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A Solar Powered Micro-grid Network for Low Power Application Using Micro-Inverter

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***Abstract*— Normal solar power inverter uses a series parallel combination of solar PV modules to boost the power level at the DC side. A single inverter is used to generate AC power. This type of configuration suffers from partial shading of PV modules that reduces the output generation level. Secondly, during maintenance or breakdown period, total power generation stops. In the proposed system a small inverter is connected with each PV module. The generated AC power from the modules is added at the AC side to boost the power level. Partial shading or breakdown of one or two inverters will not hamper the main production of power. Secondly, replacement of a micro inverter is very easy. Boosting of power needs only adding micro-inverter whereas single inverter based system needs to replace the inverter itself which is very costly. Since the cost of a micro-inverter is very less, one can keep extra standby unit for replacement. Though the initial investment of a micro-inverter based power system will be higher but it can be shown that it is cost effective if we think of more than 2-3 years of use. Each unit continuously senses the voltage, frequency and phase of the grid supply and tracks the generated output voltage accordingly. The micro-inverter eliminates the problem as it handles low DC voltage at its input. PLCC based communication will be used to monitor the condition of power generation from each inverter from a remote place.**

***Keywords*— PV Module, Micro-Inverter, Power-Grid, Low Power Application**

I. INTRODUCTION

Nowadays we depend upon the non-renewable energy source to generate the electricity.But this non-renewable sources are limited and we will not be able to get them for lifetime. Due to this reason the demand for generating the electricity from renewable sources of energy is increasing. Solar power is one of the most widely used renewable source of energy due to many reasons such as freely available and pollution free. The intention of this work is to simulate a micro-inverter that can be used for lower income groups. Usually the voltage produced by the PV panels is low voltage and the boost converters are used to step up the voltage from the panel.

The boosted voltage of the converter is then connected to the inverter to convert from DC to AC. This AC voltage is used for the different application based on the power needs. Solar inverter architecture shown in figure1 represents traditional grid-connected photovoltaic system. The entire DC output of the series parallel combination of PV modules is brought to a point and then converted to AC by one inverter. In this kind of architecture the MPPT is implemented at the system level. The micro inverter implements, at the panel level, the power conversion stages (D The micro inverter implements, at the panel level, the power conversion stages (DC-DC with MPPT and DC-AC), the communication capability and the connection to the AC grid.

II. LITERATURE SURVEY

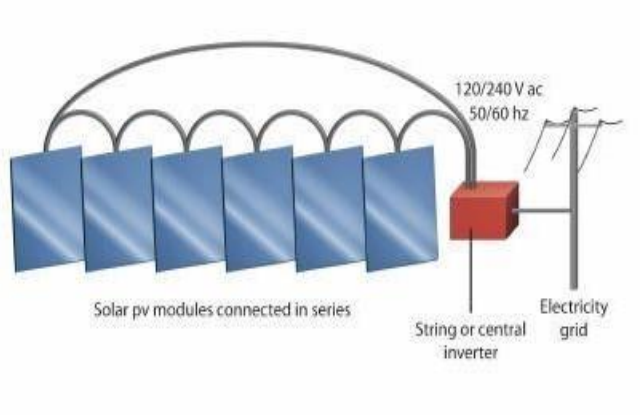

Fig-1: Working Principle of the Grid

Figure shows the conventional operation of the Grid tied inverter in which one centralized inverter is employed to converter the power received from the PV Module and then most important thing is if any partial shading problem comes and the output of the PV Module gets diverted from the desired performance. Therefore, the actual performance of the Grid can be said violated.

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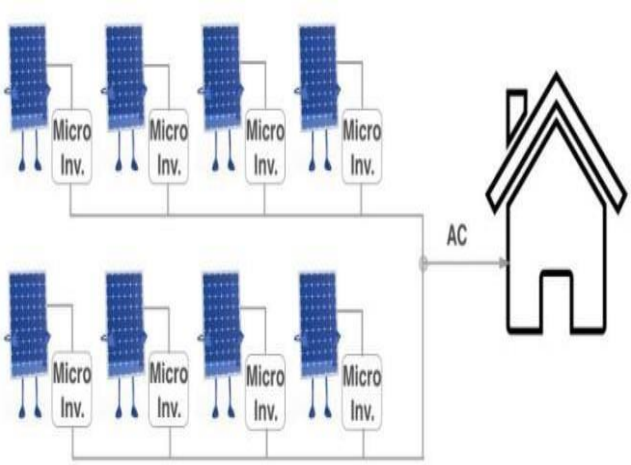

Fig-2 Micro-Inverter Topology

Figure shows one more topology to enhance the performance of the PV Module, in which numbers of Micro Inverters are connected to separate PV Module to achieve the required output. However this topology faces problem of providing MPPT control. As such in this topology separate controlling is required to provide the MPPT of PV Module which makes the topology more difficult.

III. Proposed Topology

There are so many difficulties we have faced while employing the Micro-inverter topology for the Micro-Grid Application. To overcome the disadvantages of the topology one more topology here in this paper is proposed.

This paper presents the design of a 300 watts, portable and cost effective solar micro-inverter. The system as shown in figure3 consists of a solar panel, DC-DC push-pull Converter, DCAC inverter, LC filter.

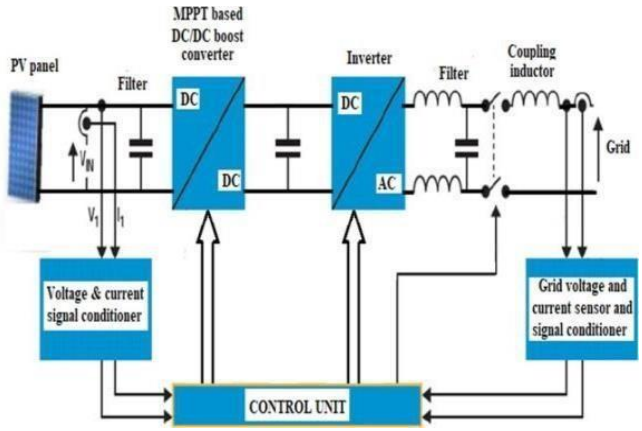

Fig-3: Proposed Topology

The solar cell powers DCDC push pull converter which boosts the input DC Voltage into the desired rated input voltage of the inverter. Maximum power point tracking (MPPT) control loop has been used for extracting best power output from the PV module. Figure 4 shows the V-I characteristicsindicating the maximum power point.

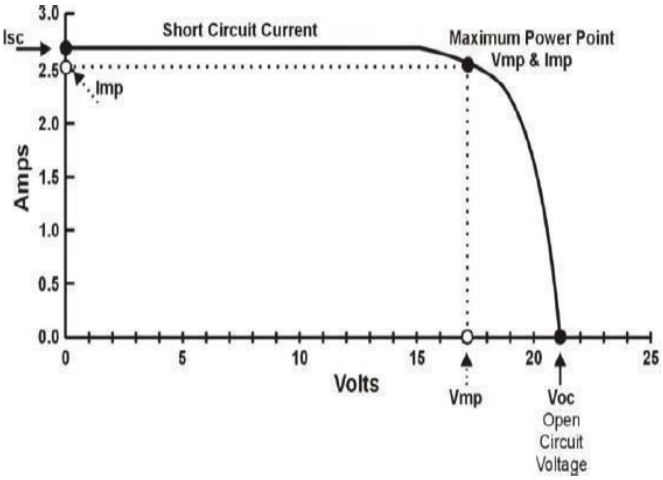

Fig-4 MPPT of the PV Module using IV characteristic

We are using the pulse width modulation to control the power of the inverter so our supply is remaining constant. No errors are in the power output. High frequency Pulse Width Modulated gate pulses are provided be the microcontroller and provided to the power IGBT of a full bridge inverter.

IV. Simulation & Results

The performance of the proposed topology is ensured by simulating it on the MATLAB/Simulink platform. For that the control strategy has been developed in the programming format and which is useful to achieve the MPPT and therefore the required PWM output is received and that can be employed as the gate pulses to the switches of the Micro Inverter.

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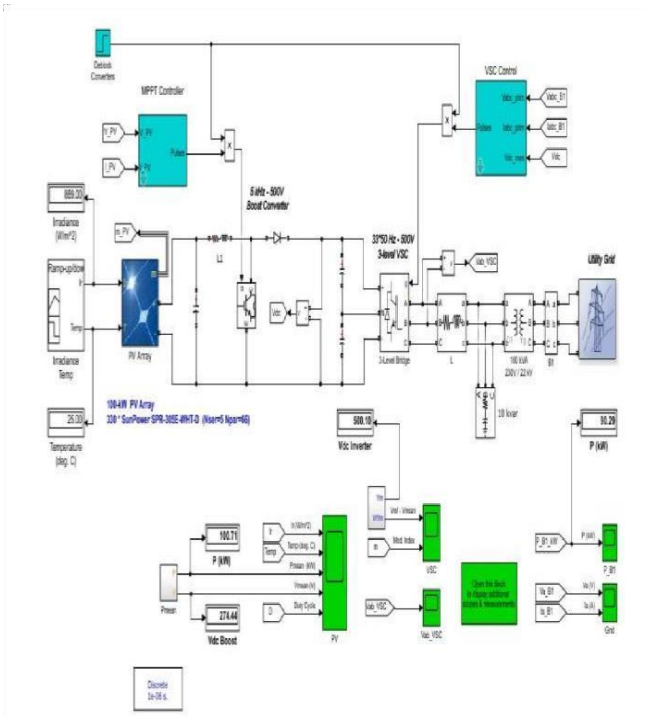

Fig-5: Simulation Model of the Proposed Topology

The Figure shows the proposed topology simulated in MATLAB/simulink platform to ensure the performance of the topology.

The Topology is well performed in MATLAB platform and provides the better results to show that the proposed topology is well suitable for the Grid Tied operation and ensures the reliability in terms of output while having the partial shading operation and also ensures the output does not vary much under the partial shading operation.

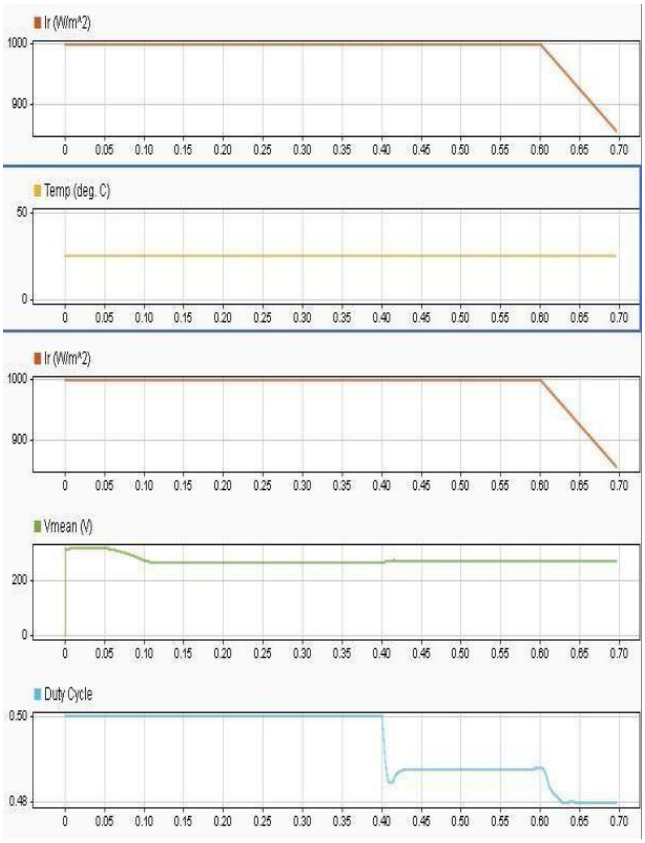

Fig-6: Output Results of the proposed topology

Figure-6 shows the output results of the proposed topology. The results achieved depicts that the proposed topology works very reliable to deliver the power to the Grid under any condition such as full irradiance condition as well as partially shaded condition and the required output is well achieved with the proposed control strategy.

V. CONCLUSION

In this paper one topology is explained with the support of the simulation work in MATLAB/Simulink platform to achieve the continuity of power in the Grid Tied Micro-Inverter mode. The performance of the Inverter is found more reliable in various operating modes. Therefore, such topology can be made available at the geographically difficult area where Grid Integration is difficult. Such topology can be said to play an important role in both the condition such as Grid Tied mode and off grid mode.

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