GROUND FAULT DETECTION
IN THE REAL WORLD

GOOD NEWS!

So, the "***GROUND***" indicator on your battery charger is ***ON***. It is most likely working properly, and has ***correctly*** detected a ground fault somewhere along the dc bus. ☺ Typically, it does ***not*** mean the charger is malfunctioning. Now all you must do is identify the ***source*** of the fault...and eliminate it.

BACKGROUND

Power plants and substations are initially clean and free of grounding material. As time passes, dirt and other contaminants pervade their environments. Batteries, often stored unprotected, can spill electrolyte onto the support racks and enclosures. This conductive electrolyte, combined with carbon dust and other conductive material, can cause an imbalance and a ground fault.

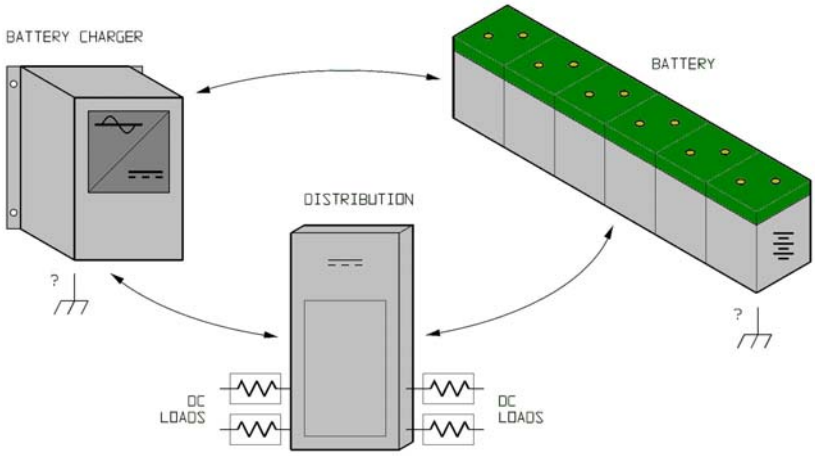
Placing two (2) battery chargers together onto one (1) battery is a common way to achieve a higher level of redundancy on the dc bus. This configuration also connects two (2) ground detection circuits in parallel, simultaneously cutting the detection sensitivity in half and doubling the current flow from the battery to building ground. A quick way to restore sensitivity is to disable the ground detection circuit on one (1) of the battery chargers. Some dc bus configurations can create a false ground fault when more than one (1) type of ground detection circuit is connected to the system. An imbalance can also be created in applications where two (2) batteries/chargers are tied together at the negative (-), with two (2) separate positive (+) feeds to the individual dc loads. Each battery charger contains its own ground detection alarm circuit which is in parallel with the negative (-), but ***not*** with the positive (+).

SO...WHO'S AT FAULT?

There are three (3) ***major*** components along the dc bus.

- charger
- dc loads
- battery

There are often several other components, or configurations. Any one (1) of these can become the source of a ground fault.



TROUBLESHOOTING GROUND DETECTION CIRCUITS

Once a ground fault has been detected, measure and record the two (2) voltages, between building ground to positive (+) and building ground to negative (-). Next, measure the ***total*** dc bus voltage.

- If there is a slight difference between the first two (2) measurements, then there is a ***partial short to building ground***. Depending on the detection circuit supplied with the charger, you will need to make calculations to determine the resistance of the ground fault that has been detected.
- If there is full voltage with one measurement and zero Volts with the other, then there is a ***direct short to the bus*** on the side that measures zero.
- If the first two (2) measurements are ***equal*** (half the dc bus voltage), then the ground fault alarm is false. The ground detection circuit may need an adjustment, or it may need to be checked for defective parts in the circuit. The problem is with the ***charger***.

FIXING A GROUND FAULT

Once we have determined the severity of the fault, we can examine the components that might contain those paths to ground. Often it is easy to shed the loads (one at a time) to find the partial short through the dc distribution panel. If the ground fault to the dc bus is a direct short, remove pieces of equipment connected to the dc bus one (1) at a time. Attempt to determine the location of the fault in the following order:

1) First, remove the ***battery charger***. This often removes the ground detection circuit itself. Once the dc bus leads are removed, a DVM can be used to measure the voltages between the dc bus and building ground, to see if the bond to ground has been reduced.
2) If the short to building ground is still present, reconnect the battery charger utilizing its ground detection circuit. Shed the individual ***dc loads*** one (1) at a time. Identify if (and when) the ground fault disappears. Inspect wiring to and from the dc distribution panel.
3) The last place to look is the ***batteries***. If the battery charger can ***fully*** support the dc loads, lift the main leads off the batteries. Use a DVM to measure voltage of the dc bus to building ground. Inspect the battery cells / jars, intercell connectors, and support mechanism (rack).

OTHER SOURCES OF GROUND FAULTS (not dc sources or loads)

We have covered the ***main*** electro-mechanical sources of possible ground faults.

1) battery charger / rectifier
2) dc distribution panel / individual dc loads
3) battery / intercell connectors / rack

If the fault is not present in these components, check the following:

1) Are two (2) battery chargers operating in ***parallel***? If the dc output connections of two (2) or more rectifiers are paralleled for system redundancy, a false ground fault can sometimes occur if one (1) of the units is turned ***off***. Inspect all battery chargers along the dc fault, and confirm they are all operating, and properly configured for parallel operation. If possible, ***disable*** the ground detection circuit in the secondary charger, and allow the primary to properly detect faults.
2) Are any powered components (e.g. ac-to-dc inverter, dc-to-dc converter, vent/fan controller, etc.) installed along the dc bus? Likewise, are any ***pass-through*** components (e.g. battery disconnect switch, dc fuses, steering diodes, CEMF device, etc.) installed along the dc bus? Inspect, and if possible, ***isolate*** these dc components to see if the fault disappears.
3) Are any special ground fault detection circuits, ***external*** to the battery charger, installed along the dc bus? Inspect, and if possible, ***isolate*** these components to see if the fault disappears. If this succeeds, consider choosing only one (1) ground fault detection circuit to avoid such conflicts.
4) Is the installation ***dirty***? Coal-burning plants (or other industrial installations) often contain soot, which is an electrical conductor. Inspect and ***carefully*** clean off all components, especially uninsulated connections.
5) Has it recently ***rained***, or is the installation naturally damp? Water deposits can sometimes create an unwanted path to ground. These types of ground faults often disappear when the environment dries out. Inspect and ***carefully*** eliminate any moisture.
6) Is the wiring ***old***? Battery cabling features insulation, which can break down over long periods of time. Carefully inspect all dc cabling between the major components listed above.
7) If all else fails, and a ground fault still exists, **contact** the battery charger manufacturer for further assistance.

RELATED MATERIAL

JD0062-00 SCR/SCRF Application Note: Measuring Battery-To-Ground Voltages