



Now! A Combined DMM and Oscilloscope

You Can Hold
In Your Hand

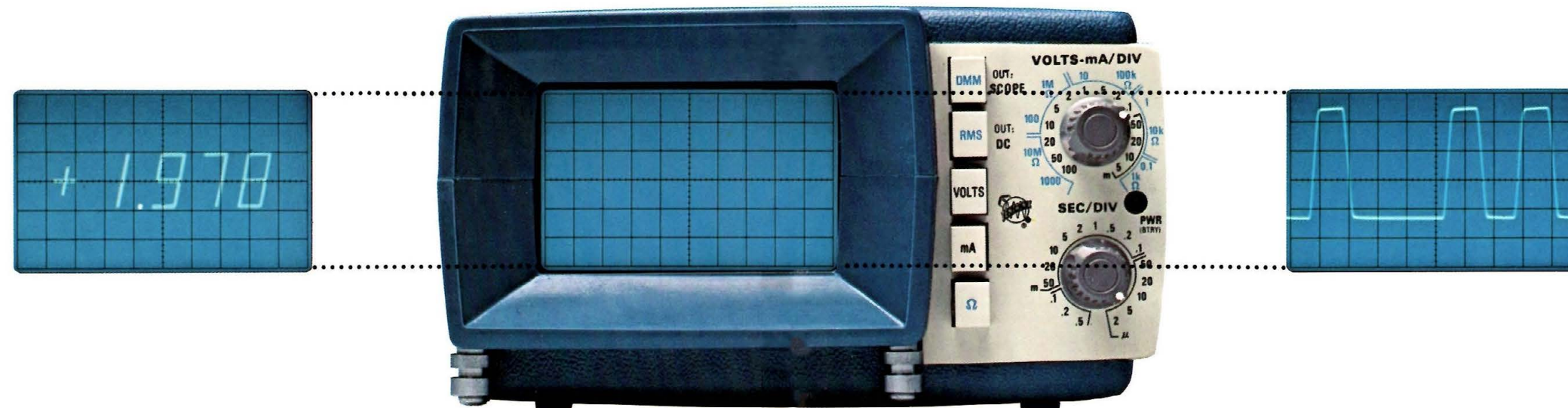
The 213
From Tektronix



Complete DMM

The 213 makes all of the precision measurements associated with a high performance, 3½ digit multimeter and displays the results as large clear numbers (1 cm x 4 cm for 4 digits plus sign) on a crt.

Precise dc voltage is measured for full scale ranges from 0.1 V to 1000 V. Five ranges provide precise dc current measurement from 0.1 mA full scale to 1000 mA full scale. True rms readings of ac voltage and current are provided over these same ranges. Resolution extends to 100 μ V for voltage measurement and 100 nA for current. Resistance is measured with an accuracy of 1% or better over five ranges extending from 1 k Ω full scale to 10 M Ω full scale.



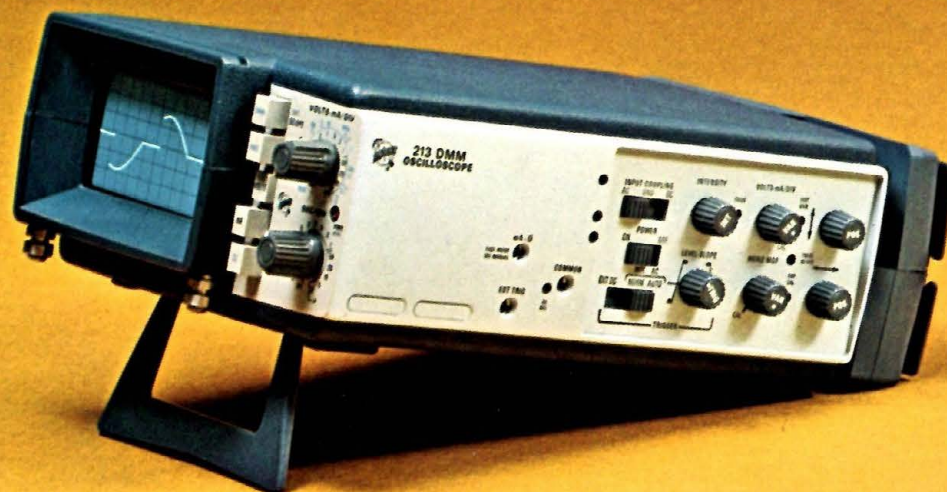
Actual Size

Miniscope

Although small in size, the 213 includes many of the performance features of much larger oscilloscopes. DC to 1 MHz bandwidth and 14 calibrated deflection factors from 5 mV/div to 100 V/div (400 kHz for 5 and 10 mV/div) provide the capability needed for a wide range of service applications. And a unique, built-in current waveform display feature, with calibrated deflection factors from 5 μ A/div to 100 mA/div, increases the versatility of the 213 still further.

Calibrated sweep rates range from 2 μ s/div to 500 ms/div, and a variable magnifier extends the maximum (uncalibrated) sweep rate to 0.4 μ s/div for display of fast signals. Versatile sweep triggering from either internal or external sources assures stable displays.

213 DMM/Oscilloscope



Easy Portability

The 213 combines a precision 3½ digit multimeter and a 1 MHz oscilloscope with excellent performance and versatility in one compact instrument that will go wherever there are measurements to be made. At 3.7 lbs. and 3.0 x 5.2 x 8.9 inches, the 213 will easily fit into a briefcase or toolkit. In operation the lightweight 213 can be handheld, rested on the equipment being tested, or carried on a convenient neck strap. For maximum versatility the 213 operates on internal batteries or on 48 to 62 Hz ac from 90 to 136 V (180 to 250 V ac or dc with option 1). The batteries charge whenever the instrument is connected to an ac line.

Small size and internal battery power assure that the 213 can readily make

measurements at the top of a ladder, on a catwalk in an industrial processing plant, in a moving vehicle, in office environments, at a remote field location, and at many other locations often inaccessible for measurements with such complete instrumentation. What's more, the 213's rugged construction equips it to withstand hostile industrial or transportation environments as well as the hard use of field service applications. Battery operation and a double-insulated case aid the operator in isolating the 213 from ground or power line when making measurements at elevated voltage levels or in the presence of power line noise.

Easy Operation

Operating controls of the 213 are designed to be easily understood and to speed measurements. A single push button is used to select DMM or oscilloscope operation. A second push button selects dc or rms mode. Three additional push buttons provide quick selection of voltage, current, or resistance measurement. Scale factor (volts, mA, or ohms) for both DMM and oscilloscope modes is selected with one clearly labeled dial. A second convenient dial is used to select time/div for the oscilloscope mode. A choice of external, internal normal, or internal automatic triggering of the oscilloscope sweep assures stable displays in virtually any application. Both trigger level and trigger slope are adjusted with one easily reached side panel dial.

Applications

By combining both DMM and oscilloscope functions the 213 provides the capabilities required for a wide range of on-site servicing applications. The 213 is the ideal instrument for many troubleshooting applications in industrial control systems, computer peripherals, communication equipment, office machines, point-of-sale terminals, mobile electronics, and hospital equipment.

In a typical troubleshooting procedure the 213 can be used first to check the power supply. Line voltage to the system is tested quickly and accurately using the true rms voltage function of the 213. If either direct or high impedance short circuits are suspected

they can be easily detected using the 213 as an ohmmeter. Next the dc output voltage level can be accurately checked and adjusted in dc voltage mode, and ripple can be checked using the oscilloscope mode. Power supply current loading is accurately checked by using the 213 as a milliammeter. Once the power supply is known to be working properly the 213 can be used to check and adjust voltages, waveforms, and timing relationships throughout the system. With the voltage probe attached to a given point, dc voltage, rms voltage, and waveform can be tested by simply switching between DMM and oscilloscope modes.

Certainly the 213 offers distinct convenience to the serviceman who has had to carry both an oscilloscope and a DMM or make do with only one. With both instruments available in one compact package, service is performed faster and success in diagnosing problems on site, on the first call is improved.



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committed to
technical excellence

Specifications :

DMM

True rms readings of voltage and current are provided for all waveforms with a crest factor of 5 or less.

Dc and Ac Voltage

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

Overrange Capability—At least 200% of full scale. Except for 1000 V range.

Resolution—100 μ V at 0.1 full scale.

Dc Voltage Accuracy*—For 25°C \pm 5°C. Beyond these limits add temperature coefficient.

0.100 V Range	Within 0.1% of reading \pm 3 counts. Temp Coef is (within 0.015% of reading \pm 0.04% of full scale) per °C.
1.000 V Range	Within 0.1% of reading \pm 1 count. Temp Coef is (within 0.01% of reading \pm 0.01% of full scale) per °C.
10.0 V and 100.0 V Ranges	Within 0.15% of reading \pm 1 count. Temp Coef is (within 0.015% of reading \pm 0.01% of full scale) per °C.
1000 V Range	Within 0.2% of reading \pm 1 count. Temp Coef is (within 0.02% of reading \pm 0.01% of full scale) per °C.

*Accuracy for battery operation. For ac line operation add 10°C before computing DMM accuracy temperature coefficient.

RMS Voltage Accuracy*—For 25°C \pm 5°C. Beyond these limits add temperature coefficient. Temp Coef is within 0.05% of reading \pm 0.1% for full scale per °C.

	Within % of reading shown \pm 5 counts at frequency shown.		
	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz
0.100 V Range	2.5%	1.5%	3.5%
1.000 V Range	2%	1%	1%
10.0 V Range	2%	1%	1%
100.0 V Range	2%	1%	1%
1000 V Range	2%	1%	2%

*Accuracy for battery operation. For ac line operation add 10°C before computing DMM accuracy temperature coefficient. Accuracy limit increases linearly for crest factor greater than 2. Up to twice indicated limit for crest factor of 5.

Input Resistance—10 M Ω .

Input Capacitance—Approx. 150 pF on 0.1 V to 10 V ranges, 100 pF on 100 V and 1,000 V ranges.

Settling Time—1.5 seconds within 0.1% of reading in dc mode, 2 seconds within 1% of reading in rms mode.

Maximum Input Voltage—

500 V (dc \pm peak ac) for 0.1 V to 10 ranges dc coupled,
800 V (dc \pm peak ac) for 0.1 V to 10 V ranges ac coupled,
800 V (dc \pm peak ac) for 100 V and 1000 V ranges.

Dc and Ac Current

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

Overrange Capability—At least 200% of full scale.

Resolution—100 nA at 0.1 mA full scale.

Input Shunt Resistance (Approximate)

Scale	Resistance
0.100 mA	1000 Ω
1.000 mA	100 Ω
10.00 mA	10.2 Ω
100.0 mA	1.2 Ω
1000 mA	0.3 Ω

Dc Current Accuracy*—25°C \pm 5°C. Beyond these limits add temperature coefficient. Temp Coef is (within 0.02% of reading \pm 0.04% of full scale) per °C.

0.100 mA Range	Within 0.5% of reading \pm 3 counts
1.000 to 1000 mA Range	Within 0.25% of reading \pm 3 counts

*Accuracy for battery operation. For ac line operation add 10°C before computing DMM accuracy temperature coefficient.

RMS Current Accuracy*—For 25°C \pm 5°C. Beyond these limits add temperature coefficient. Temp. Coef is (within 0.05% of reading \pm 0.1% of full scale) per °C.

	Within % of reading shown \pm 5 counts at frequency shown.		
	Dc	40 Hz to 4 kHz	4 kHz to 40 kHz
0.100 mA Range	2.5%	1.5%	4.5%
1.000 to 1000 mA Ranges	2.5%	1.5%	3.5%

*Accuracy for battery operation. For ac line operation add 10°C before computing DMM accuracy temperature coefficient. Accuracy limit increases linearly for crest factor greater than 2. Up to twice indicated limit for crest factor of 5.

Settling Time—1.5 seconds within 0.1% of reading in dc mode, 2 seconds within 1% of reading in rms mode.

Maximum Input Current—2 A rms or 3 A peak on any scale.

Resistance

Ranges—1 k Ω to 10 M Ω full scale in 5 ranges.

Resolution—1 Ω on 1 k Ω scale.

Accuracy*—For 25°C \pm 5°C.

1 k Ω	Within 0.5% of reading \pm 3 counts. Temp Coef is (within 0.03% of reading \pm 0.04% of full scale) per °C.
10 k Ω to 1 M Ω	Within 0.5% of reading \pm 1 count. Temp Coef is (within 0.02% of reading \pm 0.02% of full scale) per °C.
10 M Ω	Within 1% of reading \pm 1 count. Temp Coef is (within 0.05% of reading \pm 0.02% of full scale) per °C.

*Accuracy for battery operation. For ac line operation add 10°C before computing DMM accuracy temperature coefficient.

Settling Time—2 seconds within 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 Indication—Readout displays scrambled characters.

OSCILLOSCOPE

Vertical Deflection (Voltage)

Deflection Factor—5 mV/div to 100 V/div in 14 calibrated steps (1-2-5 sequence). Accurate within \pm 3%. Uncalibrated, continuously variable between steps and to at least 250 V/div.

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 bandwidth limit (−3 dB point) for ac coupling is 1 Hz or less.

Input R and C—10 M Ω paralleled by approx. 150 pF for 5 mV/div through 1 V/div and 100 pF for 2 V/div through 100 V/div.

Maximum Input Voltage—

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

Vertical Deflection (Current)

Deflection Factor—5 μ A/div to 100 mA/div in 14 calibrated steps (1-2-5 sequence). Accurate within \pm 3%. Uncalibrated, continuously variable between steps and to at least 250 mA/div.

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

Maximum Input Current—2 A rms or 3 A peak for any range.

Horizontal Deflection

Sweep Rate—2 μ s/div to 500 ms/div in 17 calibrated steps (1-2-5 sequence). Accurate within \pm 5%.

Horizontal Magnifier—Provides continuously variable sweep rate settings between calibrated settings. Extends fastest sweep rate to at least 0.4 μ s/div.

Trigger

Internal Ac Coupled (Auto)—Triggers on deflection of 0.5 div or more from 7 Hz to 1 MHz. Sweep free-runs in absence of trigger signal or for frequencies below 7 Hz.

Internal Ac Coupled (Normal)—Triggers on deflection of 0.5 div or more from 7 Hz to 1 MHz.

External Dc Coupled—Triggers on signals of 1.0 V or more from dc to 1 MHz.

Crt

6 X 10 div display area, each div is approx. 0.2 in. Internal black line, non-illuminated graticule. P43 phosphor is standard.

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 feet. Maximum operating temperature decreased by 1°C per 1000 feet above 15,000 feet. Nonoperating, to 40,000 feet.

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

Vibration—Operating and nonoperating, 15 minutes along each of the 3 major axes at a total displacement of 0.025 inch p-p (4 g's at 55 Hz) with frequency varied from 10 to 55 to 10 Hz in one-minute sweeps. Held for three minutes at 55 Hz. All major resonances must be above 55 Hz.

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 Ni Cd batteries provide a typical operating period of 3.5 hours at maximum trace intensity for a charging and operating temperature between 20°C and 30°C. Internal charger provides for charging batteries any time the instrument is connected to an ac line even if the instrument is turned off. Dc operation is automatically interrupted when battery voltage drops below 2 V to protect batteries against deep discharge. Full recharge requires approximately 16 hours. External operation from 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 \pm 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 \pm dc \pm peak ac not to exceed 350 V.

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 1 only) (161-0077-01).

DIMENSIONS AND WEIGHTS

Height	3.0 in	7.6 cm
Width	5.2 in	13.2 cm
Depth	8.9 in	22.6 cm
Net Weight Without Accessories	3.7 lb	1.7 kg
Shipping Weight	8.6 lb	3.9 kg

ORDERING INFORMATION

213 Miniscope/DMM including batteries and probe\$1200
Instrument Option
Option 1 provides for operation on 180 to 250 V ac (48 to 62 Hz) or dc (includes batteries and probe)No charge