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ELECTRONIC ENGINEERING

Development of Constant Current Charge Controller for 3KW Wind Turbine

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***Abstract*— This paper describes the development of constant current charge controller for 3kW wind turbine designing with 48VAC PM alternator. As the wind speed is not constant, the output voltage from the wind turbine is always changing. In the circuit design, the changing voltage is sent to the 48V battery bank (series connection with 12V 200Ah batteries) by using the constant current charging method to extend the battery life. It does not only provide the two-step charging; the first step for the slow charging and the second step for the fast charging, but also use the overheat sensing circuit to prevent the damage of the expensive battery bank. In this work, the controller circuit operates properly switching first stage or second stage alternately depending on the full/low battery voltage. Unfortunately, if the overheating condition appears in the circuit, the cut-out circuit using temperature sensor decides to stop charging. To indicate clearly the battery charging conditions, the LCD display unit using the microcontroller is provided in the circuit design. The current sensing circuit is also added to show the battery charging current on the LCD display through the microcontroller. In this paper, the voltage comparator circuit, the two-step charging circuit, the overheating sensing circuit and the LCD display are described by simulating with Proteus (ISIS) software.**

***Keywords*— Charge Controller, Wind Turbine, Lead-Acid Battery, Circuit Simulation, Proteus (ISIS) software**

I. Introduction

Harnessing the renewable energy is substantially increasing to generate the electricity as some other energy sources can cause the environmental problems. Wind energy is also becoming popular building the wind turbines to generate the electricity for both homes and industries. At the same time, batteries are also becoming necessary to store the energy for the off grid consumers. As the batteries are expensive, it needs to maintain a long life for them without damage. So, the battery charger and control unit are used between the wind power source and the expensive battery bank to be able to charge these batteries at a healthy and efficient way.

The purpose of a charge controller is to supply the energy to the battery in a manner which fully recharges the battery without overcharging. If the batteries are fully charged, the controller decides to disconnect the battery terminals from the power source or to hold at the slow charge condition or to send the excess power to the dump load. If the batteries reach the level below the normal voltage condition, the controller is to connect the battery terminals to the power source to recharge again.

The objective of this paper is to develop a lead-acid battery charge controller for wind turbine. To be able to charge safely and fully the batteries, this control circuit design is proposed with high performance and multi functions.

II. Circuit Description

The system proposed in this paper is a constant current charge controller (48V, 10A) for 3kW wind turbine. Figure 1 shows the system configuration with separate blocks required to build a battery charging control system.

First, 3-phase variable AC input voltage depending on the variable wind speed is received from the power box of the wind turbine. A 3-phase bridge rectifier is used to convert AC (48V) to DC voltage (≈65V), and to feed the voltage regulator which regulates the DC voltage (5V) to be able to supply the suitable voltage to other control circuit portions. The overheat sensing circuit which also is the cut-out circuit disconnects the battery terminals from the DC voltage source to stop the charging when the temperature sensor gives the data of high temperature condition. In the normal temperature condition, the whole circuit operates safely again. The current sensor is also used to know easily which current rate is at the batteries. The overheating condition in the circuit and the current values of the battery bank are indicated on the LCD display by using the microcontroller.

The main goal of the controller circuit is to decide either to recharge the batteries again when the battery voltage is below 13.5V×4 which is the required voltage level for the battery bank or to stop the charging when the battery bank has the full condition. The voltage comparator circuit operates in order to reach this goal. It always monitors the battery voltage and compares with the reference voltage. And then, it decides whether to send the energy to the battery bank or not, depending on the compared results. In this work, the two-step charging method is also added to extend the battery life. The first step is the slow charging to the batteries and its job is to