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Communications Signal Analyzer

CSA8000B



Features & Benefits

Automatic Communication Measurements (RZ and NRZ)
- Q-factor
- Extinction Ratio
- Optical Power
- Signal-to-Noise Ratio
- Jitter

Wide Bandwidth (DC to 70+ GHz*[1] with up to 12.5 GHz Trigger)

Automatic ITU/ANSI Mask Testing

Normal, Infinite, Variable Persistence and Color Graded Display Modes

Intuitive User Interface
- Large Color Display (10 in.)
- MS Windows Operating System

Modular Architecture

Fast Acquisition Rate

Excellent Signal Fidelity (Jitter <800 fsec RMS – Typical)

FrameScan™ Acquisition Mode
- Isolate Data Dependent Faults
- Examine Low-power PRBS Signals
- Eliminate Random Noise and Jitter Via Averaging

Windows 2000 for Enhanced Network Security

Applications

Manufacturing/Testing for ITU/ANSI Conformance

Designing/Verification of Telecom and Datacom Elements

*[1] Bandwidth is determined by plug-in modules and may exceed 70 GHz should higher speed modules become available in the future.

Communications Signal Analysis Solutions

Specifically designed for high-performance communications applications, the CSA8000B Communications Signal Analyzer is the ideal tool for design evaluation and manufacturing test of datacom and telecom components, transceiver subassemblies and transmission systems.

The CSA8000B 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, extinction ratio, Q-factor, mean optical power and amplitude measurements for both RZ and NRZ signals.

In addition, mask testing of SDH/SONET, Gigabit Ethernet and other standards simplifies conformance testing.

A large, full color display helps you to discriminate waveform details. Color-grading of waveform data adds a third dimension, sample density, to your signal acquisitions and analyses.

Modularity and Flexibility

The CSA8000B supports a large and growing family of optical and electrical plug-in modules. This modular architecture lets you configure the instrument with the right features for your application both now and in the future.

The available optical modules provide complete optical test solutions for both telecom (155 Mb/s to 43 Gb/s) and datacom (FibreChannel, InfiniBand and Gigabit Ethernet) applications.

Each optical module includes all of the elements necessary for communications testing, including an optical to electrical converter, an average power monitor, up to five data rate filters, a full bandwidth path and a low-noise electrical sampler. In addition, clock recovery is available as an option for most optical modules.

The electrical plug-ins include a variety of modules with bandwidths up to 70+ GHz and specialized features such as Time Domain Reflectometry (TDR). High bandwidth probes are also available for constructing a total acquisition and measurement solution.

Tektronix
Enabling Innovation

8000 Series Module Matrix

	Module	Option	Bandwidth (GHz)	Wavelength range (nm)	Fiber input (um)	Mask test sensitivity (dBm)	# of Channels	Rates Supported: ■=Filter, ●=Optical Clock Recovery, ⊖=Electrical Clock Recovery																		
								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	10.31 Gb/s	10.52 Gb/s	10.66 Gb/s	10.71 Gb/s	11.1 Gb/s	39.81 Gb/s	43.02 Gb/s
Optical Modules	80C01		20	1100-1650	9	-8	1	■	■										■							
		CR	20	1100-1650	9	-8	1	●	●																	
	80C02		30	1100-1650	9	-9	1												■							
		CR	30	1100-1650	9	-9	1												●							
	80C07B	F1	2.5	700-1650	9 & 62.5	-22	1	■	■				■	■												
		F2	2.5	700-1650	9 & 62.5	-22	1	■		■			■	■												
		F3	2.5	700-1650	9 & 62.5	-22	1	■			■		■	■												
		F4	2.5	700-1650	9 & 62.5	-22	1	■				■	■	■												
		F5	2.5	700-1650	9 & 62.5	-22	1		■	■			■	■												
		F6	2.5	700-1650	9 & 62.5	-22	1		■		■		■	■												
		F7	2.5	700-1650	9 & 62.5	-22	1		■			■	■	■												
		F8	2.5	700-1650	9 & 62.5	-22	1			■	■		■	■												
		F9	2.5	700-1650	9 & 62.5	-22	1			■		■	■	■												
		F10	2.5	700-1650	9 & 62.5	-22	1				■	■	■	■												
		CR1	2.5	700-1650	9 & 62.5	-22	1	●	●	●	●	●	●	●												
	80C08C		10	700-1650	9 & 62.5	-15	1												■	■	■	■	■	■		
		CR1	10	700-1650	9 & 62.5	-15	1												●	●						
		CR2	10	700-1650	9 & 62.5	-15	1													●	●					
		CR4	10	700-1650	9 & 62.5	-15	1												●	●	●	●	●	●		
	80C10		65	1290-1330 1530-1570	9	0	1																		■	■
	80C11		30	1100-1650	9	-9	1												■	■	■	■	■	■		
		CR1	30	1100-1650	9	-9	1												●							
		CR2	30	1100-1650	9	-9	1												●			●				
		CR3	30	1100-1650	9	-9	1												●				●			
		CR4	30	1100-1650	9	-9	1												●	●	●	●	●	●		
	80C12	F1	4.25	700-1650	9 & 62.5	-15	1			■		■						■								
		F2	9	700-1650	9 & 62.5	-15	1					■						■								
		F3	9	700-1650	9 & 62.5	-15	1			■		■														
		F4	4.25	700-1650	9 & 62.5	-15	1					■			■	■		■								
		F5	9	700-1650	9 & 62.5	-15	1								■	■		■								
		F6	9	700-1650	9 & 62.5	-15	1					■			■	■										
		FC	9	700-1650	9 & 62.5	-15	1								■	■	■									
		10G	10	700-1650	9 & 62.5	-12	1												■	■	■	■	■	■		
		(CR available using 80A05)						●	●	●	●	●	●	●	●	●	●	●								
		(CR available using 80A05 with Option 10G)						●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Electrical Clock Recovery	80A05							⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖								
		10G						⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖		
Electrical Modules	80E01		50				1																			
	80E02		12.5				2																			
	80E03		20				2																			
	80E04		20				2																			
	80E06		70				1																			

Superior Performance

With its industry-best horizontal timebase stability, trigger jitter, signal sensitivity and noise performance, the CSA8000B ensures the most accurate acquired signal for high-speed optical communications testing.

The CSA8000B's multi-processor architecture, with dedicated per channel digital signal processors (DSP), also provides industry-best waveform acquisition rates that shorten test times.

The CSA8000B's FrameScan™ acquisition mode can be used with a variety of BERTs and/or protocol analyzers to isolate pattern dependent effects in transmitters or show the bit sequence leading up to a mask violation. FrameScan acquisition mode also allows averaging of eye diagrams. This can be used to extract a clean eye diagram from noisy low-level signals.

8000 Series Sampling Oscilloscope Platform

The CSA8000B is built on Tektronix' sampling oscilloscope platform that combines familiar MS Windows-based PC technologies with world-class waveform acquisition technology.

This platform provides a wide array of standard instrumentation and communications interfaces (such as GPIB, Parallel Printer Port, RS-232-C and USB Serial Ports and an Ethernet LAN connection). In addition, the platform includes several mass storage devices (floppy disk, removable hard drive and CD-ROM). Gated triggering, a feature that allows the exclusion of selected time periods from being measured, is offered as an option.

Finally, because the system supports an Open Windows environment, new levels of data analysis can be done directly on the instrument using commercially available software packages.

Additionally, TekVISA™, a standard software accessory, allows the instrument to be placed under the control of software applications (e.g., LabView, LabWindows, Visual Basic, Microsoft Excel, C, etc.) running on the instrument, or on external PC workstations network connected to the instrument, without the need for a GPIB hardware interface. Plug and play drivers for LabView and other programs are also supplied.

8000 Series Sampling Oscilloscope Optical Modules

80C01 Multi-rate Telecom Sampling Module – The 80C01 module supports waveform conformance testing of long-wavelength (1100 to 1650 nm) signals at 622, 2488 Mb/s and 9.953 Gb/s as well as general-purpose testing with up to 20 GHz optical bandwidth. With its clock recovery option, the 80C01 provides testing solutions for 622 and 2488 Mb/s telecom applications.

80C02 High-performance Telecom Sampling Module – The 80C02 module is optimized for testing of long-wavelength (1100 to 1650 nm) signals at 9.953 Gb/s (SONET OC-192/SDH STM-64). With its high optical bandwidth of 30 GHz (typical), it is also well-suited for general-purpose high-performance optical component testing. The 80C02 can be optionally configured with clock recovery that supports 9.953 Gb/s telecom standards.

80C07B Multi-rate, Datacom & Telecom Optical Sampling Module – The 80C07B module is a broad wavelength (700 to 1650 nm) multi-rate optical sampling module optimized for testing datacom/telecom signals from 155 to 2500 Mb/s. With its amplified O/E converter design, this module provides excellent signal-to-noise performance, allowing users to examine low-power optical signals. The 80C07B can be optionally configured with clock recovery that supports 155, 622, 1063, 1250, 2125, 2488, 2500 and 2666 Mb/s rates.

80C08C Multi-rate, Datacom & Telecom Optical Sampling Module with 10 GbE Forward Error Correction – The 80C08C module is a broad wavelength (700 to 1650 nm) multi-rate optical sampling module providing datacom rate testing for 10GbE applications at 9.953, 10.3125, 11.0957 Gb/s and 10G FibreChannel applications at 10.51875 Gb/s. The 80C08C also provides telecom rate testing at 9.953, 10.664, and 10.709 Gb/s. With its amplified O/E converter 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 clock recovery options that can support any standard or user defined rate in the continuous range from 9.8 to 12.6 Gb/s.

80C10 65 GHz 40 Gbps Optical Sampling Module with 43 Gbps ITU-T G.709 Forward Error Correction – The 80C10 module provides integrated and selectable reference receiver filtering, enabling conformance testing at either 1310 nm or 1550 nm for 39.813 Gbps (OC-768/STM-256) and 43.018 Gbps (43 Gbps ITU-T G.709 FEC) rates. In addition to the filter rates, the user may also choose selectable bandwidths of 30 GHz or 65 GHz for optimal noise vs. bandwidth performance for accurate signal characterization.

80C11 Multi-rate, Datacom & Telecom Optical Sampling Module – The 80C11 module is a long wavelength (1100 to 1650 nm) multi-rate optical sampling module optimized for testing 10 Gb/s datacom and telecom standard rates at 9.953, 10.3125,

10.51875, 10.664, 10.709, and 11.0957 Gb/s. With its high optical bandwidth of up to 30 GHz (typical) it is well-suited for general purpose high-performance 10 Gb/s optical component testing. The 80C11 can be optionally configured with clock recovery options that can support any standard or user defined rate in the continuous range from 9.8 to 12.6 Gb/s.

80C12 Multi-rate, Datacom & Telecom Optical Sampling Module – The 80C012 module is a broad wavelength (700 to 1650 nm) multi-rate optical sampling module providing multi-rate 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 10Gb/s applications. The low data rate applications include: 1, 2, and 4 Gb/s FibreChannel and "by 4" wavelength division multiplex standards such as 10GBase-X4 and 4-Lane 10 Gb/s FibreChannel. The supported 10Gb/s application includes both datacom and telecom application. The supported 10Gb/s datacom applications include 10GbE applications at 9.953, 10.3125, 11.0957 Gb/s and 10G FibreChannel applications at 10.51875 Gb/s. The 80C12 also provides telecom rate testing at 9.953, 10.664, and 10.709 Gb/s. With its amplified O/E converter 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 via the 80A05 (sold separately).

8000 Series Sampling Oscilloscope Electrical Modules

80E01 Sampling Module – The 80E01 is a single-channel, 50 GHz bandwidth sampling module. The 80E01 has a measured bandwidth of 50 GHz or more and a calculated rise time of 7.0 ps or less. Displayed noise is typically 1.8 mV_{RMS}. The front-panel connector is female 2.4 mm and an adapter is provided (2.4 mm male to 2.92 mm female) to maintain compatibility with SMA connector systems.

80E02 Low-noise Sampling Module – The 80E02 is a dual-channel, 12.5 GHz sampling module specifically designed for low-noise measurements in digital communications and device characterization applications. It provides an acquisition rise time of 28 ps and typically 400 μV_{RMS} of displayed noise. The 80E02 is the ideal instrument for low-noise applications. Common applications for the 80E02 are capturing and displaying switching characteristics of high-speed communications circuits, making accurate statistical measurements of signal noise and signal timing jitter or obtaining stable timing measurements of fast digital ICs.

80E03 Sampling Module – The 80E03 is a dual-channel, 20 GHz sampling module. This sampling module provides an acquisition rise time of 17.5 ps.

80E04 TDR Sampling Module – The 80E04 is a dual-channel, 20 GHz sampling module with TDR capability. This sampling module provides an acquisition rise time of 17.5 ps, with a typical 20 GHz equivalent bandwidth. The TDR feature provides high resolution with true differential capability and fast 35 ps reflected rise time of the TDR slope.

80E06 70+ GHz Sampling Module – The 80E06 is a single channel, 70+ GHz (typical bandwidth) sampling module with 5.0 ps calculated rise time. Typical RMS noise is 1.8 mV. This sampling module provides a 1.85 mm (Type V) front-panel connector and a precision adapter to 2.92 mm with a 50 Ω SMA termination. 1 meter or 2 meter length Extender Cables can be ordered for remote operation of the sampling module from the sampling oscilloscope mainframe.

80A05 Electrical Clock Recovery Module – The 80A05 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 4.26 Gb/s range. Option 10G adds support for standard rates up to 12.6 Gb/s. The module accepts either single-ended or differential signals at its input, providing both single-ended and differential clock recovery. This module also serves as the clock recovery module for the 80C12.

▶ Characteristics

Signal Acquisition

Acquisition Modes – Sample (normal), envelope and average.

Number of Sampling Modules Accommodated – Up to four, dual-channel electrical and two, single-channel optical sampling modules.

Number of Simultaneously Acquired Inputs – Eight channels maximum (eight electrical or two optical and six electrical).

Vertical Systems

Rise Time/Bandwidth – Determined by the sampling modules used.

Vertical Resolution – 14 bits over the sampling modules' dynamic range.

Horizontal System

Main and Magnification View Timebases – 1 ps/div to 5 ms/div in 1-2-5 sequence or 1 ps increments.

Maximum Trigger Rate – 200 kHz.

Typical Acquisition Rate – 150 Ksamples/sec per channel.

Time Interval Accuracy –
Horizontal scale: <21 ps/div: 1 ps + 1% of interval.
Horizontal scale: ≥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: –500 ps to +100 ns on any individual channel in 1 ps increments.

Record Length – 20, 50, 100, 250, 500, 1000, 2000 or 4000 samples.

Magnification Views – In addition to the main timebase, the CSA8000B supports two magnification views. These magnifications are independently acquired using separate timebase settings which enable higher resolution sampling.

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) – internally connected to pre-scaled trigger.

Trigger Sensitivity –
External direct trigger output:
50 mV, DC –4 GHz (typical).
100 mV, DC –3 GHz (guaranteed).
Pre-scaled trigger input:
800 mV, 2 to 3 GHz (guaranteed).
600 mV, 3 to 10 GHz (guaranteed).
1000 mV, 10 to 12, 5 GHz (typical).

Jitter –
Short-term jitter optimized mode:
≤0.8 ps_{RMS} +5 ppm (typical).
≤1.2 ps_{RMS} +10 ppm (max.).
Locked to 10 MHz reference:
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).

Trigger Level Range – ±1.0 V.

Trigger Input Range – ±1.5 V.

Trigger Holdoff – Adjustable 5 µs to 100 ms in 2 ns increments.

External Trigger Gate (optional) – TTL logic 1 enables gate, a TTL logic 0 disables gate, maximum non-destruct input level ±5 V.

Display Features

Touch Screen Display – 10.4 in. diagonal, color.

Colors – 16,777,216 (24 bits).

Video Resolution – 640 horizontal by 480 vertical displayed pixels.

Math/Measurement System Measurements –
The CSA8000B 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, Pk-Pk, +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), Phase, Optical Modulation Amplitude.
Timing Measurements: Rise, Fall, Period, Bit Rate, Bit Time, Frequency, Crossing (%, Level, Time), +Cross, –Cross, Jitter (pk-pk, 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 –
In addition to user-defined masks, the following predefined masks are built-in:

Standard	Rate (Gb/s) unless otherwise noted
STM-0/OC-1	51.84 Mb/s
STM-1/OC-3	155.52 Mb/s
STM-4/OC-12	622.08 Mb/s
STM-16/OC-48	2.4883
STM-64/OC-192	9.9533
STM-256/OC-768	39.81312
FEC 2.666	2.66606
FEC 10.66	10.6642
FEC 10.709	10.709
FEC 43 Gb/s G.709	43.018
FEC 42.66	42.656914
FC-10 G	10.51875
FC-133	132.813 Mb/s
FC-266	265.6 Mb/s
FC-531	531.2 Mb/s
FC-1063	1.0625
FC-2125	2.125
FC-4250	4.250
10 G BASE-X4	3.125
10 G BASE-W	9.95328
10 G BASE-R	10.3125
10 GbE FEC	11.097
InfiniBand	2.500
Gigabit Ethernet	1.2500

Power Requirements

Line Voltage and Frequency –
100 to 240 VAC ±10% 50/60 Hz.
115 VAC ±10% 400 Hz.

Environmental

Temperature –
Operating: +10 ºC to +40 ºC.
Nonoperating: –22 ºC to +60 ºC.

Relative Humidity –
Operating: Floppy disk and CD-ROM not installed: 20% to 80% at or below 40 ºC (upper limit derates to 45% relative humidity at 40 ºC).
Nonoperating: 5% to 90% at or below 60 ºC (upper limit de-rates to 20% relative humidity at +60 ºC).

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.

Physical Characteristics for Optical Sampling Modules

	Dimensions (mm/inches)			Weight (kg/lb)
	Width	Height	Depth	Net
80C01	165/6.5	25/1.0	305/12.0	<2.61/<5.75
80C02	165/6.5	25/1.0	305/12.0	<2.61/<5.75
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
80C10	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

▶ Optical Sampling Module Characteristics (Refer to Optical Sampling Module User Manual for more detailed information)

	Application Type	Standard and Supported Data Filtering Rates	Number of Input Channels	Effective Wavelength Range	Calibrated Wavelengths
80C01	Tributary Telecom	OC-12/STM-4 (622 Mb/s), OC-48/STM-16 (2.488 Gb/s), OC-192/STM-64 (9.953 Gb/s)	1	1100 nm to 1650 nm	1310 nm and 1550 nm (±20 nm)
80C02	10 Gb/s Telecom	OC-192/STM-64 (9.953 Gb/s) 10GBASE-W (9.953 Gb/s)	1	1100 nm to 1650 nm	1310 nm and 1550 nm (±20 nm)
80C07B	Tributary Datacom/Telecom	Standard Included: OC-48/STM-16 (2.488 Gb/s), InfiniBand, 2 GbE (2.500 Gb/s); Optional (choose any two): OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s), FibreChannel (1.063 Gb/s), GbE (1.250 Gb/s), 2G FibreChannel (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 (10.31 Gb/s), 10G FibreChannel (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)	1	700 nm to 1650 nm	780 nm, 850 nm, 1310 nm, and 1550 nm (±20 nm)
80C10	40 Gb/s Telecom	OC-768/STM-256 (39.813 Gb/s), ITU-T G.709 FEC (43.018 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 (10.31 Gb/s), 10G FibreChannel (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)	1	1100 nm and 1650 nm	1310 nm and 1550 nm (±20 nm)
80C12	FibreChannel, Datacom rates between 2.5 Gb/s and 10 Gb/s Option 10G: 10 Gb/s multistandard low cost	Option 10G: OC192/STM64 9.953 Gb/s 10GBase-W 9.953 Gb/s 10GBase-R 10.31 Gb/s 10 GFC 10.51 Gb/s G.975 FEC 10.66 Gb/s G.709 FEC 10.71 Gb/s 10 GbE FEC 11.10 Gb/s Option F1: 1.063 Gb/s, 2.125 Gb/s, and 4.25 Gb/s FC Option F2: 2.125 Gb/s, 4.25 Gb/s FC, 9 GHz Option F3: 1.063 Gb/s, 2.125 Gb/s FC, 9 GHz Option F4: 2.125 Gb/s, 10GBase-LX4, 3.188 Gb/s, 4.25 Gb/s FC Option F5: 10GBase-LX4, 3.188 Gb/s, 4.25 Gb/s FC, 9 GHz Option F6: 2.125 Gb/s FC, 10GBase-LX4, 3.188 Gb/s, 9 GHz Option FC: 11GBase-LX4 filter, 3.188 Gb/s, 3.318 GHz, 9 GHz	1	700 nm to 1650 nm	850, 1310 and 1550 nm (±20 nm)

▶ Optical Sampling Module Characteristics (continued)

	Clock Recovery (Optional)	Clock Recovery Outputs	Unfiltered Optical Bandwidth*[1]	Absolute Maximum Nondestructive Optical Input	Internal Fiber Diameter
80C01	Option CR: 622 Mb/s, 2.488 Gb/s	±Clock, ±Data	20 GHz	5 mW average; 10 mW peak power at wavelength of highest relative responsivity	9 µm/125 µm single-mode
80C02	Option CR: 9.953 Gb/s	Clock, Clock/16, Data	28 GHz	5 mW average; 10 mW peak power at wavelength of highest relative responsivity	9 µm/125 µm single-mode
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 µm/125 µm multi-mode
80C08C	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	Single-mode and multi-mode fibers up to core diameter of 62.5 µm
80C10	Future Upgradeable	Future	*65 GHz*	20 mW average; 60 mW peak power at wavelength of highest relative responsivity	9 µm/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 µm/125 µm single-mode
80C12	Provided by separately sold 80A05 (50 Mb/s to 12.6 Gb/s)	(Clk/16, 10G Clk)	4 to 10 Gb/s depending on option	1 mW average; 10 mW peak power at wavelength of highest responsitivity	Single-mode and multi-mode fibers up to core diameter of 62.5 µm

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

▶ Optical Sampling Module Characteristics (continued)

	Optical Return Loss	Fiber Input Accepted	RMS Optical Noise (typical)	RMS Optical Noise (maximum)	Independent Channel Deskew
80C01	>30 dB	single-mode	8.0 µW at 622 Mb/s, 2.488 Gb/s, 9.953 Gb/s, 12.5 GHz; 15.0 µW at 20 GHz	12.0 µW at 622 Mb/s, 2.488 Gb/s, 9.953 Gb/s, 12.5 GHz; 25 µW at 20 GHz	Standard
80C02	>30 dB	single-mode	6.0 µW at 9.953 Gb/s, 12.5 GHz; 10.0 µW at 20 GHz; 15.0 µW at 30 GHz	10.0 µW at 9.953 Gb/s, 12.5 GHz mode; 15 µW at 20 GHz; 30 µW at 30 GHz	Standard
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	3.0 µW at all filter rates	Standard
80C10	>30 dB	single-mode	40 µW at 39.813 Gb/s, 43.018 Gb/s (1550 nm); 75 µW at 39.813 Gb/s, 43.018 Gb/s (1310 nm); 30 µW at 30 GHz mode (1550 nm); 55 µW at 30 GHz mode (1310 nm); 85 µW at 65 GHz mode (1550 nm); 150 µW at 65 GHz mode (1310 nm)	60 µW at 39.813 Gb/s, 43.018 Gb/s (1550 nm); 110 µW at 39.813 Gb/s, 43.018 Gb/s (1310 nm); 50 µW at 30 GHz (1550 nm); 90 µW at 30 GHz (1310 nm); 120 µW at 65 GHz (1550 nm); 220 µW at 65 GHz (1310 nm)	Standard
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 (62.5 µm multi-mode) >24 dB (9 µm single mode)	single- or multi-mode	Below 9 Gb/s: 1.7 µW Above 9 Gb/s and 9 GHz: 3.4 µW	Below 9 Gb/s: 3 µW Above 9 Gb/s and 9 GHz: 6 µW	Standard

	Offset Capability	Power Meter	Power Meter Range	Power Meter Accuracy	Mask Test Optical Sensitivity*[2]
80C01	Standard	Standard	+4 dBm to –30 dBm	5% of reading	–8 dBm at 622 Mb/s, 2.488 Gb/s, 9.953 Gb/s; –5.0 dBm at 20 GHz
80C02	Standard	Standard	+4 dBm to –30 dBm	5% of reading	–9 dBm at 9.953 Gb/s; –7 dBm at 20 GHz; –4 dBm at 30 GHz
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	–15 dBm at all filter rates
80C10	Standard	Standard	+13 dBm to –21 dBm	5% of reading	0 dBm at 39.813 Gb/s, 43.018 Gb/s; 0 dBm at 30 GHz; +3 dBm at 65 GHz
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	Below 9 Gb/s: –15 dBm Above 9 Gb/s and 9 GHz: –12 dBm

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

▶ Physical Characteristics for Electrical Sampling Modules

	Dimensions (mm/inches)			Weight (kg/lb)
	Width	Height	Depth	Net
80E01	79/3.1	25/1.0	135/5.3	0.4/0.87
80E02	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
80E04	79/3.1	25/1.0	135/5.3	0.4/0.87
80E06	79/3.1	25/1.0	135/5.3	0.4/0.87

▶ Electrical Sampling Module Characteristics
(Refer to Electrical Sampling Module User Manual for more detailed information)

	Application Type	Channels	Input Impedance	Channel Input Connector	Bandwidth*[3]
80E01	Microwave General Purpose	1	50 ±0.5 Ω	2.4 mm female Precision adapter to 2.92 mm included with 50 Ω SMA termination	50 GHz
80E02	Low-level Signals	2	50 ±0.5 Ω	3.5 mm female	12.5 GHz*[4]
80E03	Device Characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[4]
80E04	TDR Impedance Characterization with single-ended, common, differential TDR capability	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[4]
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*

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

*[4] Rise time is calculated from the formula Rise time = 0.35/Bandwidth; bandwidth is calculated from the formula Bandwidth = 0.35/Rise time.

▶ Electrical Sampling Module Characteristics (continued)

	Rise Time (10% to 90%)	Dynamic Range	Offset Range	Maximum Input Voltage	Vertical Number of Digitized Bits
80E01	7 ps*[4]	1.0 V_{p-p}	±1.6 V	±2.0 V	14 bits full scale
80E02	≤28 ps	1.0 V_{p-p}	±1.6 V	±3.0 V	14 bits full scale
80E03	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±3.0 V	14 bits full scale
80E04	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±3.0 V	14 bits full scale
80E06	5.0 ps*[4]	1.0 V_{p-p}	±1.6 V	±2.0 V	14 bits full scale

*[4] Rise time is calculated from the formula Rise time = 0.35/Bandwidth; bandwidth is calculated from the formula Bandwidth = 0.35/Rise time.

▶ Electrical Sampling Module Characteristics (continued)

	Vertical Sensitivity Range	DC Vertical Voltage Accuracy, Single Point, Within ±2 °C of Compensated Temperature	Typical Step Response Aberrations*[5]	RMS Noise*[5]
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)
80E02	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*	*400 µV* ≤800 µV (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)
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)
80E06	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)

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

▶ TDR System (80E04 only)

	80E04*[6]
Channels	2
Input Impedance	50 ±0.5 Ω
Channel Input Connector	3.5 mm
Bandwidth	20 GHz
TDR Step Amplitude	250 mV (polarity of either step may be inverted)
TDR System Reflected Rise Time	≤35 ps each polarity
TDR System Incident Rise Time	28 ps (typical)
TDR Step Maximum Repetition Rate	200 kHz
TDR System Step Response Aberrations	*±3% or less over the zone 10 ns to 20 ps before step transition; +10%, –5% or less typical for the first 400 ps following step transition; ±3% or less over the zone 400 ps to 5 ns following step transition; ±1% or less after 5 ns following step transition*

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

▶ Ordering Information

CSA8000B

Communications Signal Analyzer

Includes: User manual, quick reference card, MS Windows 2000 compatible keyboard, MS Windows 2000 compatible mouse, touch screen stylus, online help, programmer online guide, power cord.

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.

CSA8000B Options

Option C3 – Three years of Calibration Service.

Option D1 – Calibration data report.

Option D3 – Three years of Calibration data reports.

Option GT – Gated Trigger.

Option R3 – Extended repair warranty to three years.

Option 1K – Cart.

Option 1R – Rackmount kit (includes: hardware, tooling and instructions for converting bench model to rackmount configuration).

International Power Plug Options

Option A0 – North America power.

Option A1 – Universal EURO power.

Option A2 – United Kingdom power.

Option A3 – Australia power.

Option A4 – 240 V, North America power.

Option A5 – Switzerland power.

Option A99 – No power cord or AC adapter.

Option AC – China power.

Other Accessories

Calibration Step Generator with Power Cords –

Std, US: 067-1338-00.

A1, Europe: 067-1338-01.

A2, UK: 067-1338-02.

A3, Australia: 067-1338-03.

A4, North America: 067-1338-04.

A5, Switzerland: 067-1338-05.

A6, Japan: 067-1338-06.

80A02 – TDS/CSA8000 Series EOS/ESD Protection Module (1 channel).

Sampling Module Extender Cable (1 meter) – Order 012-1568-00.

Sampling Module Extender Cable (2 meter) – Order 012-1569-00.

2X Attenuator (SMA male-to-female) – Order 015-1001-01.

5X Attenuator (male-to-female) – Order 015-1002-01.

Adapter (2.4 mm male to 2.92 mm female) – Order 011-0157-00.

Power Divider – Order 015-1014-00.

Rackmount Kit – Order 016-1791-01.

P8018 – 20 GHz Single-ended TDR Probe.

P7225 – 2.5 GHz Active Probe.

P6209 – 4 GHz Active FET Probe.

P6150 – 9 GHz Passive Probe.

80A01 – Pre-scaled Trigger Amplifier: The 80A01 Pre-scaled Trigger Amplifier provides enhanced triggering capability on low-level signals up to 12.5 Gb/s. This module plugs into any of the four available electrical sampling module slots on the TDS8000B and the CSA8000B mainframes. It is ideally suited for component designers and manufacturers who are verifying the performance of optical and electrical components that run at non-standard clock rates up to 12.5 GHz.

80A03 – TekConnect™ Probe Interface Module. The 80A03 TekConnect Probe Interface Module provides an interface to Tektronix P7000 series high-performance active and differential probes with 3 GHz bandwidths and higher. The 80A03 accepts up to two P7000 series probes and one electrical sampling module. It plugs into any of the four available electrical sampling module slots on the TDS8000B and CSA8000B mainframes. The 80A03 and P7000 series probes are ideally suited for probing directly on IC pins, traces, or test points that are not accessible through a connector.

K4000 – Mobile Workstation.

Communications Signal Analyzer

▶ CSA8000B

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