Data Sheet

Programmable DC Electronic Loads

8600 Series

2U half-rack 3U 6U

The 8600 Series programmable DC electronic loads provide the performance of modular system DC electronic loads in a compact benchtop form factor. With fast transient operation speeds and high 16-bit measurement resolution, these standalone DC loads can be used for testing and evaluating a variety of DC sources such as DC power supplies, DC-DC converters, batteries, battery chargers, and photovoltaic arrays.

The DC loads can operate in constant current (CC), constant voltage (CV), constant resistance (CR), or constant power (CW) mode and be configured to provide a dynamically changing load to the DC source with fast load switching times. Versatile internal, external, and remote triggering options allow the dynamic load behavior to be synchronized with other events.

Increase productivity by saving your test parameters into any one of the 100 memory areas for quick system recall. All load parameters such as voltage, current, slew rate, and width can be set via the front panel or programmed remotely. The 8600 Series provides standard USB (USBTMC-compliant), GPIB, or RS-232 serial interfaces for remote communication.

To ensure the reliability of your testing, the 8600 Series provides a power-on system self-test and numerous protection features: overtemperature (OTP), overvoltage (OVP), overcurrent (OCP), overpower (OPP), and local/remote reverse voltage (LRV/RRV) protection.

Special applications

The 8600 Series provides a built-in battery test mode to measure the ampere-hour (Ah) characteristic of a battery and a unique CR-LED mode to simulate the loading behavior of a typical LED.

Features and Benefits

- Voltage range up to 500 V
- Current range up to 720 A
- CC/CV/CR/CW operating modes
- 16-bit voltage and current measurement system providing 1 mV / 0.1 mA resolution
- Transient mode up to 25 kHz in CC mode
- List mode function

Features and Benefits (cont.)

- Store and recall up to 100 setups
- Adjustable slew rate in CC mode
- Flexible triggering options via front panel, external input, timer, or bus
- Built-in battery test function with voltage level, capacity level, and timer stop conditions
- Test modes to validate the OCP/OPP protection functions of a power supply
- CR-LED mode to simulate the loading behavior of typical LEDs
- Remote sense
- Analog current control and monitoring
- Thermostatically controlled fan
- Standard USB (USBTMC-compliant), RS232, and GPIB interfaces supporting SCPI commands for remote control
- OVP/OCP/OPP/OTP including local and remote reverse voltage (LRV/RRV) protection

Model	8600	8601	8602	8610	8612	8614	8616	8620	8622	8624	8625
Power	150 W	250 W	200 W	750 W	750 W	1500 W	1200 W	3000 W	2500 W	4500 W	6000 W
Operating Voltage	0 – 120 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 120 V
Rated Current	0 – 30 A	0 – 60 A	0 – 15 A	0 – 120 A	0 – 30 A	0 – 240 A	0 – 60 A	0 – 480 A	0 – 100 A	0 – 600 A	0 – 720 A
Form Factor	2U half-rack			3U						6U	

Technical data subject to change
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ELECTRONIC TEST INSTRUMENTS

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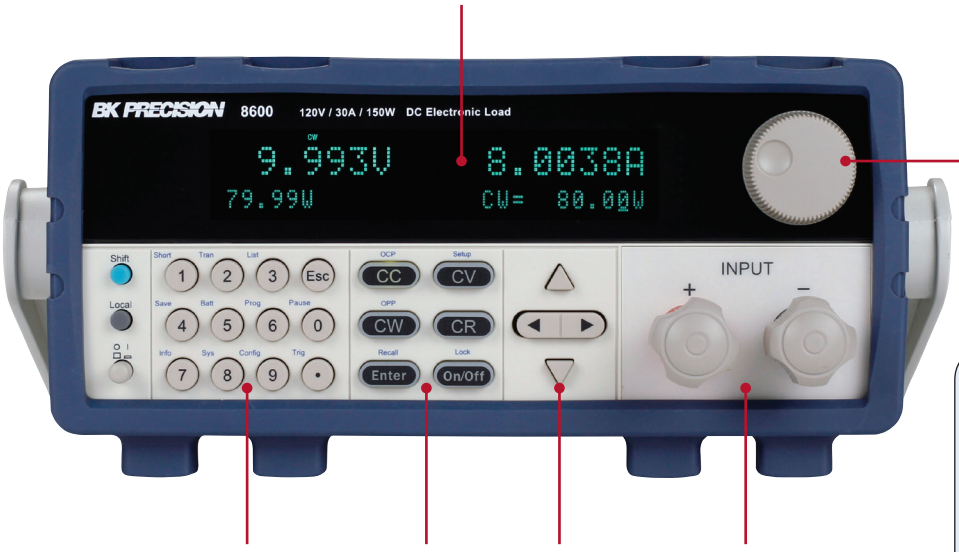
▶ Models 8600, 8601 & 8602

Front panel

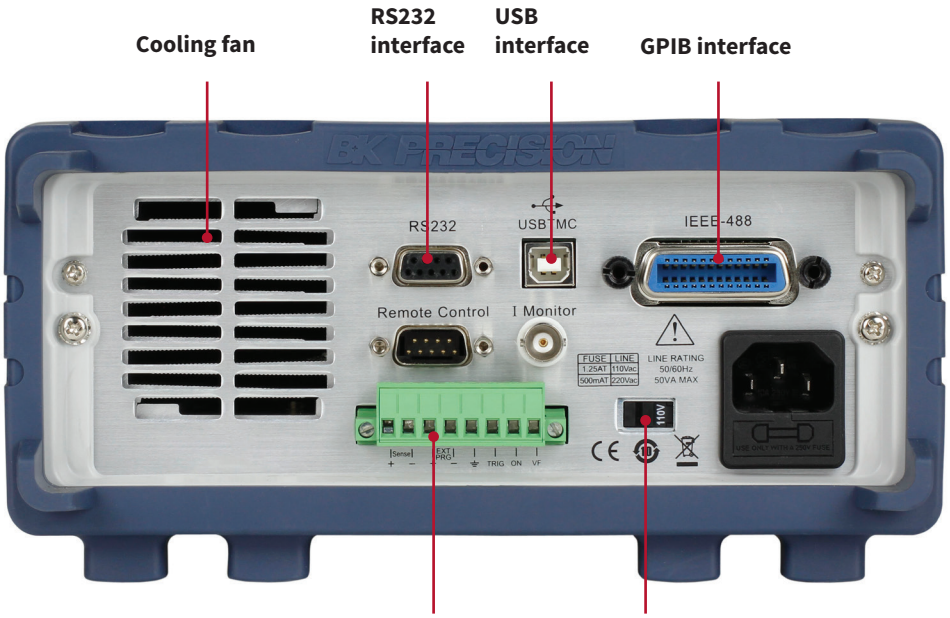
Bright dual-line display
The 8600 Series display shows both measured input values and set parameters simultaneously.



High current test lead accessory model TLPWRI

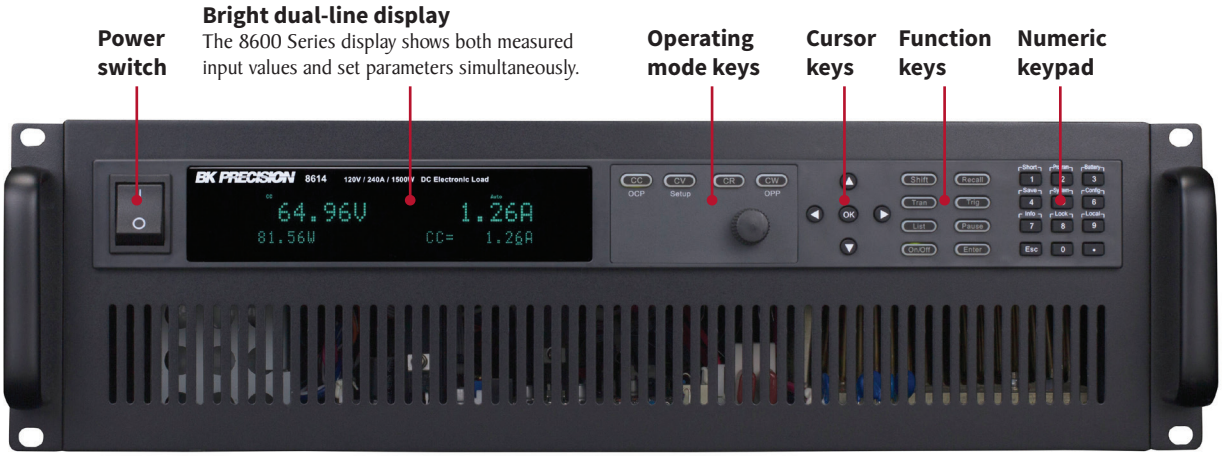
Intuitive user interface
The numeric keys and rotary knob provide a convenient interface for setting the operating mode and desired current, voltage, and resistance levels quickly and precisely.

Rear panel



▶ Models 8610, 8612, 8614, 8616, 8620, 8622 (3U)

Front panel



Rear panel

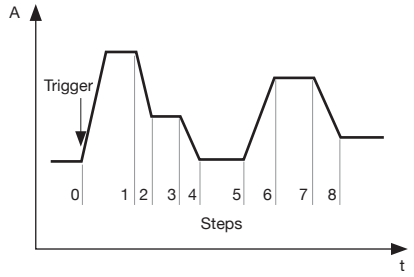
▶ Models 8624 & 8625 (6U)

6U form factor models use the same front panel interface as the 3U models

The rear panel configurations of 6U and 3U models are identical, however the number of fans installed varies by model

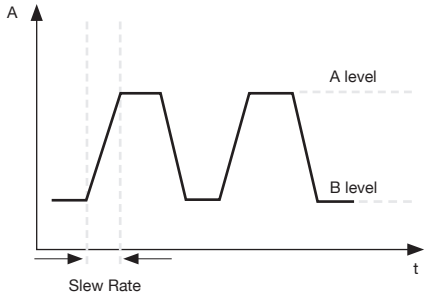
Flexible operation

List mode



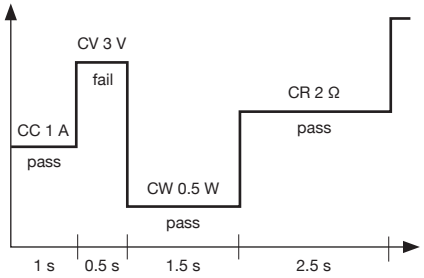
List mode lets you generate more complex sequences of input changes with several different levels. Up to 7 groups of list files can be saved. Each list can contain up to 84 steps with a minimum width time of 20 µs per step.

Transient operation



Transient operation enables the module to periodically switch between two load levels. A power supply's regulation and transient characteristic can be evaluated by monitoring the supply's output voltage under varying combinations of load levels, frequency, duty cycle, and slew rate. Transient operation can simulate these conditions.

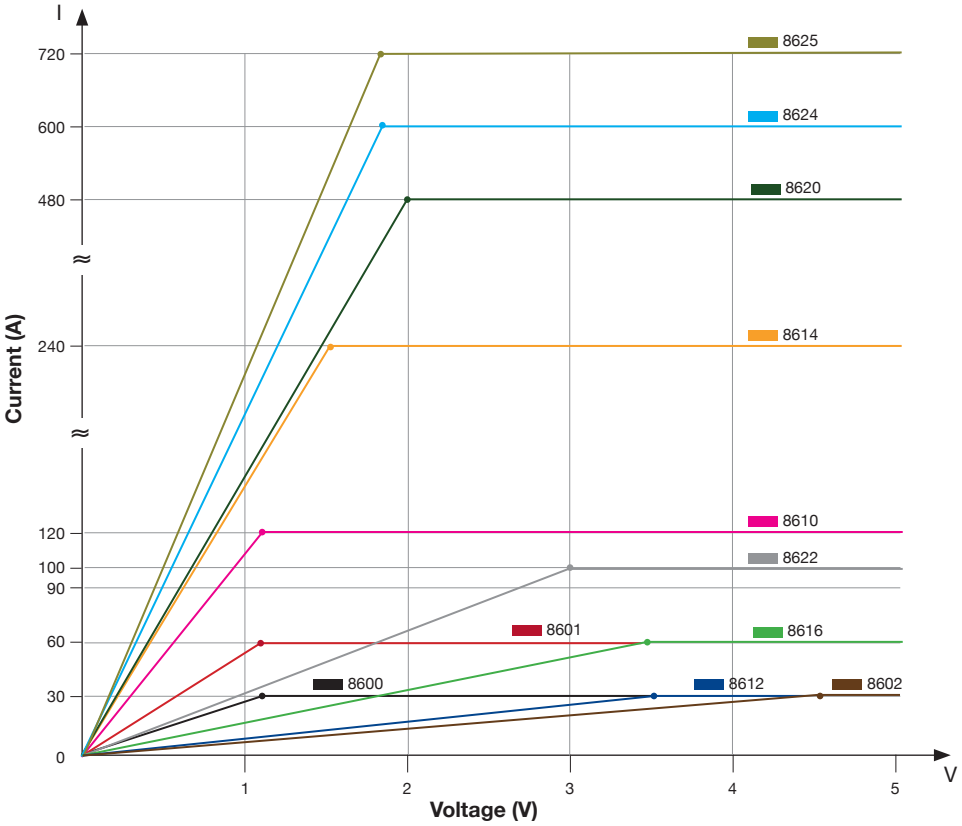
Automatic test mode



The 8600 Series can execute multiple test sequences in automatic test mode. Up to 100 different sequences can be linked to run steps of various operating modes and loading conditions. Each sequence can also be programmed with upper and lower limit Pass/Fall criteria. When applied in production testing, you can easily judge whether the test parameters of your devices are within the specification limits and adjust your process according to the Pass/Fall verdict.

Low voltage operation

The 8600 Series can operate at low voltages for applications such as fuel cell and solar cell testing.



Typical minimum operating voltage at full scale current										
8600	8601	8602	8610	8612	8614	8616	8620	8622	8624	8625
1.1 V	1.1 V	4.5 V	1.2 V	3.6 V	1.5 V	3.6 V	2 V	3 V	1.8 V	1.8 V

CR-LED mode

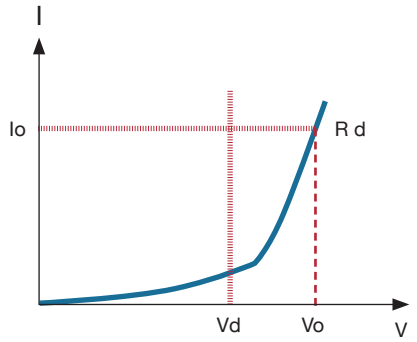


Figure - LED I-V Curve

Vd = Forward voltage of the LED
Rd = LED's operating resistance
Vo = Operating voltage across the LED
Io = Operating current across the LED

Use the load's unique CR-LED operating mode to test LED drivers. This function allows users to configure the LED's operating resistance and forward voltage along with the voltage range (same as CR operation) to simulate the loading behavior of typical LEDs.

Remote control and programming

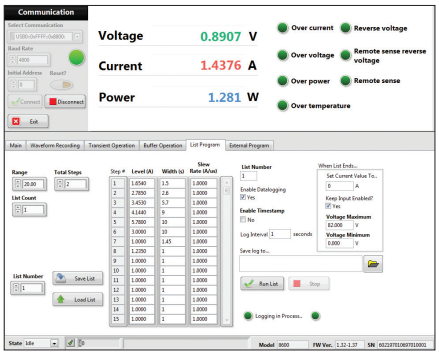
Powerful communication interfaces

The 8600 Series provides standard GPIB, USB, and RS232 interfaces for remote communication. These interfaces offer SCPI and USBTMC standard communication protocols to control your electronic load from a PC.

External analog programming and monitoring interface

In addition to front panel and remote interface control, current values can also be programmed with an analog control signal. The electronic loads can be externally controlled from zero to full scale with a 0-10 V input signal. A BNC output is available on the rear for monitoring the current with a 0-10 V output signal.

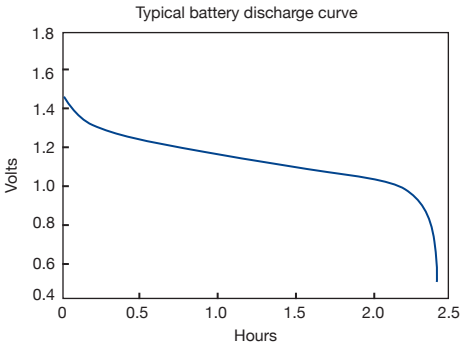
Application software



PC software is provided for front panel emulation, generating and executing test sequences, or logging measurement data without the need to write source code. Additionally, this application software integrates with NI Data Dashboard for LabVIEW apps, which allows users to create a custom dashboard on a tablet computer or smartphone to remotely monitor 8600 Series DC loads via this PC software.

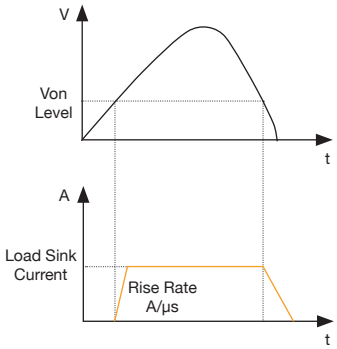
- Remote monitoring on iOS, Android or Windows 8 compatible tablets or smartphones via NI Data Dashboard for LabVIEW apps
- Log voltage, current, and power values with timestamp
- Run transient operation and list mode programs remotely
- Create an unlimited number of external list files to be executed from PC memory

Battery test function



The built-in battery test function uses CC mode to calculate the battery capacity using a fixed current load discharge. Users can specify cut-off voltage level, capacity level, and time stop conditions.

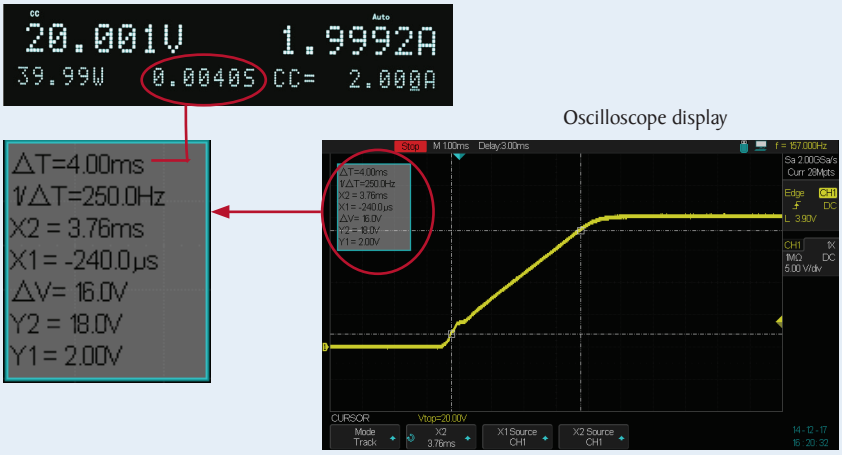
Voltage-on (Von) latch operation



Control the input turn on state for the DC electronic load by configuring the Von latch function. This can be used to start and stop discharging of a battery or other power source at a specified voltage level.

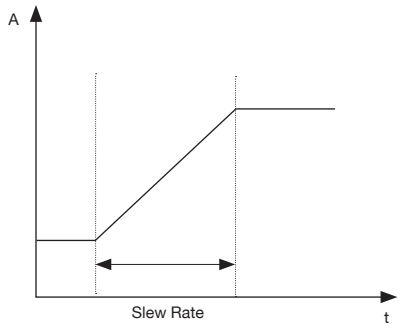
Built-in rise and fall time measurement

8600 Series display



The 8600 Series can measure the rise or fall time from a specified start and stop voltage level of the measured input without the need for an oscilloscope. This function can also be used as an internal timer to count how long the input has been enabled.

Adjustable slew rate



In CC mode, users can control the rate or slope of the change in current in a transient response test. Set the slew rate to as slow as 0.001 A/ms or as fast as 2.5 A/µs depending on the model and selected current range.

Specifications

Model		8600	8601	8602
Input ratings				
Input voltage		0 – 120 V	0 – 120 V	0 – 500 V
Input current	Low	0 – 3 A	0 – 6 A	0 – 3 A
	High	0 – 30 A	0 – 60 A	0 – 15 A
Input power		150 W	250 W	200 W
Minimum operating voltage	Low	0.11 V at 3 A	0.18 V at 6 A	1 V at 3 A
	High	1.1 V at 30 A	1.1 V at 60 A	4.5 V at 15 A
CV mode				
Range	Low	0 – 18 V		0 – 50 V
	High	0 – 120 V		0 – 500 V
Resolution	Low	0.1 mV		1 mV
	High	1 mV		10 mV
Accuracy	Low	±(0.05%+ 0.02% FS)	±(0.025%+ 0.05% FS)	±(0.05%+ 0.025% FS)
	High	±(0.05%+ 0.025% FS)	±(0.025%+ 0.05% FS)	±(0.05%+ 0.025% FS)
CC mode				
Range	Low	0 – 3 A	0 – 6 A	0 – 3 A
	High	0 – 30 A	0 – 60 A	0 – 15 A
Resolution	Low	0.1 mA		
	High	1 mA		
Accuracy	Low	±(0.05%+0.05% FS)		
	High	±(0.05%+0.05% FS)		
CR mode				
Range	Low	0.05 Ω – 10 Ω		0.3 Ω – 10 Ω
	High	10 Ω - 7.5 kΩ		
Resolution		16 bit		
Accuracy (I>10% of range)	Low	0.01%+0.08 S (12.5 Ω)		
	High	0.01%+0.0008 S (1250 Ω)		
CW mode				
Range		150 W	250 W	200 W
Resolution		10 mW		
Accuracy		0.1% + 0.1% FS	0.2% + 0.2% FS	0.1% + 0.1% FS
Transient mode (CC mode)				
T1 & T2 [1]		20 µs – 3600 s / Resolution: 10 µs		
Accuracy		5 µs + 100 ppm		
Slew Rate [2]	Low	0.001-2.5 A/ms		0.001-1 A/ms
	High	0.001-2.5 A/µs		0.001-1 A/µs

[1] Fast pulse trains with large transitions may not be achievable.

[2] The slew rate specifications are not warranted, but are descriptions of typical performance. The actual transition time is defined as the time for the input to change from 10% to 90%, or vice versa, of the programmed current values. In case of very large load changes, e.g. from no load to full load, the actual transition time will be larger than the expected time. The load will automatically adjust the slew rate to fit within the range (high or low) that is closest to the programmed value.

Readback voltage				
Range	Low	0 – 18 V	0 – 18 V	0 – 50 V
	High	0 – 120 V	0 – 120 V	0 – 500 V
Resolution	Low	0.1 mV		1 mV
	High	1 mV		10 mV
Accuracy		±(0.05%+0.05% FS)		
Readback current				
Range	Low	0 – 3 A	0 – 6 A	0 – 3 A
	High	0 – 30 A	0 – 60 A	0 – 15 A
Resolution	Low	0.01 mA	0.1 mA	0.01 mA
	High	0.1 mA	1 mA	0.1 mA
Accuracy		±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)
Readback power				
Range		150 W	250 W	200 W
Resolution		10 mW		
Accuracy		±(1%+0.1% FS)	±(0.2%+0.2% FS)	±(0.1%+0.1% FS)
Protection range (typical)				
OPP		150 W	250 W	200 W
OCP	Low	3.3 A	6.6 A	3.3 A
	High	33 A	66 A	16.5 A
OVP		120 V	120 V	500 V
OTP		185 °F (85 °C)		
Short circuit (typical)				
Current (CC)	Low	3.3 A	6.6 A	3.3 A
	High	33 A	66 A	16.5 A
Voltage (CV)		0 V		
Resistance (CR)		35 mΩ	30 mΩ	300 mΩ
General (typical)				
Input terminal impedance		150 kΩ	300 kΩ	1 MΩ
AC input		110 V/220 V ±10%, 50/60 Hz		
Operating temperature		32 °F to 104 °F (0 °C to 40 °C)		
Storage temperature		14 °F to 140 °F (-10 °C to 60 °C)		
Humidity		Indoor use, ≤ 95%		
Safety		EN61010-1:2001, EU Low Voltage Directive 2006/95/EC		
Electromagnetic compatibility		Meets EMC Directive 2004/108/EC, EN 61000-3-2:2006, EN 61000-3-3:1995+A1:2001+A2:2005 EN 61000-4-2/-3/-4/-5/-6/-11, EN 61326-1:2006		
Dimensions (W x H x D)		8.5" x 3.5" x 15.2" (218 x 90 x 387 mm)		
Weight		9.9 lbs (4.5 kg)		
Three-Year Warranty				
Standard accessories		User manual, power cord, certificate of calibration & test report		
Optional accessories		TLPWR1 high current test leads, IT-E151 rackmount kit (models 8600, 8601, and 8602 only)		

Specifications (cont.)

Model		8610	8612	8614	8616	8620	8622	8624	8625
Input ratings									
Input voltage		0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 120 V
Input current	Low	0 – 12 A	0 – 3 A	0 – 24 A	0 –6 A	0 – 48 A	0 – 10 A	0 – 60 A	0 – 72 A
	High	0 – 120 A	0 – 30 A	0 – 240 A	0 –60 A	0 – 480 A	0 – 100 A	0 – 600 A	0 – 720 A
Input power		750 W		1500 W	1200 W	3000 W	2500 W	4500 W	6000 W
Minimum operating voltage	Low	0.12 V at 12 A	0.36 V at 3 A	0.15 V at 24 A	0.36 V at 6 A	0.2 V at 48 A	0.3 V at 10 A	0.18 V at 60 A	0.18 V at 72 A
	High	1.2 V at 120 A	3.6 V at 30 A	1.5 V at 240 A	3.6 V at 60 A	2 V at 480 A	3 V at 100 A	18 V at 600 A	1.8 V at 720 A
CV mode									
Range	Low	0 – 18 V	0 – 50 V	0 – 18 V	0 – 50 V	0 – 18 V	0 – 50 V	0 – 18 V	0 – 18 V
	High	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 120 V
Resolution	Low	0.1 mV	1 mV	0.1 mV	1 mV	1 mV	1 mV	1 mV	1 mV
	High	1 mV	10 mV	1 mV	10 mV	10 mV	10 mV	10 mV	10 mV
Accuracy	Low	±(0.025% + 0.05% FS)		±(0.025%+ 0.025% FS)	±(0.025%+ 0.05% FS)	±(0.025% + 0.05% FS)			
	High	±(0.025% + 0.05% FS)							
CC mode									
Range	Low	0 – 12 A	0 – 3 A	0 – 24 A	0 – 6 A	0 – 48 A	0 – 10 A	0 – 60 A	0 – 72 A
	High	0 – 120 A	0 – 30 A	0 – 240 A	0 – 60 A	0 – 480 A	0 – 100 A	0 – 600 A	0 – 720 A
Resolution	Low	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	1 mA	1 mA	1 mA
	High	10 mA	1 mA	10 mA	1 mA	10 mA	10 mA	10 mA	10 mA
Accuracy	Low	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.025%+ 0.05% FS)			
	High	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.025%+ 0.05% FS)			
CR mode									
Range	Low	0.02 Ω – 10 Ω	0.15 Ω – 10 Ω	0.01 Ω – 10 Ω	0.01 Ω – 10 Ω	0.01 Ω – 10 Ω	0.03 Ω – 10 Ω	0.01 Ω – 10 Ω	0.005 Ω – 10 Ω
	High	10 Ω - 7.5 kΩ							
Resolution		16 bit							
Accuracy (I>10% of range)	Low	0.01%+0.08 S (12.5 Ω)							
	High	0.01%+0.0008 S (1250 Ω)							
CW mode									
Range		750 W		1500 W	1200 W	3000 W	2500 W	4500 W	6000 W
Resolution		10 mW		100 mW					
Accuracy		0.2% + 0.2% FS							
Transient mode (CC mode)									
T1 & T2 [1]		20 µs – 3600 s / Resolution: 10 µs							
Accuracy		5 µs + 100 ppm							
Slew Rate [2]	Low	0.001-0.25 A/µs	0.0001-0.1 A/µs	0.001-0.25 A/µs	0.0001-0.1 A/µs	0.001-0.25 A/µs	0.001-0.1 A/µs	0.001-0.25 A/µs	0.001-0.25 A/µs
	High	0.01-2.5 A/µs	0.001-1 A/µs	0.01-2.5 A/µs	0.001-1 A/µs	0.01-2.5 A/µs	0.01-1 A/µs	0.01-2.5 A/µs	0.01-2.5 A/µs

[1] Fast pulse trains with large transitions may not be achievable.

[2] The slew rate specifications are not warranted, but are descriptions of typical performance. The actual transition time is defined as the time for the input to change from 10% to 90%, or vice versa, of the programmed current values. In case of very large load changes, e.g. from no load to full load, the actual transition time will be larger than the expected time. The load will automatically adjust the slew rate to fit within the range (high or low) that is closest to the programmed value.

Specifications (cont.)

Model		8610	8612	8614	8616	8620	8622	8624	8625
Readback voltage									
Range	Low	0 – 18 V	0 – 50 V	0 – 18 V	0 – 50 V	0 – 18 V	0 – 50 V	0 – 18 V	
	High	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 500 V	0 – 120 V	0 – 120 V
Resolution	Low	0.1 mV	1 mV	0.1 mV	1 mV				
	High	1 mV	10 mV	1 mV	10 mV				
Accuracy		±(0.05% + 0.05% FS)				±(0.025% + 0.025% FS)			
Readback current									
Range	Low	0 – 12 A	0 – 3 A	0 – 24 A	0 – 6 A	0 – 48 A	0 – 10 A	0 – 60 A	0 – 72 A
	High	0 – 120 A	0 – 30 A	0 – 240 A	0 – 60 A	0 – 480 A	0 – 100 A	0 – 600 A	0 – 720 A
Resolution	Low	1 mA	0.1 mA	1 mA	0.1 mA	1 mA			
	High	10 mA	1 mA	10 mA	1 mA	10 mA			
Accuracy		±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	±(0.05%+ 0.05% FS)	±(0.05%+ 0.1% FS)	
Readback power									
Range		750 W		1500 W	1200 W	3000 W	2500 W	4500 W	6000 W
Resolution		10 mW		100 mW					
Accuracy		±(0.2% + 0.2% FS)							
Protection range (typical)									
OPP		760 W		1550 W	1250 W	3050 W	2550 W	4550 W	6050 W
OCP	Low	13.2 A	3.3 A	26.4 A	6.6 A	26.4 A	11 A	66 A	79.2 A
	High	132 A	33 A	264 A	66 A	264 A	110 A	660 A	792 A
OVP		130 V	530 V	130 V	530 V	130 V	530 V	130 V	130 V
OTP		185 °F (85 °C)							
Short circuit (typical)									
Current (CC)	Low	13.2 A	3.3 A	26.4 A	6.6 A	52.8 A	11 A	66 A	79.2 A
	High	132 A	33 A	264 A	66 A	528 A	110 A	660 A	793 A
Voltage (CV)		0 V							
Resistance (CR)		10 mΩ	120 mΩ	6 mΩ	60 mΩ	5 mΩ	30 mΩ	3 mΩ	2.5 mΩ
General (typical)									
Input terminal impedance		300 kΩ	1 MΩ	300 kΩ	1 MΩ	300 kΩ	1 MΩ	300 kΩ	300 kΩ
AC input		110 V/220 V ±10%, 50/60 Hz							
Operating temperature		32 °F to 104 °F (0 °C to 40 °C)							
Storage temperature		14 °F to 140 °F (-10 °C to 60 °C)							
Humidity		Indoor use, ≤ 95%							
Safety		EN61010-1:2001, EU Low Voltage Directive 2006/95/EC							
Electromagnetic compatibility		Meets EMC Directive 2004/108/EC, EN 61000-3-2:2006, EN 61000-3-3:1995+A1:2001+A2:2005 EN 61000-4-2/-3/-4/-5/-6/-11, EN 61326-1:2006							
Dimensions (W x H x D)		17.3" x 5.3" x 22.5" (439 x 133.3 x 580 mm)						17.3" x 10.5" x 23.2" (439 x 266 x 590 mm)	
Weight		54 lbs (24.6 kg)						142 lbs (64.4 kg)	
Three-Year Warranty									
Standard accessories		User manual, power cord, certificate of calibration & test report							
Optional accessories		TLPWR1 high current test leads							