

Application Note

Minimizing Inrush Current on PWM-type Voltage Regulators

Automatic voltage regulators that incorporate Pulse Width Modulated (PWM) technology in their output power stages typically employ a substantial amount of capacitance. The amount of capacitance depends on the power stage design but, usually, the higher the output current capacity of the regulator, the larger the amount of capacitance required to sustain adequate filtering in the PWM design.

There are several advantages for the generation system when utilizing voltage regulators with PWM-type power stages over traditional Silicon Controlled Rectifier (SCR) type power stages:

- PWM power stages offer higher forcing capability to assist with motor starting or fault clearing. This is because the output potential of the PWM power stage will essentially charge to the peak value of the RMS voltage applied to its input power terminals.
- PWM power stages accept a wider frequency range, which increases the regulator’s flexibility for the type of source intended to supply power to the voltage regulator. Typically, the acceptable frequency range for a PWM power stage is from 50Hz to 500Hz. Therefore, one voltage regulator model is versatile enough to be powered from the generator’s output (shunt), an auxiliary winding of the generator, or a Permanent Magnet Generator (PMG).
- PWM power stages provide greater immunity to waveform distortions that are typically caused by non-linear generator loads in shunt-powered applications. The capacitance required in PWM-type power stages also filters out undesirable waveform distortions that can cause erratic firing or false firing of SCR-based power stages.

Considerations

Even though PWM power stages offer many advantages, they also require special attention when being powered from low impedance sources or from a source that is already at the regulator’s input power rating, such as a wall outlet or a station service source. With these types of power sources, applying a voltage directly to the input of a PWM power stage may result in undesirable inrush current levels for the first few cycles. These high inrush current levels may stress relay contacts and could even potentially damage the voltage regulator. This is due to the large amount of capacitance inherent in the PWM design. Therefore, the lower the source impedance of the power supply, the greater the inrush current potential will be. It is

also important to be aware that the applied voltage level is directly proportional to the amount of inrush current that will be present.

Solution

Basler Electric offers an Inrush Current Reduction Module (ICRM) that is specially designed for PWM-type voltage regulators that will be applied to applications that may result in undesirable inrush current levels when energized. The ICRM is simply installed in series between the power source and the voltage regulator’s power input terminals (see Figures 1 and 2). ICRM dimensions are shown in Figure 3. For more details, refer to the instruction manuals for the voltage regulator and the ICRM.

ICRM Model	Compatible Voltage Regulator
ICRM-7	DECS-150, DECS-100
ICRM-15	AVC63-12, AVC125-10, DECS-250

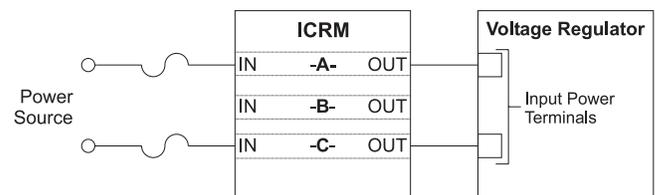


Figure 1. Typical ICRM Connections, 1-Phase Operating Power

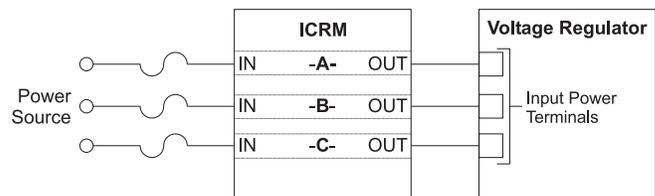


Figure 2. Typical ICRM Connections, 3-Phase Operating Power

For More Information

For details on Basler’s Inrush Current Reduction Module, visit www.basler.com. With an approved account, you can also access our full library of product documentation and Application Notes. To discuss your specific application, consult Basler at +1 618.654.2341.

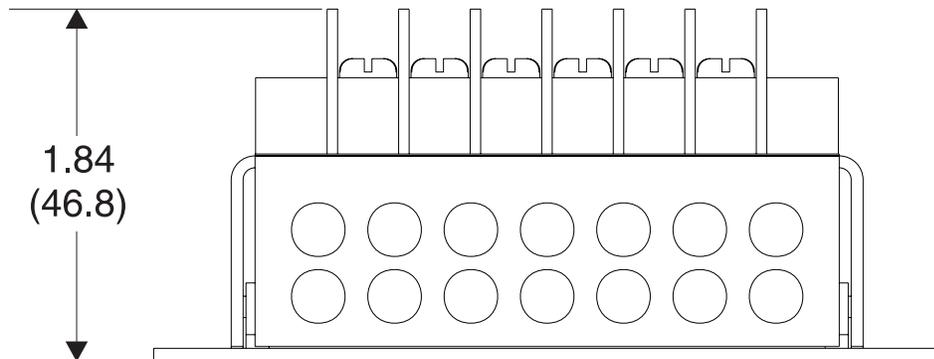
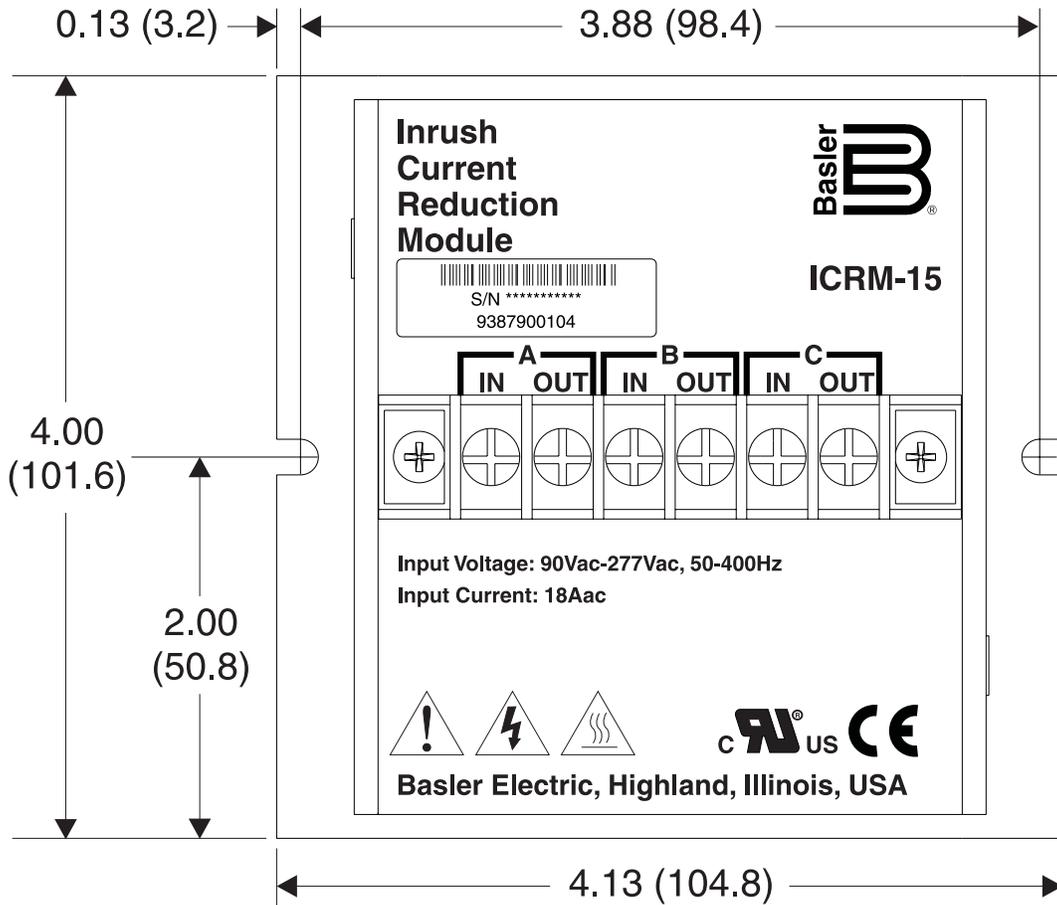


Figure 3. ICRM Dimensions in Inches (Millimeters)