DATASHEET

Innovation for the next generation

ML4039E

4-Channel | 56 GBd PAM4 & NRZ | 400G BERT|

4 x 56 GBd NRZ/PAM4 BERT | SSPRQ, PRBS13Q & PRBS31Q | TX and RX Equalizers | Signal SNR and Histogram|

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 ML4039E is a 4x112 Gbps BERT that supports PAM4 signal generation required for 400G measurements as well as NRZ encoding. It is ideally suited for the validation and production testing of optical transceivers, in addition to functional and signal integrity testing. It supports the required test patterns defined by IEEE and OIF. Other features include signal-to-noise ratio (SNR) and histogram measurements, as well as transmitter and receiver equalizers.

ML4039E

4 x 56 GBd PAM4 BERT

Introduction

The ML4039E is a full featured 400G BERT that can be configured as four channels of 56 GBaud PAM4 or 56 Gbps NRZ. Also, half rates of 28 GBd are supported in PAM4 and NRZ modes.
The transmitters support all standard test patterns mandated by IEEE and OIF such as PRBS13Q, SSPRQ, PRBS31Q, etc. Additionally, the user may program the TX to output a user-defined pattern up to 131 kb long.
In addition, the ML4039E supports transmitter and receiver equalization to overcome signal integrity impairments due to channel losses or reflections.

Key Features

Transmit

- Data Rates: 23-29 & 46-58 GBaud (116 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 0.8 Vppd output swing
- Supports Gray coding and polarity inversion
- Error injection
- 3-tap LUT-based Pre- and Post-emphasis or 7-tap linear FFE

Available patterns are:

- PRBS 7/9/11/13/15/16/23/31/58 and their inverses
- PRBS13Q, PRBS31Q
- SSPRQ
- Square wave

Receive

- Programmable front-end attenuator
- 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
- Automatic pattern detects
- LOS indicators.

General

- LabView driver and Python wrapper available.
- API libraries with documentation.
- Same product available in ATE format for Advantest 93K system.

Target Applications

- Production testing of transceivers.
- Functional and SI testing

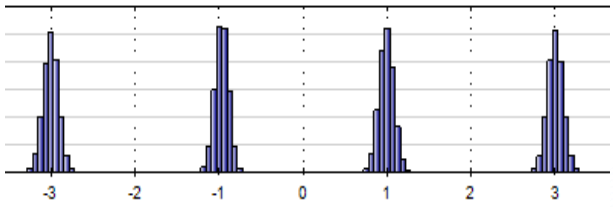

Figure 1: PAM eye histogram

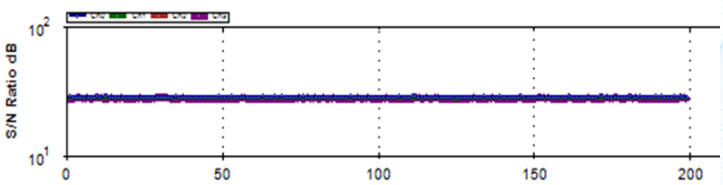

Figure 2: S/N Ratio over 200 captures

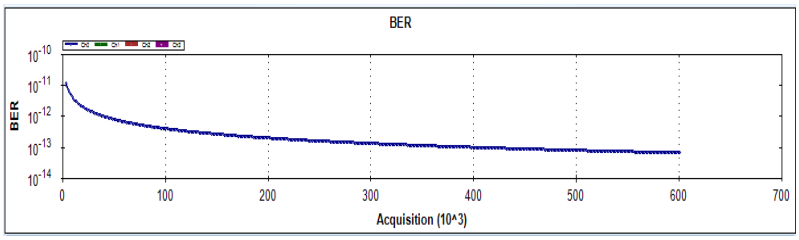

Figure 3: BER curves for one channel with 1 error inserted at the MSB and LSB respectively

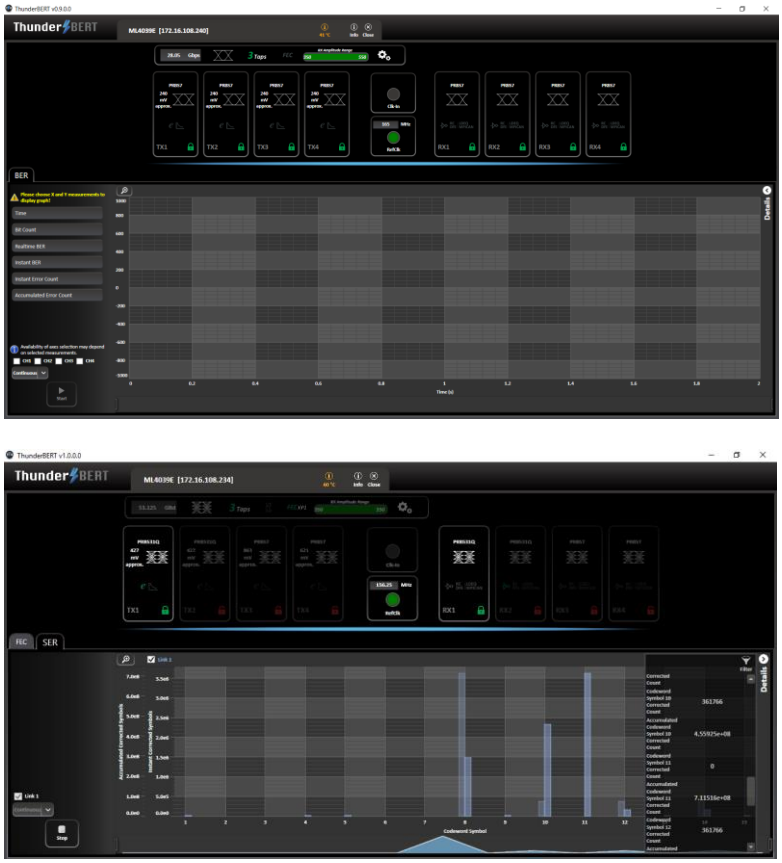

Figure 4: ThunderBERT GUI Screenshots

Specifications

Parameter	Specifications
Bit Rates	PAM4: 23-29 GBaud / 46-58 GBaud NRZ: 23-29 Gbps / 46 – 58 Gbps
TX Amplitude Differential	0 - 800 mVpp
Patterns	PRBS13Q, 31Q and SSPRQ Square wave
TX Amplitude Adjustment	Steps of 1 mV
Pre-emphasis resolution	1000 steps
Pre- / Post-emphasis	6 dB
Equalizing Filter Spacing	1 UI
Random Jitter RMS	< 290 fs[1]
Rise/ Fall Time (20–80%) [1]	< 10 ps
Coding	Gray coding supported
Output Return Loss up to 10GHz	< -15 dB
Output Return Loss (16-25GHz)	< -10 dB
Error Detector input range	50 – 800 mV diff.
TX/RX connectors	2.4 mm connectors (2.92 mm optional)
Reference clock Output	Rate division 8/16/32/128/170
Diff. Input Return Loss	Better than 10 dB
Clock Input Range	Up to 2.5 GHz
Clock Input Amplitude	100 - 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, 1.5 A

[1] With appropriate pre and post emphasis settings and 50 GHz scope. Trigger from adjacent data channel rate/8

Mechanical Dimensions

The ML4039E is a benchtop instrument that fits in a 19-inch 2U rack. Two ML4039Es arranged side by side take up one 2U slot in your rack. MultiLane also supplies the needed brackets.

Ordering Information

Option	Description
ML4039E	400G BERT (4 CH 56 GBd PAM4)
3YW	Total 3-year warranty
CAL	Single calibration
3YWC	Total 3-year warranty + 3 annual calibrations
FEC	Real hardware FEC
29	2.92 mm connectors

Recommended Accessories

Instruments	Recommended *Phase matched cable pairs*	Alternative *Phase matched cable sets*	Comments
ML4039E standard	8x MLCBPM-2.4-30	2x MLCBPM-2.4-30-8	2.4 mm connector 2x8 channel 30 cm
ML4039E standard	8x MLCBPM-2.4-60	2x MLCBPM-2.4-60-8	2.4 mm connector 2x8 channel 60 cm
ML4039E-29	8x MLCBPM-2.92-30	2x MLCBPM-2.92-30-8	2.92 mm connector 2x8 channel 30 cm
ML4039E-29	8x MLCBPM-2.92-60	2x MLCBPM-2.92-60-8	2.92 mm connector 2x8 channel 60 cm

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