

WRx Series

DC Electronic Load • Water cooled, Active Resistance Technology



Overview

Utilizing Magna-Power's patented Active Resistance Technology (US Patent 9,429,629) in combination with the company's internally manufactured microchannel water-cooled heatsinks, the WRx Series addresses high power DC applications where exhaust heat control is essential. The WRx Series greatly increases power density compared air-cooled alternatives. An integrated solenoid controls the flow of water to avoid condensation. Full power can be achieved using conventional water, with water inlet temperatures up to 25°C.

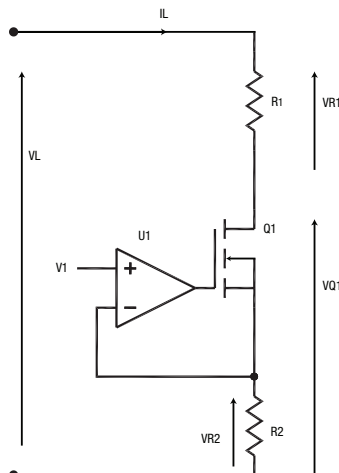
Magna-Power's Active Resistance Technology utilizes a switched binary matrix of resistances and MOSFET network, combined with Magna-Power's new MagnaLINK™ distributed DSP architecture, the WRx Series delivers the same features and performance as traditional electronic loads, at a fraction of the price. In addition to the 16-bit precision voltage, current, resistance, power, and shunt regulator control modes, the WRx Series also provides a rheostat control mode, allowing direct control of the product's internal resistance network.

Technology

The WRx Series utilizes Active Resistance Technology to deliver performance consistent with conventional electronic loads, but at a fraction of the price and with the ability to directly switch passive resistors on-the-fly.

In Magna-Power's Active Resistive Technology, switched resistors are placed in series with MOSFETs. High-performance DSPs simultaneously control both dissipation elements in harmony. Assuming the power across the shunt resistor is insignificant, the power dissipated in load resistor R1 is $I_L \times V_{R1}$ and the power dissipated in MOSFET Q1 is $I_L \times V_{Q1}$. The resistors can be operated at higher temperatures than the MOSFETs, simplifying cooling requirements of the passive elements. Keeping V_{Q1} small and V_{R1} large lowers system costs in comparison with purely semiconductor electronic loads. Adjusting the value of resistor R1 is accomplished with a binary switching matrix. Finally, keeping the resistor switching increments small and over a wide range maintains the smallest voltages across the linear modules and over the widest operating range.

The advantage of resistive loads are reliability and cost per watt for dissipating power, while the advantage of MOSFET loads is speed of performance and the ability to dissipate power over a wide operating range. Active Resistive Technology blends switched resistance with MOSFETs to significantly lower the product's cost, add new control modes, while still delivering 16-bit precision and high-accuracy performance.



Key Features

- MagnaLINK™ Distributed DSP Architecture
- 16-bit digital programming and monitoring resolution
- SCPI Remote Programming API
- Many control modes, including: voltage, current, power, resistance, shunt regulator, and rheostat
- Multiple operating ranges
- Integrated front and rear full control USB ports, RS485, and dual MagnaLINK™ ports, with LXI TCP/IP Ethernet and IEEE-488 GPIB available.
- Digital plug-and-play master-slaving
- Programmable protection limits
- Configurable external analog-digital user I/O
- Designed and manufactured in the USA

Rheostat Mode

Rheostat Mode, one of six available control modes, bypasses the linear elements to provide direct on-the-fly control of the MagnaLOAD's switched resistor matrix for true step load response. A total of 31 different resistor states are available. Each resistor state has an associated power limit, less than the MagnaLOAD's full scale rated power, which cannot be exceeded. Resistor states can be switched on-the-fly, with the DC input enabled, at the resistor state's maximum power rating. The full scale rated output voltage or full scale rated output current can be achieved at each resistor state, as long as that resistor state's power limit is not exceeded.

The 31 available Rheostat resistance values vary by model. For a single resistor state on a specific model, the resistance value is calculated as:

(Reference Resistor Value) x (Resistor Multiplier)

Refer to the User Manual for each model's resistor parameters.

Models

| Model | Maximum Power | Maximum Voltage | Maximum Current | Package Type | Minimum Voltage |
|-----------------|---------------|-----------------|-----------------|----------------|-----------------|
| WRx12.5-200-130 | 12.5 kW | 200 Vdc | 130 Adc | Rack-mount | 2.5 Vdc |
| WRx12.5-500-52 | 12.5 kW | 500 Vdc | 52 Adc | Rack-mount | 3.0 Vdc |
| WRx12.5-1000-26 | 12.5 kW | 1000 Vdc | 26 Adc | Rack-mount | 5.0 Vdc |
| WRx25-200-260 | 25 kW | 200 Vdc | 260 Adc | Floor-standing | 2.5 Vdc |
| WRx25-500-104 | 25 kW | 500 Vdc | 104 Adc | Floor-standing | 3.0 Vdc |
| WRx25-1000-52 | 25 kW | 1000 Vdc | 52 Adc | Floor-standing | 5.0 Vdc |
| WRx50-200-520 | 50 kW | 200 Vdc | 520 Adc | Floor-standing | 2.5 Vdc |
| WRx50-500-208 | 50 kW | 500 Vdc | 208 Adc | Floor-standing | 3.0 Vdc |
| WRx50-1000-104 | 50 kW | 1000 Vdc | 104 Adc | Floor-standing | 5.0 Vdc |
| WRx75-200-780 | 75 kW | 200 Vdc | 780 Adc | Floor-standing | 2.5 Vdc |
| WRx75-500-312 | 75 kW | 500 Vdc | 312 Adc | Floor-standing | 3.0 Vdc |
| WRx75-1000-156 | 75 kW | 1000 Vdc | 156 Adc | Floor-standing | 5.0 Vdc |
| WRx100-200-1040 | 100 kW | 200 Vdc | 1040 Adc | Floor-standing | 2.5 Vdc |
| WRx100-500-416 | 100 kW | 500 Vdc | 416 Adc | Floor-standing | 3.0 Vdc |
| WRx100-1000-208 | 100 kW | 1000 Vdc | 208 Adc | Floor-standing | 5.0 Vdc |

Specifications

AC Input Specifications

| | |
|---------------------------|---|
| AC Input Voltage | 85-265 Vac 1 Φ , 2-wire + ground |
| AC Input Frequency | 45-66 Hz |
| AC Input Isolation | \pm 1500 Vac, maximum input voltage to ground |

Programming Specifications

| | |
|-------------------------------|--|
| Resolution (All Modes) | 16-bit, 0.0015% |
| Accuracy | Voltage: \pm 0.02% of full scale voltage rating Current: \pm 0.25% of full scale current rating Power: \pm 0.50% of full scale power rating Resistance: \pm 0.50% of full scale resistance rating |
| Voltage Slew Rate | 0.0015% to 6.30% max voltage rating per ms |
| Current Slew Rate | 0.0030% to 75% max current rating per ms |
| Power Slew Rate | 0.0030% to 5.50% max power rating per ms |
| Resistance Slew Rate | 0.0015% to 6.30% max resistance rating per ms |
| Rheostat Slew Rate | Instantaneous load step |
| Trip Settings Range | Over Voltage: 10% to 110% of max voltage rating Under Voltage: 0% to 110% of max voltage rating Over Current: 10% to 110% of max current rating Over Power: 10% to 110% of max power rating |

Connectivity Specifications

| | |
|--|---|
| Communication Interfaces (Standard) | USB Host (Front): Type B USB Host (Rear): Type B RS485 (Rear): RJ-45 MagnaLINK™: RJ-25 x 2 External User I/O: Standard, 25-pin D-sub Female |
| Communication Interfaces (Optional) | LXI TCP/IP Ethernet (Rear): RJ-45 GPIB (Rear): IEEE-488 |

Water Cooling Specifications

| | |
|--|---|
| Water Connection Provided 12.5 kW Models | 1/2" NPT male inlet and outlet |
| Water Connection Provided 25 kW to 100 kW Models | 1" NPT male inlet and outlet |
| Maximum Inlet Temperature | 25°C |
| Maximum Inlet Pressure | 80 PSI |
| Minimum Flow Rate | 12.5 kW Models: 1.5 GPM 25 kW Models: 3.0 GPM 50 kW Models: 6.0 GPM 75 kW Models: 9.0 GPM 100 kW Models: 12.0 GPM |

Environmental Specifications

| | |
|--------------------------------------|--|
| Ambient Operating Temperature | 0°C to 50°C |
| Storage Temperature | -25°C to +85°C |
| Humidity | Relative humidity up to 95% non-condensing |
| Air Flow | Front air inlet, rear exhaust |

External User I/O Specifications

| | |
|--------------------------------------|------------------------------|
| Digital Inputs | 5 V, 10 k Ω impedance |
| Digital Monitoring Signals | 5 V, 32 mA capacity |
| Digital Reference Signal | 5 V output, 20 mA capacity |
| Analog Sampling Rate | 2 kHz |
| Analog Programming Input | 0-10 V |
| Analog Programming Impedance | 10 k Ω |
| Analog Programming Resolution | 12-bit, 0.025% |
| Analog Monitoring Signals | 0-10 V, 3 mA capacity |
| Analog Monitoring Impedance | 0.005 Ω |
| Analog Monitoring Accuracy | 0.05% of max rating |
| Analog Reference Signal | 10 V, 20 mA capacity |

Physical Specifications

| Power Level | Rack Units | Size | Weight |
|----------------|-------------|--|---------------------|
| 12.5 kW | 4U | 7" H x 24" W x 19" D (17.8 x 60.9 x 48.2 cm) | 165 lbs (74.8 kg) |
| 25 kW | 12U Cabinet | 30.7" H x 24" W x 31.5" D (78.0 x 61.0 x 80.0 cm) | 455 lbs (206.4 kg) |
| 50 kW | 24U Cabinet | 58.25" H x 24" W x 31.5" D (148.0 x 61.0 x 80.0 cm) | 785 lbs (356.1 kg) |
| 75 kW | 24U Cabinet | 58.25" H x 24" W x 31.5" D (148.0 x 61.0 x 80.0 cm) | 1115 lbs (505.8 kg) |
| 100 kW | 36U Cabinet | 74" H x 24" W x 31.5" D (188.0 x 61.0 x 80.0 cm) | 1445 lbs (655.4 kg) |

Regulatory Compliance

| | |
|-----------------------|--|
| EMC | Complies with European EMC Directive for test and measurement products, 2014/30/EU |
| Safety | Complies with EN61010-1:2010 |
| CE Mark | Yes |
| RoHS Compliant | Yes |

500 kW WRx Series MagnaLOAD System



Five 100 kW WRx Series MagnaLOADs in digital master-slave parallel, performing as a single 500 kW system with measurement aggregation

WRx Series

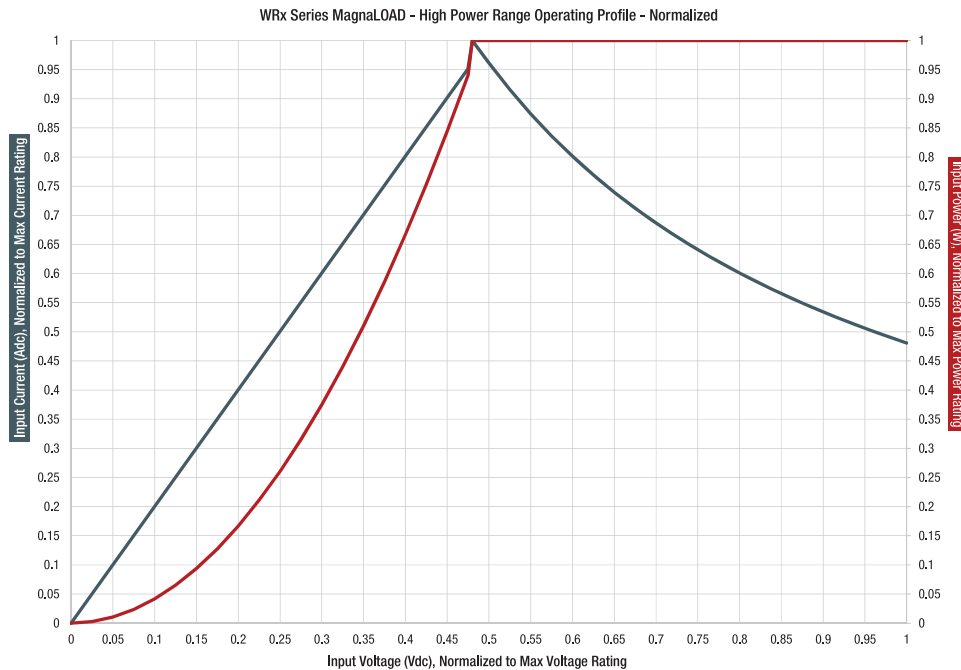
DC Electronic Load • Water cooled, Active Resistance Technology

Operating Ranges

With its combination of resistor and linear elements, the WRx Series DC electronic load provides two distinct operating ranges: High Power Range and Low Power Range. The operating range can be selected from the front panel or by computer command.

The operating ranges figures below apply to all WRx Series models, normalized about the model's maximum voltage, current, and power ratings.

High Power Range

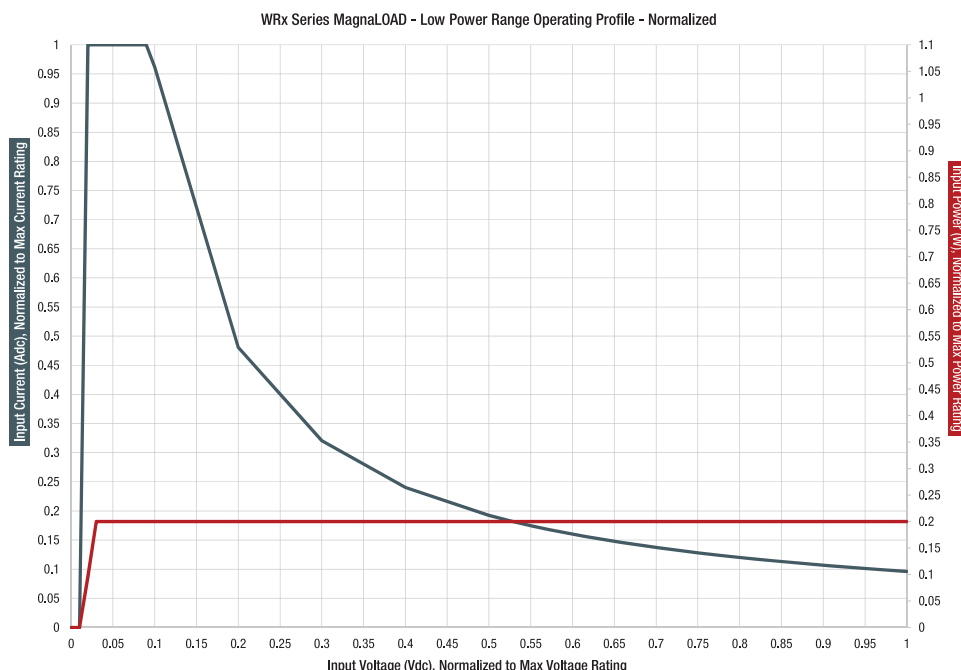


Understanding the High Power Operating Range

The chart on the left normalizes the High Power Operating Range about the product's maximum voltage, current and power ratings.

The High Power Range allows the WRx Series MagnaLOAD to operate up to its maximum power rating over the range of 48% to 100% of the product's maximum voltage rating (shown by the light blue series). Below 48% of the product's maximum voltage rating, the current available decays linearly (shown by the dark blue series).

Low Power Range



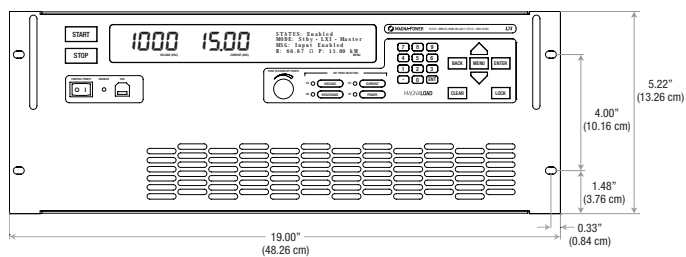
Understanding the Low Power Operating Range

The chart on the left normalizes the Low Power Operating Range about the product's maximum voltage, current and power ratings.

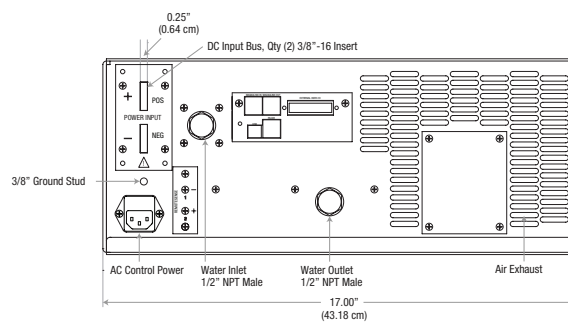
The Low Power Range allows the WRx Series MagnaLOAD to operate at the full current rating from the product's minimum voltage rating to 10% of the product's maximum voltage rating. Above 10% of the maximum voltage rating, the unit is limited to just over 20% of the maximum power rating, so the available current falls as a function of voltage.

Product Diagrams

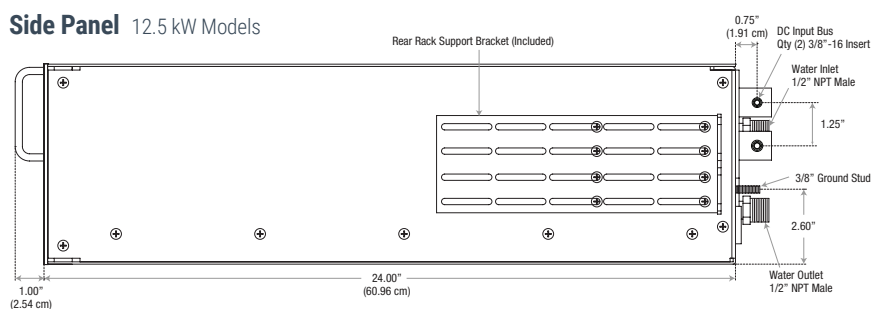
Front Panel 12.5 kW Models



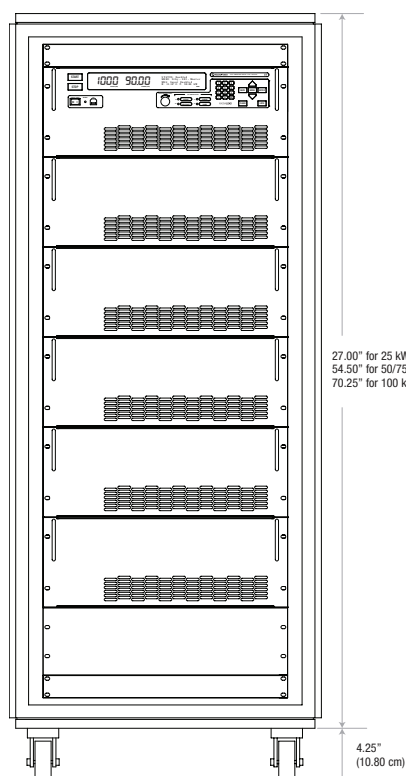
Rear Panel 12.5 kW Models



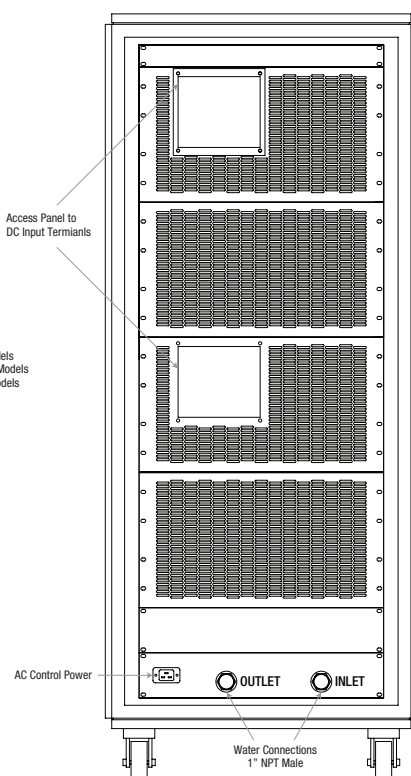
Side Panel 12.5 kW Models



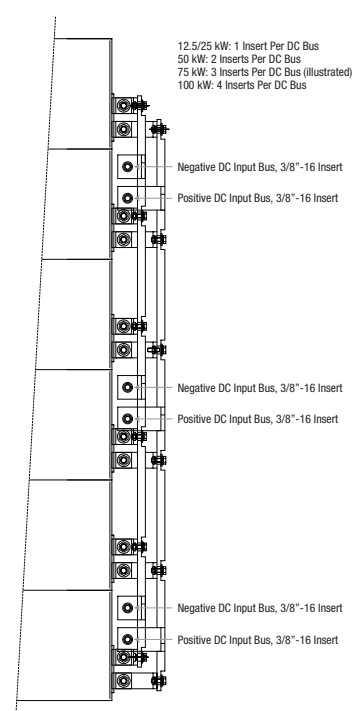
Front Side 25 kW to 100 kW Models



Rear Side 25 kW to 100 kW Models



DC Input Bus 25 kW to 100 kW Models



MagnaLOAD Overview

MagnaLINK™ Distributed Digital Control



Magna-Power's MagnaLINK™ technology provides distributed Texas Instrument DSP control across power processing stages inside the MagnaLOAD DC electronic load. This technology follows a significant internal development cycle from Magna-Power to provide a unified digital control platform across its electronic loads and power supplies, featuring fully digital control loops, adjustable control gains, programmable slew rates, digital master-slaving, and many new advanced control technologies.

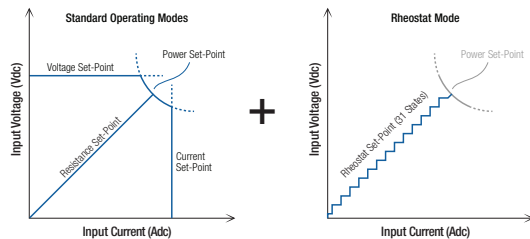
All MagnaLOADs come with the following interfaces:

- Front panel knob, keypad, and menu system
- 25-pin configurable external user I/O, including a high-speed analog input
- Front and rear USB and rear RS-485 or optional Ethernet

When in standby or diagnostic fault, the DC input bus is disconnected via a switching device.

Finally, with a dedicated +5V interlock input pin and included +5V reference on all models, external emergency stop systems can be easily integrated using an external contact.

Flexible Operating Modes



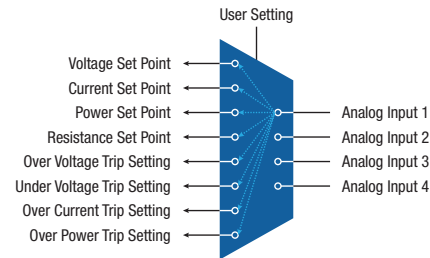
To accommodate a variety of DC sources, all MagnaLOADs come with many configurable control modes, including:

- Voltage Mode
- Current Mode
- Power Mode
- Resistance Mode
- Shunt Regulator Mode
- Rheostat Mode (ARx Series and WRx Series only)

Preference for DC regulation is given to the parameter in the selected mode within the programmed set-points. Using the MagnaLOAD's set-points and trip settings, the product can be configured to either trip with a fault when a limit is exceeded or to cross-over into a different regulation state.

Shunt Regulator Mode turns the MagnaLOAD into a high-speed smart braking resistor, engaging the DC input only when a specified voltage and exceeded by a user-defined percentage, while limiting the shunt current to a programmed set-point.

Configurable External User I/O



Beyond the front panel and computer controls, all MagnaLOADs come standard with a 25-pin D-Sub connector designated as the External User I/O. This connector provides:

- 8 Digital Outputs
- 4 Digital Inputs
- 4 Analog Outputs
- 4 Analog Inputs

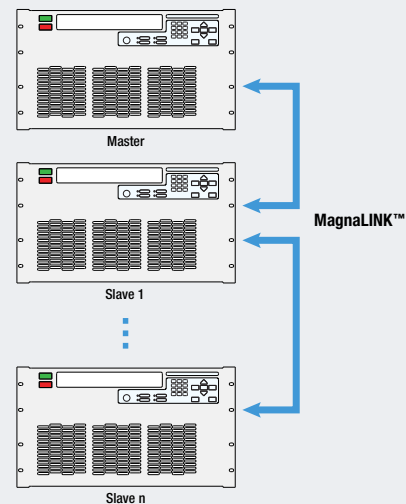
All the analog-digital I/O ports are configurable, allowing the user to select which parameters they want to control and monitor. This configurable I/O scheme reduces complexity, eases PLC integration and allows control parameters from various interfaces simultaneously.

The MagnaLOAD's configurable analog inputs provide 0-10V programming from PLCs and external D/A converters.

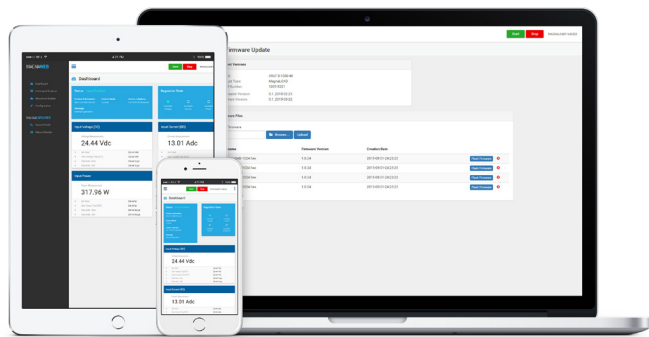
Digital Master-Slaving: Expandability Without Compromise

All MagnaLOADs come standard with a MagnaLINK™ Input and a MagnaLINK™ Output port, which provides plug and play digital master-slaving. Simply connect the master's MagnaLINK™ Output to the slave's MagnaLINK™ Input and, using the MagnaWEB software, the products will automatically configure themselves for master-slave operation as a higher-power unit based on the populated ports. Buffered digital MagnaLINK™ connections means many MagnaLOADs can be daisy-chained in master-slave operation. Master-slave MagnaLOAD units will aggregate measurements to one display panel.

The internal MagnaLINK™ protocol was developed with expandability at the forefront. When configured for master-slave operation, the master controller takes control of all the slave's digital "targets." With this digital master-slaving strategy, it is completely transparent whether the unit is operating as a stand-alone product or in master-slave.



MagnaWEB Software Interface



Magna-Power's next generation software interface, MagnaWEB, provides intuitive and user-friendly web-browser based controls for programming and measurement read-back of the MagnaLOAD's activity. Virtually all of the MagnaLOAD's available functions can be controlled and monitored from the MagnaWEB software over any of product's installed communication interfaces.

MagnaWEB uses a server-client software model to provide access to the MagnaLOAD from nearly any device and operating system. Install and run the MagnaWEB software locally on Windows then, using a web browser, access the server connected to the MagnaLOAD from a variety of devices including other desktops, tablets or smart-phones.

Extensive Programming Support

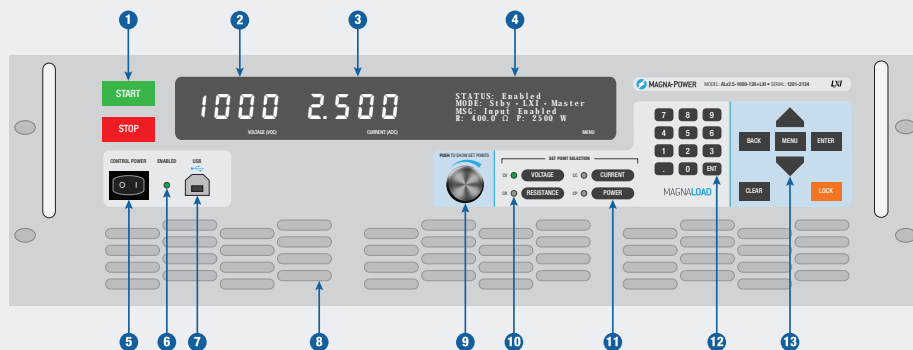
All MagnaLOAD DC electronic loads come with a dedicated National Instruments LabVIEW™ driver, Interchangeable Virtual Instrument (IVI) driver, and support for a wide range of Standard Commands for Programmable Instrumentation (SCPI). These programming interfaces support full control, measurement, and monitoring of the MagnaLOAD. All of the MagnaLOAD's available communication interfaces are supported by these drivers and command sets, including: USB, RS-485, LXI TCP/IP Ethernet, and IEEE-488 GPIB.

Showcased in the following basic code examples, SCPI commands provide the simplest form of communication by using plain ASCII text and parameters sent over a basic socket connection. Over 50 commands are provided, with detailed documentation in the respective product series user manual.

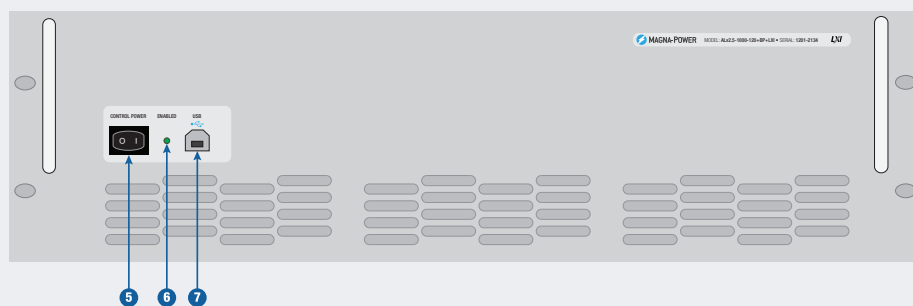
Python programming example using SCPI commands

```
import visa
rm = visa.ResourceManager()
magna_power = rm.open_resource(USB::0x0403::0x6015::1201-2358::INSTR)
magna_power.write('*IDN?')
magna_power.read()
magna_power.write('VOLT 1000')
magna_power.write('IDN?CURR 20')
magna_power.write('INP:START')
```

MagnaLOAD Front Panel - Standard



MagnaLOAD Front Panel - Blank Panel (+BP) Option



- 1 START: Enables the DC input bus
STOP: Disable the DC input bus
- 2 Voltage measurement display
- 3 Current measurement display
- 4 4-line character display featuring a menu system, operating status and modes, product messages with diagnostic codes, resistance measurement display, and power measurement display
- 5 Control power switch, energizes the control circuits without engaging DC bus
- 6 LED indicator that the DC input is enabled
- 7 Full control (host) front panel USB port
- 8 Clean air intake, with integrated fans
- 9 Aluminium digital encoder knob for programming set-points
- 10 LED indicator of the MagnaLOAD's present regulation state, which can include: constant voltage (CV), constant current (CC), constant power (CP), or constant resistance (CR)
- 11 Illuminated selector buttons to choose which set-point the digital encoder knob and digital keypad buttons will modify.
- 12 MENU: Enters the menu system on the 4-line display
BACK: Moves back one level in the menu
ENTER: Selects the highlighted menu item
CLEAR: Removes the product from a faulted state
LOCK: Locks the front panel



Innovation in Programmable Power

Magna-Power designs and manufactures robust programmable power products in the USA that set industry standards for quality, size, and control. The company's experience in power electronics is reflected in its 1.25 kW to 2000 kW+ product line, quality service, and reputation for excellence. Today, you will find Magna-Power's standard products at its thousands of customers worldwide, aiding in the manufacture of electric vehicles, simulating solar arrays for development of inverters, steering magnets for particle accelerators, powering radar systems, driving traction controllers for locomotive development, or at a wide range of Universities for cutting-edge energy research.

Quick Facts

Year Founded

1981

Total Power Shipped

310+ megawatts

Headquarters and Manufacturing Location

Flemington, New Jersey USA

Facility Size

73,500 ft²

Vertically Integrated USA Manufacturing

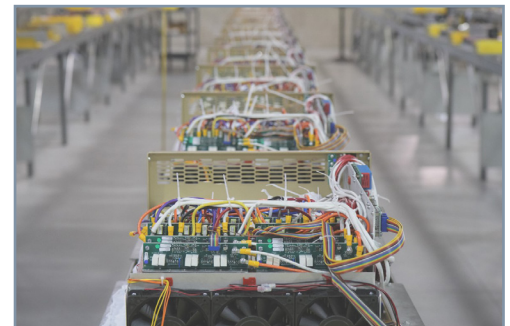
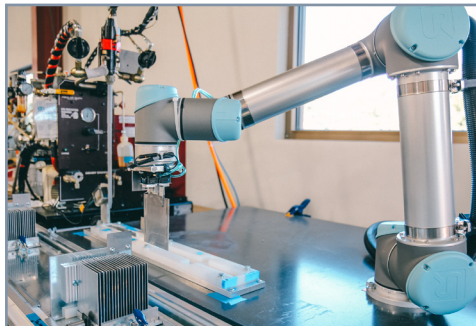
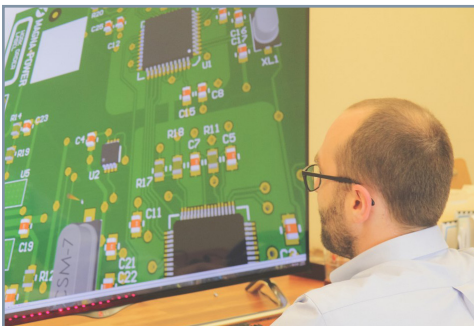
Magna-Power Electronics products are proudly made in the USA at the company's vertically integrated, company designed and owned 73,500 ft² headquarters in Flemington, New Jersey. All engineering, manufacturing and North America product servicing is performed at the company's headquarters.

Magna-Power Electronics utilizes vertical integration in its manufacturing process for complete control over quality, cost, and lead-time of its made-to-order products. As the company has grown, more operations have been internalized.

Vertical integration enables Magna-Power to manufacture a very broad line of sophisticated electronic products, while still maintaining industry leading lead-times. Housing engineering and manufacturing teams in the same facility forces strong collaboration between the two teams for continual process and product improvements.

Internal Company Processes

- Research and development
- Magnetics winding
- Magnetic core punching and cutting
- Full sheet metal operations
- EDM and CNC machining
- Cable harnessing
- Powder coating
- Robotic air- and water-cooled heat-sink fabrication
- Surface-mount and through-hole printed circuit board assembly
- Final assembly, testing, and burn-in



Where to Buy

Magna-Power Electronics Partners and Sales Offices

North America

Headquarters, Manufacturing

Magna-Power Electronics, Inc.
39 Royal Road
Flemington, NJ 08822
United States of America

Phone: 1-908-237-2200
Email: sales@magna-power.com
magna-power.com

**Germany, Austria, Switzerland,
Central and Eastern Europe**
Sales Office

Magna-Power Electronics GmbH
Daimlerstr. 13
85521 Ottobrunn
Germany

Phone: +49-(0)89-95890293
Email: sales@magna-power.de
magna-power.com/de

United Kingdom
Sales Office

Magna-Power Electronics Limited
400 Thames Valley Park Drive
Reading, Berkshire RG6 1PT
United Kingdom

Phone: +44 1189 663143
Email: sales.uk@magna-power.com
magna-power.com

China

Sales Office

Magna-Power Electronics Co., Ltd.
6F, 56 East 4th Ring Road Middle
Beijing, 100025
China

Phone: +86 139 1068 4490
Email: sales.zh@magna-power.com
magna-power.com/zh

Distributors of Magna-Power Electronics products are located worldwide.

To find the nearest sales partner, please visit:
magna-power.com/contact

Magna-Power Electronics – designing and delivering rugged programmable power products, built in the USA to the highest quality standards through a vertically integrated manufacturing process.

Published by
Magna-Power Electronics, Inc.
Flemington, NJ 08822 USA

© 2018 Magna-Power Electronics, Inc.
All Rights Reserved.

Visit us:
magna-power.com

ATTENTION

The information and specifications given in this document are subject to change without notice.

INFORMATION

For further information on technology, terms and conditions, and product prices, contact the nearest Magna-Power Electronics sales partner (magna-power.com/contact).