



ABN 43 064 478 842

➤ 231 Osborne Avenue Clayton South, VIC 3169
 PO Box 1548, Clayton South, VIC 3169
 t 03 9265 7400 f 03 9558 0875
 freecall 1800 680 680
www.tmgtestequipment.com.au

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Complimentary Reference Material

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Product Lifecycle Management System

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Communications Signal Analyzer

► CSA7404B



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 CSA7404B 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.

The CSA7404B has 4 GHz true analog bandwidth, a 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% to 80%)

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

20 GS/s Maximum Real-time Sample Rate

MyScope® Custom Control Windows Enhance Productivity

Right Mouse Click Menus for Exceptional Efficiency

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 Microsoft 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

Communications Signal Analyzers

► CSA7404B

MyScope® Custom Control Windows

MyScope control windows allow you to build your own control windows with only the controls, features and capabilities that you care about and are important in your job. For the first time you can create your own personalized “toolbox” of oscilloscope features. No longer do you need to search through menus for features or re-learn how to drive the oscilloscope after a break from the lab. MyScope control windows are easily created in a matter of minutes using a simple, visual, drag-and-drop process. Once created, these customized windows are easily accessed through a dedicated MyScope button and menu selection on the oscilloscope button/menu bar, just like any other control window. You can make an unlimited number of custom control windows, enabling each person who uses the oscilloscope in a shared environ-

ment to have their own unique control window. Since the control windows are stored as files on the hard drive, they can easily be transferred to other TDS5000B, TDS6000B/C or TDS7000B Series oscilloscopes, or they can even be e-mailed to a co-worker around the world when the need arises. MyScope control windows will benefit all oscilloscope users, from eliminating the ramp-up time that many face when returning to the lab after not using an oscilloscope for a while, to the power user who can now operate far more efficiently. Everything you need is found in one control window rather than having to constantly navigate through menu after menu to repeat similar tasks.

Right Clicks

Right mouse click menus make simple things as they should be – simple. Right click menus are context sensitive, meaning the choices presented in the menu depend

on where you right clicked the mouse. This makes right click menus extremely intuitive. Want to change the cursor type? Right click on a cursor or the cursor readouts. Want to change the reference levels of an automatic measurement? Right click on the measurement. Want to change trigger parameters? Right click on the trigger readouts. Want to change a waveform's color? Right click on the waveform handle. Virtually all objects on the oscilloscope display have right click menus associated with them that include all the appropriate actions or features relative to those objects. There are also right click menus for regions of the display, in addition to just objects. For example, right clicking in the main graticule brings up a menu with choices such as Clear Data, Default Setup, Autoset, Screen Captures, Save All Waveforms and Add Screen Text, providing single click access to many of your most commonly performed tasks.

► Characteristics

► Vertical System

| | CSA7404B |
|--------------------------------------|--|
| Input Channels | 4 ¹ |
| Hardware Analog Bandwidth (-3 dB) | 4 GHz |
| Rise Time 10% to 90% (typical) | 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 ≥100 mV/div settings. Also determined by TekConnect® accessory |
| Offset Range | 2 mV to 50 mV/div ±0.5 V, 50.5 mV to 99.5 mV ±0.25 V, 100 mV to 500 mV ±5 V, 505 mV to 1 V/div ±2.5 V |
| DC Gain Accuracy 4 mV/div to 1 V/div | ±(2% + (2% x net offset/10)) net offset = voltage level at center screen (vertically) |

¹ At ≥10 mV/div.

► Optoelectronic System

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

| | CSA7404B |
|--|--|
| Optical Channel Unfiltered Bandwidth | 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 | ≥0.27 V/mW (0.35 V/mW typical) @ 780 nm ±20nm ≥0.33 V/mW (0.40 V/mW typical) @ 850 nm ±20nm ≥0.64 V/mW (0.75 V/mW typical) @ 1310 nm ±20nm ≥0.64 V/mW (0.75 V/mW typical) @ 1550 nm ±20nm |
| Sensitivity (smallest average power for mask test). Assumes Scale Factor is Set to Minimum μW/div Settings and Signal is at Least 4 Divisions _{p-p} | 40 μW _{p-p} at 1310 nm and 1550 nm. 20 μW (-17 dBm) average power assuming 50% average duty cycle 80 μW _{p-p} at 780 nm and 850 nm. 40 μW (-14 dBm) average power assuming 50% average duty cycle |
| RMS Noise | ≤1.1 μW + (6.5% of W/div setting) at 1310 nm and 1550 nm ≤2.1 μW + (6.5% of W/div setting) at 850 nm ≤2.6 μW + (6.5% of W/div setting) at 780 nm |
| Input range | 10 μW/div to 500 uW/div Optical reference receiver typically available over the following range: 40 μW (-14 dBm) to 400 μW (-4 dBm) at wavelength <1200 nm; 25 μW (-16 dBm) to 250 μW (-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 μW average input (340 μW peak) at 850 nm <120 μW average input (240 μW peak) at 1310 and 1550 nm |
| Fiber Input | 62.5 μm core multimode fiber |
| Input Return Loss (typical) | With 50 μm or 62.5 μm core multimode fiber (CPC6) attached: >14 dB for 780 nm ±20 nm >14 dB for 850 nm ±20 nm With 9 μm core single mode fiber (SMF-28) attached: >28 dB for 1310 nm ±20 nm >28 dB for 1550 nm ±20 nm |

Communications Signal Analyzers

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► Optical Reference Receiver System

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

| | 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-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) FC2125 (2127 Mb/s) |
| IEEE 1394b | 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

CSA7404B

| | |
|--|--|
| Clock Recovery Phase Locked Loop Bandwidth | Fbaud/1600 typical |
| Tracking/Acquisition Range | ±2% of requested baud |
| Clock Recovery Jitter (typical) | <0.25% bit period +5 ps _{RMS} for PRBS data pattern or 4 ps _{RMS} for repeating "011" data patterns |
| Input Sensitivity for Clock Recovery | 1 division peak-to-peak displayed signal |
| Input Data Rates | 1.5 Mbaud to 3.125 Gbaud |

► Communications Mask Testing

CSA7404B

| | |
|--|--|
| SONET/SDH GR 253-CORE (Issue 39/21/2000) | 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 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, 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 S1600 Optical S1600b T1, S1600b T2 |
| Serial ATA (Rev 1.0 June 2002) | G1 Rx (5 Cycle), G1 Tx (5 Cycle) |
| Rapid IO LP_LVDS Rev 0.3 (draft) May 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, 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 IO 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 Clk (2.4888 Gb/s) SFI-5, SPI-5 TC Clk (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 Clk (2.4888 Gb/s) SFI-5, SPI-5_5 RD Clk (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) |

Communications Signal Analyzers

► CSA7404B

► Timebase System

| | CSA7404B |
|---|--|
| Timebase Range | 50 ps to 10 s/div |
| Timebase Delay Time Range | 5 ns to 250 s |
| Channel-to-Channel Deskew Range | ±75 ns in 1 ps steps |
| Time Interval Accuracy, Single-shot Sample Mode | (0.06/sample rate + 2.5 ppm x reading) RMS |
| Trigger Jitter | 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 | $V_{in} \geq 200 \text{ mV}_{pk-pk}$ |
| External Reference Maximum Input Signal | $7 V_{pk-pk}$ |
| 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 | $V_{out} (Hi) \geq 2.5 \text{ V}$ open circuit; $\geq 1.0 \text{ V}$ into 50Ω load to gnd $V_{out} (Lo) \leq 0.7 \text{ V}$ into a load of $\leq 4 \text{ mA}$; $\leq 0.25 \text{ V}$ into 50Ω load to gnd |

► Acquisition System

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

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

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

► Acquisition Modes

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 2x10 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 wfms/sec. Time of arrival recorded with each event |

► Trigger System

CSA7404B

| | |
|-----------------------------------|--|
| Sensitivity | |
| Internal DC Coupled, Main Trigger | 0.5 div from DC to 50 MHz, ≤1.5 div at 3 GHz |
| External (Auxiliary Input) | 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) | ±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 |

Communications Signal Analyzers

► CSA7404B

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.

Width –

Trigger on width of positive or negative pulse (down to 225 ps) either within or out of selectable time limits: 340 ps 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 340 ps to 1 s with 100 ps 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.

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.

Trigger Delay by Time –

Trigger Delay by Time 5 ns 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-to-peak, RMS and 6σ), Noise (peak-to-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))) $\times 1.414$.

Arithmetic –

Add, subtract, multiply, divide waveforms and scalars.

Relational –

Boolean result of comparison $>$, $<$, \geq , $=$, \neq .

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, Flattop2, Tek Exponential.

Waveform Definitions –

Waveform definition as arbitrary math expressions.

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 –

1024 horizontal x 768 vertical pixels.

Waveform Styles –

Vectors, Dots, Variable Persistence, Infinite Persistence.

Computer System and Peripherals

CPU – Intel Pentium 4 processor, 2.8 GHz²

PC System Memory – 1 GB².

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 rear-panel (Option FHD).

CD-RW Drive –

Rear-panel CD-RW drive.

Mouse – Thumb wheel model included, USB interface.

Keyboard –

Mini-keyboard included (fits in pouch); PS-2 interface. Order 119-6633-00 for full-size keyboard; USB interface and hub.

² Available September 2004.

Input/Output Ports

Probe Compensation Output –

Front panel BNC connector, requires Probe Cal-Deskew Fixture (included) for probe attachment. 1 V ±20% into >10 kΩ load. 500 mV ±20% into a 50 Ω load.

Recovered Clock Out –

Front-panel SMA connector provides output of clock signal recovered from specified channel. Output compatible with ECL terminated with 50 Ω to GND. Peak-to-peak output swing at 650 MHz is at least 200 mV into 50 Ω. 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 Ω.

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 Ω load. Amplitude: 20 mV/div ±20% into a 1 MΩ load, 10 mV/div ±20% into a 50 Ω 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. Two 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}, ±10%, 50/60 Hz CAT II.
115 V_{RMS} ±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-RW drives.

+10 °C to +45 °C, including floppy disk and CD-RW 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, 20% 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 89/336 EEC).

AS/NZS 2064 (Australian EMC Framework).

Safety –

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

Communications Signal Analyzers

► CSA7404B

► Ordering Information

CSA7404B

4 GHz Communications Signal Analyzer

Includes: 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.

Please specify power plug and disk drive option when ordering.

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 Oscilloscope cart.
- Opt. 1R** – Rackmount kit.

Disk Drive Options

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 Mb** – 1 Mb 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

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

Test Fixtures

- TDSUSBF** – 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 071-1227-xx.
- Transit Case** – Order 016-1522-00.

► Options (available on models indicated by "x")

CSA7404B

Acquisition Memory Options

| | | |
|----|---------------------------------|---|
| 2M | 8 Msamples max, 2 Msamples/ch | x |
| 3M | 16 Msamples max, 4 Msamples/ch | x |
| 4M | 32 Msamples max, 8 Msamples/ch | 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 |
| ET3 | TDS ET3 Ethernet compliance test software | x |
| JA3 | TDS J3 Advanced jitter analysis software | x |
| J3E | TDS J3 Essentials | x |
| J2 | TDS J2 Disk drive analysis software | x |
| CP2 | TDS CP2 ANSI/ITU Telecom pulse compliance testing software | x |
| USB ¹ | TDS USB2.0 Compliance test S/W only | x |
| PW3 | TDS PW3 Power measurement and analysis software | x |
| RTE | Serial Data Compliance and Analysis Software | x |
| PCE ² | PCI Express Compliance Module for Option RTE | x |
| IBA ² | InfiniBand Compliance Module for Option RTE | x |

¹ Requires Option TDSUSB (USB Test Fixture).

² Requires Option RTE.

To view instrument upgrades, please go to www.tektronix.com/csa7000b_upgrades.

Communications Signal Analyzers

► CSA7404B

Contact Tektronix:

ASEAN / Australasia / Pakistan (65) 6356 3900

Austria +41 52 675 3777

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

Belgium 07 81 60166

Brazil & South America 55 (11) 3741-8360

Canada 1 (800) 661-5625

Central East Europe, Ukraine and the Baltics +41 52 675 3777

Central Europe & Greece +41 52 675 3777

Denmark +45 80 88 1401

Finland +41 52 675 3777

France & North Africa +33 (0) 1 69 86 81 81

Germany +49 (221) 94 77 400

Hong Kong (852) 2585-6688

India (91) 80-22275577

Italy +39 (02) 25086 1

Japan 81 (3) 6714-3010

Luxembourg +44 (0) 1344 392400

Mexico, Central America & Caribbean 52 (55) 56666-333

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

The Netherlands 090 02 021797

Norway 800 16098

People's Republic of China 86 (10) 6235 1230

Poland +41 52 675 3777

Portugal 80 08 12370

Republic of Korea 82 (2) 528-5299

Russia & CIS 7 095 775 1064

South Africa +27 11 254 8360

Spain (+34) 901 988 054

Sweden 020 08 80371

Switzerland +41 52 675 3777

Taiwan 886 (2) 2722-9622

United Kingdom & Eire +44 (0) 1344 392400

USA 1 (800) 426-2200

For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

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www.tektronix.com

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