MLCBPM-2.4-30	1x MLCBPM-2.4-30-4 1x MLCBPM-2.4-30-8	2.4 mm connector 2x6 channel 30 cm
ML4039EML standard	6x MLCBPM-2.4-60	1x MLCBPM-2.4-60-4 1x MLCBPM-2.4-60-8	2.4 mm connector 2x6 channel 60 cm
ML4039EML-29	6x MLCBPM-2.92-30	1x MLCBPM-2.92-30-4 1x MLCBPM-2.92-30-8	2.92 mm connector 2x6 channel 30 cm
ML4039EML-29	6x MLCBPM-2.92-60	1x MLCBPM-2.92-60-4 1x MLCBPM-2.92-60-8	2.92 mm connector 2x6 channel 60 cm

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