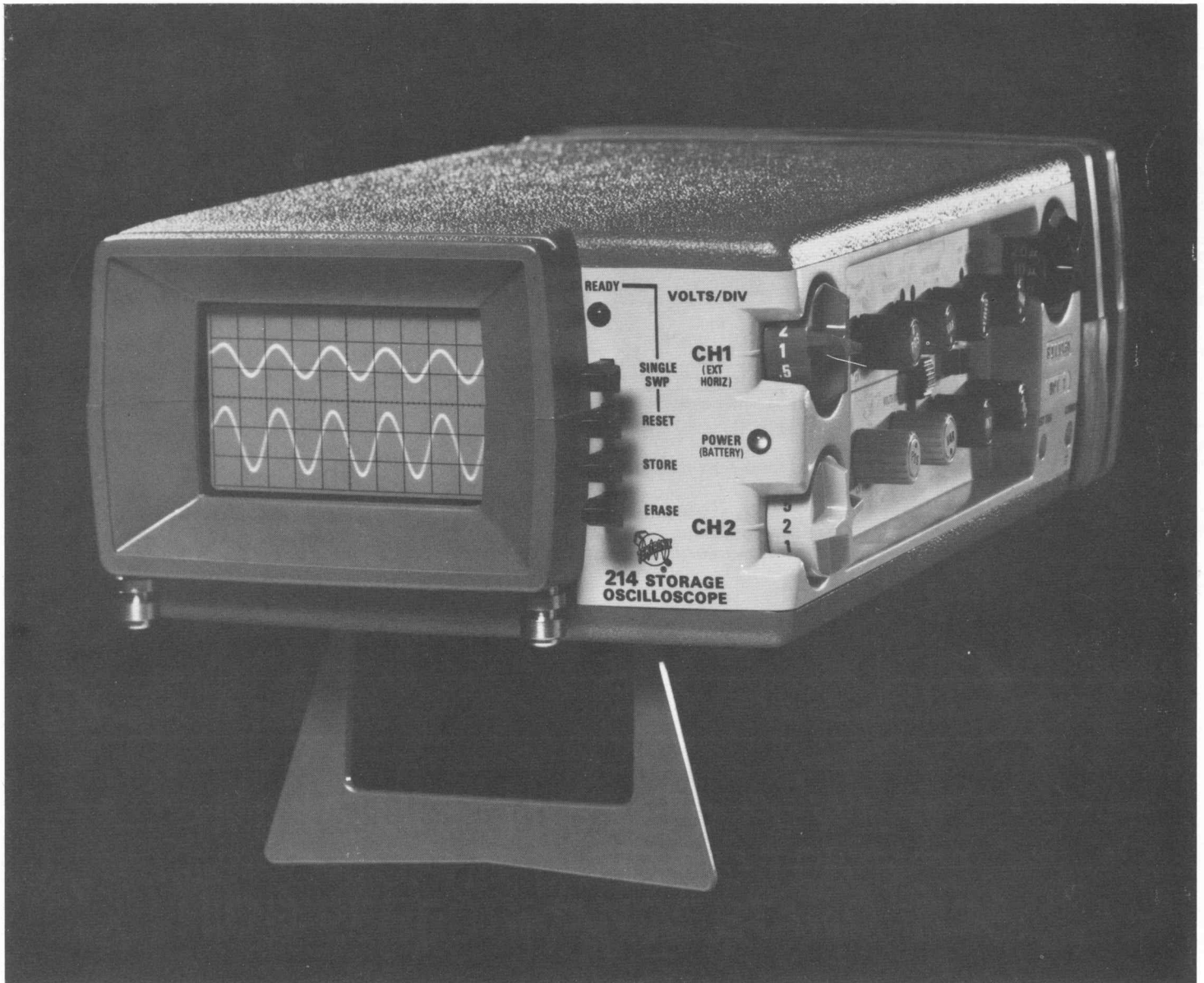


# MINIATURE, BATTERY-POWERED SCOPES, BUILT TO TEK'S HIGH-PERFORMANCE STANDARDS.



# 213 SPECIFICATIONS

## VERTICAL DEFLECTION (VOLTAGE)

**Bandwidth**—Dc to 1 MHz (–3 dB point) for 20 mV/div to 100 V/div deflection factors. Dc to 400 kHz (–3 dB point) for 5 mV/div and 10 mV/div. Lower –3 dB point for ac coupling is approx 1 Hz.

**Deflection Factor**—5 mV/div to 100 V/div (1-2-5 sequence), accurate  $\pm 3\%$ . Uncalibrated; continuously variable between steps to at least 250 V/div.

**Input R and C**—10 M $\Omega$  paralleled by 150 pF for 5 mV/div through 1 V/div and 100 pF for 2 V/div through 100 V/div.

### Max Input Voltage

Input Condition	Max Input Voltage
Dc coupled, 5 mV/div to 1 V/div	500 V (dc + peak ac) at 1 MHz or less
Ac coupled, 5 mV/div to 1 V/div	800 V (dc + peak ac) 500 V peak ac component
Ac, Dc coupled, 2 V/div to 100 V/div	800 V (dc + peak ac) at 1 MHz or less

## VERTICAL DEFLECTION (CURRENT)

**Bandwidth**—Dc to at least 400 kHz (–3 dB point) for 20  $\mu$ A/div through 100 mA/div deflection factors. Dc to at least 200 kHz (–3 dB point) for 5  $\mu$ A/div and 10  $\mu$ A/div.

**Deflection Factor**—5  $\mu$ A/div to 100 mA/div (1-2-5 sequence), accurate  $\pm 3\%$ . Uncalibrated; continuously variable between steps to at least 250 mA/div.

**Max Input Current**—2 A rms or 3 A peak for any range (fuse and diode protection).

## HORIZONTAL DEFLECTION

**Time Base**—2  $\mu$ s/div to 500 ms/div (1-2-5 sequence), accurate  $\pm 5\%$ .

**Variable Magnifier**—Increases all sweep speeds to at least X5 with a max sweep speed of 0.4  $\mu$ s/div.

## TRIGGER

**Modes**—Normal (sweep runs when triggered). Automatic (sweep free-runs in absence of trigger signal or for frequencies below 7 Hz).

**Trigger Sensitivity and Coupling**—Ac Internal (auto and normal, 1 MHz), 0.5 div Dc External, 1 MHz, 1 V.

## DISPLAY

**Crt**—6 x 10 div (0.52 cm/div) display. P43 phosphor is standard.

**Graticule**—Internal, black line, non-illuminated.

## ENVIRONMENTAL CAPABILITIES

**Ambient Temperature**—Operating: (battery only). –15°C to +55°C. Charging or operating from ac line: 0°C to +40°C. Nonoperating: –40°C to +60°C.

**Altitude**—Operating: to 25,000 ft, decrease max temperature by 1°C/1,000 ft above 15,000 ft. Nonoperating: 40,000 ft.

**Vibration**—Operating and nonoperating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles. Held for 3 minutes at 55 Hz.

**Humidity**—40°C or less, 80% or less relative humidity.

**Shock**—Operating and nonoperating: 150 g's, ½ sine, 2 ms duration in each direction along each major axis. Total of 12 shocks.

## OTHER CHARACTERISTICS

**Power Sources**—Internal NiCd batteries provide approx 3.5 hours operation at max trace intensity for a charging and operating temperature between 20°C and 30°C. Internal charger charges batteries when connected to an ac line with instrument turned on or off. Dc operation is automatically interrupted when battery voltage drops below 2 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. External power source, 90 to 136 V ac (48 to 62 Hz). Option 1 allows operation from an external 180 to 250 V ac (48 to 62 Hz) or dc supply. Power consumption, 8 watts or less.

**Insulation Voltage**—500 V rms or 700 V (dc + peak ac) when operated from internal batteries with line cord and plug stored. When operated from ac, line voltage plus floating voltage not to exceed 250 V rms or 1.4 X line + (dc + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.2	13.2
Depth	8.9	22.6
Weights (approx)	lb	kg
Net (without accessories)	3.7	1.7
Shipping	8.6	3.9

## DMM

Provides true rms readings of voltage and current.

## DC AND AC VOLTAGE

**Range**—0.1 V to 1000 V full scale in 5 ranges.

**Resolution**—100  $\mu$ V at 0.1 V full scale.

**Accuracy in Dc Mode**—For 25°C  $\pm 5^\circ$ C.

## Range (Full Scale)

0.1 V	$\pm 0.1\%$ of reading $\pm 3$ counts. Temp coef is ( $\pm 0.015\%$ of reading + 0.04% of full scale) per °C.
1 V	$\pm 0.1\%$ of reading $\pm 1$ count. Temp coef is ( $\pm 0.01\%$ of reading + 0.01% of full scale) per °C.
10 V and 100 V	$\pm 0.15\%$ of reading $\pm 1$ count. Temp coef is ( $\pm 0.015\%$ of reading + 0.01% of full scale) per °C.
1000 V	$\pm 0.2\%$ of reading $\pm 1$ count. Temp coef is ( $\pm 0.02\%$ of reading + 0.01% of full scale) per °C.

**Accuracy in Rms Mode**—For 25°C  $\pm 5^\circ$ : Temperature coefficient ( $\pm 0.05\%$  of reading  $\pm 0.1\%$  of full scale) per °C.

Range	Within % of reading shown $\pm 5$ counts*		
	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz
0.1 V	2.5%	1.5%	3.5%
1 V, 10 V, and 100 V	2%	1%	1%
1000 V	2%	1%	2%

\*Accuracy limit increases linearly for crest factor greater than 2 up to twice indicated limit for crest factor of 5.

**Input Resistance**—10 M $\Omega$ .

**Input Capacitance**—150 pF on 0.1 V to 10 V ranges, 100 pF on 100 V and 1000 V ranges.

**Settling Time**—DC: 1.5 sec to 0.1% of reading. RMS: 2 sec to 1% of reading.

**Max Input Voltage**—

Dc Coupled	Ac Coupled
0.1 V to 10 V	100 V to 1000 V
500 V (dc + peak ac)	800 V (dc + peak ac)

0.1 V to 10 V

800 V (dc + peak ac)

## DC AND AC CURRENT

**Range**—0.1 mA to 1000 mA full scale in 5 ranges.

**Resolution**—100 nA at 0.1 mA full scale.

**Accuracy in Dc Mode**—For 25°C  $\pm 5^\circ$ C.

**Temperature Coef**—( $\pm 0.02\%$  of reading + 0.04% of full scale) per °C. 0.1 mA  $\pm 0.5\% \pm 3$  counts. 1 mA to 1000 mA  $\pm 0.25\% \pm 3$  counts.



# 212 AND 214 SPECIFICATIONS

## VERTICAL DEFLECTION

**Bandwidth**—Dc to at least 500 kHz from 10 mV/div to 50 V/div, reducing to at least 100 kHz at 1 mV/div. Lower—3 dB point ac coupled is less than 2 Hz.

**Deflection Factors**—1 mV/div to 50 V/div (1-2-5 sequence), accurate  $\pm 5\%$ . Uncalibrated, continuously variable between steps to at least 125 V/div.

**Display Modes**—Ch 1 only, Ch 2 only, or Ch 1 and Ch 2 chopped (approx chop rate—40 kHz) from 500 ms/div to 2 ms/div of time base, alternate from 1 ms/div to 5  $\mu$ s/div of time base.

**Input R and C**—Approx 1 M $\Omega$  paralleled by approx 160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.

**Max Input Voltage** (1X probe only)

1 mV/div to 50 mV/div	600 V (dc + peak ac) ac not over 2 kHz.
0.1 V/div to 50 V/div	600 V (dc + peak ac) 600 V p-p ac 5 MHz or less

## HORIZONTAL DEFLECTION

**Time Base**—5  $\mu$ s/div to 500 ms/div, accurate  $\pm 5\%$ .

**Variable Magnifier**—Increases each sweep rate X5 with a max sweep speed of 1  $\mu$ s/div.

**External Horizontal Input**—(Ch 1) 1 MV/div to 50 V/div  $\pm 10\%$ ; dc to 100 kHz; X-Y phasing to 5 kHz less than 3°. Input characteristics same as Ch. 1.

**Max External Horizontal Input Voltage**—50 V (dc + peak ac), 100 V (p-p).

**Input Impedance**—R and C, 1 M $\Omega$  paralleled by approx 30 pF.

## TRIGGER

**Trigger Modes**—Automatic or normal. Level and slope selected with a single control. Automatic operation minimizes trigger adjustment and provides a bright baseline with no input.

**Trigger Sensitivity and Coupling**

Coupling		to 500 Hz
Dc	Internal (w/composite trigger source)	0.2 div
	Internal (w/ch 2 trigger source)	0.2 div
	External	1 V to 20 V p-p

**Single Sweep**—Sweep generator produces one sweep when trigger is received. (214 only)

## DISPLAY

**Crt**—Bistable storage, 6 x 10 div (0.52 cm/div) display P44 Phosphor (214 only). P31 Phosphor (212 only).

**Graticule**—Internal, black line, non-illuminated.

## STORAGE FEATURES

**Stored Writing Speed**—Normal, at least 80 div/ms. Enhanced, increases single-sweep storage writing speed to at least 500 div/ms. Enhance is automatic from 0.1 ms to 5  $\mu$ s/div in single sweep.

**Stored Luminance**—At least 8 footlamberts.

**Storage Viewing Time**—Approx 1 hr.

## ENVIRONMENTAL CAPABILITIES

**Ambient Temperature**—Operating: (battery only),  $-15^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ . Charging or operating from ac line,  $0^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Nonoperating:  $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

**Altitude**—Operating: 25,000 ft, decrease max temperature by  $1^{\circ}\text{C}/1000$  ft above 15,000 ft. Nonoperating: 50,000 ft.

**Vibration**—Operating and nonoperating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in one-minute cycles. Held for three minutes at 55 Hz.

**Humidity**—5 cycles (120 hours). 95% relative humidity, referenced to MIL-E-16400F.

**Shock**—Operating and nonoperating: 150 g's,  $\frac{1}{2}$  sine, 2 ms duration in each direction along each major axis. Total of 12 shocks.

## OTHER CHARACTERISTICS

**Power Sources**—Internal NiCd batteries provide approx 5 hours operation (approx 3.5 hours in 214 stored mode) at max trace intensity for a charging and operating temperature between  $20^{\circ}\text{C}$  and  $30^{\circ}\text{C}$ . Internal charger charges the batteries when connected to an ac line with instruments turned off. Battery operation is automatically interrupted when battery voltage drops to approx 10 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. Extended charge times will not damage the batteries.

A pilot light battery-charge indicator light will extinguish when oscilloscope has about 10 min (5 min for the 214) of operating time remaining in the batteries.

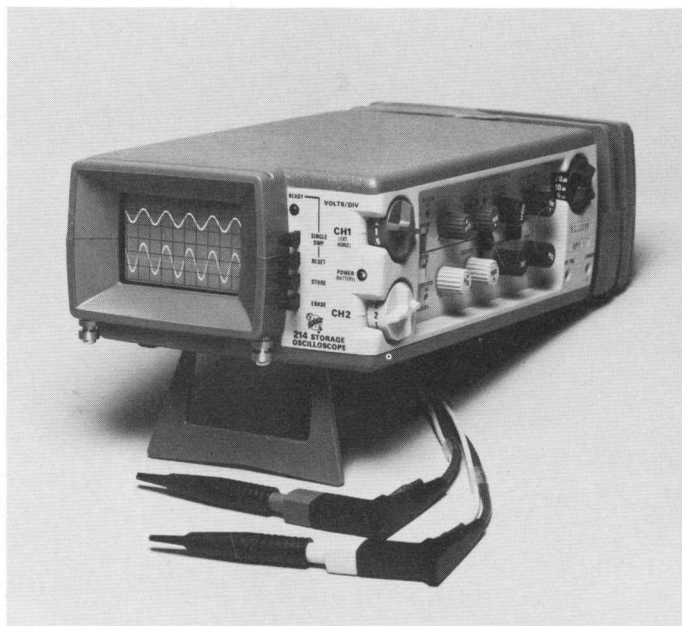
**External Ac Source**—110 to 126 V, 58 to 62 Hz, 3 W. Can be operated at 104 to 110 V with resulting slow discharge of internal batteries.

**Insulation Voltage**—500 V rms or 700 V (dc + peak ac) when operated from internal batteries, with the line cord and plug stored. When operated from ac, line voltage plus floating voltage not to exceed 250 V rms; or 1.4X line + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.3	13.3
Depth	9.5	24.1
Weights (approx)	lb	kg
Net (without accessories)	3.5	1.6
Shipping	7.0	3.2

## INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), two 4-A fuses (159-0121-00), identification tags (000-7983-00), identification tag (334-2614-00), carrying strap (346-0104-00).



# THE GO-ANYWHERE TEK 200 SERIES: SMALL-SCALE SCOPES WITH FULL-SCALE PERFORMANCE

The Tek 200 Series offers four distinct models of miniature, go-anywhere oscilloscopes, with bandwidths from 500 kHz to 5 MHz, all with a full measure of Tektronix engineering excellence.

Each 200 Series scope weighs less than 3.7 pounds (1.7 kg) and includes rechargeable internal batteries and easy-to-read 6 x 10 div (0.5 cm/div) display. Each has been human engineered to simplify operation—even under adverse conditions. Neck straps, for example, free your hands for climbing, for steadying yourself, or for using the scopes' integral probes. Controls are color-coded for simplicity of operation.

**You get miniaturization and precise measurements, too.** Vertical sensitivity of the dual-trace 214, (shown actual size on front cover), ranges from 1 mV/div to 50 V/div. The 5 mV/div to 100

V/div vertical sensitivity of the 5 MHz 221 allows on-screen measurements of signals to 600 V dc + peak ac. Sweep speeds are up to 100 ns/div.

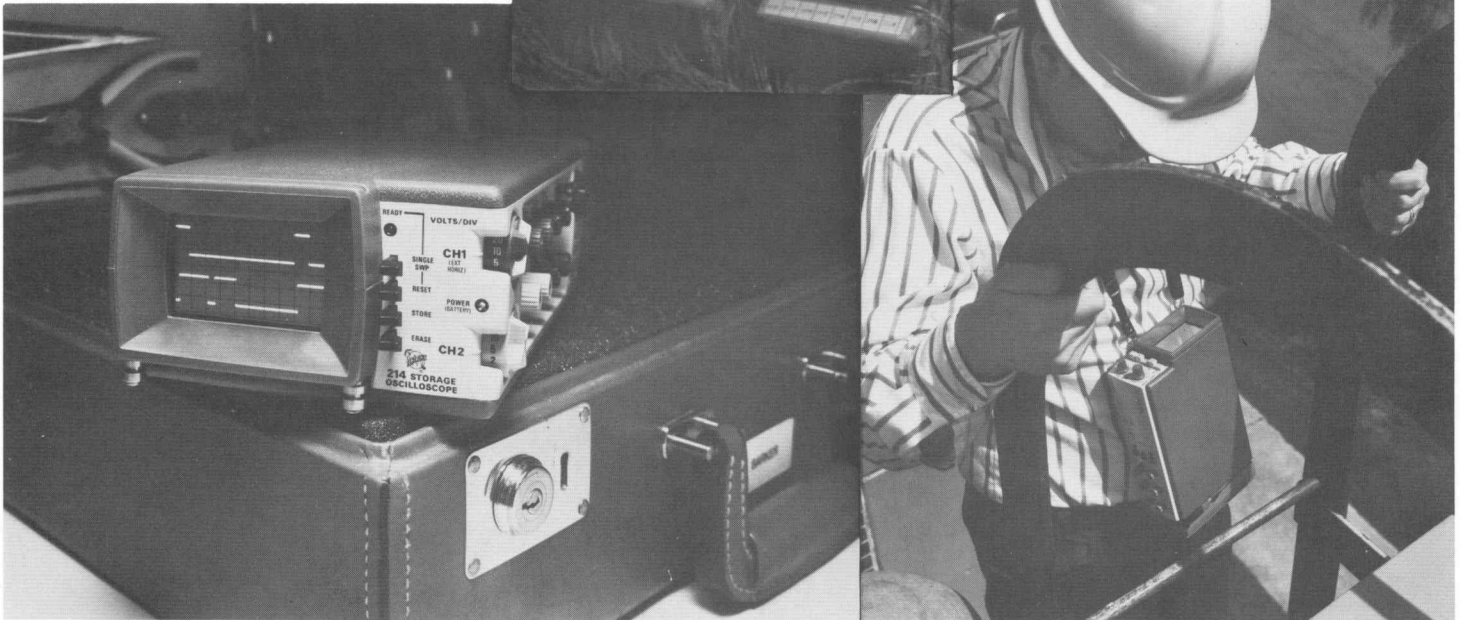
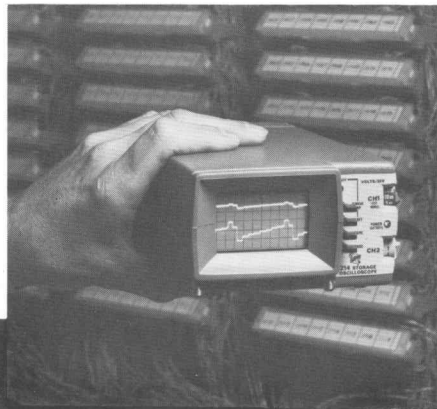
**All 200 Series scopes are double insulated for "floating" measurements.** All 200 Series scopes are made of impact-resistant plastic and provide true isolation from both the mains and the signal "common." All are rated to 250 V with respect to their mains insulation, and 700 V peak with respect to the signal being measured, when operated on their internal batteries. This basic protection makes the 200 Series especially suitable for power supply and mechanical measurement tasks.

**Select single or dual trace. Bistable storage. Or built-in DMM.** The four scopes of the Tek 200 Series let you closely specify the most desired set of capabilities for your remote measurement applications. Standard to all are viewing hood, carrying case, neck strap, integral probes—and the intelligently thought-out design that keeps operation easy.

**You can order any 200 Series miniscope, or obtain further information from technical experts, with one toll-free call.** The Tektronix National Marketing Center is just one more way we make it easy to put the 200 Series in the palm of your hand. Call today for the go-anywhere scopes that are Tektronix all the way!

**1-800-547-1845**

(Oregon, Alaska and Hawaii, call 503-627-5402 collect.)



# 221 SPECIFICATIONS

## Accuracy in Ac Mode—

Range	Within % of reading shown $\pm 5$ counts*		
	40 Hz to Dc	4 kHz to 40 kHz	4 kHz to 40 kHz
0.1 mA	2.5%	1.5%	4.5%
1 mA to 1000 mA	2.5%	1.5%	3.5%

\*Accuracy limit increases linearly for crest factor greater than 2 up to twice indicated limit for crest factor of 5.

**Settling Time**—1.5 sec to 0.1% of reading.

**Max Input Current**—2 A rms or 3 A peak on any scale (fuse and diode protection).

## RESISTANCE

**Ranges**—1 k $\Omega$  to 10 M $\Omega$  full scale in 5 ranges.

**Resolution**—1  $\Omega$  on 1 k $\Omega$  scale.

**Accuracy**—For 25°C  $\pm 5^\circ\text{C}$ .

Range	% of Reading
1 k $\Omega$	0.5% $\pm 3$ counts
0 k $\Omega$ to 1 M $\Omega$	0.5% $\pm 1$ count
10 M $\Omega$	1% $\pm 1$ count

**Settling Time**—2 seconds  $\pm 2$  counts.

## READOUT

**Number of Digits**—3½ digits plus decimal point and sign.

**Display Size**—1 cm high by 4 cm wide (5 characters).

**Overrange Capability**—At least 200% of full scale.

**Overrange Indication**—Readout displays scrambled characters.

## INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), 2 test leads (alligator clip to banana jack) (red 012-0015-00) (black 012-0014-00), neck strap (346-0104-00), 2 power line fuses (159-0080-00), power line plug adapter (option 01 only) (161-0077-01), identification tag (334-2614-00), identification tag (000-7983-00).

## VERTICAL DEFLECTION

**Bandwidth**—Dc to 5 MHz ( $-3$  dB point) at all calibrated deflection factors. Lower  $-3$  dB point ac coupled is approx 2 Hz.

**Deflection Factor**—5 mV/div to 100 V/div, accurate 3% from 0°C to +40°C and  $\pm 5\%$  from  $-15^\circ\text{C}$  to 0°C and +40°C to 55°C. Uncalibrated, continuously variable between steps to at least 300 V/div.

**Input R and C**—Aprox 1 M $\Omega$  paralleled by approx 29 pF via attached signal acquisition probe.

**Max Input Voltage**—600 V (dc + peak ac), 600 V p-p ac, 5 MHz or less.

## HORIZONTAL DEFLECTION

**Time Base**—1  $\mu\text{s}/\text{div}$  to 200 ms/div, accurate  $\pm 3\%$ .

**Magnifier**—Increases all sweep speeds X10 with a max sweep speed of 0.1  $\mu\text{s}/\text{div}$ .

**Variable Time Control**—Extends minimum sweep rate to approx 0.5 s/div. Continuously variable between calibrated settings.

## TRIGGER

**Modes**—Automatic or manual. Level and slope selected with a single control. Automatic operation minimizes trigger adjustment and provides a bright baseline with no input.

**Trigger Sensitivity**

Mode	To 1 MHz	At 5 MHz
Internal	0.5 div	1 div
External	0.5 V	1 V

## X-Y OPERATION

**Input**—X-axis input is via the external trigger or the external horizontal input.

**X-axis Deflection Factor**—1 V/div  $\pm 10\%$ , dc to 500 kHz. Sensitivity is increased by a factor of 10 (0.1 V/div) using horizontal magnifier.

**Max External Horizontal Input Voltage**—200 (dc + peak ac), 200 V (p-p ac) to 500 kHz, decreasing to 20 V p-p ac at 5 MHz.

**Input Impedance**—Aprox 0.5 M $\Omega$  paralleled by approx 30 pF.

## DISPLAY

**Crt**—6 x 10 div (0.5 cm/div) display, P31 phosphor normally supplied; P7 optional without extra charge. 1 kV accelerating potential.

**Graticule**—Internal, black line, non-illuminated.

## ENVIRONMENTAL CAPABILITIES

**Ambient Temperature**—Operating: (battery only),  $-15^\circ\text{C}$  to  $+55^\circ\text{C}$ . Charging or operating from ac line:  $0^\circ\text{C}$  to  $+40^\circ\text{C}$ . Nonoperating:  $-40^\circ\text{C}$  to  $+60^\circ\text{C}$ .

**Altitude**—Operating: 25,000 ft, decrease max temperature by  $1^\circ\text{C}/1000$  ft above 15,000 ft. Nonoperating: 50,000 ft.

**Vibration**—Operating and nonoperating: 15 minutes along each of the 3 major axes, .06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in one minute cycles. Held for 3 min at 55 Hz.

**Humidity**—5 days at  $+50^\circ\text{C}$ , 95% humidity.

**Shock**—Operating and nonoperating: 100 g's, ½ sine, 2 ms duration each direction along each major axis. Total of 12 shocks.

## OTHER CHARACTERISTICS

**Power Sources**—Internal NiCd batteries provide at least 3 hours operation at max trace intensity for a charging and operating temperature between  $+20^\circ\text{C}$  and  $+30^\circ\text{C}$ . Internal charger charges the batteries when connected to an ac line with instrument turned on or off. Dc operation is automatically interrupted when battery voltage drops to approx 10 V to protect batteries against deep discharge. Full recharge requires approx 16 hours. Extended time charges will not damage the batteries. An expanded scale battery meter indicates full, low, and recharge. External power source, 90 to 250 V ac (48 to 62 Hz) or 80 to 250 V dc, 5 W or less.

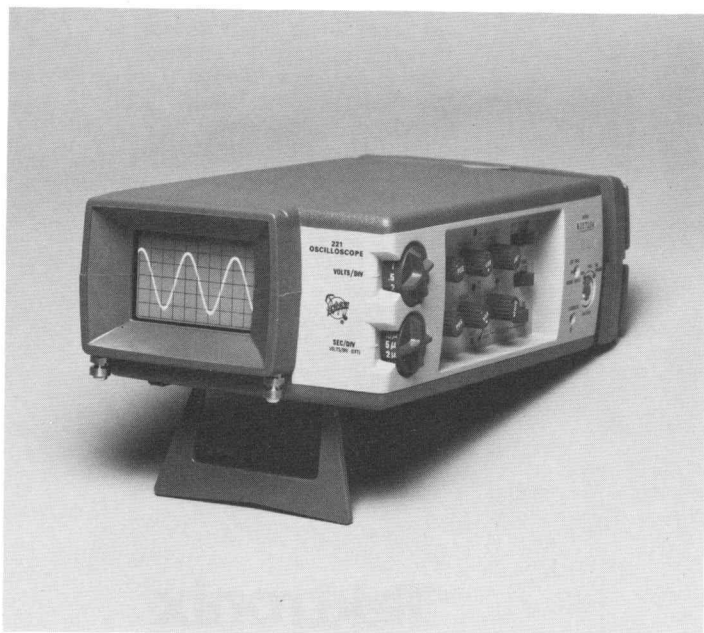
**Insulation Voltage**—500 V rms or 700 V (dc + peak ac) when operated from internal batteries, with the line cord stored and the plug protected. When operated from an external line, line voltage plus floating voltage not to exceed 250 V rms; or 1.4 x line + (dc + peak ac) not to exceed 350 V.

Dimensions	in	cm
Height	3.0	7.6
Width	5.2	13.3
Depth	9.0	22.8

Weights (approx)	lb	kg
Net (without accessories)	3.5	1.6
Shipping	$\approx 8.0$	$\approx 3.6$

## INCLUDED ACCESSORIES

Viewing hood (016-0199-01), carrying case (016-0512-00), neck strap (346-0104-00), two spare fuses (159-0080-00).



## 212/214 ORDERING INFORMATION

**212 Dual-Trace Oscilloscope, including batteries**

**214 Dual-Trace Storage Oscilloscope, including batteries**

### POWER OPTIONS

Option 01 for 220-250 V, (48 to 52 Hz) includes batteries

Option 02 for 90 to 110 V, includes batteries

### OPTIONAL ACCESSORIES

**10X Attenuator Package**—A slip-on tip to provide lower circuit loading (4.4 mΩ, approx 20 pF) and higher max input voltage 1000 V (dc + peak ac) includes: 10X attenuator (010-0378-01); pincher tip (013-0071-00); flex tip (206-0060-00); banana tip (134-0013-00); IC adapter (206-0203-00).

Order 010-0378-01

**Alligator Clip Kit**—A pair of alligator clips that allow connecting the probe (or optional 10X attenuator) and ground lead to large (up to 3/8 in) conductors. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).

Order 015-0231-00

**Probe-tip to BNC Panel Connector Adapter**

Order 013-0084-01

**Probe-tip to BNC Cable Adapter**

Order 103-0096-00

**Power Cable Adapter Assembly**—A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.

Order 161-0077-01

## 213 ORDERING INFORMATION

**213 Miniscope/DMM including batteries and probe**

### POWER OPTIONS

Option 01, 180 to 250 V ac (48 to 62 Hz) or dc (includes batteries and probe)

### OPTIONAL ACCESSORIES

**Alligator Clip Kit**—A pair of alligator clips that allow connecting the probe and ground lead to large (up to 3/8 in) conductor. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).

Order 015-0231-00

**Probe-tip to BNC Panel Connector Adapter**

Order 013-0084-01

**Probe-tip to BNC Cable Adapter**

Order 103-0096-00

**Power Cable Adapter Assembly**—A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.

Order 161-0077-01

## 221 ORDERING INFORMATION

**221 Oscilloscope, including batteries and probe**

### INSTRUMENT OPTION

Option 76, P7 Phosphor

### OPTIONAL ACCESSORIES

**Alligator Clip Kit**—A pair of alligator clips that allow connecting the probe and ground lead to large (up to 3/8 in) conductor. Includes: red clip (015-0229-00); yellow clip (015-0230-00); 6-32 to probe adapter (103-0051-01).

Order 015-0231-00

**Probe-tip to BNC Panel Connector Adapter**

Order 013-0084-01

**Probe-tip to BNC Cable Adapter**

Order 103-0096-00

**Power Cable Adapter Assembly**—A short length of two-wire power cord. One end has a female NEC socket fitting the 200-Series power cords; the other end is left open so that the wires can be attached to a non-NEC male power plug. Plugs not supplied.

Order 161-0077-01

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Portland, OR 97208

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