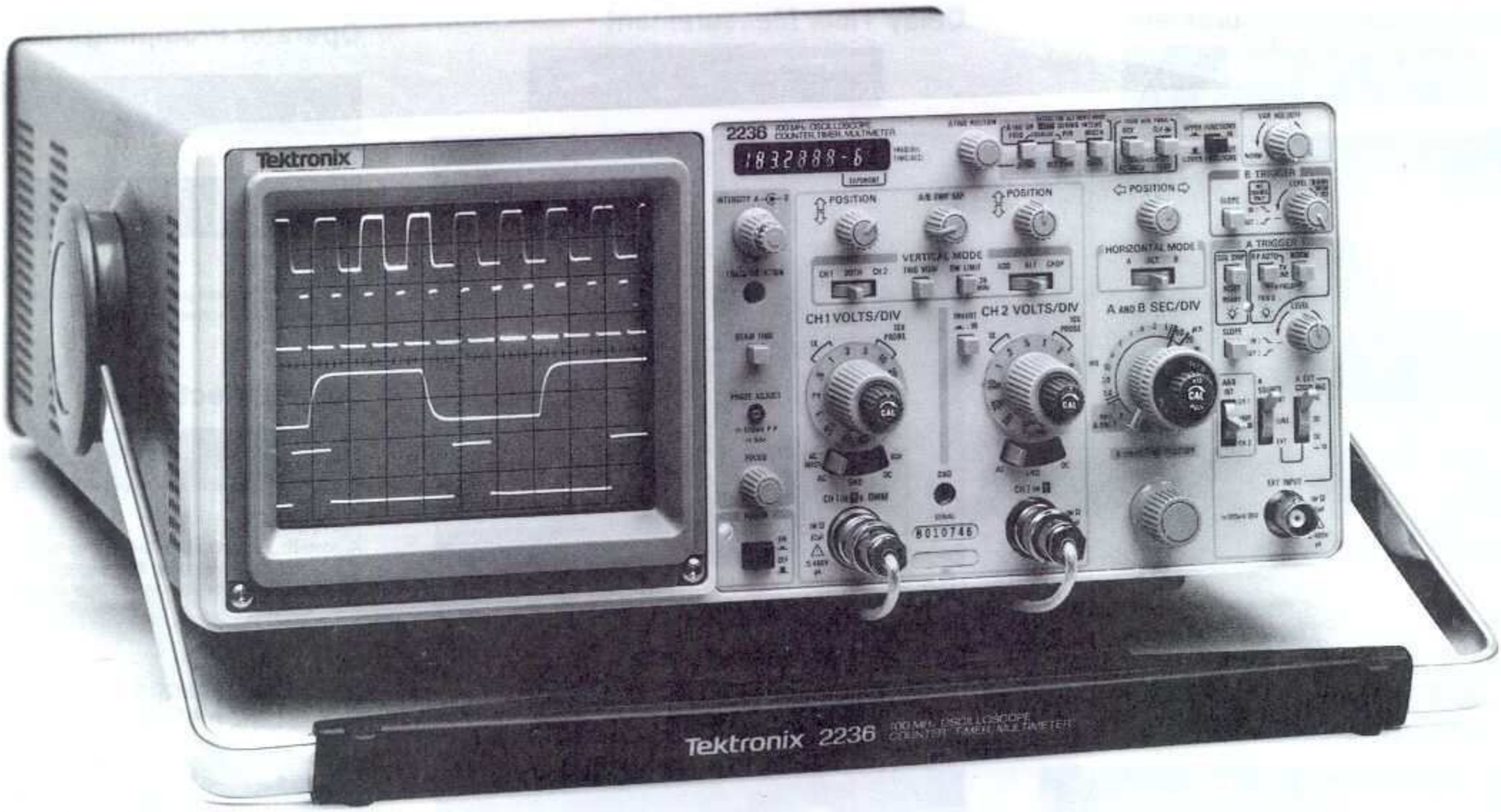


2235/2236

Dc to 100 MHz Bandwidth

Integrated Counter/Timer/DMM (2236)

Light Weight

Easy to Use

2 mV Sensitivity

Advanced Trigger System

5 ns/div Sweep Rate

Delayed Sweep Measurements

Large, Bright CRT

10X Probes Included

Three Year Warranty—Five Year Option

With the 2235 and 2236 oscilloscopes, Tektronix takes the high-value, high-performance design concept of the 2200 Series even further. Both scopes feature a low price made possible by the 2200 Series' innovative architecture. Yet both scopes offer advanced performance, 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 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. Its capabilities simplify setup, heighten measurement confidence and expand scope versatility in innumerable ways. In one application after another, the 2236 replaces mental gymnastics and round-about problem-solving with simple, direct, accurate, digital readouts that supplement your analog measurements.

The TEK 2236

The Tek 2236 provides easy, accurate, and versatile measurements through microprocessor-driven waveform analysis. While it's not unusual for a scope to include a bolt-on DMM or other outboard peripheral, the 2236 makes counter/timer/DMM-type measurements through the scope system itself. This convenient feature allows the user to make consolidated setups and combinations of measurements that have always been desirable but never before possible.

Traditionally, for example, gated measurements have been possible only by laborious knob-tweaking and mental calculations. Getting results was difficult at best.

But with the 2236, an operator 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.

Yet speed never comes at the expense of reliability: user confidence is continually enhanced.

The scope and DMM also can be applied simultaneously, with concurrent CRT and digital readout displays. The same probe that feeds data to the scope also provides information to the DMM, so there's no tangle of leads, no extra setup time required to obtain true ac RMS or dc voltage readings (see Figure 6).

DMM auto ranging simplifies setup. An ohmmeter range of 2 GΩ—a hundred times the range of most such devices—lets the service technician quickly pinpoint even small amounts of transformer leakage, for example, or allows designers to check the insulating property of capacitors more accurately than ever before (see Figure 9).

Designers and service people can both do a lot with the 2236, without learning a lot to do it. Frequency, period and width measurements are push-button simple, with accuracies to 0.001% and beyond. On-screen operator prompts further ensure fail-safe setup (see Figure 7).

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 8).

Using the 100 MHz, microprocessor-controlled 2236, autoaveraged and autoranged 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. Counter/timer/multimeter measurements are displayed on a 9-digit, 7-segment vacuum-fluorescent panel in engineering notation; audible signals supplement the resistance and continuity measurement messages. Self-testing includes power-on and user interactive routines.

The 2236 is designed for wide appeal by providing the power to simplify routine service measurements, and at the same time encouraging sophisticated designers towards creative methods of problem-solving.

In strong testimony of the incomparable reliability of the 2000 Family of oscilloscopes, Tek offers a three year warranty: All labor and parts, including CRT, excluding probes. And then, 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.

Gated Frequency Measurement

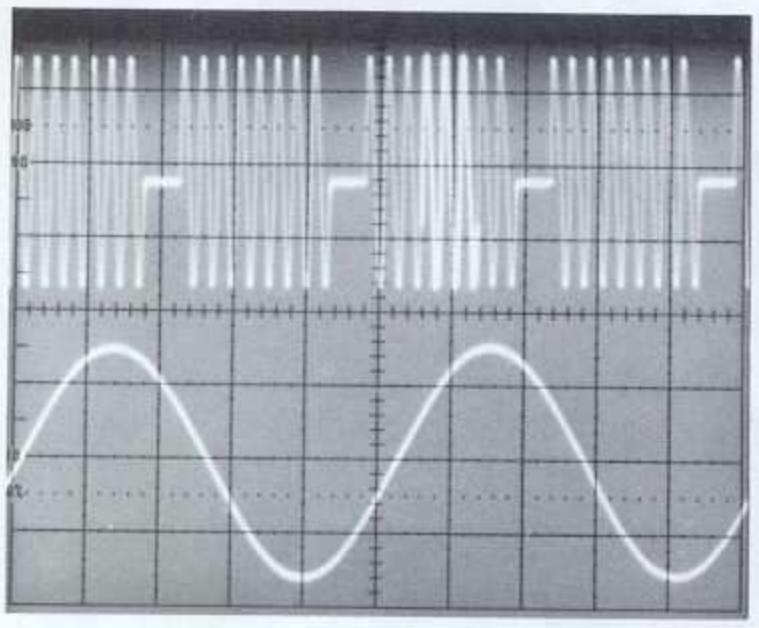


Figure 1
With the B sweep triggered, the frequency within the intensified zone on the A sweep is measured.

Gated Period Measurement

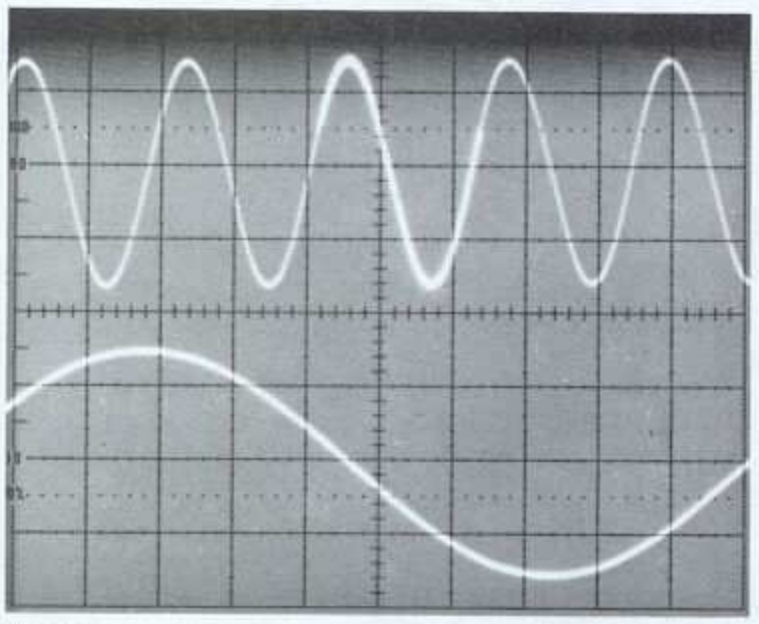


Figure 2
With the B sweep triggered, the period within the intensified zone on the A sweep is measured.

Gated Width Measurement

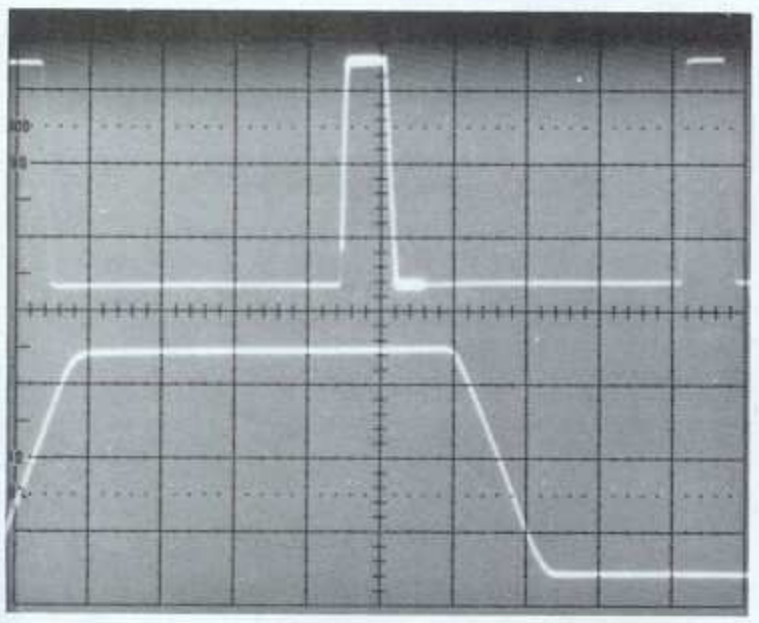


Figure 3
With the B sweep triggered, the width to be measure is within the intensified zone and polarity is selected by the B trigger slope control.

Gated Totalize Measurement

With the B sweep triggered, the events within the intensified portion of the A sweep is totalized.

Delay Time Measurement

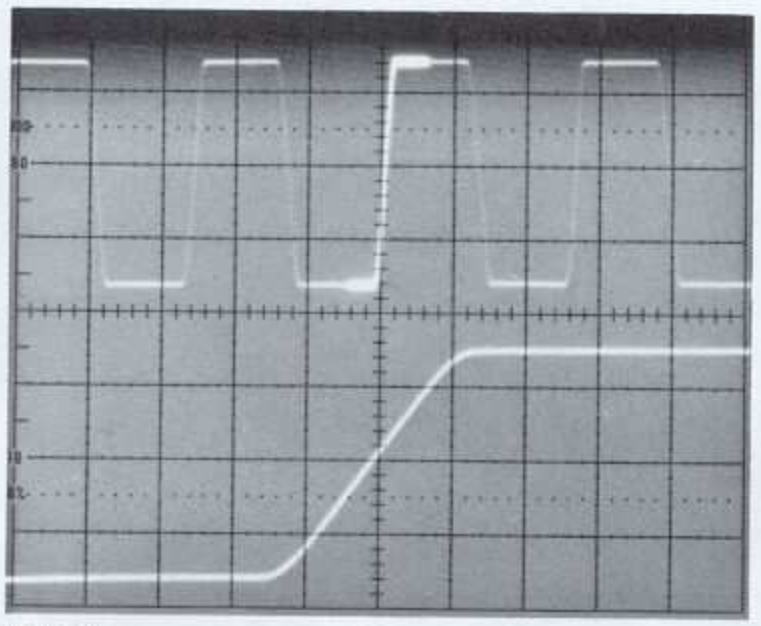


Figure 4
Delay time is measured from the start of the A sweep to the start of the intensified zone.

Delta Time Measurement

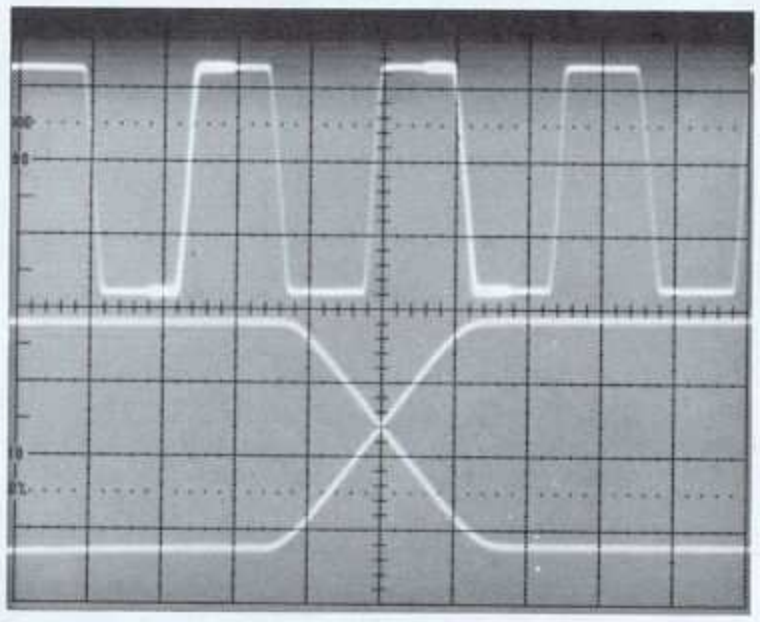


Figure 5
The time between the two intensified zones on the A sweep is measured with up to 10-picosecond resolution.

Channel 1 Volts Measurement

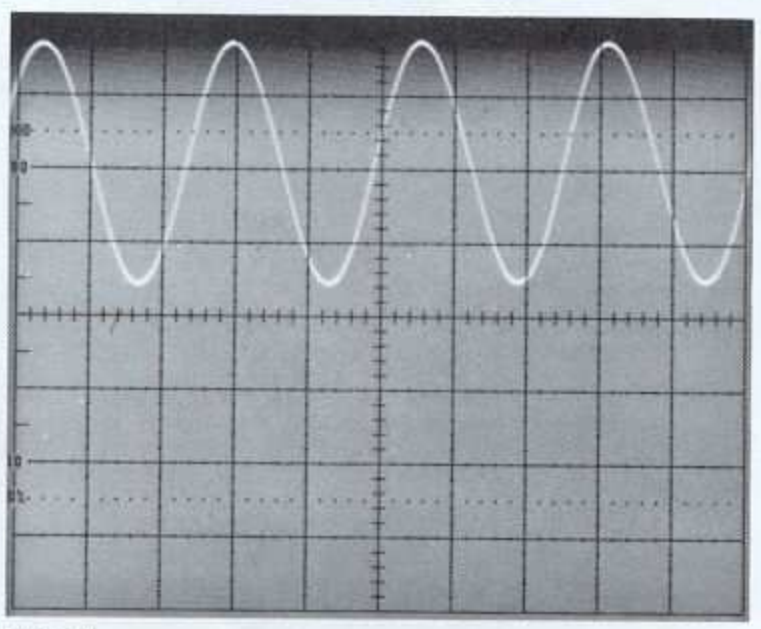


Figure 6
The average dc or true ac RMS component of a waveform is measured directly through channel 1 or from the floating DMM input.

Continuity Measurement

Resistances >5 Ω, the message "OPEN" is displayed. <5 Ω, a tone is generated and the message "SHORT" is displayed.

Operator Prompting

Figure 7
Error messages and prompts make counter-/timer/DMM measurements easier.

Diode Detection and Test

Figure 8
Automatic junction detection during normal resistance measurements first displays "DIODE" and then the forward voltage drop to 1%.

Extended Range Resistance Measurement

Figure 9
0 Ω (with 0.01 Ω resolution) to 1.99 GΩ, to find hard-to-trace problems like leaky caps or bad transformers.

Temperature Measurement

With optional P6602 Probe: From −62° C to +230° C (−80° F to +446° F); resolution to 0.1° (either range).

Microprocessor Diagnostics

Automatic power-up and user-interactive diagnostic routines simplify CTM service.

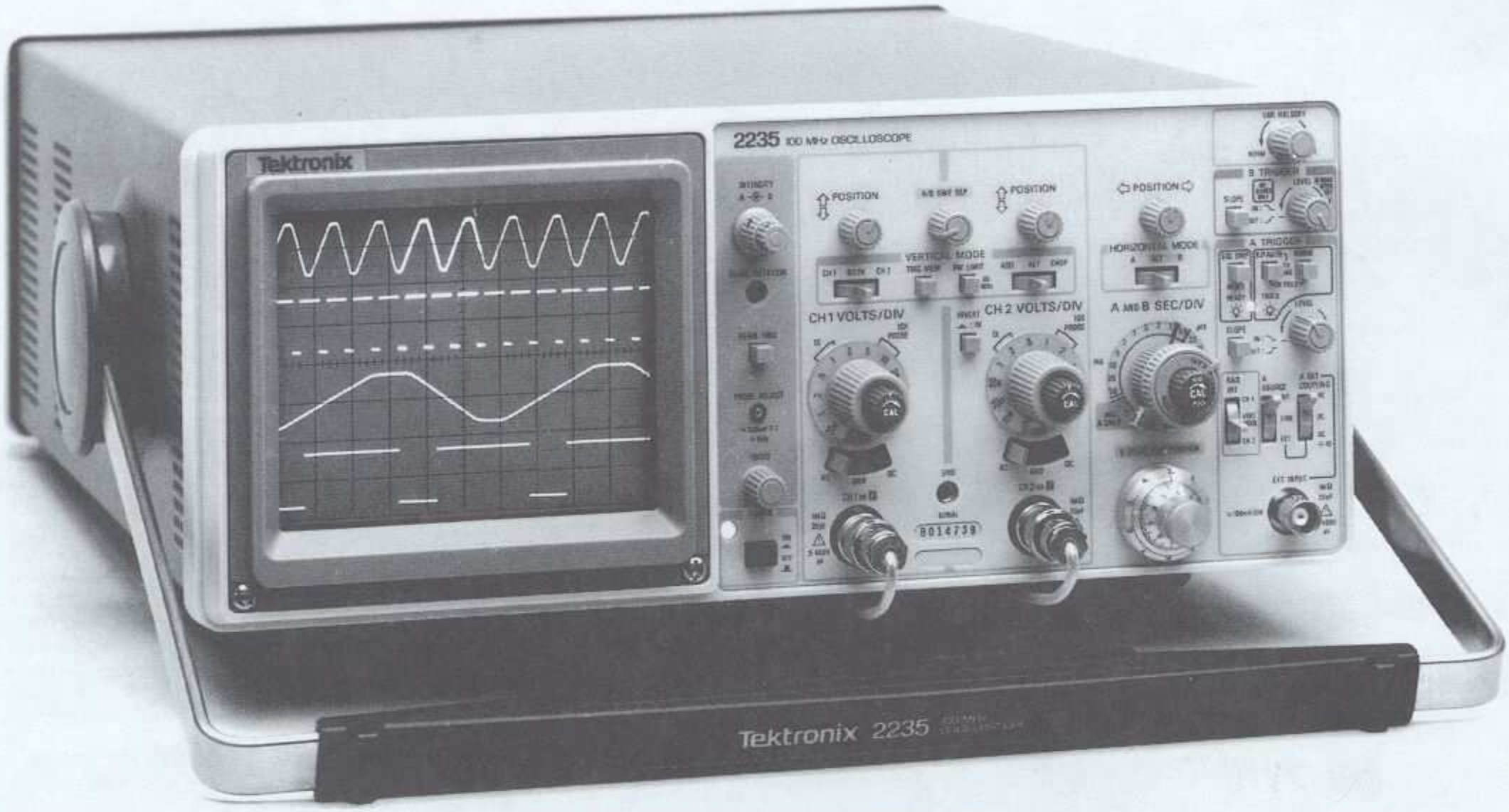
Accurate Time Measurement

Time base error only 10 ppm (0.001%) standard, and only 0.5 ppm (0.00005%) with optional temperature compensated crystal oscillator.

Measurement Ease and Accuracy

See the measurement you make on the CRT, read the result with digital accuracy on the 9-digit display.

For further information and specifications see page 305.



The TEK 2235

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 setup; single sweep for photographing transients; bandwidth limit for noisy environments; and a bright, high-resolution 14 kV dome mesh CRT.

Features like rugged design, light weight 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.

NEW 2235 Option 01 (AN/USM-488)

Fully Provisioned Through the U.S. Army System

Meets or Exceeds MIL-T-28800C

Dc to 100 MHz Bandwidth

Accepted and Specified by the U.S. Army

The TEK 2235 Option 01 (AN/USM-488)

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, cord wrap/storage pouch, P6101 1X 2-meter probe, 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, 2235 Option 01 except where noted.

VERTICAL SYSTEM
(TWO IDENTICAL CHANNELS)

Bandwidth (−3 dB) and Risetime — 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 to ±3% outside +15°C to +35°C (+10°C to +35°C 2235 Option 01. Uncalibrated: 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), +12%, −12%, 12% p-p (1 V to 5 V/div).
2236: +5%, −5%, 5% p-p (2 mV/div), +4%, −4%, 4% p-p (5 mV to 0.5 V/div), +14%, −14%, 14% p-p (1 V to 5 V/div).

Vertical System Operating Modes — CH 1, CH 2, CH 2 Invert, Add, Alt, Chop (500 kHz).

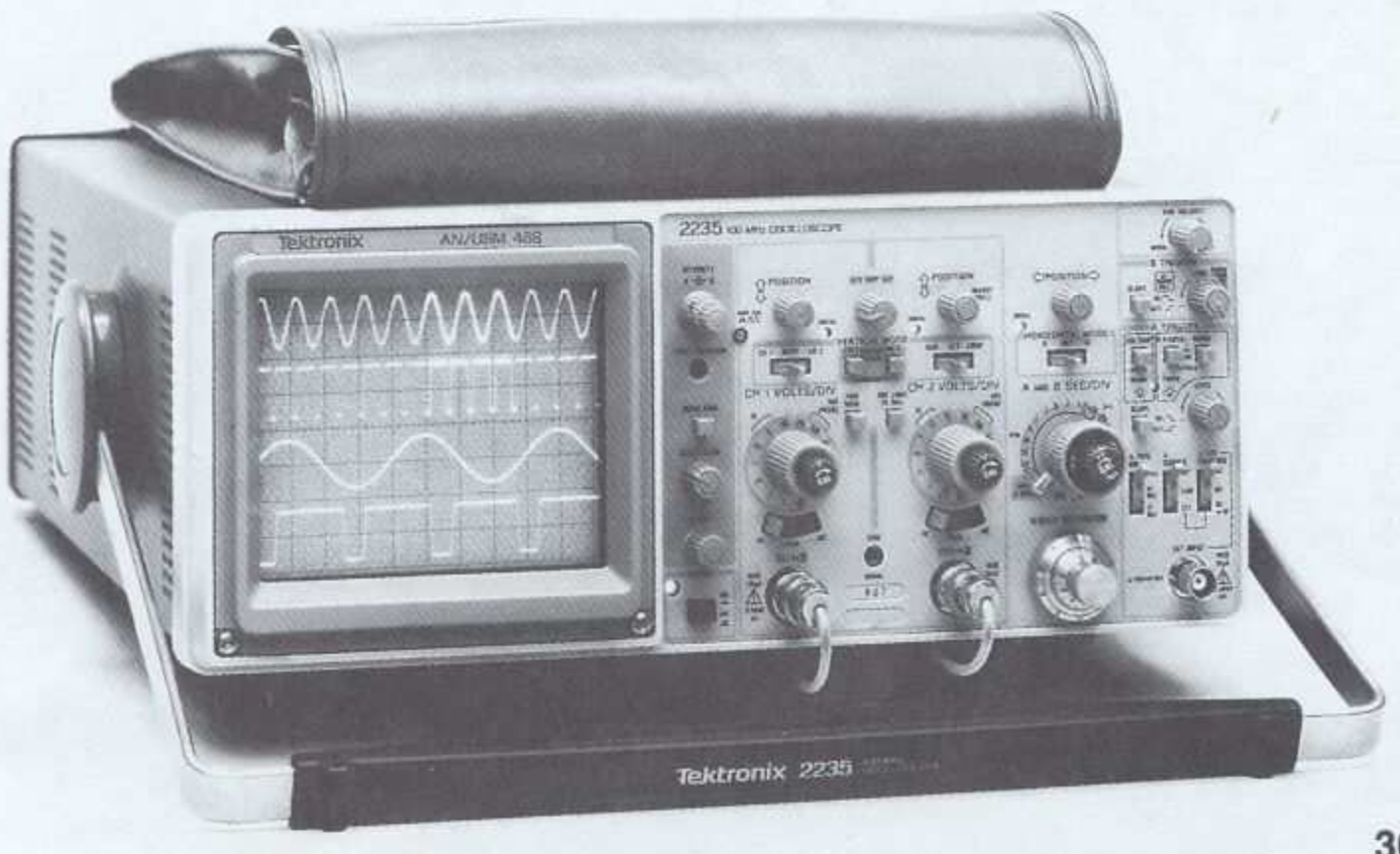
Common-Mode Rejection Ratio — For signals of 6 divisions or less, at least 10:1 @ 50 MHz. (10:1 @ 80 MHz 2235 Option 01).

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.

Trace Shift — ≤0.75 div with V/div switch rotation, ≤1 div with V/div variable, ≤1.5 div with CH 2 Invert.



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 8 divisions.

Accuracy — Magnified: ±3%. Unmagnified: ±2%. Derated outside +15°C to +35°C (+10°C to +35°C 2235 Option 01).

Horizontal Operating Modes — A, alternate (A intensified by B), B.

DELAYED SWEEP

Delay Times — Continuously variable with 10-turn control from <0.5 +300 ns to >10 divisions.

Differential Delay Dial Accuracy (2235 and 2235 Option 01) — ±1% (+15°C to +35°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%).

TRIGGER SYSTEM

A Trigger Sensitivity

2235 & 2235 Opt 01	Internal	External (p-p volts)
10 MHz	0.3 div	35 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
100 MHz	1.5 div	250 mV
2236 CTM		
10 MHz	0.5 div	50 mV
100 MHz	2.0 div	300 mV

B Trigger (Internal Only) Sensitivity

	10 MHz	100 MHz
2235 & 2235 Opt 01	0.35 div	1.5 div
2236	0.4 div	1.5 div
2236 CTM	0.5 div	2.0 div

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 field, and single sweep. Bandwidth Limit: 20 MHz ±10%.

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 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 MEASUREMENTS

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.

DISPLAY

CRT — 8 x 10 cm display; internal graticule, unilluminated GH (P31) phosphor is standard; 14 kV nominal voltage.

Controls — Beam finder, focus, separate A and B sweep intensity, trace rotation.

Z-Axis — Sensitivity: 5 V cause noticeable modulation, positive voltage decreases intensity. Usable frequency range is dc to 20 MHz.

ENVIRONMENTAL CHARACTERISTICS

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.

Humidity — Operating and Nonoperating: 5 cycles (120 hours) referenced to MIL-T-28800C.

Altitude — Operating: To 4500 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).

Shock — Operating: 30 g's, ½ sine, 11 ms duration, 3 shocks per axis each direction for a total of 18 shocks.

Vibration — Operating test samples were subjected to sinusoidal vibration in the X, Y, and Z axis with the frequency varied from 10 Hz to 55 Hz to 10 Hz in 1 minute sweeps for a duration of 15 minutes per axis and a dwell of 10 minutes at 55 Hz. Total displacement was 0.015 in p-p (2.4 g's at 55 Hz).

EMC (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).

All 2200 series instruments meet Class B requirements per VDE 0871 for radiated and conducted emission.

OTHER CHARACTERISTICS

Power — Voltage: 90 V to 250 V ac. Frequency: 48 Hz to 440 Hz. Operation from 10 V to 30 V dc is available with Option 07. (No line switches or fuse changes needed.)

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

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

2236 with Counter/Timer/Multimeter

CHARACTERISTICS

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

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

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

Delay Time — Range: ≥2.5 s to ≤500 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±2 ns.

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

Totalize — Over 8,000,000 events. Can be gated.*1

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

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.

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.

Resistance — Range: 0 GΩ 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.

Temperature — Uses Optional Tektronix P6602 Temperature Probe. Temperatures in C or F selected with Freq/ΔTime button. Range: −62°C to +230°C. 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.*

PHYSICAL CHARACTERISTICS

	2235 and 2235 Opt 01		2236	
Dimensions	**mm**	**in**	**mm**	**in**
Width*1	328	12.9	328	12.9
Height	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.*

INCLUDED ACCESSORIES (2235)

Two P6122 10X voltage probes (010-6122-01); operator's manual; service manual optional.

INCLUDED ACCESSORIES (2235 Option 01)

Two P6122 10X Voltage Probes (010-6122-01); P6101 1X Voltage Probe (010-6101-03); BNC T-connector; BNC male to binding post; front panel cover; accessory pouch; two grabber tips; operator's manual; service manual.

INCLUDED ACCESSORIES (2236)

Two P6121 10X voltage probes (010-6121-01); DMM leads; operator's manual; service manual optional.

ORDERING INFORMATION

2235 Oscilloscope **$1,650**

2235 Option 01 Oscilloscope (AN/USM-488) **Order 2235L** **$1,995**

2236 Oscilloscope with Counter/Timer/Multimeter **$2,650**

Option 14 — TCXO Temperature-Compensated Crystal Oscillator (2236 Only) ..... **+$295**

Impact resistant packaging is available. Contact your local Tektronix Sales Engineer for details.

INTERNATIONAL POWER CORD AND PLUG OPTIONS

Option A1 — Universal Euro 220 V/16 A, 50 Hz. Order 020-0859-00.

Option A2 — UK 240 V/13 A, 50 Hz. Order 020-0860-00.

Option A3 — Australian 240 V/10 A, 50 Hz. Order 020-0861-00.

Option A4 — North American 240 V/15 A, 60 Hz. Order 020-0862-00.

Option A5 — Switzerland 220 V/10 A, 50 Hz. Order 020-0863-00.

WARRANTY-PLUS SERVICE PLANS—REFER TO PAGE 15

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 ..... **+$380**

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 ..... **$47**

Front Panel Cover*1 — Order 200-2520-00 ..... **$5.00**

Accessory Pouch*1 — Order 016-0677-00 ..... **$42**

Viewing Hood — Order 016-0566-00 ..... **$15**

Carrying Strap — Order 346-0199-00 ..... **$15**

Carrying Case — Order 016-0792-00 ..... **$295**

2235 Rack Adaptor Kit — Order 016-0466-00 ..... **$100**

2236 Rack Adaptor Kit — Order 016-0015-00 ..... **$200**

CRT Light Filter (Clear)*1 — Order 337-2775-00 ..... **$3.00**

Camera C-5C — Option 04 ..... **$495**

K212 Portable Instrument Cart — For on-site portability. **$330**

K117 Instrument Shuttle — For site-to-site portability. **$265**

See page 429 for complete description on carts.

A6902A Isolator — For floating measurements see page 434 for complete description. Order A6902A **$1,985**

P6602 Temperature Probe — For use with 2236 CTM. Order 010-6602-00 ..... **$225**

See probe section for additional probes.

2235 Service Manual — Order 070-4206-00 ..... **$25**

2236 Service Manual — Order 070-4204-00 ..... **$25**

*1 *Standard with the 2235 Option 01 (AN/USM-488).*

To order, call your local Tektronix Field Office, or call Tek's National Marketing Center, toll free: 1-800-426-2200, Ext 99. In Oregon call collect: (503) 627-9000, Ext 99.