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The Lithium-ion Battery Standby Power of Wind Turbine Pitch System

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Abstract

In this paper, the use of lithium-ion batteries as a backup power of pitch system of wind turbine is proposed. I designed the battery management system based on DSP28335 including the hardware and software of the system. By the use of CAN communication and voltage current Hall sensors, the system realizes the collection of cell voltage, total voltage, charge discharge current parameters of the batteries. I use Ampere-time integration and other methods to estimate the battery the SOC of batteries when it is charging or discharging. During the charging and discharging time， the data of ICA is recorded. Finally, the function of battery management system was verified by experiments.

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Keywods: Battery management system;Lithium-ion battery;Pitch system of wind turbine; Estimation of SOC

1. Introduction

Nomenclature

SOC	battery remaining capacity
ICA	the incrementation of capacity analyzing
OCV	the Open Circuit terminal voltage
CCS	Code Composer Studio

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1.1. Topic background

Pitch System is one of the important components of large wind turbines, it has a very important role for the entire wind turbine system's security,stability and economy. pitch system is typically equipped with backup power. When the grid power supply stopped, backup power is enabled to ensure proper operation of the pitch.

Currently, manufacturers usually use pitch lead-acid batteries or super capacitor as a backup power supply. However, lead-acid battery has a disadvantage of short life, low specific energy and high pollution. The high cost of super capacitor affects its application. Lithium batteries have mature technology and cost suitable for using in the pitch back-up power. With the development of lithium batteries, different cathode materials have also been developed, lithium batteries can achieve higher energy density[1]. At present, the lithium battery is divided into:lithium cobalt oxide, ternary materials,lithium manganese oxide, lithium iron phosphate and lithium titanate, etc. the lithium titanate battery's (Li4Ti5O12) temperature has advantage of long battery life and high security, so it's suitable for use as back-up power. From the economic analysis, although lithium titanate module's prices are twice as lead-acid batteries, but lithium titanate batteries don't need to maintain in three years, and lead-acid batteries need maintenance per year, highly frequency to replace, high labor costs and material costs, but also face the loss of turbine downtime. The cost of lithium titanate is getting lower and lower.In conclusion, the use of lithium titanate economy is better than lead-acid batteries. [2,3,4]

In this article I designed battery management system's software and hardware. It implements information of battery acquisition,battery charge and discharge control,SOC estimation and ICA data records.

2. The composition and function of battery management system

To replace the original pitch system backup lead-acid batteries, I use the lithium titanate battery whose capacity is 8.5Ah, cell voltage is 2.3V. It has 30 strings each modul, two modules in series. Herein, each battery module is equipped with a battery management system EV02 for detecting, they connected to the DSP board via CAN bus, DSP board is responsible for collecting information and the main battery control, the whole system diagram is shown below:

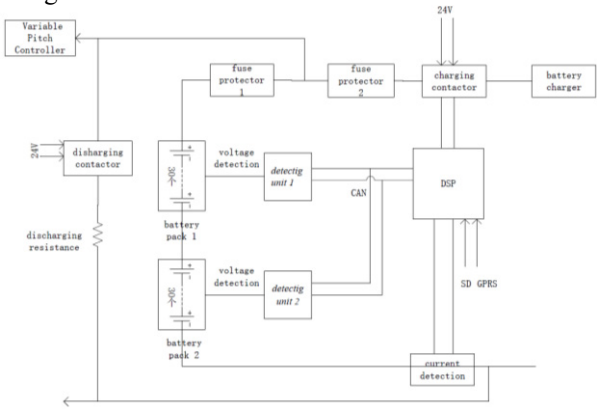

Fig. 1. Whole system

The system comes with the charging and discharging contactor for easy to control loop off during