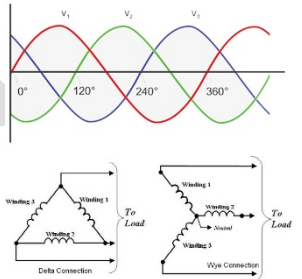

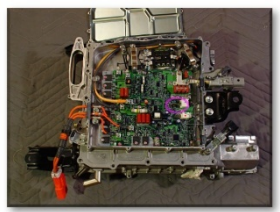
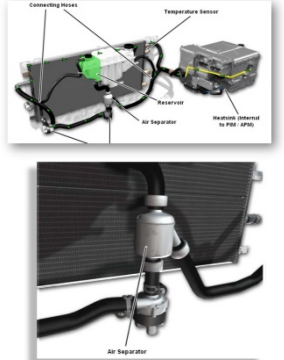

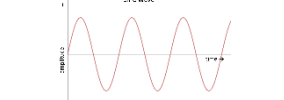
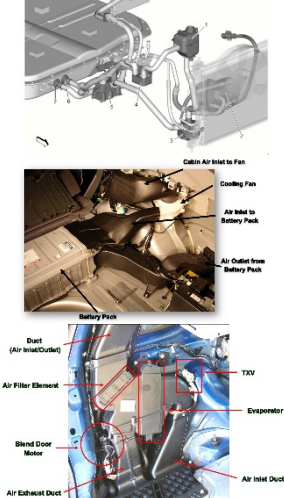


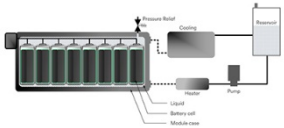
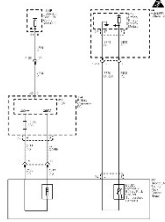
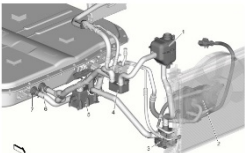

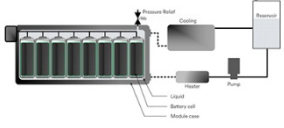
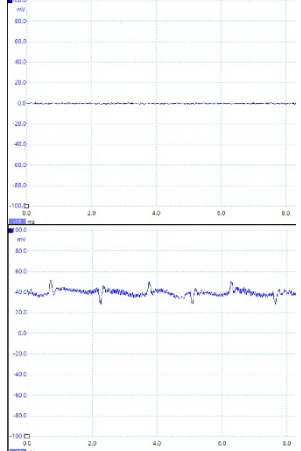
Vehicle Electrification System Standards



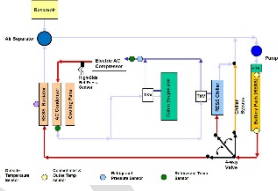
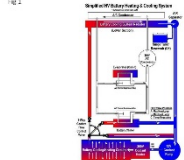

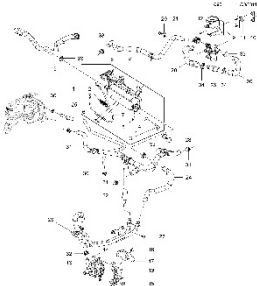
X. Vehicle Cabin HVAC Systems

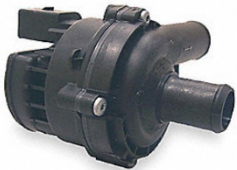

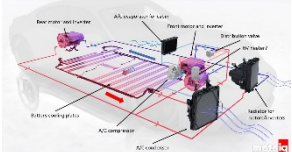

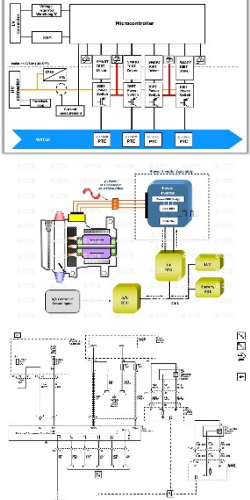
X.a Acronyms and Definitions

Name	Acronym	Definition	
3-Phase		Three Phases are the number of conductor circuits within a motor or generator that are connected in a Wye or Delta configuration.	
50/50 Glycol-Deionized Water Mixture		The cooling system is designed to transfer heat from a component to the coolant, so it can be delivered to the radiator and the heat can be removed by way of air movement passed the radiator core tubes. Coolant will operate most efficiently to absorb heat when blended with the proper amount of (deionized) water. A mixture percentage based on the lowest temperatures typically seen in your climate. Most regions are best suited to a 50/50 water-antifreeze mixture which will provide protection from a low of -34°F to a high of 265°F. In addition, maintaining proper freeze point protection ensures corrosion inhibitors remain at intended levels.	
3-Phase Power Inverter		A power electronic unit that converts dc electrical power to 3-Phase ac electrical power output for the purposes of operating and electric machine or other device.	

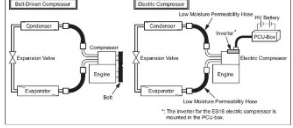

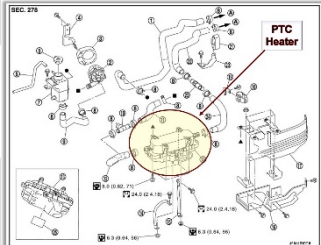


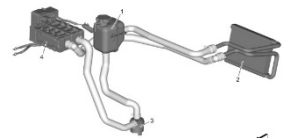
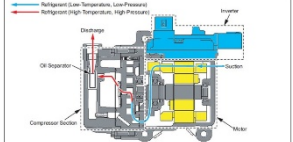
Air Separator		The air separator is designed to purge air from the power electronics cooling system. The component separates air from the coolant returning from the heat exchanger, and passes the air to the reservoir, avoiding air going to the pump inlet by slowing the coolant flow down, without adding a pressure drop in the system.	 <p>Labels in image: Connecting Hoses, Temperature Sensor, Reservoir, Air Separator, Hoses Connected to PWR / JPW, Air Separator</p>
Air-to-Air PTC Heater		A PTC heating unit that utilizes the vehicle HVAC blower motor to force air past the heating elements of the heating unit, thereby forcing warm/hot air into a vehicle cabin to warm it. The PTC Air heater can be placed behind a vehicle heater core to increase/add the air temperature to the cabin air being forced into the vehicle cabin.	 <p>Labels in image: BorgWarner</p>
Alternating Current	AC	Alternating current is an electric current which periodically reverses direction, in contrast to direct current which flows only in one direction	 <p>Labels in image: Sine Wave, Amplitude, Time</p>
Back Electromotive Force (Current)	BEMF	Back Electromotive Force (Counter-electromotive force or CEMF), also known as back electromotive force (EMF), is the electromotive force or "voltage" that opposes the change in current which induced it. CEMF is the EMF caused by magnetic induction	
Battery Pack Cooling System		A thermal (cooling) system that ensures that battery modules or cells do not exceed a temperature in which permanent (irreversible) cell damage would occur. The cooling system is designed to ensure that the battery modules/cells operate within the optimal temperature band that will result in high operating efficiencies, high capacity & power, while safeguarding long service life.	 <p>Labels in image: Cabin Air Inlet to Fan, Cooling Fan, Air Inlet to Battery Pack, Air Outlet from Battery Pack, Battery Pack, Duct (Air Inlet/Outlet), Air Filter Element, TXV, Evaporator, Blind Door Motor, Air Inlet Duct, Air Exhaust Duct</p>

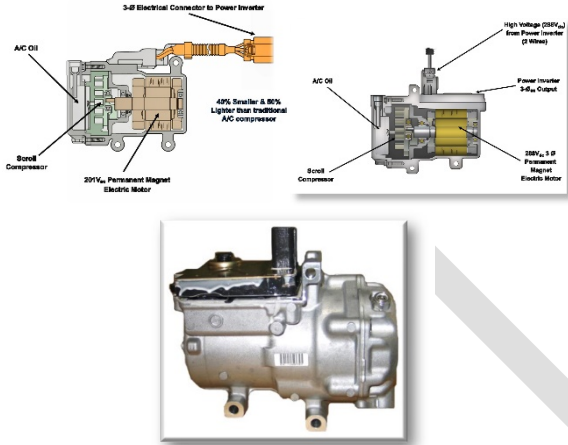



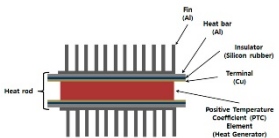
<p>Battery Pack Immersion Cooling System</p>		<p>A battery pack heating system that utilizes an immersion type of battery cooling system to the battery modules/cells. By immersing the battery cells in a chilled oil or glycol based liquid, battery cell temperature gradients can be mitigated thus, increasing battery performance, extending battery performance during the service life, and performance in hot operating conditions.</p>	 <ul style="list-style-type: none"> • USPatent Fully Submerged Battery Cells for Vehicle Energy-Storage Systems.pdf • XingMobility Immersion Cooled Modular Battery System.pdf
<p>Battery Pack Heater</p>		<p>A heating unit that heats the coolant that is transferred to the battery pack by an electric pump. The coolant is transferred to a hollow cooling plate that will heat the modules/cells by conduction or, the coolant is routed through cooling tubes/plates that are located adjacent to the modules/cells and will conduct heat from them by circulating a liquid coolant.</p> 	 
<p>Battery Pack Immersion Heater</p>		<p>A battery pack heating system that utilizes an immersion type of battery heating system to heat the battery modules/cells. By immersing the battery cells in heated oil or glycol based liquid, battery cell temperature gradients can be mitigated thus, increasing battery performance, extending battery performance during the service life, and performance in cold operating conditions.</p>	 <ul style="list-style-type: none"> • USPatent Fully Submerged Battery Cells for Vehicle Energy-Storage Systems.pdf • XingMobility Immersion Cooled Modular Battery System.pdf
<p>Boosting Current</p>		<p>The initial current injected into the phases of an electric machine stator to magnetize (provide an instantaneous strong magnetic field) in the stator necessary to overcome the internal load of the rotor (i.e., magnetic field needed to begin rotating the rotor) and any other loads that would load the rotor (i.e., A/C pressure, hydraulic pressure, etc.). Boosting current is typically injected for a specified millisecond duration and the amplitude can be 7-15 times that of normal operating current.</p>	
<p>Cabin Heater (Vehicle) (See PTC Immersion & Air-to-Air Heaters)</p>		<p>An electric heater, typically comprised of PTC materials that, can be used to heat a liquid or air, to heat the interior (cabin) of a BEV, PHEV, or HEV. PTC Heaters typically have more than one heating element, with each element independently controlled.</p>	

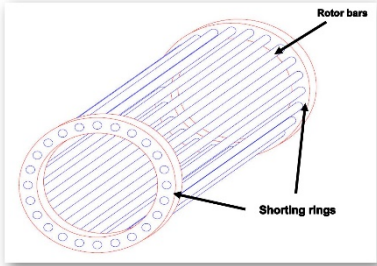
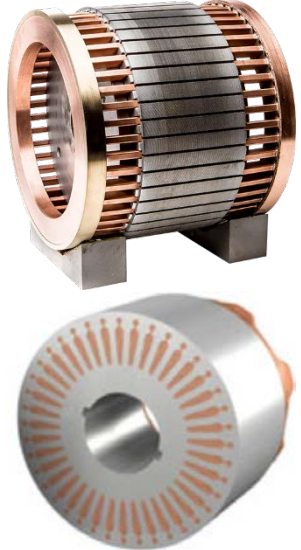
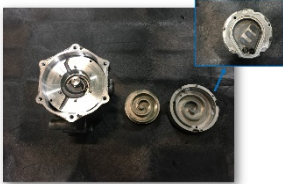
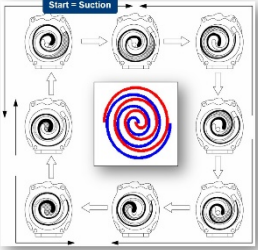
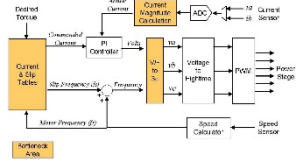
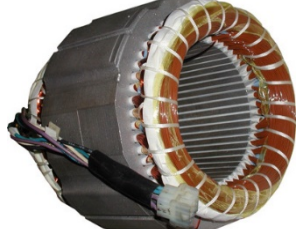
		The heating capability can range from 1.2kW to 10kW. The cabin heater can be located within the interior of the vehicle or in the front compartment (i.e., engine compartment).	
Coefficient of Performance	C.O.P.	The coefficient of performance or COP of a heat pump, refrigerator or air conditioning system is a ratio of useful heating or cooling provided to work required. Higher COPs equate to lower operating costs	
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.	
Coolant Chiller		A device used to cool the temperature of a liquid that is passed through it. In the case of an electric vehicle system, a Chiller can be used to cool (chill) liquid entering a battery pack to ensure the modules/cells maintain an optimal operating temperature.	 <p>Battery Cooling Loop Schematic</p>   <p>http://www.ti.com/200012/05/04-ev-vehicle-cooling-loop-implementation/</p>
Coolant Control Valve		An electrically controlled valve that directs coolant to various components of a system depending on the mode that the system is operating, by moving a valve or door. The control valve may be designed to move in two or more positions for directing the coolant.	 

Coolant Pump		A device that is used to transport coolant through components for the purpose of absorbing the heat of the components and transferring the warm/hot coolant to a heat exchanger so the heat can be removed. The pump is typically electrically powered and controlled with a PWM signal. A system can utilize more than one coolant pump.	
Coolant Temperature Sensor	CTS	A device that senses the temperature of a liquid by using a corresponding change in resistance with a change in temperature. Typically, a CTS uses a negative temperature coefficient design to decrease resistance as the temperature of the liquid increases.	
Cooling Loop		A phrase to describe how and where a cooling system is routed, and the components connected to the loop, throughout a system that uses air or liquid for the cooling medium.	
Coolant Reservoir		The coolant reservoir is a container that holds the excess or overflowing coolant which is used in the system. The coolant reservoir is usually pressurized, is attached to the radiator and the engine with hoses, and is a central component in the system	
Compressor Drive System		The electrical and electronic system that controls the speed and torque of the air conditioning compressor. The system commences from the high voltage battery pack (where it receives its operating energy) and completes the circuit at the air conditioning compressor stator windings.	
Compressor Control System		An electronic and software/firmware system that controls the operation of an air conditioning compressor. The control system will use software/firmware to command or change electronic and electrical signals to transmit varying amplitude and frequency 3-Phase waveforms transferred to the stator windings of the air conditioning compressor. The control system uses pressure sensor, ambient temp, cabin temp, vehicle speed, etc. to determine air conditioning speed. Compressor speed, along with other air conditioning components (i.e., orifice tube, expansion valve, etc.). Compressor speed determines refrigerant circulation speed that determines how quickly heat can be removed from the refrigerant (and the vehicle cabin).	
Direct Current	DC	Direct current is the unidirectional flow of an electric charge. A vehicle 12V is a prime example of DC power. Direct current may flow through a conductor such as a wire, but can also flow through	

		semiconductors, insulators, or even through a vacuum as in electron or ion beams	
DC Bus		Battery powered systems have a positive and negative bus. A Direct Current (DC) bus is a term to define if a component is connected to the positive or negative side of a DC system.	
Deionized Coolant	DI Coolant	Deionized water can also be referred to as DI Water and simply means all the ions have been removed. This is important for applications where the highest purity water needs to be used. Deionized water has many applications where it is favored due to its high purity. In industrial situations involving machining or high temperatures, deionized water helps by having low conductivity, and in turn, this helps lower the temperatures during manufacturing. Automotive applications such as coolant systems see the benefit of using deionized water by increasing the lifespan of the motor. The reason deionized water is preferred is due to its resistance to electricity from it not having charged ions to carry a charge.	
Electric Air Conditioning Compressor Assembly		The mechanical and electrical components that comprise an electric air conditioning compressor assembly	
Electric Grid Heater		A type of heater that utilizes a material, configured in a series or parallel pattern, that heats a component by transmitting an electric current through the material creating heat.	 <p>1. Heating Grid (powered by High Voltage) 2. Heating Grid Wiring Harness 3. Heating Grid High Voltage Connector</p> 
Frequency (Hertz)	Hz	The SI unit of frequency, equal to one cycle per second.	 <p>1 Hertz = 1 Cycle Per Second Above and Below the Atmospheric Pressure Line</p>

Heating Ventilation & Air Conditioning	HVAC	HVAC stands for Heating Ventilation and Air Conditioning. Its purpose in a vehicle is to clean, cool, heat, regulate, ventilate and dehumidify the air entering the cabin, depending on the inputs of the operator as well as electronic sensors.	
HVAC Controller		An electronic, dedicated microcontroller that controls the operation of the HVAC system. The HVAC controller is typically located in the HVAC control head electronic assembly.	
Immersion PTC Heater		<p>The PTC immersion heater is designed to be immersed in a liquid, heat the liquid, and an electric fluid pump transfers the hot liquid to a heater core where the liquid heat can be extracted by blowing air over the heater core tubes and into the vehicle cabin. Its resistance technology will increase of resistance and decrease heater power at elevated temperatures. This characteristic of the PTC heaters make them self-regulating, as their output power saturates at a fixed temperature.</p> 	  
Kilowatts	kW	$1\text{kW} = 1,000 \text{ Watts}; 1\text{kW} = 1.34\text{hp}; 103\text{kW}/0.746 = 138\text{hp}; (138\text{hp}) (0.746) = 103\text{kW}$	
Local Interconnect Network Bus	LIN	LIN is a serial network protocol used for communication between components in vehicles. The need for a inexpensive serial network arose as the technologies and the facilities implemented in the vehicle increased, while the CAN bus was more expensive to implement for every component in the car	
(Compressor) Oil Separator		The oil separator is capable of separating oil from the refrigerating gas mixture so as to improve the performance of refrigerating air conditioning system and save energy.	

<p>Permanent Magnet A/C Compressor</p>	<p>PM</p>	<p>An Electric machine that, utilizes permanent magnets that are located on the surface or interior of the rotor, for coupling the magnetic field of the rotor magnets to the magnetic field of the stator causing the rotor to rotate</p> 	
<p>Polyalkylene Glycol Oil</p>	<p>PAG</p>	<p>PAG oil, or Polyalkylene Glycol, is a fully synthetic hygroscopic oil specifically designed for automotive air conditioner compressors. It is used in automotive air conditioning systems to lubricate the compressor.</p>	
<p>Polyol Ester Oil</p>	<p>POE</p>	<p>Polyol ester oil is a type of synthetic oil used in refrigeration compressors that is compatible with the refrigerants R-134a, R-410A and R-12. It is recommended by experts as a replacement for hydrofluorocarbons</p>	
<p>Positive Temperature Coefficient Heater</p>	<p>PTC Heater</p>	<p>Positive Temperature Coefficient (PTC) heaters are self-regulating heaters that run open loop without any external diagnostic controls. As its temperature increases, the electrical resistance of the material also increases, thus limiting the current flow.</p>	
<p>Revolutions Per Minute</p>	<p>rpm</p>	<p>Revolutions per minute is the number of turns in one minute. It is a unit of rotational speed or the frequency of rotation around a fixed axis</p>	
<p>Rotor</p>		<p>The rotor is a moving component of an electromagnetic system in the electric motor or electric generator. Its rotation is due to the interaction between the windings and magnetic fields which produces a torque around the rotor's axis.</p>	

<p>Rotor Bar</p>		<p>A copper or aluminum alloy bar within the structure of an electric machine rotor (i.e., one of 40, 50, 60, etc. bars) that are analogous to the secondary windings of a transformer that, serve to circulate currents to generate magnetic fields to interact with stator magnetic fields to cause the rotor to rotate</p> 	
<p>Scroll Compressor</p>		<p>A scroll compressor is a specially designed compressor that compresses gases by rotating in a circular motion, as opposed to vertical/horizontal piston action. Scroll compressors provide in HVAC systems, as they are more reliable and efficient than reciprocating compressor types.</p> 	
<p>Software Control Table</p>		<p>Data arranged in 2 or more dimensions that serve as a location for control software to access in how a system should be controlled for a specific rpm, current load, pressure, etc. Microsoft Excel is an example of how a control table could be arranged in a 2-dimensional format (x and y).</p>	
<p>Stator</p>		<p>The stator is the stationary part of a rotary system, found in electric generators and electric motors. Electric Current flows through stator windings that create magnetic sequentially switched fields that will interact with the rotor magnetic fields that causes the rotor to rotate (spin).</p>	

To comment or offer suggestions on this standard, contact Ken Mays:

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