Performance Characteristics

Vertical : Analog Channels	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Input Channels	54830B/54833A: 2 analog 54830D/54833D: 2 analog + 16 digital 54831B/54832B: 4 analog 54831D/54832D: 4 analog + 16 digital
Analog Bandwidth @50 Ω (-3 dB)*[1]	54830B/D, 54831B/D: 600 MHz 54832B/D, 54833A/D: 1 GHz
Calculated Rise Time[2] @50 Ω	54830D/B, 54831B/D: 583 ps 54832B/D, 54833A/D: 350 ps
Input Impedance*	1 MΩ ± 1% (13 pF typical), 50 Ω ± 1.5%
Sensitivity[3]	1 mV/div to 5 V/div (1 MΩ) 1 mV/div to 1 V/div (50 Ω)
Input Coupling	1 MΩ: AC, DC; 50 Ω:DC
Hardware Bandwidth Limit	20 MHz
Vertical Resolution[4]	8 bits, ≥12 bits with averaging
Channel-to-Channel Isolation (any two channels with equal V/div settings)	DC to 50 MHz: 50 dB >50 MHz to 500 MHz: 40 dB >500 MHz to 1 GHz: 30 dB
DC Gain Accuracy*[3, 5]	± 1.25% of full scale at full resolution channel scale
Maximum Input Voltage*	
1 MΩ	150 V RMS or DC, CAT I ± 250 V (DC + AC) in AC coupling
50 Ω	5 Vrms, CAT I
Offset Range	Vertical Sensitivity / Available Offset
1 MΩ	1 mV to <10 mV/div: ± 2 V 10 mV to <20 mV/div: ± 5 V 20 mV to <100 mV/div: ± 10 V 100 mV to <1 V/div: ± 20 V 1 V to 5 V/div: ± 100 V
50 Ω	1 mV to <5 mV/div: ± 2 V 5 mV to <200 mV/div: ± 5 V 200 mV to 1 V/div: ± 20 V
Offset Accuracy*[3]	± (1.25% of channel offset+2% of full scale+1 mV)
Dynamic Range	± 8 div from center screen (1 MΩ) ± 12 div from center screen (50 Ω)
DC Voltage Measurement Accuracy*[3, 5]	
Dual Cursor	± [(DC gain accuracy)+(resolution)]
Single Cursor	± [(DC gain accuracy)+(offset accuracy)+(resolution/2)] Example for single cursor accuracy for 70 mV signal, 10 mV/div, 0 offset: Accuracy = ± [1.25% (80 mV) + (1.25% (0) + 2% (80 mV) + 1 mV) + (0.4%/2) (80 mV)] = ±3.8 mV

Performance Characteristics continued

Vertical: Digital Channels	(54830D/31D/32D/33D only)
Number of Channels	16 Digital – labeled D15 – D0
Threshold Groupings	Pod 1: D7 – D0 Pod 2: D15 – D8
Threshold Selections	TTL, 5.0V CMOS, 3.3V CMOS, 2.5V CMOS, ECL, PECL, User Defined
User-Defined Threshold Range	±8.00 V in 10 mV increments
Maximum Input Voltage	±40 V peak CAT I
Threshold Accuracy*	±(100 mV + 3% of threshold setting)
Input Dynamic Range	±10 V about threshold
Minimum Input Voltage Swing	500 mV peak-to-peak
Input Impedance	100 kΩ ± 2% (~ 8 pF) at probe tip
Channel-to-Channel Skew	2 ns typical, 3 ns maximum
Glitch Detect	≥ 2.5 ns
Resolution	1 bit

Horizontal	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D	
Main Time Base Range	54830B/D, 54831B/D 500 ps/div to 20 s/div	54832B/D, 54833A/D 200 ps/div to 20 s/div
Horizontal Position Range	0 to ± 200 s	
Delayed Sweep Range	1 ps/div to current main time base setting	
Resolution	4 ps	
Timebase Accuracy	15 ppm (±0.0015%)	
Delta-Time Measurement Accuracy ≥ 256 Averages, RMS ≥ 256 Averages, Peak Average Disabled, RMS Average Disabled, Peak	54830B/D, 54831B/D 500 fs rms ±[(2.2 ps) + (15x10^{-6} x |reading|)] peak 10 ps rms ±[(35 ps) + (15x10^{-6} x |reading|)] peak	54832B/D, 54833A/D 400 fs rms ±[(2.0 ps) + (15x10^{-6} x |reading|)] peak 7 ps rms ±[(25 ps) + (15x10^{-6} x |reading|)] peak
Channel-to-Channel Deskew Range	–100 µs to 100 µs	
Modes	Main, Delayed, Roll	
Reference Positions	Left, Center, Right	
Jitter Measurement Floor Time Interval Error Period Jitter N-Cycle, Cycle-Cycle Jitter	54830B/D, 54831B/D 7 ps rms 10 ps rms 15 ps rms	54832B/D, 54833A/D 5 ps rms 7 ps rms 11 ps rms

Performance Characteristics continued

Acquisition: Analog Channels	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Real Time Sample Rate (Max)	
2 Channels Interleaved	4 GSa/s
Each Channel	2 GSa/s
Equivalent Time Sample Rate (Max)	250 GSa/s
Memory Depth	Interleaved[10]/each channel
Standard	4 M / 2 M (1 M / 500 K for 54833A)
Option 040	8 M / 4 M
Option 080	16 M / 8 M
Option 160	32 M / 16 M
Option 320	64 M / 32 M
Option 640	128 M / 64 M
Sampling Modes	
Real Time	
Normal	Successive single-shot acquisitions
Peak Detect	Captures and displays narrow pulses or glitches at all real time sample rates
Hi Resolution	Real-time boxcar averaging reduces random noise and increases resolution
Equivalent Time	Random repetitive sampling (higher time resolution at faster sweep speeds)
Segmented Memory[11]	Captures bursting signals at maximum sample rate without consuming memory during periods of inactivity. Selectable number of segments up to 32,768 depending on memory option installed. Minimum inter-segment time (or the time between the end of the previous acquisition and the beginning of the next acquisition) of 20 µs.
Averaging	Selectable from 2 to 4096
Filters	
Sin[x])/x Interpolation	Filter On/Off selectable FIR digital filter. Digital signal processing adds points between acquired data points to enhance measurement accuracy and waveform display quality. BW= Sample Rate/4

Acquisition: Digital Channels	(54830D/31D/32D/33D only)
Maximum Real Time Sample Rate	1 GSa/s
Memory Depth per Channel	32 M
Minimum Width Glitch Detection	2.5 ns

Performance Characteristics continued

Trigger	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Sensitivity	
Internal[8]	DC to 600 MHz: 0.6 div 600 MHz to 1 GHz: 1.5 div (50 Ω)
External	DC to 100 MHz: 0.05 x (signal range) 100 MHz to 600 MHz: 0.10 x (signal range) (54830B/D, 54833A/D) 600 MHz to 1 GHz: 0.18 x (signal range) (54833A/D)
Auxiliary	DC to 600 MHz: 300 mVp-p (54831B/31D/32B/32D/33A/33D)
Level Range	
Internal	± 8 div from center screen (1 MΩ) ± 8 div from center screen (50 Ω)
External	± 1 V, ± 5 V, ± 25 V (1 MΩ) ± 1 V, ± 5 V, ± 8 V (50 Ω) (54830B/D, 54833A/D)
Auxiliary	± 5 V (54831B/32B/31D/32D/33A/33D)
Sweep Modes	Auto, triggered, single
Trigger Coupling	DC, AC, low frequency reject (50 kHz high pass filter), high frequency reject (50 kHz low pass filter)
Trigger Conditioning	Noise reject adds hysteresis to trigger circuitry decreasing sensitivity to noise
Trigger Holdoff Range	80 ns to 320 ms (54830A/B Series) 50 ns to 10 s (54830D Series)
Trigger Jitter	8 ps ± 0.05 ppm x |delay setting| rms
Trigger Actions	Specify an action to occur, and the frequency of the action, when a trigger condition occurs. Actions include: e-mail on trigger and QuickMeas+
Trigger Modes	
Edge	Triggers on a specified slope and voltage level on any channel, auxiliary trigger (4 channel models), external trigger (2 channel models) or line input.
Glitch	Triggers on glitches narrower than the other pulses in your waveform by specifying a width less than your narrowest pulse and a polarity. Minimum glitch width is 500 ps (analog channels) or 2.5 ns (digital channels on 54830D/31D/32D/33D). Glitch range settings: <1.5 ns to <160 ms (54830A/B Series), <1.5 ns to <10 s (analog channels on 54830D/31D/32D/33D), <5 ns to <10 s (digital channels on 54830D/31D/32D/33D)
Line	Triggers on the line voltage powering the oscilloscope.
Pattern	Triggers when a specified logical combination of the channels is entered, exited, is present or absent for a specified period of time or is within a specified time range. Each channel can have a value of High (H), Low (L) or Don't care (X).
State	Pattern trigger clocked by the rising or falling edge of one channel. Logic type: AND or NAND.
Delay by Time	The trigger is qualified by an edge. After a specified time delay between 30 ns to 160 ms (5 ns to 10 s for 54830D/31D/32D/33D) a rising or falling edge on any one selected input will generate the trigger.
Delay by Events	The trigger is qualified by an edge. After a specified delay between 1 to 16,000,000 rising or falling edges on any one selected input will generate the trigger.
TV	Trigger on one of the three standard television waveforms: 525 lines/60 Hz (NTSC) 625 lines/50 Hz (PAL), or define a custom waveform
Violation Triggers	
Pulse Width	See Trigger Mode Glitch for performance characteristics.
Setup/Hold	Triggers on setup, hold or setup and hold violations in your circuit. Requires a clock and data signal on any two input channels as trigger sources. High and low thresholds and setup and/or hold time must then be specified.
Transition	Trigger on pulse rising or falling edges that do not cross two voltage levels in > or < the amount of time specified.

Performance Characteristics continued

Trigger: Digital Channels	(54830D/31D/32D/33D only)
Threshold Range (user defined)	±8.0 V in 10 mV increments
Threshold Accuracy*	±(100 mV + 3% of threshold setting)
Predefined Thresholds	TTL=1.4 V, 5.0 V CMOS=2.5 V, 3.3 V CMOS=1.65 V, 2.5 V CMOS=1.25 V, ECL=–1.3 V, PECL=3.7 V

Measurements and Math	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Waveform Measurements	
Voltage (analog channels only)	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area
Time (all channels)	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time
(analog channels only)	Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion
Measurement Modes	
Automatic Measurements	Measure menu access to all measurements, 4 measurements can be displayed simultaneously
QuickMeas+	Front panel button activates five pre-selected or five user defined automatic measurements
Drag and Drop Measurement Toolbar	Measurement toolbar with common measurement icons that can be dragged and dropped onto the displayed waveforms
Statistics	Displays the mean, standard deviation, minimum and maximum measurement values for the displayed automatic measurements
Histograms (analog channels only)	Vertical (for timing and jitter measurements) or horizontal (noise and amplitude change) modes, regions are defined using waveform markers. Measurements included: mean, standard deviation, peak-to-peak value, median, total hits, peak (area of most hits), and mean ± 1,2, and 3 sigma
Eye Diagram Measurements	Eye diagram display mode allows triggering on both negative-going and positive-going edges of a signal. Eye diagram measurements include eye height, eye width, jitter, crossing percentage, Q factor, and duty cycle distortion
Mask Testing	Allows pass/fail testing to user-defined or Agilent-supplied waveform templates. AutoMask allows user to create a mask template from a captured waveform and define tolerance range in time/voltage or percentage. Test modes include test forever, test to specified time or event limit, and stop on failure. Communications Mask Test Kit Option provides a set of ITU-T G.703, ANSI T1.102, and IEEE 802.3 industry standard masks for compliance testing
Marker Modes	Manual Markers, Track Waveform Data, Track Measurements
Waveform Math	4 functions f1-f4. Select from Add, Average, Differentiate, Divide, FFT Magnitude, FFT Phase, High Pass Filter, Integrate, Invert, Low Pass Filter, Magnify, Min, Max, Multiply, Subtract, Versus
FFT	
Frequency Range[6]	DC to 2 GHz (2 channels interleaved), DC to 1 GHz (each channel)
Frequency Resolution	Resolution = Sample Rate / Memory Depth
Best resolution at maximum sample rate	4 GSa/s / 16 M = 250 Hz
Frequency Accuracy	(1/2 frequency resolution)+(5x10^{-5})(signal frequency)
Signal-to-Noise Ratio[9]	80 dB at 1 Mpts memory depth
Window Modes	Hanning, Flattop, Rectangular

Performance Characteristics continued

Display, Computer System and Peripherals, I/O Ports	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Display	8.4 inch diagonal color TFT-LCD
Resolution	640 pixels horizontally x 480 pixels vertically
Annotation	Up to 12 labels, with up to 100 characters each can be inserted into the waveform area
Waveform Styles	Connect Dots, Dots, Persistence (minimum, variable, infinite), Color Graded Infinite Persistence
Simultaneous Grids	1, 2, or 4
Display Update Rate[7]	
Standard Waveforms/second	> 3,100
Standard Vp-p Measurements/second	> 190
Maximum Waveforms/second	> 8,800
Maximum Vp-p Measurements/second	> 200
Deep Memory Waveforms/second	> 50
Deep Memory Vp-p Measurements/second	> 10
Computer System and Peripherals	
CPU	Intel Pentium® III 1 GHz microprocessor
CPU Memory	512 MB
Drives	≥20 GB internal hard drive, CD-ROM drive on rear panel, 3.5 inch 1.44 MB floppy drive
Peripherals	Logitech optical USB mouse and condensed keyboard supplied. All Infiniium models support any Windows compatible input device with a serial, PS/2 or USB interface
File Types	
Waveforms	Internal Y values; X and Y values in ASCII or Microsoft Excel formats
Images	BMP, PCX, TIFF, GIF or JPEG
I/O Ports	
LAN	RJ-45 connector, supports 10Base-T and 100Base-T. Enables Web-enabled remote control, e-mail on trigger or demand, data/file transfers and network printing
GPIB	IEEE 488.2, fully programmable
RS-232 (serial)	COM1, printer and pointing device support
Parallel	Centronics printer port
PS/2	2 ports. Supports PS/2 pointing and input devices
USB	2 ports. Allows connection of USB peripherals and pointing devices while the oscilloscope is on
Video Output	15 pin VGA, full color
Auxiliary Output	DC (±2.4 V); square wave (715 Hz[±15%], [±5%]); trigger output (255 mV p-p into 50 Ω)
TTL Output	TTL compatible signal

Performance Characteristics continued

General Characteristics	54830B, 54831B, 54832B, 54833A, 54830D, 54831D, 54832D and 54833D
Temperature	
Operating	0°C to + 50°C
Non-operating	–40°C to + 70°C
Humidity	
Operating	Up to 95% relative humidity (non-condensing) at +40°C
Non-operating	Up to 90% relative humidity at +65°C
Altitude	
Operating	Up to 4,600 meters (15,000 feet)
Non-operating	Up to 15,300 meters (50,000 feet)
Vibration	
Operating	Random vibration 5-500 Hz, 10 minutes per axis, 0.3 g(rms)
Non-operating	Random vibration 5-500 Hz, 10 minutes per axis, 2.41 g(rms); resonant search 5-500 Hz, swept sine, 1 octave/minute sweep rate, (0.75g), 5 minute resonant dwell at 4 resonances per axis
Power	100-240 VAC, ± 10%, Cat II, 47 to 440 Hz; Max power dissipated: 390 W
Weight	Net: 13.4 kg (29.5 lbs.) Shipping: 16.4 kg (36.1 lbs.)
Dimensions (excluding handle)	Height: 216 mm (8.5 in); Width: 437 mm (17.19 in); Depth: 440 mm (17.34 in)
Safety	Meets IEC1010-1 +A2, CSA certified to C22.2 No.1010.1, Self certified to UL 3111

* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ±10°C from firmware calibration temperature.

1 Typical system bandwidth for 54830 Series in 1 MΩ input with standard 1165A passive probe attached is 600 MHz.

2 Rise time figures for 54830 Series are calculated from t r = 0.35/bandwidth.

3 54830B/31B/32B/33A/30D/31D/32D/33D: Magnification is used below 5 mV/div range. Below 5 mV/div, full scale is defined as 40 mV. Full scale is defined as the major attenuator setting above an intermediate setting. (Major settings 50 Ω: 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 1 MΩ: all of the above plus 2 V).

4 Vertical resolution for 8 bits = 0.4% of full scale, for 12 bits = 0.024% of full scale.

5 The dc gain accuracy decreases 0.08% of full scale per degree C from the firmware calibration temperature.

6 FFT amplitude readings are affected by input amplifier roll-off 54830/31B/D (–3 dB at 600 MHz, with amplitude decreasing as frequency increases above 600 MHz), 54832B/32D/33A/33D: (–3 dB at 1 GHz, with amplitude decreasing as frequency increases above 1 GHz).

7 Standard measurement condition: Real time mode, 512 pts memory, minimum persistence display mode, triggered sweep mode, no interpolation, markers off, math off, connect dots off, 1 channel acquisition, 50 ns/div, only analog channels on (for 54830D models). Maximum condition is the same as standard condition except time/div is set to 1 ns/div. Deep memory condition is the same as standard condition except time/div is set to 200 µs/div and memory depth is set to 8 Mpts per channel.

8 For 54830B Series specification valid for vertical ranges > 5 mV / div.

9 Noise floor varies as memory depth increases with averaging on.

10 Maximum interleaved memory depth only available at maximum interleaved sample rate. Maximum each channel memory depth available at any selectable sample rate.

11 Standard feature with version A.03.70 system software or higher, but only available on 54830B/31B/32B models with serial number MY41003401 or greater, 54830D/31D/32D models with MY42001701 or greater, or 54833A/33D models with MY43000601 or greater.