

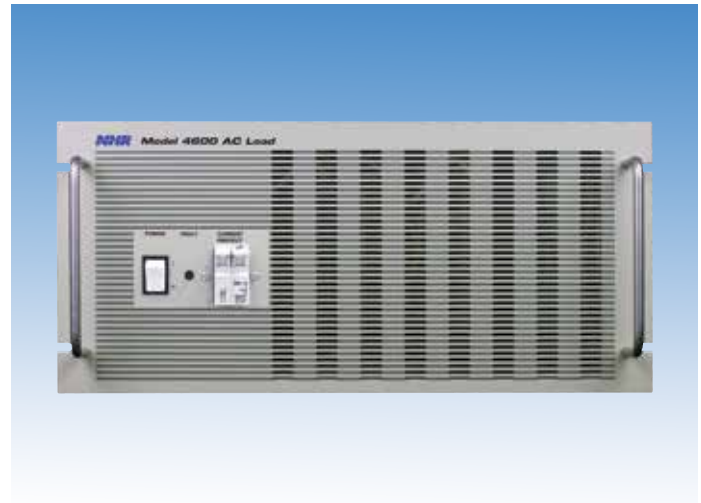
# 4600 Series Programmable AC Electronic Load



**Linear & Non-Linear AC Loading In Several Emulation Modes With Power & Crest Factor Control**

## Features

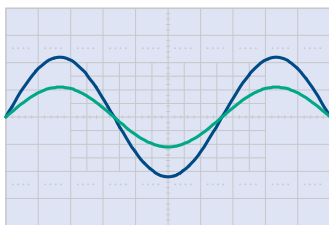
- 6 sizes – 3 to 36kW, 30 – 360A, 50 – 350V RMS (L-N)
- Sizable for single and 3-phase configurations
- CC, CR, CV, CP, SC, UPF & CNL emulation modes
- Programmable crest factor and power factor
- 12 high-accuracy internal measurements
- User-defined waveforms
- 100-step macro for per cycle loading changes
- PC softpanel GUI with current, voltage & power waveform display
- PC control using Lab VIEW & IVI drivers
- LAN & RS232 communication interfaces
- True short circuit operation



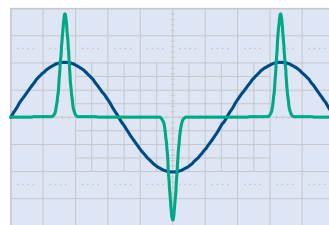
**4600 Series front panel view**

## Applications

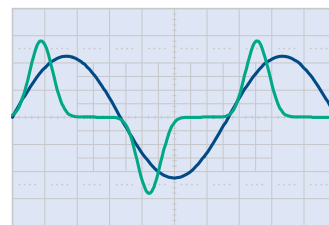
The 4600 Series AC Electronic Loads are designed for test applications that require linear and non-linear AC loading in several emulation modes with Power (Fig. 1-4) and Crest Factor control (Fig. 1-4). This programmable versatility allows testing with a wide variety of potential field operating conditions to assure unit-under-test (UUT) reliability. Products tested include uninterruptible power supplies (UPS), AC sources, inverters, switches, circuit breakers, fuses, and connectors.



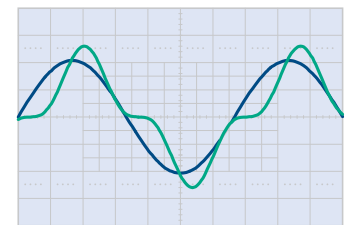
**Fig. 1 - Unity Power Factor**



**Fig. 2 - High Crest Factor**



**Fig. 3 - Leading Power Factor**



**Fig. 4 - Lagging Power Factor**

Waveforms: — Voltage & — Current

## Emulation Modes

To provide testing under the broadest range of loading conditions, the 4600 Series AC Electronic Load offers 7 different emulation modes. Constant Current (CC) mode provides current to be drawn constantly, making it suitable for non-linear, linear, and regulation loading. Constant Resistance (CR) mode allows the electronic load to emulate a power resistor. Constant Voltage (CV) allows emulating a shunt regulator. Constant Power (CP) mode emulates a constant-power load such as a switching power supply. Short Circuit (SC) mode allows the electronic load to test the UUT's short circuit protection capability. Unity Power Factor (UPF) (Fig. 1) mode brings power factor to unity, useful when the input voltage is non-sinusoidal. The new Complex Non-Linear Waveform (CNL) mode allows the user to define the waveform to prevent UUT current over-stressing in the event of a voltage collapse. These comprehensive capabilities provide the user almost every conceivable AC loading condition possible.

## High Accuracy Measurements

The 4600 Series AC Electronic Load provides high-accuracy frequency, voltage, peak voltage, current, peak current, crest factor, apparent power, true power, peak power, reactive power, power factor, and resistance measurements by combining high-resolution measurements with precision ranging. The ability to make measurements internally eliminates multiple external measurement instruments plus associated signal matrixing. In this manner, the 4600 Series AC Electronic Load provides for a more compact, less costly, and considerably faster test system.

*The AC Electronic Load has the ability to control current through a user defined waveform.*

## User-Defined Waveforms

The 4600 Series AC Electronic Load has the ability to control current through a user defined waveform (Fig. 5). The waveform is created by a powerful graphical editor that facilitates starting with a straight line or modifying a generated waveform based on current, power, and crest factor. The graphical editor includes an auto-check feature to ensure the settings are compatible with each other and within the capabilities of the electronic load. It also supports waveform smoothing, symmetrical, and asymmetrical waveform creation.

With this editor, waveforms can be quickly created to duplicate complex transient conditions. This would include adding asymmetrical inflections, inserting transient anomalies such as spikes and dropouts, and any shape else that can be drawn as a single-cycle waveform.

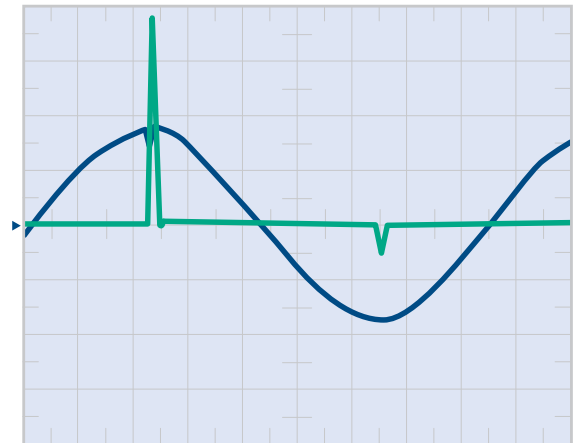
## 100-Step Multi-Mode Macros

Macros are queues of up to 100 steps that can be triggered locally, thereby providing very fast current, power, and crest factor changes, up to every cycle (Fig. 6). Further, a Macro can be executed as a single shot or looped.

*emPower® LE adds a test sequencer, basic test routines, & reporting.*

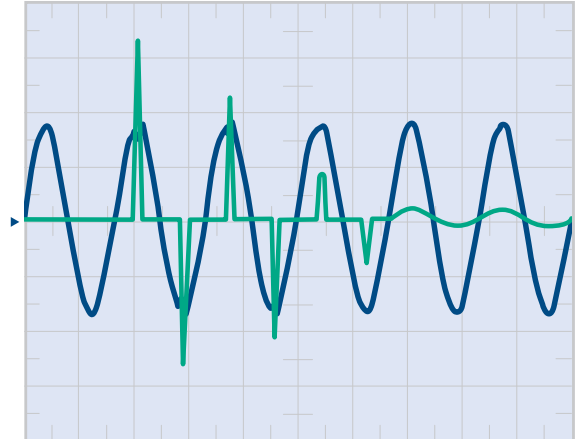
## emPower® LE Test Executive Option

The 4600 Series AC Electronic Load is supplied with software for a PC softpanel that provides complete instrument control, measurement, and waveform display. Upgrading to a full test executive with drivers for all NH Research, Inc. (NHR) power instruments is also possible through emPower® LE (Fig. 7), which adds a test sequencer, basic test routines, and reporting.



2.000 mS/div Wf1, Chn 001, 100 V/div. Wf2, Chn 002, 20 A/div.

Fig. 5 - User-Defined Asymmetrical Current



10.000 mS/div Wf1, Chn 001, 100 V/div. Wf2, Chn 002, 20 A/div.

Fig. 6 - Start-Up Inrush Current Macro

Step	Value	Signal	Test Name	Step Name
1	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000

Fig. 7 - emPower user interface

Any unit can be field expandable in 3kW increments to address future higher power needs.

### Wide Range of Power Levels

The 4600 Series AC Electronic Load is now offered in 6 power levels between 3 and 36kW (Fig. 8). Any unit can be field expandable in 3kW increments to address future higher power needs. Contact NHR for any loads higher than 36kW.

### Graphic User Interface

A PC-hosted graphic user interface eclipses the traditional front panel clutter of knobs, dials, keypads, and digital displays. This traditional clutter is a carry-over from a time in which test instrumentation had a far more limited set of features. In addition to a more comprehensive presentation of operation, measurement, and status information, softpanel advantages include the ability to program and recall Macros, editing user-defined waveforms, along with display of real-time current, voltage, and power waveforms without an oscilloscope.

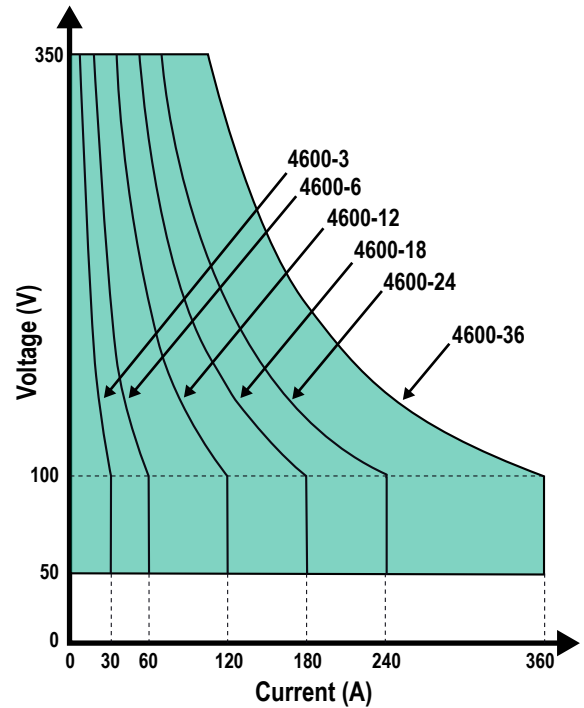


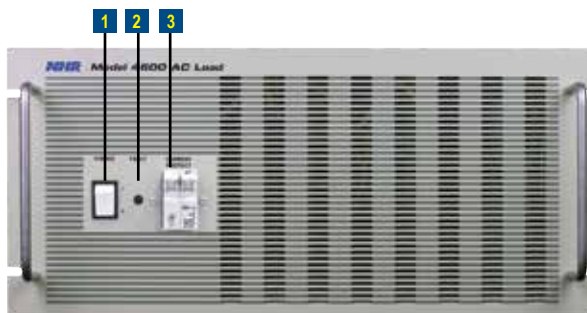
Fig. 8 - Operating Envelopes

PC softpanel provides complete instrument control, measurement and waveform display.

### PC Softpanel



### Panel Overview



- |                         |                              |                           |
|-------------------------|------------------------------|---------------------------|
| 1 Control Power switch  | 6 Status indicators          | 11 RS 232 connector       |
| 2 Fault indicator light | 7 Trig In/Out connectors     | 12 COMM In/Out connectors |
| 3 Circuit breaker       | 8 Chassis GND stud           | 13 Hold In/Out connectors |
| 4 LAN port              | 9 Load Power Input connector | 14 AC input connector     |
| 5 Address switch        | 10 LAN/RS 232 switch         |                           |

# 4600 Series Programmable AC Electronic Load Specifications<sup>1</sup>

4600 Ratings	4600-3	4600-6	4600-12	4600-18	4600-24	4600-36 <sup>2</sup>	Control	
Power	3kW	6kW	12kW	18kW	24kW	36kW	User Interface	PC soft panel
Maximum Current <sup>3</sup>	30A	60A	120A	180A	240A	360A	PC	Windows XP or Windows 7 with SVGA or better display
Voltage Range <sup>3</sup>	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	OS	Window XP, Windows 7
<b>Programmable Modes</b>							Test Executive	Optional emPower™ LE & AC Load Sequencer
Constant Current							Communications	RS-232, LAN
Range (RMS)	0 - 30A	0 - 60A	0 - 120A	0 - 180A	0 - 240A	0 - 360A	Drivers	NI LabVIEW, IVI, Active X
Accuracy	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	<b>Additional Features</b>	
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	3-Phase Operation	Provides for control of 3 individual units (for example, 3kW units for a total of 9kW, 6kW units for a total of 18kW) to simulate a 3-phase load
Constant Voltage							Remote Voltage Sense	1 MegaOhm impedance, 2VDC max drop between sense and load input
Range	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	Self Test	Power-up self test of all major functions including status of input, output, control and protection circuits
Accuracy	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	Performance Monitoring	Continuous checking of performance parameters and appropriate error messages and/or LED fault indicators
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	Calibration	Closed cover, all adjustments made in software and stored in FLASH
Constant Power							Protection	OP, OCOV, OT, and Undervoltage Lockout
Range	300W - 3kW	600W - 6kW	1.2 - 12kW	1.8 - 18kW	2.4 - 24kW	3.6 - 36kW	Trigger Output	To initiate an external measurement device and synchronized to programmed load current step
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	Fan Noise Reduction	Automatic fan speed control
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	Load Connectors	ITT Cannon DCM-21WA4P/DM 53745-1 plug & socket
Constant Resistance							Operating Temperature	0 - 50° C, maximum. Continuous and peak power derated 20% above 38° C
Ranges	2.5-100, 100-1000Ω	1.25-50, 50-500Ω	0.63-25, 25-250Ω	0.42-17, 17-167Ω	0.31-12.5, 12.5-125Ω	0.2-8.3, 8.3-83Ω	Input Power	115/230 ± 10% VAC, 47 - 63Hz
Accuracy	1, 5%	1, 5%	1, 5%	1, 5%	1, 5%	1, 5%	<sup>1</sup> Specifications apply at 23* +/- 5* C after a 10 minute warm up and are subject to change without notice. All Accuracies and Resolutions are % of full scale	
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	<sup>2</sup> Higher power and custom configurations available	
Short Circuit Max Surge Current	300A	600A	1200A	1800A	2400A	3600A	<sup>3</sup> Accuracies apply when Settings and/or Measurements >10% of Range	
Power Factor							<sup>4</sup> R+FS = Range + Full Scale	
Range	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag		
Accuracy	1%	1%	1%	1%	1%	1%		
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%		
Crest Factor								
Range	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4		
Accuracy	90A limit	180A limit	360A limit	540A limit	720A limit	1080A limit		
Resolution	1%	1%	1%	1%	1%	1%		
Accuracy	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%		
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%		
Macros	Queues of up to 100 commands can be run manually or from a triggered event (phase angle, input voltage level, system trigger)							
Custom Waveforms	User-defined waveforms can be created through a full-screen graphical editor that provides control of current, voltage, resistance, power, crest factor and power factor							
<b>Measurements</b>								
Current								
Ranges (RMS)	0 - 30A	0 - 60A	0 - 120A	0 - 180A	0 - 240A	0 - 360A		
Accuracy	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Peak Current								
Ranges	0 - 90A	0 - 180A	0 - 360A	0 - 540A	0 - 720A	0 - 1080A		
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Voltage								
Ranges	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V		
Accuracy	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Peak Voltage								
Ranges	50 - 500V	50 - 500V	50 - 500V	50 - 500V	50 - 500V	50 - 500V		
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Frequency								
Range	45 - 440Hz	45 - 440Hz	45 - 440Hz	45 - 440Hz	45 - 440Hz	45 - 440Hz		
Accuracy	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
True Power								
Ranges	0 - 10.5kW	0 - 21kW	0 - 42kW	0 - 63kW	0 - 84kVA	0 - 126kVA		
Accuracy (R+FS) <sup>4</sup>	0.2% + 0.03%	0.2% + 0.03%	0.2% + 0.03%	0.2% + 0.03%	0.2% + 0.03%	0.2% + 0.03%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Apparent Power								
Range	0 - 10.5kVA	0 - 21kVA	0 - 42kVA	0 - 63kVA	0 - 84kVA	0 - 126kVA		
Accuracy	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Reactive Power								
Range	0 - 10.5kVA	0 - 21kVA	0 - 42kVA	0 - 63kVA	0 - 84kVA	0 - 126kVA		
Accuracy	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Peak Power								
Range	0 - 45kW	0 - 90kW	0 - 180kW	0 - 270kW	0 - 360kW	0 - 540kW		
Accuracy	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%		
Resolution	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%		
Resistance								
Range	2.5-100, 100-1000Ω	1.25-50, 50-500Ω	0.63-25, 25-250Ω	0.42-17, 17-167Ω	0.31-12.5, 12.5-125Ω	0.2-8.3, 8.3-83Ω		
Accuracy	1%, 5%	1%, 5%	1%, 5%	1%, 5%	1%, 5%	1%, 5%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Crest Factor								
Range	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4	1.414 - 4		
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Power Factor								
Range	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag	0 -1, lead/lag		
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		
Resolution	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%		
Waveform Display	Continuously updated, graphical display of a full cycle of current, voltage and/or power waveforms							
<b>Physical</b>								
Enclosure	Chassis	Chassis (2)	Cabinet	Cabinet	Cabinet, 2-Bay	Cabinet, 2-Bay		
Dimensions (HxWxD)	8¾ x 19 x 23in	17½ x 19 x 25in	57 x 23 x 30in	72 x 23 x 30in	57 x 46 x 30in	72 x 46 x 30in		
Weight	23 x 49 x 59cm	45 x 49 x 64cm	145 x 59 x 77cm	183 x 59 x 77cm	117 x 59 x 77cm	183 x 117 x 77cm		
	77 lbs / 35 kg	154 lbs/70 kg	440 lbs/200 kg	650 lbs/295 kg	860 lbs/391 kg	1250 lbs/568 kg		
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