

## Application Note

### TESTING UPS SWITCHING TIME



MR8847 MEMORY HiCORDER

Electronic and computer-based equipment need a high quality, uninterrupted power supply. The national grid supply systems are subjected to interference from natural and industrial sources. No electrical supply is free from “brown-out” conditions, interference and voltage fluctuations. A “brown-out” happens when the utility voltage remains excessively low for a sustained period. The operation of computer systems can be vulnerable to many phenomena, causing excessive voltages (above 260 volts) or voltage drop (below 180 volts).

By industry standards, power supply units inside IT equipment are designed to store enough energy to keep the device running for about 20 milliseconds (ms) of power interruption. This is known as “hold-up time.” That means the device can withstand brief interruptions in power while a UPS transitions between modes of operation, such as from normal operation mode to battery and back again.

However, transfer time should actually be much faster than 20 ms, because the longer the PSU goes without power, the larger the inrush current it draws when it receives power again. Inrush could exceed the current handling capacity of the UPS and cause it to shut down.

Standby UPSs switch to battery mode in 5 to 12 ms (8 ms typical). Standby systems typically use a fast acting mechanical relay for the power switch, which extends the length of time before the transfer to battery can be made. See Figure 1.

Most power supplies can tolerate this interruption. However, when the transfer time is greater than 5 ms, the inrush current may exceed the capability of the UPS inverter and cause a reset of the IT equipment, resulting in data corruption or shut-down. If the standby system allows output voltage to dip more than 10% below nominal current, the PSU is likely to be in

a state where it is pulling higher than normal current. For this reason, a prolonged loss of output increases the odds that the PSU will shut down.

Another concern about using standby systems for highly critical servers is the issue of output voltage waveforms while on battery power. Many standby systems create a square wave or modified sine wave output, which today’s power factor corrected power supplies may not be able to handle. If this is the case, the power supply will almost always shut down once battery operation commences.

Line-interactive UPSs switch to battery mode with a typical transfer time of 3-8 ms (5 ms typical), which is within acceptable limits for most power supplies. Some PSUs could exhibit inrush currents exceeding 400% if the transfer time is longer than 5 ms; the UPS inverter could have problems supporting this high current requirement. See Figure 2

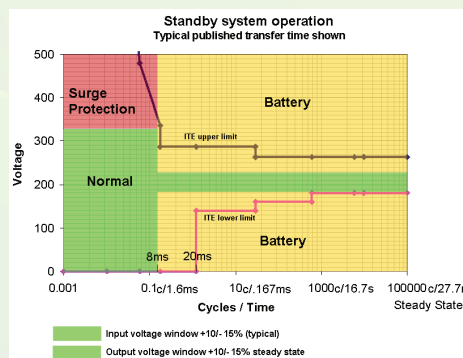


Figure 1: Standby System Ops

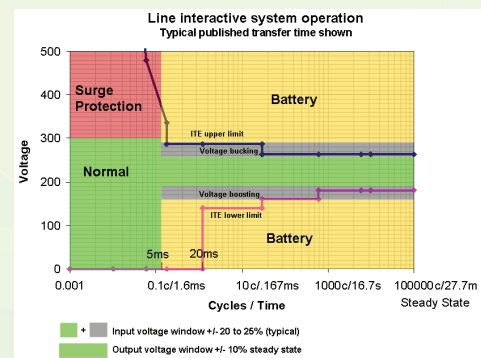


Figure 2: Line-interactive System Ops

Double-conversion UPSs begin drawing current from the battery with zero interruption (transfer time) in output power; therefore, there is no risk of the transfer causing any inrush phenomena. See Figure 3.

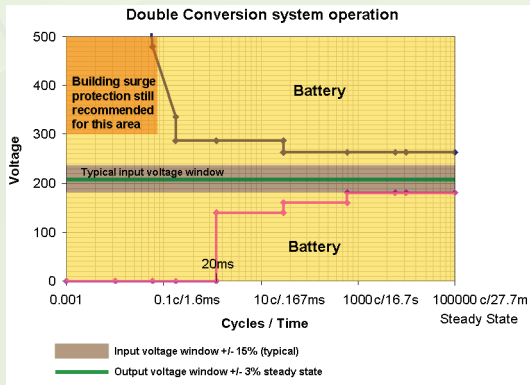


Figure 3: Double Conversion System Ops

Knowing the importance of transfer time for typical types of UPS, the transfer time of a typical line-interactive UPS can be analyzed using the Hioki MR8847-51 MEMORY HICORDER\*. See Figure 4.

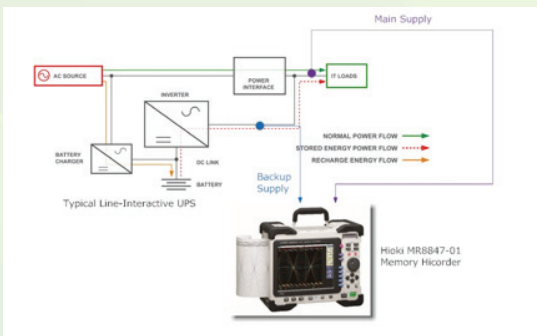


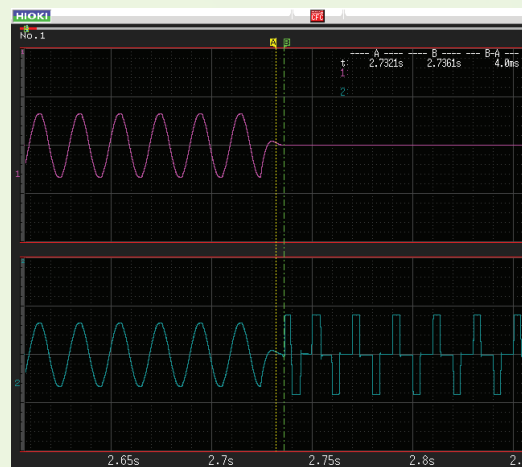
Figure 4: Line-interactive with MR8847-51

\*MR8847-51 is capable of high-speed sampling (20MS/s), multi-channel waveform monitoring and recording simultaneously. Its plug-and-play input modules enable various test and measurement applications.

### RMS Waveform



### Sinusoidal Waveform



This test and measurement application enables customers to have some assurance on their UPS transfer timing which can be captured with the MR8847-51 at high sampling speeds. Beside assurance, this application can validate the specification data sheet from the UPS manufacturers.

Reference : Loeffler, Chris. 'White Paper: Which UPS Is Right For The Job?'. Powerquality.eaton.com. N.p., 2015. Web. 24 Mar. 2015.