

MorElectric™ HVAC

The Caterpillar® MorElectric HVAC (heating, ventilating, and air conditioning) module brings together all heating and air conditioning components into one unit. The system uses a high efficiency scroll compressor to provide five times the reliability of traditional automotive-based refrigeration systems. The MorElectric electrically driven compressor removes today's belt driven compressor from the harsh engine mounted environment and removes the condenser from the radiator package or cooling package, which removes A/C heat load from the radiator air stream and improves engine cooling capacity.

The HVAC module can be dismantled and swapped out like a window air conditioner. This eliminates the need to break into the refrigeration system to get the vehicle up and running quickly. Unit shown is a dual zone for trucks with sleeper cabs. This single module replaces both the dashboard and underbunk units. The *same* HVAC is used on-road *and* when parked with APU or Shore Power Packages to provide cost effective no-idle solutions. Smaller single zone packages are also available for other applications.

Applications

- On-Highway Trucks
- Off-Highway Equipment
- Fire & Rescue Vehicles
- Military Vehicles
- Motorcoach, RV's, Buses
- Locomotives, other HD applications



Features and Benefits

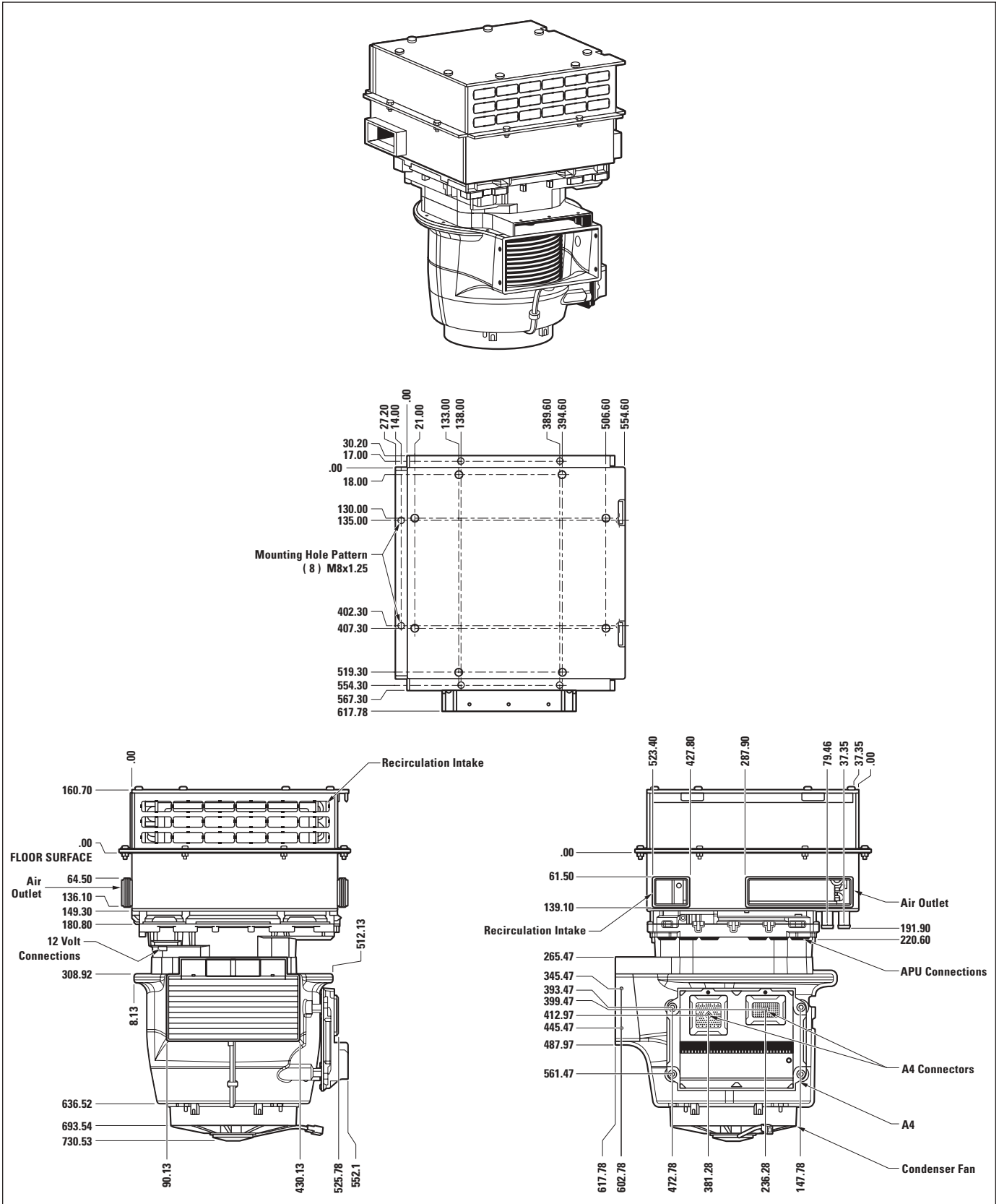
- High efficiency system designed specifically for mobile applications
- Modular design allows flexible installation locations for easy installation, and serviceability – swap out unit in 60 minutes
- Eliminates compressor, compressor belt(s) and pulley(s) from engine
- Hermetically sealed unit houses compressor, condenser, evaporator, fan assemblies and all other components
- Heating/cooling capacity independent of engine speed
- Provides 12- or 24-volt DC for vehicle's electrical system
- Refrigeration system pre-charged, ready for plug and play
- Hermetically sealed compressor and use of rigid refrigerant tubing eliminate refrigerant leaks
- Uses high efficiency scroll compressor technology
- Variable speed compressor, dependent on power needs
- HVAC system 5x more reliable, 3x more durable

Part of An Integrated System...

The HVAC is one component of the Caterpillar MorElectric System. The HVAC module is part of a highly integrated system designed to interface and work with the MorElectric Generator, APU or Shore Power Package.



Dimensions



Specifications

HVAC Unit (for dual zone 1-piece configuration as shown)

Number of Models:	4, contact Cat for other configurations
Installation:	Available as OEM option or aftermarket installation
12/24 V Capacity:	See downconverter options, page 4
Primary Components	
Power Electronics Module (PEM):	See description, page 4
Electric Resistance Heater:	See description, page 4
Compressor:	See description, page 5
Weight:	108.86 kg (240 lb)
Dimensions:	581.6 mm × 767.8 mm × 898.7 mm (22.9" × 30.2" × 35.4") for dual zone unit shown Other models and configurations available
Rated Capacity	
Cooling:	24,000 Btu/h @ 43.3° C (110° F)
Heating (Opt. Electric Resistance Grid):	10,200 Btu/h
Coolant:	Designed to handle engine OEM's coolant recommendations
Refrigerant:	R134a
Electrical Power Requirements	
Electronically Actuated Heater Control Valve:	0.3 A at 12 V DC
Multiple Zone Actuator:	0.3 A at 12 V DC
Condenser Fan:	35 A at 12 V DC, 18 A at 24 V DC
Evaporator Blower Fan:	35 A at 12 V DC, 20 A at 24 V DC
Air Flow	
Net System Air Flow:	850 m³/hr
Cab (Front):	510 m³/hr
Sleeper (Rear):	340 m³/hr

Specifications

12 V and/or 24 V DC Capacity

The Power Electronics Module (PEM) is housed within the HVAC module and contains three downconverter slots to provide 12 V and/or 24 V DC electrical power for the vehicle's conventional 12 V or 24 V DC electrical system needs. Each slot provides 1500 W of downconverter capacity at either 12 V or 24 V. The HVAC can be ordered with 1, 2, or all 3 downconverter slots populated with any combination of 12 V or 24 V DC converter modules. Some downconverter combinations not available until Jan 2007.

Output Voltage:	12 V (9 V to 16 V), 24 V (18 V to 32 V)
I/O Connection:	J1939

Performance

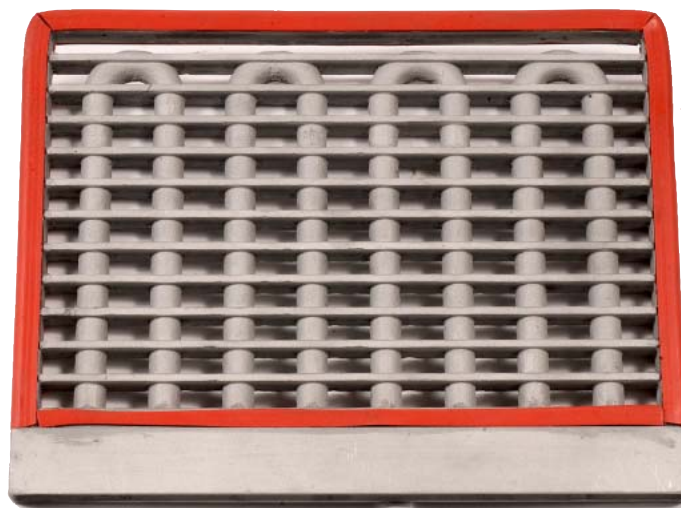
Downconverter Options	Maximum Capacity	
	12 V DC	24 V DC
a) Power, Current Output	1500 W, 105 A	1500 W, 52 A*
b) Power, Current Output	3000 W, 210 A	3000 W, 105 A
c) Power, Current Output	4500 W, 317 A*	4500 W, 158 A*

*Available Jan '07, contact Cat for more details.

Electric Resistance Heater Option Package

Availability: The electric resistance heater is provided as a part of the APU or Shore Power Idle Reduction Packages. This heater can also be purchased and installed separately to supplement the standard jacket water heat capacity. Included in the electric heater package are the electric heater grid, heater control, and wiring harness.

Weight (electric heater package):	3.63 kg (8 lb)
Capacity:	10,200 Btu/hr \pm 10% (3000 W)
Electric Resistance Grid Heater:	Part of APU or Shore Power Package, or available as optional add-on to HVAC
Mounting & Installation:	MorElectric HVAC module is designed to accept the electric resistance heater grid and controller within the HVAC module. If HVAC is ordered with electric heater option, the MorElectric HVAC module will arrive with all electric heater system hardware installed.



Electric Resistance Heater

Specifications

Compressor

The MorElectric HVAC module contains a scroll compressor that has several advantages over the conventional piston compressor used in heavy-duty mobile equipment:

- Full variable speed
- Up to 8 times quieter
- 30% higher efficiency
- 70% fewer moving parts

Moving Parts: Scroll Compressor vs. Piston Compressor

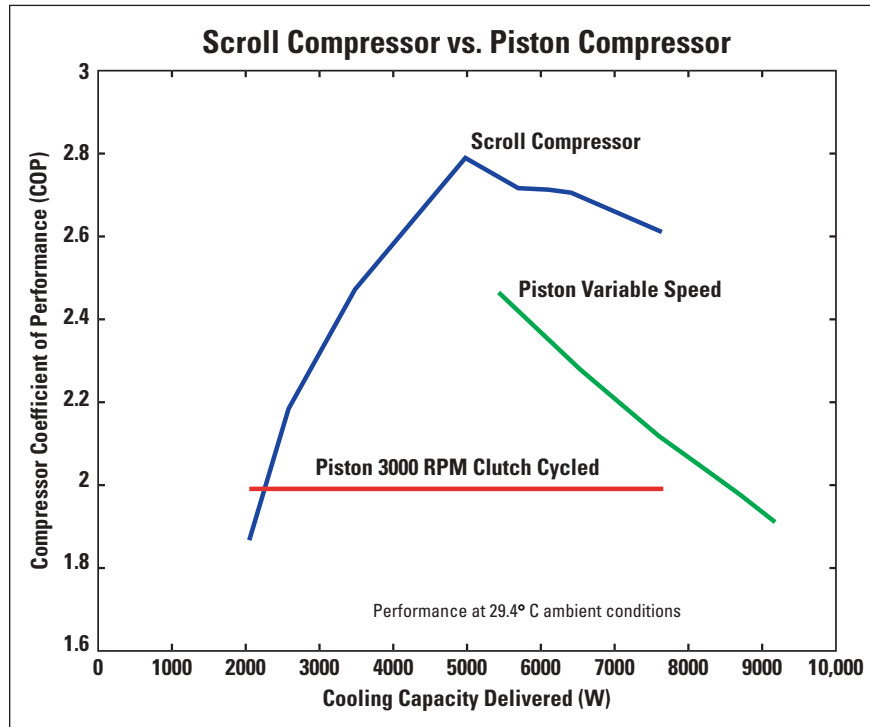


Scroll Compressor



Piston Compressor

Compressor Performance Comparison



Specifications

Diagnostics. The MorElectric system is equipped with a Power Management Controller (PMC) that is installed on the HVAC unit. The PMC is the master controller of the entire system and is the source of communication to selected service tools over J1939. The PMC or the Power Electronics Module (PEM) provide the following diagnostics for the HVAC. For any diagnostics that signal feedback to the driver, an operator display can later be provided based on an OEM's specifications/preferences.

Power Management Controller (PMC) Specific

Compressor Discharge Temperature Sensor Voltage High	
Function	Indicates high voltage in the compressor discharge temperature input to the PMC
Conditions	1) 5 V sensor supply voltage high fault is not active 2) Voltage from sensor is > 4.95 V continuously for 8 seconds
Response	System will use default value for compressor discharge temp
Compressor Discharge Temperature Sensor Voltage Low	
Function	Indicates low voltage in the compressor discharge input to the PMC
Conditions	1) 5 V sensor supply voltage low fault is not active 2) Voltage from sensor is < 0.2 V continuously for 8 seconds
Response	System will use default value for compressor discharge temp
Compressor Drive Fault	
Function	Indicates problem with A/C compressor located within the PEM module
Conditions	PEM sent message via J1939 data link indicating the compressor fault condition
Response	– Air conditioning will not work due to compressor fault – Software should discontinue attempts to run compressor until PEM shows fault is cleared
Condenser Coil Temperature Sensor Voltage High (Same as Compressor Discharge Temperature Sensor High)	
Condenser Coil Temperature Sensor Voltage Low (Same as Compressor Discharge Temperature Sensor Low)	
Condenser Fan Drive Fault	
Function	Indicates problem with A/C condenser fan drive located within the PEM module
Conditions	PEM sent message via J1939 data link indicating the condenser fan drive fault condition
Response	– Air conditioning will not work due to condenser fan drive fault – Software should discontinue attempts to run condenser fan drive until PEM shows fault is cleared
Blower Drive Fault	
Function	Indicates problem with HVAC blower drive located within the PEM module
Conditions	PEM sent message via J1939 data link indicating the blower drive fault condition
Response	– Air conditioning will not work due to blower drive fault – Software should discontinue attempts to run blower drive until PEM shows fault is cleared
Evaporator Temperature Sensor #1 Voltage High (Same as Compressor Discharge Temperature Sensor High)	
Evaporator Temperature Sensor #1 Voltage Low (Same as Compressor Discharge Temperature Sensor Low)	
Evaporator Temperature Sensor #2 Voltage High (Same as Compressor Discharge Temperature Sensor High)	
Evaporator Temperature Sensor #2 Voltage Low (Same as Compressor Discharge Temperature Sensor Low)	

Specifications

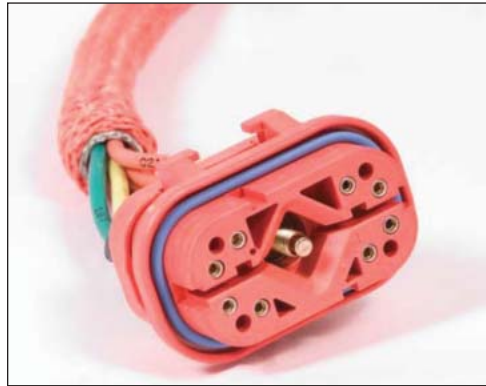
Diagnostics (continued)

Power Electronics Module (PEM) Specific

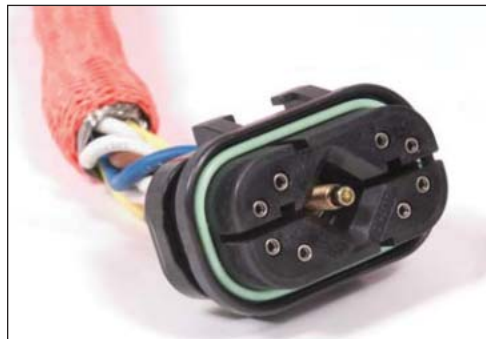
Generator Power Converter Temperature High	
Function	Indicates PEM is reporting high temperature in generator power converter module (located within PEM)
Conditions	1) PEM reports generator power converter high temperature via the J1939 data link 2) Engine speed is detected
Response	System begins derating power from generator
Generator Belt Broken or Slipping	
Function	Indicates difference between engine speed and generator speed (adjusted for pulley ratio)
Conditions	1) PEM reports generator speed greater than or less than 3 times engine speed \pm 300 rpm (engine) 2) Engine speed is detected
Response	None
Generator Open Circuit	
Function	Indicates PEM is reporting a generator open circuit
Conditions	1) PEM reports generator open circuit via J1939 data link 2) Engine speed is detected
Response	System should not allow generator mode until fault cleared
Generator Short Circuit (Same as Generator Open Circuit)	
DC-DC Down Converter Open Circuit	
Function	Indicates PEM reporting a DC-DC Down Converter open circuit The 12 V battery bus will not be charging when this fault is active
Conditions	1) PEM reports DC-DC Down Converter open circuit via J1939 data link 2) PEM is in either Generator, APU, or Shore Power mode
Response	None
DC-DC Down Converter Short Circuit (Same as DC-DC Down Converter Open Circuit)	
DC-DC Down Converter Temperature High	
Function	Indicates PEM is reporting a DC-DC Down Converter over temperature condition The 12 V battery bus may have a short circuit condition, or possibly a defective battery
Conditions	1) PEM reports DC-DC Down Converter over temperature via J1939 data link 2) PEM is in either Generator, APU, or Shore Power mode
Response	PMC should command down-converter to OFF or 0 V until fault condition no longer exists
Power Electronics Module Battery Connection Reversed	
Function	Indicates PEM is reporting a reverse battery connection Check polarity of 12 V battery connection to PEM
Conditions	PEM reports reverse battery connection via J1939 data link
Response	PMC should command PEM to stand-by mode until fault is cleared

HVAC Connectors

Connectors shown below are available for harness fabrication or Caterpillar can provide complete harness assemblies. The harness consists of six 12 AWG conductors, a protective Mylar sheath, a protective stainless steel braided sheath, and an orange braided sheath to identify high voltage circuit. Bright orange cable identification is same as used with hybrid automobile high voltage circuits. For further information on the harness specification, see the *MorElectric Connector/Harness* brochure. Overall, the HVAC is interfaced with the rest of the MorElectric system as shown in the block diagram on the next page.

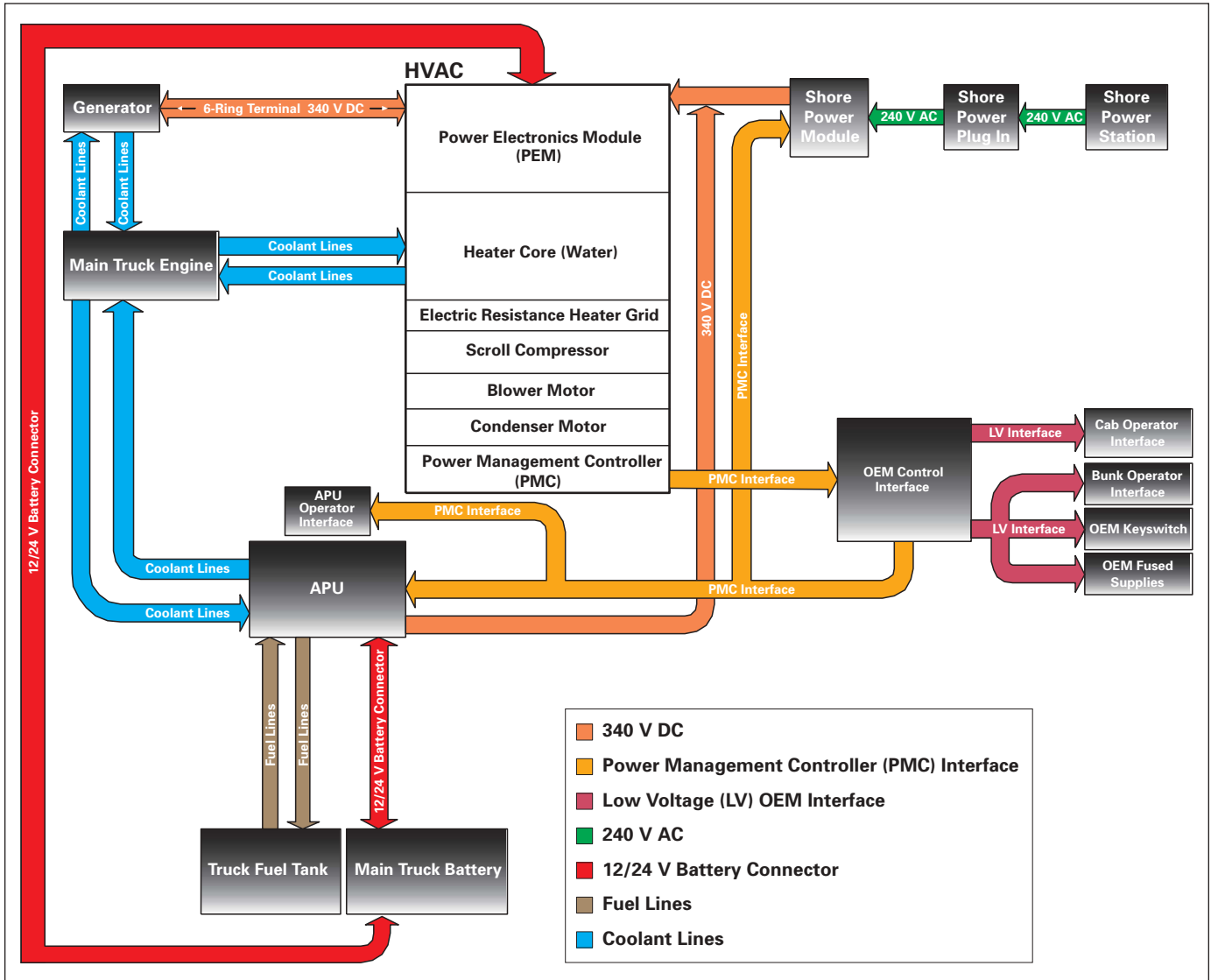


PEM Connector (Low Voltage)



PEM Connector (High Voltage)

System Integration Schematic



HVAC MorElectric Integration

MorElectric™ Resource Information

For more information on Caterpillar MorElectric Technology, please view the e-Briefing at:
http://www.cat.com/products/shared/technology_products/cat_electronics/morElectric/_ebrief/contents/index.html.
Additional printed literature is available and can be ordered by referencing the media numbers, listed below.



MorElectric Literature

- MorElectric **Generator**, EEDE1000
- MorElectric **HVAC**, EEDE1001
- MorElectric **APU** Package, EEDE1002
- MorElectric **Shore Power** Package, EEDE1003
- MorElectric **Connector/Harness** Info, EEDE1004
- MorElectric **System**: FAQs, EEDE1005

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For more complete information on Cat products, dealer services,
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