BALANCE™

HYBRID ELECTRIC

Azure Dynamics Balance™ Parallel Hybrid Electric Vehicle 2009 Ford E-450 Body Builders Layout Book Supplement

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Revision Record						
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1 FORWARD

This document is a supplement to the Ford 2009 Body Builder Layout Book. The purpose of this document is to inform Second Unit Body (SUB) builders of additional components that are added to Ford E-series stripped chassis and cutaway chassis once hybridized with an Azure Dynamics model year 2009 Balance™ Hybrid Electric Drive System.

The information herein is intended to aid SUB manufacturers in the design and installation of SUB's onto Balance™ Hybrid chassis. Specifically, to ensure that SUB manufacturers are aware of all additional component functionality, location, weights and requirements for the purposes of designing SUB's that do not damage or interfere with the Balance™ Hybrid System.

In General, the following steps must be followed when installing a body or other accessories to the Hybrid E-450 chassis:

1. Disconnect High Voltage Battery in order to minimize the risk of any inexperienced assemblers or technicians getting hurt – see section:
   6.2 Disconnecting the High Voltage System
2. If welding on the chassis, the hybrid controllers must be disconnected – see section:
   8.2 Welding on the Vehicle
3. Install Mud flaps – see section:
   8.9 Mud Flaps
4. Install body skirts – see section:
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5. For Strip Chassis Only:
   a. Install Cabin Heater Pump – see section:
      8.6 Cabin Heater Installation
   b. Install Hybrid Indicator Lights to Dash – see section:
      8.4 Dashboard LED and Switch Installation
   c. Install Decals to under hood area – see section:
      8.12 Underhood Decals
6. For Shuttle Bus Cutaway Chassis Only:
   a. Install TM16 Compressor and plumbing to Body A/C system – see section:
      8.3 Air Conditioning Installation

This document does not replace any publications by Ford Truck Body Builder Advisory Service; Ford's Body Builder Layout Book should be referenced for all Ford specific information. At the time this document was released, the Ford Body Builder Layout Book for the 2009 E-450 was found at the following web link:
https://www.fleet.ford.com/truckbbas/topics/2009/eseries_wagonvan.html

1.1 About The Company

Azure Dynamics (AZD) develops hybrid electric and electric drive technology for commercial trucks and shuttle buses. AZD is a leader in the delivery of electric and hybrid electric systems, with an accumulation of over 25 million miles of experience.

Azure Dynamics Corporation is a public company trading in Canada (TSX: AZD), in the United Kingdom (AIM: ADC) and in the US (OTCQX: AZDDF).

Azure Dynamics power trains are protected in the United States under the following patents: U.S. 6,909,200; 6,879,054; 6,768,621; 6,643,149; 6,555,991; 6,242,873; 5,898,282 and may be the subject of pending patent applications.

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2 DEFINITIONS

Unless otherwise defined, all terms used in this document are consistent with the definitions found in the Ford 2009 body builder layout book

Some terms used in this document may be followed by an abbreviation that will be used thereafter within the document.

2.1 Abbreviations

AC:	Air Conditioning
AZD:	Azure Dynamics Inc.
CA:	Cut Away
EPAS:	Electric Power Assist
FEAD:	Front End Accessory Drive
I/F:	Interface
ISG:	Integrated Starter Generator
TM:	Traction Motor
SB:	Shuttle Bus
SC:	Stripped Chassis
SUB:	Second Unit Body
WB:	Wheel Base

3 APPLICABILTY

This supplemental Body Builder Layout Book applies to the following Azure Dynamics Balance™ Parallel Hybrid Ford E-450 platforms:

- 2009 E-450 Stripped Chassis (SC), 158 and 176 inch wheelbase
- 2009 E-450 Cutaway (CA) Chassis, 158 and 176 inch wheelbase
- 2009 E-450 Cutaway Chassis, 158 inch wheelbase, Shuttle Bus Prep (SB)

In all cases, the common specifications of the Ford E-450 Chassis are:

DESCRIPTION	2009 Stripped, 158" & 176" WB	2009 Cutaway, 158" & 176" WB	2009 Cutaway, 158" WB, Shuttle Bus Prep
Engine	5.4L Triton V8		
Transmission	5R110 Automatic (Torqueshift), with tow haul and without PTO		
GVRW	14,050 lbs		
Rear Axle Ratio	4.56:1 non limited slip		
Alternator	155 Amp		

Table 1: Vehicle Applicability

4 ADDED CURB WEIGHT

The following table lists the curb weight that is added to the stock Ford E-450 due to the hybrid system. Note that the Ford Body Builder Layout Book should be referenced for the curb weights of the stock chassis corresponding to the appropriate Ford Body Code and Wheel Base.

Model	Ford Body Code	Wheelbase (inches)	Added Curb weight due to Balance™ hybrid System (lbs) – as measured on Front and Rear axles		
			Front	Rear	Total
2009 E-450 Stripped Chassis	E49	158	730	710	1440
2009 E-450 Stripped Chassis	E49	176	800	640	1440
2009 E-450 Cutaway Chassis	E45	158	730	710	1440
2009 E-450 Cutaway Chassis	E45	176	800	640	1440
2009 E-450 Cutaway Chassis, Shuttle Bus Prep	E45	158	636	1029	1665

Table 2: Added Curb Weight due to Balance™ Hybrid System

5 ABOUT HYBRID VEHICLES and the BALANCE™ HYBRID DRIVE SYSTEMS

Balance™ Hybrid Electric drive systems are classified as a full parallel hybrid. The major components are highlighted in Figure 1 below.

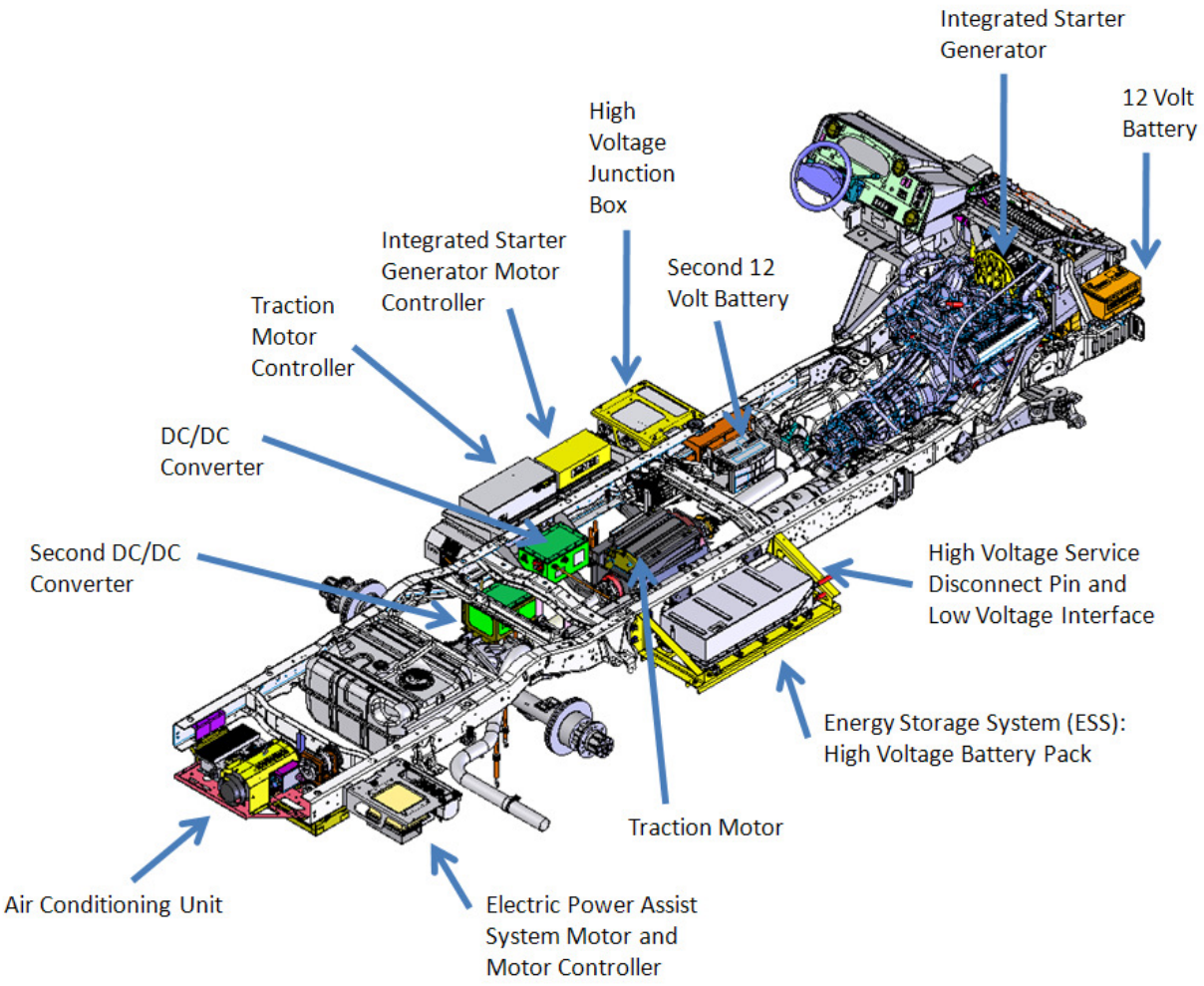


Figure 1: Balance™ Hybrid Architecture (Cutaway Chassis with Shuttle Bus Prep)

The vehicle is propelled by the Traction Motor in addition to the conventional gasoline engine and automatic transmission. The Traction Motor is used for torque assist during vehicle acceleration and to capture energy from regenerative braking events in which case the regenerative energy is stored in the Energy Storage System (ESS).

When the vehicle comes to a stop (e.g. when a driver stops at a red light), the engine will typically shut off in order to save fuel. When this happens, the Electric Power Assist System (EPAS) is enabled to maintain power steering and power brakes and the DC/DC Converter is also enabled in order to charge the 12 Volt battery.

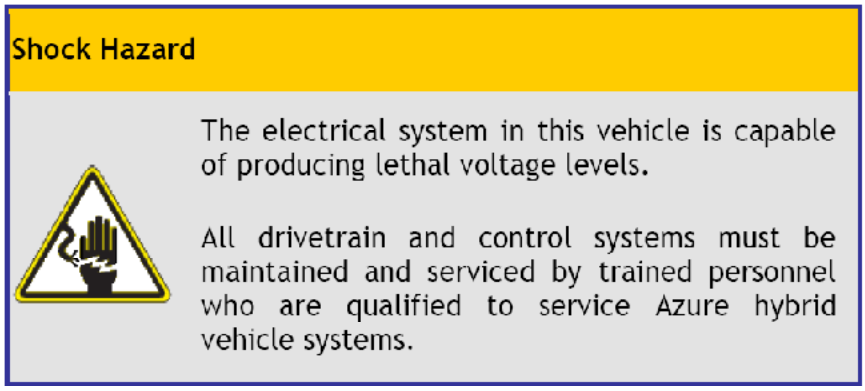
The vehicle also has an Integrated Starter Generator (ISG) mounted to the front of the engine which is used to provide quick re-starts of the engine when accelerating from a stationary position and also to generate power to charge the high voltage ESS. The high voltage system is self contained and it does not have to be plugged into an external power source for charging.

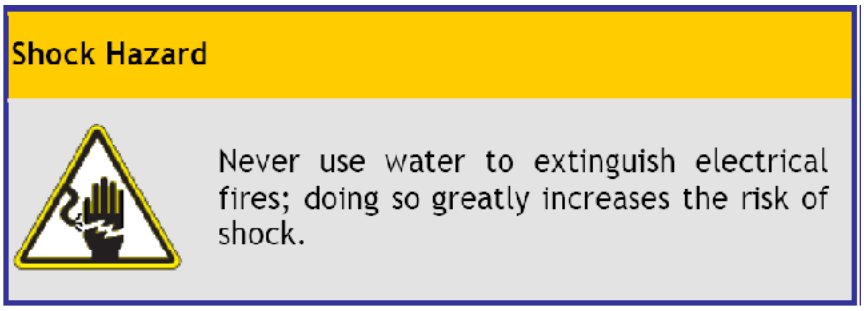
6 VEHICLE SAFETY

6.1 High Voltage System

All of the components highlighted in Figure 1, except 12V batteries, are high voltage and pose a shock hazard if handled incorrectly or compromised during SUB installation. **The high voltage cabling is identified by orange cable, orange looming or orange tape around the loom**. Only qualified technicians should touch these high voltage components and cables.

Safety procedures in Azure Dynamics Service Manual (MAN500727) for 2009 Ford E-450 parallel hybrid electric vehicles should be closely followed.





6.2 Disconnecting the High Voltage System

Warning

Always remember to consult the vehicle safety section before servicing any hybrid component.

It is recommended that the high voltage battery be disconnected before any hybrid chassis has any body build operations completed on it. Various components in the hybrid system contain capacitors that store high voltage charges. Once the battery is disconnected, a multimeter (high voltage) must be used to verify that there is no voltage present. Follow the proper procedures in this manual to disconnect the high voltage battery.

Removing the high voltage battery pack involves contact with potential deadly voltages. All safety procedures MUST be followed to prevent the possibility of an electrical shock.

When working on the battery pack, the keys to the vehicle should be in the possession of the technician. Keys should not be in the ignition.

6.2.1 Tools

- Multimeter (Rated for a working voltage of at least 500 V DC)
- Electrical safety gloves (Rated for a working voltage of at least 500 V, i.e. ASTM class 00 or better)

6.2.2 Disconnection Procedure

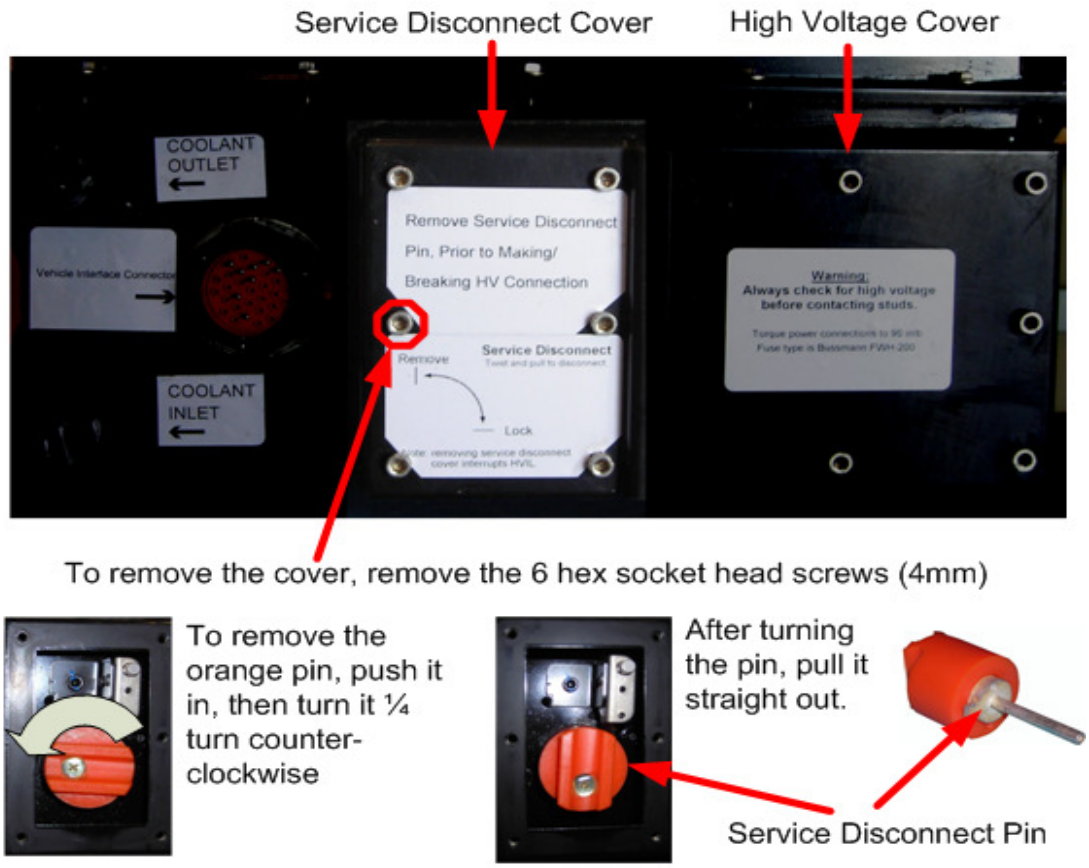
- Turn the ignition key OFF and remove the key from the ignition
- Clean the front area of the battery pack to remove dirt and debris
- Remove the low voltage connector C053S from the front of the battery pack by turning counter clockwise approximately ¼ turn (Figure 2)

Figure 2: Removing Low Voltage Connector from High Voltage Battery Pack

- Remove the service disconnect cover from the front of the battery pack. (Figure 3)
- Remove the high voltage service disconnect pin from the battery. While wearing insulated gloves, push the Service Disconnect Pin in, turn it ¼ turn counter clockwise, and then pull it out. (Figure 3)

WARNING

- Removing the high voltage service disconnect pin cuts off high voltage from the vehicle, but the individual cells inside the battery pack will remain charged.
- Do not cut into the high voltage battery case or penetrate the battery in anyway.
- Always assume the battery may still be electrically active, until it is verified that there is no voltage.



- When reassembling, insert the pin into the receptacle, aligning the keyed pin with the notch; the handle groove will be in the vertical position.
- Push the pin in and turn it ¼ turn clockwise until it pops into place; the handle groove will be in the horizontal position.

Figure 3: Removing High Voltage Disconnect Pin

- Remove the high voltage cover from the front of the battery pack. (Figure 3)

6.2.3 Verify No Voltage

While wearing insulated gloves, use a multimeter to verify there is zero (or < 1)V across the following points (Figure 4) before handling or disconnecting any high voltage cables.

- positive terminal to negative terminal
- positive terminal to chassis
- negative terminal to chassis
- positive side (right) of fuse to negative terminal
- positive side (right) of fuse to chassis

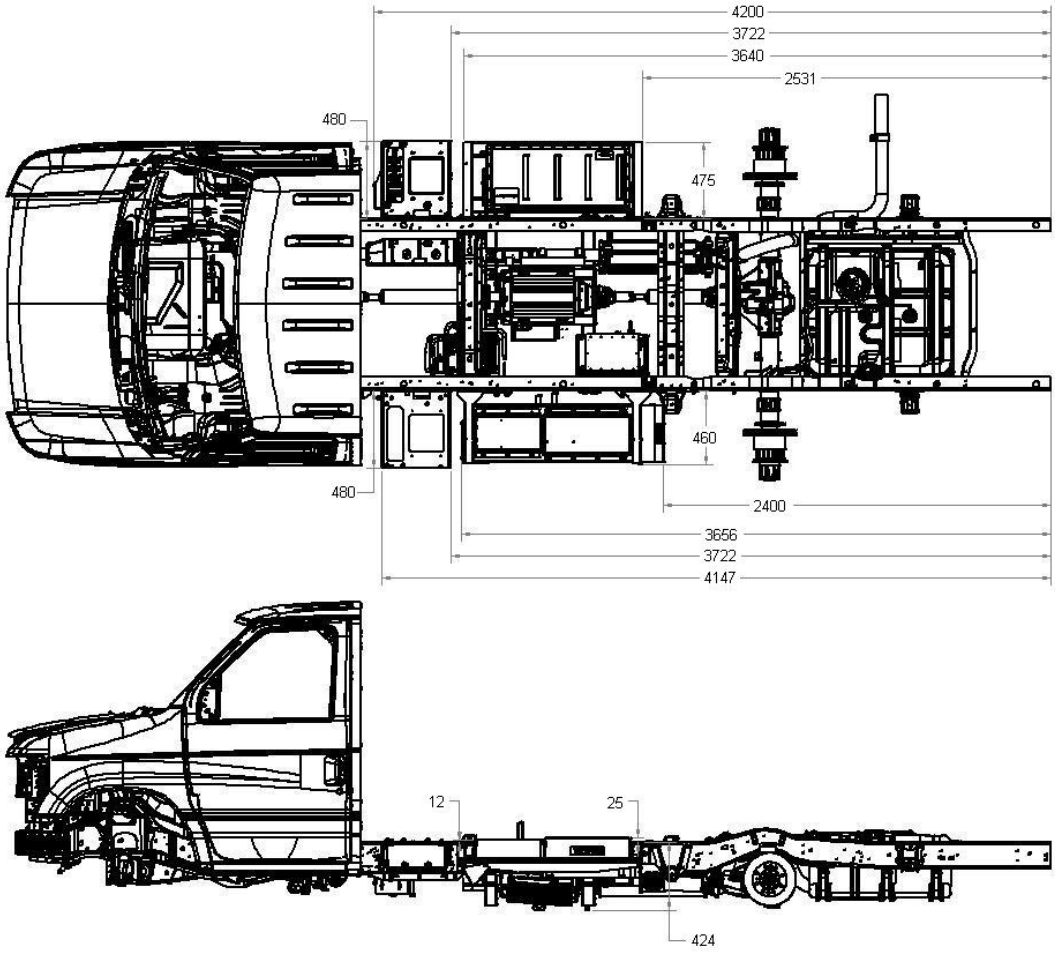
Figure 4: Measuring Points

The meter should show < 1 volt. If the voltage is higher wait five minutes and repeat procedure. **Contact Azure Dynamics if the voltage does not drop to <1 volt.**

7 COMPONENT LAYOUT

7.1 Dimensional Data

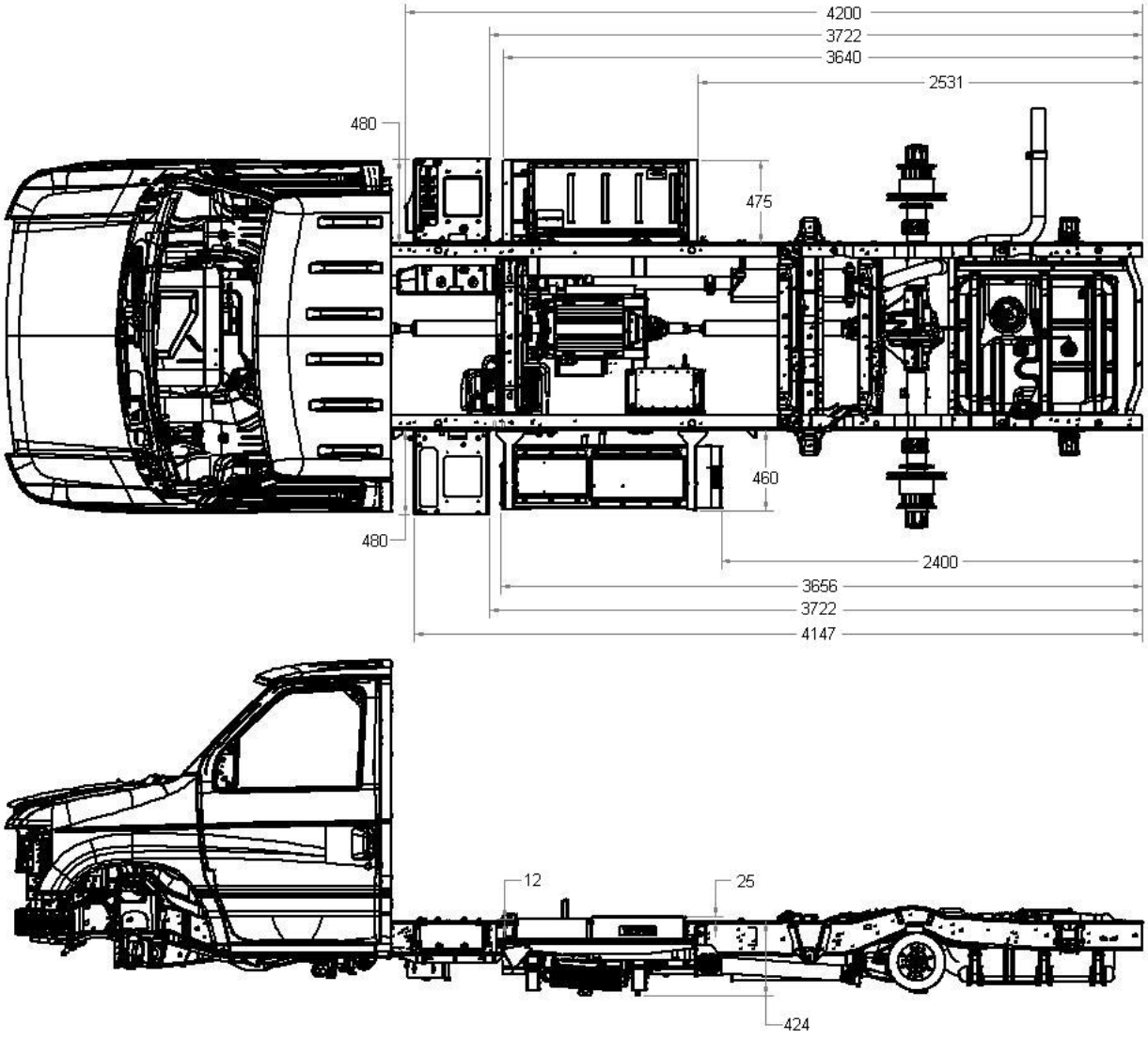
7.1.1 2009 Ford E-450 Balance™ Hybrid Cut Away Chassis, 158" wheelbase



NOTE: All Dimensions in mm

Figure 5: 158" Wheel Base CA Dimensional Data

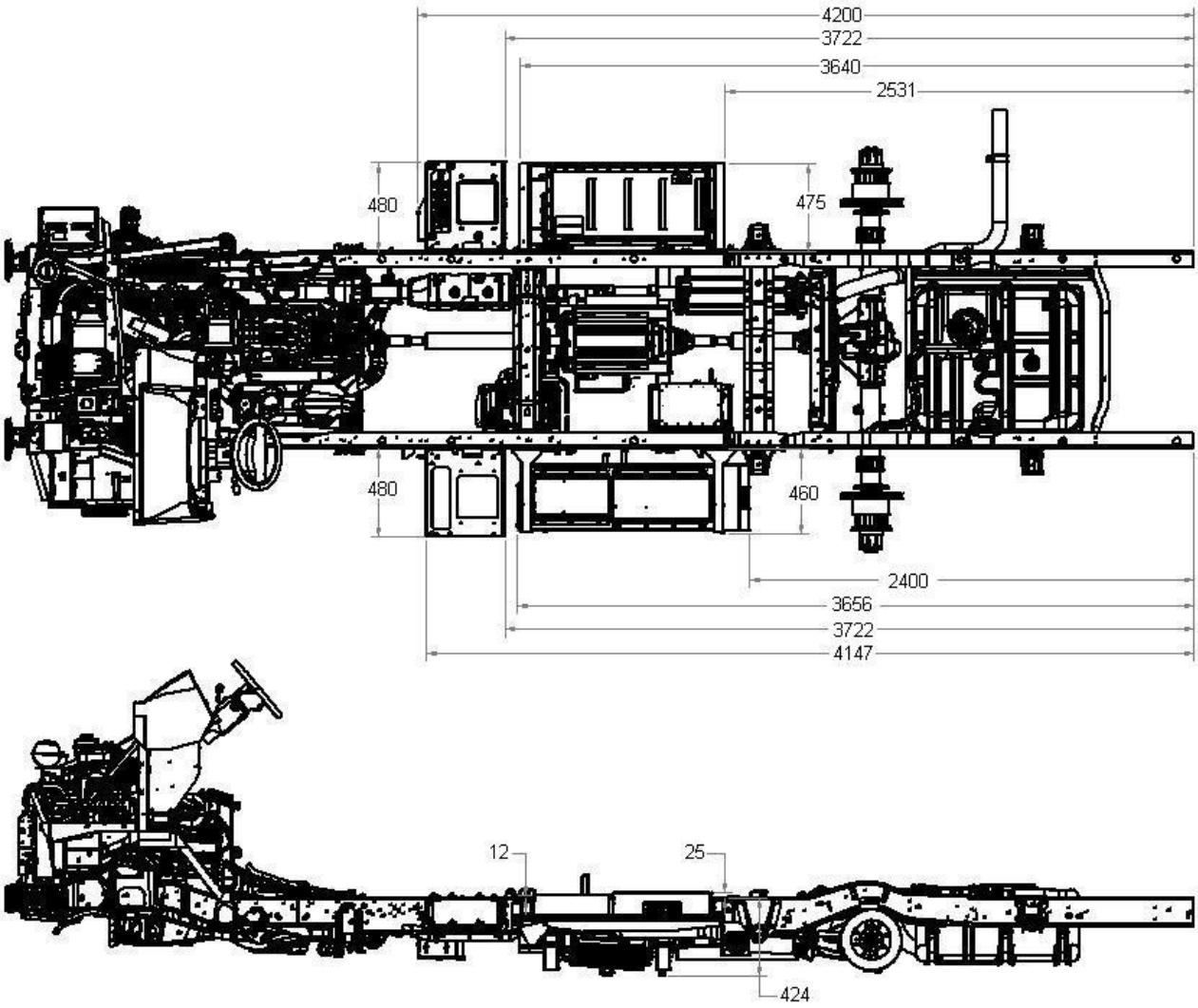
7.1.2 2009 Ford E-450 Balance™ Hybrid Cut Away Chassis, 176" wheelbase



NOTE: All Dimensions in mm

Figure 6: 176" Wheel Base CA Dimensional Data

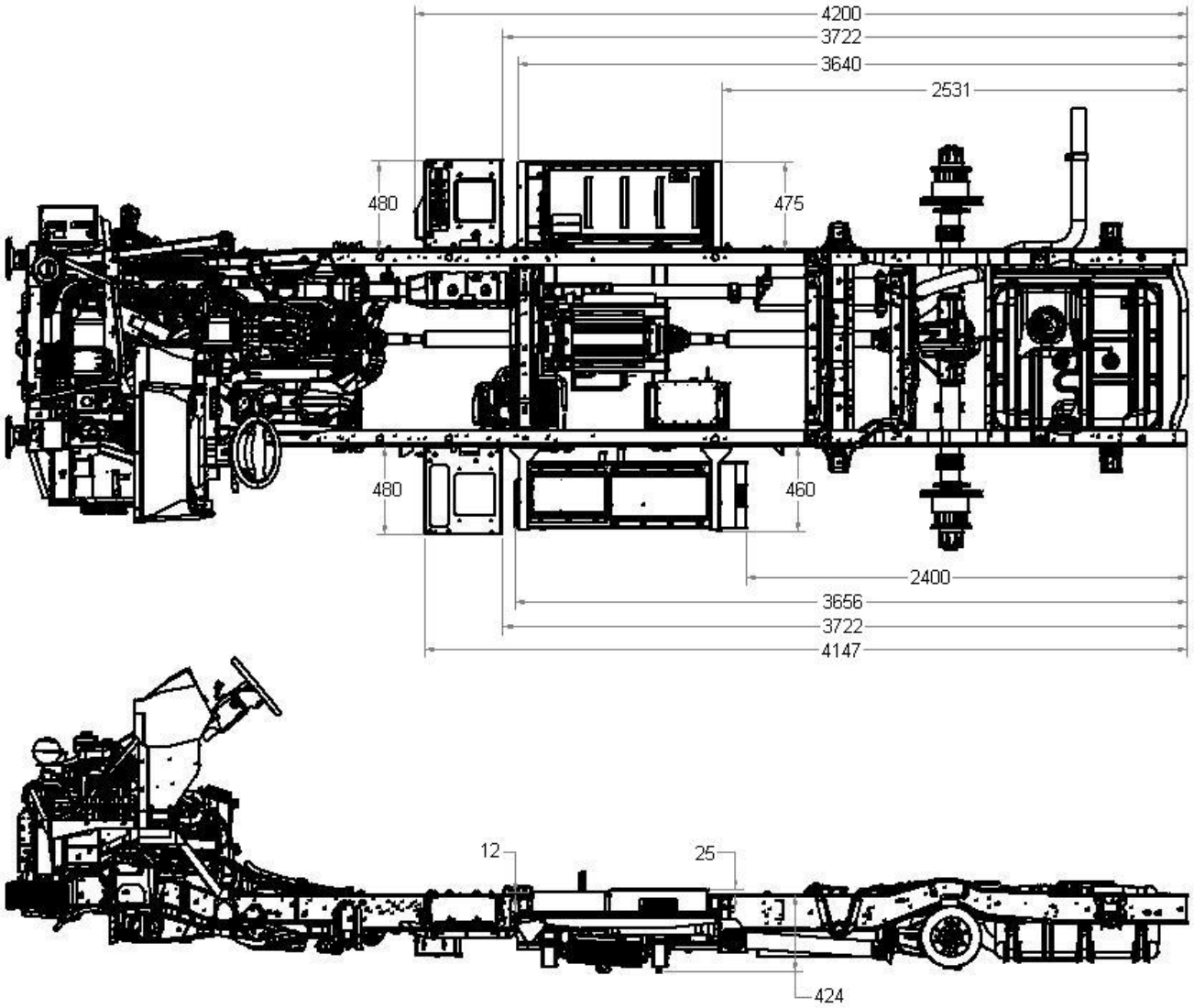
7.1.3 2009 Ford E-450 Balance™ Hybrid Stripped Chassis, 158" wheelbase



NOTE: All Dimensions in mm

Figure 7: 158" Wheel Base SC Dimensional Data

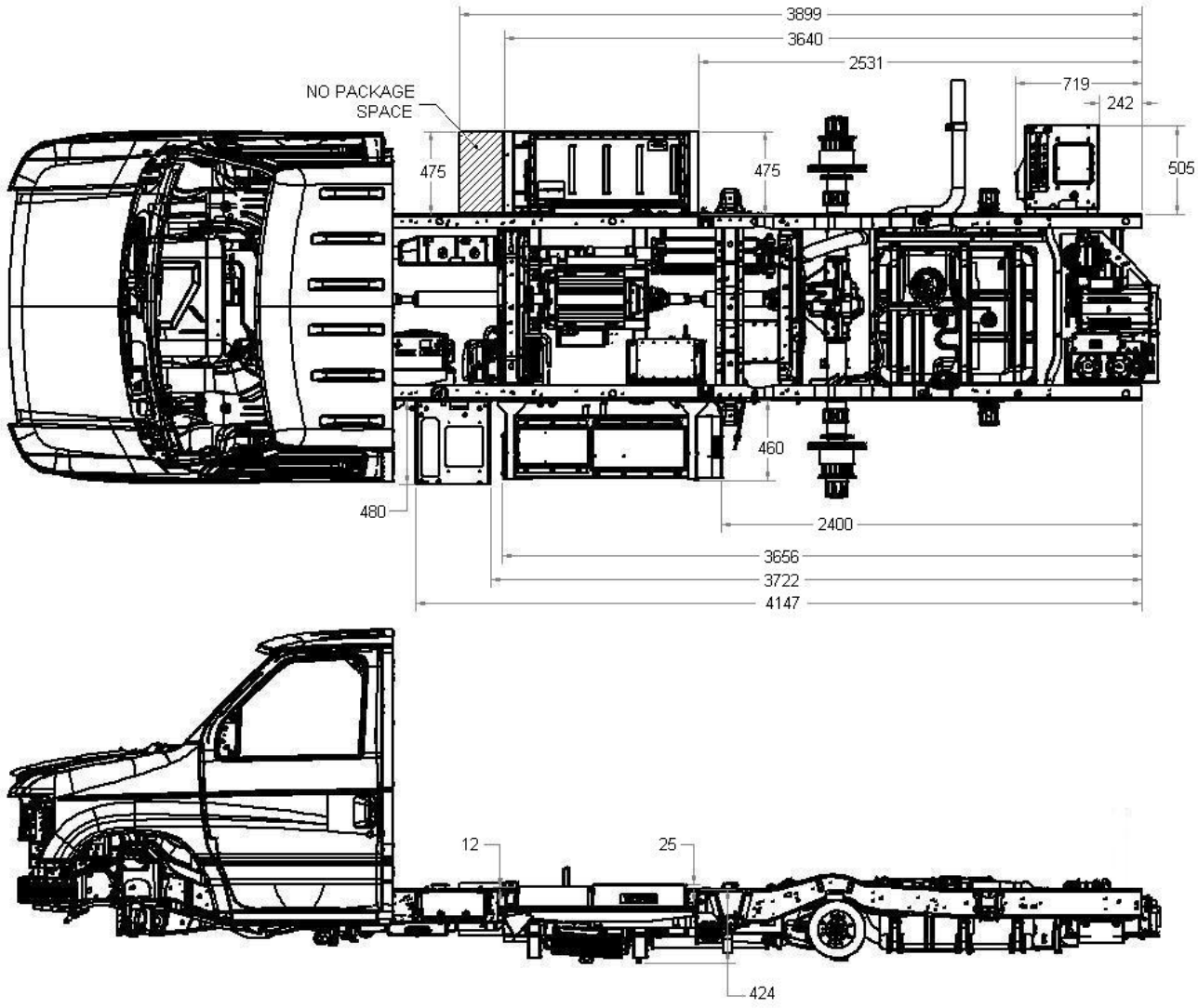
7.1.4 2009 Ford E-450 Balance™ Hybrid Stripped Chassis, 176" wheelbase



NOTE: All Dimensions in mm

Figure 8: 176" Wheel Base SC Dimensional Data

7.1.5 2009 Ford E-450 Balance™ Hybrid Cutaway Chassis, Shuttle Bus Prep, 158" wheelbase



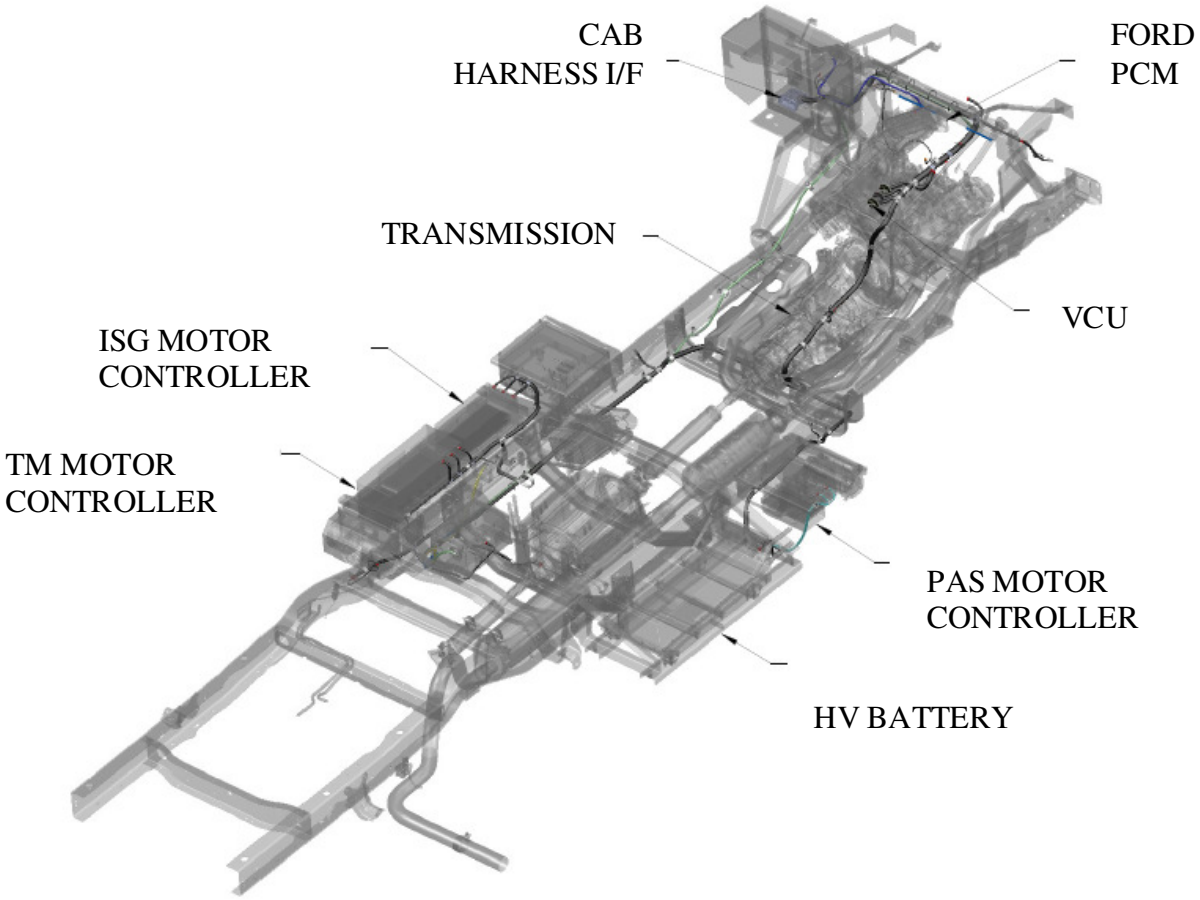
NOTE: All Dimensions in mm

Figure 9: 158" Wheel Base SB Dimensional Data

7.2 Hybrid Wiring Layout

The following subsections provide images of electrical routing on the Balance™ Hybrid Chassis. Care should be taken to carefully inspect these layout diagrams and ensure that no hybrid wiring is moved, cut, pulled, stretched or has chafe points added to its routing. If any wiring is compromised during the body build contact Product Support at productsupport@azuredynamics.com.

7.2.1 Power Train Wiring Harness



PICTORIAL VIEW

Figure 10: Power Train Wiring Harness Routing (Stripped Chassis)

7.2.2 High Voltage Cabling

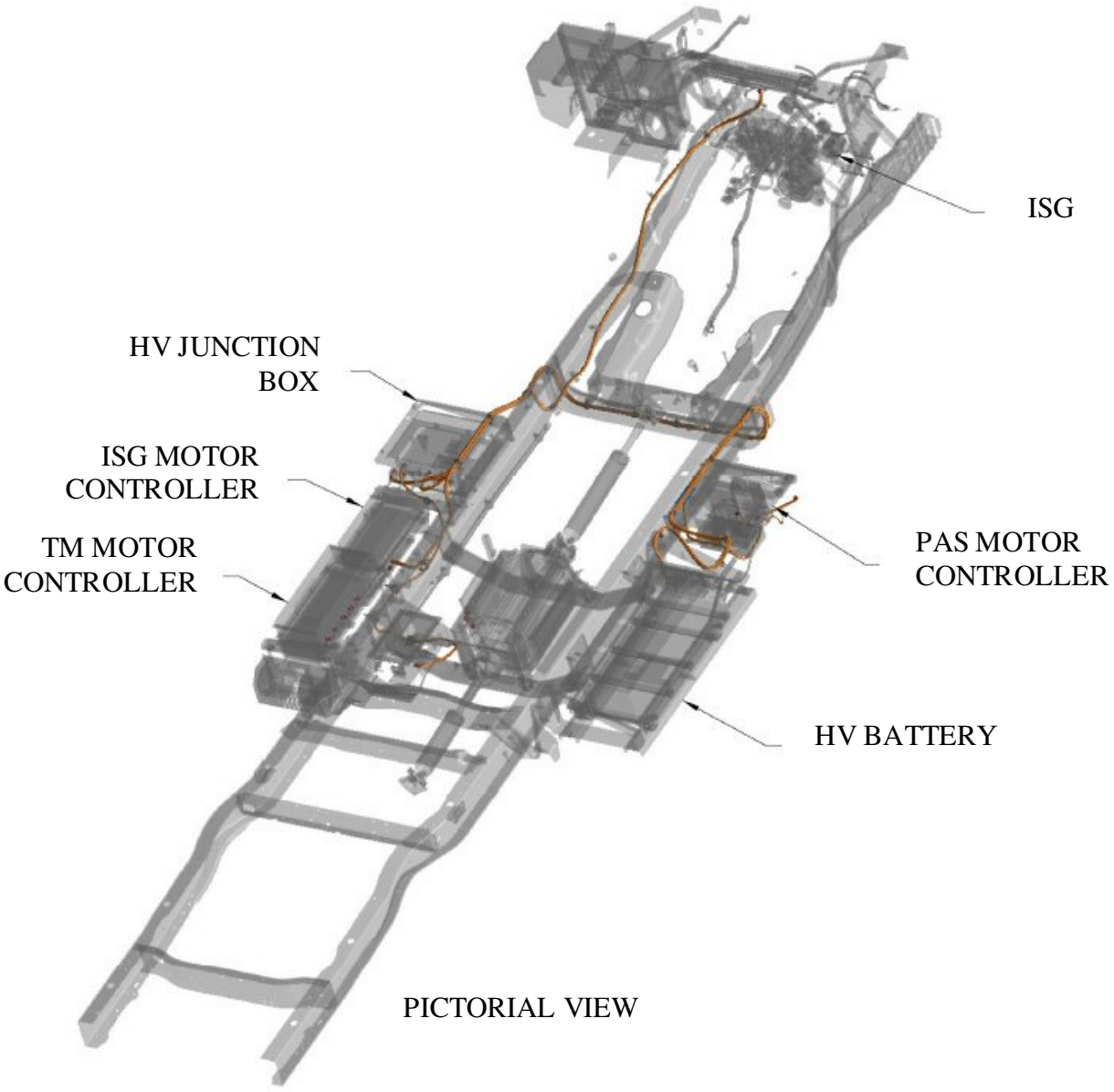


Figure 11: High Voltage Cable Routing (Stripped Chassis)

7.2.3 Power Distribution Harness

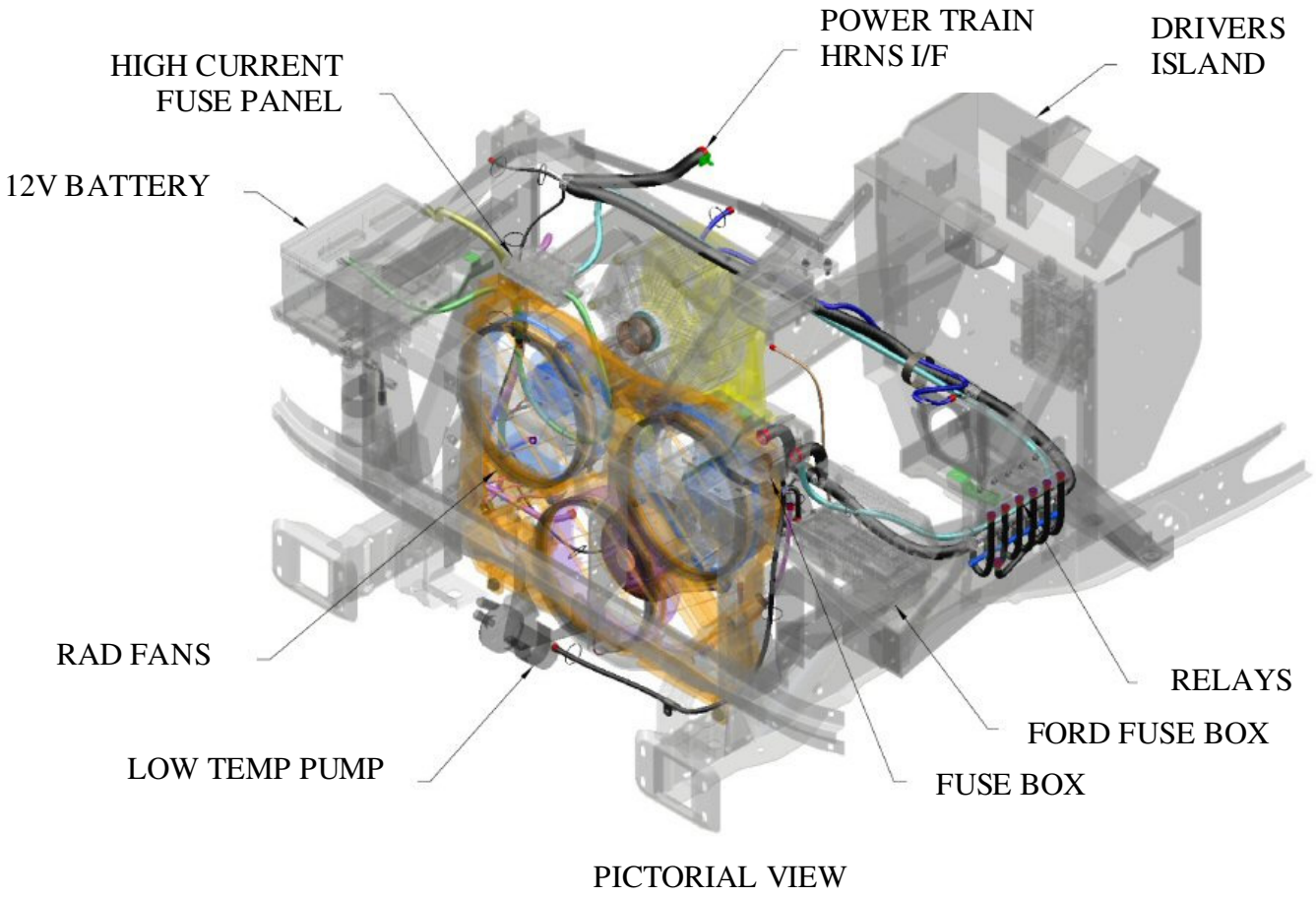
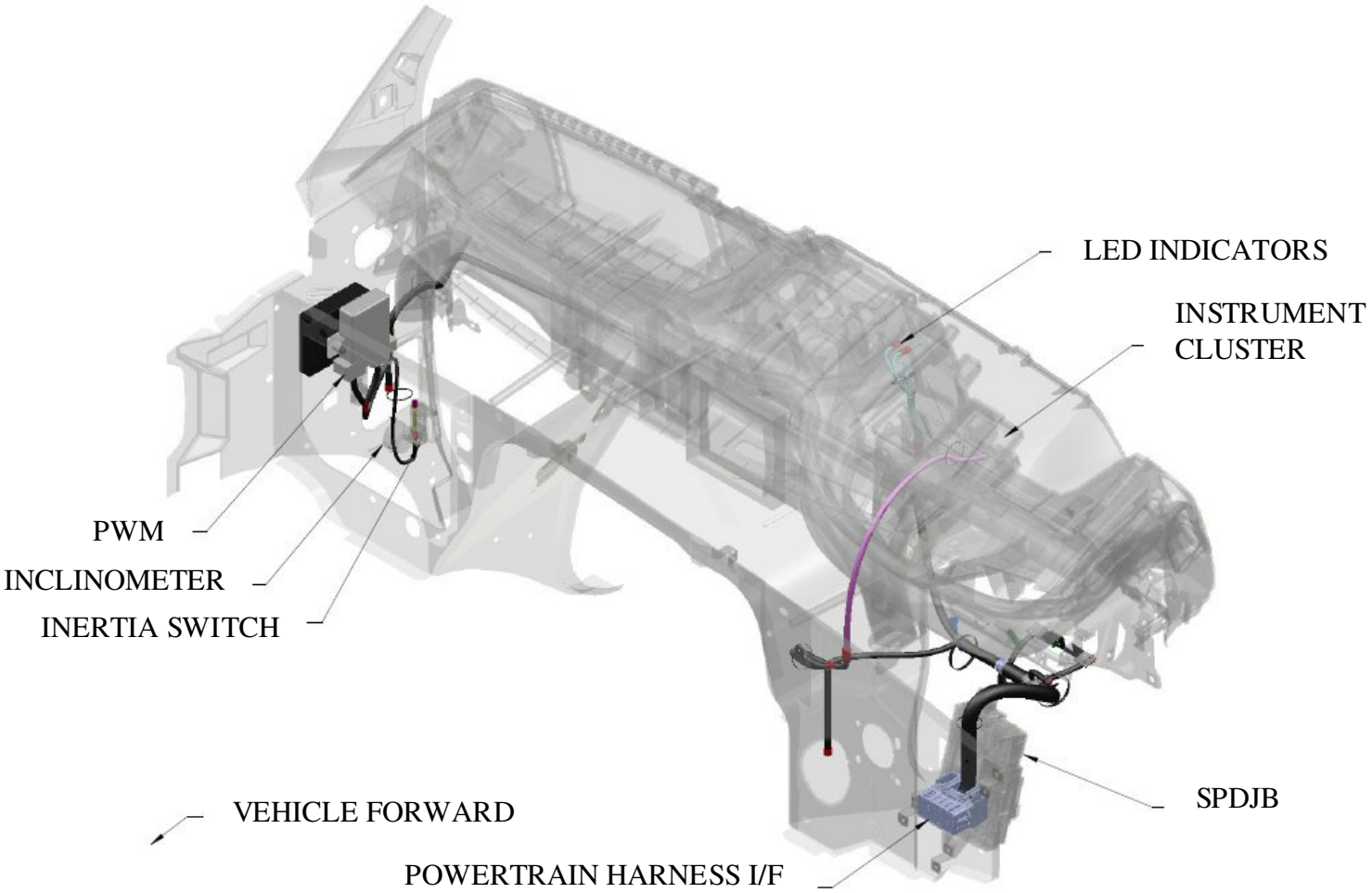


Figure 12: Power Distribution Routing (Stripped Chassis)

7.2.4 Cut Away Cab Harness



PICTORIAL VIEW

Figure 13: Cut Away Cab Harness Routing

7.2.5 Stripped Chassis Cab Harness

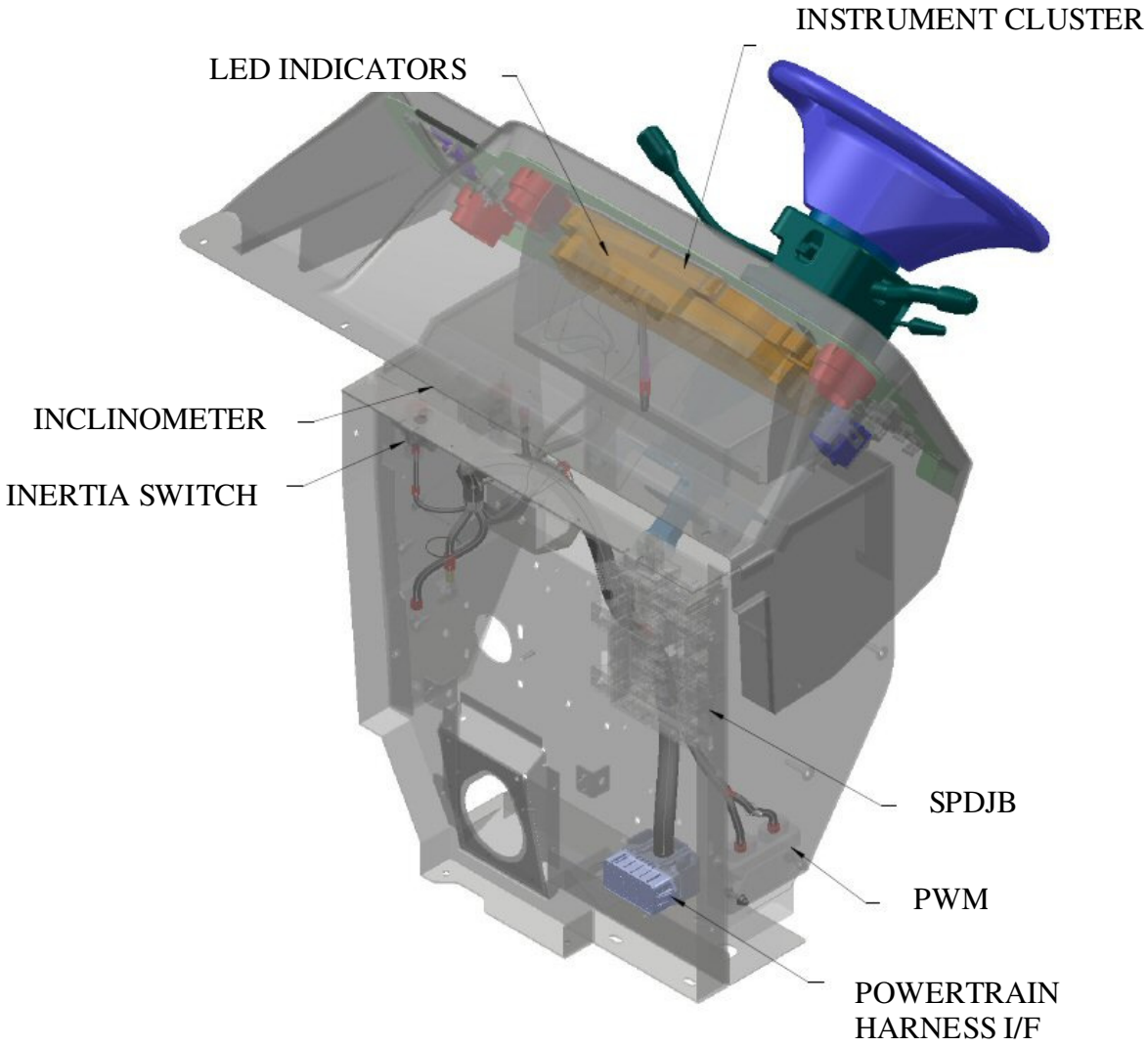


Figure 14: Stripped Chassis Cab Harness Routing

8 BODY BUILD PRECAUTIONS, REQUIREMENTS, and SPECIAL PROCEDURES

The following subsections outline precautions, requirements and procedures that are specific to the Balance™ Hybrid chassis, and must be closely followed to prevent damage or injury.

8.1 No Step Areas

Many hybrid components are not to be used as a step at any point during the body build. Figure 15 below shows the components that are added to the stock chassis and identifies whether it is suitable to stand on during the SUB build.

In addition all Hybrid wiring should not be stepped on, refer to section7.2 Hybrid Wiring Layout for reference to where these cables are routed.

NOTE: PARTICULAR ATTENTION IS TO BE PAID TO AVOIDING THE APPLICATION OF ANY PRESSURE ON THE VCU. THE VCU IS LOCATED NEAR THE REAR PASSENGER SIDE OF THE CONVENTIONAL ENGINE. AN IMAGE OF THE VCU CAN BE FOUND IN Figure 16.

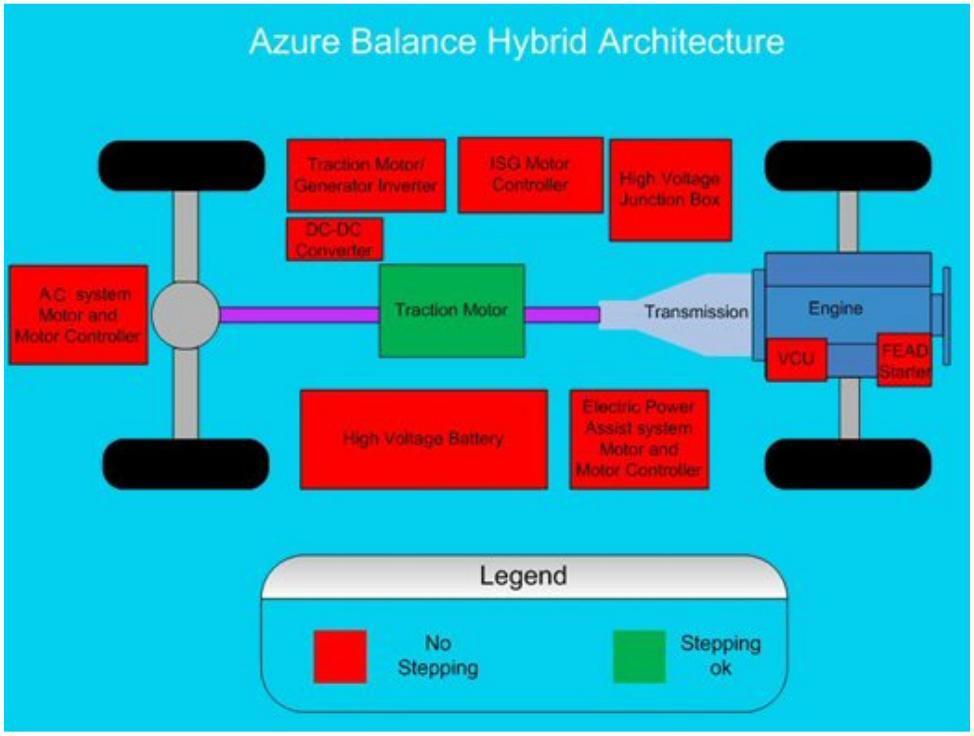


Figure 15: Step / No Step Diagram

8.2 Welding on the Vehicle

Any electrical welding on the vehicle should be avoided if possible. If electrical welding must be performed, follow the guidelines in the Ford Service Manual.

In addition to the Ford Service Manual, the following hybrid components must be disconnected before welding to prevent damage. The appropriate connecter numbers are listed below the hybrid component.

- **VCU communication connectors**
  - C308S, C309S, C310S

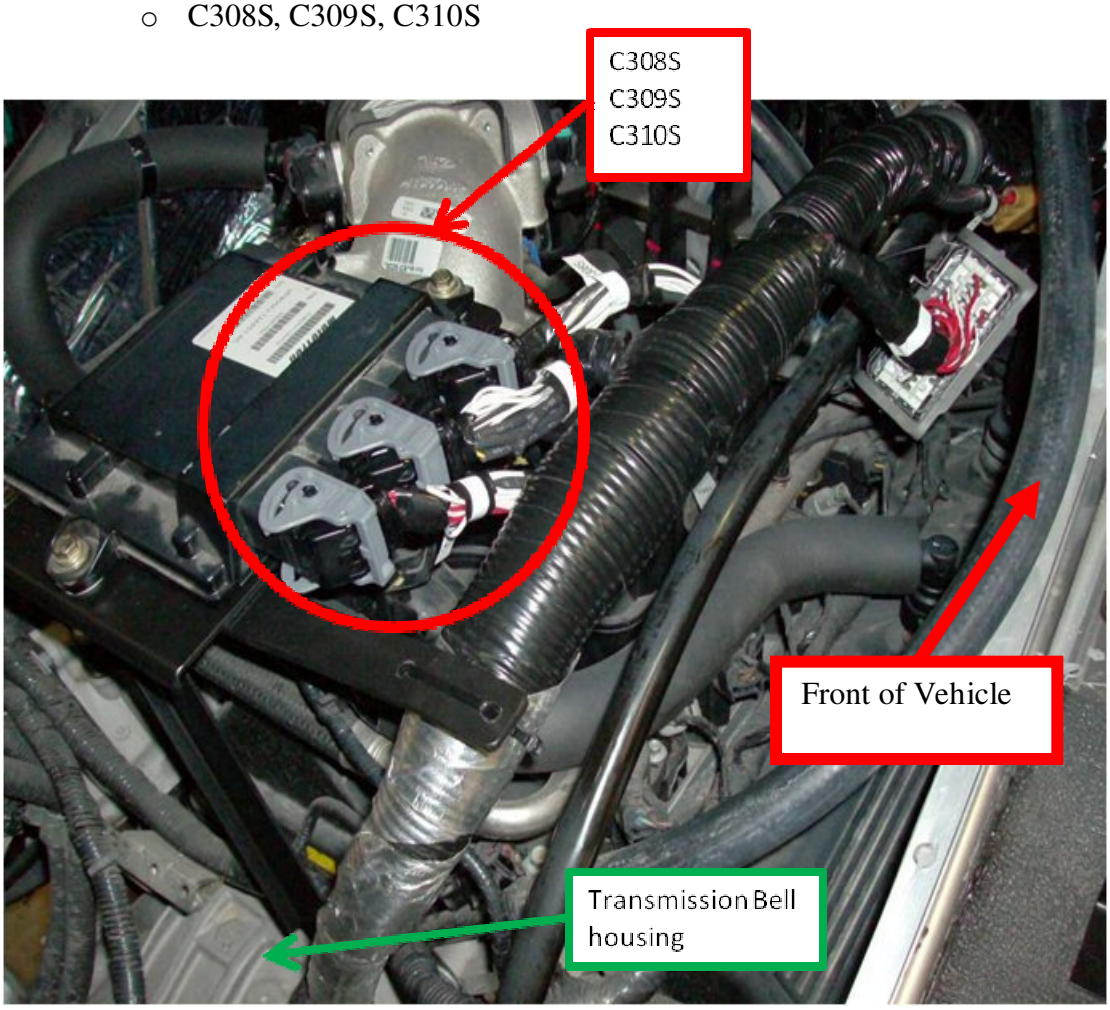


Figure 16: VCU Communication Connectors

- **Low Voltage (12 V) Batteries**
  - Disconnect Battery Terminals

Figure 17: SC 12 V Battery

Figure 18: CA 12 V Battery

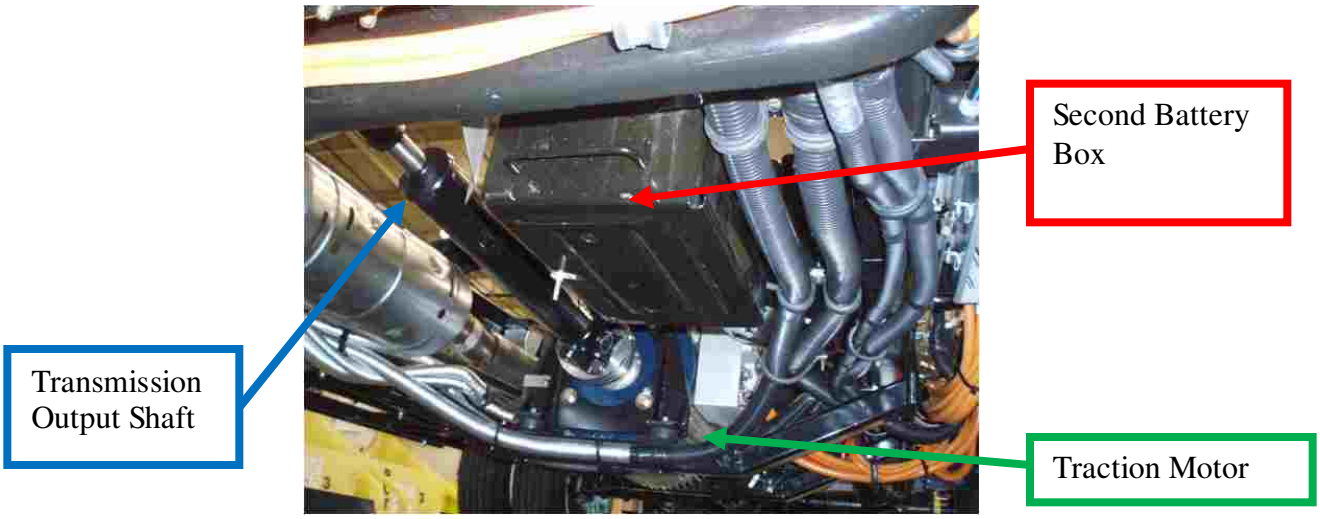


Figure 19: Second 12V Battery (if equipped)

- **High voltage battery pack control connector**
  - C053S

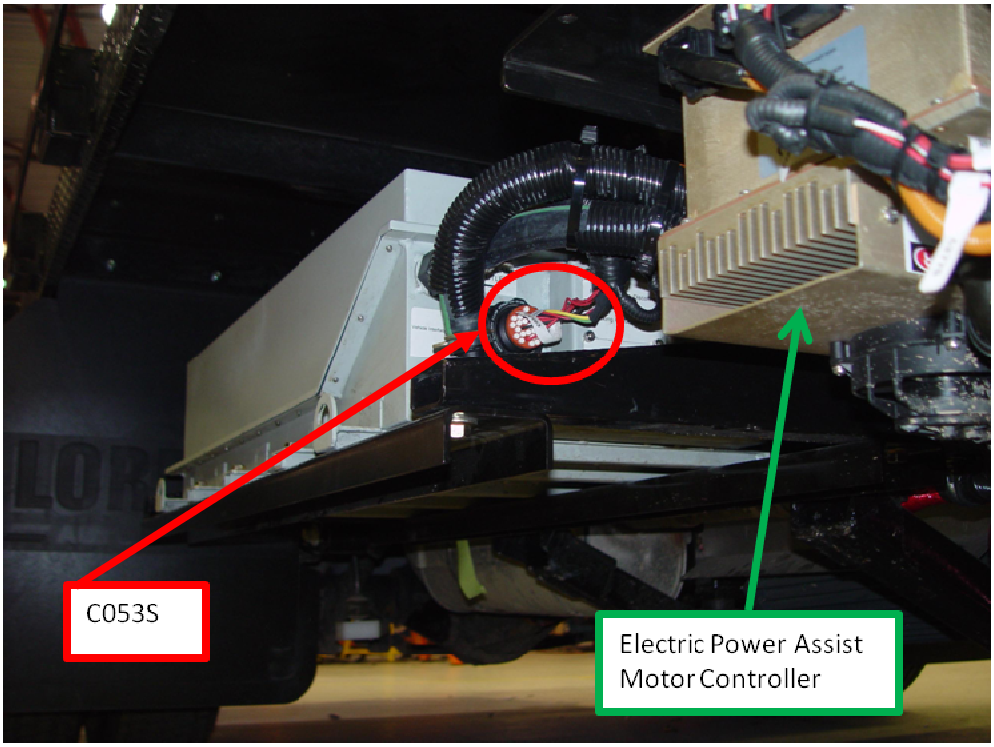


Figure 20: HV Battery Pack Control Connectors

- **Control connectors on the integrated starter generator motor controller**
  - C251S, C252S and C253S

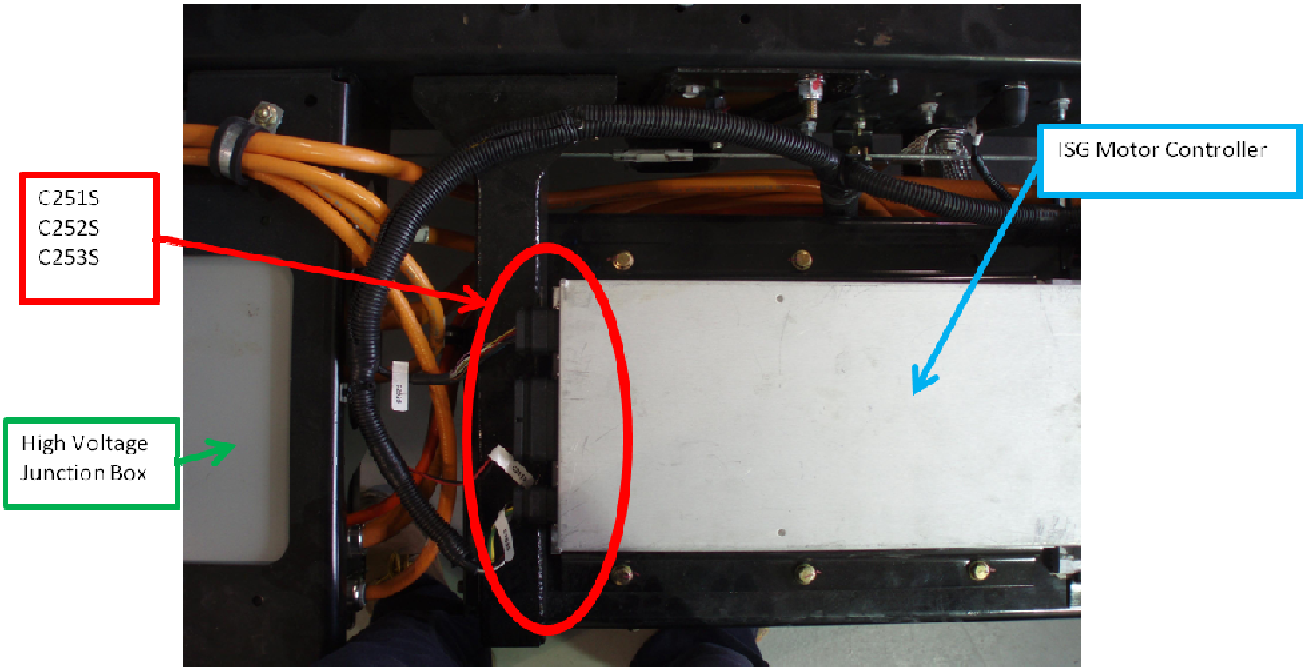


Figure 21: ISG Control Connectors

- **Control connectors on the traction motor controller**
  - C153S, C154S, C155S

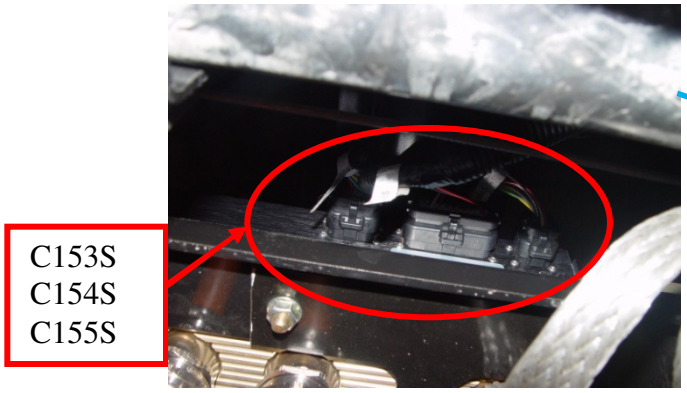


Figure 22: Traction Motor Control Connectors

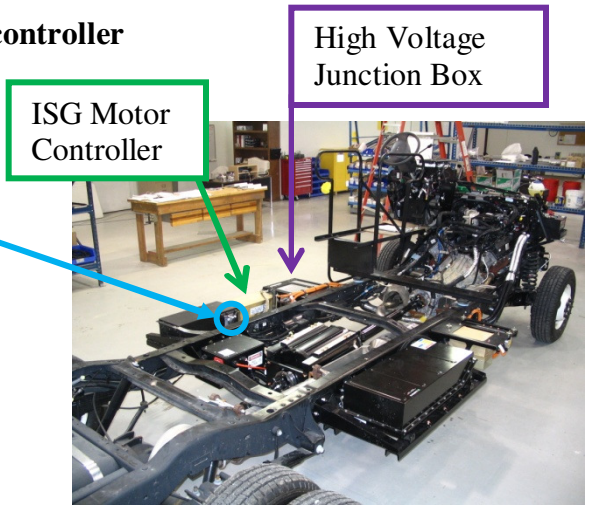


Figure 23: Traction Motor Control Location

- **Control connectors on the Electrical Power Assist (EPAS) motor controller**
  - Stripped Chassis and Cut Away Variant - C156S, C158S, C338S
    - Located as shown in Figure 1
  - Shuttle Bus Variant- C350S, C351S, C338S
    - Located aft of rear axle on passenger side

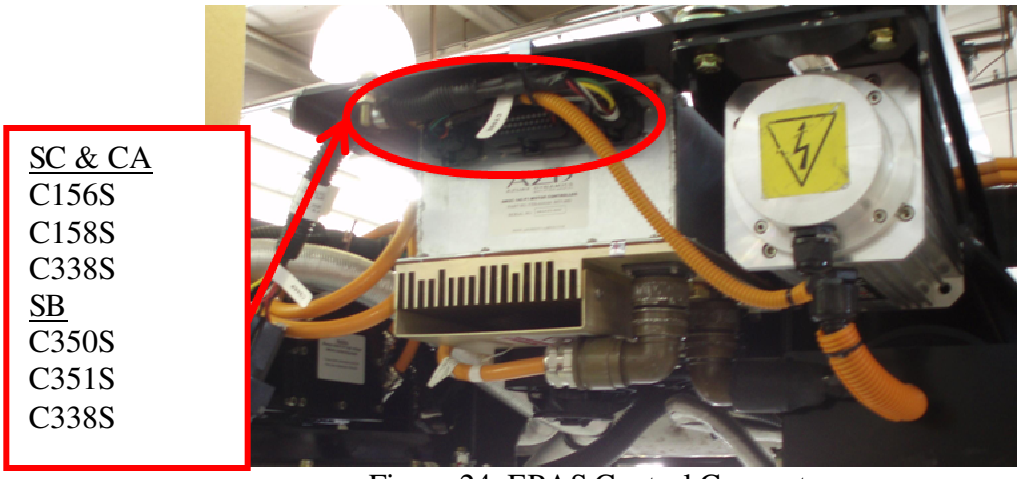


Figure 24: EPAS Control Connectors

- **DC to DC converter control connector**
  - C060S

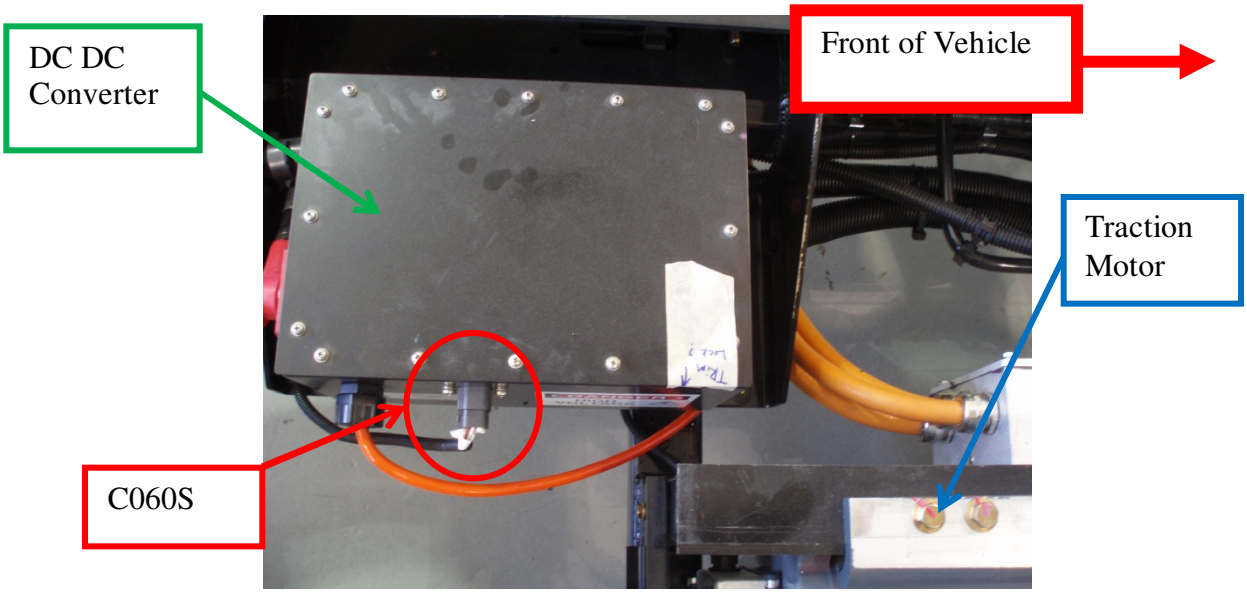


Figure 25: DC DC Control Connector

- **PWM control connectors**
  - C147SX, C148SX
  - **Stripped Chassis Mounting Location**

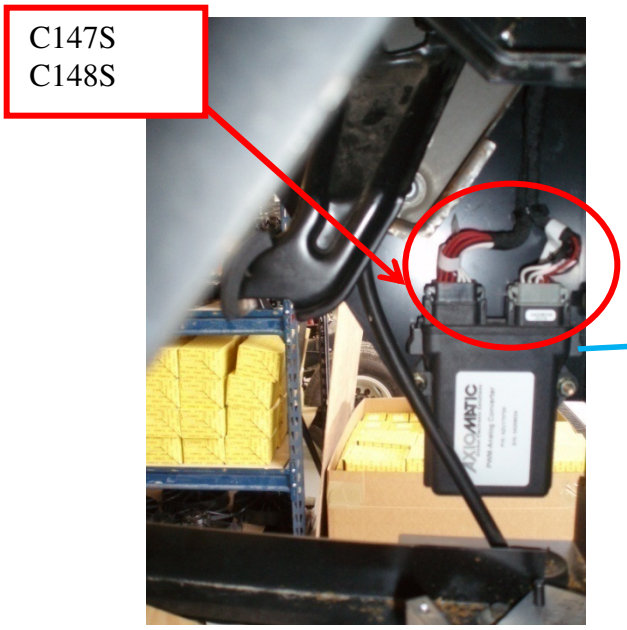


Figure 26: SC PWM Control Connectors


Figure 27: SC PWM Location

- **Cut Away Mounting Location**

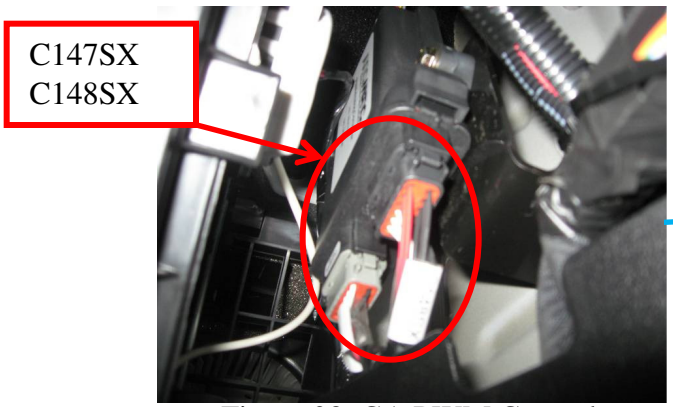


Figure 28: CA PWM Control Connectors

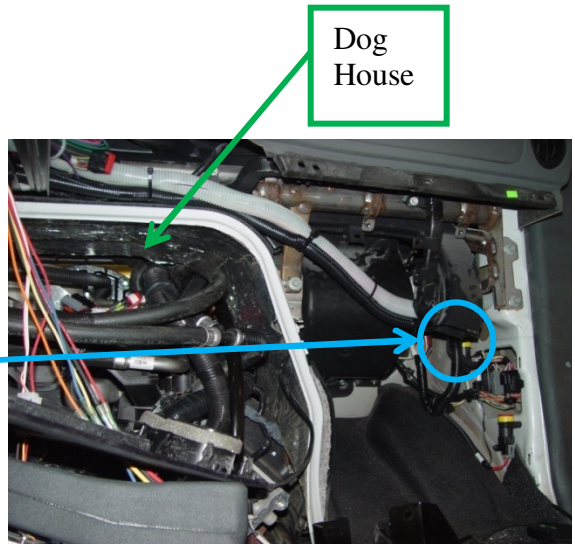


Figure 29: CA PWM Location

Rear Air Conditioning Motor Controller (Shuttle Bus Only)

- NOTE: All three connectors circled in Figure 30 need to be disconnected.
- C259S, C260S, and the unlabeled connector

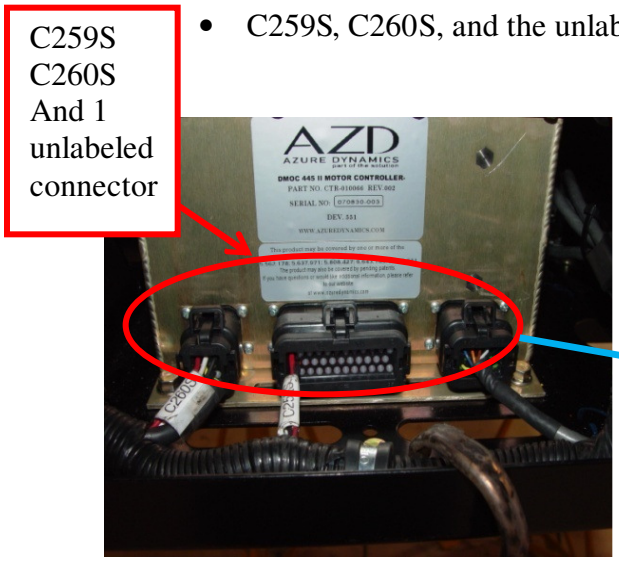


Figure 30: Rear AC Control

Figure 31: Rear AC Mounting Location

8.3 Air Conditioning Installation

This section only pertains to shuttle bus variants which are to be fitted with a secondary rear air conditioning unit to condition the passenger cabin.

Shuttle Bus Prep chassis are equipped with connector C318P on the Switch and LED Harness which is located to the right of the steering column near the bottom of the dash board. Refer to section 7.2.4 Cut Away Cab Harness for the switch and LED harness location.

C318P is the connector for Body AC demand signal and Body AC Power Relay Control. These two signals shall be connected to the body wiring harness for rear AC driver controls.

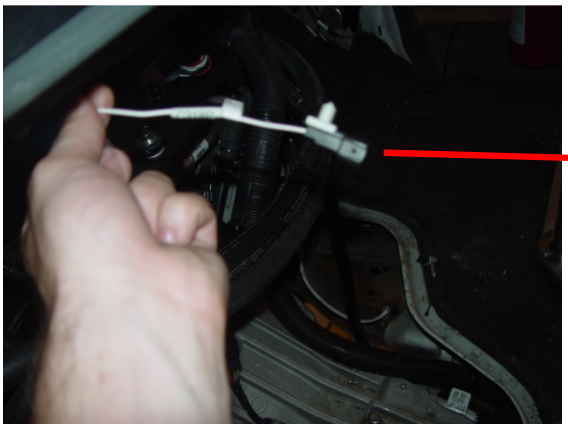


Figure 32: C318P Body AC Demand & Power Relay Control

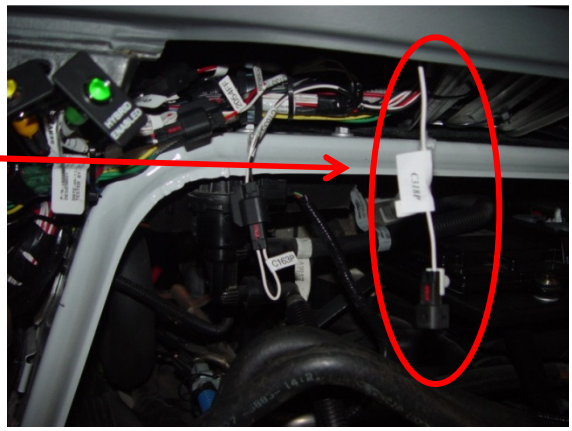


Figure 33: C318P Body AC Demand & Power Relay Control Location

C318P terminal 1 should be supplied with a 12V trigger signal when AC is desired. This signal would be equivalent to the signal used to activate a FEAD AC clutch. C318P is on wire 4253, the mating connector and terminal that the SUB builder will require are EPC (Engineering Plastics Components) 2 position unsealed connector P/N: E-3665 and Yazaki Socket terminal (0.75-1.00sqmm) P/N: 7116-4101-02.

C318P terminal 2 should be connected to the control side of a 12V relay(s) (Figure 34). The other control side of the relay(s) shall be connected to ignition power. The control side can sink a maximum of 2 Amps. On the switched side of the relay(s) the pole shall be connected to 12V battery power and the normally open side to the 12V supply side of the Body AC Fans & Controller. This signal is used to control Body AC if the vehicle enters a derated mode. The SUB builder will be required to supply Yazaki Socket terminal (0.75-1.00sqmm) P/N: 7116-4101-02 for terminal 2 of the EPC 2 position connector and 12V relay(s) equivalent to Tyco P/N: VF4-65F11-S05 for control of the Body AC Fans & Controller.

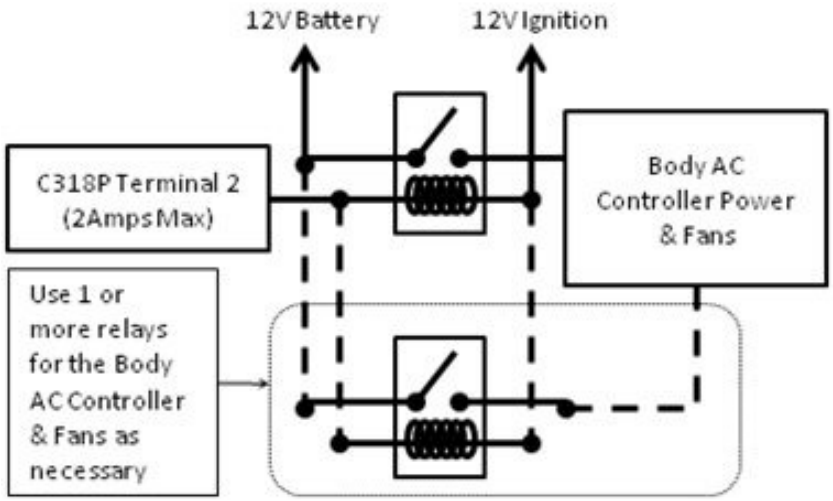


Figure 34: C318P Terminal 2 Connection

Azure Dynamics provides an electric drive system to run the rear AC compressor. Azure Dynamics also provides a pulley in the Dunnage kit that is to be used on the electric drive motor. The SUB builder is to provide the compressor and the remainder of the AC system.

The condenser and evaporator must be roof mounted since the packaging space between the frame rails is consumed by hybrid components.

It is recommended that the SUB builder perform a test to determine the appropriate refrigerant charge for the selected AC components.

NOTE: Balance™ hybrid **s**huttle bus chassis are equipped with an electric rear AC compressor drive since an additional compressor cannot be mounted as a front end accessory. The electric compressor drive is mounted between the frame rails, at the rear of the vehicle behind the fuel tank (Figure 35).

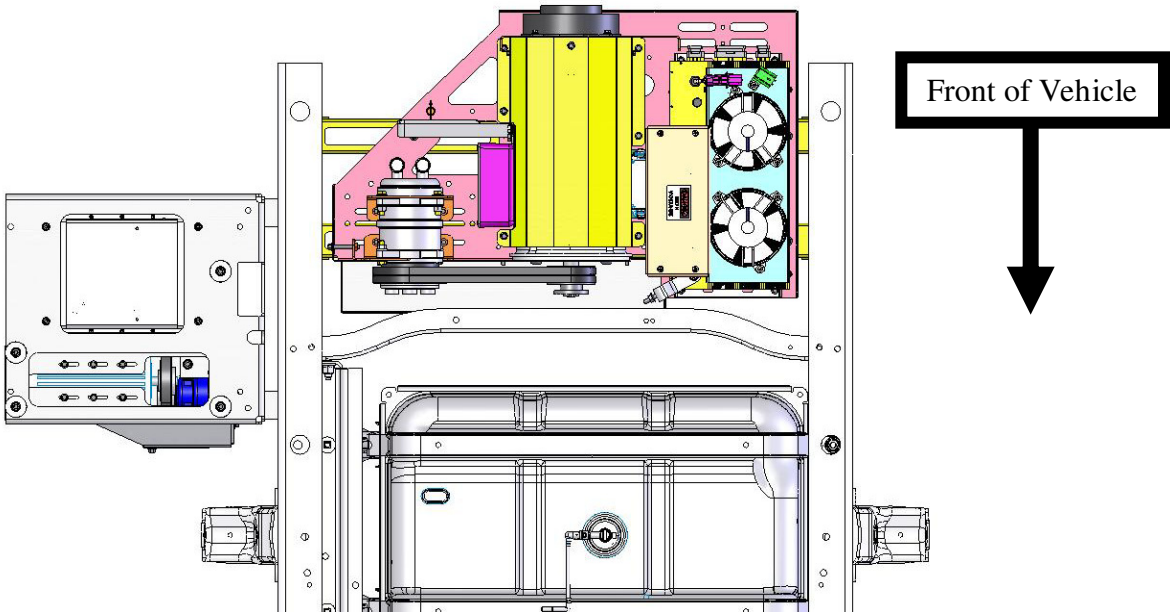


Figure 35: Rear AC System

The electric drive is mounted to a universal compressor mounting plate (shown in pink in Figure 35).

- The Universal Compressor mounting plate is designed to accommodate all Seltec model TM 16 compressors, but the compressor must
  - Have a type 2A pulley and appropriate belt
  - Have a 12V clutch
  - Have a pulley diameter of either 125mm or 135mm

NOTE: Although the electric drive system is designed and optimized for use with a TM16 compressor, a TM08 or TM21 compressor may also be used. A TM08 compressor can be installed using existing brackets and hardware, whereas a TM21 compressor will require an adapter bracket along with new fasteners. Note the adapter bracket design and fasteners for a TM21 compressor configuration is the responsibility of the body builder. Also note that the electric drive system is not capable of providing enough power to obtain full output from a TM21 compressor.

Compressor mounting must meet the following requirements

- Parallel alignment between the compressor pulley and the drive motor pulley must be within +/- 1mm
  - This can be achieved by adjusting the taper bushing position on the electric drive motor shaft

- Refrigerant supply and return lines to the compressor require between 70cm to 90cm of extra hose length. This additional hose is required to lower the entire compressor mounting plate during AC servicing
    - Hoses must be constrained such that they will not chafe on sharp edges during operation

8.4 Dashboard LED and Switch Installation

In order to install dashboard LEDs, C348P must be mated with C348S on the passenger compartment side of the firewall. This connection will connect the Switch and LED harness to the cab harness.

Detailed wiring diagrams for these circuits can be found in the electrical diagrams section of the Azure Dynamics 2009 Ford E-450 Parallel Hybrid Electric Vehicle Service Manual and general layout schematics are shown in the Wiring layout section of this document.

8.4.1 Hybrid Enabled and Hybrid Service Indicators

A green "Hybrid Enabled" and a yellow "Hybrid Service" LED indicator light is installed in the dashboard of stripped chassis, cutaways and shuttle bus cutaways. These lights are installed to the right of the steering column. Figure 36 shows the required orientation of the LED's.

Figure 36: Hybrid LED Mounting

Hybrid Service and Hybrid Enabled lights will be installed prior to arrival at the body builders in most cases. If this is not the case or if these indicators need to be moved follow these steps:
Prepare a location that meets the following criteria:

- Within reach of the driver while seated
- Clearly visible to the driver while seated
- Installed in such a way to eliminate the possibility of wire chaffing over time
- Mounted in an esthetically pleasing and flush manner

To install the yellow "Hybrid Service" LED

- Prepare the dashboard mounting location
- Connect C313P on the LED with C313S on the Switch and LED harness
- Insert the LED into the prepared location

To install the green "Hybrid Enabled" LED

- Prepare the dashboard mounting location
- Connect C314P on the LED with C314S on the Switch and LED harness
- Insert LED into the prepared location

8.4.2 Optional Hybrid Switches and Indicators

Depending on the application (stripped chassis, cutaways or cutaways for shuttle buses) optional switches may need to be installed on the vehicle dashboard.

If the optional switches are to be installed, they will be supplied with the chassis. The switches will be connected and hanging from the Switch and LED harness as shown in Figure 37. The switches will need to be installed to meet the following criteria:

- Within reach of the driver while seated
- Clearly visible to the driver while seated
- Installed in such a way to eliminate the possibility of wire chaffing over time
- Mounted in an aesthetically pleasing and flush manner

Figure 37: Switch and LED Harness

To install the switches

- Disconnect the switches from the Switch and LED Harness
- Prepare a suitable mounting location on the dashboard
- Re-Connect the switch leads to the switch and LED Harness, ensuring the following connection numbers match and are routed through the mounting location
  - C 150S mated with C150P, Regenerative Braking off Switch
  - C167S mated with C167P, EV mode Switch
- Insert the switches into the prepared mounting location

8.5 Additional 12V Battery Installation

If the chassis is equipped with an additional 12V battery, the battery will be mounted on the inside of the frame rail behind the transmission. The additional battery will be wired in parallel with the stock 12V battery.

If a battery disconnect switch is required refer to Figure 38 to determine an adequate location. Figure 38 outlines the routing of the 12V wiring between the 2 batteries.

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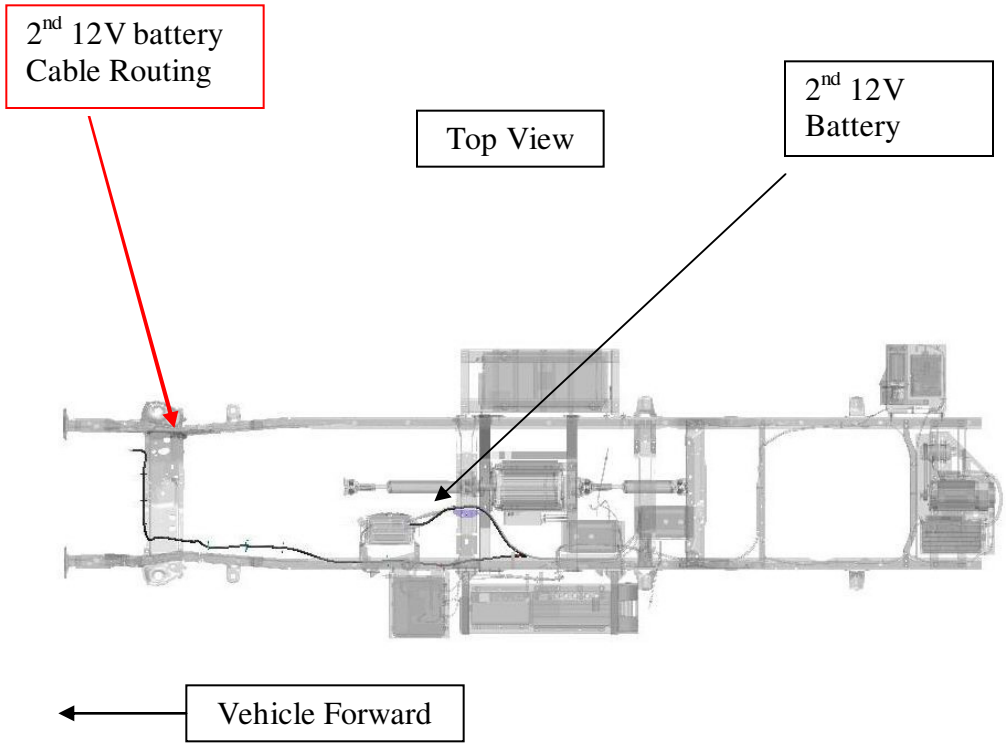


Figure 38: 2nd 12V Battery Cable Routing

8.6 Cabin Heater Installation

This section only pertains to stripped chassis as the cab heater pump is installed on cut away variants during hybridization.

An electric powered cab heater pump is to be installed in line with the conventional heater circulation system. The purpose of this additional pump is to circulate engine coolant through the heater core while the conventional engine is off.

The additional circulation pump will be provided in the dunnage kit and must be installed after the SUB is built.

- On stripped chassis the pump is to be installed when the cab heater core is installed

8.6.1 Mounting

The mounting location of the pump is the SUB builder's discretion; however the mounting must meet the following criteria.

- The pump must be mounted such that it is protected, its mounting hardware does not compromise any other wire or hose routing, and its hoses and wires will not chafe over time
- The pump must not be mounted on any Azure bracketry without written consent of Azure Dynamics Inc.
- The pump must be located in the position indicated by "ELECTRIC POWERED CIRCULATION PUMP" in Figure 39, the loop diagram

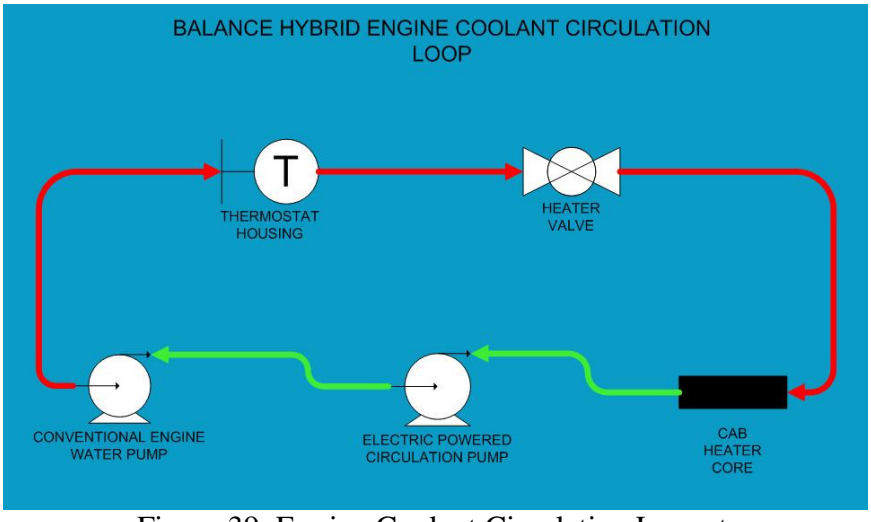


Figure 39: Engine Coolant Circulation Layout

The supplied pump is not self priming and should be mounted such that it is always flooded. The orientation of the pump can be either

- Vertical such that the inlet is above the pump body, see Figure 40.

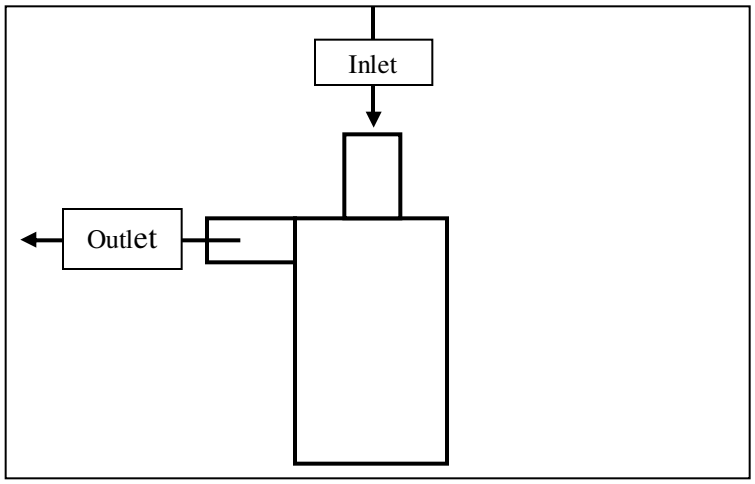


Figure 40: Coolant Pump, Vertical

- Horizontally such that the outlet is above the pump body, see Figure 41 which illustrates the 90° of freedom SUB builders have in outlet fitting orientation.

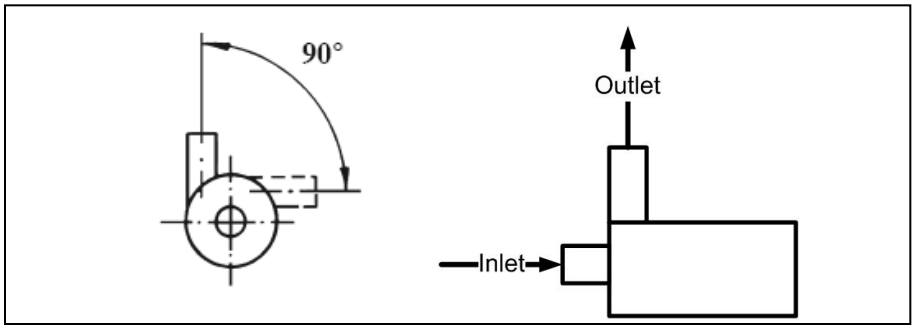


Figure 41: Coolant Pump, Horizontal

8.6.2 Wiring

Pump wiring will also be included with the chassis; the wiring includes butt splice connectors (part # 103743) and a long wire extension with connector C061P on one end (part # 103875). To wire the heater pump

- Connect C061P to C061S on the power distribution harness located on the drivers side of the engine bay
- Route the long extension wire from C061P to the heater pump such that
  - Wire will not be chafed on sharp edges
  - Wire is clear of any moving parts
  - The wire is securely clipped and restrained
- Trim the long extension wire to length such that there is enough to connect the pump lead to the extension wire with the supplied butt splice connectors
- Attach wire 2043AC on the pump lead to wire 2043AB on the wire extension using the butt splice connectors and heat shrink
- Attach wire 9004AC on the pump lead to 9004A on the extension wire using the butt splice connectors and heat shrink
- Ensure the wire routing is secured by clipping and will not chafe on sharp edges.

8.7 Front End Accessory Drive (FEAD)

The Balance™ hybrid chassis is equipped with an Integrated Starter Generator (ISG) that is connected to the engine crankshaft via a 2nd belt / spider bracket assembly. Figure 42 shows the ISG. Figure 43 shows the belt routings for the FEAD.

It is not acceptable to mount any additional front end accessories to this system.

A minimum of 30 mm of clearance is required between the FEAD belts and any other components mounted in the area.

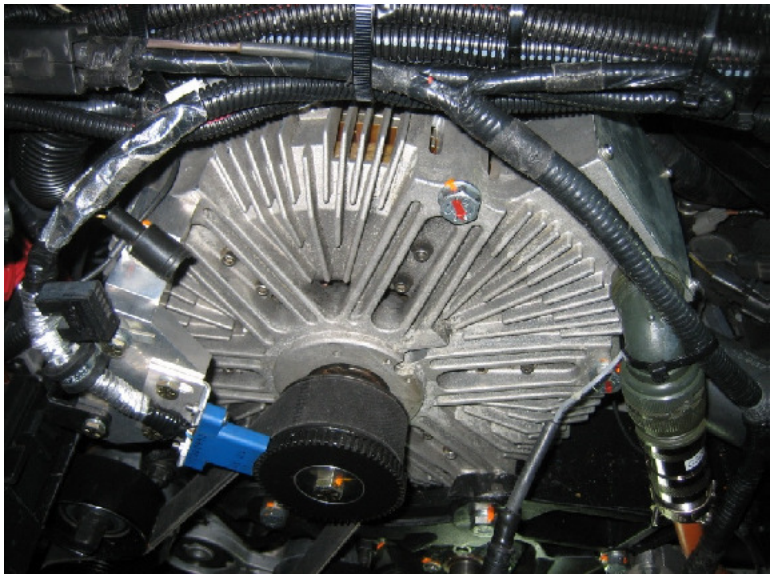


Figure 42: Integrated Starter Generator (ISG)

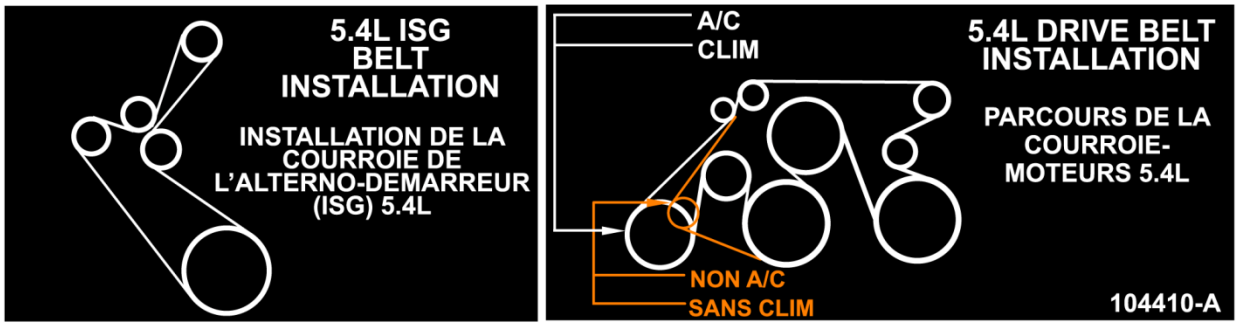


Figure 43: FEAD Belt Routing

8.8 Undercoating

Applying undercoating to any hybrid component or wiring is prohibited due to color coding and cooling requirements.

If applying undercoating to a Hybrid Chassis the undercoat must be applied to the body prior to installation on the chassis or all hybrid components and wiring must be masked off.

8.9 Mud Flaps

In order to eliminate water and other road debris spray from the wheels to the hybrid components, the following is required:

- Full width mud flaps are required behind the front wheels
- Full width mud flaps are required in front of the rear wheels

It is the SUB builder's option to install mud flaps behind the rear wheels.

Caution should be exercised during the installation of mud flaps to ensure that no hybrid components or wiring will be damaged.

8.10 Tow Haul Switch

The tow haul switch has been disabled by the hybrid vehicle controller on all Balance™ Hybrid Chassis.

8.11 Minimum Skirt Requirements

Minimum skirt requirements are intended to ensure hybrid components are out of reach of untrained individuals.

The Minimum requirement for the skirt is to be at least 250 mm (9.85 inches) below the top of the flat portion of the frame rail. This skirt must extend the entire length of the vehicle.

This is particularly relevant to cut away vehicles outfitted with boxes that generally do not have skirts.

8.12 Underhood Decals

This section only pertains to stripped chassis which do not have a hood when delivered to the SUB builder.

Two decals with part numbers 104407 and 104408 are provided to the SUB builder in the chassis dunnage kit. The two labels are to be placed under the hood as shown in Figure 44.

Prior to installing the decals the SUB builder must ensure the installation area is:

- Clean of any grime or debris
- Smooth and flat
- Dry

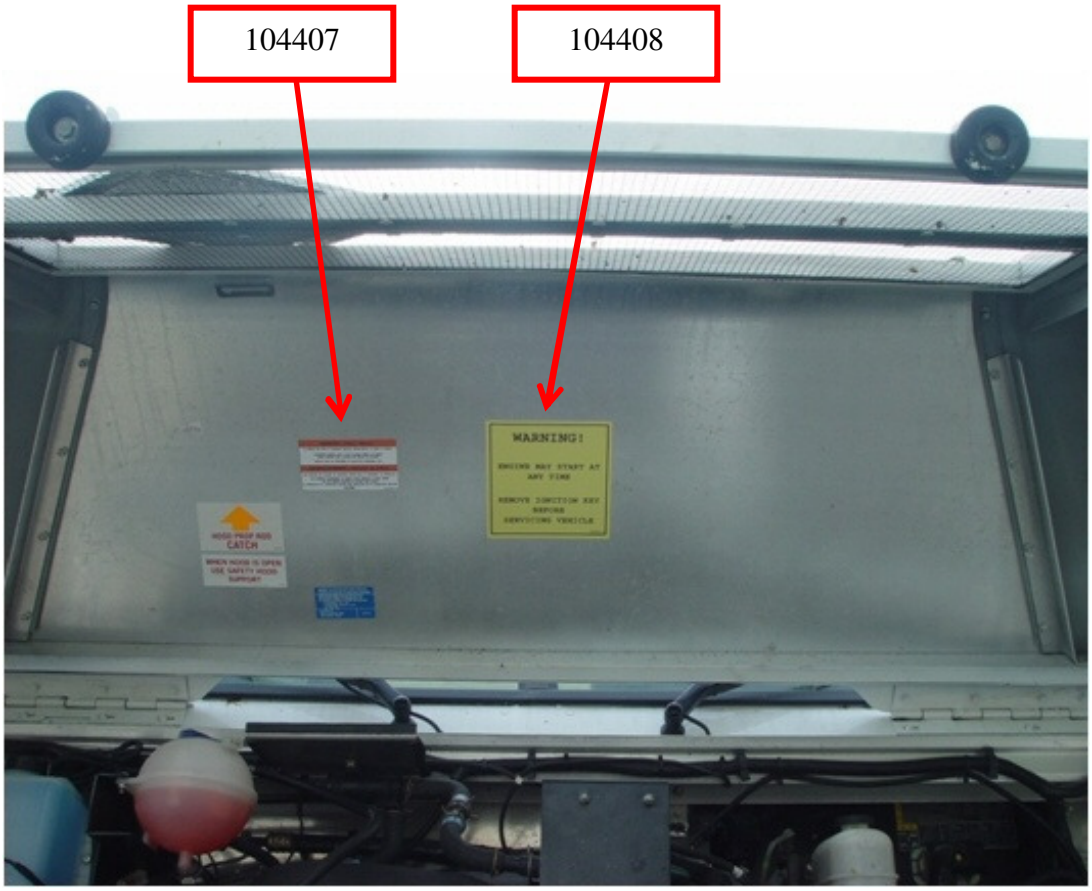


Figure 44: Underhood Decal Placement

8.13 Body Builder Electrical Loads

The need for additional 12V electrical loads to support customer specific features may be required. If these additional loads are needed, the following guidelines must be met:

- The 12V battery (1st and 2nd 12V batteries on SB only) and HV ESS shall be disconnected prior to any electrical work
- 70A continuous is the maximum allowable current to be added to the electrical 12V system
- The appropriately sized Mega fuse is to be located in the AZD high current Fuse panel as indicated in Figure 45. A buss bar in place of a Mega fuse is not acceptable.

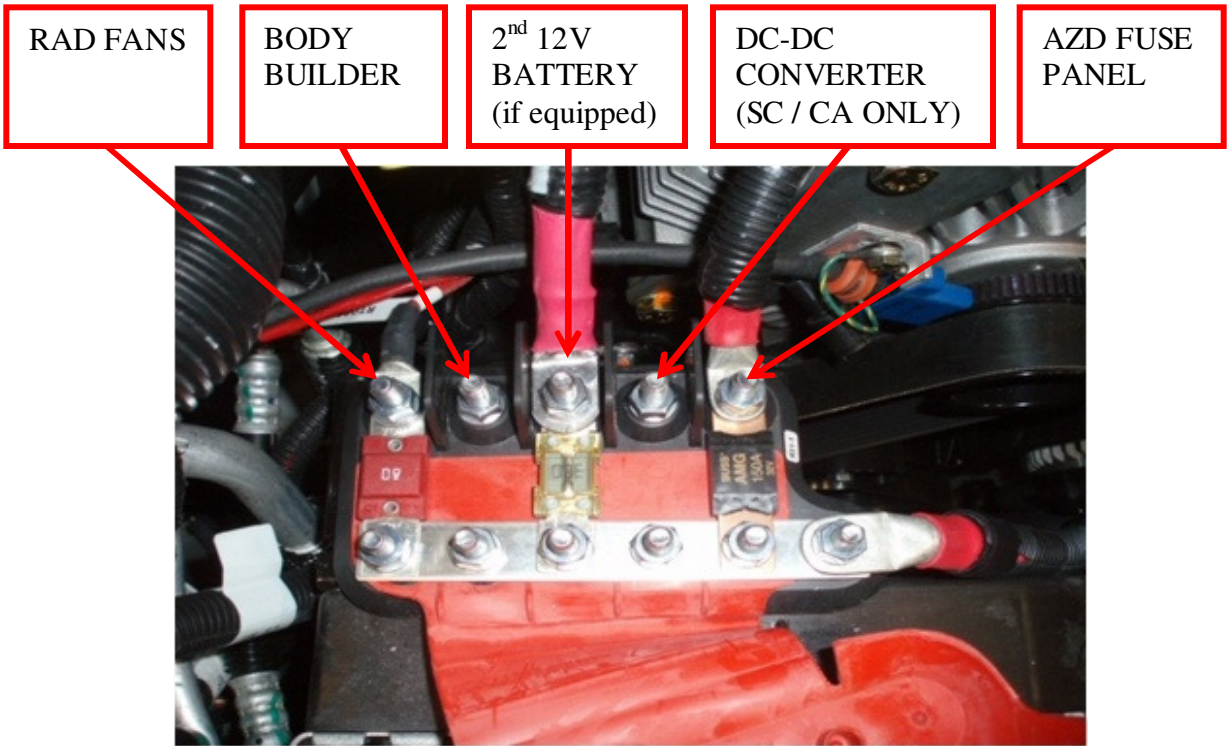


Figure 45: Underhood High Current Fuse Panel

9 POST BUILD INSPECTION AND VEHICLE SIGN OFF

The following section is to be completed once the SUB is complete. The purpose of this section is to ensure the system is fully functional and safe to operate prior to delivery to the customer.

This inspection must be completed prior to customer delivery unless the SUB builder has the signed written consent of Azure Dynamics Inc.

If the SUB builder completes a post build body check similar to the body check outlined in this section, please contact Product Support at productsupport@azuredynamics.com to discuss the option of deferring the body check section.

9.1 Hybrid Chassis Inspection

Follow the instructions in the Hybrid Chassis Inspection table and record pass or fail where required. If the item fails record the problem and corrective actions in the comments field, then re-test to ensure a pass.

To diagnose and repair some problems the Balance™ Hybrid Diagnostic tool may be required. To obtain a diagnostic tool and training contact Product Support at productsupport@azuredynamics.com.

Hybrid Chassis Inspection Table is located in A.1.1 Hybrid Chassis Inspection and it is required that a copy of this table is printed, completed and signed off for each vehicle.

9.2 Body Inspection

Follow the instructions in the Body Inspection table and record pass or fail where required. If the item fails record the problem and corrective actions in the comments field and re-test to ensure a pass.

Body Inspection Table is located in A.1.2 Body Inspection and it is required that a copy of this table is printed, completed and signed off for each vehicle.

A.1 APPENDIX 1 POST BUILD INSPECTION AND SIGN OFF

The following subsections need to be completed prior to customer delivery.

A.1.1 Hybrid Chassis Inspection

Hybrid Chassis Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
1	Engine oil level is sufficient.			
2	Transmission oil level is sufficient.			
3	Power Steering fluid level is sufficient.			
4	Engine coolant level sufficient.			
5	Electronics coolant level sufficient. Coolant must be 50/50 DexCool (orange) coolant / water mixture.			
6	Confirm all hoses and harnesses are routed and secured to original design.			
7	Confirm all connectors removed for welding are reconnected			
	VCU			
	PAS Motor Controller			
	ISG Motor Controller			
	Traction Motor, Motor Controller			
	AC Motor Controller (Shuttle Bus Only)			
	PWM to analog converter			
	Low Voltage (12V) Battery(s)			
	High Voltage Battery Control Connector			

Hybrid Chassis Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
	DC to DC Converter(s)			
8	Confirm the yellow "Hybrid Service" and the green "Hybrid Enabled" LED's are illuminated temporarily when the ignition key is turned to position 4. See key position diagram in appendix A.2 IMAGES.			
9	Confirm that only the green "Hybrid Enabled" LED is illuminated when the key is momentarily rotated to position 5. If the yellow “Hybrid Service” LED is illuminated then this is a fail. See key position diagram in appendix A.2 IMAGES. **Caution: The engine may start.**			
10	Confirm the engine power steering is functional by depressing the brake pedal and rotating the steering wheel from lock to lock while the engine is idling.			
11	Confirm the engine shuts off once the vehicle has warmed up, while in park with the key and the green "Hybrid Enabled" light on.			

Hybrid Chassis Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
12	Confirm the electric power steering is functional by depressing the brake pedal and rotating the steering wheel from lock to lock while the engine is off, the "Hybrid Enabled" light is on, and the shifter is in Neutral. Return shifter to Park after test.			
13	Confirm the DC-DC converter is functional by measuring the 12V battery voltage while the engine is off, the "Hybrid Enabled" light is on, and the shifter is in Park. The voltage should be greater than 13.5V.			
14	Confirm the electric cab heater pump is functional and fluid is circulating by feeling the electric cab heater pump for vibrations while the engine is off and the "Hybrid Enabled" light is on.			
15	Confirm the rear AC system is functional and that it cycles on and off as demand is requested. Shuttle Bus Only.			

Hybrid Chassis Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
16	Perform a road test which - Is a minimum of 20 km (12 miles) - Reaches vehicle speed of 100km/h (62 mph) - Incorporates frequent stops - Incorporates at least 3 key cycles (Turn off and on) - Incorporates forward and reverse motion - Incorporates at least one 3 point turn			
	Confirm the yellow "Hybrid Service" light does not illuminate during the road test (except for its bulb check).			
	Confirm the “Check Engine” light (shape of an engine) or any other warning lights do not illuminate on the instrument cluster during the road test (except for their bulb check).			
	Confirm the drive train does not have abnormal vibrations at highway speeds.			
17	Confirm there are no power steering system leaks and the level is sufficient after the road test is complete.			
18	Confirm there are no engine coolant system leaks and the level is sufficient after the road test is complete.			

Hybrid Chassis Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
19	Confirm there are no low temperature coolant system leaks and the level is sufficient after the road test is complete.			
20	Ensure there is at least 15mm (5/8 inch) clearance between the FEAD ISG motor and any cables, wires or hoses			
21	Ensure there is at least 30mm (1 ¼ inch) clearance between FEAD belts and any other parts			
22	7" X 7" Yellow warning label mounted under the hood. See A.2 IMAGES.			
23	Ford drive belt routing sticker replaced with Azure drive belt/ ISG belt routing sticker. See A.2 IMAGES.			

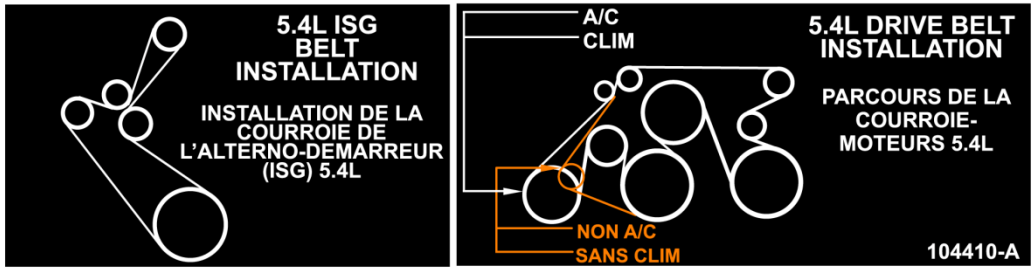
A.1.2 Body Inspection

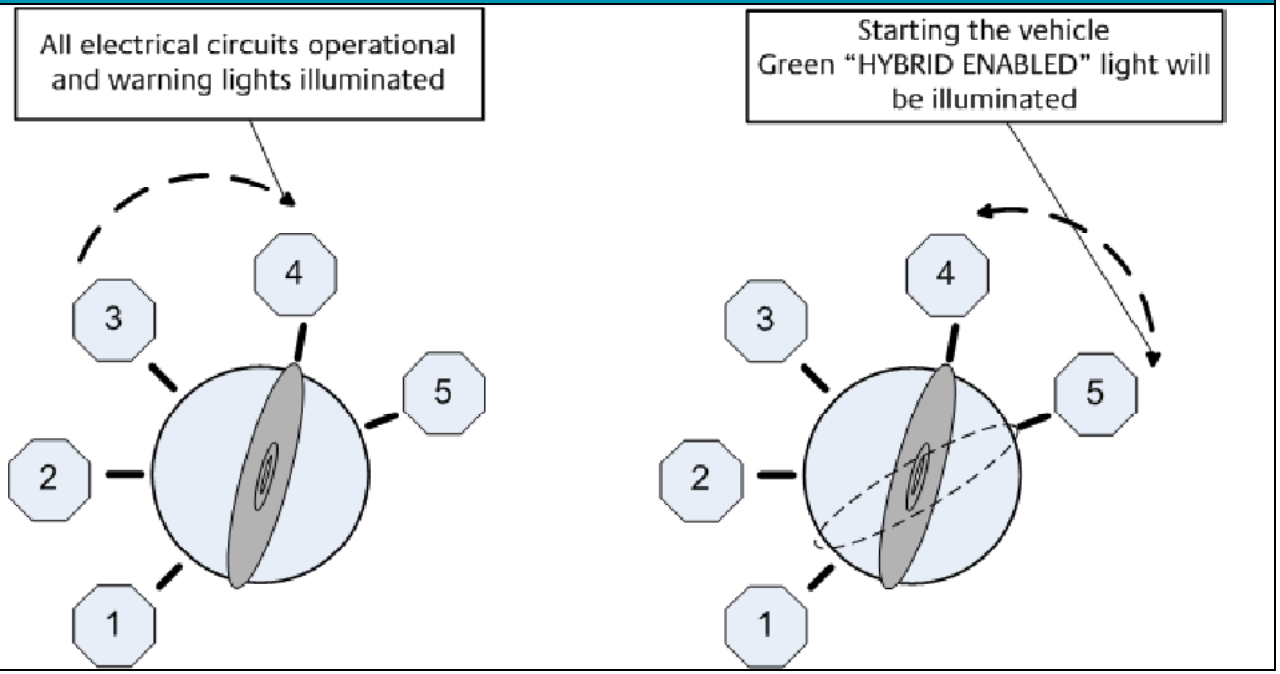
Body Inspection

Complete the following table. If any item fails, document the failure and corrective action in as much detail as possible in the comments section and then retest to ensure a pass.

ITEM	DESCRIPTION	TESTED BY/ DATE	PASS / FAIL	COMMENTS
1	Headlights functional - low beams			
2	Headlights functional - high beams			
3	Turn signals are functional			
4	Sidelights / roof lights functional			
5	Brake lights functional			
6	Reverse lights functional			
7	4 way flashers functional with ignition on			
8	4 way flashers functional with ignition off			
9	Horn functional			
10	Windshield wipers functional			
11	Windshield washer fluid functional			
12	All dash switches and indicators are properly seated and functional			

A.2 IMAGES

ITEM	DESCRIPTION	IMAGE
1	7" X 7" Warning Label	
2	Azure ISG and Drive Belt Routing Sticker	

ITEM	DESCRIPTION	IMAGE
3	Key Positions	

Notes: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