ABSTRACT

In industry, Squirrel-cage induction motor is widely used when compared to the DC motor. Squirrel-cage induction motor has less maintenance required, and higher efficiency. Because of these advantages, induction motors are more widely used in applications requiring constant speed. By conventional methods of speed control of an induction motor wide range of speed control and also precise control of speed could not be achieved.

Insulated Gate Bipolar Transistor (IGBTs) based Pulse-Width Modulated (PWM) inverter is used to get precise speed control over a wide range of speed. Electromagnetic Interference (EMI) noise is generated from IGBTs based PWM inverter switches during ON-OFF, and high rate of change of voltage (dv/dt) transient occurs. This high transient interrupts with the EMI noise current, and EMI noise is generated. Generated EMI noise is transmitted in two forms viz. 1) Radiated noise and 2) Conducted noise. Radiated noise is mitigated by metal cabinet. Conducted noise is mitigated by EMI filter. Conducted noise is classified into two types viz. 1) Differential mode (DM) noise and 2) Common mode (CM) noise. DM noise is measured between phase to phase, and hence EMI noise is circulated. CM noise is measured between phase to ground, which mitigates EMI noise. In speed control of IGBTs based PWM inverter-fed squirrel-cage induction
motor, conducted EMI noise is an important problem. Due to this problem, IGBTs based inverter is affected which in turn causes loss in squirrel-cage induction motor, leading to low efficiency of the motor.

In the conventional system, EMI noise generation and emission concentrated only in the load side and is compensated by using conventional filter. Time-domain and frequency-domain analysis of conducted EMI mitigation by using conventional (passive and active) filters do not give appropriate output. Active common mode noise canceller configuration techniques are used to suppress the EMI noise in a conventional system. Conducted EMI noise is mitigated by conventional filters connected across nearby load side. If there are any variations in load side the EMI filter will get affected. The total harmonic distortion in the conventional configuration was not analysed. In the conventional method, shoot through faith is occurring in IGBTs based PWM inverter or RPWM inverter.

The proposed switched mode pulse width modulated inverter fed AC drive is widely used in industrial applications. This switched mode PWM inverter is operated at 180 degree mode of operation, and hence it is otherwise called quasi-square wave mode PWM inverter. In quasi-square wave mode of operation shoot through faith eliminated in the proposed system. This switched mode PWM inverter has an inherent noise source. This noise is mitigated by a new Active Common Mode Electromagnetic Interference Filter (ACEF) which is proposed for switched mode power supply applications. The proposed filter is based on current sensing and a compensation circuit which utilizes fast acting transistor amplifier for current
compensation. The amplifier is biased with an isolated low voltage DC power supply. Hence, it is possible to construct an active filter independent of the source voltage of the equipment. Thus, this filter can be used in any application regardless of working voltage.

For the proposed EMI filter scheme, a comparative study has been performed with different configuration of output filters through the simulation and experimental results. The output waveforms of each phase voltage are distorted during the switching operation. For the delta connected capacitor filter, there is a decrease in each phase voltage by 56.52% and THD increased to 34.64%. For star connected output inductor and capacitor filter, there is a decrease in each phase voltage by 34.78% and THD increased to 34.67%. In the parallel connected capacitor filter, there is a decrease in each phase voltage by 39.13% and THD increased to 35.10%. For the series connected output inductor filter, decrease in each phase voltage magnitude and THD level increase of 43.47% and 47.80% respectively. When the ACEF is connected in source and load side, a symmetrical phase voltage waveform obtained with the accepted voltage magnitude and THD level decreased to 2.54%.

In the proposed system, the THD level of the load voltages at full load, was 33.37% before active common mode EMI filter compensation and 2.90% after compensation. The THD level of the load voltages at half load before and after compensation is 32.10% and 1.80% respectively. The THD level of the load voltages at quarter load, was 32.07% before active common mode EMI filter compensation, was 1.69% after compensation.
The simulation and experimental results indicate the effectiveness of the proposed ACEF. It is also very effective in suppressing the noise due to EMI. The THD spectrum of the load voltages for different load conditions with ACEF is analysed and obtained THD value of the load voltages are below the permissible limit of 5% as specified by IEEE-519-1992.