Reactive Power Compensation Using Induction Motor Driven By Four Switch Converter

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Abstract- *During the past two decades, the rise in electrical energy demand has presented higher necessity from the power industry. More power plants, substations, and transmission lines need to be built. However, the most commonly used devices in present power grid are the mechanically controlled circuit breakers. The long switching periods and discrete operation make them complex to handle the frequently changed loads smoothly and damp out the transient oscillations quickly. It increases the complexity of the system, Therefore, investment is necessary for the studies into the security and stability of the power grid, as well as the improved control schemes of the transmission system. Different methods such as reactive power compensation and phase shifting have been applied to increase the stability and the security of the power systems. Induction motors (IM) used for various industrial applications operate with lagging power factor. This paper proposes a single-stage three-phase power factor correction (PFC) for four-switch converter (FSC) fed induction motor (IM) drives. The PFC scheme uses a converter with only one switch, and consequently, it needs only one control signal. This attains low computation burden, simple control algorithm, and minimum cost. A new PFC control technique is proposed to guarantee sinusoidal supply currents with high power factor (PF) and low total harmonic distortion (THD). Moreover, the PFC technique regulates the DC bus voltage. The efficacy of the converter is verified by extensive tests in various operating conditions.*

Keywords- Reactive power compensate, Power system.

I. INTRODUCTION

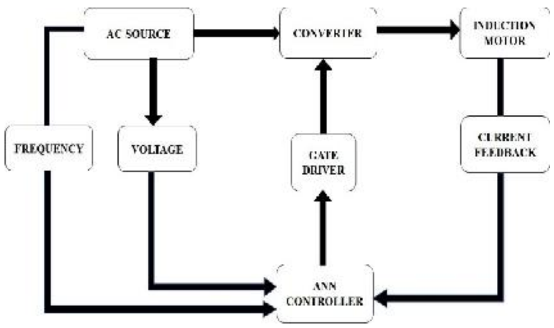
The use of induction motor (IM) drives in the industry has increased in practical applications. Inverters are considered an important part in the IM drive system. Conventional IM drives have three-phase converters with a capacitor filter to transform a DC rectified voltage to an AC voltage with variable magnitude and frequency. The inverters require 3-phase uncontrolled diode bridge rectifiers. Capacitors were utilized to smooth the DC output rectified voltage.AC/DC rectifier circuits produce unregulated current signal with non-sinusoidal shape. Different complex issues related to the resultant harmonics and losses were created. These issues reflect on the AC source and reduce the power source quality.The most undesired issues are injecting current harmonics in the grid, overheating the instruments,voltage distortion at the point of common coupling, reduced power factor (PF), and minimized efficiency. International standards indicate the limits of different harmonics of the current and voltage waves.The current should be reconstructed to be a sine wave, what improve the PF and minimize the losses. So new power factor correction (PFC) topologies for AC-DC converters were necessary to mitigate the power source quality issues. These topologies use numerous switches and complex control circuits and have increased costs.Different PFC schemes for DC-DC converters are employed. The main common scheme is the boost converter; however,it has a shortcoming. The value of output voltage exceeds he peak supply voltage. Therefore, the output cannot be simply isolated from the input. This scheme presents isolated output-input with limited inrush current at starting. Also, it has the capability of step-up/down output voltage. Nowadays, the tendency is to develop compact and cheap IM drives. Traditional six-switch inverters (SSI) were commonly employed for variable-speed drives (VSDs) Therefore, great exertions were done to replace SSI with four switch inverter (FSI) for uninterruptible power supply and VSDs . Several features are realized with replacing traditional SSI with FSI in terms of reliability, low computation burden and low price.

II. RELATED WORKS

In this project the main goal is the power supply unit are Transformer, Rectifier, Filter and Regulator. The 230V AC supply is converted into 9V AC supply through the transformer. The output of the transformer has the same frequency as in the input AC power. This AC power is converted into DC power through diodes. Here the bridge diode is used to convert AC supply to the DC power supply. This converted DC power supply has the ripple content and for normal operation of the circuit, the ripple content of the DC power supply should be as low as possible. Because the ripple content of the power supply will reduce the life of the circuit. So, to reduce the ripple content of the DC power supply, the large value of capacitance filter is used.

This filtered output will not be the regulated voltage. For this purpose IC7805 regulator IC is used in the circuit

III.PROPOSEDSYSTEM



A cascaded converter is implemented to adjust the power mismatch. And to alter the pulse width modulation whereas SVPWM comprehensively analyzed the obtained results and compared the harmonic density, power factor (PF), & switching losses of SVPWM and SPWM. First of all the power supply is given to all components by the AC voltage source with regulated power supply.The proposed inverter is a voltage source inverter made by using MOSFETS.MOSFETS are driven using a gate driver circuit. The driver circuit drives the high side MOSFETS using separate power supplies obtained from different transformers for each terminal.Gatingpulses (SVPWM) generated from a micro-controller are provided to MOSFETSs through the driver circuit. Inverter circuit is connected to Grid through LCL filter.

IV. SYSTEMDESIGN

The proposed system was designed to compensate the reactive power using induction motor driven by four switch converter..

MICROCONTROLLER (PIC 16F877A)

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller". PICs are popular with both industrial developers and enthusiast alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

VOLTAGE REGULATOR

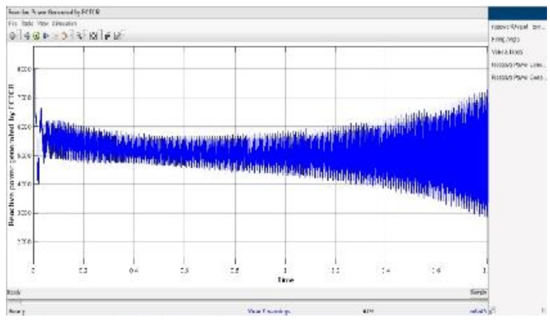
Voltage source in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. An Voltage regulator 7805 IC78xx series of fixedlinear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5volts regulated power supply with provisions to add a heat sink.

TRANSFORMER

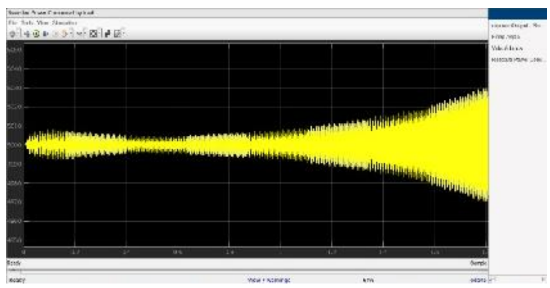
Transformer is a device used either for stepping-up or stepping-down the AC supply voltage with a corresponding decreases or increases in the current. Here, a transformer is used for stepping-down the voltage so as to get a voltage that can be regulated to get a constant 5V.

V. SIMULATION RESULTS

The simulation results of Reactive power generated by FCTCR and Reactive power consumed by load.



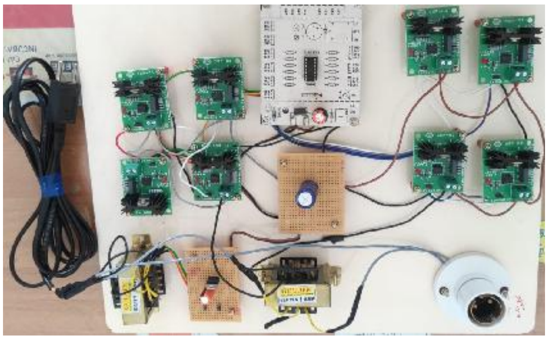
Reactive Power Generated power by FCTCR



Reactive Power Consumed by Load

VI. RESULT AND DISCUSSION

The result of reactive power compensation using an induction motor with a four-switch converter is an improved power factor and a more efficient power system. This improved efficiency is due to the improved power factor which reduces losses and increases system capacity. In addition, the four-switch converter allows for better control of the motor's speed and torque, resulting in smoother operation and improved power quality. The four-switch converter also helps reduce harmonic distortion, resulting in a cleaner power system.



Snapshot of proposed Hardware Kit

S.No	ExistingSystem	Proposed System
1	Efficiency is 75%	Efficiency is 90%
2	Consumed more power	Consumed less power
3	Cost is high	Cost is low
4	Difficult to Customize	Easy to customize

VII. FUTURE SCOPE

- The concept of reactive power compensation using induction motor by four switch converter has a great potential to become a viable and cost-effective solution for many power systems.
- In the future, this concept can be further developed to improve its reliability and efficiency, and to reduce its weight and size. For example, the use of advanced semiconductors can be explored to minimize losses, and the use of intelligent control techniques can be utilized to improve the dynamic performance of the system.
- Moreover, the use of predictive control algorithms can be investigated to improve the power factor and reduce the losses. Additionally, the concept can be further extended to various other applications such as wind turbines, industrial applications, and renewable energy sources.

VIII. CONCLUSION

In this project, an IM driven by NSC for utility reactive power compensation is presented. The utility is operated at unity as well as at leading power factor with IM drive. Required reactive power at PCC is compensated by operating IM driven by NSC at leading power factor. To achieve reactive power compensation, modified SPWM technique is developed and implemented in DSC for the generation of the gate pulses for NSC. The practical implementation of high switching power devices with Spaced vector pulse width modulation (SVPWM) techniques is possible. Optimal switching of NSC under variable frequency mode with modified SPWM operation is demonstrated.

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