![multiLane logo]

Innovation for the next generation

ML4039D

4-Channel | 28 GBaud PAM4 & NRZ | 200G BERT

4 x 28 GBd NRZ/PAM4 BERT | SSPRQ, PRBS13Q & PRBS31Q TX | FEC Estimation KR4/KP4 & SER | 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 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 ML4039D is a 200G, 4-channel, 28 GBaud PAM4 & NRZ BERT, ideal for the testing of transceivers.

ML4039D

4 x 28 GBd BERT

Introduction

The ML4039D is a fully featured 200G BERT that can be configured as 4 channels of 28 GBaud PAM4 or 4 channels of 28 Gbps NRZ.
The receivers support FEC emulator (KS4, KR4 and KP4) on both PAM4 and NRZ eye modes and will return the post-FEC BER per channel as well as MSB and LSB BERs within the stream. The receivers also show the eye's Histogram and the channel's SNR over time.
The transmitters support all standard test patterns mandated by IEEE and OIF such as PRBS13Q, SSPRQ and PRBS31Q. The user may also program the TX to output a user-defined pattern up to 32 kb long. The transmit power is adequate for testing up to 10 km SMF links.

Key Features

Transmit

- Data Rates in NRZ mode 9 – 14.2 and 23.1 – 29.6 Gbps
- Ability to tune the bit rate in steps of 100 kbps and find the RX PLL locking margin
- Data Rates in PAM4 mode 23.1 – 29.6 GBd
- High frequency clock out > 6.4 GHz
- Independent control of inner eye levels Up to 1.2 Vppd output swing
- Supports Gray coding and polarity inversion

Available patterns are:
- PRBS 7/9/11/13/15/16/23/31/58
- PRBS13Q and SSPRQ
- Square wave, JP03A/B, CID JTOL pattern
- Error injection
- 3-tap or 7-tap FIR Pre- and Post-emphasis
- Amplitude tunable in steps of 1.2 mV
- Separate control to scale the PAM4 signal

Receive

- Adaptive equalizer and channel IL estimator up to 14 dB (FFE+DFE).
- SNR monitoring over time
- Eye monitor
- PAM slicer threshold adjustable Error-detection on following patterns:
- PRBS7/9/11/13/15/16/23/31
- PRBS7Q/9Q/11Q/13Q/15Q/23Q/31Q
- LOS indicators

General

- API libraries with documentation
- LabView sample code
- Python wrapper
- Same product available in ATE format for Advantest 93K

Target Applications

- Production testing of transceivers
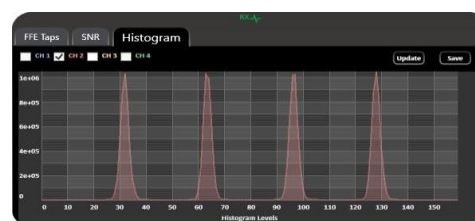- Functional and SI testing
- Research and development of High-Speed IOs
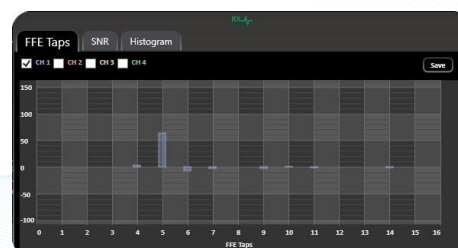

Figure 1: PAM eye histogram

Figure 2: RX FFE Taps

ThunderBERT GUI

Using the ThunderBERT GUI both accumulated and instantaneous BER and FEC measurements and analysis can be shown:
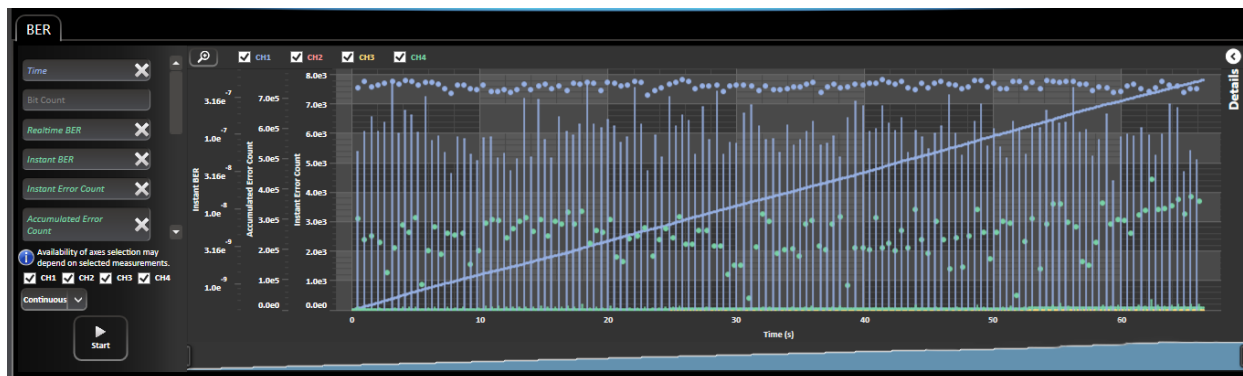

Figure 3: BER graphs over time using ThunderBERT GUI on the ML4039D
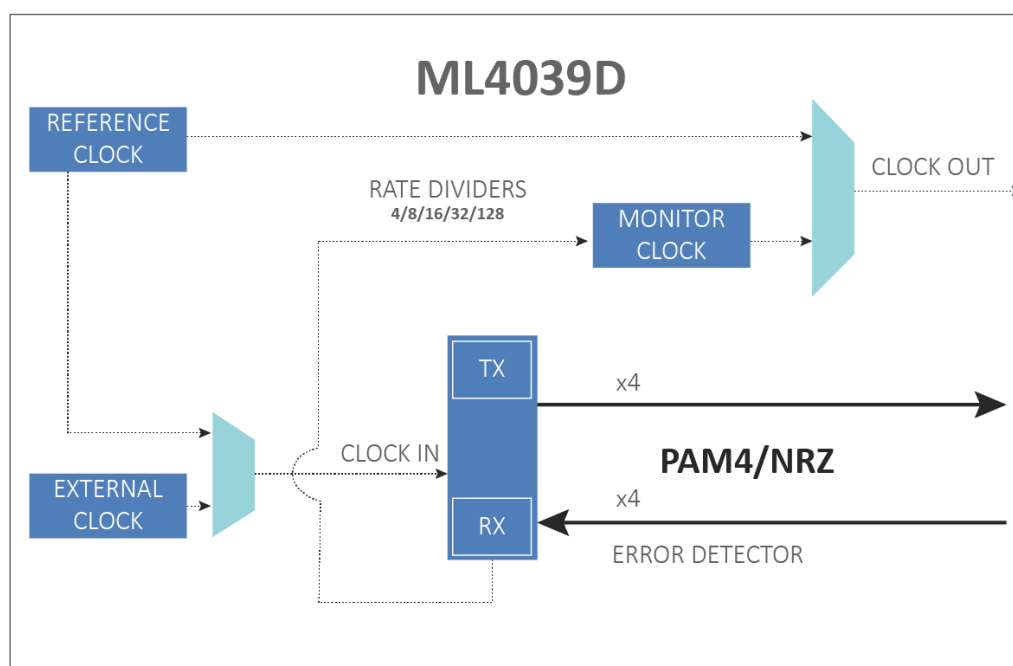
Block Diagram

Figure 4: Block Diagram

Specifications

Parameter	Specifications
Bit Rates	PAM4: 23.1-29.6 GBaud NRZ: 9-14.2 and 23.1-29.6 Gbps
TX Amplitude Differential	0 - 1200 mVpp
Linear Region	50 mV – 800 mV
TX Amplitude Adjustment	Steps of 1.5 mV
Pre- / Post-emphasis Resolution	±1000 steps
Equalizing Filter Spacing	1 UI
Random Jitter RMS	< 230 fs[1]
Rise/ Fall Time (20–80%)	16 ps
Coding	Gray coding supported
Output Return Loss up to 10GHz	< -10 dB
Output Return Loss (16-25 GHz)	< -8 dB
Error Detector input range	50 - 1200 mV differential
Total DFE/FFE/CTLE Equalization	More than 14 dB
TX/RX connectors	2.92 mm connectors (2.4 mm optional)
Reference clock Output	Rate div 4/8/16/32/128
Clock out amplitude	1.2 Vpp
Diff. Input Return Loss	Better than -8 dB up to 40 GHz
Clock Input Range	50 - 550 MHz
Clock Input Amplitude	200 - 1000 mV
Input Impedance	50 Ω
Operating Temperature	0-75 °C

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[1] Measured at 25G PRBS9. Scope trigger > 3GHz from adjacent channel

Mechanical Dimensions

The ML4039D is a benchtop instrument that also fits in a 19-inch 2U rack. Two ML4039Ds arranged side by side take up one 2U slot in your rack. MultiLane also supplies the needed brackets.

Ordering Information

Option	Description
ML4039D	200G BERT (4 CH 28 GBd PAM & NRZ)
3YW	Total 3-year warranty
CAL	Single calibration
3YWC	Total 3-year warranty with 3 annual calibrations
Option 24	2.4 mm connectors

Recommended Accessories

Instruments	Recommended *Phase matched cable pairs*	Alternative *Phase matched cable sets*	Comments
ML4039D standard	8x MLCBPM-2.92-30	2x MLCBPM-2.92-30-8	2.92 mm connector 2x8 channel 30 cm
ML4039D standard	8x MLCBPM-2.92-60	2x MLCBPM-2.92-60-8	2.92 mm connector 2x8 channel 60 cm
ML4039D-24	8x MLCBPM-2.4-30	2x MLCBPM-2.4-30-8	2.4 mm connector 2x8 channel 30 cm
ML4039D-24	8x MLCBPM-2.4-60	2x MLCBPM-2.4-60-8	2.4 mm connector 2x8 channel 60 cm

Please contact us at sales@multilaneinc.com.