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Advanced Control of a 63-Level Multilevel Inverter in a Grid-Connected Photovoltaic System

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ABSTRACT

This project mainly focus on the development of an advanced power conversion system for grid-connected photovoltaic (PV) installations, with a primary focus on a 63-level multilevel H-bridge inverter. The heart of the project lies in the precise control of the 63-level inverter output, achieved through a multi-carrier offset method implemented with a proportional-integral (PI) controller. This control strategy optimizes the synchronization of the inverter output with the grid, minimizing harmonics and enhancing overall system stability and efficiency. The PV panel output is efficiently processed through a fly back converter, and the resulting energy is fed into the high-performance 63-level inverter. This synergy between the control strategies for the fly back converter and the 63-level inverter ensures the seamless and reliable integration of clean energy into the grid. The proposed control methodologies promise enhanced performance, reduced harmonic distortions, and improved power quality, aligning with the global push towards sustainable and efficient renewable energy utilization. This proposed topology is simulated in MATLAB/Simulink and verified experimentally with a hardware prototype under various conditions

INTRODUCTION

Nowadays, electric power generation through PV systems has emerged as an alternative to conventional power generating systems due to simple maintenance, eco-friendly nature, low noise and abundant availability. Extracting maximum power and inverting the output power of the PV system into useful AC to feed the utility are the tedious task associated with solar power generation.

To feed the utility grid DC power generated from the PV array has to be inverted into AC power. The conversion circuit includes a dc-dc power converter and Multi-Level Inverter (MLI). Multilevel inverters (MLIs) are the most popular means for voltage conversion from DC to AC power, and are used in fuel cell and photo-voltaic (PV) based sustainable or renewable energy systems (RES). In this project a Novel PV fed Fly back converter based MLI is introduced for grid utility applications.

The generated power from PV is fed to the load power network through an inverter. For high power applications it is necessary to transform the generated DC into AC. For this conversion, traditional two level inverter is not sufficient due to harmonics and switching losses.

Hence, a novel 63 level based MLI is introduced for domestic applications and elimination of harmonic distortion and its effects.

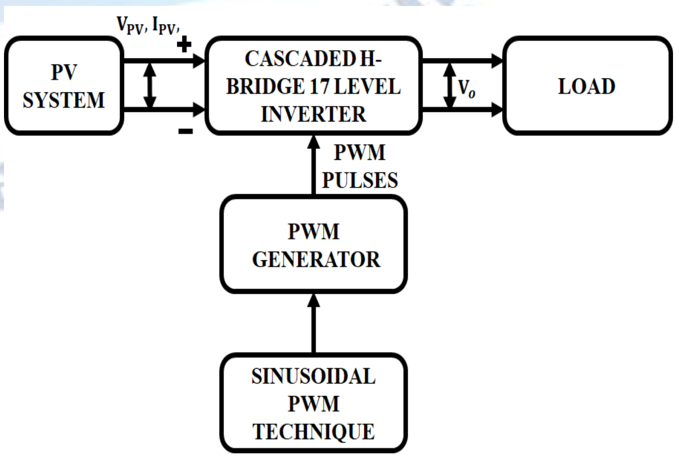
LITERATURE SURVEY

OBJECTIVE

To develop a 63-level multilevel H-bridge inverter capable of efficiently converting the PV panel output to a form suitable for grid integration. To implement a fly back converter to process the PV panel output, ensuring optimal power transfer and compatibility with the 63-level inverter. To utilize a multi-carrier offset method in conjunction with a PI controller to regulate and control the 63-level inverter output. To achieve precise synchronization with the grid, minimize harmonic distortions, and enhance overall system stability.

S.NO	TITLE AND AUTHOR	METHODOLOGY USED	ADVANTAGES	DRAWBACKS
3	'An Improved Artificial Neural Network-Based Approach for Total Harmonic Distortion Reduction in Cascaded H-Bridge Multilevel Inverters' &Y. Y. Ghadi , et al [2023] IEEE	In this paper presented an improved artificial neural network (ANN) based approach that can be useful to reduce the THD levels in a cascaded H-bridge (CHB) multilevel inverter (MLI).	➢ The use of an improved ANN-based approach is advantageous for its ability to learn and adapt to complex patterns. ➢ It enhancing power quality by reducing Total Harmonic Distortion (THD) in energy conversion.	➢ The switching angles optimization using the ANN architecture have limitations or challenges, especially under varying operating conditions. Applicable only for Specific load types.
4	'A New Four-Level Inverter-fed Motor Drive for Marine Propulsion Systems: Topology, Control, and Analysis' & H. Le, A. Dekka and D. Ronanki [2023] IEEE	In this paper introduces a new four-level inverter (NFLI) with a reduced component count and superior harmonic performance for MV applications.	➢ The NFLI is engineered to provide superior harmonic performance. The proposed four-level inverter (NFLI) is designed with a reduced component count	While the modified multi-carrier PWM scheme is introduced to minimize capacitor voltage ripple, its complexity may pose challenges in terms of implementation.
5	'A Switched-Capacitor Multi-Level Inverter With Variable Voltage Gain Based on Current-Fed Dickson Voltage Multiplier' & Y. Niazi , et al [2023] IEEE	In this paper voltage boost switched-capacitor multi-level inverter (SCMLI) structure is planned which is able to control the voltage gain. The structure is based on Current-fed Dickson Voltage Multiplier (CFDVM).	The use of CFDVM at the input stage is advantageous as it limits the capacitor peak current and enhances the voltage gain compared to other SCMLIs.	➢ High Capacitor Voltage Ripple rises. Limited for low power Applications.
6	A Five-Level X-Type Boosting Inverter With Reduced Stored Energy of Switched-Capacitors'' & A. Jakhar, et al [2023] IEEE	In this paper proposes a novel five-level (5L) common ground type (CGT) inverter based on switched capacitors (SCs) with dual voltage boosting ability.	➢ Dual Voltage Boosting Ability In the event of capacitor failures, the proposed inverter sustain operation with reduced voltage levels. This fault-tolerant feature enhances the reliability of the system.	While using SCs rated for half of the peak output voltage reduces the energy storage requirement, it trade-offs in terms of overall system efficiency.

EXISTING DIAGRAM



- The multilevel converter is an electronic device that can provide various levels of voltage at the output for more similarity with a pure sine wave.
- In such converters, various lower-level DC voltages are used at the input side. Multilevel converter applications have been mostly used in renewable energy systems.
- This project present a single-phase 17-level cascaded H-bridge multilevel converter (CHMC) model for a stand-alone system using solar PV arrays.
- The proposed model employs eight different flexible PV arrays that can be replaced with DC voltage sources when required to meet the load demand.
- The temperature and irradiance are provided to the solar PV arrays, which produce DC voltages, and these varying DC voltages are stabilized using capacitor banks.
- Then these fixed DC voltages are fed to the CHMC to convert these into AC voltages.
- The seventeen-level CHMC is used to convert the DC voltages into AC to drive the loads.
- This system converter is sinusoidal PWM controlled, which consists of a reference sinusoidal signal and sixteen triangular waves to achieve the desired 17 levels

DEMERITS OF THE EXISTING SYSTEM

- It attains high harmonics.
- PV output changes periodically as a results it achieves poor efficiency.

It generate damping oscillations and power quality issues in the output of the load.

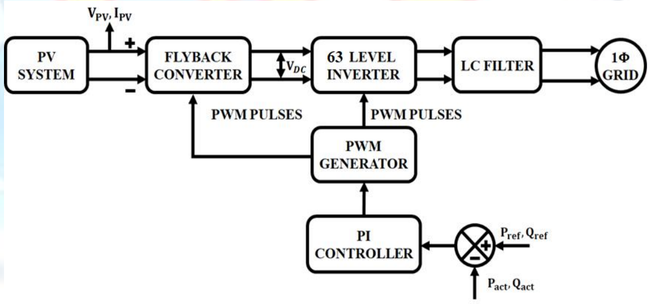
- High Switching losses.
- THD for this system is quit high compared to proposed work.

PROPOSED SYSTEM

- In this proposed system, PV panel output is directed to a fly back converter, a power electronic device designed to efficiently transform and regulate the incoming energy.
- The fly back converter is controlled by a proportional-integral (PI) controller to optimize the power transfer and ensure the stability of the conversion process.
- The regulated output from the fly back converter is then fed into a 63-level multilevel H-bridge inverter.
- The 63-level inverter's output is precisely controlled using a multi-carrier offset method implemented with a PI controller.
- This control strategy ensures the inverter's output waveform is synchronized with the grid requirements, minimizing harmonic distortions and meeting the necessary grid standards.
- The controlled output from the 63-level inverter is then connected to the single-phase grid through an LC filter.
- The LC filter helps in refining the inverter output, reducing harmonics, and improving power quality before injection into the grid.

This proposed topology is simulated in MATLAB/Simulink and verified experimentally with a hardware prototype under various conditions.

BLOCK DIAGRAM

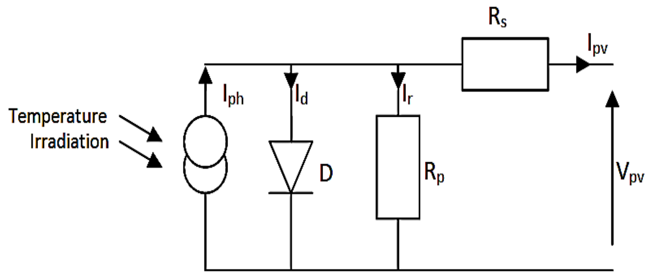


PHOTOVOLTAIC SYSTEM

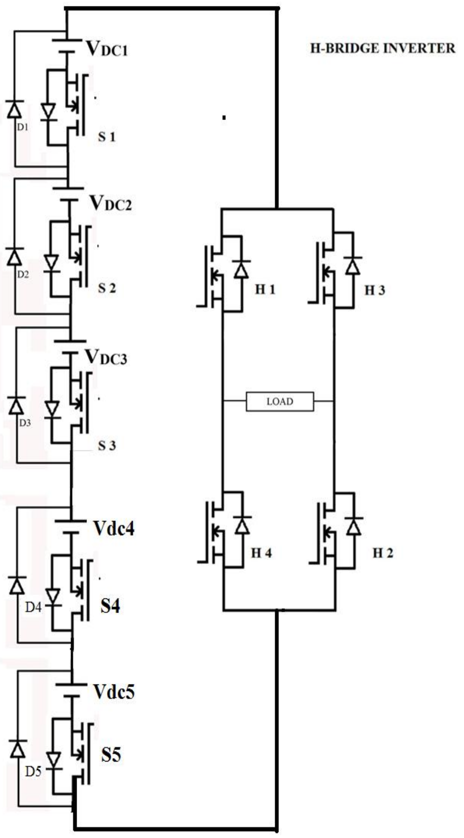
A photovoltaic (PV) system, also known as a solar PV system, is a technology that converts sunlight directly into electricity using solar cells.

It is a type of renewable energy system that harnesses the photovoltaic effect, which is the process by which certain materials can generate an electric current when exposed to sunlight.

PV modules and arrays are just one part of a PV system. The PV system also include mounting structures, along with the components that take the direct-current (DC) electricity produced by modules and convert it to the alternating-current (AC) electricity. The fluctuating nature of Sun, necessitates the use of DC-DC converters for boosting the PV output.



63 MLI CIRCUIT DIAGRAM



MODES OF OPERATION

The proposed single-phase sixty three-level inverter was developed from the five-level inverter.

It comprises a Single phase conventional H-bridge inverter, three switches, and three voltage sources.

This H-bridge topology is significantly advantageous over other topologies, i.e., less power switch, power diodes, for inverters of the same number of levels.

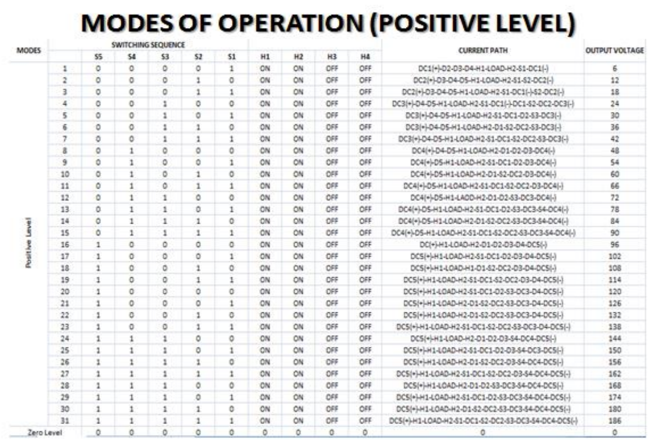
Proper switching of the inverter can produce sixty three level output-voltage levels.

The proposed inverter's operation can be divided into sixty three switching states, the required sixty three levels of output voltage were generated.

When H1 and H2 are ON, connecting load terminals to Vdc, and specific switches are closed, the output voltage is set to maximum (Vdc).

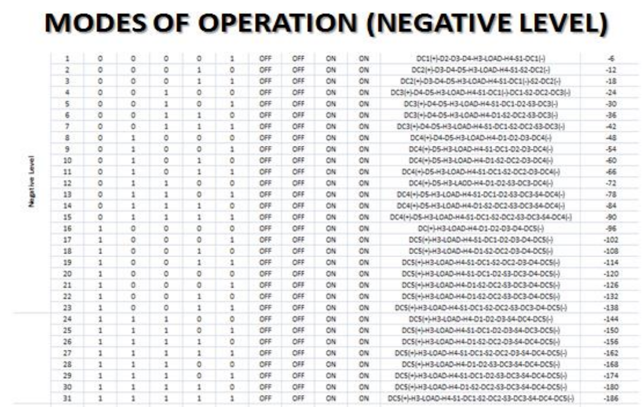
By selectively activating different combinations of switches, the inverter produces variable positive output voltages, ranging from 31/31Vdc to 1/31Vdc in incremental steps.

The output voltage at each step is precisely controlled using a multi-carrier offset method implemented with a PI controller. This ensures accurate synchronization with the grid and minimizes harmonic distortions.



MODES OF OPERATION (POSITIVE LEVEL)

MODES		SWITCHING SEQUENCE								CURRENT PATH	OUTPUT VOLTAGE
	S5	S4	S3	S2	S1	H1	H2	H3	H4		
Positive Level 1	0	0	0	0	1	ON	ON	OFF	OFF	DC1(+)-D2-D3-D4-H1-LOAD-H2-S1-DC1(-)	6
2	0	0	0	1	0	ON	ON	OFF	OFF	DC2(+)-D3-D4-D5-H1-LOAD-H2-S1-S2-DC2(-)	12
3	0	0	0	1	1	ON	ON	OFF	OFF	DC2(+)-D3-D4-D5-H1-LOAD-H2-S1-DC1(-)-S2-DC2(-)	18
4	0	0	1	0	0	ON	ON	OFF	OFF	DC3(+)-D4-D5-H1-LOAD-H2-S1-DC1(-)-DC1-S2-DC2-DC3(-)	24
5	0	0	1	0	1	ON	ON	OFF	OFF	DC3(+)-D4-D5-H1-LOAD-H2-S1-DC1-D2-S3-DC3(-)	30
6	0	0	1	1	0	ON	ON	OFF	OFF	DC3(+)-D4-D5-H1-LOAD-H2-D1-S2-DC2-S3-DC3(-)	36
7	0	0	1	1	1	ON	ON	OFF	OFF	DC3(+)-D4-D5-H1-LOAD-H2-S1-DC1-S2-DC2-S3-DC3(-)	42
8	0	1	0	0	0	ON	ON	OFF	OFF	DC4(+)-D4-D5-H1-LOAD-H2-D1-D2-D3-DC4(-)	48
9	0	1	0	0	1	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-S1-DC1-D2-D3-DC4(-)	54
10	0	1	0	1	0	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-D1-S2-DC2-D3-DC4(-)	60
11	0	1	0	1	1	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-S1-DC1-S2-DC2-D3-DC4(-)	66
12	0	1	1	0	0	ON	ON	OFF	OFF	DC4(+)-D5-H1-LADD-H2-D1-D2-S3-DC3-DC4(-)	72
13	0	1	1	0	1	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-S1-DC1-D2-S3-DC3-S4-DC4(-)	78
14	0	1	1	1	0	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-D1-S2-DC2-S3-DC3-S4-DC4(-)	84
15	0	1	1	1	1	ON	ON	OFF	OFF	DC4(+)-D5-H1-LOAD-H2-S1-DC1-S2-DC2-S3-DC3-S4-DC4(-)	90
16	1	0	0	0	0	ON	ON	OFF	OFF	DC(+)-H1-LOAD-H2-D1-D2-D3-D4-DC5(-)	96
17	1	0	0	0	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-D2-D3-D4-DC5(-)	102
18	1	0	0	1	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H1-D1-S2-DC2-D3-D4-DC5(-)	108
19	1	0	0	1	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-S2-DC2-D3-D4-DC5(-)	114
20	1	0	0	0	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-D2-S3-DC3-D4-DC5(-)	120
21	1	0	0	0	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-S2-DC2-S3-DC3-D4-DC5(-)	126
22	1	0	0	1	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-S2-DC2-S3-DC3-D4-DC5(-)	132
23	1	0	0	1	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-S2-DC2-S3-DC3-D4-DC5(-)	138
24	1	1	1	0	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-D2-D3-S4-DC4-DC5(-)	144
25	1	1	1	0	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-D2-D3-S4-DC3-DC5(-)	150
26	1	1	1	1	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-S2-DC2-D3-S4-DC4-DC5(-)	156
27	1	1	1	1	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-S2-DC2-D3-S4-DC4-DC5(-)	162
28	1	1	1	0	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-D2-S3-DC3-S4-DC4-DC5(-)	168
29	1	1	1	0	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-D2-S3-DC3-S4-DC4-DC5(-)	174
30	1	1	1	1	0	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-D1-S2-DC2-S3-DC3-S4-DC4-DC5(-)	180
31	1	1	1	1	1	ON	ON	OFF	OFF	DC5(+)-H1-LOAD-H2-S1-DC1-S2-DC2-S3-DC3-S4-DC4-DC5(-)	186
Zero Level	0	0	0	0	0	0	0	0	0	0	0



MODES OF OPERATION (NEGATIVE LEVEL)

Negative Level 1	0	0	0	0	1	OFF	OFF	ON	ON	DC1(+)-D2-D3-D4-H3-LOAD-H4-S1-DC1(-)	-6
2	0	0	0	1	0	OFF	OFF	ON	ON	DC2(+)-D3-D4-D5-H3-LOAD-H4-S1-S2-DC2(-)	-12
3	0	0	0	1	1	OFF	OFF	ON	ON	DC2(+)-D3-D4-D5-H3-LOAD-H4-S1-DC1(-)-S2-DC2(-)	-18
4	0	0	1	0	0	OFF	OFF	ON	ON	DC3(+)-D4-D5-H3-LOAD-H4-S1-DC1(-)-DC1-S2-DC2-DC3(-)	-24
5	0	0	1	0	1	OFF	OFF	ON	ON	DC3(+)-D4-D5-H3-LOAD-H4-S1-DC1-D2-S3-DC3(-)	-30
6	0	0	1	1	0	OFF	OFF	ON	ON	DC3(+)-D4-D5-H3-LOAD-H4-D1-S2-DC2-S3-DC3(-)	-36
7	0	0	1	1	1	OFF	OFF	ON	ON	DC3(+)-D4-D5-H3-LOAD-H4-S1-DC1-S2-DC2-S3-DC3(-)	-42
8	0	1	0	0	0	OFF	OFF	ON	ON	DC4(+)-D4-D5-H3-LOAD-H4-D1-D2-D3-DC4(-)	-48
9	0	1	0	0	1	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-S1-DC1-D2-D3-DC4(-)	-54
10	0	1	0	1	0	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-D1-S2-DC2-D3-DC4(-)	-60
11	0	1	0	1	1	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-S1-DC1-S2-DC2-D3-DC4(-)	-66
12	0	1	1	0	0	OFF	OFF	ON	ON	DC4(+)-D5-H3-LADD-H4-D1-D2-S3-DC3-DC4(-)	-72
13	0	1	1	0	1	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-S1-DC1-D2-S3-DC3-S4-DC4(-)	-78
14	0	1	1	1	0	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-D1-S2-DC2-S3-DC3-S4-DC4(-)	-84
15	0	1	1	1	1	OFF	OFF	ON	ON	DC4(+)-D5-H3-LOAD-H4-S1-DC1-S2-DC2-S3-DC3-S4-DC4(-)	-90
16	1	0	0	0	0	OFF	OFF	ON	ON	DC(+)-H3-LOAD-H4-D1-D2-D3-D4-DC5(-)	-96
17	1	0	0	0	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-D2-D3-D4-DC5(-)	-102
18	1	0	0	1	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-S2-DC2-D3-D4-DC5(-)	-108
19	1	0	0	1	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-S2-DC2-D3-D4-DC5(-)	-114
20	1	0	0	0	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-D2-S3-DC3-D4-DC5(-)	-120
21	1	0	0	0	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-S2-DC2-S3-DC3-D4-DC5(-)	-126
22	1	0	0	1	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-S2-DC2-S3-DC3-D4-DC5(-)	-132
23	1	0	0	1	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-S2-DC2-S3-DC3-D4-DC5(-)	-138
24	1	1	1	0	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-D2-D3-S4-DC4-DC5(-)	-144
25	1	1	1	0	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-D2-D3-S4-DC3-DC5(-)	-150
26	1	1	1	1	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-S2-DC2-D3-S4-DC4-DC5(-)	-156
27	1	1	1	1	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-S2-DC2-D3-S4-DC4-DC5(-)	-162
28	1	1	1	0	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-D2-S3-DC3-S4-DC4-DC5(-)	-168
29	1	1	1	0	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-D2-S3-DC3-S4-DC4-DC5(-)	-174
30	1	1	1	1	0	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-D1-S2-DC2-S3-DC3-S4-DC4-DC5(-)	-180
31	1	1	1	1	1	OFF	OFF	ON	ON	DC5(+)-H3-LOAD-H4-S1-DC1-S2-DC2-S3-DC3-S4-DC4-DC5(-)	-186

63 Level PWM Generation

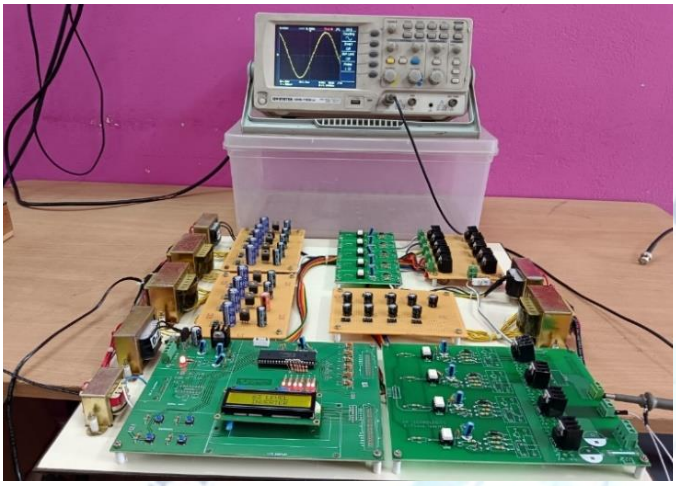
In this project multi carrier pulse width modulation technique is used to generate the sixty three level output voltage.

Seven equal amplitude carrier triangular signals with offset is compared with the sinusoidal reference signal.

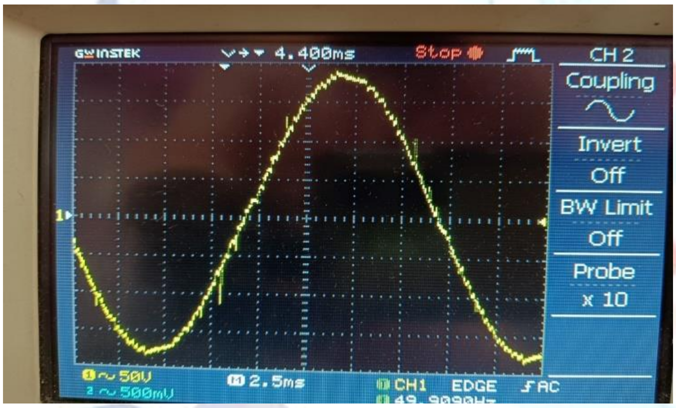
These PWM signals are given to the switches S1, S2, S3, S4, S5. Then the two sinusoidal signals having 180 degree displacement signals are compared with the carrier triangular signal, these PWM pulses are having dead band, it will avoid the shoot through problem between two devices.

These PWM pulses are given to the single phase inverter circuit switches H1, H2, H3 and H4.

This pulse having 5KhZ switching frequency to control the additional switches. These PWM pulses are the main reason to control the output voltage of the inverter.



63 Level DC Output Voltage Waveform

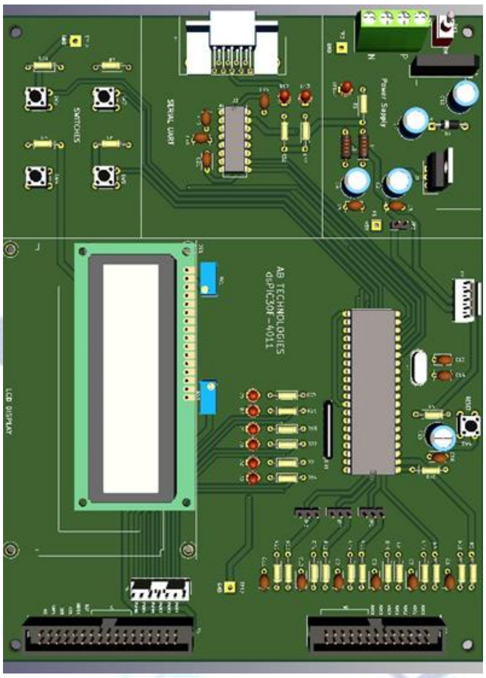


Hardware Description

- Dspic30f4011 controller
- Works in 5 v supply.
- Micro controller belongs to transister-transister logic (ttl) family.
- Programmed using embedded c language.
- It generates pwm pulse for the switches used in converter and inverter.
- Driver circuit- tlp250
- Driver circuit has opto coupler.
- It enhances the 5v pulse to 15v pulse.
- It also provides isolation, for the protection of micro controller.

DSPIC30F4011 CONTROLLER BOARD

DSPIC30F4011 microcontroller includes a large 48kB internal flash memory and a wide range of timers together with a number of PWM modules.



FEATURES

- High - Performance Modified RISC CPU
- Modified Harvard architecture
- C compiler optimized instruction set architecture
- 84 base instructions with flexible addressing modes
- 24-bit wide instructions, 16-bit wide data path
- 16 x 16-bit working register array
- DC to 40 MHz external clock input
- 4 MHz - 10 MHz oscillator input with PLL active (4x, 8x, 16x)
- Peripheral and External interrupt sources
- 8 user selectable priority levels for each interrupt
- 4 processor exceptions and software traps
- Primary and Alternate interrupt Vector Tables

TLP250 DRIVER CIRCUIT

TLP250 is an isolated IGBT/Mosfet driver IC.

The input side consists of a GaAlAs light-emitting diode.

The output side gets a drive signal through an integrated photo detector.

Therefore, the main feature is electrical isolation between low and high power circuits It transfers electrical signals optically via light.

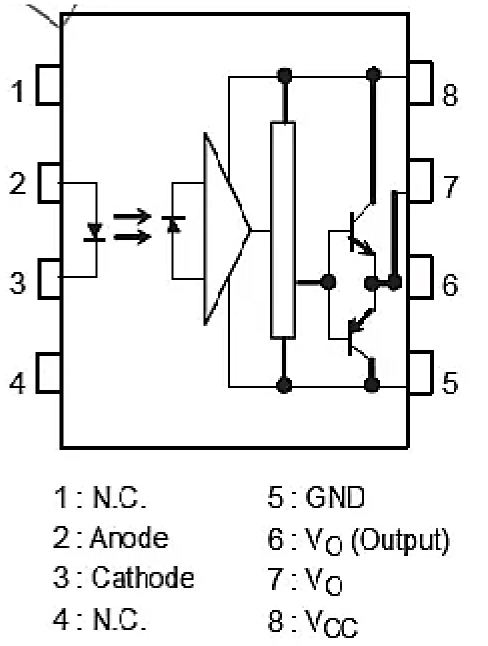
TLP250 has photo diode and photo transistor.

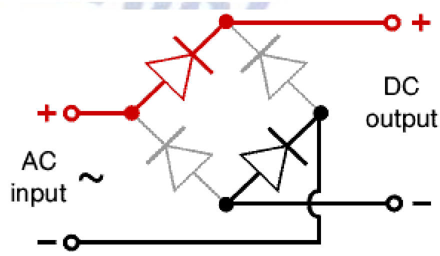
When 5v pulse is given to photo diode, it send signal to the gate of photo transistor, allowing it to send 15v pulse.

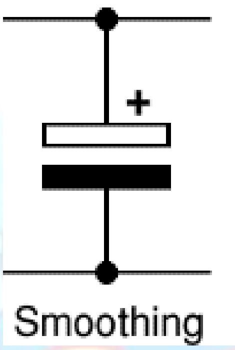
Photo diode is current controlled device so there is a current limiting resistor is placed in the front.

Zener diode is used as voltage regulator for 15v.

Then there is snubber protection for the circuit.







POWER SUPPLY

It has bridge rectifier and smoothing capacitor.

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier.

Smoothing is performed by a large value electrolytic capacitor connected across the DC Supply to act as a reservoir, supplying current to the output when the varying DC Voltage from the rectifier is falling.

FILTER CAPACITOR- 25V, 1000μF

A filter capacitor, also referred to as a smoothing capacitor or a decoupling capacitor, is an electronic component utilized in electronic circuits to mitigate voltage fluctuations.

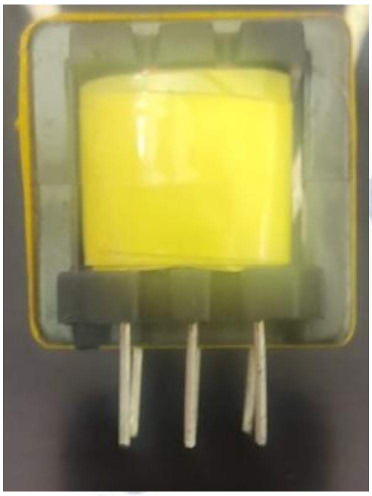
Its primary function is to eliminate unwanted AC components from a DC power supply, resulting in a more stable DC voltage output.

INDUCTOR

An inductor is a passive component that is used in most power electronic circuits to store energy in the form of magnetic energy when electricity is applied to it.

One of the key properties of an inductor is that it impedes or opposes any change in the amount of current flowing through it.

We use transformer type inductor, here primary winding and secondary windings are connected in series. This type of inductor provides galvanic isolation.



CRYSTAL OSCILLATOR

With an operating frequency ranging from 10Hz to 16MHz, a crystal oscillator is an electronic circuit that leverages the mechanical resonance of a piezoelectric crystal to produce a stable frequency signal.

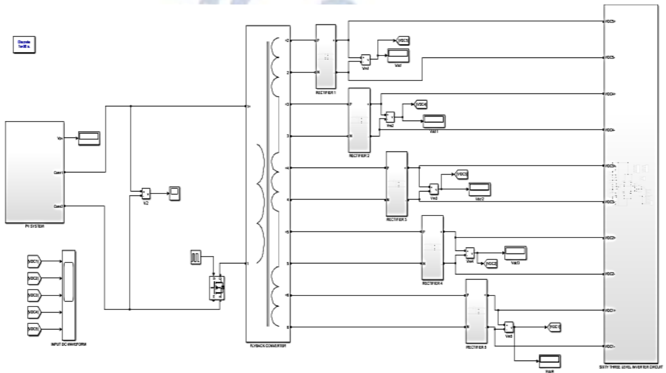
Upon application of an electric field to the crystal, it oscillates at an extremely accurate frequency, which can be utilized as a stable clock signal for digital electronics.

CERAMIC CAPACITOR

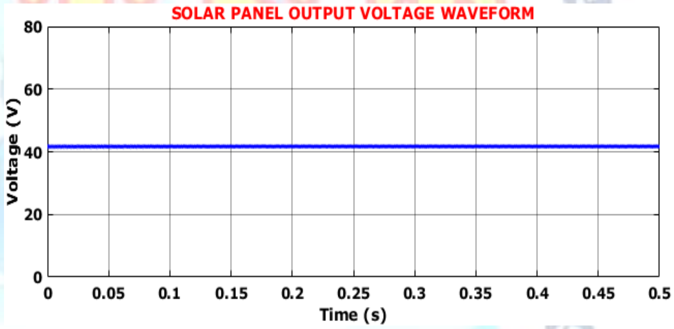
To stabilize the oscillation and establish a ground reference for the crystal, a ceramic capacitor is commonly used in a crystal oscillator circuit.

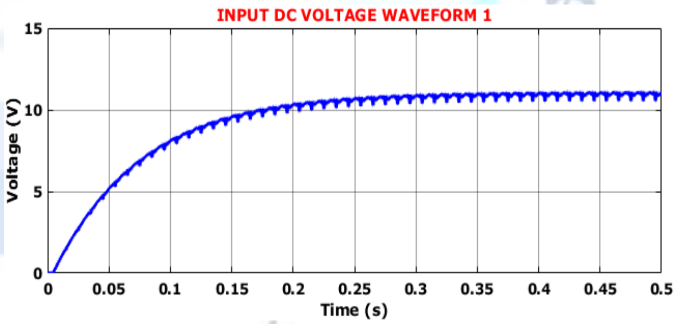
The capacitor is situated between the ground and the two crystal terminals

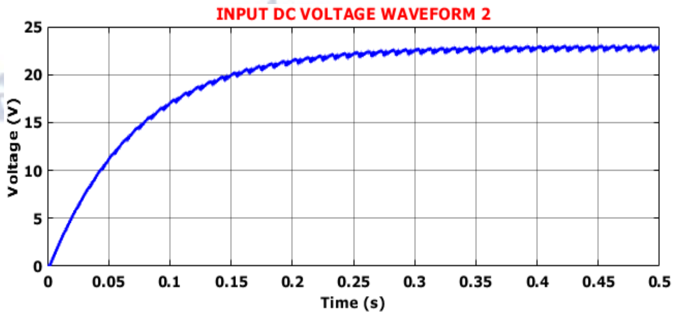
OVER ALL SIMULATION

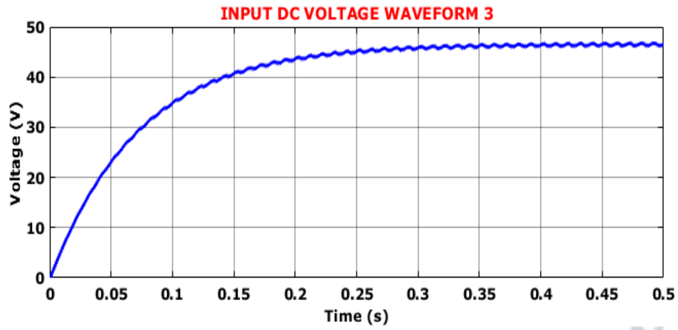


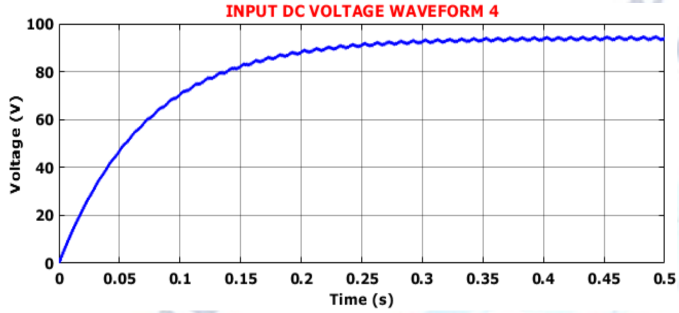
SIMULATION RESULTS

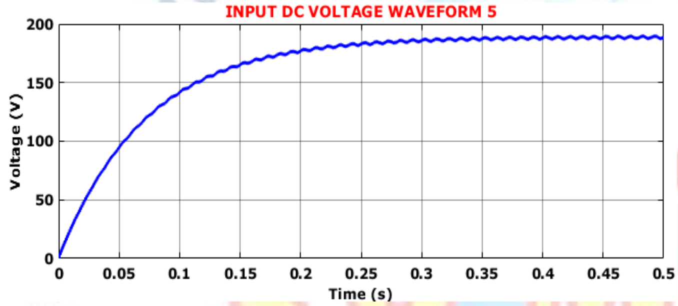


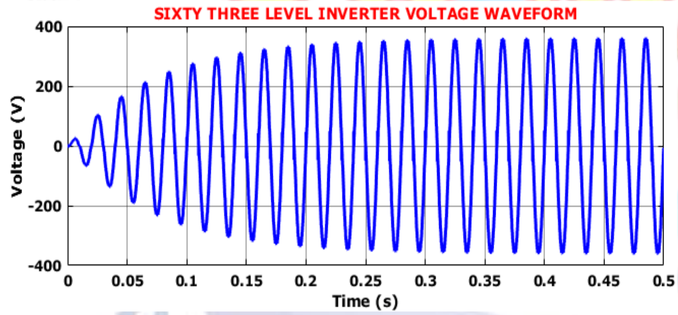


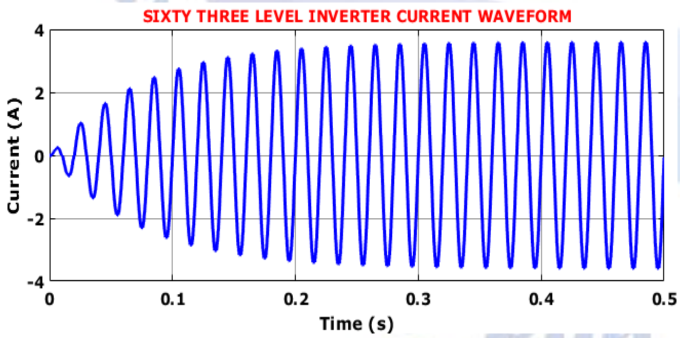




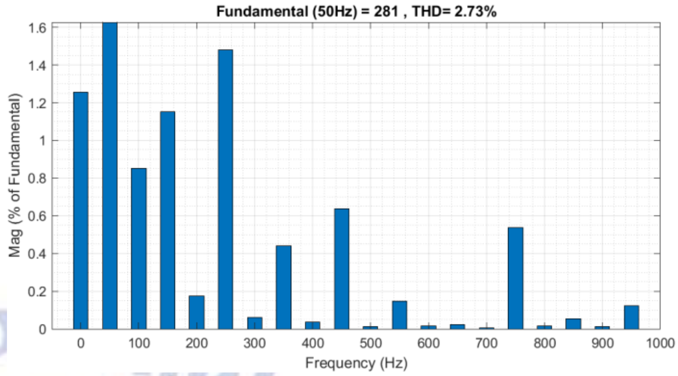




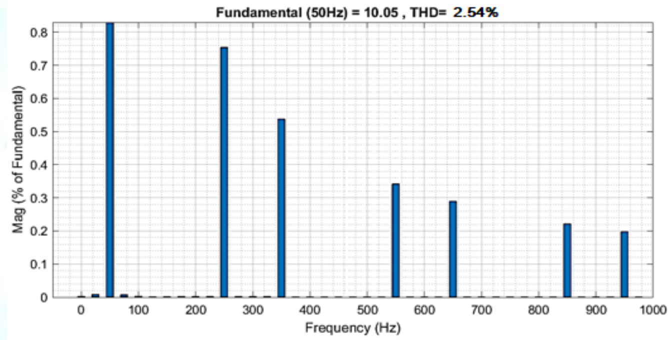




VOLTAGE THD WAVEFORM



CURRENT THD WAVEFORM



ADVANTAGES

- Power low is less due to the usage of less components.
- It has no clamping devices.
- This 63 level inverter improves the efficiency and reduces the losses.
- Total harmonic distortion is low.
- Efficient load synchronization.
- Less switching losses.

APPLICATION

- Industrial applications variable ac motor, induction heating, standby power systems.
- Solar pumping applications.
- Used in high speed AC motors.
- Used in grid connected systems.
- On grid stations.
- Very less THD.
- Reduced number of switches and DC sources.
- Efficient load and grid synchronization.
- Less switching losses.
- Harmonics distortion are less.
- Lesser the number of power switches.
- Capacitor unbalancing problem will not come.

CONCLUSION

In conclusion, this project successfully demonstrates the feasibility and effectiveness of integrating a 63-level multilevel inverter into a grid-connected photovoltaic (PV) system.

The key components of the project, including the fly back converter and the 63-level inverter, are controlled by proportional-integral (PI) controllers, showcasing a enhanced system performance.

The implementation of a multi-carrier offset method with the PI controller for the 63-level inverter proves to be instrumental in achieving precise control over the output waveform.

This strategy ensures synchronization with the grid, minimizing harmonic distortions and meeting the stringent standards set for grid-connected renewable energy systems.

The findings of this project contribute valuable insights to the field of power electronics and renewable energy systems, promoting sustainable practices in grid-connected applications.

In MATLAB 2021a this topology is simulated and then empirically tested with a hardware prototype under various circumstances.

FUTURE SCOPE

Enhanced Control Algorithms: Further development in control strategies and modulation techniques for improved efficiency, reduced losses, and better harmonic suppression.

High Power Charging: Integration into high-power charging infrastructure for electric vehicles, facilitating faster charging and reducing grid stress during peak demand.

Battery Energy Storage: Utilizing 63-level inverters in battery energy storage systems for efficient power conversion and grid integration, optimizing the use of stored energy.

Cyber security Measures: Implement robust cyber security measures to secure the communication and control interfaces of the grid-connected PV system.
As these systems become more interconnected, ensuring cyber security is crucial for protecting against potential cyber threats.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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