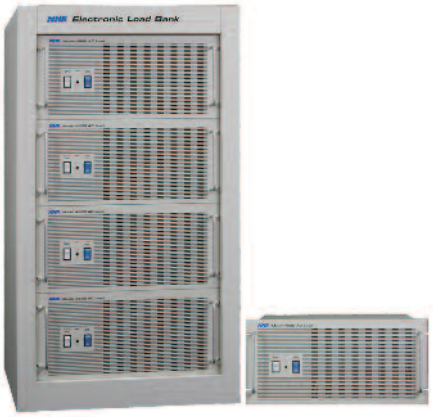
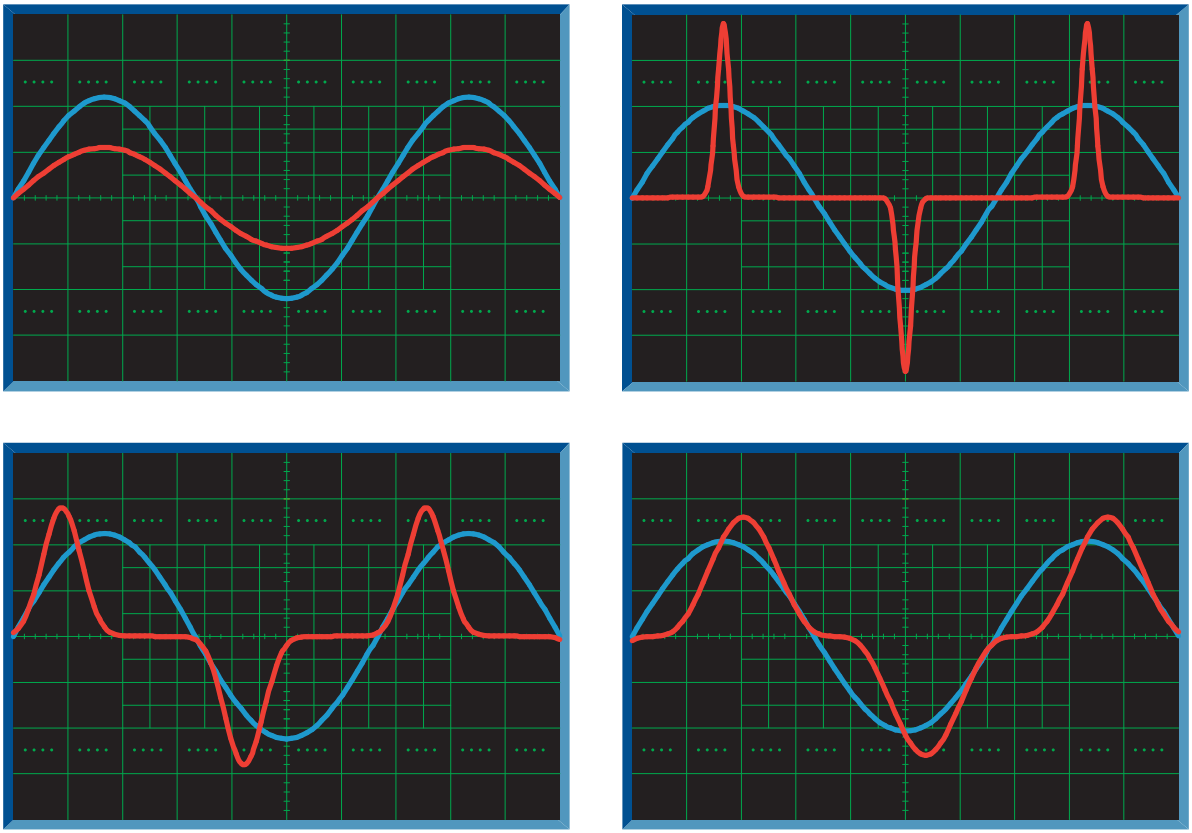
# AC Electronic Loads

## 4600 SERIES



- ❑ 6 power levels: 3, 6, 12, 18, 24 & 36 kW
- ❑ CC, CR, CV, CP, SC, UPF and CNL emulation modes
- ❑ Programmable crest factor and power factor
- ❑ 12 high-accuracy, internal measurements
- ❑ User-defined waveforms
- ❑ 100-step Multi-Mode Macros
- ❑ PC softpanel with current, voltage and power waveform display
- ❑ Single and 3-phase configuration options
- ❑ RS-232 and USB communication interfaces



## APPLICATION

4600 AC Loads are design for test applications that require linear and non-linear AC loading in several emulation modes with power and crest factors control. 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.

## EMULATION MODES

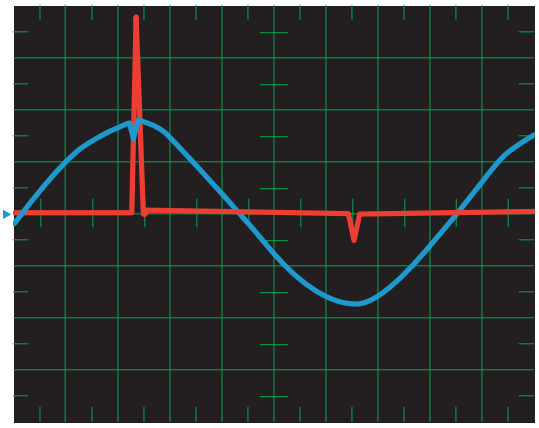
To provide testing under the broadest range of loading conditions, the 4600 Series offers 7 different emulation modes. Constant Current (CC) mode provides current to be drawn constantly, making it suitable for non-linear, linear and regulation loading. While Constant Resistance (CR) mode allows the load 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. The Short Circuit (SC) mode allows the load to test the UUT's short circuit protection capability. Unity Power Factor (UPF) mode causes power factor to be as close as possible 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 overstressing in the event of a voltage collapse. These comprehensive capabilities provide the user almost every conceivable AC loading condition.

## USER-DEFINED WAVEFORMS

The 4600 has the ability to control current through a user-defined waveform. 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 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 just about anything else that can be drawn as a single-cycle waveform.

**User-Defined Asymetrical Current Waveshape**

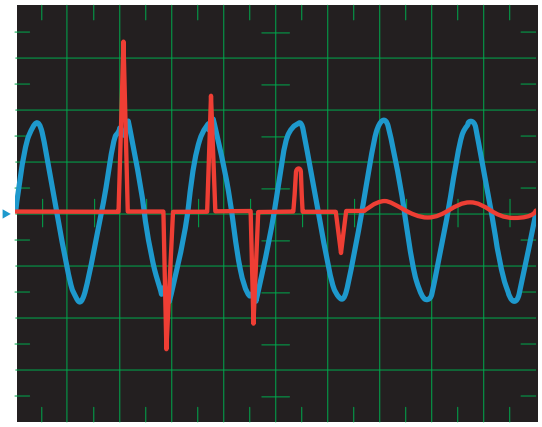


2.000 mS/div
Wf1, Chn 001, 100 V/div.
Wf2, Chn 002, 20 A/div

## 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. Further, a Macro can be executed as a single shot or looped.

**Start-Up Inrush Current Macro**



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

## *em*POWER LE TEST EXECUTIVE OPTION

The 4600 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 NHR power instruments is also possible through *em*Power LE, which adds a test sequencer, basic test routines, and reporting.

## HIGH ACCURACY MEASUREMENTS

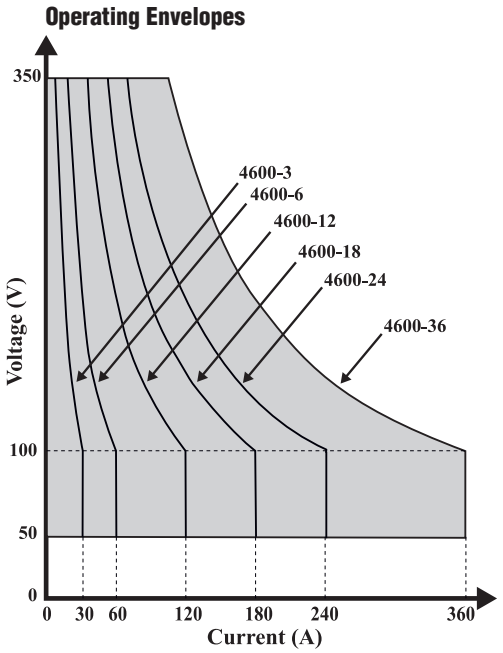
The 4600 Series provides high-accuracy frequency, voltage, peak voltage, current, peak current, crest factor, apparent power, true power, peak power, reactive power, power factor and resistance measurements by combining high-resolution measurements with precision ranging. The ability to make measurements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

## WIDE RANGE OF POWER LEVELS

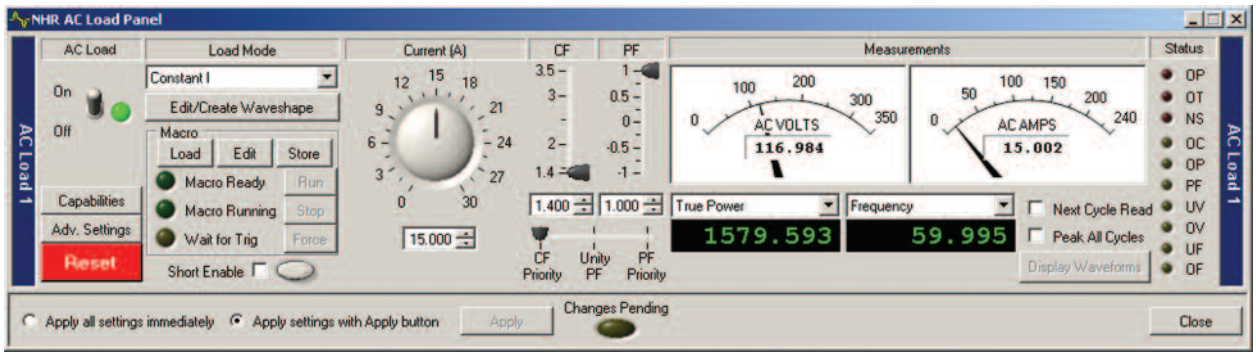
The 4600 Series is now offered in 6 power levels between 3 and 36 kW. Any unit can be field expandable in 3 kW increments to address future higher power needs. Contact factory for loads higher than 36 kW.

## GRAPHIC USER INTERFACE

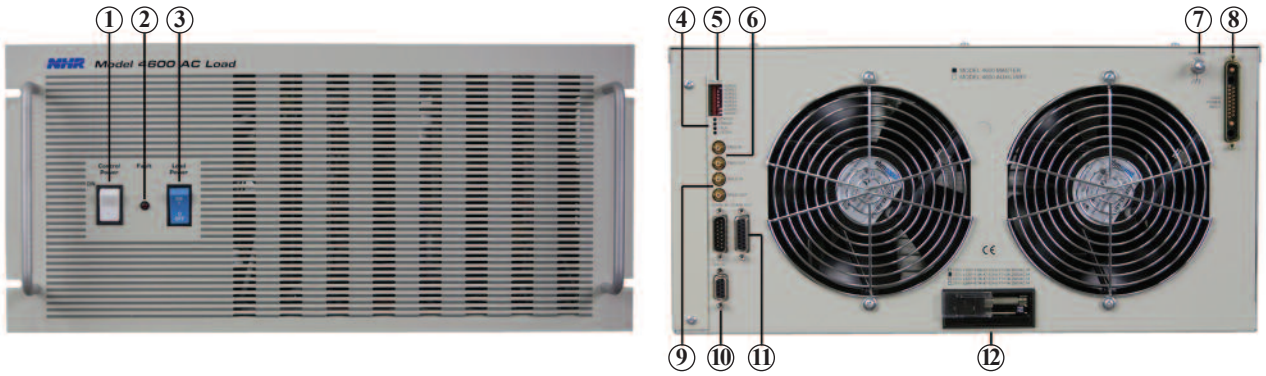
A PC-hosted graphic user interface eclipses the traditional front panel clutter of knobs, dials, keypads, and digital displays that are carry-over from a time of test instrumentation with a far more limited set of features. In addition to a more comprehensive presentation of operation, measurement and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




## PC SOFT PANEL




## PANEL OVERVIEW




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

# SPECIFICATIONS[1]

| 4600 Ratings | 4600-3 | 4600-6 | 4600-12 | 4600-18 | 4600-24 | 4600-36[2] |
|---|---|---|---|---|---|---|
| Power | 3 kW | 6 kW | 12 kW | 18 kW | 24 kW | 36 kW |
| Maximum Current[3] | 30 A | 60 A | 120 A | 180 A | 240 A | 360 A |
| Voltage Range[3] | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V |
| **Programmable Modes** | | | | | | |
| Constant Current | | | | | | |
| Range (RMS) | 0 - 30 A | 0 - 60 A | 0 - 120 A | 0 - 180 A | 0 - 240 A | 0 - 360 A |
| 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 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V |
| 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 | 300 W - 3 kW | 600 W - 6 kW | 1.2 - 12 kW | 1.8 - 18 kW | 2.4 - 24 kW | 3.6 - 36 kW |
| 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 | 300 A | 600 A | 1200 A | 1800 A | 2400 A | 3600 A |
| 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 - 3.5<br>90 A limit | 1.414 - 3.5<br>180 A limit | 1.414 - 3.5<br>360 A limit | 1.414 - 3.5<br>540 A limit | 1.414 - 3.5<br>720 A limit | 1.414 - 3.5<br>1080 A 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 such as phase angle, input voltage level, or 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 - 30 A | 0 - 60 A | 0 - 120 A | 0 - 180 A | 0 - 240 A | 0 -360 A |
| 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 - 90 A | 0 - 180 A | 0 - 360 A | 0 - 540 A | 0 - 720 A | 0 - 1080 A |
| 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 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V | 50 - 350 V |
| 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 - 500 V | 50 - 500 V | 50 - 500 V | 50 - 500 V | 50 - 500 V | 50 - 500 V |
| 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 - 440 Hz | 45 - 440 Hz | 45 - 440 Hz | 45 - 440 Hz | 45 - 440 Hz | 45 - 440 Hz |
| 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 - 10.5 kVA | 0 - 21 kVA | 0 - 42 kVA% | 0 - 63 kVA | 0 - 84 kVA | 0 - 126 kVA |
| Accuracy | 0.2% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% |
| Resolution | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% |
| Apparent Power | | | | | | |
| Range | 0 - 10.5 kVA | 0 - 21 kVA | 0 - 42 kVA% | 0 - 63 kVA | 0 - 84 kVA | 0 - 126 kVA |
| 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 - 10.5 kVA | 0 - 10.5 kVA | 0 - 10.5 kVA | 0 - 10.5 kVA | 0 - 10.5 kVA | 0 - 10.5 kVA |
| 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 - 45 kW | 0- 90 kW | 0 - 180 kW | 0 - 270 kW | 0 - 360 kW | 0 - 540 kW |
| 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 - 3.5 | 1.414 - 3.5 | 1.414 - 3.5 | 1.414 - 3.5 | 1.414 - 3.5 | 1.414 - 3.5 |
| 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) | 8¾ x 19 x 23 in<br>23 x 49 x 59 cm | 17½ x 19 x 25 in<br>45 x 49 x 64 cm | 57 x 23 x 30 in<br>145 x 59 x 77 cm | 72 x 23 x 30 in<br>183 x 59 x 77 cm | 57 x 46 x 30 in<br>117 x 59 x 77 cm | 72 x 46 x 30 in<br>183 x 117 x 77 cm |
| Weight | 77 lbs / 35 kg | 154 lbs/70 kg | 440 lbs/200 kg | 650 lbs/295 kg | 860 lbs/391 kg | 1250 lbs/568 kg |

| | |
|---|---|
| **Control** | |
| User Interface | PC soft panel |
| PC | 3 GHz $\mu$P with 512 MB RAM, SVGA display, 80 GB HD |
| OS | Window XP |
| Test Executive | Optional *em*Power™ LE |
| Communications | RS-232, USB option |
| Drivers | NI LabVIEW, IVI, Active X |
| **Additional Features** | |
| 3-Phase Operation | Provides for control of 3 individual units (for example, 3kVA units for a total of 9kVA, 6kVA units for a total of 18 kVA) to simulate a 3-phase load |
| Remote Voltage Sense | 1 MegaOhm impedance, 2 VDC 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 EEPROM |
| Protection | OP, OC, OV, OT, Reverse Voltage 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 Temperatue | 0 - 50° C, maximum continuous and peak power derated 20% above 38° C |
| Input Power | 115/230 ± 10% VAC, 47 - 63 Hz |

[1]Specifications apply at 23* +/- 5* C after a 10 minute warm up and are subject to change without notice.

All Accuries and Resolutions are % of full scale

[2]Higher power and custom configurations available

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

NH Research, Incorporated
16601 Hale Avenue, Irvine, California 92606
Tel: 949-474-3900
Fax: 949-474-7062
www.nhresearch.com
www.electronicloads.com