International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A REVIEW ON APPROACH TO IMPLEMENT CAPACITOR BASED CHARGING SYSTEM WITH RELAY USING SOLAR SYSTEM IN GRIDS

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ABSTRACT

Photovoltaic (PV) systems may make use of the capacitor charging technique for a couple of common tasks: tracking the I–V curve of a PV generator of any size, and tracking the Maximum Power Point (MPP), particularly when partial shadowing is present. Accurate, consistent, and smooth results can only be achieved by properly sizing the capacitor. Using a simplified computation, the capacitor may be designed in a short period of time. This can only be done based on the array's primary characteristics and the most critical PV module datasheet parameters. We must develop a more efficient system that can stimulate the load, such as an electric or electronic system, in order to employ renewable energy to minimise electricity and fuel usage. With these goals in mind, we'll need to develop a system that's both lightweight and very energy efficient. Supercapacitor banks may be charged using an interleaved DCDC converter that takes into consideration the drawbacks of batteries. This article discusses the development of a supercapacitor energy harvesting device for automobile applications. A microcontroller-based converter system for supercapacitors is presented.

***Keywords**: Photovoltaic, converter, protection, discrete, Super capacitor,*

1. INTRODUCTION

The photovoltaic (PV) effect is a property of semiconductors that may be used to convert solar energy into direct current electricity. Solar panels with photovoltaic cells are used to generate electricity in photovoltaic systems. Since its inception, solar PV power production has been largely accepted as the most environmentally friendly and abundant source of renewable energy on the planet—the sun. During operation, sunlight is converted directly into electricity without the need of moving components or emitting any emissions into the environment. [1] The use of photovoltaics (PV) in today's technology environment has grown significantly in recent years. Currently, solar photovoltaics are the third most widely installed renewable energy source worldwide, after hydropower and wind power. Solar PV is used in more than 100 countries. [1] It's important to note that the typical PV system has three components: a photovoltaic (PV) array for harvesting sunlight, a charge controller, and a load controller. One of the most important components of any PV battery charging system is a competent, sturdy, and dependable PC charge controller, which may provide several advantages to the user while still being reasonably priced. Its primary job is to manage the voltage and current flowing from a rechargeable battery to the PV solar panels in a PV system. PV chargers are also designed to prevent the battery from overcharging by disconnecting the array when it is completely charged, thereby avoiding battery damage. It may also prolong the life of the batteries in the PV system from excessive discharge and avoid battery damage. Non-renewable resources like as gas and coal are used to generate electricity from the national grid. A long-term contribution cannot be assumed since both fuels are limited and will be depleted over time. This pollution comes from the incomplete combustion of fossil fuels, which releases greenhouse gases, non-biodegradable waste products, etc. In addition, even as conditions in cities improve, the electricity problem persists in rural regions. A few days ago, the batteries of the electric rickshaws and other electric-powered vehicles were charged using energy from the national grid. Power consumption is already high due to the large number of them, so this further adds to it. As a consequence, the government recently prohibited the use of electric rickshaws in the city in an effort to curb demand. Therefore, an alternative, sustainable source of energy is urgently needed right now, and solar power is the best accessible choice.

2. LITERATURE SURVEY

V Sheejaet al. [1] Proposals by Here, a DC-DC converter with a high voltage gain and a low switch count is given. The DC load of a base transceiver station is supported by a solar PV array and battery energy storage powered by low DC voltage renewable energy sources. Therefore, a bidirectional DC-DC converter is needed for the bidirectional power transfer between the DC grid and the AC grid. Furthermore, Mohammed et al. carefully investigated the performance of the system for step-up and step-down operations with a solar PV array, BES, and a load linked to the DC grid. monitoring the reference voltage for any changes Implementation and analysis of the outcomes finishes by using simulated changes in direct duty ratios. The advantages and disadvantages of both systems are clear.

Tobón and his colleagues [2] The year 2019 is the year of the IEEE. This research proposes a power management technique for use in EV systems that are both hybrid and electric. A hybrid electric car is one of the many ways in which renewable energy sources like solar photovoltaic, fuel cell, and wind are being used today. Photovoltaic (PV) was selected as the primary EV power source because to its high efficiency and high dependability in this study. However, in order to alleviate the issue of solar cell intermittency, an auxiliary source must be included. PV with MPPT alone cannot meet the load requirement in particular when high power is needed in the load without the assistance of backup sources. Kok and Saad created a novel IncCond algorithm for tracking in partial darkness that makes greater use of the PV curve and is faster than the classic INC technique.

Standalone photovoltaic (PV) systems typically employ a battery bank to store energy, according to S. Liu et al. With a solar charge controller and solar array attached, a battery bank may be recharged. Charge controller efficiency is largely dependent on the DC-DC converter that is built within the controller. There will be substantial energy lost throughout the charging process, however. This study proposes a strategy for repurposing this squandered energy while also increasing the overall efficiency of stand-alone photovoltaic systems. Only half of the energy that may be stored in an electrochemical battery can be stored in an empty capacitor once it has been charged.

3. METHODOLOGY

Because of our current reliance on fossil fuels, the need to minimise carbon emissions from our energy usage, and the prospect of fostering innovation in the technology sector, photovoltaics are becoming more popular. With photovoltaics, everyone can make their own power in a way that's both safe and kind to the environment. One of the most common types of photovoltaic systems is a set of linked solar panels that produce power. To convert light into electricity, a photovoltaics system is used. [2] Because of the photovoltaic system's adaptability, it is feasible to build solar power systems that can fulfil a broad variety of electrical needs.

In rural locations, off-grid charging stations are essential for increasing the use of electric cars as well as reducing the load on metropolitan power networks. The off-grid charging station's major power source is renewable energy. Charging stations provide a variety of options to satisfy a broad range of standards, such as heavy-duty or unusual connections. DC rapid charging often makes use of chargers that have two or three of the following features: Fast AC charging and combined charging have become the standard in a lot of places.A "switched capacitor" is a circuit in which charges move into and out of capacitors when switches are opened and closed.A switched capacitor in a step-up switched mode converter[4] provides a high voltage gain. For high voltage applications, a complete bridge converter should be used[5]. It is possible to change the voltage of a direct current (DC) source by temporarily storing the input energy and then discharging it at a different output value using a DC-DC boost converter[6]. Battery power systems, heaters, welders, communication systems, battery charging circuits, fuel cell application, and solar cell energy conversion system are just a few examples of the various applications of this technology. [7] You may make a DC-to-AC conversion using voltage multiplier cells and a DC boost converter (8). Ripple current and overall efficiency may be lowered in input and output circuits by utilising an interleaved boost converter. With a single switch action, DC-DC boost converters are very efficient and have a short operating duty cycle with high output voltage and low voltage on the switches.

To prevent batteries from being overcharged, a charge controller, also known as a charge regulator, acts as a voltage and/or current regulator. Basically, it controls the voltage and current from the solar panels and from the batteries to the battery. Batteries may be harmed by overcharging when "12 volt" panels generate 16 to 20 volts, therefore control is essential [James and Dunlop, 2012].

As a result, the logical question arises: "Why aren't panels just designed to produce 12 V?" Why? Because if you do that, the panels will only give electricity when the temperature is cold, the sun is shining, and the circumstances are just right. In most areas, you won't be able to rely on this. Even if the sun is low in the sky, there must be some additional power provided by the panels so that even in the worst-case scenario—when there is thick haze, cloud cover, or extreme temperatures—the panels can still offer some output.

The fundamental role of a charge controller is to keep the battery at the greatest possible charge level. The charge controller prevents deep discharge by preventing the battery from being overcharged. Charge controllers should be able to directly influence the status of a battery. Between pulses, the controller monitors the battery's charge and adjusts accordingly. It is possible to "taper" the charging current using this method, and the end outcome is the same as with "constant voltage" charging [Samlex, 2014]. For example, if there was no charge control, electricity from the PV module would flow into a battery regardless of whether or not the battery needed charging. Battery voltage may reach dangerously high levels if not properly managed during charging, resulting in gassing and electrolyte loss as well as heating and corrosion of the battery's grid when the battery is completely charged. As a result, a charge controller helps to keep the battery healthy and increase its useful life. PWM charge controllers are the most efficient way of ensuring constant voltage battery charging by altering the duty ratio of the switches (MOSFET). As the battery status and recharging requirements change, the solar panel's output current is modulated using PWM. The PWM algorithm gradually decreases the charging current when a battery voltage hits the regulation set point, preventing overheating and gassing while still returning the greatest amount of energy to the battery in the quickest period possible. An attempt will be made to bring array voltage down to the battery's voltage level.

4. BLOCK DIAGRAM

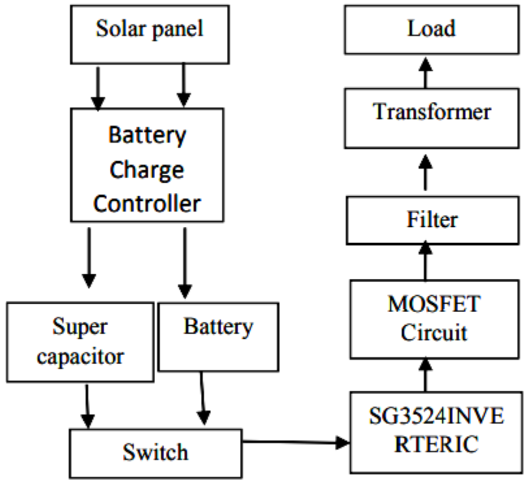

Fig 1 .Block Diagram of overall system

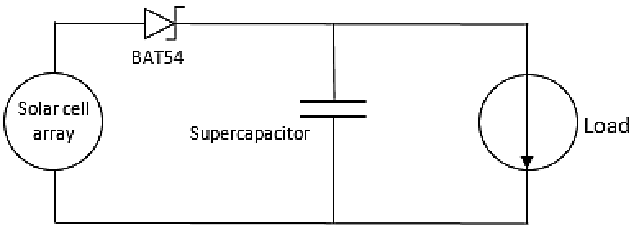

Fig 2 Equivalent circuit

However, if light levels fall below Vscap, you won't be able to harvest any energy using the simple and inexpensive circuit shown above. The only way to make this circuit function is to have a steady supply of light available at all times. Under order to continue harvesting energy even in low light conditions, it's preferable to utilise a charging IC. 54 cells make up the PV panel, which has an open circuit voltage (VOC) of 32.9 volts and an ISC of 8.21 amps. Photovoltaic panels may be linked to high-gain boost converters that can be used to charge electric vehicles and other loads in distant areas. The boost converter receives 24V of power from the panel as an input. With the aid of a voltage converter, the converter raises the voltage to 330 volts, which may be maintained at this level. The converter's switching voltage gain is 13.75, making it appropriate for charging electric vehicles. AC loads may now be supplied by the inverter, which transforms the dc voltage into the correct AC voltage. A single phase inverter may be used to connect the system to the AC distribution grid, providing even more benefits. DC to DC transformers aren't used in PWM controllers. Using a PWM controller, a solar panel may be connected to a battery bank. As soon as you shut the switch, the voltages on the panel and battery will be practically identical. If the battery is fully charged, the first charge voltage will be approximately 13V, and the panel will be around 13.5V if the cabling and controller have a voltage loss of 0.5V. The voltage will gradually rise as the battery's charge level rises. To avoid overcharging, the PWM controller will begin periodically disconnecting and reconnecting the panel when the absorption voltage is achieved (hence the name; pulse width modulated charge controller).

5. DESIGN CONSIDERATIONS

Solar energy is readily accessible in large quantities in India. However, external factors like temperature, irradiance, and more have a nonlinear effect on the output characteristics of PV cells [2]. It is also vital to maintain an optimal operating point of the PV cell in order to maximize the amount of electricity that may be generated. For energy-conscious applications, supercapacitors are an appealing alternative because of their efficiency, longevity, and minimal environmental impact[3].Converter System for DC to DC. A photovoltaic system's nonlinearity is defined as its key feature (PV system). illustrates the I-V characteristic, which may be split into three operational regions: current source, power source, and voltage source. The I-V characteristic is shown in Fig. 2. A PV module's voltage-to-current relationship is nonlinear, thus it varies depending on how much voltage or current is delivered to the device. Dynamic resistance is the term used to describe the relationship between voltage and current when voltage changes. The dynamic resistance in the voltage source area is fixed due to the linearity of the PV module's I-V curve, but it is almost constant in the power zone. This divergence in dynamic resistance in the current source area complicates tracking the MPP if the MPPT is operating at a frequency in the current source range due to the high nonlinearity. First, it's required to go through the power and voltage ranges to ensure that the MPP can accurately measure its maximum power point. [104]. According to the manufacturer, the MPPT controller's adaption should be in the power range as a consequence of this phenomena. For this reason, it is difficult to build the controller for a PV module because of the wide range of current divergence and the substantial dynamic resistance change with temperature and insolation fluctuation, making it necessary to pay more attention to the controller design. [105] To compute the output of the PV panel, traditional MPPT techniques such as P&O and INC use the PV panel's (P–V) characteristics The perturbation introduced by this method to maintain maximum power point (MPP) causes steady-state oscillations after reaching maximum power point (MPP), increasing the loss of power. The INC technique, on the other hand, has zero slop at maximum power and potentially no disturbance after attaining maximum power (MPP). It fails to make an acceptable judgement even when the sun irradiation is rapidly boosted. In terms of power and energy density, a supercapacitor may be more than 10 to 20 times more powerful than a typical capacitor or battery [1]. Concerns about global warming have led to an increased focus on generating power from renewable resources. The inconsistency of renewable energy power output has resulted in a supply-demand mismatch [2]. In light of thissthe need for energy storage is increasing. A relatively new kind of energy storage, supercapacitors have a greater energy density than dielectric capacitors and a higher power density than batteries of all the storage devices.

A porous dielectric separator in the supercapacitor avoids a short circuit between the two electrodes when it is used. In a supercapacitor, the porous dielectric separator avoids short circuits between the two electrodes. Because of the battery's energy storage capabilities, the system will be able to function in settings it was not intended to. A battery's lifespan and performance are both shortened when it undergoes a quick discharge/charge cycle. Chemical reactions occur constantly within batteries, but since there are none in supercapacitors, the energy stored in them may be released far more rapidly. It's also capable of unleashing a significant amount of power. A supercapacitor may be discharged and re-charged without affecting its lifespan. It all relies on the load demand current or the source current [3]. [3]. Charge and discharge times may be affected by temperature changes. There are several applications where energy storage is required, and the supercapacitor has emerged as a prominent player. Although conventional capacitors have a lower power density than supercapacitors, they are nevertheless possible to achieve higher energy densities than conventional capacitors, which are known as ultracapacitors or electrochemical capacitors Li-ion battery and Supercapacitors are used for electric storage. In which primary storage is referred to battery and supercapacitor act as secondary storage. This hybrid storage technique offers increased lifetime. Due to low leakage charge battery is used for holding the charge for a long time and is discharged only when solar energy is not available and supercapacitor storage is exhausted.

The role of supercapacitor changes in accordance with the mode of operation, when solar power is available it smoothens the energy flow to match the charging profile of the battery resulting in a constant DC Bus voltage. During unavailability of solar power, the supercapacitor gets dripped charged from the battery and supply at the time of peak power demand.

6. CONCLUSION

Photovoltaic (PV) systems may make use of the capacitor charging technique for a couple of common tasks: tracking the I–V curve of a PV generator of any size, and tracking the Maximum Power Point (MPP), particularly when partial shadowing is present. Accurate, consistent, and smooth results can only be achieved if the capacitor is properly sized. The capacitor is designed rapidly using a simpler calculation in the first use. PV array and PV module datasheet specifications are the sole factors that go into this decision-making process. next the setup of I–V curve tracers, which are important in the identification of PV system underperformance, is described.

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