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International Journal for Modern Trends in Science and Technology, 8(05):339-343, 2022

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0805050
Available online at: http://www.ijmtst.com/vol8issue05.html

ANN based Multi-Mode Power Converter for Electric Vehicle Charging Station

[1]D. Dhana Prasad, [2]G. Vasanatha Rao, [2]E. Mohana Rao, [2]Ganesh S, [2]P. Vishnu Vardhan

[1]Assistant Professor, Dept of EEE, Avanthi Instituite of Engineering and Technology, Visakhapatnam
[2]Dept of EEE, Avanthi Instituite of Engineering and Technology, Visakhapatnam

To Cite this Article

D. Dhana Prasad, G. Vasanatha Rao, E. Mohana Rao, Ganesh S and P. Vishnu Vardhan. ANN based Multi-Mode Power Converter for Electric Vehicle Charging Station. International Journal for Modern Trends in Science and Technology 2022, 8(05), pp. 339-343. https://doi.org/10.46501/IJMTST0805050

Article Info

Received: 07 April 2022; Accepted: 12 May 2022; Published: 15 May 2022.

ABSTRACT

As an environmental friendly vehicle, the increasing number of electrical vehicles (EVs) leads to a pressing need of widely distributed charging stations, especially due to the limited on-board battery capacity. However, fast charging stations, especially super-fast charging stations may stress power grid with potential overload at peaking time, sudden power gap and voltage sag. This project discusses the detailed modeling of a multiport converter based EV charging station integrated with PV power generation, and battery energy storage system. In this project, the control scheme and combination of PV power generation, EV charging station, and battery energy storage (BES) provides improved stabilization including power gap balancing, peak shaving and valley filling, and voltage sag compensation. An ANN based controller is designed for regulating performance of multi-mode power converter.

1. INTRODUCTION

The continuous rise in gasoline prices along with the increased concerns about the pollutions produced by fossil fuel engines are forcing the current vehicle market to find new alternatives to reduce the fossil fuel usage. Along with the research on bio-fuel driven engines; different electric vehicles and hybrid electric vehicles are evolving as viable alternatives to replace, or at least reduce, the current fleet of fossil fuel driven vehicles. Although current manufactured electric/hybrid vehicles are being marketed as a way to reduce fossil fuel usage, several promising technologies are being demonstrated that can utilize power electronics to charge the battery from the utility using plug-in vehicles or act as a distributed resource to send power back to the utility with vehicle-to-grid capabilities. In this paper, different plug-in vehicle topologies are described to review the power electronics required for them. The newly evolving V2G technology is also discussed along with economics and compliance requirements to allow the vehicle to be connected to the grid. Before going into the details of power electronics required for the electric/hybrid vehicles, the common forms of these vehicles are described next to get accustomed with the terminologies.

2. ELECTRIC VEHICLES

A typical electric vehicle (EV) has a battery pack connected to an electric motor and provides traction power through the use of a transmission. The batteries are charged primarily by a battery charger that receives its power from an external source such as the electrical utility. Also during regenerative braking, the motor acts