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(54) Title: A POWER FLOW CONTROLLER CONTROLLING VEHICLE TO GRID (V2G) POWER FLOW CONTROL AND METHOD THEREOF

(57) Abstract: Disclosed herein is power flow controller and method for providing vehicle to grid (V2G) power flow control. The method comprises receiving battery current value (I_{bat}) and battery voltage value (V_{bat}) of the battery. Based on the (I_{bat}) and (V_{bat}), method comprises computing a battery power value (P) of the battery. Further, reference current value (I_{d_ref}) is generated based on the battery power value (P). The reference current value (I_{d_ref}) is provided to a decoupled d-q controller to generate voltage vector values (V_{d_ref} and V_{q_ref}). Further, inverter pulse width modulation signals are generated based on the V_{d_ref} and V_{q_ref} . On the other hand, the DC-DC pulse width modulation signals are generated and provided to DC-DC converter in such a manner that the DC-DC converter generates desired voltage (V_{dc}) which is fed to the active frontend inverter to further enable the active frontend inverter to facilitate the V2G power flow control.

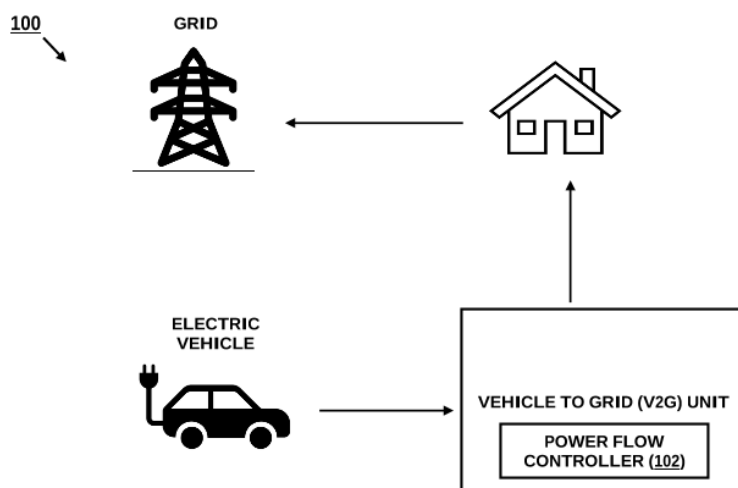


Fig. 1

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)

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The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

**A POWER FLOW CONTROLLER CONTROLLING VEHICLE TO GRID (V2G)
POWER FLOW CONTROL AND METHOD THEREOF**

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification describes the invention and the manner in which it is to be performed

DESCRIPTION

Technical Field

[001] The present disclosure relates to power conversion technologies, and more particularly, to a vehicle to grid (V2G) power flow control technique.

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BACKGROUND OF THE INVENTION

[002] The following description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

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[003] With the impending deregulated environment, it is imperative that new technologies provide acceptable power quality and reliability. It has been prophesied that Distribution Generation (DG) System would play a vital role in the coming years for meeting the future energy demand with clean and green environment. Various DG technologies are present which includes, for example, photovoltaic, wind turbines, gas turbines, diesel engines, and fuel cell systems. The advent of power electronic devices has also ushered a new era for the maintenance of power quality as they efficiently interface these renewable energy systems to the grid. The integration of these renewable energy to the grid can result in several benefits including line loss reduction, increased overall energy efficiency, reduced environmental impacts, relieved transmission, and distribution congestion etc. For power conversion, basically source side and the grid side converters are used. In the grid code compliances, the grid connected inverter control strategy plays a vital role in the improvement of DGS. The grid code compliances include control of active and reactive power between the DGS and the grid, balancing the power flow between the input side converter and the grid, providing high output power quality, and maintaining synchronization with the grid.

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[004] Conventionally, in the vehicle to grid (V2G) power flow, the DC bus voltage is regulated by an active frontend converter/inverter (AFC), whereas the DC-DC converter is controlled by battery voltage, current or power. During unbalance conditions such as voltage sags, presence of harmonics and fault conditions, these conventional techniques fail to provide the required sinusoidal grid current and voltage which degrades the power quality. Thus, there is a need exist for an effective and improved technique for providing the V2G power flow control in an organized cycle which addresses the above limitations.

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SUMMARY OF THE INVENTION

[005] The present disclosure overcomes one or more shortcomings of the prior art and provides additional advantages discussed throughout the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

[006] In one non-limiting embodiment of the present disclosure, a method of providing a vehicle to grid (V2G) power flow control is disclosed. The method comprising providing a power flow controller being implemented with a three phase off board electric vehicle (EV) charger comprising an active frontend inverter, a DC-DC converter, and a battery. The method further comprises implementing an inverter control loop operation and DC-DC converter control loop operation for providing inverter pulse width modulation signals and DC-DC pulse width modulation signals to the active frontend inverter and the DC-DC converter respectively. During the inverter loop operation being implemented by a first control unit of the power flow controller, the method further comprises following steps. For example, the method comprises a step of receiving a battery current value (I_{bat}) and a battery voltage value (V_{bat}) of the battery. The method further comprises a step of computing a battery power value (P) of the battery based on the battery current value (I_{bat}) and the battery voltage value (V_{bat}). The method further comprises a step of generating a reference current value (I_{d_ref}) based on the battery power value (P), and providing the reference current value (I_{d_ref}) to a decoupled d-q controller of the first control unit to generate voltage vector values (V_{d_ref} and V_{q_ref}). The method further comprises a step of generating the inverter pulse width modulation signals based on the voltage vector values (V_{d_ref} and V_{q_ref}). Further, the DC-DC pulse width modulation signals are provided to the DC-DC converter in such a manner that the DC-DC converter generates a desired voltage (V_{dc}) which is fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control.

[007] In another non-limiting embodiment of the present disclosure, a power flow controller for controlling vehicle to grid (V2G) power flow control is disclosed. The power flow controller being implemented with a three phase off board electric vehicle (EV) charger comprising an active frontend inverter, a DC-DC converter, and a battery. The power flow controller comprises a first control unit to implement an inverter control loop operation for

providing inverter pulse width modulation signals to the active frontend inverter. The power flow controller further comprises a second control unit to implement a DC-DC converter control loop operation for providing DC-DC pulse width modulation signals to the DC-DC converter. The first control unit to implement the inverter control loop operation is configured to perform the following operations. At first, the first control unit receives a battery current value (I_{bat}) and a battery voltage value (V_{bat}) of the battery. The first control unit then computes a battery power value (P) of the battery based on the battery current value (I_{bat}) and the battery voltage value (V_{bat}). Further, the first control unit generates a reference current value (I_{d_ref}) based on the battery power value (P). The first control unit further provides the reference current value (I_{d_ref}) to a decoupled d-q controller to generate voltage vector values (V_{d_ref} and V_{q_ref}) and further generates inverter pulse width modulation signals based on V_{d_ref} and V_{q_ref} .

[008] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF DRAWINGS

[009] The embodiments of the disclosure itself, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings. One or more embodiments are now described, by way of example only, with reference to the accompanying drawings in which:

[0010] **Figure 1** illustrates an environment implementing a vehicle to grid (V2G) technology, in accordance with an embodiment of the present disclosure;

[0011] **Figure 2(a)** discloses a block diagram **200A** of a power flow controller, in accordance with an embodiment of the present disclosure;

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[0012] **Figure 2(b)** illustrates a process flow **200B** carried out in the power flow controller, in accordance with an embodiment of the present disclosure; and

[0013] **Figures 3** illustrates a flowchart **300** of a method of providing a vehicle to grid (V2G) power flow control, in accordance with an embodiment of the present disclosure.

5 [0014] The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION OF DRAWINGS

10 [0015] The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present disclosure.

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[0016] The novel features which are believed to be characteristic of the disclosure, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying Figures. It is to be expressly understood, however, that each of the Figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

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[0017] Disclosed herein is a power flow controller and a method for providing an improved and efficient way of controlling vehicle to grid (V2G) power flow control. The power flow controller is implemented with a three phase off board electric vehicle (EV) charger which comprises an active frontend inverter, a DC-DC converter, and battery. Conventionally, the DC bus voltage is regulated by an active frontend converter (AFC), whereas the DC -DC converter is controlled by battery voltage, current or power. However, when the conditions such as voltage sags, presence of harmonics and fault conditions are encountered, these conventional techniques fail to provide the required sinusoidal grid current and voltage which degrades the power quality. The disclosed power flow controller addresses these concerns by modifying the control loop operations for providing a controlled battery discharge in a constant power mode.

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[0018] The present disclosure discloses technique in which direct axis current component is derived from the available battery power. The present disclosure implements an inverter control loop operation and DC-DC converter control loop operation. In the inverter control loop operation, an inverter pulse width modulation signals are provided to the active frontend inverter. Whereas, in the DC-DC converter control loop operation, DC-DC pulse width modulation signals are provided to the DC-DC converter. According to an embodiment, the DC-DC pulse width modulation signals are provided to the DC-DC converter in such a manner that the DC-DC converter generates a desired voltage which is fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control. The detailed explanation of both the operations i.e. inverter control loop operation and DC-DC converter control loop operation is explained in subsequent paragraphs of the specification.

[0019] **Fig. 1** shows an environment where vehicle to grid (V2G) technology is deployed to effectively manage power flow control from an electric vehicle (EV) to an electrical grid. The V2G can be defined as a system in which a controllable and bi-directional electrical energy flows between the EV to the electrical grid. The V2G technology involves drawing unused power from the EVs into the electric grid. Here, the electric grid may refer to as smart grid or a microgrid which uses the unused power from the EVs for various applications like lightning a building or a house. Thus, the V2G may help the energy grids to supply electricity during peak hours. The V2G may also create an extra power source when weather-dependent renewable energy sources are not available. For example, a home that uses solar power cannot generate electricity at night, but an electric vehicle could provide a secondary source of power if needed.

[0020] As shown in **Fig. 1**, EV is a four-wheeler, however according to various embodiments of present disclosure, the EV can also be a two-wheeler or a three-wheeler, or any other configuration of EVs. During the V2G power flow operation, the EV is communicably coupled to a V2G unit which may be implemented at parking lots, charging stations, or at houses. The V2G unit may be further connected to the electric grid for providing the power. The disclosed power flow controller is implemented at the V2G unit where it efficiently controls the battery discharge of the EV in a constant power mode.

[0021] **Figs. 2(a)** and **2(b)** shows a block diagram **200A** of a power flow controller and a process flow **200B** carried out in the power flow controller respectively. **Figs. 2(a)** and **2(b)** is explained in conjunction with each other for providing the detailed working of the power flow controller **102**.

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[0022] The power flow controller **102** comprises a first control unit **204**, a second control unit **206**, a processor **210**, I/O interface **212**, and a memory **208** which may be communicably coupled with each other to implement one or more functionalities of the power flow controller **102**. In an exemplary embodiment, the power flow controller **102** may reside inside at the V2G unit (as shown in **Fig. 1**) and may interact with other utilities as per requirement. In another embodiment, the power flow controller **102** may reside outside the V2G unit to carry out the functionalities in accordance with the present disclosure.

[0023] The first control unit **204** and the second control unit **206** may comprise hardware components like processor, microprocessor, microcontrollers, application-specific integrated circuit for performing various operations of the system **102**. Further, processor **210** may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor **210** is configured to fetch and execute computer-readable instructions stored in the memory **208**. It must be understood to a person skilled in art that the processor **210** may perform all the functions of the first control unit **204** and the second control unit **206** according to various embodiments of the present disclosure. The I/O interface **212** may include a variety of software and hardware interfaces which enables the power flow controller **102** to communicate with EV and the grid.

[0024] While the components **204-212** are illustrated and described herein with respect to the power flow controller **102** may form essential components to carry out the present disclosure, it may be worth noted that the power flow controller **102** may comprise other/additional components as well which are not shown for the sake of brevity and are used in conjunction with the illustrated components to implement present disclosure.

[0025] Now referring to **Fig. 2(b)**, the working of the first control unit **204** and the second control unit **206** in explained in detail. The lower part of **Fig. 2(b)** (shown as rectangular box)

illustrates the functioning of the power flow controller **102**, whereas the upper part of **Fig. 2(b)** shows the components (active frontend inverter, a DC-DC converter, and a battery) related to a three phase off board electric vehicle (EV) charger. These components are coupled to each other for providing the power flow control process from source to destination (i.e. from battery to grid).

[0026] As stated above, the disclosed power flow controller **102** addresses the concerns of the conventional V2G technique by modifying the control loop operations for providing a control battery discharge in a constant power mode. The control loop operations comprises an inverter control loop operation (indicated by dotted lines at left-side of the rectangular box) and DC-DC converter control loop operation (indicated by dotted lines at right-side of the rectangular box).

[0027] According to an aspect of the present disclosure, the first control unit **204** performs the inverter control loop operation for providing inverter pulse width modulation signals to the active frontend inverter. Whereas, the second control unit **206** performs the DC-DC converter control loop operation for providing DC-DC pulse width modulation signals to the DC-DC converter. Both the operations are explained below:

Inverter control loop operation

[0028] Unlike the conventional technique, in the inverter control loop operation as performed by the present disclosure, the direct axis current component (referred as reference current value (I_{d_ref})) is derived from the available battery power. The first control unit **204** starts the inverter control loop operation by receiving a battery current value (I_{bat}) and a battery voltage value (V_{bat}) of the battery. Based on the battery current value (I_{bat}) and a battery voltage value (V_{bat}), the first control unit **204** computes a battery power value (P) which indicates the available power of the battery. According to an embodiment, the first control unit **204** computes the batter power value (P) using the below equation 1:

a. Power equals Current times Voltage ($P= V_{bat} \times I_{bat}$) equation (1)

[0029] Now using the batter power value (P), the first control unit **204** generates a reference current value (I_{d_ref}). According to an embodiment, the battery power value (P) is divided by phase RMS grid voltage value to form the reference current value (I_{d_ref}). That is, the battery

current value (I_{bat}) and battery voltage value (V_{bat}) are used to compute the battery power value (P) which are then scaled accordingly to obtain reference current value (I_{d_ref}), by using input voltage rms value.

5 **[0030]** Post generating the reference current value (I_{d_ref}), the first control unit **204** provide the reference current value (I_{d_ref}) to a decoupled d-q controller to generate voltage vector values (V_{d_ref} and V_{q_ref}). In the decoupled d-q control technique, the reference current value (I_{d_ref}) is compared with a d-current value (I_d) of the decoupled d-q controller. The first control unit **204** then generates the inverter pulse with modulation signals based on the voltage vector values
10 (V_{d_ref} and V_{q_ref}). The generated pulse width modulation signals are fed to the active frontend inverter to facilitate the V2G power flow control. According to an embodiment, the pulse width modulation signals may be generated by pulse width modulation generator of the first control unit **204**.

15 **DC-DC converter control loop operation**

[0031] On the other hand, the second control unit **206** performs the DC-DC converter control loop operation which is indicated by dotted lines at right-side of the rectangular box of **Fig. 2A**. To implement the DC-DC converter control loop operation, the second control unit **206**
20 first compares a predefined reference voltage value (V_{dc_ref}) with an actual voltage value (V_{dc}) corresponding to the desired voltage which is to be fed from the DC-DC converter to the active frontend inverter. That is, the desired voltage is sensed and the actual voltage value (V_{dc}) is fed to an error amplifier provided in the DC-DC converter control loop. The actual voltage value (V_{dc}) is compared with the reference voltage value (V_{dc_ref}) and an error is produced. Then, the
25 error flows into a voltage controller (provided in the DC-DC converter control loop) to produce a control signal which is an input to PMW generator. Finally, the PMW generator of the second control unit **206** generates the DC-DC pulse width modulation signals.

[0032] Thus, with both the control loop operations being performed, the inverter pulse width
30 modulation signals are provided to the inverter and the DC-DC pulse width modulation signals are provided to the DC-DC converter. Here, it may be noted that, the DC-DC pulse width modulation signals are provided to the DC-DC converter in such a manner that the DC-DC converter generates the desired voltage (V_{dc}) which is now fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control.

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[0033] This way, the present disclosure provides various technical effects or advantages such as cross coupling is done in order to decouple the d-q components for the active and reactive power control, and thus helping in effective control of the active and reactive power independently. Further, the disclosed technique also helps to balance out electricity demand and avoid unnecessary costs for building an electricity system. Also, the efficiency of the power flow controller **102** has been greatly improved by providing the proposed V2G power flow control technique.

[0034] **FIG. 3** shows a flowchart of a method **300** of providing a vehicle to grid (V2G) power flow control, in accordance an embodiment of the present disclosure.

[0035] The method shown in **Fig. 3** is performed by a power flow controller being implemented with a three phase off board electric vehicle (EV) charger comprising an active frontend inverter, and battery. It can be seen in **Fig. 3** that both the control operations i.e. inverter control loop operation and DC-DC converter control loop operation are explained using the blocks **302-310** and **312-314** respectively.

[0036] At block **302**, the method **300** comprises receiving a battery current value (I_{bat}) and a battery voltage value (V_{bat}) of the battery.

[0037] At block **304**, the method **300** comprises computing a battery power value (P) of the battery based on the battery current value (I_{bat}) and the battery voltage value (V_{bat}).

[0038] At block **306**, the method **300** comprises generating a reference current value (I_{d_ref}) based on the battery power value (P). According to an embodiment, the reference current value (I_{d_ref}) may be generated by performing scaling of the battery power value (P) using an input volage RMS value.

[0039] At method at block **308**, the method **300** comprises providing the reference current value (I_{d_ref}) to a decoupled d-q controller to generate voltage vector values (V_{d_ref} and V_{q_ref}). According to an embodiment, the voltage vector values (V_{d_ref} and V_{q_ref}) is generated by comparing the reference current value (I_{d_ref}) with a d-current value (I_d) of the decoupled d-q controller.

[0040] At block 310, the method 300 comprises generating the inverter pulse width modulation signals based on the voltage vector values (V_{d_ref} and V_{q_ref}).

5 [0041] At block 312, the method 300 comprises comparing a predefined reference voltage value (V_{dc_ref}) with an actual voltage value (V_{dc}) corresponding to the desired voltage which is to be fed from the DC-DC converter to the active frontend inverter.

[0042] At block 314, the method 300 comprises generating the DC-DC pulse width modulation signals based on the comparison performed at block 312.

10 [0043] Finally, at block 316, the method 300 comprises providing the DC-DC pulse width modulation signals to the DC-DC converter in such a manner that the DC-DC converter generates a desired voltage (V_{dc}) which is fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control.

15 [0044] A description of an embodiment with several components in communication with each other does not imply that all such components are required. On the contrary, a variety of optional components are described to illustrate the wide variety of possible embodiments of the invention.

20 [0045] When a single device or article is described herein, it will be clear that more than one device/article (whether they cooperate) may be used in place of a single device/article. Similarly, where more than one device or article is described herein (whether they cooperate), it will be clear that a single device/article may be used in place of the more than one device or
25 article or a different number of devices/articles may be used instead of the shown number of devices or programs. The functionality and/or the features of a device may be alternatively embodied by one or more other devices which are not explicitly described as having such functionality/features. Thus, other embodiments of the invention need not include the device itself.

30 [0046] Finally, the language used in the specification has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the inventive subject matter. It is therefore intended that the scope of the invention be limited not by this detailed description, but rather by any claims that issue on an application
35 based here on. Accordingly, the embodiments of the present invention are intended to be

illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

5 [0047] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

WE CLAIM:

1. A method of providing a vehicle to grid (V2G) power flow control, wherein the method comprising:

providing a power flow controller (102) being implemented with a three phase off board electric vehicle (EV) charger comprising an active frontend inverter, a DC-DC converter, and a battery, wherein the method further comprising:

implementing an inverter control loop operation and a DC-DC converter control loop operation for providing inverter pulse width modulation signals and DC-DC pulse width modulation signals to the active frontend inverter and the DC-DC converter respectively;

during the inverter control loop operation implemented by a first control unit (204) of the power flow controller (102), the method comprising:

receiving battery current value (I_{bat}) and battery voltage value (V_{bat}) of the battery;

computing a battery power value (P) of the battery based on the battery current value (I_{bat}) and the battery voltage value (V_{bat});

generating a reference current value (I_{d_ref}) based on the battery power value (P);

providing the reference current value (I_{d_ref}), to a decoupled d-q controller of the first control unit (204), to generate voltage vector values (V_{d_ref} and V_{q_ref}); and

generating the inverter pulse width modulation signals based on the voltage vector values (V_{d_ref} and V_{q_ref});

and wherein the DC-DC pulse width modulation signals are provided to the DC-DC converter in such a manner that the DC-DC converter generates a desired voltage (V_{dc}) which is fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control.

2. The method as claimed in claim 1, wherein during the DC-DC converter control loop operation implemented by a second control unit (206) of the power flow controller (102), the method comprising:
 - comparing a predefined reference voltage value (V_{dc_ref}) with an actual voltage value (V_{dc}) corresponding to the desired voltage which is to be fed from the DC-DC converter to the active frontend inverter; and
 - generating the DC-DC pulse width modulation signals based on the comparison.

3. The method as claimed in claim 1, wherein generating the reference current value (I_{d_ref}) based on the battery power value (P) comprises:
 - performing scaling of the battery power value (P) using an input voltage RMS value.

4. The method as claimed in claim 1, wherein generating the voltage vector values (V_{d_ref} and V_{q_ref}) comprises:
 - comparing the reference current value (I_{d_ref}) with a d-current value (I_d) of the decoupled d-q controller.

5. A power flow controller (102) for controlling vehicle to grid (V2G) power flow control, wherein the power flow controller (102) being implemented with a three phase off board electric vehicle (EV) charger comprising an active frontend inverter, a DC-DC converter, and a battery, and wherein the power flow controller (102) comprises:
 - a first control unit (204) to implement an inverter control loop operation for providing inverter pulse width modulation signals to the active frontend inverter; and
 - a second control unit (206) to implement a DC-DC converter control loop operation for providing DC-DC pulse width modulation signals to the DC-DC converter;
 wherein the first control unit (204) to implement the inverter control loop operation is configured to:
 - receive a battery current value (I_{bat}) and a battery voltage value (V_{bat}) of the battery;

compute a battery power value (P) of the battery based on the battery current value (I_{bat}) and the battery voltage value (V_{bat});

generate a reference current value (I_{d_ref}) based on the battery power value (P);

provide the reference current value (I_{d_ref}), to a decoupled d-q controller of the first control unit (204), to generate voltage vector values (V_{d_ref} and V_{q_ref}); and

generate inverter pulse width modulation signals, based on V_{d_ref} and V_{q_ref} ;

and wherein the DC-DC pulse width modulation signals are provided to the DC-DC converter in such a manner that the DC-DC converter generates a desired voltage (V_{dc}) which is fed to the active frontend inverter in order to further enable the active frontend inverter to facilitate the V2G power flow control.

6. The power flow controller (102) as claimed in claim 1, wherein the second control unit (206) to implement DC-DC converter control loop operation is configured to:

compare a predefined reference voltage value (V_{dc_ref}) with an actual voltage value (V_{dc}) corresponding to the desired voltage which is to be fed from the DC-DC converter to the active frontend inverter; and

generate the DC-DC pulse width modulation signals based on the comparison;

7. The power flow controller (102) as claimed in claim 1, wherein the first control unit (204) to generate the reference current value (I_{d_ref}) based on the battery power value (P), is configured to:

perform scaling of the battery power value (P) using an input voltage RMS value.

8. The power flow controller (102) as claimed in claim 1, wherein the first control unit (204) to generate the voltage vector values (V_{d_ref} and V_{q_ref}) is configured to:

compare the reference current value (I_{d_ref}) with a d-current value (I_d) of the decoupled d-q controller.

Dated this 16th Day of September 2022

-- Digitally Signed--

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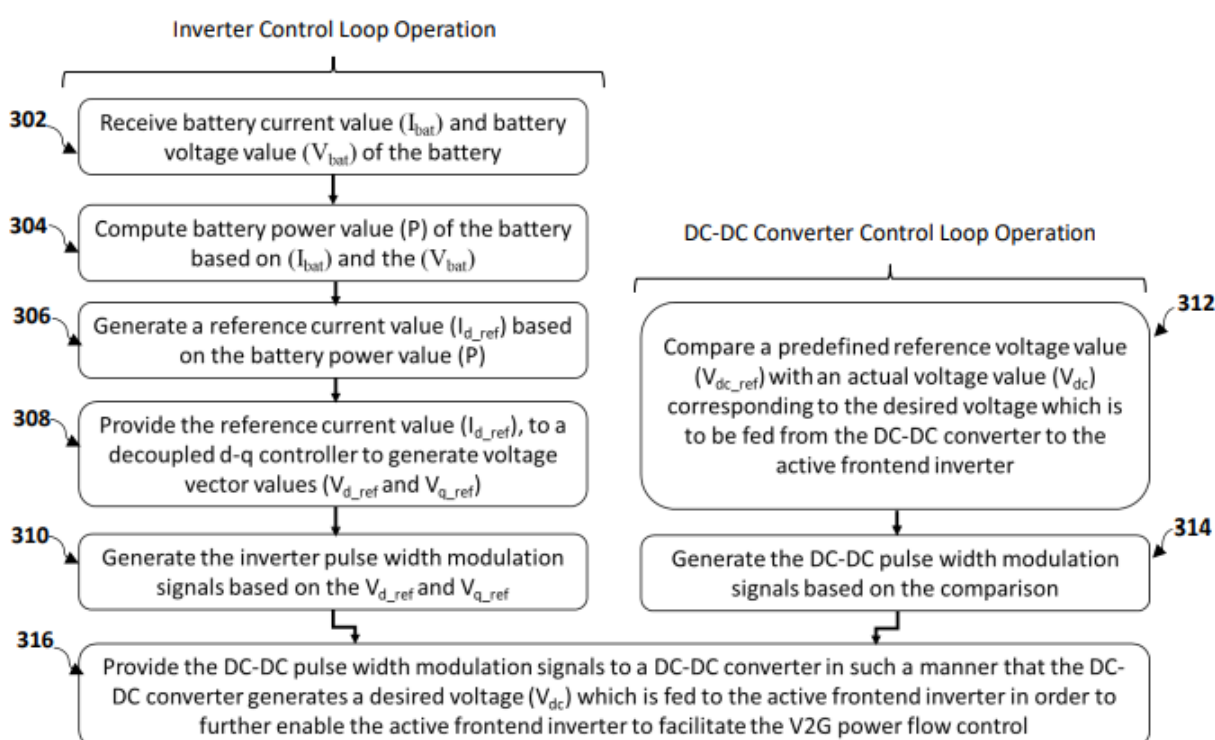
Manapakkam, Chennai - 600089.

ABSTRACT

A POWER FLOW CONTROLLER CONTROLLING VEHICLE TO GRID (V2G) POWER FLOW CONTROL AND METHOD THEREOF

Disclosed herein is power flow controller and method for providing vehicle to grid (V2G) power flow control. The method comprises receiving battery current value (I_{bat}) and battery voltage value (V_{bat}) of the battery. Based on the (I_{bat}) and (V_{bat}), method comprises computing a battery power value (P) of the battery. Further, reference current value (I_{d_ref}) is generated based on the battery power value (P). The reference current value (I_{d_ref}) is provided to a decoupled d-q controller to generate voltage vector values (V_{d_ref} and V_{q_ref}). Further, inverter pulse width modulation signals are generated based on the V_{d_ref} and V_{q_ref} . On the other hand, the DC-DC pulse width modulation signals are generated and provided to DC-DC converter in such a manner that the DC-DC converter generates desired voltage (V_{dc}) which is fed to the active frontend inverter to further enable the active frontend inverter to facilitate the V2G power flow control.

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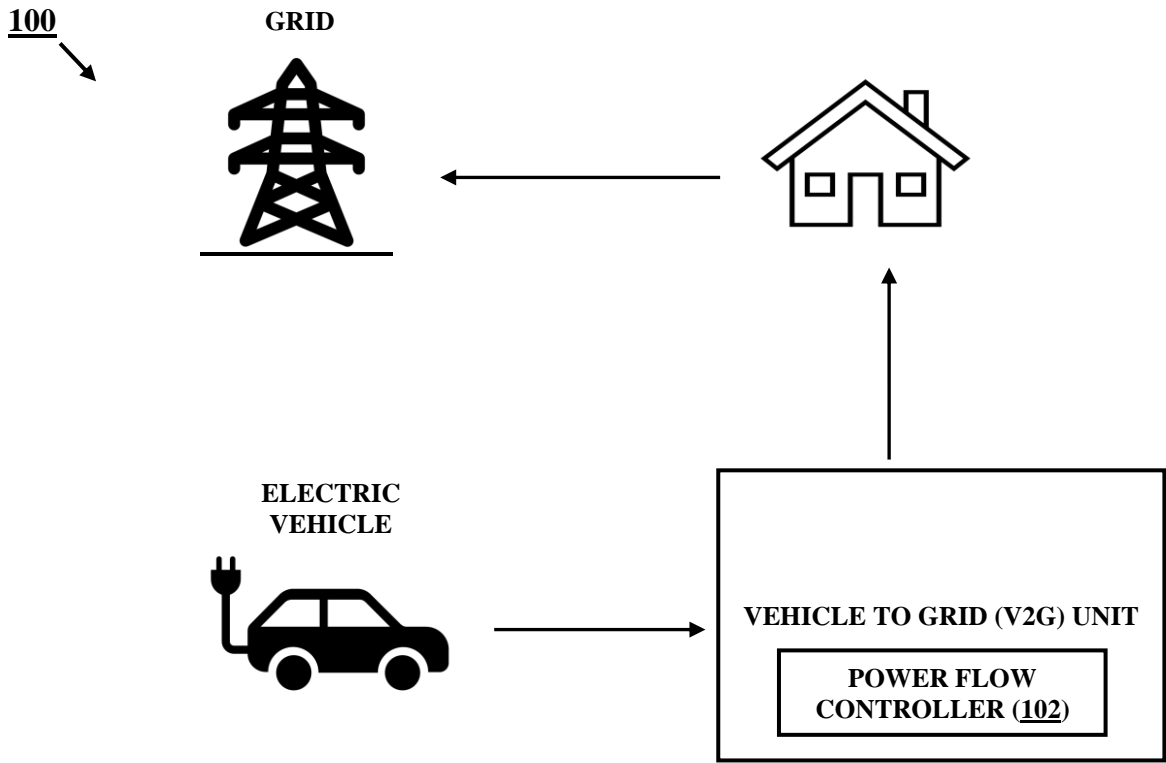


Fig. 1

200A →

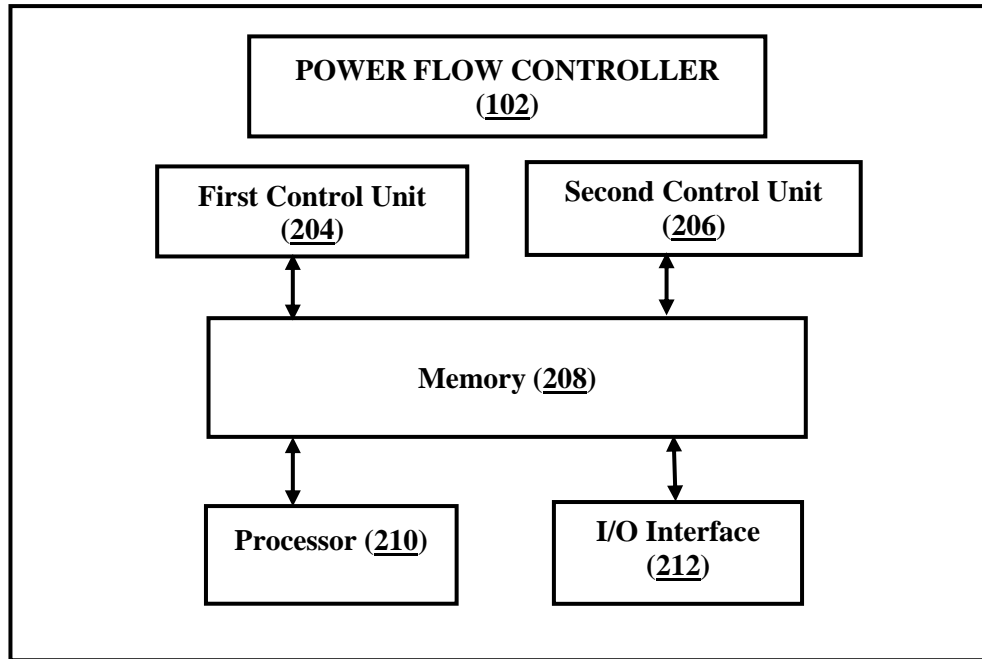


Fig. 2 (a)

200B

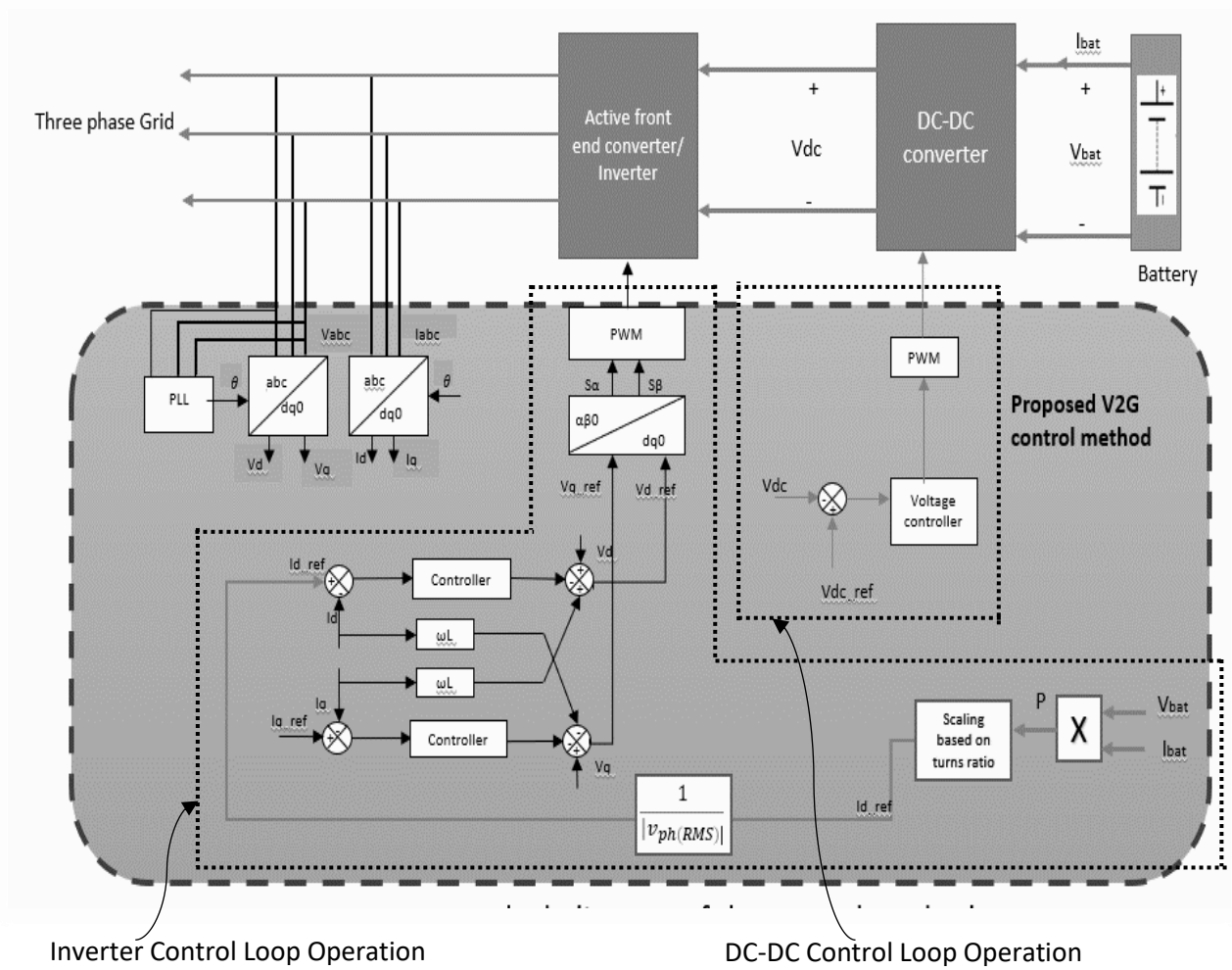


Fig. 2 (b)

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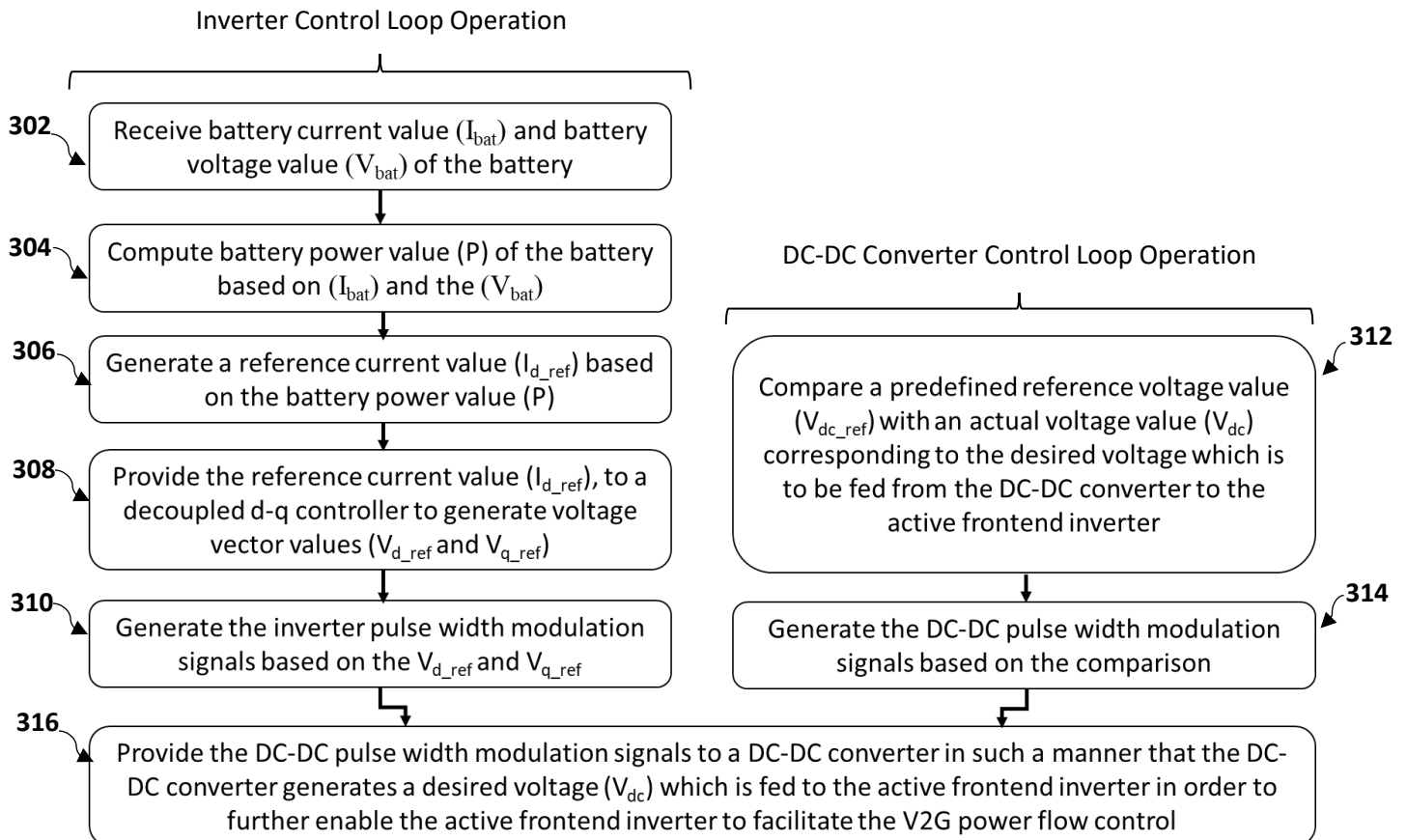


Fig. 3