

Vertiv™ Liebert® GXT5 UPS

Application brief



Overview

Modern power factor corrected power supplies present special challenges when it comes to properly sizing a UPS system. This becomes more apparent when supporting large redundant power supply solutions, such as those found in Cisco PoE switches.

In this brief we will discuss configuration options to support a Cisco Catalyst 9300-48U PoE switch with a Vertiv GXT5 UPS.

Cisco PoE switches typically have oversized redundant power supplies to allow for future expansion. While the idle draw of these units might be modest, at initial power up they can draw dramatically more than their total power supply capacity.

For a unit with dual 1100 Watt power supplies this could mean a draw of 50 Amps or more for just a single switch. This large inrush current should be kept in mind when sizing UPS solutions for any IT gear with large and/or redundant PFC power supplies.



Vertiv™ Liebert® GXT5 Family

Improving performance with PFC Power Supplies and other High In-rush Load



Cisco Catalyst 9300 Series Switches

Scenario:

Customer has (Qty 2) Cisco 9300-48U PoE switches on each of their GXT5-2000LVRT2UXL. Each 9300-48U switch is equipped with (2) 1100 Watt power supplies, with all 4 power supplies plugged into the GXT5.

The UPS typically reports a load of 30-40% and switches to/from battery without issue.

During an extended outage the UPS shuts down after exhausting the battery. When the power is restored, the UPS reports an “Output Short Circuit” Fault and does not turn on as expected. This is due to the massive inrush of the attached load combined with the charger attempting to energize the DC bus as the UPS turns on. This alert is more commonly associated with an attached load having a wiring issue. To minimize any potential safety risk, the UPS requires a manual restart. This requires someone to physically lay eyes on the system and can verify that there are no potential safety issues. The system can then be safely be returned to online operation.

Cause:

Modern power factor corrected power supplies exhibit a large inrush current when first starting up. Think of it like a pump being primed before it can begin moving water. Once the power supply takes this initial “gulp” of power, it begins moving power to the load. With large PoE switches the power supplies are oversized to give ample headroom so the switch can scale to the power needs of the user. The switch needs to be able to support the PoE load even when every port is occupied and running at peak output.

These large power supplies effectively present as a short to the UPS until the power supply is fully powered up and begins passing power to the load. To avoid this situation, a UPS should be sized at 1.25 times the total rating of the power supplies. In this case the user is supporting four 1100 Watt power supplies which would equate to a 5500 Watt UPS. That would prevent issues at startup but results in a dramatically oversized UPS for normal operation.

Options:

There are three possible ways to address this behavior

- 1. Use the “Start on Bypass” feature.** When the Vertiv Liebert GXT5 starts on bypass, it initially passes utility power directly to the attached load. This gives the load time to boot up without the UPS having to support the inrush current. Once the power supplies are started and the inrush has passed, the UPS switches to normal online operation and is able to support the load on battery as needed. Most users will find this to be the simplest approach. You can enable Start On Bypass via the LCD Screen on the UPS or remotely using [Vertiv™ Environet™ Connect](#). If using this option, care should be given to determine that the upstream breaker is sufficient to support the inrush.
- 2. Use Programmable Outlets to stagger load startup.** Vertiv Liebert GXT5 features programmable outlets. Programmable outlets can turn on one at a time to sequence startup of attached loads. This avoids the inrush of all power supplies starting at once. This sequence can be configured via the LCD screen on the UPS. If your load is not plugged into the UPS directly, you can use a Switched Rack PDU to achieve the same results.
- 3. Oversize the UPS.** This may not be cost effective or practical in all applications, but it typically gives the necessary headroom for most large inrush applications. Select a unit that is at least 25% higher capacity than the total of the power supplies attached. In this case, (Qty 4) 1100 Watt power supplies is a 4400 Watt potential load. Multiplied by 1.25 that would result in a minimum 5500 Watt UPS.

Background:

The Cisco 9300-48U PoE switch ships standard with two (2) 1100W rated power supplies.

A GXT5 user reported that after an EOD (end of discharge) shutdown their GXT5 units would not auto restart and recorded an “Output Short Circuit” fault in the event log. This fault requires a physical reset at the UPS to restore power to the attached load.

Reported configurations:

- (Qty 2) Cisco 9300-48U PoE switches (4 power supplies) per GXT5-2000LVRT2UXL
- (Qty 3-4) Cisco 9300-48U PoE switches (6-8 power supplies) per GXT5-3000LVRT2UXL

Vertiv Engineering purchased two (2) Cisco 9300-48U PoE switches, each with two (2) 1100W power supplies and conducted tests to measure the inrush current both on utility and when connected to a 2000VA and 3000VA Vertiv Liebert GXT5 UPS.

In the included figures of the oscilloscope waveforms, the top (yellow) waveform is the voltage at the input to the power supplies, and the bottom (blue) waveform is the current at the input of the power supplies.



Figure 1 shows set up of the two (2) Cisco Catalyst 9300-48U switches and the rating label of the GXT5-2000LVRT2UXL used for testing.

Please note that there was no load on the switches. Any load attached would add to the inrush currents.

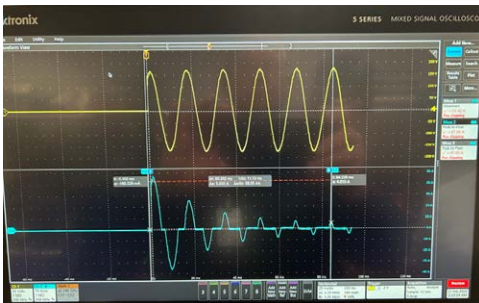


Figure 2 shows the inrush current of the four (4) power supplies on straight utility power @ 120VAC. The peak-to-peak inrush current is 87.6 amps.

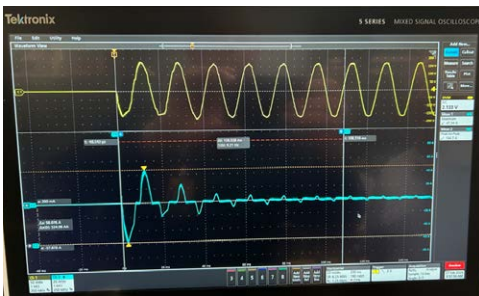


Figure 3 shows the inrush current of the four (4) power supplies on the inverter output of the GXT5 2000VA model with 120VAC input and a near fully charged battery. The peak-to-peak inrush current is 104.7 amps.

- The inrush current is higher while on the UPS as the UPS inverter is a “softer” (current limited) source than utility.
- This amount of inrush current represents a 627% overload and caused an output short circuit fault before the fans in the switch turned on
- Note the voltage collapse during the first few cycles of the waveform

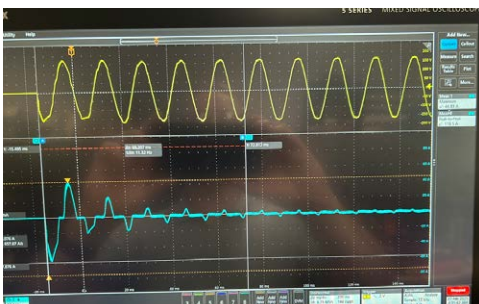


Figure 4 shows the inrush current of the four (4) power supplies on the inverter output of the GXT5-2000LVRT2UXL @ 120VAC after and EOD shutdown during auto-restart.

- The peak-to-peak inrush current is 119.5 amps.
- The inrush current is even higher due to the discharged state of the battery not being able to assist with input power to the UPS inverter
- This amount of inrush current represents a 715% overload and caused an output short circuit fault before the fans in the switch turned on
- Please note that on the first few cycles of the voltage waveform that there is an even greater collapse of the voltage

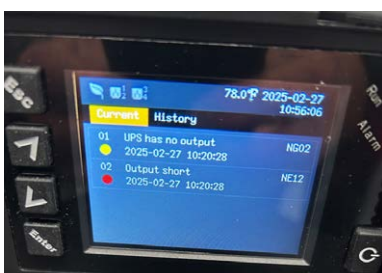


Figure 5 shows the event log of the UPS showing the output short fault.

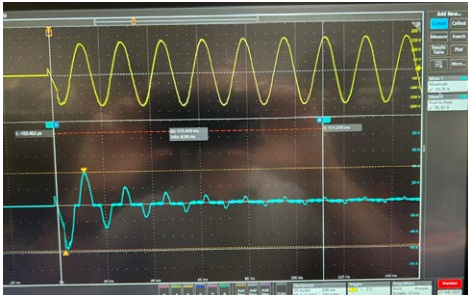


Figure 6 shows the inrush current during auto restart after EOD shutdown with “start on bypass” enabled on a GXT5-2000LVRT2UXL

- The inrush current was 95.97 amps, which is slightly higher than when on straight utility due to the surge suppression and bypass circuitry in the UPS
- The 4 power supplies came online and remained powered. After a few seconds the UPS transferred to online operation.

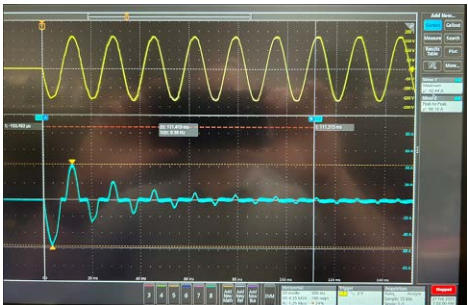


Figure 7 shows the inrush current of the four (4) power supplies on the inverter output of the GXT5-3000LVRT2UXL @ 120VAC after and EOD shutdown during auto-restart. The peak-to-peak inrush current is 98.4 amps.

- The inrush was not as high as the overload of the inverter is less at 393% due to the increase power available.
- Note there was the start of voltage waveform collapse, but this did not cause any UPS fault

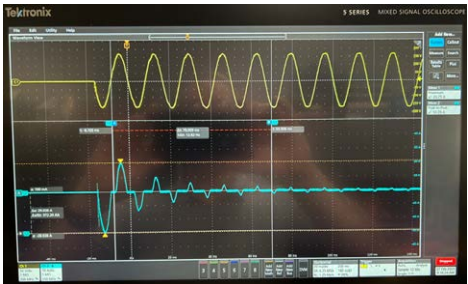


Figure 8 shows only 2 power supplies on utility with an inrush current of 50.2 amps

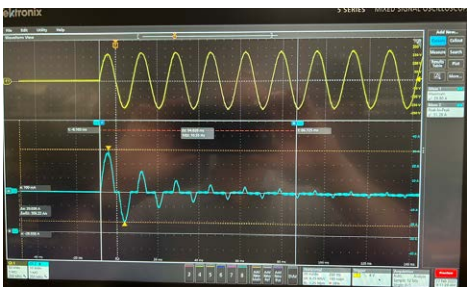


Figure 9 shows the same two power supplies on the 2000VA inverter auto-restart with inrush of 51.2 amps and no UPS fault

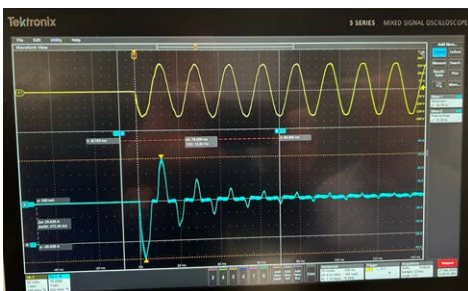


Figure 10 shows three power supplies on the 2000VA inverter auto-restart with inrush of 72.6 amps and we start to see voltage waveform collapse, but no UPS fault.