APC

APPLICATION NOTE #115

UPS Power for the InfraStruXure InRow SC

By David Roden

Abstract

The InfraStruXure® InRow™ SC (ACSC100 and ACSC101) is a self-contained air conditioner for server rooms and wiring closets. This application note outlines considerations for powering the unit from a UPS.

Introduction

The InfraStruXure InRow SC is an air cooled, self-contained, cooling-only air conditioner designed to be placed in-row, between equipment racks. The in-row design allows the SC to draw in air from the rear, capturing heat from the IT equipment in the hot aisle and neutralizing it before it mixes with the room air. Conditioned air is then discharged into the cold aisle, ready for immediate use by the equipment in the adjacent racks. The SC is a singled-corded device with input power provided from 200-240V, 1Ø, 60Hz (ACSC100) or 200-240V, 1Ø, 50Hz (ACSC101) sources.

The unit's refrigeration system is driven by a compressor which has a considerable in-rush current. Sizing a UPS to handle this in-rush without going to bypass results in a significantly larger UPS then would be otherwise warranted to support the IT load cooled by the InRow SC unit. Customers wishing to place the SC on the UPS must take the in-rush current into account, to make their sizing decision. Additionally, for battery run-time calculations, the SC consumes up to 3 kW of power (2,940 watts for ACSC100, 2,390 watts for ACSC101) during normal operation.

In-Rush Current

Testing conducted by APC Engineering demonstrates intensity and duration of the in-rush current. In the first test an ACSC100 unit (60 Hz) is powered from utility and the current draw was measured during the compressor start. Fans were set to a typical operating condition; when the compressor cycles on a current draw of approximately 40 amps RMS was observed. In the second test an ACSC101 unit (50 Hz) is powered from a generator and the same procedure repeated. In both cases the units reached a steady state current draw of approximately 8.5 amps (RMS). See **Table 1** for results.

Legendary Reliability®

Table 1 – InRow SC in-rush current

	Evaporator fan speed	Condenser fan speed	In-rush current (RMS)	In-rush duration (ms)	Steady state current (RMS)
ACSC100	100%	80%	40A	200	8.5A
ACSC101	100%	80%	46A	60	8.5A

Compressor Cycling

The compressor will cycle on and off as needed to maintain the temperature set points of the unit; minimum on/off timers limit the maximum frequency of compressor cycling to no more than once every 9 minutes. In Discrete capacity control mode compressor cycling may be a fairly routine occurrence as the unit takes no steps to modulate its capacity. In the Proportional mode the unit will always modulate its capacity using the variable speed fans and hot gas bypass valve to best match the load. This makes compressor cycling more unlikely, however it should not be assumed that the unit will run without the compressor cycling at some point. See Application Note AN-113 for more detailed information on compressor control.

If multiple SC units are powered from the same UPS, then the UPS must be able to accommodate the in-rush from all connected units starting simultaneously. While the chance of this happening is very small, currently there is no control feature in the InRow SC to prevent this from occurring.

Sizing a UPS for InRow SC

Given the in-rush current it is possible to provide guidelines regarding the selection of a UPS to power the InRow SC. The UPS must be sized to handle the in-rush current without going to bypass. Anytime the UPS transfers to bypass there is a risk of failure and dropping the load, therefore this must be avoided.

To determine if a UPS is appropriately sized, compare the output current rating to the SC in-rush current, allowing for a 20% factor of safety; this rating can be found in the UPS technical specifications. As an example, the Symmetra PX 40 kW 208V UPS (SY40K40F) can handle 111 amps RMS per phase. Therefore if one (ACSC100 was supported then 2 of the 3 phases would have approximately 63 amps available to support IT load, or 15 amps available if two such units are supported.

Sample calculation:

UPS output current – (SC in-rush current x factor of safety) = Available current

111A – (40A x 1.2) = 63 A

Similarly, an InfraStruXure 20 kW 208V can support up to 55.5 amps per phase. With a single ACSC100 unit connected only 7.5 amps would be available to support additional loads on 2 of 3 phases.

Sizing a Generator for InRow SC

Using a generator to supply back up power for the InRow SC avoids the problem of over sizing the UPS to accommodate the high in-rush current. This approach can be used by any customer that can tolerate brief interruptions in cooling; typically only very high density racks will be significantly impacted by a short duration cooling outage. When sizing a generator all mechanical and electrical systems that it supports must be included. There are two widely used methods for determining the correct sizing for emergency power systems the measurement method and the load summation method.

Measurement Method

As the name implies, the measurement method entails taking load panel measurements of each phase conductor and determining the maximum phase current. This can then be added to the other load considerations for the generator to determine the ultimate solution. This method is only suitable for an existing facility where the connected load is already operating. Typical sizing criteria dictate that the generators are sized at 25% over the peak measured load condition.

3 Phase panel

Max phase current x system voltage x 1.73 x 1.25

Single phase panel

Phase current x system voltage x 1.25

Load Summation Method

When dealing with new construction, it is often required to calculate the design load from the equipment manufacturer data. Good engineering judgment should be applied to nameplate data to ensure proper sizing. Often times operating loads differ greatly from the nameplate loads. Mechanical and non-mechanical devices that will be supported by the generator must be identified and the power requirements recorded. The following tables can be used to assist in this process. When examining the mechanical loads, pay particular attention to the in-rush currents of each device so the highest starting load can be identified.

Mechanical load summation:

Device	Rated Current	Inrush Current	kW Running	kW Starting

Non-mechanical load summation:

Device	Amps	kW

Mechanical load (minus load with largest start up inrush) _____**kW**

Mechanical starting load from largest inrush _____**kW**

IT load total _____**kW**

Total _____**kW**

Generator sizing will need to accommodate the total load, any future growth planned, and typically 25% safety factor.

Total load (kW) x Future growth % x 1.25 = Generator size in kW

LCDI Cord Nuisance Tripping

The ACSC100 ships with a Leakage Current Detector and Interrupter (LCDI) cord that has an outer shield around the line and neutral conductors of the cord. If the cord is damaged such that the line or neutral conductor shorts to this shield, the cord will trip. The cord also contains a Ground Fault Circuit Interrupter (GFCI) that monitors the current flow between the line and neutral conductors. If there is an imbalance of current flow between the two conductors the cord will trip. The cord is designed to trip on an imbalance in the 4-6 mA current range. It is possible that nuisance tripping can occur due to normal electrical characteristics commonly found in information technology equipment power modules/supplies within the wiring closets / data centers, or on the same electrical supply panel. Normal electrical characteristics include harmonics that are induced from the power modules / supplies. When the cord trips, it requires a user to manually reset it. Refer to Informational Bulletin IB0070GB01 for more information on this topic.

Conclusions

The InfraStruXure InRow SC can be powered from a UPS to provide uninterruptible cooling in the wiring closet or server room; however users should first consider using a generator system to provide back up power for the SC. Careful consideration during the design process is required to ensure proper sizing of the UPS to prevent undesirable transfers to bypass. As the InRow SC is nominally rated at 5 kW of cooling, having to provide a 20 kW or larger UPS to support it demonstrates that significant over-sizing is needed. This leads to operating inefficiencies, excess capital expenditures and

increased maintenance requirements that can be avoided by not using a UPS to support the InRow SC unit unless absolutely required.

About the Author:

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