4600 Series
Programmable AC Electronic Load

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

NH Research

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.

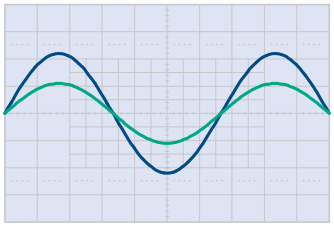


***Fig. 1** - Unity Power Factor*

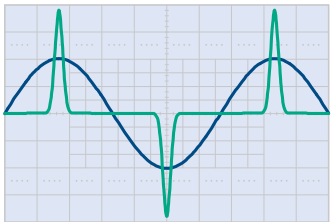


***Fig. 2** - High Crest Factor*

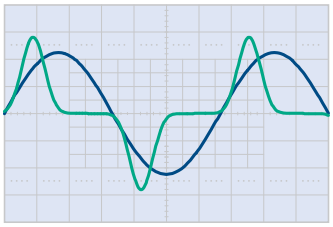


***Fig. 3** - Leading Power Factor*

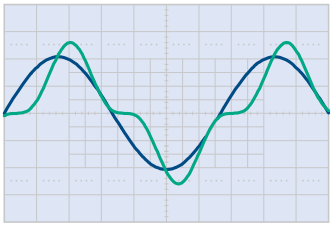


***Fig. 4** - Lagging Power Factor*

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.

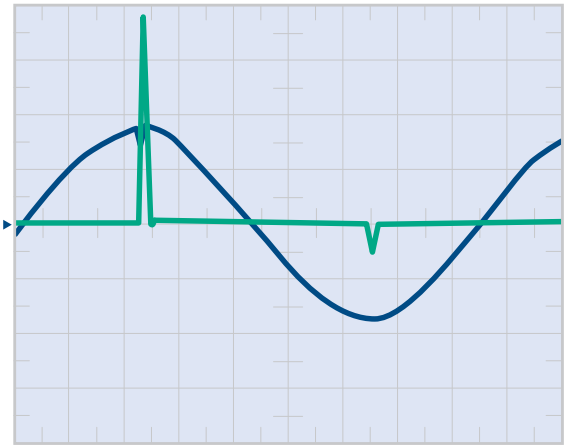
High Accuracy Measurements

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.



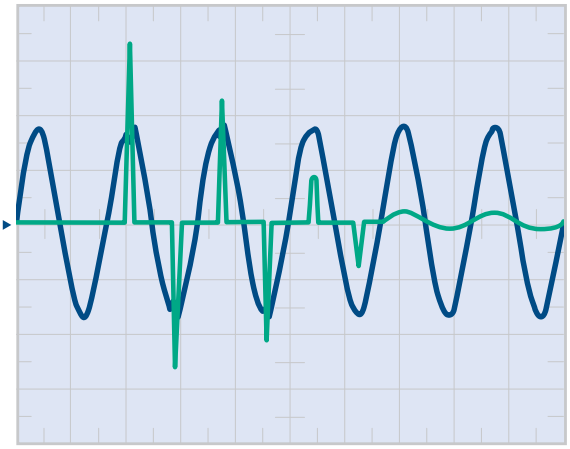
2.000 mS/div Wf1, Chn 001, 100 V/div. Wf2, Chn 002, 20 A/div.

***Fig. 5** - User-Defined Asymmetrical Current*

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.



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

***Fig. 6** - Start-Up Inrush Current Macro*

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

*em*Power® 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 *em*Power® LE (*Fig. 7*), which adds a test sequencer, basic test routines, and reporting.

***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.

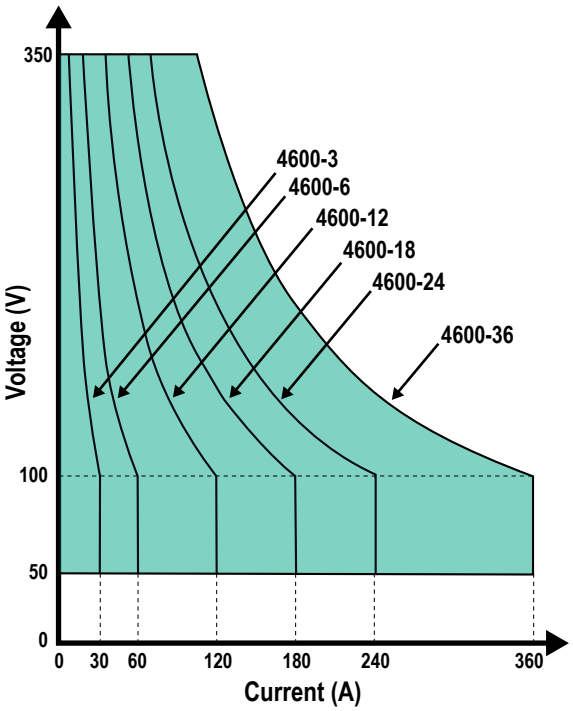
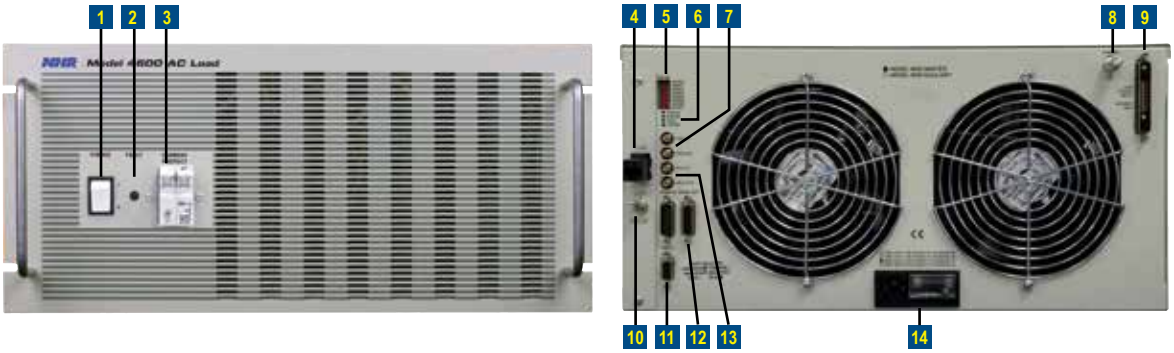


***Fig. 8** - Operating Envelopes*

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[1]

4600 Ratings	4600-3	4600-6	4600-12	4600-18	4600-24	4600-36[2]
Power	3kW	6kW	12kW	18kW	24kW	36kW
Maximum Current[3]	30A	60A	120A	180A	240A	360A
Voltage Range[3]	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V
Programmable Modes						
Constant Current						
Range (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	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Constant Voltage						
Range	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V	50 - 350V
Accuracy	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Constant Power						
Range	300W - 3kW	600W - 6kW	1.2 - 12kW	1.8 - 18kW	2.4 - 24kW	3.6 - 36kW
Accuracy	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Resolution	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Constant Resistance						
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
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 90A limit	1.414 - 4 180A limit	1.414 - 4 360A limit	1.414 - 4 540A limit	1.414 - 4 720A limit	1.414 - 4 1080A limit
Accuracy	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					
Measurements						
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)[4]	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					
Physical						
Enclosure	Chassis	Chassis (2)	Cabinet	Cabinet	Cabinet, 2-Bay	Cabinet, 2-Bay
Dimensions (HxWxD)	8¾x19x23" 222x483x58mm	17½x19x25" 445x483x635mm	57x23x30" 1448x584x762mm	72x23x30" 1829x584x762mm	57x46x30" 1448x1168x762mm	72x46x30" 1829x1168x762mm
Weight	77lbs/35kg	154lbs/70kg	440lbs/200kg	650lbs/295kg	860lbs/390kg	1250 lbs/567 kg

Control	
User Interface	PC soft panel
PC	Windows 10 with SVGA or better display
OS	Windows 10
Test Executive	Optional emPower™ LE & AC Load Sequencer
Communications	RS-232, LAN
Drivers	NI LabVIEW, IVI

Additional Features	
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
Remote Voltage Sense	1 MegaOhm impedance, 2VDC max drop between sense and load input
Self Test	Power-up self test of all major functions including status of input, output, control and protection circuits
Performance Monitoring	Continuous checking of performance parameters and appropriate error messages and/or LED fault indicators
Calibration	Closed cover, all adjustments made in software and stored in FLASH
Protection	OP, OCOV, OT, and Undervoltage Lockout
Trigger Output	To initiate an external measurement device and synchronized to programmed load current step
Fan Noise Reduction	Automatic fan speed control
Load Connectors	ITT Cannon DCM-21WA4P/DM 53745-1 plug & socket
Operating Temperature	0 - 50° C, maximum. Continuous and peak power derated 20% above 38° C
Input Power	115/230 ± 10% VAC, 47 - 63Hz

[1]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

[2]Higher power and custom configurations available

[3]Accuracies apply when Settings and/or Measurements >10% of Range

[4]R+FS = Range + Full Scale

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