

CHAPTER 11

CONCLUSIONS AND FUTURE WORK

A summary of the major contributions of this work is presented in the following sections. The significance of these contributions towards the advancement of understanding the multilevel topologies is included in this chapter. In the end, future

carrier-based generalized discontinuous PWM schemes was developed. Detailed analysis for deriving the generalized zero sequence voltage is being laid out. A novel control scheme for controlling the neutral point voltage using the hysteresis control was developed. A prototype of three-level inverter was developed to validate the control scheme. Simulation and experimental results are provided.

11.2 Control of Three Phase Three Leg Three Level Rectifier

Control schemes for a three-phase three-leg three-level rectifier is presented to regulate the dc link voltage and to draw balanced and sinusoidal line currents. The report formulates step-by-step modeling of the converter both in the abc and qdo reference frame. Steady-state analysis has also been done. In the proposed control schemes, the line currents are controlled to be sinusoidal with unity power factor under the balanced operation. The control methodology using the natural reference frame and the control methodology using the qd analysis is laid out. Two control schemes with detailed modeling and also the control design has been provided. Simulation results show the validity of the proposed control scheme.

voltage; while for unbalances in the sources and/or in the load impedances, the input power is constant and the DC voltage regulated.

11.5 Current Regulation of a Three-Phase Unbalanced Voltage Source Inverter

A detailed analysis and design procedure of an abc reference frame current regulated three-phase voltage source inverter feeding a load with balanced/unbalanced impedances and back emfs is presented. The controller structure in this reference frame is determined with methodologies to determine their gains when the response is desired to follow the Butterworth pattern. In order to synthesize the likely unbalanced required voltages to regulate and balance the phase currents, a novel discontinuous carrier-based modulation scheme

Generalization of the zero sequence voltage, which reduces the complexity of implementing the three-level inverter.

Complete description of the analysis in deriving the modulation signals and the discontinuous scheme.

The carrier based PWM scheme using single-carrier and multiple modulation signals for a generalized N-level inverter is one of the contributions.

Development of laboratory prototype of three level diode clamped inverter.

Developing a DSP code for generating the gating signals using the carrier-based PWM method for controlling the neutral voltage by using TMS320LF2407 DSP.

Analysis and a detailed studied of the new structure of the controller called the natural reference frame controller.

Control of the three-phase three-leg three-level rectifier using the natural variables to regulate the dc bus voltage and to achieve the unity power factor operation.

Control of the three-phase two-leg three-level rectifier using the natural variables to regulate the dc bus voltage and to achieve the unity power factor operation.

Control of the three-phase three-level unbalanced rectifier using the natural variables to regulate the dc bus voltage and to transfer constant power under unbalanced conditions and also to achieve the unity power factor condition in case of balanced operation.

Current regulation of the three-phase unbalanced voltage source inverter using the natural reference frame controller.

11.7 Future Work

Finally, there are several interesting topics for future research work:

The principle for discontinuous scheme proposed for the three-level diode clamped converter could be extended in generalizing the technique to N level converter.

Analysis of the over modulation operation of the three-level inverter using the carrier-based technique.

Extending the scheme for single-phase, five-phase and multi-phase converters.

The research work that is been done on the multilevel inverters is under balanced load conditions, which is not the case in general, hence similar to the two-level

The extension of the control scheme proposed for the unity power factor operation of the three-phase three-leg three-level rectifier and three-phase two-leg three-level rectifier such that the rectifier can be controlled to produce variable power factors so that it can operate in the leading or lagging or unity power factor mode. Generalizing the current regulation technique using the natural reference frame