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ENHANCING POWER QUALITY BY REDUCING TOTAL HARMONIC DISTORTION (THD) WITH A PWM INVERTER

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Abstract

This paper recommends a PWM DC-AC converter to decrease total harmonic distortion (THD) and thus increase power quality. Equipment performance and lifetime are affected by power quality issues. The THD produced by the nonlinear loads is decreased by the suggested system. Because the presence of harmonics causes issues likes overheating, insulation failure, etc. Here, MAT Lab Simulink is used to analyze the simulation outcomes of the suggested system. Lower THD is achieved using the system, demonstrating its effectiveness.

Key words: Index Terms – PWM, Total harmonic Distortion, Power Quality

1. INTRODUCTION

Electrical Power, which is entirely dependent on the availability of power, is one of the most practical forms of energy. As a result, the power quality is a vital element that must be taken into consideration for the effective management of user-side equipment. frequency and voltage power choices are important. If the choice differs from the conventional variety, it has an effect on the quality of power [3]–[7].

The development of technology has significantly improved semi conductive devices. The energy industry relies heavily on semiconductor devices because they simplify system control. However, because the semiconductor components are nonlinear, they pull nonlinear source from the current. When nonlinear loads are employed, harmonics and reactive power are generated. Harmonics are thought to be a significant problem with power quality. Harmonics must be removed in edict to preserve power quality and keep THD less than 5% according to IEEE 519 harmonics customary [2]. In this work, a PWM Inverter is employed to enable 230V or 110V continuous output voltage regardless of constant load or variable load.

PWM inverters offer a range of protection and voltage control circuits, making them preferable to conventional inverters.

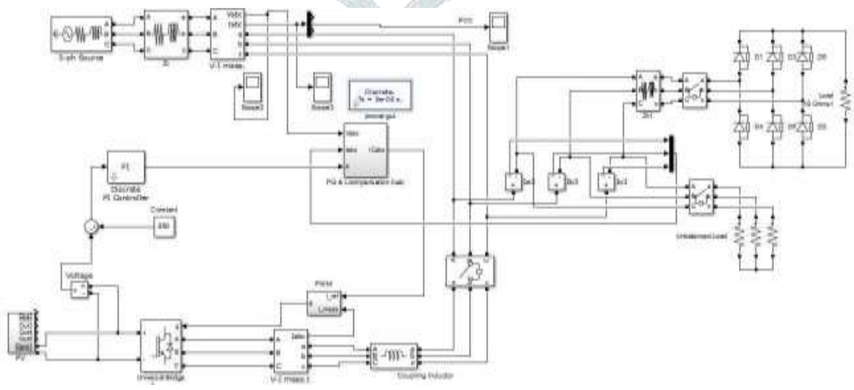

Fig 1. PROPOSED SYSTEM

2. SYSTEM BEING STUDIED

Fig. 1 depicts how the suggested approach is set up to reduce THD. Connected to a three phase supply is a non-gradual load. At this time, a three-phase fully controlled converter with a resistive load connected to it serves as the nonlinear load. In total, there are six diodes.D1 to D6.

A. PV Panel

A solar panel is the primary part of a photovoltaic panel. In essence, it is between 4-6 inches in size and uses tiny cells to generate roughly 3 watts of power. The cells are essentially coupled in a series-parallel method in order to path maximum power [1].

The PV panel hunk employs a five limitation model to describe the irradiance- and temperature-dependent I-V characteristics of the device. This model includes a current source IL (light-generated current), diode (I0 and nI parameters), series resistance Rs, and shunt resistance Rsh elements.

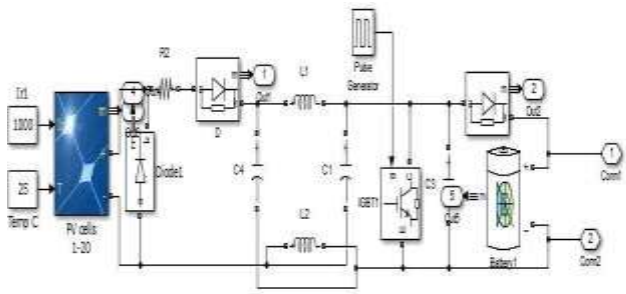

FIG 2. PV MODULE COMPONENT SYSTEM

The inputs to the PV panel in this scenario are temperature and irradiance. Direct current voltage is produced by the PV panel. A buck boost converter is cast-off to raise the converter's input voltage. The DC voltage is maintained by the power source.

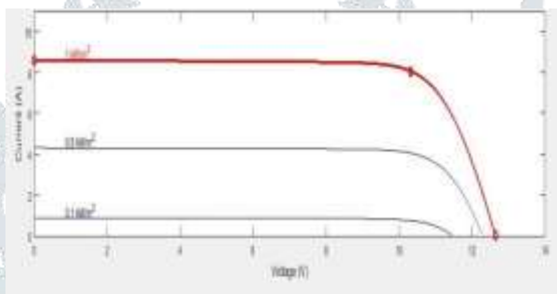

Fig. 3 VI characteristics

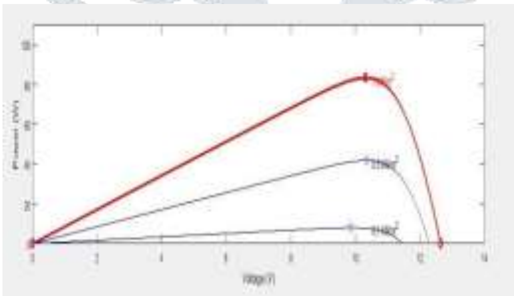

Fig. 4 PV Characteristics

B. PQ AND I COMPENSATION CALCULATION

The voltage Vabc from the cradle and the current Iabc from the load are transformed into Power Quality by this block using Clarke's Transformation. Then it will change to Alpha Beta before becoming present Icabc for compensation.

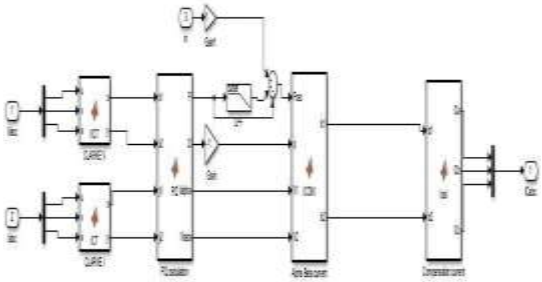

Fig. 5 PQ and I compensation calculation block

C. PWM

The PWM block compares the currents Iabc (I_meas) and Iabc (I_ref) simultaneously. Fig. 1 shows how the universal bridge receives an injection of the difference between the two currents.

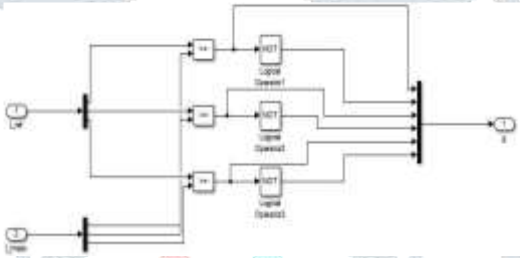

Fig. 6 PWM converter block

3. SIMULATION RESULT

Iabc (I Ref) and Iabc (I Meas) are two currents that are compared by the PWM hunk. Furthermore, as depicted in Fig. 1, the universal bridge gets the difference between the two currents.

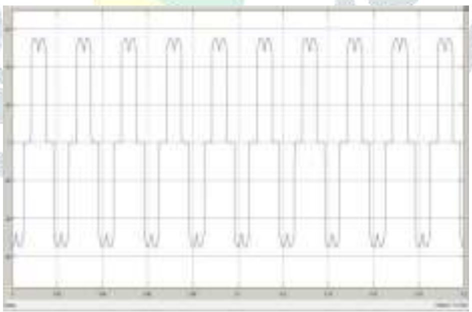

Fig. 7 Current waveform without applying PWM

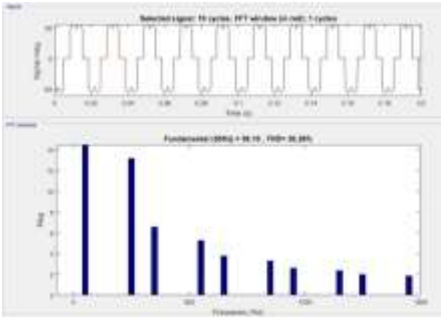

Fig. 8 THD before applying PWM

Fig. 9 Current waveform with PWM

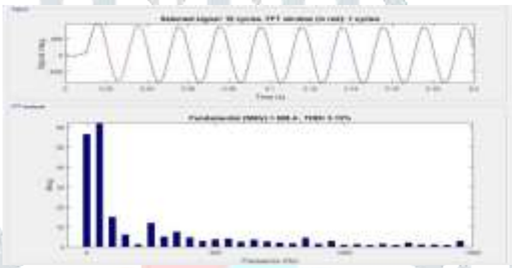

Fig. 10 THD after applying PWM

THD and the waveforms of current is seen here. Figures 7 and 8 illustrate the current waveform before PWM application, when distortion may be noticed, and the THD, which is 30.26%. Following the application of PWM, the current waveform can be seen in Fig. 9 with less distortion, and Fig. 10 displays the THD, value is 3.13%.

4. CONCLUSION

In order to reduce THD, a PWM inverter is utilized in this work to investigate and simulate a three-phase supply system with a non gradual load. According to the simulation results, using PWM reduced THD from 30.26% to 3.13%. This strategy can be taken into consideration for increasing the quality of the electricity because THD should be below 5% according to IEEE 519 harmonics standard.

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