Advanced Metering Technology Can Improve Battery Application Reliability

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Lentequip Inc.

The need for reliable and predictable portable power is widespread, and the Film and Video Production Industry is certainly no exception.

The evolution of battery chemistry continues. However, no matter what the chemistry happens to be, the need for monitoring the performance and life cycle status of *any* given battery product is universal.

It has been customary to measure the energy capacity of any battery in Ampere-hours. However, an ampere-hour is not really a measure of energy at all, but rather a measure of the number of electrons pumped around the circuit in an hour.

Ampere-hours are used to allow battery running time to be approximated using the simple formula: amp-hours = I*t. For example, a 100Amp-hour battery theoretically will run for 100 hours at 1 Amp before all energy is removed, or equivalently it will run for 1 hour at 100 Amps. Standardized tests have evolved with this underlying I*t concept.

Many battery users will know from experience that a battery having a so called 100-amp hour rating, does not always deliver the expected running time the I*t calculation predicts. This is because in real life loads vary, and so do the losses in the battery. This makes the simple I*t formula somewhat inaccurate.

Figure 1 illustrates a realistic view of the situation. The user's load is not constant, nor is the internal resistance of the battery.

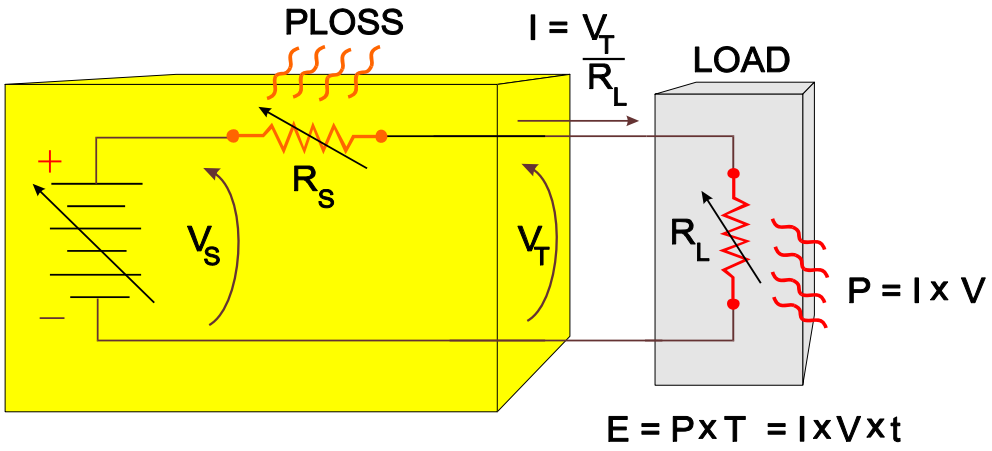

FIGURE 1

As the battery discharges, all of the energy stored in V_S never makes it to the load R_L. Similarly, when the battery is charged, all of the energy delivered from the charger, never makes it into the battery source V_S. This is why batteries feel warm when they are charged and discharged. Some battery chemistry and construction types can even become explosive if the loss power is too great. If an internal short happens, high internal temperatures from excess internal power loss can lead to rupture of the casing.

In the more typical scenario, as batteries age and begin to wear out, the amount of total energy lost in the internal battery impedance during the charging and discharging process tends to grow. This is a result of various chemical and physical wear out mechanisms which progressively affect the charge and discharge efficiency of the battery.

The energy loss taken to charge and discharge a battery is a useful indicator of battery health and age. If one could measure the characteristic energy loss in a given battery at various stages of its life cycle then it would be possible to monitor battery quality and gauge its reliability as it ages.

Lentequip Inc. has designed and developed a new product that is capable of measuring Watt-Hours for this purpose, as well as providing many other measurement capabilities. It is called the BrainDrain®.

During a charging process the BrainDrain® counts up from zero until the battery is fully charged. Figure 2 illustrates the typical charging setup. In this example, a final reading of 130.5 Watt-hours represents the energy taken from the charger. When power is disconnected, the BrainDrain® remembers this Watt-hour reading which is displayed again the next time it is powered up.

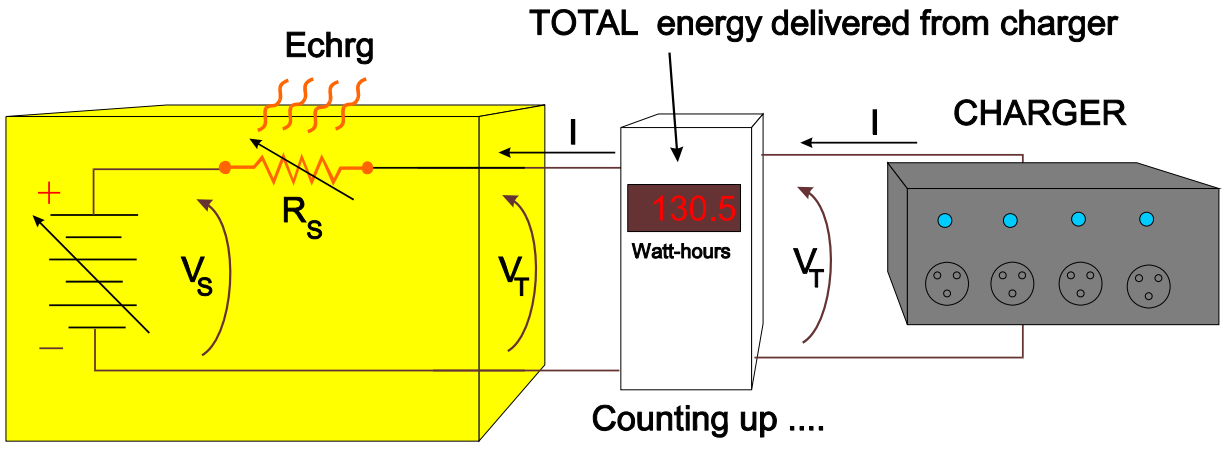

FIGURE 2

When the battery is subsequently reconnected in the application and discharged into a load as shown in Figure 3, the BrainDrain® operates in reverse and monitors how much total energy is extracted from the battery. The BrainDrain® counts down but never reaches zero, because no battery is 100% efficient. The Watt-hour reading that remains on the BrainDrain® when the discharge is complete is an indication of the combined charge and discharge energy losses of the battery.

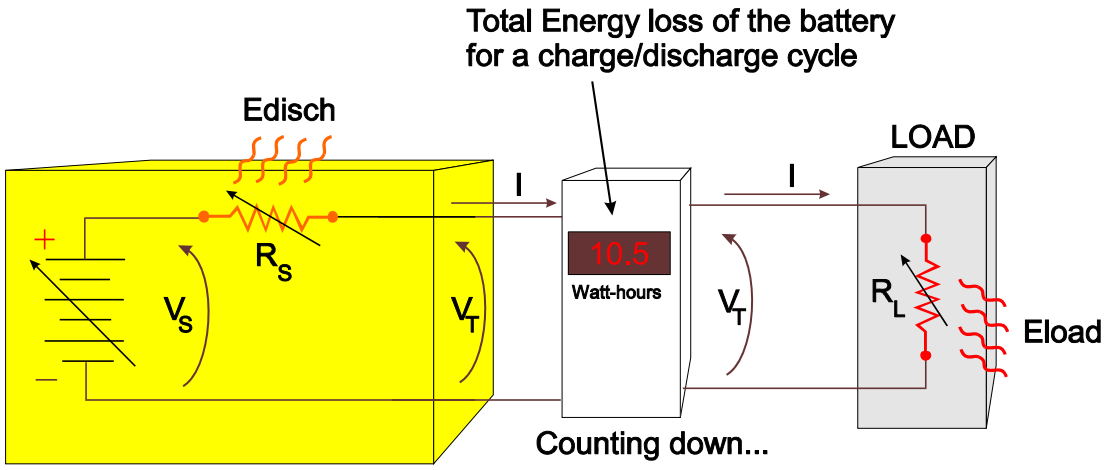

FIGURE 3

This loss energy can be logged over the battery life and used to establish the quality and life-cycle state the battery.

The BrainDrain® has many other useful applications as well. For example, the BrainDrain® can be used to determine the general energy requirements for any particular equipment setup and application.

At the beginning of a shoot, the BrainDrain® Watt-hour accumulator can be reset to 0000, and at the end of the shoot the energy consumed by equipment setup will have been measured. This allows one to better plan the battery needs for the next job.

The BrainDrain® offered by Lentequip is a smart cable that measures Volts, Amps, Watts, Amp-Hours and Watt-Hours. The voltage input range is +/-50V and +/- 15A DC.
It has the ability to store personal ownership information in non-volatile memory. It has two current direction LED's that indicate the direction and amplitude of current flow. As current amplitude increases the direction LED's blink faster. The display can be selected manually by pushbuttons, or alternatively an automatic display scan mode can be selected that pauses as the reading of Volts, Amps, Watts, Amp-Hours and Watt-hours are progressively scanned in an endless loop. This allows a user to read a great deal of

information “hands-free” even when standing several meters away, which is extremely convenient.

Amp-hours and Watt-hours are accumulated continuously. When powered-down the BrainDrain® “remembers” the Amp-hour and Watt-hour settings, as well as any other settings that are in effect.

The BrainDrain® has two main power lines and behaves as a pass-through device with independent replaceable fuses in each of the lines. This provides comprehensive short circuit protection. A third wire that is also fused is provided to allow the BrainDrain® to communicate with compatible Lentequip batteries. These are equipped with embedded chips that contain information about the battery. The BrainDrain® can measure current, power and energy flow in any direction and in any connection polarity. In engineering terms, this is referred to as a four-quadrant measuring device.

The BrainDrain® has a user adjustable display intensity that is restored to its last setting on the next power-up and is remembered on power down. It also has a USB port that allows remote software upgrades. This will allow support of PC interface programs already in planning for the future. It is designed to work with another new product soon to be introduced by Lentequip Inc. that is called the Drain. The Drain will contain an electronic load that will allow the BrainDrain® to control and execute specific load tests on batteries automatically to allow detailed measurement, logging and reporting of the loss Energy as described in this article, as well as many other important parameters.

Figure 4

The BrainDrain® will be demonstrated at CINEC, Germany, in September 2006. BrainDrain® production units will be available for purchase later this year. For more information see www.lentequip.com.

Biography:

Michael J. Richards is President of Algozen Corporation and Senior Design Engineer of Lentequip Inc. He is a power electronics, motor control and digital signal processing specialist, and consults to the commercial, industrial, biomedical, military and aerospace sectors.