MagnaLOAD Overview

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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.

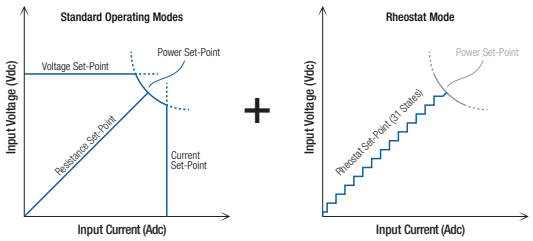
All MagnaLOADs come with the following interfaces:

- Front panel knob, keypad, and menu system
- 26-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



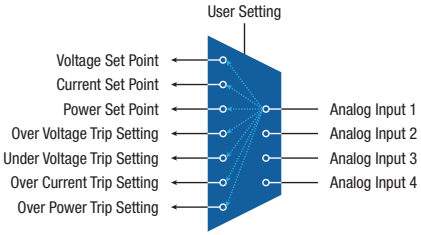
To accommodate a variety of DC sources, all MagnaLOADs come with many configurable control modes, including:

- 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 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 26-pin D-Sub connector designated as the External User I/O. This connector provides:

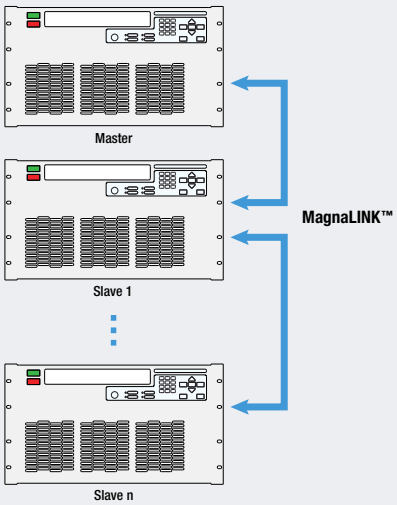
- 8 Digital Outputs
- 4 Digital Inputs
- 4 Analog Outputs
- 4 Analog Inputs

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.

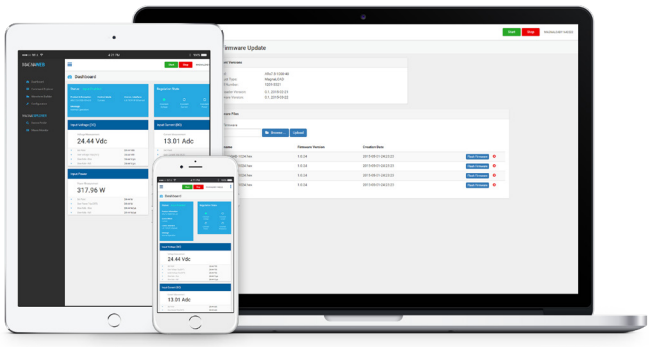
Digital Master-Slaving: Expandibility Without Compromise

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

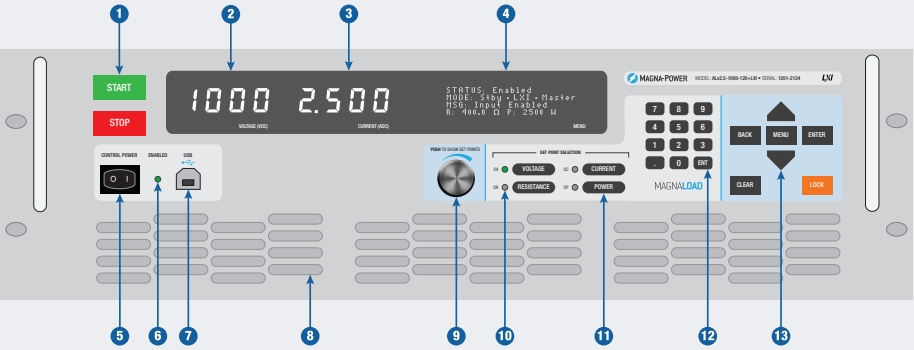
All MagnaLOAD DC electronic loads come with a dedicated National Instruments LabVIEW™ driver, Interchangeable Virtual Instrument (IVI) driver, and support for a wide range of Standard Commands for Programmable Instrumentation (SCPI). These programming interfaces support full control, measurement, and 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.

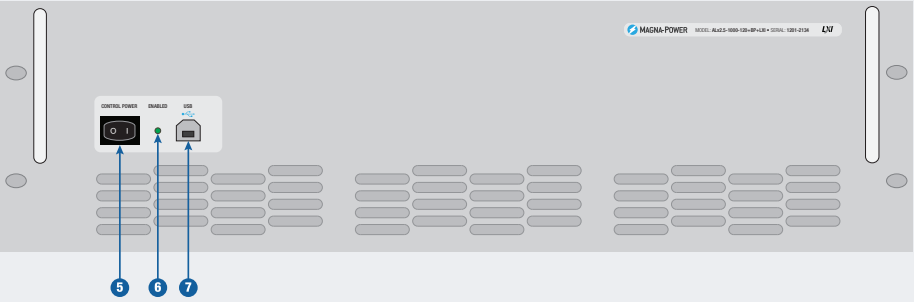
Python programming example using SCPI commands

```
import serial
conn = serial.Serial(port='COM8', baudrate=115200)
conn.write('*IDN?\n')
print conn.readline()
conn.write('VOLT 1000\n')
conn.write('CURR 2.5\n')
conn.write('INP:START\n')
conn.write('MEAS:ALL?\n')
print conn.readline()
```

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

ALx Series

DC Electronic Load • Air cooled, linear MOSFET topology, wide operating range

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, and shunt regulator
- Wide voltage-current-power operating profile
- 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

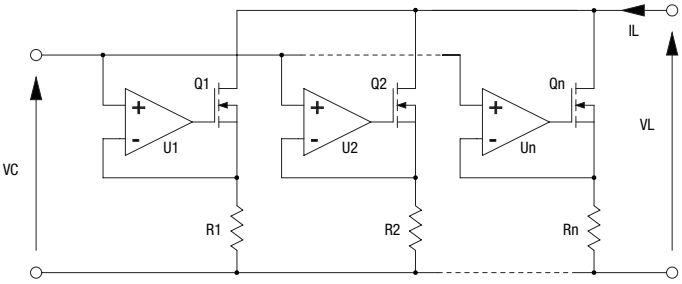
Overview

The ALx Series MagnaLOAD utilizes conventional linear MOSFET-based dissipative elements, allowing the series to achieve a very wide voltage-current operating range within the model's maximum power rating. Using the same heat management innovations developed for Magna-Power's high density programmable DC power supplies, the ALx Series' conservative cooling ensures long product life with continuous full power operation in environments up to 50°C ambient operating temperature.

Technology

The ALx Series uses MOSFETs for power dissipation, delivering among the industry's widest full-power operating for its product class. The ALx Series uses MOSFETs operated in the linear region to allow full power and full control over the entire VA rating of the product.

MOSFETs are specifically selected based on their ability to operate in the linear region and have safe operating curves well below the maximum power rating when used as an electronic switch. Control circuitry for ALx Series MagnaLOADs are operated in a closed loop to linearize the response. Each MOSFET device produces a load current defined by VC/Rn. Closed loop amplifiers enable multiple MOSFETs to share load current equally.



Models

Model	Maximum Power	Maximum Voltage	Maximum Current	Package Type	Minimum Voltage
ALx1.25-200-300	1.25 kW	200 Vdc	300 Adc	Rack-mount	2.5 Vdc
ALx1.25-500-125	1.25 kW	500 Vdc	125 Adc	Rack-mount	6.0 Vdc
ALx1.25-1000-37.5	1.25 kW	1000 Vdc	37.5 Adc	Rack-mount	7.5 Vdc
ALx2.5-200-600	2.5 kW	200 Vdc	600 Adc	Rack-mount	2.5 Vdc
ALx2.5-500-250	2.5 kW	500 Vdc	250 Adc	Rack-mount	6.0 Vdc
ALx2.5-1000-75	2.5 kW	1000 Vdc	75 Adc	Rack-mount	7.5 Vdc
ALx5-200-1200	5 kW	200 Vdc	1200 Adc	Floor-standing	2.5 Vdc
ALx5-500-500	5 kW	500 Vdc	500 Adc	Floor-standing	6.0 Vdc
ALx5-1000-150	5 kW	1000 Vdc	150 Adc	Floor-standing	7.5 Vdc
ALx7.5-200-1800	7.5 kW	200 Vdc	1800 Adc	Floor-standing	2.5 Vdc
ALx7.5-500-750	7.5 kW	500 Vdc	750 Adc	Floor-standing	6.0 Vdc
ALx7.5-1000-225	7.5 kW	1000 Vdc	225 Adc	Floor-standing	7.5 Vdc
ALx10-200-2400	10 kW	200 Vdc	2400 Adc	Floor-standing	2.5 Vdc
ALx10-500-1000	10 kW	500 Vdc	1000 Adc	Floor-standing	6.0 Vdc
ALx10-1000-300	10 kW	1000 Vdc	300 Adc	Floor-standing	7.5 Vdc
ALx12.5-200-3000	12.5 kW	200 Vdc	3000 Adc	Floor-standing	2.5 Vdc
ALx12.5-500-1250	12.5 kW	500 Vdc	1250 Adc	Floor-standing	6.0 Vdc
ALx12.5-1000-375	12.5 kW	1000 Vdc	375 Adc	Floor-standing	7.5 Vdc
ALx15-200-3600	15 kW	200 Vdc	3600 Adc	Floor-standing	2.5 Vdc
ALx15-500-1500	15 kW	500 Vdc	1500 Adc	Floor-standing	6.0 Vdc
ALx15-1000-450	15 kW	1000 Vdc	450 Adc	Floor-standing	7.5 Vdc
ALx17.5-200-4200	17.5 kW	200 Vdc	4200 Adc	Floor-standing	2.5 Vdc
ALx17.5-500-1750	17.5 kW	500 Vdc	1750 Adc	Floor-standing	6.0 Vdc
ALx17.5-1000-525	17.5 kW	1000 Vdc	525 Adc	Floor-standing	7.5 Vdc
ALx20-200-4800	20 kW	200 Vdc	4800 Adc	Floor-standing	2.5 Vdc
ALx20-500-2000	20 kW	500 Vdc	2000 Adc	Floor-standing	6.0 Vdc
ALx20-1000-600	20 kW	1000 Vdc	600 Adc	Floor-standing	7.5 Vdc

Available Integrated Options

- CANopen **+CAN**
- EtherCAT **+ECAT**
- EtherNet/IP **+EIP**
- LXI TCP/IP Ethernet **+LXI**
- ModbusTCP **+MTCP**
- PROFINET **+PROF**

Specifications

Power Specifications

AC Input Voltage 1Φ, 2-wire + ground	120 to 240 Vac (UI: Universal Input) Available on 1.25 to 17.5 kW Models 208-240 Vac (UI2: Universal Input 2) Available on 20 kW Models
Input Voltage Tolerance	± 10%
AC Input Frequency	50-60 Hz
AC Input Isolation	±1500 Vac, maximum AC input voltage to ground
DC Input Isolation	±1500 Vdc, maximum DC input voltage to ground

Programming Specifications

Resolution (All Modes)	16-bit, 0.0015%
Accuracy	Voltage: ±0.1% of full scale voltage rating Current: ±0.2% of full scale current rating Power: ±0.3% of full scale power rating Resistance: ±0.3% of full scale resistance rating
Rise/Fall Time Maximum	Voltage Mode: 100 ms, 10% to 90% max voltage Current Mode: 2 ms, 10% to 90% max current Power Mode: 100 ms, 10% to 90% max power Resistance Mode: 40 ms, 10% to 90% max res.
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: 26-pin D-Sub, female
Communication Interfaces (Optional)	CANopen (+CAN): RJ-45 x 2 EtherCAT (+ECAT): RJ-45 x 2 EtherNet/IP (+EIP): RJ-45 x 2 LXI TCP/IP Ethernet (+LXI): RJ-45 ModbusTCP (+MTCP): RJ-45 x 2 PROFINET (+PROF): RJ-45 x 2

Regulatory Compliance

EMC	Complies with European EMC Directive for test and measurement products, 2014/30/EU
Safety	NRTL Listed, TÜV SÜD Certificate U8 123461 0002 Tested to UL 61010-1:2012/R:2019-07 and CSA C22.2 No. 61010:2012/A1:2018-11 Complies with EN61010-1 Complies with 2014/35/EU (Low Voltage Directive)
CE Mark	Yes
RoHS Compliant	Yes

External User I/O Specifications

Digital Inputs	5 V, 10 kΩ impedance
Digital Monitoring Signals	5 V, 32 mA capacity
Digital Reference Signals	5 V output, 20 mA capacity
Analog Sampling Rate	2 kHz
Analog Programming Input	0-10 V
Analog Programming Impedance	10 kΩ
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

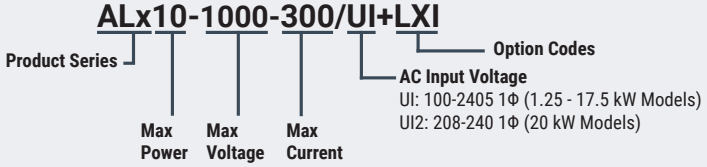
Physical Specifications

Power Level	Rack Units	Size	Weight
1.25 kW	3U	5.25" H x 19" W x 24" D (13.34 x 48.26 x 60.96 cm)	40 lbs (18.1 kg)
2.5 kW	3U	5.25" H x 19" W x 24" D (13.34 x 48.26 x 60.96 cm)	65 lbs (29.5 kg)
5 kW	12U Cabinet	30.7" H x 24" W x 31.5" D (78.0 x 61.0 x 80.0 cm)	255 lbs (115.7 kg)
7.5 kW	12U Cabinet	30.7" H x 24" W x 31.5" D (78.0 x 61.0 x 80.0 cm)	320 lbs (145.2 kg)
10 kW	12U Cabinet	30.7" H x 24" W x 31.5" D (78.0 x 61.0 x 80.0 cm)	385 lbs (174.6 kg)
12.5 kW	24U Cabinet	51" H x 24" W x 31.5" D (129.5 x 61.0 x 80.0 cm)	500 lbs (226.8 kg)
15 kW	24U Cabinet	51" H x 24" W x 31.5" D (129.5 x 61.0 x 80.0 cm)	565 lbs (256.3 kg)
17.5 kW	24U Cabinet	51" H x 24" W x 31.5" D (129.5 x 61.0 x 80.0 cm)	630 lbs (285.8 kg)
20 kW	28U Cabinet	58.25" H x 24" W x 31.5" D (148.0 x 61.0 x 80.0 cm)	695 lbs (315.3 kg)

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

ALx Series Model Ordering Guide

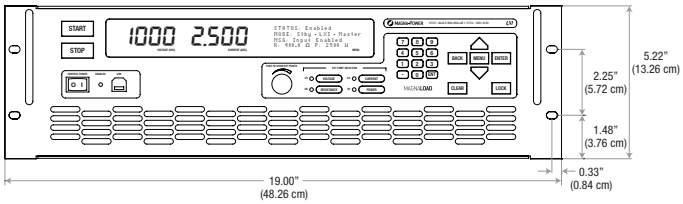


ALx Series

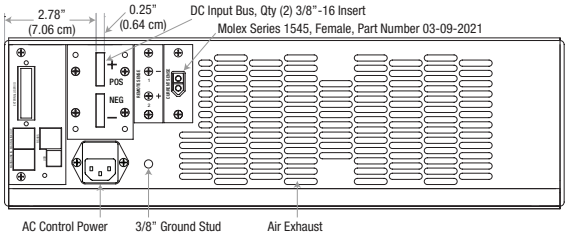
DC Electronic Load • Air cooled, linear MOSFET topology, wide operating range

Product Diagrams

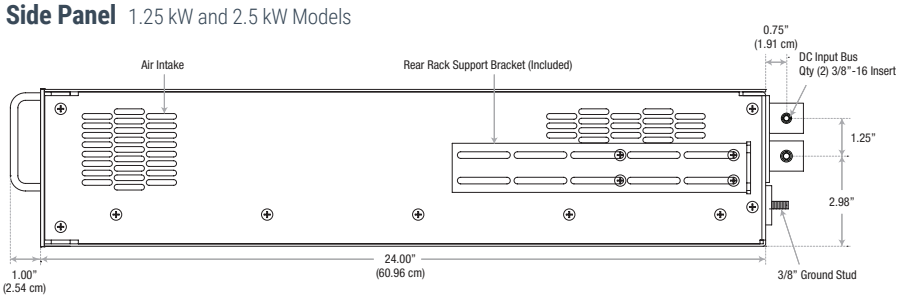
Front Panel 1.25 kW and 2.5 kW Models



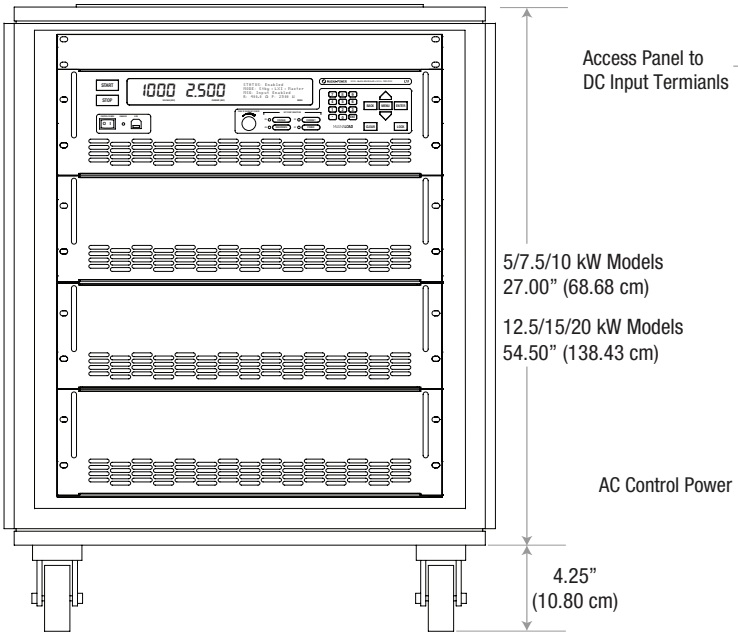
Rear Panel 1.25 kW and 2.5 kW Models



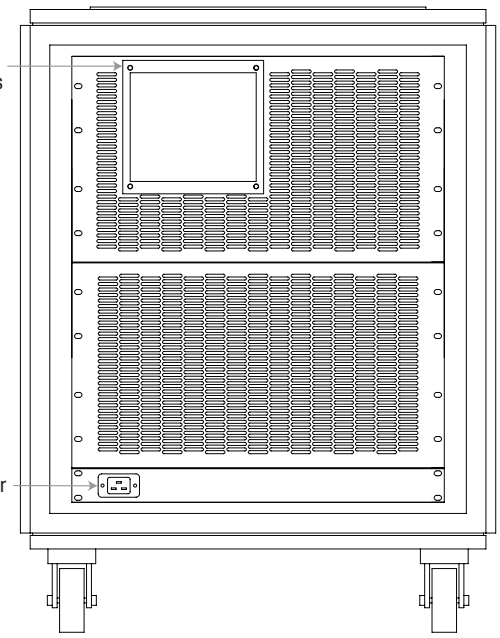
Side Panel 1.25 kW and 2.5 kW Models



Front Side 5 kW to 20 kW Models



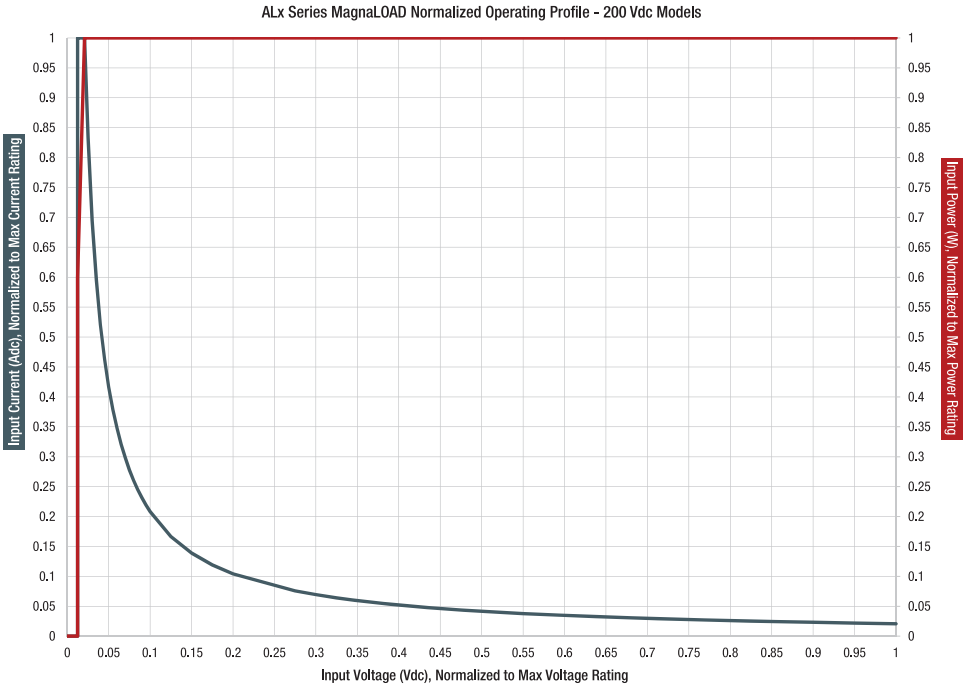
Rear Side 5 kW to 20 kW Models



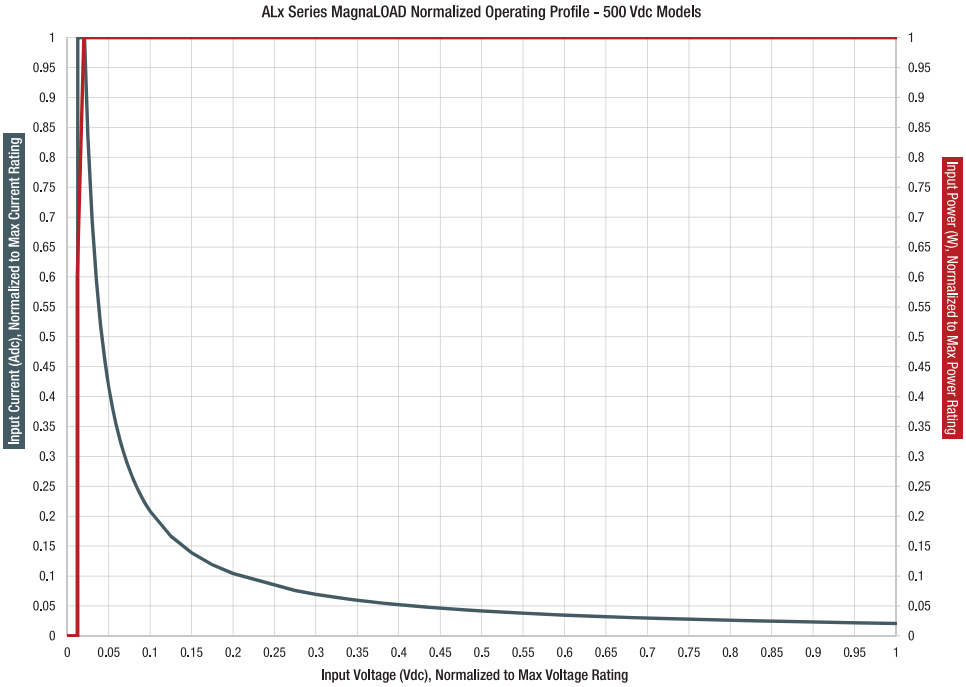
Operating Profiles

With its sole use of linear elements for heat dissipation, the ALx Series has the widest operating profile of the MagnaLOAD products. This operating profile figure applies to all ALx Series models, normalized about the model's maximum voltage, current, and power ratings.

200 Vdc ALx Series Models

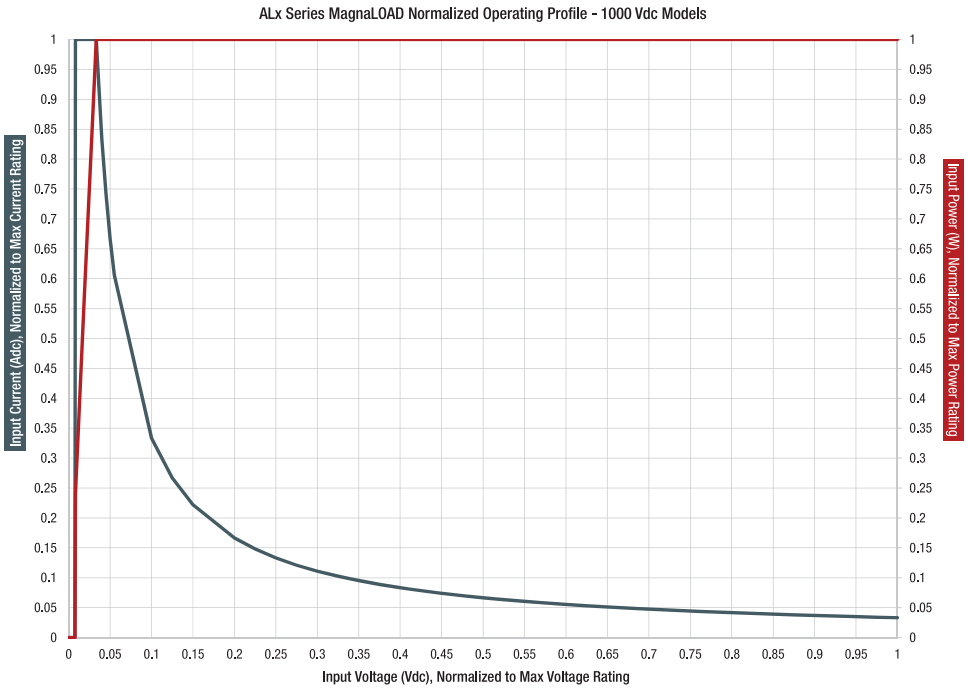


500 Vdc ALx Series Models



Operating Profiles, Continued

1000 Vdc ALx Series Models



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