# 6 Series Low Profile Digitizer

## LPD64 Datasheet

*Highest Performance Digitizer. On ALL Channels!*

*4 channels with 25 GS/s, 12-bits, 8 GHz, and 250 Mpts in 2U*

## Performance in numbers

**Input Channels**

- 4 SMA inputs
- Each SMA input supports Analog, Spectral (using DDC), or both simultaneously

**Performance for EVERY Channel**

- Sample Rate: 25 GS/s
- Bandwidth: DC to 8 GHz (optional)
- Vertical Resolution: 12-bit ADC
- Real-Time 2 GHz DDC (optional)
- Record Length: 125 Mpts (std), 250 Mpts (optional)
- Lowest-in-class Noise
- Highest-in-class ENOB
- Best-in-class channel-to-channel isolation

**Real-Time Digital Down Converter (DDC)**

- Patented individual time domain and frequency domain controls
- Up to 2 GHz capture bandwidth (optional)
- IQ data transfers to PC for analysis (optional)
- Frequency vs time, Phase vs time and Magnitude vs time plotting (optional)

**Superior low noise, vertical resolution and accuracy**

- Low input noise enabled by new TEK061 front-end ASICs
- Noise at 1mV/div: 54.8 uV @ 1 GHz
- Input Range: 10mV to 10 V full scale
- DC Gain Accuracy: +/-1.0% at all gain settings >1 mV/div
- Effective Number of Bits (ENOB):
  - 8.2 bits at 1 GHz
  - 7.6 bits at 2.5 GHz
  - 7.25 bits at 4 GHz
  - 6.8 bits at 6 GHz
  - 6.5 bits at 8 GHz

**Remote communication and connectivity**

- Ethernet 10/100/1000 port
- USB 3.0 device port (USBTMC) up to 800 Megabits/second
- LXI 1.5 Certified (VXI-11)
- Easy remote access with e*Scope; just enter the instrument IP address into a browser
- Award-winning user interface
- Drivers: IVI-C, IVI-COM, LabVIEW
- Support for VISA, MATLAB, Python, C/C++/C#, Sockets

**Measurement Analysis**

- 36 standard measurements
- Jitter Measurements (optional)
- DDR Measurements (optional)
- Power Measurements (optional)

**Operating System**

- Closed Linux Embedded OS (standard)

**Security & Declassification (option 6-SEC)**

- Password protect all user-accessible ports
- Locks down the digitizer, prevents on-instrument user data storage
- Meets the needs for top secret and high security environments

**Dimensions**

- 2U (3.5 in./89 mm) tall & rack ready out of the box (standard configuration)
- 17 in. (432 mm) wide
- Fits into standard 24 - 32 in. (610 - 813 mm) racks
- Air flow is left to right for rack setup

With the lowest input noise and up to 8 GHz analog bandwidth, the 6 Series Low Profile Digitizer LPD64 provides the best signal fidelity for analyzing and debugging signals in a compact 2U rack space. With four SMA inputs each supporting Analog, Spectral (using DDC), or both simultaneously, lowest-in-class noise, and highest-in-class ENOB, the 6 Series Low Profile Digitizer LPD64 is ready for today's toughest challenges and tomorrow's too.

## The 6 Series family

The 6 Series Low Profile Digitizer (LPD64) represents the highest performance digitizer on all channels in its class. This high-speed digitizer has the functionality of a digitizer and the power of an oscilloscope, sharing a similar hardware platform as the 6 Series MSO.

The transition from a 6 Series MSO benchtop oscilloscope to a Low Profile Digitizer has never been easier for R&D engineers needing to move their code, test work and platform performance into manufacturing and automation. Both products support the same user interface, remote capability, performance characteristics and programming back-end to make this transition as simple and easy as possible. No need to rewrite test routines and development test cycle code!

For more information on the capabilities of the benchtop 6 Series MSO, including the award-winning user experience and the various analysis software options, please see the 6 Series MSO datasheet at www.tek.com/6SeriesMSO.

## 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 benchtop 5 Series MSO Low Profile, please see the datasheet at www.tek.com/MSO58LP

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

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

## Machine diagnostics for physics

Physics is constantly leading the world to exciting new scientific discoveries in both matter and energy. These experiments require digitizers and oscilloscopes with improvements in precision, accuracy, performance and density when monitoring target test points. The 6 Series Low Profile Digitizer meets these requirements by bringing an industry leading performance, small form factor, Tektronix's class of reliability, easy remote accessibility, and award-winning user interface.

Common physics fields

- High Energy (Particle) Physics
- Nuclear Physics
- Atomic, Molecular and Optical Physics
- Condensed Matter

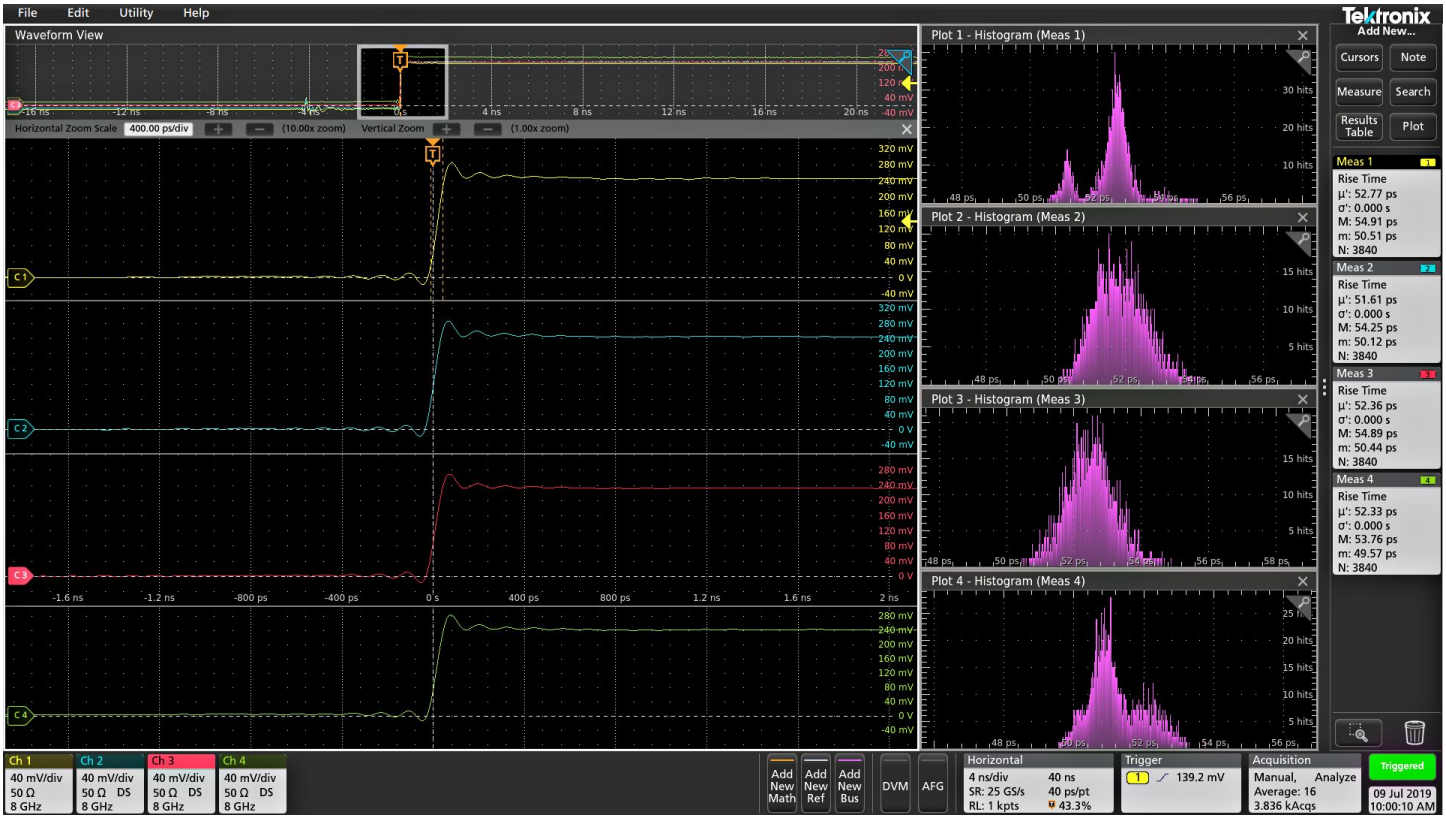
Research fields requiring single shot events or fast repetitive monitoring in their research labs; experiments like Photo Doppler Velocimetry (PDV), VISAR, gas guns, spectroscopy, accelerators and more. Many of these are diagnosing experiments and validating doppler shifts, phase alignments, beat frequencies, beam steering alignment or amplitudes. Doing this with reliable, high performance equipment is key for long term success.

## Performance on every channel

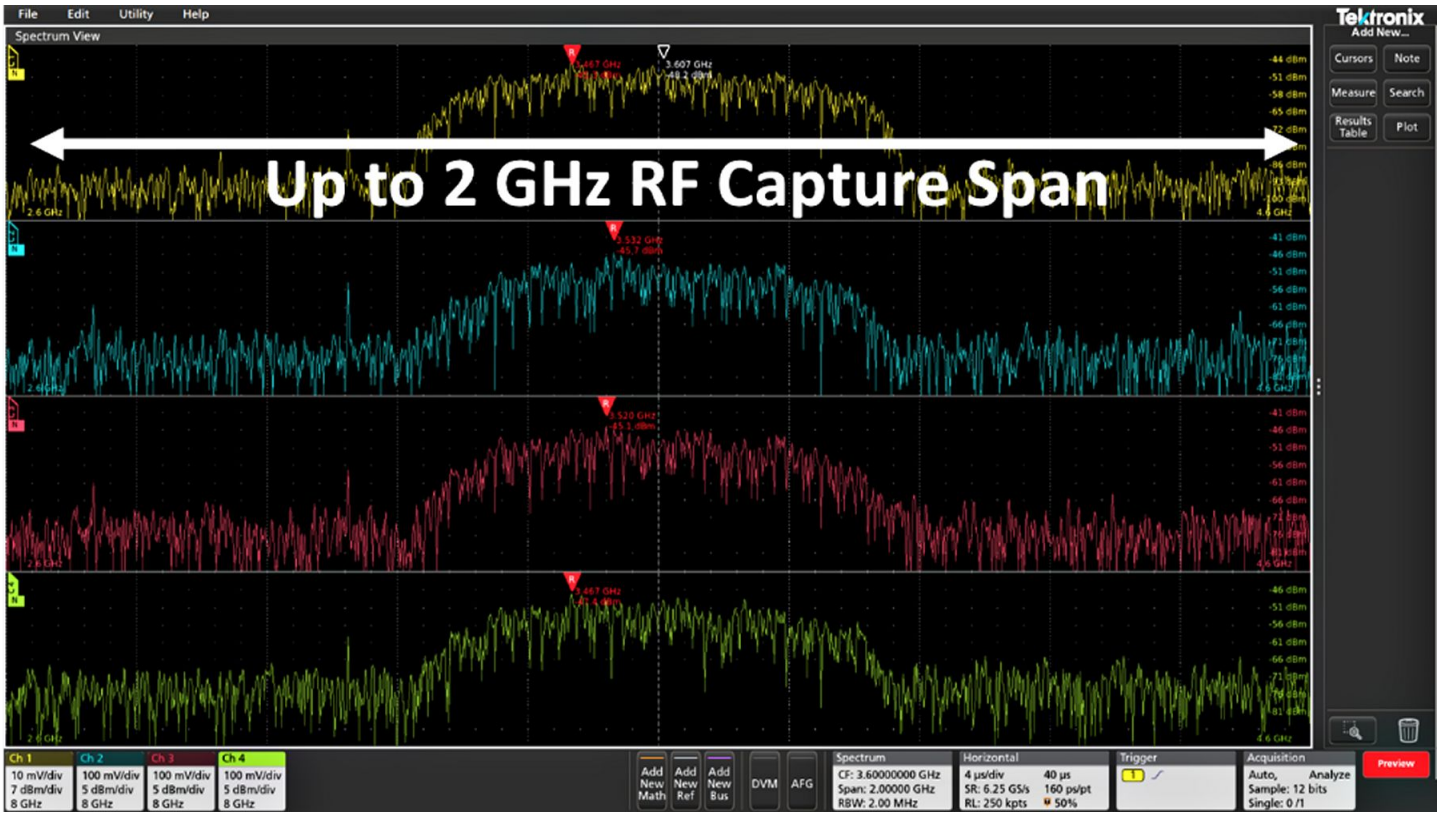
Tired of turning on multiple digitizer channels and wondering what the sample rate, record length or bandwidth settings are? The 6 Series Low Profile Digitizer has industry leading performance on EVERY channel, always. No compromises!

Key performance features:

- 25 GS/s on ALL channels
- DC to 8 GHz on ALL channels
- Up to 250 Million samples on ALL channels
- Up to 2 GHz RF DDC capture bandwidth on ALL channels
- ALL channels fit nicely in a 2U rack-ready digitizer
- 12-bit analog-to-digital converters
- Best-in-class low noise
- Best-in-class Effective Number Of Bits
- Best-in-class channel isolation (crosstalk)



## Spectrum View

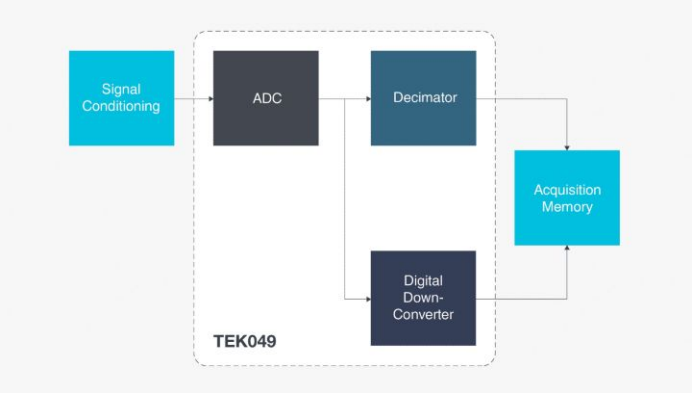



*Intuitive spectrum analyzer controls like center frequency, span and resolution bandwidth (RBW), independent from time domain controls, provide easy setup for frequency domain analysis. A spectrum view is available for each analog input, enabling multichannel mixed domain analysis.*

It is often easier to debug an issue by viewing one or more signals in the frequency domain. Oscilloscopes and digitizers 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 down-converter for the frequency-domain behind each input. 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.

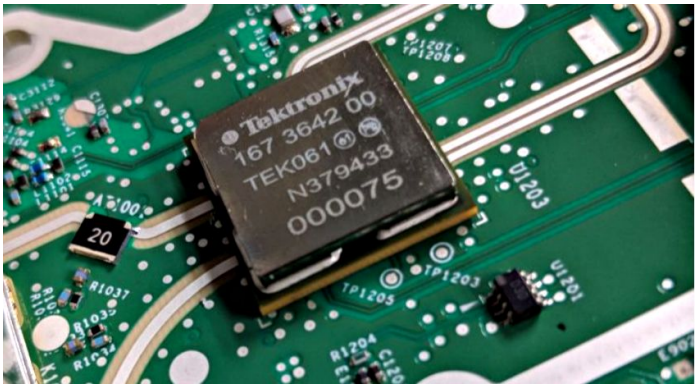
Waveform and IQ data can easily be transferred from the 6 Series Low Profile to a PC using a variety of programming commands and API interfaces that come standard on all Tektronix 5 Series & 6 Series products.




*Tektronix's TEK049 ASIC has a patented signal path enabling signals to travel from the ADC to both a traditional decimator (scope) and Digital Down Converter (DDC - RF) for independent control of both the time and frequency domains.*

## Behind the performance

The Tektronix-designed TEK049 ASIC contains 12-bit analog-to-digital converters (ADCs) that provide 16 times more resolution than traditional 8-bit ADCs. The TEK049 is paired with the new Tektronix TEK061 front-end amplifier with industry leading low noise that enables the best signal fidelity possible to capture small signals with high resolution.




*Lowest in class noise enabled by new front-end amplifier*

A key attribute to being able to view fine signal details on small, high-speed signals is noise. The higher a measurement systems' intrinsic noise, the less actual signal detail will be visible. This becomes more critical on a digitizer when the vertical settings are set to high sensitivity (like ≤ 10 mV/div) to view small signals that are prevalent in high-speed bus topologies. The 6 Series Low Profile has a new front-end ASIC, the TEK061, that enables breakthrough noise performance at the highest sensitivity settings.

In addition, 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 digitizer 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 ≤ 625 MS/s sample rates and 200 MHz of bandwidth.

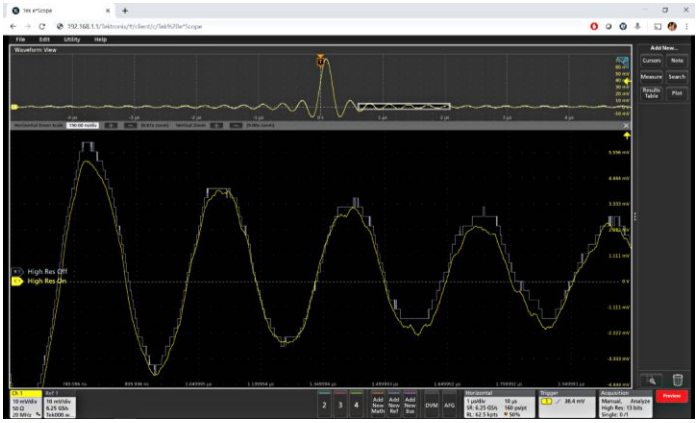
## Remote control made easy

*Programming the 6 Series Low Profile Digitizer in a test rack for easy remote control has never been easier.*

Automated test equipment and multichannel systems require robust programming capability and are often subject to rack-space constraints and/or speed restraints. The 6 Series Low Profile Digitizer packs 4 high performance 25 GS/s channels into just 2 rack units and comes ready to mount in a rack. Each input can work as a precision analog channel and/or Spectrum channel with multiple remote interfaces that can be transferred over 1000Base-T Ethernet or Super Speed USB 3.0 ports to your local PC for further analysis. With the wide range of programming language support and GitHub repository, there are many ways to easily integrate your new digitizer into a test rack.

Key remote access features include:

- 2 rack units high (3.5 inches) with rackmount attached
- Easy web browser remote access and control
- LXI 1.5 certified (VXI-11)
- Ethernet and USB 3.0 (USBTMC) device port with up to 800 Mbps transfer rate
- Programmers manual with 1000+ VISA commands
- Programming support: IVI-C, IVI-COM, MATLAB, LabView, Python, VISA, Sockets, and more
- Tektronix GitHub programming examples



*Easy remote control using e*Scope in a browser like Chrome, Firefox or Edge*

e*Scope is an easy remote viewing method of controlling a 5 Series or 6 Series oscilloscope or digitizer over a network connection through a standard web browser, in the exact same way that you do in-person. Simply type the instrument IP address into a modern browser and the LXI landing page is displayed, then select the Instrument Control to access e*scope. No drivers needed, it's all self-sustained with the browser, just like you were connected using the instrument screen or an attached monitor. Its fast, responsive and perfect for single or multiple instrument situations to visualize the data.

*Easy remote control using e*Scope across multiple instruments by tiling browser tabs on a monitor for viewing*

## Synchronizing


*Synchronize multiple instrument channels within 200 ps using manual deskew and the Aux Trigger input*

When synchronizing multiple instruments its important to have the smallest amount of skew between instrument channels to allow for data timing accuracy. Generally speaking this can be broken down into two types of skew; the part that comes from uncertainty between the aux trigger to analog channel, and the part that comes from trigger jitter. By calibrating out the effects of channel delay to the aux input we can reduce the amount of timing inaccuracy between instrument channels to just the jitter. This process is called deskewing an instrument.

Deskewing can be done to a reference channel that is simultaneously feeding a trigger edge (preferably over 1 Vpp) into the Aux Trigger input of multiple instruments and to the reference channel. When everything is adjusted, instrument to instrument channels can be within a very tight tolerance of only a couple sample points and within our specification of 200 ps. Whether you have 16 channels or 200 channels, all the data can be easily synchronized and analyzed.

## Enhanced security option

The optional 6-SEC enhanced security option enables password-protected enabling/disabling of all instrument I/O ports and firmware upgrades. In addition, option 6-SEC provides the highest level of security by ensuring that internal memory never stores user settings or waveform data, in compliance with National Industrial Security Program Operating Manual (NISPOM) DoD 5220.22-M, Chapter 8 requirements and Defense Security Service Manual for the Certification and Accreditation of Classified Systems under the NISPOM. This ensures that you can confidently move the instrument out of a secure area.

## Arbitrary/Function Generator (AFG)

The instrument contains an optional integrated arbitrary/function generator, perfect for simulating sensor signals within a design or adding noise to signals to perform margin testing. The integrated function generator provides output of predefined waveforms up to 50 MHz for sine, square, pulse, ramp/triangle, DC, noise, sin(x)/x (Sinc), Gaussian, Lorentz, exponential rise/fall, Haversine and cardiac. The AFG can load waveform records up to 128 k points in size from an internal file location or a USB mass storage device.

The AFG feature is compatible with Tektronix' ArbExpress PC-based waveform creation and editing software, making creation of complex waveforms fast and easy.

## Digital Voltmeter (DVM) and Trigger Frequency Counter

The instrument contains an integrated 4-digit digital voltmeter (DVM) and 8-digit trigger frequency counter. Any of the analog inputs can be a source for the voltmeter, using the same probes that are already attached for general oscilloscope usage. The trigger frequency counter provides a very precise readout of the frequency of the trigger event on which you're triggering.

Both the DVM and trigger frequency counter are available for free and are activated when you register your product.

# Specifications

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

## Model overview

### LPD64 Low Profile Digitizer

| Characteristic | LPD64 |
|---|---|
| Analog inputs | 4 |
| Bandwidth (calculated rise time) | 1 GHz (400 ps), 2.5 GHz (160 ps), 4 GHz (100 ps), 6 GHz (66.67 ps), 8 GHz (50 ps) |
| DC Gain Accuracy | 50 Ω: ±2.0% [1], (±2.0% at 2 mV/div, ±4.0% at 1 mV/div, typical)<br>50 Ω: ±1.0% [2] of full scale, (±1.0% of full scale at 2 mV/div, ±2.0% at 1 mV/div, typical) |
| ADC Resolution | 12 bits |
| Vertical Resolution (all channels) | 8 bits @ 25 GS/s; 8 GHz<br>12 bits @ 12.5 GS/s; 4 GHz<br>13 bits @ 6.25 GS/s (High Res); 2 GHz<br>14 bits @ 3.125 GS/s (High Res); 1 GHz<br>15 bits @ 1.25 GS/s (High Res); 500 MHz<br>16 bits @ ≤625 MS/s (High Res); 200 MHz |
| Sample Rate | 25 GS/s on all channels |
| Record Length | 125 Mpoints on all channels (standard)<br>250 Mpoints on all channels (optional) |
| Waveform Capture Rate | >500,000 wfms/s (Peak Detect, Envelope acquisition mode),<br>>30,000 wfms/s (all other acquisition modes) |
| Arbitrary/Function Generator (option) | 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

| | |
|---|---|
| **Input coupling** | DC |
| **Input impedance 50 Ω, DC coupled** | 50 Ω ±3% |
| **Input sensitivity range** | |
| **50 Ω** | 1 mV/div to 1 V/div in a 1-2-5 sequence<br>Note: 1 mV/div is a 2X digital zoom of 2 mV/div. |
| **Maximum input voltage** | 50 Ω: 2.5 $V_{RMS}$ at <100 mV/div, with peaks ≤ ±20 V (DF ≤ 6.25%)<br>50 Ω: 5 $V_{RMS}$ at ≥100 mV/div, with peaks ≤ ±20 V (DF ≤ 6.25%) |

1 Warranted specification, immediately after SPC, add 2% for every 5 °C change in ambient temperature.

2 Warranted specification, immediately after SPC, add 1% for every 5 °C change in ambient temperature. At full scale is sometimes used to compare to other manufactures.

## Vertical system

**Effective bits (ENOB), typical**

**2 mV/div, High Res mode, 50 Ω, 10 MHz input with 90% full screen**

| Bandwidth | ENOB |
|---|---|
| 4 GHz | 5.9 |
| 3 GHz | 6.1 |
| 2.5 GHz | 6.2 |
| 2 GHz | 6.35 |
| 1 GHz | 6.8 |
| 500 MHz | 7.2 |
| 350 MHz | 7.4 |
| 250 MHz | 7.5 |
| 200 MHz | 7.75 |
| 20 MHz | 8.8 |

**50 mV/div, High Res mode, 50 Ω, 10 MHz input with 90% full screen**

| Bandwidth | ENOB |
|---|---|
| 4 GHz | 7.25 |
| 3 GHz | 7.5 |
| 2.5 GHz | 7.6 |
| 2 GHz | 7.8 |
| 1 GHz | 8.2 |
| 500 MHz | 8.5 |
| 350 MHz | 8.8 |
| 250 MHz | 8.9 |
| 200 MHz | 9 |
| 20 MHz | 9.8 |

## Vertical system

**2 mV/div, Sample mode, 50 Ω, 10 MHz input with 90% full screen**

| Bandwidth | ENOB |
|---|---|
| 8 GHz | 5.1 |
| 7 GHz | 5.3 |
| 6 GHz | 5.5 |
| 5 GHz | 5.65 |
| 4 GHz | 5.9 |
| 3 GHz | 6.05 |
| 2.5 GHz | 6.2 |
| 2 GHz | 6.35 |
| 1 GHz | 6.8 |
| 500 MHz | 7.2 |
| 350 MHz | 7.3 |
| 250 MHz | 7.5 |
| 200 MHz | 7.3 |
| 20 MHz | 7.6 |

**50 mV/div, Sample mode, 50 Ω, 10 MHz input with 90% full screen**

| Bandwidth | ENOB |
|---|---|
| 8 GHz | 6.5 |
| 7 GHz | 6.6 |
| 6 GHz | 6.8 |
| 5 GHz | 7 |
| 4 GHz | 7.2 |
| 3 GHz | 7.4 |
| 2.5 GHz | 7.6 |
| 2 GHz | 7.7 |
| 1 GHz | 8.2 |
| 500 MHz | 8.4 |
| 350 MHz | 8.7 |
| 250 MHz | 8.8 |
| 200 MHz | 7.8 |
| 20 MHz | 7.9 |

**DC balance**

0.1 div with DC-50 Ω digitizer input impedance (50 Ω terminated)

0.2 div at 1 mV/div with DC-50 Ω digitizer input impedance (50 Ω terminated)

**Position range**

±5 divisions

**Offset ranges, maximum**

Input signal cannot exceed maximum input voltage for the 50 Ω input path.

| Volts/div Setting | Maximum offset range, 50 Ω Input |
|---|---|
| 1 mV/div - 99 mV/div | ±1 V |
| 100 mV/div - 1 V/div | ±10 V |

**Offset accuracy**

±(0.005 X | offset - position | + DC balance); Offset, position, and DC Balance in units of Volts

## Vertical system

**Bandwidth selections**

| | |
|---|---|
| **8 GHz model, 50 Ohm** | 20 MHz, 200 MHz, 250 MHz, 350 MHz, 500 MHz, 1 GHz, 2 GHz, 2.5 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz, 7 GHz, and 8 GHz |
| **6 GHz model, 50 Ohm** | 20 MHz, 200 MHz, 250 MHz, 350 MHz, 500 MHz, 1 GHz, 2 GHz, 2.5 GHz, 3 GHz, 4 GHz, 5 GHz, and 6 GHz |
| **4 GHz model, 50 Ohm** | 20 MHz, 200 MHz, 250 MHz, 350 MHz, 500 MHz, 1 GHz, 2 GHz, 2.5 GHz, 3 GHz, and 4 GHz |
| **2.5 GHz model, 50 Ohm** | 20 MHz, 200 MHz, 250 MHz, 350 MHz, 500 MHz, 1 GHz, 2 GHz, and 2.5 GHz |
| **1 GHz model, 50 Ohm** | 20 MHz, 200 MHz, 250 MHz, 350 MHz, 500 MHz, and 1 GHz |

**Bandwidth filtering optimized for** Flatness or Step response

**Random noise, RMS, typical**

**50 Ω, typical**

**25 GS/s, Sample Mode, RMS**

| V/div | 1 mV/div | 2 mV/div | 5 mV/div | 10 mV/div | 20 mV/div | 50 mV/div | 100 mV/div | 1 V/div |
|---|---|---|---|---|---|---|---|---|
| **8 GHz** | 158 µV | 158 µV | 208 µV | 342 µV | 630 µV | 1.49 mV | 3.46 mV | 29.7 mV |
| **7 GHz** | 141 µV | 143 µV | 192 µV | 311 µV | 562 µV | 1.31 mV | 3.11 mV | 26.2 mV |
| **6 GHz** | 127 µV | 127 µV | 165 µV | 274 µV | 489 µV | 1.18 mV | 2.71 mV | 23.6 mV |
| **5 GHz** | 112 µV | 113 µV | 149 µV | 239 µV | 446 µV | 1.05 mV | 2.42 mV | 21.1 mV |

**12.5 GS/s, HiRes Mode, RMS**

| V/div | 1 mV/div | 2 mV/div | 5 mV/div | 10 mV/div | 20 mV/div | 50 mV/div | 100 mV/div | 1 V/div |
|---|---|---|---|---|---|---|---|---|
| **4 GHz** | 97.4 µV | 98.7 µV | 124 µV | 192 µV | 344 µV | 817 µV | 1.92 mV | 16.3 mV |
| **3 GHz** | 82.9 µV | 84 µV | 105 µV | 160 µV | 282 µV | 680 µV | 1.62 mV | 13.6 mV |
| **2.5 GHz** | 76.5 µV | 77.5 µV | 93.8 µV | 144 µV | 257 µV | 606 µV | 1.44 mV | 12.1 mV |
| **2 GHz** | 68.1 µV | 69.1 µV | 83.6 µV | 131 µV | 226 µV | 528 µV | 1.28 mV | 10.6 mV |
| **1 GHz** | 54.8 µV | 51.2 µV | 63.4 µV | 90.9 µV | 160 µV | 378 µV | 941 µV | 7.65 mV |
| **500 MHz** | 39.7 µV | 39.8 µV | 48.1 µV | 65.1 µV | 115 µV | 280 µV | 666 µV | 5.6 mV |
| **350 MHz** | 33.8 µV | 33.5 µV | 40 µV | 54.8 µV | 94.3 µV | 217 µV | 560 µV | 4.35 mV |
| **250 MHz** | 30.8 µV | 31.2 µV | 36.1 µV | 49.9 µV | 80.3 µV | 187 µV | 482 µV | 3.75 mV |
| **200 MHz** | 25.3 µV | 25.4 µV | 29.7 µV | 44 µV | 70.7 µV | 165 µV | 445 µV | 3.3 mV |
| **20 MHz** | 8.68 µV | 8.9 µV | 10.4 µV | 15.1 µV | 27.5 µV | 70.4 µV | 158 µV | 1.41 mV |

**Crosstalk (channel isolation), typical**

≥ -80 dB up to 2 GHz

≥ -65 dB up to 4 GHz

≥ -55 dB up to 8 GHz

for any two channels set to 200 mV/div.

## Horizontal system

**Time base range**

40 ps/div to 1,000 s/div

**Sample rate range**

6.25 S/s to 25 GS/s (real time)

50 GS/s to 2.5 TS/s (interpolated)

**Record length range**

All acquisition modes are 250 M maximum record length, down to 1 k minimum record length, adjustable in 1 sample increments.

Standard: 125 Mpoints

Option 6-RL-2: 250 Mpoints

**Seconds/Division range**

| Record length | 1 K | 10 K | 100 K | 1 M | 10 M | 62.5 M | 125 M | 250 M |
|---|---|---|---|---|---|---|---|---|
| Standard: 125 M | 40 ps - 16 s | 400 ps - 160 s | 4 ns - 1000 s | | | 2.5 µs - 1000 s | 5 µs - 1000 s | N/A |
| Option 6-RL-2: 250 M | 40 ps - 16 s | 400 ps - 160 s | 4 ps - 1000 s | | | 2.5 µs - 1000 s | 5 µs - 1000 s | 10 µs - 1000 s |

**Aperture uncertainty**

| Time duration | Typical jitter |
|---|---|
| <1 µs | 80 fs |
| <1 ms | 130 fs |

**Timebase accuracy**

±1.0 x$10^{-7}$ over any ≥1 ms time interval

| Description | Specification |
|---|---|
| Factory Tolerance | ±12 ppb. At calibration, 25 °C ambient, over any ≥1 ms interval |
| Temperature stability | ±20 ppb across the full operating range of 0 °C to 50 °C, after a sufficient soak time at the temperature. Tested at operating temperatures |
| Crystal aging | ±300 ppb. Frequency tolerance change at 25 °C over a period of 1 year |

**Delta-time measurement accuracy**

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

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

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

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

$SR_1$ = Slew Rate (1st Edge) around 1st point in measurement

$SR_2$ = Slew Rate (2nd Edge) around 2nd point in measurement

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

TBA = timebase accuracy or Reference Frequency Error

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

**Maximum duration at highest sample rate**

5 ms (standard) or 10 ms (option 6-RL-2, 250 Mpoints)

**Time base delay time range**

-10 divisions to 5,000 s

## Horizontal system

**Deskew range**

-125 ns to +125 ns with a resolution of 40 ps (for Peak Detect and Envelope acquisition modes).

-125 ns to +125 ns with a resolution of 1 ps (for all other acquisition modes).

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

≤ 10 ps for any two channels with input impedance set to 50 Ω, DC coupling with equal Volts/div or above 10 mV/div

## 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 bandwidth (edge, pulse and logic), typical**

| Model | Trigger type | Trigger bandwidth |
|---|---|---|
| 8 GHz | Edge | 8 GHz |
| 8 GHz | Pulse, Logic | 4 GHz |
| 6 GHz | Edge | 6 GHz |
| 6 GHz | Pulse, Logic | 4 GHz |
| 4 GHz, 2.5 GHz, 1 GHz: | Edge, Pulse, Logic | Product Bandwidth |

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

| Path | Range | Specification |
|---|---|---|
| 50 Ω path | 1 mV/div to 9.98 mV/div | 3.0 div from DC to instrument bandwidth |
| | ≥ 10 mV/div | < 1.0 division from DC to instrument bandwidth |
| Line | 90 V to 264 V line voltage at 50 - 60 Hz line frequency | 103.5 V to 126.5 V |
| AUX Trigger in | | 250 $mV_{PP}$, DC to 400 MHz |

**Edge-type trigger sensitivity, not DC coupled, typical**

| Trigger Coupling | Typical Sensitivity |
|---|---|
| NOISE REJ | 2.5 times the DC Coupled limits |
| HF REJ | 1.0 times the DC Coupled limits from DC to 50 kHz. Attenuates signals above 50 kHz. |
| LF REJ | 1.5 times the DC Coupled limits for frequencies above 50 kHz. Attenuates signals below 50 kHz. |

**Trigger jitter, typical**

≤ 1.5 $ps_{RMS}$ for sample mode and edge-type trigger

≤ 7 $ps_{RMS}$ ≤ 2 $ps_{RMS}$ for edge-type trigger and FastAcq mode

≤ 40 $ps_{RMS}$ for non edge-type trigger modes

≤ 40 $ps_{RMS}$ for AUX trigger in, Sample acquisition mode, edge trigger

≤ 40 $ps_{RMS}$ for AUX trigger in, FastAcq acquisition mode, edge trigger

**Trigger jitter, AUX input, typical**

≤ 200 $ps_{RMS}$ for sample mode and edge-type trigger

≤ 220 $ps_{RMS}$ for edge-type trigger and FastAcq mode

**AUX In trigger skew between instruments, typical**

±100 ps jitter on each instrument with <450 ps skew; <550 ps total between instruments. Can be manually deskewed so channel-to-channel total skew is <200ps between instruments using AUX In.

Skew improves for pulse input voltages ≥1 $V_{pp}$

## Trigger system

**Trigger level ranges**

| Source | Range |
|---|---|
| Any Channel | ±5 divs from center of screen |
| Aux In Trigger | ±5 V |
| Line | Fixed at about 50% of line voltage |

This specification applies to logic and pulse thresholds.

**Trigger frequency counter** 8-digits (free with product registration)

**Trigger types**

**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 & 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

**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 & 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

**Parallel Bus:** Trigger on a parallel bus data value. Parallel bus can be from 1 to 4 bits (from the analog channels) in size. Supports Binary and Hex radices

**$I^2C$ Bus (option 6-SREMBD):** Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data on $I^2C$ buses up to 10 Mb/s

**SPI Bus (option 6-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 6-SRCOMP):** Trigger on Start Bit, End of Packet, Data, and Parity Error up to 15 Mb/s

**CAN Bus (option 6-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 6-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 6-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 6-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 6-SRAUTOSEN)** Trigger on Start of Packet, Fast Channel Status and Data, Slow Channel Message ID and Data, and CRC Errors

**SPMI Bus (option 6-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 6-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

## Trigger system

| | |
|---|---|
| **Ethernet Bus (option 6-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 ($I^2S$, LJ, RJ, TDM) Bus (option 6-SRAUDIO):** | Trigger on Word Select, Frame Sync, or Data. Maximum data rate for $I^2S$/LJ/RJ is 12.5 Mb/s. Maximum data rate for TDM is 25 Mb/s |
| **MIL-STD-1553 Bus (option 6-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 6-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 |
| **Trigger holdoff range** | 0 ns to 10 seconds |

## Acquisition system

| | |
|---|---|
| **Sample** | Acquires sampled values |
| **Peak Detect** | Captures glitches as narrow as at all sweep speeds |
| **Averaging** | From 2 to 10,240 waveforms |
| **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.<br>High Res mode always provides at least 12 bits of vertical resolution and extends all the way to 16 bits of vertical resolution at ≤ 625 MS/s sample rates. |
| **FastAcq®** | FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events.<br>Maximum waveform capture rate:<br>>500,000 wfms/s (Peak Detect or Envelope Acquisition mode)<br>>30,000 wfms/s (All other acquisition modes) |
| **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. |
| **FastFrame™** | Acquisition memory divided into segments.<br>Maximum trigger rate >5,000,000 waveforms per second<br>Minimum frame size = 50 points<br>Maximum Number of Frames: For frame size ≥ 1,000 points, maximum number of frames = record length / frame size.<br>For 50 point frames, maximum number of frames = 691,000 |

## Waveform measurements

**Cursor types**

Waveform, V Bars, H Bars, and V&H Bars

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

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

**Automatic measurements**

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

**Amplitude measurements**

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

**Timing measurements**

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

**Jitter measurements (standard)**

TIE and Phase Noise

**Measurement statistics**

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

**Reference levels**

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

**Gating**

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

**Measurement plots**

Time Trend, Histogram, and Spectrum plots are available for all standard measurements

**Jitter analysis adds the following:**

**Measurements**

Jitter Summary, TJ@BER, RJ- δδ, DJ- δδ, 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

**Measurement Plots**

Eye Diagram and Jitter Bathtub

**Eye Diagram Mask Testing**

Automated mask pass/fail testing

**Power analysis 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, $R_{DSon}$)

Magnetic Analysis (Inductance, I vs. Intg(V), Magnetic Loss, Magnetic Property)

Output Analysis (Line Ripple, Switching Ripple, Efficiency, Turn-on Time, Turn-off Time)

Frequency Response Analysis (Control Loop Response Bode Plot, Power Supply Rejection Ratio, Impedance)

**Measurement Plots**

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

## Waveform measurements

| | |
|---|---|
| **Digital Power Management adds the following:** | |
| **Measurements** | Ripple Analysis (Ripple)<br>Transient Analysis (Overshoot, Undershoot)<br>Power Sequence Analysis (Turn-on, Turn-off) |
| **DDR3/LPDDR3 memory debug and analysis option (6-DBDDR3) adds the following:** | |
| **Measurements** | Amplitude Measurements (AOS, AUS, Vix(ac), AOS Per tCK, AUS Per tCK, AOS Per UI, AUS Per UI)<br>Time Measurements (tRPRE, tWPRE, tPST, Hold Diff, Setup Diff, tCH(avg), tCK(avg), tCL(avg), tCH(abs), tCL(abs), tJIT(duty), tJIT(per), tJIT(cc), tERR(n), tERR(m-n), tDQSCK, tCMD-CMD, tCKSRE, tCKSRX) |

## Waveform math

| | |
|---|---|
| **Number of math waveforms** | Unlimited |
| **Arithmetic** | Add, subtract, multiply, and divide waveforms and scalars |
| **Algebraic expressions** | Define extensive algebraic expressions including waveforms, scalars, user-adjustable variables, and results of parametric measurements. Perform math on math using complex equations. For example (Integral (CH1 - Mean(CH1)) X 1.414 X VAR1) |
| **Math functions** | Invert, Integrate, Differentiate, Square Root, Exponential, Log 10, Log e, Abs, Ceiling, Floor, Min, Max, Degrees, Radians, Sin, Cos, Tan, ASin, ACos, and ATan |
| **Relational** | Boolean result of comparison >, <, ≥, ≤, =, and ≠ |
| **Logic** | AND, OR, NAND, NOR, XOR, and EQV |
| **Filtering function** | User-definable filters. Users specify a file containing the coefficients of the filter |
| **FFT functions** | Spectral Magnitude and Phase, and Real and Imaginary Spectra |
| **FFT vertical units** | Magnitude: Linear and Log (dBm)<br>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** | 74.5 Hz – 1.25 GHz (standard)<br>74.5 Hz – 2 GHz (option 6-SV-BW-1)<br>Coarse adjustment in a 1-2-5 sequence |
| **RF vs. Time Traces** | Magnitude vs. time, Frequency vs. time, Phase vs. Time |
| **Resolution Bandwidth (RBW)** | 93 µHz to 62.5 MHz<br>93 µHz to 100 MHz (option 6-SV-BW-1) |

## Spectrum View

**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** | Reference level is automatically set by the analog channel Volts/div setting<br>Setting range: -42 dBm to +44 dBm |
| **Vertical Position** | -100 divs to +100 divs |
| **Vertical units** | dBm, dBµW, dBmV, dBµV, dBmA, dBµA |

## Search

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

## Display

| | |
|---|---|
| **Display type** | External monitor |
| | 1,920 horizontal × 1,080 vertical pixels (High Definition) |
| **Display modes** | Overlay: traditional oscilloscope display where traces overlay each other<br>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<br>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

**Amplitude range**

Values are peak-to-peak voltages

| Waveform | 50 Ω | 1 MΩ |
|---|---|---|
| Arbitrary | 10 mV to 2.5 V | 20 mV to 5 V |
| Sine | 10 mV to 2.5 V | 20 mV to 5 V |
| Square | 10 mV to 2.5 V | 20 mV to 5 V |
| Pulse | 10 mV to 2.5 V | 20 mV to 5 V |
| Ramp | 10 mV to 2.5 V | 20 mV to 5 V |
| Triangle | 10 mV to 2.5 V | 20 mV to 5 V |
| Gaussian | 10 mV to 1.25 V | 20 mV to 2.5 V |
| Lorentz | 10 mV to 1.2 V | 20 mV to 2.4 V |
| Exponential Rise | 10 mV to 1.25 V | 20 mV to 2.5 V |
| Exponential Fall | 10 mV to 1.25 V | 20 mV to 2.5 V |
| Sine(x)/x | 10 mV to 1.5 V | 20 mV to 3.0 V |
| Random Noise | 10 mV to 2.5 V | 20 mV to 5 V |
| Haversine | 10 mV to 1.25 V | 20 mV to 2.5 V |
| Cardiac | 10 mV to 2.5 V | 20 mV to 5 V |

**Sine waveform**

**Frequency range**

0.1 Hz to 50 MHz

**Frequency setting resolution**

0.1 Hz

**Frequency accuracy**

130 ppm (frequency ≤ 10 kHz), 50 ppm (frequency > 10 kHz)

This is for Sine, Ramp, Square and Pulse waveforms only.

**Amplitude range**

20 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z; 10 $mV_{pp}$ to 2.5 $V_{pp}$ into 50 Ω

**Amplitude flatness, typical**

±0.5 dB at 1 kHz

±1.5 dB at 1 kHz for < 20 $mV_{pp}$ amplitudes

**Total harmonic distortion, typical**

1% for amplitude ≥ 200 $mV_{pp}$ into 50 Ω load

2.5% for amplitude > 50 mV AND < 200 $mV_{pp}$ into 50 Ω load

This is for Sine wave only.

**Spurious free dynamic range, typical**

40 dB ($V_{pp}$ ≥ 0.1 V); 30 dB ($V_{pp}$ ≥ 0.02 V), 50 Ω load

**Square and pulse waveform**

**Frequency range**

0.1 Hz to 25 MHz

**Frequency setting resolution**

0.1 Hz

**Frequency accuracy**

130 ppm (frequency ≤ 10 kHz), 50 ppm (frequency > 10 kHz)

**Amplitude range**

20 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z; 10 $mV_{pp}$ to 2.5 $V_{pp}$ into 50 Ω

**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

## Arbitrary-Function Generator optional

| | |
|---|---|
| **Overshoot, typical** | < % for signal steps greater than 100 $mV_{pp}$ |
| | 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 $TIE_{RMS}$, ≥ 100 $mV_{pp}$ 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 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z; 10 $mV_{pp}$ to 2.5 $V_{pp}$ 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 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z |
| | 10 $mV_{pp}$ to 2.5 $V_{pp}$ 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 $mV_{pp}$ to 2.4 $V_{pp}$ into Hi-Z |
| | 10 $mV_{pp}$ to 1.2 $V_{pp}$ into 50 Ω |
| **Cardiac** | |
| **Frequency range** | 0.1 Hz to 500 kHz |
| **Amplitude range** | 20 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z |
| | 10 $mV_{pp}$ to 2.5 $V_{pp}$ into 50 Ω |
| **Arbitrary** | |
| **Memory depth** | 1 to 128 k |
| **Amplitude range** | 20 $mV_{pp}$ to 5 $V_{pp}$ into Hi-Z |
| | 10 $mV_{pp}$ to 2.5 $V_{pp}$ into 50 Ω |
| **Repetition rate** | 0.1 Hz to 25 MHz |
| **Sample rate** | 250 MS/s |
| **Signal amplitude accuracy** | ±[ (1.5% of peak-to-peak amplitude setting) + (1.5% of absolute DC offset setting) + 1 mV ] (frequency = 1 kHz) |
| **Signal amplitude resolution** | 1 mV (Hi-Z) |
| | 500 µV (50 Ω) |

## Arbitrary-Function Generator optional

| | |
|---|---|
| **Sine and ramp frequency accuracy** | 130 ppm (frequency ≤10 kHz)<br>50 ppm (frequency >10 kHz) |
| **DC offset range** | ±2.5 V into Hi-Z<br>±1.25 V into 50 Ω |
| **DC offset resolution** | 1 mV (Hi-Z)<br>500 µV (50 Ω) |
| **DC offset accuracy** | ±[ (1.5% of absolute offset voltage setting) + 1 mV ]<br>Add 3 mV of uncertainty per 10 °C change from 25 °C ambient |

## Digital volt meter (DVM)

| | |
|---|---|
| **Measurement types** | DC, $AC_{RMS}$+DC, $AC_{RMS}$, Trigger frequency count |
| **Voltage resolution** | 4 digits |
| **Voltage accuracy** | |
| **DC:** | ±((1.5% * \|reading - offset - position\|) + (0.5% * \|(offset - position)\|) + (0.1 * Volts/div))<br>De-rated at 0.100%/°C of \|reading - offset - position\| above 30 °C<br>Signal ± 5 divisions from screen center |
| **AC:** | ± 3% (40 Hz to 1 kHz) with no harmonic content outside 40 Hz to 1 kHz<br>AC, typical: ± 2% (20 Hz to 10 kHz)<br>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** | ±(1 count + time base accuracy * input frequency)<br>The signal must be at least 8 $mV_{pp}$ or 2 div, whichever is greater. |
| **Maximum input frequency** | 10 Hz to maximum bandwidth of the analog channel<br>The signal must be at least 8 $mV_{pp}$ or 2 div, whichever is greater. |

## Processor system

| | |
|---|---|
| **Host processor** | Intel i5-4400E, 2.7 GHz, 64-bit, dual core processor |
| **Internal storage** | ≥ 80 GB. Form factor is an 80 mm m.2 card with a SATA-3 interface |
| **Operating system** | Closed Embedded OS. No access to OS file system. |

## 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-I 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 front right of the instrument
- **Amplitude:** 0 to 2.5 V
- **Frequency:** 1 kHz
- **Source impedance:** 1 kΩ

**External reference input**
The time-base system can phase lock to an external 10 MHz reference signal .

There are two ranges for the reference clock.

The instrument can accept a high-accuracy reference clock of 10 MHz ±2 ppm or a lower-accuracy reference clock of 10 MHz ±1 kppm.

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

Rear panel USB Host ports: Two USB 2.0 Hi-Speed ports, two USB 3.0 SuperSpeed ports

Rear panel USB Device port: One USB 3.0 SuperSpeed Device port providing USBTMC support and up to 800 Mbps transfer speeds

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

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

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

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

**LXI**
Class: LXI 2016

Version: 1.5

## Power source

**Power**

- **Power consumption** 360 Watts maximum
- **Source voltage** 100 - 240 V ±10% at 50 Hz to 60 Hz

  115 V ±10% at 400 Hz

## Physical characteristics

| | |
|---|---|
| **Dimensions** | Height: 3.44 in (87.3 mm)<br>Width: 17.01 in (432 mm)<br>Depth: 23.85 in (605.7 mm)<br>Fits rack depths from 24 inches to 32 inches |
| **Weight** | 29.4 lbs (13.34 kg) |
| **Cooling** | The clearance requirement for adequate cooling is 2.0 in (50.8 mm) on the left and right sides of the instrument. Air flows from left to right through the instrument. |
| **Rackmount configuration** | 2U rack mount kit is included as standard configuration |

## 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<br>5% to RH above +40 °C up to +50 °C, noncondensing |
| **Non-operating** | 5% to 90% relative humidity (% RH) at up to +60 °C, noncondensing |
| **Altitude** | |
| **Operating** | Up to 3,000 meters (9,843 feet) |
| **Non-operating** | Up to 12,000 meters (39,370 feet) |

## EMC Environmental and Safety

| | |
|---|---|
| **Regulatory** | CE marked for the European Union and CSA approved for the USA and Canada<br>RoHS compliant |

## Software

| | |
|---|---|
| **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. |
| **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. All web interaction conforms to LXI specification, version 1.5. |
| **Programming Examples** | Programming with the 5 & 6 Series platforms has never been easier. With a programmers manual and a GitHub site you have many commands and examples to help you get started remotely automating your instrument. |

# Ordering Information

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

## Step 1

**Start by selecting the model.**

| Model | Number of channels |
|---|---|
| LPD64 | 4 |

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

## Step 2

**Configure your Low Profile Digitizer by selecting the analog channel bandwidth you need**

Choose the bandwidth you need today by choosing one of these bandwidth options. You can upgrade it later by purchasing an upgrade option.

| Bandwidth Option | Bandwidth |
|---|---|
| 6-BW-1000 | 1 GHz |
| 6-BW-2500 | 2.5 GHz |
| 6-BW-4000 | 4 GHz |
| 6-BW-6000 | 6 GHz |
| 6-BW-8000 | 8 GHz |

## Step 3

**Add instrument functionality**

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

| Instrument Option | Built-in Functionality |
|---|---|
| 6-RL-2 | Extend record length from 125 Mpoints/channel to 250 Mpoints/channel |
| 6-AFG | Add Arbitrary / Function Generator |

## Step 4

**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 |
|---|---|
| 6-SRAERO | Aerospace (MIL-STD-1553, ARINC 429) |
| 6-SRAUDIO | Audio ($I^2S$, LJ, RJ, TDM) |
| 6-SRAUTO | Automotive (CAN, CAN FD, LIN, FlexRay, and CAN symbolic decoding) |
| 6-SRAUTOEN1 | 100BASE-T1 Automotive Ethernet serial analysis |
| 6-SRAUTOSEN | Automotive sensor (SENT) |
| 6-SRCOMP | Computer (RS-232/422/485/UART) |
| 6-SREMBD | Embedded ($I^2C$, SPI) |
| 6-SRENET | Ethernet (10BASE-T, 100BASE-TX) |
| 6-SRI3C | MIPI I3C (I3C decode and search only) |
| 6-SRPM | Power Management (SPMI) |
| 6-SRSPACEWIRE | Spacewire serial analysis |
| 6-SRUSB2 | USB (USB2.0 LS, FS, HS) |

## Step 5

**Add optional memory analysis**

| Instrument Option | Advanced Analysis |
|---|---|
| 6-DBDDR3 | DDR3 and LPDDR3 Debug and Analysis |

## Step 6

**Add optional analysis capabilities**

| Instrument Option | Advanced Analysis |
|---|---|
| 6-DJA | Advanced Jitter and Eye Analysis |
| 6-PWR | Power Measurement and Analysis |
| 6-DPM | Digital Power Management |
| 6-SV-RFVT | Spectrum View RF versus Time Analysis and remote IQ data transferring |
| 6-SV-BW-1 | Increase Spectrum View Capture Bandwidth to 2 GHz |
| 6-PAM3 | PAM3 analysis |

## 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 |
| 003-1929-xx | SMA 8-lb Torque Wrench for connecting SMA cables |
| 174-6211-xx | 2x Matched SMA cables (within 1 pS) |
| 174-6212-xx | 4x Matched SMA cables (within 1 pS) |
| 174-6215-00 | Power Divider, 2-way, 50 Ohm, DC-18 GHz |
| 174-6214-00 | Power Divider, 4-way, 50 Ohm, DC-18 GHz |
| GPIB to Ethernet adapter | Order model 4865B (GPIB to Ethernet to Instrument Interface) directly from ICS Electronics |

## 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 |
|---|---|
| G3 | Three Year Gold Care Plan. Includes expedited repair of all product failures including ESD and EOS, access to a loaner product during repair or advanced exchange to reduce downtime, priority access to Customer Support among others. |
| G5 | Five Year Gold Care Plan. Includes expedited repair of all product failures including ESD and EOS, access to a loaner product during repair or advanced exchange to reduce downtime, priority access to Customer Support among others. |
| R3 | Standard Warranty Extended to 3 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. |
| R5 | Standard Warranty Extended to 5 Years. Covers parts, labor and 2-day shipping within country. Guarantees faster repair time than without coverage. All repairs include calibration and updates. Hassle free - a single call starts the process. |
| C3 | Calibration service 3 Years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 2 years calibration coverage. |
| C5 | Calibration service 5 Years. Includes traceable calibration or functional verification where applicable, for recommended calibrations. Coverage includes the initial calibration plus 4 years calibration coverage. |
| D1 | Calibration Data Report |
| D3 | Calibration Data Report 3 Years (with Option C3) |
| D5 | Calibration Data Report 5 Years (with Option C5) |

## Feature upgrades after purchase

**Add feature upgrades in the future**

The 6 Series products offer many ways to 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 | SUP6-AFG | SUP6-AFG-FL | Add arbitrary function generator |
| | SUP6-RL-2 | SUP6-RL-2-FL | Extend record length to 250 Mpts / channel |
| Add protocol analysis | SUP6-SRAERO | SUP6-SRAERO-FL | Aerospace serial triggering and analysis (MIL-STD-1553, ARINC 429) |
| | SUP6-SRAUDIO | SUP6-SRAUDIO-FL | Audio serial triggering and analysis ($I^2S$, LJ, RJ, TDM) |
| | SUP6-SRAUTO | SUP6-SRAUTO-FL | Automotive serial triggering and analysis (CAN, CAN FD, LIN, FlexRay, and CAN symbolic decoding) |
| | SUP6-SRAUTOEN1 | SUP6-SRAUTOEN1-FL | 100Base-T1 automotive Ethernet serial analysis |
| | SUP6-SRAUTOSEN | SUP6-SRAUTOSEN-FL | Automotive sensor serial triggering and analysis (SENT) |
| | SUP6-SRCOMP | SUP6-SRCOMP-FL | Computer serial triggering and analysis (RS-232/422/485/UART) |
| | SUP6-SREMBD | SUP6-SREMBD-FL | Embedded serial triggering and analysis ($I^2C$, SPI) |
| | SUP6-SRENET | SUP6-SRENET-FL | Ethernet serial triggering and analysis (10Base-T, 100Base-TX) |
| | SUP6-SRI3C | SUP6-SRI3C-FL | MIPI I3C serial decoding and analysis |
| | SUP6-SRPM | SUP6-SRPM-FL | Power Management serial triggering and analysis (SPMI) |
| | SUP6-SRSPACEWIRE | SUP6-SRSPACEWIRE-FL | Spacewire serial analysis |
| | SUP6-SRUSB2 | SUP6-SRUSB2-FL | USB 2.0 serial bus triggering and analysis (LS, FS, HS) |
| Add advanced analysis | SUP6-DJA | SUP6-DJA-FL | Advanced jitter and eye analysis |
| | SUP6-PWR | SUP6-PWR-FL | Advanced power measurements and analysis |
| | SUP6-DPM | SUP6-DPM-FL | Digital power management |
| | SUP6-SV-RFVT | SUP6-SV-RFVT-FL | Spectrum View RF versus time analysis |
| | SUP6-SV-BW-1 | SUP6-SV-BW-1-FL | Increase Spectrum View capture bandwidth to 2 GHz |
| | SUP6-PAM3 | SUP6-PAM3-FL | PAM3 analysis |
| Add memory analysis | SUP6-DBDDR3 | SUP6-DBDDR3-FL | DDR3 and LPDDR3 debug and analysis |
| Add digital voltmeter | SUP6-DVM | N/A | Add digital voltmeter / trigger frequency counter |

## Bandwidth upgrades after purchase

**Add bandwidth upgrades in the future**

The analog bandwidth of 6 Series Low Profile Digitizer products can be upgraded after initial purchase. Bandwidth upgrades are purchased based on the current bandwidth and the desired bandwidth. All bandwidth upgrades can be performed in the field by installing a software license and a new front panel label.

| Model to be upgraded | Bandwidth before upgrade | Bandwidth after upgrade | Order this bandwidth upgrade |
|---|---|---|---|
| LPD64 | 1 GHz | 2.5 GHz | SUP6LP-BW10T254 |
| | 1 GHz | 4 GHz | SUP6LP-BW10T404 |
| | 1 GHz | 6 GHz | SUP6LP-BW10T604 |
| | 1 GHz | 8 GHz | SUP6LP-BW10T804 |
| | 2.5 GHz | 4 GHz | SUP6LP-BW25T404 |
| | 2.5 GHz | 6 GHz | SUP6LP-BW25T604 |
| | 2.5 GHz | 8 GHz | SUP6LP-BW25T804 |
| | 4 GHz | 6 GHz | SUP6LP-BW40T604 |
| | 4 GHz | 8 GHz | SUP6LP-BW40T804 |
| | 6 GHz | 8 GHz | SUP6LP-BW60T804 |

CE

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

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

Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.