multiLane

DATASHEET

Innovation for the next generation

ML4015F

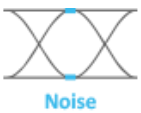
Electrical Sampling Oscilloscope

112GBaud PAM4 signals validation | Supports 802.3bs TDECQ measurements via SSPRQ patterns | Open Eye MSA support | 100G and 200G per lane channel characterization | 70Ghz Electrical sampler bandwidth | Available with SMPS or 1.85mm connectors

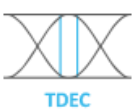
Summary

Rapid transition and adoption to 200G per channel electrical interfaces – key to 800G and 1.6T networks – requires cost-effective characterization tools to accelerate the deployment and enable proof of concept and validation. The precise validation of 53.125GBaud, 106.25GBaud, and 112GBaud PAM4 Electrical Signals requires prohibitively expensive instrumentation setups for production applications. MultiLane introduces the ML4015F Electrical Sampling Oscilloscopes as a well-correlated solution for accelerated validation at scale.

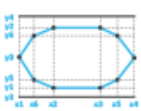
Key Features



Extremely low noise



Fast TDECQ



Comprehensive eye mask library

Extensive library of built-in DSP filters

Brand new user interface

Precision TimeBase

Extremely low jitter

ML4015F

Electrical DSO

Introduction

The ML4015F is a fully featured, cost effective single or Dual channel Electrical sampling oscilloscope, with a 70Ghz differential electrical sampler.

Key Features

The ML4015F family boasts an extensive set of features and functions that are unique in the industry. These include:

- A noise floor of 1.2mV at 70Ghz bandwidth
- Up to 50 - 70 MHz sampling rate
- Less than 10 seconds TDECQ on an SSPRQ pattern
- FPGA-based architecture enabling TDECQ measurements via capture of 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
- Comprehensive eye mask library
- Individual impulse response calibration performed at factory
- Compact instrument footprint with a ruggedized enclosure and handle
- Comprehensive set of APIs and associated sample scripts to accelerate automation development under Linux and Windows, supporting Python, LabView, Matlab, and C#

Typical Electrical Applications

- TP1a stress calibration for 224G
- SERDES characterization
- Receiver electrical output characterization
- Benchtop characterization of electrical circuits

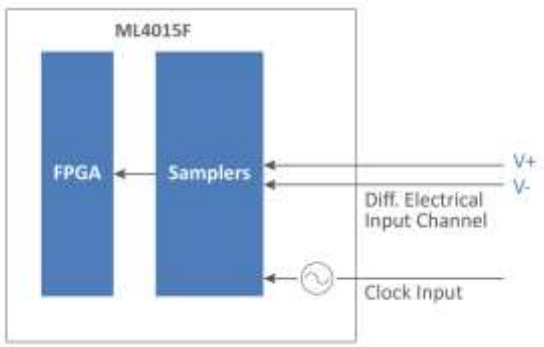


Figure 1: Schematics of the ML4015F

Electrical Specifications

Parameter	Specifications
Electrical amplitude	< 600 mV SE and < 1200 mV Diff
Electrical bandwidth	70Ghz
Intrinsic jitter	250 fs rms
Electrical channel Connectors	SMPS, 1.85 (available upon request)
Analog Sampling Hardware Resolution	14 bits
Clock input bandwidth	0.1 - 14Ghz
Clock input swing	225 - 1800 mVpp
Clock input connector	K (f), 50 Ω
Pattern capture	> 8 M Samples
Sampling frequency	50 - 70 MHz
Memory	8 MSa
Pattern Lock	Up to PRBS16, SSPRQ
Temperature range	0 - 75 °C
Line Power	100 - 240 V AC, 50 / 60 Hz

Minimum PC Specifications	
OS	Windows 7 64-bit
Processor	Core i5 / Ryzen 5
Memory	8 GB
Storage	2 GB

Recommended PC Specifications	
OS	Windows 10 64-bit
Processor	Core i7 / Ryzen 7
Memory	16 GB
Storage	10 GB

Supported DSP Functions

- Frequency response correction of O/E & analog front end.
- N^{th}-Order Bessel-Thomson.
- CTLE adaptive or manual.
- FFE adaptive or manual.
- DFE adaptive or manual.
- De-embedding or embedding of four-ports (.s4p) and two-ports (.s2p) files.
- Moving average.

Figure 2: Multi-Signal Display Feature

	Measurements	Unit	Current	De
▸	OMA(outer)	µW	340.62	X
	OMA(outer)_Level3	µW	463.21	X
	OMA(outer)_Level0	µW	122.59	X
	OMA(outer)	dBm	-4.68	X
	Open Eye MSA DC Balance		0.0707	X
	Open Eye MSA Inter Eye Skew	UI	0.00	X
	Open Eye MSA Symbol Symmetry		0.96	X
	Open Eye MSA EHlow	% OMA Outer	12.43	X
	Open Eye MSA EHmid	% OMA Outer	11.46	X
	Open Eye MSA EHupp	% OMA Outer	10.36	X
	Open Eye MSA EWlow	UI	0.26	X
	Open Eye MSA EWmid	UI	0.26	X
	Open Eye MSA EWupp	UI	0.23	X
	Open Eye MSA VEC Deterministic	dB	0.3107	X
	Open Eye MSA VEC Statistical	dB	1.09	X
	Open Eye MSA Mask Failing Points		453.00	X
	Extinction Ratio (outer)	dB	5.89	X
	RLM(IEEE 802.3 clause 94)		0.96	X
	RLM(IEEE 802.3 Annex 120D)		0.93	X

Filter 'CTLE' configured and applied | 1048K Sample/UI | Acquisition 1

Figure 3: Supported Open Eye MSA measurements

Supported Measurements

Coding	Measurement
PAM4	TDECQ
	SNDR
	Open Eye MSA
	RLM
	Eye Height by BER
	Eye Width by BER
NRZ	Top & Base
	Min & Max
	One & Zero
	Transition Time
	Crossing %
	Mask
	Peak to Peak
	Eye Amplitude
	Eye Height
	Eye Width
	Jitter
	SNR
	VEC
	Vrms
	DJ & RJ
	Noise

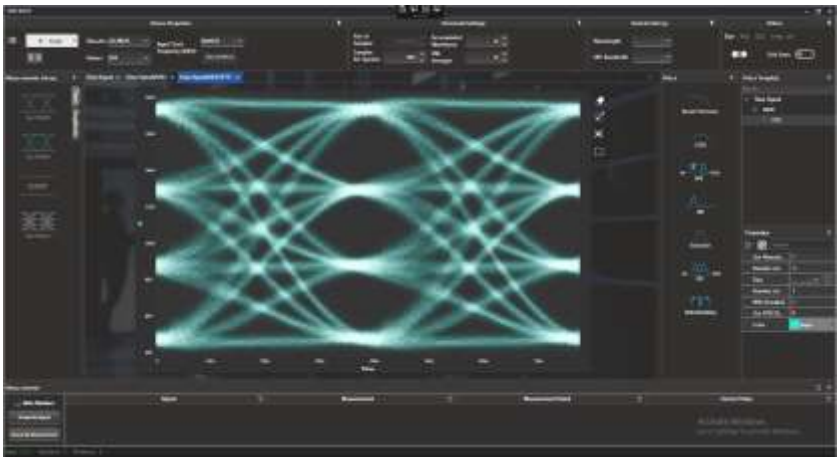


Figure 4: 26 GBaud Eye Diagram – SRC+FFE

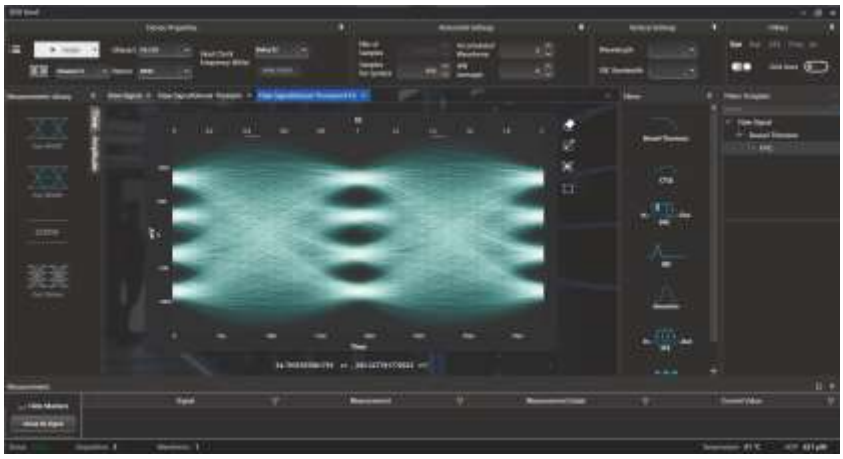


Figure 5: 53.125 GBaud Electrical Eye Diagram – Bessel Thomson + FFE

Figure 6: 112 GBaud (or 224Gbps) Electrical Eye Diagram with BT4 and 21 Taps FFE

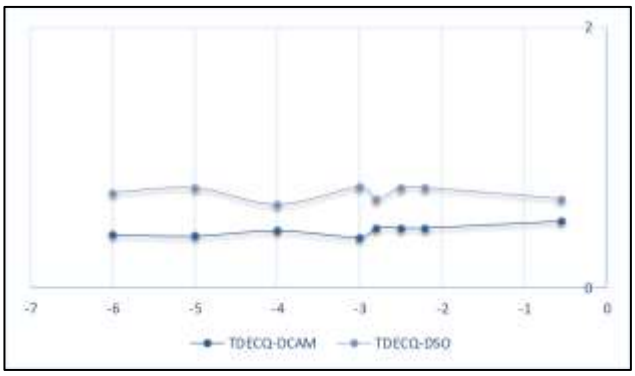
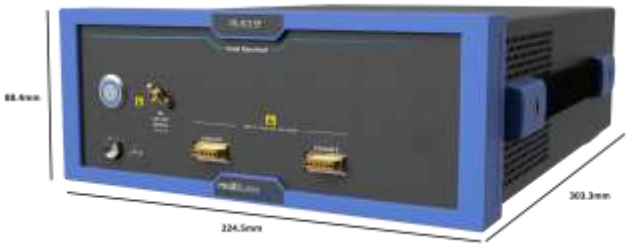


Figure 7: TDECQ-DCAM and TDECQ-DSO comparison

Mechanical Dimensions

The ML4015F is a benchtop instrument that also fits in a 19-inch 2U rack. It has a ruggedized Enigma enclosure with improved mechanical rigidity. Two ML4015Fs arranged side by side comprise one 2U slot in the rack. MultiLane also supplies the needed bracket.



Ordering Information

Name	ML Part number	Description
ML4015F	ML4015F	Electrical70Ghz BW
	3YW	3 years warranty
	5YW	5 years warranty
	EXP1	Extended Warranty Plan-1 year
ML4015F-2X	70	Dual Electrical70Ghz BW
	3YW	3 years warranty
	5YW	5 years warranty
	EXP1	Extended Warranty Plan-1 year

Required Accessories

Instrument	Required Cables	Comments
ML4015F	SMPS to 1.85mm male	1.85 mm connector, 15cm
ML4015F-2X	SMPS to 1.85mm male	1.85 mm connector, 15cm

Please contact us at sales@multilaneinc.com