



SOLAR POWERED EV CHARGING STATION

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Abstract - Electric vehicles (EVs) are increasingly popular as a dependable alternative to gas-powered vehicles. These vehicles rely on batteries for operation. Despite the long-standing prevalence of grid-based EV charging, solar-powered EV chargers are emerging as an intriguing alternative. By supplying clean electricity to electric vehicles, which produce no pollution of their own, these chargers play a significant role in environmental conservation. The escalating demand for sustainable energy solutions and the growing appeal of electric vehicles have driven the development of innovative charging infrastructure. This project aims to pioneer the development and construction of an advanced solar-powered electric vehicle charging station. The primary aim of the station is to charge electric cars using solar energy, providing a cost-effective and environmentally friendly option. The integration of solar panels, energy storage systems, charging infrastructure design, and smart grid connectivity are among the critical components of this project. The program seeks to merge electric car technology with renewable energy sources to contribute to a more eco-friendly and sustainable transportation ecosystem. The project's abstract emphasizes its importance in addressing the urgent issues of energy sustainability and reducing the carbon footprint associated with transportation.

I. INTRODUCTION

The use of electric vehicles (EVs) as a dependable substitute for conventional gas-powered automobiles is growing in popularity. Batteries power these vehicles. Solar-powered EV chargers are becoming more and more popular, even though grid-based EV charging has long been the standard. Because EVs don't emit any pollutants, these chargers help to preserve the environment by giving EVs access to clean electricity. The creation of creative charging infrastructure has been fueled by the growing need for renewable energy sources and the allure of electric cars. The goal of this project is to set the standard for building cutting-

edge solar-powered charging stations for electric vehicles.. Its primary goal is to charge electric cars using solar energy, offering a cost-effective and environmentally friendly option. Key components of this project include the integration of solar panels, energy storage systems, charging infrastructure design, and smart grid connectivity. The program seeks to combine electric vehicle technology with renewable energy sources to foster a more eco-friendly and sustainable transportation ecosystem. The project's abstract underscores its significance in tackling pressing issues related to energy sustainability and reducing the transportation sector's carbon footprint.

HISTORY OF EV CHARGING STATION

The history of electric vehicle (EV) charging stations is closely tied to the development and evolution of electric vehicles themselves. Here's a brief overview of key milestones in the history of EV charging stations:

A) Early 20th Century

- The concept of electric vehicles dates back to the early 19th century, but it wasn't until the late 19th and early 20th centuries that electric cars gained popularity.
- In the early 20th century, some cities in the United States had electric charging stations for electric taxis and delivery vehicles.

B) Mid-20th Century

- The mid-20th century saw a decline in the popularity of electric vehicles as gasoline-powered cars became dominant.
- Charging infrastructure for electric vehicles virtually disappeared as gas stations proliferated.

C) Late 20th Century

- Interest in electric vehicles was revived in the late 20th century, driven by concerns about environmental issues and oil dependence.
- The California Air Resources Board (CARB) introduced the Zero Emissions Vehicle (ZEV) mandate in 1990, requiring automakers to produce and sell electric vehicles in the state.
- In response to the ZEV mandate, automakers began experimenting with electric vehicle technology, and some charging infrastructure began to re-emerge.

D) Early 21st Century

- The launch of the Tesla Roadster in 2008 marked a significant milestone in the modern era of electric vehicles.
- Tesla's Supercharger network, introduced in 2012, was one of the first high-speed charging networks, allowing Tesla owners to charge their vehicles quickly during long-distance travel.

E) Global Expansion

- As electric vehicles from various manufacturers gained popularity, governments and private companies worldwide began investing in charging infrastructure.
- Public charging stations, ranging from slow chargers for daily use to fast chargers for longer journeys, became more common in urban areas and along highways.

F) Industry Standardization

- Various standards for charging connectors and communication protocols emerged to ensure interoperability between different electric vehicles and charging stations.
- Common standards include CHAdeMO, CCS (Combined Charging System), and Tesla's proprietary connector.

G) Ongoing Developments

- Governments, businesses, and organizations continue to invest in expanding charging infrastructure to support the growing number of electric vehicles on the road.
- Technological advancements, such as faster charging speeds and wireless charging, are being developed to enhance the convenience of electric vehicle charging.

The history of electric vehicle charging stations reflects the dynamic interplay between technological innovation, environmental concerns, government regulations, and market forces. As the electric vehicle market continues to grow, the infrastructure supporting it is likely to evolve and expand further.

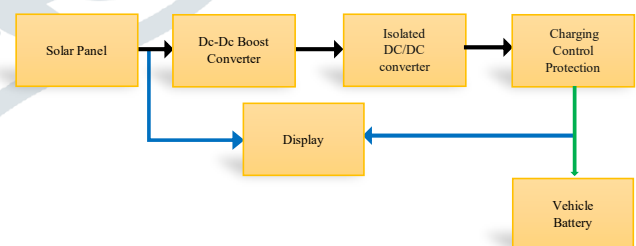
EXISTING METHOD OF EV CHARGING STATION

Existing electric vehicle (EV) charging stations, often found in urban areas and along highways, play a crucial role in supporting the growing adoption of electric vehicles. Their primary merits lie in their convenience and accessibility. EV owners can rely on these stations for quick recharges, making them suitable for daily commuting and long-distance travel. Moreover, they are grid-connected, ensuring uninterrupted charging, regardless of weather conditions or time of day. These stations are often equipped with multiple connectors to accommodate different types of EVs, enhancing their practicality.

However, existing EV charging stations also have their share of demerits. One of the primary drawbacks is the source of their energy, which depends on the grid. The environmental impact of charging at these stations can vary significantly based on the grid's energy composition, potentially resulting in a carbon footprint if fossil fuels dominate the grid mix. Additionally, the availability of charging stations can be uneven, particularly in rural or less densely populated areas, limiting EV adoption for some users. Finally, charging time at these stations can be longer compared to fully solar-based charging, affecting the overall convenience of EV ownership.

In essence, existing EV charging stations offer convenience but may not consistently provide a clean energy source. Their widespread accessibility supports EV adoption, yet their environmental impact depends on regional grid sustainability. Future developments should aim to address these limitations, ensuring that electric vehicle charging is not only accessible but also environmentally responsible and efficient.

II. METHODOLOGY



Block Diagram

In the field of renewable energy systems, the integration of solar panels is essential for harnessing sunlight to produce electricity. To create a reliable energy generation unit, two solar panels, each with a power capacity of 500 watts, are interconnected in a well-planned setup. It is important to note that these panels are not standalone units but are strategically connected to a DC-to-DC boost converter. This converter serves a crucial role in increasing the output voltage to a more practical level. The desired stable output voltage is 56.6 volts.

To address fluctuations and ripples in voltage and current that can disrupt the system's operation, the prompt mentions the use of a voltage and current ripple reduction circuit. This circuit effectively minimizes undesirable effects caused by the converter, resulting in a more stable and cleaner

power output. By reducing oscillations, the circuit enhances the system's lifespan, efficiency, and overall performance.

Furthermore, the journey of power extends beyond this point to ensure optimal utilization and protection of energy resources. An auto-cutoff circuit, a sophisticated feature integrated into the system, acts as a safeguard against wasteful energy consumption and potential damage to connected components. This circuitry is designed to monitor the charging process of a 48-volt battery, a critical energy storage element within the system. As the battery nears its maximum charge capacity, indicated by a distinct voltage threshold, the auto-cutoff circuit activates. Its primary function is to intelligently detect this critical point and promptly disconnect the power supply to prevent overcharging, which could degrade the battery and pose safety hazards.

Additionally, the prompt highlights the inclusion of a display unit in the system. This display provides real-time feedback on key parameters such as voltage levels, offering users transparency and user-friendliness. Through intuitive visual cues, users can easily monitor the battery's status and stay informed about its charging progress. This transparency empowers users with valuable insights and instills a sense of control and accountability over energy consumption patterns.

The thoughtful coordination of components in this solar power system exemplifies the fusion of scientific advancement with environmental stewardship. To maximize sustainability and efficiency, every component—from solar energy capture to conversion, control, and storage—is crucial. Through clever design and integration, the system achieves a balance between device protection, resource conservation, and energy production optimization. It underscores the ongoing efforts to leverage the benefits of renewable energy sources while mitigating their negative environmental impacts and adapting to fluctuating energy demands.

III. SOLAR PANELS



Integrating solar panels is essential for utilizing the sun's power to create electricity in the context of renewable energy systems. These panels, such as the 250W, 36V, 6.9A model, are crucial parts of a well-thought-out system intended to produce sustainable energy. By carefully arranging and joining these solar panels, a sturdy energy producing apparatus is produced. Together with its 36-volt output and 6.9-ampere current, each panel's capacity to generate 250 watts of power adds to the efficacy and efficiency of the system.

Moreover, incorporating a solar panel that meets these requirements shows a dedication to maximizing energy output and reducing environmental effect. The solar panel produces a steady and dependable 36-volt output, which is necessary to power a range of gadgets and applications.

The system's needs are met by the 6.9-ampere current guarantee and the 250-watt capacity, which enables large energy generation.

Utilizing a solar panel that meets these requirements also signifies a move toward sustainable energy sources. These solar panels provide a clean, plentiful, and eco-friendly source of electricity by utilizing the sun's energy. The 250-watt capacity is a reflection of solar technology developments that allow for increased energy production and efficiency. In addition, the solar panel's 6.9-ampere current and 36-volt output allow it to be used in a variety of applications, which increases its usefulness and versatility.

To sum up, the integration of a 250W, 36V, 6.9A solar panel into renewable energy systems is a noteworthy advancement in the direction of sustainable energy generation. The world's expanding energy needs may be met while lowering dependency on fossil fuels thanks to this solar panel's efficient and dependable electricity producing capabilities. Solar panels meeting these standards will become more and more crucial in the shift to a cleaner, greener future as technology develops.

IV. DC – DC BOOST CONVERTER

One kind of DC power supply that accepts DC voltage as an input is a DC-DC converter. DC-DC converters' primary job is to provide regulated output voltage for use in electrical and electronic devices. DC, as contrast to AC, cannot have its voltage levels stepped up or down by a transformer. Rather, a DC-DC converter is employed in this capacity. As a result, this kind of DC power source is comparable to a transformer. DC-DC converters change the incoming energy into a different impedance level, just like transformers do. It should be mentioned that since all of the output power originates from the input power, no energy is produced inside the converter. In practical applications, the converter has energy losses; Some of the circuit's components use up the energy. As a result of improvements in circuit design and component technology, DC-DC converter efficiency can reach 90%. The efficiency of the earlier versions typically falls between 80 and 85%. AC, DC, battery, or ultralow voltage can all be used as inputs by a DC power supply control subsystem. Step down transformation, rectification, DC filtration, and regulation are the four major steps in a regulated DC power supply block diagram. DC power supply designs are categorized into two types: unregulated power supply and regulated power supply. The regulated power supply can be linearly regulated or switched. Primary switch mode and secondary switch mode are the two types of switchmode regulated power supplies. A DC-DC converter is a type of DC power supply that utilizes DC voltage as an input. Two types of DC-DC converters are non-isolating and isolating converters. Operating car radio, CB transceiver, or mobile phone, running a personal CD player, energizing one of the latest CPU chips, engaging a PC power supply application, operating an electronic circuitry, providing an insulation testing voltage, running a car HiFi amplifier's circuitry, and engaging a DC-AC sine wave inverter application are some of the uses of DC-DC converters. DC power supplies have four basic outputs: constant voltage, constant current, voltage limit, and current

limit. Battery eliminators, constant voltage power supply, constant voltage/constant current power supply, programmable supply, and multi-range power supply are the most common DC power supplies available. When selecting a DC power supply, one should consider the following specifications: constant current and constant voltage mode, output, regulation, temperature, ripple and noise, tracking accuracy, and DC isolation.

Boost converter is a DC to DC step-up voltage converter whose output voltage is always greater than its input while its output current is lower than its input. It is a category of switch mode power supply or SMPS which can efficiently convert voltage from one level to another and its input and output power are ideally the same.

A basic practical boost converter circuit consists of two semiconductor and two energy storage components. The two semiconductor components are a switching MOSFET and a schottky diode; the two energy storage components are an inductor which plays a key role in boosting voltage and a capacitor to smooth the DC output.

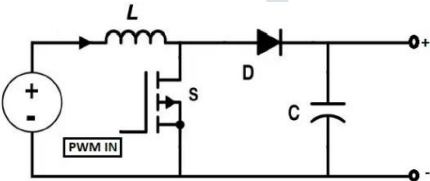


Fig 1.1 General Boost Converter Schematic

The diagram above is a generalized non-inverting boost converter, also referred to as a non-inverting boost converter, because its input and output polarity sides are the same. The four (main) components that enhance and smooth the output in the circuit above are the N-Channel MOSFET, inductor, reverse blocking diode, and electrolytic capacitor.

For the above circuit to work, a high frequency signal in the tens of KHz range with a changing duty cycle must be applied. The duty cycle will determine the output voltage. If the duty cycle is low, the output voltage will be lower but still greater than the input; if the duty cycle is high, the output voltage will be substantially higher than the input.

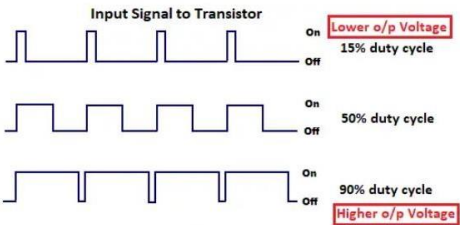


Fig 4.1.2 PWM duty cycle

V. COMPONENTS

A) 1200W DC TO DC BOOST CONVERTER

An electrical circuit called a boost converter, sometimes referred to as a step-up converter, is made to raise the voltage of a direct current (DC) power supply. Its main job is to increase the input voltage from a lower level to a greater output value. The boost converter of the particular module you specified is intended to function in the input voltage

range of 10 to 60 volts, and it may increase this voltage to an output range of 12 to 83 volts. When a higher voltage is needed, such as in power supply systems or battery charging scenarios, this conversion procedure is especially helpful.

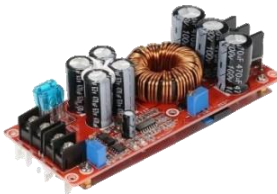


Fig 4.1.3 Dc to Dc Boost Converter

The boost converter achieves voltage elevation through the use of an inductor, a switching element (often a transistor), and capacitors. During the operation of the converter, the input voltage is applied to the inductor, which stores energy in its magnetic field. The switching element controls the flow of current through the inductor by periodically opening and closing, causing the inductor to release its stored energy into the output circuit.

S.No	Description	Range
1.	Module Properties	Stepup Module (BOOST)
2.	Input Voltage	DC 10V~60V
3.	Maximum Current	20A
4.	Quiescent Current	15 mA
5.	Output Voltage	12~83V
6.	Constant Range	0.5~18A(±0.3A)
7.	Output Current	MAX 20A
8.	Temperature	40~ + 85°C
9.	Operating Frequency	150 kHz
10.	Conversion Efficiency	92% ~ 97%
11.	Low Battery Protection	yes
12.	Input Reverse Polarity Protection	yes
13.	Enter the Anti reverse Protection	yes
14.	Short Circuit Protection	yes

One of the advantages of boost converters is their ability to efficiently increase voltage levels, making them valuable in situations where a stable and elevated voltage supply is necessary. However, it's crucial to operate boost converters within their specified input and output voltage ranges to ensure proper functioning and prevent damage. Additionally, they are widely used in applications ranging from electronics and telecommunications to renewable energy systems, contributing to the versatility and ubiquity of these voltage-boosting devices in various technological domains.

B) ISOLATED DC/DC CONVERTER



Fig 4.1.4 Isolated Boost Converter

A 600W DC-DC step-up boost converter, designed to operate with input voltages ranging from 10V to 60V and output voltages between 12V and 80V, serves as a crucial component in power electronics. This type of converter is instrumental in scenarios where a higher output voltage is required than what the input source provides. The device achieves this voltage boost through an intricate interplay of components such as an inductor, a switching element (often a transistor), and capacitors.

During operation, the boost converter stores energy in the inductor's magnetic field when the input voltage is applied. The switching element controls the flow of current through the inductor, periodically opening and closing to release the stored energy into the output circuit. This results in a stepped-up output voltage compared to the input.

With a power rating of 600W, this boost converter is capable of handling substantial power demands, making it suitable for various applications such as power supply units, electric vehicles, renewable energy systems, and other electronics requiring higher voltage levels. The wide input voltage range from 10V to 60V enhances its versatility, allowing compatibility with diverse power sources. However, it is essential to operate the converter within its specified voltage limits to ensure optimal performance and prevent potential damage. This type of DC-DC converter contributes significantly to efficient energy management and voltage regulation in a broad spectrum of electronic and electrical systems.

Features

- 600W high-power booster module,
- wide voltage input: 12V to 60V,
- 12V to 80V adjustable the width voltage output;
- output current can be adjusted
- ultra-low dropout voltage

Applications

- DIY a regulated power supply, input 12V can be, the output can be 12-80V adjustable.
- For your electronic equipment, power supply, you can set the output voltage with your system voltage.
- As the vehicle power supply for your laptop, PDA or digital products supply.
- DIY a high-power notebook mobile power: coupled with large-capacity 12V lithium battery pack, so that

your books where you can light to where.

- The solar panel regulator.
- To the battery, rechargeable lithium batteries.
- Drive high-power LED lights.

C) DIGITAL VOLTMETER

So a digital voltage is a voltage that can be in only 1 of 2 states. The voltage can either be entirely off or LOW at 0V. Or the voltage can be entirely ON or HIGH at the peak voltage. Let's say the voltage of the signal goes to 5V. This means the digital voltage can either be 5V or 0V.

voltage tester (0-100 V) Voltage Measurement Module with LEDs.



Fig 4.1.5 Digital voltage display

A voltage that can only exist in one of two states is called a digital voltage. Either LOW at 0V or completely off is possible for the voltage. Alternatively, at the highest voltage, the voltage may be completely ON or HIGH. Assume that the signal's voltage increases to 5V. Thus, the digital voltage has two possible values: 0V and 5V.

An analogue signal is converted into a series of pulses by a digital voltmeter. In relation to the input signal, the number of pulses is proportionate. Thus, any A/D conversion technique can be used to create a digital voltmeter. The pulse generator is initially fed a voltage signal. Present both voltage and current at the same time in distinct colours: blue for current and red for voltage (current is measured in the negative rail). need an external power source and have protection against reversed connections. The same wire serves as both the testing end's ground and the power supply terminal; a 500 MS/time rapid refresh occurs. contains calibration potentiometers for both voltage and current, and a built-in shunt. Uses: Ideal for measuring the voltage current of other products or for monitoring the batteries of automobiles, electric vehicles, and motorcycles.

S.No	Specification	Range
1.	Measure voltage	DC 0 ~ 100V
2.	Operating voltage	DC 4.5 ~ 30V
3.	Minimum resolution(V)	0.1V
4.	Minimum resolution(A)	10A
5.	Operating current	20mA
6	Display	three 0.28" LED
7.	Display color	Red and Blue (two color display)
8.	Dimensions	48 x 29 x 21mm
9.	Mounting cutout	45.5 x 26.5mm
10.	Refresh rate	about 500mS / times

11.	Measure accuracy	1%
12.	Operating temperature	10 to 65°C
13.	Operating Humidity	10 to 80% (non-condensing)
14.	Working pressure	80 to 106 kPa
15.	Working voltage	DC 4V - 28V
16.	Working current	20mA
17.	Display	0.28" red color
18.	Measuring range	DC 0 - 100V
19.	Operating temperature	10 to 65° c
20.	Working pressure	80 to 106 kPa
21.	Size	48×25×20 mm
22.	Voltage	Range x 0.08%+Two digits

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