



## APPLICATION NOTES FOR USE WITH SPELLMAN HIGH VOLTAGE POWER SUPPLIES

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### Current Loop/Arc Detection Circuitry

#### Current Feedback/Current Loop

The current feedback and current control loop have absolutely nothing to do with the way Spellman's power supplies detect an arc. Overcurrent is a long term, low impedance fault condition that may persist for an extended period of time. The power supply sense this via its current feedback and crosses over from constant voltage mode to constant current mode to regulate the continuous DC current to the level as per the current programming input signal. The time constants associated with the current feedback circuit and current error amplifier usually take milliseconds or tens of milliseconds to occur so we do not use the current feedback to determine if an arc has occurred. Current feedback is only used to regulate long term DC current as per the current loop.

#### Arc Characteristics

Arcs are characterized by a very low impedance that can happen very, very quickly and may exist for only microseconds, tens or hundreds of microseconds. When this situation occurs this is basically a capacitive discharge event as far as the power supply is concerned. We have a charged capacitor (the power supplies internal multiplier capacitance) and a very low impedance connection placed upon the output of the supply. The only thing that will limit the current that flows is our internal series limiting assembly (typically resistors and/or inductors). Without some kind of limiting employed technically infinite current would flow during the arc. But our internal limiting resistors limit the current to a safe discharge level. A high voltage power supply that is rated to put out milliamperes continuously may have amps or even tens of amps flowing during that short arc discharge event. This is NOT the normal rated power supply current, it is capacitive arc discharge current...they are two very different things.

#### Current Sense Transformer

Due to the fast time frames and the huge currents that flow during an arc Spellman uses a different means of sensing arc events... a current sense transformer. A current sense transformer is connected to the bottom end of the multiplier circuitry. The normal low level DC current the power supply is rated for is not seen by the current sense transformer. When an arc occurs in microsecond time frames with huge current levels...that is seen by the current sense transformer. We use this to determine an arc has occurred.

### **Arc Intervention Process**

We need to go through an arc intervention process because whatever energy is stored in our multiplier capacitance is dissipated as heat in our output limiting assembly. Individual arcing will not damage the power supply, but repetitive long term arcing can overheat the output limiting circuitry. The power supply has a finite amount of arcing it can tolerate in a given amount of time before overheating damage occurs. Our arc intervention process prevents any damage from occurring. There is no ability to change or modify WHAT we call an arc; Spellman determines what is sensitive enough to protect the power supply, while not being too sensitive that would prevent normal operation.

### **What Our Arc Circuitry Is Not**

Spellman's arc sense and arc intervention process is there to protect the power supply from excessive long term arcing; it is not a precision, infinitely adjustable, circuit for customers to play with. If precision, adjustable arc detection is required by the customer, Spellman recommends that this be done via an external current sense transformer implemented by the customer. This way the required arc protection the power supply needs remains intact, and the customer can configure their external arc sense transformer to behave in any way they see fit.