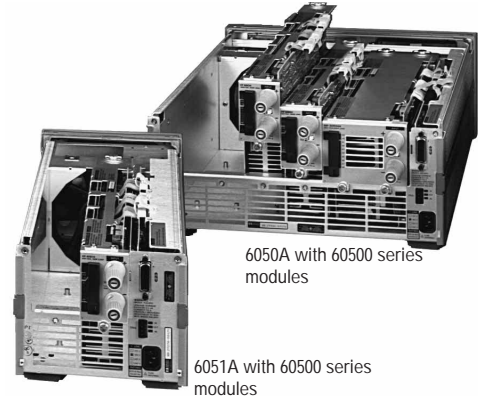


- GPIB control of current, voltage, and resistance
- GPIB readback of current, voltage, and power
- Built-in pulse waveform generation with programmable amplitude, frequency, duty cycle, and slew rate
- Continuous and pulse modes
- Full protection from overcurrent, overvoltage, overpower, overtemperature, and reverse polarity
- Electronic calibration
- Trigger for external synchronization
- Analog voltage control in constant current mode
- Parallel units in constant current mode for higher power
- Remote voltage sense in constant voltage mode
- Loads available for up to 240 V
- Standard three-year warranty
- VXI *plug&play* drivers



6060B and 6063B



6050A with 60500 series modules

6051A with 60500 series modules

### Agilent dc Electronic Loads

Agilent dc electronic loads are ideal for the test and evaluation of dc power sources and power components and are well-suited for applications in areas such as manufacturing, research and development, and incoming inspection.

#### The Agilent One-Box Solution

Agilent single-input loads and load mainframes are equipped with standard GPIB interfaces. This built-in IEEE-488 interface allows complete control of all load functions as well as readback of input voltage, current, power, and detailed operating status. Each stand alone load or load module also includes programming inputs that allow control of load current via an analog voltage. Other system features contributing to the one-box solution concept are internal voltage and current monitors and an internal transient generator with programmable amplitudes, frequency, duty cycle, and slew rate. The one-box solution saves space, cost, and time while making these dc electronic loads easy to integrate into automated test systems.

Agilent dc electronic loads are optimized to address a broad range of dynamic loading applications. They are specifically designed for stability in applications where fast transients are applied to the load inputs, such as during dc power supply startup characterization or transient response testing. Dynamic load performance can be further tailored to specific application needs with the programmable slew rate feature.

#### Fully-Compatible Operation

These dc electronic loads respond to instructions from the industry-standard SCPI command set. Moreover, the features of these dc electronic loads are fully compatible with one another. For example, test programs developed for 6060B 300 W single-input electronic load or 60502B 300 W single-input load module are interchangeable.

The dc electronic load family is also fully compatible with the 59510A relay accessory (see page 33). The 59510A provides physical isolation of the dc electronic load from the device under test or any other test instrument by switching power and sense leads. Capable of switching up to 60 A and 200 Vdc, the 59510A can be controlled by rear-panel signals on the electronic load.

#### Battery Testing

The 6050A Option J10, 6051A Option J10 and 6060B Option J10 electronic loads are modified for battery testing. These products provide tri-level pulse loading, to simulate accurate conditions on batteries. They also feature a programmable minimum battery voltage threshold (measured at load terminal). If the voltage of the battery under test falls below this threshold, the load will automatically turn off.

## G

dc  
Electronic  
Loads

6050A

6051A

6060B

6063B

60501B

60502B

60503B

60504B

60507B

## System or Manual Applications

Agilent dc electronic loads are equally suitable for manual use on the bench. The front-panel LCD meters indicate voltage, current, and power readings. The full-function front-panel keypad allows easy, repeatable, and reliable control of the load when it is used manually. Six volatile user-definable states allow you to easily save settings for later recall. An additional user-definable power-up state allows you to define settings that are remembered when the unit is switched off and then recalled when it is switched on again.

## Specifying System Performance

Because Agilent electronic loads feature an integrated GPIB programmer, pulse generator, current shunt, DMM, and cabling, their performance is specified as a system. Specifications cover all the integrated functions as one unit, which eliminates the need to calculate the actual performance of the automated test system based on each component's specification. The one-box solution makes the integration and documentation of your test system fast and easy.

## Single-Input Products

The 6060B and 6063B are single-input loads with standard rear-panel inputs. They are also available with optional front-panel inputs in addition to the rear-panel inputs. Front-panel inputs (Option 020) make input connections to the electronic load convenient for bench applications. These front-panel terminals are capable of handling the entire current rating of the load and can accept wire gauges up to AWG#4 (22 mm<sup>2</sup>). They require no tools to tighten, making the connections quick and easy.

## Mainframe Products

The 6050A 1,800-W and 6051A 600-W electronic load mainframes accept the user-installable load modules for easy system configuration and future reconfiguration, if desired. The 6050A holds up to six 60501B, 60502B, and 60503B load modules, or three 60504B and 60507B load modules, allowing up to 1,800 W of total maximum power. The 6051A holds up to two 60501B, 60502B, 60503B modules, or one 60504B or 60507B module allowing up to 600 W of total maximum power. One GPIB address is all you need for complete control and readback of all load modules within a single mainframe.

## Operating Agilent Loads Below the Minimum Input Voltage Specification

Agilent electronic loads meet all specifications when operated above 3.0 V; however, the dc operating characteristics also extend below this minimum-input voltage for static tests. Because of the FET technology used in the power input circuits, these electronic loads have a low minimum input resistance allowing them to sink high currents even at low voltages.

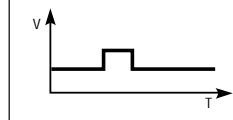
Figure A shows the operating range of a typical Agilent dc electronic load. Notice that low-voltage operation, down to zero volts, is possible at correspondingly-reduced current levels, depending on the minimum resistance of the load. These electronic loads, therefore, can be used in many applications that previously required zero-volt loads.

### Constant Current



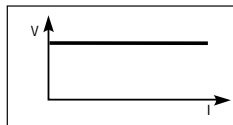
Power Supply Load  
Regulation Testing  
Battery Capacity  
Testing  
Capacitor Discharging

### Pulse and Dynamic Loading



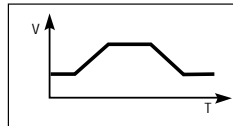
Power Supply Load  
Transient Response  
Power Component  
Testing  
Pulse Electroplating

### Constant Voltage



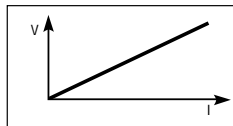
Current Source Testing  
Current Limit Testing  
Shunt Regulator

### Programmable Slew Rate



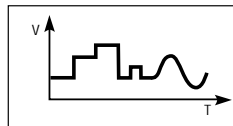
Power Supply Testing  
Power Component  
Testing  
Power Supply Load  
Transient Response

### Constant Resistance



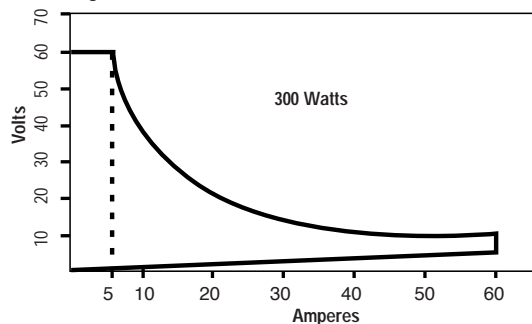
Characterizing  
Power Supply Crossover  
Power Supply  
Start-Up Delay  
Power Resistor Emulation

### Analog Programming



Battery Capacity Testing  
"Real-life" Load Simulation

Figure A



## G

dc  
Electronic  
Loads

For more information in the U.S.A. call  
1-800-452-4844

## SPECIFICATIONS

	6060B, 60502B	6063B, 60503B	60501B	60504B	60507B
<b>Amperes</b>	0 to 60 A	0 to 10 A	0 to 30 A	0 to 120 A	0 to 60 A
<b>Volts</b>	3 to 60 V	3 to 240 V	3 to 60 V	3 to 60 V	3 to 150 V
<b>Maximum power</b> (at 40° C)	300 W	250 W	150 W	600 W	500 W
<b>Constant current mode</b>					
Ranges	0 to 6 A, 0 to 60 A	0 to 1 A, 0 to 10 A	0 to 3 A, 0 to 30 A	0 to 12 A, 0 to 120 A	0 to 6 A, 0 to 60 A
Accuracy	0.1% ±75 mA	0.15% ±10 mA	0.1% ±40 mA	0.12% ±130 mA	0.1% ±80 mA
Regulation	10 mA	8 mA	10 mA	10 mA	10 mA (w/ ≥3 V at the point)
<b>Constant voltage mode</b>					
Accuracy	0.1% ±50 mV	0.12% ±120 mV	0.1% ±50 mV	0.1% ±50 mV	0.1% ±125 mV
Regulation (w/remote sense)	10 mV	10 mV	5 mV	20 mV	10 mV
<b>Constant resistance mode</b>					
Ranges	0.033 to 1.0 Ω 1 to 1,000 Ω 10 to 10,000 Ω	0.20 to 24.0 Ω 24 to 10,000 Ω 240 to 50,000 Ω	0.067 to 2 Ω 2 to 2,000 Ω 20 to 10,000 Ω	0.017 to 0.5 Ω 0.5 to 500 Ω 5 to 5,000 Ω	0.033 to 2.5 Ω 2.5 to 2,500 Ω 25 to 10,000 Ω
Accuracy	1 Ω: 0.8% ±8 mΩ (with ≥6 A at input) 1 KΩ: 0.3% ±8 mS (with ≥6 V at input) 10 KΩ: 0.3% ±8 mS (with ≥6 V at input)	24 Ω: 0.8% ±200 mΩ (with ≥1 A at input) 10 KΩ: 0.3% ±0.3 mS (with ≥24 V at input) 50 KΩ: 0.3% ±0.3 mS (with ≥24 V at input)	2 Ω: 0.8%, ±16 mΩ (with ≥3 A at input) 2 KΩ: 0.3% ±5 mS (with ≥6 V at input) 10 KΩ: 0.3% ±5 mS (with ≥6 V at input)	0.5 Ω: 0.8% ±5 mΩ (with ≥12 A at input) 500 Ω: 0.3% ±18 mS (with ≥6 V at input) 5 KΩ: 0.3% ±18 mS (with ≥6 V at input)	2.5 Ω: 0.8% ±16 mΩ (with ≥6 A at input) 2.5 KΩ: 0.3% ±5 mS (with ≥15 V at input) 10 KΩ: 0.3% ±5 mS (with ≥15 V at input)
<b>Transient generator</b>					
Frequency range	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz
Accuracy	3%	3%	3%	3%	3%
Duty cycle range	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)
Accuracy	6% of setting ±2%	6% of setting ±2%	6% of setting ±2%	6% of setting ±2%	6% of setting ±2%
Current level high range	60-A range: Accuracy: 0.1% ±350 mA	10-A range: Accuracy: 0.18% ±50 mA	30-A range: Accuracy: 0.1% ±200 mA	120-A range: Accuracy: 0.15% ±700 mA	60-A range: Accuracy: 0.1% ±350 mA
Current level low range	6-A range: Accuracy: 0.1% ±80 mA	1-A range: Accuracy: 0.18% ±13 mA	3-A range: Accuracy: 0.1% ±40 mA	12-A range: Accuracy: 0.15% ±160 mA	6-A range: Accuracy: 0.1% ±85 mA
Voltage level	3 to 60 V	3 to 240 V	3 to 60 V	3 to 60 V	3 to 150 V
Voltage level accuracy	0.1% ±300 mV	0.15% ±1.1 V	0.1% ±300 mV	0.15% ±300 mV	0.15% ±750 mV
<b>Readback specifications</b>					
Current readback accuracy	0.05% ±65 mA	0.12% ±10 mA	0.06% ±40 mA	0.1% ±110 mA	0.1% ±65 mA
Voltage readback accuracy	±(0.05% + 45 mV)	±(0.1% + 150 mV)	±(0.5% + 45 mV)	±(0.1% + 45 mV)	±(0.17% + 90 mV)
<b>Ripple and noise</b> (20-Hz to 10-MHz noise)					
Current	4 mA rms 40 mA peak-to-peak	1 mA rms 10 mA peak-to-peak	2 mA rms 20 mA peak-to-peak	6 mA rms 60 mA peak-to-peak	4 mA rms 40 mA peak-to-peak
Voltage	6 mV rms	6 mV rms	5 mV rms	8 mV rms	10 mV rms
<b>Supplemental Characteristics</b>	(Non-warranted characteristics determined by design that are useful in applying the product)				
<b>Constant current mode</b>					
Resolution	60-A range: 16 mA 6-A range: 1.6 mA	10-A range: 2.6 mA 1-A range: 0.26 mA	30-A range: 8 mA 3-A range: 0.8 mA	120-A range: 32 mA 12-A range: 3.2 mA	60-A range: 16 mA 6-A range: 1.6 mA
Temperature coefficient	100 ppm/°C ±5 mA/°C	150 ppm/°C ±1 mA/°C	100 ppm/°C ±3 mA/°C	120 ppm/°C ±8 mA/°C	120 ppm/°C ±5 mA/°C
<b>Constant voltage mode</b>					
Resolution	16 mV	64 mV	16 mV	16 mV	40 mV
Temperature coefficient	100 ppm/°C ±5 mV/°C	120 ppm/°C ±10 mV/°C	100 ppm/°C ±5 mV/°C	100 ppm/°C ±5 mV/°C	100 ppm/°C ±5 mV/°C
<b>Constant resistance mode</b>					
Resolution	1 Ω: 0.27 mΩ 1 KΩ: 0.27 mS 10 KΩ: 0.027 mS	24 Ω: 6 mΩ 10 KΩ: 0.011 mS 50 KΩ: 0.001 mS	2 Ω: 0.54 mΩ 2 KΩ: 0.14 mS 10 KΩ: 0.014 mS	0.5 Ω: 0.14 mΩ 500 Ω: 0.54 mS 5 KΩ: 0.054 mS	2.5 Ω: 0.67 mΩ 2.5 KΩ: 0.10 mS 10 KΩ: 0.01 mS
Temperature coefficient	1 Ω: 800 ppm/°C ±0.4 mΩ/°C 1 KΩ: 300 ppm/°C ±0.6 mS/°C 10 KΩ: 300 ppm/°C ±0.6 mS/°C	24 Ω: 800 ppm/°C ±10 mΩ/°C 10 KΩ: 300 ppm/°C ±0.03 mS/°C 50 KΩ: 300 ppm/°C ±0.03 mS/°C	2 Ω: 800 ppm/°C ±0.8 mΩ/°C 2 KΩ: 300 ppm/°C ±0.5 mS/°C 10 KΩ: 300 ppm/°C ±0.5 mS/°C	0.5 Ω: 800 ppm/°C ±0.2 mΩ/°C 500 Ω: 300 ppm/°C ±1.2 mS/°C 5 KΩ: 300 ppm/°C ±1.2 mS/°C	2.5 Ω: 800 ppm/°C ±0.8 mΩ/°C 2.5 KΩ: 300 ppm/°C ±0.3 mS/°C 10 KΩ: 300 ppm/°C ±0.3 mS/°C
<b>Transient generator</b>					
Frequency range	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz
Resolution	4% or less	4% or less	4% or less	4% or less	4% or less
Duty cycle range	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)
Resolution	4%	4%	4%	4%	4%
Current level high range	60-A range: Resolution: 260 mA	10-A range: Resolution: 43 mA	30-A range: Resolution: 130 mA	120-A range: Resolution: 520 mA	60-A range: Resolution: 260 mA
Current level low range	6-A range: Resolution: 26 mA	1-A range: Resolution: 4 mA	3-A range: Resolution: 13 mA	12-A range: Resolution: 52 mA	6-A range: Resolution: 26 mA
Current temperature coefficient	100 ppm/°C ±7 mA/°C	180 ppm/°C ±1.2 mA/°C	100 ppm/°C ±5 mA/°C	150 ppm/°C ±10 mA/°C	150 ppm/°C ±5 mA/°C
Voltage level resolution	260 mV	1 V	260 mV	260 mV	650 mV
Voltage temperature coefficient	150 ppm/°C ±5 mV/°C	120 ppm/°C ±10 mV/°C	150 ppm/°C ±5 mV/°C	150 ppm/°C ±5 mV/°C	150 ppm/°C ±5 mV/°C
Programmable slew rate	60-A range: 1 A/ms to 5 A/μs 6-A range: 0.1 A/ms to 0.5 A/μs	10-A range: 0.17 A/ms to 0.83 A/μs 1-A range: 17 A/ms to 83 A/ms	30-A range: 0.5 A/ms to 2.5 A/μs 3-A range: 0.2 A/ms to 0.25 A/μs	120-A range: 2 A/ms to 10 A/μs 12-A range: 0.2 A/ms to 1 A/μs	60-A range: 1 A/ms to 5 A/μs 6-A range: 0.1 A/ms to 0.5 A/μs
Rise/fall time	12 μs to 8 ms	16 μs to 8 ms	12 μs to 8 ms	12 μs to 8 ms	18 μs to 8 ms

G

dc  
Electronic  
LoadsVisit our web site  
<http://www.agilent.com/find/power>

## Supplemental Characteristics (cont'd)

	6060B, 60502B	6063B, 60503B	60501B	60504B	60507B
<b>Analog programming bandwidth</b>	10 kHz (-3 dB frequency)	10 kHz (-3 dB frequency)	10 kHz (-3 dB frequency)	10 kHz (-3 dB frequency)	10 kHz (-3 dB frequency)
<b>Analog programming accuracy</b>					
Current (low range)	4.5% ±75 mA	3% ±8 mA	4.5% ±40 mA	4% ±200 mA	4.5% ±75 mA
Current (high range)	4.5% ±250 mA	3% ±20 mA	4.5% ±130 mA	4% ±400 mA	4.5% ±200 mA
Temperature coefficient	100 ppm/°C ±6 mA/°C	150 ppm/°C ±1 mA/°C	100 ppm/°C ±3 mA/°C	100 ppm/°C ±12 mA/°C	150 ppm/°C ±6 mA/°C
Voltage	0.8% ±200 mV	0.5% ±150 mV	0.8% ±200 mV	0.8% ±200 mV	0.8% ±375 mV
Temperature coefficient	100 ppm/°C ±1 mV/°C	120 ppm/°C ±10 mV/°C	100 ppm/°C ±1 mV/°C	100 ppm/°C ±1 mV/°C	120 ppm/°C ±12.5 mV/°C
<b>Analog programming voltage</b>	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V
<b>Readback specifications</b>					
Current readback resolution	17 mA (via HP-IB) 20 mA (front panel)	2.7 mA (via HP-IB) 10 mA (front panel)	9 mA (via HP-IB) 10 mA (front panel)	34 mA (via HP-IB) 100 mA (front panel)	17 mA (via HP-IB) 20 mA (front panel)
Temperature coefficient	50 ppm/°C ±5 mA/°C	100 ppm/°C ±1 mA/°C	65 ppm/°C ±3 mA/°C	100 ppm/°C ±8 mA/°C	100 ppm/°C ±5 mA/°C
Voltage readback resolution	17 mV (via HP-IB) 20 mV (front panel)	67 mV (via HP-IB) 100 mV (front panel)	17 mV (via HP-IB) 20 mV (front panel)	20 mV (via HP-IB) 20 mV (front panel)	40 mV (via HP-IB) 100 mV (front panel)
Temperature coefficient	50 ppm/°C ±1.2 mV/°C	100 ppm/°C ±8 mV/°C	50 ppm/°C ±1.2 mV/°C	100 ppm/°C ±2 mV/°C	100 ppm/°C ±5 mV/°C
<b>Analog monitor accuracy</b>					
Current monitor (0 to 10 V out)	4% ±85 mA	3% ±10 mA	4% ±40 mA	4% ±170 mA	3% ±85 mA
Temperature coefficient	50 ppm/°C ±6 mA/°C	100 ppm/°C ±1 mA/°C	60 ppm/°C ±3 mA/°C	100 ppm/°C ±10 mA/°C	100 ppm/°C ±6 mA/°C
Voltage monitor (0 to 10 V out)	0.25% ±40 mV	0.4% ±240 mV	0.25% ±40 mV	0.4% ±60 mV	0.4% ±120 mV
Temperature coefficient	50 ppm/°C ±0.2 mV/°C	70 ppm/°C ±1.2 mV/°C	50 ppm/°C ±0.2 mV/°C	100 ppm/°C ±2 mV/°C	100 ppm/°C ±5 mV/°C
<b>Remote sensing</b>	5-Vdc maximum between sense and load input				
<b>Minimum operating voltage (at full rated current)</b>	2 volts (1.2 V typical)	2 volts (1.2 V typical)	2 volts (1.2 V typical)	2 volts (1.4 V typical)	2 volts (1.4 V typical)
<b>Programmable short</b>	0.033 Ω (0.020 Ω typical)	0.20 Ω (0.10 Ω typical)	0.066 Ω (0.040 Ω typical)	0.017 Ω (0.012 Ω typical)	0.033 Ω (0.025 Ω typical)
<b>Programmable open (typical)</b>	20 kΩ	80 kΩ	20 kΩ	20 kΩ	20 kΩ
<b>Drift (over 8-hour interval)</b>					
Current	0.03% ±10 mA	0.03% ±15 mA	0.03% ±5 mA	0.03% ±20 mA	0.03% ±10 mA
Voltage	0.01% ±10 mV	0.01% ±20 mV	0.01% ±10 mV	0.01% ±10 mV	0.01% ±25 mV
<b>dc isolation voltage</b>	±240 Vdc, between any input and chassis ground				
<b>Digital inputs</b>	$V_{IL} = 0.9 V$ max at $I_{IL} = -1 mA$ / $V_{IH} = 3.15 V$ min (pull-up resistor on input)				
<b>Digital outputs</b>	$V_{OL} = 0.72 V$ max at $I_{OL} = 1 mA$ / $V_{OH} = 4.4 V$ min at $I_{OH} = -20 \mu A$				
<b>Net weight (approx.)</b>	6060B: 6.12 kg (13.5 lb) 60502B: 3.2 kg (7 lb)	6063B: 6.12 kg (13.5 lb) 60503B: 3.2 kg (7 lb)	3.2 kg (7 lb)	5.4 kg (13 lb)	5.4 kg (13 lb)
<b>Shipping weight</b>	6060B: 8.16 kg (18 lb) 60502B: 4.5 kg (10 lb)	6063B: 8.16 kg (18 lb) 60503B: 4.5 kg (10 lb)	4.5 kg (10 lb)	7.3 kg (16 lb)	7.3 kg (16 lb)

Notes: 1. Operating temperature range is 0° to 55° C. All specifications apply for 25° C ±5° C, except as noted.  
 2. Maximum continuous power available is derated linearly from 40° C to 75% of maximum at 55° C.  
 3. DC current accuracy specifications apply 30 seconds after input is applied.

**Net Weight:** 6050A: 9.5 kg (21 lb); 6051A: 5.5 kg (12 lb)  
**Shipping Weight:** 6050A: 13.6 kg (30 lb); 6051A: 7.5 kg (17 lb)

**Size:**

**6050A:** 425.5 mm W x 177 mm H x 624.7 mm D  
 (16.75 in x 7 in x 24.6 in)  
**6051A:** 213 mm W x 177 mm H x 624.7 mm D  
 (8.4 in x 7 in x 24.6 in)  
**6060B, 6063B:** 425.5 mm W x 88.1 mm H x 396 mm D  
 (16.75 in x 3.5 in x 13.7 in).

See pages 49 and 50 for dimension drawings

### GPIB Interface Capabilities

The following GPIB functions are implemented: SH1, AH1, L4, SR1, DC1, DT1, and RL1

**Regulatory Compliance:** Listed to UL 1244; certified to CSA556B; conforms to IEC 61010-1. See page 69 for more information.

### Option Descriptions

- Opt 020 Front-Panel Inputs (for 6060B and 6063B only)
- Opt 100 87 to 106 Vac, 47 to 66 Hz input (for Japan only)
- Opt 220 191 to 233 Vac, 47 to 66 Hz input
- Opt 240 209 to 250 Vac, 47 to 66 Hz input
- \* Opt 800 Rack-mount Kit for two units (for 6051A) mounted side-by-side (p/n 5061-9694 and 5063-9215)
- \* Opt 908 Rack-mount Kit (p/n 5063-9215 with 6050A, p/n 5063-9245 with 6051A, and p/n 5063-9212 with 6060B and 6063B)
- \* Opt 909 Rack-mount Kit with Handles (p/n 5063-9222 when mounting 6050A and p/n 5063-9219 when mounting 6060B and 6063B)
- Opt 910 Extra manual set, including one each of the operating manual, programming reference manual, and service manual. The programming manual is available with the mainframe, and therefore not with individual modules.
- \* Options 908 and 909 for the 6050A, and Options 800 and 908 for the 6051A, require either the slide kit (p/n 1494-0059) or support rails (p/n E3663AC) to support the weight of the load mainframe.