

# Architecture & Specifications

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## INSTRUMENT ARCHITECTURE OVERVIEW

### Processors

The Jitter and Timing Analyzer's central processing unit (CPU), a PowerPC™ microprocessor, performs the oscilloscope's computations, and controls its operation. A range of peripheral interfaces allow you to control remotely, store waveforms and other data, and make hard copies. A support processor constantly monitors the front panel controls. The Jitter and Timing Analyzer transfers data to display memory for direct waveform display, or stores it in reference memories for fast data processing.

### ADCs

The instrument's ADC architecture is designed to give excellent amplitude and phase correlation, maximum analog-to-digital conversion performance, large record lengths, and superior time resolution.

### Memories

Jitter and Timing Analyzer acquisition memories simplify signal acquisition by producing waveform records that allow detailed analysis over large time intervals. There are four memories for temporary storage, and four more for waveform zooming and processing.

### RIS

The Jitter and Timing Analyzer captures and stores repetitive signals at a maximum Random Interleaved Sampling (RIS) rate of 50 GS/s. This advanced digitizing technique enables measurement of repetitive signals with an effective sampling interval of 20 ps, and a resolution of up to 5 ps.

### Trigger System

You can control Jitter and Timing Analyzer triggering to a highly specialized degree in accordance with waveform characteristics and chosen trigger conditions. The trigger source can be any of the input channels, line (synchronized to scope's main input supply) or external. The coupling is selected from AC, LF REJect, HF REJect, HF, and DC; the slope from positive and negative. The Jitter and Timing Analyzer SMART Trigger offers a wide range of sophisticated trigger modes matched to special trigger conditions and sets of conditions.

### Automatic Calibration

The Jitter and Timing Analyzer's automatic calibration ensures the overall vertical accuracy. Vertical gain and offset calibration, and horizontal (time) resolution take place each time you change the volts per division setting. Periodic and temperature dependent auto-calibration ensures long-term stability at the current setting.

### Display System

You control the display's interactive, user-friendly interface using push buttons and knobs. Display as many as eight different waveforms at once on eight separate grids. The parameters controlling signal capture are simultaneously reported. The Jitter and Timing Analyzer displays internal status and measurement results, as

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well as operational, measurement, and waveform analysis menus.

The 10.4-inch color flat panel TFT LCD screen displays waveforms and data by means of advanced color management. Overlap mixing and contrast enhancement functions ensure that overlapping waveforms remain distinct at all times. Preset and personal color schemes are available.

The Analog Persistence function offers display attributes of an analog instrument with all the advantages of digital technology. The Full Screen function expands waveform grids to fill the entire screen.

A hard copy of the screen can be easily produced by pressing the front panel PRINT SCREEN button.

### Interface and Panel Setups

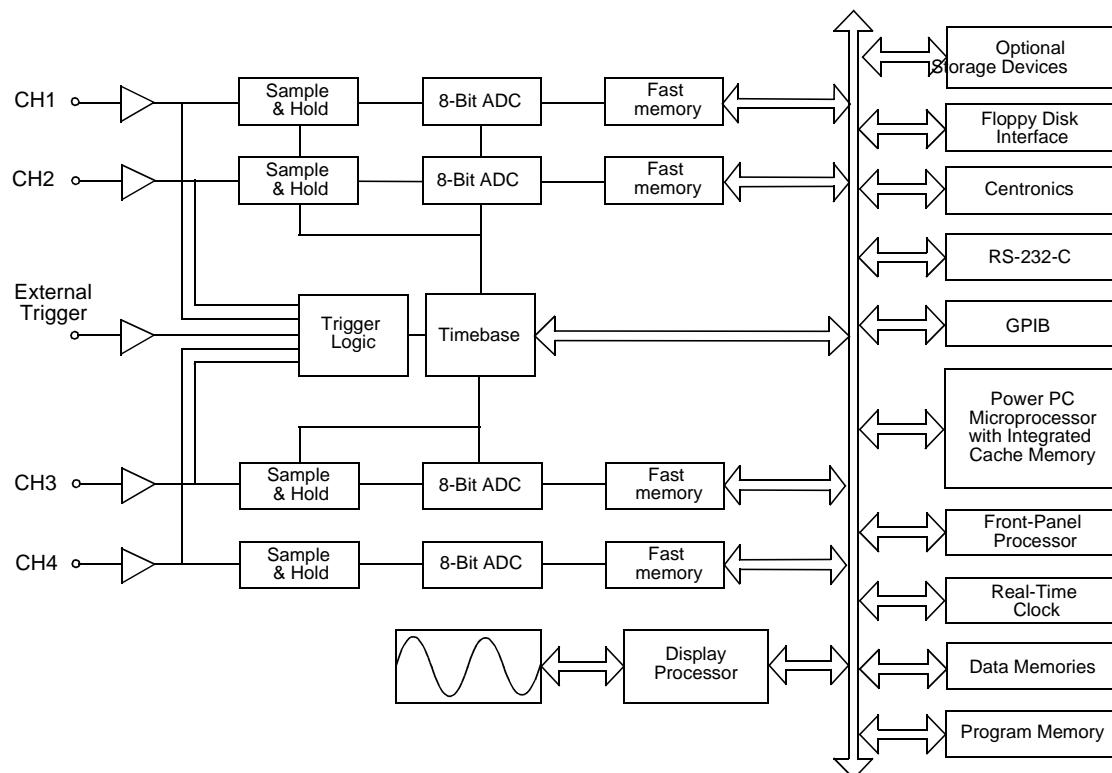
Although the Jitter and Timing Analyzer is a truly digital instrument, the front panel layout and controls are similar to those of an analog oscilloscope. Rapid response and instant representation of waveforms on the high resolution screen add to this similarity. Four front panel setups can be stored internally, and recalled directly or by remote control, thus ensuring rapid front panel configuration. When power is switched off, the front panel settings are automatically stored for recall when the scope is next powered on.

### Remote Control

The Jitter and Timing Analyzer has also been designed for remote control operation in automated testing and computer aided measurement applications. You control the entire measurement process — cursor and pulse-parameter settings, dynamic modification of front panel settings, and display organization — through the rear panel industry standard GPIB (IEEE-488), standard RS-232-C, and optional LAN (Ethernet) ports. See Chapter 12, “Use the WavePro DSO with a PC,” in this manual; see also the *Remote Control Manual*.

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### Hi Z, 50 Ohm Amplifiers + Attenuators



*Jitter and Timing Analyzer Models*

# Jitter and Timing Analyzer

## SPECIFICATIONS

### Models

Jitter and Timing Analyzer J-260/J-250: Four channels

**NOTE: Specifications are subject to change without notice.**



### Vertical System

**Bandwidth** (–3dB): **J-260:** 2 GHz\* @ 50  $\Omega$ ; **J-250:** 1 GHz @ 50  $\Omega$

**Bandwidth Limiter:** 20 MHz or 200 MHz.

**Input Impedance:** 50  $\Omega$   $\pm$ 1.5%; 10 M $\Omega$  // 11 pF typical (using PP005 probe)

**Input Coupling:** 1 M $\Omega$ : AC, DC, GND; 50  $\Omega$ : DC, GND



**Max Input:** 50  $\Omega$ : 5 V rms; 1 M $\Omega$ : 100 V max (peak AC  $\leq$  5 kHz + DC)

**Vertical Resolution:** 8 bits; up to 11 bits with enhanced resolution (ERES)

**Sensitivity:** 50  $\Omega$ : 1 mV to 1 V/div fully variable; 1 M $\Omega$ : 1 mV to 2 V/div fully variable

**DC Accuracy:**  $\pm$ 2.0% of full scale +1.5% offset value @ gain > 10 mV

**Offset Accuracy:**  $\pm$ (1.5% + 0.5% of full scale + 1 mV)

**Offset Range:** 50  $\Omega$  or 1 M $\Omega$ : 1 mV to 4.99 mV/div:  $\pm$ 400 mV

50  $\Omega$ : 5 mV to 99 mV/div:  $\pm$ 1 V; 0.1 V to 1 V/div:  $\pm$ 10V

1 M $\Omega$ : 5 mV to 100 mV/div:  $\pm$ 1 V; 101 mV to 2 V/div:  $\pm$ 20 V

**Isolation – channel to channel:** > 250:1 at same V/div settings

### Timebase System

**Timebases:** Main and up to four zoom traces simultaneously

**Time/Div Range:** 200 ps/div to 1000 s/div

**Clock Accuracy:**  $\leq$  3 ppm

**Interpolator Resolution:** 5 ps

**External Clock Frequency:** 500 MHz max., 50  $\Omega$ , or 1 M $\Omega$  impedance

**Roll Mode – Operating Range:** time/div 500 ms to 1000 s/div or sample rate < 100 kS/s max.

**External Reference (Optional):** 10 MHz timebase reference clock available with input on rear panel

\* at sample speeds > 4 GS/s and @ 10 mV or greater volts/division settings

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**External Timebase Clock:** 500 MHz maximum external sample clock input on front panel EXT BNC

### Acquisition System

	Single Shot Sample Rate	
	J-260	J-250
1 Channel Max.	16 GS/s	16 GS/s
2 Channels Max.	8 GS/s	8 GS/s
3–4 Channels Max.	4 GS/s	4 GS/s

	Max. Acquisition Points/ Channel 1 Ch / 2 Ch / 3–4 Ch	
	J-260	J-250
L Memory Option	16M/8M/4M	16M/8M/4M
VL Memory Option	32M/16M/8M	32M/16M/8M

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	Acquisition Modes	
	J-260	J-250
Random Interleaved Sampling (RIS)	50 GS/s for repetitive signals: 200 ps/div to 1 $\mu$ s/div	
Single Shot	For transient and repetitive signals: 200 ps/div to 1000 s/div	
Sequence	2 to 4000 segments	
Max. Segments/Memory	4000/8M 1000/1M 250/250K	
Intersegment Time	Typically 30 $\mu$ s	

**Acquisition Processing:** Averaging: summed averaging to  $10^3$  sweeps (standard)  
continuous averaging up to  $10^6$  sweeps; continuous averaging with weighting  
ranges from 1:1 to 1:1023

**Enhanced Resolution (ERES):** from 8.5 to 11 bits vertical resolution

**Envelope (Extrema):** Envelope, floor, roof for up to  $10^6$  sweeps

### Triggering System

**Modes:** NORMAL, AUTO, SINGLE and STOP

**Sources:** Any input channel, External, EXT/5, or line; slope, level, and coupling unique to each except line

**Slope:** Positive, Negative, Window

**Coupling Modes:** DC, AC, HF, HFREJ, LFREJ

**AC Cutoff Frequency:** 7.5 Hz typical

**HFREJ, LFREJ:** 50 kHz typical

**Pre-trigger Recording:** 0 to 100% of horizontal time scale

**Post-trigger Delay:** 0 to 10000 divisions

**Holdoff by Time or Events:** Up to 20 s or from 1 to 99999999 events

**Internal Trigger Range:**  $\pm 5$  div

**Maximum Trigger Frequency:** Triggers up to maximum bandwidth (HF), 1 GHz (AC, DC)



**External Trigger Input Range:**  $\pm 0.5$  V ( $\pm 2.5$  V with Ext/5 selected)

**Max. External Input @ 50  $\Omega$ :**  $\pm 5$  V DC or 5 V rms

**Max. External Input @ 1 M $\Omega$ :** 100 V max. (DC + peak AC < 5 kHz)

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### SMART Triggers (all models)

**Edge/Slope/Window/Line:** Triggers when the signal meets the slope and level condition. Window Trigger allows you to define a window region whose boundaries extend above and below the selected trigger level. A trigger event occurs when the signal leaves this window region in either direction and passes into the upper or lower region. The next trigger will occur if the signal again passes into the window region. For a trigger to occur, the time that the signal spends within the window must be at least 0.5 ns.

**State or Edge qualified:** Triggers on any input source only if a defined state or edge occurred on another input source. Delay between sources is selectable by time or events.

**Dropout:** Triggers if the input signal drops out for longer than a selected time-out between 2 ns and 20 s.

**Pattern:** Logic combination of 5 inputs (4 channels and external trigger input); Each source can be high, low, or don't care. Trigger at the start or end of the pattern.

### SMART Triggers with Exclusion Technology

**Signal or Pattern Width:** Triggers on glitches or on pulse widths selectable from 600 ps to 20 s or on intermittent faults.

**Signal or Pattern Interval:** Triggers on intervals selectable between 2 ns and 20 s.

**Slew Rate:** Triggers on edge rates; select limits for dV, dt, and slope.

**Run:** Positive or negative runs are defined by two voltage limits and two time limits selectable between 600 ps and 20 ns.

### AutoSetup

Automatically sets timebase, trigger, and sensitivity to display a wide range of repetitive signals.

**Vertical Find:** Automatically sets the vertical sensitivity and offset for the selected channels to display a waveform with maximum dynamic range.

### Probes

**Model PP005:** 10:1, 10 M $\Omega$  with auto-detect; one probe per channel

**ProBus Probe System:** Automatically detects and supports a wide variety of differential amplifiers; active, high-voltage, current, and differential probes

**Scale Factors:** Up to 12 automatically or manually selected

### Color Waveform Display

**Type:** Color 10.4-inch flat panel TFT LCD

**Resolution:** 640 x 480 resolution

**Screen Saver:** Display blanks after 10 minutes when this feature is enabled

**Real Time Clock:** Date, hours, minutes, and seconds displayed with waveform

**Number of Traces:** Maximum of eight traces; simultaneously displays channel, zoom, memory, and math traces

**Grid Styles:** Single, Dual, Quad, Octal, XY, Single+XY, Dual+XY; Full Screen gives enlarged view of each

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style

**Intensity Controls:** Separate intensity control for grids and waveforms

**Waveform Display Styles:** Sample dots joined or dots only — regular or bold sample point highlighting

**Trace Overlap Display:** Select opaque or transparent mode with automatic waveform overlap management

### Analog Persistence Display

**Analog Persistence and Color Graded Persistence:** Variable saturation levels; stores each trace's persistence data in memory

**Trace Selection:** Activate Analog Persistence on a selected trace, the top 2 traces, or all traces

**Persistence Aging Time:** From 500 ms to infinity

**Trace Display:** Opaque or transparent overlap

**Sweeps displayed:** All accumulated or all accumulated with last trace highlighted

### Zoom Expansion Traces

**Display up to four zoom traces**

**Vertical Zoom:** Up to 5x expansion, 50x with averaging

**Horizontal Zoom:** Expand to 2 pts/div, magnify to 50 000x

**Auto Scroll:** Automatically scans and displays any zoom or math trace

### Rapid Signal Processing

**Processor:** PowerPC

**Processing Memory:**  $\geq$  256 Mbytes

**Real-time Clock:** dates, hours, minutes, seconds, and time stamp trigger time to 1 ns resolution

**Pass/Fail:** Test any five parameters against selectable thresholds. Limit testing is performed using masks created on the scope or on a PC. Set up a pass or fail condition to initiate actions such as hard copy output, save waveform to memory, GPIB SRQ, or pulse out.

### Internal Waveform Memory

**Waveform:** M1, M2, M3, M4 (Store full-length waveforms with 16 bits/data point.)

**Zoom and Math:** A, B, C, D with chained trace capability

### Setup Storage

**Front Panel and Instrument Status:** Four non-volatile memories and floppy drive are standard; hard drive and memory card are optional

**CustomDSO:** Customize and access scope settings with up to 6 CustomDSO files stored in internal non-volatile virtual disk (VDisk)



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### Interface

**Remote Control:** Full control of all front panel controls and internal functions through GPIB, Ethernet, or RS-232-C

**RS-232-C:** Asynchronous transfer rate of up to 115.2 kbaud\*

**GPIB Port:** full control through IEEE-488.2; configurable as talker/listener for computer control and data transfer \*

**Ethernet (optional):** 10BaseT Ethernet interface \*

**Floppy Drive:** Internal, DOS format, 3.5 inch, high density

**PC Card Slot:** Supports memory and hard drive cards

**External Monitor Port:** 15-pin D-Type VGA compatible\*

**Centronics Port:** Parallel printer interface\*

**Internal graphics printer (optional):** provides hardcopy output in < 10 s. The part number is GPR10 for ten rolls.

**Pass/Fail and Trigger Output:** Front panel Cal BNC output provides choice of Cal Signal, Pass/Fail Condition, Trigger Ready, or Trigger Out signals

### Outputs

**Calibrator Signal:** 500 Hz to 2 MHz square wave or 25 ns pulse; 0.05 to +1.0 V into 1 M $\Omega$  output from front panel BNC connector

**Control Signals:** Trigger Ready, Trigger Out, or Pass/Fail status

### Math Tools

Simultaneously perform up to four math processing functions; traces can be chained together to perform math on math. Standard functions: add, subtract, multiply, divide, negate, identity, summation, summed averaging to one million sweeps, continuous averaging, ERES low-pass digital filters for 11-bit vertical resolution, FFT of 25 Mpoint waveforms, Extrema for displaying envelope roof and floor, physical units, rescale (with units), sin x/x, resample (deskew), integration, derivative, log and exponential functions, (base e and base 10), square, square root, absolute value, histograms of up to two billion events, FFT averaging, reciprocal (invert), digital filtering (low pass, high pass, band pass, band stop, raised cosine, raised root cosine, Gaussian, custom; plus data log when using the trend function.

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\* To conform to CE requirements (EMC Directive 89/336/EEC), use properly shielded cables.

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## Measure Tools

### Cursor Measurements:

- **Relative Time:** Two arrow cursors measure time and voltage differences relative to each other with a resolution of  $\pm 0.05\%$  full scale.
- **Relative Amplitude (Voltage):** Two horizontal bars measure voltage differences at  $\pm 0.2\%$  fs resolution.
- **Absolute Time:** Cross-hair marker measures time relative to trigger and voltage with respect to ground.
- **Absolute Amplitude (Voltage):** A horizontal reference line cursor measures voltage with respect to ground.

**Automated Measurements:** Display any five parameters together with their average, high, low and standard deviations.

**Pass/Fail:** Test any five parameters against selectable thresholds. Limit testing is performed using masks created on the scope or on a PC. Setup a pass or fail condition to initiate actions such as hardcopy output, save waveform to memory, GPIB SRQ, or pulse out.

### Jitter Measurements

**Jitter Noise Floor:** 2 ps rms @ 50 MHz

**Jitter Accuracy:** 1 ps rms with 3 sigma confidence level

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### General

**Auto Calibration:** Ensures specified DC and timing accuracy is maintained for 1 year minimum

**Auto Calibration Time:** < 500 ms

**Power Requirements:** Max. power consumption: < 350 VA

Voltage	Frequency
90 to 132 V AC	45 to 440 HZ
180 to 250 V AC	45 to 66 Hz

**Battery Backup:** Front panel settings retained for two years minimum

**Dimensions (HWD):** 264 mm x 397 mm x 453 mm (10.4 in. x 15.6 in. x 17.8 in.); height measurement excludes foot pads

**Weight:** 14 kg (31 lbs) with internal printer

**Shipping Weight:** 22.2 kg (49 lbs)

**Warranty and Calibration:** Three years; calibration recommended yearly

### Environmental and Safety

#### Operating Conditions:

**Temperature:** 5 to 45 °C

**Humidity:** 75% max. RH (non-condensing) up to 35 °C  
Derates to 50% max. RH at 45 °C

**Altitude:** 3000 m max. up to 25 °C  
Derates to 2000 m max. at 45 °C

## Jitter and Timing Analyzer

**Certifications:** CE, UL and cUL

**CE Declaration of Conformity:** The oscilloscope meets requirements of the EMC Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for Product Safety.

EMC Directive:	EN 61326-1:1997 +A1:1998	
	EMC requirements for electrical equipment for measurement, control, and laboratory use.	
Electromagnetic Emissions:	EN55022:1998, Class A	Radiated and conducted emissions
	EN 61000-3-2:1995+A1:1998+A2:1998	Harmonic Current Emissions
	EN 61000-3-3:1995	Voltage Fluctuations and Flickers

**Warning: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take appropriate measures.**

Electromagnetic Immunity:	EN 61000-4-2:1995 +A1:1998*	Electrostatic Discharge
	EN 61000-4-3:1996 +A1:1998*	RF Radiated Electromagnetic Field
	EN 61000-4-4:1995*	Electrical Fast Transient/Burst
	EN 61000-4-5:1995*	Surges
	EN 61000-4-6:1996*	RF Conducted Electromagnetic Field
	EN 61000-4-11:1994†	Mains Dips and Interruptions

\* Meets Performance Criteria "B" limits – during the disturbance, product undergoes a temporary degradation or loss of function of performance which is self recoverable.

† Meets Performance Criteria "C" limits – during the disturbance, product undergoes a temporary degradation or loss of function of performance which requires operator intervention or system reset.

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**Low Voltage Directive:**

EN 61010-1:1993 +A2:1995

Safety requirements for electrical equipment for measurement, control, and laboratory use.

The oscilloscope has been qualified to the following EN 61010-1 category:

300 V Installation (Overvoltage) Category II

Pollution Degree 2

Protection Class I

**UL and cUL Certifications:**

UL Standard: UL 3111-1

Canadian Standard: CSA-C22.2 No. 1010.1-92

**Supported Printers:**

B/W: LaserJet, DeskJet, Epson

Color: DeskJet 550C, Epson Stylus, Canon 200/600/800 series

An optional internal, high-speed graphics printer is also available for screen dumps; stripchart output formats capable of up to 200 cm/div

Hard

Copy

Formats: TIFF b/w, TIFF color, BMP color, and BMP compressed

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