CT Series

Increased Efficiency with 3-Phase Power Supplies

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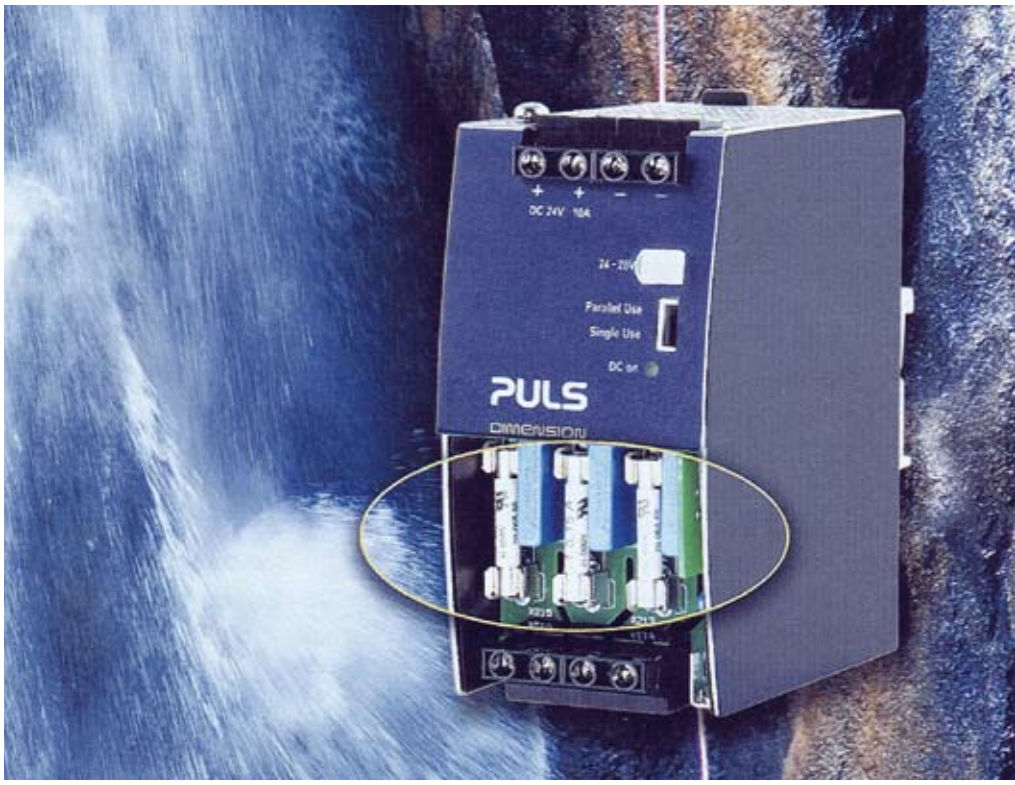
Every design engineer or system builder will recognize the challenge to improve performance while lowering cost.
In development of new 3-Phase supplies, the challenge is to reduce not only the device cost, but also the total system cost.
With 3-phase power supplies, substantial costs are involved with circuit breakers which are usually needed to connect the device to the supplying mains. If it were possible to do without the special protection circuits for the power supplies and to use those already present for other loads, this would be an excellent way to cut costs. In addition to the savings in material as well as the reduced wiring, installation time and logistics expenses, this design would also save considerable space.
With the focus on reducing cost, it is important to remember that the technical aspects and performance of a system must not be neglected.



CT Series: Device and system costs reduced, space requirements halved.

Elimination of the additional circuit breakers saves space and money

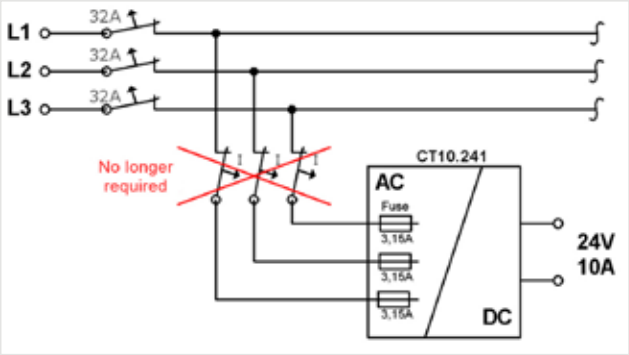
In industrial buildings the use of 3-phase 32A CEE plugs to connect machines and systems is commonly used. The power supplies in the CT-Series have been designed for these specifications and unlike many other power supplies, no longer require individual 16A maximum protection. To achieve this, a large 6.3 x 32mm fuse with the corresponding UL approval was installed in the power supply for each of the three phases. As well as cost savings, the user also gains a significant amount of extra space. The previous solution consisting of a SilverLine Series power supply with a width of 89mm and the three-pole miniature circuit breaker of 52.5mm required a total of 141.5mm on the DIN-rail. Despite its space demanding additional requirement, the CT10 device in the DIMENSION Series is only 62mm wide and does not need its own external fuses or circuit breakers. The only requirement is that the supply branch be protected with 32A or less.
This means that the total space requirements could be more than halved from 141.5 to 62mm.

Improved efficiency at full load

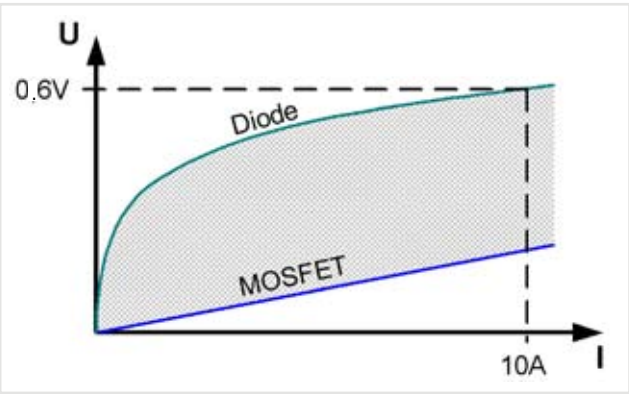
For this optimization one would think that the highly efficient multi-stage technology from the 480W device of the QT20 Series had to be used. However, including this feature would have prevented PULS from achieving the cost targets for 120W and 240W units. The decision was to continue developing and improving the simple but still very efficient technology for the single-stage self-oscillating flyback converter which has the advantages of partially resonant switching with low losses. Furthermore, this concept requires only one single inductor.

The first key improvement was the use of a synchronous MOSFET instead of a diode for the rectification of the output current. This replaced the forward voltage of a diode with the resistance of a MOSFET, resulting in lower losses. The control of this MOSFET is problematic with a self-oscillating flyback converter, particularly if energy can flow backwards from the load to the power supply. This can usually happen in industrial applications when for example, a motor decelerates and acts as a generator.

As a pioneer in the use of synchronous rectifiers in industrial power supplies, PULS has accumulated many years of pertinent experience and offers a reliable and simple solution.



Doing without additional miniature circuit breakers saves space and money

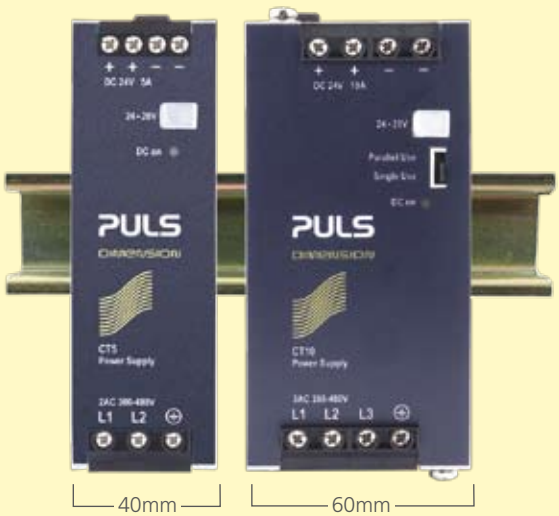


Voltage across the rectifier: Synchronous rectification with MOSFETs reduces the losses at full load about two-thirds.

The efficiency at partial load is a good point of discussion

Previously, power supply manufacturers primarily optimized the efficiency at full load as this represents the thermally least favorable operating condition that needs to be controlled safely. In reality, power supplies tend to be partially loaded and for energy efficiency reasons it would be desirable to have a efficiency curve as uniform as possible across the entire load range. In the various standardization committees for reducing energy consumption, a minimum efficiency at partial load is therefore often discussed.

Unfortunately, a uniform and high level of efficiency is not easy to achieve as circuit designs with good full load efficiencies often lag behind in the partial load range.



The CT5 Series is available with a 12V, 8A or a 24V, 5A output.
The CT10 Series is available with a 24V, 10A or a 48V, 5A output.

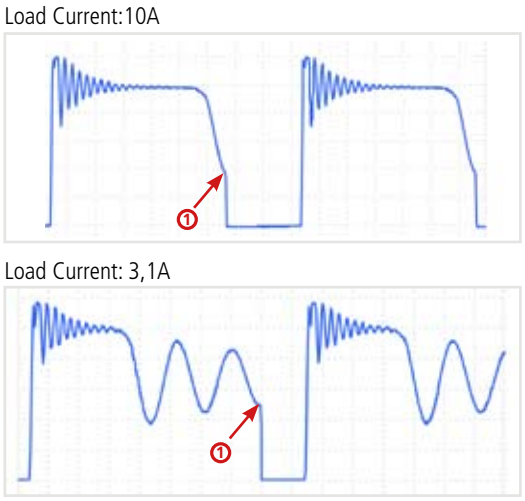
However, there are measures for improving this and one of these is to avoid the frequency increase of the self-oscillating flyback converter at reduced load. Normally the switching frequency rises at partial loads leading to an increase of unavoidable switching losses in the MOSFETs.
In the CT Series, load-dependent frequency control has been introduced into the self-oscillatoing flyback converter for the first time in which the frequency and switching losses are reduced under partial load conditions.
The most noticeable achievement here was that in these operating scenarios it was still always possible to switch-on cleanly at the lowest point of the resonant sine wave (valley switching). This results in almost no loss with significantly improved efficiency in the partial load range.
In comparison to one competitor's device which has an equally high efficiency level of 93% at full load, losses are one third lower in the CT10 at 25% load. This is even with a considerably simpler, single-stage converter design.

Low weight demonstrates material efficiency

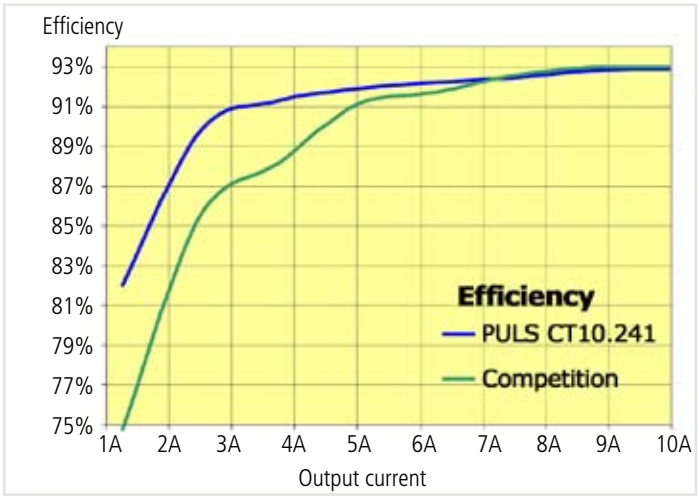
The high efficiency of these power supplies is also reflected in the low weight and associated minimal use of material resources. At just 740g for the 240W CT models they are noticeable lighter than other devices and prove less of a burden on everything on the DIN-rail (impact, shock and vibration) and to the packaging. An ingenious design makes this possible.

Other advantages include the large easy-to-wire terminals for 4mm² flexible wire, the electronic inrush current limitation, the ability to cover peak loads with 20% current reserves and the jumper which allows a uniform load distribution to be achieved in parallel operation. If the input voltage drops down to 320V, the devices are very robust even on poor power networks, and ensure a secure and reliable supply of loads around the globe.

With the CT5 and CT10 Series, PULS presents power supplies that demonstrate its ability to meet the current challenges in mechanical and electronical engineering. The development expertise of PULS repeatedly shows that it is possible to offer leading-edge power supplies with attractive prices without compromising any of the key specifications.



Valley switching: Switching at minimum voltage reduces losses



Increased efficiency in the partial load range via frequency-optimized control processes

① Turn-on time