

# APPLICATION NOTE

## Power Electronics State of Charge Readings and Aquion Products

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For all Aquion batteries

April 15, 2016

### Summary

Battery state of charge (SOC) is an important parameter of any hybrid renewable power system. The accessory battery management systems (BMS) for nearly all commercial off-the-shelf (COTS) inverters are preconfigured with settings for calculating and displaying the SOC of lead acid batteries. Due to fundamental differences between lead acid and Aquion's Aqueous Hybrid Ion (AHI™) electrochemistries, the algorithms used by these inverters do not calculate and display an accurate SOC reading for Aquion batteries. This application note explains why, what it means for Aquion battery systems, and what Aquion customers can do about it.

### Background

SOC is usually for information purposes only. However, it is still very important to display a reasonably accurate number because the "energy left in the tank" profoundly impacts end-user perceptions of the energy storage system's quality, system performance, and overall reliability and utility.

SOC readings can also be functional. Some systems base their generator or grid connection dispatch decisions on the calculated SOC of the energy storage system. In these instances, overall system performance hinges on accurately measuring the battery's SOC.

The ubiquitous lead acid battery has been made for over a century, has remained technologically unchanged for 30 years, and has been well studied and documented. Inverter manufacturers have had a long time to develop and incorporate lead acid SOC algorithms.

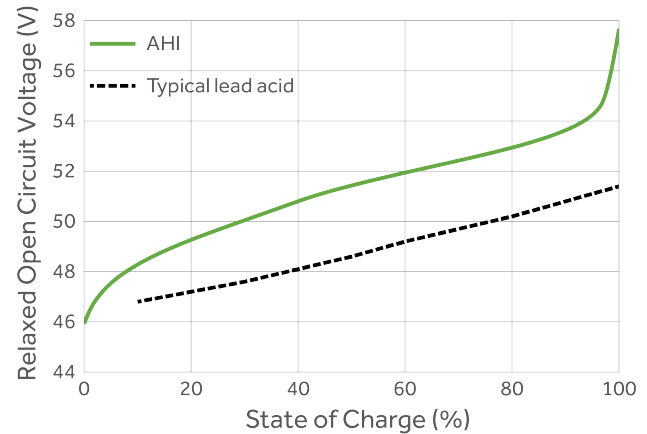
By comparison, Aquion is a relative newcomer to the industry, so COTS inverters have not yet incorporated our batteries' parameters into their SOC algorithms. Customers eager to use a cleaner, more robust battery product often install AHI batteries and use the lead acid settings on their power electronics. Most of these scenarios do not compromise the overall function of the system. However, these customers often note that the SOC of their newly installed AHI system doesn't quite match expectations.

## Technical Details

Comparing the SOC versus open circuit voltage graphs of lead acid and AHI batteries shows why lead acid SOC algorithms don't map well to AHI SOC. The lead acid curve shown is representative of typical valve-regulated lead acid (VRLA) batteries, with voltage scaled up to the AHI battery's voltage range.

To determine battery SOC, most inverters combine voltage measurements, temperature compensation, and charge/discharge amperage compensation. The AHI battery chemistry simply has a different set of parameters, which means lead acid calculations do not produce the correct value.

### Voltage vs. Capacity



## What does this mean for my system?

Again, for most systems, having an accurate SOC does not have a direct impact on system effectiveness. However, if you have an Aquion battery system and require an accurate SOC measurement and readout, Aquion recommends buying and installing its battery monitoring system (BMS-200) and, for stack-based installations, its stack sensing system (SMI-100). These systems deliver the accurate SOC values for Aquion batteries. In most cases, if you install the Aquion BMS, you won't need the inverter manufacturer's BMS.

[BMS-200 specification sheet](#)

[SMI-100 specification sheet](#)

Aquion is developing a simplified and more cost-effective solution for sensing and monitoring smaller AHI energy storage systems. This alternative will be available for purchase in the second half of 2016.

## Next Steps

To encourage more direct support of Aquion batteries in power control electronics, we're engaging with leading inverter manufacturers. You can help. Contact the manufacturer of your power electronics and tell them that they need to support Aquion's state of charge algorithms on their inverters and battery monitoring hardware. This is the simplest and best solution, and Aquion is ready to deliver and support AHI-specific calculations on your favorite hardware platforms.



32 39<sup>th</sup> Street  
Pittsburgh, PA 15201  
412.904.6400  
[aquionenergy.com](http://aquionenergy.com)

## Contact Us for More Information

If you purchased your batteries from an authorized Aquion Energy dealer, please contact the dealer for assistance. If you purchased your batteries directly from Aquion Energy, contact Aquion Technical Support: <http://www.aquionenergy.com/support>.

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