MULTI-LEVEL INVERTER FOR SOLAR ON-GRID SYSTEM DESIGN

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Abstract - *The demand for clean and sustainable energy has spurred research in all forms of renewable energy sources, including solar energy from photo voltaic systems. GCPS provide an effective solution to integrate solar energy into the existing grid. A key component of the GCPS is the inverter. The inverter can have a significant impact on the overall performance of the GCPS, including MPPT, THD, and efficiency. Multi level inverters are one of the most promising classes of converters that offer a low THD.*

***Key Words*: Grid connected photovoltaic system (GCPS), Boost converter, MPPT, Multi-level inverter.**

1. INTRODUCTION

Energy demand is continuously growing around the globe. In the past, most part of the energy demand was supplied by non renewable sources like coal, oil, gas etc. But they are depleting at a faster rate in recent years. So the researchers and scientists are trying to find some alternative solutions for required energy demand. Renewable sources like solar, wind, biomass etc. are the cost effective and pollution free solutions for providing green energy to all kinds of loads. Among the renewable sources, solar and wind are major contributors in the worlds energy arena. But the solar energy is foremost choice among there new able sources because of its availability and promising nature for variety of power applications. However, the initial cost of installing solar PV system is high and conversion efficiency is low. Researchers are continuously makingeffortstoinvent new topologies and control algorithms to extract maximum power from the solar.
Multilevel inverter having several advantages over conventional two level inverter that uses high switching frequency pulse width modulation.

1.1 Features of a multilevel inverter

1) They can generate output voltages with extremely low distortion and lower dv/dt.
2) They draw input current with very low distortion.
3) They generate smaller common-mode (CM) voltage.
4) They can operate with a lower switching frequency.

2. SOLAR ON GRID SYSTEM

The PV system is connected to grd. The grid-connected system can either be a grid-tied system, which can only feed power into the grid and such system cannot deliver power locally during blackouts and emergencies because these systems have to be completely disconnected from the grid and have to be shut down as per national and international electrical safety standards. Some grid-connected PV systems with energy storage can also provide power locally in an islanding mode.

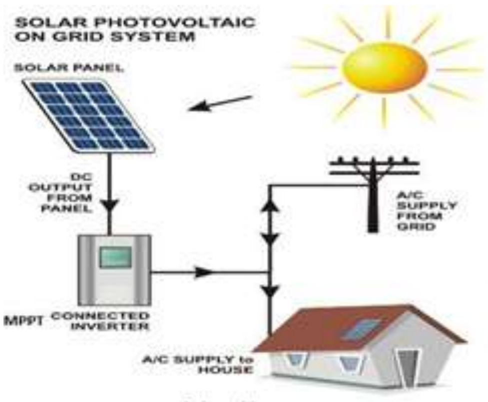

Fig -1:On-grid PV system

2.2 Flowchart of Design

A systematic approach is important and required when sizing and designing On-grid solar PV systems. The following procedures are generally followed:

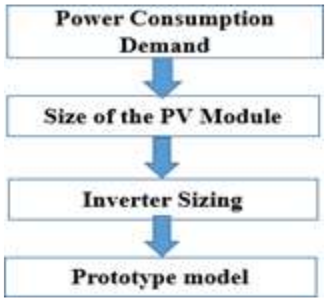

Fig -2: Flowchart

3.MAXIMUM POWER POINT TRACKING

The overall efficiency of PV system can be enhanced by operating the system at MPP. The tracking of maximum power point on the PV curve, irrespective of envi- ronmental changes like temperature and irradiance is called maximum power point tracking. Suitable MPPT method is required to maintain the operating point at maxi- mum power point, so that maximum power can be extracted from the solar PV system.

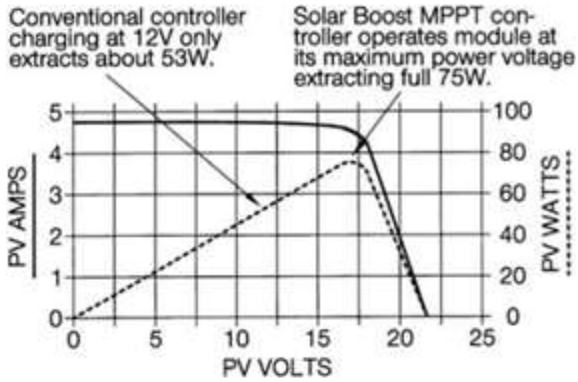

Fig-3:MPPT Test condition

3.1. MPPT Flowchart

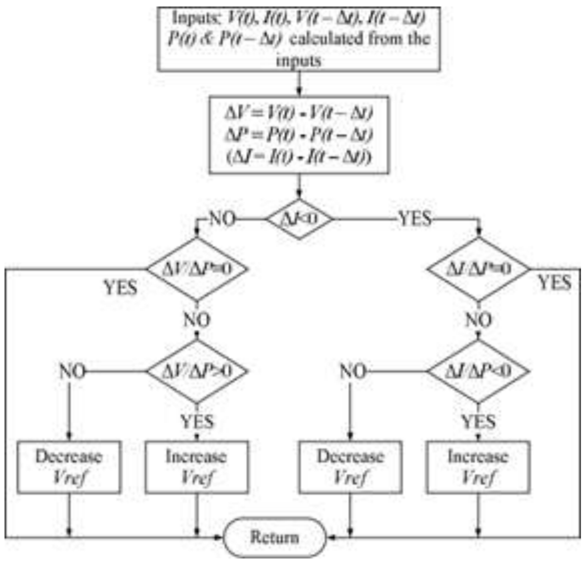

Fig-4: MPPT flowchart

3.2Design of MPPT system

For the MPPT booster circuit we have to find L and C Converter power rating =100 W

Switching frequency = 8000 Hz
Efficiency =100
Duty ratio $=T_{ON}/T_s$
$=(1-v_s/v_0)$
$= (1-12/100)$
$=0.8$
L $=V_{min}*D/F_S*\Delta IL$
=0.640 milli Henry We take it as 1 milli Henry

C = $I_{max}*D/F_s*\Delta V_c$ =960 micro Farad We take it as 1000 micro farad

Resistance, $R=V_0^2/P=10000/100=100$ ohm

4.MULTI-LEVEL INVERTER

4.1 Modes of operation- 3 Level Inverter

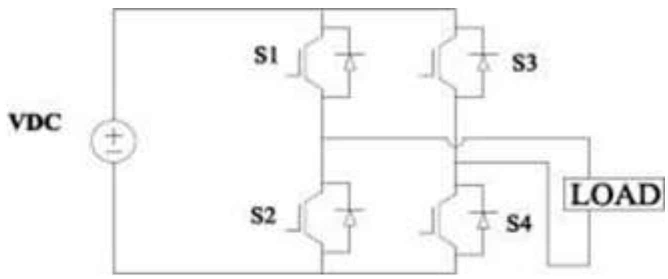

Fig-5: 3 Level Inverter

MODE	S1	S2	S3	S4
1	1	1	0	0
2	1	0	0	1
3	0	0	1	1
4	0	1	1	0

Fig-6: Switching sequence

Mode 1:- In this mode of operation of three level cascaded H- Bridge inverter switches s1, s2 are turned on no source is connected to the load .Zero output voltage across the load is obtained.

Mode 2:-In this mode of operation of three level cascaded H- Bridge inverter switches s1 s4 are turned on. Output voltage obtained across the load is +V dc.

Mode 3:- In this mode of operation of three level cascaded H- Bridge inverter switches s3 s4 are turned on. Output voltage obtained across the load is zero.

Mode 4:- In this mode of operation of three level cascaded H-Bridge inverter switches s2 s3 are turned on. Output voltage obtained across the load is V dc.

5. THREE LEVEL INVERTER WITH MPPT SYSTEM

5.1Simulink model and output

The model consists of input converter, inverter and a load. The input is a solar PV module(or DC source). The converter is a boost converter and contain an inductor, capacitor and MOSFET as a switching device. The inverter contains four MOS-FET'S and corresponding pulse generators. The load used here is a resistor. The following figures shows the simulation and output that we got in MATLAB17.

Parameters	Specification
Input Voltage Vin	12 V
Inductance	1 mH
Capacitance	1000 μF
Load resistance	100 Ω
Phase delay P1 & P2	.033
Phase delay P3 & P4	.0133
Time period	.02

Fig-7: Simulink parameters

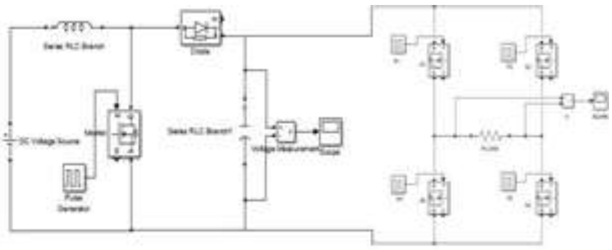

Fig-8: Simulink model

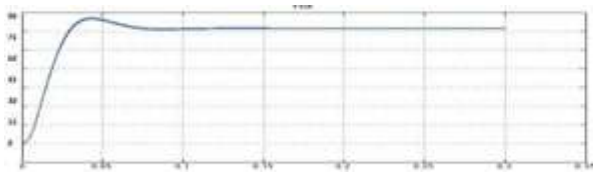

Fig-9: Converter output

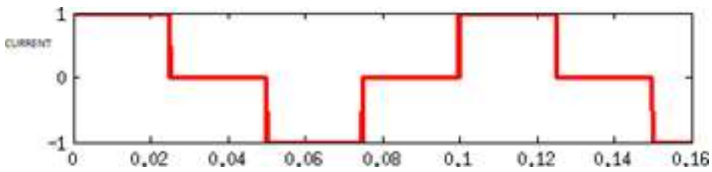

Fig-10: Current wave form of inverter output

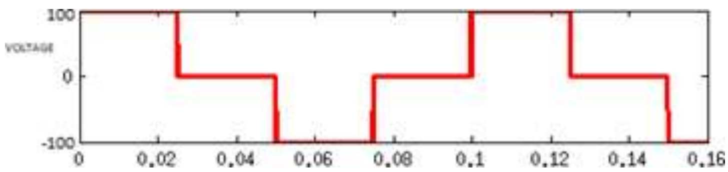

Fig-11: Voltage wave form of inverter output

5.2 Prototype Model

figure shows the working model of the system. Starting with the solar panel which is the input of the system. A 230V/12V transformer powers the controller and the driver circuit. The controller circuit consists of Arduino uno and driver circuit consists of TLP250. The output is LED lamp.

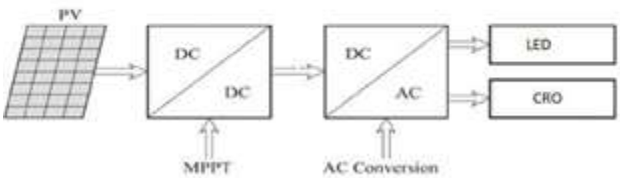

Fig-12: Block diagram of Prototype model

6. CONCLUSION

In recent years, there has been an increasing interest in electrical power generation from renewable-energy sources. They are essentially inexhaustible and environmentally friendly. Among the different renewable- energy sources possible to obtain electricity, solar energy has been one of the most active research areas in the past decades, both for grid- connected and stand-aloneap- lications. The exponential rate of growth in the world wide cumulative PV capacity is mainly due to enhancement in grid-connected inverter topologies. The PV array and the battery are connected to the AC grid via a common DC/AC inverter. AC output voltage is created by switching the full bridge in an appropriate sequence. The power converters are used for two major tasks. First, is to injecta sinusoidal current in to the grid. And second is to reduce the harmonics content in the grid injected voltage and current. Multilevel inverter provide high voltage operation capability, low switching losses, high efficiency andlow output of Electro Magnetic Interference (EMI).

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