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(54) METHOD AND SYSTEM FOR OFF-GRID TESTING AND DIAGNOSTICS OF A VEHICLE CHARGE STATION

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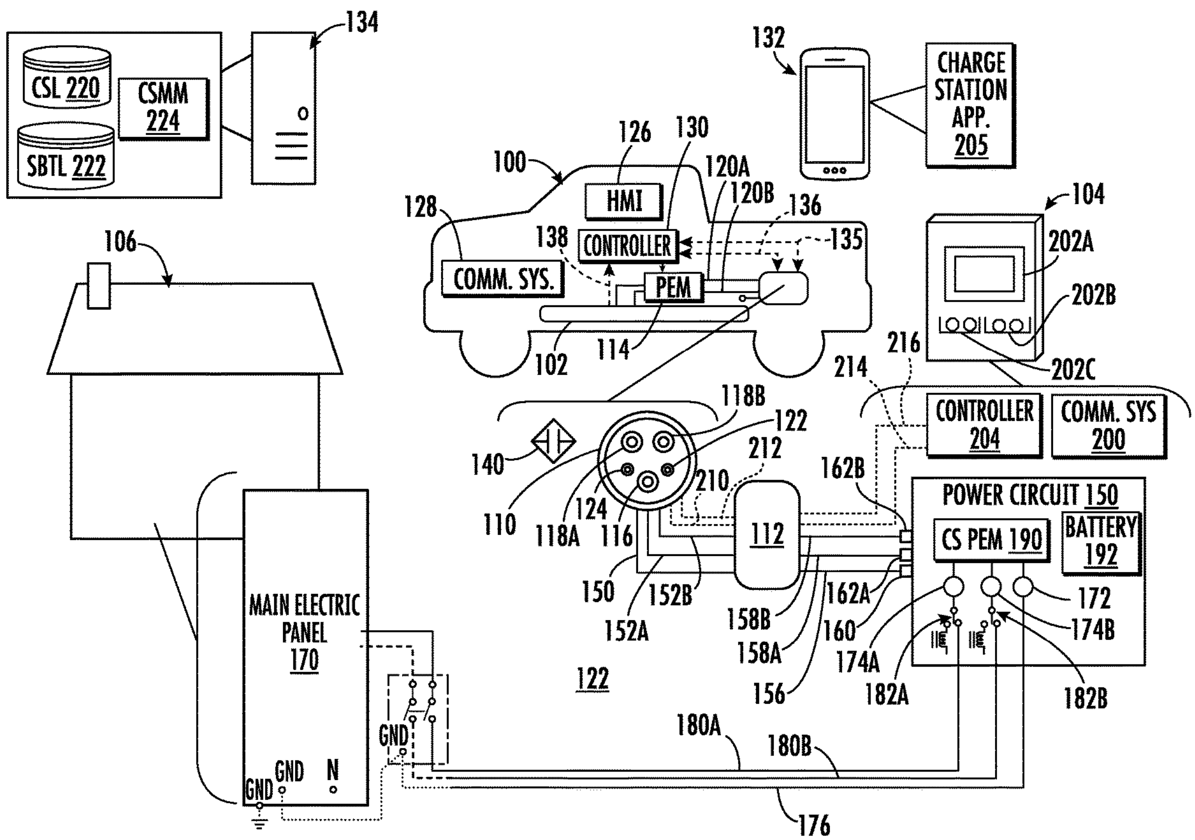
(57) ABSTRACT

A method includes supplying, by an electric vehicle (EV), electrical power to an EV charge station, and outputting a message including data indicative of a task result for a software-based task performed at the EV charge station with the EV charge station receiving power from the EV.



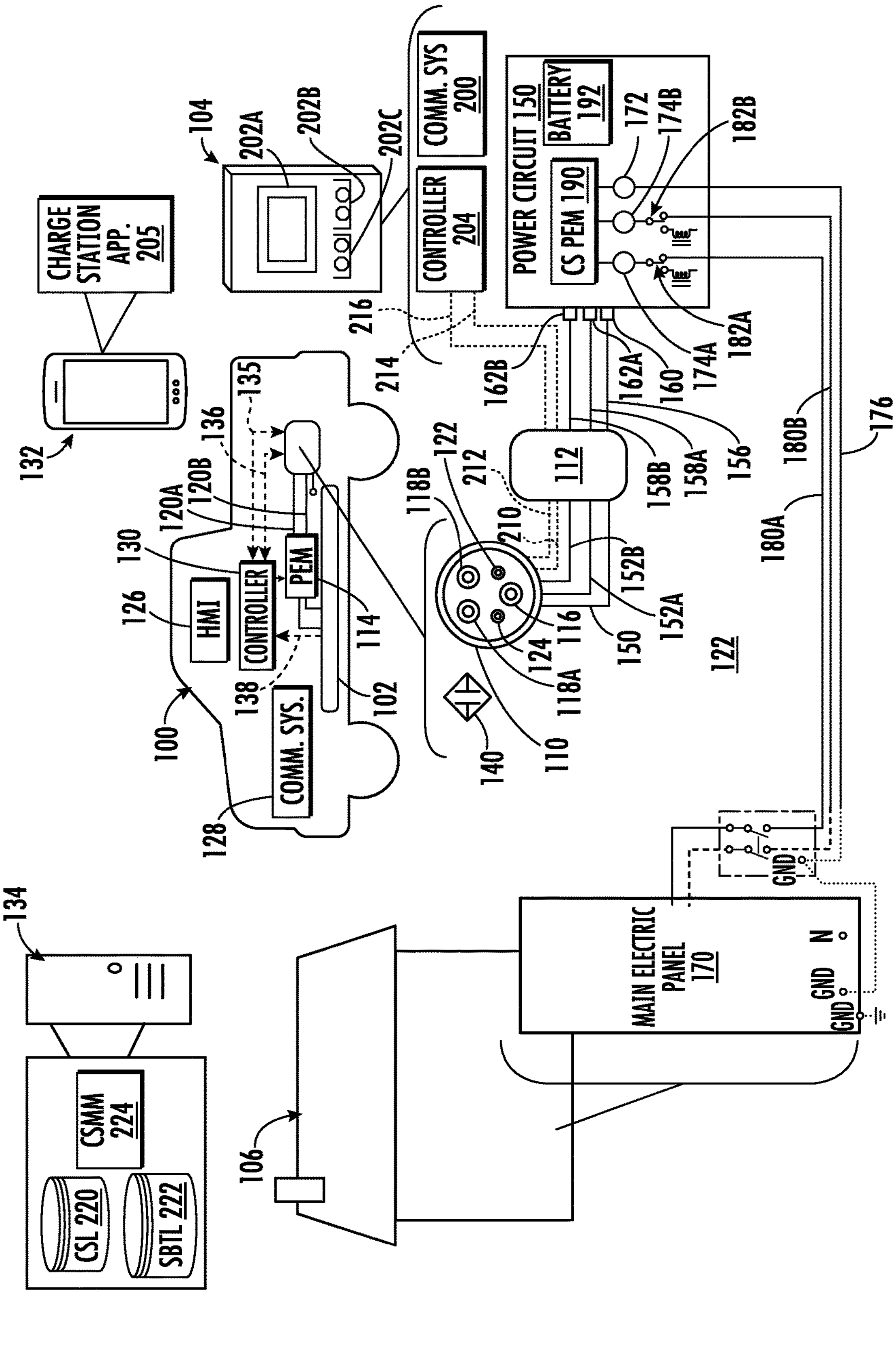

CHARGE STATION APP. 205
COMM. SYS 200
CONTROLLER 204
POWER CIRCUIT 150
BATTERY 192
CS PEM 190
HMI
CONTROLLER
PEM
COMM. SYS.
112
122
MAIN ELECTRIC PANEL 170
GND
GND
N
GND
CSMM 224
CSL 220
SBTL 222

FIG. 1

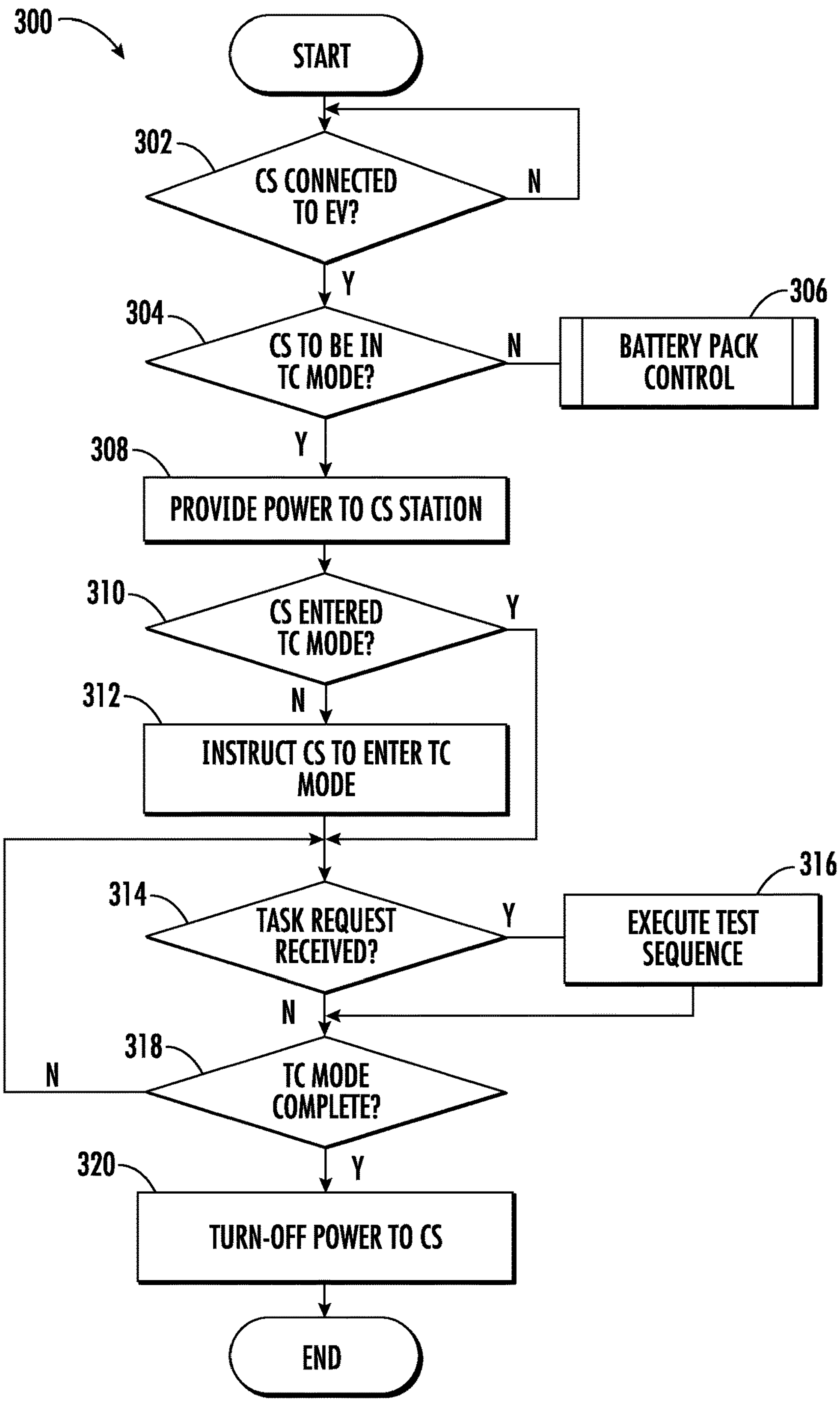

300
START
302
CS CONNECTED TO EV?
N
Y
304
CS TO BE IN TC MODE?
N
306
BATTERY PACK CONTROL
Y
308
PROVIDE POWER TO CS STATION
310
CS ENTERED TC MODE?
Y
N
312
INSTRUCT CS TO ENTER TC MODE
314
TASK REQUEST RECEIVED?
Y
316
EXECUTE TEST SEQUENCE
N
318
TC MODE COMPLETE?
N
Y
320
TURN-OFF POWER TO CS
END

FIG. 2

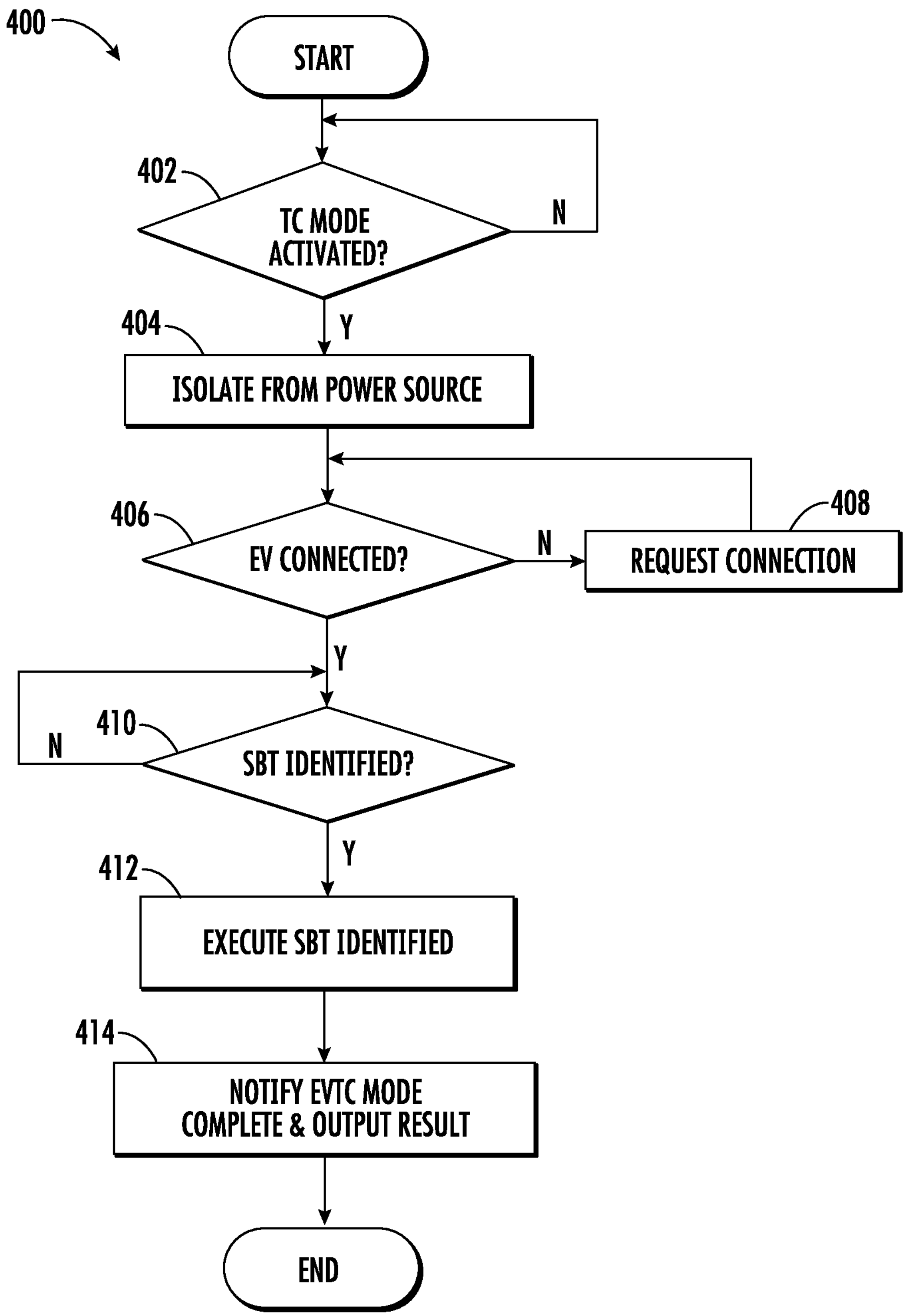

400
START
402
TC MODE ACTIVATED?
N
Y
404
ISOLATE FROM POWER SOURCE
406
EV CONNECTED?
N
408
REQUEST CONNECTION
Y
410
SBT IDENTIFIED?
N
Y
412
EXECUTE SBT IDENTIFIED
414
NOTIFY EVTC MODE COMPLETE & OUTPUT RESULT
END

FIG. 3

METHOD AND SYSTEM FOR OFF-GRID TESTING AND DIAGNOSTICS OF A VEHICLE CHARGE STATION

TECHNICAL FIELD

[0001] The present disclosure is generally directed to a method of testing a charge station for an electric vehicle.

BACKGROUND

[0002] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0003] Electric vehicles, such as plug-in hybrid vehicles and fully electric vehicles, generally connect to a charge station to charge a high voltage battery pack of the electric vehicle using power from a power grid. In a non-limiting example, the charge station is electrically connected to a building power network, which is connected to the power grid. In some arrangements, the electric vehicle and the charge station are configured to form a bidirectional power transfer system to not only charge the electric vehicle, but to provide power to a power grid, a building, and/or a load.

SUMMARY

[0004] This section provides a general summary of the disclosure and is not a comprehensive disclosure of its full scope or all of its features.

[0005] In one form, the present disclosure is directed to a method including supplying, by an electric vehicle (EV), electrical power to an EV charge station, and outputting a message including data indicative of a task result for a software-based task performed at the EV charge station with the EV charge station receiving power from the EV.

[0006] In one form, the present disclosure is directed to a system including one or more controllers configured to control a power electronics module to supply electric power to an electric vehicle (EV) charge station from a battery pack of an EV, and output a message including data indicative of a task result for a software-based task performed at the EV charge station with the EV charge station receiving electric power from the EV.

[0007] In one form, the present disclosure is directed to a method, including supplying, by an electric vehicle (EV), alternating current (AC) power to an EV charge station after detecting a charger of the EV charge station connected to a charge port of the EV and having the EV charge station electrically isolated from an installed power source; having at least one software-based task performed at the EV charge station after supplying power to the EV charge station; and outputting a message to at least one of a remote server or a human machine interface, the message including data indicative of a task result for the at least one software-based task performed at the EV charge station.

[0008] Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In order that the disclosure may be well understood, there will now be described various forms thereof, given by way of example, reference being made to the accompanying drawings, in which:

[0010] FIG. **1** illustrates a system having at least an electric vehicle and a charge station in accordance with the present disclosure;

[0011] FIG. **2** is a flowchart of an example EV test-configuration (EVTC) routine in accordance with the present disclosure; and

[0012] FIG. **3** is a flowchart of an example charge station test-configuration (CSTC) routine in accordance with the present disclosure.

[0013] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

DETAILED DESCRIPTION

[0014] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

[0015] Installation of an electric vehicle charge station can be very complex and, even before the charge station is installed, there can be significant prep work at an installation location to have the charge station connected to a power network at the installation location. Accordingly, if the charge station is faulty, significant resources may be needed to correct the fault. In addition, if the charge station is not faulty and the charge station does not operate as expected, the charge station may be incorrectly flagged for being faulty and the actual issue may not be identified. Furthermore, charge stations that may be in stock but not yet assigned to a location, may need to be routinely tested and/or may need to undergo software updates. Generally, to perform tests and/or perform software updates, the charge station may need to be fully wired to a power source, which is time consuming.

[0016] The present disclosure is directed to a method and/or system for performing a software-based task on a charge station without the use of an installed power source (i.e., a power source that is used once the charge station is installed). Specifically, in one form, the method may include supplying, by an EV, electrical power to an EV charge station, and outputting a message including data indicative of a task result for a software-based task performed at the charge station with the charge station receiving power from the EV. That is, with the charge station receiving power from the EV and isolated from the installed power source, the charge station is configured to operate in test-configuration mode to perform, for example, diagnostic test and/or software configuration/updates. Accordingly, the charge station is not required to be wired to the installed power source to detect possible faults and/or to perform software updates.

[0017] Referring to FIG. **1**, an electric vehicle (EV) **100**, such as a plug-in hybrid vehicle or a fully electric vehicle, includes a battery pack **102** that is chargeable via a charge station **104**, which may also be referred to as an electric vehicle supply equipment. In one form, the EV **100**, and the charge station **104** are configured to form a bidirectional power transfer system in which the EV **100** provides power to, for example, a power grid, a house/building, and/or a load (i.e., a device or system receiving power from the EV **100** is referred to as an "electric receiver.")

[0018] The EV **100** includes a charge port **110** configured to connect to a charger **112** of the charge station **104** and a power electronic module (PEM) **114**. The charge port **110** is configured to have an EV conductive ground terminal **116** and EV conductive power terminals **118**A, **118**B (collectively "power terminals" **118**) connected to the PEM **114** via power lines **120**A, **120**B (collectively "power lines **120**"), respectively, to receive and output power. In a non-limiting example, the charge port **110** is configured based on EV charger standards, such as but not limited to, combined charging system (CCS).

[0019] The PEM **114** is configured to charge the battery pack **102** using power from a power source via the charge station **104** and to supply alternating current (AC) power to an electric receiver. In one form, among other components, the PEM **114** includes an inverter to convert direct current (DC) power from the battery pack **102** to alternating current (AC) power. In a non-limiting example, the power source may be provided as a power network of a building and/or an electrical power grid.

[0020] In some variations, in addition to conductive terminals **118**, **116**, the charge port **110** includes a proximity pin **122** and a control pilot **124** to connect to associated ports on the charger **112**. The proximity pin **122** detects the charger **112** indicating the EV **100** is connected to the charge station **104**. The control pilot **124** is a communication port to establish digital communication with the charge station **104** using, for example, pulse-width modulation (PWM) per one or more communication standards (e.g., standards IEC 61851-1; DIN SPEC 70121; and/or the ISO/IEC 15118-series).

[0021] In one form, the EV **100** further includes one or more human machine interfaces (HMIs) **126**, a communication system (Comm. Sys.) **128**, and a controller **130**. The EV **100** may exchange information with a user via the HMIs **126**, which may include, but are not limited to display (e.g., touchscreen display, overhead display), audio system having speaker and microphone, pushbuttons, and/or knobs.

[0022] In one form, the communication system **128** is configured to communicate with various external devices/systems using wired and/or one or more wireless communication techniques (e.g., BLUETOOTH, WiFi, ZigBee, Z-Wave, vehicle-to-anything (V2X)). The communication system **128** may also be configured to define a vehicle wireless communication network/hotspot that external devices may join to communicate with other devices/systems. Specifically, as described herein, the charge station **104** and a portable computing device **132** may connect to the vehicle wireless communication network to communicate to each other, and/or to a remote cloud-based server (e.g., charge station server (CSS) **134**). Accordingly, the communication system **128** may include a router, a modem, an antenna, an input-output interface, a universal serial bus (USB) port, and/or other suitable devices for wireless and wired communication.

[0023] In one form, the controller **130** is configured to control the PEM **114** to charge the battery pack **102** or to supply power to the electric receiver using power from the battery pack **102**, as part of a battery pack control process. Specifically, in a non-limiting example, the controller **130** is configured to estimate operating characteristics of the battery pack **102**, such as but not limited to, power limit, current, and state of charge (SOC) using sensor data **138**. Using the operating characteristics and with the charger **112** connected to the charge port **110** as detected by the proximity pin **122**, the controller **130** determines if the battery pack **102** is to be charged or is to provide power to the electric receiver. If the battery pack **102** is to be charged, the controller **130** controls the PEM **114** to charge the battery pack **102** with AC power received via the power lines **120**, and if the EV **100** is to supply power, the controller **130** controls the PEM **114** to convert DC power from the battery pack **102** to AC power, which is outputted via the power lines **120**.

[0024] The controller **130** is configured to detect whether the EV **100** is connected to the charge station **104** via a signal received from the proximity pin **122** provided via communication line **135**. The controller **130** is further configured to exchange messages with the charge station **104** via the control pilot **124**, which is connected to the controller **130** via communication line **136**. In a non-limiting example, the controller **130** exchanges information, such as, but not limited to, a state of charge of the battery pack **102**, an electric current measurement of the battery pack **102**, whether the battery pack **102** is to be charged, and/or is able to supply power.

[0025] In one form, the controller **130** is further configured to operate in a charge station test-configuration (CSTC) mode to assist in executing one or more software-based tasks at the charge station **104**. As detailed herein, when in a test-configuration (TC) mode, the charge station **104** may perform software-based tasks, such as, but not limited to: a diagnostic test to test operation of the charge station **104** and/or specific components (e.g., tests directed to checking communication links, response of circuit board, and/or performance of a component); and/or software downloads for software configuration and/or updates. Under these scenarios, the EV **100** may be used to supply power to the charge station **104** and the controller **130** may initiate the CSTC mode to: instruct the charge station **104** to perform one or more software-based task, provide the vehicle WiFi hotspot, and/or communicate with the CSS **134** to exchange one or more messages regarding the charge station **104** and the tasks being performed. In a non-limiting example, the controller **130** may initiate the CSTC mode by receiving a signal indicative of a CSTC switch **140** being operated and/or a message from the charge station **104** indicating the station **104** is in a TC mode received via the control pilot **124**.

[0026] In one form, the charge station **104** is configured as a level 1 or level 2 EV charger. The charger **112** is configured to electrically couple the ground terminal **116** and the power terminals **118** of the charge port **110** with a power circuit **150** of the charge station **104**. In FIG. **1** lines **152**, **154**A, **154**B represent electrical coupling of the ground terminal **116** and power terminals **118** to associated terminals of the charger **112**, and lines **156**, **158**A, and **158**B represent electrical coupling of the terminals of the charger **112** to a ground terminal **160** and power terminals **162**A, **162**B of the power circuit **150**.

[0027] In a non-limiting example, the charge station **104** may be installed at or near a building and connects to a building power network **170**, which is generally illustrated as a main electric panel in FIG. **1**. While FIG. **1** illustrates the building as a house, the present disclosure is applicable to charge stations **104** arranged at various locations including, but not limited to, parks, shopping centers, office buildings, parking garages, and/or apartment complexes, and should not be limited to single family dwellings. In this example, the building power network **170** is provided as the installed power source from which the EV **100** draws power via the charge station **104** to charge the battery pack **102**.

[0028] When installed, the power circuit **150** terminals **172** and **174**A, **174**B are electrically coupled to a ground line **176** and power lines **180**A, **180**B that are electrically coupled to the build power network **170**. In one form, relays **182**A, **182**B are provided between the terminals **174**A, **174**B to electrically couple the charge station **104** to the build power network **170** or decouple the charge station **104** from the build power network **170** to isolate the charge station **104**. Specifically, the charger station **104** may be electrically isolated from the build power network **170** when the EV **100** provides power from the battery pack **102** to the charge station **104**.

[0029] In one form, the power circuit **150** includes power electronic module **190** (i.e., charge station (CS) PEM) and a battery **192**. The CS PEM **190** may include an inverter for converting the AC power from the build power network **170** to DC power for the battery pack **102** and a rectifier for converting DC power to AC power. In one form, the battery **192** is a low voltage rechargeable battery (e.g., 12V, 20V) that provides power to components within the charge station **104**. FIG. **1** illustrates a simple diagram of the power circuit **150**, and it should be readily understood that the power circuit **150** includes additional components for transferring power between the EV **100** and the installed power source, such as the building power network **170**, and should not be limited to the example provided here.

[0030] The charge station **104** further includes a (CS) communication system (Comm. Sys.) **200**, one or more (CS) human machine interfaces (HMIs) **202**, and a (CS) controller **204**, where “CS” is “charge station” distinguish from similar components of the EV **100**. The CS communication system **200** is configured to communicate with external devices like, but not limited to, the portable computing device **132** having a charge station software application **205** and the CSS **134**. In a non-limiting example, the CS communication system **200** may establish communication using BLUETOOTH protocol, a WiFi network, satellite communication, and may include antenna, router, modem, among other components (e.g., microprocessor configured with communication protocols).

[0031] In one form, the CS HMIs **202** are configured to exchange information with a user and may include, but is not limited to, a touchscreen display **202**A, one or more illumination device **202**B (e.g., LEDs) that illuminate to identify a status of a specific function and/or component, and/or one or more push buttons **202**C (e.g., one of the push buttons is a TC button that places the charge station in a TC mode when operated). For example, the touchscreen may provide information on a charging status of the EV **100**, an operation mode of the charge station **104** (e.g., charging, TC mode, providing power). The illumination devices **202**B may be used to indicate if certain sensors are operating or whether certain communication mediums are not operating (e.g., no WiFi).

[0032] In one form, the CS controller **204** is configured to operate the charge station **104** based on whether the EV **100** is to be charged or provide power. Specifically, like the controller **130**, the CS controller **204** detects whether the charge station **104** is connected to the EV **100** using a proximity pin provided at the charger **112** and exchanges information with the controller **130** via a control pilot of the charger **112** to determine whether the battery pack **102** is to provide power or is to be charged. In FIG. **1**, lines **210**, **212** represent communication coupling of the proximity pin **122** and the control pilot **124** with associated terminals of the charger **112**, respectively, and lines **214**, **216** represent communication coupling of proximity pin and control pilot of the charger **112** with the CS controller **204**.

[0033] In addition to controlling power transfer between the EV **100** and the installed power source, the CS controller **204** is configured to operate in a TC mode to execute one or more software-based tasks. Specifically, using the bidirectional transfer energy, the charge station **104** is configured to operate in the TC mode without having to be connected to the installed power source. This allows the charge station **104** to undergo testing/configuration in various situations. In one form, the software-based tasks may include, but is not limited to, component or system level tests (e.g., testing whether the CS communication system **204** is able to communicate via WiFi, pinging sensors within the charge station **104**, etc.), software configuration, and software update. In a non-limiting example, when the charge station **104** is not yet installed, the charge station may still perform software-based tasks to, for example, validate components within the charge station **104**, and/or check communication capability. Accordingly, if a fault is detected, the charge station **104** may undergo repairs prior to installation. Conversely, if no fault is detected, but the charge station **104** is not operating as intended after installation, then the user may rule out the charge station **104** as the cause of the error. In yet another example, after the charge station **104** is installed and fault occurs, the charge station **104** may be disconnected from the installed power source before the charge station **104** is evaluated. Accordingly, using power from the EV **100**, which may be a service vehicle, the charge station **104** may transition to TC mode to undergo evaluation.

[0034] Referring to FIGS. **2** and **3**, an example electric vehicle test-configuration (EVTC) routine **300** performed by the EV **100** and a CSTC routine **400** performed by the charge station **104** is provided. At operation **302**, the EV **100** determines if the charge station **104** is connected based on a signal from the proximity pin **122**. If connected, the EV **100** determines if the TC mode is requested, at operation **304**. As provided above, the T-C mode may be detected in various suitable ways, including but not limited to operation of the CSTC switch **140** and/or a message from the charge station **104** via the control pilot **124**. If the TC mode is not requested, the EV **100** proceeds to a battery pack control at operation **306** to control the battery pack (i.e., charge/supply power).

[0035] If the TC mode is requested, the EV **100** supplies power to the charge station **104** at operation **308**, and determines if the charge station entered TC mode at operation **310**. In a non-limiting example, the EV **100** may determine if the charge station **104** entered the TC mode based on a message received from the charge station **104**. If no message is received, the EV **100** instructs the charge station **104** to enter the TC mode at operation **312**. In return, the charge station **104** may enter the TC mode once it receives the message from the EV **100**, an external device.

[0036] At operation **314**, the EV **100** determines if a task request is received from the charge station **104**. In a non-limiting example, the charge station **104** may have the EV **100** take part in a specific test, and the message from the charge station **104** may identify the specific test, which may be stored in the controller **130**. If the test is received, the EV **100** executes the test at operation **316**. In one example, the test may be a communication test in which the charge station **104** is evaluating whether the CS communication system **200** is able to communicate via one or more protocols such as but no limited to, WiFi and/or BLUETOOTH. In the communication test, the EV **100** transmits a request to communicate using the selected protocol, and if confirmation is received from the charge station **104**, the EV **100** may determine that the communication system **200** is operating. On the other hand, if a confirmation is not received, the EV **100** determines that the test for the selected protocol was not successful.

[0037] If no task request is received or after the execution of a selected test, the EV **100** determines if the TC mode is complete, at operation **318**. In a non-limiting example, the EV **100** may determine that the TC mode is complete if the CSTC switch **140** is operated and/or if a message from the charge station **104** is received. If the TC mode is not complete, the EV **100** returns to operation **314**. If the TC mode is complete, the EV **100** stops power to the charge station **104**, at operation **320**. In some instances, if the EV **100** took part in a test, the EV **100** may output a message including data indicative of a test result (i.e., a task result) for a test (i.e., the software-based task). In another example, the EV **100** may also receive message from the charge station **104** via the control pilot or the CS communication system **200** indicating the results of the software-based tasks executed, and the EV **100** may display information indicative of the message via the HMIs **126**, which is received by the user.

[0038] The EVTC routine **300** may be configured in various suitable ways and is not intended to be limited to the operations of FIG. **2**. For example, with EV **100** communicating with the charge station **104** (e.g., using control pilot **124** or communication system **128**), the EV **100** may be configured to transmit a task sequence that identifies one or more software-based tasks to be performed to the charge station **104** once the charge station **104** is in the TC mode.

[0039] In yet another example, the controller **130** of the EV **100** is configured to have the charge station software application **205** that is configured to store the software-based tasks available for execution by the charge station **104** and provides a series of graphical interfaces that allows the user to select the tasks to be executed and receive results. Accordingly, the EV **100** is configured to direct the charge station **104** through the TC mode based on inputs from the user.

[0040] Referring to FIG. **3**, at operation **402** of the CSTC routine **400**, the charge station **104** is configured to determine if TC mode is to be activated, at operation **402**. In a non-limiting example, the charge station **104** may detect the TC mode when power is supplied from the EV **100** and the charge station **104** is isolated from the installed power source (e.g., relays **182**A, **182**B are not connected to power lines **180**); when the TC mode button is operated by the user; and/or a message is received from the EV **100** to enter TC mode. If the charge station **104** determines it is not to enter the TC mode, the routine **400** waits until the TC mode is requested, as a default state. Alternatively, if the charge station **104** is not yet installed, the charge station **104** may go into a sleep mode for a selected period of time or until a signal is received. Similarly, if the charge station **104** is connected to EV **100** and has not received a signal from the EV **100**, the charge station **104** may enter sleep mode. In yet another scenario, if the charge station **104** is installed, the routine **400** may be configured to have the charge station **104** detect if the charger **112** is connected to the EV **100** and operate as intended to control power to/from the EV **100**.

[0041] If the TC mode is to be activated, the charge station **104**, at operation **404**, isolates from the installed power source by, for example, detecting and having the relays **182**A, **182**B open. If the charge station **104** is not yet installed, the relays **182**A are already open and stay open. At operation **406**, the charge station **104** is configured to detect if the EV **100** is not connected via, for example, the proximity pin. If the EV **100** is not connected, the charge station **104** is configured to display a message via the HMIs (e.g., illuminate an illumination device **202**B or display a message on the touchscreen **202**A) requesting the EV **100** to be connected, at operation **408**.

[0042] Once connected, the charge station **104** receives power from the EV **100**, and determines if the software-based tasks (SBTs) to be performed are identified at operation **410**. In a non-limiting example, the charge station **104** may receive a task sequence that identifies the software-based tasks to be performed by the user via the HMIs **202**. In another example, if the charge station **104** is in communication with the EV **100** via the CS communication system **200**, the charge station **104** may receive the task sequence from the EV **100**.

[0043] At operation **412**, the charge station **104** performs the software-based tasks identified and once complete, notifies the EV **100** that the TC mode is complete and outputs the results, at operation **414**. More specifically, at operation **412**, the charge station **104** performs each subprogram associated with each of the tasks, and outputs results associated with each task. At any time during execution of the task, the charge station **104** may communicate information with the user via, for example, the HMIs **202** and/or the EV **100**. Furthermore, if required by the selected task, the charge station **104** may transmit a task request to the EV **100** requesting the EV **100** to perform the selected task. In a non-limiting example, the results outputted by the charge station **104** may indicate: whether the task performed was completed or incomplete; whether a selected component associated with the task is operating as intended (e.g., did a sensor operate as intended); and/or whether a component associated with the task is to be analyzed further.

[0044] The CSTC routine **300** may be configured in various suitable ways and is not intended to be limited to the operations of FIG. **3**. In a non-limiting example, the charge station **104** may be configured to have one or more task sequences that are executed at selected installation stages of the charge station **104**, and thus, once the TC mode is entered, the software-based tasked to be performed are automatically identified at operation **410** based on the task sequence that is to be executed next. Once completed, the task sequence is identified as being done. In yet another example, the charge station **104** may be configured to join the vehicle wireless communication network (e.g., Wi-Fi, BLUETHOOTH, ZigBee, Z-Wave) to communicate with external devices such as, the EV **100**, the portable computing device **132**, and/or the CSS **134**. This enables the charge station **104** to exchange messages related to the TC mode even if the charge station **104** is not installed and/or connected to a building wireless communication network.

[0045] In some variations, the CSS **134** is configured to track and monitor multiple charge stations **104**, and, using a web-based interface or the charge station application **205**, the user is able access information of the CSS **134**. In a non-limiting example, the CSS **134** is supported by the maker of the charge station **104**, maker of the EV **100**, and/or an entity that owns the charge stations **104**. As a remote server, the CSS **134** is configured to communicate with other systems including the charge station **104**, the EV **100**, and the charge station application **205**.

[0046] In one form, the CSS **134** is configured to also include a charge station library (CSL) **220**, software-based task library (SBTL) **222**, and a charge station manager module (CSMM) **224**. The charge station library **220** is configured to store a station record for each charge station **104**, where the station record includes information such as, but not limited to: unique identification of the charge station **104**, location information of the charge station **104**, software profile indicating version history of the software/firmware on the charge station; hardware profile indicating part name and number of components that make up the charge station **104**; and operation history which may provide charge operations, detected faults, and communication exchanges with the CSS **134**. The SBTL **222** is configured to store software-based tasks for the charge stations **104**, such as, but not limited to: tests to check operation and/or performance of the charge station **104** as a whole and/or of specific components; and software or firmware programs to be employed by the charge stations **104**.

[0047] The CSMM **224** is configured to track and monitor the charge stations **104** by, for example, determining whether firmware/software of the charge station **104** is to be updated, and periodically communicating with the charge station **104** to check operation state of the charge station. In some forms, the CSMM **224** may also process messages from other systems that may request information regarding a selected charge station and software programs associated with identified software-based tasks. In a non-limiting example, the charge station **104** may request the CSMM **224** to provide software programs associated with identified software-based tasks to be executed during the T-M mode.

[0048] In some variations, the charge station application **205** accesses the information in the CSS **134** to control the charge station **104** for the TC mode. In a non-limiting example, based on inputs from the user, the charge station application **205** communicates with the charge station **104** to initiate the TC mode, identifies software-based tasks to be performed, instructs the charge station **104** to execute the selected software-based tasks, obtains result of the tasks from the charge station **104**, and outputs a message including data indicative of the result for the task (i.e., identified software-based tasks) to the CSS **134**.

[0049] Unless otherwise expressly indicated herein, all numerical values indicating mechanical/thermal properties, compositional percentages, dimensions and/or tolerances, or other characteristics are to be understood as modified by the word “about” or “approximately” in describing the scope of the present disclosure. This modification is desired for various reasons including industrial practice, material, manufacturing, and assembly tolerances, and testing capability.

[0050] In this application, the term “controller” and/or “module” may refer to, be part of, or include: an Application Specific Integrated Circuit (ASIC); a digital, analog, or mixed analog/digital discrete circuit; a digital, analog, or mixed analog/digital integrated circuit; a combinational logic circuit; a field programmable gate array (FPGA); a processor circuit (shared, dedicated, or group) that executes code; a memory circuit (shared, dedicated, or group) that stores code executed by the processor circuit; other suitable hardware components that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip.

[0051] The term memory is a subset of the term computer-readable medium. The term computer-readable medium, as used herein, does not encompass transitory electrical or electromagnetic signals propagating through a medium (such as on a carrier wave); the term computer-readable medium may therefore be considered tangible and non-transitory. Non-limiting examples of a non-transitory, tangible computer-readable medium are nonvolatile memory circuits (such as a flash memory circuit, an erasable programmable read-only memory circuit, or a mask read only circuit), volatile memory circuits (such as a static random access memory circuit or a dynamic random access memory circuit), magnetic storage media (such as an analog or digital magnetic tape or a hard disk drive), and optical storage media (such as a USB drive, CD, a DVD, or a Blu-ray Disc).

[0052] The apparatuses and methods described in this application may be partially or fully implemented by a special purpose computer created by configuring a general-purpose computer to execute one or more particular functions embodied in computer programs. The functional blocks, flowchart components, and other elements described above serve as software specifications, which can be translated into the computer programs by the routine work of a skilled technician or programmer.

[0053] The description of the disclosure is merely exemplary in nature and, thus, variations that do not depart from the substance of the disclosure are intended to be within the scope of the disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the disclosure.

What is claimed is:

1. A method, comprising:

supplying, by an electric vehicle (EV), electrical power to an EV charge station; and

outputting a message including data indicative of a task result for a software-based task performed at the EV charge station with the EV charge station receiving power from the EV.

2. The method of claim **1**, further comprising communicably coupling the EV charge station to a wireless communication network supported by the EV.

3. The method of claim **2**, wherein outputting the message further comprises transmitting, by the EV charge station, the message to a remote server via the wireless communication network supported by the EV.

4. The method of claim **1**, further comprising instructing, by an external device, execution of the software-based task in response to the EV charge station not executing the software-based task automatically after receiving power from the EV.

5. The method of claim **4**, wherein the external device is at least one of the EV or a portable computing device having a software application configured to provide commands to the EV charge station to have the EV charge station initiate execution of the software-based task stored at at least one of the EV charge station, a remove server, or the EV.

6. The method of claim **1**, wherein outputting the message further comprises, at least one:

transmitting the message to a remote server; or

providing the message via one or more human machine interface devices.

7. The method of claim **1**, wherein the software-based task is at least one of a software upgrade or diagnostic test.

8. The method of claim **7**, wherein the diagnostic test includes tests evaluating, at least one of, a circuit board or a communication connection.

9. The method of claim **1**, wherein supplying electrical power to the EV charge station further comprises having a charger of the EV charge station connected to a charge port of the EV with the EV charge station being isolated from a power grid.

10. The method of claim **1**, further comprising electrically coupling the EV charge station to a power grid in response to the task result indicating a nominal result of the EV charge station.

11. A system comprising

one or more controllers configured to:

control a power electronics module to supply electric power to an electric vehicle (EV) charge station from a battery pack of an EV; and

output a message including data indicative of a task result for a software-based task performed at the EV charge station with the EV charge station receiving electric power from the EV.

12. The system of claim **11**, wherein the one or more controllers is further configured to communicably couple the EV charge station to a wireless communication network supported by the EV.

13. The system of claim **12**, wherein the one or more controllers is further configured to transmit the message to a remote server via the wireless communication network supported by the EV.

14. The system of claim **11**, wherein the one or more controllers is further configured to instruct execution of the software-based task in response to the EV charge station not executing the software-based task automatically after receiving power from the EV.

15. The system of claim **11**, wherein the one or more controllers is further configured to provide the message to one or more human machine interface devices.

16. The system of claim **11**, wherein the software-based task is at least one of a software upgrade or diagnostic test.

17. The system of claim **16**, wherein the diagnostic test includes tests evaluating, at least one of, a circuit board or a communication connection.

18. The system of claim **11**, wherein at least one of the one or more controllers is provided at the EV and at least one of the one or more controllers is provided at the EV charge station.

19. The system of claim **11**, wherein the one or more controllers is configured to detect a charger of the EV charge station connected to a charge port of the EV and controls power to the EV charge station in response to detecting the charger being connected to the charge port.

20. A method, comprising:

supplying, by an electric vehicle (EV), alternating current (AC) power to an EV charge station after detecting a charger of the EV charge station connected to a charge port of the EV and having the EV charge station electrically isolated from an installed power source;

having at least one software-based task performed at the EV charge station after supplying power to the EV charge station; and

outputting a message to at least one of a remote server or a human machine interface, the message including data indicative of a task result for the at least one software-based task performed at the EV charge station.

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