

# 5 Series MSO Low Profile

## MSO58LP Datasheet

*More system visibility in less rack space.*



*Standard rack mount configuration*



*Optional bench conversion configuration*

## Strength in numbers

### Input channels

- 8 FlexChannel<sup>®</sup> inputs
- Each FlexChannel provides:
  - One analog signal that can be displayed as a waveform view, a spectral view, or both simultaneously
  - Eight digital logic inputs with TLP058 logic probe

### Bandwidth (all analog channels)

- 1 GHz

### Sample rate (all analog / digital channels)

- Real-time: 6.25 GS/s
- Interpolated: 500 GS/s

### Record length (all analog / digital channels)

- 125 Mpoints (std.)
- 250, 500 Mpoints (optional)

### Waveform capture rate

- >500,000 waveforms/s

### Vertical resolution

- 12-bit ADC
- Up to 16-bits in High Res mode
- 7.6 ENOB at 1 GHz

### Standard trigger types

- Edge, Pulse Width, Runt, Timeout, Window, Logic, Setup & Hold, Rise/Fall Time, Parallel Bus, Sequence, Visual Trigger, Video (optional), RF vs. Time (optional)
- Auxiliary Trigger  $\leq 5 V_{RMS}$ , 50 $\Omega$ , 200 MHz (Edge Trigger only)

### Standard analysis

- Measurements: 36
- Spectrum View: Frequency-domain analysis with independent controls for frequency and time domains RF vs. time traces (magnitude, frequency, phase)
- FastFrame<sup>™</sup>: Segmented memory acquisition mode with maximum trigger rate >5,000,000 waveforms per second
- Plots: Time Trend, Histogram, Spectrum and Phase Noise
- Math: Basic waveform arithmetic, FFT, and advanced equation editor
- Search: Search on any trigger criteria
- Jitter: TIE and Phase Noise

<sup>1</sup> Optional and upgradable.

<sup>2</sup> Free with product registration.

### Optional analysis

- Advanced Jitter and Eye Diagram Analysis
- Advanced Spectrum View
- RF vs. Time traces (magnitude, frequency, phase)
- Digital Power Management
- Mask/Limit Testing
- Advanced Power Measurements and Analysis

### Optional serial bus trigger, decode and analysis

- I<sup>2</sup>C, SPI, I3C, RS-232/422/485/UART, SPMI, CAN, CAN FD, LIN, FlexRay, SENT, PSI5, Automotive Ethernet, USB 2.0, eUSB2, Ethernet, Audio, MIL-STD-1553, ARINC 429, Spacewire, 8B/10B, NRZ, SVID, MDIO

### Arbitrary/Function Generator <sup>1</sup>

- 50 MHz waveform generation

### Digital voltmeter <sup>2</sup>

- 4-digit AC RMS, DC, and DC+AC RMS voltage measurements

### Trigger frequency counter <sup>2</sup>

- 8-digit

### Video display output

- High Definition (1,920 x 1,080) resolution video output

### Connectivity

- USB Host (6 ports), USB 3.0 Device (1 port), LAN (10/100/1000 Base-T Ethernet), Display Port, DVI-D, VGA

### e\*Scope<sup>®</sup>

- Remotely view and control the oscilloscope over a network connection through a standard web browser

### Operating system

- Closed Embedded OS

### Warranty

- 3 years standard

### Dimensions

- 2U Rack Mount Kit included
- 3.44 in (87.3 mm) H x 17.01 in (432 mm) W x 24.74 in (621.5 mm) D
- Weight: 28 lbs. (12.7 kg)

With a remarkable 8 input channels in a 2U high package and a 12-bit ADC, the 5 Series MSO Low Profile sets a new standard for performance in applications where extreme analog, spectrum, or digital channel density is required.

### Based on the highly successful 5 Series MSO

The 5 Series MSO Low Profile is based on the 5 Series MSO benchtop platform. The benchtop 5 Series MSO has a remarkably innovative pinch-swipe-zoom touchscreen user interface, the industry's largest high-definition display, and 4, 6, or 8 FlexChannel® inputs that let you measure a single analog channel waveform, a spectral view of the analog input, simultaneous analog and spectral views with independent acquisition controls for each domain, or eight digital logic inputs (with TLP058 logic probe). The 5 Series MSO is ready for today's toughest challenges, and tomorrow's too. It sets a new standard for performance, analysis, and overall user experience.

Like the benchtop 5 Series MSO, the low profile instrument offers FlexChannel inputs, an optional arbitrary/function generator output, and a built-in digital voltmeter and trigger frequency counter. And, if you plug in an external touch-capable monitor you can experience the same revolutionary pinch-swipe-zoom user experience as if you were in front of the benchtop 5 Series MSO.

For more information on the capabilities of the benchtop 5 Series MSO, including the revolutionary user experience and the various analysis software options, please see the 5 Series MSO datasheet at [www.tek.com/5SeriesMSO](http://www.tek.com/5SeriesMSO).



The 5 Series MSO Low Profile is based on the 5 Series MSO benchtop platform.

### Low-profile, high-density package saves space

The 5 Series MSO Low Profile has 8 FlexChannel inputs plus an auxiliary trigger input in a space-saving 2U high package designed to fit into 19-inch wide racks. The instrument has side air vents so that instruments can be mounted in a rack directly on top of one another, saving even more space.

The 5 Series MSO Low Profile comes standard with rack mount brackets installed, ready for mounting into a rack right out of the box.

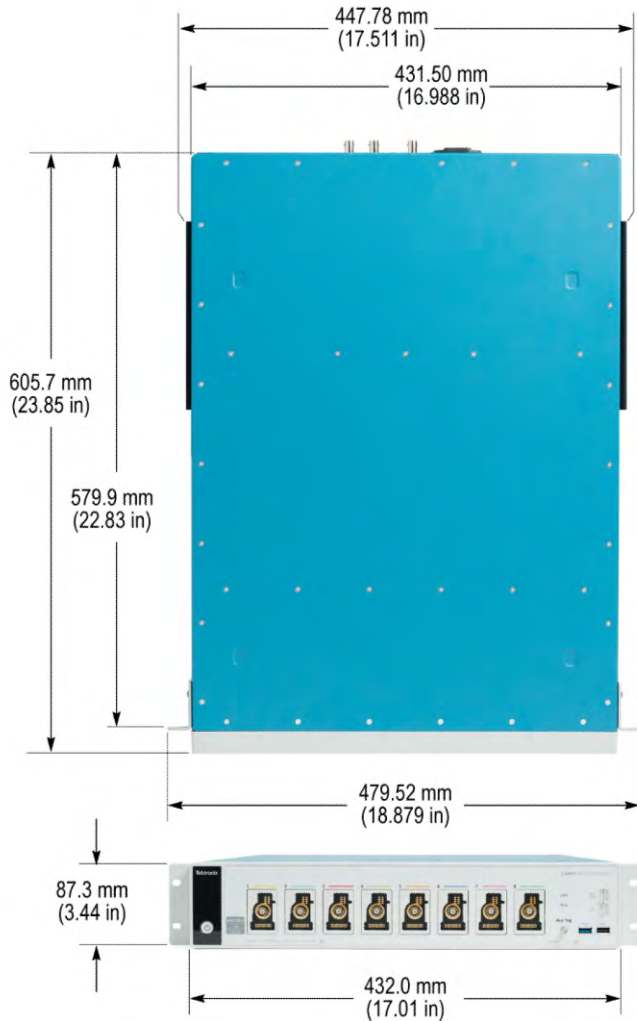


Multiple MSO58LP instruments installed in a rack, making efficient use of available space.

An optional bench conversion kit includes four feet and a strap handle for use in a lab environment on a bench surface.



The MSO58LP with the optional bench conversion kit installed, optimizing the instrument for use on a benchtop.



The 5 Series MSO Low Profile saves valuable rack space.

### Experience the performance difference

With 1 GHz analog bandwidth, 6.25 GS/s sample rate, 500 Mpts record length, and 12-bit analog to digital converters (ADCs), the 5 Series MSO Low Profile has the performance you need to capture accurate waveform data with the best possible signal integrity and vertical resolution for seeing small waveform details.

The 5 Series MSO Low Profile has up to 6.25 GS/s sample rate on all channels, providing more than 5x oversampling, enabling better noise performance and fine timing resolution.

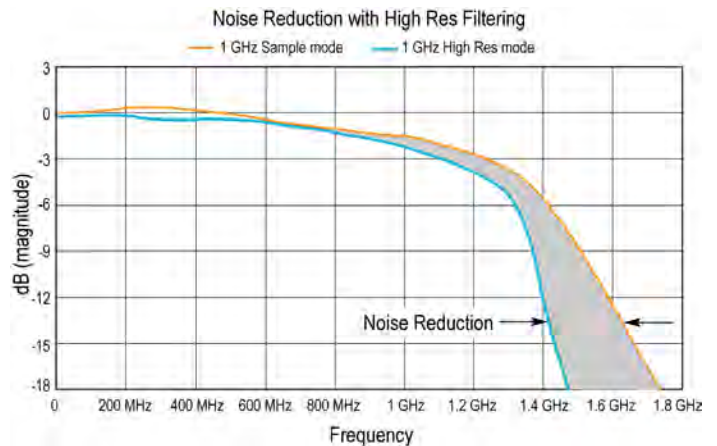
The optional 500 Mpts record length provides 80 ms of acquisition time at the highest sample rate (6.25 GS/s), enabling long time captures while maintaining high timing resolution for more accurate measurements.

<sup>3</sup> 6.25 GS/s not available as real-time sample rate when High Res is on.

### Industry leading vertical resolution

The 5 Series MSO Low Profile provides the performance to capture the signals of interest while minimizing the effects of unwanted noise when you need to capture high-amplitude signals while seeing smaller signal details. At the heart of the 5 Series MSO Low Profile are 12-bit analog-to-digital converters (ADCs) that provide 16 times the vertical resolution of traditional 8-bit ADCs.

A new High Res mode applies a hardware-based unique Finite Impulse Response (FIR) filter based on the selected sample rate. The FIR filter maintains the maximum bandwidth possible for that sample rate while preventing aliasing and removing noise from the oscilloscope amplifiers and ADC above the usable bandwidth for the selected sample rate.



1 GHz frequency plot with High Res filter overlaid shows the reduction in noise when High Res mode is enabled

High Res mode always provides at least 12 bits of vertical resolution and extends all the way to 16 bits of vertical resolution at ≤ 125 MS/s sample rates. The following table shows the number of bits of vertical resolution for each sample rate setting when in High Res.

Sample rate	Number of bits of vertical resolution
6.25 GS/s <sup>3</sup>	8
3.125 GS/s	12
1.25 GS/s	13
625 MS/s	14
312.5 MS/s	15
≤125 MS/s	16

Typical 8-bit ADC oscilloscopes have an Effective Number of Bits (ENOB) of between 4 and 6, depending on bandwidth and vertical scale selected. The 12-bit ADC in the 5 Series MSO Low Profile, coupled with a new low-noise front-end amplifier, provides an ENOB of between 7 and 9 bits, enabling better viewing of fine signal detail in the presence of large amplitude signals.

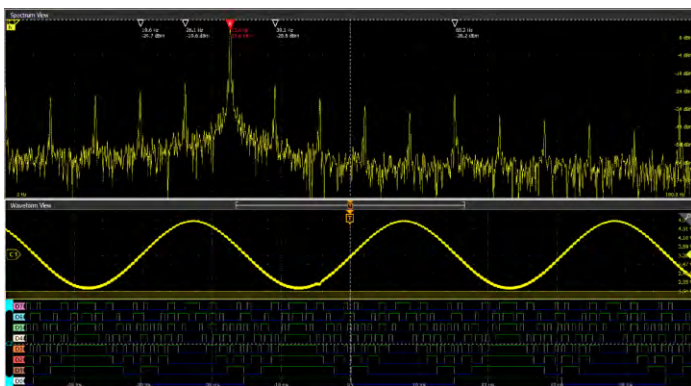
The following table shows the typical ENOB values for the 5 Series MSO Low Profile measured with High Res mode, 50 Ω, 10 MHz input with 90% full screen.

Bandwidth	ENOB
1 GHz	7.6
500 MHz	7.9
350 MHz	8.2
250 MHz	8.1
20 MHz	8.9

### Spectrum View

It is often easier to debug an issue by viewing one or more signals in the frequency domain. Oscilloscopes have included math-based FFTs for decades in an attempt to address this need. However, FFTs are notoriously difficult to use as they are driven by the same acquisition system that's delivering the analog time-domain view. When you optimize acquisition settings for the analog view, your frequency-domain view isn't what you want. When you get the frequency-domain view you want, your analog view is not what you want. With math-based FFTs, it is virtually impossible to get optimized views in both domains.

Spectrum View changes all of this. Tektronix' patented technology provides both a decimator for the time-domain and a digital downconverter for the frequency-domain behind each FlexChannel. The two different acquisition paths let you simultaneously observe both time- and frequency-domain views of the input signal with independent acquisition settings for each domain. Other manufacturers offer various 'spectral analysis' packages that claim ease-of-use, but they all exhibit the limitations described above. Only Spectrum View provides both exceptional ease-of-use and the ability to achieve optimal views in both domains simultaneously.



Intuitive spectrum analyzer controls like center frequency, span and resolution bandwidth (RBW), independent from time domain controls, provide easy setup for frequency domain analysis. A spectrum view is available for each FlexChannel analog input, enabling multi-channel mixed domain analysis.

### TekVPI Probe Interface

The TekVPI® probe interface sets the standard for ease of use in probing. In addition to the secure, reliable connection that the interface provides, many TekVPI probes feature status indicators and controls, as well as a probe menu button right on the probe compensation box. The TekVPI interface enables direct attachment of current probes without requiring a separate power supply. TekVPI probes can be controlled remotely through USB or LAN, enabling more versatile solutions in ATE environments. The 5 Series MSO Low Profile provides up to 80 W of power to the front panel connectors, sufficient to power all connected TekVPI probes without the need for an additional probe power supply.

The TekVPI probe interface is key to enabling the high bandwidth and low attenuation versions of the optional TPP Series of passive voltage probes. The TPP Series probes offer all the benefits of general-purpose probes -- high dynamic range, flexible connection options, and robust mechanical design, while providing the performance of active probes. At 1 GHz bandwidth, the optional TPP1000 probes enable you to see high frequency components in your signals, and extremely low 3.9 pF capacitive loading minimizes adverse effects on your circuits. The optional low-attenuation (2x) TPP0502 has 500 MHz bandwidth and is exceptional at measuring low voltages.



MSO58LP with TekVPI probes and touch monitor attached for use in a lab environment.

## Designed with your needs in mind

### Remote operation to speed automated test

IVI-COM<sup>4</sup>, IVI-C<sup>5</sup>, and LabVIEW<sup>4</sup> instrument drivers are available for free and enable easy communication with the oscilloscope using LAN or USBTMC connections from an external PC. A full set of programmatic commands to setup and control the instrument remotely enable easy test automation.

### Remote operation to improve collaboration

The embedded e\*Scope<sup>®</sup> capability enables fast control of the oscilloscope over a network connection through a standard web browser. Simply enter the IP address or network name of the oscilloscope and a web page will be served to the browser. Control the oscilloscope remotely in the exact same ways you do in-person, whether you are across the lab or across the globe. e\*Scope enables multiple sites to connect to an instrument providing data acquisition results in real-time.



e\*Scope provides easy remote viewing and control using modern web browsers.

### Enhanced security option

The 5-SEC enhanced security option enables password-protected enabling/disabling of all USB communication ports and firmware upgrades. In addition, option 5-SEC provides the highest level of security by ensuring that internal memory is clear of all setup and waveform data in compliance with National Industrial Security Program Operating Manual (NISPOM) DoD 5220.22-M, Chapter 8 requirements as well as Defense Security Service Manual for the Certification and Accreditation of Classified Systems under the NISPOM. This ensures you can confidently move the instrument out of a secure area.

To permanently store data, you can save it to an external flash memory device or programmatically to USBTMC ports in keeping with your lab security protocols.

<sup>4</sup> Drivers are available from [www.tek.com/downloads](http://www.tek.com/downloads).

<sup>5</sup> Drivers are available from [www.ni.com](http://www.ni.com).

## Quickly transition from the lab to manufacturing

The 5 Series MSO Low Profile is based on the successful 5 Series MSO platform. This means you can use the benchtop 5 Series MSO with its beautiful 15.6-in touch display and its full measurement analysis capabilities during the development process. Then, when you are ready to transition your product to manufacturing, you can use the same software and test routines developed during R&D in your manufacturing test application, saving time and rack space.



Use the benchtop 5 Series MSO during R&D, then seamlessly transition to the low profile version for manufacturing test.

## The Low Profile family

The 6 Series Low Profile Digitizer expands the performance of the 5 Series MSO Low Profile by adding twice the number of Tektronix TEK049 ASICS in the same 2U footprint. Now with 25 GS/s and up to 8 GHz on all channels. Low Profile users now have the choice of extreme high channel count or extreme performance in the same rack form factor.

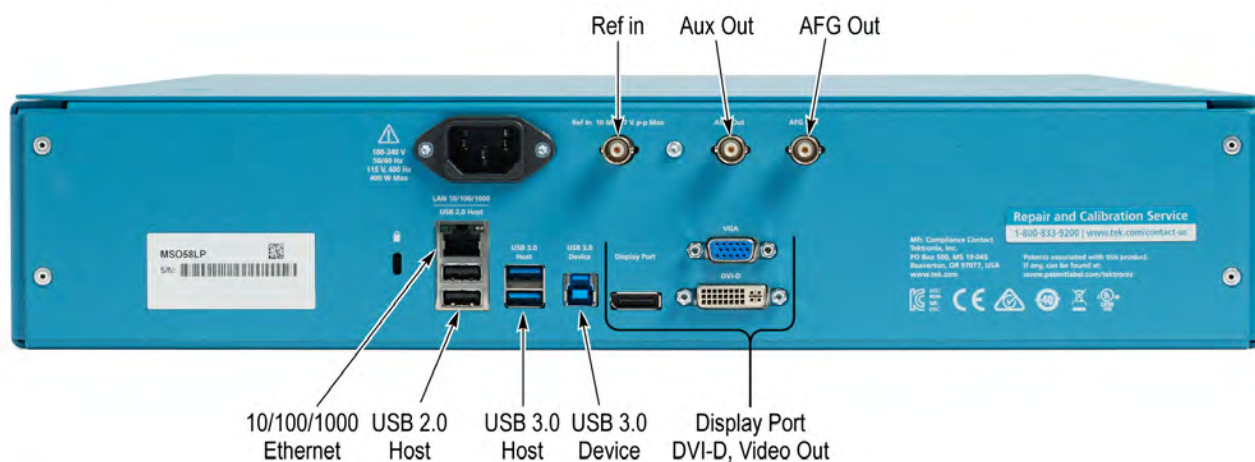
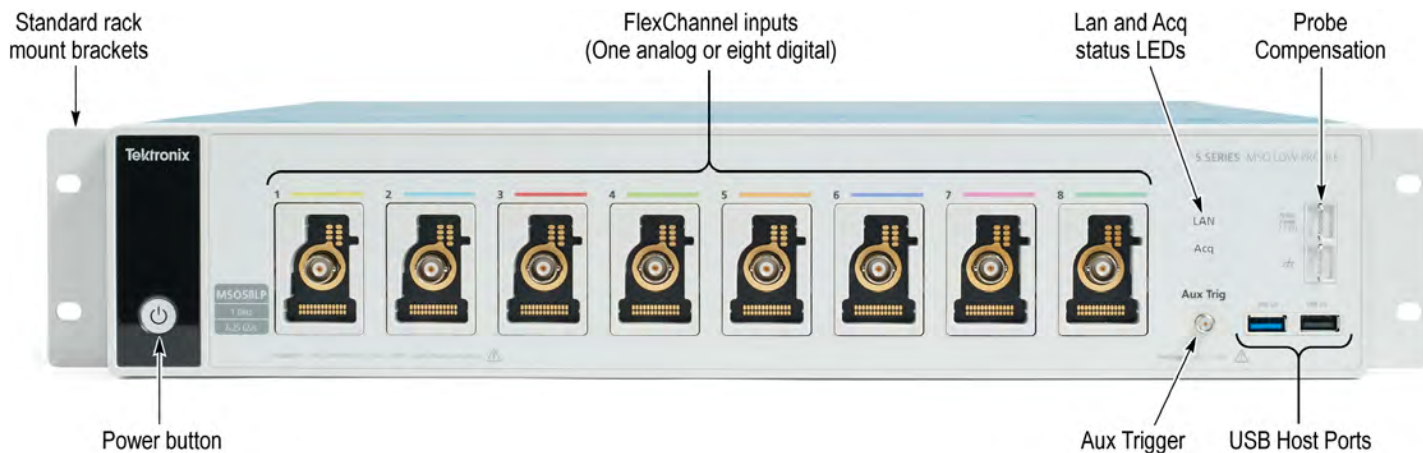
For more information on the capabilities of the 6 Series Low Profile Digitizer, please see the datasheet at <https://www.tek.com/high-speed-digitizer/>



Two 6 Series Low Profile Digitizers (left) and two 5 Series MSO Low Profile oscilloscopes (right)

Quick Comparison	6 Series Low Profile Digitizer	5 Series MSO Low Profile
Sample Rate	25 GS/s	6.25 GS/s
Analog Bandwidth	Up to 8 GHz	1 GHz
RF (DDC) Span Bandwidth	2 GHz	500 MHz
ENOB @ 1 GHz	8.2 bits	7.6 bits
LXI compliance version	1.5	-
Rack Dimensions	2U	2U

**5 Series MSO Low Profile - The highest channel density and greatest performance in its class**



## Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

### Model overview

#### Oscilloscope

	MSO58LP, MSO58LPGSA
FlexChannel inputs	8
Maximum analog channels	8
Maximum digital channels (with optional logic probes)	64
Bandwidth (calculated rise time)	1 GHz (400 ps)
DC Gain Accuracy	50 $\Omega$ : $\pm 1.0\%$ , ( $\pm 2.0\%$ at $\leq 1$ mV/div), $\pm 0.5\%$ of full scale, ( $\pm 1.0\%$ of full scale at 1 mV/Div and 500 $\mu$ V/Div Settings) 1 M $\Omega$ : $\pm 1.0\%$ , ( $\pm 2.0\%$ at $\leq 1$ mV/div), $\pm 0.5\%$ of full scale, ( $\pm 1.0\%$ of full scale at 1 mV/Div and 500 $\mu$ V/Div Settings)
ADC Resolution	12 bits
Vertical Resolution	8 bits @ 6.25 GS/s 12 bits @ 3.125 GS/s 13 bits @ 1.25 GS/s (High Res) 14 bits @ 625 MS/s (High Res) 15 bits @ 312.5 MS/s (High Res) 16 bits @ $\leq 125$ MS/s (High Res)
Sample Rate	6.25 GS/s on all analog / digital channels (160 ps resolution)
Record Length	Up to 500 Mpoints on all analog / digital channels
Waveform Capture Rate	>500,000 wfms/s
Arbitrary/Function Generator (opt.)	13 predefined waveform types with up to 50 MHz output
DVM	4-digit DVM (free with product registration)
Trigger Frequency Counter	8-digit frequency counter (free with product registration)

### Vertical system - analog channels

**Bandwidth selections** 20 MHz, 250 MHz, and 1 GHz

**Input coupling** DC, AC

**Input impedance** 50  $\Omega \pm 1\%$   
1 M $\Omega \pm 1\%$  with 13.0 pF  $\pm 1.5$  pF

#### Input sensitivity range

**1 M $\Omega$**  500  $\mu$ V/div to 10 V/div in a 1-2-5 sequence

**50  $\Omega$**  500  $\mu$ V/div to 1 V/div in a 1-2-5 sequence

Note: 500  $\mu$ V/div is a 2X digital zoom of 1 mV/div

**Maximum input voltage** 50  $\Omega$ : 5 V<sub>RMS</sub>, with peaks  $\leq \pm 20$  V (DF  $\leq 6.25\%$ )

1 M $\Omega$ : 300 V<sub>RMS</sub>, CAT II

For 1 M $\Omega$ , derate at 20 dB/decade from 4.5 MHz to 45 MHz;

Derate at 14 dB/decade from 45 MHz to 450 MHz; > 450 MHz, 5.5 V<sub>RMS</sub>



## Vertical system - analog channels

Effective bits (ENOB), typical

< 1 GHz models, High Res mode, 50 Ω, 10 MHz input with 90% full screen

Bandwidth	ENOB
1 GHz	7.6
500 MHz	7.9
350 MHz	8.2
250 MHz	8.1
20 MHz	8.9

Random noise, RMS, typical

1 GHz, High Res mode (RMS)

V/div	50 Ω					1 MΩ			
	1 GHz	500 MHz	350 MHz	250 MHz	20 MHz	500 MHz	350 MHz	250 MHz	20 MHz
1 mV/div <sup>6</sup>	254 μV	198 μV	141 μV	118 μV	70.0 μV	189 μV	143 μV	118 μV	64.8 μV
2 mV/div	255 μV	198 μV	143 μV	121 μV	70.4 μV	194 μV	145 μV	121 μV	66.0 μV
5 mV/div	262 μV	202 μV	150 μV	133 μV	72.8 μV	196 μV	152 μV	130 μV	69.6 μV
10 mV/div	283 μV	218 μV	169 μV	158 μV	79.8 μV	212 μV	167 μV	154 μV	78.2 μV
20 mV/div	357 μV	273 μV	222 μV	223 μV	102 μV	269 μV	214 μV	223 μV	104 μV
50 mV/div	677 μV	516 μV	436 μV	460 μV	196 μV	490 μV	410 μV	480 μV	207 μV
100 mV/div	1.61 mV	1.23 mV	1.02 mV	1.04 mV	464 μV	1.16 mV	964 μV	1.05 mV	475 μV
1 V/div	13.0 mV	9.88 mV	8.41 mV	8.94 mV	3.77 mV	13.6 mV	10.6 mV	11.1 mV	5.47 mV

Position range

±5 divisions

Offset ranges, maximum

Volts/div Setting	Maximum offset range	
	50 Ω Input	1 MΩ Input
500 μV/div - 63 mV/div	±1 V	±1 V
64 mV/div - 999 mV/div	±10 V	±10 V
1 V/div - 10 V/div	±10 V	±100 V

Offset accuracy

±(0.005 X | offset - position | + )

Crosstalk (channel isolation), typical

≥ 200:1 up to the rated bandwidth for any two channels having equal Volts/div settings

DC balance

0.1 div with DC-50 Ω oscilloscope input impedance (50 Ω BNC terminated)  
 0.2 div at 1 mV/div with DC-50 Ω oscilloscope input impedance (50 Ω BNC terminated)  
 0.4 div at 500 μV/div with DC-50 Ω oscilloscope input impedance (50 Ω BNC terminated)  
 0.2 div with DC-1 MΩ oscilloscope input impedance (50 Ω BNC terminated)  
 0.4 div at 500 μV/div with DC-1 MΩ scope input impedance (50 Ω BNC terminated)

<sup>6</sup> Bandwidth at 500 μV/div is limited to 250 MHz in 50 Ω.

**Vertical system - digital channels**

Number of channels	8 digital inputs (D7-D0) per installed TLP058 (traded off for one analog channel)
Vertical resolution	1 bit
Maximum input toggle rate	500 MHz
Minimum detectable pulse width, typical	1 ns
Thresholds	One threshold per digital channel
Threshold range	$\pm 40$ V
Threshold resolution	10 mV
Threshold accuracy	$\pm [100 \text{ mV} + 3\% \text{ of threshold setting after calibration}]$
Input hysteresis, typical	100 mV at the probe tip
Input dynamic range, typical	30 V <sub>pp</sub> for F <sub>in</sub> ≤ 200 MHz, 10 V <sub>pp</sub> for F <sub>in</sub> > 200 MHz
Absolute maximum input voltage, typical	$\pm 42$ V peak
Minimum voltage swing, typical	400 mV peak-to-peak
Input impedance, typical	100 k $\Omega$
Probe loading, typical	2 pF

**Horizontal system**

Time base range	200 ps/div to 1,000 s/div
Sample rate range	1.5625 S/s to 6.25 GS/s (real time) 12.5 GS/s to 500 GS/s (interpolated)
Record length range	
Standard	1 kpoints to 125 Mpoints in single sample increments
Optional 5-RL-250M	250 Mpoints
Optional 5-RL-500M	500 Mpoints
Maximum duration at highest sample rate	20 ms (std.) or 80 ms (optional)
Time base delay time range	-10 divisions to 5,000 s
Deskew range	-125 ns to +125 ns with a resolution of 40 ps

## Horizontal system

Timebase accuracy  $\pm 2.5 \times 10^{-6}$  over any  $\geq 1$  ms time interval

Description	Specification
Factory Tolerance	$\pm 5.0 \times 10^{-7}$ At calibration, 23 °C ambient, over any $\geq 1$ ms interval
Temperature stability	$\pm 5.0 \times 10^{-7}$ Tested at operating temperatures
Crystal aging	$\pm 1.5 \times 10^{-6}$ . Frequency tolerance change at 25 °C over a period of 1 year

Delta-time measurement accuracy, nominal

$$DTA_{pp}(\text{typical}) = 10 \times \sqrt{\left(\frac{N}{SR_1}\right)^2 + \left(\frac{N}{SR_2}\right)^2 + \left(0.450 \text{ ps} + \left(1 \times 10^{-11} \times t_p\right)\right)^2} + TBA \times t_p$$

$$DTA_{RMS} = \sqrt{\left(\frac{N}{SR_1}\right)^2 + \left(\frac{N}{SR_2}\right)^2 + \left(0.450 \text{ ps} + \left(1 \times 10^{-11} \times t_p\right)\right)^2} + TBA \times t_p$$

*(assume edge shape that results from Gaussian filter response)*

The formula to calculate delta-time measurement accuracy (DTA) for a given instrument setting and input signal assumes insignificant signal content above Nyquist frequency, where:

$SR_1$  = Slew Rate (1<sup>st</sup> Edge) around 1<sup>st</sup> point in measurement

$SR_2$  = Slew Rate (2<sup>nd</sup> Edge) around 2<sup>nd</sup> point in measurement

N = input-referred guaranteed noise limit ( $V_{RMS}$ )

TBA = timebase accuracy or Reference Frequency Error

$t_p$  = delta-time measurement duration (sec)

Aperture uncertainty  $\leq 0.450 \text{ ps} + (1 \times 10^{-11} \times \text{Measurement Duration})_{RMS}$ , for measurements having duration  $\leq 100$  ms

Delay between analog channels, full bandwidth, typical  $\leq 100$  ps for any two channels with input impedance set to 50  $\Omega$ , DC coupling with equal Volts/div or above 10 mV/div

Delay between analog and digital FlexChannels, typical  $< 1$  ns when using a TLP058 and a passive probe matching the bandwidth of the scope, with no bandwidth limits applied

Delay between any two digital FlexChannels, typical 320 ps

Delay between any two bits of a digital FlexChannel, typical 160 ps

## Trigger system

Trigger modes Auto, Normal, and Single

Trigger coupling DC, HF Reject (attenuates  $> 50$  kHz), LF Reject (attenuates  $< 50$  kHz), noise reject (reduces sensitivity)

Trigger holdoff range 0 ns to 10 seconds

Trigger jitter, typical

- $\leq 5 \text{ ps}_{RMS}$  for sample mode and edge-type trigger
- $\leq 7 \text{ ps}_{RMS}$  for edge-type trigger and FastAcq mode
- $\leq 40 \text{ ps}_{RMS}$  for non edge-type trigger modes
- $\leq 40 \text{ ps}_{RMS}$  for AUX trigger in, Sample acquisition mode, edge trigger

## Trigger system

AUX In trigger skew between instruments, typical

$\pm 100$  ps jitter on each instrument with 150 ps skew;  $\leq 350$  ps total between instruments. With manual deskewing of individual channels, total instrument skew can reach 200ps between different instrument channels.

Skew improves for sinusoidal input voltages  $\geq 500$  mV

Edge-type trigger sensitivity, DC coupled, typical

Path	Range	Specification
1 M $\Omega$ path (all models)	0.5 mV/div to 0.99 mV/div	4.5 div from DC to instrument bandwidth
	$\geq 1$ mV/div	The greater of 5 mV or 0.7 div from DC to lesser of 500 MHz or instrument BW, & 6 mV or 0.8 div from > 500 MHz to instrument bandwidth
50 $\Omega$ path		The greater of 5.6 mV or 0.7 div from DC to the lesser of 500 MHz or instrument BW, & 7 mV or 0.8 div from > 500 MHz to instrument bandwidth
Line		Fixed
AUX Trigger in		200 mV <sub>pp</sub> , DC to 250 MHz

Trigger level ranges

Source	Range
Any Channel	$\pm 5$ divs from center of screen
Aux In Trigger	$\pm 5$ V
Line	Fixed at about 50% of line voltage

This specification applies to logic and pulse thresholds.

Trigger frequency counter

8-digits (free with product registration)

Trigger types

<b>Edge:</b>	Positive, negative, or either slope on any channel. Coupling includes DC, AC, noise reject, HF reject, and LF reject
<b>Pulse Width:</b>	Trigger on width of positive or negative pulses. Event can be time- or logic-qualified
<b>Timeout:</b>	Trigger on an event which remains high, low, or either, for a specified time period. Event can be logic-qualified
<b>Runt:</b>	Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Event can be time- or logic-qualified
<b>Window:</b>	Trigger on an event that enters, exits, stays inside or stays outside of a window defined by two user-adjustable thresholds. Event can be time- or logic-qualified
<b>Logic:</b>	Trigger when logic pattern goes true, goes false, or occurs coincident with a clock edge. Pattern (AND, OR, NAND, NOR) specified for all input channels defined as high, low, or don't care. Logic pattern going true can be time-qualified
<b>Setup &amp; Hold:</b>	Trigger on violations of both setup time and hold time between clock and data present on any input channels
<b>Rise / Fall Time:</b>	Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either. Event can be logic-qualified
<b>Video (option 5-VID):</b>	Trigger on all lines, odd, even, or all fields of NTSC, PAL, and SECAM video signals
<b>Sequence:</b>	Trigger on B event X time or N events after A trigger with a reset on C event. In general, A and B trigger events can be set to any trigger type with a few exceptions: logic qualification is not supported, if A event or B event is set to Setup & Hold, then the other must be set to Edge, and Ethernet and High Speed USB (480 Mbps) are not supported
<b>Visual trigger</b>	Qualifies standard triggers by scanning all waveform acquisitions and comparing them to on-screen areas (geometric shapes). An unlimited number of areas can be defined with In, Out, or Don't Care as the qualifier for each area. A boolean expression can be defined using any combination of visual trigger areas to further qualify the events that get stored into acquisition memory. Shapes include rectangle, triangle, trapezoid, hexagon and user-defined.
<b>Parallel Bus:</b>	Trigger on a parallel bus data value. Parallel bus can be from 1 to 64 bits (from the digital and analog channels) in size. Supports Binary and Hex radices
<b>I<sup>2</sup>C Bus (option 5-SREMBD):</b>	Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data on I <sup>2</sup> C buses up to 10 Mb/s
<b>SPI Bus (option 5-SREMBD):</b>	Trigger on Slave Select, Idle Time, or Data (1-16 words) on SPI buses up to 20 Mb/s
<b>RS-232/422/485/UART Bus (option 5-SRCOMP):</b>	Trigger on Start Bit, End of Packet, Data, and Parity Error up to 15 Mb/s

## Trigger system

<b>CAN Bus (option 5-SRAUTO):</b>	Trigger on Start of Frame, Type of Frame (Data, Remote, Error, or Overload), Identifier, Data, Identifier and Data, End Of Frame, Missing Ack, and Bit Stuff Error on CAN buses up to 1 Mb/s
<b>CAN FD Bus (option 5-SRAUTO):</b>	Trigger on Start of Frame, Type of Frame (Data, Remote, Error, or Overload), Identifier (Standard or Extended), Data (1-8 bytes), Identifier and Data, End Of Frame, Error (Missing Ack, Bit Stuffing Error, FD Form Error, Any Error) on CAN FD buses up to 16 Mb/s
<b>LIN Bus (option 5-SRAUTO):</b>	Trigger on Sync, Identifier, Data, Identifier and Data, Wakeup Frame, Sleep Frame, and Error on LIN buses up to 1 Mb/s
<b>FlexRay Bus (option 5-SRAUTO):</b>	Trigger on Start of Frame, Indicator Bits (Normal, Payload, Null, Sync, Startup), Frame ID, Cycle Count, Header Fields (Indicator Bits, Identifier, Payload Length, Header CRC, and Cycle Count), Identifier, Data, Identifier and Data, End Of Frame, and Errors on FlexRay buses up to 10 Mb/s
<b>SENT Bus (option 5-SRAUTOSEN)</b>	Trigger on Start of Packet, Fast Channel Status and Data, Slow Channel Message ID and Data, and CRC Errors
<b>SPMI Bus (option 5-SRPM):</b>	Trigger on Sequence Start Condition, Reset, Sleep, Shutdown, Wakeup, Authenticate, Master Read, Master Write, Register Read, Register Write, Extended Register Read, Extended Register Write, Extended Register Read Long, Extended Register Write Long, Device Descriptor Block Master Read, Device Descriptor Block Slave Read, Register 0 Write, Transfer Bus Ownership, and Parity Error
<b>USB 2.0 LS/FS/HS Bus (option 5-SRUSB2):</b>	Trigger on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error on USB buses up to 480 Mb/s
<b>Ethernet Bus (option 5-SRENET):</b>	Trigger on Start of Frame, MAC Addresses, MAC Q-tag, MAC Length/Type, MAC Data, IP Header, TCP Header, TCP/IPV4 Data, End of Packet, and FCS (CRC) Error on 10BASE-T and 100BASE-TX buses
<b>Audio (I<sup>2</sup>S, LJ, RJ, TDM) Bus (option 5-SRAUDIO):</b>	Trigger on Word Select, Frame Sync, or Data. Maximum data rate for I <sup>2</sup> S/LJ/RJ is 12.5 Mb/s. Maximum data rate for TDM is 25 Mb/s
<b>MIL-STD-1553 Bus (option 5-SRAERO):</b>	Trigger on Sync, Command (Transmit/Receive Bit, Parity, Subaddress / Mode, Word Count / Mode Count, RT Address), Status (Parity, Message Error, Instrumentation, Service Request, Broadcast Command Received, Busy, Subsystem Flag, Dynamic Bus Control Acceptance, Terminal Flag), Data, Time (RT/IMG), and Error (Parity Error, Sync Error, Manchester Error, Non-contiguous Data) on MIL-STD-1553 buses
<b>ARINC 429 Bus (option 5-SRAERO):</b>	Trigger on Word Start, Label, Data, Label and Data, Word End, and Error (Any Error, Parity Error, Word Error, Gap Error) on ARINC 429 buses up to 1 Mb/s
<b>RF Magnitude vs. Time and RF Frequency vs. Time (option 5-SV-RFVT):</b>	Trigger on edge, pulse width and timeout events
<b>RF Magnitude vs. Time and RF Frequency vs. Time (option 5-SV-RFVT)</b>	Trigger on edge, pulse width, and timeout events

## Acquisition system

<b>Sample</b>	Acquires sampled values
<b>Peak Detect</b>	Captures glitches as narrow as 640 ps at all sweep speeds
<b>Averaging</b>	From 2 to 10,240 waveforms
<b>Envelope</b>	Min-max envelope reflecting Peak Detect data over multiple acquisitions
<b>High Res</b>	Applies a unique Finite Impulse Response (FIR) filter for each sample rate that maintains the maximum bandwidth possible for that sample rate while preventing aliasing and removing noise from the oscilloscope amplifiers and ADC above the usable bandwidth for the selected sample rate.  High Res mode always provides at least 12 bits of vertical resolution and extends all the way to 16 bits of vertical resolution at ≤ 125 MS/s sample rates.
<b>FastAcq®</b>	FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events by capturing >500,000 wfms/s (one channel active; >100K wfms/s with all channels active).

## Acquisition system

<b>Roll mode</b>	Scrolls sequential waveform points across the display in a right-to-left rolling motion, at timebase speeds of 40 ms/div and slower, when in Auto trigger mode.
<b>FastFrame™</b>	Acquisition memory divided into segments. Maximum trigger rate >5,000,000 waveforms per second Minimum frame size = 50 points Maximum Number of Frames: For frame size ≥ 1,000 points, maximum number of frames = record length / frame size. For 50 point frames, maximum number of frames = 1,000,000

## Waveform measurements

**Cursor types** Waveform, V Bars, H Bars, V&H Bars, and Polar (XY/XYZ plots only)

**DC voltage measurement accuracy, Average acquisition mode**

Measurement Type	DC Accuracy (In Volts)
Average of ≥ 16 waveforms	$\pm((\text{DC Gain Accuracy}) *  \text{reading} - (\text{offset} - \text{position})  + \text{Offset Accuracy} + 0.1 * \text{V/div setting})$
Delta volts between any two averages of ≥ 16 waveforms acquired with the same oscilloscope setup and ambient conditions	$\pm(\text{DC Gain Accuracy} *  \text{reading}  + 0.05 \text{ div})$

**Automatic measurements** 36, of which an unlimited number can be displayed as either individual measurement badges or collectively in a measurement results table

**Amplitude measurements** Amplitude, Maximum, Minimum, Peak-to-Peak, Positive Overshoot, Negative Overshoot, Mean, RMS, AC RMS, Top, Base, and Area

**Timing measurements** Period, Frequency, Unit Interval, Data Rate, Positive Pulse Width, Negative Pulse Width, Skew, Delay, Rise Time, Fall Time, Phase, Rising Slew Rate, Falling Slew Rate, Burst Width, Positive Duty Cycle, Negative Duty Cycle, Time Outside Level, Setup Time, Hold Time, Duration N-Periods, High Time, and Low Time

**Jitter measurements (standard)** TIE and Phase Noise

**Measurement statistics** Mean, Standard Deviation, Maximum, Minimum, and Population. Statistics are available on both the current acquisition and all acquisitions

**Reference levels** User-definable reference levels for automatic measurements can be specified in either percent or units. Reference levels can be set to global for all measurements, per source channel or signal, or unique for each measurement

**Gating** Screen, Cursors, Logic, Search, or Time. Specifies the region of an acquisition in which to take measurements. Gating can be set to Global (affects all measurements set to Global) or Local (all measurements can have a unique Time gate setting; only one Local gate is available for Screen, Cursors, Logic, and Search actions).

**Measurement plots** Time Trend, Histogram, Spectrum, Eye Diagram (TIE measurement only), and Phase Noise (Phase Noise measurement only) plots are available for all standard measurements

**Measurement limits** Pass/fail testing for user-definable limits on measurement values. Act on event for measurement value failures include Save Screen Capture, Save Waveform, System Request (SRQ), and Stop Acquisitions

**Jitter analysis (option 5-DJA) adds the following:**

<b>Measurements</b>	Jitter Summary, TJ@BER, RJ- $\delta\delta$ , DJ- $\delta\delta$ , PJ, RJ, DJ, DDJ, DCD, SRJ, J2, J9, NPJ, F/2, F/4, F/8, Eye Height, Eye Height@BER, Eye Width, Eye Width@BER, Eye High, Eye Low, Q-Factor, Bit High, Bit Low, Bit Amplitude, DC Common Mode, AC Common Mode (Pk-Pk), Differential Crossover, T/nT Ratio, SSC Freq Dev, SSC Modulation Rate
<b>Measurement plots</b>	Eye Diagram and Jitter Bathtub

## Waveform measurements

	Fast eye rendering: Shows the Unit Intervals (UIs) that define the boundaries of the eye along with a user specified number of surrounding UIs for added visual context
	Complete eye rendering: Shows all valid Unit Intervals (UIs)
<b>Measurement limits</b>	Pass/fail testing for user-definable limits on measurement values. Act on event for measurement value failures include Save Screen Capture, Save Waveform, System Request (SRQ), and Stop Acquisitions
<b>Eye diagram mask testing</b>	Automated mask pass/fail testing
<hr/>	
<b>Power analysis (option 5-PWR) adds the following:</b>	
<b>Measurements</b>	Input Analysis (Frequency, $V_{RMS}$ , $I_{RMS}$ , voltage and current Crest Factors, True Power, Apparent Power, Reactive Power, Power Factor, Phase Angle, Harmonics, Inrush Current, Input Capacitance )
	Amplitude Analysis (Cycle Amplitude, Cycle Top, Cycle Base, Cycle Maximum, Cycle Minimum, Cycle Peak-to-Peak)
	Timing Analysis (Period, Frequency, Negative Duty Cycle, Positive Duty Cycle, Negative Pulse Width, Positive Pulse Width)
	Switching Analysis (Switching Loss, dv/dt, di/dt, Safe Operating Area, $R_{DSON}$ )
	Output Analysis (Line Ripple, Switching Ripple, Efficiency, Turn-on Time, Turn-off Time)
	Magnetic Analysis (Inductance, I vs. Intg(V), Magnetic Loss, Magnetic Property)
	Frequency Response Analysis (Control Loop Response Bode Plot, Power Supply Rejection Ratio, Impedance)
<b>Measurement Plots</b>	Harmonics Bar Graph, Switching Loss Trajectory Plot, and Safe Operating Area
<b>Measurement limits</b>	Pass/fail testing for user-definable limits on measurement values. Act on event for measurement value failures include Save Screen Capture, Save Waveform, System Request (SRQ), and Stop Acquisitions
<hr/>	
<b>Digital power management (option 5-DPM) adds the following:</b>	
<b>Measurements</b>	Ripple Analysis (Ripple)
	Transient Analysis (Overshoot, Undershoot, Turn On Overshoot, DC Rail Voltage)
	Power Sequence Analysis (Turn-on, Turn-off)
	Jitter Analysis (TIE, PJ, RJ, DJ, Eye Height, Eye Width, Eye High, Eye Low)
<hr/>	
<b>Digital Power Management Basic (option 5-DPMBAS) adds the following:</b>	
<b>Measurements</b>	Ripple Analysis (Ripple)
	Transient Analysis (Overshoot, Undershoot)
	Power Sequence Analysis (Turn-on, Turn-off)
<hr/>	
<b>LVDS debug and analysis option (option 5-DBLVDS) adds the following:</b>	
<b>Data Lane Measurements</b>	Generic Test (Unit Interval, Rise Time, Fall Time, Data Width, Data Intra Skew (PN), Data Inter Skew (Lane-to-Lane), Data Peak-to-Peak)
	Jitter Test (AC Timing, Clock Data Setup Time, Clock Data Hold Time, Eye Diagram (TIE), TJ@BER, DJ Delta, RJ Delta, DDJ, De-Emphasis Level)
<b>Clock Lane Measurements</b>	Generic Test (Frequency, Period, Duty Cycle, Rise Time, Fall Time, Clock Intra Skew (PN), Clock Peak-to-Peak)
	Jitter Test (TIE, DJ, RJ)
	SSC On (Mod Rate, Frequency Deviation Mean)
<hr/>	

## Waveform math

Number of math waveforms	Unlimited
Arithmetic	Add, subtract, multiply, and divide waveforms and scalars
Algebraic expressions	Define extensive algebraic expressions including waveforms, scalars, user-adjustable variables, and results of parametric measurements. Perform math on math using complex equations. For example (Integral (CH1 - Mean(CH1)) X 1.414 X VAR1)
Math functions	Invert, Integrate, Differentiate, Square Root, Exponential, Log 10, Log e, Abs, Ceiling, Floor, Min, Max, Degrees, Radians, Sin, Cos, Tan, ASin, ACos, and ATan
Relational	Boolean result of comparison >, <, ≥, ≤, =, and ≠
Logic	AND, OR, NAND, NOR, XOR, and EQV
Filtering function	User-definable filters. Users specify a file containing the coefficients of the filter
FFT functions	Spectral Magnitude and Phase, and Real and Imaginary Spectra
FFT vertical units	Magnitude: Linear and Log (dBm) Phase: Degrees, Radians, and Group Delay
FFT window functions	Hanning, Rectangular, Hamming, Blackman-Harris, Flattop2, Gaussian, Kaiser-Bessel, and TekExp

## Spectrum View

Center Frequency	Limited by instrument analog bandwidth														
Span	18.6 Hz to 312.5 MHz 18.6 Hz to 500 MHz (with option 5-SV-BW-1) Coarse adjustment in a 1-2-5 sequence														
RF vs. Time Traces	Magnitude vs. time, Frequency vs. time, Phase vs. time (with option 5-SV-RFVT)														
RF vs. Time Trigger	Edge, pulse width, and timeout trigger on RF Magnitude vs. Time and RF Frequency vs. Time (with option 5-SV-RFVT)														
Resolution Bandwidth (RBW)	93 μHz to 62.5 MHz 93 μHz to 100 MHz (with option 5-SV-BW-1)														
Window types and factors	<table border="1"> <thead> <tr> <th>Window type</th> <th>Factor</th> </tr> </thead> <tbody> <tr> <td>Blackman-Harris</td> <td>1.90</td> </tr> <tr> <td>Flat-Top 2</td> <td>3.77</td> </tr> <tr> <td>Hamming</td> <td>1.30</td> </tr> <tr> <td>Hanning</td> <td>1.44</td> </tr> <tr> <td>Kaiser-Bessel</td> <td>2.23</td> </tr> <tr> <td>Rectangular</td> <td>0.89</td> </tr> </tbody> </table>	Window type	Factor	Blackman-Harris	1.90	Flat-Top 2	3.77	Hamming	1.30	Hanning	1.44	Kaiser-Bessel	2.23	Rectangular	0.89
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Flat-Top 2	3.77														
Hamming	1.30														
Hanning	1.44														
Kaiser-Bessel	2.23														
Rectangular	0.89														
Spectrum Time	FFT Window Factor / RBW														
Reference level	Reference level is automatically set by the analog channel Volts/div setting Setting range: -42 dBm to +44 dBm														



**Spectrum View**

Vertical Position	-100 divs to +100 divs
Horizontal scaling	Linear, Log
Vertical units	dBm, dBμW, dBmV, dBμV, dBmA, dBμA

**Search**

Number of searches	Unlimited
Search types	Search through long records to find all occurrences of user specified criteria including edges, pulse widths, timeouts, runt pulses, window violations, logic patterns, setup & hold violations, rise/fall times, and bus protocol events. Search results can be viewed in the Waveform View or in the Results table.

**Save**

Waveform Type	Tektronix Waveform Data (.wfm), Comma Separated Values (.csv), MATLAB (.mat)
Waveform Gating	Cursors, Screen, Resample (save every nth sample)
Screen Capture Type	Portable Network Graphic (*.png), 24-bit Bitmap (*.bmp), JPEG (*.jpg)
Setup Type	Tektronix Setup (.set)
Report Type	Adobe Portable Documents (.pdf), Single File web Pages (.mht)
Session Type	Tektronix Session Setup (.tss)

**Display (available only through the video out ports or e\*Scope)**

	1,920 horizontal × 1,080 vertical pixels
Display modes	<p>Overlay: traditional oscilloscope display where traces overlay each other</p> <p>Stacked: display mode where each waveform is placed in its own slice and can take advantage of the full ADC range while still being visually separated from other waveforms. Groups of channels can also be overlaid within a slice to simplify visual comparison of signals.</p>
Zoom	Horizontal and vertical zooming is supported in all waveform and plot views.
Interpolation	Sin(x)/x and Linear
Waveform styles	Vectors, dots, variable persistence, and infinite persistence
Graticules	Movable and fixed graticules, selectable between Grid, Time, Full, and None
Color palettes	<p>Normal and inverted for screen captures</p> <p>Individual waveform colors are user-selectable</p>
Format	YT, XY, and XYZ
Local Language User Interface	English, Japanese, Simplified Chinese, Traditional Chinese, French, German, Italian, Spanish, Portuguese, Russian, Korean
Local Language Help	English, Japanese, Simplified Chinese

**Arbitrary/Function Generator (optional)**

**Function types** Arbitrary, sine, square, pulse, ramp, triangle, DC level, Gaussian, Lorentz, exponential rise/fall,  $\sin(x)/x$ , random noise, Haversine, Cardiac

**Sine waveform**

**Frequency range** 0.1 Hz to 50 MHz  
**Frequency setting resolution** 0.1 Hz  
**Frequency accuracy** 130 ppm (frequency  $\leq$  10 kHz), 50 ppm (frequency  $>$  10 kHz)  
 This is for Sine, Ramp, Square and Pulse waveforms only.  
**Amplitude range** 20 mV<sub>pp</sub> to 5 V<sub>pp</sub> into Hi-Z; 10 mV<sub>pp</sub> to 2.5 V<sub>pp</sub> into 50  $\Omega$   
**Amplitude flatness, typical**  $\pm$ 0.5 dB at 1 kHz  
 $\pm$ 1.5 dB at 1 kHz for  $<$  20 mV<sub>pp</sub> amplitudes  
**Total harmonic distortion, typical** 1% for amplitude  $\geq$  200 mV<sub>pp</sub> into 50  $\Omega$  load  
 2.5% for amplitude  $>$  50 mV AND  $<$  200 mV<sub>pp</sub> into 50  $\Omega$  load  
 This is for Sine wave only.  
**Spurious free dynamic range, typical** 40 dB ( $V_{pp} \geq 0.1$  V); 30 dB ( $V_{pp} \geq 0.02$  V), 50  $\Omega$  load

**Square and pulse waveform**

**Frequency range** 0.1 Hz to 25 MHz  
**Frequency setting resolution** 0.1 Hz  
**Frequency accuracy** 130 ppm (frequency  $\leq$  10 kHz), 50 ppm (frequency  $>$  10 kHz)  
**Amplitude range** 20 mV<sub>pp</sub> to 5 V<sub>pp</sub> into Hi-Z; 10 mV<sub>pp</sub> to 2.5 V<sub>pp</sub> into 50  $\Omega$   
**Duty cycle range** 10% - 90% or 10 ns minimum pulse, whichever is larger  
 Minimum pulse time applies to both on and off time, so maximum duty cycle will reduce at higher frequencies to maintain 10 ns off time  
**Duty cycle resolution** 0.1%  
**Minimum pulse width, typical** 10 ns. This is the minimum time for either on or off duration.  
**Rise/Fall time, typical** 5 ns, 10% - 90%  
**Pulse width resolution** 100 ps  
**Overshoot, typical**  $<$  6% for signal steps greater than 100 mV<sub>pp</sub>  
 This applies to overshoot of the positive-going transition (+overshoot) and of the negative-going (-overshoot) transition  
**Asymmetry, typical**  $\pm$ 1%  $\pm$ 5 ns, at 50% duty cycle  
**Jitter, typical**  $<$  60 ps TIE<sub>RMS</sub>,  $\geq$  100 mV<sub>pp</sub> amplitude, 40%-60% duty cycle

**Ramp and triangle waveform**

**Frequency range** 0.1 Hz to 500 kHz  
**Frequency setting resolution** 0.1 Hz  
**Frequency accuracy** 130 ppm (frequency  $\leq$  10 kHz), 50 ppm (frequency  $>$  10 kHz)  
**Amplitude range** 20 mV<sub>pp</sub> to 5 V<sub>pp</sub> into Hi-Z; 10 mV<sub>pp</sub> to 2.5 V<sub>pp</sub> into 50  $\Omega$   
**Variable symmetry** 0% - 100%  
**Symmetry resolution** 0.1%

**DC level range**  $\pm$ 2.5 V into Hi-Z  
 $\pm$ 1.25 V into 50  $\Omega$

**Random noise amplitude range** 20 mV<sub>pp</sub> to 5 V<sub>pp</sub> into Hi-Z  
 10 mV<sub>pp</sub> to 2.5 V<sub>pp</sub> into 50  $\Omega$

## Arbitrary/Function Generator (optional)

<b>Sin(x)/x</b>	
Maximum frequency	2 MHz
<b>Gaussian pulse, Haversine, and Lorentz pulse</b>	
Maximum frequency	5 MHz
<b>Lorentz pulse</b>	
Frequency range	0.1 Hz to 5 MHz
Amplitude range	20 mV <sub>pp</sub> to 2.4 V <sub>pp</sub> into Hi-Z
	10 mV <sub>pp</sub> to 1.2 V <sub>pp</sub> into 50 Ω
<b>Cardiac</b>	
Frequency range	0.1 Hz to 500 kHz
Amplitude range	20 mV <sub>pp</sub> to 5 V <sub>pp</sub> into Hi-Z
	10 mV <sub>pp</sub> to 2.5 V <sub>pp</sub> into 50 Ω
<b>Arbitrary</b>	
Memory depth	1 to 128 k
Amplitude range	20 mV <sub>pp</sub> to 5 V <sub>pp</sub> into Hi-Z
	10 mV <sub>pp</sub> to 2.5 V <sub>pp</sub> into 50 Ω
Repetition rate	0.1 Hz to 25 MHz
Sample rate	250 MS/s
Signal amplitude accuracy	±[ (1.5% of peak-to-peak amplitude setting) + (1.5% of absolute DC offset setting) + 1 mV ] (frequency = 1 kHz)
Signal amplitude resolution	1 mV (Hi-Z)
	500 μV (50 Ω)
Sine and ramp frequency accuracy	(frequency ≤10 kHz)
	(frequency >10 kHz)
DC offset range	±2.5 V into Hi-Z
	±1.25 V into 50 Ω
DC offset resolution	1 mV (Hi-Z)
	500 μV (50 Ω)
DC offset accuracy	±[ (1.5% of absolute offset voltage setting) + 1 mV ] Add 3 mV of uncertainty per 10 °C change from 25 °C ambient

**Digital volt meter (DVM)**

<b>Measurement types</b>	DC, AC <sub>RMS</sub> +DC, AC <sub>RMS</sub>
<b>Voltage resolution</b>	4 digits
<b>Voltage accuracy</b>	
<b>DC:</b>	$\pm((1.5\% *  \text{reading} - \text{offset} - \text{position} ) + (0.5\% *  (\text{offset} - \text{position}) )) + (0.1 * \text{Volts/div})$ De-rated at 0.100%/°C of  reading - offset - position  above 30 °C Signal $\pm 5$ divisions from screen center
<b>AC:</b>	$\pm 2\%$ (40 Hz to 1 kHz) with no harmonic content outside 40 Hz to 1 kHz AC, typical: $\pm 2\%$ (20 Hz to 10 kHz) For AC measurements, the input channel vertical settings must allow the $V_{pp}$ input signal to cover between 4 and 10 divisions and must be fully visible on the screen

**Trigger frequency counter**

<b>Accuracy</b>	$\pm(1 \text{ count} + \text{time base accuracy} * \text{input frequency})$ The signal must be at least 8 mV <sub>pp</sub> or 2 div, whichever is greater.
<b>Maximum input frequency</b>	10 Hz to maximum bandwidth of the analog channel The signal must be at least 8 mV <sub>pp</sub> or 2 div, whichever is greater.
<b>Resolution</b>	8-digits

**Processor system**

<b>Host processor</b>	Intel i5-4400E, 2.7 GHz, 64-bit, dual core processor
<b>Operating system</b>	Default instrument: Closed Embedded OS
<b>Internal storage</b>	$\geq 80$ GB. Form factor is an 80 mm m.2 card with a SATA-3 interface

**Input-Output ports**

<b>DisplayPort connector</b>	A 20-pin DisplayPort connector; connect to show the oscilloscope display on an external monitor or projector
<b>DVI connector</b>	A 29-pin DVI-D connector; connect to show the oscilloscope display on an external monitor or projector
<b>VGA</b>	DB-15 female connector; connect to show the oscilloscope display on an external monitor or projector
<b>Probe compensator signal, typical</b>	
<b>Connection:</b>	Connectors are located on the lower right front panel of the instrument
<b>Amplitude:</b>	0 to 2.5 V
<b>Frequency:</b>	1 kHz
<b>Source impedance:</b>	1 k $\Omega$
<b>External reference input</b>	The time-base system can phase lock to an external 10 MHz reference signal ( $\pm 4$ ppm).

## Input-Output ports

**USB interface (Host, Device ports)** Front panel USB Host ports: One USB 2.0 Hi-Speed port, one USB 3.0 SuperSpeed port  
 Rear panel USB Host ports: Two USB 2.0 Hi-Speed ports  
 Rear panel USB Device port: One Device port providing USBTMC support

**Ethernet interface** 10/100/1000 Mb/s

**Auxiliary output** Rear-panel BNC connector. Output can be configured to provide a positive or negative pulse out when the oscilloscope triggers, the internal oscilloscope reference clock out, or an AFG sync pulse

Characteristic	Limits
Vout (HI)	≥ 2.5 V open circuit; ≥ 1.0 V into a 50 Ω load to ground
Vout (LO)	≤ 0.7 V into a load of ≤ 4 mA; ≤ 0.25 V into a 50 Ω load to ground

**Aux Trigger In**  
**Connection** Front-panel SMA connector  
**Input impedance** 50 Ω  
**Maximum input** ≤ 5 V<sub>RMS</sub>

**Kensington-style lock** Rear-panel security slot connects to standard Kensington-style lock

## Power source

**Power**  
**Power consumption** 400 Watts maximum  
**Source voltage** 100 - 240 V ±10% at 50 Hz to 60 Hz  
 115 V ±10% at 400 Hz ±10%

## Physical characteristics

**Dimensions**  
 Height: 3.44 in (87.3 mm)  
 Width: 17.01 in (432 mm)  
 Depth: 23.85 in (605.7 mm)  
 Fits rack depths from 24 inches to 32 inches

**Weight** 25.5 lbs (11.6 kg)

**Cooling** The clearance requirement for adequate cooling is 2.0 in (50.8 mm) on the left and right sides of the instrument (when viewed from the front). Air flows through the instrument from left to right

**Rackmount configuration** 2U (rack mounts and screws come standard)

## Environmental specifications

### Temperature

<b>Operating</b>	+0 °C to +50 °C (32 °F to 122 °F)
<b>Non-operating</b>	-20 °C to +60 °C (-4 °F to 140 °F)

### Humidity

<b>Operating</b>	5% to 90% relative humidity (% RH) at up to +40 °C
	5% to 55% RH above +40 °C up to +50 °C, noncondensing, and as limited by a maximum wet-bulb temperature of +39 °C
<b>Non-operating</b>	5% to 90% relative humidity (% RH) at up to +40 °C
	5% to 39% RH above +40 °C up to +50 °C, noncondensing, and as limited by a maximum wet-bulb temperature of +39 °C

### Altitude

<b>Operating</b>	Up to 3,000 meters (9,843 feet)
<b>Non-operating</b>	Up to 12,000 meters (39,370 feet)

### Random vibration

<b>Operating</b>	0.31 GRMS, 5-500 Hz, 10 minutes per axis, 3 axes (30 minutes total)
<b>Non-operating</b>	2.46 GRMS, 5-500 Hz, 10 minutes per axis, 3 axes (30 minutes total)

## EMC, Environment, and Safety

<b>Regulatory</b>	CE marked for the European Union and UL approved for the USA and Canada RoHS compliant
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## Software

### Software

<b>IVI driver</b>	Provides a standard instrument programming interface for common applications such as LabVIEW, LabWindows/CVI, Microsoft .NET, and MATLAB. Compatible with Python, C/C++/C# and many other languages through VISA.
<b>e*Scope®</b>	Enables control of the oscilloscope over a network connection through a standard web browser. Simply enter the IP address or network name of the oscilloscope and a web page will be served to the browser. Transfer and save settings, waveforms, measurements, and screen images or make live control changes to settings on the oscilloscope directly from the web browser.
<b>LXI Web interface</b>	Connect to the oscilloscope through a standard Web browser by simply entering the oscilloscope's IP address or network name in the address bar of the browser. The Web interface enables viewing of instrument status and configuration, status and modification of network settings, and instrument control through the e*Scope web-based remote control.
<b>Programming Examples</b>	Programming with the 4/5/6 Series platforms has never been easier. With a programmers manual and a GitHub site you have many commands and examples to help you get started remotely automating your instrument. See <a href="https://github.com/tektronix/Programmatic-Control-Examples">https://github.com/tektronix/Programmatic-Control-Examples</a> .

## Ordering information

Use the following information to select the appropriate instrument and options for your measurement needs.

### Step 1

Start by selecting the 5 Series MSO Low Profile model that you need.

Model	Description
MSO58LP	Low Profile Mixed Signal Oscilloscope; 1 GHz bandwidth, (8) FlexChannels with 125 M record length
MSO58LPGSA	Low Profile Mixed Signal Oscilloscope; 1 GHz bandwidth, (8) FlexChannels with 125 M record length; Trade Agreements Act (TAA) compliant

Each model includes
Rackmount attachments installed
Installation and safety manual (translated in English, Japanese, Simplified Chinese)
Embedded Help
Power cord
Calibration certificate documenting traceability to National Metrology Institute(s) and ISO9001/ISO17025 quality system registration
Three-year warranty covering all parts and labor on the instrument.

### Step 2

Add instrument functionality

Instrument functionality can be ordered with the instrument or later as an upgrade kit.

Instrument Option	Built-in Functionality
5-RL-250M	Extend record length from 125 Mpoints/channel to 250 Mpoints/channel
5-RL-500M	Extend record length from 125 Mpoints/channel to 500 Mpoints/channel
5-AFG	Add Arbitrary / Function Generator
5-SEC <sup>7</sup>	Add enhanced security for instrument declassification and password-protected enabling and disabling of all USB ports and firmware upgrade.

<sup>7</sup> This option must be purchased at the same time as the instrument. Not available as an upgrade.

### Step 3

#### Add optional serial bus triggering, decode, and search capabilities

Choose the serial support you need today by choosing from these serial analysis options. You can upgrade later by purchasing an upgrade kit.

Instrument Option	Serial Buses Supported
5-SRAERO	Aerospace (MIL-STD-1553, ARINC 429)
5-SRAUDIO	Audio (I <sup>2</sup> S, LJ, RJ, TDM)
5-SRAUTO	Automotive (CAN, CAN FD, LIN, FlexRay, and CAN symbolic decoding)
5-SRAUTOEN1	100BASE-T1 Automotive Ethernet serial analysis
5-SRAUTOSEN	Automotive sensor (SENT)
5-SRCOMP	Computer (RS-232/422/485/UART)
5-SREMBD	Embedded (I <sup>2</sup> C, SPI)
5-SRENET	Ethernet (10BASE-T, 100BASE-TX)
5-SR8B10B	8B/10B
5-SRI3C	MIPI I3C (I3C decode and search only)
5-SRMDIO	MDIO (decode and search only)
5-SRNRZ	NRZ (decode and search only)
5-SRPM	Power Management (SPMI)
5-SRPSI5	PSI5 (decode and search only)
5-SRSPACEWIRE	Spacewire (decode and search only)
5-SRVID	SVID (decode and search only)
5-SRUSB2	USB (USB2.0 LS, FS, HS)
5-SREUSB2	eUSB2.0 (decode and search only)

Differential serial bus? Be sure to check *Add analog probes and adapters* for differential probes.

### Step 4

#### Add optional analysis capabilities

Instrument Option	Advanced Analysis
5-DJA	Advanced Jitter and Eye Analysis
5-DPM	Digital Power Management
5-DPMBAS	Basic Digital Power Management
5-MTM	Mask and Limit testing
5-PS2 <sup>8 9</sup>	Power Solution Bundle (5-PWR, THDP0200, TCP0030A, 067-1686-xx deskew fixture)
5-PS2FRA <sup>8 9</sup>	Power Solution Bundle (5-PWR, THDP0200, TCP0030A, two TPP0502, 067-1686-xx deskew fixture)
5-PWR <sup>10</sup>	Power Measurement and Analysis
5-SV-BW-1	Increase Spectrum View Capture Bandwidth to 500 MHz
5-SV-RFVT	Spectrum View RF versus Time analysis, trigger and remote IQ data transferring
5-VID	NTSC, PAL, and SECAM video triggering

<sup>8</sup> This option is not compatible with option 5-PWR.

<sup>9</sup> This option must be purchased at the same time as the instrument. Not available as an upgrade.

<sup>10</sup> This option is not compatible with option 5-PS2 or 5-PS2FRA.



## Step 5

### Add analog probes and adapters

Add additional recommended probes and adapters

Recommended Probe / Adapter	Description
TAP1500	1.5 GHz TekVPI® active single-ended voltage probe, ±8 V input voltage
TAP2500	2.5 GHz TekVPI® active single-ended voltage probe, ±4 V input voltage
TCP0030A	30 A AC/DC TekVPI® current probe, 120 MHz BW
TCP0020	20 A AC/DC TekVPI® current probe, 50 MHz BW
TCP0030A	30 A AC/DC TekVPI current probe, 120 MHz BW
TCP0150	150 A AC/DC TekVPI® current probe, 20 MHz BW
TRCP0300	30 MHz AC current probe, 250 mA to 300 A
TRCP0600	30 MHz AC current probe, 500 mA to 600 A
TRCP3000	16 MHz AC current probe, 500 mA to 3000 A
TDP0500	500 MHz TekVPI® differential voltage probe, ±42 V differential input voltage
TDP1000	1 GHz TekVPI® differential voltage probe, ±42 V differential input voltage
TDP1500	1.5 GHz TekVPI® differential voltage probe, ±8.5 V differential input voltage
TDP7704	4 GHz TriMode™ voltage probe
THDP0100	±6 kV, 100 MHz TekVPI® high-voltage differential probe
THDP0200	±1.5 kV, 200 MHz TekVPI® high-voltage differential probe
TMDP0200	±750 V, 200 MHz TekVPI® high-voltage differential probe
TPR1000	1 GHz, Single-Ended TekVPI® Power-Rail Probe; includes one TPR4KIT accessory kit
TIVH02	Isolated Probe; 200 MHz, ±2500 V, TekVPI, 3 Meter Cable
TIVH02L	Isolated Probe; 200 MHz, ±2500 V, TekVPI, 10 Meter Cable
TIVH05	Isolated Probe; 500 MHz, ±2500 V, TekVPI, 3 Meter Cable
TIVH05L	Isolated Probe; 500 MHz, ±2500 V, TekVPI, 10 Meter Cable
TIVH08	Isolated Probe; 800 MHz, ±2500 V, TekVPI, 3 Meter Cable
TIVH08L	Isolated Probe; 800 MHz, ±2500 V, TekVPI, 10 Meter Cable
TIVM1	Isolated Probe; 1 GHz, ±50 V, TekVPI, 3 Meter Cable
TIVM1L	Isolated Probe; 1 GHz, ±50 V, TekVPI, 10 Meter Cable
TPP0500B	500 MHz, 10X TekVPI® passive voltage probe, 1.3 Meter Cable
TPP0502	500 MHz, 2X TekVPI® passive voltage probe, 12.7 pF input capacitance
TPP0850	2.5 kV, 800 MHz, 50X TekVPI® passive high-voltage probe
TPP1000	1 GHz, 10X TekVPI® passive voltage probe, 1.3 Meter cable, 3.9 pF input capacitance
P6015A	20 kV, 75 MHz high-voltage passive probe
TPA-BNC <sup>11</sup>	TekVPI® to TekProbe™ BNC adapter
TEK-DPG	TekVPI deskew pulse generator signal source
067-1686-xx	Power measurement deskew and calibration fixture

Looking for other probes? Check out the probe selector tool at [www.tek.com/probes](http://www.tek.com/probes).

<sup>11</sup> Recommended for connecting your existing TekProbe probes to the MSO58LP Low Profile.

## Step 6

### Add digital probes

Each FlexChannel input can be configured as eight digital channels simply by connecting a TLP058 logic probe. TLP058 probes are ordered separately.

For this instrument	Order	To add
MSO58LP, MSO58LPGSA	1 to 8 TLP058 Probes	8 to 64 digital channels

### Add accessories

Optional Accessory	Description
020-3180-xx	Benchtop conversion kit including four (4) instrument feet and a strap handle
016-2139-xx	Hard transit case with handles and wheels for easy transportation
GPIO to Ethernet adapter	Order model 4865B (GPIO to Ethernet to Instrument Interface) directly from ICS Electronics <a href="http://www.icselect.com/gpio_instrument_intf.html">www.icselect.com/gpio_instrument_intf.html</a>

### Select power cord option

Power Cord Option	Description
A0	North America power plug (115 V, 60 Hz) Includes mechanism that retains power cord to instrument
A1	Universal Euro power plug (220 V, 50 Hz)
A2	United Kingdom power plug (240 V, 50 Hz)
A3	Australia power plug (240 V, 50 Hz)
A5	Switzerland power plug (220 V, 50 Hz)
A6	Japan power plug (100 V, 50/60 Hz)
A10	China power plug (50 Hz)
A11	India power plug (50 Hz)
A12	Brazil power plug (60 Hz)
A99	No power cord

## Step 9

### Add extended service and calibration options

Service Option	Description
T3	Three Year Total Protection Plan, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS.
T5	Five Year Total Protection Plan, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS.
R5	Standard Warranty Extended to 5 Years. Covers parts, labor and 2-day shipping within country. Guarantees faster repair time than without coverage. All repairs include calibration and updates. Hassle free - a single call starts the process.
C3	Calibration service 3 Years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 2 years calibration coverage.
C5	Calibration service 5 Years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 4 years calibration coverage.
D1	Calibration Data Report
D3	Calibration Data Report 3 Years (with Option C3)
D5	Calibration Data Report 5 Years (with Option C5)

## Feature upgrades after purchase

**Add feature upgrades in the future** You can easily add functionality after the initial purchase. Node-locked licenses permanently enable optional features on a single product. Floating licenses allow license-enabled options to be easily moved between compatible instruments.

Upgrade feature	Node-locked license upgrade	Floating license upgrade	Description
Add instrument functions	SUP5-AFG	SUP5-AFG-FL	Add arbitrary function generator
	SUP5-RL-125MT250M	SUP5-RL-125MT250M-FL	Extend record length from 125 Mpts to 250 Mpts
	SUP5-RL-125MT500M	SUP5-RL-125MT500M-FL	Extend record length from 125 Mpts to 500 Mpts
	SUP5-RL-250MT500M	SUP5-RL-250MT500M-FL	Extend record length from 250 Mpts to 500 Mpts
Add protocol analysis	SUP5-SR8B10B	SUP5-SR8B10B-FL	8b/10b serial decoding and analysis
	SUP5-SRAERO	SUP5-SRAERO-FL	Aerospace serial triggering and analysis (MIL-STD-1553, ARINC 429)
	SUP5-SRAUDIO	SUP5-SRAUDIO-FL	Audio serial triggering and analysis (I <sup>2</sup> S, LJ, RJ, TDM)
	SUP5-SRAUTO	SUP5-SRAUTO-FL	Automotive serial triggering and analysis (CAN, CAN FD, LIN, FlexRay, and CAN symbolic decoding)
	SUP5-SRAUTOEN1	SUP5-SRAUTOEN1-FL	100Base-T1 Automotive Ethernet serial analysis
	SUP5-SRAUTOSEN	SUP5-SRAUTOSEN-FL	Automotive sensor serial triggering and analysis (SENT)
	SUP5-SRCOMP	SUP5-SRCOMP-FL	Computer serial triggering and analysis (RS-232/422/485/UART)
	SUP5-SREMBD	SUP5-SREMBD-FL	Embedded serial triggering and analysis (I <sup>2</sup> C, SPI)
	SUP5-SRENET	SUP5-SRENET-FL	Ethernet serial triggering and analysis (10Base-T, 100Base-TX)
	SUP5-SRI3C	SUP5-SRI3C-FL	MIPI I3C serial decoding and analysis
	SUP5-SRMDIO	SUP5-SRMDIO-FL	Management Data Input/Output serial decoding and analysis
	SUP5-SRNRZ	SUP5-SRNRZ-FL	NRZ serial decoding and analysis
	SUP5-SRPM	SUP5-SRPM-FL	Power Management serial triggering and analysis (SPMI)
	SUP5-SRSPACEWIRE	SUP5-SRSPACEWIRE-FL	Spacewire serial analysis
	SUP5-SRSVID	SUP5-SRSVID-FL	Serial Voltage Identification (SVID) serial decoding and analysis
	SUP5-SRUSB2	SUP5-SRUSB2-FL	USB 2.0 serial bus triggering and analysis (LS, FS, and HS)
SUP5-SREUSB2	SUP5-SREUSB2-FL	Embedded USB2 (eUSB2) serial decoding and analysis	

Upgrade feature	Node-locked license upgrade	Floating license upgrade	Description
Add advanced analysis	SUP5-DJA	SUP5-DJA-FL	Advanced jitter and eye analysis
	SUP5-DPM	SUP5-DPM-FL	Digital Power Management
	SUP5-MTM	SUP5-MTM-FL	Mask and Limit Testing
	SUP5-DPMBAS	SUP5-DPMBAS-FL	Basic digital power management
	SUP5-PWR	SUP5-PWR-FL	Advanced power measurements and analysis
	SUP5-SV-BW-1	SUP5-SV-BW-1-FL	Increase Spectrum View Capture Bandwidth to 500 MHz
	SUP5-SV-RFVT	SUP5-SV-RFVT-FL	Spectrum View RF versus Time analysis and trigger
	SUP5-VID	SUP5-VID-FL	NTSC, PAL, and SECAM video triggering
Add digital voltmeter	SUP5-DVM	N/A	Add digital voltmeter / trigger frequency counter (Free with product registration at <a href="http://www.tek.com/register5mso">www.tek.com/register5mso</a> )



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.



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**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tek.com](http://www.tek.com).

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