

Innovation for the next generation



# ML4039B

4-Lane BERT | 1.25 – 29 GBd |  
NRZ & PAM4

4 Differential Error Detectors with CDR | 4 Differential Pulse Pattern Generators | PRBS31Q, SSPRQ & Custom Pattern | Adaptive FFE on receivers | Pre and Post Emphasis on TX

## Summary

With the accelerated growth of hyperscale datacenters, performance demands of Ethernet networks are increasing exponentially. As customer expectations for high-speed data throughput are at an all-time high, Bit Error Rate Testers (BERTs) have become a cornerstone for physical layer testing. Use cases range 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) quantifies the full end-to-end performance of a connectivity system and assures communication reliability.

The ML4039B is a 4-lane 200G BERT ideal for the testing of active semiconductor implementations. Some of its highlighted features include 4 differential error detectors and pulse pattern generators, custom pattern generation in addition to PRBS and SSPRQ, adaptive receiver FFE, transmitter pre/post-emphasis and progressive troubleshooting capabilities.

# ML4039B

## 200G BERT

### Introduction

The ML4039B is a fully featured 200G Bit Error Rate Tester. It has instrument-grade 2.92 mm coaxial connectors and covers a wide range of bitrates between 1.25 and 29 Gigabaud, while supporting both NRZ and PAM4 encoding schemes.

The GUI supports individual control of each TX level, equalization, eye balance, pattern selection and gray coding. The user may also inject error sequences into the stream. The receiver features CTLE and FFE equalization that, in combination with TX FFE, compensates for up to 30 dB of loss at Nyquist. It also enables advanced debug capabilities by showing separate LSB and MSB BER, offering targeted error-insertion and allowing real-time monitoring of the received signal histogram level, signal-to-noise ratio and receiver equalizer tap values.

### Key Features

- Low cost, instrument-grade BERT optimized for high-speed data analysis of 100G/200G devices
- Wide range of bitrate coverage enables PHY testing for Ethernet, HDMI 2, USB 3.1, PCIe, Fiber-Channel and more
- Ability to tune the bit rate in very fine steps to facilitate finding the locking margin
- Supports PRBS13Q/15Q/31Q and user-defined patterns.
- Low power consumption
- API library, sample code and Python wrapper

### Typical Applications

- Production testing of modules, cables and optoelectrical ICs
- Benchtop testing for functional and SI functionality
- Transceiver functionality validation testing



Figure 1: ML4039B - ThunderBERT GUI Window

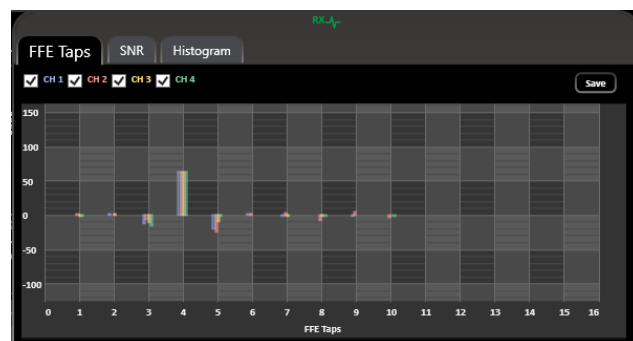


Figure 2: RX Diagnostics - FFE Taps using ML4039B

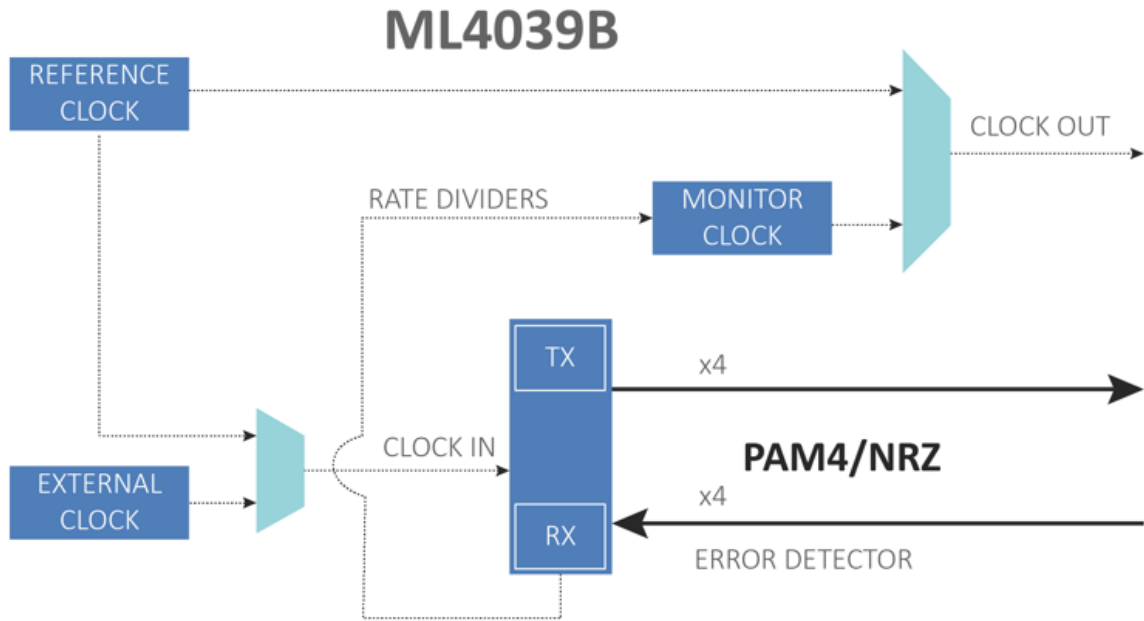


Figure 3: ML4039B Block Diagram

### ThunderBERT GUI

The ThunderBERT GUI is highly intuitive and responsive, supporting a variety of tests and measurements on the ML4039B platform. Please refer to the ThunderBERT User's Guide for detailed operational instructions.



Figure 6: Main GUI



Figure 4: ML4039B front view



Figure 5: ML4039B back view

## Electrical Specifications

Parameter	Specifications
Bit Rates	PAM4: 7 – 29 GBaud NRZ: 1.12–1.54 Gbps, 2.24 – 6.1 and 6.6 – 28.125 Gbps
TX Amplitude Differential	0 – 800 mVpp at 10 GBd 0 – 600 mVpp at 26 GBd
Patterns	PRBS 7/9/11/13Q/15/23/31Q/58/9_4 JP083B, IEEE 802.3bs, OIF-CEI-3.1 User defined
TX Amplitude Adjustment	Steps of 2 mV
Pre-Emphasis Resolution	±1000 steps
Equalizing Filter Spacing	1UI
Random Jitter RMS	230 fs
Rise / Fall Time (20–80%)	15 / 15 ps
Error Detector sensitivity	30 mVpp
Input Equalizer Dynamic Range	Up to 30 dB
TX/RX connectors	2.92 mm
Reference clock Output	Bitrate / 32, 64, 128, 256 or bitrate/170 LVPECL
Clock Input Range	80-700 MHz with an optimal value of 156.25MHz
Clock Input Amplitude	200 - 1200 mV
Clock Input Impedance	50 Ω
Temperature range	-15 to 70 °C
Weight	~1.5 kg
Dimensions LxWxH (cm)	35 x 22 x 9

## Mechanical Dimensions

The ML4039B is a benchtop instrument which also fits in a 19-inch 2U rack. Two ML4039B arranged side by side take up a single 2-RU slot in a rack. MultiLane also supplies the needed brackets.



Figure 7: ML4039B dimensions

## Ordering Information

Option	Description
<b>ML4039B</b>	200G BERT (4-lane up to 30 GBd)
<b>3YW</b>	Total 3-year warranty
<b>CAL</b>	Single calibration
<b>3YWC</b>	Total 3-year warranty with 3 annual calibrations

## Recommended Accessories

Instruments	Recommended phase matched cable pairs	Alternative phase matched cable sets	Comments
<b>ML4039B</b>	8x MLCBPM-2.92-30	2x MLCBPM-2.92-30-8	2.92 mm connector 2x8 channel 30 cm
<b>ML4039B</b>	8x MLCBPM-2.92-60	2x MLCBPM-2.92-60-8	2.92 mm connector 2x8 channel 60 cm

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