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Comparison of different methods for generating SPWM signal for the development of a pure Sine wave inverter

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An inverter is an electronic device which is used for converting Direct Current (DC) to Alternating Current (AC) because AC is the predominant form of electrical power used in homes, businesses, and most electrical appliances. Inverters can be categorized based on the type of waveform that they produce, such as Pure Sine Wave Inverters, Modified Square Wave Inverters and Square Wave Inverters. This paper discusses the development of a Pure Sine Wave Inverter with an output voltage of 230 V_{RMS} and a frequency of 50 Hz using the Sinusoidal Pulse Width Modulation (SPWM) technique. Three SPWM signal generation methods, including analogue comparator, microcontroller, and SPWM driver module methods, were tested. This study presents a method to obtain a 230 V_{RMS}, 50 Hz output sine wave in three steps. The first step involves the generation of an SPWM signal with frequency control, utilizing the DC source supply. The analogue comparator method uses op-amps as the analogue comparator. Then, it compares a reference sinusoidal wave with a high-frequency (in kHz range) carrier triangular wave. The output of the op-amp comparator is SPWM. The frequency of this reference sinusoidal wave is chosen based on the required inverter output frequency (50 Hz). In that process, the comparator gives out a pulse when the voltage of the sine waveform is greater than the triangular voltage, and this pulse is used to trigger the respective inverter switches. When designing a circuit that involves op-amps, the slew rate of the op-amp is a critical consideration. To generate an SPWM signal using an ATmega328p microcontroller, the microcontroller was used to generate a series of PWM signals by digital high and digital low. The corresponding time of each pulse's delay is added using the microsecond function. Increasing and decreasing duty cycle, and then a series of PWM signals. As the pure sine wave inverter SPWM driver module EGS002 was used and, that method was the more accurate method, and a clean SPWM signal was generated with less harmonics. Although this type of inverter board has more features, the circuitry was not complex because of the module. Secondly, we employ the MOSFET H-bridge stage to obtain the desired sine wave output. Finally, the third step focuses on supplying a high DC voltage to the H-bridge circuit, which the DC-DC PWM boost converter generates. Several circuit protections were included to ensure the device's safety and reliability. In the process of SPWM generation, although in the analogue comparator method, op-amps offer a low-cost option, a microcontroller is favoured for its superior precision and ability to handle high-power applications effectively. However, the EGS002 module stands out as the preferred method due to its user-friendly nature, comprehensive protection features, and ability to provide valuable feedback, making it a more economically efficient choice in the overall design.

Keywords: Analogue Comparator, Boost Converter, EGS002 Module, H-bridge, Pure Sine Wave, SPWM Signal