INVESTIGATION OF SUPRA-HARMONICS EMISSION DUE TO SOLAR PV INVERTERS

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159305H

Degree of Master of Science

Department of Electrical Engineering

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science in Electrical Engineering

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DECLARATION

I declare that this is my own work and this thesis 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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Dr. J. V. U. P. Jayatunga

ABSTRACT

The number and rating of power electronic systems interfaced to electricity distribution networks have been rising at residential, commercial, industrial and utility environments over the last few decades. Domestic roof top solar photovoltaic (PV) systems, utility level solar generating systems and modern lighting systems can be taken as examples of such systems from the more recent years.

This trend has caused an increasing concern on the associated power quality problems. High frequency harmonics in the frequency range between 2 and 150 kHz (referred to as Supra-harmonics) has become a topic of growing interest due to higher amount poor power electronic switching interfaces. Amongst the possible repercussions of High Frequency emissions, malfunctioning of equipment, interference with Power Line Carrier communication and lifetime degradation of other connected equipment are prominent. Alongside with the power electronic systems, generation of unwanted harmonics have received considerable attention over the years, where much of the focus has been on the low frequency harmonics below 2 kHz. With these efforts, standards have evolved to ensure electromagnetic compatibility and many engineering solutions now exist to control their magnitudes. However, the knowledge associated with HF emissions is still in the premature level.

An increasingly prominent grid connected devices, which can contribute to these HF emissions are the photovoltaic (PV) systems. Thus, this research is focused on investigating supra-harmonic emission in the low voltage distribution system due to photovoltaic inverters. The thesis presents the analysis on HF emission of PV inverters under different configurations and their propagation is also studied. The study results are based on the detailed simulations carried out in MATLAB/SIMULINK environment and they provide further research thoughts for laboratory controlled experiments.

Key words: High Frequency, photovoltaic, inverter, Supra-harmonics, distribution system

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LIST OF ABBREVIATIONS

Abbreviation	Description
APFC	Active Power Factor Correction
BJT	Bipolar Junction Transistor
CFL	Compact Fluorescent Lamps
ECM	Electrically Commutated Motor
EV	Electric Vehicle
HF	High Frequency
HFH	High Frequency Harmonics
HVAC	Heating, Ventilation and Air Conditioning
IGBT	Insulated Gate Bipolar Transistor
LED	Light Emitted Diode
LF	Low Frequency
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
PFC	Power Factor Correction
PLC	Power Line Communication
PV	Photovoltaic
PWM	Pulse Width Modulation
SIT	Static Induction Transistor
SMPS	Switch Mode Power Supply
TL	Transformer Less

LIST OF APPENDICES