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ANALOG MODULES, INC.

Specialists in Analog and Laser Electronics

CAPACITOR CHARGING POWER SUPPLIES

GENERAL APPLICATION NOTES

To date, the most common method of pumping solid-state pulsed lasers is through the use of flashlamps which receive energy from the discharge of a high energy storage capacitor. In such systems the job of the power supply is to repeatedly charge a given capacitance to a specific voltage. Some commonly asked questions and answers about capacitor charging power supplies are:

1) How long will it take to charge a given capacitance to a specific voltage with a particular supply?

Answer: $\textit{Charge time} = \dfrac{(CV^2)}{2\ (\textit{ramp power rating of supply})}$

Where charge time is in seconds, C is the capacitance in Farads, V is the voltage in Volts, and ramp power is expressed in Joules per second. To be conservative, the average power rating can be used in place of the ramp power rating.

2) What is the maximum pulse repetition rate I can operate at with a given supply?

Answer: $\textit{Max. rep. rate} = \dfrac{2\ (\textit{average power rating of supply})}{(CV^2)}$

Where rep. rate is in Hertz, C is in Farads, V is in Volts, and average power is expressed in Watts.

The ramp and average power ratings of a power supply are both functions of the operating output voltage expressed as a percentage of the maximum output voltage. In other words, a supply that can deliver 1000J/s with an output voltage of 1000V will deliver appreciably less power with an output voltage of 200V. It is important to understand these limitations when applying these equations and when considering the purchase of a power supply. The power delivery capabilities of AMI power supplies have been fully characterized and this information is expressed in the form of Power Derating Curves which plot normalized available power (actual power as a percentage of maximum power) as function of normalized operating voltage (actual voltage as a percentage of maximum voltage).

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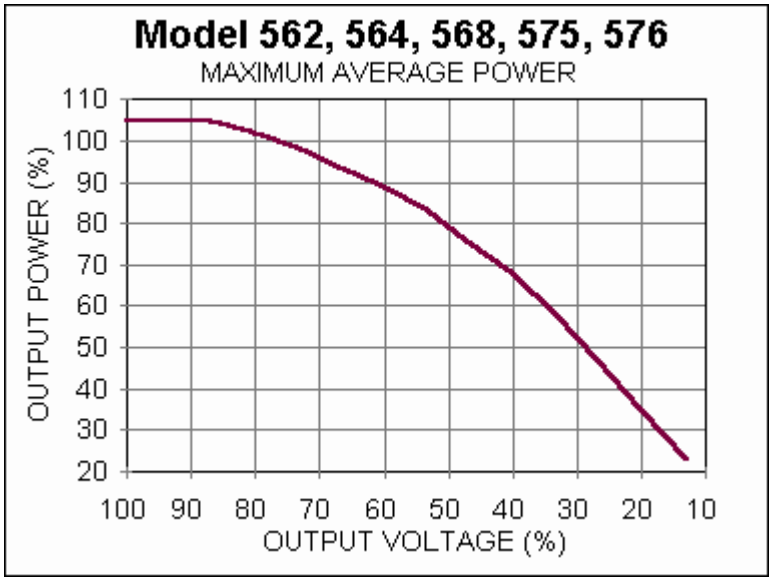
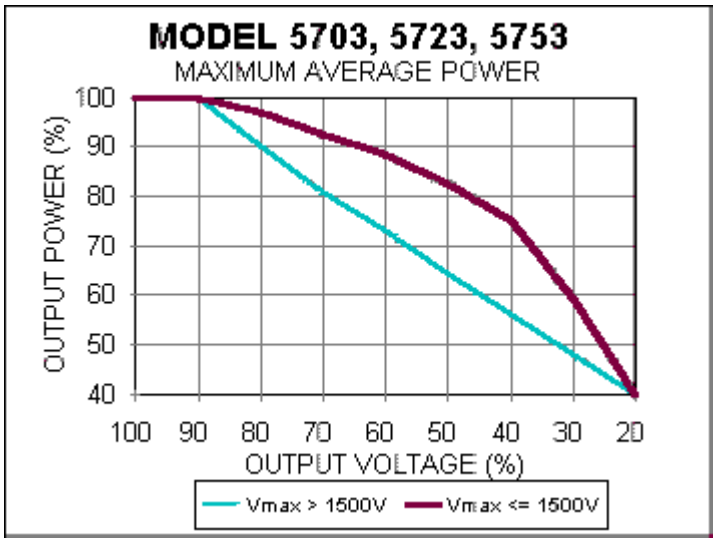
3) For a given application, how much input supply current will be required from a single-phase service?

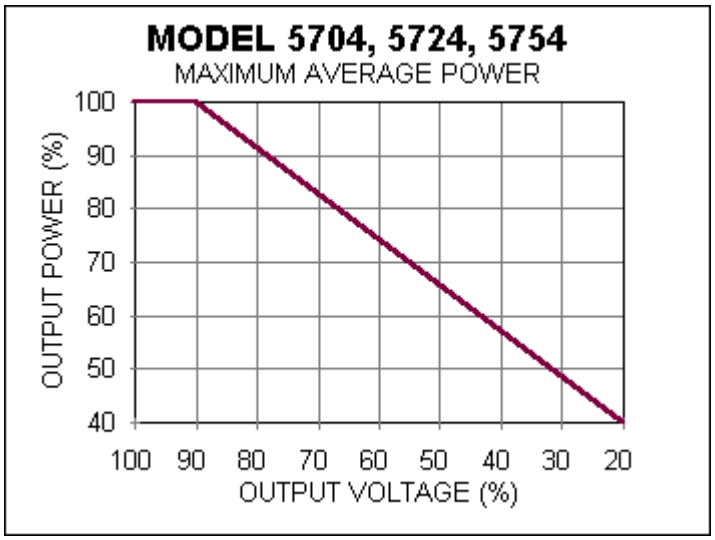
Answer: $$I_{input} = \frac{Average\ Output\ Power}{(power\ \ factor)\ (efficiency)\ (input\ voltage)}$$

Where I_{input} is in Amps (rms), output power is in Watts, power factor and efficiency are expressed as fractions, and the input voltage is in Volts (rms).

Power Derating Curves







Like all power supplies, AMI's supplies must be derated when operating at less than maximum output voltage. For most supplies, this rating is linear. For capacitor charging applications below 1500V, however, the 57X3 series of supplies can deliver up to 80% of rated power even when operating at 50% of the maximum output voltage.