multiLane

Innovation for the next generation

ML4079E

8 Channel | 56 GBd PAM4 & NRZ | 800G BERT

8 x 56 GBd NRZ/PAM4 BERT | SSPRQ, PRBS13Q & PRBS31Q | TX and RX Equalizers | Real FEC analysis | Gearbox cables testing

Summary

The early adoption of 800G brings new considerations for companies on the cutting edge. The exponential increase in data transfer speeds has resulted in higher Bit Error Rates, and a keen understanding of system functionality is crucial. Bit Error Rate Testers (BERTs) have therefore become a cornerstone of physical layer testing. From testing fiber optic and copper wire digital data transmission lines to testing signal integrity of transceivers, these instruments ensure the validity of the devices at the heart of data centers all over the world.

The ML4079E is an 800G BERT tailored to the needs of those looking to transition to an 800G environment with minimal hassle. This BERT supports the newly emerging 8x100 Gbps fiber-optic technology and the increasingly crucial real hardware FEC analysis to understand how your DUT will behave in a real data center environment.

The ML4079E features signal to noise ratio (SNR) and histogram measurements, and allows the user to implement transmitter and receiver equalizers. The ML4079E can also be used to optimize link performance to be able to minimize the ever-more important power consumption of high-speed connections. The ML4079E can be combined with the ML407-PAM jitter clock source for jitter tolerance testing.

ML4079E

8 x 56 GBd PAM4 BERT

Introduction

The ML4079E is a full featured 800G BERT that can be configured as eight channels of 23-29 and 46-58 GBaud PAM4 or 23 – 29 and 46 – 58 Gbps NRZ.

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.

The ML4079E supports real hardware FEC, with the following FEC modes:

- 400G line KP4
- 100G line KP1
- 100G line KR1

Once the FEC is enabled, the user will be able to see the post-FEC BER which indicates the bit error rate after enabling FEC and the amount of errored bits being corrected in real time.

In addition, the ML4079E supports transmitter and receiver equalization to overcome signal integrity impairments due to channel losses or reflections. This capability can also be used to optimize link performance and thus minimize power consumption.

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
- Supports Gray coding and polarity inversion
- Error injection

- 3-tap Pre- and Post-emphasis or 7-tap linear FFE
- Real hardware FEC. Pre- and post-FEC BER/SER, and FEC margin available on channels individually as well as on 100G, 400G, 800G blocks

Available patterns:
- PRBS 7/9/11/13/15/16/23/31/58
- PRBS13Q, PRBS31Q

Receive

- SNR monitoring over time
- PAM histogram monitor
- Error-detection on following patterns:
  - PRBS 7/9/11/15/16/23/31
  - PRBS13Q and PRBS31Q
- Automatic pattern detection
- LOS indicators
- Supported Rx equalization capabilities: DFE, Reflection Canceller, Level-Dependent Equalizer, Multipath Interference Canceller

General

- LabView driver and Python wrapper available.
- API libraries with documentation.

Target Applications

- Testing of copper and fiber-optic transmission lines
- Functional and SI testing of transceivers
- Characterization of 800G pluggables
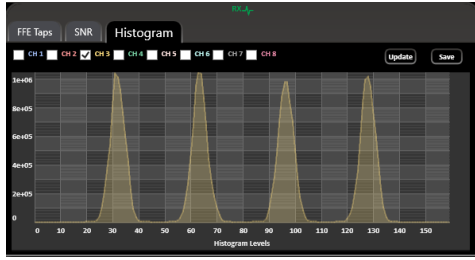- Gearbox cables testing
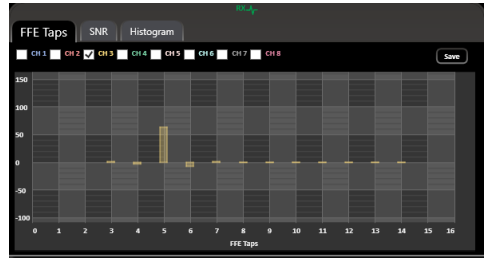
Figure 1: PAM4 eye histogram

Figure 2: RX FFE Taps

ThunderBERT GUI

Using ThunderBERT GUI, both instant and accumulated BER, FEC and SER measurements can be displayed and monitored:
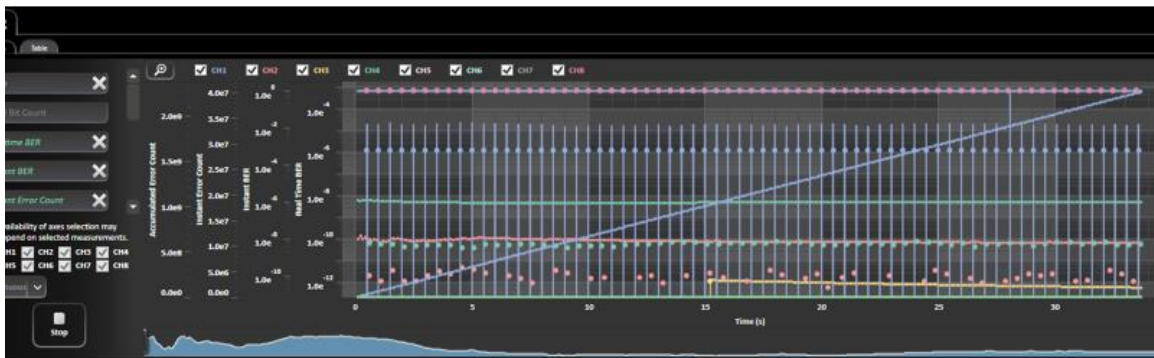

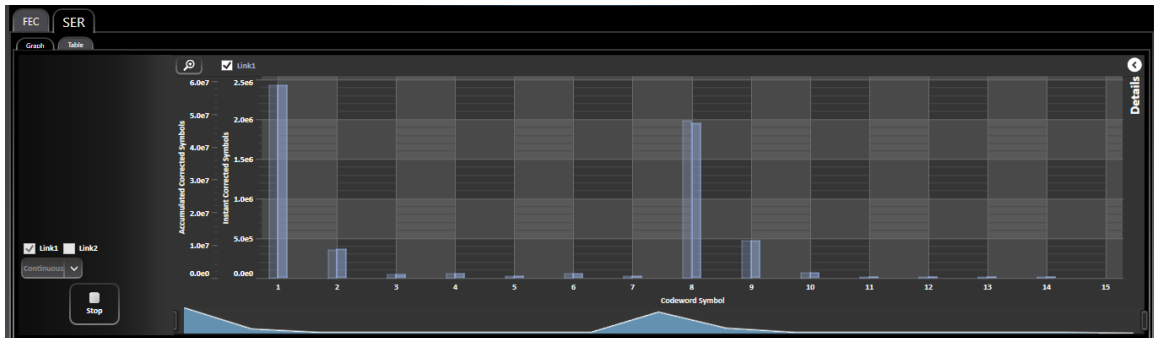**Figure 3: ThunderBERT GUI Screenshots showing BER measurements**

Figure 4: ThunderBERT GUI Screenshots showing SER measurements

Specifications

Parameter	Specifications
Bit Rates	PAM4: 23 – 29 GBaud / 46 – 58 GBaud NRZ: 23 – 29 Gbps / 46 – 58 Gbps
TX Amplitude Differential	0 – 700 mVpp
Patterns	PRBS 7/9/11/13/15/16/23/31/58/9_4 SQ16, SQ32, LIN, CJT, JP0838, SSPRQ, User Defined
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 [1]	< 300 fs
Rise/ Fall Time (20–80%) [1]	< 10 ps
Coding	Gray coding supported
FEC (up to 400G stripes)	KP (100G, 400G)
	KR (100G)
Output Return Loss up to 10 GHz	< -15 dB
Output Return Loss (16-25 GHz)	< -10 dB
Error Detector input range	50 – 800 mV differential
TX/RX connectors	4x M-SMPM 8 channel foot print on front panel
Reference clock Output — Reference clock	156.25 MHz
Reference clock Output — Monitor clock	Rate division 4/8/16/32/128/256
Diff. Input Return Loss	Better than 10 dB
Eye monitor resolution	8 bits horizontal across 2 UI / 9 bits vertical
Clock Input Range	Up to 4.4 GHz
Clock Input Amplitude	200 – 1000 mV
Input Impedance	50 Ω
Ambient Temperature	0 – 75 °C
Power	110 V, 1.4 A or 220 V, 0.9 A – 50/60 Hz

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

Mechanical Dimensions

The ML4079E is a benchtop instrument that fits in a 19-inch 2U rack. Two ML4079Es arranged side by side take up one 2U slot in your rack. MultiLane also supplies the needed brackets.

Ordering Information

Option	Description
ML4079E	800G BERT (8 CH 56 GBd PAM4)
3YW	Total 3-year warranty
CAL	Single calibration
3YWC	Total 3-year warranty with 3 annual calibrations
FEC	Real Hardware FEC analysis

Recommended Accessories

Instruments	Recommended	Comments
ML4079E	4x MLCBMS-2.4-25-B-M	4x 8-channel 10-inch (25 cm) cable, M-SMPM to 2.4 mm male connector
ML4079E	4x MLCBMS-2.4-25-B-F	4x 8-channel 10-inch (25 cm) cable, M-SMPM to 2.4 mm female connector
ML4079E	4x MLCBMS-2.4-60-B-M	4x 8-channel 24-inch (60 cm) cable, M-SMPM to 2.4 mm male connector
ML4079E	2x MLCBMS-67G-25-B-LB	2x 8-channel 10-inch (25 cm) loopback cable, M-SMPM to M-SMPM with 67 GHz bandwidth connector

Please contact us at sales@multilaneinc.com