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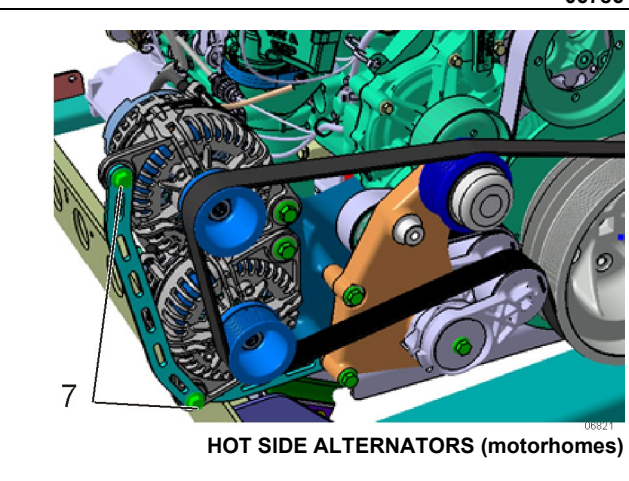
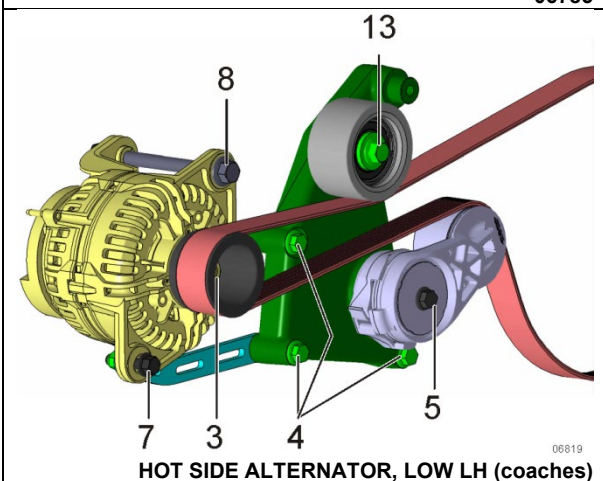
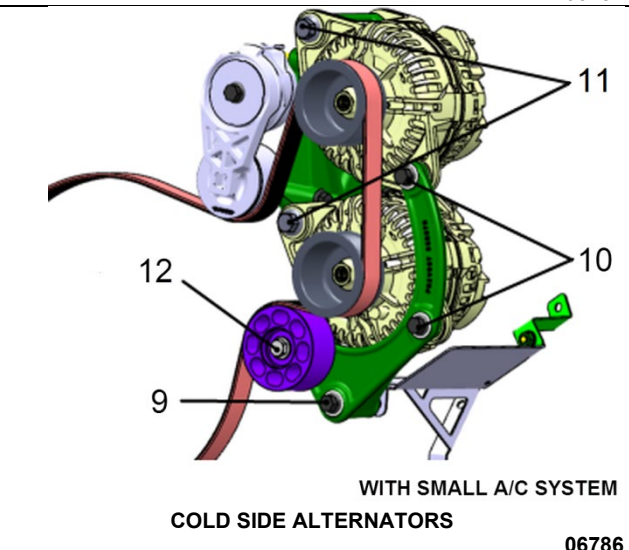
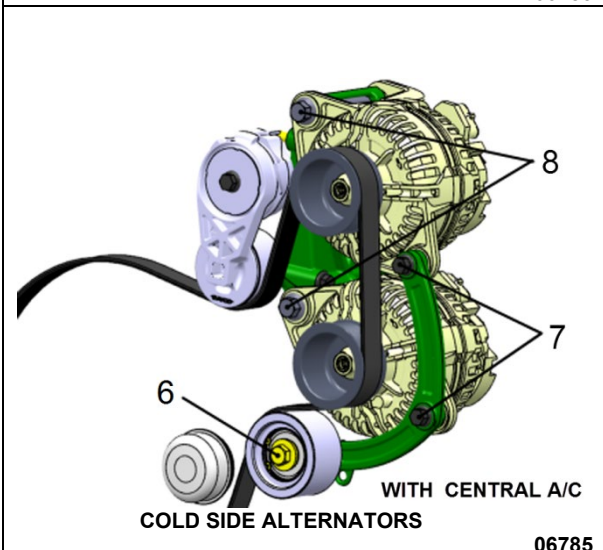
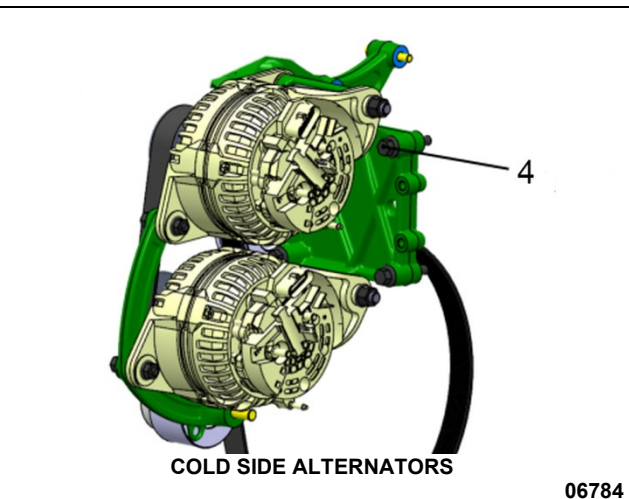
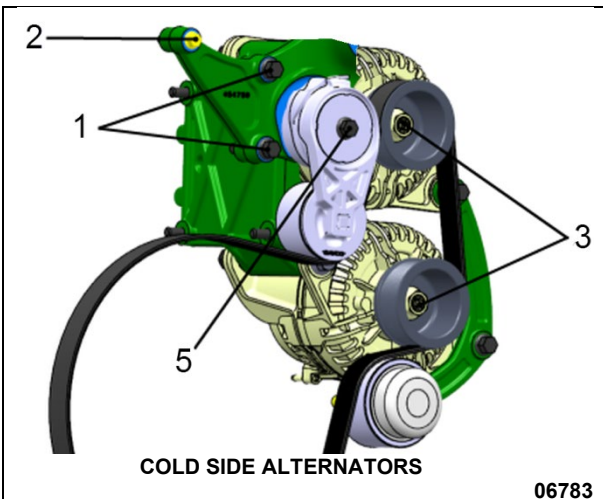


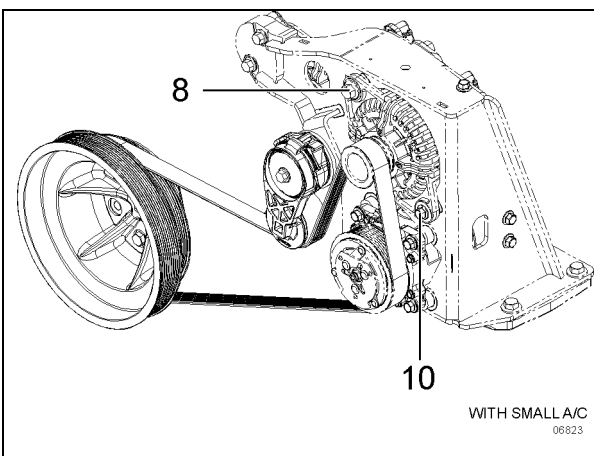
**SECTION CHANGE LOG**

	DESCRIPTION	DATE
1		
2		
3		
4		
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9		

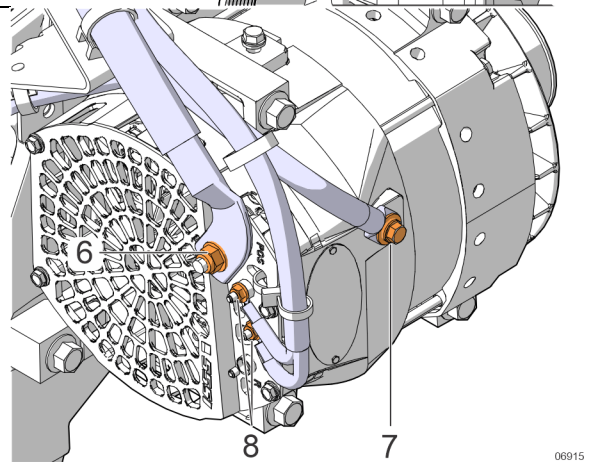
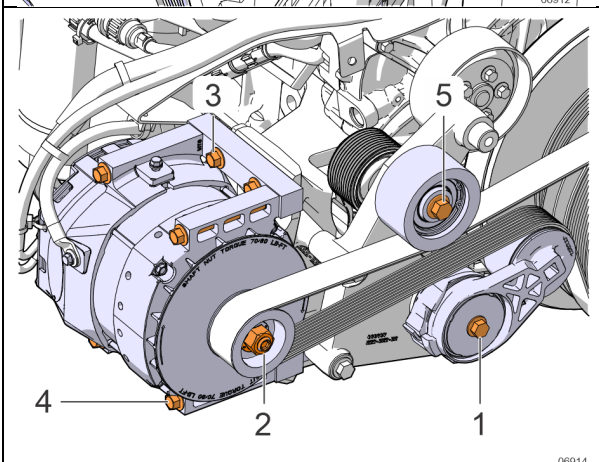
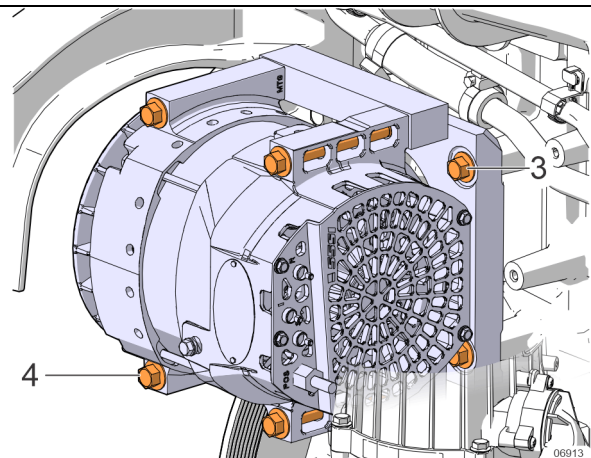
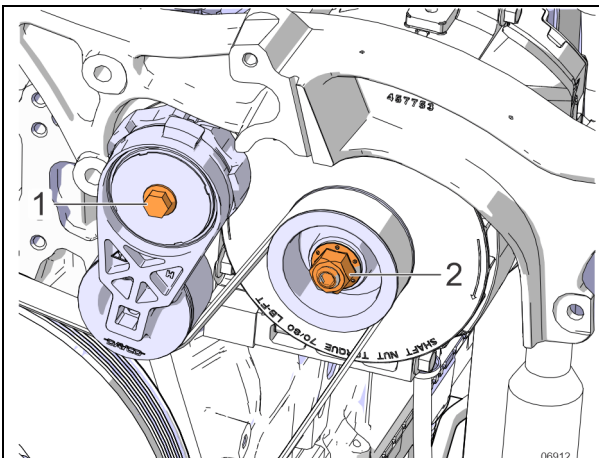
1. TORQUE TABLES

1.1 ALTERNATORS AND SURROUNDING COMPONENTS



**BOSCH HD10 ALTERNATORS**

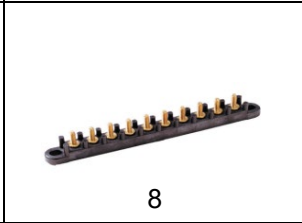
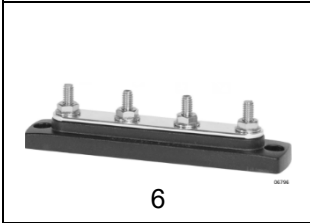
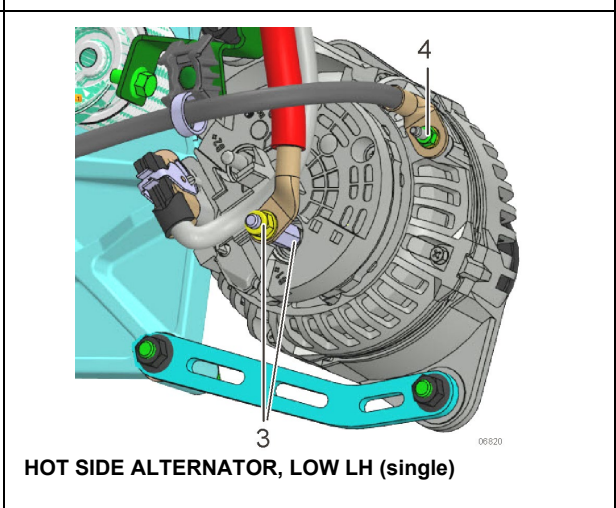
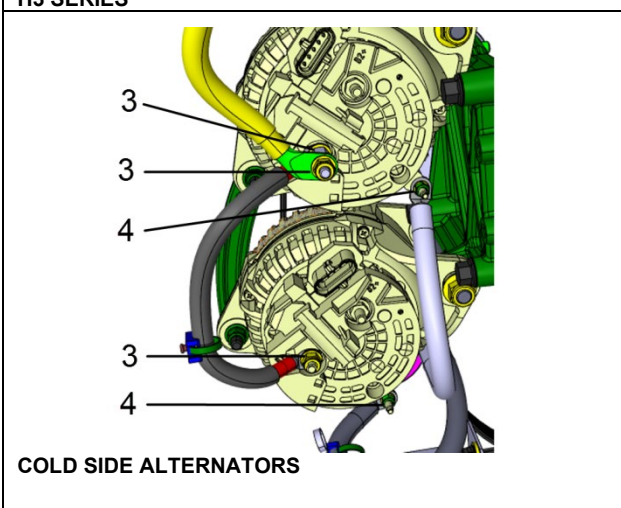
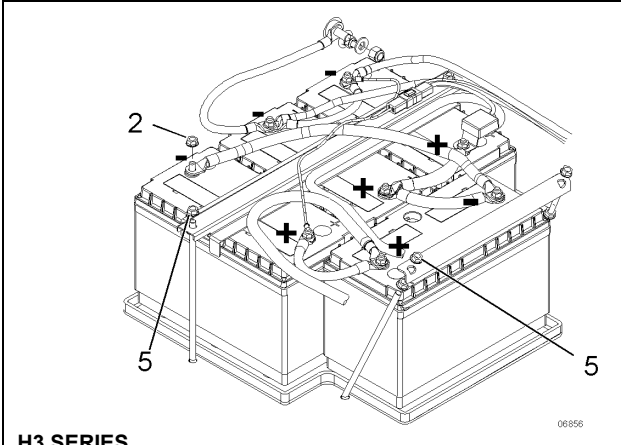
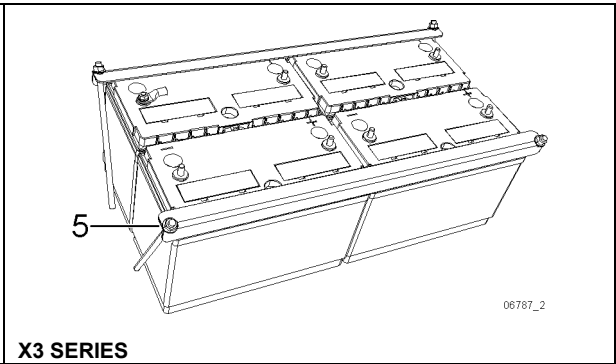
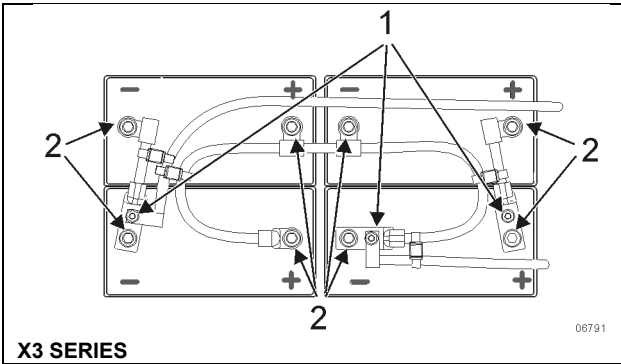
No	DESCRIPTION	TORQUE
1	A/C tensioner / idler bracket mounting bolts (2)	43 lb-ft (58 Nm)
2	A/C tensioner / idler bracket mounting bolt (1)	22 lb-ft (30 Nm)
3	Alternator pulley (2) LH threads	70-80 lb-ft (95-108 Nm)
4	Alternator mounting bracket mounting bolts	48 lb-ft (65 Nm)
5	Alternator belt tensioner mounting bolt	48 lb-ft (65 Nm)
6	Alternator belt idler mounting bolt (central A/C config.)	82 lb-ft (111 Nm)
7	Alternator mounting bolts, short	48 lb-ft (65 Nm)
8	Alternator mounting bolts, long	82 lb-ft (111 Nm)
9	Alternator bottom bracket mounting bolt (small A/C system)	48 lb-ft (65 Nm)
10	Alternator mounting bolts (small A/C system)	48 lb-ft (65 Nm)
11	Alternator mounting bolts (small A/C system)	82 lb-ft (111 Nm)
12	Alternator belt idler mounting bolt (small A/C system)	48 lb-ft (65 Nm)
13	Alternator belt idler mounting bolt (hot side)	59 lb-ft (80 Nm)



**DELCO REMY ALTERNATORS**

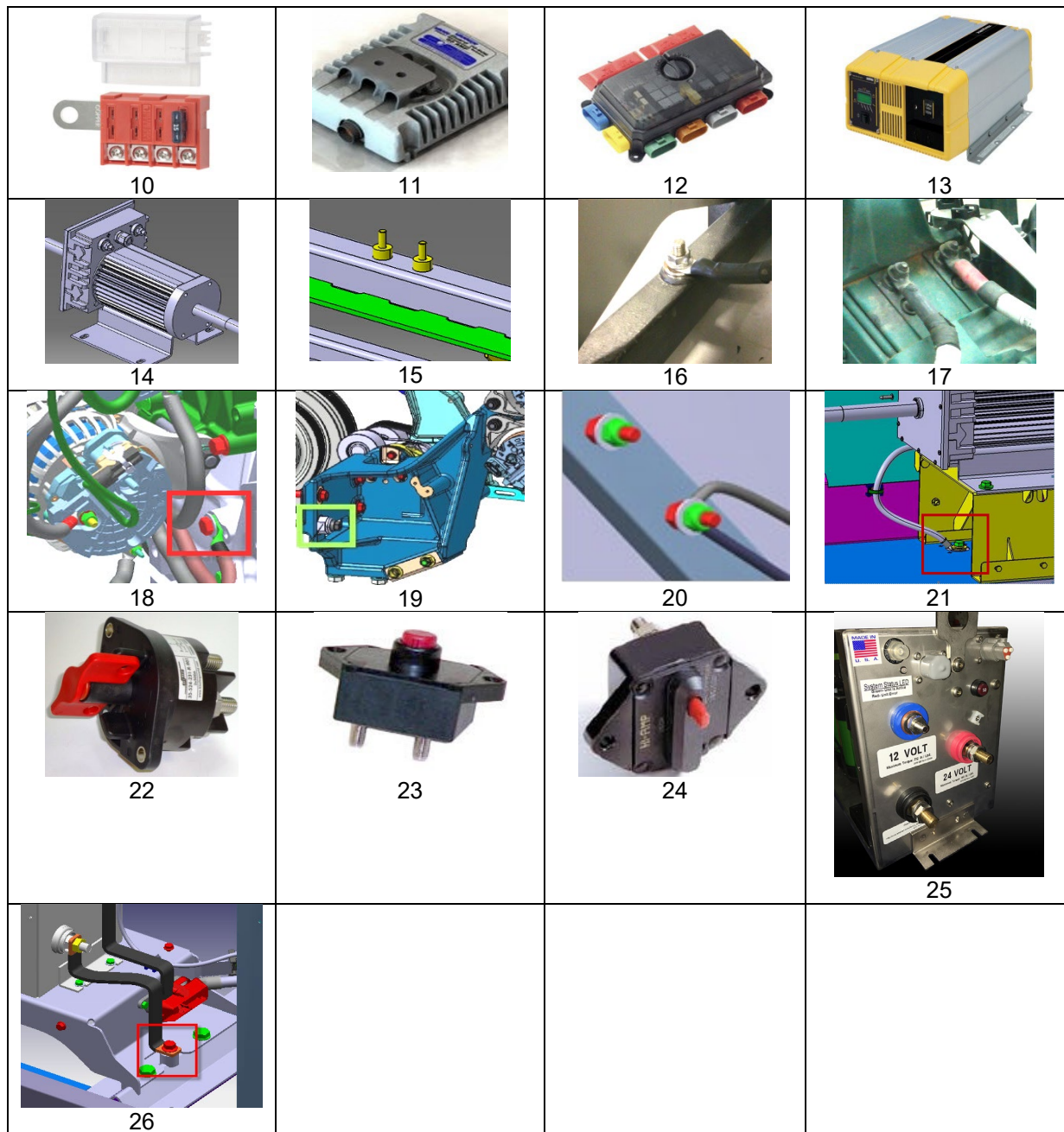
No	DESCRIPTION	TORQUE
1	A/C tensioner / idler bracket mounting screws (2)	43 lb-ft (58 Nm)
2	Alternator pulley nut (2)	70-80 lb-ft (95-108 Nm)
3	Alternator bracket mounting screws (8)	35 lb-ft (47 Nm)
4	Alternator mounting screws (8)	48 lb-ft (65 Nm)
5	Idler, hot side	59 lb-ft (80 Nm)
6	Alternator power connection nut (POS)	80-125 lb-in (9-14 Nm)
7	Alternator ground screw	50-60 lb-in (6-7 Nm)
8	Alternator connection (I; S)	25-45 lb-in (3-5 Nm)

1.2 ELECTRICAL CONNECTIONS – BATTERIES, MISCELLANEOUS





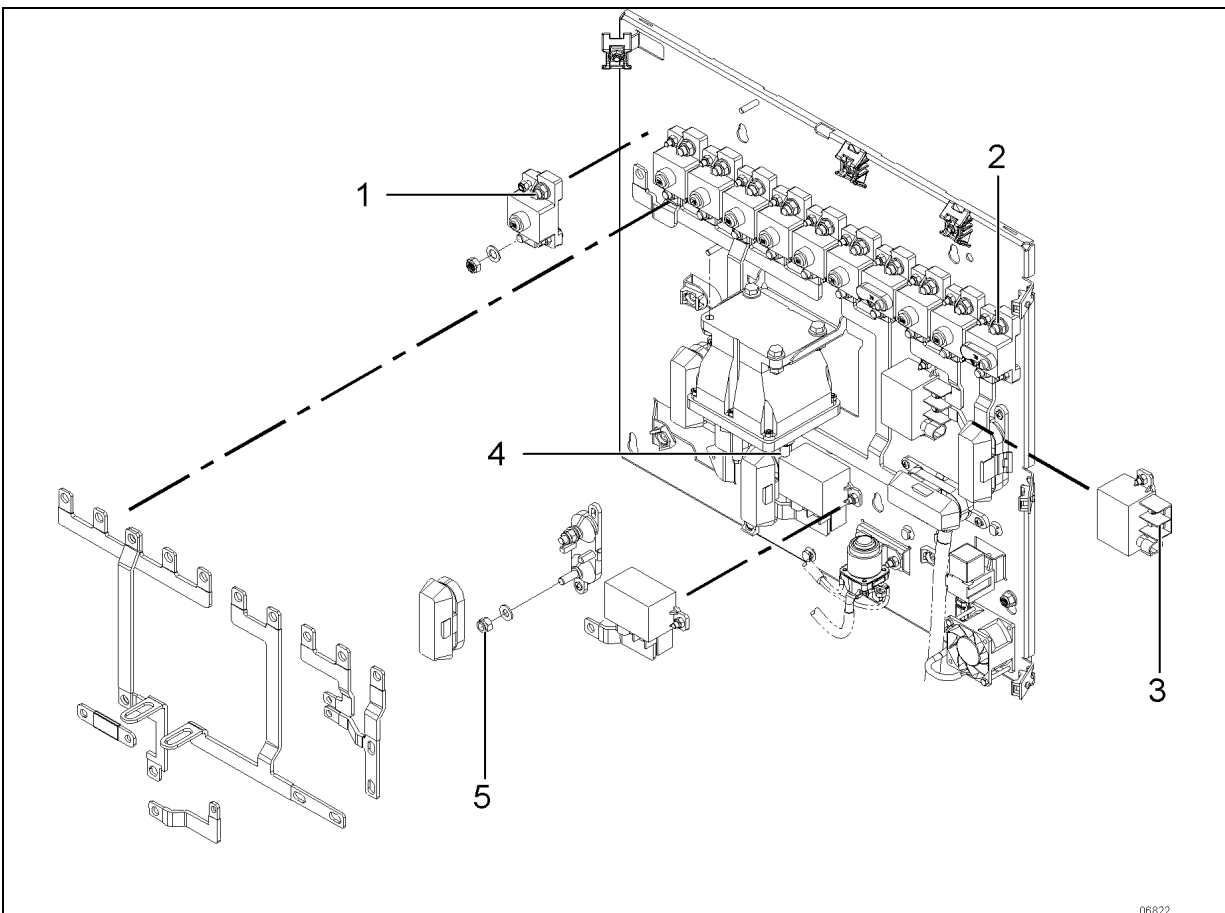
**SECTION 06: ELECTRICAL**



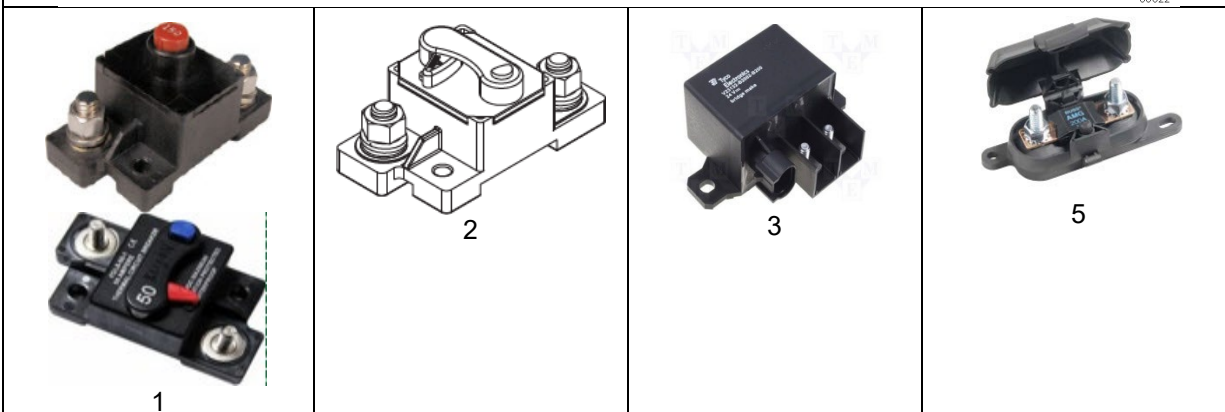
**ELECTRICAL CONNECTIONS - BATTERIES, MISC.**

No	DESCRIPTION	TORQUE
1	AGM battery Ground, 12VD & 24VD terminal nut	170 lb-in (19 Nm)
2	AGM battery connections, cap nut	170 lb-in (19 Nm)
3	Alternator power connection – nut & adaptor	11 lb-ft (15 Nm)
4	Alternator ground connection – nut	6 lb-ft (8 Nm)
5	Battery tie-down	45-55 lb-in (5-6 Nm)
6	Electronic ground bus bar ¼-20 stud (front & rear electric cmpt)	60 lb-in (7 Nm)
7	Junction block – 1 stud 3/8-16	120 lb-in (14 Nm)

8	Junction block – 4, 6, 8, 10 studs #10-32 brass	20 lb-in (2 Nm)
9	Boost terminal – 3/8-16 studs	119-131 lb-in (13-15 Nm)
10	ATC type fuse box – #8-32 screw terminal	15 lb-in (2 Nm)
11	Battery equalizer – 5/16-18 stud	96 lb-in (11 Nm)
12	VECR/F – M8-1.5 studs	216 lb-in (24 Nm)
13	24-V Inverter – M8-1.25 studs	104-115 lb-in (12-13 Nm)
14	Evaporator fan motor – 5/16-18 stud	50 lb-in (6 Nm)
15	Chassis ground studs – 1/2-13 stud stainless steel	170 lb-in (19 Nm)
16	Chassis battery ground studs – 1/2-13 stud stainless steel	170 lb-in (19 Nm)
17	Engine air preheater – M8-1.25 stud	84-108 lb-in (9-12 Nm)
18	Engine ground studs – M10-1.5 stud	240 lb-in (27 Nm)
19	Alternator ground cable stud (hot side) – M10-1.5 stud	240 lb-in (27 Nm)
20	On chassis welded ground stud – M6-1 stud	106 lb-in (12 Nm)
	On chassis welded ground stud – M10-1.5 stud	170 lb-in (19 Nm)
21	Evaporator fan motor ground cable stud – M8-1.25 stud	170 lb-in (19 Nm)
22	Main electrical shut-off switch (Kissling type) – M12-1.75 stud	166-183 lb-in (19-21 Nm)
23	Circuit breaker (manual reset) 1/4-28 stud nut	60 lb-in (7 Nm)
24	Circuit breaker (switchable, manual reset) 1/4-24 stud nut	50 lb-in (6 Nm)
25	Ultracapacitor starting module 1/2-13 power studs (option)	180 lb-in (20 Nm)
	Ultracapacitor starting module 3/8-16 12V power stud (option)	180 lb-in (20 Nm)
26	Bus bar, chassis ground stud, M10-1.5, ultracap starting module	240 lb-in (27 Nm)



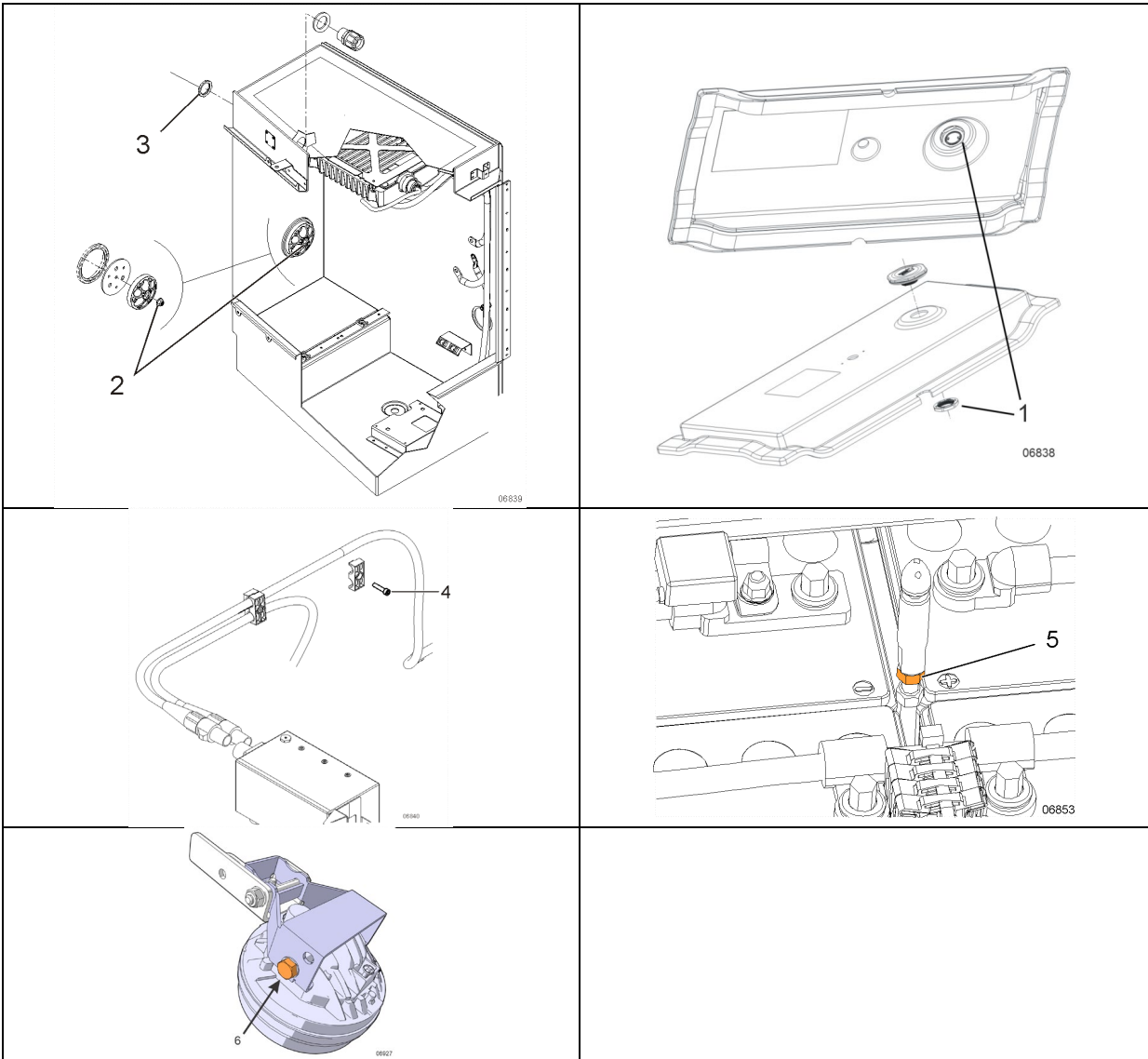
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**ELECTRICAL CONNECTIONS – MAIN POWER COMPARTMENT**

No	DESCRIPTION	TORQUE
1	Main circuit breaker 3/8-16 stud nut	135 lb-in (15 Nm)
2	Main circuit breaker (switchable, manual reset) 3/8-16 stud nut	135 lb-in (15 Nm)
3	Power relay stud nut M6-1	60 lb-in (7 Nm)
4	Master relay R1 - Port 30 – M10-1.5 buss bar connection stud nut	160-195 lb-in (18-22 Nm)
5	Fuse holder M8-1.25 stud nut	96 lb-in (11 Nm)





**MISCELLANEOUS COMPONENTS**

No	DESCRIPTION	TORQUE
1	Battery cover vent mounting nut	40-48 lb-in (4.5-5.4 Nm)
2	Cable pass-through assembly nut	90-110 lb-in (10-12 Nm)
3	Strain relief mounting lock nut	90-110 lb-in (10-12 Nm)
4	Screw - power cable support- electrical cooling fans	50-60 lb-in (5.6-6.8 Nm)
5	Battery cover stud nut (X3 Series only)	86-106 lb-in (10-12 Nm)
6	Fog light pod installation	50-60 lb-in (6-7 Nm)

## 2. GENERAL DESCRIPTION

This vehicle uses a dual voltage system to obtain two different voltages (12-volts and 24-volts) for various electrical controls and accessories. The main power source incorporates four batteries connected in series-parallel. All batteries are kept uniformly charged by means of a 100-amp battery equalizer (standard), giving a maximum possible output supply of 100 amps on the 12-volt system. Both the 12V and 24V systems are controlled through individual main battery relays. Base configuration uses three 24V self-regulated alternators, belt driven from the engine, and can be reached through the engine compartment doors.

This vehicle is equipped with PRIME energy management system which features AGM batteries and a Vanner Vann-Bus 80 Series battery equalizer.

### 2.1 WIRING DIAGRAMS

A paper copy of the master wiring diagram of the electric circuits, covering standard and optional accessories and systems is located in the Technical Publications box. Usually, a separate wiring diagram page is provided for each major function or system. In some cases, more than one circuit may appear on one wiring diagram page; when this occurs, each circuit covered in this page is listed in the wiring diagram index. Moreover, a circuit may appear on several pages; in such case, the number(s) at the extremity of the diagram title will indicate the sheet reference number. Refer to the *"Wiring Diagram Index"* to ensure that the correct diagram is being used to trace the circuit in question. In addition to the major functions page reference, the wiring diagram index contains the following information pages.

- The Multiplexed Device Index,
- The Arrangement-Harness drawing showing the harnesses arrangement and harness number on the vehicle,
- Glossary,
- Circuit number listing,
- Circuit breaker code,
- Connector code,
- Diode number code,
- Resistor number code,
- Fuse code.

#### 2.1.1 Using Wiring Diagrams

Three methods are used to "work" with electric wiring diagrams.

**Situation:** You have identified the defective part (breaker, diode, relay, etc.), and you wish to locate its corresponding circuit.

**Problem:** Circuit breaker CB5 is released (open circuit) and you don't know which circuit is affected.

- a) Refer to wiring diagram index and look for *"Circuit breaker list"*.
- b) At item CB5, you will find the location, the Prevost number, the breaker function, the breaker ampere rating and the page on which to find the corresponding diagram.
- c) Refer to page 3.1.
- d) When you have located CB5, follow the wiring up to the end and find the diagram page number and function on which the circuit continues.

**Situation:** You have a problem with a specific system, and you want to find the corresponding diagram.

**Problem:** The last three (3) speakers on the R.H. side of vehicle are inoperative, and you must trace the electric circuit.

- a) Refer to wiring diagram index and look for *"Sound system"*.
- b) You will find on page 35.2 the components as well as the electric wiring, thus providing you with a complete understanding of this circuit.

**Situation:** Using the Driver's Info Display (DID), you check on arrival if there are active errors in the vehicle electrical system. With the DIAGNOSTICS menu, highlight VIEW ACTIVE FAULTS, highlight ELECTRICAL to request a diagnostic of the electrical system and then press the enter key. If applicable, the DID shows the fault messages or fault codes recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down arrow to see all the fault messages.

**Problem:** DID displays the fault "Elec. Horn SW63; shorted to ground" as being active.

- a) Refer to wiring diagram index, and look for *"Multiplexed Device Index"*, pages B1-B8.
- b) In first column DEVICE ID, look for device SW63.
- c) At device SW63, find the fault message, the minimum condition to activate, other inputs

involved in logic, the multiplex module related to switch 63, the connector and pin number on the module and the page on which to find the corresponding diagram.

- d) Once the problem corrected, the DID still shows the fault as being active. You have to leave the VIEW ACTIVE FAULTS menu, wait approximately 20 to 30 seconds and then return to VIEW ACTIVE FAULTS to request a new diagnostic of the electrical system from the MCM. The DID should display the fault as being inactive.

## 2.2 TESTING CIRCUITS

A careful study of the wiring diagrams should be made to determine the source and flow of current through each circuit. When a circuit is thoroughly understood, a point-to-point check can be made with the aid of the applicable wiring diagrams. Any circuit can be tested for continuity or short circuits with a multimeter or a suitable voltmeter.

All electrical connections must always be kept clean and adequately tight. Loose or corroded connections can result in discharged batteries, difficult starting, dim lights and improper functioning of other electric circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol-type plugs are securely tightened. Knurled nuts on the plastic amphenol-type connectors will click into a detent when properly tightened. Line connectors, who have the side locking tabs, must have the locks latched in place to ensure a proper electrical connection.

## 2.3 WIRE SIZES AND COLORS

Each wire in the electrical system has a specific size as designated on the wiring diagram. When

replacing a wire, the correct size must be used. Never replace a wire with one of a smaller size. The vehicle electrical system is provided with different voltages. The insulation on each wire is distinctly colored in order to determine visually the wiring voltage and to assist in making connectors. The wires are color coded as follows:

Yellow	Data link High
Green	Data link Low
Orange	Connected to multiplex outputs
White	Connected to multiplex inputs
Red	24-volt system
Yellow	12-volt system
Black	grounded wire
Orange	speakers (+) ( <b>Coaches Only</b> )
Brown	speakers (-) ( <b>Coaches Only</b> )
Grey	spare wire

Black convolute tube with orange tape containing:	
Black	120V ac system (live)
White	120V ac system (neutral)
Green	120V ac system (ground)

### **NOTE**

*Wires are identified at each 2-4 inch (5-10 cm) intervals by a printed number.*

## 2.4 WIRE IDENTIFICATION

Each wire on a diagram is patterned to assist in tracing and testing circuits. The wire identification identifies the voltage reading or network, the circuit identification and the basic wire gauge.

<div style="text-align: center;"> <u>12-A47J1.8-16</u>                      VOLTAGE READING OR NETWORK      WIRE GAUGE (AWG)   CIRCUIT IDENTIFICATION <span style="float: right; font-size: small;">06048_2</span> </div>																				
<b>VOLTAGE READING OR NETWORK</b>																				
0	120	J1939																		
5	ANA	J2284																		
0/12	BBUS	LIN																		
0/24	DATA	PWM																		
12	DBUS	GND																		
24	J1587	...other																		
<b>CIRCUIT IDENTIFICATION</b>																				
<b>Ground circuits</b>																				
Electronic: I/O module number followed by an R, followed by the connector number and pin number (cavity) (ex: A47RJ1.8, A54 RJ2.14).																				
Electronic ground studs: Number 00 followed with the stud location <sup>1</sup> and sequential number (ex: 00R1, 00F4).																				
Chassis ground studs: Number 0 followed with the stud location and sequential number (ex: 0EV1, 0FH2).																				
<b>Power &amp; voltage carrying circuits</b>																				
Power distribution: Uphill component identification as circuit number (ex.: F96, CB22).																				
Multiplex outputs: Output module number and connector and pin number (cavity) (ex: A49J2.9) A55J1.4,																				
Relays, diodes, resistors and any other component output: Component number and pin number as circuit name (ex: SW55A, R30.87, D12.B).																				
<b>NETWORKS</b>		<b>WIRE GAUGE (AWG)</b>																		
J1939	- DL0 (Bbus Mux) - DL1 (drivetrain control network) - DL3 (Dbus Mux) - DL7 (engine subnet) - DL9 (engine transmission/I-Shift subnet)	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 20%;">0000</td><td style="width: 20%;">3</td><td style="width: 20%;">14</td></tr> <tr><td>000</td><td>4</td><td>16</td></tr> <tr><td>00</td><td>6</td><td>18</td></tr> <tr><td>0</td><td>8</td><td>20</td></tr> <tr><td>1</td><td>10</td><td>22</td></tr> <tr><td>2</td><td>12</td><td>24</td></tr> </table>	0000	3	14	000	4	16	00	6	18	0	8	20	1	10	22	2	12	24
0000	3	14																		
000	4	16																		
00	6	18																		
0	8	20																		
1	10	22																		
2	12	24																		
J2284	- DL2																			
J1587	- DL4 (powertrain subnet 900/901)																			

<sup>1</sup> For stud location, refer to page 2.1 of wiring diagram

## 2.5 SPARE WIRES

When the vehicle leaves the factory, and even in the case of a fully-equipped vehicle, an important number of unconnected spare wires are routed between the junction boxes. Consequently, for any connection of an additional accessory, refer to page "Spare wires" in master wiring diagram to determine the number, the gauge and location of these wires.



### CAUTION

Wire size is calibrated according to the breaker or fuse that protects it. When using a spare wire to replace a damaged wire, assure that the spare wire size is equal or larger than the wire being replaced. Using a wire too small for the breaker or fuse amperage might cause overheating of the wire.

### NOTE

Spare wires are identified by a wire identification number and by the letters "SP", to designate "spare".

## 2.6 CIRCUIT BREAKERS

The electric circuits are protected by manual reset type circuit breakers. The main circuit breakers (Figure 2), as well as those protecting the A/C system, are located in the main power compartment.

This type of circuit breaker de-energizes the circuit without disconnecting any wire.

Some circuit breakers such as CB2 & CB6 are different in the fact that you may open the circuit manually, to do so simply press the blue button on breaker to open the circuit, repair defective circuit, and afterwards swing red reset lever of breaker to close the circuit.



FIGURE 1: BREAKER WITH MANUAL TRIP BUTTON AND RESET LEVER SUCH AS CB2 & CB6

### 2.6.1 Main Circuit Breakers On Coaches

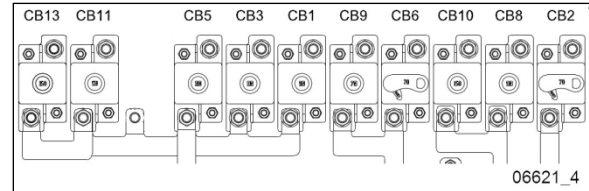


FIGURE 2: MAIN CIRCUIT BREAKERS ON COACHES

MAIN CIRCUIT BREAKERS ON COACHES		
CB1	24 WUP front distribution rear junction box	90 A
CB2	12VD & 12 ECU front distribution – ignition & engine start rear junction box rear junction box	70 A
CB3	24 WUP HVAC evaporator rear junction box	90 A
CB5	24 WUP rear distribution-rear junction box	90 A
CB6	24VD rear distribution & WCL rear junction box	70 A
CB8	12 WUP rear distribution-rear junction box	90 A
CB9	Diesel exhaust fluid system	40 A
CB10	12 WUP front distribution – VECF power rear junction box	150 A
CB11	24 WUP Sound system-rear junction box	50 A
CB13	24 WUP Inverter charger 120 VAC outlets rear junction box	90 A

VD= volts direct. The electrical components connected to these circuit breakers are direct-connected to the battery.

### 2.6.2 Main Circuit Breakers On VIP Motorhomes

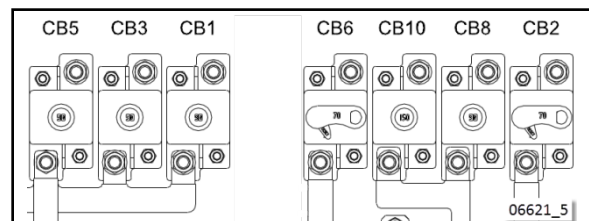


FIGURE 3: MAIN CIRCUIT BREAKERS ON VIP MOTORHOMES

MAIN CIRCUIT BREAKERS –VIP MOTORHOMES		
CB1	24 WUP front distribution	90 A
CB2	12VD front distribution – ignition & engine start	70 A
CB3	24 WUP Main distribution power full A/C	90 A
CB5	24 WUP rear distribution	90 A
CB6	24VD rear distribution	70 A

CB8	12 WUP rear distribution	90 A
CB10	12 WUP front distribution	150 A

### 2.6.3 VECR/VECF Circuit Breakers

Smaller circuit breakers are located in the VECF and VECR in front and rear electrical compartment respectively. Refer to the vehicle wiring diagram.

### 2.6.4 Electric Cooling Fan Circuit Breakers

#### MAXI 50 Amp manual reset CB

Each radiator or Charge Air Cooler electric fan may be protected by a MAXI 50 amp single pole thermal type breaker with manual reset. If tripped, the circuit breaker remains open until it is reset by pressing the reset button.



This type of circuit breaker inserts in MAXI fuse blades mounting style. Simply pull the circuit breaker off the blade type mount to replace.

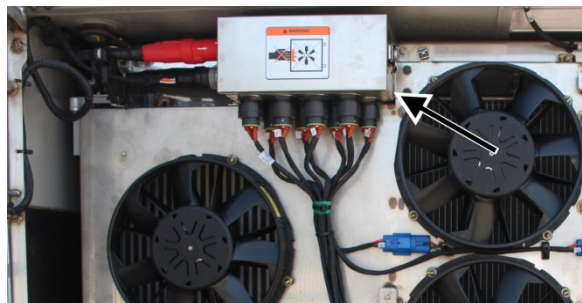


FIGURE 4: ELECTRIC COOLING FAN CIRCUIT BREAKER BOX

ELECTRIC FAN DRIVE 50 Amps CIRCUIT BREAKERS		
ID	Description	connector
CB201	Charge Air Cooler fan #1 - Mo65	1
CB202	Charge Air Cooler fan #2 - Mo67	2
CB203	Radiator fan #3 - Mo68	3
CB204	Radiator fan #4 - Mo69	4
CB205	Radiator fan #5 - Mo70	5
CB206	Radiator fan #6 - Mo71	6
CB207	Radiator fan #7 - Mo72	7
CB208	Radiator fan #8 - Mo73	8

## 2.7 MULTIPLEX FUSES

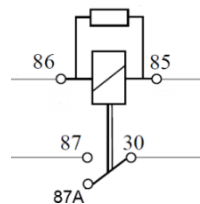
The multiplex outputs are protected in current by an internal "soft-fuse". Each output has programmed specific maximum amperage. When an output is shorted, the current gets above the limit and the soft-fuse intervenes to turn the output OFF. The output stays OFF until the "soft-fuse" is reset.

Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft-fuses".

There is also hardware fuses used to protect the incoming power to the multiplex modules. These fuses are located inside the VECF (Vehicle Electrical Center Front) and VECR (Vehicle Electrical Center Rear).

## 2.8 RELAYS

Relays are used to automatically energize or de-energize a circuit from a remote location. The relay draws a very low current to energize its coil. Once the coil is energized, it develops a magnetic field that pulls a switch arm closed or open, to either energize or de-energize a given component. As the control current required for the coil is very low, the relay allows a remote station to control a high energy circuit without running great lengths of costly high capacity cable, and also eliminates the need for high amperage switches and heavy connectors.



86 coil  
 85 coil  
 30 common feed  
 87 normally open contact NO  
 87A normally closed contact NC

FIGURE 5: SINGLE POLE DOUBLE THROW RELAY

#### NOTE

Each relay is identified with "12V" or "24V" printed on its casing in order to identify the coil operating voltage.



**CAUTION**

The Multiplex vehicle uses a VF4 relay specially designed for Volvo that has different internal characteristics than the current VF4 relay. It is important to use only the new part marked Volvo as a replacement in Multiplex vehicles. Regular relays have an inadequate lifespan for Multiplex vehicles.

### 2.9 DASHBOARD SWITCH - REMOVAL

To remove a dashboard switch, proceed as follows. You will need the switch removal tool p/n 392667.

1. Insert the switch removal tool as shown in the opening above the switch.

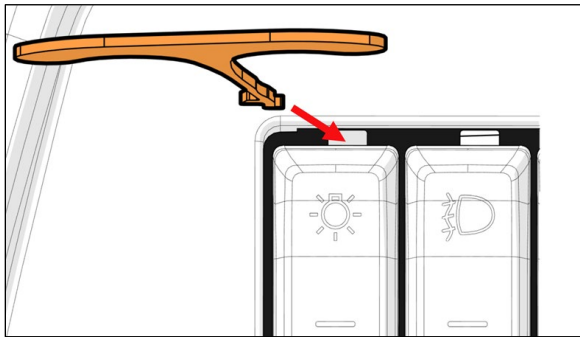


FIGURE 6

2. Rotate the tool so the handle is vertical.

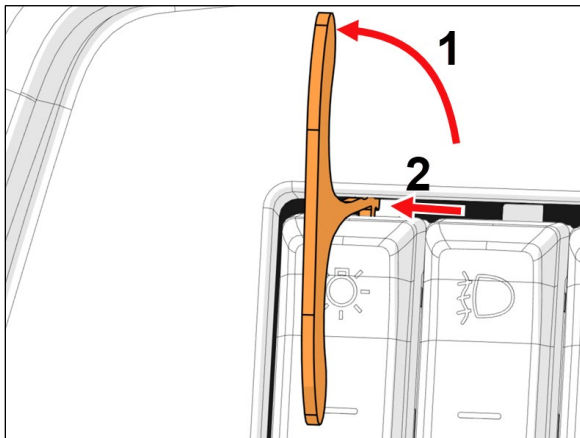


FIGURE 7

3. Pull the tool gently to lower the switch upper tab.



FIGURE 8

4. Pull the upper part of the switch just enough to disengage the upper tab.

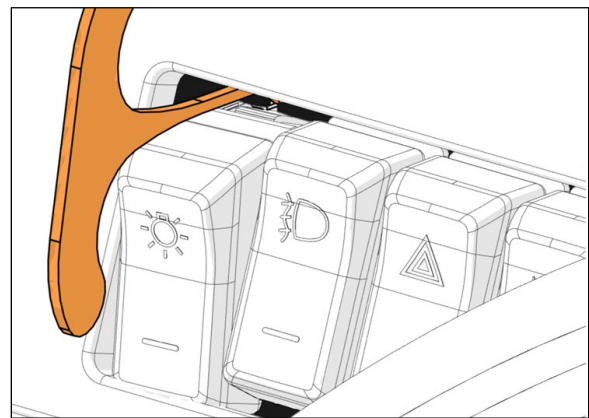


FIGURE 9

5. Repeat the process for the lower switch tab. The tool must be inverted compared to position in step 2.

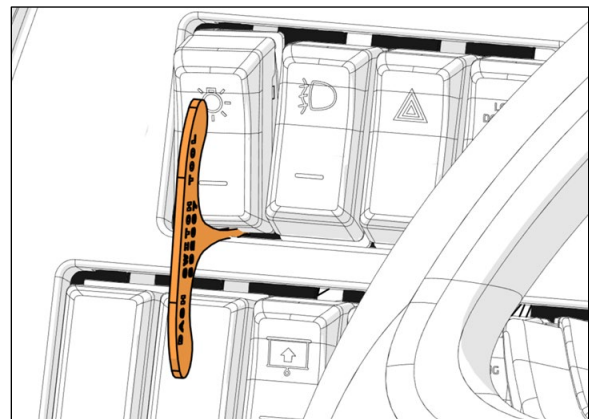


FIGURE 10

## 2.10 COOLING FAN CONNECTIONS

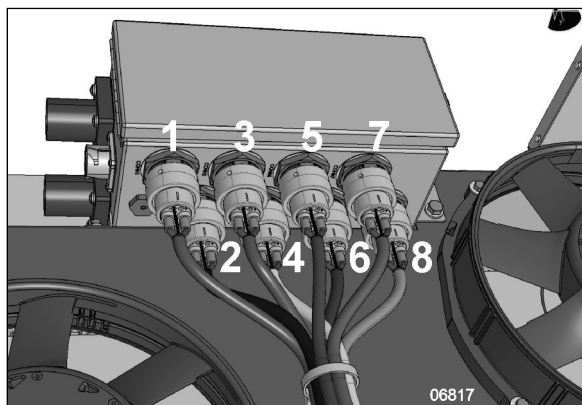


FIGURE 11: COOLING FANS CIRCUIT BREAKER BOX - CONNECTOR NUMBER

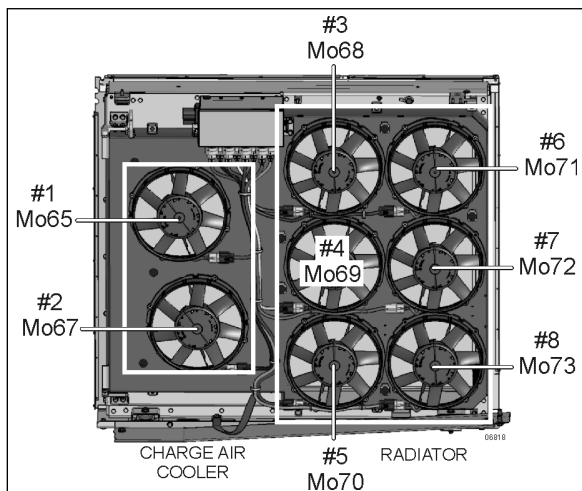


FIGURE 12: COOLING FAN IDENTIFICATION

**WARNING****WHEN THE ENGINE IS RUNNING...**

Cooling fans may start running at any moment.

Keep hands away from cooling fans or keep the radiator door closed.

**WARNING**

Cooling fans may be running when the engine is shut down in the following conditions:

- If a High Exhaust Temperature condition exists (e.g. following regeneration). The CAC fans will keep running for a maximum of 15 minutes.
- During the **Electric Motors Test Sequence**, the cooling fans will start running briefly.

The CAC fans and the radiator fans are controlled by two multiplex modules, i.e.

**AE49 & AE52 X3 Series****AE50 & AE53 H3 Series**

Each module controls one (1) CAC fan and three (3) radiator fans. For this reason, if one module fails, sufficient cooling will still be available for the CAC and the radiator through the second module.

Module AE49: Fans 1, 4, 6, 8

Module AE52: Fans 2, 3, 5, 7

Module AE50: Fans 1, 4, 6, 8

Module AE53: Fans 2, 3, 5, 7

If one fan doesn't function, diagnose the probable causes of failure for this particular fan. If one CAC fan and three radiator fans are not functioning, then you should suspect that one of the multiplex modules is defective.

## 2.11 ELECTRONIC GROUND

All the electronic modules installed on this vehicle are grounded to the electronic ground stud located in the main power compartment, using separate and protected circuits.

All the loads fed by a particular electronic module are grounded to that same module. However, a load can be grounded to another module in the situation when the load can be powered by two different modules for redundancy need.



## 2.12 PRECAUTIONS



Prior to working on a system inside vehicle, make sure to cut electrical power and air supply. A component could be supplied with electricity even if the ignition switch is set to the OFF position and/or a component could be pressurized even if air tanks are emptied. Always refer to the appropriate wiring and pneumatic diagrams prior to working on electrical and/or pneumatic systems.

**NOTE**

*When the ignition switch is set to the OFF position, the electrical components are not energized except for the MCM, engine ECU, transmission ECU, instrument cluster module, the battery equalizer, the preheater system, AFSS, the wheelchair lift system and some Multiplex modules which remain energized during 15 minutes after the ignition has been set to the OFF position. Prior to working on one of these electrical components, set the main electrical shut-off switch located above the batteries, on the exterior wall of the main power compartment to the OFF position.*

*If the vehicle will not be operated for a long period (more than 2 weeks), it is recommended, in order to prevent the batteries from discharging, to trip main circuit breakers CB2 & CB6 located on the rear junction panel to stop the small current drawn by the radio preset station memory, the MCM memory and the instrument cluster clock. Note that the radio station presets will be erased, same thing for the diagnostic codes history and the instrument cluster clock will have to be reset.*

**CAUTION**

Never put grease or other product on the multiplex modules connector terminals.



Use sprayed sealer in a well-ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist.

## 2.13 CORROSION INHIBITOR

A corrosion inhibitor has been sprayed on certain electrical components in order to protect them from corrosion. Refer to procedure SAV00002E at the end of this section for recommended products and where they are used.

### 3. ELECTRONIC MODULES

#### 3.1 MCM

The Master Control Module (MCM), identified A36 in wiring diagram, plays the role of interface between the engine ECM, the transmission ECU, the telltale panel module and other I/O-EA, I/O-EB modules. When a multiplex module is being replaced, the MCM will inform the new module of its role and function accordingly to the vehicle options. The MCM keeps the back-up program of the vehicle specific multiplex program. So, a specific MCM cannot be removed from a vehicle and be installed on another vehicle.

##### 3.1.1 Replacing the MCM

If the MCM must be replaced, a new MCM, pre-programmed at the factory specifically for the vehicle must be ordered. The actual vehicle identification number (V.I.N) will be needed at the time of ordering.

1. The vehicle should be connected to a battery charger.
2. Turn the hazards ON. Doing this will prevent the vehicle to fall in "sleep" mode after the normal 15 minutes delay.
3. Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
4. On rear electrical junction panel, trip circuit breaker CB6.
5. Replace the MCM.
6. Reset circuit breaker CB6.
7. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming of the I/O modules is complete unless a higher priority message must be displayed. If this is the case, press ESCape button repeatedly to acknowledge the higher priority messages.
8. The previous message displayed on the DID may disappear event if the programming is not completed. For this reason, wait another 5 minutes before proceeding to the next step.
9. Trip and reset circuit breaker CB6.
10. Check the DIAGNOSTICS menu of the Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. Verify the fault message to be certain the module is

reprogrammed. If the module is not reprogrammed, the message "Axx Not Responding" appears where Axx is the module number (Ex: A41, A42...etc).

##### 3.1.2 Uploading a multiplex program update into the MCM

An updated vehicle multiplex program saved on a laptop computer can be uploaded into the MCM. A laptop computer must be connected to the RS232 serial port DB9 connector (identified C226) found on the front service compartment electrical panel. Please contact your Prevost Service Representative in order to get the vehicle specific multiplex program and upload procedure. Save the specific multiplex program on your laptop computer.



#### WARNING

##### WHEN UPLOADING A NEW MUX SOFTWARE INTO THE MCM ...

Cooling fans WILL start running for a short while.

Keep hands away from cooling fans or keep the radiator door closed.

#### 3.2 I/O-EA AND I/O-EB MODULES

I/O-EA modules receive inputs and control outputs. I/O-EA's are used for all outputs of 1 amp or less.

I/O-EB modules receive inputs and control outputs. I/O-EB's are used for outputs up to 30 amps.

##### 3.2.1 Replacing I/O-EA or I/O-EB Modules

I/O-EA, I/O-EB modules can be replaced and reprogrammed without having to connect a computer to the vehicle.

Set the ignition switch to the ON position and leave it in that position at all time while performing this procedure.

6. On rear electrical junction panel, trip circuit breaker CB6.
7. Replace the defective module.
8. Reset circuit breaker CB6. Doing so will initiate the I/O auto programming.

9. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming is complete unless a higher priority message must be displayed. If this is the case, press ESCape button repeatedly to acknowledge the higher priority messages.
10. The previous message displayed on the DID may disappear even if the programming is not completed. For this reason, wait another 5 minutes before proceeding to the next step.
11. Trip and reset circuit breaker CB6.
12. Check the **Diagnostics** menu of the Driver Information Display (DID). Select VIEW

ACTIVE FAULTS and. Verify the fault message to be certain the module is reprogrammed. If the module is not reprogrammed, the message "Axx Not Responding" appears where Axx is the module number (Ex: A41, A42...etc).

3.3 ELECTRONIC MODULES CONNECTOR PIN-OUT

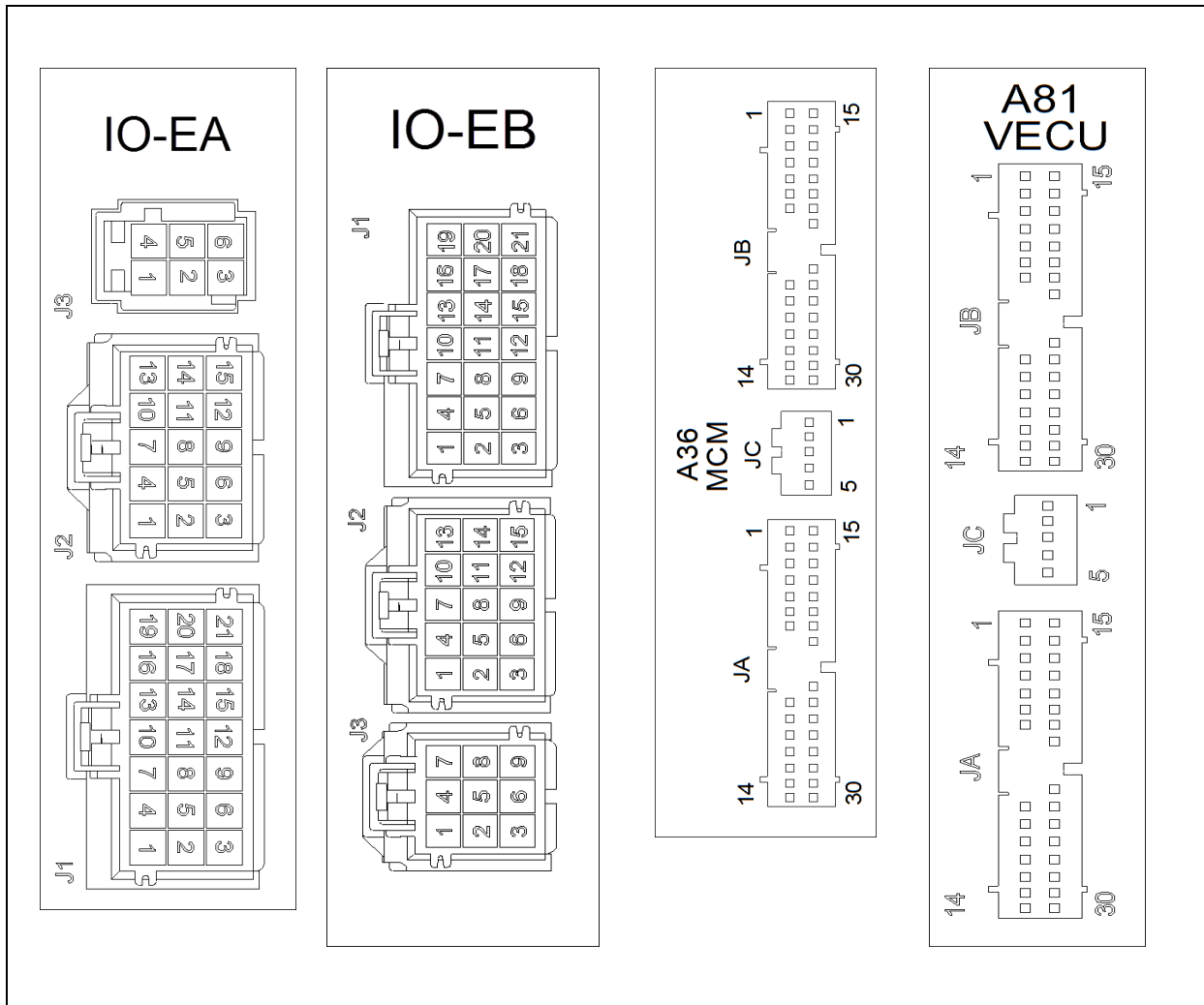


FIGURE 13: ELECTRONIC MODULES CONNECTOR PIN-OUT - BACK PROBING VIEW

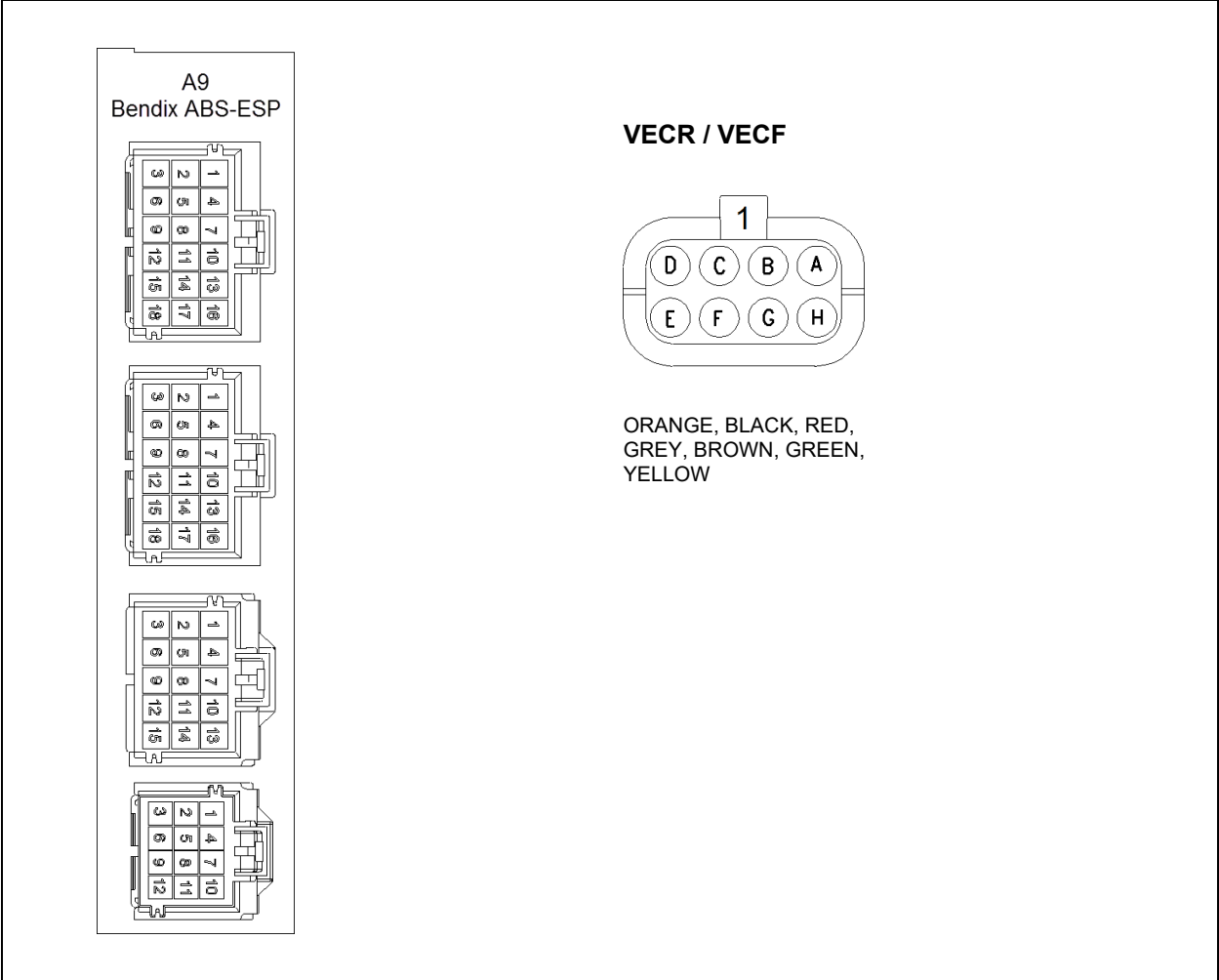
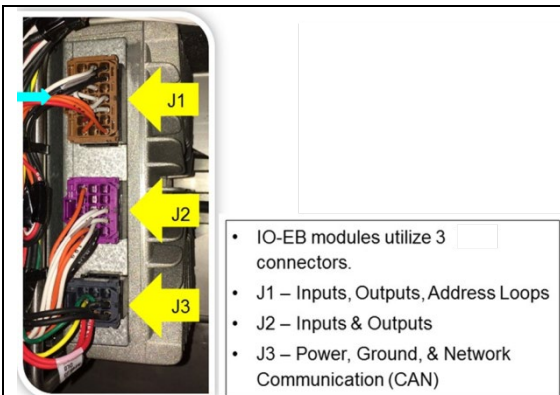
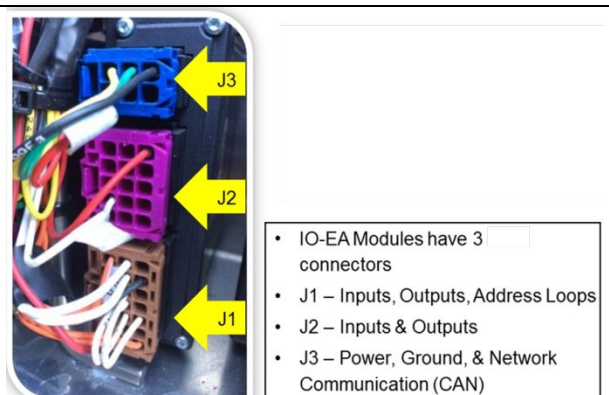


FIGURE 14: ELECTRONIC MODULES CONNECTORS PIN-OUT - BACK PROBING VIEW



- IO-EB modules utilize 3 connectors.
- J1 – Inputs, Outputs, Address Loops
- J2 – Inputs & Outputs
- J3 – Power, Ground, & Network Communication (CAN)

FIGURE 15: I/O-EB MODULE



- IO-EA Modules have 3 connectors
- J1 – Inputs, Outputs, Address Loops
- J2 – Inputs & Outputs
- J3 – Power, Ground, & Network Communication (CAN)

FIGURE 16: I/O-EA MODULE

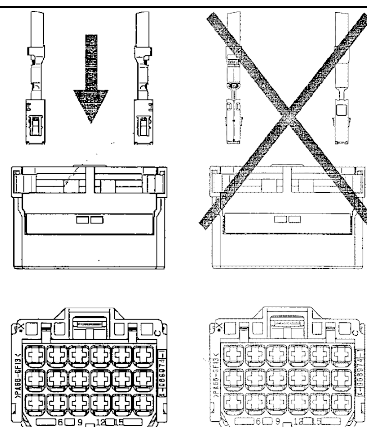
## I/O-EA & I/O-EB MUX modules

### Connector: AMP MCP 2.8

#### Contact loading of housings

Loading the contacts is only possible if the secondary lock is in the unlock position.

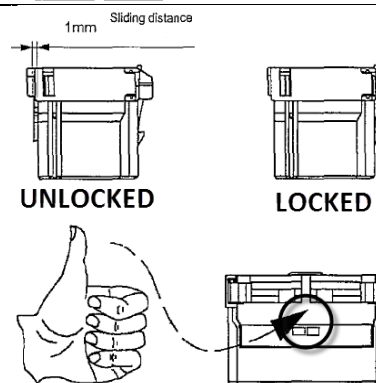
Proper orientation of the contact is important. If the orientation is incorrect, the contact stops too early in the region of the secondary lock and the whole crimp stands out from the housing. With correct orientation the secondary lock stops with a metallic “click” sound.



#### Locking the secondary lock

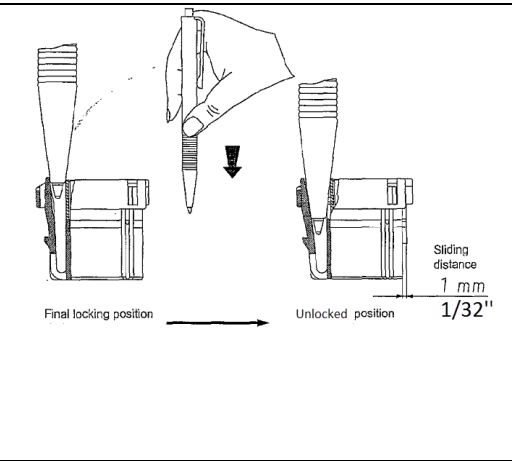
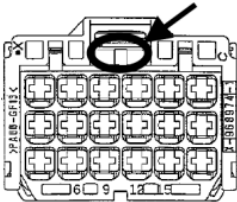
Delivery state of the secondary lock is the open position. In this position the AMP MCP2.8 contacts can be loaded. After that the secondary lock is moved into the final locking position by hand.

At a sufficient large surface a perpendicular force is initiated by (preferably) the thumb of one hand. Proper final position is reached a click noise can be heard. Make sure that both sides are locked.



**Unlocking the secondary lock**

To unlock the secondary lock on these housings, a simple solid commercial ball pen is sufficient. The ball pen has to be inserted perpendicularly according the image, between the locking latch of the housing and the secondary lock block. Then it will be pushed with care until the opening is felt (a “click” sound can be heard).



**Extracting the contacts from housings**

To extract contacts, the secondary lock has to be in the unlock position. The tool has to be inserted from connection side into the cavity of housing up to the stop; the contact will be unlocked thereby. Keep the tool in that position and then take the contact out by pulling on the cable. Note: Do not pull the cable before unlocking the contact; on the other hand by pressing the cable gently against the cable outlet direction the unlocking procedure will be facilitated.



Multiplex modules	Connector type	Contact removal
<p><b>VECR / VECF</b> 06627</p>	<p>INSERT EXTRACTOR HERE</p> <p>Orange Black Red Grey Brown Green Yellow</p> <p>06632</p> <p><b>BUSSMAN</b></p>	<p>EXTRACTOR/TOOL: Prevost #682256 (Packard 12094429)</p> <p>Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>

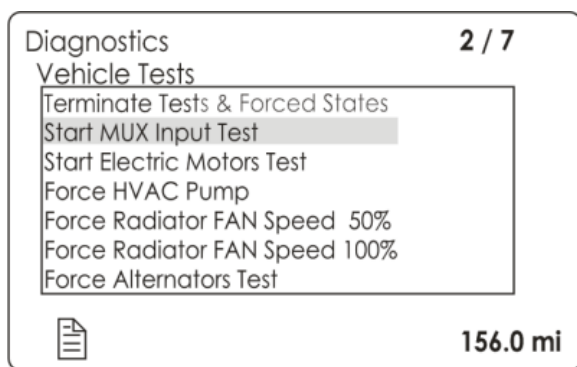
#### 4. AVAILABLE TEST MODES

The available test modes are the followings:

1. Alternators test;
2. Electric motors test;
3. MUX Input Test;
4. HVAC pump test;
5. Force Radiator Fan Speed 50%;
6. Force Radiator Fan Speed 100%.

##### 4.1 MULTIPLEX INPUT TEST

The multiplex input test provides useful information to diagnose multiplexed input of switches and sensors, complimentary to the electrical system diagnosis.



To initiate the test, use the Driver Information Display (DID) DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then START MUX INPUT TEST. Press ENTER button to start the test. The DID status line will show TEST to confirm the test mode is active. To exit test, press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice. TEST will disappear from the DID status line.

Instrument panel audible alarm emits a *beep* each time an OFF/ON transition is detected on a multiplex input. This allows quick verifying if the switches and sensors are detected or seen by the multiplex modules. When the vehicle is parked, the back-up alarm also emits a *beep* that allows verification of the sensors at the rear of the vehicle.

Certain inputs are doubled (for example, turn signal switch on multi-function lever, door operating buttons) and also other inputs activate at the same time (ex. kneeling switch and Kneeling proximity sensor switch). For these

inputs, 2 *beeps* are emitted. If only one *beep* is heard, one of the inputs is defective.

SWITCHES AND SENSORS SUPPORTED BY THE SWITCH/SENSOR TEST MODE
HVAC control unit driver's section ON/OFF
HVAC control unit driver recirculate switch
HVAC overhead compartment fan switch
HVAC control unit passenger's section ON/OFF
Engine rear start selector switch "rear start"
Engine rear start selector switch "normal"
Engine ignition front switch
Engine ignition rear switch
Entrance door inside opening /closing switch
Entrance door outside opening /closing switch
Electric horn button
Kneeling down switch
Kneeling up switch
Baggage compartment locking system switch
Baggage compartment door ajar open sensor
Steering wheel control buttons
Lavatory emergency switch
Interior lighting switch, 2 positions
Driver's area lighting switch
Reading lights switch
Multi-function lever LH turn signal
Multi-function lever RH turn signal
Fog lights switch
Hazard warning flashers switch
Multi-function lever courtesy blinkers switch
Headlamps switch, 2 positions
Multi-function lever headlamps beam toggle switch
Baggage compartment door lock/unlock switch
Tag axle lever
Wheelchair lift activation switch
Windshield lower wiper



Multi-function lever windshield wipers intermit.
Lower windshield wipers backup switch
Lower windshield washer switch
Upper windshield washer switch
Upper windshield wipers switch, 2 positions

The following inputs, either certain options or sensors which are difficult to activate, are not supported by the switch/sensor test:

- Service chime enable switch,
- Fast idle switch,
- Outside Rear View Mirror & Video Camera Mirror System Heat,
- Traction control system switch,
- Outside rear-view mirror heat,
- Mirror control switches,
- Low-buoy switch,
- Starter sensor,
- ABS warning input,
- WCL switch,
- Driver's power window switch,
- Alternator sensors 1 & 2,
- Retarder active signal,

In test mode, with the parking brake applied and the passenger set point set to a value higher than 64°F (18°C), the circulator pump is not set to OFF as it would normally do when the outside temperature gets above 50°F (10°C). This feature allows verification of the pump when inside a garage. This is also useful when working on the heating system to remove air pockets trapped in the system.

When performing an A/C cooling test and having the water pump shut off is required, initiate the multiplex input test mode. While in this mode, just set the passenger set point temperature to the minimum 64°F (18°C) to shut off the pump.

#### 4.2 ELECTRIC MOTOR TEST SEQUENCE

This test mode allows testing of the electric motors, the A/C compressor clutch and unloader and the HVAC system solenoid valves without the

need to have the engine running. Note that while in test mode, the engine cannot be started.

Prerequisite conditions for the motor test mode:

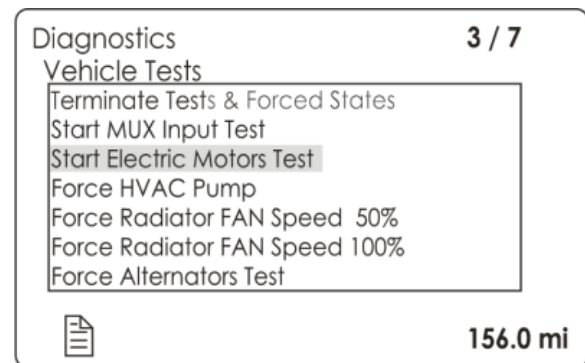
- The battery charger must be connected to a 110-120 volt power supply. If not, the test will be interrupted when the voltage drops below 24.4 volts,
- Engine not running,
- Parking brake applied,



Before starting the test sequence, make sure that no one is doing maintenance in the evaporator compartment, the condenser compartment or close to the CAC & radiator electric cooling fans.

#### NOTE

*The back-up alarm will sound (beep) ten (10) times prior the test starts to warn the persons who do work on the vehicle. Moreover, the alarm will beep to tell the person conducting the electric motors test sequence to move to the next test location on the vehicle.*



To enter this mode:

- Using the dashboard DID, select DIAGNOSTICS menu and press ENTER button ;
- Select VEHICLE TEST, press ENTER button then select START ELECTRIC MOTORS TEST and press ENTER button to initiate the test mode for electrical motors;
- Ten (10) beeps can be heard indicating the motor test mode has started.

Using the test mode:

- During the entire test, the telltale panel audible alarm gives a signal each second to remind that the motor test mode is underway.

## 4.2.1 Test Sequence – Coaches only

**Test Sequence – Coaches only**

Go to the condenser compartment



- The condenser fans start. Speed will gradually increase to maximum speed.
- The passenger's unit refrigerant solenoid valve activates. The refrigerant solenoid valve of the overhead compartment A/C system activates.

*Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment.*

In the engine compartment, the sequence is as follows



- The main power compartment fan activates for 3 seconds.
- Toilet fan motor starts.
- A/C compressor clutch activates 3 times.
- The compressor unloader activates 3 times.
- The electric cooling fans start running for 20 seconds.

*Then 5 beeps can be heard from the back-up alarm to indicate to go to the evaporator compartment.*

In the evaporator compartment



- Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 2 seconds.
- Hot water pump starts running for 5 seconds and hot water pneumatic valve cycles 3 times.

*5 beeps from the back-up alarm indicate to get to the driver's area inside the vehicle.*



Inside the vehicle




- The driver's HVAC unit refrigerant solenoid valve cycles 3 times and the hot water pneumatic valve cycles 3 times also.
- Left and right overhead compartment fans start running one after the other for 5 seconds.

**To exit the electric motors test sequence, press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice.**


## 4.2.2 Test Sequence – VIP With Central HVAC System

<b>Test Sequence – VIP With Central HVAC System</b>	
	<ul style="list-style-type: none"> <li>• Driver's &amp; passenger's unit fresh air damper open. <i>[20 seconds delay]</i></li> </ul>
Go to the condenser compartment	<div style="text-align: center;"></div> <ul style="list-style-type: none"> <li>• The condenser fans start. Speed will gradually increase to maximum speed. <i>[3 seconds delay]</i></li> <li>• The passenger's unit refrigerant solenoid valve activates 3 times. <i>[10 seconds delay]</i></li> </ul>


*Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment and main power compartment.*

In the engine compartment, the sequence is as follows	<div style="text-align: center;"></div> <ul style="list-style-type: none"> <li>• The main power compartment fan activates for 3 seconds.</li> <li>• A/C compressor clutch activates 3 times.</li> <li>• A/C compressor unloader activates 3 times.</li> <li>• The electric cooling fans start running for 20 seconds.</li> </ul>
---	---



*5 beeps from the back-up alarm indicate to go to the evaporator compartment.*

In the evaporator compartment	<div style="text-align: center;"></div> <ul style="list-style-type: none"> <li>• Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 2 seconds.</li> <li>• Hot water pump starts running for 5 seconds and hot water pneumatic valve cycles 3 times.</li> </ul>
-------------------------------	--


*5 beeps from the back-up alarm indicate to go to the spare wheel compartment behind the reclining bumper.*

Inside the spare wheel compartment	<div style="text-align: center;"></div> <ul style="list-style-type: none"> <li>• Driver's unit refrigerant solenoid valve activates 3 times.</li> <li>• Driver's unit hot water pneumatic valve cycles 3 times.</li> <li>• Closing of the fresh air dampers.</li> </ul>
<p><b>To exit the electric motors test sequence, press ESCAPE button, select TERMINATE TESTS &amp; FORCED STATES submenu and then press ENTER button twice.</b></p>	


## 4.2.3 Test Sequence – VIP With Small HVAC System

<b>Test Sequence – VIP With Small System</b>	
	<ul style="list-style-type: none"> <li>• Driver's unit fresh air damper opening. [20 seconds delay]</li> </ul>
Go to the condenser compartment	
	<ul style="list-style-type: none"> <li>• The condenser fan start. Speed will gradually increase to maximum speed. [3 seconds delay]</li> </ul>

*Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment and main power compartment.*

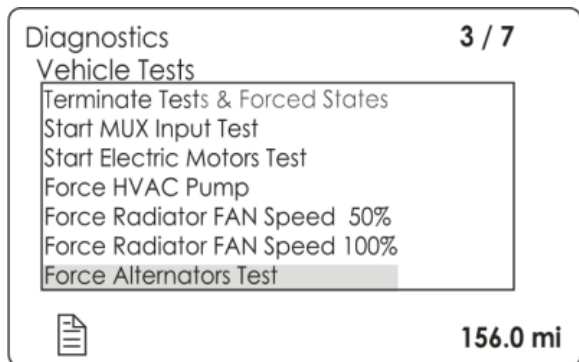
In the engine compartment, the sequence is as follows		<ul style="list-style-type: none"> <li>• The main power compartment fan activates for 3 seconds.</li> <li>• A/C compressor clutch activated 3 times. [5 seconds delay]</li> <li>• The electric cooling fans start running for 20 seconds.</li> </ul>
---	---	--

*5 beeps from the back-up alarm indicate to go to the spare wheel compartment behind the reclining bumper.*

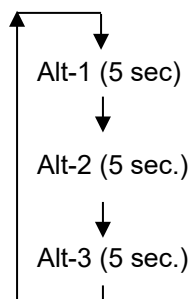
Inside the spare wheel compartment		<ul style="list-style-type: none"> <li>• Auxiliary unit refrigerant solenoid valve activates 3 times. [10 seconds delay]</li> <li>• Hot water pump starts running for 5 seconds.</li> <li>• Driver's unit refrigerant solenoid valve activates 3 times.</li> <li>• Driver's unit hot water pneumatic valve cycles 3 times.</li> <li>• Closing of the fresh air dampers.</li> </ul>
<p><b>To exit the electric motors test sequence, press ESCAPE button, select TERMINATE TESTS &amp; FORCED STATES submenu and then press ENTER button twice.</b></p>		

### 4.3 ALTERNATOR TEST

Anytime an alternator is suspected of being defective, this test will help you when performing your own alternator power output test, without the need to disconnect the alternator power cable. A clamp-on current meter is required.



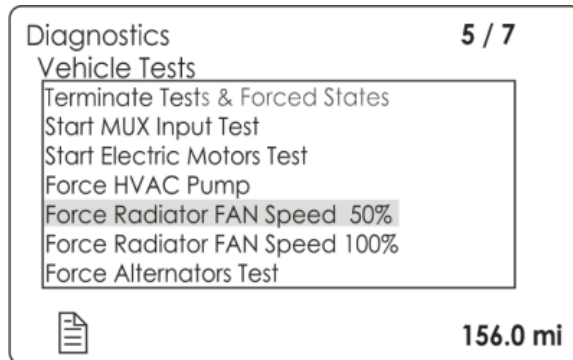
To initiate the test, use the Driver Information Display (DID) DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then FORCE ALTERNATORS TEST. Press ENTER button to start the test. This feature will activate one alternator at a time during 5 seconds, cycling between alternator 1, 2 & 3.



To exit test, press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice.

### 4.4 FORCED ACTIVATION OF THE COOLING FANS

To allow the technicians to visually check if all the cooling fans are in working conditions or to prevent the engine from overheating in case of malfunction of the cooling fans activation system, it is possible to force activation of the CAC & radiator fans.



Prerequisite condition: The engine is running (fast idle if at stand still).

1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then FORCE RADIATOR FAN SPEED 50% or FORCE RADIATOR FAN SPEED 100% as required.
2. The DID status line will show TEST to confirm the forced activation of the radiator fan clutch. To cancel, turn the ignition switch to the OFF position or press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice. TEST will disappear from the DID status line.

**WARNING**

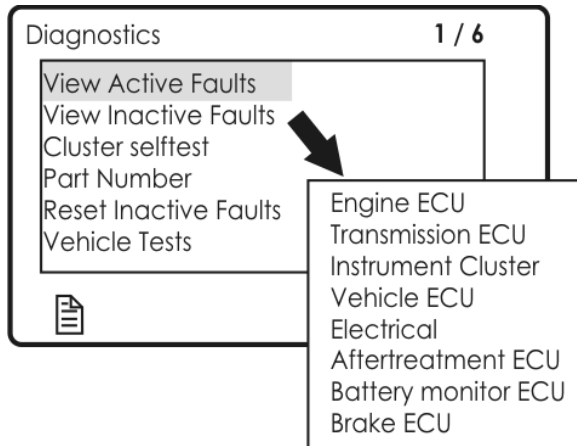
**Keep hands away from the cooling fans as they may start running at any moment.**

#### 4.4.1 Cooling Fans Cleaning Mode Validation

In order to make sure the cleaning mode is working, the following steps should be taken:

1. From the instrument panel DID, look for any fault codes related to cooling fans in the ELECTRICAL section.

Select: Diagnostics > View Active Faults > Electrical



- From the dash cluster DID, look at the cooling fans status under the fans status gauge. While in cleaning mode, the status will show CLEANING.

Fan run in reverse mode once per drive cycle when the vehicle reaches for the first time a speed between 31 mph and 43 mph. Note that no cooling request should be present in order for the cleaning mode to start. The sequence will last 10 seconds at full speed.

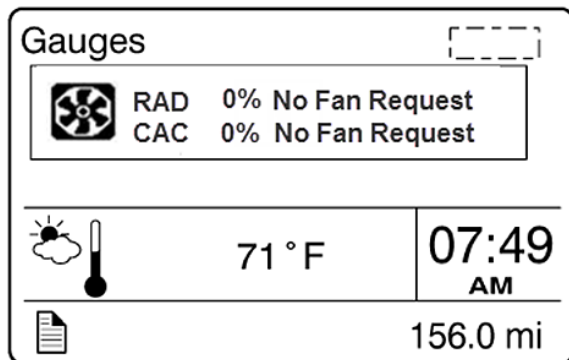


FIGURE 17: DURING THE NORMAL OPERATION OF THE VEHICLE, DISPLAYS THE SPEED AND THE STATE OF BOTH CHARGE AIR COOLER AND RADIATOR COOLING FANS, EXPRESSED IN PERCENTAGE FROM 0 TO 100%

## 5. LOWER PRIORITY I/O-EA & I/O-EB MODULES FOR BREAKDOWN SERVICE

Modules AE42 (I/O-EA) and AE43 (I/O-EA) affect lower priority functions. These modules can therefore be used as spare parts for breakdown service while on the road.

Functions lost if AE42 is removed and used as spare part:

- Kneeling, low buoy & auxiliary axle

Functions lost if AE43 is removed and used as spare part:

- Cruise control & ACB,
- Baggage compartment door lock,
- Door ajar,
- Tire Pressure Monitoring System,
- Front identification & clearance lights.

### 5.1 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective MCM (Chassis Control Module) or a DL0 (BBUS MUX) network problem, essential base functions are maintained to rear start the vehicle from the engine compartment and drive in a secure manner.

However, many secondary functions are lost. In this case, the following directives must be followed.

- Never connect a battery charger when the ignition is at the ON position on a vehicle with a DL0 (BBUS MUX) defective or certain functions will start up by themselves,
- Disconnect the charger before starting the vehicle, if not the default functions will not activate,
- If the default mode does not activate, try to turn the ignition OFF while ensuring that no charger is connected and then restart the vehicle.

#### 5.1.1 Available Functions

- Startup: Turn on the ignition in the driver's area and rear start the vehicle from the engine compartment,
- Opening the door: Functions normally,
- Closing the door: Manually pull on the door and it will lock automatically,

- Windshield wipers: Wipers functions at 1st speed only,
- Headlamps: Low beams only,
- Directional signals: Rear and front only,
- Stoplights: 2 upper stoplights + high-mounted stoplight are functional,
- HVAC: Functional with set point fixed at 70°F (22°C), evaporator and condenser fixed at speed 1, defroster fixed at speed 4.

## 6. NETWORKS

Networks identification

NETWORKS	
J1939 network)	- DL0 (Bbus Mux) - DL1 (drivetrain control network) - DL3 (Dbus Mux) - DL7 (engine subnet) - DL9 (engine transmission/I-Shift subnet)
J2284	- DL2
J1587 900/901)	- DL4 (powertrain subnet)

### 6.1 DL0 (BBUS MUX) NETWORK

The DL0 (BBUS MUX) network wiring is separated in sections and uses the following connectors that are not shared with other circuits: C1, C3, C5, C13, C100. These connectors allow sections of the network to be isolated to help locate short-circuit on the DL0 (BBUS MUX).

In case of a short-circuit on the DL0 (BBUS MUX) network, this affects all the modules and they all act as “No response” in the error messages of the VIEW ACTIVE FAULTS/ELECTRICAL menu. To locate a short-circuit, proceed by disconnecting one module zone at a time while verifying if this makes inactive the errors in the modules still connected. Connector C1 (front electrical & service compartment) disconnects all the modules at the rear of the vehicle from the network. Connector C5 (front electrical & service compartment) disconnects all the modules from the entrance door & wiper control panel. Connector C3 (rear electrical panel) disconnects all the modules at the rear of the vehicle from the network.

Example: Disconnect C5 and C1 and then verify the status of the errors. If the front modules (A41 to A46) now give inactive errors, which means short-circuit is elsewhere than in the front electrical & service compartment.



## 6.2 DL0 (BBUS MUX) CONNECTION ON THE TELLTALE PANEL AND THE HVAC CONTROL UNIT

The telltale panel module and HVAC module are linked to the MCM by a DL0 (BBUS MUX) connection. In case of a connection default, the telltale panel LCD display shows "CAN", and on the HVAC control unit, the temperature display indicates "---". To confirm a connection default, check that the fan speed on the driver's section HVAC control unit cannot be adjusted.

Moreover, specific error messages from these 2 modules can be read in the ELECTRICAL menu.

### **NOTE**

*While downloading a new vehicle program in the MCM from a computer, the DL0 (BBUS MUX) network is temporarily interrupted and therefore a DL0 (BBUS MUX) reference appears in the telltale panel LCD display.*

## 6.3 SPARE DL0 (BBUS MUX)

A spare DL0 (BBUS MUX) network is installed between the front and the rear of the vehicle. It has connectors installed at each end to facilitate swapping from the regular DL0 (BBUS MUX) network to the spare DL0 (BBUS MUX) network. Refer to the vehicle wiring diagram and section 4.6 for more information.

## 7. TROUBLESHOOTING

### 7.1 PROBING VOLTAGE ON THE MULTIPLEX CIRCUITS

Some Multiplex modules are supplied by 12 volts while others are supplied by 24 volts. The 12-volt or 24-volt information is found on the modules symbol in the wiring diagram. Before taking voltage readings to track the source of a problem, first verify if the module is supplied by 12V or 24V, if not, residual voltage on the module inputs/outputs can draw an erroneous conclusion.

Inactive Multiplex output = Residual voltage of 18% to 33% of supply voltage.

Inactive Multiplex input = Residual voltage of 50% of supply voltage.

### **NOTE**

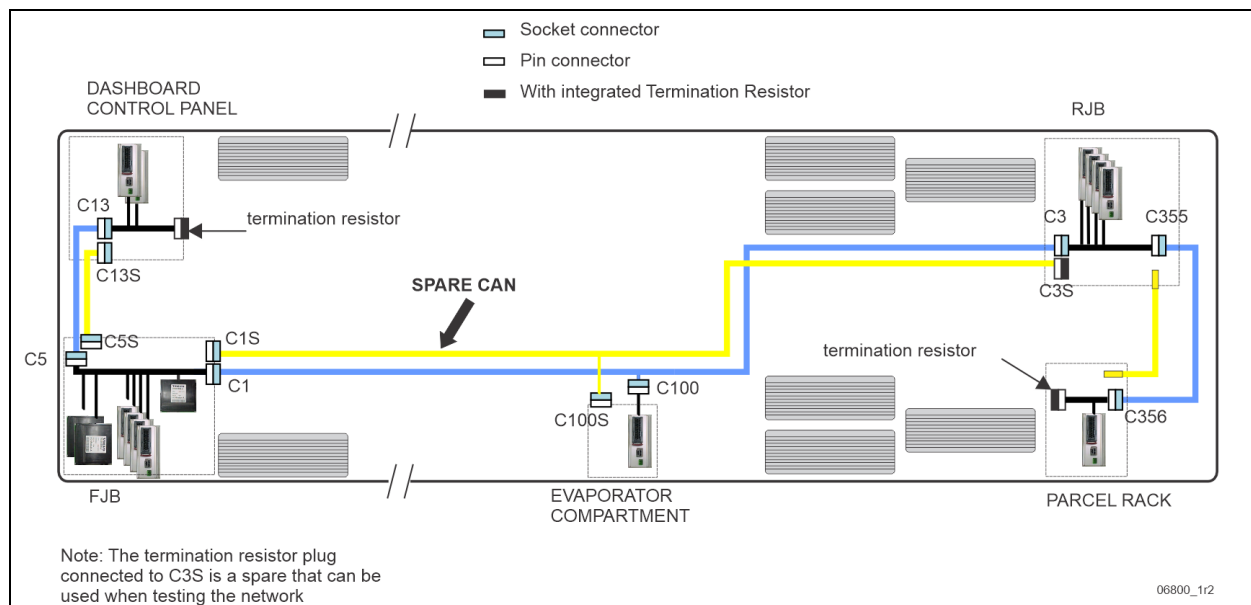
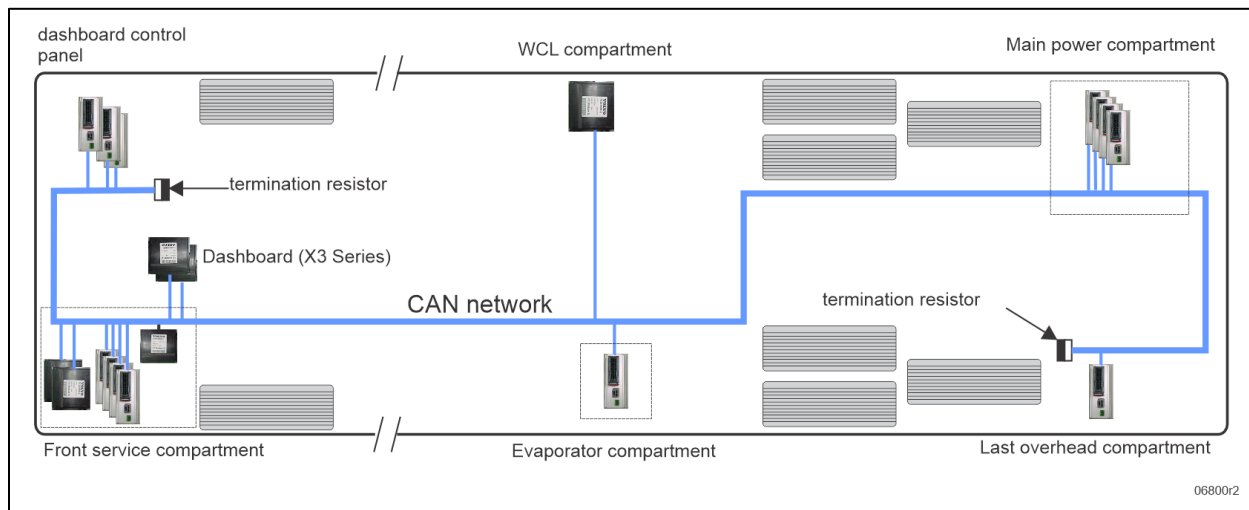
- *Verify on the wiring diagram whether the voltage is 12V or 24V,*
- *For a 12V module: an active voltage would be 12V or 0V but not in between. If you measure the intermediate tensions (ex. 6V, 2V, or 4V) this must be interpreted as if the input or the output is inactive.*
- *For a 24V module: an active voltage would be 24V or 0V but not in between. If you measure the intermediate tensions (ex. 12V, 4V, or 8V) this must be interpreted as if the input or the output is inactive.*

## 7.2 DL0 (BBUS MUX) NETWORK LAYOUT AND TROUBLESHOOTING

X3 SERIES		
MUX MODULE IDENTIFICATION	MODULE TYPE	LOCATION
A36	MCM	FJB
AE41	I/O-EA	FJB
AE42	I/O-EA	FJB
AE43	I/O-EB	FJB
AE44	I/O-EB	FJB
AE45	I/O-EB	FJB
AE46	I/O-EB	FJB
AE47	I/O-EB	DASHBOARD CONTROL PANEL
AE48	I/O-EB	DASHBOARD CONTROL PANEL
AE49	I/O-EB	MAIN POWER COMPARTMENT
AE50	I/O-EB	MAIN POWER COMPARTMENT
AE51	I/O-EB	MAIN POWER COMPARTMENT
AE52	I/O-EB	MAIN POWER COMPARTMENT
AE53	I/O-EB	LAST OVERHEAD COMPARTMENT, L.H. SIDE
AE54	I/O-EB	EVAPORATOR COMPARTMENT CONTROL PANEL
AE55	I/O-EA	DASHBOARD
AE56	I/O-EA	DASHBOARD
AE57	I/O-EA	WCL CMPT, ABOVE WHEELCHAIR LIFT

H3 SERIES		
MUX MODULE IDENTIFICATION	MODULE TYPE	LOCATION
A36	MCM	FJB
AE41	I/O-EA	FJB
AE42	I/O-EA	FJB
AE43	I/O-EB	FJB
AE44	I/O-EB	FJB
AE45	I/O-EB	FJB
AE46	I/O-EB	FJB
AE47	I/O-EB	DASHBOARD CONTROL PANEL
AE48	I/O-EB	DASHBOARD CONTROL PANEL
AE49	I/O-EB	DASHBOARD CONTROL PANEL
AE50	I/O-EB	MAIN POWER COMPARTMENT
AE51	I/O-EB	MAIN POWER COMPARTMENT
AE52	I/O-EB	MAIN POWER COMPARTMENT
AE53	I/O-EB	MAIN POWER COMPARTMENT
AE54	I/O-EB	EVAPORATOR COMPARTMENT CONTROL PANEL
AE55	I/O-EA	DASHBOARD CONTROL PANEL
AE56	I/O-EA	DASHBOARD CONTROL PANEL
AE57	I/O-EA	WCL CMPT, ABOVE WHEELCHAIR LIFT
AE58	I/O-EB	LAST OVERHEAD COMPARTMENT, L.H. SIDE

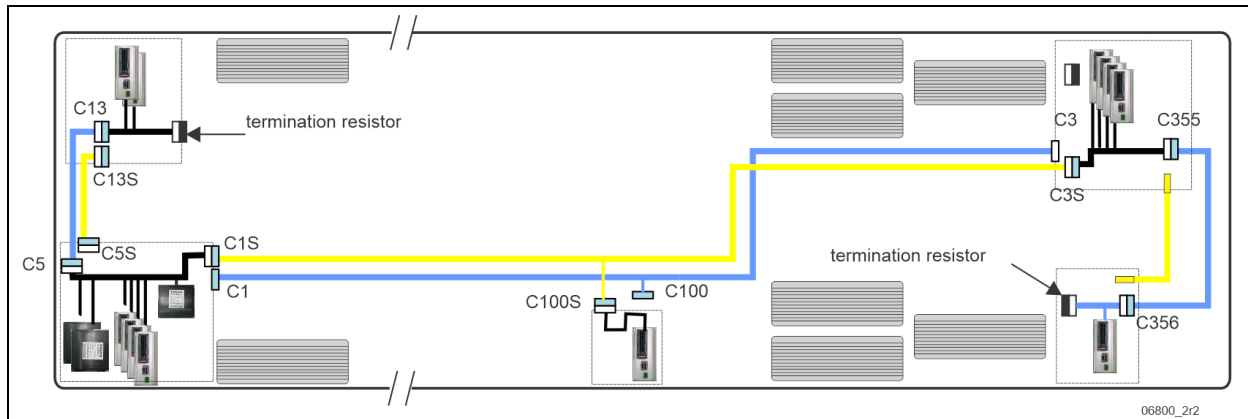
## SECTION 06: ELECTRICAL



If all modules (AE41 to AE58) are showed as Not Responding and Active Fault, the problem could be:

- A short circuit somewhere on the DL0H, DL0L (BBUS MUX) network.
- The network is completely open circuit. That means none of the two termination resistors are connected.

Several simple tests can be done to locate the problem.



**Use the spare “FRONT ELECTRICAL COMPARTMENT to MAIN POWER COMPARTMENT” CAN**

FRONT ELECTRICAL COMPARTMENT: disconnect C1 and connect C1 pin housing to C1S socket housing.

RJB: disconnect C3 and connect C3 socket housing to C3S pin housing.

5<sup>th</sup> baggage compartment: disconnect C100 and connect C100 pin housing to C100S socket housing.

**NOTE**

All modules including Wake-up modules and MCM have to be powered OFF prior to probe the DL0 (BBUS MUX) lines with an ohmmeter.

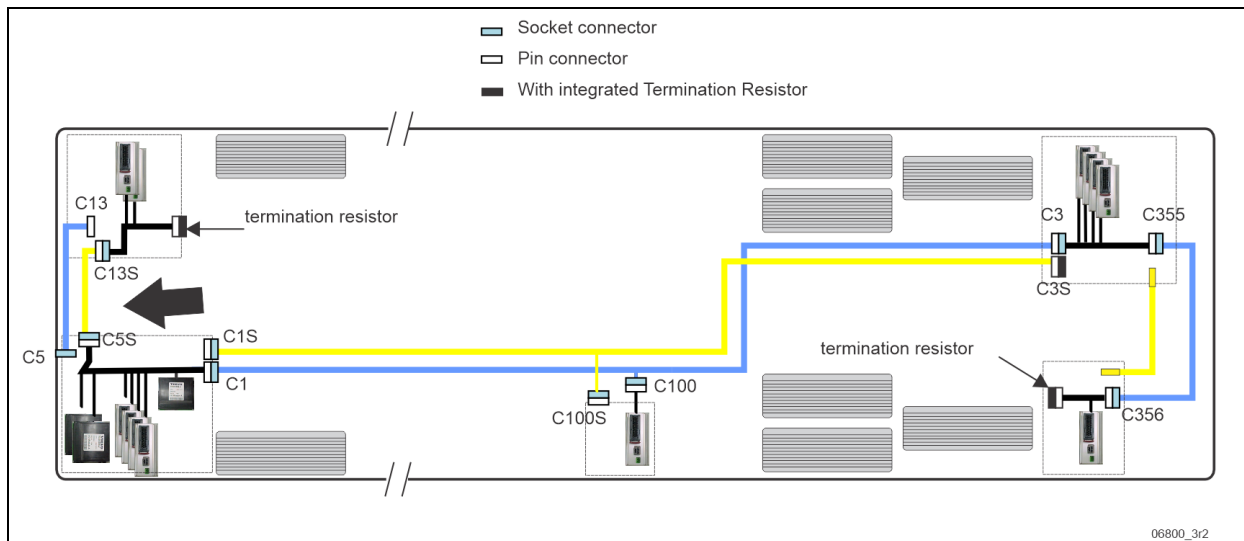
Probing the resistance between the DL0H and DL0L wire is a useful method to localize short circuits or open circuit on the DL0 (BBUS MUX) network. However, when doing so, make sure none of the modules connected to the DL0 (BBUS MUX) line are powered, including wake-up powered modules and battery direct supply module (MCM). Otherwise the measured value is invalid and will always show OL (Open Load). This is because the modules are applying a voltage on the DL0 (BBUS MUX) lines and this is fooling the ohmmeter.

Proceed as follow when probing the DL0 (BBUS MUX) line with an ohmmeter in order to get a valid reading:

- Turn ignition key to the OFF position.
- Set the main electrical shut-off switch to the OFF position to turn all Wake-up modules power to OFF.

Trip circuit breakers CB2 and CB6 to remove direct battery power from the MCM.

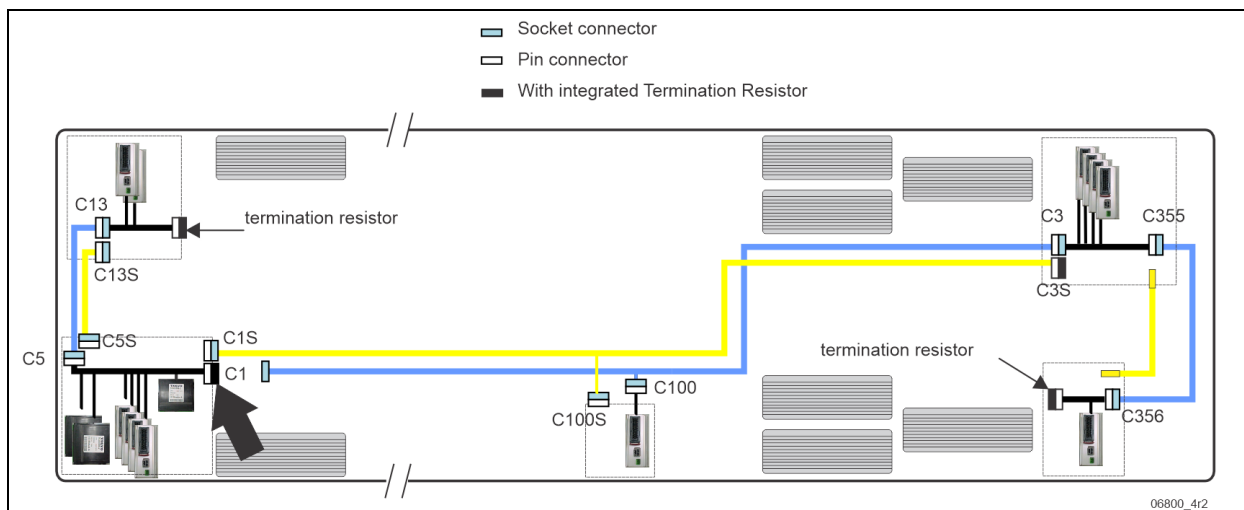
## SECTION 06: ELECTRICAL



### Use the spare “FRONT ELECTRICAL COMPARTMENT TO DASHBOARD CONTROL PANEL” CAN

Dashboard control panel: disconnect C13 and connect C13S pin housing to C13 socket.

FRONT ELECTRICAL COMPARTMENT: Disconnect C5 and connect C5S socket housing to C5 pin housing.

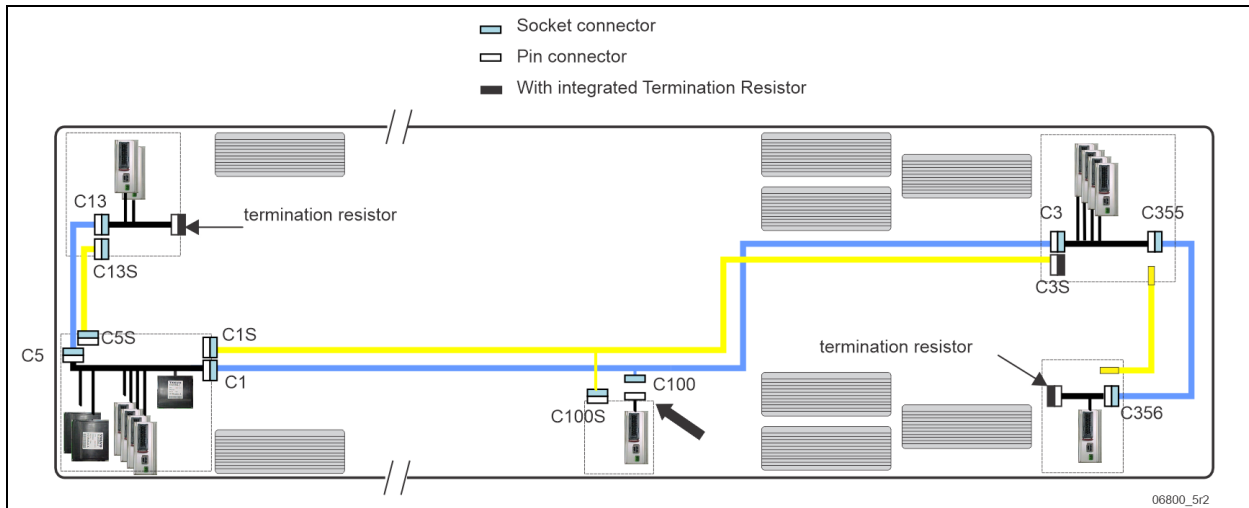


### Isolate the front from the rear

Take one of the termination resistors in the MAIN POWER COMPARTMENT.

Disconnect C1 and connect the termination resistor to C1 pin housing.

If all the front modules respond normally, the short circuit is in the rear portion.

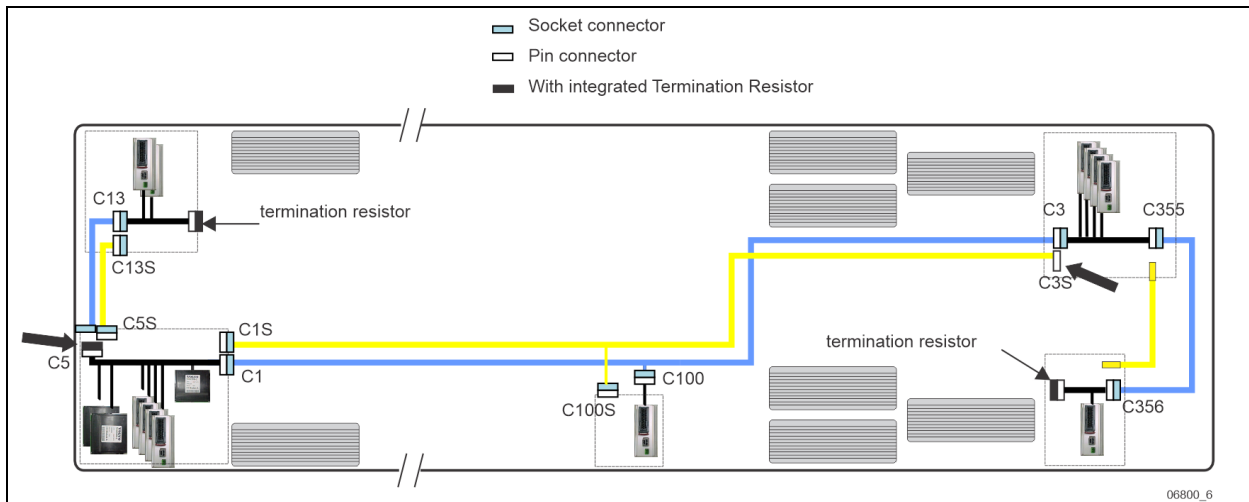


### Isolate the evaporator module from the network

Disconnect C100.

No need to connect a termination resistor there since C100 is a stub connection.

If the short circuit problem is in the evaporator panel, all modules except AE54 will respond normally.

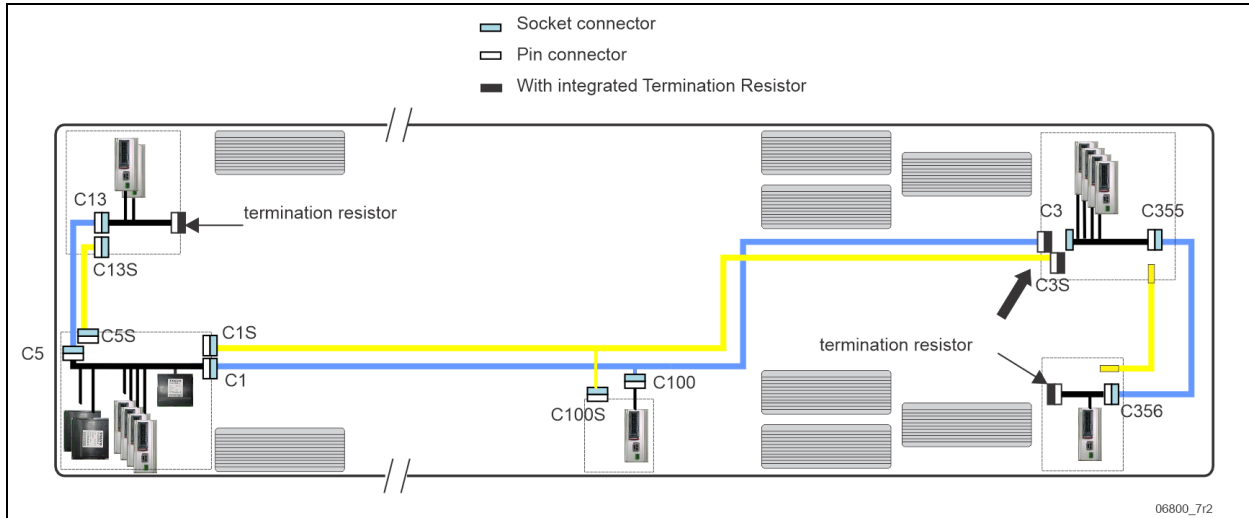


### Isolate the pneumatic accessories panel modules from the network

In the FRONT ELECTRICAL COMPARTMENT, disconnect C5.

Take the spare termination resistor on C3S in the MAIN POWER COMPARTMENT and connect it to C5 pin housing.

If the short circuit problem come from the DASHBOARD CONTROL PANEL, all modules except the ones located on the DASHBOARD CONTROL PANEL will respond normally.



**Isolate the MAIN POWER COMPARTMENT from the network**

Disconnect C3 Plug and connect the termination resistor into C3 pin housing.

If the short circuit problem is in the MAIN POWER COMPARTMENT or downstream, all front modules + the evaporator module will respond normally.

The same process can be for the overhead compartment module.

DL0 (BBUS MUX) wires are not like other common electrical wires.

- Maintaining a proper wire twisting is important. The two yellow and green wires must be twisted and in close contact all along the network to maintain the transmission line impedance.
- A slack handmade twisting is not acceptable.
- There should be no more than 50 mm (2 inches) without twist at the connection points.

We recommend replacing the DL0 (BBUS MUX) harnesses instead of trying to repair them.

**7.3 ELECTRICAL SYSTEM DIAGNOSTIC THROUGH THE DID**

Using the Driver's Info Display (DID), check if there are active errors in the vehicle electrical system. With the DIAGNOSTICS menu, highlight VIEW ACTIVE FAULTS and then highlight ELECTRICAL to request a diagnostic of the electrical system from the MCM. Press the enter key. If applicable, the DID shows the multiplex device ID, the fault messages or fault codes

recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down arrow to see all the fault messages.

Once the problem corrected, the DID still shows the fault as being active. You have to leave the VIEW ACTIVE FAULTS menu, wait approximately 20 to 30 seconds and then return to VIEW ACTIVE FAULTS to request a new diagnostic of the electrical system from the MCM. The DID should display the fault as being inactive. The MCM can store up to 20 faults, i.e. the first 10 and the last 10. Middle faults will be erased. If the breakers are tripped, the fault history will be erased from the MCM memory.

**NOTE**

*When performing an electrical system diagnostic with the DID, the message « No Response ModA41» indicates either module A41 is not responding due to a DL0 (BBUS MUX) link problem or module A41 is not powered. Similar messages exist for all modules (A42, A43, A44, etc.).*



**NOTE**

*Because it is easier to do, check first if the module is powered by probing on J3 connector. If it is, then you can conclude that there is a DLO (BBUS MUX) link problem. Refer to DLO (BBUS MUX) NETWORK LAYOUT AND TROUBLESHOOTING in this section.*

8. ELECTRICAL COMPARTMENTS

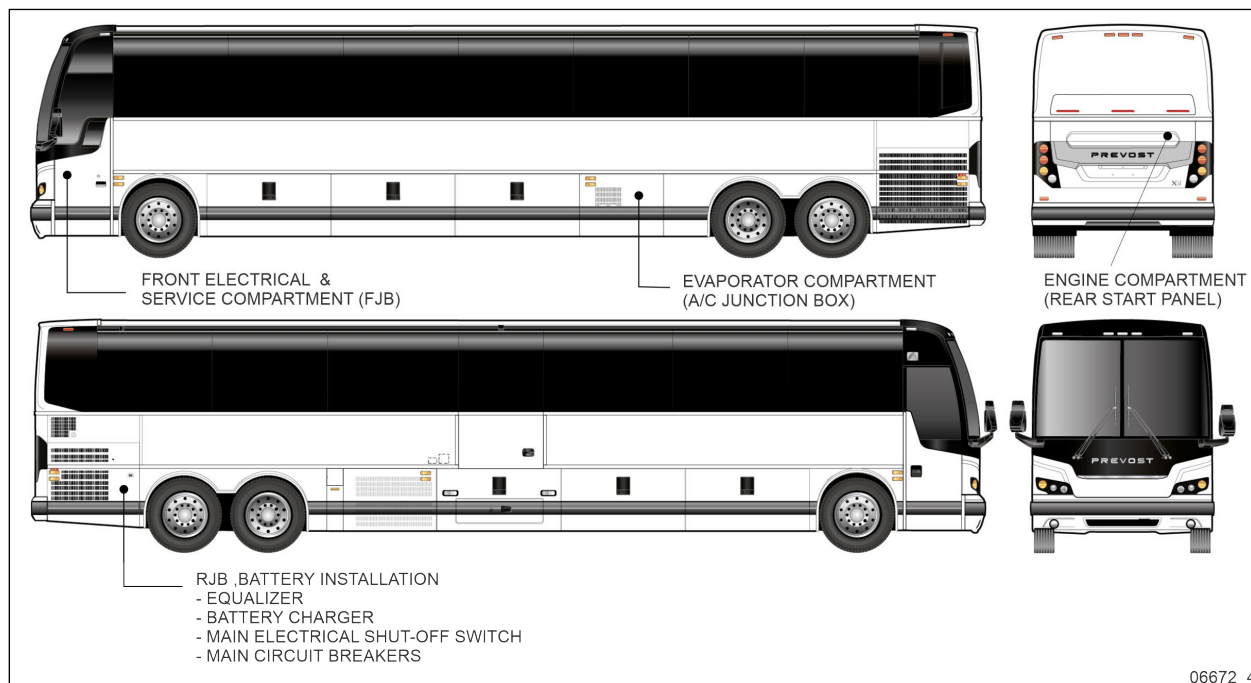


FIGURE 18: ELECTRICAL COMPARTMENTS (X3-45 COACH)



FIGURE 19: ELECTRICAL COMPARTMENTS (X3-45 VIP)

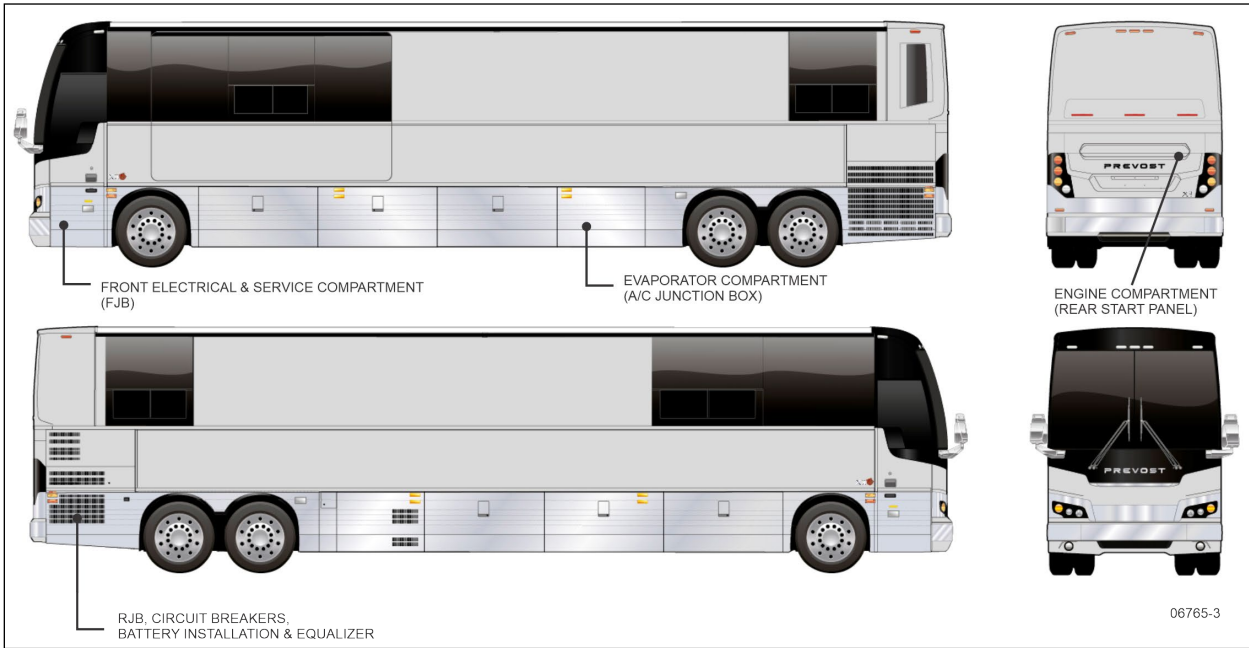


FIGURE 20: ELECTRICAL COMPARTMENTS (X3-45 VIP COMMERCIAL BUS SHELL)

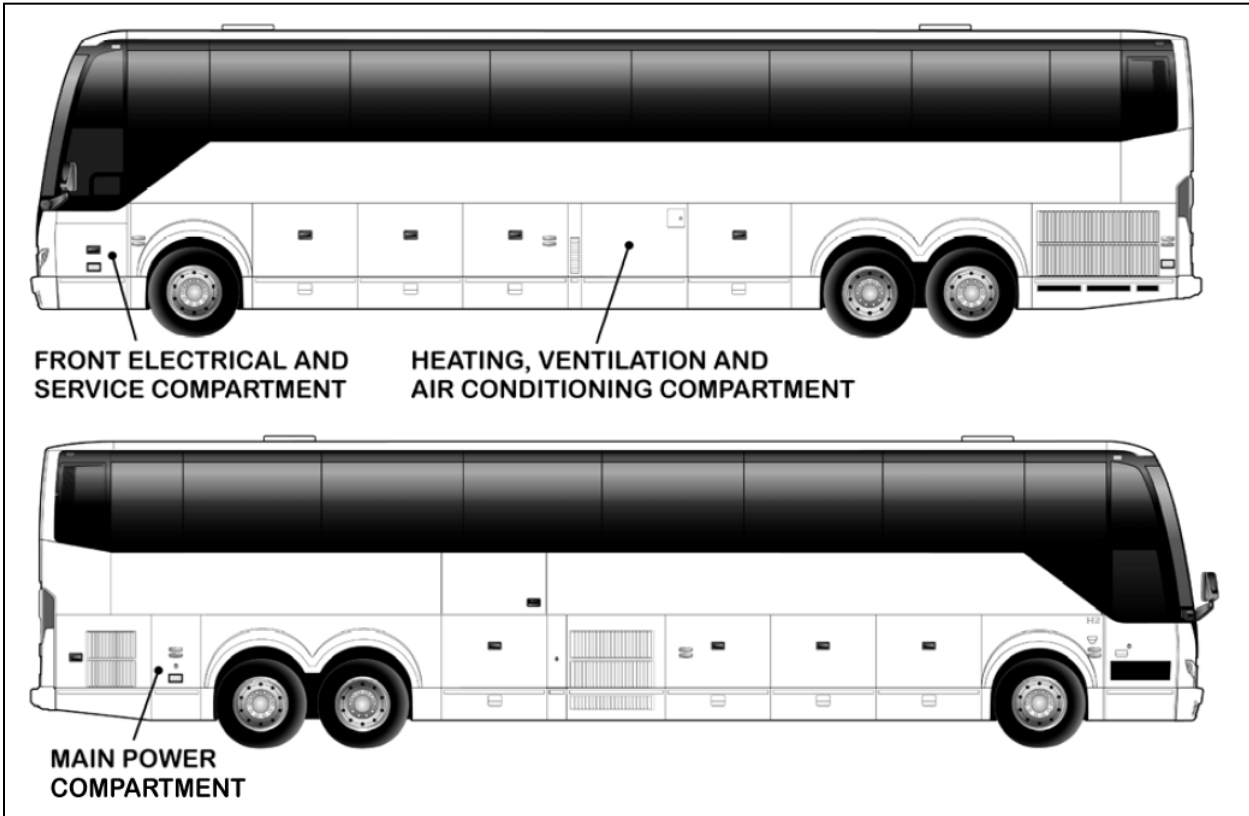


FIGURE 21: ELECTRICAL COMPARTMENTS (H3-45 COACH)

### 8.1 X3 SERIES MAIN POWER COMPARTMENT (RJB)

The main power compartment (a.k.a. rear junction box or RJB) and battery installation (Figure 22) are accessible from the engine compartment curb-side door.

The batteries are housed and secured on the engine R.H side deck. The battery posts and connections are protected by a watertight cover. The cover is fitted with a built-in vent. The cover can be unlocked and then removed with the use of the same type of hardware that allows opening and closing of the rear fender. Refer to paragraph 9.6 for the battery removal procedure.

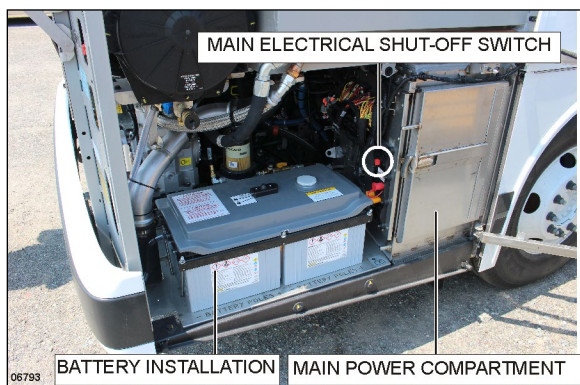


FIGURE 22: ENGINE R.H. SIDE COMPARTMENT

The main power compartment panel provides access to the following:

- Rear 12VD, 24VD junction blocks;
- Main circuit breakers;
- AE49, AE50, AE51, AE52 I/O-EB Multiplex modules;
- Vehicle Electrical Center Rear (VECR);
- Master relay R1;
- 12V ignition relay R3;
- Starter relay;
- Relays and fuses;
- Battery equalizer;
- 12VD & 24 VD current sensors;

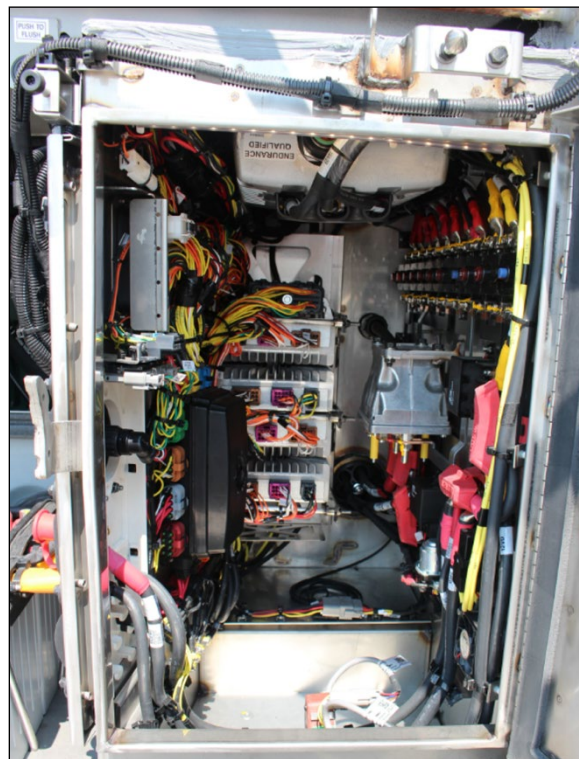


FIGURE 23: MAIN POWER COMPARTMENT

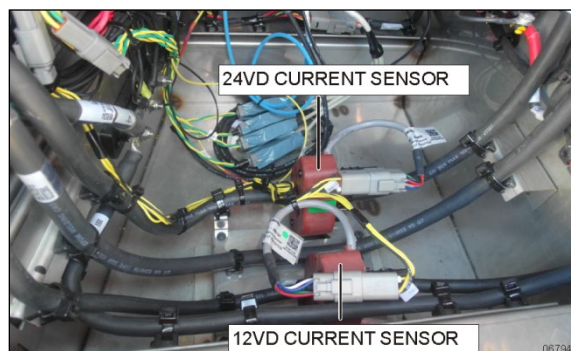


FIGURE 24: 12VD / 24VD CURRENT SENSORS IN MPC

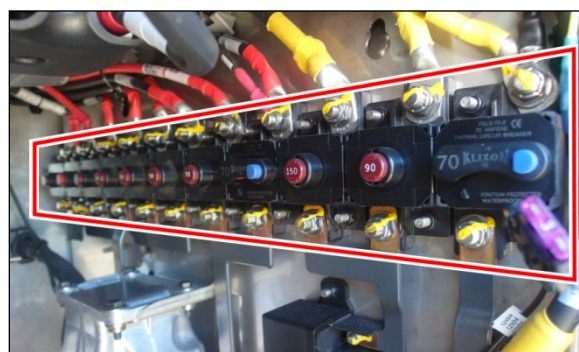


FIGURE 25: MAIN CIRCUIT BREAKERS IN MPC

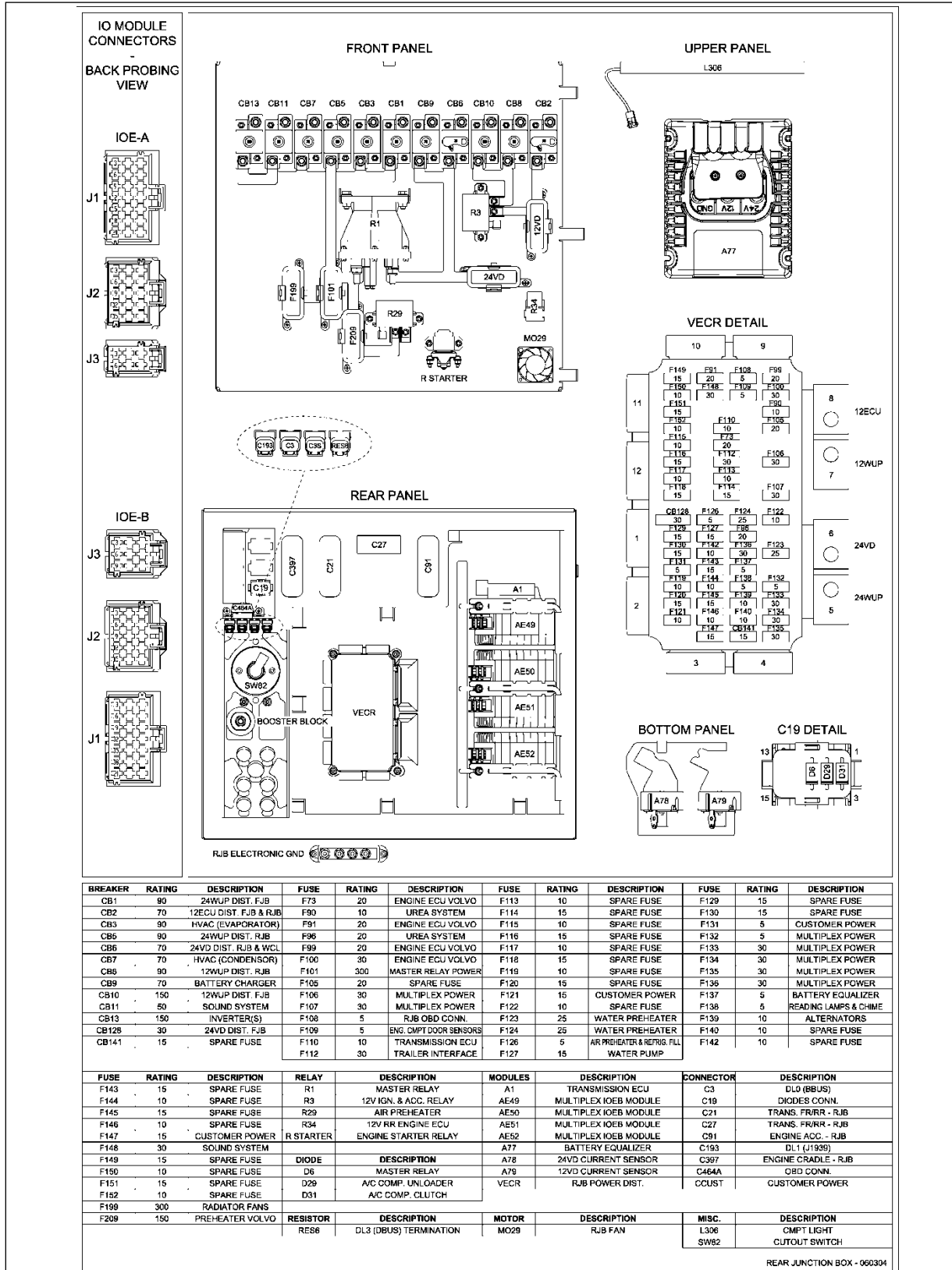


FIGURE 26: X3 SERIES MAIN POWER COMPARTMENT COMPONENTS IDENTIFICATION



### 8.2 X3 SERIES FRONT ELECTRICAL AND SERVICE COMPARTMENT (FJB)

The front electrical and service compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Figure 27):

- Front terminal block;
- Master Control Module (MCM);
- Vehicle Electrical Center Front (VECF) and Multiplex Modules;
- Relays and fuses;
- ABS Electronic Control Unit (ECU);
- VECU with Volvo D13 engine;

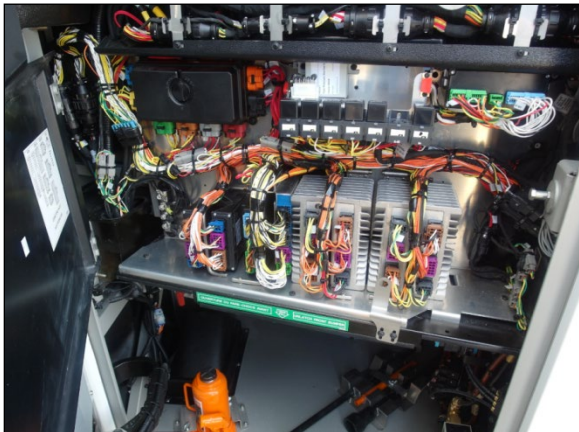


FIGURE 27: FRONT ELECTRICAL & SERVICE COMPARTMENT

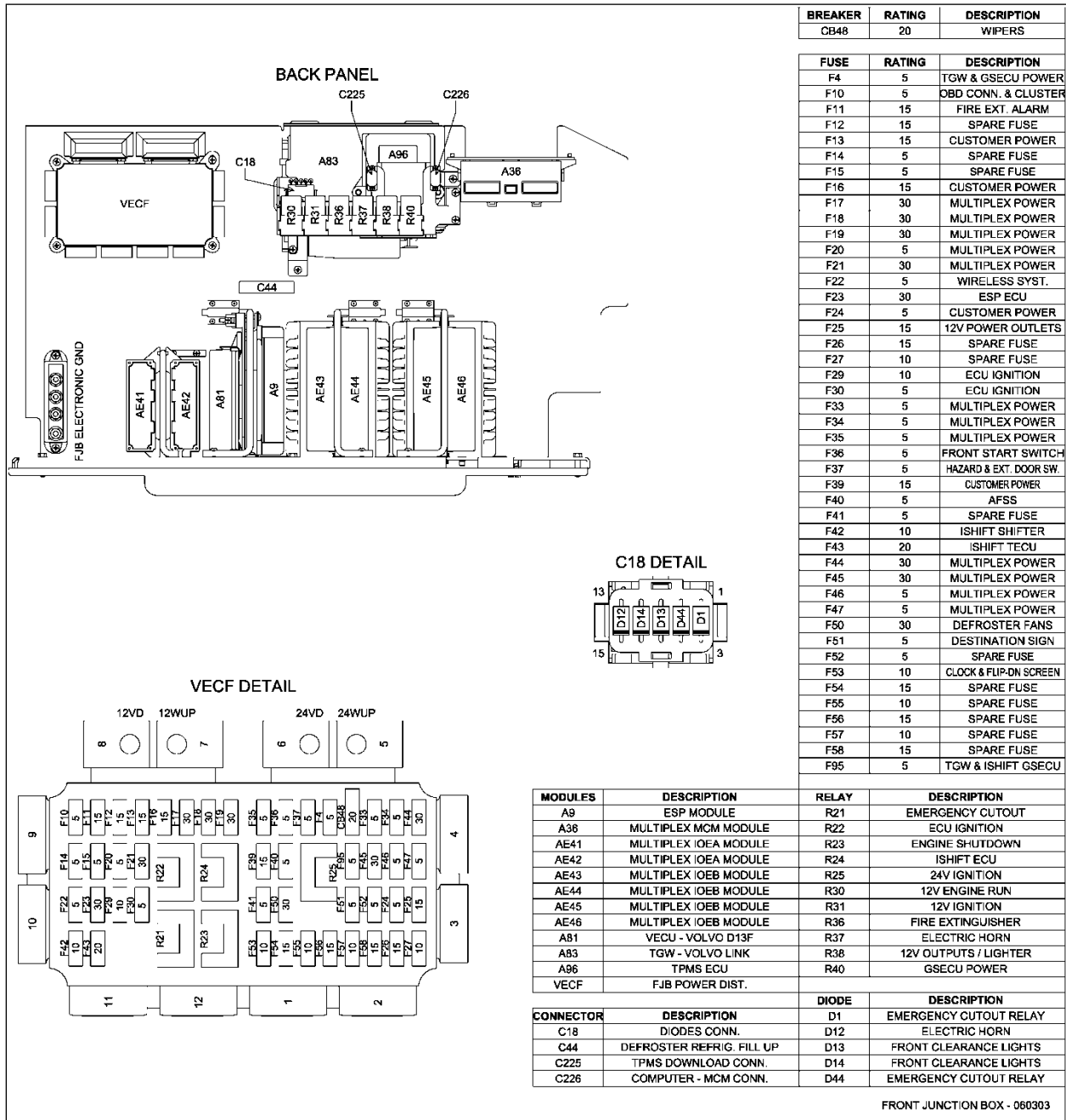


FIGURE 28: X3 SERIES FRONT ELECTRICAL & SERVICE COMPARTMENT COMPONENTS IDENTIFICATION

8.3 H3 SERIES MAIN POWER COMPARTMENT (RJB)

The main power compartment is located on rear R.H. side of vehicle behind the rear wheelhousing (Figure 29 & Figure 30).

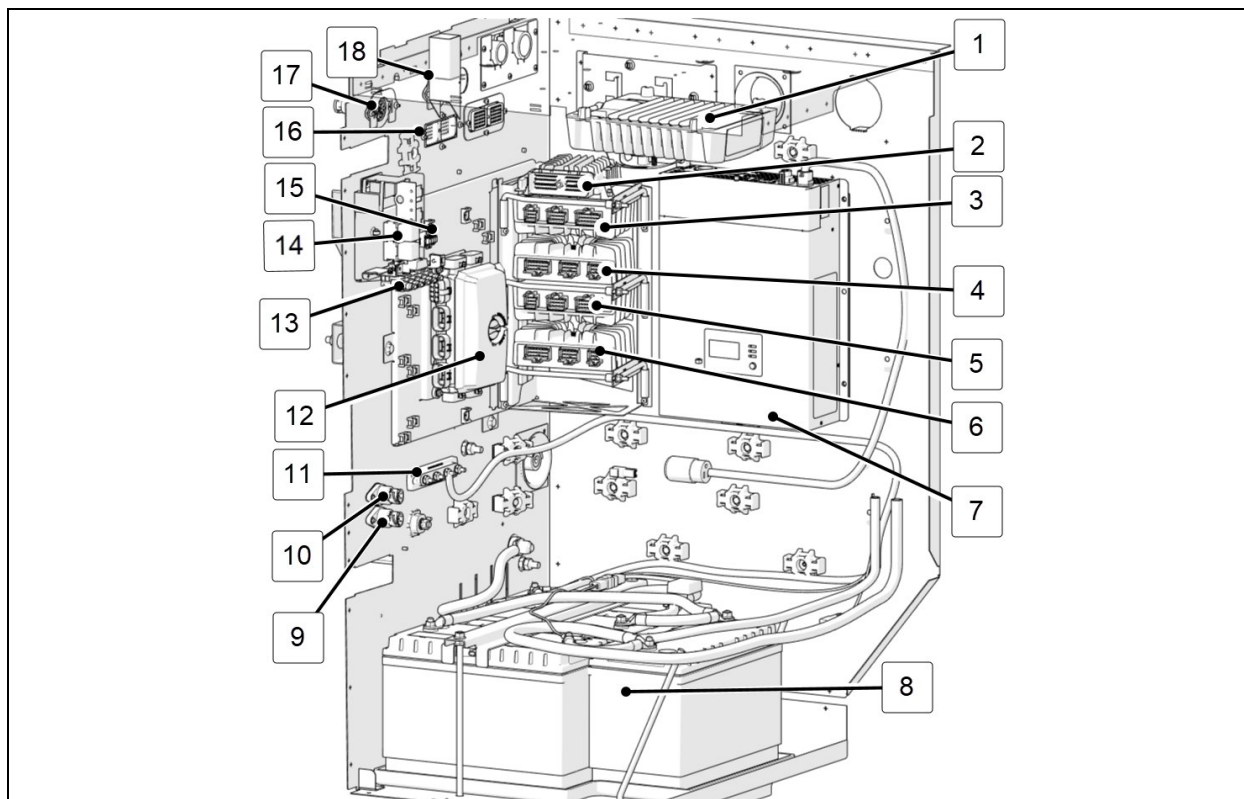


FIGURE 29: H3 SERIES MAIN POWER COMPARTMENT

- |   |     |  |
|---|-----|--|
| 1. Battery equalizer (Vanner)                 | 14. | C464A OBD tool receptable<br>Res6 DL3<br>C3S DL0<br>C3 DL0<br>C193 DL1                   |
| 2. A1 transmission ECU (Allison)              | 15. | R45 120V relay charger<br>R16 preheater max temp   |
| 3. AE50 multiplex module                      | 16. | C19 diode block<br>D31 clutch<br>D29 unloader<br>Spare<br>Spare<br>Res21 RJB compt light |
| 4. AE51 multiplex module                      | 17. | C397 (left), C91 (right)   |
| 5. AE52 multiplex module                      | 18. | C355   |
| 6. AE53 multiplex module                      | 19. | C54A   |
| 7. Inverter charger (Xantrex Freedom XC 1800) |     |  |
| 8. Battery bank                               |     |  |
| 9. SW 30                                      |     |  |
| 10. SW 82                                     |     |  |
| 11. RJB electronic ground studs               |     |  |
| 12. VECR                                      |     |  |
| 13.   |     |  |



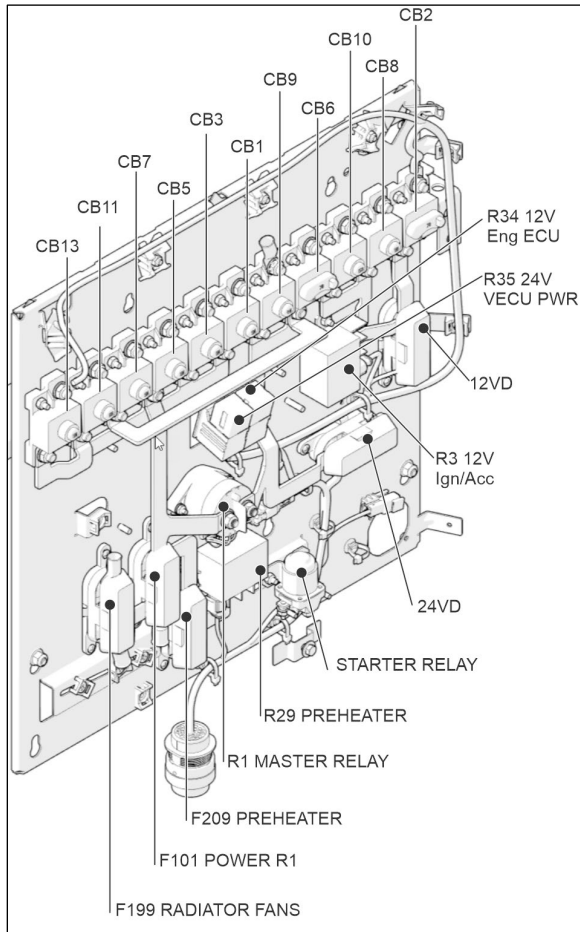


FIGURE 30: H3 SERIES MAIN POWER COMPARTMENT

8.3.1 H3 Series Vehicle Electrical Center Rear (VECR)

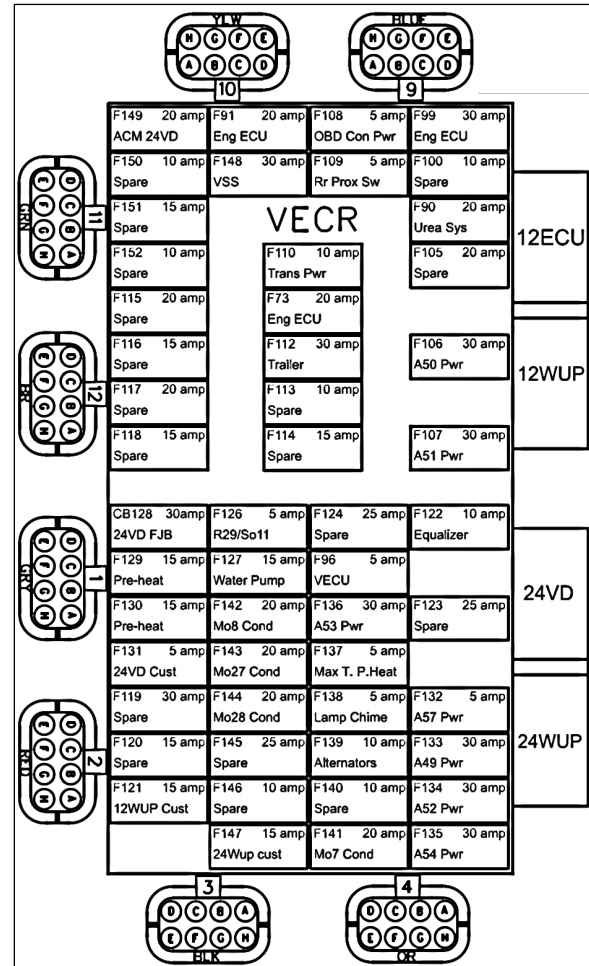


FIGURE 31: VECR – FUSE IDENTIFICATION

#### 8.4 H3 SERIES FRONT ELECTRICAL AND SERVICE COMPARTMENT (FJB)

The front electrical and service compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components among others (Figure 32):

- Electronic ground bus bar;
- Master Control Module (MCM);
- Fuses;
- Front power distribution module known as Vehicle Electrical Center Front (VECF);
- Multiplex Modules I/O-AE, I/O-BE;
- Electronic modules;
- Relays, diodes;
- ABS Electronic Control Unit (ECU);
- Emergency door opening unlock valve (coaches only);
- Windshield washer reservoir;
- Reclining bumper handle;
- Accessories system fill valve;
- Keyless entry system module (VIP only);

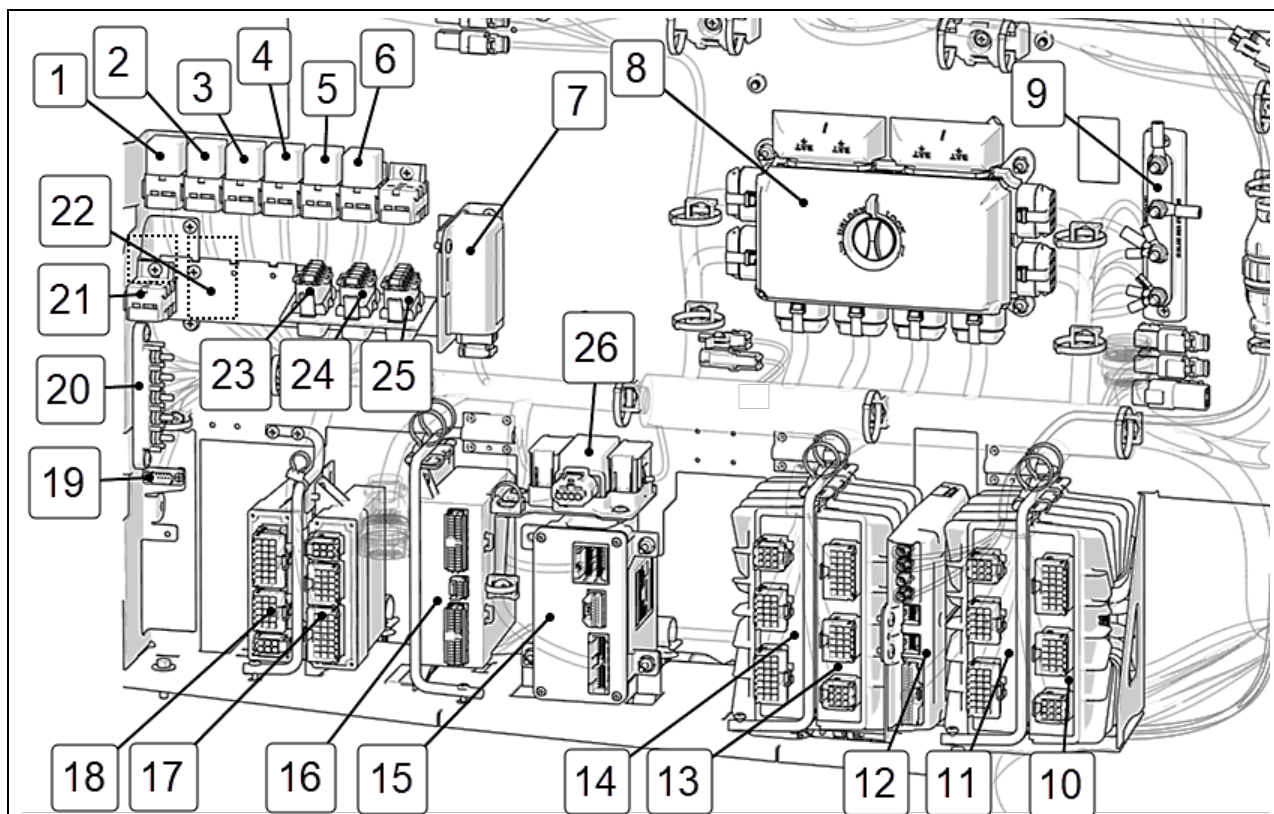


FIGURE 32: H3 SERIES FRONT ELECTRICAL &amp; SERVICE COMPARTMENT

- |   |                            |
|---|----------------------------|
| 1. R23A vecu ign                              | 21. A27 12 V steer control |
| 2. R30 12V engine run                         | 22. R4 cut preheater       |
| 3. R31 12V ign                                | 23. C18 diode block        |
| 4. R36 fire extinguisher                      | D1 accessories             |
| 5. R37 electric horn                          | D44 ignition               |
| 6. R38 12V pwr outlet (lateral control panel) | D13 front clearance lights |
| 7. Light pipe module (headlights)             | D14 fire extinguisher      |
| 8. VECF                                       | D12 electric horn          |
| 9. Electronic ground studs                    | 24. C22 diode block        |
| 10. AE46 multiplex module                     | 4x spare diode             |
| 11. AE45 multiplex module                     | Res22 light                |
| 12. A83 Telematic GW                          | 25. C36 diode block        |
| 13. AE44 multiplex module                     | D80 cutoff preheater       |
| 14. AE43 multiplex module                     | Spare                      |
| 15. A81 VECU                                  | D41 ignition               |
| 16. A36 MCM                                   | D43 ignition               |
| 17. AE42 multiplex module                     | Spare                      |
| 18. AE41 multiplex module                     | 26. R21 intel sleep mode   |
| 19. C226 COM port MCM                         |                            |
| 20. Power distribution                        |                            |
| 24 VD   |                            |
| 12 VI   |                            |
| 12 V engine run                               |                            |
| 12 VD   |                            |

ground

### 8.4.1 H3 Series Vehicle Electrical Center Front (VECF)

The VECF is a power distribution module. It incorporates fuses, relays and one circuit breaker.

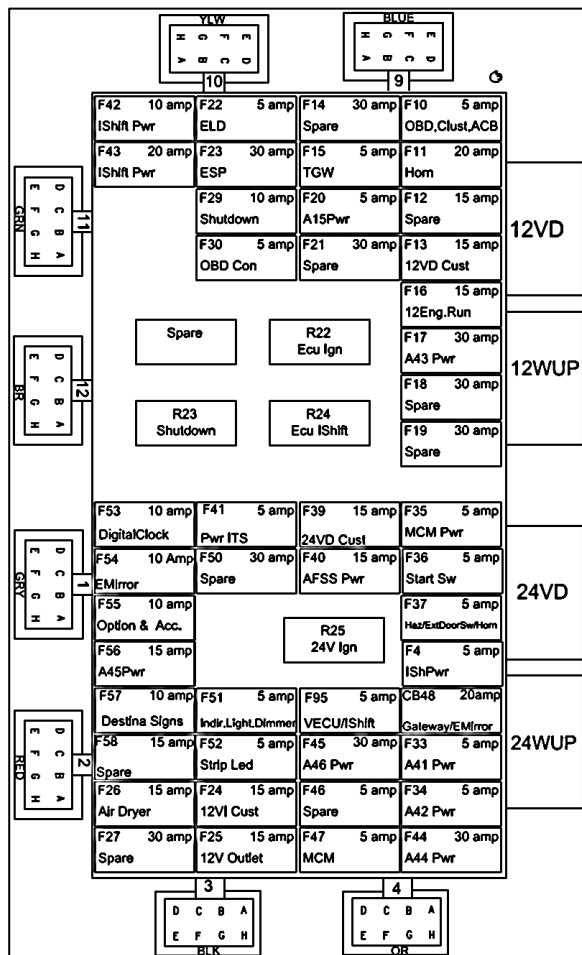


FIGURE 33: VECF – FUSE IDENTIFICATION

## 8.5 EVAPORATOR COMPARTMENT CONTROL PANEL

The evaporator compartment control panel is located on the evaporator fan housing.

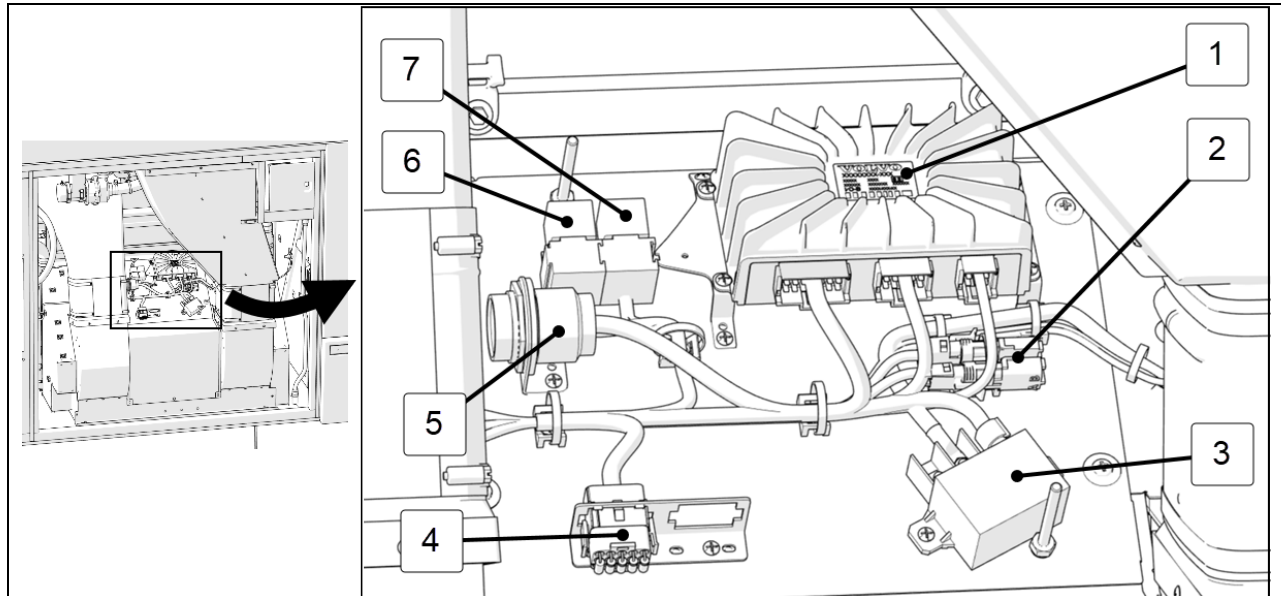


FIGURE 34: EVAPORATOR COMPARTMENT CONTROL PANEL

1. AE54 multiplex module
2. C24 refrigerant refill
3. R12 evaporator
4. C9 diode block
  - D9 water pump
  - D10 water pump
  - D11 passenger liquid
  - D8 A/C overhead cmpt
  - Res14 condenser fans
5. C15A
6. R20 water pump
7. R26 preheater

## 8.6 ENGINE REAR START PANEL

This control panel is located close to the back-up alarm in the engine compartment. This control panel includes the **engine rear start push button** and the **engine stop/ignition interlock** button. On some vehicles, a **tachometer** is also integrated in the start panel.

The **engine rear start push button** is used to start engine from engine compartment.

When servicing the engine, push the **engine stop/ignition interlock** button to prevent the engine from being started from the dashboard

ignition switch or the rear start push button. Once servicing is done, twist and pull the button to allow normal engine start. Pressing the **engine stop/ignition interlock** button while the engine is running will stop the engine.

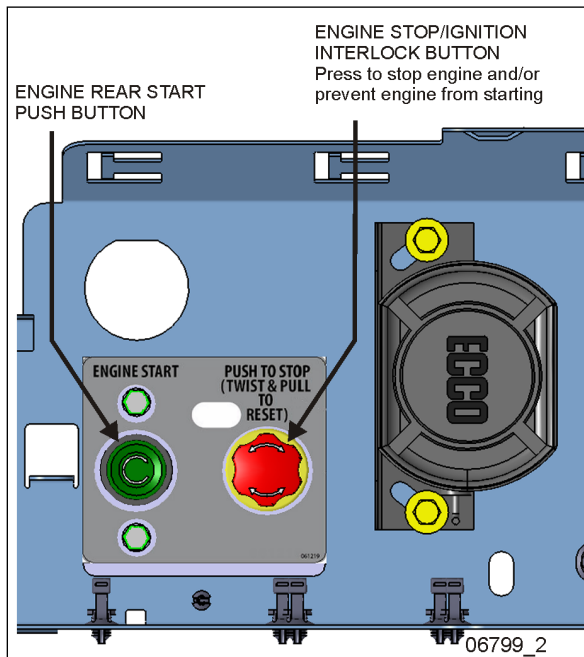


FIGURE 35: H3 SERIES REAR START PANEL

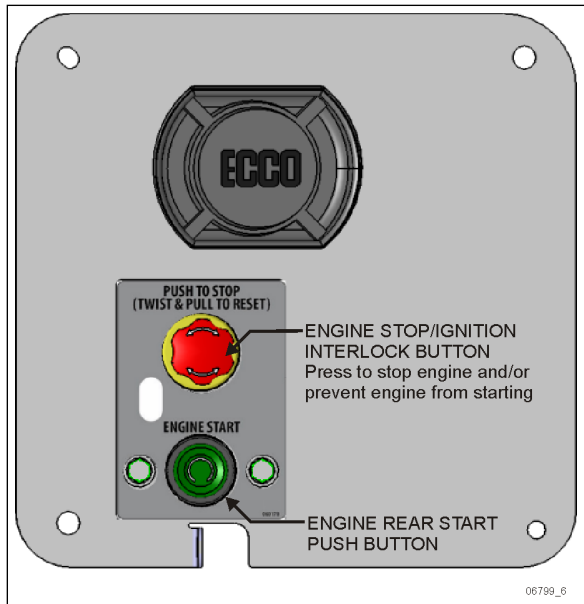


FIGURE 36: X3 SERIES REAR START PANEL

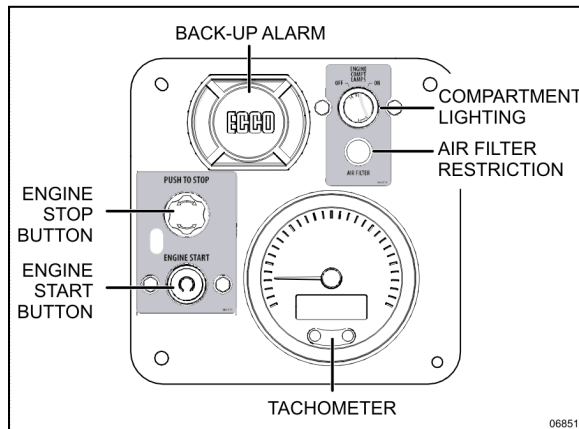


FIGURE 37: REAR START PANEL WITH TACHOMETER

## 8.7 CONTROL PANEL AT TO THE RIGHT OF THE DASHBOARD

To access the entrance door & wiper control panel of the right console, remove the panel under the larger utility compartment at the base of the windshield.

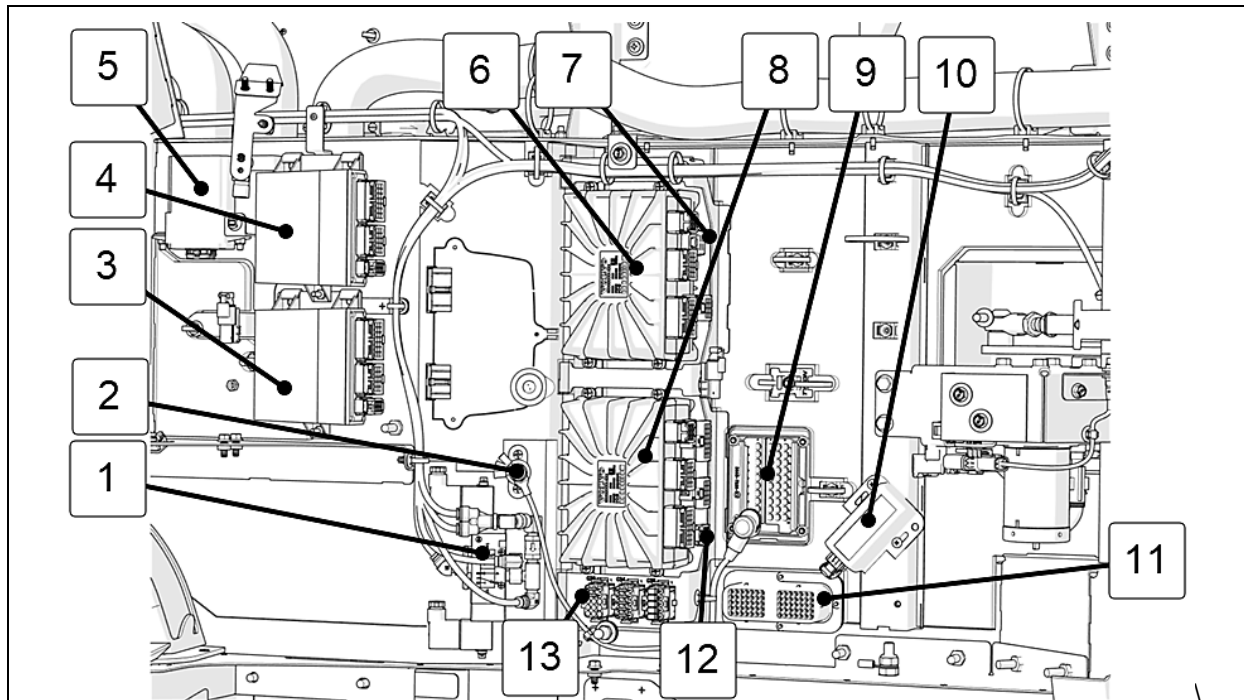


FIGURE 38: DASHBOARD CONTROL PANEL - H3 SERIES SHOWN

<ol style="list-style-type: none"> <li>1. Entrance door solenoid valve</li> <li>2. Electronic ground stud</li> <li>3. AE56 multiplex module</li> <li>4. AE55 multiplex module</li> <li>5. A99 ELD gateway</li> <li>6. AE49 multiplex module</li> <li>7. A21 wiper control</li> <li>8. AE48 multiplex module</li> <li>9. VEC RHC</li> <li>10. Light pipe module (headlights)</li> <li>11. C42</li> <li>12. AE47 multiplex module</li> </ol>	<ol style="list-style-type: none"> <li>13. C28 diode block               <ul style="list-style-type: none"> <li>Res12 (Res18 VIP) LH mirror</li> <li>Res13 RH mirror</li> <li>Spare</li> <li>Spare</li> <li>Spare</li> </ul> </li> <li>C34 diode block               <ul style="list-style-type: none"> <li>Res2 air recirc damper (spare VIP)</li> <li>Res9 defroster</li> <li>Res10 dashbd damper (Res2 air recirc damper VIP)</li> <li>Res11 pwm switch (Res10 dashboard damper VIP)</li> <li>Spare (Res12 pwm switch VIP)</li> </ul> </li> <li>C35 diode block               <ul style="list-style-type: none"> <li>Spare (D66 water pump VIP)</li> <li>Spare (D4 front door)</li> <li>D7 open door sw (Spare VIP)</li> <li>D2 refrigerant solenoid So7</li> <li>Spare</li> </ul> </li> </ol>
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## 8.8 OVERHEAD COMPARTMENT MODULE

A single I/O B module, AE53 (X3 Series) AE58 (H3 Series) is found at the rear end of the left overhead compartment.

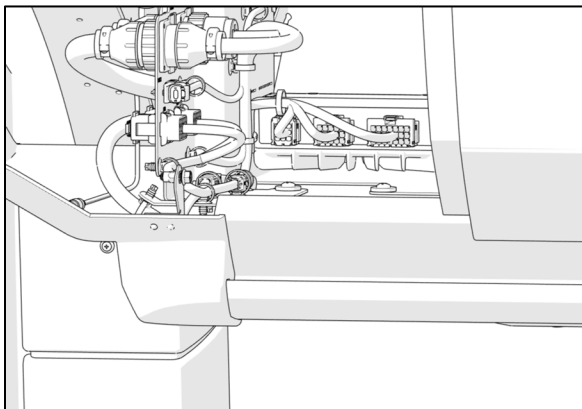


FIGURE 39: OVERHEAD COMPARTMENT I/O-EB MODULE AE58

## 9. BATTERIES

The battery has four (4) major functions:

1. Providing a source of current for starting the engine.
2. Stabilizing the voltage in the electrical system.
3. Supplying current for a limited time, when electrical demands of the equipment exceed the power output of the alternator.
4. Providing a limited source of power for connected accessories, when the engine is not running.



### WARNING

Battery posts, terminals and other related accessories contain lead and lead compounds, chemical known to the State of California to cause cancer and other reproductive harm.

Batteries also contain other chemicals known to the State of California to cause cancer.

**Wash hands after handling.**

### 9.1 BATTERY INSTALLATION X3 SERIES

The battery bank is composed of four AGM batteries. To prevent improper installation of the batteries, the positive (+) and negative (-) signs are laser cut on the battery deck steel sheet. When installing new batteries, place the battery negative and positive poles according to the signs on the battery deck (Figure 40).

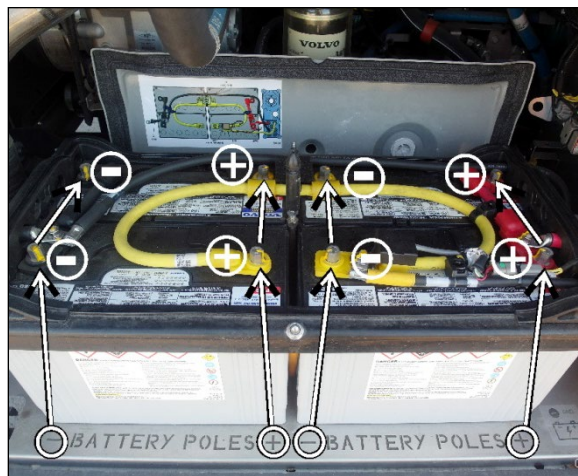


FIGURE 40: BATTERY INSTALLATION

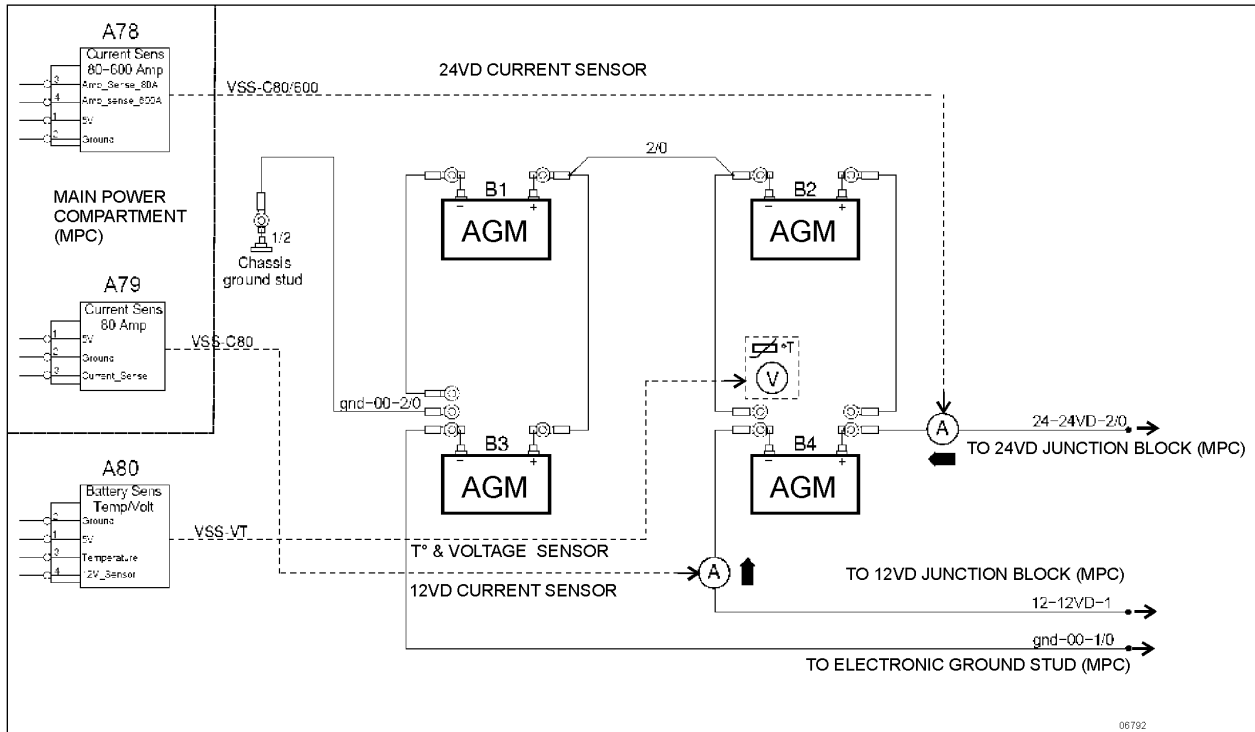


FIGURE 41: BATTERY CONNECTIONS SCHEMATIC – X3 SERIES

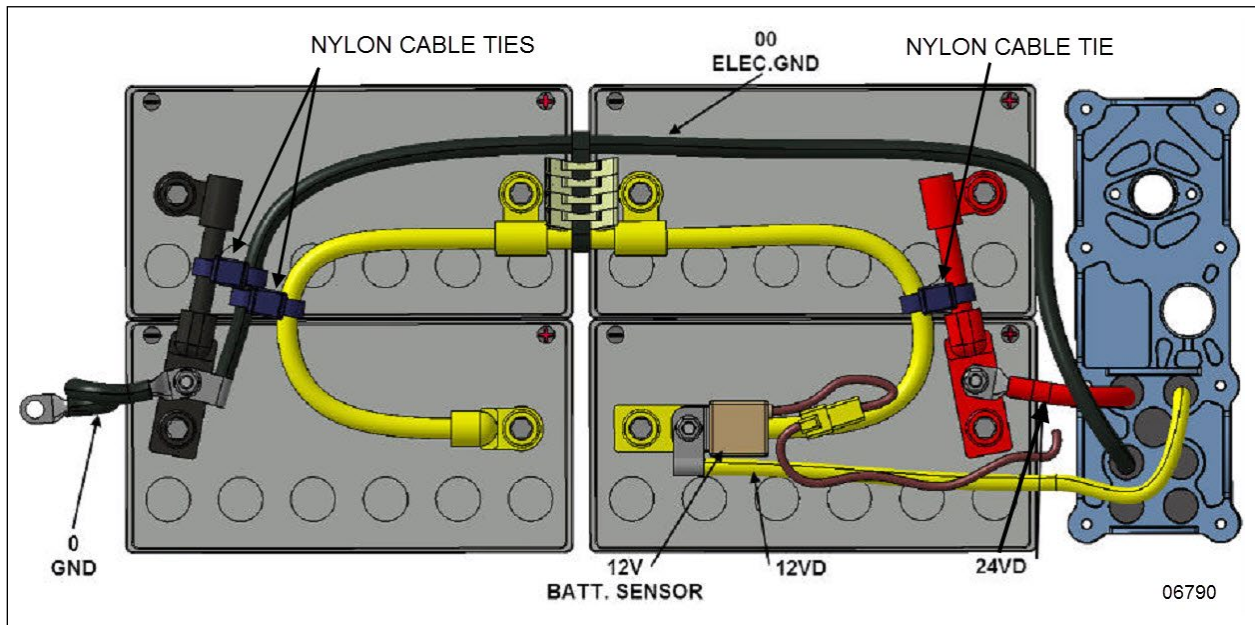


FIGURE 42: AGM BATTERY CONNECTIONS – X3 SERIES

9.2 BATTERY INSTALLATION H3 SERIES

The battery bank is composed of four AGM batteries. To prevent improper installation of the batteries, place the battery negative and positive poles according to the image below (Figure 43).

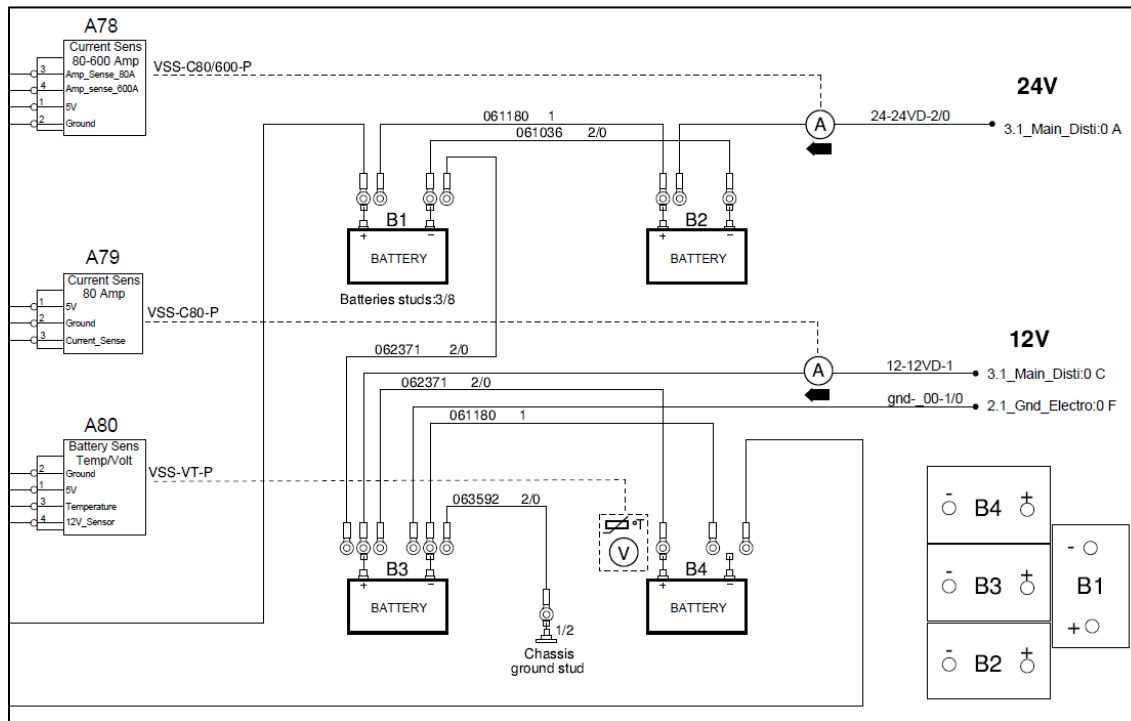


FIGURE 43: BATTERY CONNECTIONS SCHEMATIC – H3 SERIES

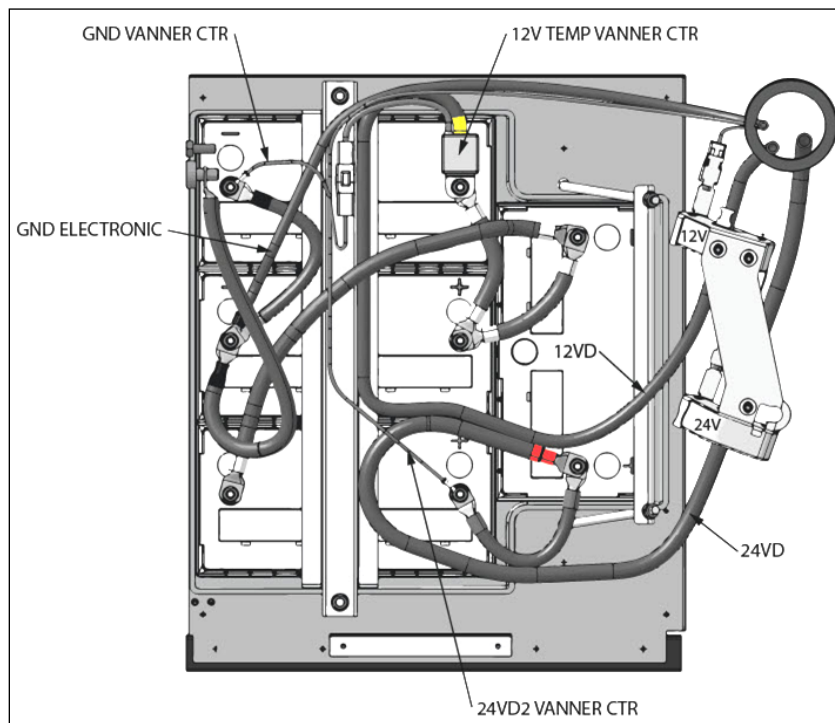


FIGURE 44: AGM BATTERY CONNECTIONS – H3 SERIES

### 9.3 AGM BATTERIES

This vehicle is equipped with PRIME energy management system, it is provided with four (4) Absorbed Glass Mat (AGM) 12-volt batteries connected in series-parallel.

These batteries require no maintenance for their lifetime. They can withstand deeper discharge cycles and several times the charging cycles of a standard battery.

These are sealed, valve regulated recombinant batteries which means that the oxygen created will recombine with the hydrogen in the battery, creating water and preventing water loss. Water never needs to be added to this type of battery.

The top-mounted negative and positive terminals are tightly sealed to prevent leaks.

The electrolyte in this type of battery is absorbed in micro-porous glass separators. This design prevents spills and results in greater resistance to vibration.

Always replace these batteries with identical make and model batteries as the system is balanced and optimized for this type of battery.



#### CAUTION

Replace only with AGM type batteries of the same specification and capacity.

PRIME system is programmed for the charging capacity of the batteries installed.

Installing a higher capacity battery will affect the battery life as the system will not fully charge the batteries, which is detrimental to battery performance.

Refer to "Specifications" at the end of this section for further details.

AGM batteries should be replaced in pairs or four at a time.



#### CAUTION

AGM (Absorbed Glass Mat) batteries require a voltage-limited charger, ideally fitted with a battery temperature sensor for temperature correction of charging parameters.

Charge voltage: 13.8-14.6 Volt @77°F (25°C)

Float voltage: 13.4-13.6 Volt @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even one time – may greatly shorten its life.

### 9.4 BATTERY DISCHARGE PROTECTION

To prevent discharge of the batteries when the engine is not running, some functions are automatically switched off if the batteries voltage drops below 24.4 volts for more than 30 seconds. The "Battery Voltage Warning" pictogram will show on the DID. Set the ignition key to the OFF position and then turn the ignition key to the ON position to reactivate the functions for a period of 30 seconds before they switch off again.

If a prolonged use of the functions with the engine not running is necessary, connect the battery to a charger.

### 9.5 MAIN ELECTRICAL SHUT-OFF SWITCH

Main 12-volt and 24-volt battery (master) relays are provided for this vehicle. The relays are located in the main power compartment. The 24-volt battery relay R1 & 12-volt battery relay R3 engage when ignition key is in the ON or ACC position and the main electrical shut-off switch is set to the ON position.

When the main electrical shut-off switch is set to the OFF position, the main battery relays R1 & R3 disengage thus all electrical supply from the batteries to main circuit breakers CB1, CB3, CB5, CB8, CB10, CB11, CB13, is cut off, with the exception of the following items, among others.

- Main circuit breakers CB2, CB6, CB9 which are directly connected to the batteries;
- Battery equalizer check module;
- MCM;
- ECM;
- TCM (Allison transmission);
- Aftertreatment Control Module (ACM);
- Preheater electronic timer;
- Preheater and water recirculating pump;
- Entrance door;
- Radio memory;
- Fire suppression system (momentarily);
- Horn, Hazard;
- Wheelchair lift system;
- Cluster memory.



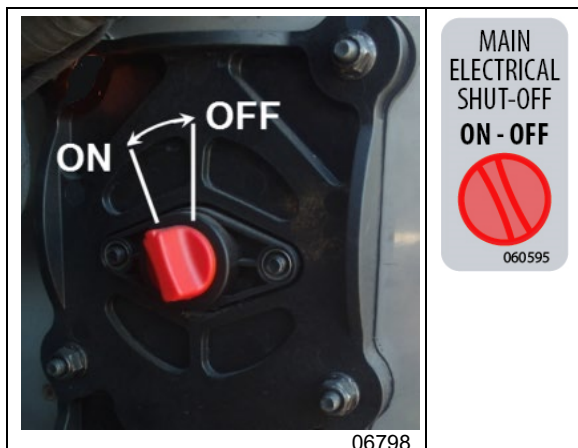


FIGURE 45: X3 SERIES MAIN ELECTRICAL SHUT-OFF SWITCH

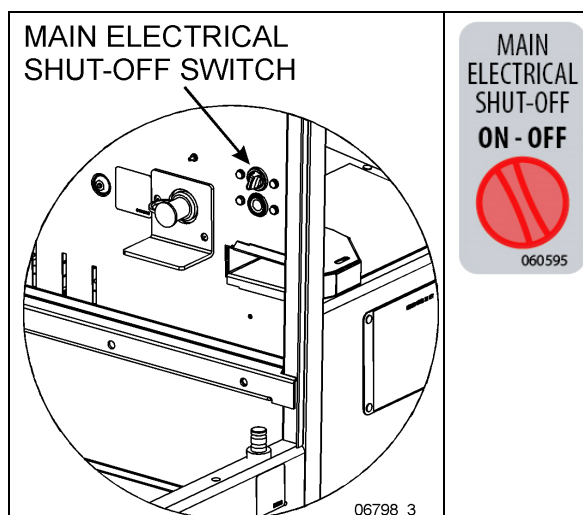



FIGURE 46: H3 SERIES MAIN ELECTRICAL SHUT-OFF SWITCH

## 9.6 BATTERY REMOVAL AND INSTALLATION – X3 SERIES

The batteries are located in the R.H. side of the engine compartment.



To prevent possible electric shocks or sparking, the main electrical shut-off switch in the R.H. side of the engine compartment (Figure 45) should be in the "Off" position before disconnecting cables from the batteries. In addition, trip main circuit breakers CB2 & CB6.

### 9.6.1 Battery Removal

1. Remove the battery bank cover and place behind the battery bank (FIGURE 47).



FIGURE 47: BATTERY BANK COVER REMOVED

2. Disconnect the ground cable first (FIGURE 48).

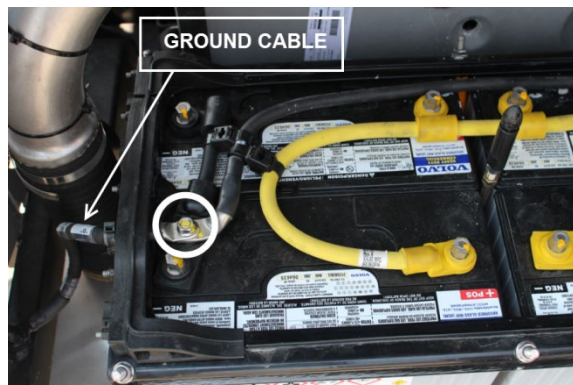


FIGURE 48: DISCONNECT GROUND CABLE FIRST

3. Using a 9/16 hex socket box, disconnect the eight (8) battery cable terminals (FIGURE 49).

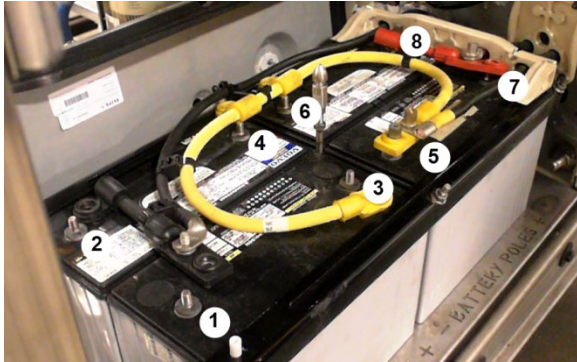


FIGURE 49: DISCONNECT 8 CABLE TERMINALS

4. Put the whole battery cable arrangement aside (FIGURE 50).

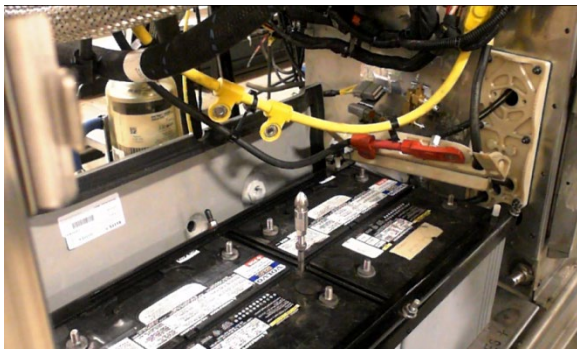


FIGURE 50

5. Unscrew three nuts (indicated with arrows) and then remove the front angle (FIGURE 51).

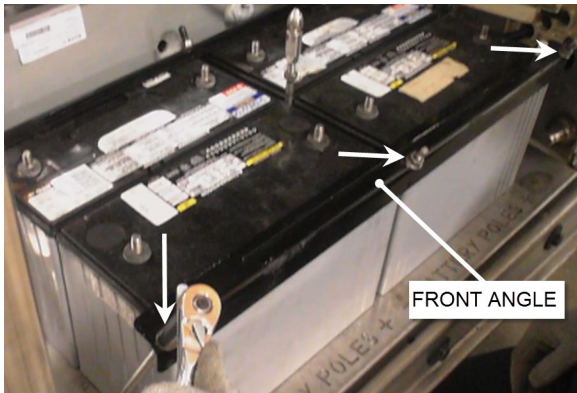


FIGURE 51: REMOVE THE FRONT ANGLE

6. Remove the rear angle similarly.



FIGURE 52: REMOVE THE REAR ANGLE

7. Slide the batteries on a mobile scissor lift table placed slightly lower than the battery deck level.



FIGURE 53

### 9.6.2 Battery Installation

Reinstalling the batteries is quite similar as the removal procedure but in reverse order.

However, special care should be taken to the following points:

1. To respect battery polarity in the arrangement, positive (+) and negative (-) signs are laser cut on the battery deck steel sheet. When installing the batteries, place the battery negative and positive poles according to the signs on the battery deck (Figure 54).

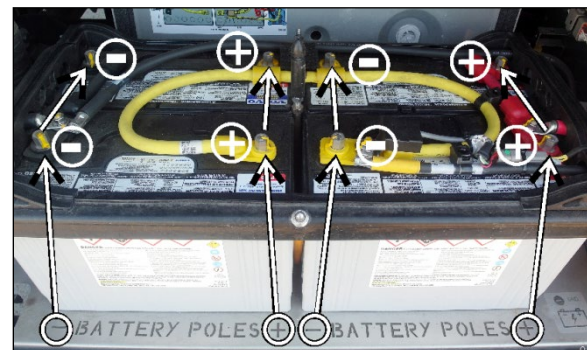


FIGURE 54: BATTERY BANK



- Rest the aft batteries against the fold on the battery deck. Rest the fore batteries against the aft batteries.

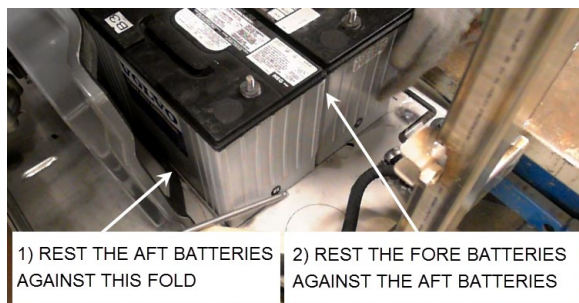


FIGURE 55: PROPER POSITIONING OF THE BATTERIES

- The upper end of the rods is shaped to match with the angle (FIGURE 56).

- Tighten the rod nut to the following torque:

**TORQUE: 45-55 lb-in (5-6 Nm)**

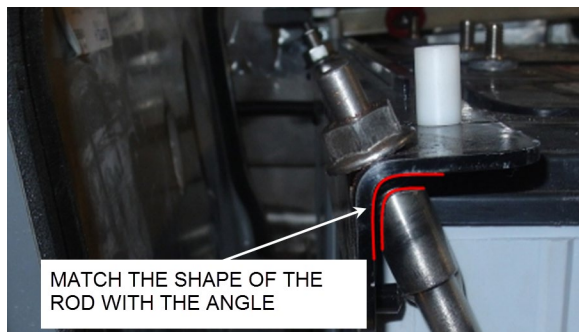


FIGURE 56: SHAPE OF THE ROD

- Align the dowels on the angles with the holes on the cable guides (FIGURE 57).

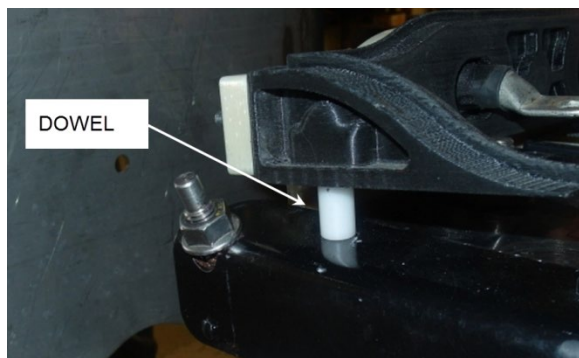


FIGURE 57: DOWEL ON ANGLE

**NOTE**

*When partially disconnecting battery cable arrangement, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and connected last.*

**NOTE**

*When reinstalling batteries, battery connections must be tightened. A torque wrench is required to ensure an accurate tightening torque.*

- Connect the battery cables. Tighten the cable terminal (item 1, FIGURE 58) nuts to the following torque:

**TORQUE: 170 lb-in (19 Nm)**

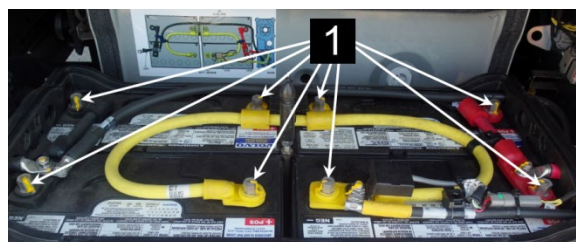


FIGURE 58: INSTALL THE BATTERY CABLE LUGS

- Connect the ground cable last (FIGURE 59). Tighten the ground cable nut to the following torque:

**TORQUE: 170 lb-in (19 Nm)**



FIGURE 59: GROUND CABLE

- To keep the battery connections clean, make sure that battery bank cover leans perfectly on the cable guides and the angles.





To prevent possible electric shock or sparking, the main electrical shut-off switch must be set to the “Off” position before tightening an electrical connection.

#### NOTE

*A protective coating should be applied on certain power connections that have been disconnected. Refer to Procedure SAV00002E included at the end of this section to know the recommended products and where they are used.*

## 9.7 AGM BATTERY RATING

Each of the 12-volt batteries used on the vehicle has the following rating:

- Reserve capacity: 200 minutes
- Cold Cranking Amps (CCA): 800 @ 0°F (-18°C)
- Weight: 69 lb (26,7 kg)

The reserve capacity is defined as the number of minutes a new, fully charged battery at 80°F (26,6°C) can be discharged at 25 amperes and maintain a minimum of 1.75 volts per cell (10.5 volts total for one 12-volt battery). This rating can be used as a basis for determining how long a vehicle might run after an alternator failure.

The cold cranking rating is defined as the minimum discharge current a battery will deliver in amperes for 30 seconds at 0°F (-18°C) while maintaining a minimum of 1.2 volts per cell (7.2 volts total for one 12-volt battery). This rating can be used as a basis for comparing starting performance.

## 9.8 BATTERY TESTING

Several factors influence battery performance. The methods and inspection procedures proposed here will ensure your batteries are in good shape.

### 9.8.1 Visual Inspection

1. Check the outside of the battery for a broken or cracked cover or case that could permit

loss of electrolyte. If obvious physical damage is noted, replace the battery. If the battery is bulged, replace the battery. Also check for wet areas around the terminals.

2. Check for loose terminal posts, cable connections, damaged cables, and for evidence of corrosion. Correct conditions as required before proceeding with tests.
3. Check for damaged or loose battery tie-downs.

### 9.8.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in Figure 61. Connect a load equal to half the CCA across the terminal for 5 seconds to remove surface charge from the battery.

### 9.8.3 Load Test

This test is one means of checking the battery to determine its ability to function as required in the vehicle.

To make this test, use test equipment that will withstand a heavy electrical load from the battery, such as a **carbon pile load tester**. A charging system analyzer test equipment may also be used.

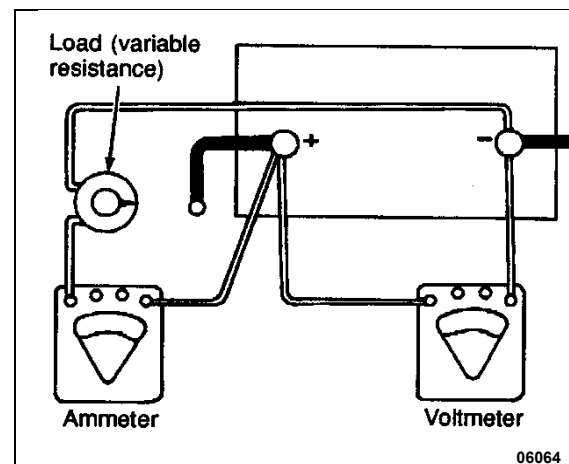


FIGURE 60: LOAD TEST



### CAUTION

Observe the polarity of the meters and the battery when making connections, and select the correct meter range.

1. You cannot test a discharged battery. If the voltage is below 12.4 volts, be sure to

completely charge the battery before continuing.

2. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in Figure 60.
3. Apply a load equal to one-half the CCA rating @ 0°F for 15 seconds. Note the voltage at 15 seconds with the load on and immediately shut the load off.
4. A voltage reading at least equal to the value from the chart below indicates a good battery.
5. If the voltage reading is less than the value from the chart for a given battery temperature, replace the battery.

Battery Temperature	Minimum Voltage
70°F (21°C) and above	9.6
60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

**NOTE**

*The accuracy of this test procedure is dependent upon close adherence to the proper load, time and temperature specifications.*

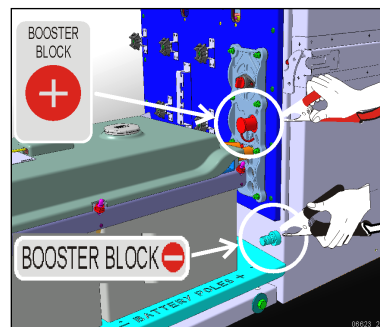


3. **NOT EQUIPPED WITH ONBOARD CHARGER.** Connect the clamps of an external charger to the booster block terminals. Make sure the external charger is **not** powered.



**WARNING**

Always turn off the external charger before connecting or disconnecting to a battery.




4. Turn ON the external charger.

Proceed in reverse order to stop the charging operation and to disconnect the onboard or external charger.

9.9 BATTERY CHARGING

The batteries used on this vehicle can be charged on the vehicle. To charge the batteries, proceed as follows:

1. With the engine turned off and the ignition switch set to OFF.
2. **EQUIPPED WITH ONBOARD CHARGER.** Connect 120 V supply to the onboard charger connector (the onboard charger is an optional equipment and might not be installed on the vehicle).



During charging of the batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through the vent holes and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion, which may shatter the battery.

1. Do not smoke near a battery which is being charged or which has been recently charged.
2. Do not break live circuits at battery terminals because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on chargers. Poor connections are a common cause of electric arcs, which cause explosions.
3. The electrical system on this vehicle is negative ground. Installing the batteries with the positive terminals grounded or incorrect use of the booster battery and jumper cables will result in serious damage to the alternator, batteries and battery cables.

The clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs after the vehicle cables are detached. The clamps should make firm contact with the lead pads (Figure 61).

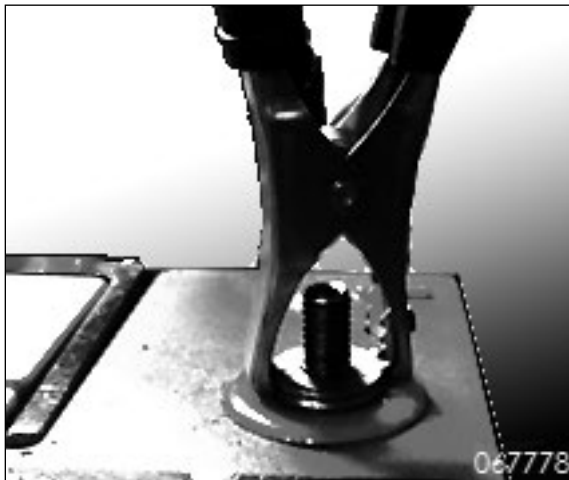


FIGURE 61 CLAMP POSITION— TYPICAL AGM BATTERY

**NOTE**

*The charge rate must be doubled when the batteries are charged by the booster block, because of the series-parallel circuit.*

**AGM (Absorbed Glass Mat) batteries require a voltage-limited charger, ideally fitted with a battery temperature sensor for temperature correction of charging parameters.**

**Do not manually charge AGM batteries. Look for the following voltage values on your voltage-limited charger.**

Charge voltage: 13.8-14.6 Volt @77°F (25°C)

Float voltage: 13.4-13.6 Volt @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even once – may greatly shorten its life.

- The maximum charge rate in amperes should be no more than 1/3 of the battery's reserve capacity minute rating.
- State-of-charge is estimated from the **OCV** (open-circuit voltage). Typical values are shown on the charging time table below.

CHARGING TIME FOR A SINGLE BATTERY				
OCV (AGM)	STATE OF CHARGE	CHARGER MAXIMUM RATE		
		30 A	20 A	10 A
12.8V	100%	Ready to use		
12.6V	75%	0.9	1.3	2.5
12.2V	50%	1.9	2.7	5.1
12.0V	25%	2.9	4.3	7.8
11.8V	0%	4.0	5.7	10.7

**CAUTION****AGM Battery Charging Considerations**

Many common battery chargers are not fully compatible with AGM batteries, however; they will not ruin the battery if used a few times over the battery's life.

Adversely, not all chargers are really AGM compatible and can do significant damage to an AGM battery. Large "wheeled chargers" found in many shops, which exceed 15.4 volts must be avoided.

If an AGM battery needs to be charged outside of the vehicle's charging system, charging voltage should be 13.8 –14.8 @ 77°F (25°C). Not to exceed 30 Amps.

The time required for a charge will vary according to the following factors:

**Temperature**

A longer time will be needed to charge any battery at 0°F (-18°C) than at 80°F (27°C). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, and then in time, the battery will accept a higher rate as it warms.

**State of Charge**

For example, a completely discharged battery requires more than twice as much charge than a half-charged battery. Since the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

**Charger Capacity**

A charger supplying only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes.

**9.9.1 Emergency Jump Starting With Auxiliary (Booster) Battery.**

Off-board battery charger with a start boost facility must not be used to jump start the

vehicle. This could damage the electrical system.

**Booster Block**

The booster block is located near next to the main power compartment and is accessible through the engine R.H. side door (Figure 62).

Both booster and discharged batteries should be treated carefully when using jumper cables. A vehicle with a discharged battery may be started by using energy from a booster battery or the battery from another vehicle.



Jump starting may be dangerous and should be attempted only if the following conditions are met:

The booster battery or the battery in the other vehicle must be of the same voltage as the battery in the vehicle being started, and must be negative grounded.



Follow the procedure exactly as outlined hereafter. Avoid making sparks.



Wear adequate eye protection when working on or near the batteries. Ensure that metal tools or jumper cables do not contact the positive battery terminal (or a metal surface in contact with it) as a short circuit will result. Do not attempt to jump start a vehicle suspected of having a frozen battery because the battery may rupture or explode. Both the booster and discharged batteries must be treated carefully when using jumper cables. Follow exactly the procedure outlined later in this section, being careful not to cause sparks.

**WARNING****DURING EMERGENCY JUMP STARTING**

...

Cooling fans **WILL** start running for a short while.

Keep hands away from cooling fans. Keep the radiator door closed.

Wear eye protection and remove rings, watches with metal bands and other metal jewelry.

Apply parking brake and place the transmission to Neutral (N) position in both vehicles. Turn off lights, heater and other electrical loads.

The following procedure should be used only when the batteries are discharged.

**Do not** attempt jump starting if you suspect the batteries are charged. Inspect the engine starting system prior to using this procedure.

To jump start, proceed as follows:

5. Remove the red protective cap from the (+) booster block terminal located in the R.H. side engine compartment;

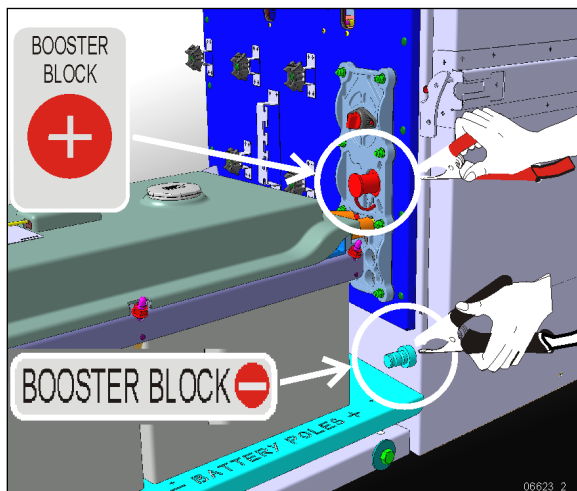


FIGURE 62: X3 SERIES BOOSTER BLOCKS

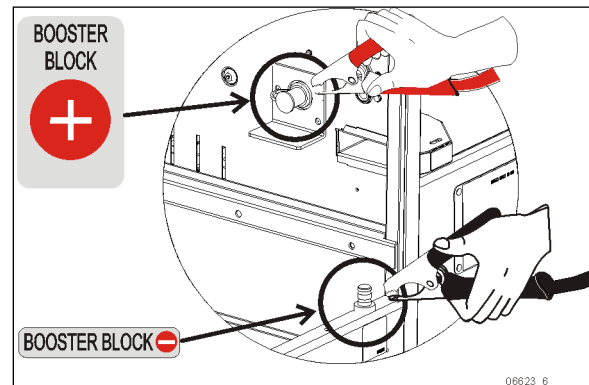


FIGURE 63: H3 SERIES BOOSTER BLOCKS

6. Connect the red jumper cable to the positive (+) post of the booster power source. If the good battery is in another vehicle, that vehicle's engine must be shut OFF before connecting;
7. Connect the other end of the red jumper cable to the positive (+) terminal on the booster block;
8. Connect one end of the black jumper cable to the negative (-) post on the booster power source;
9. Connect the other end of the same black jumper cable to the negative (-) terminal on the booster block. If the good battery is in another vehicle, start that vehicle's engine and increase the engine rpm speed slightly and maintain at that level for approximately 5 minutes to recharge run-down batteries and then **stop** the engine;
10. Start the vehicle with the run-down battery;
11. Disconnect the jumper cables in reverse order given in steps 2 through 5;
12. Install protective cap on the booster block terminal.

**NOTE**

*Jumper cables must be rated at 500 cranking amperes. If jumper cable length is 20 feet (6 m) or less, use 2/0 (AWG) gauge wires. If cable length is between 20 to 30 feet (6 to 9 m), use 3/0 (AWG) gauge wires.*



Any procedure other than the above could result in personal injury, property damage due to battery explosion, or damage to the charging system of the booster vehicle or of the boosted vehicle.

### 9.10 AGM BATTERY CHARGING PRECAUTIONS

AGM (Absorbed Glass Mat) batteries require a voltage-limited, temperature corrected charger.

Make sure your charger is multi-staged and minimally provides the following voltage values:

Charge stage voltage:

13.8-14.6 V @77°F (25°C)

Float stage voltage:

13.4-13.6 V @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even one time – may greatly shorten its life.

### 9.11 BATTERY EQUALIZATION AND AGM BATTERIES

Equalization is a controlled over charge. Conventional batteries may benefit from this procedure, stirring the chemistry of the entire battery it counters stratification (layers of different concentration of electrolyte), and also counters sulfation that may have accumulated on the battery plates.

AGM battery design prevents chemical unbalance of the electrolyte. Manufacturers of this type of battery generally do not recommend performing equalization.

### 9.12 CLEANING AND INSPECTION

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery tie-down clamp bolts should be kept properly tightened. For best results when cleaning the battery, wash first with a diluted solution of ammonia or soda to neutralize any acid present then wash out with clean water. The battery tie-down bolts should be kept tight enough to prevent the batteries from moving, but they should not be tightened to the point that

excessive strain is placed on the battery hold-down cover. Tighten as prescribed. Refer to torque tables at the beginning of this section.



## MAINTENANCE

### Battery terminals

Clean and coat terminals with Nyogel at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

*A protective coating should be applied on certain power connections that have been disconnected. Refer to Procedure SAV00002E included at the end of this section to know the recommended products and where they are used.*

To insure good contact, the battery cable ring terminals should be tight on the battery posts. If the posts or cable ring terminals are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install cable ring terminals on battery posts and tighten. Tighten as prescribed. Refer to torque tables at the beginning of this section.

Replace protective caps to prevent corrosion and sparks.

### 9.13 COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may be related to something other than the battery. For this reason, when a battery failure occurs, do not be satisfied with merely recharging or replacing the battery. Locate and correct the cause of the failure to prevent recurrence. Some common external causes of battery failure are as follows:

1. A defect in charging system such as high resistance or a faulty alternator or regulator. The dashboard ALTERNATOR telltale light illuminates if one of the alternators is defective.



ALTERNATOR telltale

2. A malfunction within the 12-volt system (equalizer).




3. Overloads caused by a defective starter or excessive use of accessories.
4. Dirt and electrolyte on top of the batteries causing a constant drain.
5. Hardened battery plates, due to battery being in a low state of charge over a long period of time.
6. Shorted cells, loss of active material from plates.
7. Driving conditions or requirements under which the vehicle is driven for short periods of time.
8. A constant drain caused by a shorted circuit such as an exposed wire or water infiltration in junction boxes causing ground fault.
9. Extended operation of preheating system with engine not running.
10. Failing to close disconnect switches during the night.

#### 9.14 TROUBLESHOOTING

If a battery is known to be good and then has not performed satisfactorily in service for no apparent reason, the following factors may reveal the cause of trouble:

1. Vehicle accessories and disconnect switches inadvertently left on overnight.
2. Defects in the charging system, such as high wiring resistance, faulty alternator, regulator or battery equalizer.
3. A vehicle electrical load exceeding the alternator (or battery equalizer) capacity, with the addition of electrical devices, such as CB radio equipment, a cellular phone or additional lighting systems.
4. Defects in the electrical system, such as shorted or pinched wires.
5. Extended driving at a slow speed while using many accessories.
6. Loose or poor battery cable-to-post connections, previous improper charging of a run-down battery, or loose hold-down clamp bolts.
7. High-resistance connections or defects in the cranking system.

#### 9.15 "BATTERY VOLTAGE WARNING" PICTOGRAM

If the "BATTERY VOLTAGE WARNING"  (Low Voltage – Connect Battery Charger) pictogram shows up in the DID (Driver Information Display), check the voltmeter gauge to determine if the battery voltage is too high or too low.

##### 9.15.1 Voltage Gauge Definitions

Voltmeter drops below 24.4 volts dc

- Check alternator output.
- Check battery connections.
- Check battery equalizer connections.

Voltmeter exceeds 30 volts dc

- Check alternator output (voltage regulator might be defective).
- Check battery connections.


Checking Battery Balance

#### **NOTE**

*Allow at least 15 minutes to balance batteries after any corrective measure has been taken.*

1. Batteries out of balance (difference greater than 1.5 volts between the two battery banks).
  - Check battery equalizer connections.
  - Check equalizer cables for proper gauge.
  - Check battery connections.
2. Demand for 12-volt power exceeding rated amperage output of battery equalizers causing batteries to go out of balance.
  - Reduce 12-volt load or install additional battery equalizer(s).

##### 9.15.2 BATTERY warning Pictogram MAY appear as a reminder

If you leave *ignition ON, park brake set* and *engine not running*, this warning  may appear after 20 minutes as a reminder to connect the battery charger. The reminder will appear even if the batteries are in the right voltage range. Confirm battery voltage is indeed correct with the DID Gauges screen and if you do need to leave the ignition ON for a prolonged period, connect a battery charger.

## 10. BATTERY EQUALIZER

The Vanner “Vann-Bus 80 Series” 100amp Battery equalizer with Power Management System is installed inside the main power compartment.

Refer to Vanner **Vann-Bus 80 Series Owner's Manual** found on your Technical Publications USB flash drive.

## 11. SUPERCAPACITOR STARTING MODULE (OPTION)

The vehicle may be equipped with a supercapacitor starting module located in the 3rd luggage bay. (Figure 64)

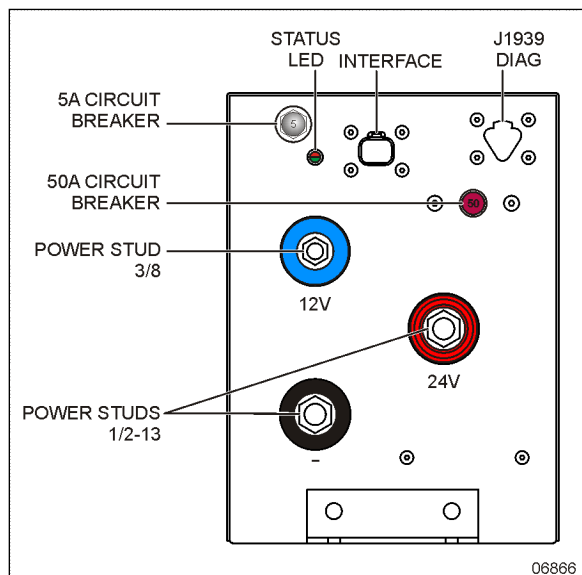


FIGURE 64: STARTING MODULE

This module houses supercapacitors that derive power from the vehicle electrical system and discharges it when starting the engine.

On engine start-up, the module provides power in parallel with the standard batteries. If the standard batteries are depleted, the module will provide enough power for engine start-up.

A vehicle equipped with a starting module will have a differing starting switch arrangement on the dashboard. This system uses an on/off ignition switch and an engine starting (cranking) switch.



FIGURE 65: SWITCH ARRANGEMENT WITH STARTING MODULE

### 11.1 STARTING THE VEHICLE WITH DEPLETED BATTERIES.

With a supercapacitor starting module, if the batteries are depleted and the charging system works correctly, it is still possible to start the vehicle.

Place ignition switch to the “ON” position (Figure 65)

Press and hold engine start switch (Figure 65) until engine is running and keep holding minimum of 3 seconds after engine run.

Holding the switch provides the circuit with power coming from the starting module.

### 11.2 STARTING MODULE STATUS LED

The bi-color (red/green) LED is an indicator for how the starting module is functioning. The green side of the LED is connected parallel with the contactor. The red side is connected to an output on the module's programmable logic controller (PLC).

**Green:** Anytime the LED Status Indicator is illuminated green, the contactor is closed. In a typical engine-starting event you will see the LED illuminate during engine cranking and then go out for several seconds after the engine has started. The LED will then illuminate again and could remain illuminated for several seconds based on the condition of the module. The LED may “cycle” depending on the vehicle or system voltage during the recharging events.

**Red:** The PLC monitors the capacitor voltage during and after the recharge cycle. If the capacitor voltage drops to below an acceptable



level in the first 5 minutes after the recharge, the red LED will flash, indicating a fault.

If at any time while the PLC is powered up, the 5A circuit breaker trips or the capacitor voltage level drops below 4 volts the red LED will flash. (Source: KBI)

**NOTE**

*The starting module is not a high-voltage device. It simply supplies the same voltage that it was charged up to. Handle it with the same respect you would give to a fully charged battery.*

**11.3 TROUBLESHOOTING**

Refer to supplier manual *KSM Starting Module Manual RevD.pdf* from KBI on the technical publications web site or on the technical publications USB drive for troubleshooting instructions.

**WARNING**

The starting module is a polarity sensitive device. Polarity should be strictly observed when connecting the KAPower module into any circuit

**WARNING**

The Starting Module is a product of high electric power. Avoid shorting module terminals!

**11.4 MAINTENANCE**

Regularly inspect the wiring and bus bar connections to make sure they are clean and free of corrosion.

1/2-13 power stud nut torque:

**180 lb-in (20 Nm)**

3/8-16 12V power stud torque:

180 lb-in (20 Nm)

M10-1.5 bus bar ground stud:

**240 lb-in (27 Nm)**

**11.5 HANDLING AND STORAGE****CAUTION**

Module should be stored at a minimum voltage of 8V for the 24V circuit and 4V for the 12V circuit.

## 12. PRIME ENERGY MANAGEMENT SYSTEM

The acronym “PRIME” stands for Power Recovery by Intelligent Management of Energy.

This system focuses on eliminating parasitic loads on the engine by intelligent management of the alternators and air compressor duty cycle.

Instead of constantly charging, the alternators will use engine negative torque (braking, deceleration) to generate “Free” electricity.

Depending on the compressed air requirement, PRIME will also trigger the production of compressed air on negative torque.

PRIME also introduces maintenance-free Absorbed Glass Mat (AGM) batteries and a Vanner 80 series battery equalizer that monitors battery State of Charge (SOC).

Battery temperature, voltage and current are also monitored to prevent overcharging and overheating.

Maximum fuel economy is obtained on a ride when the mix of hilly and flat portions allows the batteries to be charged when the vehicle is in free wheel. It basically means that batteries are charged with free energy and that no fuel consumption is dedicated to charge the batteries.

### 12.1 COMPONENTS

New components includes AGM batteries, a Vanner Battery equalizer, a temperature sensor located on the battery post and two voltage and current sensors monitoring 12V and 24 V circuits. Refer to Figure 66 below.

The compressor duty cycle control is achieved by an electric air dryer. This is covered in section 12 of this manual.

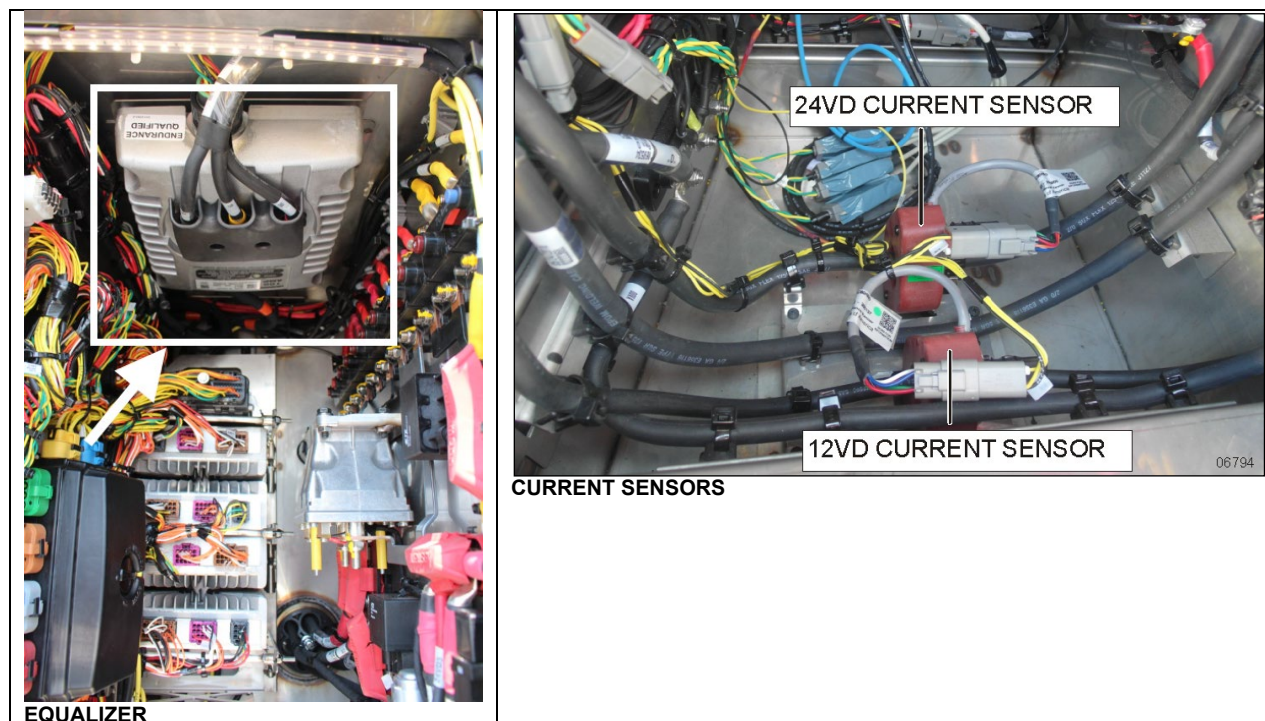


FIGURE 66: PRIME ELECTRICAL COMPONENTS

## 12.2 DID DISPLAY

In the DID you will find the percentage of trip made with regenerated electricity displayed along with the instantaneous fuel consumption.

This value is reset each time the engine is restarted.

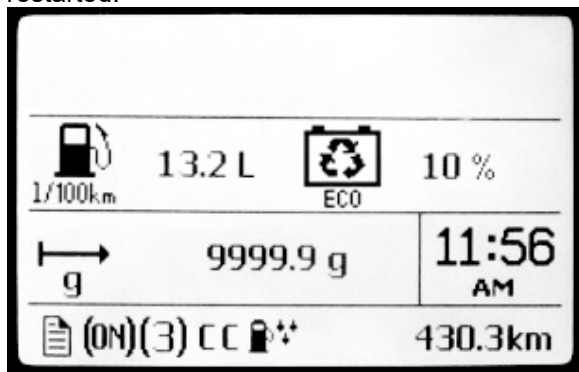


FIGURE 67: PRIME DID DISPLAY

In addition to the standard voltage gage, the DID also includes a state of charge gage for the batteries:

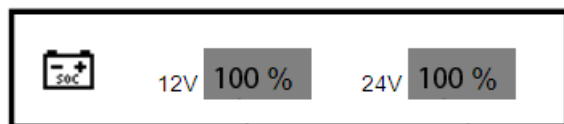


FIGURE 68: BATTERY STATE OF CHARGE

This gage displays the level of charge for the 12V and 24V battery banks in percentage.

## 13. ALTERNATORS

Standard configuration includes three 24-volt 150A, self-regulated, belt driven, air-cooled HD 10 BOSCH alternators are used in the 24-volt electrical system.

### NOTE

*For the complete removal/installation instructions, refer to Maintenance Information MI16-17 Bosch HD10 alternator removal and installation included at the end of this section.*

As an option, two 24-volt 250A Delco Remy 55SI alternators may be installed. One on each side of the engine.

In this configuration, the multiplex system will identify the alternator on the right (cold side) as *Upper Right* and the left (hot side) as *Lower Left*.

### 13.1 IDENTIFYING A DEFECTIVE ALTERNATOR

When an alternator is not charging, the *charging system warning light* will illuminate.



charging system warning light

#### 13.1.1 Alternator identification

Cold side alternators are the one found on the A/C compressor side. The hot side alternators are the one located on the engine turbo side.

##### Cold Side (R.H.):

ALTERNATOR Up RH= upper right

ALTERNATOR Low RH=lower right

ALTERNATOR Ext RH= above small A/C comp.

(MTH only)

##### Hot Side (L.H.):

ALTERNATOR Up LH= upper left (MTH only)

ALTERNATOR Low LH=lower left

#### 13.1.2 Identifying a defective alternator using the instrument cluster DID

1. On the DID (Driver Information Display), select DIAGNOSTICS menu.

2. Select VIEW ACTIVE FAULTS and then ELECTRICAL.
3. The active electrical system faults will appear. Scroll through the active faults. You will find one of the following messages:

MID (188) ELECTRICAL SYSTEM
PSID 34 ALTERNATOR Low RH
FMI (5) OPEN CIRCUIT

MID (188) ELECTRICAL SYSTEM
PSID 35 ALTERNATOR Up RH
FMI (5) OPEN CIRCUIT

### 13.1.3 Identifying a Defective Alternator – Back-probing Multiplex Modules Method

Prerequisite conditions:

- a) Engine running;
- b) Parking brake applied.

Back-probe the following modules:

**AE49 & AE52 X3 Series**

**AE50 & AE53 H3 Series**

Alternator Up RH =pin J1:20, module AE49/AE50  
 Alternator Low RH=pin J2:8, module AE52/AE53  
 Alternator Low LH= pin J2:9, module AE52/AE53

Back-probe pin 20 (AE49/AE50 J1:20):

- If multimeter reads 1-2 volts, the **upper R.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;
- If multimeter reads 26 volts or greater, the **upper R.H.** alternator operates normally.

Back-probe pin 8 (AE52/AE53 J2:8) and a good ground (use ground stud in the compartment):


- If multimeter reads 1-2 volts, the **lower R.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;

- If multimeter reads 26 volts or greater, the **lower R.H.** alternator operates normally.

Back-probe pin 9 (AE52/AE53 J2:9) and a good ground (use ground stud in the compartment):

- If multimeter reads 1-2 volts, the **lower L.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;
- If multimeter reads 26 volts or greater, the **lower L.H.** alternator operates normally.

### 13.2 ALTERNATOR DRIVE BELT

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p><b>Drive belt</b></p> <p>Inspect for crack or frayed material at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION &amp; SERVICING.</p>

#### 13.2.1 Removal and installation

1. Insert a ½" socket drive into the automatic belt tensioner opening.
2. Twist the tensioning arm to slacken belt.
3. Remove belt.

Installation of the alternator drive belt is the reverse of removal.

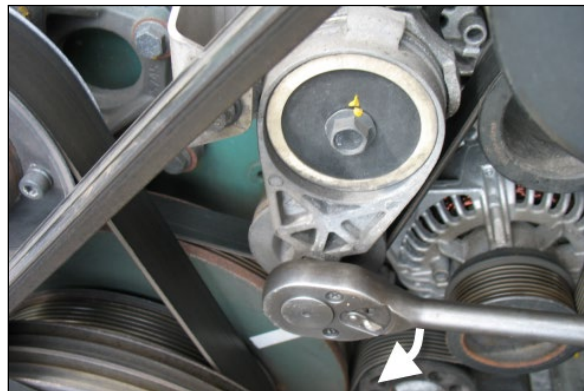


FIGURE 69: ½" SOCKET DRIVE WRENCH

**NOTE**

*Belts specifications may vary. For proper belt selection, always consult your vehicle Coach Final Record.*

### 13.2.2 Adjustment

Correct belt tension is required to maximize belt life. The tensioning arm maintains proper belt tension, no adjustment is required.

## 14. STARTER

Refer to Mitsubishi Electric Corporation (MELCO) Service bulletin ME003-P found on your Technical Publications USB flash drive for information and maintenance instruction on MELCO 105P70 starter.

### NOTE

*For the complete removal/installation instructions, refer to Maintenance Information MI16-16 Starter removal and installation included at the end of section 01ENGINE.*



### CAUTION

Do not engage starter for more than 15 seconds at a time. If engine does not start within 15 seconds, release ignition key and let starter cool for one minute before attempting to restart.

## 15. ENGINE BLOCK HEATER

The vehicle may be equipped with an engine immersion-type electric block heater to assist cold weather starting. The heater male electric plug is easily accessible through the engine compartment R.H. side door (FIGURE 70). To use it, connect the female plug of an electrical extension cord to the heater plug. The extension cord must be plugged into a 120 V AC power source only. The engine block heater should be used whenever the vehicle is parked for an extended period of time in cold weather and a suitable power source is available.

### 15.1 MAINTENANCE

This heater is non-serviceable except for the cord, and if faulty, must be replaced as a unit.

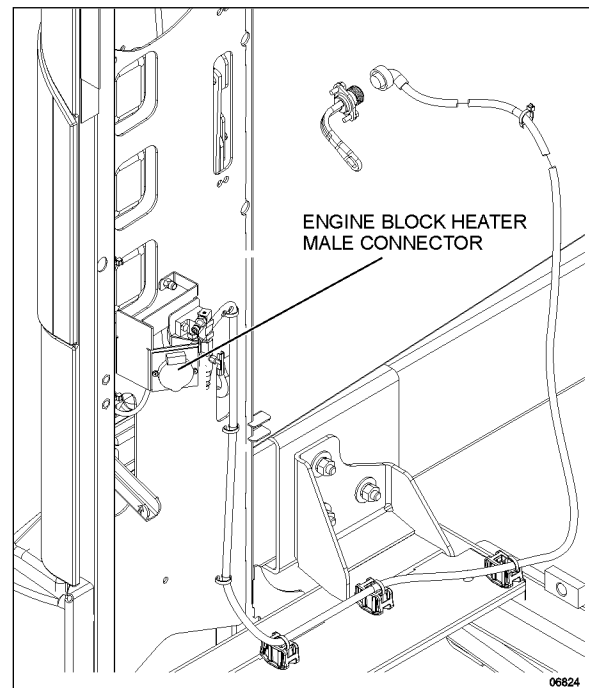


FIGURE 70: ENGINE BLOCK HEATER CONNECTION

16. EXTERIOR LIGHTING

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams.

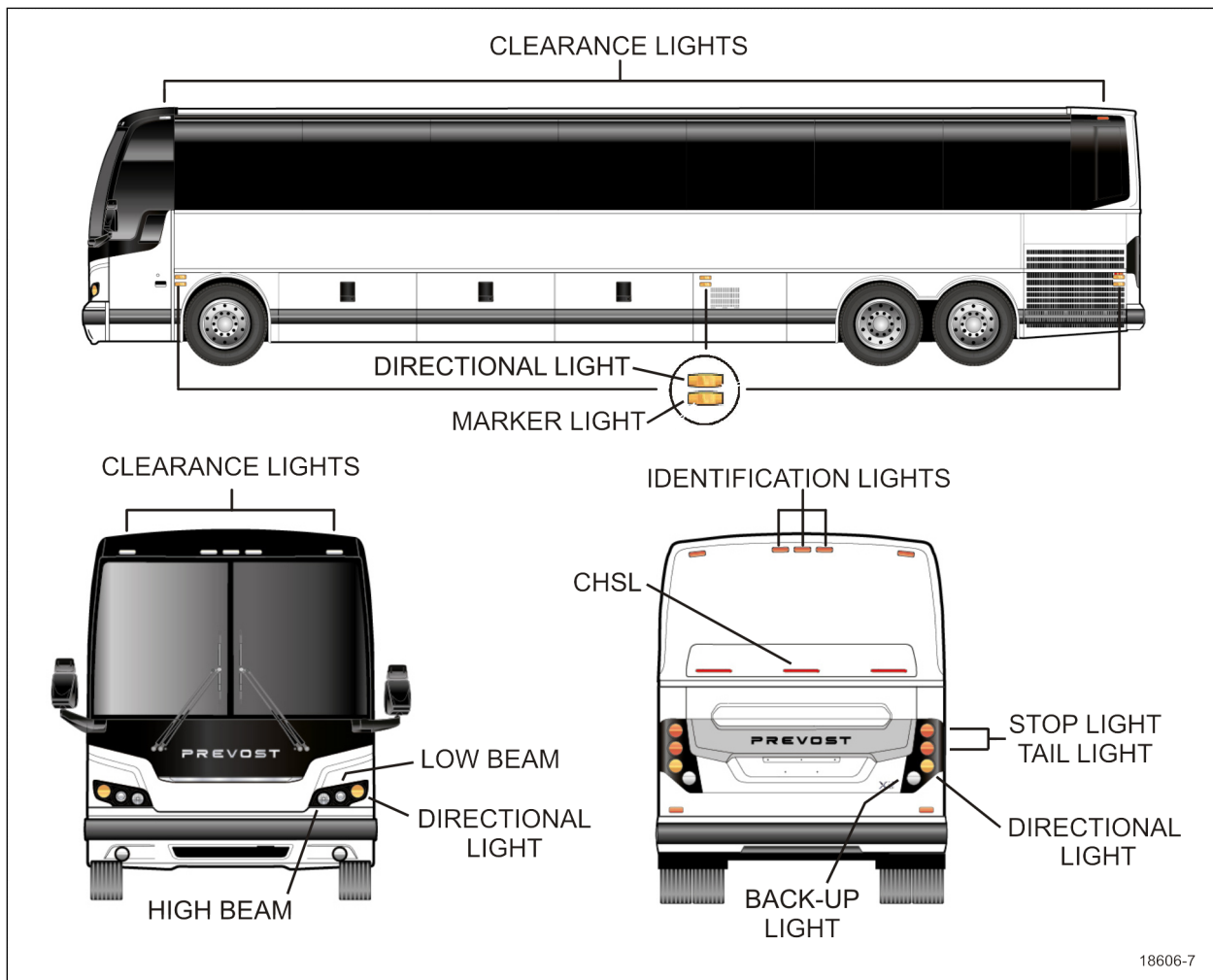


FIGURE 71: VARIOUS LIGHTS LOCATION, REAR DIRECTIONAL LIGHT MAY BE ON TOP POSITION ON SOME VEHICLES



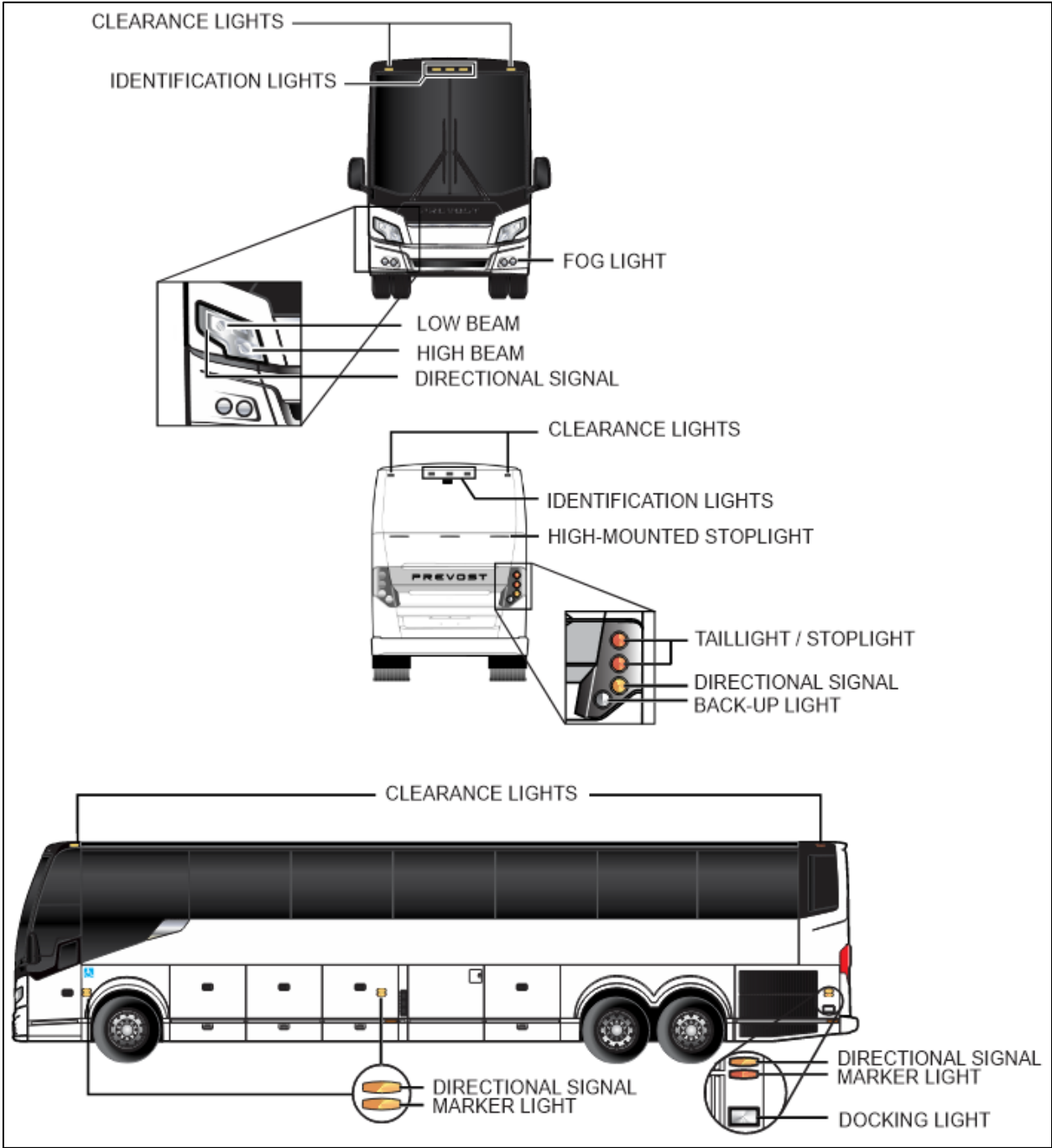


FIGURE 72: VARIOUS LIGHT LOCATIONS



## 16.1 X3 SERIES HEADLAMPS

Each headlamps assembly consists of two 90 mm (3½ inch) headlamp module (Figure 73) and one 100 mm (4 inch) 12-volt LED parking/directional signal lamp. Middle lamps are used for low beams. Inner lamps are used for high beams.

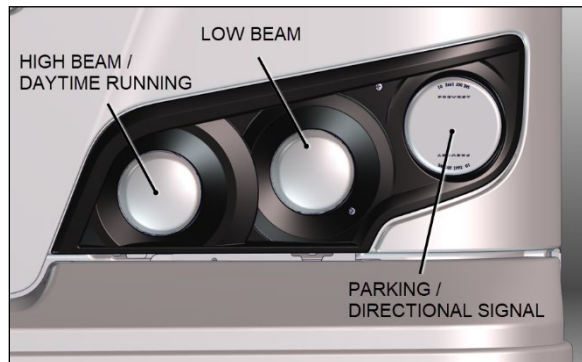


FIGURE 73: HEADLAMPS ASSEMBLY

The high beams serve as daytime running lights. The high beams light intensity is lower in the daytime running mode.

MODEL	LOW BEAM	LOW BEAM	HIGH BEAM
	H9 halogen 65W/12V	HID SAE D2S Xenon 35W	H9 halogen 65W/12V
X3-45 coach	standard	option	standard
X3 VIP motorhome	standard	option	standard
X3 VIP Commercial Use	standard	option	standard



### CAUTION

DO NOT use replacement bulbs with a power rating higher than specified. Damage to the headlamp module will occur due to overheating. Refer to the table above.



### CAUTION

DO NOT use aftermarket bulbs. Use only Hella or Osram bulbs. Refer to the Parts

Manual for the appropriate replacement bulbs.

### NOTE

*If the vehicle is equipped with optional xenon headlamps, refer to paragraph 5.*

### 16.1.1 Maintenance

Clean headlamps assembly with soap and water. When a headlamp burns out, a new bulb must be installed. Headlamp modules must be properly aimed to provide maximum allowable road illumination. When using mechanical aiming devices, follow the manufacturer's instructions.

Horizontal aiming of headlamp module is provided by an adjustment screw that rotates the headlamp module in the housing for the proper alignment (Figure 74).

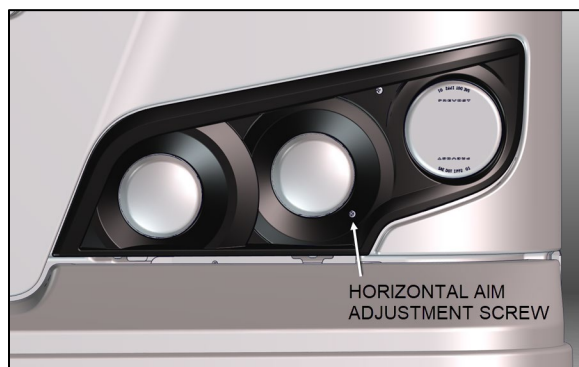


FIGURE 74: HEADLAMPS ASSEMBLY

### NOTE

*Make sure headlamps assembly module is properly positioned into its housing before securing using fixing screws.*

### 16.1.2 General recommendations

- 1- Inspect lamp assembly and wiring harness on a regular basis and replace defective parts with OEM parts only.
- 2- Pay particular attention to socket terminal wider or burnished. Do not attempt to repair wiring harness, replace the entire cable assembly when required.

- 3- Train the repair personal to make sure the glass of the bulb always stays free of grease. Never touch the glass part of the bulb.
- 4- Double check the work to make sure the socket bulb is properly turned and locked in the lamp assembly.
- 5- Make sure repair personal do not push meter probe or other type of tool in the socket terminal.
- 6- Secure wiring harness and socket terminal with nylon ties to avoid risk of pin fretting wear.

### 16.1.3 Headlamps Cable Routing

*Make sure connector and wiring harnesses are properly secured to avoid pin fretting wear.*

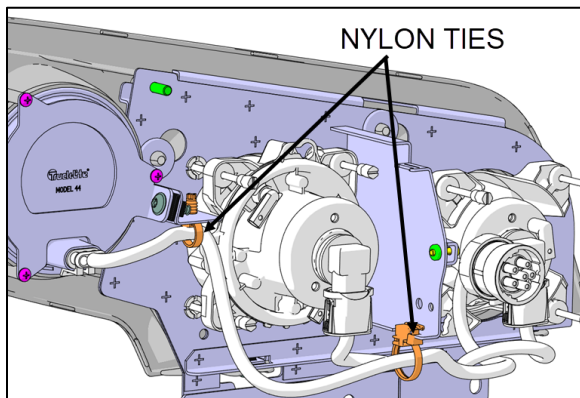


FIGURE 75: TYPICAL CABLE ROUTING WITH TWO HALOGEN HEADLAMPS

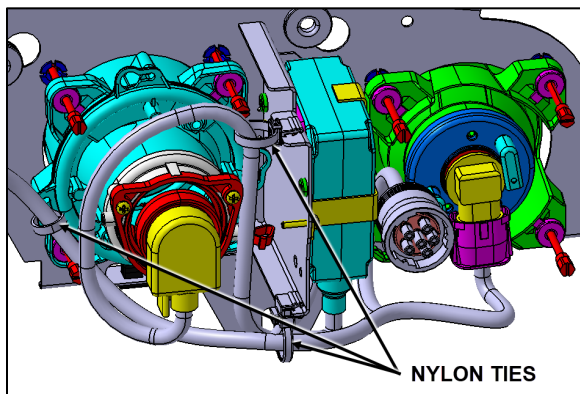


FIGURE 76: TYPICAL CABLE ROUTING WITH ONE XENON HEADLAMP (LEFT) AND ONE HALOGEN HEADLAMP (RIGHT). ROUTE THE XENON CABLE AROUND THE XENON HEADLAMP MODULE TO PREVENT ANY RISK OF FRICTIONAL WEAR

### 16.1.4 Halogen Bulb Replacement

1. Lower the reclining bumper.
2. Unfasten the two screws (Figure 77) fixing the headlamps assembly then tilt the headlamps assembly down.

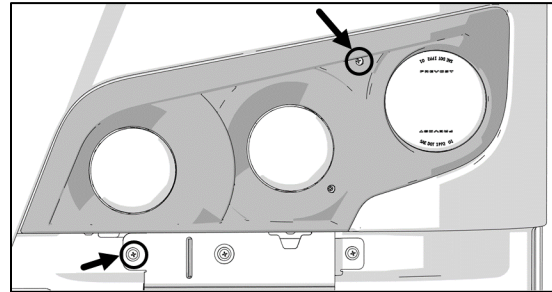


FIGURE 77: HEADLAMPS ASSEMBLY FIXING SCREWS

3. Unplug the bulb connector (Figure 78).

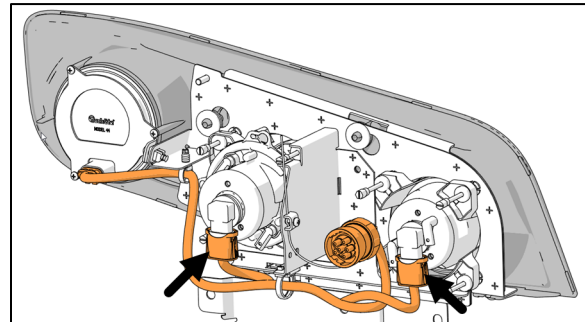


FIGURE 78

4. Press lightly, rotate the bulb socket counterclockwise, and remove from the headlamp module.

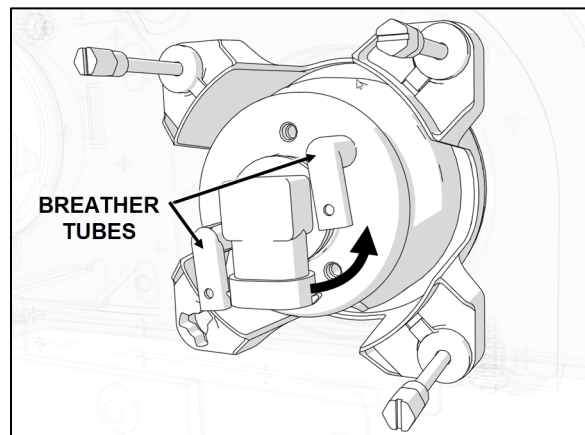


FIGURE 79: HALOGEN BULB REMOVAL

5. Install the new bulb by reversing the previous steps. Orient as indicated with the connector downwards.

**CAUTION**

During this step, **DO NOT** touch the bulb with the fingers not to alter the bulb life. Hold the bulb by its socket. Avoid any contact with grease.

- *Make sure to insert the bulb socket perfectly straight.*
  - *Make sure the bulb socket is fully turned and locked.*
  - *Do not use dielectric grease.*
6. Plug the harness to the bulb socket. **Make sure it is properly connected.**
  7. Make sure the breather tubes are present and properly secured.
    - *Make sure no stress is created on the connector.*
    - *Make sure the connector and harness are secured to avoid pin fretting wear.*

**NOTE**

*Do not disrupt headlamp module adjustment screws.*

**16.1.5 Headlamp Module Replacement**

1. Unfasten the two screws (Figure 77) fixing the headlamps assembly and then tilt the headlamps assembly down.
2. Unplug the bulb connector.

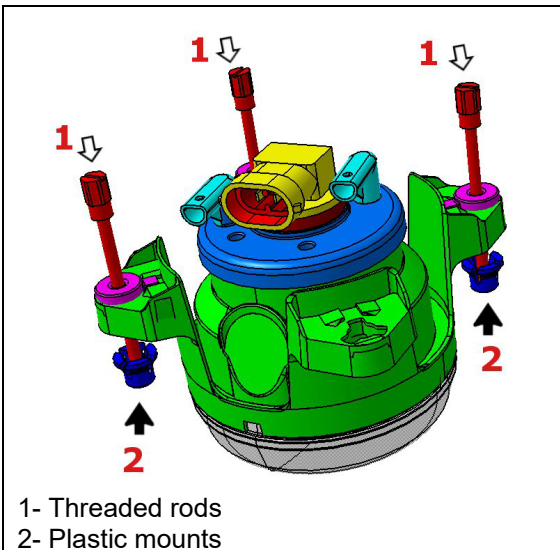


FIGURE 80: HEADLAMP MODULE

3. Using pliers, unfasten all plastic mounts from the headlight metal support (Figure 81).

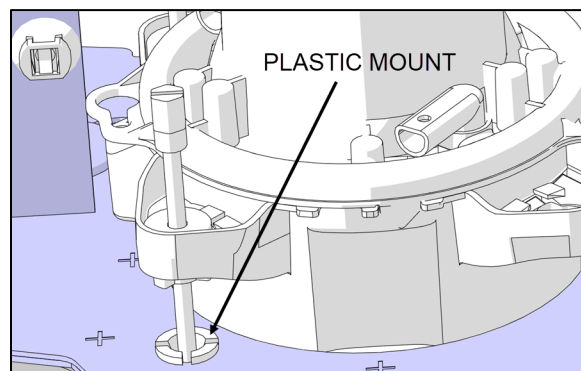


FIGURE 81: UNFASTEN PLASTIC MOUNTS

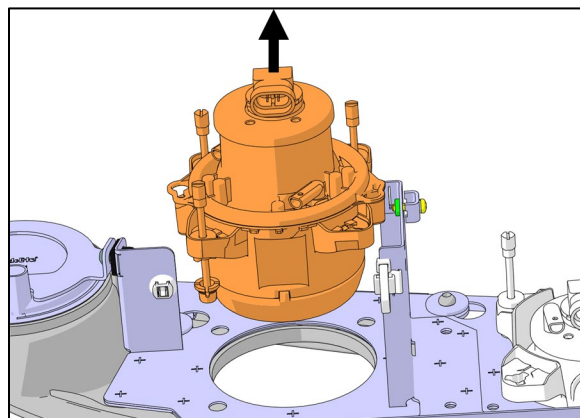


FIGURE 82

4. Discard defective headlamp module complete with plastic mounts and threaded rods.
5. Install three new threaded rods (item 1, Figure 80) on the new headlamp module.
6. Use pliers to lock threaded rods by rotating the tab counterclockwise until it “clicks” in place (Figure 83).



FIGURE 83: LOCK THREADED ROD

7. Snap new plastic mounts on threaded rods (3x) (item 2 in Figure 80 & Figure 84). You will hear or feel a click.

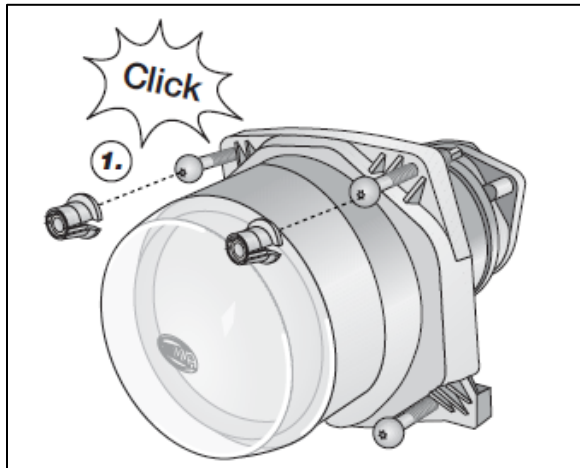


FIGURE 84

8. Mount (snap) headlamp module complete with threaded rods and plastic mounts onto the headlamp module metal support. **Make sure the plastic mounts are properly seated.**

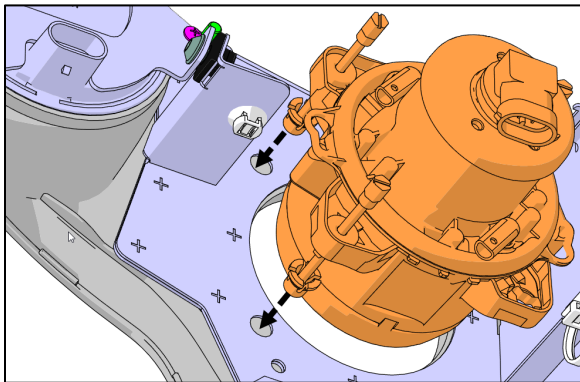


FIGURE 85

9. Adjust the headlamp module height in relation to the metal support at each threaded rod. Screw threaded rods until height of the headlamp module reaches the values shown in Figure 86 & Figure 87.

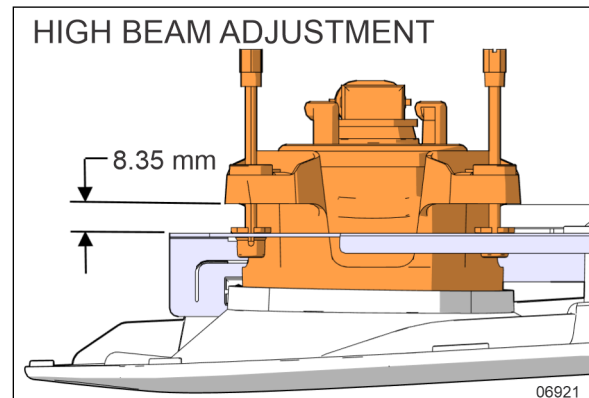


FIGURE 86: HIGH BEAM ADJUSTMENT

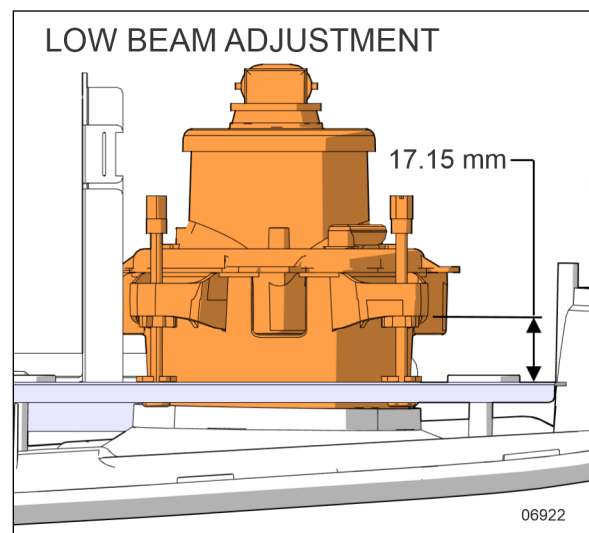


FIGURE 87: LOW BEAM ADJUSTMENT

10. Plug the harness to the bulb socket. **Make sure it is properly connected.**

- Make sure the breather tubes are present and properly secured.
- *Make sure no stress is created on the connector.*
- Make sure the connector and harness are secured to avoid pin fretting wear.

**NOTE**

*Make sure headlamps assembly is properly positioned into its housing before securing using fixing screws.*

11. Test the lights.
12. Perform the alignment procedure.



**NOTE**

The headlamp module aim must be checked and adjusted even if it was properly adjusted before the headlamp module was replaced. Only low beam can be adjusted with an adjusting screw (see Figure 74).

**16.1.6 Directional Turn Signal Replacement**

The front turn signal is part of the front headlamps assembly. The turn signal is a sealed unit and should be replaced as an assembly.

1. Remove the two screws (Figure 77) fixing the headlamps assembly and then **tilt** the headlamps assembly down.
2. Disconnect the electrical harness connector from the light module.
3. Unscrew the 4 mounting fasteners.

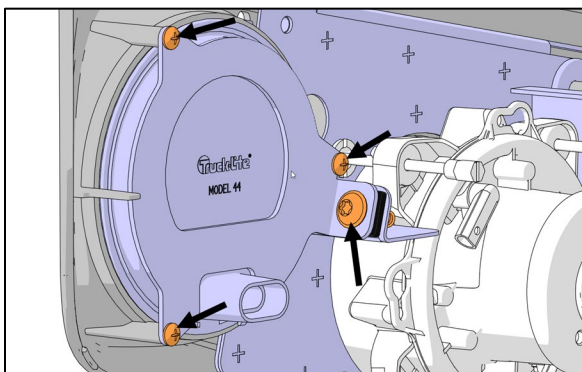


FIGURE 88

4. Replace the directional signal module.

Important: Orient as indicated with the connector downwards. The "Prevost" brand on the face should be placed horizontally as much as possible.

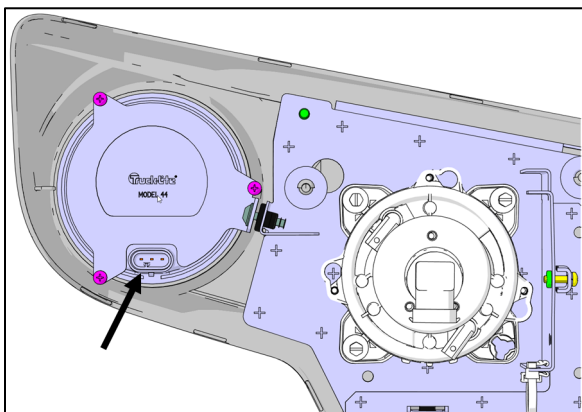


FIGURE 89

5. Install wiring connector on the back of the new turn signal module. **Make sure it is properly connected.**

**16.1.7 Xenon Bulbs Replacement**

The outer lamps (low beam) of each headlamp assembly may be equipped with the optional Xenon lamps.

1. Lower the reclining bumper.
2. Unplug connector from the headlamp bulb by turning counterclockwise.

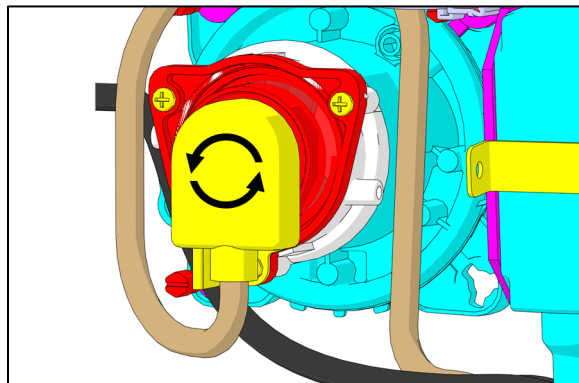


FIGURE 90

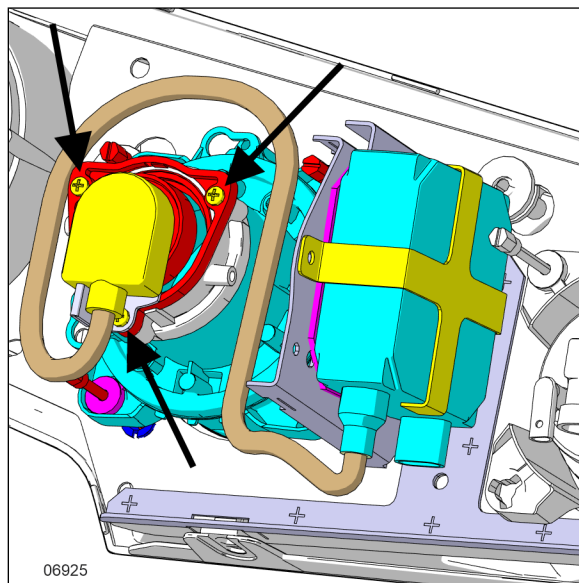


FIGURE 91: XENON HEADLAMP

3. Unscrew the three Phillips head screws (Figure 91) pull the retainer and bulb out.
4. Install the new bulb by reversing the previous steps and make sure the connector stopper is in place (Figure 92). **Make sure the connector is properly connected.**

- *Make sure to insert the bulb socket perfectly straight.*
- *Make sure the bulb socket is fully turned and locked.*
- *Do not use dielectric grease.*
- *Make sure no stress is created on the connector.*
- *Make sure the connector and harness are secured to avoid pin fretting wear.*

**CAUTION**

To avoid breaking the bulb, make sure the connector is in proper position against the stop.

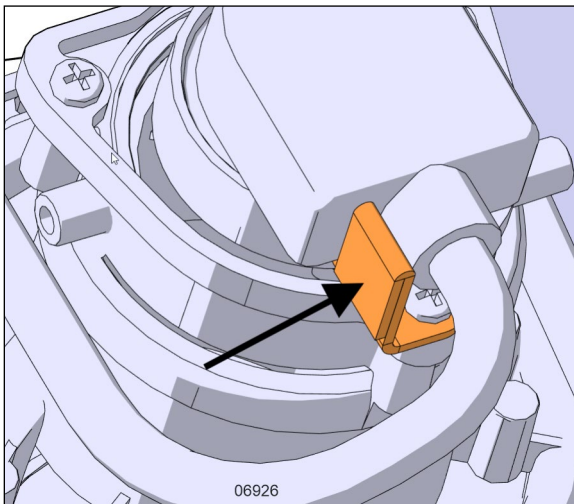


FIGURE 92: CONNECTOR STOPPER

**CAUTION**

During this step, DO NOT touch the bulb with the fingers not to alter the bulb life. Hold the bulb by its socket. Avoid any contact with grease.

**NOTE**

*Do not disrupt headlamp adjustment screws.*

**CAUTION**

Never connect a voltmeter or V.O.M. to measure bulb voltage as the instrument will be destroyed.

When switching on the Xenon headlamp using the rocker switch, a lamp short-circuit test is performed.

Current is detected in the lamp circuit before the ignition time and ignition prevented. Connection of the "hot" lamp to the body mass also prevents ignition. In both cases, the system is cut off within  $< 0.2$  s and can only be restarted via the rocker switch.

In general, the maximum ignition time is  $< 0.2$  s, which period is followed by cutoff. This would happen if a lamp was defected.

Lamp missing: system is cut off after  $< 0.2$  s.

If lamp components or cables are damaged by force (accident) so that contact with hazardous parts is possible, the current in these lines is earthed by the vehicle body and - as with a defective household appliance - switched off when 30 mA are reached within  $< 0.2$  s. the cutoff time is shortened by a more powerful defect current.

To protect the ballast, a counter in the electronic safety system ensures that a defective lamp can only be switched off 7 times consecutively after a successful ignition, after which the device is cut off. This prevents flutter and flashing. This counter is put out of action when the lamp cutoff time repetition interval is longer than 1.3 s so that temporary non-defect disturbances that result in immediate invisible re-ignition do not cause lamp cutoff.

A warning notice on the lamp plug makes you aware of the fact that the lamp is operated in this system on a higher voltage (you should therefore switch off the lamp before working on this part).

After taking out the lamp, the contact pins are in a practically idle state ( $< 34$  Volt) after  $< 0.5$  seconds so that there is no immediate danger of electric shock even if the warning is disregarded.

With this safety concept there is no danger to check the ballast with a new bulb. There is a very high probability that the ballast is OK if the ballast can ignite the bulb.

One simple test to check the ballast would be to measure the nominal current of 1.58 A after one minute for the 24V ballast.

## 16.2 H3 SERIES HEADLAMP MODULE

## 16.2.1 Maintenance

Clean headlamps with soap and water.

## 16.2.2 Headlamp Module Replacement

The following illustrations show how to remove and replace the headlamp module.

1. First, make sure the ignition switch and light switch are off.
2. Pull on the reclining bumper opening handle located inside the front electrical and service compartment.
3. Unplug the connector (Figure 93).

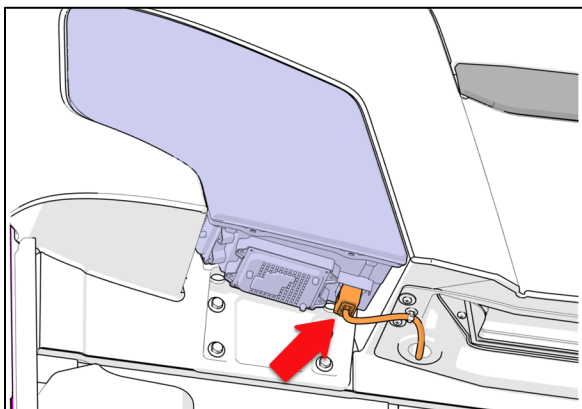


FIGURE 93

4. Unscrew and remove four (4) bolts and washers.

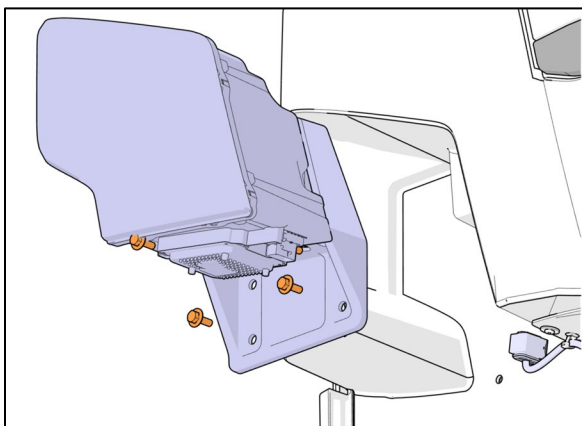


FIGURE 94

5. Unscrew six (6) nuts (Figure 94) and separate the headlamp module from the support.

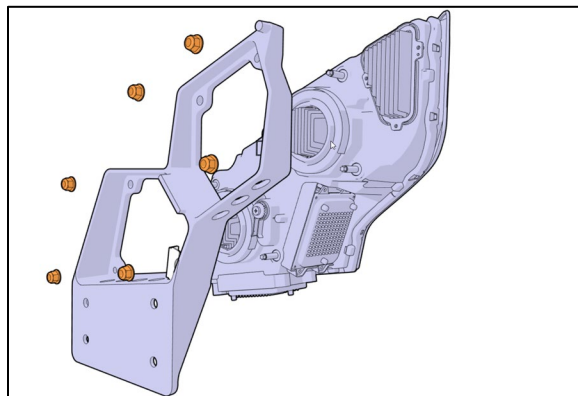


FIGURE 95

6. Mount the new headlamp module to the support. Tighten the six (6) nuts by hand only.
7. Perform final nut tightening in accordance with the tightening sequence (Figure 96).

**TORQUE: 14 lb-ft (6x)**

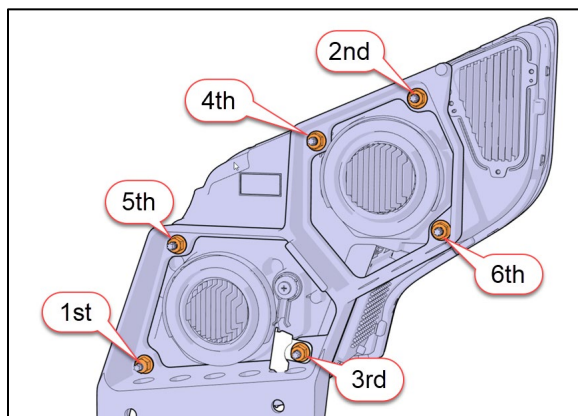


FIGURE 96

8. Reinstall the headlamp module and support assembly. Tighten the four (4) bolts by hand.

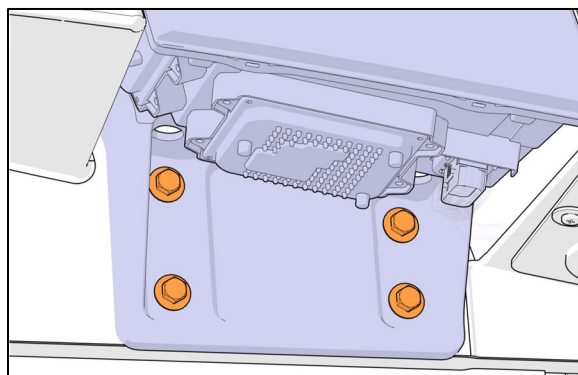


FIGURE 97

9. With the bolts slightly tighten, center the headlight module in the opening to distribute the play evenly on each side (Figure 98).



REF	VALUE	TOLERANCE
A play	centered	$\pm 1.5$ mm
B straightness	0 mm	$\pm 3$ mm

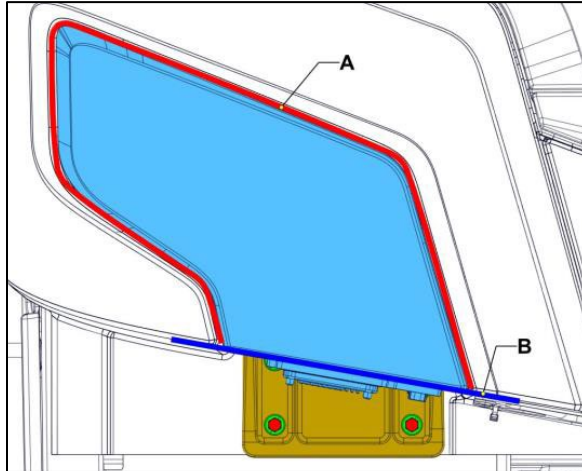


FIGURE 98

10. Apply final torque to the four (4) bolts in accordance with the tightening sequence (Figure 99).

**TORQUE: 14 lb-ft (4x)**

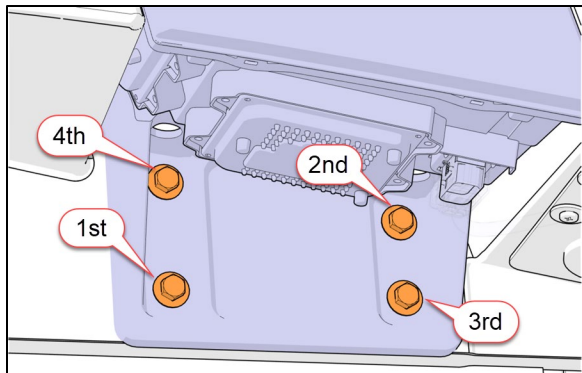


FIGURE 99

11. Plug the connector.

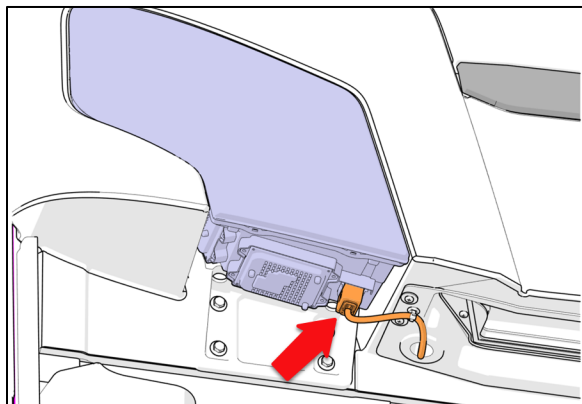


FIGURE 100

### NOTE

*Do not disrupt headlamp adjustment screws.*

### 16.2.3 Headlamps Vertical Aiming

Aiming is not necessary after replacing the headlamp module as it is preadjusted.

If it ever becomes necessary, the vertical orientation of the two headlights is carried out by a rotating adjuster which, using a Phillips screwdriver, rotates all the headlamps in the headlamp module (Figure 101).

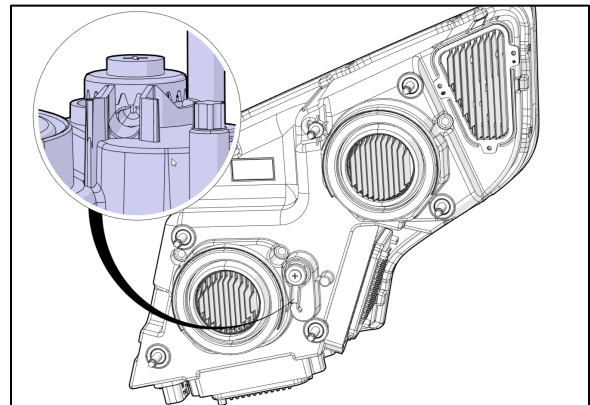


FIGURE 101: VERTICAL AIMING

### 16.3 HEADLAMP ADJUSTMENT

1. Headlamp aiming and inspection can be accomplished by visual means. This is done on a screen located at a distance of 25 feet (7,6 m) of the headlamps. It should be of adequate size with a matte-white surface well shaded from extraneous light and properly adjusted to the floor area on which the vehicle stands. Provisions should be made for moving the screen or its vertical centerline so that it can be aligned with the vehicle axis. In addition to the vertical centerline, the screen should be provided with four laterally adjustable vertical tapes and two vertically adjustable horizontal tapes.
2. The four movable vertical tapes should be located on the screen at the left and right limits called for in the specification with reference to centerlines ahead of each headlamps assembly.

The headlamp centerlines shall be spaced either side of the fixed centerline on the screen by  $\frac{1}{2}$  the lateral distance between the light source centers

of the pertinent headlamps. The horizontal tapes should be located on the screen at the upper and lower limits called for in the specification with reference to the height of beam centers and the plane on which the vehicle rests, not the floor on which the screen rests.

TABLE 1 – VERTICAL BEAM AIM GUIDELINES

Headlamp (centerline) Mounting Height	Nominal Vertical Aim	Aim Inspection Limits for Vertical Aim
56 to 90 cm (22 to 36 inch)	0 Vertical	10 cm (4 inch) up to 10 cm (4 inch) down
90 to 120 cm (36 to 48 inch)	5 cm (2 inch) down	5 cm (2 inch) up to 15 cm (6 inch) down
120 to 140 cm (48 to 54 inch)	10 cm (4 inch) down	4 cm (1.5 inch) up to 16.5 cm (6.5 inch) down

- The nominal vertical aim position on lower beam headlamps shall be adjusted based on the headlamp mounting height, from the ground to the light source center of the headlamp, according to table 1.
- High beam headlamps are aimed so that the center of the high-intensity zone is located at the horizontal and straight ahead vertically (Figure 103).
- Low beam headlamps are aimed so that the top edge (the cutoff) of the high-intensity zone is at the vertical location as per Table 1 and the left edge of the high-intensity zone is at the vertical centerline of the headlamp (Figure 104).

**NOTE**

**HIGH INTENSITY ZONE**

The brightest observable portion of a beam pattern viewed on an aiming screen or wall. This hot spot is typically located at or near the center of the beam and may not be readily observable in all beam patterns.

- The inspection limits for high-beam headlamps shall be with the center of the high-intensity zone from 10 cm (4 in) up to 10 cm (4 in) down; and, from 10 cm (4 in) left to 10 cm (4 in) right on a screen at 7.6 m (25 ft) (Figure 105).

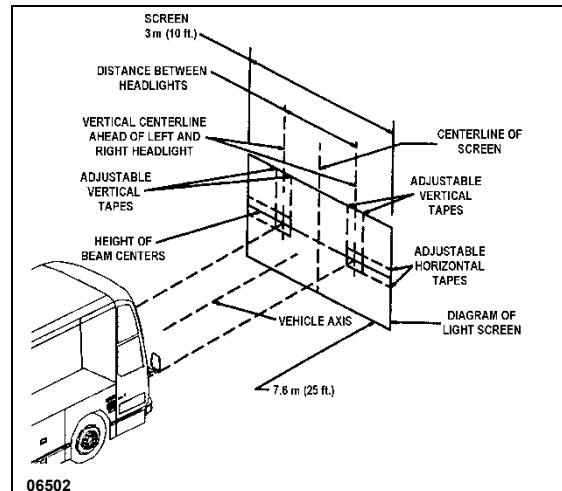


FIGURE 102: ALIGNMENT OF HEADLAMP AIMING SCREEN

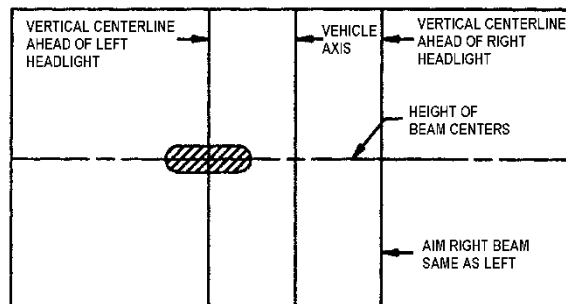


FIGURE 103: UPPER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN

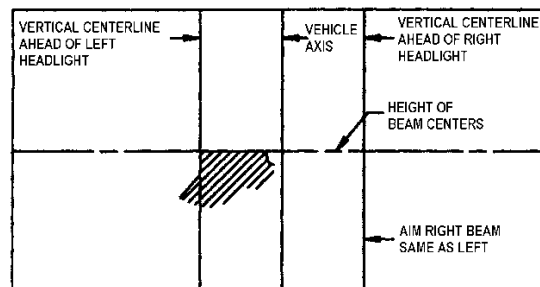
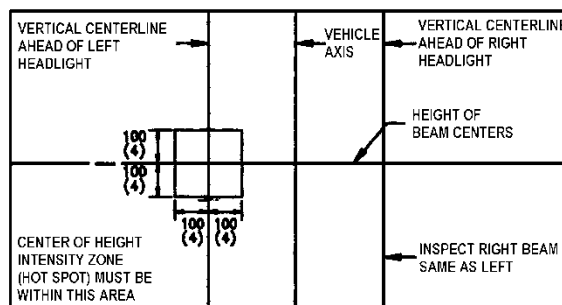


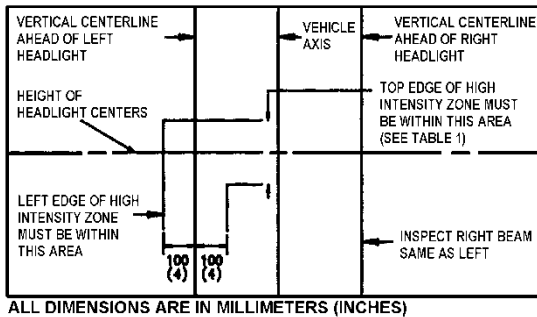
FIGURE 104: LOWER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN



ALL DIMENSIONS ARE IN MILLIMETERS (INCHES)

FIGURE 105: AIM INSPECTION LIMITS FOR UPPER-BEAM HEADLAMPS

7. The inspection limits in the vertical direction for low-beam headlamps or the low beam of a dual-beam headlamp, shall be as described in Table 1. In the horizontal direction, the left edge of the high-intensity zone shall be located from 10 cm (4 in) left to 10 cm (4 in) right of the vertical centerline of the beam. The viewing screen shall be located 7.6 m (25 ft) in front of the vehicle (Figure 106).



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FIGURE 106: AIM INSPECTION LIMITS FOR LOWER-BEAM HEADLAMPS

#### 16.4 X3 SERIES STOP, TAIL, DIRECTIONAL, BACK-UP, AND HAZARD WARNING LIGHTS

A combination stoplight, taillight, directional signal light and back-up light assembly is mounted at the rear, on each side of the vehicle. Furthermore, when braking, two center stoplights (LED) and a center high-mounted stop light (CHSL) (LED) will illuminate simultaneously with the stoplights on the sides for increased safety. The L.H. and R.H. side center stop lights are also used as directional signal and marker lights.

The stop, tail, directional signal and back-up lights consist of individual lamps, each equipped with 6 LED lights, mounted together as a module.

LED lights are not replaceable, and each lamp is serviced individually as a complete unit.

The hazard warning flashing system uses the front, side and rear directional lights simultaneously. This system is energized by a switch on the L.H. dashboard.

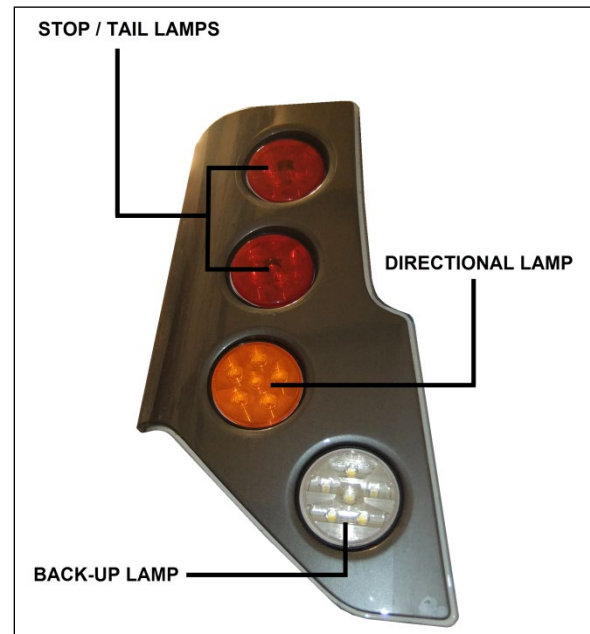


FIGURE 107: X3-SERIES REAR TAIL LAMPS, SOME VEHICLES MAY HAVE THE DIRECTIONAL LAMP MAY BE MOUNTED ON TOP POSITION

##### 16.4.1 Lamp Removal and Replacement

1. Open engine compartment rear door.
2. Remove the lamp pod from the engine compartment door by unscrewing the Torx hold down screws (4) at the back of the door and the two (2) side retaining nuts.
3. Remove the lamp support retaining screws (2), and then from the outside, disconnect and remove the faulty lamp and its support.
4. From the outside, install the new lamp with its support then fasten the retaining screws.
5. Reinstall the lamp pod on the door and reconnect the lamp.

##### 16.4.2 Center Stoplights and Cyclops Light Removal and Replacement

These (LED) lights are sealed unit and should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both "Phillips" light screws then remove the light assembly.
2. Install new light assembly and secure using screws.

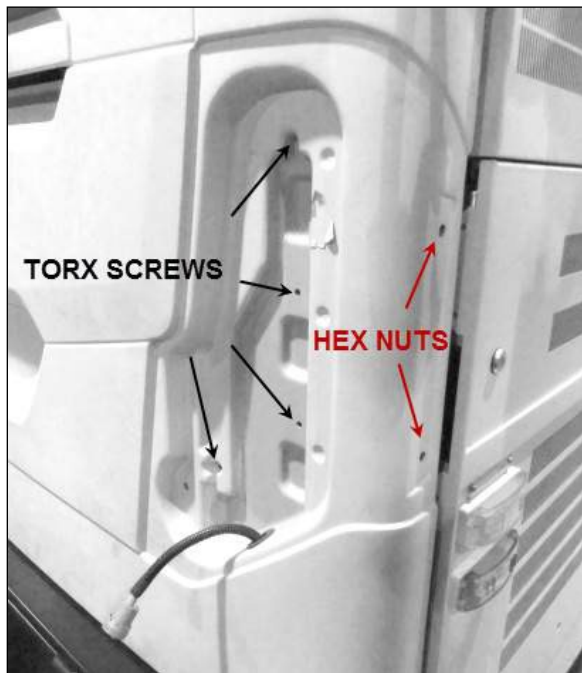


FIGURE 108: TAILLAMP POD RETAINING SCREWS &amp; NUTS

## 16.5 H3 SERIES STOP, TAIL, DIRECTIONAL, BACK-UP, AND HAZARD WARNING LIGHTS

A combination stoplight, taillight, directional signal light and back-up light assembly is mounted at the rear, on each side of the vehicle. Furthermore, when braking, a high-mounted stoplight will illuminate simultaneously with the stoplights on the sides for increased safety.

The stop and tail lights are combined in the same 6-LED lamp. The directional signal and license plate lights consist of individual LED lights mounted on the engine rear door, and each light is serviced individually as a complete unit. The back-up light sealed unit uses a regular tungsten bulb.

The hazard warning flashing system uses the front, side and rear directional lights simultaneously. This system is energized by a switch on the L.H. dashboard.

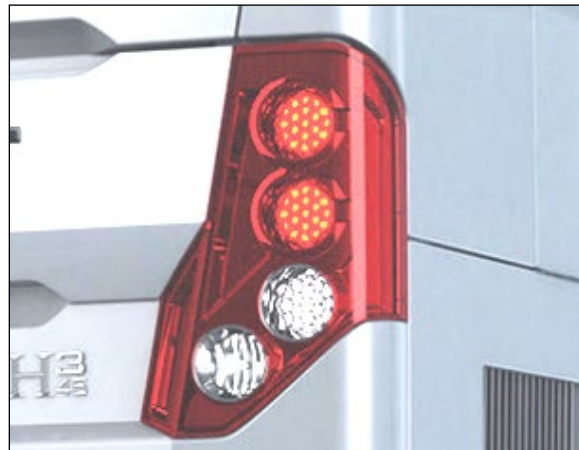


FIGURE 109: H3-SERIES REAR TAIL LAMPS

### 16.5.1 Lamp Removal And Replacement

1. Open engine compartment rear door.
2. Unscrew the lamp support retaining screws (2), and then from the outside, remove the lamp and its support.
3. From the outside, install the new lamp with its support then fasten the retaining screws.

### 16.5.2 High-Mounted Stop Light Removal And Replacement

This vehicle is equipped with a high-mounted stop light (LED). This light is a sealed unit and should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both "Phillips" light screws, and then remove the light assembly.
2. Position the new light assembly and install the "Phillips" screws.

## 16.6 LICENSE PLATE LIGHT

Two LED units are mounted above the rear license plate(s) of vehicle. In case of burn out, the LED unit must be changed according to the following procedure.

1. Pry out the rubber seal with a small screwdriver. Pull on the LED unit and disconnect it.
2. Reconnect new LED unit, place rubber seal, and press on it until it is seated in position.

## 16.7 CLEARANCE, IDENTIFICATION AND MARKER LIGHTS

The vehicle is equipped with marker, identification and clearance lights (LED). The clearance lights are mounted at each corner of the coach near the top and the identification lights are in the upper center of rear and front sections.

### 16.7.1 Clearance and Identification Lights Removal and Replacement

The rear clearance and identification lights are red and the front ones are amber.

These lights are LED sealed units and should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both "Phillips" screws, and then remove the LED unit. Unplug the connectors.

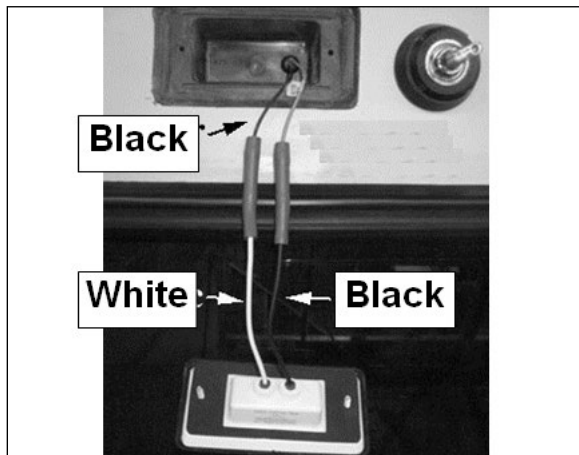


FIGURE 110: LED SEALED UNIT WIRE CONNECTION

2. Plug the new unit connectors. Engage the mating parts; push until the connector is fully seated. Turn slightly until you feel a click.
3. Position the new unit and maintain a pressure on the unit to compress the rubber seal. Tighten the "Phillips" screws.



FIGURE 111: CLEARANCE/IDENTIFICATION LIGHTS

### 16.7.2 Marker Lights Removal and Replacement

The amber and red marker lights are mounted along the sides of vehicle.

The side marker light is a sealed unit (LED) and should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both "Phillips" screws, and then remove the marker light unit. Unplug the connector.
2. Plug the connector to the new marker light unit. Position the new light assembly and tighten the "Phillips" screws (19 lbs-in).

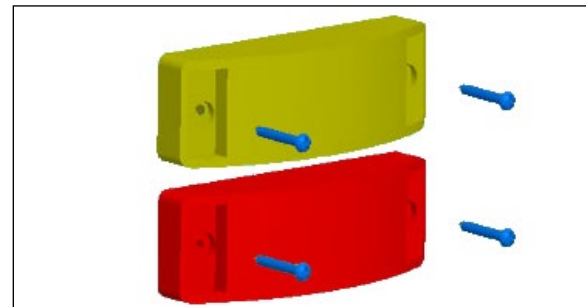


FIGURE 112: SIDE MARKER AND SIDE DIRECTIONAL LIGHTS

## 16.8 DOCKING AND CORNERING LIGHTS

This vehicle is provided with two halogen sealed-beam units that serve as cornering lights. They are mounted on the vehicle as follows: one is mounted on the front L.H. side service compartment door, while the other is located between the front wheel and the entrance door on the R.H. side. The main function of these lights is to increase lateral visibility when turning a corner. These lights are energized simultaneously with the directional lights. On the V.I.P. model, a dashboard-mounted rocker switch may be



actuated to cancel this system in special situations.

Two additional halogen sealed-beam units are installed on rear electrical compartment door (R.H.) and radiator door. These lights are used as docking lights and both will illuminate automatically when reverse range is selected to facilitate back-up or docking procedure.

On the V.I.P. model, these lights do not operate automatically when the reverse range is selected, but by means of a dashboard-mounted rocker switch. When actuated, the docking as well as the cornering lights illuminate. Furthermore, a “*Low docking*” switch, also located on dashboard, allows the use of the docking and cornering lights at a lower intensity when the docking switch is actuated.

#### 16.8.1 Lamp Removal And Replacement

Both docking and cornering sealed-beam units can be changed in accordance with the following procedure:

1. Remove the two “Phillips” screws attaching the retaining ring.
2. Disconnect the light unit connection.
3. Remove the lamp.
4. Position new lamp.
5. Connect and position the light unit.
6. Finally, install the retaining ring and screw.

### 16.9 FOG LIGHTS

Optional fog lights can be mounted on the vehicle to give the driver better visibility in foggy weather, or to improve the range of vision just ahead of the coach.

#### 16.9.1 H3 models Fog light removal and Replacement

1. Lower the bumper by pulling the release handle located in the front electrical and service compartment.
2. Disconnect the wiring and cut the cable ties.
3. Remove the screws that supports the fog light subassembly on the bumper support (Figure 113).

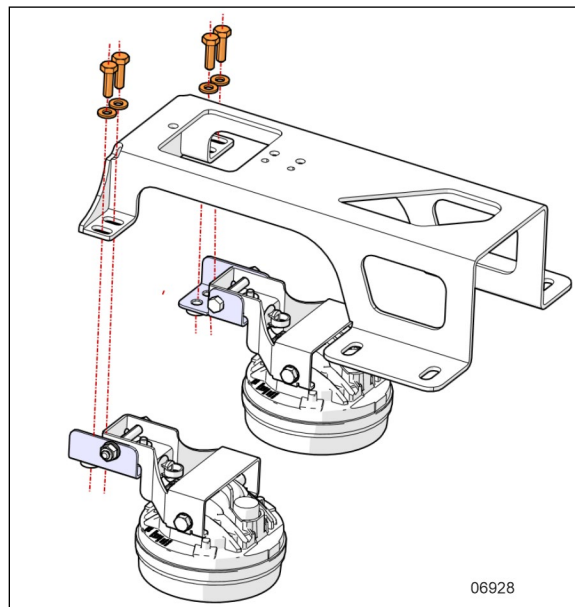


FIGURE 113: FOG LIGHT SUBASSEMBLY DISMOUNT

4. Remove the screws (2) that supports the fog light pod, keep screws and lockwashers.

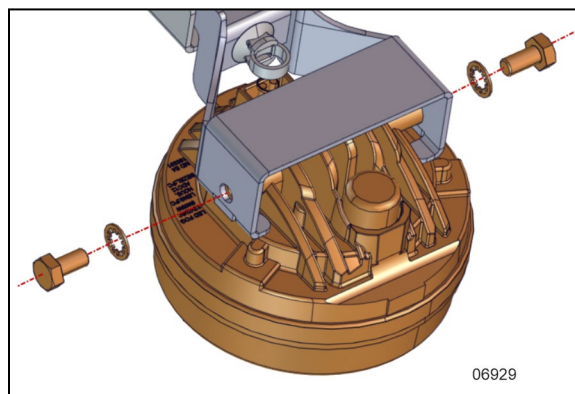


FIGURE 114: FOG LIGHT REMOVAL

5. Discard the defective fog light pod.
6. Install a new cable tie on the fog light support.

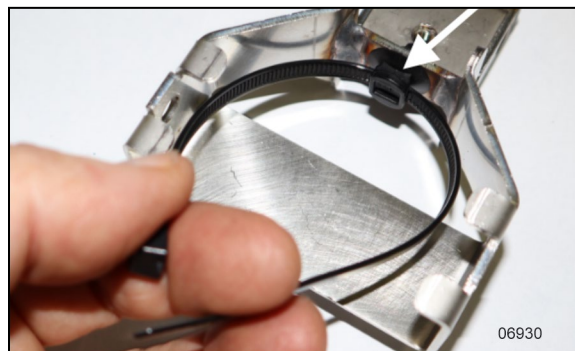


FIGURE 115: CABLE TIE INSTALLATION



7. Install the new fog light pod on the pod support with the existing screws and lockwashers.

Tighten screws to a torque value of 50-60 lb-in (6-7 Nm).



FIGURE 116: FOG LIGHT INSTALLATION

8. Secure the wiring with a cable tie as shown in Figure 116.
9. Reinstall the fog light subassembly on the bumper support.
10. Plug the connector and secure all wiring.
11. Test the fog light.

#### 16.9.2 X3 Models Fog Light Removal And Replacement

1. Lower the bumper by pulling the release handle located in the front electrical and service compartment.
2. From the bumper inner side, dismount the screws fixing the fog light subassembly from the bumper.

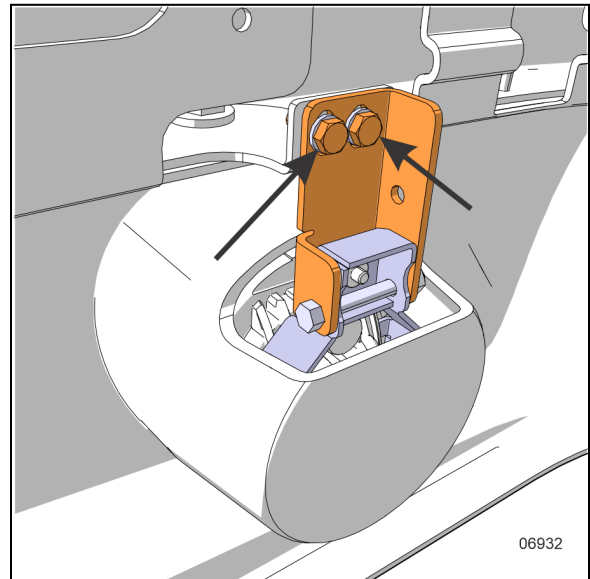


FIGURE 117: FOG LIGHT MOUNTING BOLT

3. Dismount the screws (2) fixing the pod from the fog light support, keep the screws and the lock washers.

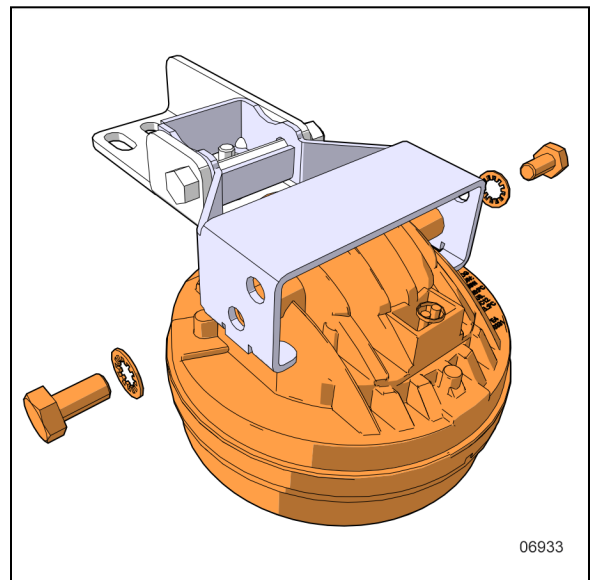


FIGURE 118: FOG LIGHT POD DISMOUNT

4. Install the new fog light pod on the pod support with the existing screws and lock washers (Figure 118).
5. Tighten screws to a torque value of 50-60 lb-in (6-7 Nm).
6. Reinstall the fog light subassembly on the bumper support.
7. Plug the connector and secure all wiring.
8. Test the fog light.

### 16.10 BAGGAGE COMPARTMENT, MAIN POWER COMPARTMENT LIGHTS

This type of compartment light is a sealed unit (LED) and can be replaced as a complete unit.

It is found in the following locations:

- Baggage compartments
- Main power compartment

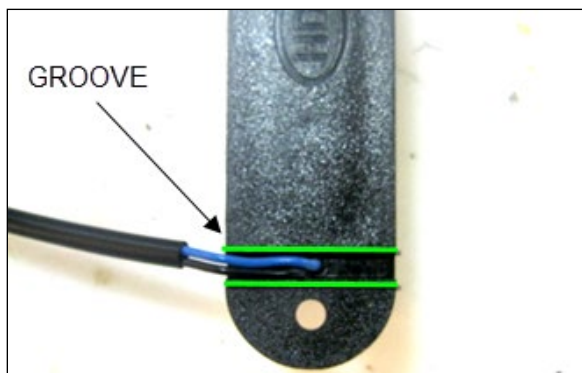


FIGURE 119: ROUTE THE WIRES IN THE GROOVE UNDER THE SEALED UNIT BODY



FIGURE 120: BAGGAGE COMPARTMENT LIGHTS LED SEALED UNIT

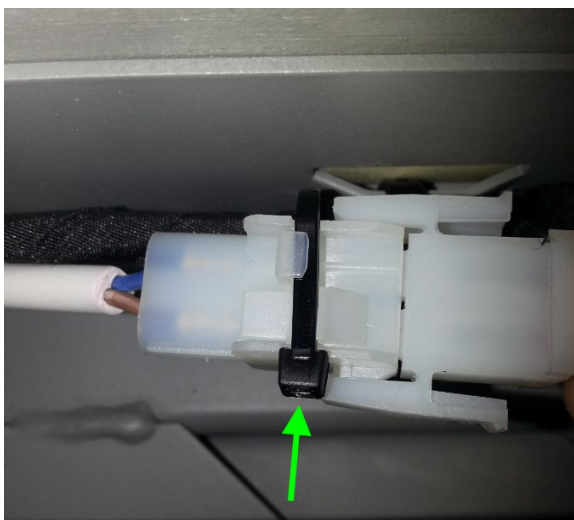


FIGURE 121: SECURE THE CONNECTOR WITH A NYLON TIE

### 16.11 ENGINE COMPARTMENT LIGHTING

Three 24-volts LED modules illuminate the engine compartment when the following conditions are met:

1. The engine compartment rear door or curbside door is open.
2. Ignition switch in ON or ACC position.

The light module is sealed thus not serviceable.

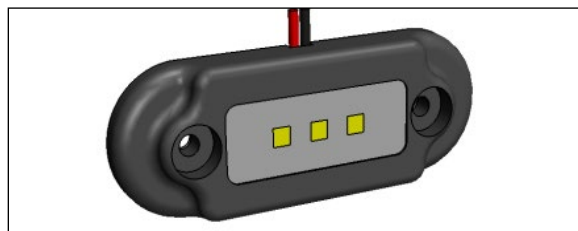


FIGURE 122: ENGINE COMPARTMENT LIGHT

## 17. INTERIOR LIGHTING EQUIPMENT

### 17.1 CONTROL PANEL LIGHTING

The instrument gauges and switches mounted on all control panels are energized whenever the exterior light switch is pushed to the first position. A control dimmer located on the dashboard is used to vary the brightness of the panel gauges, switches and indicator lights.

#### 17.1.1 Switch Lighting

1. Slightly pull the switch with a defective LED away from the control panel.
2. Disconnect the electric cable from the switch.
3. To install a new switch, reverse the procedure (Figure 123)

#### **NOTE**

*Switches are lighted by the use of LED. When lighting on a switch fails, replace defective switch as a unit.*

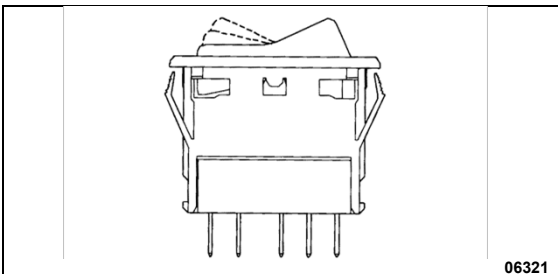


FIGURE 123: SWITCH

#### 17.1.2 Instrument Cluster Lights

The instrument cluster is non-serviceable and must be replaced as a unit.

### 17.2 X3 SERIES - STEPWELL LIGHTS

Two stepwell lights are illuminated when the door opening system is activated.

#### 17.2.1 Bulb Removal and Replacement

Proceed as follows to replace a defective bulb:

1. Unscrew the two Phillips-head screws retaining the lens to the wall, and remove it.
2. With the light lens removed, pull bulb from the lamp while applying lateral pressure.

3. Install the new bulb into the lamp.
4. Position the light lens and install it.

### 17.3 H3 SERIES - STEPWELL LIGHTS

#### 17.3.1 Coach Entrance

The stepwell lights are illuminated when the door opening system is activated (FIGURE 124).

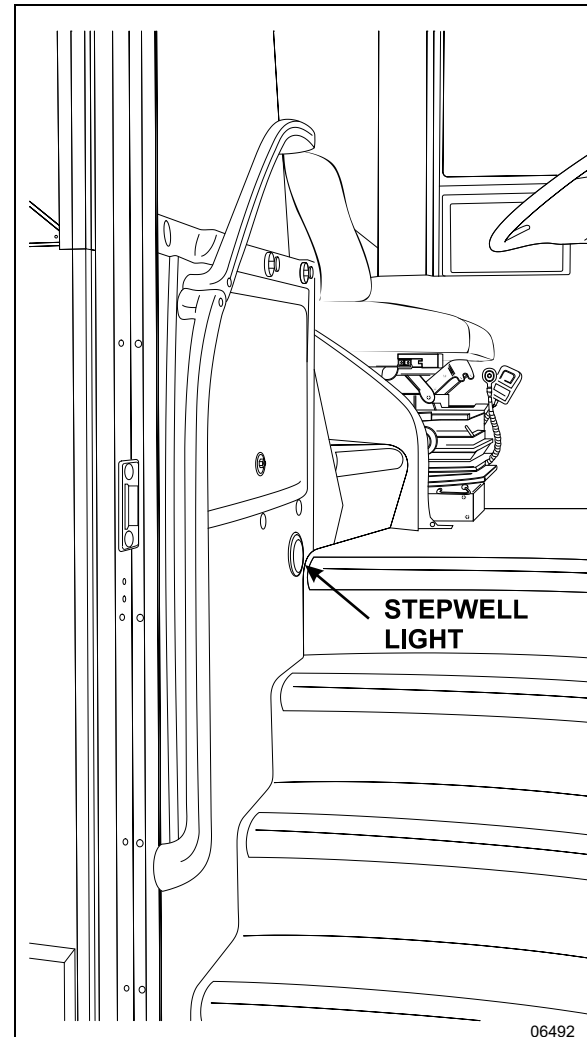


FIGURE 124: COACH ENTRANCE STEPWELL

#### Light Removal and Replacement

1. Unsnap the lamp outer ring and remove it.
2. Unfasten the three fixing screws, remove and disconnect LED light assembly.
3. Connect and install the new LED assembly in position.

4. Fasten the three fixing screws and replace the lamp outer ring by snapping it back in place.

### 17.3.2 VIP Entrance

The stepwell light is illuminated when the door opening system is activated (FIGURE 125).

### 17.3.3 Bulb Removal And Replacement

Proceed as follows to replace defective bulb:

1. Unscrew the two Phillips-head screws retaining the lens to the wall, and remove it.
2. With the light lens removed, pull bulb from the lamp while applying lateral pressure.
3. Install the new bulb into the lamp.
4. Position the light lens and install it.

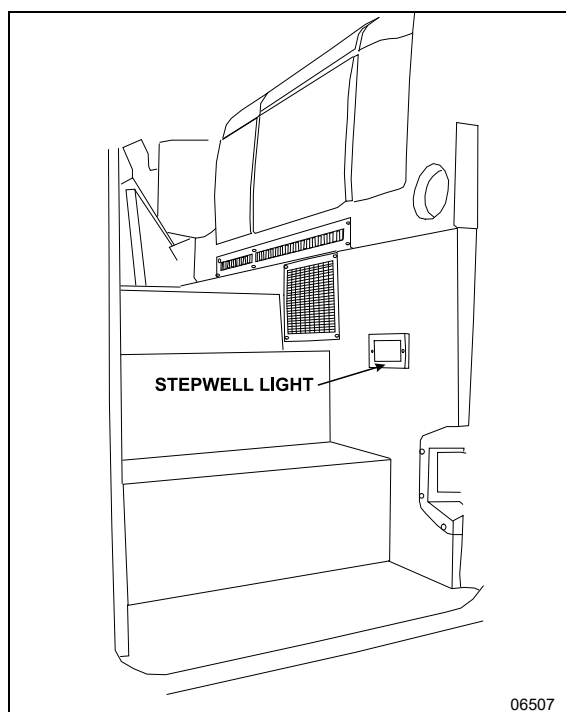


FIGURE 125: VIP ENTRANCE STEPWELL

### 17.4 DRIVER'S AREA CEILING LIGHTS

One halogen ceiling light is installed over the stepwell and another one is installed over the driver's area. These lights are frequently used for night-time coach operation when passengers board or leave coach.



FIGURE 126: DRIVER'S AREA CEILING LIGHT

### 17.4.1 Bulb Removal and Replacement

1. Pull the lamp assembly by the outer ring using your fingers.
2. Pull the defective bulb out of the socket.
3. Install the new bulb by pushing it in position.
4. Replace the lamp by snapping it back in place.



### CAUTION

Do not touch halogen bulbs with bare hands as natural oils on skin will shorten bulb life span.

### 17.5 PASSENGER SECTION LIGHTING

The passenger section of coach is lit by two types LED strips installed on the overhead compartments. The aisle or *indirect lights* are located on front of overhead compartments, and provide soft, indirect cabin lighting and overhead compartment interior lighting.

More powerful lighting is provided by LED strips located under the overhead compartments, close to the windows. 24 volt power is available for this lighting. In order to save batteries during extended periods, the battery charger can be connected prior use.

Moreover, adjustable reading lamps are installed under the overhead compartments for passenger accommodation.

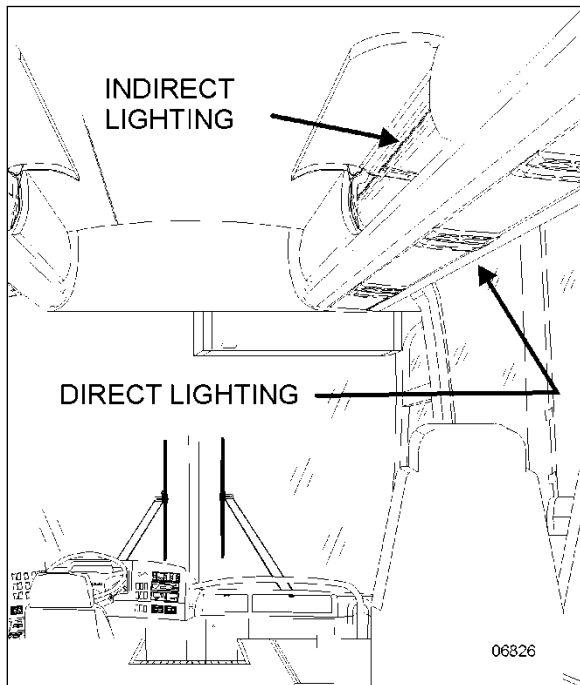


FIGURE 127: OVERHEAD COMPARTMENT LIGHTING

### 17.5.1 LED Indirect Lighting / Overhead compartment Interior Lighting

1. Open the overhead compartment access door.
2. Using a Phillips head screwdriver, unscrew and remove the existing LED strip (FIGURE 128).
3. Install a new LED strip as a complete unit.

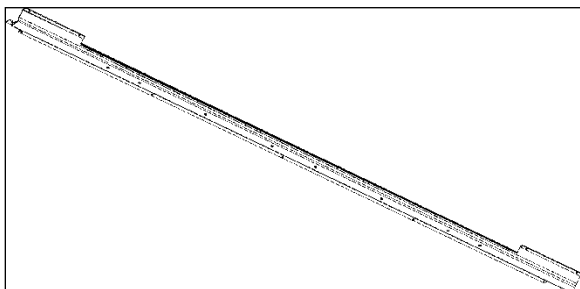


FIGURE 128: LED INDIRECT LIGHTING IN OVERHEAD COMPARTMENT

### 17.5.2 LED Direct Lighting

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.
2. Unscrew and remove the LED strip assembly (4 Phillips screws).
3. Install a new LED strip assembly.

4. Replace the screen lens by first inserting one side in the seat, then push the other side in and snap it in place by running it in from one corner to the next.

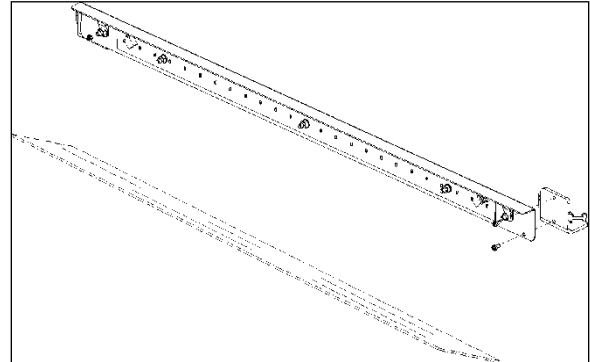


FIGURE 129: LED DIRECT LIGHTING AND LENS

### 17.5.3 Removal and Replacement of Reading Lamp Bulb

1. Engage the tool (#830164) over the lamp and turn one quarter turn counterclockwise. Then, remove the tool slowly.
2. Pull the bulb socket off the reading lamp unit.
3. Push and turn bulb counterclockwise, then pull it out of the socket.
4. Install new bulb in the socket, then push and turn clockwise to lock bulb in position.
5. Push the bulb socket in the reading lamp unit.
6. Position the reading lamp with the tool (#830164), turn one quarter turn clockwise.

## 17.6 LAVATORY NIGHT-LIGHT

The lavatory halogen lights are installed on ceiling. A microswitch, mounted in the door exterior frame, is activated by the door lock mechanism upon locking to energize the circuit. This switch is readily serviced by removing the two Phillips-head screws securing the mounting plate to the door exterior frame.

### 17.6.1 Bulb Removal And Replacement

Proceed as follows to replace defective bulb:

1. Unscrew the two Phillips-head screws retaining the lens to the lavatory wall, and remove it.
2. With the light lens removed, pull bulb from the lamp while applying lateral pressure.

3. Install the new bulb into the lamp.
4. Position the light lens and install it.

#### 17.7 LIGHT BULB DATA

Please, refer to your vehicle Parts Manual for selection of replacement light bulbs.



**18. SPECIFICATIONS****AGM Battery**

Make.....	Volvo
Type .....	Absorbed Glass Mat
Terminal type .....	Top Stud
Group size .....	8A31
Volts .....	12
Load test amperage .....	400
Reserve capacity (minutes).....	200
Cold cranking (in amps)	
-At 0°F (-18°C).....	800 (each battery)
Maximum dimensions (inches/mm)	
-Length (including flange).....	12.93/328
-Width .....	6.7/169
-Height (including top posts) .....	9.3/237
-Approximate weight (lbs/kg).....	61.7/28

**Alternators**

Make.....	BOSCH
Series .....	HD 10
Amperes .....	150
Volts .....	28.4
Output Power .....	3 Kw
Ground .....	negative
Make.....	Delco Remy
Series .....	55SI
Amperes .....	250
Volts .....	28.4
Ground .....	negative

**Inverter charger (H3 Series)**

Make.....	Xantrex
Model.....	Freedom XC 1800

**Battery equalizer**

Make.....	Vanner
Model.....	Vann-bus 80-Series
Amperes .....	100 amps

**Starter**

Make.....	Mitsubishi Electric Corporation (MELCO)
Type .....	105P70
Voltage .....	24
No-load test	
-Volts .....	23.5
-Max. current draw .....	125 amperes
-Min. rpm .....	3000 rpm

**Starter solenoid**

Make.....	Mitsubishi Electric Corporation (MELCO)
-----------	---

Pull In Voltage ..... 16 volts max.

# ELECTRICAL CONNECTORS PROTECTION

**PROCEDURE NO SAV00002E**

**NOVEMBER 2009  
REVISION 02**

## **Kent Sealer**

Sprayed sealer. It is used for structure ground connections. It prevents corrosion and ensures maximum contact. Refer to table for proper use.

Apply this product once installation is finished.

***Warning:*** It is very important to be in a well ventilated area when applying this product.



680324

## **Nyogel Grease**

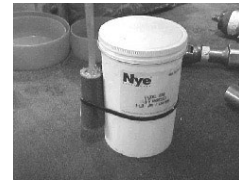
Grease-type product.

It is used to facilitate connectors or terminals insertion.

Refer to table for proper use of Nyogel grease.

It is preferable to apply Nyogel into the female part of connector.

Apply this product as the last assembling operation.



3 Oz. tube: 681095

Container 500g: 683409

## **“Color Guard” black rubber coating**

This product may be applied with a brush.

It is used for structure ground connections or other connections that will most likely not be disconnected later on.

Apply this product once installation is finished.

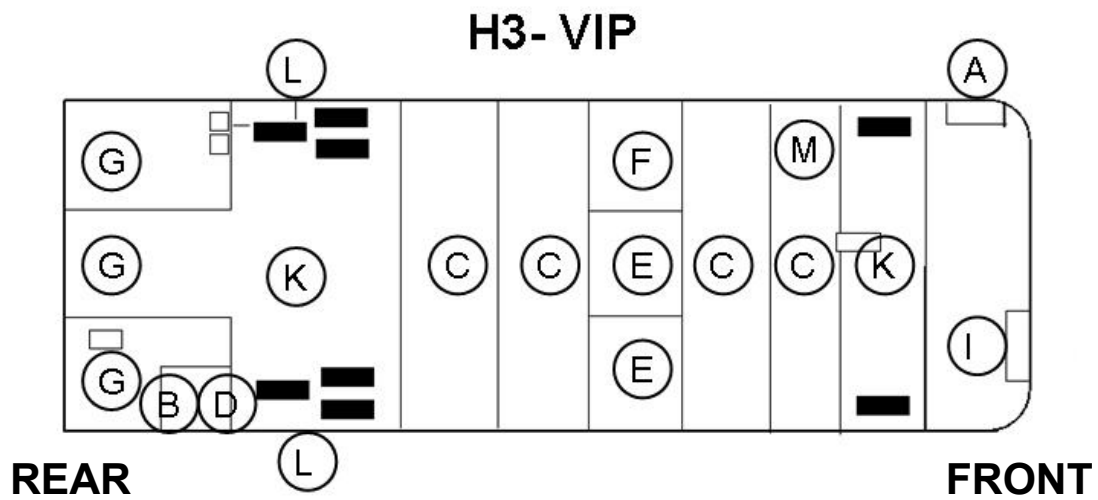
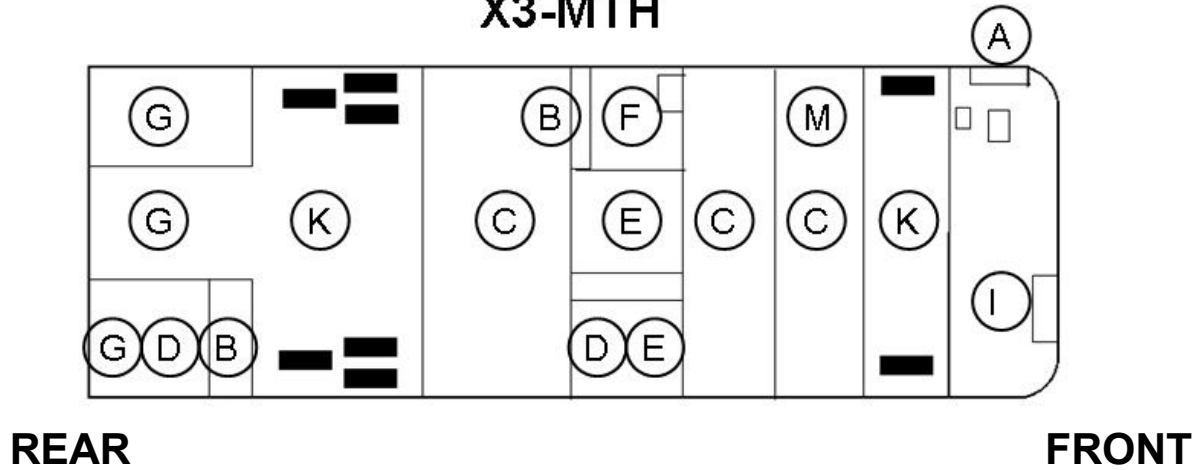
***Warning :*** Wear goggles and rubber gloves.



684013

### Vehicle Zoning

#### X3-MTH



## Electrical Connectors Protection Procedure Table

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
A- Front Elect. Compt	Diode Block	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	Customer Terminal Block	X	X	X	X	Nothing	
A Front Elect. Compt	Terminal Block Electronic Ground	X	X	X	X	Kent	
A- Front Elect. Compt	Structure Ground	X	X	X	X	Kent	
A- Front Elect. Compt	Electronic Module	X	X	X	X	Nothing	
A- Front Elect. Compt	VEC Power	X	X	X	X	Nothing	
A- Front Elect. Compt	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
A- Front Service Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Customer Terminal Block	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Power Terminal Block		X			Nothing	
B- Rear Elect. Compt/panel	Circuit Breaker		X	X	X	Nothing	
B- Rear Elect. Compt/panel	Circuit Breaker	X				Kent	Surface only
B- Rear Elect. Compt/panel	Volvo Air Heater Fuse			X		Nothing	
B- Rear Elect. Compt/panel	Structure Ground		X	X	X	Kent	
B- Rear Elect. Compt/panel	Electronic Module	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	VEC Power		X	X	X	Nothing	
B- Rear Elect. Compt/panel	VEC Power	X				Kent	Surface only
B- Rear Elect. Compt/panel	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
B- Rear Elect. Compt/panel	Master Switch Relay		X	X	X	Nothing	
B- Rear Elect. Compt/panel	Master Switch Relay	X				Kent	Surface only
B- Rear Elect. Compt/panel	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
B- Rear Elect. Compt/panel	200A Power Relay	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Power Relay Stud		X			Nothing	
B- Rear Elect. Compt/panel	All connectors except those specified in this zone	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Vanner			X	X	Kent	

**PROCEDURE NO: SAV00002E**

**REVISION 02**

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
C- Baggage Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
C- Baggage Compt	Door Switch	X	X	X	X	Nyogel	Accepted to ease connection
C- Baggage Compt	Door lock Actuator Module (switch and solenoid)	X	X	X	X	Nyogel	Accepted to ease connection
C- Baggage Compt	Electronic Module	X	X	X	X	Nothing	
C- Baggage Compt	Slide-out Motor	X			X	Nyogel	Accepted to ease connection
C- Baggage Compt	WCL Junction Panel		X	X		Nothing	
C- Baggage Compt	120V Inverter Connector	X	X	X	X	Nothing	
C- Baggage Compt	Stud inverter		X	X		Color Guard or Kent	
C- Baggage Compt	WCL Remote Control		X	X		Nyogel	Accepted to ease connection
C- Baggage Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
D- Battery Compt	Battery terminals	X	X	X	X	Nyogel	
D- Battery Compt	Structure Ground	X	X			Color Guard or Kent	
D- Battery Compt	Electronic Module	X	X	X	X	Nothing	
D- Battery Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
D- Battery Compt	Battery Equalizer	X	X			Kent	
E- Condenser Compt	Fuel sender	X	X	X	X	Kent	
E- Condenser Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
E- Condenser Compt	Door Switch	X	X	X	X	Nyogel	Accepted to ease connection
E- Condenser Compt	Condenser Motor	X	X	X	X	Nothing	
F- Evaporator Compt	Diode Block	X		X	X	Nyogel	Accepted to ease connection
F- Evaporator Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
F- Evaporator Compt	Electronic Module	X		X	X	Nothing	
F- Evaporator Compt	Evaporator Motor	X	X	X	X	Color Guard or Kent	
F- Evaporator Compt	200A Power Relay	X		X	X	Nothing	
F- Evaporator Compt	All connectors except those specified in this zone	X		X	X	Nothing	



Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
G- Engine Compt	Alternator	X	X	X	X	Color Guard	
G- Engine Compt	Booster Block (+)		X	X	X	Color Guard	
G- Engine Compt	Starter Terminal	X	X	X	X	Color Guard	
G- Engine Compt	Volvo Air Element Terminal	X	X	X	X	Color Guard	
G- Engine Compt	Customer Terminal Block	X				Nothing	
G- Engine Compt	Power Terminal Block		X			Color Guard	
G- Engine Compt	Breaker	X				Kent	
G- Engine Compt	Air Heater Fuse & Relay	X	X			Nyogel	Accepted here
G- Engine Compt	Engine Ground	X	X	X	X	Color Guard	
G- Engine Compt	Structure Ground	X	X	X	X	Color Guard	
G- Engine Compt	VEC Power	X				Kent	
G- Engine Compt	Master Switch Relay	X				Kent	
G- Engine Compt	Starter Relay	X	X			Color Guard	
G- Engine Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
H- Vehicle Exterior	ABS Sensor	X	X	X	X	Nothing	
H- Vehicle Exterior	Docking & Cornering Lamps	X	X	X	X	Nyogel	Accepted to ease connection
H- Vehicle Exterior	Marker Light	X	X	X	X	Nothing	
H- Vehicle Exterior	Mirror	X	X	X	X	Nothing	
H- Vehicle Exterior	Light Module	X	X	X	X	Nothing	
H- Vehicle Exterior	Stop light, Backup light, Directional Signal Light	X	X	X	X	Nothing	
I- Vehicle Interior	Diode Block	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Junction Block		X	X		Nothing	
I- Vehicle Interior	A3 & A4 Transmission Retarder Hand lever	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	C258 & C259 Multi-function Lever Connector	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Audio - video Connection		X	X		Nothing	
I- Vehicle Interior	Defrost Compt Ground	X	X	X	X	Kent	
I- Vehicle Interior	Video Plate Direct Ground		X	X		Nothing	
I- Vehicle Interior	Structure Ground		X	X		Kent	
I- Vehicle Interior	Terminal Block Ground		X	X		Nothing	

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
I- Vehicle Interior	Dashboard Switch	X	X	X	X	Nothing	
I- Vehicle Interior	Electronic Module	X	X	X	X	Nothing	
I- Vehicle Interior	Slide-out Motor	X			X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Wiper Motor	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	200A Power Relay	X	X	X	X	Nothing	
I- Vehicle Interior	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	All connectors except those specified in this zone	X	X	X	X	Nothing	
I- Vehicle Interior	All components except those specified in this zone	X	X	X	X	Nothing	
K- Front & Rear Wheelhousing	All connectors except those specified in this zone	X	X	X	X	Nothing	
K- Front & Rear Wheelhousing	All components except those specified in this zone	X	X	X	X	Nothing	
L- Compartment above rear wheelhousing	All connectors except those specified in this zone			X	X	Nothing	
L- Compartment above rear wheelhousing	All components except those specified in this zone			X	X	Nothing	
M- Slide-out Panel	All connectors except those specified in this zone	X			X	Nothing	
M- Slide-out Panel	All components except those specified in this zone	X			X	Nothing	



# PREVOST


## MAINTENANCE INFORMATION

### MI15-24B

DATE :	MAY 2015	SECTION:	06 - Electrical
SUBJECT :	<b>POWER CABLES INSPECTION GUIDELINES</b>		

Revision: B    Added: Power cables for L.H. side alternator & fan drive breaker box  
March 25, 2020

### APPLICATION

Model	VIN
 <p data-bbox="868 688 1291 772">V.I.N. PREVOST CAR INC. PREVOST CAR INC. 7110 QUÉBEC STREET, VAL-D'AULÉ, CANADA</p> <p data-bbox="649 850 958 892">All PrevoSt models</p>	

### DESCRIPTION

It is important to carry out a regular inspection of the vehicle power cables. Power cables in poor condition can be the cause of failures and serious damage in the engine compartment.

*Please note that some images in this document may represent arrangements different from those found on vehicles of former generations. However, inspection criteria and points to check presented in this document remain applicable in essence for all models of PrevoSt vehicles.*

POWER CABLES MAINTENANCE SCHEDULE	
DESCRIPTION	INTERVAL
Perform power cables inspection	Every 3 months

## POWER CABLES

– The power cables are those through which flow the highest currents. These cables are those with the largest electrical conductor diameters on the vehicle.

– The power cables are 1/0, 2/0, 3/0 wire gauges respectively  $\varnothing 0.325\text{in}$ ,  $\varnothing 0.365\text{in}$ ,  $\varnothing 0.409\text{in}$ .

*Note: not to be confused with the 1, 2, 3 wire gauges that are actually smaller.*

– There are power cables at the following locations:

- On the **alternators positive (+) stud terminal** and from there, up to junction block in the electrical compartment (Figure 1 to Figure 5).

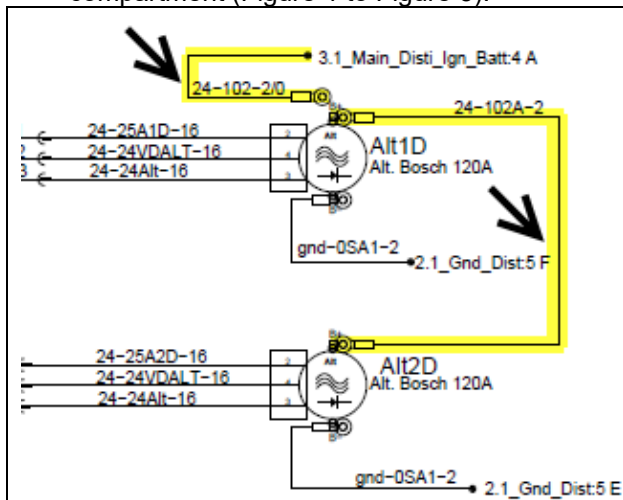


Figure 1 – R.H. SIDE ALTERNATORS (2x BOSCH)  
MECHANICAL COOLING FAN DRIVE CONFIGURATION

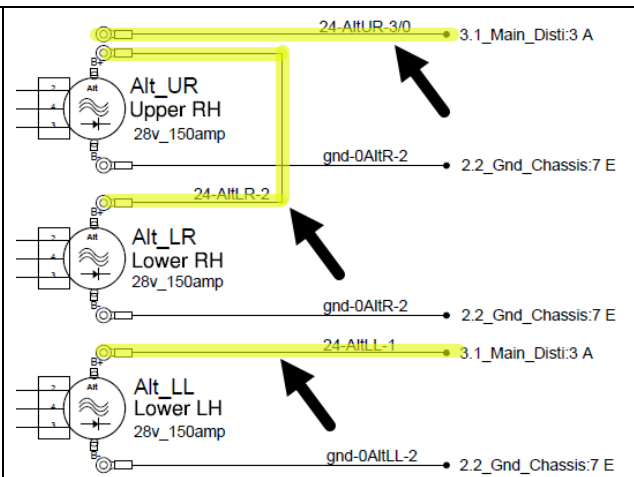


Figure 2 – L.H. + R.H. SIDE ALTERNATORS (3x BOSCH)  
ELECTRIC FAN DRIVE CONFIGURATION

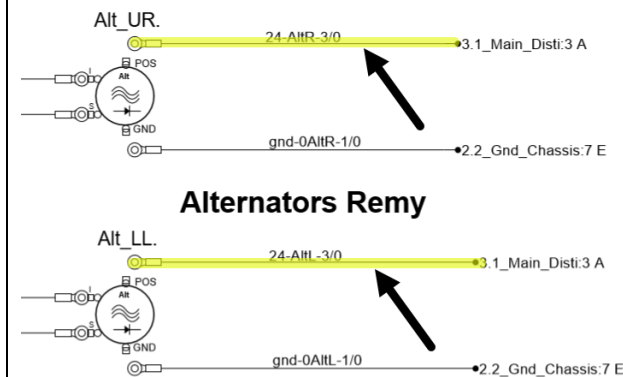


Figure 3 – R.H. + L.H. SIDE ALTERNATORS (2x DelcoRemy)

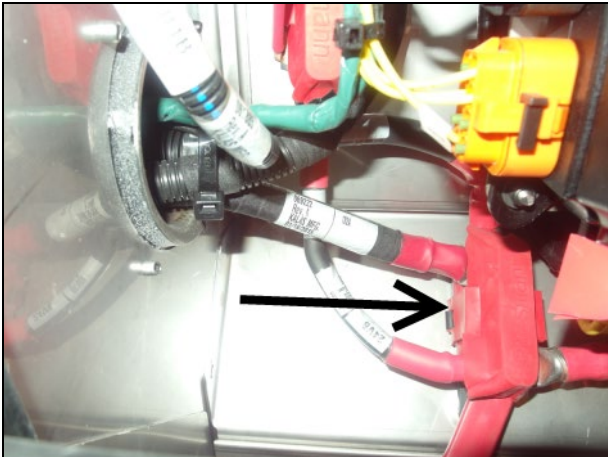


Figure 4: Busman Junction Block - X3 Series.



Figure 5: Busman Junction Block - H3 Series.

- On the **starter positive (+) stud terminals** and from there, up to Busman junction block in the electrical compartment (Figure 6, Figure 7).

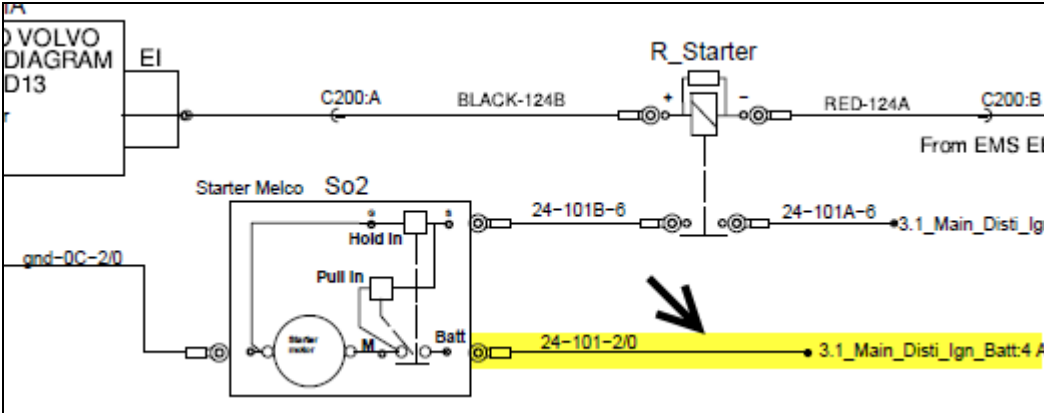


Figure 6



Figure 7: starter cables

- In the electrical compartment, **connected to the junction block** (Figure 8).



Figure 8

- In the **battery compartment** between **battery and master relay R1** (Figure 9).

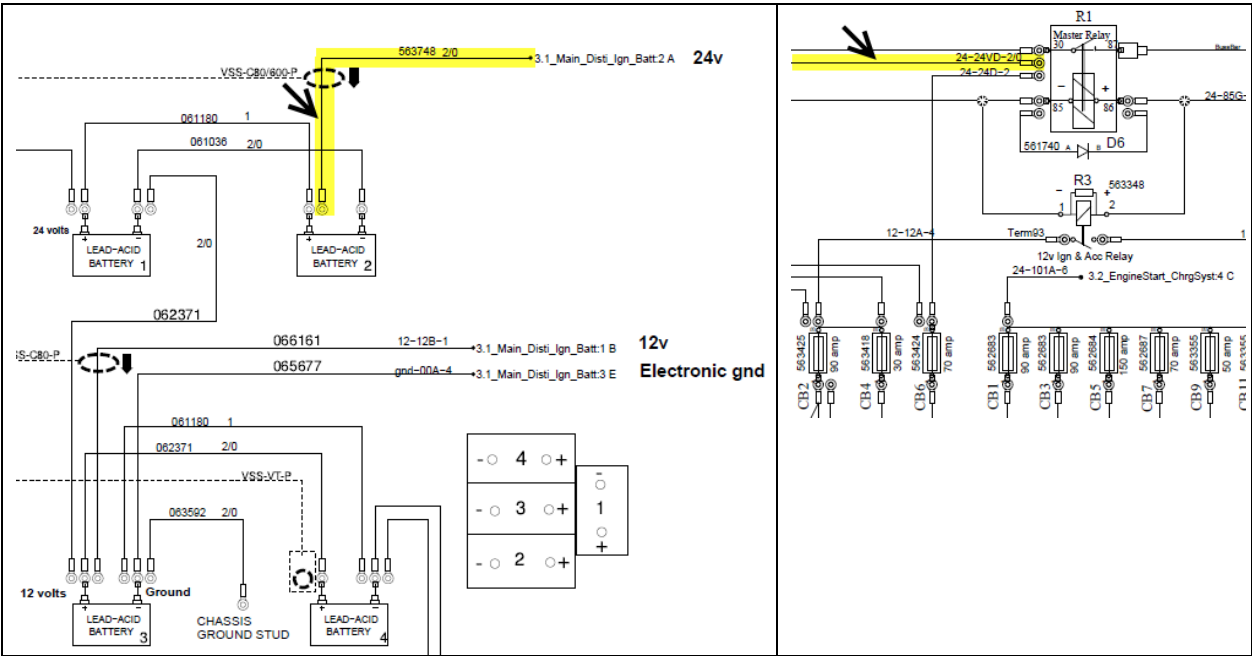


Figure 9



- Between **Bussman junction block** and **main circuit breaker bus bar** (Figure 10 & Figure 11).

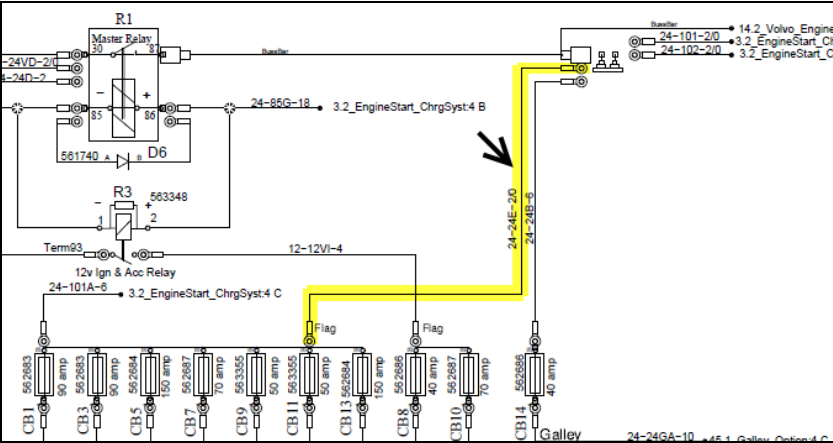


Figure 10

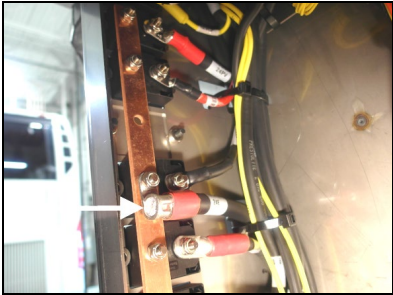


Figure 11: Power cable on main circuit breakers' bus bar.

- From the electric fan drive breaker box up to fuse F199 in main power compartment (Figure 12)

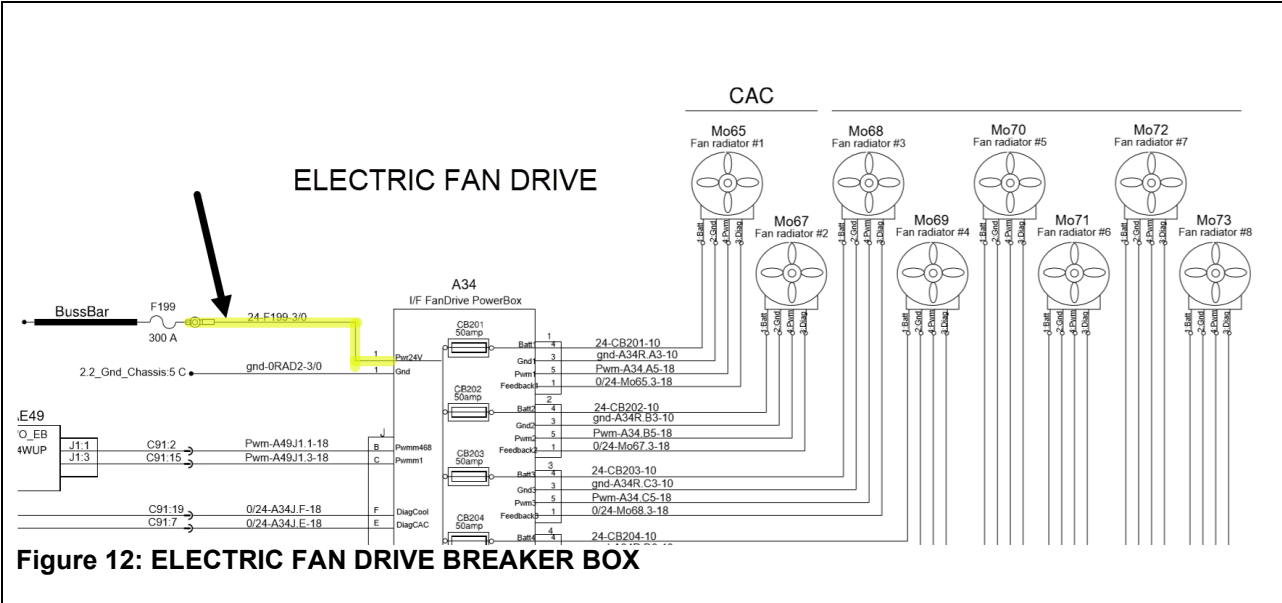


Figure 12: ELECTRIC FAN DRIVE BREAKER BOX

## PROCEDURE



### DANGER

Park vehicle safely, apply parking brake, stop engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

## POWER CABLES GENERAL INSPECTION CRITERIA

1. **Make sure that the power cables are properly secured with appropriate fasteners so that they do not move. Movement of the cables can cause wear of the extruded protective sheath, strains on stud terminals and ring cable lugs.**
2. **Ensure that the power cables do not rub on other cables or other components.**
3. **Make sure ring cable lugs are securely attached to the stud terminals, that the retaining nut is tightened. Also, make sure that cable lug crimping holds firmly on copper conductor.**

## OTHER THINGS TO CHECK

- Check for damages caused by electric arcs with loss of material along the copper conductor.
- Check for damaged cable extruded sheath and having lost its insulating properties.
- Bosch T1 alternator: ensure that the rubber grommets at the rear cap of the alternator are present.
- P-clamp type cable clamps must be suitable for cable diameter. The cable must remain in the P-clamp without moving or rubbing, thus oversized P-clamps are not allowed. Inspect the corrugated protective sheath passing through the P-clamp for signs of wear.
- At certain locations, power cables are protected by a corrugated protective sheath and should remain as such.

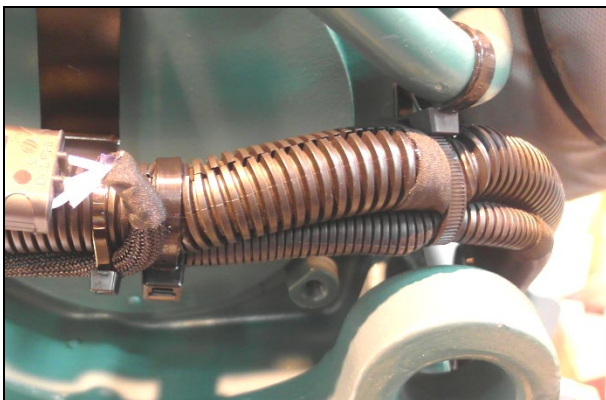


Figure 13: starter cables in a corrugated protective sheath.

- Ensure that the power cables do not rub on bolt heads or sharp metal edges that can cut or wear the cable extruded sheath.

- For power cables passing through a corrugated protective sheath, it is recommended to apply two layers of fabric tape every 3 to 6 inches minimum to prevent the cable from coming out of the corrugated protective sheath (Figure 14). The ends of the corrugated protective sheath should be covered with fabric tape (figure 15).

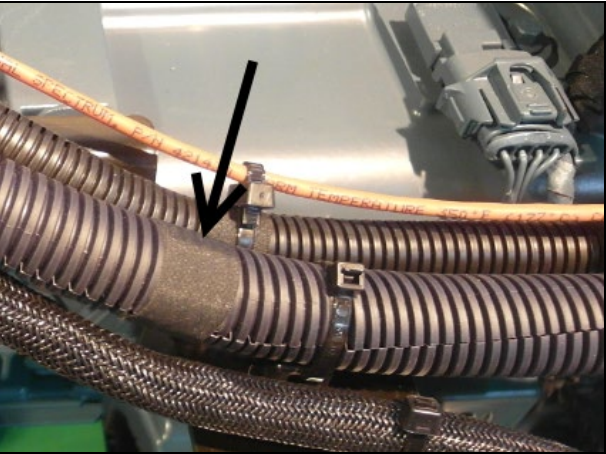


Figure 14: Two layers of fabric tape applied every 3 to 6 inches to prevent the cable from coming out of the corrugated protective sheath.

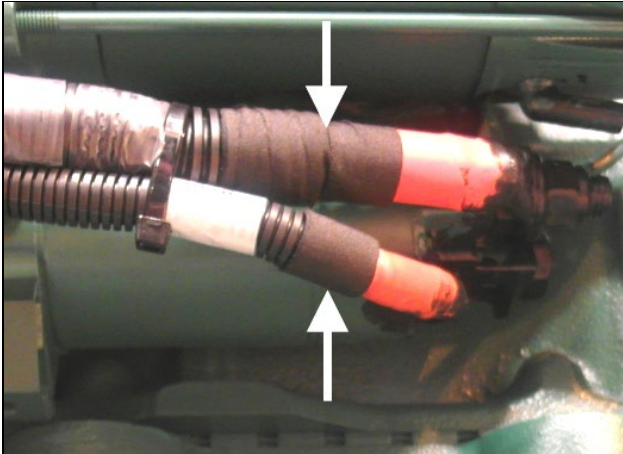


Figure 15: The ends of the corrugated protective sheath should be covered with fabric tape.

- Stud terminal nuts properly tightened. Use a nut with nylon insert to replace a similar nut where applicable. Protect ring cable lugs against tightening force by placing a flat washer between nut and ring cable lug.



## RING CABLE LUGS

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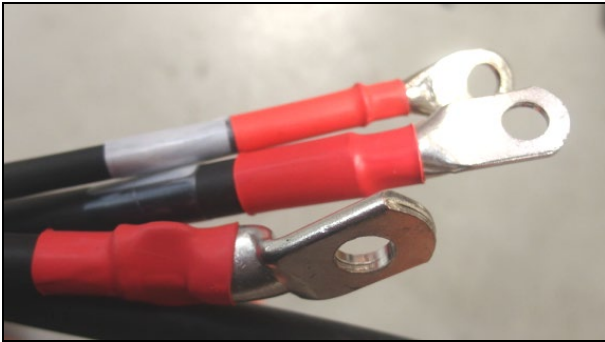


Figure 16: Cable lugs must be closed type, crimped or welded.

- Ring cable lugs should not be distorted.
- Ring cable lugs should not suffer strains that can deform.
- Ring cable lugs must be installed with smooth washers and nuts to prevent damage to the cable lug when tightening.



Figure 17: Power cable shouldn't be bent just next to the cable lug. Angled cable lugs are used to avoid mechanical stress.

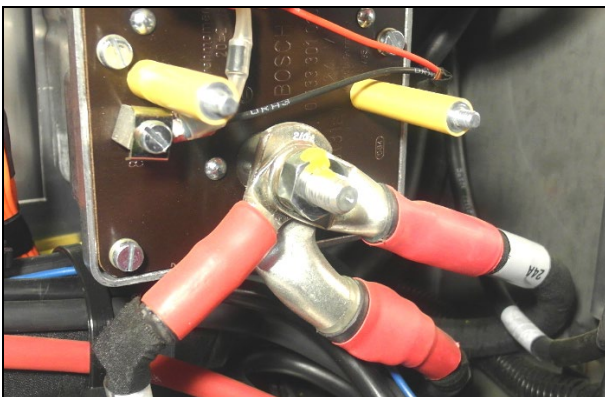


Figure 18: When several terminals are connected on a single stud terminal, the largest cable lug must be placed first, followed by the second larger and so on. Cable lugs should be distributed around the stud terminal in a way that no cable lug is distorted when tightening the nut.

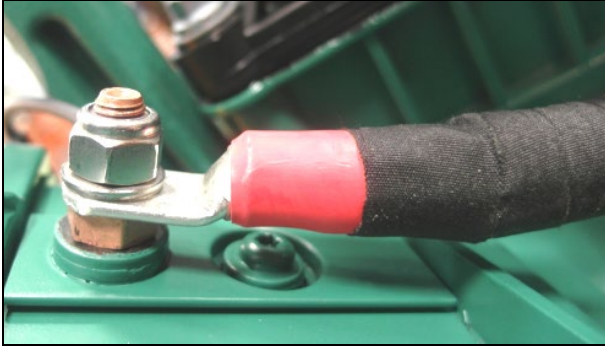


Figure 19: No exposed or broken copper strands.

- A shrink tubing (or fabric tape) should cover the copper strands.
- Ensure that the power cables and ground wire are not stretched tight.
- Ensure that the cable lugs are still properly crimped on the copper conductor, that the conductor strands are not broken so that the power cable retain its capacity and ensure unrestricted current flow.

## BATTERY CABLES

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- Battery interconnection cables must be checked too :
  - Ensure the cables are properly fastened to battery posts and that the cables are in good condition (consult battery manufacturer documentation for appropriate tightening torque).
  - No corroded or cut copper strands. No apparent copper strands. Protective sheath in good condition, no cuts, no rubbing against metal edges.

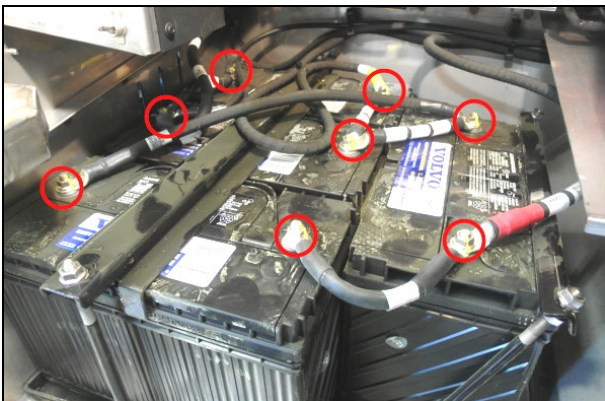


Figure 20: battery bank



## STEEL P-CLAMPS

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Figure 21: P-clamps are no longer used to secure power cables, but they can nevertheless be found on coaches of older generations. The piece of rubber that protects cable against the P-clamp steel loop must absolutely be in place. Replace any P-clamps where the rubber piece is missing, broken or likely to separate from the steel loop.

### *NOTE*

*Unlike steel P-clamps, plastic clamps have the advantage of being not conductive. A good practice would be to replace P-clamps **securing power cables** with appropriate nylon cable ties like the following:*

**#507664 CABLE TIE, DOUBLE LOOP**

**#509491 CABLE TIE, WIDE**

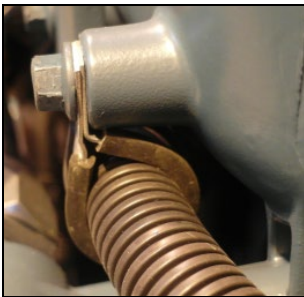


Figure 22: P-clamp with appropriate diameter prevents the power cable or corrugated protective sheath from moving and rubbing inside the clamp.

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## ALTERNATORS

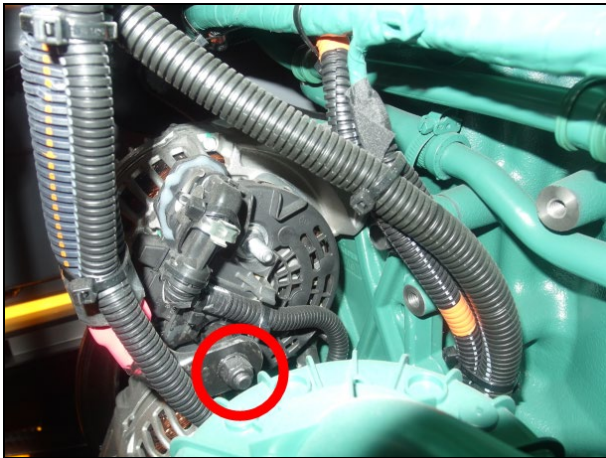


Figure 23: Make sure power cables/positive cables (+) are properly connected to alternator, that stud terminal nuts are properly tightened.

### TERMINAL NUT PRESCRIBED TORQUE

#### Delco Remy 55SI

- Ground : 50-60 lb-in
- Positive (+): 80-125 lb-in
- Sense (S) 25-45 lb-in
- Indicator (I) 25-45 lb-in

#### Bosch HD10

- B1(+) terminal: 10 lbf-ft
- ground: 6 lbf-ft

#### Bosch T1

- D+: 21-28 lbf-in
- B+, B-: 88-115 lbf-in
- W: 36-48 lbf-in

#### Delco 50DN

- DC Output: 30-35 lbf-ft
- F1, F2, Relay: 6 lbf-ft



Figure 24: Bosch T1 alternator with the two required rubber grommets. Alternator cables connected to the alternator stud terminals must be protected against metal edges with rubber grommets.



Figure 25: Fire in engine compartment caused by rubbing of power cable against metal edge of Bosch T1 alternator rear cover. Lower rubber grommet was missing when fire occurred. Evidence of electrical arc can be seen.

## CORROSION PROTECTION

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- Power cable connections on alternators, starter and ground connections exposed to water, dust, etc. should be protected against corrosion with Loctite Color Guard rubber coating (**Figure 26**) (Prevost p/n: 684013).



Figure 26: Loctite Color Guard.



Figure 27: Upper R.H. side Bosch alternator power cable lug protected with Color Guard rubber coating.

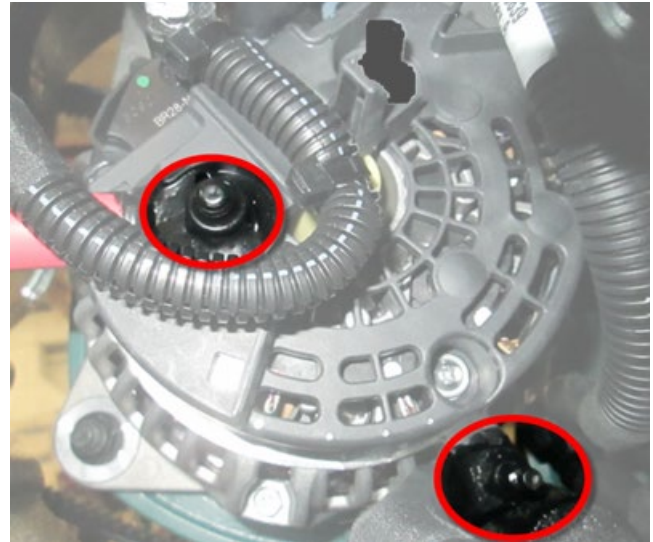


Figure 28: Lower R.H. side Bosch alternator power cable lug protected with Color Guard rubber coating.

*Protect the cable lug similarly on the L.H. side alternator (with electric fan drive)*

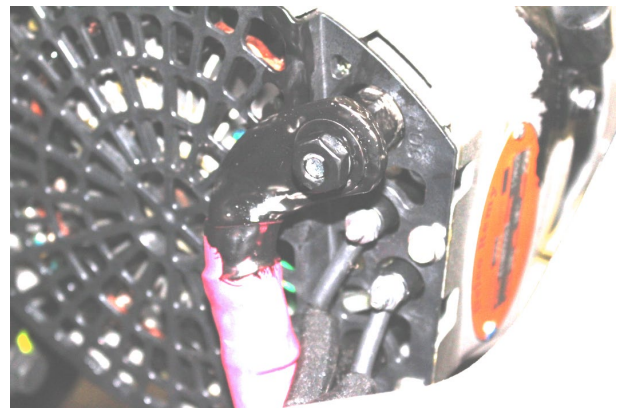


Figure 29: DELCO REMY ALTERNATOR

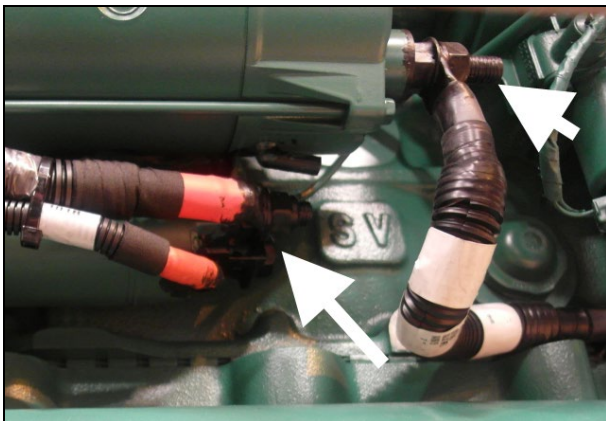


Figure 30: Starter power cable and ground cable lugs protected with Color Guard rubber coating.

## **PARTS / WASTE DISPOSAL**

Discard according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)



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by e-mail.



**PREVOST**

## MAINTENANCE INFORMATION

**MI16-17**

DATE :	FEBRUARY 2016	SECTION: 06 - Electrical
SUBJECT :	<b>BOSCH HD10 ALTERNATOR REMOVAL AND INSTALLATION</b>	

Please, get the latest revision of Maintenance Information MI16-17 on PrevoSt Technical Publications web site:

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