a.l.e. systems

High Voltage Power

Capacitor Charging Supplies

Outputs to 50kV, Power to 30kJ/sec

Continuous DC Supplies

Outputs to 50kV, Power to 50kW

Water and Air-Cooling

Parallel operation to 1MJ/sec

Compact Switchmode Design

LAMBDA

WWW.LAMBDA-HP.COM

Contents

A History Of Innovation and Leadership

Lambda Americas ALE High Voltage Products group has been designing and manufacturing quality High Voltage DC and Capacitor Charging Power Supplies since 1982 when ALE Systems Inc., was conceived and formed to fill the need for a quality supplier of switched mode power supplies for the laser market. In 1987, when ALE was acquired by Electronic Measurements, Inc. (now Lambda Americas), the company was already the world leader in its field.

Today our ALE Series High Voltage power supplies are used throughout the world in applications including Homeland Security, Flat Panel Display Manufacturing, Semiconductor Processing, Micro Machining, Dentistry, Eye Surgery, Research Accelerators, and Radiation Therapy.

The ALE branded product range is the broadest in the industry, covering low powers with our OEM series from 500J/sec to 2kJ/sec at voltages to 40kV, medium powers with our rackmount series from 4kJ/sec to 12kJ/sec at voltages to 50kV, and high powers up to 30kJ/sec at voltages to 50kV with our water-cooled 203 and 303 models.

In addition to the standard products outlined in this brochure, our highly experienced design team can offer a unique capability to design custom supplies to meet specific OEM applications. Please contact the factory to discuss your detailed requirements. All ALE power supplies are proudly manufactured in the USA.

Features

- **Capacitor charging or continuous DC operation**
- **Broad range of output power levels**
  - **500J/sec to 30kJ/sec for capacitor charging**
  - **500W to 50kW for continuous DC**
- **Output voltages available from 0-1kV to 0-50kV**
- **Constant current output topology with full local or remote voltage programming**
- **Efficient IGBT based switchmode design with patented resonant inverter**
- **Simple parallel operation for high power up to 1MJ/sec or beyond**
- **Excellent pulse to pulse repeatability at high repetition rates**
- **Standard comprehensive remote analog control interface**
- **Fast output inhibit (<15µs) aids load switch recovery**
- **Air and water-cooled versions available**
- **Optional Active Electronic PFC (models up to 2kJ/sec)**
- **Available remote sense for operation with precision external HV dividers**
- **Compact OEM and rack mount packages**
- **Optional front panel configurations**
  - **L (lab) - Voltage/Current meters, status LEDs, power switch, and full local controls**
  - **S (slave) - status LEDs and power switch**
  - **OEM - blank chromate finished front panel**

Applications

ALE series high voltage power supplies were originally designed to rapidly and efficiently charge capacitors in laser and modulator circuits. Over our more than 20 year history, the high voltage products have continuously evolved and today are used in an extensive range of medical, industrial, military, research and semiconductor applications worldwide.

Pulsed Lasers - ALE series high voltage capacitor charging and DC supplies can be used in almost all types of pulsed laser. For excimer lasers requiring very high pulse to pulse stability, our patented parallel resonant inverter topology offers unsurpassed performance even at extreme repetition rates. Water-cooled designs prevent excessive and undesirable heat load being exported to the laser cabinet. The world's first 6kHz repetition rate industrial F_2 laser was powered by an ALE designed power supply delivering better than ±0.05% pulse to pulse output voltage variation. In addition to Excimer light sources, our products have also been employed in the following lasers;

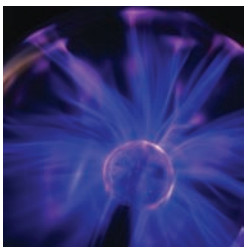
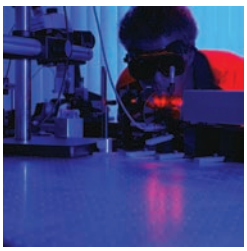
- **Excimer**
- **Nd:YAG**
- **Er:YAG**
- **Nd:Glass**
- **Yb:YAG**
- **Alexandrite**
- **F_2**
- **Ruby**
- **TEA CO_2**
- **Nitrogen**
- **Copper Vapor**
- **EUV Gas Discharge Sources**

Accelerators - often require high powers and excellent pulse to pulse stability. ALE high voltage supplies have been widely used to replace traditional resonant charging systems, where they offer the advantages of improved pulse to pulse repeatability, power factor, and efficiency, without the need for complex and costly D-Qing circuits, often in half the space of conventional supplies. In addition to powering RF devices, ALE supplies are also used for powering tube grid bias circuits, and kicker magnet pulsers. Lambda's high power low voltage, high current products are perfect for solenoid and magnet power in accelerator systems - see page 14 in this brochure for a product overview.

Microwave Tubes - Magnetrons, Klystrons, Gyrotrons, IOTs, and TWTs, all require stable DC or pulsed DC beam power for operation. With our high power capability, and simple parallel operation, ALE supplies offer excellent solutions in low to high power RF applications. Our HV products provide power for precision R&D heating systems from a few hundred watts, to military systems delivering over 100kW of CW RF power. In addition to these highlighted sectors, ALE supplies are also used to power the following devices/applications;

- **Lithotripters**
- **Xray radiation therapy**
- **LIDAR**
- **Ocean sub-bottom profiling**
- **RADAR systems**
- **Battery charging**
- **Xray Cargo Inspection Systems**
- **Laser Depainting**
- **Lightning simulation**
- **Electron-beam sterilization**
- **RF Amplifiers**
- **Energy research**



500A, 102A, 152A and 202A OEM Series

High Performance, cost effective, reliable, OEM style capacitor charging and DC power supplies available in four power levels from 500J/sec to 2kJ/sec or 500W to 2kW DC.

- **Power rating from 500J/sec to 2kJ/sec**
- **Compact air cooled OEM style package**
- **Medical safety approvals**
- **Excellent pulse to pulse repeatability**
- **Selectable 110/220VAC input voltage**
- **Reliable, cost effective design with reduced parts count**
- **Output Voltages from 0-1kV to 0-40kV**
- **Optional Active PFC (pf = 0.98)**
- **Full remote control interface**
- **Simple parallel operation for higher power**

Specification

Model	500A	102A	152A	202A
Average Capacitor Charging Power	500 J/sec	1,000 J/sec	1,500 J/sec	2,000 J/sec
Peak Capacitor Charging Power	550 J/sec	1,100 J/sec	1,650 J/sec	2,200 J/sec
Average Continuous DC Power	500 W	1,000 W	1,500 W	2,000 W
Output Voltage Range	1, 1.5, 2, 3, 4, 5, 6, 10, 15, 20, 30, 40kV, variable from 10-100% of rated			
AC Input Voltage	110/230, 1Ø	110/230, 1Ø(1)	110/230, 1Ø(1)	230, 1Ø
AC Input Current - non PFC (2)	10A/5A	20A/10A	31A/15A	N/A
AC Input Current - Active PFC (2)	7A/3.5A	6.6A	10A	13.5A
Power Factor	Non PFC - 0.65, Optional Active PFC - 0.98 at full load			
Polarity	Available as fixed Positive or Negative. Please specify at time of ordering			
HV Output Cable	1-6kV Models - RG8/U Coax with Amphenol MHV connector			
	7-40kV Models - DS2024 Silicon lead with proprietary connector			
Efficiency	Better than 85% at full load			
Stability	±0.2% per hour after 1 hour warmup			
Temperature Coefficient	100ppm per °C			
Stored Energy	Less than 0.3J all models			
Pulse to Pulse Repeatability	±0.2% to 300Hz, consult factory for higher rep rates			
Dimensions - inches (mm)	5.75 (146) W x 5.56 (141) H x 14.2 (361) D			14.8 (376) D
Weight - lbs (kg)	20 (9)			
Ambient Temperature	Storage: -40 to +85°C. Operating: -20 to +45°C			
Humidity	10-90%, non-condensing			
Protection	Open/short circuits, Overloads, Arcs, Overvoltage			
Agency Approvals	IEC601	IEC601	IEC601	N/A
Remote Control	Via 15-pin D-sub connector on front of unit			
Accessories	8ft HV cable, mating control connector, operating manual, mounting brackets			
Options	LH - Low Inhibit. Replaces standard high inhibit			
	EN - Low Enable. Replaces standard high enable			
	5V - 0-5V Analog programming. Replaces standard 0-10V programming.			
	LP - Latching Overload Protection, requires HV reset after overload fault			
	DC - Continuous DC operation			
Ordering Info	Model - XXkV - POS (or NEG) - PFC (blank for non PFC) - YY (options)			
Ordering Examples	152A-10kV-POS, 102A-40kV-POS-PFC-LH, 202A-1kV-POS-PFC-DC			

(1) 110VAC input voltage not available with PFC option for models 102A, 152A, and 202A
(2) Input current figure valid for repetition rates greater than 10Hz. For operation below 10Hz contact factory.

All specifications subject to change without notice

Mechanical Details

Front Views

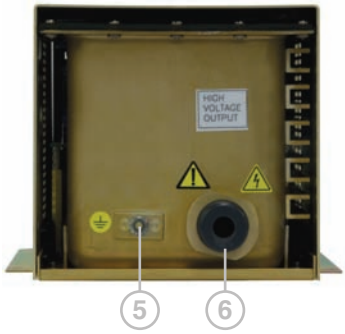
500A/102A/152A Models

202A Models

Rear Views

All Models - Outputs 1-6kV

All Models - Outputs 7-40kV



1 - Cooling Fan
2 - AC Input Connector
3 - 15pin D-Sub Female Control Connector
4 - MHV Output Connector (Outputs 1-6kV)
5 - Ground Stud (Outputs 7-40kV)
6 - HV Output Connector (Outputs 7-40kV)

Dimensional Outline Drawings

500A/102A/152A Models

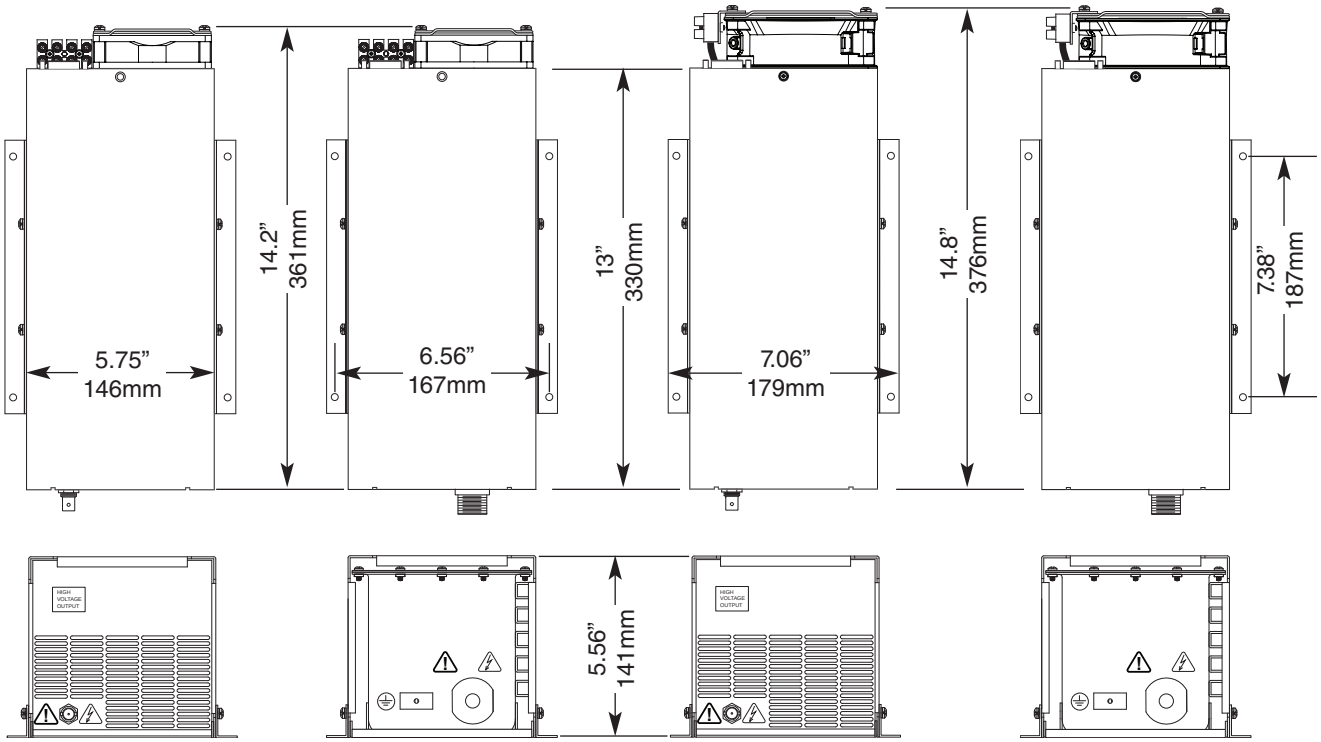
Outputs from 1-6kV

Outputs from 7-40kV

202A Models

Outputs from 1-6kV

Outputs from 7-40kV



402/802 Series

Industry standard rack mount capacitor charging and DC power supplies available in 4kJ/sec and 8kJ/sec for capacitor charging, or 4kW and 8kW in continuous DC applications.

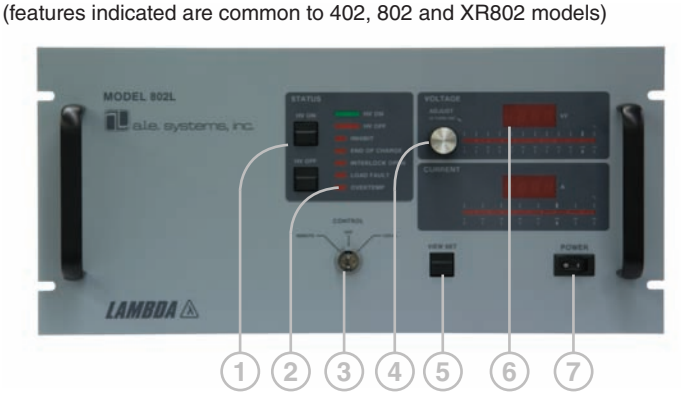
- **Power ratings of 4kJ/sec and 8kJ/sec**
- **Compact air cooled rack mount package**
- **Efficient IGBT based resonant inverter**
- **Excellent pulse to pulse repeatability**
- **208 or 400VAC 3Ø input voltage**
- **Full remote control interface**
- **Ultra reliable and rugged industry standard design**
- **Output Voltages from 0-1kV to 0-50kV**
- **Passive PFC (pf = 0.85)**
- **Full local output voltage and HV On/Off controls (L version)**
- **Simple parallel operation for higher power**
- **Lab, Slave, or OEM front panel options**
- **UL Approved AC line contactor (optional for OEM models)**

Specification

Model	402	802
Average Capacitor Charging Power	4,000 J/sec	8,000 J/sec
Peak Capacitor Charging Power	5,000 J/sec	9,000 J/sec
Average Continuous DC Power	4,000 W	8,000 W
Output Voltage Range	1, 2, 4, 5, 10, 15, 20, 30, 40, 50kV, variable from 10-100% of rated	
AC Input Voltage	208/400VAC, 3Ø	208/400VAC, 3Ø
AC Input Current	20A/15A	40A/25A
Power Factor	Passive PFC pf = 0.85 at full load	
Polarity	Available as fixed Positive or Negative. Please specify at time of ordering	
HV Output Cable	1-39kV Models - DS2124 Coaxial cable with proprietary HV connector	
	40-50kV Models - DS2214 Coaxial cable with proprietary HV connector	
Front Panel	402/802L - Voltage Control, Voltage & Current Meters, Status Indicators	
	402/802S - On/Off Switch, Status Indicators	
	402/802-OEM - Blank front panel	
Efficiency	Better than 85% at full load	
Stability	±0.2% per hour after 1 hour warmup	
Temperature Coefficient	100 ppm per °C typical	
Stored Energy	Less than 0.3J all models	
Pulse to Pulse Repeatability	±2% to 1000Hz, consult factory for higher rep rates	
Dimensions - inches (mm)	19 (483) W x 7 (178) H x 17 (432) D	19(483) W x 8.75(222) H x 17(432) D
Weight - lbs (kg)	60 (28)	85 (39)
Temperature	Storage: -40 to +85°C. Operating: -20 to +45°C	
Altitude	Storage: 40,000ft (12,000m), Operating: 9,900ft (3,000m)	
Humidity	10-90%, non-condensing	
Protection	Open/short circuits, Overloads, Arcs, Overtemp, Overvoltage	
Remote Control	Via 25-pin D-sub connector on rear of unit	
Accessories	10ft HV cable, operating manual	
Options	EN - Low Enable. Replaces standard high enable	
	5V - 0-5V Analog programming. Replaces standard 0-10V programming.	
	LP - Latching Overload Protection, requires HV reset after overload fault	
	DC - Continuous DC operation	
	CT - AC line contactor (for OEM models only)	
Ordering Info	Model - XXkV - POS (or NEG) - YYYVAC - ZZ (options)	
Ordering Examples	402L-10kV-POS, 802S-1kV-NEG-DC, 802-OEM-50kV-POS-400VAC	
All specifications subject to change without notice		

Mechanical Details

802L Front View
(features indicated are common to 402, 802 and XR802 models)



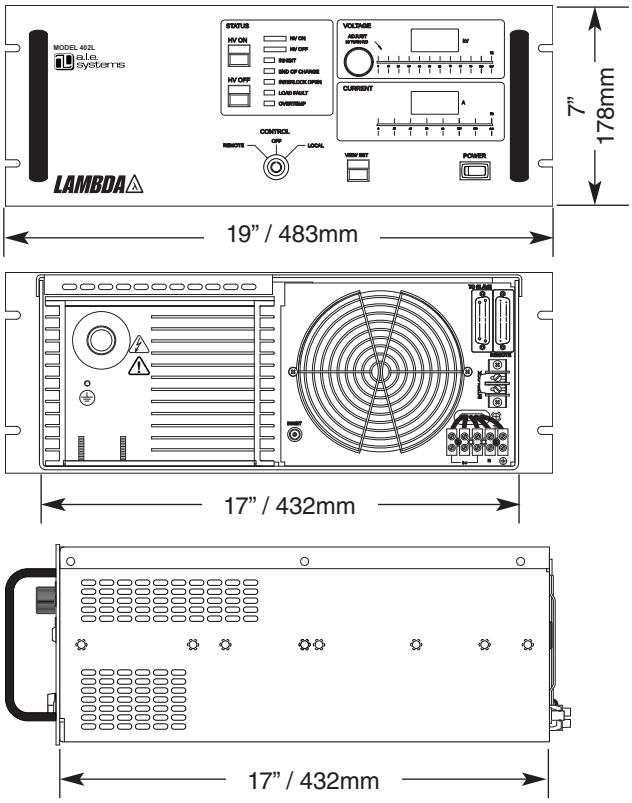
1 - HV On/Off Push Buttons (L model only)
2 - Status Indicator LEDs (L and S models only)
3 - Local/Remote Keyswitch (L model only)
4 - 10-Turn HV Output Control (L models only)
5 - View Set Push Button (L models only)
6 - Output Voltage and Current Displays (L models only)
7 - Power Switch (L and S models only)

802L Rear View
(features indicated are common to 402, 802 and XR802 models)

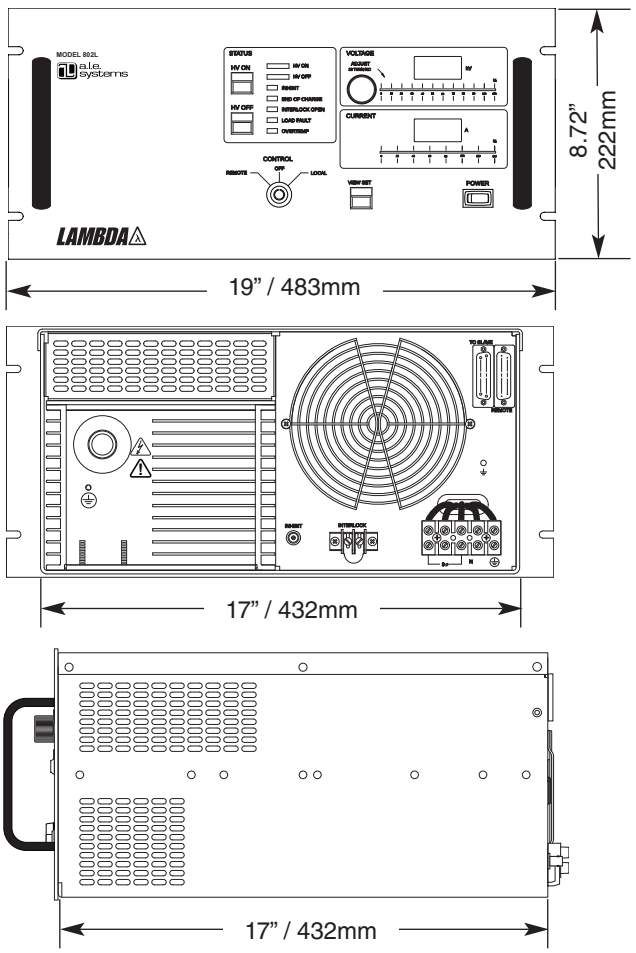
8 - Ground Stud
9 - HV Output Connector
10 - Inhibit BNC (L models only)
11 - Interlock Terminals (L and S models only)
12 - Cooling Fan
13 - AC Input Terminal Block
14 - Slave Supply Programming Connector (L models only)
15 - Remote Programming Connector

Dimensional Outline Drawings

402



802



XR802/LC1202 Series

High performance, high rep rate, air and water-cooled capacitor charging and DC power supplies available in 6kJ/sec and 12kJ/sec for capacitor charging, or 6kW and 15kW(1) in continuous DC applications.

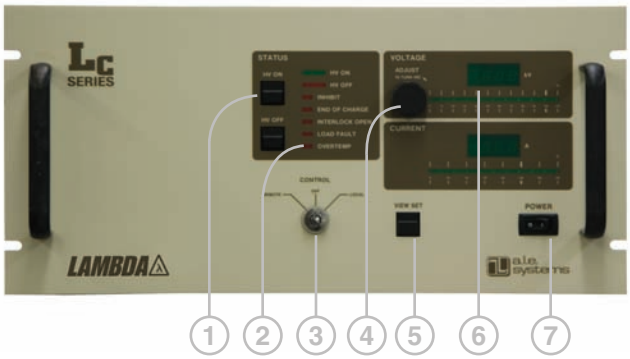
- **Power ratings of 6kJ/sec and 12kJ/sec**
- **Compact air/water cooled packages**
- **Optional Remote Voltage Sense input**
- **208 or 400VAC 3Ø input voltage**
- **Full remote control interface**
- **UL Approved AC line contactor (optional for OEM models)**
- **Better than 0.1% pulse-pulse repeatability at rep rates to 2kHz**
- **Output Voltages from 0-1kV to 0-30kV**
- **Passive PFC (pf = 0.85-0.9)**
- **Full local output voltage and HV On/Off controls (L version)**
- **Lab, Slave, or OEM front panel options**

Specification

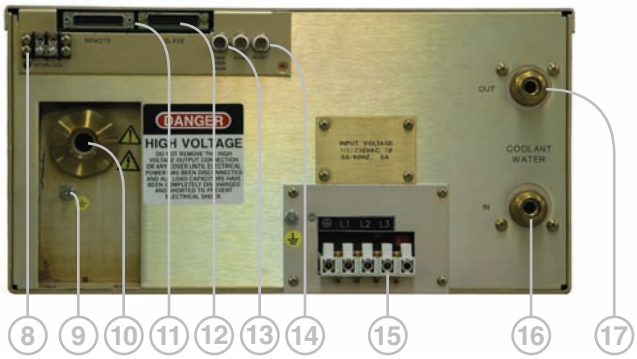
Model	XR802	LC1202
Average Capacitor Charging Power	6,000 J/sec	12,000 J/sec
Peak Capacitor Charging Power	7,000 J/sec	13,500 J/sec
Average Continuous DC Power	6,000 W	15,000 W (1)
Output Voltage Range	1, 2, 4, 5, 10, 15, 20, 30kV, variable from 10-100% of rated	
AC Input Voltage	208/400VAC, 3Ø	208/400VAC, 3Ø field configurable
AC Input Current	45A/25A	50A/26A
Power Factor	Passive PFC pf = 0.85 at full load	Passive PFC pf = 0.9 at full load
Polarity	Available as fixed Positive or Negative. Please specify at time of ordering	
HV Output Cable	DS2214 Coaxial cable with proprietary HV connector	
Front Panel	L Models - Output Voltage Control, Voltage & Current Meters, Status Indicators	
	S Models - On/Off Switch, Status Indicators	
	OEM Models - Blank front panel	
Efficiency	Better than 85% at full load	Better than 90% at full load
Stability	±0.2% per hour after 1 hour warmup	
Stored Energy	Less than 0.3J all models	
Pulse to Pulse Repeatability	±0.1% to 1000Hz, consult factory for higher rep rates	
Dimensions - inches (mm)	19 (483) W x 8.72 (222) H x 17 (432) D	
Weight - lbs (kg)	85 (39)	90 (41)
Cooling	Air cooled	Water cooled, 2US GPM flow with coolant temp max inlet of 35°C
Temperature	Storage: -40 to +85°C.	Storage: -40 to +85°C.
	Operating: 0 to +45°C	Operating: +5 to +45°C
Altitude	Storage: 40,000ft (12,000m), Operating: 9,900ft (3,000m)	
Humidity	10-90%, non-condensing	
Protection	Open/short circuits, Overloads, Arcs, Overtemp, Overvoltage	
Remote Control	Via 25-pin D-sub connector on rear of unit	
Accessories	10ft HV cable, operating manual	
Options	EN - Low Enable. Replaces standard high enable	
	5V - 0-5V Analog programming. Replaces standard 0-10V programming.	
	LP - Latching Overload Protection, requires HV reset after overload fault	
	DC - Continuous DC operation	
	CT - AC line contactor (for OEM models only)	
	RS - Connector for external 1000:1 precision HV divider	
Ordering Info	Model - XXkV - POS (or NEG) - YYYVAC - ZZ (options)	
Ordering Examples	XR802L-10kV-POS, LC1202S-1kV-NEG-DC, LC1202L-20kV-POS-RS	
(1) Continuous DC output power de-rated to 12,000W average with 208VAC 3Ø line voltage		
All specifications subject to change without notice		

Mechanical Details

LC1202L Front View
(For XR802 model see the 802 views on page 6)



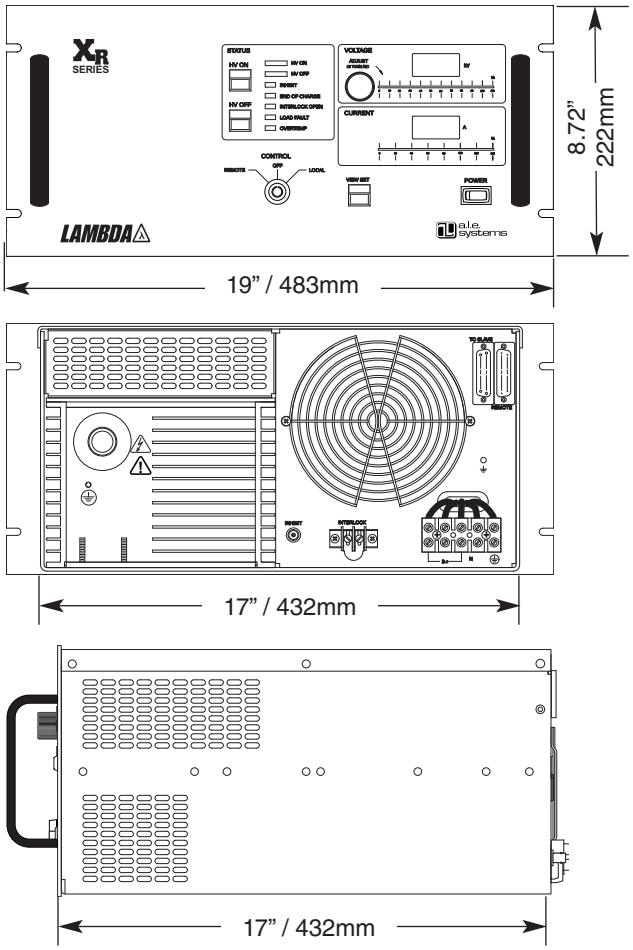
LC1202L Rear View
(For XR802 model see the 802 views on page 6)



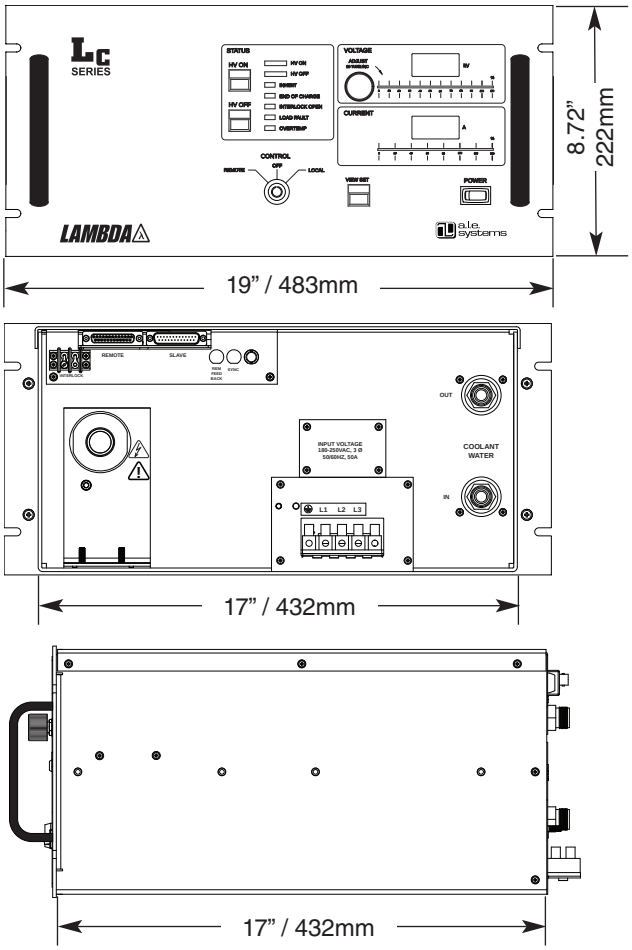
1 - HV On/Off Push Buttons (L model only)
2 - Status Indicator LEDs (L and S models only)
3 - Local/Remote Keyswitch (L model only)
4 - 10-Turn HV Output Control (L models only)
5 - View Set Push Button (L models only)
6 - Output Voltage and Current Displays (L models only)
7 - Power Switch (L and S models only)
8 - Interlock Terminals (L and S models only)
9 - Ground Stud
10 - HV Output Connector
11 - Remote Programming Connector
12 - Slave Supply Programming Connector (L models only)
13 - Remote Sense Input (optional)
14 - Inhibit BNC (L models only)
15 - AC Input Terminal Block
16 - Cooling water inlet
17 - Cooling water outlet

Dimensional Outline Drawings

XR802



LC1202



203/303 Series

High Power Ultra-Compact water-cooled capacitor charging and DC power supplies available in 20kJ/sec and 30kJ/sec for capacitor charging, or 30kW and 50kW(1) in continuous DC applications.

- **Power ratings of 20kJ/sec(1) and 30kJ/sec(2)**
- **Unique evaporative cooling/insulation**
- **Efficient IGBT based resonant inverter**
- **Excellent pulse to pulse repeatability**
- **208 or 400 or 480VAC 3Ø input voltage**
- **Full remote control interface**
- **Ultra compact water cooled rack mount design**
- **Output Voltages from 0-1kV to 0-50kV**
- **Passive PFC (pf = 0.9)**
- **Full local output voltage and HV On/Off controls (L version)**
- **Simple parallel operation for higher power**
- **Lab or Slave front panel options**

Specification

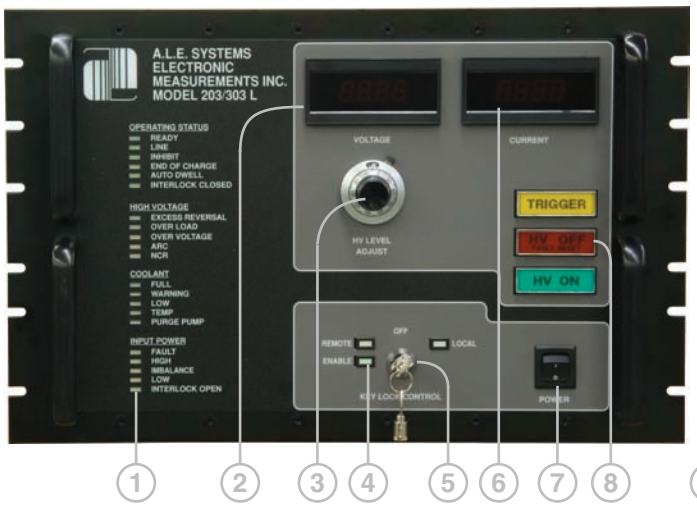
Model	203	303
Average Capacitor Charging Power	20,000 J/sec (1)	30,000 J/sec (2)
Peak Capacitor Charging Power	25,000 J/sec (1)	37,500 J/sec (2)
Average Continuous DC Power	30,000 W (1)	50,000 W (2)
Output Voltage Range	1, 2, 4, 5, 10, 15, 20, 30, 40, 50kV, variable from 10-100% of rated	
AC Input Voltage	208/400/480VAC, 3Ø (1)	400/480VAC, 3Ø (2)
AC Input Current	75A/45A/35A (3)	68A/53A (3)
Power Factor	Passive PFC pf = 0.9 at full load	
Polarity	Available as fixed Positive or Negative. Please specify at time of ordering	
HV Output Cable	1-29kV Models DS2214 Coaxial cable with proprietary HV connector	
	30-50kV Models DS2212 Coaxial cable with proprietary HV connector	
Front Panel	203/303L - Output Voltage Control, Voltage & Current Meters, Status Indicators	
	203/303S - On/Off Switch Status Indicators	
Efficiency	Better than 85% at full load	
Stability	±0.2% per hour after 1 hour warmup	
Temperature Coefficient	100 ppm per °C typical	
Stored Energy	Less than 0.3J all models	
Pulse to Pulse Repeatability	±2% to 100Hz, consult factory for higher rep rates	
Cooling Water	2US GPM (7.6 L/min) with max inlet temp 35°C and min inlet of 15°C. All water paths are copper or brass. Connections are ¼NPT male pipe.	
Dimensions - inches (mm)	19 (483) W x 12.25 (311) H x 22.5 (571) D	
Weight - lbs (kg)	185 (84)	
Temperature	Storage: -40 to +70°C. Operating: 0 to +55°C	
Altitude	Storage: 40,000ft (12,000m), Operating: 9,900ft (3,000m)	
Humidity	10-90%, non-condensing	
Protection	Open/short circuits, Overloads, Arcs, Overtemp, Overvoltage	
Remote Control	Via 25-pin D-sub connector on rear of unit	
Accessories	10ft HV cable, operating manual	
Options	EN - Low Enable. Replaces standard high enable	
	5V - 0-5V Analog programming. Replaces standard 0-10V programming.	
	LP - Latching Overload Protection, supply requires HV reset after overload fault	
	DC - Continuous DC operation	
Ordering Info	Model - XXkV - POS (or NEG) - YYYVAC - ZZ (options)	
Ordering Examples	303L-10kV-POS, 203S-1kV-NEG-DC, 303S-50kV-POS-400VAC	

(1) Power de-rated to 18,000J/sec average, 22,000J/sec peak or 18,000W DC with 208VAC input
(2) Power de-rated to 25,000J/sec average, 32,500J/sec peak or 40,000W DC with 400VAC input
(3) AC line current for capacitor charging operation. For DC operation use formula on page 13.

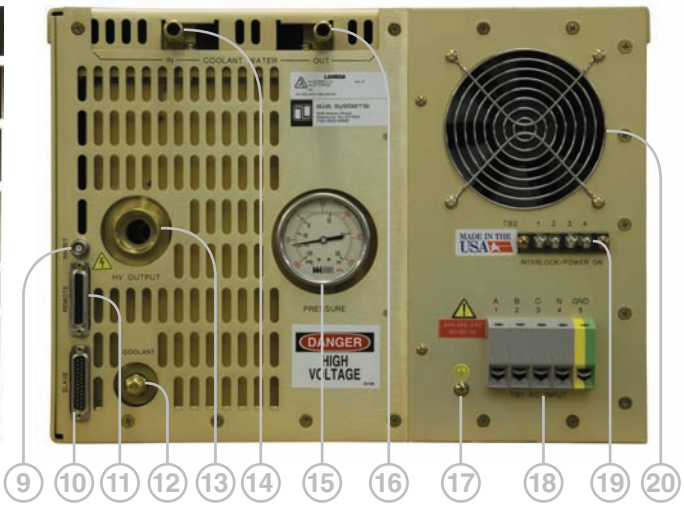
All specifications subject to change without notice

Mechanical Details

203/303L Front View

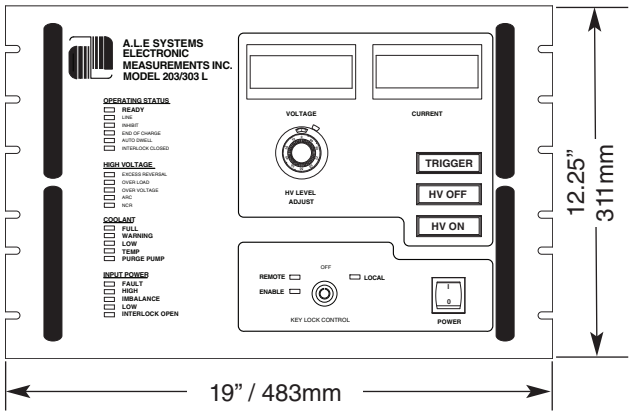


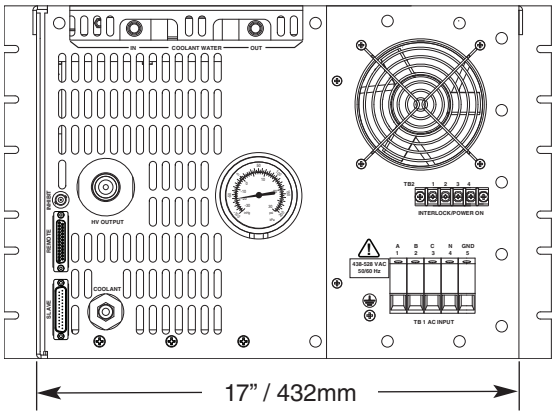
202/303L Rear View

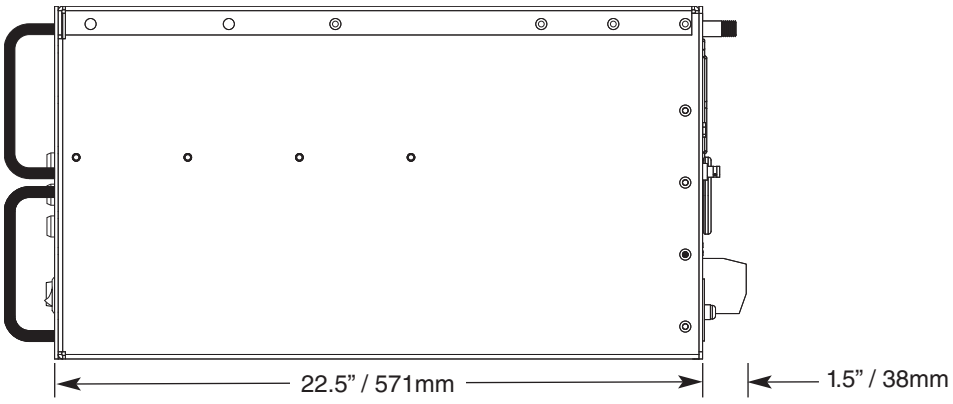


1 - Status Indicator LEDs
2 - Voltage Display (L models only)
3 - 10-Turn HV Output Control (L models only)
4 - Local Remote Status LEDs (L model only)
5 - Local/Remote Keyswitch (L model only)
6 - Current Display (L models only)
7 - Power Switch
8 - HV ON/OFF Push Buttons
9 - Inhibit BNC (L models only)
10 - Slave Supply Programming Connector (L models only)
11 - Remote Programming Connector
12 - FC72 Refill connection
13 - HV Output Connector
14 - Cooling Water Inlet
15 - HV Tank Pressure Gauge
16 - Cooling Water Outlet
17 - Ground Stud
18 - AC Input Connector
19 - Interlock/Remote Power On Terminals
20 - Cooling Fan

Dimensional Outline Drawings







Custom Solutions

If your application requirements cannot be met by a standard product offering, then the best approach could be to develop a modified standard version of an existing product, or a complete custom design. The engineering staff in the ALE high voltage design team have unrivaled experience developing leading edge power solutions for a broad range of applications.

Modified standard products can encompass simple modifications of a standard design such as front panel paint, AC input connector, high voltage cable, output voltage or power level.

Some examples of modified standard products are;

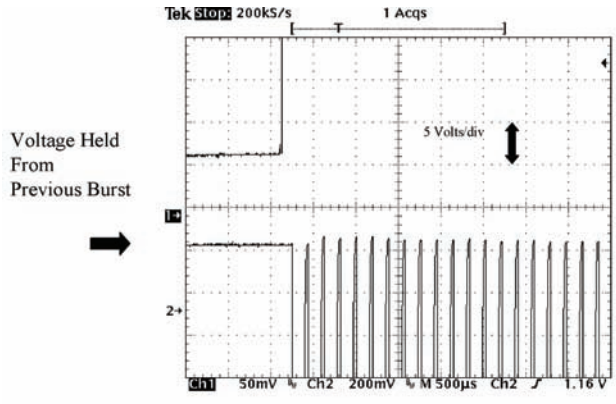
- 303L-15kV-NEG-DC with floating HV return for RF tube body current measurement
- 303L-15kV-POS-DC with dual output connectors for daisy chain HV parallel hookup
- 152A-15kV with output adapter for coaxial HV cable
- 402-OEM-40kV with nomex front panel
- LC1202L with Harting style AC input connector

Custom products can be highly modified standard designs or a completely new design for novel or demanding applications. Our custom product developments have been installed in the most challenging electrical and environmental applications to enable our customers to deliver reliable and high performance world class systems.

Some examples of custom products are;

- 303S for Naval environment designed for tilt/roll operation
- 20kW 2.5kV water-cooled supply running at 8kHz rep rate with ±0.05% p-p repeatability
- 50kV 1MW average power system
- 10kW dual channel (2 x 5kV @1A) magnetron supply
- Parallel system controller for multi-unit 303-DC systems (80kW, 24kV, 0.01% ripple)
- 25kJ/sec capacitor charging supply with Active 3 phase PFC (PF~0.99) and universal 180-528VAC input voltage.

Example of a Custom design of water-cooled resonant power supply, capable of delivering 20kW average power, at voltages to 2500V, and repetition rates to 8kHz.



Output voltage waveform at 5kHz PRF, 5V/div, showing p-p repeatability less than 2V or ±0.04%.

High Power Parallel Operation

All ALE series capacitor charging and DC power supplies can simply be connected in parallel for higher power operation. For parallel operation all supplies in a system must have the same output voltage rating, but do not necessarily need to have the same power rating. There is no limit to the number of supplies that can be connected in a parallel system, and system pulse to pulse repeatability performance will often be better compared with a single large supply with the same overall power capability.

In deep discharge capacitor charging applications (load capacitance is fully discharged between each pulse), the power supply HV output cables are simply connected together at the load, and the control signals shared between all the supplies. For systems requiring local control, at least one L model supply can be operated with any number of S or OEM models. Control is achieved by connecting the slave interface featured on the L model supply to the remote interface(s) on any S or OEM supplies. The front panel of the L model supply will then give the user local control of the entire system. For systems requiring only remote control, any number of S or OEM supplies can be 'daisy chained' together via their remote control interfaces. When operating parallel systems with supplies from different model series, the user should be sure to check the interface connections for correct pin assignments.

In reservoir charge or pulsed DC applications (load capacitance is only discharged by a small percentage between each pulse) the power supply HV output cables can be simply connected together at the load, however some care is required with the control technique to ensure equal power sharing among system supplies. The most effective control method in this type of application is to use the first system supply reaching the programmed charge voltage (end of charge or EOC) to shut off the other system supplies. This is simply achieved by using the logical OR of the EOC signal from all supplies in the system (standard control feature on all ALE models), and connecting it to the inhibit input (standard feature) of all supplies in a system. The factory can supply a simple programming interface adapter that performs this function if required.

For continuous DC load applications such as providing beam power for Gyrotrons, Klystrons, Magnetrons, or similar microwave devices, a parallel system combined with an ALE designed system controller can offer the user full control of the system output current and voltage in addition to significantly improved load ripple and regulation.

ALE supplies have been operated in parallel systems at power levels from a few kilowatts (two model 202A supplies), to over one megawatt (thirty model 303 supplies). A small sample of parallel systems operating today are highlighted below:

- 6 x 303S and controller generating 300kW of Gyrotron beam power
- 2 x 202A - pulsed magnetron for RF threat simulation
- 6 x 303L - line type modulator for medical sterilization
- 4 x 303S - hard tube modulator in a research linear accelerator
- 2 x 303L - line type modulator in a research linear accelerator
- 2 x 303S with controller - power a Klystron for precision operation of a deep space radar
- 2 x LC1202 - high power industrial excimer laser
- 3 x LC1202 - high power pulsed CO_2 laser
- 3 x 303S - N+1 redundant Naval Radar System
- 2 x 303L - high power industrial Nd:Yag laser

Useful Equations

1. Calculating Capacitor Charge Time

$$T_C = \frac{0.5 \times C_{load} \times V_{rated} \times V_{charge}}{P_{peak}}$$

T_c - *time to charge load*
C_{load} - *load capacitance in Farads*
V_{rated} - *power supply rated output voltage in volts*
V_{charge} - *capacitor charge voltage in volts*
P_{peak} - *power supply peak charge rate in Joules per second*

2. Average Power Rating Required

$$P_{av} = 0.5 \times C_{load} \times V_{rated} \times V_{charge} \times R$$

P_{av} - average power in watts
C_{load} - *load capacitance in Farads*
V_{rated} - *power supply rated output voltage in volts*
V_{charge} - *capacitor charge voltage in volts*
R - *discharge repetition rate in Hz*

3. AC line current draw

$$I_{1\varnothing} = \frac{Pav}{V_L \times PF \times Eff} \qquad I_{3\varnothing} = \frac{Pav}{\sqrt{3} \times V_L \times PF \times Eff}$$

$I_{1\varnothing}$ - *single phase RMS line current*
$I_{3\varnothing}$ - *three phase RMS line current per phase*
P_{av} - *average output power in watts*
V_L - *AC line voltage in volts*
PF - *Power Factor (see product data)*
Eff - *Efficiency (see product data)*

4. Pulse to Pulse Repeatability

$$\delta V = \frac{1}{2 \times F_{switch} \times T_c}$$

δV - *pulse to pulse repeatability (percentage)*
T_c - *time to charge load*
F_{switch} - *switching frequency of supply*
~ 40kHz for 500A, 102A, 152A, 202A, XR802, and LC1202
~ 30kHz for 402, 802, 203, and 303

5. Continuous DC Operation

$$Ripple = \frac{I_{load}}{2 \times F_{switch} \times C_f}$$

Ripple - *output voltage peak to peak ripple*
I_{load} - *current drawn by the load circuit*
C_f - *external filter capacitance across supply output*
F_{switch} - *switching frequency of supply*
~ 40kHz for 500A, 102A, 152A, 202A, XR802, and LC1202
~ 30kHz for 402, 802, 203, and 303

6. Voltage Reversal Protection

Voltage reversal following load capacitor discharge can potentially damage the power supply. Any reverse current must be limited by a series resistor, or by a clamp diode and resistors to prevent the possibility of damage to the output diodes inside the supply. The degree of protection required is a function of reverse voltage, duration of reversal, and repetition rate of reversal. If the reverse current is greater than the rated current of the supply then a protection diode should be used. Refer to our online Application Note 517 for details, and guidance in determining the protection component ratings.

The equations presented are just a small selection taken from our detailed collection of high voltage Application Notes. The latest versions of these Application Notes can be downloaded from our web site at www.lambda-hp.com/product_html/high_volt.htm. The available titles are listed below;

APP Note 500: Calculating Capacitor Charge Time
APP Note 502: Calculating AC Line Currents
APP Note 505: Charging units as Continuous Output DC Supplies
APP Note 507: Charging Large Load Capacitors
APP Note 509: What is Regulation and Repeatability?
APP Note 513: Power Factor Correction
APP Note 517: Protection Against Voltage Reversal

Low Voltage Programmable AC-DC Supplies

In addition to the ALE branded high voltage supplies detailed in this brochure, Lambda manufactures the widest range of low voltage (<600V), high power programmable AC to DC power products. A summary of our low voltage supplies is shown below, however to obtain detailed information about these products, please call or visit our web site at www.lambda-hp.com.

Product Matrix

Model	GENH	GEN 1U	GEN 1U	GEN 2U	GEN 2U	GEN 3U	GEN 3U	ESS	ESS	EMHP	EMHP	EMHP
Rated Power	**750W**	**750W**	**1500W**	**3300W**	**5000W**	**10kW**	**15kW**	**10kW**	**15kW**	**20kW**	**30kW**	**60kW**
Voltage	**Output Current**											
0~6V	0~100A	0~100A	0~200A									
0~7.5V						0~1000A		0~1000A	0~1500A			
0~8V	0~90A	0~90A	0~180A	0~400A	0~600A							
0~10V				0~330A	0~500A	0~1000A		0~1000A		0~1000A	0~1500A	0~3000A
0~12.5V	0~60A	0~60A	0~120A			0~800A		0~800A				
0~15V				0~220A								
0~16V					0~310A							
0~20V	0~38A	0~38A	0~76A	0~165A	0~250A	0~500A		0~500A	0~750A	0~750A	0~1000A	0~1500A
0~25V						0~400A		0~400A				
0~30V	0~25A	0~25A	0~50A	0~110A	0~170A	0~333A		0~333A	0~500A	0~600A	0~800A	0~1250A
0~40V	0~19A	0~19A	0~38A	0~85A	0~125A	0~250A		0~250A	0~375A	0~450A	0~600A	0~1000A
0~50V			0~30A			0~200A		0~200A	0~300A			
0~60V	0~12.5A	0~12.5A	0~25A	0~55A	0~85A	0~167A	0~250A	0~165A	0~250A	0~300A	0~500A	0~750A
0~80V	0~9.5A	0~9.5A	0~19A	0~42A	0~65A	0~125A	0~187.5A	0~125A	0~185A	0~250A	0~375A	0~600A
0~100V	0~7.5A	0~7.5A	0~15A	0~33A	0~50A	0~100A	0~150A	0~100A	0~150A			
0~125V						0~80A	0~120A	0~80A	0~120A			
0~150V	0~5A	0~5A	0~10A	0~22A	0~34A	0~66A	0~100A	0~66A	0~100A	0~130A	0~200A	0~350A
0~200V						0~50A	0~75A	0~50A	0~75A			
0~250V						0~40A	0~60A	0~40A	0~60A			
0~300V	0~2.5A	0~2.5A	0~5A	0~11A	0~17A	0~33A	0~50A	0~33A	0~50A	0~60A	0~100A	0~200A
0~400V						0~25A	0~37.5A	0~25A	0~37A			
0~500V						0~20A	0~30A	0~20A	0~30A			
0~600V	0~1.3A	0~1.3A	0~2.6A	0~5.5A	0~8.5A	0~17A	0~25A	0~16A	0~25A	0~30A	0~50A	0~100A
Weight (kg/lb)	4.5 / 9.9	7 / 15	8.5 / 18	13 / 29	16 / 33	43 / 97	43 / 97	50 / 105	50 / 105	340/750	410/900	682/1500

AC Inputs

85-265VAC, 1Ø	● (1)	● (1)	● (1)									
230VAC, 1Ø				● (1)								
208VAC, 3Ø				● (1)	● (2)	● (2)	● (2)	● (3)	● (3)	●	●	
400VAC, 3Ø				● (1)	● (2)	● (2)	● (2)	● (2)	● (2)			
480VAC, 3Ø						● (3)	● (3)	●	●	●	●	●

(1) UL Listed; CE Mark, (2) UL Recognized; CE Mark, (3) UL Recognized

Options

	●	●	●	●	●	●	●					
IEMD IS420 IS510 LAN MD	GPIB Master (IEEE 488.2 SCPI) Isolated Analog Programming 4-20mA Isolated Analog Programming 0-5V or 0-10V User Selectable LXI Compliant LAN Interface GPIB or LAN Slave enabled											
								●	●	●	●	●
RSTL	Combined IEEE 488.1 and RS232 Interface											

(All options are factory installed and limited to one per power supply)

All specifications subject to change without notice.

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