# 2235

- Dc to 100 MHz Bandwidth
- Lightweight, Easy to Use
- 2 mV Sensitivity
- 5 ns/Div Sweep Rate
- Advanced Trigger System
- Trigger View
- Delayed Sweep Measurements
- Large, Bright CRT
- 10X Probes Included
- Three Year Warranty—Five Year Option

**TYPICAL APPLICATIONS**

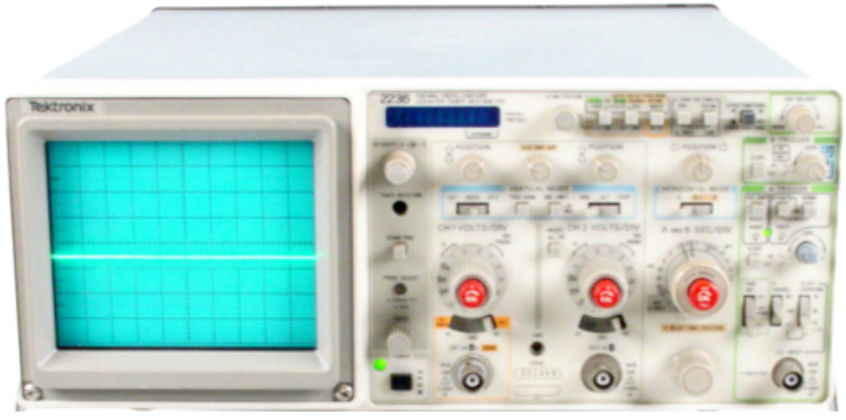
**Field Service**
**Design**
**Component Testing**

See page 277 for available Application Notes.

The 100 MHz 2235 offers high value and high performance. The low price is made possible by the 2200 Series innovative architecture. Yet it has the needed features, operational simplicity and—not least—solid reliability. All backed by a three year warranty on all parts and labor, including the CRT, excluding probes.

The 2235 ensures measurement quality and reliability while reducing instrument cost. Tek started with the innovative architecture of the 2200 Series: fewer boards, fewer mechanical parts, less cabling and electrical connectors. This approach, plus advanced circuit design and a focus on essential features, has led to a scope that's more accurate, more reliable, lighter and more serviceable—and simpler to use—than any other 100 MHz scope.

The 2235 delivers 2% vertical and horizontal accuracy in normal operation. Accuracy of 3% or better is maintained across a wide range of environmental extremes. Trace noise, chop noise, vertical aberrations and sweep interference have been reduced to a minimum. Delay jitter of 1:20,000 ensures excellent timing measurement resolution. Triggering is sensitive to 0.3 div at 10 MHz. There's a trigger view for simplifying set-ups; single sweep for photographing transients; bandwidth limit for noisy environments; and a bright, high resolution 14 kV dome mesh CRT.



*Features like rugged design, lightweight and an easy-to-learn front panel make the 2235 an ideal service scope. In both service and design, it offers the sensitivity for low level measurements and sweep rates for fast logic families, plus 10:1 variable holdoff range for complex word triggering. And at the bottom line, it offers the price and reliability to significantly lower the cost of owning a quality scope.*

# 2235 Option 01

**(AN/USM-488)**

- Fully Provisioned Through the U.S. Army System
- Meets or Exceeds MIL-T-28800C and MIL-STD-461B Part 4 for EMC/EMI
- Dc to 100 MHz Bandwidth
- Accepted and Specified by the U.S. Army

The 2235 Option 01 is accepted and specified by the U.S. Army. If you're involved in designing and specifying systems for the U.S. Army, here is a 100 MHz oscilloscope that should top your support equipment lists.

Comparable in performance to the standard 2235, the 2235 Option 01 version has impressive features. It meets the rigid environmental requirements of MIL-T-28800C for Class 5 instruments. Electromagnetic interference is improved over the standard 2235, and meets MIL-STD-461B part 4 requirements. It has adjustable graticule illumination as well as uncalibrated indicator lights for both the horizontal time base and the vertical channels. HF REJ and LF REJ filtering expand flexibility for trigger coupling.

For your convenience we've also included a protective front-panel cover, accessory pouch, P6101A 1X 2-meter probe, binocular viewing hood, BNC T connector, BNC male-to-binding post, two IC grabber tips and a service manual.

## CHARACTERISTICS

The following electrical characteristics are common to the 2236, 2235, and 2235 Option 01 except where noted.

### VERTICAL SYSTEM (TWO IDENTICAL CHANNELS)

**Bandwidth (−3dB) and Rise Time** — 100 MHz and 3.5 ns, derated to 90 MHz at 2 mV/div and outside 0°C to +35°C. Bandwidth Limit: 20 MHz ± 10%.

**Deflection Factor** — 2 mV to 5 V/div at ±2%. Accuracy derated ±3% outside +15°C to +35°C (+10°C to +35°C, 2235 Option 01). Continuously variable between steps by at least 2.5:1.

**Step Response Aberrations** — 2235 and 2235 Option 01: +4%, −4%, 4% p-p (2 mV to 0.5 V/div).
2236: +4%, −4%, 4% p-p (5 mV to 0.5 V/div), +5%, −5%, 5% p-p (2 mV/div).

**Display Modes** — CH 1, CH 2, CH 2 Invert, Add, Alternate, Chop (500 kHz).

**Common-Mode Rejection Ratio** — At least 10:1 at 50 MHz for signals of 6 div or less (10:1 at 80 MHz 2235 Option 01).

**Input R and C** — 2235 and 2235 Option 01: 1 MΩ, 20 pF. 2236: 1 MΩ, 22 pF.

**Maximum Input Voltage (Ac and Dc Coupled)** — 400 V (dc + peak ac) or 800 V (p-p to 10 kHz).

**Channel 1/Channel 2 Isolation** — 100:1 at 50 MHz.

### HORIZONTAL SYSTEM

**Sweep Rate** — A Time Base: 0.05 µs to 0.5 s/div in 1-2-5 sequence. 10X Mag: 5 ns/div. B Time Base: 0.05 µs to 50 ms/div in 1-2-5 sequence. 10X Mag. 5 ns/div.

**Sweep Linearity** — ±5% over any two of center eight divisions.

**Accuracy**

| | +15°C to +35°C*1 | 0°C to +50°C |
|---|---|---|
| Unmagnified | ±2% | ±3% |
| Magnified | ±3% | ±4% |

*1 +10°C to +35°C for 2235 Option 01.

**Display Modes** — A, Alternate (A Intensified and B Delayed) and B.

### CALIBRATED SWEEP DELAY

**Delay Time Range** — Continuously variable with 10-turn control from <0.5 +300 ns to >10 div.

**Differential Delay Time Accuracy** — (2235 and 2235 Option 01) ±1% (+15°C to +35°C); ±2% (0°C to +50°C).

**ΔTime Measurement Accuracy** — (2236) Max accuracy equal to time base accuracy ±50 ps. Time Base Accuracy With Standard Oscillator: 10 ppm (0.001%); with Option 14 TCXO (Temperature-Compensated Crystal Oscillator): 0.5 ppm (0.00005%).

**Delay Jitter** — 2236: 10,000:1 (0.01%). 2235 and 2235 Option 01: 20,000:1 (0.005%).

### TRIGGERING

**A Trigger Sensitivity**

| 2235 & 2235 Opt 01 | Internal | External (p-p volts) |
|---|---|---|
| 10 MHz | 0.3 div*1 | 35 mV |
| 60 MHz | 1.0 div | 120 mV |
| 100 MHz (2235) | 1.5 div | 200 mV |
| 100 MHz (2235 Opt 01) | 1.5 div | 150 mV |
| **2236** | | |
| 10 MHz | 0.35 div | 40 mV |
| 60 MHz | 1.2 div | 150 mV |
| 100 MHz | 1.5 div | 250 mV |
| **2236 CTM** | | |
| 10 MHz | 0.5 div | 50 mV |
| 60 MHz | 1.5 div | 180 mV |
| 100 MHz | 2.0 div | 300 mV |

**B Trigger (Internal Only) Sensitivity**

| | 10 MHz | 60 MHz | 100 MHz |
|---|---|---|---|
| 2235 & 2235 Opt 01 | 0.35 div | 1.0 div | 1.5 div |
| 2236 | 0.4 div | 1.2 div | 1.5 div |
| 2236 CTM | 0.5 div | 1.5 div | 2.0 div |

*1 0.35 for 2235 Option 01.

**TV Trigger Sensitivity** — TV Field: 1.0 div of composite sync. TV Line: 0.3 div (2235); 0.35 div (2236 and 2235 Option 01).

**Bandwidth Limiting** — 20 MHz when bandwidth limit switch depressed.

**High Frequency Reject** — (2235 Option 01 only) Attenuates signals above 40 kHz.

**Low Frequency Reject** — (2235 Option 01 only) Attenuates signals below 40 kHz.

**Trigger System Operating Modes** — Normal, p-p automatic, TV line, TV field, and single sweep.

**Trigger View System** — Same deflection factors as vertical channels with internal sources; 100 mV/div with ac and dc external, and 1 V/div with dc ÷10 external. Accuracy is ±20%. Delay difference between trigger view (EXT input) and either vertical channel is <2.0 ns.

**External Trigger Input** — Coupling: Ac, dc, or dc ÷10.

**Variable Holdoff Control** — Increases A sweep holdoff time at least 10:1.

### X-Y OPERATION

**Deflection Factors** — Same as scope's vertical system with the V/div switch in calibrated detent.

**Accuracy**

| | Y-Axis | X-Axis |
|---|---|---|
| +15°C to +35°C | ±2% | ±3% |
| 0°C to +50°C | ±3% | ±4% |

**Bandwidth** — Y-Axis: same as scope's vertical system. X-Axis: 2.5 MHz.

**Phase Difference Between X-Axis and Y-Axis Amplifiers** — ±3° from dc to 150 kHz with dc coupled inputs.

### CRT AND DISPLAY FEATURES

**CRT** — 8 cm x 10 cm display; internal unilluminated graticule (2235 Option 01 is illuminated). Accelerating potential is 14 kV. GH (P31) phosphor standard.

**Controls** — Beam Finder, Focus, Separate A and B Sweep Intensity, Trace Rotation. 2235 Option 01 also has Variable Scale Illumination.

**Z-Axis Input** — Dc coupled, positive-going signal decreases intensity; 5 V p-p signal causes noticeable modulation; dc to 20 MHz.

### OTHER CHARACTERISTICS

**Probe Adjust Signal** — (2235/2236) Squarewave, 0.5 V ±5%, 1 kHz ±20%.

**Amplitude Calibrator** — (2235 Option 01 only) Squarewave, 0.5 V ±2%, 1 kHz ±20%.

### POWER REQUIREMENTS

**Line Voltage Range** — 90 V ac to 250 V ac. (No line switches or fuse changes needed.)

**Line Frequency** — 48 Hz to 440 Hz.

**Maximum Power Consumption** — 2235: 40 W, 70 VA. 2236: 60 W, 110 VA.

**Dc Operation** — 12 V to 30 V available with 1105, 1106, and 1107.

### ENVIRONMENTAL

**Ambient Temperature** — Operating: 0°C to +50°C (except 2236 CTM ac RMSV, DCV, and Ω Modes: 0°C to +40°C). Nonoperating: −55°C to +75°C.

**Altitude** — Operating: To 4600 m (15,000 ft). Maximum operating temperature decreased 1°C/1,000 ft (5,000 ft to 15,000 ft). Nonoperating: To 15 000 m (50,000 ft).

**Vibration** — Operating: 15 minutes along each of the major axes. 0.015 in p-p displacement 10 Hz to 55 Hz to 10 Hz in one minute cycles. Held for 10 minutes at 55 Hz (2.4 g's at 55 Hz).

**Humidity** — Operating and Nonoperating: 95%, five cycles (120 hours) referenced to MIL-T-28800C, Paragraph 4.5.5.1.2.2.

**Shock** — Operating: 30 g's, ½ sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**EMC** — Meets Class B requirements per VDE 0871B for radiated and conducted emission. 2235 Option 01 AN/USM 488 Only: Meets requirements of MIL-STD-461B Part 4, CE03, CS01, CS02, CS06, RE02 (to 1 GHz), and RS03 (1 V/meter to 1 GHz).

### PHYSICAL CHARACTERISTICS

| | 2235 and 2235 Opt 01 | | 2236 | |
|---|---|---|---|---|
| **Dimensions** | mm | in | mm | in |
| Width*1 | 328 | 12.9 | 328 | 12.9 |
| Height*2 | 137 | 5.4 | 137 | 5.4 |
| Depth*2 | 440 | 17.3 | 440 | 17.3 |
| **Weights≈** | kg | lb | kg | lb |
| Net | 6.1 | 13.5 | 7.3 | 16.2 |

*1 Without handle.
*2 Without front cover.
*3 2235 Option 01 height with pouch is 150 mm (5.9 in).


# 2236 Counter/Timer/Multimeter

## CHARACTERISTICS

The following characteristics are unique to the 2236.

**Time Base Accuracy** — Standard: 10 ppm (0.001%). With Option 14 TCXO: 0.5 ppm (0.00005%).

**Frequency** — Range: ≤0.2 Hz to ≥100 MHz. Maximum Resolution: 0.00001 Hz. Maximum Accuracy: Equal to time base accuracy. Can be gated.*1*2

**Period** — Range: ≥5 s to ≤10 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy. Can be gated.*1*2

**Width** — Range: ≥5 s to ≤5 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±10 ns. Can be gated.*1*2

**Delay Time** — Range: ≥2.5 s to ≤50 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±20 ns.*2

**ΔTime** — Range: ≥2.5 s to ≤1 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±50 ps.*2

**Totalize** — Over 8,000,000 events. Can be gated.

**Dc Volts** — Range: 0 V to 500 V. Maximum Resolution: 100 μV. Accuracy: ±0.1%. Input: Through side DMM leads.*2

**RMS Ac Volts** — Ac Coupled: True RMS with 20 Hz to 20 kHz frequency range. Range: 0 V to 350 V. Maximum Resolution: 100 μV. Accuracy: ±1.0%. Input: Through side DMM leads.*2

**CH 1 Volts** — Measures average dc voltage (with CH 1 dc coupling) or true RMS voltage (with CH 1 ac coupling); 1X/10X ranged by coded probes: Single Sweep button zeros display and permits relative dc and ac RMS measurements. Range, Dc and Ac Volts: 0 V to 50 V (500 V dc/350 V ac with P6121 10X Probe). Maximum Resolution, Dc and Ac Volts: 100 μV (1 mV with P6121). Maximum Accuracy, Dc Volts (18°C to 28°C): ±0.3% with 1X probe, ±0.5% with 10X probe. Maximum Accuracy, Ac Volts with 1X probe (18°C to 28°C): ±2%, 50 Hz to 100 Hz, ±1%, 100 Hz to 20 kHz. Maximum Accuracy, Ac Volts with 10X Probe: ±2%, 20 Hz to 20 kHz, with proper probe compensation.*2

**Resistance** — Range: 0 Ω to 1.99 GΩ. Maximum Resolution: 0.01 Ω. Accuracy: To 0.15%. Automatic diode detection displays forward voltage drop to ±1%; continuity mode activates tone if resistance is <5 Ω.*2

**Temperature** — Uses Optional Tektronix P6602 Temperature Probe. Temperatures in C or F selected with Freq/ΔTime button. Range: −62°C to +230°C (−80°F to +446°F). Resolution: To 0.1° (either range). Accuracy: To ±2% of reading ±1.5°C; ±2% of reading ±2.70°F.

**Multimeter Inputs** — Isolated from oscilloscope ground. Input Z: 10 MΩ. Maximum Input Voltage: 500 V (dc + peak ac), for all functions.

*1 *Ranges, resolutions, and accuracies can be degraded due to gating errors and a smaller number of automatic averages made during a gated frequency, period, or width measurement. For complete formula specifications see operator's manual.*

*2 *For complete accuracy and resolution error formula specifications see operator's manual.*