



APPLICATION NOTES FOR USE WITH SPELLMAN HIGH VOLTAGE POWER SUPPLIES

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Capacitor Charging and Spellman High Voltage Power Supplies

Issue:

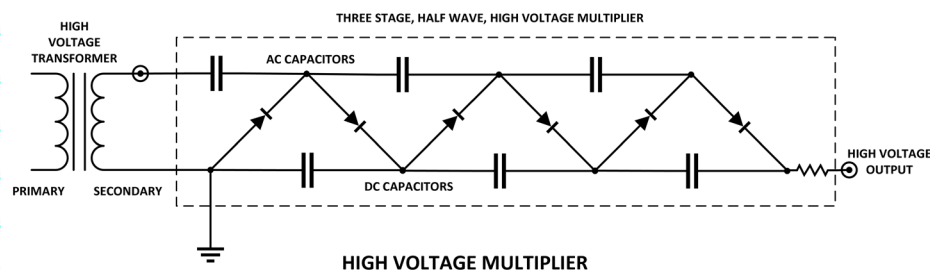
Spellman High Voltage power supplies are used in a wide variety of applications including capacitor charging. Not all capacitor charging applications can be addressed with our units, so we typically have the customer fill out a capacitor charging questionnaire. We review the application and see if a standard unit will work, if a modified standard unit will work, or if we do not have a hardware solution and need to decline the opportunity. What are the fundamental issues with Spellman High Voltage power supplies and capacitor charging? Let us explore this in a bit more detail.

How Spellman Makes High Voltage:

Virtually all the products Spellman designs, manufactures and sells make use of a circuit called a Cockcroft-Walton multiplier circuit. This circuit is a cascaded network of diodes and capacitors used to generate high voltages. This circuit has been around for a long time, originally used for early particle accelerator experimentation in the 1930's. By placing multiple stages of this circuit in series extremely high voltages can be generated, but this method of generating high voltage has its benefits and drawbacks.

Cockcroft-Walton Multiplier Circuit:

Unlike the early uses of this circuit, today's high frequency switch mode inverter techniques operate in the tens or hundreds of kilohertz, reducing the value of overall capacitance needed to operate. Still the capacitance can be significant and once charged to the desired output voltage, the stored energy in the multiplier's capacitance can be substantial. Spellman inserts a series limiting resistor assembly between the output of the Cockcroft-Walton multiplier and the output connector of the high voltage power supply to limit the short circuit discharge current to a reasonable level.



Series Limiting Resistor:

This series limiting resistor assembly must dissipate the I^2R losses of the rated output current of the power supply along with dissipating the energy stored in the multiplier during a short circuit. During a short circuit, the voltage on the output connector falls to zero but the capacitance of the multiplier is still charged. The full output voltage is impressed across the resistive output limiting assembly. Whatever energy is stored in

the multiplier capacitance is dissipated as heat in the resistive output limiting assembly. This resistive output limiting assembly is of limited physical size and power handling capability. Frequently the resistive output limiting assembly is encapsulated with the rest of the multiplier assembly, further impeding its ability to dissipate thermal energy.

Overheating the Series Output Limiting Resistor Assembly:

Individual or intermittent arcing will not damage the power supply, the series output limiting assembly has ample capability to dissipate this kind of power dissipation. The “problem” arises when repetitive, continuous arcing occurs. Under this scenario the power being dissipated in the series output limiting resistor can exceed its power handling capability. The series limiting resistor can thermally overheat and fail, permanently damaging the power supply. This type of damage is considered abuse of the power supply and repairs will not be covered under warranty.

Arc Intervention Circuitry:

Many of Spellman’s high voltage power supplies have arc intervention circuitry that monitors arcing and can intervene on the power supplies behalf to prevent continuous arcing from damaging the power supply. Some of Spellman’s less expensive modular power supplies have no arc intervention circuitry so care must be taken to protect the power supply from continuous arcing.

Capacitor Charging Applications:

The kind of capacitor charging applications that Spellman’s power supplies are suited to address are the low frequency or “single shot” application where heat build up in the series output limiting resistor assembly will not be an issue. If your application requires multiple Hertz, tens or hundreds of Hertz of short circuit discharges continuously, a true “capacitor charging power supply” would better serve your application. These dedicated cap chargers are designed to minimize output capacitance and have very capable output limiting circuitry making continuous short circuit discharging of the output a non-issue.

Spellman has just a few real “cap charging” power supplies, the CCM, CCM500 and the CCM1KW. These are true capacitor charging power supplies, but they are somewhat limited in output voltage capability.

Capacitor Charging Questionnaire:

If your application is capacitor charging, please speak to a sales individual and fill out our capacitor charging questionnaire so we can evaluate your requirement and see if we have a hardware solution we can recommend.