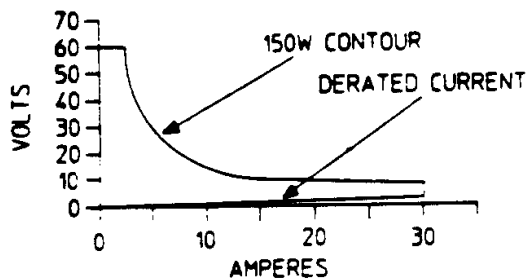


Table 60501-1. Specification and Supplemental Characteristics

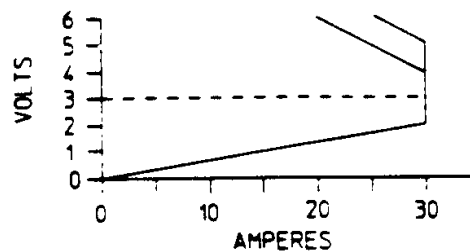
SPECIFICATIONS

DC Input Rating:

- Current:** 0 to 30 A
- Voltage:** 3 to 60 V (minimum dc operation from 0 to 2 V for 0 to 30 A)
- Power:** 150 W at 40 °C (derated to 112 W at 55 °C)



A. OPERATING CHARACTERISTICS



B. DERATED CURRENT DETAIL

Constant Current Mode:

- Ranges:** 0 to 3 A; and 0 to 30 A
- Accuracy:** (after 30 second wait): $\pm 0.1\% \pm 40 \text{ mA}$ (both ranges)
- Resolution:** 0.8 mA (3 A range); 8 mA (30 A range)
- Regulation:** 10 mA (both ranges)
- Temperature Coefficient:** 100 ppm/°C $\pm 3 \text{ mA}/^\circ\text{C}$ (both ranges)

Constant Resistance Mode:

- Ranges:** 0.067 to 2 Ω ; 2 Ω to 2 k Ω ; and 20 Ω to 10 k Ω
- Accuracy:** $\pm 0.8\% \pm 16 \text{ m}\Omega$ with $\geq 6 \text{ A}$ at input (2 Ω range); $\pm 0.3\% \pm 5 \text{ mS}$ with $\geq 6 \text{ V}$ at input (2 k and 10 k Ω ranges)
- Resolution:** 0.54 m Ω (2 Ω range); 0.14 mS (2 k Ω range); 0.014 mS (10 k Ω range)
- Regulation:** 10 mV with remote sensing (2 Ω range); 10 mA (2 k and 10 k Ω ranges)
- Temperature Coefficient:** 800 ppm/°C $\pm 0.8 \text{ m}\Omega/^\circ\text{C}$ (2 Ω range); 300ppm/°C $\pm 0.5 \text{ mS}/^\circ\text{C}$ (2 k and 10 k Ω ranges)

Constant Voltage Mode:

- Range:** 0 to 60 V
- Accuracy:** $\pm 0.1\% \pm 50 \text{ mV}$
- Resolution:** 16 mV
- Regulation:** 5 mV (remote sense); 40 mV (local sense)
- Temperature Coefficient:** 100 ppm/°C $\pm 5 \text{ mV}/^\circ\text{C}$

Table 60501-1 Specifications and Supplemental Characteristics (continued)

Transient Operation:

Continuous Mode

| | |
|-------------------------------|---|
| Frequency Range: | 0.25 Hz to 10 kHz |
| Frequency Resolution: | 4% |
| Frequency Accuracy: | 3% |
| Duty Cycle Range: | 3% to 97% (0.25 Hz to 1 kHz); 6% to 94% (1 kHz to 10 kHz) |
| Duty Cycle Resolution: | 4% |
| Duty Cycle Accuracy: | 6% of setting \pm 2% |

Pulsed Mode

| | |
|---------------------|---|
| Pulse Width: | 50 μ s \pm 3% minimum; 4 s \pm 3% maximum |
|---------------------|---|

Transient Current Level (0 to 3 A and 0 to 30 A ranges):

| | |
|---------------------------------|--|
| Resolution: | 13 mA (3 A range); 130 mA (30 A range) |
| Accuracy: | \pm 0.1% \pm 40 mA (3 A range); \pm 0.1% \pm 200 mA (30 A range) |
| Temperature Coefficient: | 100 ppm/ $^{\circ}$ C \pm 5 mA/ $^{\circ}$ C |

Transient Resistance Level (0.067 to 2 Ω , 2 Ω to 2 k Ω , and 20 Ω to 10 k Ω ranges):

| | |
|--------------------|---|
| Resolution: | 8.6 m Ω (2 Ω range); 2.1 mS (2 k Ω range); 0.2 mS (10 k Ω range) |
| Accuracy: | \pm 0.8% + 16 m Ω with \geq 3 A at input (2 Ω range) \pm 0.3% + 5 mS with \geq 6 V at input (2 k Ω range) \pm 0.3% + 5 mS with \geq 6 V at input (10 k Ω range) |

Transient Voltage Level (0 to 60 V):

| | |
|---------------------------------|--|
| Resolution: | 260 mV |
| Accuracy: | \pm 0.1% \pm 300 mV |
| Temperature Coefficient: | 150 ppm/ $^{\circ}$ C \pm 5 mV/ $^{\circ}$ C |

Current Readback:

| | |
|---------------------------------|---|
| Resolution: | 9 mA (via GPIB); 10 mA (front panel) |
| Accuracy: | (after 30 minute wait): \pm 0.06% \pm 40 mA |
| Temperature Coefficient: | 65 ppm/ $^{\circ}$ C \pm 3 mA/ $^{\circ}$ C |

Voltage Readback:

| | |
|-------------------------------------|---|
| Resolution: | 17 mV (via GPIB); 20 mV (front panel) |
| Accuracy: | \pm 0.05% \pm 45 mV |
| Temperature Coefficient: | 50 ppm/ $^{\circ}$ C \pm 1.2 mV/ $^{\circ}$ C |
| Maximum Readback Capability: | 65 to 70 V (typical) |

Power Readback:

| | |
|------------------|----------------------|
| Accuracy: | \pm 0.2% \pm 2 W |
|------------------|----------------------|

Table 60501-1 Specifications and Supplemental Characteristics (continued)

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

| | |
|---------------------------------|---|
| Bandwidth: | 10 kHz (3 db frequency) |
| Accuracy: | $\pm 4.5\% \pm 40$ mA (0 to 3 A range) $\pm 4.5\% \pm 130$ mA (0 to 30 A range) $\pm 0.8\% \pm 200$ mV (0 to 60 V range) |
| Temperature Coefficient: | 100 ppm/ $^{\circ}$ C ± 3 mA/ $^{\circ}$ C (current ranges) 100 ppm/ $^{\circ}$ C ± 1 mV/ $^{\circ}$ C (voltage range) |

External Current Monitor (0 to 10 V):

| | |
|---------------------------------|---|
| Accuracy: | $\pm 4\% \pm 40$ mA (referenced to analog common) |
| Temperature Coefficient: | 60 ppm/ $^{\circ}$ C ± 3 mA/ $^{\circ}$ C |

External Voltage Monitor (0 to 10 V):

| | |
|---------------------------------|--|
| Accuracy: | $\pm 0.25\% \pm 40$ mV (referenced to analog common) |
| Temperature Coefficient: | 50 ppm/ $^{\circ}$ C ± 0.2 mV/ $^{\circ}$ C |

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

Maximum Input Levels:

| | |
|-----------------|---------------------------------------|
| Current: | 30.6 A (programmable to lower limits) |
| Voltage: | 75 V |

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

PARD (20 Hz to 10 MHz noise):

| | |
|-----------------|--------------------|
| Current: | 2 mA rms/20 mA p-p |
| Voltage: | 5 mV rms |

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

Digital Inputs:

| | |
|------------------------|--|
| V_{lo}: | 0.9 V maximum at I_{lo} = -1 mA |
| V_{hi} | 3.15 V minimum (pull-up resistor on input) |

Digital Outputs:

| | |
|------------------------|---|
| V_{lo}: | 0.72 V maximum at I_{lo} = 1 mA |
| V_{hi}: | 4.4 V minimum at I_{lo} - 20 μ A |

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 1 A. The following are typical values; $\pm 25\%$ tolerance):

Table 60501-1 Specifications and Supplemental Characteristics (continued)

Current Slew Rate:*

| Rate # | 30 A Range Step | 3 A Range Step | Transition Time |
|--------|-----------------|-----------------|-----------------|
| 1 | 0.5 A/ms | 0.05 A/s | 8.0 ms |
| 2 | 1.2 A/ms | 0.12 A/s | 3.2 ms |
| 3 | 2.5 A/ms | 0.25 A/ms | 1.6 ms |
| 4 | 5 A/ms | 0.5 A/ms | 800 μ s |
| 5 | 12 A/ms | 1.2 A/ms | 320 μ s |
| 6 | 25 A/ms | 2.5 A/ms | 160 μ s |
| 7 | 0.05 A/ μ s | 5 A/ms | 80 μ s |
| 8 | 0.12 A/ μ s | 12 A/ms | 32 μ s |
| 9 | 0.25 A/ μ s | 25 A/ms | 16 μ s |
| 10 | 0.5 A/ μ s | 0.05 A/ μ s | 12 μ s |
| 11 | 1.2 A/ μ s | 0.12 A/ μ s | 12 μ s |
| 12 | 2.5 A/ μ s | 0.25 A/ μ s | 12 μ 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 μ s |
| 5 | 25 V/ms | 320 μ s |
| 6 | 50 V/ms | 160 μ s |
| 7 | 0.1 V/ μ s | 85 μ s |
| 8 | 0.25 V/ μ s | 85 μ s |
| 9 | 0.5 V/ μ s | 85 μ s |

*Transition time based on low capacitance current source.

Resistance Slew Rate (2 Ω range): Uses the value programmed for voltage slew rate.

Resistance Slew Rate (2 k and 10 k Ω ranges): Uses the value programmed for current slew rate.

Transient Current Overshoot (When programmed from 0A):

| Range | Transient Current Level | Current Slew Rate | Overshoot* |
|-------|-------------------------|-------------------------------------|------------|
| 30 A | 3-30 A | All slew rates | 0 |
| | 1.5 A | 0.5 A/ μ s to 2.5 A/ μ s | 6% |
| | 1.5 A | 0.5 A/ms to 0.25 A/ μ s | 0 |
| 3 A | 3 A | All slew rates | 0 |
| | 1.5 A | 0.13 A/ μ s and 0.25 A/ μ s | 3% |
| | 1.5 A | 0.05 A/ms and 0.05 A/ μ s | 0 |

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

Table 60501-1 Specifications and Supplemental Characteristics (continued)

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: 0.066 Ω (0.04 Ω typical)

Programmable Open Circuit: 20 kΩ (typical)

Drift Stability (over an 8 hour interval):

Current: ± 0.03% ± 5 mA
Voltage: ± 0.01% ± 10 mV

Reverse Current Capacity: 50 A when unit is on; 20 A when unit is off

Weight: 3.2 kg (7 lbs.)

Table 60501-2. Programming Ranges

| Function | Front Panel Key | Front Panel Display | HPSL Command (Short Form) | Range of Values |
|----------------------------|---------------------|----------------------------|--|--|
| Constant Current | | | | |
| Set Range | Range | C:RNG value | "CURR:RANG value" | ≥ 0 and ≤ 3 A > 3 A and ≤ 30 A |
| Low Range | | | | |
| High Range | | | | |
| Set Main Level | CURR | CURR value | "CURR value" | 0 to 3 A 0 to 30 A |
| Low Range | | | | |
| High Range | | | | |
| Set Slew Rate | (shift) Slew | C:SLW value | "CURR:SLEW value" | 0.00005 to 0.25 (A/µs) 0.0005 to 2.5 (A/µs) |
| Low Range | | | | |
| High Range | | | | |
| Set Transient Level | Tran Level | C:TLV value | "CURR:TLEV value" | same as main level |
| *Set Triggered Level | | | "CURR:TRIG value" | same as main level |
| Constant Resistance | | | | |
| Set Range | Range | R:RNG value | "RES:RANG value" | ≥ 0 and ≤ 2 Ω > 2 Ω and ≤ 2 kΩ >2 kΩ and ≤ 10 kΩ |
| Low Range | | | | |
| Middle Range | | | | |
| High Range | | | | |
| Set Main Level | RES | RES value | "RES value" | 0 to 2 Ω 2 Ω to 2 kΩ 20 Ω to 10 kΩ |
| Low Range | | | | |
| Middle Range | | | | |
| High Range | | | | |
| Set Slew Rate | (shift) Slew | V:SLW value C:SLW value | "VOLT:SLEW value" "CURR:SLEW value" | same as voltage slew same as current slew |
| Low Range | | | | |
| Middle/High Range | | | | |
| Set Transient Level | Tran Level | R:TLV value | "RES:TLEV value" | same as main level |
| *Set Triggered Level | | | "RES:TRIG value" | same as main level |
| Constant Voltage | | | | |
| Set Main Level | VOLT | VOLT value | "VOLT value" | 0 to 60 V |
| Set Slew Rate | (shift) Slew | V:SLW value | "VOLT:SLEW value" | 0.001 to 0.5 (V/µs) |
| Set Transient Level | Tran Level | V:TLV value | "VOLT:TLEV value" | same as main level |
| *Set Triggered Level | | | "VOLT:TRIG value" | same as main level |

Table 60501-2. Programming Ranges (continued)

| | | | | |
|--|-----------------------|--------------|-----------------------|---|
| Transient Operation | | | | |
| Set Frequency | FREQ | FREQ value | "TRAN:FREQ value" | 0.25 Hz to 10 kHz |
| Set Duty Cycle | (shift) Dcycle | DCYCLE value | "TRAN:DCYC value" | 3-97% (0.25 Hz-1 kHz) 6-94% (1 kHz-10 kHz) |
| *Set Pulse Width | | | "TRAN:TWID value" | 0.00005 to 4 s |
| Trigger Operation | | | | |
| *Set Trigger Period | | | "TRIG:TIM value" | 0.000008 to 4 s |
| Current Protection | | | | |
| *Set Current Level | | | "CURR:PROT value" | 0 to 30.6 A |
| *Set Delay Time | | | "CURR:PROT:DEL value" | 0 to 60 s |
| *Can only be programmed remotely via the GPIB. | | | | |

Table 60501-3. 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 | 0.5 A/μs | Short (on/off) | off |
| CURR range | 30 A | Transient operation (on/off) | off |
| *CURR protection (on/off) | off | ***TRAN mode | continuous |
| **CURR protection level | 30.6 A | (continuous, pulse, toggle) | |
| **CURR protection delay | 15 s | TRAN frequency | 1 kHz |
| RES level | 2 kΩ | TRAN duty cycle | 50% |
| RES transient level | 2 kΩ | **TRAN pulse width | 0.5 ms |
| RES range | 2 kΩ | **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 2.5 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. | | | |

Table 60501-4. Calibration Information

| Ranges and Calibration Points | Variables | Variables Value | Power Supply Settings | Current Shunt |
|--------------------------------------|------------------|------------------------|------------------------------|----------------------|
| High Current Range | Hi_curr_rng | 30 | 5 V/31 A | 100 A |
| High Current Offset | Hi_curr_offset | 0.013 | | |
| Low Current Range | Lo_curr_rng | 3 | 5 V/10 A | 15 A |
| Low Current Offset | Lo_curr_offset | 0.013 | | |
| Voltage Range | N/A | N/A | 61 V/2 A | N/A |
| Voltage Hi point | Volt_hipt | 60 | | |
| Voltage Lo point | Volt_lopt | 2.7 | | |
| Low Resistance Range | Lo_res_rng | 2 | 15 V/5.5 A | 15 A |
| Low Resistance Hi point | Lo_res_hipt | 1.9 | | |
| Low Resistance Lo point | Lo_res_lopt | 0.067 | | |
| Middle Resistance Range | Mid_res_rng | 20 | 10.9 V/8 A | 15 A |
| Middle Resistance Hi point | Mid_res_hipt | 60 | | |
| Middle Resistance Lo point | Mid_res_lopt | 2.1 | | |
| High Resistance Range | Hi_res_rng | 2002 | 60 V/5 A | 15 A |
| High Resistance Hi point | Hi_res_hipt | 200 | | |
| High Resistance Lo point | Hi_res_lopt | 24 | | |