

## 2300 Series Portable Analog Oscilloscopes



2336 shown above.

### 2335/2336/2336YA/ 2337

#### TYPICAL APPLICATIONS

- Rugged Field Service
- Computer Peripheral Service
- Communication Equipment Service

#### BENEFITS

- Three-Year Warranty—Five Year Option
- UL Listed, CSA

#### FEATURES

- DC to 100-MHz Bandwidth
- 5 mV/Div to 5 V/Div
- 5 ns/Div Sweep Rate

#### Designed for Field Service

The 100 MHz 2300 Series oscilloscopes are the most rugged and durable instruments in their bandwidth. Offering a one-piece case, flitop cover, scratch resistant front panels, the ability to withstand shocks of 50 g's, and meet the environmental specifications for Class 3 instrumentation as prescribed in MIL-T28800, in an industry standard size make these the ultimate field-service oscilloscopes.

#### Flexibility

All 2300 Series oscilloscopes are dual channel, dual trace, and delayed sweep dc to 100 MHz oscilloscopes. The 2336 and the 2336YA feature DELTA TIME on the flitop front cover, while the 2337 features DELTA TIME as well as a DMM. The controls for these features are conveniently and logically located in the cover as well. The DELTA TIME and DMM readouts emanate from a backlighted LCD for clear viewing at any angle. The CRT produces bright, highly visible traces that are viewable in most light conditions. The 2335 is rackmountable for system configurations. The 2336YA also features a 5000 hour elapsed time indicator (ETI), extra manuals, and an extra set of probes.

#### Ease of Operation

The front panel layout features logical groupings of switches and knobs to avoid errors and delays during operation. Auto-trigger allows triggering on waveforms with repetitive rates down to approximately 10 Hz. Vertical deflection factors

range from 5 mV/div to 5 V/div with a variable control to increase the sensitivity to at least 2 mV/div. Variable sweep speeds range from 0.5 s/div to 50 ns/div, with a X10 magnifier that can increase the sweep speed to 5 ns/div.

National Stock Numbers are assigned for all 2300 Series oscilloscopes. Check the Logistics Data Book for information.

### CHARACTERISTICS

The following characteristics are common to the 2335, 2336, 2336YA, and 2337 oscilloscopes except where indicated.

#### VERTICAL SYSTEM (Two Identical Channels)

##### Bandwidth and Rise Time

| -15 to +40°C                      | 40 to 55°C                        |
|-----------------------------------|-----------------------------------|
| dc to at least<br>100 MHz, 3.5 ns | dc to at least<br>85 MHz, 4.15 ns |

**Bandwidth Limit**—20 MHz by bandwidth limit switch.

**Lower -3 dB Point AC Coupling**—1X Probe: 10 Hz or less. 10X Probe: 1 Hz or less.

**Deflection Factor**—5 mV/div. 1-2-5 sequence. Accuracy  $\pm 3\%$ . Uncalibrated: Continuously variable between steps and to at least 2 mV/div.

**Display Modes**—CH 1, CH 2, Add CH 2 (normal and inverted), Alternate, Chopped ( $\approx 275$  kHz rate).

**Common-Mode Rejection Ratio (common-mode signals of 6 div or less)**—2335, 2336, 2337:  $\geq 25:1$  at 10 MHz; 10:1 at 100 MHz.

**Channel Isolation**— $>100:1$  at 25 MHz.

**Input R and C**—1 M $\Omega$   $\pm 2\%$  paralleled by 20 pF  $\pm 10\%$ .

**Maximum Input Voltage**—AC or dc coupled, 400 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

#### HORIZONTAL SYSTEM

**Time Base A**—0.05  $\mu$ s/div to 0.5 s/div (1-2-5 sequence). X10 magnifier extends maximum sweep rate to 5 ns/div.

**Time Base B**—0.05  $\mu$ s/div to 50 ms/div (1-2-5 sequence). X10 magnifier extends maximum sweep rate to 5 ns/div.

**Variable Time Control**—Time base A provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div.

##### Time Base A and B Accuracy\*1

|             | 20 to 30°C | -15 to +55°C |
|-------------|------------|--------------|
| Unmagnified | $\pm 2\%$  | $\pm 3\%$    |
| Magnified   | $\pm 3\%$  | $\pm 4\%$    |

\*1 Full ten divisions.

**Display Modes**—A, A intensified by B, B delayed.

### CALIBRATED SWEEP DELAY

**Delay Time Range**—Continuous from 50 ns to at least 5 s after starting of delaying sweep.

### Differential Time Measurement Accuracy\*1

|                     | 15 to<br>30°C                 | -15 to<br>+55°C                |
|---------------------|-------------------------------|--------------------------------|
| 2335                | 0.75%+0.015<br>major dial div | 1.5%+0.015<br>major dial div   |
| 2336/2337<br>2336YA | ±1% of read-<br>ing ±1 count  | ±2.5% of read-<br>ing ±1 count |

\*1 2336YA only: 10 to 55°C is 2% of reading ±1 count.

**Jitter**—One part or less in 20,000 (0.005%) of 10 times the A Sweep Time/Div setting.

### TRIGGERING

**A Trigger Mode**—Normal: sweep runs when triggered. Automatic: sweep free-runs in absence of a triggering signal and for signals below 30 Hz. Single Sweep: sweep runs once on first triggering event after reset selector is pressed. (LED indicates when sweep is triggered and when single sweep is ready.)

### A and B Trigger Sensitivity

| 2335, 2336<br>2337 | Internal | External*1 | External<br>+10*1 |
|--------------------|----------|------------|-------------------|
| 20 MHz             | 0.3 div  | 50 mV      | 500 mV            |
| 100 MHz            | 1.1 div  | 150 mV     | 1.5 V             |
| <b>2336YA</b>      |          |            |                   |
| 25 MHz             | 0.3 div  | 50 mV      | 500 mV            |
| 100 MHz            | 1.0 div  | 150 mV     | 1.5 V             |
| 150 MHz            | 1.1 div  | 300 mV     | 3 V               |

\*1 External B Trigger sensitivity is not applicable to the 2335.

**Trigger Coupling**—AC (−3 dB 20 Hz), dc, LF REJ attenuates signals above 50 kHz. B Trigger coupling is ac only.

**A Trigger Holdoff**—Adjustable control permits stable presentation of repetitive waveforms

**ΔTime B Trigger Modes**—(2336, 2336YA and 2337 only): Provides two intensified zones on CRT trace for differential time measurements. Time difference between two intensified zones determined by B Delay Time Position and ΔTime Position controls, and is displayed on LCD readout.

**Runs After Delay**—B Sweep starts immediately after the delay time selected by the Delay Time Position control and is independent of B trigger signal.

**Triggerable After Adjustable Delay Time**—B Sweep Trigger sourced from a composite of CH 1 and CH 2; CH 1 only, CH 2 only or from the Ext Trigger input connector.

**Jitter**—2335, 2336, 2337: 1.0 ns or less at 100 MHz. 2336YA: 0.5 ns at 100 MHz.

**A Trigger View**—A spring-loaded pushbutton overrides other vertical controls to display the signal used to trigger the A Sweep. This control provides quick verification of the (trigger) signal and permits a time comparison between the vertical input signal and the trigger signal. Deflection Factor is 100 mV/div ±40% (1 V/div with Ext ÷10).

**Level and Slope**—Internal: Permits selection of triggering at any point on positive or nega-

tive slope of vertical input signal. Level adjustment: Through at least ±1 V in Ext; through at least ±10 V in Ext ÷10.

**A Sources**—Vertical Mode, CH 1, CH 2, Line, Ext, Ext ÷10.

**B Sources**—(2336, 2336YA and 2337 only) ΔTime runs after delay, Vertical Mode, CH 1, CH 2, Ext (all modes ac coupled).

**External Inputs**—R and C: 1 MΩ ±10%, 20 pF +30%. 400 V (dc+peak ac) or 500 V ac p-p at 1 kHz or less.

### X-Y OPERATION

**Full Sensitivity X-Y (CH 1 Horizontal, CH 2 Vertical)**—5 mV/div to 5 V/div (1-2-5 sequence), accurate ±5% from 0 to +40°C, accurate ±8% from −15 to +55°C. X axis bandwidth: dc to ≥2 MHz. Y-axis bandwidth: dc to >100 MHz. Phase difference between amplifiers: ≤3° dc to 200 kHz.

### CRT AND DISPLAY FEATURES

**CRT**—8×10 div (8 mm/div) display. Horizontal and vertical centerlines further marked in 0.2 div increments. Accelerating potential: 18 kV. GH (P31) phosphor.

**Graticule**—Internal, nonparallax, nonilluminated; markings for measurement of rise time.

**Beam Finder**—Compresses trace to within graticule area to locate an offscreen signal.

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

### OTHER CHARACTERISTICS

**Amplitude Calibrator**—0.2 V accurate ±1% from 0 to 40°C, ±1.5% from −15 to +55°C.

### POWER REQUIREMENTS

**Line Voltage Ranges**—100 to 132 V ac and 200 to 250 V ac. Option 03: 90 to 115 V ac or 180 to 230 V ac.

**Line Frequency**—48 to 440 Hz.

**Maximum Power Consumption**—35 W at 115 V, 60 Hz.

### ENVIRONMENTAL

The 2335 Oscilloscope meets environmental capabilities for Class 3, type 3, style D instruments as prescribed in MIL-T-28800C. The 2336, 2336YA and 2337 Oscilloscopes meet the environmental capabilities for Class 3, Type 3, Style D instruments as prescribed by MIL-T-28800 except as indicated herein to avoid potential damage to the LCD readout.

**Temperature (Forced-air ventilation during normal operation)**—2335 Operating: −15 to +55°C. Nonoperating: −62 to +85°C.

2335 Option 1R (Rackadapted)—Operating temperature inside equipment rack: −15 to +55°C. Max exhaust-fan temperature: +65°C. Nonoperating: −62 to +85°C.

2236/2237 Operating: −15 to +55°C. Nonoperating: −40 to +80°C.

**Altitude**—Operating: Sea level to 4600 m (15,000 ft). Nonoperating: Sea level to 15 000 m (50,000 ft).

**Vibration**—Test samples subjected to sinusoidal vibration in X, Y, and Z-axes; frequency varied from 10 to 55 to 10 Hz in one minute cycle for 15 minutes. Total displacement: 0.025 in. p-p (4 g's at 55 Hz).

**Humidity Operating and Nonoperating**—2335: 95%, five cycles (120 hours), referenced to MIL-T-28800B Paragraph 3.9.2.2.

2336, 2336YA and 2337—Operating: 90% (72 hours) at +55°C.

2336, 2336YA, 2337 and DMM: Operating: 90% (24 hours) at +35°C and 70% (24 hours) at +50°C.

2336, 2336YA, 2337 and DMM: Nonoperating: 90% (72 hours) at +60°C.

**Shock**—Operating: 50 g's, ½ sine, 11-ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**Electromagnetic Compatibility (EMC)**—Test samples in compliance with the Class 3 requirements of MIL-STD-461B using procedural steps outlined in MIL-STD-462. Increase RS03 requirements from 1 V/m to 10 V/m. For RE01, use 500 Hz to 30 kHz in place of 30 Hz to 30 kHz.

### PHYSICAL CHARACTERISTICS

|                                | 2335, 2336,<br>2336YA, 2337 Cabinet |      | 2335 Option 1R<br>Rackmount |      |
|--------------------------------|-------------------------------------|------|-----------------------------|------|
|                                | mm                                  | in.  | mm                          | in.  |
| <b>Dimensions</b>              |                                     |      |                             |      |
| Width                          | 274                                 | 10.8 | 483                         | 19.0 |
| w/handle                       | 315                                 | 12.4 |                             |      |
| Height                         |                                     |      | 133                         | 5.2  |
| w/feet/pouch                   | 210                                 | 8.3  |                             |      |
| w/o pouch                      | 135                                 | 5.3  |                             |      |
| Depth                          |                                     |      | 378                         | 14.9 |
| w/o front cover                | 430                                 | 17.0 |                             |      |
| handle extended                | 528                                 | 20.8 |                             |      |
|                                | 2335                                |      | 2336, 2336YA, 2337          |      |
| <b>Weight ~</b>                | kg                                  | lb   | kg                          | lb   |
| Net (w/o accessories or pouch) | 7.7                                 | 17.0 | 8.0                         | 17.8 |
| Net (w/accessories & pouch)    | 8.6                                 | 19.0 | 8.9                         | 19.6 |
| Shipping                       | 10.6                                | 23.5 | 10.9                        | 24.1 |
|                                |                                     |      | 16.9                        | 37.3 |

\*1 No pouch for 2335 Option 1R.

## 2337 With Digital Multimeter

The following characteristics are unique to the 2337.

### DC VOLTAGE

**Full Scale Ranges**—2 V (autoranging to 200 mV); 200 V (autoranging to 20 V); and 500 V. **Resolution**—100  $\mu$ V at 200 mV full scale.

### Accuracy

|                        |   |
|------------------------|---|
| 15 to 35°C             | Within $\pm 0.15\%$ of reading<br>$\pm 1$ count |
| -15 to +15°C           | Add $\pm 0.01\%$ for every °C<br>below +15°C    |
| 35 to 55°C             | Add $\pm 0.01\%$ for every °C<br>above +35°C    |
| >80% Relative Humidity | Add $\pm 0.25\%$ of reading $\pm 3$<br>counts   |

**Input Resistance**—10 M $\Omega$   $\pm 0.25\%$ .

**Rejection Ratio**—Normal-Mode: 60 dB minimum at 50 and 60 Hz. Common-Mode: 100 dB minimum at dc, 60 dB minimum at 50 and 60 Hz.

**Response Time**—Within 3 s (no autorange); within 9 s (up range); within 7 s (down range). **Maximum Input Voltage**—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

### AC VOLTAGE

**Full Scale Ranges**—2 V (autoranging to 200 mV); 200 V (autoranging to 20 V); and 350 V. **Crest Factor** (When peak voltage input is <3 times full scale)—6.

### Accuracy\*\*

|              |   |
|--------------|---|
| 15 to 35°C   | Within $\pm 3\%$ , $\pm 6$ counts*1,<br>20 Hz to 20 kHz |
| -15 to +15°C | Add $\pm 0.05\%$ for every °C<br>below +15°C            |
| 35 to 55°C   | Add $\pm 0.05\%$ for every °C<br>above +35°C            |

\*1 Nonsine waves: Derate below 50 Hz. For crest factors >3, add +0, -1% of reading.

**Input Impedance**—Resistance 10 M $\Omega$   $\pm 0.25\%$  in series with input blocking cap. Capacitance (20 V, 200 V, and 350 V range) <150 pF; (200 mV, 2 V range) <220 pF.

**Common-Mode Rejection Ratio**—60 dB minimum at 50 and 60 Hz, 2 V range; 53 dB minimum at 50 and 60 Hz, 200 V and 300 V ranges.

**Response Time**—Within 3 s (no autorange); within 9 s (up range); within 7 s (down range). **Maximum Input Voltage**—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

### RESISTANCE

**Full Scale Ranges**—2 k $\Omega$  (autoranging to 200  $\Omega$ ); 200 k $\Omega$  (autoranging to 20 k $\Omega$ ); 20 M $\Omega$  (autoranging to 2 M $\Omega$ ).

**Resolution**—0.1  $\Omega$ .

### Accuracy

|                        |  |
|------------------------|--|
| 15 to 35°C             | Within $\pm 0.5\%$ $\pm 2$ counts<br>$+0.4 \Omega$ |
| -15 to +15°C           | Add $\pm 0.05\%$ for every °C<br>below +15°C       |
| 35 to 55°C             | Add $\pm 0.05\%$ for every °C<br>above +35°C       |
| >80% Relative Humidity | Add $\pm 1\%$ of reading $\pm 8$<br>counts         |

**Response Time**—<4 s.

**Maximum Input Voltage**—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

## ORDERING INFORMATION

**2335 Oscilloscope \$3,940**

Includes: Two P6108A 10X probes; accessory pouch (016-0674-00); zip lock accessory pouch (016-0537-00); clear CRT implosion shield (337-2781-00); installed, blue CRT implosion shield (337-2760-00); two 1 A fuses (159-0022-00); 1/2 A fuse (159-0025-00); power cord (161-0104-00); operator manual (070-4115-00).

**2336 Oscilloscope With  $\Delta$ Time \$4,270**

Includes: Same as 2335, instruction manual (070-4117-00) instead.

**2336YA Oscilloscope With  $\Delta$ Time, Elapsed Time Meter, Extra**

Accessories and Manuals \$4,490

Includes: Same as 2336 plus P6101A probe; three probe tip adaptors (103-0051-01); three spring tip adaptors (206 0060-00); operator manual (070-5010-00); service manual (070-5011-00).

**2337 Oscilloscope With  $\Delta$ Time and DMM \$4,700**

Includes: Same as 2335, instruction manual (070-4119-00) instead.

### OPTIONS

**Option 03**—100 V/200 V, ac nominal, 48 to 440 Hz. NC

**Option 1R**—(2335 only) Rack Conversion. + \$375

### CONVERSION KIT

**Rackmount Conversion**—2335 only. Order 016-0468-00 \$390

### INTERNATIONAL POWER PLUG OPTIONS

**Option A1**—Universal Euro 220 V, 50 Hz.

**Option A2**—UK 240 V, 50 Hz.

**Option A3**—Australian 240 V, 50 Hz.

**Option A4**—North American 240 V, 60 Hz.

**Option A5**—Switzerland 220 V, 50 Hz.

### WARRANTY-PLUS SERVICE PLANS

See Customer Service Section

|  |           |
|--|-----------|
| <b>M1</b> —(2335) 2 Calibrations.                          | + \$153   |
| <b>M1</b> —(2336/2336YA) 2 Calibrations.                   | + \$184   |
| <b>M1</b> —(2337) 2 Calibrations.                          | + \$205   |
| <b>M2</b> —(2335) +2 Years Service.                        | + \$171   |
| <b>M2</b> —(2336/2336YA) +2 Years Service.                 | + \$202   |
| <b>M2</b> —(2337) +2 Years Service.                        | + \$254   |
| <b>M3</b> —(2335) +2 Years Service & 4 Calibrations.       | + \$477   |
| <b>M3</b> —(2336/2336YA) 2 Years Service & 4 Calibrations. | + \$569   |
| <b>M3</b> —(2337) 2 Years Service & 4 Calibrations.        | + \$664   |
| <b>M4</b> —(2335) 5 Calibrations.                          | + \$366   |
| <b>M4</b> —(2336/2336YA) 5 Calibrations.                   | + \$437   |
| <b>M4</b> —(2337) 5 Calibrations.                          | + \$490   |
| <b>M5</b> —(2335) 9 Calibrations +2 Years Service.         | + \$826   |
| <b>M5</b> —(2336/2336YA) 9 Calibrations +2 Years Service.  | + \$985   |
| <b>M5</b> —(2337) 9 Calibrations +2 Years Service.         | + \$1,131 |

### OPTIONAL ACCESSORIES

**Battery Pack**—Order 1106 \$1,580

**DC Power**—Order 1107 \$1,175

### RECOMMENDED PROBES

See Signal Acquisition Section for complete descriptions.

**P6108A**—10X probe. \$75

**P6202A**—10X FET probe. \$735

**P6022**—Current probe. \$495

**P6062B**—1X/10X probe. \$175

**A6902B Voltage Isolator**—For floating measurements, see page 543. \$1,980

### RECOMMENDED CAMERA

**C-5C Option 04**—Includes 016-0359-01 adaptor and flash (camera mount not provided). \$495

### RECOMMENDED CART

**K212 Portable Instrument Cart**—For on-site mobility. \$350