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ONBOARD BATTERY CHARGERS FOR PLUG-IN ELECTRIC VEHICLES WITH DUAL FUNCTIONAL CIRCUIT USING PID CONTROL ACTION

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ABSTRACT--The main aim of this paper is to design such a charging station coupled with solar energy for urban urban areas. Worked on EV load models are created by thinking about most well known business EV on the lookout. The planned sun oriented controlled accusing station is tried of the created EV load models and, would be situated in chosen metropolitan urban areas. In this paper, battery of electric vehicle is charge through two source, solar and electricity board. Solar is primary source, if any case solar isn't working (in winter season or rainy season), EV draws power from electricity board.

Index Term-AC/DC Converter, EV Batteries, Isolated DC/DC Converter, PID Controller.

I. INTRODUCTION

Pure-electric and plug-in hybrid electric vehicles, hereafter denoted as Plug-in Electric Vehicles (PEVs), are more and more running on the roads. They represent an effective solution to the increasing worry about environmental pollution and energy consumption of the thermal vehicles. PEV batteries are recharged from the utility by help of either a house connection or a recharging bollard . In Europe, the house connection provides electric energy from a single-phase 230V outletwhilst the recharging bollard does it from a three-stage 400V outlet.Almost all the PEVs are fitted with battery chargers that consent to both the outlets.Pure-electric and module mixture electric vehicles, henceforth indicated as Plug-in Electric Vehicles (PEVs), are an ever increasing number of running on the streets. They address a compelling answer for the rising stress over ecological contamination and energy utilization of the warm vehicles. PEV batteries are re-energized from the utility by help of either a house association or a re-energizing bollard. In Europe, the house association gives electric energy from a solitary stage 230V outletwhilst the re-energizing bollard does it from a three-stage 400V outlet.Almost all the PEVs are fitted with battery chargers that comply with both the outlets.Pure-electric and plug-in hybrid electric vehicles, hereafter denoted as Plug-in Electric Vehicles (PEVs), are more and more running on the roads. They represent an effective solution to the increasing worry about environmental pollution and energy consumption of the thermal vehicles. PEV batteries are recharged from the utility by help of either a house connection or a recharging bollard . In Europe, the house connection provides electric energy from a single-phase

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Different types of Electric Vehicles (EVs) are being developed nowadays as alternative to the Internal Combustion Engines (ICE) vehicles, namely, Battery Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV), in its different configurations, and Fuel-Cell Electric Vehicles (FCEV). This chapter presents batteries charging systems for Electric and Plug-in Hybrid Electric Vehicles. To simplify the reading and to contribute to a simple understanding, from now on, in this chapter, it will be used the terminology of Electric Vehicle (EV) to define these two types of vehicles. EVs are increasingly popular, as demonstrated by the numerous vehicles recently made available in the market by almost all automakers. The main energy storage systems of these vehicles are the electrochemical batteries, the ultra capacitors and the full-cells. However, taking into account nowadays limits of energy storage of those technologies, the vehicles have limited range autonomy. Different energy storage systems configurations can be implemented; however, the electrochemical batteries still are the most used technology to store energy. Nevertheless, they are usually used in conjunction withultracapacitors to store energy during transient moments, as during the vehicle regenerative braking. Actually, the ultracapacitors are used in this way to receive a significant amount of energy in a short time, and to provide this energy to the next acceleration, or to help charging the batteries.

The electrical power grids were not designed for this new type of load, which corresponds to the batteries charging systems of EVs, therefore the impact caused by the proliferation of EVs cannot be neglected. The challenge is to rebuild the electrical power grids, as early as possible, as “smarter” as possible, and the most environmentally friendly as possible. To achieve these targets arise the Smart Grids, which are not characterized as a single technology or device, but rather as a vision of a distributed electrical system, supported by reference technologies, as integrated communications, Power Electronics devices, Energy Storage Systems (ESS), and Advanced Metering Infrastructures (AMI). The Smart Grids intend to reduce the energy costs, and simultaneously to achieve a sustainable balance between production and consumption, increasing the reliability of the power grids and the power quality of the electrical energy delivered to the loads.

1.1 Electric Vehicle Supply (EVS)

The equipments that constitute an Electric Vehicle Charging Station are collectively called as Electric Vehicle Supply Equipment (EVSE). The term is more popular, and it refers nothing but to the charging stations. Some people also refer it as ECS which stands for Electric charging station. An EVSE is designed and engineered to charge a battery pack by using the grid for Power Delivery; these battery packs might be present in an Electric Vehicle (EV) or in a Plug-in Electric Vehicle (PEV). The power, connector and protocol for these EVSE will vary based on it design which we will discuss in this article.

1.2 Types of EV Charging Stations (EVSE)

Charging Stations can be broadly classified into two types, AC charging Station and DC charging Station. An AC charging Station as the name implies provides AC power form the grid to the EV which is then converted to DC using the On-board charger to charge the vehicle. These chargers are also called the Level 1 and Level 2 Chargers which is used in residential and commercial places. The advantage of an AC charging station is that the on-board charger will regulate the voltage and current as required for the EV hence it is not mandatory for the charging station to communicate to the EV. The disadvantage is its low output power which increase the charging time. A typical AC charging system is show in the below picture. As we can see the AC from grid is supplied directly to OBC through EVSE, the OBC then converts it to DC and chargers the battery through the BMS. The Pilot wire is used to sense the type of charger connected to the EV and set the required input current for the OBC. We will discuss more on this later.

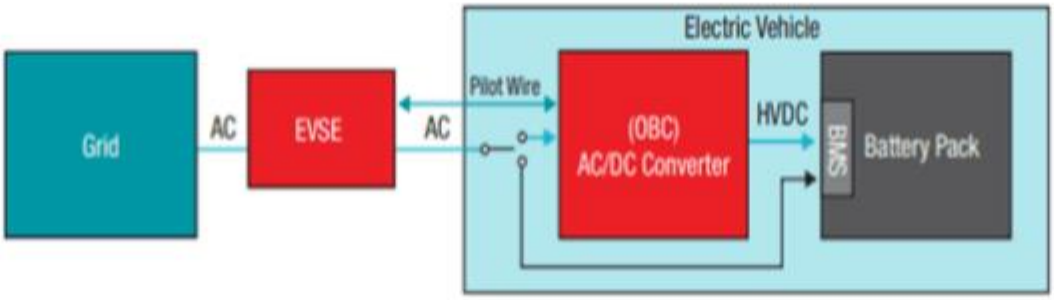

Fig 1: AC charging station 1 & 2

A DC charging Station gets AC power form the grid and converts it to DC voltage and uses it charge the Battery pack directly by by-passing the On-board Charger (OBS). These chargers normally output high voltage of upto 600V and current upto 400A which enables the EV to be charged in less than 30 minutes as compared with 8-16 hours on AC charger. These are also called Level 3 chargers and commonly known as DC Fast Chargers (DCFC) or Super chargers. The advantage of this type of charger is its fast charging time while the disadvantage is its complex engineering where it needs to communicate with EV to charge it efficiently and safely. A typical DC charging system is shown below, as you can see the EVSE provides DC directly to Battery pack bypassing the OBS. The EVSE is arranged in stacks to provide high current a single stack will not be able to provide high current due to power switch limitations.

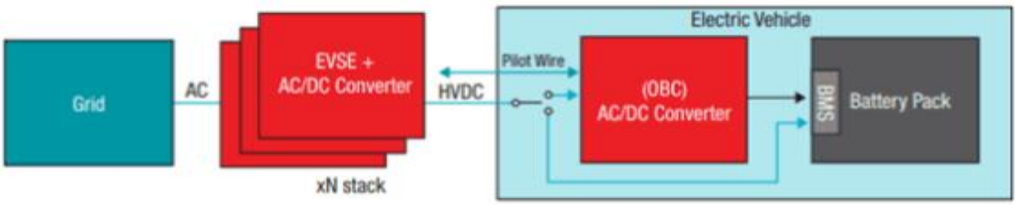

Fig 2: AC charging station level 3

II. WRITE DOWN YOUR STUDIES AND FINDINGS

2.1 BITS AND PIECES TOGETHER

Hoang Vu Nguyen et al proposed a single-phase onboard battery charger (OBC) for plug-in electric vehicles (EVs) where the low-voltage (LV) battery charging circuit is utilized for an active power decoupling function. The OBC is operated in three different modes by sharing the transformer, switches, and capacitors. For a grid-to-vehicle (G2V) mode or a vehicle-to-grid (V2G) mode, the LV battery charging circuit serves as an active filter to eliminate the low-frequency power ripple at the DC link. Thus, small film capacitors can be employed instead of large capacitors at the DC link. For the third operating mode (H2L) where the LV battery is charged from the HV battery, the isolation is provided by the dual active bridge (DAB) DC-DC converter. Since some components in the proposed OBC are used in common, the size and cost of the OBC can be reduced significantly. The simulation and experimental results have verified the validity of the proposed system [1].

Hoang Vu Nguyen and Dong-Choon Lee proposed a single-phase multifunctional onboard battery charger for electric vehicles (EVs), where the active power decoupling capability is provided by utilizing the low voltage (LV) battery charging circuit. For this, the buck converter for the LV battery charger is used as an active power decoupling (APD) circuit while the high voltage (HV) battery is connected to the grid, by which the inherent second-order ripple power component of the single-phase charger is filtered out. Hence, small film capacitors can replace the large electrolytic capacitors, leading to the reduction of cost and the volume of the charger for EV applications [2].

In [4], an innovative single-phase integrated onboard charger, using the PEV propulsion machine and its traction converter, is proposed. The charger topology enables power factor correction (PFC) and battery voltage/current regulation with only one add-on diode rectifier. Stator windings of the propulsion machine are utilized as mutually-coupled inductors to develop a two-channel interleaved boost converter. Based on a permanent magnet synchronous machine (PMSM), the detailed circuit analyses of the proposed integrated charger are presented. A 3-kW prototype using a 220-Vrms, 3-phase PMSM is built to experimentally verify the performance of the proposed integrated charging approach. A nearly unity power factor (PF) and 3.96% total harmonic distortion (THD) of input ac current is acquired with a maximum efficiency of 93.1%.

In [5], an improved low-voltage (LV) charging circuit for a single-phase onboard battery charger (OBC) is proposed, which can operate as not only the active power decoupling circuit to filter out ripple power, but also the current doubler rectifier to charge the LV battery from high-voltage (HV) battery. When the HV battery needs to be charged from the grid the proposed module is used as the active filter. Also, when the LV battery needs to be charged from the HV battery, this circuit becomes the LV charging circuit. By that way, the DC-link capacitance in the AC-DC converter of the HV charging circuit can be reduced significantly without requiring any additional devices. In addition, some components of the proposed circuit are shared for the different operating modes among the AC-DC converter, LV charging circuit, and active power filter. Therefore, the cost and volume of the onboard battery charger can be reduced

K. A. Chinmaya and G. K. Singh proposed a CuK converter based integrated battery charger for plug-in electric vehicles (PEVs). Proposed bidirectional DC/DC converter is capable of performing buck/boost function during all modes of vehicle operation. It operates as a power factor correction (PFC) converter during plug-in charging mode, and as conventional single stage inverting buck/boost converter in driving and regenerative braking modes. Selection of a wide range of battery voltages and adequate control over braking can be achieved with the proposed multi-functional converter. In addition, size, weight and cost of the charger are also reduced, as it involves minimum number of components compared to existing buck/boost converters used in chargers. The proposed converter is highly suitable for onboard charger of PEVs. Simulation is performed on MATLAB/Simulink environment and a laboratory prototype of the aforementioned converter has been built to validate its feasibility [6].

Inductive power transfer (IPT) technologies have gained a wide acceptance in onboard battery charging applications due to some significant advantages over traditional plug-in systems. An IPT battery charger is expected to provide a configurable charging profile consisting of an initial constant current (CC) and a subsequent constant voltage (CV) efficiently. With a wide load range during the charging process, two sets of IPT topologies with the inherent load-independent CC and CV at the same zero-phase angle (ZPA) frequency are commonly combined into a hybrid topology to avoid sophisticated control schemes, while maintaining nearly unity power factor and soft switching of power switches simultaneously. However, the load independent CC and CV are usually constrained by parameters of a loosely coupled transformer (LCT), making the LCT hard to design

III. CONCLUSION

The major benefit of on-board charging is that it uses readily-available AC power and, via an extension lead, the vehicle can be plugged into any of the billions of outlets installed in every building In this paper, a solitary stage multifunctional installed battery charger for electric vehicles (EVs) is proposed, where the dynamic power decoupling ability is given by using the low voltage (LV) battery charging circuit without the cumbersome DC-interface capacitors. The proposed OBC uses the LV battery charger as a functioning power channel to take out the second-request swell power when the EVs are connected to the grid. By adding an inductor on the primary side of the LV charger, the converter can achieve the APC function without adding additional switches, heat sinks, and gate drive circuits.

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