



Test Equipment Depot
99 Washington Street
Melrose, MA 02176-6024

2236

- DC to 100-MHz Bandwidth
- Integrated Counter/Timer/DMM
- Lightweight, Easy to Use
- 2-mV Sensitivity
- 5-ns/Div Sweep Rate
- 100-MHz Counter
- Gated Counter Measurements/ Δ Time
- UL Listed, CSA
- Channel 1 AC and DC Volts
- Full Function DMM—5000 Counts
- Three-Year Warranty—Five-Year Option

TYPICAL APPLICATIONS
Digital Design and Testing
Field Service
Amplifier Design and Testing

The 100-MHz 2236 introduces a new concept in waveform measurement: a 100-MHz counter/timer/DMM, integrated into the scope's vertical, horizontal and trigger systems. This convenient feature simplifies setups (by allowing consolidated set-ups and combinations of measurements) heightens measurement confidence, and expands the scope's versatility. The 2236 replaces mental gymnastics and roundabout problem-solving with simple, direct, accurate, digital readouts that supplement your analog measurements.

The Tek 2236 provides easy, accurate, and versatile measurements through micro-processor-driven waveform analysis. Autoranged and autoaveraged counter/timer measurements are made on the signal triggering the A sweep, or in gated modes, on the signal triggering the B sweep. Autoranged DMM measurements are made through floating DMM side inputs and up-range at 5000 counts. Channel 1 voltage measurements made on Channel 1 signal include: dc, relative dc, relative and true ac RMS voltage. Self testing includes power-on and user interactive routines.

The 2236 uses intensified markers on-screen to define the area to be measured on a burst or short duration pulse train. Gated counter measurements are made via the B trigger with operator prompting and automatic, digital readout of results (see Figures 1, 2, 3). With period averaging the 2236 can make low-frequency measurements instantly, in contrast to the several seconds delay encountered on conventional counter/timers.

The scope and DMM can be applied simultaneously, with concurrent CRT and digital-readout displays. The same probe feeds data to the scope and provides information to the DMM, thus eliminating tangled leads and extra set-up time required to obtain true ac RMS or dc voltage readings (see Figure 4).

DMM autoranging simplifies set-up. An ohmmeter range of 2 Ω —one hundred times the range of most such devices—allows service technicians to quickly pinpoint even small amounts of transformer leakage, or designers to accurately check the insulating property of capacitors (see Figure 7).

Frequency, period, and width measurements are pushbutton simple, with accuracies to 0.001% and beyond. On-screen operator prompts further ensure failsafe set-up (see Figure 8).

An audible, automatic diode/junction detection and continuity signal saves both time and interpretation errors by allowing the operator to concentrate on probing rather than on observing the front panel (see Figure 9).

In strong testimony of the incomparable reliability of the 2000 Family of oscilloscopes, Tek offers a three year warranty: labor and parts (including CRT), excluding probes. Beyond the "basic three years" of warranty coverage, Tek will extend your service coverage up to five years, offering you a choice of three practical service plans to meet your specific service needs.

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
- UL Listed, CSA Certified

TYPICAL APPLICATIONS
Field Service
Design
Component Testing

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. And all are 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.

Continued on page 322.

MILITARY AND SPECIAL SERVICE OSCILLOSCOPES

2235 Option 01

- DC to 100 MHz Bandwidth
- Fully Provisioned Through the U.S. Army System
- Meets or Exceeds MIL-T-28800C and MIL-STD-461B Part 4 for EMC/EMI
- Three Year Warranty—Five Year Option
- National Stock Number
6625-01-187-7847
- UL Listed CSA

For complete description see this section.

2336YA

- DC to 100 MHz Bandwidth
- 5 mV/Div to 5 V/Div
- 5-ns/Div Sweep Rate
- Rugged for Field Service
- Three Year Warranty—Five Year Option
- Meets MIL-T-28800C, Class 3
- National Stock Number
6625-01-172-6119
- UL Listed, CSA

For complete description see this section.

2430M Digital Oscilloscope

**GPIB
IEEE-488** The 2430M complies with IEEE Standard 488-1978 and with Tektronix Standard Codes and Formats.

- Imbedded CILL/MATE Capabilities
- 150-MHz Bandwidth at Probe Tip
- 5-ns/Div Sweep Speed
- 100-MS/s Sample Rate
- Simultaneous Acquisition of Two Channels
- Envelope Mode With 2-ns Glitch Capture
- 8-Bit Resolution Over 10 Divisions
- Save on Delta (Tek Patented Feature) Provides Unattended Pass/Fail Testing and Babysitting Against a User Defined Reference or Envelope

For complete description see this section.

NEW 2246 Option 1Y

- DC to 100 MHz Bandwidth
- 4 Independent Channels
- 2 ns/Div Time Base
- 2 mV to 5 V/div
- Voltmeter Measurements
- Tracking Smart Cursors
- Δ Time with Cursors or Alternate Sweep
- Meets MIL-28800C, Type III, Class 3
- UL Listed
- Three-Year Warranty

For complete description see this section.



TRAINING

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

RMS AC Volts—AC Coupled: True RMS with 20 Hz to 20 kHz frequency range. Range: 0 to 350 V. Maximum Resolution: 100 μ V. Accuracy: $\pm 1.0\%$. 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 to 50 V (500 V dc/350 V ac with P6121 10X Probe). Maximum Resolution, dc and ac Volts: 100 μ V (1 mV with P6121). Maximum Accuracy, dc Volts (18 to 28°C): $\pm 0.3\%$ with 1X probe, $\pm 0.5\%$ with 10X probe. Maximum Accuracy, ac Volts with 1X probe (18 to 28°C): $\pm 2\%$, 50 to 100 Hz, $\pm 1\%$, 100 Hz to 20 kHz. Maximum Accuracy, ac Volts with 10X Probe: $\pm 2\%$, 20 Hz to 20 kHz, with proper probe compensation.*2

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

Temperature—Uses Optional Tektronix P6602 Temperature Probe. Temperatures in C or F selected with Freq/ Δ Time button. Range: -62 to +230°C (-80 to +446°F). Resolution: To 0.1° (either range). Accuracy: To $\pm 2\%$ of reading $\pm 1.5^\circ$ C; $\pm 2\%$ of reading $\pm 2.7^\circ$ F.

Multimeter Inputs—Isolated from oscilloscope ground. Input Z: 10 M Ω . 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.

OPTIONS

- Option 02**—(2235, 2236 only) Front panel cover and accessory pouch, +\$850
- Option 14**—(2236 only) TCXO Temperature-Compensated Crystal Oscillator, 0.5 ppm accuracy. +\$315
- Option 33**—Travel Line Package Includes rubber molding, accessory pouch, front panel cover, carrying strap. (2235) +\$200 (2236) +\$295 (2220/2230) Includes rubber molding, carrying strap. +\$245

CONVERSION KITS

- Rackmount Adapter**— Includes: Rackmount depth extenders, all mounting hardware, labels, instruction manual. (2335) Order 016-0466-00 \$130 (2235 Option 01) Order 016-0833-00 \$145 (2236) Order 016-0015-00 \$290
- TCXO Retrofit Kit**—(2236 only) Temperature compensated crystal oscillator, 0.5 ppm accuracy. Order 040-1136-00 \$370

INTERNATIONAL POWER PLUG OPTIONS

- Option A1**—Universal Euro 220 V, 50 Hz. Order 020-0859-00. \$26
- Option A2**—UK 240 V, 50 Hz. Order 020-0860-00. \$37
- Option A3**—Australian 240 V, 50 Hz. Order 020-0861-00. \$27
- Option A4**—North American 240 V, 60 Hz. Order 020-0862-00. \$30
- Option A5**—Switzerland 220 V, 50 Hz. Order 020-0863-00. \$19

WARRANTY-PLUS SERVICE PLANS

See Customer Service Section

- M1**—(2235/2235 Option 01) 2 Calibrations. +\$135
- M1**—(2236) 2 Calibrations. +\$160
- M2**—(2235/2235 Option 01) +2 Years Service. +\$125
- M2**—(2236) +2 Years Service. +\$150
- M3**—(2235/2235 Option 01) 2 Years Service & 4 Calibrations. +\$350
- M3**—(2236) 2 Years Service & 4 Calibrations. +\$450
- M4**—(2235/2235 Option 01) 5 Calibrations. +\$385
- M4**—(2236) 5 Calibrations. +\$425
- M5**—(2235/2235 Option 01) 9 Calibrations +2 Years Service. +\$805
- M5**—(2236) 9 Calibrations +2 Years Service. +\$900

OPTIONAL ACCESSORIES

- Front Panel Cover and Accessory Pouch***1—Order 020-0672-02 \$50
- Front Panel Cover***1— Order 200-2520-00 \$8.50
- Accessory Pouch***1— Order 016-0677-02 \$33
- Viewing Hoods**— (Collapsible) Order 016-0592-00 \$14.25 (Binocular) Order 016-0566-00*1 \$19 (Polarized) Order 016-0180-00 \$60

- Carrying Strap**— Order 346-0199-00 \$17.50
- Carrying Case***2— Order 016-0792-01 \$360
- Rackmount Adaptor Kits**— (2235) Order 016-0466-00 \$130 (2235 Option 01) Order 016-0833-00 \$145 (2236) Order 016-0015-00 \$290
- CRT Light Filter**— (Clear*) Order 337-2775-01 \$1.95 (Blue) Order 337-2775-00 \$3.80
- 1107 Mounting Kit**— Order 016-0785-00 \$55
- 1107 DC Inverter**—See end of this Section \$1,140
- 1106 Battery Pack**—See end of this Section \$1,580
- 1105 Power Supply**—See end of this Section \$2,090
- A6901 Ground Isolation Monitor**—See Accessories Section. \$680
- A6902B Voltage Isolator**— See Accessories Section. \$1,885

RECOMMENDED PROBES

- See Probe Section for additional probes.
- P6121**—10X Probe. \$100
 - P6122**—10X Probe. \$58
 - P6420**—DMM RF. \$155
 - 40 kV DMM**—Order 010-0277-00 \$180
 - P6602 Temperature Probe**—For use with 2236 CTM. \$235

RECOMMENDED CAMERAS

- C-5C**—See Accessories Section. (2235 Option 01) C-5C Option 02 \$465 (2235, 2236) C-5C Option 04 \$495
- C-7**—See Accessories Section. (2235, 2236) C-7 Option 02 \$595 (2235 Option 01) Option 03 \$565
- C-4**—(2235 Option 01) See Accessories Section. \$375

RECOMMENDED CART

- K212**—For on-site mobility. See Accessories Section. \$350

SERVICE MANUALS

- (2235) Order 070-4206-00 \$26
- (2236) Order 070-4204-00 \$28
- *1 Standard with the 2235 Option 01 (AN/USM-488).
- *2 Recommend use with front panel cover (200-2520-00).

ORDERING INFORMATION

- 2236 Oscilloscope With Counter/Timer/Multimeter** \$2,795
Includes: Two P6121 10X voltage probes; DMM leads; Reference Guide; Operator Manual (070-4205-00).
- 2235 Oscilloscope** \$1,075
Includes: Two P6122 10X voltage probes; Operator manual (070-4207-00).
- 2235 Option 01 Oscilloscope (AN/USM-488) Order 2235L** \$2,195
Includes: Two P6122 10X Voltage Probes (015-0467-00); P6101A 1X Voltage Probe (010-6101-03); viewing hood (016-0566-00); BNC T-connector (103-0030-00); BNC male to binding post (103-0033-00); front panel cover (200-2520-00); accessory pouch (016-0677-02); two grabber tips (013-0191-00); Operator Manual (070-4976-00); Service Manual (070-4977-00).

Accuracy**

	+15 to +35°C	0 to +50 °C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

*1 +10 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 to +35°C); ±2% (0 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

2235/2235-01	Internal	External (p-p volts)
10 MHz	0.3 div*1	35 mV
60 MHz	1.0 div	120 mV
100 MHz	1.5 div*1	200 mV*2

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	160 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 div for 2235 Option 01.

*2 150 mV 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 (bandwidth limit switch depressed)—20 MHz.

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: ±20%. Delay difference between trigger view (EXT input) and either vertical channel: <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 vertical system (V/div switch in calibrated detent).

Accuracy	Y-Axis	X-Axis
+15 to +35°C	±2%	±3%
0 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—8×10 cm display; internal unilluminated graticule (2235 Option 01 is illuminated). Accelerating potential: 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) Square wave, 0.5 V ±5%, 1 kHz ±20%.

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

POWER REQUIREMENTS

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

Line Frequency—48 to 440 Hz.

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

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

ENVIRONMENTAL

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

Altitude—Operating: To 4600 m (15,000 ft). Maximum operating temperature decreased 1° C/1,000 ft (5,000 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 to 55 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 & 2235 Opt 01		2236	
	mm	in.	mm	in.
Dimensions				
Width*1	328	12.9	328	12.9
Height*3	137	5.4	137	5.4
Depth*2	440	17.3	440	17.3
Weight ≈	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.).



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 ≤500 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 to 500 V. Maximum Resolution: 100 μV. Accuracy: ±0.1%. Input: Through side DMM leads.*2

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 provided a scope that's more accurate, more reliable, lighter and more serviceable—and simpler to use—than any other 100 MHz scope.

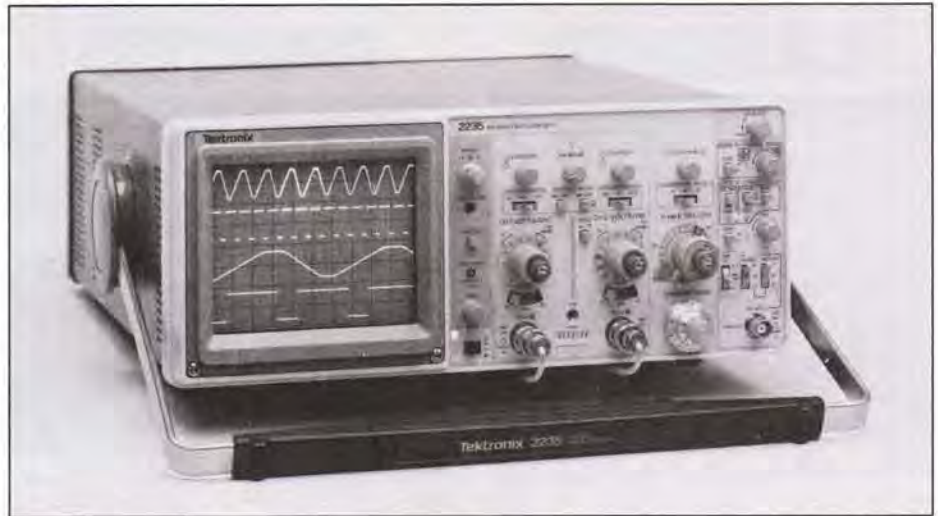
The 2235 delivers 2% vertical and horizontal accuracy in normal operation. Accuracy of 3% or better is maintained across a wide range of environmental extremes. Trace noise, chop noise, vertical aberrations and sweep interference have been reduced to a minimum. Delay jitter of 1:20,000 ensures excellent 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.

2235 Option 01 (AN/USM-488)

- Meets or Exceeds MIL-T-28800C and MIL-STD-461B Part 4 for EMC/EMI
- DC to 100-MHz Bandwidth
- National Stock No. 6625-01-187-7847
- UL Listed, CSA Certified

Comparable in performance to the standard 2235, the 2235 Option 01 version has impressive features. It meets the rigid environmental capabilities for Class 5 instruments as prescribed in MIL-T-28800C. 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.



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.



CHARACTERISTICS

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

VERTICAL SYSTEM (TWO IDENTICAL CHANNELS)

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

Deflection Factor—2 mV to 5 V/div at ±2%. Accuracy derated ±3% outside +15 to +35°C (+10 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.