

# MICRO INVERTER

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**Abstract** - Micro-inverters convert direct current (DC) from a single solar panel to alternating current (AC). They have several advantages over conventional string inverters like higher maximum power point tracking efficiency, easier installation and longer lifetime. One type of renewable energy source is the photovoltaic (PV) cell, which converts sunlight to electrical current, without any form for mechanical or thermal interlink. PV cells are usually connected together to make PV modules PV modules can therefore not be connected directly to the grid, but must be connected through an inverter. Inverters can come in many different varieties, different parameters like price, power rating, efficiency and applications. Inverter output is depends upon the PWM (Pulse Width Modulation) signals to the gating of the inverter switches.

**Key Words:** photo voltaic (pv) system, grid connection, Micro-inverter, Controller, AC grid, PWM control skim

## 1. INTRODUCTION

One type of renewable energy source is the photovoltaic (PV) cell, which converts sunlight to electrical current, without any form for mechanical or thermal interlink. PV cells are usually connected together to make PV modules PV modules can therefore not be connected directly to the grid, but must be connected through an inverter. With the fast development of this market, more and more researchers have focused on the topologies and control of the micro-inverter. Current controlled PWM inverters are widely used in high performance AC drivers.

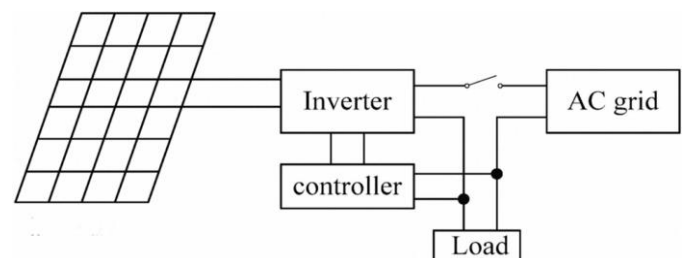
The paper describes two inverter control methods including the voltage source inverter control method and the power type PWM inverter control method which are common used at present. Voltage source inverter control method regulates phase angle of the grid mainly through receiving voltage signals from DC side of inverter which is called the outer loop to control the grid voltage, while it regulates the voltage reference from the AC side load voltage to control the inverter output current which is called the inner loop. However, the process of the inner loop will not affect the results of the outer loop. Power-type PWM inverter

Power type PWM inverter control method

Voltage source inverter control method regulates phase angle of the grid mainly through receiving voltage signals from the dc side of the inverter which is called the outer loop to control the grid voltage while it regulates voltage reference from ac side load voltage to control inverter output current which is called inner loop. However the

process of inner loop won't affect results of the outer loop. Power type PWM inverter bridge circuits is formed by two groups, which uses two reverse diodes synchronized transformation. Required power can be got by changing the modulation rate of PWM inverter.

Thus, even the grid-connected PV generation inverter control system is able to achieve maximum power point tracking (MPPT) and to ensure the high power quality of the photovoltaic cells or not are key issues in the electrical power system.



## 2. PAPER REVIEWED

Zhe Zhang, Min Chen, Mingzhi Gao, Qiong Mo, Zhaoming Qian at [1] have performed on An Optimal Control Method for Grid-Connected Photovoltaic Micro-inverter to Improve the Efficiency at Light-load Condition

Micro-inverters convert direct current (DC) from a single solar panel to alternating current (AC). They have several advantages over conventional string inverters like higher maximum power point tracking efficiency, easier installation and longer lifetime. For the control of micro inverter, boundary current mode (BCM) is chose to improve the efficiency while discontinuous current mode (DCM) is used to limit the switching frequency. If the switching frequency in DCM is constant, the switching loss will play a more significant role in the overall power loss at light load condition. In this paper, the effect of the DCM/BCM control and frequency limitation to the efficiency and output performance is analyzed first. Then a variable switching control method is proposed to reduce the switching loss under different PV panel's output power level and input/output voltage changes. Simulation and a 120W prototype's experimental results validated the proposed control method

Prakash Kumar Dewangan, U .T. Nagdeve at [2] have performed on Review Of An Inverter For Grid Connected Photovoltaic (PV) Generation System The review of inverter is developed with focus on low cost, high reliability and mass

production for converting electrical energy from the pv module to the grid. Various inverter topologies are presented, compared, and evaluated against demands, lifetime, component ratings, and cost. Inverter based PV system to explain electrical performance subjected to different operating conditions. Multilevel inverter is one of the most recent and popular type of inverter finds its applications in the system based on renewable energy. This paper describes a new Single-phase Eleven level inverter topology for solar photovoltaic (PV) system using a carrier based PWM control scheme. This new topology has reduced number of switches for an increased number of levels when compared to conventional seven-level inverter. Here PWM switching scheme is used to control the switches in this multilevel inverter and this inverter is fed from a solar PV. By using this inverter topology, the harmonics is reduced and efficiency is enhanced significantly.

Satheesh Kumar.D. Ramya.N.D. Indira.R., R.Ashok at [3] have performed on Design and Analysis of Single Phase Grid Connected Inverter Power inverters are devices which can convert electrical energy of DC form into that of AC. Inverters can come in many different varieties, different parameters like price, power rating, efficiency and applications. The DC/AC power inverter is normally to take DC power supplied by a solar panel (or) battery, such as a 12 volt battery, and transform it into a 120 volt AC power source operating at 60 Hz, it has emulates the power available at an ordinary household electrical application. The tasks of Power inverters are used for day today life powering appliances in Domestic applications. When the inverter output is pure sinusoidal and its connected to the grid. But, to match the frequency, phase and amplitude of the grid and inverter output. Inverter output is depends upon the PWM (Pulse Width Modulation) signals to the gating of the inverter switches. The PWM pulses are generated with the help of Arduino Atmel 328 controller. Hysteresis current controller is used to adjust the inverter frequency up to the grid frequency. In this controller is implemented by simply and it provides good dynamic response and good output current regulation.

H. Koniki, P. Bajpai at [4] have performed on Central and Micro Inverters for Solar Photovoltaic Integration in AC grid

This paper presents detailed modeling of central inverter and micro inverter for solar photovoltaic (PV) integration in AC grid. Data of a 100 kW solar PV plant installed in IIT Kharagpur is used to validate these models and their performance on sunny, cloudy and partially shaded days are compared. Models of 5 kW grid tie central inverter and 250 W micro inverter are developed with polycrystalline solar PV in MATLAB/Simulink. solar irradiance and PV module temperature data are taken from SCADA system from that actual solar PV plant as inputs to the simulation models. Comparative results are captured in terms of inverter AC power output under different operating conditions and the solar PV system with micro inverters have illustrated better performance compared to central inverter.

Yanqing Li, Member, IEEE, Cheng Chen, Student, Qing Xie, Member, IEEE at [5] have performed on Research of An Improved Grid-connected PV Generation Inverter Control System. The paper firstly introduces the structure and operational principle of the present grid-connected PV generation system. And then describes the two inverter control methods including the voltage source inverter control method and the power type PWM inverter control method which are common used at present. Based on the above two kinds of inverter control methods, the second step is to present an improved PWM inverter control system that can be applied in grid-connected PV generation. Finally, it constructs a single-phase grid-connected PV generation system, and uses MATLAB/Simulink software to simulate and analyze. The result of the simulation shows that the improved inverter control system can effectively control the grid current waveform which tends to sine wave, meanwhile it can achieve the maximum power point tracking, besides it is able to put the arbitrary power out to the load or to the grid, while the control system has a good stability.

### 3. OBJECTIVES OF MODELING OF MICRO INVERTER

The Photo Voltaic (PV) energy system, utilized as a part of this undertaking, is another idea being used, which is increasing huge ubiquity because of expanding significance to developing option wellsprings of source of energy over exhaustion of customary nonrenewable energizes all around the globe. The systems which are being created concentrate on making sun as source of energy in the most productive way and supply them to the accessible loads without influencing their execution.

#### 3.1 PWM PULSE GENERATION

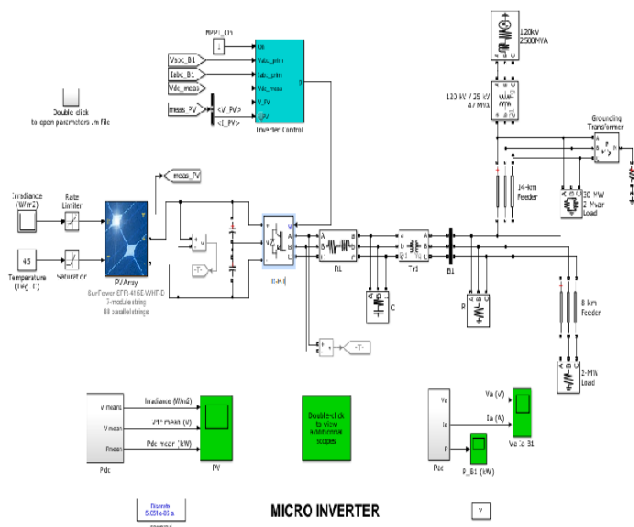
The Pulse Width Modulation (PWM) is a technique which is characterized by the generation of constant amplitude pulse by modulating the pulse duration by modulating the duty cycle. The block diagram representation of PWM pulse generation is shown in fig.4. Analog PWM control requires the generation of both reference and carrier signals that feeds to the comparator and it's based on some logic output, the final output is to derive the power MOSFET switches The reference signal output maybe sinusoidal or square wave, while the saw tooth or triangular waves are carrier signal at a frequency significantly greater than the reference. The waveform representation of PWM pulse is shown in fig.5. There are various types of PWM techniques and so we get different output and the choice of the Inverter depends on cost, noise level and power efficiency. In this thesis we can select sinusoidal PWM method.

### 4. METHODOLOGY

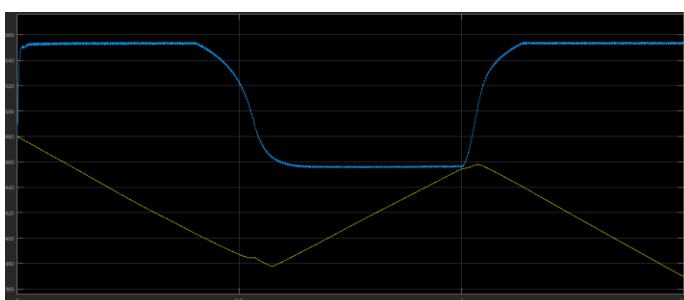
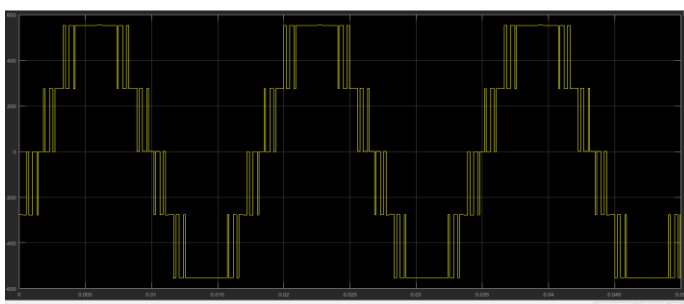
Photovoltaic generation system generates electricity by converting the Sun's energy directly into electricity. Photovoltaic-generated energy can be delivered to power system networks through grid-connected inverters. A single-phase grid-connected inverter is usually used for residential

or low-power applications of power ranges. Types of single-phase grid-connected inverters have been investigated. A device that converts dc power in to ac power at desired output voltage and frequency is called an inverter. Phase controlled converters when operated in the inverter mode, are called line-commutated inverters, but line-commutated inverters require at the output terminal an existing ac supply which is used for their commutation. This means that line commutated inverter cannot function as isolated ac voltage sources or as variable frequency generators with dc power at the input. Therefore voltage level, frequency and waveform on the ac side of line commutated inverters cannot be changed, on the other hands force commutated inverters provide an independent ac output voltage of adjustable voltage and adjustable frequency and have therefore much wider application

**SIMULATION CKT**



**WAVEFORM**



**5. CONCLUSION**

The structure of improved PWM inverter control system is very simple which is based on the voltage type control method and the PWM power type control method. From the result of simulation, conclusions are come to as follows. First, the improved PWM inverter control method can make the voltage and the current waveform of the grid tend to sine wave effectively and quickly, and the power factor will reach to one. Second, the power can be sent to the grid or load arbitrary through controlling the PWM regulator, while the control system has a good stability. Finally, many inverter control systems are used in grid-connected at present, but there are several problems which need be to solved about how to keep a good stability of the power system when the grid changes from island to grid-connected. Today, research of a large number of grid-connected PV generation inverter control system is still very important for everyone

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**BIOGRAPHIES**



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