UNIVERSITI TEKNOLOGI MARA

IMPLEMENTATION OF HALF-BRIDGE ACTIVE POWER FILTER USING FUZZY LOGIC CONTROL

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Candidate's Declaration

I declare that that the work in this thesis was carried out in accordance with the regulations of Universiti Tecnologi MARA. It is original and it is the result of my own work, unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

In this work, a single-phase half-bridge topology employing the commonly used hysterisis current control loop complemented with fuzzy logic based voltage control loop is proposed for use in single-phase parallel active power filter (APF). This is connected in parallel with a typical non-linear load performing appropriate compensations to resolve associated problems such as current displacement and harmonics. The unique use of fuzzy logic control (FLC) strategy has been chosen for voltage control; known for providing fast response and simple for microprocessor based implementations in control electronics independent of load changes. In this instance, it is being used to maintain the DC capacitor voltage of the APF for compensation purposes. This voltage is maintained at an appropriate higher value than the supply voltage to ensure that current can be injected into the system when required. To facilitate, a boost inductor is used to increase the charging voltage to the capacitor. The proposed scheme was implemented as a computer model using MATLAB/Simulink to evaluate the behaviour and performance. This is then implemented using an experimental test-rig for investigations on the proposed APF operation; with a single-phase bridge rectifier used to represent a non-linear load. The APF comprising a half-bridge inverter is constructed using 2 units of BUP314D. The proposed control scheme was then implemented using 2 units of PIC 16F877 microcontroller complemented with analogue circuits. Investigations have shown that the proposed APF is capable of achieving nearly sinusoidal input current and in-phase with respect to the supply voltage whilst providing a highly distorted supply current required by the load, even under certain transient condition. The performance when compared to BS-EN61000 and IEEE 519 is satisfactory.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

The field of power electronics is not new. In 1930 – 1950 during the post-and pre-war periods, saw extensive application of power electronics which is based primarily on the mercury arc rectifier and the gas-filled tube [1]. It was in December 1939 that William Shockley first noted the principle of semi conductor which could be used for controlling electrical power [2]. The official date for the invention of the transistor was on 23 December 1947 by William Shockley, John Bardeen and Walter Brattain. It was at this point that semiconductor electric technology was born.

Furthermore, power electronics is a field of electronics that deals with conversion of electric energy for power applications in the range of VA to MVA [3-4]. Because of a modern trend of power conversion nowadays and the progress in developing new solid-state switching device, has resulted in tremendous increased in development and usage of power electronics base products. Device such as power diodes, thyristors and transistors with higher ratings and switching frequencies have been used extensively in converting and controlling electrical power from the generation side to the end user, i.e. HVDC, switch mode power supply (SMPS), arc furnaces and adjustable speed drives.

In general, the conversion of electric energy to the power electronics loads is through switching action, by means of chopping, shaping and modifying the sinusoidal nature of the supply currents and/or voltages. Therefore, in many reports they are known to be non-linear in nature and their behaviours reach in undesirable effects to the electric equipment in the neighbouring network as well as reducing the quality of power to the electric power system as a whole [5-6].Therefore, to reduced the undesired effect and to have good quality of power, harmonics existed in the network have to be filtered.