Abstract

In this thesis, various issues of medium voltage (MV) drives like high voltage stress on the motor, high power, medium voltages are handled using three-level neutral point clamped (NPC) inverter modules with various interconnections and L-C filters. The thesis investigates the medium voltage drive topologies having switching devices of standard ratings. The control strategies for the various suggested topologies are also presented in the thesis.

A sensorless vector-controlled drive of a squirrel cage induction motor is developed with a three-level neutral point clamped inverter whose output is filtered by the L-C filter. Thus, the motor encounters sinusoidal voltages instead of PWM voltages thereby reducing the problem of voltage stress due to high *dv/dt*. A control technique is proposed to control the filter voltages and currents. This enables the drive to retain high dynamic performance with the presence of the output filter. Experimental results confirm the dynamic responses of the drive with the proposed control technique.

The power rating of the drive is increased by paralleling '*n*' number of three-level NPC inverters with output filter. Thus, larger power drives are formulated using standard rating switching devices with sinusoidal voltage at the motor terminals. A master-slave control technique is proposed for the judicious sharing of motor currents. The effective switching ripple current of the filter capacitor is also increased by a factor of '*n*' with the suggested PWM strategy. The experimental results of the sharing of motor currents and the ripple current supplied by the inverters are presented in support of the proposed control technique.

The voltage rating of the drive is increased by the series operation of three-phase three-level NPC inverter modules. A detailed analysis of the topology and the control techniques are presented. The topology presents stepped output voltage waveform. Hence the use of filter is dispensed with. Various PWM techniques are investigated for this topology. Simulation results along with harmonic analysis of the individual inverter modules are also presented in details. A vector controlled SQIM drive is formulated using this proposed topology. Experimental results of the output voltage from the topology are presented with various PWM techniques.

Abstract

To meet the demand of very fast torque responses in some applications, a direct torque and flux control of three-level NPC inverter with optimum ripple current is presented. This method produces very fast torque response. The principle of optimum current ripple is established. Based on this, the selection of proper inverter switching states is proposed for optimum current ripple at steady state and fast torque response during transients. The experimental results to validate these concepts are also presented.

The experimental setup consisting of the 10KVA IGBT based three-level inverter modules along with the relevant protection schemes and the L-C filter are developed in the laboratory. A digital control card, based on TMS320F240 DSP, generates the control signals for the converter. The proposed topologies are used to drive a sensorless 7.5hp, 415V squirrel cage induction motor.