

# Model 2335A

## Wideband Power Analyzer



- DC to more 500kHz or 1MHz
- Inputs up to 10A and 1000V
- 0.2% Uncertainty
- Isolated inputs
- Low Power Factor accuracy

- Harmonic analysis
- Total Harmonic Distortion
- Low current ranges
- USB and IEEE interface
- Graphical display

### TRUE RMS/WIDE BANDWIDTH

The Model 2335A Power Analyzer is a precision, high accuracy, auto-ranging instrument which measures and displays true rms and peak Voltage, true rms and peak Current, and true mean Power over a frequency range from dc to more than 1MHz. Full scale Current and Voltage inputs are typically measured within  $\pm 0.1\%$  of the amplitude reading to at least 500kHz. The corresponding Power is typically measured to within  $\pm 0.1\%$  of the input Volt-Amperes to 250kHz and to within  $\pm 0.2\%$  of the input Volt-Amperes to 500kHz for loads having any Power Factor.

### MULTI-FUNCTION

In addition to the primary functions, the Model 2335A measures the input

Frequency, the phase angle between the current and voltage inputs, and the harmonic amplitudes, up to 50, for both the current and voltage inputs. It also calculates the Power Factor, the Volt-Amperes, and the Energy (if it has been selected). These functions may be displayed or read over the IEEE-488 or USB interface.

### LOW POWER FACTOR ACCURACY

Five digits or resolution combined with excellent phase matching between the current and voltage channels make the Model 2335A an exceptionally good instrument for making low power factor measurements up to 500kHz or 1MHz. This ability makes the instrument ideal for high frequency core loss measurements which have inherently low power factors.

## **UNPARALLELED HIGH FREQUENCY ACCURACY**

The Model 2335A allows broadband and high accuracy measurements of both sinusoidal and highly distorted wave shapes. The Current, Voltage, Power, and Power Factor accuracies to 1MHz of the Model 2335A-01 far exceed any other Watt Meter or Power Analyzer, or for that matter, with respect to Current or Voltage, almost all conventional multimeters.

## **WIDE MEASUREMENT RANGE**

The Model 2335A has full scale Power ranges from 1.0000mW to 10000W. With external shunts or current to voltage transducers, the upper range may be extended by a factor of ten or one hundred. Full scale Voltage from 2.000V to 2000V (usable to 1000V) and full scale Current ranges from 5.000mA to 5.000A (all rms values) cover a wide range of load impedances. Full scale Current and Voltage inputs may have crest factors up to three while smaller inputs may have even higher crest factors. Sinusoidal inputs with rms values of twice the nominal Full Scale value may be measured with no loss in accuracy.

## **POSSIBLE MEASUREMENT USES**

Measurement of Ultrasonic Equipment of all types and power levels, Ferrite Core Loss, Transformer Core Material, Switching Power Supplies, Fluorescent Lamp Ballasts of all types, Mercury Arc Lamp Circuits, Sodium Lamp Ballasts, Speed Controlled Motors of all types, Efficiency of any device with an electrical input and an electrical output, SCR Controlled Devices of all types, High Frequency and/or Distorted Currents from any source, Voltage Response of any device, and the

Characteristics of Electric Automobile Drives.

## **EASY TO CALIBRATE**

The Model 2335A has isolated input channels. DC coupling in both channels allows calibration and/or verification with high accuracy dc sources. Internal software calibration routines allow most recalibrations to be accomplished in just a few minutes **without opening the instrument and without screwdriver adjustments.**

## **UNIQUE SAMPLING APPROACH**

The Voltage and Current inputs of the Model 2335A are simultaneously sampled (with 16 bit resolution), converted to digital form, and transmitted via isolated links to the control board on the main chassis. This allows both the Current and Voltage inputs to be completely isolated from each other and from the main chassis ground. The asynchronous sampling frequency is controlled by the system microprocessor in such a fashion that neither it nor any of its harmonics can come close to the measured input frequency or any of its harmonics. This precaution permits sampling at frequencies that are significantly below the Nyquist rate.

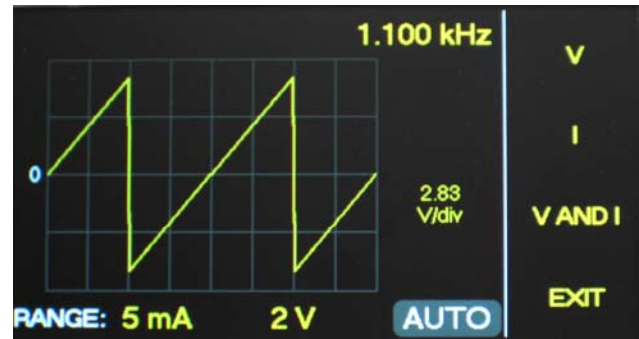
## **REMOTE CONTROL**

The Model 2335A is equipped with an IEEE-488.2 interface and a USB interface which both incorporate all of the IEEE-488.2 Common Commands and Queries as well as the commands and queries required for device operation. Any function that can be entered via the front panel can be controlled via either interface. A menu item selects either the IEEE-488 or the USB interface to be active.

## CURRENT, VOLTAGE, AND POWER



## OSCILLOSCOPE



## PHASE, PF, AND VOLT-AMPERES



## HARMONICS



## SPECIFICATIONS

### CURRENT AND VOLTAGE

#### Range, Resolution and Input Impedance (Voltage Channel)

Full Scale Voltage	Max. Peak Value	Resolution	Input Impedance
2.000V	6V	1mV	1.05M/30pF
20.00V	60V	10mV	1.05M/30pF
200.0V	600V	100mV	1.00M/30pF
2000 V	3000V	1 V	1.00M/30pF

The 2000V range is useable to 1000V rms

#### Range, Resolution and Input Impedance (Current Channel)

Full Scale Voltage	Max. Peak Value	Resolution	Input Impedance
5.000mA	15mA	1uA	2.0 Ω
50.00mA	150mA	10uA	2.0 Ω
500.0mA	1500mA	100uA	0.034 Ω
5000 mA	15A	1mA	0.034Ω

EXTERNAL (100mV)	300mV	-	100kΩ
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**Uncertainty (rms) Current and Voltage** (double uncertainty spec for peak readings)

	5% - 100% of Full Scale	100% - 200% of Full Scale
Frequency	±(% of Reading+% of Range)	% of Reading
dc	±(0.10 + 0.10)	±0.20
5Hz - 250kHz	±(0.10 + 0.10)	±0.20
250kHz - 500kHz	±(0.20 + 0.20)	±0.40
*500kHz - 1.0MHz	±(0.40 + 0.40)	±0.80

\* Specify option -01

**ISOLATION:** 500V peak may be placed between the LO Voltage Terminal and Chassis

**POWER AND POWER x 10:**

**Ranges** Eight decade Full Scale ranges from 1.0000mW to 10,000W. The ranges are all combinations of a Full Scale Current range multiplied by a Full Scale Voltage range plus a corresponding set of combinations with ten times the sensitivity which occur when the Px10 range is activated.)

**Resolution** 1 part in 10000 of the Full Scale range

**Uncertainty Power**

	5% - 100% of Full Scale	100% - 200% of Full Scale
Frequency	±(% of V-A+% of Range)	% of V-A
dc	±(0.20 + 0.10)	±0.30
5Hz - 250kHz	±(0.20 + 0.10)	±0.30
250kHz - 500kHz	±(0.40 + 0.20)	±0.60
*500kHz - 1.0MHz	±(0.80 + 0.40)	±1.20

(for any Power Factor) (V-A is the Volt-Ampere product) \* Specify option -01

**POWER X 10:** Any Px10 range may be selected when both the Peak Current and the Peak Voltage are less than 0.316 of their Peak Range values.

**VOLT-AMPERES:**

Volt-Amperes is calculated as the product of the rms Current and the rms Voltage. It has the same Full Scale ranges, resolution and uncertainty as POWER.

**POWER FACTOR:**

Power Factor is calculated as the ratio of Power to Volt-Amperes. It has a range from 0 to ±1.0000 and a resolution of .0001 for Volt-Ampere products greater than 7.5% of Full Scale. The resolution decreases as the Volt-Ampere product decreases. The uncertainty is ±0.002 ±10 digits up to 250kHz, ±0.004 ±20 digits from 250kHz to 500kHz, and ±0.008 ±40 digits from 500kHz to 1000kHz with option -01.

**PHASE ANGLE:**

The resolution of the phase angle between the current and the voltage is 0.01. The uncertainty is  $\pm 0.17^\circ$  up to 250kHz,  $\pm 0.34^\circ$  from 250kHz to 500kHz, and  $\pm 0.68^\circ$  from 500kHz to 1000kHz with option -01.

**HARMONICS:**

The Harmonic amplitude is specified for the harmonic frequency below 1MHz. For this case, the specified uncertainty is that of the current or the voltage at the harmonic frequency and the range is that of the fundamental (the first harmonic). The uncertainty of the harmonic phase is three times greater than the uncertainty of the phase angle between the current and the voltage

**FREQUENCY:**

Frequency of Voltage or Current from 5.0000Hz to greater than 1MHz with five digits of resolution and an uncertainty of  $\pm 100\text{ppm} \pm 1$  digit.

**DISPLAY:** High resolution graphical TFT

**DIGITAL INTERFACE:** USB, IEEE-488

**DISPLAY UPDATE:** 80ms

**TEMPERATURE RANGE:**

Operating  $0^\circ\text{C}$  to  $40^\circ\text{C}$   
Within Specifications  $23^\circ\text{C} \pm 5^\circ\text{C}$   
Storage  $-40^\circ\text{C}$  to  $75^\circ\text{C}$

**RELATIVE HUMIDITY:** Less than 90%

**WARM-UP TIME:** Thirty minutes for all specifications

**POWER REQUIREMENTS:** 100 to 260V rms, 47 to 63Hz, 30VA max.

**PHYSICAL:**

19" Rack Mountable, 3-1/2" high (2U)  
Weight: (11pounds)  
Size: 48.3cm x 8.90cm x 33.0cm (19" x 3.5" x 13")



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