Tektronix®

Ethernet Electrical Testing Software for 5/6 Series MSO

Option 5-CMENET and 6-CMENET Application Datasheet

Get more visibility into your Ethernet designs

Get more visibility into your Ethernet designs with 1000BASE-T/100BASE-TX/10BASE-T PHY Measurement and Analysis on the 5/6 Series MSO. The combination of the oscilloscope, analysis software – Option 5-CMENET/6-CMENET, and a wide range of available analog probes enables you to perform detailed and accurate amplitude and timing measurements on your designs. The 12-bit analog-to-digital converters in the 5/6 Series MSO deliver precise measurement data.

Option 5-CMENET/6-CMENET is a standard specific application for Tektronix 5/6 Series MSO Oscilloscopes. This application includes compliance measurements that enable you to achieve new levels of debugging, efficiency, and accuracy. Option 5-CMENET/6-CMENET adds a long list of IEEE 802.3 and ANSI X3.263 specific measurements for different Ethernet standards to the standard jitter, timing, and signal quality measurements in the 5/6 Series MSO oscilloscopes.

Key features

- Comprehensive Ethernet PHY test coverage supporting multiple speeds.
- Highly optimized and intuitive user interface for quick test configuration and validation of electrical signals.
- Compliance and margin testing for accurate analysis and improved interoperability.
- Time-domain and frequency-domain measurements made with a single instrument.
- Jitter and timing measurements with and without filters.
- Amplitude and droop testing for transmitter performance.
- User-defined mode to configure parameters for characterization and margin analysis.
- Detailed test reports with margin and statistical information.
- Configure test parameters and limits for debug and characterization.
- Configure multiple test runs and analyze the results.
- Preview the test mode waveform before running the tests.
- Additional *Peak Distortion Vs Phase Offset* and *Error Values Vs Symbol Number* plots for 1000BASE-T distortion tests.

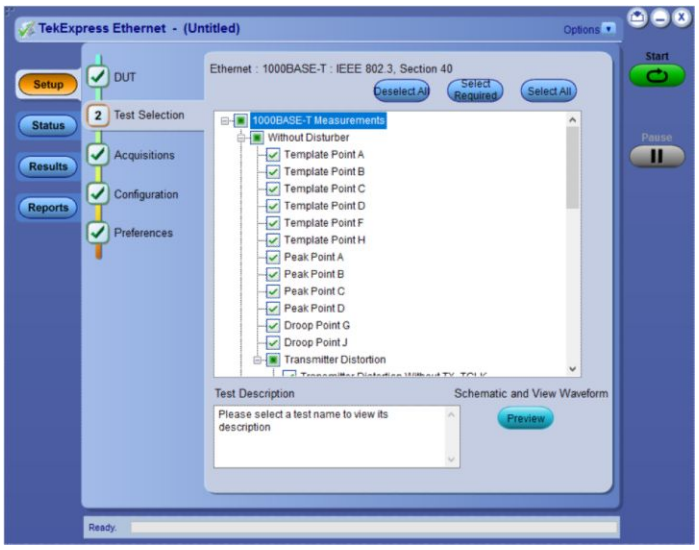
Ethernet compliance testing has some unique measurement challenges:

- Generating the disturbing signals requires you to generate pattern data and noise to create real-world noise for some measurements.
- You must test amplitude, timing, return loss, and template measurements for the ethernet standards:
  - The 100BASE-TX standard outlines 12 tests per port plus CMRR and more
  - The 1000BASE-T standard calls for 80 tests per port plus BER, CMRR, and more
  - The 10BASE-T standard specifies 22 tests per port plus fault tolerance and CMRR
- Because of the large number of individual tests, compliance testing takes a lot of setup and measurement time, and makes repeatable measurement results difficult to achieve.

Automated Ethernet physical layer compliance testing

Automated TekExpress Ethernet electrical testing with option 5-CMENET/6-CMENET requires an oscilloscope with minimum bandwidth of 1 GHz. This application provides automated compliance testing for Ethernet verification.

Executing all of the measurements manually is extremely time-consuming. TekExpress Ethernet software provides you an automation framework, enabling you to execute all of the measurements with less user intervention, such as when you need to change the connections.



TekExpress Ethernet test selection panel

TekExpress Ethernet software allows you to choose complete or selective testing of any of the transmitter electrical specifications. Tests are configured by following a step-by-step process. The software sets up the oscilloscope and automates the testing, guiding you to accurate and repeatable results. It generates a comprehensive, date-stamped test report with pass/fail results, waveforms, and data plots.

Software navigation follows a logical workflow for quick test setups, changes and review of test results. Valid testing requires proper cabling, probes, and connections between fixtures, instruments, and the device under test (DUT). The software provides setup instructions for each test, with images and reference illustrations showing correct configurations.

TekExpress Ethernet software requires a Tektronix 5/6 Series MSO oscilloscope with Option 5-WIN/6-WIN or SUP5-WIN/SUP6-WIN (Microsoft Windows 10). This is a Windows application and the software displays TekExpress Ethernet software and test reports on the oscilloscope display. However, for convenience an external monitor may be connected to the 5/6 Series MSO so test controls and reports can be viewed on the external display, while signal acquisition is observed on the primary oscilloscope display.

TekExpress Ethernet results panel displaying tests results

Amplitude tests

The industry standards require the signals to have amplitudes within specified ranges to assure interoperability between devices. The amplitude tests vary with the signal speeds but include such parameters as peak or peak-to-peak amplitude, overshoot, common mode voltage, and positive/negative pulse symmetry.

Timing tests

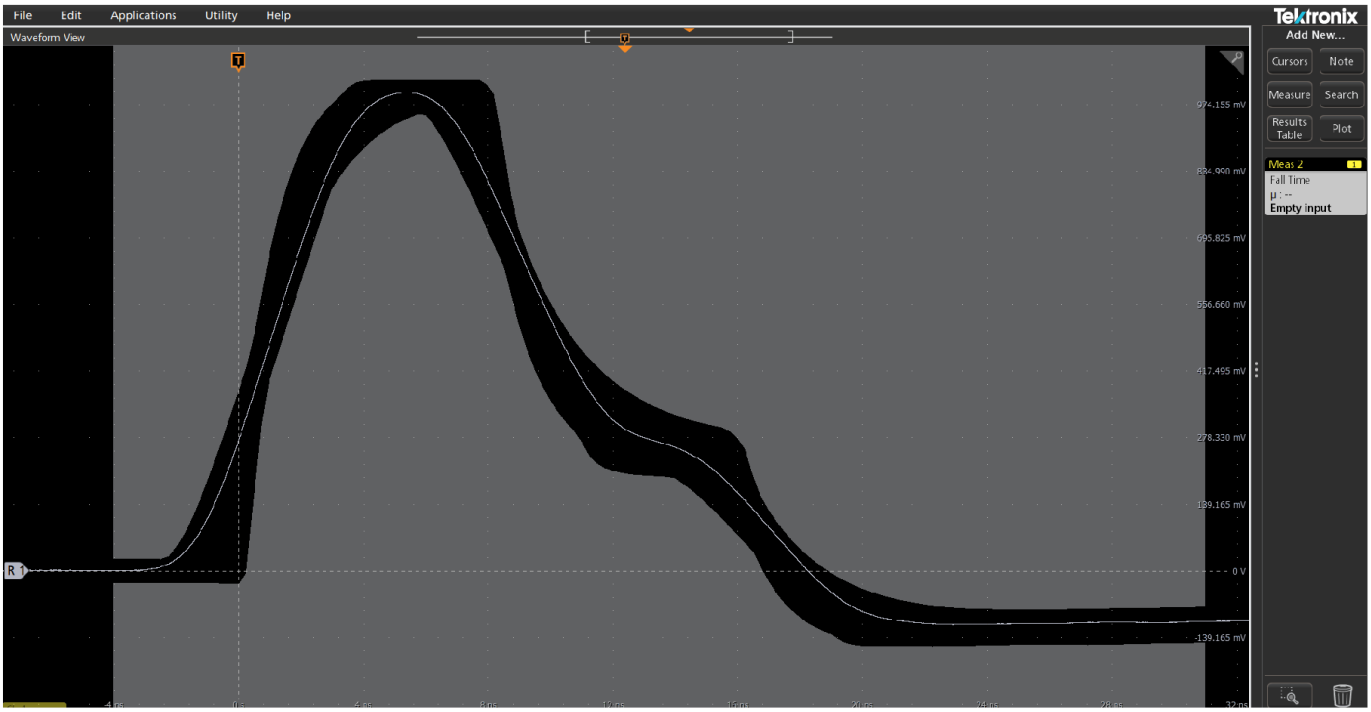
Timing parameters of the signals are also specified by the standards. These tests include timing measurements such as rise time, fall time, and difference or symmetry between rise and fall times.

Jitter tests

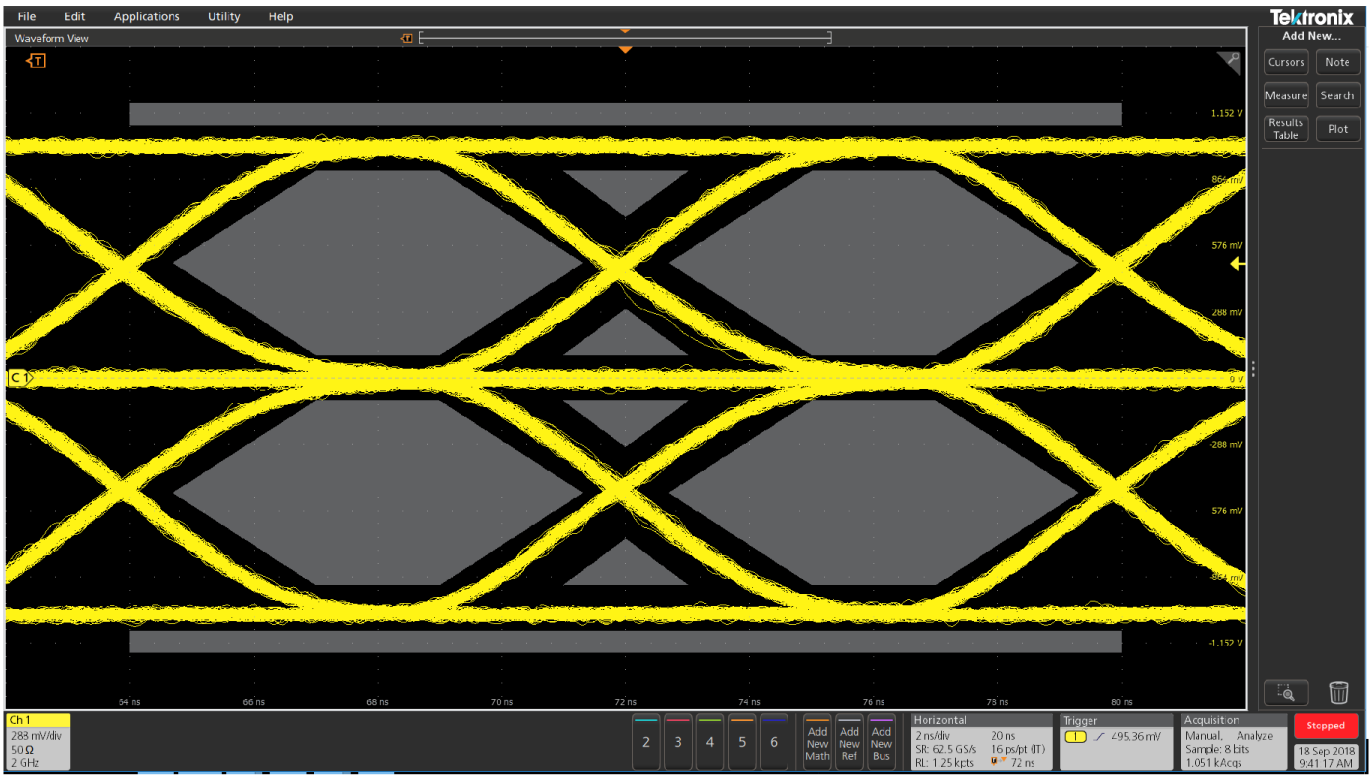
Jitter tests quantify the timing variations of the edges of the signal, using specified test patterns. These jitter measurements include the contributions from duty cycle distortion and the baseline wander. Jitter is determined by accumulating waveforms, measuring the width of the accumulated points at the eye crossing. The peak-to-peak is inferred from minimum and maximum values in the tails of the histogram.

Template tests

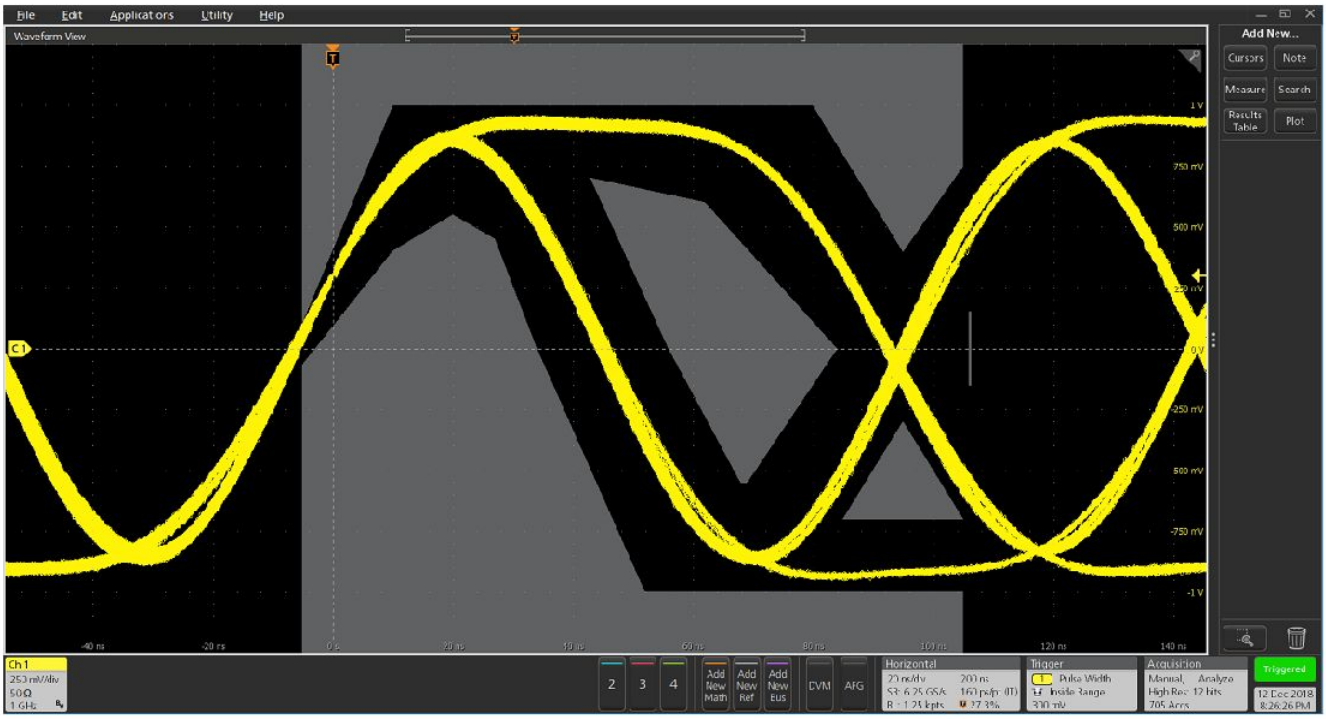
Template mask tests are often used to quickly verify that the transmitted signal meets industry-standard requirements. These template masks are defined so that signal distortions such as overshoot, jitter, incorrect rise and fall times, etc., will cause the mask test to fail.



TekExpress Ethernet running 1000BASE-T template measurement



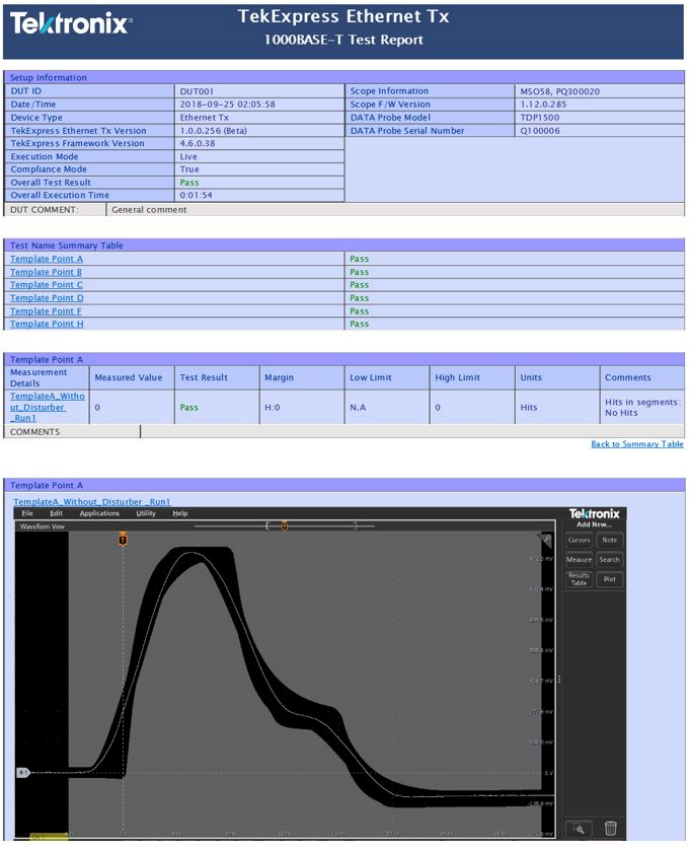
TekExpress Ethernet running 100BASE-T AOI template



TekExpress Ethernet running 10BASE-T MAU temple test

Test report generation

TekExpress Ethernet automation allows you to quickly validate and generate detailed reports with images and setup details at the end of every execution.



TekExpress Ethernet Tx
1000BASE-T Test Report

Setup Information			
DUT ID	DUT001	Scope Information	MSO58, PQ300020
Date/Time	2018-09-25 02:05:58	Scope F/W Version	1.12.0.285
Device Type	Ethernet Tx	DATA Probe Model	TDP1500
TekExpress Ethernet Tx Version	1.0.0.256 (Beta)	DATA Probe Serial Number	Q100006
TekExpress Framework Version	4.6.0.38		
Execution Mode	Live		
Compliance Mode	True		
Overall Test Result	Pass		
Overall Execution Time	0:01:54		
DUT COMMENT:	General comment		

Test Name Summary Table	
Template Point A	Pass
Template Point B	Pass
Template Point C	Pass
Template Point D	Pass
Template Point F	Pass
Template Point H	Pass

Template Point A

Measurement Details	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
TemplateA_Without_Disturber_Run1	0	Pass	H:0	N.A	0	Hits	Hits in segments: No Hits

COMMENTS

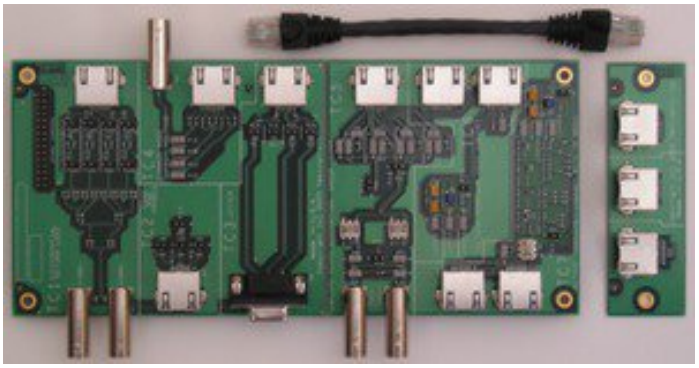
Back to Summary Table

Template Point A

TemplateA_Without_Disturber_Run1

Test fixtures

The TF-GBE Series of test fixtures supports many of the Ethernet compliance tests, providing convenient signal access, test points for accurate removal of disturbing signals, return loss calibration, and cross-connect circuits to connect to traffic generators and link partners. The TF-GBE-BTP is the basic test fixture package for 10/100/1000BASE-T tests. The TF-GBE-ATP is the advanced test fixture package which also includes a 1000BASE-T jitter test channel cable.



TF-GBE-BTP Basic Ethernet Test Fixture.

Key measurements

TekExpress Ethernet Electrical Testing Software provides the following key measurements:

1000BASE-T (available with and without disturbing signal test option)

- Template A
- Template B
- Template C
- Template D
- Template F
- Template H
- Peak A
- Peak B
- Peak C
- Peak D
- Droop G
- Droop J
- Distortion (with and without clock)

100BASE-TX

- AOI Template
- Rise Time
- Fall Time
- Rise/Fall Symmetry
- Output Voltage
- Amplitude Symmetry
- Waveform Overshoot
- Duty Cycle Distortion

10BASE-T

- Link Pulse (With and without TPM)
- TP_IDL (With and without TPM)
- MAU Template
- Harmonics
- Common Mode Voltage
- Differential Voltage

Ordering information

Required hardware

Oscilloscope	5 or 6 Series MSO oscilloscope with minimum bandwidth of 1 GHz (option 5-BW-1000 or 6-BW-1000) 5-WIN or 6-WIN (Removable SSD with Microsoft Windows 10 operating system)
Supported instruments	MSO54, MSO56, MSO58 and MSO64

Required software

Application	Options	License type
TekExpress Ethernet automated compliance test solution (1000 BASE-T, 100BASE-TX, 10 BASE-T)	5-CMENET 6-CMENET	New instrument license
	SUP5-CMENET SUP6-CMENET	Upgrade license
	SUP5-CMENET-FL SUP6-CMENET-FL	Floating license

Recommended probes and accessories

Probes	Recommended	Quantity
Differential probe	TDP3500	2 [1]
	TDP1500	
	P6247 [2]	
	P6248 [2]	

Recommended test fixtures

Test Fixtures	Vendor
TF-GBE-BTP	Basic Ethernet Test Fixture
TF-GBE-ATP	Advanced Ethernet Test Fixture with Jitter Channel
TF-GBE-JTC	103 meter 1000BASE-T Jitter Test Channel Cable
TF-GBE-SIC	Short (4 inch or 0.1 meter) RJ-45 Interconnect Cable

Supported signal sources (for disturbing signal testing)

Arbitrary Function Generator AFG3000

Arbitrary Waveform Generator AWG5200 (recommended), AWG5000C, AWG7000C, AWG7000C Series

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

1 For 1000BASE-T Slave jitter testing an additional differential probe is needed.

2 For P6247/8 need the appropriate TPA-BNC Adapter

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