Table of Contents

1. BACK-UP LIGHTS

1.1. CIRCUIT FUNCTIONS

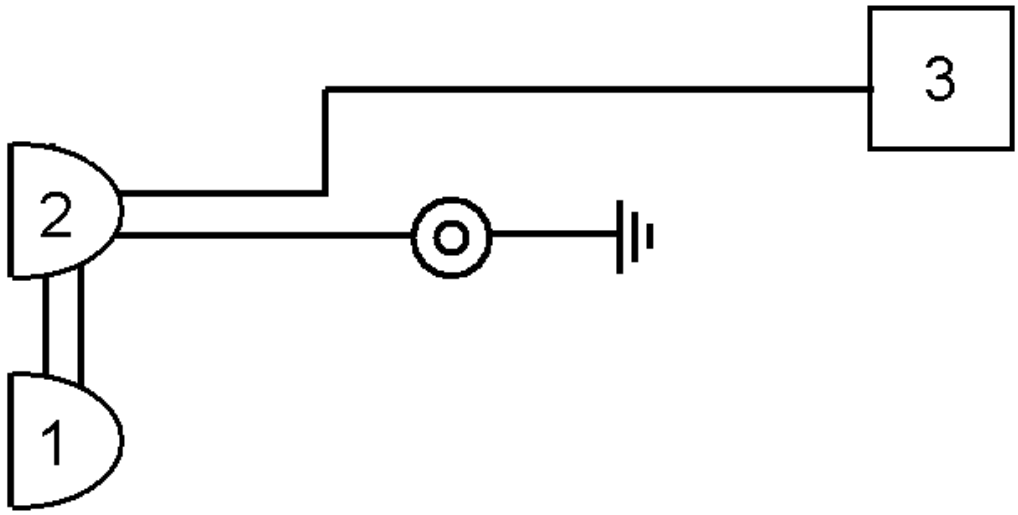

Figure 248 Back–Up Lights Function Diagram

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

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 160 Back Up Lights

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the back up light circuits.
2033 14 2 0	Lamp test reverse lamps, there is a load on this pin that has been configured unused, 1601 pin E.
2033 14 2 1	Lamp test reverse lamps output overloaded, 1601 pin E.
2033 14 2 2	Lamp test reverse lamps output open circuit, 1601 pin E.
2033 14 2 3	Lamp test reverse lamps output shorted to ground, 1601 pin E.

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 Circuits with LCT Transmission or Back-Up Lights Circuits with MD Transmission.

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.

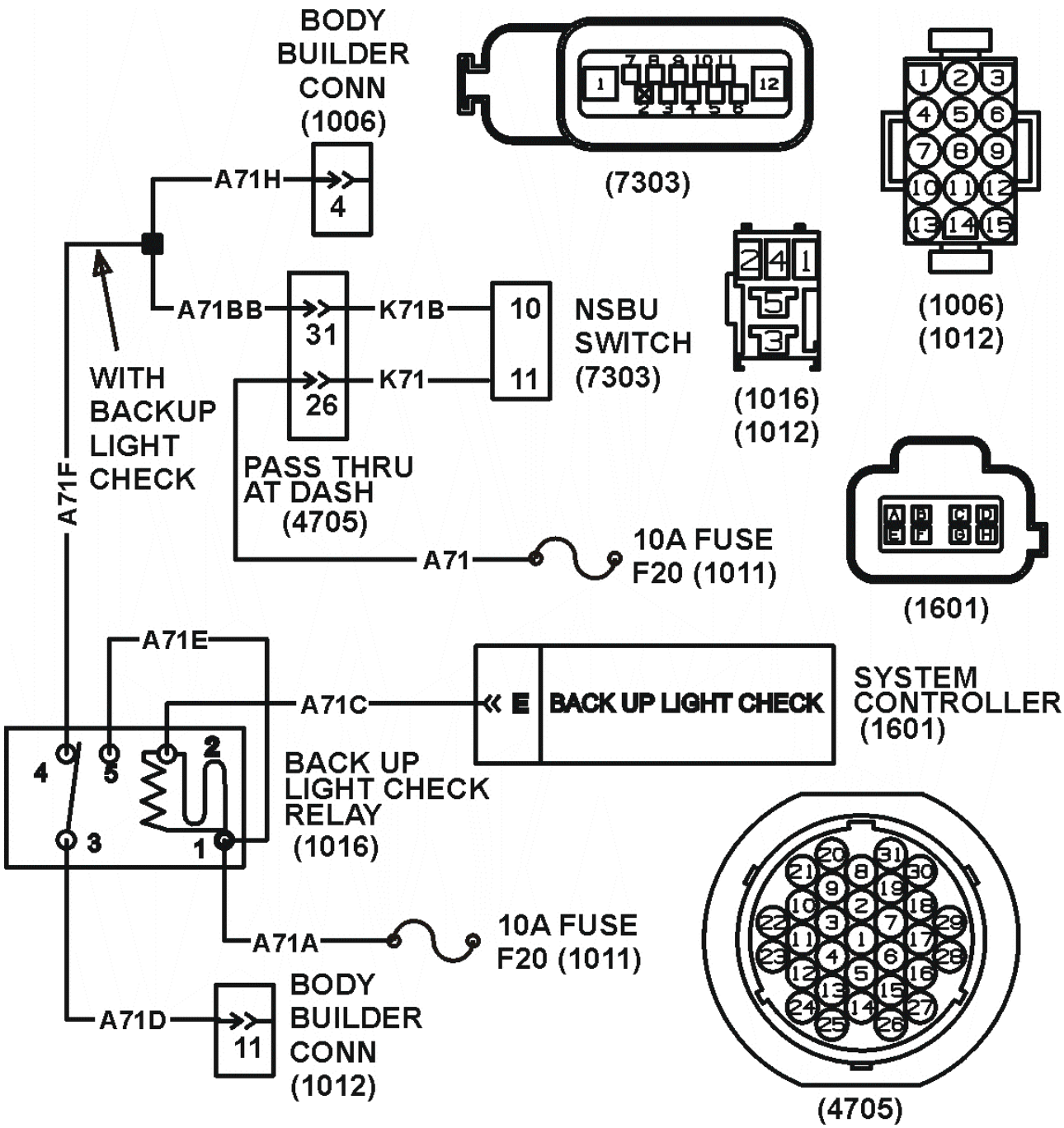

Figure 249 Back–Up Lights Circuit (w/LCT Transmission) Diagram — Always Refer to the Circuit Diagram Book for Latest Circuit Information.

NOTE – If Back Up Lamp Check is not installed on vehicle, then back up lamps will be connected at Body Builder Connector (1006) pin 4 with the back up alarm.

Table 161 Back–Up Lights Circuit Tests for LCT Transmission

NSBU Switch (7303) Voltage Test Check with ignition on, transmission in reverse and backup lamp check relay (1016) removed. Bench test relay. If relay fails, replace and check for faults. **NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.**		
Test Points	Spec.	Comments
With transmission in reverse, NSBU switch (7303) cavity 11 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20, open or short to ground in circuits A71 and K71.
With transmission in reverse, NSBU switch (7303) cavity 11 to cavity 10.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits K71B, A71BB and A71F.
Back Up Lamp Check Relay (1016) Voltage Test Check with ignition on, transmission in reverse and backup lamp check relay (1016) removed. Bench test relay. If relay fails, replace and check for faults. **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
With transmission in reverse, back up light check relay (1016) cavity 1 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20, open or short to ground in circuit A71A. Also check for open or short in circuits A71E and A71C.
With transmission in reverse, back up light check relay (1016) cavity 4 to cavity 3.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A71F, A71BB, and K71H.

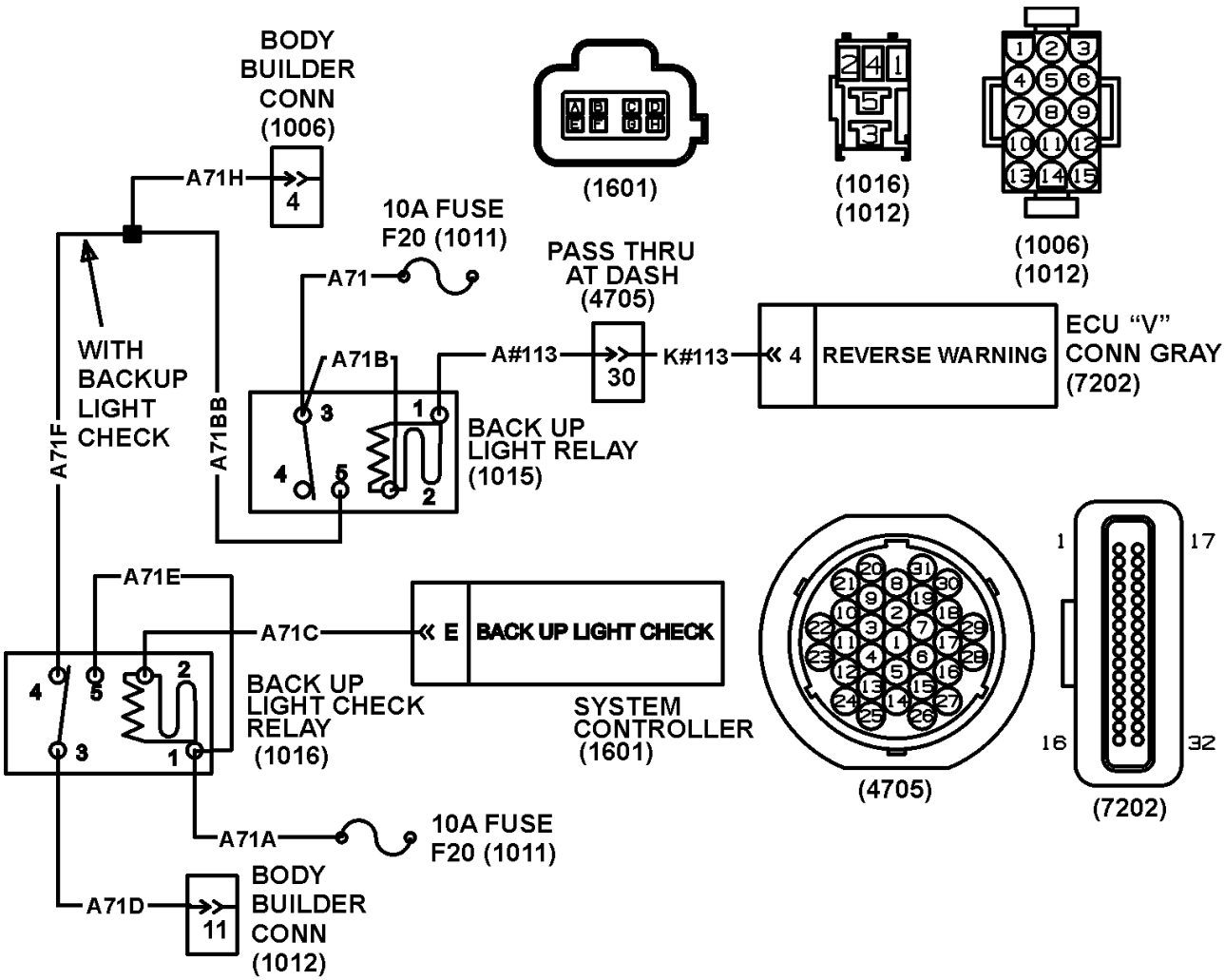

Figure 250 Back–Up Lights Circuit (w/WTEC MD Transmission) Diagram — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1012) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1015) BACK UP LIGHT RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1016) BACK UP LIGHT CHECK RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1601) SYSTEM CONTROLLER CONNECTOR
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4705) PASS THRU AT DASH
LOCATED AT INSIDE DASH PANEL LEFT SIDE
(7202) MD ECU "V" CONNECTOR GRAY
LOCATED AT ENGINE COMPARTMENT TRANSMISSION
(7303) NSBU SWITCH
LOCATED AT ENGINE COMPARTMENT TRANSMISSION

NOTE – If Back Up Lamp Check is not installed on vehicle, then back up lamps will be connected at Body Builder Connector (1006) pin 4 with the back up alarm.

Table 162 Back–Up Lights Circuit Tests for WTEC MD Transmission

Back Up Light Relay (1015) Voltage Test Check with ignition on, transmission in reverse, back up lamp check relay (1016) installed (if applicable) and backup lamp check relay (1016) removed. Bench test relay. If relay fails, replace and check for faults. **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
With transmission in reverse, back up light relay (1015) cavity 3 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20 and check for open or short to ground in circuit A71.
With transmission in reverse, back up light relay (1015) cavity 3 to cavity 1.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A#113 and K#113. Also check for open or short in circuit A71B. Also ensure proper ground signal form ECU “V” Connector Gray (7202) pin 4.
Back Up Lamp Check Relay (1016) Voltage Test Check with ignition on, transmission in reverse, back up light relay (1015) installed and backup lamp check relay (1016) removed. Bench test relay. If relay fails, replace and check for faults. **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
With transmission in reverse, back up light check relay (1016) cavity 1 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20, open or short to ground in circuit A71A. Also check for open or short in circuits A71E and A71C.
With transmission in reverse, back up light check relay (1016) cavity 4 to cavity 3.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A71F, and A71BB.

1.4. EXTENDED DESCRIPTION

Refer to the Back–Up Lights Connector Diagram.

For LCT transmission:

Refer to the Back–Up Lights Circuits with LCT Transmission.

When the transmission is shifted into reverse, the NSBU switch (7303) will provide a voltage on pin 10. This will then provide a voltage to the backup light assemblies and the back up alarm.

For WTEC MD transmission:

Refer to the Back–Up Lights Circuits with MD Transmission.

When the transmission is shifted into reverse, the ECU “V” Connector Gray (7202) will supply a ground on pin 4. This will then provide a voltage to energize the back up light relay (1015). Voltage from fuse F20 will then be supplied to the back up lights and back up alarm.

Back Up Lamp Check:

The back up lamp check occurs at key on. A ground is supplied on the System Controller connector (1601) pin E. This will charge the back up light check relay (1016). Electrical current will then be divided between the System Controller connector (1601) pin E and the back up lights. The System Controller will signal and error (burnt out or missing back up light bulb) depending on the amount of current that is measured at connector (1601) pin E.

1.5. COMPONENT LOCATIONS

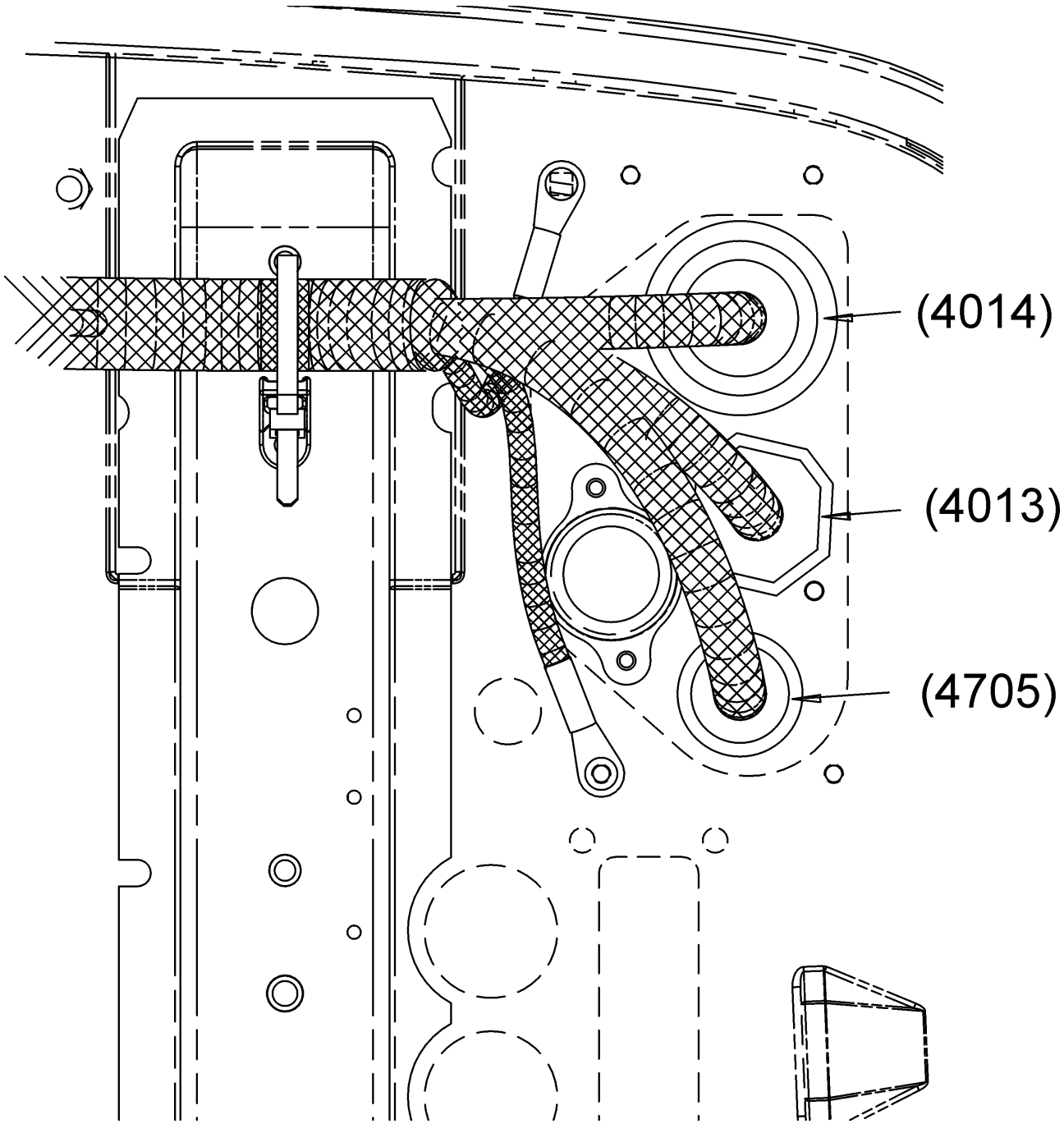

Figure 251 Pass Thru Wiring Connector Locations

(4013) PASS THRU AT DASH CONNECTOR
(4014) DASH/ENGINE PASS THRU CONNECTOR
(4705) PASS THRU AT DASH CONNECTOR

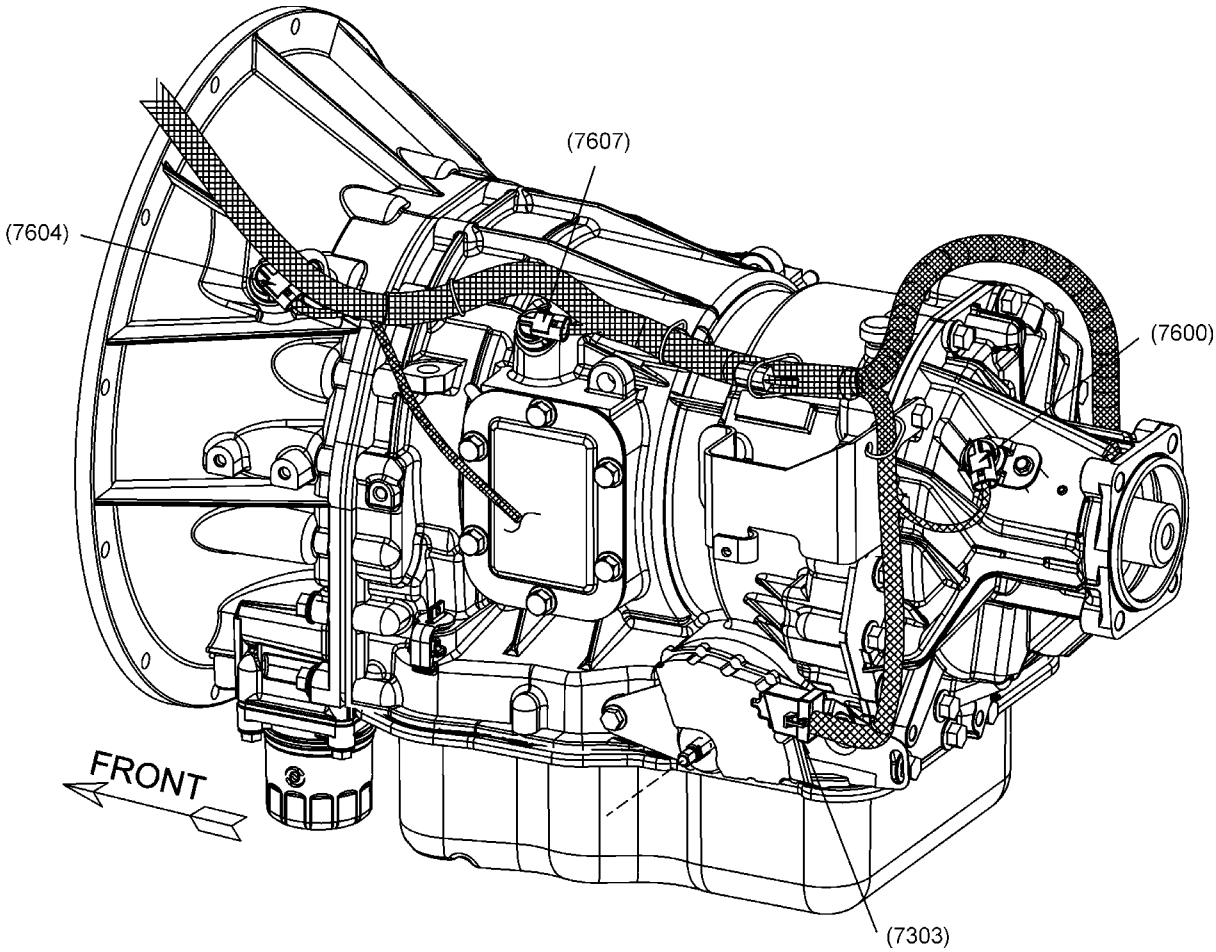

Figure 252 LCT Transmission Connector Location

(7303) NSBU SWITCH CONNECTOR
(7600) OUTPUT SPEED SENSOR CONNECTOR
(7604) ENGINE SPEED SENSOR CONNECTOR
(7607) TURBINE SPEED SENSOR CONNECTOR

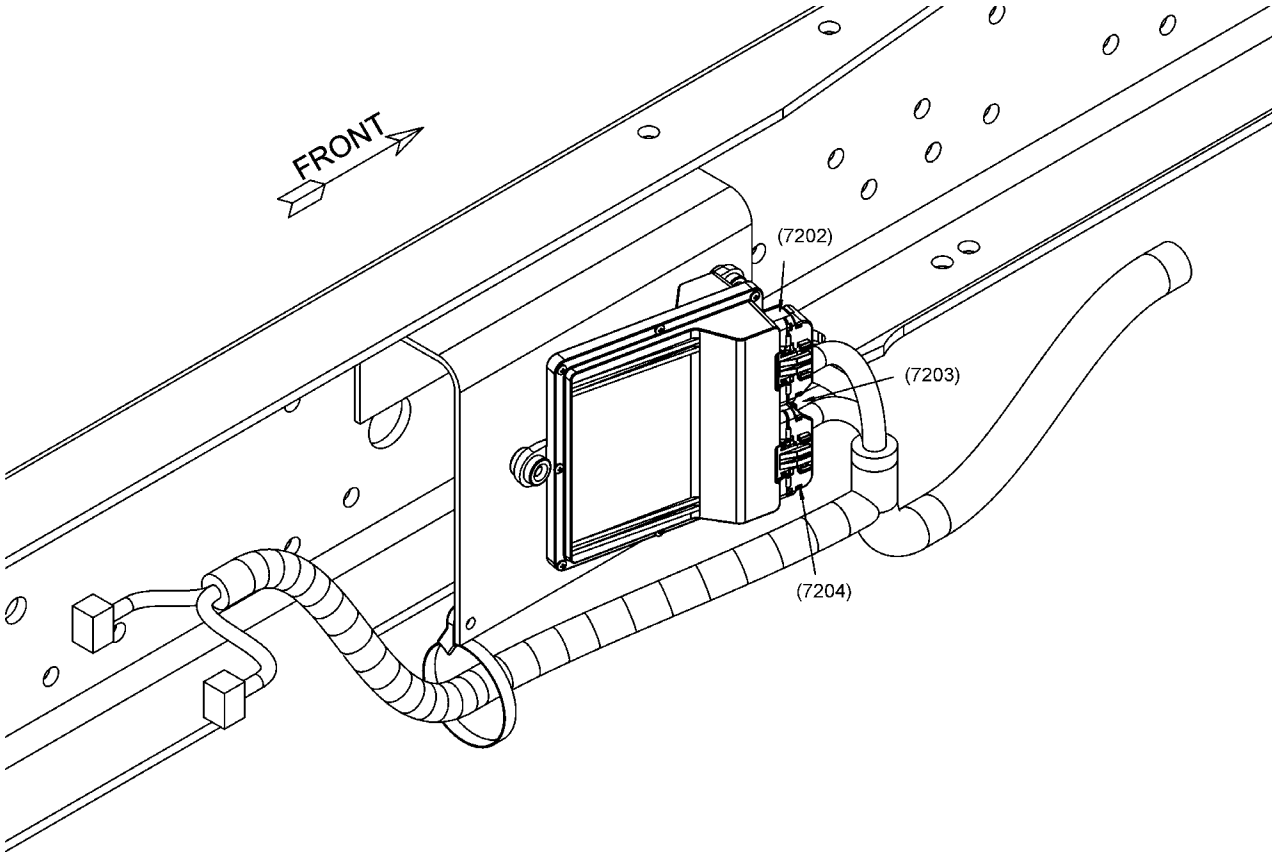

Figure 253 WTEC MD Transmission Controller Connector Locations

(7202) MD ECU “V” CONNECTOR GRAY
(7203) MD ECU “T” CONNECTOR BLUE
(7204) MD ECU “S” CONNECTOR BLACK

2. CLEARANCE LIGHTS

2.1. CIRCUIT FUNCTIONS

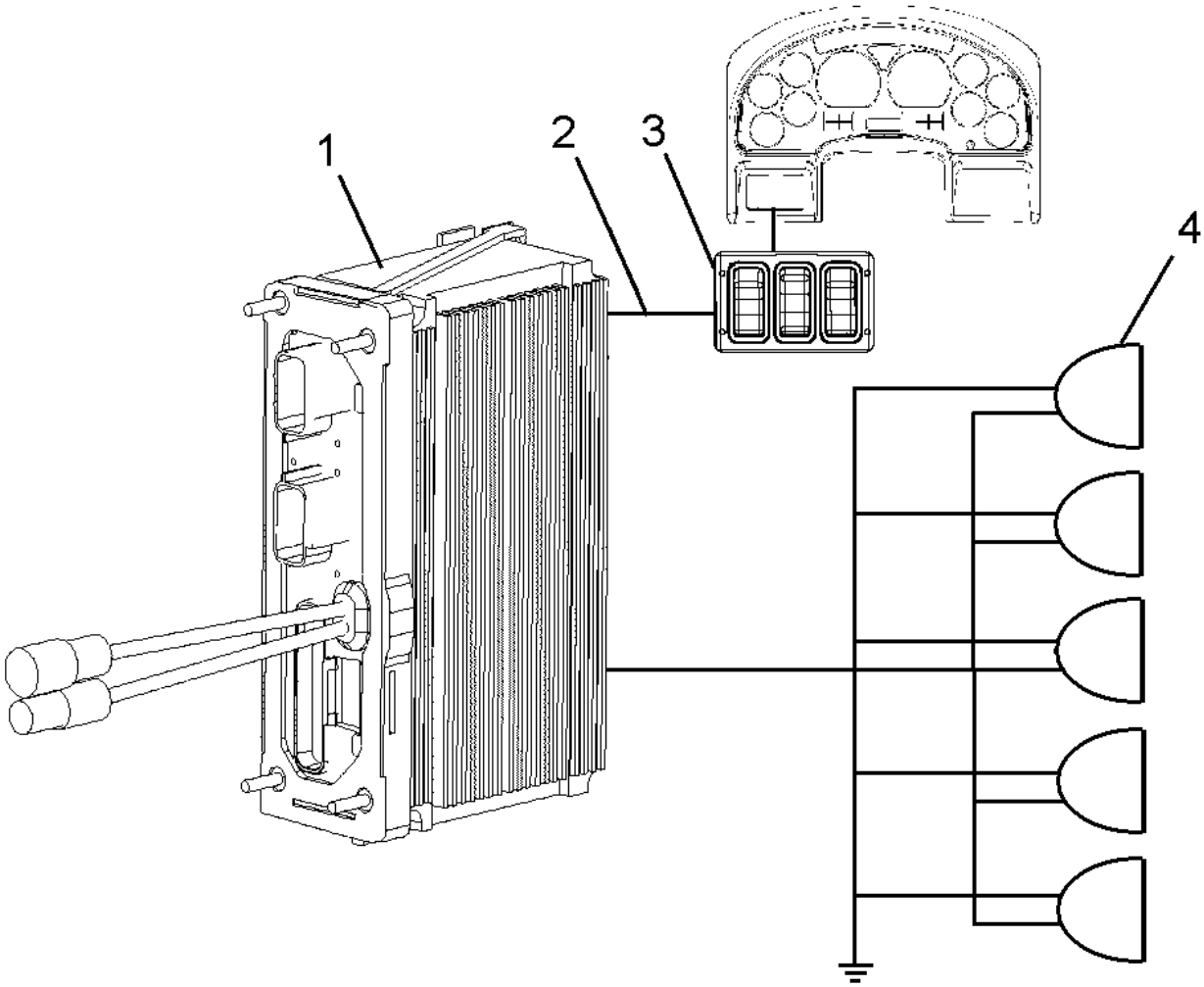

Figure 254 Clearance Lights Function Diagram

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

Refer to the Clearance Lights Function Diagram.

NOTE – The clearance 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. 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.

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 ESC supplies battery voltage to the clearance 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 clearance light circuits will be apparent when the park or headlights are turned on and the clearance lights do not come on.

An electronic service tool, running the "Diamond Logic Builder™" 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 Clearance Lights Circuit Diagram.

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

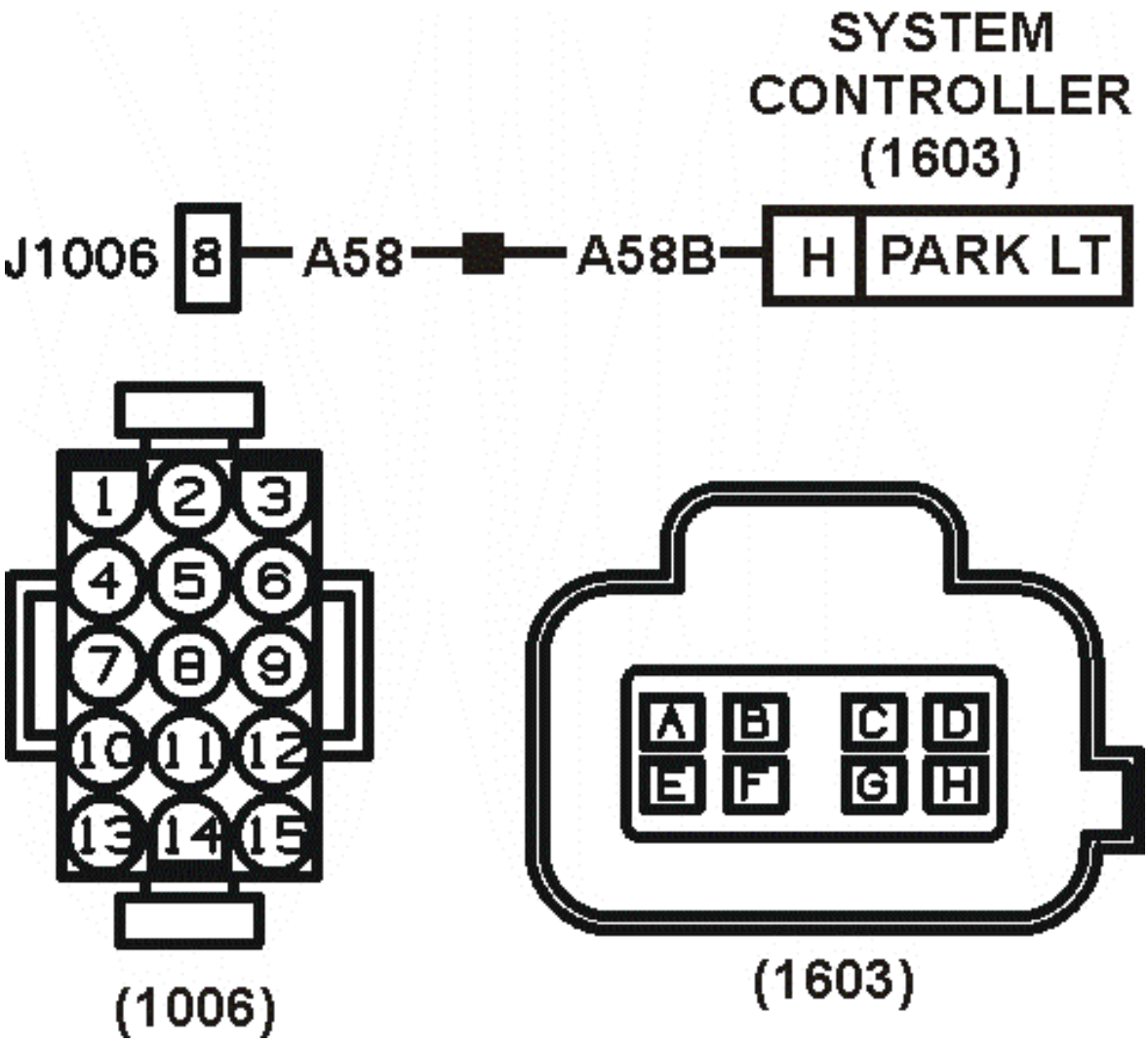

Figure 255 Clearance Lights Circuit Diagram — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED AT LEFT SIDE VEHICLE AT FLASHER PLATE
(1603) SYSTEM CONTROLLER CONNECTOR
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 163 Clearance Lights Circuit Tests

Clearance Lights Voltage Checks
Check with key switch on and park lights on.
NOTE – Always check connectors for damage and pushed–out terminals. Also check turn signal assemblies for damage or corrosion.

Table 163 Clearance Lights Circuit Tests (cont.)

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
Body builder connector (1006) pin H to ground.	12 ± 1.5 volts	If voltage is missing check for open or short in circuits A58 and A58B. Also ensure proper voltage from system controller (1603) pin H. Refer to ESC Replacement in this manual.

2.4. EXTENDED DESCRIPTION

Refer to Clearance Lights Circuit Diagram.

3. MARKER, PARK AND TAIL LAMPS

3.1. CIRCUIT FUNCTIONS

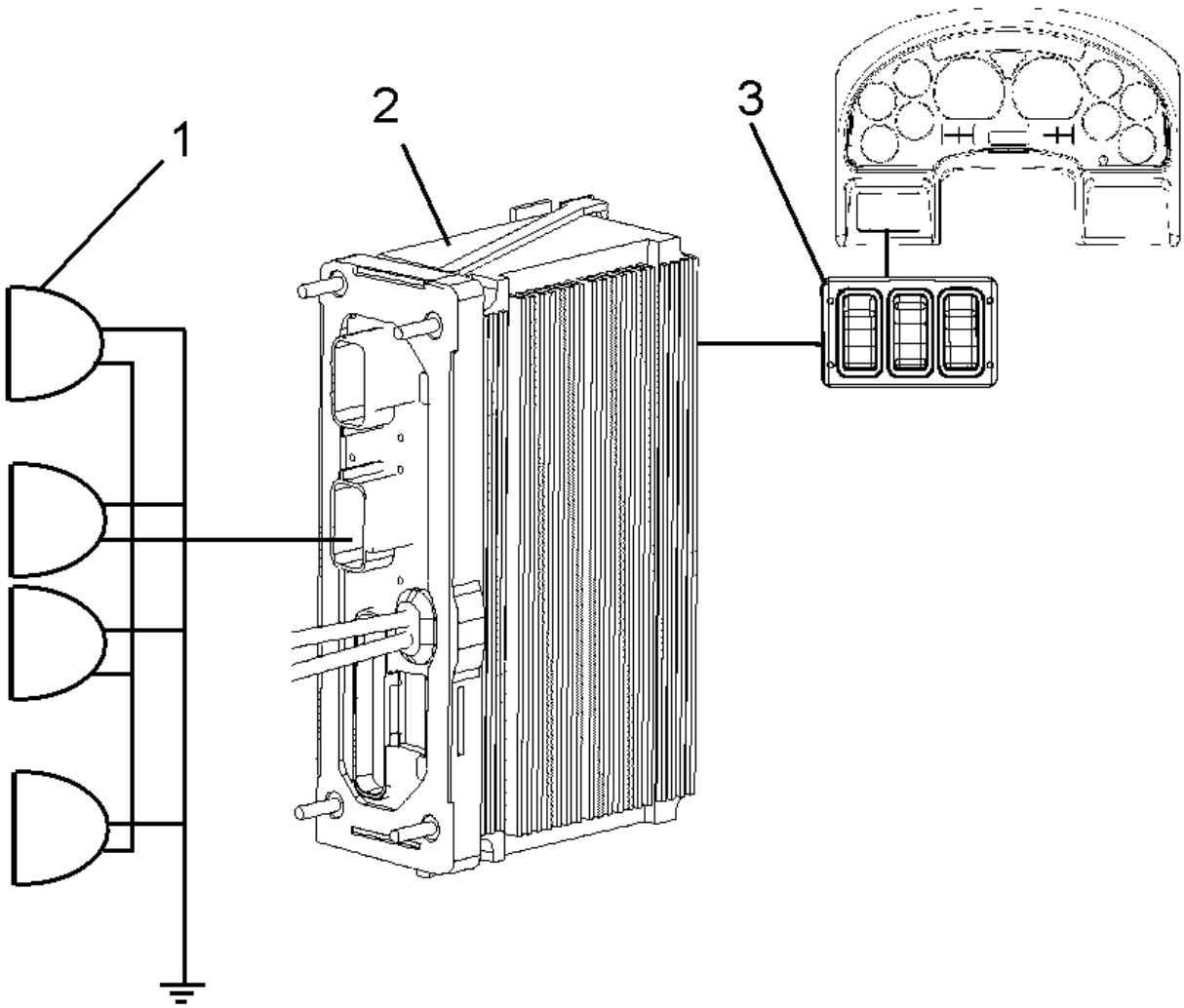

Figure 256 Marker, Park and Tail Lights

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 clearance and marker lights are directly connected to the park circuits inside the ESC. Refer to the Clearance Lights Section (See CLEARANCE LIGHTS, page 529)

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 faulty 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 "Diamond Logic Builder™" 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 164 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).
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.

Table 164 Marker, Park and Tail Lights Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
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 535)	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 536)	Go to marker, park and tail lights circuit outputs from ESC. (See MARKER, PARK AND TAIL LIGHT OUTPUTS FROM ESC, page 538)

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 165 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 faulty 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 536)	
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.	

Table 165 Marker, Park and Tail Lights (cont.)

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 CLEARANCE LIGHTS, page 529)	
611 14 4 1	Marker, park and tail lamps open circuit, 1603 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 538) for proper operation.	
611 14 4 2	Marker, park and tail lamps over current, 1603 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 538) 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 drivetrain 1939 data link section 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.

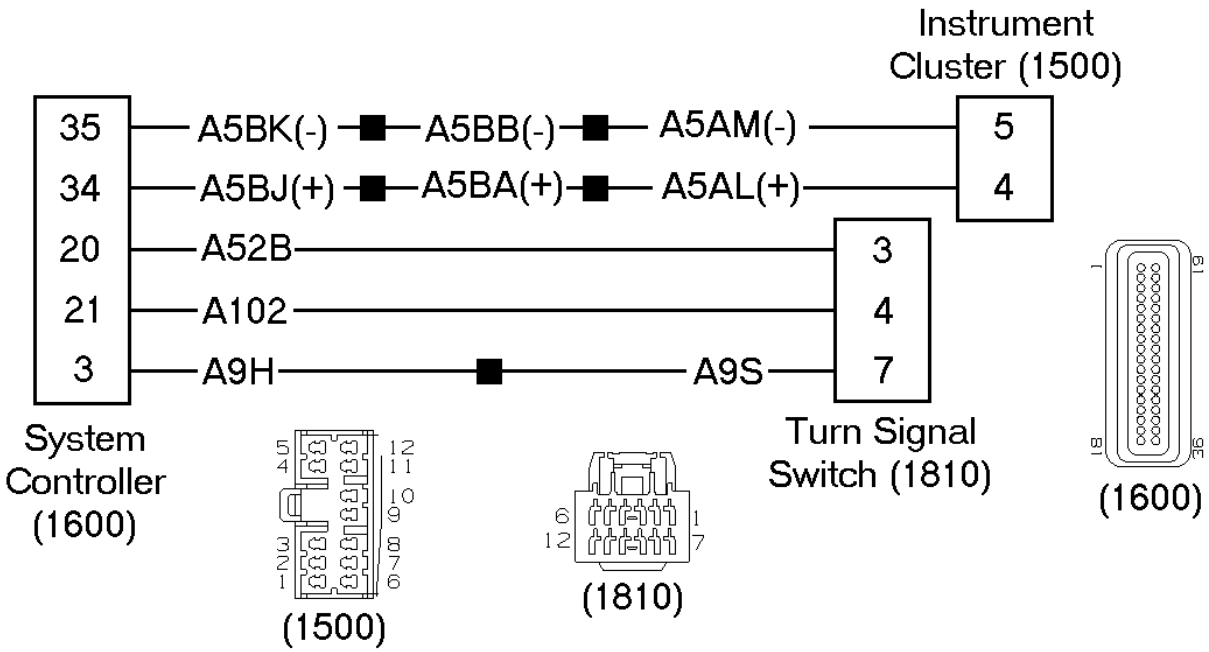

Figure 257 Park Light EGC and ESC Input Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1500) INSTRUMENT CLUSTER
LOCATED AT BACK SIDE INSTRUMENT CLUSTER
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(1810) TURN SIGNAL SWITCH
LOCATED AT STEERING COLUMN

Table 166 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 faulty 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.		
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

Table 166 EGC, 3 Switch Pack Circuit Tests (cont.)

3 switch pack harness connector, cavity 8 to ground.	5 ± 0.5 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 ± 0.5 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 do not 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.

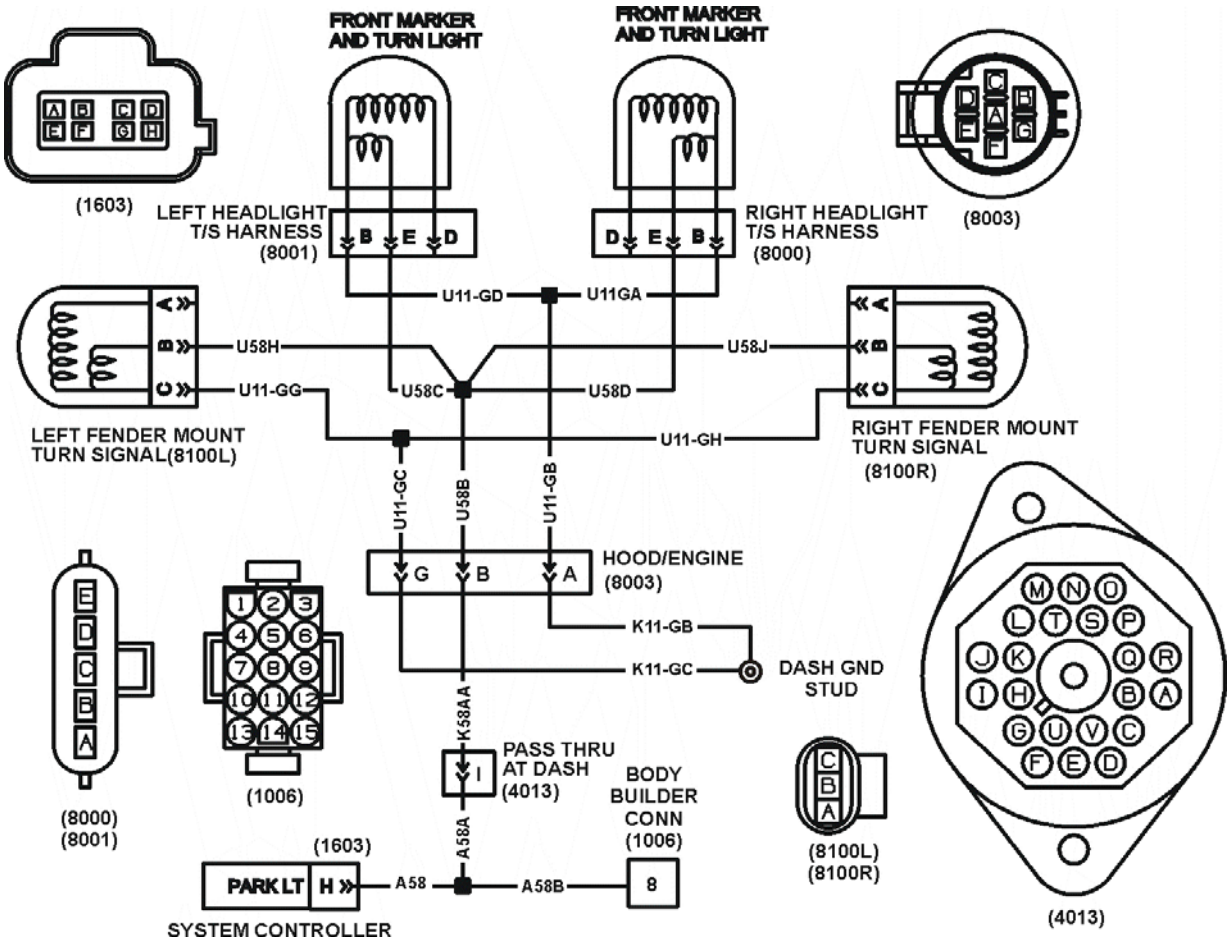

Figure 258 Marker, Park and Tail Lamps — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1603) SYSTEM CONTROLLER
LOCATED INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(8000) RIGHT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR RIGHT HEADLIGHT
(8001) LEFT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR LEFT HEADLIGHT
(8003) HOOD/ENGINE
LOCATED AT INSIDE LEFT FRAME RAIL NEAR BUMPER
(8100L) RIGHT FENDER MOUNT TURN SIGNAL
LOCATED AT HOOD ABOVE RIGHT WHEEL
(8100R) LEFT FENDER MOUNT TURN SIGNAL
LOCATED AT HOOD ABOVE LEFT WHEEL

Table 167 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 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 blue ESC connector (1603), 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.

Front Marker and Turn Light Voltage Checks

With front marker and turn light harnesses (8000) and (8001) 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.

Test Points	Spec.	Comments
(8000) cavity E 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 U58D, U58B, K58AA, A58A and A58. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)

Table 167 Marker, Park And Tail Lights Circuit Tests (cont.)

(8000) cavity E 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 or short to high in circuits U11GA, U11–GB, and K11–GB.
(8001) cavity E 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 U58C, U58B, K58AA, A58A and A58. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
(8000) cavity E 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 or short to high in circuits U11–GD, U11–GB, and K11–GB.

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 (1603) terminal H to body builder connector terminal 8.

3.5. COMPONENT LOCATIONS

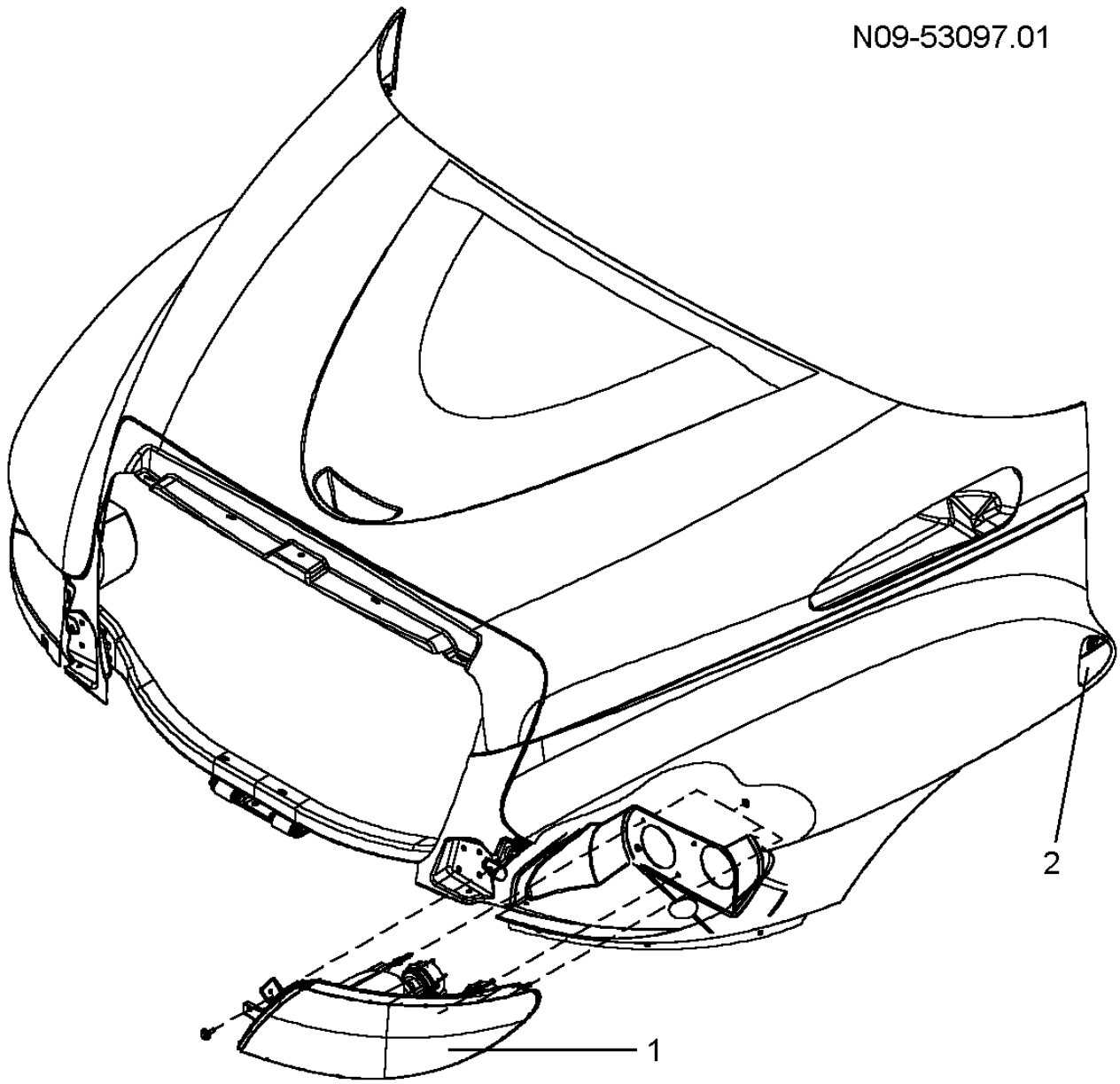

Figure 259 Headlights, Front and Side Marker Lights

1. FRONT PARK LIGHT
2. SIDE MARKER LIGHT

4. FOG LIGHT SYSTEM

4.1. CIRCUIT FUNCTIONS

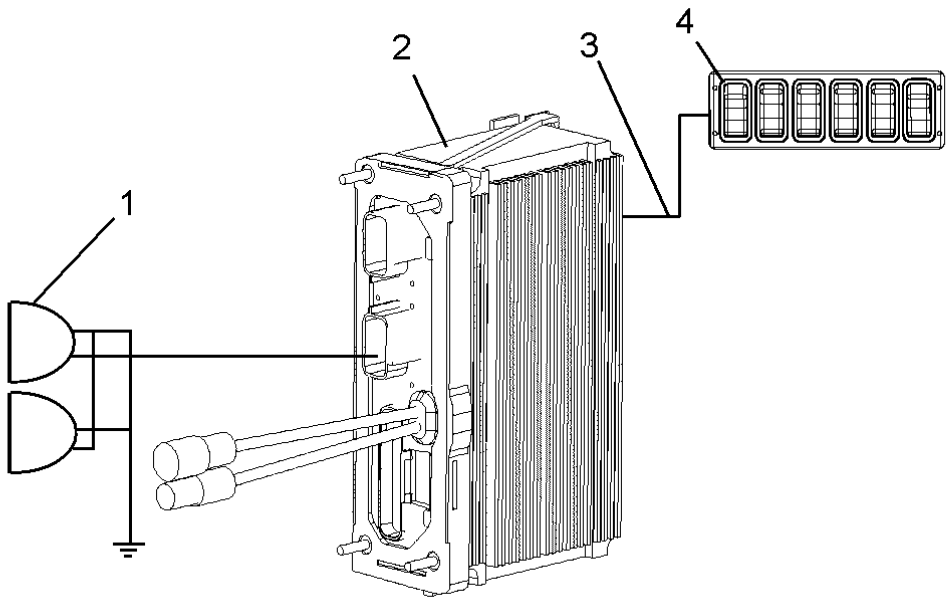

Figure 260 Fog Lights Function Diagram

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.

4.2. 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 "Diamond Logic Builder™" 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 168 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 168 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 545)	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 546)
5.		**Check for switch pack faults.** Problem may be in multiplexed switches. Check for switch diagnostic trouble codes. (See Diagnostic Trouble Codes, page 545)		No multiplexed switch diagnostic trouble codes are active.	Go to fault detection management. (See FAULT DETECTION MANAGEMENT, page 546)	

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 169 Fog Light DTC

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.	
2033 14 4 1	Fog light lamps, too much load attached.
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.	
2033 14 4 2	Fog light lamps, open circuit
This fault is the result of an open in circuits between the fog lights and the ESC. Check for burned out bulb.	
2033 14 4 0	Fog light lamps, an unexpected load is attached to this pin.
2033 14 4 3	Fog light lamps, shorted to ground.

4.3. 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 do not 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.

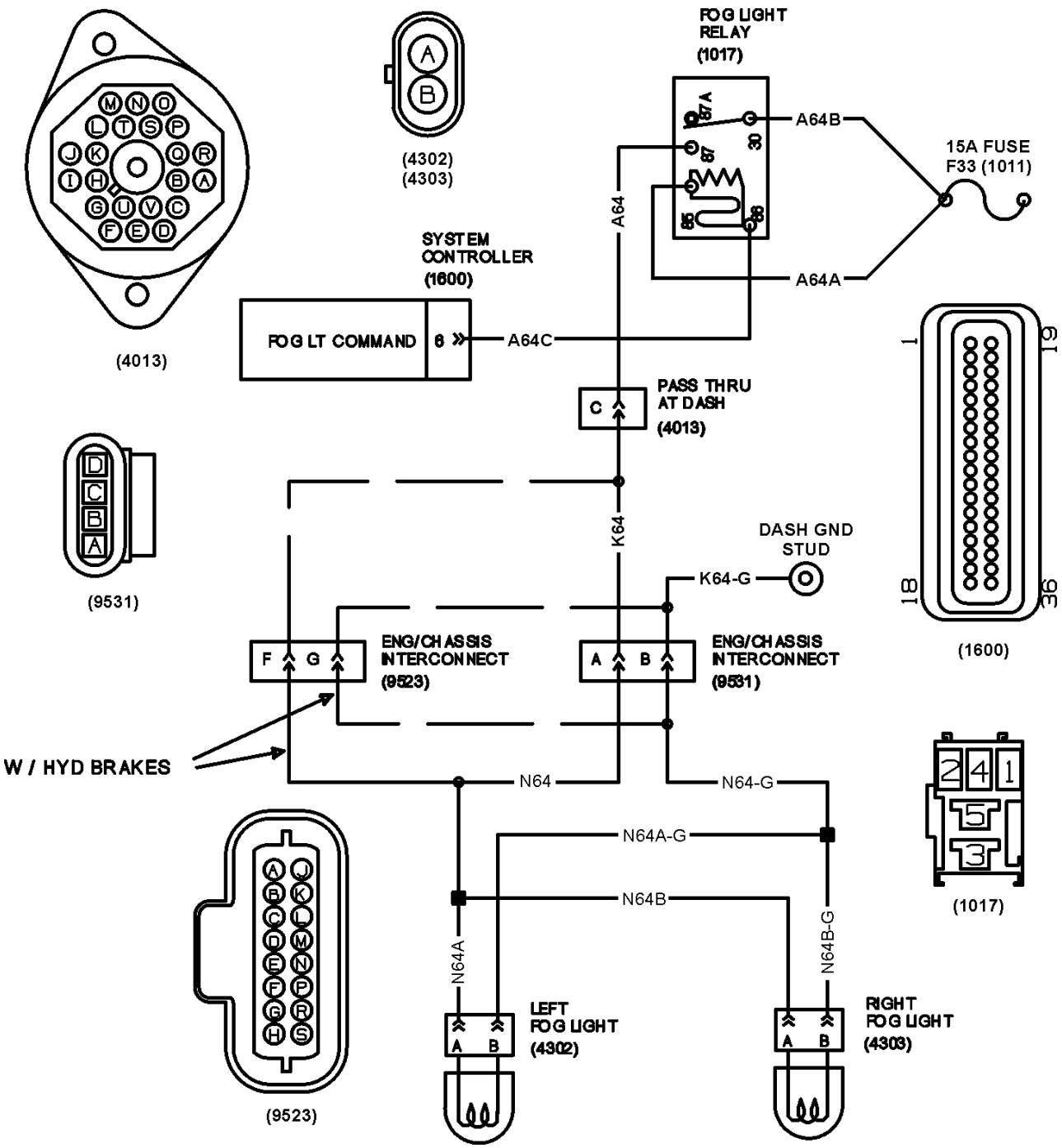

Figure 261 Fog Light Circuits From ESC — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1017) FOG LIGHT RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4302) LEFT FOG LIGHT
LOCATED AT LEFT SIDE NEAR FRONT BUMPER
(4303) RIGHT FOG LIGHT
LOCATED AT RIGHT SIDE NEAR FRONT BUMPER
(9523) (9531) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

Table 170 Fog Lights Circuit Tests

FAULTS	
2033 14 4 0	Fog light lamps, an unexpected load is attached to this pin.
2033 14 4 1	Fog light lamps, too much load attached.
2033 14 4 2	Fog light lamps, open circuit.
2033 14 4 3	Fog light lamps, shorted to ground.

Fog Light Relay (1017) Voltage Checks

Check with ignition on, headlights on, low beams selected, fog light switch on, and fog light relay (1017) removed.

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.

Remove fog light relay (1017) and bench test. If relay fails bench test, replace and check for faults.

Test Points	Spec.	Comments
Cavity 86 to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F33 and check for short or open in circuit A64A.
Cavity 86 to 85.	12 ± 1.5 volts	If voltage is missing check for short or open in circuit A64C. Also check system controller connector (1600) pin 6 for ground signal. If ground signal missing, system controller may need reprogrammed or replaced. Refer to ESC Replacement in this manual.

Table 170 Fog Lights Circuit Tests (cont.)

Cavity 30 to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F33 and check for short or open in circuit A64B.
Fog Light Connector (4302) Voltage Checks Check with ignition on, headlights on, low beams selected, fog light relay (1017) installed and fog light switch on. **NOTE – Always check connectors for damage and pushed–out terminals.** **NOTE – 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
Left fog light connector (4302) 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 N64A, N64, K64, and A64.
Left fog light connector (4302) 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 or short to high in circuits N64A-G, N64–G, and K64–G.
Fog Light Connector (4303) Voltage Checks Check with ignition on, headlights on, low beams selected, fog light relay (1017) installed and fog light switch on. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Right fog light connector (4303) 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 missing, check for open or short to ground in circuits N64B, N64, K64, and A64.
Right fog light connector (4303) 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.**	If voltage is missing, check for short to high in circuits N64B-G, N64–G, and K64–G.

Table 170 Fog Lights Circuit Tests (cont.)

	12 ± 1.5 volts	

4.4. 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 a ground to the fog light relay (1017) cavity 85. Current will then flow from fuse F33 charging the relay. With the relay activated current will flow to the foglights through the pass thru at dash (4013), engine/chassis interconnect (9531) or (9523), to the foglight connectors (4302) and (4303).

Ground for the fog lights is supplied from the dash ground stud on circuits K64–G, engine/chassis interconnect (9531) or (9523) and N64–G. From N64–G the circuits are split on N64A–G to left fog light connector (4302) terminal B and N64B–G to right fog light connector (4303) terminal B.

4.5. COMPONENT LOCATIONS

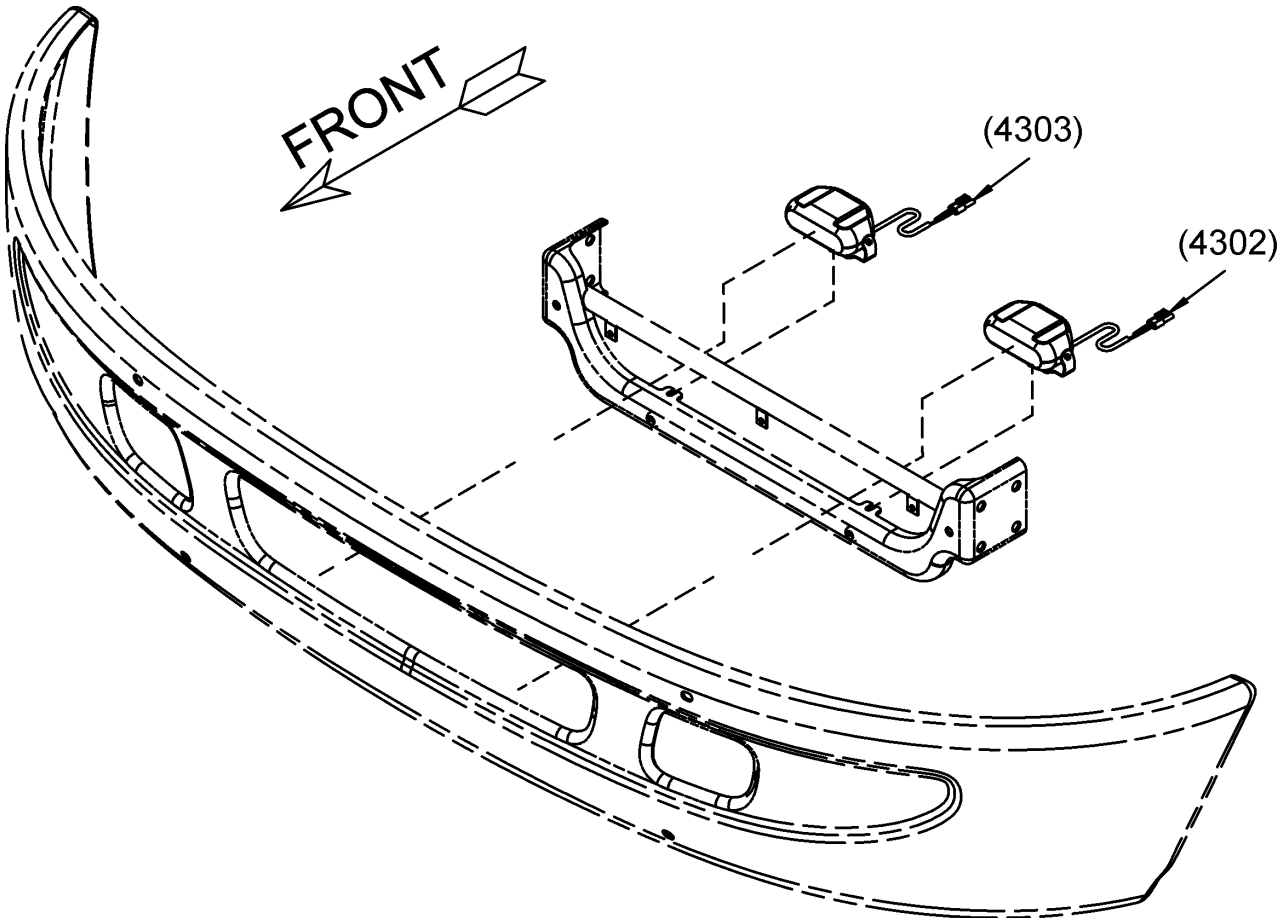

Figure 262 Fog Light Wiring

(4302) LEFT FOG LIGHT CONNECTOR
(4303) RIGHT FOG LIGHT CONNECTOR

5. HEADLIGHT SYSTEM

5.1. CIRCUIT FUNCTIONS

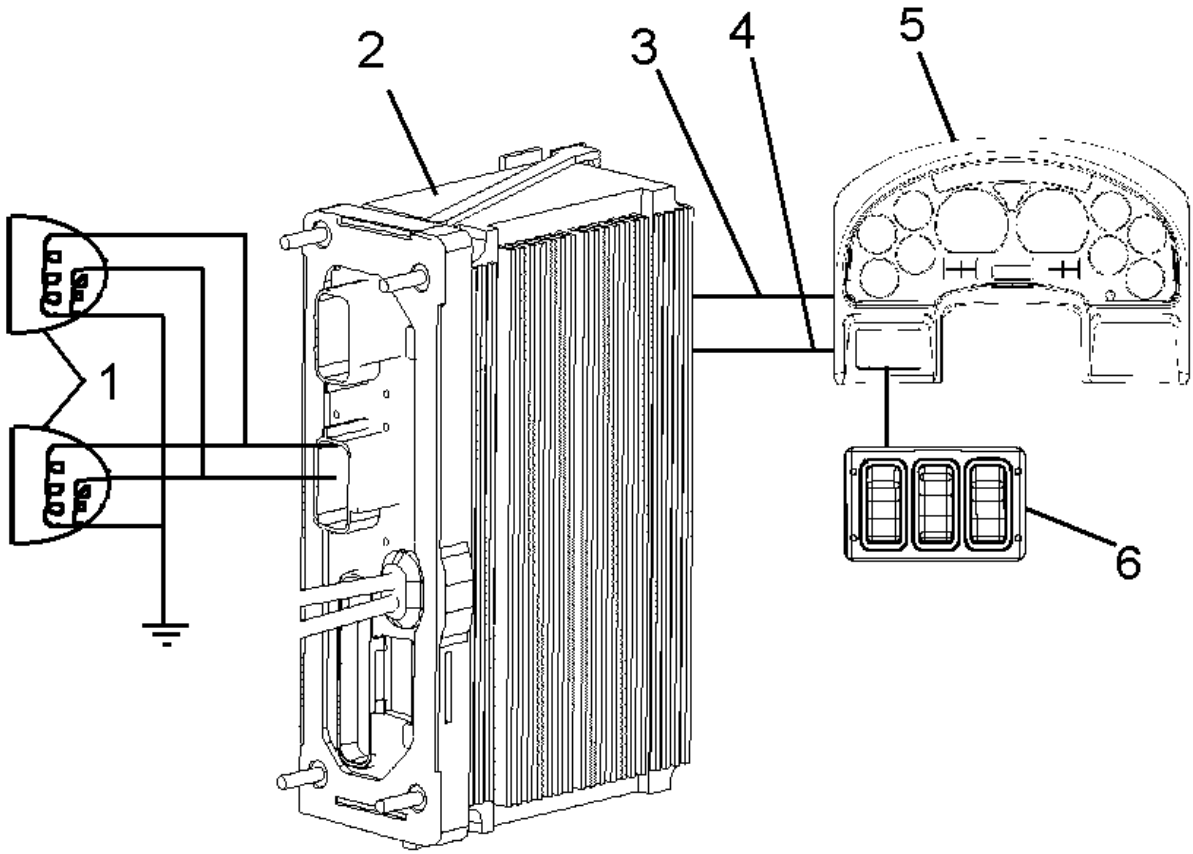

Figure 263 Headlights Function Diagram

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)

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.

5.2. 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 "Diamond Logic Builder™" 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 171 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 554)	Read display on odometer.	Headlight diagnostic codes are present.	Go to headlight outputs from ESC (See HEADLIGHT OUTPUTS FROM ESC, page 559)	Go to Headlight circuit inputs to ESC (See HEADLIGHT CIRCUIT INPUTS TO ESC, page 555)

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 172 Headlight DTC

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

5.3. 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 do not 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.

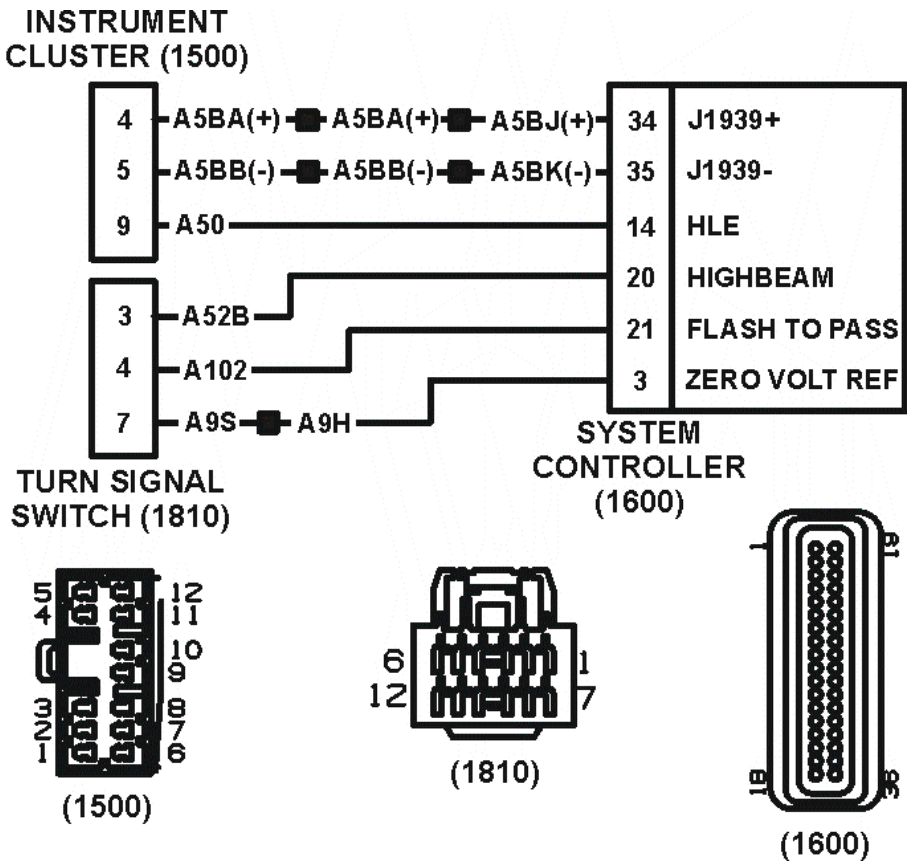

Figure 264 Headlight Circuit Inputs to ESC — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1500) INSTRUMENT CLUSTER
LOCATED AT BACK SIDE INSTRUMENT PANEL
(1600) SYSTEM CONTROLLER
LOCATED INSIDE RIGHT SIDE DASH PANEL
(1810) TURN SIGNAL SWITCH
LOCATED AT STEERING COLUMN

Table 173 Headlight Switch Inputs to ESC Circuit Tests

THERE ARE NO DIAGNOSTIC TROUBLE CODES ASSOCIATED WITH THESE CIRCUITS
A mechanically faulty 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.

Table 173 Headlight Switch Inputs to ESC Circuit Tests (cont.)

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). **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Headlight switch “on”, ESC connector (1600) 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.** 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 – 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 173 Headlight Switch Inputs to ESC Circuit Tests (cont.)

3 Switch Pack Headlight Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
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.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
(1810) Cavity 3 to ground. Headlight/highbeam switch input.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit A52B. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
(1810) Cavity 4 to ground. Flash to pass switch input.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit A102. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
(1810) Cavity 7 to ground. Zero volt reference.	<1 volt	If voltage is seen, check circuits A9S and A9H for shorts to high. Also insure proper zero volt reference signal out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Turn Signal Switch (1810) Resistance Checks Check with (1810) removed Checks dimmer and flash to pass switches in turn signal assembly. **NOTE – Always check connectors for damage and pushed–out terminals.**		

Table 173 Headlight Switch Inputs to ESC Circuit Tests (cont.)

(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 A52B. 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 A9S and circuit A9H 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 A102. 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, circuits A9S and A9H 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.

5.4. 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 do not 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.

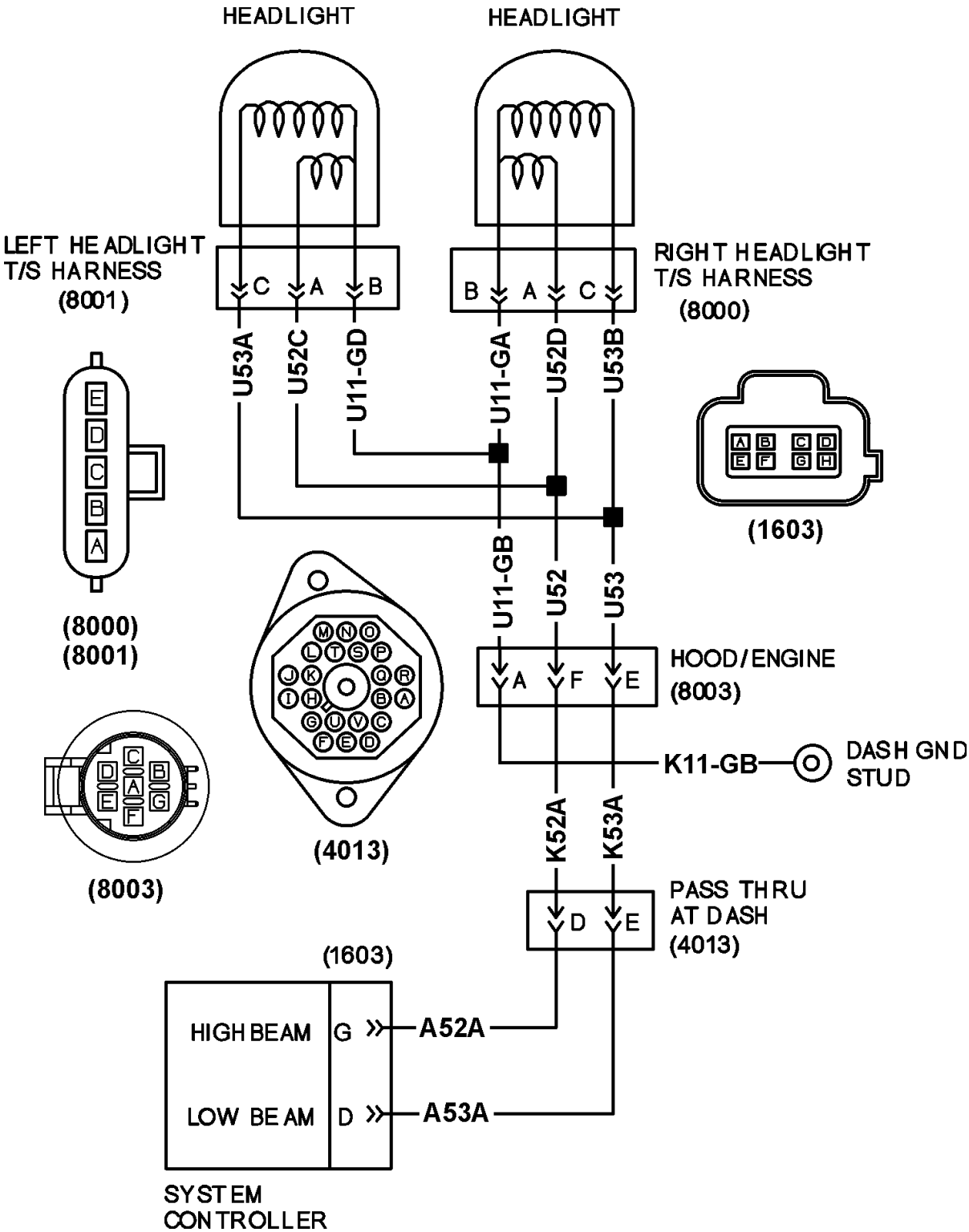

Figure 265 Circuits From ESC to Headlights — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1603) SYSTEM CONTROLLER
LOCATED INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(8000) RIGHT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR RIGHT HEADLIGHT
(8001) LEFT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR LEFT HEADLIGHT
(8003) HOOD/ENGINE
LOCATED AT INSIDE LEFT FRAME RAIL NEAR BUMPER

Table 174 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. **NOTE – With sealed beam headlamps 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.** **NOTE – Always check connectors for damage and pushed–out terminals.**	
Test Points	Spec.	Comments

Table 174 ESC Low Beam Outputs to Headlight Circuit Tests (cont.)

Headlights in low beam. Left headlight (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 U53A, U53, K53A or A53A. If no open or shorts are found check for voltage out of EGC.
Headlights in low beam. Left headlight (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 or short to high in circuits U11–GD, U11–GB, and K11–GB.

Table 175 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.	
Right Headlight Connector (8000) Voltage Checks Check with key in ignition position, headlight switch on, high beams selected and connector (8000) disconnected. **NOTE – With sealed beam headlamps 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.** **NOTE – Always check connectors for damage and pushed–out terminals.**	
Test Points	Spec.	Comments

Table 175 ESC High Beam Outputs to Headlight Circuit Tests (cont.)

Headlights in low beam. Right headlight (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 or short in circuits U53B, U53, K53A and A53A. If no open or shorts are found check for voltage out of EGC.
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 or short to high in circuits U11GA, U11–GB and K11–GB.

Extended Description

Refer to Circuits From ESC to Headlights.

When low beams are requested, the EGC will send a signal on the 1939 data link and the headlight enable circuit to the ESC. The ESC will supply 12 volts to system controller connector (1603) terminal D, circuit A53A, pass thru at dash (4013) terminal E, circuit K53A, hood/engine (8003) terminal E, and circuit U53. From there the circuit is split on U53A to left headlight connector (8001) terminal C and U53B to right headlight connector (8000) terminal C.

When high beams are requested, the EGC will send a signal on the 1939 data link. The ESC will supply 12 volts to system controller front connector (1603) terminal G, circuit A52A, pass thru at dash (4013) terminal D, circuit K52A, hood/engine connector terminal F, and circuit U52. From there the circuit is split on U52C to left headlight connector (8001) terminal A and U52D to right headlight connector (8000) terminal A.

Ground for the headlights is supplied from the dash ground stud (4037) on circuits K11–GB, hood/engine connector (8003) terminal A and circuit U11–GB. From there the circuit is split on U11–GD to left headlight connector (8001) terminal B and U11–GA to right headlight connector (8000) terminal B.

5.5. COMPONENT LOCATIONS

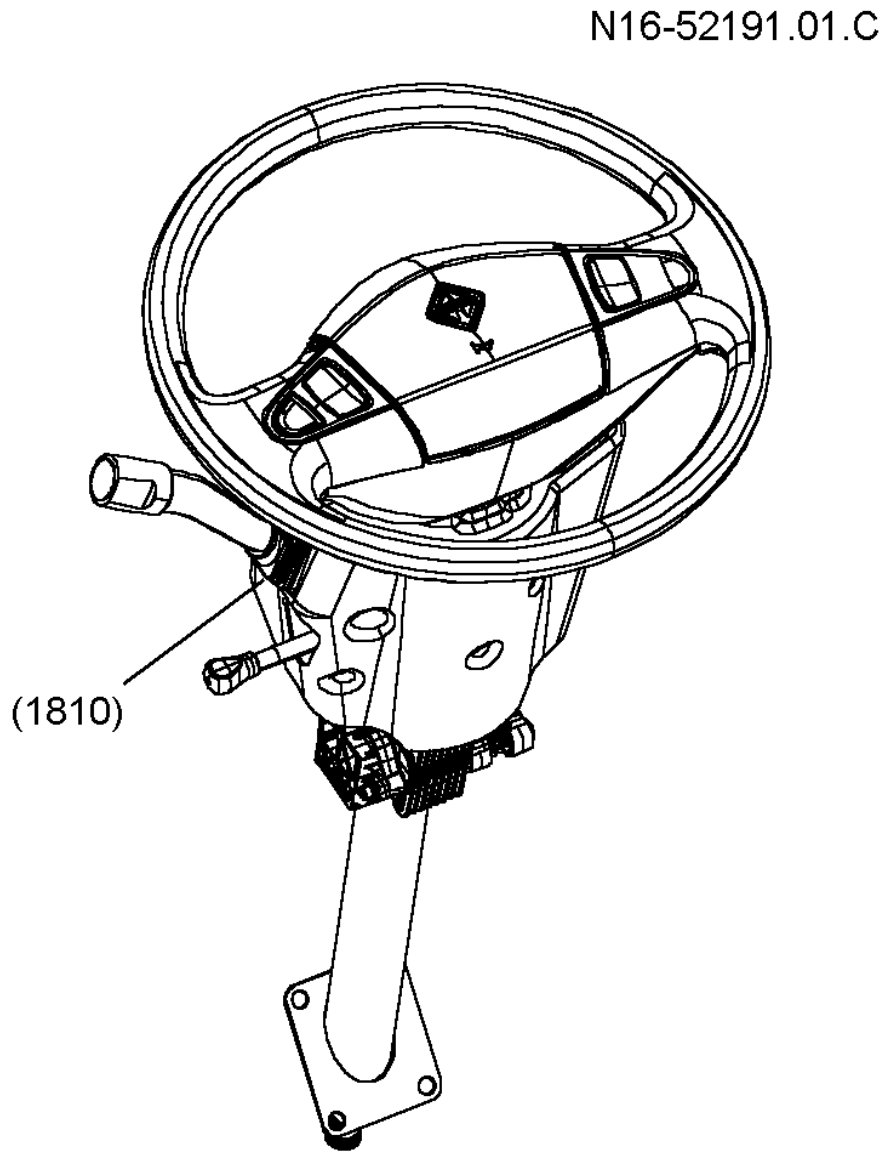

Figure 266 Turn Signal Assembly

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

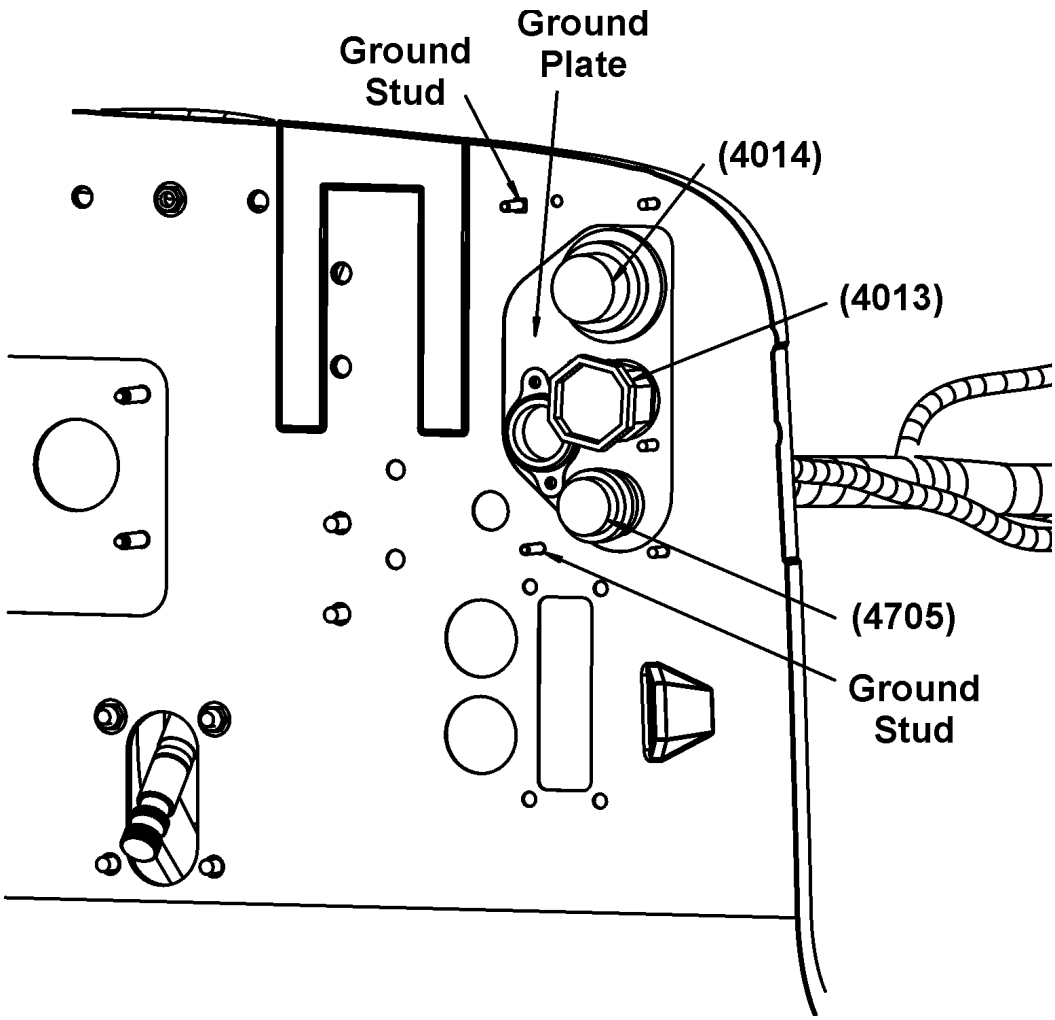

Figure 267 Headlight Connector Locations (Dash Panel From Engine Compartment)

(4013) PASS THRU AT DASH
(4014) DASH/ENGINE PASS THRU
(4705) PASS THRU AT DASH

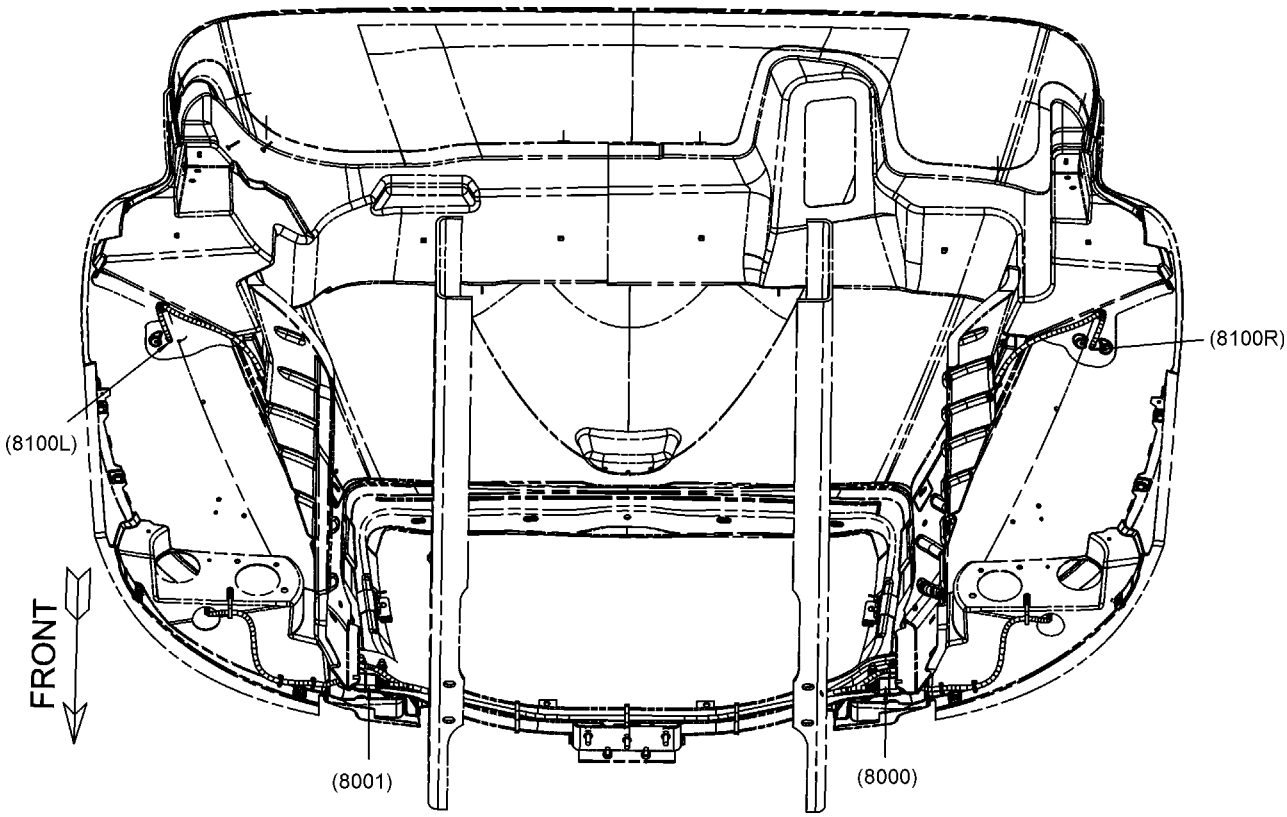

Figure 268 Headlight Wiring

(8000) RIGHT HEADLIGHT CONNECTOR
(8001) LEFT HEADLIGHT CONNECTOR
(8100L) LEFT FENDER MOUNT TURN SIGNAL
(8100R) RIGHT FENDER MOUNT TURN SIGNAL

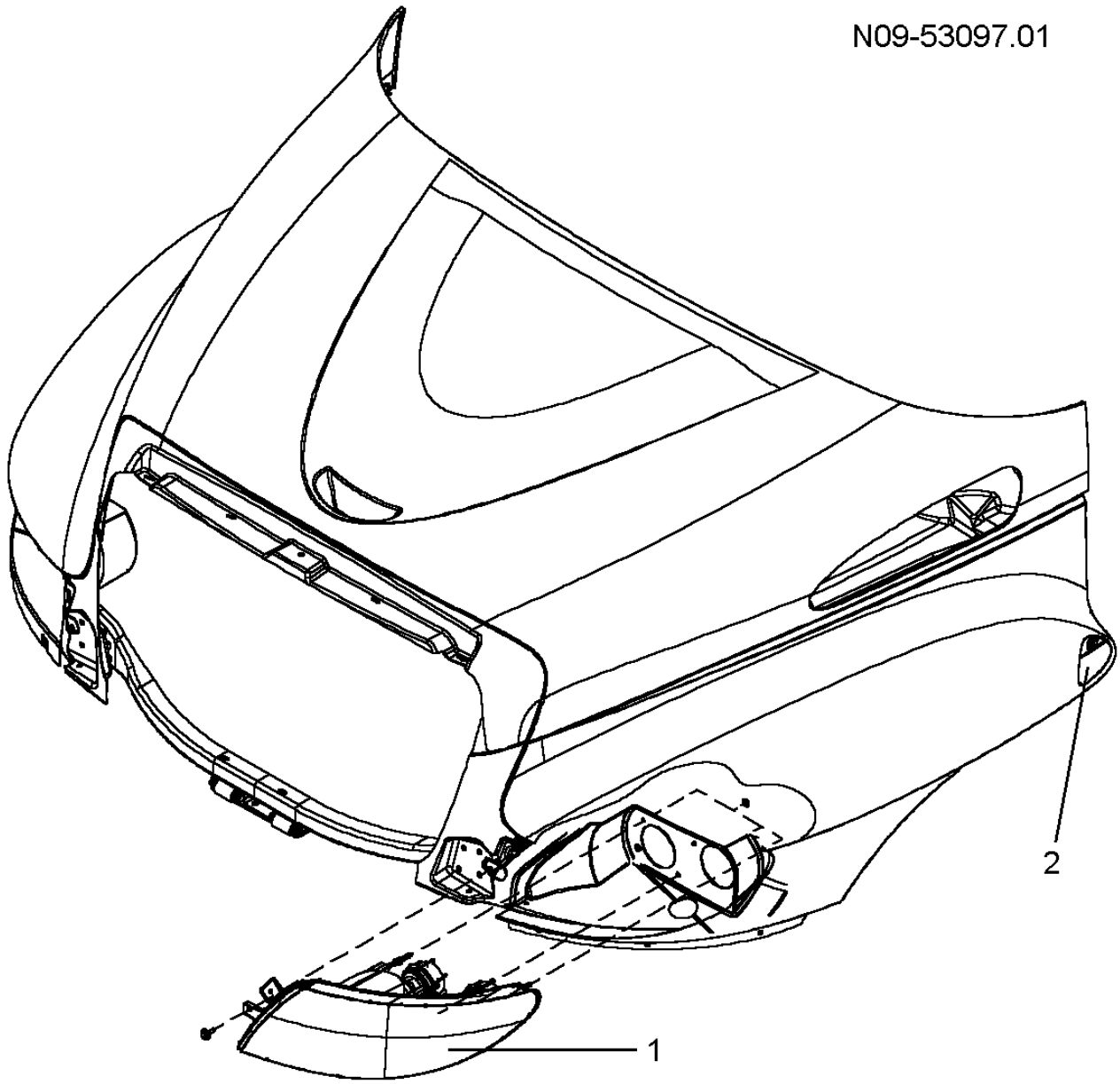

Figure 269 Headlights, Front and Side Marker Lights

1. HEADLIGHT ASSEMBLY
2. SIDE MARKER LIGHT

6. PANEL LIGHTS

6.1. CIRCUIT FUNCTIONS

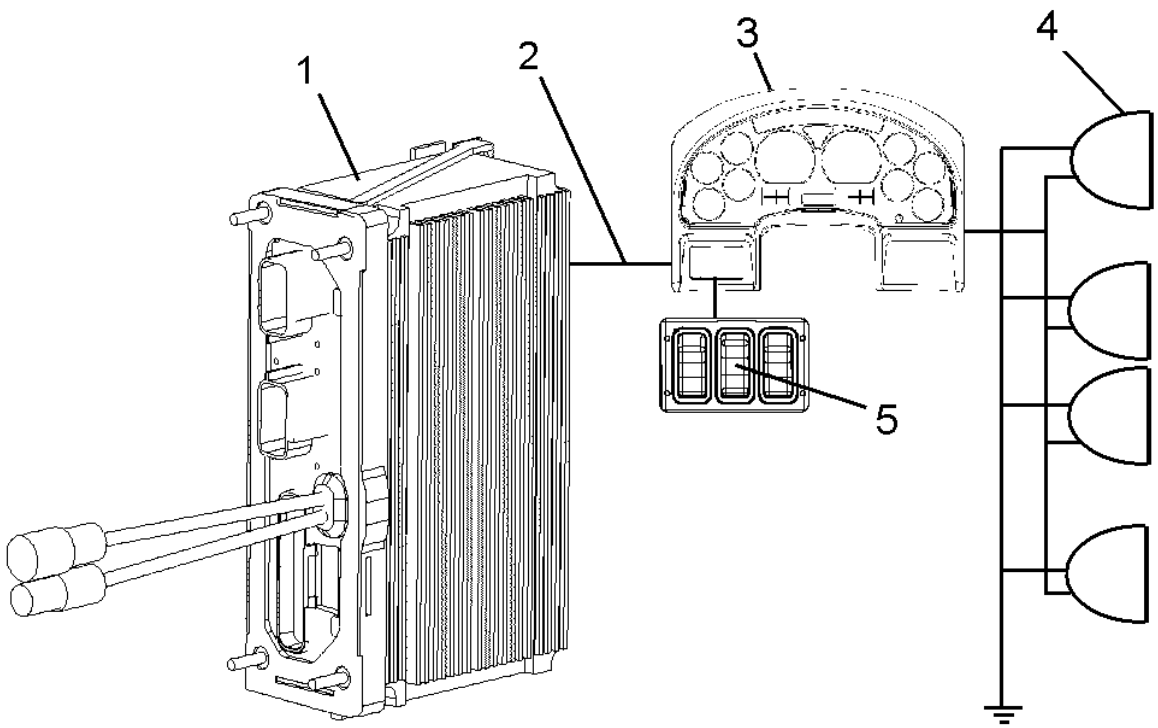

Figure 270 Panel Lights Function Diagram

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

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, heater control, etc.

6.2. 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.

An electronic service tool, running the "Diamond Logic Builder™" 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 176 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 572)
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 569).

Diagnostic Trouble Codes

Table 177 Panel Light Circuits Diagnostic Trouble Codes

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

6.3. 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.

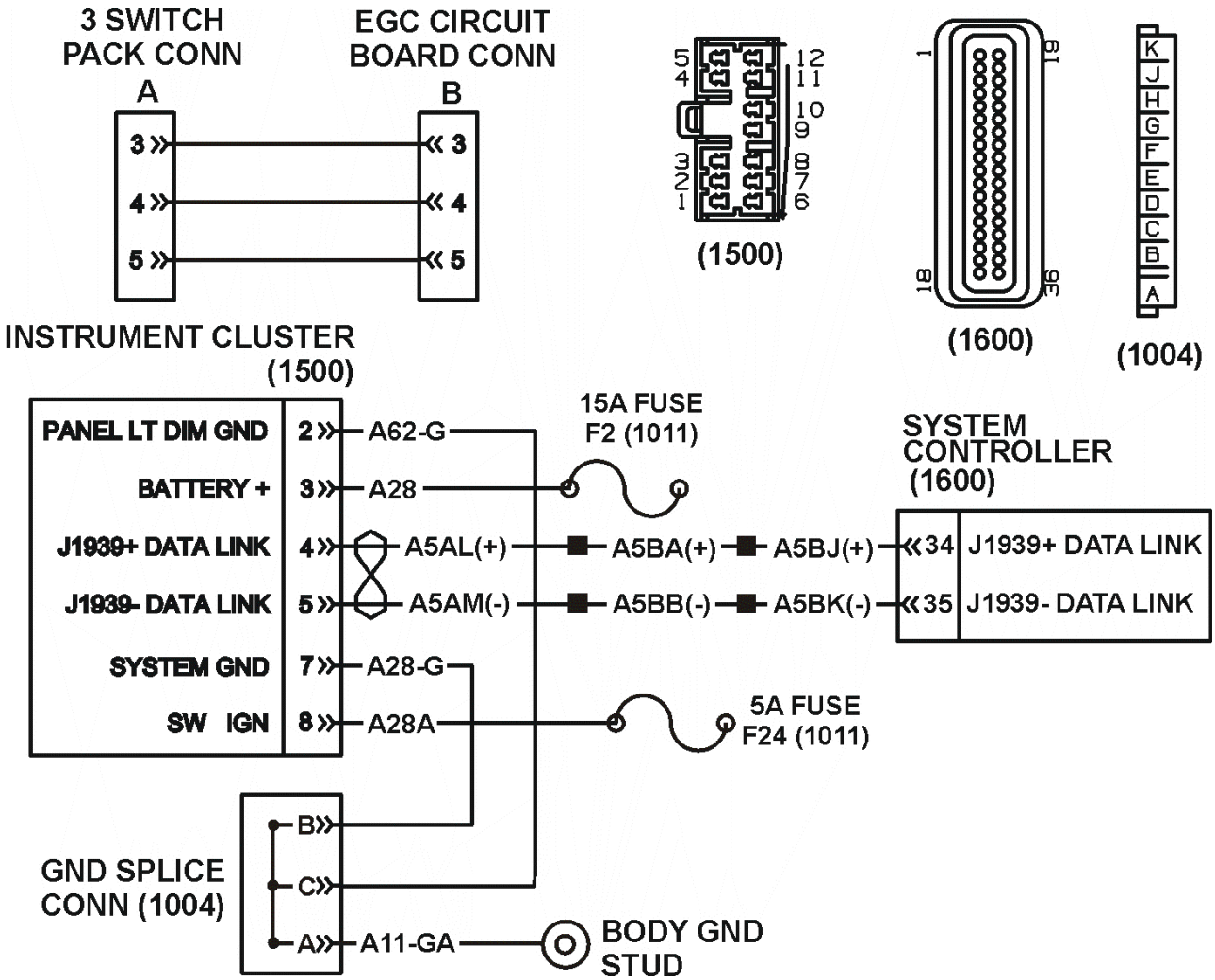

Figure 271 Panel Light EGC Input Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

A. 3 SWITCH PACK CONNECTOR
B. EGC CIRCUIT BOARD CONNECTOR
(1004) GROUND SPLICE CONNECTION
LOCATED RIGHT SIDE INSTRUMENT PANEL
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1500) EGC CONNECTOR
LOCATED BEHIND CLUSTER
(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 178 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 faulty 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.

Table 178 EGC, 3 Switch Pack Circuit Tests (cont.)

Instrument Cluster (1500) Voltage Checks Check with ignition key on, 3 switch pack connected and instrument cluster (1500) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Instrument cluster connector (1500) cavity 8 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F24. Also check for open or short in circuit A28A.
Instrument cluster connector (1500) cavity 3 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F2. Also check for open or short in circuit A28.
Instrument cluster connector (1500) cavity 3 to cavity 2.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits A62–G and A11–GA.
Instrument cluster connector (1500) cavity 3 to cavity 7.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits A28–G and A11–GA. If voltages check good and panel lights still fail, replace instrument cluster.

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.

6.4. 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 do not 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.

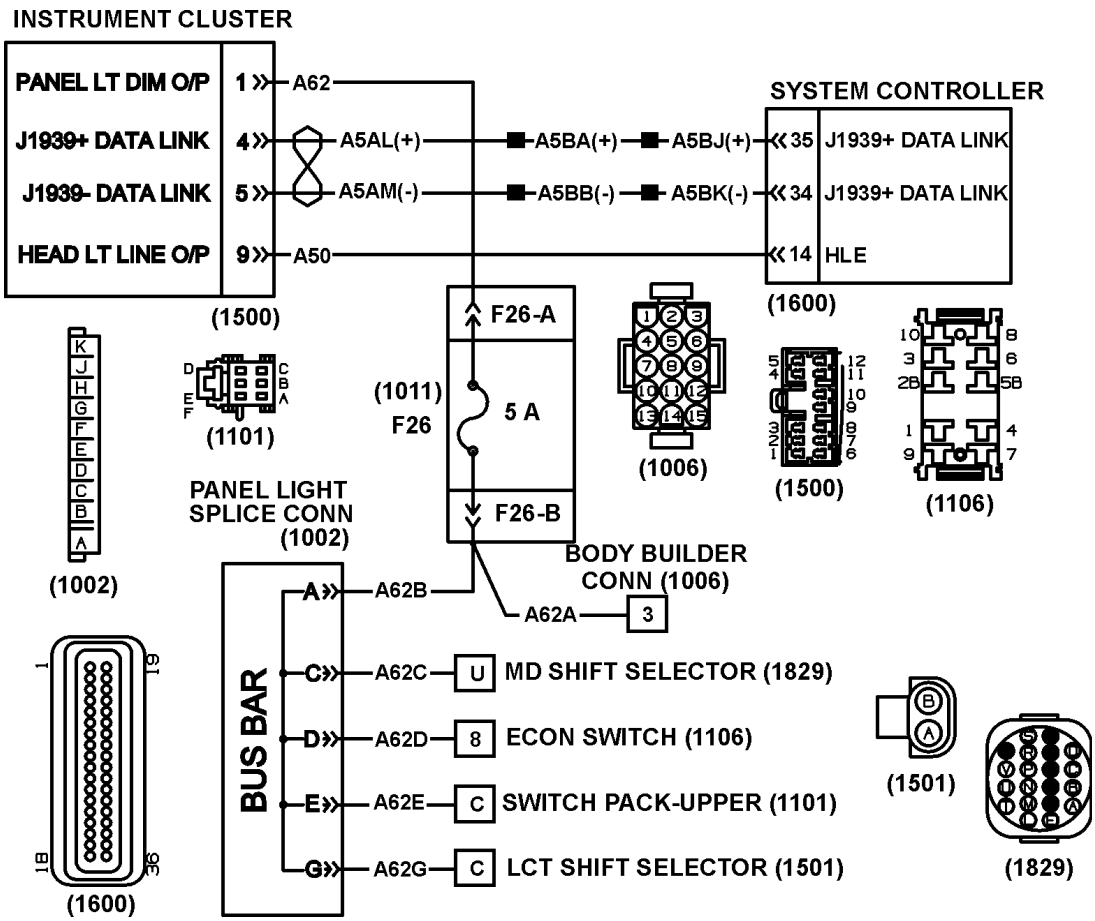

Figure 272 Panel Light Outputs from EGC — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1002) PANEL LIGHT SPLICE CONNECTOR
LOCATED LEFT SIDE INSTRUMENT PANEL
(1006) BODY BUILDER CONNECTOR
LOCATED AT LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) CAB FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1101) SWITCH PACK, UPPER ADDRESS
LOCATED AT INSTRUMENT WING PANEL
(1106) ECON SWITCH
LOCATED AT INSTRUMENT CLUSTER
(1500) INSTRUMENT CLUSTER
LOCATED AT BACK SIDE INSTRUMENT CLUSTER
(1501) SHIFT CONTROL CONNECTION
LOCATED AT INSTRUMENT WING PANEL
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(1829) MD TRANSMISSION PRIMARY SHIFT SELECTOR
LOCATED AT INSTRUMENT WING PANEL

Table 179 Panel Light Circuit Tests

Diagnostic Trouble Codes	
No Diagnostic Trouble Codes	There are no diagnostic trouble codes for panel light circuits.
Panel Light Buss Bar (1002) Voltage Checks Check with ignition key on, park lights on and buss bar cover removed. **NOTE – If the fuse is blown check for shorts on circuit A62 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 circuits A62 and A62B. Insure fuse F26 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 through fuse F26. 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.

6.5. COMPONENT LOCATIONS

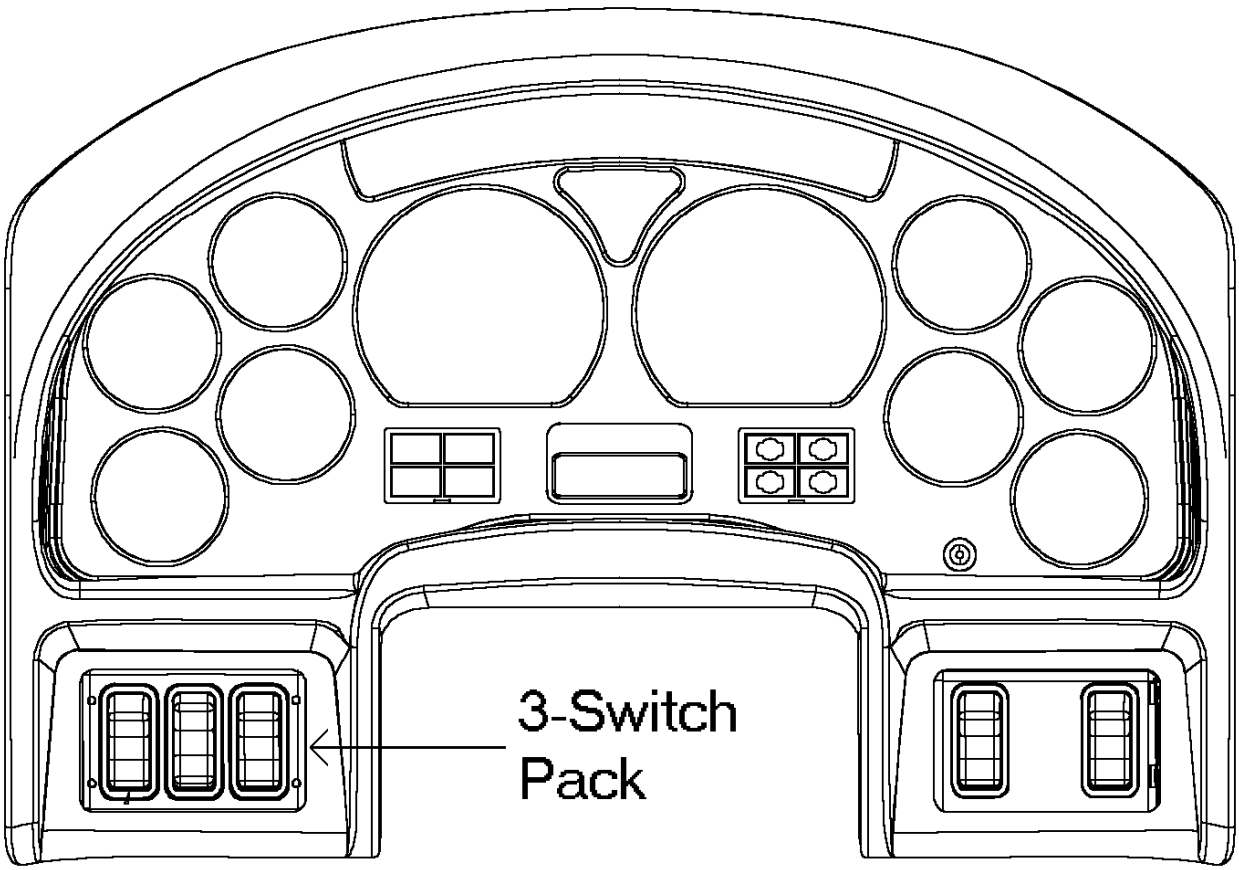

Figure 273 Instrument Cluster

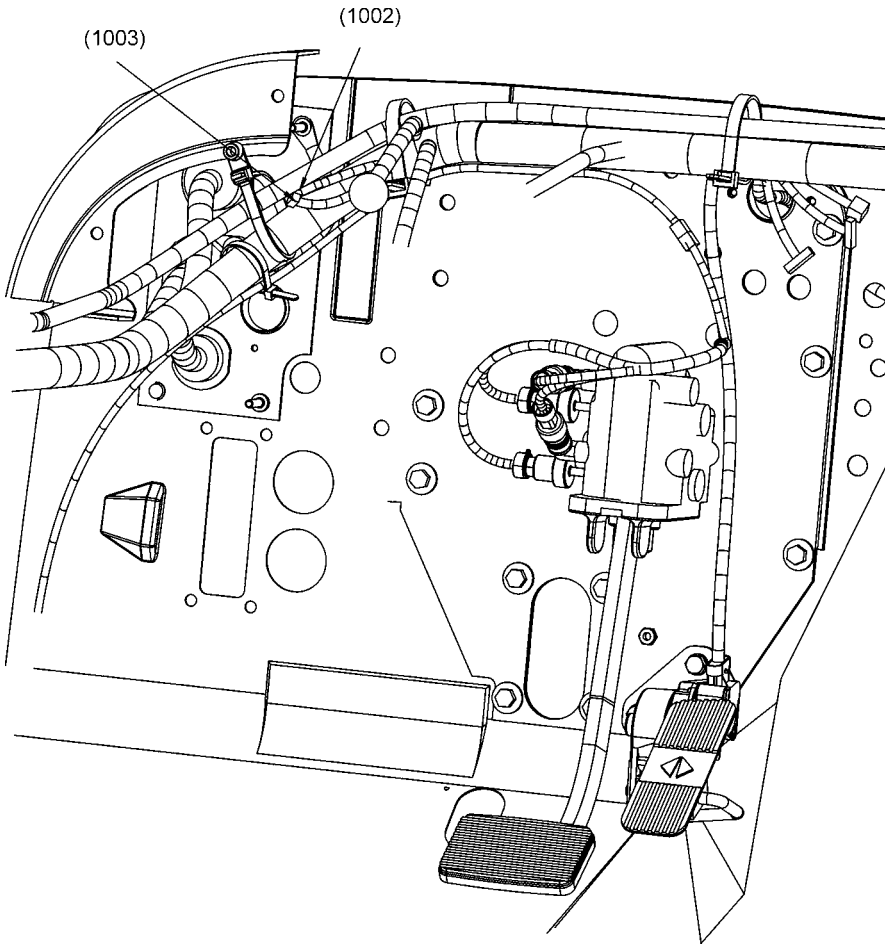

Figure 274 Panel Dimmer Wiring

(1002) PANEL LIGHT SPLICE CONNECTION
(1003) GROUND SPLICE CONNECTION

7. STOP/TURN SIGNAL/HAZARD LIGHTS

7.1. CIRCUIT FUNCTIONS

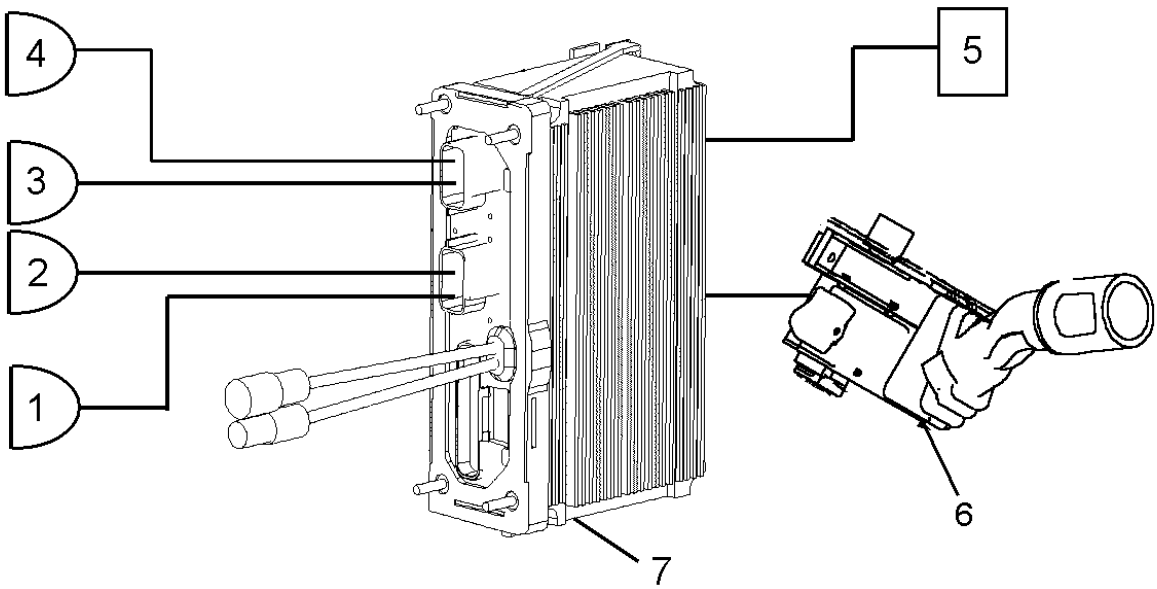

Figure 275 Stop/Turn Signal/Hazard Light Function Diagram

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. 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.

7.2. 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, faulty 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 "Diamond Logic Builder™" 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 180 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).
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.

Table 180 Turn/Hazard Signal And Stop Light (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
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 inoperative.	All turn/hazard signal and stop 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 579)	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 582)	Go to next step.	Follow directions in the turn/hazard signal and stop light diagnostic trouble code table. (See Table 182, page 583)

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 181 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.	

Table 181 Turn/Hazard Signal And Stop Light (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
If hazard flashers do not work, but the turn signals do, the turn signal/hazard switch is faulty. If hazard flashers do work, but the turn signals do not, the turn signal/hazard switch is faulty.	
If hazard flashers and turn signals do not 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 582) 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 faulty. Inspect hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 585) or air brake switch(See AIR BRAKE SWITCH INPUTS TO ESC, page 587) 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 592) 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 592) 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
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

Table 181 Turn/Hazard Signal And Stop Light (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
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 592) 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 592) 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 TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 599) 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 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
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 TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 599) for proper operation.	

Table 181 Turn/Hazard Signal And Stop Light (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
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 TURN SIGNAL/HAZARD LIGHT OUTPUTS FROM ESC, page 599) 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 585) or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 587) 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 585) or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 587) for proper operation. Also check wiring harness.	

7.3. 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.

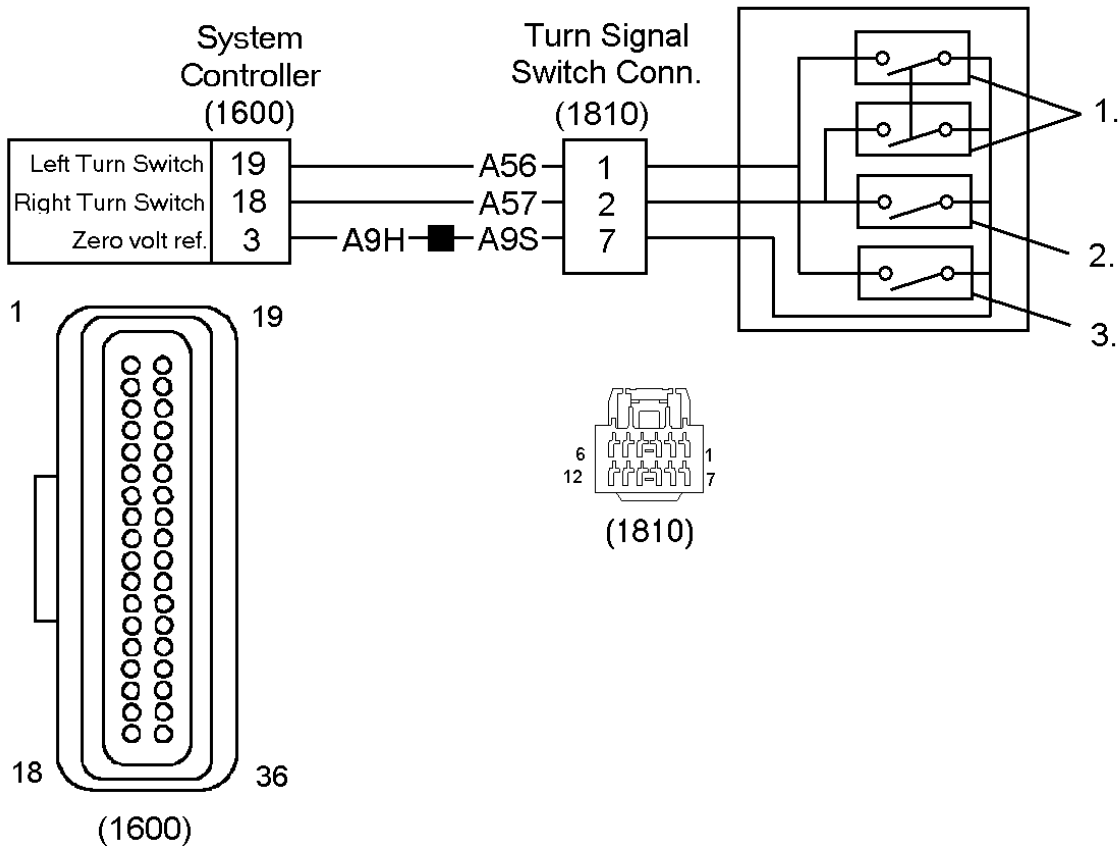

Figure 276 Turn Signal/Hazard Light Inputs to ESC — Always Refer to Circuit Diagram Book for Latest Circuit Information

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

(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(1810) TURN SIGNAL SWITCH
LOCATED AT STEERING COLUMN

Table 182 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 182 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 circuit A56. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Harness connector (1810), cavity 2 to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit A57. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
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 A9S, or A9H or incorrect zero volt reference signal from the ESC.
Turn Signal Switch Resistance Checks Check with switch disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
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 182 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.

7.4. 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.

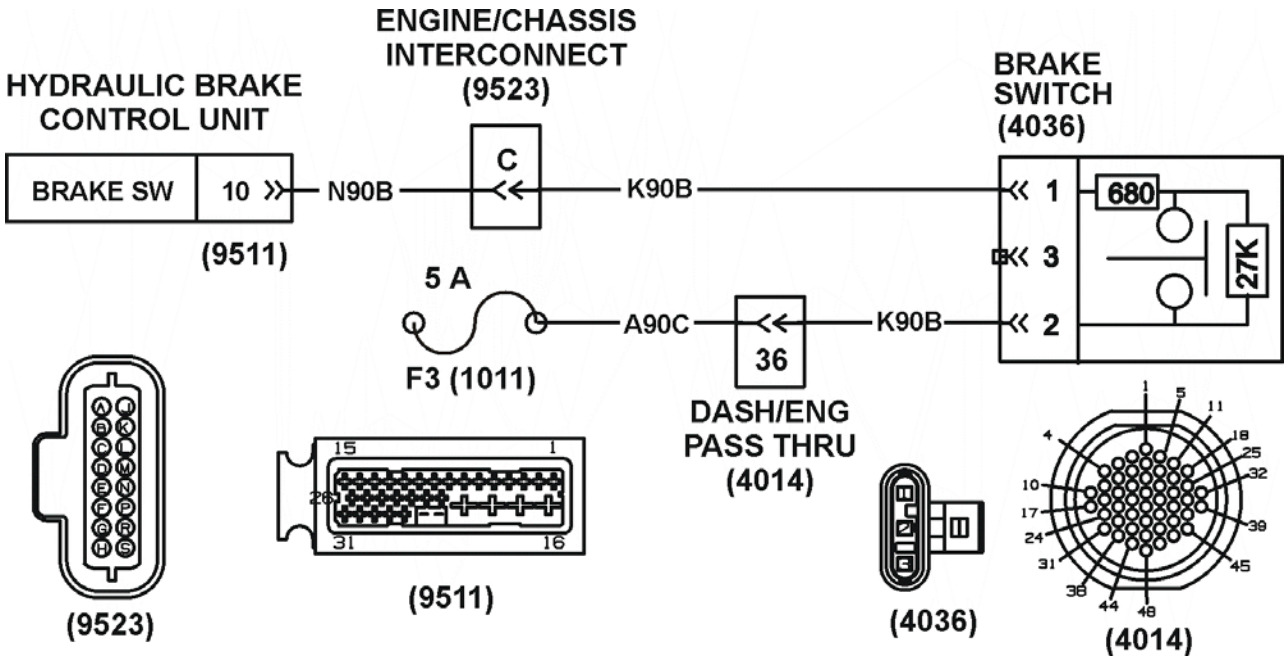

Figure 277 Hydraulic Brake Switch Inputs to ESC — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4036) HYDRAULIC BRAKE SWITCH
LOCATED AT HYDRAULIC MASTER CYLINDER
(9511) HYDRAULIC BRAKE CONTROL UNIT — HCU
LOCATED AT INSIDE LEFT FRAME RAIL AT HCU
(9523) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

Table 183 Hydraulic Brake Stop/Turn Signal/Hazard Light 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
Brake Switch Harness Connector (4036) 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.**	

Table 183 Hydraulic Brake Stop/Turn Signal/Hazard Light Input Check Chart (cont.)

Test Points	Spec.	Comments
Harness connector (4036), cavity 2 to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits K90C or A90C. Also insure 5 amp fuse F3 is not blown.
Harness connector (4036), cavity 2 to .	12 ± 1.5 volts	If voltage is incorrect check for open or short on circuits K90B and N90B.
Brake Switch Resistance Checks Check with switch disconnected, negative probe of meter connected to pin B and positive probe connected to pin A. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Brake switch (4036), pin B to pin A.	With stop light switch closed resistance should be approximately 680 ohms	Switch has a small resistor in series with contacts. If resistance is incorrect, replace the switch.
Brake switch (4036), pin B to pin A.	With stop light switch open resistance should be approximately 27K ohms	Switch has a large resistor in parallel with the switch contacts.

Extended Description

Refer to Hydraulic Brake Switch Inputs to ESC.

When the key is in the ignition position 12 volts from battery fuse F3 will be applied to the brake switch (4036) at pin 2. When the brake switch is closed (brake pedal pressed), the 12 volt signal is applied to the hydraulic brake control unit (9511) at pin 10 through the engine/chassis interconnect (9523) pin C.

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 hydraulic brake control unit will sense that the brake is applied. The hydraulic brake control unit and the ESC communicate over the J1939 data link.

7.5. 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.

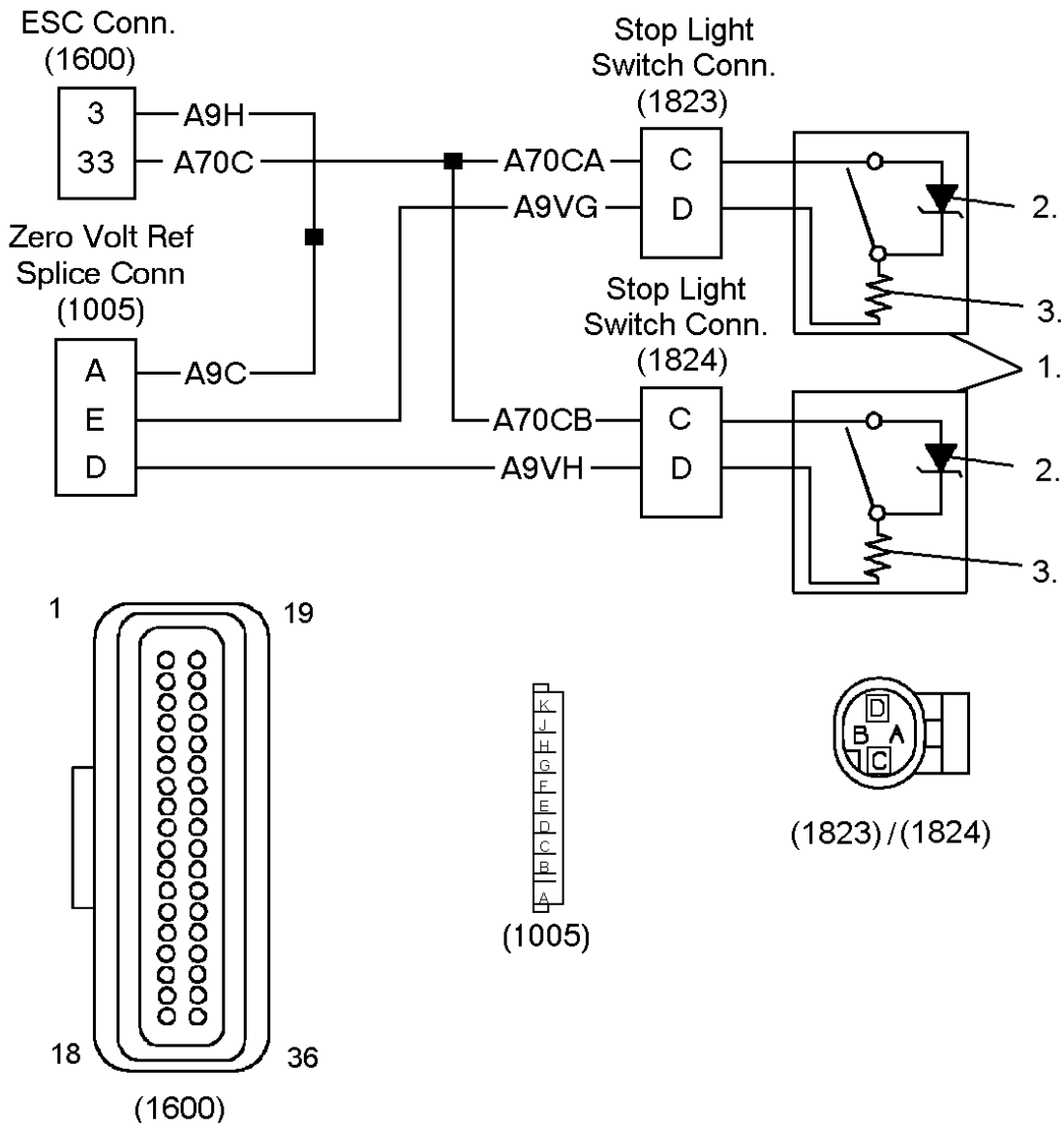

Figure 278 Brake Switch Inputs to ESC With Air Brakes — Always Refer to the Circuit Diagram Book for Latest Circuit Information

1. AIR BRAKE SWITCH(ES) (1823)/(1824)
   LOCATED TO LEFT OF LOWER STEERING COLUMN
2. ZENER DIODE
3. 150 OHM RESISTOR

(1005) ZERO VOLT REFERENCE SPLICE CONNECTION
LOCATED RIGHT SIDE INSTRUMENT PANEL

(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

(1823) AIR BRAKE STOP LIGHT #1 SWITCH
LOCATED NEAR BRAKE PEDAL

(1824) AIR BRAKE STOP LIGHT #2 SWITCH
LOCATED NEAR BRAKE PEDAL

Table 184 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 C to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A70CA, or A70A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Harness connector (1823) cavity D 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 C to cavity D.	12 ± 1.5 volts	If voltage is incorrect, check for open in zero volt reference signal circuits A9VG, A9C 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 184 Air Brake Switch Input Check Chart (cont.)

Harness connector (1824) cavity C to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits A70CB, or A70C. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Harness connector (1824) cavity D 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 C to cavity D.	12 ± 1.5 volts	If voltage is incorrect, check for open in zero volt reference signal circuits A9VH, A9C 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. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Pin D to pin C.	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 D to pin C.	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 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 D and brake switch 2 (1824) terminal D, from ESC connector (1600) terminal 3, through the zero volt reference splice connector (1005).

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

7.6. 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.

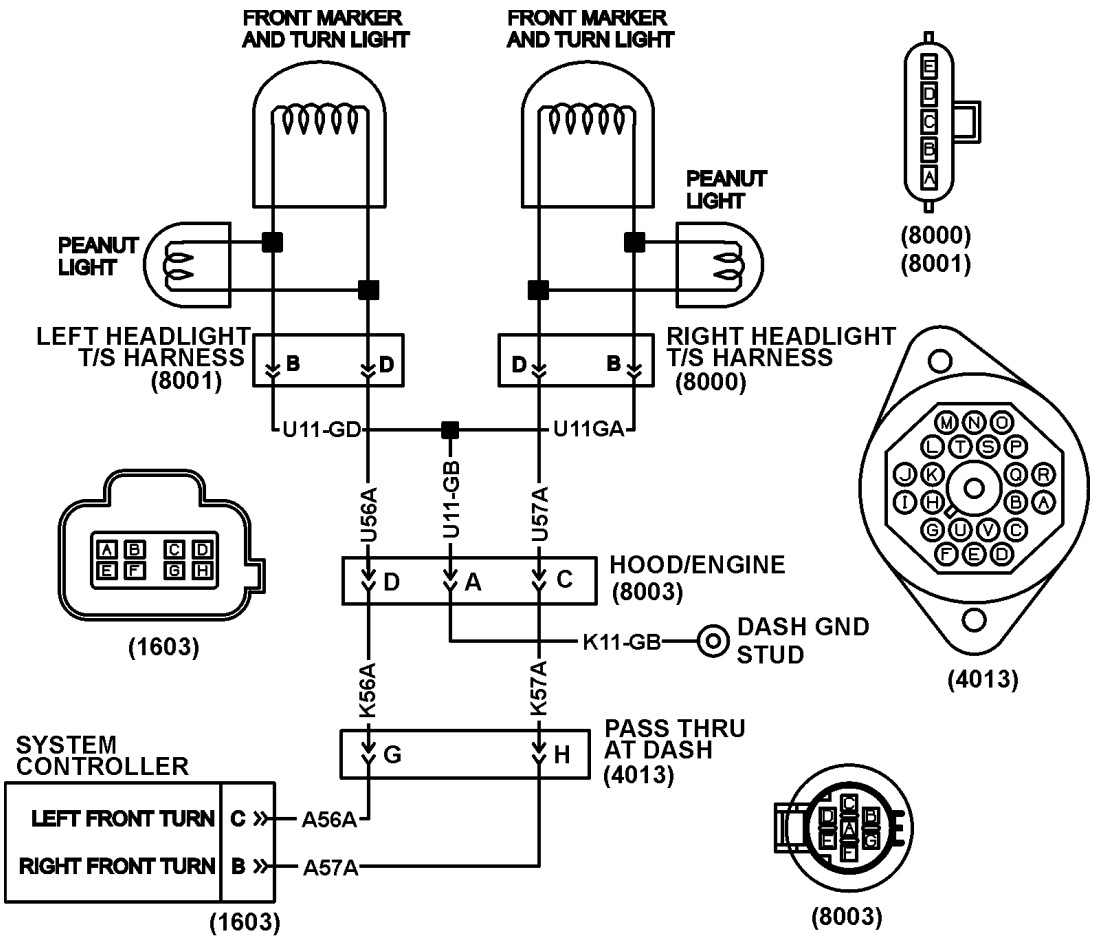

Figure 279 Front Turn Signal/Hazard Light outputs from ESC — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1603) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(8000) RIGHT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR RIGHT HEADLIGHT
(8001) LEFT HEADLIGHT AND TURN SIGNAL
LOCATED AT HOOD NEAR LEFT HEADLIGHT
(8003) HOOD/ENGINE
LOCATED AT INSIDE LEFT FRAME RAIL NEAR BUMPER

Table 185 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

Table 185 Front Turn Signal/Hazard Light Connector Check Chart (cont.)

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 (1603). 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 U57B, U57A, K57A, and A57A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Right turn signal connector (8000), pin D to B.	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short to high in circuits U11–GA, U11–GB, and K11–GB. If circuit check is good and the light is still failing, replace headlight assembly.

Diagnostic Trouble Codes

611 14 15 3	Left front turn lamps, less than normal low current but more than open circuit

Table 185 Front Turn Signal/Hazard Light Connector Check Chart (cont.)

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.

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 (1603). 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

Left Front Turn Signal/Hazard Light Voltage Checks

Check with hazard flashers on and left 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.

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

Test Points	Spec.	Comments
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 U56B, U56A, K56A and A56A. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Left turn signal connector (8001), pin D to B.	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short to high in circuits U11–GD, U11–GB, and K11–GB. If circuits test good and light is still failing, replace headlight assembly.

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 (1603) terminal B.

Ground for the light is supplied from ground stud (4037) 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 (1603) terminal C to left headlight turn signal harness connector (8001) terminal D.

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

7.7. REAR STOP 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 Light Outputs From ESC.

When the brake light 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 brake or turn signal is activated.

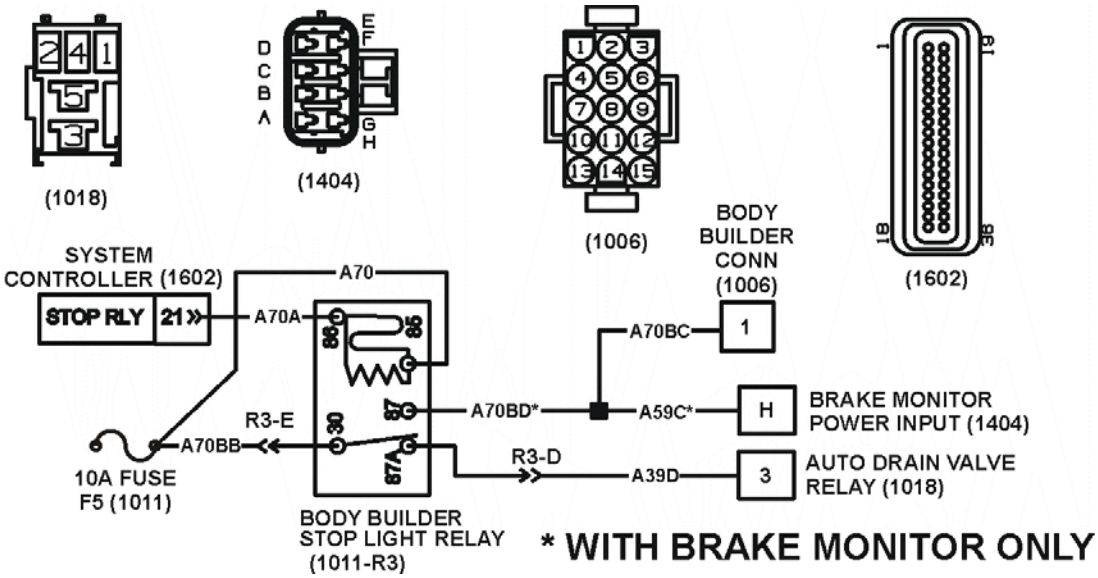

Figure 280 Rear Stop Light Outputs From ESC — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1018) AUTO DRAIN VALVE RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1404) BRAKE MONITOR MODULE POWER INPUT
LOCATED AT INSIDE MIDDLE DASH PANEL
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 186 Rear Stop Light Connector Check Chart

Diagnostic Trouble Codes	
2033 14 9 1	Connector #1602 Pin #21 Stop Relay output overloaded
2033 14 9 2	Connector #1602 Pin #21 Stop Relay output open circuit
2033 14 9 3	Connector #1602 Pin #21 Stop Relay output shorted to ground

Body Builder Stop Light Relay (1011–R3) Voltage Checks

Check with brake pedal depressed and body builder stop light relay (1011–R3) removed.

Bench test relay. If relay fails bench test, replace and check for faults.

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
(1011–R3) cavity 30 to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F5 and check for open or short to ground in circuit A70BB.
(1011–R3) cavity 85 to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F5 and check for open or short to ground in circuit A70.
(1011–R3) cavity 85 to cavity 86.	12 ± 1.5 volts	If voltage is missing check for open or short to high in circuit A70A. Also ensure proper ground signal from ESC connector #1602 pin 21. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)

Extended Description

Refer to Rear Stop Light Outputs From ESC.

Voltage for the rear stop lights is supplied from fuse F5 through the body builder stop light relay (1001–R3) pin 87 to pin a of body builder connector (1006).

7.8. REAR 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 Turn Signal/Hazard Light Outputs From ESC.

When the left or right rear 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.

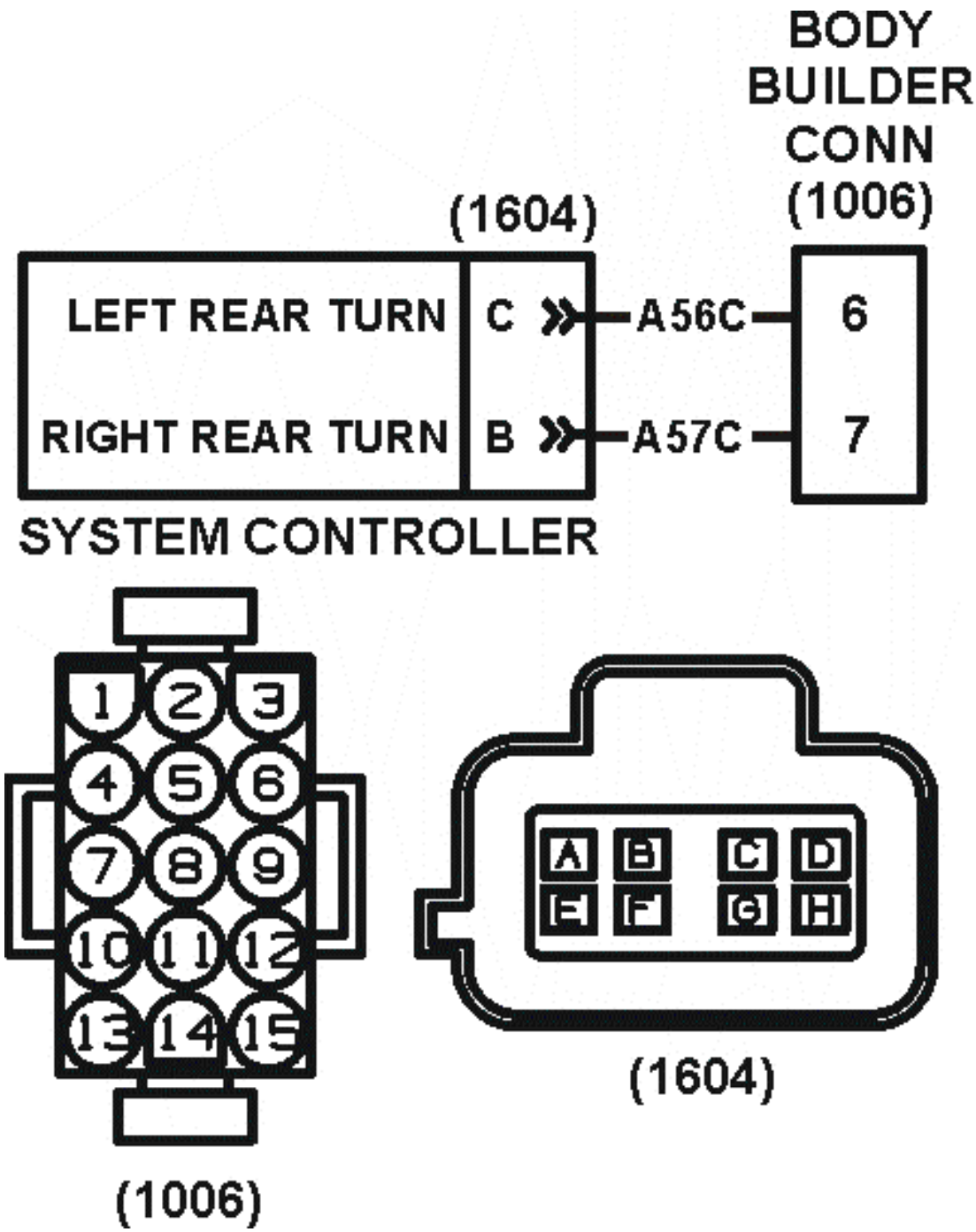

Figure 281 Rear Turn Signal/Hazard Light Outputs From ESC — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1604) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 187 Rear 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 rear turn connector. 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 (1604). 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 left rear turn signal light. If the fault reoccurs, there is a short inside the ESC.	
Diagnostic Trouble Codes	
611 14 13 1	Left rear turn lamp circuit open
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 187 Rear 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 rear light connector. 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 (1604). 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)	
Rear Turn Signal/Hazard Light Voltage Checks Check with hazard flashers on and body builder connector (1006) 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.**		
Body builder connector (1006) pin 6 to ground.	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short to ground in circuit A56C. Also insure proper voltage out of ESC connector #1604 pin C. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Body builder connector (1006) pin 7 to ground.	Voltage switching from 12 ± 1.5 volts to 0 volts	If voltage is missing, check for open or short to ground in circuit A57C. Also insure proper voltage out of ESC connector #1604 pin B. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)

Extended Description

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

Voltage for the right rear turn light is supplied from ESC connector (1604) terminal B.

Voltage for the left rear turn light is supplied from ESC connector (1604) terminal C.

7.9. COMPONENT LOCATIONS

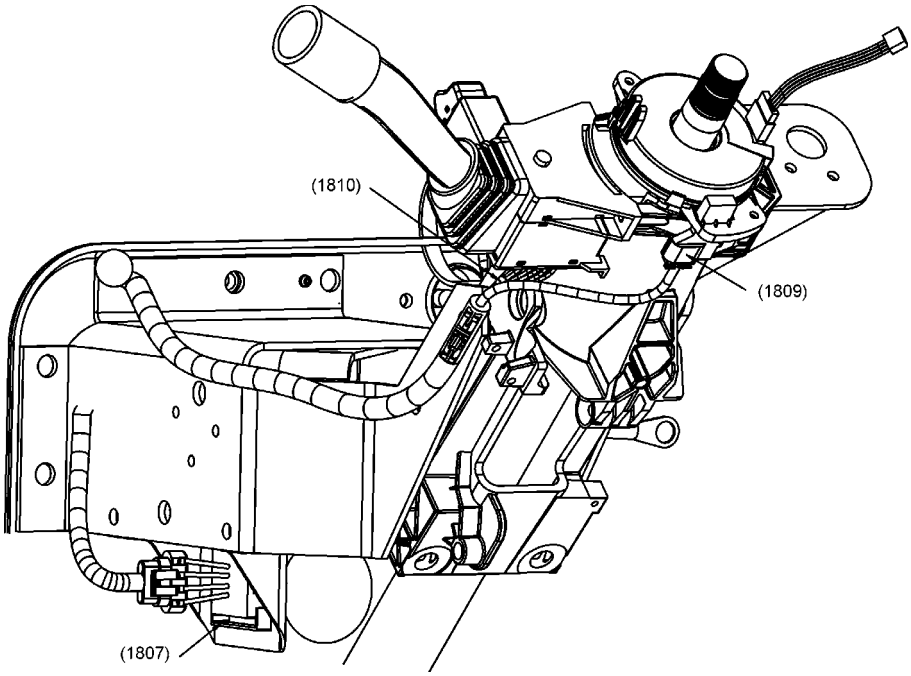

Figure 282 Stop/Turn Signal/Hazard Light Connector Locations (Steering Column Support View)

(1807) CLUTCH SWITCH CONNECTOR
(1809) CLOCK SPRING CONNECTOR
(1810) TURN SIGNAL SWITCH CONNECTOR

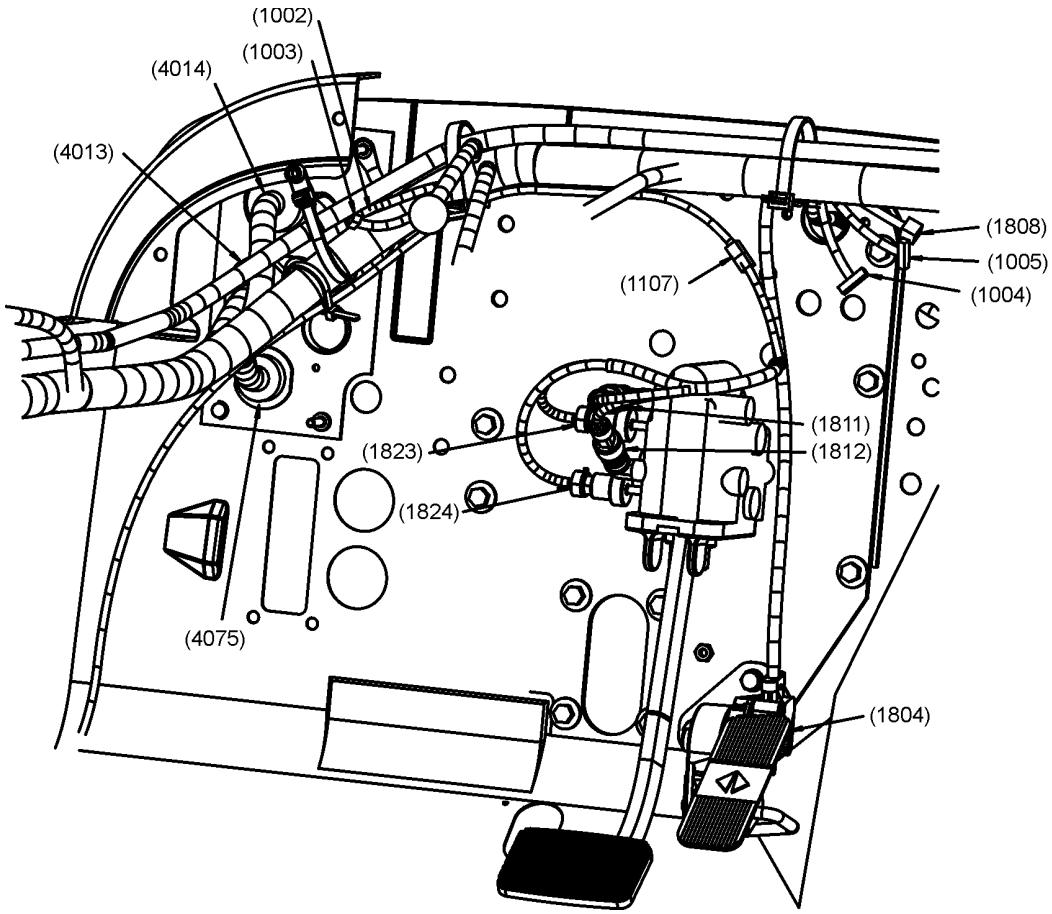

Figure 283 Inside Dash Panel Showing Pass-Thrus

(1002) PANEL LIGHT SPLICE CONNECTOR
(1003) (1004) GROUND SPLICE CONNECTOR
(1005) ZERO VOLT REFERENCE SPLICE CONNECTOR
(1107) CABLE PARK BRAKE INTERCONNECT
(1804) APS/IVS CONNECTOR
(1808) BAP SENSOR CONNECTOR
(1811) PRIMARY AIR PRESSURE SENSOR CONNECTOR
(1812) SECONDARY AIR PRESSURE SENSOR CONNECTOR
(1823) AIR BRAKE STOP LIGHT #1 SWITCH CONNECTOR
(1824) AIR BRAKE STOP LIGHT #2 SWITCH CONNECTOR
(4013) PASS THRU AT DASH CONNECTOR
(4014) DASH/ENGINE PASS THRU CONNECTOR

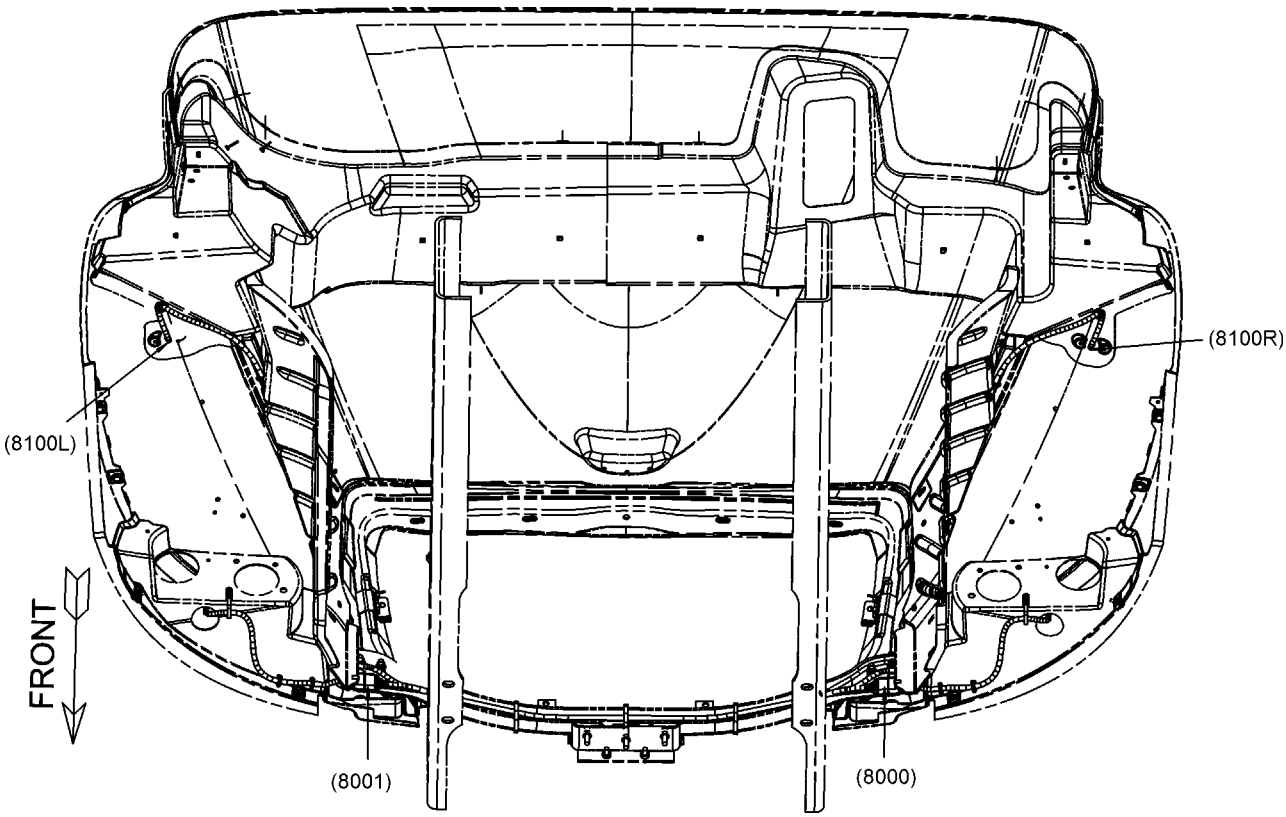

Figure 284 Stop/Turn Signal/Hazard Light Connector Locations

(8000) RIGHT HEADLIGHT AND TURN SIGNAL CONNECTOR
(8001) LEFT HEADLIGHT AND TURN SIGNAL CONNECTOR
(8100L) LEFT FENDER MOUNT TURN SIGNAL CONNECTOR
(8100R) RIGHT FENDER MOUNT TURN SIGNAL CONNECTOR

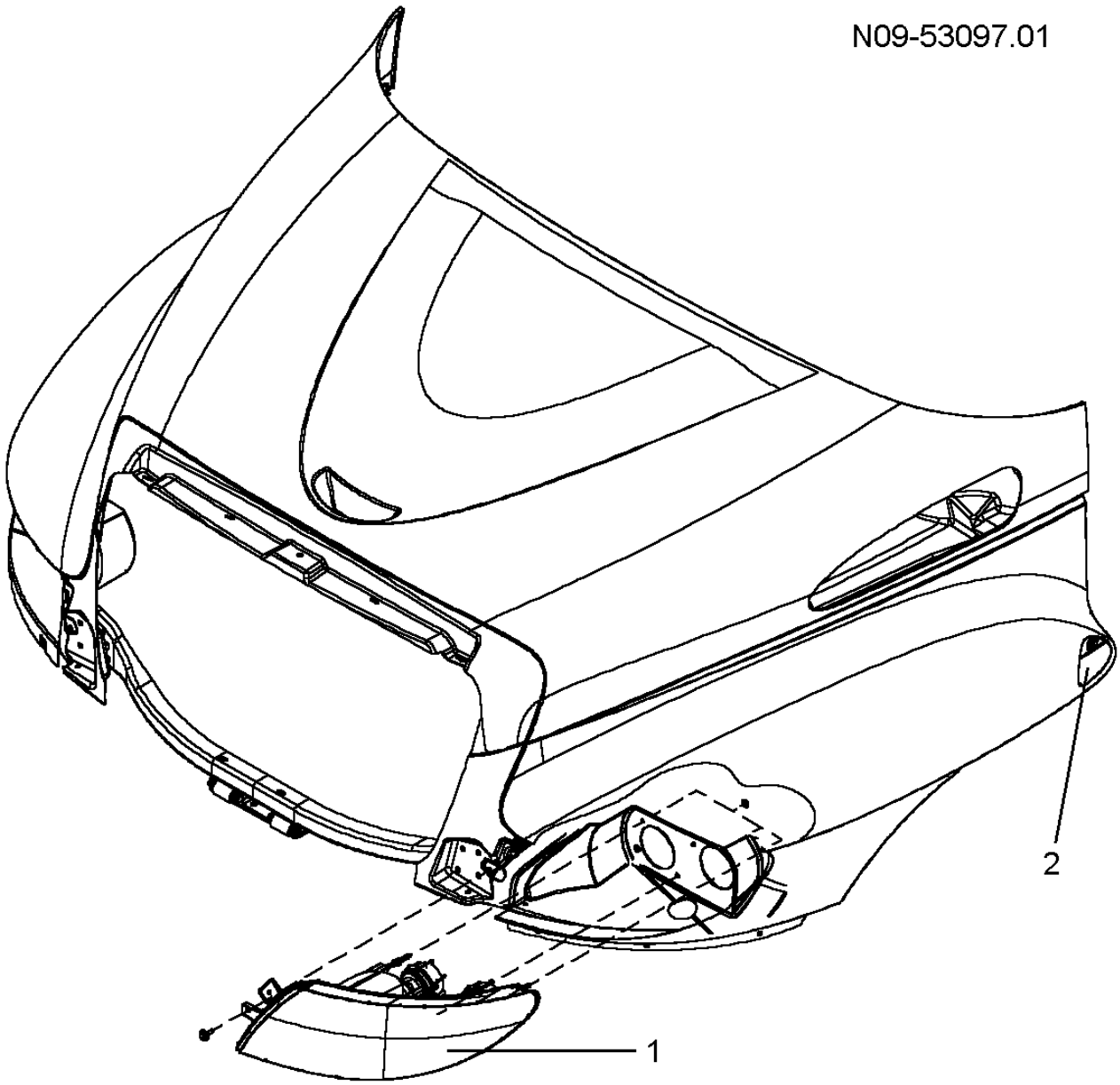

Figure 285 Headlights, Front and Side Marker Lights

1. FRONT PARK LIGHT
2. SIDE MARKER LIGHT

8. RED AND AMBER PUPIL WARNING LIGHTS

8.1. CIRCUIT FUNCTIONS

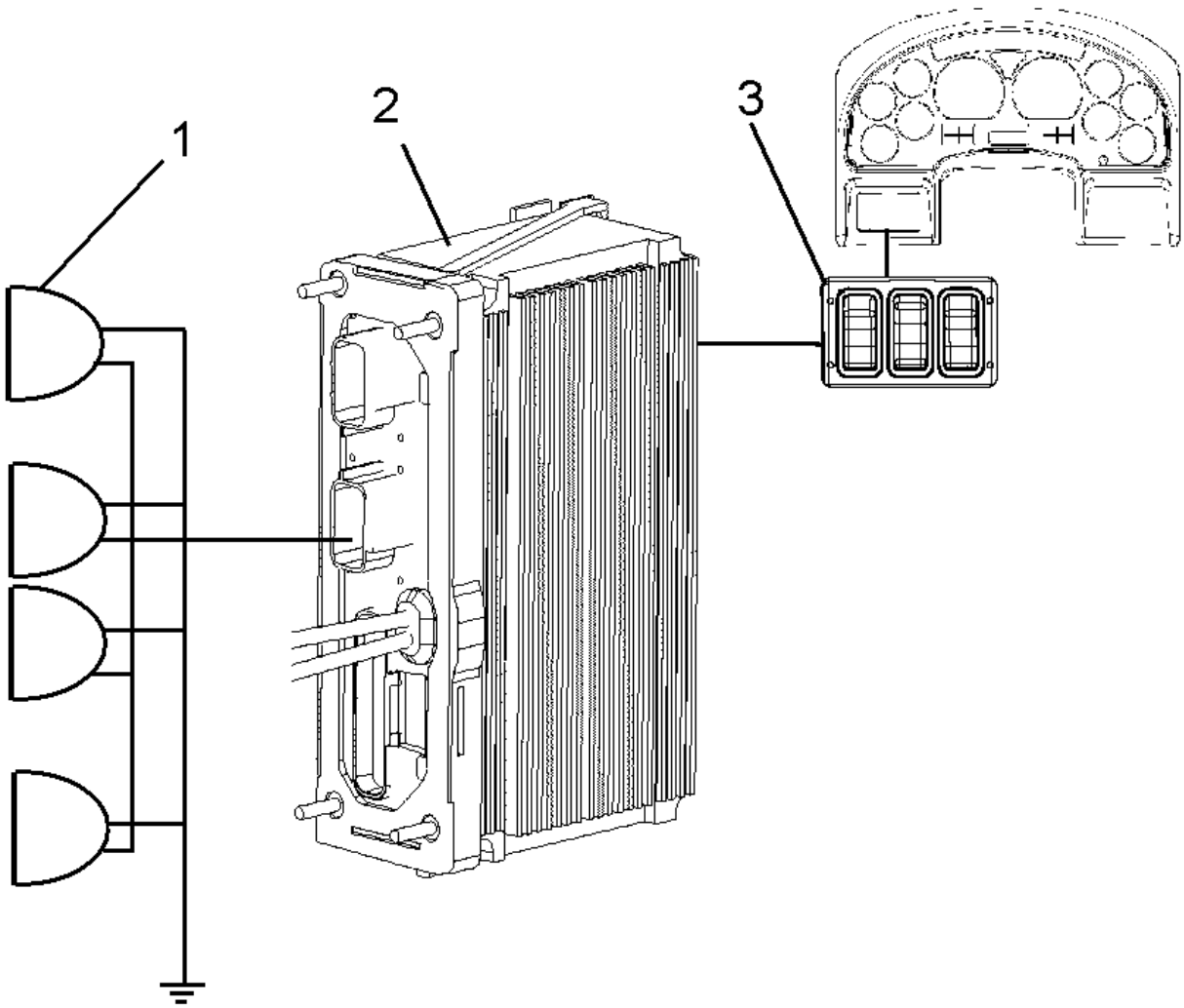

Figure 286 Red And Amber Pupil Warning Lights Function Diagram

1. RED AND AMBER PUPIL WARNING LIGHTS
2. ELECTRICAL SYSTEM CONTROLLER
3. RED/AMBER LIGHT FLASHER SWITCH

The stop arm and Red & Amber Pupil Warning Lights are activated when the red/amber flasher switch is activated. The steering wheel switches will send a message to the ESC to command the lights on. The ESC supplies battery voltage for the red/amber lights. The ESC supplies a ground for the stop arm relay to activate.

8.2. DIAGNOSTICS

If the lights stay on when the red/amber flasher switch is in the off position, the problem is most likely a faulty red/amber flasher switch, wiring between the switch and the ESC, a problem in the ESC, or a problem with the wiring between the ESC and the red/amber flashers.

Should the lights fail to come on when the red/amber flasher switch is in the “on” position, the problem is most likely a faulty red/amber flasher switch, wiring between the switch and the ESC, a problem in the ESC, or a problem with the wiring between the ESC and the red/amber flashers.

Should the stop arm fail to operate when the red/amber flasher switch is in the “on” position, the problem is most likely a faulty red/amber flasher switch, wiring between the switch and the ESC, a problem in the ESC, or a problem with the wiring between the ESC and the stop arm motor.

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 red/amber flasher 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 "Diamond Logic Builder™" diagnostic software, can be used to command the ESC to turn on the lights and monitor activation of the red/amber flasher light switch. See the diagnostic software manual for details on using the software.

Red And Amber Pupil Warning Lights Preliminary Check

Table 188 Red And Amber Pupil Warning Lights Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify stop arm and red/amber flasher lights are inoperative.	Visually check stop arm and red/amber flasher lights.	Stop arm and red/amber flasher lights are inoperative.	Go to next step.	Stop arm and red/amber flasher 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.

Table 188 Red And Amber Pupil Warning Lights Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Are all red/amber flasher 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 red/amber flasher light diagnostic trouble codes.	Read display on odometer.	No red/amber flasher light diagnostic trouble codes are active.	Go to stop arm and red/amber flasher light circuit inputs to ESC.	Go to stop arm and red/amber flasher light circuit inputs to ESC.

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 189 Stop Arm and Red/Amber Lights Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
NO DIAGNOSTIC TROUBLE CODE	Diagnostic trouble codes are not logged for every possible fault in the flasher light circuits.
611 14 11 1	Connector #1603 Pin #F (Right Front Amber PWL's) under current.
611 14 11 2	Connector #1603 Pin #F (Right Front Amber PWL's) over current.
611 14 11 3	Connector #1603 Pin #F (Right Front Amber PWL's) less than normal current but more than open circuit.
611 14 11 4	Connector #1603 Pin #F (Right Front Amber PWL's) greater than normal high current and less than fusing current.
611 14 11 6	Connector #1603 Pin #F (Right Rear Amber PWLs) has current flow when output commanded off.
611 14 10 1	Connector #1601 Pin #C (Right Rear Amber PWLs) under current.

Table 189 Stop Arm and Red/Amber Lights Diagnostic Trouble Codes (cont.)

611 14 10 2	Connector #1601 Pin #C (Right Rear Amber PWL) over current.
611 14 10 3	Connector #1601 Pin #C (Right Rear Amber PWL) less than normal current but more than open circuit.
611 14 10 4	Connector #1601 Pin #C (Right Rear Amber PWL) greater than normal high current and less than fusing current.
611 14 10 6	Connector #1601 Pin #C (Right Rear Amber PWL) has current flow when output commanded off.
611 14 9 1	Connector #1604 Pin #G (Left Rear Amber Flashers) under current.
611 14 9 2	Connector #1604 Pin #G (Left Rear Amber Flashers) over current.
611 14 9 3	Connector #1604 Pin #G (Left Rear Amber Flashers) less than normal current but more than open circuit.
611 14 9 4	Connector #1604 Pin #G (Left Rear Amber Flashers) greater than normal high current and less than fusing current.
611 14 9 6	Connector #1604 Pin #G (Left Rear Amber Flashers) has current flow when output commanded off.
611 14 2 1	Connector #1604 Pin #A (Left Front Amber PWL) under current.
611 14 2 2	Connector #1604 Pin #A (Left Front Amber PWL) over current.
611 14 2 3	Connector #1604 Pin #A (Left Front Amber PWL) less than normal current but more than open circuit.
611 14 2 4	Connector #1604 Pin #A (Left Front Amber PWL) greater than normal high current and less than fusing current.
611 14 2 6	Connector #1604 Pin #A (Left Front Amber PWL) has current flow when output commanded off.
2033 14 1 1	Connector #1601 Pin #A (Stop Arm Command) Too Much Load Attached.
2033 14 1 2	Connector #1601 Pin #A (Stop Arm Command) Open Circuit.
2033 14 1 3	Connector #1601 Pin #A (Stop Arm Command) Shorted To Ground.

8.3. RED AND AMBER PUPIL WARNING LIGHTS INPUTS TO ESC FROM STEERING WHEEL SWITCHES

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 Red And Amber Pupil Warning Lights ESC Input Circuits.

A fault in the input circuits will be apparent when the flashers and/or stop arm fail to operate.

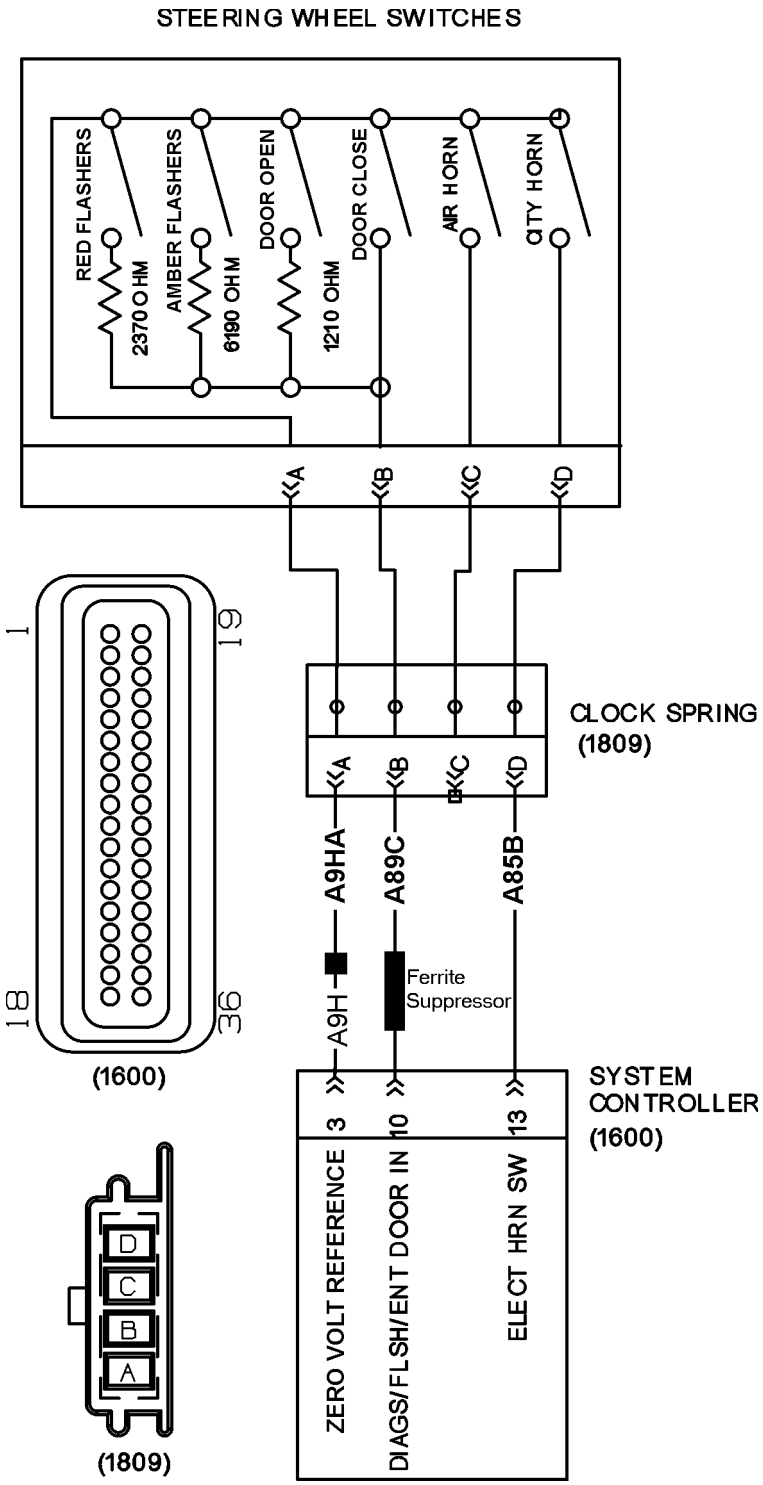

Figure 287 Red And Amber Pupil Warning Lights ESC Input Circuits From Steering Wheel Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(1809) CLOCK SPRING
LOCATED IN STEERING COLUMN

Table 190 Steering Wheel Switch Circuit Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the steering wheel switches.		
Steering Wheel Switches Resistance Checks Check with clock spring (1809) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Clock spring (1809) cavity A to cavity B.	Open circuit	If Ohmmeter reads a resistance value, there is a short circuit in the steering wheel switches. Replace steering wheel switches.
Clock spring (1809) cavity A to cavity B while holding “Flashers On/Off” button.	Approximately 6.2 Kohms	If Ohmmeter reads a different resistance there is an open or short in the steering wheel switches. Replace steering wheel switches.
Clock spring (1809) cavity A to cavity B while holding “Red Override” button.	Approximately 2.4 Kohms	If Ohmmeter reads a different resistance there is an open or short in the steering wheel switches. Replace steering wheel switches.
Clock spring (1809) cavity A to cavity B while holding “Door Open” button.	Approximately 1.2 Kohms	If Ohmmeter reads a different resistance there is an open or short in the steering wheel switches. Replace steering wheel switches.
Clock spring (1809) cavity A to cavity B while holding “Door Close” button.	Short Circuit	If Ohmmeter reads a resistance there is a short in the steering wheel switches. Replace steering wheel switches.
System Controller Zero Volt Reference Check Check with key in ignition position on and system controller connector 1600 disconnected. **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
System controller (1600) pin 3 to ground.	0 volts	If there is a voltage or an open circuit, then system controller may need to be reprogrammed.

Extended Description

The steering wheel switches are wired to the ESC at pins 3 and 10. Pin 3 is the zero volt signal. This signal is received at pin 10 through one of four resistive possibilities. The resistance value detected at pin 10 tells the ESC what function to do.

8.4. RED AND AMBER PUPIL WARNING LIGHTS 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.

A fault in the Red or Amber Pupil Warning Lights Output Circuits will be apparent when the red or amber pupil warning lights fail to operate. The ESC will also log a diagnostic trouble code (DTC) when there is a short in any of the red or amber pupil warning lamp circuits. Problems in the red or amber pupil warning lamp circuits can be caused by burned out lamps, a short, an open, or a problem in the ESC.

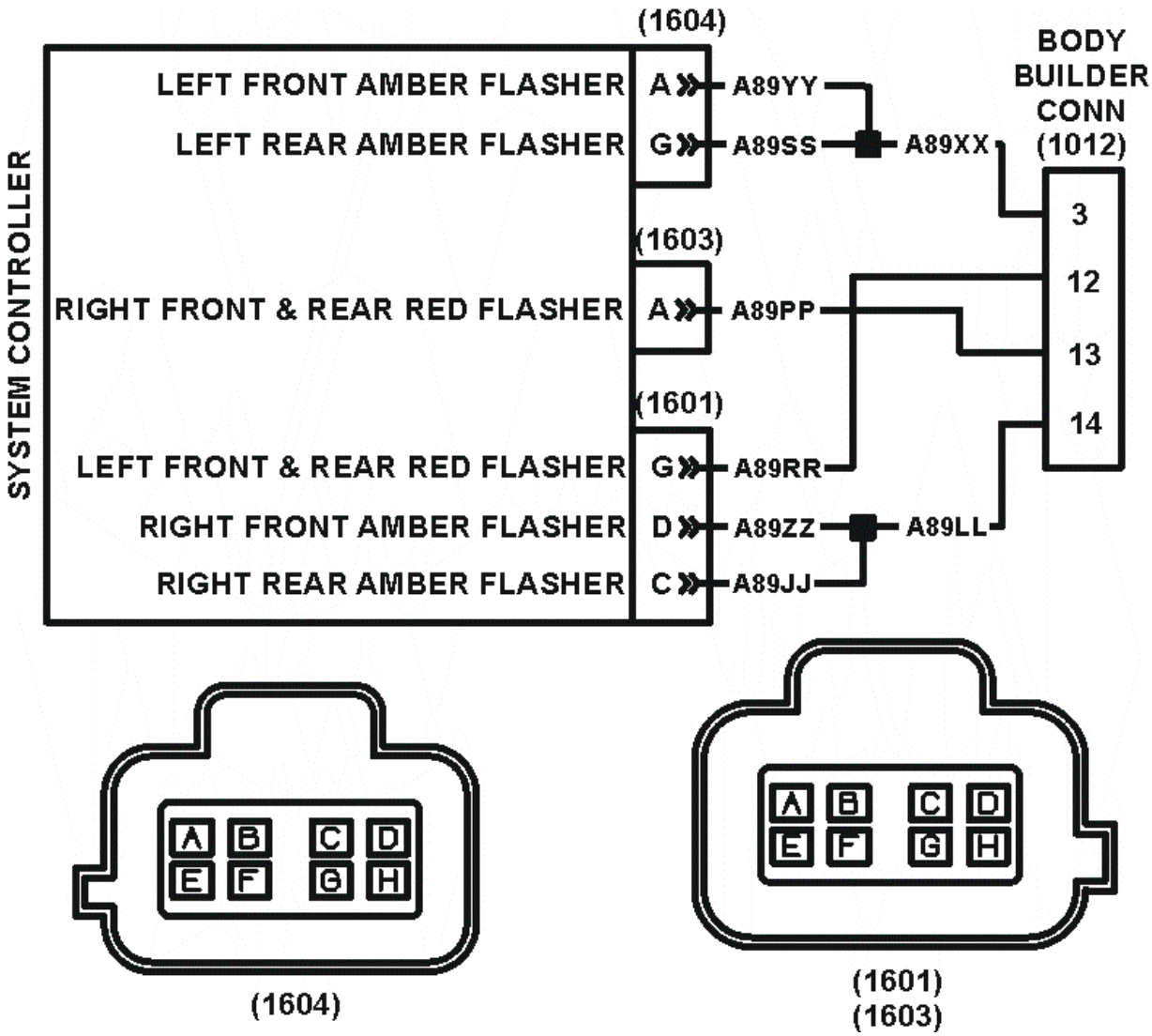

Figure 288 Red and Amber Pupil Warning Lights Outputs from ESC — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1012) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1601) (1603) (1604) SYSTEM CONTROLLER
LOCATED INSIDE RIGHT SIDE DASH PANEL

NOTE – Before testing any red or amber pupil warning light circuits, check individual bulbs to ensure that they are not burnt out.

Table 191 Pupil Warning Lights Circuit Tests

Body Builder Connector (1012) Voltage Checks Check with body builder connector (1012) disconnected and amber pupil warning lights activated. **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
Body builder connector (1012) pin 3 to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** Flashing between 12 ± 1.5 volts and 0 volts	If voltage is missing, check for open or short to ground in circuits A89XX, A89SS, and A89YY. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Body builder connector (1012) pin 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.** Flashing between 12 ± 1.5 volts and 0 volts	If voltage is missing, check for open or short to ground in circuits A89LL, A89JJ, and A89ZZ. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Activate red pupil warning lights.		
Body builder connector (1012) pin 12 to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** Flashing between 12 ± 1.5 volts and 0 volts	If voltage is missing, check for open or short to ground in circuit A89RR. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)
Body builder connector (1012) pin 13 to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** Flashing between 12 ± 1.5 volts and 0 volts	If voltage is missing, check for open or short to ground in circuits A89PP. Also insure proper voltage out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)

Extended Description

When the ESC is commanded to turn the amber pupil warning lights on, the ESC will alternate 12 volts and zero volts to the lights from ESC connector (1604) terminals A and G and connector (1601) terminals C and D

through body builder connector (1012) to the amber pupil warning lights. The right side amber pupil warning lights will be on when the left side amber pupil warning lights are off and vice versa.

When the ESC is commanded to turn the red pupil warning lights on, the ESC will alternate 12 volts and zero volts to the lights from ESC connector (1603) terminal A and connector (1601) terminal G through body builder connector (1012) to the red pupil warning lights. The right side red pupil warning lights will be on when the left side red pupil warning lights are off and vice versa. The stop arm lights will also alternate.

8.5. STOP ARM 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.

A fault in the Stop Arm Circuits will be apparent when the red pupil warning lights are activated and the stop arm does not extend. The ESC will also log a diagnostic trouble code (DTC) when there is a short in stop arm. Problems in the stop arm circuits can be caused by burned out lamps, a short, an open, or a problem in the ESC.

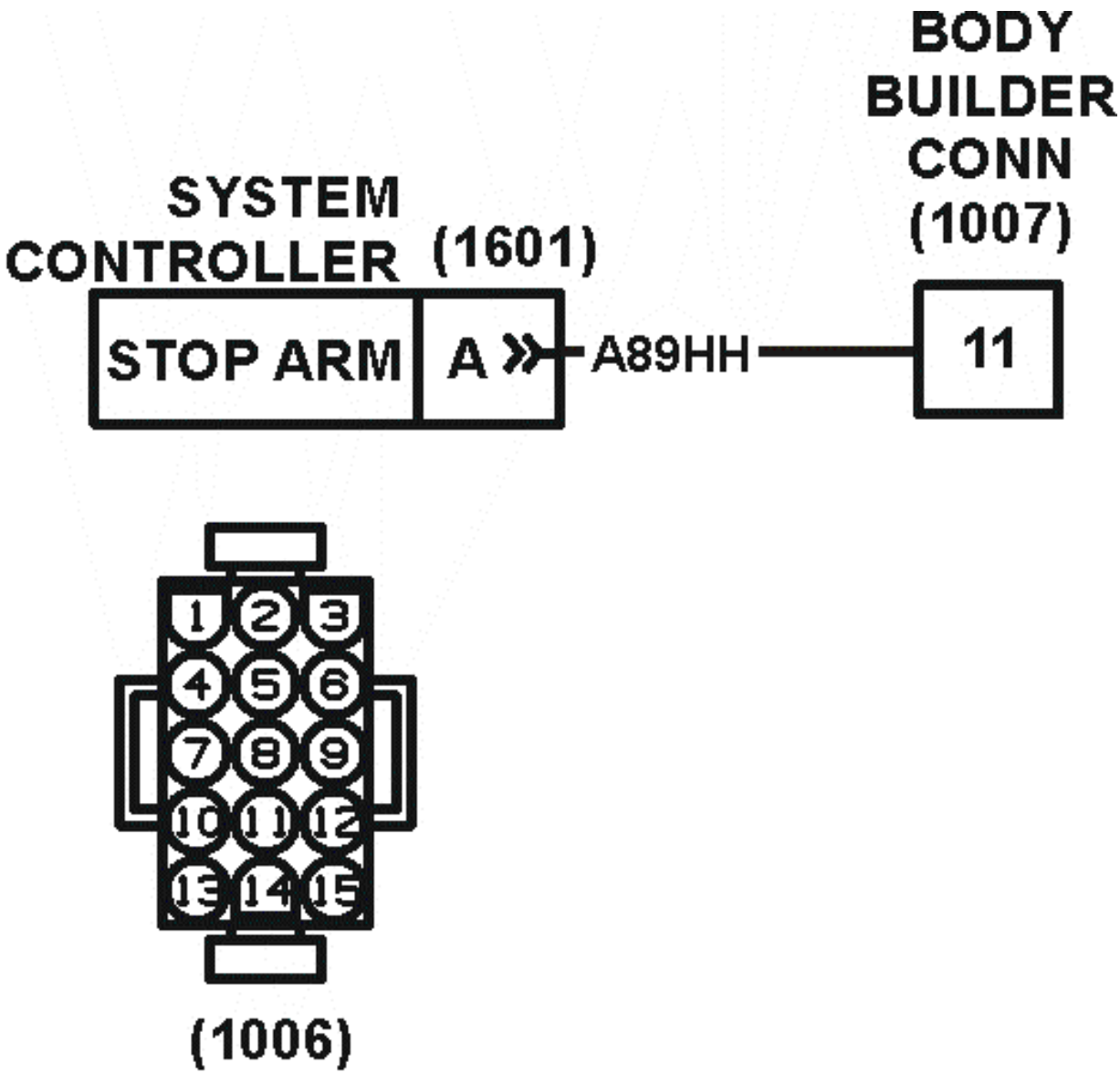

Figure 289 Stop Arm Outputs from ESC — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1601) SYSTEM CONTROLLER
LOCATED INSIDE RIGHT SIDE DASH PANEL

Table 192 Stop Arm Circuit Tests

Body Builder Connector (1007) Voltage Checks With key in ignition position on and red pupil warning lights activated. **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
Body builder connector (1007) pin 11 to ground.	0 ± 1.5 volts	If voltage is present, check for short to high on circuit A89HH. Also insure proper ground signal out of ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 117)

Extended Description

When the ESC is commanded to turn the red pupil warning lights on, the ESC will provide a ground signal on connector 1601 pin A.

8.6. COMPONENT LOCATIONS

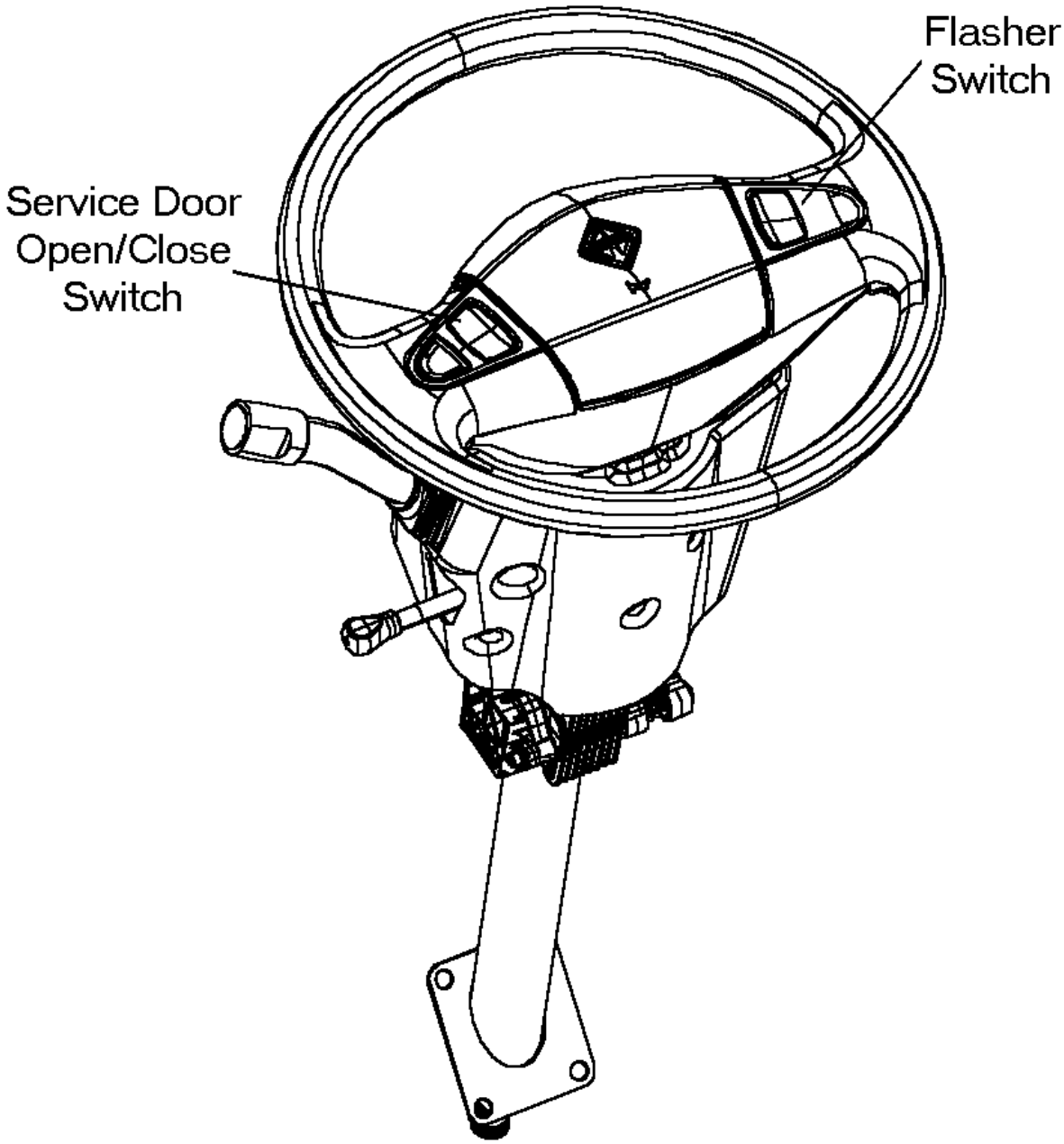

Figure 290 Steering Wheel Switches