

Near Zero AC Inrush Current An Advantage Worth Looking At

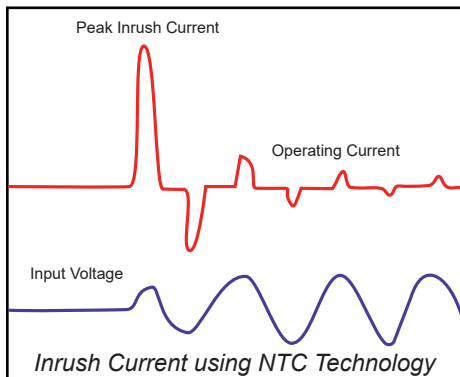
We all have seen the effect of inrush current in our homes when the refrigerator, a power tool or the air conditioner turns on. The surrounding lights may dim for a short period of time, a sign that the voltage is being drawn down on the start up of this equipment. Fortunately, in the home environment, this is typically the worst condition that occurs and is something that most people are used to. However, in an industrial setting, inrush current can have a strong impact on the day to day operation with unexpected down time or damage to equipment.

Inrush Current for Power Supplies:

Switch mode power supplies use pulse technology and the supply voltage is converted to DC using a bridge rectifier. The voltage is then smoothed using a large electrolytic capacitor. This input capacitor will demand as much energy as it needs to become charged. This demand causes inrush which can generate voltage dips, weld relay contacts, blow fuses or trip circuit breakers. This inrush can be controlled by one of many design techniques.

NTC: (Thermistors)

NTC (Negative Temperature Coefficient) thermistors are thermally sensitive



semiconductor resistors which show a decrease in resistance as temperature increases. A thermistor is a very simple way of controlling inrush for power supplies. When power is first applied, the thermistor is cold and has a high resistance, which limits the charging

current. The thermistor heats up very rapidly due to the design and the resistance drops to a low level. There are also some disadvantages to using temperature sensitive resistors. The inrush is dependent on the ambient temperature; a very cold environment can lead to starting problems, and a hotter ambient can render the inrush control useless. Notice on the graph to the left, the high peak inrush, reduces the input voltage, potentially starving other AC components in the system. This method also generates a power loss and can lower the efficiency. In addition, in the case of a warm restart, damage to the capacitor can occur because of the low resistance of the thermistor.

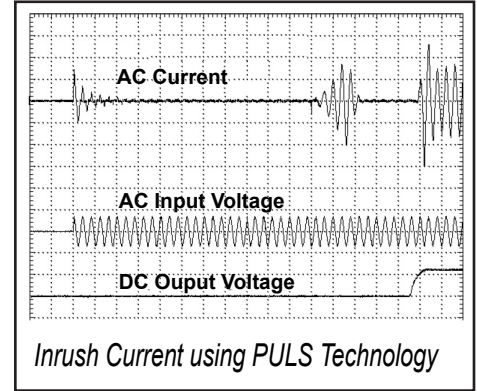
Fixed Resistors with Bypass:

A power resistor is used in this method to control the inrush current. The resistor is bypassed after the electrolytic capacitor is charged. Several different components can be used as a bypass such as relays, Triacs or IGBT's. This type of inrush control is independent of temperature and the power losses are much lower. However, this method is more expensive, so it is used primarily in the larger wattage designs.

Pulse Charging of Input Capacitor:

PULS in the Dimension Series, developed a new way of controlling inrush by pulse charging the input capacitor. This method is a superior way of softly controlling how much energy is allowed to charge the capacitor. The advantage is that peak

current can be defined more accurately, as there are no variables involved. A delay on



the charging is also incorporated into the design so that when power is initiated or restored, the supply does not contribute to unnecessary inrush as neighboring equipment is also energized. The PULS Dimension series has near zero inrush, meaning the inrush current is only slightly higher than the normal operating current. Some competitive models using NTC technology can have an inrush as high as 60A. Other advantages are that fuses or circuit breakers can be sized for operating current and not peak current. The inrush is independent of input voltage or temperature and at lower temperatures, there are no starting problems. This new design for inrush control has shown once again that PULS is a leader in power supply design, and will continue to use cutting edge technology to improve the overall performance of power supplies.

| | NTC | Resistor with Bypass | Pulse Charging |
|----------------------------------|-----|----------------------|----------------|
| Limiting of Inrush on Cold Start | + | + | ++ |
| Inrush after Short Power Loss | - | + | ++ |
| Temperature Dependency | - | + | ++ |
| Input Voltage Dependency | - | - | ++ |
| Power Loss | - | ++ | ++ |
| Good at Low Temps (<10°C) | - | + | ++ |

++ Very Good + Good - Poor

Comparison of Different Types of Inrush Control