

# 4600 Series Programmable AC Electronic Load

**NHR**  
NH Research

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

## Features

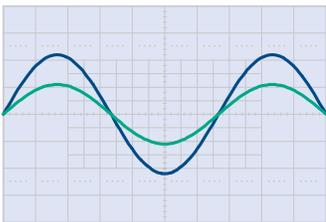
- 6 sizes – 3 to 36kW, 30 – 360A, 50 – 350V RMS (L-N)
- Sizable for single and 3-phase configurations
- CC, CR, CV, CP, SC, UPF & CNL emulation modes
- Programmable crest factor and power factor
- 12 high-accuracy internal measurements
- User-defined waveforms
- 100-step macro for per cycle loading changes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



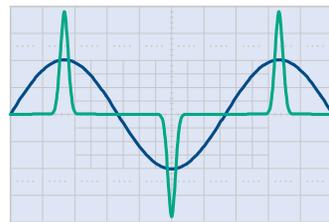
**4600 Series front panel view**

## Applications

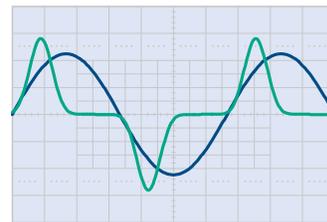
The 4600 Series AC Electronic Loads are designed for test applications that require linear and non-linear AC loading in several emulation modes with Power (*Fig. 1-4*) and Crest Factor control (*Fig. 1-4*). This programmable versatility allows testing with a wide variety of potential field operating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



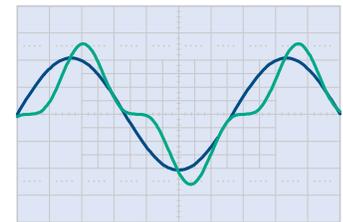
**Fig. 1 - Unity Power Factor**



**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.

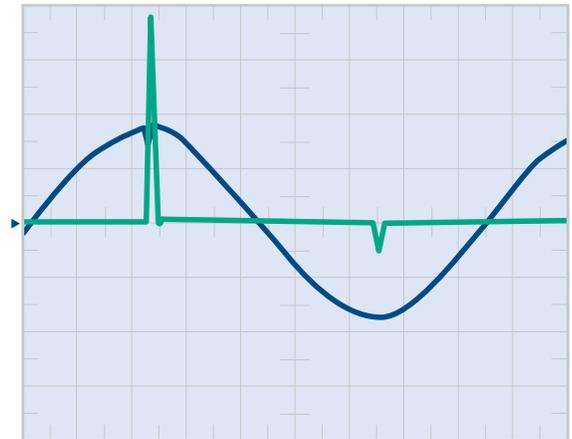
## 100-Step Multi-Mode Macros

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.*

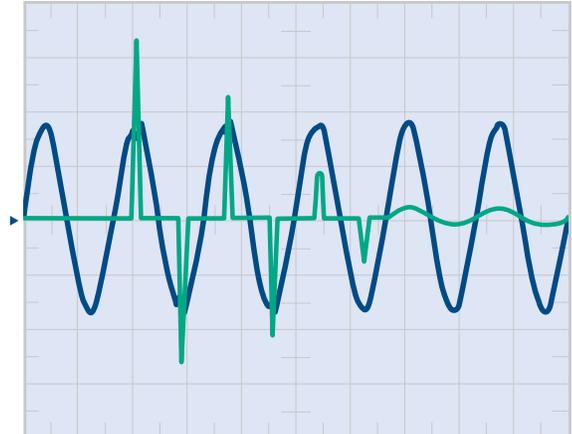
## emPower® LE Test Executive Option

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	Name	Status	Signal	Test Name	Operator
1	Set Point	Done	Set Point	Set Point	Operator
2	Start Test	Done	Start Test	Start Test	Operator
3	Stop Test	Done	Stop Test	Stop Test	Operator
4	Set Point	Done	Set Point	Set Point	Operator
5	Start Test	Done	Start Test	Start Test	Operator
6	Stop Test	Done	Stop Test	Stop Test	Operator
7	Set Point	Done	Set Point	Set Point	Operator
8	Start Test	Done	Start Test	Start Test	Operator
9	Stop Test	Done	Stop Test	Stop Test	Operator
10	Set Point	Done	Set Point	Set Point	Operator
11	Start Test	Done	Start Test	Start Test	Operator
12	Stop Test	Done	Stop Test	Stop Test	Operator
13	Set Point	Done	Set Point	Set Point	Operator
14	Start Test	Done	Start Test	Start Test	Operator
15	Stop Test	Done	Stop Test	Stop Test	Operator
16	Set Point	Done	Set Point	Set Point	Operator
17	Start Test	Done	Start Test	Start Test	Operator
18	Stop Test	Done	Stop Test	Stop Test	Operator
19	Set Point	Done	Set Point	Set Point	Operator
20	Start Test	Done	Start Test	Start Test	Operator
21	Stop Test	Done	Stop Test	Stop Test	Operator
22	Set Point	Done	Set Point	Set Point	Operator
23	Start Test	Done	Start Test	Start Test	Operator
24	Stop Test	Done	Stop Test	Stop Test	Operator
25	Set Point	Done	Set Point	Set Point	Operator
26	Start Test	Done	Start Test	Start Test	Operator
27	Stop Test	Done	Stop Test	Stop Test	Operator
28	Set Point	Done	Set Point	Set Point	Operator
29	Start Test	Done	Start Test	Start Test	Operator
30	Stop Test	Done	Stop Test	Stop Test	Operator

**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.

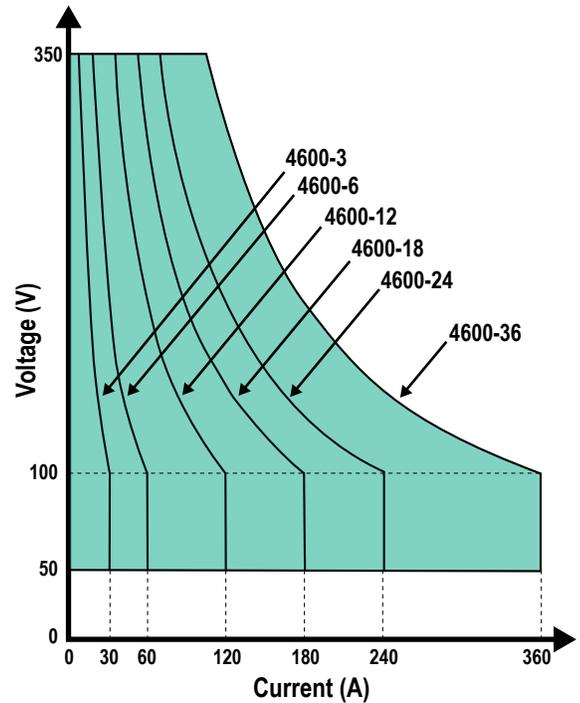


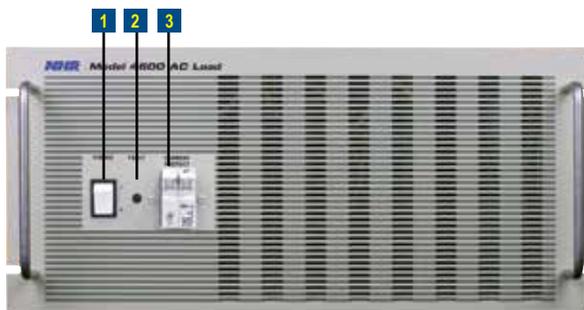
Fig. 8 - Operating Envelopes

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

## PC Softpanel



## Panel Overview



- 1 Control Power switch
- 2 Fault indicator light
- 3 Circuit breaker
- 4 LAN port
- 5 Address switch

- 6 Status indicators
- 7 Trig In/Out connectors
- 8 Chassis GND stud
- 9 Load Power Input connector
- 10 LAN/RS 232 switch

- 11 RS 232 connector
- 12 COMM In/Out connectors
- 13 Hold In/Out connectors
- 14 AC input connector

# 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
Maximum Current <sup>3</sup>	30A	60A	120A	180A	240A	360A	PC
Voltage Range <sup>3</sup>	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	OS
<b>Programmable Modes</b>							Test Executive
Constant Current							Communications
Range (RMS)	0 - 30A	0 - 60A	0 - 120A	0 - 180A	0 - 240A	0 - 360A	Drivers
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
Constant Voltage							Remote Voltage Sense
Range	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	Self Test
Accuracy	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	Performance Monitoring
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	Calibration
Constant Power							Protection
Range	300W - 3kW	600W - 6kW	1.2 - 12kW	1.8 - 18kW	2.4 - 24kW	3.6 - 36kW	Trigger Output
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	Fan Noise Reduction
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	Load Connectors
Constant Resistance							Operating Temperature
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
Accuracy	1, 5%	1, 5%	1, 5%	1, 5%	1, 5%	1, 5%	
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	
Short Circuit							
Max Surge Current	300A	600A	1200A	1800A	2400A	3600A	
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	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%	
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)	8½x19x23"	17½x19x25"	57x23x30"	72x23x30"	57x46x30"	72x46x30"	
Weight	222x483x58mm	445x483x635mm	1448x584x762mm	1829x584x762mm	1448x1168x762mm	1829x1168x762mm	
	77lbs/35kg	154lbs/70kg	440lbs/200kg	650lbs/295kg	860lbs/390kg	1250 lbs/567 kg	

<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

<sup>2</sup>Higher power and custom configurations available

<sup>3</sup>Accuracies apply when Settings and/or Measurements >10% of Range

<sup>4</sup>R+FS = Range + Full Scale



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