

Advanced Control Strategy for Solar PV and Battery Storage Integration Using Three Level NPC Inverter

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ABSTRACT

A new control algorithm for the proposed system is also presented in order to control the power delivery between the solar PV, battery and grid which simultaneously provides maximum power point tracking (MPPT) operation for the solar PV. Using this systems save solar energy, reduce pollution, less total harmonic distortion (THD), as well as and lower maintenance. Cost also efficient. We used solar energy plays an important role in electricity generation in our project. Solar photovoltaic (PV) system and battery storage, which is implemented using a three level neutral-point-clamped (NPC) inverter. An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the resulting AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Renewable energy (solar energy) plays an important role in electricity generation. Proposed work. The solar inverter consist of solar panel, controller, inverter & batteries, all of which can function independently without utility. The solar system are now being used widely in different fields, like street lighting, traffic, telecommunications base, large scale billboards & home power. In this paper, a novel configuration of a three-level neutral-point-clamped (NPC) inverter that can integrate solar photovoltaic (PV) with battery storage in a grid-connected system is proposed. The strength of the proposed topology lies in a novel, extended unbalance three-level vector modulation technique that can generate the correct ac voltage under unbalanced dc voltage conditions.

Keywords: Solar photovoltaic (PV), Battery storage, Space vector modulation (SVM), three level NPC inverter

1 Introduction

Now a days the demand for power is increases all over the world and this cannot be met by the conventional sources because it going to be vanishes. And also, there are so many environmental problems, energy crises due to the conventional power generation. This can be replace by using the renewable energy source like solar photovoltaic (PV) for generation of electricity. Advanced power electronic systems are needed to utilize and develop renewable energy sources. In solar PV or wind energy applications, utilizing maximum power from the source is one of the most important functions of the power electronic systems. In three-phase applications, two types of power electronic configurations are commonly used to transfer power from the renewable energy resource to the grid: single-stage and double-stage conversion. In the is a DC/AC inverter. The function of the DC/DC converter is to facilitate the maximum power point tracking (MPPT) of the PV array. An inverter is an electrical device that converts direct current (DC) to alternating current (AC); the resulting AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Renewable energy (solar energy) plays an important role in electricity generation. Proposed work.



2 Future Scope

The solar inverter consists of solar panel, controller, inverter & batteries, all of which can function independently without utility power. The solar system are now being used widely in different fields, like street lighting , traffic , telecommunications base ,large scale billboards & home power.

3 Block diagram–

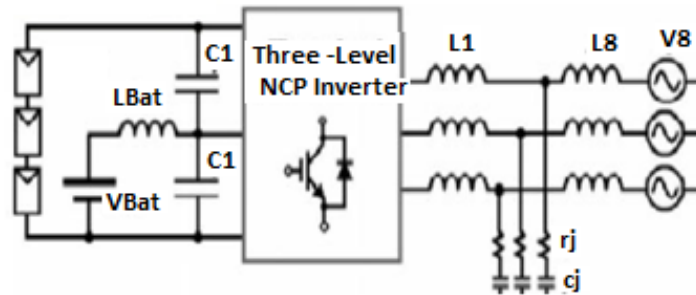


Figure 1. block diagram of three level NPC inverter

4.Pin Diagram

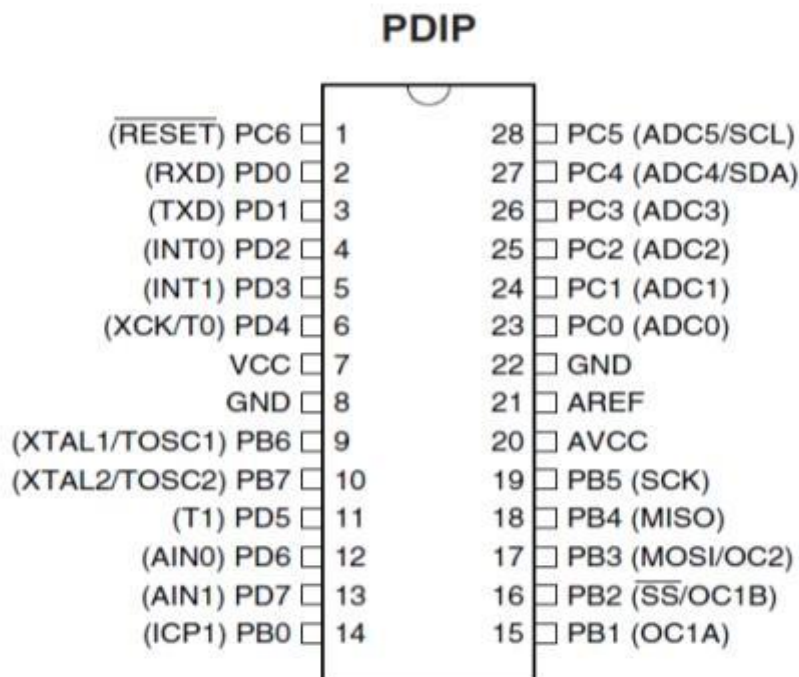


Figure 2.Pin diagramATmega328

4 Pin Description-

VCC: - Supply Voltage

GND: - Ground

Port 0:-

Port 0 is an 8-bit open-drain bi-directional I /O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured. The crank plate is connected to the piston rod of the cylinder, where the rotary motion of crank plate is converted to the reciprocation motion in the pneumatic cylinder. The double acting cylinder is connected with the water tank by a non-return valve. The air goes to the water tank pushes water out of

the tank. This pushed out water is sprayed through the sprinkler to the plants. to be the multiplexed low order address / data bus during accesses to external program and data memory

Port 1 -

Port1 also receives the low-order address bytes during Flash programming and verification. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

Port 2:-

When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3 -

Port 3 also serves the functions of various special features of the AT89C51 as listed below, Port Pin

Alternate Functions –

- P3.0 RXD (Serial input port)
- P3.0 RXD (Serial input port)
- P3.1 TXD (Serial output port)
- P3.2 INT0 (External Interrupt 0)
- P3.3 INT1 (External Interrupt 1)
- P3.4 T0 (Timer 0 external input)
- P3.5 T1 (Timer 1 external input)
- P3.6 WR (External data memory write strobe)
- P3.7 RD (External data memory read strobe)

RST:-

Reset input, A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE / PROG:-

In normal operation ALE is emitted at a constant rate 1 / 6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. This pin is also the program pulse input (PROG) during Flash programming. Setting the ALE-disable bit has no effect if the Microcontroller is in external execution mode.

PSEN:-

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each cycle, except that two PSEN activations are skipped during each access to external data memory.

EA / VPP:-

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions.

XTAL 1-

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL 2:-

Output from the inverting oscillator amplifier.

5 Components Used

This project is designed by following blocks

1. Transistor
2. LCD Display
3. Battery
4. Microcontroller ATmega328
5. Light Emitting Diodes (LED)
6. Solar Panel

5.1 Transistors -

Transistors amplify current, for example they can be used to amplify the small output current from a logic chip so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to amplify voltage.

A transistor may be used as a switch (either fully on with maximum current, or fully off with no current) or as an amplifier (always partly on). The amount of current amplification is called the current gain, symbol h_{FE} .

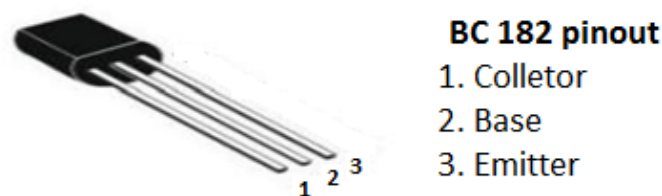


Figure 3. Transistor

Types of Transistors –

There are two types of standard transistors, NPN and PNP, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN because this is the easiest type to make from silicon. If you are new to electronics it is best to start by learning how to use NPN transistors. The leads are labeled base (B), collector (C) and emitter (E). These terms refer to the internal operation of a transistor but they are not much help in understanding how a transistor is used, so just treat them as labels.

5.2 LCD Display –

This display contains two internal byte wise registers, One for the commands ($RS=0$) and second for character to be displayed ($RS=1$). It also contains a user programmed RAM area (the character RAM) that can be programmed to generate any desired character that can form using a dot matrix. To distinguish between these two data areas, the hex command byte 80H will be used to signify that display RAM 00H is chosen. Port 1 is used to furnish the command or data byte, and ports 3.2 to 3.4 furnish register select and read/write levels. The display takes varying amounts of time to accomplish the functions. LCD bit 7 is monitored for a logic high (Busy) to ensure the display is not overwritten

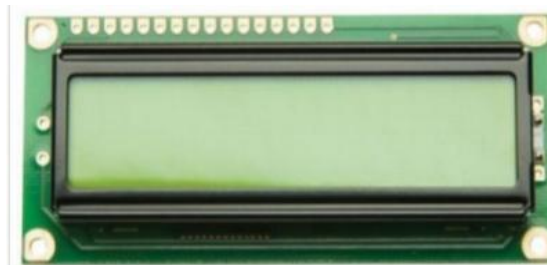


Figure 4 . LCD display

5.3 Battery -

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device.



Figure 5. Battery

5.4 Microcontroller ATmega328 –

The ATmega328 is designed with static logic for operation down to zero frequency and supports two Software selectable power saving modes. The device is manufactured using Atmel's high-density non volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications

5.5 Light Emitting Diodes (LEDs) –

LEDs emit light when an electric current passes through them.

Colours of LEDs -

LEDs are available in red, orange, amber, yellow, green, blue and white. Blue and white LEDs are much more expensive than the other colours. The colour of an LED is determined by the semiconductor material, not by the colouring of the package (the plastic body).

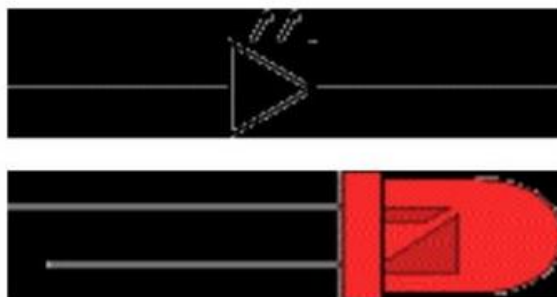


Figure 6 . LED

5.6 Solar panel -

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules

constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential application.



Figure 7 .Solar Panel

6 Conclusion

Inverters are usually about 95% efficient. Inverters play a significant role in providing alternate current supplies at the times of crucial power requirements. The primary use of solar inverters is to convert direct current to alternating current through an electrical switching process. A new algorithm is proposed to control the power flow between the solar PV, grid, and battery storage. The MPPT is used for the smooth and reliable operation for the solar PV. The results show the proposed system will control the balance and unbalance voltage levels from the solar irradiance.

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