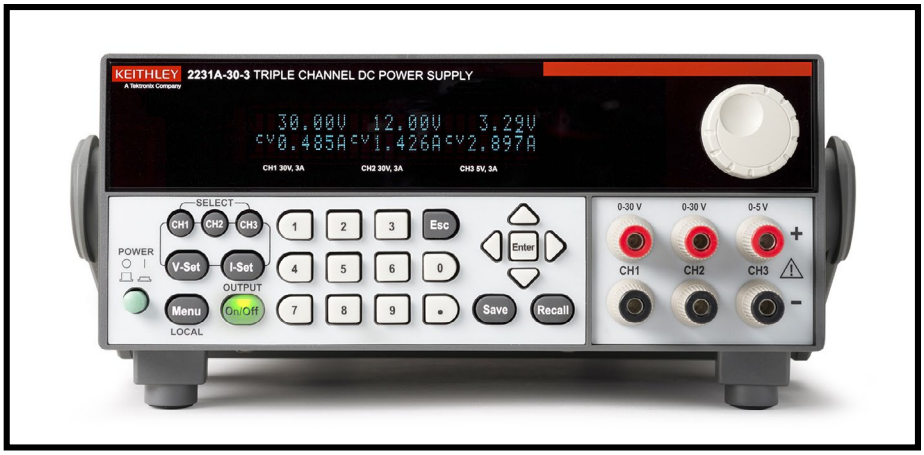
2231A-30-3

195W Triple Channel DC Power Supply

3-Year Warranty

- Get three isolated, independent, and adjustable outputs in one instrument
- Output a total of 195W of power with two 30V@3A outputs and one 5V@3A output
- Set voltage outputs with 0.06% basic accuracy and current outputs with 0.2% basic accuracy
- Output DC power with less than 5mVp-p noise
- Display voltage and current measurements continuously from all three outputs
- Double output levels by connecting the two 30V channels in series or parallel
- Store frequently used configurations in any of 30 setup memory locations
- Turn off any output after a predetermined test time with each channel's output timer
- Control the supply from a PC with an optional USB adapter



The Model 2231A-30-3 Triple Channel DC Power Supply can output a total of 195W of power, providing the power levels needed to energize a wide range of circuits and devices for benchtop work. Two channels can supply up to 30V at 3A each; the third channel can provide up to 5V at 3A. The Model 2231A-30-1 does not compromise on performance or convenience features, offering the versatility and ease of use you need, so it can be the only DC power supply on your bench.

Quality DC Power

The Model 2231A-30-3 is a linear-based design with less than 5mVp-p noise per output. Voltage and current settings have basic accuracies of 0.06% and 0.2% respectively. The load voltage and load current readback results provide the same levels of accuracy, so you can be confident you are sourcing accurate, low noise voltages and currents to your device-under-test (DUT).

Three Fully Independent Outputs

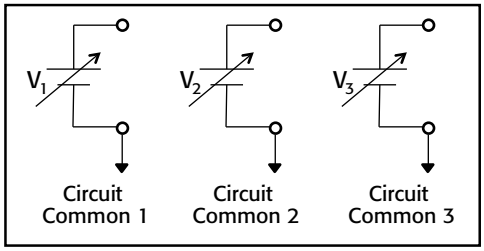
Each output of the Model 2231A-30-3 is fully programmable and can be turned on and off independently from the other channels; it essentially provides three power supplies in one instrument. You can power up both the analog circuitry and the digital circuitry of a printed circuit board or a complete device, all with the same instrument.

All Outputs Are Isolated from Each Other and from Ground

Each output can power a circuit on a different ground reference. The low connection on each output is not connected to any of the other outputs. That means one supply can test three separate circuits on three different ground references or can power circuits that are transformer or optically isolated from each other. Furthermore, all outputs are not referenced to ground, so the Model 2231A-30-3 can power both floating circuits and grounded circuits.

Power Bipolar Circuits

Because the Model 2231A-30-3's outputs are isolated, one output can be turned effectively into a negative source by connecting its high terminal to the common reference point of a bipolar circuit. A second output can connect its low terminal to the same common reference point. The result is a positive output and a negative output. If the two 30V channels are used in this configuration, both outputs can be changed at the same time by using the Model 2231A-30-3's tracking function. That allows varying both channels at the same time while keeping their outputs at identical magnitudes.



The Model 2231A-30-3 has three fully independent, programmable outputs that are electrically isolated from each other. This allows them to power circuits that are on different grounds, such as optically isolated circuits.

APPLICATIONS

- Engineering and science student labs
- Service work
- Electronic design

2231A-30-3

195W Triple Channel DC Power Supply

Ordering Information

2231A-30-3
Triple Channel DC Power Supply

Accessories Supplied

Documentation CD with User Manual
Certificate of Calibration
Power Cord

ACCESSORIES AVAILABLE

2231A-001	USB Adapter with USB Cable
RMU2U	Rack Mount Kit
386759800	RMU2U Rack Mount Cosmetic Filler Panel

SERVICES AVAILABLE

2231A-30-3-EW	1 Year KeithleyCare® Gold Plan
2231A-30-3-5Y-EW	5 Year KeithleyCare Gold Plan
C/2231A-30-3-3Y-STD	KeithleyCare 3 Yr Std Calibration Plan
C/2231A-30-3-5Y-STD	KeithleyCare 5 Yr Std Calibration Plan

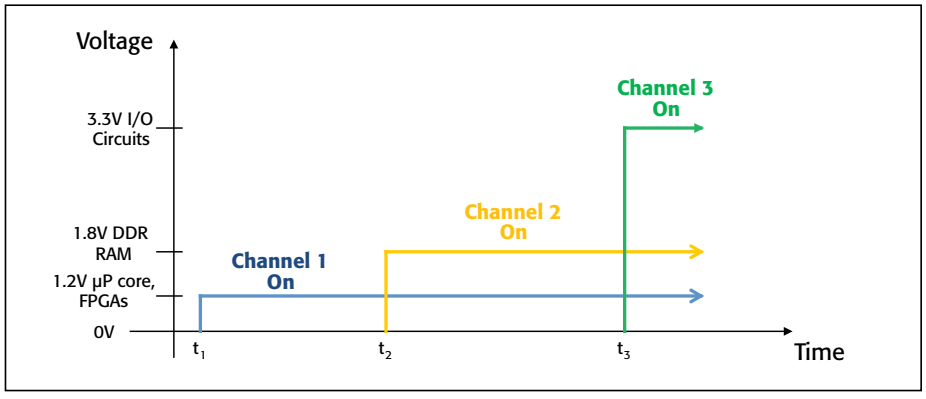
Supply 60V or 6A

When the application requires outputting more than 30V or 3A, the two 30V channels can be combined to double the output level. Wire the two outputs in series to deliver up to 60V or wire them in parallel to deliver up to 6A. For your convenience, the Model 2231A-30-3 display will read the total output, either voltage or current, to eliminate confusion. Also, the supply controls both outputs to deliver the required voltage or current. There's no need to set up each channel individually; the supply manages the channels for you, so combining channels is uncomplicated.

Wire the two 30V channels in series or parallel to double the output voltage to 60V or the supplied current to 6A. The Model 2231A-30-3 has series and parallel modes that manage the channels and display the total output. This display shows the supply's parallel mode, including the output voltage and the total current from the channels wired in parallel.

Easily Test, Monitor, and Protect Your Circuits

- Adjust the outputs with the rotary knob or enter the output values precisely using the keypad with setting resolution of 10mV or 1mA.
- See the voltage and current readings on all channels at all times; the Model 2231A-30-3's display shows the readings from all three outputs simultaneously.
- Protect your DUT with an overvoltage protection setting for each output.
- Set timers to turn off an output after a programmed time to prevent excess stress on a circuit under development.
- Store and recall instrument setups for frequently used tests to begin testing quickly. You can store up to 30 unique test setups.



Safely power circuits up and down in the proper sequence using the three independently programmable output channels.

Control the Supply and Upload Data to a PC

Use the optional Model 2231A-001 USB Adapter to control the Model 2231A-30-1 via a PC's USB interface, then transfer readings from the outputs to combine with other test data for a more thorough analysis of DUT performance. The 2231A-001 USB Adapter provides the flexibility to use the supply under either manual or automated control.

2231A-30-3 195W Triple Channel DC Power Supply

Specifications

DC OUTPUT RATING

	Channel 1	Channel 2	Channel 3
Voltage	0–30 V	0–30 V	0–5 V
Current	0–3 A	0–3 A	0–3 A

MAXIMUM POWER: 195W

LOAD REGULATION:
Voltage: ≤0.02% + 4mV
Current: ≤0.2% + 3mA

LINE REGULATION:
Voltage: ≤0.02% + 4mV
Current: ≤0.2% + 3mA

RIPPLE AND NOISE (20Hz–20MHz):
Voltage: ≤1mVrms/≤5mVp-p
Current: ≤6mArms

SETTING RESOLUTION:
Voltage: 10mV
Current: 1mA

SETTING ACCURACY:
Voltage: ≤0.06% + 20mV
Current: ≤0.2% + 10mA

READBACK RESOLUTION:
Voltage: 10mV
Current: 1mA

READBACK ACCURACY:
Voltage: ≤0.06% + 20mV
Current: ≤0.2% + 10mA

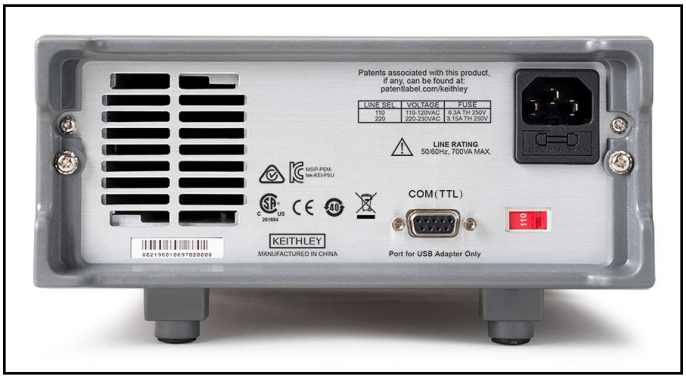
ISOLATION VOLTAGE, OUTPUT TO CHASSIS: Any output can be isolated up to 240V (DC + peak AC with AC limited to a maximum of 3Vpk-pk and a maximum of 60Hz) relative to the earth ground terminal.

ISOLATION VOLTAGE, OUTPUT TO OUTPUT: Any output can be isolated up to 240V (DC + peak AC with AC limited to a maximum of 3Vpk-pk and a maximum of 60Hz) relative to any other output terminal.

TRACKING AND COMBINATION MODES:
Tracking Mode: Maintains the ratio on the two 30V output channels that is present when the control is activated.
Combination V1 + V2 Series Mode: Deliver up to 60V when CH1 and CH2 are wired in series. Meter reads back combined voltage.
Combination I1 + 12 Parallel Mode: Deliver up to 6A when CH1 and CH2 are wired in parallel. Meter reads back combined current.

GENERAL

MEMORY: 30 setup memory locations.
OUTPUT TIMER RANGE: 0.1s to 99999.9s.
DISPLAY: Vacuum fluorescent display.
CONNECTIONS:
Front: Power output jacks: 3 sets, safety-shrouded banana jacks.
Rear: DB9 connector for remote control,
OVERTEMPERATURE PROTECTION: If the internal temperature of the supply exceeds 85°C, the supply will automatically turn off.
EMC COMPLIANCE: Conforms to European Union EMC Directive.
SAFETY COMPLIANCE: Conforms to European Union Low Voltage Directive.
POWER LINE RATINGS: 110VAC/230VAC ±10%.
POWER LINE FREQUENCY: 47Hz–63Hz.
MAXIMUM POWER CONSUMPTION: 750VA.
OPERATING ENVIRONMENT: 0° to 40°C, 5% to 80% relative humidity at up to 40°C.
STORAGE ENVIRONMENT: –20° to 70°C, 5% to 80% relative humidity up to 40°C, and 5% to 60% relative humidity from 40° to 70°C.
PHYSICAL CHARACTERISTICS
Height: 88.2 mm (3.5 in)
Width: 214.5 mm (8.5 in)
Depth: 354.6 mm (14 in)
Net Weight: 7.10kg (15.7 lbs.).
Shipping Weight: 9.40kg (20.7 lbs.).
WARRANTY: 3 years.



Model 2231A-30-3 rear panel showing the communication port, line power setting switch, and the power input connector with fuse holder.

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Tektronix®

High-voltage Differential Probes

TMDP0200 - THDP0200 - THDP0100 - P5200A - P5202A - P5205A - P5210A

Tektronix offers a broad portfolio of high-voltage probing solutions that enable users to safely and accurately make floating measurements.

Key performance specifications

- Bandwidths up to 200 MHz
- Up to 6000 V differential (DC + pk AC)
- Up to 2300 V common (RMS)

Key features

- Overrange Indicator
- Safety Certified
- Switchable Attenuation
- Switchable bandwidth limit

Applications

- Floating measurements
- Switching power supply design
- Motor drive design
- Electronic ballast design
- CRT display design
- Power converter design and service
- Power device evaluation

- BNC interface (P5200A probes)
- TekVPI® interface (TMDP and THDP Series probes)
- TekProbe® interface (P5202A, P5205A, and P5210A Series probes)

Safe high-voltage probe solutions

The THDP0100 and P5210A have the largest differential dynamic range capability from Tektronix, allowing users to safely measure up to ±6000 V. The THDP0100 supports bandwidths up to 100 MHz and slew rates up to 2500 V/ns at 1/1000 gain. These probes are supplied with two sizes of hook tips and have an overrange visual and audible indicator which warns the user when they are exceeding the linear range of the probe.

The THDP0200 and P5205A are active differential probes that are capable of safely measuring differential voltages up to ±1500 V. The probes are effective in making measurements in IGBT circuits such as motor drives and power converters. The THDP0200 supports bandwidths up to 200 MHz and slew rates up to 275 V/ns at 1/250 gain.

The TMDP0200 and P5202A are designed for medium-voltage applications with differential requirements up to ±750 V. These probes have lower attenuation ranges and offer better signal-to-noise ratio.

The P5200A can be used with any oscilloscope and enables users to safely make measurements of floating circuits with their oscilloscope grounded. The P5200A Active Differential Probe converts floating signals to low-voltage ground-referenced signals that can be displayed safely and easily on any ground-referenced oscilloscope.

Connectivity options

The TMDP and THDP Series probes are equipped with the TekVPI® interface which allows smart communication between the oscilloscope and probe. Pushing the probe menu button will launch the probe control menu on the oscilloscope display providing access to all relevant probe settings and controls. These probes are designed to operate on TekVPI® oscilloscopes without requiring the TPA-BNC adapter.

The P52xxA Series probes are equipped with the Tektronix TekProbe® interface which communicates scale information to the oscilloscope. Direct connections can be made to oscilloscopes configured with the TekProbe® interface or to any oscilloscope when used with the 1103 TekProbe® Power Supply.

Specifications

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

Model overview

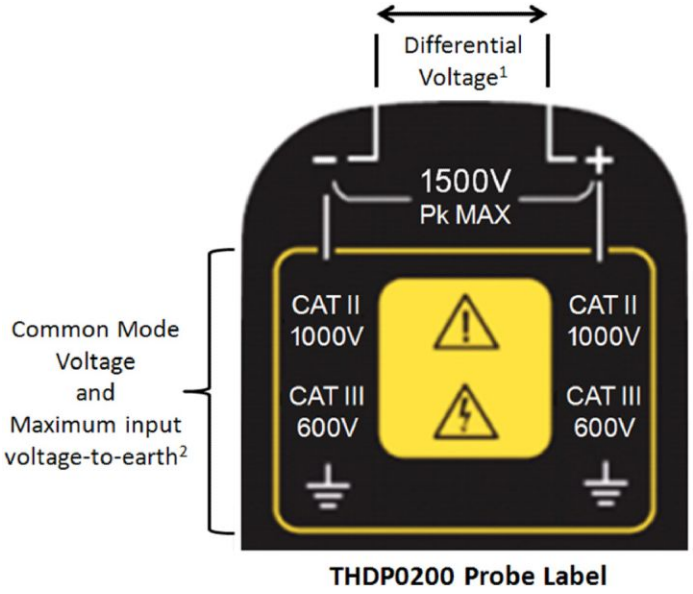
Probes with the TekVPI® interface

	TMDP0200	THDP0200	THDP0100
Attenuation	25X / 250X	50X / 500X	100X / 1000X
Differential Voltage	250X: ±750 V 25X: ±75 V	500X: ±1500 V 50X: ±150 V	1000X: ±6000 V 100X: ±600 V
Common Mode Voltage	±750 V	±1500 V	±6000 V
Maximum Input Voltage-to-Earth	550 V CAT I 300 V CAT III	1000 V CAT II 600 V CAT III	2300 V CAT I 1000 V CAT III
Bandwidth	200 MHz	200 MHz	100 MHz
Rise Time	<1.8 ns	<1.8 ns	<3.5 ns
Slew Rate	<275 V/ns at 1/250 gain	<650 V/ns at 1/500 gain	<2500 V/ns at 1/1000 gain
Input Impedance at the Probe Tip	5 MΩ || <2 pF	10 MΩ || <2 pF	40 MΩ || <2.5 pF
Typical CMRR	DC: > -80 dB 100 kHz: > -60 dB 3.2 MHz: > -30 dB 100 MHz: > -26 dB	DC: > -80 dB 100 kHz: > -60 dB 3.2 MHz: > -30 dB 100 MHz: > -26 dB	DC: > -80 dB 100 kHz: > -60 dB 3.2 MHz: > -30 dB 100 MHz: > -26 dB
Cable Length	1.5 m	1.5 m	1.5 m

Probes with the BNC and TekProbe® interface

	P5200A	P5202A	P5205A	P5210A
Attenuation	50X / 500X	20X / 200X	50X / 500X	100X / 1000X
Differential Voltage	500X: ±1300 V 50X: ±130 V	200X: ±640 V 20X: ±64 V	500X: ±1300 V 50X: ±130 V	1000X: ±5600 V 100X: ±560 V
Common Mode Voltage	±1300 V	±640 V	±1300 V	±5600 V
Maximum Input Voltage-to-Earth	1000 V CAT II	450 V CAT I 300 V CAT II	1000 V CAT II	2300 V CAT I 1000 V CAT III
Bandwidth	50 MHz	100 MHz	100 MHz	50 MHz
Differential Input Impedance	10 MΩ || 2 pF	5 MΩ || 2 pF	10 MΩ || 2 pF	40 MΩ || 2.5 pF
Input Impedance between each Input and Ground	5 MΩ || 4 pF	2.5 MΩ || 4 pF	5 MΩ || 4 pF	20 MΩ || 5 pF
Typical CMRR	DC: >80 dB 100 kHz: >60 dB 3.2 MHz: >30 dB 50 MHz: >26 dB	DC: >80 dB 100 kHz: >60 dB 3.2 MHz: >40 dB 50 MHz: >30 dB		
Cable length	1.8 m			

Model overview



THDP0200 Probe Label

1. The differential voltageis the maximum measurable range between the (+) and (-) input leads of the probe. Beyond these limits, the output could be clipped.
2. The maximum common mode voltage and maximum input voltage-to-earth (RMS) are the maximum voltages that each input lead (+/-) can be from ground.

Ordering information

Standard accessories

P5200A, P5202A, and P5205A

Description	Quantity included	Reorder part number
Hook clips	1 set of red and black hook clips	AC280-FL
Pincer clips	1 set of red and black pincer clips	AC283-FL
Alligator clips	1 set of red and black alligator clips	AC285-FL
Extension cables	1 set of red and black extension cables	196-3523-00

TMDP0200 and THDP0200

Description	Quantity included	Reorder part number
Hook clips	2	AC280-FL
Pincer clips	2	AC283-FL
Alligator clips	2	AC285-FL
Extension cables	2	196-3523-00
Test leads	2	TP175-FL
High voltage differential browser	1	THV-BROWSER
Probe holder	1	TPH1000

THDP0100 and P5210A

Description	Quantity included	Reorder kit part number
Probe tips	2	020-3070-00
Large hook clips	2	
Small hook clips	2	
Probe heads	2	

Probe and Accessory Derating Table

Common mode, relative to ground, when used with P52xxA Series probes

Accessory	Description	TMDP0200 / P5202A 450 V CAT I 300 V CAT II	THDP0200 / P5200A / P5205A 1000 V CAT II 600 V CAT III	THDP0100 / P5210A 2300 V CAT I 1000 V CAT III
196-3523-00	2x Extender Leads (1.5 m) 2300 V CAT I 1000 V CAT III	Standard 450 V CAT I 300 V CAT II	Standard 1000 V CAT II 600 V CAT III	Standard 2300 V CAT I 1000 V CAT III
AC280-FL	2x Hook Clips 1000 V CAT III 600 V CAT IV	Standard 450 V CAT I 300 V CAT II	Standard 1000 V CAT II 600 V CAT III	Optional 1000 V CAT I 1000 V CAT III
AC283-FL	2x Pincer Clips 1000 V CAT III 600 V CAT IV	Standard 450 V CAT I 300 V CAT II	Standard 1000 V CAT II 600 V CAT III	Optional 1000 V CAT I 1000 V CAT III
AC285-FL	2x Alligator Clips 1000 V CAT III 600 V CAT IV	Standard 450 V CAT I 300 V CAT II	Standard 1000 V CAT II 600 V CAT III	Optional 1000 V CAT I 1000 V CAT III
020-3070-00	Hook Clip Kit 2300 V CAT I 1000 V CAT II	Optional 450 V CAT I 300 V CAT II	Optional 1000 V CAT II 600 V CAT II	Standard 2300 V CAT I 1000 V CAT II
TP175-FL	2x Test Leads 1000 V CAT III 600 V CAT IV	Standard (TMDP0200) 550 V CAT I 300 V CAT III	Standard (THDP0200) 1000 V CAT II 600 V CAT III	Optional 2300 V CAT I 1000 V CAT III

Options

Power plug options (P5200A only)

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A4	North America power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)
Opt. SILV200	Standard warranty extended to 5 years

Probes and accessories are not covered by the oscilloscope warranty and Service Offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

The P52xxA Series probes provide high-voltage differential measurement solutions for any oscilloscope.

CE

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

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25 Jan 2016 51W-11195-11

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Tektronix®

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30 A AC/DC Current Probe

TCP0030A Datasheet

TCP0030A is a high-performance, easy-to-use AC/DC current probe designed for use and direct connection to oscilloscopes with the TekVPI™ probe interface. This AC/DC current measurement probe provides greater than 120 MHz of bandwidth with selectable 5 A and 30 A measurement ranges. It also provides exceptional low-current measurement capability and accuracy to current levels as low as 1 mA, important for meeting today's challenging current measurement needs.

Key features

- Easy-to-use and accurate AC/DC current measurements
- Intelligent communication with TekVPI™ oscilloscopes provides:
  - Units scaling and readout. Automatic, on-screen readout of amps and magnitude. Manual setup is not required. Hand calculation from volts to amps is unnecessary
  - Push button degauss and Autozero functionality
  - Probe status and diagnostic indicator LEDs
  - Remote GPIB/USB probe control
- Split-core construction allows easy circuit connection
- High accuracy with typically less than 1% DC gain error
- Low noise and DC drift
- 3rd party safety certification

Key performance specifications

- DC to >120 MHz bandwidth
- 30 A RMS maximum current capability
- 50 A peak pulse current capability
- High accuracy with typically less than 1% DC gain error
- Accurately measures current levels as low as 1 mA

Applications

- Power supplies
- Semiconductor devices
- Power inverters/converters
- Electronic ballasts
- Industrial/consumer electronics
- Mobile communications
- Motor drives
- Transportation systems

Specifications

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

Electrical characteristics

Bandwidth	DC to ≥120 MHz
Rise time	≤2.92 ns
Maximum DC current	30 A
Maximum RMS current	30 A
Maximum peak pulse current	50 A
Maximum bare wire voltage	150 V CAT II, (insulated wire 300 V CAT II)
Sensitivity	1 mA (on oscilloscopes that support 1 mV/div setting)
DC accuracy	±3% warranted
Accuracy, typical	DC: ±1% of reading DC to 60 Hz, ≤5 A: ±1% 60 Hz – 5 kHz, ≤5 A: ±1.5% DC – 5 kHz, >5 A: ±1.5%
Maximum Amp-Second product	500 A*µs (in 30 A range)
Insertion impedance	1 mΩ at 10 kHz 3.5 mΩ at 100 kHz 0.08 Ω at 1 MHz 0.15 mΩ at 10 MHz 0.7 Ω at 100 MHz 0.85 Ω at 120 MHz
Signal delay	14.5 ns
Current ranges	5 A and 30 A
Power requirements	TCP0030A is powered directly by oscilloscopes with the TekVPI™ interface. Note: For best support, download and install the latest version of the oscilloscope software from www.tek.com.

Physical characteristics

Probe head	
Length	20 cm (7.77 in)
Width	1.6 cm (0.625 in)
Height	3.2 cm (1.25 in)
Maximum conductor size	5 mm (0.197 in)
Cable length	200 cm (79 in)
Shipping weight	1.55 kg (3.44 lb)

EMC environment and safety

Temperature	
Operating	0 °C to 50 °C (32 °F to 122 °F)
Nonoperating	-40 °C to +75 °C (-40 °F to 167 °F)
Humidity	
Operating	5% to 95% Relative Humidity (RH) at up to +30 °C; 5% to 85% RH above 30 °C up to +50 °C, noncondensing
Nonoperating	5% to 95% Relative Humidity (RH) at up to +30 °C; 5% to 85% RH above 30 °C up to +75 °C, noncondensing
Altitude	
Operating	Up to 3,000 m (10,000 ft.)
Nonoperating	Up to 12,192 m (40,000 ft.)
Compliance labeling	CE (European Union), WEEE (European Union)

Ordering information

Models

TCP0030A	AC/DC Current Probe

Standard accessories

Instruction manual	071-3006-xx
Probe ground lead - 6 in. length	196-3120-xx
Nylon carrying case	016-1952-xx

Recommended accessories

Current Loop, 1 Turn, 50 Ω with BNC connector used for Performance Verification	Order 067-2396-00

Warranty

One year parts and labor.

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R3DW	Repair Service Coverage 3 Years (includes product warranty period). 3-year period starts at time of instrument purchase
Opt. R5	Repair Service 5 Years (including warranty)
Opt. R5DW	Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrument purchase
Opt. SILV600	Standard warranty extended to 5 years

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France 00800 2255 4835*
India 000 800 650 1835
Luxembourg +41 52 675 3777
The Netherlands 00800 2255 4835*
Poland +41 52 675 3777
Russia & CIS +7 (495) 6647564
Sweden 00800 2255 4835*
United Kingdom & Ireland 00800 2255 4835*

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Canada 1 800 833 9200
Denmark +45 80 88 1401
Germany 00800 2255 4835*
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Tektronix®

DMM6500 6½-Digit Bench/System Digital Multimeter

Datasheet

KEITHLEY
A Tektronix Company

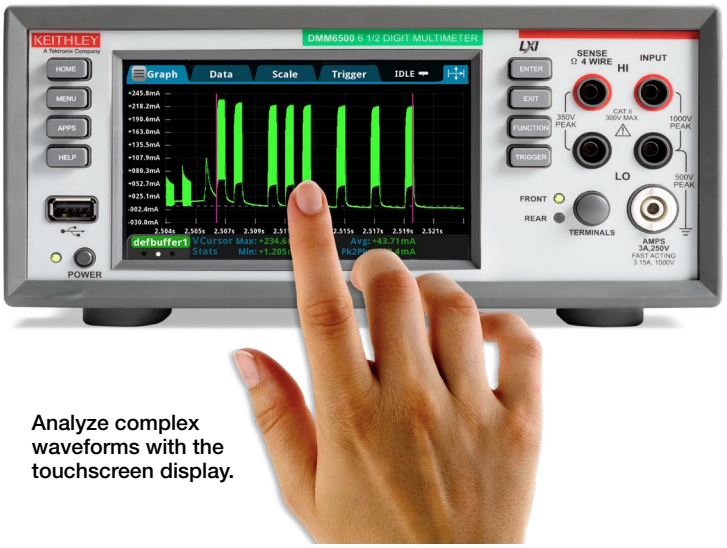
The DMM6500 is a modern bench/system DMM delivering more measurement functionality, best-in-class measurement insight, and a price that will not break your budget. The most recognizable feature of the DMM6500 is the large 5-inch (12.7 cm) capacitive touch screen display that makes it easy to observe, interact with, and explore measurements with “pinch and zoom” simplicity. Beyond its display technology, the DMM 6500 superior analog measurement performance delivers 25 PPM basic DCV accuracy for one year and 30 PPM for two years, potentially allowing you to extend your calibration cycles.

The DMM6500 is equipped with all the measurement functions you would expect in a bench multimeter, so there’s no need to buy additional measurement capabilities. Its 15 measurement functions, including capacitance, temperature (RTD, thermistor, and thermocouple), diode test with variable current sources, and up to 1 MS/sec digitizing are now included.

The digitizing function can be used for voltage or current and is especially useful in capturing transient anomalies or to help profile power events such as the operating states of today’s battery operated devices. Current and voltage can be digitized with a programmable 1 MS/sec 16-bit digitizer, making it possible to acquire waveforms without the need for a separate instrument.

Key Features

- 15 measurement functions including capacitance, temperature, and digitizing
- Expanded measurement ranges include 10 pA to 10 A and 1 mΩ to 100 MΩ
- Large 5-inch (12.7 cm) multi-touch capacitive touchscreen with graphical display
- Large internal memory; store up to 7 million readings
- Multiple language modes: SCPI, TSP® scripting, Keithley 2000 SCPI emulation, Keysight 34401A SCPI emulation
- Two-year specifications allow for longer calibration cycles
- Standard USB-TMC and LXI/Ethernet communication interfaces
- Optional user-installable communication interfaces including: GPIB, TSP-Link®, and RS-232
- Capture voltage or current transients with 1 MS/sec digitizer
- USB host port for storing readings, instrument configurations, and screen images
- Three-year warranty

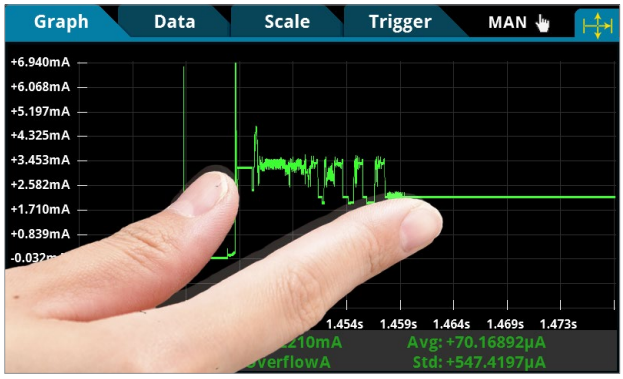


Analyze complex waveforms with the touchscreen display.

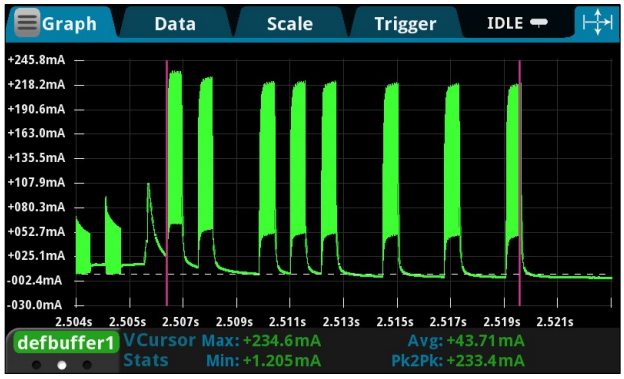
Tektronix®

Capture and Analyze Voltage or Current Transitions

Power analysis is becoming more important in today's electronic designs. Designers must now consider more efficient components and complex system design typically requiring multiple power states. The DMM6500 has the tools you need to help design and troubleshoot these complex systems. Eight different current ranges allow measurements from 10 amps down to 10 pico-amps, giving you the dynamic range to measure your power states. In addition, a built-in 1 MS/sec digitizing function can help capture transient events, allowing you to see and analyze transitions as they occur.

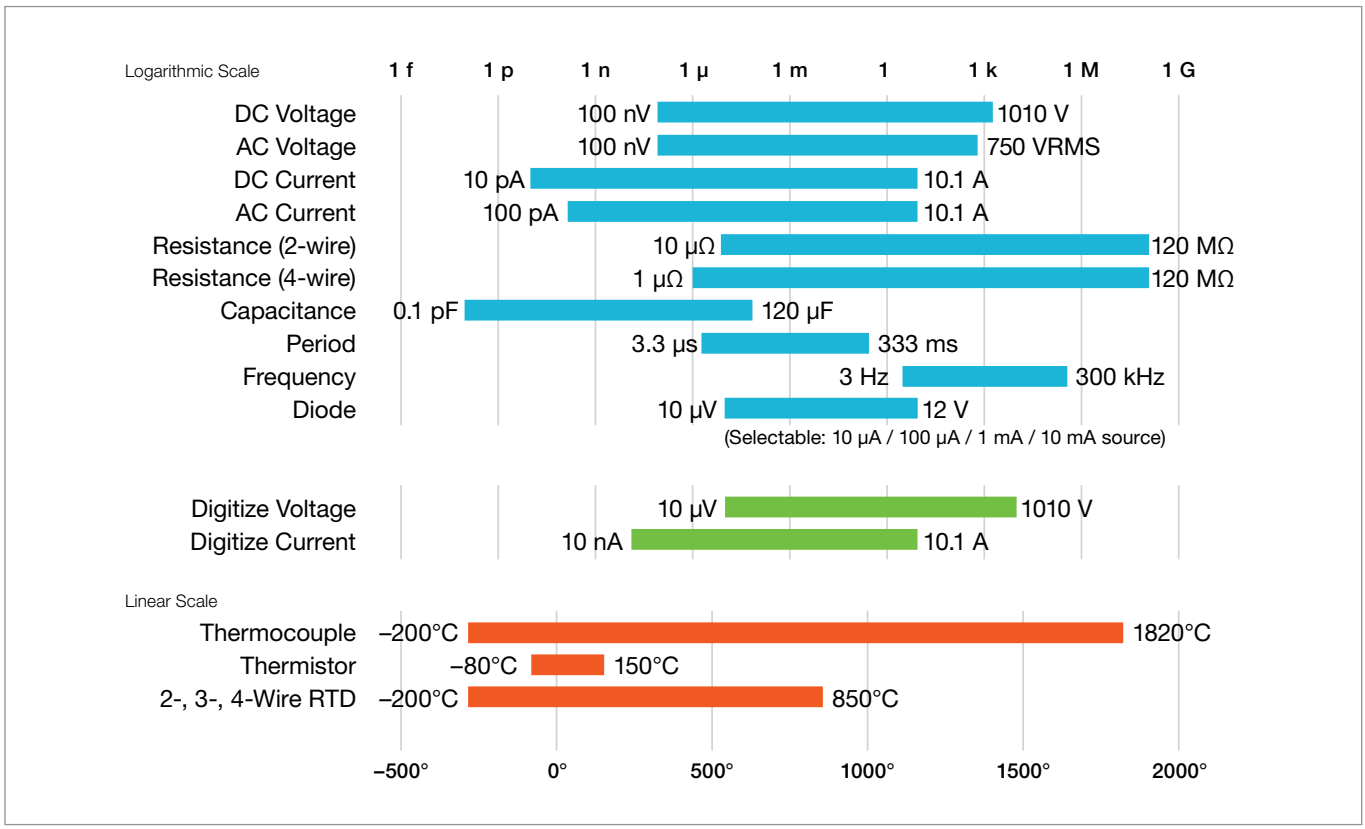


Pinch and zoom simplicity for in-depth waveform analysis.



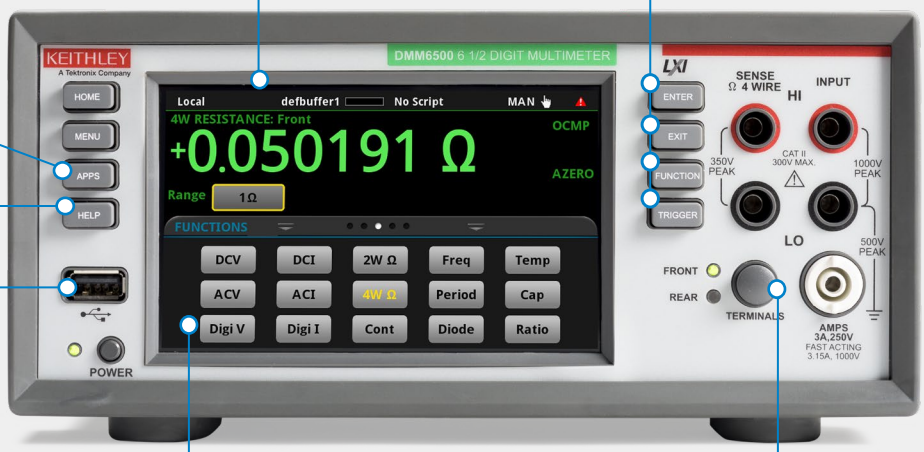
Visualize and analyze waveforms using adjustable cursors and statistics.

DMM6500 Measurement Capabilities

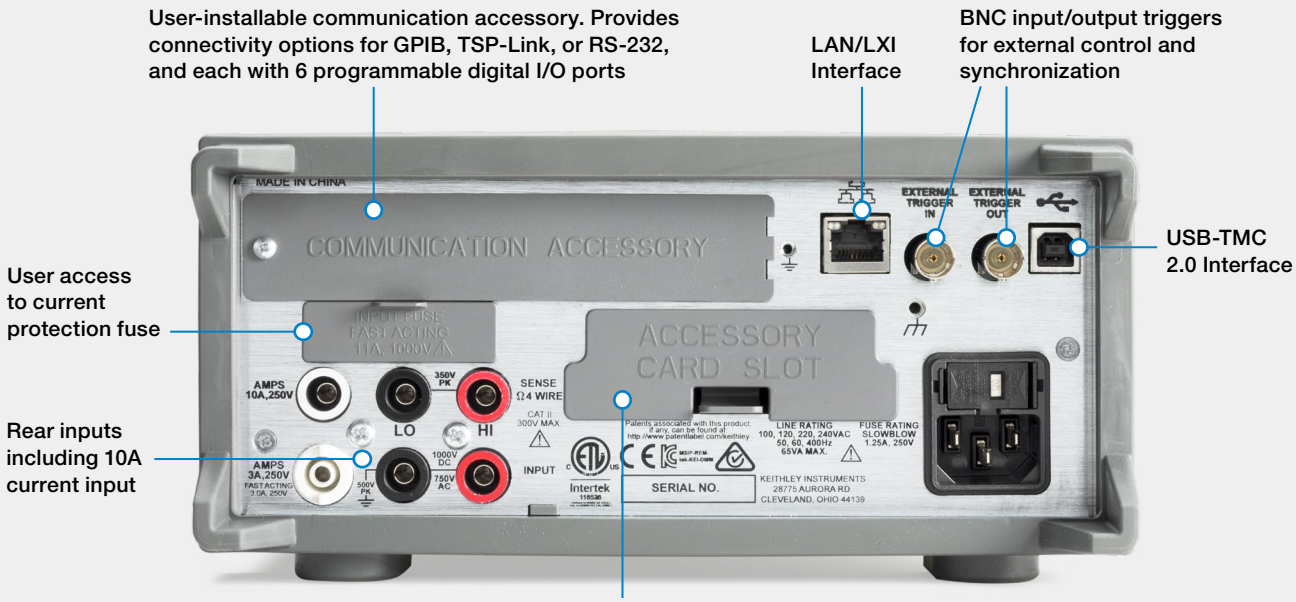


DMM6500 15 measurement functions and ranges.

DMM6500 Touchscreen Display Front Panel

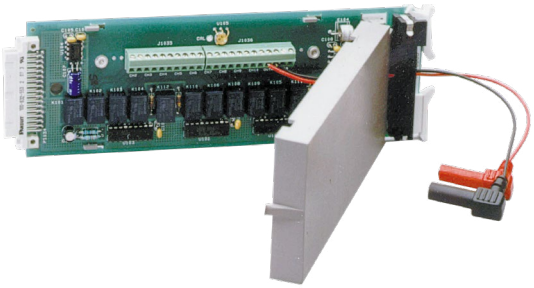


DMM6500 Rear Panel



Multi-channel/Scanning Applications

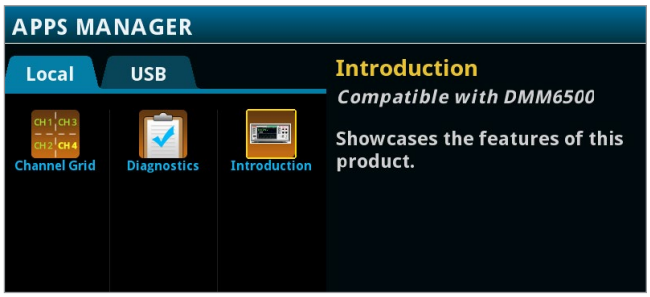
When characterizing or profiling your design it is often critical to make a series of measurements. In these applications the need for automated multi-channel measurements is advantageous. The DMM6500 is equipped with a scanner card slot allowing up to 10 channels of switching, giving you the capability to make automated multi-channel measurements. Plugging in the 2000-SCAN card gives users up to 10 channels of 2-pole measurements or 5 channels of 4-pole measurements. Functions can be programmed on a per-channel basis if supported by the switch topology.



2000-SCAN 10-Channel Multiplexer.

Application Programs

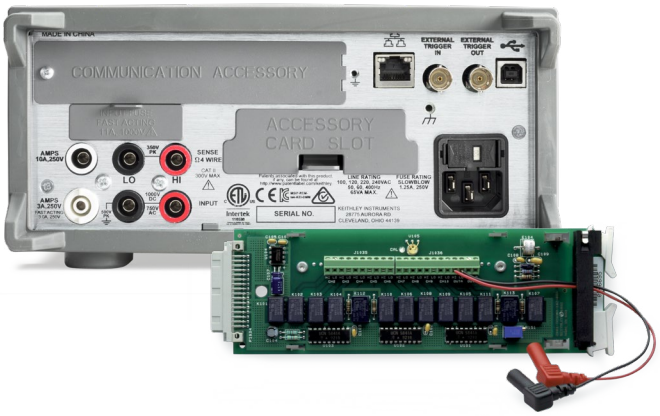
The DMM6500 is factory installed with application programs to help you get more out of your instrument. These application programs appear when the instrument is used in the TSP or native SCPI communication language mode. These examples highlight the unique ability of the DMM6500 to run specialized applications which customize the user interface. This can significantly change the way information is displayed or even automated in performing an application



Menu of application programs that can customize the display or perform special functions.

Temperature Measurement Applications

Temperature is one of the most measured signal types in the world, and the DMM6500 has many options to help you make this measurement. Besides RTD, thermistor, and thermocouple functions, you can equip your DMM with a nine-channel scanner card with built-in CJC for automated thermocouple temperature scanning. This feature is very useful when your design requires thermal profiling, especially when enclosed in a temperature chamber.



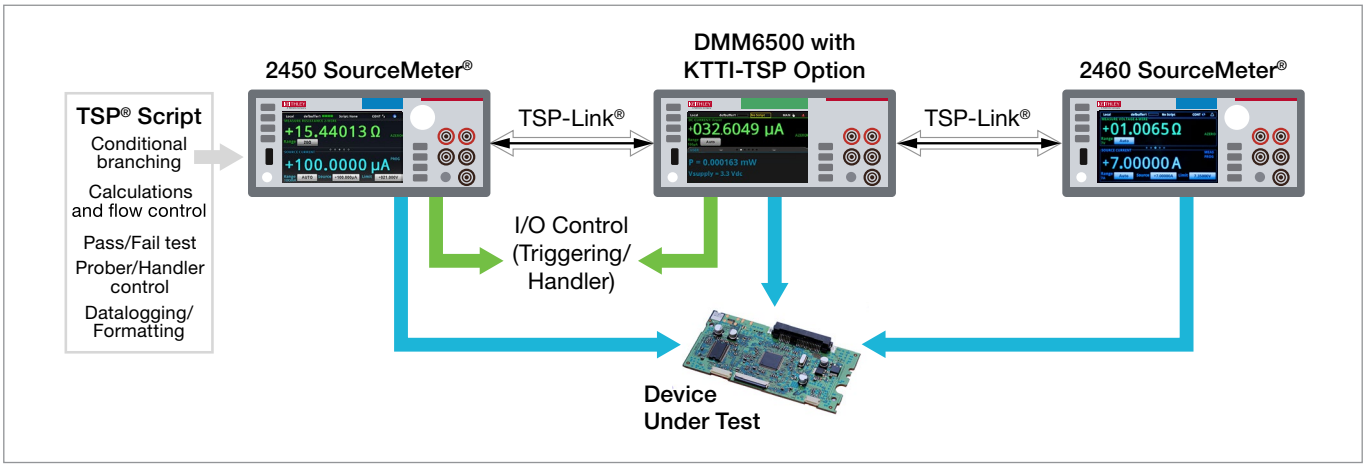
2001-TCSCAN 9-Channel Thermocouple Multiplexer and DMM6500 rear panel.

Ready to Use Instrument Drivers Simplify Programming

Prefer to create your own customized application software? Native National Instruments Labview®, IVI-C, and IVI-COM drivers are available for downloading to simplify the programming process. For the Labview® driver visit www.ni.com; for IVI drivers visit www.tek.com.

System Integration and Programming

Users have maximum programming flexibility with the DMM6500. In addition to traditional SCPI programming (default), the unit can also be configured for SCPI emulation for the Keithley 2000 or the Keysight 34401A. Additionally, Keithley's powerful Test Script Processor (TSP®) programming is another option that allows unique single- or multi-instrument testing applications where speed is critical.



TSP System using TSP-Link for instrument to instrument communication.

TSP® scripting allows running powerful test scripts directly on the instrument, without the need for an external PC controller. These test scripts are complete test programs based on an easy-to-use yet highly efficient and compact scripting language, LUA (www.lua.org). Scripts are a collection of instrument control commands and/or program statements. Program statements control script execution and provide facilities such as variables, functions, branching, and loop control. This allows you to create powerful measurement applications without an integrated development environment (IDE). Test scripts can contain any sequence of routines that are executable by conventional programming languages (including decision-making algorithms), so the instrument can manage every facet of the test without the need to communicate with a PC for decision making. This eliminates delays due to GPIB, Ethernet, or USB traffic congestion and greatly improves test times.

```
-- Define functions...
function meas4WRes(nplcVal)
    --Set measure function to 4-wire Res
    dmm.measure.func = dmm.FUNC_4W_RESISTANCE

    --Enable autorange.
    dmm.measure.autorange = dmm.ON

    --Enable autozero.
    dmm.measure.autozero.enable = dmm.ON

    --Enable OCOMP
    dmm.measure.offsetcompensation.enable = dmm.ON

    --Set the number of power line cycles
    dmm.measure.nplc = nplcVal

    --Read the resistance value.
    return dmm.measure.read()
end

-- Run main code...
-- Reset the Model DMM6500
reset()

-- Execute a 4W measurement
print(meas4WRes(1.0))
```

TSP Scripting example showing 4-wire resistance.

TSP technology also offers mainframe-less channel expansion. The KTTI-TSP is a user installable accessory card offering connectivity to TSP-Link® technology. This channel expansion bus allows connecting multiple DMM6500's or other TSP-enabled instruments together to form a tightly synchronized instrument system. Connection is provided with simple low cost Category 5 Ethernet cabling. The system is organized in a master-subordinate configuration, essentially allowing the connected instruments to act as one. Other Keithley TSP-enabled instruments include the 2450 and 2460 Graphical SourceMeter® SMU Instruments, Series 2600B SourceMeter® SMU Instruments, DMM7510, DAQ6510, and the Series 3700A Switch/Multimeter Measurement systems. TSP-Link technology supports up to 32 units, so it's easy to scale a system to fit the requirements of an application.

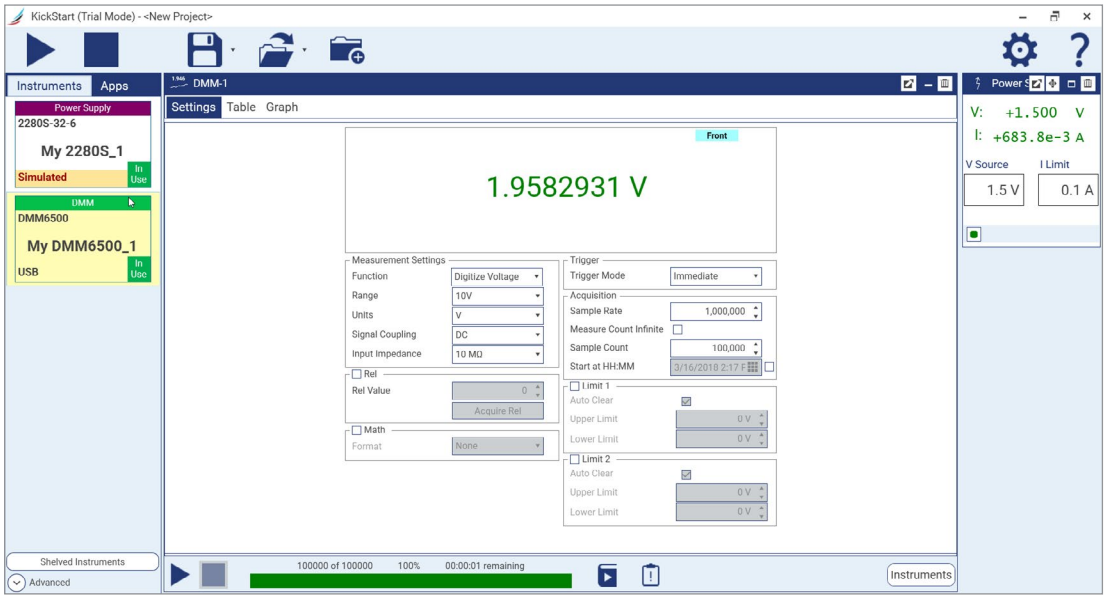
KickStart Instrument PC Control Software

KickStart allows you to configure, test, and collect data from multiple instruments, including DMMs, power supplies, SMU instruments, and dataloggers. You can control up to eight instruments at the same time and retrieve millions of readings from each instrument. This makes KickStart a great solution for your datalogging needs and for capturing lots of data from transient events with a digitizing DMM.

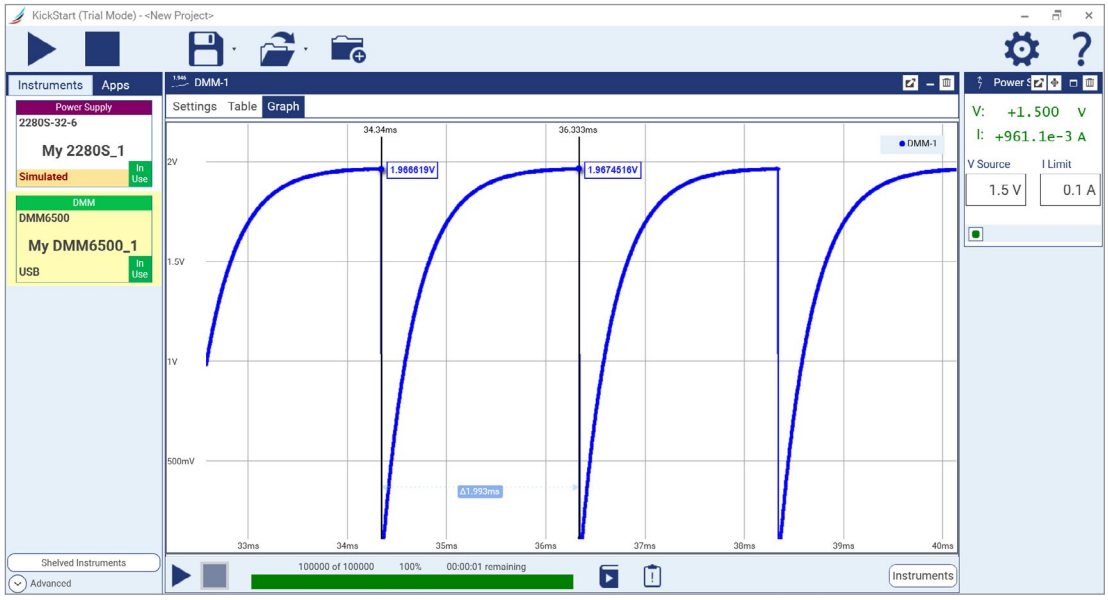
Getting insights quickly is important, so KickStart plots your data immediately and dedicates a large portion of the viewing area to the graph, while also allowing you to view and edit the most essential parameters of other instruments in your test setup. Kickstart also includes comparison tools to allow you to plot and overlay data from the run history of each test.

Key KickStart features:

- Automate data collection from up to eight instruments
- Replicate tests quickly using saved test configurations
- Use statistical summaries and built-in plotting and comparison tools to quickly discover measurement anomalies and trends
- Export data in ready-to-use formats for additional analysis or to share test updates with your colleagues



Kickstart allows you to perform and setup a test quickly and easily using a single point-and-click setup screen.



KickStart allows you to display data in both graphical and tabular formats. Mouse over the data in the graph to see exact values or use cursors to view detail on multiple data series at once.

Specification Conditions

This document contains specifications and supplemental information for the DMM6500 Multimeter System. Specifications are the standards against which the DMM6500 is tested. Upon leaving the factory, the DMM6500 meets these specifications. Supplemental and typical values are nonwarranted, apply at 23°C, and are provided solely as useful information. Measurement accuracies are specified for DMM6500 front or rear input terminals and include conversion error for thermocouple, thermistor, and RTD measurements.

Measurement Conditions Include:

- After a 30-minute warmup period.
- 1 PLC or 5 PLC measurement rate; for NPLC settings less than 1 PLC, add appropriate noise error from “Measurement Noise” table.
- Autozero enabled.
- Calibration period: one year (recommended) or two years. Calibration period may vary depending on customer requirements.
- 24-hour accuracy specification is relative to calibrator accuracy.
- Communication accessory card slot cover or an optional KTTI interface card is properly installed onthe rear of the unit.

Definitions:

- **T_{CAL}** — The temperature at which the instrument was calibrated (23°C for factory calibration).
- **Temperature coefficient** — Additional uncertainty added for each°C outside T_{CAL} ±5°C.
- **Power Line Cycle (PLC)** — 16.67 ms at 60 Hz and 20 ms at 50 Hz or 400 Hz line frequency. Frequency automatically sensed at power up.

DC Voltage

DC Voltage Accuracy ±(% of reading + % of range)

Range	Resolution	Input Impedance	24 Hours T_{CAL} ±1°C	90 Days T_{CAL} ±5°C	1 Year T_{CAL} ±5°C	2 Years T_{CAL} ±5°C	Temperature Coefficient
100 mV	100 nV	>10 GΩ or 10 MΩ ±1%	0.0015 + 0.0030	0.0025 + 0.0035	0.0030 + 0.0035	0.0035 + 0.0035	0.0001 + 0.0005
1 V	1 µV	>10 GΩ or 10 MΩ ±1%	0.0015 + 0.0006	0.0020 + 0.0006	0.0025 + 0.0006	0.0030 + 0.0006	0.0001 + 0.0001
10 V	10 µV	>10 GΩ or 10 MΩ ±1%	0.0010 + 0.0004	0.0020 + 0.0005	0.0025 + 0.0005	0.0030 + 0.0005	0.0001 + 0.0001
100 V	100 µV	10 MΩ ±1%	0.0015 + 0.0006	0.0035 + 0.0006	0.0040 + 0.0006	0.0050 + 0.0006	0.0006 + 0.0001
1000 V [1]	1 mV	10 MΩ ±1%	0.0020 + 0.0006	0.0035 + 0.0006	0.0040 + 0.0006	0.0050 + 0.0006	0.0006 + 0.0001

Measurement Noise Characteristics and Rejection Ratios

Measurement Rate in NPLCs	Digits	DCV RMS Noise Uncertainty (in % of range + fixed base) [2]	NMRR [3]	CMRR [3]
5 [4]	6.5	0	100 dB	140 dB
5		0	60 dB	140 dB
1 [4]		0	90 dB	140 dB
1		0	60 dB	140 dB
0.1 [4]		0.00015 + 1 µV	40 dB	120 dB
0.1	5.5	0.00015 + 4 µV	--	120 dB
0.01		0.00030 + 6 µV	--	80 dB
0.0005	4.5	0.00500 + 40 µV	--	80 dB

DC Voltage Characteristics

Overrange	20% on 100 mV, 1 V, 10 V, and 100 V. 1% on 1000 V
ADC Linearity (10 V range)	0.0001% of 10 V range
Input Impedance	**100 mV to 10 V Ranges:** Selectable: (>10 GΩ or 10 MΩ ±1%) in parallel with <400 pF. **100 V to 1000 V Ranges:** 10 MΩ ±1% in parallel with <400 pF
Input Bias Current	<50 pA at 23°C
Common Mode Current	<600 nA peak-peak at 50 Hz or 60 Hz
Earth Isolation	500 V_{peak} >10 GΩ and <300 pF any terminal to chassis
Common Mode Voltage	500 V_{peak} LO terminal to chassis maximum
Autozero Off Error	Add ±(0.0002% of range + 3 µV) within ±1°C and ≤10 minutes since last autozero Add ±(0.0010% of range + 10 µV) within ±5°C and ≤60 minutes since last autozero
Input Protection	Input HI 1100 V, Sense HI (SHI) and Sense LO (SLO) 350 V referenced to LO

Scanner Card Additional Uncertainties and Maximum Input Signal Levels

Scanner Card	Add the Following Uncertainty	Maximum Input Signal Level
2000-SCAN	1 µV	110 V
2001-TCSCAN	1 µV	110 V

Notes

1. For each additional volt over ±500 V, add 0.02 mV of uncertainty.
2. Noise values apply to terminals using a low-thermal short for 50 Hz and 60 Hz operation only. Measurements through a card may introduce additional noise.
3. NMRR for line frequency ±0.1%. For DC common mode and 1 kΩ unbalance on LO terminal, rejection of AC common mode signals is >80 dB for line frequency ±0.1%.
4. Line sync on.

Resistance

Resistance Accuracy ±(% of reading + % of range) [5]

Range	Resolution	Test Current (±5%)	Open Circuit Voltage (±5%)	24 Hours T_{CAL} ±1°C	90 Days T_{CAL} ±5°C	1 Year T_{CAL} ±5°C	2 Years T_{CAL} ±5°C	Temperature Coefficient
1 Ω [6]	1 µΩ	10 mA	12.5 V	0.0080 + 0.0200	0.0080 + 0.0200	0.0085 + 0.0200	0.0100 + 0.0200	0.0006 + 0.0010
10 Ω [6]	10 µΩ	10 mA	12.5 V	0.0020 + 0.0020	0.0080 + 0.0020	0.0085 + 0.0020	0.0100 + 0.0020	0.0006 + 0.0001
100 Ω	100 µΩ	1 mA	9.2 V	0.0020 + 0.0020	0.0075 + 0.0020	0.0085 + 0.0020	0.0100 + 0.0020	0.0006 + 0.0001
1 kΩ	1 mΩ	1 mA	9.2 V	0.0020 + 0.0006	0.0065 + 0.0006	0.0075 + 0.0006	0.0090 + 0.0006	0.0006 + 0.0001
10 kΩ	10 mΩ	100 µA	12.7 V	0.0020 + 0.0006	0.0065 + 0.0006	0.0075 + 0.0006	0.0090 + 0.0006	0.0006 + 0.0001
100 kΩ	100 mΩ	10 µA	12.5 V	0.0020 + 0.0006	0.0070 + 0.0010	0.0075 + 0.0010	0.0100 + 0.0010	0.0006 + 0.0001
1 MΩ	1 Ω	10 µA	12.5 V	0.0020 + 0.0006	0.0075 + 0.0006	0.0100 + 0.0006	0.0120 + 0.0006	0.0006 + 0.0001
10 MΩ [7]	10 Ω	0.7 µA ‖ 10 MΩ	7.1 V	0.0150 + 0.0006	0.0200 + 0.0010	0.0400 + 0.0010	0.0450 + 0.0010	0.0070 + 0.0001
100 MΩ [7]	100 Ω	0.7 µA ‖ 10 MΩ	7.1 V	0.0800 + 0.0030	0.2000 + 0.0030	0.2000 + 0.0030	0.2500 + 0.0030	0.0385 + 0.0001

Resistance Measurement Noise Characteristics [8]

Measurement Rate in NPLC	Digits	2-wire RMS Noise Uncertainty (in % of range + fixed base)	4-wire RMS Noise Uncertainty, Offset Compensation OFF (in % of range + fixed base) [9]	4-wire RMS noise uncertainty, offset compensation ON (in % of range + fixed base) [9]
5	6.5	0	0	0
1		0	0	0
0.1 [10]		0.00015 + 0.10 mΩ	0.00020 + 0.20 mΩ	0.00030 + 0.25 mΩ
0.1	5.5	0.00050 + 0.35 mΩ	0.00180 + 2.00 mΩ	0.00350 + 3.50 mΩ
0.01		0.00070 + 0.50 mΩ	0.00260 + 2.50 mΩ	0.00500 + 4.00 mΩ
0.0005	4.5	0.00650 + 3.50 mΩ	0.01000 + 7.00 mΩ	0.01500 + 10.00 mΩ

Resistance Characteristics

Overrange	20% on all ranges
Autozero Off Error	Add ±(0.0005% of range + 5 mΩ) within ±1°C and ≤10 minutes since last autozero Add ±(0.0020% of range + 10 mΩ) within ±5°C and ≤60 minutes since last autozero
Offset Compensation	Selectable on 1 Ω, 10 Ω, 100 Ω, 1 k Ω, and 10 kΩ ranges, 4-wire mode only
Maximum 4-wire Lead Resistance	5 Ω per lead for 1 Ω range 10% of range per lead for 10 Ω, 100 Ω, 1 kΩ, and 10 kΩ ranges 1 kΩ per lead for 100 kΩ, 1 MΩ, 10 MΩ, and 100 MΩ
Open Lead Detector	Selectable on all ranges, 4-wire mode only; default is off.
Input Protection	Input HI 1100 V, Sense HI (SHI) and Sense LO (SLO) 350 V referenced to LO

Scanner Card Additional Contact Resistance

Scanner Card	Contact Resistance
2000-SCAN	1 Ω at end of life
2001-TCSCAN	1 Ω at end of life

Notes

5. Specifications are for 2- and 4-wire resistance. For 2-wire, use relative offset and add 100 mΩ of additional uncertainty. For 4-wire, turn offset compensation on for ≤10 kΩ and off for >10 kΩ. The 1 Ω range is for 4-wire only.
6. Requires a 10-reading digital filter at 1 PLC or 2-reading digital filter at 5 PLC.
7. Specified for < 10% lead-resistance mismatch at HI and LO.
8. Applies for 1 Ω through 1 MΩ ranges. For 100 Ω range, multiply the listed values by five. Noise values apply to terminals using a low-thermal short for 50 Hz and 60 Hz operation only. Measurements through a card may introduce additional noise.
9. Open lead detection off.
10. Line sync on.

DC Current

DC Current Accuracy ±(% of reading + % of range)

Range	Resolution	Burden Voltage	24 Hours T_{CAL} ±1°C	90 Days T_{CAL} ±5°C	1 Year T_{CAL} ±5°C	2 Years T_{CAL} ±5°C	Temperature Coefficient
10 µA	10 pA	<0.13 V	0.007 + 0.002	0.035 + 0.005	0.045 + 0.005	0.055 + 0.005	0.0030 + 0.0006
100 µA	100 pA	<0.14 V	0.010 + 0.020	0.035 + 0.005	0.045 + 0.005	0.055 + 0.005	0.0020 + 0.0005
1 mA	1 nA	<0.17 V	0.007 + 0.006	0.035 + 0.005	0.045 + 0.005	0.055 + 0.005	0.0020 + 0.0005
10 mA	10 nA	<0.17 V	0.006 + 0.003	0.018 + 0.005	0.020 + 0.005	0.025 + 0.005	0.0015 + 0.0005
100 mA	100 nA	<0.20 V [11]	0.010 + 0.030	0.015 + 0.005	0.020 + 0.005	0.025 + 0.005	0.0015 + 0.0005
1 A	1 µA	<0.55 V [11]	0.020 + 0.004	0.030 + 0.005	0.040 + 0.005	0.050 + 0.005	0.0030 + 0.0005
3 A	1 µA	<1.70 V [11]	0.030 + 0.004	0.040 + 0.004	0.050 + 0.004	0.060 + 0.004	0.0030 + 0.0005
10 A [12]	10 µA	<0.50 V	0.140 + 0.025	0.190 + 0.025	0.220 + 0.025	0.250 + 0.025	0.0060 + 0.0005

DC Current Characteristics

Overrange

20% on 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, and 1 A ranges
1% on 3 A and 10 A ranges

Terminal Input Protection

Externally accessible 3 A, 250 V fast-acting fuse, 5 × 20 mm
Keithley replacement part number FU-99-1

Externally accessible 11 A and 1000 V fuse
Keithley replacement part number (11A) 159-0583-00

Autozero Off Error

Add ±0.004% of range within ±1°C and ≤10 minutes since last autozero
Add ±0.015% of range within ±5°C and ≤60 minutes since last autozero

Nominal Shunt Resistance [13]

10 µA	100 µA	1 mA	10 mA	100 mA	1 A	3 A	10 A
10 kΩ	1 kΩ	100 Ω	10 Ω	1 Ω	100 mΩ	100 mΩ	5 mΩ

DC Current Measurement Noise Characteristics [14]

Measurement Rate in NPLC	Digits	Additional Noise Error (in % of range + fixed base)
5	6.5	0
1		0
0.1 [15]		0.0009 + 10.0 pA
0.1	5.5	0.0015 + 3.5 nA
0.01		0.0030 + 3.5 nA
0.0005	4.5	0.0200 + 5.0 nA

Notes

11. When using the rear terminals, add 0.1 V to the 100 mA range and 0.5 V to the 1 A and 3 A ranges.
12. For each additional ampere over ±6 A, add 2 mA of uncertainty. Operation for >1000 hours with a signal level of >7 A, add 0.05% of reading uncertainty for every 1000 hours.
13. Guaranteed by design.
14. Noise values apply to open terminals. Measurements through a card may introduce additional noise.
15. Line sync on.

Temperature

Thermocouple Accuracy ±°C [16]

Type	Resolution	Range	2 Year Accuracy T_{CAL} ±5°C; all uncertainties in °C			Temperature Coefficient in°C/°C
			Simulated or External CJC		Internal CJC (on module)	
			Front/Rear Terminals	2001-TCSCAN	2001-TCSCAN	
J	0.001°C	0° to 760°C	0.20	0.20	0.65	0.03
		–200° to <0°C	0.20	0.20	0.65	0.03
K	0.001°C	0° to 1372°C	0.20	0.20	0.70	0.03
		–200° to <0°C	0.30	0.30	0.70	0.03
N	0.001°C	0° to 1300°C	0.20	0.20	0.70	0.03
		–200° to <0°C	0.50	0.60	1.50	0.03
T	0.001°C	0° to 400°C	0.20	0.20	0.70	0.03
		–200° to <0°C	0.30	0.30	0.70	0.03
E	0.001°C	0° to 1000°C	0.20	0.20	0.70	0.03
		–200° to <0°C	0.20	0.30	0.70	0.03
R	0.010 °C	600° to 1768°C	0.40	0.50	1.30	0.03
		0° to <600°C	0.80	1.00	1.30	0.03
S	0.010 °C	600° to 1768°C	0.40	0.50	1.30	0.03
		0° to <600°C	0.80	1.00	1.30	0.03
B	0.010 °C	1100° to 1820°C	0.40	0.50	1.65	0.03
		350° to <1100°C	1.20	1.50	1.65	0.03

Resistance Temperature Detector (RTD) Accuracy ±°C

Types: 100 Ω platinum PT100, D100, F100, PT385, and PT3916 or user-configurable 0 Ω to 10 kΩ

Measurement Method	Resolution	Range	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient in°C/°C
2-wire [17]	0.01°C	–200° to 850°C	0.80	0.003
3-wire [18]	0.01°C	–200° to 600°C	0.35	0.003
		>600° to 850°C	0.37	0.003
4–wire	0.01°C	–200° to 600°C	0.06	0.003
		>600° to 850°C	0.12	0.003

Thermistor Accuracy ±°C

Types: 2.2 kΩ, 5 kΩ, **and 10 kΩ**

Measurement Method	Resolution	Range	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient in°C/°C
2-wire	0.01°C	80° to 150°C	0.08	0.002

For readings >70°C, add this additional uncertainty per Ω of lead, channel, and contact resistance

Thermistor Type	Common Model Number	70° to 100°C	>100° to 150°C
2.2 kΩ	44004	0.22°C per Ω	1.11°C per Ω
5 kΩ	44007	0.10°C per Ω	0.46°C per Ω
10 kΩ	44006	0.04°C per Ω	0.19°C per Ω

Notes

16. Accuracy excludes probe errors.
17. Specifications do not include errors that may arise from user's cable or terminal resistance.
18. 3-wire RTD accuracy is for <0.1 Ω lead-resistance mismatch for input HI and LO. Add 0.25°C per 0.1 Ω of HI-LO resistance mismatch.

Temperature Characteristics

Thermocouple Conversion	ITS-90
Thermocouple Reference Junction	External (CJC on 2001-TCSCAN or user-provided with 2000-SCAN) or simulated (fixed)
Open Thermocouple Detection	Selectable per channel (open >130 kΩ; default on
Earth Isolation	500 V_{PEAK} > 0 GΩ and <300 pF any terminal to chassis

AC Voltage

AC Voltage Accuracy ±(% of reading + % of range) [19]

Range	Resolution	Calibration Cycle	3 Hz to 5 Hz	5 Hz to 10 Hz	10 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
100 mV	100 nV	24 hours	1.00 + 0.02	0.35 + 0.02	0.04 + 0.02	0.10 + 0.04	0.55 + 0.08	4.00 + 0.50
1 V	1 µV	90 days	1.00 + 0.03	0.35 + 0.03	0.05 + 0.03	0.11 + 0.05	0.60 + 0.08	4.00 + 0.50
10 V	10 µV	1 year	1.00 + 0.03	0.35 + 0.03	0.06 + 0.03	0.12 + 0.05	0.60 + 0.08	4.00 + 0.50
100 V	100 µV	2 years	1.00 + 0.03	0.35 + 0.03	0.07 + 0.03	0.13 + 0.05	0.60 + 0.08	4.00 + 0.50
750 V	100 µV							
Temperature Coefficient			0.100 + 0.003	0.035 + 0.003	0.005 + 0.003	0.011 + 0.005	0.060 + 0.08	0.200 + 0.020

AC Voltage Characteristics

Overrange (voltages in V_{RMS})	20% on 100 mV, 1 V, 10 V, and 100 V ranges. 0% for 750 V range
AC Measurement Method	AC-coupled digital sampling with anti-alias filter
Crest Factor (excludes sine wave)	Crest factors of up to 3:1 at full-scale input or 10:1 maximum, whichever is greater. Autorange selects optimum range for crest factor up to 10:1. Accuracy specifications apply to all crest factors and are limited to a product of (crest factor) × (fundamental frequency) ≤ 3 kHz.
Volt*Hertz Product	≤8×10^7 V*Hz [20]
Common Mode Rejection Ratio	>70 dB, for 1 kΩ unbalance in LO lead
Detector Bandwidth	Setting of 3 Hz, 30 Hz, or 300 Hz sets maximum measurement aperture of 200 ms, 20 ms, or 2 ms, respectively; only signals with frequency greater than the detector bandwidth are measured.
Input Impedance	1.1 MΩ ±2%, in parallel with <100 pF
Input Protection	1100 V_{peak}
Maximum DCV	400 V on any ACV range
ACV Frequency	Frequency reading automatically returned in reading buffer when in full buffer mode. Frequency readings are specified as in the frequency and period table.

Scanner Card Maximum Input Signal Levels

Module	Maximum input signal level
2000-SCAN	125 V_{RMS}/175 V_{peak}
2001-TCSCAN	125 V_{RMS}/175 V_{peak}

Notes

19. Specifications are for sine wave inputs >5% of range.
20. Guaranteed by design.

AC Current

AC Current Accuracy ± (% of reading + % of range) [21]

Range	Resolution	Burden Voltage	Frequency	24 Hours T_{CAL} ±1°C	90 Days T_{CAL} ±5°C	1 Year T_{CAL} ±5°C	2 Years T_{CAL} ±5°C	Temperature Coefficient
100 µA	100 pA	<0.14 V	3 Hz – 1 kHz	0.10 + 0.07	0.10 + 0.07	0.10 + 0.07	0.10 + 0.07	0.015 + 0.010
			>1 kHz – 10 kHz [22]	0.15 + 0.07	0.15 + 0.07	0.15 + 0.07	0.15 + 0.07	0.030 + 0.010
1 mA	1 nA	<0.17 V	3 Hz – 5 kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
			>5 kHz – 10 kHz [22]	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.030 + 0.006
10 mA	10 nA	<0.17 V	3 Hz – 5 kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10+ 0.04	0.015 + 0.006
			>5 kHz – 10 kHz [22]	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.030 + 0.006
100 mA	100 nA	<0.20 V [23]	3 Hz – 5 kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
			>5 kHz – 10 kHz [22]	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.030 + 0.006
1 A	1 µA	<0.75 V [23]	3 Hz – 5 kHz [24]	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
			>5 kHz – 10 kHz [22]	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.030 + 0.006
3 A	1 µA	<1.70 V [23]	3 Hz – 5 kHz [24]	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.015 + 0.006
			>5 kHz – 10 kHz [22]	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.030 + 0.006
10 A	10 µA	<0.50 V	3 Hz – 1 kHz [24]	0.40 + 0.06	0.40 + 0.06	0.40 + 0.06	0.40 + 0.06	0.015 + 0.006
			>1 kHz – 5 kHz	1.00 + 0.07	1.00 + 0.07	1.00 + 0.07	1.00 + 0.07	0.030 + 0.012
			>5 kHz – 10 kHz [22]	1.00 + 0.07	1.00 + 0.07	1.00 + 0.07	1.00 + 0.07	0.030 + 0.012

AC Current Characteristics

Overrange	20% on 100 µA, 1 mA, 10 mA, 100 mA, and 1 A ranges 1% on 3 A and 10 A ranges
AC Measurement Type	AC-coupled True RMS; measures the AC component of the input Digital sampling with anti-alias filter
Input Protection	See DC current characteristics.
Crest Factor [25] (excludes sine wave)	10:1 maximum crest factor (1.75:1 at full-scale) Autorange selects optimum range for crest factor up to 10:1 Accuracy specifications apply to all crest factors less than 5 and are limited to the product of (crest factor) × (fundamental frequency) ≤ 200 Hz.
ACI Frequency	Frequency readings are automatically returned in the reading buffer when in full buffer mode. Frequency values are typical.
Nominal Shunt Resistance [26]	100 µA: 1 kΩ, 1 mA: 100 Ω, 10 mA: 10 Ω, 100 mA: 1 Ω, 1 A: 100 mΩ, 3 A: 100 mΩ, 10 A: 5 mΩ

Notes

21. Specifications are for sine wave inputs >5% of range and >10 μA_{RMS}.
22. Typical performance for the indicated frequency ranges.
23. When using the rear terminals, add 0.1 V to the 100 mA range and 0.5 V to the 1 A and 3 A ranges.
24. For signals of <5 Hz, add 0.2% of reading uncertainty.
25. 100 µA range is specified only for crest factors <3.
26. Guaranteed by design.

Frequency and Period

Frequency and Period Accuracy ± (% of reading) [27]

Range	Resolution	Frequency	Period	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient in°C/°C
100 mV to 750 V (For signals >5% of range and >10 mV_{RMS})	0.0001% of reading	3 Hz to 10 Hz	333 ms to 100 ms	0.100	0.0002
		>10 Hz to 100 Hz	<100 ms to 10 ms	0.030	0.0002
		>100 Hz to 1 kHz	<10 ms to 1 ms	0.010	0.0002
		>1 kHz to 300 kHz	<1 ms to 3.3 µs	0.009	0.0002
		Square Wave [28]		0.008	0.0002

Frequency and Period Characteristics

Measurement Method	Reciprocal-counting technique; measurement is AC-coupled using AC measurement functions.
Voltage Ranges	100 mV_{RMS} full scale to 750 V_{RMS}; auto or manual ranging.
Gate Time	User definable from 2 ms to 273 ms (default 200 ms)

Continuity

Continuity Accuracy 2-Wire ±(% of reading + % of range) [29]

Range	Resolution	Test Current	Open Circuit Voltage (±5%)	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient
1 kΩ	100 mΩ	1 mA	9.2 V	0.010 + 0.010	0.0006 + 0.0001

Capacitance

Capacitance Accuracy ±(% of reading + % of range) [30]

Range	Resolution	Charge Current (±5%) [31]	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient
1 nF	0.1 pF	1 µA	0.80 + 0.50	0.05 + 0.05
10 nF	1 pF	10 µA	0.40 + 0.10	0.05 + 0.01
100 nF	10 pF	100 µA	0.40 + 0.10	0.05 + 0.01
1 µF	0.1 nF	100 µA	0.40 + 0.10	0.05 + 0.01
10 µF	1 nF	1 mA	0.40 + 0.10	0.05 + 0.01
100 µF	10 nF	1 mA	0.40 + 0.10	0.05 + 0.01

Capacitance Characteristics

Overrange	20% on all ranges.
Measurement Method	Constant current slope measurement.
Maximum Voltage and Voltage Clamp	**For all devices:** Clamped by hardware to <3 V.

Notes

27. Specifications apply for sine wave input; detector bandwidth of 3 Hz. For detector bandwidth 30 Hz, add 100 mHz uncertainty. For detector bandwidth 300 Hz, add 1 Hz uncertainty.
28. Used for square waves with amplitude > 10% of range and 10 Hz to 300 kHz.
29. Does not include the user's lead-resistance.
30. Accuracies are specified for cable, channel, and other stray connector capacitance properly zeroed with the REL function.
31. Discharge current limited to <10 mA.

Diode

Diode Voltage Accuracy ±(% of reading + additional uncertainty) [32]

Voltage Measure Range	Resolution	Maximum Voltage Measurement	Test Current (±5%)	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient
10 V	10 µV	12 V	10 µA	0.0045 + 60.0 µV	0.0008 + 10 µV
		10 V	100 µA	0.0045 + 80.0 µV	0.0008 + 10 µV
		7 V	1 mA	0.0045 + 170.0 µV	0.0010 + 10 µV
		7 V	10 mA	0.0045 + 1.1 mV	0.0010 + 10 µV

Digitize

Digitize DC Voltage Accuracy ±(% of reading + % of range) [33]

Range	Resolution	Input Impedance	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient
100 mV	10 µV	>10 GΩ or 10 MΩ ±1%	0.040 + 0.020	0.0025 + 0.0030
1 V	100 µV	>10 GΩ or 10 MΩ ±1%	0.030 + 0.010	0.0025 + 0.0010
10 V	1 mV	>10 GΩ or 10 MΩ ±1%	0.030 + 0.010	0.0025 + 0.0010
100 V	10 mV	10 MΩ ±1%	0.030 + 0.010	0.0025 + 0.0010
1000 V	100 mV	10 MΩ ±1%	0.030 + 0.010	0.0025 + 0.0010

Digitize DC Current Accuracy ±(% of reading + % of range) [33]

Range	Resolution	Burden Voltage	2 Year Accuracy T_{CAL} ±5°C	Temperature Coefficient
100 µA	10 nA	<0.14 V	0.07 + 0.05	0.0030 + 0.0035
1 mA	100 nA	<0.17 V	0.07 + 0.03	0.0030 + 0.0035
10 mA	1 µA	<0.17 V	0.05 + 0.03	0.0030 + 0.0035
100 mA	10 µA	<0.20 V [34]	0.05 + 0.03	0.0020 + 0.0035
1 A	100 µA	<0.55 V [34]	0.07 + 0.03	0.0040 + 0.0035
3 A	100 µA	<1.70 V [34]	0.09 + 0.04	0.0040 + 0.0035
10 A	1 mA	<0.50 V	0.25 + 0.08	0.0060 + 0.0100

Notes

32. Specifications do not include errors that may arise from user's cable or connection resistance.
33. DC accuracy specified with 1000 samples per second, 100-reading digital filter.
34. When using the rear terminals, add 0.1 V to the 100 mA range and 0.5 V to the 1 A and 3 A ranges.

Typical Digitize Signal Characteristics

1 dB full-scale of range

Function: Range	Spur-free Range SFDR (1 kHz / 10 kHz / 50 kHz)	THD + Noise SNDR (1 kHz / 10 kHz / 50 kHz)	Bandwidth (–3 dB, 5%)	Effective Number of Bits (1 kHz/10 kHz/50 kHz)
DCV: 100 mV	75 / 70 / 50	65 / 60 / 50	210 kHz	9 / 9 / 7
DCV: 1 V	95 / 90 / 75	80 / 80 / 75	210 kHz	12 / 12 / 11
DCV: 10 V	95 / 80 / 70	90 / 80 / 70	440 kHz	13 / 12 / 10
DCV: 100 V	50 / 35 / 25	50 / 40 / 30	17 kHz	10 / 8 / 7
DCV: 1000 V	50 / 35 / 25	50 / 40 / 30	17 kHz	13 / 11 / 10
DCI: 100 µA	80 / 65 / 45	70 / 65 / 45	430 kHz	12 / 10 / 8
DCI: 1 mA	80 / 65 / 45	70 / 65 / 45	570 kHz	12 / 10 / 8
DCI: 10 mA	80 / 65 / 45	70 / 65 / 45	230 kHz	12 / 10 / 8
DCI: 100 mA	80 / 65 / 45	70 / 65 / 45	340 kHz	12 / 10 / 8
DCI: 1 A	70 / 50 / 40	65 / 50 / 40	25 kHz	11 / 8 / 7
DCI: 3 A	70 / 50 / 40	65 / 50 / 40	25 kHz	11 / 8 / 7
DCI: 10 A	45 / 25 / 20	43 / 30 / 30	40 kHz	7 / 5 / 5

Digitizing Additional Characteristics

Maximum Resolution	16 bits
Measurement Input Coupling	DC coupled
Sampling Rate	Programmable 1 k through 1 MS/s
Minimum Record Time	1 µs
Maximum Record Length (Volatile)	Up to 7 million with standard buffer (includes channel and formatting information)

DC Voltage Ratio

DC Voltage Ratio Calculation [35]

Method	Measurement
Channel Ratio (through rear input scanner card)	$\text{Channel Ratio} = \frac{\text{Channel A}}{\text{Channel B}}$ Accuracy = (Accuracy of channel A measure range + Accuracy of channel B measure range) × Channel ratio
Channel Average (through rear input scanner card)	$\text{Channel Average} = \frac{\text{Channel A} + \text{Channel B}}{2}$ Accuracy = Accuracy of channel A measure range + Accuracy of paired channel B measure range
DCV Input Ratio (HI-LO/SHI–SLO) [36]	$\text{Ratio} = \frac{\text{HI signal}}{\text{SHI signal} - \text{SLO signal}}$ $\text{Accuracy} = \left(\frac{\text{HI range}}{\text{HI signal}} \times \text{DCV\% of range accuracy} + \frac{10\ \text{V}}{\text{SHI signal} - \text{SLO signal}} \times 0.0008\% \right) \times \text{Ratio}$

Notes

35. See DC Voltage Accuracy. SHI and SLO: 10 V range only. SHI and SLO (sense) terminals referenced to LO input. Maximum voltage referenced to LO 12 V.
36. Sense terminals on inputs are limited to 10 V range during ratio measurement. Add 0.0015% + 0.0005% per °C temperature coefficient to DCV percent of range accuracy when using the 100 V or 1000 V range on the input terminals.

System Specifications

Typical Reading Rates, DC Functions [37, 38]

60 Hz (50 Hz) Operation

NPLC	Functions: DCV (10 V) 2-wire Ω (≤10 kΩ), DCI (1 mA)		Functions: 4-wire Ω (≤1 kΩ) 4-wire and 3-wire RTD		Function: Thermistor or Thermocouple	
	Measurements (readings per second) [39]					
	Buffer	Computer	Buffer	Computer	Buffer	Computer
5	12 (10)	11 (9)	5 (4)	5 (4)	12 (10)	11 (9)
1	59 (48)	58 (48)	28 (23)	28 (23)	59 (49)	57 (48)
0.1	584 (490)	440 (380)	180 (160)	170 (150)	580 (480)	440 (380)
0.01	4900 (4100)	4800 (4100)	400 (390)	400 (390)	4800 (4100)	4700 (4000)
0.0005	20600 (20600)	19800 (19800)	460 (460)	460 (460)	21000 (21000)	20300 (20300)

Typical Reading Rates, AC Functions [37]

60 Hz (50 Hz) Operation

Function: ACV, ACI	Function: Frequency, Period	Measurements (readings per second)
Detector Bandwidth	Aperture	Buffer or Computer
3 Hz	200 ms	1
30 Hz	20 ms	10
300 Hz	2 ms	100

Scanning/Multiple Channels (with optional scan cards) [40]

Typical Scanning Measurement Rates	Measurements Into Buffer/Computer (channel per second)
Scanning DCV or 2-wire Ω	>90 with 2000-SCAN card, >90 with 2001-TCSCAN card
Scanning Thermocouple, Thermistor, or 2-wire RTD	>85 with 2000-SCAN card, >85 with 2001-TCSCAN card
Scanning 4-wire Ω and 3- or 4-wire RTD	>80 with 2000-SCAN card, >80 with 2001-TCSCAN card
Scanning ACV	>60 with 2000-SCAN card, >60 with 2001-TCSCAN card
Scanning Alternating DCV and 2-wire Ω	>85 with 2000-SCAN card, >85 with 2001-TCSCAN card

Notes

37. Reading speeds for autozero off, fixed range, autodelay off, offset compensation off, and open lead detector off where applicable.
38. Buffer measurements: For <0.1 PLC, multisample, and single buffer transfer binary reading only.
39. Computer measurements: For 5 PLC, 1 PLC, and 0.1 PLC single reading and single transfer to computer (USB).
40. Set-up conditions of the factory default setting with the following exceptions: 3.5 digits (0.0005 PLC), autorange off, autozero off, autodelay off, and open lead detection off.

Typical Function and Range Change Speed

Function	Function Change Time [42]	Range Change Time [43]	Autorange Time [42]
DCV, DCI, or 2-wire Ω [44]	<4 ms	<1.3 ms	<3.2 ms
4-wire Ω [45] or 3-wire RTD			<5.5 ms
Thermistor			—
Frequency or Period (2 ms aperture)	<1800 ms	<50 ms [46]	<50 ms [46]
ACV (300 Hz bandwidth)			
ACI (300 Hz bandwidth)	<100 ms	<4 ms	<5 ms
Capacitance	<4 ms	<3 ms	<30 ms
Digitize	<4 ms	<5 ms	—
Diode	<11 ms	—	—
Continuity	<11 ms	—	—
Thermocouple	<4 ms	—	—

Bus Transfer Speed [47]

	USB	LAN	GPIB	RS232 (Baud 115200)
Average for 1000 readings (binary)	441,000	268,000	201,000	10,000
Average for 1000 readings with relative timestamp (binary)	272,000	150,000	105,000	2,900
Average for 1000 readings with formatted elements [48]	46,000	29,000	17,000	290

Typical Digitize Voltage or Current [49]

Sampling rate	Measurements over USB to computer (readings per second)
10 kS/s	Up to 10,000
50 kS/s	Up to 50,000
100 kS/s	Up to 100,000
1 MS/s up to 7 s maximum duration	At least 90,000

Triggering

Trigger Sources	Front panel trigger key, timer, command interface, LAN/LXI, Trigger In (BNC rear panel), Digital I/O (optional accessory card), and TSP-Link® (optional accessory card)
External Trigger Delay	<1 µs when triggering from accessory card or rear BNC input
External Trigger Jitter	<1 µs when triggering from accessory card or rear BNC input
External Trigger In/Trigger Out	0 V to 5 V logic signal input and output, TTL-compatible, programmable edge pulse Minimum pulse width: 1 µs
External Trigger Out, Maximum Rate	Up to 90 kHz, measurement dependent
External Trigger In, Maximum Rate	Up to 150 kHz, measurement dependent

Notes

41. Assume the signal is 10 kHz or above.
42. 3.5 digits, autozero off, 0.0005 PLC, excludes measurement time.
43. DCV = 10 V; 2-wire or 4-wire = 1 kΩ; DCI = 1 mA; ACI = 1 mA; ACV = 1 V; Capacitance = 10 µF.
44. 2-wire function for 100 Ω range and up. For the 10 Ω range, add 2.7 ms.
45. 4-wire function for 100 Ω range and up. For the 1 Ω and 10 Ω ranges, add 2.7 ms.
46. When ranging to 10 V and above, add 1.8 s.
47. SCPI programmed using 4-byte binary format.
48. Format elements: Reading, relative timestamp, channel, and unit.
49. SCPI programmed using 4-byte binary format.

Scanning (with optional scan cards)

Scan Count	1 to continuous
Scan Interval	0 s to 27.7 hours
Channel Delay	0 to 60 s
Measure Interval	0 s to 27.7 hours

Internal Memory

Maximum Reading Memory (volatile)
Up to 7 million readings with standard buffer (includes channel and formatting information).

Internal (non-volatile) Memory for Saved Scripts and Scan Configurations
6 MB, enables hundreds of scan configurations or TSP scripts to be saved in non-volatile memory.

General Specifications

Line Power

Power Supply	100 V, 120 V, 220 V, and 240 V (±10%)
Power Line Frequency	50 Hz to 60 Hz and 400 Hz, automatically sensed at power-up
Maximum Power Consumption	50 VA
Typical Power Consumption	30 VA
Mains Input Fuse	250 V, 1.25 A slow-blow fuse: Keithley replacement part number FU-106-1.25

Environment and Regulatory

Operating Environment	Specified for 0° to 50°C, ≤80% relative humidity at 35°C, altitude up to 2000 meters
Storage Environment	–40° to 70°C
Vibration	MIL-PRF-28800F Class 3, random
Warm-up	30 minutes to rated accuracy
Safety	NRTL listed to UL61010-1, and CSA C22.2 No 61010-1; conforms with European Union Low Voltage Directive
EMC	Conforms to European Union EMC Directive

Mechanical

Display	12.7 cm (5 in.) capacitive touch, color TFT WVGA (800 × 480) with LED backlight
Rack Dimensions (W × H × D)	213.8 mm (8.42 in.) × 88.4 mm (3.48 in.) × 356.6 mm (14.04 in.)
Bench Dimensions (W × H × D)	224.0 mm (8.82 in.) × 107.2 mm (4.22 in) × 387.4 mm (15.25 in.)
Shipping Weight	4.54 kg (10.0 lb.) instrument only
Input Signal Connections	Front/rear safety banana jacks or scanner cards
Plug-in Scanner Slot	One slot on rear panel, see Optional Multi-Channel/Scanner Accessories.
Communication Slot	One slot on rear panel, see Optional Interfaces And Programmable Digital I/O.
Cooling	Forced air, fixed speed

Remote Interface – Standard

LAN/LXI Compliance	**RJ-45 Connector:** 10/100BT. **IP Configuration:** Static or DHCP (manual or automatic). **Web Interface:** Virtual front panel. **LXI Compliance:** LXI version 1.4 core 2016.
USB Device (rear panel, Type B)	2.0 full speed, USBTMC compliant
USB Host (front panel, Type A)	USB 2.0, support for flash drives, FAT32. **Capability:** Import/export instrument configuration files, reading buffers, screen captures, and scripts

Language

SCPI (default)	Default command set, Standard Commands for Programmable Instruments, SCPI-1999
TSP	Embedded Test Script Processor (TSP) accessible from any host interface; responds to high-speed test scripts comprised of remote commands and statements (for example, branching, looping, and math); able to execute test scripts stored in memory without host intervention
Emulation Modes	Keithley Model 2000 and 34401A

Math Functions

	REL, Minimum, Maximum, Average, Standard Deviation, peak-peak, dB, Limit Test, Percent, 1/x, and mX+b with user- defined units displayed

Miscellaneous

Real-time Clock	Lithium battery backup, CR2032 coin-type, factory replaceable, (3+ years of battery life); set and read year, month, day, hour, minute, and second. (Note: Seconds are not adjustable.)
Timestamp Resolution	15 ns with standard or full buffer style
Password Protection	30 characters
Alarms	Up to six: see Optional Interfaces and Programmable Digital I/O
Power Failure Recovery Mode	User selectable, resumes scanning once power is re-applied

Optional Interfaces and Programmable Digital I/O

KTTI-GPIB	GPIB IEEE-488.1 compliant; supports IEEE-488.2 common commands and status model topology
KTTI-RS232	RS232, 9-pin d-sub female connector; standard baud rates from 300 to 115,200 bps are supported
KTTI-TSP	RJ-45 (quantity 2); TSP-Link® expansion interface allows TSP-enabled instruments to trigger and communicate with each other
Digital I/O	For KTTI-RS232, KTTI-GPIB, and KTTI-TSP **Connector:** 9 pin d-sub female **5 V Power Supply Pin:** Limited to 500 mA > 4 V (solid-state fuse protected) **Lines:** Six input / output, user-defined for control, alarms (limits), or triggering **Input Signal Levels:** 0.7 V (maximum logic low), 3.7 V (minimum logic high) **Input Voltage Limits:** –0.25 V (absolute minimum), 5.25 V (absolute maximum) **Maximum Source Current:** 2.0 mA at > 2.7 V (per pin) **Maximum Sink Current:** –50 mA at 0.7 V (per pin, solid state fused)

Ordering Information

DMM6500	6½-Digit Bench/System Digital Multimeter

Supplied Accessories

1757	Pair, General Purpose Test Lead Set, 1000 V Cat II
USB-B-1	USB Cable, Type A to Type B, 1 m (3.3 ft.)
	Traceable Calibration Certificate
	Three-Year Warranty

Instruction Manuals/Documentation (available at www.tek.com/DMM6500)

DMM6500 Quick Start Guide
DMM6500 User's Manual
DMM6500 Reference Manual

Software and Drivers (available at tek.com)

IVI/VISA Drivers for Microsoft® Visual Basic®, Visual C/C++®
National Instruments (NI®) LabView™, NMI LabWindows™/CVI (available at ni.com)
Keithley Test Script Builder available at https://www.tek.com/keithley-test-script-builder
KickStart available at www.tek.com/kickstart

Power Cord Options

AO	North America power plug (120 V, 60 Hz)
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)
A4	Chile, Italy (220 V, 50 Hz)
A5	Switzerland power plug (220 V, 50 Hz)
A6	Japan power plug (100 V, 50/60 Hz)
A7	Denmark
A8	Israel
A9	Argentina
A10	China power plug (50 Hz)
A11	India power plug (50 Hz)
A12	Brazil power plug (60 Hz)
A99	No power cord

Optional Multi-Channel/Scanner Accessories

2000-SCAN Card	10 channel 2-pole or 5 channel 4-pole multiplexer
2001-TCSCAN Card	9 channel 2-pole or 4-channel 4-pole multiplexer with CJC sensor
	Limited compatibility with 2001-SCAN and 2000-SCAN-20. See the DMM6500 Firmware Release Notes for additional information.

Optional Interfaces and Programmable Digital I/O

KTTI-RS232	RS-232 Communication and Digital I/O Accessory, user-installable
KTTI-GPIB	GPIB Communication and Digital I/O Accessory, user-installable
KTTI-TSP	TSP-Link Communication and Digital I/O Accessory, user-installable

Available Accessories

Test Leads and Probes

1752	Premium Safety Test Lead Kit
1754	2-Wire Universal 10-Piece Test Lead Kit
1756	General Purpose Test Lead Kit
5804	Kelvin (4-Wire) Universal 10-Piece Test Lead Kit
5805	Kelvin (4-Wire) Spring-Loaded Probes
5806	Kelvin Clip Lead Set
5808	Low Cost Single-pin Kelvin Probe Set
8606	High Performance Modular Probe Kit
8610	Low Thermal Shorting Plug

Replacement Fuses

FU-106-1.25	Main Input Fuse, 3 A
FU-99-1	Current Input Fuse, 3 A, 250 V Fast Acting 5×20mm
159-0583-00	Current Input Fuse, 11 A, 1000 V

Cables, Connectors, Adapters

CA-18-1	Shielded Dual Banana Cable, 1.2 m (4 ft.)

Communication Interfaces & Cables

KPCI-488LPA	IEEE-488 Interface for PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter
7007-1	Shielded GPIB Cable, 1 m (3.2 ft)
7007-2	Shielded GPIB Cable, 2 m (6.5ft)
CA-180-3A	CAT5 Crossover Cable for TSP-Link / Ethernet
USB-B-1	USB Cable, Type A to Type B, 1 m (3.3 ft)

Triggering and Control

2450-TLINK	DB-9 to Trigger Link Connector Adapter
8501-1	Trigger Link Cable, DIN-to-DIN, 1 m (3.2 ft.)
8501-2	Trigger Link Cable, DIN-to-DIN, 2 m (6.5 ft.)
8503	DIN-to-BNC Trigger Cable

Rack Mount Kits

4299-8	Single Fixed Rack Mount Kit
4299-9	Dual Fixed Rack Mount Kit
4299-10	Dual Fixed Rack Mount Kit. Mount One DMM6500 and One Series 26xxB Instrument
4299-11	Dual Fixed Rack Mount Kit. Mount One DMM6500 and One Instrument from Series 2400, Series 2000, etc.

Available Services

Extended Warranties

Instruments	
DMM6500-EW	3 year factory warranty extended to 4 years from date of shipment
DMM6500-5Y-EW	3 year factory warranty extended to 5 years from date of shipment

Calibration Contracts

C/DMM6500-3Y-DATA	KeithleyCare 3 Year Calibration w/Data Plan
C/DMM6500-3Y-STD	KeithleyCare 3 Year Std Calibration Plan
C/DMM6500-5Y-DATA	KeithleyCare 5 Year Calibration w/Data Plan
C/DMM6500-5Y-STD	KeithleyCare 5 Year Std Calibration Plan
C/NEW DATA	Calibration data for new units
C/NEW DATA ISO	ISO-17025 Calibration data for new units

Contact Information

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Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium* 00800 2255 4835
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Central East Europe/Baltics +41 52 675 3777
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Indonesia 007 803 601 5249
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South Africa +41 52 675 3777
Spain* 00800 2255 4835
Sweden* 00800 2255 4835
Switzerland* 00800 2255 4835
Taiwan 886 (2) 2656 6688
Thailand 1 800 011 931
United Kingdom/Ireland* 00800 2255 4835
USA 1 800 833 9200
Vietnam 12060128

* European toll-free number.
If not accessible, call: +41 52 675 3777

Rev. 090617

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Tektronix®

3 Series MDO

Mixed Domain Oscilloscopes

The largest display. The versatility to work on any bench.
The greatest experience.

Key performance specifications

- 2 and 4 analog channel models
- 100 MHz, 200 MHz, 350 MHz, 500 MHz, 1 GHz bandwidth models
- Bandwidth is upgradable (up to 1 GHz)
- Up to 5 GS/s sample rate
- 10 M record length on all channels
- >280,000 wfm/s maximum waveform capture rate
- Standard passive voltage probes with 3.9 pF capacitive loading and 250 MHz or 500 MHz analog bandwidth
- Spectrum Analyzer (optional)
  - Frequency range: 9 kHz - 1 GHz or 3 GHz
  - Ultra-wide capture bandwidth up to 3 GHz
- Arbitrary Function Generator (optional)
  - 13 predefined waveform types
  - 50 MHz waveform generation
  - 128 k arbitrary generator record length
  - 250 MS/s arbitrary generator sample rate
- Digital Channels (optional)
  - 16 digital channels
  - 10 M record length on all channels
  - 121.2 ps timing resolution
- Serial Bus Decode, Triggering and Search (optional)
  - Serial bus support for I^2C, SPI, RS-232/422/485/UART, USB 2.0, CAN, CAN FD, LIN, FlexRay, MIL-STD-1553, ARINC429, and Audio standards
- Digital Voltmeter / Frequency Counter (Free with product registration)
  - 4-digit DC, AC RMS, and DC+AC RMS voltage measurements
  - 5-digit frequency measurements

Typical applications

- **Embedded design and IoT**

  Discover and solve issues quickly by performing system level debug on mixed signal embedded systems including today's most common serial bus technologies with the 3 Series MDO and support for a broad set of common serial buses.

- **Power design**

  Make reliable and repeatable voltage, current, and power measurements using automated power quality, switching loss, harmonics, ripple, modulation, and safe operating area measurements with the widest selection of power probes in an affordable solution.

- **Education**

  Managing multiple instruments on a bench can be troublesome. The 3 Series MDO combines analog, digital, and RF measurements with a signal source in a single, small (5.9 in., 149 mm deep) instrument. The combination of a small instrument and high level of integration aids in the teaching of various electronics principles as well as in its usage for more sophisticated lab experiments. Full upgradeability enables adding functionality over time as needs change or budgets allow.

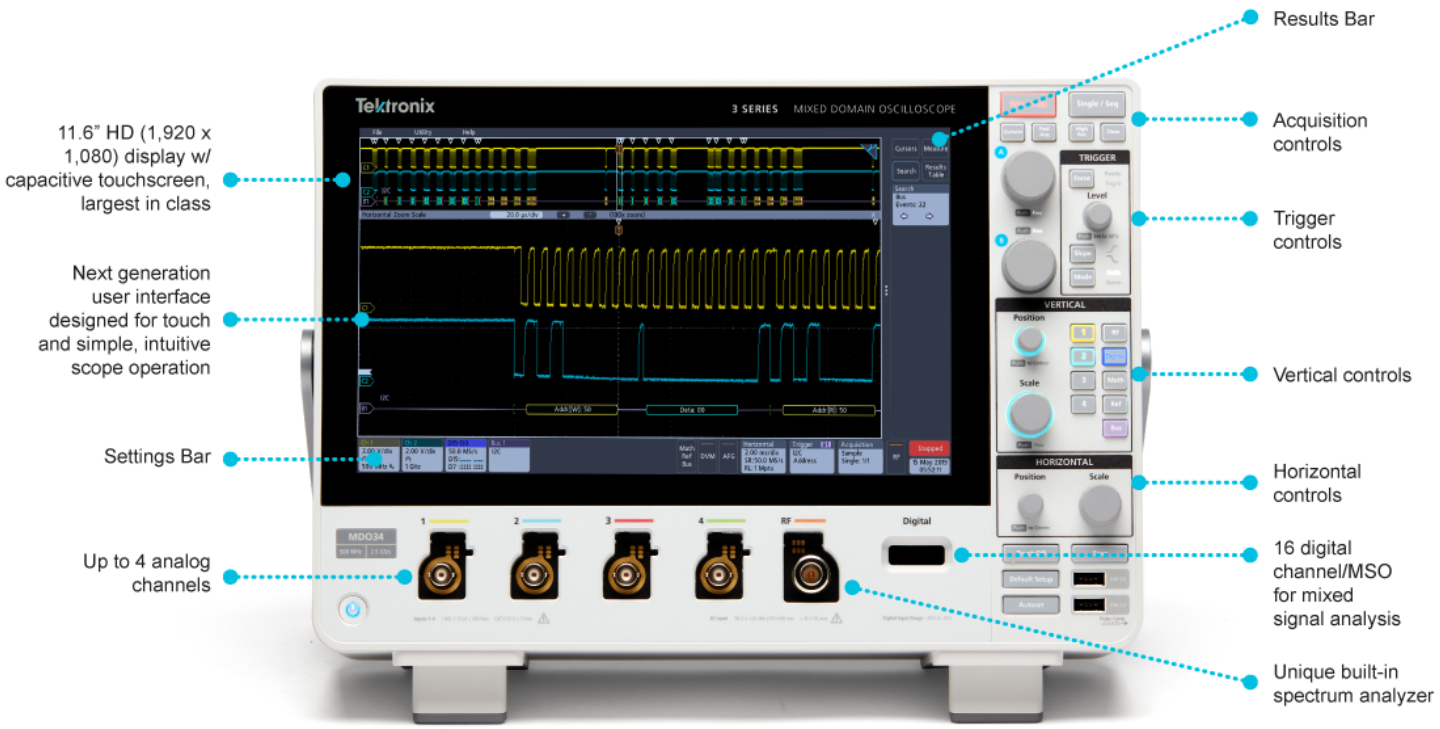
- **Manufacturing Test and Troubleshooting**

  Size and space constraints can play havoc on a manufacturing floor. The 3 Series MDO minimizes rack or bench space by integrating multiple instruments into one small package. Integration reduces cost associated with utilizing multiple different instrument types in manufacturing test or troubleshooting stations.

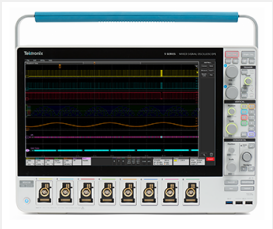
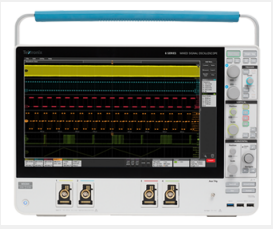
- **Service Installation and Maintenance**

  Having the right instruments when and where you need them is critical. The 3 Series MDO combines analog waveforms, digital logic, and spectrum analysis in a lightweight (11.7 lbs, 5.3 kg), portable package - making it the perfect choice where space is limited and flexibility is desired.

3 Series MDO front panel overview



The next generation of oscilloscopes

				
	3 Series MDO	**4 Series MSO**	**5 Series MSO**	**6 Series MSO**
Bandwidth	up to 1 GHz	up to 1.5 GHz	up to 2 GHz	up to 8 GHz
Vertical Resolution	8 bits	12 bits	12 bits	12 bits
Display	11.6" HD	13.3" HD	15.6" HD	15.6" HD
Inputs	TekVPI	FlexChannel / TekVPI	FlexChannel / TekVPI	FlexChannel / TekVPI
Advanced Analysis			Compliance / Jitter / Windows OS	Compliance / Jitter / Windows OS

Exceptionally easy-to-use user interface lets you focus on the task at hand

The Settings Bar - key parameters and waveform management

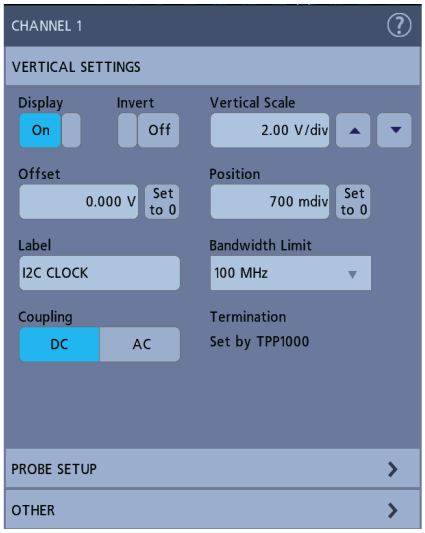
Waveform and scope operating parameters are displayed in a series of badges in the Settings Bar that runs along the bottom of the display. The Settings Bar provides immediate access for the most common waveform management tasks. With a single tap, you can:

- Turn on channels
- Add math waveforms
- Add reference waveforms
- Add bus waveforms
- Enable 16 digital channels MSO
- Enable the Spectrum Analyzer
- Enable the integrated Arbitrary/Function generator (AFG)
- Enable the integrated digital voltmeter (DVM)

The Results Bar - analysis and measurements

The Results Bar on the right side of the display includes immediate, one-tap access to the most common analytical tools such as cursors, measurements, searches and bus decode results tables.

Cursors, measurements and search results badges are displayed in the Results Bar without sacrificing any waveform viewing area. For additional waveform viewing area, the Results Bar can be dismissed and brought back at any time.



Configuration menus are accessed by simply double-tapping on the item of interest on the display. In this case, the Channel badge was double-tapped to open the channel configuration menu. Menus are dismissed by simply tapping outside of them.

Touch interaction finally done right

Scopes have included touch screens for years, but the touch screen has been an afterthought. The 3 Series MDO 11.6" display includes a capacitive touchscreen and provides a user interface truly designed for touch.

The touch interactions that you use with phones and tablets, and expect in a touch enabled device, are supported in the 3 Series MDO.

- Drag waveforms left/right or up/down to adjust horizontal and vertical position or to pan a zoomed view
- Pinch and expand to change scale or zoom in/out in either horizontal or vertical directions
- Swipe in from the right to reveal the Results Bar or down from the top to access the menus in the upper left corner of the display

Smooth, responsive front panel controls allow you to make adjustments with familiar knobs and buttons, and you can add a mouse or keyboard as a third interaction method.

Interact with the capacitive touch display in the same way you do on your phones and tablets.

Powerful Waveform Capture and Analysis

At the core of the 3 Series MDO is a world-class oscilloscope, offering comprehensive tools that speed each stage of debug – from quickly discovering anomalies and capturing them, to searching your waveform record for events of interest and analyzing their characteristics and your device's behavior.

Digital phosphor technology with FastAcq™ high-speed waveform capture

To debug a design problem, first you must know it exists. Every design engineer spends time looking for problems in their design, a time-consuming and frustrating task without the right debug tools.

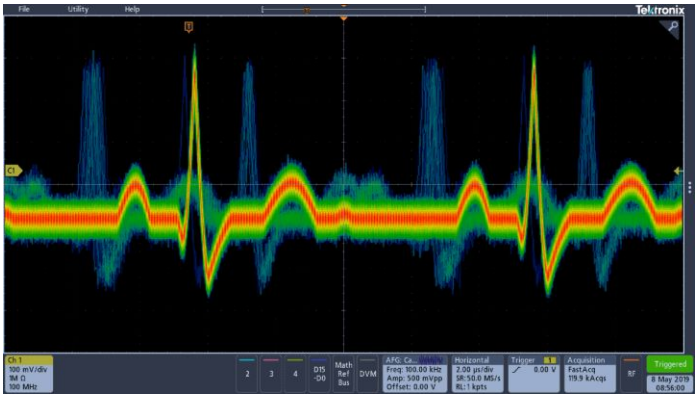
Digital phosphor technology provides you with fast insight into the real operation of your device. Its fast waveform capture rate – greater than 280,000 wfms/s with FastAcq – gives you a high probability of quickly seeing the infrequent problems common in digital systems: runt pulses, glitches, timing issues, and more.

To further enhance the visibility of rarely occurring events, intensity grading is used to indicate how often rare transients are occurring relative to normal signal characteristics. There are four waveform palettes available in FastAcq acquisition mode.

- The *Temperature palette* uses color-grading to indicate frequency of occurrence with hot colors like red/yellow indicating frequently occurring events and colder colors like blue/green indicating rarely occurring events.
- The *Spectral palette* uses color-grading to indicate frequency of occurrence with colder colors like blue indicating frequently occurring events and hot colors like red indicating rarely occurring events.
- The *Normal palette* uses the default channel color (like yellow for channel one) along with gray-scale to indicate frequency of occurrence where frequently occurring events are bright.
- The *Inverted palette* uses the default channel color along with gray-scale to indicate frequency of occurrence where rarely occurring events are bright.

These color palettes quickly highlight the events that over time occur more often or, in the case of infrequent anomalies, occur less often.

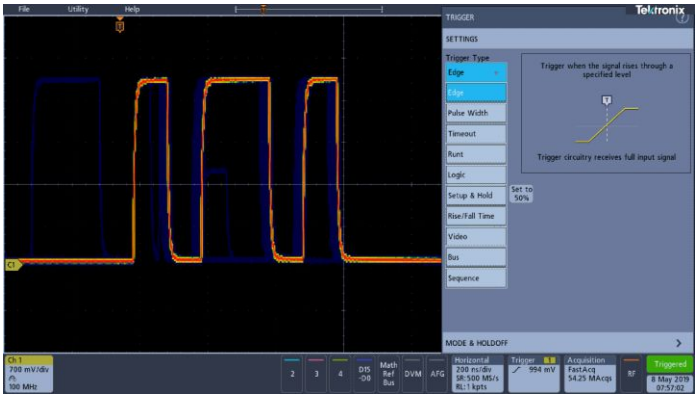
Infinite or variable persistence choices determine how long waveforms stay on the display, helping you to determine how often an anomaly is occurring.



Digital phosphor technology with FastAcq enables greater than 280,000 wfms/s waveform capture rate and real-time color-intensity grading.

Triggering

Discovering a device fault is only the first step. Next, you must capture the event of interest to identify root cause. To enable this, the 3 Series MDO contains over 125 trigger combinations providing a complete set of triggers - including runt, logic, pulse width/glitch, setup and hold violation, serial packet, and parallel data - to help quickly locate your event of interest. And with up to a 10 M record length, you can capture many events of interest, even thousands of serial packets, in a single acquisition for further analysis while maintaining high resolution to zoom in on fine signal details.



Over 125 trigger combinations make capturing your event of interest easy.

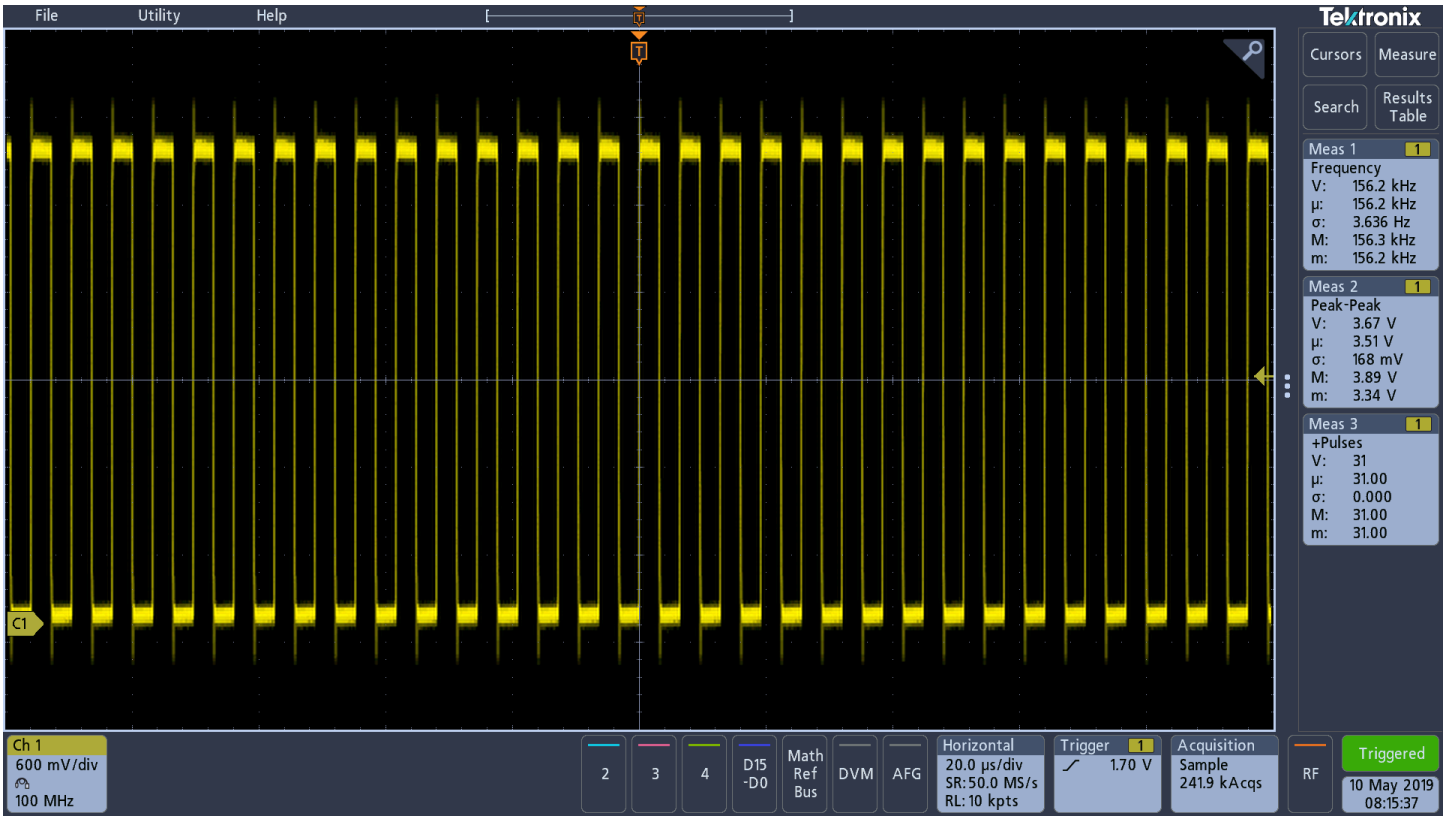
Basic waveform analysis and automated measurements

Verifying that your prototype's performance matches simulations and meets the project's design goals requires careful analysis, ranging from simple checks of rise times and pulse widths to sophisticated power loss analysis, characterization of system clocks, and investigation of noise sources.

The 3 Series MDO offers a comprehensive set of standard analysis tools including:

- Waveform- and screen-based cursors
- Automated measurements
- Basic waveform math
- Basic FFT analysis
- Advanced waveform math with equation editor

Measurement results tables provide comprehensive statistical views of measurement results.



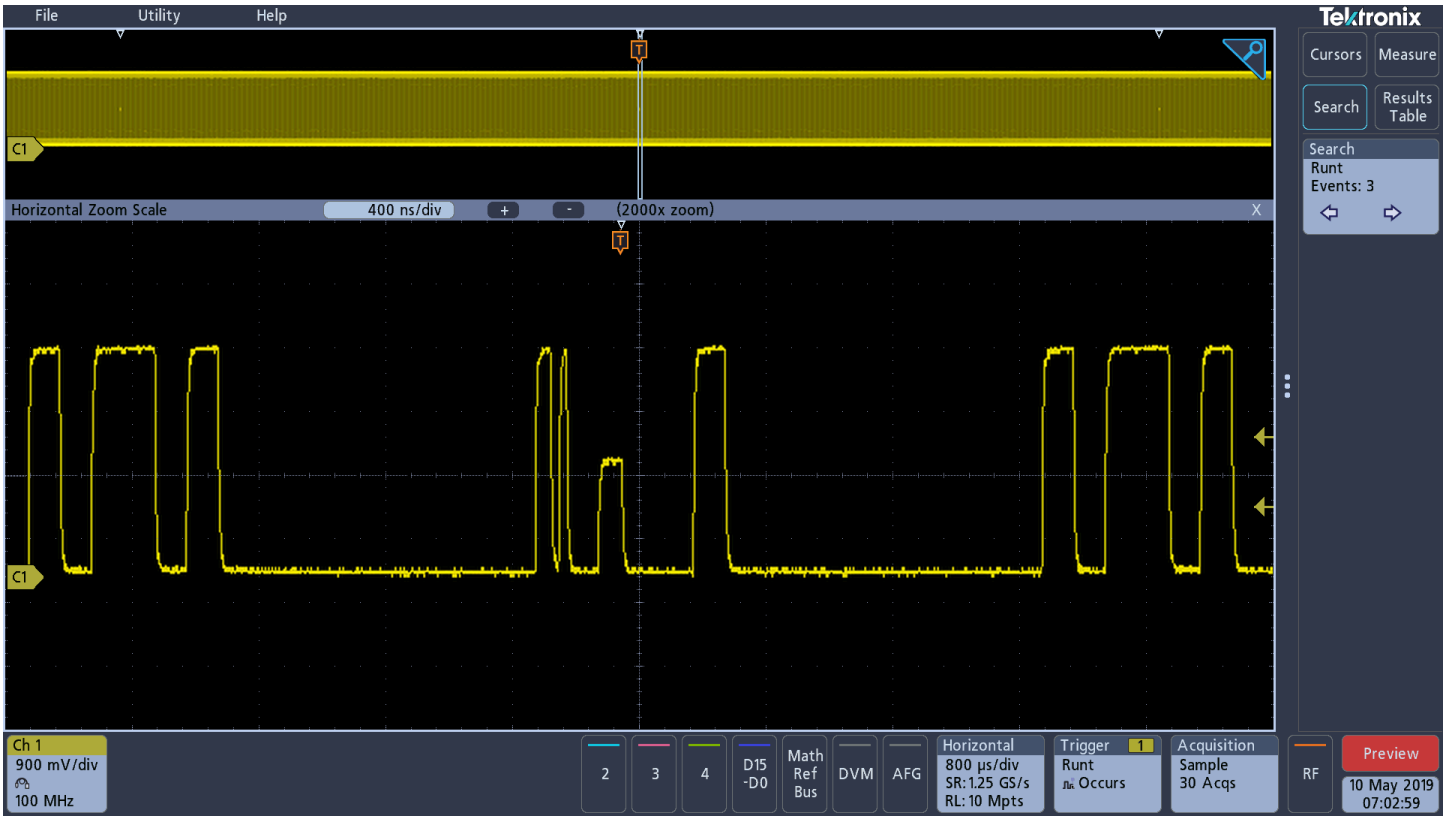
Automated measurements on Frequency, Peak-Peak and Positive Pulse Count with statistics shown.

Easy navigation and search

Finding your event of interest in a long waveform record can be time consuming without the right search tools. With today's record lengths of many millions of data points, locating your event can mean scrolling through literally thousands of screens of signal activity.

The 3 Series MDO offers the industry's most comprehensive search and waveform navigation with its innovative on-screen controls. These controls speed panning and zooming through your record. Use intuitive pinch/expand gestures on the display itself to investigate areas of interest in a long record.

The Search feature allows you to automatically search through your long acquisition looking for user-defined events. All occurrences of the event are highlighted with search marks and are easily navigated to, using the Previous (←) and Next (→) buttons found on the Search badge on the display. Search types include edge, pulse width, timeout, runt, logic, setup and hold, rise/fall time and parallel/serial bus packet content.



FastAcq helps with revealing the presence of runt pulses in the digital data stream for further investigation. In this test case, Search revealed and marked 3 runt pulses in the 10 Mpoints acquisition.

Comprehensive power analysis (optional)

Ever increasing consumer demands for longer battery-life devices and for green solutions that consume less power require power-supply designers to characterize and minimize switching losses to improve efficiency. In addition, the supply's power levels, output purity, and harmonic feedback into the power line must be characterized to comply with national and regional power quality standards. Historically, making these and many other power measurements on an oscilloscope has been a long, manual, and tedious process. The 3 Series MDO optional power analysis tools greatly simplify these tasks, enabling quick, repeatable and accurate analysis of power quality, switching loss, harmonics, safe operating area (SOA), modulation, ripple, and slew rate (di/dt, dv/dt). Completely integrated into the oscilloscope, the power analysis tools provide automated, repeatable power measurements with a touch of a button. The optional power analysis functionality is offered free for a 30-day trial period. This free trial period starts automatically when the instrument is powered on for the first time.

Power Quality measurement table. Automated power measurements enable quick and accurate analysis of common power parameters.

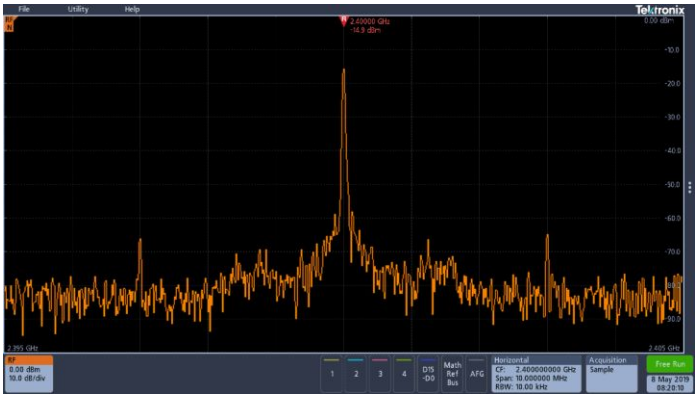
Unique built-in Spectrum Analyzer (optional)

The Tektronix MDO series is the only oscilloscope to offer an integrated, hardware-based spectrum analyzer. The spectrum analyzer frequency range of the 3 Series MDO can be from 9 kHz to 1 GHz or 3 GHz (option 3-SA1 or 3-SA3), enabling spectral analysis on IoT and most consumer wireless standards.

Fast and accurate spectral analysis

When using the spectrum analyzer standard N-connector input, the 3 Series MDO display becomes a full-screen Spectrum Analyzer view.

Key spectral parameters such as Center Frequency, Span, Reference Level, and Resolution Bandwidth are all adjusted quickly and easily using on-screen touch controls.



3 Series MDO frequency domain display.

Intelligent efficient markers

In a traditional spectrum analyzer, it can be a very tedious task to turn on and place enough markers to identify all your peaks of interest. The 3 Series MDO makes this process far more efficient by automatically placing markers on peaks that indicate both the frequency and the amplitude of each peak. You can adjust the criteria that the oscilloscope uses to automatically find the peaks.

The highest amplitude peak is referred to as the reference marker and is shown in red. Marker readouts can be switched between Absolute and Delta readouts. When Delta is selected, marker readouts show each peak's delta frequency and delta amplitude from the reference marker.

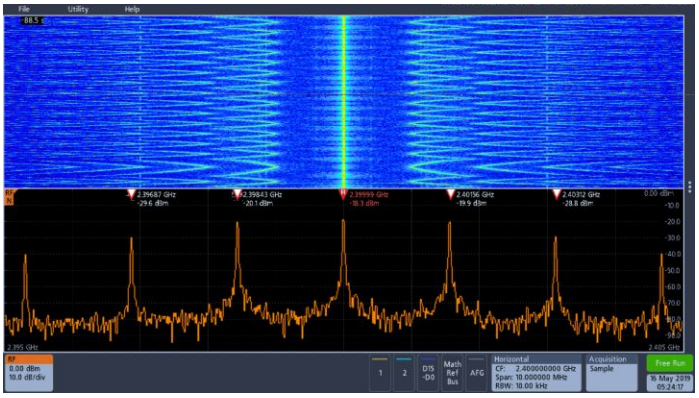
Two manual cursors are also available for measuring non-peak portions of the spectrum. When enabled, the reference marker is attached to one of the cursors, enabling delta measurements from anywhere in the spectrum. In addition to frequency and amplitude, cursor readouts also include noise density and phase noise readouts depending on whether Absolute or Delta readouts are selected. A "Reference Marker to Center" function instantly moves the frequency indicated by the reference marker to center frequency.

Automated peak markers identify critical information at a glance. As shown here, the five highest amplitude peaks that meet the threshold and excursion criteria are automatically marked along with each peak's frequency and amplitude.

Spectrogram

The 3 Series MDO includes a spectrogram display which is ideal for monitoring slowly changing RF phenomena. The x-axis represents frequency, just like a typical spectrum display. However, the y-axis represents time, and color is used to indicate amplitude.

Spectrogram slices are generated by taking each spectrum and "flipping it up on its edge" so that it's one pixel row tall, and then assigning colors to each pixel based on the amplitude at that frequency. Cold colors (blue, green) are low amplitude and hotter colors (yellow, red) are higher amplitude. Each new acquisition adds another slice at the bottom of the spectrogram and the history moves up one row. When acquisitions are stopped, you can scroll back through the spectrogram to look at any individual spectrum slice.



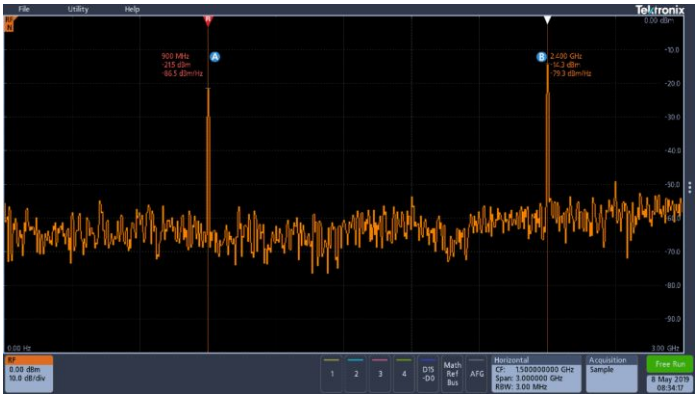
Spectrogram display illustrates slowly moving RF phenomena. As shown here, a signal that has multiple peaks is being monitored. As the peaks change in both frequency and amplitude over time, the changes are easily seen in the Spectrogram display.

Ultra-wide capture bandwidth

Today's wireless communications vary significantly with time, using sophisticated digital modulation schemes and, often, transmission techniques that involve bursting the output. These modulation schemes can have very wide bandwidth as well. Traditional swept or stepped spectrum analyzers are ill equipped to view these types of signals as they are only able to look at a small portion of the spectrum at any one time.

The amount of spectrum acquired in one acquisition is called the capture bandwidth. Traditional spectrum analyzers sweep or step the capture bandwidth through the desired span to build the requested image. As a result, while the spectrum analyzer is acquiring one portion of the spectrum, the event you care about may be happening in another portion of the spectrum. Most spectrum analyzers on the market today have 10 MHz capture bandwidths, sometimes with expensive options to extend that to 20, 40, or even 160 MHz in some cases.

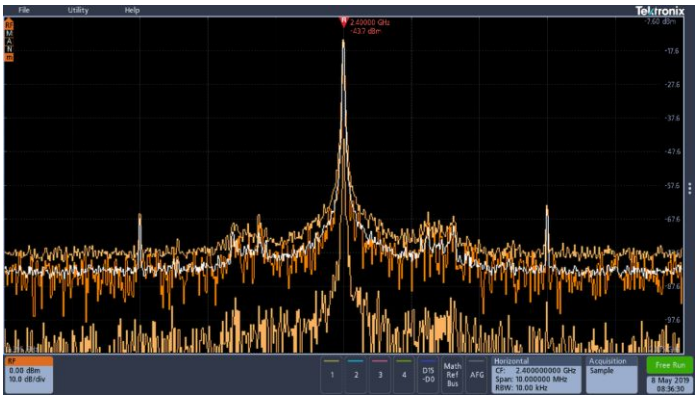
In order to address the bandwidth requirements of modern RF, the 3 Series MDO provides up to 3 GHz of capture bandwidth. The spectrum is generated from a single acquisition, thus guaranteeing you'll see the events you're looking for in the frequency domain.



Spectral display of a bursted communication both into a device through Zigbee at 900 MHz and out of the device through Bluetooth at 2.4 GHz, captured with a single acquisition.

Spectrum traces

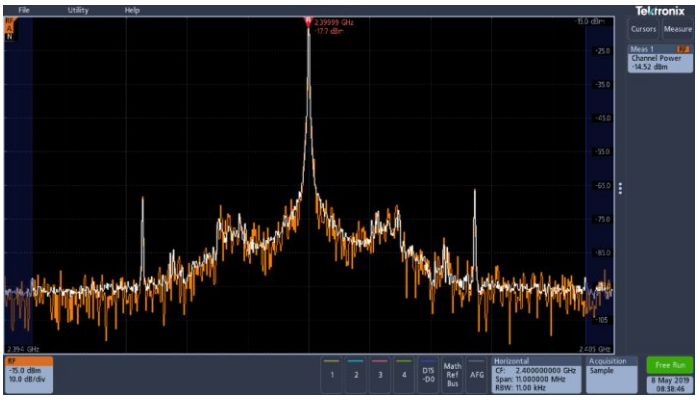
The 3 Series MDO spectrum analyzer offers four different traces or views including Normal, Average, Max Hold, and Min Hold.



Normal, Average, Max Hold, and Min Hold spectrum traces

RF measurements

The 3 Series MDO includes three automated RF measurements - Channel Power, Adjacent Channel Power Ratio, and Occupied Bandwidth. When one of these RF measurements is activated, the oscilloscope automatically turns on the Average spectrum trace and sets the detection method to Average for optimal measurement results.



Automated Channel Power measurement

RF probing

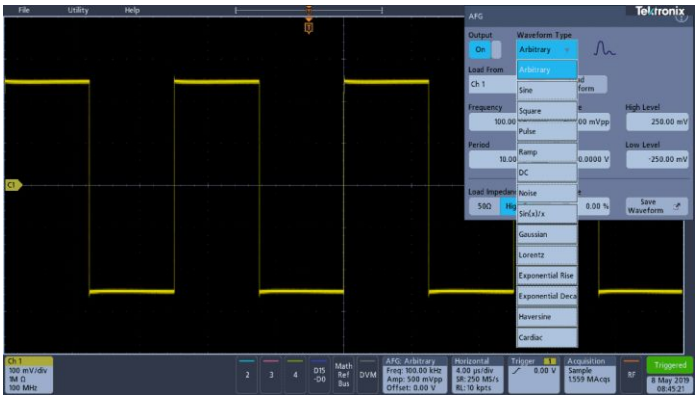
Signal input methods on spectrum analyzers are typically limited to cabled connections or antennas. In addition to using the standard N-connector, the 3 Series MDO Spectrum Analyzer can use 50 Ω TekVPI probes with the optional TPA-N-VPI adapter. This enables additional flexibility when hunting for noise sources and enables easier spectral analysis by using true signal browsing on a spectrum analyzer input.

In addition, an optional preamplifier accessory assists in the investigation of lower-amplitude signals. The TPA-N-PRE preamplifier provides 10 dB nominal gain across the 9 kHz – 3 GHz frequency range.

Arbitrary Function Generator (optional)

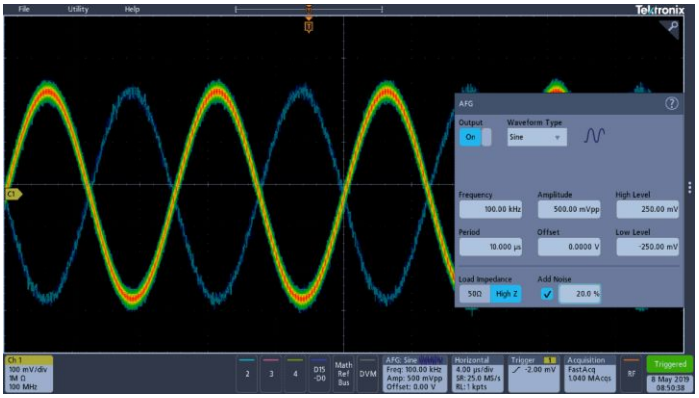
The 3 Series MDO contains an optional integrated arbitrary function generator (option 3-AFG), perfect for simulating sensor signals within a design or adding noise to signals to perform margin testing.

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.



Waveform type selection in the integrated AFG.

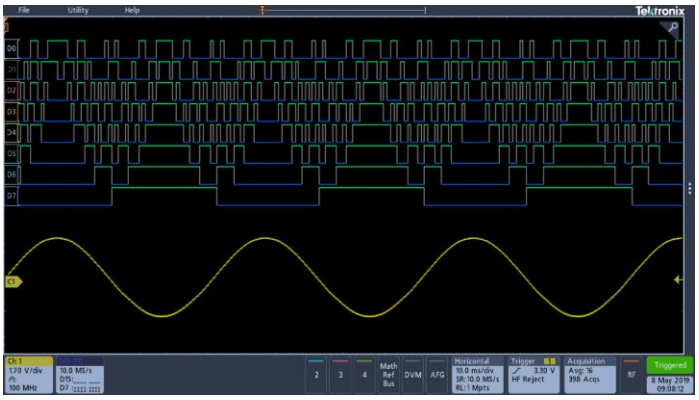
The arbitrary waveform generator provides 128 k points of record for storing waveforms from the analog input, a saved internal file location, a USB mass storage device, or from an external PC. Transfer waveform files to your 3 Series MDO edit memory via USB or LAN or using a USB mass storage device to be output from the AFG in the oscilloscope.



Flexible settings of AFG outputs. In this test case, 20% of noise was added to the Sine waveform.

Digital Channels (optional)

The logic analyzer (option 3-MSO) provides 16 digital channels which are tightly integrated into the oscilloscope's user interface. This simplifies operation and makes it possible to solve mixed-signal issues easily.



The 3 Series MDO with 3-MSO option is used to simultaneously view analog and digital signals by probing both sides of a D/A converter.

Color-coded digital waveform display

Color-coded digital traces display ones in green and zeros in blue. This coloring is also used in the digital channel monitor. The monitor shows if signals are high, low, or are transitioning so you can see channel activity at a glance without having to clutter your display with unneeded digital waveforms.

The multiple transition detection hardware shows you a white edge on the display when the system detects multiple transitions. White edges indicate that more information is available by zooming in or acquiring at faster sampling rates. In most cases zooming in will reveal the pulse that was not viewable with the previous settings. If the white edge is still present after zooming in as far as possible, this indicates that increasing the sample rate on the next acquisition will reveal higher frequency information than the previous settings could acquire.

You can group digital waveforms and enter waveform labels easily on the touchscreen. By simply placing digital waveforms next to each other, they form a group.

With color-coded digital waveform display, groups are created by simply placing digital channels together on the screen, allowing digital channels to be moved as a group.

Once a group is formed, you can position all the channels contained in that group collectively. This greatly reduces the normal setup time associated with positioning channels individually

MagniVu™ high-speed acquisition

The main digital acquisition mode on the 3 Series MDO will capture up to 10 M at 500 MS/s (2 ns resolution). In addition to the main record, the 3 Series MDO provides an ultra high-resolution record called MagniVu which acquires 10,000 points at up to 8.25 GS/s (121.2 ps resolution). Both main and MagniVu waveforms are acquired on every trigger and can be switched between in the display at any time, running or stopped. MagniVu provides significantly finer timing resolution than comparable oscilloscopes on the market, instilling confidence when making critical timing measurements on digital waveforms.

P6316 MSO probe

This unique probe design offers two eight-channel pods, simplifying the process of connecting to the device-under-test. When connecting to square pins, the P6316 can connect directly to 8×2 square pin headers spaced on tenth-inch centers. When more attachment flexibility is required, you can use the included flying lead sets and grabbers to clip onto surface mount devices or test points. The P6316 offers outstanding electrical characteristics applying only 8 pF of capacitive loading with 101 kΩ input impedance.

The P6316 MSO probe offers two eight-channel pods to simplify connecting to your device.

Serial Protocol Triggering and Analysis (optional)

On a serial bus, a single signal often includes address, control, data, and clock information. This can make isolating events of interest difficult. Automatic trigger, decode, and search on bus events and conditions gives you a robust set of tools for debugging serial buses. The optional serial protocol triggering and analysis functionality is offered free for a 30-day trial period. This free trial period starts automatically when the instrument is powered on for the first time.

Triggering on a specific address and data packet going across an I^2C bus. The yellow waveform is clock and the blue waveform is the data. A bus waveform provides decoded packet content including Start, Address, Read/Write, Data, and Stop.

Serial triggering

Trigger on packet content such as start of packet, specific addresses, specific data content, unique identifiers, etc. on popular serial interfaces such as I^2C, SPI, RS-232/422/485/UART, USB2.0, CAN, CAN FD, LIN, FlexRay, MIL-STD-1553, ARINC429, and I^2S/LJ/RJ/TDM.

Bus display

Provides a higher-level, combined view of the individual signals (clock, data, chip enable, etc.) that make up your bus, making it easy to identify where packets begin and end and identifying sub-packet components such as address, data, identifier, CRC, etc.

Bus decoding

Tired of having to visually inspect the waveform to count clocks, determine if each bit is a 1 or a 0, combine bits into bytes, and determine the hex value? Let the oscilloscope do it for you! Once you've set up a bus, the 3 Series MDO will decode each packet on the bus, and display the value in hex, binary, decimal (USB, CAN, CAN FD, LIN, FlexRay, MIL-STD-1553, and ARINC429 only), signed decimal (I^2S/LJ/RJ/TDM only), or ASCII (USB, MIL-STD-1553 and RS-232/422/485/UART only) in the bus waveform.

Serial bus technologies supported by the 3 Series MDO

Technology		Trigger, Decode, Search	Order product
Embedded	I^2C	Yes	3-SREMBD
	SPI	Yes	3-SREMBD
Computer	RS232/422/485, UART	Yes	3-SRCOMP
USB	USB LS, FS, HS	Yes (trigger on LS and FS only; HS decode only on 1 GHz models)	3-SRUSB2
Automotive	CAN, CAN FD	Yes	3-SRAUTO
	LIN	Yes	3-SRAUTO
	FlexRay	Yes	3-SRAUTO
Military and Aerospace	MIL-STD-1553, ARINC429	Yes	3-SRAERO
Audio	I^2S	Yes	3-SRAUDIO
	LJ, RJ	Yes	3-SRAUDIO
	TDM	Yes	3-SRAUDIO

Event table

In addition to seeing decoded packet data on the bus waveform itself, you can view all captured packets in a tabular view much like you would see in a software listing. Packets are time stamped and listed consecutively with columns for each component (Address, Data, etc.). You can save the event table data in .CSV format.

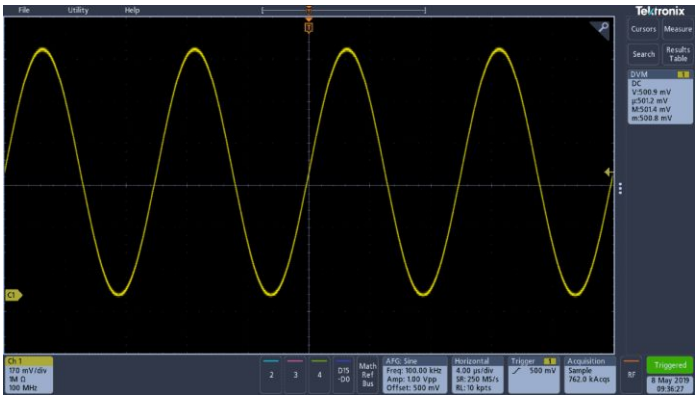
Event table showing decoded identifier, DLC, DATA, and CRC for every CAN packet in a long acquisition.

Search (serial triggering)

Serial triggering is very useful for isolating the event of interest, but once you've captured it and need to analyze the surrounding data, what do you do? In the past, users had to manually scroll through the waveform counting and converting bits and looking for what caused the event. You can have the oscilloscope automatically search through the acquired data for user-defined criteria including serial packet content. Each occurrence is highlighted by a search mark. Rapid navigation between marks is as simple as pressing the **Previous** (←) and **Next** (→) buttons on the screen.

Digital Voltmeter (DVM) and Frequency Counter (free with registration)

The 3 Series MDO contains an integrated 4-digit digital voltmeter (DVM) and 5-digit 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 DVM and frequency counter is available on any 3 Series MDO and is activated when you register your product.



A DC measurement value is shown.

The 3 Series MDO Platform

Large high-resolution touch display

The 3 Series MDO features an 11.6 inch (295 mm) wide-screen, HD display (1920 x 1080) for seeing intricate signal details.

Connectivity

The 3 Series MDO contains a number of ports which can be used to connect the instrument to a network, directly to a PC, or other test equipment.

- Front and rear USB host ports enable easy transfer of screen shots, instrument settings, and waveform data to a USB mass storage device. A USB keyboard or mouse can also be attached to a USB host port for data entry or control.
- Rear USB device port is useful for controlling the oscilloscope remotely from a PC.
- The standard 10/100 Ethernet port on the rear of the instrument enables easy connection to networks, provides network printing, and provides LXI Core 2011 compatibility.
- A HDMI port on the rear of the instrument allows the display to be exported to an external monitor or projector.

Remote connectivity and instrument control

Exporting data and measurements is as simple as connecting a USB cable from the oscilloscope to your PC. Key software applications – OpenChoice® Desktop, and Microsoft Excel and Word toolbars enable fast and easy direct communication with your Windows PC.

The OpenChoice Desktop enables fast and easy communication between the oscilloscope and your PC through USB or LAN for transferring settings, waveforms, and screen images.

The embedded e*Scope® capability enables fast control of the oscilloscope over a network connection through a standard web browser. Simply enter the IP address or network name of the oscilloscope and a web page will be served to the browser. Transfer and save settings, waveforms, measurements, and screen images or make live control changes to settings on the oscilloscope directly from the web browser.

Compact form factor

With the compact, portable form factor, you can easily move the oscilloscope between labs. And with a depth of just 5.9 inches (149 mm), it saves you valuable space on your test bench. The 3 Series MDO has all the tools you'll need for everyday debug tasks, all in a single instrument.

The 3 Series MDO compact form factor frees up valuable space on your bench or desktop while making sure you will always have the debug tools you need.

Accurate high-speed probing

The 3 Series MDO ships standard with passive voltage probes and uses the TekVPI probe interface.

Standard passive voltage probes

The 3 Series MDO include passive voltage probes with industry best capacitive loading of only 3.9 pF. The included TPP probes minimize the impact on devices under test and accurately deliver signals to the oscilloscope for acquisition and analysis. The following table shows which TPP probes come standard with each 3 Series MDO model.

3 Series models: MDO32, MDO34	Included probe
100 MHz, 200 MHz	TPP0250: 250 MHz, 10x passive voltage probe. One per analog channel.
350 MHz, 500 MHz, 1 GHz	TPP0500B: 500 MHz, 10x passive voltage probe. One per analog channel.

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, TekVPI probes feature status indicators and controls, as well as a probe menu button right on the comp box itself. This button brings up a probe menu on the oscilloscope display with all relevant settings and controls for the probe. The TekVPI interface enables direct attachment of current probes without requiring a separate power supply. TekVPI probes can be controlled remotely through USB, GPIB, or LAN, enabling more versatile solutions in ATE environments. The instrument provides up to 25 W of power to the front panel connectors from the internal power supply.

TekVPI probe interface simplifies connecting your probes to the oscilloscope.

Specifications

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

	MDO32 and MDO34									
Analog channel bandwidth	100 MHz	100 MHz	200 MHz	200 MHz	350 MHz	350 MHz	500 MHz	500 MHz	1 GHz	1 GHz
Analog channels	2	4	2	4	2	4	2	4	2	4
Rise time (typical, calculated) *(10 mV/div setting with 50 Ω input termination)*	4 ns	4 ns	2 ns	2 ns	1.14 ns	1.14 ns	800 ps	800 ps	400 ps	400 ps
Sample rate (1 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s
Sample rate (2 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s
Sample rate (4 ch)	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s
Record length (1 ch)	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M
Record length (2 ch)	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M
Record length (4 ch)	-	10 M	-	10 M	-	10 M	-	10 M	-	10 M
Digital channels with 3-MSO option	16	16	16	16	16	16	16	16	16	16
Arbitrary Function Generator outputs with 3-AFG option	1	1	1	1	1	1	1	1	1	1
Spectrum analyzer channels	1	1	1	1	1	1	1	1	1	1
Optional spectrum analyzer frequency range with 3-SA1 option	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz
Optional spectrum analyzer frequency range with 3-SA3 option	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz

Oscilloscope

Vertical system analog channels

Hardware bandwidth limits

≥350 MHz models	20 MHz or 250 MHz
100 MHz and 200 MHz models	20 MHz

Input coupling AC, DC

Input impedance 1 MΩ ±1%, 50 Ω ±1%

Input sensitivity range

1 MΩ	1 mV/div to 10 V/div
50 Ω	1 mV/div to 1 V/div

Vertical resolution 8 bits (11 bits with Hi Res)

Vertical system analog channels

Maximum input voltage

1 MΩ	300 V_{RMS} CAT II with peaks ≤ ±425 V
50 Ω	5 V_{RMS} with peaks ≤ ±20 V

DC gain accuracy

±1.5% for 5 mV/div and above, derated at 0.10%/°C above 30 °C

±2.0% for 2 mV/div, derated at 0.10%/°C above 30 °C

±2.5% for 1 mV/div, derated at 0.10%/°C above 30 °C

±3.0% for variable gain, derated 0.10%/°C above 30 °C

Channel-to-channel isolation (typical)

Any two channels at equal vertical scale ≥100:1 at ≤100 MHz and ≥30:1 at >100 MHz up to the rated bandwidth

Random noise, sample acquisition mode, 50 Ω termination setting, full bandwidth, typical

	1 mV/div	100 mV/div	1 V/div
1 GHz	114 µV	1.98 mV	17.07 mV
500 MHz	111 µV	1.54 mV	13.47 mV
350 MHz	106 µV	1.7 mV	12.7 mV
200 MHz	111 µV	1.6 mV	15.19 mV
100 MHz	98 µV	1.38 mV	15.87 mV

Offset range

Volts/div setting	Offset range	
	1 M Ω input	50 Ω input
1 mV/div to 50 mV/div	±1 V	±1 V
50.5 mV/div to 99.5 mV/div	±0.5 V	±0.5 V
100 mV/div to 500 mV/div	±10 V	±10 V
505 mV/div to 995 mV/div	±5 V	±5 V
1 V/div to 10 V/div	±100 V	±5 V

Horizontal system analog channels

Time base range

1 GHz models	400 ps/div to 1000 s/div
≤ 500 MHz models	1 ns/div to 1000 s/div

Maximum duration at highest sample rate (all/half channels)

1 GHz models	4/2 ms
≤ 500 MHz models	4/4 ms

Time-base delay time range

-10 divisions to 5000 s

Channel-to-channel deskew range

±125 ns

Time base accuracy

±10 ppm over any ≥1 ms interval

Trigger system

Trigger modes
Auto, Normal, and Single

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

Trigger holdoff range
20 ns to 8 s

Trigger sensitivity (typical)
Edge type, DC coupled

Trigger source	Sensitivity
Any analog channel input	For 1 mV/div to 4.98 mV/div; 0.75 div from DC to 50 MHz, increasing to 1.3 div at instrument bandwidth ≥ 5 mV/div: 0.40 div from DC to 50 MHz, increasing to 1 div at instrument bandwidth
Aux In (External); available on two-channel instruments only	200 mV from DC to 50 MHz, increasing to 500 mV at 200 MHz
Line	Fixed

Trigger level ranges

Any input channel
±8 divisions from center of screen, ±8 divisions from 0 V when vertical LF reject trigger coupling is selected

Aux In (External)
±8 V

Line
The line trigger level is fixed at about 50% of the line voltage.

Trigger frequency readout
Provides 6-digit frequency readout of triggerable events.

Trigger types

Edge
Positive, negative, or either slope on any channel. Coupling includes DC, AC, HF reject, LF reject, and noise reject.

Sequence (B-trigger)
Trigger Delay by Time: 9.2 ns to 8 s. Or Trigger Delay by Events: 1 to 4,000,000 events. Not available when “Either” edge is selected.

Pulse Width
Trigger on width of positive or negative pulses that are >, <, =, ≠, or inside/outside a specified period of time.

Timeout
Trigger on an event which remains high, low, or either, for a specified time period (4 ns to 8 s).

Runt
Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again.

Logic
Trigger when any logical pattern of channels goes false or stays true for specified period of time. Any input can be used as a clock to look for the pattern on a clock edge. Pattern (AND, OR, NAND, NOR) specified for all input channels defined as High, Low, or Don’t Care.

Setup and Hold
Trigger on violations of both setup time and hold time between clock and data present on any of the analog and digital input channels.

Setup and hold trigger type	Description
Setup Time Range	-0.5 ns to 1.024 ms
Hold Time Range	1.0 ns to 1.024 ms
Setup + Hold Time Range	0.5 ns to 2.048 ms

Rise/Fall Time
Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either and time range is 4.0 ns to 8 s.

Video
Trigger on all lines, odd, even, or all fields on NTSC, PAL, and SECAM video signals.

480p/60, 576p/50, 720p/30, 720p/50, 720p/60, 875i/60, 1080i/50, 1080i/60, 1080p/24, 1080p/24sF, 1080p/25, 1080p/30, 1080p/50, 1080p/60

Custom bi-level and tri-level sync video standards.

Parallel (available when option 3-MSO is installed)
Trigger on a parallel bus data value. Parallel bus can be from 1 to 20 bits (from the digital and analog channels) in size. Binary and Hex radices are supported.

Acquisition system

Acquisition modes

Sample	Acquire sampled values.
Peak Detect	Captures glitches as narrow as 1.5 ns (1 GHz models), 2.0 ns (500 MHz models), 3.0 ns (350 MHz models), 5.0 ns (200 MHz models), 7.0 ns (100 MHz models) at all sweep speeds
Averaging	From 2 to 512 waveforms included in average.
Envelope	Min-max envelope reflecting Peak Detect data over multiple acquisitions. Number of waveforms in the envelope selectable between 1 and 2000 and infinity
Hi Res	Real-time boxcar averaging reduces random noise and increases vertical resolution.
Roll	Scrolls waveforms right to left across the screen at sweep speeds slower than or equal to 40 ms/div.
FastAcq®	FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events, capturing >280,000 wfms/s on 1 GHz models and >235,000 wfms/s on 100 MHz – 500 MHz models.

Waveform measurements

Cursors	Waveform and Screen
Automatic measurements (time domain)	30, of which up to four can be displayed on-screen at any one time. Measurements include: Period, Frequency, Delay, Rise Time, Fall Time, Positive Duty Cycle, Negative Duty Cycle, Positive Pulse Width, Negative Pulse Width, Burst Width, Phase, Positive Overshoot, Negative Overshoot, Total Overshoot, Peak to Peak, Amplitude, High, Low, Max, Min, Mean, Cycle Mean, RMS, Cycle RMS, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Area and Cycle Area.
Automatic measurements (frequency domain)	3, of which one can be displayed on-screen at any one time. Measurements include Channel Power, Adjacent Channel Power Ratio (ACPR), and Occupied Bandwidth (OBW)
Measurement statistics	Mean, Min, Max, Standard Deviation.
Reference levels	User-definable reference levels for automatic measurements can be specified in either percent or units.
Gating	Isolate the specific occurrence within an acquisition to take measurements on, using either the screen or waveform cursors.

Waveform math

Arithmetic	Add, subtract, multiply, and divide waveforms.
Math functions	Integrate, differentiate, FFT
FFT	Spectral magnitude. Set FFT Vertical Scale to Linear RMS or dBV RMS, and FFT Window to Rectangular, Hamming, Hanning, or Blackman-Harris.
Spectrum math	Add or subtract frequency-domain traces.
Advanced math	Define extensive algebraic expressions including waveforms, reference waveforms, math functions (FFT, Intg, Diff, Log, Exp, Sqrt, Abs, Sine, Cosine, Tangent, Rad, Deg), scalars, up to two user-adjustable variables and results of parametric measurements (Period, Freq, Delay, Rise, Fall, PosWidth, NegWidth, BurstWidth, Phase, PosDutyCycle, NegDutyCycle, PosOverShoot, NegOverShoot, TotalOverShoot, PeakPeak, Amplitude, RMS, CycleRMS, High, Low, Max, Min, Mean, CycleMean, Area, CycleArea, and trend plots). For example, (Intg(Ch1 - Mean(Ch1)) × 1.414 × VAR1)

Act on Event

Events	None, when a trigger occurs, or when a defined number of acquisitions complete (1 to 1,000,000)
Actions	Stop acquisition, save waveform to file, save screen image, print, AUX OUT pulse, remote interface SRQ, e-mail notification, and visual notification
Repeat	Repeat the act on event process (1 to 1,000,000 and infinity)

Power measurements (optional)

Power quality measurements	V_{RMS}, $V_{Crest\ Factor}$, Frequency, I_{RMS}, $I_{Crest\ Factor}$, True Power, Apparent Power, Reactive Power, Power Factor, Phase Angle.
Switching loss measurements	
Power loss	T_{on}, T_{off}, Conduction, Total.
Energy loss	T_{on}, T_{off}, Conduction, Total.
Harmonics	THD-F, THD-R, RMS measurements. Graphical and table displays of harmonics. Test to IEC61000-3-2 Class A and MIL-STD-1399, Section 300A.
Ripple measurements	V_{Ripple} and I_{Ripple}.
Modulation analysis	Graphical display of +Pulse Width, -Pulse Width, Period, Frequency, +Duty Cycle, and -Duty Cycle modulation types.
Safe operating area	Graphical display and mask testing of switching device safe operating area measurements.
dV/dt and dI/dt measurements	Cursor measurements of slew rate

Spectrum Analyzer

(Requires 3-SA1 or 3-SA3 option)

Capture bandwidth	All models: 1 GHz with option 3-SA1 or 3 GHz with option 3-SA
Span	All models: 9 kHz - 1 GHz with option 3-SA1 or 3 GHz with option 3-SA3, in a 1-2-5 sequence
Resolution bandwidth	20 Hz - 150 MHz in a 1-2-3-5 sequence
Reference level	-140 dBm to +20 dBm in steps of 5 dBm
Vertical scale	1 dB/div to 20 dB/div in a 1-2-5 sequence
Vertical position	-100 divs to +100 divs (displayed in dB)
Vertical units	dBm, dBmV, dBµV, dBµW, dBmA, dBµA
Displayed average noise level (DANL)	
9 kHz - 50 kHz	< -109 dBm/Hz (< -113 dBm/Hz typical)
50 kHz – 5 MHz	< -126 dBm/Hz (< -130 dBm/Hz typical)
5 MHz - 2 GHz	< -136 dBm/Hz (< -140 dBm/Hz typical)
2 GHz – 3 GHz	< -126 dBm/Hz (< -130 dBm/Hz typical)

DANL with TPA-N-PRE preamp attached	Preamp set to "Auto", and Reference Level set to -40 dB
9 kHz - 50 kHz	< -117 dBm/Hz (< -121 dBm/Hz typical)
50 kHz – 5 MHz	< -136 dBm/Hz (< -140 dBm/Hz typical)
5 MHz - 2 GHz	< -146 dBm/Hz (< -150 dBm/Hz typical)
2 GHz – 3 GHz	< -136 dBm/Hz (< -140 dBm/Hz typical)
Spurious response	
2nd harmonic distortion (>100 MHz)	< -55 dBc (< -60 dBc typical)
3rd harmonic distortion (>100 MHz)	< -53 dBc (< -58 dBc typical)
2nd order intermodulation distortion (>15 MHz)	< -55 dBc (< -60 dBc typical)
3rd order intermodulation distortion (>15 MHz)	< -55 dBc (< -60 dBc typical)
Residual spurious response	< -78 dBm (< -84 dBm typical, ≤ -15 dBm reference level and RF input terminated with 50 Ω)
At 2.5 GHz	< -62 dBm (< -73 dBm typical)
At 1.25 GHz	< -76 dBm (< -82 dBm typical)
Crosstalk to spectrum analyzer from oscilloscope channels	
≤800 MHz input frequencies	< -60 dB from ref level (typical)
>800 MHz - 2 GHz input frequencies	< -40 dB from ref level (typical)
Phase noise from 1 GHz CW	
10 kHz	< -81 dBc/Hz, < -85 dBc/Hz (typical)
100 kHz	< -97 dBc/Hz, < -101 dBc/Hz (typical)
1 MHz	< -118 dBc/Hz, < -122 dBc/Hz (typical)
Level measurement uncertainty	Reference level 10 dBm to -15 dBm. Input level ranging from reference level to 40 dB below reference level. Specifications exclude mismatch error.
18 °C to 28 °C	9 kHz-1.5 GHz < ±1 dBm (<±0.4 dBm typical) 1.5 GHz-2.5 GHz < ±1.3 dBm (<±0.6 dBm typical) 2.5 GHz-3 GHz < ±1.5 dBm (<±0.7 dBm typical)
Over operating range	< ±2.0 dBm
Level measurement uncertainty with TPA-N-PRE preamp attached	Preamp mode set to “Auto”. Reference level 10 dBm set to -40dBm. Input level ranging from reference level to 30 dB below reference level. Specifications exclude mismatch error.
18 °C - 28 °C	< ±1.5 dBm (typical) either preamp state
Over operating range	< ±2.3 dBm either preamp state
Frequency measurement accuracy	±(([Reference Frequency Error] x [Marker Frequency]) + (span/750 + 2)) Hz; Reference Frequency Error = 10ppm (10 Hz / MHz)
Maximum operating input level	
Average continuous power	+20 dBm (0.1 W)
DC maximum before damage	±40 V DC

Maximum power before damage (CW)	+33 dBm (2 W)
Maximum power before damage (pulse)	+45 dBm (32 W) (<10 µs pulse width, <1% duty cycle, and reference level of ≥ +10 dBm)
Maximum operating input level with TPA-N-PRE preamp attached	
Average continuous power	+20 dBm (0.1 W)
DC maximum before damage	±20 V DC
Maximum power before damage (CW)	+30 dBm (1 W)
Maximum power before damage (pulse)	+45 dBm (32 W) (<10 µs pulse width, <1% duty cycle, and reference level of ≥ +10 dBm)
Frequency domain trace types	Normal, Average, Max Hold, Min Hold
Detection methods	+Peak, -Peak, Average, Sample
Automatic markers	One to eleven peaks identified based on user-adjustable threshold and excursion values
Manual markers	Two manual markers indicating frequency, amplitude, noise density, and phase noise
Marker readouts	Absolute or Delta

FFT windows

FFT window	Factor
Kaiser	2.23
Rectangular	0.89
Hamming	1.30
Hanning	1.44
Blackman-Harris	1.90
Flat-Top	3.77

Arbitrary Function Generator

(Requires 3-AFG option)

Waveforms	Sine, Square, Pulse, Ramp/Triangle, DC, Noise, Sin(x)/x (Sinc), Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine, Cardiac, and Arbitrary.

Sine

Frequency range	0.1 Hz to 50 MHz
Amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Amplitude flatness (typical)	±0.5 dB at 1 kHz (±1.5 dB for <20 mV_{p-p} amplitudes)
Total harmonic distortion (typical)	1% into 50 Ω 2% for amplitude < 50 mV and frequencies > 10 MHz 3% for amplitude < 20 mV and frequencies > 10 MHz
Spurious free dynamic range (SFDR) (typical)	-40 dBc (V_{p-p} ≥ 0.1 V); -30dBc (V_{p-p} ≤ 0.1 V), 50 Ω load

Square / Pulse

Frequency range	0.1 Hz to 25 MHz
Amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Duty cycle	10% to 90% or 10 ns minimum pulse, whichever is larger cycle
Duty cycle resolution	0.1%
Pulse width minimum (typical)	10 ns
Rise/fall time (typical)	5 ns (10% - 90%)
Pulse width resolution	100 ps
Overshoot (typical)	< 4% for signal steps greater than 100 mV
Asymmetry	±1% ±5 ns, at 50% duty cycle
Jitter (TIE RMS) (typical)	< 500 ps

Ramp / Triangle

Frequency range	0.1 Hz to 500 kHz
Amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Variable symmetry	0% to 100%
Symmetry resolution	0.1%

DC

Level range (typical)	±2.5 V into Hi-Z; ±1.25 V into 50 Ω

Random noise waveform

Amplitude range	20 mV_{p-p} to 5 V_{p-p} in to Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Amplitude resolution	0% to 100% in 1% increments

Sin(x)/x (Sinc)

Frequency range (typical)	0.1 Hz to 2 MHz
Amplitude range	20 mV_{p-p} to 3.0 V_{p-p} into Hi-Z; 10 mV_{p-p} to 1.5 V_{p-p} into 50 Ω

Gaussian

Frequency range (typical)	0.1 Hz to 5 MHz
Amplitude range	20 mV_{p-p} to 2.5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 1.25 V_{p-p} into 50 Ω

Lorentz	
Frequency range (typical)	0.1 Hz to 5 MHz
Amplitude range	20 mV_{p-p} to 2.4 V_{p-p} into Hi-Z; 10 mV_{p-p} to 1.2 V_{p-p} into 50 Ω
Exponential Rise / Decay	
Frequency range (typical)	0.1 Hz to 5 MHz
Amplitude range	20 mV_{p-p} to 2.5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 1.25 V_{p-p} into 50 Ω
Haversine	
Frequency range (typical)	0.1 Hz to 5 MHz
Amplitude range	20 mV_{p-p} to 2.5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 1.25 V_{p-p} into 50 Ω
Cardiac (typical)	
Frequency range	0.1 Hz to 500 kHz
Amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Arbitrary	
Memory depth	1 to 128 k
Amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Repetition rate	0.1 Hz to 25 MHz
Sample rate	250 MS/s
Frequency accuracy	
Sine wave and ramp	130 ppm (frequency < 10 kHz) 50 ppm (frequency ≥ 10 kHz)
Square wave and pulse	130 ppm (frequency < 10 kHz) 50 ppm (frequency ≥ 10 kHz)
Resolution	0.1 Hz or 4 digits; whichever is larger
Signal amplitude accuracy	±[(1.5% of peak-to-peak amplitude setting) + (1.5% of DC offset setting) + 1 mV] (frequency = 1 kHz)
DC offset	
DC offset range	±2.5 V into Hi-Z; ±1.25 V into 50 Ω
DC offset resolution	1 mV into Hi-Z; 500 uV into 50 Ω
DC offset accuracy	±[(1.5% of absolute offset voltage setting) + 1 mV] Add 3 mV for every 10 °C change from 25 °C

Logic Analyzer

(Requires 3-MSO option)

Vertical system digital channels

Input channels	16 digital (D15 to D0)
Thresholds	Threshold per set of 8 channels
Threshold selections	TTL, CMOS, ECL, PECL, User-defined
User-defined threshold range	-15 V to +25 V
Maximum input voltage	-20 V to +30 V
Threshold accuracy	±[130mV + 3% of threshold setting]
Input dynamic range	50 V_{p-p} (threshold setting dependent)
Minimum voltage swing	500 mV
Input resistance	101 kΩ
Probe loading	8 pF
Vertical resolution	1 bit

Horizontal system digital channels

Maximum sample rate (Main)	500 MS/s (2 ns resolution)
Maximum record length (Main)	10 M
Maximum sample rate (MagniVu)	8.25 GS/s (121.2 ps resolution)
Maximum record length (MagniVu	10k centered on the trigger
Minimum detectable pulse width (typical)	2 ns
Channel-to-channel skew (typical)	500 ps
Maximum input toggle rate	250 MHz (Maximum frequency sine wave that can accurately be reproduced as a logic square wave. Requires the use of a short ground extender on each channel. This is the maximum frequency at the minimum swing amplitude. Higher toggle rates can be achieved with higher amplitudes.)

Serial Protocol Analyzer

Automated Serial Triggering, Decode, and Search options for I^2C, SPI, RS-232/422/485/UART, USB2.0, CAN, CAN FD (ISO and non-ISO), LIN, FlexRay, MIL-STD-1553, ARINC429, and Audio buses.

For more detailed information about serial bus support products please see the Serial Triggering and Analysis datasheet.

Trigger types

I^2C (optional)	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 (optional)	Trigger on SS active, Start of Frame, MOSI, MISO, or MOSI and MISO on SPI buses up to 50.0 Mb/s.
RS-232/422/485/UART (optional)	Trigger on Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, and Rx Parity Error up to 10 Mb/s.
USB: Low speed (optional)	Trigger on Sync Active, Start of Frame, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error. Token packet trigger - Any token type, SOF, OUT, IN, SETUP; Address can be specified for Any Token, OUT, IN, and SETUP token types. Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using binary, hex, unsigned decimal and don't care digits. Data packet trigger - Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Handshake packet trigger - Any handshake type, ACK, NAK, STALL. Special packet trigger - Any special type, Reserved Error trigger - PID Check, CRC5 or CRC16, Bit Stuffing.
USB: Full speed (optional)	Trigger on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error. Token packet trigger - Any token type, SOF, OUT, IN, SETUP; Address can be specified for Any Token, OUT, IN, and SETUP token types. Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using binary, hex, unsigned decimal and don't care digits. Data packet trigger - Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Handshake packet trigger - Any handshake type, ACK, NAK, STALL. Special packet trigger - Any special type, PRE, Reserved. Error trigger - PID Check, CRC5 or CRC16, Bit Stuffing.
CAN, CAN FD (optional)	Trigger on Start of Frame, Frame Type (data, remote, error, overload), Identifier (standard or extended), Data, Identifier and Data, End of Frame, Missing ACK, or Bit Stuffing Error on CAN signals up to 1 Mb/s and on CAN FD signals up to 7 Mb/s (ISO and non ISO). Data can be further specified to trigger on ≤, <, =, >, ≥, or ≠ a specific data value. User-adjustable sample point is set to 50% by default.
LIN (optional)	Trigger on Sync, Identifier, Data, Identifier and Data, Wakeup Frame, Sleep Frame, Errors such as Sync, Parity, or Checksum Errors up to 100 kb/s (by LIN definition, 20 kb/s).
FlexRay (optional)	Trigger on Start of Frame, Type of Frame (Normal, Payload, Null, Sync, Startup), Identifier, Cycle Count, Complete Header Field, Data, Identifier and Data, End of Frame or Errors such as Header CRC, Trailer CRC, Null Frame, Sync Frame, or Startup Frame Errors up to 10 Mb/s.
MIL-STD-1553 (optional)	Trigger on Sync, Word Type (Command, Status, Data), Command Word (set RT Address, T/R, Sub-address/Mode, Data Word Count/Mode Code, and Parity individually), Status Word (set RT Address, Message Error, Instrumentation, Service Request Bit, Broadcast Command Received, Busy, Subsystem Flag, Dynamic Bus Control Acceptance (DBCA), Terminal Flag, and Parity individually), Data Word (user-specified 16-bit data value), Error (Sync, Parity, Manchester, Non-contiguous data), Idle Time (minimum time selectable from 2 µs to 100 µs; maximum time selectable from 2 µs to 100 µs; trigger on < minimum, > maximum, inside range, outside range). RT Address can be further specified to trigger on =, ≠, <, >, ≤, ≥ a particular value, or inside or outside of a range.
ARINC429 (optional)	Trigger on Word Start/End, Label, SDI, Data, Label and Data, Error conditions (any, parity, word, gap).
I^2S/LJ/RJ/TDM (optional)	Trigger on Word Select, Frame Sync, or Data. Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a specific data value, or inside or outside of a range. Maximum data rate for I^2S/LJ/RJ is 12.5 Mb/s. Maximum data rate for TDM is 25 Mb/s.

Digital Voltmeter

(Free with product registration)

Source	Channel 1, Channel 2, Channel 3, Channel 4
Measurement types	AC_{rms}, DC_{rms}, AC+DC_{rms} (reads out in volts or amps); frequency count
Resolution	Voltage: 4 digits Frequency: 5 digits
Frequency accuracy	±(10 µHz/Hz + 1 count)
Measuring rate	100 times/second; measurements updated on the display 4 times/second
Vertical settings autorange	Automatic adjustment of vertical settings to maximize measurement dynamic range; available for any non-trigger source
Graphical measurement	Graphical indication of minimum, maximum, current value, and five second rolling range

General Product Specifications

Display system

Display type	11.6 in. (295 mm) TFT LCD with capacitive touch
Display resolution	1920 horizontal × 1080 vertical HD
Interpolation	Sin(x)/x
Waveform styles	Vectors, Dots, Variable Persistence, Infinite Persistence
FastAcq. palettes	Temperature, Spectral, Normal, Inverted
Graticules	Full, Grid, Solid, Cross Hair, Frame, IRE and mV
Format	YT, XY, and simultaneous XY/YT
Maximum waveform capture rate	>280,000 wfms/s in FastAcq acquisition mode on 1 GHz models >230,000 wfms/s in FastAcq acquisition mode on 100 MHz – 500 MHz models >50,000 wfms/s in DPO acquisition mode on all models

Input/output ports

USB 2.0 high-speed host port	Supports USB mass storage devices and keyboard. Two ports on front and one port on rear of instrument.
USB 2.0 device port	Rear-panel connector allows for communication/control of oscilloscope through USBTMC or GPIB (with a TEK-USB-488).
Printing	Print to network printer or to a printer that supports e-mail printing. Note: This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)
LAN port	RJ-45 connector, supports 10/100 Mb/s
HDMI port	19-pin, HDMI type connector
Auxilliary input (typical)	(Available on two-channel models only)
Front-panel BNC connector	Input impedance, 1 MΩ
Maximum input	300 V_{RMS} CAT II with peaks ≤ ±425 V
Probe compenstor output voltage and frequency	Front-panel pins
Amplitude	0 to 2.5 V
Frequency	1 kHz
Aux Out	Rear-panel BNC connector V_{OUT} (Hi): ≥2.25 V open circuit, ≥1.0 V into 50 Ω to ground V_{OUT} (Lo): ≤0.7 V into a load of ≤4 mA; ≤0.25 V into 50 Ω to ground Output can be configured to provide a pulse out signal when the oscilloscope triggers, a trigger signal from the internal arbitrary function generator, or an event out
Kensington-style lock	Rear-panel security slot connects to standard Kensington-style lock.

LAN eXtensions for Instrumentation (LXI)

Class	LXI Core 2011
Version	V1.4

Software

OpenChoice® Desktop	Enables fast and easy communication between a Windows PC and your oscilloscope using USB or LAN. Transfer and save settings, waveforms, measurements, and screen images. Word and Excel toolbars automate the transfer of acquisition data and screen images from the oscilloscope into Word and Excel for quick reporting or further analysis.
IVI driver	Provides a standard instrument programming interface for common applications such as LabVIEW, LabWindows/CVI, MicrosoftNET, and MATLAB.
e*Scope® Web-based interface	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 Core 2011 Web interface	Connect to the oscilloscope through a standard Web browser by simply entering the oscilloscope 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 e*Scope Web-based remote control. All Web interaction conforms to LXI Core 2011 specification, version 1.4.

Power source

Power source voltage	100 to 240 V ±10%
Power source frequency	50 to 60 Hz at 100 to 240 V 400 Hz ±10% at 115 V
Power consumption	130 W maximum

Physical characteristics

Dimensions	
Height	252 mm (9.93 in.)
Width	370 mm (14.57 in.)
Depth	148.6 mm (5.85 in.)
Weight	
Net	MDO34 1GHz: 11.7 lbs (5.31 kg) MDO32 1GHz: 11.6 lbs (5.26 kg)
Shipping	17.4 lbs (7.89 kg)
Rackmount configuration	6U
Cooling clearance	2 in. (50.8 mm) required on right side (facing the instrument) and rear of instrument

EMC and safety

Temperature	
Operating	0 °C to +55 °C (+32 °F to +131 °F)
Non-operating	–40 °C to +71 °C (–40 °F to +160 °F)
Humidity	
Operating	5% to 90% relative humidity (% RH) at up to +40 °C 5% to 60% RH above +40 °C up to +55 °C, non-condensing, and as limited by a maximum wet-bulb temperature of +39 °C
Non-operating	5% to 90% relative humidity up to +40 °C, 5% to 60% relative humidity above +40 °C up to +55 °C 5% to 40% relative humidity above +55 °C up to +71 °C, non-condensing, and as limited by a maximum wet-bulb temperature of +39 °C
Altitude	
Operating	3,000 m (9,843 feet)
Non-operating	12,000 m (39,370 feet)
Regulatory	
Electromagnetic compatibility	EC Council Directive 2004/108/EC
Safety	UL61010-1:2004, CAN/CSA-C22.2 No. 61010.1: 2004, Low Voltage Directive 2006/95/EC and EN61010-1:2001, IEC 61010-1:2001, ANSI 61010-1-2004, ISA 82.02.01

Random vibration	
Non-operating:	2.46 G_{RMS}, 5-500 Hz, 10 minutes per axis, 3 axes, 30 minutes total
Operating:	0.31 G_{RMS}, 5-500 Hz, 10 minutes per axis, 3 axes, 30 minutes total
	Meets IEC60068 2-64 and MIL-PRF-28800 Class 3
Shock	
Operating:	50 G, 1/2 sine, 11 ms duration, 3 drops in each direction of each axis, total of 18 shocks
	Meets IEC 60068 2-27 and MIL-PRF-28800 Class 3
Non-operating	50 G, 1/2 sine, 11 ms duration, 3 drops in each direction of each axis, total of 18 shocks
	Exceeds MIL-PRF-28800F
Acoustic noise emission	
Sound power level	38 dBA - 40 dBA typical in accordance with ISO 9296

Ordering information

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

Step 1 Choose the 3 Series MDO base model

3 Series MDO family

MDO32	Mixed Domain Oscilloscope with (2) analog channels, (1) auxiliary trigger input, (1) spectrum analyzer input, and (1) logic analyzer input
MDO34	Mixed Domain Oscilloscope with (4) analog channels, (1) spectrum analyzer input, and (1) logic analyzer input

Standard accessories

Probes

350 MHz, 500 MHz and 1 GHz models	TPP0500B, 500 MHz bandwidth, 10X, 3.9 pF. One passive voltage probe per analog channel
100 MHz and 200 MHz models	TPP0250, 250 MHz bandwidth, 10X, 3.9 pF. One passive voltage probe per analog channel
Any model with 3-MSO option	One P6316 16-channel logic probe and accessories

Accessories

071-3608-00	Installation and Safety Instructions, printed manual (translated in English, Japanese, and Simplified Chinese)
016-2144-xx	Accessory bag
-	Power cord
-	OpenChoice® Desktop Software available for download from www.tek.com/software/downloads.
-	Calibration certificate documenting traceability to National Metrology Institute(s) and ISO9001 quality system registration

Warranty

Three-year warranty covering all parts and labor on the 3 Series MDO instrument. One-year warranty covering all parts and labor on included probes.

Step 2 Configure your 3 Series MDO by adding options

Instrument options

All 3 Series MDO instruments can be preconfigured from the factory with the following options:

3-AFG	Arbitrary function generator with 13 predefined waveforms and arbitrary waveform generation.
3-MSO	16 digital channels; includes P6316 digital probe and accessories.
3-SA1	Spectrum analyzer; frequency range from 9 kHz to 1 GHz and capture bandwidth to 1 GHz.
3-SA3	Spectrum analyzer; frequency range from 9 kHz to 3 GHz and capture bandwidth to 3 GHz.
3-SEC	Enhanced instrument security to enable password protected control of turning on/off all instrument ports and instrument firmware update functionality.

Bandwidth options

3-BW-100	100 MHz Bandwidth for analog channels
3-BW-200	200 MHz Bandwidth for analog channels
3-BW-350	350 MHz Bandwidth for analog channels
3-BW-500	500 MHz Bandwidth for analog channels
3-BW-1000	1 GHz Bandwidth for analog channels

Power cord and plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Localized user interface and online help

The Instrument user interface is localized into eleven languages.

The Instrument help, localized in eleven languages, is included in each product and in pdf format on the Web.

All products are shipped with an Installation and Safety manual that is in English, Japanese, and Simplified Chinese, except instruments ordered with option L99, which receives no printed manual.

Opt. L99	No manual

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 Years (including warranty)
Opt. T3	Three Year Total Protection Plaln, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS plus preventative maintenance, including a 5 day turnaround time and priority acdess to customer support.
Opt. T5	Five Year Total Protection Plaln, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS plus preventative maintenance, including a 5 day turnaround time and priority acdess to customer support.

Probes and accessories are not covered by the oscilloscope warranty and service offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

Step 3 Select triggering and analysis options

Triggering and analysis options

3-BND	Adds an application bundle (includes all serial options and power analysis option).
3-SRAERO	Adds aerospace serial triggering and analysis (MIL-STD-1553, ARINC429).
3-SRAUDIO	Adds audio serial triggering and analysis (I2S, LJ, RJ, TDM).
3-SRAUTO	Adds automotive serial triggering and analysis (CAN, CAN FD, LIN, FlexRay).
3-SRCOMP	Adds computer serial triggering and analysis (RS-232/422/485/UART).
3-SREMBD	Adds embedded serial triggering and analysis (I2C, SPI).
3-SRUSB2	Adds USB serial triggering and analysis (USB 2.0 LS, FS, HS).
3-PWR	Adds power measurement and analysis.

Recommended accessories

Probes

Tektronix offers over 100 different probes to meet your application needs. For a comprehensive listing of available probes, please visit www.tektronix.com/probes.

TPP0250	250 MHz, 10X attenuation passive probe with TekVPI® interface
TPP0500B	500 MHz, 10X attenuation passive probe with TekVPI® interface
TPP0502	500 MHz, 2X attenuation passive probe with TekVPI® interface
TPP0850	2.5 kV, 800 MHz, 50X TekVPI® passive high-voltage probe
TPP1000	1 GHz, 10X TekVPI® passive voltage probe, 1.3 Meter cable
TDP0500	500 MHz TekVPI® differential voltage probe, ±42 V differential input voltage
TDP1000	1 GHz TekVPI® differential voltage probe, ±42 V differential input voltage
THDP0100	±6 kV, 100 MHz TekVPI® high-voltage differential probe

THDP0200	±1.5 kV, 200 MHz TekVPI® high-voltage differential probe
TMDP0200	±750 V, 200 MHz TekVPI® high-voltage differential probe
TIVM1 / L	Isolated Probe; 1 GHz, ±50 V, TekVPI, 10 Meter Cable
P6246	400 MHz differential active FET probe (Level II TekProbe)
P6427	1 GHz differential active FET probe (Level II TekProbe)
P5100	2.5 kV, 100x high voltage probe (Level II TekProbe)
TCP0020	20 A AC/DC TekVPI® current probe, 50 MHz BW
TCP0030A	30 A AC/DC TekVPI® current probe, 120 MHz BW
TCP0150	150 A AC/DC TekVPI® current probe, 20 MHz BW
A621	2000 A AC Current probe/BNC
A622	100 A AC/DC Current probe/BNC
TCPA300	AC/DC current probe, DC to 100 MHz, (Requires TCP305A or TCP312A or TCP303 probes)
TCPA400	AC/DC current probe, DC to 50 MHz, (Requires TCP404XL probe)
TCP303	15MHz AC/DC 150A current probe for TCPA300
TCP305	50MHz AC/DC 50A current probe for TCPA300
TCP312	100MHz AC/DC 30A current probe for TCPA300
TCP404XL	2 MHz AC/DC 500A current probe for TCPA400
ADA400A	100x, 10x, 1x, 0.1x high gain differential amplifier
P6316	16 Channel Logic Probe

Accessories

TPA-N-PRE	Preamplifier, 12 dB nominal Gain, 9 kHz - 6 GHz
TPA-N-VPI	N-to-TekVPI adapter
119-4146-00	Near field probe set, 100 kHz - 1 GHz
119-6609-00	Flexible monopole antenna
077-1500-xx	Service manual, download from Web (English only)
TPA-BNC	TekVPI® to TekProbe™ BNC adapter
TEK-DPG	TekVPI Deskew pulse generator signal source
067-1686-xx	Power measurement deskew and calibration fixture
TEK-USB-488	GPIB-to-USB adapter
RM3	Rackmount kit
HC3	Hard transit case
SC3	Soft transit case (includes front protective cover)

Other RF probes

Contact Beehive Electronics to order: http://beehive-electronics.com/probes.html

101A	EMC probe set
150A	EMC probe amplifier
110A	Probe cable
0309-0001	SMA probe adapter
0309-0006	BNC probe adapter

Future instrument upgrades after purchase

Instrument upgrades

The 3 Series MDO products offer a number of ways to add functionality after the initial purchase. Listed below are the various product upgrades available and the method of upgrade used for each product.

Post-purchase instrument options	The following products are sold as stand-alone products and can be purchased at any time to add functionality to a 3 Series MDO product. Software option key products require that the instrument model and serial number be provided at the time of purchase. The software option key is specific to the model and serial number combination. One-time, permanent upgrade to any model enabled through software option key.
SUP3 AFG	Add arbitrary function generator to any 3 Series MDO product.
SUP3 MSO	Add 16 digital channels; includes P6316 digital probe and accessories .
SUP3 SA1	Add spectrum analyzer; frequency range from 9 kHz to 1 GHz and capture bandwidth to 1 GHz.
SUP3 SA3	Add spectrum analyzer; frequency range from 9 kHz to 3 GHz and capture bandwidth to 3 GHz.
SUP3 SEC	Add enhanced instrument security to enable password protected control of turning on/off all instrument ports and instrument firmware update functionality.
SUP3 BND	Add an application bundle (includes all serial options and power analysis option).
SUP3 SRAERO	Add aerospace serial triggering and analysis (MIL-STD-1553, ARINC429).
SUP3 SRAUDIO	Add audio serial triggering and analysis (I2S, LJ, RJ, TDM).
SUP3 SRAUTO	Add automotive serial triggering and analysis (CAN, CAN FD, LIN, FlexRay).
SUP3 SRCOMP	Add computer serial triggering and analysis (RS-232/422/485/UART).
SUP3 SREMBD	Add embedded serial triggering and analysis (I2C, SPI).
SUP3 SRUSB2	Add USB serial triggering and analysis (USB 2.0 LS, FS, HS).
SUP3 PWR	Add power measurement and analysis.
SUP3 T3	Three Year Total Protection Plaln, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS plus preventative maintenance, including a 5 day turnaround time and priority acdess to customer support.
SUP3 T5	Five Year Total Protection Plaln, includes repair or replacement coverage from wear and tear, accidental damage, ESD or EOS plus preventative maintenance, including a 5 day turnaround time and priority acdess to customer support.

Bandwidth upgrade options

Instrument bandwidth can be upgraded on any 3 Series MDO product after initial purchase. Each upgrade product increases analog bandwidth and spectrum analyzer frequency range. Bandwidth upgrades are purchased based on the combination of the current bandwidth and the desired bandwidth. Software option key products depend on instrument model and serial number combination. Bandwidth upgrades up to 500 MHz can be performed in the field, while upgrades to 1 GHz require installation at a Tektronix service center.

Model to be upgraded	Bandwidth before upgrade	Bandwidth after upgrade	Order option
MDO32	100 MHz	200 MHz	SUP3 BW1T22
	100 MHz	350 MHz	SUP3 BW1T32
	100 MHz	500 MHz	SUP3 BW1T52
	100 MHz	1 GHz	SUP3 BW1T102
	200 MHz	350 MHz	SUP3 BW2T32
	200 MHz	500 MHz	SUP3 BW2T52
	200 MHz	1 GHz	SUP3 BW2T102
	350 MHz	500 MHz	SUP3 BW3T52
	350 MHz	1 GHz	SUP3 BW3T102
	500 MHz	1 GHz	SUP3 BW5T102
MDO34	100 MHz	200 MHz	SUP3 BW1T24
	100 MHz	350 MHz	SUP3 BW1T34
	100 MHz	500 MHz	SUP3 BW1T54
	100 MHz	1 GHz	SUP3 BW1T104
	200 MHz	350 MHz	SUP3 BW2T34
	200 MHz	500 MHz	SUP3 BW2T54
	200 MHz	1 GHz	SUP3 BW2T104
	350 MHz	500 MHz	SUP3 BW3T54
	350 MHz	1 GHz	SUP3 BW3T104
	500 MHz	1 GHz	SUP3 BW5T104

CE

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

GPIB IEEE-488

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

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* European toll-free number. If not accessible, call: +41 52 675 3777

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

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