Optimization and Simulation of IGBT Inverter Using PWM Technique

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ABSTRACT

This paper proposes a special pulse-width modulation (PWM) technique to stabilize a non-stable D.C Input by using an H-Bridge IGBT (Insulated Gate Bipolar Transistor) -inverter which is adaptive and able to send and receive messages quickly. The output voltage of this inverter is a stable A.C output of V_{rms}=220 V and f=50 Hz. The application of such inverters is important for systems fed by photovoltaic panels where their output can fluctuate over short periods. The design circuit consists of a voltage measuring circuit, a PIC micro-controller, a gate driver, and an H-Bridge IGBT inverter. The desired stable output is achieved even for rapid changes in the input by tracking the input and regulating the output for every (0.02) seconds.

Keywords: IGBT-Inverter, Pulse-width Modulation, PIC Micro controller

1. INTRODUCTION

In recent years, photovoltaic (PV) systems are widely used in contemporary societies; this is related to the increased environmental awareness, and the fact that photovoltaic energy has a low cost compared to fossil fuels [1]. Whether a grid-connected or a stand-alone PV system is used, the output power lacks the stability due to the fact that the sun emissions vary during the day which results in a non-stable electric output power. For Stand-alone PV systems, this problem can be over passed by storing the generated electric power in storage elements, and then converting it to a suitable electric power form, however, storage elements suffer from having a short-life period, and high electric power losses. A problem rises with grid-connected PV systems is the resulting harmonics when connecting them through power inverters to Medium Voltage Distribution (MVD) networks [2, 5, 6].

Inverters are essential components in many electrical systems, since conversion of D.C voltage to A.C voltage is becoming more desired. Basic Inverters such as H-bridge inverters convert applied D.C voltages to A.C voltages of a desired frequency and amplitude using a convenient controlling method, but if the input is unstable, the output will be unstable as well, whether the output voltage is a pure sine wave or a modified sine wave [3, 4].

This paper, introduces a novel methodology of eliminating the before-mentioned harmonics by designing a inverter whose output (220V/50Hz) is always stable for a variable input even without including any storage elements in the system.

2. SYSTEM DESIGN DESCRIPTION

The system applied in this work includes a PIC-16f877A micro-controller, a voltage measuring circuit, a gate driver, and an H-Bridge inverter. The PIC micro-controller is the key component of this system; it reads the unstable input using the measuring circuit, then it makes the necessary PWM calculations and drives the main inverter through the gate driver. These duties are done by the micro-controller every (0.02) second to insure a stable output is continually available even for rapid changes in the input. Figure 1 shows the block diagram of the system used in this work.

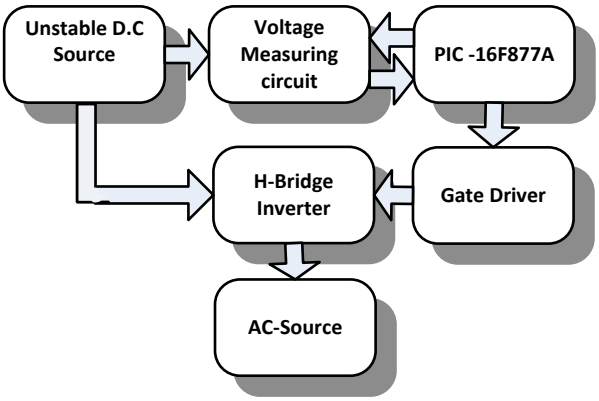

Figure 1: Block diagram of the system

3. METHODOLOGY AND DISCUSSION

The methodology used in this paper is explained in the flowchart as shown in figure 2.