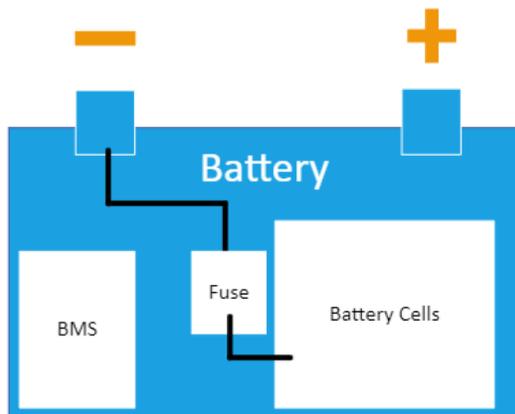


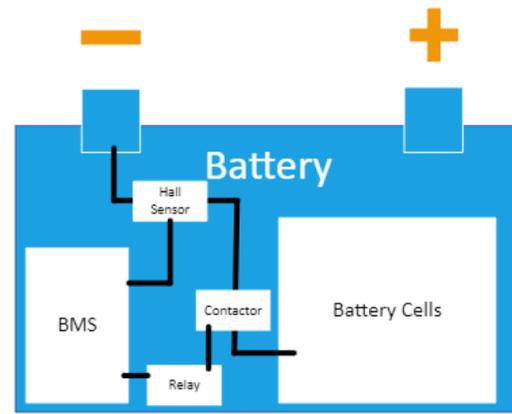
## Ground Fault Monitoring and Protection with eVault MAX and eFlex

### Introduction

Fortress batteries monitor and control ground faults through multiple, redundant means. Lithium batteries have very low internal resistance—which means true ground faults would attempt to dump the entire battery potential to ground, far exceeding the battery continuous amperage rating. As shown in Fig 1, an internal fast-trip 350A fuse will interrupt this current flow. The fuse will also interrupt severe arc faults. This protection is part of the batteries UL1973 listing.



**Fig 1.** Battery Fuse Protection



**Fig 2.** Current Sensor for Overload Detection

### High Current Fault Monitoring

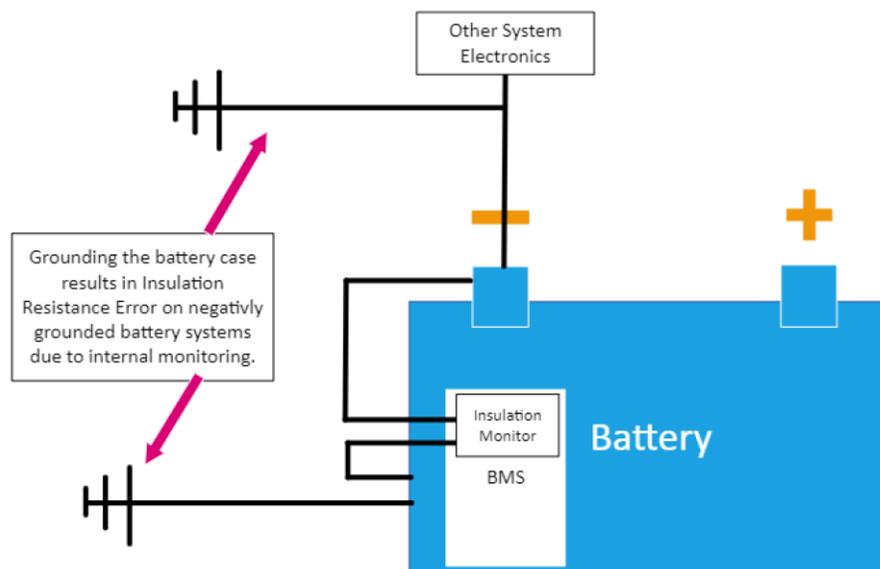
An integral part of UL1973 testing is the additional fault protection provided by the BMS. Inside both the Max and eFlex a sophisticated Hall effect sensor continuously monitors the battery current (Fig 2) and is able to disconnect it from the circuit with a high amperage contractor. Surge currents exceeding the battery maximum output rating for more than 10s will trigger the contractor. This protects against ground faults, battery-to-battery back-feeding, and oversized inverters with bad programming. Another example of when this same error can occur is when battery inverter capacitors are energized for the very first time, causing a brief current surge due to the low ESR (equivalent series resistance) of the internal filtering capacitors, resetting the battery will re-initiate the battery pre-charge circuit which will clear this kind of short circuit error.

## Insulation Resistance Monitoring

Another kind of short circuit can occur if the battery cells contact the inside of the battery case (both positive and negative would need to contact to result in a fault). This event is monitored by BMS insulation resistance monitoring.

Ironically, grounding the battery case to the rest of the electrical system can interfere with built-in insulation resistance monitoring for “negatively grounded” inverter systems (modern battery inverter systems typically leave the battery conductors ungrounded). If the battery case is grounded and the battery negative is grounded, no resistance differential will be measured between the battery negative and battery case.

While a grounding stud is provided on the eVault MAX and the eFlex has a T-slot channel where a standard ground lug w/ WEEB clip or grounding star may be installed if required by the local jurisdictional authority—it should be noted that there is already internal monitoring inside the battery to detect faults to the battery case or ground and deactivate the battery. The simplest solution to maintain the integrity of this internal insulation resistance monitoring circuit is to leave the battery case ungrounded.



**Fig 3.** Internal Insulation Resistance Monitoring Diagram



## Application Note

### **About Fortress Power**

Our mission is to provide compact, user-friendly, and affordable energy storage solutions using the latest technology for all homes and businesses. Fortress solar energy storage batteries can easily integrate with new and existing PV systems and work with a wide range of existing inverter and charge controller manufacturers for ease in system design.

### **Contact Information**

Address:

Corporate Headquarters  
505 Keystone Rd  
Suite D  
Southampton, PA 18966 USA

Website: [www.fortresspower.com](http://www.fortresspower.com)

Phone: (877) 497-6937

### **Legal**

Fortress Power assumes no responsibility or liability for loss or damage, whether direct, indirect, consequential or incidental, which might arise out of the use of this information. Use of this information is entirely at the user's risk.

Fortress Power cannot be responsible for system failure, damages, or injury resulting from improper installation of their products. Information included in this document is subject to change without notice.

© 2021 by Fortress Power LLC. All Rights Reserved.