Overvoltage and Undervoltage Protection in DC Power Supply System

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ABSTRACT: The stability of the loads may be compromised if the DC power supply is not properly designed. Overvoltage and overcurrent are the primary causes of the issues. It is critical to build a protective system in order to ensure the dependability and efficiency of the electricity provided. In this paper the modelling and simulation of an overvoltage and undervoltage protection systems in DC power supply are demonstrated. The approach is based on relay operation during overvoltage and undervoltage failures. The test model of single phase of 230Vpeak, 50 Hz has been designed in NI Multisim simulation software. According to the findings, the tripping time is about 1-2 seconds (comply with IEEE 1159 and Suruhanjaya Tenaga standard) when using the proposed undervoltage and overvoltage protection circuit.

Keywords: *Power Supply, Overvoltage, Undervoltage*

1. INTRODUCTION

A power supply is an essential component of any electrical equipment that provides electricity to electrical appliances and loads. It converts the source voltage, current, and frequency to power the load [1]. The protection circuit is part of safety element in power supply. Now a day, protection circuit in power supply is crucial due to the equipment that mainly build with semiconductors devices. Semiconductor devices are very sensitive to overvoltage, undervoltage, current surges and high temperature spike. Power supply that has protection circuit can overcome the problem and guarantee the safety of the equipment and the user. In [2, 3, 4] the programmable DC power supply with protection circuit have been introduced.

This paper is organized as follows. In Section 2, the methodology of the proposed protection circuit in the DC power supply is presented. The simulation results of the suggested protective circuit are provided in Section 3.

2. PROTECTION CIRCUIT FOR DC POWER SUPPLY

Figure 1 depicts a conventional DC power supply that lacks a safety circuit to safeguard the load equipment from harm. To address the issue, the major goal of this project is to prevent such problems by creating a system that will monitor undervoltage and overvoltage and guarantee that the tripping mechanism is engaged if the provided voltage magnitude is not within the required limit. Figure 2 shows the block diagram of the proposed system, which is consists of transformer, rectifier, filter and protection circuit. The process starts from transformer to step down the ac source that supply 230V to the set value. The rectifier used for transforms an oscillating two-way alternating current (AC) into a single-directional direct current (DC). The filter is one that eliminates the alternating current component from the rectified output and lets the direct current component to reach the load. The protection circuit to protect the load from unstable supply that can harm the appliances. Furthermore, there is a load that may be linked to any appliances. Figure 3 depicts the schematic circuit of the proposed system.

Protection circuit in this proposal used op-amps circuit. The design of the protection circuit consists of op-amps comparator to distinguish the overvoltage and undervoltage condition. The flow chart of the proposed system is defined in Figure 4. If the system detects undervoltage or overvoltage condition, the relay will activate and the supply will not be allowed to connect to the load.

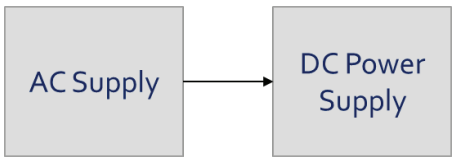

Figure 1 Conventional DC power supply, no protection circuit

Figure 2 DC power supply with protection circuit

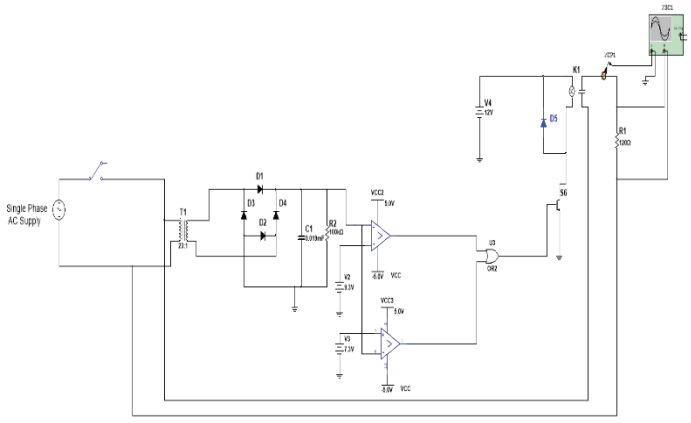

Figure 3 Schematic circuit of the proposed system

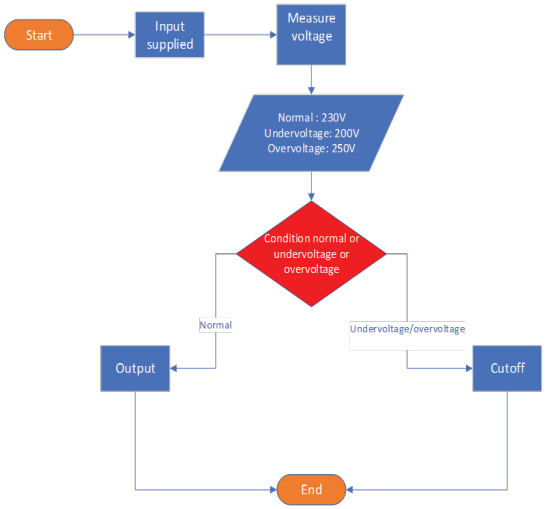

Figure 4 Flowchart of protection circuit in DC power supply system

3. SIMULATION RESULTS

In most cases, a circuit breaker and a fuse will be needed to safeguard the device. However, in this project, an electronics component will be utilised to keep the circuit inside the specified limits (refer to IEEE 1159 and Suruhanjaya Tenaga standard).The protection circuit in the DC power supply system is validated using the NI Multisim simulation software to demonstrate the concept of the proposed system. Figures 5 and 6 demonstrate the detection of undervoltage and overvoltage condition at 200 Vpeak and 250 Vpeak respectively. The suggested method, based on the waveforms illustrated in Figures 5 and 6, permits supply voltage to be provided to the load even when there is no overvoltage or undervoltage condition. When the under undervoltage (200 Vpeak) and overvoltage (250 Vpeak) condition are detected, the supply voltage is promptly removed from the load within 1-2 seconds as shown in Figures 5 and 6 respectively. The findings of two waveforms demonstrate that the proposed circuit is functional.

4. CONCLUSION

The proposed system has been verified, and the protective circuit works as intended when an overvoltage or undervoltage occurs. According to the simulation results, the tripping time (about 1-2 seconds) to disengage from the load is instantaneous, and it protects the power supply from degradation.

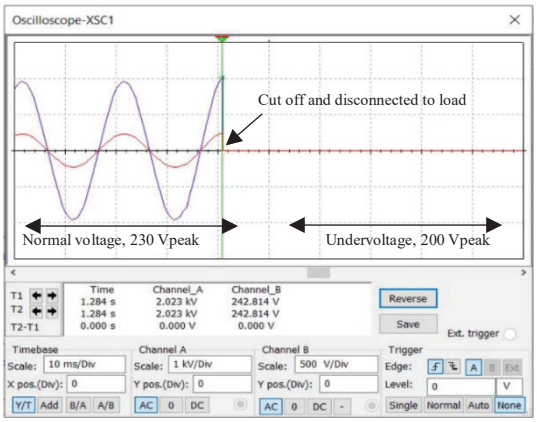

Figure 5 Voltage and current load during undervoltage condition (200 Vpeak)

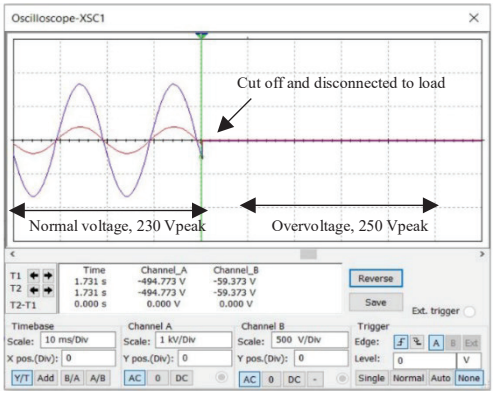

Figure 6 Voltage and current load during overvoltage condition (250 Vpeak)

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