

Innovation for the next generation



## ML4015D

25 GHz | 40 GHz Bandwidth  
Optical Sampling Oscilloscope

53.1 GBaud PAM4 signaling | Reduced cost of test  
Ideal for 100G Lambda MSA transceivers  
TDECQ measurements | SSPRQ patterns  
High throughput | High sensitivity

### 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.

# ML4015D

## 25 & 40 GHz Optical DSO

### Introduction

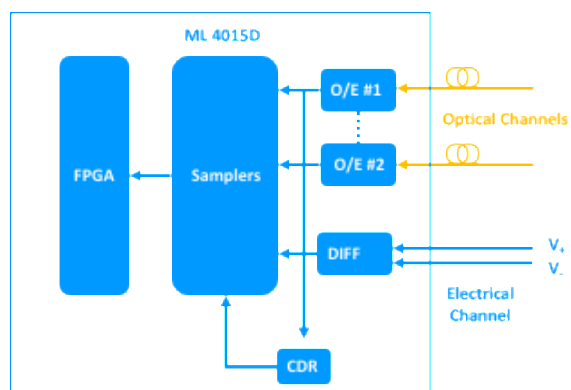
The ML4015D is a fully featured, cost effective single, dual or quad channel optical sampling oscilloscope. It can be configured to have an analog bandwidth of 25 or 40 GHz. The supported wavelengths are either 1260 to 1650 nm Single-Mode or 750 to 860 nm Multi-Mode. The ML4015D can also be configured with one differential electrical channel.

### Key Features

The ML4015D family of optical DSOs is truly powerful, boasting an extensive set of features and functions that are unique in the industry. These include:

- A noise floor of 3  $\mu$ W at an analog bandwidth of 25 GHz, and 5  $\mu$ W at 40 GHz bandwidth.
- -13 dBm sensitivity level for a 25.78 Gbps NRZ signal<sup>1</sup>.
- Up to 100 MHz sampling rate
- Less than 5 seconds TDECQ on a SSPRQ pattern
- Fast pattern capture and DSP due to an FPGA-based architecture.
- Pattern capture above 8 M samples enabling measurements such as TDECQ on SSPRQ and PRBS16 patterns.

- An extensive library of built-in DSP filters such as Bessel-Thomson, CTLE, DFE, FFE, de-embedding and component emulation, all available free of charge in the standard GUI.
- Built-in standard masks library
- Individual impulse response correction at factory.
- Cost-effective, small footprint, rugged instrument.
- A complete set of APIs and a dozen of example code to speed up integration under Linux and Windows, using Python, LabView, Matlab and C#.



### Typical Applications

- Production testing of 1G to 400G transceivers
- Optical transceiver test
- Transceiver manufacturing test
- Transceiver evaluation and validation
- Qualification of PAM-N and NRZ optical modulators and drivers.
- Sensitivity testing of optical receivers
- TP1-a stress calibration
- System testing with ML1016D-CR clock recovery

<sup>1</sup> The sensitivity level is measured using the 25.78G CWDM4 mask. It indicates the average optical power at which the 5E-5 mask margin drops to 0%

## Electrical Specifications

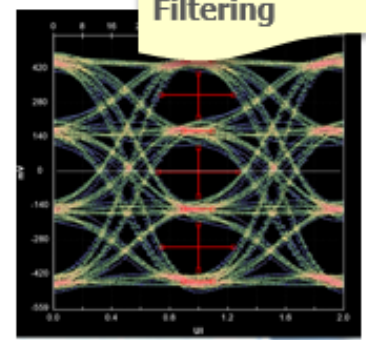
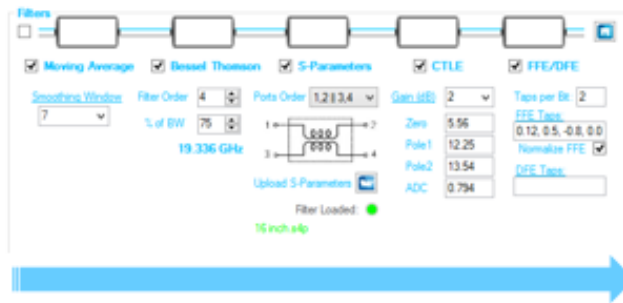
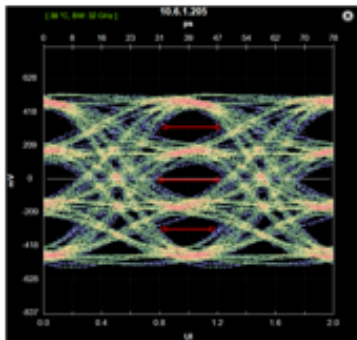
Parameter	Specifications
SM Wavelength	1260 – 1620 nm
MM Wavelength	780 – 860 nm
Calibrated wavelengths	1310 nm and 850 nm
Optical bandwidth	25 or 40 GHz
Noise RMS at 1310 nm	3 $\mu$ W at 25 GHz 5 $\mu$ W at 40 GHz
Sensitivity at 1310 nm at 25.8 G NRZ	< -13 dBm
Intrinsic jitter	200 fs rms
Input Power damage level	10 dBm
Fiber Input SM	9 / 125 $\mu$ m
Fiber Input MM	62.5 / 125 $\mu$ m
Connector	FC PC
Electrical channel Connectors	2.92 or 2.4 mm
Clock input bandwidth	0.1 – 4.4 GHz
Clock input swing	225 ~ 1800 mVpp
Clock input connector	SMA (f), 50 $\Omega$
Sampling frequency	70 ~ 100 MHz
Memory	8 MSa.
Pattern Lock	Up to PRBS-16, SSPRQ
Temperature range	0 ~ 75 $^{\circ}$ C
Line Power	100 ~ 240 V ac, 50/60 Hz
Electrical bandwidth	32 or 50 GHz

## Supported Measurements

Coding	Measurement
<b>PAM-4</b>	TDECQ
	SNDR
	RLM
	OMA <sub>outer</sub>
	Eye Height by BER
	Eye Width by BER
<b>NRZ</b>	Top & Base
	Min & Max
	One & Zero
	Transition Time
	Crossing %
	AOP
	OMA
	Mask
	Peak to Peak
	Eye Amplitude
	Eye Height
	Eye Width
	Jitter
	SNR
	ER
	VEC
	Vrms
	DJ & RJ
Noise	

## Supported DSP Functions

- Frequency response correction of O/E & analog front end.
- Bessel Thomson 4th Order
- CTLE Adaptive/manual
- FFE Adaptive/manual
- DFE Adaptive/manual
- De-embedding S4
- Normalizing filter
- Moving average





## Annex A: PAM4 and NRZ Sample Measurements on the ML4015D

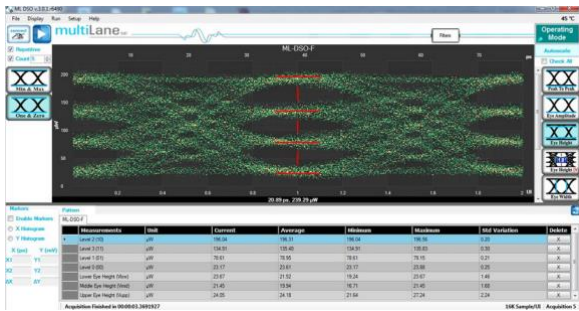


Figure 1: 25 Gb/s Optical PAM4 Signal with AOP= -8.5dBm

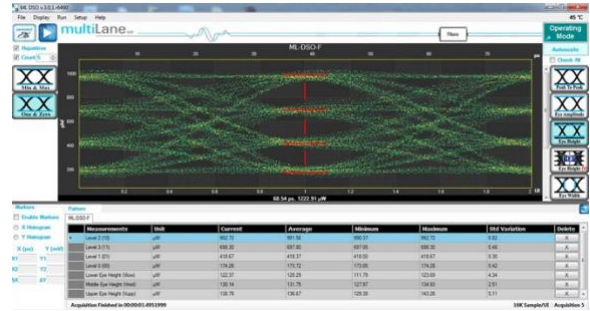


Figure 2: Optical 25 Gb/s PAM4 signal with -1.5dBm AOP

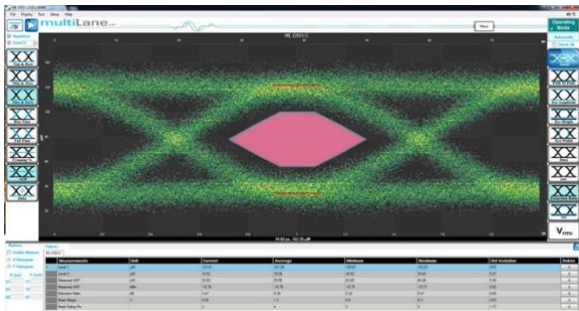


Figure 3: 25G NRZ optical signal at -8 dBm AOP

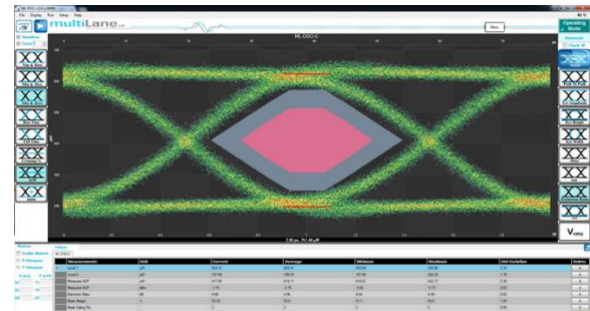
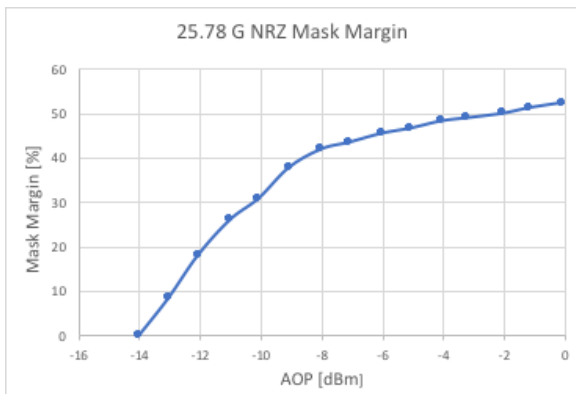


Figure 4: Optical NRZ 25G Signal with AOP -1dBm

## Annex B: 25.78 G NRZ Mask Margin on a CWDM4 Commercial Transceiver over AOP



## Mechanical Dimensions

The ML4015D is a benchtop instrument that also fits in a 19-inch 2U rack. Two ML4015Ds arranged side by side comprise one 2U slot in the rack. MultiLane also supplies the needed brackets.



## Ordering Information

Option	Description
<b>ML4015D-XX-YY</b>	
<b>-XX</b>	Bandwidth optical = <b>25</b> or <b>40</b> GHz <sup>1</sup>
<b>-YY</b>	Single-mode or multi-mode fiber <b>SM</b> or <b>MM</b>
<b>3YW</b>	3-year warranty

**Note 1:** multi-mode is not available as 40 GHz version  
Other configurations may be possible. Please contact MultiLane.

Please contact us at [sales@multilaneinc.com](mailto:sales@multilaneinc.com).

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