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Extending the Life of Batteries through Rational Exploitation

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GOAL OF THE STUDY

The development of the car market in the direction of electric traction, but also in general, the increasing use of electricity storage in batteries, has generated an approach regarding the duration of use of batteries. In order to reduce costs, we are trying to find solutions to increase the duration of their use. There is a limit to the number of charging-discharging cycles.

METHODOLOGY OF THE INVESTIGATION

For a period of time, the idea of this article is to reduce the number of charge-discharges, which can be achieved by using the battery's charge and discharge limits to the maximum.

There are two basic methods of charge-discharge process (applicable more or less to various types of batteries): constant current charging, constant voltage charging and some combinations thereof .

The design started from the idea that the lifetime of the battery depends on the finite number of charge-discharge operations. A possible solution to reduce them in a given time interval is to increase the amount of time that the battery voltage varies between the upper and lower limits of the battery voltage by doing more extensive charge-discharge operations, Fig. 1.

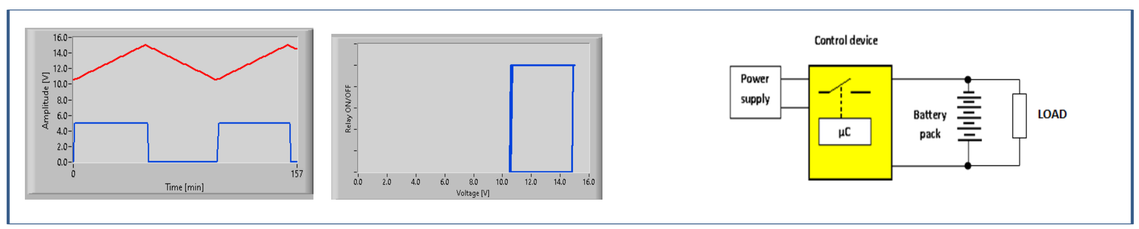

Fig. 1. Method of charge-discharge operation (left), block diagram of device (right).

MAIN RESULTS FROM THE STUDY

The device shown can interleave between power and battery, Fig. 1. It is assumed that the load is attached directly or through another circuit to the monitored battery. A schematic with microcontroller, power supply and power element was designed. The microcontroller allows versatility, greater adaptability of the device to the battery; the functionality can be modified by rewriting the program. In addition, a display and a series of buttons can be used to control the device.

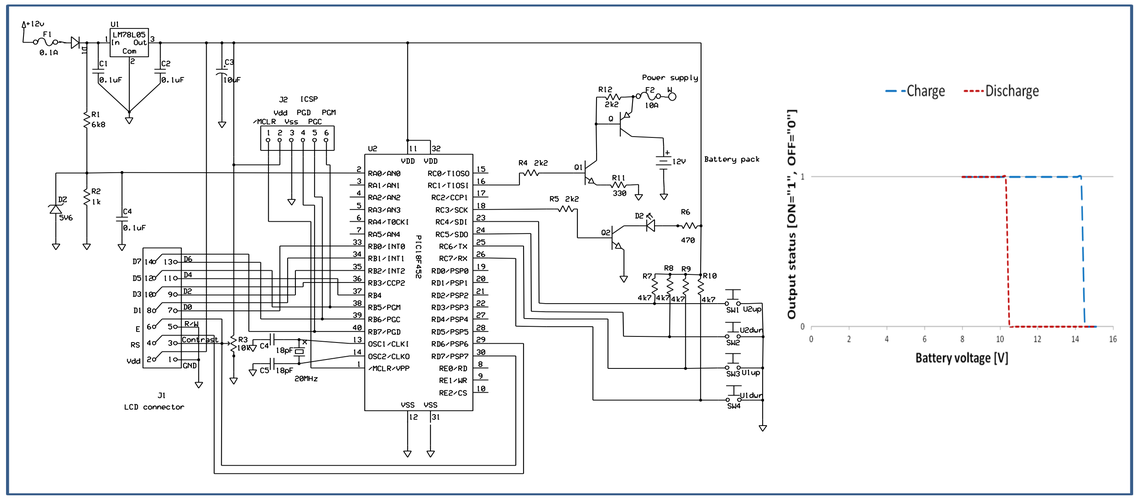

Fig. 2. Circuit schematic of proposed charge-discharge device (left), example of experimental hysteresis (right).

The developed algorithm is optimized, in the sense that the possibility of "hanging" is avoided, if a loop were to be used. It also avoids multiple readings, because it avoids situations where the load varies and can affect the hysteresis limits. The program in the microcontroller allows changing the hysteresis thresholds. These limits defined for each battery depend on the battery technology used.

The hysteresis can be adjusted in steps of 0.1 V. Must be take care not to exaggerate the voltage limits for the hysteresis, because it is possible to enter an area where is an operating regime inappropriate for the battery.

The experimental hysteresis here is about 3.9V and can be easily customized from the switches.

CONCLUSIONS

Batteries are still the most common way to store energy. Their longer lifespan was reflected in operating costs. There are additional related implications, such as environmental protection by reusing the chemical elements in the battery composition.

To extend the life of the battery, you can act on the time interval between charges. In this sense, achieving a hysteresis in charging and discharging is an example that can be considered. The device also finds use in the charging operation of various rechargeable batteries (Li-Ion, Cd-Ni, Ni-MH) with minimal redesign, especially in software.

The reconfiguration will take into account the typical charging characteristic for each battery type separately. It doesn't matter if the charging method uses constant current or constant voltage; the device monitors the voltage. Depends of battery type, life span can increase more than 50%. Extending battery life is done by how it is used, not by intervention on it. The major challenge for the design of this device was to build up a robust algorithm to achieve hysteresis in battery charging.