

Table 60504-1. Specification and Supplemental Characteristics

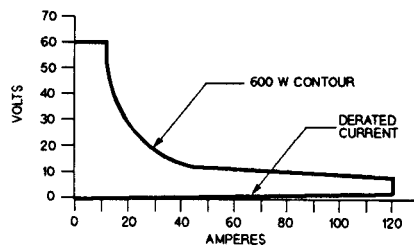
## SPECIFICATIONS

### DC Input Rating:

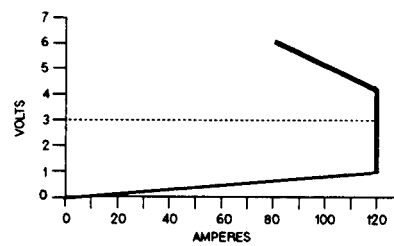
**Current:** 0 to 120 A

**Voltage:** 3 V to 60 V (minimum dc operation from 0 to 2 V for 0 to 10 A)

**Power:** 600 W at 40 °C (derated to 450 W at 55 °C)



A. OPERATING CHARACTERISTICS



B. DERATED CURRENT DETAIL

### Constant Current Mode:

<b>Ranges:</b>	0 to 12 A; and 0 to 120 A
<b>Accuracy:</b>	(after 30 second wait): $\pm 0.12\% \pm 130 \text{ mA}$ (both ranges)
<b>Resolution:</b>	3.2 mA (12 A range); 32 mA (120 A range)
<b>Regulation:</b>	10 mA (both ranges)
<b>Temperature Coefficient:</b>	120 ppm/°C $\pm 8 \text{ mA/°C}$ (both ranges)

### Constant Resistance Mode:

<b>Ranges:</b>	0.017 to 0.5 $\Omega$ ; 0.5 $\Omega$ to 500 $\Omega$ ; and 5 $\Omega$ to 5 k $\Omega$
<b>Accuracy:</b>	$\pm 0.8\% \pm 5 \text{ m}\Omega$ with $\geq 12 \text{ A}$ at input (0.5 $\Omega$ range); $\pm 0.3\% \pm 18 \text{ mS}$ with $\geq 6 \text{ V}$ at input (500 $\Omega$ and 5 k $\Omega$ ranges)
<b>Resolution:</b>	0.14 m $\Omega$ (0.5 $\Omega$ range); 0.54 mS (500 k $\Omega$ range); 0.054 mS (50 k $\Omega$ range)
<b>Regulation:</b>	20 mV with remote sensing (0.5 $\Omega$ range); 10 mA (500 $\Omega$ and 5 k $\Omega$ ranges)
<b>Temperature Coefficient:</b>	800 ppm/°C $\pm 0.2 \text{ m}\Omega/\text{°C}$ (0.5 $\Omega$ range); 300ppm/°C $\pm 1.2 \text{ mS/°C}$ (500 $\Omega$ and 5 k $\Omega$ ranges)

### Constant Voltage Mode:

<b>Range:</b>	0 to 60 V
<b>Accuracy:</b>	$\pm 0.1\% \pm 50 \text{ mV}$
<b>Resolution:</b>	16 mV
<b>Regulation:</b>	20 mV (remote sense); 100 mV (local sense)
<b>Temperature Coefficient:</b>	100 ppm/°C $\pm 5 \text{ mV/°C}$

**Table 60504-1 Specifications and Supplemental Characteristics (continued)**

**Transient Operation:**

**Continuous Mode**

<b>Frequency Range:</b>	0.25 Hz to 10 kHz
<b>Frequency Resolution:</b>	4%
<b>Frequency Accuracy:</b>	3%
<b>Duty Cycle Range:</b>	3% to 97% (0.25 Hz to 1 kHz); 6% to 94% (1 kHz to 10 kHz)
<b>Duty Cycle Resolution:</b>	4%
<b>Duty Cycle Accuracy:</b>	6% of setting $\pm$ 2%

**Pulsed Mode**

<b>Pulse Width:</b>	50 $\mu$ s $\pm$ 3% minimum; 4 s $\pm$ 3% maximum
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**Transient Current Level (0 to 12 A and 0 to 120 A ranges):**

<b>Resolution:</b>	52 mA (12 A range); 520 mA (120 A range)
<b>Accuracy:</b>	$\pm$ 0.15% $\pm$ 160 mA (12 A range); $\pm$ 0.15% $\pm$ 700 mA (120 A range)
<b>Temperature Coefficient:</b>	150 ppm/ $^{\circ}$ C $\pm$ 10 mA/ $^{\circ}$ C

**Transient Resistance Level (0.017 to 0.5  $\Omega$ , 0.5  $\Omega$  to 500  $\Omega$ , and 5  $\Omega$  to 5 k $\Omega$  ranges):**

<b>Resolution:</b>	2.2 m $\Omega$ (0.5 $\Omega$ range); 8.7 mS (500 $\Omega$ range); 0.87 mS (5 k $\Omega$ range)
<b>Accuracy:</b>	$\pm$ 0.8% + 7 m $\Omega$ with $\geq$ 12 A at input (0.5 $\Omega$ range) $\pm$ 0.3% + 26 mS with $\geq$ 6 V at input (500 $\Omega$ range) $\pm$ 0.3% + 18 mS with $\geq$ 6 V at input (5 k $\Omega$ range)

**Transient Voltage Level (0 to 60 V):**

<b>Resolution:</b>	260 V
<b>Accuracy:</b>	$\pm$ 0.15% $\pm$ 300 V
<b>Temperature Coefficient:</b>	150 ppm/ $^{\circ}$ C $\pm$ 5 mV/ $^{\circ}$ C

**Current Readback:**

<b>Resolution:</b>	34 mA (via GPIB); 100 mA (front panel)
<b>Accuracy:</b>	(after 30 minute wait): $\pm$ 0.1% $\pm$ 110 mA
<b>Temperature Coefficient:</b>	100 ppm/ $^{\circ}$ C $\pm$ 1 mA/ $^{\circ}$ C

**Voltage Readback:**

<b>Resolution:</b>	17 mV (via GPIB); 20 mV (front panel)
<b>Accuracy:</b>	$\pm$ 0.1% $\pm$ 45 mV
<b>Temperature Coefficient:</b>	100 ppm/ $^{\circ}$ C $\pm$ 2 mV/ $^{\circ}$ C
<b>Maximum Readback Capability:</b>	65 to 70 V (typical)

**Power Readback:**

<b>Accuracy:</b>	$\pm$ 0.2% $\pm$ 8 W
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**Table 60504-1 Specifications and Supplemental Characteristics (continued)**

**External Analog Programming 0 to 10 V (dc or ac):**

<b>Bandwidth:</b>	10 kHz (3 db frequency)
<b>Accuracy:</b>	± 4% ± 200 mA (0 to 12 A range) ± 4% ± 400 mA (0 to 120 A range) ± 0.8% ± 200 mV (0 to 60 V range)
<b>Temperature Coefficient:</b>	100 ppm/°C ± 12 mA/°C (current ranges) 100 ppm/°C ± 1 mV/°C (voltage range)

**External Current Monitor (0 to 10 V):**

<b>Accuracy:</b>	± 0.4% ± 170 mA (referenced to analog common)
<b>Temperature Coefficient:</b>	100 ppm/°C ± 10 mA/°C

**External Voltage Monitor (0 to 10 V):**

<b>Accuracy:</b>	± 0.4% ± 60 mV (referenced to analog common)
<b>Temperature Coefficient:</b>	100 ppm/ °C ± 2 mV/ °C

**Remote Sensing:** 5 Vdc maximum between sense and input binding posts

**Maximum Input Levels:**

<b>Current:</b>	122.4 A (programmable to lower limits)
<b>Voltage:</b>	75 V

**Minimum Operating Voltage:** 2 V (derated to 0 V at 0 A)

**PARD (20 Hz to 10 MHz noise):**

<b>Current:</b>	6 mA rms/60 mA p-p
<b>Voltage:</b>	8 mV rms

**DC Isolation Voltage:** ± 240 Vdc between + or - input binding post and chassis ground

**Digital Inputs:**

<b>V<sub>lo</sub>:</b>	0.9 V maximum at I <sub>lo</sub> = -1 mA
<b>V<sub>hi</sub>:</b>	3.15 V minimum (pull-up resistor on input)

**Digital Outputs:**

<b>V<sub>lo</sub>:</b>	0.72 V maximum at I <sub>lo</sub> = 1 mA
<b>V<sub>hi</sub>:</b>	4.4 V minimum at I <sub>lo</sub> = 20 µA

**SUPPLEMENTAL CHARACTERISTICS**

**Programmable Slew Rate** (For any given input transition, the time required will be either the total slew time or a minimum transition time, whichever is longer. The minimum transition time increases when operating with input currents under 2 A. The following are typical values; ± 25% tolerance):

**Table 60504-1 Specifications and Supplemental Characteristics (continued)**

**Current Slew Rate:\***

Rate #	120 A Range Step	12 A Range Step	Transition Time
1	2 A/ms	0.2 A/s	8.0 ms
2	5 A/ms	0.5 A/s	3.2 ms
3	10 A/ms	1 A/ms	1.6 ms
4	20 A/ms	2 A/ms	800 $\mu$ s
5	50 A/ms	5 A/ms	320 $\mu$ s
6	100 A/ms	10 A/ms	160 $\mu$ s
7	0.2 A/ $\mu$ s	20 A/ms	80 $\mu$ s
8	0.5 A/ $\mu$ s	50 A/ms	32 $\mu$ s
9	1 A/ $\mu$ s	100 A/ms	16 $\mu$ s
10	2 A/ $\mu$ s	0.2 A/ $\mu$ s	12 $\mu$ s
11	5 A/ $\mu$ s	0.5 A/ $\mu$ s	12 $\mu$ s
12	10 A/ $\mu$ s	1 A/ $\mu$ s	12 $\mu$ s

\*AC performance specified from 3 to 60 V.

**Voltage Slew Rate:**

Rate #	Voltage Range Step	Transition Time*
1	1 V/ms	8.0 ms
2	2.5 V/ms	3.2 ms
3	5 V/ms	1.6 ms
4	10 V/ms	800 $\mu$ s
5	25 V/ms	320 $\mu$ s
6	50 V/ms	160 $\mu$ s
7	0.1 V/ $\mu$ s	85 $\mu$ s
8	0.25 V/ $\mu$ s	85 $\mu$ s
9	0.5 V/ $\mu$ s	85 $\mu$ s

\*Transition time based on low capacitance current source.

**Resistance Slew Rate (0.5  $\Omega$  range):** Uses the value programmed for voltage slew rate.

**Resistance Slew Rate (500  $\Omega$  and 5 k $\Omega$  ranges):** Uses the value programmed for current slew rate.

**Transient Current Overshoot (When programmed from 0A):**

Range	Transient Current Level	Current Slew Rate	Overshoot*
120 A	24-120 A	All slew rates	0
	6 A	0.5 A/ $\mu$ s and 10 A/ $\mu$ s	6%
	6 A	2 A/ $\mu$ s	3%
	6 A	1 A/ $\mu$ s	1%
	6 A	0.2 A/ms to 0.5 A/ $\mu$ s	0
	12 A	2 A/ms to 2 A/ $\mu$ s	0
	12 A	5 A/ms and 10 A/ $\mu$ s	2%

Range	Transient Current Level	Current Slew Rate	Overshoot*
12 A	6 A	0.5 A/μs, 1 A/μs	5%
	6 A	0.2 A/μs to 0.2 A/μs	0
	12 A	1 A/μs	2%
	12 A	0.2 A/ms to 0.5 A/μs	0

\*Overshoot may be higher during the first five seconds of programming if unit has been operating at full current. Overshoot values assume a total inductance of 1μH, or less, in the load leads connected to the D.U.T.

**Source Turn-On Current Overshoot:** Less than 10% of final value (in CC and CR modes when connected to power supplies with voltage rise times of greater than 500μs).

**Programmable Short Circuit:** 0.17 Ω (0.012 Ω typical)

**Programmable Open Circuit:** 20 kΩ (typical)

**Drift Stability** (over an 8 hour interval):

**Current:** ±0.03% ± 20 mA  
**Voltage:** ±0.01% ± 10 mV

**Reverse Current Capacity:** 120 A when unit is on; 60 A when unit is off

**Weight:** 5.4 kg (12 lbs.)

**Table 60504-2. Programming Ranges**

Function	Front Panel Key	Front Panel Display	HPSL Command (Short Form)	Range of Values
<b>Constant Current</b>				
Set Range	<b>Range</b>	C:RNG value	"CURR:RANG value"	
Low Range				≥ 0 and ≤ 12 A
High Range				> 12 A and ≤ 120 A
Set Main Level	<b>CURR</b>	CURR value	"CURR value"	
Low Range				0 to 12 A
High Range				0 to 120 A
Set Slew Rate	(shift) <b>Slew</b>	C:SLW value	"CURR:SLEW value"	
Low Range				0.0002 to 1 (A/μs)
High Range				0.002 to 10 (A/μs)
Set Transient Level	<b>Tran Level</b>	C:TLV value	"CURR:TLEV value"	same as main level
*Set Triggered Level			"CURR:TRIG value"	same as main level
<b>Constant Resistance</b>				
Set Range	<b>Range</b>	R:RNG value	"RES:RANG value"	
Low Range				≥ 0 and ≤ 0.5 Ω
Middle Range				> 0.5 Ω and ≤ 500 kΩ
High Range				>500 Ω and ≤ 5 kΩ
Set Main Level	<b>RES</b>	RES value	"RES value"	
Low Range				0 to 0.5 Ω
Middle Range				0.5 Ω to 500 Ω
High Range				5 Ω to 5 kΩ

**Table 60504-2. Programming Ranges (continued)**

Function	Front Panel Key	Front Panel Display	HPSL Command (Short Form)	Range of Values
<b>Constant Resistance</b> Set Slew Rate Low Range Middle/High Range Set Transient Level *Set Triggered Level	(shift) <b>Slew</b>  <b>Tran Level</b>	V:SLW value C:SLW value R:TLV value	"VOLT:SLEW value" "CURR:SLEW value" "RES:TLEV value" "RES:TRIG value"	same as voltage slew same as current slew same as main level same as main level
<b>Constant Voltage</b> Set Main Level Set Slew Rate Set Transient Level *Set Triggered Level	<b>VOLT</b> (shift) <b>Slew</b> <b>Tran Level</b>	VOLT value V:SLW value V:TLV value	"VOLT value" "VOLT:SLEW value" "VOLT:TLEV value" "VOLT:TRIG value"	0 to 60 V 0.001 to 0.5 (V/μs) same as main level same as main level
<b>Transient Operation</b> Set Frequency Set Duty Cycle  *Set Pulse Width	<b>FREQ</b> (shift) <b>Dcycle</b>	FREQ value DCYCLE value	"TRAN:FREQ value" "TRAN:DCYC value"  "TRAN:TWID value"	0.25 Hz to 10 kHz 3-97% (0.25 Hz-1 kHz) 6-94% (1 kHz-10 kHz) 0.00005 to 4 s
<b>Trigger Operation</b> *Set Trigger Period			"TRIG:TIM value"	0.000008 to 4 s
<b>Current Protection</b> *Set Current Level *Set Delay Time			"CURR:PROT value" "CURR:PROT:DEL value"	0 to 122.4 A 0 to 60 s

\*Can only be programmed remotely via the GPIB.

**Table 60504-3. Factory Default Settings**

Function	Settings	Function	Setting
CURR level	0 A	Mode (CC, CR, CV)	CC
CURR transient level	0 A	Input (on/off)	on
*CURR slew rate	2 A/μs	Short (on/off)	off
CURR range	120 A	Transient operation (on/off)	off
*CURR protection (on/off)	off	***TRAN mode	continuous
**CURR protection level	122.4 A	(continuous, pulse, toggle)	
**CURR protection delay	15 s	TRAN frequency	1 kHz
RES level	500 Ω	TRAN duty cycle	50%
RES transient level	500 Ω	**TRAN pulse width	0.5 ms
RES range	500 Ω	**TRIG source	hold
VOLT level	60 V	(bus, external, hold, timer, line)	
VOLT transient level	60 V	**TRIG period	0.001 s
VOLT slew rate	5 V/μs	**PORT0 output (on/off)	off (logic 0)
		**CAL mode (on/off)	off

The \*RST command resets the CURR slew rate to 0.83 A/μ, not to the factory default.

\*\*Can only be programmed remotely via the GPIB.  
\*\*\*Continuous transient mode is the only mode available at the front panel. Pulsed, toggled, and continuous modes can all be programmed remotely via the GPIB.