

PORTABLE STORAGE OSCILLOSCOPES

Tek offers a broad line of portable storage oscilloscopes, beginning with CRT storage in this section. Digital storage scopes feature three *NEW* offerings, the 2220, 2230, and 2430. These and other digital storage scopes are listed in the Digitizers section beginning on page 306.



466

100 MHz at 5 mV/div

5 ns/div Sweep Rate with X10
Sweep Magnifier

Variable Persistence and Fast Mesh
Transfer Storage Modes

3000 div/ μ s Stored Writing Speed

Battery Operation (Optional)

Third Channel Trigger View

Weights \approx 11.8 kg (26 lb)

TYPICAL APPLICATIONS

- * Disk/Tape Drive Logic Design
- * Laser Pulse Analysis
- * Low Rep Rate Radar Pulse Analysis
- * Destructive Test Monitoring

The 466 Portable Storage Oscilloscope is designed to display nonrepetitive or slow moving signals. And with the exception of increased stored writing speed on the 466, both instruments offer similar performance.

466 with Differential Time/DMM Option (466 DM44)

Operating in a reduced scan mode, the stored writing speed is 3000 div/ μ s (1350 cm/ μ s). This instrument features two modes of storage — variable persistence and fast transfer.

The bright 8 x 10 div CRT has 0.90 cm divisions. A reduced scan 8 x 10 div graticule is superimposed over the center of the main graticule, with 0.45 cm divisions. The graticules is etched onto the inner face of the CRT to eliminate parallax problems.

A third channel trigger view allows the simultaneous display of channels 1 and 2 with the external A trigger.

Tektronix P6062B Probes provide operator convenience of 1X or 10X input attenuation at the probe tip. The correct deflection factor is automatically indicated on the front panel when the probe attenuation factor is switched.

Lightweight plus the ability to use optional, external dc power makes the 466 sufficiently portable for virtually all field measurement applications. The snap-on 1106 Battery Pack is also useful in isolating these oscilloscopes from noisy or intermittent power sources.

CHARACTERISTICS VERTICAL SYSTEM (2 IDENTICAL CHANNELS)

Bandwidth*1 and Risetime — At all deflection factors from 50 Ω terminated source.

-15°C to +40°C	+40°C to +55°C
Dc to 100 MHz, \leq 3.5 ns	Dc to 85 MHz, \leq 4.15 ns

*1 Measured at -3 dB down. Bandwidth may be limited to \approx 20 MHz by bandwidth limit switch. Lower -3 dB point, ac coupling 1X probe; 10 Hz or less. 10X probe; 1 Hz or less.

Deflection Factor — 5 mV/div to 5 V/div (1-2-5 sequence). Accuracy: $\pm 3\%$. Uncalibrated: Continuously variable between steps and to ≈ 12.5 V/div. In cascade mode sensitivity is ≈ 1 mV/div. Cascaded bandwidth is at least 50 MHz when signal out is terminated in 50 Ω .

Display Modes — CH 1, CH 2 (normal or inverted), Alternate, Chopped (≈ 250 kHz), added, X-Y.

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 automatically indicated by two readout lights behind the knob skirts. All lights are off when the channel is not displayed. Ground reference display selectable at probe (when dc coupled).

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

Maximum Input Voltage

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

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Time Base A — 0.05 μ s/div to 0.5 s/div (1-2-5 sequence). X10 magnifier extends sweep rate to 5 ns/div.

Time Base B — 0.05 μ s/div to 50 ms/div (1-2-5 sequence). X10 mag extends sweep rate to 5 ns/div.

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

Time Base A and B Accuracy*1

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

*1 Full 10 divisions.

Display Modes — A, mixed sweep, A intensified, B delayed. B ends A for increased intensity in the delayed mode.

Calibrated Mixed Sweep — Displays A sweep for period determined by Delay-Time Position control, then displays B sweep for remainder of horizontal sweep.

CALIBRATED SWEEP DELAY

Delay Time Range — 0.2 to X10 delay Time/Div settings of 200 ns to 0.5 s (minimum delay time is 200 ns).

Differential Time Measurement Accuracy

Delay Time Setting	+15°C to +35°C	-15°C to +55°C
Over one or more major dial div	$\pm 1\%$	$\pm 2.5\%$
Less than one major dial div	± 0.01 major dial div	± 0.025 major dial div

Jitter — One part or less in 50,000 (0.002%) of X10 the A sweep time/div setting.

TRIGGERING

A Trigger Modes — Normal (sweep runs when triggered), automatic (sweep free-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). 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. At least 10:1 variation.

B Trigger Modes — B starts after delay time (starts automatically at the end of the delay time). 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
Dc Internal	0.3 div deflection	1.5 div deflection
Dc External	50 mV	150 mV
Dc External $\div 10$	500 mV	1.5 V
Ac	Requirements increase below 60 Hz	
Ac LF Reject	Requirements increase below 50 kHz	
Ac HF Reject	Requirements increase below 30 Hz and above 50 kHz	

Jitter — 0.5 ns or less at 100 MHz and 5 ns/div (X10 magnifier).

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and 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. The deflection factor is ≈ 50 mV/div (0.5 V/div with external $\div 10$ source).

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 ± 2 V in external, through at least ± 20 V in external $\div 10$.

A Sources — Normal, CH 1, CH 2 line, external and external $\div 10$.

B Sources — Starts after delay, normal, CH 1, CH 2, and external.

External Inputs — R and C ≈ 1 M Ω paralleled by ≈ 20 pF. 250 V (dc + peak ac) maximum input.

Third Channel Trigger View — Deflection Factor (Dc Trigger Coupling Only). Ext is: 100 mV/div $\pm 5\%$. Ext $\div 10$ is: 1 V/div $\pm 5\%$. Delay Difference: 5.0 ns ± 0.5 ns after vertical display. Trigger Point: \approx center screen. Risettime: ≤ 5 ns. Aberration: $< 10\%$ p-p.

X-Y OPERATION

Full Sensitivity X-Y (CH 1 Horizontal, CH 2 Vertical) — 5 mV/div to 5 V/div. Accuracy: $\pm 4\%$. Bandwidth: Dc to at least 4 MHz. Phase Difference Between Amplifiers: 3° or less from dc to 50 kHz.

CRT AND DISPLAY FEATURES

CRT — 8 x 10 div display, each div is 0.9 cm (normal); 0.45 cm/div reduced scan. Accelerating potential is 8.5 kV (normal), 10 kV (reduced scan). GH (P31) phosphor standard.

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

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen 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.

STORED WRITING SPEEDS

Full Scan*1	Stored Writing Speed	Storage*2 View Time
Fast Transfer	67.5 cm/ μ s	> 15 s
Variable Persistence	225 cm/ μ s	> 15 s
Reduced Scan*3		
Fast Transfer	135 cm/ μ s	> 15 s
Variable Persistence	1.35 cm/ μ s	> 15 s

*1 Center 6 x 8 division; 0.9 cm/division.

*2 These times are at full-stored display intensity; they can be extended at least 25 times using reduced intensity in Save Display Mode.

*3 Center 8 x 10 division; 0.45 cm/division.

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	≈ 1 kHz	

Vertical Signal Output — CH 1 vertical signal is dc to at least 50 MHz and ≈ 25 mV/div terminated into 50 Ω , and ≈ 50 mV/div terminated into 1 M Ω .

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

POWER REQUIREMENTS

Line Voltage Range — Quick change, line voltage selector provides 110 V, 115 V, 120 V, 220 V, 230 V, and 240 V ac, each $\pm 10\%$. Option 07 is 12 V dc to 24 V dc.

Line Frequency — 48 Hz to 440 Hz.

Maximum Power Consumption — 100 W at 115 V and 60 Hz.

ENVIRONMENTAL

Ambient Temperature — Operating: -15°C to $+55^\circ\text{C}$. Nonoperating: -55°C to $+75^\circ\text{C}$. Forced air ventilation is provided.

Altitude — Operating: To 4600 m (15,000 ft); maximum allowable ambient temperature decreased by 1°C/1000 ft from 5,000 ft to 15,000 ft. Nonoperating: To 15 000 m (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 Hz to 55 Hz to 10 Hz in 1 minute cycles.

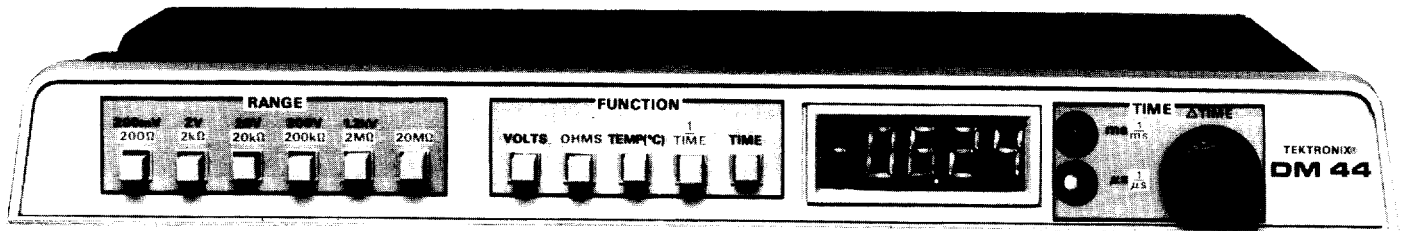
Humidity — Operating and Nonoperating: 95%, 5 cycles (120 hours). Referenced to MIL-T-28800C, par. 4.5.5.1.2.2.

Shock — Operating and Nonoperating: 30 g's, 1/2 sine, 11 ms duration, 2 shocks per axis in each direction for a total of 12 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	330	13.1
Height (without pouch)	159	6.2
Depth (with panel cover)	550	21.7
Depth (handle extended)	597	23.8
Weights \approx	kg	lb
Net (without panel cover or accessories)	11.8	26.0
Net (with panel cover and accessories)	13.5	29.8
Shipping	18.8	41.5

See ordering information on next page.



DM 44

Differential-Time/DMM Option for 466

3 1/2 Digit LED Display

Time Intervals Accurate to 1%

Frequency Accurate to 2%

Dc Voltage Measurements Accurate to 0.1%

Resistance Accurate to 0.3%

Temperature from -55°C to +150°C

One percent timing measurements were never this easy! With the DM 44 Option time intervals can be read directly from the 3 1/2 digit LED screen. Simply use the Delay Time control and the ΔTime 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. It 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.

CHARACTERISTICS TIMING MEASUREMENTS

Differential Time Delay Accuracy

+15°C to +35°C	-15°C to +55°C
Within 1% of reading ±1 count	Within 2.5% of reading ±1 count

1/Time Accuracy

+15°C to +35°C	-15°C to +55°C
Within 2% of reading ±1 count	Within 3.5% of reading ±1 count

DC VOLTAGE

Ranges — 0 to 200 mV, 0 to 2 kV, 0 to 20 V, 0 to 200 V, 0 to 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 2 V 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 to 200 Ω, 0 to 2 kΩ, 0 to 20 kΩ, 0 to 200 kΩ, 0 to 2 MΩ and 0 to 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

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

TEMPERATURE USING P6430 PROBE

Range — -55°C to +150°C.

Accuracy

DM 44 Temperature	P6430 Tip Temperature	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

ORDERING INFORMATION

466 Storage Oscilloscope \$7,560

Includes: Two P6105A probes (010-6105-13); blue accessory pouch (016-0535-02); clear pouch (016-0537-00); CRT light filter (337-1674-01); two 1 1/2 A fuses (159-0016-00); one 3/4 A fuse (159-0042-00); ground wire adaptor (134-0016-01); viewing hood (016-0592-00); operator manual (070-2037-00).

466 DM 44

Storage Oscilloscope/DMM

\$8,260

Includes: Same as 466 plus, one pair test leads (003-0120-00); one P6430 Temperature Probe (010-6430-00); service manual (070-2036-01); operator manual (070-4796-00).

OPTIONS

Option 01 — Delete DM 44 Temperature Probe (466DM 44 only). — \$90

Option 04 — EMC Capability. + \$220

Option 05 — TV Sync Separator (Provides Triggering on TV Field). + \$385

Option 07 — External Dc Operation (Not for DM 44). + \$330

INTERNATIONAL POWER PLUG OPTIONS

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

Option A2 — UK 240 V/13 A, 50 Hz.

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

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

OPTIONAL ACCESSORIES

1106 — Battery Pack (Used with Option 07.) (See page 281.) **\$1,235**

1105 — Battery Power Supply (See page 281.) **\$1,650**

Mesh Filter — Improves display contrast in high ambient light. Order 378-0726-01 **\$75**

Protective Cover — Waterproof vinyl. Order 016-0365-00 **\$24**

Folding Viewing Hood — Order 016-0592-00 **\$13**

Folding Binocular Hood — Order 016-0566-00 **\$18.50**

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

Rack Adaptor — (Not for DM 44.) Order 016-0676-00 **\$430**

A6902B Isolator — For floating measurements see page 437 for complete description.

RECOMMENDED CAMERA

C-30BP Option 01 — General Purpose Camera. Includes 016-0301-01 mounting adaptor/corrector lens. See page 412. **\$1,524**

RECOMMENDED CARTS

K212 Portable Instrument Cart — For on-site portability. See page 423. **\$330**

K117 Instrument Shuttle — For site-to-site portability. See page 423. **\$265**

RECOMMENDED PROBES

See pages 255 and 426.

Modification kits for field conversion of existing 466s to Option 07 or 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.