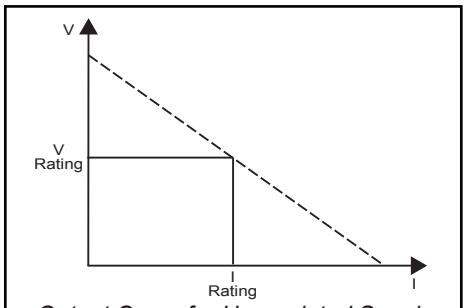
The PULS Advantage

Issue 13

Different Types of Power Supplies..... What is the Best Choice

As with any control component, picking the right device for any application is critical to ensure proper operation and long life. A power supply is no different and since the circuit designs have changed so drastically over the past several years, many engineers are still using older technology. This article will discuss the various types of power supplies used in the commercial and industrial segments and why using the latest technology might be the best way to go.

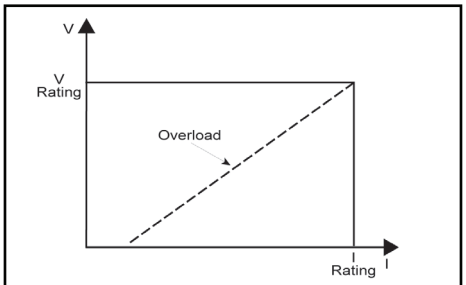
Unregulated Power Supply:
An unregulated power supply consists of three main components; a power transformer, a bridge rectifier and a filtering capacitor. The transformer steps down the incoming AC voltage and then the bridge rectifier converts the AC to DC. The filtering capacitor takes the rectified voltage and converts it to a smooth DC voltage. An unregulated power supply is the most simplistic of designs but there are many trade-offs in performance. The output graph shows that the output voltage can be twenty to forty percent higher than normal when the unit is carrying no load or is lightly loaded. The nominal output voltage is achieved when the unit is loaded at its rated current. If the current continues to increase above its rated value, the output voltage will decrease. The output voltage is also affected by the input voltage and the output will follow what occurs above or below the nominal input voltage. The efficiency of the unit is mostly impacted by the transformer and can be around 80%. All unregulated supplies are



Output Curve for Unregulated Supply

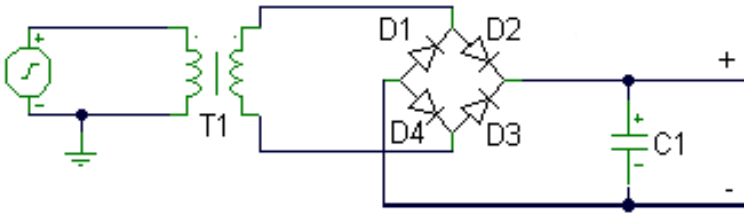
only UL Component recognized so de-rating may be required by certain codes and standards.

Linear Power Supply (Regulated):
A linear supply uses the same base design as an unregulated supply and the transformer, bridge rectifier and filtering capacitor accomplishes the same task. However, extra circuitry is added so that the output voltage can hold regulation independent of the input voltage or percent of load. These extra components, although they make the output voltage more stable, have an adverse effect on the performance of the supply. Because the DC voltage passes through so many components, the power losses are high resulting in a very poor efficiency. The efficiency can be as low as 60-70% producing excess wasted heat in the control panel, and in certain environments, this has to be dealt with by cooling methods. Linear supplies are laid out in a pancake design which is necessary to dissipate all the heat that is being produced by the unit. Almost all base units are sold open faced to allow more heat to escape, possibly allowing inadvertent contact with dangerous voltages. The design of a linear supply does not allow for very good overload capabilities. Once the unit goes above 105-110% of its rated current, the output folds back on itself resulting in a drop in the output voltage and current. Ohm's law indicates that a drop in voltage and current results in a drop in output power as well. Linear supplies are also only UL Component recognized. As explained in the unregulated section, component recognized units must be de-rated when used in certain UL environments. UL 508A Section 42 covers power

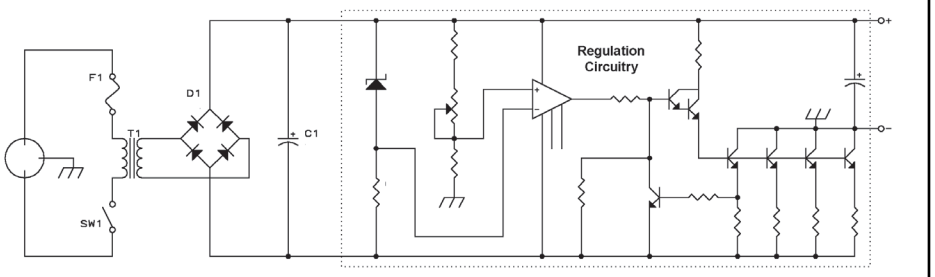


Output Curve for Linear Power Supply

supplies. Paragraph 42.2.3.1 states that " a power supply shall not be loaded more than 50% of the ampere rating of the device". Any linear supply used in a UL 508 panel must be de-rated by 50%. Let's take a look at how de-rating can affect an overall control panel. For example, a linear supply available today is rated 12A at 24VDC and if used in a UL 508 would only be allowed to be used up to 6A. Because of the substantial heat loss, the data sheet indicates that a 20 CFM fan is required or 30% de-ration is required. The unit is sold without a cover, but if a cover is added then an additional 15% de-ration is required. If all the standards and manufacturer's requirements are followed, the 12A linear supply is actually only rated for 3.57A under certain conditions. There is a lot of wasted panel space, extra components needed and possible labor



Basic Circuit Design for Unregulated Power Supply



Basic Design for Linear Power Supply

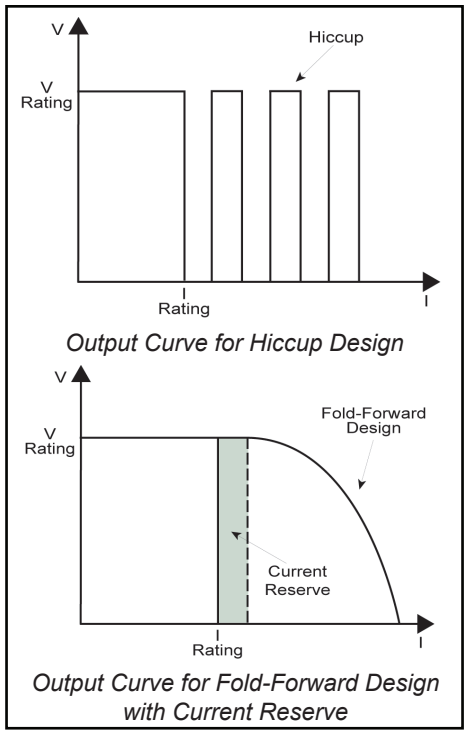
involved. All these costs have to be added to the unit cost. One advantage is that linear supplies have very low ripple and noise in the output.

Switch-Mode Supply

Switch-mode design is completely different than the two previously mentioned power supplies but it is still considered a regulated power supply. The technology uses switching transistors that turn on and off at a very high rate producing a rectangle waveform. Since the switching frequency is so high, a much smaller transformer can be used than in the unregulated and regulated supplies. The circuit design can be very complex, but the result is a smaller and lighter supply with very good efficiency from 80-90% for most manufacturers. There are two types of overload designs; hiccup and fold-forward (or constant current). The hiccup unit shuts down once the output reaches 105-110% of rated current. After a small delay, the unit attempts to start again, but if the load hasn't changed, the unit shuts down again. This process continues until the current drops back into nominal range. The fold-forward design reduces the output voltage as the current increases beyond the nominal rating. Unlike the linear supplies that fold back and lose power, this design attempts to maintain the output power. Some supplies have an extra current reserve that allows the current to go above the nominal rating with no change in the output voltage under certain conditions. Most modern switch-mode designs are UL508 Listed and therefore can be used at full capacity with no de-rating according to the UL 508 paragraph 42.2.3.1 exception. There are many switch-mode supplies that can be installed on DIN-rail for easy mounting and are IP20 touch-safe. Switch-mode supplies also have many more features. Capabilities such as wide range input voltage without having to move jumpers, paralleling and output monitoring.

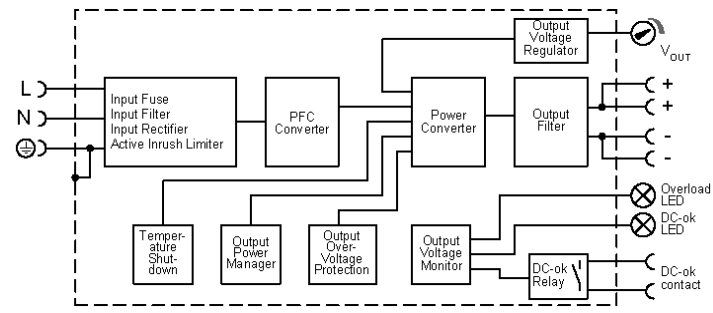
PULS Switch-Mode Power Supplies

PULS has been developing power supplies for almost 30 years. PULS design engineers use cutting edge technology, resulting in superior performance and long life. PULS patented designs ensure the most efficient and most compact series of supplies, allowing for the lowest panel cost. The high efficiency and small size can allow for a smaller enclosure lowering sheet metal costs while eliminating the need for fans or air conditioning. The unique input stage of the Dimension series has near zero inrush with very small input current allowing for lower energy costs. The output has a very robust overload design with up to 50% current reserve with no change in the output voltage. The high quality components used are designed to provide over 55,000 hours lifetime with an extremely high MTBF even at 40°C. Many of the PULS supplies utilize spring clamp terminals which can save 50-75% wiring time and never require re-torquing as compared to a traditional screw terminal. The PULS supplies also have very low ripple and noise. When comparing all aspects involved when using the other types of supplies, PULS is the best choice for highest performance, long life and lowest application cost.



Output Curve for Hiccup Design

Output Curve for Fold-Forward Design with Current Reserve



Functional Diagram for PULS QS20.241 Switch-Mode Power Supply