Data Sheet

Power Meter
5335B

The 5335B is a compact, single-phase AC / DC power meter for measuring and analyzing power consumption and power quality parameters quickly and accurately. It supports power measurements up to 600 Vrms and 20 Arms, with a bandwidth up to of 100 kHz.

Applications

Measure power, electrical energy bought or sold back to the power grid, inverters, harmonics of motors, un-interruptible power supplies, appliances, and consumer electronics.

Rich Measurement Functions

Measure all AC and DC parameters, including power, current, voltage, power factor, frequency, and phase. Additionally, the meter features a powerful integration function, the ability to perform harmonic measurements to the 50th order and an oscilloscope mode for viewing voltage and current readings in the time domain.

12 real-time parameters can be measured and displayed simultaneously in user customizable views.

Features & Benefits

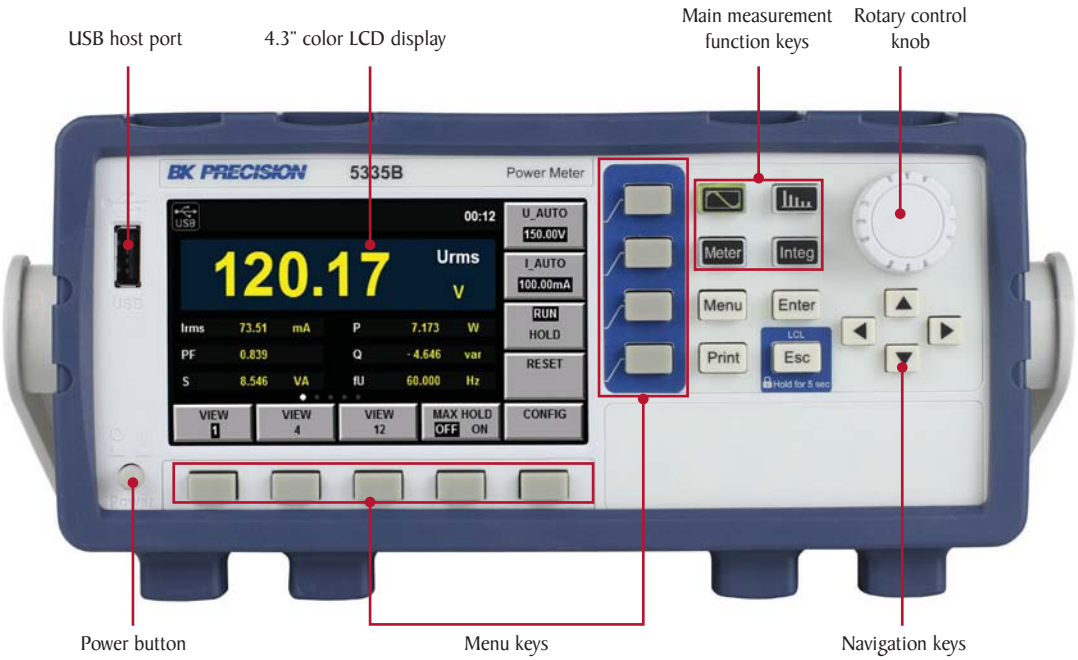
- 600 Vrms (Cat II) and 20 Arms direct input ranges
- Frequency ranges DC, 0.5 Hz to 100 kHz
- 0.1% basic accuracy for voltage and current measurements
- 4.3-inch color LCD (TFT)
- Simultaneously measure and display up to 12 measurement parameters
- Capture inrush current, and voltage surge with the peak function
- Harmonic measurements to the 50th order
- Integration function with automatic range switching
- Ability to measure electrical energy which is produced or consumed
- Pre-compliance testing according to IEC/EN 62000-3-2 / 4-7
- Standard USB (USBTMC-Compliant), GPIB, RS232 and LAN interfaces
- Line and frequency filter capability for reducing unwanted signal noise
- Optional universal breakout box to simplify connection between power meter and DUT

Model	Basic voltage and current accuracy	Measurement range		Input bandwidth	Measurements
		Voltage	Current		
5335B	±(0.1% + 0.2% F.S.)	0 - 600 Vrms	0 - 20 Arms	DC, 0.5 Hz – 100 kHz	Voltage, Current, Active power, Reactive power, Apparent power, Power factor, Phase angle, Frequency, V Max/V Min, A Max/A Min, Crest factor, Integration, Harmonic distortion factor, Total harmonic distortion (THD)

CALRIGHT INSTRUMENTS
The Right Source For Your Test & Measurement Needs

8715 Mesa Point Terrace San Diego, CA 92154
Toll Free: 1.866.363.6634 Tel: 1.619.429.4545 Fax: 1.619.374.7012
Email: sales@calright.com http://www.calright.com

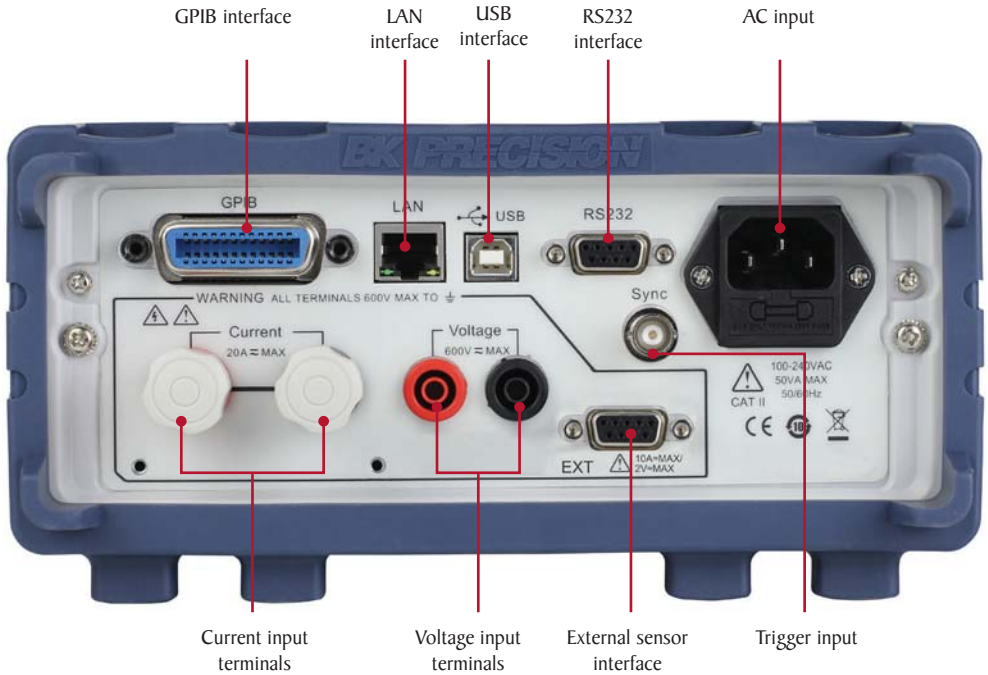
Front panel



Intuitive user interface

The large 4.3 inch color LCD screen enables easy viewing of configuration and measurements. Use the dedicated function keys to select one of the 4 main measurement modes: meter, harmonic, integral or oscilloscope. The results are displayed in numeric and graphical format. Screenshots can be saved directly to a USB flash drive.

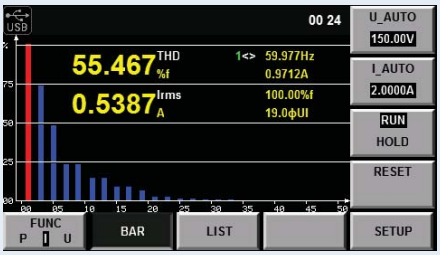
Rear panel



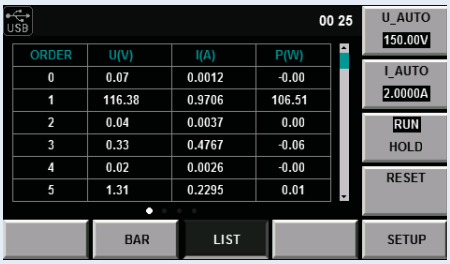
Flexible operation

Harmonic measurement

Voltage, current, active power, reactive power and phase values of each harmonic can be measured and displayed as a list or bar chart, enabling the user to quickly visualize and analyze the results. Total harmonic distortion (THD) can be evaluated up to the 50th order with the ability to display individual harmonic components.

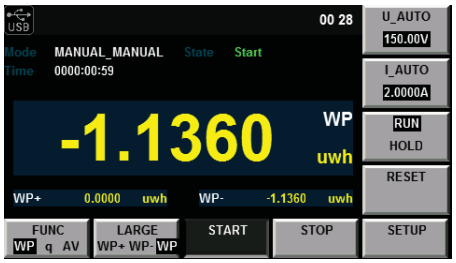


Bar chart



List

Integration measurement



The integration function is useful for analyzing bought and sold electrical energy of a grid tied power systems. The 5335B meter provides current integral and active power integral (Wh) functionality using automatic range switching for accurate measurement results.

Current sensor input

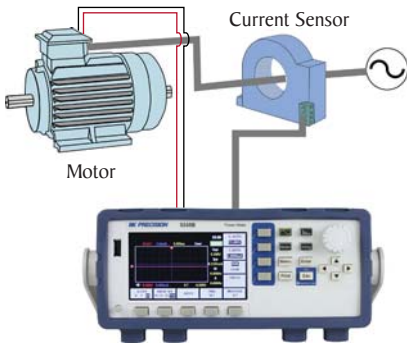
Example current transducers

Current measurements above 20 A are supported by connecting an external current sensor to the external sensor interface.

External sensor interface

To accommodate commonly available current sensor types, users can select from the 50 mV - 2 V or 2.5 V - 10 V ranges.

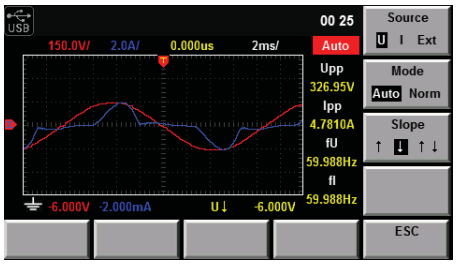
Motor testing



Power Meter

Many industrial products use PWM as a speed control method. The 5335B is able to measure input signals ranging from 0.5 Hz - 100 kHz and input voltages up to 600 V. Current can be monitored directly or by using external industry standard sensors.

Oscilloscope function



Displays waveforms of sampled voltage and current.

Optional universal breakout box

The optional TLBB53 breakout box simplifies AC line connection between the power meter and the DUT, and eliminates the need to cut the power cord and strip wires to connect to the power meter. This breakout box supports easy plug in connection and uses a universal socket to support most plugs used worldwide. A circuit breaker/ switch is also provided for additional protection.

Specifications

Specifications are subject to the following conditions
Temperature: 23±5° C, humidity: 30 to 75% RH.
Warm-up time: 30 minutes

Model	5335B	
General Measurement Specifications		
Basic measurements	Voltage, Current	Peak to peak, Maximum, Minimum, Average_rms, Average_rectified, DC, Crest factor (current), Inrush (current)
	Power	Real, Apparent, Reactive, DC, Power factor
	Time	Frequency, Phase
	Integration	Total power, Total current, Maximum power, Minimum power
Harmonic measurements	Type	Current, Voltage, Real power, Apparent power, Reactive power, Power factor, Phase, Percentage of total (Current, Voltage, Power)
	Range	DC up to 50th order
	Max. Frequency	100 kHz
Input bandwidth	DC, 0.5 Hz to 100 kHz	
Measurement method	Digital sampling	
A/D Converter	Simultaneous conversion of voltage and current inputs, Resolution: 18-bit, Maximum conversion rate: 10 µs	
Line filter	Select OFF or ON (cutoff frequency at 500 Hz)	
Peak (max,min)	Voltage, current, or power	
Input voltage continuous max.	1.5 kV-peak or 1 kV-RMS, whichever is less	
Input voltage transient (<1s) max.	2 kV-peak or 1.5 kV-RMS, whichever is less	
Input voltage common-mode max.	600 Vrms	
Voltage input impedance	2 MΩ + 13 pF in parallel (typical)	
Current input impedance (typical)	5 mA to 200 mA range	505 mΩ + 0.1 µH
	0.5 A to 20 A range	5 mΩ + 0.1 µH
	Sensor input	20 kΩ (50 mV to 2 V) 100 kΩ (2.5 V to 10 V)
Input current continuous max.	5 mA to 200 mA range	30 A-peak or 20 A-RMS, whichever is less
	0.5 A to 20 A range	100 A-peak or 30 A-RMS, whichever is less
	Sensor input	Peak value less than or equal to 5 times the rated range
Input current transient (<1s) max.	5 mA to 200 mA range	30 A-peak or 20 A-RMS, whichever is less
	0.5 A to 20 A range	150 A-peak or 40 A-RMS, whichever is less
	Sensor input	Peak value less than or equal to 10 times the rated range
Voltage Measurement Accuracy and Ranges		
Ranges	CF=3: 15 V, 30 V, 60 V, 150 V, 300 V, 600 V CF=6: 7.5 V, 15 V, 30 V, 75 V, 150 V, 300 V	
Accuracy [2] (line, frequency, & digital filter set to off)	DC to 1 kHz	±(0.1% + 0.2% F.S.)
	1 kHz < f ≤ 10 kHz	±((0.07 f[1])% + 0.3% F.S.)
	10 kHz < f ≤ 100 kHz	±(0.5% + 0.5% F.S.) ± [{0.04 × (f[1] - 10)}%]
Temperature coefficient	For temperature changes after zero-level compensation or range change	+ 0.02% F.S. /°C to the DC voltage accuracy
	Influence of self-generated heat caused by voltage input (U is the voltage reading (V))	+ 0.0000001 × U^2% to the AC voltage accuracy + 0.0000001 × U^2 % + 0.0000001 × U^2 % F.S. to DC current accuracy

[1] Input signal frequency in kHz

[2] Input waveform: Sine wave crest factor: 3, common-mode voltage: 0 V, power factor: 1
Frequency filter: Turn on when measuring ≤ 200 Hz

Specifications (cont.)

Current Measurement Accuracy and Ranges		
Direct input range		CF= 3:5 mA, 10 mA, 20 mA, 50 mA, 100 mA, 200 mA, 0.5 A, 1 A, 2 A, 5 A, 10 A, 20 A
		CF= 6:2.5 mA, 5 mA, 10 mA, 25 mA, 50 mA, 100 mA, 250 mA, 0.5 A, 1 A, 2.5 A, 5 A, 10 A
Sensor input range	External 1	CF = 3: 2.5 V, 5 V, 10 V CF = 6: 1.25 V, 2.5 V, 5 V
	External 2	CF= 3: 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V CF= 6: 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V
Accuracy [2] (line, frequency, & digital filter set to off)	DC to 1 kHz	±(0.1% + 0.2% F.S.)
	1 kHz < f ≤ 10 kHz	±{(0.07 f^{1})% + 0.3% F.S.}
	10 kHz < f ≤ 100 kHz	±(0.5% + 0.5% F.S.) ± [{0.04×(f^{1}-10)}%]
Temperature coefficient	2.5 to 200 mA	5 µA/ °C (after zero-level compensation, or range change)
	500 mA to 20 A	500 µA/ °C (after zero-level compensation, or range change)
	Influence of internal sensor self-heating	+ 0.00013 × I^2 % of reading to the AC current accuracies + 0.00013 × I^2 % of reading + 0.004 × I^2 mA (0.5 to 20 A) or 0.00013 × I^2 % of reading + 0.00004 × I^2 mA (2.5 to 200 mA), add to the DC current accuracy specifications

Power Measurement Accuracy		
Real power accuracy [2, 3] (CF= 3)[4]	DC	±(0.1% + 0.2% F.S.)
	0.5 Hz ≤ f < 45 Hz	±(0.3% + 0.2% F.S.)
	45 Hz ≤ f ≤ 66 Hz	±(0.1% + 0.1% F.S.)
	66 Hz < f ≤ 1 kHz	±(0.2% + 0.2% F.S.)
	1 kHz < f ≤ 10 kHz	±(0.1% + 0.3% F.S.) ± [{0.067×(f-1)}%]
	10 kHz < f ≤ 100 kHz	±(0.5% + 0.5% F.S.) ± [{0.09×(f-10)}%]
Apparent power (S)	Voltage accuracy + current accuracy	
Reactive power (Q)	Apparent power accuracy + ($\sqrt{1.0004\text{-PF}^2}$) - ($\sqrt{1\text{-PF}^2}$) × 100%	
Power factor (PF)	±[(PF–PF/1.0002) + abs(cosØ - cos{Ø+$\sin^{-1}$(influence from the power factor when PF=0%/100)})] ± 1 digit when voltage and current are at the measurement range rated input	
Phase angle (Φ)	±[abs(Ø - $\cos^{-1}$(PF/1.0002)) + $\sin^{-1}${(influence from the power factor when PF=0%)/100}] deg ± 1 digit when voltage and current are at the measurement range rated input	
Temperature coefficient	Same as the temperature coefficient for voltage and current	

Frequency Measurement Accuracy							
Frequency measurement range	Data update interval	0.1 s	0.25 s	0.5 s	1 s	2 s	5 s
	Measurement range	25 Hz ≤ f ≤ 100 kHz	10 Hz ≤ f ≤ 100 kHz	5 Hz ≤ f ≤ 100 kHz	2.5 Hz ≤ f ≤ 100 kHz	1.5 Hz ≤ f ≤ 50 kHz	0.5 Hz ≤ f ≤ 20 kHz
Accuracy	±0.06%			(CF 3 and signal <30% F.S.) or, (CF 6 and signal <60% F.S.), and ≤ 200 Hz with frequency filter on			
Frequency filter	500 Hz low-pass						

[1] Input signal frequency in kHz

[2] Input waveform: Sine wave crest factor: 3, common-mode voltage: 0 V, power factor: 1
Frequency filter: Turn on when measuring ≤ 200 Hz

[3] When power factor (PF)=0 (apparent power (S)):
±0.2% of S when 45 Hz ≤ f ≤ 66 Hz
±{(0.2+0.2×f)% of S} when 0.066 ≤ f ≤ 100 kHz
When 0<PF<1(phase angle (Φ)):
(power reading) × [(power reading error %) + (power range %) × (power range/indicated apparent power value) + {tanΦ× (influence when PF=0)%}]
When the line filter is turned ON:
45 to 66 Hz: Add 0.3% of reading
<45 Hz: Add 1% of reading

[4] Accuracy when the crest factor is set to 6, the accuracy is obtained by doubling specified accuracies

Specifications (cont.)

Harmonic Measurement Parameters					
Measurement method	PLL synchronization				
Frequency range	PLL frequency source range 10 Hz to 1.2 kHz (typical)				
FFT data length	1024				
Window function	Rectangle				
Fundamental frequency (Fund. freq.)	10 Hz to 75 Hz	75 Hz to 150 Hz	150 Hz to 300 Hz	300 Hz to 600 Hz	600 Hz to 1200 Hz
Sample rate	(Fund. freq.) x 1024	(Fund. freq.) x 512	(Fund. freq.) x 256	(Fund. freq.) x 128	(Fund. freq.) x 64
Window width	1	2	4	8	16
Upper limit of analysis orders	50	32	16	8	4
Harmonic Measurement Accuracy (when line filter is off)					
Frequency	10 Hz ≤ f < 45 Hz	45 Hz ≤ f ≤ 440 Hz	440 Hz < f ≤ 1 kHz	1 kHz < f ≤ 2.5 kHz	2.5 kHz < f ≤ 5 kHz
Voltage and current	±0.15% ± 0.35% F.S.	±0.15% ± 0.35% F.S.	±0.20% ± 0.35% F.S.	±0.80% ± 0.45% F.S.	3.05% ± 0.45% F.S.
Power	±0.15% ± 0.50% F.S.	±0.20% ± 0.50% F.S.	±0.40% ± 0.50% F.S.	1.56% ± 0.60% F.S.	5.77% ± 0.60% F.S.
Oscilloscope Function					
Channels	2				
Measurement	Voltage and current				
Bandwidth (-3 dB)	10 kHz				
Sample rate	100 kS/s				
Record length	300 points/channel				
Horizontal scale (Accuracy ±4.0%)	500 us, 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms				
Vertical scale ranges (Accuracy ±4.0%)	CF 3	I: 2.5, 5, 10, 25, 50, 100, 250, 500 mA/div, 1 A, 2.5 A, 5 A, 10 A/div, U: 7.5, 15, 30, 75, 150, 300 V/div			
	CF 6	I: 5, 10, 20, 50, 100, 200, 500 mA/div, 1 A, 2 A, 5 A, 10 A, 20 A/div, U: 15, 30, 60, 150, 300, 600 V/div			
Maximum input voltage (DC+AC peak)	1800 V				
Maximum input current (DC+AC peak)	60 A				
Environmental and Safety					
Temperature	Operating: 41 °F to 104 °F (5 °C to 40 °C) Storage: -4 °F to 122 °F (-20 °C to 50 °C)				
Humidity	20% RH to 80% RH (non-condensing)				
Electromagnetic compatibility	IEC 61326				
Safety	IEC 61010-1, EN 61010-1, Measurement 600 V CAT II				
General					
Display	4.3" TFT-LCD display, 480 x 272				
Remote Interfaces	USB (USBTMC-Compliant), GPIB, RS232, LAN				
Power	100 to 240 VAC, 50 / 60 Hz				
Power Consumption	50 VA max.				
Dimensions (W x H x D)	8.4" x 3.5" x 14" (214.5 mm × 88.2 mm × 354.6 mm)				
Weight	6.2 lbs (2.8 kg)				
Three-Year Warranty					
Standard Accessories	Getting started manual, instruction manual (downloadable), AC power cord, USB type A-to-type B cable, certificate of calibration				