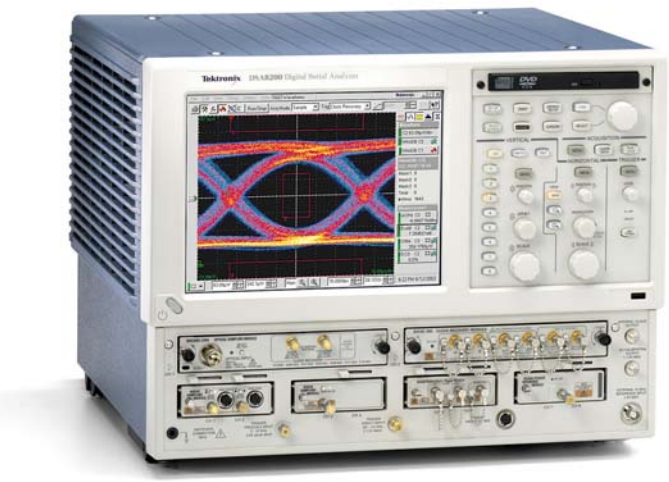
Digital Serial Analyzer Sampling Oscilloscope

DSA8200 Data Sheet



Features & Benefits

- State-of-the-Art Sampling Oscilloscope for Communication Signal Analysis, TDR / TDT / Serial Data Network Analysis, Acquisition, and Measurements of Repetitive Ultrafast Signals
  - Acquisition of Spread Spectrum Clocking (SSC) Signals
  - Industry's Only Mainframe to Support up to 8 Input Channels for Increased Flexibility and Throughput
  - Four Color-graded, Variable Persistence Waveform Databases
  - Measurement System with Over 100 Automated Measurements
  - Complete Suite of Communications Measurements includes Both Types of OMA, SSC Profile, and Many Others
  - Automated ITU/ANSI/IEEE Mask Testing
  - Masks and Measurements for SONET/SDH, FC, Ethernet, and Other Standards Built-in
  - Mask Updates can be Loaded from Factory-supplied File
  - Mask Margin Testing for Guard Banding Production Testing
- Acquisition Modules
  - Fully Integrated Multirate Optical Modules
  - Optical Modules up to 80 GHz 80C10B
  - High-accuracy "ER Calibrated" Measurement Available in Some Modules
  - Electrical Modules up to 70+ GHz Bandwidth and 5 ps Measured Rise Time (10-90%)
  - Flexible Rate Clock Recovery
  - Clock Recovery with SSC (Spread Spectrum Clocking) Support Available
- Jitter, Noise, BER, and Serial Data Link Analysis
  - Measures and Separates Deterministic Data-dependent Jitter from Random Jitter
  - Measures Vertical Noise, Separating Deterministic Data-dependent Noise from Random Noise
  - Highly Accurate BER and Eye Contour Estimation, Support for DDPWS
  - FFE/DFE Equalization, Transmitter Equalization
  - Channel Emulation for Channels with >30 dB of Loss
  - Linear Filter for Fixture De-embedding, Linear Filtering
- TDR (Time Domain Reflectometry)
  - Up to 50 GHz TDR Bandwidth with 15 ps Reflected Rise Time and 12 ps Incident Rise Time
  - Lowest Noise for Accurate Repeatable TDR Measurement Results – 600 μV_{RMS} at 50 GHz
  - Independent Sampler Deskew ensures Easy Fixture and Probe De-embedding
  - Industry's Only Mainframe to Accommodate up to Four True-differential TDR or Electrical Channel Pairs for Increased System Versatility
- S-parameter Measurements
  - Up to 50 GHz Differential, Single Ended, Mixed Mode; Insertion Loss, Return Loss, Frequency Domain Crosstalk, Mode Conversion
  - PCI Express, Serial ATA, Infiniband, Gigabit Ethernet Manufacturing, and Standard Compliance Testing for Gigabit Signal Path and Interconnects – Including Eye Mask Tests
  - Intuitive, Easy, and Accurate for Serial Data, Gigabit Digital Design, and Signal Integrity
  - Fast and Accurate Automated Multiport S-parameter Measurements with Command Line Interface
- Industry's Best Standard Time-base Jitter Performance, 800 fs_{RMS}
- Industry-leading Time-base Jitter Performance, <200 fs_{RMS}*1 Available with Phase Reference Module
- Fast Acquisition Rate and High Throughput
- Remote Samplers enabling Placement Near DUT for Superior Signal Fidelity
- FrameScan™ Acquisition Mode with Eye Diagram Averaging:
  - Isolate Data-dependent Faults
  - Examine Low-power Signals
- MS Windows XP Operating System
- Advanced Connectivity to 3rd party Software

Tektronix®

Applications

- Design/Verification of Telecom and Datacom Components and Systems
- Manufacturing/Testing for ITU/ANSI/IEEE/SONET/SDH Compliance
- High-performance True-differential TDR Measurements
- Advanced Jitter, Noise, and BER Analysis
- Impedance Characterization and Network Analysis for Serial Data Applications including S-parameters
- Channel and Eye Diagram Simulation and Measurement-based SPICE Modeling

*1 Typical, with the Phase Reference module, some conditions apply. Without the module, the jitter is <800 fs_{RMS} (typical).

Superior Performance with Extraordinary Versatility

For developing today's high-speed serial devices, the DSA8200 Digital Serial Analyzer sampling oscilloscope is the most versatile tool for communication, computer and consumer electronics gigabit transmitter and signal path characterization, and compliance verification. With exceptional bandwidth, signal fidelity, and the most extensible modular architecture, the DSA8200 provides the highest performance TDR and interconnect analysis, most accurate analysis of signal impairments, and BER calculations for current and emerging serial data technology.

The DSA8200 provides unmatched measurement system fidelity with ultra-low jitter floor that ensures the most accurate acquisition of high-speed signals. You get advanced analysis benefits from the 200 fs acquisition jitter with the Phase Reference module. And in another step forward for a sampling oscilloscope, with the help of the Phase Reference module the DSA8200 can acquire and measure SSC (Spread Spectrum Clocking) signals.

The multiprocessor architecture, with dedicated per-slot digital signal processors (DSPs), provides fast waveform acquisition rates, reducing the test times necessary for reliable characterization and compliance verification.

The DSA8200's versatile modular architecture supports a large and growing family of plug-ins enabling you to configure your measurement system with a wide variety of electrical, optical, and accessory modules that best suit your application now and in the future. With 6 module slots, the DSA8200 can simultaneously accommodate a Clock Recovery module, a precision Phase Reference module, and multiple acquisition modules, electrical or optical, so you can match system performance to your evolving needs.

Featuring industry-leading signal fidelity, the family of electrical modules includes bandwidth performance from 12 GHz to 70+ GHz. Two true-differential Time Domain Reflectometer (TDR) modules, with remote samplers, offer up to 50 GHz bandwidth and 15 ps reflected rise time and 12 ps incident rise time. The family of low-noise variable-bandwidth electrical modules provides the industry's best noise performance with remote samplers, featuring 450 μV_{RMS} noise at 60 GHz, and 300 μV_{RMS} at 30 GHz.

DSA8200 optical modules provide complete optical test solutions with superior system fidelity from 125 Mb/s to 43 Gb/s and beyond. The modules cover a range of wavelengths for both single- and multi-mode fibres. Each module can be optionally configured with a number of selectable optical reference receiver (ORR) filters and/or a full bandwidth path. The 80C07B, 80C08C, and 80C11 can be configured with a number of available flexible integrated clock recovery options. The 80C12 and 80C14 Multirate module clock recovery support is achieved with an electrical output for use with the 80A05 module, or CR175A/CR125A instruments.

The DSA8200's popular FrameScan™ acquisition mode can be used with patterns from DUTs, BERTs, and other sources, to isolate pattern-dependent effects in transmitters or show the bit sequence preceding a mask violation. FrameScan automatically sequences the time base so that each bit of the data stream is acquired in time order. When used in combination with mask-testing conditional acquisition features of the DSA8200, such as stop after mask hits, FrameScan can automatically identify at which bit a pattern-dependent failure occurred.

In addition, specialized modules supporting features such as single-ended and differential electrical clock recovery, electrostatic protection for the TDR, and connectivity to the popular TekConnect probing system brings you the performance of Tektronix state-of-the-art probes for high-impedance and differential probing. Low-impedance probes for 50 Ω probing and for TDR probing are also available.

Jitter, Noise, BER, and Serial Data Link Analysis

High-speed serial data link measurements and analysis are supported with three software solutions: **80SJARB**, **80SJNB Essentials**, and **80SJNB Advanced**.

80SJARB is a basic jitter measurement tool capable of measuring jitter on any waveform – random or repetitive. The simplicity of acquisition limits the amount of analysis possible so only the simplest decomposition can be used; repeatability is pattern dependent.

80SJNB Essentials offers complete analysis of jitter, noise, and BER, with decomposition of components for clear understanding of a signal's problems and margins. The acquisition methodology requires a repetitive pattern. Both accuracy and repeatability are improved relative to 80SJARB since the tool has access to the complete signal pattern.

80SJNB Advanced adds features to 80SJNB Essentials for Serial Data Link Analysis – de-embedding of fixture, channel emulation, FFE/DFE equalization, pre-emphasis/de-emphasis.

TDR and electrical modules with fully integrated remote sampler.

Small form factor remote sampler enables placement near DUT assuring optimal signal fidelity.

TDR (Time Domain Reflectometry)

The DSA8200 is the industry's highest performance fully integrated Time Domain Reflectometry (TDR) measurement system. Offering true-differential TDR measurements up to 50 GHz bandwidth with 15 ps reflected rise time and 12 ps incident rise time, you are able to keep pace with today's most demanding Serial Data Network Analysis (SDNA) requirements.

The 80E10 and 80E08 TDR modules feature a fully integrated independent dual-channel 2-meter remote sampler system to minimize fixturing and assure optimal system fidelity. Independent sampler deskew ensures fast and easy fixture and probe de-embedding. The user can characterize differential crosstalk by using TDR steps from a differential module to drive one line pair while monitoring a second line pair with a second differential module.

The DSA8200 is the industry's most versatile TDR measurement system, accommodating up to 4 dual-channel true-differential TDR modules for fast, accurate multilane impedance and S-parameter characterization.

The P80318 True-differential TDR probe and P8018 Single-ended Passive Handheld TDR probe provide high-performance probing solutions for circuit board impedance and electrical signal characterization. The P80318, an 18 GHz 100 Ω input impedance differential TDR hand probe, enables high-fidelity impedance measurements of differential transmission lines. The adjustable probe pitch enables a wide variety of differential line spacing and impedances. The P8018 is a 20 GHz Single-ended Passive Handheld TDR probe. Both the P80318 and P8018 can be used as stand-alone probes but are especially designed to work with the 80A02 for the control of EOS/ESD protection.

Gigabit Signal Path Characterization and Analysis – Serial Data Network Analysis (SDNA)

As clock speeds and rise times of digital circuits increase, interconnect signal integrity dramatically affects digital system performance. Accurate and efficient Serial Data Network Analysis (SDNA) of the signal path and interconnects in time and frequency domains is critical to predict signal losses, jitter, crosstalk, terminations and ringing, digital bit errors, and eye diagram degradation, ensuring reliable system operation.

Tektronix offers several true-differential TDR modules, which in combination with IConnect® software, allow S-parameters measurements with up to –70 dB of dynamic range. This performance assures accurate repeatable measurement in serial data analysis, digital design, signal integrity, and electrical compliance testing applications.

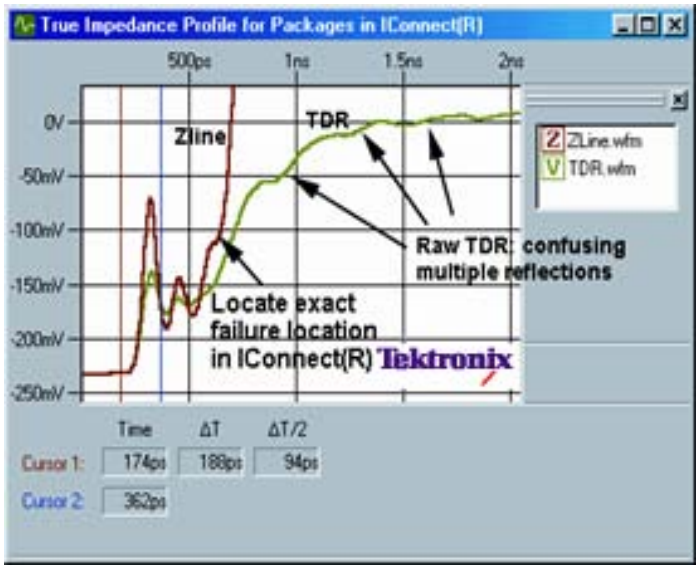
The table below summarizes the S-parameter measurement bandwidth performance when IConnect and the true-differential TDR modules are used in combination.

TDR Module	S-parameter Measurement Bandwidth Performance
80E10	50 GHz
80E08	30 GHz
80E04	20 GHz

With the long record length acquisitions, IConnect® provides great flexibility for obtaining the desired frequency range and frequency step when performing S-parameter measurements. Up to 1,000,000 points can be acquired*2.

When you employ IConnect® Signal Integrity TDR and S-parameter software with the DSA8200 you have an efficient, easy-to-use, and cost-effective solution for measurement-based performance evaluation of multi-gigabit interconnect links and devices, including signal integrity analysis, impedance, S-parameter, and eye-diagram tests, and fault isolation. IConnect can help you complete interconnect analysis tasks in minutes instead of days, resulting in faster system design time and lower design costs. IConnect also enables impedance, S-parameters, and eye-diagram compliance testing as required by many serial data standards, as well as full channel analysis, Touchstone (SnP) file output, and SPICE modeling for gigabit interconnects.

*2 Long record lengths are supported only on DSA8200, CSA8200, TDS8200, CSA8000, and TDS8000 platforms.



Quickly identify the exact location of faults with the 80E10's sub-millimeter resolution and IConnect True Impedance Profile.

Failure Analysis – Quickly Identify Fault Location

The 80E10, with its 12 ps typical TDR rise time, provides superior resolution enabling the fastest and most efficient fault isolation in package, circuit board, and on-chip failure analysis applications.

Advanced Communication Signal Analysis

Specifically designed for ultra high-performance optical and electrical serial data applications, the DSA8200 is the ideal tool for design characterization and validation, as well as manufacturing test of datacom and telecom components, transceiver subassemblies, and transmission systems. The DSA8200 generates measurement results, not just raw data, with time and amplitude histograms, mask testing, and statistical measurements. It provides a communications-tailored measurement set that includes jitter, noise, duty cycle, overshoot, undershoot, OMA, extinction ratio, Q-factor, mean optical power, and amplitude. In addition, you can do mask testing of SONET/SDH, 100 Gigabit (4×25), 10 Gigabit, Gigabit Ethernet, and other electrical and optical standards compliance verification. Color grading and intensity grading of waveform data adds a third dimension, sample density, to your signal acquisitions and analysis to provide visual insight. In addition, the variable persistence database feature enables exact data aging to all of the functions, and facilitates eye measurements on DUTs under adjustment.

OpenChoice® Software Enables Familiar Tools to Extend Your Measurement System

The DSA8200 provides an open Windows environment offering new levels of data analysis on the instrument using your favorite commercially available third-party software packages. Additionally, TekVISA™, a standard software accessory, allows the instrument to be placed under the control of software applications (such as LabVIEW, LabWindows, Visual Basic, Microsoft Excel, C, etc.) running on the instrument or on an external PC workstation's network connected to the instrument without the need of a GPIB hardware interface. Plug-and-play drivers for LabVIEW and other programs are also supplied.

The DSA8200 combines the familiarity of Microsoft's Windows XP operating system with world-class waveform acquisition technology. This platform provides a wide array of standard instrumentation and communications interfaces, including: GPIB, parallel printer port, RS-232-C, USB serial ports, and an Ethernet LAN connection. In addition, the platform includes a DVD-CD/RW combo drive and removable hard drive for storage of waveforms, setups, and analysis results.

155 Mb/s to 14+ Gb/s Optical Test

Tektronix optical modules for DSA8200 offer highest level of integration in the industry, with corresponding higher repeatability and transferability of the result. A particularly method-sensitive measurement, Extinction Ratio (ER) is now also available as ER Calibrated, with an additional layer of improvement to the portability of the result (80C08C, 80C11, and 80C14 modules only).

80C14 14 GHz Broad Wavelength Multirate 14 Gb/s Optical Module

The new 80C14 is a broad-wavelength (700 to 1650 nm) multirate optical sampling module that supports 10 Gb/s applications including both datacom and telecom. The supported datacom applications include 10GbE at 9.95, 10.31, 11.09 Gb/s and 8G Fibre Channel, 10G Fibre Channel, 16G Fibre Channel applications at 8.5, 10.51, 11.3, 14.025 Gb/s. The 80C14 also provides telecom rate testing at 9.95, 10.66, 10.70, and 12.5 Gb/s. 14G Infiniband FDR is also supported at 14.063 Gb/s.

With its amplified O/E design, the 80C14 provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low-power optical signals. Clock recovery for the 80C14 is provided by the CR175A or CR286A Clock Recovery Instrument (sold separately).

80C08C 10 GHz Broad Wavelength Multirate 10 Gb/s Optical Module

The 80C08C is a broad-wavelength (700 to 1650 nm) multirate optical sampling module providing datacom rate testing for 10GbE applications at 9.95, 10.31, 11.09 Gb/s and 10G Fibre Channel applications at 10.51 Gb/s. The 80C08C also provides telecom rate testing with several filters between 9.95 and 11.3 Gb/s. With its amplified O/E design, this module provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low power level optical signals. The 80C08C can be optionally configured with integrated clock recovery options that can support any standard or user-defined rate in a continuous range from 9.8 to 12.6 Gb/s.

80C12 Up to 10 GHz Broad Wavelength Multirate 1 Gb/s to 10 Gb/s Optical Module

The 80C012 is a broad-wavelength (700 to 1650 nm) multirate optical sampling module providing 1G, 2G, and 4G telecom and datacom testing. This highly flexible module can be configured to support either lower data rate applications (1 to 4 Gb/s) or a wide variety of 10 Gb/s applications. The low data rate applications include: 1, 2, and 4 Fibre Channel and "by 4" wavelength division multiplex standards such as 10GBase-X4 and 4-Lane 10 Gb/s Fibre Channel. The supported 10 Gb/s applications include both datacom and telecom. The supported 10 Gb/s datacom applications include 10GbE at 9.95, 10.31, 11.09 Gb/s, 8G Fibre Channel, and 10G Fibre Channel applications at 8.5 Gb/s, 10.51, and 11.3 Gb/s. The 80C12 also provides telecom rate testing at 9.95, 10.66, and 10.70 Gb/s. With its amplified O/E design, this module provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low power level optical signals. Clock recovery for the 80C12 is provided through the 80A05 module or CR125A instrument (sold separately).

80C11 30 GHz Long Wavelength Multirate 10 Gb/s Optical Module

The 80C11 is optimized for testing of long wavelength signals (1100 to 1650 nm) at a number of rates around 10 Gb/s with a highly flexible multirate filter. Additionally the high optical bandwidth of 30 GHz (typical) and the excellent frequency response of its full bandwidth path is well suited for general purpose high-performance optical component testing. The 80C11 can be configured with clock recovery options that supports any standard or user-defined rate from 9.8 to 12.6 Gb/s.

80C07B 2.5 GHz Broad Wavelength Multirate 155 Mb/s to 2.5 Gb/s Optical Module

The 80C07B is a broad-wavelength (700 to 1650 nm) multirate optical sampling module optimized for testing datacom/telecom signals from 155 to 2500 Mb/s. With its amplified O/E design, this module provides excellent signal-to-noise performance, allowing users to examine low-power optical signals. The 80C07B can be optionally configured with multirate clock recovery that operates from 155 to 2.7 Mb/s.

40 Gb/s and 100 Gb/s Optical Test

80C10B Multirate Datacom and Telecom 40 Gb/s and 100 Gb/s

The 80C10B module provides integrated and selectable reference receiver filtering, enabling compliance testing at either 1310 nm or 1550 nm for 39.813 Gb/s (OC-768/STM-256, VSR2000 G.693, 40G NRZ G.959.1), 41.25 Gb/s (40GBase-FR), and 43.018 Gb/s [G.709 FEC, OTU3, (4x10G LAN PHY)] rates. In addition to the filter rates, the user may also choose selectable bandwidths of 30 GHz, 65 GHz, and 80 GHz for 80C10B for optimal noise vs. bandwidth performance for accurate signal characterization. The 80C10B is optionally available with Option F1 which extends filter selections to include 27.739 Gb/s (100GBase-LR4 + FEC and 100GBase-ER4 + FEC), and 25.781 Gb/s (100GBase-LR4 and 100GBase-ER4). When equipped with Option CRTP, an electrical signal pickoff is provided for clock recovery using an external module (such as the Tektronix CR286A-HS). The 80C10B is also optionally available in a bundled ordering configuration which includes a 70+ GHz electrical sampling channel.

80C25GBE Multirate Datacom 100 Gb/s

80C25GBE module provides 65 GHz full bandwidth with integrated selectable reference receiver filtering, enabling compliance testing at either 1310 nm or 1550 nm for 27.739G (100GBase-LR4 + FEC and 100GBase-ER4 + FEC), and 25.781G (100GBase-LR4 and 100GBase-ER4). When equipped with Option CRTP, an electrical signal pickoff is provided for clock recovery using an external module (such as the Tektronix CR286A-HS).

Performance You Can Count On

Depend on Tektronix to provide you with performance you can count on. In addition to industry-leading service and support, this product comes backed by a three-year warranty as standard.

Optical Modules: 80C07B

Module	**80C07B**										
Opt.	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**CR1**
Bandwidth (GHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Wavelength Range (nm)	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650
Fibre Input (µm)	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5
Mask Test Sensitivity (dBm)	–22	–22	–22	–22	–22	–22	–22	–22	–22	–22	–22
Number of Channels	1	1	1	1	1	1	1	1	1	1	1
Rates Supported: ■=Filter, ♦=Optical Clock Recovery, ⊕=Electrical Clock Recovery											
125 Mb/s*3	■	■	■	■							♦
155 Mb/s	■	■	■	■							♦
622 Mb/s	■				■	■	■				♦
1063 Mb/s		■			■			■	■		♦
1250 Mb/s			■			■		■		■	♦
2125 Mb/s				■			■		■	■	♦
2488 Mb/s	■	■	■	■	■	■	■	■	■	■	♦
2500 Mb/s	■	■	■	■	■	■	■	■	■	■	♦
3.125 Gb/s											
3.188 Gb/s											
3.32 Gb/s											
4.25 Gb/s											
9.95 Gb/s											

*3 125 Mb/s is supported by selecting 155 Mb/s rate.

Optical Modules: 80C08C, 80C10B, 80C11, and 80C25GBE

Module	80C08C				80C10B*5			80C11					80C25GBE	
Opt.		**CR1**	**CR2**	**CR4**		**CRTP**	**F1**		**CR1**	**CR2**	**CR3**	**CR4**		**CRTP**
Bandwidth (GHz)	10	10	10	10	80		65	30	30	30	30	30	65	
Wavelength Range (nm)	700-1650	700-1650	700-1650	700-1650	1290-1330 1520-1620		1290-1330 1520-1620	1100-1650	1100-1650	1100-1650	1100-1650	1100-1650	1290-1330 1520-1620	
Fibre Input (µm)	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9		9	9	9	9	9	9	9	
Mask Test Sensitivity (dBm)	–16	–15	–15	–15	–7		–8	–9	–9	–9	–9	–9	–8	
Number of Channels	1	1	1	1	1		1	1	1	1	1	1	1	
Rates Supported: ■=Filter, ♦=Optical Clock Recovery, ⊕=Electrical Clock Recovery														
9.95 Gb/s	■	♦		♦				♦■	♦	♦	♦	♦		
10.31 Gb/s	■	♦	♦	♦				■				♦		
10.52 Gb/s	■		♦	♦				■				♦		
10.66 Gb/s	■			♦				■	♦			♦		
10.71 Gb/s	■			♦				■		♦	♦	♦		
11.1 Gb/s	■			♦				■				♦		
11.3 Gb/s	■			♦				■				♦		
25.78 Gb/s						♦*6	■						■	♦*6
27.74 Gb/s						♦*6	■						■	♦*6
39.81 Gb/s					■	♦*4	■							♦*4
41.25 Gb/s					■	♦*4	■							♦*4
43.02 Gb/s					■	♦*4	■							♦*4

*4 Contact Tektronix for details.

*5 Option CRTP reduces sensitivity by 0.6 dB (max) and increases noise by 15% (max).

*6 Clock recovery with CR286A-HS (sold separately).

Optical Modules: 80C12 and 80C14

Module	80C12									80C14	
Opt.	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**FC**	**10G**	**CR*7, 8**		**CR*8**
Bandwidth (GHz)	4.25	9	9	4.25	9	9	9	10		14	
Wavelength Range (nm)	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650	700-1650		700-1650	
Fibre Input (µm)	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5	9 or 50 or 62.5		9 or 50 or 62.5	
Mask Test Sensitivity (dBm)	–19	–19	–19	–19	–19	–19	–19	–14		–15	
Number of Channels	1	1	1	1	1	1	1	1			
Rates Supported: ■=Filter, ♦=Optical Clock Recovery, ⊕=Electrical Clock Recovery											
155 Mb/s									♦*7		
622 Mb/s									♦*7		
1063 Mb/s	■		■						♦*7		
1250 Mb/s									♦*7		
2125 Mb/s	■	■	■	■		■			♦*7		
2488 Mb/s									♦*7		
2500 Mb/s									♦*7		
3.125 Gb/s				■	■	■	■		♦*7		
3.188 Gb/s				■	■	■	■		♦*7		
3.32 Gb/s							■		♦*7		
4.25 Gb/s	■	■		■	■				♦*7		
8.5 Gb/s*9		■	■		■	■	■	■	♦*10	■	♦*10
9.95 Gb/s								■	♦*8	■	♦*8
10.31 Gb/s*9								■	♦*8	■	♦*8
10.52 Gb/s								■	♦*8	■	♦*8
10.66 Gb/s								■	♦*8	■	♦*8
10.71 Gb/s								■	♦*8	■	♦*8
11.1 Gb/s								■	♦*8	■	♦*8
11.3 Gb/s								■	♦*8	■	♦*8
12.5 Gb/s										■	♦*8
14.025 Gb/s										■	CR175A
14.063 Gb/s										■	CR175A

*7 With 80A05, CR125A, or CR175A.

*8 With 80A05 Option 10G, CR125A, or CR175A.

*9 Draft version of the 8.5GFC filter. T11 committee redefined this filter at the April 2008 meeting. New 8.5GFC filter, as defined by T11 committee in April 2009, is identical to the 10GBase-R 10.313G filter and is available for 80C12 Option 10G modules and 80C14 modules; and is identified as 10Base-R.

*10 With CR125A or CR175A.

DSA8200 Electrical Modules

TDR Modules: 80E10, 80E08, and 80E04

The 80E10, 80E08, and 80E04 are dual-channel Time Domain Reflectometry (TDR) sampling modules, providing typical 12 ps incident and 15 ps reflected TDR step rise time. Each channel of these modules is capable of generating a fast step for use in TDR mode and the acquisition portion of the sampling module monitors the incident step and any reflected energy. The polarity of each channel's step can be selected independently. This allows for true-differential or common-mode TDR or S-parameters testing of two coupled lines, in addition to the independent testing of isolated lines. The independent step generation for each channel allows true-differential measurements, which ensures measurement accuracy of nonlinear differential devices.

80E10 and 80E08 feature a small form factor, fully integrated independent 2-meter remote sampler system, enabling the location of the sampler and TDR step generator near the DUT for the best system fidelity. The modules characterize crosstalk by using TDR steps to drive one line (or line pair for differential crosstalk) while monitoring a second line (or line pair) with the other channel (or another module for differential crosstalk). The "rise time filter" function on the DSA8200 mainframe can be used with TDR or crosstalk measurements to characterize expected system performance with slower edge speeds. An optional 2-meter extender cable for the 80E04 is available, which enables placement of the module near the DUT for the best system fidelity.

All modules have independent incident step and receiver deskew to remove the effect of fixtures and probes, enabling faster and easier deskew. The 80E10 Sampling module provides an acquisition rise time of 7 ps, with up to 50 GHz user-selectable equivalent bandwidth (with 50 GHz, 40 GHz, and 30 GHz settings). 80E08 sampling bandwidth is 30 GHz (user-selectable with 30 GHz and 20 GHz settings) and 80E04 sampling bandwidth is 20 GHz. The 20 GHz P8018 single-ended and the 18 GHz P80318 differential variable pitch TDR handheld probes provide excellent performance, ensuring easy and accurate backplane and package measurements.

TDR Module Summary

Module	Typical TDR Rise Time at Full Bandwidth		Bandwidth Performance*[12]	RMS Noise at Bandwidth*[12]	Remote Sampler
	Incident*[11]	Reflected*[11]			
80E10	*12 ps*	*15 ps*	50 GHz, 40 GHz, and 30 GHz (user selectable)	50 GHz: *600 µV* 40 GHz: *370 µV* 30 GHz: *300 µV*	Yes, fully integrated 2-meter cable
80E08	*18 ps*	*20 ps*	30 GHz, 20 GHz (user selectable)	30 GHz: *300 µV* 20 GHz: *280 µV*	Yes, fully integrated 2-meter cable
80E04	*23 ps*	*28 ps*	20 GHz	*600 µV*	No, optional 80N01 – 2-meter extender cable

*[11] Values shown are warranted unless printed in an italic typeface which represents a typical value.

*[12] Calculated from .35 bandwidth rise time product.

Electrical Modules: 80E09, 80E07, 80E06, 80E03, and 80E01

The 80E09 and 80E07 are dual-channel modules with remote samplers, capable of noise as low as 450 μV_{RMS} at 60 GHz bandwidth and 300 μV_{RMS} noise at 30 GHz bandwidth. Each small form factor remote sampler is attached to a 2-meter cable to minimize the effects of cables, probes, and fixtures to ensure the best system fidelity. User-selectable bandwidth settings (60/40/30 on 80E09 and 30/20 on 80E07) offer optimal noise/bandwidth trade-off.

80E06 and 80E01 are single-channel 70+ and 50 GHz bandwidth sampling modules respectively. 80E06 provides the widest bandwidth and fastest rise time with world-class system fidelity. Both 80E06 and 80E01 provide a superior maximum operating range of ±1.6 V. Both modules can be used with the optional 2-meter extender cable, ensuring superior system fidelity and measurement flexibility.

The 80E03 is a dual-channel 20 GHz sampling module. This module provides an acquisition rise time of 17.5 ps or less. An optional 2-meter extender cable is available.

When used with Tektronix 80SJNB Jitter, Noise, and BER Analysis software, these modules enable separation of both jitter and noise into their constituent components, for insight into the underlying causes of eye closure and obtain highly accurate calculation of BER and 3-D eye contour. When used with the 82A04 Phase Reference module, time-base accuracy can be improved down to 200 fs_{RMS} jitter which, together with the 300 μV_{RMS} noise floor and 14 bits of resolution, ensures the highest signal fidelity for your measurements.

Electrical Module Summary

Electrical Module	Step Response at Full Bandwidth (10-90%)*11	Number Of Channels	Bandwidth*11, 13	RMS Noise at Bandwidth*11	Remote Sampler
80E09	5.8 ps	2	60/40/30 GHz (user selectable)	60 GHz: *450 µV* 40 GHz: *330 µV* 30 GHz: *300 µV*	Yes, fully integrated 2-meter cable
80E07	11.7 ps	2	30/20 GHz (user selectable)	30 GHz: *300 µV* 20 GHz: *280 µV*	Yes, fully integrated 2-meter cable
80E06	5.0 ps	1	70+ GHz	*1.8 mV*	No, optional 80N01 – 2-meter extender cable
80E03	17.5 ps	2	20 GHz	*600 µV*	No, optional 80N01 – 2-meter extender cable
80E01	7 ps	1	50 GHz	*1.8 mV*	No, optional 80N01 – 2-meter extender cable

*11 Values shown are warranted unless printed in an italic typeface which represents a typical value.

*13 Now obsolete module useful with older versions of the mainframe, but not needed with the 8200 Series mainframes.

DSA8200 Accessory Modules

82A04 Phase Reference Module

The 82A04 Phase Reference module enhances the DSA8200 sampling oscilloscope from the industry's standard time-base jitter performance of 800 fs_{RMS}, to the extremely low time-base jitter of <200 fs_{RMS}. Typical application for the Phase Reference module is the acquisition and analysis of very high-speed optical and electrical signals in communication devices and systems. The 82A04 supports both the Triggered mode of operation, which is similar to usual acquisition, and the untriggered Free Run mode where all timing information comes from the customer-supplied clock alone (no trigger signal necessary). When the external clock is not available the module can accept the clock signal from the clock recovery output of the 80Cxx modules, as well as from the 80A05 module or CR125A, CR175A, or CR286A instruments. Additionally 82A04 supports SSC (Spread Spectrum Clocking) operation.

80A05 Electrical Clock Recovery Module

The 80A05 Electrical Clock Recovery module enables clock recovery for electrical signals, as well as internal triggering on the recovered clock. The module recovers clocks from serial data streams for all of the most common electrical standards in the 50 Mb/s to 4.25 Gb/s, around 5 to 6 Gb/s, and from 9.953 Gb/s to 12.5 Gb/s ranges. The module accepts either single-ended or differential signals as its input, providing clock recovery for both. The signal(s) is/are then passed on to the output connectors (at about 50% of the input level) and can be connected to sampling module(s) for differential or single-ended sampling. Option 10G is required for support of standard rates from 9.953 Gb/s to 12.6 Gb/s. Clock recovery for the 80C12 Optical Sampling module is provided through the 80A05 module or CR125A, CR175A, or CR286A instruments.

80A06 PatternSync Module

The 80A06 PatternSync Trigger module, when used in combination with 80SJNB software, enables characterizing jitter, noise, and BER performance of high-speed serial designs from 1 Gb/s to 60 Gb/s data rates. It extends the capability of the DSA8200 sampling oscilloscope by creating a pattern trigger from any data-related clock – a recovered clock, user-supplied clock, sub-clock, or super-clock. The PatternSync Trigger module is programmable to pattern lengths of up to 2^{23} bits and accepts a user-supplied clock signal from 150 MHz to 12.5 GHz. The 80A06 module is required with the DSA8200 when using 80SJNB Advanced Jitter, Noise, and BER Analysis software package. This module can be used in combination with the 82A04 Phase Reference module for the best time-base accuracy or for acquisition of signals under SSC (Spread Spectrum Clocking).

CR125A, CR175A, and CR286A Clock Recovery Instruments

CR125A, CR175A and CR286A Clock Recovery instruments recover clocks from serial data streams for all of the most common electrical standards in the continuous 150 Mb/s to 12.5 Gb/s, 150 Mb/s to 17.5 Gb/s, or 150 Mb/s to 28.6 Gb/s range respectively. Auto-locking capability is selectable from the user interface or programmatic interface, so the design and test engineers can search and lock onto signals of undefined or unknown data rate. The module accepts either single-ended or differential signals as its input, providing clock recovery for both. The signal(s) is/are then passed on to the output connectors and can be connected to sampling module(s) for differential or single-ended sampling. Tektronix clock recovery instruments offer complete configurability and state-of-the-art specifications and are the preferred solution for most serial data standards due to excellent stability, superior jitter and slew rate tolerance for recovering clocks from stressed or degraded signals, and unequaled PLL bandwidth and roll-off shape control for either Golden PLL compliance testing or custom PLL response. The clock recovery instruments also lock on spread-spectrum signals. The CR125A, CR175A, or CR286A can also serve as the Clock Recovery instrument for the 80C10B*[14], 80C12, 80C14, or 80C25GBE. For more information on Tektronix Clock Recovery instruments see the BERTScope® CR Series data sheet at www.tektronix.com.

*[14] Up to data rates of 28.6 Gb/s.

P80318 Differential Handheld TDR Probe

The P80318 is an 18 GHz 100 Ω input impedance differential TDR hand probe. This probe enables high-fidelity impedance measurements of differential transmission lines. The adjustable probe pitch from 0.5 mm to 4.2 mm enables a wide variety of differential line spacing and impedances. The P80318 probe also includes two precision SMA cables with parallel control lines that provides the 80A02 module the control for EOS/ESD protection.

P8018 Single-ended Handheld TDR Probe

The P8018 Handheld TDR Probe is a 20 GHz, 50 Ω input impedance, single-ended passive probe that provides a high-performance solution for electrical sampling, TDR circuit board impedance characterization, and high-speed electrical signal analysis applications. The P8018 probe also includes a precision SMA cable and parallel control line that provides the 80A02 module the control for EOS/ESD protection.

80A02 EOS/ESD Protection Module

The 80A02 EOS/ESD Protection module protects the sampling bridge of Tektronix electrical sampling module inputs from damage by electrostatic charge. The 80A02 is intended for use in applications such as electrical TDR circuit board testing and cable testing where large static charges can be stored in the DUT.

When used with the matching P8018 20 GHz single-ended handheld probe or the P80318 differential handheld probe (both with probe tip pressure actuating feature) the 80A02 provides a superior technique and performance capability for electrical module EOS/ESD protection of acquired electrical signals and TDR measurements (two 80A02 modules required for differential applications).

80A03 TekConnect Probe Interface Module

The 80A03 provides probe power and control for up to two Tektronix P7000 Series probes. The 80A03 is powered through the oscilloscope and requires no user adjustments or external power cords. An Electrical Sampling module can be plugged directly into the slot on the 80A03 to provide the optimum system fidelity and a short electrical path. Using the 80A03, designers can benefit from industry-leading Tektronix active and differential probes to measure signals on SMD pins and other challenging circuit features.

SlotSaver Small Module Extender Cable

This cable can be used to power and operate one 80A02 or 80A06 accessory module, eliminating the need to consume a small form factor mainframe slot. The SlotSaver extender cable plugs into the 'Trigger Power' connector on the mainframe or (for 80A02) into the 'Probe Power' connector on most Electrical Sampling modules.

DSA8200 Application Software

Jitter, Noise, BER, and Serial Data Link Analysis (SDLA) Software

80SJNB speeds the identification of the underlying causes of both horizontal and vertical eye closure through separation of jitter and noise. With its unique insight into the constituent components of both jitter and noise, 80SJNB provides a highly accurate and complete BER calculation and eye contour analysis.

Additionally available in the software package is the first-ever set of features addressing the design issues of modern Serial Data Links: equalization with either FFE or DFE, channel emulation, support for fixture de-embedding, as well as full support for SSC – Spread Spectrum Clocking. When you combine jitter, noise, and BER analysis with the DSA8200 modular flexibility, uncompromised performance, and unmatched signal fidelity you get the ideal solution for next-generation high-speed serial data design validation and compliance testing. 80SJNB requires the 80A06 PatternSync module, which creates a trigger pulse on each complete pattern. 80SJNB may be used with the 82A04 Phase Reference module for enhanced accuracy or for SSC signals, or without it depending on your requirements. SSC max. amplitude 5000 ppm (6000 ppm) at 30 ±3 kHz. Version V2.1 and later of 80SJNB supports save and recall of the complete signal description. Also added is a new measurement DDPWS (Data Dependent Pulse Width Shrinkage) and a corresponding graph.

80SJNB Jitter and Noise Analysis Measurements

Jitter Analysis

Measurements	Description
TJ at BER	Total jitter at specified BER
J2	Total jitter for BER = $2.5e^{-3}$
J9	Total jitter for BER = $2.5e^{-10}$
RJ	Random jitter
RJ(h)	Horizontal component of random jitter
RJ(v)	Vertical component of random jitter
RJ(d-d)	Random jitter according to the Dual Dirac model
DJ	Deterministic jitter
DDJ	Data-dependent jitter
DDPWS	Data-dependent Pulse Width Shrinkage
DCD	Duty cycle distortion
DJ(d-d)	Deterministic jitter computed in the Dual Dirac model
PJ	Periodic jitter
PJ(h)	Horizontal component of periodic jitter
PJ(v)	Vertical component of periodic jitter
EO at BER	Horizontal eye opening at specified BER

80SJNB Noise Analysis

Measurements	Description
RN	Random noise
RN(v)	Vertical component of random noise
RN(h)	Horizontal component of random noise
DN	Deterministic noise
DDN1	Data-dependent noise on logical level 1
DDN0	Data-dependent noise on logical level 0
PN	Periodic noise
PN(v)	Vertical component of periodic noise
PN(h)	Horizontal component of periodic noise
EO at BER	Vertical eye opening at specified BER
SSC Magnitude	Magnitude of SSC modulation in ppm
SSC Frequency	Frequency of SSC modulation in ppm

80SJNB Advanced Supports:

- FFE (Feed Forward Equalization) to 100 Taps
- DFE (Decision Feedback Equalization) to 40 Taps
- Filter for support of linear filters from fixture de-embed to transmitter equalization. Channel emulation supported for channels with >30 dB of loss at 1st harmonic frequency

Jitter Analysis of Arbitrary Data

The 80SJARB jitter measurement application software for the DSA8200 Series addresses IEEE 802.3ba applications requiring the J2 and J9 jitter measurements. It also enables basic jitter measurements for NRZ data signals including PRBS31, random traffic, and scrambled data. This provides an entry-level jitter analysis capability with simple Dual Dirac model jitter analysis and no hardware module requirements. 80SJARB can acquire continuously in "free run" mode, delivering acquisitions and updates beyond the IEEE minimum requirement of 10,000 data points. Plots include jitter bathtub curves for both measured and extrapolated data, as well as a histogram of the acquired data.

Measurement	Description
J2	Total jitter for BER = $2.5e^{-3}$
J9	Total jitter for BER = $2.5e^{-10}$
Tj	Total jitter for BER = $1.0e^{-12}$
DJdd	Deterministic jitter (Dual Dirac model)
RJdd	Random jitter (Dual Dirac model)

- **Free Run Mode**: For continuous acquisitions and update beyond the IEEE minimum requirement of 10,000 data points
- **Plots**: Jitter / Eye Opening Bathtub, Histogram of Acquired Data

IConnect® Signal Integrity TDR and S-parameter Software

Operating on the DSA8200 TDR platform, IConnect® S-parameters is the most cost-effective and highest throughput approach for S-parameter measurements in digital design, signal integrity analysis, and interconnect compliance testing, providing as much as 50% cost savings compared to similar bandwidth VNAs, and dramatically speeding up measurements. You can also take advantage of the IConnect® S-parameters command line interface, which automates the S-parameter measurements, to the overall suite of manufacturing tests you perform using your TDR instrument, significantly reducing test time while increasing measurement repeatability.

The simplicity of S-parameter calibration using a reference (open, short, or through), and an optional 50 Ω load makes the measurement, fixture de-embedding, and moving the reference plane a snap. Touchstone file format output enables easy S-parameter file sharing for further data analysis and simulations.

Tektronix offers several true-differential TDR modules, which in combination with IConnect® offers S-parameter measurements to 50 GHz with up to 70 dB of dynamic range. This performance exceeds requirements for serial data analysis, digital design, and signal integrity applications, resolving down to 1% (–40 dB) accuracy of crosstalk, whereas electrical compliance testing masks typically call for the measurements in the –10 to –30 dB range.

IConnect® software allows you to quickly and easily generate SPICE and IBIS models for your PCBs, flex boards, connectors, cables, packages, sockets, and I/O buffer inputs directly from TDR/T or VNA S-parameter measurements. IConnect® allows you to display eye diagram degradation, jitter, loss, crosstalk, reflections, and ringing in your digital system. IConnect® Linear Simulator allows the designer to link several interconnect channels together to evaluate the total time, frequency domain performance, and eye diagram of the overall channel. IConnect® substantially simplifies the signal integrity analysis of the interconnect link, equalization and emphasis component design, and analysis of the interconnect link with transmitter and receiver.

Characteristics

Signal Acquisition

Acquisition Modes

Mode	Sample (Normal), Envelope, and Average
Number of Sampling Modules Accommodated	Up to four dual-channel electrical; up to two optical sampling modules. (Both single- and dual-channel modules are appropriate for the two channels associated with the slot)
	Population of the CH1/CH2 large slot with any module other than one requiring *power only* displaces functionality of the CH1/CH2 small slot; population of the CH3/CH4 large slot with any module other than one requiring *power only* displaces functionality of the CH3/CH4 small slot
Number of Simultaneously Acquired Inputs	Eight channels maximum

Acquisition Characteristics

Characteristic	Description
Vertical Systems	
Rise Time / Bandwidth	Determined by the sampling modules used
Vertical Resolution	14 bits over the sampling modules' dynamic range
Horizontal System	
Four time-base modes are available:	
Triggered Phase Reference*[15] Time Base Mode	Timing information extracted from a user-supplied or clock recovery signal significantly improves time-base accuracy and jitter performance of the triggered acquisition. Horizontal position is referenced to the trigger signal as with a traditional time base
Free Run Phase Reference*[15] Time Base Mode	All timing is based on a phase reference signal; accuracy and jitter as above; no trigger is needed, and correspondingly there is no timing relation to trigger signal
Short-term Optimized Sequential*[16] Time Base Mode	Best short-delay performance for acquisitions without the external phase reference signal
Locked to 10 MHz Reference Sequential Time Base	Provides the best long-delay performance for acquisitions without the external phase reference signal. The Lock is selectable between *Lock to Internal 10 MHz* and *Lock to External 10 MHz* for highest frequency accuracy
Main and Magnification View Time Bases	100 fs/div to 5 ms/div in 1-2-5 sequence or 100 fs increments
Maximum Trigger Rate	200 kHz; in Phase Reference mode: 50 kHz
Maximum Acquisition Rate	200 kS/s per channel (standard sequential time base); 50 kS/s (Phase Reference modes)
Time Interval Accuracy (Standard Time Base) and Timing Deviation (Phase Reference Modes)	
Phase Reference Time Base: Triggered	Maximum timing deviation relative to phase reference signal:
Horizontal position after trigger event:	
>40 ns	0.2% of phase reference signal period (typical)
≤40 ns	0.4% of phase reference signal period (typical) **Note**: The performance depends on stable clock supplied to the Phase Reference module. Performance under SSC is lower and depends on modulation shape
Phase Reference Time Base: Free Run	Maximum timing deviation relative to phase reference signal: 0.1% or better of phase reference signal period (typical)
Sequential Time Base*[16]	
Time interval accuracy, horizontal scale:	
<21 ps/div	1 ps + 1% of interval
≥21 ps/div	8 ps + 0.1% of interval (short-term optimized mode)
	8 ps + 0.01% of interval (locked to 10 MHz mode)
Horizontal Deskew Range Available*[17] (Sequential time base only)	–500 ps to +100 ns on any individual channel in 100 fs increments
DSA8200 Record Length	20, 50, 100, 250, 500, 1000, 2000, or 4000 samples; Longer records available as follows:
IConnect®	1,000,000 points
80SJNB Jitter, Noise, and BER Analysis software	3,200,000 points
Waveform Databases	4 independently accumulated waveform records of up to 4 G waveform points. Variable waveform database mode with true first-in/first-out of 2000 waveforms available on each of 4 waveform databases
Magnification Views	In addition to the main time base, the DSA8200 supports two magnification views. These magnifications are independently acquired using separate time-base settings which allow same or faster time/div than that of the main time base

*[15] When using the 82A04 Phase Reference module.

*[16] Traditional mode – *not* using the 82A04 Phase Reference module.

*[17] Mainframe deskew only. The 80E07, 80E08, 80E09, and 80E10 include additional channel deskew range.

Trigger System

Trigger Sources

External direct trigger.

External pre-scaled trigger.

Internal clock trigger: Internally connected to direct trigger.

Clock recovery triggers from Optical Sampling modules and from the 80A05 module (pre-scaled above 2.7 Gb/s) internally connected.

Phase Reference*15 time base supports acquisitions without a trigger signal in its Free Run mode.

*15 When using the 82A04 Phase Reference module.

Trigger Sensitivity	
External Direct Trigger Output	50 mV, DC - 4 GHz (typical)
	100 mV, DC - 3 GHz (guaranteed)
Trigger Level Range	±1.0 V
Trigger Input Range	±1.5 V
Trigger Holdoff	Adjustable 5 µs to 100 ms in 0.5 ns increments
External Trigger Gate (Optional)	TTL logic 1 enables gate, a TTL logic 0 disables gate, maximum nondestruct input level ±5 V
Pre-scaled Trigger Input	200 mV_{p-p} to 800 mV_{p-p}, 2 to 12.5 GHz (guaranteed)
Time-base Jitter	
Phase Reference*18 Time Base	System jitter of 200 fs_{RMS} typical on a 10 GHz or faster acquisition module, with f ≥ 8 GHz, 0.6 V ≤ VREF ≤ 1.8 V phase reference signal
	Jitter: System jitter of 280 fs_{RMS} typical on a 10 GHz or faster acquisition module, in DSA8200 mainframe, with 2 GHz ≤ f ≤ 8 GHz, 0.6 V ≤ VREF ≤ 1.8 V phase reference signal
	The phase reference time base remains operational to 100 mV (typical) with increased jitter
Short-term Jitter Optimized Sequential Mode	800 fs_{RMS} +5 ppm of position (typical)
	1.2 ps_{RMS} +10 ppm of position (max.)
Locked to 10 MHz Reference Sequential Mode	1.6 ps_{RMS} +0.04 ppm of position (typical)
	2.5 ps_{RMS} +0.01 ppm of position (max.)
Internal Clock	Adjustable from 25 to 200 kHz (drives TDR, internal clock output and calibrator)

*18 When using the 82A04 Phase Reference module performance under SSC is lower and depends on modulation shape, clock recovering setting, and cabling lengths.

Display Features

Touch Screen Display	264 mm / 10.4 in. diagonal, color
Colors	16,777,216 (24 bits)
Video Resolution	640 horizontal by 480 vertical displayed pixels
Monitor Type	LCD

Math/Measurement

Characteristic	Description
System Measurements	The DSA8200 supports up to eight simultaneous measurements, updated three times per second with optional display of per-measurement statistics (min, max, mean, and standard deviation)
Measurement Set	Automated measurements include RZ, NRZ, and Pulse signal types, and the following:
Amplitude measurements	High, Low, Amplitude, Max, Mid, Min, +Width, Eye Height, Eye Opening Factor, Pulse Symmetry, Peak-to-Peak, OMA, +Overshoot, –Overshoot, Mean, +Duty Cycle, Cycle Mean, RMS, Cycle RMS, AC RMS, Gain, Extinction Ratio (Ratio, %, dB), Suppression Ratio (Ratio, %, dB), Peak-to-Peak Noise, RMS Noise, Q-Factor, SNR, Average Optical Power (dBm, watts), OMA
Timing measurements	Rise, Fall, Period, Bit Rate, Bit Time, Frequency, Crossing (%, Level, Time), +Cross, –Cross, Jitter (P-P, RMS), Eye Width, +Width, –Width, Burst Width, +Duty Cycle, –Duty Cycle, Duty Cycle Distortion, Delay, Phase
Area measurements	Area, Cycle Area
Cursors	Dot, vertical bar, and horizontal bar cursors
Waveform Processing	Up to eight math waveforms can be defined and displayed using the following math functions: Add, Subtract, Multiply, Divide, Average, Differentiate, Exponentiate, Integrate, Natural Log, Log, Magnitude, Min, Max, Square Root, and Filter. In addition, measurement values can be utilized as scalars in math waveform definitions
Mask Testing – Standard rate (Gb/s) unless otherwise noted	For many applications, masks will be found in the following list of predefined, built-in masks. To get a list of all currently available masks contact your local Tektronix representative. File-based masks are used to distribute new, Tektronix factory created, updated masks as a file loadable by the firmware. User-defined masks allow the user to create (through UI or PI) user masks
	STM-0/OC-1 51 Mb/s
	STM-1/OC-3 155 Mb/s
	STM-4/OC-12 622 Mb/s
	STM-16/OC-48 2.488
	STM-64/OC-192 9.953
	STM-256/OC-768 39.813
	FEC 2.666 2.666
	FEC 10.66 10.664
	FEC 10.709
	FEC 11.100
	FEC 27.739 Gb/s (100GBase-LR4 100GBase-ER4)
	FEC 42.66 42.657
	FEC 43 Gb/s G.709 43.018
	FC-10 G 10.5188 – optical only
	FC-16 17.0 – optical and electrical
	FC-133 132.813 Mb/s – optical and electrical
	FC-266 265.6 Mb/s – optical and electrical
	FC-531 531.2 Mb/s – optical and electrical
	FC-1063 1.063 – optical and electrical
	FC-2125 2.125 – optical and electrical
	FC-4250 4.250 – optical and electrical
	FC-8500 8.500 – optical and electrical, optical 10GFC, FEC 11.3*[9]
Mask Testing Cont.	16GFC MM r6.1 14.025000 Gb/s
	16GFC SM r6.1 14.025000 Gb/s
	10GBase-X4 3.125
	10GBase-W 9.953
	10GBase-R 10.313, FEC 11.1, 8.5 GFC
	40GBase-LR4 10.312500 Gb/s
	40GBase-SR4 10.312500 Gb/s
	40GBase-FR 41.250000 Gb/s
	100GBase-ER4 25.781250 Gb/s
	100GBase-LR4 25.781250 Gb/s
	100GBase-SR10 10.31250 Gb/s
	InfiniBand 2.500 – optical and electrical
	Gigabit Ethernet 1.250
	Gigabit Ethernet 2.5 Gb/s
	XAUI, XFI
	PCI-Express 2.5G
	PCI-Express 5.0G
	SAS XR 3.0G
	SAS XR AASJ 3.0G
	SATA G1Tx 1.5G
	SATA G1Rx 1.5G
	SATA G2Tx 3.0G
	SATA G2Rx 3.0G
	SATA G3Tx 6.0G
	SATA G3Rx 6.0G
	Rapid I/O 1.25G
	Rapid I/O 2.50G
	Rapid I/O 3.125

*[9] Draft version of the 8.5GFC filter. T11 committee redefined this filter at the April 2008 meeting. New 8.5GFC filter, as defined by T11 committee in April 2009, is identical to the 10GBase-R 10.313G filter and is available for 80C12 Option 10G modules and 80C14 modules; and is identified as 10Base-R.

Optical Sampling Module Characteristics

Refer to Optical Sampling module's User Manual for more detailed information.

Optical Sampling Module Characteristics

Module	Application Type	Standards and Supported Filtering Rates*[19]	Number of Input Channels	Effective Wavelength Range	Calibrated Wavelengths
80C07B	Tributary Datacom/Telecom	Standard Included: OC-48/STM-16 (2.488 Gb/s), Infiniband SDR, 2 GbE (2.500 Gb/s); Optional (choose any two): OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s), Fibre Channel (1.063 Gb/s), GbE (1.250 Gb/s), 2G Fibre Channel (2.125 Gb/s)	1	700 nm to 1650 nm	780 nm, 850 nm, 1310 nm, and 1550 nm (±20 nm)
80C08C	10 Gb/s Datacom/Telecom	OC-192/STM-64 (9.953 Gb/s), 10GBase-W (9.953 Gb/s), 10GBase-R, 40GBase-R4, 100GBase-SR10 (10.31 Gb/s), 10G Fibre Channel (10.52 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 10 GbE FEC (11.1 Gb/s), 10 GFC FEC (11.3 Gb/s), 10GBase-LRM, 40GBase-SR4, 100GBase-SR10, 40GBase-LR4	1	700 nm to 1650 nm	780 nm, 850 nm, 1310 nm, and 1550 nm (±20 nm)
80C10B	100 Gb/s and 40 Gb/s Telecom and Datacom	OC-768/STM-256 (39.813 Gb/s), OTU3, VSR-2000 G.693, 40G NRZ G.959.1, FEC (43.018 Gb/s), OTU3 (44.5 Gb/s), 40GBase-FR (41.25 Gb/s), 100GBase-LR4 (25.781 Gb/s, FEC 27.739 Gb/s), 100GBase-ER4 (25.781 Gb/s, FEC 27.739 Gb/s)	1	1310 nm and 1550 nm	1310 nm and 1550 nm (±20 nm)
80C11	10 Gb/s Datacom/Telecom	OC-192/STM-64 (9.953 Gb/s), 10GBase-W (9.953 Gb/s), 10GBase-R, 40GBase-LR4 (10.31 Gb/s), 10G Fibre Channel (10.52 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 10 GbE FEC (11.1 Gb/s), 10 GFC FEC (11.3 Gb/s), 40GBase-LR4	1	1100 nm to 1650 nm	1310 nm and 1550 nm (±20 nm)
80C12	1 to 8.5 Gb/s Datacom/Telecom	Fibre Channel (1.063 Gb/s), 2G Fibre Channel (2.125 Gb/s), 4G Fibre Channel (4.250 Gb/s), 10GBase-X4 (3.125 Gb/s), 8G Fibre Channel (8.50 Gb/s)*[9], 10GFC-X4 (3.1875 Gb/s), VSR5-3318 (3.318 Gb/s), 1x Infiniband SDR (2.5 Gb/s), 10GBase-LRM, 40GBase-SR4, 100GBase-SR10, 40GBase-LR4	1	700 nm to 1650 nm	850 nm, 1310 nm, and 1550 nm (±20 nm)
	10 Gb/s Datacom/Telecom	OC-192/STM-64 (9.953 Gb/s), 10GBase-W (9.953 Gb/s), 10GBase-R*[9], 40GBase-R4, 100GBase-SR10 (10.31 Gb/s), 10G Fibre Channel (10.52 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 10 GbE FEC (11.1 Gb/s), 10 GFC FEC (11.3 Gb/s)			
80C14	8.5 to 14 Gb/s Datacom/Telecom	8GFC (8.500 Gb/s), OC-192/STM-64 (9.953 Gb/s), 10GBase-W (9.953 Gb/s), 10GBase-R, 40GBase-R4, 100GBase-SR10 (10.31 Gb/s), 10G Fibre Channel (10.52 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 12.5 G+FEC, 10 GbE FEC (11.1 Gb/s), 10 GFC FEC (11.3 Gb/s), 16GFC (14.025 Gb/s), 14G Infiniband FDR (14.0625 Gb/s)	1	700 nm to 1650 nm	850 nm, 1310 nm, and 1550 nm (±20 nm)
80C25GBE	100 Gb/s Datacom	100GBase-LR4 (25.781 Gb/s, FEC 27.739 Gb/s), 100GBase-ER4 (25.781 Gb/s, FEC 27.739 Gb/s)	1	1310 nm and 1550 nm	1310 nm and 1550 nm (±20 nm)

*[8] With 80A05 Option 10G, CR125A, or CR175A.

*[9] Draft version of the 8.5GFC filter. T11 committee redefined this filter at the April 2008 meeting. New 8.5GFC filter, as defined by T11 committee in April 2009, is identical to the 10GBase-R 10.313G filter and is available for 80C12 Option 10G modules and 80C14 modules; and is identified as 10Base-R.

*[19] Bandwidths shown are warranted unless printed in an italic typeface which represents a typical value. 80C08C, 80C12: Bandwidths and optical filters valid for OMA ≤ 500 µW (1550/1310 nm), OMA ≤ 860 µW (850 nm), OMA ≤1020 µW (780 nm).

Note: Refer to Optical Sampling module's User Manual for more detailed information.

Optical Sampling Module Characteristics (Cont.)

Module	Clock Recovery (Optional)	Clock Recovery Outputs	Unfiltered Optical Bandwidth*[19]	Absolute Maximum Nondestructive Optical Input	Internal Fibre Diameter
80C07B	Option CR1: 155 Mb/s, 622 Mb/s, 1.063 Gb/s, 1.250 Gb/s, 2.125 Gb/s, 2.488 Gb/s, 2.500 Gb/s, 2.666 Gb/s	±Clock, ±Data	*2.5 GHz*	5 mW average; 10 mW peak power at wavelength of highest responsivity	62.5/125 µm Multi Mode
80C08C*[21]	Option CR1: 9.953 Gb/s, 10.31 Gb/s; Option CR2: 10.31 Gb/s, 10.52 Gb/s; Option CR4: Continuous from 9.8 Gb/s to 12.6 Gb/s	Clock, Clock/16	*10 GHz*	1 mW average; 10 mW peak power at wavelength of highest responsivity	62.5/125 µm Multi Mode
80C10B	Provided by CR286A-HS or other compatible external CR units*[4]	ELECTRICAL SIGNAL OUT (to 44.5 Gb/s, 50 Ω, AC coupled, differential 2.92 mm female connectors, max. 1 ps diff. skew)*[20]	*80 GHz*	20 mW average; 60 mW peak power at wavelength of highest relative responsivity	9/125 µm Single Mode
80C11	Option CR1: 9.953 Gb/s; Option CR2: 9.953 Gb/s, 10.664 Gb/s; Option CR3: 9.953 Gb/s, 10.709 Gb/s; Option CR4: Continuous between 9.8 Gb/s to 12.6 Gb/s	CR1: Clock, Clock/16, Data; CR2, CR3, CR4: Clock, Clock/16	*28 GHz*	5 mW average; 10 mW peak power at wavelength of highest responsivity	9/125 µm Single Mode
80C12	Provided by 80A05 or CR125A (sold separately)	ELECTRICAL SIGNAL OUT	*9 GHz* (for all options except 10G) *10 GHz* (Option 10G)	1 mW average; 10 mW peak power at wavelength of highest responsivity	62.5/125 µm Multi Mode
80C14	Provided by CR175A or CR286A (sold separately)	ELECTRICAL SIGNAL OUT (to 14.2 Gb/s, AC coupled, differential)	*14 GHz*	2 mW average (1310/1550 nm); 4 mW average (850 nm); 10 mW peak power at wavelength of highest responsivity	62.5/125 µm Multi Mode
80C25GBE	Provided by CR286A-HS	ELECTRICAL SIGNAL OUT (to 44.5 Gb/s, 50 Ω, AC coupled, differential 2.92 mm female connectors, max. 1 ps diff. skew)*[20]	*65 GHz*	20 mW average; 60 mW peak power at wavelength of highest relative responsivity	9/125 µm Single Mode

*[4] Contact Tektronix for details.

*[19] Bandwidths shown are warranted unless printed in an italic typeface which represents a typical value. 80C08C, 80C12: Bandwidths and optical filters valid for OMA ≤ 500 µW (1550/1310 nm), OMA ≤ 860 µW (850 nm), OMA ≤1020 µW (780 nm).

*[20] With Option CRTP.

*[21] Frequency characteristic and ORR guaranteed for signals up to 500 μW_{p-p} (80C08C, 80C12), respectively 200 µW (80C07B) at 1550 nm; pro-rated (higher power) for other wavelengths.

Optical Sampling Module Characteristics (Cont.)

Module	Optical Return Loss	Fibre Input Accepted	RMS Optical Noise (Typical)		RMS Optical Noise (Maximum)		Independent Channel Deskew
80C07B	>14 dB (Multi Mode) >24 dB (Single Mode)	Single or Multi Mode	0.50 µW at 155 Mb/s, 622 Mb/s, 1063 Mb/s, 1250 Mb/s; 0.70 µW at 2.488/2.500 Gb/s		1.0 µW at 155 Mb/s, 622 Mb/s, 1063 Mb/s, 1250 Mb/s; 1.5 µW at 2.488/2.500 Gb/s		Standard
80C08C	>14 dB (Multi Mode) >24 dB (Single Mode)	Single or Multi Mode	1.7 µW at all filter rates (1550/1310 nm, no CR)		3.0 µW at all filter rates (1550/1310 nm)		Standard
80C10B*[5]	>30 dB	Single Mode	1310 nm	1550 nm	1310 nm	1550 nm	Standard
			21 µW (25.8, 27.7 Gb/s) 26 µW (30 GHz) 28 µW (39.8 Gb/s - 43.0 Gb/s) 44 µW (65 GHz) 72 µW (80 GHz)	15 µW (25.8, 27.7 Gb/s) 19 µW (30 GHz) 20 µW (39.8 Gb/s - 43.0 Gb/s) 33 µW (65 GHz) 55 µW (80 GHz)	38 µW (25.8, 27.7 Gb/s) 45 µW (30 GHz) 50 µW (39.8 Gb/s - 43.0 Gb/s) 75 µW (65 GHz) 130 µW (80 GHz)	28 µW (25.8, 27.7 Gb/s) 35 µW (30 GHz) 38 µW (39.8 Gb/s - 43.0 Gb/s) 60 µW (65 GHz) 105 µW (80 GHz)	
80C11	>30 dB	Single Mode	5.5 µW at all filter rates; 10.0 µW at 20 GHz 20.0 µW at 30 GHz		8.0 µW at all filter rates; 14.0 µW at 20 GHz 30.0 µW at 30 GHz		Standard
80C12	>14 dB (Multi Mode) >24 dB (Single Mode)	Single or Multi Mode	1.3 µW (all filters except Option 10G) 2.4 µW ('Full BW' and Option 10G filters)		2.5 µW (all filters except Option 10G) 5.0 µW ('Full BW' and Option 10G filters)		Standard
80C14	>14 dB (Multi Mode) >24 dB (Single Mode)	Single or Multi Mode	850 nm	1310/1550 nm	850 nm	1310/1550 nm	Standard
			2.5 µW (10G filters) 3.7 µW (14G filters)	1.3 µW (10G filters) 1.9 µW (14G filters)	5 µW (10G filters) 7 µW (14G filters)	2.5 µW (10G filters) 3.5 µW (14G filters)	
80C25GBE	>30 dB	Single Mode	1310 nm	1550 nm	1310 nm	1550 nm	Standard
			21 µW (25.8, 27.7 Gb/s) 44 µW (65 GHz)	15 µW (25.8, 27.7 Gb/s) 33 µW (65 GHz)	38 µW (25.8, 27.7 Gb/s) 75 µW (65 GHz)	28 µW (25.8, 27.7 Gb/s) 60 µW (65 GHz)	

*[5] Option CRTP reduces sensitivity by 0.6 dB (max) and increases noise by 15% (max).

Optical Sampling Module Characteristics (Cont.)

Module	Offset Capability	Power Meter	Power Meter Range	Power Meter Accuracy	Mask Test Optical Sensitivity*[22]
80C07B	Standard	Standard	+4 dBm to –30 dBm	5% of reading	–22 dBm at 155 Mb/s, 622 Mb/s; –20 dBm at 2488/2500 Mb/s
80C08C	Standard	Standard	0 dBm to –30 dBm	5% of reading	–16 dBm at all filter rates
80C10B*[5], 80C25GBE	Standard	Standard	+13 dBm to –21 dBm	5% of reading	25.8 and 27.7 Gb/s: –8 dBm (1550 nm) and –7 dBm (1310 nm); 39.813 to 43.018 Gb/s: –7 dBm (1550 nm) and –6 dBm (1310 nm)
80C11	Standard	Standard	+4 dBm to –30 dBm	5% of reading	–10 dBm at all filter rates; –7 dBm at 20 GHz; –4 dBm at 30 GHz
80C12	Standard	Standard	0 dBm to –30 dBm	5% of reading	–19 dBm (for all options except Option 10G) –14 dBm (for Option 10G)
80C14	Standard	Standard	0 dBm to –30 dBm	5% of reading	–15 dBm

*[5] Option CRTP reduces sensitivity by 0.6 dB (max) and increases noise by 15% (max).

*[22] Smallest power level for mask test. Values represent theoretical typical sensitivity of NRZ eyes for comparison purposes. Assumes instrument peak-peak noise consumes most of the mask margin.

Optical Sampling Module Characteristics (Cont.)

Module	Extinction Ratio Calibrated Accuracy (Opt. 01 ER Calibrated)*[23]		
	Reference Filter in Range [Gb/s]	Repeatability (Typical) (to itself and to other 80Cxx-Opt. 01)	Accuracy
80C07B	—	Option not available	
80C08C	9.9…11.3	±0.6% (–0.39 dB / +0.42 dB at 12 dB)	±1.2% (–0.76 dB / +0.92 dB at 12 dB)
80C10B	—	Option not available	
80C11	9.9…11.3	±0.6% (–0.39 dB / +0.42 dB at 12 dB)	±1.2% (–0.76 dB / +0.92 dB at 12 dB)
80C14*[24]	8.5…11.3	±0.6% (–0.39 dB / +0.42 dB at 12 dB)	±1.2% (–0.76 dB / +0.92 dB at 12 dB)
80C25GBE	—	Option not available	

*[23] Low ER signals (ER ≤ 6 dB): signal passes 802.3ae-like mask (scaled horizontally for bit rate); 10^5 samples in mask. High ER signals (ER > 6 dB): signal passes OC-192-like mask (scaled horizontally for bit rate); 10^5 samples in mask.

*[24] Calibrated ER for the 80C14 supports standard rates from 8.5 to 11.3 Gb/s.

TDR System (80E10, 80E08, 80E04 only)

Characteristic	80E10	80E08	80E04
Channels	2	2	2
Input Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal
Channel Input Connector	1.85 mm	2.92 mm	3.5 mm
Bandwidth	50 GHz	30 GHz	20 GHz
TDR Step Amplitude	250 mV (polarity of either step may be inverted)	250 mV (polarity of either step may be inverted)	250 mV (polarity of either step may be inverted)
TDR System Reflected Rise Time	*15 ps*	*20 ps*	*28 ps*
TDR System Incident Rise Time	*12 ps*	*18 ps*	*23 ps*
TDR Step Deskew Range	*±250 ps*	*±250 ps*	*±50 ps*
TDR Sampler Deskew Range	*±250 ps*	*±250 ps*	*+100 ns – 500 ps (slot deskew only)*
TDR Step Maximum Repetition Rate	200 kHz	200 kHz	200 kHz

Physical Characteristics

Module	Dimensions (mm/in.)			Weight (kg/lb.)
	Width	Height	Depth	Net
80C07B	165/6.5	25/1.0	305/12.0	<1.36/<3.0
80C08C	165/6.5	25/1.0	305/12.0	<1.22/<2.7
80C10B	165/6.5	25/1.0	305/12.0	<2.61/<5.75
80C11	165/6.5	25/1.0	305/12.0	<1.22/<2.7
80C12	165/6.5	25/1.0	305/12.0	<2.61/<5.75
80C14	165/6.5	25/1.0	305/12.0	<2.61/<5.75
80C25GBE	165/6.5	25/1.0	305/12.0	<2.61/<5.75

Electrical Sampling Module Characteristics

Module	Application Type	Channels	Input Impedance	Channel Input Connector	Bandwidth*[25]
80E10	True-differential TDR, S-parameters and fault isolation	2	50 ±1.0 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	50/40/30 GHz*[12, 26]
80E09	High-frequency, low-noise signal acquisition and jitter characterization	2	50 ±1.0 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	60/40/30 GHz*[12, 26]
80E08	True-differential TDR and S-parameters	2	50 ±1.0 Ω	2.92 mm female	30/20 GHz*[12, 26]
80E07	Optimal noise/performance trade-off for jitter characterization	2	50 ±1.0 Ω	2.92 mm female	30/20 GHz*[12, 26]
80E06	High-speed electrical device characterization	1	50 ±0.5 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	70+ GHz
80E04	TDR impedance and crosstalk characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[12]
80E03	Device characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[12]
80E01	High-frequency, high maximum operating range signal acquisition	1	50 ±0.5 Ω	2.4 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	50 GHz

*[12] Calculated from .35 bandwidth rise time product.

*[25] Values shown are warranted unless printed in an italic typeface which represents an unwarranted characteristic value that the instrument will typically perform to.

*[26] User selectable.

Electrical Sampling Module Characteristics (Cont.)

Module	Rise Time (10-90%)	Dynamic Range	Offset Range	Maximum Operating Voltage	Maximum Nondestruct Voltage, DC+AC$_{p-p}$	Vertical Number of Digitized Bits
80E10	7 ps*[12]	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E09	5.8 ps*[12]	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E08	11.7 ps*[12]	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E07	11.7 ps*[12]	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E06	5.0 ps*[27]	1.0 V_{p-p}	±1.6 V	±1.6 V	2.0 V	14 bits full scale
80E04	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±1.6 V	3.0 V	14 bits full scale
80E03	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±1.6 V	3.0 V	14 bits full scale
80E01	11.7 ps*[12]	1.0 V_{p-p}	±1.6 V	±1.6 V	2.0 V	14 bits full scale

*[12] Calculated from .35 bandwidth rise time product.

*[27] Calculated from formula rise time = 0.35/(typical bandwidth).

Electrical Sampling Module Characteristics (Cont.)

Module	Vertical Sensitivity Range	DC Vertical Voltage Accuracy, Single Point, within ±2 °C of Compensated Temperature	Typical Step Response Aberrations	RMS Noise*[11]
80E10	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±1% or less over the zone 10 ns to 20 ps before step transition; +6%, –10% or less for the first 400 ps following step transition; +0%, –4% or less over the zone 400 ps to 3 ns following step transition; +1%, –2% or less over the zone 3 ns to 100 ns following step transition; ±1% after 100 ns following step transition*	50 GHz: *600 µV, ≤700 µV* 40 GHz: *370 µV, ≤480 µV* 30 GHz: *300 µV, ≤410 µV*
80E09	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±1% or less over the zone 10 ns to 20 ps before step transition; +6%, –10% or less for the first 400 ps following step transition; +0%, –4% or less over the zone 400 ps to 3 ns following step transition; +1%, –2% or less over the zone 3 ns to 100 ns following step transition; ±1% after 100 ns following step transition*	60 GHz: *450 µV, ≤600 µV* 40 GHz: *330 µV, ≤480 µV* 30 GHz: *300 µV, ≤410 µV*
80E08	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±1% or less over the zone 10 ns to 20 ps before step transition; +6%, –10% or less for the first 400 ps following step transition; +0%, –4% or less over the zone 400 ps to 3 ns following step transition; +1%, –2% or less over the zone 3 ns to 100 ns following step transition; ±1% after 100 ns following step transition*	30 GHz: *300 µV, ≤410 µV* 20 GHz: *280 µV, ≤380 µV*
80E07	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±1% or less over the zone 10 ns to 20 ps before step transition; +6%, –10% or less for the first 400 ps following step transition; +0%, –4% or less over the zone 400 ps to 3 ns following step transition; +1%, –2% or less over the zone 3 ns to 100 ns following step transition; ±1% after 100 ns following step transition*	30 GHz: *300 µV, ≤410 µV* 20 GHz: *280 µV, ≤380 µV*
80E06*[27]	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±5% or less for first 300 ps following step transition*	*1.8 mV, ≤2.4 mV (maximum)*
80E04	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±3% or less over the zone 10 ns to 20 ps before step transition; +10%, –5% or less for the first 300 ps following step transition; ±3% or less over the zone 300 ps to 5 ns following step transition; ±1% or less over the zone 5 ns to 100 ns following step transition; 0.5% after 100 ns following step transition*	*600 µV, ≤1.2 mV (maximum)*
80E03	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±3% or less over the zone 10 ns to 20 ps before step transition; +10%, –5% or less for the first 300 ps following step transition; ±3% or less over the zone 300 ps to 5 ns following step transition; ±1% or less over the zone 5 ns to 100 ns following step transition; ±0.5% after 100 ns following step transition*	*600 µV, ≤1.2 mV (maximum)*
80E01	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±3% or less over the zone 10 ns to 20 ps before step transition; +12%, –5% or less for the first 300 ps following step transition; +5.5%, –3% or less over the zone 300 ps to 3 ns following step transition; ±1% or less over the zone 3 ns to 100 ns following step transition; ±0.5% after 100 ns following step transition*	*1.8 mV, ≤2.3 mV (maximum)*

*[11] Values shown are warranted unless printed in an italic typeface which represents a typical value.

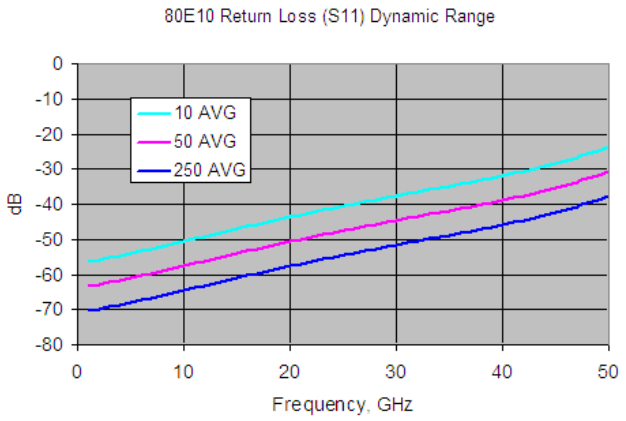
*[27] Calculated from formula rise time = 0.35/(typical bandwidth).

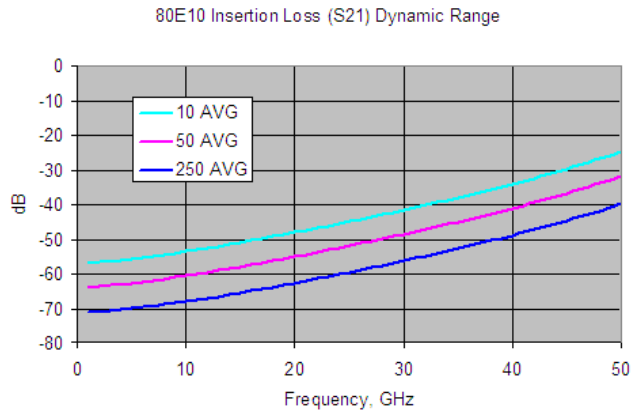
S-parameter Performance Characteristics (80E10)

Measurement Conditions

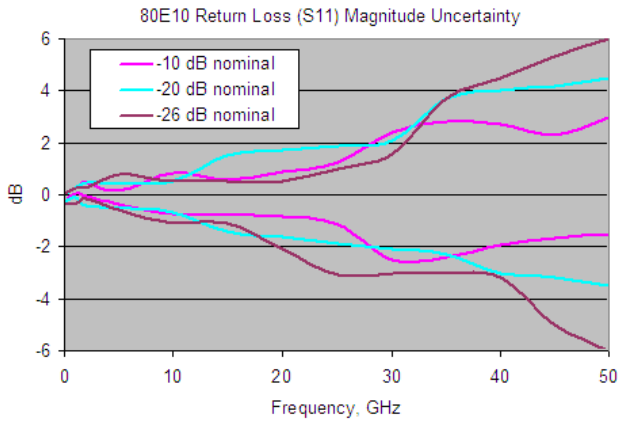
- All measurements were performed after proper warm up as specified in the DSA8200 manual
- Standard S-parameter dynamic range measurement practices were used to determine the dynamic range of the module
- Uncertainty results were derived from a wide range of devices, with 250 averages
- Better dynamic range can be achieved by selecting lower bandwidth settings on the 80E10 module due to lower RMS noise floor
- Results apply to single-ended or differential measurements

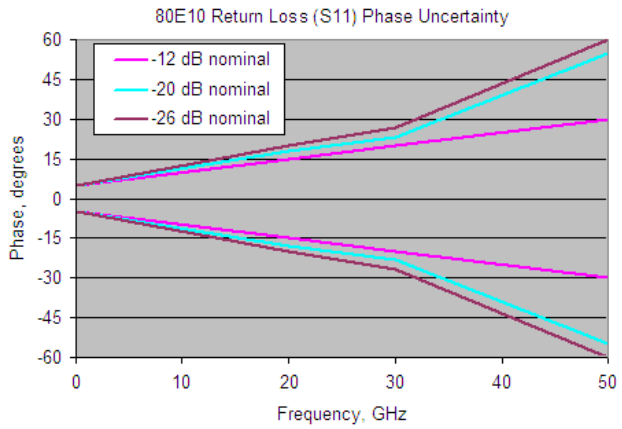
Dynamic Range





Uncertainty





Physical Characteristics for Electrical Sampling Modules

Module	Dimensions (mm/in.)			Weight (kg/lb.)
	Width	Height	Depth	Net
80E10*[28]	55/2.2	25/1.0	75/3.0	0.175/0.37
80E09*[28]	55/2.2	25/1.0	75/3.0	0.175/0.37
80E08*[28]	55/2.2	25/1.0	75/3.0	0.175/0.37
80E07*[28]	55/2.2	25/1.0	75/3.0	0.175/0.37
80E06	79/3.1	25/1.0	135/5.3	0.4/0.87
80E04	79/3.1	25/1.0	135/5.3	0.4/0.87
80E03	79/3.1	25/1.0	135/5.3	0.4/0.87
80E01	79/3.1	25/1.0	135/5.3	0.4/0.87

*[28] Remote module characteristics.

80A05, CR125A, CR175A, and CR286A Electrical Clock Recovery

Product Feature		80A05		CR125A	CR175A	CR286A
		Standard	Option 10G			
Supported Specifications						
Enumerated Standards						
OC3/STM1	155.52 Mb/s	■	■	♦*[29]	♦*[29]	♦*[29]
OC12/STM4	622.08 Mb/s	■	■	■	■	■
Fibre Channel	1.063 Gb/s	■	■	■	■	■
Gigabit Ethernet	1.25 Gb/s	■	■	■	■	■
SAS Gen I	1.50 Gb/s	♦*[30]	♦*[30]	■	■	■
2 GB Fibre Channel	2.125 Gb/s	■	■	■	■	■
OC48/STM16	2.488 Gb/s	■	■	■	■	■
2 GB Ethernet	2.50 Gb/s	■	■	■	■	■
PCI Express I	2.50 Gb/s	♦*[30]	♦*[30]	■	■	■
Infiniband®	2.50 Gb/s	■	■	♦*[29]	♦*[29]	♦*[29]
2.5G G.709 FEC	2.666 Gb/s	■	■	♦*[29]	♦*[29]	♦*[29]
SAS Gen II	3.0 Gb/s	♦*[30]	♦*[30]	■	■	■
XAUI, 10GBase-X	3.125 Gb/s	■	■	♦*[29]	♦*[29]	♦*[29]
10GB Fibre Channel x4	3.188 Gb/s	■	■	♦*[29]	♦*[29]	♦*[29]
4 GB Fibre Channel	4.25 Gb/s	■	■	■	■	■
FB-DIMM1	3.2, 4.0, 4.8 Gb/s		♦*[29, 30]	■	■	■
PCI Express II	5.0 Gb/s		♦*[29, 30]	■	■	■
FB-DIMM2	4.8, 6.4, 8.0, 9.6 Gb/s		♦*[29, 30]	■	■	■
OIF CEI	6+ Gb/s		♦*[29]	■	■	■
2x XAUI	6.25 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
8 GB Fibre Channel*[9]	8.50 Gb/s			■	■	■
OC192/STM64	9.953 Gb/s		■	■	■	■
XFP/XFI	9.95-11.2		♦*[29]	■	■	■
10GBase-W	9.953 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
10GBase-R*[9]	10.31 Gb/s		■	■	■	■
10GB Fibre Channel	10.51 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
G.975 FEC	10.66 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
G.709 FEC	10.71 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
OIF CEI	11+ Gb/s		♦*[29]	■	■	■
10 GbE w/ FEC	11.10 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
Super FEC	12.50 Gb/s		■	♦*[29]	♦*[29]	♦*[29]
16GFC	14.025 Gb/s			♦*[29]	♦*[29]	♦*[29]
14G Infiniband FDR	14.063 Gb/s				♦*[29]	♦*[29]
100GbE-LR4/ER4	25.7 Gb/s					♦*[29]
100GbE-LR4/ER4 FEC	28.8 Gb/s					♦*[29]

Product Feature	80A05		CR125A	CR175A	CR286A
	Standard	Option 10G			
Additional enumerated standard rates are supported with 8000 Series Firmware Releases higher than 2.4.x					
Clock Recovery Ranges for Custom (User-specified) Rates (in addition to enumerated lists above)	50 Mb/s to 3.188 Gb/s 4.25 Gb/s	50 Mb/s to 3.188 Gb/s 3.267 to 4.25 Gb/s 4.900 to 6.375 Gb/s 9.800 to 12.60 Gb/s	150 Mb/s to 12.5 Gb/s continuous	150 Mb/s to 17.5 Gb/s continuous	150 Mb/s to 28.6 Gb/s continuous
Sensitivity (Clock recovery will lock, differential data is given for each input)					
Lowest Supported Rate to 2.70 Gb/s	Differential ≤8 mV_{p-p} Single Ended 10 mV_{p-p}			Differential 50 mV (typ) Single Ended 100 mV (typ)	
2.70 to 11.19 Gb/s		Differential ≤12 mV_{p-p} Single Ended 15 mV_{p-p}			
11.19 to 12.60 Gb/s		Differential ≤15 mV_{p-p} Single Ended 20 mV_{p-p}			
12.6 to 28.6 Gb/s				Differential 50 mV (typ) Single Ended 100 mV (typ) When equipped with Option HS: Differential 20 mV (typ) Single Ended 40 mV (typ)	

*9 Draft version of the 8.5GFC filter. T11 committee redefined this filter at the April 2008 meeting. New 8.5GFC filter, as defined by T11 committee in April 2009, is identical to the 10GBase-R 10.313G filter and is available for 80C12 Option 10G modules and 80C14 modules; and is identified as 10Base-R.

*29 The standard is not enumerated but is supported as a custom rate.

*30 No spread spectrum clocking support.

DSA8200 Mainframe Physical Characteristics

Dimensions (mm/in.)			Weight (kg/lb.)
Width	Height	Depth	Net
457/18.0	343/13.5	419/16.5	21/46

Computer System and Peripherals

Characteristic	Description
Operating System	Windows XP
CPU	Intel Celeron 2.93 GHz processor
PC System Memory	1 GB
Hard Disk Drive	Rear-panel, removable hard disk drive, 40 GB capacity
DVD-ROM/CD-RW Drive	Front-panel DVD-ReadOnly/CD-ReadWrite drive with CD-creation software application

Input/Output Ports

Characteristic	Description
Front Panel	
USB 2.0 Port	One USB 2.0 connector
Anti-static Connection	Banana-jack connector, 1 MΩ
Trigger Direct Input	See Trigger System specification
Trigger Pre-scale Input	See Trigger System specification
Internal Clock Output	See Trigger System specification
External 10 MHz Reference Input	±5 V maximum
DC Calibration Output	±1.25 V maximum
Rear Panel	
USB Ports	4 USB 2.0 connectors
Parallel Port	IEEE 1284, DB-25 connector
LAN Port	RJ-45 connector, supports 10Base-T, 100Base-T
Serial Port	DB-9 COM1 port
GPIB	IEEE488.2 connector
VGA Video Port	DB-15 female connector; connect a second monitor to use dual-monitor display mode
Oscilloscope VGA Video Port	DB-15 female connector, connect to show the oscilloscope display, including live waveforms on an external monitor or projector
Gated Trigger Input	(Option GT only); See Trigger System specification

Operating Requirements

Characteristic	Description
Power Requirements	
Line voltage and frequency	100 to 240 V AC ±10% 50/60 Hz
	115 V AC ±10% 400 Hz
Environmental Characteristics	
Temperature	
Operating	+10 °C to +40 °C
Nonoperating	–22 °C to +60 °C
Relative Humidity	
Operating (Floppy disk and CD-ROM not installed)	20% to 80% at or below 40 °C (upper limit de-rates to 45% relative humidity at 40 °C)
Nonoperating	5% to 90% at or below 60 °C (upper limit de-rates to 20% relative humidity at +60 °C)
Altitude	
Operating	3,048 m (10,000 ft.)
Nonoperating	12,190 m (40,000 ft.)
Electromagnetic Compatibility	89/336/EEC
Safety	UL3111-1, CSA1010.1, EN61010-1, IEC61010-1

Ordering Information

DSA8200 Digital Serial Analyzer Sampling Oscilloscope

Includes: User manual, quick reference card, MS Windows XP compatible keyboard and mouse, touch screen stylus, online help, programmer online guide, power cord, three-year warranty.

With OpenChoice® software, Tektronix provides enhanced test and measurement analysis with the capability of full integration of third-party software on the open Windows oscilloscopes. By working with the industry leaders, National Instruments and The MathWorks, examples of software programs from these companies are featured on all Tektronix open Windows oscilloscopes.

Options

Option	Description
Opt. GT	Gated Trigger
Opt. JARB	Jitter Analysis of Arbitrary Data (included with purchase of Opt. JNB or Opt. JNB01). See 80SJARB for more information
Opt. JNB Opt. JNB01	Essential and Advanced Jitter, Noise, and BER Analysis Software. See 80SJNB Essentials and 80SJNB Advanced for more information

Service Options

Option	Description
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 Years

International Power Plug Options

Option	Description
Opt. A0	North America power
Opt. A1	Universal Euro power
Opt. A2	United Kingdom power
Opt. A3	Australia power
Opt. A4	240 V, North America power
Opt. A5	Switzerland power
Opt. A10	China power
Opt. A99	No power cord

Other Accessories

Accessory	Description
Sampling Module Extender Cable (2 meter)	Order 80N01 (not compatible with 80E10, 80E09, 80E08, or 80E07 modules)
SlotSaver Adapter Extender Cable	Brings power and control to the 80A06 when operated externally from the mainframe, saving slot space (compatible with 80A06 and 80A02). Order 174-5230-xx
82A04 Filter 2 GHz	Filter kit for non-sinusoidal phase reference clock signal with frequency between 2 GHz and 4 GHz. Order 020-2566-xx
82A04 Filter 4 GHz	Filter kit for non-sinusoidal phase reference clock signal with frequency between 4 GHz and 6 GHz. Order 020-2567-xx
82A04 Filter 6 GHz	Filter kit for non-sinusoidal phase reference clock signal with frequency between 6 GHz and 8 GHz. Order 020-2568-xx
2X Attenuator (SMA male-to-female)	DC to 18 GHz. Order 015-1001-xx
5X Attenuator (SMA male-to-female)	DC to 18 GHz. Order 015-1002-xx
Connector Adapter	(2.4 mm or 1.85 mm male to 2.92 mm female) DC to 40 GHz. Order 011-0157-xx
Power Divider	50 Ω, impedance matching power divider, SMA male to two SMA females. Order 015-0705-xx
Rackmount Kit	Order 016-1791-xx
Wrist Strap (Anti-static)	Order 006-3415-04
P7513/P7516	13 GHz and 16 GHz TriMode™ Differential probes. Requires 80A03 Interface module
P7260	6 GHz Active FET Probe. Requires 80A03 Interface module
P7350	5 GHz Active FET Probe. Requires 80A03 Interface module
P7350SMA	5 GHz 50 Ω Differential to Single-ended Active Probe. Requires 80A03 Interface module. Note that the P7380 probes are recommended over the P7350 probes for sampling purposes due to their higher bandwidth and signal fidelity
P7380SMA	8 GHz 50 Ω Differential to Single-ended Active Probe. Requires 80A03 Interface module
P6150	9 GHz Passive Probe; the probe consists of a very high-quality 20 GHz probe tips, plus an extremely flexible SMA cable. For higher frequency performance the 015-0560-xx, or some of the accessory cables listed can be used
P8018	20 GHz Single-ended TDR Probe. 80A02 module recommended for static protection of the sampling or TDR module
P80318	18 GHz 100 Ω Differential Impedance TDR Hand Probe
80A01	Pre-scaled Trigger Amplifier. Not required on the DSA8200, CSA8200, or TDS8200 mainframes with their increased sensitivity pre-scaler. The amplifier enhances pre-scaler sensitivity on the older TDS8000B and CSA8000B mainframes
80A02	DSA8200 EOS/ESD Protection module (1 channel). P8018 TDR probe recommended
80A03	Enables the use of two Tektronix P7000 Series TekConnect™ probes on the DSA8200 or 8000 Series sampling oscilloscopes
82A04	Phase Reference module for low-jitter acquisition (with or without trigger). Accepts signals from 2 GHz to 25 GHz (external filter might be required below 8 GHz), or to 60 GHz with Option 60G
80A05	Electrical Clock Recovery module. Applicable to electrical signals and for the 80C12
The standard version of 80A05 supports signals in the following ranges:	50 Mb/s - 2.700 Gb/s 2.700 Gb/s - 3.188 Gb/s Rate of 4 Gigabit Fibre Channel 4.250 Gb/s
The Option 10G adds the ranges of:	3.267 Gb/s - 4.250 Gb/s 4.900 Gb/s - 6.375 Gb/s 9.800 Gb/s - 12.60 Gb/s
80A06	PatternSync module for 80SJNB jitter analysis package. Programmable divider for creating a trigger pulse from patterns up to 2^{23} in length
CR125A	Electrical Clock Recovery instrument. CR125A recovers clocks from serial data streams for all of the most common electrical standards in the continuous 100 Mb/s to 12.5 Gb/s range. Applicable to electrical signals and for 80C12
CR175A	Electrical Clock Recovery instrument. CR175A recovers clocks from serial data streams for all of the most common electrical standards in the continuous 100 Mb/s to 17.5 Gb/s range. Applicable to electrical signals and for 80C12 and 80C14
CR286A	Electrical Clock Recovery instrument. CR286A recovers clocks from serial data streams for all of the most common electrical standards in the continuous 100 Mb/s to 28.6 Gb/s range. Applicable to electrical signals and for 80C12, 80C14, 80C10B*[14], and 80C25GBE
80SJARB	80SJARB Jitter Analysis of Arbitrary Data software. Provides a basic jitter measurement tool capable of measuring jitter on any waveform – random or repetitive. Also see Opt. JARB
80SJNB Essentials	80SJNB Essentials with Jitter, Noise, and BER Analysis software. Provides separation of jitter and noise into their constituent components and provides highly accurate eye-opening and BER calculations. Also see Opt. JNB/JNB01
80SJNB Advanced	80SJNB Advanced adds equalization, channel emulation, fixture de-embedding. Also see Opt. JNB/JNB01

*[14] Up to data rates of 28.6 Gb/s.

Interconnect Cables (3rd Party)

Tektronix recommends using quality high-performance interconnect cables with these high-bandwidth products in order to minimize measurement degradation and variations. The W.L. Gore and Associates' cable assemblies listed below are compatible with the 2.92 mm, 2.4 mm, and 1.85 mm connector interface of the 80Exx modules. Assemblies can be ordered by contacting Gore by phone at (800) 356-4622, or on the Web at www.gore.com/tektronix

Calibration Kits and Accessories (3rd Party)

To facilitate S-parameter measurements with the 80E10, 80E08, and 80E04 electrical TDR modules and IConnect® software, we recommend precision calibration kits, adapter kits, connector savers, airlines, torque wrenches, and connector gauges from Maury Microwave. These components, accessible at www.maurymw.com/tektronix.htm, are compatible with the 2.92 mm, 2.4 mm, and 1.85 mm connector interface of the 80Exx modules. Cal kits and other components can be ordered by contacting Maury Microwave.

Interconnect Cables

015-0560-xx (450 mm / 18 in.; 1 dB loss at 20 GHz) cable is a high-quality cable recommended for work up to 20 GHz.

Cable	Frequency	Connectors	Length
Bench Top Test Cable Assemblies			
TEK40PF18PP	40 GHz	2.92 mm male	18.0 inches
TEK50PF18PP	50 GHz	2.4 mm male	18.0 inches
TEK65PF18PP	65 GHz	1.85 mm male	18.0 inches
High-frequency Interconnect Cables for Electrical Sampling Modules			
TEK40HF06PP	40 GHz	2.92 mm male	6.0 inches
TEK40HF06PS	40 GHz	2.92 mm male; 2.92 mm female	6.0 inches
TEK50HF06PP	50 GHz	2.4 mm male	6.0 inches
TEK50HF06PS	50 GHz	2.4 mm male; 2.4 mm female	6.0 inches
TEK65HF06PP	65 GHz	1.85 mm male	6.0 inches
TEK65HF06PS	65 GHz	1.85 mm male, 1.85 mm female	6.0 inches

CE

ISO 9001 Product(s) are manufactured in ISO registered facilities.

Contact Tektronix:

ASEAN / Australasia (65) 6356 3900

Austria 00800 2255 4835*

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777

Belgium 00800 2255 4835*

Brazil +55 (11) 3759 7627

Canada 1 800 833 9200

Central East Europe and the Baltics +41 52 675 3777

Central Europe & Greece +41 52 675 3777

Denmark +45 80 88 1401

Finland +41 52 675 3777

France 00800 2255 4835*

Germany 00800 2255 4835*

Hong Kong 400 820 5835

India 000 800 650 1835

Italy 00800 2255 4835*

Japan 81 (3) 6714 3010

Luxembourg +41 52 675 3777

Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90

Middle East, Asia, and North Africa +41 52 675 3777

The Netherlands 00800 2255 4835*

Norway 800 16098

People's Republic of China 400 820 5835

Poland +41 52 675 3777

Portugal 80 08 12370

Republic of Korea 001 800 8255 2835

Russia & CIS +7 (495) 7484900

South Africa +41 52 675 3777

Spain 00800 2255 4835*

Sweden 00800 2255 4835*

Switzerland 00800 2255 4835*

Taiwan 886 (2) 2722 9622

United Kingdom & Ireland 00800 2255 4835*

USA 1 800 833 9200

* European toll-free number. If not accessible, call: +41 52 675 3777

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit **www.tektronix.com**

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