DEVELOPMENT OF A SURGE PROTECTOR SUITABLE FOR EQUATORIAL BELT COUNTRIES

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Degree of Master of Science in Industrial Automation

Department of Electrical Engineering

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Dissertation submitted in partial fulfilment of the requirements for the
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DECLARATION OF THE CANDIDATE & SUPERVISOR

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the supervisor: ……. Date :
Prof. J.R. Lucas

Signature of the supervisor: ……. Date :
Dr. D.P. Chandima

DEDICATION

I dedicate this thesis to Mr. Buddhika Ranatunga, my husband for his endless encouragement and patience and to Mr. Nissanka & Mrs.Ramyalatha, my parents for earning an honest living for us and for supporting and encouraging me, to believe in myself and for nursing me with affections and love and their dedicated partnership for success in my life.

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ABSTRACT

In most tropical countries like Sri Lanka, lightning activity is high and can cause severe damage to equipment within buildings. Thus lightning surges should be prevented from entering sensitive equipment by installing high quality surge protection devices. Traditionally, surge protection circuits use non-linear devices to clamp the overvoltage. However, typical non-linear devices have low relatively short duration energy absorption ratings and cause the life of the surge protection device to decrease.

As it is known that supercapacitors have large continuous energy storage capabilities, a supercapacitor based surge energy absorption technique has been developed by combining a multi-winding magnetic component with a typical non-linear device in a novel configuration. This research presents an overview of new supercapacitor technique and the basis for selecting the magnetic core required so that the supercapacitor sub-circuit works effectively.

Selection of the magnetic core is critical for the success of the technique, since the combination of the leakage and magnetizing components of the multi-winding magnetic core plays a dominant role. Experimental results generated using a lightning surge simulator with surge capability up to 6 kV/3 kA are used to validate the results. Overall performance of this technique with optimized magnetics is compared with a typical commercially available surge protector, which is practically used to safeguard electronic systems against transient over-voltage related power quality issues.

This technique utilizes a multi-winding transformer, common surge protector devices such as metal oxide varistors combined with a supercapacitor sub-circuit to absorb part of the surge energy usually expected to dissipate within the metal oxide varistor and improve the life of the surge protective device. Also the output clamping voltage is controlled to a lower value to give better protection for the equipment.

Test results clearly indicate, the supercapacitor assisted surge protective device has a much higher energy absorption capacity than tested commercial products and can be

used in commercial surge protectors with better performance than traditional surge protectors with higher component counts.

Keywords: Lightning Protection, Supercapacitor, Metal Oxide Varistor, Non Linear Device

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LIST OF ABBREVIATIONS

Abbreviation	Description
BBD	Bidirectional Break-Over Diode
HV	High Voltage
MOV	Metal Oxide Varistor
NLD	Nonlinear Device
SC	Supercapacitor

LIST OF APPENDICES