Abstract

High frequency link power converters for DC – 3Φ AC applications are investigated. Low cost, reduced size, galvanic isolation and efficient large boosting of voltage level are the key motivations behind the selection of such topologies. This thesis proposes high frequency link 3Φ inverters for three wire and four wire systems. The proposed topologies have the simplest power circuit configuration and commutation requirements among all high frequency link topologies reported in the literature. A full load efficiency greater than 90% is achieved with a passive snubber.

The effect of various circuit non-idealities are common and important for desirable performances of these topologies. A few such issues are highlighted. Firstly, the special commutation requirement of the power circuit causes a non-linear distortion in the output voltages and thus makes the gain of the power converter time varying. A simple compensation technique is adopted to mitigate the problem. Secondly, the high frequency transformer should operate with only switching frequency component. However, in the practical situations a significant amount of low frequency component gets injected into the transformer and results in peaky transformer magnetizing current unless it is over designed. A suitable measure is incorporated in the proposed topologies to achieve a magnetic protection.

The power circuit topology is used as stand-by AC power supply. These are of interest for Uninterruptible Power Supply (UPS) and Micro-grid applications. One of the main objectives of such supplies is to provide a high quality and highly reliable power to the connected loads. A voltage regulation loop based on proportional + multiresonant controller is proposed to achieve excellent quality of the output voltage with unbalanced and non-linear loadings. The factors influencing regulation and stability of the voltage waveform are identified and necessary modifications are carried out to improve the performance. The potential of this voltage regulation loop along with P/Q droop technique and a simple

resistive virtual output impedance loop is exploited to achieve decentralized paralleling of inverters. A trade off between the output voltage power quality and the sharing accuracy is examined. The total harmonic distortion and degree of unbalance in the output voltage waveform are experimentally measured well below the specified limit for stand alone AC supplies with an excellent sharing accuracy.

Some of the grid interactive modes are addressed for the completeness of the work. A shunt compensator system and a double conversion system based on the same high frequency link converter are experimentally evaluated. These systems can find their application in UPS systems. A few important observations on the power circuit performances are indicated.