

NEW

Three **NEW Special Editions**
and
Five **NEW Options**



2465DVS

2465

2465/2445

300 MHz Bandwidth at Probe Tip (2465)

150 MHz Bandwidth at Probe Tip (2445)

500 ps/Div Sweep Rate (2465)

1 ns/Div Sweep Rate (2445)

2 mV/Div Vertical Sensitivity

500 MHz (2465) and 250 MHz (2445)

Minimum Triggering Bandwidth

Four Independent Channels

Waveform Cursors

Three-Year Warranty—Five Years Optional

The 300-MHz 2465 and 150-MHz 2445 represent the leading edge of technology, establishing higher standards in both value and performance for today's portable oscilloscopes. They enable faster and more precise measurements than ever

before possible in a portable oscilloscope. For even more value, Tektronix is offering three *specialty priced* products, the 2465DVS, 2465DMS, and 2465CTS. Each is configured with new options to greatly simplify complex measurements and substantially increase user productivity.

GPIB
IEEE-488 The 2465/2445 Option 10, 2465DVS, 2465DMS and 2465CTS comply with IEEE Standard 488-1978 and with Tektronix *Standard Codes and Formats*.

2465CTS Special Edition

2465 Performance PLUS:

- 10 ps Time Interval Resolution
- Crystal Controlled Time Base
- 0.001% Accuracy
- 150 MHz Counter/Timer
- Delay-By-Events Triggering
- Boolean Logic Triggering
- 17-Bit Word Recognizer Probe
- Fully Programmable

2465DMS Special Edition

2465CTS Performance PLUS:

- 4 1/2 Digit Autoranging Digital Multimeter
- True RMS Ac Volts and Current
- Continuity Beeper
- DMM Calibration via Front Panel and GPIB
- 10 μ V Resolution on Dc Volts
- Fully Programmable

2465DVS Special Edition

2465DMS Performance PLUS:

- TV Waveform Measurement System
- This System Includes all the 2465 Measurement Options for the Upmost in Versatility and Performance

PORTABLE OSCILLOSCOPES

NEW



OPTION 01 Digital Multimeter

All of the High Performance Characteristics of Standard 2465/2445 Oscilloscopes Plus a 4 1/2 Digit Autoranging Digital Multimeter

True RMS Ac Volts from 20 Hz to 100 kHz

True RMS Ac Current from 20 Hz to 10 kHz

10 μ V Resolution on Dc Volts

Continuity Beeper

UL Listed, CSA Certified

Temperature Probe -62°C to +230°C

Calibration via Front Panel without Removing Instrument Covers

Convenience Features Include:

- Set Reference, Hold, Smooth,
- Minimum/Maximum, dBV, and dBm

Option 01 (DMM) complements the measurement demands placed on the 2400 Series oscilloscopes. This 4 1/2 digit DMM offers features not normally found on other DMMs in its class, such as: (1) Direct readout of dBV and dBm; (2) Continuity with audible tone; (3) Display of minimum or maximum values of readings that occurred since the last reset or function change; (4) Averaging blocks of accumulated measurement values to create a smoothing or filtering effect when desired; (5) Rugged, designed to meet or exceed the requirements of MIL-T-28800C, Class 3 environment, thus ensuring reliable operation under the same temperature and humidity extremes as the 2400 Series oscilloscopes; (6) UL listed and CSA certified.

CHARACTERISTICS

The set of characteristics is the same as specified for standard 2465/2445 oscilloscopes and includes the following additions: All accuracy specifications are stated with an operating temperature range of +18°C to +28°C and a relative humidity of 95% or less.

DC VOLTAGE

Ranges — 200 mV, 2 V, 20 V, 200 V, 500 V.

Resolution — 10 μ V (4 1/2 digits).

Accuracy — \pm (0.03% of reading + 0.01% of full scale). For 500 V range \pm (0.03% of reading + 0.04% of full scale).

Input Resistance — >100 G Ω on the 0.2 V and 2 V ranges, 10 M Ω on the higher ranges. Resistance can be changed to 10 M Ω on all ranges.

Normal-Mode Rejection Ratio — \geq 60 dB at 50 Hz and 60 Hz.

Common-Mode Rejection Ratio — 100 dB at dc, >80 dB at 50 Hz and 60 Hz with 1 k Ω imbalance.

Maximum Input Voltage — 500 V RMS, 700 V peak between inputs and ground.

Response Time — <2 s in Auto, <1 s in Manual range.

AC RMS VOLTAGE

Ranges — 200 mV, 2 V, 20 V, 200 V, 500 V.

Resolution — 10 μ V (4 1/2 digits).

Accuracy — \pm (% of reading + % of full scale).

Ranges	200 mV to 200 V	500 V
20 Hz to 40 Hz	\pm (0.7% + 0.1%)	\pm (0.7% + 0.2%)
40 Hz to 10 kHz	\pm (0.3% + 0.1%)	\pm (0.3% + 0.2%)
10 kHz to 20 kHz	\pm (0.7% + 0.1%)	\pm (0.7% + 0.2%)
20 kHz to 100 kHz	\pm (5% + 0.1%)	\pm (5% + 0.2%)

Crest Factor — \leq 4 at full scale.

Common-Mode Rejection Ratio — \geq 60 dB at 50 Hz and 60 Hz with 1 k Ω imbalance.

Response Time — <3 s in Auto, <2 s in Manual range.

Input Impedance — 1 M Ω in parallel with <100 pF.

Maximum Input Voltage — 500 V RMS, 700 V peak between inputs and ground, not to exceed 10⁷ V-Hz product.

dBV, dBm — Calculated reading of ac voltage measurements. dBV is the display result equal to 20 Log (V_{UNK}/V_{REF}) where V_{REF} = 1 V. dBm is referenced 1 mW into 600 Ω .

HI Ω RESISTANCE

Ranges — 2 k Ω , 20 k Ω , 200 k Ω , 2 M Ω , 20 M Ω .

Accuracy — \pm (0.1% of reading + 0.01% of full scale) for 2 k Ω to 2 M Ω , \pm (0.5% of reading + 0.01% of full scale) for 20 M Ω . For Relative Humidity (RH) above 70%, add 2% of reading per 10% RH for the two highest resistance ranges.

Maximum Input Voltage — 500 V RMS, 700 V peak.

Full Scale Voltage — 2 V.

Open Circuit Voltage — <6 V.

Resolution — 0.1 Ω (4 1/2 digits).

Response Time — <2 s in Auto, <1 s in Manual range. <5 s in 20 M Ω range.

LO Ω RESISTANCE

Ranges — 200 Ω , 2 k Ω , 20 k Ω , 200 k Ω , 2 M Ω .

Accuracy — \pm (0.1% of reading + 0.1% of full scale) for 200 Ω , \pm (0.1% of reading + 0.01% of full scale) for 2 k Ω to 200 k Ω , \pm (0.25% of reading + 0.01% of full scale) for 2 M Ω . For Relative Humidity (RH) above 70%, add 2% of Reading per 10% RH for the two highest resistance ranges.

Maximum Input Voltage — 500 V RMS, 700 V peak.

Full Scale Voltage — 0.2 V.

Open Circuit Voltage — <6 V.

Resolution — 0.01 Ω .

Response Time — <2 s in Auto, <1 s in Manual range.

Continuity — An audible tone indicates <10 Ω . Reponse time is \approx 0.1 s.

DC AMPS

Ranges — 100 μ A, 1 mA, 10 mA, 100 mA, 1 A.

Accuracy — \pm (0.1% of reading + 0.02% of full scale).

Burden Voltage — <150 mV up to 100 mA increasing to <500 mV at 1 A.

Resolution — 10 nA.

Response Time — <2 s in Auto, <1 s in Manual range.

AC (RMS) AMPS

Ranges — 100 μ A, 1 mA, 10 mA, 100 mA, 1 A.

Accuracy — \pm (0.6% of reading + 0.1% of full scale) from 20 Hz to 10 kHz.

Burden Voltage — <150 mV up to 100 mA increasing to <500 mV at 1 A.

Resolution — 10 nA.

Response Time — <3 s in Auto, <2 s in Manual range.

TEMPERATURE

Range — -62°C to +230°C, \pm (2% of reading + 1.5°C). Readout may be in °C or °F with a resolution of 0.1°.

OTHER CHARACTERISTICS

Reading Rate — Three readings/s nominal except 1.5 readings/s on 20 M Ω range.

Temperature Coefficient — \leq 0.1 x the accuracy specification/°C from -15°C to +18°C and from +28°C to +55°C.

GPIB Compatibility for Semiautomatic Measurement Systems — When combined with Option 10, the DMM (Option 01)/oscilloscope combination is fully programmable. Complies with Tektronix Standard Codes and Formats.

INCLUDED ACCESSORIES (Option 01)

In addition to the accessories listed for 2465 and 2445 instruments, a probe set (012-0941-00); probe set accessories (020-0087-00); temperature probe (010-6602-00); and DMM operator's manual and reference guide are provided.



OPTION 09

Counter/Timer/Trigger (CTT)
With Word Recognizer (WR)

All of the High Performance Characteristics of Standard 2465/2445 Oscilloscopes Plus Crystal-Controlled Time Base

0.001% Accuracy

Totalize up to 9,999,999 Events

Delay-By-Events Triggering up to a Total of 4,194,303 Events

Boolean Logic Triggering on Both Digital and Analog Signals

17-Bit Word Recognizer Probe

Adding Option 09 to the 2400 Series oscilloscopes provides crystal-controlled time base accuracy for several time related measurements. Its use is fully integrated with the operation of the oscilloscope and with user on-screen menus. Four new 2400 Series capabilities are provided by this option: (1) Precision time-interval measuring; (2) Event and frequency counting; (3) Delay-by-events triggering; (4) Boolean logic triggering.

A 17-Bit word recognizer probe is available for a variety of applications, such as triggering on a word occurrence, counting words, or delaying the B sweep by a number of words.

CHARACTERISTICS

The set of characteristics is the same as specified for standard 2465/2445 oscilloscopes and includes the following additions:

Sensitivity — Signal input requirements for Frequency, Period, Totalize, Delay-by-Events and Logic Trigger.

Input	Displayed Signal	Frequency Range
CH1, CH2	1.5 div	Dc (0.5 Hz for Frequency and Period) to 50 MHz
CH3, CH4	0.75 div	
CH1, CH2	4.0 div	50 MHz to \geq 150 MHz
CH3, CH4	2.0 div	

Source — A trigger or word recognizer for Frequency, Period, and Totalize.

PORTABLE OSCILLOSCOPES

2465CTS



New Options

Five new options can be ordered with the 2465 or 2445. Their descriptions follow the 2400 Series characteristics.

GPIB IEEE Standard 488 Programmable for Semiautomatic Measurement Systems (Option 10)

150 MHz Counter/Timer/Trigger (CTT) with 17-Bit Word Recognizer (Option 09)

150 MHz Counter/Timer/Trigger (CTT) (Option 06)

TV Waveform Measurement System (Option 05)

4 1/2 Digit Autoranging DMM (Option 01)

Multiple Option Allowance

When more than one option is ordered, a Multiple Option Allowance is applied to the purchase.

Special Edition 2465DVS, 2465DMS, and 2465CTS

For maximum versatility and high-resolution video applications, choose the *2465DVS*. This is a *specialty priced* and configured 2465 with five options: (1) a 4 1/2 digit autoranging digital multimeter (Option 01); (2) a crystal-controlled timebase, 150-MHz counter/timer/trigger and 17-bit word recognizer (Option 09); (3) an IEEE Standard 488 Interface Bus (Option 10) which provides complete talker/listener control, making the 2465DVS programmable; (4) the TV waveform measurement system (Option 05) and (5) two additional P6131 probes (Option 22).

For automatic test and measurement applications, the *2465DMS*, is a *specialty priced* and configured 2465 with Options 01, 09, 10, 22.

The *2465CTS* is a *specialty priced* and configured 2465 with Options 09, 10, and 22. It is ideal for automatically measuring frequency, period pulse width, and time between events. For moderate speed signals risetimes and falltimes can be automatically measured.

For more information about these instruments, refer to the characteristics and ordering information for the 2465 and the individual options.

Precision Measurements

Crystal Controlled Time Base (Option 09/06)

ΔVolts and ΔTime Cursors

Adjustable Channel 1—Channel 2 Delay Matching

Time-Interval Resolution to 20 ps (10 ps Option 09/06)

Calibrated Horizontal Variable

The 2465/2445 Family oscilloscopes set new norms in measurement precision. With 1% horizontal system accuracy and 2% vertical deflection accuracy, they give you greater measurement confidence than ever before. On-screen vertical and horizontal cursors deliver immediate and accurate results of voltage, time, frequency, ratio, and phase measurements.

Cursors increase accuracy and operator productivity. With them, measurements can be made quickly, with almost no chance of interpretation errors and no CRT linearity error. The front-panel-controlled Channel 1—Channel 2 delay-matching adjustment compensates probe and vertical-channel delay differences.

CRT Readouts

Vertical and Horizontal Scale Factors

Trigger Level

Voltage, Time, Frequency, Phase, and Ratio Measurement Values

50 Ω Overload Condition

Mode Indicators

Readouts permit easy setup and interpretation of waveform displays. The horizontal time base always remains calibrated with three significant digits and a decimal point, even if variable settings are used.

Versatile Triggering

Hands-Off Auto Level Triggering

Predictable Triggering on Logic Thresholds and Intermittent Signals

Delay-By-Events and Boolean Triggering (Option 09/06)

These oscilloscopes can trigger on any one of the four channels. New auto-level circuitry gives you convenient hands-off triggering, even with changing trigger-signal amplitudes. With the position-independent triggering, trigger level remains constant whenever you reposition the display. And the trigger-level readout enables you to preset the amplitude for predictable triggering on both logic thresholds and transient events.

Single-sequence triggering can capture a single event or multiple events by displaying a single sweep of each trace on the CRT. At the end of the sequence, scale factors and other readout data are briefly displayed and graticule illumination flashes on momentarily, allowing waveform photography.

Measurement Convenience

Four Independent Channels

B Sweep Displays A-Sweep Trigger Event Selectable 50 Ω and 1 MΩ Input Impedances with 50 Ω Overload Protection

Four channels produce clear and complete views to simplify complex measurements. With the B sweep you can display any portion of the A sweep, including the A-sweep trigger event. Sweep-delay range is adjustable down to zero delay. This combination allows easy timing measurements to be made on highly asymmetric or jittering waveforms. It provides accurate delayed- and Δ-time measurements—from the first pulse on the trace—and allows the operator to examine the A-trigger event in detail.

Input impedance is selectable between 1 MΩ and 50 Ω on Channels 1 and 2, eliminating the need for external 50-Ω terminators. Overload protection is also ensured. If excessive signal is applied while 50-Ω coupling is selected, coupling automatically switches to 1-MΩ coupling to prevent possible damage.

Environmental

Exceptional electromagnetic compatibility qualities make the 2465/2445 Family oscilloscopes attractive for use in high-RF situations such as computer manufacturing, testing, and servicing. These instruments are also UL listed and CSA certified for safety. Their rugged design meets MIL-T-28800C environmental requirements for Type III, Class 3, Style C equipment.

Reliability

Because of our confidence in their trouble-free performance, Tektronix offers a three-year warranty. It covers all labor and parts, including CRT and excluding probes. You can also economically extend the warranty coverage up to five years by choosing from five practical service plans. These optional plans are designed to meet specific maintenance needs and are available in most countries.

NEW

PORTABLE OSCILLOSCOPES



This sample waveform and CRT readout show a 2445's high-fidelity display of the Vertical Interval Reference Signal on Line 19, Field 1 with the television blanking-level clamp (TVC) engaged. The instrument used is also equipped with Option 10 (GPIB).

Back-porch clamp circuitry delivers a stable display of composite video, even when signals are characterized by changing average picture level and low frequency hum.

Direct CRT readout of the triggering line number is a feature unique to Tektronix 2465/2445 oscilloscopes with Option 05. By eliminating operator line counting, we removed the uncertainty that is inherent with less-advanced oscilloscope television options.

New circuitry optimizes triggering on television signals. Any of four trigger coupling modes can be chosen to display desired portions of the composite signal—Lines, Field 1, Field 2, Field 1 alternating with Field 2.

CHARACTERISTICS

The set of characteristics is the same as specified for standard 2465/2445 oscilloscopes and includes the following additions:

VERTICAL DEFLECTION SYSTEM (CHANNEL 1 AND CHANNEL 2)

Frequency Response — For Volts/Div switch settings between 5 mV and 0.2 V with Var Volts/Div control in calibrated detent and using a 5-div, 50 kHz reference signal from a 50 Ω or 75 Ω system.

Range	Frequency Response	
	With Full BW	With BW Limiting
50 kHz to 5 MHz	$\pm 1\%$	+1%, -4%
>5 MHz to 10 MHz	+1%, -2%	*1
>10 MHz to 30 MHz	+2%, -3%	*1
>30 MHz	*1	*1

*1 Same as 2445/2465.

Squarewave Flatness — 1% p-p for both 60 Hz and 15 kHz squarewaves, from a 50 Ω or 75 Ω system using a 1.0 V input with a 50 mV/div setting and using a 0.1 V input at 20 mV/div setting. 1.5% p-p using a 0.1 V input with 5 mV/div and 10 mV/div settings. Setup with 1 M Ω dc input coupling, external 50 Ω termination, Var Volts/Div control in calibrated detent, and fast-rise input signal (risetime ≤ 1 ns). Exclude first 50 ns following step transition. For signals with risetimes ≤ 10 ns, add 2% p-p between 155 ns and 165 ns after step transition.

Television Blanking-Level Clamp (Back-Porch) 60 Hz Rejection (Channel 2 Only) — ≥ 18 dB at 60 Hz; with calibrated Volts/Div settings between 5 mV and 0.2 V, and a 6-div reference signal.

Television Blanking-Level Clamp (Back-Porch) Reference — Within 1.0 div of ground reference.

TRIGGERING

Sync Separation — Stable sync separation from sync-positive or sync-negative composite video on systems with 525 to 1280 lines/frame, 50 Hz or 60 Hz field rate, interlaced or noninterlaced scan.

Trigger Modes — LINES, FLD 1, FLD 2, and ALT (FLD 1-FLD 2) coupling.

Input Signal Amplitude for Stable Triggering Channel 1 and Channel 2 — 1.0 div for composite video and 0.3 div for composite sync signals (dc + peak video-signal amplitude must be within 18 div of input ground reference).

Channel 3 and Channel 4 — 0.5 div for composite video and 0.25 div for composite sync signals (dc peak video-signal amplitude must be within 9 div of input ground reference).

GPIB Compatibility for Semiautomatic Measurement Systems — When combined with Option 10, the TV Waveform Measurement Systems (Option 05)/oscilloscope combination is fully programmable. Complies with Tektronix Standard Codes and Formats.

INCLUDED ACCESSORIES (Option 05)

In addition to the accessories listed for 2465 and 2445 instruments, a CCIR graticule CRT filter (378-0199-01); an NTSC graticule CRT filter (378-0199-02); a polarized collapsible viewing hood (016-0180-00); an operator's manual and reference guide are provided.

ORDERING INFORMATION

2465 300 MHz Oscilloscope \$5,150

2445 150 MHz Oscilloscope \$3,550

2465DVS 300 MHz Oscilloscope [Includes DMM (Option 01), TV (Option 05), CCT/WR (Option 09), GPIB (Option 10), and two additional P6131 probes (Option 22). Provides most cost-effective combination of these options \$8,550

2465DMS 300 MHz Oscilloscope [Includes DMM (Option 01), CCT/WR (Option 09), GPIB (Option 10), and two additional P6131 probes (Option 22). Provides most cost-effective combination of these options \$7,850

2465CTS 300 MHz Oscilloscope [Includes CCT/WR (Option 09), GPIB (Option 10), and two additional P6131 probes (Option 22). Provides most cost-effective combination of these options \$6,650

INSTRUMENT OPTIONS

Option 01*3 — Digital Multimeter +\$1,500

Option 05 — TV Waveform Measurement System . . . +\$1,050

Option 06*2 — Counter/Timer/Trigger +\$1,000

Option 09**1*2 — CTT/Word Recognizer +\$1,400

Option 10 — GPIB Interface +\$900

MULTIPLE OPTION ALLOWANCE (MOA)

When a 2465 or 2445 is ordered with more than two of the above options, a special price allowance is applied. This allowance is not applicable to the 2465DVS, 2465DMS, or the 2465CTS specially priced edition.

Option 2A — MOA for combining two of the above options -\$300

Option 3A — MOA for combining three of the above options -\$600

Option 4A — MOA for combining four of the above options -\$900

OTHER INSTRUMENT OPTIONS

Option 1R*3 — Configure Oscilloscope for Rackmount +\$305

Option 11*1 — Rear Panel Probe Power +\$155

Option 22 — Two additional P6131 Probes +\$250

*1 Option 11 may not be ordered with Option 09 or the 2445.

*2 Option 09 includes Option 06.

*3 Option 1R may not be ordered with Option 01. For rack-mounting Option 01, 2465DVS, and 2465DMS contact your Tektronix Sales Office.

NOTE: Options 01, 05, 06, 09, and 10 are not retrofitable with field upgrade kits.

INTERNATIONAL POWER CORD AND PLUG OPTIONS

Option A1 — Universal Euro 220 V/16 A, 50 Hz

Option A2 — UK 240 V/13 A, 50 Hz

Option A3 — Australian 240 V/10 A, 50 Hz

Option A4 — North American 240 V/15 A, 60 Hz

Option A5 — Switzerland 220 V/10 A, 50 Hz

WARRANTY-PLUS SERVICE PLANS—REFER TO PAGE 15

M1 — (2465 and Special Editions) 2 Calibrations +\$265

M1 — (2445) 2 Calibrations +\$255

M2 — (2465 and Special Editions) 2 Years Service +\$270

M2 — (2445) 2 Years Service +\$215

M3 — (2465 and Special Editions) 2 Years Service and 4 Calibrations +\$695

M3 — (2445) 2 Years Service and 4 Calibrations +\$645

M4 — (2465 and Special Editions) 5 Calibrations +\$670

M4 — (2445) 5 Calibrations +\$660

M5 — (2465 and Special Editions) 9 Calibrations +2 Years Service +\$1,350

M5 — (2445) 9 Calibrations +2 Years Service +\$1,295



Rackmount 2465 Option 1R comes complete with slide-out chassis tracks.

OPTIONAL ACCESSORIES

Rackmounting Conversion Kit — Not compatible with Option 01. Order 016-0691-01 \$305

Probe Power Extender Cable for Rackmount 2465 Option 11 — Order 020-0104-00 \$210

Word Recognizer Extender Cable for Rackmount 2445/2465 Option 09 and 2465CTS.

GPIB Cable — 1 m double shield, low EMC. Order 012-0991-01 \$135

GPIB Cable — 2 m double shield, low EMC. Order 012-0991-00 \$150

Polarized Collapsible Viewing Hood — Order 016-0180-00 \$40

Folding Light Shield Viewing Hood — Order 016-0592-00 \$12

Folding Binocular Viewing Hood — Order 016-0566-00 \$15

Protective Waterproof Blue Vinyl Cover — Order 016-0720-00 \$20

Carrying Case — Order 016-0792-00 \$295

Carry Strap — Order 346-0199-00 \$15

Camera — See C-30B Option 01 or C-4. For more information see page 420.

SCOPE-MOBILE Cart — See K117 or K212 on page 429.

Dc Power — Order 1107 Dc Inverter. For more information see page 302

P6131 Probe Package — For use with Channel 3 or Channel 4. Order 010-6131-01 \$140

P6230 — 10X Bias/Offset Probe. Order 010-6230-01 \$395

Current Probes — See P6021, P6022, A6302, A6303. For more information see pages 447 and 446 respectively.

Service Manuals:

2445 — Order 070-3829-00 \$20

2465 — Order 070-3831-00 \$20

Option 01 — Order 070-4182-00 \$10

Option 05 — Order 070-4630-00 \$10

Option 06/09

Option 10 — Order 070-4640-00 \$15

Additional accessories begin on page 417.

To order, call your local Tektronix Field Office, or call Tek's National Marketing Center, toll free: 1-800-426-2200, Ext 99. In Oregon call collect: (503) 627-9000, Ext 99.