

203/303 SERIES HIGH VOLTAGE SWITCH MODE POWER SUPPLIES

POWER FOR
SCIENCE AND
INDUSTRY



LAMBDA
EMI



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systems

203/303 SERIES



A 75MW Klystron Modulator incorporating traditional resonant charging. The 203/303 Series technology drastically reduces size and complicity. Photo courtesy of Stanford Linear Accelerator Center.

A HISTORY OF INNOVATION AND LEADERSHIP

The High Voltage Products Division of EMI has been making quality High Voltage DC Power Supplies and Capacitor Charging Units since 1982. ALE Systems Inc., was conceived and formed to fill the need for a quality supplier of switched mode HVDC supplies for the laser market. In 1987, when ALE was acquired by Electronic Measurements, Inc. the company was already the world leader in its field.

APPLICATIONS

Electronic Measurements puts great emphasis on full application support, both before you decide to buy and after you receive the product. You will find the most critical information on this data sheet. Should you need more information, you can request any of our High Voltage APP NOTES. Of course for assistance in solving a problem at any time, you can call, fax, or E-mail our team of Applications Engineers for prompt and accurate service. Our supplies are used in such applications as:

- | | |
|-----------------------------------|-------------------------|
| ▶ Lasers | ▶ X-Ray |
| ▶ Sputtering | ▶ High Power Modulators |
| ▶ Electron Beam | ▶ Ion Implantation |
| ▶ CW and Pulsed Magnetron Heating | ▶ RF Transmitters |

DESCRIPTION

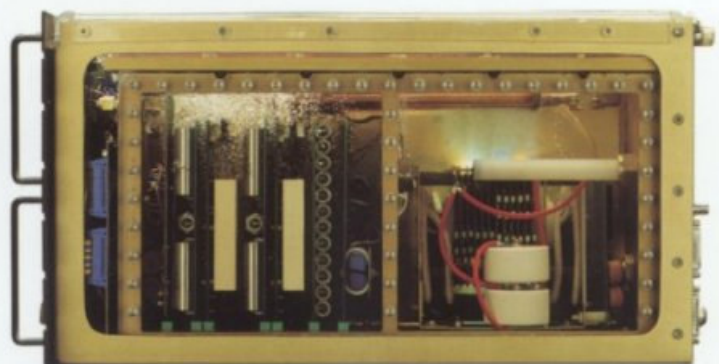
The 203 and 303 Series of water cooled, High Voltage Power Supplies are designed to be configured in two modes of operation. In their most common format they are constant current Capacitor Charging Supplies which will directly charge HV capacitors and Pulse Forming Networks (PFNs). The second configuration allows operation as constant voltage, continuous output HVDC Power Supplies.

Features Include:

- ▶ 303 generates 30 kJ/s average or 50 kW DC continuous; 203 is rated 20 kJ/s or 30 kW.
- ▶ Thirteen standard models in each series with outputs from 1 kV to 50 kV.
- ▶ Package Height is only 12.25 inches (7U)
- ▶ Proven IGBT Switch Mode Design
- ▶ Full command charging: No need for complicated and expensive Resonant Charging circuits
- ▶ Tight pulse to pulse regulation: No need for "D-Qing"
- ▶ High EMI-RFI Immunity for operation near Pulse discharge
- ▶ 100 kV rated output cable and connector (30 to 50 kV models) for long shot life
- ▶ Simple parallel operation for increased power to 300 kJ/s average pulsed or 500 kW average continuous
- ▶ Proven, assured long time reliability—even in the event of failure in the PFN

ADVANCED THERMAL MANAGEMENT SYSTEM

- ▶ Advanced "Heat Pipe Cooling" System.
- ▶ Coolant/Insulant Fluid is safe, environmentally friendly Fluorinert FC-72.
- ▶ Multi-level leak protected Tank Assembly.
- ▶ Water cooled from normal tap water or glycol mix.



"Heat Pipe Cooling"

As the inverter heats, the fluorinert insulant boils at about 58°C. Heat transfer is affected by resultant condensation at the water cooled heat exchanger.

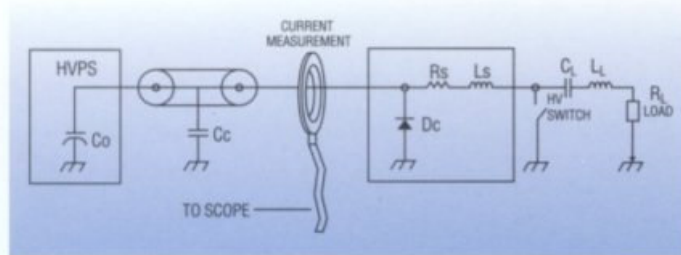


203/303 SERIES

CHARGING CAPACITORS WITH 203/303 SERIES HV POWER SUPPLIES

The figure below represents a typical capacitor charge and discharge schematic. C_o is the output capacitance of the supply; C_c is the HV cable capacitance and C_L is the load capacitor. R_L is the load. Design care must be taken in any circuit which is under-damped since resultant voltage reversal can damage the power supply. In this event a series terminating resistor (R_s) or inductor (L_s) or even a clamp diode (D_c) must be added to provide ultimate protection (Ask for APP NOTE 517 for more details).

Capacitor Charge and Discharge Schematic



Output Voltage Waveform

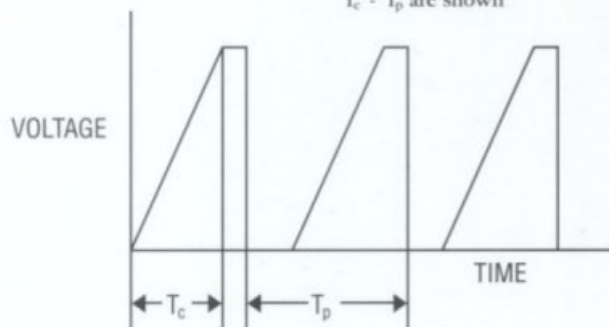
$$\text{Peak Charge Rate} = \frac{1}{2}(CV^2)/T_c$$

$$\text{Average Charge Rate} = \frac{1}{2}(CV^2)/T_p$$

C - Output Load Capacitor

V - Programmed Output Voltage

T_c - T_p are shown



(Ask for APP NOTE 500 for more details)

CONTINUOUS OUTPUT DC OPERATION

The 203/303 Series can be used as Constant Voltage Supplies by the addition of an external filter capacitor or CLC network for low ripple, low stored energy. The value of the filter will determine the ripple voltage on the DC output. (Ask for APP NOTE 505 for more details). *Please consult our Applications Department if this type of operation is required.*

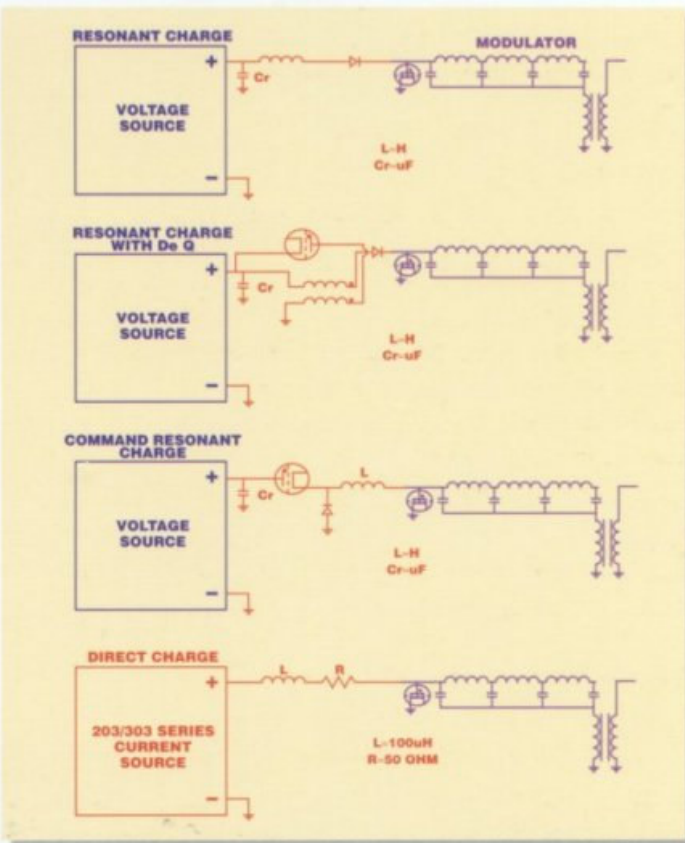
ORDERING INFORMATION

Model Number Example: 303 L - 50 KV - POS - SYS



DIRECT COMMAND CAPACITOR CHARGING

- Current source as opposed to voltage source.
- Connects directly to the load capacitor. The only other components required are those that provide protection against voltage reversal.
- Negates the need for charging inductor, isolation components and floating deck.
- Supply can perform true command charging since charging of the capacitor can be controlled via external control signals quickly and accurately. The power supply provides output signals such as end of charge and can be inhibited after the discharge for any duration the user wishes. This improves charge efficiency and minimizes the risk of switch latch up.
- In most applications where the repetition rate is less than 100 Hz, the 303 can maintain pulse to pulse regulation to less than $\pm 0.1\%$ without the need for an expensive and complicated D-Qing circuit. Regulation of 0.1% at up to 1 kHz is also available as a special option.



APP NOTES

- APP NOTE 500 Charging Rates
- APP NOTE 501 Charging With Current or Voltage
- APP NOTE 505 Charging Units as Continuous Output DC Supplies
- APP NOTE 509 What is Regulation and Repeatability?
- APP NOTE 513 Power Factor Correction
- APP NOTE 517 Protection Against Voltage Reversal

SPECIFICATIONS

Output Power

	203	303
Avg. Cap Charging	20,000 J/s	30,000 J/s
Peak Cap Charging	25,000 J/s	37,500 J/s
Constant DC Output	30 kW	50 kW

Standard Output Voltage Ranges

1 kV, 1.5 kV, 2 kV, 3 kV, 4 kV, 5 kV, 6 kV, 10 kV, 15 kV, 20 kV, 30 kV, 40 kV, 50 kV. All models continuously variable from 0 to 100% of rated voltage output.

Max. Output Current (Capacitor Charging Versions)

	203	303
50 kW pk.		75 kW pk.
V _{OUT} MAX.		V _{OUT} MAX.

Max. Output Current (Continuous DC Versions)

	203	303
30 kW		50 kW
V _{OUT} MAX.		V _{OUT} MAX.

Polarity

Positive or Negative. Please specify.

Repetition Rate

To 2 kHz

Voltage Regulation

±0.5% full load range and input voltage range into minimum capacitance (value dependent on minimum voltage range). ±0.1% available. Consult factory.

Output Ripple

Dependent on output filter capacitance. Consult factory.

Input Power

Series	Application	Input Voltage (VAC 50/60 Hz)		
		185-250	380-450	432-528
203	A/Phase Cap Charging	75	45	35
	A/Phase Constant DC	120	75	58
303	A/Phase Cap Charging	N.A.	55*	53
	A/Phase Constant DC	N.A.	90*	88

*Reduced output -25 kJ/sec avg. Cap Charging, 40 kW DC

Phase Configuration

Wye or Delta as specified above, any rotation, separate ground

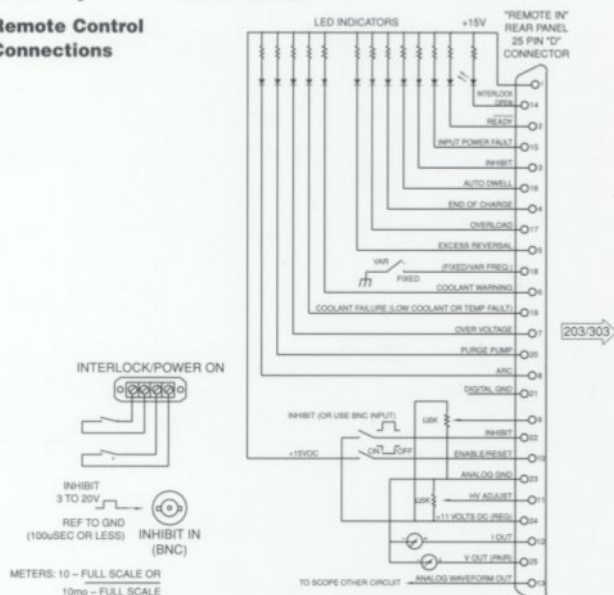
Power Factor

0.9

Efficiency

85% at full load

Remote Control Connections



AC Line Filtering

Passive Power Factor Correction and EMI filters.

Inrush Current

Limited to below full power level.

Cooling Water

Max./Min. exit temp. for cooling water at approximately 2.0 gpm (7.58 L/min) is 35 to 15°C (Higher temp. water requires greater flow). All water paths are at ground potential and are copper or brass.

Water Fittings

1/4 inch NPT.

Shock and Vibration

Unboxed 0.5 g. Factory packing 2.0 g.

Air Temperature Range

Operating: 0°C to +55°C ambient air (lower temperatures on special request).
Storage: -55°C to +70°C

Humidity Range (Non-Condensing)

Operating: 0% to 90%
Storage: 0% to 90%

Max. Altitude

Operating: 12,000 ft. (3658 m)
Storage: 30,000 ft. (9144 m) at 25°C or less

Output Cable Supplied

Voltage	Output Cable
1 kV to 25 kV	DS2214 (80 kV rated)
30 kV to 50 kV	DS2147 (100 kV rated)

Standard Length
10 ft (3.04 m)

HV Return

Ground through HV output cable shield to chassis and through separate safety ground cable

Max. Discharge

15 seconds to safe output level at output cable without external load consideration

Protection

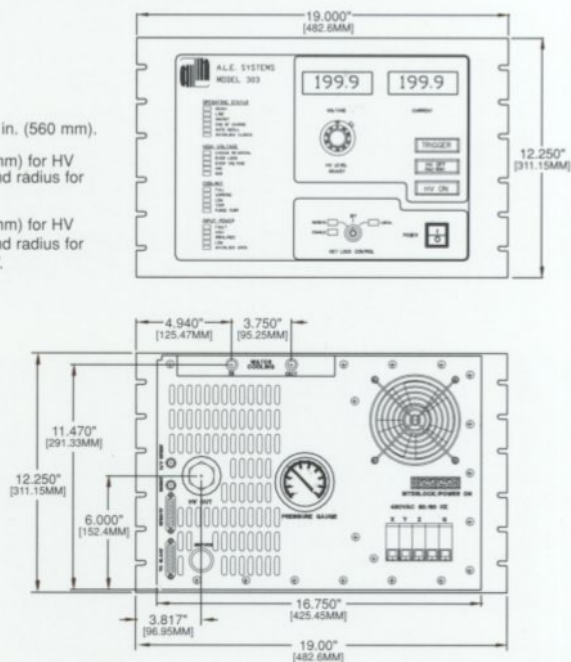
Open Circuit
Overvoltage trip
Short circuit
AC input power failure protected
Protected from excess voltage reversal and modulator feedback noise (See APP NOTE 517)

Mechanical

Case Depth: 22 in. (560 mm).

Allow 5 in (127 mm) for HV Output cable bend radius for Models 1-25 kV.

Allow 7 in (179 mm) for HV Output cable bend radius for Models 30-50 kV.



Weight

185 lbs (84 kgs)

F97/3U/2E

