UNIVERSITI PUTRA MALAYSIA

NEW METHOD FOR REDUCTION OF HARMONIC OF THREE PHASE RECTIFIER USING HARMONIC INJECTION METHOD

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By

ALI SAADON MTAIR

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirements for the Degree of Master of Science

October 2011

Dedication

TO MY BELOVED PARENTS, MY BROTHERS AND MY SISTERS

Abstract of thesis presented to the Senate of Universit Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

NEW METHOD FOR REDUCTION OF HARMONIC OF THREE PHASE RECTIFIER USING HARMONIC INJECTION METHOD

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ALI SAADON MTAIR

October 2011

Chairman: Professor Madya Norhisam b. Misron

Faculty: Engineering

The three-phase rectifier is becoming more common in power systems. This rectifier produces a non-linear waveform of the input current into a power system. This causes a number of problems for the power system control and for other electrical systems which require such rectifiers. In fact, the harmonic components generated by such power electronic devices have severe effects on several aspects of power networks especially

on distribution. In addition, the high value of Total Harmonic Distortion (THD) causes undesirable distortion on the sinusoidal shape of the wave for the input current.

This thesis proposes a new circuit for three-phase rectifier using harmonic current injection method. The proposed circuit was simulated using MATLAB software. A prototype of the proposed circuit has been developed. The proposed circuit uses active harmonic current injection method with a capacitor bank, which is simple compared to conventional circuits using harmonic current injection method with star-delta transformer as the current injection device.

The prototype has been examined with feedback injection harmonic current to show the validity of the system. The comparison between simulation results and experimental results from the prototype shows minor difference. It has been observed that conventional three-phase rectifiers produce high THD for input currents, i.e., around 7.5%, while the proposed circuit has reduced the THD drawn from the input current supply down to 5.5%. This makes the waveform of the input current close to sinusoidal wave.

Abstrak thesis yang dikemukakan Senate Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KAEDAH BARU UNTUK MENGURANGKAN HARMONIK PENERUS TIGA FASA MENGGUNAKAN KAEDAH SUNTIKAN HARMONIK

Oleh

ALI SAADON MTAIR

Oktober 2011

Pengerusi : Profesor Madya Norhisam b. Misron

Fakulti: Kejuruteraan

Penerus tiga fasa menjadi perkara biasa dalam sistem kuasa. Ianya menghasilkan gelombang arus yang tidak terurus ke dalam sistem kuasa. Ini menyebabkan pelbagai masalah pada sistem kuasa dan sistem elektrik yang lain di mana penerus diperlukan. Tambahan pula, komponen harmonik dihasilkan oleh peralatan electronik kuasa mempunyai kesan buruk terhadap beberapa aspek jaringan kuasa terutamanya dalam pengagihan. Tambahan pula, ketinggian jumlah ganguan harmonik (THD) menyebabkon ganguan yang tidak diingini terhadap bentuk sinosiodal arus gelompang masukan.

Tesis ini mencadangkan litar baru untuk penerus tiga fasa menggunakan cara cucukkan arus harmonik. Litar yang dicadangkan telah disimulasi dengan mengunakan MATLAB. Prototaip litar cadangan telah dibangunkan. Litar cadangan menggunakan cucukan arus harmonik yang akfif dengan bank kapasitor di mana ianya lebih ringkas berbanding dengan liltar sedia ada menggunakan cara cucukan arus harmonik dengan pengubah segitiga-bintang sebagai peralatan arus cucukan.

Prototaip telah diperiksa dengan maklum balas arus cucukan harmonik menunjukkan pergesahan terhadap sistem. Perbandingan antara keputusan simulasi dan keputusan amali menunjukkan perbezaan minor. Pemerhatian terhadap penerus konvensional penukar arus terus tiga fasa menghasilkan THD yang tinggi untuk arus terus, sebagai contoh 7.5%, sementara litar yang dicadangkan telah menurunkan THD arus masukan bekalan kepada 5.5%. Ini menjadikan bentuk gelombang arus masukan hamper kepada sinusoidal.

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I certify that an Examination Committee met on __ to conduct the final examination of Ali Saadon Mtair AL-Ogaili on his Master of Science thesis entitled" Improvement of Current Harmonic in Three-Phase Bridge Rectifier Using Harmonic Current Injection Method" in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are follows:

Examiner 1

(Chairman)

Examiner 2

(Internal Examiner)

Examiner 3

(Internal Examiner)

Examiner 4

(External Examiner)

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This thesis was submitted to senate of Universiti Putra Malaysia and has been accepted as fulfillment of requirements for degree of Master of Science. Members of the Supervisory Committee were follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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ALI SAADON MTAIR

Date: 12 October 2011

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