
Agilent 54640-series Performance Characteristics

*Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and $\pm 10^\circ\text{C}$ from firmware calibration temperature.

Acquisition: Analog Channels

Max Samplerate	2GSa/s interleaved, 1GSa/s each channel
Max Memory Depth	8MB interleaved, 4MB each channel
Vertical Resolution	8bits
Peak Detection	1ns @ max samplerate
Averages	selectable from 2, 4, 8, 16, 32, 64... to 16383
High Resolution Mode	12bits of resolution when $\geq 100\mu\text{s}/\text{div}$, average mode with average=1
Filter:	Sinc/x interpolation (single shot BW = samplerate/4 or bandwidth of scope, whichever is less) with vectorson.

Acquisition: Digital Channels (on 54641D and 54642D only)

Max Sample Rate	1GSa/s
Max Memory Depth	4MB
Vertical Resolution	1bit
Glitch Detection (min pulse width)	5ns

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Vertical System: Analog Channels

Analog channels	Ch1 and 2 simultaneous acquisition
Bandwidth (-3dB)*	54641A/41D: dc to 350 MHz 54642A/42D: dc to 500 MHz
coupled	54641A/41D: 3.5 Hz to 350 MHz 54642A/42D: 3.5 Hz to 500 MHz
Calculated risetime (=0.35/bandwidth)	54641A/41D: ~1.0 ns 54642A/42D: ~700 ps
Single Shot Bandwidth	54641A/41D: 350 MHz maximum 54642A/42D: 500 MHz maximum
Range ¹	2 mV/div to 5 V/div
Maximum Input	 CAT I 300 Vrms, 400 Vpk CAT II 100 Vrms, 400 Vpk with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk 5 Vrms with 50-ohm input
Offset Range	$\pm 5\text{V}$ on ranges < 10 mV/div $\pm 20\text{V}$ on ranges 10 mV/div to 200 mV/div $\pm 75\text{V}$ on ranges > 200 mV/div
Dynamic Range	Lesser of $\pm 8\text{div}$ or $\pm 32\text{V}$
Input Resistance	1 M Ω $\pm 1\%$, 50-ohm selectable
Input Capacitance	~13 pF
Coupling	ac, dc
BW Limit	~25 MHz selectable
Channel-to-Channel Isolation (with channels at same V/div)	DC to max bandwidth > 40 dB
Probes	10:1 10073C shipped standard for each analog channel
Probe ID (Agilent/HP & Tek Compatible)	Auto probe sense

¹ 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 2 mV/div sensitivity setting.

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Vertical System: Analog Channels (continued)

ESD Tolerance	$\pm 2\text{kV}$
Noise Peak-to-Peak	3% full scale or 3mV, whichever is greater
Common Mode Rejection Ratio	20dB@50MHz
DC Vertical Gain Accuracy* ¹	$\pm 2.0\%$ full scale
DC Vertical Offset Accuracy	$\leq 200\text{mV/div} : \pm 0.1\text{div} \pm 2.0\text{mV} \pm 0.5\%$ offset $> 200\text{mV/div} : \pm 0.1\text{div} \pm 2.0\text{mV} \pm 1.5\%$ offset value
Single Cursor Accuracy ¹	$\pm \{\text{DC Vertical Gain Accuracy} + \text{DC Vertical Offset Accuracy} + 0.2\%$ full scale ($\sim 1/2\text{LSB}$) <i>Example: For 50mV signal, scope set to 10mV/div (80mV full scale), 5mV offset, accuracy = $\pm \{2.0\%(80\text{mV}) + 0.1(10\text{mV}) + 2.0\text{mV} + 0.5\%(5\text{mV}) + 0.2\%(80\text{mV})\} = \pm 4.78\text{mV}$</i>
Dual Cursor Accuracy* ¹	$\pm \{\text{DC Vertical Gain Accuracy} + 0.4\%$ full scale ($\sim 1\text{LSB}$) <i>Example: For 50mV signal, scope set to 10mV/div (80mV full scale), 5mV offset, accuracy = $\pm \{2.0\%(80\text{mV}) + 0.4\%(80\text{mV})\} = \pm 1.92\text{mV}$</i>

¹ 2mV/div is a magnification of 4mV/div setting. For vertical accuracy calculations, use full scale of 32mV for 1mV/div sensitivity setting.

Vertical System: Digital Channels (54641 D and 54642 D only)

Number of Channels	16 Digital – labeled D15 – D0
Threshold Groupings	Pod1: D7 – D0 Pod2: D15 – D8
Threshold Selections	TTL, CMOS, ECL, user-definable (selectable by pod)
User-Defined Threshold Range	$\pm 8.0\text{V}$ in 10mV increments
Maximum Input Voltage 	$\pm 40\text{V}$ peak CAT I
Threshold Accuracy*	$\pm (100\text{mV} + 3\%$ of threshold setting)
Input Dynamic Range	$\pm 10\text{V}$ about threshold
Minimum Input Voltage Swing	500mV peak-to-peak
Input Capacitance	$\sim 8\text{pF}$
Input Resistance	100k $\Omega \pm 2\%$ at probe tip
Channel-to-Channel Skew	2ns typical, 3ns maximum

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Horizontal

Range	1ns/div to 50s/div
Resolution	2.5ps
Vernier	1-2-5 increments when off, 25 minor increments between major settings when on
Reference Positions	Left, Center, Right
Delay Range	
Pre-trigger (negative delay)	Greater of 1 screen width or 1ms
Post-trigger (positive delay)	500 seconds
Analog Delta-t Accuracy	
Same Channel*	$\pm 0.005\% \text{ reading} \pm 0.1\% \text{ screen width} \pm 20\text{ps}$ <i>Example: for signal with pulse width of 10us, scope set to 5us/div (50us screen width), delta-t accuracy = $\pm\{.005\%(10\text{us}) + 0.1\%(50\text{us}) + 20\text{ps}\} = 50.52\text{ns}$</i>
Channel-to-Channel	$\pm 0.005\% \text{ reading} \pm 0.1\% \text{ screen width} \pm 40\text{ps}$
Digital Delta-t Accuracy	(non-Vernier settings)
Same Channel	$\pm 0.005\% \text{ reading} \pm 0.1\% \text{ screen width} \pm (1 \text{ digital sample period}, 1\text{ns})$ <i>Example: for signal with pulse width of 10us, scope set to 5us/div (50us screen width), and single post active (1GSa/s), delta-t accuracy = $\pm\{.005\%(10\text{us}) + 0.1\%(50\text{us}) + 1\text{ns}\}$ = 51.5ns</i>
Channel-to-Channel	$\pm 0.005\% \text{ reading} \pm 0.1\% \text{ screen width} \pm (1 \text{ digital sample period}) \pm (\text{chan-to-chan skew})$
Delay Jitter	10ppm
RMS Jitter	0.025% screen width + 30ps
Modes	Main, Delayed, Roll, XY
XY	
Bandwidth	Max bandwidth
Phase error @ 1MHz	1.8 degrees

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Trigger System

Sources:	54641A/42A: Ch1, 2, line, ext 54641D/42D: Ch1, 2, line, ext, D15-D0
Modes	Auto, Triggered (normal), Single
Holdoff Time	~60 ns to 10 seconds
Selections	Edge, Pattern, Pulse Width, CAN, Duration, I ² C, LIN, Sequence, SPI, TV, USB
Edge	Trigger on a rising or falling edge of any source.
Pattern	Trigger on a pattern of high, low, and don't care levels and a rising or falling edge established across any of the sources. The analog channel 's high or low level is defined by that channel 's trigger level.
Pulse Width	Trigger when a positive- or negative-going pulse is less than, greater than, or within a specified range on any of the source channels. Minimum pulse width setting: 2 ns Maximum pulse width setting: 10 s
CAN	Trigger on CAN (Controller Area Network) version 2.0A and 2.0B signals. It can trigger on the Start of Frame bit of a data frame, a remote transfer request frame, or an overload frame.
Duration	Trigger on a multi-channel pattern whose time duration is less than a value, greater than a value, greater than a time value with a time out value, or inside or outside of a set of time values. Minimum duration setting: 5 ns Maximum duration setting: 10 s
I ² C	Trigger on I ² C (Inter-IC bus) serial protocol at a start/stop condition, a restart, a missing acknowledge, or user-defined frame with address and/or data values. Also trigger on Missing Acknowledge, Restart, EEPROM read, and 10-bit write.
LIN	Trigger on LIN (Local Interconnect Network) sync break at beginning of message frame.
Sequence	Find event A, trigger on event B, with option to reset on event C or time delay.
SPI	Trigger on SPI (Serial Peripheral Interface) data pattern during a specific framing period. Support positive and negative Chip Select framing as well as clock Idle framing and user-specified number of bits per frame.
USB	Trigger on USB (Universal Serial Bus) Start of Packet, End of Packet, Reset Complete, Enter Suspend, or Exit Suspend on the differential USB data lines. USB low speed and high speed are supported.
TV	Trigger on any analog channel for NTSC, PAL, PAL-M, or SECAM broadcast standards on either positive or negative composite video signals. Modes supported include Field 1, Field 2, or both, all lines, or any line within a field. Also support triggering on non-interlaced fields. TV trigger sensitivity: 0.5 division of sync signal.
Autoscale	Find and display all active analog and digital (for 54641D/54642D) channels, set edge trigger mode on highest numbered channel, set vertical sensitivity on analog channels and thresholds on digital channels, time base to display ~1.8 periods. Requires minimum voltage > 10 mVpp, 0.5% duty cycle and minimum frequency > 50 Hz.

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Analog Channel Triggering

Range (Internal)	± 6 div
Sensitivity*	$< 10\text{mV/div}$: Greater of 1 div or 5mV $\geq 10\text{mV/div}$: 0.6 div
Coupling	ac (~10Hz), dc, noise reject, HF reject and LF reject (~50kHz)

Digital (D15-D0) Channel Triggering (54641 D and 54642 D)

Threshold Range (used defined)	$\pm 8.0\text{V}$ in 10mV increments
Threshold Accuracy*	$\pm (100\text{mV} + 3\% \text{ of threshold setting})$
Predefined Thresholds	TTL=1.4V, CMOS=2.5V, ECL=-1.3V

External (EXT) Triggering

Input Resistance	$1\text{M}\ \Omega \pm 3\%$ or 50- Ω
Input Impedance	$\sim 13\text{pF}$
Maximum Input	 CAT I 300Vrms, 400Vpk CAT II 100Vrms, 400Vpk with 10073C 10:1 probe: CAT I 500Vpk, CAT II 400Vpk 5Vrms with 50- Ω input
Range	DC coupling: trigger level $\pm 8\text{V}$ AC coupling/LF reject: AC input min trigger level not to exceed $\pm 8\text{V}$
Sensitivity	DC to 100MHz, $< 100\text{mV}$ 100MHz to max bandwidth, $< 200\text{mV}$
Coupling	ac (~3.5Hz), dc, noise reject, HF reject and LF reject (~50kHz)
Probe Id (Agilent/HP&Tek compatible)	Auto probe sense for 54641A/42A

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Display System

Display	7-inch raster monochrome CRT
Throughput of Analog Channels	25 million grayscale vectors/sec per channel
Resolution	255 vertical by 1000 horizontal points (waveform area) 32 levels of grayscale
Controls	Waveform intensity on front panel Vector on/off; infinite persistence on/off 8x10 grid with continuous intensity control
Built-in Help System	Key-specific help in 11 languages displayed by pressing and holding key or soft key of interest
Real Time Clock	Time and date (user settable)

Measurement Features

Automatic Measurements	Measurements are continuously updated Cursor track current measurement
Voltage (analog channel only)	Peak-to-Peak, Maximum, Minimum, Average, Amplitude, Top, Base, Overshoot, Preshoot, RMS (dc)
Time	Frequency, Period, +Width, -Width, and Duty Cycle on any channels. Rise time, Fall time, XatMax (Time at max volts), XatMin (Time at min volts), Delay, and Phase on analog channel only.
Counter	Built-in 5-digit frequency counter on any channel. Counts up to 125 MHz.
Threshold Definition	Variable by percent and absolute value; 10%, 50%, 90% default for time measurements
Cursors	Manually or automatically placed readout of Horizontal (X, ΔX , $1/\Delta X$) and Vertical (Y, ΔY). Additionally digital or analog channels can be displayed as binary or hex values
Waveform Math	1-2, 1*2, FFT, differentiate, integrate. Source of FFT: differentiate, integrate, analog channels 1 or 2, 1-2, 1+2, 1*2

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FFT

Points	Fixed at 2048 points
Source of FFT	Analog channels 1 or 2, 1+2, 1-2, 1*2
Window	Rectangular, Flattop, Hanning
Noise Floor	-70 to -100 dB depending on averaging
Amplitude Display	Ind BV, dBm @ 50 ohm
Frequency Resolution:	0.097656 / (time per div)
Maximum Frequency	102.4 / (time per div)

Storage

Save/Recall (non-volatile)	4 setups and traces can be saved and recalled internally
Floppy Disk	3.5" 1.44 MB double density
Image formats	TIF, BMP
Data formats	X and Y (time/voltage) values in CSV format
Trace/setup formats	Recalled

I/O

RS-232 (serial) standard port	1 port; XON or DTR; 8 data bits; 1 stop bit; parity = none; 9600, 19200, 38400, 57600 baud rates
Parallel standard port	Printer support
Printer Compatibility	HP DeskJet, HP LaserJet with HPPCL3 or greater compatibility Compatibility—black and white @ 150x150 dpi grayscale @ 600x600 dpi Epson—black and white @ 180x180 dpi Seiko—DPU-414 black and white
Optional GPIB Interface Module	Fully programmable with IEEE 488.2 compliance Typical GPIB throughput of 20 measurements or twenty 2000-point records per second.

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General Characteristics

Physical:	
Size	32.26cm wide x 17.27cm high x 31.75cm deep (without handle)
Weight	6.82kgs (15lbs)
Calibrator Output	Frequency ~2kHz; Amplitude ~5V
Trigger Out	0 to 5V with 50 Ω source impedance; delay ~22ns
Printer Power	7.2 to 9.2V, 1A
Kensington lock	Connection on rear panel for security

Power Requirements

Line Voltage Range	100-240VAC, 50/60Hz, CAT II, automatic selection 100-132VAC, 440Hz, CAT II, automatic selection
Line Frequency	50/60Hz, 100-240VAC 440Hz, 100-132VAC
Power Usage	110W max

Environmental Characteristics

Ambient Temperature	Operating -10 $^\circ\text{C}$ to +55 $^\circ\text{C}$ Non-operating -51 $^\circ\text{C}$ to +71 $^\circ\text{C}$
Humidity	Operating 95% RH at 40 $^\circ\text{C}$ for 24hr Non-operating 90% RH at 65 $^\circ\text{C}$ for 24hr
Altitude	Operating to 4,570m (15,000ft) Non-operating to 15,244m (50,000ft)
Vibration	HP/Agilent class B1 and MIL-PRF-28800F Class 3 random
Shock	HP/Agilent class B1 and MIL-PRF-28800F (operating 30g, 1/2s sine, 11-ms duration, 3 shocks/axis along major axis. Total of 18 shocks)
Pollution degree 2	Normally only dry non-conductive pollution occurs. Occasionally temporary conductivity caused by condensation must be expected.
Indoor use only	This instrument is rated for indoor use only

Installation categories	CAT I: Mains isolated
	CAT II: Line voltage in appliance and to wall outlet