

**MICROCONTROLLER BASED VARIABLE FREQUENCY POWER
INVERTER**

By

KHALED ALI MADI A. AHMED

**Thesis Submitted to the School of Graduate Studies, Universiti
Putra Malaysia, in Fulfilment of the Requirement for the Degree of
Master of Science**

April 2007

To my Parents, Wife, Daughter, Son, Sisters and Brothers

Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirement for the degree of Master of Science

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Chairman: Associate Professor Senan Mahmud Abdalah, PhD.

Faculty: Engineering

The variable frequency inverters have been used in wide applications, such as speed control of induction motors. The variable speed operation of a single phase and three-phase induction motors suffer from large harmonic and limited speed range. Therefore, intensive researches were carried out in order to eliminate the harmonic distortion, simplify the motor speed control task over a wide range, and to reduce the overall system cost.

This work investigates performance of the microcontroller based variable frequency power inverter to reduce the Total Harmonic Distortion (THD) for the overall system. The fully controlled single

phase and three-phase bridge voltage source inverter have been designed and implemented with semiconductors power devices Insulated Gate Bipolar Transistor. The microcontroller has been employed in this inverter to provide SPWM signal that controls the applied voltage on the gate drive, which provides the desired SPWM frequency at the output of the power inverter.

The Matlab simulation results for the proposed system have been achieved with different SPWM frequencies. From the results a stable AC voltage with variable frequency over wide range has been obtained with fewer harmonics and a good agreement has been found between the simulation and hardware results of a single phase and three-phase inverter. Also, the result obtained has been compared with previous work and it shown a good agreement too. Therefore, this system can be considered as variable frequency voltage source power inverter, with low total harmonic distortion (THD <2).

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENYONGSANG KUASA FREKUENSI BOLEHUBAH
BERASASKAN PENGAWALMIKRO**

Oleh

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Pengerusi: Profesor Madya Senan Mahmud Abdalah, PhD.

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Sistem penyongsang frekuensi bolehubah telah digunakan secara meluas seperti di dalam pengawalan halaju motor aruhan. Perubahan halaju bagi operasi sesebuah motor aruhan sefasa dan tiga fasa sentiasa mengalami julat laju terhad dan harmonik yang tinggi. Oleh yang demikian, berbagai penyelidikan secara intensif telah dijalankan untuk menghapuskan gangguan harmonik, memudahkan tugas mengawal halaju motor bagi julat yang besar dan mengurangkan kos keseluruhan sistem.

Projek ini menyelidik keupayaan penyongsang frekuensi bolehubah berasaskan Pengawalmikro. Sebuah penyongsang punca voltan tiga fasa dan sefasa yang boleh dikawal sepenuhnya telah direka menggunakan peranti kuasa semikonduktor yang dipanggil IGBT. Pengawalmikro tersebut telah digunakan di dalam litar penyongsang untuk menghasilkan isyarat SPWM yang mengawal voltan yang diberi pada pemacu pintu. Ia akan menghasilkan isyarat frekuensi SPWM yang dikehendaki pada output litar penyongsang kuasa untuk mengurangkan gangguan harmonik bagi sistem tersebut.

Keputusan simulasi menggunakan Matlab bagi sistem tersebut dengan beberapa frekuensi SPWM yang berbeza-beza telah berjaya diperolehi. Daripada keputusan tersebut, suatu voltan AC yang stabil dengan frekuensi yang berbeza-beza serta harmonik yang lebih kecil telah diperolehi. Suatu persetujuan juga telah dicapai di antara keputusan melalui simulasi dan eksperimen bagi kedua-dua penyongsang sefasa dan tiga fasa. Oleh yang demikian, sistem yang dicadangkan ini boleh dianggap berupaya di dalam mengurangkan masalah gangguan harmonik dalam operasi sesebuah motor.

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I certify that an examination committee has met on ...-.....-..... to conduct the final examination of Khaled Ali Madi on his Master of Science thesis entitled “Microcontroller Based Variable Frequency Power Inverter” in accordance with Universiti Pertanian Malaysia (higher Degree) Act 1980 and Universiti Pertanian Malaysia (higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. The Committee Members for the candidate are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

KHALED ALI MADI A. AHMED

Date:

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