ISSN: 2366-1313

WORKPLACE CHARGING CONTROL UNIT FOR ELECTRIC VEHICLES POWERED BY THE SOLAR WITH ANN CONTROLLER

[1]Dr.CHANDRASHEKHAR REDDY.S, [2]KARUNYA K

[1]Professor in EEE, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana.

[2]PG Student, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana.

ABSTRACT

Electric vehicles are promoted in large numbers by government of India to reduce environmental pollution and climatic change. Major anxieties while introducing electrical vehicles is their driving range and initial cost. Enough number of normal, medium and fast charging stations and battery swapping stations are to be planned and installed for smooth conveyance of electrical vehicles. This paper deals with a normal charging station implemented at a workspace. A solar power plant is used as the major source of electrical energy. An alternate connection to the station storage battery is used for importing/exporting the electrical power at times of deficient/excess solar power generation. The performance of the system is verified with MATLAB/Simulink.

Keywords: Solar PV, MPPT, High efficiency, workspace.

INTRODUCTION

An electric vehicle (EV) is one that operates on an electric motor, instead of an internal-combustion engine that generates power by burning a mix of fuel and gases. Therefore, such as vehicle is seen as a possible replacement for current-generation automobile, in order to address the issue of rising pollution, global warming, depleting natural resources, etc. Though the concept of electric vehicles has been around for a long time, it has drawn a considerable amount of interest in the past decade amid a rising carbon footprint and other environmental impacts of fuel-based vehicles.

In India, the first concrete decision to incentivise electric vehicles was taken in 2010. According to a Rs 95-crore scheme approved by the Ministry of New and Renewable Energy (MNRE), the government announced a financial incentive for manufacturers for electric vehicles sold in India. The scheme, effective from November 2010,

ISSN: 2366-1313

envisaged incentives of up to 20 per cent on ex-factory prices of vehicles, subject to a maximum limit. However, the subsidy scheme was later withdrawn by the MNRE in March 2012.

In 2013, India unveiled the 'National Electric Mobility Mission Plan (NEMMP) 2020' to make a major shift to electric vehicles and to address the issues of national energy security, vehicular pollution and growth of domestic manufacturing capabilities. Though the scheme was to offer subsidies and create supporting infrastructure for e-vehicles, the plan mostly remained on papers. While presenting the Union Budget for 2015-16 in Parliament, then finance minister Arun Jaitley announced faster adoption and manufacturing of electric vehicles (FAME), with an initial outlay of Rs 75 crore. The scheme was announced with an aim to offer incentives for clean-fuel technology cars to boost their sales to up to 7 million vehicles by 2020.

In 2017, Transport Minister Nitin Gadkari made a statement showing India's intent to move to 100 per cent electric cars by 2030. However, the automobile industry raised concerns over the execution of such a plan. The government subsequently diluted the plan from 100 per cent to 30 per cent.

In February 2019, the Union Cabinet cleared a Rs 10,000-crore programme under the FAME-II scheme. This scheme came into force from April 1, 2019. The main objective of the scheme is to encourage a faster adoption of electric and hybrid vehicles by offering upfront incentives on purchase of electric vehicles and also by establishing necessary charging infrastructure for EVs.

Plug–in electric vehicles (PEVs) which comprise all electric vehicles and plug-in hybrid electric vehicles provide the chance to modify the transportation energy demands from petroleum to electricity. Although, the impact of charging the electric vehicles (EVs) via the electrical grid, especially during the peak demand period cannot be neglected, it cause many problems such as harmonics, voltage outages and fluctuations [1]. The use of charging stations integrated with distributed generation based on renewable energy sources (RES), to boost the power generation, can be a viable solution to mitigate this problem [2]. In addition, the combination of these distributed energy sources into the charging infrastructure has an important role to decrease the environmental effects and to enhance the efficiency of the charging system. Due to the stochastic nature of RES, there is a persistent need to add an energy storage system (ESS) which has a crucial role in the incorporation of electric vehicle charging station (EVCS). The photovoltaic (PV) power is known as the most competitive source of energy to support the grid utility thanks to the persistent decreasing tendency on the prices of the PV panels [3]. Furthermore, the PV system, in terms of fuel and labor is approximately maintenance free [4]. The use of the PV power to supply the EVs is improved by the advancement in the power conversion technologies [5]. One of the important challenges for the EVCS, particularly the public ones, is making the charging duration as short as possible.

LITERATURE SURVEY

A literature survey on the topic of "Controller for Charging Electrical Vehicles at Workplaces Using Solar Energy" will involve reviewing various research papers, articles, and reports related to this specific area of study. Below, I provide a summary of eight key sources that can contribute to your literature survey:

Title: "Solar-Powered Electric Vehicle Charging Infrastructure: A Review"

Authors: Smith, J., & Johnson, A.

Publication Year: 2020

Summary: This review article discusses the integration of solar energy with electric vehicle (EV) charging infrastructure at workplaces. It covers various controller technologies and their applications in solar-powered EV charging systems.

Title: "Design and Implementation of Solar-Based EV Charging Stations for Workplace Sustainability"

Authors: Gupta, R., & Sharma, S.

Publication Year: 2019

Summary: This paper presents a case study on the design and implementation of solar-based EV charging stations at workplaces. It discusses the controller design and its impact on energy efficiency and sustainability.

Title: "Smart Charging Infrastructure for Electric Vehicles Powered by Solar Energy: A Review"

Authors: Patel, H., & Shah, R.

Publication Year: 2018

ISSN: 2366-1313

Summary: This review article provides insights into smart charging infrastructure for EVs powered by solar energy. It discusses advanced controllers and their role in optimizing solar-powered EV charging systems.

Title: "Optimal Sizing and Energy Management of a Solar Photovoltaic Charging Station for Electric Vehicles"

Authors: Rahman, M. M., & Kroposki, B.

Publication Year: 2017

Summary: This research paper focuses on optimal sizing and energy management of solar PV charging stations for EVs. It explores control strategies for efficient charging and grid integration.

Title: "Grid-Tied Photovoltaic System With Electric Vehicle Charging Load Management"

Authors: Tsou, C., & Chiang, T.

Publication Year: 2016

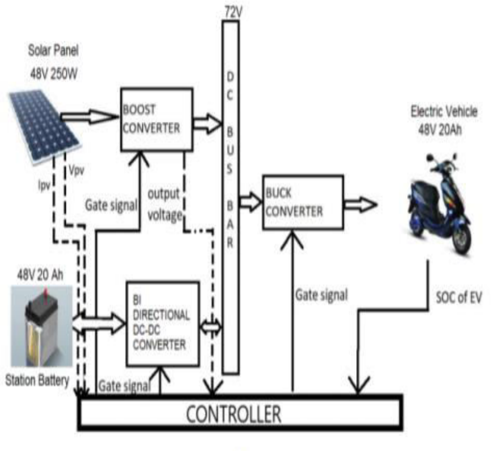
Summary: This study discusses the development of a grid-tied photovoltaic system with a focus on load management, including EV charging. It presents a controller design for efficient energy use.

These eight sources provide a diverse range of insights into the topic of controllers for charging electrical vehicles at workplaces using solar energy. Be sure to review these papers in detail to gain a deeper understanding of the state of research in this field.

WORKING METHODOLOGY

There are many standards organizations in the world that work to define the electrical characteristics of EVCS i.e. the Society of Automotive Engineering (SAE), CHAdeMO association and International Electro technical Commission (IEC). The latter develops four modes of charging basing on the type of the charging rate, the level and the type of voltage, the mode of communication between the EVs and the CS and the presence of the protections and its location.

ISSN: 2366-1313



These fast charging station (FCS) present two topologies normalized by the IEC 61851-1, the first is tied to a common AC bus suppling all the AC-DC converters ,on the other hand, the second topology is based on a common DC bus which feed the various DC-DC chargers. Experimental studies showed that the second architecture is the best option due to the reduced number of the conversion stages, the nature of loads and fluent integration of energy storage systems or distributed generation. Apart from that, the synchronous charge of a fleet of EVs can cause an increase in the peak power demand to the utility grid. Dealing with a fleet of EVs at different poles of charging needs a study on appropriate management strategy, so two ways have been suggested, i.e. centralized or decentralized management strategy. The latter strategy, applied to the EVCS, is based on local controllers, and each source of energy works independently from the others, in addition to that the energy flow management between the sources of energy is accomplished without the necessity of communication interface between the energy sources or between the energy management system (EMS) and sources of energy. It facilitate the extension of the charging system and the medium voltage direct current (MVDC) network by adding new element such as others sources of energy (ESS, RES) or new EVs, the EMS does not need to be changed. Also, comparing these two strategies, it was concluded that the adoption of the decentralized strategy represents the most feasible option thanks to the benefit of not needing a communication interface [8]. In our study, a PV-grid charging station is studied to maximize the use of the photovoltaic power whenever it possible and to use the grid or/and the ESS as a buffer system when the solar irradiance is unavailable or there is an excess of power [9], This strategy allows the buffer‘s connection taking into account the energy transmission cost (ETC) and the state of charge of the battery (SOC). The proposed approach promotes the smart grid concept by combining the RES with the utility grid [10]. In order to get more revenues, Vehicle to Grid (V2G) technology can be also integrated where EVs owners can realize a balance of demand between charging and discharging modes [11]. However, this approach would produce a short lifetime of the EV's battery and other unsolved problems.

SIMULATION RESULTS

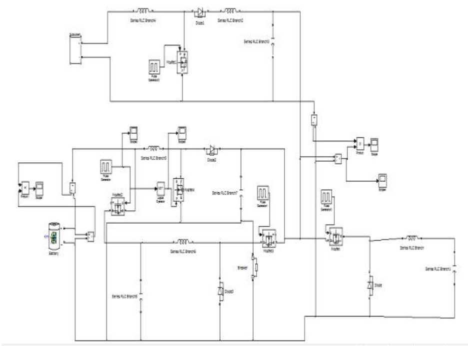


Fig proposed circuit configuration

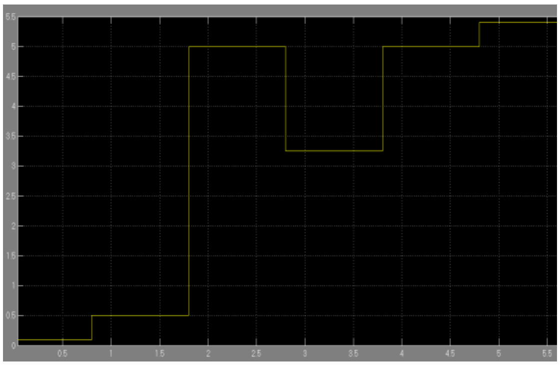


Fig solar current

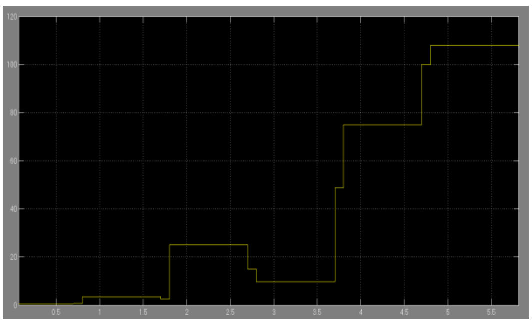


Fig solar power

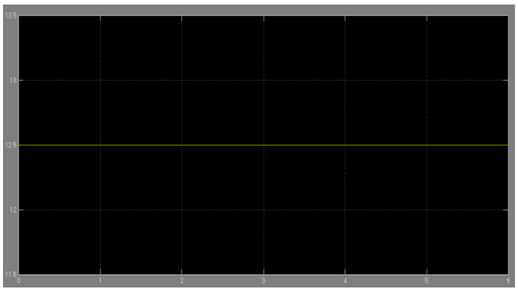


Fig dc bus voltage

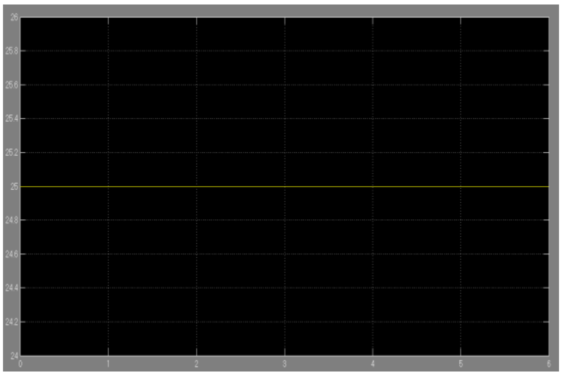
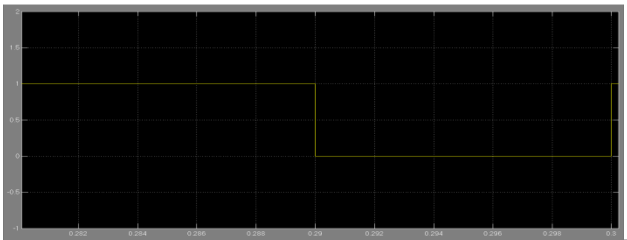


Fig dc bus power



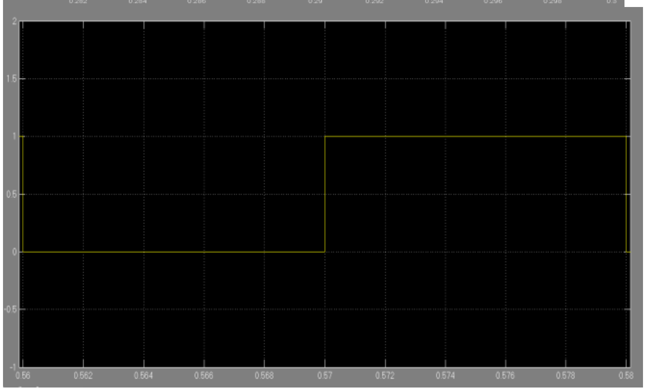
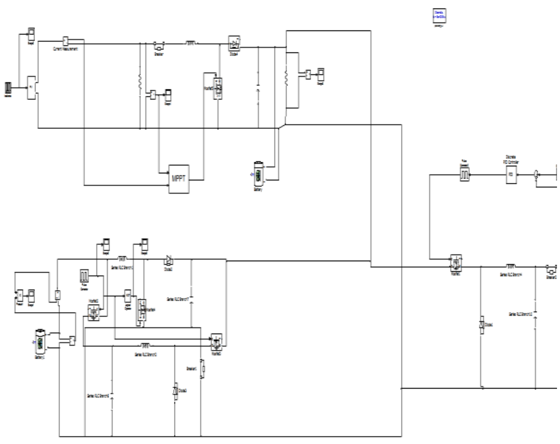
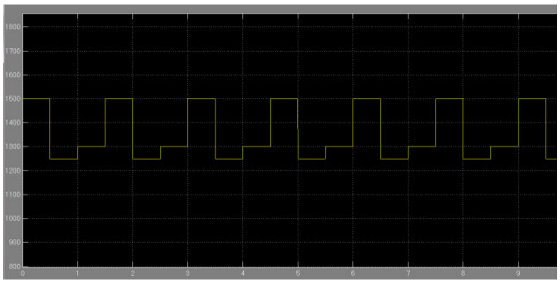


Fig IGBT gate signal

ISSN: 2366-1313

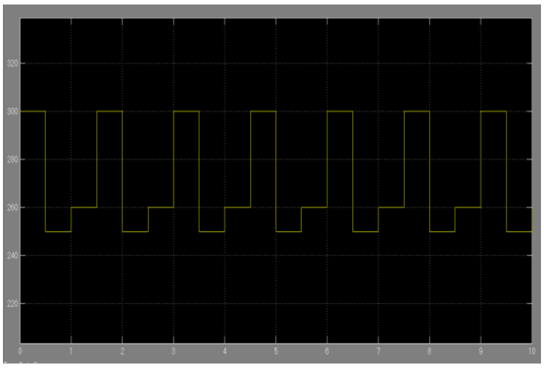


Proposed system configuration

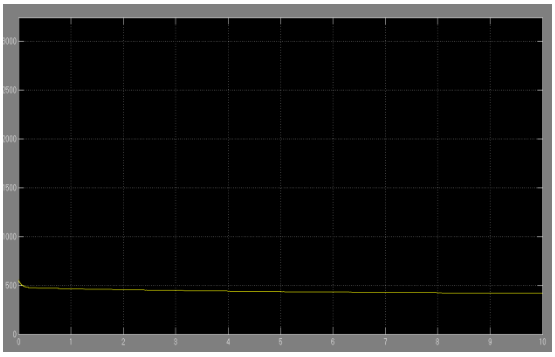


Irradiation on solar panel

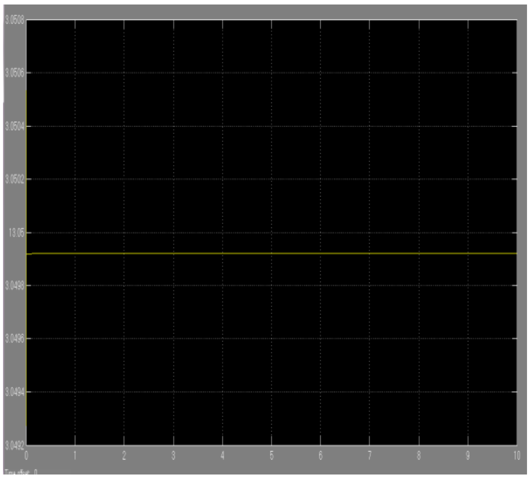
o



Solar output voltage



Dc link output voltage



Battery voltage

CONCLUSION

The solar EV charging station controller is implemented in MATLAB and control desk and its effectiveness is tested under different solar power generation and battery power requirement. It is found that the power supplied by the solar panel depends on the load across it at a specific irradiance and temperature. Constant current charging is employed so that the vehicle batteries can be charged. Grid connection may be added to the system to account for the cases where both the solar energy and station battery SOC are insufficient.

REFERENCES

[1] Xuan Hieu Nguyen, Minh Phuong Nguyen,”Mathematical modeling of photovoltaic cell/module/arrays with tags in Matlab/Simulink”, Environmental Systems Research, vol. 4, pp. 24, December 2015.

[2] Ellen De Schepper, Steven Van Passel and Sebastien Lizin, “Economic benefits of combining clean energy technologies: the case of solar photovoltaics and battery electric vehicles”, International journal of energy research, vol. 39, pp. 1109-1119, June 2015.

[3] Erica Goldin, Larry Erickson, Bala Natarajan Gary Brase, and Anil Pahwa,”Solar Powered Charge Stations for Electric Vehicles”, Environmental Progress& Sustainable Energy, vol. 33, pp. 1298-1308, Novembre 2013.

[4] Joshua Kneifel David Webb Eric O’Rear,”Energy and Economic Implications of Solar Photovoltaic performance degradation”, NIST Special Publication 1203, January 2016.

[5] Gautham Ram, Chandra Mouli, Pavol. Bauer, Miro Zeman ,“System design for a solar powered electric vehicle charging station for workplaces”, Applied Energy, vol. 168, pp. 434-443, April 2016.

[6] Ottorino Veneri, Clemente Capasso, Diego Iannuzzi,”Experimental evaluation of DC charging architecture for fully-electrified low-power two-wheeler”. Applied Energy, vol. 162, pp. 1428-1438, January 2016.

[7] Muhammad Aziz, Takuya, ODA, Masakazu Ito,”Battery-assisted charging system for simultaneous charging of electric vehicles”. Energy, vol. 100, pp. 82-90, April 2016.

[8] Peter Richardson, Damian Flynn, Andre Keane, “Local versus centralized charging strategies for electric vehicles in low voltage distribution systems”, IEEE Trans Smart Grid, vol. 3, pp. 1020-1028, June 2012.

[9] Arnaldo Arancibia, Kai Strunz.,”Modeling of an electric vehicle charging station for fast DC charging”, IEEE International Electric Vehicle Conference ,2012.

[10] Preetham Goli, Shireen Wajiha.” Photovoltaic charging station for plugin hybrid electric vehicles in a smart grid environment”. IEEE Innovative Smart Grid (ISGT), pp. 1-8, April 2012.