

1000 ohms/volt sensitivities, a TVM or DVM with greater than 1 Megohm input impedance, or analog or digital ammeter with less than 1 volt total voltage drop.

### 1-28. Complete Specifications

1-29. The complete specifications for the 5100 Series Calibrators are listed in Table 1-2 through 1-9, with each

table covering a specific portion of the specification. Refer to Table 1-2 for detailed listing on DC volts; Table 1-3 for AC volts; Table 1-4 for Current, both direct and alternating; Table 1-5 for Resistance; Table 1-6 for the Wideband Option -03; Table 1-7, for the General Specifications, including environmental information; Table 1-8, for combined use with a Model 5205A/5215A and Table 1-9, with a Model 5220A.

Table 1-1. Summarized Specifications

PROGRAMMED OUTPUT	RANGE	ACCURACY +/- (% OF OUTPUT + % OF RANGE + FLOOR)
DC Voltage	All	.005 + .001 + 5 $\mu$ V
AC Voltage	50 Hz - 1 kHz (All ranges)	.05 + .005 + 50 $\mu$ V
	1 kHz - 10 kHz (Up to 110V)	
	10 kHz - 20 kHz (Up to 110V)	
	20 kHz - 50 kHz (Up to 19.9999V)	.08 + .008 + 50 $\mu$ V
Direct Current	All	.025 + .0025 + .01 $\mu$ A
Alternating Current	50 Hz - 1 kHz (All ranges)	.07 + .01 + 2 $\mu$ A
Resistance	Four terminal	
	1 ohm	.02%
	10 ohm	.01%
	100 ohm, 1 kilohm, 10 kilohm	.005%
	Two terminal	
	100 kilohm	.005%
	1 Megohm	.01%
	10 Megohm	.05%

Table 1-2. DC Volts Specifications

DC Volts				
RANGE	RESOLUTION	MAXIMUM CURRENT	RIPPLE AND NOISE (10 Hz to 3 kHz) NO LOAD TO MAXIMUM RATED LOAD	ACCURACY (6 months) (20°C to 30°C)
±(200V to 1100V)	10 mV	6 mA/400 pF max	<0.05% of setting rms	± (0.005% of setting + 0.001% of range + 5 µV)
±(20V to 199.999V)	1 mV	10 mA/400 pF max	<0.05% of setting rms (open to 20k Ω) <0.1% of setting rms (20k Ω to max rated load)	
±(2V to 19.9999V)	100 µV	25 mA/1000 pF	<0.02% of setting + 50 µV rms	
±(0.2V to 1.99999V)	10 µV	Limited by 50Ω output resistance	<0.01% of setting + 25 µV rms	
±(20 mV to 199.999 mV)	1 µV		<0.01% of setting + 25 µV rms	
±(0 to 19.9999 mV)	0.1 µV		<0.01% of setting + 25 µV rms	
±(0 to 1.99999V) 50Ω OVERRIDE	100 µV	25 mA/1000 pF	<0.02% of setting + 50 µV rms	

**Temperature Coefficient**

Above 30°C and Below 20°C add to accuracy limits ±(5 ppm of setting + 1 ppm of range + 1 µV)/°C. 200V to 1100V range add ±15 ppm of setting + 2 ppm of range /°C.

**Remote Sensing**

Four wire remote sensing is available from 2V to 1100V and below 2V in 50Ω DIVIDER OVERRIDE mode. The three lowest ranges are normally internal sensed. Internal sense connections are made automatically inside the box.

**Transient Recovery Time**

2 seconds to settle within 50 ppm of final value following any change in output voltage or current for all ranges except 20 to 199.999V, 20 kΩ to 2 kΩ load and switching between two highest ranges which requires 4 seconds.

**Short Term Stability (10 Minutes)**

At any fixed temperature from 0°C to 50°C the short term stability is ±(10 ppm of setting + 2 ppm of range + 5 µV) except above 500V which is ±25 ppm of setting.

**Load Regulation**

EXTERNAL SENSE: 2V to 1100V ±10 ppm no load to full rated load. Same for 0V to 1.99999V using 50Ω DIVIDER OVERRIDE.

INTERNAL SENSE: Same as external except max. full load is 400Ω.

**Overcurrent Protection**

On all ranges current is limited to prevent damage due to an overload or short circuit at output terminals. The operator is alerted by a flashing "O.L." on the central display. After approximately 2 seconds the calibrator goes to standby.

**Guard**

The DC voltage section is guarded and a front panel terminal is provided labeled "V GUARD".

Table 1-3. AC Volts Specifications

AC Volts					
RANGE <sup>1</sup>	RESOLUTION	MAXIMUM CURRENT	FREQUENCY	AMPLITUDE ACCURACY (6 months) (20°C to 30°C)	TOTAL HARMONIC DISTORTION AND NOISE
200V to 1100V	10 mV	6 mA/400 pF max	(1 mV to 1100V) 50 Hz to 1 kHz  (1 mV to 110V) 50 Hz to 20 kHz (Below 20V) 50 Hz to 50 kHz	50 Hz to 10 kHz ±(0.05% of setting +0.005% of range +50 µV)  >10 kHz to 50 kHz ±(0.08% of setting +0.008% of range +50 µV)	Bandwidth of 10 Hz to 200 kHz. Distortion, line interference + noise including random spikes.  (20V and higher) 50 Hz to 10 kHz: (0.08% of output) rms  (Below 20V) 50 Hz to 10 kHz: (0.05% of output +10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
20V to 19.999V	1 mV	10 mA/400 pF max			
2V to 19.9999V	100 µV	25 mA/400Ω/ 1000 pF max			
0.2V to 1.99999V	10 µV	2kΩ/1000 pF max			
20 mV to 199.999 mV	1 µV	25 mA from 50Ω source resistance	Accuracy: ±3% Resolution: 1 MSD		
1 mV <sup>2</sup> to 19.9999 mV	0.1 µV				

(1) Can be set in dBm = 1 mW across 600 $\Omega$  = .7746V

(2) 10% Lower voltage available using the Edit control

**Temperature Coefficient (Above 30°C and Below 20°C)**AMPLITUDE: Accuracy limits increase by  $\pm(20 \text{ ppm of setting} + 2 \text{ ppm of range})/^{\circ}\text{C}$ FREQUENCY: Accuracy limits increase by  $\pm 0.1/^{\circ}\text{C}$ **Remote Sensing**

Four wire remote sensing is available from 2V to 1100V. The three lowest ranges are internally sensed.

Internal sense connections are made automatically inside the box.

**Transient Recovery Time**

2 Seconds to settle within 100 ppm for amplitude and within 0.3% for frequency following any change in output voltage, current, or frequency. Switching between two highest ranges requires 2.2 seconds.

**Short Term Stability (10 Minutes)**At any fixed temperature from 0°C to 50°C the short term stability is  $\pm(0.01\%$  of range  $+10 \mu\text{V})$ .**Load Regulation**EXTERNAL SENSE: 0.2V to 1100V  $\pm 200 \text{ ppm}$  no load to full rated load.INTERNAL SENSE: Same as external except voltages less than 0.2V have a load regulation expressed as an output impedance of 50 $\Omega$ .

The above load regulations are met with reactive loads with power factors between 0.9 and 1.0.

**Overcurrent Protection**

On all ranges current is limited to prevent damage due to an overload or short circuit at output terminals.

The operator is alerted by a flashing "O.L." on the central display. After approximately 2 seconds the calibrator goes to standby.

Table 1-3. AC Volts Specifications (cont)

<b>Guard</b> The AC voltage function is guarded and a front panel terminal labeled "V GUARD" is provided.														
<b>DISCRETE FREQUENCIES AVAILABLE</b>														
IN Hz	50	60	70	80	90	100	200	300	400	500	600	700	800	900
110V to 1100V	•	•	•	•	•	•	•	•	•	•	•	•	•	•
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	•	•	•
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•
IN kHz	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•													
20V to 110V	•	•	•	•	•	•	•	•	•	•	•			
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Table 1-4. Current Specifications

DC Current				
RANGE	RESOLUTION	COMPLIANCE VOLTAGE	ACCURACY (6 months) (20°C to 30°C)	RIPPLE AND NOISE
±(0.2A to 1.99999A)	10 μA	0 to 2.1V min	±(0.025% of setting +0.0025% of range +0.01 μA)	(0.05% of output +0.01 μA) rms
±(20 mA to 199.999 mA)	1 μA	0 to 10V min		
+(2 mA to 19.9999 mA)	100 nA	0 to 10V min	Compliance voltage: >1V add 0.002% setting/volt	Measured with a bandwidth of 10 Hz to 10 kHz including random spikes
±(0.2 mA to 1.99999 mA)	10 nA	0 to 10V min		
±(10 μA <sup>1</sup> to 199.999 μA)	1 nA	0 to 10V min		
(1) 10% lower current available using the Edit Control.				
<b>Temperature Coefficient (Above 30°C and Below 20°C)</b> The accuracy limits increase by ±(10 ppm of setting +2 ppm of range)/°C				
<b>Transient Recovery Time</b> 1 Second to settle to within 0.01% of final value following any change in current or compliance voltage.				
<b>Short Term Stability (10 Minutes)</b> At any fixed temperature from 0°C to 50°C the short term stability is ±(50 ppm of setting + 5 ppm of range + 0.002 μA).				

Table 1-4. Current Specifications (cont)

**Load Regulation**

±20 ppm/volt for a change in the output voltage from 1 volt to maximum rated compliance voltage.

**Overvoltage Protection**

On all ranges voltage is limited to not more than 2V greater than maximum rated compliance voltage due to an open circuit condition. The operator is alerted by a flashing "O.L." on the central display. After approximately 2 seconds the calibrator goes to standby.

**Guard**

The DC current section is guarded and a front panel terminal labeled "I GUARD" is provided.

**AC Current**

RANGE	RESOLUTION	COMPLIANCE VOLTAGE	ACCURACY (6 months) (20°C to 30°C)	FREQUENCY	TOTAL HARMONIC DISTORTION AND NOISE
0.2A to 1.99999A	10 $\mu$ A	0 to 1.4V rms min.	$\pm(0.07\%$ of setting + $\pm 0.01\%$ of range +0.02 $\mu$ A  Compliance voltage: >1V rms add 0.005% of setting/volt	50 Hz to 1 kHz	Distortion, line interference + noise including random spikes  (0.05% of output +2 $\mu$ A) rms
20 mA to 199.999 mA	1 $\mu$ A	0 to 7V rms min.		Accuracy: $\pm 3\%$ Resolution: 1 MSD	
2 mA to 19.9999 mA	100 nA	0 to 7V rms min.		Although no accuracy specifications apply above 1 kHz, output is usable to 5 kHz.	
0.2 mA to 1.99999 mA	10 nA	0 to 7V rms min.			
10 $\mu$ A <sup>1</sup> to 199.999 $\mu$ A	1 nA	0 to 7V rms min.			

(1) 10% lower current available using the Edit Control.

**Temperature Coefficient (Above 30°C and Below 20°C)**

CURRENT: Accuracy limits increase by  $\pm(25$  ppm of setting + 10 ppm of range +0.2 nA)/°C.

FREQUENCY: Accuracy limits increase by  $\pm 0.1\%$ /°C.

**Transient Recovery Time**

4 Seconds to settle within 0.02% for current and within 0.3% for frequency following any change in output current, voltage, or frequency.

**Short Term Stability (10 Minutes)**

At any fixed temperature from 0°C to 50°C the short term stability is  $\pm(0.014\%$  of setting + 0.002% of range + 0.4  $\mu$ A).

**Load Regulation**

+50 ppm-20 nA/volt for a change in the output voltage from 1V to maximum rated compliance voltage. Load regulation is met with reactive loads with power factors between 0.9 and 1.0.

**Overvoltage Protection**

On all ranges voltage is limited to not more than 2V peak greater than maximum rated compliance voltage due to an open circuit condition. The operator is alerted by a flashing "O.L." on the central display. After approximately 2 seconds the calibrator goes to standby.

**Guard**

The AC current section is guarded and a front panel terminal labeled "I GUARD" is provided.

Table 1-5. Resistance Specifications

Resistance						
RANGE	POWER DISSIPATION	MAXIMUM CURRENT	PEAK VOLTAGE	ACCURACY (6 Months) (20°C to 30°C)	TEMPERATURE COEFFICIENT >30°C and <20°C ACCURACY LIMITS INCREASE BY	POWER COEFFICIENT
1Ω	1W	1A	1V	0.02%	10 ppm/°C	0.1 ppm/mW
10Ω		300 mA	3V	0.01%		0.3 ppm/mW
100Ω		100 mA	10V	0.005%	5 ppm/°C	
1 kΩ		30 mA	30V			
10 kΩ		10 mA	100V			
100 kΩ			3 mA	300V		
1 MΩ	100 mW	0.3 mA	0.01%		0.2 ppm/mW	
10 MΩ	10 mW	0.03 mA	0.05%		10 ppm/°C up to 40°C 50 ppm/°C above 40°C	0.02 ppm/mW

**Two or Four Terminal Ohms Below 100 kΩ**

The maximum residual resistance that can be compensated for using the Cal 1Ω function is 0.99999Ω.

Table 1-6. Wideband Option -03 Specifications

Wideband Option -03			
RANGE VOLTS	RANGE APPROX dBm <sup>1</sup>	AMPLITUDE ACCURACY AT 1 kHz TERMINATED IN 50Ω (6 Months 20°C to 30°C)	FREQUENCY VS. AMPLITUDE FLATNESS TERMINATED WITH 50Ω AND 1 FT OF RG58/AU
1V to 3.1623V	+13 to +23	±(0.25% of setting + 0.25% of range)	10 Hz to 30 Hz: ±0.3%  >30 Hz to 1 MHz: ±0.25%
0.31624V to 0.99999V	+3 to +13	±(0.50% of setting + 0.25% of range)	
0.1V to 0.31623V	-7 to +3	±(0.75% of setting + 0.25% of range)	>1 MHz to 5 MHz ±0.25% above 1 mV +0.6% at 1 mV and lower
31.624 mV to 99.999 mV	-17 to -7	±(1.00% of setting + 0.25% of range)	
10 mV to 31.623 mV	-27 to -17	±(1.25% of setting + 0.25% of range)	>5 MHz to 10 MHz: ±0.6%
3.1624 mV to 9.9999 mV	-37 to -27	±(1.50% of setting + 0.25% of range)	
1 mV to 3.1623 mV	-47 to -37	±(1.75% of setting + 0.25% of range)	Frequency Resolution: 1 MSD
300 μV to 0.99999 mV	-57 to -47	±(2.00% of setting + 0.25% of range)	Frequency Accuracy: ±3%

(1) 0 dBm = mW across 50Ω = 0.22361V.

**Temperature Coefficient (Above 30° and Below 20°C)**

**AMPLITUDE:** Accuracy limits increase by 0.1 times the accuracies listed in the amplitude accuracy column/°C.

**FREQUENCY:** Accuracy limits increase by 0.25%/°C.

**Transient Recovery Time**

2 Seconds to settle within 500 ppm for amplitude and within 0.3% for frequency following any change in voltage, current, or frequency.

**Harmonics**

-40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz.

**Spurious Outputs**

-50 dB or lower relative to fundamental for each frequency.

**Overload Protection**

A short circuit on the wideband output will not damage the calibrator. Normal operation is restored upon removal.

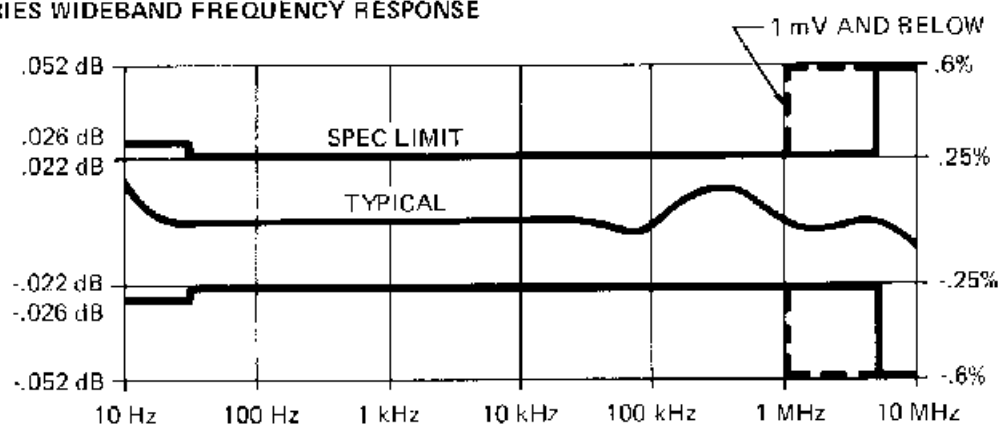
**5100 SERIES WIDEBAND FREQUENCY RESPONSE**

Table 1-7. General Specifications

**Stability/Environmental**

All specifications have been stated with the following conditions:

**Time:** Six months

**Temp:** 25°C ± 5°C

**R.H.:** < 85%

**Temperature Range**

**5100B/5101B:** Operating 0°C to +50°C

Non Operating -20°C to +65°C

**5101A w/tape:** Operating +10°C to +40°C

Non Operating +4°C to +50°C

**Humidity Range**

**0°C to 35°C:** 85% RH (Non-Condensing)

**35°C to 40°C:** 70% RH

**40°C to 50°C:** 50% RH

**Shock and Vibration**

Meets requirements of MIL-T 28800 for class 5 style E equipment.

**Operating Power**

**(100V to 240V ± 10%: 50 - 60 Hz)**

**5100B:** 200 VA Fully Loaded

**5101B:** 220 VA Fully Loaded

**Warmup**

30 Minutes to rated accuracy

**Dimensions**

22.23 cm H X 43.18 cm L X 60.33 cm W

(8.75 in H X 17.00 in L X 23.75 in W)

**Weight**

**5100B:** 30.4 kgm (67 lbs.) basic.

32.7 kgm (72 lbs.) fully loaded.

**5101B:** 32.7 kgm (72 lbs.) basic.

34.9 kgm (77 lbs.) fully loaded.

**5102B:** 35.8 kgm (79 lbs.) basic.

38.1 kgm (84 lbs.) fully loaded.



**Table 1-8. System Specifications for Power Amplifier Application**  
**(5100 Series B + Y500, Y5001, 5205A/5215A Combination)**

### **DC Operation (with 5205A)**

#### **Output Voltage**

$\pm(100 \text{ to } 1100)$  volts

#### **Output Current**

100 mA maximum

#### **Accuracy**

(90-Day)  $\pm(0.06\% \text{ of output} + 20 \text{ mV})$

(180-Day)  $\pm(0.07\% \text{ of output} + 20 \text{ mV})$

#### **Maximum Capacitive**

Load:  $< 1500 \text{ pF}$

#### **Temperature Coefficient**

$\pm(25 \text{ ppm of output} + 3 \text{ mV}/^{\circ}\text{C})$

#### **Ripple and Noise**

Random noise, in a 1 MHz bandwidth shall not exceed 100 mV rms. Line-related noise shall be less than 50 mV rms.

### **AC Operation (with 5206A or 5215A)**

#### **Output Voltage**

100 to 110V rms

#### **Output Current**

200 mA from 100 Hz to 50 kHz linearly decreasing to 140 mA in the region 100 Hz to 50 Hz.

#### **Amplitude Accuracy (180-Day, $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ )**

50 Hz to 10 kHz  $\pm(.08\% E_o + .1 \text{ volt})$

10 kHz to 50 kHz  $\pm(.12\% E_o + .15 \text{ volt})$

#### **Total Distortion and Noise, (in the band 10 Hz to 1 MHz)**

50 Hz to 20 kHz 0.1% of output

20 kHz to 50 kHz 0.2% of output

#### **Maximum Capacitive Load**

1500 pF or that value which draws the maximum rated load current, whichever is less.

#### **Amplitude Temperature Coefficient**

Above  $30^{\circ}\text{C}$  and below  $20^{\circ}\text{C}$  the accuracy limit increases by  $\pm(30 \text{ ppm of output} + 3 \text{ mV})/^{\circ}\text{C}$  for 50 Hz to 10 kHz; and  $\pm(50 \text{ ppm of output} + 5 \text{ mV})/^{\circ}\text{C}$  for 10 kHz to 50 kHz.

**Table 1-9. System Specifications for Transconductance Amplifier Application  
(5100 Series B + Y5000, Y5002, 5220A Combination)**

### DC Mode

#### Output Range

$\pm 1$  to  $\pm 19.9999$  A

#### Accuracy of Output

$\pm(0.025\%$  of selected output + 1 mA)

#### Resolution

$\pm 0.1$  mA

#### Temperature Coefficient

$\pm(0.003\%$  of selected output +  $100\ \mu\text{A}$ ) in ten minutes, with constant line, load, and temperature.

#### Line Regulation

Output changes less than 0.001% for a  $\pm 10\%$  in line voltage.

#### Load Regulation

Output changes less than  $\pm(0.005\%$  +  $100\ \mu\text{A}$ ) for a full load change of 4 volts of compliance.

### AC Mode

#### Output Range

1 A rms to 19.9999 A rms

#### Accuracy of Output

$\pm(0.07\%$  of selected output + 1 mA rms) from 50 Hz to 1 kHz, and  $\pm(0.07\%$  of selected output + 1 mA rms)  $\times f$  from 1 kHz to 5 kHz, where  $f$  = frequency in kHz.

#### Resolution

$\pm 0.1$  mA rms

#### Temperature Coefficient

$\pm(0.003\%$  of selected output +  $100\ \mu\text{A}$  rms) per degree C, above  $30^\circ\text{C}$  and below  $20^\circ\text{C}$ .

#### Short Term Stability

Output changes less than  $\pm(0.02\%$  +  $500\ \mu\text{A}$  rms) in 10 minutes, with constant line, load, and temperature.