

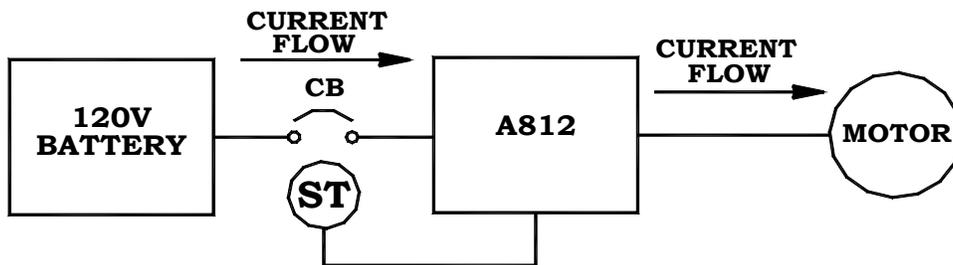
Brookville Mining Equipment Corporation
Product Information Bulletin 60 (02-12-04)
Brookville Battery Units
Installation of a Braking Module

Purpose:

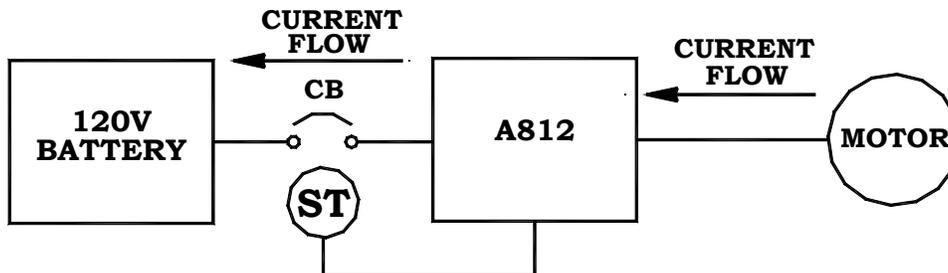
This information bulletin is to provide information on improving electrical braking on Brookville battery machines. It has recently been discovered that operating a battery machine with a faulty battery could result in loss of regenerative braking due to an over voltage condition. The following information explains the how regenerative braking operates and why a brake module should be added.

Current Machine Operation:

During normal tramping and acceleration, current flows from the battery to the A812 controller and then to the motor.



When an electric vehicle is slowing down, the motor becomes a generator and provides energy to the batteries. An additional benefit of this process is the braking effect of the motor on the vehicle, thereby reducing mechanical brake wear. During "regen" braking, current flows from the motor to the A812 and then to the battery. This current is controlled to provide smooth electrical braking.



Due to the energy returning to the batteries during regen braking, the battery voltage will rise. For example, under normal conditions a “healthy” 120V battery absorbing 300A of regen current might show 150V for a short duration. There are some instances that may cause the voltage level to rise to higher levels. To protect the A812 controller and motor in the event of these higher voltages, two levels of over-voltage protection are provided:

165V – the A812 will be inhibited momentarily until the voltage drops below 160V after which braking can be resumed.

200V – the A812 shuts down and trips the circuit breaker.

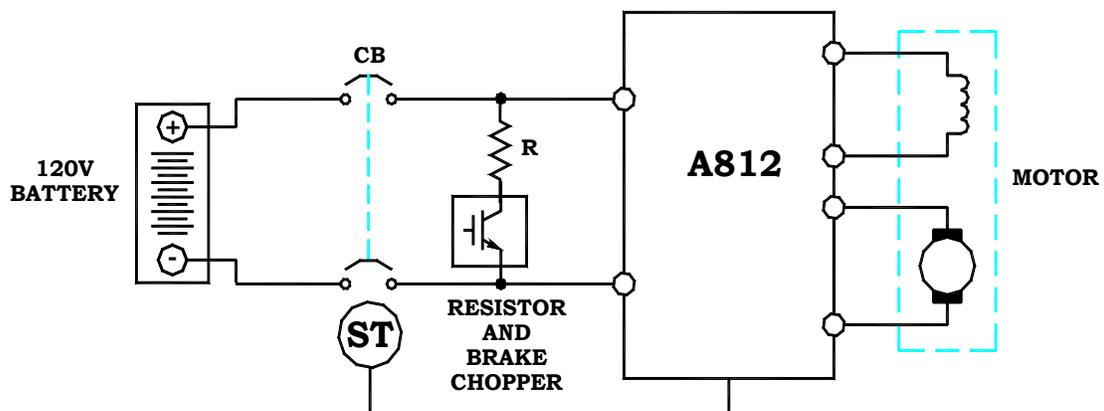
If the internal impedance of the battery happens to increase, the resulting battery voltage may rise above the 165V protection level during hard electrical braking. Some of the reasons for this increased internal impedance may be:

- Low water level
- Bad cell
- Shorted cell

When the battery is healthy, its voltage at 300A braking current is less than 160V, but if the water level is low (or other battery related problem) it might go above 165V and momentarily inhibit the A812, in which case the operator will lose electrical braking control until the voltage returns below the trip level.

Machine Operation with Added Brake Chopper:

The Over Voltage trip problem with a faulty battery can be eliminated by the addition of a brake chopper as shown below. The chopper is set to turn ON at 155V. If the battery impedance has increased, the resistor will be switched ON to absorb the excess energy during regen braking to maintain the battery voltage level less than 160 V.



The Brake Module also provides a contact closure, which can send a signal to the vehicle operator indicating repeated operation of the braking module. This would be an indication of battery degradation alerting the operator to have maintenance of the battery performed. This contact can be programmed to activate after a preset number of cycles in a set period of time to avoid nuisance indications and allow for self resetting of the indicator.

It is very important to maintain a healthy battery by ensuring that the water level in all cells is always at the appropriate level. A regular battery maintenance schedule is important to ensure:

- Safety during vehicle operation
- Longer battery life
- Longer vehicle operating time before battery is recharged
- Better regen braking
- Increased mechanical brake pad life

Please note the purpose of this system is to prevent loss of regenerative braking under normal operating conditions. Instance where the E-Stop button is pressed, all electrical power to the unit is disconnected. This disables all electrical related functions including but not limited to tramming, regenerative braking, lights, sanders, horn, etc.

Action:

Brookville recommends all equipment built before January 1, 2004 be upgraded with a Braking Module kit designed for the particular machine model and a regular battery inspection be added to the maintenance schedule.

Units Affected:

Brookville manufactured battery machines built prior to January 1, 2004.

Verification:

Contact Brookville Equipment Corporation at (814) 849-2000 with the machine model and serial number specifications for a price of the Braking Module kit required for a particular machine.