DESIGN OF THE DUAL-INVERTER FOR GRID-CONNECTION AND ISLAND MODE

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Abstract: The high-level design for the dual-mode inverter has been proposed. The first stage is required in the design to buck the high input voltage from the PV array to a constant low voltage. The second second stage is for converting DC into AC. The LC filter is introduced to the design to eliminate the harmonic distortions produced by the inverter. IGBT-based switch is proposed to mode transition considering efficiency and response time.

Key words: THD - Total Harmonic Distortion,

1. INTRODUCTION

2. BACKGROUND

2.1 Constraints and Assumptions

- The input to the system is 400Vdc ±10% and assumed to be constant at maximum power of 1kW generated from MPPT.
- The is no limits to the system loads (Resistive, inductive or capacitive).
- The system has no earthing issues.
- The system must be simple and robust without the use of the microcontroller.

2.2 Success Criteria

- The system is able to switch between two modes, operates as the current under grid tie, and act as a voltage source under islanded mode.
- The system is able to deliver 220Vrms pure sine wave.

The system has functional faults protection (overload and short-circuit).

3. DESIGN OF THE INVERTER SYSTEM

This section highlight the proposed design for the transformerless dual-inverter. Figure 1 shows the block diagram of the dual-inverter system that is further discussed below.

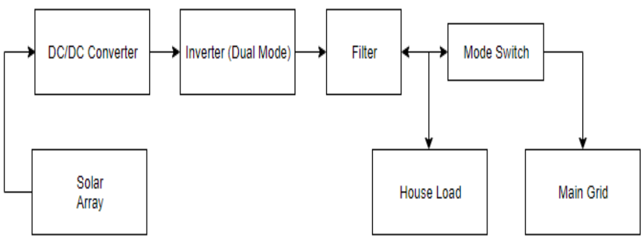

Figure 1: Block diagram of the of the dual-inverter system.

3.1 DC/DC Converter

In south Africa, the nominal voltage available for domestic is 220Vrms (between phase and neutral). The input to the system is at a constant voltage voltage of 400Vdc, thus before the DC/AC conversion the step-down of the voltage is necessary. The buck-converter will be employed to buck the input voltage to a constant low voltage to ensure after the inverter the 220Vrms is achieved.

3.2 Inverter

Multiple design of the DC/AC inverter exist. In this the design, the H-bridge inverter inverter design is used due to its simplicity. The MOSFET's switch on in pairs at the time, with bottom left pair with top right MOSFET from Figure 2. The output to the inverter is a square wave.

MOSFET's are susceptible to the electrostatic discharge and their extra insulator increases the capacitance which makes them vulnerable to arcing of the voltage and further damages the internal circuit. The new IGBT can tolerate voltage arcing and overloads. The response of the IGBT is also greater than the MOSFET's [1]. The H-bridge will therefore use the IGBT's.

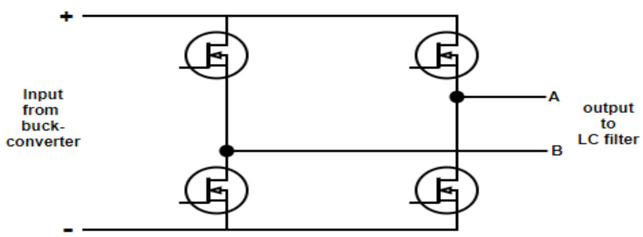

Figure 2: H-bridge inverter power circuit.

3.3 Filter

A filter is required to minimize or eliminate the harmonic distortion produced by the inverter to reach standard recommended value.The LC filter will be used instead of the RC filter. The RC filter limits the maximum output voltage that can be achieved at the output of the inverter due to voltage drop across the resistor. The RC filter also provides less attenuation (20dB/decade) which result in high ripple on the output compared to the attenuation provided by the LC filter (40dB/decade) [2, 3].

3.4 Mode Switch

For the inverter to be utility-interactive, a switch is required to ensure that the inverter system connection and disconnection with the main-grid is rapid and smooth. The system mode switch will utilize the IGBT-based switch. Reference [4] analyzed three different type of switches used in micro-grids systems. The IGBT-based switch is found to be the most acceptable for dual-mode inverter considering response time and efficiency.

4. RESULTS AND ANALYSIS

5. FUTURE RECOMMENDATIONS

6. CONCLUSION

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