Table of Contents

1. BACK-UP LIGHTS

1.1. CIRCUIT FUNCTIONS

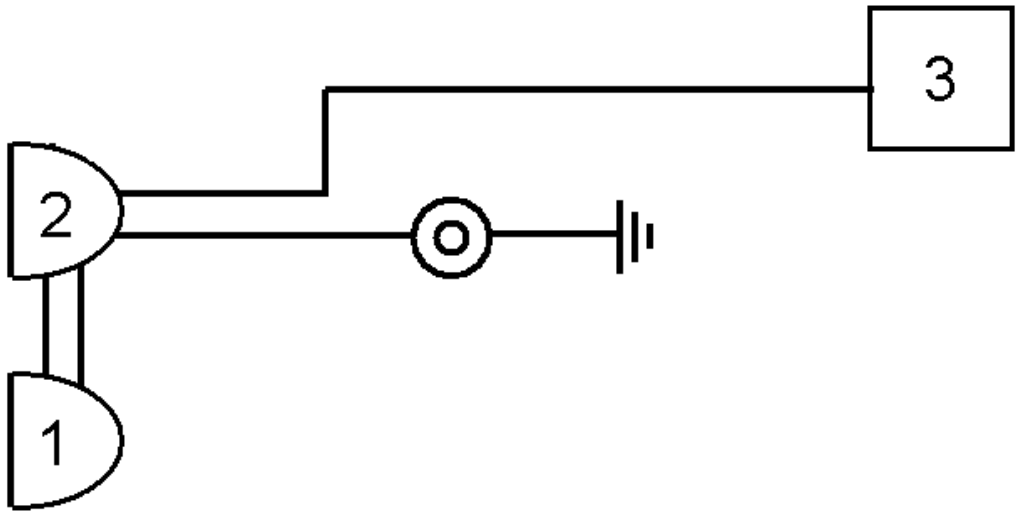

Figure 409 Back–Up Lights Function Diagram

1. RIGHT BACK–UP LIGHT
2. LEFT BACK–UP LIGHT
3. BACK–UP LIGHT SIGNAL FROM TRANSMISSION CIRCUITS (SEE TRANSMISSION SECTION)

The vehicle back-up lights come on when the vehicle transmission is shifted into reverse. Depending on the transmission installed on the vehicle, the lights are controlled by a switch on the transmission or a signal from the transmission electronic control unit (ECU). Refer to the Back–Up Lights Function Diagram.

This section only covers circuits from the back-up light turn signal splice (4810) to the tail lights. Refer to the transmission section for information on the circuits from the transmission to the back-up light turn signal splice.

1.2. DIAGNOSTICS

There are no diagnostic trouble codes (DTC's) associated with the back-up light circuits.

A fault in the back-up light circuits will be apparent when the transmission is shifted into reverse and the lights don't come on and back-up lamps are not burned out.

1.3. FAULT DETECTION MANAGEMENT

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to the Back–Up Lights Connector Diagram

Problems in the back-up light circuits can be caused by burned out lamps, a blown fuse, a short, an open, a faulty relay, a faulty switch on the transmission, or a failed transmission ECU.

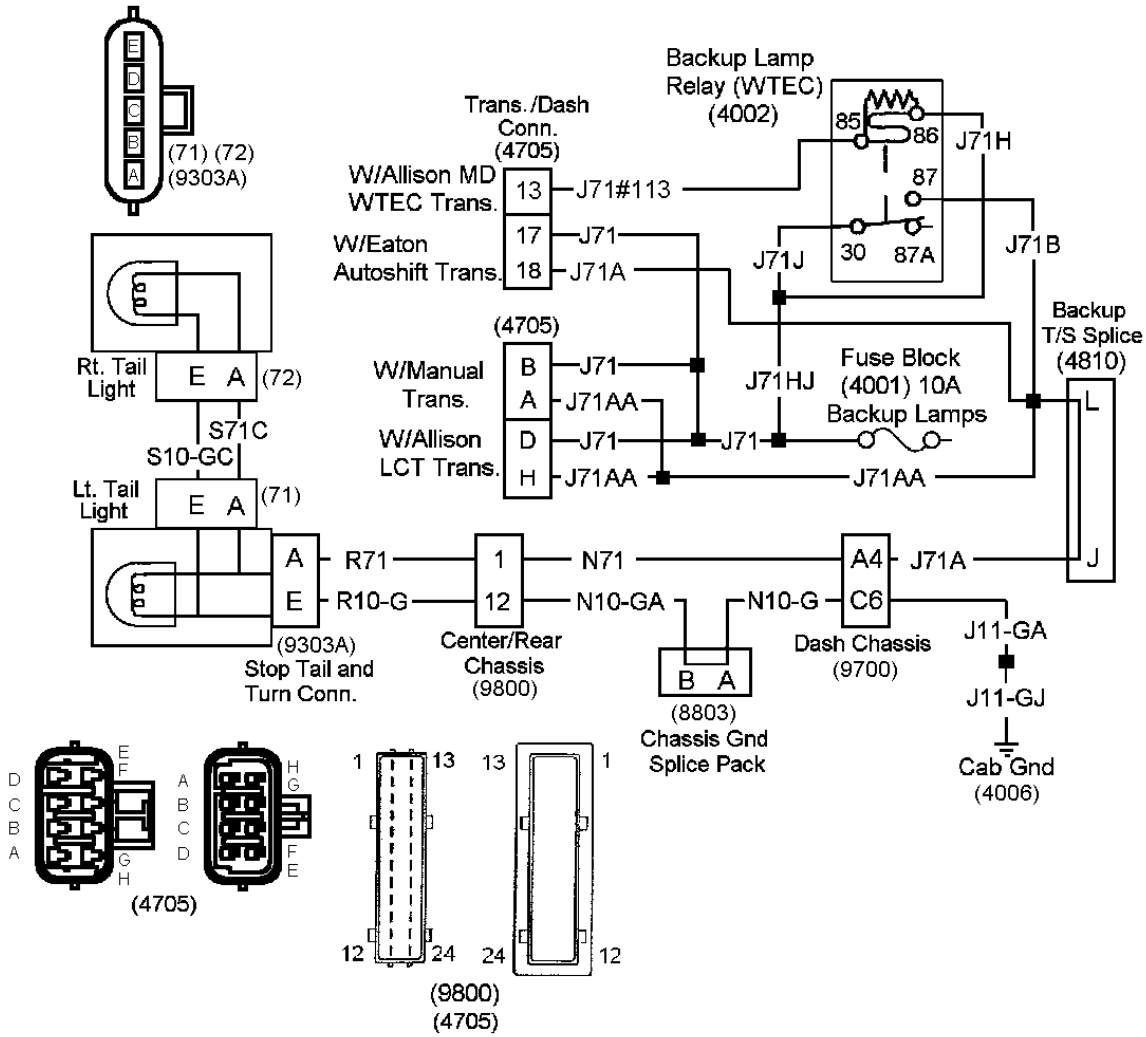

Figure 410 Back–Up Lights Connector Diagram—Always Refer to the Circuit Diagram Book for Latest Circuit Information.

(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR
(4705) TRANSMISSION/DASH CONNECTOR (TO TRANSMISSION CIRCUITS)
LOCATED IN ENGINE COMPARTMENT BY WIPER MOTOR BRACKET
(4810) BACK–UP LIGHT TURN SIGNAL SPLICE
LOCATED NEAR ENGINE POWER DISTRIBUTION CENTER
(8803) CHASSIS GROUND SPLICE PACK
(9303) STOP TAIL AND TURN CONNECTOR
(9700) CHASSIS DASH INTERCONNECT
(9800) CENTER CHASSIS/REAR CHASSIS CONNECTOR

Table 284 Back–Up Lights Circuit Tests

Stop Tail and Turn connector (9303) Check with ignition on, transmission in reverse and (9303) disconnected.		
Test Points	Spec.	Comments
With transmission in reverse, (9303) cavity A to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse, short or open in circuits between (9303) cavity A and transmission backup light switch circuits. Perform the Transmission/Dash Connector (4705) Transmission Backup light Switch check.
With transmission in reverse, (9303) cavity A to cavity E.	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits between (9303) cavity E and Cab ground (4006). Perform the Tail Light Connector (72) Resistance and Voltage checks
With transmission in neutral, (9303) cavity A to ground.	0 volts	If voltage is present, check for faulty transmission backup circuits. (See transmission section)
Transmission/Dash Connector (4705) Transmission Backup light Switch check Check with ignition on, transmission in reverse and (9303) connected.		
Manual Transmission connector (4705), jumper terminals A to B.	Backup lights on.	If backup lights off, see transmission section for switch repair.
Allison LCT Transmission connector (4705), jumper terminals D to H.	Backup lights on.	If backup lights are off, see transmission section for switch repair.
Eaton Autoshift Transmission connector (4705), jumper terminals 18 to 19.	Backup lights on.	If backup lights are off, see transmission section for switch repair.
Allison MD WTEC Transmission connector (4705), jumper terminal 13 to Ground.	Backup lights on.	If backup lights are off, see transmission section for switch repair. Check backup lamp relay (WTEC) (4002) in the engine compartment power distribution center.
Tail Light Connector (72) Resistance checks Check with (9303) disconnected		
Harness connector (72) terminal A to ground	Resistance should read >50K ohms.	If resistance is incorrect check for shorts to ground in both tail light assemblies.
Tail Light Connector (72) Voltage checks Check with transmission in reverse and (9303) connected.		
Harness connector (72) terminal A to ground	12 ± 1.5 volts.	If voltage is incorrect check for open circuits in tail light assemblies.
Harness connector (72) terminal E to terminal A	12 ± 1.5 volts.	If voltage is incorrect check for open in ground circuits in tail light assemblies.

1.4. EXTENDED DESCRIPTION

Refer to the Back–Up Lights Connector Diagram.

When the transmission is shifted into reverse, transmission circuits will apply battery voltage to backup lamp/turn signal splice (4810) and the back-up lights.

Ground for the back-up lights is supplied from ground stud (4006) to stop tail & turn connector (9303) terminal E.

1.5. COMPONENT LOCATIONS

N08-52385.02.B

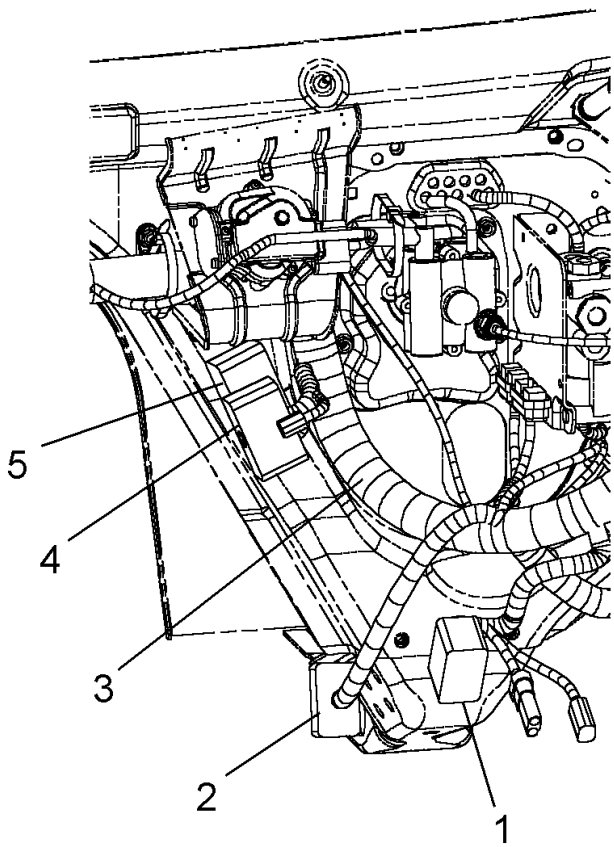

Figure 411 Stop/Turn Signal/Hazard Light Connector Locations (Engine Compartment Looking Toward Cab)

1. FORWARD CHASSIS CONNECTOR (4301)
2. DASH/CHASSIS CONNECTOR (9700)
3. TRANSMISSION CONNECTOR
4. ENGINE CONNECTOR

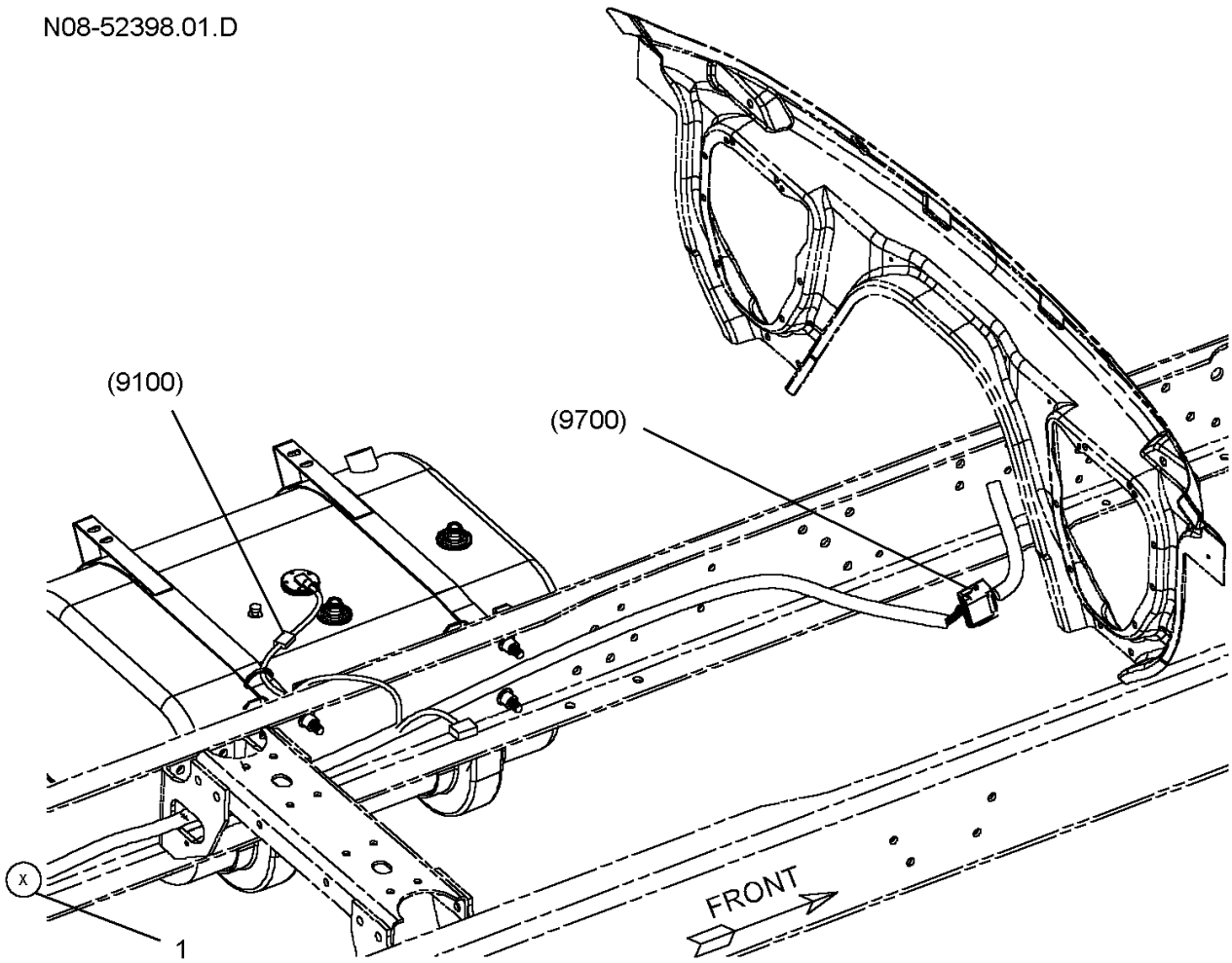

Figure 412 Rear Chassis Wiring Connector Locations

1. HARNESS TO CENTER CHASSIS WIRING
(9100) FUEL LEVEL SENDER CONNECTOR
(9700) REAR CHASSIS CONNECTOR

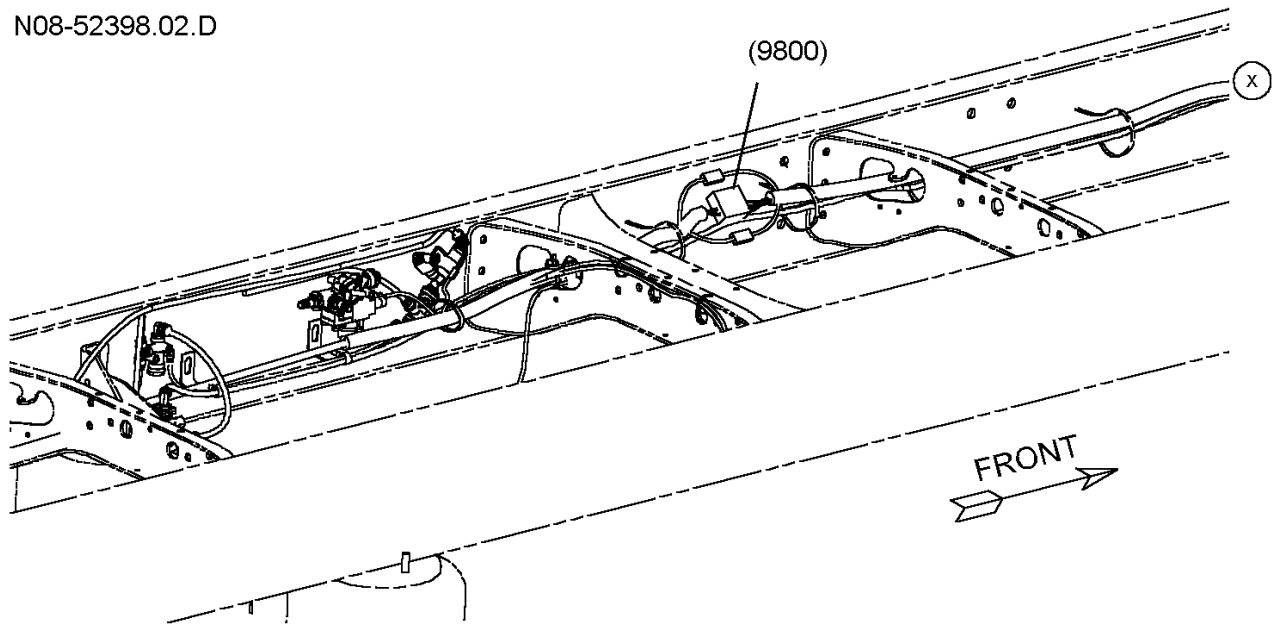

Figure 413 Rear Center Chassis Connector Locations

(9800) REAR CENTER CHASSIS CONNECTOR

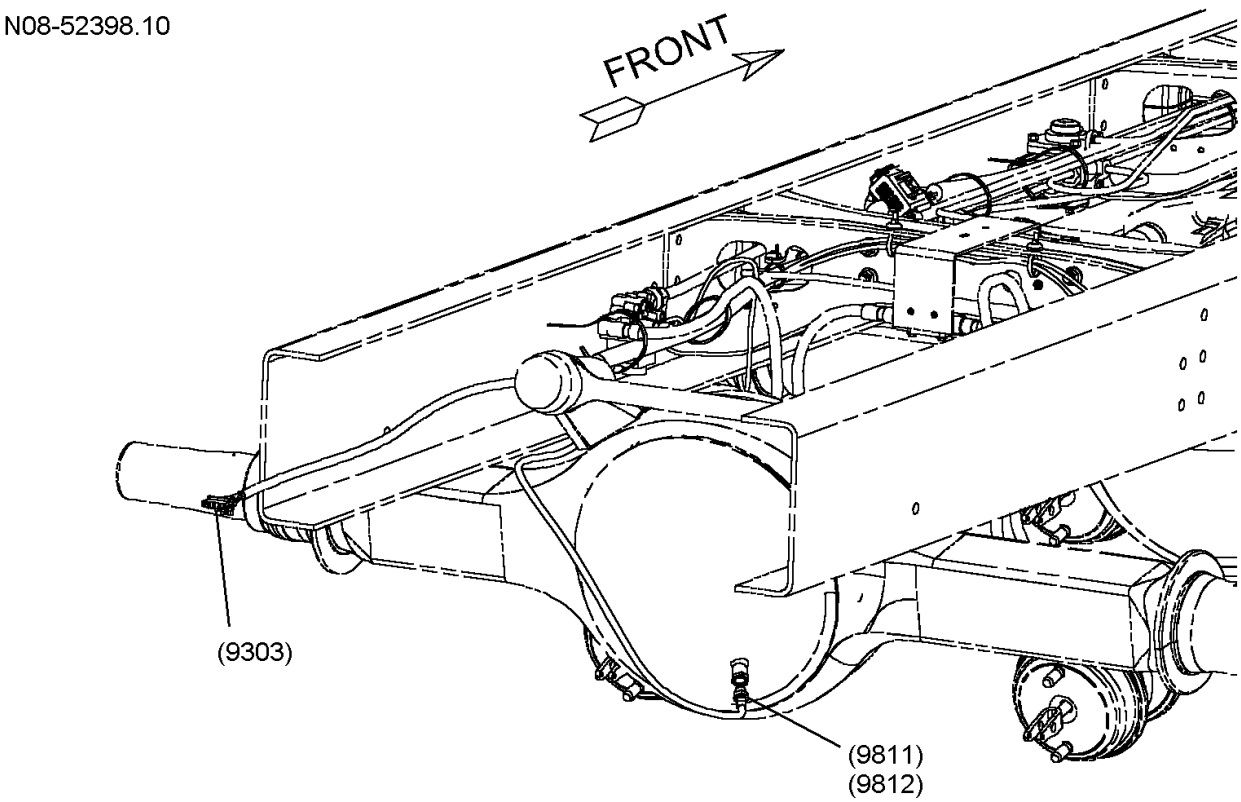

Figure 414 Stop, Tail and Turn Connector Location

(9303) STOP, TAIL AND TURN CONNECTOR

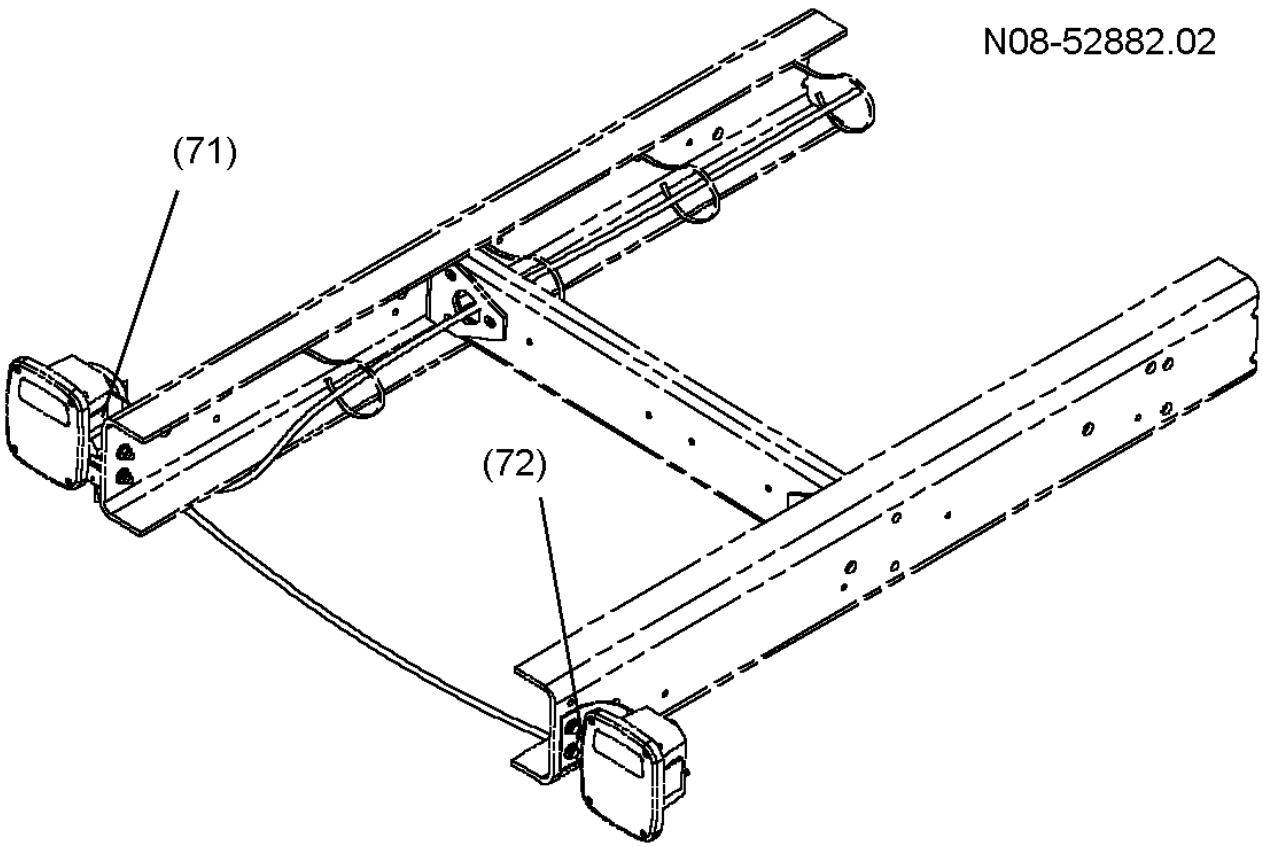

Figure 415 (Typical) Rear Signal Light Connector Locations

(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR

2. ROOF CLEARANCE AND MARKER OR SUNSHADE LIGHTS

2.1. CIRCUIT FUNCTIONS

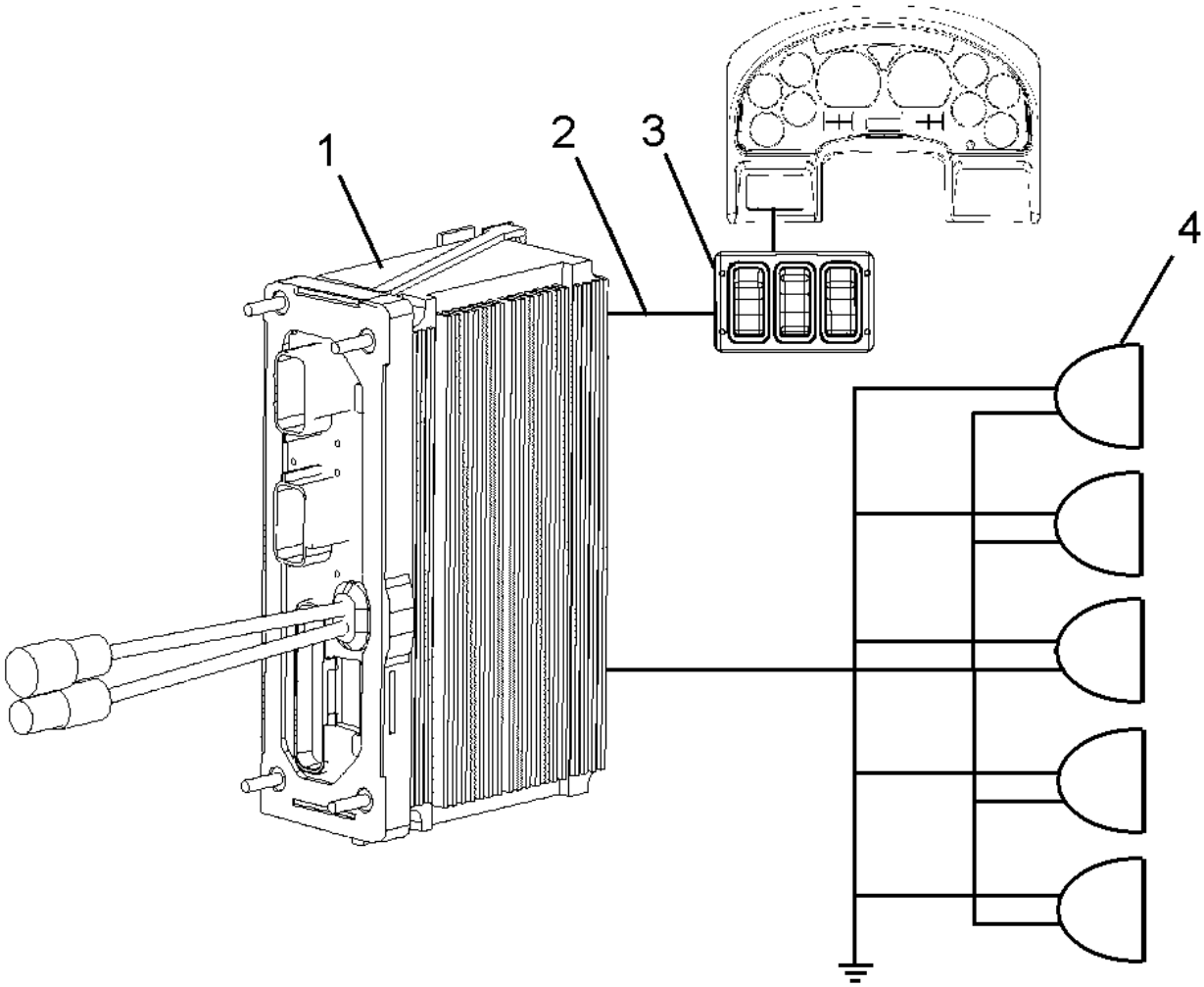

Figure 416 Roof Clearance and Marker or Sunshade Lights Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER
2. DRIVETRAIN J1939 DATA LINK
3. HEADLIGHT PARK LIGHT SWITCH (MOUNTED ON ELECTRONIC GAUGE CLUSTER)
4. CAB ROOF CLEARANCE AND MARKER OR SUNSHADE LIGHTS

Refer to the Roof Clearance and Marker or Sunshade Lights Function Diagram.

NOTE – The clearance or sunshade lights are connected to the park lamp circuits in the ESC. If clearance lights and park lamps are inoperative refer to the Marker, Park and Tail lamps section (See MARKER, PARK AND TAIL LAMPS, page 844) of this manual. If the clearance lights are inoperative but the park lights are working, proceed with this section.

The standard cab roof clearance and marker lights are part of the basic cab design. If a sunshade is installed, the 5 lights are located in the sunshade.

The lights are activated when the headlight switch is in the headlight or park position. The electronic gauge cluster will send a message to the ESC to command the lights on.

The marker interrupt switch will also affect operation of the marker lights, park lights and clearance lights. The lights will turn on while the switch is held on, if the lights were previously off. The lights will turn off while the switch is held on, if the lights were previously on.

The ESC supplies battery voltage to the roof lights, marker and identification lights.

2.2. DIAGNOSTICS

If any of the other park lights are working (only the roof marker lights are inoperative) there will be no diagnostic trouble codes logged.

A short or open in the roof clearance and marker or sunshade light circuits will be apparent when the park or headlights are turned on and the clearance, marker and identification lights don't come on.

The mirror marker lights are also connected to the roof clearance and marker or sunshade light circuits.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the park lights and monitor activation of the park light switch. See the diagnostic software manual for details on using the software.

2.3. FAULT DETECTION MANAGEMENT

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Roof Clearance and Marker or Sunshade Lights.

Problems which affect only the roof clearance or sunshade light circuits can be caused by burned out lamps, a short, an open, or a problem in the ESC.

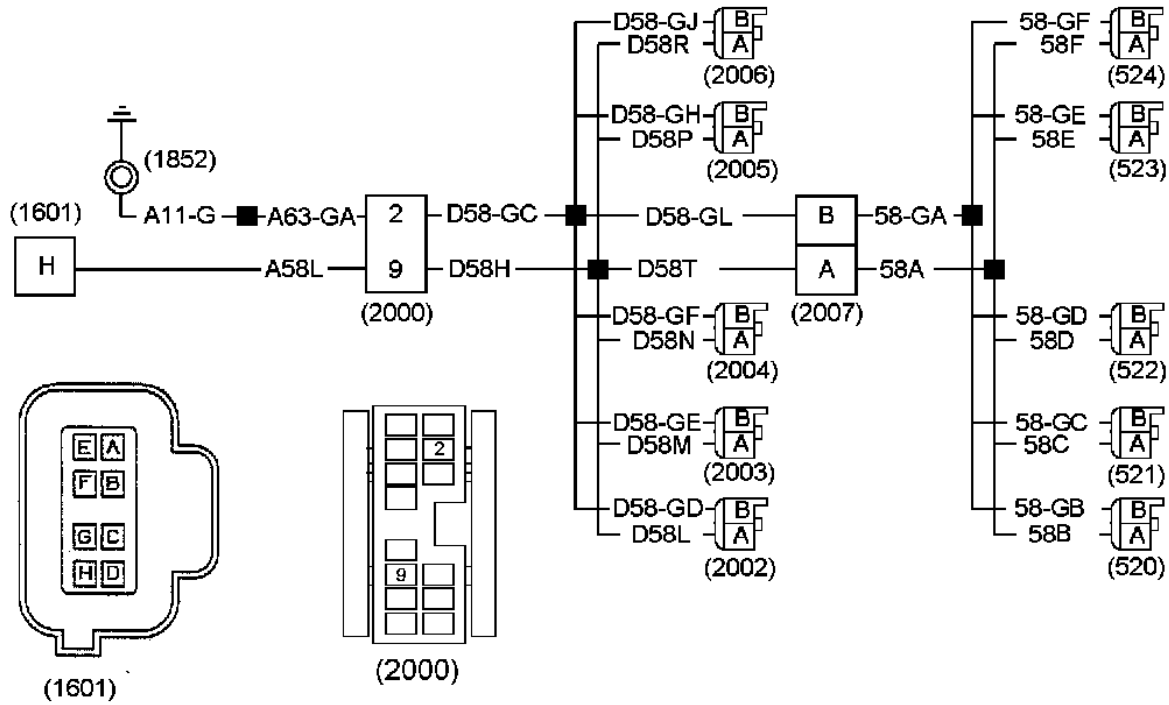

Figure 417 Roof Clearance and Marker or Sunshade Lights — Always Refer to Circuit Diagram Book for Latest Circuit Information

(520)-(524) SUNSHADE CLEARANCE LIGHT CONNECTORS
(1601) ESC BOOSTER CONNECTOR
(1851) CAB GROUND
(2000) ROOF/INSTRUMENT PANEL CONNECTOR
(2002)-(2006) MARKER AND CLEARANCE LAMP CONNECTORS
(2007) SUNSHADE CONNECTOR

Table 285 Roof Clearance and Marker or Sunshade Lights Circuit Tests

Roof Instrument Panel Connector (2000) Voltage Checks		
With (2000) disconnected and park lights on, check instrument panel harness connector **NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments

Table 285 Roof Clearance and Marker or Sunshade Lights Circuit Tests (cont.)

(2000) Socket 9 to ground	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open or short in circuit A58L. A short in circuits A58L or A58S to the mirror lights. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(2000) Socket 9 to Socket 2	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits A63–GA or A11–G to ground.
Roof Connector (2000) Resistance checks.		
Test Points	Spec.	Comments
Pin 9 to ground	>1000 ohms	Resistance less than 1000 ohms indicates a short to ground.
Pin 9 to pin 2	< 5 ohms	Resistance greater than 5 ohms indicates open in power circuits or ground circuits to lights.

2.4. EXTENDED DESCRIPTION

Refer to Roof Clearance and Marker or Sunshade Lights.

Roof Clearance and Marker Lights

When the ESC is commanded to turn the roof lights on, the ESC will provide 12 volts to the lights from ESC booster connector (1601) terminal H. The circuit path is from Connector (1601) terminal H through circuit A58L, through roof/IP connector (2000) terminal 9 through D58H to individual circuits splitting out to the lights.

The ground circuit path is from negative stud (1852) through circuit A11–G, circuit A63–GA, roof connector (2000) terminal 2 and circuit D58–GC to individual ground circuits splitting out to the lights.

Sunshade Lights

When the ESC is commanded to turn the roof lights on, the ESC will provide 12 volts to the lights from ESC booster connector (1601) terminal H. The circuit path is from Connector (1601) terminal H through circuit A58L, through roof/IP connector (2000) terminal 9 through D58H and D58T, through sunshade connector (2007) terminal A, through circuit 58A to individual circuits splitting out to the lights.

The ground circuit path is from negative stud (1852) through circuit A11–G, circuit A63–GA, roof connector (2000) terminal 2, through circuit D58–GC and D58–GL, through sunshade connector (2007) terminal B, through circuit 58–GA to individual ground circuits splitting out to the lights.

Marker Interrupt

When the marker interrupt is held on, the switch pack will send a message via the switch data link to the ESC. The ESC will command the lights to go and off as required.

2.5. COMPONENT LOCATIONS

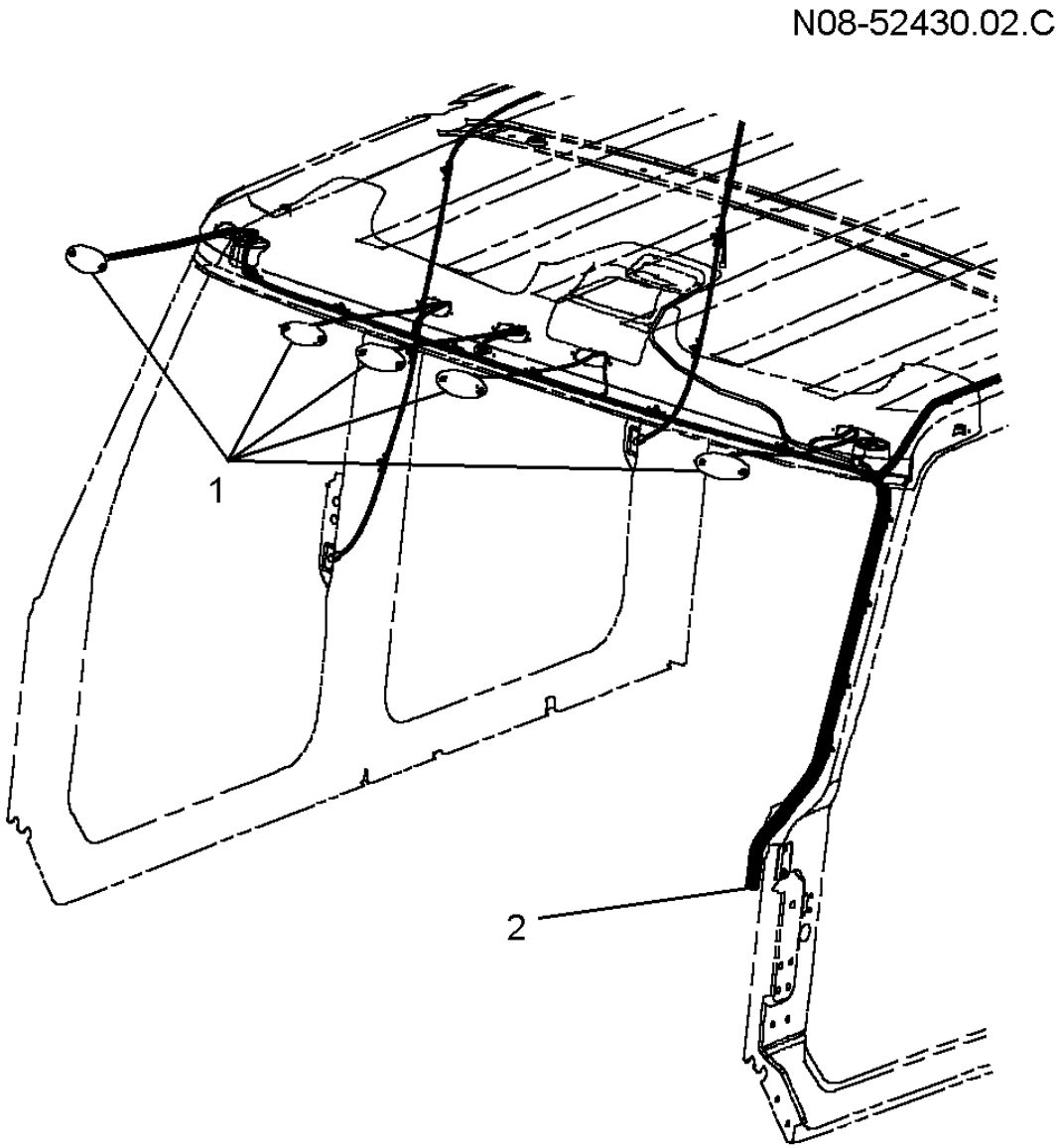

Figure 418 Roof Clearance and Marker Lights

1 CLEARANCE AND MARKER LIGHTS
2. ROOF HARNESS TO ROOF/INSTRUMENT PANEL CONNECTOR (2000)

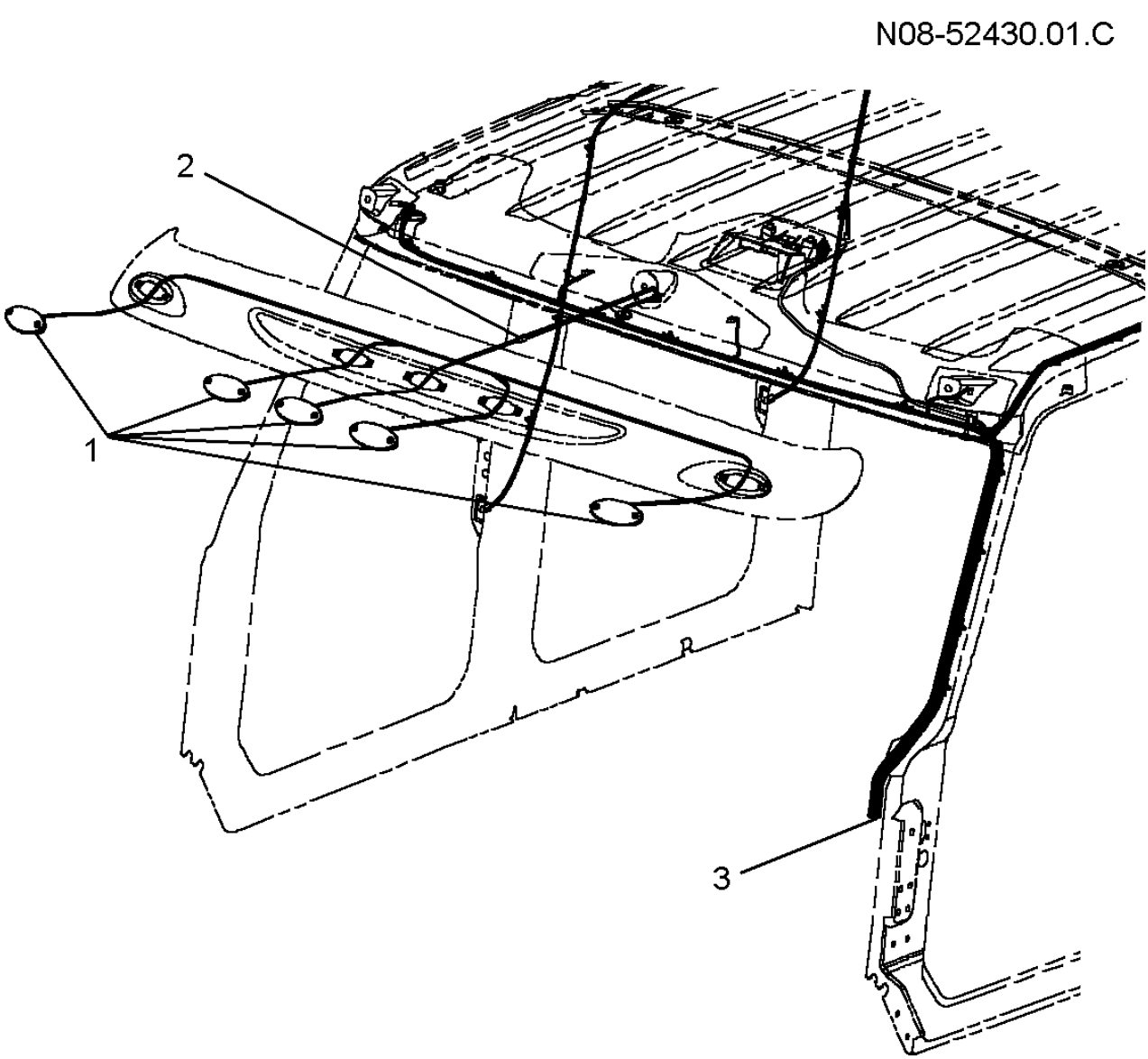

Figure 419 Sunshade Lights

1. SUNSHADE CLEARANCE LIGHTS
2. SUNSHADE CONNECTOR (2007)
3. ROOF HARNESS TO ROOF/INSTRUMENT PANEL CONNECTOR (2000)

3. MARKER, PARK AND TAIL LAMPS

3.1. CIRCUIT FUNCTIONS

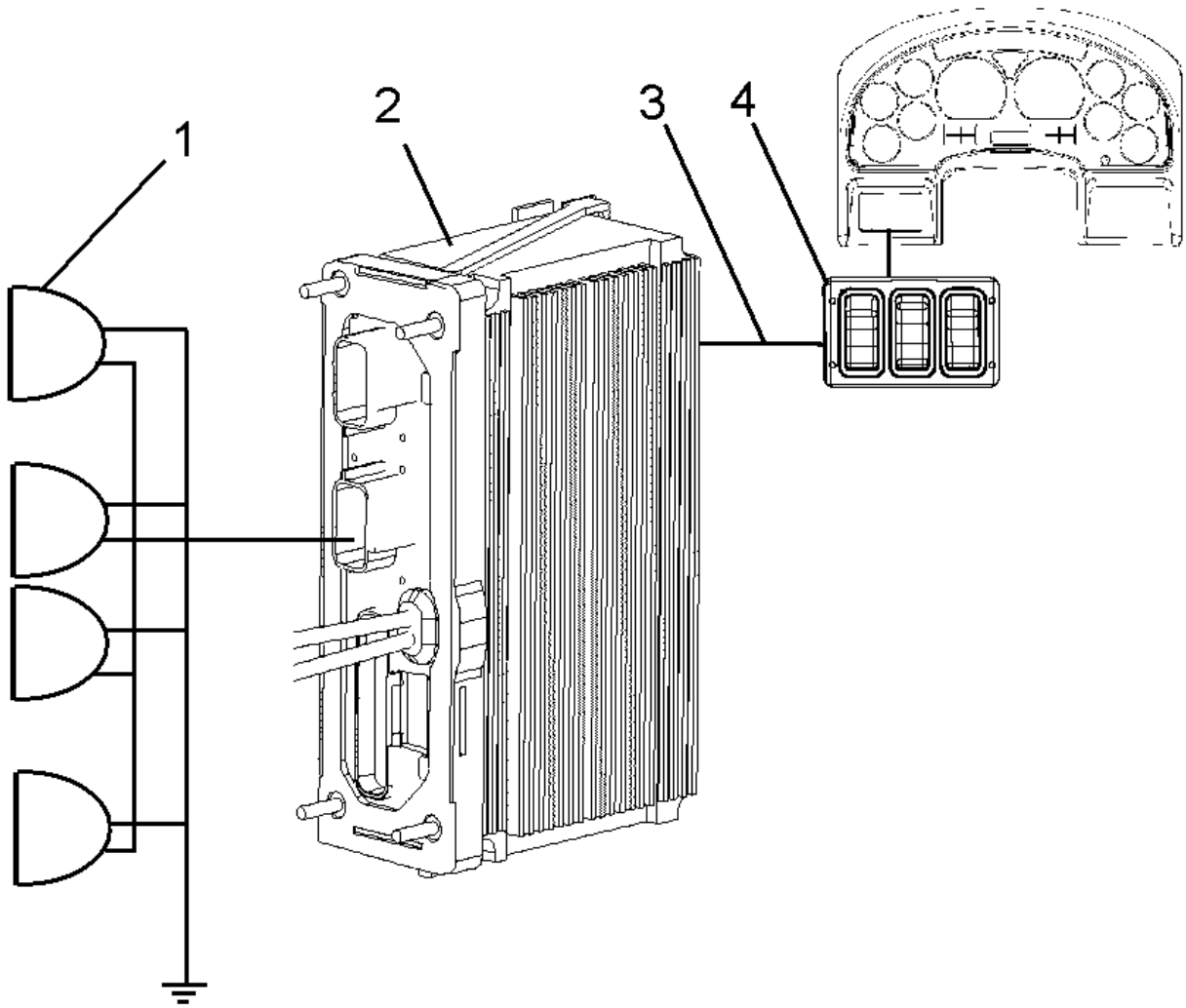

Figure 420 Marker, Park and Tail Lights

1. MARKER, PARK AND TAIL LIGHTS
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVETRAIN J1939 DATA LINK
4. HEADLIGHT PARK LIGHT SWITCH (PART OF ELECTRONIC GAUGE CLUSTER)

The marker, park and tail lamps are activated when the headlight switch is in the headlight or park position. The electronic gauge cluster will send a message to the ESC to command the lights on. The ESC supplies battery voltage for the marker, park and tail lamps.

The marker interrupt switch will also affect operation of the marker lights and park lights. The lights will turn on while the switch is held on, if the lights were previously off. The lights will turn off while the switch is held on, if the lights were previously on.

The roof clearance and marker lights or sunshade lights are directly connected to the park circuits inside the ESC. The roof or sunshade lights have a separate fuse between their circuits and the ESC. If the clearance lights are inoperative but the park lights work, refer to the Roof Clearance and Marker or Sunshade Section (See ROOF CLEARANCE AND MARKER OR SUNSHADE LIGHTS, page 838)

3.2. DIAGNOSTICS

Refer to Marker, Park and Tail Lights.

If the lights stay on when the headlight switch is in the off position, the problem is most likely a defective headlight switch, switch pack, wiring between the switch pack and the EGC, or a problem in the EGC (the system is designed to turn the park lights on when there is no input to the EGC from the switch).

Should the lights fail to come on when the headlights are on, the problem could be attributed to open or shorted output wiring between the ESC and the tail lights, side marker lights and front marker lights lamps. The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

A diagnostic trouble code will be logged if there is an over current caused by a short to ground or excessive load (too many accessories) or an open in the circuits between the ESC and the tail lights, side marker lights and front marker lights.

If individual lights are inoperative the problem must be attributed to faulty lamps or open wiring to the individual lamps.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to command the ESC to turn on the lights and monitor activation of the park light switch. See the diagnostic software manual for details on using the software.

Marker, Park and Tail Lights Preliminary Check

Table 286 Marker, Park and Tail Lights Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify marker, park and tail lights are inoperative.	Visually check marker, park and tail lights.	Marker, park and tail lights are inoper-ative.	Go to next step.	Marker, park and tail lights are operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)

Table 286 Marker, Park and Tail Lights Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunctioning features.	No other features are malfunctioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.
3.	On	Are all marker, park and tail lights inoperative?	Visually check if all lights are inoperative.	All lights are inoperative.	Go to next step.	Check specific circuits of the inoperative light(s) for open circuits.
4.	On	Check for marker, park and tail lights diagnostic trouble codes. (See Diagnostic Trouble Codes, page 846)	Read display on odometer.	No light diagnostic trouble codes are active.	Go to marker, park and tail lights circuit inputs to ESC. (See MARKER, PARK AND TAIL LIGHT INPUTS TO ESC, page 847)	Go to marker, park and tail lights circuit outputs from ESC. (See MARKER, PARK AND TAIL LIGHT OUTPUTS FROM ESC, page 849)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 287 Marker, Park and Tail Lights

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the park light circuits.
If the lights stay on when the headlight switch is in the off position, the problem is most likely a defective headlight switch, switch pack, wiring between the switch pack and the EGC, or a problem in the EGC (The system is designed to turn the park lights on when there is no input to the EGC from the switch). Go to marker, park and tail lights circuit inputs to ESC. (See MARKER, PARK AND TAIL LIGHT INPUTS TO ESC, page 847)	
When the park light switch is on and an individual light or several lights, but not all lights, are inoperative there is probably a failed bulb or an on open circuit to those lights.	
The roof clearance and marker lights or sunshade lights have a separate fuse between their circuits and the ESC. Refer to the Roof Clearance and Marker or Sunshade section (See ROOF CLEARANCE AND MARKER OR SUNSHADE LIGHTS, page 838)	
611 14 4 1	Marker, park and tail lamps open circuit, 4007 pin H.
This fault is the result of an open in the circuits between the marker, park and tail lamps circuits and the ESC. Inspect marker park and tail lights (See MARKER, PARK AND TAIL LIGHT OUTPUTS FROM ESC, page 849) for proper operation	
611 14 4 2	Marker, park and tail lamps over current, 4007 pin H.
This fault is the result of a short or overload in the circuits between the marker, park and tail lamps circuits and the ESC. Inspect Marker Park And Tail Lights (See MARKER, PARK AND TAIL LIGHT OUTPUTS FROM ESC, page 849) for proper operation	
611 14 4 3	Marker, park and tail lamps, less than normal low current but more than open circuit
611 14 4 4	Marker, park and tail lamps, greater than normal high current and less than fusing current
611 14 4 6	Marker, park and tail lamps has current flow when output commanded off

3.3. MARKER, PARK AND TAIL LIGHT INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Park Light EGC and ESC Input Circuits.

A fault in the input circuits will be apparent when the park lights are always on and no active faults are present. The ESC will not log any faults for park light circuits in the EGC. The park light request from the EGC is communicated on the 1939 data link. Loss of the drivetrain 1939 data link between the EGC and ESC will cause several problems to occur simultaneously and the check electrical system lamp will illuminate. **Go to**

the section on the drivetrain 1939 data link to troubleshoot this condition. Problems in the work light input circuits can be caused by a short circuit between the 3 switch pack and the EGC, an open circuit between the 3 switch pack and the EGC, a faulty switch, or a problem in the EGC.

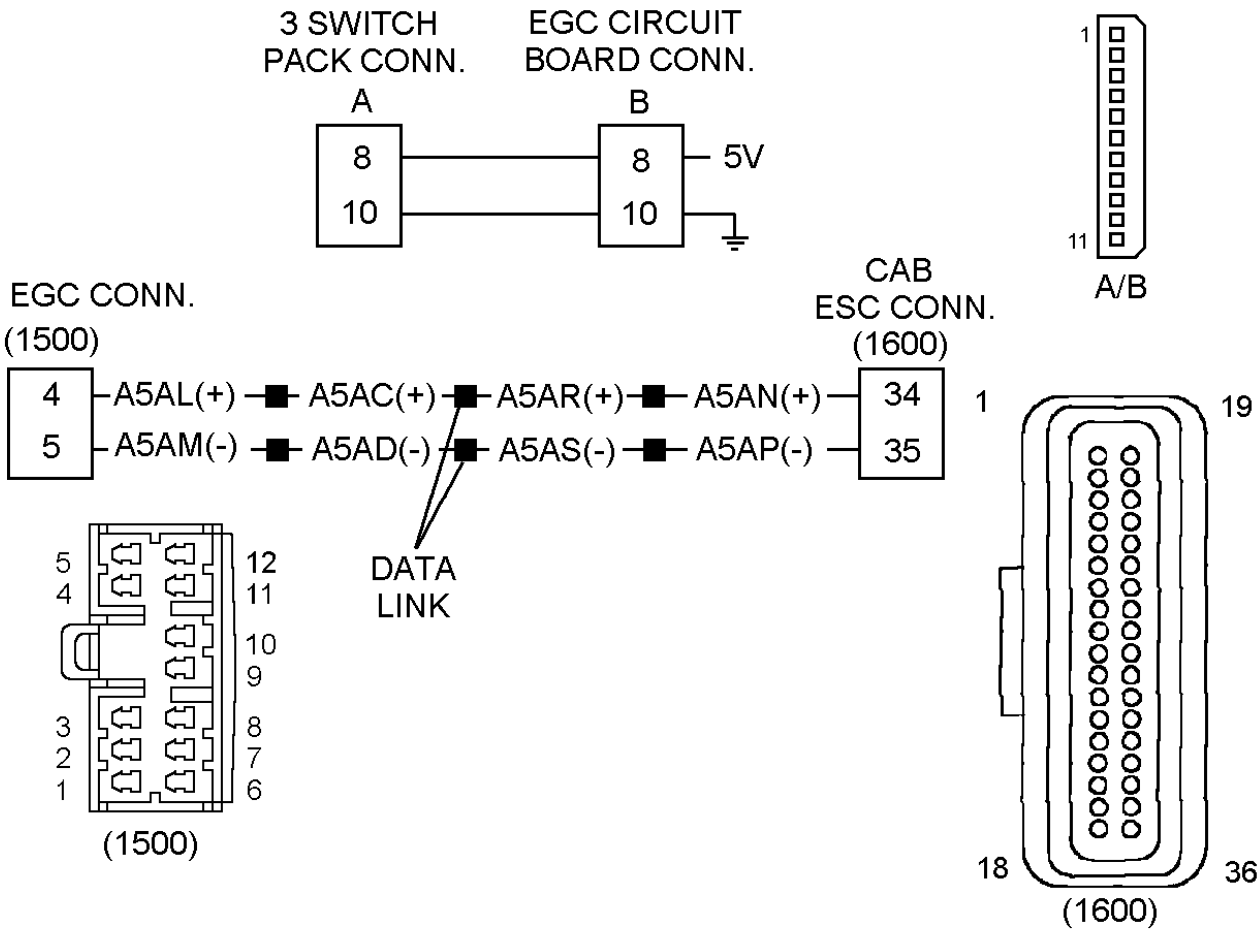

Figure 421 Park Light EGC and ESC Input Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

A. 3 SWITCH PACK CONNECTOR
B. EGC CIRCUIT BOARD CONNECTOR
(1500) EGC CONNECTOR
LOCATED BEHIND CLUSTER
(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC

Table 288 EGC, 3 Switch Pack Circuit Tests

Diagnostic Trouble Codes
There are no diagnostic trouble codes associated with the 3 switch pack in the EGC.
A mechanically defective park light switch could also prevent the park light from operating. Remove the mechanical portion of the switch and attempt to turn the switch on by pressing the top microswitch. If the park lights go out, the mechanical switch assembly should be replaced.

Table 288 EGC, 3 Switch Pack Circuit Tests (cont.)

3 Switch Pack Harness Connector Park Light Voltage Checks Check with ignition key on and 3 switch pack disconnected. **NOTE – If the EGC and switch are working correctly, disconnecting the 3 switch pack connector should cause the park lights to come on.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
3 switch pack harness connector, cavity 8 to ground	5 ± .5 volts	If voltage is missing, check for open or shorts in circuits between EGC connector and switch connector. Also insure proper voltage out of EGC.
3 switch pack harness connector, cavity 10 to ground	0 volts	Ground circuit from EGC If voltage is incorrect, check for shorts in circuits between EGC and switch. Also insure proper voltage out of EGC.
3 switch pack harness connector, cavity 8 to cavity 10.	5 ± .5 volts	If voltage is incorrect, check for shorts in circuits between EGC and switch.
3 Switch Pack Work Light Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Check resistance between pins 10 (negative probe on pin 10) and 8 of the switch pack, when the switch is off.	Approximately 1.5M ohms.	If there is no continuity, the switch pack needs replaced.

Extended Description

The park light switch is wired directly to the EGC circuit board. When the park light switch is turned off, 5 volts on pin 8 from the EGC will drop to ground. This will cause the EGC to send a message to the ESC requesting the light to be turned on.

3.4. MARKER, PARK AND TAIL LIGHT OUTPUTS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Marker, Park and Tail Lamps.

A fault in the marker, park and tail lights will be apparent when the headlights are turned on and the marker, park and tail lamps don't come on. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the marker, park and tail lamp circuits. Problems in the marker, park and tail lamp circuits can be caused by burned out lamps, a short, an open, or a problem in the ESC.

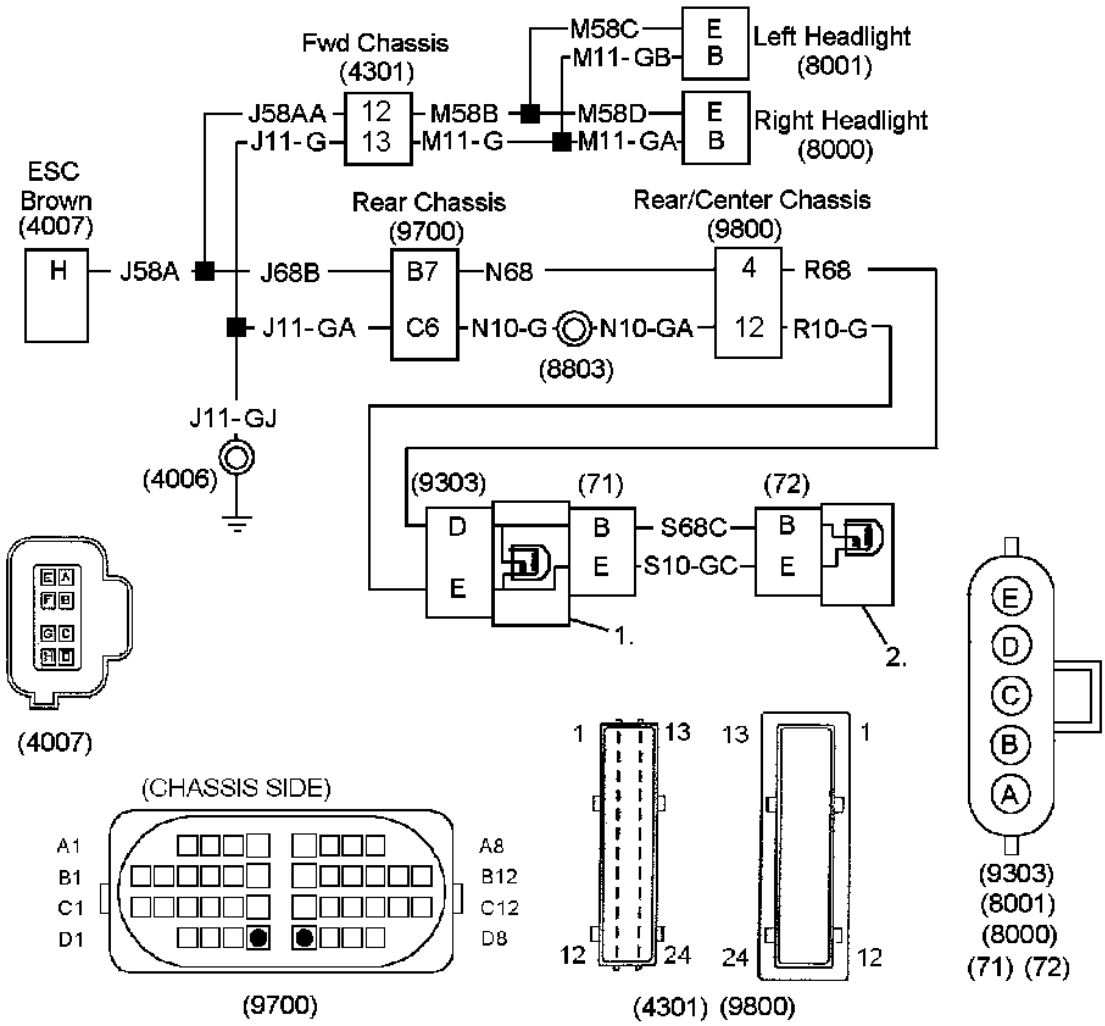

Figure 422 Marsker, Park and Tail Lamps — Always Refer to Circuit Diagram Book for Latest Circuit Information

1. LEFT REAR LIGHT ASSEMBLY
2. RIGHT REAR LIGHT ASSEMBLY

(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR
(4007) BROWN ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4301) FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(9303) STOP/TAIL/TURN CONNECTOR
LOCATED ON LEFT LIGHT ASSEMBLY
(9700) REAR CHASSIS CONNECTOR
(9800) REAR/CENTER CHASSIS CONNECTOR

Table 289 Marker, Park And Tail Lights Circuit Tests

611 14 4 3	Marker, park and tail lamps, less than normal low current but more than open circuit
611 14 4 4	Marker, park and tail lamps, greater than normal high current and less than fusing current
611 14 4 6	Marker, park and tail lamps has current flow when output commanded off
611 14 4 1	Marker, park and tail lamps open circuit
This fault is the result of an open in the circuits between the marker, park and tail lamps circuits and the ESC.	
611 14 4 2	Marker, park and tail lamps over current
This fault may be the result of a short in the circuits between the marker, park and tail lamps and the ESC. It could also be caused by an excessive load on the circuits. **NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored.** Clear DTC's. Disconnect stop tail and turn connector (9303), then turn on the park light switch and check for fault. If the fault has not reoccurred, there is a short or an overload in the tail lights. If the fault reoccurs, there is a short in one of the other circuits or in the ESC. **NOTE – With sealed beam headlamps, as used with Severe Service trucks, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1** Clear DTC's. Disconnect left headlight harness connector (8001), then turn on the park light switch and check for fault. If the fault has not reoccurred, there is a short or an overload in the left front marker lights. If the fault reoccurs, there is a short in one of the other circuits or in the ESC. Clear DTC's. Disconnect right headlight harness connector (8000), then turn on the park light switch and check for fault. If the fault has not reoccurred, there is a short or an overload in the right front marker lights. If the fault reoccurs, there is a short in one of the other circuits or in the ESC. Clear DTC's. Disconnect brown ESC connector (4007), then turn on park lights and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and the marker, park and tail lamps. If the fault reoccurs, there is a short inside the ESC.	
Stop Tail and Turn Connector (9303) Voltage Checks With (9303) disconnected and park lights on. **NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**	

Table 289 Marker, Park And Tail Lights Circuit Tests (cont.)

Test Points	Spec.	Comments
(9303) cavity D to ground	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open or short in circuits between brown ESC connector (4007) terminal H and stop tail and turn connector cavity D. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(9303) cavity D to cavity E	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits between (9303) cavity E and ground.

Extended Description

Refer to Marker, Park and Tail Lamps.

When the ESC is commanded to turn the tail lights on, the ESC will provide 12 volts to the lights from ESC connector (4007) terminal H to left stop tail and turn connector (9303) terminal D. Voltage to right tail light connector (72) terminal B is provided on circuit S68C from left tail light connector (71) terminal B.

Ground for the tail lights is supplied from ground stud 2 (4006) to left stop tail and turn connector (9303) terminal E. Ground to right tail light connector (72) terminal E is provided on circuit S10–GC from left tail light connector (71) terminal E.

When the ESC is commanded to turn the side and front marker lights on, the ESC will provide 12 volts to the lights from ESC connector (4007) terminal H to circuit M58B. Circuit M58B is split on circuit M58D to right headlight/turn signal connector (8000) terminal E. Circuit M58B is also split to circuit M58C to left headlight/turn signal connector (8001) terminal E.

The ground circuit path is from ground stud 2 (4006) to circuit M10–GA. Circuit M10–GA is split on circuit M52–GA to right headlight /turn signal connector (8000) terminal B. Circuit M10–GA is also split to circuit M52–GB to left headlight/turn signal connector (8001) terminal E.

3.5. COMPONENT LOCATIONS

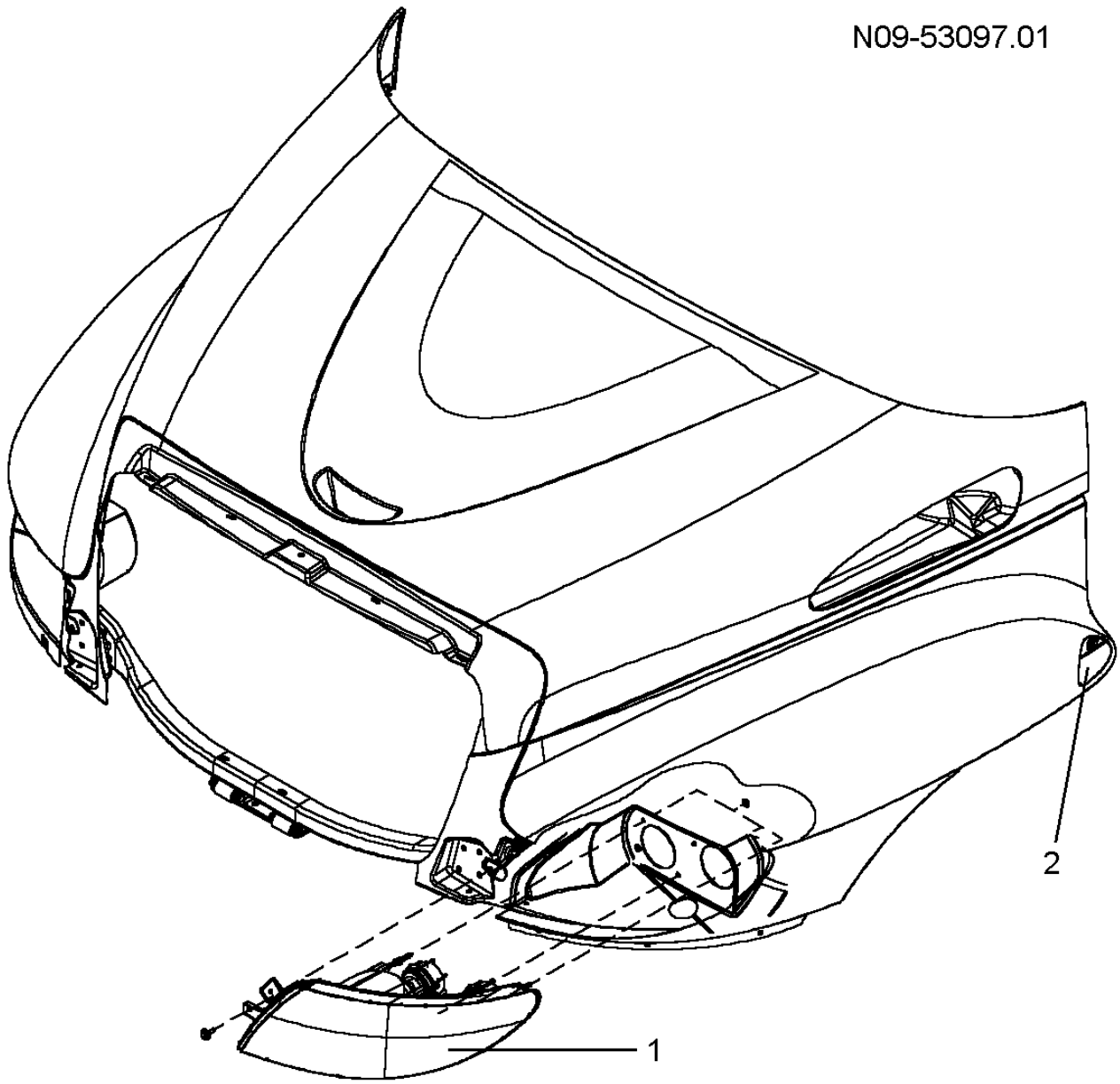

Figure 423 Headlights, Front and Side Marker Lights (Not Severe Service)

1. FRONT PARK LIGHT
2. SIDE MARKER LIGHT

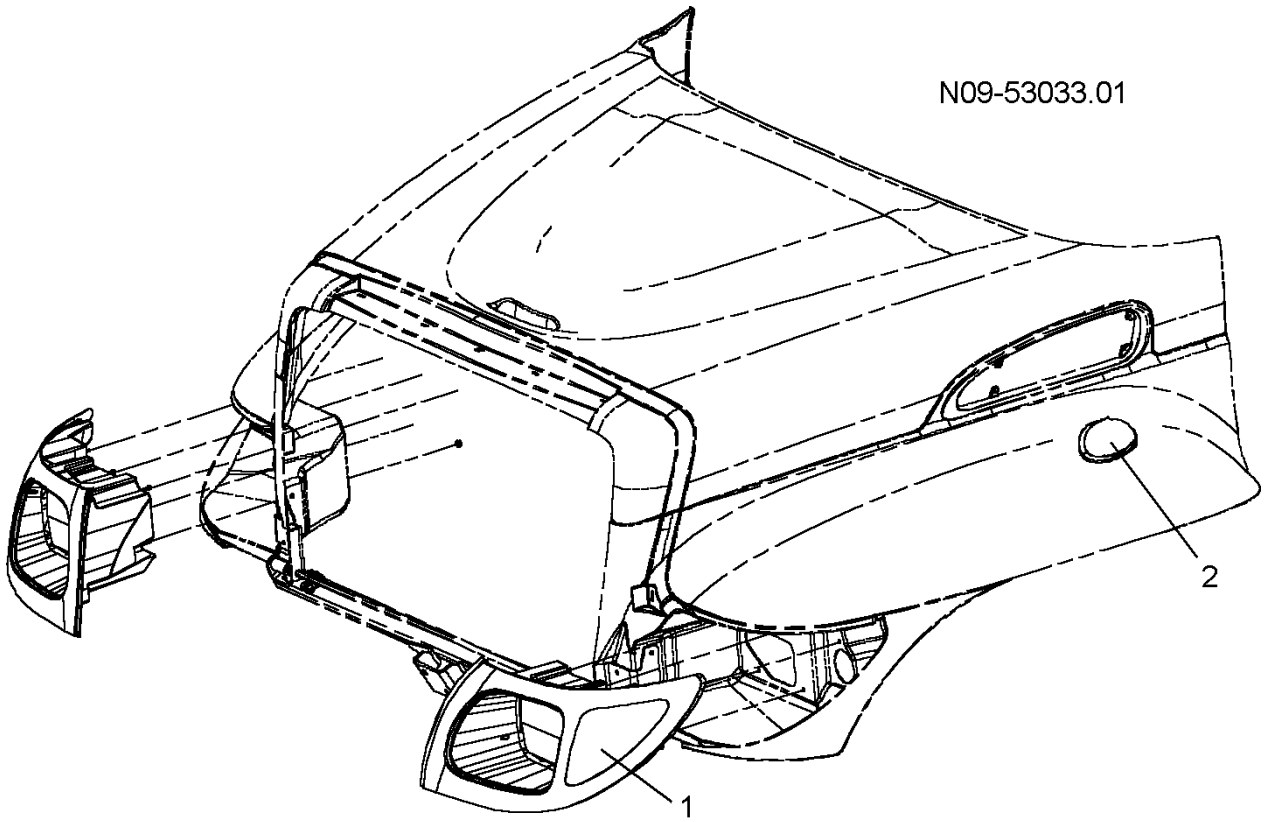

Figure 424 Headlights, Front and Side Marker Lights (Severe Service)

1. FRONT PARK LIGHT
2. STANDARD SIDE MARKER LIGHT

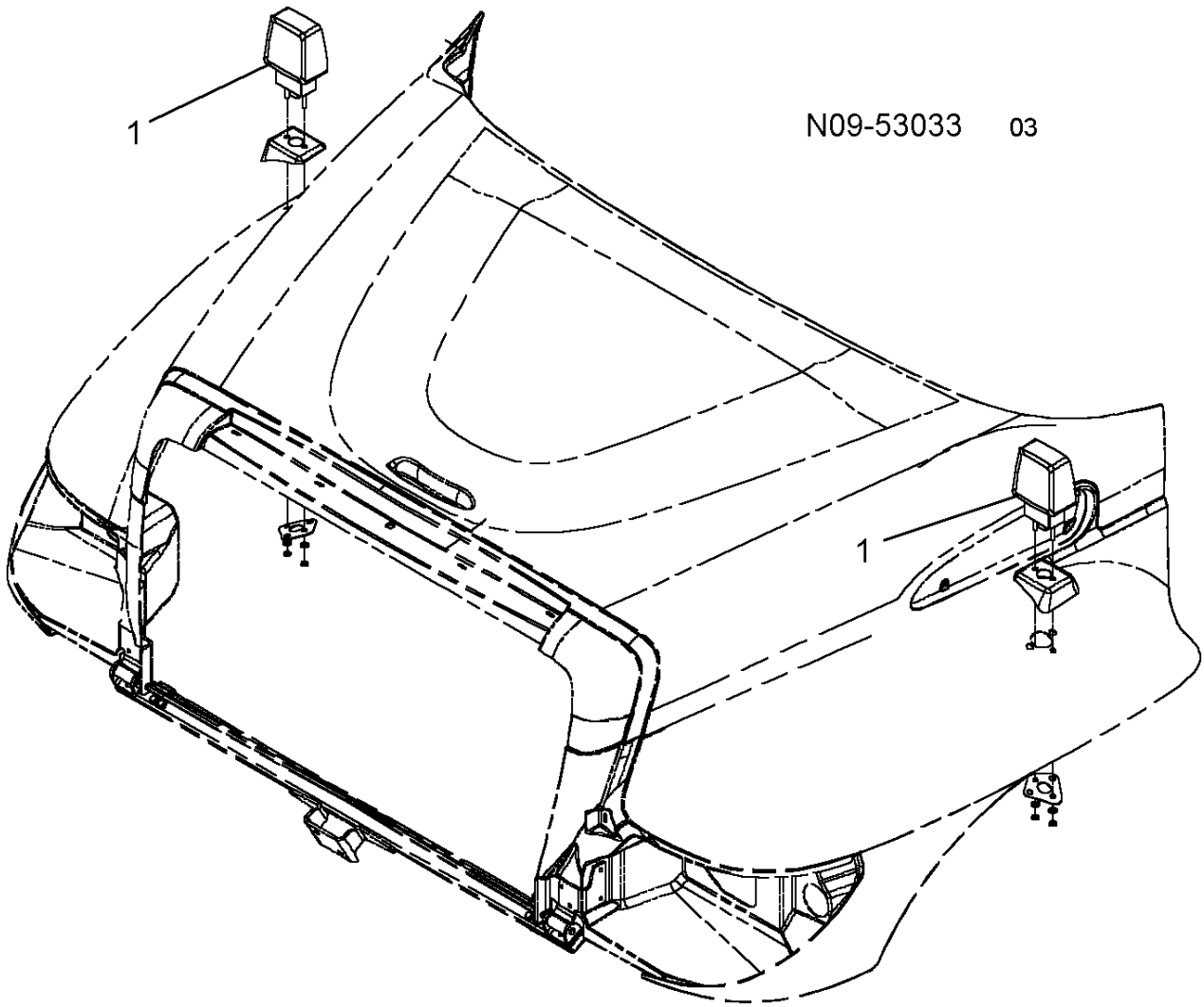

Figure 425 Optional Side Marker/Turn Signal Lights (Severe Service)

1. OPTIONAL SIDE MARKER/TURN SIGNAL LIGHT

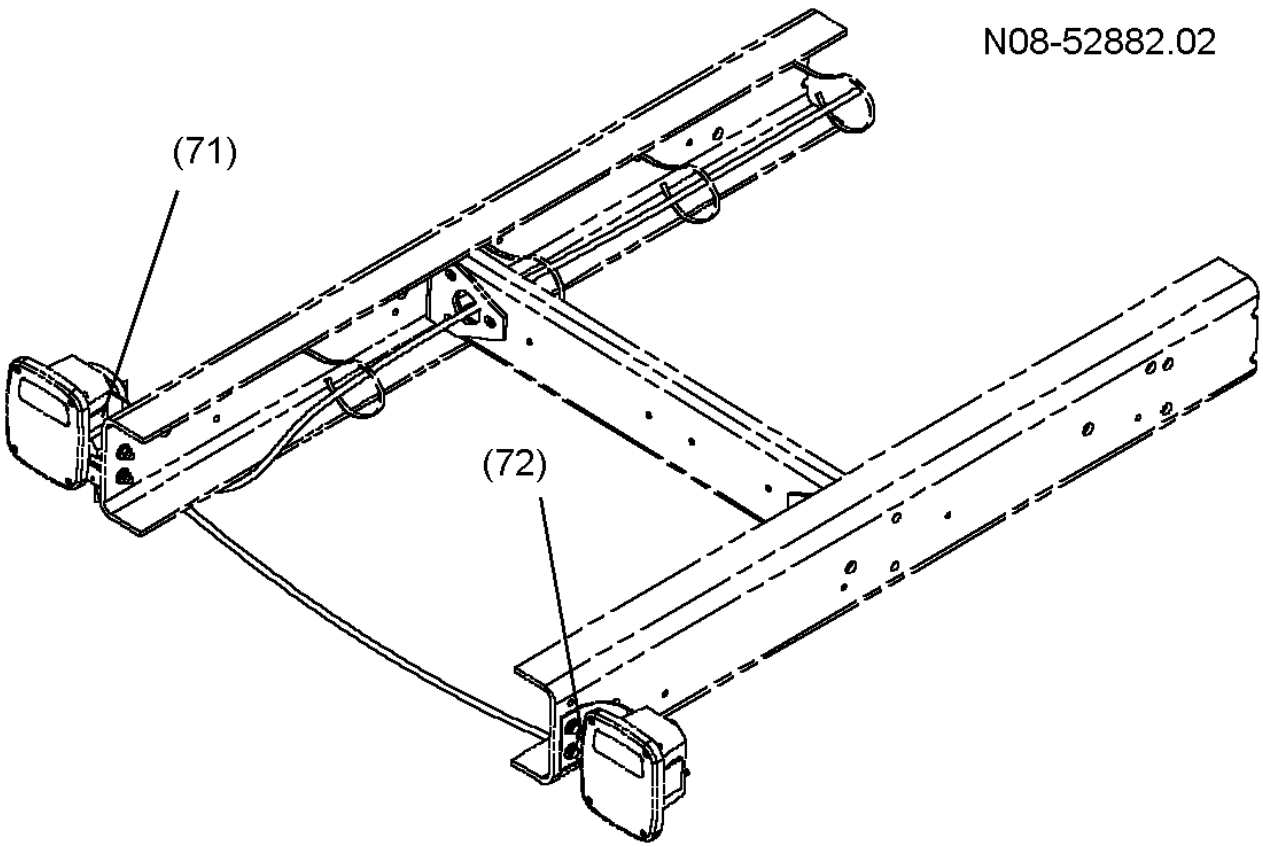

Figure 426 Rear Tail Light Connector Locations

(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR

4. DOME AND MAP LIGHTS

4.1. CIRCUIT FUNCTIONS

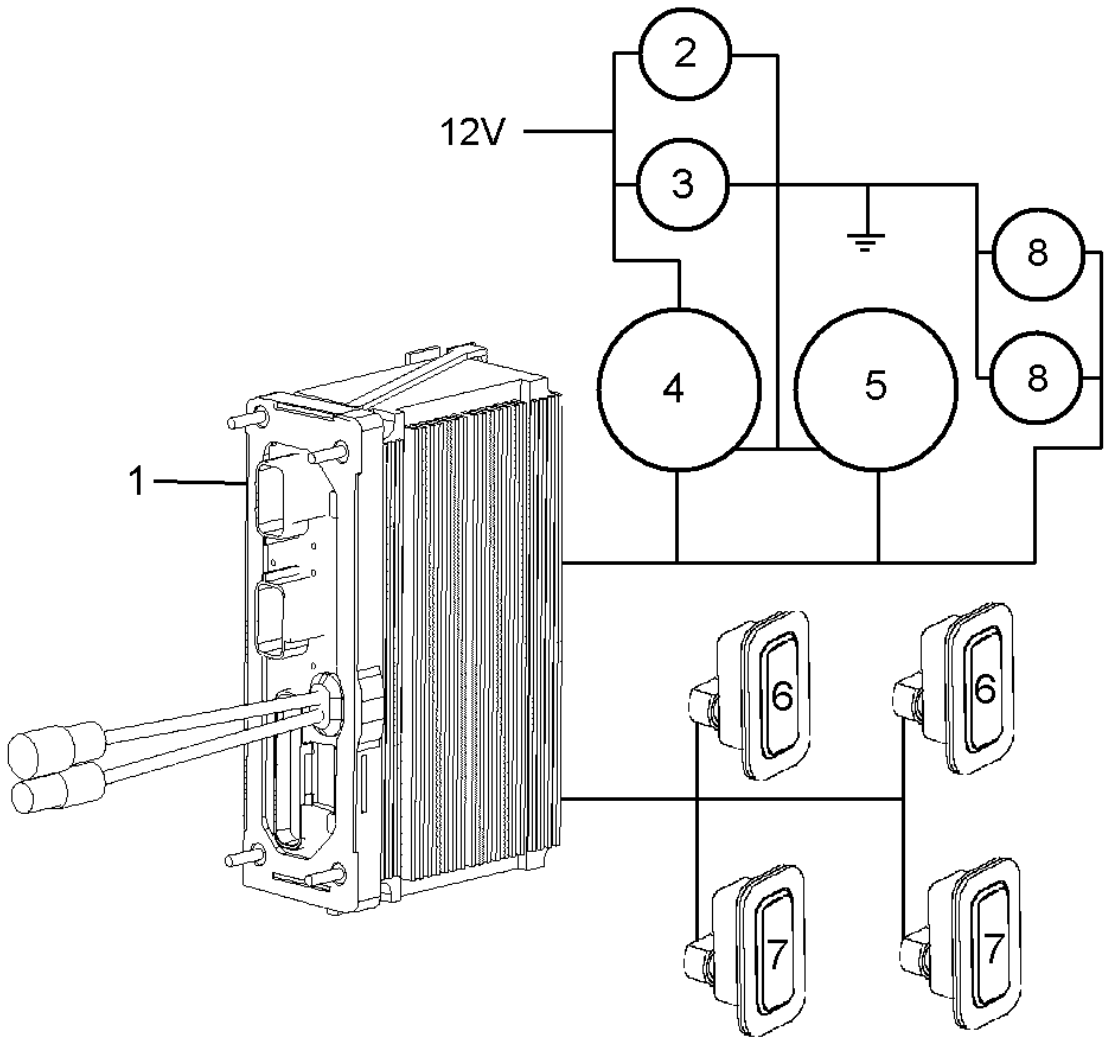

Figure 427 Dome and Map Lights Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER
2. MAP LIGHT
3. MAP LIGHT
4. FRONT DOME LIGHT
5. REAR DOME LIGHT (CREW CAB ONLY)
6. FRONT DOOR SWITCHES
7. REAR DOOR SWITCHES (CREW CAB ONLY)
8. COURTESY LAMPS

Refer to Dome and Map Lights Function Diagram.

The dome lights are controlled by the door switch(es). Individual dome light(s) can also be turned on by their dome light switch.

The dome light output from the ESC has theater style dimming capability, which can be disabled with programming. The lights will remain on if a door, with a switch mounted in the cab opening, is open. As soon as all doors are closed, and the dome light switch is off, the light will remain on at a modified level for 20 seconds or until the ignition has been started. At that time, the lights will dim gradually until the light is off.

With theater lighting disabled the dome light(s) will go off as soon as the doors are shut.

On January 28, 2003, the ESC software was revised. Prior to the revision, a door with a plunger type switch that was not fully latched would not turn off the dome light. If left on for an extended period of time, the dome light will drain the batteries. Now the dome light power will be cut back to 1% after 10 minutes. Cycling the door plunger or key switch will reactivate the dome light.

The remote keyless entry (RKE) also turns on the light for a timed period when the 'unlock' button is pressed, and turns off the light when the 'lock' button is pressed

When a door is opened or closed the courtesy lights (located under the dash) will operate the same as the dome lights.

The map lights are controlled by the switches on the lights.

4.2. DIAGNOSTICS

If the dome light(s) or map lights fail to operate from their individual switches, the problem is most likely in the power circuits or the switches to the lights.

The door with a plunger type switch that was not fully latched, the dome light power will be cut back to 1% after 10 minutes.

If the dome lights stay on when the doors are closed and the dome light switches are off, the problem is most likely a defective door switch, a short in wiring between the door switch and the EGC, or a problem in the EGC.

Should the lights fail to come on when a door is opened, the problem could be attributed to an open in the wiring between the door switches and the ESC, open or shorted output wiring between the ESC and the dome lights.

The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

A diagnostic trouble code will be logged if there is an over current caused by a short to ground or excessive load (too many accessories) on the circuits between the ESC and the dome lights.

If individual lights are inoperative the problem must be attributed to faulty lamps or open wiring to the individual lamps.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to command the ESC to turn on the lights and monitor activation of the dome light switch(es). The software will also display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

Dome Light Preliminary Check

Table 290 Dome Light Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the dome lights and map lights operate from their individual switches.	Visually check operation of lights.	Lights operate correctly.	Go to next step.	Locate and repair cause of inoperative light. Check for blown fuse, short circuit, open circuit or defective switch.
2.	On	Verify the dome lights operate correctly when a door is held opened.	Visually check dome light.	Dome light power will be cut back to 1% after 10 minutes. Cycling the door plunger or key switch will reactivate the dome light.	Go to next step.	Check ESC for software revision V22. Program or replace ESC.
3.	On	Verify operation of any dome light(s) from other doors.	Visually check dome light.	Dome light(s) operate correctly with other door(s).	Go to next step.	Locate open in circuits to door switch(es) which are not operating correctly.
4.	On	If more than one light is connected to dome light circuits (rear dome lights or courtesy lights), are all lights inoperative?	Visually check if all work lights are operating correctly.	All work lights are not operating correctly.	Go to next step.	Dome light feature is operating correctly. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)

Table 290 Dome Light Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
5.	On	Locate open in circuits to inoperative dome lights.				
6.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 861)	Read display on odometer.	No dome light diagnostic trouble codes are active.	Go to door switch inputs. (See DOOR SWITCH INPUTS INTO ESC, page 862)	Go to dome light circuit checks. (See DOME LIGHT CIRCUITS, page 864)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 291 Dome Light Circuits

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the dome light circuits.
611 14 10 1	Dome Light Under Current (open circuit, 1601 pin C).
This fault is the result of an open in the circuits between the the ESC and the dome/courtesy lights. Inspect dome light circuits (See DOME LIGHT CIRCUITS, page 864) for proper operation	
A diagnostic trouble code will only be logged for shorts on circuits from the ESC to the dome/courtesy lights.	
611 14 10 2	Dome Light Over Current (Short Circuit)
This fault is the result of a short or overload on the circuits between the ESC and the dome/courtesy lights. Inspect dome light circuits (See DOME LIGHT CIRCUITS, page 864) for proper operation	

Table 291 Dome Light Circuits (cont.)

611 14 10 3	Dome Light lamps, less than normal low current but more than open circuit
611 14 10 4	Dome Light lamps, greater than normal high current and less than fusing current
611 14 10 6	Dome Light lamps has current flow when output commanded off

4.3. DOOR SWITCH INPUTS INTO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Door Switch Circuits to ESC.

Several options are available for door switches. Options range from one switch on the drivers door to switches on every door.

A problem in the door switch circuit(s) will prevent the lights from operating when one or both doors are opened. A problem in the door switch circuits could be attributed to a defective switch, a problem in the ESC, a short circuit or an open circuit.

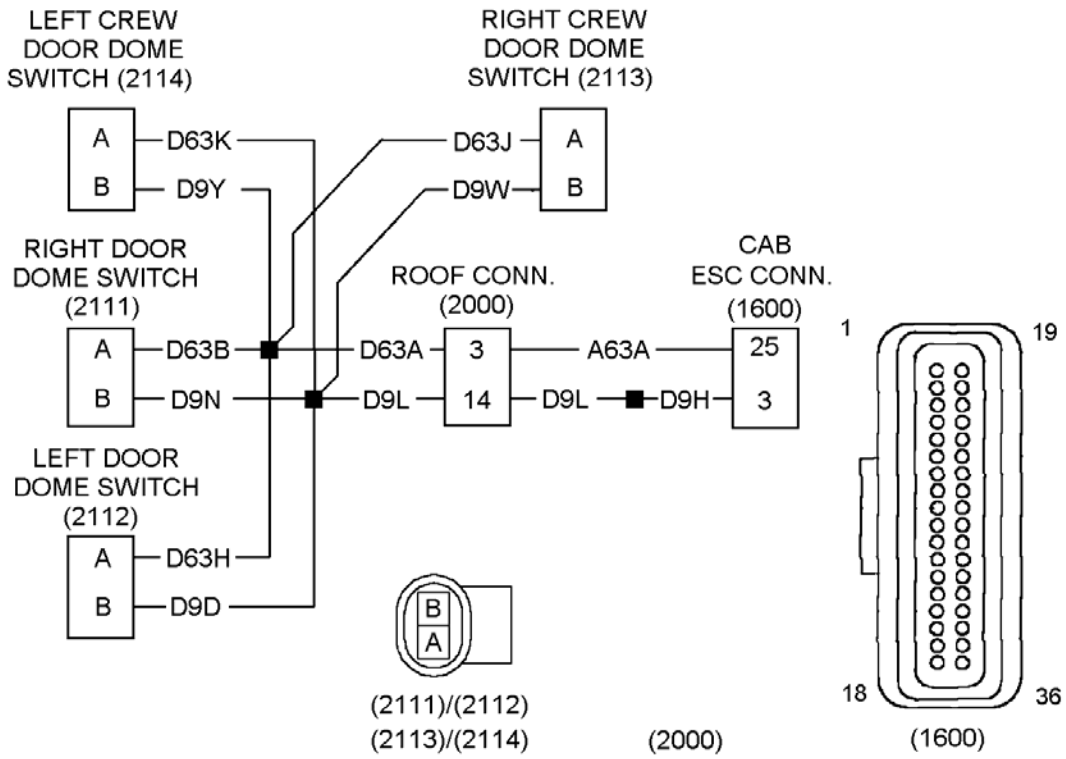

Figure 428 Door Switch Circuits to ESC (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1600) 36–WAY ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
(2000) ROOF CONNECTOR
LOCATED NEAR DRIVER SIDE A PILLAR
(2111) RIGHT DOOR DOME SWITCH CONNECTOR
LOCATED IN PASSENGER SIDE B PILLAR
(2112) LEFT DOOR DOME SWITCH CONNECTOR
LOCATED IN DRIVER SIDE B PILLAR
(2113) RIGHT CREW DOOR DOME SWITCH CONNECTOR
LOCATED IN PASSENGER SIDE C PILLAR (CREW CAB ONLY)
(2114) LEFT CREW DOOR DOME SWITCH CONNECTOR
LOCATED IN DRIVER SIDE C PILLAR (CREW CAB ONLY)

Table 292 Door Switch Circuit Tests

FAULTS		
There are no diagnostic trouble codes associated with door switch circuits. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments

Table 292 Door Switch Circuit Tests (cont.)

Harness connector cavity A to ground.	12 ± 1.5 volts with ignition on, 5 ± .5 with ignition off.	If voltage is missing, check for open in circuits D63A or A63A. Also check for short in circuits D63A, A63A or circuits to other door switches. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector cavity B to ground.	<.3 volts	Zero volt reference level signal.
Harness connector cavity A to cavity B.	12 ± 1.5 volts with ignition off. 5 ± .5 with ignition off.	If voltage is missing, check for open in circuits between ESC connector (1600) cavity D and dome switch connector cavity B. A missing zero volt reference level from the ESC will cause several other features to be inoperative.
Door Switch (2112) Resistance Checks Check at door switch.		
Resistance between door switch connector pins A and B.	<1 ohm with door open. >50K ohms with piece of steel in front of switch.	If resistance is incorrect replace defective switch.
If the door switch and door switch circuits check good proceed to the dome light circuit checks (See DOME LIGHT CIRCUITS, page 864).		

Extended Description

Refer to Door Switch Circuits to ESC.

A proximity switch is used for the door switch(es). When steel passes in front of the switch it will open. When the door is opened the switch will close.

The ESC monitors the voltage at ESC connector (1600). When a door switch closes, a zero volt reference signal from the ESC will be applied through the door switch back to the ESC. This will cause the voltage to drop and the ESC will turn the dome light(s) on.

4.4. DOME LIGHT CIRCUITS

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Dome Light Circuits.

A fault in the dome, courtesy or map light circuits will be apparent when the lights don't come on. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the dome light circuits from the ESC. Problems in the dome light circuits can be caused by burned out lamps, a blown fuse, a short, an open, or a problem in the ESC. Problems in the map light circuits can be caused by burned out lamps, a blown fuse, a short or an open circuit.

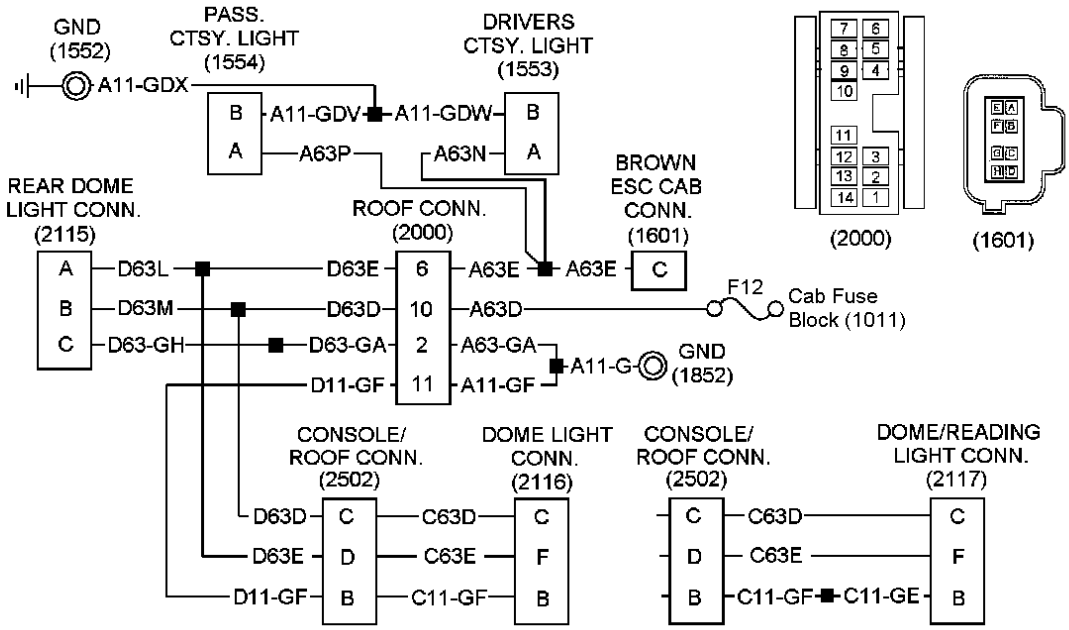

Figure 429 Dome Light Circuits (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(F12) DOME LIGHT FUSE
LOCATED IN CAB FUSE BLOCK (1011)
(1553) DRIVERS COURTESY LIGHT CONNECTOR
LOCATED BEHIND DRIVERS COURTESY LIGHT IN INSTRUMENT PANEL
(1553) PASSENGERS COURTESY LIGHT CONNECTOR
LOCATED BEHIND PASSENGERS COURTESY LIGHT IN INSTRUMENT PANEL
(1601) BROWN ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
(2000) ROOF CONNECTOR
LOCATED NEAR DRIVER SIDE A PILLAR
(2115) REAR DOME LIGHT CONNECTOR
LOCATED NEAR DRIVER SIDE A PILLAR AT HEADLINER
(2116) DOME LIGHT CONNECTOR
LOCATED BEHIND DOME LIGHT ASSEMBLY
(2117) DOME READING LIGHT CONNECTOR
LOCATED BEHIND DOME/READING LIGHT ASSEMBLY
(2502) CONSOLE/ROOF CONNECTOR
LOCATED NEAR DRIVER SIDE A PILLAR

Table 293 Dome and Map lights Circuit Tests

Diagnostic Trouble Codes	
611 14 10 3	Dome Light lamps, less than normal low current but more than open circuit
611 14 10 4	Dome Light lamps, greater than normal high current and less than fusing current
611 14 10 6	Dome Light lamps has current flow when output commanded off
611 14 10 2	Dome Light Over Current (Short Circuit)
NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored. Disconnect dome light connector (2116) and close all doors. Cycle key switch and clear DTC's. Open the drivers door and check for fault. If the fault has not reoccurred, there is a short or an overload in the front dome light. If the fault reoccurs, there is a short in other dome or courtesy light circuits or in the ESC. Perform the same procedure on the remaining dome light and courtesy light connectors until the short circuit is isolated. If the active fault remains active, there is a short in the circuits between the ESC and dome light(s) or a short inside the ESC. Disconnect brown ESC connector (1601) and close all doors. Cycle key switch and clear DTC's. Open the drivers door and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and dome light(s). If the fault reoccurs, there is a short inside the ESC.	
611 14 10 1	Dome Light Under Current (Open Circuit)
Dome Light Connector (2116) Voltage Checks Check with ignition on, drivers door open and dome light connector disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**	

Test Points	Spec.	Comments
Cavity C to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse F12 or open or short in circuits between cavity C and F12.
Cavity F to ground	12 ± 1.5 volts	If voltage is missing, check for open in circuits between cavity F and ESC connector (1601) cavity C.
Cavity C to cavity B	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits between cavity B and ground stud (1852).

Extended Description

Refer to Dome Light Circuits.

When the front dome light or map lights are operated from the manual switches, power for the dome and map lights is provided from fuse F12 through circuit A63D, roof connector (2000) terminal 11, circuit D63D, console roof connector (2502) terminal C, circuit C63D and dome lamp connector (2116) terminal C to the switches on the dome light and map lights.

Ground for the dome light and map lights is supplied from ground terminal (1852) to the dome light and map lights.

Power to the front dome light (when a door is opened) is supplied from brown ESC connector (1601) terminal C and dome light connector (2116) terminal F to the dome light.

When the rear dome light is operated from the manual switch, power for the dome light is provided from fuse F12 and rear dome lamp connector (2115) terminal A to the switch on the dome light.

Power to the rear dome light (when a door is opened) is supplied from brown ESC connector (1601) terminal C and rear dome light connector (2115) terminal A to the dome light.

Ground for the rear dome light is supplied from ground terminal (1852) and rear dome lamp connector (2115) terminal B to the rear dome light switch.

Power to the optional courtesy lights (when a door is opened) is supplied from brown ESC connector (1601) terminal C to drivers courtesy light (1553) terminal A passenger courtesy light (1554) terminal A.

Ground for the courtesy lights is supplied from ground terminal (1552) to passenger courtesy light (1554) terminal B.

4.5. COMPONENT LOCATIONS

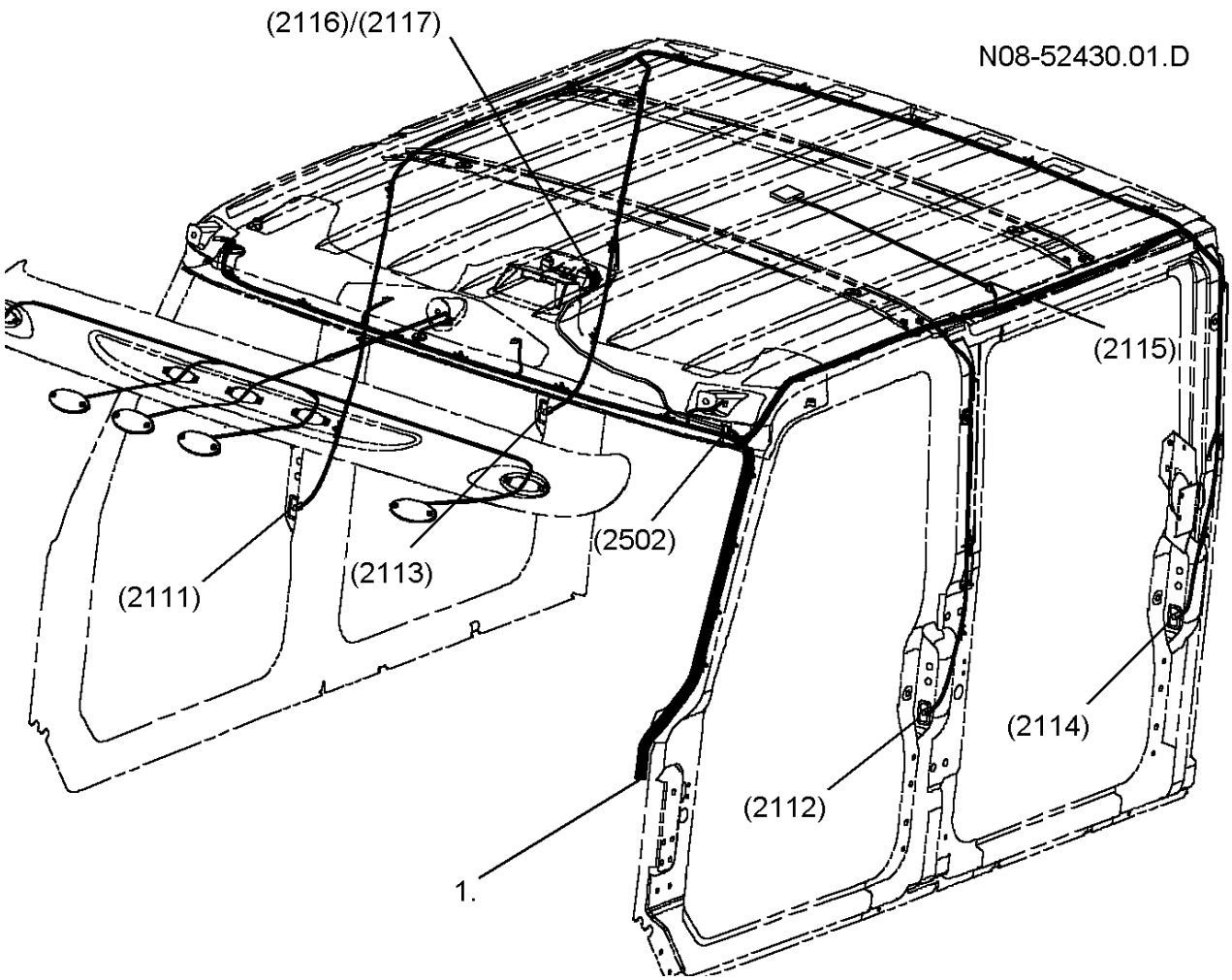

Figure 430 Dome Light Wiring

1. ROOF HARNESS TO ROOF CONNECTOR (2000)
(2111) RIGHT DOOR DOME SWITCH CONNECTOR
(2112) LEFT DOOR DOME SWITCH CONNECTOR
(2113) RIGHT CREW DOOR DOME SWITCH CONNECTOR
(2114) LEFT CREW DOOR DOME SWITCH CONNECTOR
(2115) REAR DOME LIGHT CONNECTOR
(2116)/(2117) DOME READING LIGHT CONNECTOR

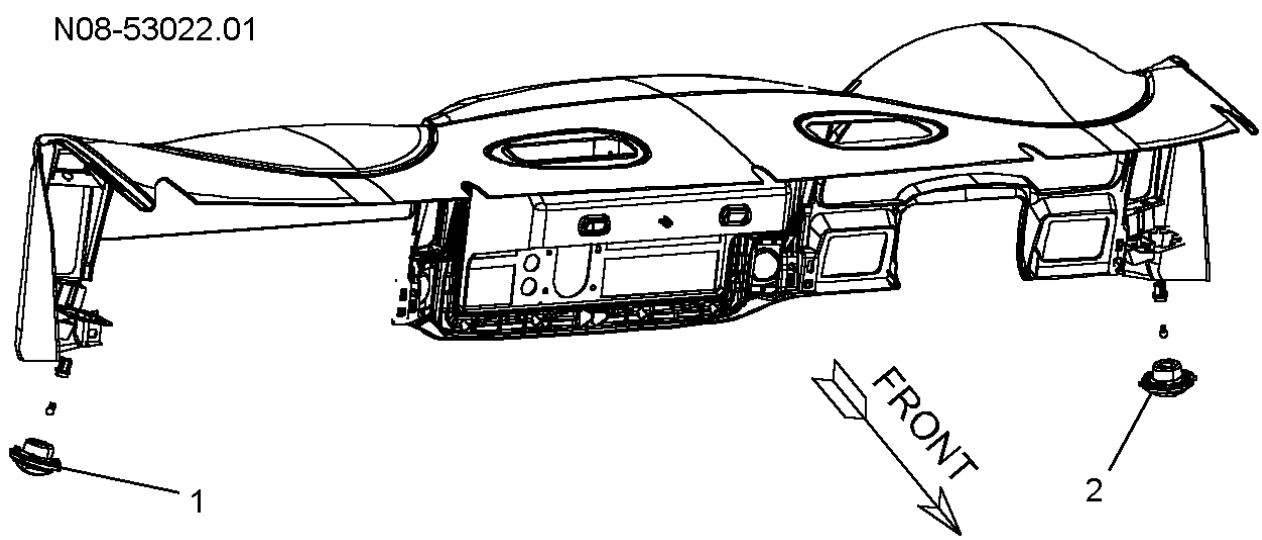

Figure 431 Courtesy Light Locations

1. PASSENGER COURTESY LIGHT
2. DRIVER COURTESY LIGHT

5. FOG LIGHT SYSTEM

5.1. CIRCUIT FUNCTIONS

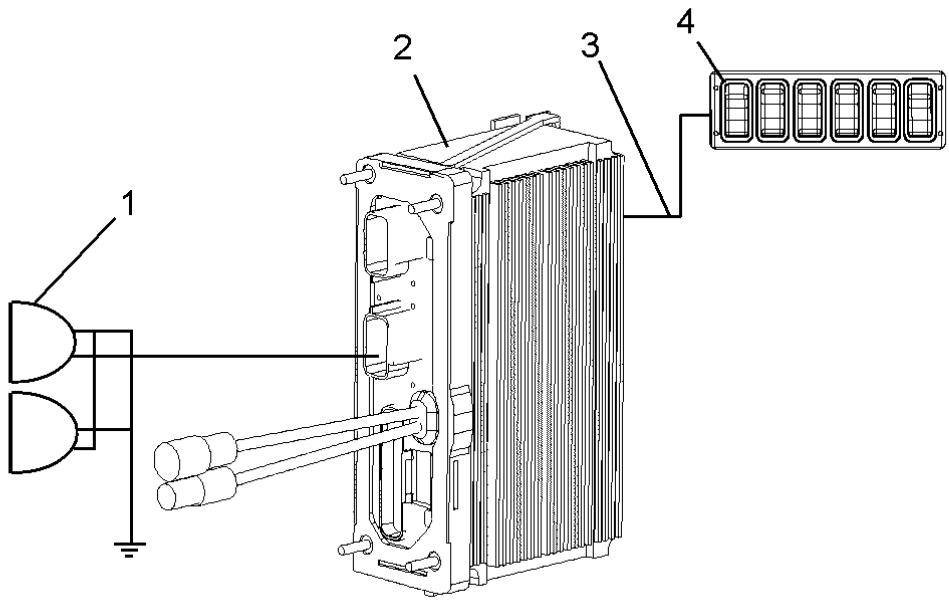

Figure 432 Fog Lights Function Diagram

1. FOG LIGHTS
2. ELECTRICAL SYSTEM CONTROLLER
3. SWITCH DATA LINK
4. FOG LIGHT SWITCH (IN SWITCH PACK)

Refer to Fog Lights Function Diagram.

Fog lights are rectangular halogen lights mounted in the bumper opening and are available with either amber or clear lenses.

When the fog light switch is turned on the switch pack will send a message, on the switch data link, to the ESC requesting the fog lights to be turned on. If the key is in the ignition position, the headlights are on and in the low beam position the ESC will provide voltage to power the fog lights. If the high beams are selected the voltage to the fog lights will be interrupted by the ESC until the low beams are turned on.

The ESC will also send a message back to the switch pack to illuminate the fog light switch “on” light.

5.2. DIAGNOSTICS

Should the fog lights fail to operate, the problem could be attributed to a faulty switch in the switch pack, a faulty switch pack or open or shorted output wiring between the ESC and the fog lights.

A problem with the mechanical portion of the switch or the switch contacts may cause the ESC to command the switch on lamp to blink.

The ESC will also log faults for switch errors or switch pack errors, identified by location. Switch locations will vary depending on vehicle configuration. The ESC is programmed to recognize the location and function of the switch.

The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

A diagnostic trouble code will be logged if there is an over current (short to ground or excessive load) or an open in the circuits between the ESC and the fog lights.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the fog lights and monitor activation of the fog light switch. See the diagnostic software manual for details on using the software.

Fog Light Preliminary Check

Table 294 Fog Light Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify fog lights are inoperative. (Ignition on, headlights on, low beam selected and fog light switch on.)	Visually check fog lights.	Fog lights are inoperative.	Go to next step.	Fog lights are operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunctioning features.	No other features are malfunctioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.
3.	On	Are both fog lights inoperative?	Visually check if both fog lights are inoperative.	Both fog lights are inoperative.	Go to next step.	Check specific circuits of the inoperative light for open circuits.

Table 294 Fog Light Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
4.	On	Check for fog light diagnostic trouble codes. (See Diagnostic Trouble Codes, page 872)	Read display on odometer.	No fog light diagnostic trouble codes are active.	Go to next step.	Go to fault detection management. (See FAULT DETECTION MANAGEMENT, page 873)
5.		**Check for switch pack faults.** Problem may be in multiplexed switches. Check for switch diagnostic trouble codes. (See Diagnostic Trouble Codes, page 872)		No multiplexed switch diagnostic trouble codes are active.	Go to fault detection management. (See FAULT DETECTION MANAGEMENT, page 873)	

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 295 Fog Light Circuits

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
Diagnostic trouble codes starting with 625	625 series diagnostic trouble codes relate to switch pack faults.
Refer to the switch pack module section.	
611 14 3 2	Fog light over current
This fault may be the result of a short in the circuits between the fog lights and the ESC. It could also be caused by an excessive load on the circuit.	
611 14 3 1	Fog light open circuit
This fault is the result of an open in circuits between the fog lights and the ESC. Check for burned out bulb.	
611 14 3 3	Fog light lamps, less than normal low current but more than open circuit

Table 295 Fog Light Circuits (cont.)

611 14 3 4	Fog light lamps, greater than normal high current and less than fusing current
611 14 3 6	Fog light lamps has current flow when output commanded off

5.3. FAULT DETECTION MANAGEMENT

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Fog Light Circuits From ESC.

A fault in the fog light circuits will be apparent when the lights don't come on. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the circuits to the fog light. Problems in the fog light circuits can be caused by burned out lamps, a blown fuse, a short, an open, or a problem in the ESC.

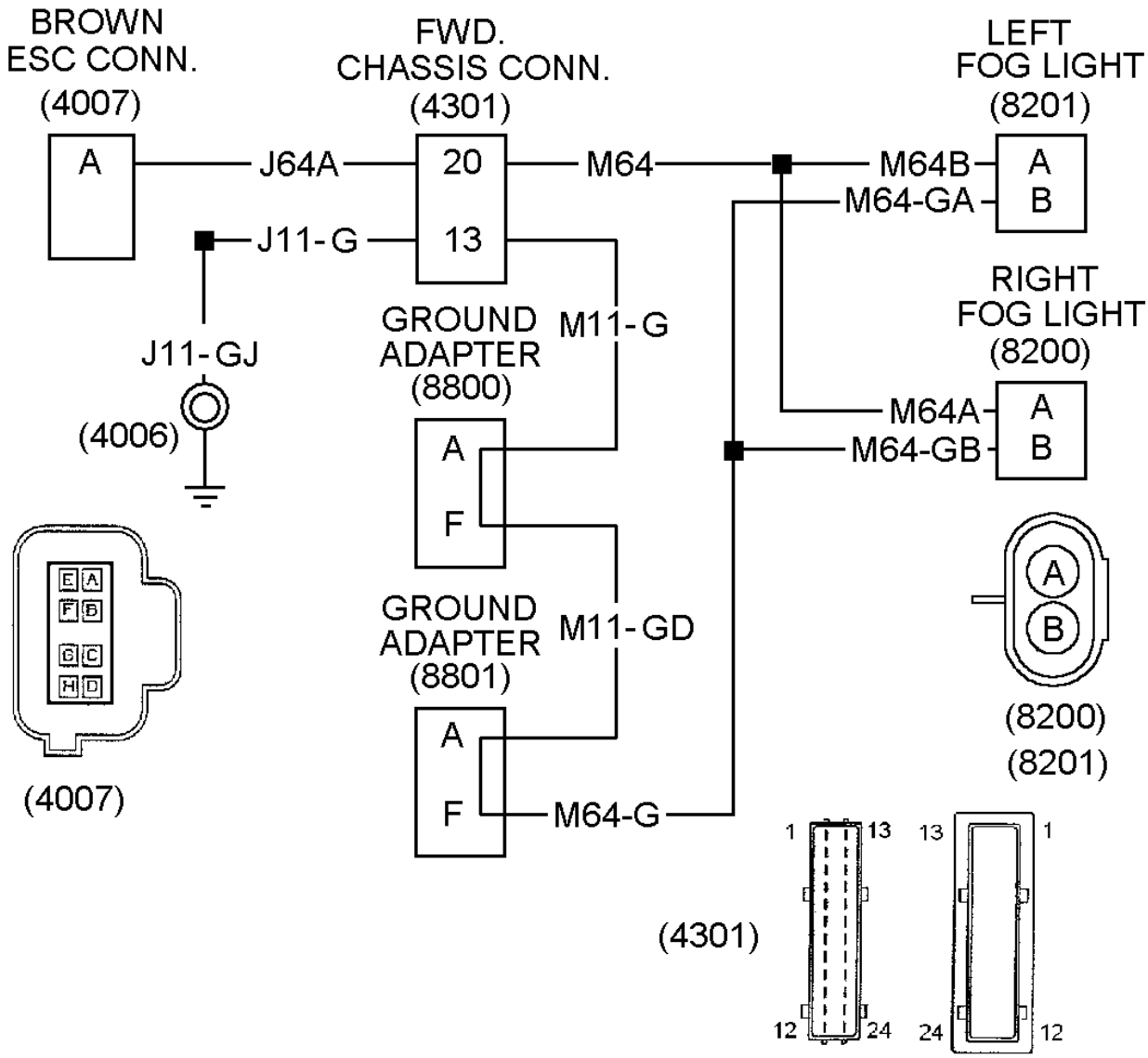

Figure 433 Fog Light Circuits From ESC (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(4006) GROUND STUD
(4007) BROWN ESC CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4301) FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(8200) RIGHT FOG LIGHT CONNECTOR
LOCATED BEHIND RIGHT FOG LIGHT
(8201) LEFT FOG LIGHT CONNECTOR
LOCATED BEHIND LEFT FOG LIGHT
(8800) GROUND ADAPTER
(8801) GROUND ADAPTER

Table 296 Fog Lights Circuit Tests

FAULTS	
611 14 3 3	Fog light lamps, less than normal low current but more than open circuit
611 14 3 4	Fog light lamps, greater than normal high current and less than fusing current
611 14 3 6	Fog light lamps has current flow when output commanded off
611 14 3 2	Fog light over current (Short Circuit)
611 14 3 1	Fog light under current (Open Circuit)

Fog Light Connector (8201) Voltage Checks

Check with ignition on, headlights on, low beams selected and fog light switch on.

NOTE – Always check connectors for damage and pushed–out terminals.

The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments
(8201) cavity A to ground	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open or short in circuits M64B, M64, J64A or M64A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(8201) cavity B to ground	0 volts	Ground circuit, no voltage expected.
(8201) Pin A to cavity B	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in ground circuits and connectors between ground stud (4006) and the fog light connector.

Fog Light Connector (8200) Voltage Checks

Check with ignition on, headlights on, low beams selected and fog light switch on.

NOTE – Always check connectors for damage and pushed–out terminals.

Test Points	Spec.	Comments

Table 296 Fog Lights Circuit Tests (cont.)

(8200) cavity B to ground	0 volts	Ground circuit, no voltage expected.
(8200) cavity A to cavity B	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in ground circuits and connectors between ground adapter (8801) and the fog light connector.

5.4. EXTENDED DESCRIPTION

Refer to Fog Light Circuits From ESC.

The fog light switch communicates with the ESC. When it is in the on position and the headlights are in low beam the ESC will turn on the fog lights.

The ESC will supply 12 volts to system controller brown connector (4007) terminal A, circuit J86A, forward chassis connector (4301) terminal 20 and circuit M64 to a tie point. From the tie point the circuits are split on M64B to left fog light connector (8201) terminal A and M64A to right fog light connector (8200) terminal A.

Ground for the fog lights is supplied from ground stud (4006) on circuits J11–GJ, J11–G, forward chassis connector (4301) terminal 13 and circuit M10–GA to tie point CS5. From CS5 the circuits are split on M64–GA to left fog light connector (8201) terminal B and M64–G to right fog light connector (8200) terminal B.

5.5. COMPONENT LOCATIONS

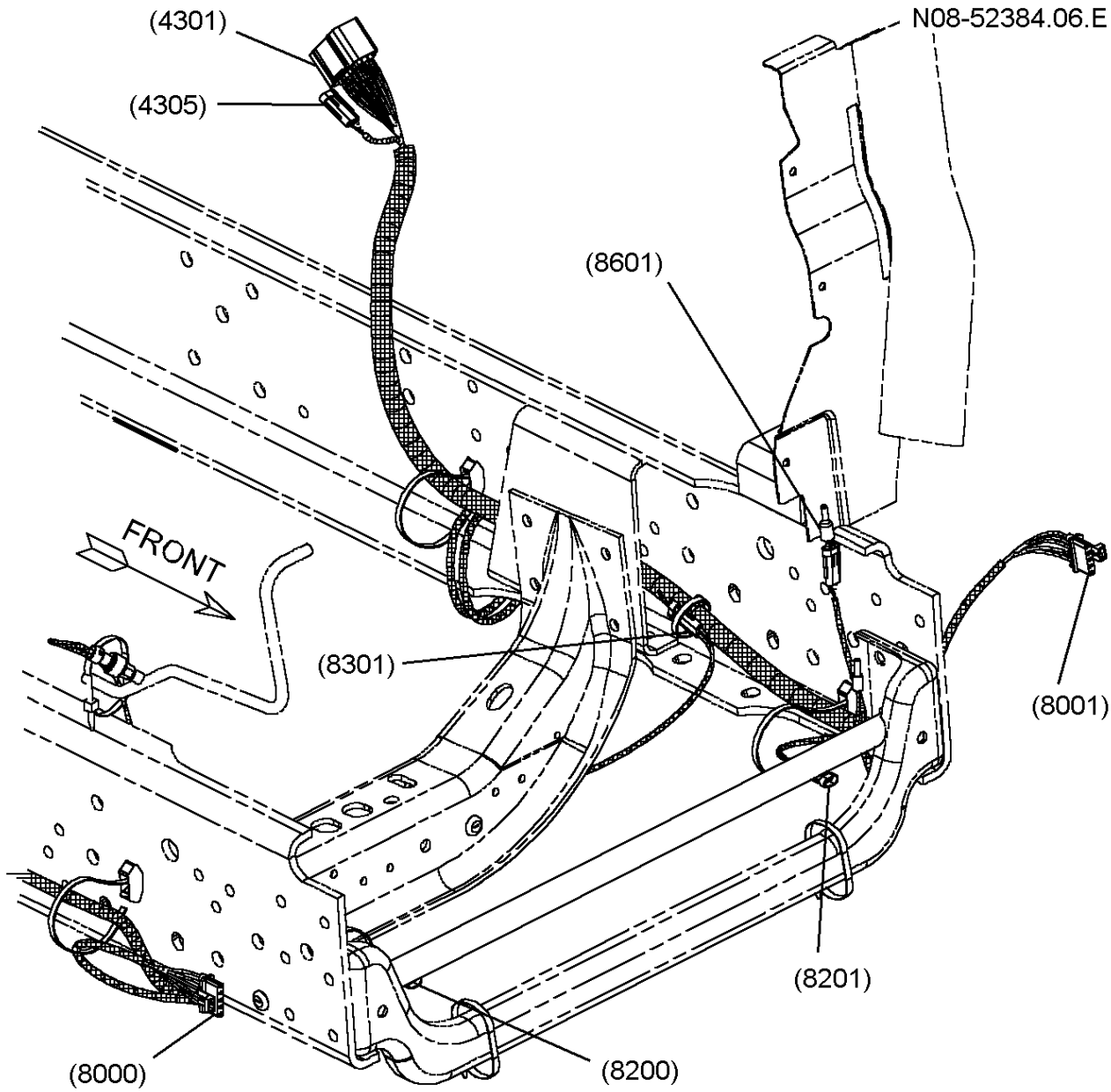

Figure 434 Fog Light Wiring

(4301) FORWARD CHASSIS CONNECTOR
(8000) RIGHT HEADLIGHT CONNECTOR
(8001) LEFT HEADLIGHT CONNECTOR
(8200) RIGHT FOG LIGHT CONNECTOR
(8201) LEFT FOG LIGHT CONNECTOR
(8302) HORN CONNECTOR

6. HEADLIGHT SYSTEM

6.1. CIRCUIT FUNCTIONS

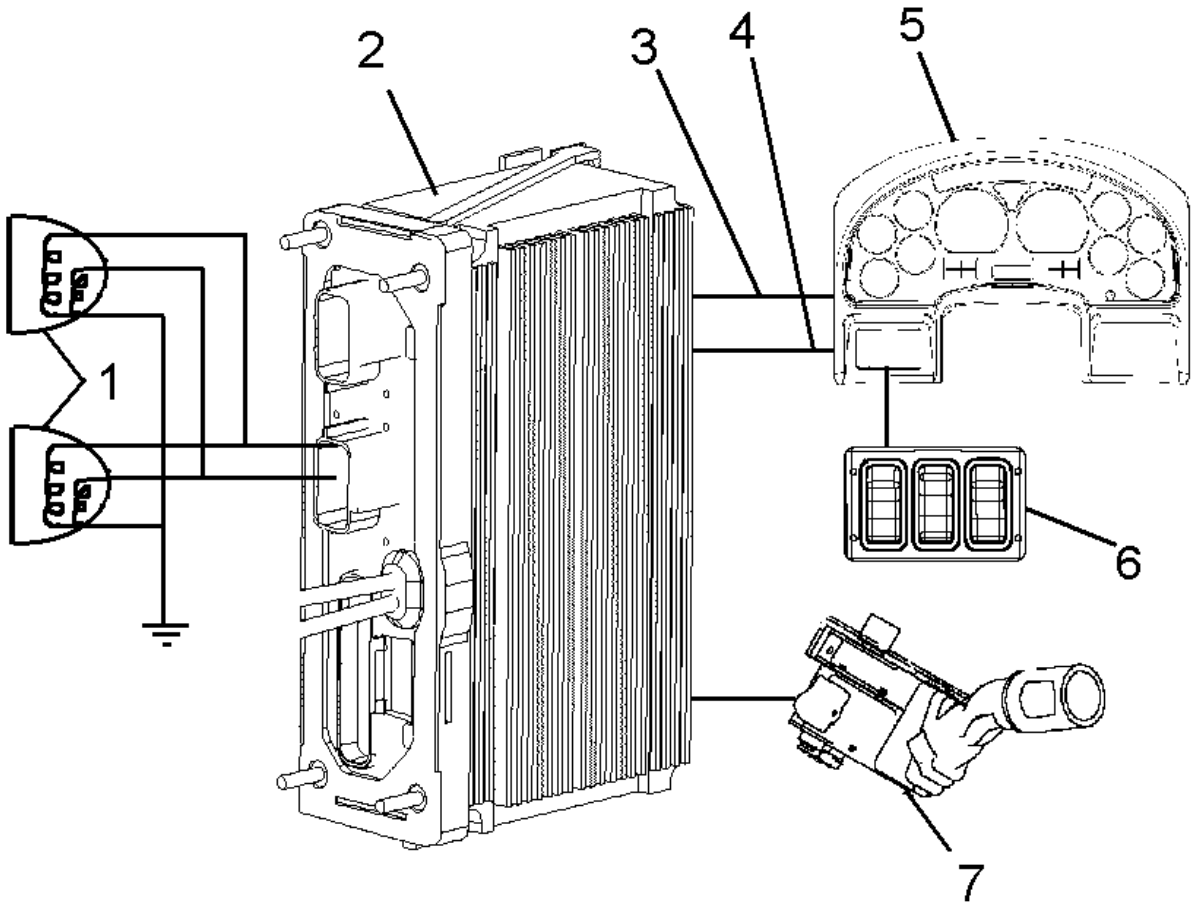

Figure 435 Headlights Function Diagram

1. HEADLIGHTS
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVETRAIN 1939 DATA LINK (FROM ELECTRONIC GAUGE CLUSTER)
4. DIRECT HEADLIGHT ENABLE CIRCUIT FROM EGC
5. ELECTRONIC GAUGE CLUSTER
6. HEADLIGHT SWITCH (IN ELECTRONIC GAUGE CLUSTER)
7. DIMMER SWITCH (PART OF TURN SIGNAL ASSEMBLY)

Refer to Headlights Function Diagram.

The headlight system consists of the headlights, headlight switch, dimmer switch, flash to pass, day time running lights (mandatory for Canada, optional for USA) and the optional “lights on with wipers feature”.

The fender mounted headlights are a one lamp system and share a molded cavity with the turn signals. The headlight switch is a 3–position (off/parking lights/headlights) rocker type located below the EGC. When the key is in the ignition position and the headlight switch is on the EGC will communicate with the ESC on the drivetrain 1939 data link. The ESC supplies voltage to the headlights as requested.

While the key is not in the ignition position, the headlights will only operate in the low beam mode. This is enabled by a direct circuit from the EGC to the ESC, which is not dependant on the data link. This also acts as a fail-safe to activate the low beam headlights when communication on the drivetrain 1939 data link is interrupted.

The dimmer and flash to pass switches are located in the turn signal assembly. Pulling the turn signal lever toward the driver as far as it will go, while the headlights are on, will switch the headlights between hi-beam and low-beam operation.

When the key is on and the headlights are off, pulling the turn signal slightly toward the driver and releasing the turn signal lever will flash the headlights.

When the key is on and the headlights are on, pulling the turn signal slightly toward the driver and releasing the turn signal lever will momentarily switch the headlights between hi-beam and low-beam operation.

The programmable day time running light feature allows the vehicle to operate in a “lights on” condition at all times without driver input. This system operates the headlights at partial illumination, but still helps to increase visibility even in bright sunshine. The daytime running lights will go off when the park brake is set or the ignition is turned off.

When the programmable “lights on with wipers feature” is enabled the low beam headlights and park lights will be turned on by the ESC anytime the windshield wipers are activated, except during momentary wash/wipe. The lights will remain on after the wipers are turned off until the headlight switch is turned on and off or the key is turned off.

If the vehicle is equipped with a remote keyless entry, the ESC will also turn the headlights on or off as required.

6.2. DIAGNOSTICS

Should the lights fail to operate, the problem could be attributed to a faulty switch in the EGC, a faulty switch pack in the EGC a faulty EGC, open circuits or shorted circuits. The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

Should the lights fail to switch between high and low beams or the flash to pass fail to operate, the problem could be attributed to a faulty switch in the turn signal assembly, open circuits, shorted circuits or a problem in the ESC.

A diagnostic trouble code will be logged if there is an over current (short to ground or excessive load) or an open in the circuits between the ESC and the headlights.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the lights and monitor activation of the turn/hazard signal switches and stop light switch(es). See the diagnostic software manual for details on using the software.

The diagnostic software will also identify if the daytime running light or lights on with wipers features are activated.

Headlight Preliminary Check

Table 297 Headlight Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify headlights are malfunctioning.	Visually check headlights.	Headlights are malfunc-tioning.	Go to next step.	Headlights are operating correctly. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunc-tioning features.	No other features are malfunc-tioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.
3.	On	Are both high beam or both low beam lights malfunctioning?	Visually check if both high beam or both low beam lights are malfunc-tioning?	Both high beam or both low beam lights are malfunc-tioning.	Go to next step.	Check specific circuits of the inoperative light for open circuits.
4.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 880)	Read display on odometer.	Headlight diagnostic codes are present.	Go to headlight outputs from ESC (See HEADLIGHT OUTPUTS FROM ESC, page 885)	Go to Headlight circuit inputs to ESC (See HEADLIGHT CIRCUIT INPUTS TO ESC, page 881)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 298 Headlight Circuits

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the headlight circuits.
There are no diagnostic trouble codes associated with the dimmer switch, flash to pass switch or 3 switch pack in the EGC. Open circuits to an individual headlight will not generate a fault. An open in the zero volt reference signal to the turn signal switch will cause the wipers to operate at high speed which will turn on the low beams if the “lights on with wipers” feature is enabled.	
611 14 5 1	Headlight low beam open circuit
611 14 5 2	Headlight low beam over current
611 14 5 3	Headlight low beam lamps, less than normal low current but more than open circuit
611 14 5 4	Headlight low beam lamps, greater than normal high current and less than fusing current
611 14 5 6	Headlight low beam lamps has current flow when output commanded off
611 14 7 1	Headlight high beam open circuit
611 14 7 2	Headlight high beam over current
611 14 7 3	Headlight high beam lamps, less than normal low current but more than open circuit
611 14 7 4	Headlight high beam lamps, greater than normal high current and less than fusing current
611 14 7 6	Headlight high beam lamps has current flow when output commanded off

6.3. HEADLIGHT CIRCUIT INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Headlight Circuit Inputs to ESC.

A fault in the headlight circuit inputs to the ESC will be apparent when the lights don’t operate correctly. There are no diagnostic trouble codes associated with headlight input circuits to the ESC. Problems in the headlight input circuits can be caused by faulty switches, a short, an open, or a problem in the ESC or EGC.

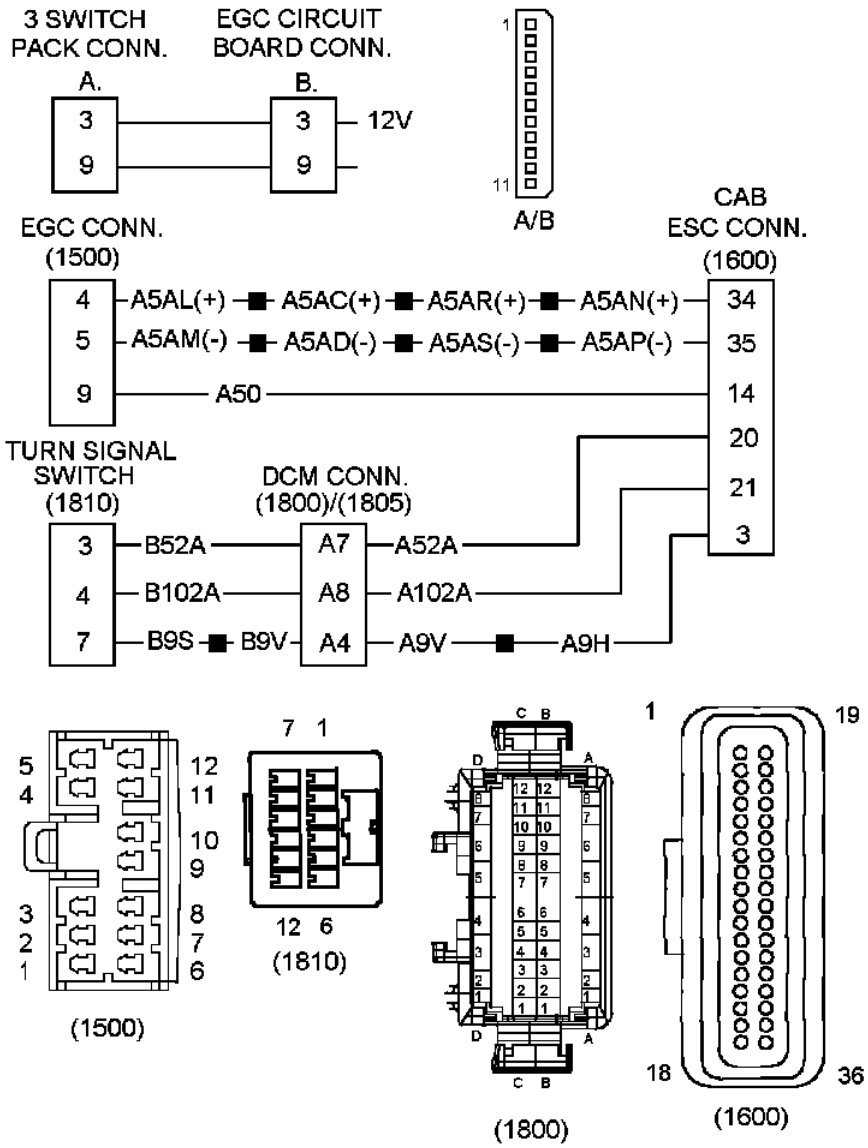

Figure 436 Headlight Circuit Inputs to ESC (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

A. 3 SWITCH PACK CONNECTOR
LOCATED ON BACK OF 3 SWITCH PACK
B. ELECTRONIC GAUGE CLUSTER (EGC) CONNECTOR
LOCATED ON EGC CIRCUIT BOARD
(1500) ELECTRONIC GAUGE CLUSTER (EGC) CONNECTOR
LOCATED ON BACK OF EGC
(1600) 36–WAY ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1800)/(1805) DRIVER CONTROL MODULE (DCM) CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN
(1810) TURN SIGNAL SWITCH HARNESS CONNECTOR
LOCATED BEHIND TURN SIGNAL ASSEMBLY

Table 299 Headlight Switch Inputs to ESC Circuit Tests

THERE ARE NO DIAGNOSTIC TROUBLE CODES ASSOCIATED WITH THESE CIRCUITS		
A mechanically defective headlight switch could also prevent the headlight from operating. Remove the mechanical portion of the switch and attempt to turn the switch on by pressing the bottom switch contact. If the headlights illuminate, the mechanical switch assembly should be replaced.		
ESC Harness Connector (1600) Voltage Checks Checks headlight fail-safe circuit input to ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** Connect breakout box to harness connector (1600)		
Test Points	Spec.	Comments
Headlight switch “on”, ESC connector (1600) terminal 14 to ground	12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open or short in circuit A50. If no open or shorts are found check for voltage out of EGC.
Headlight switch “off”, Terminal 14 to ground	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 0 volts with headlight switch “off”	Identify source of incorrect voltage and repair
EGC 3 Switch Pack Harness Connector Headlight Voltage Checks Check with ignition key on and 3 switch pack disconnected. **NOTE – If the EGC is working correctly, disconnecting the 3 switch pack connector should cause the park lights to come on.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
3 switch pack harness connector, pin 3 to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between EGC connector and switch connector. Also insure proper voltage out of EGC.
3 switch pack harness connector, pin 9 to ground	0 –.3 volts	Low circuit from EGC If voltage is incorrect, check for open or shorts in circuits between EGC and switch. Also insure proper voltage out of EGC.

Table 299 Headlight Switch Inputs to ESC Circuit Tests (cont.)

Test Points	Spec.	Comments
3 Switch Pack Headlight Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Checking for continuity between pins 3 and 9 of the switch pack, when the switch is on.	<2 ohms.	If there is no continuity, the switch pack needs replaced.
Turn Signal Switch Harness Connector (1810) Voltage Checks Check with key in ignition position Checks high/low beam select input circuits. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
(1810) Cavity 3 to ground Headlight dimmer switch input	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuits B52A or A52A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(1810) Cavity 4 to ground Flash to pass switch input	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuits B102A or A102A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(1810) Cavity 7 to ground	<1 volt.	Zero volt reference level circuit, no voltage expected.
Turn Signal Switch (1810) Resistance Checks Check with (1810) removed Checks dimmer and flash to pass switches in turn signal assembly.		
(1810) pin 3 to 7	Switching between >50K ohms and < 2 ohms as lever is pulled and released.	If resistance is incorrect replace turn signal switch assembly.
(1810) pin 4 to 7	Switching between >50K ohms and < 2 ohms as lever is pulled and released.	If resistance is incorrect replace turn signal switch assembly.

Extended Description

Refer to Input Circuits to ESC.

When the key is in the ignition position and the headlight switch is turned on, the EGC will communicate with the ESC through the drivetrain 1939 data link to command the lights on.

The ESC applies 12 volts to terminal 3 (headlight dimmer switch contacts) of turn signal switch (1810) through circuit A52A, connector (1800)/(1805) and circuit B52A. When the headlight dimmer switch is activated the ESC will sense this voltage drop to ground through turn signal switch connector (1810) terminal 7, circuit B9S, circuit B9V, connector (1800)/(1805), circuit A9V, circuit A9H and ESC connector (1600) terminal 3 to the zero volt reference signal.

The ESC applies 12 volts to terminal 4 (flash to pass switch contacts) of turn signal switch (1810) through circuit A102A, connector (1800)/(1805) and circuit B102A. When the flash to pass switch is activated the ESC will sense this voltage drop to ground through turn signal switch connector (1810) terminal 7, circuit B9S, circuit B9V, connector (1800)/(1805), circuit A9V, circuit A9H and ESC connector (1600) terminal 3 to the zero volt reference signal.

When the headlight switch is in the on position, 12 volts is applied from EGC connector (1500) terminal 9 to circuit A50 and ESC connector (1600) terminal 14. This signals the ESC To turn on the low beams even when the key is not in the ignition position.

6.4. HEADLIGHT OUTPUTS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Circuits From ESC to Headlights.

A fault in the circuits between the ESC and the headlights will be apparent when the lights don't operate correctly. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the headlight circuits or an open circuit between the ESC and the headlights. Problems in the circuits between the ESC and the headlights can be caused by burned out lamps, a short, an open, or a problem in the ESC.

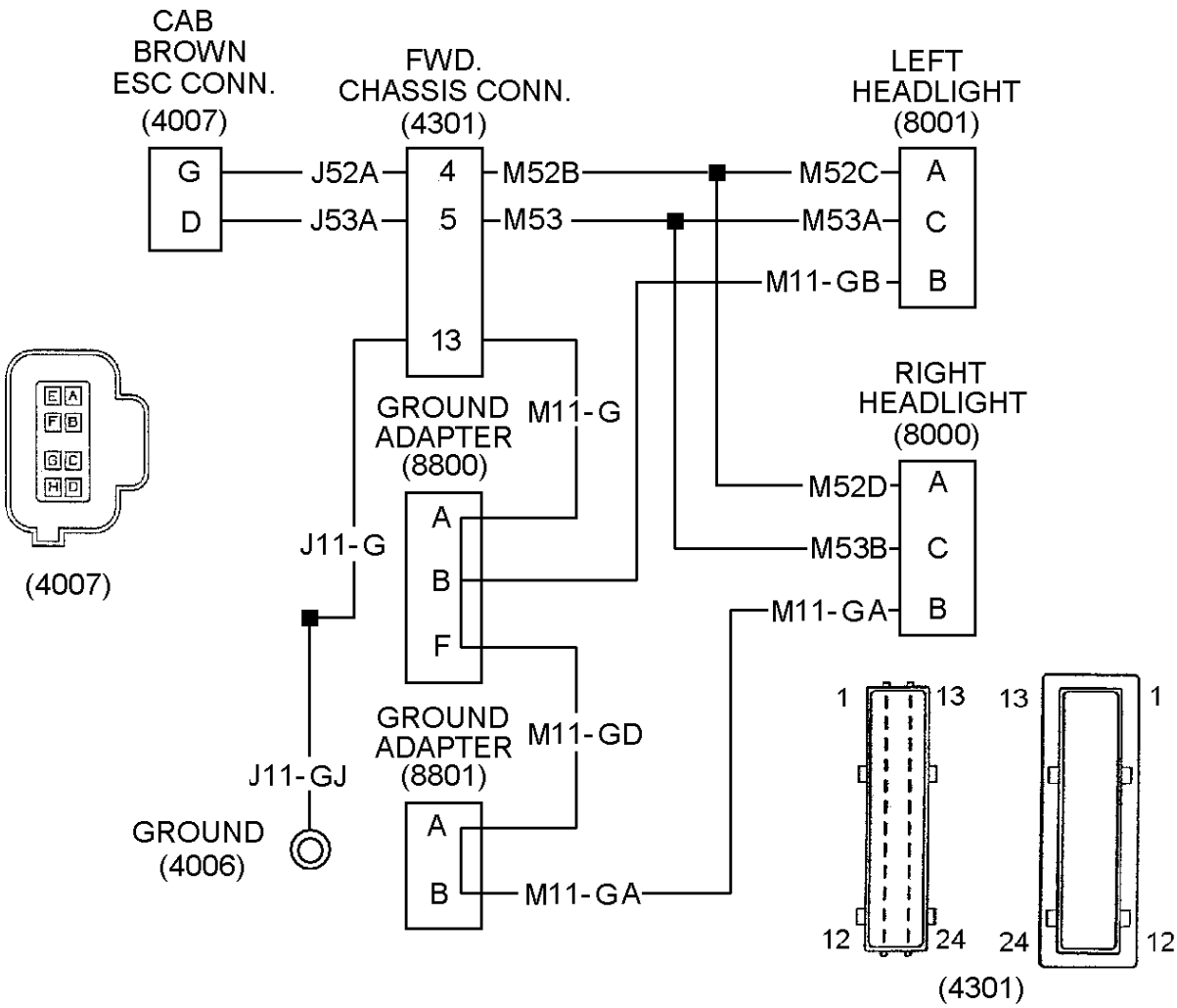

Figure 437 Circuits From ESC to Headlights (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(4006) GROUND STUD
(4007) BROWN ESC CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4301) FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(8000) RIGHT HEADLIGHT CONNECTOR
LOCATED BEHIND RIGHT HEADLIGHT
(8001) LEFT HEADLIGHT CONNECTOR
LOCATED BEHIND LEFT HEADLIGHT
(8800) LEFT GROUND ADAPTER
(8801) RIGHT GROUND ADAPTER

Table 300 ESC Low Beam Outputs to Headlight Circuit Tests

FAULTS	
611 14 5 3	Headlight low beam lamps, less than normal low current but more than open circuit
611 14 5 4	Headlight low beam lamps, greater than normal high current and less than fusing current
611 14 5 6	Headlight low beam lamps has current flow when output commanded off
611 14 5 2	Low beam over current
This fault may be the result of a short in the circuits between the low beam headlight circuits and the ESC. It could also be caused by an excessive load on the circuit.	
611 14 5 1	Low beam under current
This fault is the result of an open in circuits between the low beam headlight circuits and the ESC. Check for burned out bulbs.	

Left Headlight Connector (8001) Low Beam Voltage Checks

Check with key in ignition position, headlight switch on, low beams selected and connector (8001) disconnected.

With sealed beam headlamps, as used with severe service vehicles, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1

NOTE – With sealed beam headlamps, as used with Severe Service trucks, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments
Headlights in low beam. (8001) terminal C to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open or short in circuits J53A, M53, M53A or M53B. If no open or shorts are found check for voltage out of EGC.
Headlights in low beam. (8001) terminal C to terminal B.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuits between terminal B and ground.

Table 300 ESC Low Beam Outputs to Headlight Circuit Tests (cont.)

Headlights in low beam. (8000) terminal C to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuit M53B.
Headlights in low beam. (8000) terminal C to terminal B.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuits between terminal B and ground adapter (8800).

Table 301 ESC High Beam Outputs to Headlight Circuit Tests

FAULTS	
611 14 7 3	Headlight high beam lamps, less than normal low current but more than open circuit
611 14 7 4	Headlight high beam lamps, greater than normal high current and less than fusing current
611 14 7 6	Headlight high beam lamps has current flow when output commanded off
611 14 7 2	High beam over current
This fault may be the result of a short in the circuits between the high beam headlight circuits and the ESC. It could also be caused by an excessive load on the circuit.	
611 14 7 1	High beam under current
This fault is the result of an open in circuits between the high beam headlight circuits and the ESC. Check for burned out bulbs.	
Left Headlight Connector (8001) Voltage Checks Check with key in ignition position, headlight switch on, high beams selected and connector (8001) disconnected. **NOTE – With sealed beam headlamps, as used with Severe Service trucks, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**	
Test Points	Spec.	Comments

Table 301 ESC High Beam Outputs to Headlight Circuit Tests (cont.)

Headlights in high beam. (8001) terminal A to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open or short in circuits J52A, M52B, M52C or M52D. If no open or shorts are found check for voltage out of EGC.
Headlights in high beam. (8001) terminal A to terminal B.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuits between terminal B and ground.
Headlights in high beam. (8000) terminal A to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuit M52D.
Headlights in high beam. (8000) terminal A to terminal B.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts with headlight switch “on”	If voltage is missing, check for open in circuits between terminal B and ground adapter (8800).

Extended Description

Refer to Circuits From ESC to Headlights.

When low beams are requested, the ESC will supply 12 volts to system controller front connector (4007) terminal 5, circuit J53A, forward chassis connector (4301) terminal 5 and circuit M53 to tie point CS3. From CS3 the circuits are split on M53A to left headlight connector (8001) terminal C and M53B to right headlight connector (8000) terminal C.

When high beams are requested, the ESC will supply 12 volts to system controller front connector (4007) terminal 2, circuit J52A, forward chassis connector (4301) terminal 4 and circuit M52B to tie point CS4. From CS4 the circuits are split on M52C to left headlight connector (8001) terminal A and M52D to right headlight connector (8000) terminal A.

Ground for the headlights is supplied from ground stud (4006) on circuits J11–GJ, forward chassis connector (4301) terminal 13 and circuit M11–G to tie point CS5. From CS5 the circuits are split on M11–GB to left headlight connector (8001) terminal B and M11–GA to right headlight connector (8000) terminal B.

6.5. COMPONENT LOCATIONS

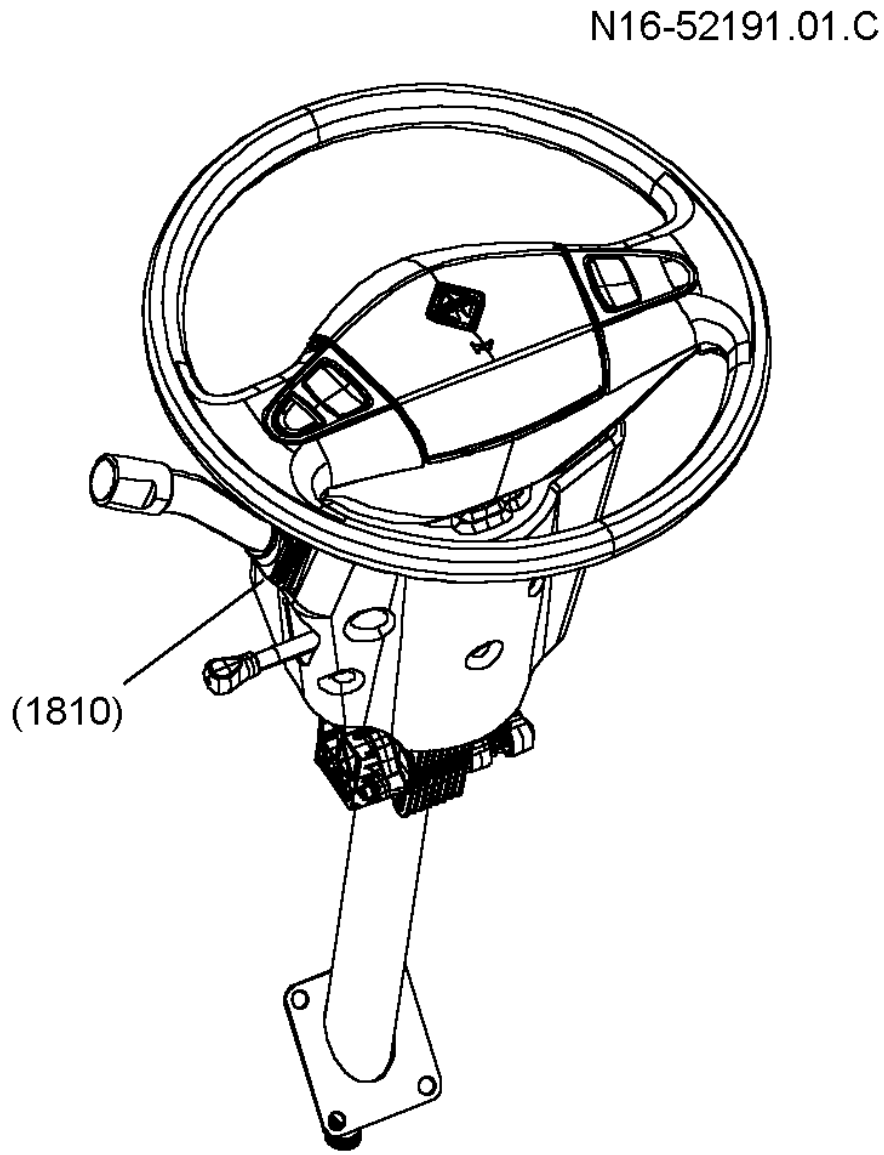

Figure 438 Turn Signal Assembly

(1810) TURN SIGNAL ASSEMBLY CONNECTOR (BEHIND STEERING COLUMN SHROUD)

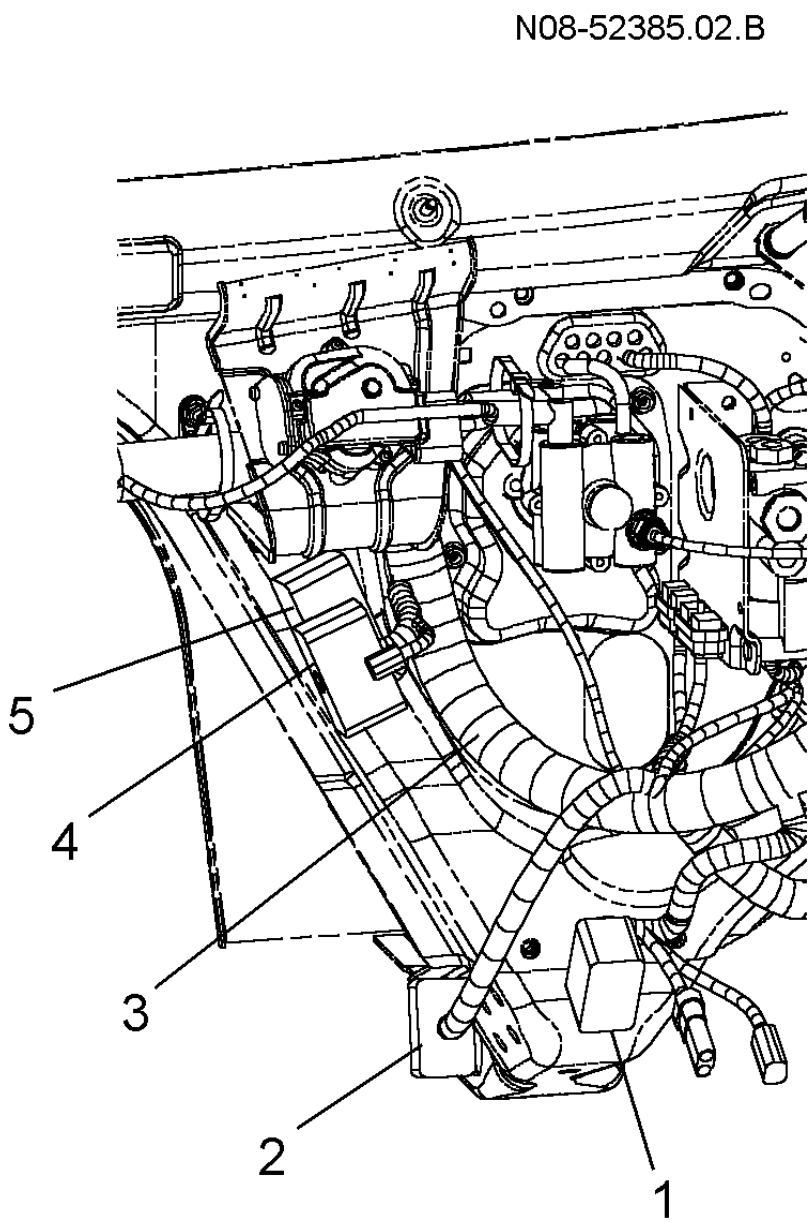

Figure 439 Headlight Connector Locations (Dash Panel From Engine Compartment)

1. FORWARD CHASSIS CONNECTOR (4301)
2. REAR CHASSIS CONNECTOR (9700)
3. CHASSIS HARNESS
4. TRANSMISSION CONNECTOR
5. ENGINE CONNECTOR

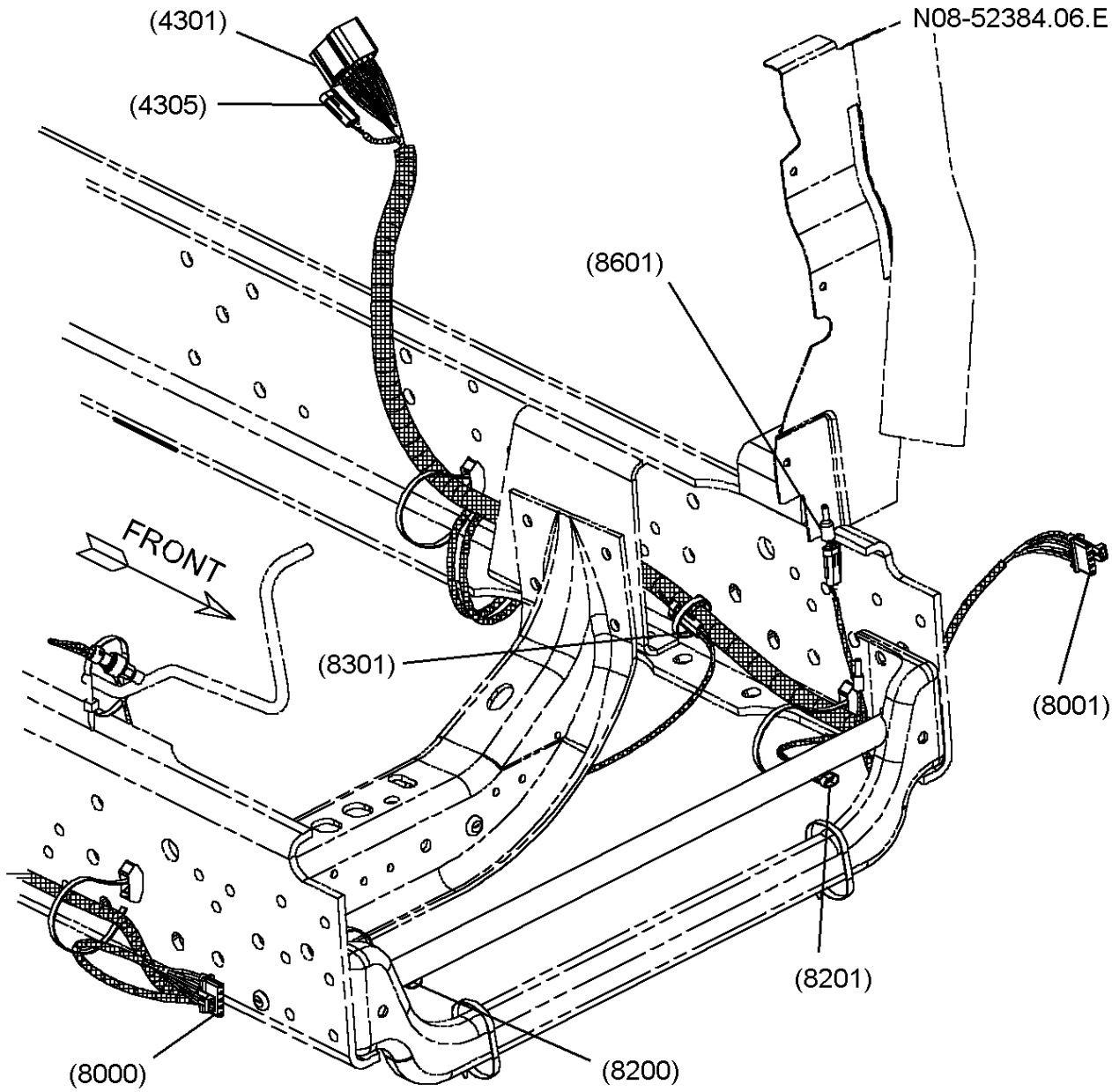

Figure 440 Headlight Wiring

(4301) FORWARD CHASSIS CONNECTOR
(8000) RIGHT HEADLIGHT CONNECTOR
(8001) LEFT HEADLIGHT CONNECTOR
(8200) RIGHT HEADLIGHT CONNECTOR
(8201) LEFT HEADLIGHT CONNECTOR
(8302) HORN CONNECTOR

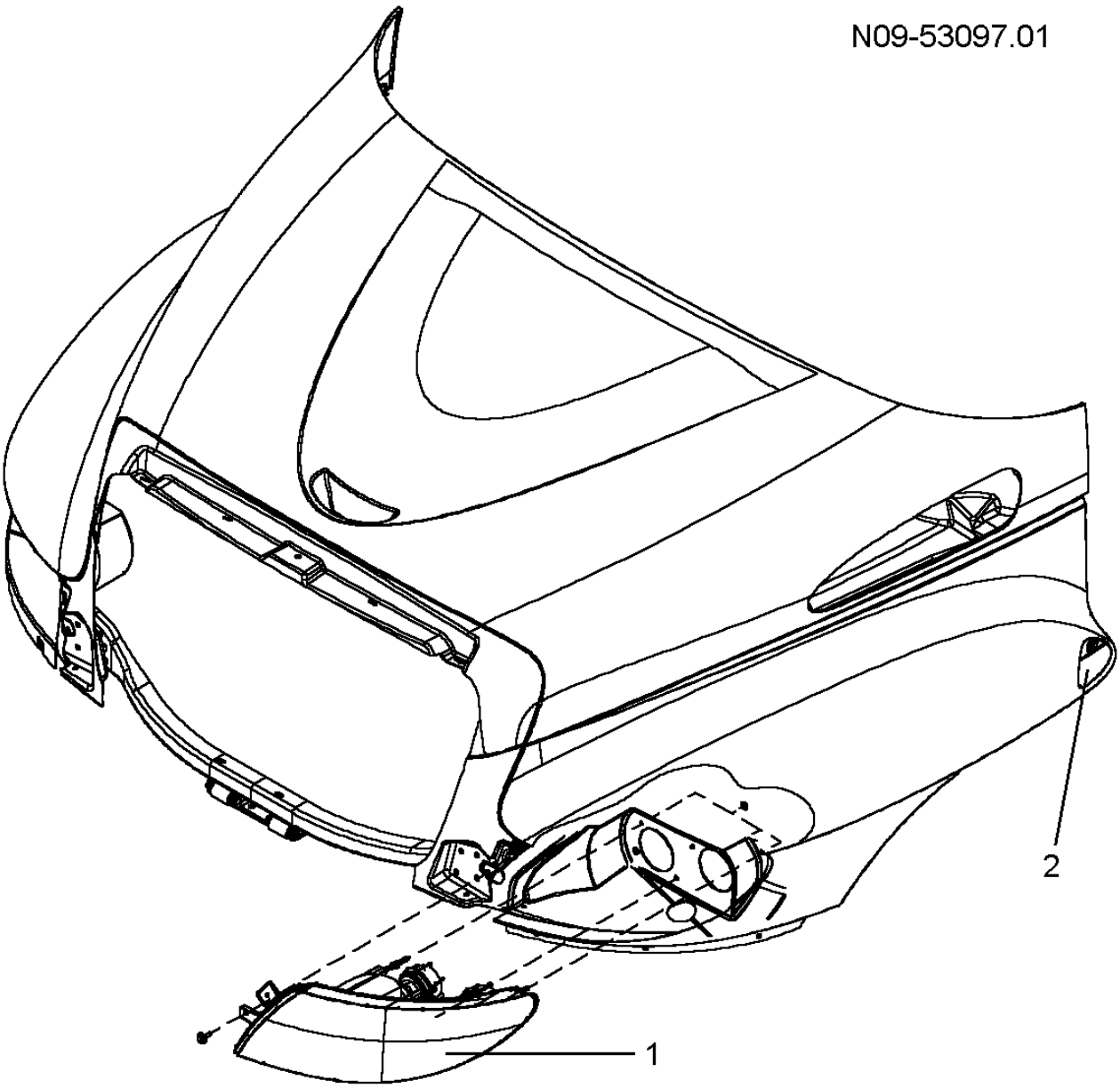

Figure 441 Headlights, Front and Side Marker Lights (Not Severe Service)

1. HEADLIGHT ASSEMBLY
2. SIDE MARKER LIGHT

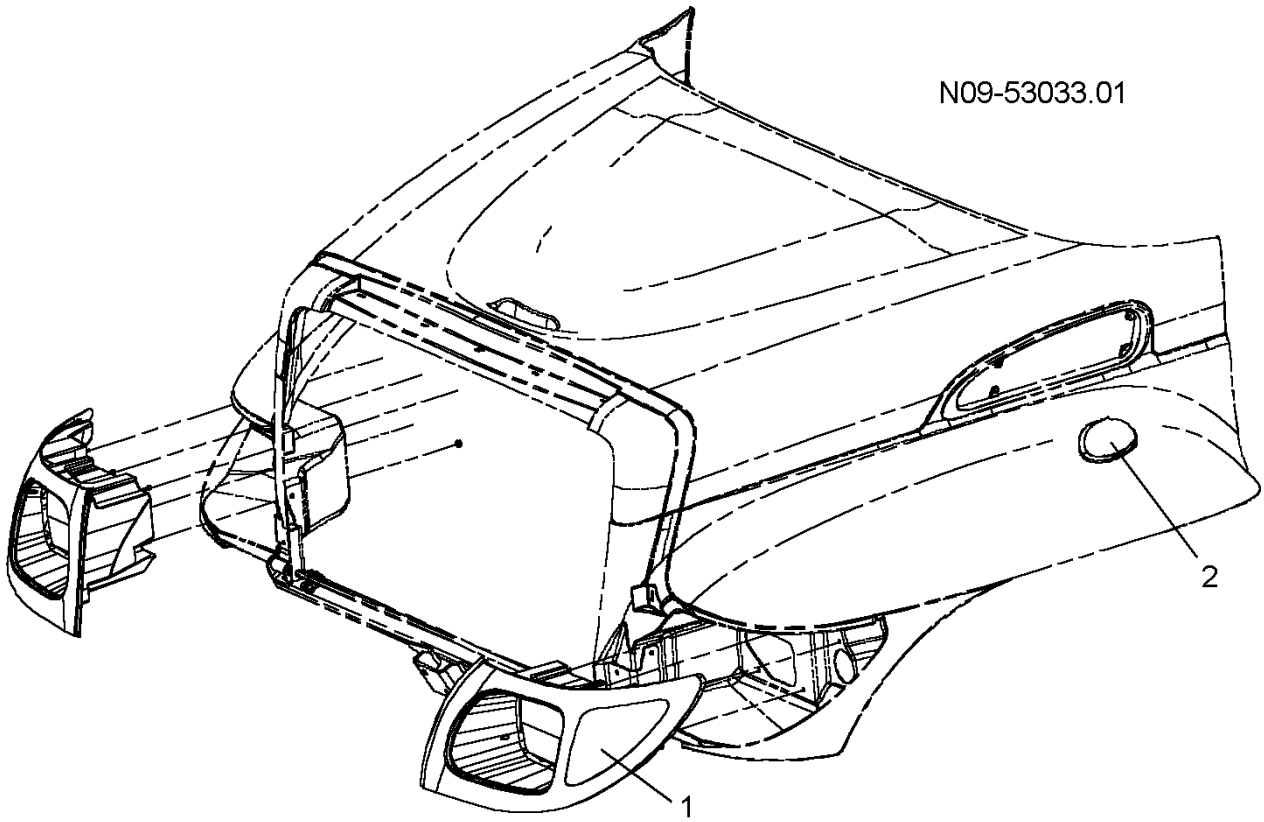

Figure 442 Headlights, Front and Side Marker Lights (Severe Service)

1. HEADLIGHT ASSEMBLY
2. STANDARD SIDE MARKER LIGHT

7. PANEL LIGHTS

7.1. CIRCUIT FUNCTIONS

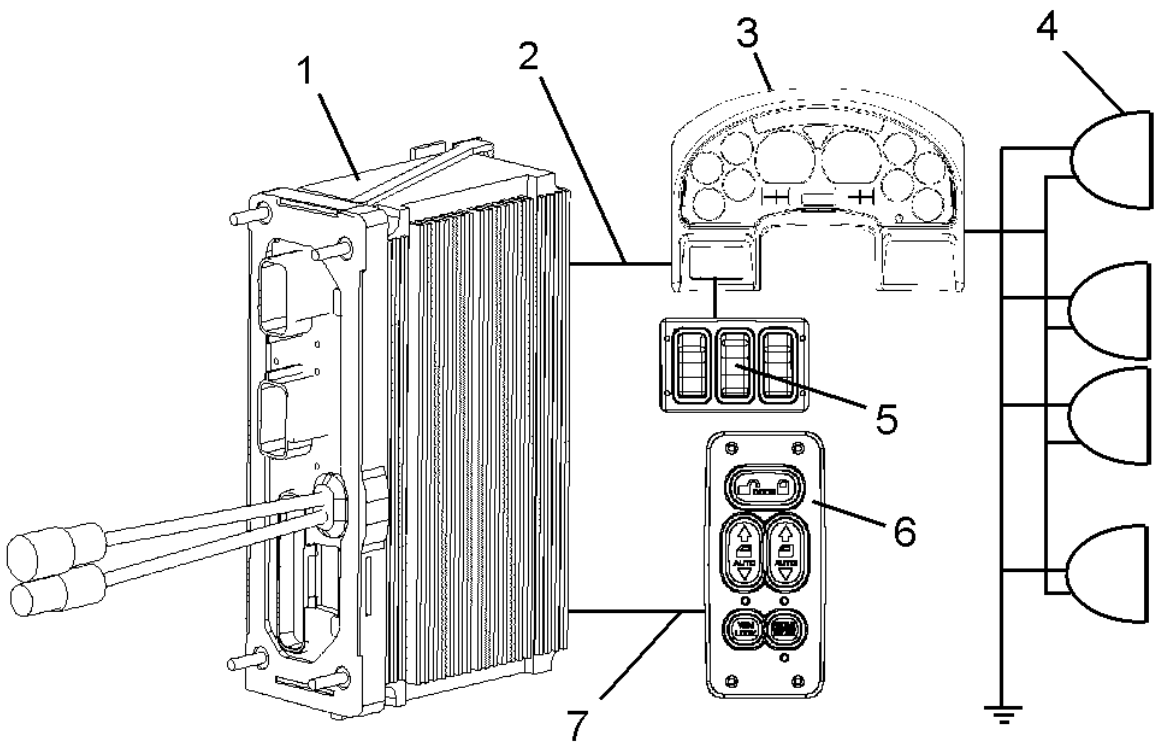

Figure 443 Panel Lights Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER (ESC)
2. DRIVETRAIN 1939 DATA LINK BETWEEN ELECTRONIC GAUGE CLUSTER (EGC) AND ESC
3. EGC
4. DIMMER CIRCUITS CONTROLLED BY PANEL LIGHT SWITCH
5. DIMMER SWITCH MOUNTED IN 3 SWITCH PACK MOUNTED IN EGC
6. DOOR PODS
7. SWITCH DATA LINK

Refer to Panel Lights Function Diagram

Panel lights are low wattage bulbs that illuminate gauges and other miscellaneous items. The panel light switch provides input to the EGC which generates the voltage to dim/brighten the panel lights for the gauge clusters, speedometer/tachometer module, cigar lighter, door pods, heater control, etc.

Most panel lights receive a control voltage directly from the EGC. The door pods receive dimmer control messages from the ESC on the switch data link.

7.2. DIAGNOSTICS

If the panel lights do not respond to the dimmer switch the problem could be attributed to a faulty panel light dimmer switch, a problem in the EGC, open circuits or shorted circuits.

If the panel lights in a door pod fail to operate correctly, while the other panel lights work, the problem must be in the pod or the ESC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the lights and monitor activation of the turn/hazard signal switches and stop light switch(es). See the diagnostic software manual for details on using the software.

Panel Light Preliminary Check

Table 302 Panel Light Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify panel lights are operating incorrectly.	Visually check panel lights.	Panel light is inoperative.	Go to next step.	Panel lights are operating correctly. Problem does not exist or is intermittent.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunctioning features.	No other features are malfunctioning.	Go to next step.	Identify and repair condition causing several features to operate incorrectly.
3.	On	Are all panel lights operating incorrectly?	Visually check if all panel lights are operating incorrectly.	All panel lights are operating incorrectly.	Go to next step.	Check specific circuits of the inoperative lights for open circuits.
4.	On	Are panel lights illuminating when park lights are turned on?	Visually check if panel lights illuminate.	Panel lights illuminate.	Go to next step.	Go to panel light circuit outputs from EGC. (See PANEL LIGHT OUTPUT FROM EGC, page 900)
5.	On	Do panel lights respond correctly to activation of the panel dimmer switch?	Visually check if panel lights respond to panel dimmer switch.	Panel lights respond correctly.	Panel lights are working correctly.	Go topanel light circuit outputs from EGC.(See PANEL LIGHT SWITCH INPUTS TO EGC, page 897).

Diagnostic Trouble Codes

Table 303 Panel Light Circuits

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
There are no faults for panel light circuits	

7.3. PANEL LIGHT SWITCH INPUTS TO EGC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Panel Light EGC and ESC Input Circuits.

A problem in the panel light switch circuits will be apparent when the panel lights are always on and the switch has no effect on the intensity of the panel lights. There are no diagnostic trouble codes associated with the switch circuits in the EGC. Loss of the drivetrain 1939 data link between the EGC and ESC will cause several problems to occur simultaneously and the check electrical system lamp will illuminate. **Go to the section on the drivetrain 1939 data link to troubleshoot this condition.** Problems in the Panel light circuits in the EGC can be caused by a short circuit between the 3 switch pack and the EGC, an open circuit between the 3 switch pack and the EGC, a faulty switch, or a problem in the EGC.

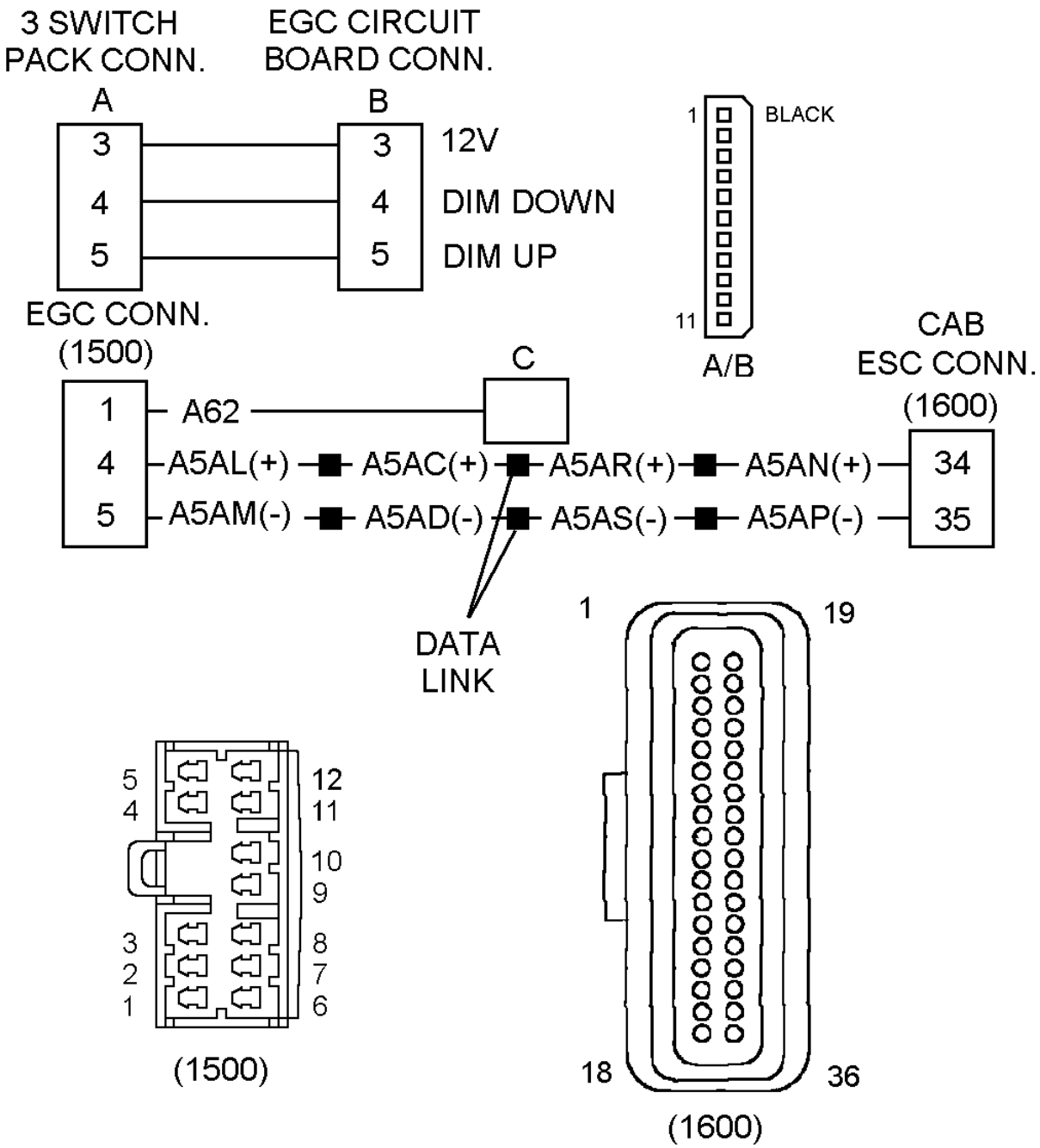

Figure 444 Panel Light EGC and ESC Input Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

A. 3 SWITCH PACK CONNECTOR
B. EGC CIRCUIT BOARD CONNECTOR
(1500) EGC CONNECTOR
LOCATED BEHIND CLUSTER
(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC

Table 304 EGC, 3 Switch Pack Circuit Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the 3 switch pack in the EGC.		
A mechanically defective panel light switch could also prevent the panel light from operating. Remove the mechanical portion of the switch and attempt to turn the switch on by pressing the microswitches. If the panel lights respond, the mechanical switch assembly should be replaced.		
3 Switch Pack Harness Connector Panel Light Voltage Checks Check with ignition key on and 3 switch pack disconnected. **NOTE – If the EGC and switch are working correctly, disconnecting the 3 switch pack connector should cause the panel lights to come on.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
3 switch pack harness connector, cavity 3 to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between EGC connector and switch connector. Also insure proper voltage out of EGC.
3 switch pack harness connector, cavity 4 to ground.	<1 volt	Dimmer down circuit between switch and EGC. If voltage is incorrect, check for shorts in circuits between EGC and switch. Also insure proper voltage out of EGC.
3 switch pack harness connector, cavity 5 to ground	<1 volt	Dimmer up circuit between switch and EGC. If voltage is incorrect, check for shorts in circuits between EGC and switch. Also insure proper voltage out of EGC.
3 Switch Pack Panel Light Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Check resistance between pins 3 and 4 of the switch pack, when the dimmer down switch is pressed.	<1 ohm.	If there is no continuity, the switch pack needs replaced.
Check resistance between pins 3 and 5 of the switch pack, when the dimmer up switch is pressed.	<1 ohm.	If there is no continuity, the switch pack needs replaced.

Extended Description

Refer to Panel Light EGC and ESC Input Circuits.

The panel light switch is wired directly to the EGC circuit board. When the panel light dimmer switch is pressed down, 12 volts from pin 3 from the EGC will be connected to pin 4. This will cause the EGC to lower the panel light voltage. When the panel light dimmer switch is pressed up, 12 volts from pin 3 from the EGC will be connected to pin 5. This will cause the EGC to raise the panel light voltage.

7.4. PANEL LIGHT OUTPUT FROM EGC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Panel Light Outputs from EGC.

A fault in the circuits between the EGC and the panel lights will be apparent when the lights don't operate correctly. There are no diagnostic trouble codes associated with the panel lights. Problems in the circuits between the EGC and the panel lights throughout the vehicle may be caused by burned out lamps, a short, an open, a blown fuse or a problem in the EGC.

Panel lights in the door pods are controlled by messages communicated between the EGC and the ESC on the drivetrain 1939 datalink and messages between the ESC and the door pods on the switch data link. Problems with the data links will cause more severe problems than loss of panel lights.

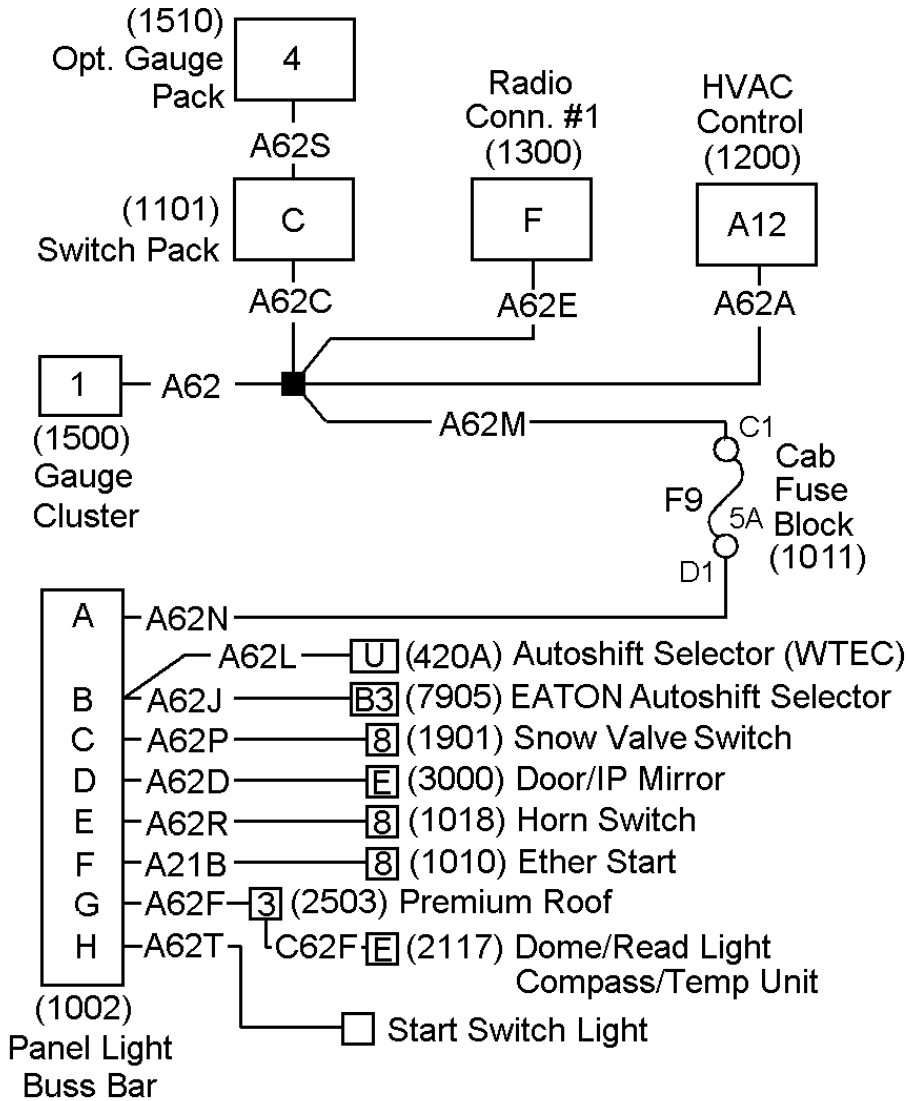

Figure 445 Panel Light Outputs from EGC (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1002) PANEL LIGHT ADAPTER
LOCATED IN INSTRUMENT PANEL
(1011) CAB FUSE BLOCK
LOCATED IN INSTRUMENT PANEL (PASSENGER SIDE)
(1500) ELECTRONIC GAUGE CLUSTER CONNECTOR
LOCATED ON BACK OF GAUGE CLUSTER

Table 305 Panel Light Circuit Tests

Diagnostic Trouble Codes	
No Diagnostic Trouble Codes	There are no diagnostic trouble codes for panel light circuits.

Table 305 Panel Light Circuit Tests (cont.)

Panel Light Fuse (1011) Voltage Checks Check with ignition key on, park lights on and fuse F9 removed. Press and hold the dimmer up button for 15 seconds to insure panel lights are at full intensity. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
(1011) fuse block 1, terminal C1 to ground.	12 ± 1.5 volts	If voltage is missing, check for open in circuit A62M or short in circuits A62N, A62C, A62E, or A62A. If no shorts or opens are present, the ESC must be faulty.
Panel Light Buss Bar (1002) Voltage Checks Check with ignition key on, park lights on, fuse F9 installed and buss bar cover removed. **NOTE – If the fuse is blown check for shorts on circuit A62N and other circuits connected to the buss bar. Repair the short and replace the fuse.** Press and hold the dimmer up button for 15 seconds to insure panel lights are at full intensity. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Panel Light Buss Bar (1002) cavity A to ground.	12 ± 1.5 volts	If voltage is missing, check for open in circuit A62N. Insure fuse F9 is not blown.

Extended Description

Refer to Panel Light Outputs from EGC.

A variable voltage, controlled by the panel dimmer switch but generated in the EGC, is supplied at gauge cluster connector (1500) terminal 1 and circuit A62 to a tie point. At the tie point the circuit splits on circuit A62C to switch pack connector (1101) terminal C, circuit A62E to radio connector (1300) terminal F, circuit A62A to the HVAC control connector (1200) terminal A12, and circuit A62M to cab fuse block (1011) terminal D1 and 5 amp fuse F9. Voltage from the fuse is applied to circuit A62N to panel light adapter (1002). The panel light adapter is the source of panel light voltage for any other features with panel lights (except the door pods).

7.5. COMPONENT LOCATIONS

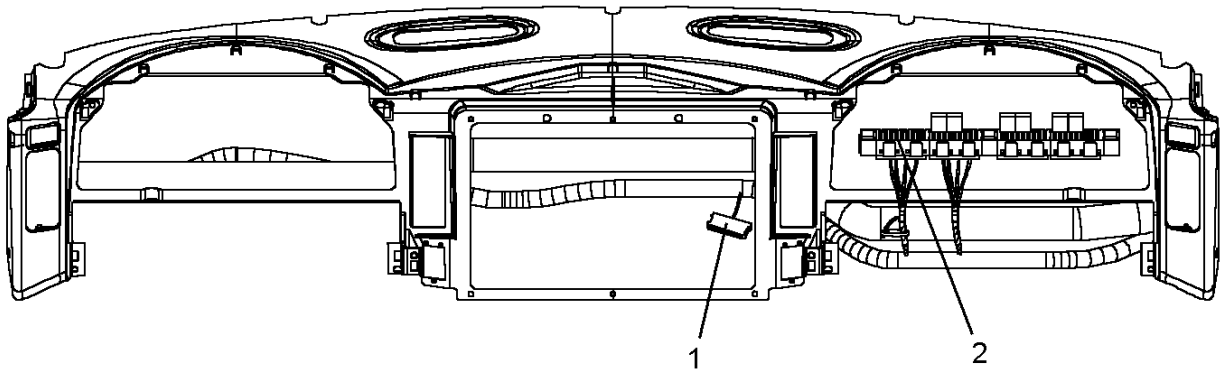

Figure 446 Panel Dimmer Wiring

1. PANEL LIGHT BUSS BAR (1002)
2. F9 PANEL LIGHT FUSE

8. TRUCK STOP/TURN SIGNAL/HAZARD LIGHT

8.1. CIRCUIT FUNCTIONS

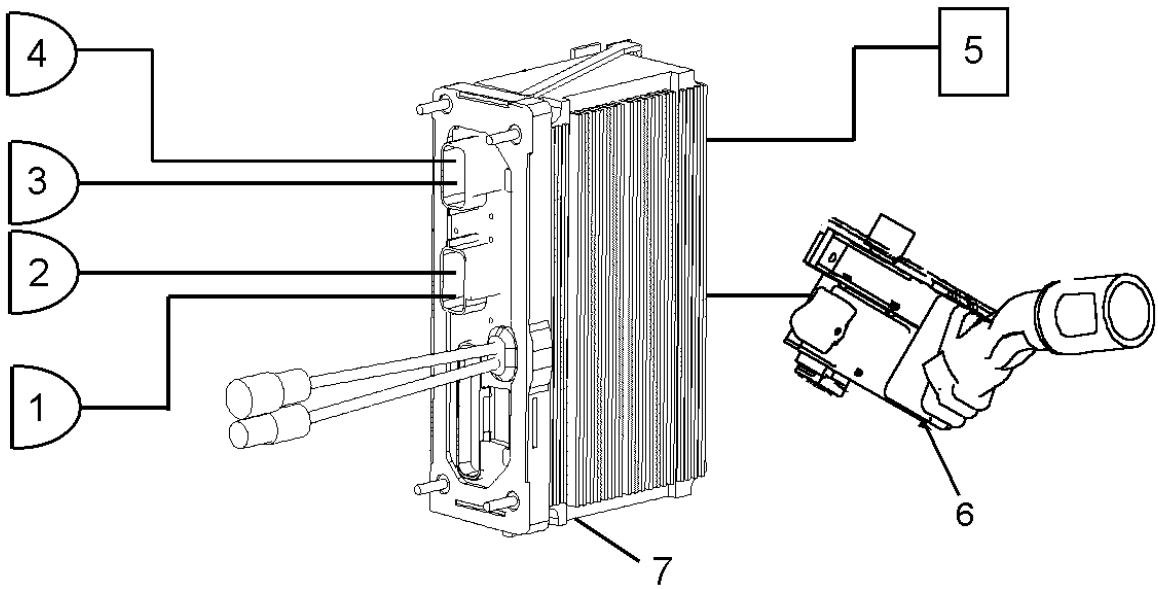

Figure 447 Stop/Turn Signal/Hazard Light Function Diagram

1. RIGHT FRONT TURN SIGNAL LIGHT
2. LEFT FRONT TURN SIGNAL LIGHT
3. LEFT REAR TURN SIGNAL LIGHT
4. RIGHT REAR TURN SIGNAL LIGHT
5. STOP LIGHT SWITCH, HYDRAULIC BRAKES OR BRAKE SWITCH, AIR BRAKES
6. TURN SIGNAL SWITCH
7. ELECTRICAL SYSTEM CONTROLLER

Refer to the Stop/Turn Signal/Hazard Light Function Diagram.

The ESC controls the turn and stop lights based on inputs from the turn signal switches and brake switch.

A combination turn/stop lamp system is standard on this vehicle. The turn signal overrides the stop lights on the rear.

The turn signal and hazard lights are selected with the turn signal lever and hazard switch on the steering column.

On vehicles with hydraulic brakes the stop light signal to the ESC comes from a switch activated by the brake pedal.

On vehicles with air brakes the stop light signal to the ESC comes from switches, connected to the air brake lines, activated by brake air pressure. Two switches are used for trucks but only one is used for tractors. The switches are located near the steering column.

The ESC has separate outputs supplying current for each front turn lamp and each rear turn/brake lamp. Additional turn lamps, which only illuminate when turn signals are selected, should be connected to the front turn signal circuits. Additional lamps required to illuminate with turn signals and brake lights should be connected to the rear turn signal circuits. The flashing of the turn signals and hazard lights is controlled by the ESC.

When the hazard lights are activated the turn signal will not affect operation of the lights. Normally, the brake switches will override the hazards. The ESC can be programmed to allow the hazard lights to override the rear brake lights.

8.2. DIAGNOSTICS

Should the lights fail to operate correctly the problem could be attributed to faulty input wiring between the ESC and turn signal/stop light switches, defective switches or faulty output wiring between the ESC and the turn signal lamps. The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

A diagnostic trouble code will be logged when there is an over current (short to ground or excessive load) or open circuit on any of the four light output circuits.

A diagnostic trouble code will be logged if there is an open or short in the brake switch or brake switch circuits.

The lower current limits, which determine when a DTC is set, are programmable. LED stop/turn lamps use far less current than incandescent lamps. If the truck configuration is changed it may be necessary to reprogram the lower current limit in the ESC before LED lamps will operate.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the lights and monitor activation of the turn/hazard signal switches and stop light switch(es). See the diagnostic software manual for details on using the software.

Turn/Hazard Signal And Stop Light Preliminary Check

Table 306 Turn/Hazard Signal And Stop Light

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify turn/hazard signal and stop lights are inoperative.	Visually check turn/ hazard signal and stop light.	Turn/ hazard signal and stop lights operate incorrectly.	Go to next step.	Turn/hazard signal and stop lights are operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)

Table 306 Turn/Hazard Signal And Stop Light (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunc-tioning features.	No other features are malfunc-tioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.
3.	On	If more than one turn/hazard signal and stop light is connected to a circuit, are all lights inoperative?	Visually check if all turn/hazard signal and stop lights are inoper-ative.	All turn/ hazard signal and stop lights are inoper-ative.	Go to next step.	Check specific circuits of the inoperative light for open circuits.
4.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 906)	Read display on odometer.	No turn/ hazard signal and stop light diagnostic trouble codes are active. (See TURN SIGNAL/ HAZARD SWITCH INPUTS TO ESC, page 909)	Go to next step.	Follow directions in the turn/hazard signal and stop light diagnostic trouble code table. (See Table 307, page 907)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 307 Turn/Hazard Signal And Stop Light

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the turn signal/hazard circuits.
When all left or all right signals are inoperative, and no faults are present, the turn/hazard signal switches, their circuits to the ESC, or the ESC are most likely at fault.	
If hazard flashers don't work, but the turn signals do, the turn signal/hazard switch is defective. If hazard flashers do work, but the turn signals don't, the turn signal/hazard switch is defective.	
If hazard flashers and turn signals don't work, the problem is most likely in the circuits between the switch and the ESC. Inspect turn/hazard signal switches (See TURN SIGNAL/ HAZARD SWITCH INPUTS TO ESC, page 909) for proper operation	
When more than one bulb is connected to an ESC output circuit, the ESC will not sense that an individual bulb or the circuits to that specific bulb are open. Example: There are two bulbs on the forward turn circuit. One burned out bulb will not set a fault. If the two bulbs are the only ones on the circuit and they both burn out, an open circuit fault will be set. When an individual light will not illuminate, check for an open circuit to the specific light.	
597 14 1 0	Brake switch stuck in the open or closed position
597 14 2 0	Brake switch inputs do not match
Sets when the vehicle has decelerated to a stop, without brake switch activation.	
The brake switch is stuck closed, is not making contact with brake pedal or being activated by air pressure, or the switch contacts are defective. Inspect hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 912)or air brake switch(See AIR BRAKE SWITCH INPUTS TO ESC, page 915) for proper operation	
611 14 16 1	Right front turn lamp open circuit
This fault is the result of an open in the circuits between the right front lamps and the ESC. Check for burned out bulbs. Inspect right front circuits(See FRONT TURN SIGNAL/HAZARD AND SEPARATE TURN SIGNAL LIGHT OUTPUTS FROM ESC, page 919) for proper operation	
611 14 16 2	Right front turn lamp over current
This fault may be the result of a short in the circuits between the left front lamps and the ESC. It could also be caused by an excessive load (too many accessories) on the circuit. Inspect right front circuits (See FRONT TURN SIGNAL/HAZARD AND SEPARATE TURN SIGNAL LIGHT OUTPUTS FROM ESC, page 919) for proper operation	
611 14 16 3	Right front turn lamps, less than normal low current but more than open circuit
611 14 16 4	Right front turn lamps, greater than normal high current and less than fusing current

Table 307 Turn/Hazard Signal And Stop Light (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 16 6	Right front turn lamps has current flow when output commanded off
611 14 15 1	Left front turn lamp open circuit
This fault is the result of an open in circuits between the left front lamps and the ESC. Check for burned out bulbs. Inspect left front circuits (See FRONT TURN SIGNAL/HAZARD AND SEPARATE TURN SIGNAL LIGHT OUTPUTS FROM ESC, page 919) for proper operation	
611 14 15 2	Left front turn lamp over current
This fault may be the result of a short in the circuits between the left front lamps and the ESC. It could also be caused by an excessive load (too many accessories) on the circuit. Inspect left front circuits (See FRONT TURN SIGNAL/HAZARD AND SEPARATE TURN SIGNAL LIGHT OUTPUTS FROM ESC, page 919) for proper operation	
611 14 15 3	Left front turn lamps, less than normal low current but more than open circuit
611 14 15 4	Left front turn lamps, greater than normal high current and less than fusing current
611 14 15 6	Left front turn lamps has current flow when output commanded off
611 14 14 1	Right rear turn lamp open circuit
This fault is the result of an open in the circuits between the right rear lamps and the ESC. Check for burned out bulbs. Inspect right rear circuits (See REAR STOP/TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 924) for proper operation	
611 14 14 2	Right rear turn lamp over current
This fault may be the result of a short in the circuits between the right rear lamps and the ESC. It could also be caused by an excessive load (too many accessories) on the circuit. Inspect right rear circuits (See REAR STOP/TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 924) for proper operation	
611 14 14 3	Right rear turn lamps, less than normal low current but more than open circuit
611 14 14 4	Right rear turn lamps, greater than normal high current and less than fusing current
611 14 14 6	Right rear turn lamps has current flow when output commanded off
611 14 13 1	Left rear turn lamp open circuit

Table 307 Turn/Hazard Signal And Stop Light (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
This fault is the result of an open in the circuits between the left rear lamps and the ESC. Check for burned out bulbs. Inspect left rear circuits (See REAR STOP/TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 924) for proper operation	
611 14 13 2	Left rear turn lamp over current
This fault may be the result of a short in the circuits between the left rear lamps and the ESC. It could also be caused by an excessive load (too many accessories) on the circuit. Inspect left rear circuits (See REAR STOP/TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 924) for proper operation	
611 14 13 3	Left rear turn lamps, less than normal low current but more than open circuit
611 14 13 4	Left rear turn lamps, greater than normal high current and less than fusing current
611 14 13 6	Left rear turn lamps has current flow when output commanded off
612 14 1 1	Brake switch out of range low (Open Circuit)
Brake switch not connected or open circuit in wiring between ESC and switch.	
Inspect hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 912) or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 915) for proper operation. Also check wiring harness	
612 14 1 2	Brake switch out of range high (Short Circuit)
Circuit between ESC and Brake switch has been shorted to positive voltage.	
Inspect hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 912)or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 915) for proper operation Also check wiring harness	

8.3. TURN SIGNAL/ HAZARD SWITCH INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

There are no detectable faults associated with the turn signal/hazard switches or switch input circuits to the ESC.

Refer to Turn Signal/Hazard Light Inputs to ESC.

Problems in the switches or circuits will be apparent when all left, all right or all signals cannot be selected.

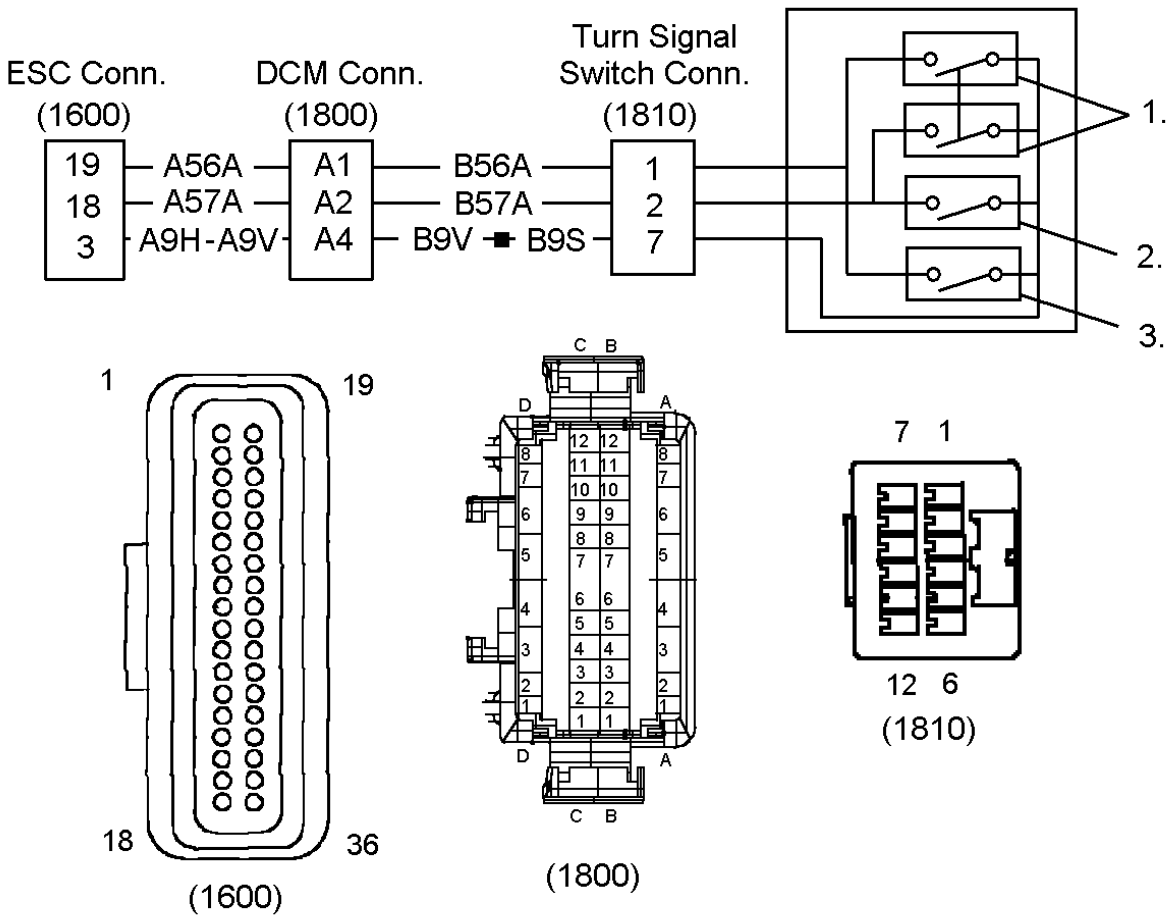

Figure 448 Turn Signal/Hazard Light Inputs to ESC (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information

1. TURN SIGNAL SWITCH – HAZARD CONTACTS
2. RIGHT TURN SIGNAL CONTACTS
3. LEFT TURN SIGNAL CONTACTS

(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN
(1810) TURN SIGNAL SWITCH HARNESS CONNECTOR
LOCATED ON STEERING COLUMN

Table 308 Turn Signal/Hazard Light Connector Check Chart

Diagnostic Trouble Codes
No faults will be logged for problems with turn/hazard signal switch inputs to the ESC

Table 308 Turn Signal/Hazard Light Connector Check Chart (cont.)

Test Points	Spec.	Comments
Turn/Hazard Signal Switch Harness Connector (1810) Voltage Checks (Check with ignition key on and turn signal switch disconnected.) **NOTE – With the key off voltage to the switches will be approximately 5 volts** **NOTE – Always check connectors for damage and pushed–out terminals.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Harness connector (1810), cavity 1 to ground	12 ± 1.5 volts	If voltage is incorrect, check for open or short in circuits A56A or B56A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector (1810), cavity 2 to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A57A or B57A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector (1810), cavity 7 to ground	0 volts	Zero volt reference to switches. If voltage is incorrect check for shorts to other circuits or incorrect signal out of the ESC. **NOTE – If this signal is not present at the switch connector, the wipers will also be inoperative. If this signal is incorrect from the ESC, several features will be inoperative.**
Harness connector (1810), cavity 1 to cavity 7.	12 ± 1.5 volts	If voltage is incorrect, check for open in zero volt reference signal circuits B9S, B9V, A9V or A9H or incorrect zero volt reference signal from the ESC.
Turn Signal Switch Resistance Checks (Check with switch disconnected)		
Turn signal switch, pin 2 to pin 7	With hazard switch and turn signal off, resistance should read >50K ohms.	Continuity through switch when hazard and turn lever is off, is the result of a failed switch.
Turn signal switch, pin 1 to pin 7	With hazard switch and turn signal off, resistance should read >50K ohms.	Continuity through switch when hazard and turn lever is off, is the result of a bad switch.

Table 308 Turn Signal/Hazard Light Connector Check Chart (cont.)

Turn signal switch, pin 2 to pin 7	With Hazard switch or turn signal on, resistance should read <2 ohms.	No continuity through switch when hazard or right turn lever is on, is the result of a failed switch.
Turn signal switch, pin 1 to pin 7	With Hazard switch or turn signal on, resistance should read < 2 ohms.	No continuity through switch when hazard or left turn lever is on, is the result of a bad switch.

Extended Description

Refer to Turn Signal/Hazard Light Inputs to ESC.

The zero volt reference signal is supplied to the turn signal switches on connector (1810) terminal 7 from the ESC connector (1600) terminal 3.

When the left turn signal is selected the zero volt reference signal is fed from turn signal switch (1810) terminal 1, to ESC connector (1600) terminal 19.

When the right turn signal is selected the zero volt reference signal is fed to ESC connector (1600) terminal 18 from turn signal switch (1810) terminal 2. This signals the ESC that the right turn signal has been requested.

When the hazard switch is selected, two additional contacts close to complete both turn signal inputs to the ESC. The zero volt reference signal will be sent to pins 18 and 19 of the ESC at the same time. This signals the ESC that the hazard lights have been requested.

8.4. HYDRAULIC BRAKE SWITCH INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Hydraulic Brake Switch Inputs to ESC.

While the ignition is on, the ESC will continuously monitor the brake switch(es) and circuits for an open condition or a short to ground. The ESC will also log a diagnostic trouble code (DTC) if it determines the vehicle has decelerated to 0 mph (0 kmh) without brake activation or has accelerated to 35 mph (56 kph) while the switch is closed.

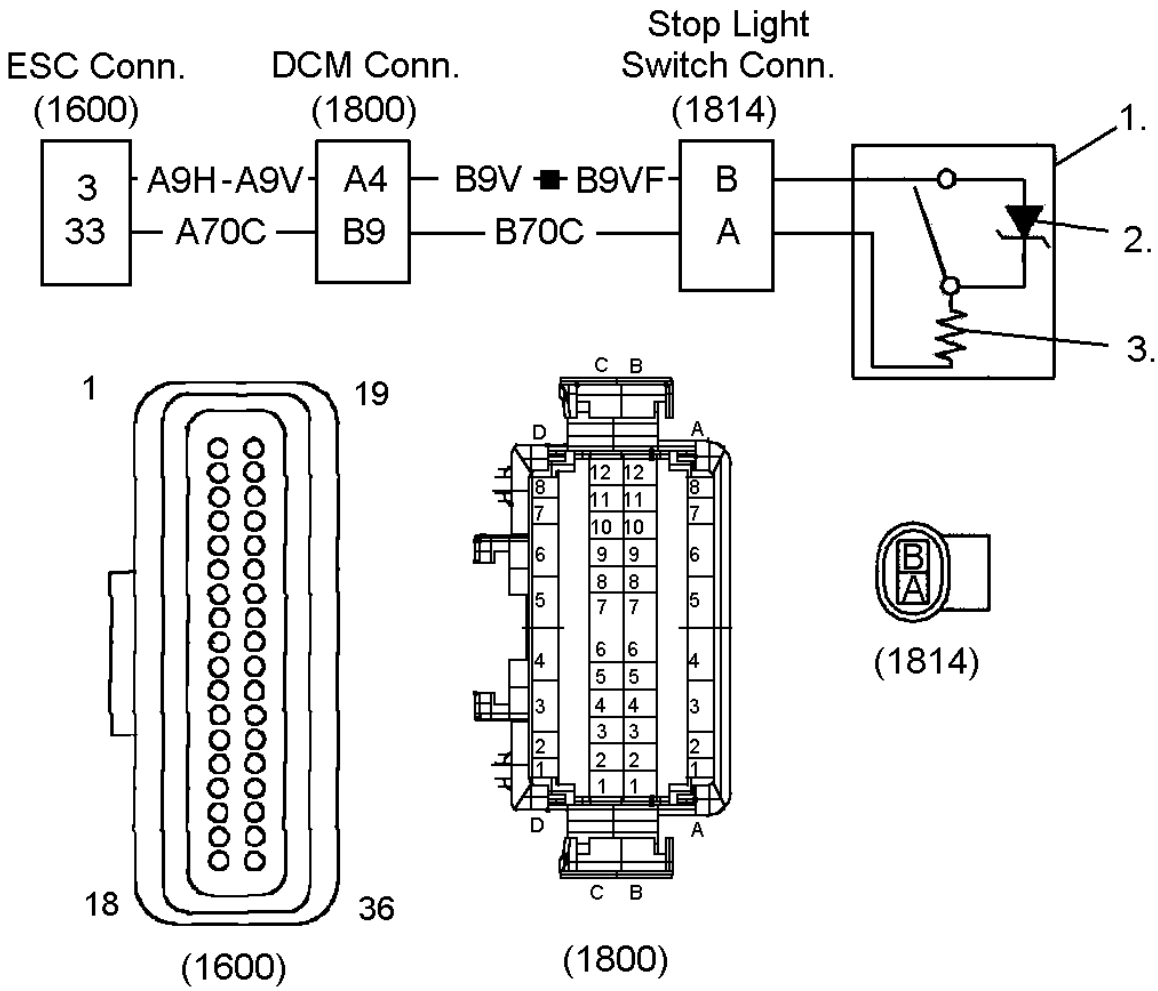

Figure 449 Hydraulic Brake Switch Inputs to ESC (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

1. HYDRAULIC BRAKE SWITCH
   LOCATED NEAR BRAKE PEDAL LEVER
2. ZENER DIODE
3. 150 OHM RESISTOR

(1600) SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC

(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN

(1814) STOP LIGHT SWITCH CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN

Table 309 Hydraulic Brake Stop/Turn Signal/Hazard Light Input Check Chart

Diagnostic Trouble Codes	
597 14 1 0	Brake Switch Stuck

Table 309 Hydraulic Brake Stop/Turn Signal/Hazard Light Input Check Chart (cont.)

597 14 2 0	Brake switch inputs do not match
612 14 1 1	Brake switch out of range low
612 14 1 2	Brake switch out of range high

Brake Switch Harness Connector (1814) Voltage Checks

(Check with ignition key on and brake switch disconnected.)

NOTE – With the key off voltage to the switches will be approximately 5 volts

NOTE – Always check connectors for damage and pushed–out terminals.

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments
Harness connector (1814), cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A70C or B70C. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector (1814), cavity B to ground	0 volts	Zero volt reference signal to switch. If voltage is incorrect check for shorts to other circuits or incorrect signal out of the ESC. **NOTE – If this signal is incorrect from the ESC, several features will be inoperative.**
Harness connector (1814), cavity A to cavity B	12 ± 1.5 volts	If voltage is incorrect, check for open in circuits B9VF, B9V, A9V or A9H or missing signal from ESC. **NOTE – If this signal is incorrect from the ESC, several features will be inoperative.**

Brake Switch Resistance Checks

(Check with switch disconnected, negative probe of meter connected to pin B and positive probe connected to pin A)

Brake switch, pin B to pin A	With stop light switch closed resistance should be approximately 150 ohms.	Switch has a resistor in series with contacts. If resistance is incorrect, replace the switch.
Brake switch, pin B to pin A	With stop light switch open resistance should be approximately 50K ohms.	Switch has a Zener diode in parallel with the switch contacts.

Extended Description

Refer to Hydraulic Brake Switch Inputs to ESC.

On vehicles with hydraulic brakes, the zero volt reference signal from ESC connector (1600) terminal 3, is supplied to stop light switch (1814) terminal B

When the key is in the ignition position 12 volts from ESC connector (1600) terminal 33 will be applied to stop light switch (1814) terminal A. When the key is in the off position 5 volts is supplied to stop light switch (1814) terminal A instead of 12 volts.

A 6.8 volt Zener diode, inside the switch body is wired in parallel with the switch contacts. The diode allows current to pass through it when the key is in the ignition position and 12 volts is applied to the switch. The diode prevents current from passing through it when the key is off and 5 volts is applied to the switch. When the key is on and the brake is not applied, the ESC monitors the voltage drop across the diode and resistor in the switch. If there is an open in the brake switch circuits there will be no voltage drop and the ESC will set a fault.

A 150 ohm resistor, inside the switch body, is wired in series with the switch. The ESC senses the voltage drop across this resistor to check for a short to ground in the brake switch circuits between the brake switch and the ESC. If there is a short, 12 volts from the ESC will be pulled to ground and the ESC will set a fault.

When the brake switch is closed, the voltage drop will change and the ESC will sense that the brake is applied.

8.5. AIR BRAKE SWITCH INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

Refer to Brake Switch Inputs to ESC With Air Brakes.

While the ignition is on, the ESC will continuously monitor the brake switch(es) and circuits for an open condition or a short to ground. The ESC will also log a diagnostic trouble code (DTC) if it determines the vehicle has decelerated to 0 mph (0 kmh) without brake activation or has accelerated to 35 mph (56 kph) while the switch is closed.

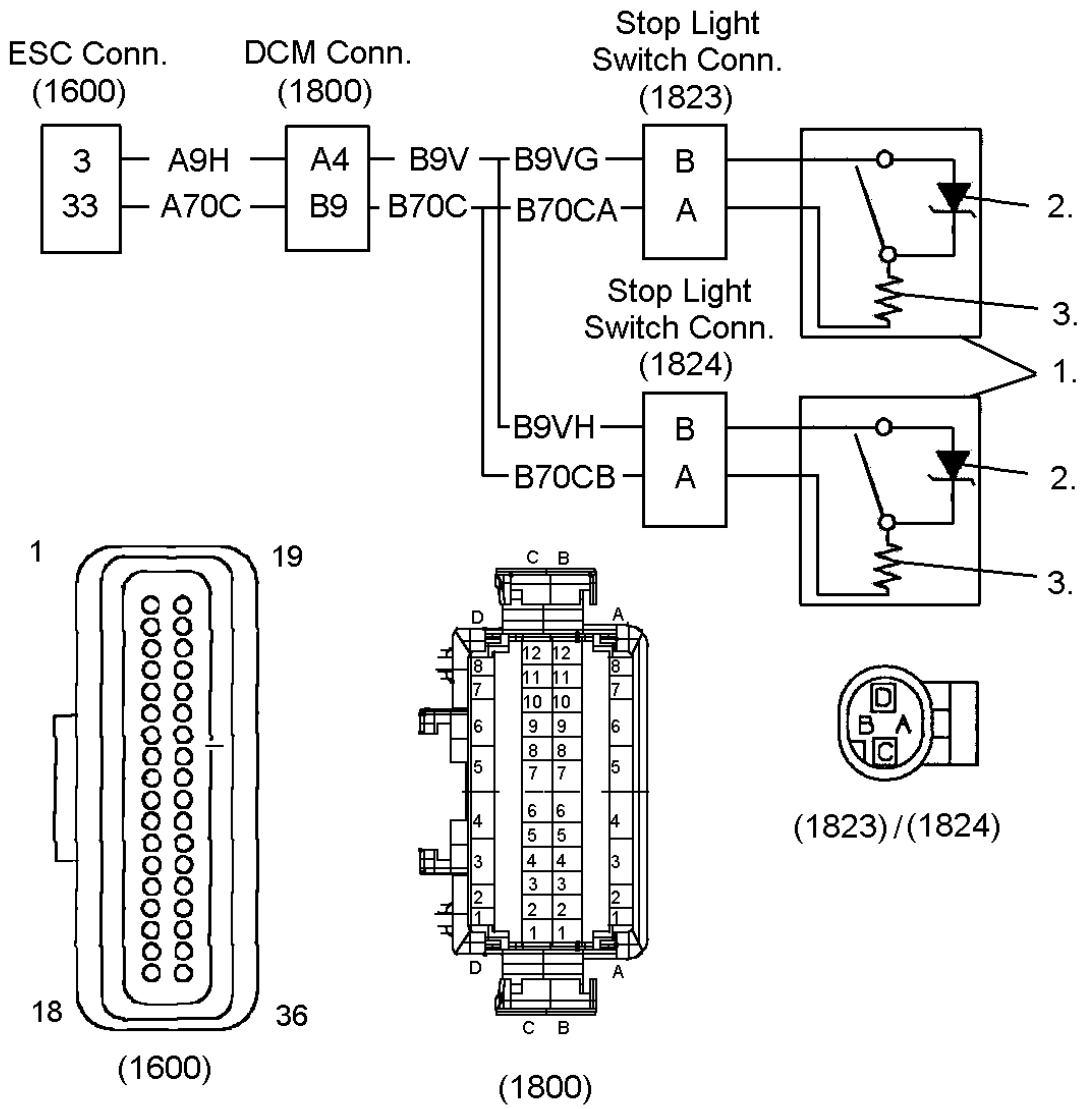

Figure 450 Brake Switch Inputs to ESC With Air Brakes (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

1. AIR BRAKE SWITCH(ES)
   LOCATED TO LEFT OF LOWER STEERING COLUMN
2. ZENER DIODE
3. 150 OHM RESISTOR

(1600) SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC

(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN

(1823) STOP LIGHT SWITCH CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN

(1824) STOP LIGHT SWITCH CONNECTOR – NOT USED ON TRACTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN

Table 310 Air Brake Switch Input Check Chart

Diagnostic Trouble Codes	
597 14 1 0	Brake Switch Stuck
597 14 2 0	Brake switch inputs do not match
612 14 1 1	Brake switch out of range low
612 14 1 2	Brake switch out of range high

Air Brake Switch Harness Connector (1823) Voltage Checks

(Check with ignition key on and brake switch disconnected.)

NOTE – With the key off voltage to the switches will be approximately 5 volts

NOTE – Always check connectors for damage or pushed–out terminals.

Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments
Harness connector (1823) cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A70C, B70C, or B70CA. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector (1823) cavity B to ground	0 volts	Zero volt reference signal to switch. If voltage is incorrect check for shorts to other circuits or incorrect signal out of the ESC. **NOTE – If this signal is missing, the wipers will be on at the high speed setting.**
Harness connector (1823) cavity A to cavity B	12 ± 1.5 volts	If voltage is incorrect, check for open in zero volt reference signal circuits B9VG, B9V or A9H or missing signal from ESC.

Air Brake Switch Harness Connector (1824) Voltage Checks

(Check with ignition key on and brake switch disconnected.)

NOTE – With the key off voltage to the switches will be approximately 5 volts

NOTE – Always check connectors for damage or pushed–out terminals.

Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments

Table 310 Air Brake Switch Input Check Chart (cont.)

Harness connector (1824) cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A70C, B70C, or B70CB. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Harness connector (1824) cavity B to ground	0 volts	Zero volt reference signal to switch. If voltage is incorrect check for shorts to other circuits or incorrect signal out of the ESC. **NOTE – If this signal is incorrect out of the ESC, several other features will also be inoperative.**
Harness connector (1824) cavity A to cavity B	12 ± 1.5 volts	If voltage is incorrect, check for open in zero volt reference signal circuits B9VH, B9V or A9H or missing signal from ESC.
Brake Switch Resistance Checks (Check with switch disconnected, negative probe of meter connected to pin B and positive probe connected to pin A)		
Pin B to pin A	With stop light switch closed resistance should be approximately 150 ohms.	Switch has a resistor in series with contacts. If resistance is incorrect, replace the switch.
Pin B to pin A	With stop light switch open resistance should be approximately 50K ohms.	Switch has a Zener diode in parallel with the switch contacts.

Extended Description

NOTE – Two brake switches are used on straight trucks. Only one is used on tractors.

Refer to Brake Switch Inputs to ESC With Air Brakes.

On vehicles with air brakes, the zero volt reference signal is supplied to brake switch 1 (1823) terminal B and brake switch 2 (1824) terminal B, from ESC connector (1600) terminal 3. (Only one switch is used in tractor applications).

When the key is in the ignition position, 12 volts will be applied to stop light switch 1 (1823) terminal A and stop light switch 2 (1824) terminal A. When the key is in the off position 5 volts is supplied to terminal A of the switch instead of 12 volts.

A 6.8 volt Zener diode, inside the switch body is wired in parallel with the switch contacts. The diode allows current to pass through it when the key is in the ignition position and 12 volts is applied to the switch. The diode prevents current from passing through it when the key is off and 5 volts is applied to the switch. When the key is on and the brake is not applied, the ESC monitors the voltage drop across the diode and resistor in the switch. If there is an open in the brake switch circuits there will be no voltage drop and the ESC will set

a fault. The diode is required to block current flow when the key is off, preventing the circuits from putting a drain on the battery.

A 150 ohm resistor, inside the switch body, is wired in series with the switch. The ESC senses the voltage drop across this resistor to check for a short to ground in the brake switch circuits between the brake switch and the ESC. If there is a short, 12 volts from the ESC will be pulled to ground and the ESC will set a fault.

When the brake switch is closed the voltage drop will change and the ESC will sense that the brake is applied.

8.6. FRONT TURN SIGNAL/HAZARD AND SEPARATE TURN SIGNAL LIGHT OUTPUTS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Front Turn Signal/Hazard Light outputs from ESC.

When the left or right turn signal is selected, the ESC will sense if the left or right signal circuits experience an over current (short to ground or excessive load) or open circuit (fault will only be logged when there is no current path through any bulb to ground). The ESC will log an active fault for either of these conditions. The fault will remain active until the condition causing the fault has been corrected and the affected turn signal is activated.

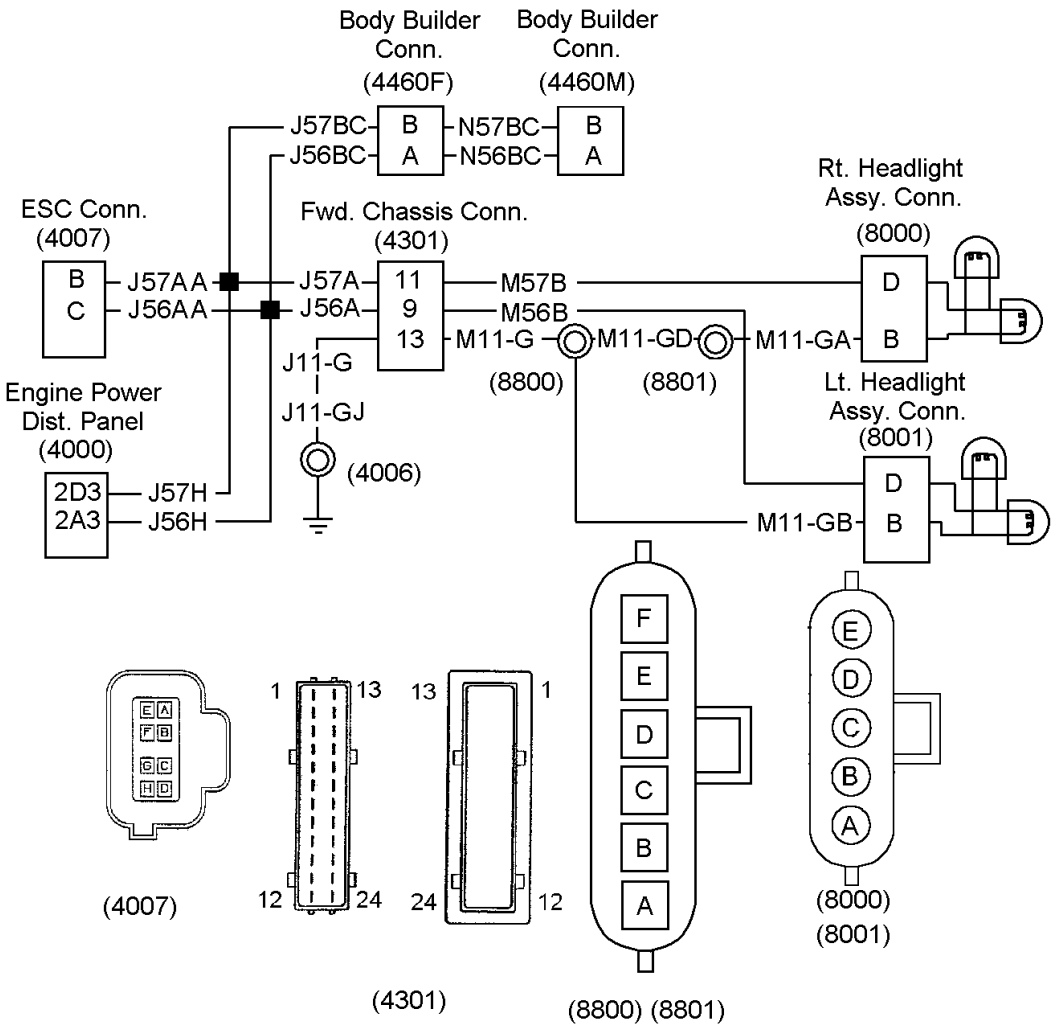

Figure 451 Front Turn Signal/Hazard Light outputs from ESC (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(4000) ENGINE POWER DISTRIBUTION PANEL-TRAILER TURN RELAYS
LOCATED INSIDE ENGINE COMPARTMENT POWER DISTRIBUTION PANEL
(4007) BROWN SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
(4301) FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4460M/F) BODY BUILDER CONNECTORS
LOCATED BACK OF CAB NEAR LEFT FRAME RAIL
(8000) RIGHT HEADLIGHT/TURN SIGNAL HARNESS
LOCATED REAR OF HEADLIGHT ASSEMBLY
(8001) LEFT HEADLIGHT/TURN SIGNAL HARNESS
LOCATED REAR OF HEADLIGHT ASSEMBLY
(8800) GROUND ADAPTER #1
(8801) GROUND ADAPTER #2

Table 311 Front Turn Signal/Hazard Light Connector Check Chart

Diagnostic Trouble Codes	
611 14 16 3	Right front turn lamps, less than normal low current but more than open circuit
611 14 16 4	Right front turn lamps, greater than normal high current and less than fusing current
611 14 16 6	Right front turn lamps has current flow when output commanded off
611 14 16 2	Right front turn lamp over current (Short Circuit)

NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored.

Disconnect right headlight/turn signal harness connector (8000). Cycle key switch and clear DTC's. Turn on right front turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in the turn signal light. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC.

Disconnect any other connectors to components that are connected to the right front turn signal circuits. Cycle key switch and clear DTC's. Turn on right front turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in that component. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC.

Disconnect brown ESC connector (4007). Cycle key switch and clear DTC's. Turn on right turn signal and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and turn signal light. If the fault reoccurs, there is a short inside the ESC.

611 14 16 1	Right front turn lamp circuit open

Right Front Turn Signal/Hazard Light Voltage Checks

Check with hazard flashers on and right front headlight turn signal disconnected.

NOTE – Always check connectors for damage or pushed–out terminals.

NOTE – In an over current situation, the ESC will not supply voltage until the short or excessive load has been removed and the key switch has been cycled.

Always use breakout box ZTSE 4477 to take measurements on ESC connectors.

Test Points	Spec.	Comments
Right turn signal connector (8000), pin D to ground	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short in circuits M-57B, J57A or J57AA. Check for a short in circuit J57BC to body builder connectors and body builder accessories. Check for short in circuit J57H to trailer turn relays. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)

Table 311 Front Turn Signal/Hazard Light Connector Check Chart (cont.)

Right turn signal connector (8000), pin B to ground	0 Volts	Ground circuit.
Right turn signal connector (8000), pin B to D	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in ground circuits.
Diagnostic Trouble Codes		
611 14 15 3	Left front turn lamps, less than normal low current but more than open circuit	
611 14 15 4	Left front turn lamps, greater than normal high current and less than fusing current	
611 14 15 6	Left front turn lamps has current flow when output commanded off	
611 14 15 2	Left front turn lamp over current	
NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored. **With sealed beam headlamps, as used with Severe Service trucks, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1** Disconnect left headlight/turn signal harness connector (8001). Cycle key switch and clear DTC's. Turn on right front turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in the turn signal light. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Disconnect any other connectors to components that are connected to the right front turn signal circuits. Cycle key switch and clear DTC's. Turn on right front turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in that component. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Disconnect brown ESC connector (4007). Cycle key switch and clear DTC's. Turn on right turn signal and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and turn signal light. If the fault reoccurs, there is a short inside the ESC.		
611 14 15 1	Left front turn lamp circuit open	

Table 311 Front Turn Signal/Hazard Light Connector Check Chart (cont.)

Left Front Turn Signal/Hazard Light Voltage Checks Check with hazard flashers on and left front headlight turn signal disconnected. **NOTE – With sealed beam headlamps, as used with Severe Service trucks, the terminals at the headlamps are not sealed - in this application the terminals of the headlamps and the terminals in the headlamp connector must be totally coated with Grafo grease 2643099R1** **NOTE – Always check connectors for damage or pushed–out terminals.** **NOTE – In an over current situation, the ESC will not supply voltage until the short or excessive load has been removed and the key switch has been cycled.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Left turn signal connector (8001), pin D to ground	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short in circuits M-56B, J56A or J56AA. Check for a short in circuit J56BC to body builder connectors and body builder accessories. Check for short in circuit J57H to trailer turn relays. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
Left turn signal connector (8001), pin B to ground	0 Volts	Ground circuit
Left turn signal connector (8001), pin B to D	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in ground circuits.

Extended Description

Refer to Front Turn Signal/Hazard Light outputs from ESC.

The ESC supplies battery voltage to the front turn signal lights.

Voltage for the right front turn signal light is supplied directly from ESC connector (4007) terminal B.

Ground for the light is supplied from ground stud (4006) to right headlight turn signal harness connector (8000) terminal B.

Voltage for the left front turn signal light is supplied directly from the ESC connector (4007) terminal C to left headlight turn signal harness connector (8001) terminal D.

Ground for the light is supplied from ground stud (4006) to left headlight turn signal harness connector (8001) terminal B.

8.7. REAR STOP/TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Rear Stop/Turn Signal/Hazard Light Outputs From ESC.

When the brake light or left or right front turn signal lights are selected, the ESC will sense if the left or right signal circuits experience an over current (short to ground or excessive load) or open circuit (fault will only be logged when there is no current path through any bulb to ground). The ESC will log an active fault for either of these conditions. The fault will remain active until the condition causing the fault has been corrected and the affected brake or turn signal is activated.

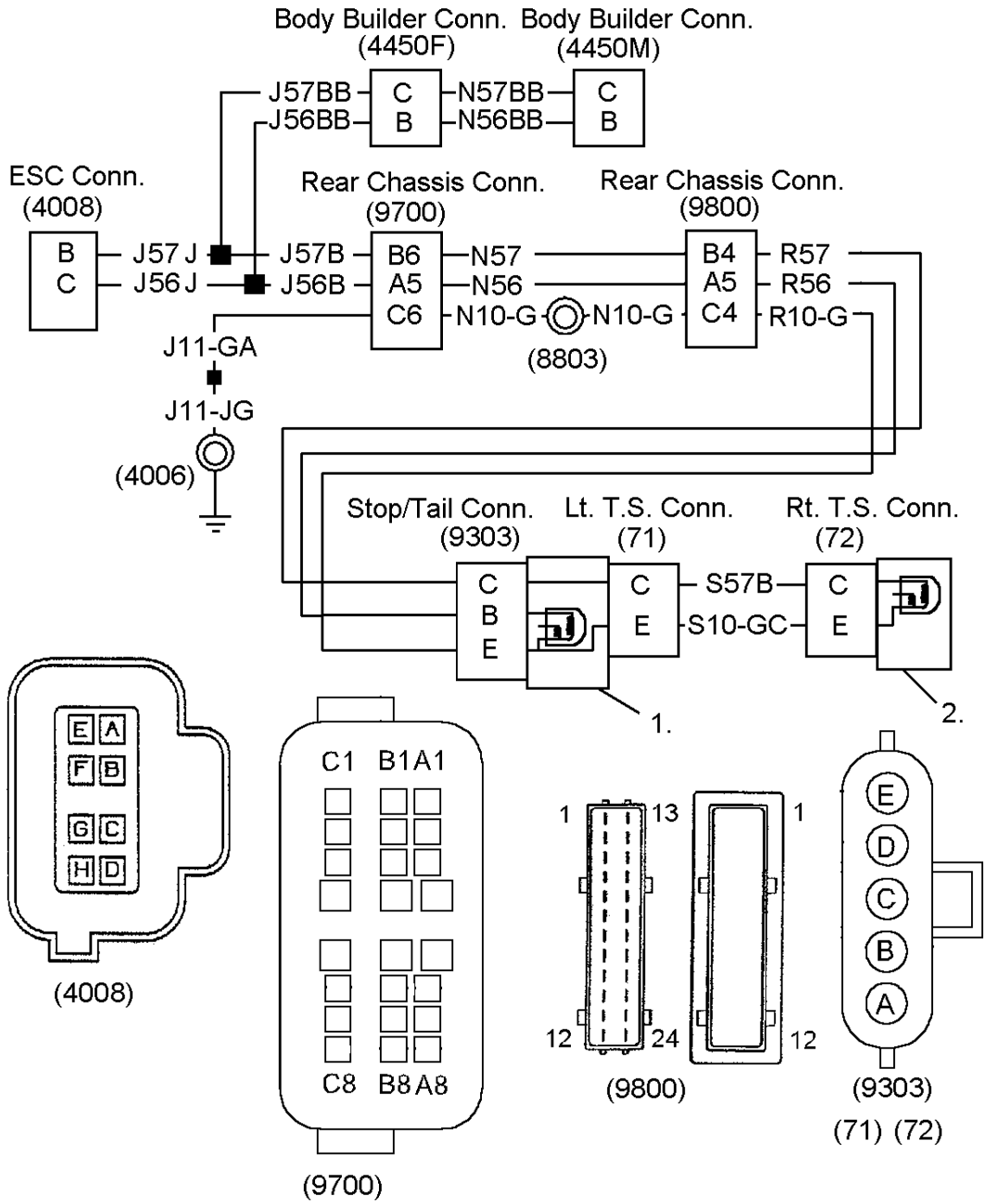

Figure 452 Rear Stop/Turn Signal/Hazard Light Outputs From ESC (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

1. LEFT REAR LIGHT ASSEMBLY
2. RIGHT REAR LIGHT ASSEMBLY
(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR
(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4450M/F) BODY BUILDER CONNECTORS
LOCATED BACK OF CAB NEAR LEFT FRAME RAIL
(8803) CHASSIS GROUND SPLICE PACK
(9303) STOP/TAIL/TURN CONNECTOR
LOCATED ON LEFT LIGHT ASSEMBLY
(9700) DASH/CENTER CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME
(9800) CENTER/REAR CHASSIS CONNECTOR
LOCATED BY LEFT FRAME RAIL NEAR REAR AXLES

Table 312 Rear Stop/Turn Signal/Hazard Light Connector Check Chart

Diagnostic Trouble Codes	
611 14 13 3	Left rear turn lamps, less than normal low current but more than open circuit
611 14 13 4	Left rear turn lamps, greater than normal high current and less than fusing current
611 14 13 6	Left rear turn lamps has current flow when output commanded off
611 14 13 2	Left rear turn lamp over current (Short Circuit)
NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored. **NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** Turn key “OFF”. Disconnect stop tail and turn connector (9303). Turn on ignition and clear DTC’s, then turn on left turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in the turn signal light. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Turn key “OFF”. Disconnect any other connectors to components that are connected to the left rear turn signal circuits. Turn on ignition and clear DTC’s, then turn on left turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in that component. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Turn key “OFF”. Disconnect blue ESC connector (4008). Turn on ignition, then turn on left turn signal and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and right rear turn signal light. If the fault reoccurs, there is a short inside the ESC.	
611 14 13 1	Left rear turn lamp circuit open

Table 312 Rear Stop/Turn Signal/Hazard Light Connector Check Chart (cont.)

Left Rear Stop/Turn Signal/Hazard Light Voltage Checks Check with hazard flashers on left rear stop tail and turn disconnected. **NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.** **NOTE – In an over current situation, the ESC will not supply voltage until the short or excessive load has been removed and the key switch has been cycled.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
(9303) Pin B to ground	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in circuits R-56B, N56, J56B or J56J. Check for a short or excessive loads in circuit J56BB to body builder connectors and body builder accessories. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(9303) Pin E to ground	0 Volts	Ground circuit.
(9303) Pin B to E	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in ground circuits.
Diagnostic Trouble Codes		
611 14 14 3	Right rear turn lamps, less than normal low current but more than open circuit	
611 14 14 4	Right rear turn lamps, greater than normal high current and less than fusing current	
611 14 14 6	Right rear turn lamps has current flow when output commanded off	
611 14 14 2	Right rear turn lamp over current (Short Circuit)	

Table 312 Rear Stop/Turn Signal/Hazard Light Connector Check Chart (cont.)

NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored. **The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** Disconnect right tail light connector (72). Cycle ignition and clear DTC's. Turn on right turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in the turn signal light. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Disconnect any other connectors to components that are connected to the right rear turn signal circuits. Cycle ignition and clear DTC's. Turn on right turn signal and check for fault. If the fault has not reoccurred, there is a short or an overload in that component. If the fault reoccurs, there is a short in the circuits between the ESC and turn signal light or in the ESC. Disconnect blue ESC connector (4008). Cycle ignition and clear DTC's. Turn on right turn signal and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and right rear turn signal light. If the fault reoccurs, there is a short inside the ESC.		
611 14 14 1	Right rear turn lamp Under Current (Circuit Open)	
Right Rear Stop/Turn Signal/Hazard Light Voltage Checks Check with hazard flashers on and right rear tail light disconnected. **NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.** **NOTE – In an over current situation, the ESC will not supply voltage until the short or excessive load has been removed and the key switch has been cycled.** **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
(72) Pin C to ground	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in circuit S57B, left rear light assembly and circuits R57, N57, J57B, and J57J. Check for a short in circuit J57BB to body builder connectors and body builder accessories. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)
(72) Pin E to ground	0 Volts	Ground circuit
(72) Pin C to E	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open in ground circuits.

Extended Description

Refer to Rear Stop/Turn Signal/Hazard Light Outputs From ESC.

Voltage for the right rear turn/stop light is supplied from ESC connector (4008) terminal B to the right turn light connector (72) terminal C.

Ground for the right rear turn/stop light is supplied from ground stud (4006) to the right turn light connector (72) terminal C.

Voltage for the left rear turn/stop light is supplied from ESC connector (4008) terminal C to stop tail and turn connector (9303) terminal B.

Ground for the left rear turn/stop light is supplied from ground stud (4006) to stop tail and turn connector (9303) terminal E.

8.8. COMPONENT LOCATIONS

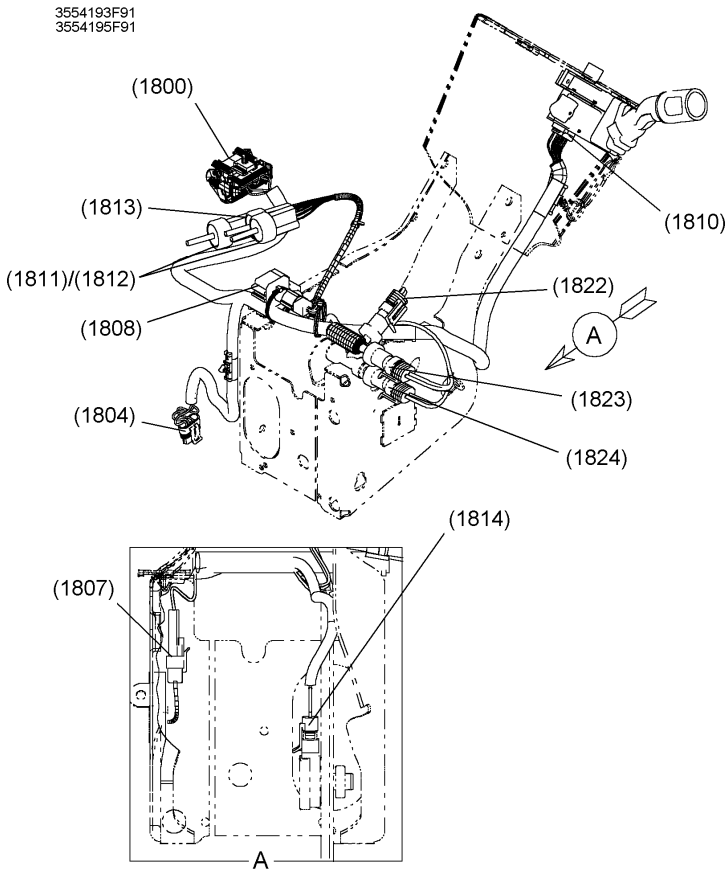

Figure 453 Stop/Turn Signal/Hazard Light Connector Locations (Steering Column Support View)

(1800) DCM CONNECTOR
(1804) THROTTLE POSITION SENSOR
(1807) CLUTCH SWITCH CONNECTOR
(1808) BAP SENSOR
(1810) TURN SIGNAL ASSEMBLY CONNECTOR (BEHIND STEERING COLUMN SHROUD)
(1811)/(1812) AIR PRESSURE TRANSDUCERS FOR GAUGES
(1813) PARK INDICATION PRESSURE SWITCH
(1814) HYDRAULIC BRAKE STOP LIGHT SWITCH (NOT USED WITH AIR BRAKES)
(1822) BRAKE APPLIED AIR SWITCH
(1823) AIR BRAKE STOP LIGHT SWITCH (NOT USED WITH HYDRAULIC BRAKES)
(1824) AIR BRAKE STOP LIGHT SWITCH (NOT USED WITH HYDRAULIC BRAKES OR TRACTOR BRAKE SYSTEM)

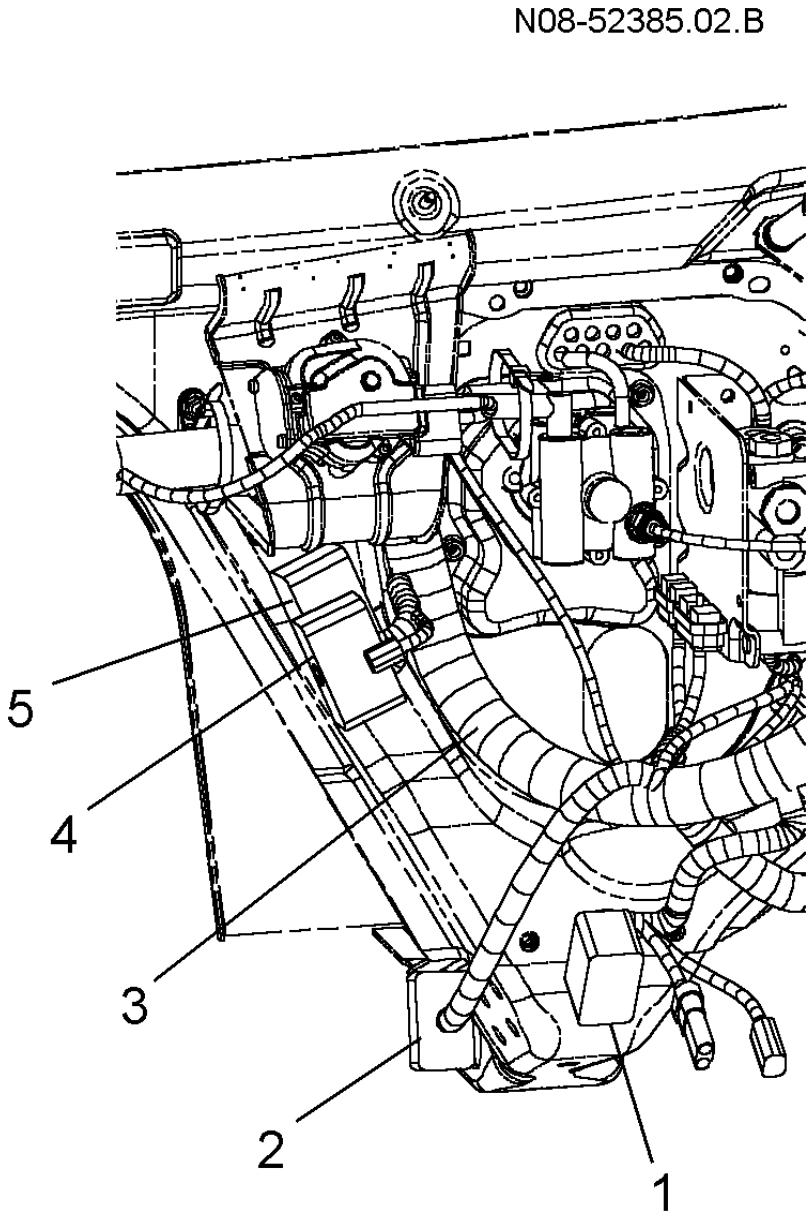

Figure 454 Stop/Turn Signal/Hazard Light Connector Locations (Dash Panel From Engine Compartment)

1. FORWARD CHASSIS CONNECTOR (4301)
2. REAR CHASSIS CONNECTOR (9700)
3. DASH HARNESS
4. TRANSMISSION CONNECTOR
5. ENGINE CONNECTOR

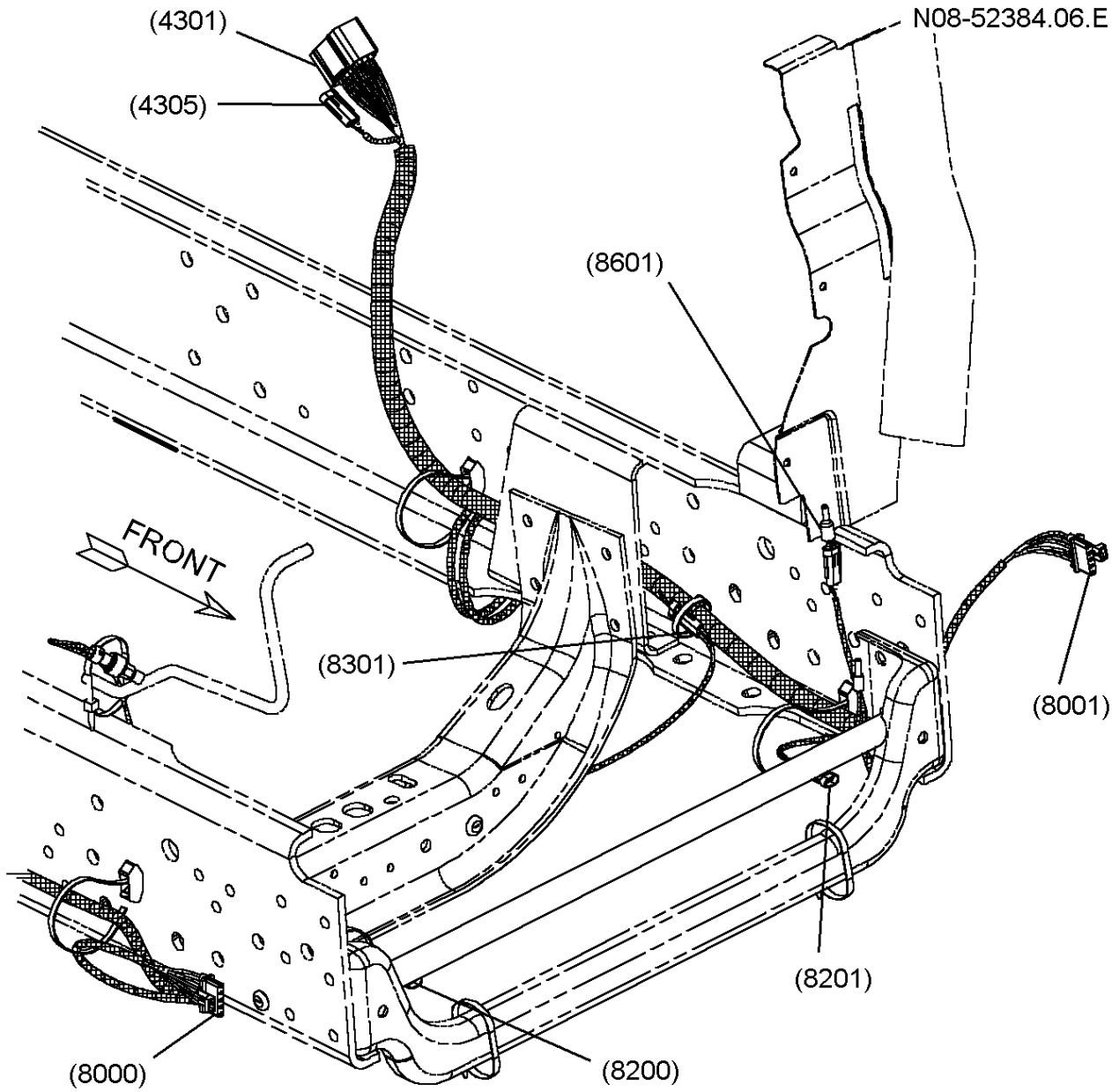

Figure 455 Stop/Turn Signal/Hazard Light Connector Locations

(4301) FORWARD CHASSIS CONNECTOR
(8000) RIGHT HEADLIGHT CONNECTOR
(8001) LEFT HEADLIGHT CONNECTOR
(8200) RIGHT FOG LIGHT CONNECTOR
(8201) LEFT FOG LIGHT CONNECTOR
(8302) HORN CONNECTOR

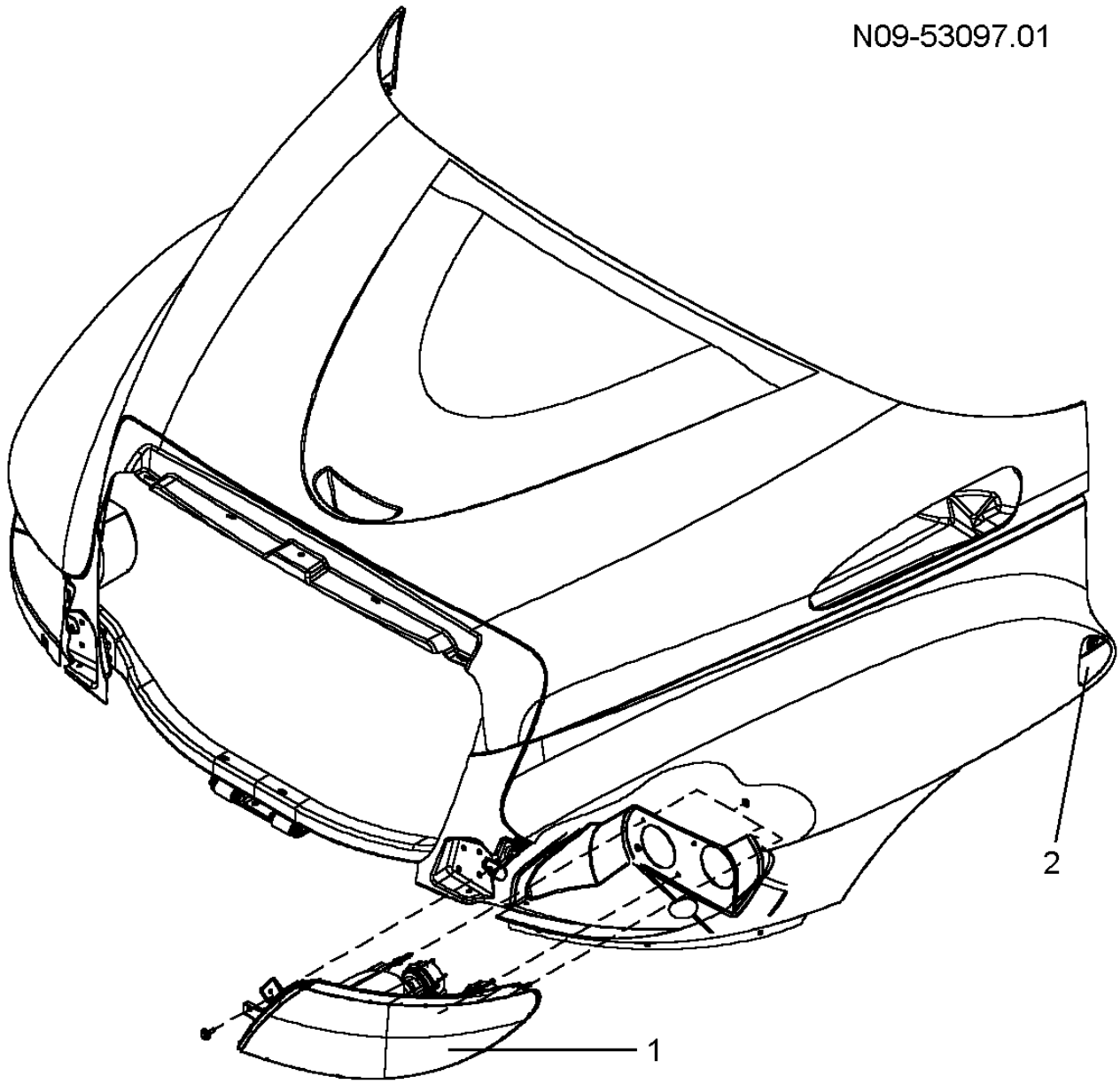

Figure 456 Headlights, Front and Side Marker Lights (Not Severe Service)

1. FRONT PARK LIGHT
2. SIDE MARKER LIGHT

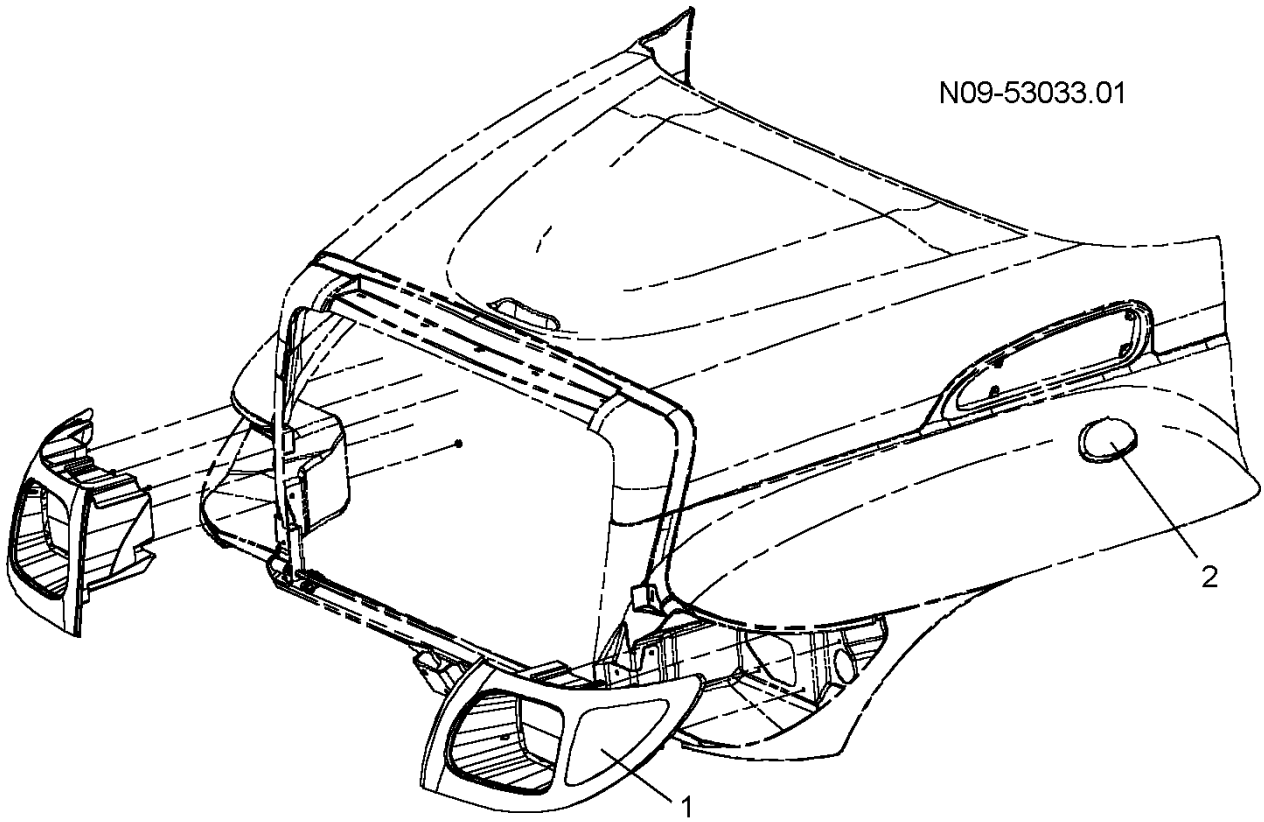

Figure 457 Headlights, Front and Side Marker Lights (Severe Service)

1. FRONT PARK LIGHT
2. STANDARD SIDE MARKER LIGHT

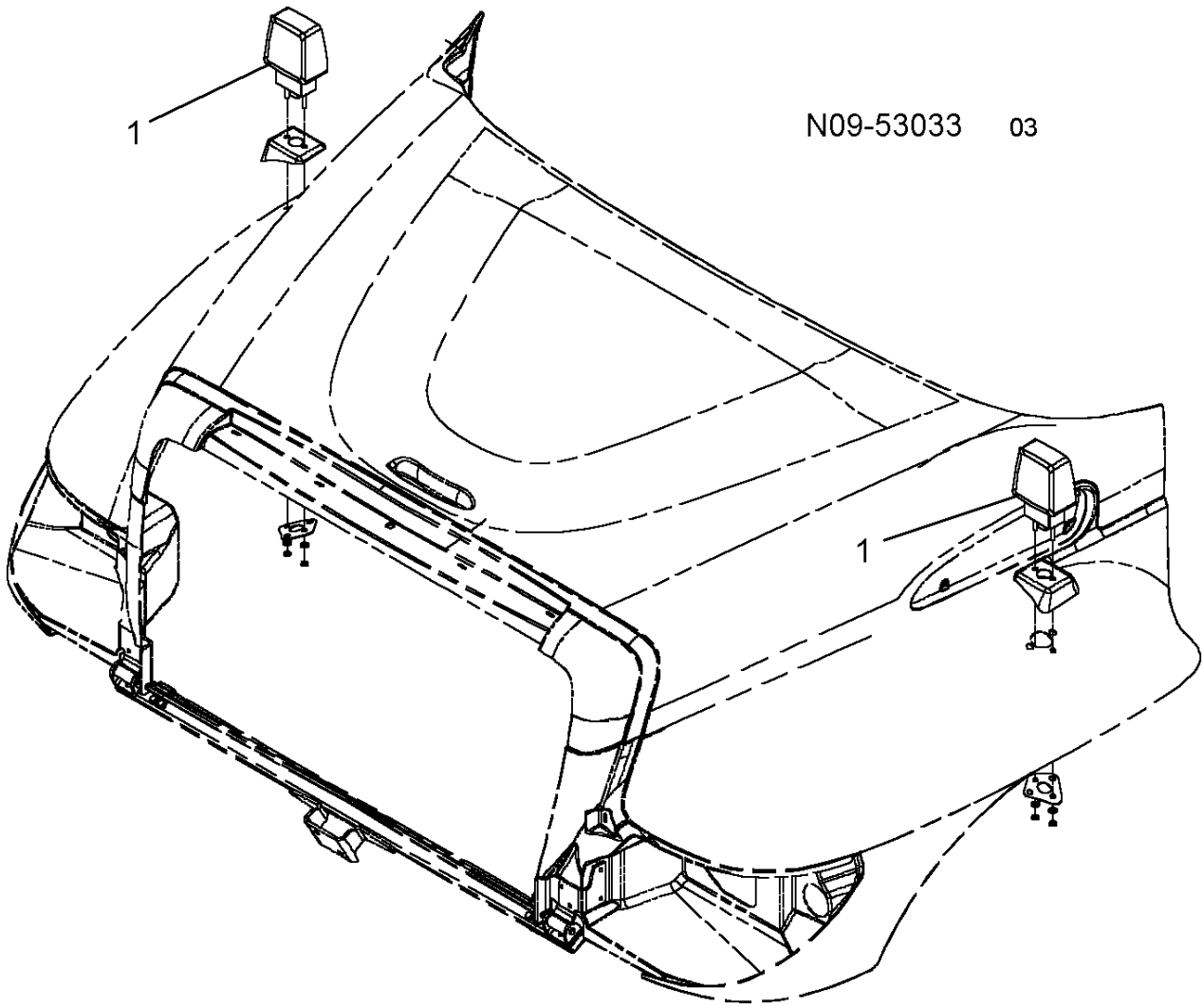

Figure 458 Optional Side Marker/Turn Signal Lights (Severe Service)

1. OPTIONAL SIDE MARKER/TURN SIGNAL LIGHT

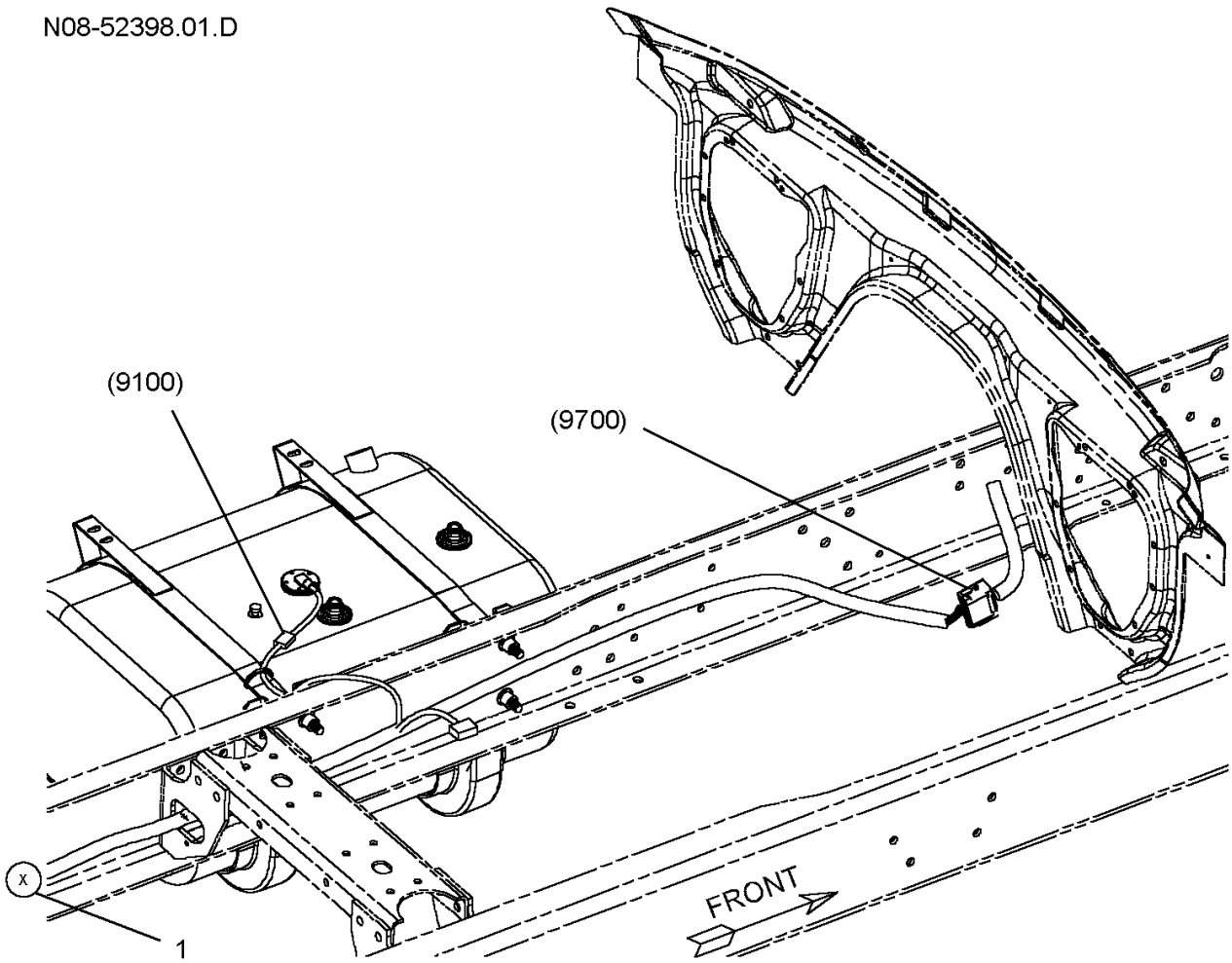

Figure 459 Rear Chassis Wiring Connector Locations

1. HARNESS TO CENTER CHASSIS WIRING
(9100) FUEL LEVEL SENDER CONNECTOR
(9700) REAR CHASSIS CONNECTOR

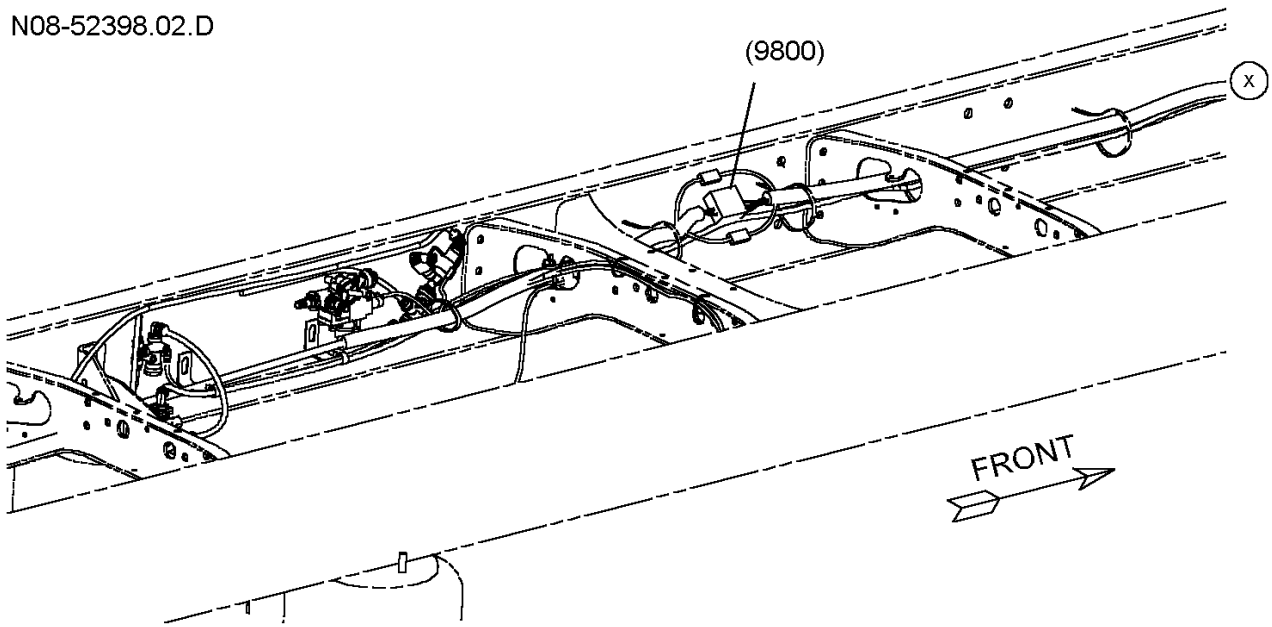

Figure 460 Rear Center Chassis Connector Locations

(9800) REAR CENTER CHASSIS CONNECTOR

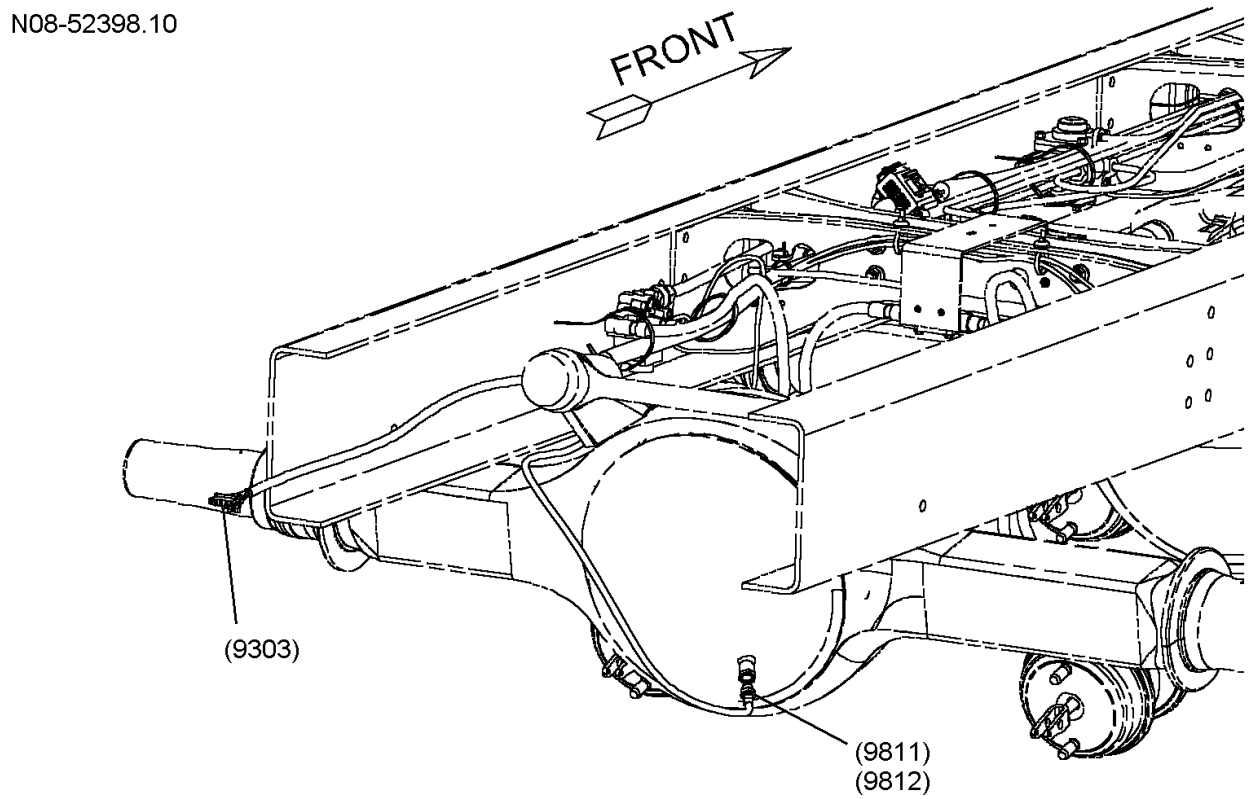

Figure 461 Stop, Tail and Turn Connector Location

(9303) STOP, TAIL AND TURN CONNECTOR
(9812) AXLE TEMPERATURE SENSOR

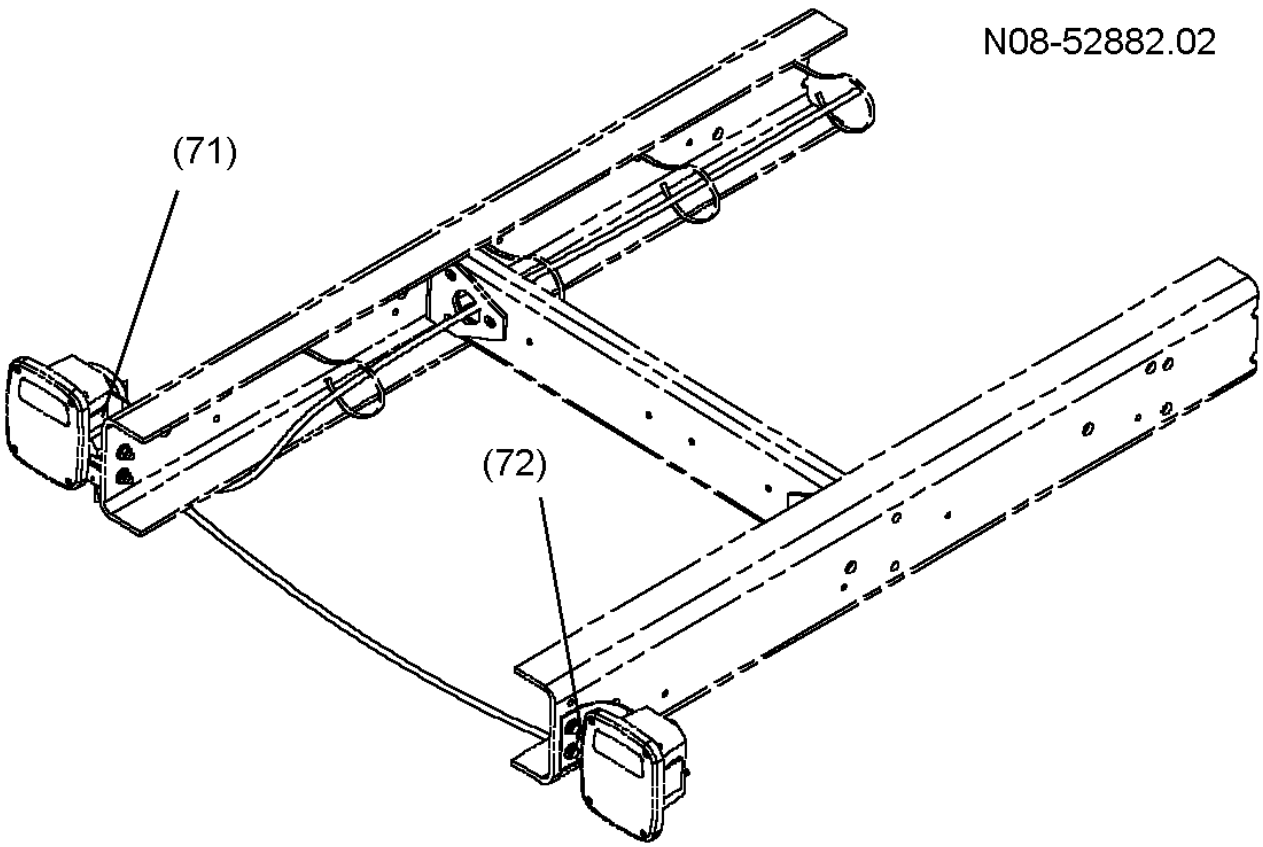

Figure 462 (Typical) Rear Signal Light Connector Locations

(71) LEFT TAIL LIGHT CONNECTOR
(72) RIGHT TAIL LIGHT CONNECTOR

9. WORK LIGHTS

9.1. CIRCUIT FUNCTIONS

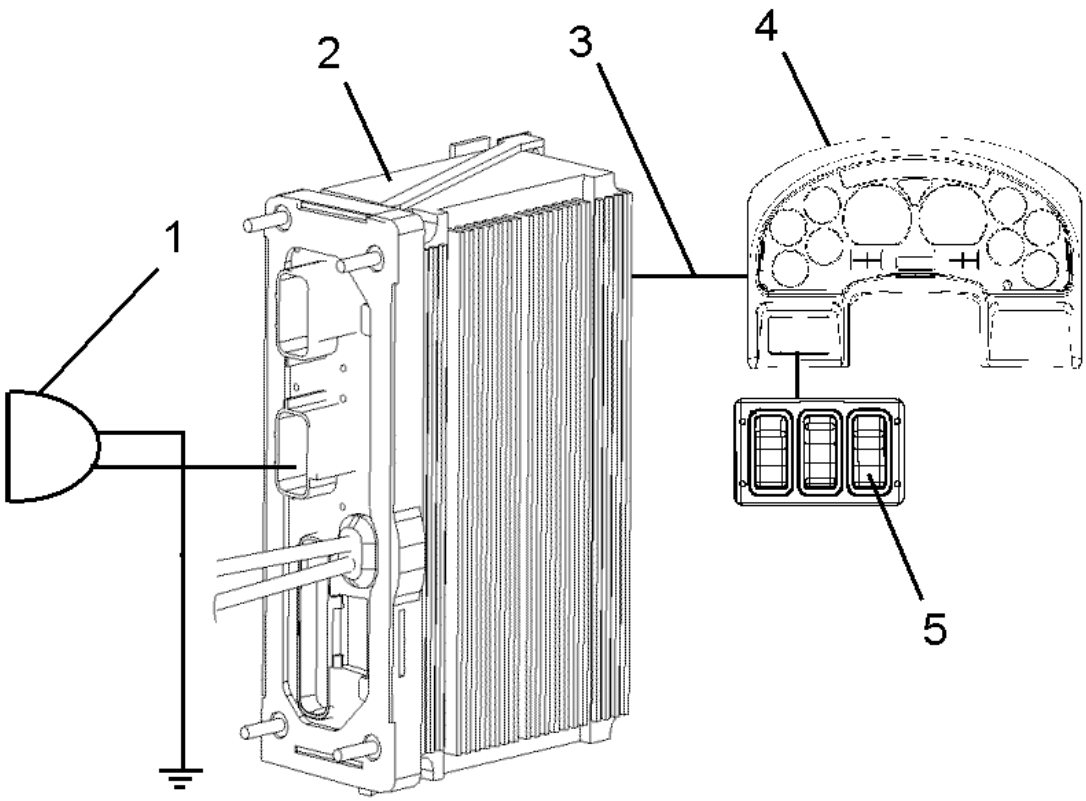

Figure 463 Work Light Function Diagram

1. WORK LIGHT
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVETRAIN 1939 DATA LINK
4. EGC
5. WORK LIGHT SWITCH (IN 3 SWITCH PACK ON EGC)

Refer to the Work Light Function Diagram.

The work light illuminates the fifth wheel area for easier trailer hook-up.

The momentary work light switch is wired directly to the EGC circuit board. When the work light momentary switch is pushed “on” the electronic gauge cluster will send a message to the ESC, on the drivetrain 1939 data link, to command the light on and light the switch indicator. The ESC provides power to the work light. When the switch is pushed “off”, the ESC will turn the light off.

The auxiliary button on the remote key fob will also activate/deactivate this feature.

This feature utilizes a timer function option to turn the work light off after a set amount of time.

9.2. DIAGNOSTICS

Should the light fail to operate, the problem could be attributed to a faulty switch in the EGC, a faulty switch pack in the EGC, a problem in the EGC, open or shorted wiring between the ESC and the work light or an open circuit between the work light and ground.

The ESC has an internal virtual fuse software algorithm to protect output circuits in an over current situation.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

A diagnostic trouble code (DTC) will be logged if there is an over current (short to ground or excessive load) or an open in the circuits between the ESC and the work light.

A diagnostic trouble code will also be logged if there is a burned out bulb (as long as there is only one lamp connected to the circuit).

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the work light and monitor activation of the work light switch. See the diagnostic software manual for details on using the software.

Work Light Preliminary Check

Table 313 Work Light Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify work light is inoperative.	Visually check work light.	Work light is inoperative.	Go to next step.	Work light is operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other malfunctioning features.	No other features are malfunctioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.

Table 313 Work Light Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	If more than one work light is connected to this circuit, are all lights inoperative?	Visually check if all work lights are inoperative.	All work lights are inoperative.	Go to next step.	Check specific circuits of the inoperative light for open circuits.
4.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 941)	Read display on odometer.	No work light diagnostic trouble codes are active.	Go to work light input circuits to the ESC. (See WORK LIGHT CIRCUIT INPUTS TO ESC, page 942).	Go to work light circuit outputs from ESC. (See WORK LIGHT CIRCUIT OUTPUTS FROM ESC, page 944)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 314 Work Light Diagnostic Trouble Codes carl

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 11 1	Work light open circuit Refer to Work Lights in the Light Systems section of this manual. (See WORK LIGHT CIRCUIT OUTPUTS FROM ESC, page 944)

Table 314 Work Light Diagnostic Trouble Codes carl (cont.)

611 14 11 2	Work light over current Refer to Work Lights in the Light Systems section of this manual. (See WORK LIGHT CIRCUIT OUTPUTS FROM ESC, page 944)
611 14 11 3	Work light lamps, less than normal low current but more than open circuit
611 14 11 4	Work light turn lamps, greater than normal high current and less than fusing current
611 14 11 6	Work light turn lamps has current flow when output commanded off

9.3. WORK LIGHT CIRCUIT INPUTS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to the Work Light EGC and ESC Input Circuits.

A fault in the input circuits will be apparent when the lights don't come on and no active faults are present. The ESC will not log any faults for work light input circuits to the ESC.

Loss of the drivetrain 1939 data link between the EGC and ESC will cause several problems to occur simultaneously and the check electrical system lamp will illuminate. **Go to the section on the drivetrain 1939 data link to troubleshoot this condition.**

Problems in the work light input circuits can be caused by a short circuit between the 3 switch pack and the EGC, an open circuit between the 3 switch pack and the EGC, a faulty switch, or a problem in the EGC.

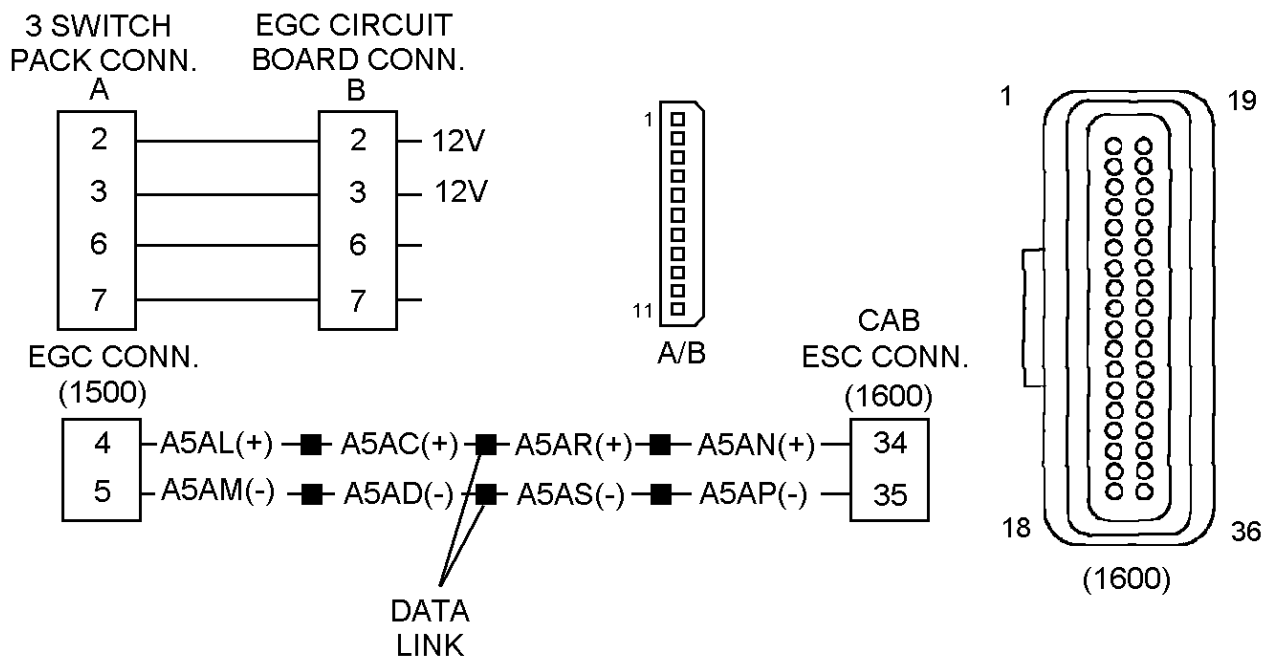

Figure 464 Work Light EGC and ESC Input Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

A. 3 SWITCH PACK CONNECTOR
B. EGC CIRCUIT BOARD CONNECTOR
(1500) EGC CONNECTOR
LOCATED BEHIND CLUSTER
(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC

Table 315 EGC, 3 Switch Pack Circuit Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the 3 switch pack in the EGC.		
A mechanically defective work light switch could also prevent the work light from operating. Remove the mechanical portion of the switch and attempt to turn the switch on by pressing the bottom switch contact. If the work lights illuminate, the mechanical switch assembly should be replaced.		
3 Switch Pack Harness Connector Work Light Voltage Checks Check with ignition key on and 3 switch pack disconnected. **NOTE – If the EGC is working correctly, disconnecting the 3 switch pack connector should cause the park lights to come on.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments

Table 315 EGC, 3 Switch Pack Circuit Tests (cont.)

3 switch pack harness connector, pin 3 to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between EGC connector and switch connector. Also insure proper voltage out of EGC.
3 switch pack harness connector, pin 7 to ground	0 –.3 volts	Low circuit from EGC If voltage is incorrect, check for open or shorts in circuits between EGC and switch. Also insure proper voltage out of EGC.
3 Switch Pack Work Light Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Checking for continuity between pins 3 and 7 of the switch pack, when the switch is on.	<1 ohm.	If there is no continuity, the switch pack needs replaced.

Extended Description

Refer to the Work Light EGC and ESC Input Circuits.

The work light switch is wired directly to the EGC circuit board. When the work light switch is turned on, 12 volts on pin 3 from the EGC will pass through the switch to pin 7 back to the EGC. This will cause the EGC to send a message to the ESC requesting the light to be turned on.

9.4. WORK LIGHT CIRCUIT OUTPUTS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer toWork Light Outputs from ESC.

A fault in the work light output circuits from the ESC will be apparent when the lights don't come on and an active work light fault is active. The ESC will log a diagnostic trouble code (DTC) when there is a short in any of the circuits between the ESC and the work light or when there is an open in a circuit between the work light and ground. Problems in the work light circuits can be caused by burned out lamps, a short, an open, a faulty switch, a problem in the ESC or a problem in the EGC.

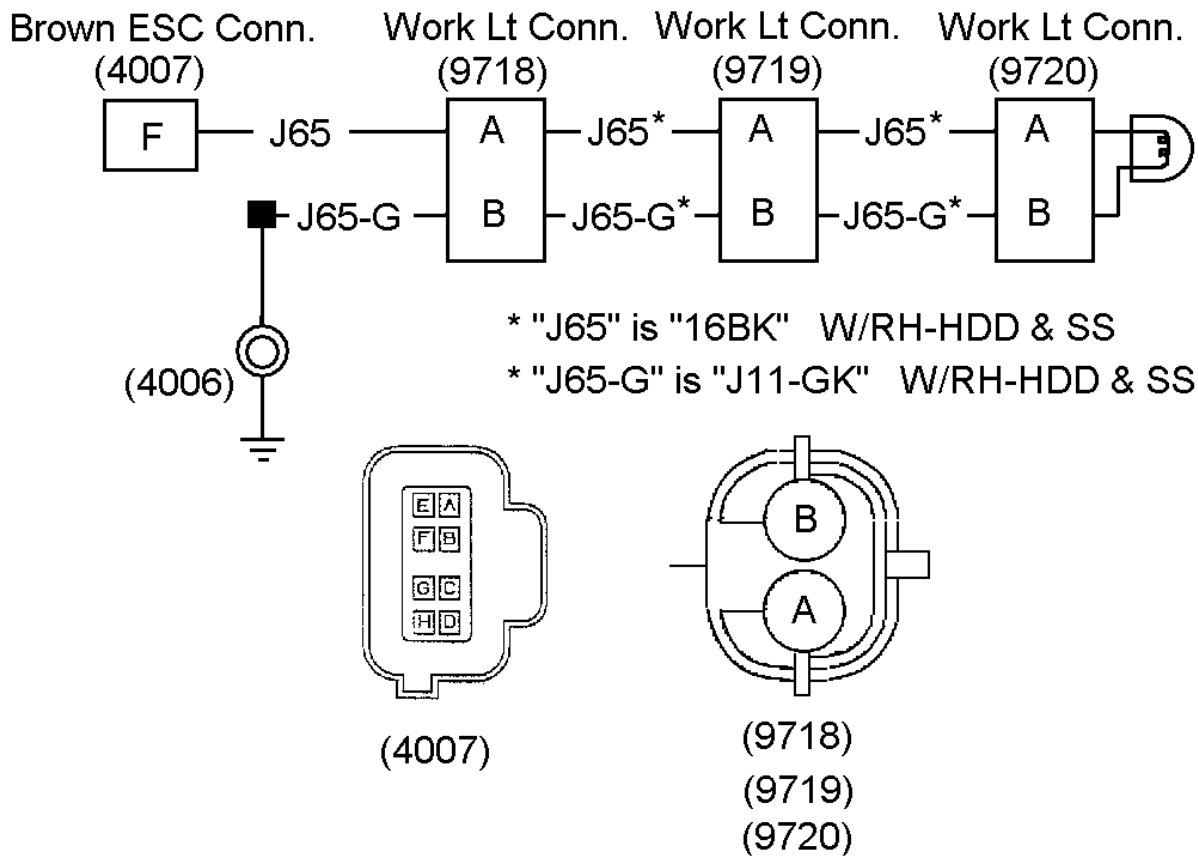

Figure 465 Work Light Outputs from ESC (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information

(4006) GROUND STUD
(4007) BROWN ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(9718) WORK LIGHT CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME
(9719) WORK LIGHT CONNECTOR
LOCATED BELOW BACK OF CAB NEAR LEFT FRAME
(9720) WORK LIGHT CONNECTOR
LOCATED ON LIGHT MOUNTED ON BACK OF CAB

Table 316 Work Light Circuit Tests carl

Diagnostic Trouble Codes	
611 14 11 3	Work light lamps, less than normal low current but more than open circuit
611 14 11 4	Work light lamps, greater than normal high current and less than fusing current
611 14 11 6	Work light lamps has current flow when output commanded off
611 14 11 2	Work light over current

Table 316 Work Light Circuit Tests carl (cont.)

<table>
<tr><td colspan="3">This fault is logged when there is a short in the circuits between the work light and the ESC or an excessive load on the circuit caused by too many accessories on the work light circuits.

NOTE – Disconnecting connectors will cause new open circuit faults to be logged. Clear all faults after connections have been restored.

Disconnect work light connector (9720). Cycle key switch and clear DTC's. Turn on work light switch and check for fault. If the fault has not reoccurred, there is a short or an overload in the work light. If the fault reoccurs, there is a short in the circuits between the ESC and work light or in the ESC.

Disconnect brown ESC connector (4007). Cycle key switch and clear DTC's. Then turn on work light switch and check for fault. If the fault has not reoccurred, there is a short in the circuits between the ESC and work light. If the fault reoccurs, there is a short inside the ESC.</td></tr>
<tr><td colspan="2">611 14 11 1</td><td>Work light open circuit</td></tr>
<tr><td colspan="3">This fault is the result of an open in circuits between the work light output of the ESC and ground.

Check for open circuits</td></tr>
<tr><td colspan="3">Work Light Harness Connector (9720) Voltage Checks

Check with ignition key on, work light on, and work light connector (9720) disconnected.

NOTE – Always check connectors for damage and pushed–out terminals.

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</td></tr>
<tr><td>Test Points</td><td>Spec.</td><td>Comments</td></tr>
<tr><td>(9720) Harness connector, pin A to ground</td><td>12 ± 1.5 volts</td><td>If voltage is missing, check for open in circuit J65.

Also insure proper voltage out of ESC.

Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)</td></tr>
<tr><td>(9720) Harness connector, pin B to ground</td><td>0 volts</td><td>Ground circuit. No voltage expected.</td></tr>
<tr><td>(9720) Harness connector, pin A to pin B</td><td>12 ± 1.5 volts</td><td>If voltage is missing, check for open in ground circuit J65–G.</td></tr>
</table>

Extended Description

Refer to Work Light Outputs from ESC.

The ESC will supply 12 volts from system controller brown connector (4007) terminal F to work light connector (9720) terminal A.

Ground for the work light is supplied from ground stud (4006) to work light connector (9720) terminal B.

9.5. COMPONENT LOCATIONS

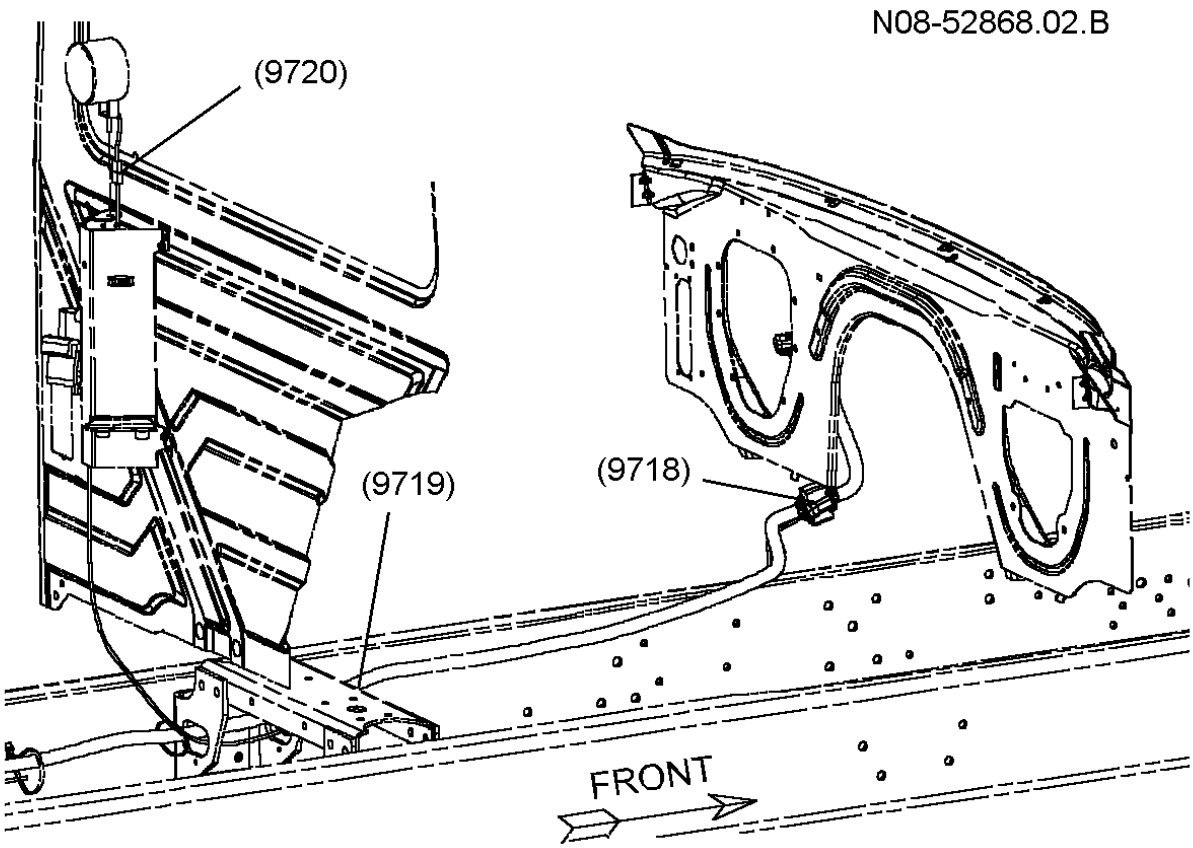

Figure 466 Work Light Wiring

(9718) WORK LIGHT CONNECTOR
(9719) WORK LIGHT CONNECTOR
(9720) WORK LIGHT CONNECTOR

10. AUXILIARY HEADLIGHTS

10.1. CIRCUIT FUNCTIONS

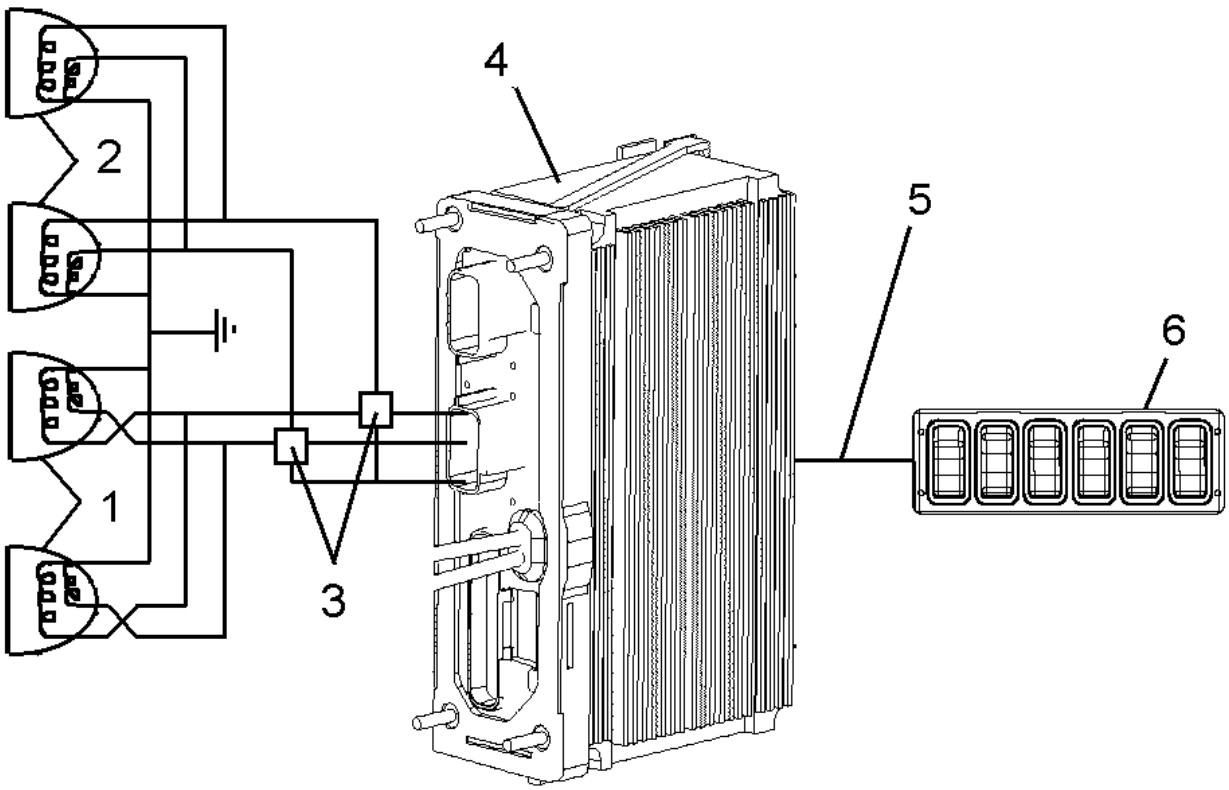

Figure 467 Auxiliary Headlights Function Diagram

1. AUXILIARY HEADLIGHTS
2. STANDARD HEADLIGHTS
3. AUXILIARY HEADLIGHT RELAYS
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. AUXILIARY HEADLIGHT SWITCH (IN SWITCH PACK)

Refer to Auxiliary Headlights Function Diagram.

The Auxiliary headlights system allows the driver to switch between standard headlights and auxiliary headlights mounted above a snowplow. Switching between the lights can only be performed when the key is on. If the key is turned off while the lights are on they will remain in that state until the key is turned on.

Relays, controlled by the ESC, are used to switch headlight current between the standard headlights and the auxiliary headlights. The auxiliary headlight switch mounted in a switch pack will communicate with the ESC to request the lights to be switched.

A separate relay is used for high beam and low beam auxiliary headlight operation.

All auxiliary lights, other than the headlights, are connected to splices. No switching between standard and auxiliary headlights occurs on these circuits.

10.2. DIAGNOSTICS

Should the auxiliary headlight system fail to switch from standard to auxiliary headlights, the problem could be attributed to a faulty switch in the switch pack, a faulty switch pack, failed relays, open circuits or shorted circuits.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the auxiliary headlights and monitor activation of the auxiliary headlight switch. See the diagnostic software manual for details on using the software.

Auxiliary Headlights Preliminary Check

Table 317 Auxiliary Headlights Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify standard headlights lights are operating correctly.	Visually check standard headlights.	Standard lights are operating correctly.	Go to next step.	If standard headlights are not functioning correctly, Go to Headlight System. (See HEADLIGHT SYSTEM, page 878)
2.	On	Check if either high or low beam headlights switch from standard to auxiliary when selected by auxiliary headlights switch. (Lights may not work correctly. Just look for change from standard to auxiliary.)	Visually check switching of headlights.	At least some lights switch from standard to auxiliary.	Go to next step.	Go to Auxiliary Headlights Circuits To ESC. (See AUXILIARY HEADLIGHTS CIRCUITS TO ESC, page 951)

Table 317 Auxiliary Headlights Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Are both high beam or both low beam auxiliary headlights inoperative?	Visually check if both auxiliary headlights are inoperative.	Both high beam or both low beam auxiliary headlights inoperative.	Go to next step.	Check specific circuits of the inoperative light for open circuits.
4.	On	With the auxiliary headlights selected,check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 950)	Read display on odometer.	No diagnostic trouble codes are active.	Go to auxiliary headlights circuit outputs from ESC. (See AUXILIARY HEADLIGHTS CIRCUITS FROM ESC, page 953)	Go to auxiliary headlights circuit outputs to ESC. (See AUXILIARY HEADLIGHTS CIRCUITS TO ESC, page 951)

Diagnostic Trouble Codes

To display diagnostic trouble codes (DTC's), set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously. If no faults are present, the cluster odometer will display "NO FAULTS". If faults are present, the gauge cluster display will show the number of faults and each diagnostic trouble code for 10 seconds and then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active faults or "P" for previously active faults. Releasing the parking brake or turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

After all repairs have been made, the diagnostic trouble codes may be cleared by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 318 Auxiliary Headlights Circuits

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 5 1	Headlight low beam open circuit
611 14 5 2	Headlight low beam over current
611 14 5 3	Headlight low beam lamps, less than normal low current but more than open circuit
611 14 5 4	Headlight low beam lamps, greater than normal high current and less than fusing current
611 14 5 6	Headlight low beam lamps has current flow when output commanded off

Table 318 Auxiliary Headlights Circuits (cont.)

611 14 7 1	Headlight high beam open circuit
611 14 7 2	Headlight high beam over current
611 14 7 3	Headlight high beam lamps, less than normal low current but more than open circuit
611 14 7 4	Headlight high beam lamps, greater than normal high current and less than fusing current
611 14 7 6	Headlight high beam lamps has current flow when output commanded off

10.3. AUXILIARY HEADLIGHTS CIRCUITS TO ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Auxiliary Headlights Circuits To ESC.

A fault in the headlight switching circuits will be apparent when the lights will not switch between normal and auxiliary headlights. The ESC will log a diagnostic trouble code (DTC) when there is a short or overload in the switching circuit between the ESC and the switching relays. Problems in the switching circuits may be the result of a shorted circuit, an open circuit, failed relays, or a problem in the ESC.

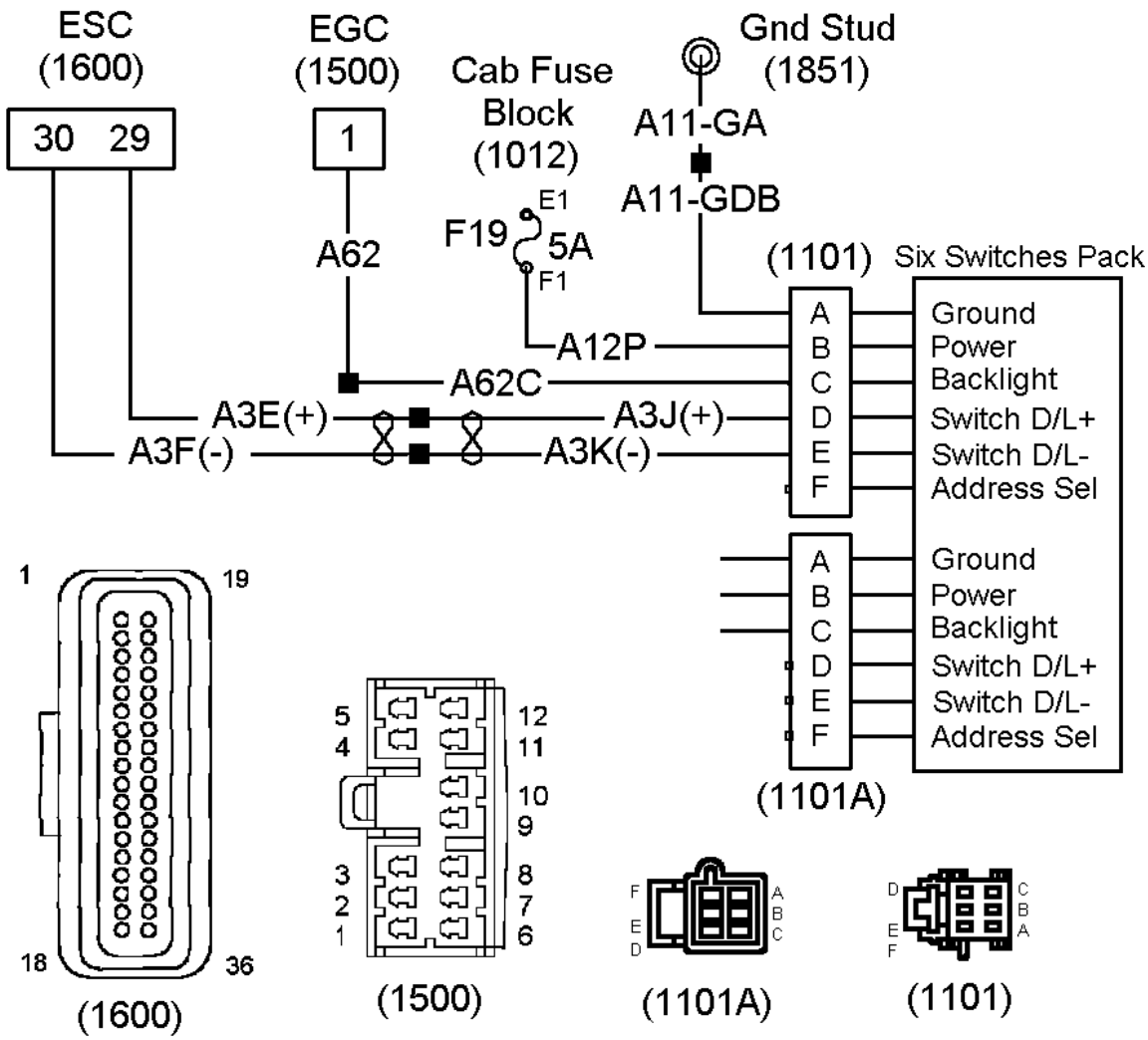

Figure 468 Auxiliary Headlights Circuits To ESC (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1012) F19 SWITCH PACK FUSE
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1101) 6 SWITCHES PACK CONNECTOR (TO INSTRUMENT PANEL HARNESS OR PREVIOUS SWITCH PACK)
LOCATED BEHIND SWITCH PACK
(1101A) 6 SWITCHES PACK CONNECTOR (TO NEXT SWITCH PACK)
LOCATED BEHIND SWITCH PACK
(1500) ELECTRONIC GAUGE CLUSTER (EGC) CONNECTOR
LOCATED ON BACK OF EGC
(1600) 36–WAY ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1851) GROUND STUD CONNECTOR

Table 319 Auxiliary Headlights Circuits To ESC 6 Switches Pack Connector Check Chart

Auxiliary Headlights Circuits To ESC 6 Switches Pack Connector (1101) Voltage Checks This chart assumes there is power to cab fuse block (1012) from the mega fuse.		
Test Points	Spec.	Comments
(1101) Pin B to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse (F19) or open or short in circuits A12P.
(1101) Pin A to ground	0 volts	Ground circuit to pod.
(1101) Pin D to ground	Approximately 4.5 volts	(+) data link circuit. If voltage is low check for open or short in circuit A3J(+) or shorted components on data link.
(1101) Pin E to ground	Approximately .2 volt	(-) data link circuit. If voltage is low check for open in circuit A3K(-) or shorted components on data link. If voltage is high check for crossed data link wires.
If voltage and data link circuits to the pod are good, and a communication fault is still active, the switch pack should be replaced.		
(1101) Pin C to pin A	12 ± 1.5 volts (with park lights on and panel dimmer at maximum).	Panel dimmer voltage from electronic gauge cluster (EGC). If voltage is missing check circuits between switch pack and EGC.
Inoperative panel lights in individual switches should be replaced. If the panel light voltage to the switch pack is correct, but none of the panel lights operate, the switch pack should be replaced.		

Extended Description

Refer to Auxiliary Headlights Circuits To ESC.

Battery voltage to 6 switches pack connector (1101) terminal B is provided from fuse block (1012), fuse F19 on circuit A12P.

System ground to 6 switches pack connector (1101) terminal A is provided from negative stud (1850) on circuit A11–GA and A11–GDB.

The switch data link is connected to switch pack connector (1101) terminal D and E from ESC connector (1600) terminals 29 and 30 on twisted pair A3F(-)/A3E(+), to a splice and on A3K(-)/A3J(+).

Panel light voltage to switch pack connector (1101) terminal C is supplied from EGC connector (1500) on circuits A62 and A62C.

The Auxiliary headlights switch selects the auxiliary headlights mounted above a snowplow.

10.4. AUXILIARY HEADLIGHTS CIRCUITS FROM ESC

Fault Detection Management

NOTE – The testing method for troubleshooting the electrical systems portrayed in this manual is a basic voltage test. An alternative method of checking for voltage drops within a given circuit may be a quicker method of identifying an exact problem.

NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.

Refer to Auxiliary Headlights Circuits From ESC.

A fault in the auxiliary headlight circuits between the ESC and the headlights will be apparent when the lights don't operate correctly. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the headlight circuits or an open circuit between the ESC and the headlights. Problems occurring in the auxiliary headlights (not affecting normal headlights) can be caused by burned out lamps, a short to ground or an open circuit.

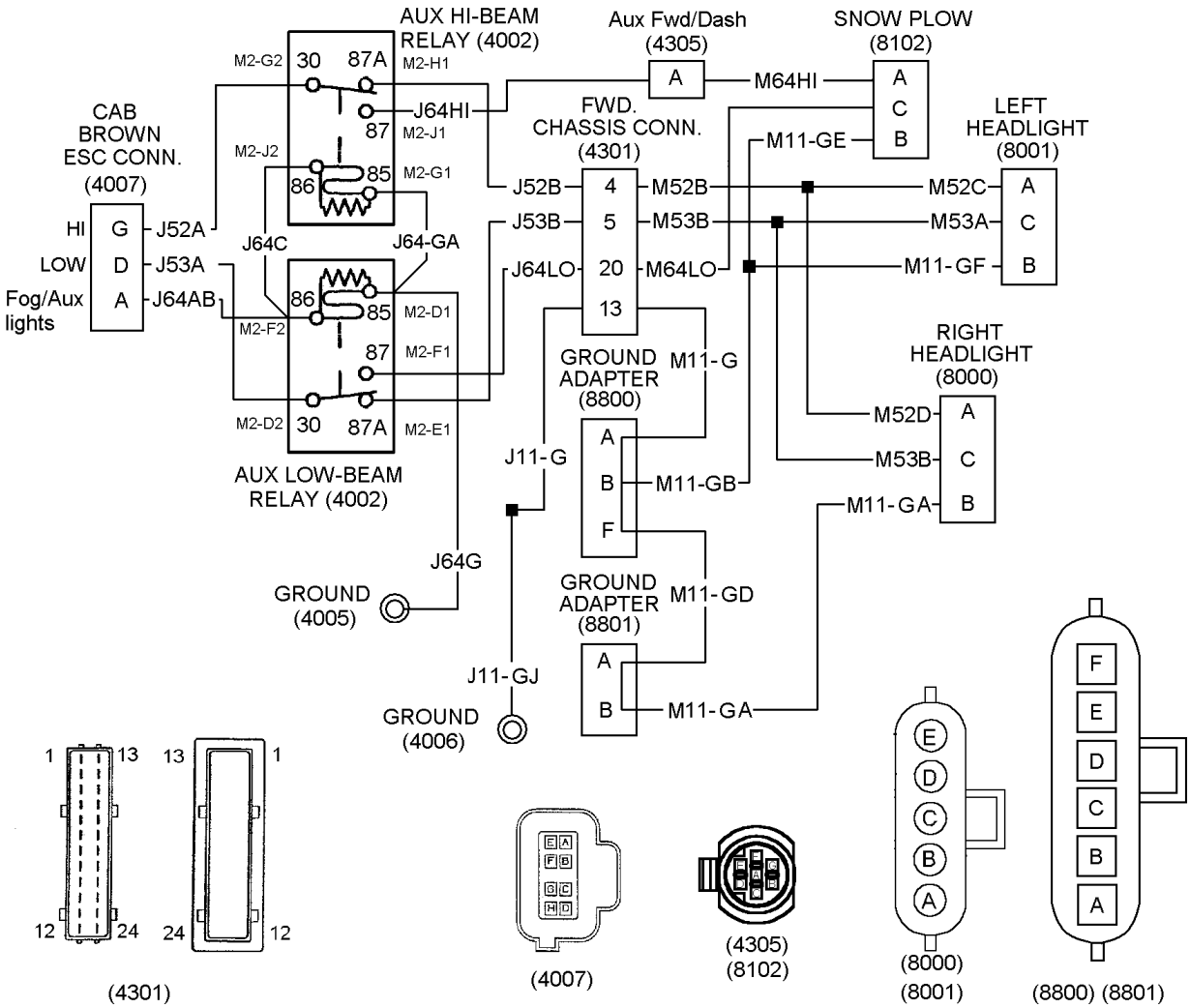

Figure 469 Auxiliary Headlights Circuits From ESC (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(4005), (4006) GROUND STUDS
(4007) BROWN ESC CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4301) FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4305) AUX FORWARD/DASH CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(8000) RIGHT HEADLIGHT CONNECTOR
LOCATED BEHIND RIGHT HEADLIGHT
(8001) LEFT HEADLIGHT CONNECTOR
LOCATED BEHIND LEFT HEADLIGHT
(8102) SNOW PLOW HARNESS CONNECTOR
LOCATED NEAR LEFT HEADLIGHT CONNECTOR
(8800) LEFT GROUND ADAPTER
(8801) RIGHT GROUND ADAPTER

Table 320 Auxiliary Headlight Switching Circuits Tests

Auxiliary High and Low Beam Relay Checks Check with auxiliary high beam and low beam relays removed, key in ignition position, headlight switch on and auxiliary headlight switch on. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Bench check auxiliary high and low beam relays. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)	Relays energize and there is continuity thorough the closed contacts.	If a relay tests bad, replace it.
Measure voltage between aux low beam relay socket cavity M2–F2 and ground.	12 ± 1.5 volts with auxiliary headlight switch “on”.	If voltage is missing, check for open or short in circuit J64AB or short to ground in circuit J64C.
Measure voltage between aux high beam relay socket cavity M2–J2 and ground.	12 ± 1.5 volts with auxiliary headlight switch “on”.	If voltage is missing, check for open or short in circuit J64AB or short to ground in circuit J64C.
Measure voltage between aux high beam relay socket cavity M2–J2 and M2–G1	12 ± 1.5 volts with auxiliary headlight switch “on”.	If voltage is missing, check for open in circuit J64–GA or J64–G to ground stud (4005).

Table 321 Auxiliary Low Beam Headlight Circuit Tests

FAULTS	
611 14 5 3	Headlight low beam lamps, less than normal low current but more than open circuit
611 14 5 4	Headlight low beam lamps, greater than normal high current and less than fusing current
611 14 5 6	Headlight low beam lamps has current flow when output commanded off
611 14 5 2	Low beam over current
This fault may be the result of a short in the circuits between the low beam headlight circuits and the ESC. It could also be caused by an excessive load on the circuit.	
611 14 5 1	Low beam under current
This fault is the result of an open in circuits between the low beam headlight circuits and the ESC. Check for burned out bulbs.	
Snow Plow Connector (8102) Low Beam Voltage Checks **NOTE – Verify headlight bulbs are not burned out before proceeding.** Check with key in ignition position, headlight switch on, low beams selected and connector (8102) disconnected.	

Table 321 Auxiliary Low Beam Headlight Circuit Tests (cont.)

Test Points	Spec.	Comments
Headlights in low beam. (8102) terminal C to ground.	12 ± 1.5 volts with headlight low beams switched “on”	If voltage is missing, check for open or short to ground in circuits J64LO or M64LO. If no open or shorts are found check circuits between (8102) and the auxiliary headlamps
Headlights in low beam. (8102) terminal C to terminal B.	12 ± 1.5 volts with headlight low beams switched “on”	If voltage is missing, check for open in circuits between terminal B and ground.

Table 322 Auxiliary High Beam Headlight Circuit Tests

FAULTS	
611 14 7 3	Headlight high beam lamps, less than normal low current but more than open circuit
611 14 7 4	Headlight high beam lamps, greater than normal high current and less than fusing current
611 14 7 6	Headlight high beam lamps has current flow when output commanded off
611 14 7 2	High beam over current
This fault may be the result of a short in the circuits between the high beam headlight circuits and the ESC. It could also be caused by an excessive load on the circuit.	
611 14 7 1	High beam under current
This fault is the result of an open in circuits between the high beam headlight circuits and the ESC. Check for burned out bulbs.	
Snow Plow Connector (8102) High Beam Voltage Checks **NOTE – Verify headlight bulbs are not burned out before proceeding.** Check with key in ignition position, headlight switch on, high beams selected and connector (8102) disconnected.	
Test Points	Spec.	Comments
Headlights in high beam. (8102) terminal A to ground.	12 ± 1.5 volts with headlight high beams switched “on”	If voltage is missing, check for open or short to ground in circuits J64HI or M64HI. If no open or shorts are found check circuits between (8102) and the auxiliary headlamps
Headlights in high beam. (8102) terminal A to terminal B.	12 ± 1.5 volts with headlight low beams switched “on”	If voltage is missing, check for open in circuits between terminal B and ground.

Extended Description

Refer to Auxiliary Headlights Circuits From ESC.

When low auxiliary headlights are requested, the ESC will supply 12 volts to the coils of auxiliary high beam micro relay (4002) and auxiliary low beam micro relay (4002).

This will cause both relays to energize switching headlight voltage to the auxiliary headlights.

Ground for the auxiliary headlights is supplied from ground stud (4006) to ground adapter (8800) and cavity B of snowplow connector (8102).

10.5. COMPONENT LOCATIONS

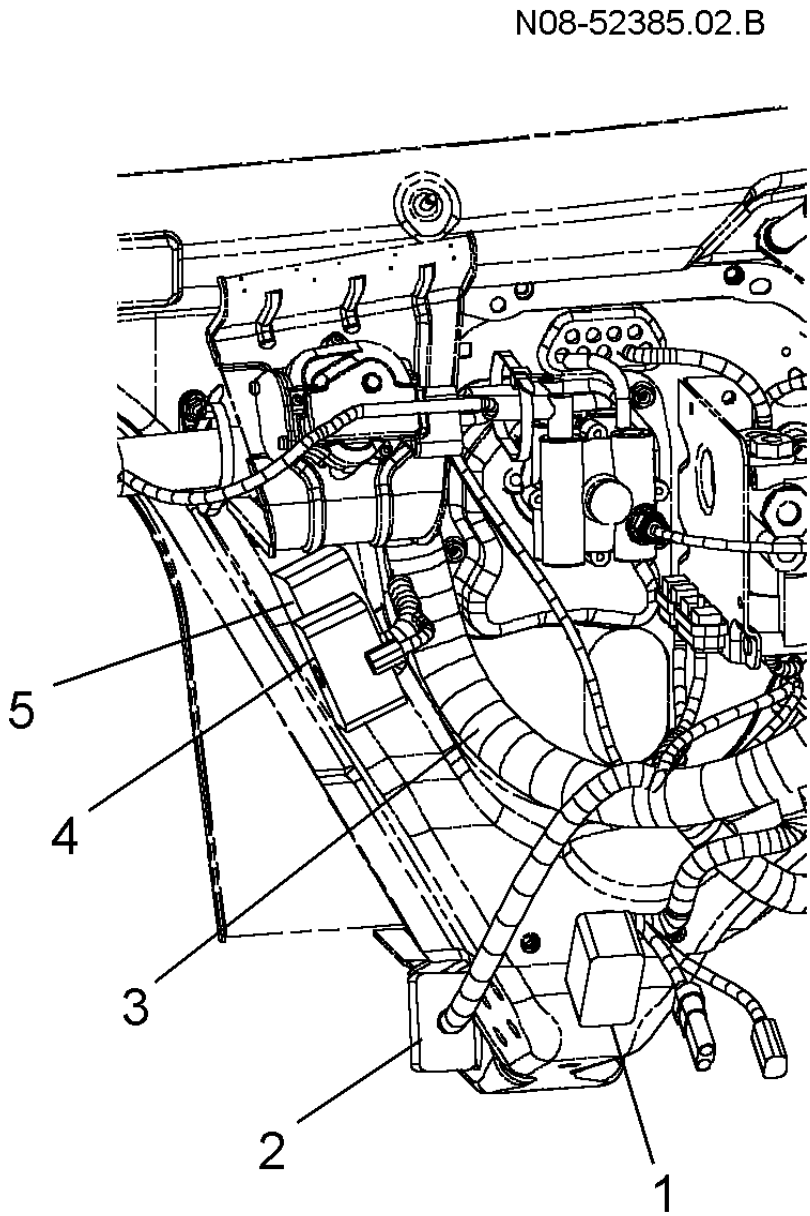

Figure 470 Headlight Connector Locations (Dash Panel From Engine Compartment)

1. FORWARD CHASSIS CONNECTOR (4301) AND AUX FORWARD/DASH CONNECTOR (4305)
2. REAR CHASSIS CONNECTOR (9700)
3. CHASSIS HARNESS
4. TRANSMISSION CONNECTOR
5. ENGINE CONNECTOR

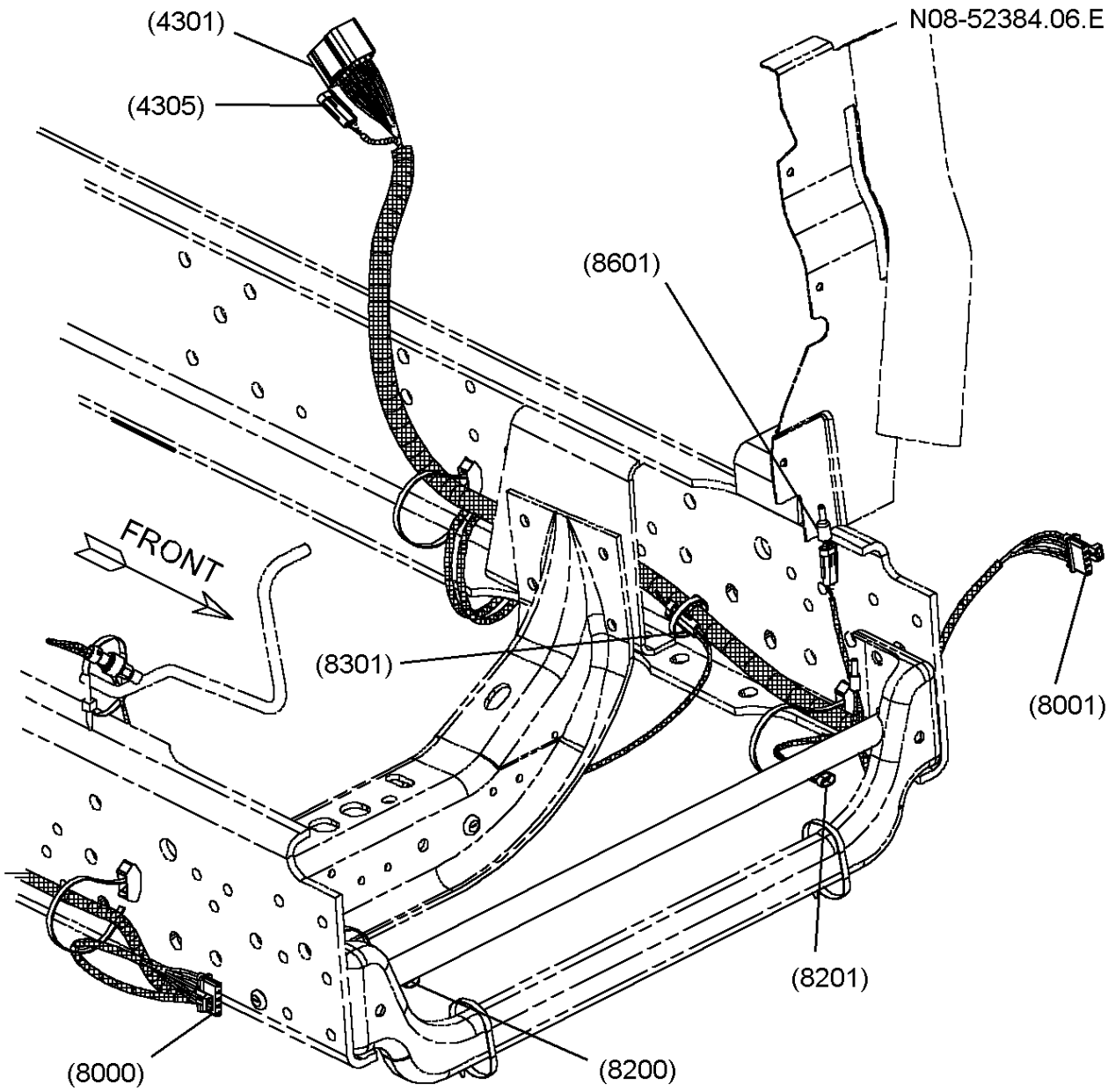

Figure 471 Headlight Wiring

(4301) FORWARD CHASSIS CONNECTOR
(4305) AUX FORWARD/DASH CONNECTOR
(8000) RIGHT HEADLIGHT CONNECTOR
(8001) LEFT HEADLIGHT CONNECTOR
(8200) RIGHT HEADLIGHT CONNECTOR
(8201) LEFT HEADLIGHT CONNECTOR
(8302) HORN CONNECTOR