

Communications Signal Analyzers

► CSA7000/B Series



Versatile, High-performance Real-time Digital Oscilloscopes Dedicated to Rapid Design Analysis and Verification of Communications Signals Up To 2.5 Gb/s Rates (OC-48/STM-16 or Fibre Channel FC2125)

The CSA7000/B Series of communications signal analyzers reduces product development time by providing one tool that spans circuit development and physical layer testing. With this family, engineers can test designs for compliance to network communications standards as well as analyze critical internal parameters such as signal integrity, timing margins and jitter.

They combine up to 4 GHz true analog bandwidth, 20 GS/s maximum real-time sample rate, and more than 400,000 wfms/s waveform capture rate, enabled by exclusive DPX® acquisition technology, to rapidly acquire electrical and optical signal information not revealed with other analysis tools. Integrated broad wavelength optical

response, clock recovery, serial pattern triggering, and mask testing make testing faster, easier, and more efficient. Innovative software solutions deliver domain expertise for advanced analysis and compliance testing, while the OpenChoice™ architecture enables users to integrate their expertise through the ability to easily write custom programs or utilize popular commercial software. Instrument operation is familiar and intuitive through direct controls and a graphical user interface. This unique combination of superior measurement fidelity, unrivaled analysis and uncompromised usability speeds the development of network communications circuit designs.

► Features & Benefits

Real-time Oscilloscope Platform with Up to 4 GHz True Analog Bandwidth and Down to 72 ps Rise Time (20% – 80%)

>400,000 wfms/s Waveform Capture Rate, Powered by Exclusive DPX® Acquisition Technology

20 GS/s Maximum Real-time Sample Rate

Built-in Compliance Mask Tests with up to 2.5 Gb/s Optical and Electrical Data Stream Rates

Integrated Optical Reference Receiver Protects Integrity of System Calibration

Integrated Hardware Clock Recovery Provides Single-connection Convenience

Up to 64 MB Record Length with MultiView Zoom™ for Quick Navigation of Long Records

64-Bit Serial Trigger for Isolation of Pattern-dependent Effects

Complete Eye Pattern Measurements Suite Including Extinction Ratio, Q-factor, Eye Height/Width, Jitter and Noise

Waveform Database Acquisition Technology for Accurate Parametric Measurements on Eye Patterns

TekConnect® Interface for High Fidelity Connection

OpenChoice™ with Windows 2000 Delivers Built-in Networking and Analysis

► Applications

Design Development and Compliance Testing of Optical and Electrical Signals to 2.5 Gb/s Rates

Physical Layer Characterization of Communication Signals in Backplane, Midplane and Embedded Designs

Optical and Electrical Signal Integrity, Margin Verification, Jitter and Timing Analysis

COMPUTING

COMMUNICATIONS

VIDEO

Communications Signal Analyzers

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► Characteristics

► Vertical System

	CSA7154	CSA7404B
Input Channels	4	4
Hardware Analog Bandwidth (–3 dB)	1.5 GHz	4 GHz
Rise Time, 10% to 90% (Typical)	240 ps	100 ps
Rise Time, 20% to 80% (Typical)		72 ps
Input Coupling	DC, GND	
Input Impedance	50 Ω	
Input Sensitivity	2 mV/div to 1 V/div	
Vertical Resolution	8 bits, (>11 bits with averaging)	
Max. Input Voltage	<1 V _{RMS} for <100 mV/div, <5 V _{RMS} for \geq 100 mV/div settings. Also determined by TekConnect® accessory	
Offset Range	2 mV to 50 mV/div \pm 0.5 V, 50.5 mV to 99.5 mV \pm 0.25 V 100 mV to 500 mV \pm 5 V, 505 mV to 1 V/div \pm 2.5 V	
DC Gain Accuracy 4 mV/div to 1 V/div	\pm (2% + (2% x net offset/10)) net offset = voltage level at center screen (vertically)	

► Optoelectronic System

Specifications assume use of the included 013-0327-00 O-to-E Output to CH1 interconnect (unless otherwise noted).

	CSA7154	CSA7404B
Optical Channel Unfiltered Bandwidth	1.6 GHz	2.4 GHz
Input Connector	Rifocs universal connector	
Wavelength Range	700 nm to 1650 nm	
Calibrated Wavelengths	780 nm, 850 nm, 1310 nm, 1550 nm	
O/E Gain	\geq 0.27 V/mW (0.35 V/mW typical) at 780 nm \pm 20 nm \geq 0.33 V/mW (0.40 V/mW typical) at 850 nm \pm 20 nm \geq 0.64 V/mW (0.75 V/mW typical) at 1310 nm \pm 20 nm \geq 0.64 V/mW (0.75 V/mW typical) at 1550 nm \pm 20 nm	
Sensitivity (smallest average power for mask test). Assumes scale factor is set to minimum μ W/div settings and signal is at least 4 divisions _{p-p}	40 μ W _{p-p} at 1310 nm and 1550 nm. 20 μ W (–17 dBm) average power assuming 50% average duty cycle. 80 μ W _{p-p} at 780 nm and 850 nm. 40 μ W (–14 dBm) average power assuming 50% average duty cycle.	
RMS Noise	\leq 0.85 μ W + (6.5% of W/div setting) at 1310 nm and 1550 nm. \leq 1.6 μ W + (6.5% of W/div setting) at 850 nm. \leq 2.0 μ W + (6.5% of W/div setting) at 780 nm.	\leq 1.1 μ W + (6.5% of W/div setting) at 1310 nm and 1550 nm. \leq 2.1 μ W + (6.5% of W/div setting) at 850 nm. \leq 2.6 μ W + (6.5% of W/div setting) at 780 nm.
Input Range	10 μ W/div to 500 μ W/div Optical reference receiver typically available over the following range: 40 μ W (–14 dBm) to 400 μ W (–4 dBm) at wavelength <1200 nm; 25 μ W (–16 dBm) to 250 μ W (–6 dBm) at wavelength >1200 nm	
Absolute Maximum Nondestructive Optical Input	5 mW average; 10 mW peak at wavelength with highest relative responsivity	
Maximum Nonsaturating Linear Response to Transient Input (Typical)	<170 μ W average input (340 μ W peak) at 850 nm <120 μ W average input (240 μ W pk) at 1310 and 1550 nm	
Fiber Input	62.5 μ m core multimode fiber	
Input Return Loss (Typical)	With 50 μ m or 62.5 μ m core multimode fiber (CPC6) attached: >14 dB for 780 nm \pm 20 nm >14 dB for 850 nm \pm 20 nm With 9 μ m core single mode fiber (SMF-28) attached: >28 dB for 1310 nm \pm 20 nm >28 dB for 1550 nm \pm 20 nm	

► Optical Reference Receiver System

Fourth-order Bessel-Thompson filter response at the following rates:

	CSA7154	CSA7404B
SONET/SDH	OC-1/STM0 (51.84 Mb/s) OC-3/STM1 (155.52 Mb/s) OC-12/STM4 (622.08 Mb/s)	OC-1/STM0 (51.84 Mb/s) OC-3/STM1 (155.52 Mb/s) OC-12/STM4 (622.08 Mb/s) OC-48/STM16 (2488.3 Mb/s) OC-48 FEC (2.666 Gb/s)
Gigabit Ethernet		1000Base-SX (1.25 Gb/s) 1000Base-LX (1.25 Gb/s)
Fibre Channel	FC133 (132.7 Mb/s) FC266 (265.6 Mb/s) FC531 (531.2 Mb/s) FC1063 (1063.5 Mb/s)	FC133 (132.7 Mb/s) FC266 (265.6 Mb/s) FC531 (531.2 Mb/s) FC1063 (1063.5 Mb/s) FC2125 (2127 Mb/s)
IEEE 1394b	S400 (491.5 Mb/s) S800 (983.04 Mb/s)	S400 (491.5 Mb/s) S800 (983.04 Mb/s) S1600 (1.9661 Gb/s)
InfiniBand		2.5 Gb/s (2127 Mb/s)
VSR		1.24416 Gb/s

► Clock Recovery System

	CSA7154	CSA7404B
Channel Type	Electrical, Multimode Optical, Single Mode Optical	
Clock Recovery Phase Locked Loop Bandwidth	Fbaud/1600 typical	
Tracking/Acquisition Range	±2% of requested baud	
Clock Recovery Jitter (Typical)	0.25% bit period + 9 ps _{RMS} for PRBS data patterns or 8 ps _{RMS} for repeating "0011" data patterns	0.25% period + 5 ps _{RMS} for PRBS data patterns or 4 ps _{RMS} for repeating "0011" data patterns
Input Sensitivity for Clock Recovery	1 division pk-pk displayed signal	
Input Data Rates	1.5 Mbaud to 1.5 Gbaud	1.5 Mbaud to 3.125 Gbaud

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► Communications Mask Testing

	CSA7154	CSA7404B
SONET/SDH GR 253-CORE (Issue 39/21/2000)	OC-1/STM0 OC-3/STM1 OC-12/STM4	OC-1/STM0 OC-3/STM1 OC-12/STM4 OC-48/STM16 OC-48 FEC (2.666 Gb/s)
ITU-T G.703 (10/98)	DS1 Rate, DS2 Rate Sym Pair, DS2 Rate Coax, DS3 Rate E1 Sym Pair, E1 Coax, E2, E3, E4 Binary 0, E4 Binary 1 32 Mb, 97 Mb STM 1E 0/Bin 0, STM 1E 1/Bin 1	
ANSI T1.102-1993 (R1999)	DS1, DS1A, DS1C, DS2, DS3, DS4NA, DS4NA Max Output STS-1 Pulse, STS-1 Eye STS-3, STS-3 Max Output	
Ethernet IEEE Std 802.3 and ANSI X3.263-1995	100Base-T STP, 100Base-T UTP 1000Base-SX Short Wave Optical 1000Base-LX Long Wave Optical 1000Base-CX	
Fibre Channel Optical (ANSI X3.303-1997)	FC133, FC266, FC531, FC1063, FC1063 Draft Rev 11	FC133, FC266, FC531, FC1063, FC1063 Draft Rev 11 FC2125 Draft Rev 11
Fibre Channel Electrical (ANSI X3.303-1997)	FC133E, FC266E, FC531E, FC1063E, FC1063E Normalized Beta, Delta, Gamma Transmit FC1063E Absolute Beta, Delta, Gamma Transmit FC1063E Absolute Beta, Delta, Gamma Receive	FC133E, FC266E, FC531E, FC1063E, FC1063E Normalized Beta, Delta, Gamma Transmit FC1063E Absolute Beta, Delta, Gamma Transmit FC1063E Absolute Beta, Delta, Gamma Receive, FC2125E Normalized Beta, Delta, Gamma Transmit FC2125E Absolute Beta, Delta, Gamma Transmit FC2125E Absolute Beta, Delta, Gamma Receive
USB (Rev 2.0 April 2000)	FS (12 Mb/s) HS: T1, T2, T3, T4, T5, T4 (480 Mb/s)	
InfiniBand (Draft)		2.5 Gb/s Optical, 2.5 Gb/s Electrical
IEEE 1394b (Draft)	S400 Optical S400b T1, S400b T2 S800 Optical S800b T1, S800b T2	S400 Optical S400b T1, S400b T2 S800 Optical S800b T1, S800b T2 S1600 Optical S1600b T1, S1600b T2
Serial ATA (Rev 1.0 June 2002)		G1 Rx (5 Cycle), G1 Tx (5 Cycle)
Rapid I/O LP_LVDS Rev 0.3 (draft) 5/2002	+Drv: 500 Mb/s, 750 Mb/s, 1 Gb/s, 1.5 Gb/s, 2.0 Gb/s +Ext Drv: 500 Mb/s, 750 Mb/s, 1 Gb/s +Rcv: 500 Mb/s, 750 Mb/s, 1 Gb/s	+Drv: 500 Mb/s, 750 Mb/s, 1 Gb/s, 1.5 Gb/s, 2.0 Gb/s +Ext Drv: 500 Mb/s, 750 Mb/s, 1 Gb/s 1.5 Gb/s, 2.0 Gb/s +Rcv: 500 Mb/s, 750 Mb/s, 1 Gb/s, 1.5 Gb/s, 2.0 Gb/s
Rapid I/O Serial Rev 1.1 December, 2001		RIO Serial: 1.25 Gb/s, 2.5 Gb/s
OIF Standards Draft 1.13 June 5, 2002	SFI-5, SPI-5 TA/TC/RB/RD Data/Clock (2.4888 Gb/s) SFI-5, SPI-5 TC Data (2.4888 Gb/s) SFI-5, SPI-5 TA Clock (2.4888 Gb/s) SFI-5, SPI-5 TC Clock (2.4888 Gb/s) SFI-5, SPI-5 Data (2.4888 Gb/s) SFI-5, SPI-5 RD Data (2.4888 Gb/s) SFI-5, SPI-5 RB Clock (2.4888 Gb/s) SFI-5, SPI-5_5 RD Clock (2.4888 Gb/s) VSR OC 192/STM64 1.24416 Gb/s TFI-5 (2.4888 Gb/s)	
PCI Express Rev 1.0		Transmit/Receive (2.5 Gb/s)

► Timebase System

	CSA7154	CSA7404B
Timebase Range	50 ps to 10 s/div	
Timebase Delay Time Range	16 ns to 250 s	5 ns to 250 s
Channel to Channel Deskew Range	±25 ns in 1 ps steps	±75 ns in 1 ps steps
Time Interval Accuracy, Single-shot Sample Mode	(0.06/sample rate + 2.5 ppm x lreading!) RMS	
Trigger Jitter	6 ps _{RMS} typical	1.5 ps _{RMS} typical
Long Term Sample Rate and Delay Time Accuracy	±2.5 ppm over ≥100 ms interval; aging <1 ppm per year from date of factory calibration	
External Timebase Reference	Rear Panel Connection	
External Reference Input Frequency Range	9.8 MHz to 10.2 MHz	
External Reference Input Sensitivity	$V_{in} \geq 200 \text{ mV}_{p-p}$	
External Reference Maximum Input Signal	7 V_{p-p}	
Internal Reference Output Frequency	±2.5 ppm over ≥100 ms interval; aging <1 ppm per year from date of factory calibration	
Internal Reference Output Voltages	$V_{out} \text{ (Hi)} \geq 2.5 \text{ V open circuit; } \geq 1.0 \text{ V into } 50 \Omega \text{ load to gnd}$ $V_{out} \text{ (Lo)} \leq 0.7 \text{ V into a load of } \leq 4 \text{ mA; } \leq 0.25 \text{ V into } 50 \Omega \text{ load to gnd}$	

► Acquisition System

	CSA7154	CSA7404B
Real-time Sample Rates		
1 channel (Max. rate)	20 GS/s	
2 channels (Max. rate)	10 GS/s	
3-4 channels (Max. rate)	5 GS/s	
Equivalent Time Sample Rate (Maximum)	1 TS/s	
Maximum Record Length per Channel with Standard Memory	2 M (1 ch), 1 M (2 ch), 500 k (4 ch)	4 M (1 ch), 2 M (2 ch), 1 M (4 ch)
With Memory Opt. 2M	8 M (1 ch), 4 M (2 ch), 2 M (4 ch)	
With Memory Opt. 3M	16 M (1 ch), 8 M (2 ch), 4 M (4 ch)	
With Memory Opt. 4M	32 M (1 ch), 16 M (2 ch), 8 M (4 ch)	
With Memory Opt. 5M	64 M (1 ch), 32 M (2 ch), 16 M (4 ch)	

► Maximum Duration at Highest Real-time Resolution (1 ch)

	CSA7154	CSA7404B
Time Resolution (Single-shot)	50 ps (20 GS/s)	
Maximum Duration with Standard Memory	100 us	200 us
Maximum Duration with Opt. 2M	400 us	
Maximum Duration with Opt. 3M	800 us	
Maximum Duration with Opt. 4M	1.6 ms	
Maximum Duration with Opt. 5M	3.2 ms	

Communications Signal Analyzers

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► Acquisition Modes

	CSA7154	CSA7404B
FastAcq Acquisition	Powered by DPX® acquisition technology, FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events	
Maximum FastAcq Waveform Capture Rate	>400,000 wfms/sec	
Sample	Acquire sampled values	
Waveform Database (WfmDB)	Accumulate waveform database providing three-dimensional array of amplitude, time and counts	
Peak Detect	Captures narrow glitches at all real-time sampling rates	
Minimum Peak Detect Pulse Width	400 ps	
Average	From 2 to 10,000 waveforms included in average	
Envelope	From 2 to 2×10^9 waveforms included in min-max envelope	
Hi-Res	Real-time boxcar averaging reduces random noise and increases resolution	
FastFrame™ Acquisition	Acquisition memory divided into segments; maximum trigger rate >265,000 waveforms per second. Time of arrival recorded with each event	

► Trigger System

	CSA7154	CSA7404B
Sensitivity		
Internal DC Coupled, Main Trigger	0.5 div from DC to 50 MHz, ≤1 div at 1.5 GHz	0.5 div from DC to 50 MHz, ≤1.5 div at 3 GHz
External (Auxiliary Input)	250 mV from DC to 50 MHz increasing to 350 mV at 500 MHz	150 mV from DC to 50 MHz increasing to 500 mV at 2.5 GHz
Main Trigger Modes	Auto, Normal and Single	
Trigger Sequences	Main, Delayed by Time, Delayed by Events. All sequences can include separate horizontal delay after the trigger event to position the acquisition window in time	
Trigger Level Range		
Internal	±12 divisions from center of screen	
External (Auxiliary Input)	±8 V	±5 V
Line	fixed at 0 V	
Trigger Coupling	DC, AC (attenuate <60 Hz), HF Rej (attenuate >30 kHz), LF Rej (attenuates <80 kHz), Noise Reject (reduce sensitivity)	
Trigger Holdoff Modes	Random, Automatic or User-specified Time	
Trigger Holdoff Range	250 ns minimum to 12 seconds maximum	

Trigger Modes

Edge – Positive and/or negative slope on any channel or front panel auxiliary input. Coupling includes DC, AC, noise reject, HF reject and LF reject.

Comm –

Support for AMI, HDB3, BnZS, CMI, MLT3 and NRZ encoded communications signals.

AMI encoding: Standards include DS1, DS1A, DS1C, DS3, E1, E2, E3, STS-1 or a custom bit rate. Select between positive or negative isolated one, zero pulse form or eye patterns.

HDB3 encoding: Standards include E1, E2, E3, DS1A or custom bit rate. Select between positive or negative isolated one pulse or eye pattern.

BnZS encoding: Standards include DS1, DS1C, DS2, DS3, STS-1 or custom bit rate. Select between positive or negative isolated one pulse or eye pattern. CMI encoding: Standards include STS-3, STM1E, DS4NA, E4 or a custom bit rate. Select between positive or negative one pulse, zero pulse or eye pattern.

MLT3 encoding: Standards include 100Base-TX.

NRZ encoding: Standards include OC1/STM0, OC3/STM1, OC12/STM4, OC48/STM16, GB Ethernet, FC133, FC266, FC531, FC1063, FC2125, InfiniBand 2.5, G1 ATA, FS USB, HS USB, IEEE 1394b S400b, S800b, S1600b, OC-48 FEC, 1000 BASE CX, RapidIO, SFI-5, SPI-5, VSR, PCI Express, TFI-5; eye patterns only. CSA7154 limited to standards ≤ 1.25 Gb/s.

Serial Pattern – 64-Bit serial word recognizer, bits specified in binary (high, low, don't care) or hex format. Trigger on NRZ-encoded data up to 1.25 Gbaud.

Glitch – Trigger on or reject glitches of positive, negative, or either polarity. Minimum glitch width is 1.0 ns with 200 ps resolution. Minimum glitch width is 225 ps with rearm time of 250 ps (B models).

Width – Trigger on width of positive or negative pulse (down to 225 ps on B models) either within or out of selectable time limits: 1 ns (CSA7154) or 340 ps (B models) to 1 s.

Runt – Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Optional time qualification.

Timeout – Trigger on an event which remains high, low, or either, for a specified time period, selectable from 1 ns or 340 ps (B models) to 1 s with 200 ps or 100 ps (B models) resolution.

Transition – Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative or either.

Setup/Hold – Trigger on violations of both setup time and hold time between clock and data present on any two input channels.

Pattern – Trigger when pattern goes false or stays true for specified period of time. Pattern (AND, OR, NAND, NOR) specified for four input channels defined as HIGH, LOW or Don't Care.

State – Any logical pattern of channels (1, 2, 3) clocked by edge on channel 4. Trigger on rising or falling clock edge.

Window – Trigger on an event that enters or exits a window defined by two user-adjustable thresholds. Event can be time or logic qualified (B models only).

Logic Qualified Trigger applicable to Glitch, Width, Runt, Timeout, Transition, Setup/Hold, Window triggers – Trigger on the specified event only if the logic state defined with the remaining unused channels occurs (B models only).

Trigger Delay by Time – Trigger Delay by Time 16 ns (5 ns for B models) to 250 seconds.

Trigger Delay by Events – Trigger Delay by Events 1 to 10,000,000 Events.

Waveform Measurements

Amplitude – Amplitude, High, Low, Maximum, Minimum, Peak to Peak, Mean, Cycle Mean, RMS, Cycle RMS, Positive Overshoot, Negative Overshoot.

Time – Rise time, Fall time, Positive Width, Negative Width, Positive Duty Cycle, Negative Duty Cycle, Period, Frequency, Delay.

Combination – Area, Cycle Area, Phase, Burst Width.

Histogram-related – Waveform count, Hits in box, Peak hits, Median, Maximum, Minimum, Peak to Peak, Mean (μ), Standard Deviation (σ), $\mu+1\sigma$, $\mu+2\sigma$, $\mu+3\sigma$.

Eye Pattern-related – Extinction Ratio (absolute, % and dB), Eye Height, Eye Top, Eye Base, Eye Width, Crossing %, Jitter (peak-peak, RMS and 6σ), Noise (peak-peak and RMS), S/N ratio, Cycle Distortion, Q-factor.

Waveform Processing/Math

Algebraic Expressions – Define extensive algebraic expressions including waveforms, scalars and results of parametric measurements e.g., (Integral (Ch. 1–Meas(Ch. 1)))*1.414.

Arithmetic – Add, subtract, multiply, divide waveforms and scalars.

Relational – Boolean result of comparison $>$, $<$, \geq , \leq , $==$, $!=$.

Calculus – Integrate, differentiate.

Frequency Domain Functions – Spectral magnitude and phase, real and imaginary spectra.

Vertical Units –

Magnitude: Linear, dB, dBm.

Phase: degrees, radians.

Window Functions – Rectangular, Hamming, Hanning, Kaiser-Bessel, Blackman-Harris, Gaussian, Flatop2, Tek Exponential.

Waveform Definitions – Waveform definition as arbitrary math expressions.

Communications Signal Analyzers

► CSA7000/B Series

Display Characteristics

Display Type – Liquid crystal active-matrix color display; integral touch screen.

Display Size – 211.2 mm (W) x 158.4 mm (H), 264 mm (10.4 in.) diagonal.

Display Resolution –

CSA7154: 640 horizontal x 480 vertical pixels.
CSA7404B: 1024 horizontal x 768 vertical pixels.

Waveform Styles – Vectors, Dots, Variable Persistence, Infinite Persistence.

Computer System and Peripherals

CPU –

CSA7154: 850 MHz Celeron Processor.
CSA7404B: Intel Pentium 4 processor, 2.0 GHz.

PC System Memory – 512 MB.

Hard Disk Drive – 40 GB removable hard disk drive: rear-panel, or (B model only) front-panel (Option FHD).

Floppy Disk Drive – 1.44 MB 3.5-in. floppy disk drive: front-panel, or (B model only) rear-panel (Option FHD).

CD-RW Drive – Rear-panel CD-RW drive.

Mouse – Thumb wheel model included, USB interface.

Keyboard – Order 118-9402-00 for small keyboard (fits in pouch); PS-2 interface.
Order 119-6633-00 for full-size keyboard; USB interface and hub.

Input/Output Ports

Probe Compensation Output – Front panel BNC connector, requires Probe Cal-Deskew Fixture (included) for probe attachment.
400 mV (non B model) or 1 V (B model) $\pm 20\%$ into $>10\ \Omega$ load.
200 mV (non B model) or 500 mV (B model) $\pm 20\%$ into a $50\ \Omega$ load.

Recovered Clock Out – Front-panel SMA connector provides output of clock signal recovered from specified channel. Output compatible with ECL terminated with $50\ \Omega$ to GND. Peak-to-peak output swing at 650 MHz is at least 200 mV into $50\ \Omega$. Higher frequencies will be further attenuated by approximately 6 dB per octave above 625 MHz.

Recovered Data Out – Front-panel SMA connector provides regenerated data output from clock recovery system. Serial data output baud rate ≤ 1250 MBaud. Output swing at this baud rate will be at least 200 mV into $50\ \Omega$.

Optical In – Optoelectronic converter input, 700 nm to 1650 nm, Rifocs connector.

O/E Output – Front-panel BMA connector providing electrical output of optoelectronic converter. SMA adapter included.

Analog Signal Output Amplitude – Rear-panel BNC connector, provides a buffered version of the signal that is attached to the Channel 3 input when Ch. 3 is selected as trigger source. Frequency response: 1.8 GHz into a $50\ \Omega$ load. Amplitude: 20 mV/div $\pm 20\%$ into a $1\ \text{M}\Omega$ load, 10 mV/div $\pm 20\%$ into a $50\ \Omega$ load.

Auxiliary Output – Rear-panel BNC connector, provides a TTL-compatible, polarity switchable pulse when the oscilloscope triggers or optionally, upon mask test failure or test completion.

External Timebase Reference In – Rear-panel BNC connector, timebase system can phase-lock to external 10 MHz reference.

Timebase Reference Out – Rear-panel BNC connector, provides TTL-compatible output of internal 10 MHz reference oscillator.

Parallel Port – IEEE 1284, DB-25 connector.

Audio Ports – Miniature phone jacks for stereo microphone input and stereo line output.

USB Port – Allows connection or disconnection of USB keyboard, mouse or other peripherals while oscilloscope power is on. B models have 2 USB ports.

Keyboard Port – PS-2 compatible.

Mouse Port – PS-2 compatible.

LAN Port – RJ-45 connector, supports 10Base-T and 100Base-T.

Serial Port – DB-9 COM1 port.

Windows Video Port – 15 pin D-sub connector on the rear panel; connect a second monitor to use dual-monitor display mode. Video is DDC2B compliant.

GPIO Port – IEEE 488.2 standard.

Scope Video Port – 15 pin D-sub connector on the rear panel, video is IBM XGA compatible for B models. Connect to show the oscilloscope display, including live waveforms on an external monitor or projector. The primary Windows desktop can also be displayed on an external monitor using this port.

Power Source

Power –

100 to 240 V_{RMS} , $\pm 10\%$, 50/60 Hz CAT II.
115 V_{RMS} $\pm 10\%$, 400 Hz CAT II.
<300 Watts (450 VA).

Physical Characteristics

BENCHTOP CONFIGURATION

Dimensions	mm	in.
Height	277	10.9
Width	455	17.9
Depth	425	16.75
Weight	kg	lb.
Net	19	41.5
Shipping	37	85

RACKMOUNT CONFIGURATION

Dimensions	mm	in.
Height	277	10.9
Width	502	19.75
Depth	486	19.125
Weight	kg	lb.
Net	20	43.5
Shipping	5.6	12.32

MECHANICAL

Required Clearance	mm	in.
Top	0 or >76	0 or >3
Bottom	0	0
Left side	76	3
Right side	76	3
Front	0	0
Rear	0	0

Environmental

Temperature –

Operating: 0 °C or 5 °C (B models) to +50 °C, excluding floppy disk and CD-R/W drives.
+10 °C to +45 °C, including floppy disk and CD-R/W drives.
Nonoperating: –22 °C to +60 °C.

Humidity –

Operating: 20% to 90% relative humidity with a maximum wet bulb temperature of +29 °C at or below +50 °C, noncondensing. Upper limit derated to 25% relative humidity at +50 °C.
Nonoperating: With no diskette in floppy disk drive, 5% to 90% relative humidity with a maximum wet bulb temperature of +29 °C at or below +60 °C, noncondensing. Upper limit derated to 20% relative humidity at +60 °C.

Altitude –

Operating: 10,000 ft. (3,048 m).
Nonoperating: 40,000 ft. (12,190 m).

Random Vibration –

Operating: 0.00015 g²/Hz from 5 to 350 Hz, –3 dB/octave from 350 to 500 Hz, 0.000105 g²/Hz at 500 Hz.
Overall level of 0.27 g_{RMS}.
Nonoperating: 0.0175 g²/Hz from 5 to 100 Hz, –3 dB/octave from 100 to 200 Hz, 0.0875 g²/Hz from 200 to 350 Hz, –3 dB/octave from 350 to 500 Hz, 0.006132 g²/Hz at 500 Hz.
Overall level of 2.28 g_{RMS}.

Electromagnetic Compatibility –

EN 61326 (EU EMC Directive 89/336EEC).
AS/NZS 2064 (Australian EMC Framework).

Safety – UL 3111-1, CSA-22.2 No. 1010.1, EN61010-2.

► Ordering Information

CSA7404B

4 GHz Communications Signal Analyzer.

CSA7154

1.5 GHz Communications Signal Analyzer.

All Models Include: Accessory pouch, front keyboard cover, mouse, probe calibration and deskew fixture (067-0405-xx), O/E Electrical Output to Ch. 1 Input Adapter (013-0327-xx), Fiber cleaning kit (020-2494-xx), GPIB Programmer's Reference, Optional Applications Software CD-ROM, Oscilloscope Analysis and Connectivity Made Easy Kit, Performance verification procedure PDF file, NIST, MIL-STD-45662A, ISO9000 Calibration Certificate and Power Cord.

CSA7404B Also Includes: (4) TekConnect® to SMA adapters (TCA-SMA), Quick Reference (020-2519-xx), User Manual (071-1226-xx), Option SM and ST User Manual (071-1228-xx), TDS/CSA7000B Series Product Software CD-ROM, and TDS/CSA7000B Series operating system restoration CD-ROM.

CSA7154 Also Includes: (4) TekConnect to BNC adapters (TCA-BNC), (2) TekConnect high-impedance buffer amplifiers (TCA-1MEG), Quick Reference (020-2404-xx), User Manual (071-7010-xx), Option SM and ST User Manual (071-1035-xx), TDS/CSA7000 Series Product Software CD-ROM, and TDS/CSA7000 Series operating system restoration CD-ROM.

Please specify power plug and disk drive option when ordering B model.

Communications Signal Analyzers

► CSA7000/B Series

Instrument Options

Power Plug Options

- Opt. A0** – North America power.
- Opt. A1** – Universal EURO power.
- Opt. A2** – United Kingdom power.
- Opt. A3** – Australia power.
- Opt. A5** – Switzerland power.
- Opt. A6** – Japan power.
- Opt. A10** – China power.
- Opt. A99** – No power cord or AC adapter.

Mounting Options

- Opt. 1K** – K4000 Scope cart.
- Opt. 1R** – Rackmount kit.

Disk Drive Options (for CSA7404B only)

Opt. FHD – Front-panel 40 GB removable hard disk drive, replaces floppy disk drive that goes on the rear panel.

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.

Recommended Accessories

Probes and Converters

- P7260** – 6 GHz Low Capacitance Active Voltage Probe (TekConnect®).
 - P7350** – 5 GHz Differential Probe (TekConnect).
 - P7350SMA** – 5 GHz SMA Input differential Probe.
 - P6150** – 9 GHz Low Capacitance Passive Voltage Probe (requires TCA-SMA adapter).
 - P6158** – 3 GHz Low Capacitance Passive Voltage Probe (requires TCA-BNC adapter).
 - CT6** – 2 GHz AC Current Probe (requires TCA-BNC adapter).
 - CT1** – 1 GHz AC Current Probe (requires TCA-BNC adapter).
 - P6701B** – Optical-to-Electrical Converter; 500 nm to 950 nm (requires TCA-BNC adapter).
 - P6703B** – Optical-to-Electrical Converter; 1100 nm to 1650 nm (requires TCA-BNC adapter).
 - TCP202** – DC to 50 MHz Current Probe (requires TCA-BNC adapter).
 - P6245** – 1.5 GHz Active Probe.
 - P6248** – 1.7 GHz Differential Probe.
 - P7240** – 4 GHz Active Probe.
 - P7330** – 3.5 GHz Differential Probe.
- ### Adapters
- TCA75** – 4 GHz precision TekConnect 75 Ω to 50 Ω adapter with 75 Ω BNC input connector.
 - TCA-SMA** – TekConnect-to-SMA Adapter.
 - TCA-BNC** – TekConnect-to-BNC Adapter.
 - TCA-N** – TekConnect-to-N Adapter.
 - TCA-1 Meg** – 1 Meg amplifier, high impedance buffer 1 M Ω /10 pF, TekProbe BNC-to-TekConnect; includes P6139A.
 - AFTDS** – Telecom differential electrical interface adapter (for line rates <8 Mb/s; requires TCA-BNC adapter).
 - AMT75** – 1 GHz precision 75 Ω adapter (for line rates >8 Mb/s; requires TCA-BNC adapter).

Optical Connector Adapters

- FC/PC** – Order 119-5115-00.
- SC/PC** – Order 119-5116-00.
- ST/PC** – Order 119-4513-00.
- DIN/PC 47256** – Order 119-4546-00.
- Diamond 2.5** – Order 119-4556-00.
- Diamond 3.5** – Order 119-4558-00.
- SMA 2.5** – Order 119-4517-00.
- SMA** – Order 119-4557-00.

Cables

- GPIO Cable (1M)** – Order 012-0991-01.
- GPIO Cable (2M)** – Order 012-0991-00.
- Centronics Cable** – Order 012-1214-00.

Test Fixtures

TDSUSB – USB test fixture to be used in conjunction with Opt. USB.

Software

WSTRO – WaveStar™ waveform capture and documentation software.

Miscellaneous

- Keyboard** – Full size, USB interface; Order 119-6633-00.
- Service Manual** – Order 071-7011-xx for CSA7154, 071-1227-xx for CSA7404B.
- Transit Case** – Order 016-1522-00.

► Options (available on models indicated by “x”)

		CSA7154	CSA7404B
Acquisition Memory Options			
2M	8 Msamples max, 2 Msamples/ch	x	x
3M	16 Msamples max, 4 Msamples/ch	x	x
4M	32 Msamples max, 8 Msamples/ch	x	x
5M	64 Msamples max, 16 Msamples/ch		x
Software Options			
DVI	TDS DVI compliance test solution		x
DVD	TDS DVD Optical storage analysis	x	x
ET3	TDSET3 Ethernet compliance test software	x	x
JT3	TDSJIT3 Advanced jitter analysis software	x	x
J3E	TDSJIT3 Essentials	x	x
J2	TDSDDM2 Disk drive analysis software	x	x
CP2	TDSCPM2 ANSI/ITU Telecom pulse compliance testing software	x	x
USB* ¹	TDSUSBS USB2.0 Compliance test S/W only	x	x
PW3* ²	TDSPWR3 Power measurement and analysis software	x	x
RTE	Serial Data Compliance and Analysis Software	x	x
PCE* ³	PCI Express Compliance Module for Option RTE		
IBA* ³	InfiniBand Compliance Module for Option RTE		

*¹Requires Option TDSUSBF (USB Test Fixture).

²Option 3M and a TCA-1MEG TekConnect 1 MΩ buffer amplifier are recommended for use with this software.

*³Requires Option RTE.

To view instrument upgrades for the CSA7000/B Series, please go to www.tektronix.com/csa7000b_upgrades.

Communications Signal Analyzers

► CSA7000/B Series

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

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03/04 HB/WOW

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