A NOVEL CONTROLLER FOR A VOLTAGE SOURCE SINE WAVE TRANSFORMERLESS BOOST INVERTER

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Degree of Master of Science

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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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The above candidate has carried out research for the Masters thesis under my supervision.

Signature of the supervisor: Date

Prof. S. Rohan Munasinghe

I dedicate this to my wife, parents and brother.

Acknowledgement

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Abstract

In this thesis a transformerless voltage source sine wave inverter is proposed. A previously developed tri-state boost converter is utilized for the stepping up operation. By using this topology the dynamic response of the inverter is increased, by avoiding the right hand plane zero in the converter's small-signal control-to-output transfer function when operating in the continuous conduction mode. The reference voltage for the tri-state boost converter is determined from the measured output voltage of the sine wave inverter, and the calculated instantaneous value of the sine wave. The inverter with the tri-state boost converter and the inverter with a classical boost converter with voltage mode control and current mode control are compared for the dynamic response and efficiency. The analytical work of the design has been verified using a simulation. Furthermore, the boost converter is implemented in hardware to verify the boost inverter calculations. The current mode control and the tri-state logic hardware implementation is ongoing, and it is presented as future work. Finally, two user selectable modes are proposed for the inverter optimized for dynamic performance or efficiency.

Index Terms – Tri-state boost converter, sine wave inverter, regulation, dynamic performance, efficiency

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List of abbreviations

CCM	Continuous Conduction Mode
DCM	Discontinuous Conduction Mode
VMC	Voltage Mode Control
CMC	Current Mode Control
RHP zero	Right Hand Plane Zero
UPS	Uninterrupted power supply
LUT	Look up table
MCU	Micro controller unit
EMI	Electro Magnetic Interference
LTI	Linear Time Invariant
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
IGBT	Insulated Gate Bipolar Transistor
PWM	Pulse Width Modulation

List of Appendices