DSA80000B Digital Signal Analyzer

2-GHz to 13-GHz Oscilloscope Measurement Systems

Data Sheet

Design, debug and validate your serial-data-based designs faster

With today's higher data rates and serial buses, you need specialized tools to design, debug and validate your designs. Your measurements of low-voltage, differential signals can be impacted by oscilloscope noise, trigger jitter, and probe fidelity. Clock signals are typically embedded in your data, and the data may be 8b/10b encoded, so debugging your signal requires a smart oscilloscope. Once your design is complete, you are faced with compliance testing, which means making many complicated tests in a short amount of time. A standard oscilloscope no longer does the job.

The DSA80000B digital signal analyzer (DSA) is an oscilloscope measurement system optimized for these measurement tasks. The system is built around an Infiniium DSO80000B Series oscilloscope and the InfiniiMax probing system. The oscilloscope and probe capabilities are augmented with high-speed serial data analysis and EZJIT Plus jitter analysis software to give you the capabilities you need for designing, debugging and validating serial-data-based designs.

Key features:

- 2 to 13 GHz bandwidth real-time with up to 40 GSa/s sample rate
- Industry's lowest noise floor, jitter measurement floor, trigger jitter, and flattest frequency response
- Industry's only full bandwidth probe system for all use models – up to 13 GHz bandwidth for differential solder-in, browser and SMA connections
- Serial data analysis with clock recovery, 8b/10b decode, and symbol search/trigger
- Jitter analysis with random jitter (RJ) and deterministic jitter (DJ) decomposition
- Upgrade program allows you to upgrade to a higher bandwidth model, protecting your investment
- LXI functional class C compliant

Agilent Technologies

Serial data analysis with clock recovery

The high-speed serial data analysis software provides you with a fast and easy way to pinpoint signal integrity problems and validate performance for serial interface designs. It allows you to perform mask testing, characterize serial data streams that employ embedded clocks, and decode 8b/10b data from serial data streams. The software enables you to verify compliance to computer, communication, and data communications standards such as PCI Express®, Serial ATA (SATA), Serial attached SCSI (SAS), Fibre Channel (FC), XAUI and Gigabit Ethernet.

Key features:

- Measurement setup wizard for ease-of-use
- Clock recovery first-order or second-order PLL, external reference clock
- Real-time eye diagram display
- Masks for PCI Express, SATA, SAS, Fibre Channel, Gigabit Ethernet and XAUI
- Eye mask unfolding
- 8b/10b decoding of serial data
- Symbol search and trigger

A serial data wizard walks you quickly through the steps required to setup and perform a measurement. Intuitive displays and clear labeling of information make it easy to comprehend measurement results.

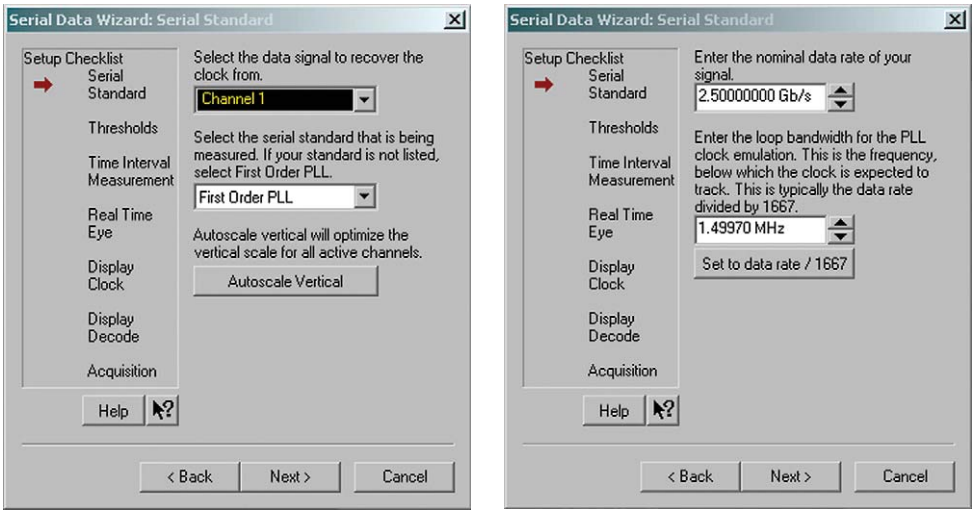

Figure 1. The serial data setup wizard quickly sets up a measurement by defining the signal, the clock recovery method, and what you want displayed.

Serial data analysis with clock recovery (continued)

Flexible clock recovery

Embedded clocks can be recovered via constant-frequency, first-order phase-locked loop (PLL), or second-order PLL approaches. You can adjust the center frequency and bandwidth, and in the case of second-order PLL, the damping factor. For PCI Express, the clock recovery algorithm specified by the PCI-SIG® is provided. When you choose PLL clock recovery, the clock recovery algorithm requires some time at the start of each record to lock to the data. This interval cannot be viewed or analyzed. The serial data wizard will indicate the required time period for the clock recovery algorithm to lock.

Real-time eye analysis

The real-time eye display is reconstructed from all unit intervals in the oscilloscope memory aligned by the recovered clock. In this display mode the center screen (or zero in the time base) corresponds to the active edge of the recovered clock. Once you identify a failure of the eye mask, you can unfold the eye diagram to show the specific unit interval that caused the failure. When you use it with the 8b/10b decoding feature, you can identify data-dependent errors that result in eye mask violations caused by inter-symbol interference (ISI). Or use 8b/10b decode to assist you with debugging during the link bring-up phase of development.

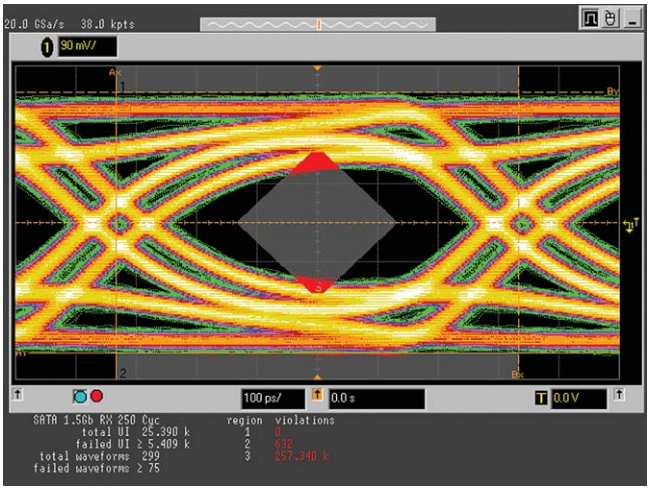

Figure 2. An eye mask test on a failing Serial ATA signal. The information below the mask screen helps you determine the level of confidence in meeting your desired bit error rate.

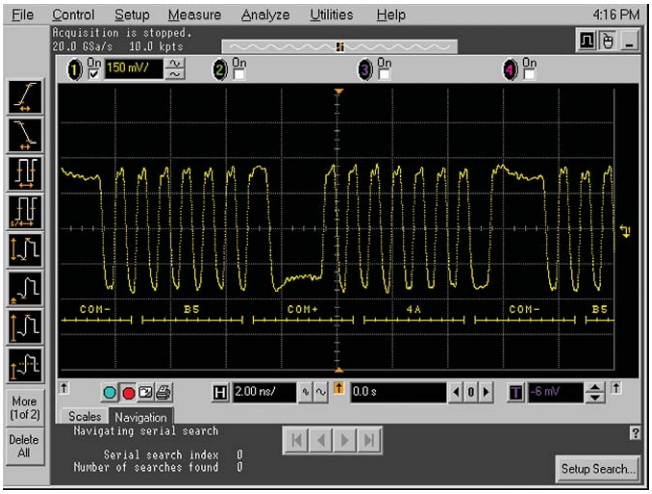

Figure 3. The 8b/10b decoded symbol information is displayed below the appropriate portion of a PCI Express signal.

Jitter analysis with RJ/DJ decomposition

With the faster edge speeds and shrinking data valid windows in today's high-speed digital designs, insight into the causes of signal jitter is critical for ensuring the reliability of your design. The EZJIT Plus jitter analysis software helps to identify and quantify jitter components. Time correlation of jitter to the real-time signal makes it easy o trace jitter components to their sources.

Key features:

- Easy-to-use jitter measurements
- Measure repetitive or arbitrary data waveforms
- Constant frequency or PLL clock recovery
- Real-time measurement trend, histogram, and spectrum displays
- Separation of RJ, DJ, PJ, DDJ, ISI jitter subcomponents
- TJ estimation at low BER
- Graphical displays of DDJ versus bit, histograms and bathtub curve

The EZJIT Plus setup wizard helps you quickly set up the oscilloscope and begin taking measurements. With time-correlated jitter trend and signal waveform displays, you can clearly see the relationships between jitter and signal conditions. Intuitive displays and clear information labeling make it easy to comprehend measurement results.

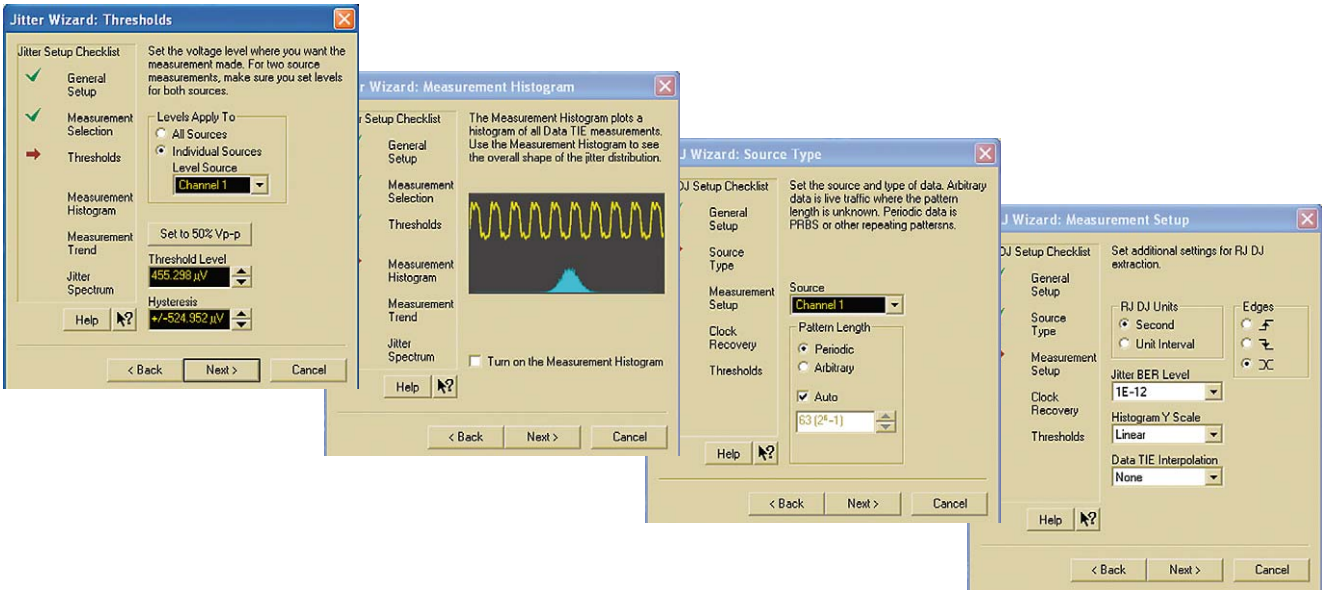

Figure 4. The EZJIT Plus setup wizard prompts you to select measurement thresholds, parameters to display, and for RJ/DJ analysis, the data pattern type, TJ BER calculation level, and clock recovery method.

Jitter analysis with RJ/DJ decomposition (continued)

Easily review jitter parameters
The 4-in-1 jitter display allows for multiple views of jitter populations and distributions, data-dependent jitter versus bit in repetitive patterns, as well as the bathtub curve plot, which measures eye-opening versus bit error rate. Composite histogram displays relative contributions of data-dependent jitter, total jitter, random jitter and periodic jitter. Total jitter is a convolution of the data-dependent jitter probability density function (PDF) and the random/periodic jitter PDF.

RJ/DJ results with confidence
With RJ/DJ separation required by many standards today, you need confidence that you're making accurate, repeatable jitter measurements. The RJ/DJ jitter separation in EZJIT Plus software uses similar algorithms to those used in Agilent's 86100C DCA-J, giving you confidence that your measurement results are accurate and repeatable across multiple platforms. EZJIT Plus software also allows you to choose between periodic and arbitrary data modes when you analyze jitter for compliance.

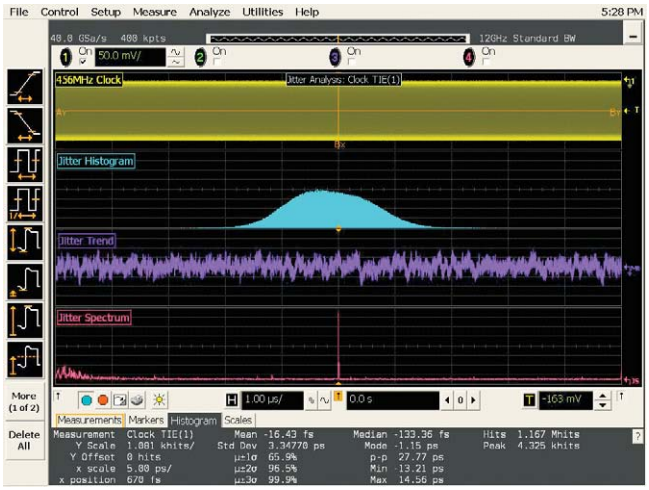

Figure 5. For debugging jitter problems, the histogram display plots the relative occurrence of values for the measured parameter, the trend display shows a time plot of the measurement time-correlated with the signal waveform data, and the spectrum display shows the spectral content of the jitter.

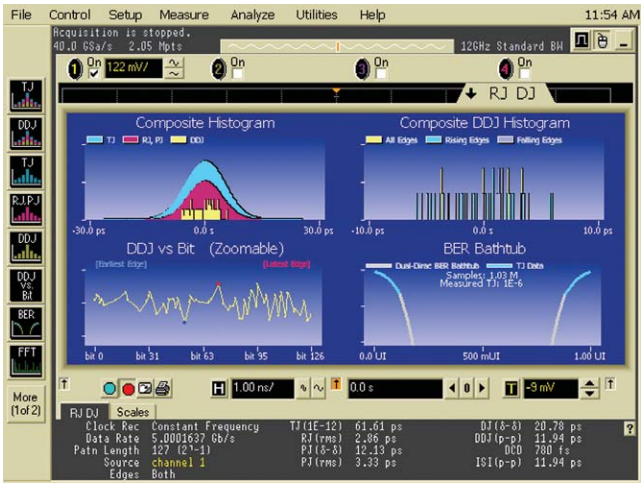

Figure 6. The EZJIT Plus 4-in-1 results display provides a comprehensive view of the jitter components. You control which parameter is displayed and where. Plus, you can quickly toggle between the jitter analysis screen and the measured signal.

Bandwidth with low noise and flexible probing

Low-voltage, differential measurements require a low-noise receiver and probe. The DSA80000B DSA and the InfiniiMax probing system feature the industry's lowest noise floor, lowest jitter measurement floor, lowest trigger jitter and flattest frequency response. These foundational capabilities are crucial for achieving accurate and repeatable measurements. These superior signal integrity capabilities come from Agilent's RF design experience, proprietary packaging technologies and unique CMOS ADC architecture. Superior signal integrity maximizes your design margins by not wasting any measurement accuracy due to the poor noise, jitter or frequency response of the oscilloscope or probing system.

Key features:

- Industry's lowest noise floor for both oscilloscopes and probes – < 419 µV rms @ 5 mV/div (13 GHz bandwidth)
- Industry's lowest jitter measurement floor – < 0.7 ps rms (13 GHz bandwidth)
- Industry's lowest trigger jitter – < 500 fs rms (13 GHz bandwidth)
- Industry's flattest frequency response
- Industry's only full-bandwidth probe system for all use models – up to 13 GHz bandwidth for differential solder-in, browser and SMA connections

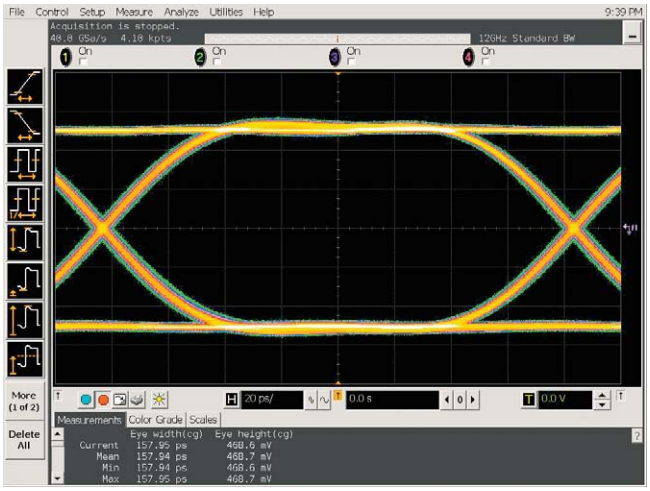

Figure 7. With the industry's lowest noise floor, the DSA80000B delivers superior measurement results and maximizes design margins.

Figure 8. With the industry's lowest trigger jitter – less than 500 fs rms (typically, less than 200 fs rms on 5 Gb/s PRBS signal) – the DSA80000B facilitates accurate waveform viewing of multiple waveforms.

Probing without compromise
The InfiniiMax Series probes offer the industry's widest selection of probe amplifier bandwidths (currently six) and the industry's widest variety of different probe head types (currently nine). InfiniiMax is also the only probing system to offer the full 13 GHz bandwidth for the differential solder-in, differential browsing and differential SMA use models. Since its inception, the award-winning InfiniiMax probe system has provided maximum performance with unmatched usability.

Figure 9. A wide range of InfiniiMax probe amplifiers and probe heads from 1.5 GHz to 13 GHz are available to meet your performance and budget requirements.

Compliance testing made easy

Once your design is done, you need to validate its performance relative to the industry-standard specifications. Performing compliance tests can be a long, complicated process. In fact, some measurements are difficult to make manually. The DSA80000B supports several compliance test software packages based upon a common Infiniium test framework. The Infiniium test framework saves you time by setting the stage for automatic execution of compliance electrical tests. Part of the difficulty in performing compliance electrical tests is properly connecting to the oscilloscope, loading the proper setup files, and then analyzing the measured results by comparing them to limits published in the specification. The Infiniium test framework does much of this work for you.

Key features:

- Task-driven flow for defining measurements, connections, and measurement setup
- Results displayed with pass/fail, margin, and supporting waveforms
- Electrical compliance solutions for computation standards: PCI Express, USB, Ethernet, Firewire
- Electrical compliance solutions for memory standards: FBD, DDR
- Electrical compliance solutions for storage standards: FC, SATA, SAS
- Electrical compliance solutions for video standards: DVI, HDMI

You can easily choose what measurements to make, then the Infiniium test framework automatically configures the oscilloscope for each test, instructs you how to configure the test setup, and makes all measurements, minimizing setup changes. The results are provided in an informative results report that includes margin analysis indicating how close your product is to passing or failing that specification. Compliance test packages are available for many industry standards – see Table 1 for solutions available from Agilent and our partners.

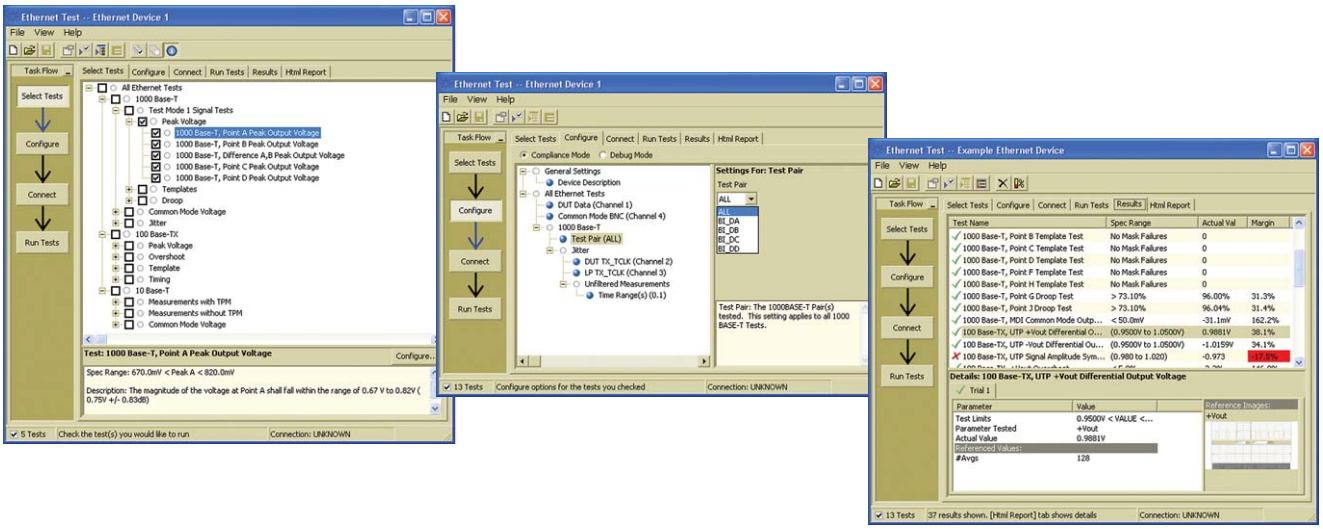

Figure 10. Infiniium test framework guides you quickly through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of tests with a mouse-click.

Compliance testing made easy (continued)

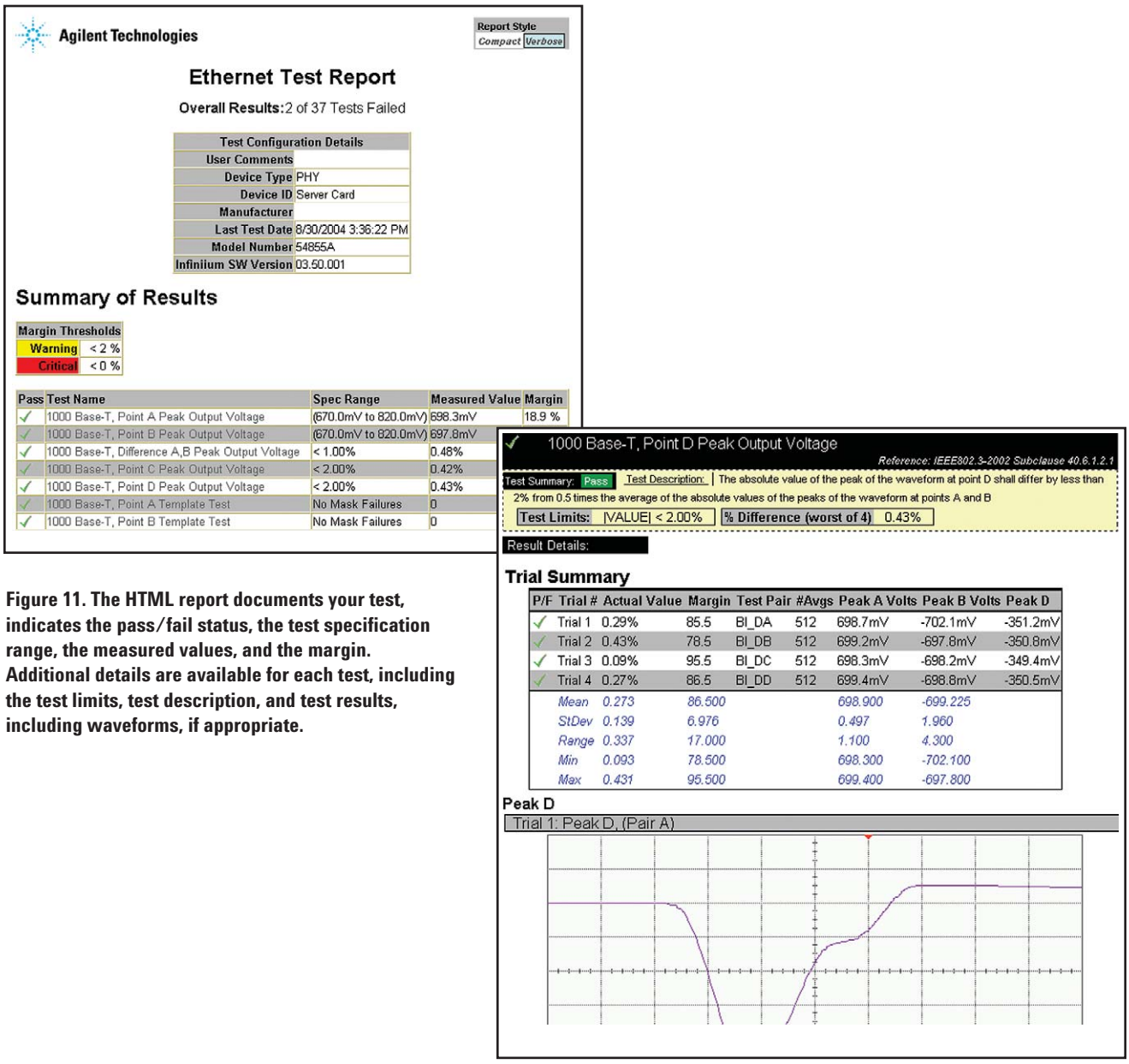

Figure 11. The HTML report documents your test, indicates the pass/fail status, the test specification range, the measured values, and the margin. Additional details are available for each test, including the test limits, test description, and test results, including waveforms, if appropriate.

Agilent compliance test software and fixture solutions

			Required functionality				Solutions	
Industry standard	**Bit rate**	**Recommended bandwidth[1]**	**Jitter analysis**	**Software clock recovery**	**8b/10b decode**	**Mask testing**	**Compliance test software**	**Test fixtures**
Ethernet (10/100/1000 Base-T)	Up to 250 Mb/s	2 GHz	Yes	Yes	Yes (for debug)	Yes	N5392A	N5395B, N5396A
USB 2.0	Up to 480 Mb/s	2 GHz	Yes	Yes	N/A	Yes	N5416A	E2649A
DDR I/II	Up to 800 MT/s	4 GHz	Yes	N/A	N/A	No	N5413A	
SATA 1.5 Gb/s	1.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes	N5411A	Contact COMAX Tech.
SAS 150	1.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes	N5412A	N5421A (SFF-8482)
DVI	1.65 Gb/s	4 GHz	Yes	Yes	Yes	Yes	N5394A	Contact Silicon Image
HDMI	Up to 1.65 Gb/s	4 GHz	Yes	Yes	Yes	Yes	N5399A	N5405A
Fibre Channel	2.125 Gb/s	4 GHz	Yes	Yes	Yes	Yes	N5410A	
PCI Express 1.1	2.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes	N5393A	Contact PCI-SIG
ExpressCard	2.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes	N5393A	Contact PCMCIA.org
InfiniBand	2.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes		Contact Fujikura
Advanced TCA	2.5 Gb/s	6 GHz	Yes	Yes	Yes	Yes		
SATA 3 Gb/s	3.0 Gb/s	10 GHz	Yes	Yes	Yes	Yes	N5411A	Contact COMAX Tech.
SAS 300	3.0 Gb/s	10 GHz	Yes	Yes	Yes	Yes	N5412A	N5421A (SFF-8482)
XAUI	3.125 Gb/s	8 GHz	Yes	Yes	Yes	Yes		
Serial Rapid IO	Up to 3.125 Gb/s	8 GHz	Yes	Yes	Yes	Yes		
FireWire (IEEE-1394)	Up to 3.2 Gb/s	8 GHz	Yes	Yes	N/A	N/A	Contact Quantum Parametrics	Contact Quantum Parametrics
Fibre Channel	4.25 Gb/s	10 GHz	Yes	Yes	Yes	Yes	N5410A	
FBD I	up to 4.8 Gb/s	12 GHz	Yes	Yes	N/A	Yes	N5409A	N4235A, N4236A, N4238A
PCI Express 2.0	5.0 Gb/s	12 GHz	Yes	Yes	Yes	No		
InfiniBand II	5.0 Gb/s	12 GHz	Yes	Yes	Yes	No		
SATA 6 Gb/s	6.0 Gb/s	13 GHz	Yes	Yes	Yes	No		
SAS 600	6.0 Gb/s	13 GHz	Yes	Yes	Yes	No		N5421A (SFF-8482)
Fibre Channel	8.5 Gb/s	13 GHz	Yes	Yes	Yes	No		
FBD II	up to 9 Gb/s	13 GHz	Yes	Yes	N/A	No		

1 Recommended bandwidth is derived from a combination of data rate and edge speed.

Table 1. Measurement requirements for common industry standards and the Agilent compliance test software and fixture solutions that are available

Ordering information

The DSA80000B digital signal analyzer is based on the Infiniium DSO80000B Series oscilloscope with several options standard.

To configure your DSA80000B, you must specify the following:

- Select the DSA80000B Digital Signal Analyzer
- Select one of DSO80000B Series oscilloscopes (see Table 2)
- Option 001 memory, Option 003 high-speed serial data analysis software with clock recovery, and Option 004 EZJIT Plus jitter analysis software will be enabled and are not modifiable
- Select any other oscilloscope options (see Table 3) for additional capability.

Oscilloscope model	Real-time bandwidth (2 channels, 40 GSa/s)	Channels
DSO80204B	2 GHz	4
DSO80304B	3 GHz	4
DSO80404B	4 GHz	4
DSO80604B	6 GHz	4
DSO80804B	8 GHz	4
DSO81004B	10 GHz	4
DSO81204B	12 GHz	4
DSO81304B	13 GHz	4

Table 2. Infiniium DSO80000B Series oscilloscope models

Option	Description
005	Noise reduction software (included standard with DSO81304B)
006	My Infiniium integration package
007	Low-speed serial data analysis software for I2C and SPI
008	CAN serial data analysis software
009	InfiniiScan event identification software
010	Infiniium user-defined function (UDF) application software
017	Removable hard disk drive
A6J	ANSI Z540-compliant calibration

Table 3. Additional options for Infiniium DSO80000B Series oscilloscopes

Summary specifications

Refer to the Infiniium DSO80000B Series Oscilloscope data sheet for complete specifications and information on probes and options.

Oscilloscope model	DSO80204B	DSO80304B	DSO80404B	DSO80604B	DSO80804B	DSO81004B	DSO81204B	DSO81304B
Real-time bandwidth (2 channels, 40 GSa/s)	2 GHz	3 GHz	4 GHz	6 GHz	8 GHz	10 GHz	12 GHz	13 GHz (analog 12 GHz)
Real-time bandwidth (4 channels, 20 GSa/s)	2 GHz	3 GHz	4 GHz	6 GHz	8 GHz	8 GHz	8 GHz	8 GHz
Channels	4 analog channels							
Sample rate	40 GSa/s – 1 or 2 channels used, 20 GSa/s – 3 or 4 channels used (20 GSa/s monolithic A/D converter behind each channel)							
Memory (with Option 001)	Max 2 Mpts – 1 or 2 channels used, 1 Mpts – 3 or 4 channels used							
Timebase range	5 ps/div to 20 s/div real-time, 5 ps/div to 500 ns/div equivalent-time							
Trigger jitter	<1 ps (rms) (typical)				< 500 fs (rms) (typical) 200 fs (rms) @ 2.5 Gb/s PRBS (DSO81204B) 150 fs (rms) @ 5 Gb/s PRBS (DSO81204B) 150 fs (rms) @ 10 Gb/s PRBS (DSO81204B)			
Trigger bandwidth	7.5 GHz							
Vertical sensitivity	Hardware setting 5 mV/div to 1 V/div (Software setting down to 1 mV/div)							
Input impedance	50 Ω (use E2697A to add 1 MΩ input impedance for a channel)							
Wavefrom update rate	Up to 4,800 waveforms/sec							
Noise floor								
at 5 mV/div	131 µV (rms)	160 µV (rms)	188 µV (rms)	241 µV (rms)	294 µV (rms)	342 µV (rms)	387 µV (rms)	419 µV (rms)
at 100 mV/div	1.0 mV (rms)	1.2 mV (rms)	1.4 mV (rms)	1.8 mV (rms)	2.1 mV (rms)	2.3 mV (rms)	2.7 mV (rms)	3.3 mV (rms)
CPU / PC interface	2.93 GHz Intel® Celeron™ with 1 GB system RAM / Windows® XP Pro (Open System)							
Storage	CD-R drive, 40 GB HDD, USB 2.0 for USB memory drives							
I/O connections	USB 2.0 high-speed (1 front and 4 rear), GPIB, RS-232, 10/100 Base-T, PS/2 (2 rear), external monitor out (shared between desktop and scope), 10-MHz reference clock in, 10-MHz reference clock out							
Display	8.4 inch (21.3 cm) touch screen color XGA LCD (1024 x 768) with 256 levels of gray scale							
Fan acoustic noise	55 dBa							
Power	100 - 240 VAC @ 50/60 Hz; maximum input power 550 Watts							
Weight	Net: 13 kg (28.5 lbs.), Shipping: 16 kg (35.2 lbs.)							
Dimensions (excluding handle)	216 mm (8.5 in) H x 437 mm (17.19 in) W x 440 mm (17.34 in) D							
Active probes								
single-end probe	1157A 2.5 GHz	1158A 14 GHz	No single-end-only probe available (use differential probe instead)					
differential probe amp	1131A 3.5 GHz		1132A 5 GHz	1134A 7 GHz	1168A 10 GHz		1169A 12 GHz	
connection	E2668A single-end connection kit E2669A differential connection kit				N5380A 12-GHz SMA probe N5381A 12-GHz solder-in probe N5382A 12-GHz browser			
Passive probes	E2697A Hi-Pod 1 MΩ adapter (includes 10073C 500 MHz passive probe) 54006A 7.5 GHz resistive divider probe							

Product upgrades

If you wish to upgrade your DSA80000B in the future by adding options listed in Table 3, please consult your local Agilent sales representative for ordering information. The After-Burner II Upgrade program is available that allows you to upgrade your Infiniium DSO80000B Series oscilloscope to a higher bandwidth model, protecting your valuable Infiniium oscilloscope and probing system investment over the long term. Learn more at **www.agilent.com/find/dsa80000b**.

Related literature

Publication title	Publication type	Publication number
Infiniium DSO80000B Series Oscilloscopes and InfiniiMax probes	Data sheet	5989-4604EN
N5400A EZJIT Plus Jitter Analysis Software	Data sheet	5989-0109EN
E2688A High-Speed Serial Data Analysis Software	Data sheet	5989-0108EN
N5414A InfiniiScan Event Identification Software	Data sheet	5989-4605EN
N5430A Infiniium User Defined Function (UDF) Application Software	Data sheet	5989-5632EN
N5391A I2C and SPI Analysis Software	Data sheet	5989-1250EN
N5402A CAN Analysis Software	Data sheet	5989-3632EN
E2699A My Infiniium Integration Package	Data sheet	5988-9934EN
N5392A Ethernet Compliance Test Package	Data sheet	5989-1527EN
N5393A PCI-Express Test Package	Data sheet	5989-1240EN
N5394A DVI Compliance Test Software	Data sheet	5989-1526EN
N5399A HDMI Compliance Test Software	Data sheet	5989-3047EN
N5409A FBD Compliance Test Software	Data sheet	5989-4128EN
N5410A Fibre Channel Compliance	Data sheet	5989-4209EN
N5411A SATA Compliance Test Software	Data sheet	5989-3662EN
N5412A SAS Compliance Test Software	Data sheet	5989-4208EN
N5413A DDR2 Clock Characterization	Data sheet	5989-3195EN
N5416A USB Compliance Test Software	Data sheet	5989-4044EN

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