Issue 1
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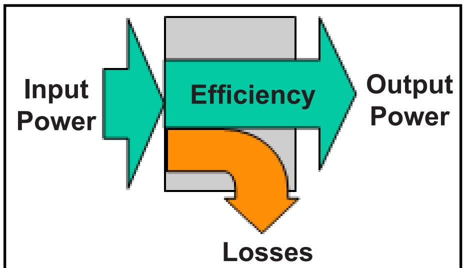
The PULS Advantage

# Efficiency.....The Forgotten Feature

Efficiency is one of the most important features that every engineer must consider when selecting a power supply. Not considering the impact of efficiency can have many adverse effects. Efficiency is simply the difference between the input and output power and almost all the loss is dissipated in the form of heat.
If we compare two different 960W




*Simple Efficiency Diagram*

power supplies, one rated 85% efficient and the other 93%, someone might say that the only difference is 8% but that is a huge understatement. If we calculate the heat loss for each power supply the 85% efficient unit dissipates approximately 169W of

$$\text{Heat Loss} = \left(\frac{\text{Output Watts}}{\text{Efficiency}}\right) - \text{Output Watts}$$

*Simple Heat Loss Formula*

energy as compared to the 93% unit which only loses 72W. The difference is almost like an extra 100W light bulb burning in your control cabinet.

## Considerations of Heat

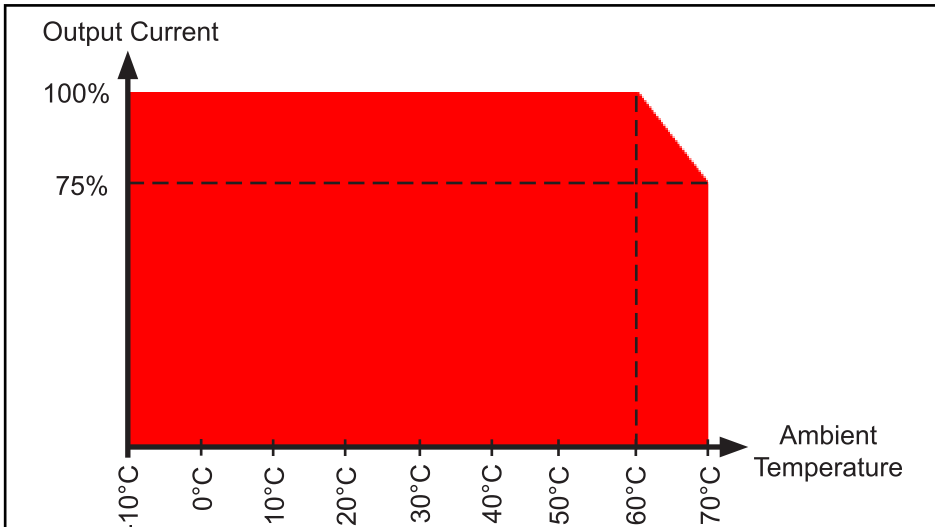
Heat is the number one enemy to a power supply because of the electrolytic capacitors, but many times there are far more sensitive electronic components inside an enclosure which can be affected by heat. Heat can radically change the reliability and lifetime of the power supply and in many cases can force you to increase your enclosure size, install some form of cooling or de-rate the unit. The general rule of thumb as published by the capacitor manufacturers is that every 10°C increase in temperature results in a 50% decrease in life for the capacitor. However, the reverse is also true, for every 10°C decrease in temperature the life is increased by a factor of two. Choosing the right power supplies can mean the difference between a highly reliable control system or a system where problems ultimately will surface.

## Enclosure Size

The physical size and foot print of the power supply is not the only element in determining enclosure size. The engineer must also consider efficiency of the power supply and other components along with ambient temperature. Most leading enclosure manufacturers offer software to assist in determining the impact of heat on the enclosure size. The selection of a power supply with low operating efficiency can result in a more costly enclosure. This is a factor that must be considered to optimize total system cost as well as reliability. If too much heat is generated inside the enclosure or if the ambient temperature also contributes to the internal temperature to a point where some form of cooling is necessary, this can also add cost to the overall control system. The simplest form of cooling is to add louvers to the enclosure where applicable, but this usually means also adding a fan. Depending on your enclosure type there are more expensive and complex cooling systems.

## De-rating Due to Heat

Depending on the ambient temperature inside your enclosure there may be a need to de-rate your power supply in order to maximize the life. The graph shown below is a typical curve for the PULS power supplies when the temperature




*Typical De-rating Curve*

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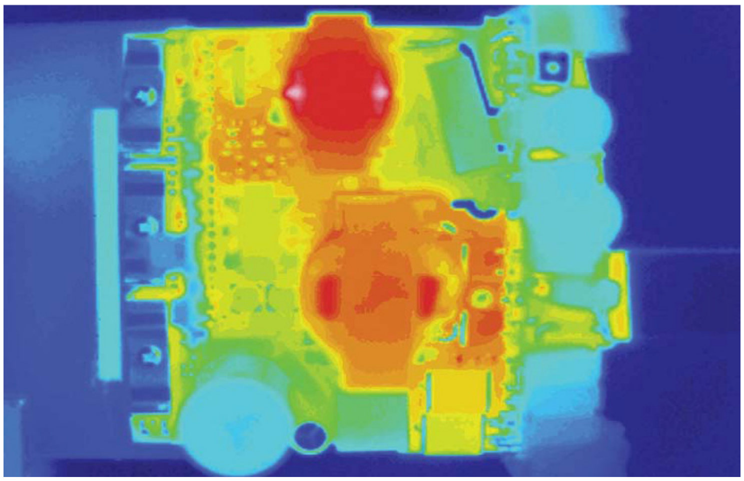

*Thermo Image of a PULS Power Supply*

exceeds 60°C and represents an approximate 2.5% / °C de-ration. Linear power supplies use very large transformers in their designs as well as additional components to improve the power quality, but the combination of these devices leads to much lower efficiency ratings and much more heat. Because of this heat, linear supplies must de-rate at a much lower temperature range or some method of cooling must be installed. Most linear supplies are also sold as an open chassis, so this and other factors must be considered when comparing the cost between the two different supplies.

## Energy Savings

One other area that should be considered by the design engineer is the amount of energy consumption required to operate the load. If we look back at the same example we used near the beginning of this article and compare the same 960W supplies, but this time from an energy standpoint, you will be surprised with the results. The power supply which was rated 85% efficient and had 169W of lost energy would from a simplistic calculation use 1.7kW over a 10 hour work day or 8.5kW for a 5 day work week. As compared to the 93% efficient supply, the same usage would be 0.72kW for the same day or only 3.6kW for the week. Using an average kilowatt cost of 13¢ per kilowatt, the lower efficient power supply would cost approximately $1.11 per week or $58.00 per year verses 47¢ per week and $24.00 per year for the higher efficient supply. Multiply this by the number of power supplies in a factory and the savings can be quite significant for a user over the life of the control system.The calculations above did not take into consideration the power factor of the supplies which can easily almost double your energy cost.

## The PULS Advantage

By using PULS high efficiency power supplies it is possible to use a smaller power supply because no de-rating is necessary in most cases. The high efficiency keeps the power supply running cooler, does not add unnecessary heat to the cabinet, and overall energy saving can be achieved. These plus all the other features makes PULS the right choice for any application. How do competitive products compare with PULS? The table below tells the story.

| | MFG/Series | Efficiency | Output (Watts) | Input (Watts) | Heat Loss (Watts) | Heat in Panel Compared to PULS |
|---|---|---|---|---|---|---|
| 5 Amp 1 Phase | PULS - Dimension | 93 | 120 | 129 | 9 | 100% |
| | Sola - SDN | 88 | 120 | 136 | 16 | 177.8% |
| | Phoenix - Quint | 87 | 120 | 138 | 18 | 200% |
| | Meanwell - DR | 84 | 120 | 143 | 23 | 255.6% |
| 10 Amp 1 Phase | PULS - Dimension | 93 | 240 | 258 | 18 | 100% |
| | Sola - SDN | 88 | 240 | 272.7 | 32.7 | 181.6% |
| | Phoenix - Quint | 88 | 240 | 272.7 | 32.7 | 181.6% |
| | Meanwell - DR | 84 | 240 | 285.7 | 45.7 | 253.9% |
| 20 Amp 3 Phase | PULS - Dimension | 95 | 480 | 505.3 | 25.3 | 100% |
| | Sola - SDN | 90 | 480 | 533.3 | 53.3 | 210.7% |
| | Phoenix - Quint | 90 | 480 | 533.3 | 53.3 | 210.7% |
| | Meanwell - DR | 89 | 480 | 539.3 | 59.3 | 234.4% |

*Efficiency Comparison Chart*