

## 5 Series MS0 Low Profile

### MS058LP Datasheet

*More system visibility in less rack space.*



*Standard rack mount configuration*



*Optional bench conversion configuration*

## Key performance specifications

### Input channels

- 8 FlexChannel® 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, 500 MHz (upgradable)

### 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™: 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

### Optional analysis (optional and upgradable)

- Advanced Jitter and Eye Diagram Analysis
- Signal Integrity Modeling (SIM)
- User-defined filtering
- Advanced Spectrum View
- RF vs. Time traces, triggers, Spectrograms, and IQ capture
- Digital Power Management
- Power Distribution Network Analysis
- Time Domain Reflectometry (TDR)
- Mask/Limit Testing
- Advanced Power Measurements and Analysis

### Optional protocol trigger, decode, and analysis (optional and upgradable)

I2C, SPI, eSPI, I3C, RS-232/422/485/UART, SPMI, SMBus, CAN, CAN FD, CAN XL, LIN, FlexRay, SENT, PSI5, CXPI, Automotive Ethernet, MIPI C-PHY, MIPI D-PHY, USB 2.0, eUSB 2.0, Ethernet, EtherCAT, Audio, MIL-STD-1553, ARINC 429, SpaceWire, 8B/10B, NRZ, Manchester, SVID, 1-Wire, MDIO, and NFC

### Arbitrary/Function Generator (optional and upgradable)

- 50 MHz Arbitrary Function Generation
- Waveform Types: Arbitrary, Sine, Square, Pulse, Ramp, Triangle, DC Level, Gaussian, Lorentz, Exponential Rise/Fall, Sin(x)/x, Random Noise, Haversine, Cardiac

### Digital voltmeter (free with product registration)

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

### Trigger frequency counter (free with product registration)

- 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), DisplayPort, 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<sup>®</sup> 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 [tek.com/products/oscilloscopes/5-series-mso](http://tek.com/products/oscilloscopes/5-series-mso).



*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.

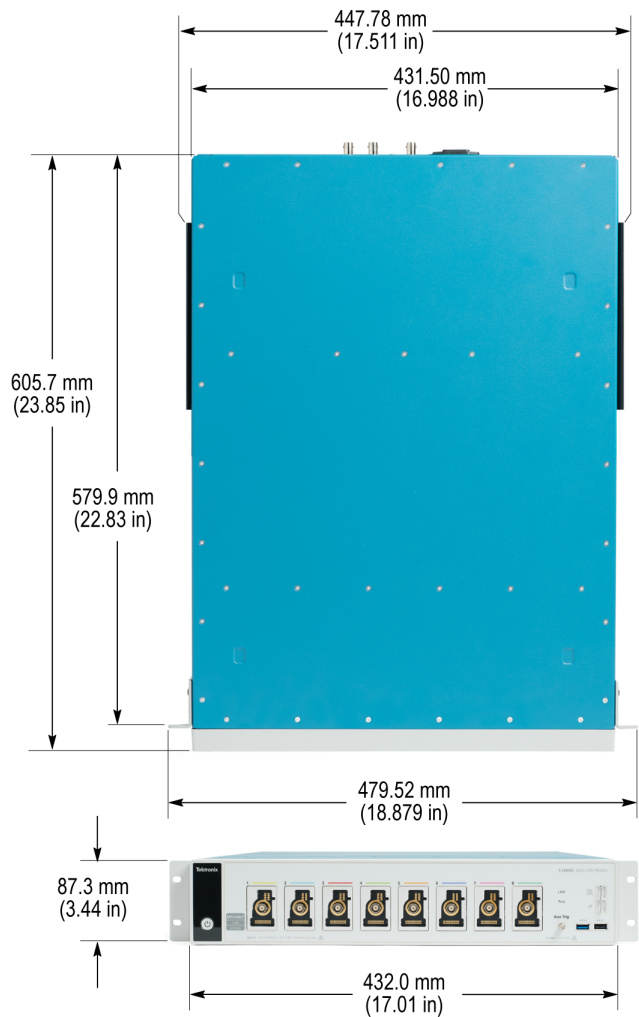


***Multiple MSO58LP instruments installed in a rack, making efficient use of available space.***

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 up to 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.

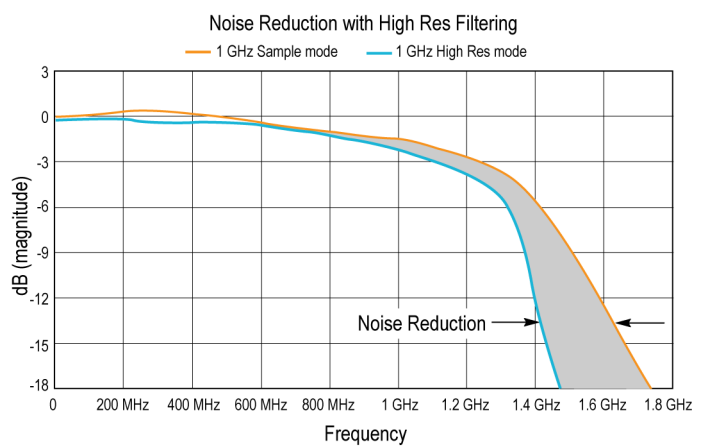
The 5 Series MSO Low Profile has up to 6.25 GS/s sample rate on all channels, providing more than 5x oversampling, enabling better noise performance and fine timing resolution.

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.

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   | 8                                     |
| 3.125 GS/s  | 12                                    |
| 1.25 GS/s   | 13                                    |
| 625 MS/s    | 14                                    |
| 312.5 MS/s  | 15                                    |
| ≤125 MS/s   | 16                                    |

**NOTE:** 6.25 GS/s not available as real-time sample rate when High Res is on.

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.

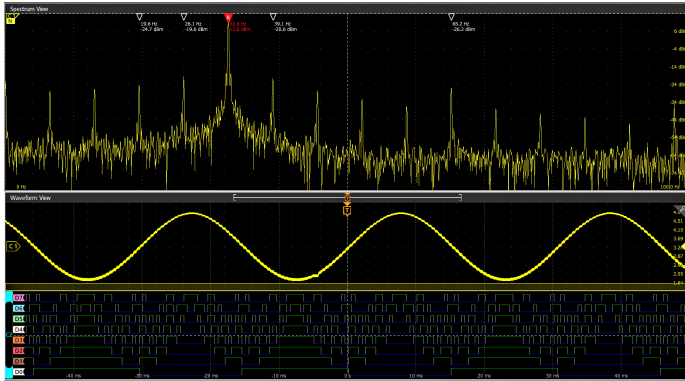
The following table shows the typical ENOB values for the 5 Series MSO Low Profile measured with High Res mode, 50 Ω, 10 MHz input with 90% full screen.

| 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 , IVI-C , and LabVIEW 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 set up and controls the instrument remotely enable easy test automation.

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**NOTE:** IVI-COM and LabVIEW : Drivers are available from [www.tek.com/downloads](http://www.tek.com/downloads).

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**NOTE:** IVI-C : Drivers are available from [www.ni.com](http://www.ni.com).

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#### Building a next-generation test rack

Looking for a modern way to refresh your test rack, view, download or analyze your data? Looking to replace obsolete hardware without rewriting your code?

We understand that test rack designs take time and include numerous tradeoffs. Tektronix has heard your voice loud and clear and is blazing a new path to provide a richer set of tools to enable flexible ways to access data and replace obsolete hardware. If that means you are automating a test rack with LabVIEW, Python or another interface, we have an expanding number of drivers and numerous support resources available.

Maybe you require an easy way to view waveforms on a remote computer. Not a problem, Tektronix has a software team designing new ways to control the instrument from a browser (E\*Scope), store your data in the cloud (TekCloud), or stream data to our PC (TekScope). Providing modern age tools at your fingertips.

Lastly, users familiar with keyboards, mice, monitors, and KVM switches can continue to operate as they always have!



TekCloud

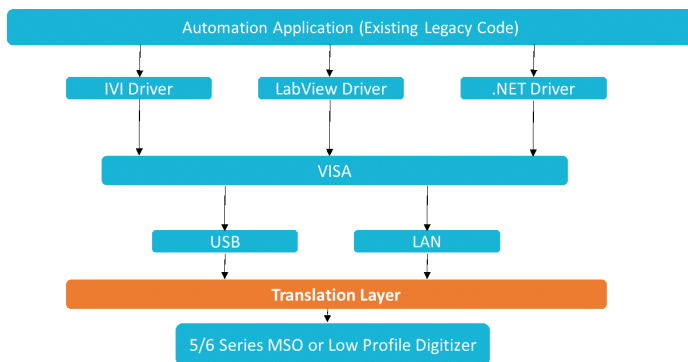
All your data in one place.

## Upgrade Automated Test Equipment (ATE) systems quickly and smoothly

Was your automation code written in the 1970s, 1980s, or 1990s?

Anyone working closely with automated test systems knows that moving to a new model or platform can be painful. Modifying an existing codebase for a new product can be prohibitively expensive and complicated. Now there's a solution.

All 5 and 6 Series Low Profile instruments include a Programmatic Interface (PI) Translator. When enabled, the PI Translator acts as an intermediate layer between your test application and the digitizer. The PI translator recognizes a subset of legacy commands from the popular DPO/MSO5000B, DPO7000C, and DPO70000C oscilloscope platforms and translates them on the fly into supported commands. The interface is designed to be human-readable and easily extensible, which means that you can customize its behavior to minimize the amount of effort required when transitioning from obsolete instruments to the newest Tektronix platform.



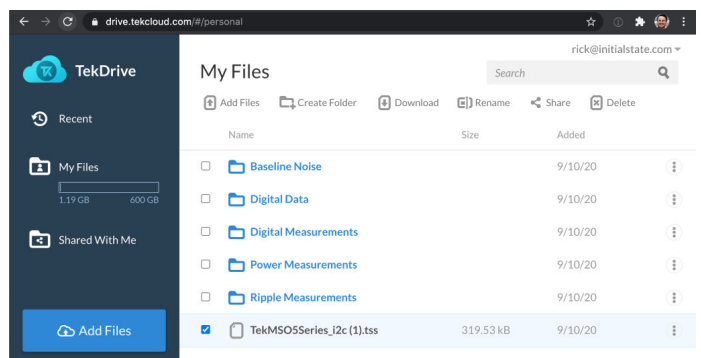
**How the PI Translator works from Automation software to Tek instrument**

## Access data in all the new ways you can dream about

Using TekDrive, you can upload, store, organize, search, download, and share any file type from any connected device. TekDrive is natively integrated into the 5 Series Low Profile instrument for seamless sharing and recalling of files - no USB stick is required. Analyze and explore standard files like .wfm, .isf, .tss, and .csv, directly in a browser with smooth interactive waveform viewers. TekDrive is purpose-built for integration, automation, and security. <http://www.tekcloud.com/tekdrive>



**Programming with a Low Profile in a test rack has never been easier**



TekDrive collaborative workspace - save files directly from your 5 Series Low Profile and share across your team

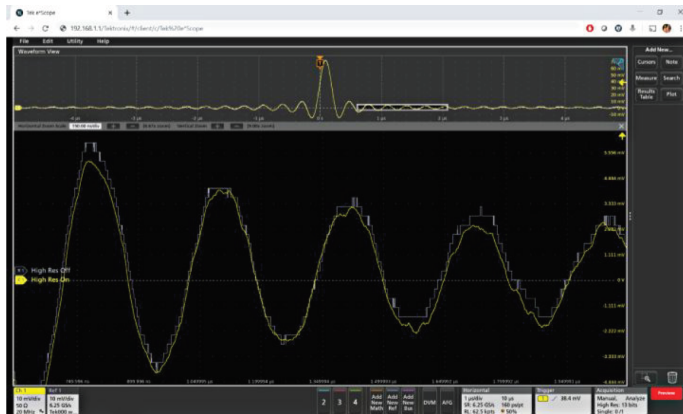
Get the analysis capability of an award-winning oscilloscope on your PC. Analyze waveforms anywhere, anytime. The basic license lets you view and analyze waveforms, perform many types of measurements and decode the most common serial buses - all while remotely accessing your oscilloscope. Advanced license options add capabilities such as multi-scope analysis, more serial bus decoding options, jitter analysis and power measurements. TekScope Multi-Scope enables you to connect and download data from up to 4 instruments (16-32 max channels) for easy viewing and cross-instrument analysis.

## 5 Series MSO Low Profile MSO58LP Datasheet



**Two MSO58LP instruments being analyzed on PC running TekScope's 'Multi-Scope'**

E\*Scope is an easy method of viewing and controlling a 5 Series Low Profile instrument over a network connection in the same way that you do in-person with a monitor or keyboard. Simply type the instrument's IP address into a browser to display the LXI landing page, then select Instrument Control to access E\*Scope. There are no drivers needed. It is all self-contained within the browser and you can control the instrument. It is fast, responsive, and perfect for controlling or visualizing single- or multiple-instrument situations.



**Live browser control is available using e\*Scope via a browser like Chrome, Firefox, or Edge**

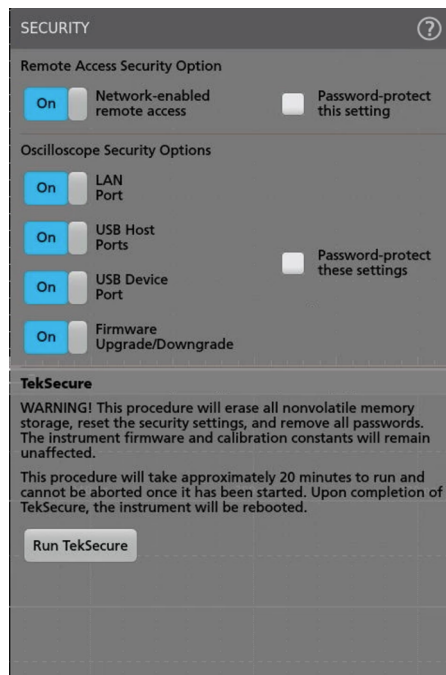


**Tile multiple e\*Scope browser tabs on a monitor for viewing live data**

### Enhanced security

The 5 Series MSO Low Profile provides you with the option to protect company data through the Security menu. This includes the option to restrict access to the instrument by password-protecting remote network access, I/O ports, and firmware updates to ensure the security of the data. By default, the oscilloscope disables remote access on initial use and gives you the option with the options to enable remote access with or without a password.

To clear user data, run TekSecure from the menu. Sanitize the oscilloscope by removing the SSD from the bottom of the instrument.



## User-defined filtering (optional)

In the broad sense, any system that processes a signal can be thought of as a filter. For example, an oscilloscope channel operates as a low pass filter where its 3 dB down point is referred to as its bandwidth. Given a waveform of any shape, a filter can be designed that can transform it into a defined shape within the context of some basic rules, assumptions, and limitations.

Digital filters have some significant advantages over analog filters. For example, the tolerance values of analog filter circuit components are high enough that high order filters are difficult or even impossible to implement. High order filters are easily implemented as digital filters. Digital filters can be implemented as Infinite Impulse Response (IIR) or Finite Impulse Response (FIR). The choice of IIR or FIR filters are based upon design requirements and application.

The MSO58LP has the ability to apply designated filters to math waveforms through a MATH arbitrary function. Option 5-UDFLT takes this functionality a level deeper, providing more than MATH arbitrary basic functions and adds flexibility to support standard filters and can be used for application centric filter designs.

*Filters can be created through the Math dialog. Once a filter is edited, it can be easily applied, saved, and recalled for use or modification later*

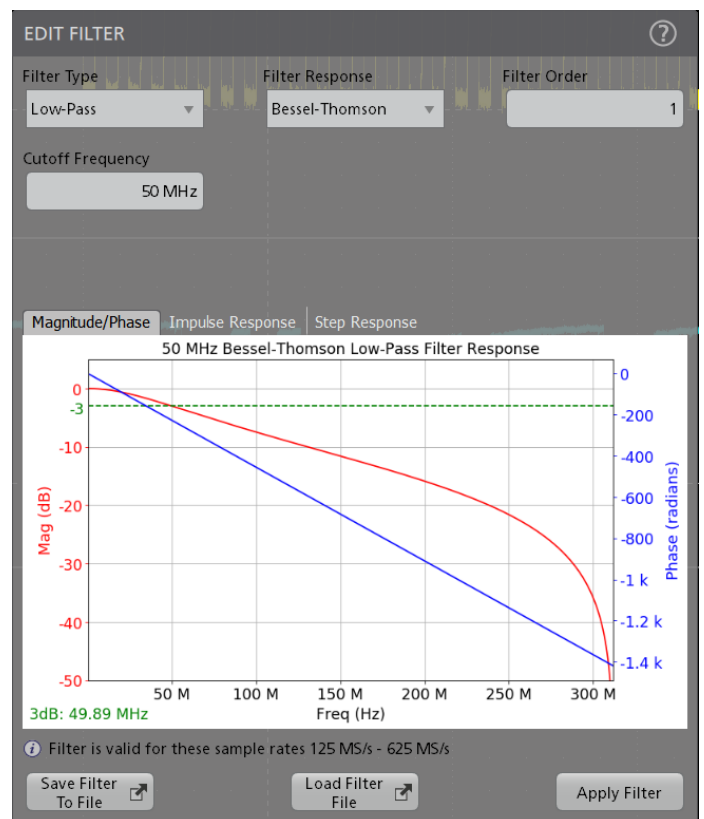
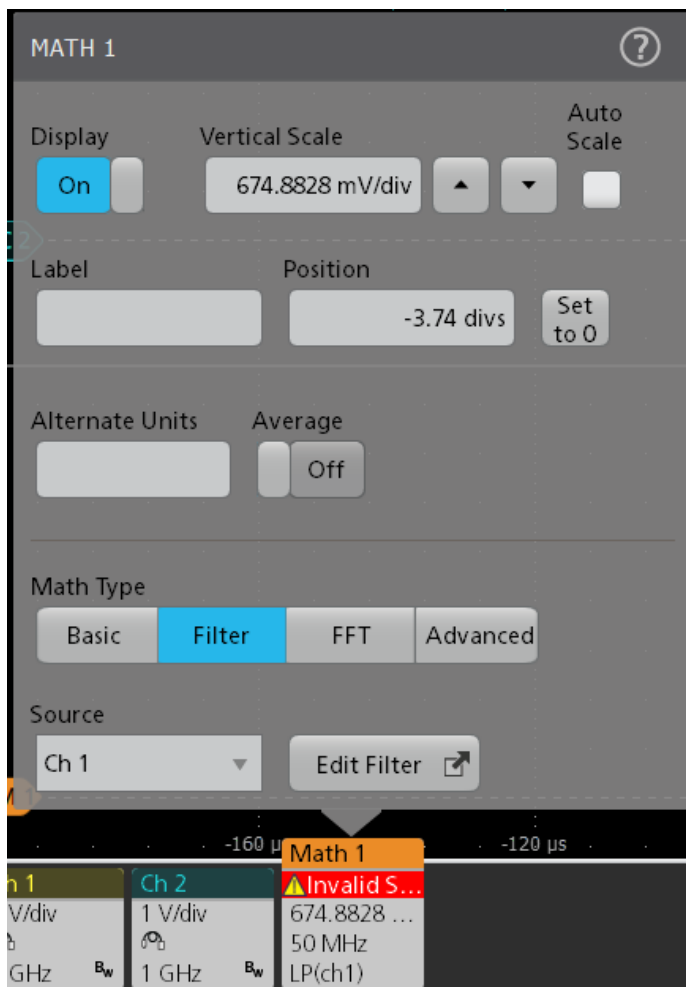
Filter types supported on the MSO58LP include:

- Low pass
- High pass
- Band pass
- Band stop
- All pass
- Hilbert
- Differentiator
- Custom

Filter response types supported on the MSO58LP include:

- Butterworth
- Chebyshev I
- Chebyshev II
- Elliptical
- Gaussian
- Bessel-Thomson

The Filter Response control is available for all Filter Types except All-pass, Hilbert, or Differentiator.



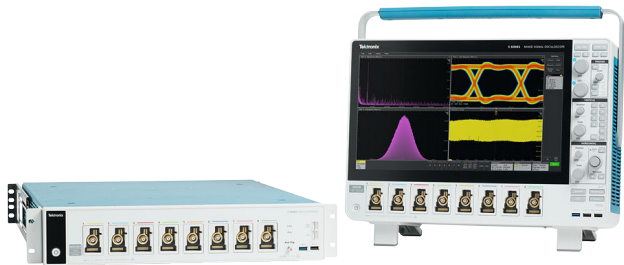
*Filter creation dialog showing selection for Filter Type, Filter Response, Cutoff Frequency, Filter Order, and a graphical representation of Magnitude/Phase, Impulse Response, and Step Response*

Filter designs can be saved, recalled, and applied once any editing has been completed.

**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.

| Quick Comparison        | 6 Series Low Profile Digitizer | 5 Series MSO Low Profile Digitizer |
|-------------------------|--------------------------------|------------------------------------|
| Sample Rate             | 25 GS/s                        | 6.25 GS/s                          |
| Analog Bandwidth        | up to 8 GHz                    | up to 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                                 |



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

**The Low Profile family**

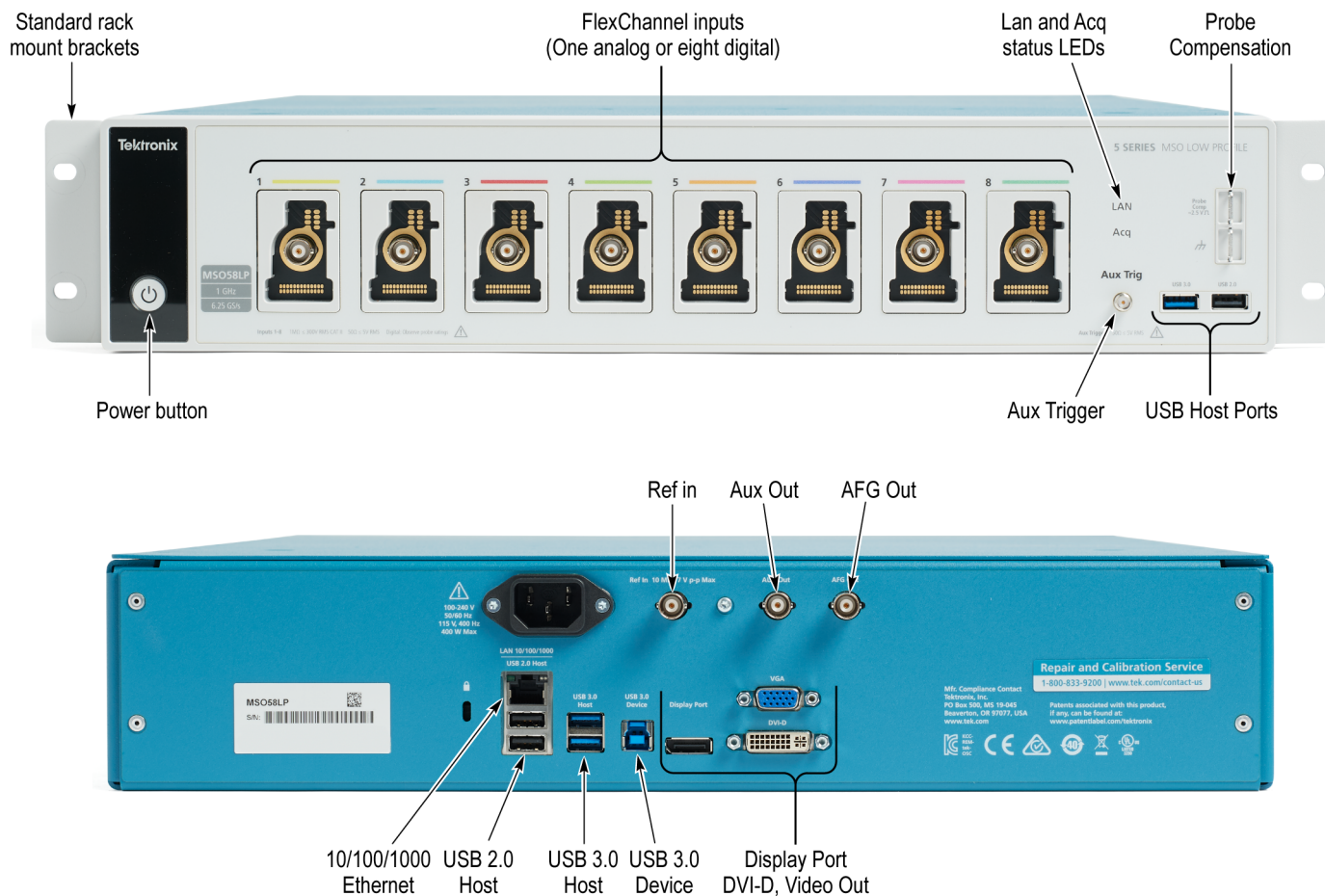
The 6 Series Low Profile Digitizer expands the performance of the 5 Series MSO Low Profile by adding twice the number of Tektronix TEK049 ASICs in the same 2U footprint. Now with 25 GS/s and up to 8 GHz on all channels. Low Profile users now have the choice of extreme high channel count or extreme performance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

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



## Specifications

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

### Model overview

#### Oscilloscope

|                                                       | MSO58LP                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FlexChannel inputs                                    | 8                                                                                                                                                                                                                                                                                                                                   |
| Maximum analog channels                               | 8                                                                                                                                                                                                                                                                                                                                   |
| Maximum digital channels (with optional logic probes) | 64                                                                                                                                                                                                                                                                                                                                  |
| Bandwidth (calculated rise time)                      | 500 MHz (800 ps), 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)<br>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<br>12 bits @ 3.125 GS/s<br>13 bits @ 1.25 GS/s (High Res)<br>14 bits @ 625 MS/s (High Res)<br>15 bits @ 312.5 MS/s (High Res)<br>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

50  $\Omega$ : 20 MHz, 250 MHz, and the full bandwidth value of your model

1 M $\Omega$ : 20 MHz, 250 MHz, 500 MHz

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

### Maximum input voltage

**50  $\Omega$ :** 5 VRMS, with peaks  $\leq \pm 20$  V (DF  $\leq 6.25\%$ )

**1 M $\Omega$ :** 300 VRMS, CAT II

Derate at 20 dB/decade between 4.5 MHz and 45 MHz; derate 14 dB/decade between 45 MHz and 450 MHz. Above 450 MHz, 5.5 VRMS

### Effective bits (ENOB), typical

< 1 GHz models, High Res mode, 50  $\Omega$ , 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)

| 1 GHz                                                                                        | 50 $\Omega$ |             |             |             |              | 1 M $\Omega$ |             |             |              |
|----------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|
| V/div                                                                                        | 1 GHz       | 500 MHz     | 350 MHz     | 250 MHz     | 20 MHz       | 500 MHz      | 350 MHz     | 250 MHz     | 20 MHz       |
| 1 mV/div<br><b>NOTE:</b> Bandwidth at 500 $\mu$ V/div is limited to 250 MHz in 50 $\Omega$ . | 254 $\mu$ V | 198 $\mu$ V | 141 $\mu$ V | 118 $\mu$ V | 70.0 $\mu$ V | 189 $\mu$ V  | 143 $\mu$ V | 118 $\mu$ V | 64.8 $\mu$ V |
| 2 mV/div                                                                                     | 255 $\mu$ V | 198 $\mu$ V | 143 $\mu$ V | 121 $\mu$ V | 70.4 $\mu$ V | 194 $\mu$ V  | 145 $\mu$ V | 121 $\mu$ V | 66.0 $\mu$ V |
| 5 mV/div                                                                                     | 262 $\mu$ V | 202 $\mu$ V | 150 $\mu$ V | 133 $\mu$ V | 72.8 $\mu$ V | 196 $\mu$ V  | 152 $\mu$ V | 130 $\mu$ V | 69.6 $\mu$ V |

| 1 GHz      | 50 $\Omega$ |             |             |             |              | 1 M $\Omega$ |             |             |              |
|------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|
| V/div      | 1 GHz       | 500 MHz     | 350 MHz     | 250 MHz     | 20 MHz       | 500 MHz      | 350 MHz     | 250 MHz     | 20 MHz       |
| 10 mV/div  | 283 $\mu$ V | 218 $\mu$ V | 169 $\mu$ V | 158 $\mu$ V | 79.8 $\mu$ V | 212 $\mu$ V  | 167 $\mu$ V | 154 $\mu$ V | 78.2 $\mu$ V |
| 20 mV/div  | 357 $\mu$ V | 273 $\mu$ V | 222 $\mu$ V | 223 $\mu$ V | 102 $\mu$ V  | 269 $\mu$ V  | 214 $\mu$ V | 223 $\mu$ V | 104 $\mu$ V  |
| 50 mV/div  | 677 $\mu$ V | 516 $\mu$ V | 436 $\mu$ V | 460 $\mu$ V | 196 $\mu$ V  | 490 $\mu$ V  | 410 $\mu$ V | 480 $\mu$ V | 207 $\mu$ V  |
| 100 mV/div | 1.61 mV     | 1.23 mV     | 1.02 mV     | 1.04 mV     | 464 $\mu$ V  | 1.16 mV      | 964 $\mu$ V | 1.05 mV     | 475 $\mu$ V  |
| 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      |

**DC gain accuracy****50 Ohm**

$\pm 2.0\%$  ( $\pm 2.0\%$  at 2 mV/div,  $\pm 4\%$  at 1 mV/div, typical)

**NOTE:** Immediately following SPC, add 2% for every 5 °C change in ambient.

$\pm 1.0\%$  of full scale, ( $\pm 1.0\%$  of full scale at 2 mV/div,  $\pm 2\%$  at 1 mV/div, typical)

**NOTE:** Immediately following SPC, add 1% for every 5 °C change in ambient.

**Position range**

$\pm 5$  divisions

**Offset ranges, maximum**

Input signal cannot exceed maximum input voltage for the 50  $\Omega$  input path.

| Volts/div Setting    | Maximum offset range, 50 $\Omega$ Input |
|----------------------|-----------------------------------------|
| 1 mV/div - 99 mV/div | $\pm 1$ V                               |
| 100 mV/div - 1 V/div | $\pm 10$ V                              |

**Crosstalk (channel isolation), typical**

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

**DC balance**

0.1 div with DC-50  $\Omega$  oscilloscope input impedance (50  $\Omega$  BNC terminated)

0.2 div at 1 mV/div with DC-50  $\Omega$  oscilloscope input impedance (50  $\Omega$  BNC terminated)

0.4 div at 500  $\mu$ V/div with DC-50  $\Omega$  oscilloscope input impedance (50  $\Omega$  BNC terminated)

0.2 div with DC-1 M $\Omega$  oscilloscope input impedance (50  $\Omega$  BNC terminated)

0.4 div at 500  $\mu$ V/div with DC-1 M $\Omega$  scope input impedance (50  $\Omega$  BNC terminated)

## 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

300 ps

### Thresholds

One threshold per digital channel

### Threshold range

±40 V

### Threshold resolution

10 mV

### Threshold accuracy

± [100 mV + 3% of threshold setting after calibration]

### Input hysteresis, typical

100 mV at the probe tip

### Input dynamic range, typical

30 Vpp for  $F_{in} \leq 200$  MHz, 10 Vpp for  $F_{in} > 200$  MHz

### Absolute maximum input voltage, typical

±42 V peak

### Minimum voltage swing, typical

400 mV peak-to-peak

### Input impedance, typical

100 kΩ

### 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

Aperture uncertainty

≤ 0.450 ps + (1 \* 10<sup>-11</sup> \* Measurement Duration)RMS, for measurements having duration ≤ 100 ms

Timebase accuracy

±2.5 x 10<sup>-6</sup> over any ≥1 ms time interval

| Description           | Specification                                                                         |
|-----------------------|---------------------------------------------------------------------------------------|
| Factory Tolerance     | ±5.0 x10 <sup>-7</sup> ; at calibration, 23 °C ambient, over any ≥1 ms interval       |
| Temperature stability | ±5.0 x10 <sup>-7</sup> ; tested at operating temperatures                             |
| Crystal aging         | ±1.5 x 10 <sup>-6</sup> ; 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<sub>1</sub> = Slew Rate (1st Edge) around 1st point in measurement

SR<sub>2</sub> = Slew Rate (2nd Edge) around 2nd point in measurement

N = input-referred guaranteed noise limit (VRMS)

TBA = time base accuracy or reference frequency error

t<sub>p</sub> = delta-time measurement duration (sec)

### 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

### Delay between analog channels, full bandwidth, typical

≤ 100 ps for any two channels with input impedance set to 50 Ω, 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

200 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

### Edge-type trigger sensitivity, DC coupled, typical

| Path                   | Range                     | Specification                                                                                                                                  |
|------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 MΩ path (all models) | 0.5 mV/div to 0.99 mV/div | 4.5 div from DC to instrument bandwidth                                                                                                        |
|                        | ≥ 1 mV/div                | The greater of 5 mV or 0.7 div from DC to lesser of 500 MHz or instrument BW, and 6 mV or 0.8 div from > 500 MHz to instrument bandwidth       |
| 50 Ω path              |                           | The greater of 5.6 mV or 0.7 div from DC to the lesser of 500 MHz or instrument BW, and 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 jitter, typical**

- $\leq 5$  ps<sub>RMS</sub> for sample mode and edge-type trigger
- $\leq 7$  ps<sub>RMS</sub> for edge-type trigger and FastAcq mode
- $\leq 200$  ps<sub>RMS</sub> for AUX trigger in, Sample acquisition mode, edge trigger (MSO58LP only)
- $\leq 220$  ps<sub>RMS</sub> for AUX trigger in, FastAcq acquisition mode, edge trigger (MSO58LP only)

**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 200 ps between different instrument channels.

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

**Trigger level ranges**

This specification applies to logic and pulse thresholds.

| 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 |

**Trigger types**

| Trigger Type          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Edge                  | Positive, negative, or either slope on any channel. Coupling includes DC, AC, noise reject, HF reject, and LF reject.                                                                                                                                                                                                                                                                                                                                                 |
| Pulse Width           | Trigger on width of positive or negative pulses. Event can be time- or logic-qualified.                                                                                                                                                                                                                                                                                                                                                                               |
| Timeout               | Trigger on an event which remains high, low, or either, for a specified time period. Event can be logic-qualified.                                                                                                                                                                                                                                                                                                                                                    |
| Runt                  | 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.                                                                                                                                                                                                                                                                                                           |
| Window                | 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.                                                                                                                                                                                                                                                                                                   |
| Logic                 | 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.                                                                                                                                                                                                                          |
| Setup and Hold        | Trigger on violations of both setup time and hold time between clock and data present on any input channels.                                                                                                                                                                                                                                                                                                                                                          |
| Rise/Fall Time        | Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either. Event can be logic-qualified.                                                                                                                                                                                                                                                                                                                       |
| Video (option 5-VID): | Trigger on all lines, odd, even, or all fields of NTSC, PAL, and SECAM video signals.                                                                                                                                                                                                                                                                                                                                                                                 |
| Sequence              | 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 and Hold, then the other must be set to Edge, and Ethernet and High Speed USB (480 Mbps) are not supported.                                                                                                       |
| Visual trigger        | 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. |

| Trigger Type                                                       | Description                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Parallel Bus                                                       | 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.                                                                                                                                                                                                                                                |
| I <sup>2</sup> C Bus (option 5-SREMBD)                             | Trigger on Start, Repeated Start, Stop, Address (7 or 10 bit), Data, or Address and Data on I2C buses up to 10 Mb/s.                                                                                                                                                                                                                                                                                        |
| I <sup>3</sup> C Bus (option 5-SRI3C)                              | Trigger on Start, Repeated Start, Stop, Address, Data, I3C SDR Direct, I3C SDR Broadcast, Missing ACK, T-Bit Error, Broadcast Address Error, Hot-Join, HDR Restart, HDR Exit on I3C buses up to 10 Mb/s.                                                                                                                                                                                                    |
| SPI Bus (option 5-SREMBD)                                          | Trigger on Slave Select, Idle Time, or Data (1-16 words) on SPI buses up to 20 Mb/s.                                                                                                                                                                                                                                                                                                                        |
| RS-232/422/485/UART Bus (option 5-SRCOMP)                          | Trigger on Start Bit, End of Packet, Data, and Parity Error up to 15 Mb/s.                                                                                                                                                                                                                                                                                                                                  |
| CAN Bus (option 5-SRAUTO)                                          | 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.                                                                                                                                                                                                               |
| CAN FD Bus (option 5-SRAUTO)                                       | 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.                                                                                                                                       |
| LIN Bus (option 5-SRAUTO)                                          | Trigger on Sync, Identifier, Data, Identifier and Data, Wakeup Frame, Sleep Frame, and Error on LIN buses up to 1 Mb/s.                                                                                                                                                                                                                                                                                     |
| FlexRay Bus (option 5-SRAUTO)                                      | 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.                                                                                                           |
| SENT Bus (option 5-SRAUTOSEN)                                      | Trigger on Start of Packet, Fast Channel Status and Data, Slow Channel Message ID and Data, and CRC Errors.                                                                                                                                                                                                                                                                                                 |
| SPMI Bus (option 5-SRPM)                                           | 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.               |
| USB 2.0 LS/FS/HS Bus (option 5-SRUSB2)                             | 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.                                                                                                                                                                                                                                           |
| Ethernet Bus (option 5-SRENET)                                     | 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.                                                                                                                                                                                                                  |
| Audio (I <sup>2</sup> S, LJ, RJ, TDM) Bus (option 5-SRAUDIO)       | Trigger on Word Select, Frame Sync, or Data. Maximum data rate for I2S/LJ/RJ is 12.5 Mb/s. Maximum data rate for TDM is 25 Mb/s.                                                                                                                                                                                                                                                                            |
| MIL-STD-1553 Bus (option 5-SRAERO)                                 | 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. |
| ARINC 429 Bus (option 5-SRAERO)                                    | 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.                                                                                                                                                                                                                                                   |
| RF Magnitude vs. Time and RF Frequency vs. Time (option 5-SV-RFVT) | Trigger on edge, pulse width and timeout events.                                                                                                                                                                                                                                                                                                                                                            |

## Acquisition system

### Sample

Acquires sampled values

### Peak Detect

Captures glitches as narrow as 640 ps at all sweep speeds

### Averaging

From 2 to 10,240 waveforms

Maximum averaging speed = 180 waveforms/s

### Fast Hardware Averaging

An acquisition mode for acquiring a large number of averages in a short amount of time. Fast hardware averaging optimizes the acquisition path, reducing storage truncation error and smoothing out fine scale non-linearity imperfections via an optional offset dithering technique. This feature is available through programmatic interface commands.

From 2 to 1,000,000 waveforms

Maximum averaging speed = 32,000 waveforms/s

### Envelope

Min-max envelope reflecting Peak Detect data over multiple acquisitions

### High Res

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  $\leq 125$  MS/s sample rates.

### FastAcq®

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).

### Roll mode

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.

### History mode

Makes use of the maximum record length, allowing you to capture many triggered acquisitions, stop when you see something of interest, and quickly review all stored triggered acquisitions.

The number of available acquisitions stored in history is (Maximum record length) / (Current record length setting).

### FastFrame™

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  $\geq 1,000$  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 $\geq 16$ 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 $\geq 16$ 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, Low Time, Time to Minimum, and Time to Maximum

#### 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. Actions for measurement value failures include Save Screen Capture, Save Waveform, System Request (SRQ), and Stop Acquisitions

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

#### Measurements

Jitter Summary, TJ@BER, SJ@Freq, 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, SSC Slew Rate, Pattern Length, and Inter-Symbol Interference (ISI)

#### Measurement plots

Eye Diagram and Jitter Bathtub

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)

### Measurement limits

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

### Eye diagram mask testing

Automated mask pass/fail testing

### Power analysis (option 5-PWR) adds the following:

#### Measurements

- 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)
- Green Power Analysis (LVRT, HVRT)

#### Measurement Plots

Harmonics Bar Graph, Switching Loss Trajectory Plot, and Safe Operating Area

### Measurement limits

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

### Digital power management (option 5-DPM) adds the following:

#### Measurements

- 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)
- PI/SI Analysis (PSIJ)

### **Digital Power Management Basic (option 5-DPMBAS) adds the following:**

#### **Measurements**

- Ripple Analysis (Ripple)
- Transient Analysis (Overshoot, Undershoot)
- Power Sequence Analysis (Turn-on, Turn-off)

### **Power Distribution Network (option 5-PDN) adds the following:**

#### **Measurements:**

- Power Integrity Analysis (Control Loop Response, Power Supply Rejection Ratio (PSRR), Impedance, Stability Evaluation for Power Integrity Analysis (SEPIA))
- Power Integrity - Signal Integrity Analysis (Power Supply Induced Jitter (PSIJ))

### **LVDS debug and analysis (option 5-DBLVDS) adds the following:**

#### **Data Lane Measurements**

- Generic Test (Unit Interval, Rise Time, Fall Time, Data Width, Data Intra Skew (PN), Data Inter Skew (Lane-to-Lane), and 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, and De-Emphasis Level)

#### **Clock Lane Measurements**

- Generic Test (Frequency, Period, Duty Cycle, Rise Time, Fall Time, Clock Intra Skew (PN), and Clock Peak-to-Peak)
- Jitter Test (TIE, DJ, and RJ)
- SSC On (Mod Rate and Frequency Deviation Mean)

### **Inverter Motor Drive Analysis (option 5-IMDA) adds the following:**

#### **Measurements**

Input Analysis (Power Quality, Harmonics, Input Voltage, Input Current, and Input Power), Ripple analysis (Line Ripple and Switching Ripple), Output analysis (Phasor Diagram and Efficiency), DQ0 analysis (DQ0) Requires option 5-IMDA-DQ0

#### **Measurement plots**

Harmonics Bar Graph and Phasor Diagram

### **Inverter Motor Drive Analysis Mechanical Measurements (option 5-IMDA-MECH: requires option 5-IMDA) adds the following:**

#### **Sensors supported**

Hall sensors, QEI (Quadrature Encoder Interface, Resolver, and Sin-Cos encoder)

#### **Measurements**

Electrical Analysis (Power Quality, Harmonics, Ripple, DQ0, and Efficiency), Mechanical Analysis (Speed, Acceleration, Angle (QEI method), Direction, and Torque)

#### **Measurement plots**

Time Trend, Acquisition Trend, Phasor Diagram, Harmonics Bar Graph, DQ0, and Histogram (speed distribution)

## 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 (standard)

Loading of user-definable filters. Users specify a file containing the coefficients of the filter.

### Filtering function (option 5-UDFLT)

- Filter types:  
Low pass, High pass, Band pass, Band stop, All pass, Hilbert, Differentiator, and Custom
- Filter response types:  
Butterworth, Chebyshev I, Chebyshev II, Elliptical, Gaussian, and Bessel-Thomson

### 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 Measurements

Channel Power (CHP), Adjacent Channel Power Ratio (ACPR), and Occupied Bandwidth (OBW) measurements on Spectrum View trace data and display

### 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)

### Spectrograms

RF Frequency vs. Time vs. Amplitude display with frequency on x-axis, time on y-axis, and power level indicated by variations in color (with option 5-SV-RFVT)

### Resolution Bandwidth (RBW)

93  $\mu$ Hz to 62.5 MHz

93  $\mu$ Hz to 100 MHz (with option 5-SV-BW-1)

### IQ capture

The data is stored as in-phase and quadrature (I&Q) samples and precise synchronization is maintained between the time domain data and the I&Q data.

When RF vs. Time traces are activated (with option 5-SV-RFVT), IQ data can be captured and exported to file for more analysis within third-party applications.

The max acquisition time varies with span and sample rate. At 6.25 GS/s and 500 MHz span, the max acquisition time is 0.086 seconds. For 312.5 MHz span, the max acquisition time is 0.172 seconds. For 40 MHz span, the max acquisition time is 0.687 seconds. For 1 MHz span, the max acquisition time is 43.980 seconds.

### Window types and factors

| 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   |

### Spectrum Time

FFT Window Factor / RBW

### Reference level

## 5 Series MSO Low Profile MSO58LP Datasheet

Reference level is automatically set by the analog channel Volts/div setting

Setting range: -42 dBm to +44 dBm

### Vertical Position

-100 divs to +100 divs

### Vertical units

dBm, dBμW, dBmV, dBμV, dBmA, dBμA

### Vertical scalings

Linear, Log

### Horizontal scaling

Linear, Log

### Multi-channel spectrum analysis

Each FlexChannel input can be configured with Spectrum View, RF vs. Time traces (with option RFVT), and Spectrogram (with option RFVT).

Multiple RF measurements can be performed simultaneously across channels.

Spectrum Time and Center Frequency settings can be unlocked and moved independently from each other across channels. All Spectrum View channels must share the same Span, Resolution Bandwidth and Window Type.

## 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 and 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)

#### Display type

External monitor

#### Display resolution

1,920 horizontal × 1,080 vertical pixels (High Definition)

#### Display modes

- Overlay: traditional oscilloscope display where traces overlay each other
- 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.

#### 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

Normal and inverted for screen captures

Individual waveform colors are user-selectable

#### 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**  
±1% ±5 ns, at 50% duty cycle
- **Jitter, typical**  
< 60 ps TIERMS, ≥ 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 ≤ 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 Ω
- **Variable symmetry**  
0% - 100%
- **Symmetry resolution**  
0.1%

#### DC level range

±2.5 V into Hi-Z  
±1.25 V into 50 Ω

#### 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 Ω

#### Sin(x)/x

- **Maximum frequency**  
2 MHz

#### Gaussian pulse, Haversine, and Lorentz pulse

- **Maximum frequency**

5 MHz

#### **Lorentz pulse**

- **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

#### **Cardiac**

- **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

#### **Arbitrary**

- **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**

$\pm [ (1.5\% \text{ of peak-to-peak amplitude setting}) + (1.5\% \text{ of absolute DC offset setting}) + 1 \text{ mV} ]$  (frequency = 1 kHz)

#### **Signal amplitude resolution**

1 mV (Hi-Z)

500 μV (50 Ω)

#### **Sine and ramp frequency accuracy**

$1.3 \times 10^{-4}$  (frequency  $\leq 10$  kHz)

$5.0 \times 10^{-5}$  (frequency  $> 10$  kHz)

#### **DC offset range**

$\pm 2.5 \text{ V}$  into Hi-Z

$\pm 1.25 \text{ V}$  into 50 Ω

#### DC offset resolution

1 mV (Hi-Z)

500  $\mu$ V (50  $\Omega$ )

#### DC offset accuracy

$\pm [ (1.5\% \text{ of absolute offset voltage setting}) + 1 \text{ mV} ]$

Add 3 mV of uncertainty per 10 °C change from 25 °C ambient

### Digital voltmeter (DVM)

#### Measurement types

DC, ACRMS+DC, ACRMS

#### Voltage resolution

4 digits

#### Voltage accuracy

- **DC:**

$\pm ((1.5\% * |\text{reading} - \text{offset} - \text{position}|) + (0.5\% * |(\text{offset} - \text{position})|) + (0.1 * \text{Volts/div}))$

De-rated at 0.100%/°C of  $|\text{reading} - \text{offset} - \text{position}|$  above 30 °C

Signal  $\pm 5$  divisions from screen center

- **AC:**

$\pm 2\%$  (40 Hz to 1 kHz) with no harmonic content outside 40 Hz to 1 kHz range

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

#### Resolution

8 digits

#### Accuracy

$\pm (1 \text{ count} + \text{time base accuracy} * \text{input frequency})$

The signal must be at least 8 mV<sub>pp</sub> or 2 div, whichever is greater.

#### Maximum input frequency

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.

## Processor system

### Host processor

Intel i5-4400E, 2.7 GHz, 64-bit, dual core processor

### Operating system

Default instrument: Closed Linux

### Internal storage

≥ 80 GB. Form factor is an 80 mm m.2 card with a SATA-3 interface

## Input-Output ports

### DisplayPort connector

A 20-pin DisplayPort connector; connect to show the oscilloscope display on an external monitor or projector

### DVI connector

A 29-pin DVI-D connector; connect to show the oscilloscope display on an external monitor or projector

### VGA

DB-15 female connector; connect to show the oscilloscope display on an external monitor or projector

### Probe compensator signal, typical

- **Connection:** Connectors are located on the lower right front panel of the instrument
- **Amplitude:** 0 to 2.5 V
- **Frequency:** 1 kHz
- **Source impedance:** 1 k $\Omega$

### External reference input

The time-base system can phase-lock to an external 10 MHz reference signal ( $\pm 4$  ppm).

### 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 Device port: One Device port providing USBTMC support
- Rear panel USB Host ports: Two USB Hi-Speed ports, two USB 3.0 SuperSpeed ports

### 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 $\Omega$ load to ground           |
| Vout (LO)      | ≤ 0.7 V into a load of ≤ 4 mA; ≤ 0.25 V into a 50 $\Omega$ load to ground |

### Aux Trigger In

- **Connection**

Front-panel SMA connector

- **Input impedance**

50  $\Omega$

- **Maximum input**

$\leq 5 V_{RMS}$

### 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  $\pm 10\%$  at 50 Hz to 60 Hz

115 V  $\pm 10\%$  at 400 Hz  $\pm 10\%$

## 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

- **Operating**  
+0 °C to +50 °C (32 °F to 122 °F)
- **Non-operating**  
-20 °C to +60 °C (-4 °F to 140 °F)

### Humidity

- **Operating**  
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
- **Non-operating**  
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

- **Operating**  
Up to 3,000 meters (9,843 feet)
- **Non-operating**  
Up to 12,000 meters (39,370 feet)

### Random vibration

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

## EMC, environmental, and safety

### Safety certification

US NRTL Listed - UL61010-1 and UL61010-2-030

Canadian Certification - CAN/CSA-C22.2 No. 61010.1 and CAN/CSA-C22.2 No 61010.2.030

EU Compliance - Low Voltage Directive 2014-35-EU and EN61010-1.

International Compliance - IEC 61010-1 and IEC61010-2-030

### Regulatory

CE marked for the European Union and UL approved for the USA and Canada

RoHS compliant

## Software

### IVI driver

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.

### e\*Scope®

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. Optionally configure e\*Scope authentication to password protect access to control and view the oscilloscope.

### LXI Web interface

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.

### Programming Examples

Programming with the 4/5/6 Series platforms has never been easier. With a programmer's manual and a GitHub site you have many commands and examples to help you get started remotely automating your instrument. See <https://github.com/tektronix/programmatic-control-examples>.

## Ordering information

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

### Step 1

Select the 5 Series MSO Low Profile model that you need.

| Model                             | Description                                                                                       |
|-----------------------------------|---------------------------------------------------------------------------------------------------|
| <a href="#">MSO58LP BW-1000RL</a> | Low Profile Mixed Signal Oscilloscope; 1 GHz bandwidth, (8) FlexChannels with 125 M record length |
| <a href="#">MSO58LP BW-500</a>    | Low Profile Mixed Signal Oscilloscope; 500 MHz bandwidth, (8) FlexChannels                        |

#### Each model includes

- Rackmount attachments installed
- Installation and safety manual
- 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                                     |

### 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-RFNFC           | ISO/IEC 15693, 14443A, 14443B, and FeliCa (decode and search only) |
| 5-SRAERO          | Aerospace (MIL-STD-1553, ARINC 429)                                |
| 5-SRAUDIO         | Audio (I2S, LJ, RJ, TDM)                                           |
| 5-SRAUTO          | Automotive (CAN, CAN FD, LIN, FlexRay, and CAN symbolic decoding)  |

| Instrument Option | Serial Buses Supported                                 |
|-------------------|--------------------------------------------------------|
| 5-SRAUTOSEN       | Automotive sensor (SENT)                               |
| 5-SRCOMP          | Computer (RS-232/422/485/UART)                         |
| 5-SRCXPI          | CXPI (decode and search only)                          |
| 5-SRDPHY          | MIPI D-PHY (DSI-1, CSI-2 decode and search only)       |
| 5-SREMBD          | Embedded (I2C, SPI)                                    |
| 5-SRENET          | Ethernet (10BASE-T, 100BASE-TX)                        |
| 5-SRESPI          | eSPI (decode and search only)                          |
| 5-SRI3C           | MIPI I3C                                               |
| 5-SRETHERCAT      | EtherCAT (decode and search only)                      |
| 5-SRMDIO          | MDIO (decode and search only)                          |
| 5-SRPM            | Power Management (SPMI)                                |
| 5-SRPSI5          | PSI5 (decode and search only)                          |
| 5-SRSDLC          | Synchronous Data Link Control Protocol Decode & Search |
| 5-SRSMBUS         | SMBus (decode and search only)                         |
| 5-SRSPACEWIRE     | Spacewire (decode and search only)                     |
| 5-SRVID           | SVID                                                   |
| 5-TDR             | Time Domain Reflectometry                              |
| 5-SRUSB2          | USB (USB2.0 LS, FS, HS)                                |
| 5-SREUSB2         | eUSB2.0 (decode and search only)                       |
| 5-SR8B10B         | 8B/10B (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-SIM             | Signal Integrity Modeling embedding and de-embedding                             |
| 5-SIMA            | Advanced Signal Integrity Modeling embedding, de-embedding, equalization and CDR |
| 5-DPM             | Digital Power Management                                                         |
| 5-DPMBAS          | Basic Digital Power Management                                                   |

| Instrument option                                                                                                                                                                                                                      | Advanced analysis                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 5-MTM                                                                                                                                                                                                                                  | Mask and Limit testing                                                                     |
| 5-PS2<br><b>Note:</b><br><ul style="list-style-type: none"> <li>This option is not compatible with option 5-PWR.</li> <li>This option must be purchased at the same time as the instrument. Not available as an upgrade.</li> </ul>    | Power Solution Bundle (5-PWR, THDP0200, TCP0030A, 067-1686-xx deskew fixture)              |
| 5-PS2FRA<br><b>Note:</b><br><ul style="list-style-type: none"> <li>This option is not compatible with option 5-PWR.</li> <li>This option must be purchased at the same time as the instrument. Not available as an upgrade.</li> </ul> | Power Solution Bundle (5-PWR, THDP0200, TCP0030A, two TPP0502, 067-1686-xx deskew fixture) |
| 5 -PWR<br><b>NOTE:</b> This option is not compatible with option 5-PS2 or 5-PS2FRA.                                                                                                                                                    | Power Measurement and Analysis                                                             |
| 5-PDN                                                                                                                                                                                                                                  | Power Distribution Network measurement and analysis                                        |
| 5-SV-BW-1                                                                                                                                                                                                                              | Increase Spectrum View Capture Bandwidth to 500 MHz                                        |
| 5-SV-RFVT                                                                                                                                                                                                                              | Spectrum View RF vs. Time traces, triggers, Spectrograms, and IQ capture                   |
| 5-TDR                                                                                                                                                                                                                                  | Time Domain Reflectometry                                                                  |
| 5-UDFLT                                                                                                                                                                                                                                | User Defined Filter Creation Tool                                                          |
| 5-VID                                                                                                                                                                                                                                  | NTSC, PAL, and SECAM video triggering                                                      |

## 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                           |

| Recommended Probe / Adapter | Description                                                                                                    |
|-----------------------------|----------------------------------------------------------------------------------------------------------------|
| 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, $\pm 42$ V differential input voltage                              |
| TDP1000                     | 1 GHz TekVPI® differential voltage probe, $\pm 42$ V differential input voltage                                |
| TDP1500                     | 1.5 GHz TekVPI® differential voltage probe, $\pm 8.5$ V differential input voltage                             |
| TDP7704                     | 4 GHz TriMode™ voltage probe                                                                                   |
| TDP7710                     | 10 GHz TriMode™ voltage probe                                                                                  |
| THDP0100                    | $\pm 6$ kV, 100 MHz TekVPI® high-voltage differential probe                                                    |
| THDP0200                    | $\pm 1.5$ kV, 200 MHz TekVPI® high-voltage differential probe                                                  |
| TMDP0200                    | $\pm 750$ V, 200 MHz TekVPI® high-voltage differential probe                                                   |
| TPR1000                     | 1 GHz, Single-Ended TekVPI® Power-Rail Probe; includes one TPR4KIT accessory kit                               |
| TIVP02                      | Isolated Probe; 200 MHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 2 meter cable                             |
| TIVP02L                     | Isolated Probe; 200 MHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 10 meter cable                            |
| TIVP05                      | Isolated Probe; 500 MHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 2 meter cable                             |
| TIVP05L                     | Isolated Probe; 500 MHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 10 meter cable                            |
| TIVP1                       | Isolated Probe; 1 GHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 2 meter cable                               |
| TIVP1L                      | Isolated Probe; 1 GHz, $\pm 5$ V to $\pm 2500$ V depending on tip; 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                     | TekVPI® to TekProbe™ BNC adapter (recommended for connecting your existing TekProbe probes to this instrument) |
| 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).

## Step 6

### Add digital probes

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

| For this instrument | Order                | To add                   |
|---------------------|----------------------|--------------------------|
| MSO58LP             | 1 to 8 TLP058 Probes | 8 to 64 digital channels |

## Step 7

### 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                                                                                                                                          |
| GPIB to Ethernet adapter | Order model 4865B (GPIB to Ethernet to Instrument Interface) directly from ICS Electronics<br><a href="http://www.icselect.com/gpib_instrument_intfc.html">www.icselect.com/gpib_instrument_intfc.html</a> |

## Step 8

### Select power cord option

| Power Cord Option | Description                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------|
| A0                | North America power plug (115 V, 60 Hz)<br>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.                                                                                                                    |
| C3             | Calibration service for 3 years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 2 years of calibration coverage.                      |
| 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. |
| C5             | Calibration service for 5 years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 4 years of calibration coverage.                      |

## 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-RFNFC                  | SUP5-RFNFC-FL            | ISO/IEC 15693, 14443A, 14443B, and FeliCa (decode and search only)                               |
|                          | 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-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-SRCXPI                 | SUP5-SRCXPI-FL           | CXPI serial decoding and analysis                                                                |
|                          | SUP5-SRDPHY                 | SUP5-SRDPHY-FL           | MIPI D-PHY (DSI-1, CSI-2 decode and search only)                                                 |
|                          | 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)                                   |

| Upgrade feature       | Node-locked license upgrade | Floating license upgrade | Description                                                              |
|-----------------------|-----------------------------|--------------------------|--------------------------------------------------------------------------|
|                       | SUP5-SRESPI                 | SUP5-SRESPI-FL           | eSPI serial decoding and analysis                                        |
|                       | SUP5-SRETHERCAT             | SUP5-SRETHERCAT-FL       | EtherCAT serial decoding and analysis                                    |
|                       | SUP5-SRI3C                  | SUP5-SRI3C-FL            | MIPI I3C serial triggering and analysis                                  |
|                       | SUP5-SRMDIO                 | SUP5-SRMDIO-FL           | Management Data Input/Output serial decoding and analysis                |
|                       | SUP5-SRPM                   | SUP5-SRPM-FL             | Power Management serial triggering and analysis (SPMI)                   |
|                       | SUP5-SRPSI5                 | SUP5-SRPSI5-FL PSI5      | Serial decoding and analysis                                             |
|                       | SUP5-SRSDLC                 | SUP5-SRDLC-FL            | Synchronous Data Link Control Protocol (decode and search only)          |
|                       | SUP5-SRSMBUS                | SUP5-SRSMBUS-FL          | SMBus serial decoding and analysis                                       |
|                       | SUP5-SRSPACEWIRE            | SUP5-SRSPACEWIRE-FL      | Spacewire serial analysis                                                |
|                       | SUP5-SRSVID                 | SUP5-SRSVID-FL           | Serial Voltage Identification (SVID) serial triggering 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                       |
|                       | SUP5-SR8B10B                | SUP5-SR8B10B-FL          | 8B/10B serial decoding and analysis                                      |
| Add advanced analysis | SUP5-DJA                    | SUP5-DJA-FL              | Advanced jitter and eye analysis                                         |
|                       | SUP5-SIM                    | SUP5-SIM-FL              | Signal Integrity Modeling                                                |
|                       | SUP5-SIMA                   | SUP5-SIMA-FL             | Advanced Signal Integrity Modeling                                       |
|                       | 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-PDN                    | SUP5-PDN-FL              | Power Distribution Network 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 vs. Time traces, triggers, Spectrograms, and IQ capture |
|                       | SUP5-TDR                    | SUP5-TDR-FL              | Time Domain Reflectometry                                                |
|                       | SUP5-UDFLT                  | SUP5-UDFLT-FL            | User Defined Filter Creation Tool                                        |
|                       | SUP5-VID                    | SUP5-VID-FL              | NTSC, PAL, and SECAM video triggering                                    |

| Upgrade feature       | Node-locked license upgrade | Floating license upgrade | Description                                                                                                                                                               |
|-----------------------|-----------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Add digital voltmeter | N/A                         | N/A                      | Add digital voltmeter / trigger frequency counter<br>(Free with product registration at <a href="https://www.tek.com/register4mso">https://www.tek.com/register4mso</a> ) |

Tektronix is registered to ISO 9001:2015 and ISO 14001:2015.

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