

Abstract

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Single-stage ac–dc buck–boost converter for medium-voltage high-power applications

This study proposes three topologies based on single-stage three-phase ac-dc buck-boost converters suitable for medium-voltage high-power applications. The first two topologies are based on a dual three-phase buck-boost converter, with a three-winding phase-shifted transformer to achieve sinusoidal input currents, with relatively small ac filters. The limitation of these two topologies is the switching devices are exposed either to a high voltage beyond that tolerable by a single device. The third topology is based on three single-phase buck-boost converters with their dc output terminals connected in series to generate high voltage. By using this approach, voltage stresses on the switching devices are greatly reduced, and sinusoidal input currents with nearly unity power factor is achieved over the entire operating range when using small ac filters. Analysis, PSCAD/EMTDC simulations and experimentation are used to assess the feasibility of the proposed topologies during normal operation. Major findings of this study are discussed and summarised as a comparison between the three topologies.