

# ALLISON HYBRID

## DPIM

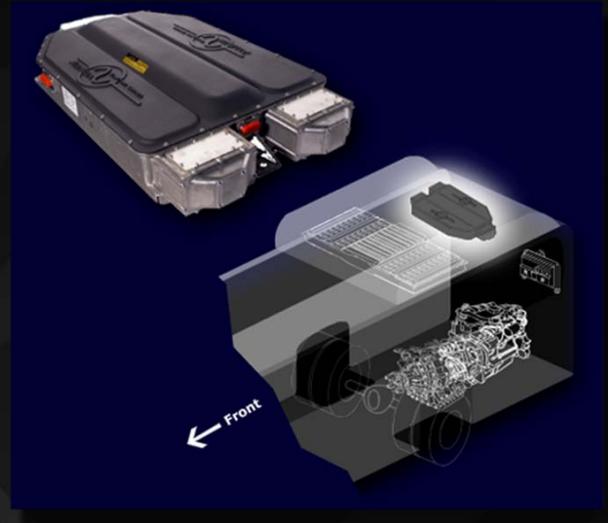


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## Dual Power Inverter Module (DPIM)

### Overview

- The DPIM converts Direct Current (DC) from the ESS into Alternating Current (AC) for the drive unit motors to use.
- The DPIM controls motor torque and energy flow based on TCM commands.
- The DPIM includes separate inverters for drive unit Motors A and B and utilizes internally-housed microcontroller circuit boards.



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## DPIM

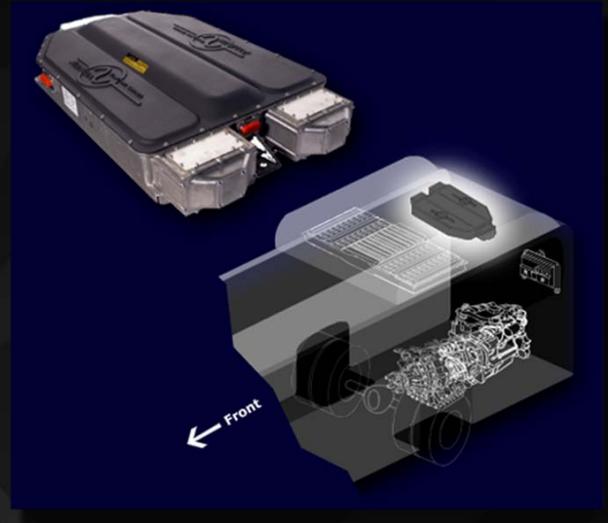


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## Dual Power Inverter Module (DPIM)

### Overview (cont'd)

- During system shutdown, the DPIM discharges the DC bus by pushing current back through the motors.
  - *This creates heat rather than torque and allows DC energy to dissipate from the system.*
- The DPIM is cooled by transmission fluid circulating through an internal channel.



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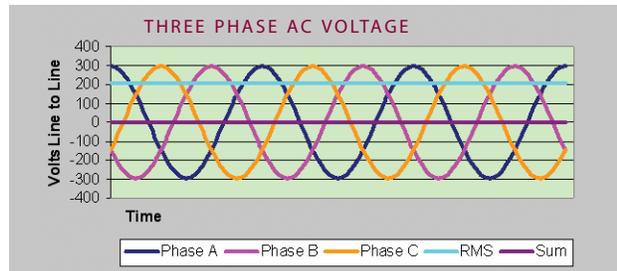
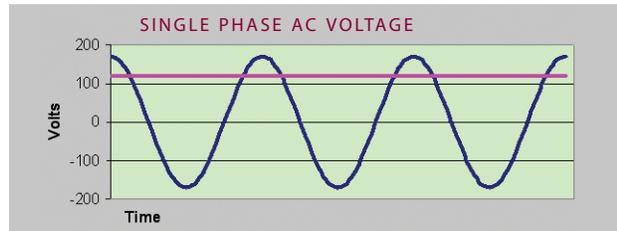


# ALLISON HYBRID

## RESOURCES: AC Electrical Power

### AC ELECTRICAL POWER

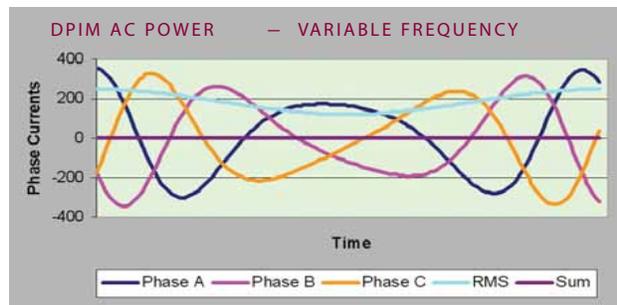
Normal house current uses AC power. A typical wall outlet provides 120 volts RMS with peaks to 170 volts at a frequency of 60 Hz. Three phase AC power produces 208 volts RMS leg-to-leg with 300 volts peak at a frequency of 60 Hz.



### INVERTER AC POWER

The DPIM turns IGBTs on and off to control phase currents. Magnitude and frequency is varied to produce the desired motor torque.

Note: IGBT stands for Insulated Gate Bipolar Transistor. These are voltage controlled power transistors used in the DPIM.



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## RESOURCES: DPIM Cooling



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# ALLISON HYBRID H 40/50 EP DPIM Cooling

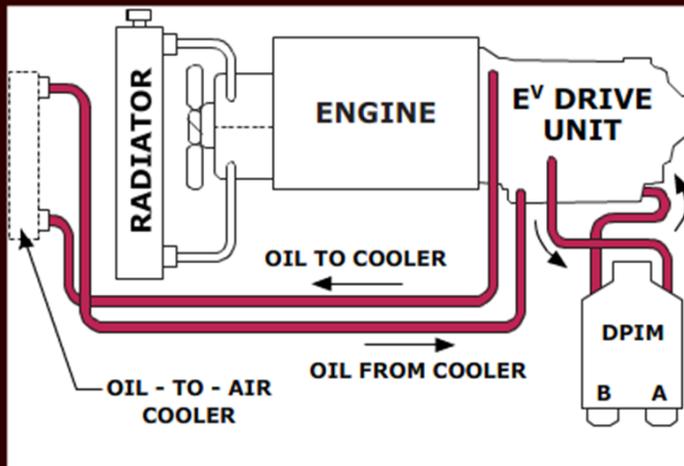
### DPIM - Cooling

The high frequency switching operation of the IGBTs generates heat.

This heat load must be routed away from the power electronics. Each IGBT is mounted on a heat sink located at the base of the DPIM.

Transmission fluid routed from the EV Drive™ circulates beneath the heat sink.

The heat load generated by the IGBT is conducted to the heat sink and then removed by the circulating transmission fluid beneath the heat sink.



RESOURCES



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## RESOURCES: DPIM Mounting



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## DPIM Mounting

# ALLISON HYBRID H 40/50 EP

### DPIM - Mounting



New Flyer Roof Mount

### Gillig Roof Mount



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## RESOURCES: DPIM Power Flow

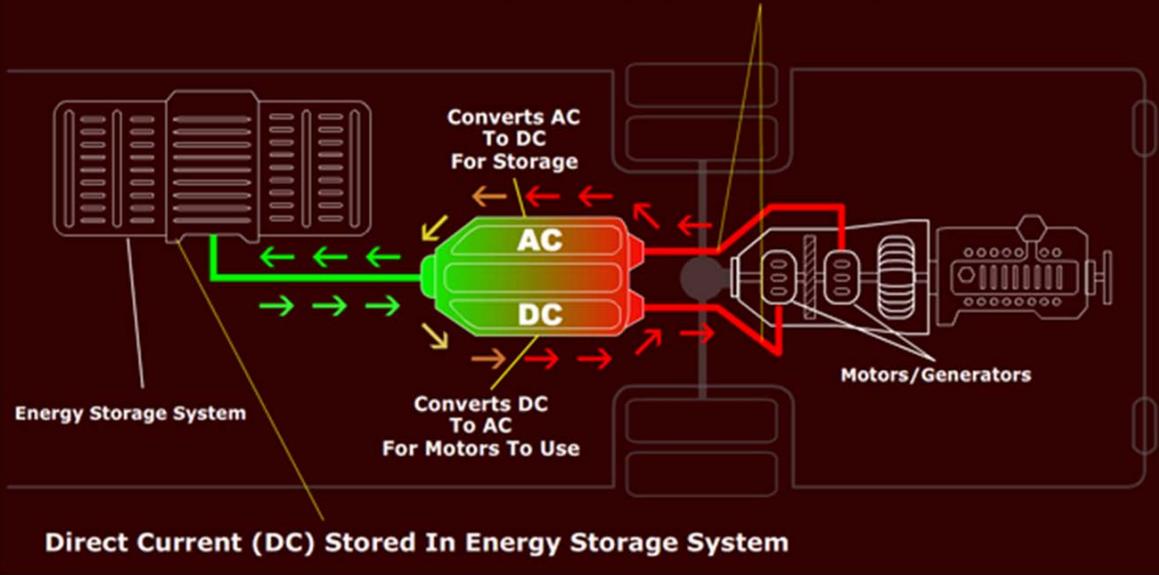


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## DPIM Power Flow

### DPIM - Power Flow

Alternating Current (AC) Used/Created By Motors/Generators



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# ALLISON HYBRID

## DPIM



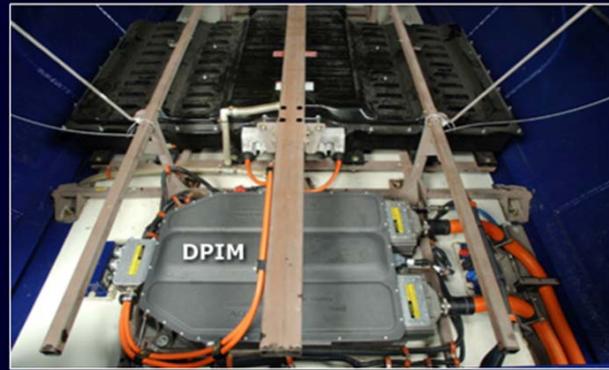
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## Dual Power Inverter Module (DPIM)

### Modes Of Operation

- The DPIM has five basic operating modes:
  - *Power Up* – brings the DPIM online, last .05 seconds.
  - *Stop* – Inverter is ready but not passing or implementing a torque command.
  - *Run* – inverter is passing current to a motor in response to a TCM command.
  - *Fault* – a fault has been detected, no current is passed to a motor.
  - *Power Down* – takes the DPIM offline, lasts 5 seconds.

Typical DPIM Location (New Flyer Roof Mount)



Rear Of Bus

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## RESOURCES: DPIM Theory of Operation

### DPIM THEORY OF OPERATION

The DPIM, or Dual Power Inverter Module, interfaces between the E<sup>V</sup> Drive™ Unit and the ESS. It includes two AC/DC power inverters, an A side and a B side. The A side is dedicated to Motor A and the B side is dedicated to Motor B. The DPIM is capable of a 3-phase 160 kW (160,000 watt) continuous AC output, with a peak output of 300 kW (300,000 watts.) Both inverters are independent from one another, but operate on a common DC bus. The mass of the DPIM is 160 pounds and the unit is approximately 4 feet long, 3 feet wide and 6 inches high.



The DPIM requires the presence of several inputs before torque production will begin:

- A CAN torque command from the TCM.
- A 12 volt torque-enable input (a 12 volt ignition input).
- A 12 volt wakeup signal on both A and B inverters.
- 12 volt power and ground signals with a minimum of 10.5 volts required for IGBT operation.
- Voltage on the DC bus resulting from a complete ESS pre-charge and a "system operational" status indication.

During system shutdown, the DC bus is discharged by pushing current back through the motors. This creates heat instead of torque and allows the DC energy to dissipate from the system.



# ALLISON HYBRID

## DPIM



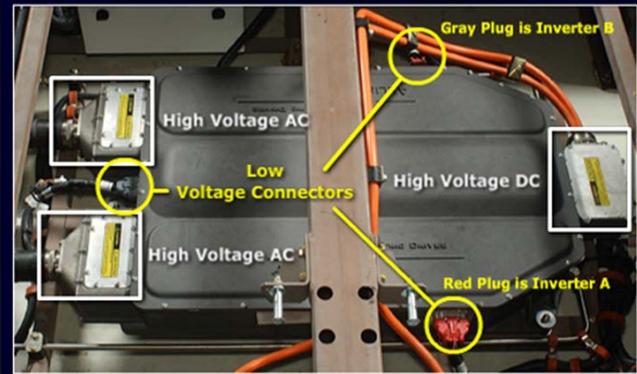
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## Dual Power Inverter Module (DPIM)

### Electrical Connections

- High voltage connection lug boxes:
  - Two AC lug boxes (one for each motor) are located at one end of the unit.
  - A single DC lug box is located at the opposite end of the unit.
- Low voltage connections:
  - Two 32-pin connectors (one for each motor) are located on each side of the unit.
  - A single 24-pin connector is located between the two AC lug boxes.

#### High And Low Voltage Connections



**NOTE:** Always follow the Electrical Disconnect Verification Procedure in Troubleshooting Manual TS3715 when performing any work on the H 40/50 EP System.



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## RESOURCES: Electrical Disconnect Verify



**NOTE:** This resource link has multiple pages and information changes frequently. Reference the source document for complete, current information.

### EP 40/50 SYSTEM™ TROUBLESHOOTING MANUAL

#### ELECTRICAL SAFETY

The Allison Electric Drive EP 40/50 System™ uses potentially hazardous electrical energy. All EP 40/50 System™ components are identified with warning labels or symbols (see Figure 1, Figure 2, and Figure 3). DO NOT attempt to service components containing potentially hazardous electrical energy if you are not trained to do so.

#### WARNING!

All persons working with potentially hazardous electric energy should familiarize themselves with safe electrical work practices. Paragraph f in Electrical Safety section contains references to publicly available documentation that can assist a technician in developing the safe electrical work practices required to service the EP 40/50 System™ electrical system.

#### EP 40/50 System™ Normal Operating Conditions

ESS Voltage Range: 432–780VDC  
DPIM Voltage Range: –350 to +350A



V10323.00.00

Figure 1. DPIM Warning Label



V10322.00.00

Figure 2. ESS Warning Label



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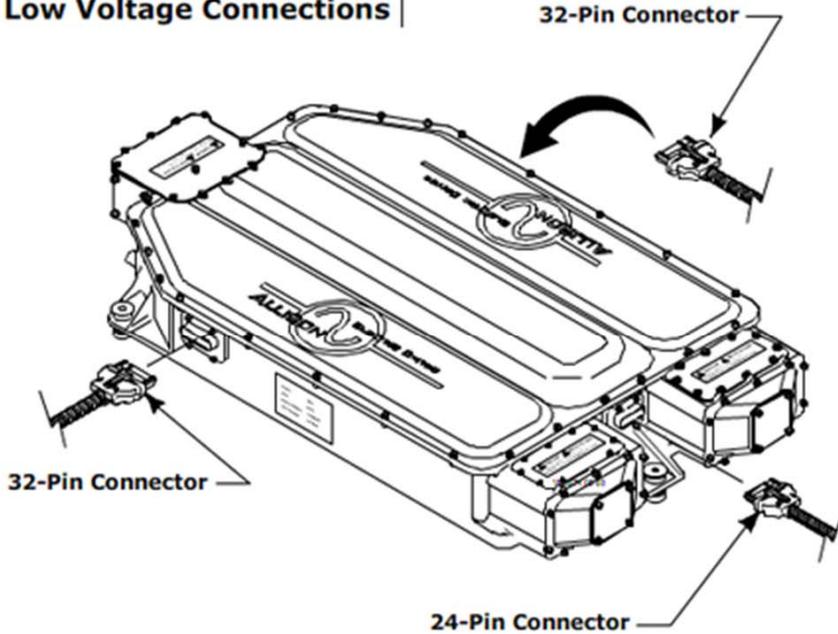
## RESOURCES: DPIM Low Voltage Connections



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### DPIM Low Voltage Connections

#### DPIM - Low Voltage Connections



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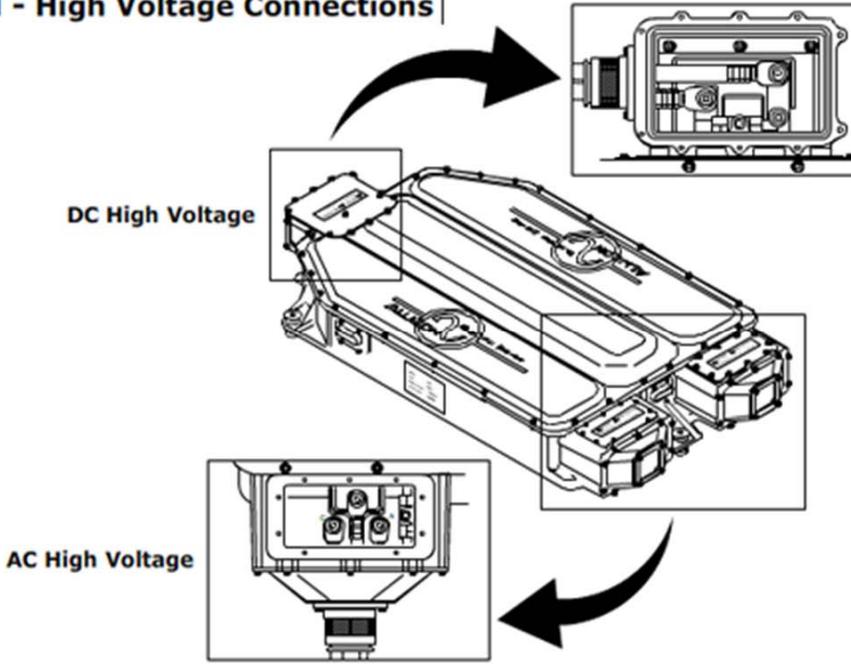
## RESOURCES: DPIM High Voltage Connections



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### DPIM High Voltage Connections

#### DPIM - High Voltage Connections



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## RESOURCES:

## DPIM High Voltage Connection Internal



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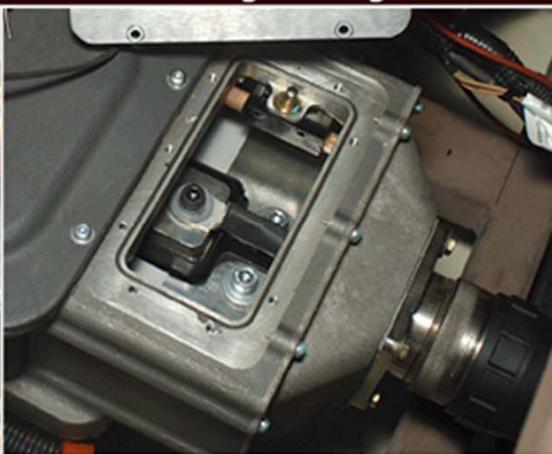
## DPIM High Voltage Connection Internal

### DPIM - High Voltage Internal

DC High Voltage



AC High Voltage



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