

3321, 3322,  
3330

# LCZ Meters



Three powerful LCZ meters: all easy to use, 4½ digits, 0.1% accuracy, DC bias capability, and built-in IEEE-488 interface.

#### MODEL 3321:

- Four test frequencies to 100kHz

#### MODEL 3322:

- Eleven frequencies in 1, 2, 5 steps to 100kHz
- Binning and deviation capability

#### MODEL 3330:

- Choice of 201 frequencies from 40Hz to 100kHz
- Finely adjustable test signal levels from 10mV to 1.100V
- Determines L, C, R, |Z|, Q, D, ESR, G, X,  $\theta$ , V or I in as little as 64ms
- Sorting/binning options include % deviation, handler interface and beeper feature
- Accepts bipolar bias voltage up to  $\pm 35V$



2V bias source in the Model 3321 and 3322 is built in for electrolytic capacitor and semiconductor test. Externally supplied voltages up to 35V can also be used.

#### High Precision

All models have 4½-digit resolution and 0.1% basic accuracy. D and Q resolution is 0.0001 and  $\theta$  resolution is 0.01°. These instruments provide top-of-the-line lab accuracy combined with high speed readings as fast as 64ms.

#### Automatic Settings

All instruments have automatic selection of function and equivalent circuits. In the AUTO mode, no knowledge of any controls is required; operation is literally as simple as connecting the DUT and reading the L, C, or |Z| and  $\theta$  of the DUT.

These instruments are for precision component, circuit, and materials testing in R&D labs, component test labs, inspection, qualification and reliability labs, and on the production line. They are very easy to use and provide accurate measurements of L, C, or |Z| and  $\theta$  along with D, Q, G, or ESR. The Model 3322 also directly reads R and X, and has a % deviation and binning function. The Model 3330 also measures V and I and has % deviation and binning functions.

The Model 3330 offers a broad test frequency range, with a choice of 201 frequencies from 40Hz to 100kHz, which makes it easy to match the test frequency to the actual in-circuit frequency. The lower end of the Model 3330's frequency range simplifies testing capacitors and inductors at the power line frequency, a valuable capability when characterizing components for power supplies. There's also a wide test signal amplitude range from 10mV to 1.100V. Lower amplitude test signals and the ability to accept bipolar external DC bias are useful when performing C-V tests on semiconductors and characterizing active devices, while the higher end of the range is valuable in passive component testing. The desired test signal level can be adjusted by as little as 1mV, so it's easy to match test signal amplitude to in-circuit amplitude. When characterizing devices with extremely low impedances, a built-in voltage/current monitor makes it easy to confirm the exact magnitude of the voltage applied to the DUT or the magnitude of the measured current, without the need for a DMM.

The Model 3322 has 11 test frequencies up to 100kHz. The Model 3321 has test frequencies of 120Hz, 1kHz, 10kHz, and 100kHz. Both units have selectable 1V or 50mV AC test voltages, permitting components to be tested at small signal levels or with minimum noise. A

#### Ordering Information

3321	LCZ Meter
3322	LCZ Meter
3330	LCZ Meter (201 test frequencies and handler interface)

These products are available with an Extended Warranty.

#### Accessories Supplied

Operating manual, power cable, and fuses

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# 3321, 3322, 3330

# LCZ Meters

Model 3321, 3322, and 3330 Specifications

LCZ/AC METERS

## ACCURACY OF IMPEDANCE |Z| AND ANGLE $\Theta$ (Models 3321 and 3322)

FOR  $0.2\Omega \leq |Z| \leq 20\text{ M}\Omega$ :

Z , $\Omega$ LEVEL = 1V rms, SPEED = MED or SLOW for 3322	3322 Frequency, [Hz]							
	120	200	1k	2k	10k	20k	50k	100k
	120	500	1k	5k	10k	20k	50k	100k
$10\text{M} \leq  Z  < 20\text{M}$	3.0% 1.5°	2.0% 1.0°	1.0% 0.8°	2.0% 1.5°	3.5% 2.0°	4.0% 3.0°	14.0% 8.0°	20.0% 12.0°
$5\text{M} \leq  Z  < 10\text{M}$	1.5% 0.9°	1.0% 0.6°	0.5% 0.4°	1.0% 0.6°	1.8% 1.1°	2.0% 1.3°	7.0% 4.0°	10.0% 6.0°
$2\text{M} \leq  Z  < 5\text{M}$	0.75% 0.45°	0.5% 0.3°	0.3% 0.2°	0.5% 0.3°	0.9% 0.6°	1.0% 0.6°	3.5% 2.0°	5.0% 3.0°
$1\text{M} \leq  Z  < 2\text{M}$	0.36% 0.22°	0.3% 0.15°	0.2% 0.1°	0.3% 0.15°	0.4% 0.2°	0.5% 0.3°	1.6% 1.0°	3.0% 2.0°
$200\text{k} \leq  Z  < 1\text{M}$	0.25% 0.15°	0.2% 0.12°	0.15% 0.09°	0.2% 0.12°	0.27% 0.16°	0.35% 0.2°	1.0% 0.6°	2.0% 1.2°
$20\text{k} \leq  Z  < 200\text{k}$	0.15% 0.10°	0.12% 0.06°	0.1% 0.04°	0.18% 0.08°	0.25% 0.15°	0.3% 0.2°	0.6% 0.4°	1.2% 0.8°
$2\text{k} \leq  Z  < 20\text{k}$	0.14% 0.09°	0.12% 0.05°	0.1% 0.03°	0.12% 0.06°	0.15% 0.08°	0.2% 0.12°	0.4% 0.3°	0.8% 0.6°
$10 \leq  Z  < 2\text{k}$	0.13% 0.08°	0.11% 0.05°	0.1% 0.03°	0.11% 0.08°	0.13% 0.1°	0.17% 0.15°	0.4% 0.25°	0.7% 0.5°
$2 \leq  Z  < 10$	0.25% 0.15°	0.2% 0.1°	0.15% 0.07°	0.2% 0.12°	0.32% 0.2°	0.5% 0.3°	0.8% 0.4°	1.5% 0.8°
$1 \leq  Z  < 2$	0.35% 0.22°	0.3% 0.2°	0.2% 0.12°	0.25% 0.15°	0.5% 0.3°	0.7% 0.4°	1.0% 0.6°	2.0% 1.2°
$0.5 \leq  Z  < 1$	0.7% 0.45°	0.6% 0.4°	0.4% 0.25°	0.5% 0.3°	0.8% 0.5°	1.2% 0.7°	1.7% 1.0°	3.3% 2.0°
$0.2 \leq  Z  < 0.5$	1.4% 0.9°	1.1% 0.7°	0.8% 0.5°	1.1% 0.7°	1.25% 0.8°	1.8% 1.1°	2.7% 1.6°	5.5% 3.0°

Z , $\Omega$ LEVEL = 50mV rms, SPEED = MED or SLOW for 3322	3322 Frequency, [Hz]							
	120	200	1k	2k	10k	20k	50k	100k
	120	500	1k	5k	10k	20k	50k	100k
$10\text{M} \leq  Z  < 20\text{M}$	7.0% 4.0°	4.5% 2.5°	3.5% 2.0°	6.0% 3.5°	8.5% 5.0°	17.0% 10.0°		
$5\text{M} \leq  Z  < 10\text{M}$	3.5% 2.0°	2.2% 1.3°	1.7% 1.0°	2.7% 1.6°	3.5% 2.0°	7.0% 4.0°		
$2\text{M} \leq  Z  < 5\text{M}$	2.0% 1.2°	1.2% 0.8°	0.9% 0.6°	1.2% 0.8°	1.6% 1.0°	3.5% 2.0°		
$1\text{M} \leq  Z  < 2\text{M}$	1.0% 0.6°	0.6% 0.35°	0.4% 0.25°	0.6% 0.35°	0.8% 0.5°	1.6% 0.9°	12.0% 7.0°	14.0% 8.0°
$200\text{k} \leq  Z  < 1\text{M}$	0.5% 0.3°	0.4% 0.25°	0.3% 0.18°	0.35% 0.24°	0.4% 0.25°	0.7% 0.4°	6.0% 3.6°	7.0% 4.0°
$20\text{k} \leq  Z  < 200\text{k}$	0.3% 0.18°	0.2% 0.12°	0.16% 0.08°	0.2% 0.14°	0.24% 0.18°	0.35% 0.23°	1.4% 1.0°	2.0% 1.5°
$2\text{k} \leq  Z  < 20\text{k}$	0.25% 0.15°	0.18% 0.09°	0.16% 0.06°	0.2% 0.12°	0.24% 0.14°	0.35% 0.20°	1.4% 0.8°	2.0% 1.2°
$10 \leq  Z  < 2\text{k}$	0.20% 0.12°	0.18% 0.09°	0.15% 0.06°	0.20% 0.12°	0.23% 0.13°	0.32% 0.18°	1.2% 0.7°	1.6% 1.0°
$2 \leq  Z  < 10$	0.5% 0.3°	0.35% 0.20°	0.25% 0.14°	0.35% 0.20°	0.5% 0.3°	0.7% 0.4°	3.4% 2.0°	4.0% 2.3°
$1 \leq  Z  < 2$	1.0% 0.6°	0.6% 0.4°	0.5% 0.3°	0.6% 0.4°	0.8% 0.5°	1.1% 0.7°	6.0% 3.6°	8.0% 5.0°
$0.5 \leq  Z  < 1$	1.8% 1.1°	1.2% 0.7°	1.0% 0.6°	1.2% 0.7°	1.5% 0.9°	1.8% 1.1°	10.0% 6.0°	14.0% 8.5°
$0.2 \leq  Z  < 0.5$	3.7% 2.2°	2.6% 1.5°	2.0% 1.2°	2.6% 1.5°	2.9% 1.7°	3.4% 2.0°	21.5% 13.0°	28.0% 16.0°

FOR  $|Z| > 20\text{ M}\Omega$ , OR  $|Z| < 0.2\Omega$ : Refer to Web site for full specifications.

## IMPEDANCE MAGNITUDE ACCURACY (%) AND PHASE ACCURACY (°) (Model 3330)

TABLE 1: Test Level= 0.9-1.1V rms, Speed = Med or Slow

Z  ( $\Omega$ )	Frequency (Hz)									
	40 to 90	100 to 130	160 to 900	1k to 1k	1.1k to 5.0k	5.1k to 10k	11k to 20k	21k to 50k	51k to 100k	51k to 100k
$10\text{M} \leq  Z  < 20\text{M}$	4.5% 2.25°	3.0% 1.5°	2.0% 1.0°	1.0% 0.80°	2.0% 1.5°	3.5% 2.0°	4.0% 3.0°	14% 8.0°	20% 12°	
$5\text{M} \leq  Z  < 10\text{M}$	2.2% 1.3°	1.5% 0.90°	1.0% 0.60°	0.5% 0.40°	1.0% 0.60°	1.8% 1.1°	2.0% 1.3°	7.0% 4.0°	10% 6.0°	
$2\text{M} \leq  Z  < 5\text{M}$	1.10% 0.68°	0.75% 0.45°	0.5% 0.30°	0.3% 0.20°	0.5% 0.30°	0.9% 0.60°	1.0% 0.60°	3.5% 2.0°	5.0% 3.0°	
$1\text{M} \leq  Z  < 2\text{M}$	0.54% 0.33°	0.36% 0.22°	0.30% 0.15°	0.20% 0.10°	0.30% 0.15°	0.40% 0.20°	0.50% 0.30°	1.6% 1.0°	3.0% 2.0°	
$200\text{k} \leq  Z  < 1\text{M}$	0.37% 0.22°	0.25% 0.15°	0.20% 0.12°	0.15% 0.09°	0.20% 0.12°	0.27% 0.16°	0.35% 0.20°	1.0% 0.60°	2.0% 1.2°	
$20\text{k} \leq  Z  < 200\text{k}$	0.22% 0.15°	0.15% 0.10°	0.12% 0.06°	0.10% 0.04°	0.18% 0.08°	0.25% 0.15°	0.30% 0.20°	0.60% 0.40°	1.2% 0.8°	
$2\text{k} \leq  Z  < 20\text{k}$	0.21% 0.13°	0.14% 0.09°	0.12% 0.05°	0.10% 0.03°	0.12% 0.06°	0.15% 0.08°	0.20% 0.12°	0.40% 0.30°	0.80% 0.60°	
$10 \leq  Z  < 2\text{k}$	0.20% 0.12°	0.13% 0.08°	0.11% 0.05°	0.10% 0.03°	0.11% 0.08°	0.13% 0.10°	0.17% 0.15°	0.40% 0.25°	0.70% 0.50°	
$2 \leq  Z  < 10$	0.37% 0.22°	0.25% 0.15°	0.20% 0.10°	0.15% 0.07°	0.20% 0.12°	0.32% 0.20°	0.50% 0.30°	0.80% 0.40°	1.5% 0.80°	
$1 \leq  Z  < 2$	0.52% 0.33°	0.35% 0.22°	0.30% 0.20°	0.20% 0.12°	0.25% 0.15°	0.50% 0.30°	0.70% 0.40°	1.0% 0.60°	2.0% 1.2°	
$0.5 \leq  Z  < 1$	1.0% 0.68°	0.70% 0.45°	0.60% 0.40°	0.40% 0.25°	0.50% 0.30°	0.80% 0.50°	1.2% 0.70°	1.7% 1.0°	3.3% 2.0°	
$0.2 \leq  Z  < 0.5$	2.1% 1.3°	1.4% 0.90°	1.1% 0.70°	0.80% 0.50°	1.1% 0.70°	1.2% 0.80°	1.8% 1.1°	2.7% 1.6°	5.5% 3.0°	

TABLE 2: Test Level = 50mV rms, Speed = Med or Slow

Z  ( $\Omega$ )	Frequency (Hz)									
	40 to 90	100 to 130	160 to 900	1k to 1k	1.1k to 5.0k	5.1k to 10k	11k to 20k	21k to 50k	51k to 100k	51k to 100k
$10\text{M} \leq  Z  < 20\text{M}$	10.5% 6.0°	7.0% 4.0°	4.5% 2.5°	3.5% 2.0°	6.0% 3.5°	8.5% 5.0°	17% 10.0°	100% 60°	120% 70°	
$5\text{M} \leq  Z  < 10\text{M}$	5.25% 3.0°	3.5% 2.0°	2.2% 1.3°	1.7% 1.0°	2.7% 1.6°	3.5% 2.0°	7.0% 4.0°	50% 30°	60% 35°	
$2\text{M} \leq  Z  < 5\text{M}$	3.0% 1.8°	2.0% 1.2°	1.2% 0.80°	0.90% 0.60°	1.2% 0.8°	1.6% 1.0°	3.5% 2.0°	25% 15°	30% 18°	
$1\text{M} \leq  Z  < 2\text{M}$	1.5% 0.90°	1.0% 0.60°	0.60% 0.35°	0.40% 0.25°	0.60% 0.35°	0.80% 0.50°	1.6% 0.90°	12% 7.0°	14% 8.0°	
$200\text{k} \leq  Z  < 1\text{M}$	0.75% 0.45°	0.50% 0.30°	0.40% 0.25°	0.30% 0.18°	0.35% 0.20°	0.40% 0.25°	0.70% 0.40°	6.0% 3.6°	7.0% 4.0°	
$20\text{k} \leq  Z  < 200\text{k}$	0.45% 0.27°	0.30% 0.18°	0.20% 0.12°	0.16% 0.08°	0.24% 0.14°	0.32% 0.18°	0.40% 0.23°	1.8% 1.0°	3.0% 1.5°	
$2\text{k} \leq  Z  < 20\text{k}$	0.37% 0.23°	0.25% 0.15°	0.18% 0.09°	0.16% 0.06°	0.20% 0.12°	0.24% 0.14°	0.35% 0.20°	1.4% 0.80°	2.0% 1.2°	
$10 \leq  Z  < 2\text{k}$	0.30% 0.18°	0.20% 0.12°	0.18% 0.09°	0.15% 0.06°	0.20% 0.12°	0.23% 0.13°	0.32% 0.18°	1.2% 0.70°	1.6% 1.0°	
$2 \leq  Z  < 10$	0.75% 0.45°	0.50% 0.30°	0.35% 0.20°	0.25% 0.14°	0.35% 0.20°	0.50% 0.30°	0.70% 0.40°	3.4% 2.0°	4.0% 2.3°	
$1 \leq  Z  < 2$	1.5% 0.9°	1.0% 0.60°	0.60% 0.40°	0.50% 0.30°	0.60% 0.40°	0.80% 0.50°	1.1% 0.70°	6.0% 3.6°	8.0% 5.0°	
$0.5 \leq  Z  < 1$	2.7% 1.65°	1.8% 1.1°	1.2% 0.70°	1.0% 0.60°	1.2% 0.70°	1.5% 0.90°	1.8% 1.1°	10% 6.0°	14% 8.5°	
$0.2 \leq  Z  < 0.5$	5.5% 3.3°	3.7% 2.2°	2.6% 1.5°	2.0% 1.2°	2.6% 1.5°	2.9% 1.7°	3.4% 2.0°	21% 13°	28% 16°	

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## ACCURACY (continued)

### Accuracy of R, ESR, and G:

In the case of  $Q < 0.1$  ( $D > 10$ ), use the accuracy of  $|Z|$ :  
 $|R| = |Z|$ ,  $|ESR| = |Z|$ ,  $|G| = 1/|Z|$ .

### Accuracy of L, C, and X:

In the case of  $Q > 10$  ( $D < 0.1$ ) use the accuracy of  $|Z|$ :

$$L = \frac{|Z|}{2\pi f}, C = \frac{1}{2\pi f |Z|}, |X| = |Z|,$$

where  $f$  is test frequency in Hz.

Refer to the conversion diagram from LC to  $|Z|$ .

### Accuracy of D and Q

In the case of  $D \ll 1$  ( $Q \gg 1$ ), use the following equations:

Accuracy of  $D = \pm(0.0175 \times \theta \text{ accuracy (deg)})$

Accuracy of  $Q = \pm(0.0175 \times \theta \text{ accuracy (deg)} \times Q^2)$

**ACCURACY OF V and I MONITORS (Model 3330 only):**  $\pm(2\% + |Z| \text{ accuracy})$ .

## TRIGGER

### TRIGGER MODES:

Models 3322 and 3330: Automatic (repeat) and manual.

Model 3321: Automatic only.

### TRIGGER DELAY TIME:

0 to 199.99s.

## MEASUREMENT TERMINALS

4 terminals (BNC-R) + guard terminal.

## FRONT PANEL SETUP MEMORY (MODELS 3322 AND 3330)

### NUMBER OF SETUPS: 10.

**CONTENT OF MEMORY:** All setting data other than bias on-off.

**LIFE OF BATTERY:** 3 years or longer after delivery.

## GPIB

**SETTING:** Of the items settable via the front panel, all the parameters except address and delimiter of GPIB can be set. Also trigger, OPEN/SHORT compensation, and memory operation can be performed.

**READOUT:** All the settable parameters, measurement data and status.

**STANDARDS:** Based on IEEE-488-1978 and IEEE-4881980.

**CODE:** ISO 7-bit code (ASCII code).

## MEASURING PARAMETERS

### MAIN PARAMETERS:

- AUTO Selects the main parameters, sub-parameters, and equivalent circuits automatically.
- L Self-inductance (unit: H, Henry)
- C Electrostatic capacity (unit: F, Farad)
- R Resistance (unit:  $\Omega$ , Ohm) (Models 3322 and 3330 only)
- |Z| Magnitude of impedance (unit:  $\Omega$ , Ohm)

There are series and parallel measuring modes for each of L, C, and R.

### SUB-PARAMETERS:

- Q Quality factor (quality of circuit)
- D Dissipation factor (=  $\tan \delta = 1/Q$ )
- ESR Equivalent series resistance (unit:  $\Omega$ )
- G Parallel conductance (unit: S, Siemens)
- X Series reactance (unit:  $\Omega$ ) (Models 3322 and 3330 only)
- $\theta$  Phase angle of impedance (unit: degree)
- V, I Monitored voltage and current (Model 3330 only) at DUT

**DEVIATION DISPLAY (Models 3322 and 3330):** Deviation and deviation of main parameter (not available for sub-parameter). Possible measurement range of deviation is  $\pm 100\%$  or more for  $\Delta$  and  $\pm 199.99\%$  for  $\Delta\%$ .

**NUMBER OF BINS (MODELS 3322 AND 3330):** 20 max.

### MEASURING (DISPLAY) RANGE:

R,  Z , ESR, X:	0.1 m $\Omega$	to	19.999 M $\Omega$
C:	0.001 pF	to	199.99 mF
L:	0.1 nH	to	19.999 kH
Q, D:	0.0001	to	19999
G:	0.001 $\mu$ S	to	199.99 S
q:	-180.00 $^\circ$	to	+179.99 $^\circ$
(3330 only) V:	0.0 mV	to	1.999 V rms
(3330 only) I:	0.00 $\mu$ A	to	19.99 mA rms

These ranges are dependent on the frequency, measuring range, and phase angle of impedance.

## MEASURING SIGNAL

### FREQUENCY:

#### Model 3330:

- Range: 40Hz–130Hz: 10Hz steps.
- 160, 200, 250Hz: 100Hz steps.
- 300Hz–9.9kHz: 100Hz steps.
- 10kHz–100kHz: 1kHz steps.

Model 3322: 100, 120, 200, 500, 1k, 2k, 5k, 10k, 20k, 50k, or 100k [Hz].

Model 3321: 120, 1k, 10k, or 100k [Hz].

Accuracy:  $\pm 50$ ppm ( $\pm 0.005\%$ ).

### SIGNAL LEVEL (Voltage with drive terminal H CUR open):

#### Models 3321 and 3322:

- 1V rms:  $\pm 3\%$  at 1kHz,  $\pm 4\%$  at 100Hz to 20kHz
- $\pm 5\%$  at 50kHz and 100kHz
- 50mV rms:  $\pm 5\%$  at 1kHz,  $\pm 6\%$  at 100Hz to 20kHz
- $\pm 7\%$  at 50kHz and 100kHz

#### Model 3330:

- Range: 10mV rms–1.100V rms: 1mV steps.
- Accuracy:  $\pm(3\% + 1\text{mV})$  for 1kHz.
- $\pm(4\% + 1\text{mV})$  for 40Hz–20kHz.
- $\pm(5\% + 1\text{mV})$  for 21kHz–100kHz.

**OUTPUT IMPEDANCE (all Models):** 100 $\Omega$  typical.

DC BIAS:	3321 and 3322	3330
Internal:	2V $\pm 5\%$	2V $\pm 5\%$
External:	0 to +35V	0 to $\pm 35$ V

## MEASURING RANGE

**NUMBER OF RANGES:** 6.

**SELECTION:** Model 3322: Automatic or manual.

Model 3321: Automatic.

**MEASURING TIME (reference value, fixed range and auto trigger mode):**

	Typical at 1kHz, 1k $\Omega$	Maximum on any range, any frequency
FAST:	64 ms	80 ms
MED:	150 ms	245 ms
SLOW:	480 ms	600 ms

Model 3322: Selectable among above three measuring times.

Model 3321: Automatic switching (equivalent to MED or SLOW).

## HANDLER INTERFACE (Model 3330)

**CONNECTOR:** 36-pin Centronix type (Cinch 57-30360).

### OUTPUT SIGNALS:

- BIN 0–11 Bin judgment signals
- A\_NG Main parameter failure
- B\_NG Sub-parameter failure
- STROBE Judgment completion pulse (pulse width  $\geq 1.5$ ms)
- BUSY Measurement in progress flag

### OUTPUT CHARACTERISTICS:

Type: TTL negative logic.

Maximum TTL Load: 10 standard TTL.

Maximum Output Current: 48mA sink (output voltage  $\leq 1$ V).

### INPUT SIGNALS:

TRIG: Measurement start trigger (pulse width  $\geq 100\mu$ s).

LOCK: Panel operation prohibited.

### INPUT CHARACTERISTICS:

Low Level Input Voltage: -1.5 to +0.8V

High Level Input Voltage: +2.4V to 30V (TRIG), +3.5V to 30V (LOCK).

Low Level Input Current (approximate):

TRIG: -0.33mA.

LOCK: -3mA.

**HANDLER INTERFACE GROUND:** Isolated from chassis ground.

Maximum voltage from chassis  $\pm 42$ VDC.

### BEEPER (two functions, DIP switch selectable):

Beeper On/Off: Enables beeper function.

Beeper Mode:

1. Beep only for NO GO.
2. 4kHz beep for GO and 2kHz beep for NO GO.

NOTE: GO refers to comparator bins 1–19, and NO GO refers to comparator bin 0.

## GENERAL

**POWER REQUIREMENTS:** AC line voltage: selectable to 100V, 120V, 220V, 240V  $\pm 10\%$  (250V max.). 48 to 62Hz, approx. 21VA.

**WARM-UP TIME:** 30 minutes.

**TEMPERATURE:** 23 $^\circ$ C  $\pm 5^\circ$ C.

**HUMIDITY:**  $\leq 90\%$  RH.

**ZERO CORRECTION:** Performed under above conditions.

**CALIBRATION PERIOD:** 12 months.

**OPERATING ENVIRONMENT:** 0 $^\circ$  to 40 $^\circ$ C, 10 to 90% RH (non-condensing).

**STORAGE ENVIRONMENT:** -10 to +50 $^\circ$ C, 10 to 80% RH (non-condensing).

**DIMENSIONS, WEIGHT:** 216mm wide  $\times$  132.5mm high  $\times$  350mm deep (8 $\frac{1}{2}$  in  $\times$  5 $\frac{1}{4}$  in  $\times$  13 $\frac{3}{4}$  in), excluding protrusions. Net weight 3.7kg (8.1 lb).

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