Power Quality Improvement by Reduction of Total Harmonic Distortion (THD) using PWM Inverter

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Abstract - In this paper, a PWM inverter is proposed for improvement of power quality i.e., reduction of total harmonic distortion (THD). The power quality problems reduce the lifetime and performance of equipments. The proposed system reduces the THD which is generated from the nonlinear loads. Because presence of harmonics leads to problems like overheating, failure of insulation etc.

Here the simulation results of the proposed system is studied using MATLAB SIMULINK. Using the system, a lower THD is achieved which shows the effectiveness of the system.

Index Terms - Power Quality, Total harmonic distortion(THD), PWM.

I. INTRODUCTION

Electrical energy is one of the most productive forms of energy and is totally dependent on electric supply. Hence the power quality is a significant factor which is quite important for the effective operation for handling user side equipment. It depends upon voltage and frequency ranges of power. If the range deviates from the standard range the quality of power gets effected [3]-[7].

With the evolution in technology, there is a radical enhancement in semi conductor devices. Semi conductor devices plays a vital role in the energy sector as they help to alleviate the control of a system. But the semi conductor devices are nonlinear and draws nonlinear current from the source. Use of nonlinear loads generates harmonics and reactive power. Harmonics is considered as a critical problem of power quality. Therefore, it is very important to eliminate the harmonics in order to maintain the power quality and reduce the THD below 5% based on IEEE 519 harmonics standard[2]. So a PWM Inverter is used in this paper to serve the purpose in order to facilitate 230V or 110V steady output voltage whether it’s a constant load or variable.

Compared to the conventional inverters, PWM inverters are unrivalled as they have various protection circuits and voltage control circuits.
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Here the inputs of the PV module are irradiance and Temperature. DC voltage is being generated from the PV module. A boost converter is used to step up the voltage from its input. The DC voltage is being saved in the battery.

B. PQ and I compensation calculation

Inside this block the voltage Vabc from source and current Iabc from load is being converted into PQ using Clarke's Transformation. Then it is converting into Alpha Beta and then into compensation current Icabc.

C. PWM

Both the currents Icabc (I_ref) and Iabc (I_meas) are compared by the PWM block. And the difference between both the currents is injected into the universal bridge as we can see in Fig. 1.

III. SIMULATION RESULT

The simulation result here demonstrates both the cases i.e., before applying PWM and after applying PWM. Here the current waveform and THD is displayed for both the cases.
In this paper a three phase system with nonlinear load is analysed and simulated where a PWM inverter is used for reduction of THD. The simulation result shows that THD has been reduced from 30.26% to 3.13% after applying PWM. Since based on IEEE 519 harmonics standard THD should be below 5%, this method can be considered for improving the quality of power.

IV. CONCLUSION

In this paper a three phase system with nonlinear load is analysed and simulated where a PWM inverter is used for reduction of THD. The simulation result shows that THD has been reduced from 30.26% to 3.13% after applying PWM. Since based on IEEE 519 harmonics standard THD should be below 5%, this method can be considered for improving the quality of power.

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