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ELECTRIC VEHICLE PROPULSION SYSTEM

Abstract

A powertrain system includes a first traction battery pack and a first drive unit in electrical communication with the first traction battery pack for driving at least one first wheel. A first charge receptacle is in electrical communication with the first traction battery pack and a second traction battery pack is configured to drive at least one wheel and is electrically isolated from the first traction battery pack.

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Background/Summary

INTRODUCTION

[0001] Electrified powertrain systems of motor vehicles and other mobile electrical systems include an electrical system configured to energize one or more electric motors to generate motive torque. For example, an electric traction motor may be connected to road wheels of an electric vehicle, with generated output torque being directed to the road wheels to propel the electric vehicle on a road surface. To this end, a high-voltage bus of the electric vehicle is connected to a rechargeable energy storage system ("RESS"), a principal component of which is a propulsion battery pack having an application-suitable number and configuration of electrochemical battery cells. The battery pack-to-motor connection is made through an intervening power inverter module when the electric traction motor is configured as polyphase/alternating current ("AC") machine.

SUMMARY

[0002] Disclosed herein is a powertrain system. The system includes a first traction battery pack and a first drive unit in electrical communication with the first traction battery pack for driving at least one first wheel. A first charge receptacle is in electrical communication with the first traction battery pack and a second traction battery pack is configured to drive at least one wheel and is electrically isolated from the first traction battery pack.

[0003] Another aspect of the disclosure may be where the second traction battery pack is in electrical communication with a second drive unit that is configured to drive at least one second wheel and the second traction battery pack is electrically isolated from the first charge receptacle.

[0004] Another aspect of the disclosure may be where the first traction battery pack includes a first battery chemistry and the second traction battery pack includes a second battery chemistry different from the first battery chemistry.

[0005] Another aspect of the disclosure may be where the at least one first wheel includes a pair of first wheels and the first drive unit includes a hub motor associated with each of the pair of first wheels.

[0006] Another aspect of the disclosure may be where the first traction battery pack includes a first plurality of battery modules located in a first battery housing and a second plurality of battery modules located in a second battery housing.

[0007] Another aspect of the disclosure may be where the first traction battery pack includes a switch for selectively forming an electrical connection with the first plurality of battery modules or the second plurality of battery modules.

[0008] Another aspect of the disclosure may be where in the first traction battery pack includes an output switch for selectively forming an electrical connection between the first drive unit and one of the first plurality of battery modules or the second plurality of battery modules.

[0009] Another aspect of the disclosure may be where the first drive unit is in electrical communication with the first traction battery pack through a first inverter and the second drive unit is in electrical communication with the second traction battery pack through a second inverter.

[0010] Disclosed herein is a vehicle system. The system includes a vehicle body supported by a first pair of wheels and a second pair of wheels. A first traction battery pack and a first drive unit in electrical communication with the first traction battery pack and in driving engagement with at least one of the first pair of wheels. A first charge receptacle in electrical communication with the first traction battery pack and a second traction battery pack electrically isolated from the first traction battery pack.

[0011] Another aspect of the disclosure may be where the second traction battery pack is in electrical communication with a second drive unit that is configured to drive at least one second wheel and the second traction battery pack is electrically isolated from the first charge receptacle.

[0012] Another aspect of the disclosure may be where the first traction battery pack includes a first battery chemistry and the second traction battery pack includes a second battery chemistry different from the first battery chemistry.

[0013] Another aspect of the disclosure may be where the first traction battery pack includes a first plurality of battery modules and a second plurality of battery modules with one of the first plurality of battery modules or the second plurality of battery modules being fixedly attached to the vehicle body and the other of the first plurality of battery modules or the second plurality of battery modules being removably attached to the vehicle body.
[0014] Another aspect of the disclosure may be where the first traction battery pack includes a switch for selectively forming an electrical connection with the first plurality of battery modules or the second plurality of battery modules. Another aspect of the disclosure may be where in the first traction battery pack includes an output switch for selectively forming an electrical connection between the first drive unit and one of the first plurality of battery modules or the second plurality of battery modules.
[0015] Another aspect of the disclosure may be where the first plurality of battery modules are located in a first battery housing and the second plurality of battery modules are located in a second battery housing separate from the first battery housing.
[0016] Disclosed herein is a method of operating a vehicle. The method includes receiving a desired operating request for the vehicle and analyzing current operating conditions of the vehicle. In one example, the desired operating request can include a requested velocity for the vehicle. A mode of operation for the vehicle is selected based on analyzing the current operating conditions and the desired operating request. Selecting the mode of operating includes operating a first drive unit in connection with a first traction battery pack to drive at least one first wheel on the vehicle and operating a second drive unit in connection with a second traction battery pack to drive at least one second wheel on the vehicle with the second traction battery pack being electrically isolated from the first traction battery pack.
[0017] Another aspect of the disclosure may be where operating the second drive unit includes operating the second drive unit as a motor to output a rotational force.
[0018] Another aspect of the disclosure may be where operating the second drive unit includes operating the second drive unit as a generator to charge the second traction battery pack.
[0019] Another aspect of the disclosure may be where the first drive unit is operated at a first voltage level, the second drive unit is operated at a second voltage level different from the first voltage level, and the current operating conditions of the vehicle include at least one of ambient temperature, a state of charge of the first traction battery pack or the second traction battery pack, or an operating temperature of the first traction battery pack or the second traction battery pack.
[0020] Another aspect of the disclosure may include charging the first traction battery pack through a first charge receptacle on the vehicle, wherein the first charge receptacle is isolated from the second traction battery pack.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0021] FIG. **1** schematically illustrates an example electrified powertrain system for a vehicle.
[0022] FIG. **2** schematically illustrates the electrified powertrain system of FIG. **1** incorporated into a vehicle.
[0023] FIG. **3** schematically illustrates another example electrified powertrain system for a vehicle.
[0024] FIG. **4** schematically illustrates the electrified powertrain system of FIG. **3** in a first example configuration.
[0025] FIG. **5** schematically illustrates the electrified powertrain system of FIG. **3** in a second example configuration.
[0026] FIG. **6** schematically illustrates yet another example electrified powertrain system for a vehicle with the electrified powertrain system in a first example configuration.

[0027] FIG. **7** schematically illustrates the electrified powertrain system of FIG. **6** in a second example configuration.
[0028] FIG. **8** is a flowchart for a method of operating an electrified vehicle having multiple traction batteries.
[0029] The present disclosure may be modified or embodied in alternative forms, with representative embodiments shown in the drawings and described in detail below. Inventive aspects of the present disclosure are not limited to the disclosed embodiments. Rather, the present disclosure is intended to cover alternatives falling within the scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0030] The present disclosure is susceptible to embodiments in many different forms. Representative examples of the disclosure are shown in the drawings and described herein in detail as non-limiting examples of the disclosed principles. To that end, elements and limitations described in the Abstract, Introduction, Summary, and Detailed Description sections, but not explicitly outlined in the claims, should not be incorporated into the claims, singly or collectively, by implication, inference, or otherwise.
[0031] For purposes of the present description, unless specifically disclaimed, use of the singular includes the plural and vice versa, the terms “and” and “or” shall be both conjunctive and disjunctive. The words “including”, “containing”, “comprising”, “having”, and the like shall mean “including without limitation”. Moreover, words of approximation such as “about”, “almost”, “substantially”, “generally”, “approximately”, etc., may be used herein in the sense of “at, near, or nearly at”, or “within 0-5% of”, or “within acceptable manufacturing tolerances”, or logical combinations thereof. As used herein, a component that is “configured to” perform a specified function can perform the specified function without alteration, rather than merely having the potential to perform the specified function after further modification. In other words, the described hardware, when expressly configured to perform the specified function, is specifically selected, created, implemented, utilized, programmed, and/or designed to perform the specified function.
[0032] Referring to the drawings, like reference numerals correspond to like or similar components throughout the several Figures. FIG. **1** illustrates an electrical system **12**, e.g., an electrified powertrain system of a motor vehicle **40** having a vehicle body **41** defining a vehicle interior **42**. The motor vehicle **40** of FIG. **1** may also include a front trunk (“frunk”) **46** or another compartment providing user access to a charging receptacle REC. The motor vehicle **40** also includes road wheels **43** for traveling along roadways. The wheels **43** may be driven/powered through the electrical system **12** or undriven/freewheeling, as described in greater detail below.
[0033] The electrical system **12** includes separate high-voltage and low-voltage buses. A first high-voltage bus **20**-H**1** is in electrical communication with a first high-voltage battery pack assembly **13**, such as a first traction battery, a second high-voltage bus **20**-H**2** is in electrical communication with a second high-voltage battery pack **50**, such as a second traction battery pack, and the low-voltage bus **20**-L is in electrical communication with an auxiliary battery (“B.sub.AUX”) **30**.
[0034] At least one auxiliary power module (“APM”) **21** isolates the high-voltage buses **20**-H**1** and **20**-H**2** from the low-voltage bus **20**-L with input in communication with the high-voltage bus **20**-H**1** and outputs in communication with the low-voltage bus **20**-L to charge the auxiliary battery **30** and power vehicle accessories, such as heated seats, power windows, or navigation systems.
[0035] The electronic controller **28** may include a computer and/or processor, and include software, hardware, memory, algorithms, connections, etc., for managing and controlling the operation of the motor vehicle **40**. As such, a method, described below and generally represented in FIG. **8**, may be embodied as a program or algorithm partially operable on the controller **28**. It should be appreciated that the controller **28** may include a device capable of analyzing data from the sensors, comparing data, making the decisions required to control the operation of the motor vehicle **40**, and executing the required tasks to control the operation of the motor vehicle **40**.

[0036] The controller **28** may be embodied as one or multiple digital computers or host machines each having one or more processors, read only memory (ROM), random access memory (RAM), electrically-programmable read only memory (EPROM), optical drives, magnetic drives, etc., a high-speed clock, analog-to-digital (A/D) circuitry, digital-to-analog (D/A) circuitry, and input/output (I/O) circuitry, I/O devices, and communication interfaces, as well as signal conditioning and buffer electronics. The computer-readable memory may include non-transitory/tangible medium which participates in providing data or computer-readable instructions. Memory may be non-volatile or volatile. Non-volatile media may include, for example, optical or magnetic disks and other persistent memory. Example volatile media may include dynamic random-access memory (DRAM), which may constitute a main memory. Other examples of embodiments for memory include a flexible disk, hard disk, magnetic tape or other magnetic medium, a CD-ROM, DVD, and/or other optical medium, as well as other possible memory devices such as flash memory.
[0037] The controller **28** includes a tangible, non-transitory memory on which computer-executable instructions, including one or more algorithms, are recorded for regulating operation of the motor vehicle **40**. The subject algorithm(s) may specifically include an algorithm configured to operate the motor vehicle **40**.
[0038] Further, concerning the representative electrical system **12** of FIG. **1**, the electrical system **12** is characterized by a separate first high-voltage **20**-H**1**, a second high-voltage bus **20**-H**2**, and low-voltage buses **20**-L. For embodiments in which the electrical system **12** is part of the motor vehicle **40**, e.g., an electric vehicle constructed as a battery electric vehicle, a hybrid electric vehicle, or an extended-range electric vehicle, the term “high-voltage” may encompass battery voltage capabilities of about 300 volts (V) or more. Such voltage levels are suitable for generating motive torque for vehicular propulsion functions and for powering various high-voltage accessories aboard the motor vehicle **40**. The term “low-voltage” for its part refers to auxiliary voltage levels, typically 12-50V. Low-voltage conductors (not shown) thus connect the low-voltage bus **20**-L to one or more low-voltage accessories located aboard the motor vehicle **40**, including but not limited to lights, radios, infotainment screens, sensors, etc.
[0039] In the exemplary embodiment of FIG. **1**, the first battery pack assembly **13** is selectively connected to and disconnected from a load by a set of high-voltage contactors **15**. The applied load in the illustrated configuration includes a DC link capacitor (C**1**), a power inverter module (“inverter”) **16** having a plurality of semiconductor switches **17** connected to a drive unit, such as an electric traction motor (“M”) **18**. As appreciated in the art, inverters such as the inverter **16** shown in FIG. **1** utilize multiple dies of the semiconductor switches **17** as fast-responding ON/OFF switching devices, e.g., insulated gate bipolar transistors (“IGBTs”), metal oxide semiconductor field-effect transistors (“MOSFETs”), thyristors, etc. In a typical three-phase configuration of the electric traction motor **18**, the semiconductor switches **17** are turned ON or OFF at predetermined switching intervals to output an alternating current (“AC”) waveform to the electric traction motor **18**.
[0040] The electric traction motor **18** shown in FIG. **1** is connected to a rotatable output member **19**, such as a motor shaft and connected gears (not shown). During drive modes, the inverter **16** is controlled with pulse width modulation (“PWM”) or another application-suitable switching control technique to energize phase windings of the electric traction motor **18**. As depicted, the electric traction motor **18** is a polyphase AC motor, in this instance exemplified as a three-phase machine. Rotation of the output member **19** ultimately transfers torque (To) to a coupled load, including one or more road wheels **43** of the motor vehicle **40**. During discharge/propulsion modes, electrical energy stored in constituent electrochemical battery cells (not shown) of the high-voltage battery pack assembly **13** is used to power rotation of one or more of the road wheels **43**. Other embodiments of the motor vehicle **40** may use more or fewer road wheels **43**. Additionally, some of the road wheels **43** could be undriven/freewheeling, e.g., in rear-wheel drive or front-wheel drive

configurations, or the road wheels **43** may be driven/powered, e.g., in an all-wheel drive or four-wheel drive configuration, without limitation.

[0041] The second traction battery pack **50** is selectively connected to and disconnected from a load by a set of high-voltage contactors **52**. The applied load in the illustrated configuration includes a DC link capacitor (C**2**), a power inverter module ("inverter") **54** having a plurality of semiconductor switches **56** connected to a drive unit, such as an electric traction motor ("M**2**") **58**, as described above with respect to the inverter **16**.

[0042] The electric traction motor **58** shown in FIG. **1** is connected to a rotatable output member **60**, such as a motor shaft and connected gears (not shown). During drive modes, the inverter **54** is controlled with pulse width modulation ("PWM") or another application-suitable switching control technique to energize phase windings of the electric traction motor **58**. As depicted, the electric traction motor **58** is a polyphase AC motor, in this instance exemplified as a three-phase machine. Rotation of the output member **60** ultimately transfers torque (To) to a coupled load, including one or more road wheels **43** of the motor vehicle **40**. During discharge/propulsion modes, electrical energy stored in constituent electrochemical battery cells (not shown) of the second traction battery pack **50** is used to power rotation of one or more of the road wheels **43**.

[0043] One feature of having the first traction battery pack **13** separate from the second traction battery pack **50** is the ability to use different methods of managing temperature within the packs. For example, the first traction battery pack may have a cell face cooling assembly while the second traction battery pack **50** could utilize an edge cooling assembly.

[0044] FIG. **2** schematically illustrates the electrical system **12** of FIG. **1** incorporated into the vehicle **40**. In the illustrated example, a first pair of wheels **43** on the vehicle **40** are driven by hub mounted motors **18**. The motor(s) **18** are in electrical communication with the first traction battery pack **13** through at least one corresponding inverter **16**. However, the first pair of wheels **43** could be driven by a single motor **18** that proves rotational force through individual axles to the wheels **43**. The first traction battery pack **13** is in electrical communication with the charge receptacle **49** to charge the first traction battery pack **13**. The motor(s) **18** can also operate with a regenerative function to generate power to charge the first traction battery pack **13** during operation of the vehicle **40**.

[0045] A second pair of the wheels **43** opposite the first pair of wheels **43** are driven by the motor **58**. The motor **58** is in electrical communication with the second traction battery pack **50** through the inverter **54**. In the illustrated example, the second traction battery pack **50** is electrically isolated from the first traction battery pack **13** such that the first high-voltage bus **20**-H**1** can operate at a different voltage from the second high-voltage bus **20**-H**2**. In one example, the first high-voltage bus **20**-H**1** can operate at 800V and the second high-voltage bus **20**-H**2** can operate at 400V. This allows for different sizing of components, such as bus bars, between the first and second high-voltage buses **20**-H**1** and **20**-H**2**.

[0046] The second high-voltage bus **20**-H**2** and the second traction battery pack **50** are also electrically isolated from charge receptacle **49** such that the second traction battery pack **50** cannot be charged by a power source external to the vehicle **40**. The second traction battery pack **50** can be charged through regenerative operations by the motor **58**. Therefore, while the motor(s) **18** are driving the vehicle **40**, the motor **58** can operate as a generator to charge the second traction battery pack **50** until a charge level in the second traction battery pack **50** has reached a predetermined level of charge or is within a predetermined charge range.

[0047] One feature of having the first and second high-voltage buses **20**-H**1** and **20**-H**2** being electrically isolated from each other is the elimination of utilizing a DC-DC converter to match the output voltages between the first traction battery pack **13** and the second traction battery pack **50**. The elimination of the DC-DC converter reduces the complexity and number of components in the electrical system **12**.

[0048] Furthermore, the first traction battery **13** includes a plurality of battery modules having battery cells with a first battery chemistry and the second traction battery pack **50** includes a second plurality of battery modules having battery cells with a second battery chemistry that is different from the first battery chemistry. For example, the first and second traction battery packs **13** and **50** could include battery cells having a battery chemistry of NiMH, LFP (lithium iron phosphate), NCM (nickel, cobalt, manganese), Ni—Si (nickel silicon), or solid state.

[0049] FIG. **3** illustrates another example electrical system **12-1**. The electrical system **12-1** is similar to the electrical system **12**, except where described below or shown in the Figures. Similar components in the electrical system **12-1** will use the addition of a "-1" at the end of the reference number while other components will retain the same reference number from the electrical system **12** described above. The electrical system **12-1** provides power to the motor(s) **18** through a first traction battery **13-1** having a fixed traction battery segment **13-1**A and a removable traction battery segment **13-1**B. While the fixed traction battery segment **13-1**A may be removed from the vehicle, it is intended to remain attached to the vehicle body **41** when the removable traction battery segment **13-1**B is removed from the vehicle **40**. For example, the removable traction battery segment can be removed when traveling short distances to reduce vehicle weight or to be swapped with another removable traction battery segment **13-1**B that is already charged. This avoids waiting for the removeable traction battery segment **13-1**B to charge in addition to the fixed traction battery segment **13-1**A.

[0050] The fixed traction battery segment **13-1**A includes a first plurality of battery modules each having plurality of battery cells and the removable traction battery segment **13-2** includes a second plurality of battery modules each having a plurality of battery cells. In one example, the fixed and removable traction battery segments **13-1**A and **13-1**B include a common battery chemistry.

[0051] FIGS. **4** and **5** schematically illustrate various configurations of utilizing the electrical system **12-1** in the vehicle **40**. In particular, when an external power source **48** is being used to charge one of the fixed traction battery segment **13-1**A or the removable traction battery segment **13-1**B, a first switch S**1** or input switch is selectively movable between a first position to charge the fixed traction battery segment **13-1**A (FIG. **5**) and a second position to charge the removable battery segment **13-2** (FIG. **4**). A second switch S**2** or output switch is selectively movable between a first position with the fixed traction battery segment **13-1**A in electrical communication with the motor(s) **18** and a second position with the removable traction battery segment **13-1**B in electrical communication with the motor(s) **18**.

[0052] FIGS. **6** and **7** schematically illustrate another example electrical system **12-2**. The electrical system **12-2** is similar to the electrical system **12-1** except where described below or shown in the figures. While the electrical system **12-1** is utilized with an all-wheel drive vehicle **40**, the electrical system **12-2** is utilized with a two-wheel drive vehicle **40**. The electrical system **12-2** only drives two of the wheels **43** on the vehicle **40** by eliminating the second traction battery pack **50** and the motor **58** along with their associated components, such as the second high-voltage bus **20-**H**2** with the second inverter **54**. The driven wheels **43** with the electrical system **12-2** can be either a front pair of wheels **43** or a pair of rear wheels **43** depending on a desired vehicle dynamic. The remaining components in the electrical system **12-2** remain the same as the components in the electrical system **12-1**.

[0053] FIG. **8** illustrates a method **100** of operating the vehicle **40** with either of the electrical systems **12** or **12-1**. In particular, the method **100** begins by receiving a desired operating request from the vehicle **40** at Block **102**. For example, the desired operating request for the vehicle **40** can include a change in speed of the vehicle **40**, such as accelerating or decelerating the vehicle **40**, or a desire to continue to maintain the same speed.

[0054] The method **100** then proceeds to Block **104** to analyze current operating conditions of the vehicle **40** in relation to the desired operating request. In one example, the current operating conditions can include at least one of ambient temperature surrounding the vehicle **40**, a state of charge of the traction battery packs, or an operating temperature of the traction battery packs. The method **100** then proceeds to Block **106** to determine a mode of operation based on the analysis from Block **104**.

[0055] At Block **106**, the method **100** selects a mode of operation for the traction battery packs **13**, **13-1**, or **50** to use to meet the desired operating request. In one example, the desired operating request may include an acceleration of the vehicle **40** beyond a predetermined threshold level. In this case, the method **100** may utilize the first and second traction battery packs **13**, **13-1**, and **50** to provide maximum acceleration for the vehicle **40**.

[0056] In another example, the method **100** may determine not to utilize the first traction battery pack **13** due to improved operating characteristics of the second traction battery pack **50** for the current operating conditions. In particular, the current operating conditions may include operating the vehicle **40** below a predetermined threshold temperature and the second traction battery pack **50** may exhibit better cold weather operating performance when compared to the first traction battery pack **13**, **13-1**. Therefore, the method **100** may select to operate to second traction battery pack **50** in connection with the motor **58** up to a predetermined point to optimize overall battery life of the vehicle **40**.

[0057] In yet another example, the method **100** may determine that the desired operating request includes decelerating the vehicle **40** such that the motor **58** can operate as a generator to charge the second traction battery pack **50** to be within a predetermined charge range. Alternatively, if the second traction battery pack **50** is below the predetermined charge range, then the method **100** can utilize the motor **58** as a generator if the first traction battery pack **13** or **13-1** and the motor(s) **18** can satisfy the desired operating request.

[0058] The terms “a” and “an” do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. The term “or” means “and/or” unless clearly indicated otherwise by context. Reference throughout the specification to “an aspect”, means that a particular element (e.g., feature, structure, step, or characteristic) described in connection with the aspect is included in at least one aspect described herein, and may or may not be present in other aspects. In addition, it is to be understood that the described elements may be combined in a suitable manner in the various aspects.

[0059] When an element such as a layer, film, region, or substrate is referred to as being “on” another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being “directly on” another element, there are no intervening elements present.

[0060] Unless specified to the contrary herein, test standards are the most recent standard in effect as of the filing date of this application, or, if priority is claimed, the filing date of the earliest priority application in which the test standard appears.

[0061] Unless defined otherwise, technical, and scientific terms used herein have the same meaning as is commonly understood by one of skill in the art to which this disclosure belongs.

[0062] While the above disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made, and equivalents may be substituted for elements thereof without departing from its scope. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular embodiments disclosed but will include embodiments falling within the scope thereof.

Claims

1. A powertrain system comprising: a first traction battery pack; a first drive unit in electrical communication with the first traction battery pack and configured to drive at least one first wheel; a first charge receptacle in electrical communication with the first traction battery pack; and a second traction battery pack configured to drive at least one wheel and electrically isolated from the first traction battery pack.

2. The powertrain system of claim 1, wherein the second traction battery pack is in electrical communication with a second drive unit that is configured to drive at least one second wheel and the second traction battery pack is electrically isolated from the first charge receptacle.

3. The powertrain system of claim 2, wherein the first traction battery pack includes a first battery chemistry and the second traction battery pack includes a second battery chemistry different from the first battery chemistry.

4. The powertrain system of claim 2, wherein the at least one first wheel includes a pair of first wheels and the first drive unit includes a hub motor associated with each of the pair of first wheels.

5. The powertrain system of claim 2, wherein the first traction battery pack includes a first plurality of battery modules located in a first battery housing and a second plurality of battery modules located in a second battery housing.

6. The powertrain system of claim 5, wherein the first traction battery pack includes a switch for selectively forming an electrical connection with the first plurality of battery modules or the second plurality of battery modules.

7. The powertrain system of claim 5, where in the first traction battery pack includes an output switch for selectively forming an electrical connection between the first drive unit and one of the first plurality of battery modules or the second plurality of battery modules.

8. The powertrain system of claim 2, wherein the first drive unit is in electrical communication with the first traction battery pack through a first inverter and the second drive unit is in electrical communication with the second traction battery pack through a second inverter.

9. A vehicle system comprising: a vehicle body supported by a first pair of wheels and a second pair of wheels; a first traction battery pack; a first drive unit in electrical communication with the first traction battery pack and in driving engagement with at least one of the first pair of wheels; a first charge receptacle in electrical communication with the first traction battery pack; and a second traction battery pack electrically isolated from the first traction battery pack.

10. The vehicle system of claim 9, wherein the second traction battery pack is in electrical communication with a second drive unit that is configured to drive at least one second wheel and the second traction battery pack is electrically isolated from the first charge receptacle.

11. The vehicle system of claim 10, wherein the first traction battery pack includes a first battery chemistry and the second traction battery pack includes a second battery chemistry different from the first battery chemistry.

12. The vehicle system of claim 10, wherein the first traction battery pack includes a first plurality of battery modules and a second plurality of battery modules with one of the first plurality of battery modules or the second plurality of battery modules being fixedly attached to the vehicle body and the other of the first plurality of battery modules or the second plurality of battery modules being removably attached to the vehicle body.

13. The vehicle system of claim 12, wherein the first traction battery pack includes a switch for selectively forming an electrical connection with the first plurality of battery modules or the second plurality of battery modules.

14. The vehicle system of claim 12, where in the first traction battery pack includes an output switch for selectively forming an electrical connection between the first drive unit and one of the first plurality of battery modules or the second plurality of battery modules.

15. The vehicle system of claim 12, wherein the first plurality of battery modules are located in a first battery housing and the second plurality of battery modules are located in a second battery housing separate from the first battery housing.

16. A method of operating a vehicle, the method comprising: receiving a desired operating request for the vehicle, wherein the desired operating request includes a requested velocity for the vehicle; analyzing current operating conditions of the vehicle; and selecting a mode of operation for the vehicle based on analyzing the current operating conditions and the desired operating request, wherein selecting the mode of operating includes operating a first drive unit in connection with a first traction battery pack to drive at least one first wheel on the vehicle, operating a second drive unit in connection with a second traction battery pack to drive at least one second wheel on the vehicle, and the second traction battery pack is electrically isolated from the first traction battery pack.

17. The method of claim 16, wherein operating the second drive unit includes operating the second drive unit as a motor to output a rotational force.

18. The method of claim 16, wherein operating the second drive unit includes operating the second drive unit as a generator to charge the second traction battery pack.

19. The method of claim 16, wherein the first drive unit is operated at a first voltage level, the second drive unit is operated at a second voltage level different from the first voltage level, and the current operating conditions of the vehicle include at least one of ambient temperature, a state of charge of the first traction battery pack or the second traction battery pack, or an operating temperature of the first traction battery pack or the second traction battery pack.

20. The method of claim 16, including charging the first traction battery pack through a first charge receptacle on the vehicle, wherein the first charge receptacle is isolated from the second traction battery pack.