Vehicle Electrification System Standards

IX. On-Board High Voltage Battery Charging Systems

IX.a Acronyms and Definitions

Name	Acronym	Definition
Actual Battery Capacity		The engineered maximum energy storage capacity of a battery pack when it at 100% SOC
Alternating Current	AC	Alternating current is an electric current which periodically reverses direction, in contrast to direct current which flows only in one direction
Alternating Current to Direct Current	AC/DC	A circuit within a battery charger system that changes alternating current (AC) to direct current (DC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry, and the global location.
Amp-Hour	A-h	The amperage that can be delivered by energy storage device (i.e. battery) for a period of 1 hour
Battery Pack	BP	An electric-vehicle battery pack is a battery system comprised of multiple battery cells or modules used to power the electric motors of a battery electric vehicle or hybrid electric vehicle. These batteries are usually rechargeable batteries, and are typically lithium-ion batteries. These batteries are specifically designed for a high ampere-hour capacity.

Battery Electric Vehicle	BEV	A battery electric vehicle (BEV) is an electric vehicle that utilizes chemical energy that is stored in a rechargeable battery pack. Electric vehicles use electric motors instead of an engine system to propel the vehicle.
Charge Port	CP	The component of an electric vehicle that functionally serves to permit the connection of a charging station connector to the vehicle for the purpose of charging the high voltage battery pack.
Charge de Move	CHAdeMO	CHAdeMO is the trade name of a quick charging method for battery electric vehicles delivering up to 62.5 kW by 500 V, 125 A direct current via a special electrical connector. A revised CHAdeMO 2.0 specification allows for up to 400 kW by 1000 V, 400 A direct current. It uses a proprietary charging connector system.
Charge Port Connector (J1772)		The component of a charging station that permits an electrical connection between the charging station and an electrified vehicle with a battery pack that can be charged with electrical energy from a local utility power company.
Chassis Ground	Gnd; G	A chassis ground is a common link between different metallic parts of a component to ensure an electrical connection between them. Examples include electronic instruments and motor vehicle chassis or body.
Combined Charging Station (SAE Standard)	CCS	A vehicle charging connection system that combines Level 1, Level 2, and Level 3 charging configuration into one charge port connection to permit the transfer of electrical power from a power utility to the vehicle for the purposes of charging the high voltage battery. Its charging connector provides a standard for all transportation manufacturers.

Constant Current / Constant Voltage Charging	CC/CV	The Constant Current (CC) / Constant Voltage (CV) charging strategy will charge a battery at a specified CC until the battery reaches 90% of its capacity. The charger will then switch to a CV charging mode and begin to charge the battery at a lower rate until the maximum battery terminal voltage is achieved. It will then switch to a lower charging current until it reaches maximum battery terminal voltage. This will continue until the final CV charging step has been achieved.
Control Pilot (J1772)	CP	The J1772 Pilot is a 1khz +12V to -12V square wave, the Duty cycle (ratio high state to low state) determined the maximum available current. The EVSE sets the duty cycle the EV must comply to original setting or changes to the duty cycle.
Controller Area Network	CAN	A Controller Area Network (CAN) bus is a communication system made for vehicle intercommunication. This bus allows many microcontrollers and different types of devices to communicate with each other in real time and also without a host computer. A CAN bus, unlike Ethernet, does not require any addressing schemes, as the nodes of the network use unique identifiers. This provides the nodes with information regarding the priority and the urgency of the transmitted message.
DC Fast Charging	DCFC	See Level 3 Charging
Direct Current	DC	An electrical current which flows consistently in one direction. The current that flows in a flashlight or another battery powered appliance is direct current.
Direct Current -	DC-	An electrical current which flows consistently in one direction. The current that flows in a flashlight or another battery powered appliance is direct current. DC- indicates the ground or negative polarity of the circuit.

Direct Current +	DC+	An electrical current which flows consistently in one direction. The current that flows in a flashlight or another battery powered appliance is direct current. DC- indicates the ground function of the circuit.
Direct Current to Alternating Current	DC/AC	A circuit within a battery charger system that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry, and the global location.
Diagnostic Trouble Code	DTC	A specific hexadecimal code assigned to a specific vehicle system and component that identifies when an abnormal operating condition is occurring.
Efficiency	η	The efficiency of a system in electronics and electrical engineering is defined as useful power output divided by the total electrical power consumed (a fractional expression), typically denoted by the Greek small letter eta (η – ήτα)
Electric Vehicle Supply Equipment	EVSE	Electric vehicle supply equipment (EVSE) supplies electricity to an electric vehicle (EV). Commonly called charging stations or charging docks, they provide electric power to the vehicle and use that to recharge the vehicle's batteries. EVSE systems include the electrical conductors, related equipment, software, and communications protocols that deliver energy efficiently and safely to the vehicle. EVSE equipment is classified as Level 1 (120 volts AC), Level 2 (240 volts, AC), and DC Fast Charger (480 volts DC and higher).

Full Wave Rectifier (Bridge)	FWRB	Full wave bridge rectifier. A Full wave rectifier is a circuit arrangement which makes use of both half cycles of input alternating current (AC) and converts them to direct current (DC). The classical use of a full wave rectifier bridge is the use a transformer that is attached to 4 diodes arranged as a bridge to rectify AC to DC. This arrangement is known as a Bridge Rectifier.
Ground (Utility Ground	Gnd; G	Electrical grounding, otherwise known as earthing, primarily provides a measure of safety against electric shocks by acting as a safety line to redirect electric current in the event of short circuits. For household appliances, this is accomplished by a three-pronged electrical outlet with a dedicated grounding prong. Grounding is also a way of providing a current return path in some electrical transmission systems. Since the earth is an electrically neutral body, it is said that the ground, or earth, is at zero electric potential, and all other voltages are determined relative to this ground potential. This allows the ground to function as an extended neutral line in that it completes the transmission electric circuit by acting as a source of electrons for the electric generator and as an endpoint for electrons after the electrical load. This means that instead of a wire that provides a current return path from the load back to the voltage source as seen in most simple circuits, the ground acts as that return path.
Input Current		
Input voltage		The voltage that is supplied from utility or other source to an electrical component.
Insulation Gate Bipolar Transistor	IGBT	Insulated Gate Bipolar Transistor is a power transistor that has characteristics of both MOSFET and bipolar junction transistors

		(BJTs). Introduced in the 1980s, the IGBT handles high current, a characteristic of BJTs, but enables fast switching with greater ease of control. IGBTs are found in home appliances, electric cars and digital stereo power amplifiers. Modules with multiple IGBTs can support very high voltage and amperage.
J1772 Charge Receptacle		SAE J1772 (IEC Type 1), also known as a J plug, is a North American standard for electrical connectors for electric vehicles maintained by the SAE International and has the formal title "SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler".
Kilowatt-Hour	kW-h	A measure of electrical energy equivalent to a power consumption of 1,000 watts for 1 hour.
Level 1 Charging		Level 1 equipment provides charging through a 110V/120 volt (V), alternating-current (AC) plug and requires a dedicated circuit. Generally speaking, Level 1 charging refers to the use of a standard household outlet. Level 1 charging equipment is standard on vehicles and therefore is portable and does not require the installation of charging equipment. On one end of the provided cord is a standard, three-prong household plug. On the other end is a J1772 connector, which plugs into the vehicle.
Level 2 Charging		Level 2 equipment provides charging through a 220/240 volt (V), alternating-current (AC) plug and requires a dedicated circuit. Level 2 charging equipment is wall or pedestal mounted and therefore, requires installation by a professional. The charging equipment utilizes a J1772 connector to interface (connect) to the vehicle.

Level 3 Charging		DC fast chargers are the highest-powered EV chargers on the market. Most DC fast chargers on the market charge at rates of 25-50 kW but, can perform higher charging rates. At current charging speeds, they are ideal for places where a person would spend 15 minutes to an hour, such as restaurants, recreational areas and shopping centers. DC fast chargers require inputs of 480+ volts and 100+ amps (50-60 kW) and can produce a full charge. New generations of DC fast chargers are gaining traction and can produce 150-350 kW of power. It is important to note that not every EV model is capable of DC fast charging, and therefore, they cannot be utilized by every EV driver. DC fast chargers have multiple standards for connectors, whereas there is only one common standard for Level 1 and 2 charging (SAE J1772). DC fast chargers have three types of connectors: CHAdeMO, CCS or Tesla.
Line 1 (Utility Hot Black Wire)	L1	The hot line (also known as a phase line) is a wire in the latter stages of the distribution grid (like inside your house) that has a non-zero average voltage relative to the Earth (also called ground), as opposed to neutral lines, which are ideally at ground potential. Since hot lines carry electricity that has a high potential energy, they are shock hazards. Many electrical devices minimize this risk by taking advantage of polarized electrical outlets to ensure that the on/off switch is on the hot line, effectively limiting the length of the hot line, which minimizes the risk of shock as only a relatively small segment of the wiring (the wire before the switch, as opposed to the whole device) is considered "hot" when the circuit is open. The hot wire color is Black and has a distinct slot in electrical outlets.

Line 2 (Utility Neutral White)	L2	Neutral lines are at zero potential relative to the ground, meaning that ideally, they do not pose a shock hazard. This is because neutral lines are wires connected deep in the ground. That means that the neutral side of the outlet would carry most of the electric energy directly into the ground and very little current would go through a person touching the device. The neutral wire color is White and has a distinct slot in electrical outlets
Metal Oxide Semiconductor Field Effect Transistor	MOSFET	The metal–oxide–semiconductor field-effect transistor, also known as the metal–oxide–silicon transistor, is a type of insulated-gate field-effect transistor that is fabricated by the controlled oxidation of a semiconductor, typically silicon.
On-Board Battery Charger Module	OBC; OBCM	An on-board charging module (OBCM) is used in an electric vehicle (EV) or plug-in hybrid electric vehicle (HEV) to charge the high voltage traction battery. The On-Board charger system converts the AC input from the grid to a DC input which charges the battery.
Output Current		The rated output current is the maximum load current that a power source can provide at a specified ambient temperature. A power source can never provide more current that it's rated output current unless there is a fault, such as short circuit at the load
Output Power		Output electrical power is the power supplied by the power producing device (up to its maximum rated output) to an external circuit
Parameter Identification	PID	OBD-II PIDs (On-board diagnostics Parameter IDs) are codes used to request data from a vehicle, used as a diagnostic tool. ... All on-road vehicles and trucks sold in North America are required to support a subset of these codes, primarily for state mandated emissions inspections.

Plug-In Hybrid Vehicle	PHEV/PHV	A PHEV is defined as a vehicle with an engine combined with an electric propulsion system that utilizes stored energy from a battery with a capacity of at least four kilowatt-hours, is capable of being charged from an external source
Power Density		Power density is the amount of power per unit volume. In energy transformers including batteries, fuel cells, motors, etc., and also power supply units or similar, power density refers to a volume. It is then also called volume power density, which is expressed as W/m^3
Power Factor Correction	PFC	Power factor is an expression of energy efficiency. It is usually expressed as a percentage—and the lower the percentage, power usage is less efficient. Poor Power Factor means that the system needs to consume more electrical power to do the same amount of work. This will reduce the range of an electric vehicle or reduce fuel economy of a hybrid/plug-in vehicle. Low Power Factor can also cause higher component temps and can reduce the service life of the component. Power factor (PF) is the ratio of working power, measured in kilowatts (kW), to apparent power, measured in kilovolt amperes (kVA). Apparent power, also known as demand, is the measure of the amount of power used to run machinery and equipment during a certain period. It is found by multiplying (kVA = V x A). The result is expressed as kVA units. PF expresses the ratio of true power used in a circuit to the apparent power delivered to the circuit. A 96% power factor demonstrates more efficiency than a 75% power factor. PF below 95% is considered inefficient in many regions.

Proximity Detection		A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation, and looks for changes in the field or return signal
Society of Automotive Engineers	SAE	SAE International, previously known as the Society of Automotive Engineers, is a U.S.-based, globally active professional association and standards developing organization for engineering professionals in various industries
State-of-Charge	SOC	The state of charge is a measurement of the amount of energy available in a battery at a specific point in time expressed as a percentage (100% energy full or 0% energy empty. The SOC provides the user with information of how much longer the battery can perform before it needs to be charged or replaced or need to be recharged.
Tesla Supercharger		A Tesla Supercharger is a 480-volt DC fast-charging technology built by American vehicle manufacturer Tesla Inc. for their all-electric cars. The Tesla Supercharger network of fast-charging stations was introduced beginning in 2012
Totem Pole (Push-Pull) Driver		The connection of four (or more) transistors that form a network to drive (power) the primary of a transformer primary winding. The transistors will be pulsed in pairs to alternately change the polarity on a primary winding that results in an alternating current output used to create an AC waveform that will be transferred an AC power waveform to the transformer secondary. The secondary waveform will eventually get rectified to DC for power lower voltage DC circuits and charging a lower voltage battery.

Usable Battery Capacity		The energy capacity of a battery pack that is accessible to an electric propulsion system (which is less than the maximum) to ensure a long service life of a battery cell (battery pack). For Example, traditional Lithium Ion battery pack usable capacity state-of-charge range is ≈20% - 90% (or 70% of total capacity).

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