

TEK 100 MHz DUAL TRACE OSCILLOSCOPE



465B44 Oscilloscope/DMM Shown Above Includes DM44 Digital Multimeter.

465B/DM44

100 MHz at 5 mV/div

2 ns/div Sweep Rate with X10 Sweep Mag

Trigger View

Versatile Trigger Selection

Alternate Sweep

The 465B offers upgraded performance to match advancements in technology, while providing improved trace quality, easier maintenance, and greater operator flexibility.

Improved trace selection versatility allows you to choose channel 1 and/or channel 2, sum or difference, and A trigger view in any combination.

In addition, the 465B has all the features of the original 465: 5 mV/div vertical trace, delayed sweep, the differential time/DMM option, and a sharp, bright 8 x 10 cm CRT.

VERTICAL DEFLECTION (2 identical channels)

Bandwidth* and Rise Time — (at all deflection factors from 50 Ω terminated source)

-15°C to +40°C	+40°C to +55°C
Dc to 100 MHz, 3.5 ns	85 MHz, 4.1 ns

*Measured at -3 dB. Bandwidth may be limited to \approx 20 MHz by bandwidth limit switch.

Cascaded bandwidth is at least 50 MHz when signal out is terminated in 50 Ω .

Lower -3 dB point, ac coupling 1X probe: 10 Hz or less, 10X probe: 1 Hz or less.

Deflection Factor at BW — 5 mV/div to 5 V/div, 1-2-5 sequence, accurate \pm 3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div. LED warning light indicates uncalibrated setting. In cascade mode sensitivity is \approx 1 mV/div.

Display Modes — Ch 1; Ch 2 ADD (normal and inverted), alternate, chopped — \approx 500 kHz rate, in any combination electronically switched.

CMrr — Common-mode rejection ratio at least 20 dB at 20 MHz for common-mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X or 10X coded probes are indicated by two readout lights behind knob skirts. LEDs are off when channel not displayed. Ground reference display selectable at probe (when dc coupled).

Input R and C — 1 M Ω \pm 2%, paralleled by \approx 20 pF.

Max Input Voltage —

Dc coupled	250 V (dc + peak ac) 500 V (p-p ac at 1 kHz or less)
Ac coupled	250 V (dc + peak ac) 500 V (p-p at 1 kHz or less)

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base A — 0.02 μ s/div to 0.5 s/div (1-2-5 sequence). X10 mag extends max sweep rate to 2 ns/div. LED indicates X10 mag.

Time Base B — 0.02 μ s/div to 50 ms/div (1-2-5 sequence). X10 mag extends max sweep rate to 2 ns/div. LED indicates X10 mag.

Variable Time Control — Time Base A provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div. LED warning light indicates uncalibrated setting.

Time Base A and B Accuracy, full 10 cm

	+20°C to +30°C	-15°C to +55°C
Unmagnified	\pm 2%	\pm 3%
Magnified	\pm 3%	\pm 4%

Horizontal Display Modes — A, A intensified, alternate (A intensified and B delayed), B delayed, B ends A for increased intensity in the delayed mode. Electronic switching between intensified and delayed sweep. A sweep and B sweep may be viewed simultaneously.

CALIBRATED SWEEP DELAY

Delay Time Range — 0.2 to X10 delay time/div settings of 200 ns to 0.5 s.

Differential Time Measurement Accuracy —

Delay Time Setting	+15°C to +35°C
over one or more major dial divisions	\pm 1%
less than one major dial division	\pm 0.01 major dial divisions

Jitter — 1 part or less in 50,000 (0.002%) of 10X the A sweep time/div setting. 1 part in 20,000 when operating from 50 Hz line.

TRIGGERING A AND B

A Trigger Modes — Normal (sweep runs when triggered), automatic (sweep runs in the absence of a triggering signal and for signals below 30 Hz), Single Sweep (sweep runs one time on the first triggering event after the reset selector is pressed). LED lights indicate when sweep is triggered and when single sweep is ready.

A Trigger Holdoff — Adjustable control permits a stable presentation of repetitive complex waveforms.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time) and B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once, in each of these modes, following the A sweep delay time.

Time Base A and B Trigger Sensitivity and Coupling —

COUPLING	to 25 MHz	At 100 MHz
Internal	0.3 div deflection	1.5 div deflection
Dc	50 mV	150 mV
External	500 mV	1.5 V
External \div 10		
Ac	Requirements increase below 60 Hz	
Ac Lf Reject	Requirements increase below 50 kHz	
Ac Hf Reject	Requirements increase below 60 Hz and above 50 kHz	

Jitter — 0.5 ns or less at 100 MHz and 2 ns/div.

Zero Delay A Trigger View — Electronically switched trigger view displays the external signal used for A sweep triggering. This provides quick verification of the signal and time comparison between a vertical signal and the trigger signal which can be displayed simultaneously. The deflection factor is \approx 100 mV/div (1 V/div with external \div 10).

Level and Slope — Internal, permits selection of triggering at any point on the positive or negative slope of the displayed waveform. Level adjustment through at least \pm 2 V in external, through at least \pm 20 V in external \div 10.

A Sources — Norm, Ch 1, Ch 2, line, external, and external \div 10.

B Sources — Starts after delay, norm, Ch 1, Ch 2, and external.

External Inputs — R and C \approx 1 M Ω paralleled by \approx 20 pF, 250 V (dc + peak ac) max input.

X-Y OPERATION

Full-sensitivity X-Y (Ch 1 Horiz, Ch 2 Vert) — 5 mV/div to 5 V/div, accurate \pm 4%. Bandwidth is dc to at least 4 MHz. Phase difference between amplifiers is 3° or less from dc to 50 kHz.

DISPLAY

CRT — 8 x 10 cm display. Horizontal and vertical centerlines further marked in 0.2 cm increments. P31 phosphor standard; P11 optional. 18 kV accelerating potential.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses trace to within graticule area for ease in locating an offscreen signal. A preset intensity level provides a constant brightness.

Z-Axis Input — Dc coupled, positive-going signal decreases intensity; 5 V p-p signal causes noticeable modulation at normal intensity; dc to 50 MHz.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: -15°C to +55°C. Non-operating: -62°C to +85°C. Filtered forced air ventilation is provided.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by 1°C/1000 ft from 5000 to 15,000 ft. Nonoperating to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes, 0.06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10-55 - 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95%-97% relative humidity as specified in MIL-T-28800B (par 3.9.2.2).

Shock — Operating and nonoperating: 30 g's 1/2 sine, 11 ms duration, 3 shocks per axis in each direction for a total of 18 shocks.

OTHER CHARACTERISTICS

Amplitude Calibrator —

Output Voltage	0.3 V	1% 0°C to +40°C
Output Current	30 mA	2% +20°C to +30°C
Frequency	Approx 1 kHz	

Vertical Signal Output — Ch 1 vertical signal is dc to at least 50 MHz (–3 dB), and ≈25 mV/div terminated into 50 Ω, and ≈50 mV/div terminated into 1 MΩ.

Gate Outputs — Positive gates from both time bases (≈5 V).

Power Requirements — Quick-change line voltage selector provides six ranges; 110 V, 115 V, 120 V, 220 V, 230 V, and 240 V, each ±10%, 48 to 440 Hz, 85 watts max at 115 V and 60 Hz. Operation from 12 or 24 V dc is available with Opt 07.

PHYSICAL CHARACTERISTICS

Dimensions	Cabinet		Rackmount	
	cm	in	cm	in
Height	15.7	6.2	17.7	7.0
Width (with handle)	32.8	13.1	48.3	19.0
Depth (with panel cover)	46.0	18.1	45.7	18.0
Depth (handle extended)	51.6	20.3		
Weights (approx)	kg	lb	kg	lb
Net (without panel cover)	10.3	22.8	13.3	29.4
Net (with panel cover and accessories)	11.5	25.3		
Shipping	16.7	37.0	26.3	58.0

INCLUDED ACCESSORIES

Two P6105 10X probes (010-0105-03), blue accessory pouch (016-0535-02), clear pouch (016-0537-00), blue CRT light filter (337-1674-00), clear CRT light filter (337-1674-01), ground wire (134-0016-01), two 1 1/2-amp fuses (159-0016-00), one 3/4-amp fuse (159-0042-00). Rack models also include mounting hardware and slide out assemblies, but not pouches.

ORDERING INFORMATION

465B Oscilloscope	\$2995
R465B Rackmount Oscilloscope	\$3165
465B44 Oscilloscope/DMM	\$3500

INSTRUMENT OPTIONS

Option 01, Delete Temperature Probe on	
465B44	Sub \$80
Option 04, Emc Modification	Add \$140
Option 05, TV Sync Separator (Provides triggering on TV field and TV line)	Add \$260
Option 07, Ext Dc Operation	Add \$220
Option 07 cannot be ordered with 465B44.	
Option 78, P11 Phosphor	\$35

Modification kits for field conversion of existing 465Bs, to Option 04, Option 07, or 465B44 scopes are available. These are typically more expensive than when the option is ordered with the instrument. Contact your Tektronix Sales Engineer, Distributor, or Representative for information.

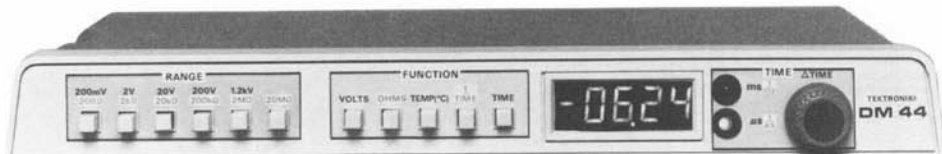
INTERNATIONAL POWER CORDS AND PLUG OPTIONS

Option A1 Universal Euro 220 V/16A	No Charge
Option A2 UK 240 V/13A	No Charge
Option A3 Australian 240 V/10A	No Charge
Option A4 North American 240 V/15A	No Charge

OPTIONAL ACCESSORIES

Probes — Probe Type	Attenuation	Input Impedance	Band- width*
P6063B 6 ft	1X Switchable 10X	1 MΩ 105 pF 10 MΩ 14 pF	6 MHz 90 MHz
P6202 FET Probe 2 Meter	10X 100X Head Ac Head	10 MΩ 2 pF 10 MΩ 2 pF 10 MΩ 4 pF	100 MHz 100 MHz 100 MHz
Current Probe	Calibration	Insertion Impedance	
P6022 5 ft	1 mA/mV 10 mA/mV (Selectable)	0.03 Ω @ 1 MHz Increasing to 0.2 Ω @ 120 MHz	85 MHz

*Bandwidths are measured at the upper –3 dB and apply only to the cable length shown. generally, shorter cable lengths increase bandwidth.



DM 44 DIFFERENTIAL-TIME/DMM OPTION

1% timing measurements were never this easy! With the DM 44 Option, available on five TEKTRONIX 400 Series Portables, time intervals can be read directly from the 3 1/2 digit LED Screen. Simply use the Delay Time control and the Δ time dial to position intensified spots at the beginning and end of the interval you wish to measure. Next, switch to delayed sweep and use the Δ time dial to superimpose the end of the interval on the beginning. Then read its differential time or frequency from the 3 1/2 digit LED panel. It's that simple. Time intervals are accurate to 1% and the frequency of periodic waveforms can be read out with 2% accuracy by simply pushing the 1/Time button.

Compare the DM 44 sequence with the measurement technique you may now be using. Calculating the interval from the CRT may take 10 times as long.

Voltage, resistance, and temperature measurements are also much easier with a DM 44-equipped 400 Series Oscilloscope. The DM 44 measures dc voltage with 0.1% accuracy, resistance with 0.3% accuracy, and temperature from –55°C to 150°C. Previously, you would have needed a separate DMM and digital thermometer in addition to your oscilloscope. Now, these features are combined in one small, inexpensive, integral package.

The DM 44 is available as a factory installed option on the 464, 465B, 466, 475 and 475A Portables. It adds Delta Delayed Sweep and independent DMM capabilities to these 400 Series Scopes. First, consider your bandwidth, sensitivity, storage, and price requirements. Then specify the DM 44 Option for simple and accurate digital measurements.

DM 44 CHARACTERISTICS

Timing Measurements

Differential Time Delay Accuracy —

+15°C to +35°C	–15°C to	+55°C
used with 464, 465B, 466, 475, and 475A	used with 464, 465B, and 466	used with 475 and 475A
within 1% of reading ±1 count	within 2.5% of reading ±1 count	within 1.5% of reading ±1 count

1/Time Accuracy —

+15°C to +35°C	–15°C to	+55°C
used with 464, 465B, 466, 475, and 475A	used with 464, 465B, and 466	used with 475 and 475A
within 2% of reading ±1 count	within 3.5% of reading ±1 count	within 3% of reading ±1 count

DC Voltage

Ranges — 0-200 mV, 0-2 V, 0-20 V, 0-200 V, 0-1.2 kV.

Resolution — 100 μV.

Accuracy — Within 0.1% of reading ±1 count.

Input Resistance — 10 MΩ for all ranges. Removal of an internal strap increases resistance to ≈1000 MΩ on 200 mV and 2V ranges.

Normal-Mode Rejection Ratio — At least 60 dB at 50 Hz and 60 Hz.

Common-Mode Rejection Ratio — At least 100 dB at dc, 80 dB at 50 Hz and 60 Hz.

Recycle Rate — ≈3.3 measurements/s.

Response Time — Within 0.5 s.

Maximum Safe Input Voltage — ±1200 V dc + peak ac between + and common inputs or between + and chassis. ±500 V (dc + peak ac) common floating voltage between common and chassis.

Resistance

Ranges — 0-200 Ω, 0-2 kΩ, 0-20 kΩ, 0-200 kΩ, 0-2 MΩ and 0-20 MΩ.

Resolution — 0.1 Ω.

Accuracy —

Range	Accuracy
200 Ω	within 0.25% ±1 count + probe resistance
2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ	within 0.25% ±1 count
20 MΩ	within 0.3% ±1 count

Recycle Rate — ≈3.3 measurements/s.

Response Time —

200 Ω through 200 kΩ ranges	within 1 s
2 MΩ ranges	within 5 s
20 MΩ ranges	

Maximum Safe Input Voltage — 120 V RMS between + and common inputs.

Temperature Using P6430 Probe

Range — –55°C to +150°C.

Accuracy —

DM 44 Temp	P6430 Tip Temp	Accuracy probe calibrated to DM 44
+15°C to +35°C	–55°C to +150°C	±2°C
–15°C to +55°C	–55°C to +125°C	±3°C
	+125°C to +150°C	±4°C

INCLUDED ACCESSORIES

One pair, Test Leads (003-0120-00), one P6430 Temperature Probe (010-6430-00).

ORDERING INFORMATION

465B DM 44 (Order 465B 44)	\$3500
475 DM 44 Oscilloscope/DMM	\$4465
475A DM 44 (Order 475A 44)	\$4915
466 DM 44 Oscilloscope/DMM	\$6890
464 DM 44 Oscilloscope/DMM	\$5670

INSTRUMENT OPTIONS

Option 01 Delete Temperature Probe

Modification kits for field conversion of existing 464s, 465s, 466s, 475s, and 475As to DM 44-equipped scopes are available. These are typically more expensive than when the option is ordered with the instrument. Contact your Tektronix Sales Engineer, Distributor, or Representative for information.

INTERNATIONAL POWER CORDS AND PLUG OPTIONS

Option A1 Universal Euro 220 V/16A	No Charge
Option A2 UK 240 V/13A	No Charge
Option A3 Australian 240 V/10A	No Charge
Option A4 North American 240 V/15A	No Charge

For information on hoods, covers, filters, carts, battery packs, rack adapter, and cameras, see previous page.