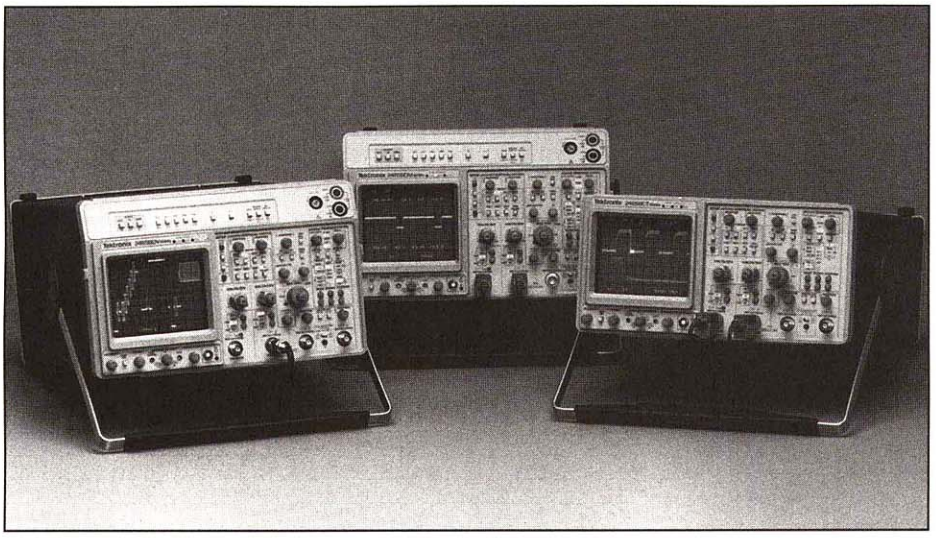
2400B Series Portable Analog Oscilloscopes



2400B Series 150 to 400 MHz Four-Channel Oscilloscopes

Now your top choice in portable analog scopes is more automatic than ever.
The Tek 2400B Series combines new convenience and leading-edge performance, *now up to 400 MHz.* Six scopes bring unprecedented efficiency to your design lab, production line or field service site.

Measure signals on screen in less time—automatically.
You can measure rise time, fall time, frequency, width, voltage and time interval A to B on A sweep at the push of a button. In addition, setup and measurement functions can be initiated by pressing an ID button on the head of Tek's new P6137 passive voltage probe.

The 2400B Series features Auto Setup—a tremendous time-saver. Just attach up to four probes to signal points, press AUTO SETUP, and within seconds you have a stable, automatically triggered display of your probed waveforms. It couldn't be simpler.

Auto Setup includes Tek's proprietary Pulse Mode for viewing narrow pulses in detail. Your scope calculates the duty factor and properly displays either the low-duty-cycle pulse or several cycles of symmetrical waveforms. The scope will display, position and scale up to four waveforms.

NEW NEW NEW

2467B/2465B/2445B

TYPICAL APPLICATIONS

- Design Test and Measurements
- Production Line Testing
- Communications Equipment Design and Service
- Field Servicing

BENEFITS

- Better Repeatability From Built-in Automation
- Faster Results From Automated Measurements
- Less Drudgery From Push-button Selections
- Better Accuracy From Reduced Operator Error

FEATURES

- 400 MHz Bandwidth (2467B, 2465B)
- 875 ps Rise Time (2467B, 2465B)
- Push-button Measurements
- Four Independent Channels 500 ps/div Time Base (2467B, 2465B)
- Auto Setup
- Save and Recall Setups
- Set-Up Sequencing
- Volts and Time Cursors
- Cursors After Delay
- 500 MHz Trigger Bandwidth (2467B, 2465B)
- Selectable Input Impedance (1 MΩ, 50 Ω)
- 20 ps Time-Interval Resolution
- 400 MHz at 5 mV/div
- 350 MHz at 2 mV/div
- Lightweight and Rugged

Instant access to complex setups means even faster measurements.
For closer examination of your signals and for specialized setups—such as delayed sweep displays or displays using the extended measurement options—front-panel control manipulations are still necessary. But now you need to create complex setups only *once.*

Non-volatile memory for 30 setups stores all front-panel information, including trace and readout intensity, cursor locations and control settings for the measurement options. Each setup can be labeled with a descriptive name for natural association and ease of recall.

This is a fast, easy alternative to the process of re-creating a front-panel setup every time you want to change measurements. Your attention can be focused on problem-solving, not control adjustments.

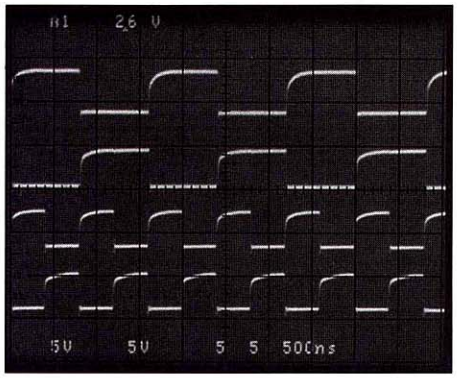
For example, by simply recalling previously saved setups, design engineers can display and make measurements on widely varying waveforms for purposes such as verifying products, demonstrating prototype behavior, generating documentation and characterizing devices, all without having to repeat time-consuming, manual front-panel setups.

Field service personnel can preset frequently used test setups and operate more effectively in much less time.

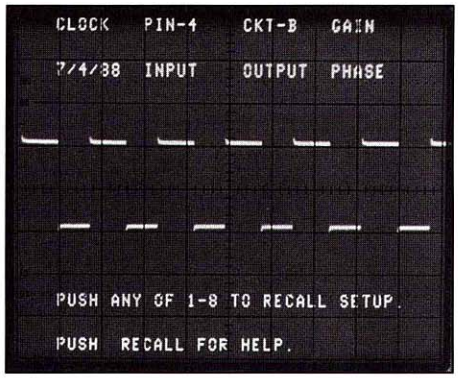
Automate measurement sequences without an external controller.
You can also set up, store and sequence your systematic verification procedures for engineering prototypes, final production test or field service without a computer—and without writing a single line of code. Step through up to 30 stored setups. Just press the STEP button once for each sequence step. Or plug a foot switch into the rear-panel jack for "hands-free" operation.

As a further aid, seven-character alphanumeric labels can be stored with each setup. These can be test titles or even operator prompts for test point connections. Guard your saved setups and sequences with write protection.

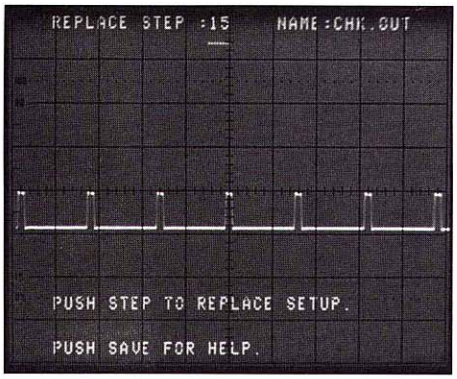
Built-in sequencing is standard throughout the 2400B Series. You can implement semi-automated procedures with a single, standalone portable oscilloscope. This also offers an excellent, price-competitive entry into automated testing. You can move from the 2445B through the 2467B and its options with complete upward mobility.



Four waveforms were triggered, scaled and positioned by simply pressing AUTO. No other adjustments were necessary.



Pressing RECALL and a test number resets the 2445B/2465B controls to a previously stored setup. The first eight names appear on the CRT when you press RECALL.



Sequences are arranged and modified with the front-panel controls. Information about the sequence steps and directions for the operator are written on the scope display for easy reference.

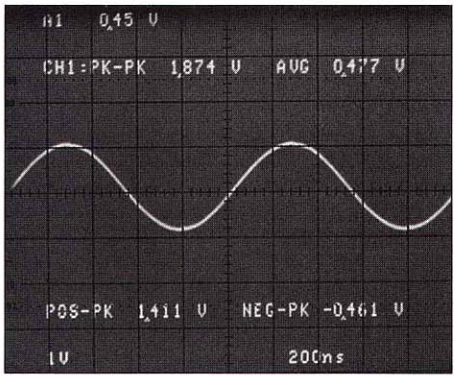
PRODUCT CONFIGURATION GUIDE

Features	Standard Models				Special Edition Models		
	2467B	2465B	2455B	2445B	2465B CT	2465B DM	2465B DV
Bandwidth	400 MHz	400 MHz	250 MHz	150 MHz	400 MHz	400 MHz	400 MHz
GPIB	Option 10	Option 10	Option 10	Option 10	Included	Included	Included
Counter/Timer/Trigger, Word Recognizer	Option 09	Option 09	Option 09	Option 09	Included	Included	Included
DMM	NA	Option 01	Option 01	Option 01	NA	Included	Included
Video Measurement System	Option 05	Option 05	Option 05	Option 05	NA	NA	Included
Counter/Timer/Trigger, No Word Recognizer	Option 06	Option 06	Option 06	Option 06	—	—	—
Two Additional Probes	Included	Option 22	Option 22	Option 22	Included	Included	Included
Rackmount	Option 1R	Option 1R	Option 1R	Option 1R	Option 1R		
Probe Power	Option 11	Option 11	Option 11	—	—	—	—

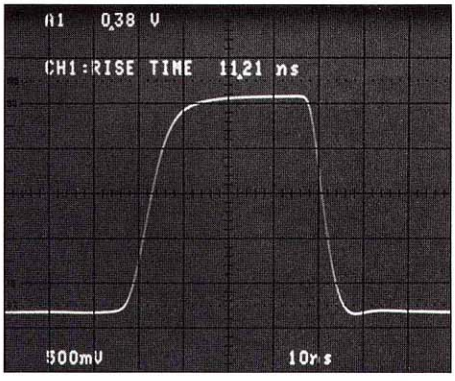
Tek state-of-the-art technology makes possible the 2465B's 400 MHz bandwidth along with new pushbutton measurements, the first in an analog instrument. In addition, new pushbutton probes take the full bandwidth to the probe tip—where you really need it.

Get rise, fall, frequency, width, voltage and time measurements at the push of a button.

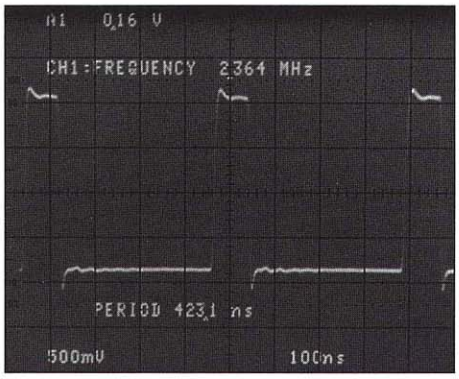
New 2400B Series pushbutton smarts offer capability previously available only with a digital storage oscilloscope or high-performance counter. No need even to press AUTO. Your scope sets itself automatically and scales a signal for display—at the push of a button.



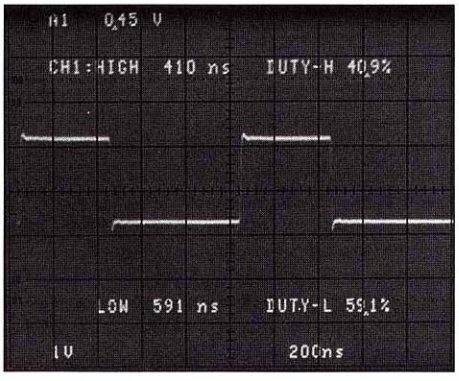
1. Volts Simply select VOLTS to access amplitude information such as Positive and Negative Peak, Average and Peak to Peak. With Tektronix-coded probes, scaling is automatic.



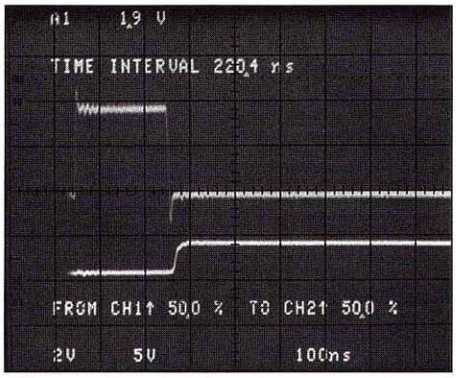
2. Risetime/Falltime Select RISETIME or FALLTIME and your scope presents an automatically triggered and scaled display of your probed waveform along with measurements results—either rise or fall using 10% and 90% points.

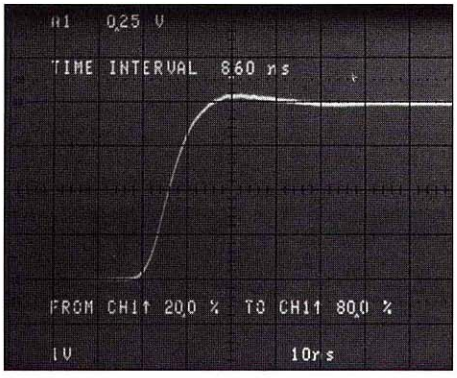


3. Frequency When you need a measurement "snapshot," both frequency and period are available at the touch of a button. For high accuracy measurements, include the Counter/Timer/Trigger option for expanded functions and accuracies to 0.001%.



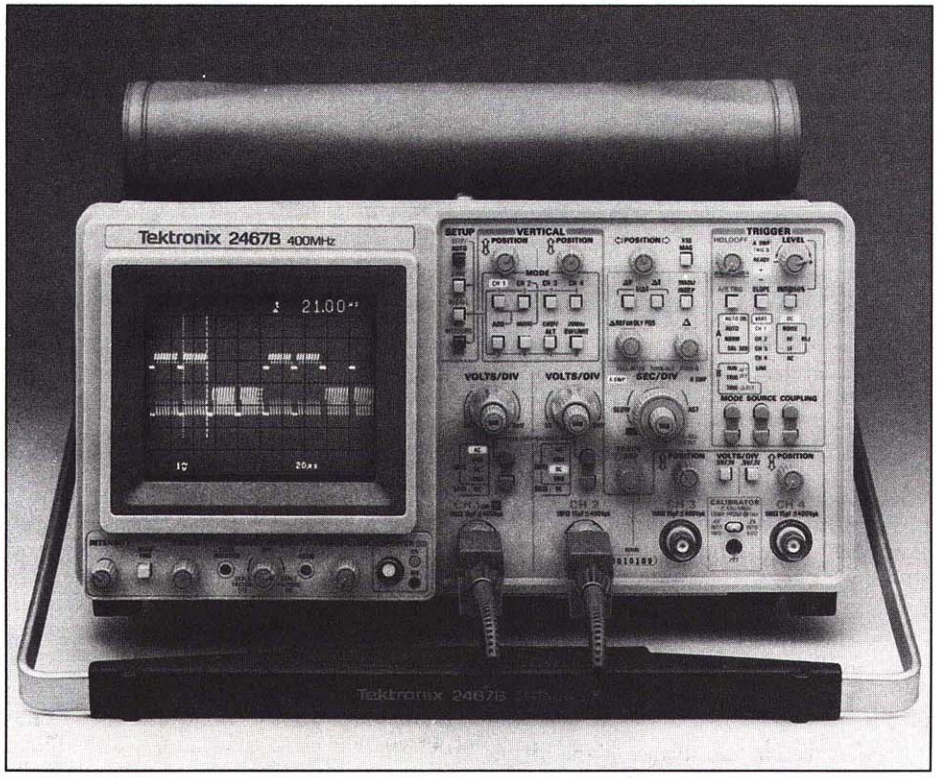
4. Width Both width and duty cycle are measured with a single selection.





5. Time A to B Channel-to-channel TIME is the most versatile of all the new pushbutton measurements. You have complete control of the triggering on channel-to-channel timing measurements. Start and stop events can be set in percent of peak-to-peak or in volts—on either rising or falling edges of CH1 and CH2. Applications include measureing risetime from other than the standard 10% and 90% points, such as 20% and 80%.

True four-channel capability includes two channels optimized for logic signals. You can also make three-channel X-Y comparisons such as multiple transducer measurements.



Visual writing speed combined with the high display update rate of the 2467B provides the quick response and high visibility necessary to see faults in today's complex, high speed systems.

Observe faults you couldn't see before. The 2467B with microchannel-plate (MCP) CRT instantly reveals events other scopes fail to show. At 4 cm/ns, its *visual writing speed* is approximately 100 times faster than that of *any other portable instrument.* This makes it possible to see and identify circuit faults caused by erratic or infrequent events that may occur only once in a million normal cycles. Plus, these faults can be seen in normal room light, without a viewing hood.

Tek's exclusive microchannel-plate CRT. Tek's unique MCP display amplifies the intensity of infrequent signals, yet limits the intensity of signals with high-repetition rates. This results in visual writing speed sufficient to display everything that happens in your circuit, whether it occurs once or repetitively.

The 2467B displays glitches that remain hidden on scopes with conventional CRTs, and that digital storage scopes fail to capture because of low trigger probability. Being able to see unexpected transients, even within highly repetitive events, makes the critical difference in many troubleshooting situations.

NEW 2467B

GPIB IEEE-488

The 2467B Option 10 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

• 4 ns/div Visual Writing Speed

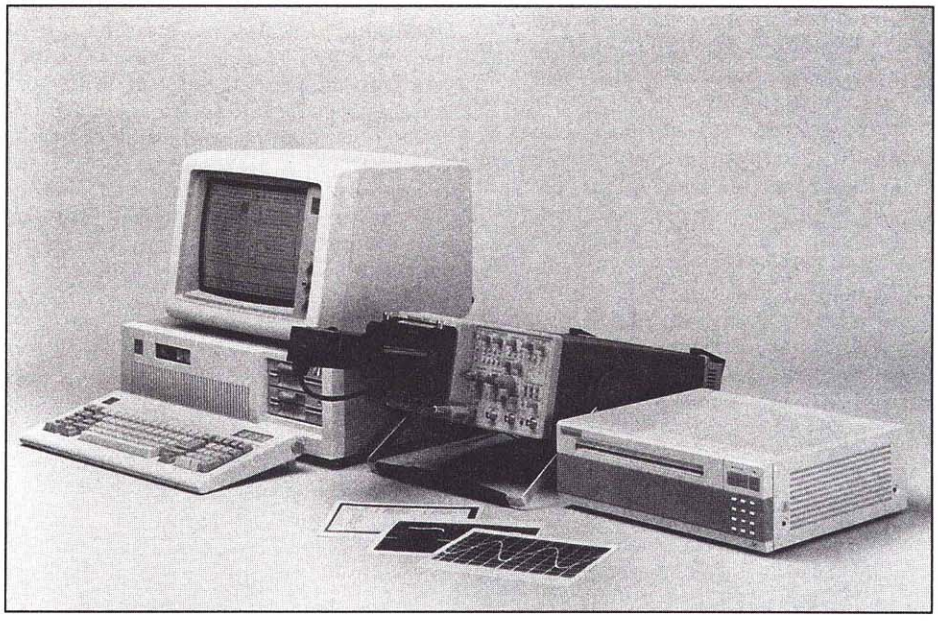
4 ns/div visual writing speed—the advantage is visible!

Writing speed has traditionally been a measure of CRT performance. However, the performance of conventional CRTs is usually specified as *photographic writing speed* and represents the point at which phosphor luminance is adequate to record a waveform using a camera and high-speed film—but still *invisible* to the eye.

On the other hand, specifying *visual writing speed* identifies a scope as being able to emit enough light to be visible to the eye in normal room light without a viewing hood.

The Tek 2467B specifies CRT visual writing speed at 4 cm/ns. Most important, its single-shot and system bandwidths are the same, 400 MHz. For the first time with a portable instrument you can use *all* of its bandwidth in single-shot applications.

The visual writing speed of conventional analog scopes is inadequate to permit full-bandwidth, single-shot use.



The 2467B and Tek DCS01 Digitizing Camera System combine to give you 400 MHz single-shot capability along with up to 10 ps/point digitizing.

Digital design and test engineers, for example, now have an effective and affordable tool for identifying system faults caused by troublesome design bugs such as asynchronous noise, crosstalk, bus contention, marginal timing, metastability or a one-in-a-million anomaly. This helps shorten product design cycles—and deliver more reliable products.

Digitize, store and analyze waveforms on your IBM PC.

The Tektronix DCS01 (Digitizing Camera System) bridges the gap between your analog scope and PC. It easily and cost-effectively adds digitizing and signal processing capability to the 2467B. The scope's microchannel-plate CRT allows the capture of transient and repetitive signals at the full 400 MHz bandwidth with 8-bit resolution (12 bits on repetitive signals).

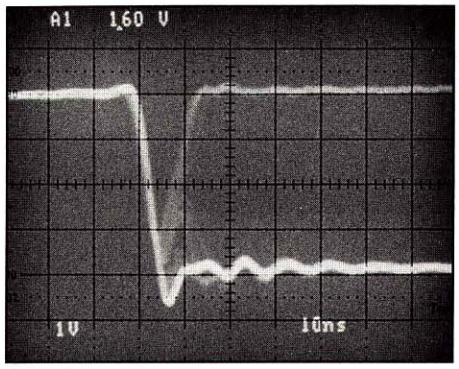
Add Tek Signal Processing and Display (SPD) software for 186 waveform analysis functions. Both DCS and SPD software are modular for solutions satisfying your unique requirements.

For additional information on DCS software see the Digitizer section. For SPD refer to the Test and Measurement Software section.

Find circuit problems in digital systems.

When troubleshooting a digital system, you want to see a fault immediately. When using a logic analyzer for digital troubleshooting, the perfect companion is the Tek 2467B. With the 2467B's high visual writing rate, digital glitches such as runt pulses and metastability are readily viewed—as they happen.

Due to short trigger holdoff and sweep reset times, the display update rate of analog scopes such as the 2467B is much higher than digital storage oscilloscopes. This plus Tek's exclusive MCP-enhanced CRT makes it possible for the 2467B to display intermittent variations *as they happen*, even if masked by thousands of normal traces.



The metastability in this high-repetition rate flip-flop output occurs only once in a million normal cycles, yet it is clearly visible thanks to the 2467B's high visual writing speed.

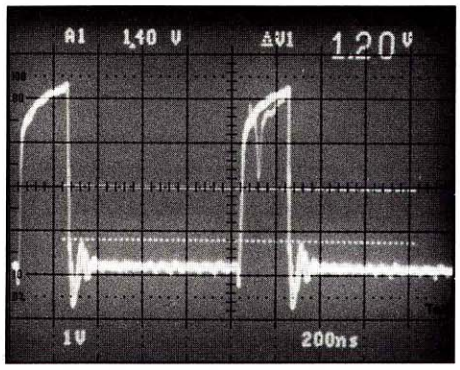
Other instruments may not display these infrequent faults at all or may take several minutes to build up a display that shows an occasional fault.

With 30 ns pretrigger display, you can examine the inputs to a logic device prior to the output transition. Seeing the inputs when a fault occurs can point to the real problem.

To see marginal amplitude signals that might otherwise go undetected, set the trigger level just above the low logic level or just below the high logic level. Trigger-level readout lets you set the trigger point where you want it, without trial and error.

Determine actual noise margins.

With its ability to clearly display transient events in the presence of numerous normal signals, the 2467B shows designers actual noise margins essential for reliable system operation. With the 2467B, no matter how infrequently noise pulses occur, they are clearly displayed. You can see the worst case even if it is asynchronous to the monitored signal.

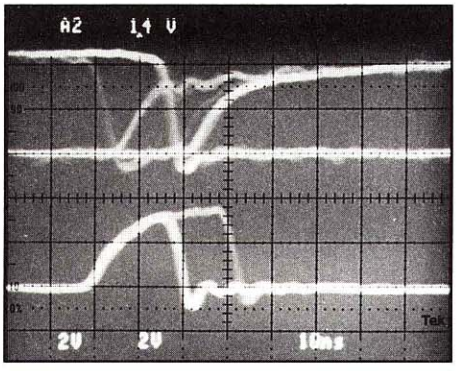


Cursors are set to indicate input threshold limits. The high visual writing speed of the 2467B easily shows this infrequent glitch narrowly missing the upper threshold limit.

Measure worst-case setup and hold times.

Digital systems rely on valid setup and hold times. Noise, timing changes in various system states, and power-supply coupling—all can cause infrequent timing violations.

The 2467B lets you see timing changes immediately, because the short dead time between sweeps gives a high probability of displaying occasional changes in high-repetition rate signals. Other instruments may require long periods to construct a display, if they can show the variations at all.



In this display, the data (upper trace) occasionally moves into coincidence with the rising edge of the clock (lower trace), violating the timing margin. Also note the occasional change in clock pulse width.

2465B Special Packages—Preconfigured Packages That Fit Specific Needs

Your choice of 2400B Series portables also includes three 400 MHz 2465B Special Editions: the 2465BCT, 2465BDM, and 2465BDV.

Substantial Savings

As preconfigured packages, Special Editions offer significant savings over the cost of individual enhancements. You get multi-instrument capabilities while reducing rack space, equipment cost and programming complexity.

Common to the 2465BCT, 2465BDM and 2465BDV is the GPIB interface which makes each a perfect systems choice. All front-panel controls are programmable.

The 2465BCT with CTT-Word Recognizer is ideal for making the precise timing measurements needed with communications, office and computer-related equipment.

The 2465BDM has the CTT-Word Recognizer *and* a digital multimeter that extends its applications as a self-contained, multipurpose instrument in government/military electronics, avionics, and ATE stations.

The 2465BDV has the CTT-Word Recognizer, the digital multimeter, *plus* video waveform display capability for even more extensive applications—including the design, manufacture and service of raster scan devices and high-resolution video equipment.

Options for the 2467B, 2465B, 2455B, and 2445B

Option 01 Digital Multimeter
Option 05 Video Waveform Measurement System
Option 06 Counter/Timer/Trigger (CTT)
Option 09 CTT with Word Recognizer
Option 10 GPIB Interface
Option 1E External Clock
Option 1R Rackmounting
Option 2R Rackmount for Opt. 01

Descriptions for each of the options begin on the following page.

Features	2467B	2465BDV	2465BDM	2465BCT	2465B	2445B
Bandwidth	400 MHz	400 MHz	400 MHz	400 MHz	400 MHz	150 MHz
High Visual Writing Speed	STD	—	—	—	—	—
GPIB	OPT	STD	STD	STD	OPT	OPT
Counter/Timer/Trigger-Word Recognizer	OPT	STD	STD	STD	OPT	OPT
Digital Multimeter	N/A	STD	STD	N/A	OPT	OPT
Video Trigger	OPT	STD	N/A	N/A	OPT	OPT
Counter/Timer/Trigger (w/o Word Recognizer)	OPT	STD	STD	STD	OPT	OPT
Probes	4	4	4	4	2	2
Rackmount	OPT	OPT	OPT	OPT	OPT	OPT
Warranty	Three years on parts and labor, including the CRT					

Digital Multimeter

Option 01

FEATURES

- **4½ 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 μV Resolution on DC Volts**
- **Continuity Beeper**
- **UL Listed, CSA Certified**
- **Temperature Probe −62 to +230°C**
- **Calibration via Front Panel Without Removing Instrument Covers**
- **Convenience Features Include: Set Reference, Hold, Smooth, Minimum/Maximum, dBV, and dBm**

The 2465B/2445B's Digital Multimeter (Option 01) makes it possible to measure dc and ac (RMS) volts and current, dBm, dBV, resistance, and temperature at your workbench with no added space requirements. Carry everything you need into the field for maintenance and repair, all in one rugged, portable package. Plug a DMM-equipped 2465B/2445B into your system (rack-mounting is optional as a modified product) to take advantage of its fully programmable measurements and screen prompts.

Blocks of accumulated measurements can be averaged and smoothed. Minimum and maximum values can also be displayed. Set a reference function if, for example you need to compare deviations from a norm. Audible continuity checking is useful for applications in service, production, and design/development. Troubleshoot circuit board hot spots with the temperature probe, which registers temperature variations with 0.1 °C or °F resolution.

Combining the DMM and CTT options allows direct measurement of system frequency, period, or time interval while monitoring ac or dc volts, current, or temperature. Use just one instrument to characterize voltage-to-frequency converters and temperature drift of crystal oscillators.

Video Waveform Measurement System

Option 05

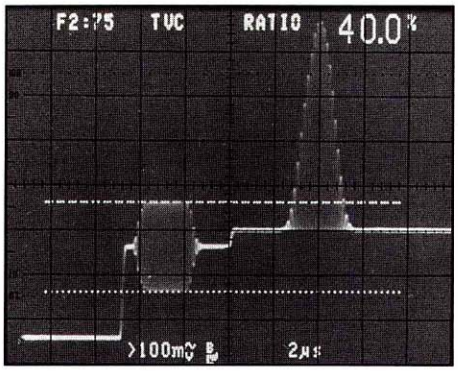
FEATURES

- **Television Waveform Analysis Capabilities**
- **Selectable System-M and Nonsystem-M Protocols**
- **Selectable Triggering on Any Line Within a Field, With Line-Number Readout**
- **Compatible With Composite Video Having 13.1 to 77 kHz Line Rates**
- **TV Blanking-Level Clamp (Back-Porch)**
- **Optimized Vertical Response Comparable to High Performance TV Waveform Monitors**

Video measurement capabilities extend the 2467B/2465B/2445B's power and versatility to meet the challenges in broadcast and cable television, graphics displays, and raster-scan systems. The Video Waveform Measurement System makes quality measurements convenient during every stage of a product's life cycle: design, production, system calibration, quality assurance, maintenance and service.

With CRT readout of the line number and field selected for triggering, an operator knows precisely what the display represents. Any line can be selected from Field 1, Field 2, or Field 1 alternating with Field 2. The fourth video trigger selection is Lines, which superimposes all the lines in both fields. Systems with up to 1280 lines can be accommodated.

The back-porch clamp locks the video black level to a fixed point, so the display is stable and clean, even when the composite video contains low-frequency hum or when the average picture level changes with ac coupling. Controls are provided for compatibility with a wide variety of system protocols.

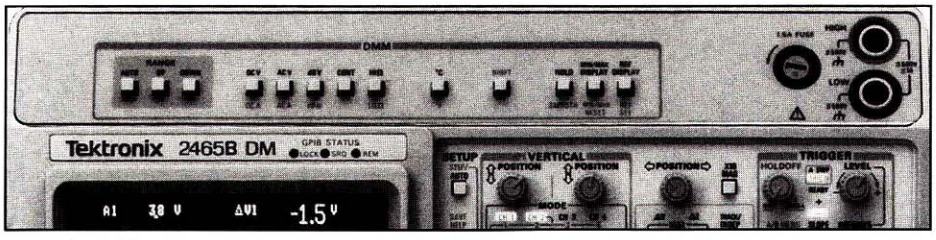


This sample waveform and CRT readout show a 2445B's high-fidelity display and measurement of the color subcarrier amplitude on Line 75, Field 2 of an NTSC signal with the television blanking-level clamp (TVC) engaged. The cursor readout of 40% is interpreted as 40 IRE units with appropriate adjustment of the vertical gain.

Counter/Timer/ Trigger (CTT)

Option 06

Option 06 provides the Counter/Timer/ Trigger without the word recognizer probe. Specifications and included accessories are the same as those for Option 09. The Word Recognizer cannot be added to Option 06 after delivery of the oscilloscope (field retrofit kits are not available.)



Digital Multimeter

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

Option 09

FEATURES

- **Crystal-Controlled Time Base**
- **0.001% Accuracy**
- **Totalize Up to 9,999,999 Events**
- **Delay-by-Events Triggering up to 4,194,303 Events**
- **Boolean Logic Triggering on both Digital and Analog Signals**
- **17-Bit Word-Recognizer Probe**

Option 09 delivers the crystal-controlled timing accuracy and the extra triggering power you need for digital systems. Frequency and period are measured directly from any vertical channel. Time intervals can also be measured by the counter, with ease. The delayed sweep (B sweep) trigger has been expanded to select independent signal sources, slopes, and levels for the beginning and ending of a time interval. This expansion allows precise time measurements between two events, each with different characteristics (using the same or separate channels). This new capability provides for measurement of propagation delay (through a level shifter or an amplifier), as well as rise time, fall time, or processor power-up delay.

When saved in the scope's setup memory, recalled measurements are completely automatic and require no operator intervention.

With the Word Recognizer, any pattern of up to 17 bits can act as an input to the counter or as a trigger for the A or B sweep.

Pinpointing a "needle-in-a-haystack" signal in a digital system becomes feasible with the Word Recognizer and Delay-by-Events functions as these advanced triggering capabilities eliminate extraneous signals.

To characterize system problems, the CTT can measure the frequency or period of recognized words. The CTT can also delay the scope trigger by a selected number of words.

With the Totalize function, you can record the passing of unusual events or verify a burst of events on any vertical input or recognized word.

The Boolean-logic trigger allows triggering on either the logical AND or OR of any two input channels. Logical-OR triggering lets you trigger on either the positive or negative slope of any input signal. This function, known as "bislope triggering," allows you to catch events reliably— even if you don't know whether the transition will be high-to-low or low-to-high.

The Counter/Timer/Trigger is also available without the Word Recognizer probe as Option 06.

Rackmounting

Option 1R

The 2467B/2465B/2445B instruments are available in standard 19-inch rackmount configuration, complete with slide-out chassis tracks.

GPIB Interface

Option 10

GPIB IEEE-488 Bus Interface complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

FEATURES

- **Remote Control of Front Panel**
- **Functions Selectable at Front Panel: Device Address, Talk/Listen Mode, Message Terminator**
- **Front-Panel Status Indicators: REM (Remote), SRQ (Service Request), LOCK (Local Lockout)**
- **Compatible With All Other 2467B/2465B/2445B Options**
- **User-Generated SRQ: To Signal Controller During Program Control**
- **RQS Control: Optional Enable or Disable of SRQ Reporting**

Network the 2467B/2465B/2445B with your other equipment on the GPIB. Option 10 adds the ability to communicate over the GPIB. Contents of setup memory can be transferred between 2467B/2465B/2445B units without an external controller. Or use a host controller to assist the oscilloscope operator in performing a series of checks and measurements. Front-panel settings can be remotely set or changed, and the results of cursor, DMM, and CTT measurements communicated back over the bus to the controller, and displayed on the scope's CRT.

The 2467B/2465B/2445B GPIB-message structure conforms to Tektronix *Standard Codes and Formats*, ensuring that all GPIB messages are "human readable" and consistent in format. Selectable message termination characters allow scope use with most types of controllers. The new 2445B and 2465B are compatible with programs for their predecessors, the 2445A and 2465A.

Tektronix software development packages provide an environment for quickly and easily generating automated and semi-automated test procedures. Not only are they easy for nonprogrammers to use, they substantially reduce the amount of time required to create a test-program using previous programming methods and languages.

TEK EZ-TEST and EZ-TEK 2400 are automatic test program generators designed for use with the Tek PEP 301 controller. EZ-TEK 2400 PC runs on the IBM PC, XT, and AT. The TEK EZ-TEST generator programs the PEP 301 or other MS DOS systems to drive a wide variety of GPIB-compatible equipment. EZ-TEK 2400 is designed for systems that need only the capabilities found in 2467B/2465B/2445B oscilloscopes and their options. None of these generators require previous GPIB programming experience because they use simple, multilevel menus to develop sophisticated test programs.

The Tek GPIB User's Resource Utility (GURU II) is a utility package for IBM PCs. It includes a GPIB interface board for the PC, GPIB cable, software and instruction manual.

For more information on GURU II, see the Test and Measurement Software section.

External Clock

Option 1E

The External Frequency Reference option (Option 1E) offers frequency measurements with eight-digit resolution. Accuracy is equal to the external reference or one count in the Least Significant Digit of the eight-digit readout, whichever is greater.

Option 1E automatically accepts any one of the following frequencies as the external reference:

1.000000 MHz
3.579545 MHz (color burst frequency for video)
4.4331875 MHz
5.000000 MHz
10.000000 MHz

CHARACTERISTICS

Characteristics are common to the 2467B, 2465B, 2455B, 2445B and 2465B Special Editions except where indicated.

VERTICAL SYSTEM

Display Modes—CH 1, CH 2, CH 3, CH 4, Add (CH 1+CH 2); Invert (CH 2 only); Alternating and Chopped display switching for all channels, and 20 MHz bandwidth limiting.

CHANNEL 1 AND CHANNEL 2

Deflection Factor—2 mV/div to 5 V/div in a 1-2-5 sequence of 11 steps.

Deflection Factor Basic Accuracy—±2% (measured at a Volts/div setting with a four- or five-division signal, centered on screen)

ΔV Accuracy—±(1.25% of reading+0.03 div+signal aberrations). Basic accuracies apply for temperatures from +15 to +35°C. Add ±2% of reading for temperatures from −15 to +15°C and from +35 to +55°C. Add 1% of reading when 50 Ω input coupling is used. Add 1% of Channel 2 reading when inverted (measured with cursors anywhere on the graticule).

Variable Range—Continuously variable between Volts/div switch settings. Extends deflection factor to at least 12.5 V/div.

Frequency Response (−3 dB Bandwidth)

Instrument	15 to 35°C	−15 to +15°C 35 to 55°C
2467B/2465B	400 MHz*1 350 MHz*2	300 MHz —
2455B	250 MHz	200 MHz
2445B	150 MHz	150 MHz

All responses measured with standard accessory probe or internal 50 Ω termination.

1 ≥5 mV/div
2 2 mV/div

AC Coupled Lower −3 dB Point—10 Hz or less. 1 Hz or less.

Step Response—2467B/2465B: ≤1 ns. (≥5 mV/div:0.875 ns). 2455B: ≤1.4 ns. 2445B: ≤2.33 ns. (Rise times calculated from $t_r = 0.35/BW$.)

Common-Mode Rejection Ratio (Add Mode With CH 2 Inverted)—≥20:1 at 50 MHz for common-mode signals of 8 div or less, with Var Volts/div control adjusted for best CMRR at 50 kHz at any Volts/div setting.

Channel Isolation—≥100:1 attenuation of deselected channel at 100 MHz; ≥50:1 at nominal bandwidth. (Measured with an 8-div input signal and equal Volts/div switch settings on both channels from 2 to 500 mV/div.)

Displayed CH 2 Signal Delay With Respect to CH 1 Signal—Adjustable through a range of at least ±500 ps.

Input Z (1 MΩ)—1 MΩ ±0.5% shunted by 15 pF, ±2 pF. Maximum Input Voltage: 400 V (dc+peak ac); 800 V p-p ac at 10 kHz or less with coupling set to AC, DC, GND.

Input Z (50 Ω)—50 Ω ±1%. VSWR (2467B/2465B): ≤1.3:1 from dc to 300 MHz; ≤1.5:1 from 300 to 350 MHz. VSWR (2455B/2445B): ≤1.3:1 from dc to nominal bandwidth. Maximum Input Voltage: 5 VRMS, averaged for 1 s; ±50 V peak.

CHANNEL 3 AND CHANNEL 4

Deflection Factor—100 and 500 mV/div ±10%.

Frequency Response—Same as Channel 1 and Channel 2. (Responses measured only with standard probe.)

Step Response—Same as Channel 1 and Channel 2.

Signal Delay Between CH 1 and Either CH 3 or CH 4—±1.0 ns. (Measured at 50% points.)

Input Z—1 MΩ±1%, shunted by 15 pF±3 pF.

Maximum Input Voltage—400 V (dc+peak ac); 800 V p-p ac at 10 kHz or less.

Channel Isolation—≥50:1 attenuation of the deselected channel at 100 MHz. (Measured with an 8-div input signal.)

ALL CHANNELS

Bandwidth Limiter—Reduces upper 3 dB bandpass to a limit of 13 to 24 MHz.

Vertical Signal Delay—≥30 ns of sweep displayed before triggering event displayed with Sec/div settings ≥10 ns/div. ≥10 ns of sweep displayed before triggering event displayed with Sec/div set to 5 ns.

CHOP Mode Switching Rate—2.5 MHz±0.2% to sec/div settings of 20 to 2 μs/div; 1 MHz±0.2% all other sweep speeds. (The complete display cycle rate equals the CHOP mode switching rate divided by the number of channels displayed. The CHOP mode switching rate is modulated slightly to minimize waveform breaks with repetitive signals.)

HORIZONTAL SYSTEM

Display Modes—A (main sweep), A INTENsified, ALTernate A Intensified with B (delayed sweep), and B. In X-Y mode, Channel 1 provides X-axis (horizontal) deflection.

A Sweep Time Base Range—2467B/2465B: 500 ms/div to 5 ns/div in a 1-2-5 sequence of 25 steps. (X10 magnification extends fastest sweep rate to 500 ps/div.) 2455B and 2445B: 500 ms/div to 10 ns/div in a 1-2-5 sequence of 24 steps. (X10 magnification extends fastest sweep rate to 1 ns/div.)

B Sweep Time Base Range—2467B/2465B: 50 ms/div to 5 ns/div in a 1-2-5 sequence of 22 steps. (X10 magnification extends fastest sweep rate to 500 ps/div) 2455B/2445B: 50 ms/div to 10 ns/div in a 1-2-5 sequence of 21 steps. (X10 magnification extends fastest sweep rate to 1 ns/div.)

Variable Timing Control—Continuously variable and calibrated between sec/div settings. Extends slowest A sweep speed to 1.5 s/div.

ΔT Readout Resolution—2467B/2465B: Either 10 ps or 0.025% of full scale, whichever is greater. 2455B/2445B: Either 20 ps or 0.025% of full scale, whichever is greater

Sweep Delay Range—0 to 9.95 times the A sec/div setting, for settings from 500 ms/div to 10 ns/div (2467B/2465B) or from 500 ms/div to 20 ns/div (2455B/2445B). With A sec/div settings of 50 μs and faster, the A Sweep triggering event is observable on the B Sweep with zero delay setting.

Delay Jitter—2467B: Within 0.01% (one part or less in 10,000) of maximum available delay, plus 100 ps. 2465B/2455B/2445B: Within 0.004% (one part or less in 25,000) of maximum available delay, plus 50 ps.

ACCURACY SPECIFICATIONS FOR AUTOMATIC MEASUREMENTS*12

Period—0.5%+500 ps.

Volts—(5% +5 mV +1 LSD) to 1 MHz

Rise Time, Fall Time—5% +3 ns (for transition times greater than 10 ns). These rise and fall times are based on measurements at 20% and 80% extrapolated to 10% and 90%. Pulse overshoot, undershoot <5% of peak-to-peak signal.

Time A-B (from % to %)—0.5% +3 ns (add 0.5 ns if measuring from Ch 1 to Ch 2) +5% of start event and 5% of stop event transition times.

Time A-B (between two voltages)—0.5% +3 ns (add 0.5 ns if measuring from Ch 1 to Ch 2) +5% of start event and 5% of stop event transition times. Voltages must not be within 10% of either peak.

Pulse Width—0.5% +1 ns (transition times <10% of measured interval).

1 Based on noise less than 0.1% of Peak-to-Peak input signal.
2 15 to 35°C.

TRIGGERING

Trigger Sensitivity From CH 1 or CH 2 Source—DC Coupled: 0.35 div from dc to 50 MHz. Noise Reject Coupled: ≤1.2 div. HF Reject Coupled: 0.5 div from dc to 30 kHz from dc to 50 MHz. LF Reject Coupled: 0.5 div from 80 kHz to 50 MHz. AC Coupled: 0.35 div from 60 Hz.

Above 50 MHz: Triggering signal requirement increases to 1.5 div at 500 MHz (for 2467B, 2465B, and 2455B) and at 250 MHz (for 2445B) with dc, LF Reject, and ac coupling. For Noise-Reject coupling above 50 MHz, triggering signal requirement increases to 3 div @300 MHz and to 4.5 div at 500 MHz (for 2467B, 2465B, and 2455B) and at 250 MHz (for 2445B).

Trigger Sensitivity From ADD Source—2467B/2465B/2455B: Add 0.5 div to CH 1 or CH 2 source requirements at 500 MHz.

Trigger Sensitivity From CH 3 or CH 4 Source—2467B/2465B/2455B: One-half the CH 1 or CH 2 source requirements.

Maximum P-P Signal Rejected by Noise-Reject Coupling Within Vertical Bandwidth—CH 1 or CH 2 Source: ≥0.4 div (with Volts/div settings of 10 mV/div and higher. Maximum noise amplitude rejected is reduced at 2 and 5 mV/div settings). CH 3 or CH 4 Source: ≥0.2 div.

Level Control Range—CH 1 or CH 2: ±18 ×Volts/div setting; CH 3 or CH 4: ±9 ×Volts/div setting.

Level Readout Basic Accuracy—CH 1 or CH 2 Source: ±[3% of Level setting+3% of p-p signal+0.2 div+0.5 mV+(0.5 mV×probe attenuation factor)]. CH 3 or CH 4 Source: ±[3% of setting+4% of p-p signal+0.1 div+(0.5 mV ×probe attenuation factor)]. Basic accuracies apply from +15 to +35°C and are measured with triggering signals having transition times greater than 20 ns and dc trigger coupling. Add 1.5 mV×probe attenuation factor for temperatures from −15 to +15°C and from +35 to +55°C. Add ±1% of setting from 50 Ω input coupling. Add ±1% of setting with CH 2 Inverted. Add ±0.6 div for CH 1 or CH 2 Source with Noise Reject trigger coupling. Add ±0.3 div for CH 3 or CH 4 Source with Noise Reject trigger coupling.

Maximum Triggering Signal Period

A Sec/div Setting	AUTO LVL Mode	AUTO Mode
<10 ms	≥20 ms	≥80 ms
10 ms to 50 ms	≥4 times A sec/div	≥16 times A sec/div
>50 ms	≥200 ms	≥800 ms

Timing Accuracy

	For 100 ms/div and Faster Settings	
Parameter	**15 to 35°C**	**−15 to +15°C 35 to 55°C**
Unmagnified		
A Sweep*1	±(0.7% of time interval +0.6% of full scale)	±(1.2% of time interval +0.6% of full scale)
ΔT Using Cursors*2	±(0.5% of time interval +0.3% of full scale)	±(0.7% of time interval +0.3% of full scale)
ΔT Using Sweep Delay*3	±(0.3% of time interval +0.1% of full scale)+200 ps	±(0.5% of time interval +0.1% of full scale)
Delay*4	±(0.3% of delay setting +0.6% of full scale) +(0 to −25 ns)	±(0.5% of delay setting +0.6% of full scale) +(0 to −25 ns)
Magnified		
A Sweep*5	±(1.2% of time interval +0.6% of full scale)	±(1.7% of time interval +0.6% of full scale)
ΔT Using Cursors*5	±(1.0% of time interval +0.3% of full scale)	±(1.2% of time interval +0.3% of full scale)

For the A sec/div settings of 200 ms and 500 ms, add ±0.5% of time interval or delay setting to preceding specifications.

*1 *Intervals are measured on center horizontal graticule line, and 0.6% of full scale is 0.06 division.*

*2 *Intervals are measured anywhere on the graticule.*

*3 *Intervals are measured with both delays at 1% or more of full scale from minimum delay (no "?" displayed in readout).*

*4 *Delay is from A Sweep trigger point to start of B Sweep.*

*5 *Exclude the first 0.5 division after sweep starts (first 0.5% of the full 100 division sweep).*

B Sweep Timing Accuracy—Add ±0.3% of time interval to the A Sweep Timing accuracy specifications for Sweep and for ΔT Using Cursors.

Variable Timing Accuracy—Add 2% of time interval to Timing Accuracy specifications for sweep when VAR control is out of detent.

X-Y OPERATION

X-Axis Deflection Factor Range, Variable Range, and Accuracy—Same as Channel 1.

X-Axis Bandwidth—DC to 3 MHz.

Input Z—Same as Channel 1.

Phase Difference Between X and Y (With Bandwidth Limiting Off)—≤1° from dc to 1 MHz. ≤3° from 1 to 2 MHz.

Z-AXIS INPUT

Sensitivity—DC to 2 MHz: Positive voltage decreases intensity; +2 V blanks a maximum intensity trace. 2 to 20 MHz: +2 V modulates a normal intensity trace.

Input Resistance—9 kΩ ±10%.

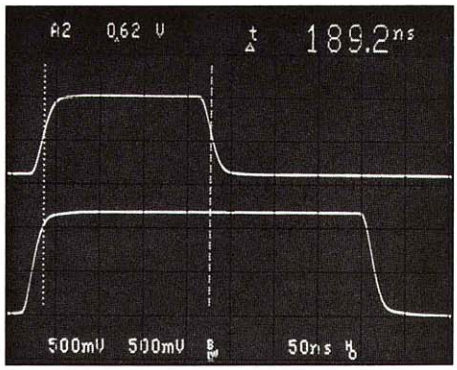
Maximum Input Voltage—±25 V peak; 25 V p-p ac at 10 kHz or less.

SIGNAL OUTPUTS

CH 2 Signal Out—Voltage: 20 mV/div ±10% into 1 MΩ. 10 mV/div±10% into 50 Ω. Offset: ±20 mV into 1 MΩ after dc balancing within ±5°C of the operating temperature.

A Gate Out and B Gate Out—Voltage: 2.4 V to 5 V positive-going pulse, starting at 0 V to 400 mV. Drive: Supplies 400 μA during high state; sinks 2 mA during low state.

CRT READOUT AND WAVEFORM INFORMATION



Your eyes never have to leave the screen to obtain front-panel settings and measurement results. In the CRT example above, the top area of the display provides trigger source, trigger voltage level, and Δtime results. The lower area displays the selected volts/div and seconds/div scale factors and that bandwidth limit and holdoff are activated.

CRT AND DISPLAY FEATURES

Standard CRT—2467B: 68×85 mm. 2465B/2455B/2445B: 80×100 mm (8×10 cm). Markings: Eight major div vertically and 10 major div horizontally, with auxiliary markings.

Standard Phosphor—GH (P31).

Visual Writing Speed—(2467B) With 20 lux=. Illumination Normal to CRT Faceplate (typical room light): ≥4 cm/ns (at maximum INTENSITY control setting).

Photographic Writing Speed—(2467B) ≥10 div/ns with C-30 Series camera and ISO 3000 film, without prefogging. (A single-shot trace of instrument rise time at 500 ps/div is recorded with high contrast at f/1.9.)

Display Intensity Limitation—(2467B) Display intensity is automatically reduced and eventually extinguished after periods of no front panel control activity. Operating any switch or the Intensity control restores the selected intensity setting.

POWER REQUIREMENTS

Line Voltage Ranges—115 V: 90 to 132 V ac; 230 V: 180 to 250 V ac.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—120 W (180 V ac) for fully-optioned instrument.

Fuse Rating—Either 2 A, 250 V, AGC/3AG, fast-blow or 1.6 A, 250 V, 5×20 mm, quick-acting (Each fuse type requires a different cap.)

Primary Circuit Dielectric Voltage Withstand Test—1500 V rms, 60 Hz, for 10 s without breakdown.

Primary Grounding—Type test to 0.1 Ω maximum. (Routine test to check grounding continuity between chassis ground and protective earth ground.)

ENVIRONMENTAL AND SAFETY

Environmental requirements qualify the electrical and mechanical specifications. When not rack mounted, the instrument meets the environmental requirements of MIL-T-28800C for Type III, Class 3, Style C equipment (humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, and 3.9.2.4).

Ambient Temperature—Operating: −15° to +55°C. Nonoperating: −62° to +85°C.

Altitude—Operating: To 4600 m (15,000 ft). Maximum operating temperature decreases 1°C for each 1,000 ft above 1500 m (5,000 ft). Nonoperating: To 15,000 m (50,000 ft).

Vibration—Operating: 15 minutes along each of three axes at a total displacement of 0.025 inch p-p (4 g's at 55 Hz), with frequency varied from 10 to 55 Hz in one-minute sweeps. Held 10 minutes at each major resonance, or if none existed, held 10 minutes at 55 Hz (75 minutes total test time).

Packaged Transportation Vibration—Meets the limits of the National Safe Transit Association Test Procedure 1A-B-1; excursion of 1 inch p-p at 4.63 Hz (1.1 g) for 30 minutes per Tektronix Standard 062-2858-00.

Humidity—Operating and Nonoperating: Stored at 95% relative humidity for 5 cycles (120 hours) from +30° to +60°C, with operational performance checks at +30° and +55°C.

Shock—Operating and Nonoperating: 50 g's, half-sine, 11-ms duration, three shocks on each face; total of 18 shocks.

Electromagnetic Compatibility—Meets requirements of the following standards: MIL-T-28800C; MIL-STD-461B Part 4 (CE-03 and CS-02), Part 5 (CS-06 and RS-02), and Part 7 (CS-01, RE-02, and RS-03), limited to 1 GHz; VDE 0871 Category B; FCC Rules and Regulations Part 15, Subpart J, Class A; and Tektronix Standard 062-2866-00.

Electrostatic Discharge Susceptibility—Instrument does not change control states with discharges of less than 10 kV. Meets requirements of Tektronix Standard 062-2862-00.

Radiation—Meets requirements of Tektronix Standard 062-1860-00.

Safety—UL listed (UL 1244) and CSA certified (CSA 556B).

Drip Proof—With Cover On: Meets MIL-T-28800C para 4.5.5.5.3.

Transit Drop—Not in Shipping Package: 8-inch drop on each corner and each face (MIL-T-28800C, para 4.5.5.4.2).

Packaged Transportation Drop—Meets the limits of the National Safe Transit Association Test Procedure 1A-B-2; 10 drops of 36 inches per Tektronix Standard 062-2858-00.

Bench Handling—With and Without Cabinet Installed: MIL-STD-810C, Method 516.2, Procedure V (MIL-T-28800C, para 4.5.5.4.3).

Ordering Information—See page 170.

PHYSICAL CHARACTERISTICS

	2467B		2465B/2445B		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width w/handle	338	13.3	338	13.3	483	19.0
Height w/feet, pouch	190	7.5	190	7.5	178	7.0
w/o pouch	160	6.3	160	6.3		
Depth w/front cover	472	18.6	434	17.1	419	16.5
handle extended	533	21.0	508	20.0		
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net w/accessories and pouch	10.9	24.0	10.2	22.5	4.0*1	8.8*1
w/o accessories and pouch	9.3	20.5	9.3	20.5		
Shipping	14.6	32.1	12.8	28.2	6.3*1	13.8*1

*1 *Weight of conversion kit only. Rear support kit weight is an additional 6.3 kg (13.8 lb).*

CHARACTERISTICS

DIGITAL MULTIMETER (OPTION 01)

This option is unavailable for the 2467B. The set of characteristics is the same as specified for all other standard 2445B/2465B oscilloscopes and includes the following additions:

All accuracy specifications are stated with an operating temperature range of +18° 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—1 part in 20,000 of FS, (except 0.1 V on 500 V range).
Accuracy—±(0.03% of reading +0.01% of full scale). For 500 V range ±(0.03% of full scale).
Input Resistance—1 GΩ or 10 MΩ on the 200 mV and 2 V ranges, 10 MΩ ±1% on the higher ranges. (Resistance can be changed to 10 MΩ on all ranges.)
Normal-Mode Rejection Ratio—≥ 60 dB at 50 and 60 Hz.
Common-Mode Rejection Ratio—>100 dB at dc; >80 dB at 50 and 60 Hz with 1 kΩ imbalance.
Maximum Input Voltage—500 V RMS; 700 V peak between inputs and ground.
Response Time—<2 s in Auto, <1 s in Manual.

AC RMS VOLTAGE

Ranges—200 mV, 2 V, 20 V, 200 V, 500 V.
Resolution—10 μV (4½ digits).
Accuracy—±(% of reading + % of full scale).

Input Frequency	200 mV to 200 V	500 V
20 to 40 Hz	±(0.7% +0.1%)	±(0.7% +0.2%)
40 Hz to 10 kHz	±(0.3% +0.1%)	±(0.3% +0.2%)
10 to 20 kHz	±(0.7% ±0.1%)	±(0.7% +0.2%)
20 to 100 kHz	±(5%+0.1%)	±(5%+0.2%)

Crest Factor—≤4 at full scale.
Common-Mode Rejection Ratio—≥60 dB at 50 and 60 Hz with 1 kΩ imbalance.
Response Time—<3 s in Auto, <2 s in Manual.
Input Impedance—1 MΩ in parallel with <100 pF.
Maximum Input Voltage—500 V RMS; 700 V peak between inputs and ground, not to exceed 10^7 V-Hz product.
dBV, dBm—Calculated reading of ac voltage measurements. dBV equals 20 Log (V_{UNK}/1 V). dBm is referenced 1 mW into 600 Ω.

HI Ω RESISTANCE

Ranges—2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.
Accuracy—±(0.1% of reading +0.01% of full scale) for 2 kΩ to 2 MΩ. ±(0.4% of reading) for 20 MΩ. Add 2% of reading for each 10% Relative Humidity above 70% when in 2 and 20 MΩ ranges.
Maximum Input Voltage—500 V RMS; 700 V peak.
Full-Scale Voltage—2 V.
Open-Circuit Voltage—<6V
Resolution—0.1 Ω (4½ digits).
Response Time—<2 s in Auto, <1 s in Manual, <5 s in 20 MΩ range.

LO Ω RESISTANCE

Ranges—200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ.
Accuracy—±(0.1% of reading +0.01% of full scale) for 200 Ω range. Subtract (0.09% of full scale) for 2 to 200 kΩ ranges. Add (0.15% of reading) and subtract (0.09% of full scale) for 2 MΩ range. Add 2% of reading for each 10% Relative Humidity above 70% when in 200 kΩ and 2 MΩ 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.
Continuity—An audible tone indicates <10 Ω. Reponse time is ≈0.1 s.

DC CURRENT

Ranges—100 μA, 1 mA, 10 mA, 100 mA, 1 A.
Accuracy—±(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.

AC (RMS) CURRENT

Ranges—100 μA, 1 mA, 10 mA, 100 mA, 1 A.
Accuracy—±(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.

TEMPERATURE

Range—−62° to +230°C.
Accuracy—±(2% of reading +1.5°C).
Resolution—0.1°.
Readout—Selectable in either °C or °F.

OTHER CHARACTERISTICS

Reading Rate—Three readings/s nominal except 1.5 readings/s on 20 MΩ range.
Temperature Coefficient—≤0.1 ×the accuracy specification/°C from −15 to +18°C and from +28 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.*

Ordering Information—See page 170.

CHARACTERISTICS

VIDEO WAVEFORM MEASUREMENT SYSTEM (OPTION 05)

The set of characteristics is the same as specified for standard 2467B/2445B/2465B oscilloscopes and includes the following additions:

VERTICAL SYSTEM (CHANNEL 1 AND CHANNEL 2)

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

Range	With Full BW
50 kHz to 5 MHz*1	±1%
>5 to 10 MHz	+1%, −2%
>10 to 30 MHz	+2%, −3%
>30 MHz	*1

*1 *With BW Limit operating, frequency response is +1%, −4% from 50 KHz to 50 MHz.*

Square wave Flatness—1% p-p for both 60 Hz and 15 kHz square waves, from a 50 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 and 10 mV/div settings. Exclude first 50 ns following step transition. For signals with rise times ≤10 ns, add 2% p-p between 155 and 165 ns after step transition.
Television Blanking-Level Clamp (Back-Porch) 60 Hz Rejection (CH 2 Only)—≥18 dB at 60 Hz; with calibrated Volt/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 or 60 Hz field rate, interlaced or noninterlaced scan.
Trigger Modes—LINES, FLD 1, FLD 2, and ALT (FLD 1-FLD 2).
Input Signal Amplitude for Stable Triggering—CH 1 and CH 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).

CH 3 and CH 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.*

CHARACTERISTICS

CTT (OPTION 06) CTT/WR (OPTION 09)

The set of characteristics is the same as specified for standard 2445B/2465B 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
CH 1, CH 2	1.5 div	DC (0.5 Hz for Frequency and Period(to 50 MHz
CH 3, CH 4	0.75 div	
CH 1, CH 2	4.0 div	50 MHz to ≥150 MHz
CH 3, CH 4	2.0 div	

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

FREQUENCY

Range—Autoranging over input frequency from 0.5 Hz to 150 MHz.

Resolution— $\pm \left[\text{LSD} + 1.4\ F^2 \left(\frac{\text{TJE}}{\text{N}} \right) \right]$

Display—7 digits, updates twice per second or every two periods, whichever is slower.

Accuracy—Resolution ±0.001% of reading over entire temperature range of −15 to +55 °C.

PERIOD

Range—Autoranging over an input period from 6.666667 ns to 2 s.

Resolution— $\pm \left[\text{LSD} + \left(1.4 \times \frac{\text{TJE}}{\text{N}} \right) \right]$

Display—7 digits (Updates twice per second or every two periods, whichever is slower.)

Accuracy—Resolution ±0.001% of reading over entire temperature range of −15 to +55 °C.

ACCURACY AND RESOLUTION DEFINITIONS

F = Input Frequency in Hz

LSD = Least Significant Digit (0.1 ppm of full scale)

TJE = Trigger Jitter Error

N = Number of cycles of measured frequency during measurement interval (0.5 s or 1 period of the input signal, whichever is greater)

TJE (Trigger Jitter Error) =

$$\frac{\sqrt{(\text{en1})^2 + (\text{en2})^2}}{\text{Input Slew Rate}}$$

Where: en1 = RMS noise of vertical system in divisions on screen

en2 = RMS noise voltage of input signal in divisions

Volts/div	en1 Trigger Coupling DC and Noise Rej	en1 Trigger Coupling HF Reject
	2 mV 0.15 div	0.05 div
5 mV to 5 V	0.1 div	0.05 div

ΔTIME, 1/ΔTIME

Trigger After Delay Accuracy—±(LSD+0.01 ×B Time/div)+(0.001% ×A Sec/div+0.001% of reading+50 ps). Measured with visually superimposed signal transitions, >0.1 div/ns trigger-signal slew rates, and with channel-to-channel delay mismatch corrected by the CH 2 DLY match adjustment from the front panel. Independent Slope and Level settings for ΔREF and ΔB triggers allow visual superposition of any pair of points within the center 80% of transitions having at least 5 div amplitude.

Run After Delay Accuracy—±(LSD+0.0008 ×A Sec/div)+(0.01×B Time/div+83 ps). B Time/div includes 10X mag.

Display Update Rate—Auto resolution, twice per second or every four sweeps, whichever is slower. (Depends on trigger and sweep rates with selectable resolution.)

DELAY TIME

Trigger After Delay Accuracy—±(LSD + 0.001% of reading +0.5 ns +A trigger-slew error +B trigger-slew error). Add 0.5 ns for dual-channel measurements.

Where: Trigger-slew error equals trigger-level control readout accuracy ÷ trigger signal slew rate at the trigger point.

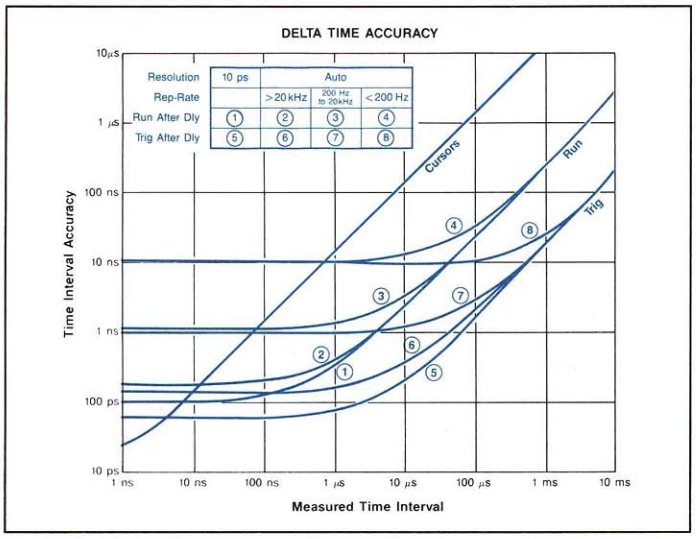
Run After Delay Accuracy—±(LSD +0.0012 ×A Sec/div+0.03×B Time/div +50 ns). (B Time/div includes 10X mag.)

Trigger After Delay and Run After Delay Accuracies Using Word Recognizer on the B Trigger—Add 100 ns if using external clock. Add 200 ns if not using external clock.

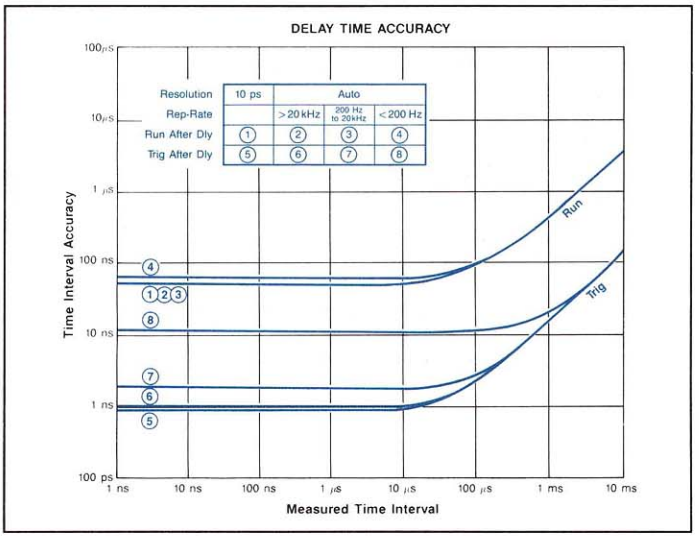
Display Update Rate—Auto, twice per second or once for each sweep, whichever is slower. Depends on trigger and sweep rate for selectable resolution.

Selectable Resolution

A Sec/Div	Selected Resolution	LSD
10 ns to 1 s	AUTO	See Auto Resolution below
10 ns to 5 μs	10 ps 100 ps 1 ns	10 ps 100 ps 1 ns
10 to 50 μs	10 or 100 ps 1 ns	100 ps 1 ns
100 to 500 μs	10 ps to 1 ns	1 ns
1 to 5 ms	10 ps to 1 ns	10 ns
10 to 50 ms	10 ps to 1 ns	100 ns
100 to 500 ms	10 ps to 1 ns	1 μs
1 s	10 ps to 1 ns	10 μs



Input Signal is five vertical div with a 2 ns rise time.
Measured times are four horizontal div.
TJE is negligible for Slew Rates >0.1 div/ns.
ΔTime Trigger After Delay assumes visual superposition.



Input Signal is five vertical div with a 2 ns rise time.
Measured times are four horizontal div.
TJE is negligible for Slew Rates >0.1 div/ns.
ΔTime Trigger After Delay assumes visual superposition.

Auto Resolution

A Sec/Div	Trigger Repetition Rate	LSD
10 ns to 2 μs	>20 kHz	100 ps
10 ns to 2 μs	200 Hz to 20 kHz	1 ns
5 to 200 μs	>200 Hz	1 ns
10 ns to 200 μs	<200 Hz	10 ns
500 μs to 5 ms	Any	10 ns
10 to 50 ms	Any	100 ns
100 to 500 ms	Any	1 μs
1 s	Any	10 μs

2445B Sec/div settings range from 20 ns to 1 s. 2465B Sec/div settings range from 10 ns to 500 ms.

TOTALIZE

Maximum Count—To 9,999,999 events.

DELAY BY EVENTS

A or B Sweep—The A trigger or 17-bit word recognizer defines start events. The B trigger or 17-bit word recognizer defines delay events. With A sweep in the delayed-by-events mode, the B sweep is delayable by time.
Maximum Delay Count—Up to 4,194,303.
Minimum Time From Start Event to Any Delay Event—≥4 ns.
Minimum Pulse Width—≥3.3 ns.

LOGIC TRIGGER

Combination Trigger—A sweep can be triggered from logical combinations of A and B triggers (A and B) or (A or B), or the word recognizer. B sweep can be triggered from the word recognizer.
Minimum Time to Satisfy Logic Combinations—≥4 ns.

WORD RECOGNIZER

Input—P6407 Word Recognizer Probe, 17 bits plus clock. (No CRT display from P6407.)

All Inputs	Threshold	Load	Safe Limit
High	<2.0 V	<20 μA	5.5 V
Low	>0.6 V	>−0.6 mA	−0.5 V

Display Radix—Hexadecimal, octal, binary.
Data Rate—0 to ≥20 MHz with clock, 0 to ≥10 MHz without clock.
Data Set-Up Time—25 ns.
Data Hold Time—0 ns.
GPIB Compatibility for Semiautomatic Measurement Systems—When combined with Option 10 the CTT/WR (Option 09) Oscilloscope combination is fully programmable. Complies with Tektronix *Standard Codes and Formats.*

Ordering Information—See page 170.

CHARACTERISTICS

GPIB INTERFACE (OPTION 10)

The set of characteristics is the same as specified for standard 2467B/2445B/2465B oscilloscopes and includes the following additions:

Standard Interface Functions Implemented—SH1, AH1, T6, L3, SR1, RL1, DC1, E1 DT0 C0, PP0.
Vertical Position Accuracy—CH 1 and CH 2 (Noninverted): ±[0.3 div +3% of distance (in divisions) from center screen +0.5 mV divided by the Volt/div setting]. For −15 to +55°C (excluding +15 to +35°C) add 1.5 mV divided by the Volt/div setting. For CH 2 Inverted add 0.2 div.

CH 3 and CH 4: ±[0.7 div +3% of distance (in div) from center screen].

Ordering Information—See page 170.

CHARACTERISTICS

EXTERNAL CLOCK (OPTION 1E)

FREQUENCY

Range—Autoranging over input frequency from 0.5 Hz to 150 MHz.

Resolution— $\pm \left[\text{LSD} + 1.4\ F^2 \left(\frac{\text{TJE}}{\text{N}} \right) \right]$

Display—Seven digits; updates twice per second or every two periods, whichever is slower.
Accuracy—Resolution ±[accuracy of reference×reading]
Definitions:
F=Input frequency in Hz.
LSD=Least Significant Digit (0.1 ppm of full scale.

TJE=Trigger Jitter Error=

$$\frac{\sqrt{(\text{en1})^2+(\text{en2})^2}}{\text{Input Slew Rate}}$$

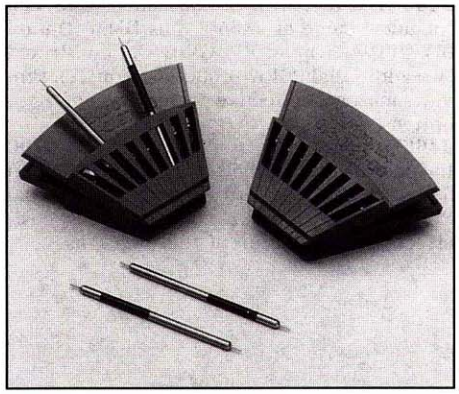
N=Number of cycles of measured frequent interval (0.5× or 1 period of input signal, whichever is greater).
en1=RMS noise of vertical system is divisions on screen.
en2=RMS noise of input signal in divisions.

CHARACTERISTICS

RACKMOUNT (OPTION 1R)

ENVIRONMENTAL

Rackmounting changes the temperature, vibration, and shock capabilities. The rackmounted oscilloscope meets or exceeds the requirements of MIL-T-18800C with respect to Type III, Class 5, Style C equipment, when installed as directed. It also meets or exceeds Tektronix Standard 062-2853-00, Class 5 requirements.
Ambient Temperature—Operating: −15 to +55°C. Measured at the instrument's air inlet, fan exhaust temperature should not exceed +65°C.
Vibration—Operation: Same as standard instrument, except total displacement is 0.015 inch p-p (2.3 g's at 55 Hz).
Shock—Operating and Nonoperating: Same as standard instrument, except shocks are 30 g's.



KLIPKIT makes high speed IC testing easy. For use directly with P6130 family probes or others vis the included signal pins.

ORDERING INFORMATION

2467B[*4] 400 MHz Oscilloscope **$11,990**
Includes: MCP CRT; four P6137 10X 1.3 m probes with accessories; 2 A, 250 V fuse (159-0021-00); zip lock accessory pouch (016-0537-00); blue plastic CRT filter (378-0199-03); clear plastic CRT filter; snap accessory pouch (016-0692-00); front cover; power cord (161-0104-00); Operator's Manual (070-5854-01).

2465B 400 MHz Oscilloscope **$5,850**
Includes: Two P6137 10X 1.5 m probes with accessories (P6136); 2 A, 250 V fuse (159-0021-00); zip lock accessory pouch (016-0537-00); blue plastic CRT filter (378-0199-03); clear plastic CRT filter; snap accessory pouch (016-0692-00); front cover; power cord (161-0104-00); Operator's Manual (070-6014-00).

2455B 250 MHz Oscilloscope **$5,350**
Includes: Same as 2465B.

2445B 150 MHz Oscilloscope **$3,695**
Includes: Same as 2465B, except two P6136 Option 25 10X 1.5 m probes; Option 01, 1.3 m probe

2465BDV 400 MHz Oscilloscope **$9,900**
Includes: Same as 2465B, plus DMM (Option 01), TV (Option 05), CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost-effective combination of these options.

2465BDM 350 MHZ Oscilloscope **$9,000**
Includes: Same as 2465B, plus DMM (Option 01), CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost effective combination of these options.

2465BCT 400 MHz Oscilloscope **$7,700**
Includes: Same as 2465B, plus CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost-effective combination of these options.

INSTRUMENT OPTIONS

Option 01[*3*4]—Digital Multimeter **+ $1,550**
Includes: Same as standard instruments, plus probe set (012-0941-00); temperature probe (P6602); probe set accessories (020-0087-00).

Option 05—TV Waveform Measurement System **+ $1,150**
Includes: Same as standard instruments, plus CCIR graticule CRT filter (378-0199-04); NTSC graticule CRT filter (378-0199-05); polarized collapsible viewing hood (016-0180-00).

Option 06— Counter/Timer/Trigger **+ $1,050**
Includes: Same as standard instruments, plus 20 grabber tips (206-0222 00); two 10 inch 10 wide comb (012-0747-00).

Option 09[*1*2]—Counter/Timer/Trigger and Word Recognizer **+ $1,450**
Includes: Same as standard instruments, plus a word recognizer probe (010-6407-01); 20 grabber tips (206-0222-00); two 10 inch 10 wide comb (012-0747-00).

Option 10—IEEE-488 GPIB Interface **+ $930**
Includes: Same as standard instruments, plus Instrument Interface Guide.

Option 1E—External Clock **+ $200**

MULTIPLE OPTION ALLOWANCE (MOA)

When a 2467B or 2465B instrument is ordered with more than two of the above options, a special price allowance is applied. This allowance is not applicable to the 2465BDV, 2465BDM, or the 2465BCT.

Option 2A—MOA for combining two of the above options. **– $250**

Option 3A—MOA for combining three of the above options. **– $500**

Option 4A—MOA for combining four of the above options. **– $750**

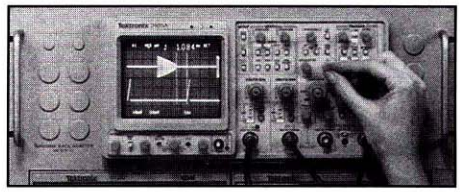
OTHER INSTRUMENT OPTIONS

Option B1—Service manual. (For 2445B/2455B/2465B/2467B) Standard manual. **+ $50**

(For Options/Special Editions) Includes standard manual plus options manual. **+ $50**

Option 1R[*3]—Configure Oscilloscope for Rackmount. **+ $320**
Includes: Same as bench model instrument (except pouch) plus rackmount hardware and slide-out assemblies.

Option 2R—Rackmount for instruments equipped with Option 01 **+ $45**



Option 1T—Transit Case. **+ $185**

Option 11[*1]—Rear Panel Probe Power. **+ $195**

Option 22—Two additional matching probes. **+ $320**

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

[*2] *Option 09 includes Option 06.*

* *Option 1R may not be ordered with Option 01, 2465BDM, or 2465BDV. For rackmounting instruments equipped with Option 01, order Option 2R.*

[*4] *Option 01 is not available with the 2467B.*

NOTE: Options are not retrofittable with field upgrade kits.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

See page 562

M1—(2467B/2465B/2455B 2 Calibrations. **+ $144**
M1—(2445B) 2 Calibrations. **+ $144**
(Special Editions) 2 Calibrations **+ $167**
M2—(2455B) 2 Years Service. **+ $360**
M2—(2467B/2465B) 2 Years Service. **+ $367**
M2—(2445B) 2 Years Service. **+ $302**
(Special Editions) 2 Years Service **+ $374**
M3—(2455B) 2 Years Service and 4 Calibrations. **+ $695**
M3—(2465B/2467B) 2 Years Service and 4 Calibrations. **+ $655**
M3—(2445B) 2 Years Service and 4 Calibrations. **+ $590**
(2455B) 5 Calibrations **+ $399**
(Special Editions) 2 Years Service and 4 Calibrations. **+ $709**
M4—(2467B/2465B) 5 Calibrations. **+ $344**
M4—(Special Editions) 5 Calibrations. **+ $399**
(2455B) 5 Calibrations **+ $1,075**
M5—(2467B/2465B) 9 Calibrations and 2 Years Service. **+ $983**
M5—(Special Editions) 9 Calibrations and 2 Years Service. **+ $1,089**
M5—(2445B) 9 Calibrations and 2 Years Service. **+ $918**

OPTIONAL ACCESSORIES

Rackmount Conversion Kit—Not compatible with Option 01. Order 016-0825-01 $395

Probe Power Extender Cable for Rackmount Instrument With Option 11—Order 020-0104-00 $490

Word Recognizer Extender Cable for Rackmount Instrument With Option 09 and 2465B CT—Order 020-0103-00 $350

GPIB Cables—Double shield, low EMC.
(1 m) Order 012-0991-01 $140
(2 m) Order 012-0991-00 $160
(4 m) Order 012-0991-02 $210

Viewing Hoods—
(Polarized Collapsible)
Order 016-0180-00 $60
(Folding Light Shield)
Order 016-0592-00 $15
(Folding Binocular)
Order 016-0566-00 $21

Protective Waterproof Vinyl Cover—Order 016-0720-00 $25

Carrying Case—
Order 016-0792-01 $221

Carrying Strap—
Order 346-0199-00 $17.50

DC Power
1105 $2,090
1106 $1,580

DC Inverter—1107 $1,175

RECOMMENDED PROBES

P6137—10X Passive Probe for use with 2467B, 2465B, 2455B, 2445B. $160

P6202A—10X FET Probe. $735

P6230—10X Bias/Offset Probe. $420

P6056—10X, 500Ω Passive Probe for 50 Ω inputs. $200

P6057—100X, 5000 Ω passive probe for 50 Ω input. $195

P6602—Temperature Probe. $260

Current Probes—
A6302 $625
A6303 $1,180
P6021 $450
P6022 $495

A6901—Ground Isolation Monitor $760

A6902B Voltage Isolator—For floating measurements. $1,980

DIGITIZING CAMERA SYSTEM

DCS01 Option 2A—Digitize waveforms from scope screen. $6,605

S58DC02—2467B/DCS Interface GPIB Driver. $295

RECOMMENDED CAMERAS

C-30BP Option 01—General Purpose. $1,665

C-5C Option 02—Low Cost. $465

RECOMMENDED CART

K212—For on-site mobility. $350

SERVICE MANUALS

(2467B/2465B) Order 070-6863-00 $50
(2455B/2445B) Order 070-6862-00 $50
(Options) Order 070-6864-00 $25

SOFTWARE

For additional information see the Test and Measurement Software section.

EZ-TEK 2400 PC Test Program Generator—For instruments with GPIB; used with IBM PC/XT/AT and compatibles. Requires GURU hardware. Order S49F103 $250

GPIB User's Resource Utility (GURU)—Includes GPIB-PC interface board, GPIB cable, software, and documentation.
Order S3FG100 $995

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the total solution Section or consult you local sales engineer.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.