



SURFACE VEHICLE INFORMATION REPORT

J1715™

MAY2021

Issued 1994-04
Revised 2021-05

Superseding J1715 OCT2014

(R) Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology

RATIONALE

As the technology related to electrified vehicles continues to expand, new terms and definitions are being created. Some of the new terms are specific to a given technology and hence are defined in specific SAE International J-documents. New terminology with broader applicability has been incorporated into this version of SAE J1715. Most notable in this version is the inclusion of terms associated with: charging vehicles via wireless power transfer (WPT) and vehicle grid integration (VGI) for electric power transfer and for reverse power flow (RPF) technologies.

This document does not contain terminology specifically related to vehicle propulsion batteries since this information is encompassed in SAE J1715/2.

FOREWORD

This document is an ongoing effort to provide the technical community with the terminology used most frequently in the hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV), and electric vehicle (EV) industry.

1. SCOPE

This SAE Information Report contains definitions for HEV, PHEV, and EV terminology. It is intended that this document be a resource for those writing other HEV, PHEV, and EV documents, specifications, standards, or recommended practices.

1.1 Purpose

The purpose of this document is to provide a record of commonly used terminology established by the technical community involved with writing practices and information reports for HEVs, PHEVs, and EVs.

1.2 Field of Application

This SAE Information Report pertains to HEVs, PHEVs, and EVs.

1.3 Product Classification

Information report.

1.4 Product Description

Information report containing commonly used terminology in the HEV, PHEV, and EV industry.

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https://www.sae.org/standards/content/J1715_202105

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 National Fire Protection Agency Publications

Available from NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471, Tel: 617-770-3000, www.nfpa.org.

NFPA 30 Flammable and Combustible Liquids Code

NFPA 70 National Electric Code

2.1.2 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

40 CFR 86.115-78 Control of Emissions from New and in-Use Highway Vehicles and Engines

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J670 Vehicle Dynamics Terminology

SAE J1634 Battery Electric Vehicle Energy Consumption and Range Test Procedure

SAE J1711 Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles

SAE J1715/2 Battery Terminology

SAE J1772 SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler

SAE J1773 SAE Electric Vehicle Inductively Coupled Charging

SAE J2894/1 Power Quality Requirements for Plug-in Electric Vehicle Chargers

SAE J2894/2 Power Quality Test Procedures for Plug-in Electric Vehicle Chargers

SAE J2836 Instructions for Using Plug-in Electric Vehicle (PEV) Communications, Interoperability and Security Documents

SAE J2836/1 Use Cases for Communication Between Plug-in Vehicles and the Utility Grid

SAE J2836/2 Use Cases for Communication Between Plug-in Vehicles and Off-Board DC Charger

SAE J2836/3 Use Cases for Plug-in Vehicle Communication as a Distributed Energy Resource

SAE J2836/4 Use Cases for Diagnostic Communication for Plug-in Electric Vehicles

SAE J2836/5	Use Cases for Customer Communication for Plug-in Electric Vehicles
SAE J2836/6	Use Cases for Wireless Charging Communication for Plug-in Electric Vehicles
SAE J2847/1	Communication for Smart Charging of Plug-in Electric Vehicles Using Smart Energy Profile 2.0
SAE J2847/2	Communication Between Plug-in Vehicles and Off-Board DC Chargers
SAE J2847/3	Communication for Plug-in Vehicles as a Distributed Energy Source
SAE J2847/6	Communication for Wireless Power Transfer Between Light-Duty Plug-in Electric Vehicles and Wireless EV Charging Stations
SAE J2931/1	Digital Communications for Plug-in Electric Vehicles
SAE J2931/4	Broadband PLC Communication for Plug-in Electric Vehicles
SAE J2931/6	Signaling Communication for Wirelessly Charged Electric Vehicles
SAE J2931/7	Security for Plug-in Electric Vehicle Communications
SAE J2953/1	Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)
SAE J2953/2	Test Procedures for the Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)
SAE J2954	Wireless Power Transfer for Light-Duty Plug-in/Electric Vehicles and Alignment Methodology
SAE J3068	Electric Vehicle Power Transfer System Using a Three-Phase Capable Coupler
SAE J3072	Interconnection Requirements for Onboard, Grid Support Inverter Systems
SAE J3105	Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices
SAE J3105/1	Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices, Infrastructure-Mounted Pantograph (Cross-Rail) Connection
SAE J3105/2	Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices, Vehicle-Mounted Pantograph (Bus-Up)
SAE J3105/3	Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices, Enclosed Pin and Socket Connection

2.2.2 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC Electropedia

2.2.3 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

ANSI/IEEE 100 Standard Dictionary of Electrical and Electronic Terms

2.2.4 NIST Publications

Available from NIST, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, www.nist.gov.

HB44 NIST Handbook 44 - Specifications, Tolerances and Other Technical Requirements for Weighing and Measuring Devices.

NIST SP 330 International System of Units

2.2.5 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

49 CFR Ch V § 571 Federal Motor Vehicle Safety Standards

2.2.6 SANDIA Publications

Available from Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, www.sandia.gov.

SAND88-2852 Distribution Category UC-212 - Glossary of Testing Terminology for Rechargeable Batteries

2.2.7 USABC Publications

United States Advanced Battery Consortium (USABC) documents available from the United States Council on Automotive Research (USCAR), 1000 Town Center Drive, Suite 300, Southfield, MI 48075, Tel: 248-223-9000, www.uscar.org.

USABC Test Procedures Manual

3. ACRONYMS

The following acronyms are commonly used in relation to hybrid and EV terminology:

A	Ampere
AC	Alternating Current
ACD	Automatic Connecting Device
APU	Auxiliary Power Unit
BAS	Belt-Alternator Starter
BEV	Battery Electric Vehicle
BMS	Battery Management System
CAN	Controller Area Network Data Bus
CCS	Combined Charging System
CFR	Code of Federal Regulations
CP	Control Pilot
DER	Distributed Energy Resource
DC	Direct Current

DCFC	DC Fast Charger
ECP	Electrical Connection Point
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EMS	Energy Management System
EPS	Electric Power System
ESD	Electrostatic Discharge
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel-Cell Electric Vehicle
FLA	Four-Letter Acronym
GA	Ground Assembly (WPT)
HAN	Home Area Network
HEV	Hybrid Electric Vehicle
HPU	Hybrid Power Unit
IMN	Impedance Matching Network
ISC	Infrastructure-Side Connection
kW	Kilowatt
kWh	Kilowatt-Hour
LAN	Local Area Network
LIN	Local Interconnect Network
NRTL	Nationally Recognized Testing Laboratory
OBC	On-Board Charger
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
RESS	Rechargeable Energy Storage System
SECC	Supply Equipment Communication Controller
SEP	Smart Energy Profile

SGIP	Smart Grid Interoperability Panel
SOC	State of Charge
TLA	Three-Letter Acronym
V	Volt
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home
V2I	Vehicle-to-Infrastructure
V2L	Vehicle-to-Load
V2V	Vehicle-to-Vehicle
V-A	Volt-Ampere
VA	Vehicle Assembly (WPT)
VGI	Vehicle/Grid Integration
VIN	Vehicle Identification Number
VM	Vehicle Manufacturer
VSC	Vehicle-Side Connection
VRef	Reference Voltage
VRefOfs	Reference Voltage Offset
W	Watt
WCS	Wireless Charging System
WPT	Wireless Power Transfer
xEV	“Any” Electrified Vehicle

4. HYBRID ELECTRIC (HEV) AND ELECTRIC VEHICLE (EV) TERMINOLOGY

4.1 AC (ALTERNATING CURRENT) CHARGING

The process of supplying electrical energy to the vehicle via an alternating current (AC) (sinusoidal, varying equidistant across the 0 A axis) which is then converted to direct current (DC) for charging an RESS and possibly supplying other vehicle demands.

4.2 ADEQUATE VENTILATION

As defined in NFPA 30 and NFPA 70, ventilation is adequate if it is sufficient to prevent accumulation of hydrogen vapor-air mixtures in concentrations over one-fourth of the lower flammability limit.

4.3 AIR CLEARANCE

The shortest distance through air between two conductive parts.

4.4 ALL ELECTRIC RANGE

The distance an electrified vehicle can travel without using any fuel (gas, diesel, natural gas, etc.) for propulsion or for performing any other functions of the vehicle. Note that the all-electric range must be accompanied with a reference to the drive cycle used to determine the range.

4.5 AUTOMATIC CONNECTION DEVICE (ACD)

A system that establishes without direct human intervention a conductive electrical interface between on-vehicle and off-vehicle components for the purpose of power transfer.

4.6 AUXILIARY POWER UNIT (APU)

A device used to generate propulsion power but without a direct mechanical connection to the drive wheels. Some examples of auxiliary power units are internal combustion engines connected solely to an electric generator, an engine connected solely to a hydraulic pump, or fuel cells.

4.7 BATTERY ELECTRIC VEHICLE (BEV)

A vehicle that receives its on-board propulsion power solely from batteries, unlike a hybrid vehicle that may receive a portion of its power from a separately fueled power source, such as an internal combustion engine.

4.8 BI-DIRECTIONAL INVERTER

A device that can convert from AC to DC in one direction to serve as a battery charger, and then be capable of being reversed and convert from DC to AC in the other direction to serve as an inverter. This term is generally not used if the inverter is also capable of injecting or absorbing reactive power while charging or discharging (see 4.3.8).

4.9 BREAKDOWN

The failure of the dielectric of an insulation due to the effects of an excessive electric field and/or physical or chemical deterioration of the dielectric material.

4.10 CHARGE CONNECTOR

A conductive or inductive device that establishes an electrical connection to the electric vehicle for the purpose of charging and information exchange.

4.11 CHARGE DEPLETING (CD) MODE

An operating mode of an HEV in which the vehicle runs by consuming only electric energy from the RESS charged from an external power source, or along with the fuel energy, simultaneously or sequentially, until the charge-sustaining (CS) mode state is obtained.

4.12 CHARGER (BATTERY)

A functional component that can be located on or off the vehicle that supplies electrical power at the correct voltage and current levels for battery charging.

4.13 CHARGE SUSTAINING (CS) MODE

An operating mode where the HEV runs by consuming fuel energy while sustaining the electric energy of the RESS.

4.14 CHARGING LEVEL

A term used to bracket the maximum amount of allowable current or power that can be transferred between off-vehicle and on-vehicle components during RESS charging or reverse power flow (RPF). Power breakpoints for the different level brackets are defined in the individual SAE documents defining the specific charge technology (e.g., SAE J1772, SAE J2954).

4.15 CHASSIS GROUND

The conductor used to connect the non-current-carrying metal parts of the vehicle high voltage system to the vehicle ground system.

4.16 COMBINED CHARGING SYSTEM (CCS)

A conductive charge method defined by SAE J1772 and other international standards supporting both AC and DC power transfer using a common communication interface and a harmonized set of electrical/physical interfaces.

4.17 CONDUCTIVE

Having the ability to transmit electricity through a physical path (conductor).

4.18 CONNECTION CYCLES

Refers to connect and disconnect cycles of connectors. One insertion and withdrawal operation is a connection cycle.

4.19 CONNECTOR

A component which terminates conductors for the purpose of providing connection and disconnection to a suitable mating component. For the purposes of charging an electric vehicle, this component creates a coupling from the EVSE to the vehicle, to transfer energy and to exchange information.

4.20 CONTACT

The part of a switch, relay, or connector that carries current.

4.21 CONTACT FORCE (N)

The force which two contacts exert against each other in the closed position under specified conditions.

4.22 CONTACT RESISTANCE (Ω)

The electrical resistance of a single mated set of contacts under specified conditions.

4.23 CONTROL PILOT

An electrical signal sourced by the electric vehicle supply equipment (EVSE). It performs several functions, including assuring that the vehicle is present and connected, permits energizing/de-energizing of the supply, transmits the supply equipment current rating to the vehicle, monitors the presence of the equipment ground, and establishes vehicle ventilation requirements. Refer to SAE J1772 for a complete description.

4.24 COOPERATIVE REGENERATIVE BRAKING

Maximizes energy recovery by actively controlling the friction braking in coordination with the regenerative braking system.

4.25 COUPLER

A device connected to the electric vehicle supply equipment that transfers power to the electric vehicle for charging the energy storage system and permits the exchange of information between the electric vehicle and the electric vehicle's supply equipment (see 4.10 and 4.36).

Informational note: Per SAE J3085, this term has another definition related to the connection of a hitch-ball for trailering. Contextual clues in actual usage of the term should make the meaning clear to the reader.

4.26 DC (DIRECT CURRENT) CHARGING

The process of supplying electrical energy to the vehicle via a direct current supply (constant, positive voltage) for direct charging of the RESS. This type of charging is accomplished with a charger located off-board from the vehicle.

4.27 DISTRIBUTED ENERGY RESOURCE (DER)

An energy storage device which functions to provide electric capacity or energy where it is needed on the distribution grid. For the purposes of using an electric vehicle battery as a DER, such units react to variable demand from a grid operator.

4.28 DER MANAGING ENTITY (DME)

An entity that monitors and manages the DER through the local DER communication interface and could be, for example, a utility company, an energy aggregator, a building energy management system, etc.

4.29 DRIVING PROFILE

A vehicle speed-versus-time schedule that is used to test vehicle and battery characteristics.

4.30 ELECTRIC VEHICLE (EV)

An automotive-type vehicle, intended for public roadway use, for which propulsion is powered by an electric motor that draws primarily from a rechargeable energy storage system (RESS). For the purpose of this document, an automotive-type vehicle is defined as follows, by the United States Code of Federal Regulations - Title 40, Part 600, Subchapter Q:

- a. Any four-wheeled vehicle propelled by a combustion engine using on-board fuel OR by an electric motor drawing current from a rechargeable storage battery or other portable energy devices.
- b. Which is manufactured primarily for use on public streets, roads, and highways.
- c. Which is rated not more than 3855.6 kg (8500 pounds), which has a curb weight of not more than 2721.6 kg (6000 pounds), and which has a basic frontal area of not more than 4.18 m² (45 ft²).

4.31 ELECTRIC POWER SYSTEM (EPS)

Equipment or facilities that deliver electric power to a load, e.g., an electric utility provider that supplies energy to a load such as an electric vehicle.

4.32 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, and other components intended to deliver energy to an electric vehicle.

4.33 ENERGY MANAGEMENT SYSTEM (EMS)

A system that can communicate with a plug-in electric vehicle or an EVSE for the purpose of controlling the charging or discharging of the PEV battery.

4.34 EQUIPMENT GROUND (GROUNDING CONDUCTOR)

A conductor used to connect the non-current-carrying metal parts of the EV supply equipment to the system grounded conductor, the grounding electrode conductor, or both at the service equipment.

4.35 EV/PHEV CHARGING SYSTEM

The equipment required to condition and transfer energy from the constant frequency, constant voltage supply network to the direct current, variable voltage EV traction battery bus for the purpose of charging the battery and/or operating vehicle electrical systems while connected.

4.36 EV CONNECTOR

Off-board component used to interface with the vehicle-mounted EV inlet to supply power and provide communication interface.

4.37 FEDERAL URBAN DRIVING SCHEDULE (FUDS)

The Environmental Protection Agency (EPA) urban dynamometer driving schedule, as defined in 40 CFR, paragraph 86.115-78. A driving profile defined by the EPA to test for vehicle emissions and city fuel economy. This schedule is also referred to as "UDDS" and "LA4."

4.38 FOUR-QUADRANT INVERTER

An electronic device that can produce or absorb both active and reactive power. When a PEV is discharging, the device serves as an inverter converting DC current to AC current. This device can displace the AC current waveform relative to the AC voltage waveform to generate or absorb reactive power, depending on whether it leads or lags the supplied current relative to the grid voltage.

4.39 FUEL CELL ELECTRIC VEHICLE (FCEV)

A vehicle that derives some fraction of its propulsion energy from an onboard fuel cell power system.

4.40 GROUND ASSEMBLY (GA)

A wireless power transfer assembly on the infrastructure side consisting of a coil, a power/frequency conversion unit and controller, as well as the wiring from the grid and between each unit, filtering circuits, housing(s), etc., necessary to function as the power source of wireless power charging system. The GA includes communication elements necessary for communication between the GA and the vehicle assembly (VA) and any auxiliary systems contained on the infrastructure side of the WPT system.

The GA for wireless power transfer is analogous to the term EVSE which is applicable to conductive power transfer systems.

Informational note: Some documents published by other standards developing organizations have used the term wireless power transfer equipment (WPTE) to be roughly equivalent to the SAE term ground assembly.

4.41 HIGH VOLTAGE

Any vehicle wiring system which contains one or more circuits operating at greater than or equal to 60 VDC or 30 VAC.

4.42 HYBRID VEHICLE

A vehicle with two or more energy storage systems, both of which must provide propulsion power, either together or independently.

4.43 HYBRID ELECTRIC VEHICLE (HEV)

A vehicle that can draw propulsion energy from both of the following sources of stored energy: (1) a consumable fuel, and (2) an RESS that is recharged by an electric motor-generator system, an external electric energy source, or both.

4.44 HYBRID POWER UNIT (HPU)

A device used to generate propulsion power, some of which can be distributed mechanically to one or more of the drive wheels.

4.45 HYDRAULIC HYBRID

A hybrid vehicle where hydraulic fluid is used as the coupling between propulsion elements and energy storage.

4.46 INDUCTIVE CHARGING SYSTEM

A charging system that transfers power across a two-part transformer and rectifies that power into DC voltage to the batteries (refer to SAE J1773).

4.47 INSERTION FORCE (N)

The force required to fully insert a set of mating components.

4.48 INFRASTRUCTURE-SIDE CONNECTION (ISC)

The connections made for the ACD system on the infrastructure side of the connection. The connection is made when the infrastructure-side connection mates with the vehicle-side connection.

4.49 INVERTER

Power conversion equipment that can take DC current from a PEV battery and provide AC power to the electric power system (EPS), or to premises which have been isolated from the grid, or to an isolated load. Such equipment is also capable of converting energy from the EPS to DC current to charge the battery of a PEV.

4.50 NET AMPERE-HOURS (A•h)

For a discharge test including both negative (discharge) and positive (regen) current or power steps, the difference between the A•h removed from the battery during discharge steps and the A•h returned to the battery during regen steps, regardless of battery charge acceptance.

4.51 OFF-VEHICLE CHARGE CAPABLE

The capability of a charging system in which a vehicle with a battery can be charged from an off-vehicle electrical energy source.

4.52 OPERATING TEMPERATURE (°C)

The temperature range in which a component is designed to operate under normal conditions.

4.53 OVERCURRENT PROTECTION DEVICE

A fuse, circuit breaker, intelligent contactor, or other device placed in an electrical circuit to provide current overload protection.

4.54 PLUG-IN ELECTRIC VEHICLE (PEV)

An electric vehicle that can be recharged with an off-board source of electricity; it includes both battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV).

4.55 PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)

A hybrid electric vehicle with an RESS that is designed to be off-vehicle charge capable.

4.56 POWER ASSIST

A hybrid mode in which the HPU power output is augmented by energy drawn from the RESS, resulting in total power output that exceeds the HPU rating.

4.57 POWER FACTOR

The ratio of active (or real) power in watts to apparent power in volt-amps at the fundamental frequency of power transmission (i.e., 60 Hz). It is a measure of the phase shift that occurs between line voltage and line current when the AC line is loaded with a linear load having reactive characteristics.

4.58 POWER-SPLIT TRANSMISSION

A transmission providing continuously variable torque/speed ratios by the use of differential gearing connected with at least one electric motor-generator.

4.59 POWERTRAIN

All components that are at least intermittently connected to one of more of the vehicle's wheels. For purposes of an electrified powertrain, such components include the elements of a propulsion system that convert electrical energy to mechanical energy at the wheels of an electric vehicle. It includes all drivetrain components plus an electrical power inverter and/or controller, but not the electrochemical storage system. For a hybrid-electric vehicle, the hybrid power unit is also included.

4.60 PRE-CHARGE

A process of limited current supply from a charger to the vehicle battery charging electronics used to bring a low voltage circuit up to the voltage of a higher voltage circuit prior to removing the current limit. The pre-charge process is typically performed to limit the current inrush into a circuit with significant capacitance such as power electronics.

4.61 PROPULSION SYSTEM

The combination of the powertrain and energy supply system.

4.62 RANGE

The maximum distance that a vehicle can travel without the addition of additional energy in the form of fuel or off-vehicle charging.

4.63 RANGE EXTENDER

A small engine-powered generator or auxiliary power unit (APU) added to a battery electric vehicle to produce a plug-in electric vehicle (PEV). This generator sustains vehicle operation beyond the range provided by the batteries alone.

4.64 RATED VOLTAGE (V)

Voltage range at which a device is designed to operate.

4.65 REGENERATIVE BRAKING

A conversion of vehicle retardation force into energy stored in the RESS. Also known as regen braking.

4.66 RESS (RECHARGEABLE ENERGY STORAGE SYSTEM)

Any energy storage system that has the capability to be charged and discharged. (Examples: batteries, capacitors, and electro-mechanical flywheels.)

4.67 RESS AVAILABLE ENERGY

Energy available at the connection point of the RESS to the system under specified conditions.

4.68 RESS DRIVING

Ability to drive the vehicle using only the energy from the RESS.

4.69 RESS LAUNCH

Capability to launch the vehicle using only the energy from the RESS.

4.70 REVERSE POWER FLOW (RPF)

The intentional flow of the electrical power from the vehicle to an external device via vehicle components normally used for charging the RESS.

4.71 SERIES HYBRID

A hybrid vehicle in which all power is converted to a non-mechanical form prior to conversion back to mechanical power. For example, a vehicle with an APU is a series hybrid because the APU converts all power to electrical power which is then combined with any available battery power and sent to one or more electric motors.

4.72 SMART CHARGING

A managed-charging condition in which an EVSE or PEV optimizes the vehicle charging and discharging such that the combination of charging schedule, customer preferences (such as time when the vehicle is expected to be fully charged), cost of energy, and grid capacity are adjusted to meet customer preferences.

4.73 SMART GRID

An electricity delivery system that monitors, protects, and automatically optimizes the operation of its interconnected elements.

4.74 STAND-ALONE INVERTER

An inverter intended to provide electrical energy to a load not associated with the electric utility or grid. Generally applied only to V2H or V2L situations and not V2G.

4.75 START/STOP

Engine is automatically turned off when power demand is zero or negative, such as during vehicle stop, and then restarted automatically. This is sometimes referenced in the industry as a micro hybrid.

4.76 VEHICLE ASSEMBLY (VA)

A wireless power transfer assembly on the vehicle side, consisting of a coil, power electronics, control, and communication necessary to receive power from an associated ground assembly (GA).

4.77 VEHICLE INLET (CHARGE)

The device on the electric vehicle into which the connector is inserted for the purpose of transferring energy and exchanging information.

4.78 VEHICLE-SIDE CONNECTION (VSC)

The connections made for the ACD system on the vehicle side of the connection. The connection is made when the infrastructure-side connection mates with the vehicle-side connection.

4.79 VEHICLE-TO-GRID INTEGRATION (VGI)

A form of managed charging in which either charging or discharging is adjusted to meet the prioritized needs of the EV owner and the power utility grid.

Term used to describe the connection of PEV vehicles to the electrical grid under coordinated, intelligent control via digital communication to allow overall optimization of both sides of the power flow. This general term includes both V1G and V2G operations.

4.80 V1G

A form of managed charging in which the charging (power level and time of charge) is adjusted to meet the prioritized needs of the EV owner and the grid.

4.81 V2G

A form of managed charging, where, in addition to adjusting charging behavior (V1G), a vehicle RESS can discharge to the utility grid. The charging time, charging power level, discharge time, and discharge power levels are all manageable in order to meet the prioritized needs of the EV owner and the grid.

4.82 WIRELESS CHARGING SYSTEM (WCS)

The system for wireless power transfer and control between the ground assembly (GA) and vehicle assembly (VA) including alignment and communications. In the forward direction, this system transfers energy from the electric supply network to the electric vehicle electromagnetically through a two-part loosely coupled transformer.

4.83 WIRELESS POWER TRANSFER (WPT)

The transfer of electrical power between the AC supply network and the electric vehicle by contactless means. WPT is a charging system that transfers power across an airgap utilizing a two-part transformer (from the ground assembly [GA] to the vehicle assembly [VA]) and then rectifies that power into DC voltage to charge the RESS (refer to SAE 2954).

Informational note: While WPT charging is technically a form of inductive charge, to avoid confusion the two terms should not be used interchangeably since other technical specifications (e.g., NFPA 70) provide different requirements for the two technologies.

4.84 xEV

Any electrified propulsion vehicle with a high voltage system, including, but not limited to, HEV, PHEV, PEV, BEV, FCEV, and EV.

5. FUNCTIONAL POWERTRAIN ARCHITECTURE DIAGRAMS

Hybrid systems can be assembled in a variety of different configurations using the HPU, E-machine, and gearing. This section provides a block-diagram overview of the major types in the market today, but does not cover all of the possible configurations. Figure 1 diagrams the classification of different types of road vehicles. It is noteworthy that the overlap in some classifications indicates that some vehicles may operate in a variety of modes.

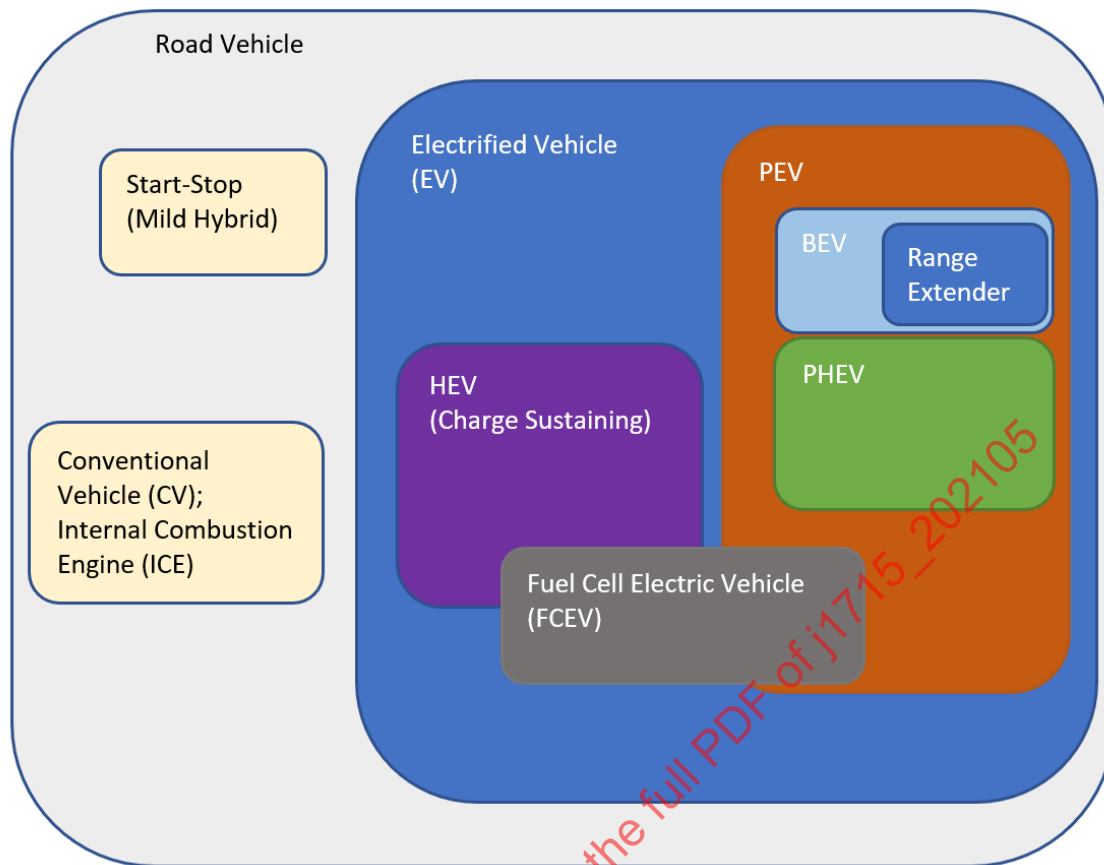


Figure 1 - Classification of road vehicles

5.1 Power-Split

A transmission providing continuously variable torque/speed ratios by the use of differential gearing connected with at least one electric motor-generator.

5.2 Power-Split Mode

A mechanical arrangement within a power-split transmission having a fixed linear combination of engine speed, output speed, and the speed of the motor-generator(s) that directly control(s) the speed ratio through the power-split.

Should the speed(s) of the controlling motor-generator(s) equal zero, this condition is a “mechanical point or mechanical ratio” of the system.

5.3 Mechanical Point or Mechanical Ratio

A ratio at which one of the motor-generators that controls the speed ratio through the transmission has come to a stop, and therefore power is transmitted mechanically through the differential gearing, but not electrically through that motor-generator.

5.4 Power-Split Design Options

5.4.1 Input Split

The input is connected separately to differential gearing. The power flow through the transmission is split by using differential gearing at the input.

5.4.2 Output Split

The output is connected separately to differential gearing. The power flow through the transmission is split by using differential gearing at the output.

A power-split with gearing at the transmission input and output are shown in Figure 2.

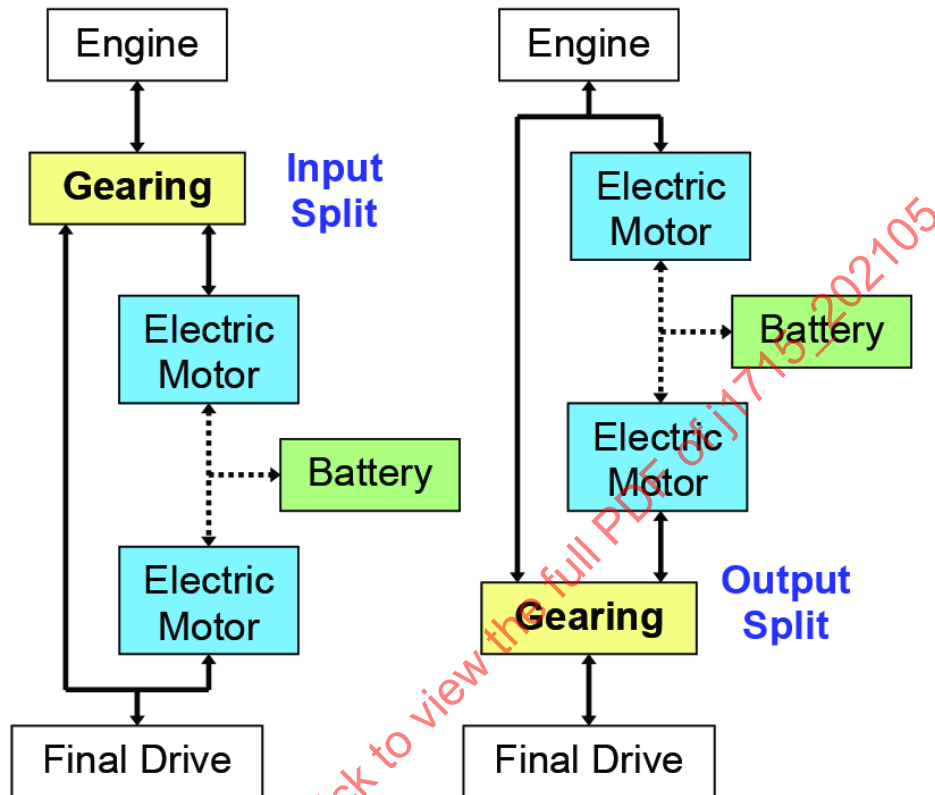


Figure 2 - Input and output split

5.4.3 Compound Split

Both the input and output are connected separately to differential gearing. The power flow through the transmission is split by using differential gearing at both the input and the output.

A power split with gearing at both input and output is shown in Figure 3.

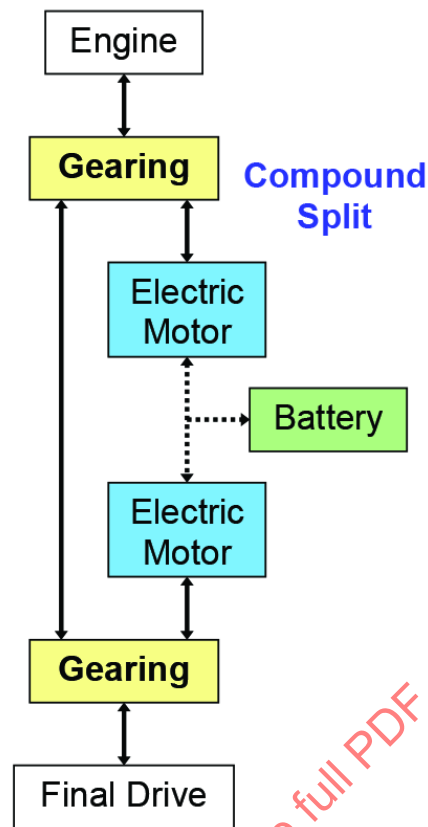


Figure 3 - Compound split

5.5 One-Mode or Single-Mode

There is only one, fixed linear combination of the input speed, output speed, and the speed of the motor-generator(s) that directly control(s) the speed ratio through the power-split transmission.

5.6 Multi-Mode (e.g., Two-Mode)

The power-split transmission can mechanically select from among more than one fixed, linear combination of input speed, output speed, and the speed of the motor-generator(s) that directly control(s) the speed ratio through the power-split transmission. For example, a two-mode power-split transmission may have an input-split mode when one clutch alone is closed and a compound-split mode when another clutch alone is closed.

A hybrid vehicle in which both sources of energy go through a single propulsion device.

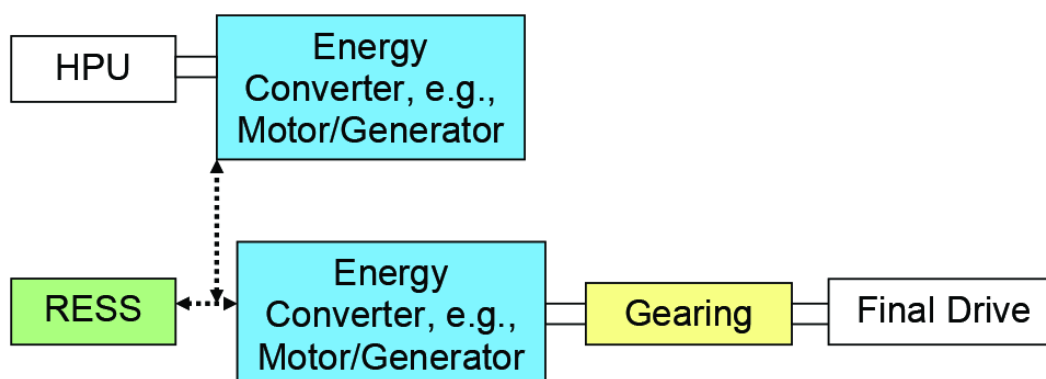


Figure 4 - Series hybrid