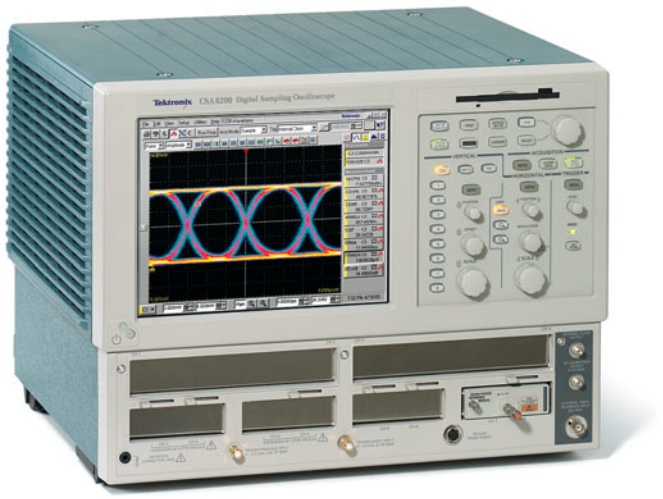
Communications Signal Analyzer

▶ CSA8200



Advanced Communications Signal Analysis Solutions

Specifically designed for high-performance communications applications, the CSA8200 Communications Signal Analyzer is the ideal tool for design, evaluation and manufacturing test of datacom and telecom components, transceiver subassemblies and transmission systems. The CSA8200 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 measurements for both RZ and NRZ signals. In addition, mask testing of SDH/SONET, 10 Gigabit and Gigabit Ethernet and other Optical and Electrical standards supports conformance testing. Color-grading and gray-scale grading of waveform data adds a third dimension, sample density, to your signal acquisitions and analyses, while industry's first variable database persistence allows exact data ageing to all of the functions, and facilitates eye measurements on DUTs under adjustment.

Flexibility and Modularity

The CSA8200 supports a large 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 mainframe's 6 module slots support a variety of module combinations for a number of functions and channels.

▶ Features & Benefits

State of the Art Communication Measurements:
- Wide Bandwidth (DC to 70+ GHz*1)
- Fastest Acquisition Rate

Very Low Jitter with the Phase Reference Mode
- Jitter <200 fs_{RMS}*2
- Both Free Run and Triggered Modes Available with Same Low Jitter
- 2 to 60 GHz Continuous

Modular Architecture
- Wide Range of Optical and Electrical Standards Supported
- Up to 8 Input Channels
- Wide Range of Electrical and Optical Clock Recovery Ranges in Modules

Automated ITU/ANSI/IEEE Mask Testing
- Masks for SONET/SDH, FC, Ethernet and Other Standards Built In
- Four Color Graded, Variable Persistence Waveform Databases

Automated Communication Measurements
- NRZ, Pulse, RZ
- Extinction Ratio (ER), Optical Modulation Amplitude (OMA), and Over 100 Other Measurements

FrameScan® Acquisition Mode with Eye Diagram Averaging:
- Isolate Data Dependent Faults
- Examine Low-power Signals
- Investigate Deterministic Jitter (Pattern-related) with Sub-100 fs Resolution
- Random Jitter/DDj (ISI) Measurements

MS Windows 2000 Operating System

Advanced Connectivity to Third-party Software

Includes TDR and All Other Features of the TDS8200 Sampling Oscilloscope

▶ Applications

Design/Verification of Telecom and Datacom Components and Systems

Manufacturing/Testing for ITU/ANSI/IEEE/SONET/SDH Conformance

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

*2 Typical, with the new Phase Reference Module, some conditions apply. Without the module, the jitter is <800 ps_{RMS} (typical).

Tektronix
Enabling Innovation

Both optical and electrical modules are available and support clock recovery for a simple connection to the DUT with optical, electrical, or electrical differential signals.

The optical modules provide complete optical test solutions for standards of both telecom from 155 Mbps to 43 Gbps and datacom (Fibre Channel, InfiniBand® and Gigabit Ethernet) applications. Modules include an average power monitor, selectable number of data rate filters and/or a full bandwidth path, and a choice of clock recovery including a variable rate clock recovery.

The electrical modules include a variety of acquisition modules with bandwidths of up to 70+ GHz, as well as Time Domain Reflectometry (TDR) modules.

In addition, specialized modules supporting features such as single-ended and differential electrical clock recovery, electrostatic protection for the TDR, connectivity to the popular TekConnect® probing system, which brings the performance of Tektronix' state-of-the-art probes for high impedance and differential probing to the CSA8200 family. Low impedance probes for 50 Ω probing and for TDR probing are also available.

Compatibility

Building on the success of the TDS/CSA8000B, with which it is compatible, the CSA8200 accepts all of the 80x00 modules, as well as the newest 82A04 module. Future Tektronix 80x00 modules can be used on both 8200 and 8000 Series instruments; 82x00 modules are 8200 Series-specific. TDS8200 and CSA8200 instruments have the same features and capabilities.

Superior Performance

With its industry-best horizontal timebase stability, signal sensitivity and noise performance, the instrument ensures the most accurate acquisition of high-speed communications signals. Advanced analysis benefits from the 200 fs acquisition jitter are made possible by the new 82A04 Phase Reference module.

In all modes the CSA8200's multi-processor architecture, with dedicated per slot digital signal processors (DSPs), also provides industry-best waveform acquisition rates, shortening the test times necessary for reliable characterization and compliance verification.

The CSA8200 supports the popular FrameScan® acquisition mode, which can be used with patterns from DUTs, BERTs, etc. to isolate pattern dependent effects in transmitters or show the bit sequence preceding a mask violation. FrameScan also allows the user to view an averaged eye diagram for applications such as evaluating Inter-Symbol-Interferences or separating pattern related Deterministic Jitter from Random Jitter. In conjunction with the new 82A04 Phase Reference module, FrameScan achieves new, unprecedented levels of performance. The instrument can accept signal modules, clock recovery module, and a Phase Reference module all at the same time, so the clock recovery Clock Out signal can be used by the Phase Reference module, to decrease the jitter of the acquired signal.

8200 Series Sampling Oscilloscope Platform

The CSA8200 is built on Tektronix' sampling oscilloscope platform that combines familiar MS Windows® 2000-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.

CSA8200 Series Sampling Oscilloscope Optical Modules

80C01 Multi-rate Telecom Optical 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 complete testing solutions for 622 and 2488 Mb/s telecom applications.

80C02 High-performance Telecom Optical 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 28 GHz 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. A superset of this module's functionality has been integrated into the newer, highly flexible 80C11 module.

80C07B Multi-rate, Telecom/Datacom Optical Sampling Module

The 80C07B module is a broad wavelength (700 to 1650 nm), Single-mode/Multi-mode, multi-rate, high sensitivity optical sampling module optimized for the testing of telecom and datacom signals; built-in and optional standards include 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), OC-48/STM-16 (2.488 Gb/s) and InfiniBand® 2 GbE (2.500 Gb/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 multi-rate clock recovery that supports rates between 155 and 2.7 Mb/s.

80C08C Multi-rate, Datacom and Telecom Optical Sampling Module for 10 Gb/s

The 80C08C module is a broad wavelength (700 nm to 1650 nm), Single-mode/Multi-mode multi-rate optical sampling module providing datacom rates testing for 10GbE applications at 9.95328 Gb/s (10GBase-W, SONET/STM), 10.3125 Gb/s (10GBase-R), 10.51875 Gb/s (10G Fibre Channel), 10GbE FEC (11.1 Gb/s), and telecom rates testing for STM64/OC198 (9.953 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s). With its amplified optical-to-electrical (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 a number of clock recovery solutions in the 9.953 Gb/s, 10.3125 Gb/s, 10.3125 Gb/s, 10.51875 Gb/s rate range, and with a multi-rate clock recovery.

80C10 65 GHz 40 Gb/s Optical Sampling Module

The 80C10 module provides integrated and selectable reference receiver filtering enabling conformance testing at either 1310 nm or 1550 nm for 39.813 Gb/s (OC-768/STM-256) and 43.018 Gb/s (43 Gb/s 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 High-performance Multi-rate Optical Sampling Module

The 80C11 module is optimized for testing of long-wavelength (1100 to 1650 nm) signals at a number of rates around 10 Gb/s with a highly flexible multi-rate filter. Additionally the high optical bandwidth of 30 GHz (typical) of its full BW path is well suited for general-purpose high-performance optical component testing. The 80C11 can be optionally configured with clock recovery and with flexible clock recovery that support rates in the 10 Gb/s band (9.953 Gb/s, 10.3125 Gb/s, 10.3125 Gb/s, 10.51875 Gb/s, 10.664 Gb/s, 10.709 Gb/s and others).

80C12 High flexibility Multi-rate Optical Sampling Module

The 80C12 module is a broad wavelength (700 to 1650 nm), Single-mode/Multi-mode, multi-rate, high sensitivity optical sampling module optimized for the testing of telecom and datacom signals; two to four filters/ optical reference receivers can be optioned

into the module. The filter selections include OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s), Fibre Channel (1.063 Gb/s), 2G Fibre Channel (2.125 Gb/s) and 4G Fibre Channel (4.25 Gb/s), GbE (1.250 Gb/s), OC-48/STM-16 (2.488 Gb/s), InfiniBand® 2 GbE (2.500 Gb/s, 10 GbE by four (10 GBase-x4 at 3.125 Gb/s), as well as 10GFC by four at 3188 Gb/s. The 80C12 also offers electrical out for e.g. BER testing, or for an electrical clock recovery module (such as the multi-rate 80A05 Electrical Clock Recovery module).

CSA8200 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. The TDR feature provides high resolution with true differential capability and rise time below 17.5 ps (incident)/35 ps (reflected). Acquisition capabilities match the 80E03 module.

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 2.0 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.

CSA8200 Series Sampling Oscilloscope 82A04 Phase Reference Module and Other Accessory Modules

80A01 Pre-scaled Trigger Amplifier

The 80A01 module can be used to increase the amplitude of the clock signal to the Phase Reference module 82A04 (see below) for clocks in the 8 to 12.5 GHz range. Another application for this module is to increase the sensitivity of the Prescaler Trigger to ≤200 mV for 8 to 12.5 GHz signals on the older CSA8000 mainframes; this functionality is typically not necessary on the CSA8200 mainframes with their increased sensitivity prescaler.

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.

The 80A02 plugs into any available electrical sampling module plug-in slot of the CSA8000 Series oscilloscopes. The unit provides a front panel SMA connector for connecting the SMA test cable or probe signal from the DUT. The 80A02 passes the acquired DUT signal to a connected electrical sampling module input for measurement after an actuating control signals the 80A02 that the DUT has been discharged.

When used with the matching P8018 20 GHz single-ended handheld probe (with probe tip pressure actuating feature) the 80A02 provides a superior technique and performance capability for single-channel electrical sampling module EOS/ESD protection of acquired electrical signal and TDR measurement. (See P8018 product description.)

80A03 TekConnect® Probe Interface Module

The 80A03 plugs into any of the four electrical sampling module slots on the CSA8000 and 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 signal fidelity and a short electrical path; or the signal from the probe can be connected to a module plugged in the mainframe, or to a mainframe input such as trigger input.

Using the 80A03 with the CSA8000 series oscilloscope, design engineers benefit from Tektronix industry-leading active and differential probes to measure signals on SMD pins and other challenging circuit features.

82A04 Phase Reference Module

The 82A04 module adds very accurate phase information to the timebase of the CSA8200. This enables an extremely low jitter – better than 200 fs_{RMS} – signal acquisition. Input frequency range of the reference clock is 2 to 60 GHz, continuous (2 to 25 GHz without Option 60G). (An external filter typically is required below 8 GHz for non-sinusoidal reference clock signals). The module occupies any one electrical module slot; the 3 remaining electrical (or 2 optical, 1 electrical; or 1 optical, 2 electrical) module slots can be used for signal acquisition. The 82A04 supports both the *Triggered* mode of operation, which is similar to usual acquisition, and an un-triggered *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 clock recovery module.

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 range. Option 10G adds support for standard rates up to 12.6 Gb/s. The module accepts either single-ended or differential signals as its input, providing both single-ended or differential clock recovery. 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.

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; up to two optical sampling modules. (Both single- and dual-channel modules appropriate the two channels associated with the slot).
Population of the Ch 1/Ch 2 large slot with any module other than one requiring *power only* displaces functionality of the Ch 1/Ch 2 small slot; population of the Ch 3/Ch 4 large slot with any module other than one requiring *power only* displaces functionality of the Ch 3/Ch 4 small slot.

Number of Simultaneously Acquired Inputs – Eight channels maximum.

Vertical Systems

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

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

Horizontal System

Four timebase modes are available:

Triggered Phase Reference*[1] Timebase Mode – Timing information extracted from a user supplied phase reference (clock) signal significantly improves timebase accuracy and jitter performance of the triggered acquisition. Horizontal position is referenced to the trigger signal as with a traditional timebase.

Free Run Phase Reference*[1] Timebase 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*[2] Timebase Mode – Best short-delay performance for acquisitions without the external phase reference signal.

Locked to 10 MHz Reference Sequential Timebase – 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 Timebases – 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.

Typical Acquisition Rate – 150 kSamples/s per channel (standard sequential timebase); 50 kSamples/s (Phase Reference modes).

Time Interval Accuracy (Standard Timebase) and Timing Deviation (Phase Reference Modes)

Phase Reference Timebase –
Triggered: maximum timing deviation relative to phase reference signal:
- horizontal position >40 ns after trigger event: 0.2% of phase reference signal period (typical).
- horizontal position ≤40 ns after trigger event: 0.4% of phase reference signal period (typical).

Phase Reference Timebase –
Free Run: maximum timing deviation relative to phase reference signal:
- 0.1% or better of phase reference signal period (typical).

Sequential Timebase*2 –
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 Available (Sequential timebase only) – –500 ps to +100 ns on any individual channel in 100 fs increments.

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

Magnification Views – In addition to the main timebase, the CSA8200 supports two magnification views. These magnifications are independently acquired using separate timebase settings which allow same or faster time/div than that of the main timebase.

*1 When using the 82A04 *Phase Reference Module*.

*2 Traditional Mode – *not* using the 82A04 *Phase Reference Timebase module*.

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 electrical clock recovery module – signal from the module (pre-scaled above 2.7 Gb/s) internally connected. Phase Reference*4 timebase supports acquisitions without a trigger signal in its Free Run mode.

Trigger Sensitivity

External Direct Trigger Output –
50 mV, DC – 4 GHz (typical).
100 mV, DC – 3 GHz (guaranteed).

Pre-scaled Trigger Input –
200 mV_{p-p} to 800 mV_{p-p}, 2 to 12.5 GHz (guaranteed).

Jitter

Phase Reference*3 Timebase –
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 CSA8200 mainframe, with 2 GHz ≤f ≤8 GHz, 0.6 V ≤VREF ≤1.8 V Phase Reference Signal.
The Phase Reference timebase remains operational to 100 mV (typical) with increased jitter.

Short-term Jitter Optimized Sequential Mode –
≤0.8 ps_{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).

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 non-destruct input level ±5 V.

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.

*3 When using the 82A04 *Phase Reference Module*.

Math/Measurement

System Measurements

The CSA8200 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, 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 (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.
InfiniBand® 2.500.
Gigabit Ethernet 1.2500.
XAUI.

Optical Sampling Module Characteristics

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

	Application Type	Standards and Supported 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) nm	1	1100 nm to 1650 nm	1310 nm and 1550 (±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), 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 (10.310 Gb/s), 10G Fibre Channel (10.520 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s),10 GbE FEC (11.100 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 (10.310 Gb/s), 10G Fibre Channel (10.520 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 10 GbE FEC (11.100 Gb/s)	1	1100 nm and 1650 nm	1310 nm and 1550 nm (±20 nm)
80C12	1 to 4.5 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) 10GFC-X4 (3.1875 Gb/s) VSR5-3318 (3.318 Gb/s)	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 (10.310 Gb/s), 10G Fibre Channel (10.520 Gb/s), ITU-T G.975 FEC (10.664 Gb/s), ITU-T G.709 (10.709 Gb/s), 10 GbE FEC (11.100 Gb/s)			

▶ Optical Sampling Module Characteristics (continued)

	Clock Recovery (Optional)	Clock Recovery Outputs	Unfiltered Optical Bandwidth*[4]	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, 10.310 Gb/s; Option CR2: 10.310 Gb/s, 10.520 Gb/s; Option CR4: Continuous from 9.800 Gb/s to 12.600 Gb/s	Clock, Clock/16	*10 GHz*	1 mW average; 10 mW peak power at wavelength of highest responsivity	62.5 µm/125 µm multi-mode
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 9.800 Gb/s to 12.600 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 80A05 (sold separately)	ELECTRICAL SIGNAL OUT	*9 GHz* (for all options except 10G) *10 GHz* (Option 10G)	1 mW average; 10 mW peak power at multi-mode wavelength of highest responsivity	62.5 µm/125 µm

*[4] 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 (multi-mode) >24 dB (single-mode)	single- or multi-mode	1.7 µW (all filters except Option 10G) 3.4 µW (Full BW and Option 10G filters)	3.0 µW (all filters except Option 10G) 6.0 µW (Full BW and Option 10G filters)	Standard

▶ Optical Sampling Module Characteristics (continued)

	Offset Capability	Power Meter	Power Meter Range	Power Meter Accuracy	Mask Test Optical Sensitivity*5
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	–15 dBm (for all options except Option 10G) –12 dBm (for Option 10G)

*5Smallest 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 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

Electrical Sampling Module Characteristics

▶ Electrical Sampling Module Characteristics

	Application Type	Channels	Input Impedance	Channel Input Connector	Bandwidth*[6]
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*[7]
80E03	Device Characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[7]
80E04	TDR Impedance Characterization with single-ended, common, differential TDR capability	2	50 ±0.5 Ω	3.5 mm female	20 GHz*[7]
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*

*[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.

*[7] Calculated from 0.35 bandwidth rise time product.

▶ 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 (typical)*[7]	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*[8]	1.0 V_{p-p}	±1.6 V	±2.0 V	14 bits full scale

*[7] Calculated from 0.35 bandwidth rise time product.

*[8] 80E06 rise time is calculated from formula rise time = 0.35/(typical bandwidth).

▶ Electrical Sampling Module Characteristics (continued)

	Vertical Sensitivity Range	DC Vertical Voltage Accuracy, Single Point, within ±2 °C of Compensated Temperature	Typical Step Response Aberrations*9	RMS Noise*9
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)

*9Values shown are warranted unless printed in an italic typeface which represents a non-warranted characteristic value that the instrument will typically perform to.

▶ Physical Characteristics for Electrical Sampling Modules

	Dimensions (mm/in.)			Weight (kg/lbs.)
	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

▶ TDR System (80E04 only) Characteristics

	80E04*[9]
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

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

Power Requirements

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

Environmental Characteristics

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 de-rates 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.

▶ Ordering Information

CSA8200

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.

CSA8200 Options

Option 1K – Cart.

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

Option GT – Gated Trigger.

Service Options

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 Option C3).

Opt. D5 – Calibration Data Report 5 Years (with Option C5).

Opt. R3 – Repair Service 3 Years.

Opt. R5 – Repair Service 5 Years.

International Power Plug Options

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. A99 – No Power Cord.

Opt. A10 – 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.

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

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

Sampling Accessory: Module Power-Only Extender Cable – (380 mm/15 inch) – Order 174-3896-00. This cable can be used to power one accessory module which doesn't require CPU communication (80A01, 80A02; but not 82A04, 80A05). This extender cable plugs into the "Trigger Power" connector on the mainframe, or into the "Probe Power" connector on the electrical sampling module.

82A04 Filter 2 GHz – Filter kit for non-sinusoidal phase reference clock signal with frequency between 2 GHz and 4 GHz. Order 020-2566-00.

82A04 Filter 4 GHz – Filter kit for non-sinusoidal phase reference clock signal with frequency between 4 GHz and 6 GHz. Order 020-2567-00.

82A04 Filter 6 GHz – Filter kit for non-sinusoidal phase reference clock signal with frequency between 6 GHz and 8 GHz. Order 020-2568-00.

2X Attenuator (SMA male-to-female) – DC to 18 GHz. Order 015-1001-01.

5X Attenuator (SMA male-to-female) – DC to 18 GHz. Order 015-1002-01.

Connector Adapter – (2.4 mm or 1.85 mm male to 2.92 mm female) DC to 40 GHz. Order 011-0157-00.

Power Divider – 50 Ω, impedance matching power divider, SMA male to two SMA females. Order 015-0705-00.

Rackmount Kit – Order 016-1791-01.

Wrist Strap (Antistatic) – Order 006-3415-04.

P6209 – 4 GHz Active FET Probe.

P7260 – 6 GHz Active FET Probe. Requires 80A03 interface module (see below).

P7350 – 5 GHz Active FET Probe. Requires 80A03 interface module (see below).

P7350SMA – 5 GHz 50 Ω Differential-to-Single ended Active Probe. Requires 80A03 interface module (see below). 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 (see below).

P6150 – 9 GHz Passive Probe; the probe consists of a very high quality, cca. 20 GHz probe tips, plus an extremely flexible SMA cable. For higher frequency performance the 015-0560-00, or some of the accessory cables listed below, can be used.

P8018 – 20 GHz Single-Ended TDR Probe. 80A02 module (below) recommended for static protection of the sampling or TDR module.

80A01 – Pre-scaled Trigger Amplifier.

Not necessary on the CSA8200 mainframe with its increased sensitivity prescaler, the Pre-scaled Trigger Amplifier enhances prescaler sensitivity on the older TDS8000B and CSA8000B mainframes.

80A02 – CSA8000 Series EOS/ESD Protection Module (1 channel). P8018 TDR probe (above) recommended.

80A03 – TekConnect.®

82A04 – Phase Reference Module for low jitter acquisition (with or without trigger). Accepts signal 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/clock recovery for the 80C12.

The standard version of 80A05 supports signals in the following ranges: 50 Mb/s to 2.700 Gb/s, 2.700 Gb/s to 3.188 Gb/s, and the rate of 4 Gigabit Fibre Channel 4.250 Gb/s. The Option 10G adds the ranges of 3.267 Gb/s to 4.250 Gb/s, 4.900 Gb/s to 6.375 Gb/s, and 9.800 Gb/s to 12.60 Gb/s.

K4000 – Mobile Workstation.

Interconnect Cables

015-0560-00 (450 mm/18 inch; 1dB loss.

Interconnect Cables (Third 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 & Associates' cable assemblies listed below are compatible with the 2.92 mm, 2.4 mm, and 1.85 mm connector interface of the 80E0x modules.

Assemblies can be ordered by contacting Gore by phone at (800) 356-4622, or on the Web at www.goreelectronics.com (click on "Contact Us").

Bench Top Test Cable Assemblies

TEK40PF18PP – Frequency: 40 GHz; Connectors: 2.92 mm male; Length: 18.0 inches.

TEK50PF18PP – Frequency: 50 GHz; Connectors: 2.4 mm male; Length: 18.0 inches.

TEK65PF18PP – Frequency: 65 GHz; Connectors: 1.85 mm male; Length: 18.0 inches.

High Frequency Interconnect Cables for Electrical Sampling Modules

TEK40HF06PP – Frequency: 40 GHz; Connectors: 2.92 mm male; Length: 6.0 inches.

TEK40HF06PS – Frequency: 40 GHz; Connectors: 2.92 mm male; 2.92 mm female; Length: 6.0 inches.

TEK50HF06PP – Frequency: 50 GHz; Connectors: 2.4 mm male; Length: 6.0 inches.

TEK50HF06PS – Frequency: 50 GHz; Connectors: 2.4 mm male; 2.4 mm female; Length: 6.0 inches).

TEK65HF06PP – Frequency: 65GHz; Connectors: 1.85 mm male; Length: 6.0 inches.

TEK65HF06PS – Frequency: 65GHz; Connectors: 1.85 mm male, 1.85 mm female; Length: 6.0 inches.

Communications Signal Analyzer

▶ CSA8200

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Our most up-to-date product information is available at:
www.tektronix.com

Product(s) are manufactured in ISO registered facilities.

04/04 HB/WOW 85W-17642-0

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