

Getting more efficiency out of your UPS system

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One of the biggest challenges data center managers face today is to maintain or improve availability in increasingly dense computing environments while increasing efficiency and reducing costs. Recent advances in technology are providing new options to help data centers meet these sometimes conflicting objectives.

One such option is an energy saving (economy) mode of operation (eco-mode) that changes the way the UPS is employed to increase energy efficiency and reduce the operating expenses experienced in the data center. Eco-mode allows UPS systems to achieve the highest possible efficiencies; however, not without tradeoffs. Before utilizing this technology it is important to have some knowledge of this mode and an understanding of your power system and load criticality to ensure the energy savings benefits while minimizing availability risks.

The use of eco-mode has been gaining support in the industry. The Green Grid, a global consortium of companies, government agencies and educational institutions dedicated to advancing resource efficiency in data centers and business computing ecosystems, included eco-mode in its Data Center Maturity Model. The Environmental Protection Agency (EPA) also mentioned eco-mode in its ENERGY STAR for Uninterruptible Power Supplies specifications – which took effect on August 1 – as one of the operating modes for efficiency improvements.

The internal design of a UPS system determines how the UPS processes incoming utility power and, ultimately, the effectiveness of the UPS at protecting against certain types of utility power disturbances. AC power UPS systems can have several modes of operation; the most ideal for mission critical data centers being double conversion mode. This mode is the only one that protects against the full range of power disturbances. (See Figure 1)

Double Conversion Operation

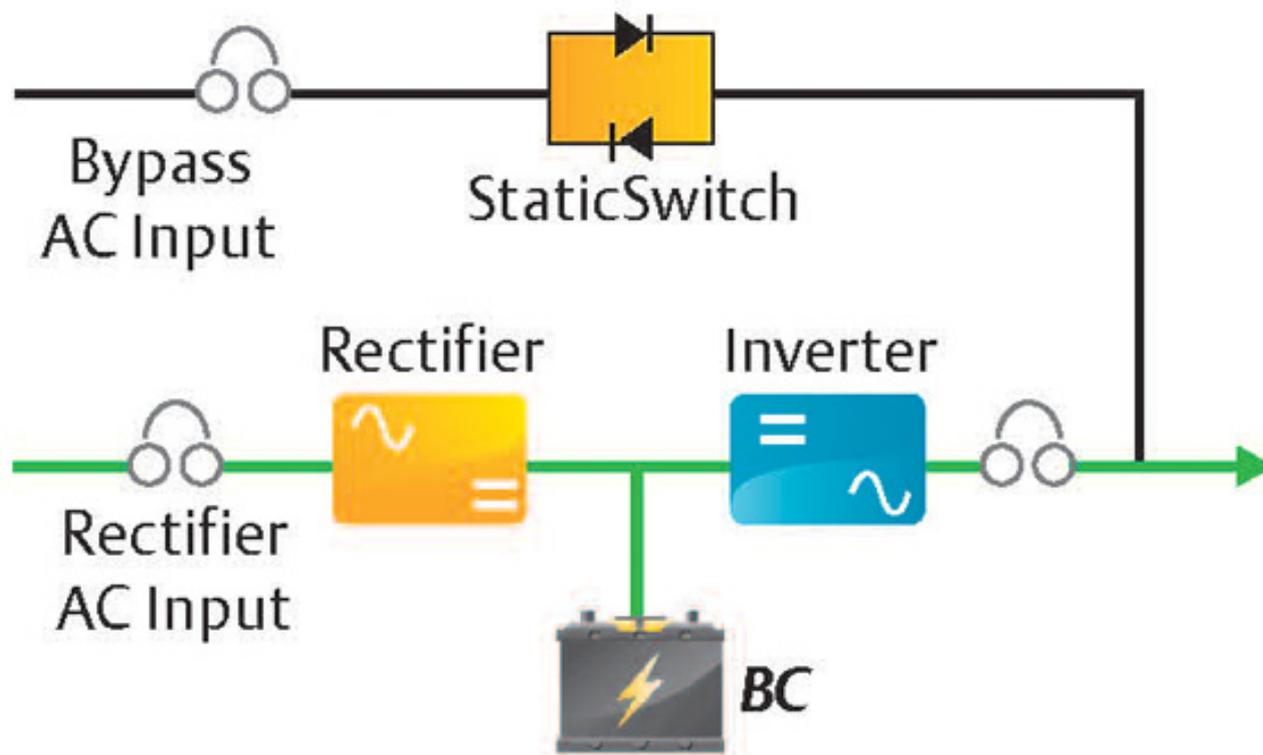


Figure 1.

Double conversion mode is the most widely deployed UPS topology in data center applications and is also known as voltage/frequency independent (VFI) mode as defined by IEC standard 62040-3. This mode is when the UPS provides a stable output voltage and stable frequency to the connected load(s) independently of the input AC voltage and frequency. Online double-conversion systems can tolerate wide power fluctuations without transferring to battery power. They also completely isolate mission critical systems from the power source, preventing equipment-damaging power anomalies from passing through.

In double conversion mode, the rectifier and inverter are designed to run continuously with the rectifier directly powering the inverter. The input AC current is rectified to DC current, which is then inverted to output AC, resulting in a low-distortion, regulated, stable AC output voltage waveform. This AC-DC-AC conversion process is about 93 to 95 percent efficient. Approximately 4 to 6 percent of the energy passing through a double-conversion UPS is lost in the conversion process. This has traditionally been accepted as a reasonable efficiency price to pay for the protection provided by the UPS system.

With new high-efficiency eco-mode options, the double-conversion process can be bypassed, and efficiency increased when utility power is determined to be of acceptable quality. Eco-mode powers the critical load via the AC bypass path and is known as voltage/frequency dependent (VFD) mode. IEC standard 62040-3 defines eco-mode as when the UPS output voltage and output frequency are identical to the input voltage and frequency from the AC source. Should the bypass AC source

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exceed acceptable voltage or frequency limits, the UPS will instantaneously change over to double conversion mode.

It is important to understand that not all eco-mode designs are created equal. Transfer time, which is the time it takes the UPS to transfer the critical load from the output of the inverter to the bypass source (or back again), is one of the most important performance characteristics for eco-mode. Transfer time is significant because it defines the amount of time that the load will be without power from the UPS output.

In typical eco-mode (See Figure 2.), the UPS incorporates an automatic static bypass switch that operates at very high speeds to provide a transfer of the critical load between the UPS inverter and bypass source to ensure uninterrupted power. When the critical load is being powered through the bypass (i.e., eco-mode), the rectifier and the inverter are both in an off state. When bypass power disturbances are detected, the UPS automatically switches back to double conversion mode. Eco-mode allows double-conversion UPS systems to achieve greater than 97 percent full load operating efficiency, but could allow the downstream load to be exposed to certain AC bypass faults and disturbance conditions.

Conventional Eco-Mode

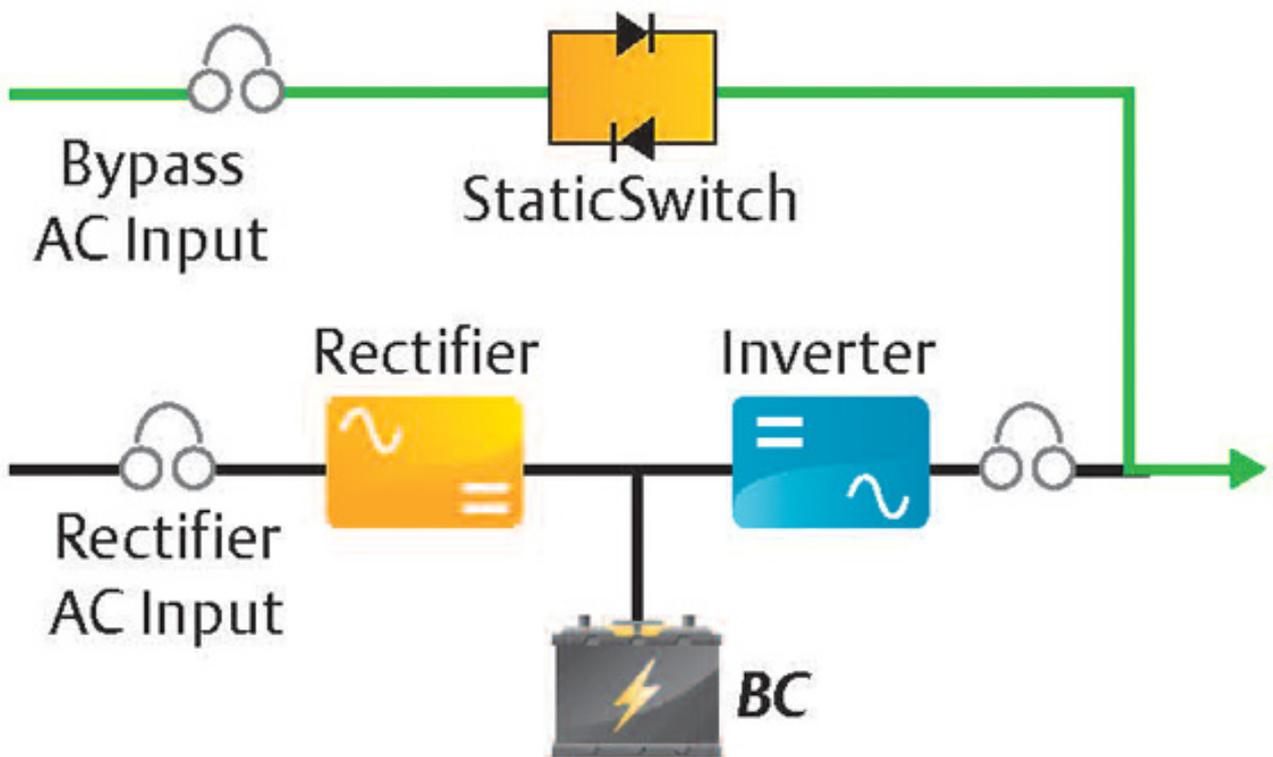


Figure 2.

This form of eco-mode typically has a notch in the output wave form when it returns from eco-mode to double conversion mode. That notch, usually the result of the rectifier and inverter being in an off state, sometimes can cause problems for downstream loads and, consequently, a slight compromise to availability. For some

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data center applications, this slight compromise falls within the parameters of acceptable risk.

For those operations where this notch in the output wave would cause concern, there is now an advanced intelligent eco-mode option that keeps the inverter (and rectifier) in an active state during eco-mode. (See Figure 3.) Because the inverter is kept in active state it is ready to accept the load immediately. As a result, the transfer to the inverter can be accomplished almost seamlessly. When the UPS senses bypass power quality falling outside accepted standards, the bypass opens and transfers power back to the inverter until the bypass anomalies are corrected. Once bypass power anomalies end, the critical load is automatically returned to the bypass mode (eco-mode).

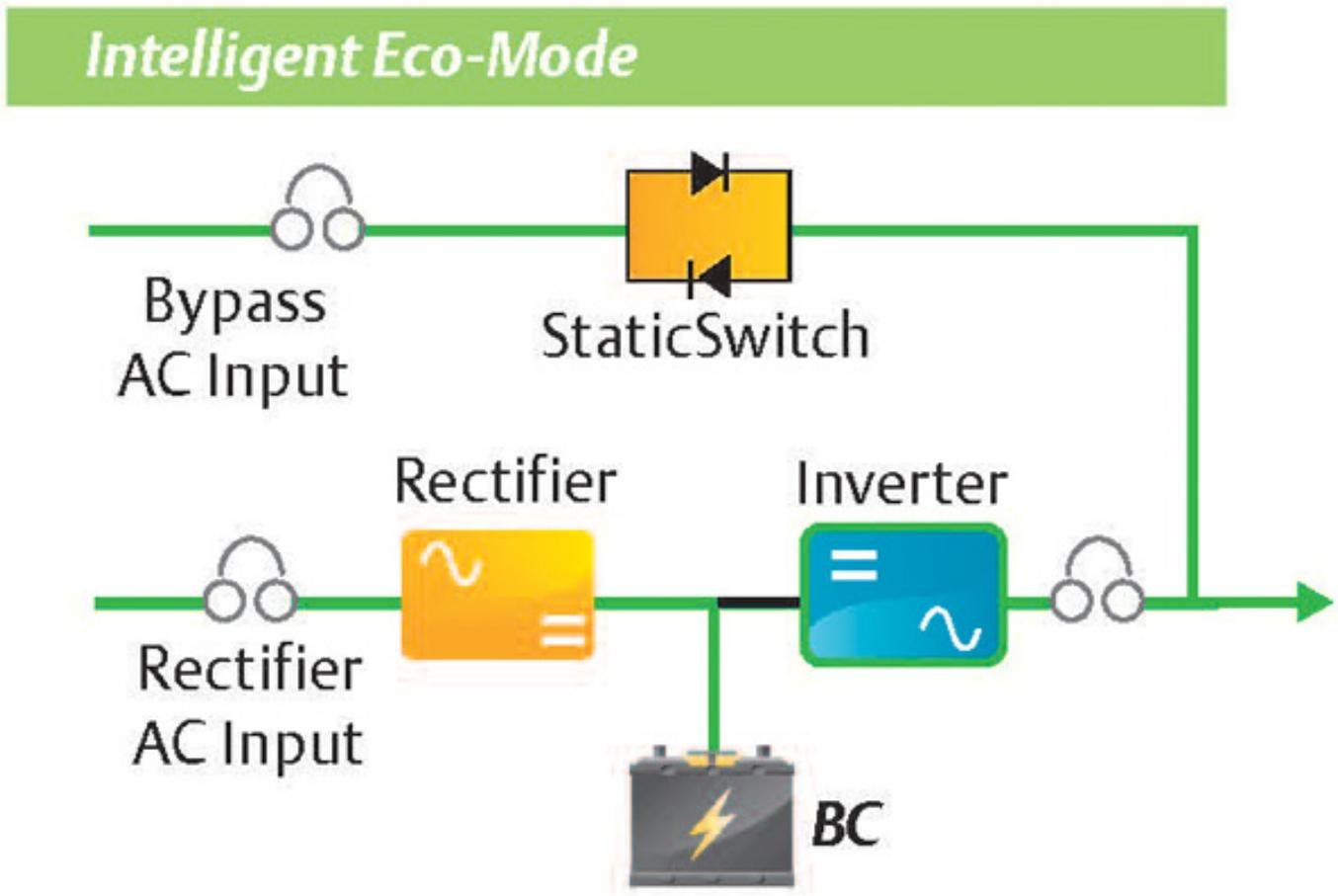


Figure 3.

Keeping the inverter in a constant state of preparedness does require additional control power; however, the power requirement is below 2 percent of the UPS rated power, creating potential savings of 4 to 4.5 percent compared with traditional double-conversion operating modes. The result is a more continuous output wave form, a more seamless transfer and a possible UPS efficiency level of 98 to 99 percent.

Recent technology advances are allowing today's high-availability double-conversion UPS systems can achieve efficiency levels similar to less robust designs through the use of eco-mode. Introducing advanced controls to the design can also further increase efficiency levels and eliminate much of the compromise to

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availability experienced by basic eco-mode operation.

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