Part 02

Developing Technologies for Operation and Maintenance Services

Battery Status in Analog

Lithium ion batteries have been increasingly adopted recently in place of lead-acid batteries in power devices such as DC power supplies or uninterruptible power supplies (see ●Fig. 1). Lithium ion batteries require less space while allowing an electrical load to be supplied with emergency backup power over a long period such as during a power outage.
We have developed a power device capable of outputting information representing the operational status of the lithium ion battery with analog values to accommodate the variety of needs of our customers. This article describes situations which may require the battery status to be output with analog values and explores a specific technique for providing this kind of analog output.

1. Analog Representation of the Battery Status

The status of a lithium ion battery is monitored via various sensors and a battery management unit, which is installed near the lithium ion battery. The battery management unit estimates the operational status of the battery on the basis of the current flowing through the battery, the battery voltage, the temperature, etc., and outputs the operational status estimated as a digital signal. Having a communication interface for receiving the digital signals sent from the battery management unit allows for the battery status to be detected by a peripheral device or to be determined remotely.

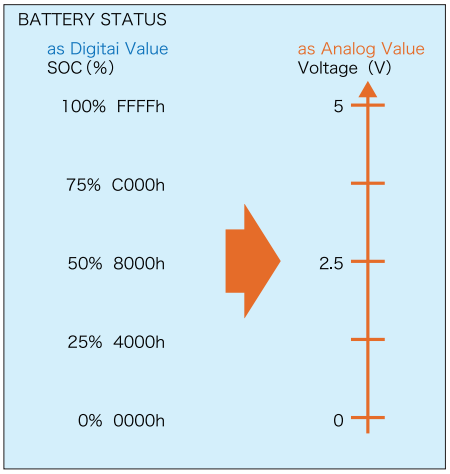
In some cases, a customer may choose to replace the lead-acid batteries in an existing installation with lithium ion batteries. However, the existing installation may have no communication function capable of receiving digital signals from the battery management unit or it may be difficult to retrofit the existing installation with a communication interface. An analog-based output of the battery status may be desirable even in such a case, assuming that the signals could be received as long as the signals were analog.

●Fig. 2 depicts an example of presenting the state of charge (SOC) of a battery with the voltage value as the analog value. The digital value output from the battery management unit represents the SOC of the battery at that point in time (0 to 100%). This digital value can be converted using a D/A converter to voltage values of 0 V to 5 V.

The various digital signals representing the status of the battery may be converted to current values instead of voltage values.

●Fig.1 Lithium Ion Battery based Power Device

●Fig.2 Example: Analog Output of the Battery Status



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2. The Analog Output Unit

GS Yuasa has developed a power device[1] that uses an analog output unit (●Fig. 3). The analog output unit receives the battery status sent as a digital signal from the battery management unit, converts the digital signal to an analog value and outputs the analog value.

Here, the D/A converter is provided, not in the battery management unit, but in the analog output unit which is placed close to the electrical load. Thus, the battery status can be transmitted from the battery management unit to the analog output unit via a digital signal cable that is less susceptible to electrical noise (e.g., an RS-485 cable). There is no need to make any alterations to the battery management unit for the device to provide an analog output.

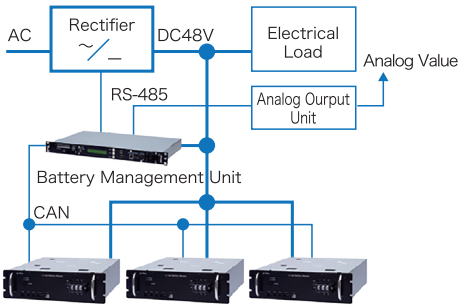
As an example, the analog output unit may be provided in compact case that has a built-in D/A converter (●Fig. 4). The case includes a connector that connects the digital signal cable from the battery management unit and an analog signal connector. The analog signal connector connects to an analog signal cable from the analog communication interface provided to an existing installation that has the electrical load.

The analog output unit converts the value data sent from the battery management unit to a voltage value of 0 V to 5 V and outputs the converted value on the analog signal cable. These value data include the average value of the SOC of multiple batteries or the state of health (SOH) of the battery with the most deteriorated SOH. For example, when the average value of the SOC of multiple batteries is at 50%, the analog output unit outputs a voltage value of 2.5 volts (see ●Fig. 2).

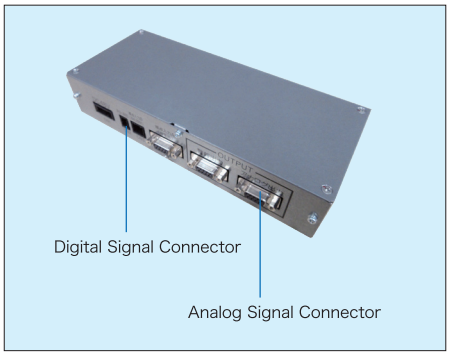
This kind of analog output unit allows an existing installation which has no digital communication interface available or cannot be retrofitted with one, to receive the battery status as an analog value. Thus, the lithium ion batteries can be monitored remotely, making it possible to track the SOC of the batteries supplying backup power during emergencies, or schedule preventative maintenance to replace aging batteries during normal times.

This article explored a technique in which the status of a lithium ion battery could be output as an analog value. As described here, GS Yuasa will continue to develop technologies that accommodate the needs of our customers including needs in the operation and maintenance of our batteries.

●Fig.3 A Power Device with an Analog Output Unit



●Fig.4 Example of an Analog Output Unit



1. Japanese Patent No. 7056771, International Patent Application No. PCT/JP2021/041819 (Filed in 2021)

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