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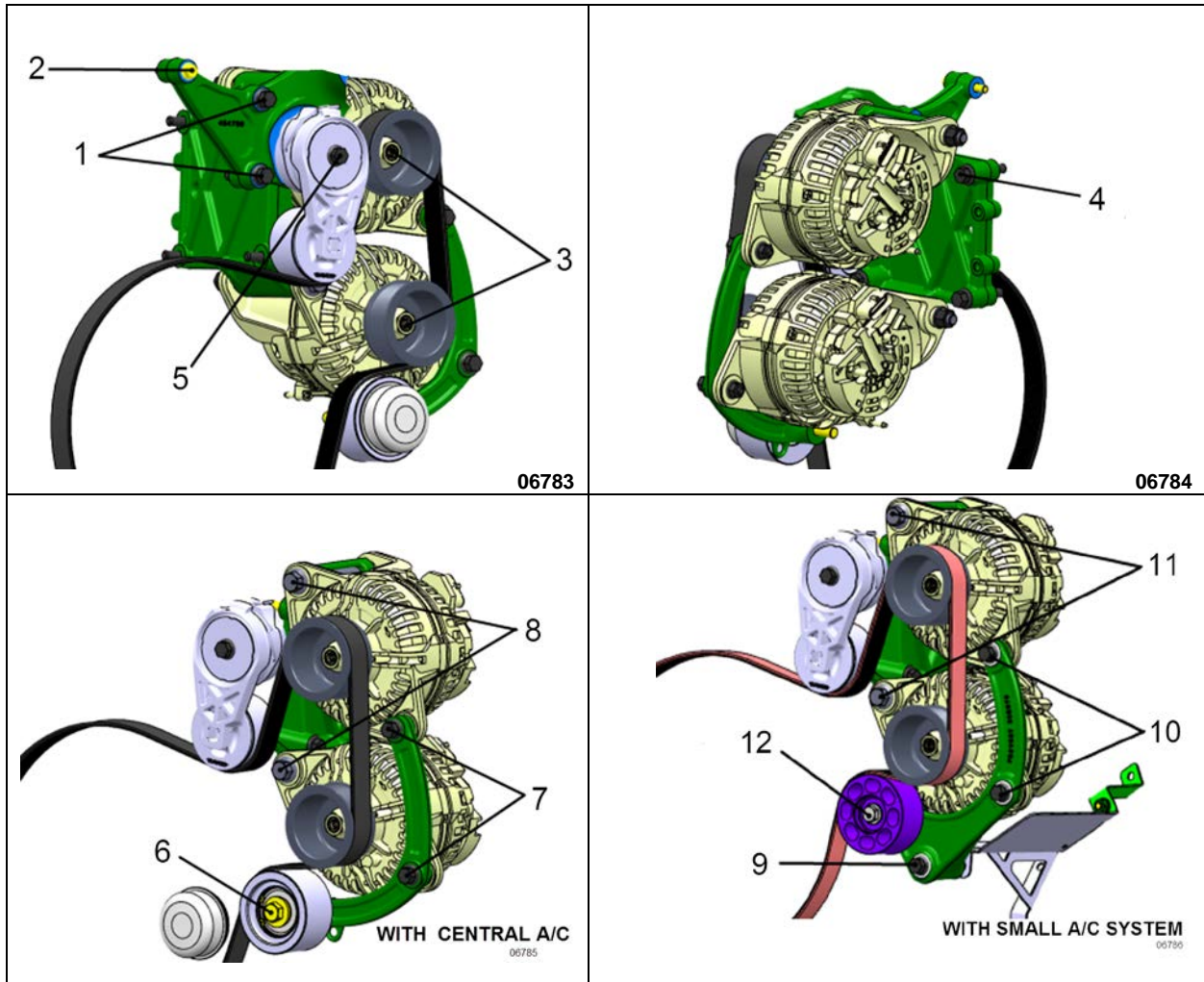
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1. TORQUE TABLES

1.1 ALTERNATORS AND SURROUNDING COMPONENTS



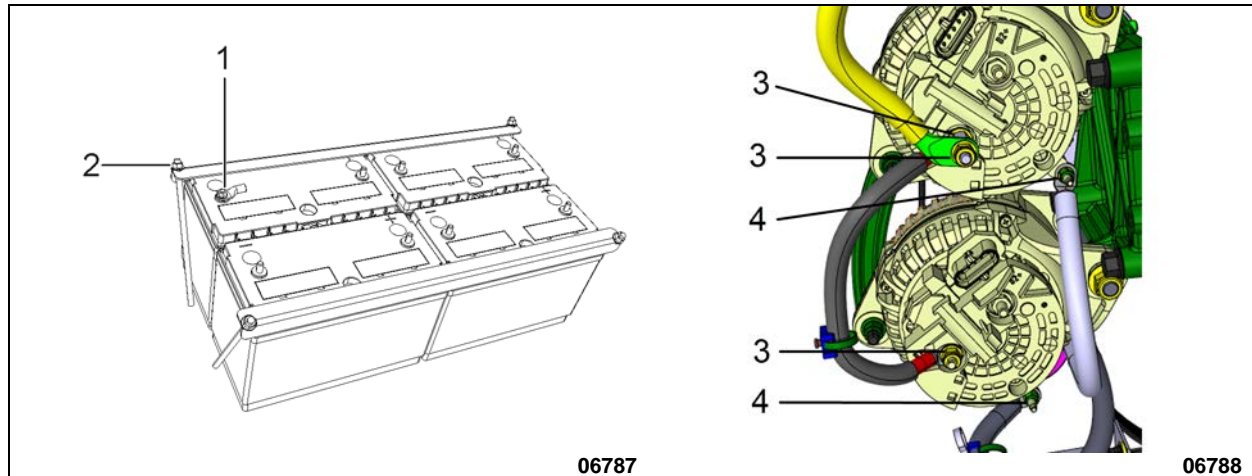
**BOSCH HD10 ALTERNATORS**

| 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 inner (2)                        | 48 lb-ft (65 Nm)        |
| 8  | Alternator mounting bolts outer (2)                        | 82 lb-ft (111 Nm)       |
| 9  | Alternator bottom bracket mounting bolt (small A/C system) | 48 lb-ft (65 Nm)        |

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|    |  |                   |
|----|--|-------------------|
| 10 | Alternator mounting bolts (2) (small A/C system)       | 48 lb-ft (65 Nm)  |
| 11 | Alternator mounting bolts (2) (small A/C system)       | 82 lb-ft (111 Nm) |
| 12 | Alternator belt idler mounting bolt (small A/C system) | 48 lb-ft (65 Nm)  |

### 1.2 ELECTRICAL CONNECTIONS AND BATTERIES



#### ELECTRICAL CONNECTIONS AND BATTERIES

| No | DESCRIPTION                  | TORQUE                 |
|----|------------------------------|------------------------|
| 1  | Battery stud connections (8) | 13-15 lb-ft (18-20 Nm) |
| 2  | Battery tie-down             | 45-55 lb-in (5-6 Nm)   |
| 3  | Alternator power connection  | 10 lb-ft (14 Nm)       |
| 4  | Alternator ground connection | 6 lb-ft (8 Nm)         |



## 2. GENERAL DESCRIPTION

These vehicles use a dual voltage system to obtain two different voltages (12 and 24 volts) for various electrical controls and accessories. The main power source incorporates four maintenance-free batteries connected in parallel-series. 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 12 and 24 volt systems are controlled through individual main battery relays. Base configuration uses two 28 volt self-regulated alternators, belt driven from the engine, and can be reached through the engine compartment doors.

Vehicles equipped with optional PRIME energy management system are equipped slightly differently and feature 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 CB12 is released (open circuit) and you don't know which circuit is affected.

- a) Refer to wiring diagram index, and look for "*Circuit breaker code*".
- b) At item CB12, 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 CB12, 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 35.1 & 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 SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC, highlight ELECTRICAL SYSTEM 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 SW61 SW62; 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 SW61, SW62.
- c) At device SW61,SW62, find the fault message, the minimum condition to activate, other inputs involved in logic, the multiplex module related to switch 61 and switch 62, 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 FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC to request a new diagnostic of the ELECTRICAL SYSTEM from the MCM. The DID should display the fault as being inactive.

|        |   |
|--------|---|
| Yellow | Multiplex modules communication CAN-H (twisted with green)  |
| Green  | Multiplex modules communication CAN-L (twisted with yellow) |
| Orange | Connected to multiplex outputs                              |
| White  | Connected to multiplex inputs                               |
| Red    | 24 volt system  |
| Yellow | 12 volt system  |
| Black  | grounded wire   |
| Blue   | 110 V ac system (live)                                      |
| White  | 110 V ac system (neutral)                                   |
| Green  | 110 V ac system (ground)                                    |
| Orange | speakers (+) ( <b>Coaches Only</b> )                        |
| Brown  | speakers (-) ( <b>Coaches Only</b> )                        |
| Grey   | spare wire  |

**NOTE**

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

2.1.2 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.

2.2 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:

Each wire on a diagram is patterned to assist in tracing and testing circuits. The wire number identifies the voltage rating, the wire identification number and the basic wire gauge as illustrated in Figure 1.

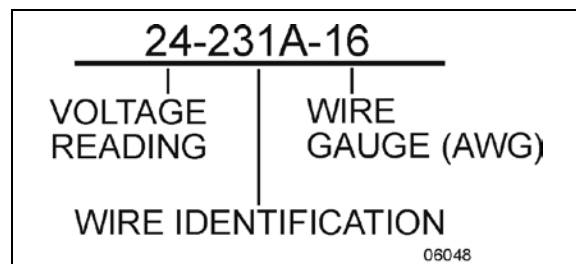


FIGURE 1: WIRE IDENTIFICATION

2.3 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 D "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**

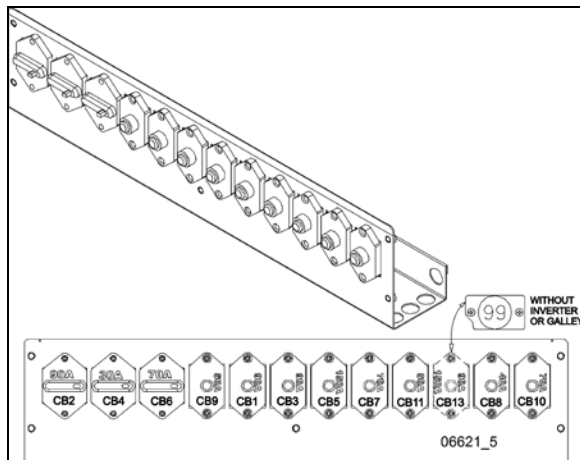
Spare wires are identified by a wire identification number and by the letters "SP", to designate "spare".

**2.4 CIRCUIT BREAKERS**

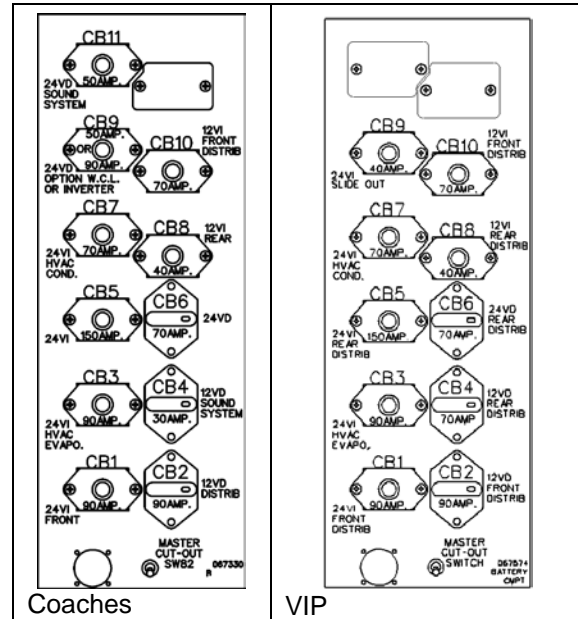
Most electric circuits are protected by circuit breakers of the "Manual Reset" type. The main circuit breakers, as well as those protecting the A/C system, are located on the rear electrical junction panel and are accessible from the engine compartment curb-side door, on R.H. side of the vehicle.

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

Some circuit breakers such as CB2, CB4 & CB6 are different in the fact that you may open the circuit manually, to do so simply press down the red tab on breaker to open the circuit, repair defective circuit, and afterwards depress black button in center of breaker to close the circuit.



**FIGURE 2: TYPICAL REAR ELECTRICAL JUNCTION PANEL – X3 SERIES**



**FIGURE 3: MAIN BREAKER PANELS – H3 SERIES**

**2.4.1 X3-45 Coaches**

Smaller circuit breakers may be located in the VECF of the front service compartment.

| CIRCUIT BREAKERS |                        |       |          |
|------------------|------------------------|-------|----------|
| CB1              | Front distribution     | 24 VI | 90 amps  |
| CB2              | Distribution           | 12 VD | 90 amps  |
| CB3              | HVAC - evaporator      | 24 VI | 90 amps  |
| CB4              | Sound system           | 12 VD | 30 amps  |
| CB5              | Rear distribution      | 24 VI | 150 amps |
| CB6              | Distribution           | 24 VD | 70 amps  |
| CB7              | HVAC - condenser       | 24 VI | 70 amps  |
| CB8              | Rear distribution      | 12 VI | 40 amps  |
| CB9              | WCL or other option    | 24VD  | 50 amps  |
| CB10             | Front distribution     | 12 VI | 70 amps  |
| CB11             | Sound system           | 24 VD | 50 amps  |
| CB13             | Galley or other option | 24 VI | 90 amps  |

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

VI= volts indirect. Electrical power is supplied via master relay R1 which engages when ignition key is in the ON or ACC position and battery master switch (master cut-out) is set to ON.

**2.4.2 X3-45 VIP**

Circuit breakers CB1 & CB2 are different in the fact that you may open the circuit manually, to do so simply press down the blue tab on breaker to

trip the circuit breaker, repair defective circuit, and afterwards toggle yellow lever upwards to reset the circuit breaker and close the circuit.

| CIRCUIT BREAKERS |                    |       |          |
|------------------|--------------------|-------|----------|
| CB1              | Distribution       | 12 VD | 150 amps |
| CB2              | Distribution       | 24 VD | 50 amps  |
| CB3              | Front distribution | 24 VI | 70 amps  |
| CB4              | HVAC - evaporator  | 24 VI | 90 amps  |
| CB5              | HVAC - condenser   | 24 VI | 70 amps  |
| CB6              | Slide-Out          | 24 VI | 35 amps  |
| CB7              | Distribution       | 24 VI | 60 amps  |
| CB8              | HVAC - condenser   | 12 VI | 40 amps  |
| CB9              | Distribution       | 12VI  | 70 amps  |

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

VI= volts indirect. Electrical power is supplied via master relay R1 which engages when ignition key is in the ON or ACC position.

#### 2.4.3 H3-41, H3-45 Coaches

Smaller circuit breakers may be located in the VECF of the front service compartment.

| CIRCUIT BREAKERS (H3 series coaches) |                      |       |          |
|--------------------------------------|----------------------|-------|----------|
| CB1                                  | Front distribution   | 24 VI | 90 amps  |
| CB2                                  | Distribution         | 12 VD | 90 amps  |
| CB3                                  | HVAC - evaporator    | 24 VI | 90 amps  |
| CB4                                  | Sound system         | 12 VD | 30 amps  |
| CB5                                  | Rear distribution    | 24 VI | 150 amps |
| CB6                                  | Distribution         | 24 VD | 70 amps  |
| CB7                                  | HVAC - condenser     | 24 VI | 70 amps  |
| CB8                                  | Rear distribution    | 12 VI | 40 amps  |
| CB9                                  | WCL or other options | 24VD  | 50 amps  |
| CB10                                 | Front distribution   | 12 VI | 70 amps  |
| CB11                                 | Sound system         | 24 VD | 50 amps  |
| CB13                                 | Galley               |       | 50 amps  |
| CB14                                 | Galley               |       | 90 amps  |
| CB82                                 | Wipers               |       | 20 amps  |
| CBOP1                                | Driver seat          |       | 40 amps  |
| CBOP1                                | Driver seat          |       | 40 amps  |

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

VI= volts indirect. Electrical power is supplied via master relay R1 which engages when ignition key is in the ON or ACC position and battery master switch is set to ON.

#### 2.4.4 H3-45 VIP

Smaller circuit breakers may be located in the VECF of the front service compartment.

| CIRCUIT BREAKERS (H3 VIP) |                          |       |          |
|---------------------------|--------------------------|-------|----------|
| CB1                       | Front distribution       | 24 VI | 90 amps  |
| CB2                       | Front distribution       | 12 VD | 90 amps  |
| CB3                       | HVAC - evaporator        | 24 VI | 90 amps  |
| CB4                       | Rear distribution        | 12 VD | 70 amps  |
| CB5                       | Rear distribution        | 24 VI | 150 amps |
| CB6                       | Rear Distribution        | 24 VD | 70 amps  |
| CB7                       | HVAC - condenser         | 24 VI | 70 amps  |
| CB8                       | Rear distribution        | 12 VI | 40 amps  |
| CB9                       | Slide-out                | 24VI  | 40 amps  |
| CB10                      | Front distribution       | 12 VI | 70 amps  |
| CB60                      | Luggage door lock - VECR |       | 20 amps  |
| CB61                      | Luggage door lock - VECR |       | 20 amps  |
| CB62                      | Lower wiper - VECF       |       | 20 amps  |

#### 2.5 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).

#### 2.6 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.

##### **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.

## 2.7 PRECAUTIONS

**DANGER**

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.

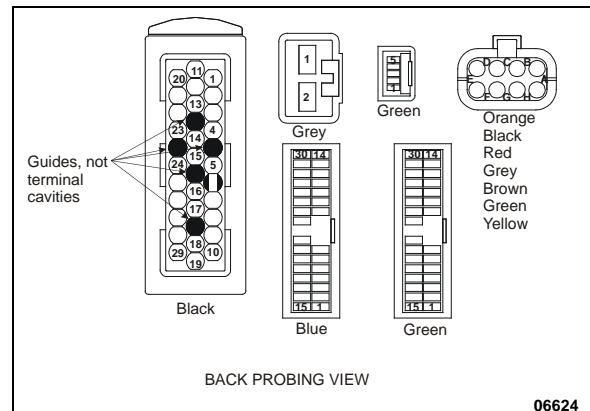
**NOTE**

When the ignition switch is set to the OFF position, the electrical components are not energized except for the MCM (Chassis Electronic Control Module), engine MCM, transmission ECU, instrument cluster module, the battery equalizer, the preheater system, the wheelchair lift system and some Multiplex modules which are 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 master cut-out switch located above the rear electrical panel to the OFF position.

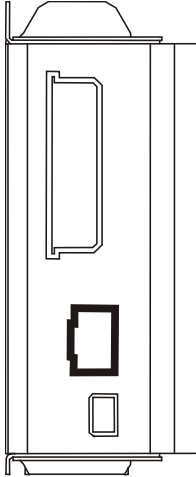
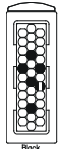
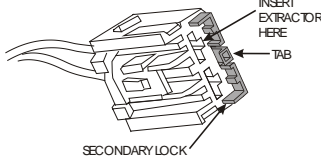
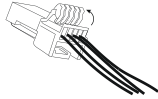
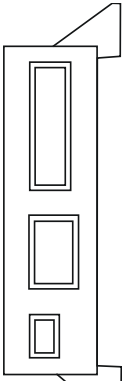
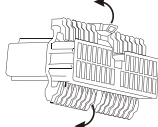
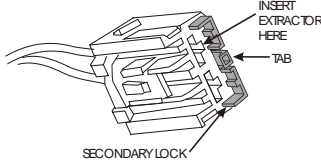
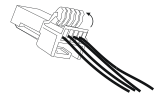
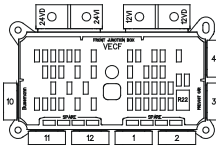
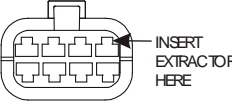
If the vehicle will not be operated for a long period (more than 2 weeks), it is recommended, in order to prevent the batteries from discharging, to trip main circuit breakers (2, 4 and 6) located on the rear junction panel to stop the small current drawn by the radio preset station memory, the MCM memory 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**

Prior to arc welding on the vehicle, refer to "Multiplex Modules Disconnection Procedure Prior To Welding" in section 00 GENERAL of this manual to avoid serious damage to the vehicle components.



**FIGURE 4: MULTIPLEX MODULE CONNECTORS PIN-OUT**

| Multiplex modules  | Connector type   | Terminal removal  |
|--|--|---|
|  <p><b>IO-B</b><br/>06625</p>   |  <p><b>AMP</b> 06628</p>  | <p><b>EXTRACTOR/TOOL:</b> Prevost #683594<br/>Insert the extractor on the front of the connector. Remove the terminal by disengaging the flexible lock tabs on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>  |
|  |  <p>grey 06629<br/><b>YAZAKI</b></p>  | <p><b>EXTRACTOR/TOOL:</b> Packard #12094430<br/>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. 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> |
|  |  <p>green 06630<br/><b>JAE</b></p>  | <p><b>EXTRACTOR/TOOL:</b> Prevost #683766<br/>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. 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>   |
|  <p><b>IO-A</b><br/>06626</p> |  <p>green, blue (MCM)<br/><b>JAE</b> 06631</p>   | <p><b>EXTRACTOR/TOOL:</b> Prevost #683766<br/>Using a small flat blade screwdriver, open both hinged secondary locks. Insert the extractor on the front of the connector, over the terminal cavity. 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> |
|  |  <p>grey 06629<br/><b>YAZAKI</b></p>  | <p><b>EXTRACTOR/TOOL:</b> Packard #12094430<br/>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. 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> |
|  |  <p>green 06630<br/><b>JAE</b></p>  | <p><b>EXTRACTOR/TOOL:</b> Prevost #683766<br/>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. 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>   |
|  <p><b>VECF</b><br/>06627</p> |  <p>Orange<br/>Black<br/>Red<br/>Grey<br/>Brown<br/>Green<br/>Yellow<br/>06632<br/><b>BUSSMAN</b></p> | <p><b>EXTRACTOR/TOOL:</b> Prevost #682256 (Packard 12094429)<br/><br/>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>   |

### 3. X3 SERIES ELECTRICAL COMPARTMENTS

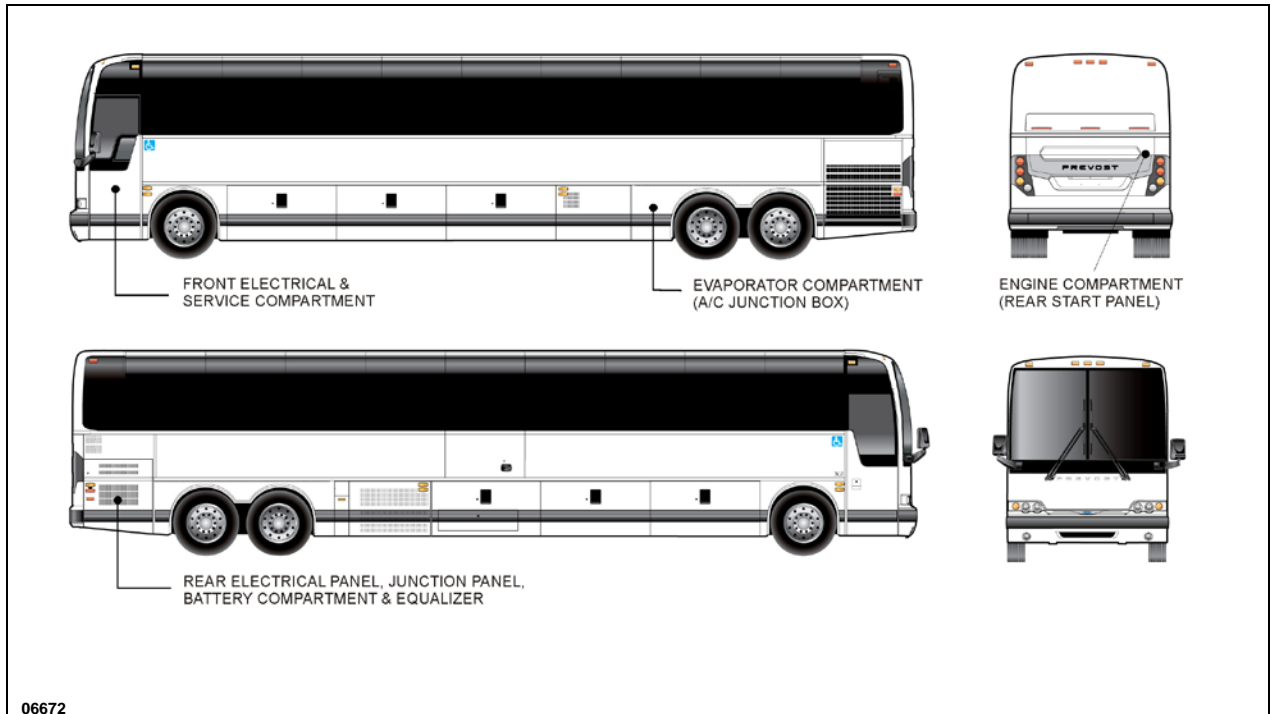


FIGURE 5: ELECTRICAL COMPARTMENTS (X3-45 COACH)

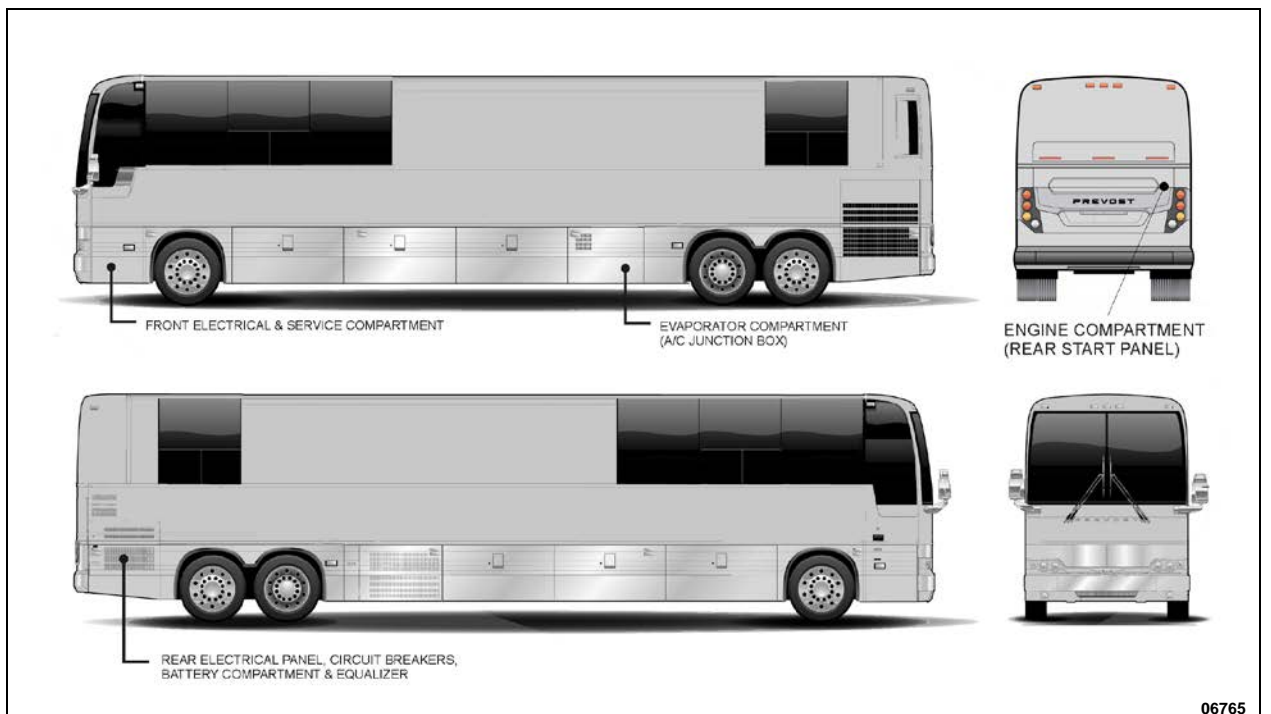


FIGURE 6: ELECTRICAL COMPARTMENTS (X3-45 VIP)

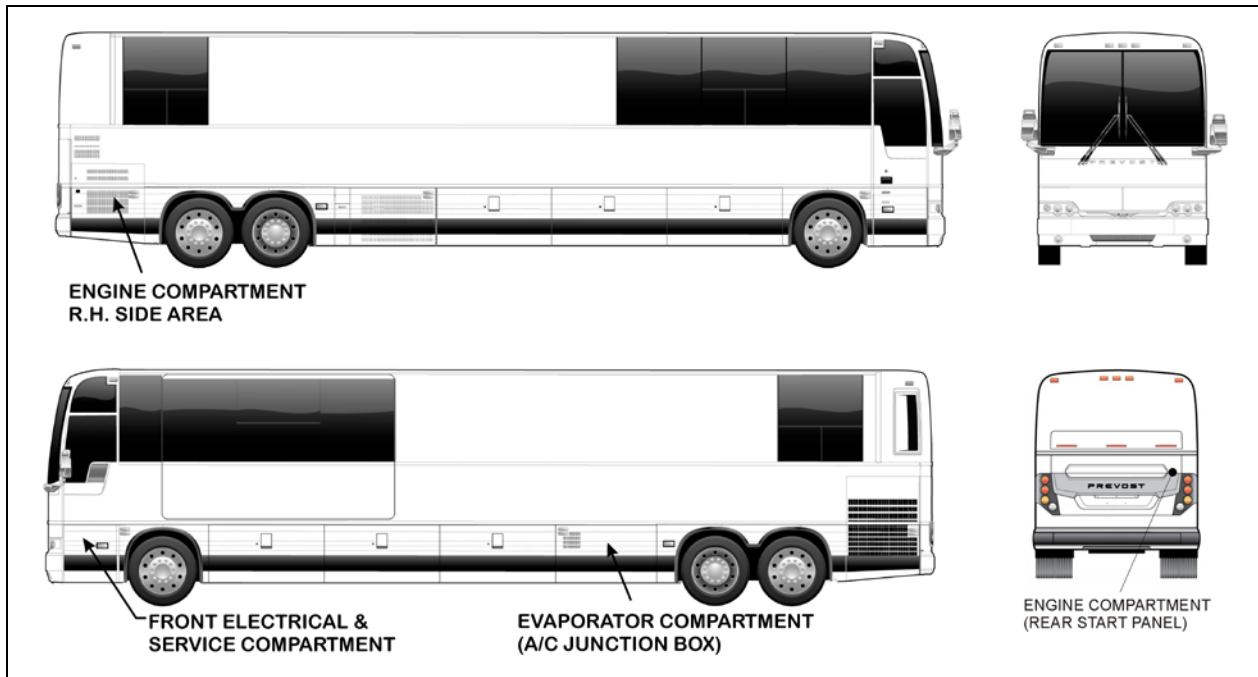


FIGURE 7: ELECTRICAL COMPARTMENTS (X3-45 VIP COMMERCIAL BUS SHELL)

### 3.1 MAINTENANCE

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.



#### CAUTION

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



#### DANGER

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



FIGURE 8: REAR ELECTRICAL PANEL, JUNCTION PANEL & BATTERY COMPARTMENT



FIGURE 9: REAR ELECTRICAL PANEL

### 3.2 REAR ELECTRICAL PANEL, JUNCTION PANEL, BATTERY COMPARTMENT & EQUALIZER

The rear electrical panel, junction panel, battery compartment & battery equalizer are located on the R.H. side of the engine compartment and are accessible from the engine compartment curb-side door.



### 3.3 REAR ELECTRICAL PANEL

**FIGURE 10: REAR ELECTRICAL PANEL**

The rear electrical panel provides access to the following:

- Rear terminal block;
- Multiplex modules;
- Vehicle Electrical Center Rear (VECR)
- Relays and fuses;
- Transmission TCM;
- Battery master switch (Master cut-out);
- On board diagnostic (OBD) receptacle, (refer to “Other Features” chapter).

### 3.4 REAR JUNCTION PANEL



**FIGURE 11: REAR ELECTRICAL JUNCTION PANEL**

### 3.5 BATTERY COMPARTMENT

The Battery Compartment provides access to the batteries (2), battery equalizer and master relay (R1).



**FIGURE 12: BATTERY COMPARTMENT**

### 3.6 FRONT ELECTRICAL AND SERVICE COMPARTMENT

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

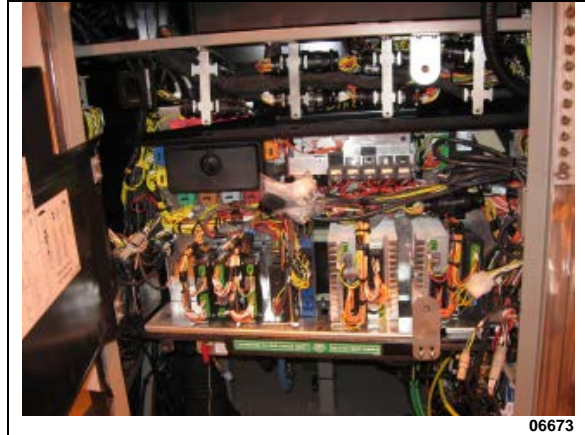
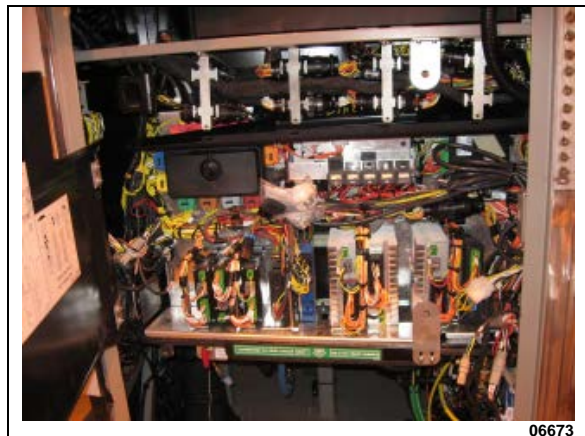


Figure 13):

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



**FIGURE 13: FRONT ELECTRICAL COMPARTMENT**

### 3.7 A/C JUNCTION BOX

The A/C junction box is located on the evaporator fan housing.

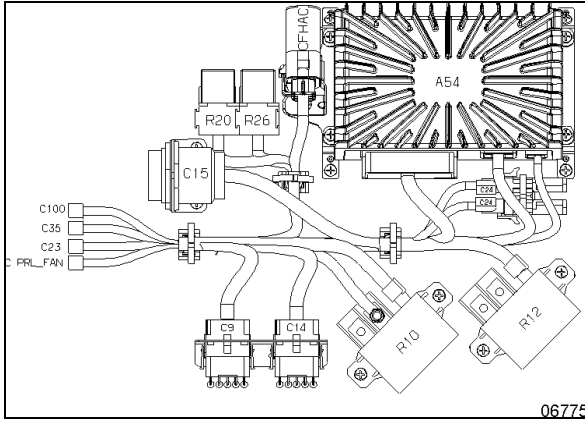


FIGURE 14: A/C JUNCTION BOX

3.8 ENGINE REAR START PANEL

This control panel is located in the R.H. side of engine compartment above the engine air filter. This control panel includes the engine starter selector switch, the rear start push button switch to start engine from engine compartment as well as the engine compartment lights switch.

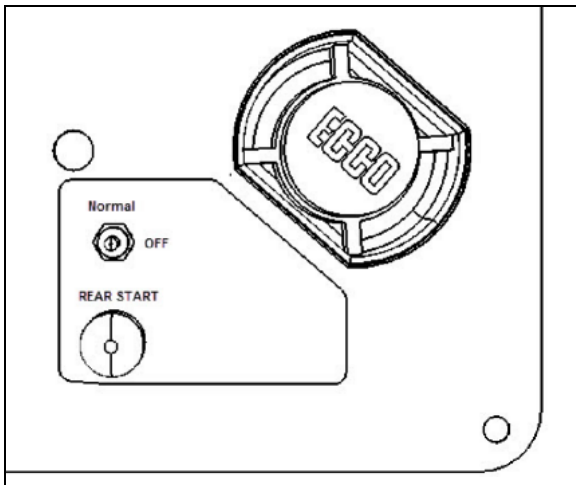


FIGURE 15: REAR START PANEL

**NOTE**

When the ignition key switch is set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizer and the Digital Clock.

3.9 ENTRANCE DOOR & WIPER CONTROL PANEL

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.

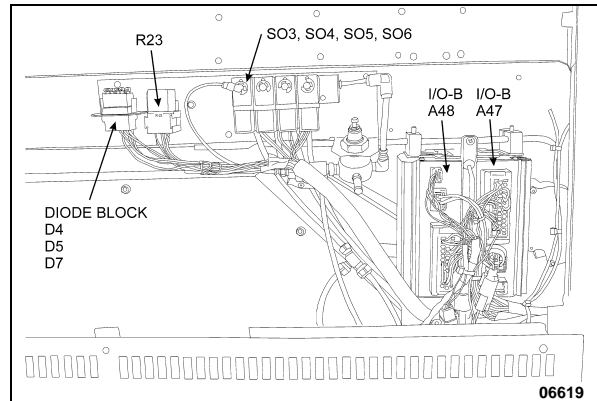


FIGURE 16: ENTRANCE DOOR & WIPER CONTROL PANEL

| Entrance Door & Wiper Control Panel |                            |     |                             |
|-------------------------------------|----------------------------|-----|-----------------------------|
| Multiplex Modules                   |                            |     |                             |
| A47                                 | I/O-B                      | A48 | I/O-B                       |
| Relays                              |                            |     |                             |
| R23                                 | Windshield wipers          |     |                             |
| Solenoids                           |                            |     |                             |
| SO3                                 | Door unlock solenoid valve | SO5 | Door opening solenoid valve |
| SO4                                 | Door unlock solenoid valve | SO6 | Door closing solenoid valve |
| Diodes                              |                            |     |                             |
| D4                                  | Windshield wipers speed 2  | D7  | Entrance door               |
| D5                                  | Windshield wipers speed 1  |     |                             |

3.10 PARCEL RACK JUNCTION BOX

A single I/O B module, A53 is found at the rear end of the left parcel rack.

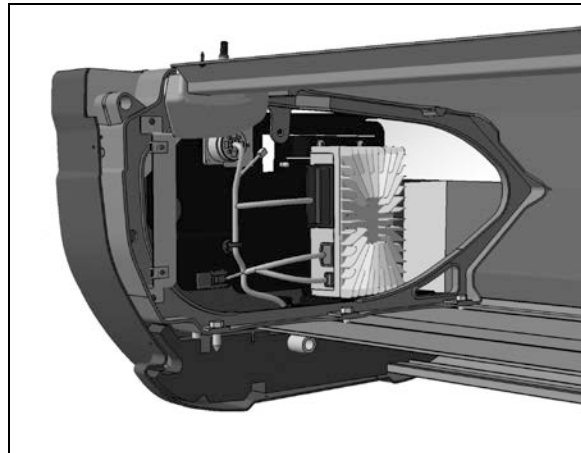


FIGURE 17: PARCEL RACK I/O B MODULE

4. H3 SERIES ELECTRICAL COMPARTMENTS

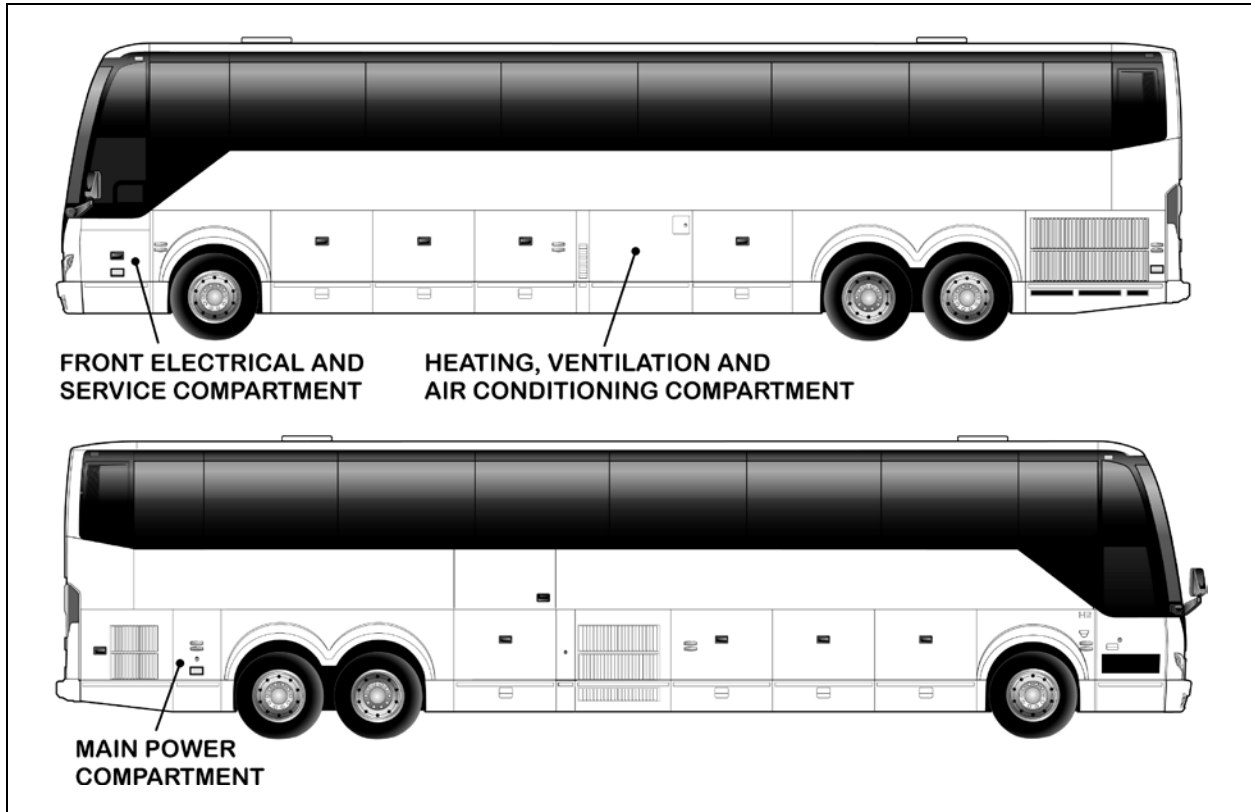




FIGURE 18: ELECTRICAL COMPARTMENTS

#### 4.1 MAINTENANCE

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.


DANGER

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


CAUTION

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

#### 4.2 MAIN POWER COMPARTMENT

The main power compartment is located on rear R.H. side of vehicle behind the rear wheelhousing. This compartment contains the following components (Figure 19 & Figure 20):

- Four 12-volt batteries;
- Main circuit breakers for 12-volt and 24-volt electrical system;
- Voltage regulator (if applicable); Battery equalizer;
- Battery Charger (optional);
- Battery master relay (R1) & battery master switch;
- TCM (Transmission Control Module);
- Secondary circuit breakers;
- Relays;
- Rear fuse box known as VECR (Vehicle Electrical Center Rear);
- Multiplex modules: I/O-A, I/O-B;
- OBD13 connector C464A (On-Board Diagnostic);
- Electronic ground stud.

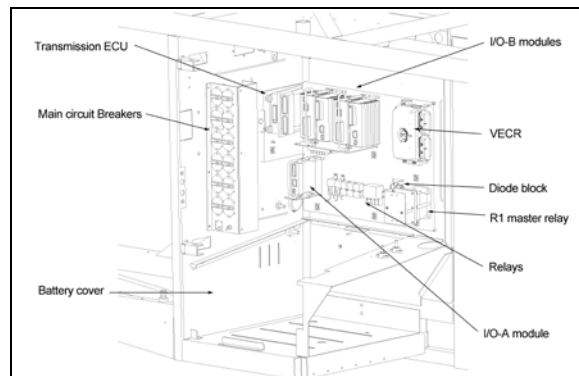


FIGURE 19: MAIN POWER COMPARTMENT (PARTIAL VIEW)

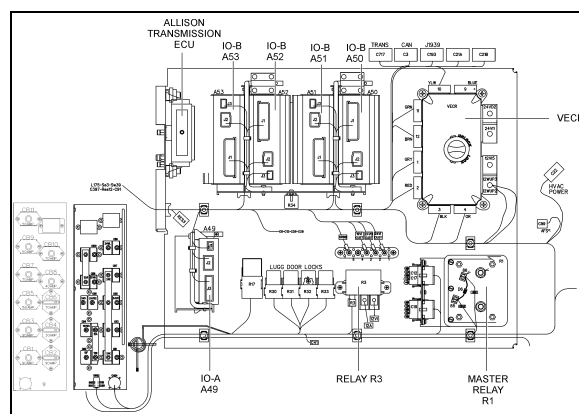


FIGURE 20 : MAIN POWER COMPARTMENT

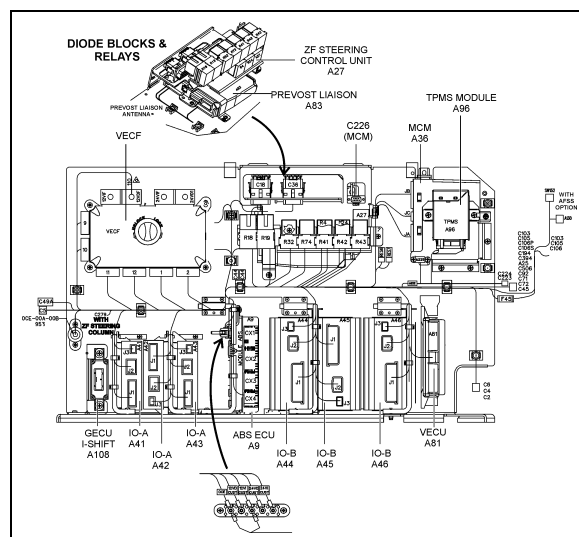


FIGURE 21: FRONT ELECTRICAL AND SERVICE COMPARTMENT

##### 4.2.1 Battery Charger Or In-Station Lighting Connector

The vehicle may be equipped with a battery charger or in-station lighting connector. When it

is connected to an external 110-120 VAC power source, the in-station lighting circuit can be energized without depleting the batteries. The receptacle is usually located on the main power compartment door or engine compartment R.H. side door.

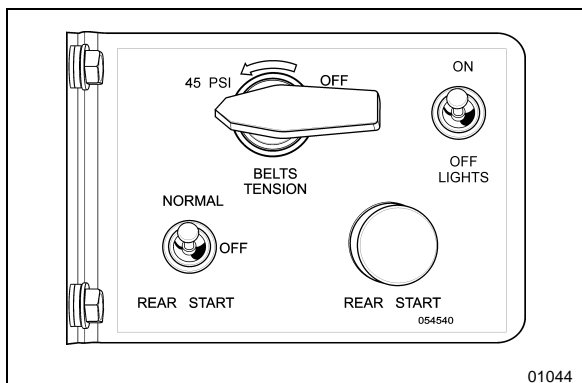
**4.3 FRONT ELECTRICAL AND SERVICE COMPARTMENT**

The front electrical and service compartment is located on front L.H. side of vehicle. It contains the front junction panel with the following components.

- Resistors;
- ABS module;
- Fuses;
- Relays;
- Kneeling audible alarm;
- Front multiplex modules;
- Front fuse box known as VECF (Vehicle Electrical Center Front);
- Emergency door opening unlock valve (coaches only);
- Windshield washer reservoir;
- Reclining bumper opening handle;
- Accessories air tank purge valve;
- Accessories system fill valve;
- Spare wheel support and rail (coaches only);
- Keyless entry system module (VIP only).

**4.4 ENGINE REAR START PANEL**

This control panel is located in the R.H. side of engine compartment near the engine oil reserve tank. This control panel includes the engine starter selector switch, as well as the rear start push button switch to start engine from engine compartment.



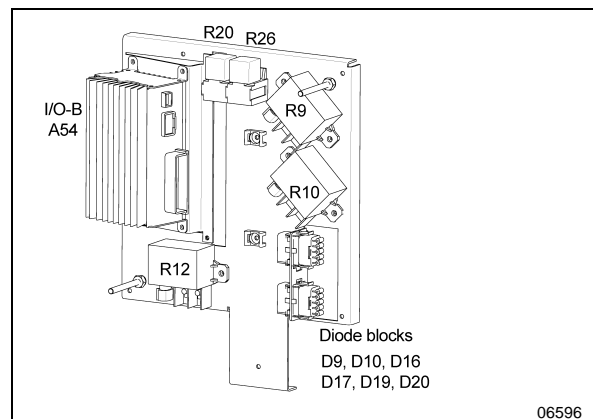
**FIGURE 22: ENGINE REAR START PANEL**

**4.5 A/C AND HEATING CONTROLS**

The following components are located in the main power compartment (Figure 19).

The following components are located in the front electrical and service compartment.

The following components are located in the Evaporator Compartment (HVAC). They are mounted on a panel located on the R.H. side wall when facing the compartment (FIGURE 23).



**FIGURE 23: HVAC PANEL IN EVAPORATOR COMPARTMENT**

Each relay or resistor is identified to facilitate its location.

**NOTE**  
*It is important when checking the A/C and heating system to keep the condenser compartment door closed in order to avoid faulty readings.*

4.6 PNEUMATIC ACCESSORY PANEL

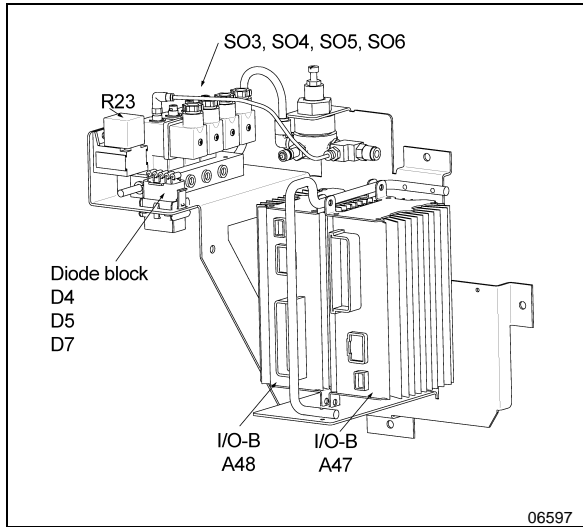


FIGURE 24 : PNEUMATIC ACCESSORY PANEL

To access the pneumatic accessory panel of the right console, remove the panel under the larger utility compartment at the right of the dashboard.

5. 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.

Two types of batteries are available.

- Standard acid-lead Group 31 maintenance free batteries
- AGM Spill proof batteries provided with optional PRIME energy management system.



**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.**

5.1 GROUP 31 MAINTENANCE FREE BATTERIES

The vehicle is provided with four (4) maintenance-free 12 volt heavy-duty batteries connected in series-parallel (FIGURE 25)

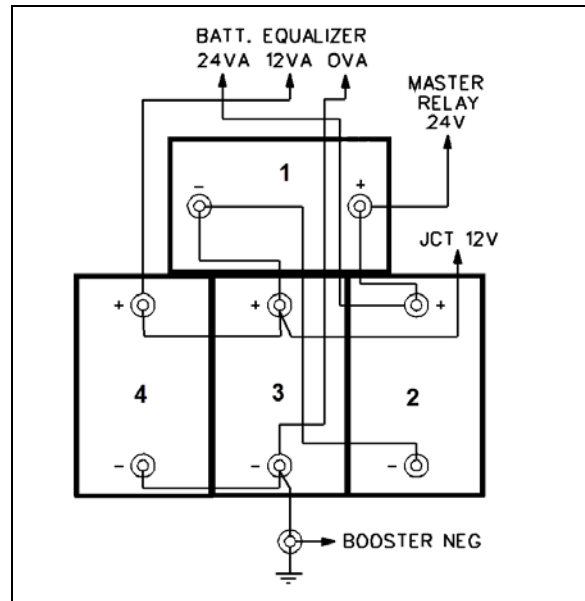


FIGURE 25 : H3 SERIES BATTERY CONNECTIONS (STANDARD ACID-LEAD GROUP 31)

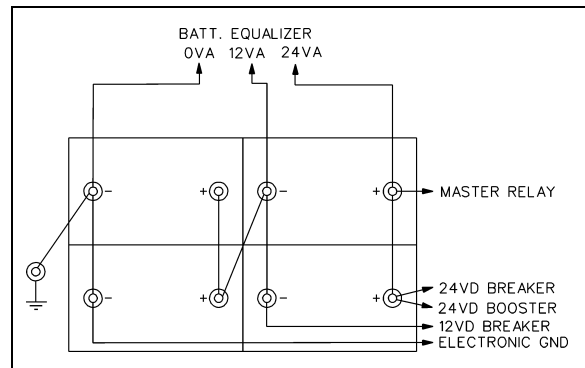


FIGURE 26: X3 SERIES STANDARD BATTERY CONNECTIONS (STANDARD ACID-LEAD GROUP 31)

The top-mounted negative and positive terminals are tightly sealed to prevent leaks. Water never needs to be added to this type of battery. There are no filler caps in the cover. The battery is sealed, except for small vent holes in the cover. The vents must not be restricted as they allow small amounts of gases produced in the battery to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. Besides reducing gassing, the special chemistry greatly reduces the possibility of overcharge damage.

The vents require keeping the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent holes.


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.

 **DANGER**

All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery, which may result in severe personal injuries. Wear safety glasses and do not smoke when working near batteries. In case of contact with acid, flush immediately with water.

 **WARNING**


DO NOT tip battery by more than 45° when carrying or installing the battery.

**NOTE**

*Evidence of electrolyte leakage does not necessarily mean the battery is defective.*

5.2 GROUP 31 AGM BATTERIES

If your 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 (FIGURE 28).

 **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.

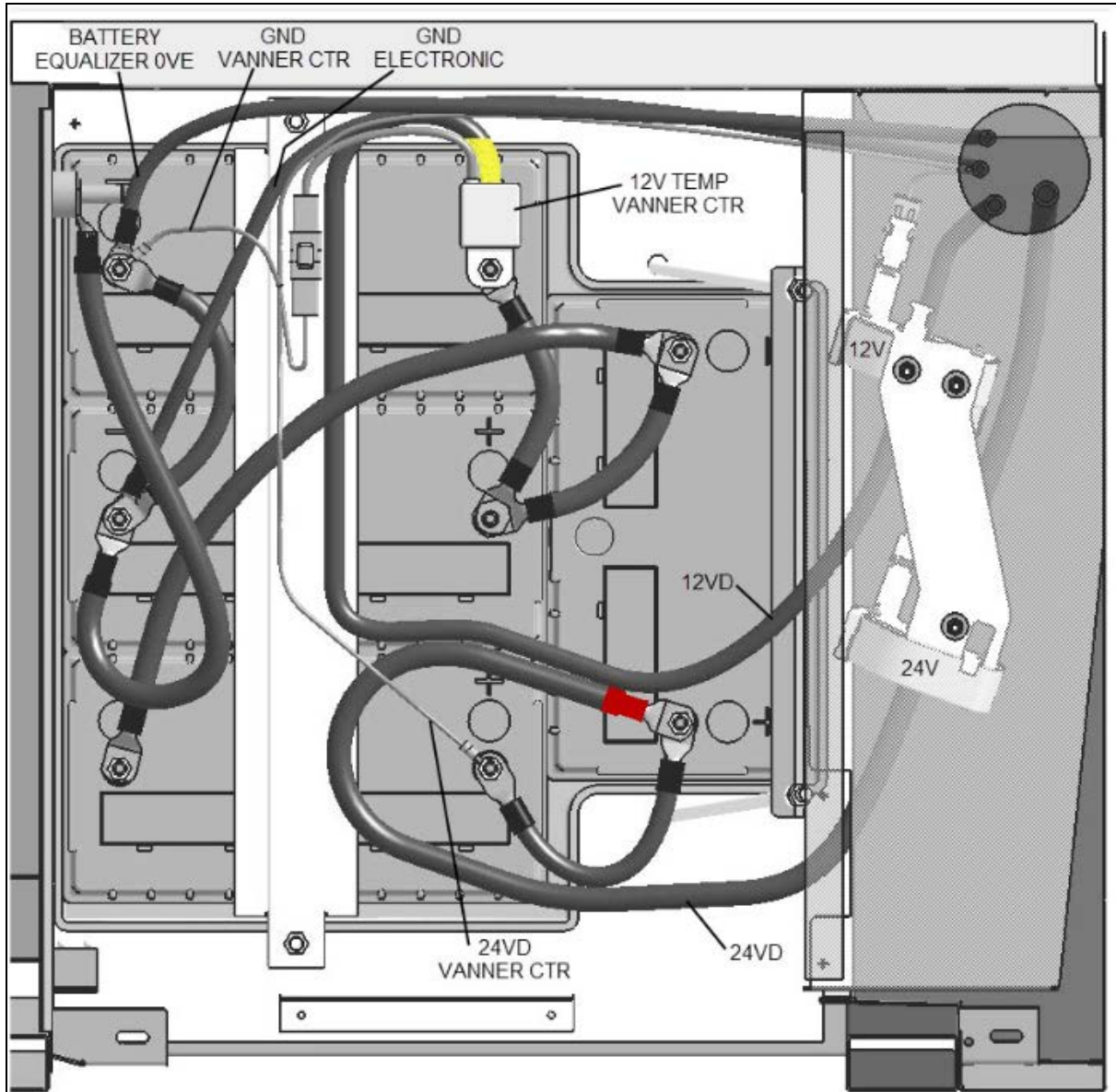


FIGURE 27: H3 SERIES AGM BATTERY CONNECTIONS (PRIME SYSTEM)



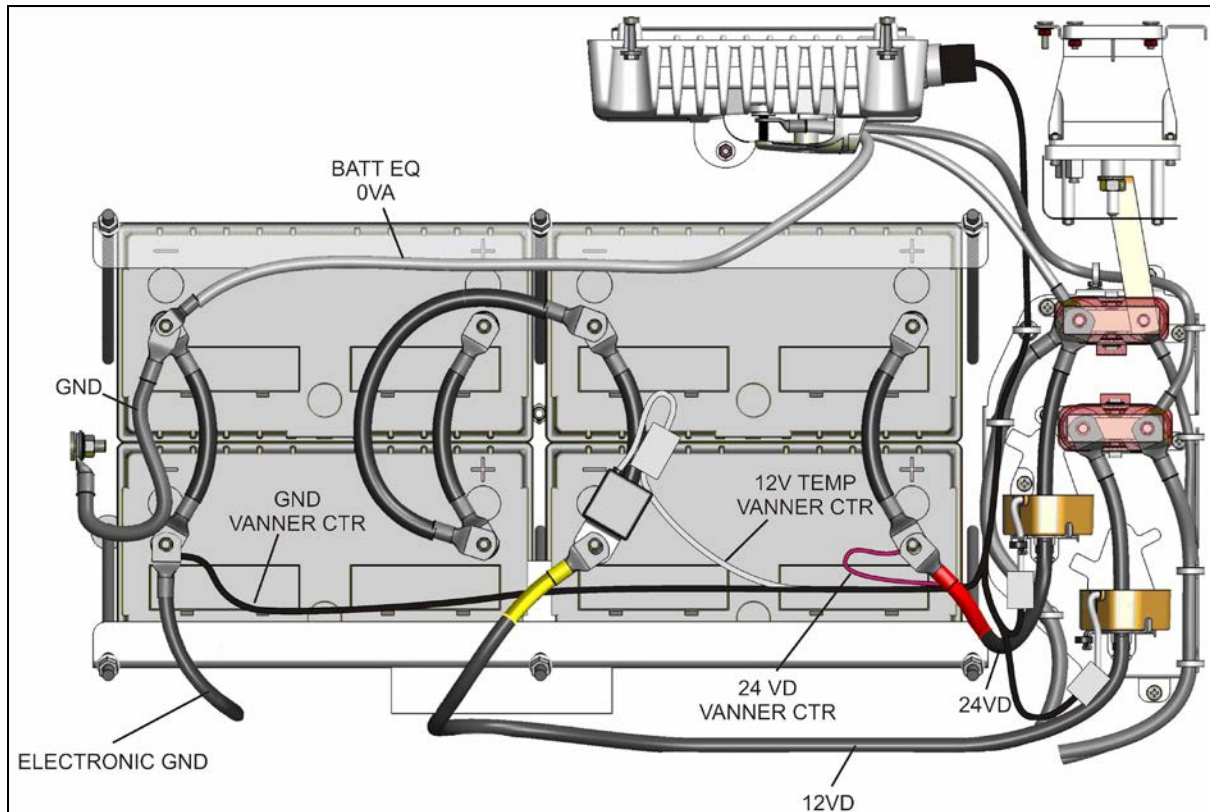


FIGURE 28: X3 SERIES AGM BATTERY CONNECTIONS

### 5.3 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.

### 5.4 MAIN BATTERY RELAYS

Main battery (master) relays (12V and 24V) are provided for this vehicle. The relays are located in the battery compartment and on the rear electrical panel. The 24-volt battery relay (R1) engages when ignition key is in the ON or ACC position and battery master switch (master cut-out) is flipped ON.

When the main battery relays (R1 & R3) are turned to the *OFF* position, all electrical supply from the batteries is cut off, with the exception of the following items.


- Battery equalizer check module;
- MCM;
- ECM;
- TCM (World transmission);
- Preheater electronic timer;
- Preheater and water recirculating pump;
- Entrance door;
- Radio memory;

- Cluster memory.

## 5.5 BATTERY REMOVAL AND INSTALLATION

The batteries are located in the battery compartment on the R.H. side of the engine compartment and are accessible from the engine compartment curb-side door.

1. Remove the battery compartment protective cover.


DANGER

To prevent possible electric shocks or sparking, the battery master switches should be in the "Off" position before disconnecting cables from the batteries.

2. Remove the supports, and unscrew terminal nuts of each defective battery.
3. Remove battery cables from the batteries.
4. Remove batteries.
5. Installation is the reverse of removal. Connect the red (24-volt) battery cables first, then the yellow (12-volt) battery cables and finish with the black (ground) cables.

### NOTE

*When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.*



### CAUTION

Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.

### NOTE

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

**TORQUE: 13-15 lb-ft (18-20 Nm)**



### DANGER

To prevent possible electric shock or sparking, the battery master 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 PR00002E included at the end of this section to know the recommended products and where they are used.*

## 5.6 BATTERY RATING

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

### Standard Low Maintenance batteries:

- Reserve capacity: 195 minutes
- Cold cranking (amps): 950 @ 0°F (-18°C)
- Cold cranking (amps): 745 @ -20°F (-29°C)
- Weight (filled): 59 lb (26,7 kg)

### AGM batteries (PRIME):

- Reserve capacity: 200 minutes
- Cold cranking (amps): 800 @ 0°F (-18°C)
- Weight (filled): 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 volts 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 volts battery). This rating can be used as a basis for comparing starting performance.

5.7 BATTERY TESTING

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

5.7.1 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. 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.

5.7.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in figure 20. Connect a load equal to half the CCA across the terminal for 5 seconds to remove surface charge from the battery.

5.7.3 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 resistor along with an ammeter and volt meter (fig 19). A charging system analyzer test equipment may also be used.

1. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in

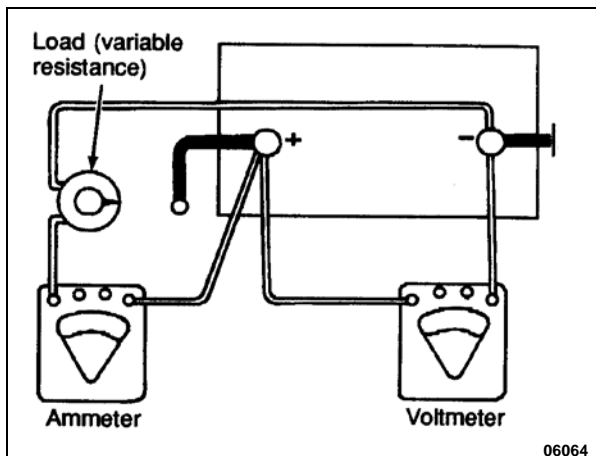


Figure 29.

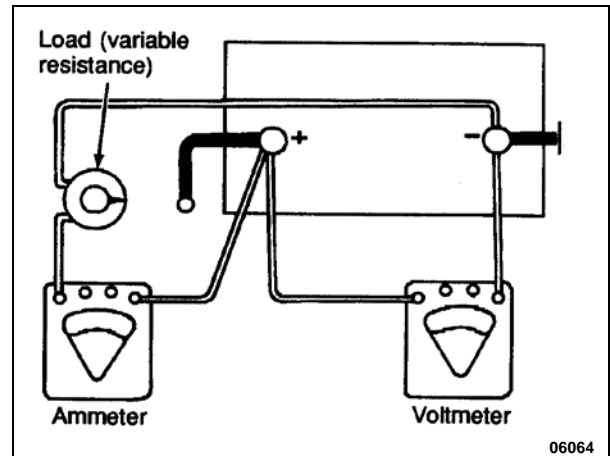


FIGURE 29: LOAD TEST

**CAUTION**

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

2. Apply a load equal to half the CCA rating @ 0°F for 15 seconds.
3. With an ammeter reading specified load, read voltage. The voltage should be at least 9.6 volts. Disconnect the load. If the voltmeter indicates 9.6 volts or more, the battery is good. If the voltmeter reading is less than 9.6 volts, replace the battery. This voltage is to be used for battery ambient temperatures of 70°F (21°C) and above. For temperatures below 70°F (21°C), refer to the following "Voltage and Temperature Chart".

**Voltage and Temperature Chart**

| Ambient 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.

## 5.7.4 Testing Battery Cables

Check all cable ring terminals and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces an abnormal voltage drop which may lower voltage at the starter to such a low value that normal operation of the starter will not be obtained. An abnormal voltage drop can be detected with a low-reading voltmeter as follows:

**DANGER**

To prevent the engine from starting during these tests, remove fuses F78 and F79 located in the VECR of the rear electrical compartment. Once the tests are completed, reinstall F78 and F79.

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame by placing one prod of the voltmeter on the battery terminal and the other on a good ground (unpainted surface) on the vehicle. With the starter cranking the engine at a temperature of 70°F (21°C), voltage reading should be less than 0.3 volt. If the voltage reading exceeds 0.3 volt, there is excessive resistance in this circuit.
2. Check voltage drop between the positive battery terminal and the starter positive terminal stud while the motor is operated. If the reading is more than 2.5 volts, there is excessive resistance in this circuit.

**NOTE**

*If it is necessary to extend the voltmeter lead for this test, use a #16 (AWG) or larger wire.*

3. Check voltage drop between the starter housing and a good ground on the vehicle. The reading should be less than 0.2 volt.

**DANGER**

Any procedure other than the following could cause personal injury or damages to the charging system resulting from battery explosion or electrical burns.

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.

## 5.8 BATTERY CHARGING

The batteries used on this vehicle can be charged either on or off the vehicle; however, when they are removed from the vehicle, it is recommended that an adapter kit, which is available from any "A/C DELCO" dealer, be used in charging sealed-terminal batteries. Use the booster block to charge the batteries when they are left on vehicle and **make sure that the main battery disconnect switch is set to the "On" position.**

**DANGER**

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 alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs (

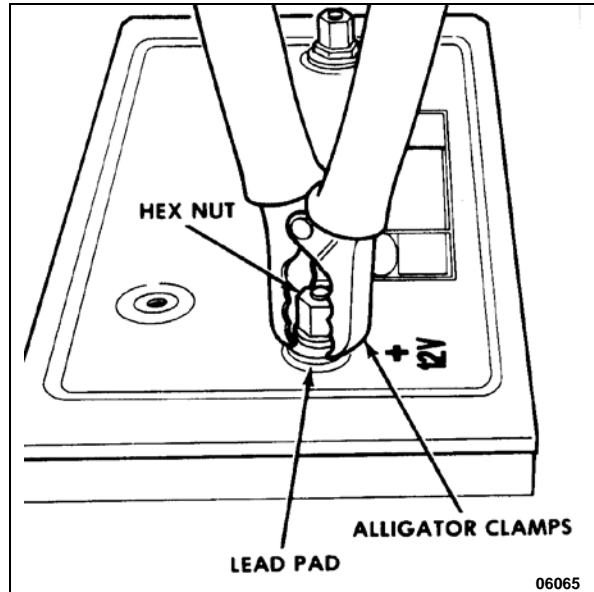
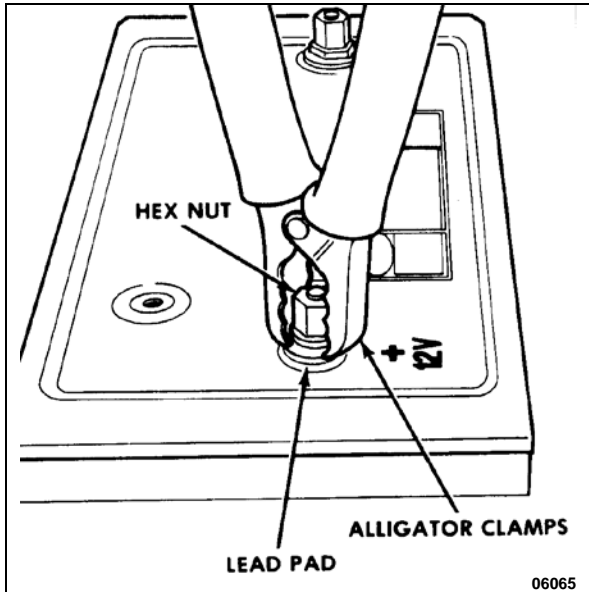


Figure 31) after the vehicle cables are detached. The alligator clamps should make firm contact with the lead pads.

FIGURE 31: ALLIGATOR CLAMP POSITION STANDARD BATTERY

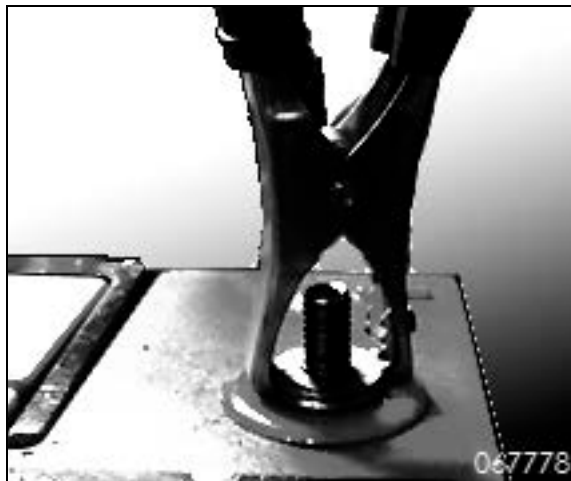


FIGURE 30 ALLIGATOR CLAMP POSITION- TYPICAL AGM BATTERY

A charge rate between 3 and 50 amperes is generally satisfactory for any maintenance-free flooded battery as long as spewing of electrolyte does not occur or the battery does not feel excessively hot (over 125°F (52°C)). If spewing or violent gassing of electrolyte occurs or battery temperature exceeds 125°F (52°C), the charging rate must be reduced or temporarily stopped to allow cooling and to avoid damaging the battery. Battery temperature can be estimated by touching or feeling the battery case. No further charging is required. Shake or tilt the battery at hourly intervals during charging to mix the electrolyte.



**WARNING**

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

**NOTE**

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

## 5.8.1 Battery Charging Guide

**NOTE**

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 one time – may greatly shorten its life.

The following guidelines are for maintenance-free flooded batteries.

**Fast Charging Rate**

3-3/4 hours @ 20 amps

2-1/2 hours @ 30 amps

2 hours @ 40 amps

1-1/2 hours @ 50 amps

**Slow Charging Rate**

15 hours @ 5 amps

7-1/2 hours @ 10 amps

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

**Size of Battery**

A completely discharged large heavy-duty battery requires more than twice the recharging time of a completely discharged small passenger car battery.

**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 or more.

## 5.8.2 Emergency Jump Starting With Auxiliary (Booster) Battery.

**DANGER**

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**

On X3-45 coaches, booster block is located near the batteries in the engine compartment on the R.H. side and is accessible through engine R.H. side door (Figure 32).

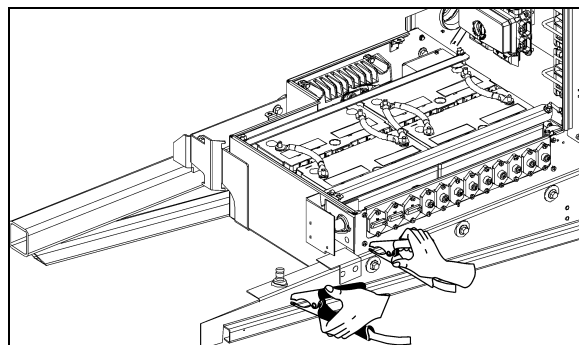


FIGURE 32: BOOSTER BLOCK

On H3 coaches, the booster block is located in the engine compartment, on the R.H. side and is accessible through engine R.H. side door.

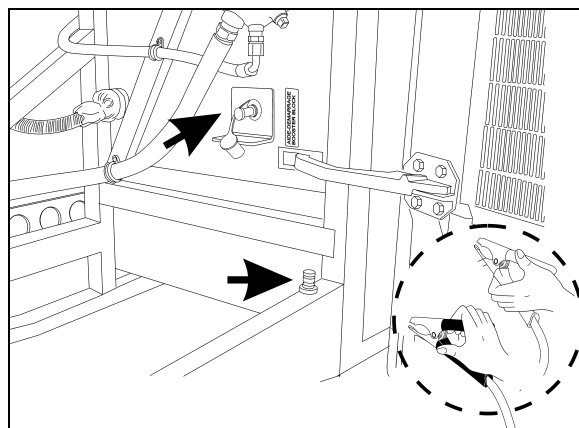


FIGURE 33: BOOSTER BLOCK

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.



## DANGER

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.



## DANGER

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

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

Apply parking brake and place the transmission shift lever or push-button pads in 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.

1. Connect one end of one red jumper cable to the positive (+) terminal of the booster power source and the other end to the positive (+) post of the booster power block, located on the R.H. side of the engine compartment (refer to Figure 32).
2. Connect one end of the remaining negative jumper cable (black) to the negative (-) terminal of the booster power source, and the other end of the black jumper cable to the negative (-) post of the booster power block.
3. Make sure the clips from one cable do not inadvertently touch the clips on the other cable. Do not lean over the battery when making connections. The ground connection must provide good electrical conductivity and current carrying capacity.
4. Start the engine in the vehicle that is providing the jump start. Let the engine run for a few minutes, then start the engine in the vehicle that has the discharged batteries.
5. When removing the jumper cables, perform the above procedure exactly in reverse

order, and replace protective caps on booster block terminals.



## DANGER

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.

### NOTE

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

## 5.9 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.

## 5.10 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.

## 5.11 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 hold-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 hold-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.

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



## 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 PR00002E 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.

**TORQUE: 13-15 lb-ft (18-20 Nm)**

Replace protective caps to prevent corrosion and sparks.

### 5.12 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 volts 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.

### 5.13 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.

#### 5.14 "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.

##### 5.14.1 Voltage Gauge Definitions

Voltmeter drops below 24.4 volts dc

- Check alternator output.
- Check voltage regulator.
- Check battery connections.
- Check battery cells.
- Check battery equalizer connections.

Voltmeter exceeds 30 volts dc

- Check alternator output.
- Check voltage regulator.
- 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).

#### 5.14.2 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.

## 6. PRIME ENERGY MANAGEMENT SYSTEM

### 6.1 DESCRIPTION

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 new 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.

### 6.2 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.

## SECTION 06: ELECTRICAL

Refer to Figure 34 below.

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

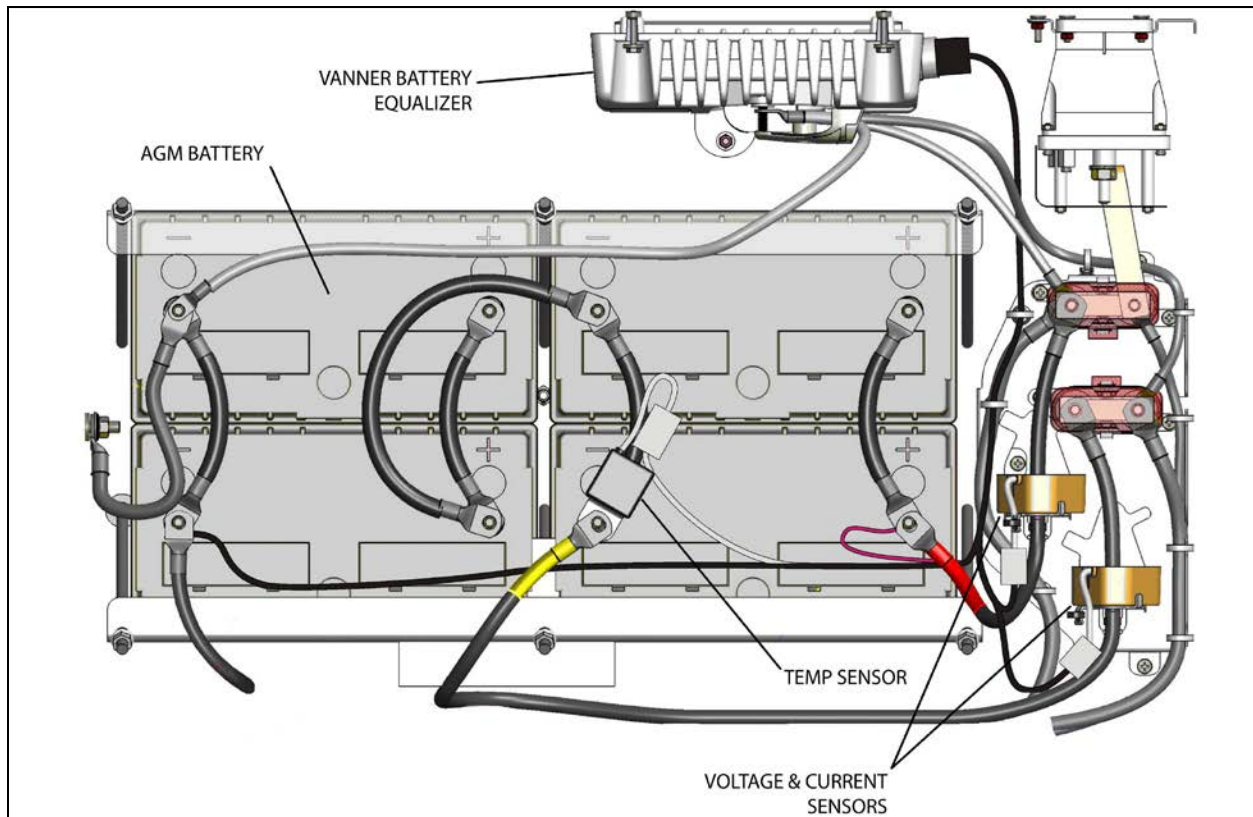


FIGURE 34: PRIME ELECTRICAL COMPONENT

## 6.2.1 Vanner 80 Series Battery Equalizer Fault Codes

The 80 Equalizer Can Bus Interface supports SAE J1939 Diagnostic Message 1 (DM1) for active Diagnostic Trouble Codes. See list below. Refer to OEM publication *Vanner Vann-Guard 80 Series Owner's Manual* PDF for additional details.

| Description                     | SPN    | FMI  |
|---------------------------------|--------|--|
| Over Voltage Fault (OVF)        | 168    | 0: Data valid, but above normal operating range<br>– Most Severe |
| Under Voltage Fault (UVF)       | 168    | 1: Data valid, but below normal operating range<br>– Most Severe |
| Imbalance (IMB)                 | 520448 | 0: Data valid, but above normal operating range<br>– Most Severe |
| Equalizer Fault (EQFLT)         | 520449 | 1: Data valid, but below normal operating range<br>– Most Severe |
| Temperature Sensor Fault (TSF)  | 520450 | 0: Data valid, but above normal operating range                  |
| Temperature Sensor Fault (TSF)  | 520450 | 1: Data valid, but below normal operating range                  |
| Temperature Sensor Fault (TSF)  | 520450 | 2: Data erratic, intermittent, or incorrect<br>– Most Severe     |
| 12V Current Sensor Fault (SCSF) | 520451 | 0: Data valid, but above normal operating range<br>– Most Severe |
| 12V Current Sensor Fault (SCSF) | 520451 | 1: Data valid, but below normal operating range                  |
| 12V Current Sensor Fault (SCSF) | 520451 | 2: Data erratic, intermittent, or incorrect<br>– Most Severe     |
| 24V Current Sensor Fault (DCSF) | 520452 | 0: Data valid, but above normal operating range<br>– Most Severe |
| 24V Current Sensor Fault (DCSF) | 520452 | 1: Data valid, but below normal operating range                  |
| 24V Current Sensor Fault (DCSF) | 520452 | 2: Data erratic, intermittent, or incorrect<br>– Most Severe     |

### 6.3 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.

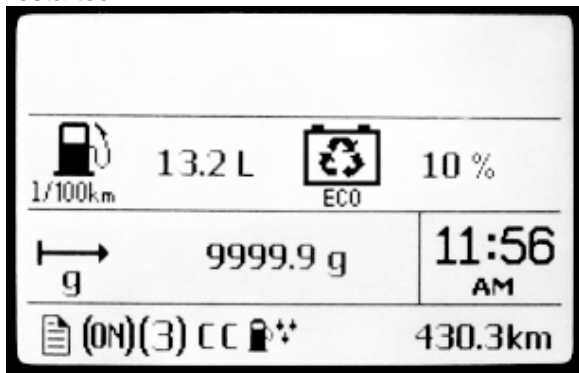


FIGURE 35: PRIME DID DISPLAY

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

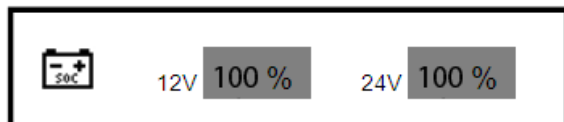


FIGURE 36: BATTERY STATE OF CHARGE

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

## 7. TROUBLESHOOTING AND TESTING THE MULTIPLEX VEHICLES

### 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 CAN NETWORK

The CAN network wiring is separated in sections and uses connectors that are not shared with other circuits. This allows sections of the network to be isolated to help locate short-circuit on the CAN.

In case of a short-circuit on the CAN network, this affects all the modules and they all act as "No response" in the error messages of the "ELECTRICAL SYSTEM" 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.

#### 7.2.1 CAN Connection On The Telltale Panel And The Hvac Control Unit

The telltale panel module and HVAC module are linked to the MCM by a CAN connection. In case of a CAN connection default, the telltale panel LCD display shows "CAN", and on the HVAC control unit, the temperature display indicates "--". To confirm a CAN 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 SYSTEM menu.

**NOTE**

While downloading a new vehicle program in the MCM from a computer, the CAN network is temporarily interrupted and therefore a CAN reference appears in the telltale panel LCD display.

**7.2.2 Spare CAN**

A spare CAN 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 CAN network to the spare CAN network. Refer to the vehicle wiring diagram and section 4.6 for more information.

**7.3 ELECTRICAL SYSTEM DIAGNOSTIC**

Using the Driver's Info Display (DID), check if there are active errors in the vehicle electrical system. With the SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC and then highlight ELECTRICAL SYSTEM 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 FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC 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**

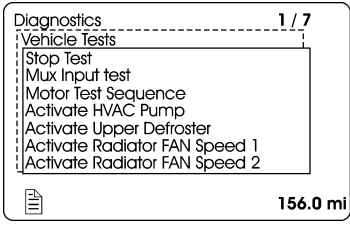
When performing an electrical system diagnostic with the DID, the message « No Response ModA41 » indicates either module A41 is not responding due to a CAN link problem or module A41 is not powered. Similar messages exist for all modules (A42, A43, A44, etc.).

**NOTE**

Because it is easier to do, check first if the module is powered by probing on its gray connector. If it is, then you can conclude that there is a CAN link problem. Refer to CAN NETWORK LAYOUT AND TROUBLESHOOTING in this section.

**7.4 MULTIPLEX INPUT TEST MODE**

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



To initiate the test mode, use the Driver Information Display (DID) DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then 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 STOP TEST 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.

| <b>SWITCHES AND SENSORS SUPPORTED BY THE SWITCH/SENSOR TEST MODE</b> |
|--|
| 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       |
| Radiator fan clutch switch                         |
| 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      |
| Headlights switch, 2 positions                     |
| Multi-function lever headlights 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,
- Horn selector switch,
- Outside rear view mirror heat,
- Mirror control switches,
- Low-buoy switch,
- Starter sensor,
- ABS warning input,
- WCL switch,
- Driver's power window switch,
- Fog lights switch,
- Alternator sensors 1 & 2,
- Retarder active signal,
- Radiator fan speed 1 & 2 signals.

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.

## 7.5 MOTOR TEST SEQUENCE

The test mode allows testing the motors and electric contactors 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:

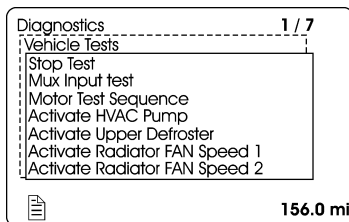
- A. The battery charger must be connected to a 110-120 volt power supply. If not, the test will be interrupted when the voltage drops below 24.4 volts,
- B. Engine not running,
- C. Parking brake applied,

**DANGER**

Before starting the test sequence, make sure nobody is working in the evaporator or condenser compartment.

**NOTE**

*The back-up alarm will beep ten (10) times prior the test starts to warn people that may be working 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 MOTOR TEST SEQUENCE 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.

### 7.5.1 Test Sequence – Coaches only

Go to the condenser compartment:

- The condenser fans start at speed 1, then after a short pause, speed 2 activates.
- The passenger's unit refrigerant solenoid valve 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:

- Toilet fan motor starts.

- A/C compressor clutch activates 3 times.
- Left compressor unloader activates 3 times.
- Right compressor unloader activates 3 times.
- Fan clutch is disengaged (fan can be turned freely by hand).
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance).
- Fan clutch engages in speed 2 (cannot be turned but hand).

*5 beeps from the back-up alarm 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.
- The upper windshield defroster (optional) starts running.

**To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.**

### 7.5.2 Test Sequence – VIP With Central HVAC System

Driver's & passenger's unit fresh air damper open. [20 seconds delay]

**Go to the condenser compartment:**

- Check the fans. The condenser motors start at speed 1 for 3 seconds, then after a short pause, speed 2 activates. [3 seconds delay]

- The passenger's unit refrigerant solenoid valve activates 3 times. [10 seconds delay]

*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:**

- The main power compartment door fan starts running for 3 seconds (will not run if door is open). [10 seconds delay]
- A/C compressor clutch activates 3 times.
- Left compressor unloader activates 3 times.
- Right compressor unloader activates 3 times. [5 seconds delay]
- Radiator fan clutch is disengaged (fan can be turned freely by hand). [3 seconds delay]
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance). [3 seconds delay]
- Fan clutch engages in speed 2 (cannot be turned but hand). [10 seconds delay]

*5 beeps from the back-up alarm 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. [20 seconds delay]

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

**Inside the spare wheel compartment:**

- Driver's unit refrigerant solenoid valve activates 3 times.

- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

**To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.**

**7.5.3 Test Sequence – VIP With Small HVAC System**

Driver's unit fresh air damper opening. [20 seconds delay]

*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:**

- The main power compartment door fan starts running for 3 seconds (will not run if door is open). [10 seconds delay]
- A/C compressor clutch activated 3 times. [5 seconds delay]
- Radiator fan clutch is disengaged (fan can be turned freely by hand). [3 seconds delay]
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance). [3 seconds delay]
- Fan clutch engages in speed 2 (cannot be turned but hand). [10 seconds delay]

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

**Inside the spare wheel compartment:**

- Auxiliary unit refrigerant solenoid valve activates 3 times. [10 seconds delay]
- Hot water pump starts running for 5 seconds.
- Driver's unit refrigerant solenoid valve activates 3 times.

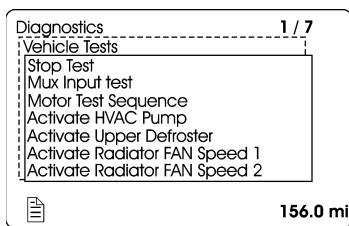


- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

**To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.**

### 7.6 FORCED ACTIVATION OF THE RADIATOR FAN CLUTCH

To prevent the engine from overheating in case of malfunction of the clutch activation system, it is possible to force activation of the clutch.

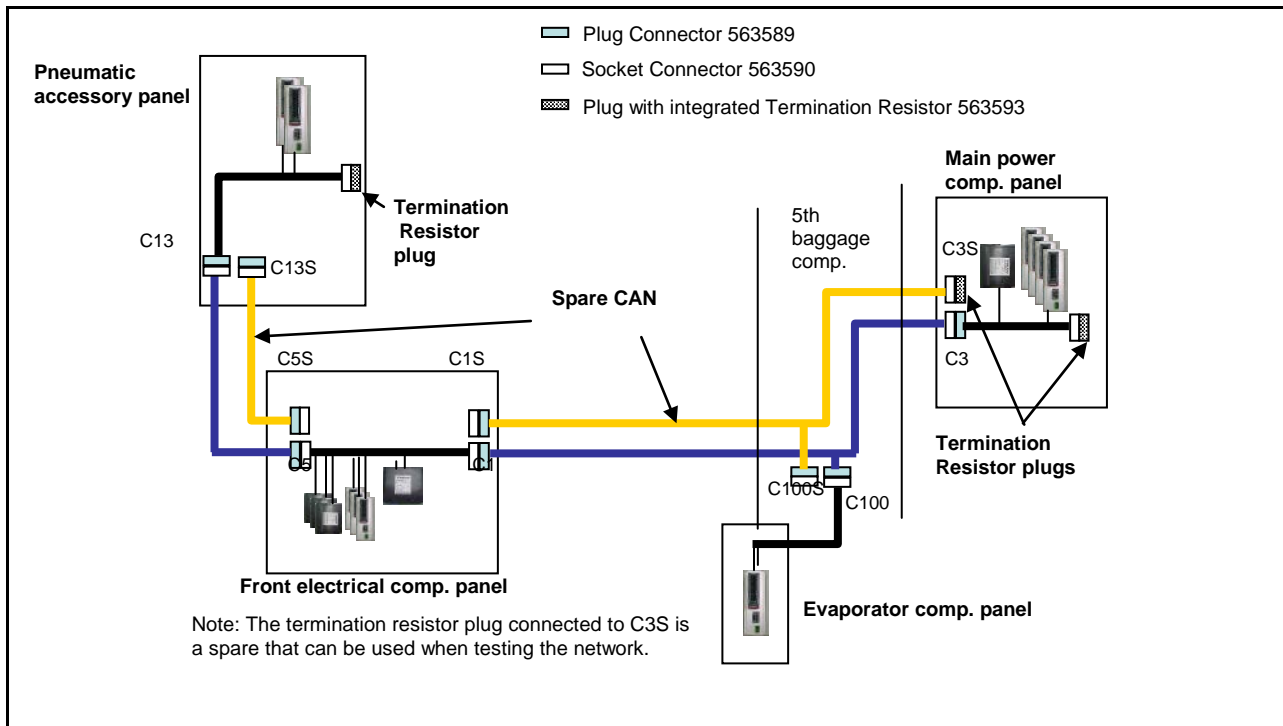
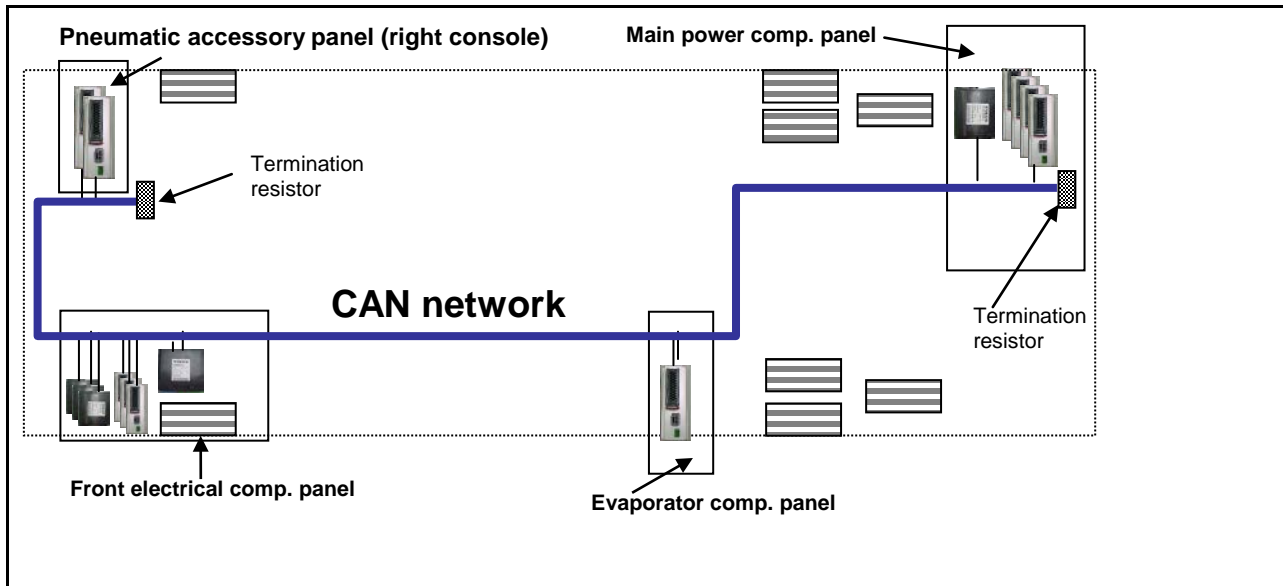


1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then ACTIVATE RADIATOR FAN SPEED 1 or ACTIVATE RADIATOR FAN SPEED 2 as required.
2. The DID status line will show TEST to confirm the forced activation of the radiator fan clutch. To cancel, turn the ignition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

If the fan clutch does not engage using this procedure then the clutch is faulty or the wiring between the multiplex module and the clutch is faulty. Mechanically lock the fan clutch as described in section 05: COOLING SYSTEM of the maintenance manual.



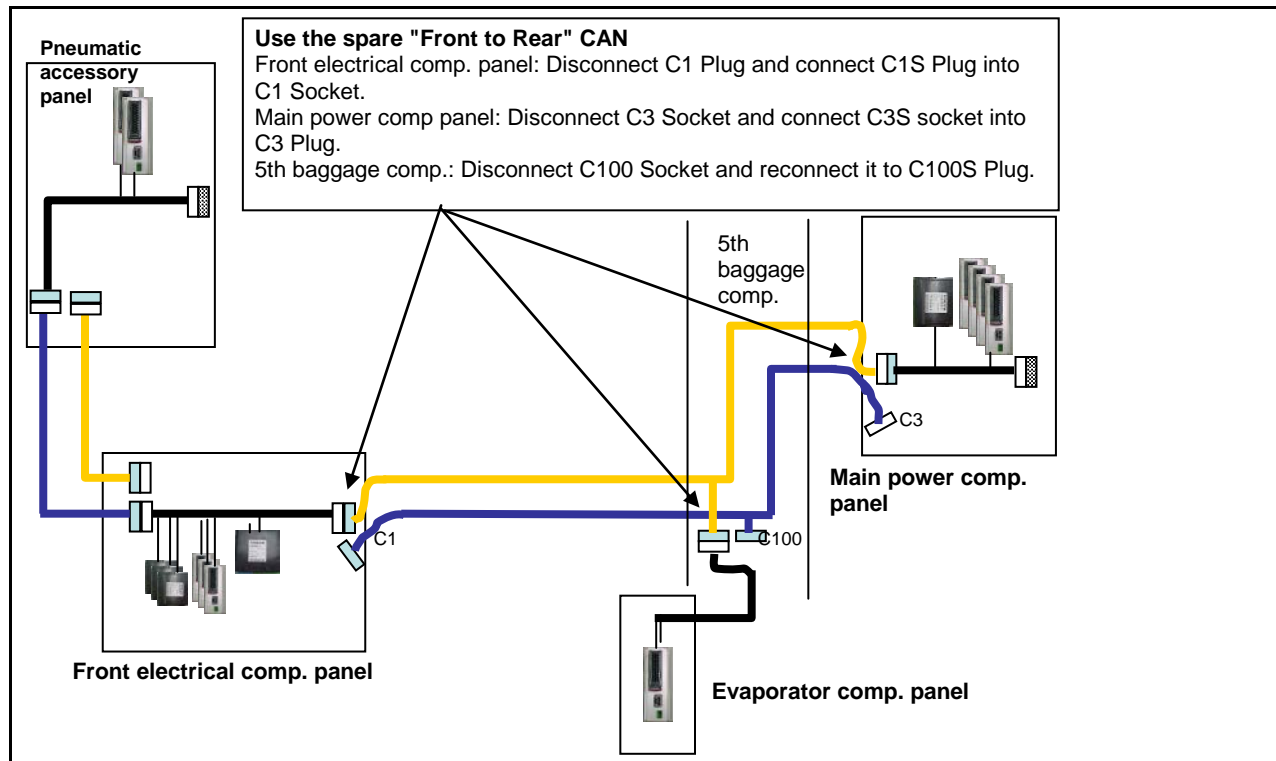
7.7 CAN NETWORK LAYOUT AND TROUBLESHOOTING



If all 14 modules (A41 to A54) are shown as Not Responding and Active Fault, the problem could be:

- A short circuit somewhere on the CAN 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.

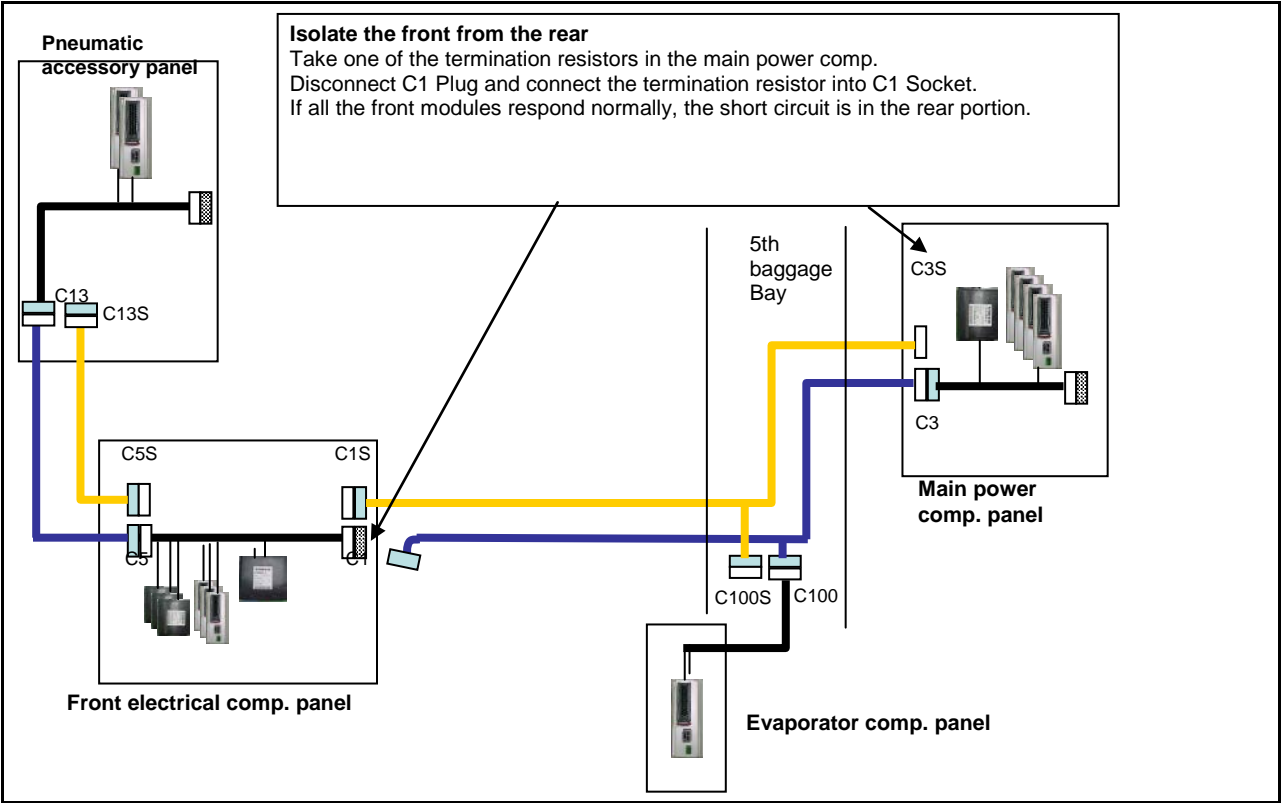
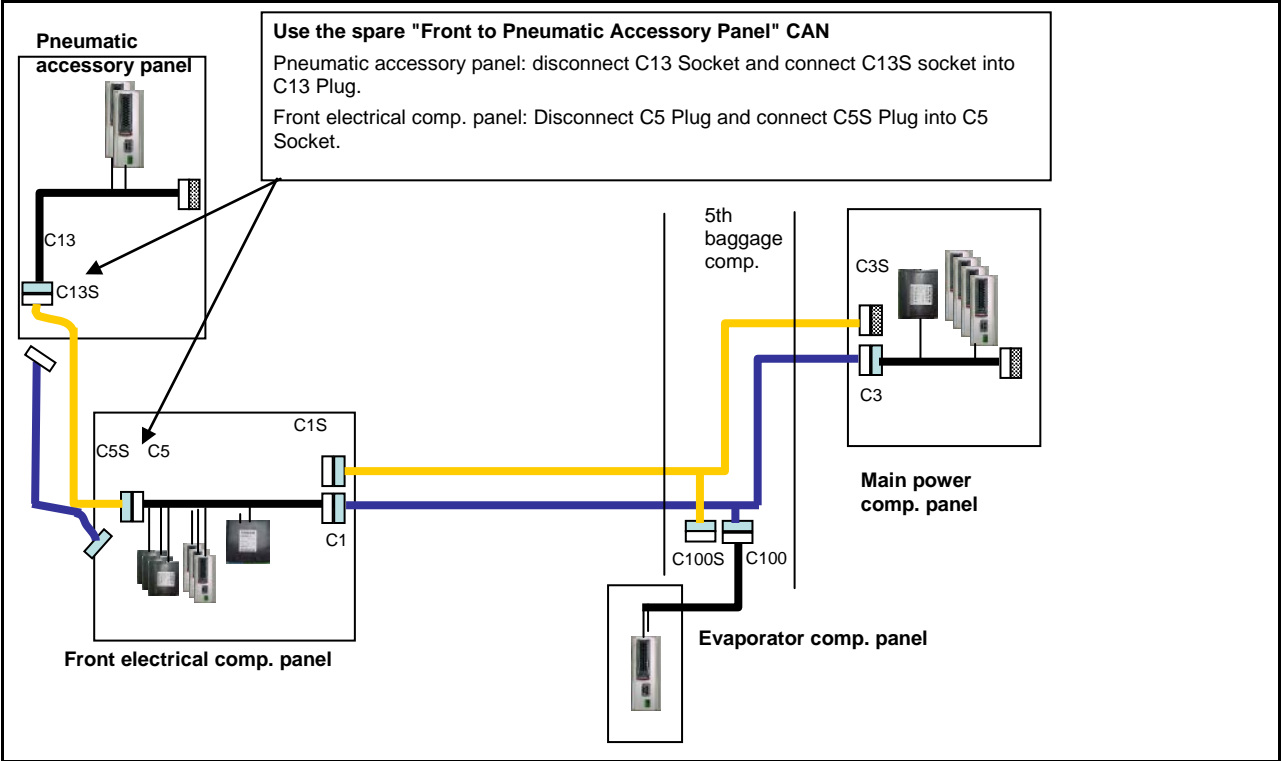


All modules including Wake-up modules and MCM have to be powered OFF prior to probe the CAN lines with an ohmmeter.

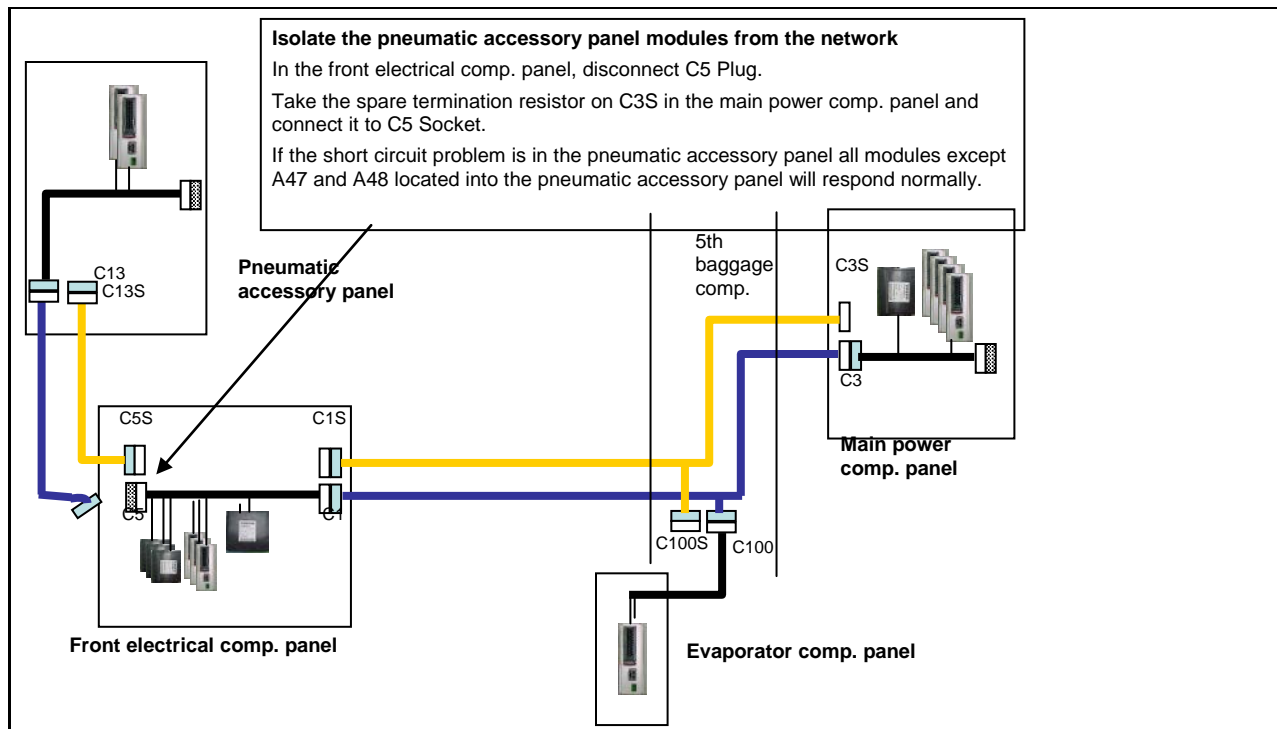
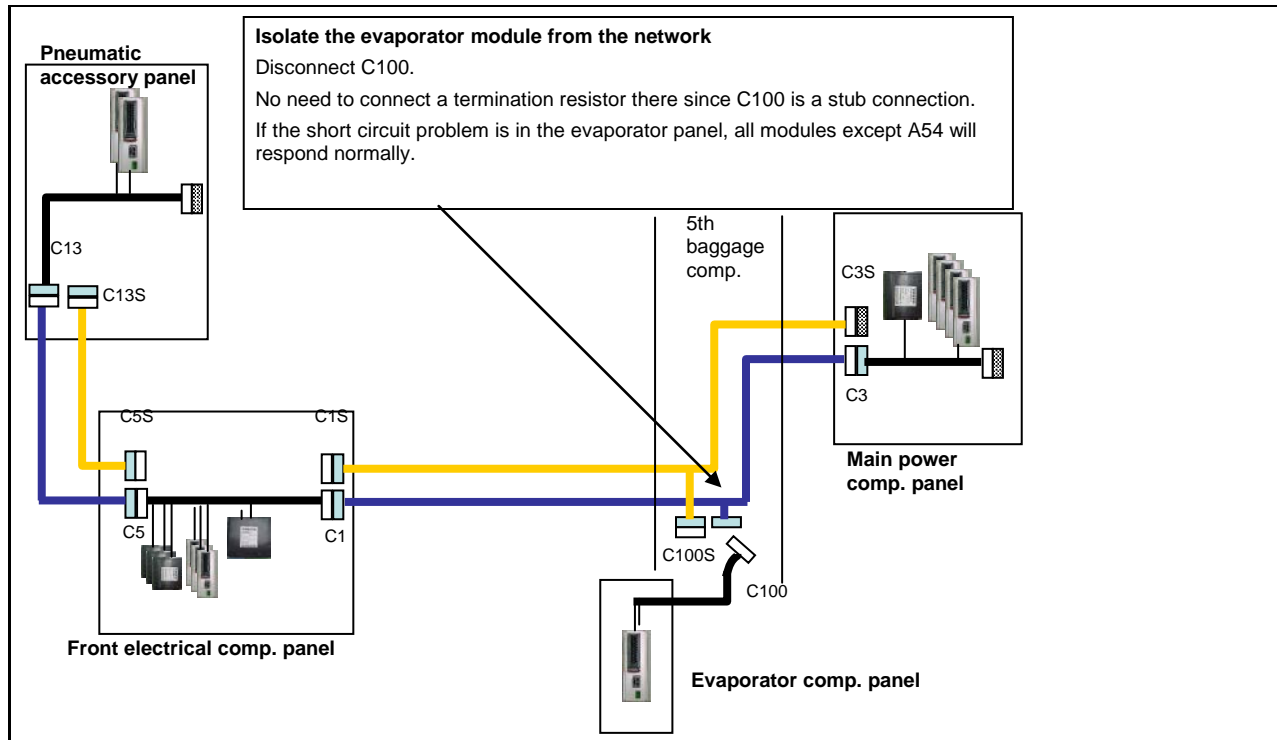
Probing the resistance between the CAN-H and CAN-L wire is a useful method to localize short circuits or open circuit on the CAN network. However, when doing so, make sure none of the modules connected to the CAN line are powered, including wake-up powered modules and battery direct supply module (MCM).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

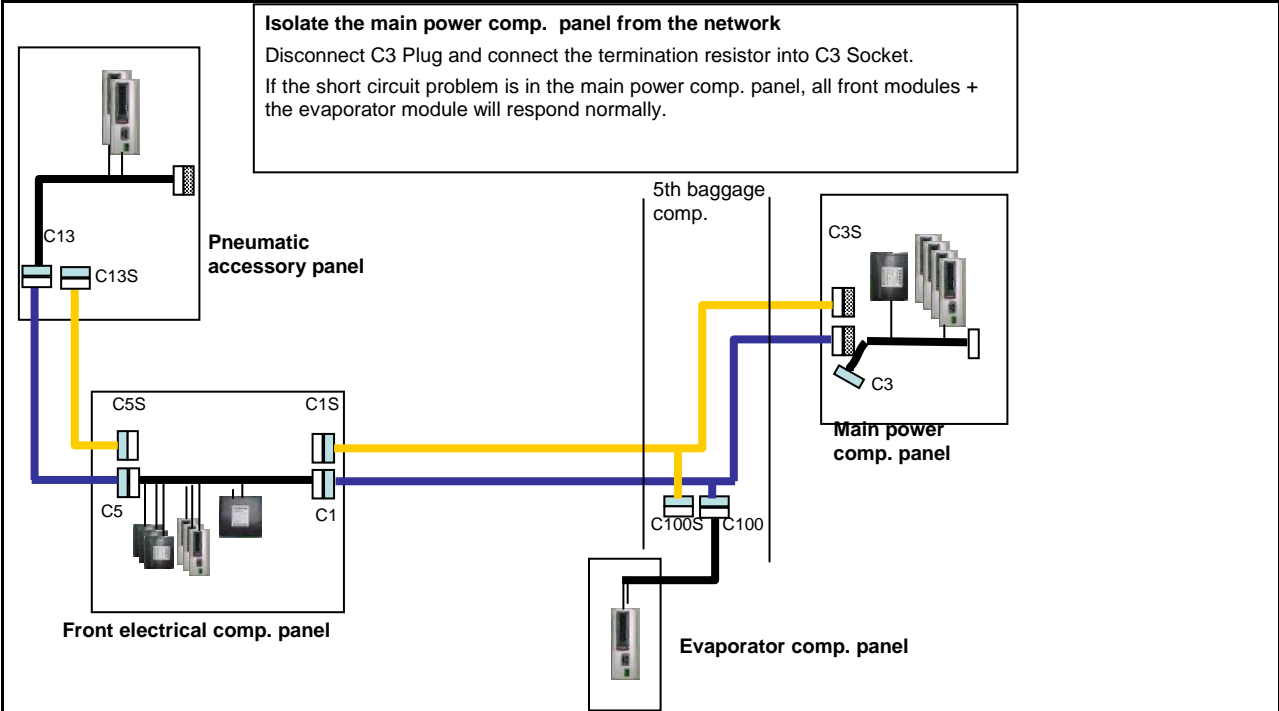
**Proceed as follow when probing the CAN line with an ohmmeter in order to get a valid reading:**

- Turn ignition key to the OFF position.
- Set the battery master switch to the OFF position to turn all Wake-up modules power to OFF.
- Trip circuit breakers CB2, CB4 and CB6 to remove direct battery power from the MCM.



## SECTION 06: ELECTRICAL





- CAN 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 CAN harnesses instead of trying to repair them.

7.8 TROUBLESHOOTING

| Problem/Symptom        | Probable Causes  | Actions  |
|------------------------|--|--|
| Vehicle does not Start | Rear Start selector switch is not in the NORMAL position<br><br>Master cut-out switch on the rear electrical panel is in the OFF position (down) | 1. Check that the rear start selector switch is flipped up to NORMAL start position and master cut-out switch is flipped up to ON and retry cranking<br><br>2. Flip the rear start selector switch to "Rear Start" and start the vehicle from the rear |

| Problem/Symptom  | Probable Causes   | Actions   |
|--|---|---|
|  | <p>CAN network problem (Multiplex)</p> <p>Module A53 not powered or is defective</p> <p>Engine ECM does not receive the ignition signal</p> <p>Engine ECM is not powered</p>  | <p>If the vehicle does not start from the rear:</p> <ol style="list-style-type: none"> <li>1. Verify that module A53 is powered:               <ol style="list-style-type: none"> <li>a) Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA53, Active", indicates a power problem on the module or a CAN network problem.</li> <li>b) Check / reset circuit breaker CB5</li> <li>c) Check / replace fuse F65</li> <li>d) Probe gray connector on module to see if it is powered.</li> </ol> </li> <li>2. Verify that the engine ECM is powered and get the ignition signal               <ol style="list-style-type: none"> <li>a) Check / reset circuit breaker CB8<br/>Check / replace fuse F74</li> <li>b) Check / reset circuit breaker CB2<br/>Check / replace fuse F78</li> </ol> </li> </ol> |
| <p>None of the Multiplexed functions are operating, including the basic limp-home functions (door opening, flashers, wipers in speed 1)</p> <p>"FLIP REAR BREAKER TO INITIATE I/O MODULES PROGRAMMING" pop-up message appears in the DID</p> <p><i>Note: The sunshades are still functioning since these are not multiplexed</i></p> | <p>The program version in the MCM is different than the program in the I/O modules and the MCM is forcing all I/O modules to stay inactive</p>  | <ol style="list-style-type: none"> <li>1. Engage the auto-programming of the I/O modules: Turn the ignition key to the ON position, trip and reset circuit breaker CB6.</li> <li>2. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming is complete.</li> </ol>  |
| <p>Many secondary functions (not essential for driving) not functioning (interior lighting, driver's area lighting, wiper speed 2 and intermittent).</p> <p>Marker lights and clearance lights are turned ON when setting ignition to the ON position.</p>   | <p>The MCM module does not receive 24 V power.</p> <p>The CAN network is not working. It could be caused by a short on the network, an open circuit, a problem with the MCM or the MCM being disconnected from the network.</p> | <ol style="list-style-type: none"> <li>1. Check / reset circuit breaker CB6.<br/>Check / replace fuse F1</li> <li>2. Operate in limp-home mode by starting the vehicle from the engine compartment (REAR START). All functions essential to drive are available</li> </ol> <p>To close and lock the door, pull the door manually up to its closed position and it will lock by itself. The door opening button</p>  |



| Problem/Symptom   | Probable Causes  | Actions  |
|---|--|--|
|   |  | is still functioning   |
| <p>No temperature control in the passenger area</p> <p>Passenger temperature display indicates two dashes "--"</p>  | <p>Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring</p> | <p>Instruct the driver to manually control the temperature by playing with the passenger set point. Set above 22°C (72°F) to heat and below 22° C (72°F) to cool</p>   |
| <p>Entrance door does not open nor close using the control buttons</p> <p>Defroster fan not functioning</p> <p>Windshield wipers not functioning in speed 1 or intermittent</p>                   | <p>Module A47 is not powered or is faulty</p>  | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA47, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms).</li> <li>2. Check / reset circuit breaker CB6</li> <li>3. Check / replace fuse F5</li> <li>4. Probe gray connector on module to see if it is powered.</li> <li>5. Use the air release valves near the entrance door and in the front service compartment to lock / unlock the door</li> </ol> |
| <p>Windshield wipers not functioning in speed 1 or intermittent</p>   | <p>No power on R23</p>   | <p>Check / replace fuse F18</p>  |
| <p>HVAC condenser fans not functioning in speed 1</p>   | <p>Circuit breaker CB7 was manually tripped and not reset</p>  | <p>Check / reset circuit breaker CB7</p>   |
| <p>HVAC condenser fans not functioning in speed 2</p>   | <p>Circuit breaker CB7 was manually tripped and not reset</p>  | <p>Check / reset circuit breaker CB7</p>   |
| <p>Windshield washer not functioning</p> <p>Windshield upper section de-icing system not functioning</p> <p>Defroster fan is functioning but no heat or cooling available in the driver area.</p> | <p>Module A46 is not powered or is faulty</p>  | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA46, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms).</li> <li>2. Check / reset circuit breaker CB1</li> <li>3. Check / replace fuse F12 or F13</li> </ol>  |

| Problem/Symptom  | Probable Causes                               | Actions  |
|--|---|--|
|  |   | <ol style="list-style-type: none"> <li>4. Probe gray connector on module to see if it is powered.</li> </ol>   |
| <p>Low beam headlights and front flasher on left side not functioning</p> <p>Electric horn not functioning</p> | <p>Module A45 is not powered or is faulty</p> | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA45, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms).</li> <li>2. Check / reset circuit breaker CB2</li> <li>3. Check / replace fuse F33 and F34</li> <li>4. Probe gray connector on module to see if it is powered.</li> </ol> |
| <p>Low beam headlights and flasher on right side not functioning</p>   | <p>Module A48 is not powered or is faulty</p> | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA48, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms).</li> <li>2. Check / reset circuit breaker CB2</li> <li>3. Check / replace fuse F33 and F34</li> <li>4. Probe gray connector on module to see if it is powered.</li> </ol> |
| <p>Rear flashers not functioning</p> <p>Stoplights and center stoplights not functioning</p>                   | <p>Module A51 is not powered or is faulty</p> | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA51, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom).</li> <li>2. Check / reset circuit breaker CB2</li> <li>3. Check / replace fuse F80</li> <li>4. Probe gray connector on module to see if it is powered.</li> </ol>           |
| <p>Engine is overheating and radiator fan clutch does not engage</p>   | <p>Module A52 is not powered or is faulty</p> | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA52,</li> </ol>   |

| Problem/Symptom  | Probable Causes  | Actions  |
|--|--|--|
| The A/C compressor clutch does not engage  |  | <p>Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom).</p> <ol style="list-style-type: none"> <li>2. Check / reset circuit breaker CB5</li> <li>3. Check / replace fuse F65</li> <li>4. Probe gray connector on module to see if it is powered.</li> </ol>  |
| Evaporator fan not functioning   | <p>Circuit breaker CB3 tripped</p> <p>Module A54 is not powered or is faulty</p> | <ol style="list-style-type: none"> <li>1. Check / reset circuit breaker CB3</li> <li>2. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA54, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom).</li> <li>3. Check / reset circuit breaker CB5</li> <li>4. Check / replace fuse F67 , F68</li> <li>5. Probe gray connector on module to see if it is powered.</li> </ol> |
| HVAC condenser fans not functioning in speed 1   | Module A54 is not powered or is faulty   | <ol style="list-style-type: none"> <li>1. Check the SYSTEM DIAGNOSTIC menu of Driver Information Display (DID). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA54, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom).</li> <li>2. Check / reset circuit breaker CB5</li> <li>3. Check / replace fuse F67 , F68</li> <li>4. Probe gray connector on module to see if it is powered.</li> </ol>   |
| Sound system not functioning   | Circuit breaker CB4 or CB11 was manually tripped and not reset                   | Check / reset circuit breaker CB4 or CB11  |
| Fire alarm telltale light and audible alarm always ON and there is no fire or high temperature in the engine compartment | Short-circuited fire sensor or defective sensor                                  | Prior to start the vehicle, cycle the ignition key to the ON position, OFF position and then ON position again and then start the vehicle. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is re-started   |

| Problem/Symptom  | Probable Causes   | Actions   |
|--|---|---|
| The vehicle is parked and the electrical horn is activated to indicate a fire in the engine compartment but there is no fire | Short-circuited fire sensor or defective sensor   | Cycle the ignition key between the ON and OFF position twice within 3 seconds. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is parked  |
| A single light, a group of LED lights or another function of the vehicle is not functioning                                  | The multiplex outputs are protected in current by an internal "soft-fuse". When an output is shorted, it turns OFF and 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"  |
| No backlighting in the instrument cluster  | Circuit breaker CB10 is tripped or fuse F20/F29 blown   | Check / reset circuit breaker CB10<br>Check / replace fuse F20/F29  |
| The radiator fan clutch does not function and the engine is overheating  |   | <p>You can manually engage the radiator fan clutch speed 1 or speed 2.</p> <ol style="list-style-type: none"> <li>1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then ACTIVATE RADIATOR FAN SPEED 1 or ACTIVATE RADIATOR FAN SPEED 2.</li> <li>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 STOP TEST submenu and then press ENTER button twice. TEST will disappear from the DID status line.</li> </ol> <p>If the fan clutch does not engage using this procedure then the clutch is faulty or the wiring between the multiplex module and the clutch is faulty. Mechanically lock the fan clutch as described in section 05: COOLING SYSTEM of the maintenance manual.</p> |

## 7.9 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective MCM (Chassis Electronic Control Module) or a CAN 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 CAN 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.

### 7.9.1 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,
- Headlights: 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.

## 7.10 LOWER PRIORITY MODULES FOR BREAKDOWN SERVICE

Modules A43 (IO-A) and A44 (IO-B) affect lower priority functions. These modules can therefore be used as spare parts for breakdown service while on the road.

Functions lost if A43 is removed and used as spare part:

- High beams,

- Ability to turn on the parking lights only,
- "Watch your step" sign,
- Driver's area lighting,
- Tag axle activation,
- Courtesy lights.
- Functions lost if A44 is removed and used as spare part:
- Fresh air damper mix trap control,
- Driver's area and entrance overhead light,
- Front clearance lights.

## 7.11 MULTIPLEX MODULES

### 7.11.1 MCM

The MCM plays the role of interface between the engine ECM, the transmission ECU, the telltale panel module and other IO-A, IO-B 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 installed on another vehicle.

### 7.11.2 IO-A

IO-A modules receive inputs and control outputs. IO-A's are used for all outputs of 1 amp or less.

### 7.11.3 IO-B

IO-B modules receive inputs and control outputs. IO-B's are used for outputs up to 30 amps.

## 7.12 MULTIPLEX MODULES REPLACEMENT

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

The MCM must be reprogrammed using a laptop computer equipped with VPG software, connected to C226 (DB9 connector) found in the front electrical compartment. However, an updated vehicle multiplex program saved on a laptop computer can be uploaded into the MCM module without the need of VPG software.

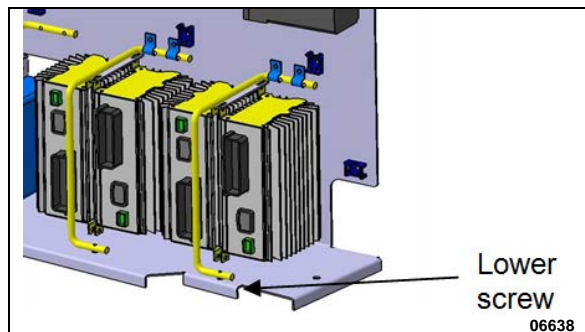
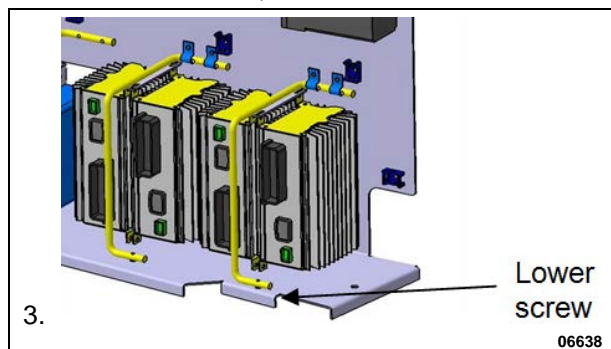


FIGURE 37: IO-B MODULE REMOVAL

## 7.12.1 Replacing IO-A Or IO-B Modules

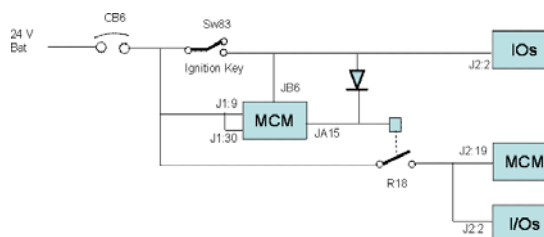
Set the ignition switch to the ON position and leave it in that position at all time while performing this procedure.

1. On rear electrical junction panel, trip circuit breaker CB6.
2. Replace the module and plug connectors (for IO-B modules, disconnect the green connector first, then the grey one and finish with the black connector. To disconnect the black connector, slide downwards the red latch. Remove the lower screw that holds the cable attachment rod onto the floor portion of the panel and flip the rod up, this will relieve the IO-B module, (see



3. Figure 37).
4. Figure 37).
5. Reset circuit breaker CB6. Doing so will initiate the I/O auto programming.
6. 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.
7. Check the **Diagnostics** menu of the Driver Information Display (DID). Select **Fault Diagnostics** and **Electrical System**. 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).

**NOTE**

JB6 is a wake-up pin. JA15 output remains active for 5 minutes after JB6 is inactive.

When initiating reprogramming:

Switch SW83 (ignition key) remains closed, providing 24-volt on JB6, I/O modules and R18. All modules get power.

CB6 is tripped and reset which is forcing MCM reboot.

When resetting CB6, all modules get power, MCM goes into "start mode". I/O modules needing new program will request reprogramming to MCM while in "start mode".

## 7.12.2 Replacing the MCM Module

1. Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
2. On rear electrical junction panel, trip circuit breaker CB6.
3. Replace the module.
4. Reset circuit breaker CB6.
5. The vehicle specific program needs to be uploaded in the MCM.

## 7.12.3 Uploading the vehicle specific multiplex program in the MCM

A laptop computer running Windows XP or Windows 7 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.

### 8. BOSCH ALTERNATORS

Two 28 volt 150A, self-regulated, belt driven, air-cooled HD 10 BOSCH alternators are used in the 24 volt electrical system.

If the alternators needed to be removed, reinstall as follows.

1. If necessary, tighten 4 screws fixing alternator support assembly onto engine (item 5). Use Loctite 243 blue (680038) onto the threads.
2. Tighten screws fixing alternator belt tensioner support assembly onto engine (item 1 & 2). Use Loctite 243 blue onto the threads.
3. Also tighten the screw fixing belt tensioner onto alternators support assembly (item 6). Use Loctite 243 blue (680038) onto the threads.

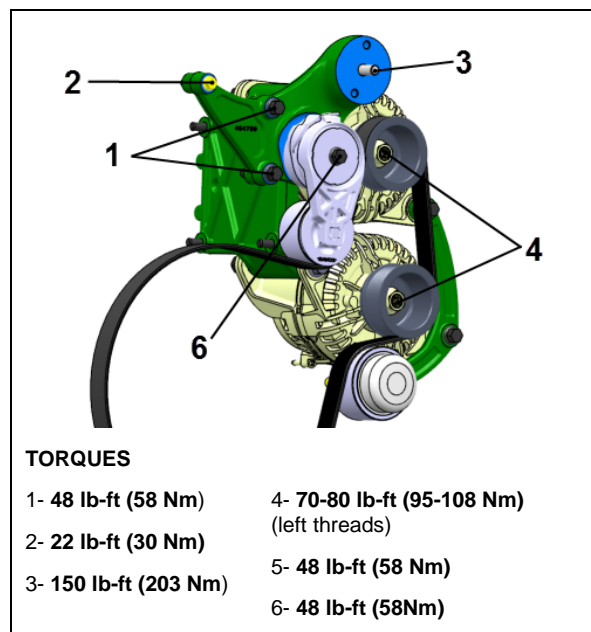


FIGURE 38: ALTERNATORS DRIVE BELT

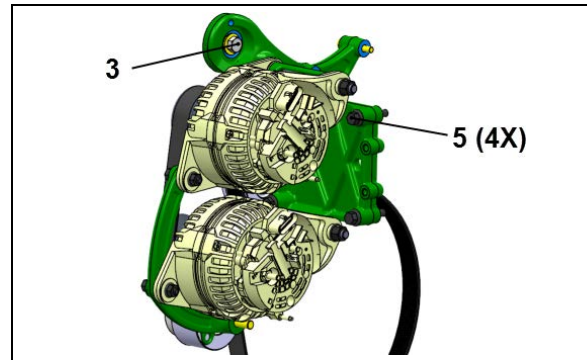


FIGURE 39: ALTERNATORS AND ACCESSORIES MOUNTING TORQUES (H3 COACH SHOWN)

4. If applicable, mount the A/C compressor idler pulley onto alternator belt tensioner support (item 3). Use some Loctite 243 blue (680038) onto the threads.
5. Fix lower and upper alternators loosely to alternators support assembly (bolts 5). Also, mount arched support loosely onto alternators. If applicable, install stone guard below lower alternator.

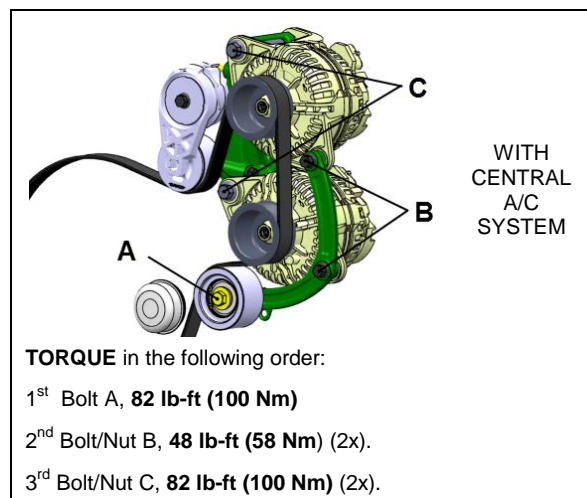
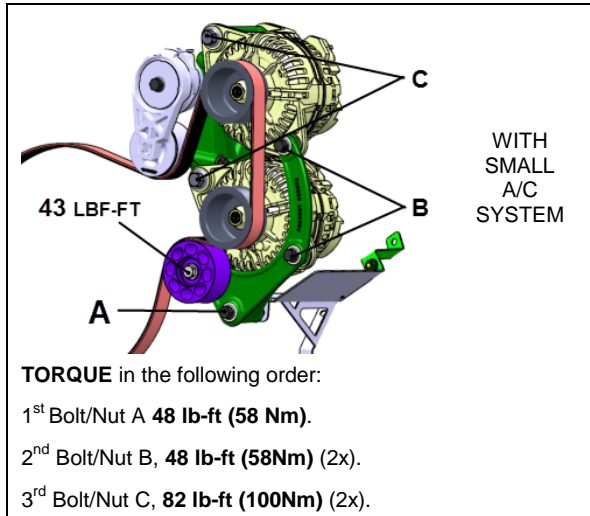


Figure 40: ALTERNATOR MOUNTING, TIGHTENING SEQUENCE – CENTRAL A/C SYSTEM

6. In order to assure installation, it is important to tighten the alternator mounting bolts in proper sequence. (Figure 40 & Figure 41).
7. Mount pulley onto alternator.
8. Install alternator belt.

**NOTE**

*Final tightening of the pulleys can be performed once the belt is installed. This will help keep the pulley from turning when tightening.*



**FIGURE 41: ALTERNATOR MOUNTING, TIGHTENING SEQUENCE – SMALL A/C SYSTEM**

### 8.1 IDENTIFYING THE DEFECTIVE ALTERNATOR

When an alternator is not charging, the instrument cluster ALTERNATOR telltale will illuminate.



ALTERNATOR telltale

To identify which alternator is defective (1=lower alternator, 2=upper alternator), proceed as follows:

1. On the DID (Driver Information Display), select DIAGNOSTICS menu.
2. Select VIEW ACTIVE FAULTS and then ELECTRICAL SYSTEM.
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 1  
 FMI (5) OPEN CIRCUIT

MID (188) ELECTRICAL SYSTEM  
 PSID 35 ALTERNATOR 2  
 FMI (5) OPEN CIRCUIT

### 8.2 ALTERNATOR DRIVE BELT



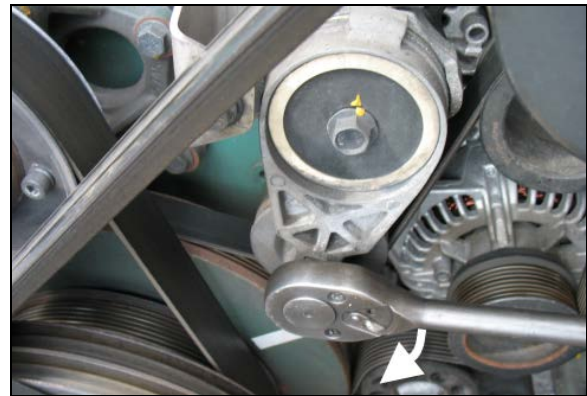
## MAINTENANCE

### Drive belt

Inspect for crack or frayed material at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

### Removal

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



**FIGURE 42: ½" SOCKET DRIVE WRENCH**

### NOTE

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

### Installation

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

### 8.3 ADJUSTMENT

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



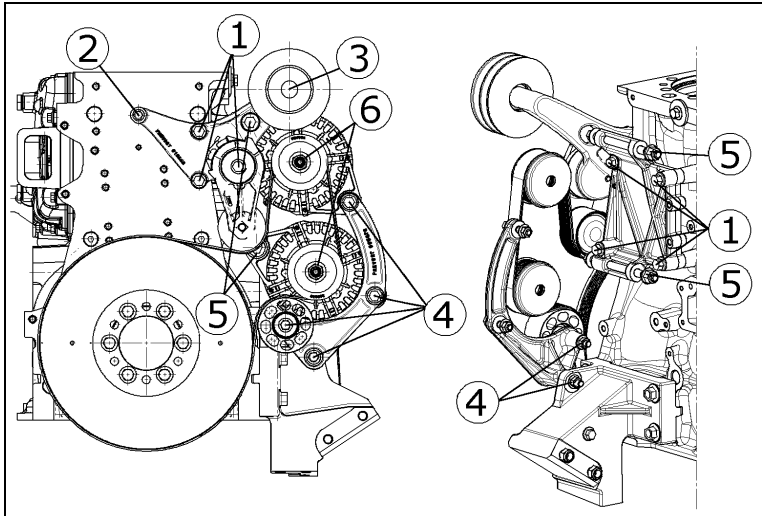
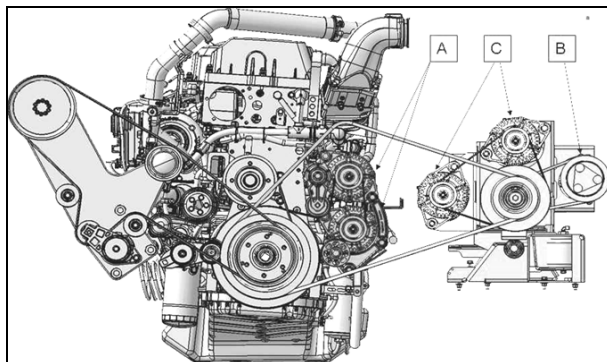
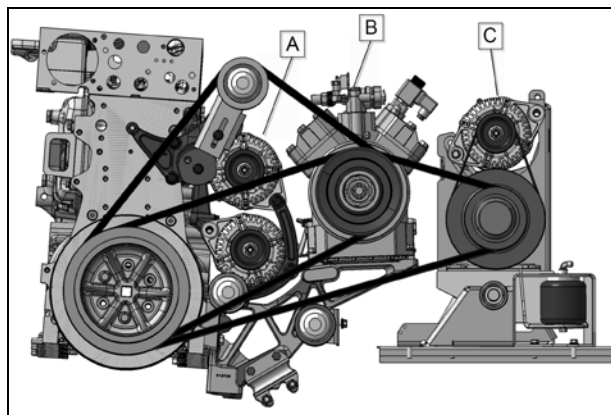


FIGURE 43: TWIN BOSCH ALTERNATORS INSTALLATION (X3-45 COACH)

| <b>EPA 2010 ALTERNATORS AND COMPRESSORS LAYOUT</b>       |   |            |
|--|---|------------|
| <b>X3-45 COACH</b>                                       |   |            |
| 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593 |   | LOCATION A |
| 1 X : CENTRAL A/C SYSTEM BITZER COMPRESSOR               |   | LOCATION B |
| <b>X3-45 VIP BUS SHELL WITH CENTRAL A/C SYSTEM</b>       |   |            |
| 1 <sup>ST</sup> OPTION                                   | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593  | LOCATION A |
|  | 1 X : CENTRAL A/C SYSTEM BITZER COMPRESSOR                | LOCATION B |
| 2 <sup>ND</sup> OPTION                                   | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593  | LOCATION A |
|  | 1 X : CENTRAL A/C SYSTEM BITZER COMPRESSOR                | LOCATION B |
|  | 1 X : HD-10 BOSCH ALTERNATOR 28V – 150 A - PART # 564593  | LOCATION C |
| 3 <sup>RD</sup> OPTION                                   | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593  | LOCATION A |
|  | 1 X : CENTRAL A/C SYSTEM BITZER COMPRESSOR                | LOCATION B |
|  | 1 X : HD 10E BOSCH ALTERNATOR 14V – 200 A – PART # 564492 | LOCATION C |



| <b>X3-45 VIP BUS SHELL WITH SMALL AUXILIARY A/C SYSTEM</b> |  |            |
|--|--|------------|
| 1 <sup>ST</sup> OPTION                                     | 1 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593                                 | LOCATION A |
|  | 1 X : SMALL A/C SYSTEM ICE COMPRESSOR TM-16HD – PART # 950436                            | LOCATION B |
| 2 <sup>ND</sup> OPTION                                     | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593 (ONLY TOP ALTERNATOR CONNECTED) | LOCATION A |
|  | 1 X : SMALL A/C SYSTEM ICE COMPRESSOR TM-16HD – PART # 950436                            | LOCATION B |
| 3 <sup>RD</sup> OPTION                                     | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593 (ONLY TOP ALTERNATOR CONNECTED) | LOCATION A |
|  | 1 X : SMALL A/C SYSTEM ICE COMPRESSOR TM-16HD – PART # 950436                            | LOCATION B |
|  | 1 X : HD 10 BOSCH ALTERNATOR 28V – 150 A - PART # 564593                                 | LOCATION C |
| 4 <sup>TH</sup> OPTION                                     | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593 (ONLY TOP ALTERNATOR CONNECTED) | LOCATION A |
|  | 1 X : SMALL A/C SYSTEM ICE COMPRESSOR TM-16HD – PART # 950436                            | LOCATION B |
|  | 2 X : HD 10 BOSCH ALTERNATOR 28V – 150 A - PART # 950436                                 | LOCATION C |
| 5 <sup>TH</sup> OPTION                                     | 2 X : HD-10 BOSCH ALTERNATOR 28V – 150 A – PART # 564593 (ONLY TOP ALTERNATOR CONNECTED) | LOCATION A |
|  | 1 X : SMALL A/C SYSTEM ICE COMPRESSOR TM-16HD – PART # 950436                            | LOCATION B |
|  | 1 X : HD 10E BOSCH ALTERNATOR 14V – 200 A  | LOCATION C |


**9. BATTERY EQUALIZER**

Vanner “Vann-Guard 70-Series” Battery equalizer is located beside the batteries in battery compartment. Battery Equalizer Owner’s Manual (100 amps) is annexed at the end of this section.

For vehicles with PRIME energy management system, a Vanner “Vann-Bus 80 Series” 100amp Battery equalizer with Smart Monitor is installed beside the batteries in the battery compartment. Owner’s Manual is annexed at the end of this section.

**10. STARTER**

Refer to Mitsubishi Electric Corporation (MELCO) Service bulletin ME003-P annexed at the end of this section for information and maintenance instruction on MELCO 105P70 starter.

|   |                       |
|---|-----------------------|
|    | <p><b>CAUTION</b></p> |
| <p>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.</p> |                       |

**11. 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 located on the engine compartment R.H. side door (H3 Series, FIGURE 46) or is easily accessible through the engine compartment R.H. side door (X3 Series, Figure 47)

To use it, connect the female plug of an electrical extension cord to the heater plug. The extension cord must be plugged into a 110-120 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.

**11.1 MAINTENANCE**

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

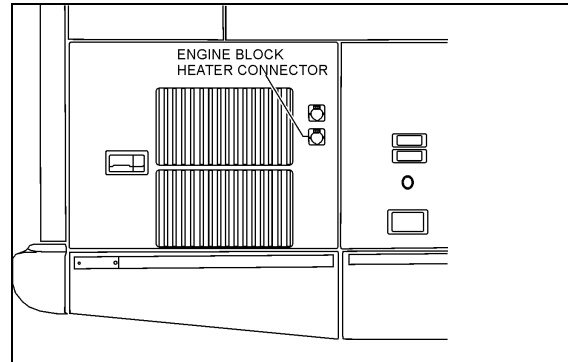


FIGURE 44: ENGINE BLOCK HEATER PLUG LOCATION

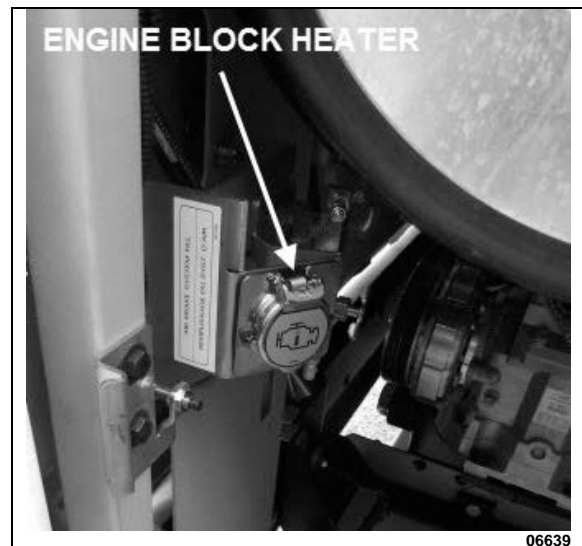


FIGURE 45: ELECTRIC HEATER CONNECTION

**12. X3 SERIES EXTERIOR LIGHTING**

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams. Wiring diagrams are found in the Technical Publication box.

**12.1 HEADLIGHTS**

Each headlight assembly consists of two headlamp module 90 mm (3½ inch) equipped with a 12-volt halogen bulb and one 100 mm (4 inch) 12-volt LED turn/signal lamp. Outer lamps have a double function (both low and high beam). Inner lamps are used for high beam or daytime running light. The inner or outer lamp uses the same single filament halogen bulb part number.

|  |
|--|
| <p><b>NOTE</b></p> <p><i>If vehicle is equipped with optional Xenon headlamps, refer to paragraph 9.1.6.</i></p> |
|--|

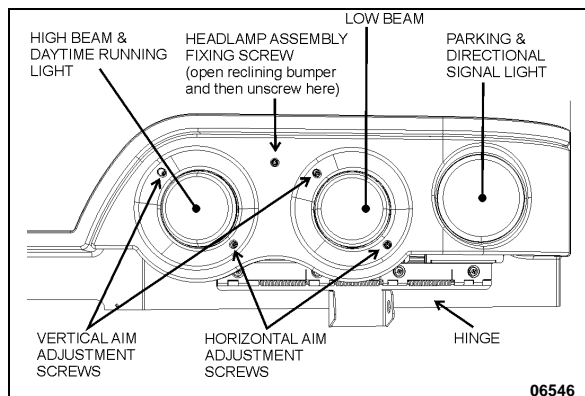


FIGURE 46: HEADLIGHT ASSEMBLY

### 12.1.1 Headlight Beam Toggle Switch

The multifunction lever located on the steering column is used to select proper lighting. High beams or low beams can be selected by pulling the lever rearward. A high beam indicator on the central dashboard panel is illuminated when the high beam circuit is energized.

#### **NOTE**

*Pulling the lever rearward while the lights are off will flash the headlights.*

### 12.1.2 Maintenance

Clean headlights with soap and water. When a headlight burns out, a new bulb must be installed. Headlights must be properly aimed to provide maximum allowable road illumination. When using mechanical aiming devices, follow manufacturer's instructions.

Aiming can be performed without opening headlight assembly. Horizontal and vertical aiming of each module is provided by two adjusting screws that pivot the module in the housing for proper alignment (Figure 49). There is no adjustment for focus since the module is set for proper focus during manufacturing assembly.

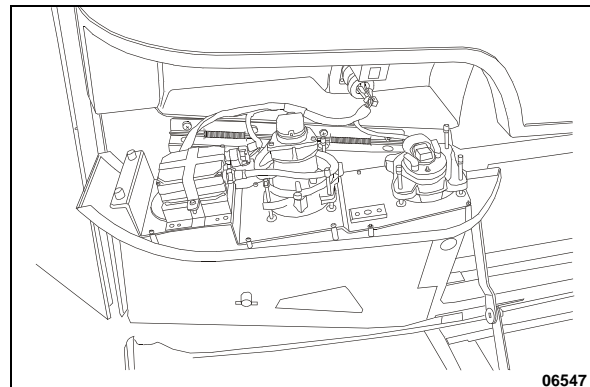


FIGURE 47: OPENING HEADLIGHT ASSEMBLY

#### **NOTE**

*Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.*



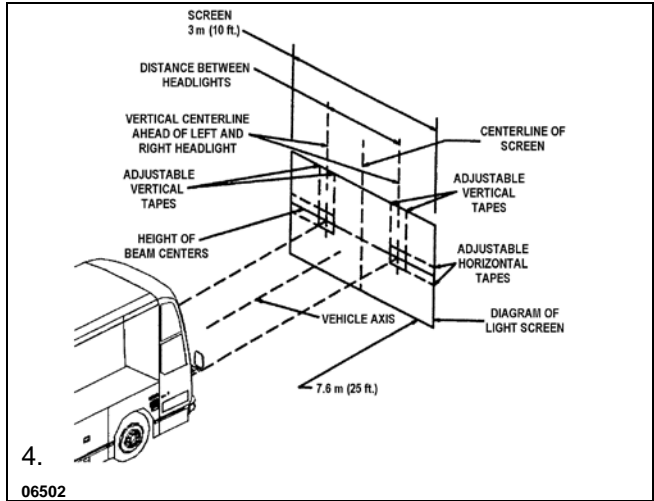
#### **CAUTION**

Use a soft cloth to clean the parking and front turn signal lamp.

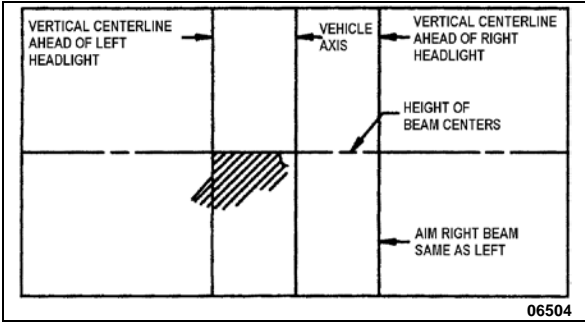
### 12.1.3 Headlight Adjustment

1. Headlight 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 headlights. 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 headlight assembly.
3. The headlight 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 headlights. 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 (



4. Figure 50).



9. Figure 52).

10. The inspection limits for high-beam headlights 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 53).

5. Figure 50).

TABLE 1 – VERTICAL BEAM AIM GUIDELINES

| Headlight (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)          | 6.4 cm (4 inch) down | 4 cm (1.5 inch) up to 16.5 cm (6.5 inch) down |

6. The nominal vertical aim position on lower beam headlights shall be adjusted based on the headlight mounting height, from the ground to the light source center of the headlight, according to table1.

7. High beam headlights are aimed so that the center of the high-intensity zone is located at the horizontal and straight ahead vertically (Figure 51).

8. Low beam headlights 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 headlight (

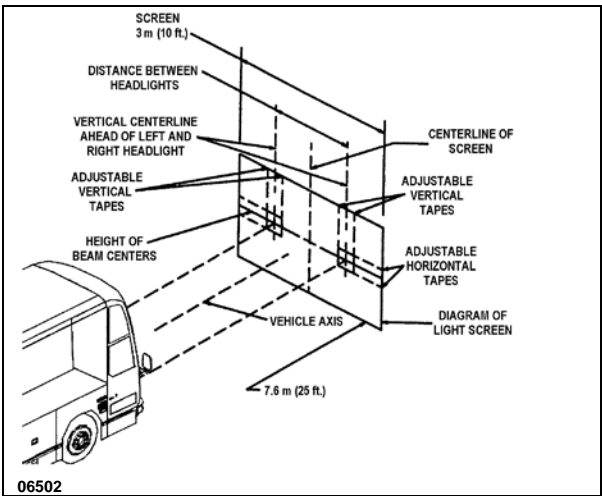


FIGURE 48: ALIGNMENT OF HEADLIGHT AIMING SCREEN

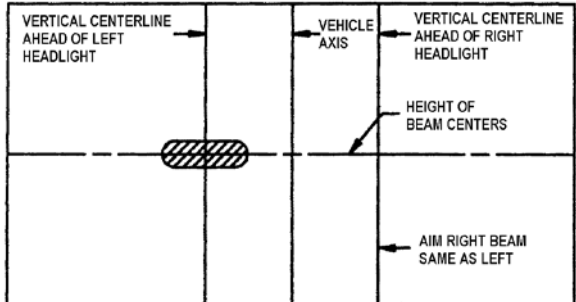


FIGURE 49: UPPER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN

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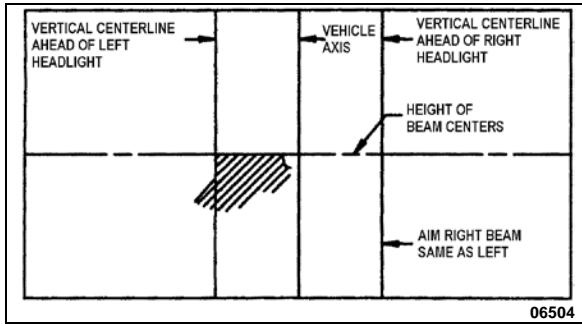


FIGURE 50: LOWER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN

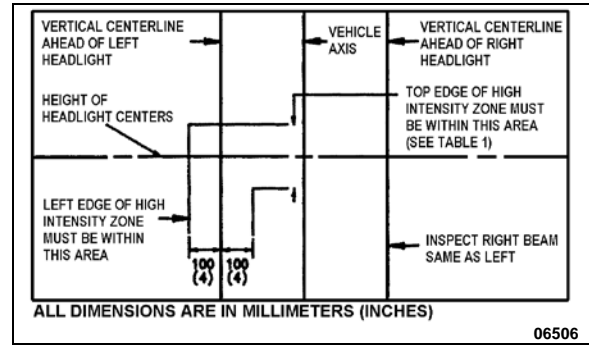


FIGURE 52: AIM INSPECTION LIMITS FOR LOWER-BEAM HEADLIGHTS

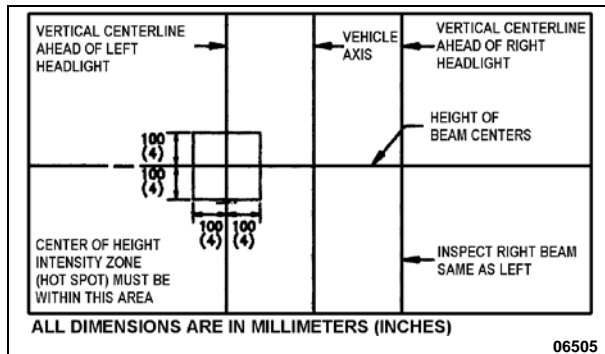
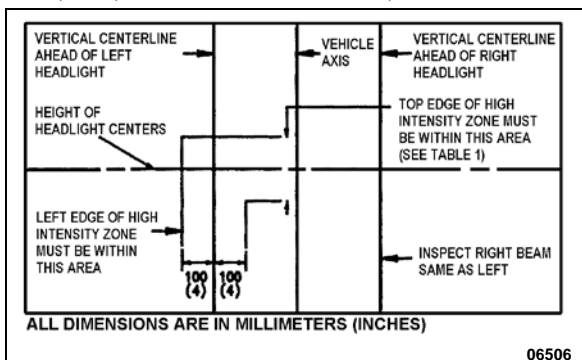


FIGURE 51: AIM INSPECTION LIMITS FOR UPPER-BEAM HEADLIGHTS

11. The inspection limits in the vertical direction for low-beam headlights or the low beam of a dual-beam headlight, 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 (



12. Figure 54).

#### 12.1.4 Sealed-Beam Unit

##### Bulb Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Figure 49).
3. Remove connector from headlight bulb.
4. Remove the bulb by pushing and rotating it out of the socket.
5. Install the new bulb by reversing the previous procedure.



### CAUTION

During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

### NOTE

Do not disrupt headlight adjustment screws.

##### Module Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Figure 49).
3. Remove connector from headlight bulb.
4. Unfasten three metal clips attaching headlight unit to support.
5. Install new module and fasten metal clips.

6. Install wiring connector on back of new sealed beam unit.
7. Tilt headlight assembly up into its housing then secure using fixing screw.

**NOTE**  
*Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.*

8. Perform alignment procedure.

**NOTE**  
*The headlight aim must be checked and adjusted even if it was properly adjusted before the sealed beam unit was replaced.*

12.1.5 Front Turn Signal

The front turn signal is part of the front headlight assembly. The turn signal is a sealed unit (LED) located on each front corner and should be replaced as an assembly. Turn signal is visible from both front and side.

**Removal and Replacement**

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Figure 49).
3. Partially unfasten back plate fixing screws, then remove signal lamp.
4. Remove socket from signal lamp.
5. Install wiring connector on back of new signal lamp then install signal lamp.
6. Fasten back plate fixing screws then tilt headlight assembly up into its housing then secure using fixing screw.

**NOTE**  
*Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.*

12.1.6 Optional Xenon Headlamp

The outer lamps of each headlight assembly may be equipped with the optional Xenon lamps.

These lamps improve visibility and provide better lifespan.

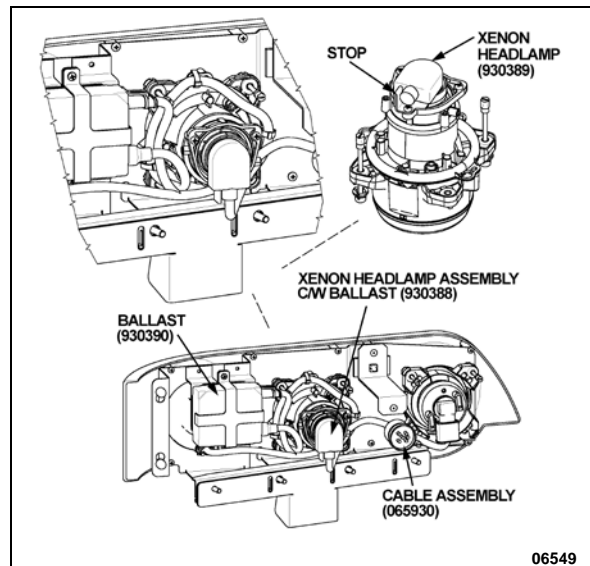


FIGURE 53: XENON HEADLAMP LOCATION

**Bulb Removal and Replacement**

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Figure 49).
3. Remove main cable connector (066011).
4. Remove connector from headlamp bulb by turning counterclockwise.
5. Unscrew the three Phillips head screws, pull the retainer and bulb out.

**CAUTION**  
 To avoid breaking the bulb, make sure the socket is in proper position against the stop.

6. Install the new bulb by reversing the previous procedure.

**CAUTION**  
 During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

**NOTE**  
*Do not disrupt headlight adjustment screws.*

**CAUTION**

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

**Troubleshooting and Safety**

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.

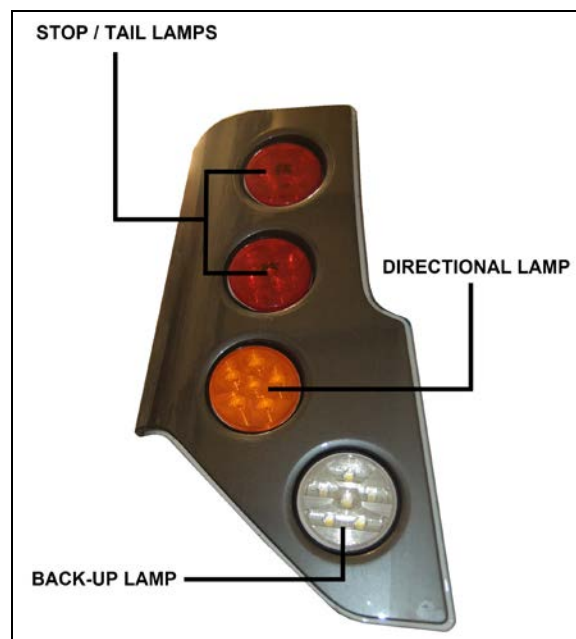
**12.2 STOP, TAIL, DIRECTIONAL, BACK-UP, AND HAZARD WARNING LIGHTS**

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 on the engine rear door.

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 54: REAR TAIL LAMPS**

**12.2.1 Lamp Removal and Replacement**

1. Open engine compartment rear door.

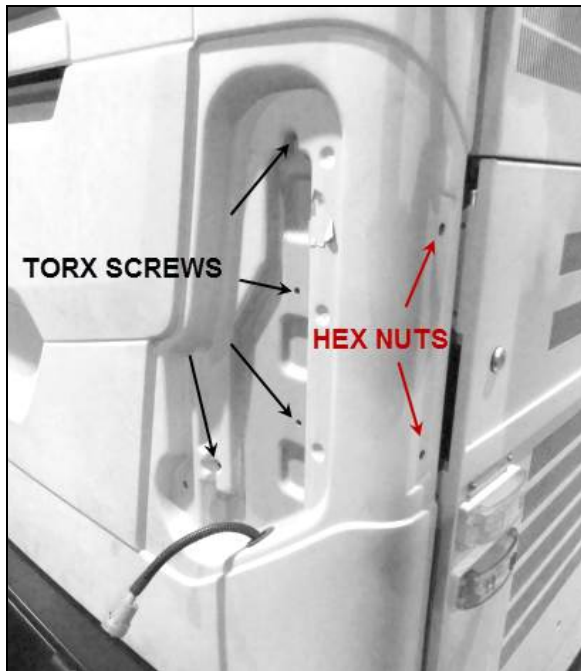


2. Remove the lamp pod from the engine compartment door by unscrewing the Torx hold down screws (4) at the back of the door and the two (2) side retaining nuts.
3. Remove the lamp support retaining screws (2), and then from the outside, disconnect and remove the faulty lamp and its support.
4. From the 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.

**12.2.2 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 55: TAILLAMP POD RETAINING SCREWS & NUTS**

**12.3 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.

**12.4 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.

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

The amber 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” light screws, and then remove the light assembly.
2. Position the new light assembly and install the “Phillips” screws.

**12.4.1 Clearance and Identification Light Removal and Replacement**

The clearance and identification light are sealed units (LED) and can be replaced 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 then install the “Phillips” screws.

**12.5 FOG LIGHTS**

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

**12.5.1 Bulb Removal and Replacement**

1. Pull on the release handle located in the front service compartment, near the door lower hinge. The bumper will lower gradually.
2. Unscrew the wing nut and pivot assembly upwards.
3. Unscrew the outer ring. Disconnect the light unit connection and remove the bulb.

4. Install the new bulb, reconnect the light unit and replace in its proper position.

**CAUTION**

During this step, avoid contacting the bulb with your fingers. This could alter the bulb life.

5. Reinstall the outer ring, pivot the assembly downwards.

Fasten the wing nut and securely close the bumper.

### 13. X3 SERIES INTERIOR LIGHTING EQUIPEMENT

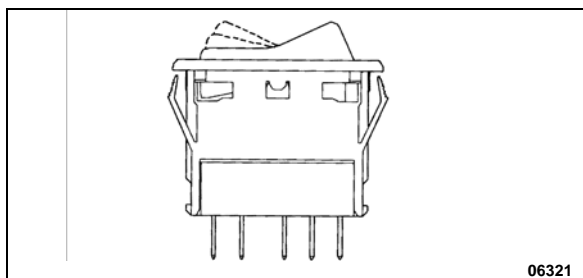
#### 13.1 CONTROL PANEL LIGHTING

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.

The gauge lights, panel lights, switch lights and indicator lights have a different bulb arrangement. Thus, the procedure to change a defective bulb can vary according to the application.

##### 13.1.1 Switch Lighting

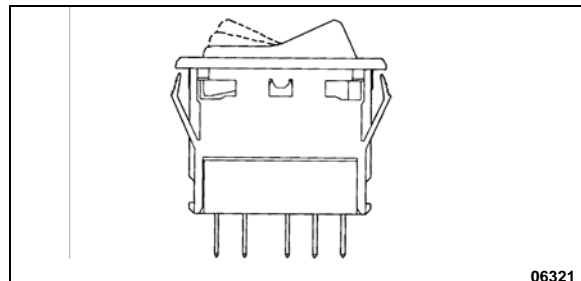
1. Slightly pull the switch with a defective LED away from the control panel.
2. Disconnect the electric cable from the switch.
3. To install a new switch, reverse the procedure (



4. Figure 58).

**NOTE**

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



**FIGURE 56: SWITCH**

##### 13.1.2 Telltale Light Replacement

Telltale module is non-serviceable and must be replaced as a unit.

1. Unscrew and remove the top dashboard panel.
2. Remove the telltale back wire electric connectors.
3. Unscrew and remove the telltale module.
4. To replace the telltale module, reverse the procedure.

##### 13.1.3 Gauge Light Bulb Replacement

1. For any gauge light bulb replacement, the dashboard panel must be removed in order to have access to the rear of gauges.
2. Remove bulb socket from the gauge, turn the defective bulb counterclockwise and pull it out of the gauge.
3. Push a new bulb and socket ASM and turn clockwise to lock in place.
4. Replace the rear dashboard housing.

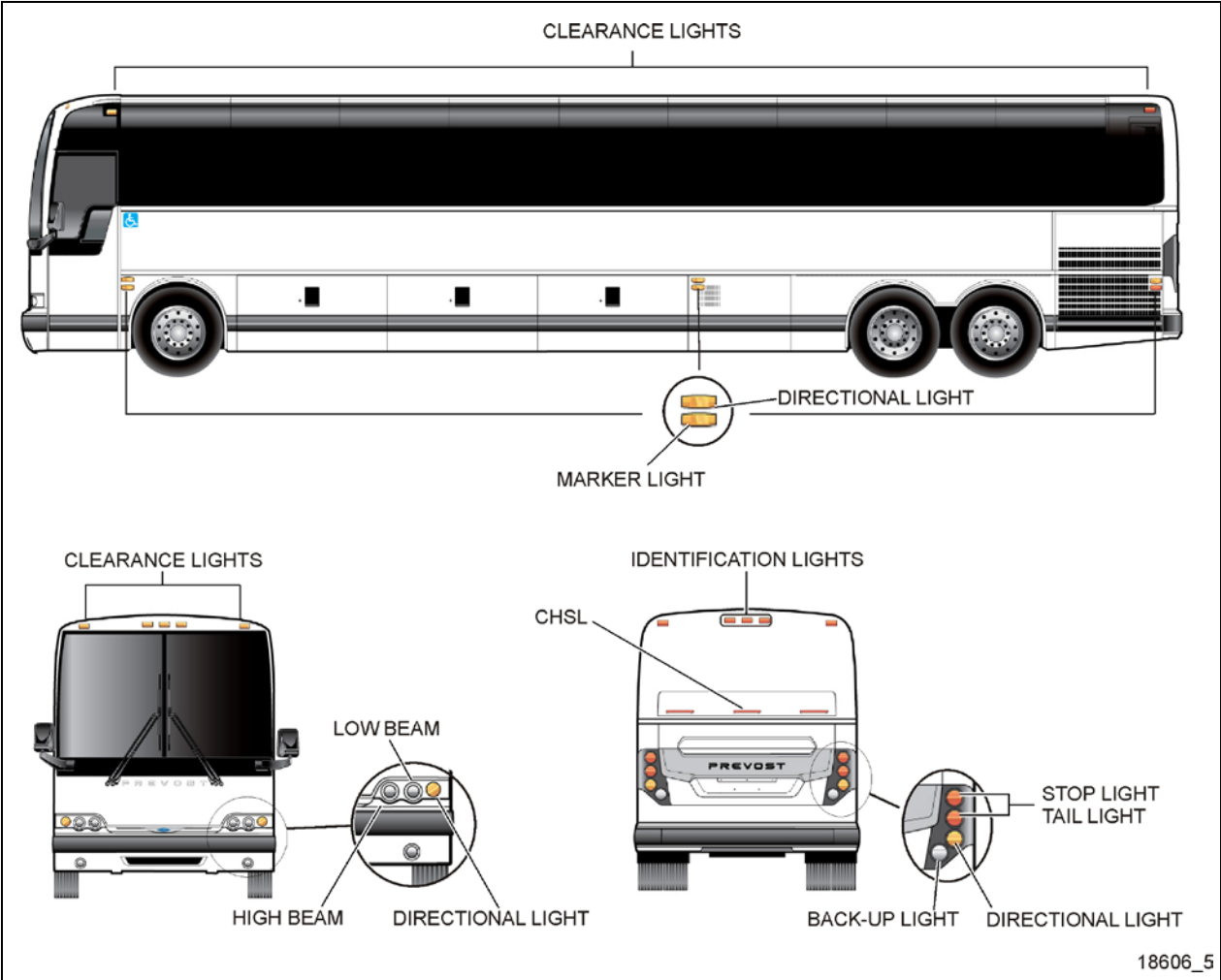


FIGURE 57: VARIOUS LIGHTS LOCATION

13.2 STEPWELL LIGHTS

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

13.2.1 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.

13.3 LAVATORY NIGHT-LIGHT

The lavatory night-light is illuminated as soon as the ignition switch is set to the "ON" position.

13.3.1 Bulb Removal and Replacement

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.

13.4 DRIVER'S AREA LIGHTS

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

13.4.1 Bulb Removal and Replacement

1. Unsnap the lamp with a flat head screwdriver and remove it.

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.

### 13.5 PASSENGER SECTION LIGHTING

The passenger section of coach is lit by two types of fluorescent tube lamps installed on the parcel racks. The aisle or indirect lights are located on front of parcel racks, and provide soft, indirect cabin lighting and parcel rack interior lighting. More powerful lighting for general and in-station applications is provided by fluorescent tubes located under the parcel racks, close to the windows. A dual power system is available for this lighting either from the 24 volt vehicle power supply or from a 110 volt outlet supply. In order to save batteries during extended periods of in-station lighting, no current is drawn from the batteries as soon as the 110 volt circuit is connected.

Moreover, adjustable reading lamps are installed under the parcel racks for passenger accommodation.

#### 13.5.1 Fluorescent Tube Replacement

##### Indirect Fluorescent Light

1. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Let the hinged cover down.
2. Remove fluorescent tube from light socket.
3. Install a new fluorescent tube.
4. Lift the hinged cover and replace the two retaining screws.

##### Parcel Rack Interior Lighting

1. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Pull the hinged cover down.
2. Push on the bulb, turn and then, pull it from the socket.
3. Install a new bulb.

4. Lift the hinged cover and replace the two retaining screws.

#### 13.5.2 Removal and Replacement of In-Station Fluorescent Tubes

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.

**CAUTION**

The lens is fragile. Be very careful when removing and handling.

2. Rotate and pull the fluorescent tube from its sockets.
3. Install a new fluorescent tube, rotating the tube to secure it in the sockets.
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.

#### 13.5.3 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.

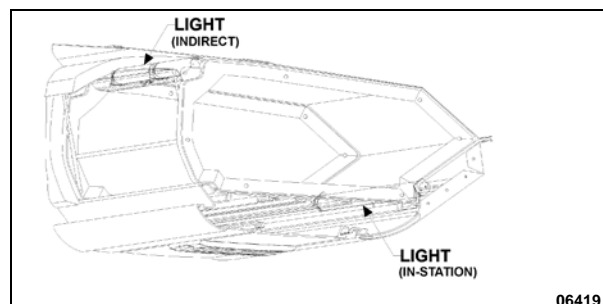


FIGURE 58: PARCEL RACK LIGHTING

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### 13.6 ENGINE COMPARTMENT LIGHTING

Two 24-volts LED module 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.
3. Engine compartment lighting switch on rear engine start panel in ON position.

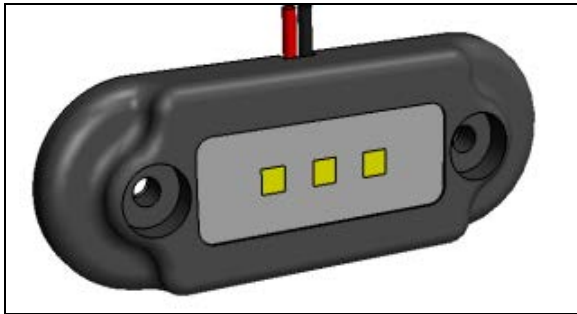


FIGURE 59: ENGINE COMPARTMENT LIGHT

Each light is sealed and can be replaced as follows:

4. Disconnect the light unit connection.
5. Remove the lamp.
6. Position new lamp.
7. Connect the light unit.
8. Make sure the retaining ring is installed properly.

### 13.7 LAVATORY LIGHT

The halogen lavatory light is 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.

Bulb removal and replacement:

1. Unsnap the lamp with a flat head screwdriver and remove it.
2. Pull the defective bulb out of the socket.
3. Install the new bulb by pushing it into position.
4. Replace the lamp by snapping it back in place.
- 5.



## CAUTION

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

## 14. H3 SERIES EXTERIOR LIGHTING

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams. Wiring diagrams are located in the Technical Publication box.

### 14.1 HEADLIGHTS

Inner headlights are used for high beam and daytime running light while outer headlights are used for low beam. The inner or outer lamp uses the same single filament halogen bulb part number.

## NOTE

*If vehicle is equipped with optional Xenon headlights, refer to paragraph 6.1.6.*

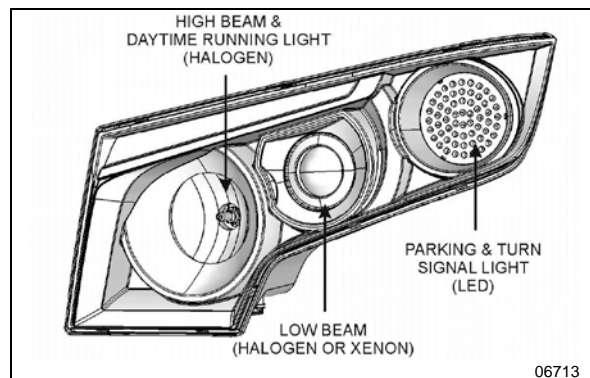


FIGURE 60: HEADLIGHT ASSEMBLY

#### 14.1.1 Headlight Beam Toggle Switch

The multifunction lever located on the steering column is used to select proper lighting. High beams or low beams can be selected by pulling the lever rearward. A high beam indicator on the central dashboard panel is illuminated when the high beam circuit is energized.

## NOTE

*Pulling the lever rearward while the lights are off will flash the headlights.*

## 14.1.2 Maintenance

Clean headlights with soap and water.

## 14.1.3 Replacing headlight bulbs

The following illustrations show how to gain access to the bulbs. When replacing a bulb, make sure the ignition switch and light switch are off.

**CAUTION**

- To prevent burning yourself, do not replace the light bulbs while they are hot.
- Halogen bulbs have pressurized gas inside and require special handling. They can burst or shatter if scratched or dropped. Hold a bulb only by its plastic case. Do not touch the glass part of a bulb with bare hands.

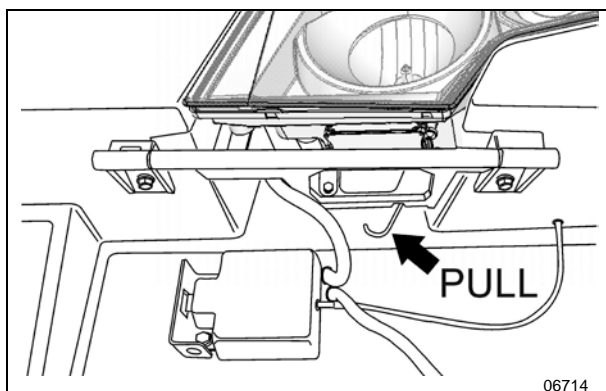
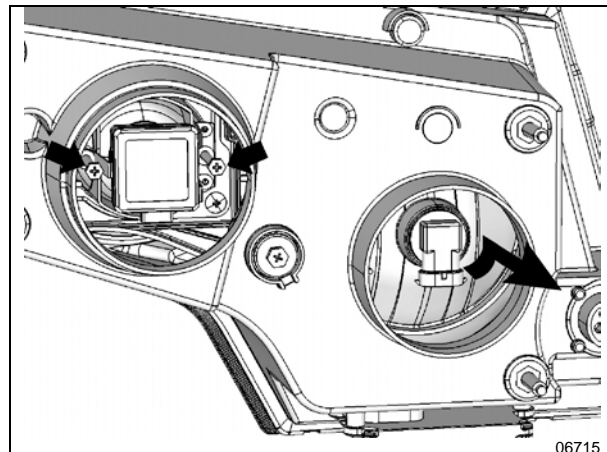


FIGURE 61: ROCKING THE HEADLIGHT ASSEMBLY

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. Pull on the rod shown on figure 29 to pivot the headlight assembly.
4. Unscrew the cap to gain access to the bulb connector.
5. HALOGEN: turn the bulb base counterclockwise. XENON: Unscrew the Phillips head screws indicated by arrows, pull the retainer and bulb out (



6. FIGURE 64).

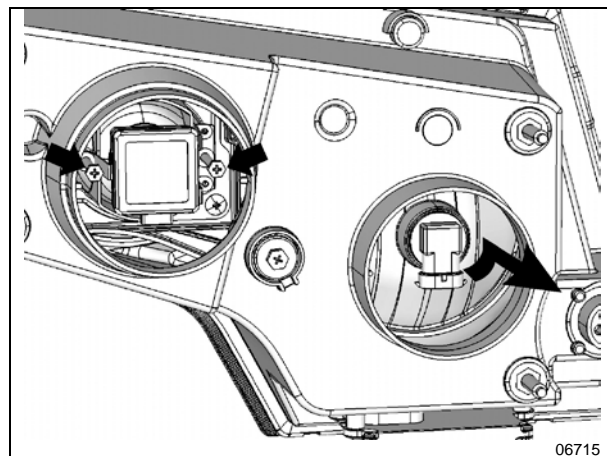


FIGURE 62: HEADLIGHT ASSEMBLY REAR VIEW

**CAUTION**

During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

7. Unplug the connector while depressing the lock release when applicable.
8. Replace bulb, connect to harness and install into mounting hole.

Aiming is not necessary after replacing the bulb. When aiming is necessary, refer to paragraph "HEADLIGHT AIMING".

## 14.1.4 Replacing Front Turn Signal LED module

The front turn signal is part of the front headlight assembly. The turn signal is a sealed unit (LED) located on each front corner and should be


replaced as an assembly. Turn signal is visible from both front and side.


**Removal and Replacement**

1. Rotate the cap to gain access to the LED module.
2. Disconnect the electrical harness connector from the LED module.
3. Unscrew the 3 mounting fasteners and replace LED module.
4. Install wiring connector on back of new turn signal module.

**14.1.5 Optional Xenon Headlamp (Low Beam)**

The outer lamps of each headlight assembly may be equipped with the optional Xenon lamps. These lamps improve visibility and provide better lifespan.

|   |                       |
|---|-----------------------|
|                | <p><b>CAUTION</b></p> |
| <p>To avoid breaking the bulb, make sure the socket is in proper position against the stop.</p> |                       |

|   |                       |
|---|-----------------------|
|                  | <p><b>CAUTION</b></p> |
| <p>Never connect a voltmeter or V.O.M. to measure bulb voltage as instrument will be destroyed.</p> |                       |

|   |
|---|
| <p><b>NOTE</b></p>  |
| <p><i>Do not disrupt headlight adjustment screws.</i></p> |

When switching on the Xenon headlamp using the rocker switch, a 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 30mA 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).

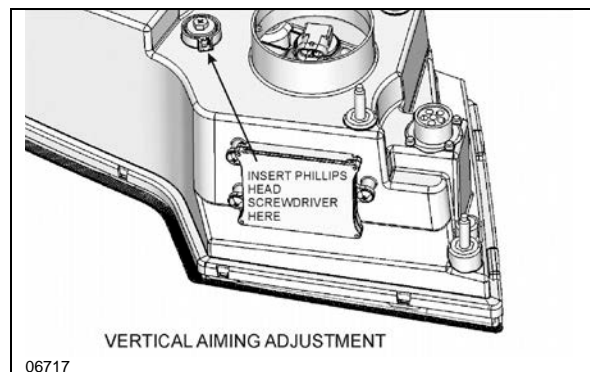
After taking out the lamp, the contact pins are in a practically idle stat (< 34 Volt) after < 0.5 seconds so that there is no immediate danger of electric shock even if the warning is disregarded.

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 1.58A after one minute for the 24V ballast.

**14.1.6 Aiming headlights**

Headlights must be properly aimed to provide maximum allowable road illumination. Aiming can be performed without opening headlight assembly. Vertical aiming of each module is provided by one adjusting screw that pivots the entire module in the housing for proper alignment (



**FIGURE 66).** There is no adjustment for focus since the module is set for proper focus during manufacturing assembly.

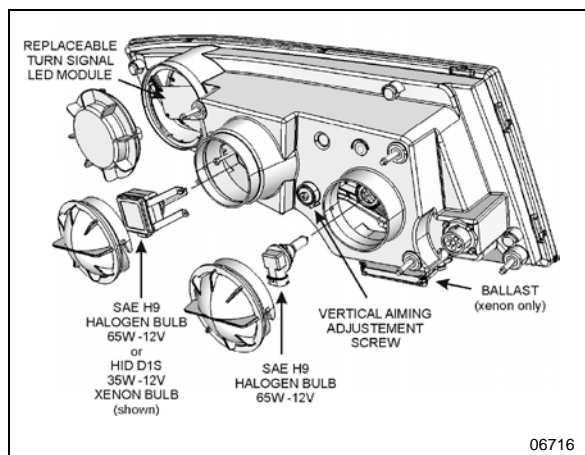


FIGURE 63: HEADLIGHT ASSEMBLY

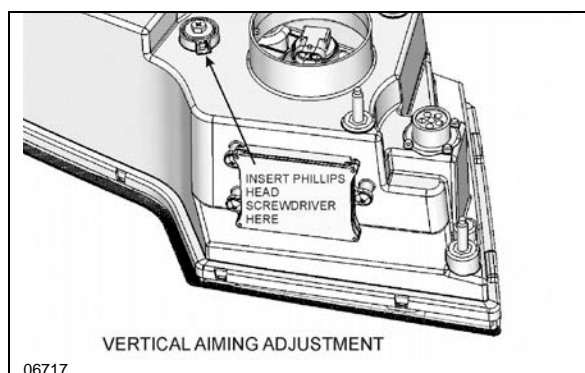


FIGURE 64: VERTICAL AIMING

## 14.2 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.

### 14.2.1 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.

### 14.2.2 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.



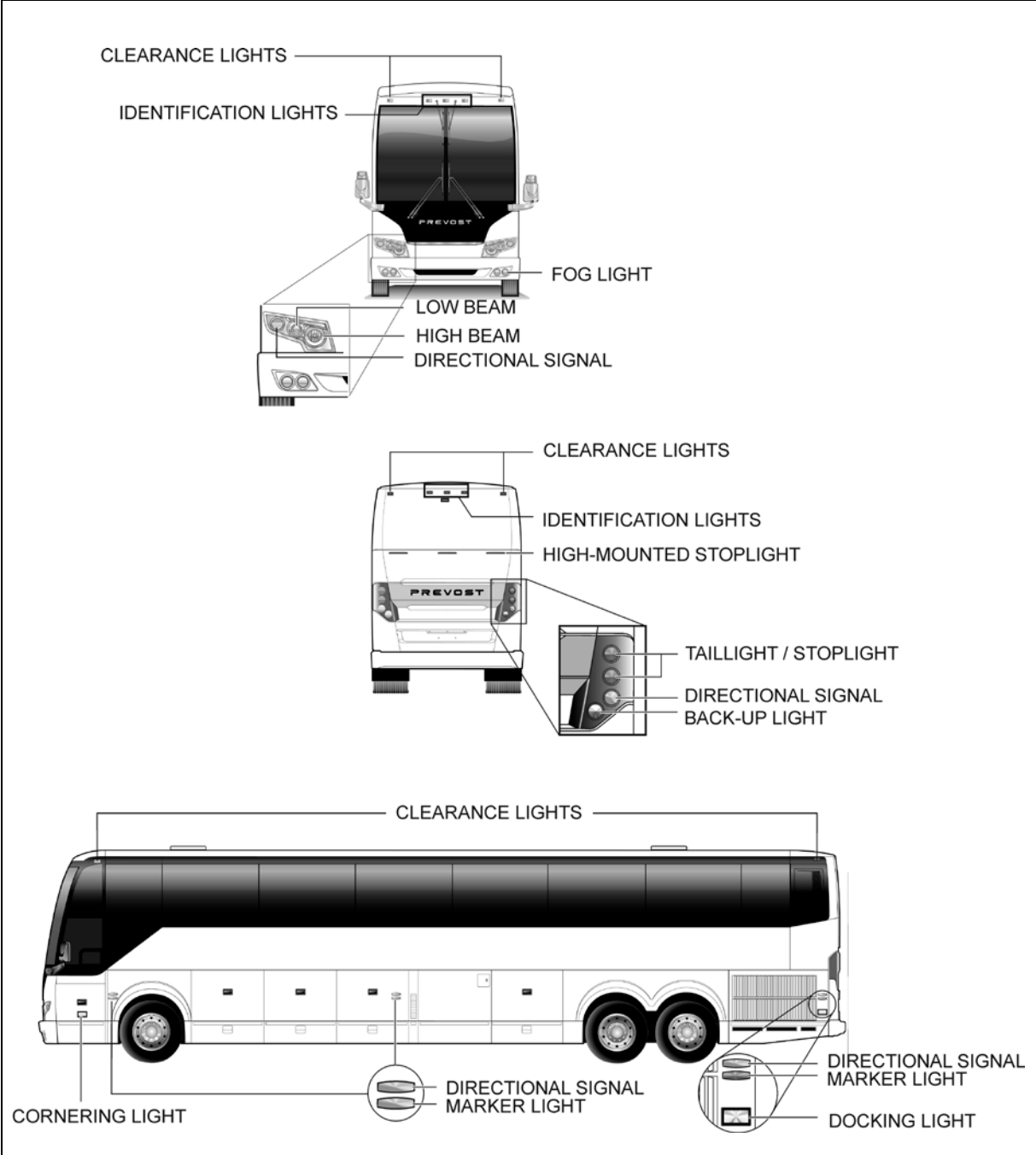


FIGURE 65: VARIOUS LIGHT LOCATIONS

### 14.3 LICENCE 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.

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

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

#### 14.4.1 Marker Light Removal And Replacement

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" light screws, disconnect and remove the light assembly.
2. Connect and position the new light assembly and install the "Phillips" screws.

#### 14.4.2 Clearance And Identification Light Removal And Replacement

The clearance and identification lights are sealed units (LED) and should be replaced as an assembly in accordance with the following procedure:

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

### 14.5 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.

### 14.6 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.

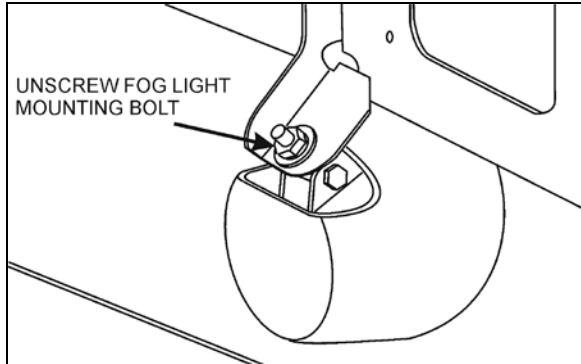
### 14.7 FOG LIGHTS

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

#### 14.7.1 Bulb Removal And Replacement

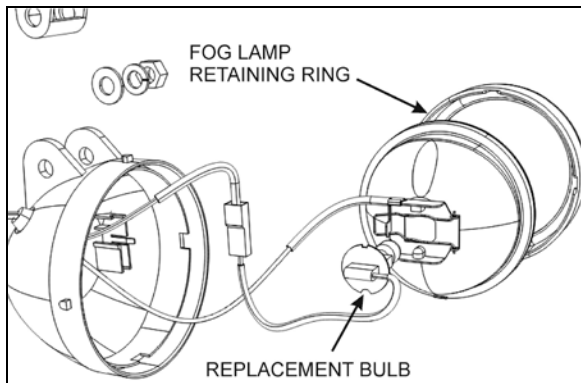
1. Pull on the release handle located in the front electrical and service compartment,

near the door lower hinge. The bumper will lower gradually.



**FIGURE 66: FOG LIGHT MOUNTING BOLT**

2. From bumper inner side, unscrew the nut fixing the fog light and remove the entire fog light assembly from the bumper.
3. Unscrew the outer ring. Disconnect the light unit connection and remove the bulb.



**FIGURE 67: FOG LIGHT EXPLODED VIEW**

|   |                       |
|---|-----------------------|
|   | <p><b>CAUTION</b></p> |
| <p>During this step, avoid contacting the bulb with your fingers. This could alter the bulb life.</p> |                       |

6. Install the new bulb, reconnect the light unit and replace in its proper position.
7. Reinstall the outer ring, then return the fog light assemble to its proper location.
8. Fasten the fog light mounting nut and securely close the bumper.

**15. H3 SERIES INTERIOR LIGHTING**

**15.1 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

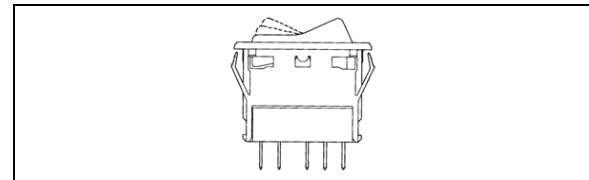
position. A control dimmer located on the dashboard is used to vary the brightness of the panel gauges, switches and indicator lights.

The gauge lights, panel lights, switch lights and indicator lights have a different bulb arrangement. Thus, the procedure to change a defective bulb can vary according to the application.

**15.1.1 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 70**).

|  |
|--|
| <p><b>NOTE</b></p>   |
| <p><i>Switches are lighted by the use of LED. When lighting on a switch fails, replace defective switch as a unit.</i></p> |



**FIGURE 68: SWITCH**

**15.1.2 Telltale Light Replacement**

Telltale module is non-serviceable and must be replaced as a unit.

1. Unscrew and remove the top dashboard panel.
2. Remove the telltale back wire electric connectors.
3. Unscrew and remove the telltale module.
4. To replace the telltale module, reverse the procedure.

**15.1.3 Gauge Light Bulb Replacement**

1. For any gauge light bulb replacement, the dashboard panel must be removed in order to have access to the rear of gauges.
2. Remove bulb socket from the gauge, turn the defective bulb counterclockwise and pull it out of the gauge.

3. Push a new bulb and socket ASM and turn clockwise to lock in place.
4. Replace the rear dashboard housing.

## 15.2 STEPWELL LIGHTS

### 15.2.1 Coach Entrance

The stepwell lights are illuminated when the door opening system is activated (

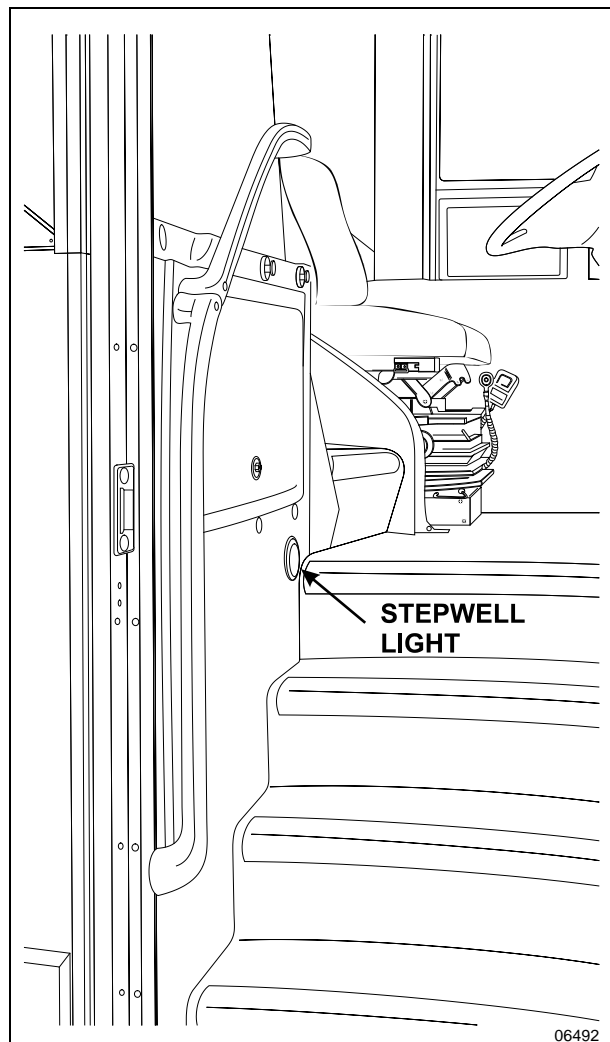


FIGURE 71).

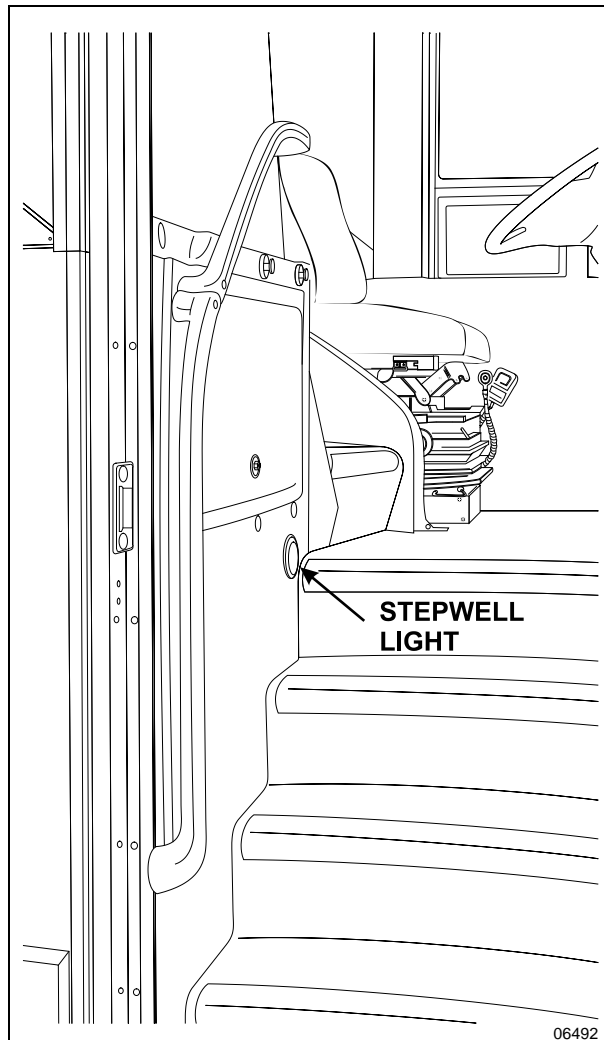


FIGURE 69: COACH ENTRANCE STEPWELL

#### Light Removal and Replacement

1. Unsnap the lamp outer ring with a flat head screwdriver 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.

### 15.2.2 VIP Entrance

The stepwell light is illuminated when the door opening system is activated (

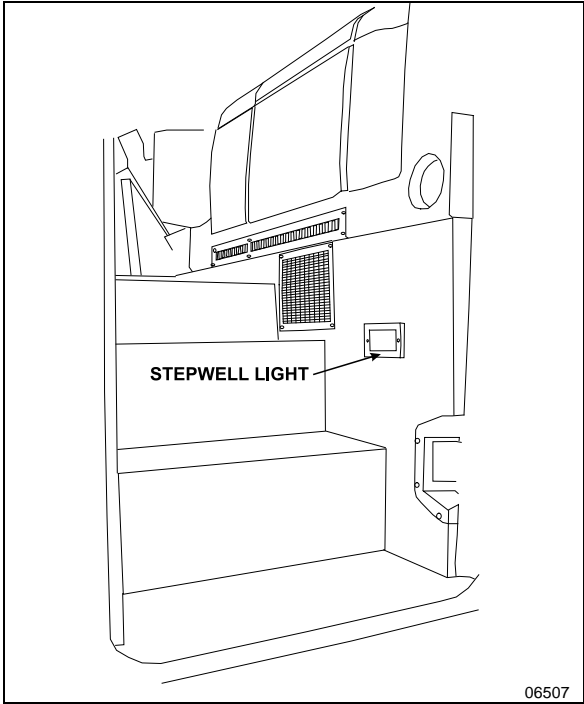


FIGURE 72).

15.2.3 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.

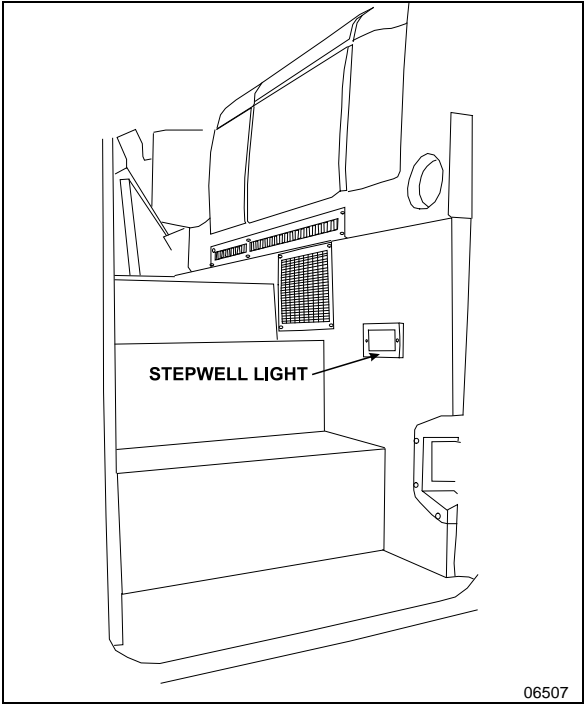


FIGURE 70: VIP ENTRANCE STEPWELL

15.3 LAVATORY NIGHT-LIGHT

The lavatory night-light is illuminated as soon as the ignition switch is set to the "ON" position.

15.3.1 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.

15.3.2 DRIVER'S AREA LIGHTS

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

15.3.3 Bulb Removal And Replacement

1. Unsnap the lamp with a flat head screwdriver and remove it.
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.

#### 15.4 PASSENGER SECTION LIGHTING

The passenger section of coach is lit by two types of fluorescent tube lamps installed on the parcel racks.

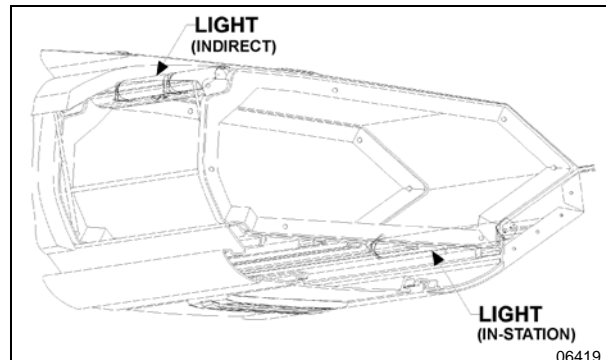
The aisle or indirect lights are located on front of parcel racks, and provide soft, indirect cabin lighting and parcel rack interior lighting. More powerful lighting for general and in-station applications is provided by fluorescent tubes located under the parcel racks, close to the windows. A dual power system is available for this lighting either from the 24-volt vehicle power supply or from a 110-volt outlet supply. In order to save batteries during extended periods of in-station lighting, no current is drawn from the batteries as soon as the 110-volt circuit is connected.

Moreover, adjustable reading lamps are installed under the parcel racks for passenger accommodation.

##### 15.4.1 Fluorescent Tube Replacement

###### Indirect Fluorescent Light

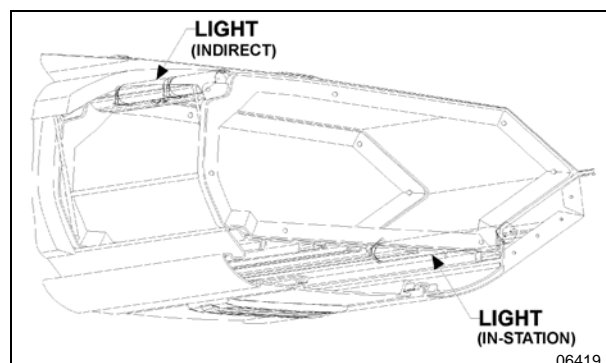
1. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Let the hinged cover down.
2. Remove fluorescent tube from light socket and install a new fluorescent tube.
3. Lift the hinged cover and replace the two retaining screws (



4. **FIGURE 73).**

###### Parcel Rack Interior Lighting

5. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Pull the hinged cover down.
6. Push on the bulb, turn and then, pull it from the socket.
7. Install a new bulb.
8. Lift the hinged cover and replace the two retaining screws.



**FIGURE 71: PARCEL RACK**

##### 15.4.2 Removal And Replacement Of In-Station Fluorescent Tubes

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.

**CAUTION**

The lens is fragile. Be very careful when removing and handling.

2. Rotate and pull the fluorescent tube from its sockets.
3. Install a new fluorescent tube, rotating the tube to secure it in the sockets.

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.

#### 15.4.3 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.

#### 15.5 ENGINE COMPARTMENT LIGHTING

Two 24-volts LED module 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.
3. Engine compartment lighting switch on rear engine start panel in ON position.

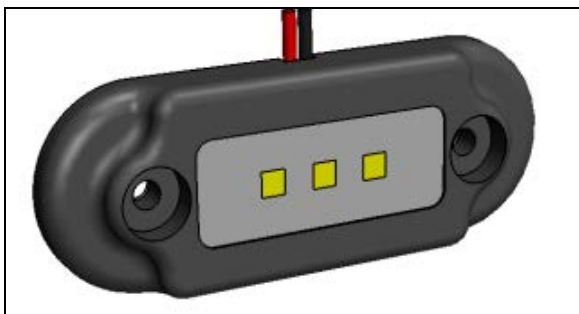


FIGURE 72: ENGINE COMPARTMENT LED MODULE

#### 15.6 LAVATORY 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.

Proceed as follows to replace the bulb:

1. Unsnap the lamp with a flat head screwdriver and remove it.
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.

#### 16. LIGHT BULB DATA

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

#### NOTE

*Exterior and interior lights can be 12 volts or 24 volts.*

**17. SPECIFICATIONS****Maintenance Free Battery**

|                                    |                    |
|------------------------------------|--------------------|
| Make.....                          | Volvo              |
| Model.....                         | 20359831           |
| Type .....                         | Maintenance-free   |
| Terminal type.....                 | Top Stud           |
| Group size .....                   | 31                 |
| Volts .....                        | 12                 |
| Load test amperage .....           | 290                |
| Reserve capacity (minutes).....    | 195                |
| Cold cranking (in amps)            |                    |
| -At 0°F (-18°C).....               | 950 (each battery) |
| Maximum dimensions (inches/mm)     |                    |
| -Length (including flange).....    | 13.0 / 330         |
| -Width.....                        | 6.7 / 169          |
| -Height (including top posts)..... | 9.3 / 237          |
| -Approximate weight (lbs/kg).....  | 59 / 27            |

\* Battery tester cable clamps should be between terminal nuts and lead pads of terminals. If not possible, load value should be 210 amperes.

**AGM Battery**

|                                    |                    |
|------------------------------------|--------------------|
| Make.....                          | Volvo              |
| Model.....                         | 21258363           |
| 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            |

**Torque specifications**

|                            |                        |
|----------------------------|------------------------|
| Battery cable to post..... | 13-15 lb-ft (18-20 Nm) |
|----------------------------|------------------------|

**Alternator**

|                      |          |
|----------------------|----------|
| Make.....            | BOSCH    |
| Series .....         | HD 10    |
| Amperes .....        | 150      |
| Volts .....          | 28.4     |
| Output Power .....   | 3 Kw     |
| Ground .....         | negative |
| Prevost Number ..... | 564593   |

**Battery equalizer standard**

|           |        |
|-----------|--------|
| Make..... | Vanner |
|-----------|--------|



Model..... Vann-Guard 70-Series  
Amperes ..... 100 amps

**Battery equalizer ( with PRIME option )**

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

**Starter**

Make..... Mitsubishi Electric Corporation (MELCO)  
Type ..... 105P70  
Voltage ..... 24  
Prevost Number ..... 510752

**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.

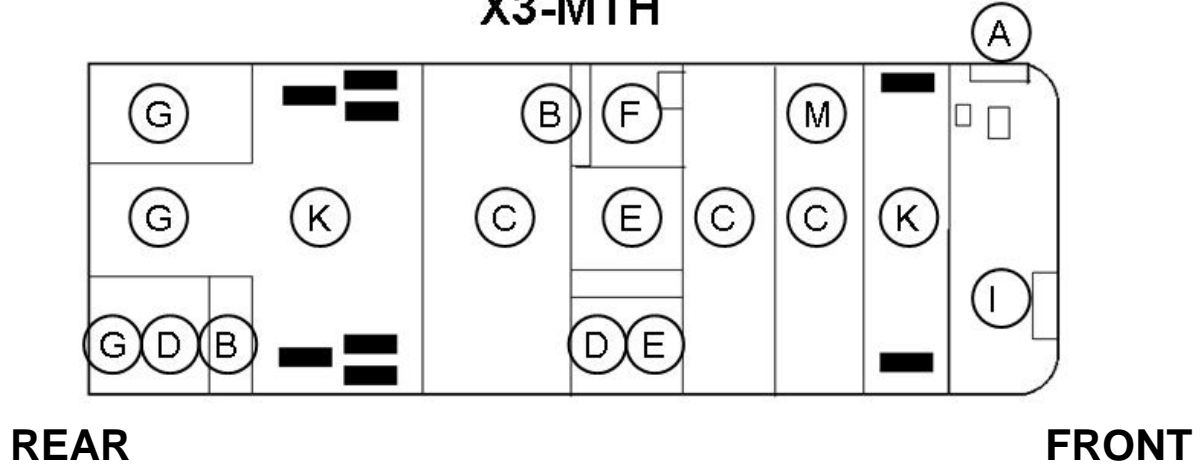
**Warning :** *Wear goggles and rubber gloves.*



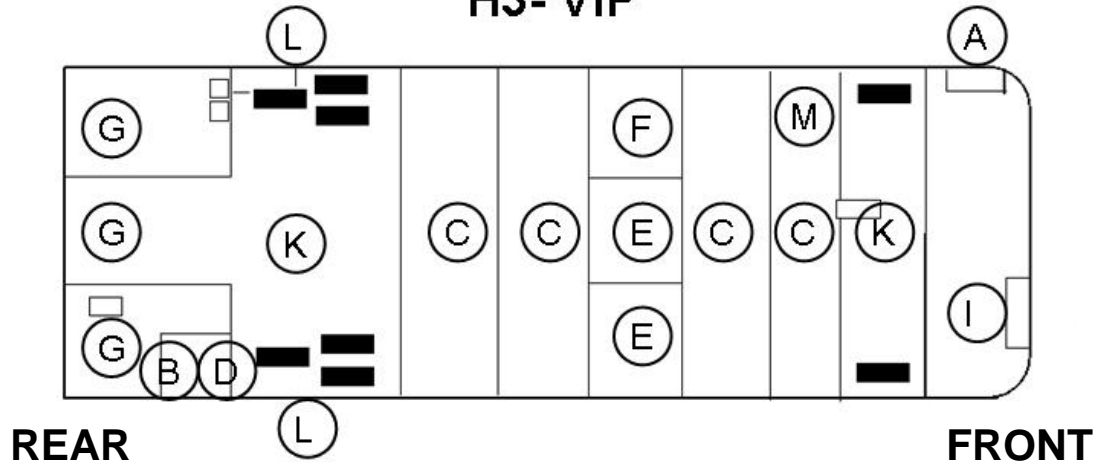
684013

### Vehicle Zoning

#### X3-MTH



#### H3- VIP



## 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    |                             |

| 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             |                             |

**PROCEDURE NO: SAV00002E**

**REVISION 02**

| Zone                | Component  | Model |    |    |     | Product     | Note                        |
|---------------------|--|-------|----|----|-----|-------------|-----------------------------|
|                     |  | MTH   | X3 | H3 | VIP |             |                             |
| G- Engine Compt     | 120A 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 |                             |
|  |  |       |    |    |     |         |                             |
|  |  |       |    |    |     |         |                             |
|  |  |       |    |    |     |         |                             |




**MAINTENANCE  
INFORMATION**

**MI15-24**

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

**APPLICATION**

| Model  | VIN |
|--|-----|
|  <p>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 damages 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.*

| <b>POWER CABLES MAINTENANCE SCHEDULE</b> |                |
|--|----------------|
| 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 Bussman junction block in the electrical compartment (Figure 1, Figure 2, Figure 3).

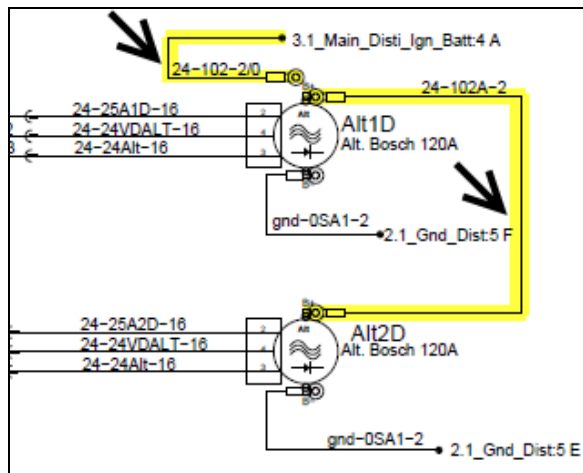


Figure 1

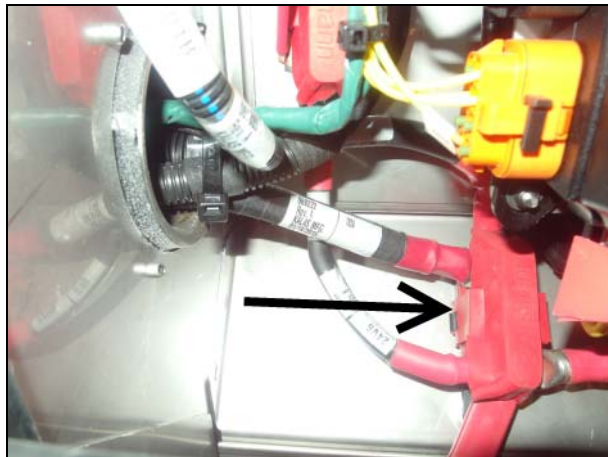


Figure 2: Bussman Junction Block - X3 Series.



Figure 3: Bussman Junction Block - H3 Series.

- On the **starter positive (+) stud terminals** and from there, up to Bussman junction block in the electrical compartment (Figure 4, Figure 5).

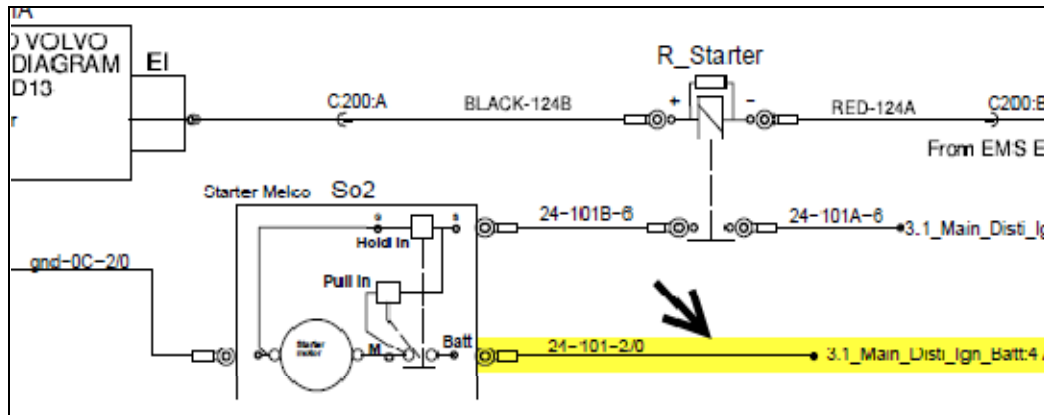


Figure 4



Figure 5: starter cables

- In the electrical compartment, **connected to Bussman junction block** (Figure 6).

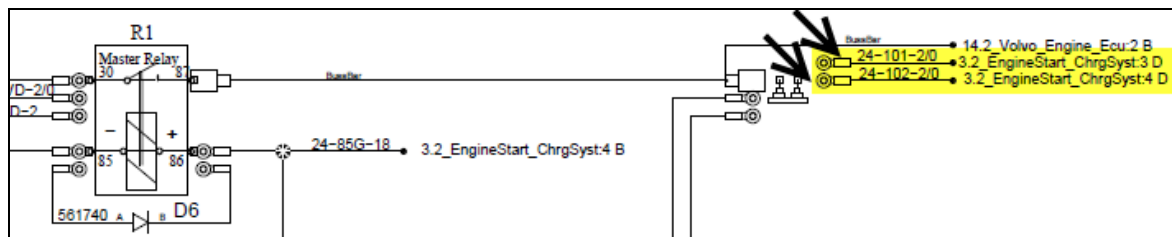


Figure 6

- In the **battery compartment** between **battery no2 and master relay R1** (Figure 7).

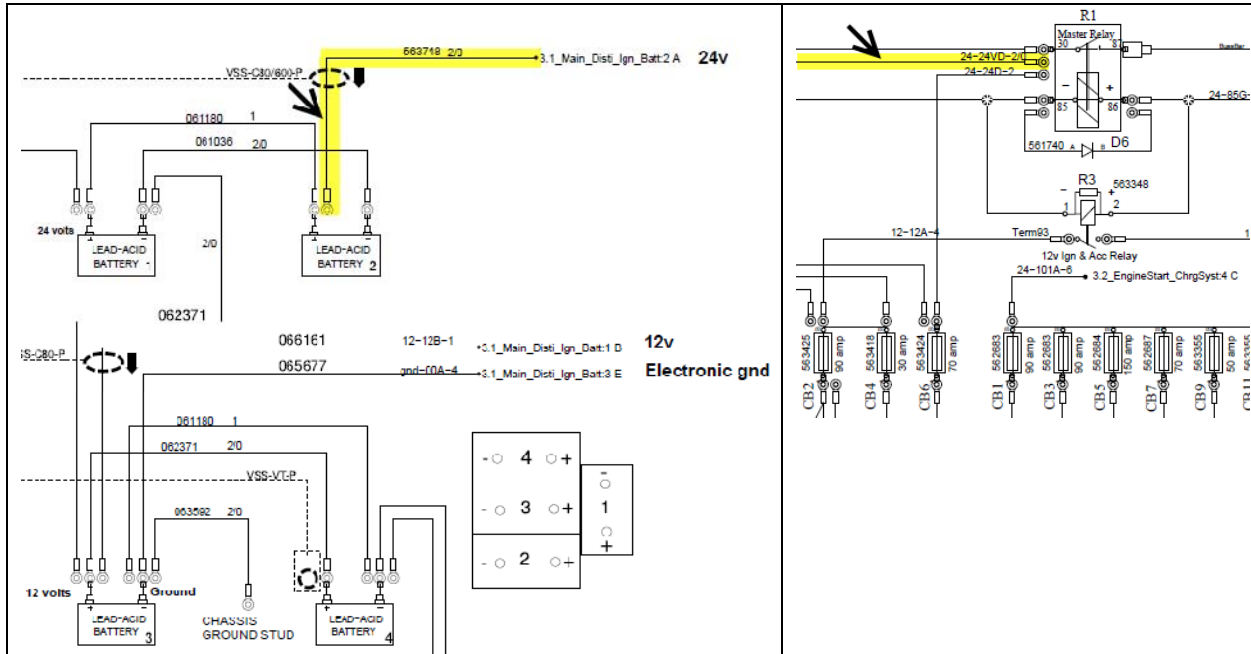


Figure 7

- Between **Bussman junction block** and **main circuit breakers' bus bar** (Figure 8).

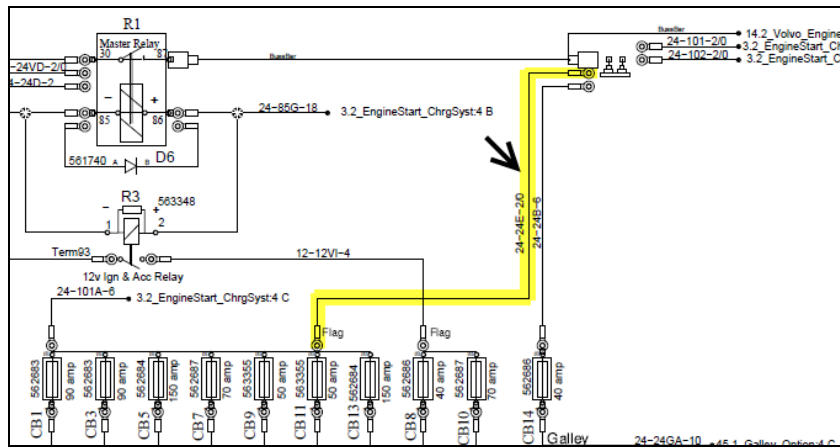


Figure 8



Figure 9: Power cable on main circuit breakers' bus bar.

## 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.

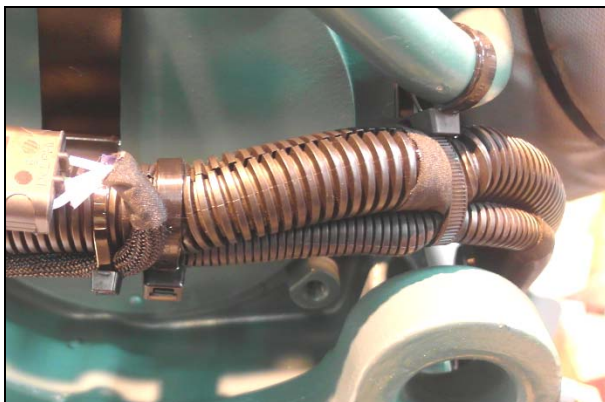


Figure 10: starter cables in a corrugated protective sheath.

- 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 11). The ends of the corrugated protective sheath should be covered with fabric tape (Figure 12).

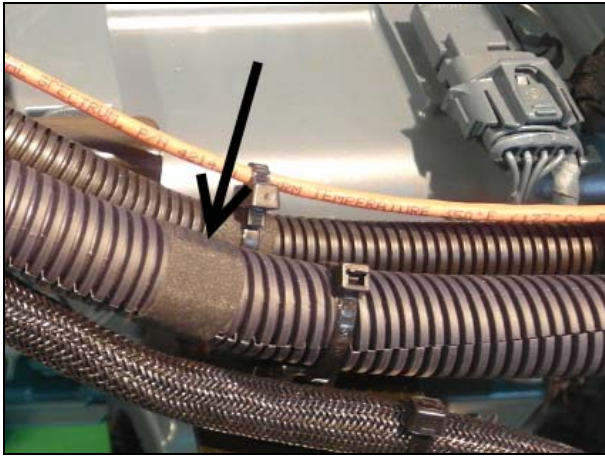


Figure 11: Two layers of fabric tape applied every 3 to 6 inches to prevent the cable from coming out of the corrugated protective sheath.

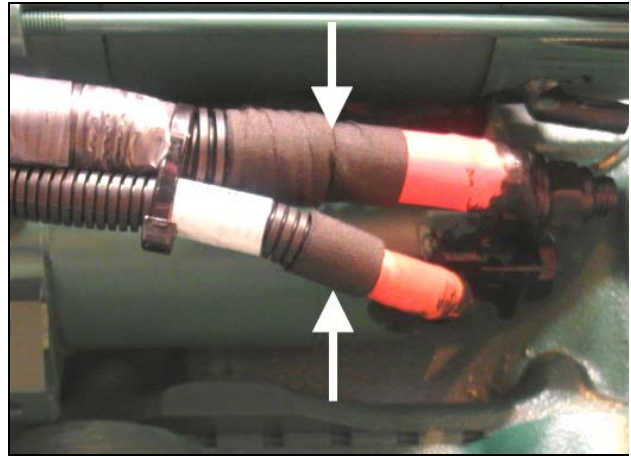


Figure 12: The ends of the corrugated protective sheath should be covered with fabric tape.

- 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

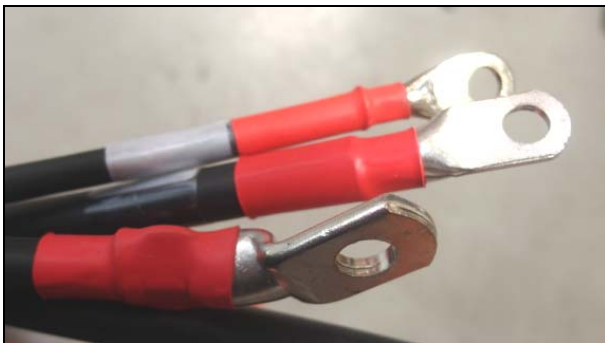


Figure 13: Cable lugs must be closed type, crimped or welded.

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

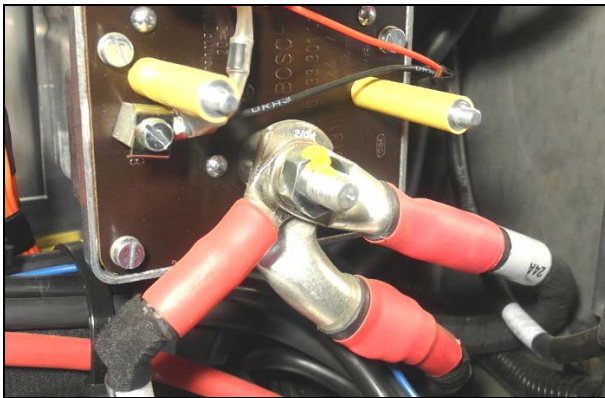


Figure 15: When several terminals are connected on a single stud terminal, the largest cable lug must be placed first, followed by the second larger and so on. Cable lugs should be distributed around the stud terminal in a way that no cable lug is distorted when tightening the nut.



Figure 16: 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 17: battery bank

## STEEL P-CLAMPS

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Figure 18: 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 19: P-clamp with appropriate diameter prevents the power cable or corrugated protective sheath from moving and rubbing inside the clamp.

## ALTERNATORS

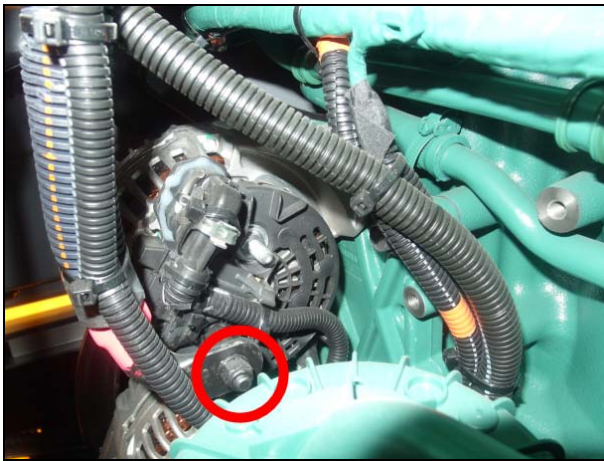


Figure 20: Make sure power cables/positive cables (+) are properly connected to alternator, that stud terminal nuts are properly tightened.

### TERMINAL NUT PRESCRIBED TORQUE

#### 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 21: 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 22: 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

- 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 23**) (Prevost p/n: 684013).



Figure 23: Loctite Color Guard.



Figure 24: Upper alternator power cable lug protected with Color Guard rubber coating.

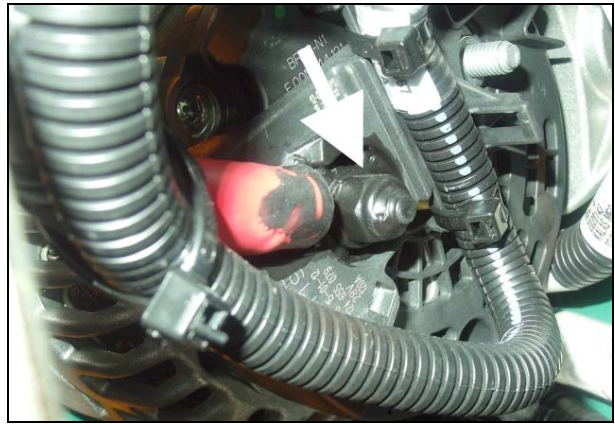


Figure 25: Lower alternator power cable lug protected with Color Guard rubber coating.

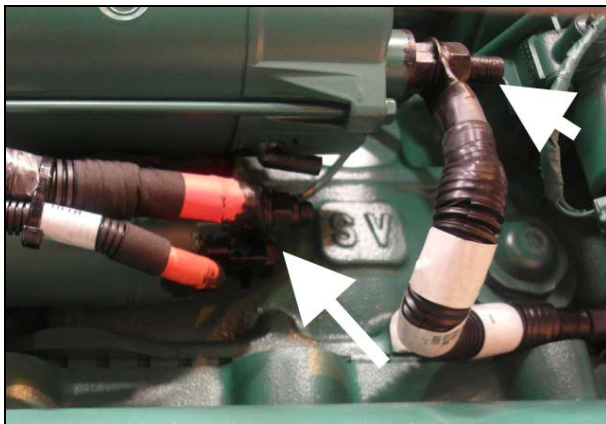


Figure 26: Starter power cable and ground cable lugs protected with Color Guard rubber coating.

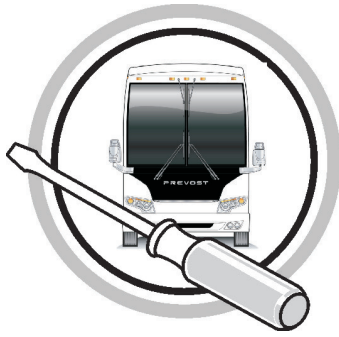
## **PARTS / WASTE DISPOSAL**

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<br/>INSTALLATION</b> |                          |

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

<https://techpub.prevoStcar.com/en/>

