

UNIVERSITI TEKNOLOGI MARA

**SINGLE STAGE FOUR QUADRANT
DIRECT CONTROL OF AN AC FED
DC MACHINE USING SINGLE
PHASE MATRIX CONVERTER**

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ABSTRACT

The technological revolution in transportation whether on land, at sea, or in the air – has reached the stage of electrification. This revolution has indicated a rise in demand in recent years for a power supply system. The typical converters to control four-quadrant operation of a permanent magnet DC motor requires at least two separate circuits including the integration of current wave shaping supply technology to ensure high power factor operation. The use of at least two separate converters circuits contributes to the increase in the number of semiconductor devices, which leads to their bulky size, high power semiconductor losses and low power density. Therefore, this thesis proposes a new model of single-stage direct control of DC machines fed with AC voltage sources using a single-phase matrix converter (SPMC). The proposed system uses a single-circuit topology to perform four-quadrant control operations and is verified from their voltage and current profiles, which include quadrant I, quadrant II, quadrant III, and quadrant IV. Besides enabling four-quadrant control operations, supply current wave shaping control to provide almost unity power factor operation has also been implemented by integrating the SPMC with the active power filter function resulting in low total harmonic distortion (THD) level and high-power density. Analysis and MATLAB simulations results and experimental test-rig proved that single-stage of SPMC in four-quadrants operations can enhance power density, reduce THD level and improve power factor.

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