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DATASHEET

Innovation for the next generation

ML6004-35-E

4 Differential Channels 33 GHz Sampling Scope

Advanced DSO for < 112G applications

Summary

Rapid transition and adoption to 100G per channel electrical interfaces key to 400G and 800G networks - requires cost-effective characterization tools to accelerate the deployment and enable proof of concept and validation. The precise validation of 26.5625GBaud and 53.125GBaud PAM4 and NRZ Electrical Signals requires prohibitively expensive instrumentation setups for production applications. MultiLane introduces the ML6004-35-E Electrical Sampling Oscilloscopes as a well-correlated solution for accelerated validation at scale.

The ML6004-35-E is available as either a standalone instrument or as the MW6004-35-E, a module in the MultiWave Test Platform (MWTP). When fitted into the MWTP, four MW6004-35-E can work simultaneously.

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ML6004-35-E

Introduction

The ML6004-35-E is a fully featured, cost effective, advanced, and highly compact four channels equivalent to Digital Sampling Oscilloscope characterized by its 33 GHz bandwidth.

The oscilloscope comes equipped with comprehensive software libraries that enable eye measurements, jitter analysis, and processing of NRZ and PAM4 data. Additionally, its extensive set of APIs makes it highly suitable for automated testing and efficient go/no-go production validation.

Banner Specifications

- 4 differential inputs channels
- 4 Single Ended inputs channels
- 33 GHz input bandwidth
- Frequency-based trigger
- Full eye and mask measurements
- NRZ & PAM4

Typical Applications

- Time domain measurements of 112G high-speed digital communication signals, including SerDes, Transceivers, TIA's
- Qualification of PAM-N and NRZ drivers
- Package and Wafer test
- Characterization and Production test

Key Features

The ML/MW6004-35-E family of DSOs is truly powerful, boasting an extensive set of features and functions that are unique in industry. These include:

- High Performance testing per Elec. Specs
- An extensive library of built-in de-embedding and component emulation API's
- Built-in standard eye window masks library
- Faster test times than benchtop methods

Electrical Specifications

Parameters	Specifications
Data Format Support	NRZ and PAM-4
Intrinsic Jitter	200 fs rms
Electrical Amplitude	< 600 mV SE and < 1200 mV Diff
Rise/Fall Time	11 ps (including conn.)
Vertical Resolution	14 bits
SFDR	46dB @ 10 GHz
ENOB	11.7 bits
Noise Floor	1.2 mV_{rms} (1. 5 mV_{rms} max)
Electrical Channel Bandwidth	33 GHz
Electrical Channel Connectors	(X4) 1X2 ML SMPM
Clock Input Bandwidth (Phase Shifter Mode)	0.1 - 4.5 Gsps
Clock Input Bandwidth (PLL Mode)	0.1 - 4.5 Gsps
Sampling Frequency	50 - 80 MHz
Data Input	AC Coupled
Supported Number of Samples per Channel	(Page 4)
Pattern Capture	SSPRQ & Up to PRBS-16
Input Return Loss Differential	< -13 dB for 10 MHz < f < 33 GHz
Normal Operating Temperature	0 - 70 °C
Instrument Automatic Shutoff	70 °C (manual reboot is needed for turn on when temperature < 65 °C)
Power Rating	31W

Supported Measurements

Coding	Measurements
PAM-4	TDECQ
	SNDR
	RLM
	Eye Height by BER
	Eye Width by BER
NRZ	Top & Base
	Min & Max
	One & Zero
	Transition Time
	Crossing %
	Mask Margin
	Peak to Peak
	Eye Amplitude
	Eye Height
	Eye Width
	Jitter
	SNR
	VEC
	Vrms
	RJ
	Noise

Recommended PC Specifications	
OS	Windows 11 64-bit
Processor	Core i7 / Ryzen 7
Memory	32 GB
GPU	4 GB (Dedicated)
Storage	10 GB (Dedicated)

Minimum PC Specifications	
OS	Windows 10 64-bit
Processor	Core i5 / Ryzen 5
Memory	16 GB
GPU	2 GB (Dedicated)
Storage	5 GB (Dedicated)

Spectrum Analysis View & THD

The DSO uses DFT to derive the spectral content of the signal present at the input. It also calculates the Total Harmonic Distortion figure.

Supported DSP Functions

- Frequency response correction of analog front end
- Bessel Thomson 4th Order
- CTLE Adaptive/manual
- FFE Adaptive/manual
- DFE Adaptive/manual
- De-embedding S4P
- Emulating S4P
- Normalizing Filter
- Moving Average

Applying Filters

Several filters including FFE, DFE, CTLE, Bessel-Thomson are available in NRZ as well as PAM mode. Concatenation of several filters is also possible, and the effect of each filter is shown immediately on the eye or pattern.

One may also import s2p or s4p files to de- embed fixtures.

A very useful function in determining the ideal CTLE gain for a given trace or the FFE number of taps for a certain target amplitude is the adaptive equalization feature available in the DSO.

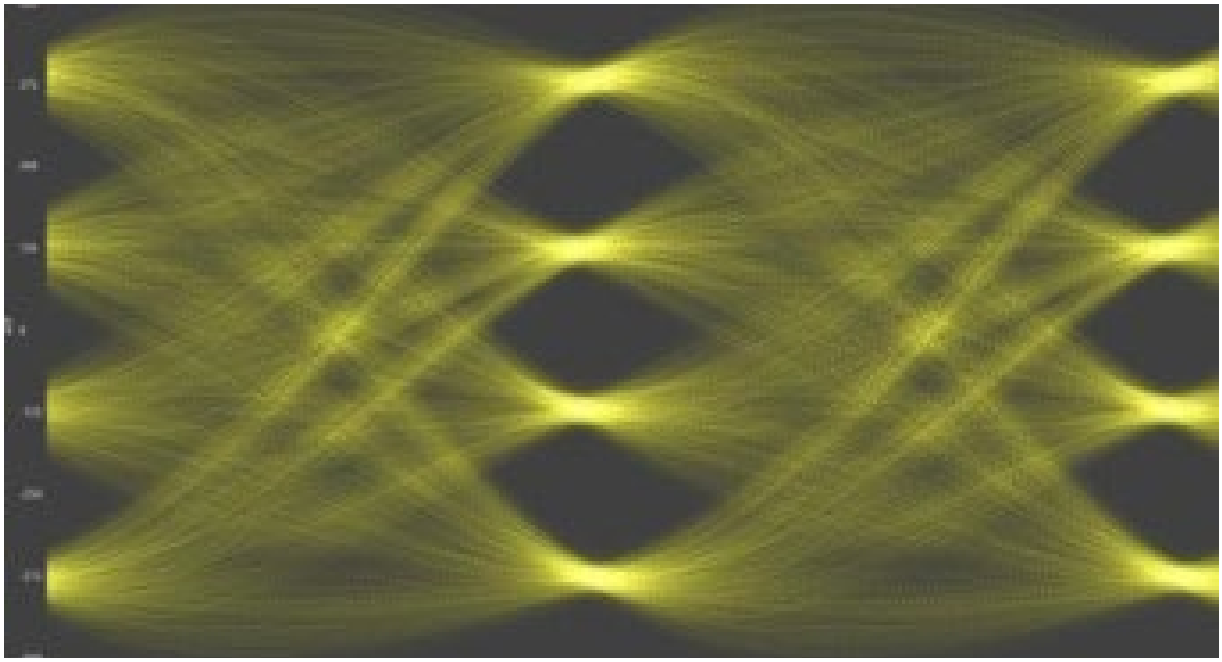

Figure 1: Eye Diagram Capture at 112G

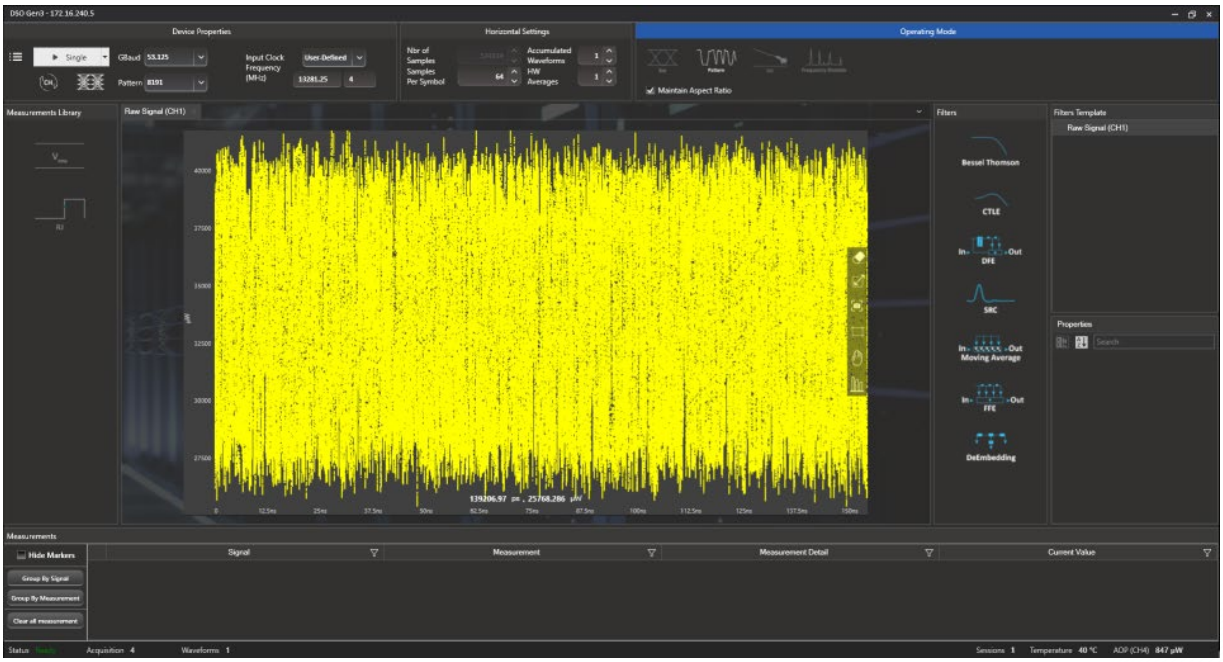

Figure 2: Pattern Capture at 112G

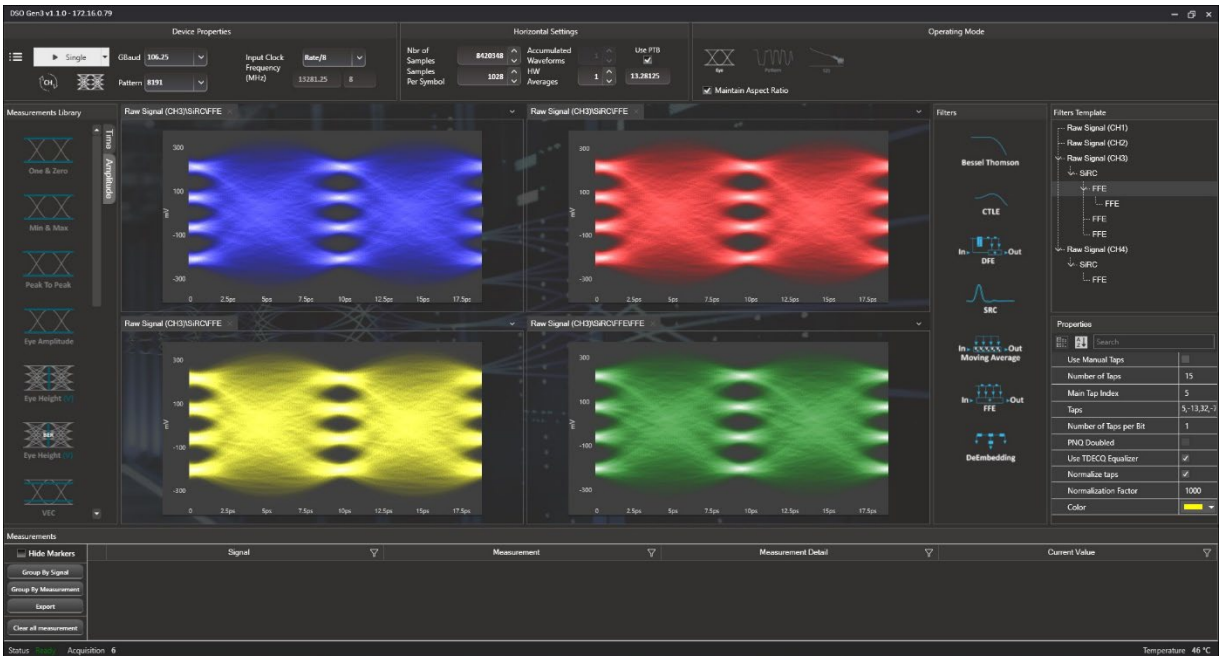

Figure 3: Multi-Signal Display Feature

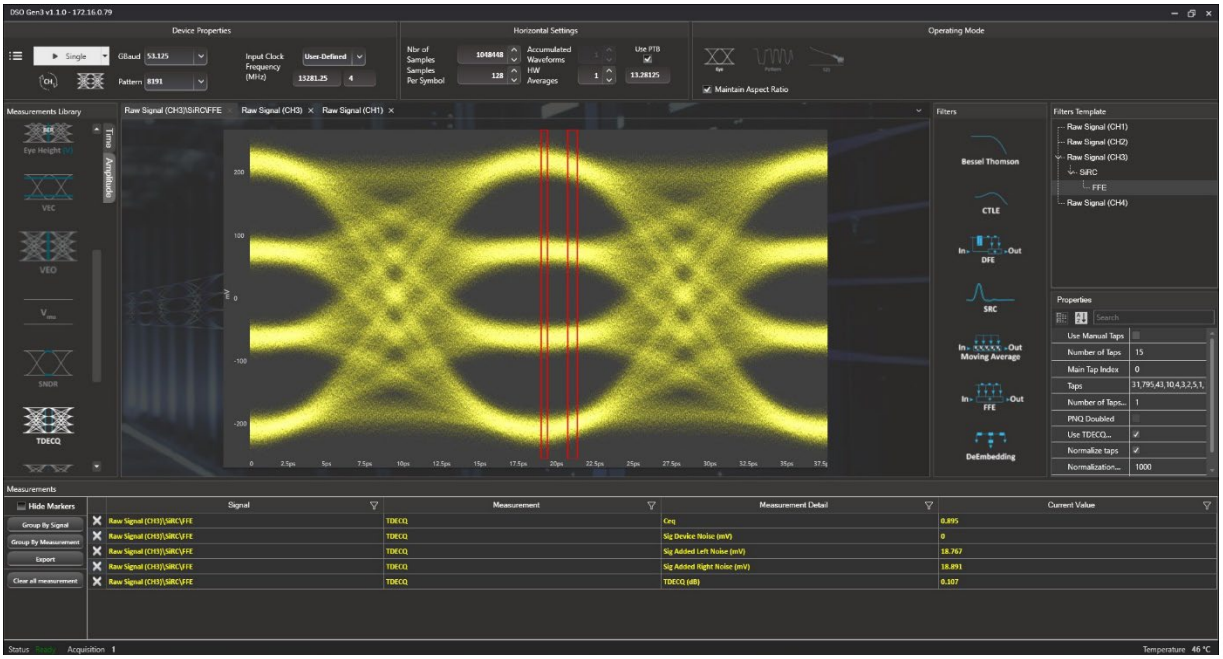

Figure 4: Eye-Diagram Capture at 53.125 GBaud with TDECQ Measurements

Supported Number of Samples per Channel

This is the maximum number of samples per symbol that can be captured by the DSO and it's calculated by:

$$Samples\ per\ Symbol = \frac{270MB}{BPS \cdot CH \cdot PRBS \cdot AVG} < 4095$$

- 270 Megabytes: Memory depth for 4 channels
- PRBS: The length of the chosen PRBS i.e., PRBS7= 127
- AVG: The number of HW averaging chosen by software
- CH: The number of channels (4)
- BPS: the number of bytes per sample (2)

Mechanical Dimensions

Figure 5: ML6004-35-E Mechanical Dimensions

The ML6004-35-E, is compatible with the MWTP platform (Sold as an MW6004-35-E), the user can choose any configurations to fit up to 4 modules in 1 MWTP

Figure 6: 4x MW6004-35-E in one MWTP

Ordering Information

Option	Description
ML6004-35-E	33 GHz Standalone Electrical Scope
MW6004-35-E	33 GHz MWTP Electrical Scope
3YW	Total 3-year Warranty
CAL	Single Calibration
3YWC	Total 3-year Warranty with 3 Annual Calibrations

Recommended Accessories

Instruments	Recommended	Comments
ML6004-35-E	(x4) 1x2 SMPM to Key	Male or Female
MW6004-35-E		

Please contact us at sales@multilaneinc.com

This equipment contains ESD sensitive components and may become damaged when contacted with an electrostatic charge. To prevent equipment damage, please use proper grounding techniques.