

ML4004-PAM

PAM4 Time Domain Analyzer

**2x56 Gb/s PAM4 BERT
with integrated 32GHz DSO**

**Dual PAM4 PPG and ED
Jitter Analysis
Eye Measurements
Eye Mask Test
Advanced Pattern Acquisition**

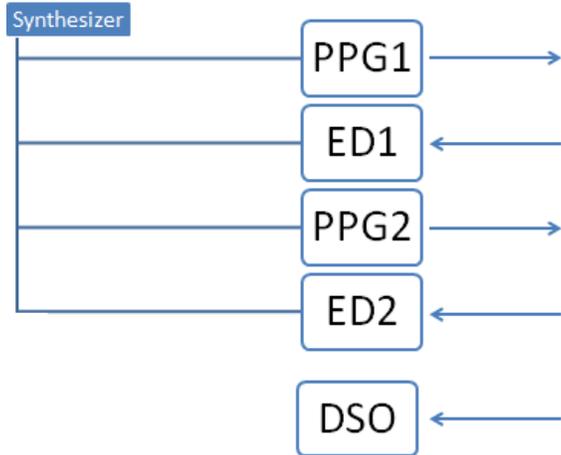


ML4004-PAM Marketing Datasheet

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ML4004-PAM

2x28 GB/s NRZ or 2x56 GB/s PAM4 BERT with 32 GHz Scope



Summary

The **ML4004-PAM** is a state of the art dual Channel PAM4 BERT and Digital Sampling Oscilloscope, integrated in an ultra-compact form factor. USB/Ethernet controlled, it performs accurate eye-diagram analysis to characterize the quality of transmitters and receivers.

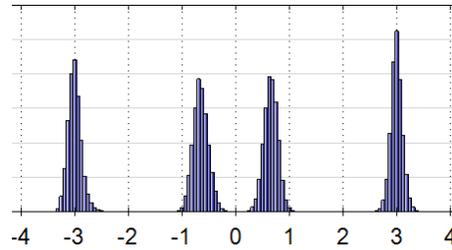
The **ML4004-PAM** DSO implements a statistical under sampling technique using comprehensive software libraries. It performs various eye and pattern measurements (if the rate is above 6Gbps), mask margin tests and jitter analysis on PAM4 and NRZ signals.

Key Features

PAM4 scope measurements are currently following the latest OIF contribution.

BERT features

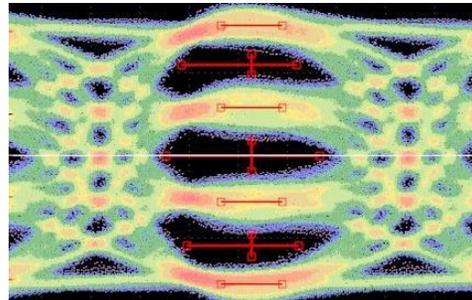
- NRZ Bit Rates¹: 18.6-30.2 Gb/s
- PAM4 Bit Rates: 37.2-60 Gb/s
- Inner eye amplitude variation (PAM4 mode)
- 100G FEC KR4 or scaled KP4



- Histogram and SNR measurements (PAM4 Mode)
- Intuitive comprehensive GUI
- QPRBS13 on the PPG
- User-defined pattern 80 bits or up to 2kb from a .txt file

DSO features

- Low intrinsic jitter
- Optional External reference clock input
- SW filters applicable include CTLE, FFE, S-Parameter De-Embedding, Moving Average
- Single ended and differential electrical input
- Eye, histogram and pattern capture in a single instrument.



- PAM4 Measurements
- Statistics histograms and Histogram measurements.
- Integrated synthesizer
- User friendly GUI that enables: zooming, markers, X and Y histograms, statistics, overlays and multiple measurements.
- Load and analyze data that was previously captured in simulation mode
- The DSO tool can operate in a data acquisition only mode where the data is saved on multiple acquisitions for post processing.
- Capability to save statistical measurement, data files and configurations
- Color graded display in eye capture mode
- Insertion loss measurement down to 40 dB

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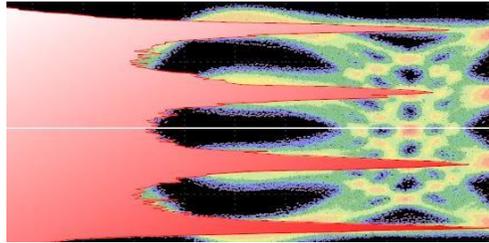


¹ NRZ bit rates 10 – 15 Gb/s can also be generated on TX0

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PAM4 Measurements
Symbol Levels
Vertical Eye Amplitudes
Vertical Eye Openings
Horizontal Eye Openings
Vertical Eye Closure (dB)
Openings by BER (soon)
Max, Min, Peak-to-Peak...



Target Applications

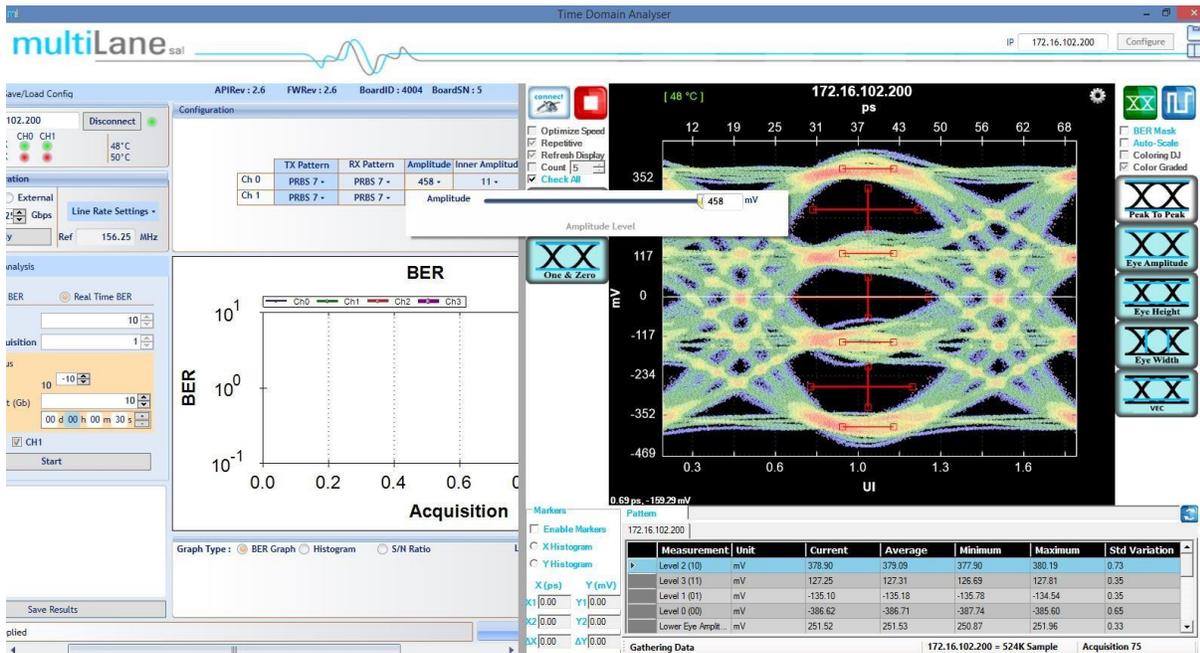
- Interconnect testing, SFP, SFP28, CFP, CFP2, CFP4, QSFP, QSFP28, ...
- Backplane testing
- Interference and Crosstalk testing
- Receiver sensitivity testing

Ordering Information

ML4004-PAM: 2x56 Gb/s PAM4 Bert with 1x 32GHz or 50GHz BW Scope

Time Domain Analyzer GUI

The user interface for the ML4004-PAM is an all-new combination of the ML-Bert and ML-DSO programs for either PAM4 or NRZ modes. Both the DSO and Bert functions are accessible by the same IP address, and can either be arranged to be tabs, or side by side in the same window



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Electrical Specifications		
NRZ Mode PPG1/2	Bit Rates	18.6-30.2 Gbps
	TX Amplitude Differential	250-1000mV
	Patterns	PRBS7/9/15/23/31 Square 16 and Square 32
	Pre-Emphasis	6 dB
	Pre-Emphasis Resolution	10 steps
	Equalizing Filter Spacing	1UI
	Random Jitter RMS	220 fS
	Rise/ Fall Time (20–80%)	12 pS
	Output Return Loss up to 10GHz	-15 dB
	Output Return Loss (16-25GHz)	-10 dB
NRZ Mode ED1/2	Error Detector Phase Margin	5 pS
	Error Detector damage level	1200 mV Diff
	Input CTLE Dynamic Range	10 dB
	TX/RX and clock connectors	2.92 mm K Connectors
	Reference clock Output	Rate / 66 for bit rates 10 to 15G Rate / 165 for 18.6 to 30.2 G
PAM4 Mode PPG1/2	Bit Rates	37.2-60 Gbps
	TX Amplitude Differential	250-1000 mV
	Patterns	PRBS7/9/11/15/23/31/Square_16/Square_32 User Pattern 80 bits/ QPRBS13 / 16640 symbols in .txt file format
	Pre-Emphasis	6 dB
	Pre-Emphasis Resolution	10 steps
	Equalizing Filter Spacing	1UI
	Random Jitter RMS	200 fS
	Rise/ Fall Time (20–80%)	12 pS
	Output Return Loss up to 10GHz	-15 dB
	Output Return Loss (16-25GHz)	-10 dB
PAM4 Mode ED1/2	Error Detector Phase Margin	5 pS
	Error Detector Maximum Input	1200 mV Diff
	Error Detector linear range	250 – 400 mVpp diff.
	Input CTLE Dynamic Range	10 dB adaptive
	TX/RX and clock connectors	2.92 mm K Connectors
	Reference clock Output	Rate / 165
DSO	Input Bandwidth	32 GHz or 50 GHz
	Input Amplitude (Single ended)	AC: 600 mVpp Single-ended
	Input Rise / Fall Time	14 ps (12ps for 50 GHz variant)
	Diff. Input Return Loss	Better than 10 dB

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	Vertical Resolution	12 bits
	Clock Input Range (Normal Mode)	50 - 710 MHz
	Clock Input Range (Bypass Mode)	50 - 125 MHz
	Clock Input Amplitude	200 - 1000 mV
	Input Impedance	50 Ω
	Intrinsic Jitter (excluding DDJ)	200 fS
	Amplitude Error	5 mV
	Data Format Support	NRZ/PAM4
	PRBS Pattern Capture	up to PN11
	Spurious-Free Dynamic Range	8 bits
	Temperature range	0-65C
	Power Requirements	1.2A @ 12V
	Memory Depth	256K sample

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