APPLICATION NOTE

Battery Chargers

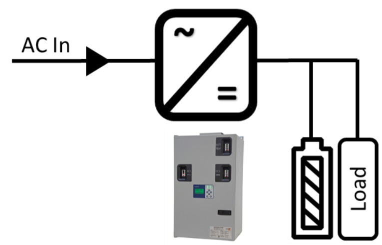
Battery Chargers in Applications without Batteries

Integritas Battery Charger

Description

Batteries are often used to ensure continuity of services when utility power is interrupted. When utility power is interrupted the load is supported by the battery, which has been kept fully charged by a battery charging system.

As shown in the diagram, right, the battery charger is used to charge the battery and also supply any persistent loads. When the AC supply is available the charger supplies power to the battery and all loads. When the AC input power fails the battery will supply power to the loads directly.



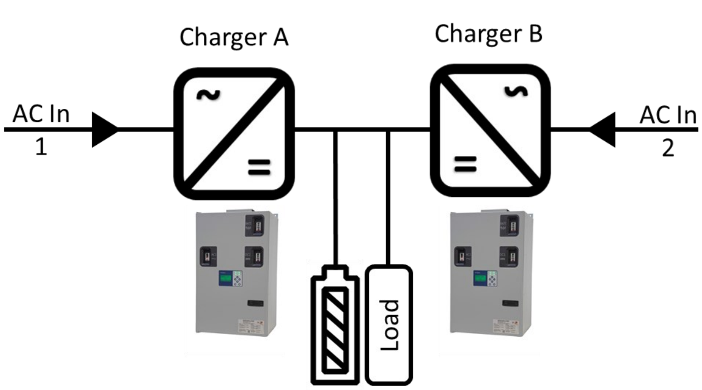
Battery Charger and Load

In this architecture, failure of the charger can be seen to put the load at risk once the battery has been exhausted.

Dual Redundancy

To mitigate the effect of battery charger failure users will often specify the use of a dual redundant battery charger architecture, as shown in the diagram below.

With the dual redundant battery charger architecture, failure of one of the AC supplies or battery chargers does not compromise the systems' operation. If the battery chargers are powered by the same utility feed there are 2 independent power sources in this architecture, the utility and the battery.



Dual Redundant Battery Charger Architecture

If the power systems have 2 completely independent utility feeds then there are actually 3 independent sources of power and the potential exists to remove the battery as the backup power source.

If the AC supplies are truly independent then we can have one utility act as the "backup" for the other and remove the battery. Before implementing this type of backup however the user should consider all of the implications of the battery's presence or absence on the performance of the charger. If the battery is not present the chargers operate as AC to DC power supplies and may or may not operate exactly as expected. The following will look at this in more detail to allow informed decision making.

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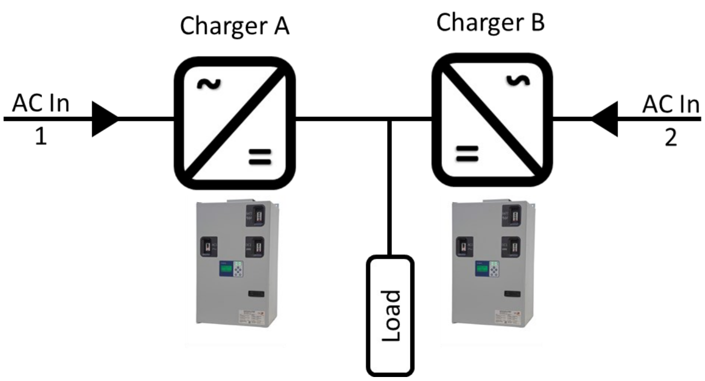
Battery Charger Design and Performance

In designing battery chargers, the electrical properties of the battery to be charged are typically central to the process. Many parameters are key; many more are critical to a reliable and cost efficient product. Let us now consider the parameters that are related to or dependent on the battery type or presence. Without a battery connected a battery charger will act as a DC power supply with characteristics determined by the design parameters used in the design of a battery charger.

Output Ripple

Batteries typically do not tolerate high ripple current (an AC signal superimposed on the DC power) very well, so battery chargers are typically designed to produce low ripple on the output charging voltage. This is a key parameter in a design of the electronics that takes AC power in and outputs DC, since residual AC components must be sufficiently filtered. The Integritas line of industrial battery chargers typically produce <30mV of ripple for all output voltage variants.



Dual Redundant Chargers / Power Supplies

30mV of AC ripple is a low value for battery charging, but it should be noted that the ripple seen by the load, when a battery is connected, is much lower than 30mV, because the battery complements the charger's filtering and further attenuates any AC component of the charger's output. If the battery is not present that additional attenuation does not happen and the load will possibly see the full output ripple voltage of the charger. Some loads may be sensitive to this level of ripple. The users load tolerance to ripple cannot be predicted by a charger designer or manufacturer, so the user needs to determine if this level of ripple can be tolerated by the specific load before deciding to operate a system without a battery.

Inductive Loads

Inductive loads, such as solenoids used in switchgear, or motors and motor starters, often require much higher currents when first energized than in the steady state running condition. When a battery is present it will support high transient currents and provide better regulation of the output voltage seen by the load under start up conditions. If the battery is not present, then any surge currents must be supported by the charger electronics alone. Proper evaluation of surge currents to ensure that the charger can support then must be performed before opting to use a charger without batteries. Again the charger manufacturer cannot be expected to understand and accommodate every users possible load characteristics for all applications.

It may be necessary to provision greater charger capacity than required by steady state loads to ensure that inductive or transient loads are adequately supported. The use of dual redundant chargers inherently adds (redundant) capacity to the overall system.

Capacity Limits

The output of an Integritas battery charger is a regulated voltage (the charger attempts to keep the voltage constant) and will be a constant voltage to the power limit, then constant power to the current limit and then constant current, as shown in the diagram below

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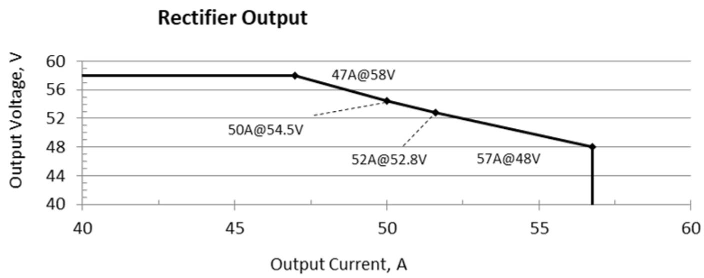
This is the curve for a 2.75KW, 48V rectifier, but other output voltage units in the Integritas line exhibit similar performance.



Rectifier Output Characteristic (NE050AC48ATEZ)

If a load tries to pull large currents, even for short periods of time, the charger output alone may not be able to support the demand and output voltage drops as shown in the rectifier output characteristic curve.

The presence of the battery increases the short term current availability, depending on the battery chemistry. Lead acid batteries, are able to support hundreds of amps of load current for short periods of time, and thousands of amps of short circuit current. [1]

Batteries using other chemistries may be able to supply high currents, but many that include electronic charge and discharge controls may only be able to support minimal additional surge currents.

Battery short circuit current capability has multiple implications on charger design, including the necessary interrupt rating of breakers used in battery circuits.

Clearly the output current from rectifiers alone may be orders of magnitude less than the current available from batteries, so removal of batteries changes the short and long term current supplying capacity of the system.

Additional Parameters

Thermal Compensation: The ability of a battery charger to adjust it's output voltage to compensate for temperature changes is typically called "Slope Thermal Compensation". This will reduce the DC output voltage as temperature increases and minimizes the risk of battery overcharging and potential thermal runaway. If the battery is not being connected, this feature should be disabled to maintain constant output voltage.

Automatic Boost Charging: When a battery is called upon to support the load during a power outage, it will go through a discharge, and require recharging when the power returns. Many chargers have a feature that will automatically increase the charge (output) voltage to facilitate more rapid recharging. If the system is to be used without a battery this feature should be disabled.

Remote Voltage Sense: To ensure correct battery charging, some users employ remote voltage sense to precisely control the voltage at the remote measurement point (battery terminals). If the battery is not being used the remote voltage sense leads must be relocated from the battery terminals to a point close to the load connection to ensure proper load voltage.

Conclusion

If battery chargers are to be operated without a battery the performance of the charger needs to be carefully evaluated and correctly configured to be able to properly power the load. The use of multiple chargers and independent utility supplies to provide backup in the absence of a battery requires even more careful evaluation. The ability of multiple chargers to operate together in a dual redundant configuration should also be considered. The Integritas line of chargers have been evaluated in parallel operation and is the subject of a separate Application Note.

[1]Example: C&D Technologies TEL12-160FW - Max rated discharge current 800A, Short Circuit Current 5,600A TEL12-160FW Data Sheet 12-1022

https://www.cdtechno.com/pdf/lit/12_1022_0512.pdf

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OmniOn Power Inc.
601 Shiloh Rd.
Plano, TX USA

omnionpower.com

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