

Automation of Battery Testing

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ABSTRACT: To design a complete modular setup to test the life of the silver oxide batteries being monitored by data acquisition system. A completely new PCB board is designed or developed where batteries are clamped on it and placed over the cabinet. To test the capacity of various silver oxide batteries, the variable load resistor is used. Initially the voltage of the battery is 1.55V. When the load is connected, the voltage of the batteries starts draining and the voltage is noted at regular intervals (every 1 hour) till it reaches 1.2V and it is also noted up to the end point. If the battery reaches 1.2V in a short period, then the battery is said to be defective else non-defective battery. The data acquisition system is interconnected with the battery testing module for the ease and effective monitoring purpose.

KEYWORDS: Data acquisition system, PCB board silver oxide battery, load resistor

I. INTRODUCTION

Periodic testing and maintenance of battery banks is imperative to ensure reliable delivery of power when they are called upon. There are a number of different tests like: visual inspections, specific gravity, float voltage and current measurements, discharge test, individual cell condition, inter-cell resistance, and others, which are used for diagnosing the condition of the battery banks. Among all the tests, the discharge test (also known as load test or capacity test) is the only test that can accurately measure the true capacity of a battery system and in turn determine the state of health of batteries.

II. EXISTING METHOD

For the development of the new technique, operation, process or methodology it is very important to make detail study on the existing techniques, operation, process or methodology and to understand the same for elimination of problems concerned with them. This section covers the literature review for battery testing and its parametric study carried out by other researchers in the same field. This study can be helpful in determining the accurate capacity of the battery, reduces the human efforts and also eliminates human errors. The samples of the batteries are loaded on the PCB board with fixed resistors. The load resistor varies for each battery. The PCB board is placed in the form of rack over the cabinet. The voltage has been recorded manually against time. The voltage is noted down at regular intervals (1 day) from its initial capacity (1.55V) till it reaches up to a certain level (1.2V). After above levels (1.2V) has been reached, the frequency of noting down the voltage increases to every four hours until the end point is reached. Based on the manually recorded voltage the capacity of the batteries is calculated.

A. DISADVANTAGES

1. This method is completely manual and the load used to discharge the battery is a fixed resistor. If there is a change in the value of the resistor by the battery manufacturer, then the resistor in the board has to be removed and replaced with the new value specified.
2. The critical period is when the battery being discharged from 1.3V to its end point (1.1V), every drop in the voltage has to be recorded against time.
3. Hence if a single data point is missed, then the actual point in the drop of voltage cannot be observed leading to the reduction in the accuracy of the measurement.
4. There may be a probability of human errors.

III. PROPOSED METHOD

In this proposal, we are going to design an automation of battery testing using data acquisition system. A completely new PCB board is designed or developed where batteries are clamped over it. Each PCB boards are given a unique identification number. The boards are mounted on the PCB cabinet in the form of racks. Connections are given at the backside of the cabinet which gets interfaced with the data acquisition system for monitoring of the data such as the voltage level each batteries are stored on memory every 1 hour automatically. Therefore, it is easy to view the details through PC interface.

A. ADVANTAGES

- Since the variable resistor is used on the PCB board, it is easy to set the resistor value.
- Data acquisition system automatically records the voltage levels of each battery against time.
- Avoidance of missing of data.
- There is no probability of human errors.
- Accuracy of data is provided.
- Voltage levels of different batteries are viewed simultaneously.

IV. DATA ACQUISITION TECHNIQUE

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems, abbreviated by the acronyms DAS or DAQ, typically convert analog waveforms into digital values for processing. The components of data acquisition systems include:

1. Sensors, to convert physical parameters to electrical signals.
2. Signal conditioning circuitry, to convert sensor signals into a form that can be converted to digital values.
3. Analog to digital converters, to convert conditioned sensor signals to digital values.

A. DAQ HARDWARE

DAQ hardware is what usually interfaces between the signal and a PC. It could be in the form of modules that can be connected to the computer's ports (parallel, serial, USB, etc.) or cards connected to slots (S-100 bus, Apple Bus, ISA, MCA, PCI, PCI-E, etc.) in the motherboard. Usually the space on the back of a PCI card is too small for all the connections needed, so an external breakout box is required. The cable between this box and the PC can be expensive due to the many wires, and the required shielding. DAQ cards often contain multiple

components (multiplexer, ADC, DAC, TTL-IO, high speed timers, RAM). These are accessible via a bus by a microcontroller, which can run small programs. A controller is more flexible than a hard wired logic, yet cheaper than a CPU so that it is permissible to block it with simple polling loops. For example: Waiting for a trigger, starting the ADC, looking up the time, waiting for the ADC to finish, move value to RAM, switch multiplexer, get TTL input, let DAC proceed with voltage ramp.

B. DAQ DEVICE DRIVERS

DAQ device drivers are needed in order for the DAQ hardware to work with a PC. The device driver performs low-level register writes and reads on the hardware, while exposing API for developing user applications in a variety of programming environments.

C. DAQ SOFTWARE

Specialized DAQ software may be delivered with the DAQ hardware. Software tools used for building large-scale data acquisition systems include EPICS. Other programming environments that are used to build DAQ applications include ladder logic, Visual C++, Visual Basic, Lab VIEW, and MATLAB

D. DATA LOGGER

A data logger (also data logger or data recorder) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer, and use software to activate the data logger and view and analyze the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.



Figure 1: Front View Data Logger

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Figure 1 shows the front panel of the data acquisition system. It has a 6 ½ digit display with the DMM measuring 11 functions without external signal conditioning. It has 50K readings of non-volatile memory and can hold data even when power is removed.



Figure 2: Rear view – Data Logger

Figure 2 shows the backside of the data acquisition system. It consists of three slots which can be accommodating three DAQ cards of 20 channels each. It has a USB port, built in LAN and RS232 interface to connect the PC and other remote locations.



Figure 3: DAQ Card for 20 Channels

Figure 3 shows the DAQ card which is a relay multiplexer having 20 channels. Data logging is done by interfacing the battery terminals to the 20 independent channels

V. HARDWARE DESIGN

The block diagram consists of resistor board, battery board, data acquisition system and a PC interface. The resistor board consists of variable load resistors. Linear sliding potentiometers are used as load resistors. They are coupled together so that with a single slide, all the value of the pots is changed. This method ensures that any value of load can be set without removing the resistor from the board. The battery to be tested are 200 in numbers with each variant having 10 sets is clamped on the battery board connected to individual load resistors. The voltage from the battery is recorded by a data logger which captures the data at defined time intervals. When the end point of the battery voltage is reached (1.2V), the logging is stopped. The data logging is converted in to an excel format and data is stored for individual batteries. The following figure 4 shows the block diagram.

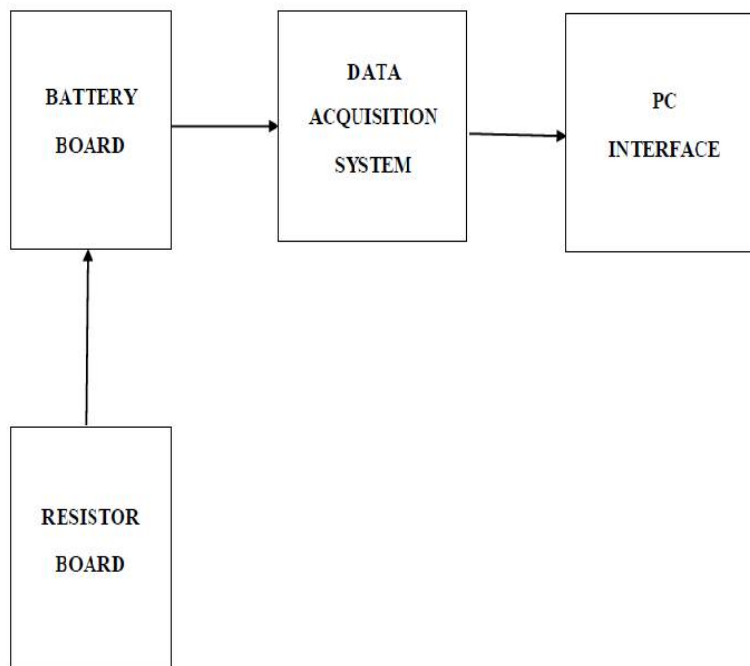


Figure 4 :Block Diagram

A. RESISTOR BOARD

Resistor board consists of a variable load resistor. Linear sliding potentiometers are used as load resistors. The potentiometers are a dual gang where a single pot can be considered as two individual resistors which gang range from 0-100 kilo ohm. The sliders are connected together such that all the pot values can be varied by a single movement.

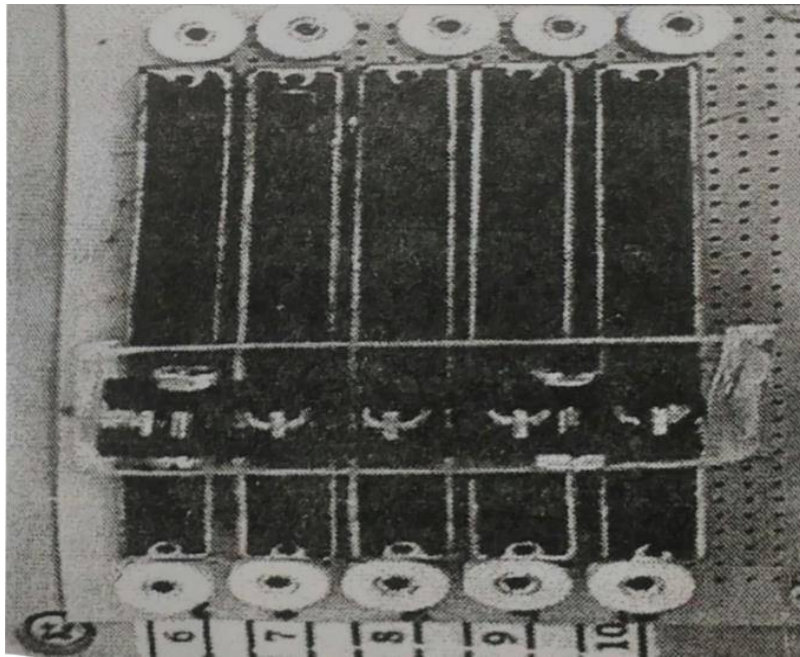


Figure 5: Resistor board

B. BATTERY BOARD

Each battery board consists of 10 batteries connected to 5 different potentiometers placed in a separate board. Silver oxide batteries are used for watches because of their consistent voltage drop.

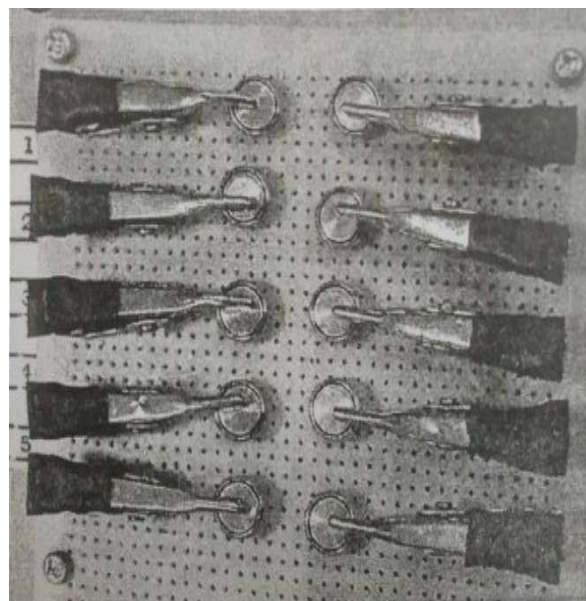


Figure 6: Battery board

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VI. CONCLUSION

This project is developed to automate the battery testing process in industries. Data acquisition system makes the testing process easy and effective where the human efforts are reduced. A continuous monitoring by the data acquisition system helps us to determine the accurate capacity or the life cycle of various silver oxide batteries.

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