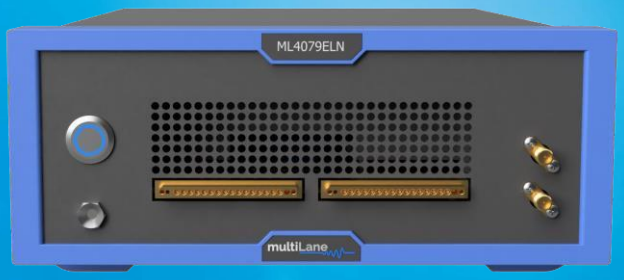
multiLane

DATASHEET

Innovation for the next generation

ML7008E-LFN



800G BERT | 8 Channel | 66 GBaud PAM4 & 66 Gbit NRZ | SSPRQ, PRBS13Q & PRBS31Q | IEEE802.3ck specs for Long Reach & AWGN Injection Compliance | Real Hardware FEC Analysis | Linear Optics Testing | PCIe Gen 3.0, 5.0 and 6.0 Applications | Up to 34dB Equalization |Compatible with the MWTP

Summary

The ML7008E-LFN is an 8-channel, 800G BERT purpose built for long reach applications including PCIe-Gen 3, 5 and 6, automotive, transceiver and data center interconnect testing. The ML7008E-LFN features a wide range of line rate coverage, up to 34dB equalization, built-in AWGN noise injection, and ratio level mismatch (RLM), control, providing a single platform for testing up to 8x66 GBaud.

The MW7008E-LFN is compatible with the MWTP, the user can fit up to 2 MW7008E-LFN, to test up to 16 channels

The ML7008E-LFN includes transmitter equalization (3 or 7 taps FFE), and receiver equalization. The ML7008E-LFN can provide measurements for Signal-to-Noise Ratio (SNR), histogram measurements, and Real Time BER Measurements and FEC Measurements.

ML7008E-LFN

8 x 64 GBaud PAM4 BERT

Introduction

The ML7008E-LFN is a fully featured 800G BERT that can be configured for eight channels of 1-1.5Gbps; 2.55-5.9Gbps; 7.3-11Gbps; 24-32Gbps and 41-66Gbps NRZ and 21.25-21.75GBaud; 26.5625-36GBaud and 44-66GBaud PAM4.

The transmitters support all standard test patterns mandated by IEEE802.3ck stress testing and OIF such as PRBS13Q, SSPRQ, PRBS31Q, etc. Tx can also be programed to output a user-defined pattern.

The ML7008E-LFN supports transmitter and receiver equalization up to 34dB to overcome signal integrity impairments due to channel losses or reflections.

Additionally, users can opt to programmatically add an ISI channel equivalent to a frequency-dependent attenuator with 1 to 9dB loss at Nyquist.

The ML7008E-LFN is specifically for linear optic, PCIe Gen 3.0, 5.0 and 6.0, and Active and Passive Cable stress testing, with unique AWGN injection and high Rx equalization capabilities.

Key Features

Transmit

Data Rates: 1-1.5Gbps; 2.55-5.9Gbps; 7.3-11Gbps; 24-32Gbps and 41-66Gbps NRZ and 21.25-21.75GBaud; 26.5625-36GBaud and 44-66GBaud PAM4.

- Ability to tune the bit rate in steps of 100kbps and find the RX PLL locking margin
- DFE and CTLE Equalization
- Independent control of inner eye levels
- Up to 1Vpp controllable Tx Amplitude swing
- Supports Gray coding

Real hardware FEC. SER and FEC measurements and margin available on channels individually as well as on 100G, 400G and 800G blocks.

- Available patterns:
    - PRBS7/9/11/13/15/16/23/31/58
    - PRBS13Q, PRBS31Q
    - SSPRQ
    - Square wave
- Burst and random noise injection.

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.
- Up to 34dB Equalization Capabilities.

General

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

Target Applications

- Pluggable and Linear Pluggable Optics Stress testing.
- PCIe Gen 3.0, 5.0, and 6.0 testing.
- Testing of copper and fiber-optic transmission lines.
- Active and Passive Cable Testing.

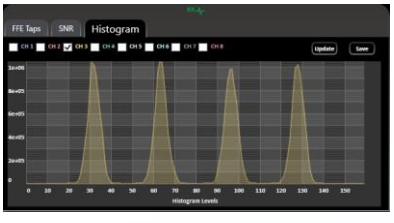


Figure 1: PAM4 eye histogram

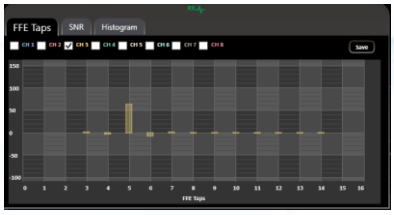


Figure 2: RX FFE Taps

Interference Tolerance – ITOL Capabilities

The ML7008E-LFN enables a noise injection feature to emulate real-life crosstalk scenarios along with shallow loopback testing. Noise implementation can take the form of a continuous interference, burst crosstalk, or single shot noise and can be configured on each channel independently. The shallow loopback function works with a variety of traffic types including unframed PRBS, framed Ethernet and FEC traffic.

In addition, the ML7008E-LFN follows the specifications of the IEEE Std 802.3-2018, IEEE Standard for Ethernet SECTION SIX, and Annex 93C stating that the noise shall be Gaussian white noise with a flat frequency response following the Mask in Figure 3, and a Crest Factor greater than 5.

Measurement	Value
Crest Factor	8.0686
Noise Flatness	2.4 dBm
V_{rms}	135.13 mV

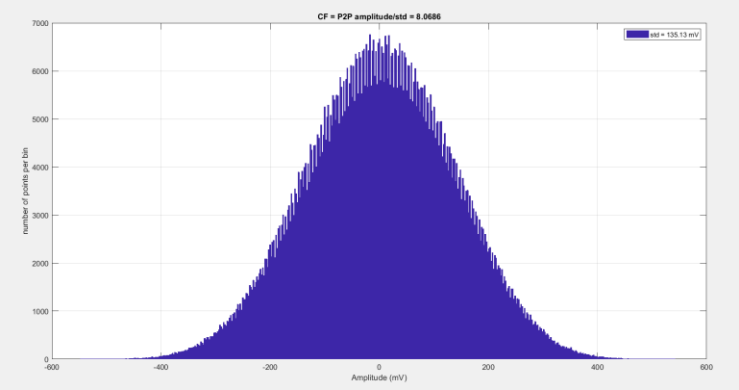


Figure 3: Crest Factor Measurement: Gaussian Noise

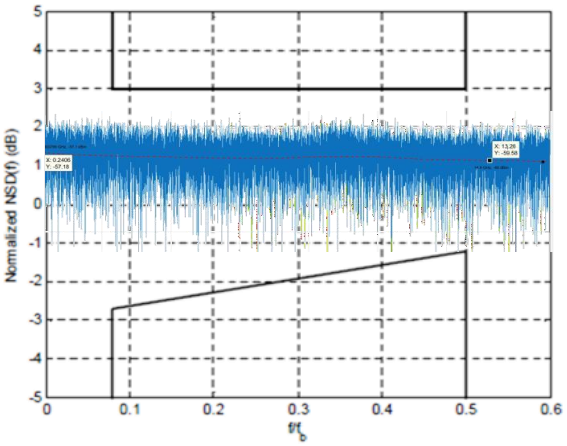


Figure 4: Noise Flatness

Random Noise Injection

- Independent Control on each pair of channels.
- Calibrated Noise Injection.
- Up to 10mV Noise Injection.

Interference Tolerance Automated Test ITOL:

- Random Noise Effect on BER.
- Pass/Fail Verdict based on each noise step and selected BER.

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

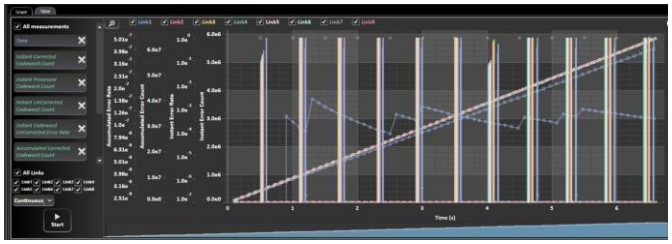


Figure 5: ThunderBERT GUI Screenshots Showing BER Measurements

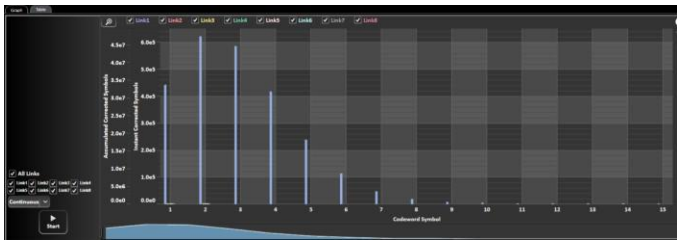


Figure 6: ThunderBERT GUI Screenshots Showing SER Measurements

Noise Effect on Eye

Shallow Loopback mode

Figure 6 depicts a ML7008E-LFN accepting traffic from an external 800GE switch, looping the traffic internally and re-transmitting it back to the RX side of the host. This can be used to test the robustness of the host port, by adding an increasing amount of crosstalk noise and understanding where the receiver starts producing errors.

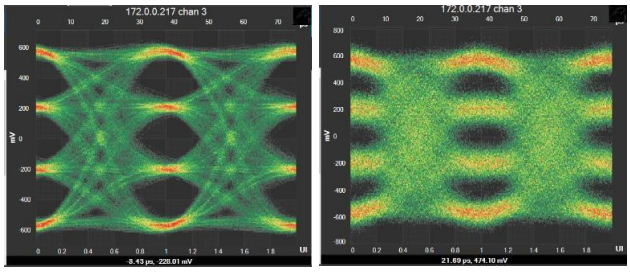


Figure 7: Eye Diagram before and after noise injection – PAM4 modulation

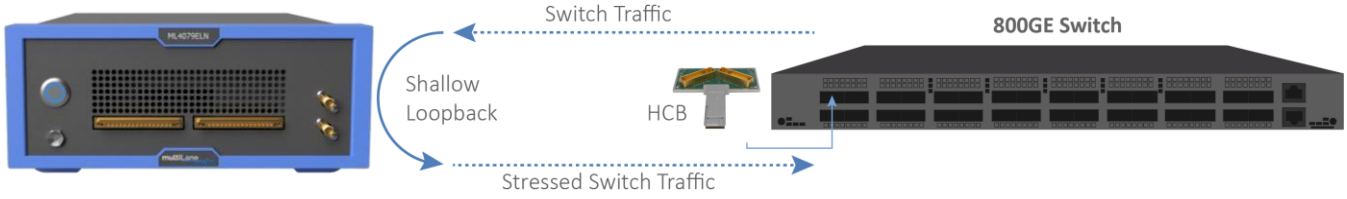


Figure 8: Shallow Loopback Using ML7008E-LFN and 800G Switch

RLM Stress Test: Inner/Outer Eye Control on PAM4 Mode:

ML7008E-LFN supports a full Inner and Outer Eye Control Range using the ThunderBERT GUI.

This feature enables the robustness testing of the transmitted signal by changing the Inner/Outer Eye settings and measuring the Level Separation Mismatch Ratio (RLM). The obtained value is compared to the IEEE 802.3 Transmitter Characteristics Value for Compliance Evaluation.

Figure 9 illustrates 3 different Inner/Outer Eye settings using the ML7008E-LFN.

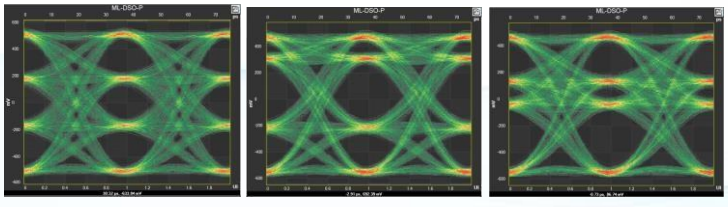


Figure 9: Inner/Outer Eye Control Using ML7008E-LFN

Specifications

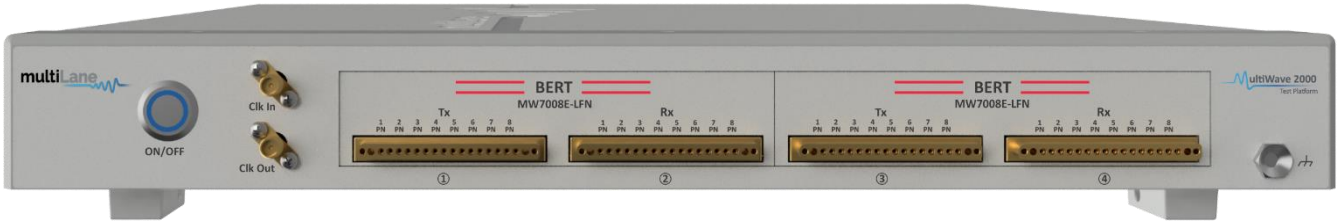
Parameter		Specifications
Bit Rates		NRZ: 1G to 1.5G; 2.55G to 5.9G; 7.3G to 11G; 24G to 32G and 41G to 66G PAM4: 21.25G to 21.75G; 26.5625G to 36G and 44G to 66G
TX Amplitude Differential		0 – 800 mVpp
Patterns		PRBS 7/9/11/13/15/16/23/31/58/9_4 SQ2, SQ4, SQ8, SQ16, SQ32
TX Amplitude Adjustment		Steps of 1 mV
Pre-emphasis resolution		1000 steps
Pre- / Post-emphasis		6 dB
Equalizing Filter Spacing		1 UI
Random Jitter RMS [1]		< 290 fs
Rise/ Fall Time (20–80%) [1]		< 10 ps
Coding		Gray coding supported
FEC (up to 800G)		8x100G and 2x400G in KP Mode
		50G KR Mode
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		1X16 SMPS footprint on front channel
Reference clock Output	**Reference clock**	156.25 MHz
	Monitor clock	High Frequency Clock: Multiplier of 1 to 30 of the reference clock
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		800 – 1600 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

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

Mechanical Dimensions

The ML7008E-LFN is a benchtop instrument that fits in a 19-inch 2U rack. Two ML7008E-LFNs arranged side by side take up one 2U slot in a rack. MultiLane also supplies the needed brackets.

Up to 2x MW7008E-LFN can fit in the MWTP chassis:



Ordering Information

Option	Description
ML7008E-LFN	800G BERT (8 CH 64 GBaud PAM4)
FEC	Real Hardware FEC analysis
AWGN	Random Noise Injection & ITOL
3YW	Total 3-year warranty
CAL	Single calibration
3YWC	Total 3-year warranty with 3 annual calibrations

Recommended Accessories

Part number	Description
MLCC-SMPSBFC116-F047075-185MST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (M), Flexible 047, 7.5 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04715-185MST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (M), Flexible 047, 15 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04730-185MST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (M), Flexible 047, 30 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04760-185MST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (M), Flexible 047, 60 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F047075-185MST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (M), Flexible 047, 7.5 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04725-SMPSBFC116	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1X16 SMPS Blind-Mate (F), Flexible 047, 25 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F047075-185FST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (F), Flexible 047, 7.5 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04715-185FST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (F), Flexible 047, 15 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04730-185FST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (F), Flexible 047, 30 cm, phase matched to +/-0.5 ps.
MLCC-SMPSBFC116-F04760-185FST	Coax Cable Assembly, 1X16 SMPS Blind-Mate (F) to 1.85 mm (F), Flexible 047, 60 cm, phase matched to +/-0.5 ps.

Please contact us at sales@multilaneinc.com