

SPECIFICATION

INTRODUCTION

The TEKTRONIX 2465A and 2467 Oscilloscopes are portable 350-MHz bandwidth instruments having four-channel vertical deflection systems. Channel 1 and Channel 2 provide calibrated deflection factors from 2 mV per division to 5 V per division. For each of these channels, input impedance is selectable between two values: either 1 M Ω in parallel with 15 pF, or 50 Ω internal termination. Input-signal coupling with 1 M Ω impedance can be selected as either AC or DC. Channel 3 and Channel 4 have deflection factors of either 0.1 V or 0.5 V per division. Each of these channels has an input impedance of 1 M Ω in parallel with 15 pF, with DC input-signal coupling.

The trigger system works automatically for most signals. They operate in various modes, from any channel, with couplings for a wide range of signals. The trigger system gives stable displays from dc to 500 MHz.

The horizontal deflection system provides calibrated sweep speeds from 1.5 s per division to 500 ps per division, including the effects of the X10 magnifier and the calibrated variable between the 1-2-5 steps. Horizontal displays include A-Sweep, B-Sweep (delayed), A alternated with B, and CH 1 (for X/Y displays).

The AUTO, SAVE, and RECALL features save time and prevent errors. Pressing the AUTO Setup button gives a workable setup for almost any signal. For repetitive measurements, the Save and Recall functions record and immediately or sequentially restore as many as 30 instrument setups. The SETUP buttons operate all instrument functions, including the extended function options.

Direct, on-screen readouts of time measurements, voltage measurements, scale factors, trigger levels, and auxiliary information also save time and improve operator confidence.

The 2467 yields 4 divisions/ns visual writing rate. This is about 100 times faster than conventional, high-performance oscilloscopes. The 2467 visibly displays any signal, at any repetition-rate, at any sweep speed, in typical room light. Visible single-shots include 1 ns steps at 500 ps/division.

The instruments are shipped with the following standard accessories:

- 2 Probe packages (2465A)
- 4 Probe packages (2467)
- 1 Snap-lock accessories pouch
- 1 Zip-lock accessories pouch
- 1 Operators manual
- 1 Power cord (installed)
- 1 2-A, 250-V fuse
- 1 Clear plastic CRT filter
- 1 Blue plastic CRT filter (installed)
- 1 Front-panel cover
- 1 Operators pocket reference card

For part numbers and further information about both standard and optional accessories, refer to "Options and Accessories" (Section 7) of the instruments Operators manual or the Accessories information at the rear of this manual. Your Tektronix representative or local Tektronix Field Office can also provide accessories information and ordering assistance.

PERFORMANCE CONDITIONS

The following electrical characteristics (Table 1-1) are valid for the instrument when it has been adjusted at an ambient temperature between +20°C and +30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between -15°C and +55°C (unless otherwise noted).

Items listed in the "Performance Requirements" column define the measurement capabilities of the instruments. Supplementary measurement conditions may also be listed in the "Performance Requirement" column.

Mechanical characteristics are listed in Tables 1-6 and 1-7.



Environmental characteristics are given in Table 1-8. The oscilloscope meets the environmental requirements of MIL-T-28800C for Type III, Class 3, Style C equipment, with the humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, and 3.9.2.4.

Table 1-1
2465A/2467 Electrical Characteristics

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM—CHANNEL 1 AND CHANNEL 2	
Deflection Factor	
Range	2 mV/division to 5 V/division in a 1-2-5 sequence of 11 steps.
Accuracy	1 M Ω input, noninverted.
+15°C to +35°C	
On-Graticule Accuracy	Within $\pm 2\%$ at any VOLTS/DIV setting for a four or five-division signal centered on the screen.
ΔV Accuracy (using cursors over entire graticule area)	$\pm (1.25\% \text{ of reading} + 0.03 \text{ div} + \text{signal aberrations})$.
-15°C to +15°C and +35°C to +55°C	Add $\pm 2\%$ of reading. ^a
50 Ω Coupling	Add $\pm 1\%$ of reading.
CH 2 Inverted	Add $\pm 1\%$ of reading.
ΔV Range	$\pm 8 \times \text{VOLTS/DIV setting}$. ^a
V/DIV VARIABLE, noninverted	Continuously variable between VOLTS/DIV settings. Extends deflection factor to > 12.5 V/division.
Frequency Response	<p>Bandwidth is measured with a leveled, low distortion, 50-Ω source, sine-wave generator, terminated in 50 Ω. The reference signal amplitude is set at the lesser of 6 divisions or the maximum leveled amplitude. External termination bandwidth is checked with a 4 division reference signal.</p> <p>Bandwidth with probe is checked using a probe-tip-to-GR (017-0520-00) termination adapter.</p> <p>Bandwidth with external termination is checked using a BNC 50-Ω feed through terminator (011-0049-01).</p>
-3 dB Bandwidth	Using standard accessory probe or internal 50- Ω termination.
+15°C to +35°C	Dc to 350 MHz.
-15°C to +15°C and +35°C to +55°C	Dc to 300 MHz. ^a
-4.7 dB Bandwidth	Using 50- Ω external termination on 1-M Ω input.


^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
AC Coupled, Lower -3 dB Frequency	10 Hz or less. ^a
With Standard Accessory Probe	1 Hz or less.
Step Response Rise Time	≤1 ns (calculated from $T_r=0.35/BW$). ^a
Channel Isolation	≥100:1 attenuation of deselected channel at 100 MHz; ≥50:1 at 350 MHz, for an eight-division input signal from 2 mV per division to 500 mV per division, with equal VOLTS/DIV settings on both channels.
Displayed Channel 2 Signal Delay with Respect to Channel 1 Signal	Adjustable through a range of at least -500 ps to +500 ps. ^a
Input R and C (1 MΩ)	
Resistance	1 MΩ ±0.5%. ^a
Capacitance	15 pF ±2 pF. ^a
Maximum Input Voltage 	
DC, AC, or GND Coupled	400 V (dc + peak ac). 800 V p-p ac at 10 kHz or less. ^a
Input R (50 Ω)	
Resistance	50 Ω ±1%. ^a
VSWR	
Dc to 300 MHz	≤1.3:1. ^a
300 to 350 MHz	≤1.5:1. ^a
Maximum Input Voltage 	5 V rms, averaged for 1 second; ±50 V peak. ^a
Cascaded Operation	Channel 2 Vertical Signal Output into Channel 1 input; DC coupled using a 50 Ω RG-58C/U coaxial cable, with 1 MΩ DC or 1 MΩ AC Channel 1 input coupling; with Channel 1 and Channel 2 VOLTS/DIV set at 2 mV and 20 MHz Bandwidth Limit On.
Deflection Factor	200 μV per division ±10%.
CMRR (ADD Mode with Channel 2 inverted)	At least 20:1 at 50 MHz for common-mode signals of eight divisions or less, with VAR VOLTS/DIV control adjusted for best CMRR at 50 kHz, at any VOLTS/DIV setting.

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM—CHANNEL 3 AND CHANNEL 4	
Deflection Factors	
Values	100 mV and 500 mV per division.
Accuracy	Within $\pm 10\%$.
Frequency Response	Bandwidth is measured with a leveled, low distortion, 50- Ω source, sine-wave generator, terminated in 50 Ω . The reference signal amplitude is set at the lesser of 6 divisions or the maximum leveled amplitude. External termination bandwidth is checked with a 4 division reference signal. Bandwidth with probe is checked using a probe-tip-to-GR (017-0520-00) termination adapter. Bandwidth with external termination is checked using a BNC 50- Ω feed through terminator (011-0049-01).
– 3 dB Bandwidth	Using standard accessory probe.
+15°C to +35°C	Dc to 350 MHz.
–15°C to +15°C and +35°C to +55°C	Dc to 300 MHz. ^a
–4.7 dB Bandwidth	Using 50- Ω external termination.
+15°C to +35°C	Dc to 350 MHz. ^a
–15°C to +15°C and +35°C to +55°C	Dc to 300 MHz. ^a
Step Response Rise Time	≤ 1 ns (calculated from $T_r = 0.35/BW$). ^a
Channel Isolation	$\geq 50:1$ attenuation of deselected channel at 100 MHz with an 8-division input signal.
Signal Delay Between Channel 1 and Either Channel 3 or Channel 4	Within ± 1.0 ns, measured at the 50% points. ^a
Input Resistance	1 M Ω $\pm 1\%$. ^a
Input Capacitance	15 pF ± 3 pF. ^a
Maximum Input Voltage 	400 V (dc + peak ac). 800 V p-p ac at 10 kHz or less. ^a

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM—ALL CHANNELS	
Low-frequency Linearity	0.1 division or less compression or expansion of a two-division, center-screen signal when positioned anywhere within the graticule area.
Bandwidth Limiter	Reduces upper 3 dB bandpass to a limit of 13 MHz to 24 MHz.
Vertical Signal Delay	At least 30 ns of the sweep is displayed before the triggering event is displayed at any SEC/DIV ≥ 10 ns/div. At 5 ns/div, at least 10 ns of the sweep is displayed before the triggering event. ^a
Chopped Mode Switching Rate	With displayed SEC/DIV in the 20 μ s to 2 μ s/div range, the switching rate is 2.5 MHz $\pm 0.2\%$. Otherwise, the switching rate is 1 MHz $\pm 0.2\%$. The display cycle rate equals the chop switching rate divided by the number of channels displayed. The chop switching rate is modulated slightly to minimize waveform breaks with repetitive signals. ^a
TRIGGERING	
Minimum P-P Signal Amplitude for Stable Triggering from Channel 1 or Channel 2 Source DC Coupled	0.35 division from dc to 50 MHz; increasing to 1.0 division at 300 MHz and 1.5 divisions at 500 MHz.
NOISE REJ Coupled	≤ 1.2 divisions from dc to 50 MHz; increasing to 3 divisions at 300 MHz and 4.5 divisions at 500 MHz.
AC Coupled	0.35 division from 60 Hz to 50 MHz; increasing to 1.0 division at 300 MHz and 1.5 divisions at 500 MHz. Attenuates signals below 60 Hz.
HF REJ Coupled	0.5 division from dc to 30 kHz.
LF REJ Coupled	0.5 division from 80 kHz to 50 MHz; increasing to 1.0 division at 300 MHz and 1.5 divisions at 500 MHz.
Minimum P-P Signal Amplitude for Stable Triggering from ADD Source	Add 0.5 division to CH 1 or CH 2 requirement at 300 MHz and 500 MHz.
Minimum P-P Signal Amplitude for Stable Triggering from CH 3 or CH 4 Source	$0.5 \times$ CH 1 or CH 2 requirement. ^a
Minimum P-P Signal Amplitude for Stable Triggering from Composite, Multiple Channel Source, ALT Vertical Mode	Checked at 50 mV per division. Add 1 division to the single-channel source specification.

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
Maximum P-P Signal Rejected by NOISE REJ COUPLING Signals Within the Vertical Bandwidth CH 1 or CH 2 SOURCE	≥0.4 division for VOLTS/DIV settings of 10 mV/div and higher. Maximum noise amplitude rejected is reduced at 2 mV/div and 5 mV/div.
CH 3 or CH 4 SOURCE	≥0.2 division. ^a
Jitter 2467	≤100 ps with 5 divisions of 300 MHz at 500 ps/division.
2465A	≤50 ps with 5 divisions of 300 MHz at 500 ps/division.
LEVEL Control Range CH 1 or CH 2 SOURCE	±18 × VOLTS/DIV setting. ^a
CH 3 or CH 4 SOURCE	±9 × VOLTS/DIV setting. ^a
LEVEL Readout Accuracy CH 1 or CH 2 SOURCE +15°C to +35°C	For triggering signals with transition times greater than 20 ns. Within ±[3% of reading + 3% of p-p signal + 0.2 division + 0.5 mV + (0.5 mV × probe attenuation factor)] with Vertical Input at 1 MΩ DC, CH 2 Source Not Inverted, and Trigger DC Coupled.
-15°C to +35°C and +35°C to +55°C	Add 1.5 mV × probe attenuation to +15°C to +35°C specification. ^a
50 Ω Input	Add ±1% to 1 MΩ input specification. ^a
CH 2 Inverted	Add ±1% of reading to non-inverted specification. ^a
NOISE REJ Coupled	Add ±0.6 division to DC Coupled specifications. ^a
CH 3 or CH 4 SOURCE	Within ±[3% of reading + 4% of p-p signal + 0.1 division + (0.5 mV × probe attenuation factor)] and Trigger DC Coupled. ^a
NOISE REJ Coupled	Add ±0.3 division to the DC Coupled specification. ^a
AUTO LVL Mode Maximum Triggering Signal Period A SEC/DIV Setting <10 ms	At least 20 ms. ^a
10 ms to 50 ms	At least four times the A-SEC/DIV setting. ^a
>50 ms	At least 200 ms. ^a

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
AUTO Mode Maximum Triggering Signal Period A-SEC/DIV Setting	
<10 ms	At least 80 ms. ^a
10 ms to 50 ms	At least 16 times the A-SEC/DIV setting. ^a
>50 ms	At least 800 ms. ^a
AUTO LVL Mode Trigger Acquisition Time	Eight to 100 times the AUTO LVL Mode maximum triggering signal period, depending on the triggering signal period and waveform.
Trigger Holdoff	
Minimum	
2467	The greater of the A-SEC/DIV setting value or 1 μ s, within +33% + 500 ns to -10%. ^a
2465A	The greater of the A-SEC/DIV setting value or 2 μ s, within +33% to -10%, except 1 μ s at 5 ns/div. ^a
Variable	Increases trigger holdoff time to 10 to 25 times the minimum holdoff.
SLOPE Selection	Conforms to trigger-source waveform or ac power-source waveform.
HORIZONTAL DEFLECTION SYSTEM	
A Sweep Time Base Range	500 ms/div to 5 ns/div in a 1-2-5 sequence of 25 steps. X10 MAG extends maximum sweep rate to 500 ps/div.
B Sweep Time Base Range	50 ms/div to 5 ns/div in a 1-2-5 sequence of 22 steps. X10 MAG extends maximum sweep rate to 500 ps/div.
Timing Accuracy	+15°C to +35°C, A Sweep, with SEC/DIV at 100 ms/div or faster.
Sweep Accuracy Unmagnified	$\pm(0.7\%$ of time interval + 0.6% of full scale).
Δt Accuracy With Cursors, Unmagnified	$\pm(0.5\%$ of time interval + 0.3% of full scale).
Δt Accuracy with Sweep Delay	$\pm(0.3\%$ of time interval + 0.1% of full scale).
Delay Accuracy, A Sweep Trigger to Start of B Sweep	$\pm(0.3\%$ of delay setting + 0.6% of full scale) +0 to -25 ns.
B-Sweep Accuracy and Δt Accuracy with Cursors on B Sweep	Add $\pm 0.3\%$ of time interval to A-Sweep specifications.


^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
X10 MAG Accuracy	Add $\pm 0.5\%$ of time interval to unmagnified Sweep and Δt Cursors specifications. Exclude the first 0.5 division after the sweep starts (the first 0.5% of the full 100 division sweep).
500 ms or 200 ms/div Timing Accuracy (A Sweep only)	Add $\pm 0.5\%$ of interval to specifications for A SEC/DIV at 100 ms or faster.
SEC/DIV VAR Timing Accuracy	Add 2% of time interval to sweep accuracy specifications when VAR is out of detent.
Timing Accuracy (-15°C to $+15^{\circ}\text{C}$ and $+35^{\circ}\text{C}$ to $+55^{\circ}\text{C}$)	Add $\pm 0.2\%$ of time interval to all Δt and delay specifications. Add $\pm 0.5\%$ of interval to sweep accuracy specification. ^a
Δt Readout Resolution	Greater of either 10 ps or 0.025% of full scale. ^a
Δt Range	± 10 times A-SEC/DIV setting with Cursors, ± 9.95 times A-SEC/DIV setting with Sweep Delay. ^a
Sweep Delay Range	0 to 9.95 times the A SEC/DIV setting, from 500 ms to 10 ns. A-Sweep triggering event is observable on B Sweep with zero delay setting for A SEC/DIV settings 50 μs or faster. ^a
Delay Jitter 2467	Within 0.01% (one part or less in 10,000) of the maximum available delay, plus 100 ps. ^a
2465A	Within 0.004% (one part or less in 25,000) of the maximum available delay, plus 50 ps. ^a
Horizontal POSITION Range	Start of 1 ms per division sweep can be positioned from right of graticule center to at least 10 divisions left of graticule center. Some portion of 1 ms per division sweep is always visible with X10 MAG off. ^a
X-Y Operation	
X-Axis Deflection Factor Range, Variable, and Input Characteristics	Same as Channel 1.
Deflection Factor Accuracy	Same as Channel 1. ^a
X-Axis Bandwidth	Dc to 3 MHz.
Phase Difference Between X and Y with BW Limit Off	$\leq 1^{\circ}$ from dc to 1 MHz; $\leq 3^{\circ}$ from 1 MHz to 2 MHz.
X-Axis Low-frequency Linearity	0.1 division or less compression or expansion of a two-division, center-screen signal when positioned within the graticule area.

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
DISPLAY	
Cursor Position Range	
Delta Volts (ΔV)	At least the center 7.6 vertical divisions. ^a
Delta Time (Δt)	At least the center 9.6 horizontal divisions. ^a
Graticule	
Size	
2467	68 mm X 85 mm. ^a
2465A	80 mm X 100 mm. ^a
Markings	8 major divisions vertically and 10 major divisions horizontally, with auxiliary markings. ^a
Trace Rotation Range	Adequate to align trace with the center horizontal graticule line.
Standard Phosphor	P31 ^a
Visual Writing Rate	
2467	≤ 4 divisions/ns.
	<i>NOTE</i>
	<i>Using the standard-accessory color filter, no more than 5 bright spots will be visible at maximum intensity and no bright-spot halo will be visible within the center 7 X 9 divisions. Additional bright spots may be visible after displaying a high-intensity trace. These added spots will extinguish when intensity is set to minimum.</i>
2465A	≥ 20 divisions/ μs .
Photographic Writing Speed (2467)	≥ 10 divisions/ns.
Display Intensity Limitation (2467)	Control settings and trigger rate are monitored to limit the display intensity after a time of no control activity. ^a
Z-AXIS INPUT	
Sensitivity	
Dc to 2 MHz	Positive voltage decreases intensity; +2 V blanks a maximum intensity trace.
2 MHz to 20 MHz	+2 V modulates a normal intensity trace. ^a
Input Resistance	9 k Ω \pm 10%. ^a
Maximum Input Voltage 	± 25 V peak; 25 V p-p ac at 10 kHz or less. ^a

^aPerformance requirement not checked in manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
SIGNAL OUTPUTS	
CALIBRATOR	With A SEC/DIV set to 1 ms.
Output Voltage and Current	0.4 V \pm 1% into a 1-M Ω load, 0.2 V \pm 1.5% into a 50- Ω load, or 8 mA \pm 1.5% into a short circuit. ^a
Repetition Period	Two times the A SEC/DIV setting for SEC/DIV from 100 ns to 100 ms.
Accuracy	\pm 0.1%, during sweep time.
CH 2 SIGNAL OUT	
Output Voltage	20 mV/division \pm 10% into 1 M Ω , 10 mV/division \pm 10% into 50 Ω .
Offset	\pm 20 mV into 1 M Ω , when dc balance has been performed within \pm 5°C of the operating temperature.
A GATE OUT and B GATE OUT	
Output Voltage	2.4 V to 5 V positive-going pulse, starting at 0 V to 400 mV.
Output Drive	Will supply 400 μ A during HI state; will sink 2 mA during LO state. ^a
AC POWER SOURCE	
Source Voltage	
Nominal Ranges	
115 V	90 V to 132 V.
230 V	180 V to 250 V.
Source Frequency	48 Hz to 440 Hz. ^a
Fuse Rating	2 A, 250 V, AGC/3AG, Fast blow; or 1.6 A, 250 V, 5 \times 20 mm Quick-acting. ^a
Maximum Power Consumption (fully optioned instrument)	120 watts (180 VA). ^a
Primary Circuit Dielectric Voltage Withstand Test	1500 V rms, 60 Hz for 10 seconds without breakdown. ^a
Primary Grounding	Type test to 0.1 Ω maximum. Routine test to check grounding continuity between chassis ground and protective earth ground. ^a

^aPerformance requirement not checked in manual.

**Table 1-6
2465A Mechanical Characteristics**

Characteristics	Description
Weight	
With Accessories and Pouch	10.2 kg (22.4 lb).
With Option 05, 06 and 09, or 10	12.0 kg (26.44 lb).
Without Accessories and Pouch	9.3 kg (20.5 lb).
Domestic Shipping Weight	12.8 kg (28.2 lb).
With Option 05, 06 and 09, or 10	17.6 kg (38.8 lb).
Height	
Without Accessories Pouch	
With or without Options 05, 06 and 09, and 10	160 mm (6.29 in).
With Feet and Accessories Pouch	
With or without Options 05, 06 and 09, and 10	202 mm ± 25.4 mm (7.94 in ± 1.0 in).
Width (with handle)	338 mm (13.31 in).
Depth	
With Front Panel Cover	434 mm (17.1 in).
With Handle Extended	508 mm (20.0 in).
Cooling	Forced-air circulation.
Finish	Tek Blue vinyl clad material on aluminum cabinet.
Construction	Aluminum-alloy chassis (sheet metal). Plastic-laminate front panel. Glass-laminate circuit boards.