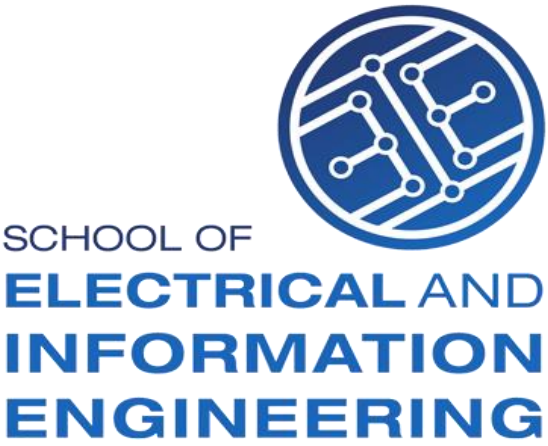
Charging Protection of a Lead Acid Battery



Measurement Systems: ELEN4006

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I. Introduction

Lead acid batteries are one of the most commonly used batteries for delivering an electric charge at a very high rate. However, they can cause serious injury if not handled correctly. The proposed measurement system makes use of Current Transducer (LA 100-P) to measures the current supplied when charging a Vented lead-acid (VLA) and Valve Regulated lead-acid (VRLA) cell/battery. The motive behind this application is due to the fact that when batteries are being recharged, they generate hydrogen gas (which is very flammable and can easily be ignited) and oxygen (which supports combustion) which can result in an explosion. By controlling the current supplied to the batteries, excessive charging can be avoided, which electrolysis some of the water in the battery causing it to emit hydrogen and oxygen in excess [1]. In some cases where a few batteries are being recharged at a time, the ventilation system can exchange an adequate amount of fresh air for the batteries. However, in places like mines, factories and etc. were batteries are recharged in large quantities, a system to help avoid excessive charging is essential to prevent an explosion. Also, a proper ventilation system is required in-case the hydrogen gas is over the limits (explosive limits are 4.1 to 72 percent hydrogen in air) [1]. This proposed system intends to use the tools mentioned above to automatically adjust current supplied to the batteries. This will make sure that the batteries are fully charged and not charged excessively.

II. Objectives

The measurement being taken is within the theme of Explosive Environments. It is also classified as an explosive atmosphere (zone 0) since explosive gasses are released into the air. This means no flame, burning cigarette, or other source of ignition should be permitted in the area. The LA 100-P current transducer will be used to monitor the current that is feed to the battery. If the current goes beyond the specified limit for the battery, the circuit supplying the current to the battery will be turned off.

III. Application Specifications

The LA 100-P current transducer will be used in a battery charge controller system. It will be used with the aim of protecting lead acid battery. The LA 100-P current transducer will be connected to the charging terminals of the lead acid battery and it will feed signal to the micro-controller. This will be in a closed loop control system, therefore the current sensor will give feedback to the plant/system in order for it to give desired output. The system will ensure that the battery is charged up to a maximum of 100% and discharged down to a minimum of 5% to increase its life span. In a nutshell the system will control the charging and discharging of the lead acid battery.

A. Dynamc Performance

- Accuracy of 0.45% at 15V and 0.70% at 12V
- Less than 0.15 linearity error
- Offset current of 0.10mA at an ambient temperature
- Magnetic offset current of 0.10mA
- Temperature variation of I_o is 0.05mA to 0.30mA at -25° to 85° and 0.10mA to 0.50mA at -40° to -28° respectively
- Less than 500ns reaction time
- Less than 1us step response
- Frequency bandwidth of 200kHz

B. Static Conditions

- Primary norminal rms current of 100A
- Primary current measuring range of zero to 150A
- Secondary nominal rms current of 50mA
- Conversion ratio: 1:2000
- Supply voltage from 12V to 15V

C. Operating Conditions

- An ambient temperature from -40° to 85°
- An ambient storage temperature from -40° to 90°
- Resistance of secondary winding is 120Ω at an a ambient temperature of 70° and 128/Ω at an ambient temperature of 85° respectively.

IV. Conclusion

The measurement system has a very excellent accuracy, good linearity, no insertion losses, and it will be used together with an ATmega 325-8-bit microcontroller.

References

[1] Lead Acid Batteries. [Online]. Available: https://www.mpoweruk.com/leadacid.htm. [Accessed: 10-Apr-2019].

[2] LEM, Current Transducer LA 100-P Data sheet, January 27, 2016 [Revised November 15, 2018].