**AIN SHAMS UNIVERSITY**

**FACULTY OF ENGINEERING**

**ELECTRICAL POWER AND MACHINES DEPARTMENT**

# A High-gain Power Converter for interfacing PV Systems

**M.Sc. Thesis**

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Submitted in partial fulfilment of the requirements for the M.Sc. degree in Electrical Engineering

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A thesis submitted to the Faculty of Engineering –Ain Shams University in partial fulfillments of the requirements for the M.Sc. degree in Electrical Power and Machines Engineering

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# STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements for M.Sc. degree in Electrical Engineering. The included work in this thesis has been carried out by the author at the department of electrical power and machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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# ABSTRACT

This thesis presents two systems for interfacing PV array to DC and AC grids. Two cascaded boost converters are proposed for PV interfacing with DC grid. The first converter is conventional boost converter (CBC) which has smooth voltage control and work at lower duty cycle for maintaining high efficiency. The CBC is responsible for performing maximum power point tracing (MPPT) on PV array. The perturb and observe (P&O) technique is used for controlling duty cycle of the CBC to track the maximum power point. The second converter is multilevel modular capacitor clamped DC/DC converter (MMCCC). This converter has high conversion ratio and high efficiency and it is responsible for step up of PV array voltage to the grid level. The structure of the MMCCC is reduced to allow only power flow in one direction from PV system to the DC grid. The reduced structure has lower number of switches and diodes which reduce converter cost. Moreover, a soft-starter which consists of resistor and bypass switch, is connected to the low voltage side of the MMCCC to allow for the initial charging of the capacitors to their operational voltage levels. This method eliminates the need for independent control technique during startup and limits inrush current of capacitor charging to the switches rated current, which decreases the converter cost. For PV array interface with AC Grid, also two cascaded converters are proposed. The first converter is unidirectional MMCCC including soft starter for capacitor charging and the second converter is three phase current controlled voltage source inverter VSI. The MMCCC steps up the PV array voltage to the DC link voltage required for VSI. The VSI performs MPPT on the PV array and control current injected to the AC grid. Hysteresis current control (HCC) is used for controlling the switches of the inverter. The P&O technique is used to allow for extracting maximum power from PV array. Simulation is performed using EMTDC/PSCAD platform to validate the effectiveness of the proposed topologies.

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***Mostafa Ibrahim***

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