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1. AIR DRYER AND HEATED DRAIN VALVE

1.1. CIRCUIT FUNCTIONS

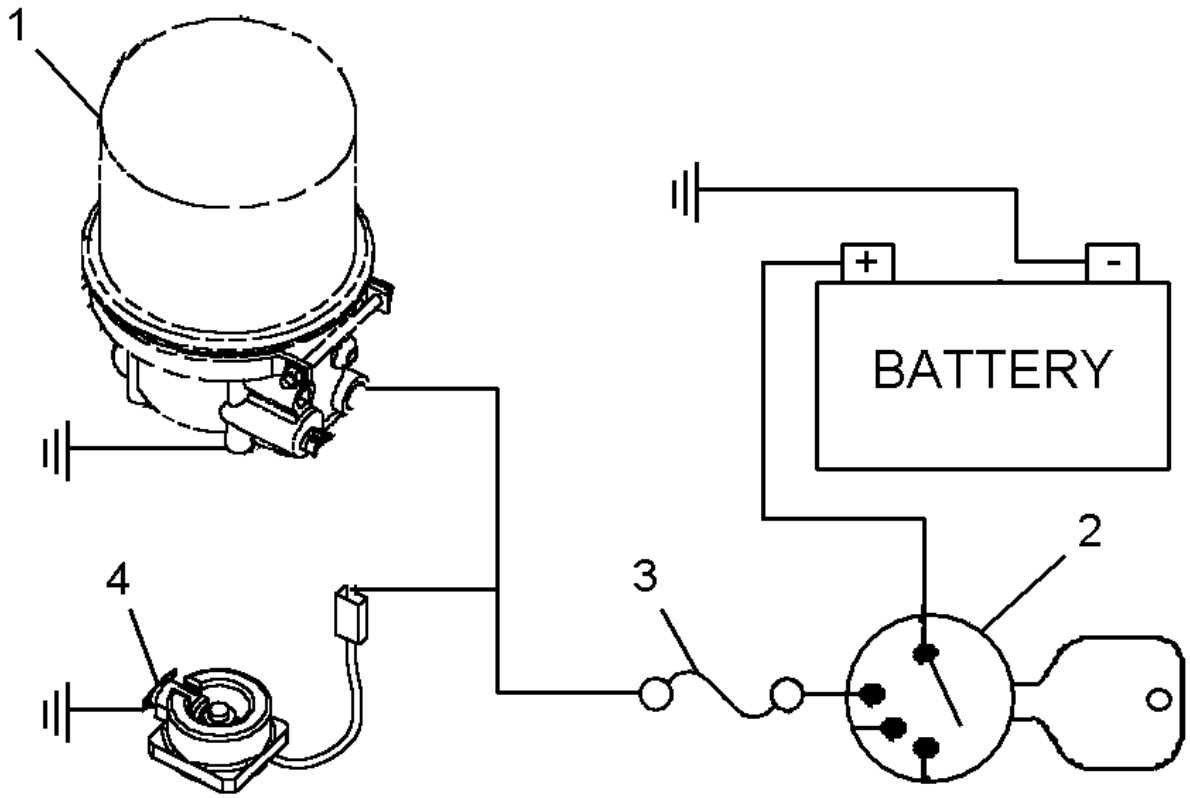

Figure 313 Air Dryer And Heated Drain Valve Function Diagram

1. AIR DRYER
2. KEY SWITCH
3. FUSE
4. HEATED DRAIN VALVE

Refer to the Air Dryer And Heated Drain Valve Function Diagram.

The function of the air dryer is to collect moisture and contaminants before air reaches the first reservoir, thus providing moisture free air for the air brake system. The heater in the air dryer prevents freeze-up in the purge drain valve during cold weather operation.

The function of the automatic drain valve is to automatically expel accumulated moisture from the air tank. The heater in the drain valve prevents freeze-up in the purge drain valve during cold weather operation.

1.2. DIAGNOSTICS

Air Dryer And Heated Drain Valve Preliminary Check

Table 187 Air Dryer And Heated Drain Valve Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify Air Dryer or Heated Drain Valve are inoperative.	Check Air Dryer And Heated Drain Valve.	Air Dryer or Heated Drain Valve are inoperative.	Go to next step.	Air Dryer And Heated Drain Valve are operating. 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.)	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.

1.3. AIR DRYER AND HEATED DRAIN VALVE CIRCUITS

Fault Detection Management

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

A fault in the air dryer and heated drain valve circuits will be apparent when the air dryer or heated drain valve are inoperative. The ESC will not log any faults for air dryer or heated drain valve circuits. Problems in the air dryer and heated drain valve circuits can be attributed to short circuits, open circuits, a blown fuse, or a failed heated drain valve or air dryer.

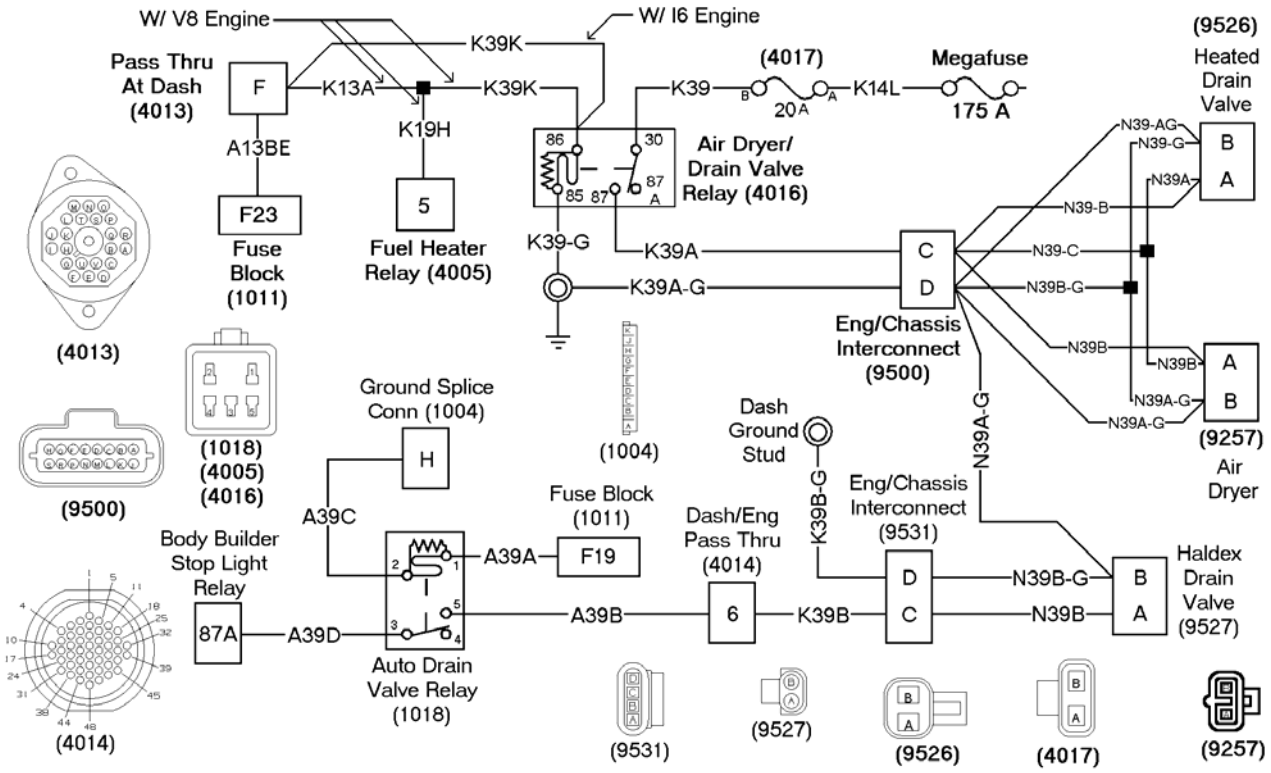

Figure 314 Air Dryer And Heated Drain Valve Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1004) GROUND SPLICE CONNECTOR
LOCATED RIGHT SIDE INSTRUMENT PANEL
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1018) AUTO DRAIN VALVE RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4005) FUEL HEATER RELAY
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT OUTSIDE LEFT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THROUGH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4016) AIR DRYER/DRAIN VALVE RELAY
LOCATED AT OUTSIDE TOP DASH PANEL
(4017) AIR DRYER/DRAIN VALVE FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(9257) AIR DRYER
LOCATED AT OUTSIDE LEFT FRAME RAIL-AIR TANK
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9526) DRAIN VALVE
LOCATED AT OUTSIDE LEFT FRAME RAIL AT AIR TANK
(9527) HALDEX DRAIN VALVE
LOCATED AT OUTSIDE LEFT FRAME RAIL AT AIR TANK
(9531) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

Table 188 Heated Drain Valve Connector Chart

Faults		
There are no diagnostic trouble codes associated with the heated drain valve		
Air Dryer/Drain Valve Relay (4016) Voltage Checks Bench test relay. If relay fails bench test, replace and check for faults. Check with air dryer/drain valve relay removed, ignition key on and heated drain valve disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air dryer/drain valve relay (4016) socket 86 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F23, and check for open or short in circuits K39K, K13A and A13BE.
Air dryer/drain valve relay (4016) socket 86 to 85.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuit K39–G.
Air dryer/drain valve relay (4016) socket 30 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuses (4017) and megafuse. Also check for open or short in circuits K39 and K14L.
Heated Drain Valve Harness Connector (9526) Voltage Checks Check with air dryer/drain valve relay (4016) installed, ignition key on and heated drain valve disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Heated drain valve harness connector (9526), pin A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit N39A, N39–C, and K39A or N39–B and K39A.
Heated drain valve harness connector, pin A to B	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits N39–AG and K39A-G or N39–G, N39B-G and K39A-G. If voltage is correct and heated drain valve is still inoperative, replace heated drain valve assembly.

Table 189 Air Dryer Connector Chart

Faults
There are no diagnostic trouble codes associated with the air dryer circuits
Air Dryer/Drain Valve Relay (4016) Voltage Checks Bench test relay. If relay fails bench test, replace and check for faults. Check with air dryer/drain valve relay removed, ignition key on and air dryer disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**

Table 189 Air Dryer Connector Chart (cont.)

Test Points	Spec.	Comments
Air dryer/drain valve relay (4016) socket 86 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F23, and check for open or short in circuits K39K, K13A and A13BE.
Air dryer/drain valve relay (4016) socket 86 to 85.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuit K39–G.
Air dryer/drain valve relay (4016) socket 30 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuses (4017) and megafuse. Also check for open or short in circuits K39 and K14L.
Air Dryer Harness Connector (9257) Voltage Checks Check with air dryer/drain valve relay (4016) installed, ignition key on and air dryer disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air Dryer harness connector (9257), pin A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits N39B N39–C, and K39A or N39B and K39A..
Air Dryer harness connector (9257), pin A to B	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits N39A-G, N39B-G and K39A-G or N39A-G and K39A-G. If voltage is correct and Air Dryer is still inoperative, replace Air Dryer assembly.

Table 190 Haldex Drain Valve Connector Chart

Faults		
There are no diagnostic trouble codes associated with the Haldex drain valve circuits.		
Auto Drain Valve Relay (1018) Voltage Checks Bench test relay. If relay fails bench test, replace and check for faults. Check with auto drain valve relay removed, ignition key on and Haldex drain valve disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Auto drain valve relay (1018) socket 1 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F19, and check for open or short in circuit A39A.
Auto drain valve relay (1018) socket 1 to 2.	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuit A39C. Also ensure proper grounding of ground splice connector (1004).

Table 190 Haldex Drain Valve Connector Chart (cont.)

Auto drain valve relay (1018) socket 3 to ground.	12 ± 1.5 volts	If voltage is missing, open or short in circuit A39D. Also ensure that the body builder stop light relay is functioning properly.
Haldex Drain Valve Harness Connector (9527) Voltage Checks Check with auto drain valve relay (1018) installed, ignition key on and Haldex drain valve disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Haldex drain valve connector (9527) pin A to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits N39B, K39B and A39B.
Haldex drain valve connector (9527) pin A to B	12 ± 1.5 volts	If voltage is missing, check for open or short to high in circuits N39A-G, K39A-G, N39B-G and K39B-G. If voltage is correct and Haldex drain valve is still inoperative, replace Haldex drain valve assembly.

Extended Description

Refer to air dryer and heated drain valve circuits.

The heated drain valve (9526) and air dryer (9257) receive battery voltage from a 20 amp fuse (4017) in the engine power distribution center through the air dryer/drain valve relay (4016). When the key switch is placed in the start or ignition position the air dryer/drain valve relay is charged from fuse F23 in the fuse block (1011). Ground for the heated drain valve and the air dryer is supplied from chassis ground.

The Haldex drain valve (9527) is supplied power with the body builder stop light relay and the auto drain valve relay (1018) are charged. The auto drain valve relay is charged from fuse F19. Ground for the Haldex drain valve (9527) is supplied from chassis ground.

1.4. COMPONENT LOCATIONS

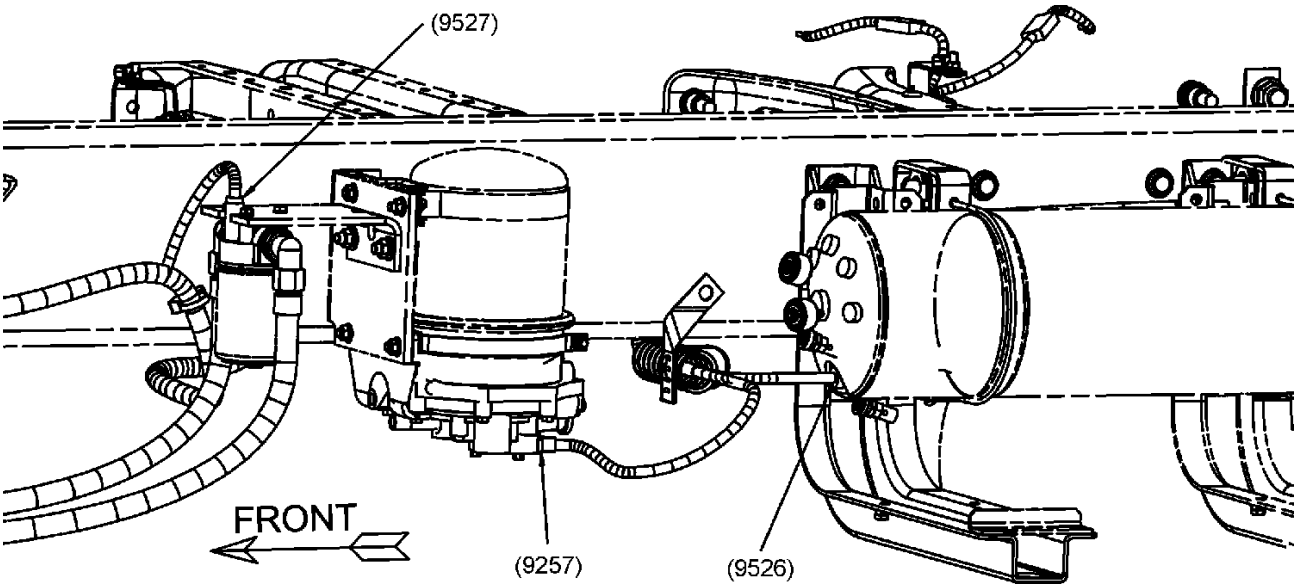

Figure 315 Air Dryer And Heated Drain Valve Wiring (Right Side Shown)

(9257) AIR DRYER
(9526) HEATED DRAIN VALVE
(9527) HALDEX DRAIN VALVE

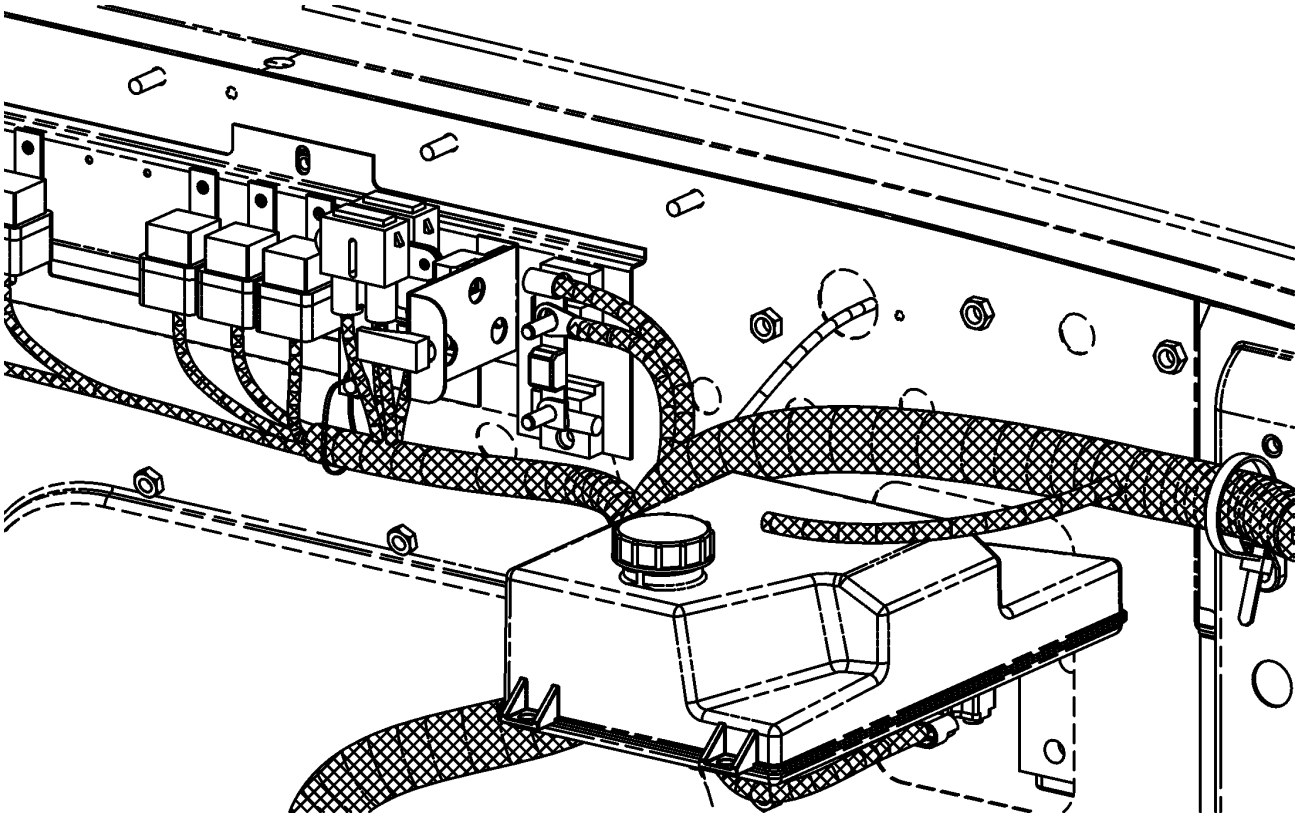

Figure 316 Air Dryer And Heated Drain Valve Wiring (Right Side Shown)

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

2. BENDIX™ AIR ABS

Discussion of the air antilock braking system in this section is limited to power circuits and data link connectivity. For detailed information on ABS operation and troubleshooting, refer to Bendix™ manual SD-13–4815.

2.1. CIRCUIT FUNCTIONS

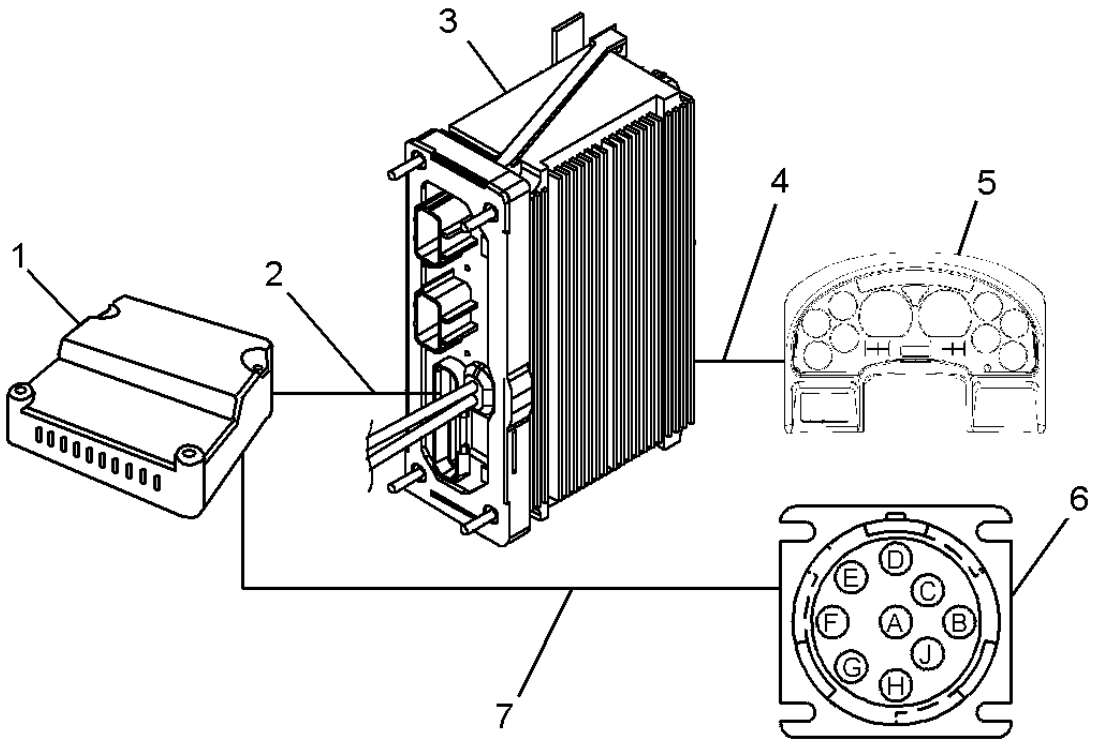

Figure 317 Air ABS Function Diagram

1. BENDIX EC-30 AIR ABS ELECTRONIC CONTROL UNIT
2. DRIVETRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. CLUSTER 1939 DATA LINK TO ELECTRICAL SYSTEM CONTROLLER
5. ELECTRONIC GAUGE CLUSTER
6. DIAGNOSTIC CONNECTOR
7. 1708 DATA LINK (PRIMARILY FOR DIAGNOSTICS AND PROGRAMMING)

The ABS function of the EC-30 is designed to optimize slip on all vehicle wheels. In addition to the ABS function, the EC-30 can be configured to provide an automatic traction control (ATC) feature. ATC can improve vehicle traction during acceleration on adverse road conditions. ATC can utilize engine torque limiting and/or differential braking to improve vehicle traction.

The EC-30 electronic control unit (ECU) receives input from the wheel speed sensors to activate the modulators required to control braking at each wheel. It also communicates, on the drive train 1939 data link, with controllers and other systems to limit engine torque, disable retarders and control the ABS, ATC and trailer ABS warning lamps.

Effective March 1, 2001, all towing vehicles must control an in-cab trailer ABS warning lamp. Trailers built after this date will transmit the status of the trailer ABS unit over the power line (center pin, blue wire of the trailer connector) to the tractor using power line carrier (PLC) communications. For detailed information on trailer ABS and PLC operation, refer to Bendix™ manual SD-13–4815.

2.2. DIAGNOSTICS

Should a failure occur in the ABS, ATC system or Trailer ABS system the appropriate warning lamp should illuminate. The warning lamps should also illuminate during the gauge sweep to test bulb functionality.

The ESC will log a diagnostic trouble code when communication between the ESC and the ABS ECU is lost.

The EC-30 ABS ECU generates and displays its own diagnostic trouble codes. ABS diagnostic trouble codes are not displayed on the gauge cluster odometer display. Diagnostic trouble codes can be read on the EC-30 lights (lights are on the ECU). Diagnostic trouble codes can also be read using an electronic service tool running the ACOM software. For detailed information on air ABS diagnostic trouble codes, refer to Bendix™ manual SD-13–4815.

ABS diagnostic trouble codes may be cleared by holding a magnet over the reset location or by using the ACOM software.

Air ABS Preliminary Check

Table 191 Air ABS Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the ABS warning lamp is operating.	Visually check ABS warning light.	ABS warning light should illumi- nate during the gauge sweep.	Go to next step.	ABS warning lamp or warning lamp circuits need repaired.
2.	On	Verify there is a problem with the ABS.	Visually check ABS warning light.	ABS warning light is on constantly.	Go to next step.	ABS is operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
3.	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 191 Air ABS Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
4.	On	Check for ESC diagnostic trouble codes. (See ESC Diagnostic Trouble Codes, page 637)	Read display on odometer.	No ESC diagnostic trouble codes for ABS are active.	Go to next step.	Go toAir ABS Power and Data Link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 638)
5.	On	Check for ABS diagnostic trouble codes. (See ESC Diagnostic Trouble Codes, page 637)	Read diagnostic trouble codes from blink codes or ECU lights.	No ABS diagnostic trouble codes are active.	Go to Air ABS Power and Data Link Circuits. (See AIR ABS POWER AND DATA LINK CIRCUITS, page 638)	Refer to Bendix™ manual SD-13–4815.

ESC Diagnostic Trouble Codes

NOTE – This procedure only applies to diagnostic trouble codes from the ESC. The ABS ECU has its own diagnostic trouble code system. For detailed information on ABS diagnostic trouble codes, refer to Bendix™ manual SD-13–4815.

To display diagnostic codes, set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch momentarily. If no faults are present, the cluster odometer will display “NO FAULT”. If faults are present, the gauge cluster display will show 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 selector button. The last character of the diagnostic trouble code will end in “A” for active faults or “P” for previously active faults. 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 ESC 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 and releasing them.

Table 192 Air ABS Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
639 14 1 240	ABS controller not communicating with the ESC.
This fault is logged when no communication between the ESC and the ABS ECU. This fault could be the result of a failure in the data link, a loss of power to the ABS ECU, or a failed ECU. Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 638)	
2023 14 150 8 or 2023 14 250 8	ABS warning light malfunction on primary EGC (150) or secondary EGC (250)
The faults are logged when ABS warning light malfunction on primary EGC (150) or secondary EGC (250). This fault could be the result of a failure in the data link, a loss of power to the ABS ECU, or a failed ECU. Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 638)	

ABS Diagnostic Trouble Codes

NOTE – Air ABS blink codes are not implemented in this vehicle. Use the LED's on the controller or the appropriate diagnostic software to determine fault conditions.

2.3. AIR ABS POWER AND DATA LINK CIRCUITS

Fault Detection Management

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

A problem in the air ABS circuits will be apparent when the ABS warning lamp is illuminated. Problems in the air ABS circuits could be attributed to short circuits, open circuits, a blown fuse or a failed ECU.

A solid green VLT LED on the EC-30 will be illuminated any time power is applied to the ECU. If this light is not illuminated when the ignition is on, identify the reason for missing power and repair it.

The red ECU LED on the EC-30 will illuminate when there is an internal fault in the ECU. If this led illuminates, attempt to reset the ECU by passing a magnet near the reset location. If the fault returns, replace the ECU per manual SD-13–4815.

The ESC will log a fault when communication between the ABS ECU and the ESC is interrupted. A failure in the drivetrain 1939 data link will cause several DTC's to be logged. **Go to the drivetrain 1939 data link section (See DRIVETRAIN 1939 DATA LINK, page 73) to troubleshoot this condition.** Problems in the air ABS circuits could be attributed to short circuits, open circuits, a blown fuse, a failed relay or a failed ECU.

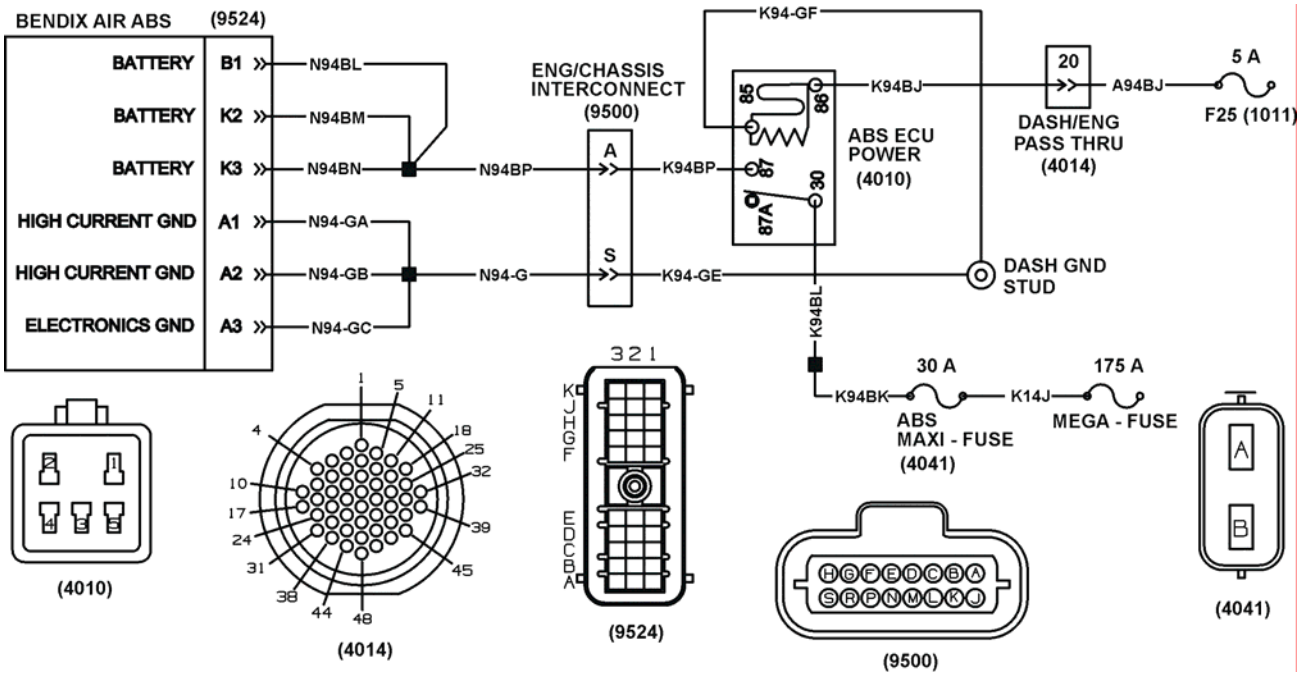

Figure 318 Air ABS Power And Ground Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4010) ABS ECU POWER RELAY
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4041) ABS MAXI FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9524) BENDIX AIR ABS
LOCATED AT INSIDE LEFT FRAME RAIL AT ABS

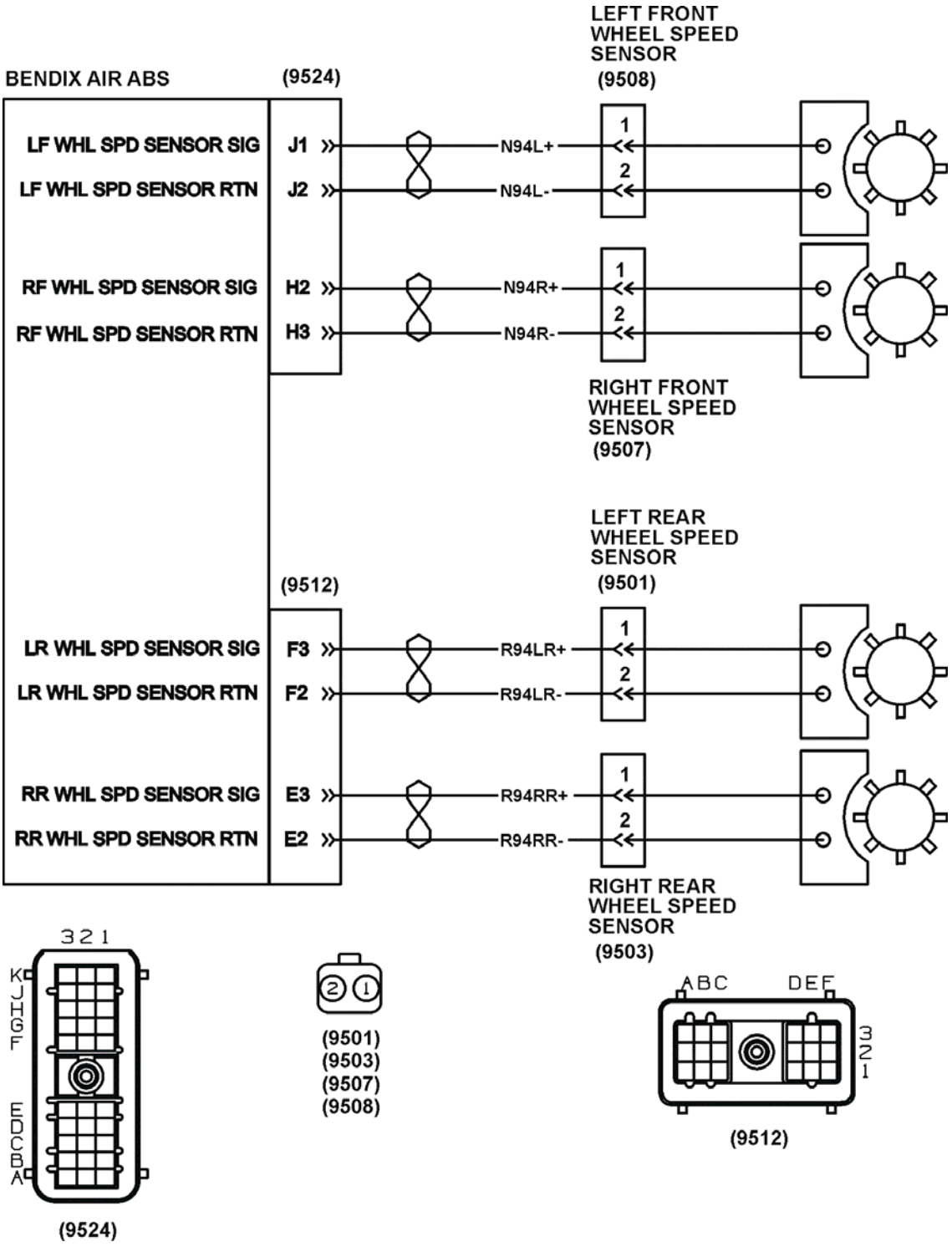

Figure 319 Air ABS Sensor Input Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(9501) (9503) (9507) (9508) AIR WHEEL SPEED SENSOR
LOCATED AT RESPECTIVE WHEEL
(9512) (9524) BENDIX AIR ABS
LOCATED AT INSIDE LEFT FRAME RAIL AT ABS

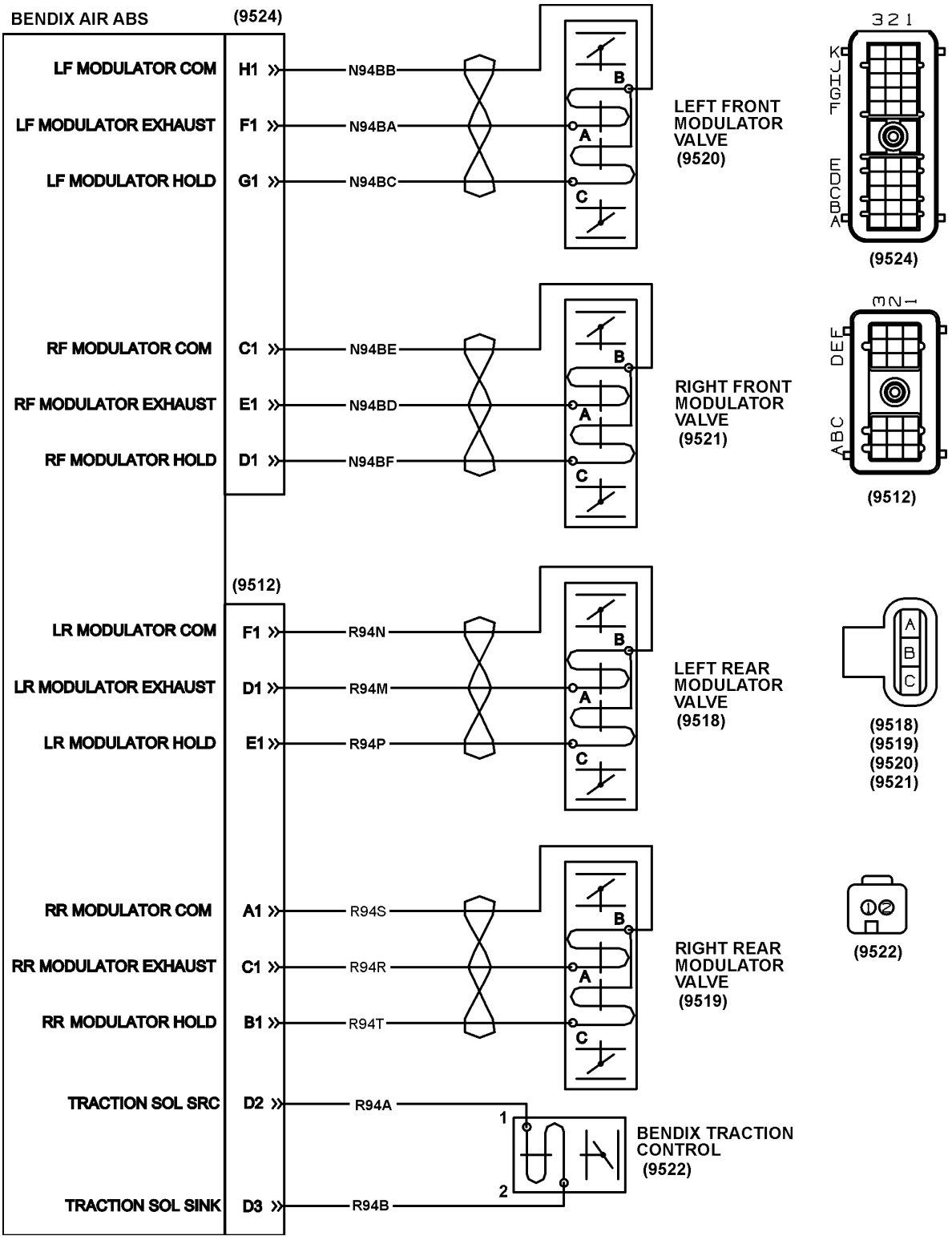

Figure 320 Air ABS Output Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(9512) (9524) BENDIX AIR ABS
LOCATED AT INSIDE LEFT FRAME RAIL AT ABS
(9518) (9519) (9520) (9521) AIR MODULATOR VALVE
LOCATED AT OUTSIDE FRAME RAIL AT RESPECTIVE WHEEL
(9522) BENDIX TRACTION CONTROL
LOCATED AT CROSSMEMBER FRONT OF REAR AXLE

Table 193 Air ABS Voltage Check Chart

ESC DTC's	
597 14 1 0	Brake switch is stuck in the open position.
597 14 2 0	Brake switch inputs do not match.
639 14 1 240	ABS controller not communicating with the ESC.
Problems in the air ABS circuits can be can be attributed to short circuits, open circuits, a blown fuse or a failed ECU.	
639 14 250 254	Brake message is not being communicated to the ESC.
2023 14 150 8 or 2023 14 250 8	ABS warning light malfunction on primary EGC (150) or secondary EGC (250)
The faults are logged when ABS warning light malfunction on primary EGC (150) or secondary EGC (250). This fault could be the result of a failure in the data link, a loss of power to the ABS ECU, or a failed ECU. Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 638)	
For detailed information on ABS diagnostic trouble codes, refer to Bendix™ manual SD-13–4815. This vehicle does not use air ABS blink codes.	
ABS ECU Power Relay (4010) Voltage Checks Check with ignition key on and relay removed. Bench test relay. If relay fails bench test, replace and check for faults. **NOTE – Always check connectors for damage and pushed–out terminals.**	

Test Points	Spec.	Comments
ABS ECU power relay (4010) socket 86 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for blown fuse F25 and check for open or short in circuits K94BJ and A94BJ.
ABS ECU power relay (4010) socket 86 to 85.	12 ± 1.5 volts.	If voltage is incorrect, check open or short to high in circuits K94–GF.
ABS ECU power relay (4010) socket 30 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for blown fuse ABS Maxi-Fuse (4041) and Megafuse and check for open or short in circuits K94BL, K94BK and K14J.

Table 193 Air ABS Voltage Check Chart (cont.)

ABS Connector (9524) Voltage Checks Check with ignition key on, ABS ECU power relay (4010) installed and Bendix air ABS connector (9524) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECU connector (9524) cavity K2 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94BM, N94BP and K94BP.
ECU connector (9524) cavity K3 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94BN, N94BP and K94BP.
ECU connector (9524) cavity B1 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94BL, N94BP and K94BP.
ECU connector (9524) cavity B1 to A1.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94–GA, N94–G, and K94–GE.
ECU connector (9524) cavity B1 to A2.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94–GB, N94–G, and K94–GE.
ECU connector (9524) cavity B1 to A3.	12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N94–GC, N94–G, and K94–GE.
If voltages check good and the air ABS ECU is the only component not communicating on the data link, there is probably an internal failure in the ECU.		

Table 194 Air ABS Data Link Voltage Check Chart

ABS Connector (9524) Drivetrain J1939 Data Link Checks Check with ignition key on and (9524) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECU connector (9524) cavity C3 to ground.	>2 volts	If voltage is incorrect, check for open or short in drivetrain 1939 data link (+) circuits.
ECU connector (9524) cavity D3 to ground.	>2 volts	If voltage is incorrect, check for open or short in drivetrain 1939 data link (-) circuits.
If voltages check good and the air ABS ECU is the only component not communicating on the data link, there is probably an internal failure in the ECU.		

Table 194 Air ABS Data Link Voltage Check Chart (cont.)

ABS Connector (9524) 1708 Data Link Checks Check with ignition key on and (9524) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.** **NOTE – Insure that the 1708 Data Link is not shorted or wired incorrectly. With the ignition on, voltage from Positive data link circuit to ground should be approximately 4 volts. Voltage from Negative data link circuit to ground should be approximately .5 volt. Refer to 1708 Data Link. (See 1708 DATA LINK, page 83)**		
Test Points	Spec.	Comments
ECU connector (9524) cavity G2 to ground.	Approximately 4 volts.	If voltage is incorrect, check for open or short in 1708 Data Link (+) circuits.
ECU connector (9524) cavity G3 to ground.	Approximately 0.5 volt	If voltage is incorrect, check for open or short in 1708 Data Link (-) circuits.
If voltages check good and the air ABS ECU is the only component not communicating on the data link, there is probably an internal failure in the ECU.		

Extended Description

Refer to the Air ABS Circuits.

When the key switch is in the ignition position the ABS ECU power should energize supplying battery voltage to 30 way ABS ECU connector (9524) pins B1, K2 and K3.

Ground for the ECU is supplied to pins A1, A2 and A3 from ground stud (4037).

Refer to the Air ABS Circuits.

The ABS ECU is connected to the drivetrain 1939 data link at pins C3 and D3.

The ECU is connected to the 1708 data link at pins G2 and G3.

2.4. E-STROKE MODULE

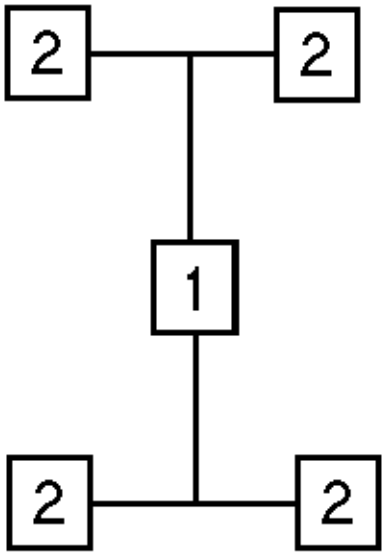

Figure 321 E-Stroke Function Diagram

1. E-STROKE MODULE
2. E-STROKE BRAKE SENSORS

The E-Stroke Module is an optional package available with an air brake system. It is a system that can easily provide the brake stroke condition of the vehicle's braking system.

The system converts air brake actuator shaft travel into an electronic signal. This signal is monitored and measured by the brake sensors. The information is relayed to the E-Stroke Module that will display brake status with a series of colored LED's.

E-Stroke Module Inspection Procedure

A. Chock vehicle's wheels (as an added safety measure)
B. Start engine and build system air pressure to 100–110 psi
C. Release parking brake
D. Apply service brake foot pedal one time only to 90–100 psi (for at least 2 seconds), then release foot pedal (wait at least 6 seconds).
E. View System Status LED & Brake Chamber LED's on E-Stroke Module.

System Status LED:

Solid Green — Operating Properly

Blinking Red — Low system voltage (may be accompanied by unlit brake chamber LED's)

Brake Chamber LED's:

Unlit — Low voltage (accompanied by Blinking Red System Status LED)

Solid Green — Normal brake stroke

Slow Red Blink — Dragging brake

Rapid Red Blink — Overstroke condition

Alternating Red/Green **(short-long-short)** — Non-functioning brake actuator

Blinking Orange **(long-short-long)** — Sensor fault

Blinking Green (or Unlit) — see MGM Brakes Trouble-Shooting Guide

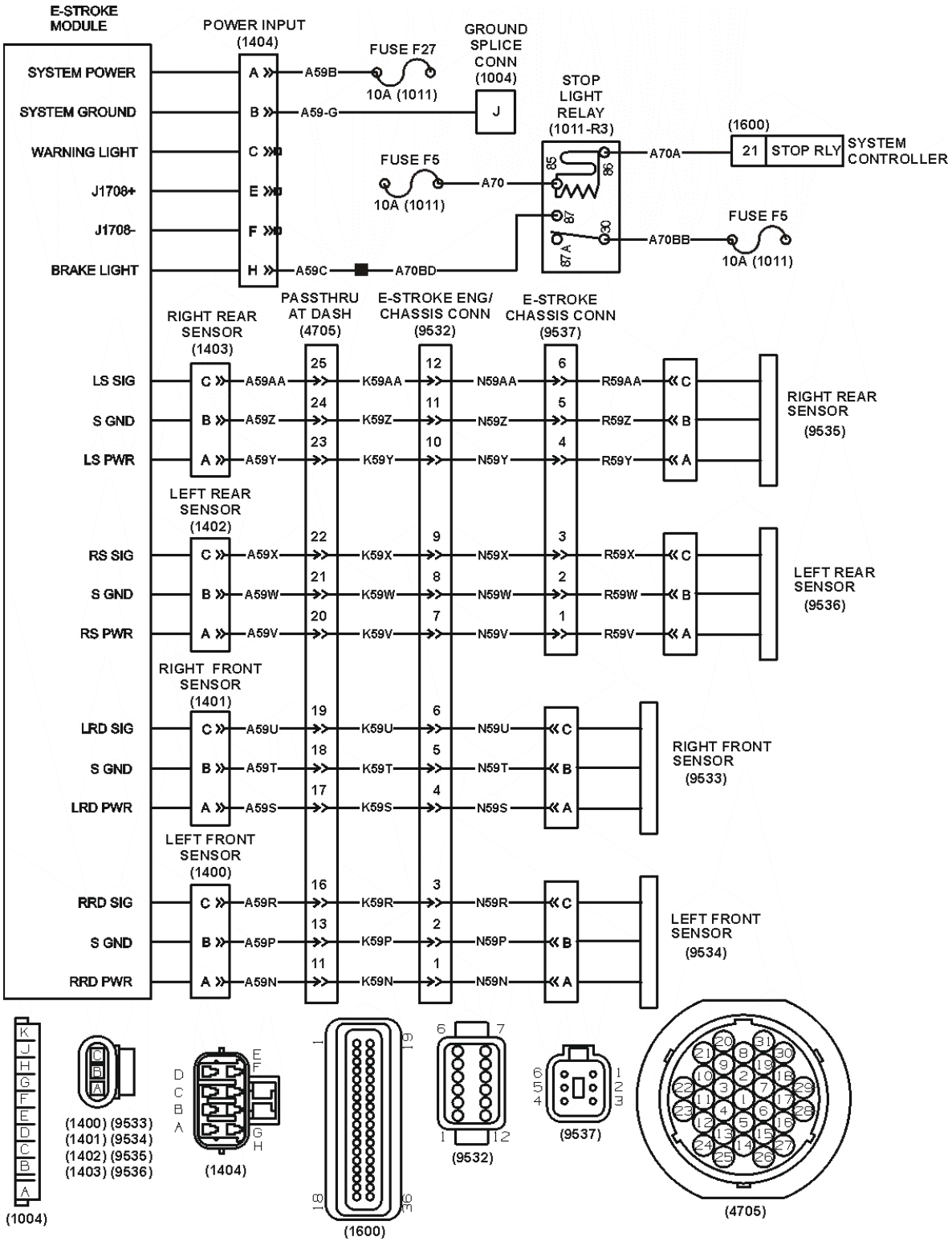

Figure 322 E–Stroke Module Circuit Diagram — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1004) GROUND SPLICE CONNECTION
LOCATED RIGHT SIDE INSTRUMENT PANEL
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1400) (1401) (1402) (1403) BRAKE MONITOR SENSOR CONNECTOR
LOCATED AT INSIDE MIDDLE DASH PANEL
(1404) BRAKE MONITOR MODULE POWER INPUT
LOCATED AT INSIDE MIDDLE DASH PANEL
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4705) PASS THRU AT DASH
LOCATED AT INSIDE DASH PANEL LEFT SIDE
(9532) E-STROKE ENGINE/CHASSIS CONNECTOR
LOCATED AT MID CHASSIS ENGINE/CHASSIS INTERCONNECTION
(9533) (9534) (9535) (9536) E-STROKE SENSOR CONNECTOR
LOCATED AT BRAKE ACTUATOR
(9537) E-STROKE CHASSIS
LOCATED AT MIDDLE INSIDE FRAME RAIL

Table 195 E-Stroke Module Voltage Check Chart

For detailed information on the E-Stroke Module, refer to the MGM company for specs.		
E-Stroke Power Input (1404) Voltage Checks Check with ignition key on, stop light relay installed, (1404) disconnected and brake pedal pressed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
E-Stroke power input (1404) pin H to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short in circuits A59C and A70BD.
E-Stroke power input (1404) pin A to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for blown fuse F27. Also check for open or short in circuit A59B.
E-Stroke power input (1404) pin A to B.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short to high in circuit A59–G. Also ensure proper ground connection to ground splice connection.
Stop Light Relay (1011–R3) Voltage Checks Check with ignition key on, stop light relay removed, (1404) connected and brake pedal pressed. Bench test relay. If relay fails, replace and check for faults. **NOTE – Always check connectors for damage and pushed–out terminals.** **Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Stop light relay (1011–R3) cavity 85 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for blown fuse F5. Also check for open or short in circuit A70.

Table 195 E-Stroke Module Voltage Check Chart (cont.)

Stop light relay (1011–R3) cavity 85 to 86.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short in circuits A70A. Also ensure proper ground from ESC (1600) pin 21.
Stop light relay (1011–R3) cavity 30 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for blown fuse F5. Also check for open or short in circuit A70BB.
Stop light relay (1011–R3) cavity 30 to 87.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short in circuits A59C and A70BD. If voltages check good and E-stroke module still fails, consult MGM for further diagnosis of E-Stroke Module.

2.5. COMPONENT LOCATIONS

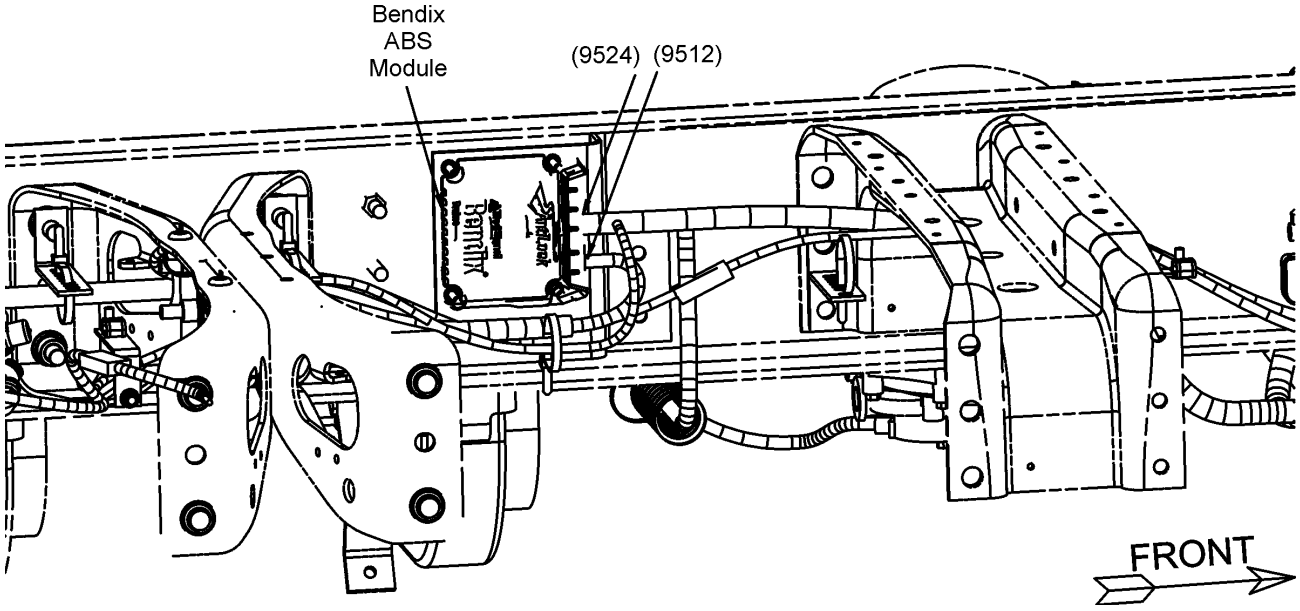

Figure 323 Air ABS ECU Location

(9512) BENDIX AIR ABS CONNECTOR
(9524) BENDIX AIR ABS MODULE CONNECTOR

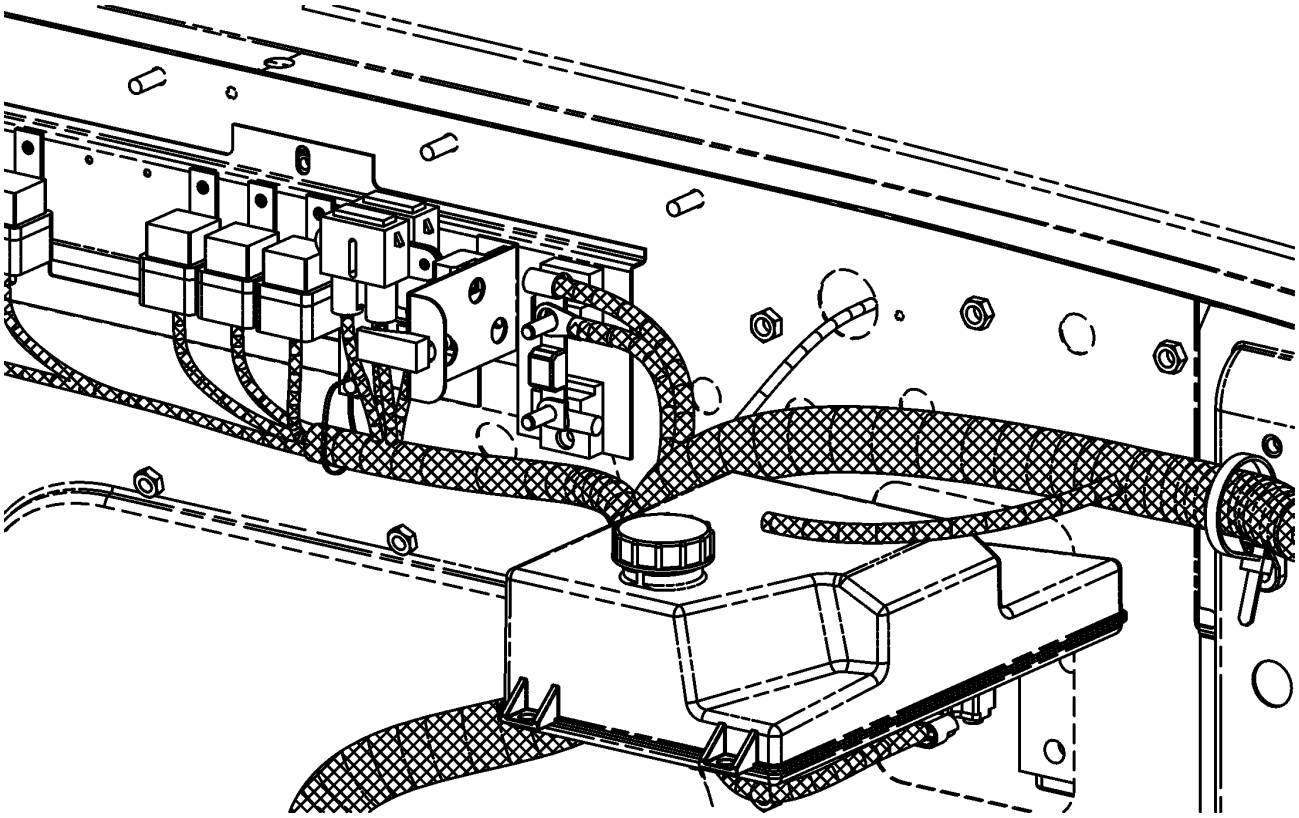

Figure 324 Engine Compartment Power Distribution Center

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

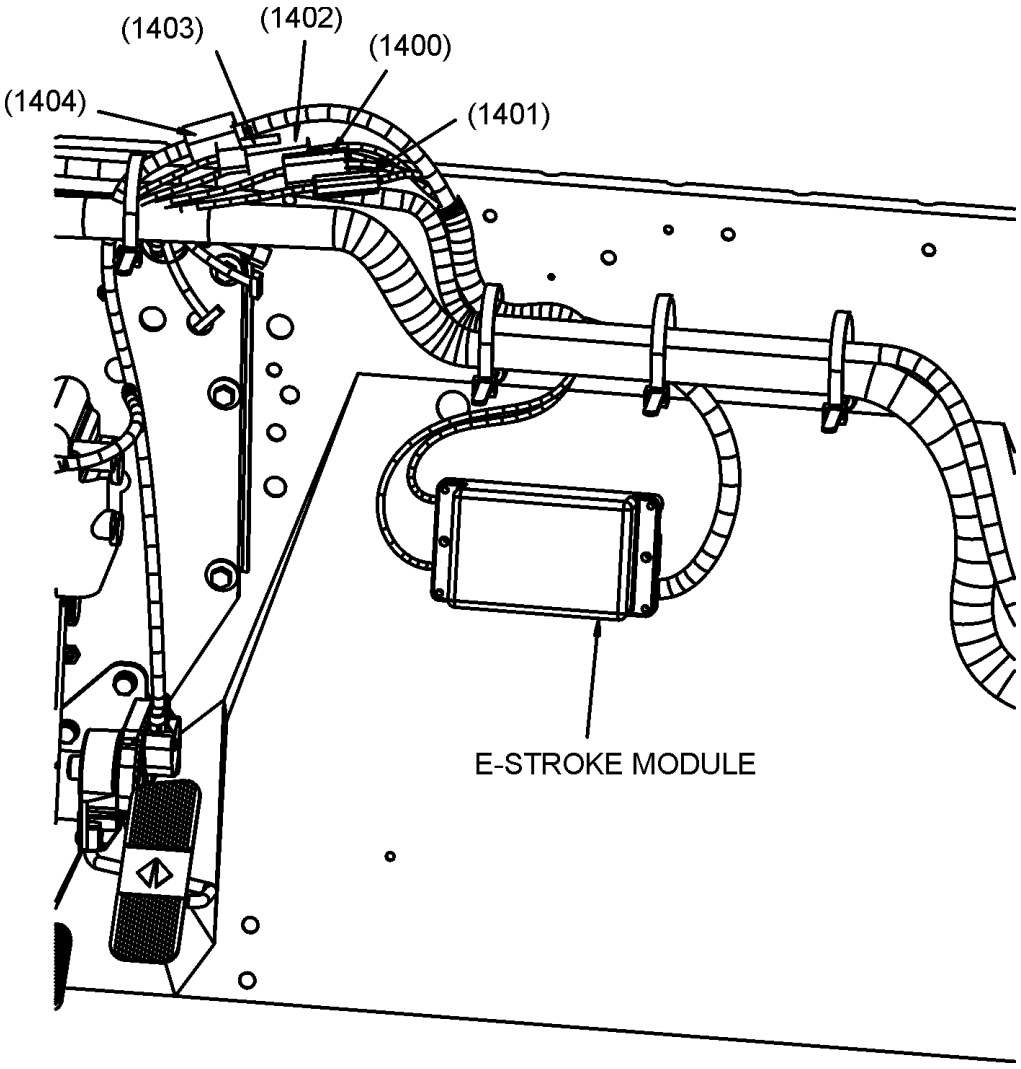

Figure 325 E-Stroke Module Location

(1400) BRAKE MONITOR LEFT FRONT SENSOR CONNECTOR
(1401) BRAKE MONITOR RIGHT FRONT SENSOR CONNECTOR
(1402) BRAKE MONITOR LEFT REAR SENSOR CONNECTOR
(1403) BRAKE MONITOR RIGHT REAR SENSOR CONNECTOR
(1404) BRAKE MONITOR MODULE POWER INPUT

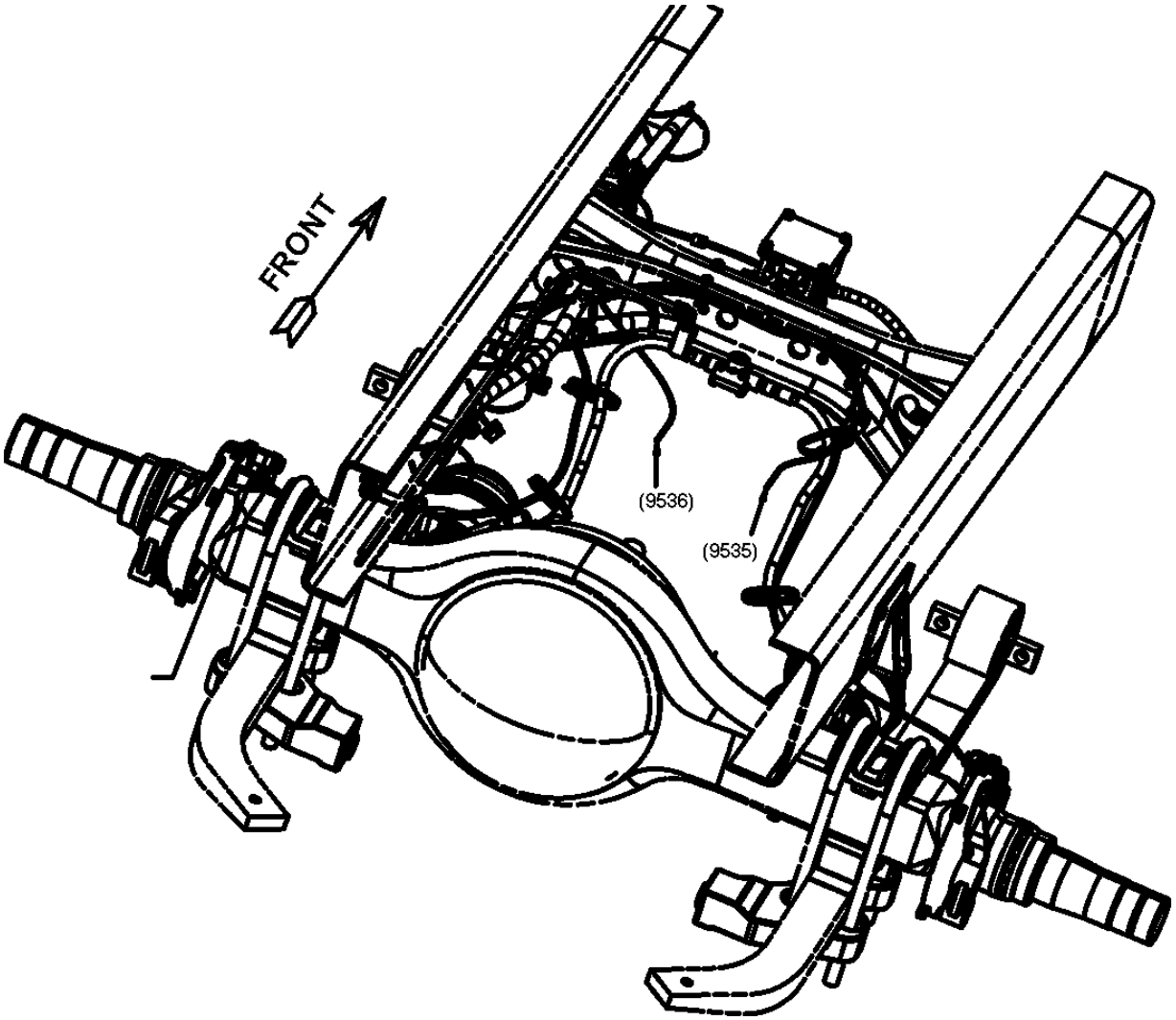

Figure 326 E-Stroke Rear Sensor Locations

(9535) E-STROKE RIGHT REAR SENSOR
(9536) E-STROKE LEFT REAR SENSOR

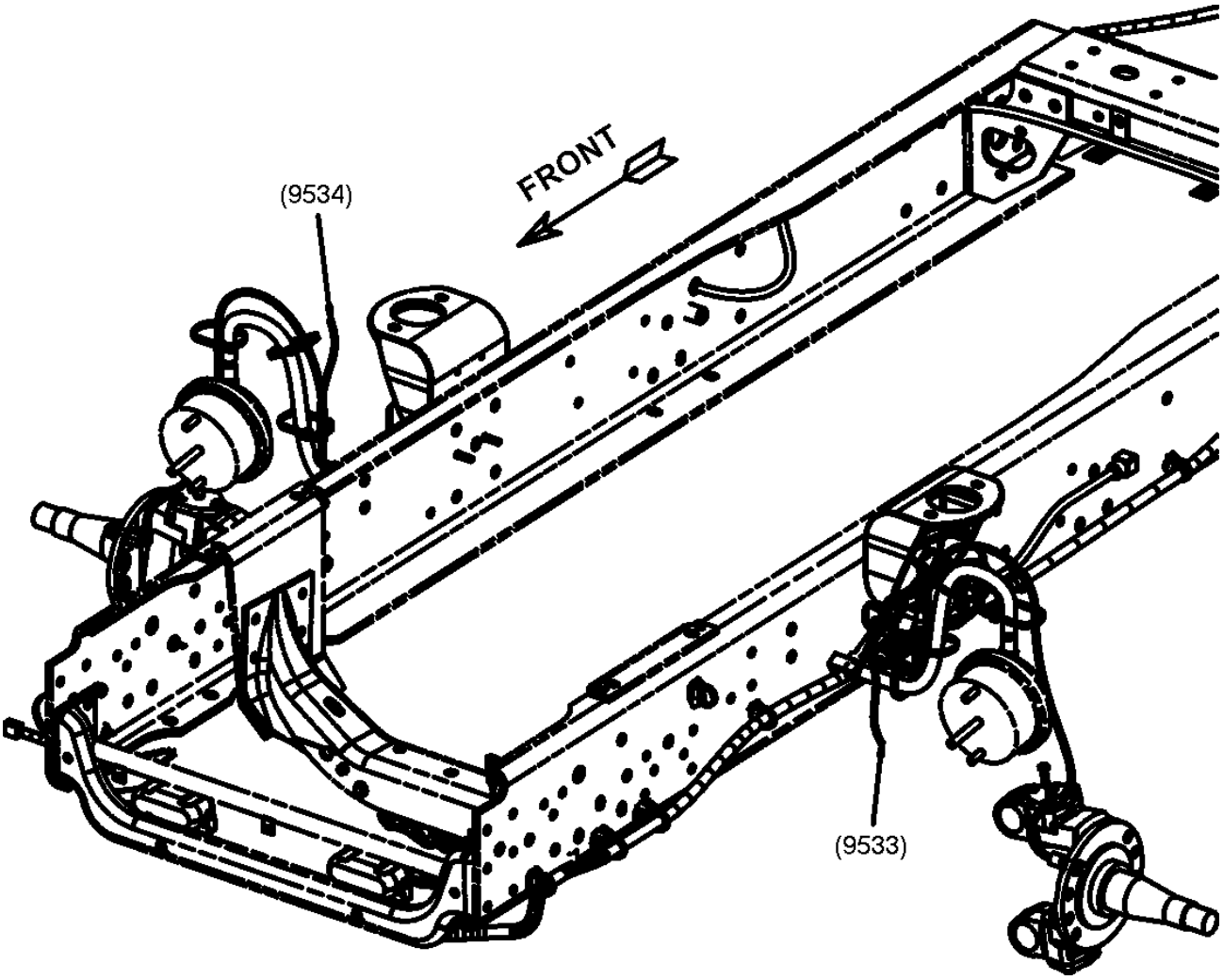

Figure 327 E-Stroke Front Sensor Locations

(9533) E-STROKE RIGHT FRONT SENSOR
(9534) E-STROKE LEFT FRONT SENSOR

3. WABCO FULL POWER BRAKES

3.1. CIRCUIT FUNCTIONS

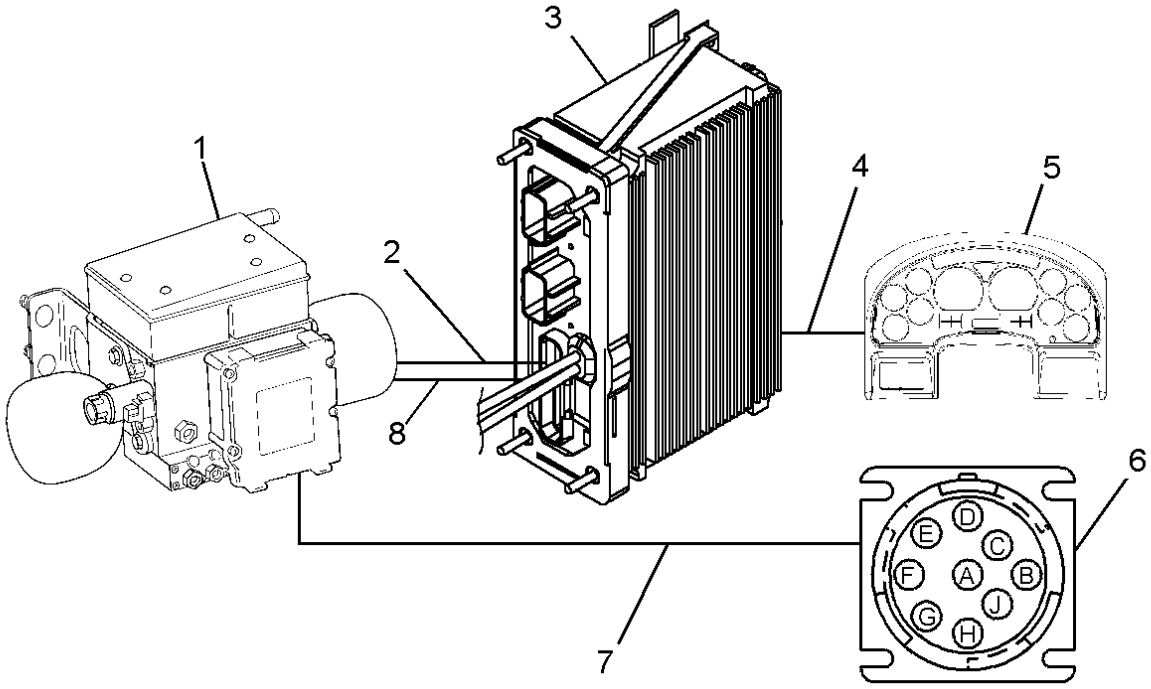

Figure 328 Full Power Brake System Function Diagram

1. MERITOR WABCO FULL POWER BRAKES ELECTRONIC CONTROL UNIT (ECU), MOUNTED ON HYDRAULIC COMPACT UNIT (HCU)
2. CIRCUITS TO ESC
3. ELECTRICAL SYSTEM CONTROLLER (ESC)
4. 1939 DATA LINK (SWITCH AND INDICATOR INFO)
5. ELECTRONIC GAUGE CLUSTER (EGC)
6. DIAGNOSTIC CONNECTOR
7. 1708 DATA LINK (PRIMARILY FOR DIAGNOSTICS AND PROGRAMMING)
8. 1939 DATA LINK (DRIVELINE)

The Meritor WABCO Full Power Braking System (FPB) is an electronic wheel speed monitoring and control system used on the IC Corporation BE and CE Buses to provide Antilock Braking, Automatic Traction Control and a Powered Parking Brake.

Discussion of the hydraulic antilock braking system, in this section, is limited to power circuits and data link connectivity. For detailed information on ABS operation and troubleshooting, refer to The Full Power Brake manual.

The ABS ECU monitors system signals and interacts with the ESC to control brake system status/warning indicators.

3.2. DIAGNOSTICS

Should a failure occur in the full power system, one or more of the brake system warning lamps will illuminate. ABS braking may be partially or completely disabled, but normal braking will still be available.

Problems in the Full Power electrical circuits can be attributed to short circuits, open circuits, a blown fuse, a failed relay, a failed sensor or switch or a failed ECU.

The ESC will only log a fault for conditions monitored by the ESC (brake pedal signal, datalink).

To initiate these DTC's the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch simultaneously for 2 seconds.

The Full Power ECU generates its own diagnostic trouble codes. These diagnostic trouble codes are not displayed on the gauge cluster odometer display. Diagnostic trouble codes generated by the Full Power ECU can be read with an electronic service tool, running the Meritor WABCO "TOOLBOX" diagnostic software. The service tool and "TOOLBOX" can also be used to clear ABS diagnostic trouble codes. Refer to S04048 for more information.

If the service tool running the "TOOLBOX" software is not able to communicate with the ABS ECU there may be a problem with the 1708 data link. (See HYDRAULIC ABS DATA LINK CIRCUITS, page 663)

Hydraulic ABS Preliminary Check

Table 196 Hydraulic ABS Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the full power system warning lamps are operating.	Visually check full power system warning lights (ABS, BRAKE PRESSURE, SERVICE PARK BRAKE, TRAC CTRL).	Full power system warning lights should illuminate during the gauge sweep.	Go to next step.	Full power system warning lamps or warning lamp circuits need repaired.
2.	On	Verify there is a problem with the full power system.	Visually check full power system warning lights (ABS, BRAKE PRESSURE, SERVICE PARK	ABS warning light is on constantly.	Go to next step.	ABS is operating. Problem does not exist or is intermittent (Check for inactive diagnostic trouble codes).

Table 196 Hydraulic ABS Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
			BRAKE, TRAC CTRL).			
3.	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.
4.	On	Check for ESC diagnostic trouble codes. (See ESC Diagnostic Trouble Codes, page 656)	Read display on odometer.	No ESC diagnostic trouble codes for ABS are active.	Go to next step.	Go to ESC Diagnostic Trouble Codes. (See ESC Diagnostic Trouble Codes, page 656)
5.	On	Check for Full Power Brake ECU diagnostic trouble codes. (See Full Power Brake ECU Diagnostic Trouble Codes, page 657)	Read diagnostic trouble codes.	No ABS diagnostic trouble codes are active.	Go to Hydraulic ABS Warning Light Circuits. (See HYDRAULIC ABS WARNING LIGHT CIRCUITS, page 663)	Refer to maintenance manual S04048.

ESC Diagnostic Trouble Codes

To display ESC diagnostic codes, set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch momentarily. If no faults are present, the cluster odometer will display “NO FAULT”. If faults are present, the gauge cluster display will show 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 selector button. The last character of the diagnostic trouble code will end in “A” for active faults or “P” for previously active faults. Turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

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 and releasing them.

Table 197 Hydraulic Brake ESC Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
597 14 1 0	Brake switch is stuck in the open or closed position.

Table 197 Hydraulic Brake ESC Diagnostic Trouble Codes (cont.)

597 14 2 0	Brake switch inputs do not match.
639 14 250 254	Brake message is not being communicated to the ESC.
One of these DTC's will be are logged when there is a problem with the power, datalink or brake switch circuit. Refer to Hydraulic ABS Warning Light Circuits. (See HYDRAULIC ABS WARNING LIGHT CIRCUITS, page 663)	

Full Power Brake ECU Diagnostic Trouble Codes

If a fault is indicated (warning lights "on"), use the electronic service tool and the TOOLBOX software to review the DTC's set by the Full Power Brake ECU. Refer to the Full Power Brake manual (S04048) and the diagrams in this section to troubleshoot the fault.

3.3. HYDRAULIC ABS POWER CIRCUITS

Fault Detection Management

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

Missing power to the ABS ECU will cause the ABS warning light to remain on and the brake message DTC will be active.

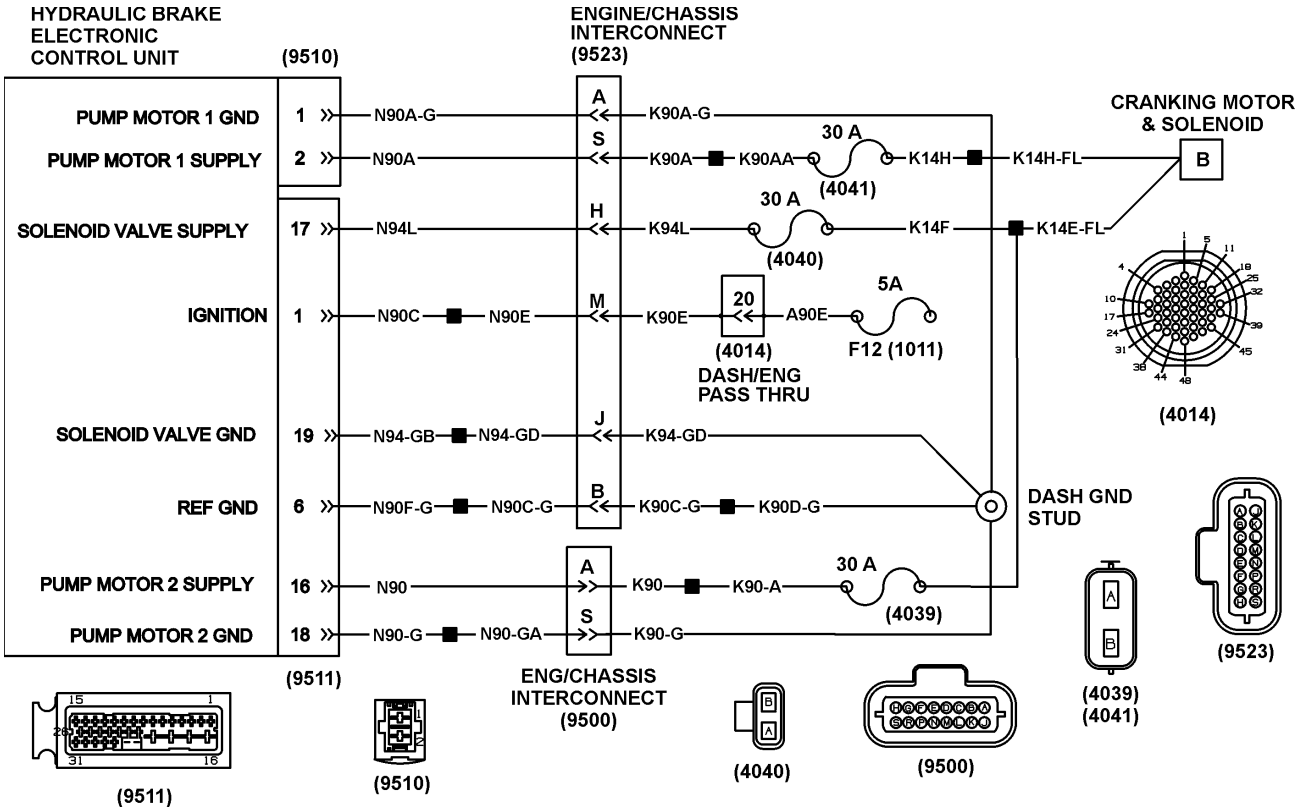

Figure 329 Hydraulic ABS Power and Ground Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4039) FULL POWER BRAKE FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4040) HYDRAULIC BRAKE VALVE FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4041) ABS MAXI FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9510) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON ABS HYDRAULIC COMPACT UNIT
(9511) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON ABS HYDRAULIC COMPACT UNIT
(9523) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

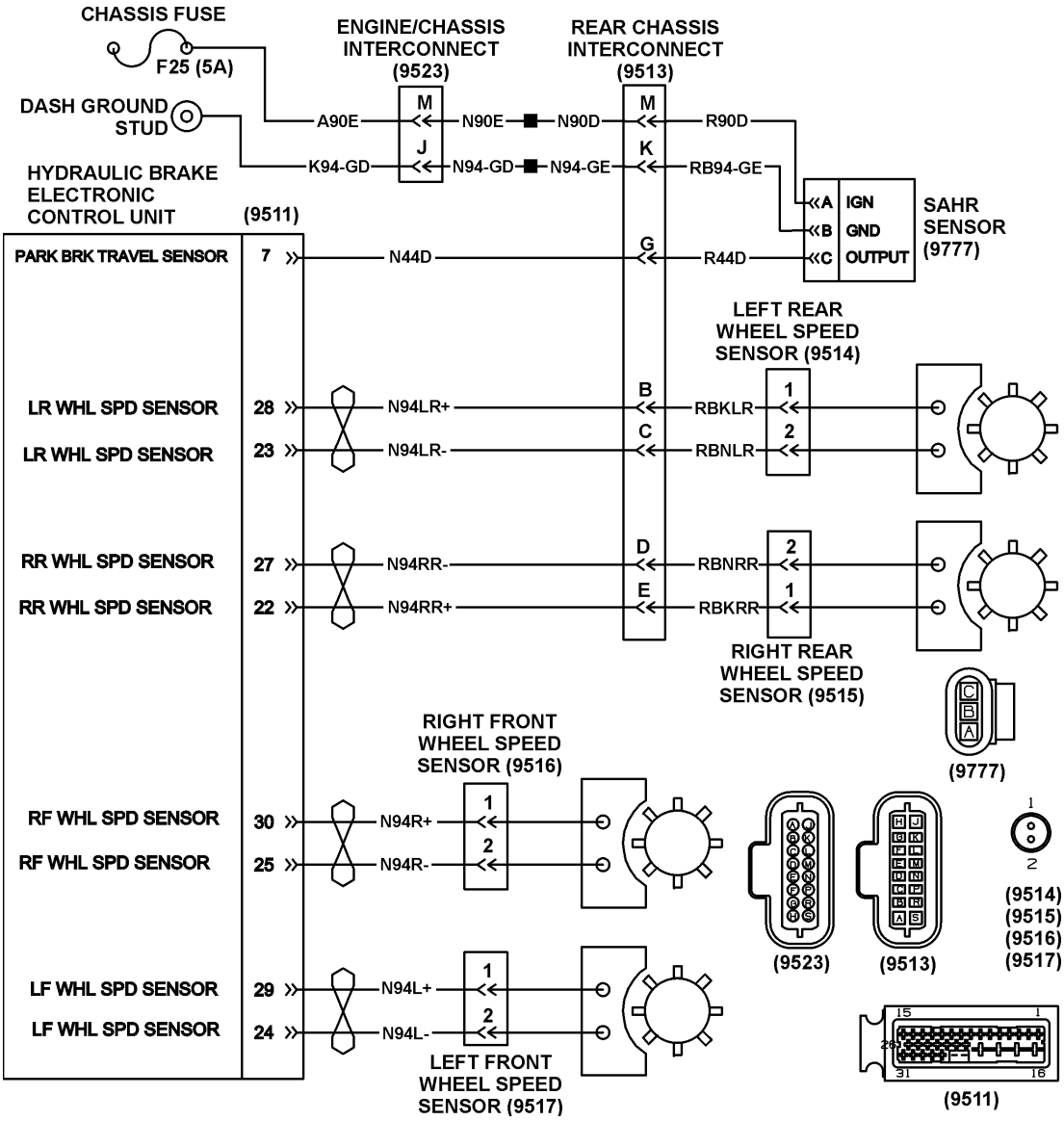

Figure 330 Hydraulic ABS Sensor Input Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(9511) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON HCU
(9513) REAR CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND HCU
(9514) (9515) (9516) (9517) HYDRAULIC WHEEL SPEED SENSOR
LOCATED AT RESPECTIVE WHEEL
(9523) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9777) PARK BRAKE SAHR SENSOR
LOCATED AT INSIDE LEFT FRAME RAIL ON SAHR CANISTER

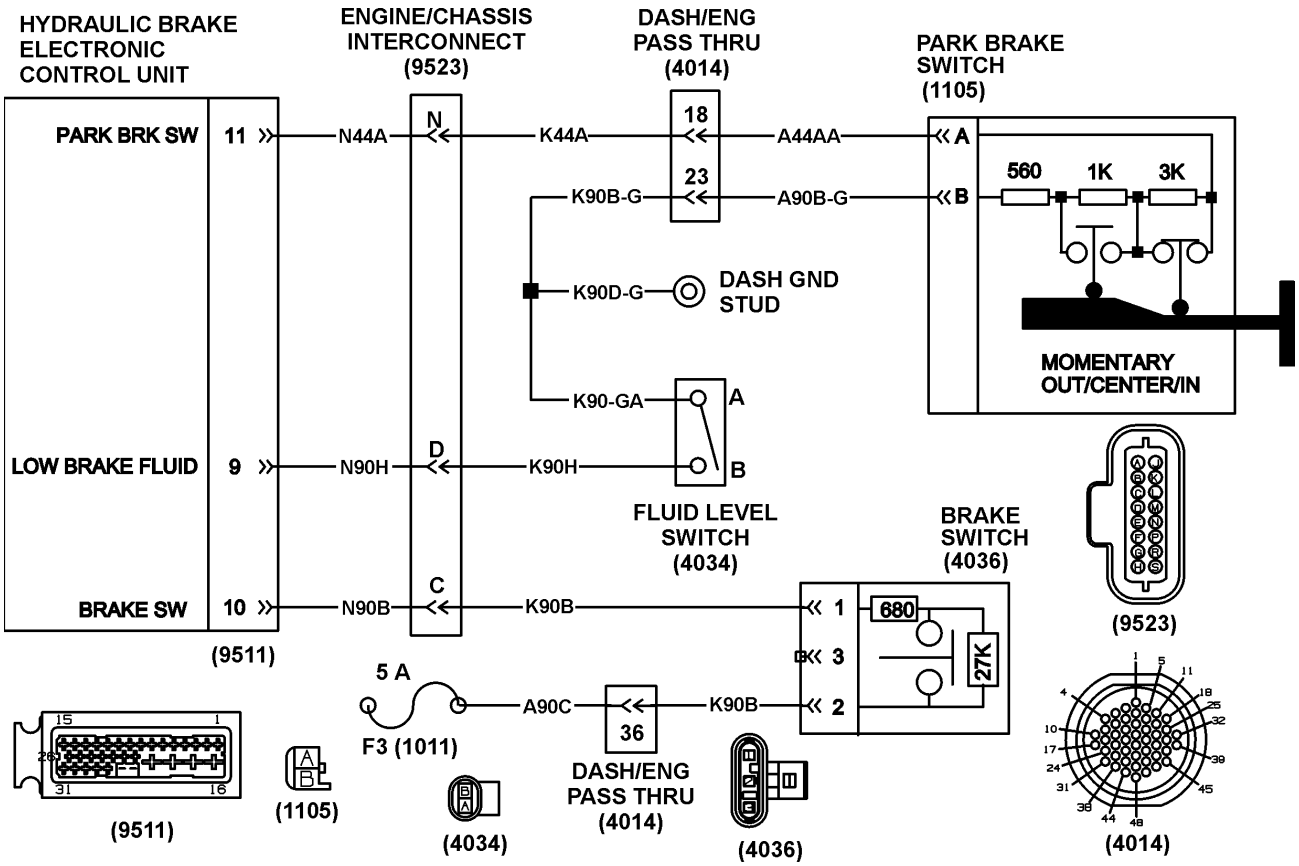

Figure 331 Hydraulic ABS Switch Input Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1105) HYDRAULIC PARK BRAKE SWITCH
LOCATED AT INSTRUMENT WING PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4034) HYDRAULIC FLUID LEVEL SWITCH
LOCATED AT HYDRAULIC MASTER CYLINDER
(4036) HYDRAULIC BRAKE SWITCH
LOCATED AT HYDRAULIC MASTER CYLINDER
(9511) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON HCU
(9523) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

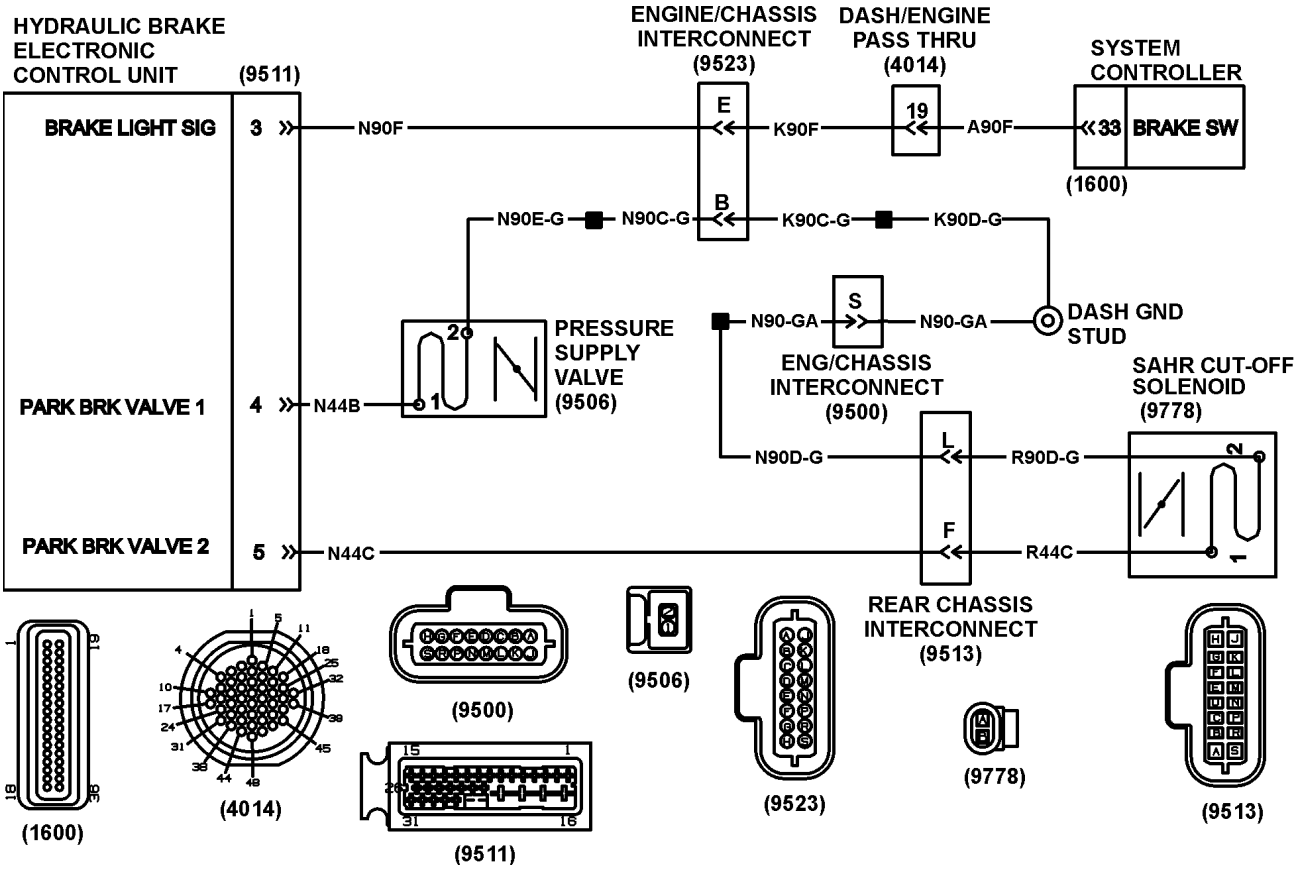

Figure 332 Hydraulic ABS Output Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9506) PARK BRAKE PRESSURE SUPPLY VALVE
LOCATED AT INSIDE LEFT FRAME RAIL ON HCU
(9511) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON HCU
(9513) REAR CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND HCU
(9523) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9778) PARK BRAKE CUT-OFF SOLENOID
LOCATED AT INSIDE LEFT FRAME RAIL ON SAHR CANISTER

Table 198 Hydraulic ABS ECU Power

Hydraulic ABS Harness Connector (9510) Check with hydraulic ABS harness connector (9510) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECU harness connector (9510) cavity 2 to ground	Checks battery power circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for blown 30 amp fuse (4041) or open or short in circuits N90A, K90A, K90AA, K14H and K14H-FL.
ECU harness connector (9510) cavity 1 to cavity 2	Checks ground circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for open in circuits N90A-G and K90A-G to ground stud.
Hydraulic ABS Harness Connector (9511) Check with ignition key on and hydraulic ABS harness connector (9511) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECU harness connector (9511) cavity 1 to ground.	Checks ignition power circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for blown 5 amp fuse F25. Also check open or short in circuits N90C, NK90E, K90E and A90E.
ECU harness connector (9511) cavity 17 to ground.	Checks battery power circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for blown 30 amp fuse (4040) or open or short in circuits N94L, K94L, K94LA, K14F and K14E-FL.
ECU harness connector (9511) cavity 16 to ground.	Checks battery power circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for blown 30 amp fuse (4039) or open or short in circuits N90, K90, K90–A, K14E and K14E-FL.
ECU harness connector (9511) cavity 16 to cavity 6.	Checks ground circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for open or short to high in circuits N90F-G, N90C-G, K90C-G and K90D-G to ground stud.
ECU harness connector (9511) cavity 16 to cavity 18.	Checks ground circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for open or short to high in circuits N90–G, N90–GA and K90-G to ground stud.
ECU harness connector (9511) cavity 16 to cavity 19.	Checks ground circuit. 12 ± 1.5 volts.	If voltage is incorrect, check for open or short to high in circuits N94–GB, N94–GD and K94-GD to ground stud.

Extended Description

The hydraulic ABS ECU receives battery power to connector (9510) cavity 2 on circuits K14H, K90AA, K90A and N90A, (9511) cavity 16 on circuits K14E-FL, K14E, K90–A, K90, and N90, and (9511) cavity 17 on circuits K14E-FL, K14F, K94LA, K94L and N94L from the battery connection of the cranking motor and solenoid. Ignition power is received on connector (9511) cavity 1 from circuits N90C, N90E, K90E and A90E from fuse F12.

Ground for the ECU is supplied to (9510) cavity 2 on circuits N90A-G and N90A–G, (9511) cavity 6 on circuits K90D-G K90C-G, N90C-G and N90F-G, (9511) cavity 18 on circuits K90–G, N90–GA, N90–G, and (9511) cavity 19 on circuits K94–GD, N94–GD, and N94–GB from the dash ground stud.

3.4. HYDRAULIC ABS WARNING LIGHT CIRCUITS

Fault Detection Management

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

This system employs 5 warning indicators (BRAKE PRESSURE, BRAKE FLUID, ABS, TRAC CTRL and SERVICE PARK BRAKE) and one status indicator (PARK BRAKE). The warning indicators are lit in various combinations based on the fault detected by the ECU. The PARK Brake indicator is lit whenever the parking brake (SAHR) travel switch senses that the park brake is applied. When a fault is detected (based on inputs monitored by the ECU), the ECU send a J1939 data link message to the ESC telling it which indicator(s) to turn on. If the ESC does not receive a communication from the ECU within a predetermined period of time it assumes that the ECU has lost power and it turns on the appropriate warning indicators.

Refer to the Full Power Brake manual for more information.

In general if a warning indicator is lit, connect the electronic service tool and the use the TOOLBOX diagnostic software to troubleshoot the system.

3.5. HYDRAULIC ABS DATA LINK CIRCUITS

Fault Detection Management

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

The hydraulic ABS ECU is connected to the 1708 data link, primarily for diagnostic and programming capability.

Problems with the 1708 data link circuits will be evident when the service tool running the diagnostic software cannot communicate with the ECU.

Problems with the J1939 data link circuits will be indicated by a lit ABS indicator and the logging of an ESC DTC.

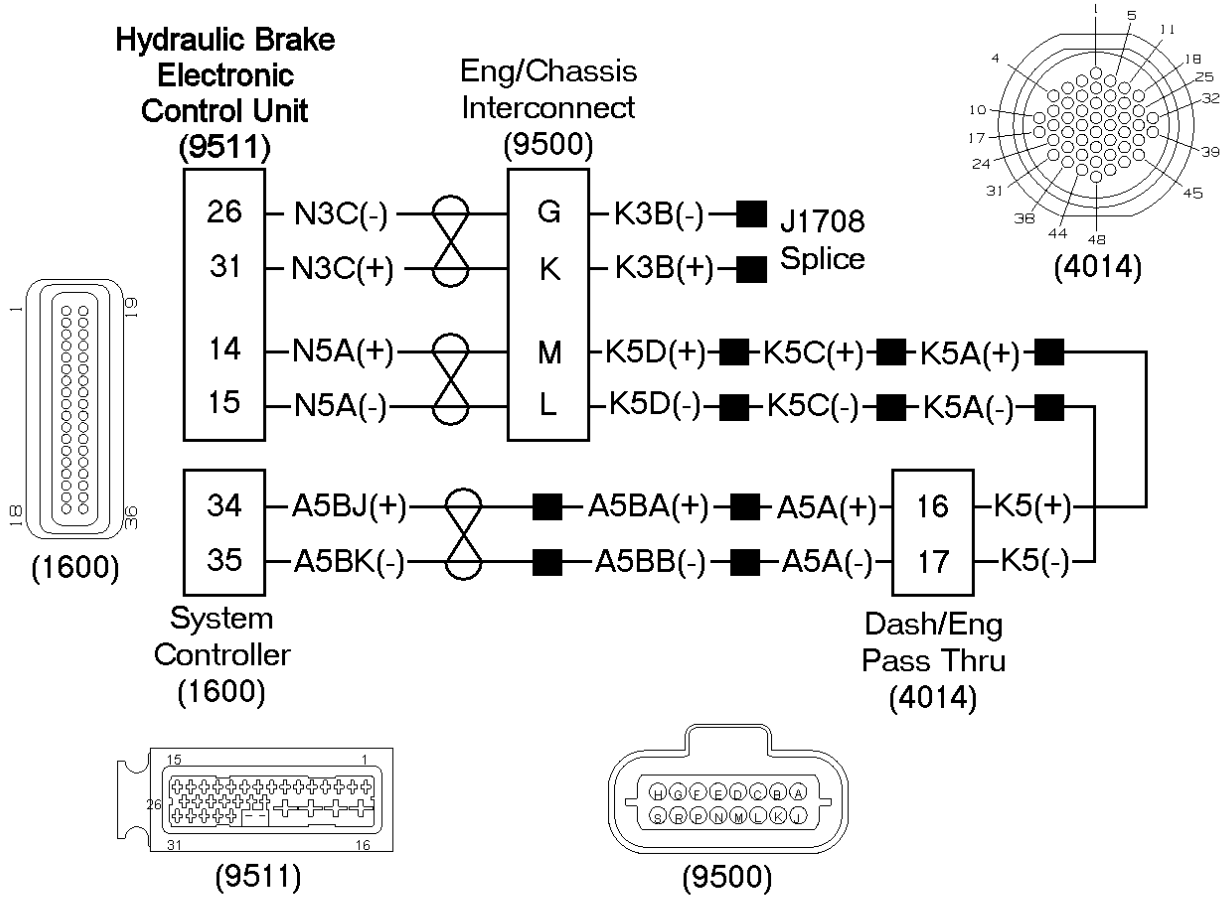

Figure 333 Hydraulic ABS Data Link Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
(9511) HYDRAULIC BRAKE ELECTRONIC CONTROL UNIT
LOCATED AT INSIDE LEFT FRAME RAIL ON HCU

Table 199 Hydraulic ABS Data Link Circuits Connector Chart

1708 data link circuits at ABS ECU Connector (9511) Perform this check only if the ABS ECU is the only component not communicating on the 1708 data link. If there is no communication with any components on the data link repair the data link. Check with ignition key on and ABS ECU connector (9511) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECU harness connector (9511) cavity 31 to ground.	Checks positive data link circuit to ground. Approximately 4 volts	(+) data link circuit. If voltage is low check for open or short to ground in circuits N3C(+) and K3B(+).
ECU harness connector (9511) cavity 26 to ground.	Checks negative data link circuit to ground. Approximately 1 volt	(-) data link circuit. If voltage is low check for open or short to ground in circuits N3C(-), and K3B(-). If voltage is high check for crossed data link circuits.
If there is a J1939 data link fault, refer to the Drivetrain 1939 Data Link section of this manual. If circuits check good, consider replacing the ECU.		

Extended Description

The Hydraulic ABS data link circuits connect to the ESC through the J1708 line through the engine/chassis interconnect (9500).

The Hydraulic ABS datalink circuits also connect to the ESC, ECM and Transmission Controller through the J1939 line through (9500).

3.6. COMPONENT LOCATIONS

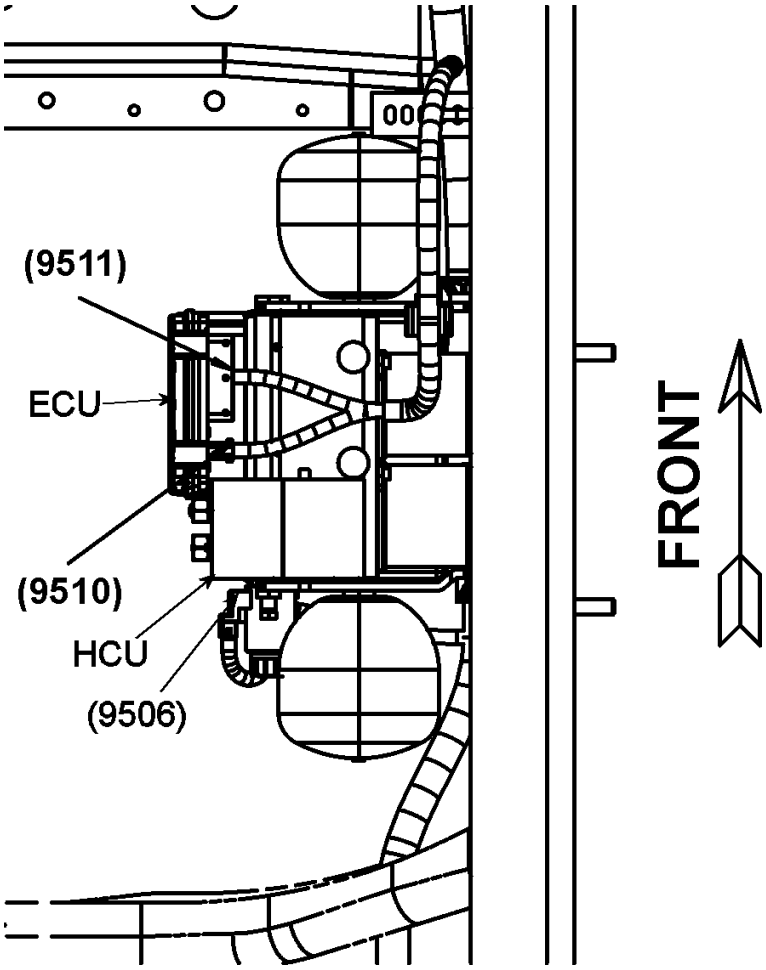

Figure 334 Hydraulic ABS Wiring (Viewed from Underneath)

(9506) PARK BRAKE SUPPLY VALVE
(9510) (9511) HYDRAULIC COMPACT UNIT (HCU) WITH ELECTRONIC CONTROL UNIT (ECU) MOUNTED

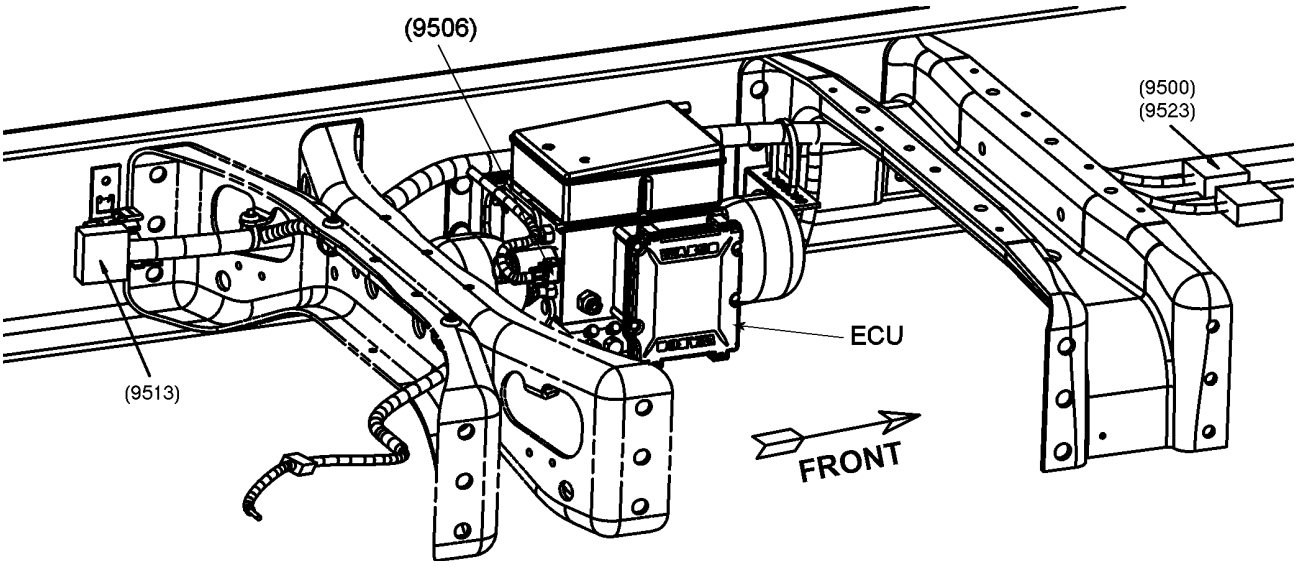

Figure 335 Hydraulic ABS ECU Location (Mounted on Hydraulic Compact Unit)

(9500) (9523) ENGINE/CHASSIS INTERCONNECT
(9506) PARK BRAKE SUPPLY VALVE
(9513) REAR CHASSIS INTERCONNECT

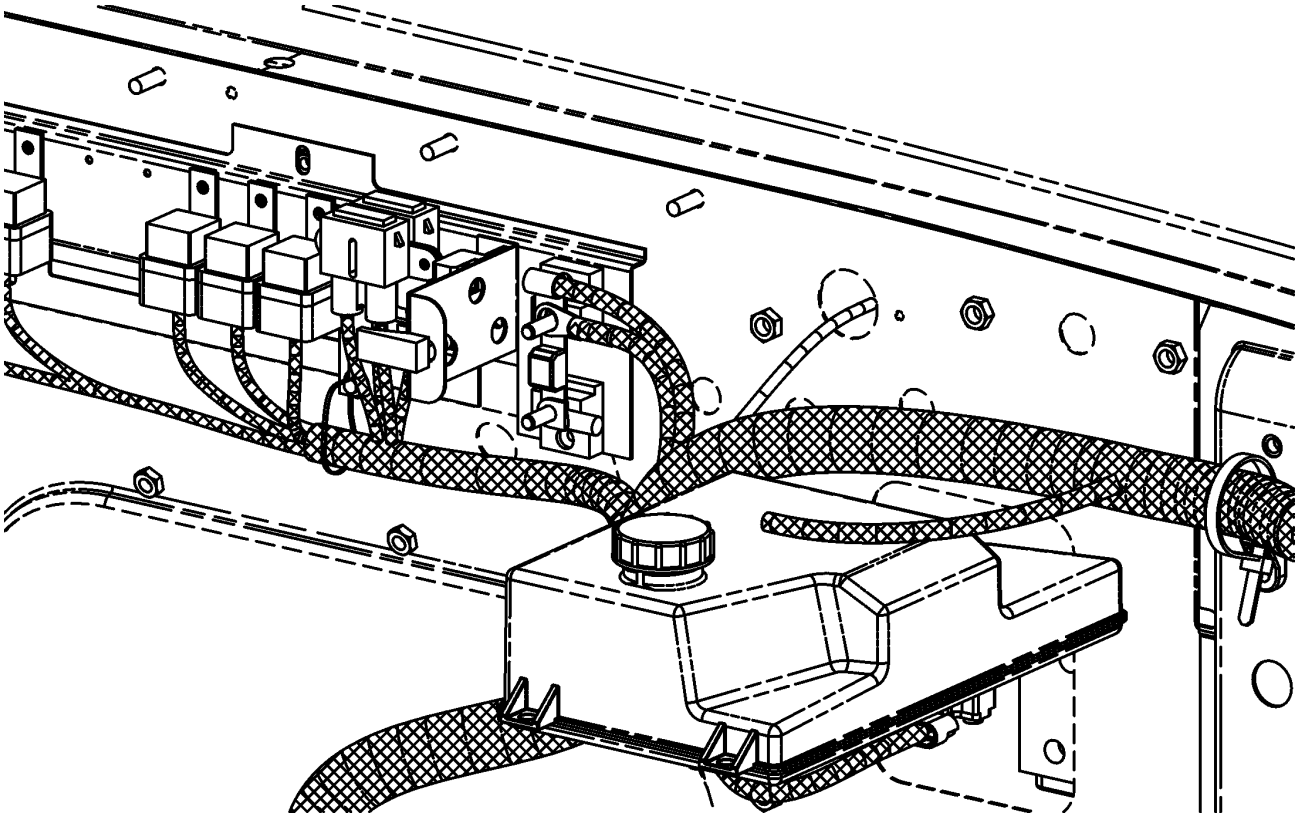

Figure 336 Engine Compartment Power Distribution Center

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

4. FUEL HEATER

4.1. CIRCUIT FUNCTIONS

The fuel heater is mounted in the fuel filter. It prevents fuel from gelling in the unfiltered side of the filter during cold weather.

The system consists of a fuel heater relay, filter heating element, and a normally open thermoswitch. The switch closes at approximately 10°C/50°F.

4.2. DIAGNOSTICS

Should the fuel heater fail to operate, the problem could be attributed to a failed relay, an open or shorted circuit or a failed heating element/switch assembly.

There are no diagnostic trouble codes associated with the fuel heater circuits.

Fuel Heater Preliminary Check

Table 200 Fuel Heater Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify fuel heater is inoperative.	Check fuel heater.	Fuel heater is inoperative.	Go to next step.	Fuel heater is operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other 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	Go to Fuel Heater Circuits. (See FUEL HEATER CIRCUITS, page 669)				

4.3. FUEL HEATER CIRCUITS

Fault Detection Management

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

A fault in the fuel heater circuits will be apparent when the temperature is below 10°C/50°F and the heater is not operating.

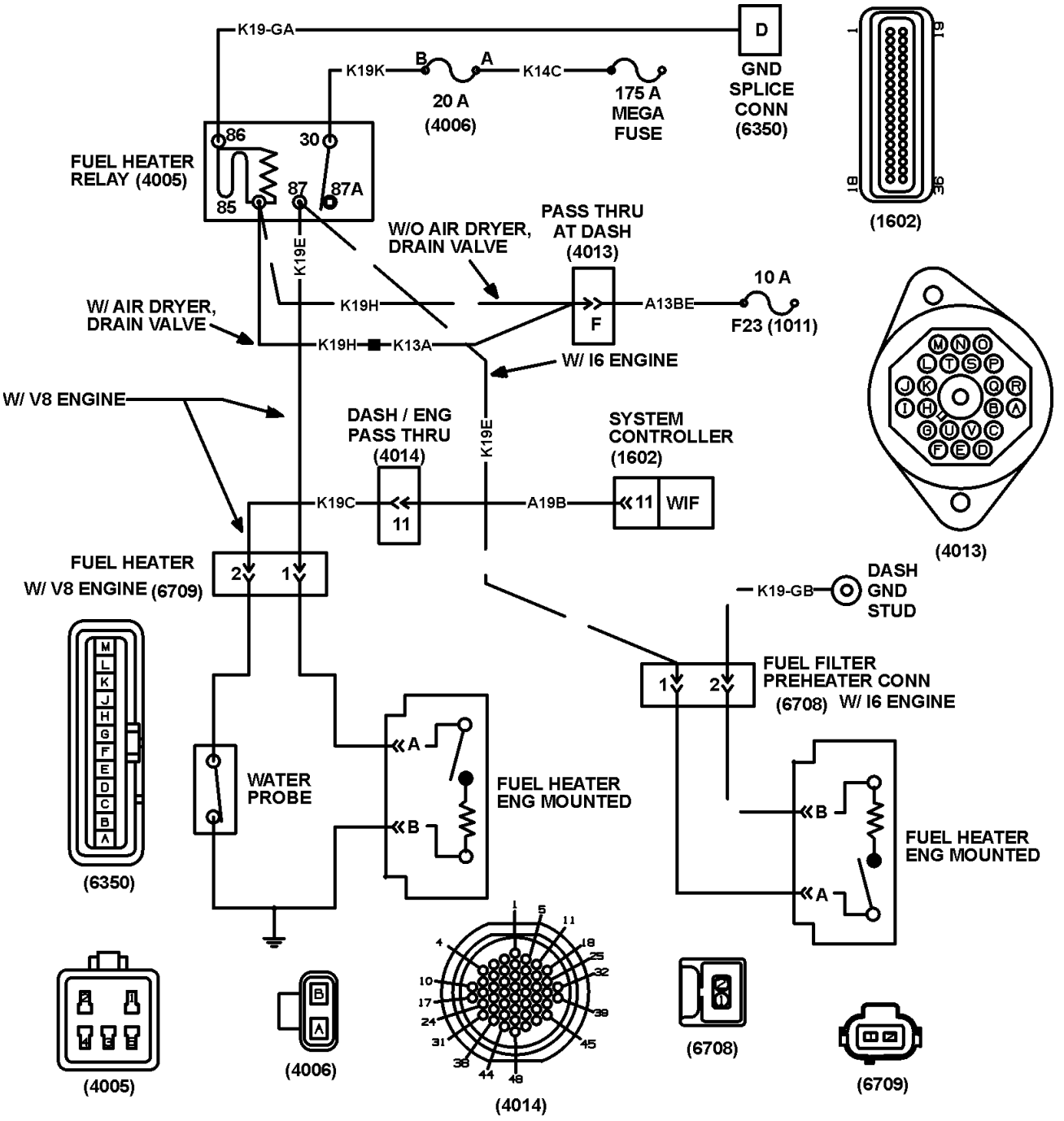

Figure 337 Fuel Heater Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4005) FUEL HEATER RELAY
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4006) FUEL HEATER FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT OUTSIDE LEFT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(6350) GROUND SPLICE PACK
LOCATED AT ENGINE COMPARTMENT NEAR STARTER
(6708) FUEL FILTER PREHEATER
LOCATED AT ENGINE COMPARTMENT FUEL FILTER
(6709) FUEL HEATER
LOCATED AT ENGINE COMPARTMENT FUEL FILTER

Table 201 Fuel Heater Connector Chart

Fuel Heater Relay (4005) Socket Voltage Checks Check with ignition on and Fuel Heater relay removed. Insure temperature is below 10°C/50°F Bench test relay. If relay fails bench test, replace and check for faults.		
Test Points	Spec.	Comments
Fuel heater relay (4005) socket cavity 30 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown 20A fuel heater fuse (4006) and blown 175A megafuse or open or short in circuits K19K and K14C.
Fuel heater relay (4005) socket 85 to ground.	12 ± 1.5 volts	If voltage is missing check for blown 10A fuse F23 and check for open or short in circuits K19H and A13BE or K19H, K13A and A13BE.
Fuel heater relay (4005) socket cavity 85 to 86.	12 ± 1.5 volts	If voltage is incorrect, check for open or short to high in circuit K19–GA to ground splice connection (6350). Also ensure proper ground connection of ground splice connector (6350).
Fuel Filter Preheater (6708) (I-6 only) Voltage Checks Check with ignition key on, fuel heater relay (4005) installed and fuel filter preheater (6708) disconnected. Insure temperature is below 10°C/50°F **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments

Table 201 Fuel Heater Connector Chart (cont.)

Fuel filter preheater (6708) terminal 1 to ground.	12 ± 1.5 volts	If voltage is missing check for open or short to ground on circuit K19E.
Fuel filter preheater (6708) terminal 1 to terminal 2.	12 ± 1.5 volts	If voltage is missing check for open or short to high on circuit K19–GB.
Fuel Heater (6709) (V8 only) Voltage Checks Check with ignition key on, fuel heater relay (4005) installed and fuel heater (6709) disconnected. Insure temperature is below 10°C/50°F **NOTE – Always check connectors for damage and pushed–out terminals.** **Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Fuel heater (6709) terminal 1 to ground.	12 ± 1.5 volts	If voltage is missing check for open or short on circuit K19E. Also ensure proper grounding of fuel heater.
Fuel heater (6709) terminal 2 to ground.	12 ± 1.5 volts	If voltage is missing check for open or short on circuits K19C and A19B. Also check for proper signal from ESC. Also ensure proper grounding of fuel heater. If voltages check good and fuel heater still fails, replace fuel heater.

Extended Description

When the ignition is on, the fuel heater relay will energize providing battery voltage to the fuel heater (V8 only) and fuel filter (I6 only). The thermoswitch in the fuel heater will close when the air temperature drops below 10°C (50°F) supplying voltage to the fuel heater.

When the water level gets to high the water probe will close the circuit providing a ground signal to the ESC pin 11.

4.4. COMPONENT LOCATIONS

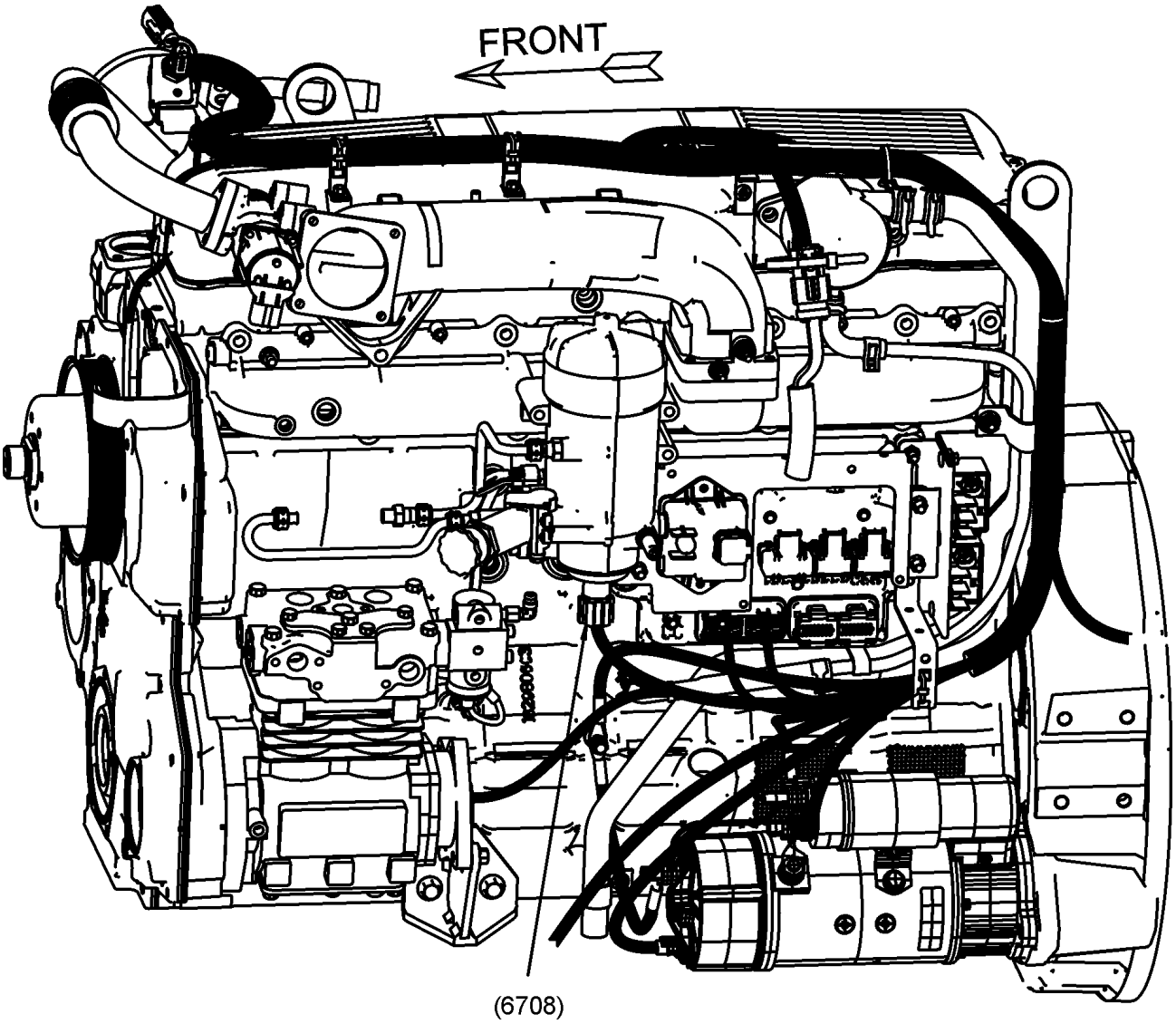

Figure 338 Fuel Preheater Location (I-6 only)

(6708) FUEL FILTER PREHEATER (I-6 ONLY)

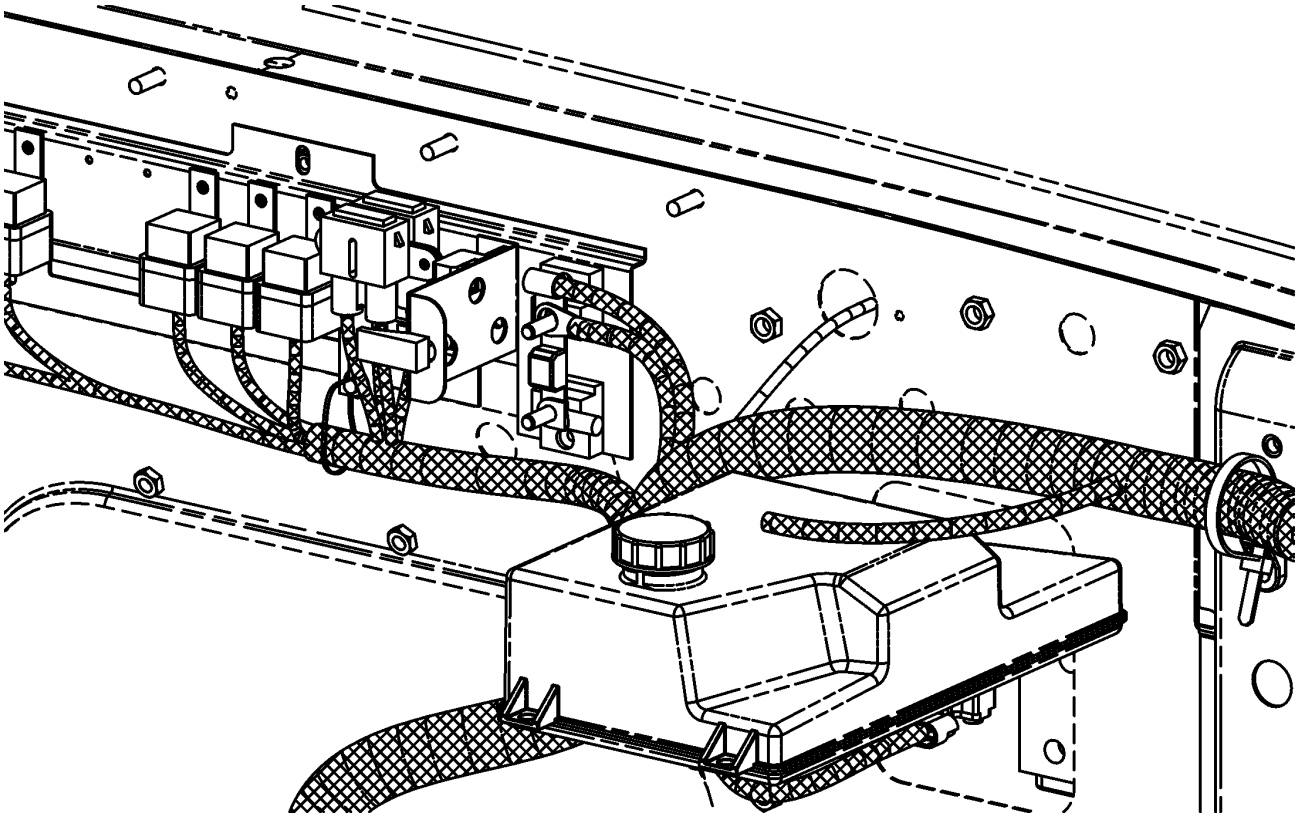

Figure 339 Engine Compartment Power Distribution Center

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

5. ESC – SOLENOID POWER CIRCUIT

5.1. CIRCUIT FUNCTIONS

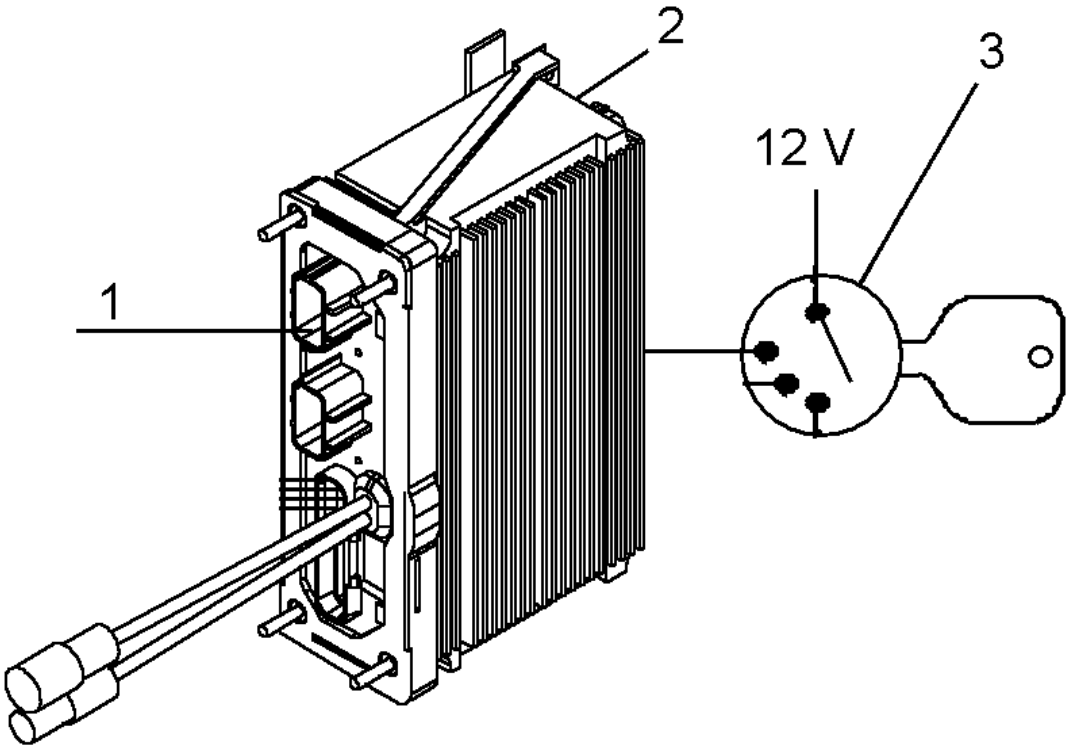

Figure 340 Solenoid Power Function Diagram

1. SOLENOID POWER CIRCUIT (TO REMOTE AIR SOLENOID MODULE)
2. ELECTRICAL SYSTEM CONTROLLER
3. KEY SWITCH

The solenoid power circuit provides battery voltage to the remote air solenoid modules. This voltage is provided on one side of the module solenoids. During normal operation the ESC will enable this voltage when the key is in the accessory or ignition position. Certain solenoid fault conditions will cause the ESC to disable the voltage.

5.2. DIAGNOSTICS

A failure in the solenoid power circuits should be suspected when several air controlled features (such as the air horn) are inoperative. The ESC will log a diagnostic trouble code when there is an open or short to ground in the circuit.

The "Diamond Logic Builder™" diagnostic software can be used to monitor the status of the signal and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

Solenoid Power Preliminary Check

Table 202 Solenoid Power Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify air solenoid controlled features are operating incorrectly.	Attempt to operate air solenoid controlled features.	Air solenoid controlled features are **not** operating correctly.	Go to next step.	Air solenoid controlled features are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other features (other than air controlled features) are malfunctioning that may have common circuits. (Example: Missing power or 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	Check for diagnostic trouble codes.	Read display on odometer.	Diagnostic trouble codes are active.	Go to next step.	An electrical failure should log a DTC. Insure there are no mechanical problems with the affected feature.
4.	On	Check for solenoid power diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 685)	Read display on odometer.	Solenoid power diagnostic trouble codes are present.	Go to Solenoid Power Circuits From ESC. (See SOLENOID POWER CIRCUITS FROM ESC, page 677)	Other DTC's are present. Go to the section on this manual associated with the DTC.

Diagnostic Trouble Codes (DTC)

To display diagnostic codes, put the vehicle in diagnostic mode. Set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch. If no diagnostic trouble codes are present, the cluster odometer will display "NO FAULT". If diagnostic trouble codes are present, the gauge cluster will display the total number of faults and cycle to the next diagnostic trouble code after 10 seconds. To manually cycle through the diagnostic trouble code list, press the cluster display select/reset

button. The last character of the diagnostic trouble code will end in “A” for active diagnostic trouble codes or “P” for previously active diagnostic trouble codes. Turning the ignition key off or releasing the park brake will take the ESC and the gauge cluster out of the diagnostic mode.

The previously active 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 203 Solenoid Power Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 7 1	Solenoid output overloaded.
2033 14 7 2	Solenoid output open circuit.
2033 14 7 3	Solenoid output shorted to ground.

5.3. SOLENOID POWER CIRCUITS FROM ESC

Fault Detection Management

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

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

A failure in the solenoid power circuits should be suspected when several air controlled features (such as the air horn) are inoperative. The ESC will log a diagnostic trouble code when there is an open or short to ground in the circuit.

The "Diamond Logic Builder™" diagnostic software can be used to monitor the status of the signal and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

Refer to Solenoid Power Circuits.

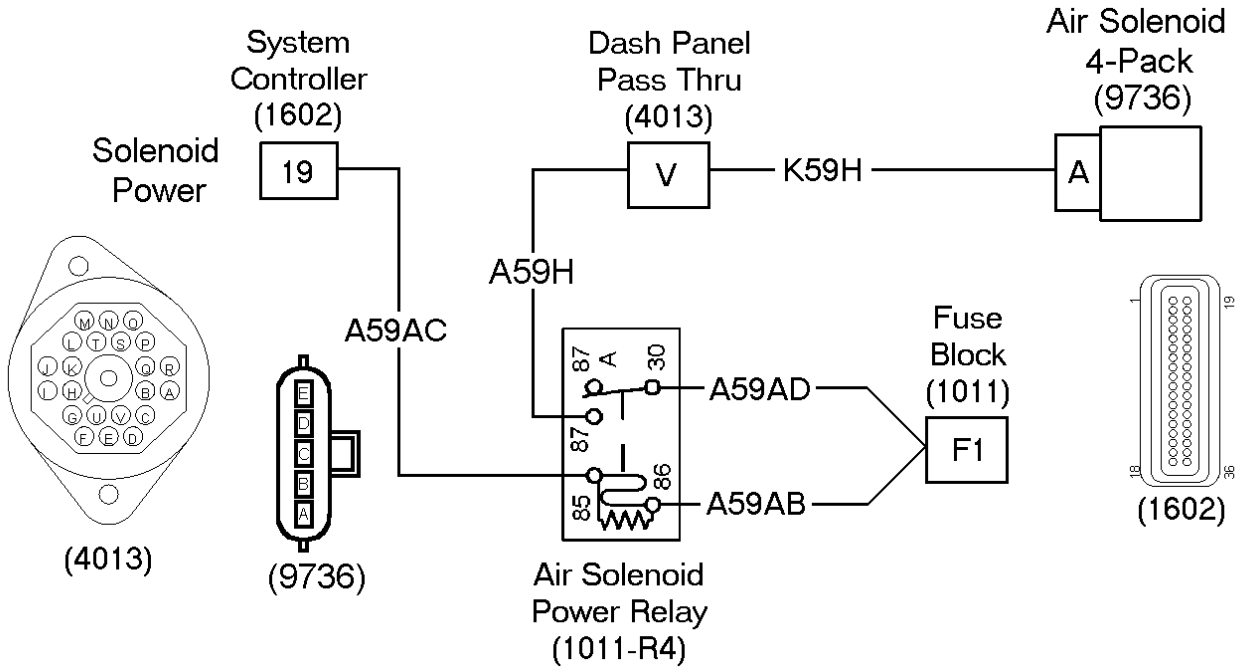

Figure 341 Solenoid Power Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(9736) AIR SOLENOID 4–PACK
LOCATED AT ENGINE COMPARTMENT REAR

Table 204 Solenoid Power Circuit Tests

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 7 1	Solenoid output overloaded.
2033 14 7 2	Solenoid output open circuit.
2033 14 7 3	Solenoid output shorted to ground.
Bench test air solenoid power relay R4 for functionality. If relay fails bench test, replace and check for faults.	
Air Solenoid Power Relay (R4) Voltage Checks (With 4–Pack Solenoid Module) Check with ignition key on and air solenoid power relay (R4) removed. Bench test relay. If relay fails bench test, replace and check for faults. **NOTE – Always check connectors for damage and pushed–out terminals.**	

Test Points	Spec.	Comments

Table 204 Solenoid Power Circuit Tests (cont.)

Air solenoid power relay R4 cavity 30 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F1 and check for open or short on circuit A59AD.
Air solenoid power relay R4 cavity 86 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F1 and check for open or short on circuit A59AB.
Air solenoid power relay R4 cavity 86 to 85.	12 ± 1.5 volts	If voltage is missing, check for open or short on circuit A59AC. Also ensure proper ground signal from system controller (1602) pin 19. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
Remote Solenoid Module Connector (9736) Voltage Checks (With 4–Pack Solenoid Module) Check with ignition key on, air solenoid power relay R4 installed and remote solenoid power unit connector (9736) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
(9736) Harness connector, pin A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits K59H and A59H. If all circuits pass test and there is still an error with the air solenoid pack, replace air solenoid pack.

Extended Description

Under normal conditions, when the key is in the accessory or ignition position, the ESC will supply 12 volts from the fuse block on fuse F1 to the air solenoid power relay. The solenoid will charge due to a ground signal produced by the system controller (1602) pin 19. Power will then flow through the air solenoid power relay to the Air Solenoid 4–pack (9736) through pin A.

5.4. COMPONENT LOCATIONS

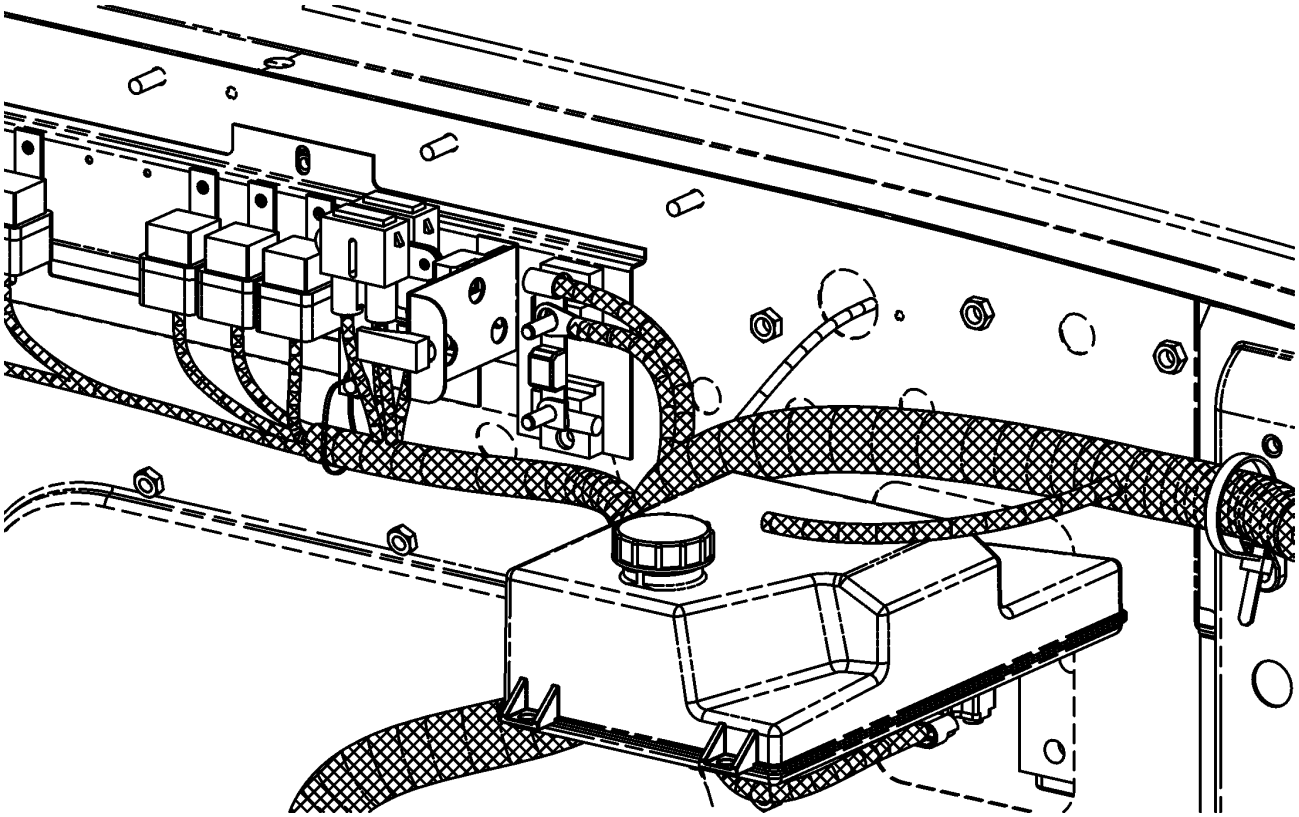

Figure 342 Engine Compartment Power Distribution Center

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

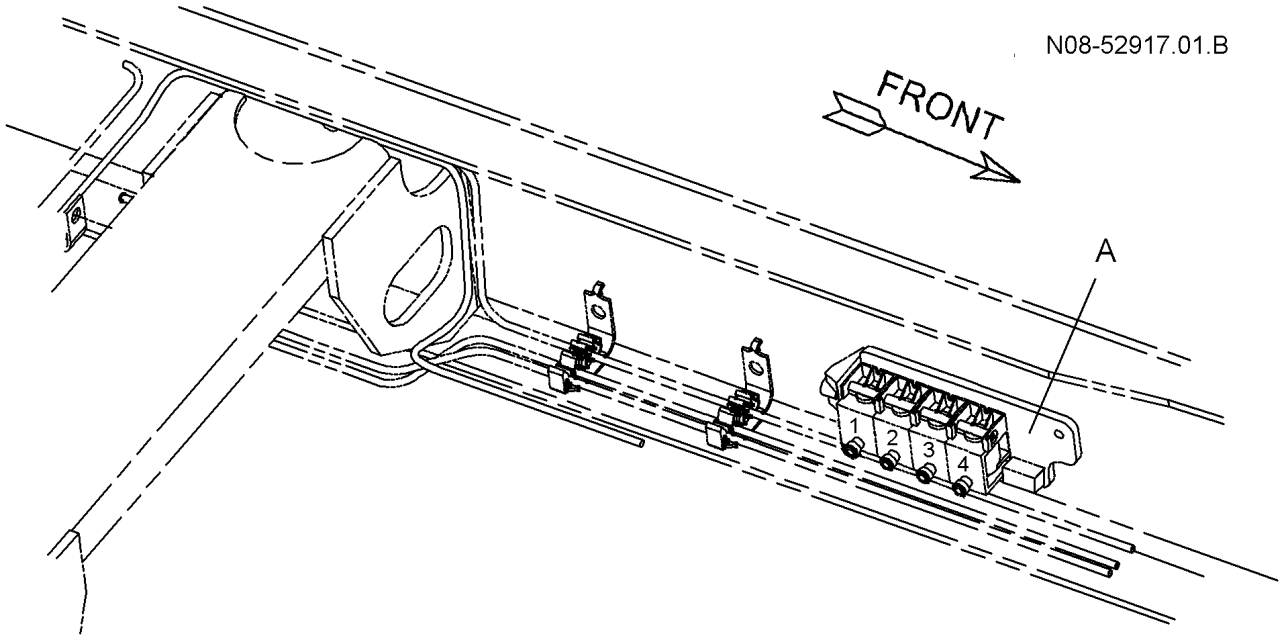

Figure 343 Typical 4–Pack Remote Air Solenoid Location (Located Below Cab)

A. 4–PACK REMOTE AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

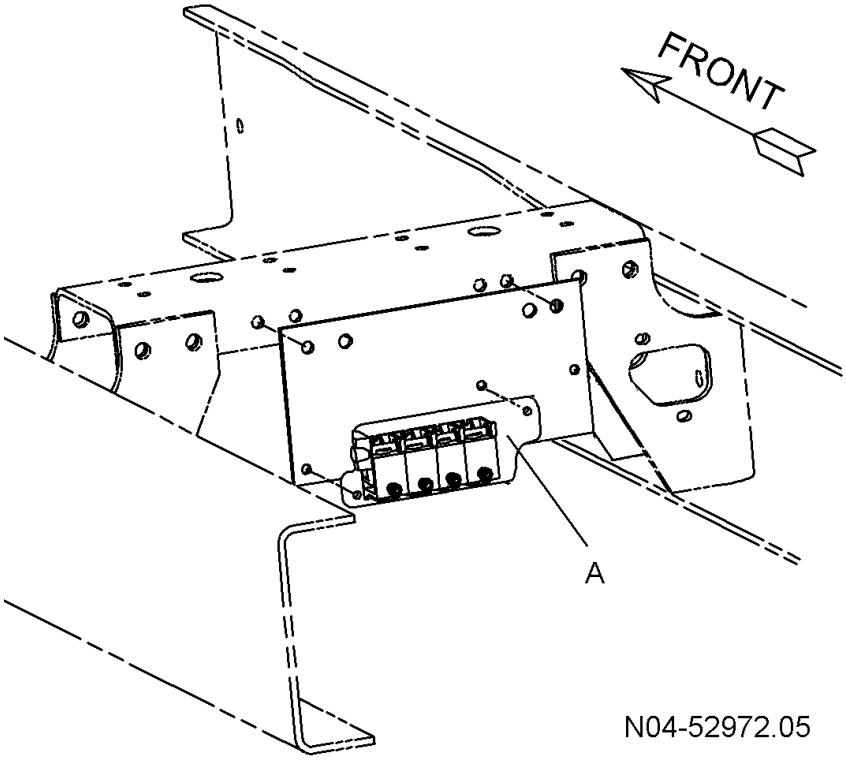

Figure 344 Typical 4–Pack Remote Air Solenoid Location (Located On Cross Member)

A. 4–PACK REMOTE AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

6. AIR SOLENOID MODULE (4–PACK)

6.1. CIRCUIT FUNCTIONS

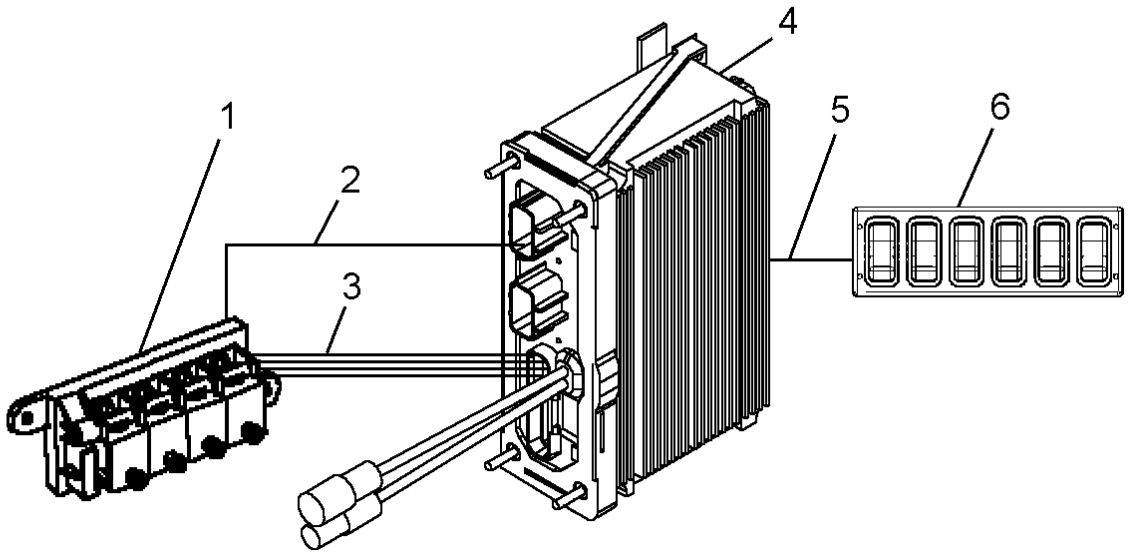

Figure 345 4– Pack Air Solenoid Module Function Diagram

1. 4 PACK AIR SOLENOID
2. SOLENOID POWER CIRCUIT
3. SEPARATE SOLENOID CONTROL CIRCUITS
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. SWITCH PACK ON INSTRUMENT PANEL

The 4–pack remote air solenoid module (RASM) is an optional feature that provides switched air valve solenoids on the chassis. The number of solenoids installed and used on the module is determined by the air driven features installed on the vehicle. Each solenoid is controlled by a separate circuit from the ESC. The ESC will activate an installed solenoid when it receives a message on the switch data link from the switch pack or from direct inputs (such as the air horn switch). The air solenoid valves in the 4 pack air solenoid module are available as normally open, normally closed and air horn configurations. The indicator in the switch-pack will illuminate when the corresponding air solenoid is energized and no errors are detected.

If the air valve is on when it had been commanded off, the ignition signal to the ASM will be turned off and the indicator in the switch will flash quickly. All air valves will be switched off when accessories are off.

Individual solenoids in the solenoid pack can be replaced when they fail to operate.

6.2. DIAGNOSTICS

A failure in the 4–pack remote air solenoid module or its circuits should be suspected when an air controlled feature (such as the air horn) does not operate correctly. The ESC will log a diagnostic trouble code when there is a problem in the switch pack, the 4–pack remote air solenoid module or the circuits to the module.

A problem with air solenoid operation could be attributed to an open or short in circuits between the air solenoid module and the ESC, an internal failure in the module or missing signals from the ESC. The problem could also be attributed to missing inputs to the ESC from a switch pack or a direct switch.

An electronic service tool (EZ-Tech®), running the "Diamond Logic Builder™" diagnostic software, can be used to determine the programmed configuration of the ESC and the air solenoid module. See the diagnostic software manual for details on using the software.

The "Diamond Logic Builder™" diagnostic software can also check operation of the air solenoids, monitor switch inputs to the ESC and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

4–Pack Air Solenoid Module Preliminary Check

NOTE – Insure there is air pressure to the air solenoid pack, there are no air line restrictions to the air powered feature, and the air powered feature is mechanically sound before performing the Preliminary Check.

Table 205 4–Pack Air Solenoid Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Insure there is air pressure to the air solenoid pack. Verify air solenoid controlled features are operating incorrectly.	Attempt to operate air solenoid controlled features.	Air solenoid controlled features are **not** operating correctly.	Go to next step.	Air solenoid controlled features are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other features (other than air controlled features) are malfunctioning that may have common circuits. (Example: Missing power or 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 205 4–Pack Air Solenoid Module Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 685)	Read display on odometer.	Diagnostic trouble codes are active.	Go to next step.	An electrical failure should log a DTC. Insure there are no mechanical problems with the affected feature.
4.	On	Check for 4–pack air solenoid diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 685)	Read display on odometer.	4–pack air solenoid module diagnostic trouble codes are present.	Go to 4-Pack Air Solenoid Circuits From ESC. (See SOLENOID POWER CIRCUITS FROM ESC, page 677)	Other DTC's are present. Go to the section on this manual associated with the DTC.

Diagnostic Trouble Codes (DTC)

To display diagnostic codes, put the vehicle in diagnostic mode. Set the parking brake and turn the Ignition key "ON". Then press the Cruise "ON" switch and the Cruise "Resume" switch. If no diagnostic trouble codes are present, the cluster odometer will display "NO FAULT". If diagnostic trouble codes are present, the gauge cluster will display the total number of faults and cycle to the next diagnostic trouble code after 10 seconds. To manually cycle through the diagnostic trouble code list, press the cluster display select/reset button. The last character of the diagnostic trouble code will end in "A" for active diagnostic trouble codes or "P" for previously active diagnostic trouble codes. Turning the ignition key off or releasing the park brake will take the ESC and the gauge cluster out of the diagnostic mode.

The previously active 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 206 4–pack Air Solenoid Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 7 1	Solenoid output overloaded.
2033 14 7 2	Solenoid output open circuit.
2033 14 7 3	Solenoid output shorted to ground.
2033 14 10 1	2 Speed Axle/4 Pack Air Solenoid Channel #3 overloaded
2033 14 10 2	2 Speed Axle/4 Pack Air Solenoid Channel #3 open circuit
2033 14 10 3	2 Speed Axle/4 Pack Air Solenoid Channel #3 shorted to ground
2033 14 12 1	Differential Lock/4 Pack Air Solenoid Channel #2 overloaded
2033 14 12 2	Differential Lock/4 Pack Air Solenoid Channel #2 open circuit
2033 14 12 3	Differential Lock/4 Pack Air Solenoid Channel #2 shorted to ground

Table 206 4–pack Air Solenoid Diagnostic Trouble Codes (cont.)

2033 14 15 1	Transfer Case A/4 Pack Air Solenoid Channel #4 overloaded
2033 14 15 2	Transfer Case A/4 Pack Air Solenoid Channel #4 open circuit
2033 14 15 3	Transfer Case A/4 Pack Air Solenoid Channel #4 shorted to ground
2033 14 16 1	Suspension Dump/4 Pack Air Solenoid Channel #1 overloaded
2033 14 16 2	Suspension Dump/4 Pack Air Solenoid Channel #1 open circuit
2033 14 16 3	Suspension Dump/4 Pack Air Solenoid Channel #1 shorted to ground

6.3. 4-PACK AIR SOLENOID CIRCUITS FROM ESC

Fault Detection Management

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

A fault in the air solenoid output circuits from the ESC will be apparent when an air controlled feature does not come on and an air solenoid DTC is present. The ESC will log a DTC when there is a short to ground in any of the circuits between the ESC and the air solenoid or when there is an open in a circuit. Problems in the air solenoid circuits could be attributed to a short, an open, a faulty 4–pack or a problem in the ESC.

The ESC has an internal virtual fuse and software algorithm to protect solenoid power on pin A of (4008) output circuits in an over current situation.

Each feature that requires the use of an air solenoid will be responsible to determine when the power to the pack(s) should be turned off based upon its predetermined failure modes. If a feature determines that power should be shut off, it will send a request to the Air Solenoid Power FET Software Feature to turn off solenoid power.

Refer to 4–Pack Air Solenoid Circuits.

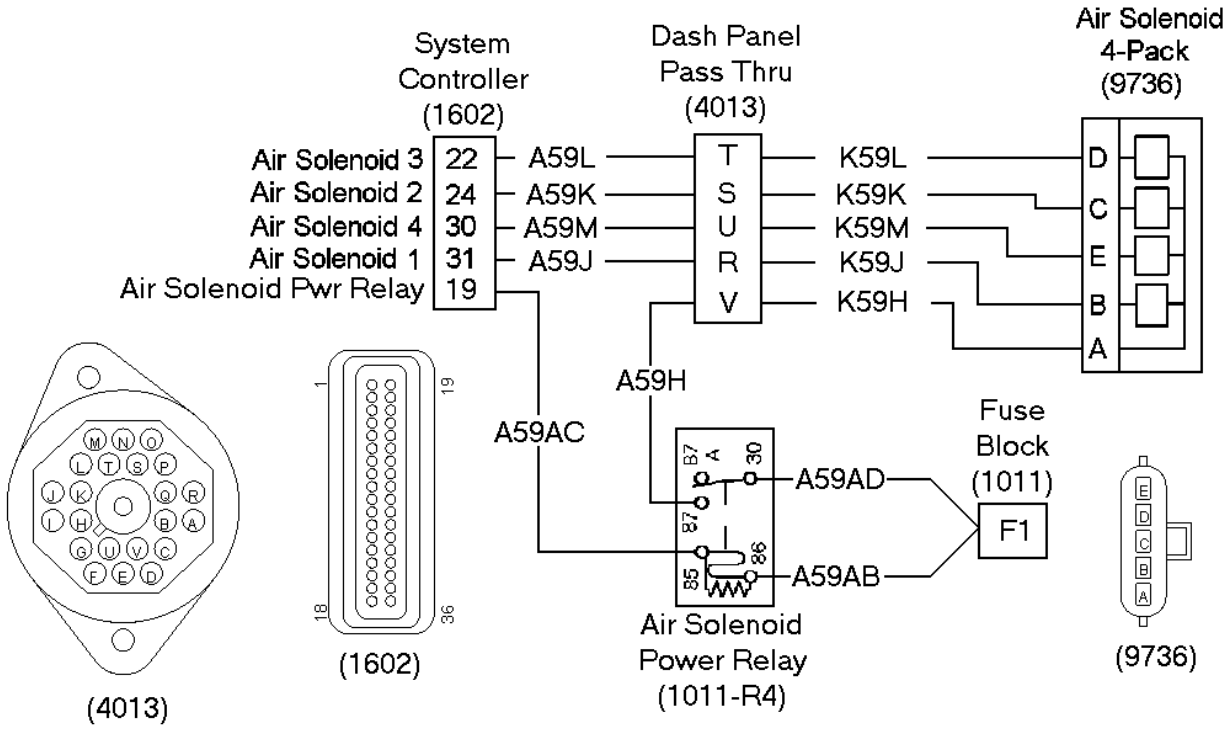

Figure 346 Typical 4–Pack Air Solenoid Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(9736) AIR SOLENOID 4–PACK
LOCATED AT ENGINE COMPARTMENT REAR

Table 207 4 Pack Air Solenoid Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 7 3	Solenoid output shorted to ground.
2033 14 10 3	2 Speed Axle/4 Pack Air Solenoid Channel #3 shorted to ground
2033 14 12 3	Differential Lock/4 Pack Air Solenoid Channel #2 shorted to ground
2033 14 15 3	Transfer Case A/4 Pack Air Solenoid Channel #4 shorted to ground
2033 14 16 3	Suspension Dump/4 Pack Air Solenoid Channel #1 shorted to ground

Table 207 4 Pack Air Solenoid Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
These DTC's are logged when there is a short in the circuits between the 4–pack air solenoid and the ESC. **NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.** Disconnect air solenoid connector (9736), then turn on the switch for the feature assigned to the solenoid and check for fault. If the fault has moved from the active to previously active list, there is a short in the air solenoid. If the fault does not go previously active there is a short in the circuits between the ESC connector (4004) and the air solenoid module. Disconnect blue ESC connector (4008), then turn on the air driven feature switch and check for fault. If the fault has moved from the active to previously active list, there is a short in the circuits between the ESC and the air solenoid. If the fault does not go previously active there is a short inside the ESC.	
2033 14 7 1	Solenoid output overloaded.
2033 14 10 1	2 Speed Axle/4 Pack Air Solenoid Channel #3 overloaded
2033 14 12 1	Differential Lock/4 Pack Air Solenoid Channel #2 overloaded
2033 14 15 1	Transfer Case A/4 Pack Air Solenoid Channel #4 overloaded
2033 14 16 1	Suspension Dump/4 Pack Air Solenoid Channel #1 overloaded
This fault is logged when there is excessive resistance in the circuits to the solenoid or the solenoid coil. **NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.** Disconnect air solenoid connector (9736), then turn on the air driven feature switch and check for fault. If the fault has moved from the active to previously active list, there is an overload in the air solenoid. If the fault does not go previously active there is an overload in the circuits between the ESC and air solenoid or in the ESC. Disconnect blue ESC connector (4004), then turn on the air driven feature switch and check for fault. If the fault has moved from the active to previously active list, there is an overload in the circuits between the ESC and air solenoid. If the fault does not go previously active there is a short inside the ESC.	
2033 14 7 2	Solenoid output open circuit.
2033 14 10 2	2 Speed Axle/4 Pack Air Solenoid Channel #3 open circuit
2033 14 12 2	Differential Lock/4 Pack Air Solenoid Channel #2 open circuit
2033 14 15 2	Transfer Case A/4 Pack Air Solenoid Channel #4 open circuit
2033 14 16 2	Suspension Dump/4 Pack Air Solenoid Channel #1 open circuit
These faults are due to an open in circuits between the 4–pack air solenoid and the ESC. Check for open circuits or open solenoid coils. Check for open or short circuits in the assembly body.	
611 14 2 3	Solenoid power less than normal low current but more than open circuit

Table 207 4 Pack Air Solenoid Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 2 4	Solenoid power greater than normal high current and less than fusing current
611 14 2 6	Solenoid power has current flow when output commanded off

Table 208 4 Pack Air Solenoid Tests

4–Pack Air Solenoid Harness Connector (9736) Voltage Checks Check with ignition key on and air solenoid connector (9736) disconnected. 4 open circuit DTC's will be logged when (9736) is 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
(9736) Harness connectors, pin A to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits K59H and A59H. If voltage is present and fault is still present after connector is reconnected, verify relay and assembly body.
Feature switch on, (9736) harness connector, pin A to pin B	12 ± 1.5 volts	If voltage is missing, check for missing low signal from ESC or missing activation signal input to ESC.
Feature switch on, (9736) harness connector, pin A to pin C	12 ± 1.5 volts	If voltage is missing, check for missing low signal from ESC or missing activation signal input to ESC.
Feature switch on, (9736) harness connector, pin A to pin D	12 ± 1.5 volts	If voltage is missing, check for missing low signal from ESC or missing activation signal input to ESC.
Feature switch on, (9736) harness connector, pin A to pin E	12 ± 1.5 volts	If voltage is missing, check for missing low signal from ESC or missing activation signal input to ESC.

Extended Description

When the key is in the accessory or ignition position, the ESC will supply a ground signal from system controller connector (1602) terminal 19 to the air solenoid power relay which will energize from the voltage from the fuse F1. The relay will then supply power to the air solenoid 4–pack (9736) terminal A. This voltage is supplied to one side of the four solenoids.

Each of the four solenoids is controlled by a direct circuit from ESC connector (1602). When the input to the ESC (a command from the switch pack on the switch data link or a direct circuit from the air horn switch) requests an air solenoid to be activated. The ESC will supply a ground signal to the appropriate solenoid causing it to energize.

6.4. TESTING INDIVIDUAL SOLENOIDS

After an Individual solenoid has been removed from the module, it can be tested by applying 12 volts (or a 9 volt battery) across the solenoid terminals. The solenoid should engage and air should pass or be blocked (depending on the type of solenoid) to the passages in the sides of the solenoid when it is applied to the port on the face of the solenoid.

If the solenoid checks good and trouble codes identifying problems with the solenoid are present after cycling the key, the RASM may need replaced.

6.5. 4–PACK REMOTE AIR SOLENOID MODULE INSTALLATION

Installing Solenoid Module

The ICAP ESC programming software must be used to configure instrument panel switches mounted in the 6 pack switch modules to control air driven features. Each air driven feature is added with the ICAP software. The software will determine which switch will control the feature and how the remote air solenoid module is configured. The 4–pack air solenoid module is used when the number of air driven features is less than five. When more than four features are to be installed the 7–pack air solenoid module must be used.

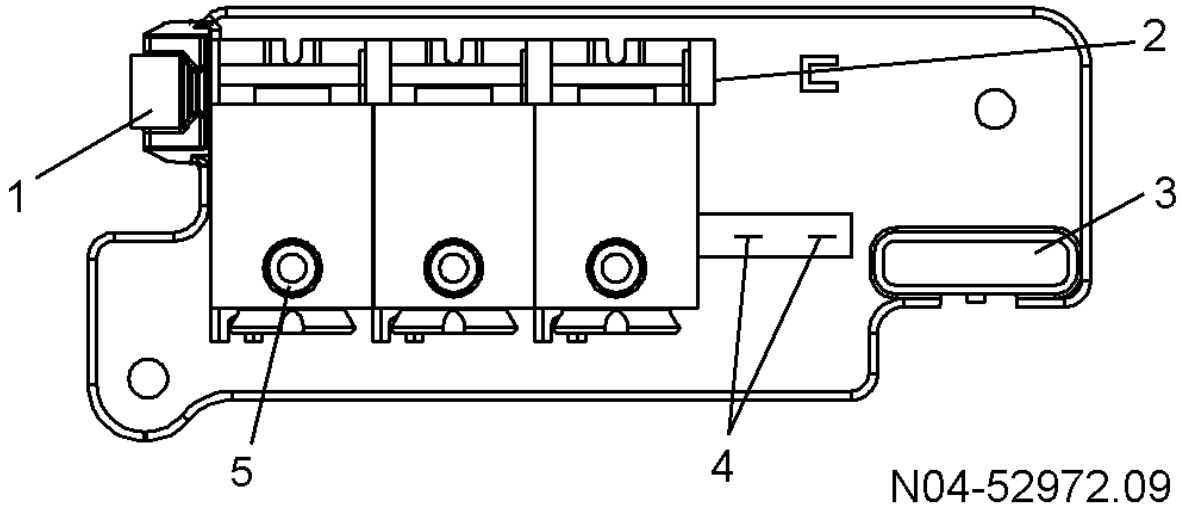

Figure 347 4–Pack Remote Air Solenoid Module (Shown with Last Solenoid Location Empty)

1. PRIMARY AIR INPUT
2. PORT PLUG (INSTALLED ON LAST SOLENOID INSTALLED ON MODULE)
3. ELECTRICAL CONNECTOR
4. SOLENOID MATING CONTACTS (BENEATH FOAM STRIP)
5. AIR OUTPUT FROM SOLENOID

The remote air solenoid module is mounted below the cab on the inside of the left frame rail or on the frame cross member. The primary air source is connected to the collar on the left side of the module. On the front of each air solenoid is an air collar to connect the air line to the air driven device. The electrical circuits are connected to the connector on the right side of the module. Overlay harnesses are available to complete the electrical connections.

Installing Additional Solenoids

Individual solenoids are only installed on the module as required to support the features on the vehicle. If only one air driven feature is installed on the vehicle, only one solenoid will be installed on the module. If other air driven features are added, additional solenoids will need to be added.

The last solenoid on the module will have a plug installed on the right side of the solenoid where the next solenoid would be installed. This plug blocks air flow out of the solenoid. When an additional solenoid is installed the plug must be removed from the existing solenoid and installed on the new solenoid.

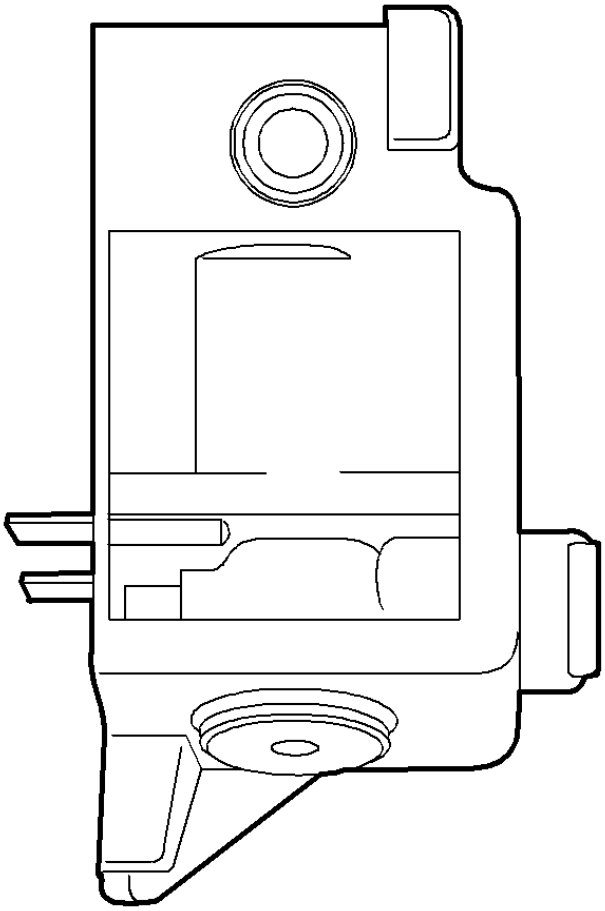

Figure 348 Air Solenoid

Each additional air solenoid interlocks with the previous solenoid. The contacts of the solenoid slide through a foam strip to connect with the contacts of the solenoid module. The solenoid is secured to the module body with two Torx® head screws.

There are three types of air solenoids: normally open, normally closed and an air horn solenoid.

The ICAP software will determine the location of the controlling switches in the switch packs and the order of installation for the solenoids.

6.6. COMPONENT LOCATIONS

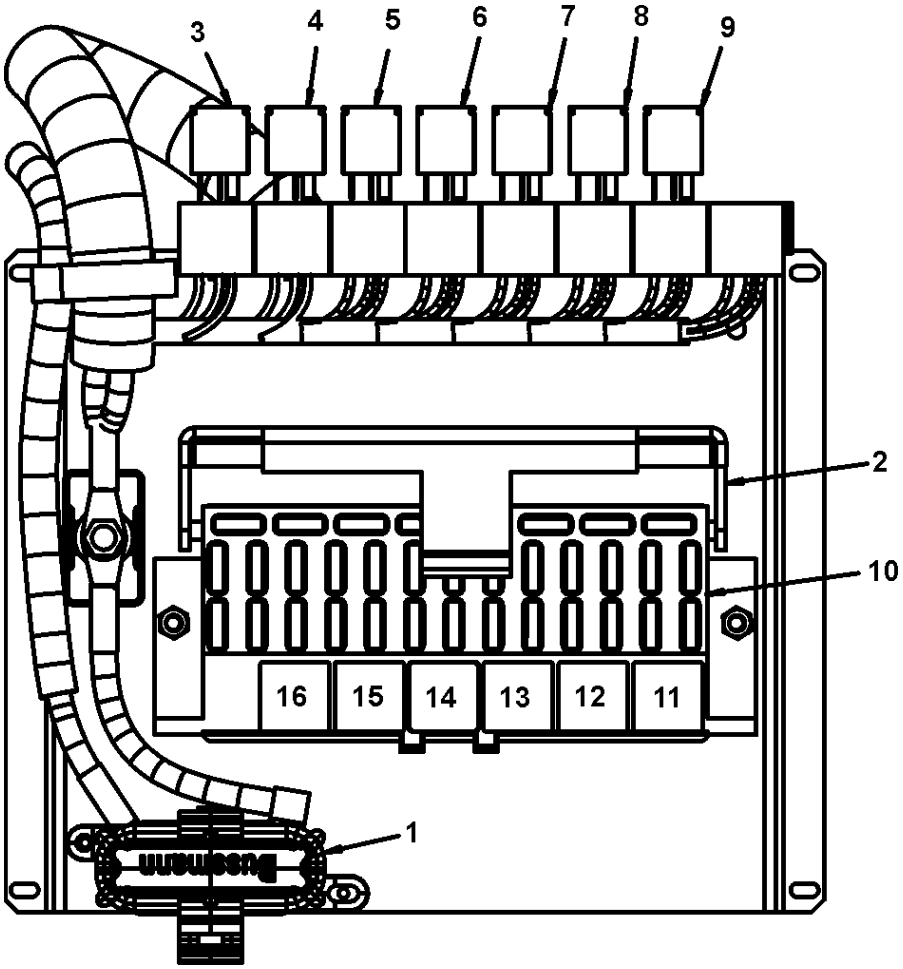

Figure 349 Chassis Flasher Plate

1. 175 AMP MEGA FUSE
2. FUSE BLOCK COVER
3. (1015) BACK-UP LIGHT RELAY
4. (1017) FOG LIGHT RELAY
5. (1018) AUTO DRAIN VALVE RELAY
6. (1016) BACK-UP LIGHT CHECK RELAY
7. (1020) EMERGENCY EXIT RELAY
8. (1021) POST TRIP INSPECTION RELAY
9. (1019) WHEELCHAIR LIFT RELAY
10. (1011) FUSE BLOCK
11. R1 WIPER POWER RELAY
12. R2 WIPER HI-LOW RELAY
13. R3 STOP LIGHT RELAY
14. R4 AIR SOLENOID POWER RELAY
15. R5 #1 IGNITION POWER RELAY
16. R6 #2 IGNITION POWER RELAY

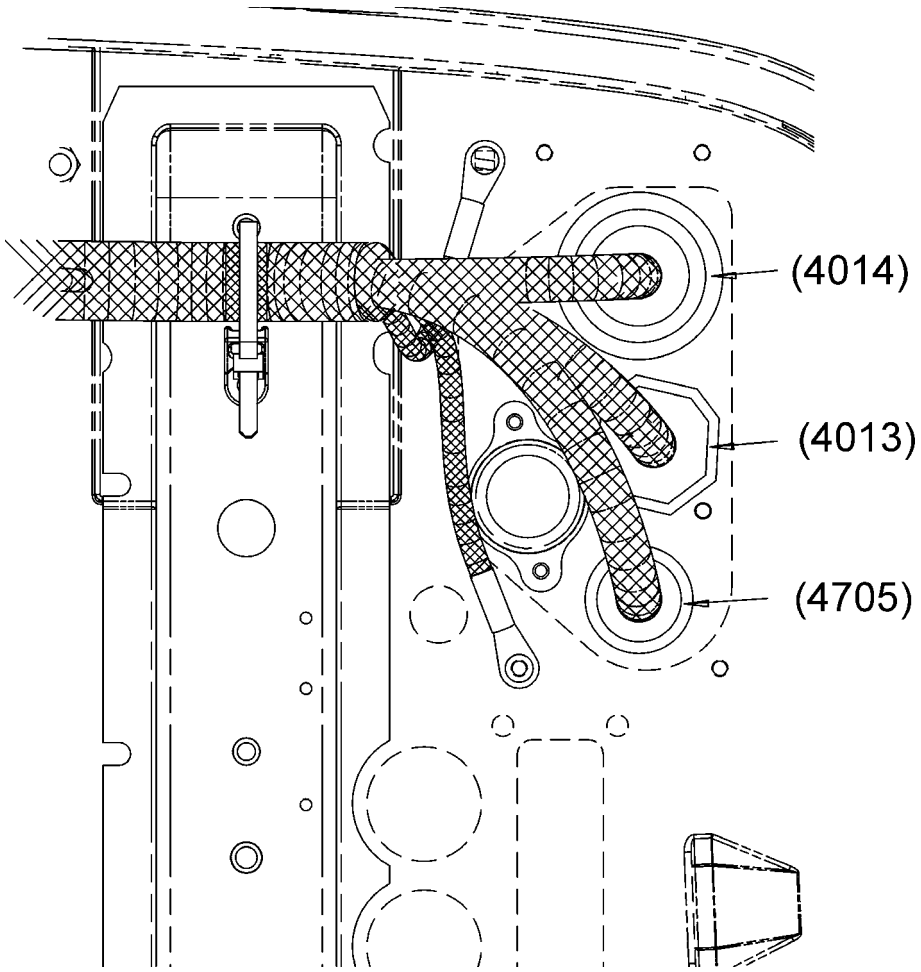

Figure 350 Pass Thru Connectors

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

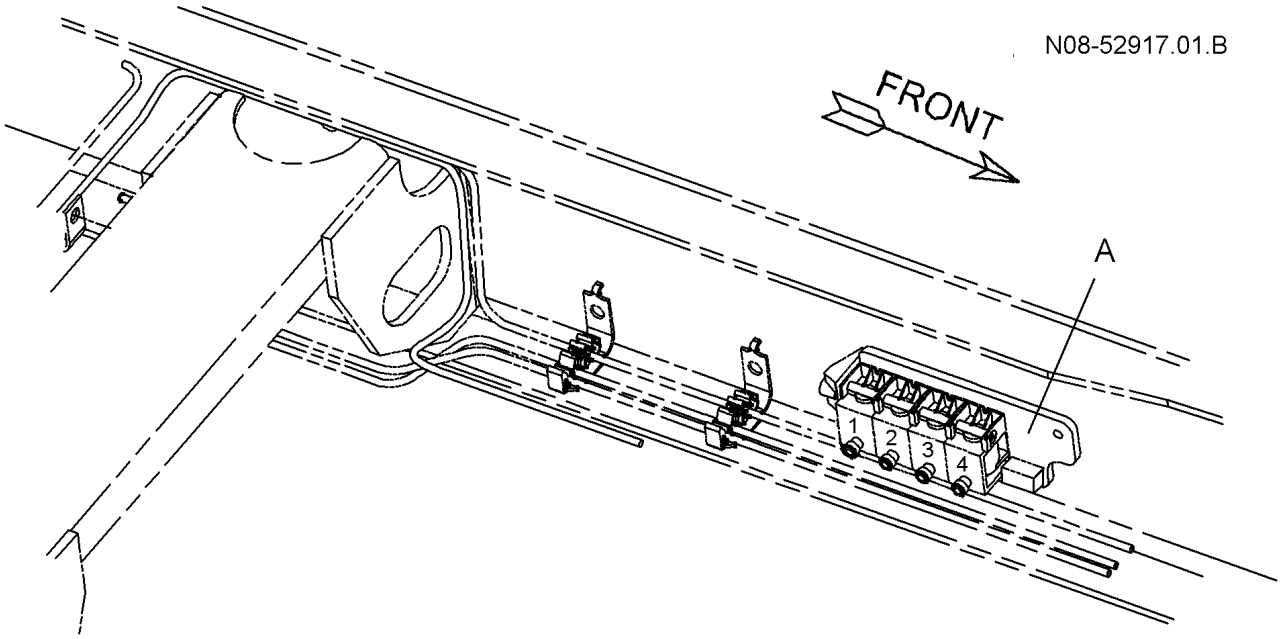

Figure 351 Typical 4–Pack Remote Air Solenoid Location (Located Below Cab)

A. 4–PACK REMOTE AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

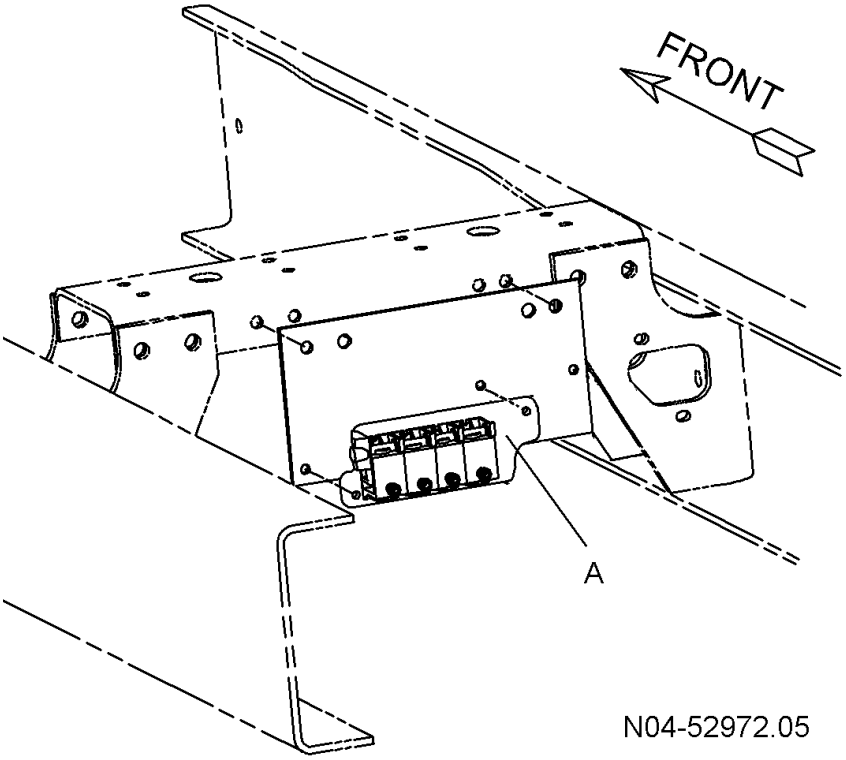

Figure 352 Typical 4–Pack Remote Air Solenoid Location (Located On Cross Member)

A. 4–PACK REMOTE AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

7. SUSPENSION DUMP

7.1. CIRCUIT FUNCTIONS

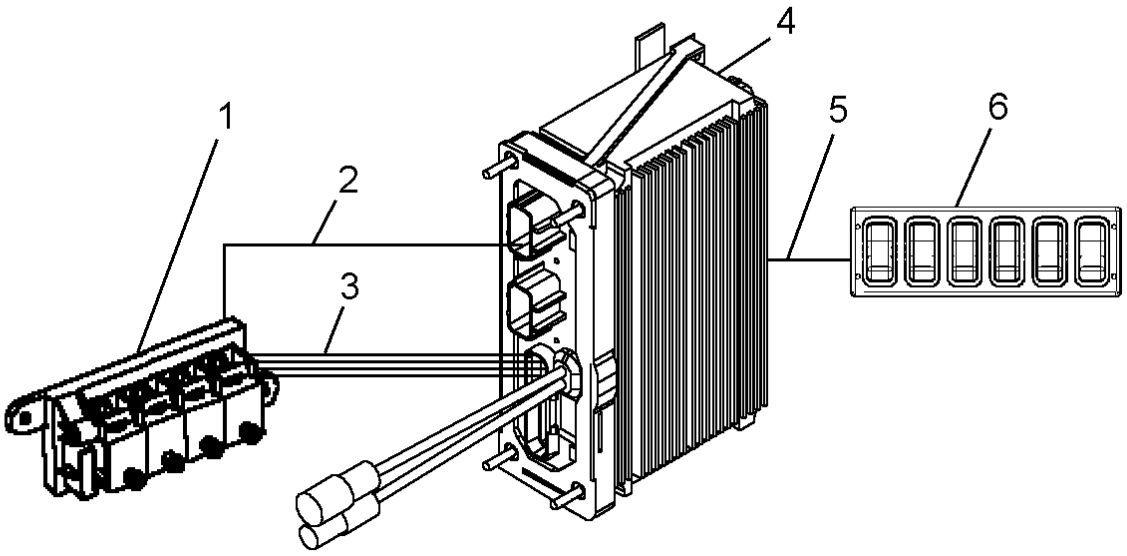

Figure 353 Suspension Dump Function Diagram

1. 4PACK AIR SOLENOID
2. SOLENOID POWER CIRCUIT
3. BODY BUILDER 1939 DATA LINK
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. SWITCH PACK ON INSTRUMENT PANEL

This feature allows the back of the vehicle to lower several inches by dumping the air from the suspension bags. This is used mainly for trailer pickup and drop off as well as loading and unloading equipment on and off the back of straight trucks.

When the suspension dump switch, mounted in the switch pack, is turned on the switch pack will communicate with the ESC to request the ESC to command the air solenoid, located in a 4 solenoid pack or a 7 solenoid pack, to energize. When the solenoid energizes it will supply pilot air to the Hadley valve of the air suspension system. This will cause the system to deflate.

The suspension dump operations will occur only when the key switch is in the ignition position or accessory feed is on. The dump suspension indicator (solid light) and the dump suspension solenoid shall be on when the dump suspension switch is set to on, the vehicle is moving at the less than maximum allowed dump speed, and any related errors are not present. If the suspension is dumped and the ignition is turned off, the normally closed SV1 valve prevents inflating the suspension system. If the suspension is not dumped, the ignition is off and the switch is turned to the on position, upon turning the key to ignition or accessory the suspension will deflate.

If there are any related errors the dump suspension solenoid shall be set to off. If vehicle speed is greater than maximum allowable dump speed the suspension dump solenoid will be set to off. If the suspension is deflated and the vehicle accelerates beyond the maximum dump speed the suspension will re-inflate even with the suspension dump switch in the dump position. If the vehicle then slows to maximum dump speed or less the suspension will not dump until the dump switch is re-initialized (turned off then back on).

If there are any related errors and the accessory power is on, the suspension dump indicator will continuously flash slowly. If suspension dump is requested and vehicle speed is greater that maximum allowable dump speed (default 5 mph), the suspension dump indicator will continuously flash at a fast rate and five short beeps will occur. Even when the vehicle speed decreases below the maximum dump speed the suspension dump indicator will continue to flash fast.

7.2. DIAGNOSTICS

Problems in the suspension dump circuits can be can be attributed to short circuits, open circuits, a failed relay or a failed ECU.

The ESC will log diagnostic trouble codes (DTCs) for problems in the switch pack (See SWITCH PACK MODULES, page 126). The ESC will also log DTCs for problems in the 4–pack remote air solenoid module (RASM) (See AIR SOLENOID MODULE (4–PACK), page 683).

Switch pack configuration and RASM configuration and programming will vary from vehicle to vehicle.

An electronic service tool, running the "Diamond Logic Builder™" diagnostic software, can be used to activate the suspension dump circuits and monitor activation of the suspension dump switch. See the diagnostic software manual for details on using the software.

Suspension Dump Preliminary Check

NOTE – Insure there is air pressure to the air solenoid pack, there are no air line restrictions to the air powered feature, and the air powered feature is mechanically sound before performing the Preliminary Check.

Table 209 Suspension Dump Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Insure there is air pressure to the air solenoid pack. Turn on suspension dump.	Observe suspension	Suspension air bags should deflate	Suspen-sion dump is working.	Go to next step.
2.	On	With suspension dump switch on check switch lamp.	Visually check status of switch lamp	Switch lamp stays on.	Problem is in air system. Check air lines.	Go to next step.

Table 209 Suspension Dump Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	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.
4.	On	Check for ESC diagnostic trouble codes. (See Diagnostic Trouble Codes, page 698)	Read display on odometer.	Diagnostic trouble codes for ABS are active.	Go to next step.	Consider replacing the ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 125)
5.	Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1193)					

Diagnostic Trouble Codes

To display diagnostic codes, set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch momentarily. If no faults are present, the cluster odometer will display “NO FAULT”. If faults are present, the gauge cluster display will show 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 selector button. The last character of the diagnostic trouble code will end in “A” for active faults or “P” for previously active faults. Turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

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 and releasing them.

DTC’s will apply to the switch pack or the solenoid module. Cross reference the DTC to the applicable section from the DTC table. (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1193)

7.3. COMPONENT LOCATIONS

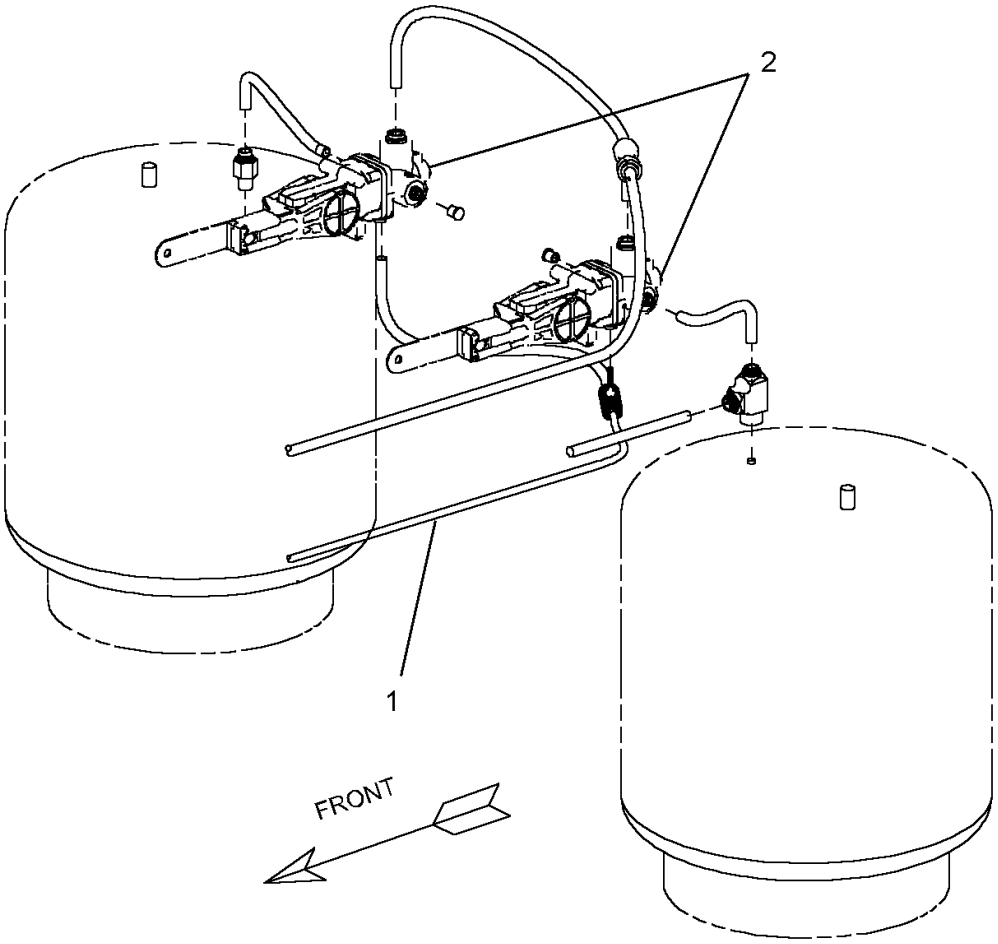

Figure 354 Air Suspension Valves

1. AIR DUMP LINE FROM REMOTE AIR SOLENOID MODULE
2. AIR SUSPENSION CONTROL VALVES

8. PYROMETER/AMMETER MODULE (PAM)

8.1. CIRCUIT FUNCTIONS

The pyrometer/ammeter module (PAM) is capable of sensing and reporting both temperature and current. The temperature sensing capability is not currently being utilized, therefore only the ammeter circuit is described here.

The module provides a current value (net battery current) by measuring the differential voltage between the battery negative terminal and the starter ground stud. Circuitry within the module converts the measured voltage into an equivalent current value. This information is reported to the ESC, Electronic Gauge Cluster (EGC) via the drivetrain J1939 data link. The information eventually is used to drive the ammeter.

8.2. DIAGNOSTICS

An electronic service tool, running the Diamond Logic® Builder (DLB) diagnostic software, can be used to check operation of the Pyrometer/Ammeter Module (PAM). See the diagnostic software manual for details on using the software.

Pyrometer/Ammeter Module (PAM) Preliminary Check

Table 210 Pyrometer/Ammeter Module (PAM) Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
NOTE – The following step verifies that the ESC, the gauge cluster, and the gauge have been tested. Once those components have been verified, proceed to step 2.						
1.	On	Check for ESC Diagnostic Trouble Codes (DTC's) related to the PAM, the ammeter, or the gauge location in the gauge cluster. Refer to DTC list (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1193). The PAM DTC is also described in the PAM DTC table in this section.	Read display on odometer.	DTC for PAM or gauge is active.	Follow the reference in the DTC list (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1193). If references return you to this table, go to next step.	Go to next step.
2.	On	Verify datalink connections to PAM (4087-7, 8, & 9) are clean, tight and functional. **NOTE – Some vehicles may not use the shield (4087-9) pin.**	Datalink connections to PAM.	Datalink connections to PAM are clean, tight and functional.	Go to next step.	Repair datalink, then recheck operation.
3.	On	Verify **ALL** connections in the sensing and charging circuits connected to the PAM (4087-10 & 11) are clean, tight and functional. **NOTE – Loose or**	PAM circuit connections	Connections to PAM sensing and charging circuits are clean, tight and functional.	Trouble-shoot PAM. Refer to Pyrometer/ Ammeter Tests. (See Table	Repair circuit connections, then recheck operation.

Table 210 Pyrometer/Ammeter Module (PAM) Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
		dirty connections in the sensing or charging circuits may cause inaccurate high readings on the ammeter.			212, page 702)	

Problems related to the PAM could be the result of shorted or open circuits (including loose, corroded connections); or a failure in the PAM; the ESC; the gauge cluster; or the ammeter.

Refer to Pyrometer/Ammeter Module Circuits.

Diagnostic Trouble Codes

To display diagnostic codes, set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch momentarily. If no faults are present, the cluster odometer will display “NO FAULT”. If faults are present, the gauge cluster display will show 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 selector button. The last character of the diagnostic trouble code will end in “A” for active faults or “P” for previously active faults. Turning the ignition key off will take the ESC and the gauge cluster out of the diagnostic mode.

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 and releasing them.

DTC’s will apply to the gauge pack or the Pyrometer/Ammeter module. Cross reference the DTC to the applicable section from the DTC list (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1193).

Table 211 Pyrometer/Ammeter Module Diagnostic Trouble Codes

639 14 82 254	Pyrometer/Ammeter Module not communicating to the ESC. See Pyrometer/Ammeter Module (PAM) Preliminary Check.

Pyrometer/Ammeter Module Tests

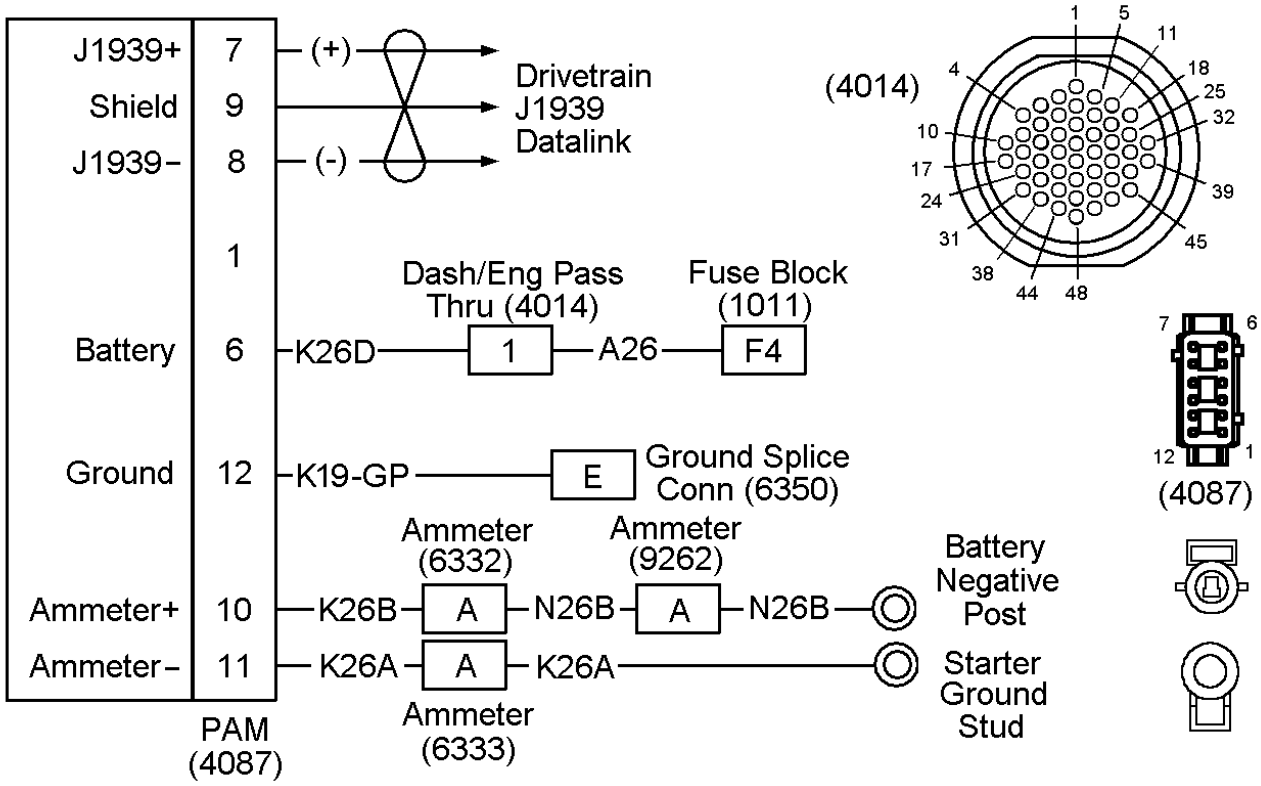

Figure 355 Pyrometer/Ammeter Module Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4087) PYROMETER/AMMETER MODULE
LOCATED OUTSIDE RIGHT SIDE DASH PANEL
(6332) (6333) AMMETER SENSE
LOCATED AT STARTER
(6350) GROUND SPLICE PACK
LOCATED AT ENGINE COMPARTMENT NEAR STARTER
(9262) BATTERY AMMETER SENSE
LOCATED AT AMMETER SENSE CABLE

Table 212 Pyrometer/Ammeter Module Tests

Pyrometer/Ammeter Module Voltage Checks Check with ignition on and PAM connector (4087) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments

Table 212 Pyrometer/Ammeter Module Tests (cont.)

(4087) cavity 7 to ground.	Approximately 2.5 volts	If voltage is missing, check for open in yellow data link circuit to PAM.
(4087) cavity 8 to ground.	Approximately 2.5 volts	If voltage is missing, check for open in green data link circuit to PAM.
(4087) cavity 6 to ground.	12 ± 1.5 volts	If voltage is missing, check for open fuse F4 in fuse block (1011). Also check for open or shorts in circuit K26D, or A26.
(4087) cavity 6 to cavity 12.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K19–GP to ground splice connection (6350). If circuits are good and voltage still missing, check connection from ground splice (6350) to ground.
(4087) cavity 6 to cavity 10.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K26B or N26B. Verify connections are tight and corrosion free.
(4087) cavity 6 to cavity 11.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K26A. Verify connections are tight and corrosion free. If all voltages are present, circuits to PAM are good. Replace PAM.

8.3. COMPONENT LOCATIONS

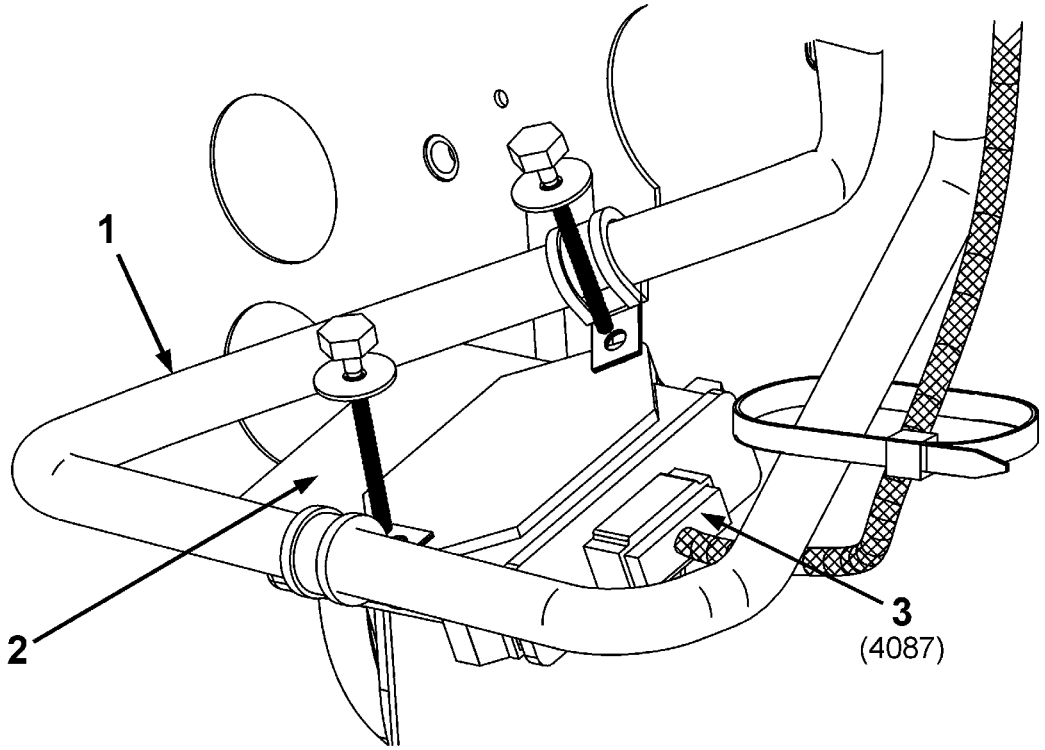

Figure 356 Pyrometer Ammeter Module (PAM)

1. MOUNTING BRACKET, ENGINE AIR CLEANER
2. PYROMETER AMMETER MODULE (PAM)
3. PAM CONNECTOR (4087)

9. AIR ACTUATED PARK BRAKE

9.1. CIRCUIT FUNCTIONS

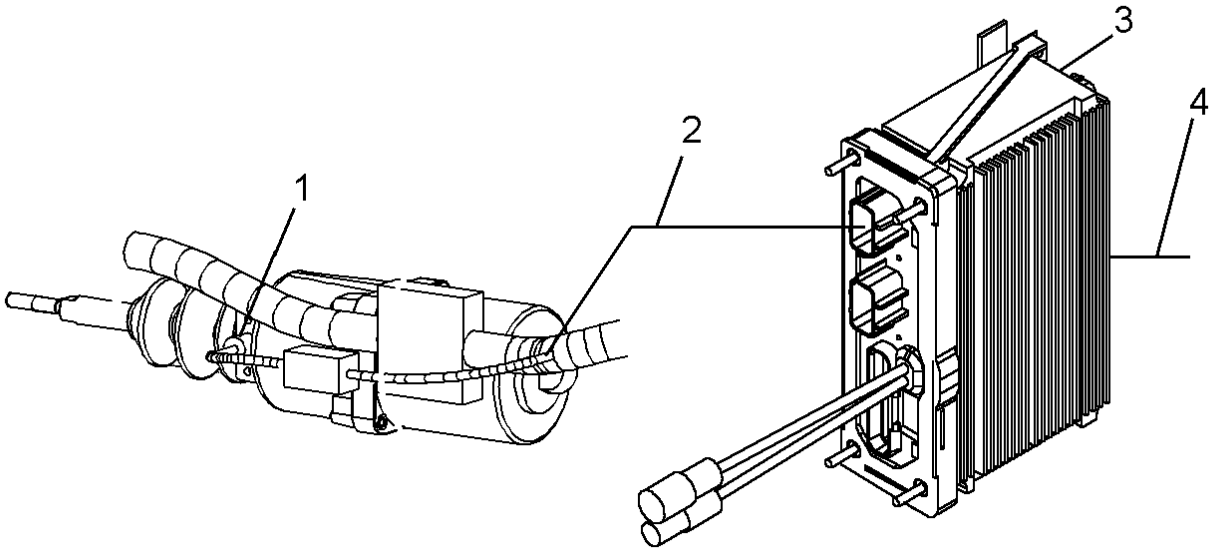

Figure 357 Air Actuated Park Brake Function Diagram

1. AIR ACTUATED PARK BRAKE
2. BODY BUILDER 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. PARK BRAKE SWITCH DATA LINK

The electrical circuits for the Travel Sensor integrated within the Spring Apply / Air Release (SAAR) Chamber used on the powered park brake system. The powered park brake system is an option for vehicles equipped with a hydraulic park brake system.

The electrical output is provided to indicate the SAAR piston has moved when air pressure is released from the chamber. A failure of the piston to move may indicate a park brake malfunction or maladjustment. The sensor output will interface with a digital input on the ESC.

SAAR – Spring Apply / Air Release: A component that actuates the park brake via a cable attached to a piston. Then air is applied to the chamber at a great enough pressure to compress the spring, the park brake is released. When air is evacuated from the chamber, the spring pushes back on the piston, which in turn pulls the cable, which then actuates the piston.

Inputs to the device shall consist of a nominal voltage of 14 VDC, and a ground connection.

Outputs:

Apply condition. The device shall deliver a HI signal when SAAR stroke is less than 19.05 +/- 3.175 mm (.75 +/- .125 inches) and when the SAAR stroke exceeds 64.8 +/- 3.175 mm (2.55 +/- .125 inches) in the apply condition. At all other times the device shall deliver a low signal.

Release condition. The device shall deliver a HI signal when the SAAR stroke is less than 17.78 +/- 3.175 mm (.70 +/- .125 inches) and when the SAAR stroke exceeds 63.50 +/- 3.175 mm (2.50 +/- .125 inches) in the release condition. At all other times the device shall deliver a low signal.

The device is meant to drive a low-current, digital input.

9.2. DIAGNOSTICS

Should the air actuated park brake fail to operate, the problem could be attributed to a failed switch on the shifter, a problem in the solenoid module, a problem in the ESC, open or shorted wiring between the ESC and the switch.

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 remote air solenoid module. Also, diagnostic trouble codes will be logged when the Air Powered Park Brake is stuck or the auto apply portion with the Air Powered Park Brake is not operating.

An electronic service tool, running the "Diamond Logic Builder™" diagnostic software, can be used to activate the air actuated park brake circuits and monitor activation of the air actuated park brake switch. See the diagnostic software manual for details on using the software.

Air Actuated Park Brake Preliminary Check

NOTE – Insure there is air pressure to the air solenoid pack, there are no air line restrictions to the air powered feature, and the air powered feature is mechanically sound before performing the Preliminary Check.

Table 213 Air Actuated Park Brake Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Insure there is air pressure to the air actuated park brake. Verify air actuated park brake is inoperative.	Visually check air actuated park brake.	Air actuated park brake is inoperative.	Go to next step.	Air actuated park brake 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 213 Air Actuated Park Brake Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 707)	Read display on odometer.	Diagnostic trouble codes are not active.	Go to next step.	Go to section for the air actuated park brake. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 686)
4.	Check for air pressure to solenoid and plumbing to air solenoid. If air plumbing is correct, go to air actuated park brake circuits to ESC. (See Air Actuated Park Brake Circuits To ESC, page 708)					

Diagnostic Trouble Codes

To display diagnostic codes, 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 FAULT”. If faults are present, the gauge cluster display will show 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 selector button. The last character of the diagnostic trouble code will end in “A” for active faults or “P” for previously active faults. 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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 214 Air Actuated Park Brake Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
70 14 1 0	Air Powered Park Brake is stuck. Occurs when the park brake switch does not match the spring apply air release (SAAR) chamber travel sensor. This indicates the park brake cannot be applied or cannot be released.
70 14 1 1	The auto apply portion with the Air Powered Park Brake is not operating. Occurs when the park brake switch is not set within 5 seconds of the receipt of the Park as the requested gear. This failure would indicate a failure in the auto apply or in the air lines between the auto apply relay and the Park Brake switch.
639 14 230 253	Full Power Park Brake not communicating with ESC.

9.3. AIR ACTUATED PARK BRAKE CIRCUITS TO ESC

Fault Detection Management

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

A fault in the air actuated park brake circuits may be apparent when the actuated park brake does not hold the truck and there are DTC's. Problems in the air actuated park brake circuits can be caused by open or short circuits between the air actuated park brake switch and the ESC, a failed switch, or a problem in the ESC.

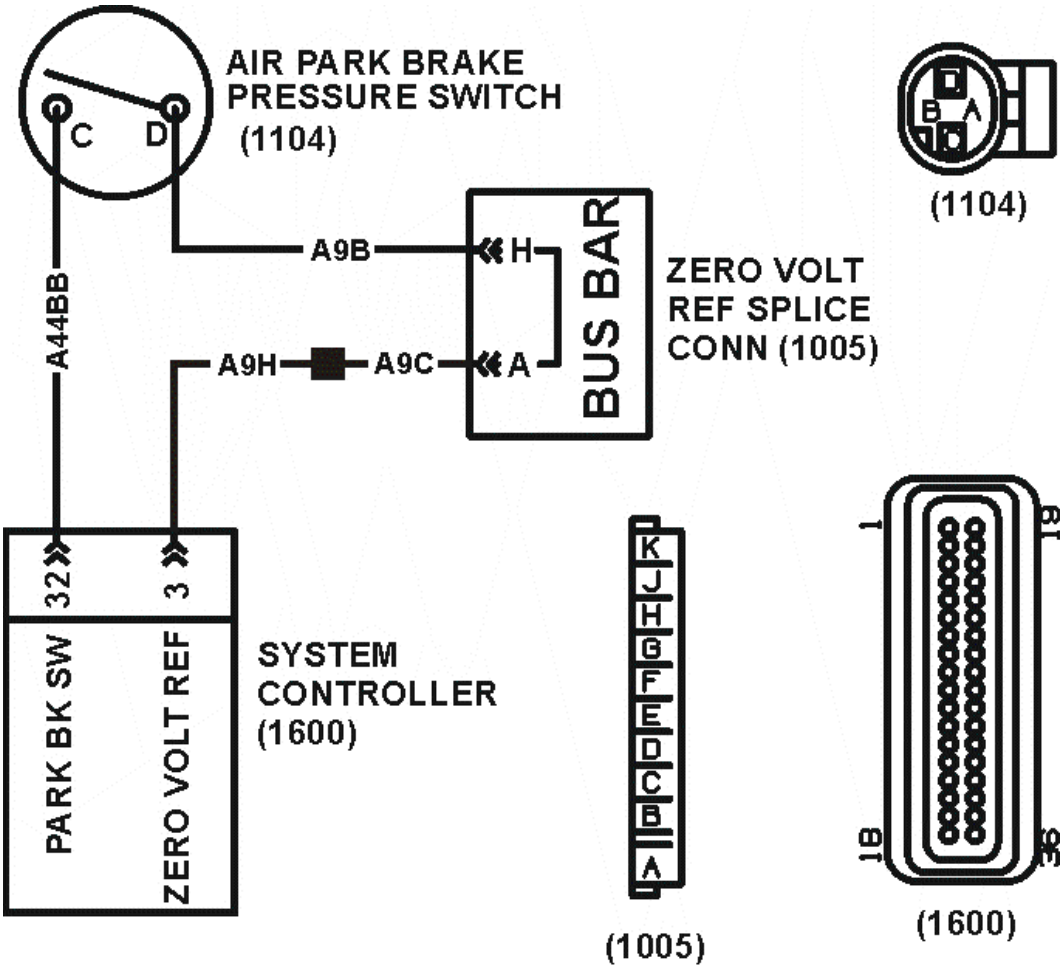

Figure 358 Air Actuated Park Brake Circuits to ESC — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1005) ZERO VOLT REFERENCE SPLICE CONNECTOR
LOCATED RIGHT SIDE INSTRUMENT PANEL
(1104) AIR PARK BRAKE PRESS SWITCH
LOCATED IN INSTRUMENT WING PANEL
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 215 Air Park Brake Pressure Switch Tests

Air Park Brake Pressure Switch (1104) Voltage Checks Check with ignition on, air park brake pressure switch (1104) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.** **Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
(1104) cavity D to ground.	0 volts	If voltage is present or voltmeter shows open circuit, check for open or shorts in circuits A9B, A9C and A9H. Also ensure proper zero volt reference from ESC connector (1600) pin 3.
(1104) cavity D to C.	0 volts	If voltage is present or voltmeter shows open circuit, check for open or shorts in circuit A44BB. If circuits test good, but air brake switch still fails, replace air park brake pressure switch.

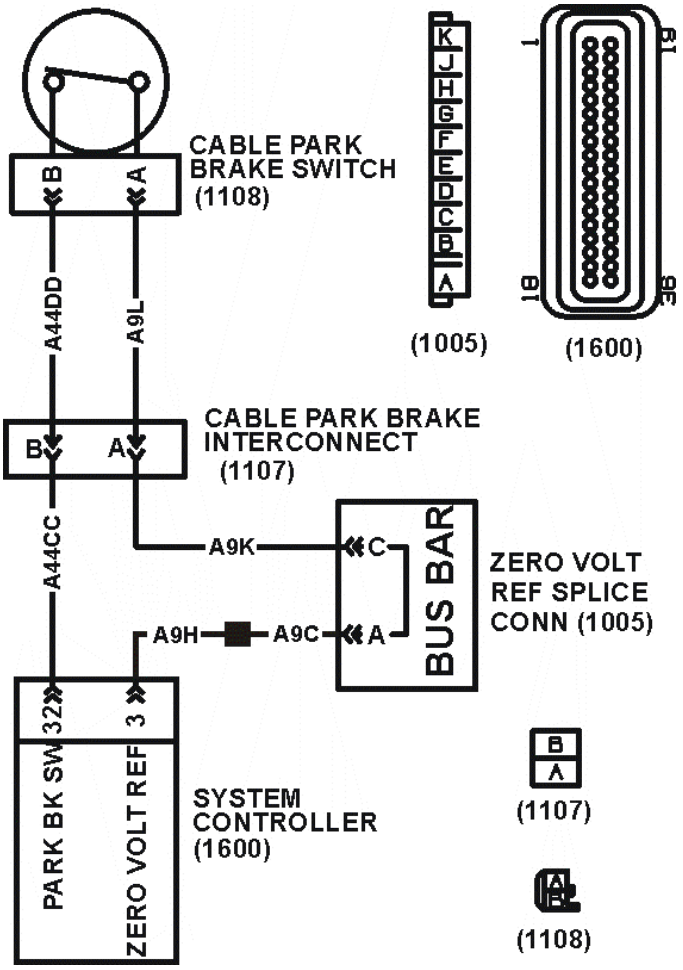

Figure 359 Spring Actuated Park Brake Circuits to ESC — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1005) ZERO VOLT REFERENCE SPLICE CONNECTOR
LOCATED RIGHT SIDE INSTRUMENT PANEL
(1107) CABLE PARK BRAKE INTERCONNECT
LOCATED ABOVE ACCELERATOR PEDAL
(1108) CABLE PARK BRAKE SWITCH
LOCATED NEAR DRIVERS SEAT
(1600) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL

Table 216 Cable Park Brake Switch Voltage Tests

Cable Park Brake Switch (1108) Voltage Checks Check with ignition on, cable park brake switch (1108) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.** **Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments

Table 216 Cable Park Brake Switch Voltage Tests (cont.)

(1108) cavity A to ground.	0 volts	If voltage is present or voltmeter shows open circuit, check for open or shorts in circuits A9L, A9K, A9C and A9H. Also ensure proper zero volt reference from ESC connector (1600) pin 3.
(1108) cavity A to B.	0 volts	If voltage is present or voltmeter shows open circuit, check for open or shorts in circuits A44DD and A44CC. If circuits test good, but cable brake switch still fails, replace cable park brake pressure switch.

Extended Description

Air and Cable Brake Switch

A zero volt reference is supplied from ESC connector (1600) terminal 3 through the brake switch back to the ESC connector (1600) terminal 32. When the signal is applied at terminal 32, the ESC will send a signal to the brake controller, via J1939, to activate the park brake.

9.4. AIR PARK BRAKE INTERLOCK

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.

A fault in the air park brake interlock circuits may be apparent when the air actuated park brake does not hold the truck and there are DTC's. Problems in the air actuated park brake interlock circuits can be caused by open or short circuits between the solenoids and the supply or ground or a failed solenoid.

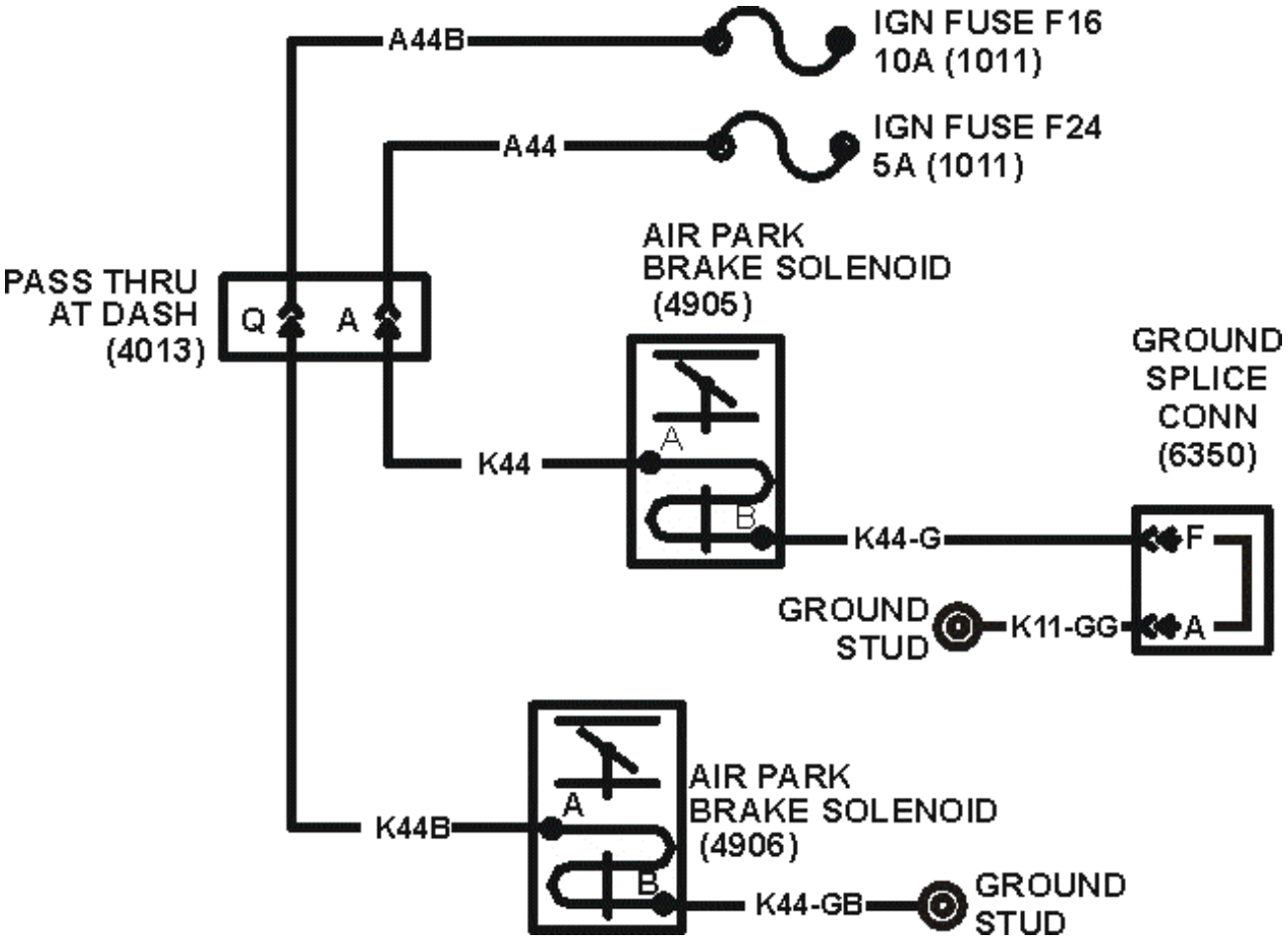

Figure 360 Air Actuated Park Brake Interlock Circuits Without Wheelchair Lift— Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4905) (4905) AIR PARK BRAKE SOLENOID
LOCATED AT OUTSIDE LEFT SIDE DASH PANEL
(6350) GROUND SPLICE PACK
LOCATED AT INSIDE LEFT SIDE DASH PANEL

Table 217 Air Park Brake Solenoid Tests Without Wheelchair Lift

Air Park Brake Solenoid (4905) Voltage Checks Check with ignition on and air park brake solenoid (4905) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air park brake solenoid (4905) cavity A to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F24. Also ensure check for open or short on circuits K44 and A44.
Air park brake solenoid (4905) cavity A to cavity B.	12 ± 1.5 volts	If voltage is missing check for open or short to high on circuits K44–G and K11–GG. If circuits test good, but air brake solenoid still fails, replace air park brake solenoid.
Air Park Brake Solenoid (4906) Voltage Checks Check with ignition on and air park brake solenoid (4906) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air park brake solenoid (4906) cavity A to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F16. Also ensure check for open or short on circuits K44B and A44B.
Air park brake solenoid (4906) cavity A to cavity B.	12 ± 1.5 volts	If voltage is missing check for open or short to high on circuit K44–GB. If circuits test good, but air brake solenoid still fails, replace air park brake solenoid.

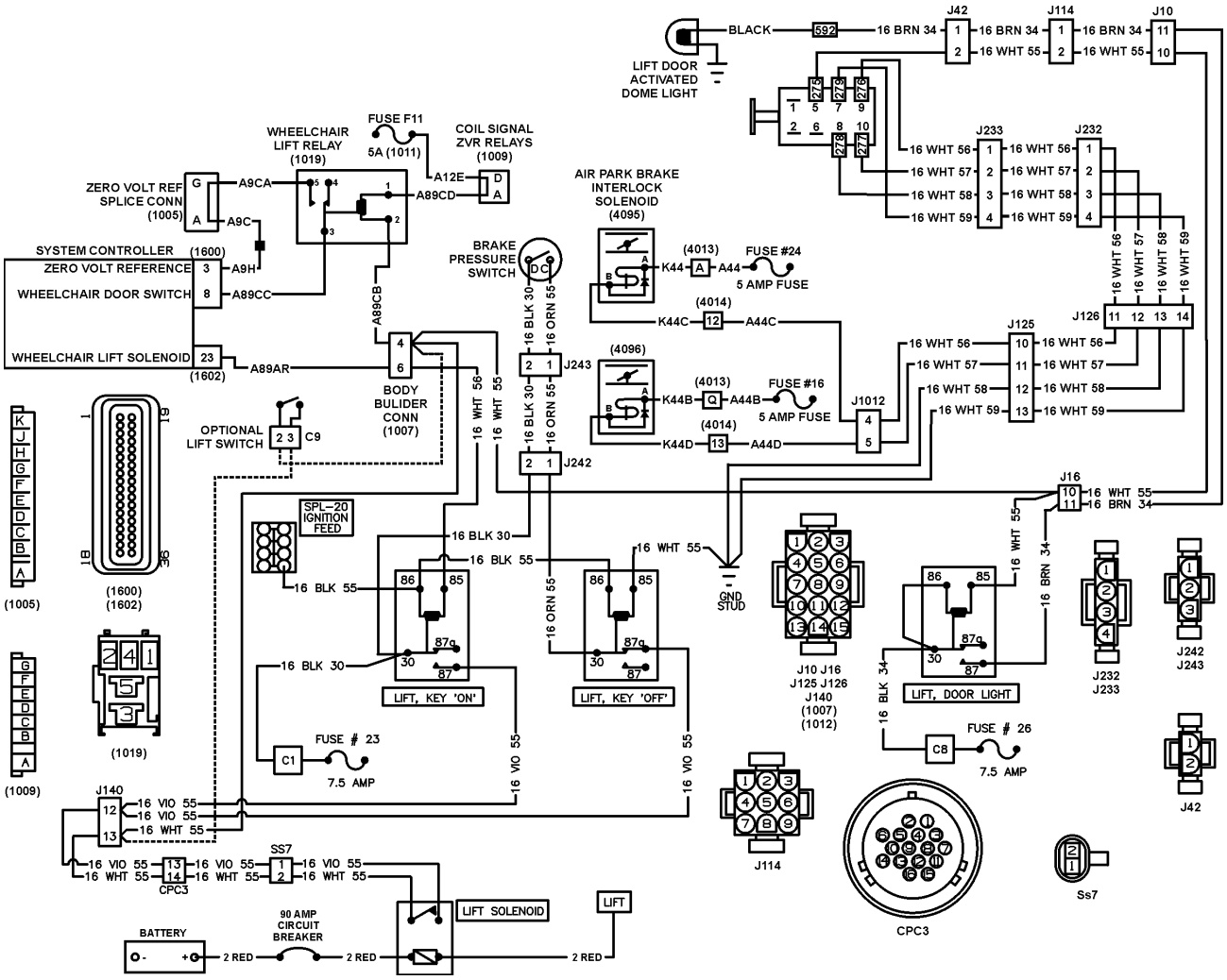

Figure 361 Air Actuated Park Brake Interlock Circuits With Wheelchair Lift — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1012) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4905) (4905) AIR PARK BRAKE SOLENOID
LOCATED AT OUTSIDE LEFT SIDE DASH PANEL

Table 218 Air Park Brake Solenoid Tests With Wheelchair Lift

Air Park Brake Solenoid (4905) Voltage Checks Check with ignition on and air park brake solenoid (4905) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air park brake solenoid (4905) cavity A to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F24. Also ensure check for open or short on circuits K44 and A44.
Air park brake solenoid (4905) cavity A to cavity B.	12 ± 1.5 volts	If voltage is missing check for open or short on circuits K44C and A44C. If circuits test good, but air brake solenoid still fails, replace air park brake solenoid.
Air Park Brake Solenoid (4906) Voltage Checks Check with ignition on and air park brake solenoid (4906) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Air park brake solenoid (4906) cavity A to ground.	12 ± 1.5 volts	If voltage is missing check for blown fuse F16. Also ensure check for open or short on circuits K44B and A44B.
Air park brake solenoid (4906) cavity A to cavity B.	12 ± 1.5 volts	If voltage is missing check for open or short on circuits K44D and A44D. If circuits test good, but air brake solenoid still fails, replace air park brake solenoid.

9.5. COMPONENT LOCATIONS

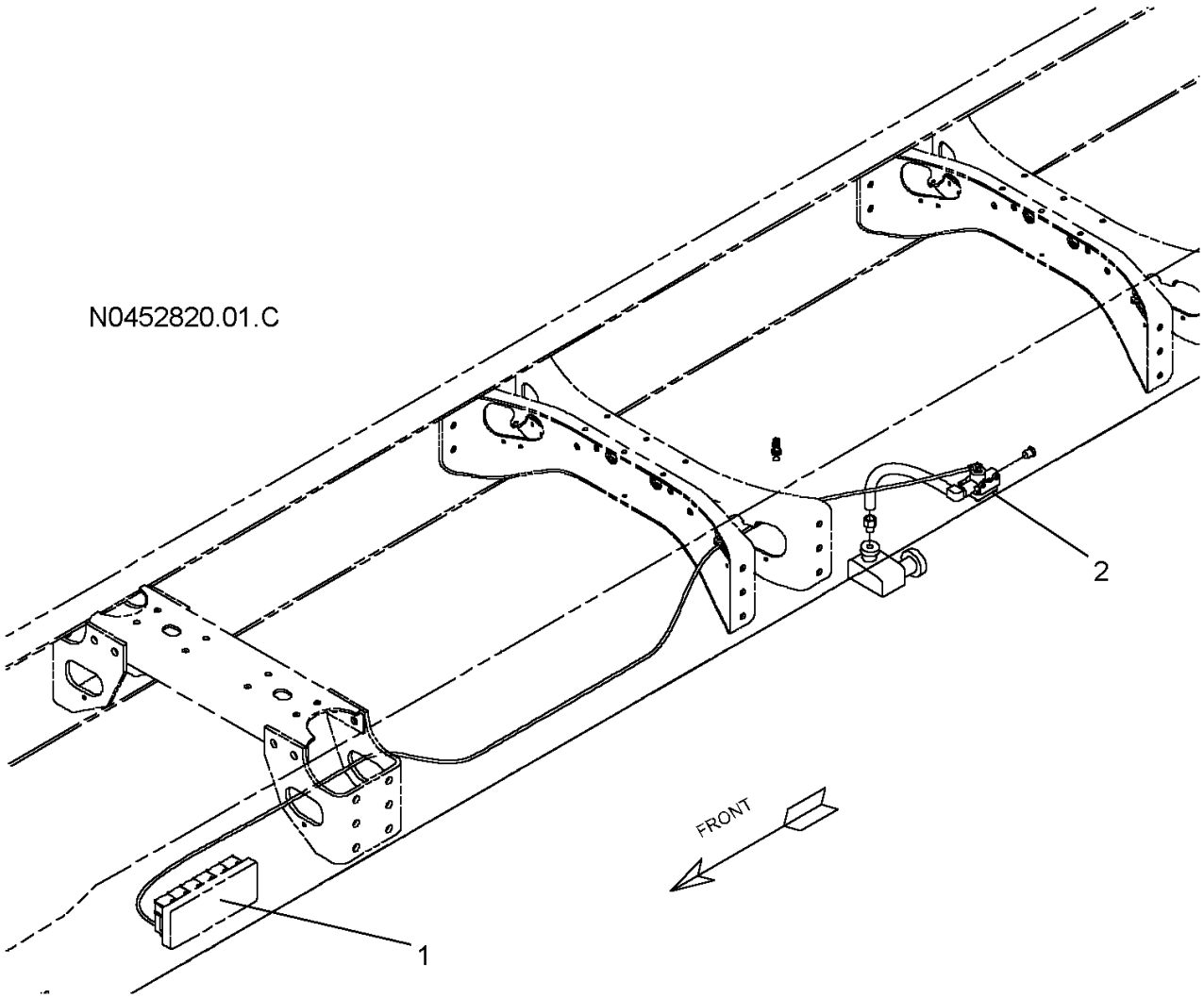

Figure 362 Air Actuated Park Brake Air Line Location

1. AIR SOLENOID MODULE
2. SAAR AIR SOLENOID

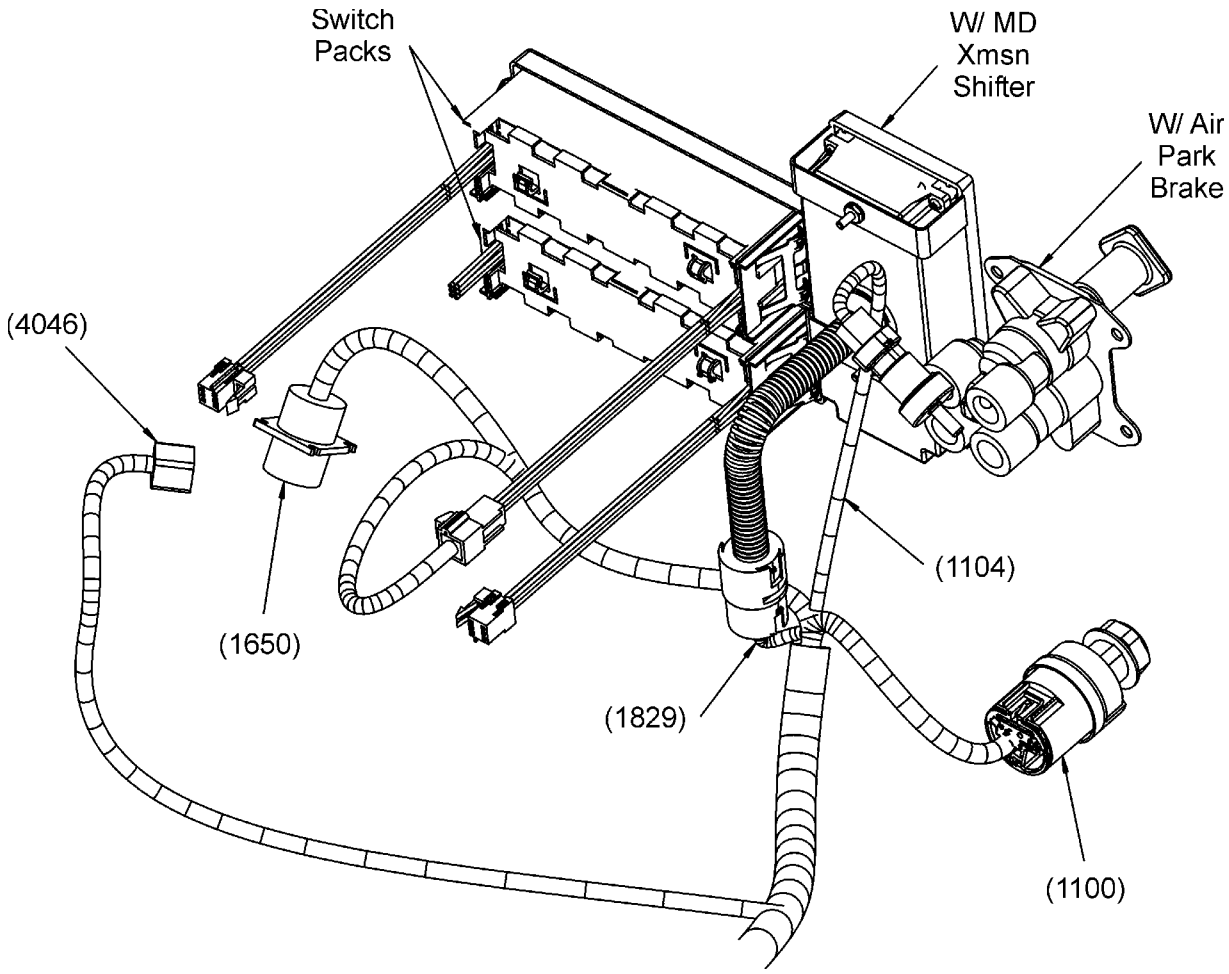

Figure 363 Air Actuated Park Brake Switch Location

(1100) KEY SWITCH
(1104) AIR PARK BRAKE PRESS SWITCH
(1650) DIAGNOSTICS CONNECTOR
(1829) MD XMSN PRIMARY SHIFT SELECTOR
(4046) WIPER MOTOR

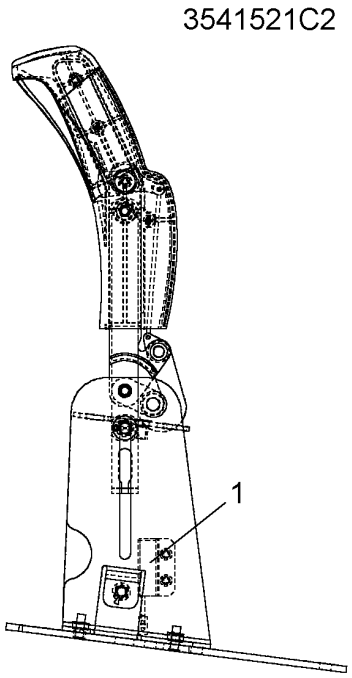

Figure 364 Cable Park Brake Pull Lever

1. CABLE PARK BRAKE SWITCH

10. FUEL/WATER SEPARATOR W/12VDC FUEL PREHEATER

10.1. CIRCUIT FUNCTIONS

The fuel/water separator with 12 VDC fuel preheater is in the fuel/water filter. It prevents fuel from gelling in the unfiltered side of the filter during cold weather.

The system consists of a fuel heater relay, filter heating element, and a normally open thermoswitch. The switch closes at approximately 10°C/50°F.

10.2. DIAGNOSTICS

Should the fuel preheater fail to operate, the problem could be attributed to a failed relay, an open or shorted circuit or a failed heating element/switch assembly.

There are no diagnostic trouble codes associated with the fuel preheater circuits.

Fuel Preheater Preliminary Check

Table 219 Fuel Preheater Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify fuel preheater is inoperative.	Check fuel preheater.	Fuel preheater is inoperative.	Go to next step.	Fuel preheater is operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.)	Visually check for other 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	Go to Fuel Preheater Circuits. (See FUEL PREHEATER CIRCUITS, page 719)				

10.3. FUEL PREHEATER CIRCUITS

Fault Detection Management

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

A fault in the fuel preheater circuits will be apparent when the temperature is below 10°C/50°F and the heater is not operating.

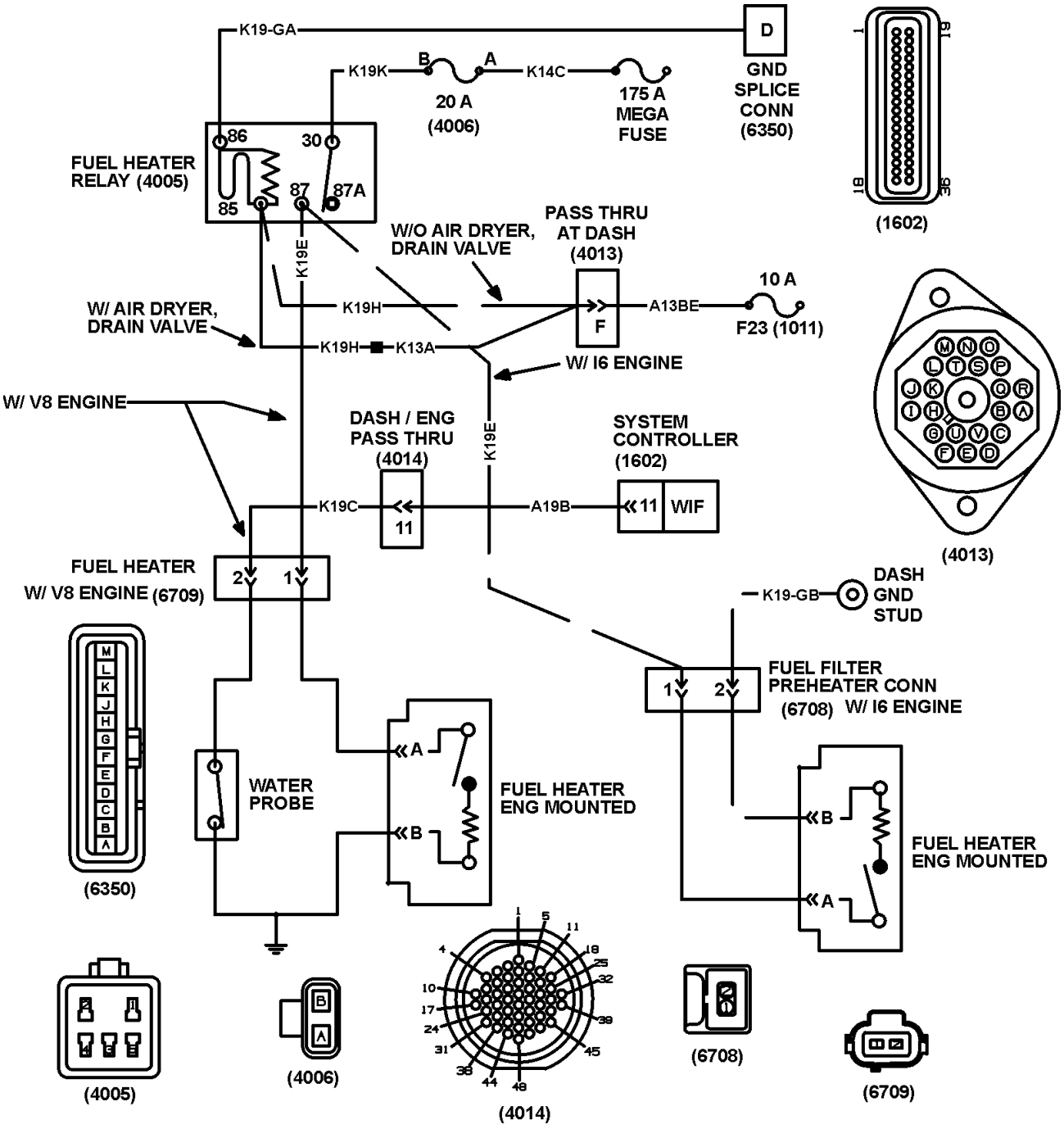

Figure 365 Fuel Preheater Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4005) FUEL HEATER RELAY
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4006) FUEL HEATER FUSE
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(6350) GROUND SPLICE RACK
LOCATED AT ENGINE COMPARTMENT NEAR STARTER
(6708) FUEL FILTER PREHEATER (I-6 ONLY)
LOCATED AT ENGINE COMPARTMENT FUEL FILTER
(6709) FUEL HEATER
LOCATED AT ENGINE COMPARTMENT FUEL FILTER

Table 220 Fuel Preheater Connector Chart

Fuel Heater Relay (4005) Socket Voltage Checks Check with ignition on and Fuel Heater relay removed. Insure temperature is below 10°C/50°F Bench test relay. If relay fails bench test, replace and check for faults.		
Test Points	Spec.	Comments
Socket cavity 30 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown 20A fuel heater fuse (4006) or open or short in circuits K19K and K14C.
Socket cavity 30 to 86.	12 ± 1.5 volts	If voltage is incorrect, check for open in circuit K19–GA to ground splice (6350). If voltage still incorrect, check for open in ground splice connection (6350) to ground.
Socket cavity 85 to 86.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse F23. Also check for open or short to ground in circuits K19H and A13BE or K19H, K13A and A13BE A13BE.
Fuel Heater Harness Connector (6709) (V8 Only) Voltage Checks Check with ignition key on, fuel heater relay (4005) installed and (6709) removed from fuel heater. Insure temperature is below 10°C/50°F **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments

Table 220 Fuel Preheater Connector Chart (cont.)

Fuel heater (6709) terminal 1 to ground.	12 ± 1.5 volts	If voltage is missing check for open or short on circuit K19E. Also ensure proper grounding of fuel heater. If all circuits test good and fuel heater stills fails, replace fuel heater.
Fuel Filter Preheater Harness Connector (6708) (I6 Only) Voltage Checks Check with ignition key on, fuel heater relay (4005) installed and (6708) removed from fuel heater. Insure temperature is below 10°C/50°F **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Fuel filter preheater (6708) terminal 1 to ground.	12 ± 1.5 volts	If voltage is missing check for open or short on circuit K19E.
Fuel filter preheater (6708) terminal 1 to 2.	12 ± 1.5 volts	If voltage is missing check for open or short to high in circuit K19–GB. If all circuits test good and fuel filter preheater still fails, replace fuel filter preheater.

Extended Description

When the ignition is on, the fuel heater relay will energize providing battery voltage to the fuel heater. The thermoswitch in the fuel heater will close when the air temperature drops below 10°C (50°F) supplying voltage to the fuel heater.

10.4. COMPONENT LOCATIONS

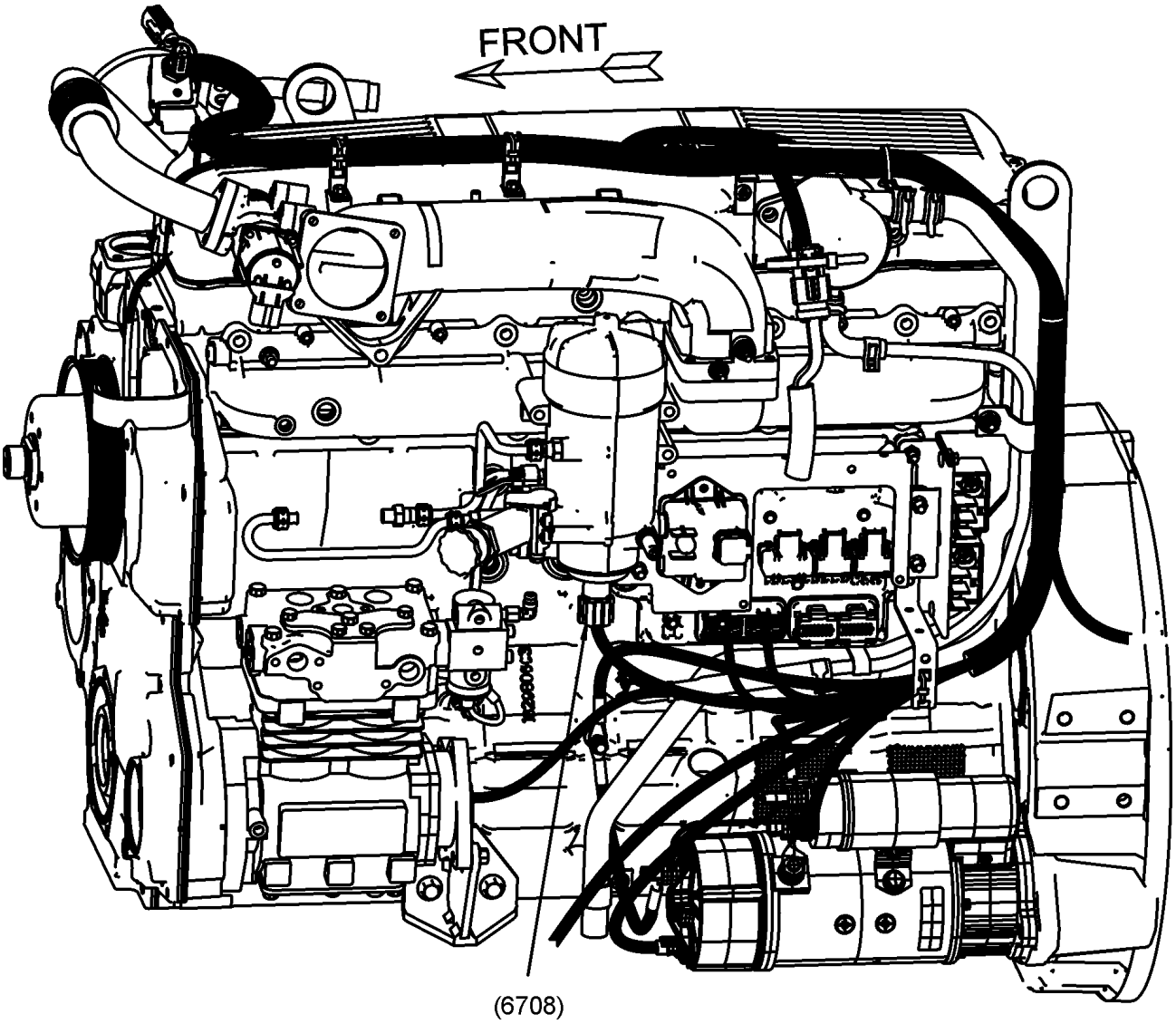

Figure 366 Fuel Preheater Location (I-6 only)

(6708) FUEL FILTER PREHEATER (I-6 ONLY)

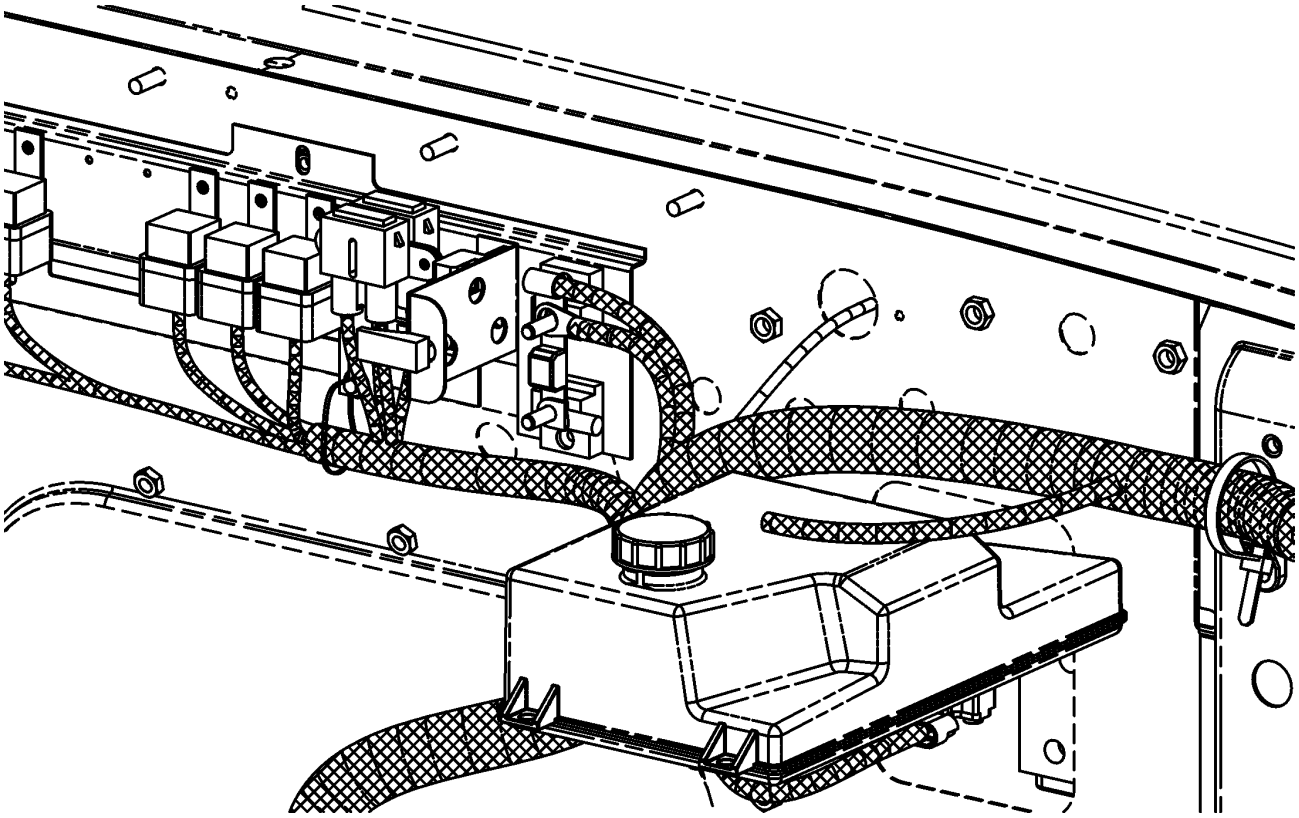

Figure 367 Engine Compartment Power Distribution Center

FUSES LOCATED IN ENGINE COMPARTMENT PDC
- FUEL HEATER FUSE (20 A)
- AIR DRYER/DRAIN VALVE FUSE (20 A)
- IDM B+ FUSE (10 A)
- ECM FUSE (10 A)
- EGR FUSE (20 A)
- FULL POWER BRAKE FUSE (30 A)
- HYDRAULIC BRAKE VALVE FUSE (30 A)
- ABS MAXI FUSE (30 A)

RELAYS LOCATED IN ENGINE COMPARTMENT PDC
- FAN RELAY
- STARTER ISO & POWER RELAY
- FUEL HEATER RELAY
- IDM POWER RELAY
- ABS ECU POWER RELAY
- ECM ISO & POWER RELAY
- AIR DRYER/DRAIN VALVE RELAY

11. CROSSING GATE ASSEMBLY

11.1. CIRCUIT FUNCTIONS

The crossing gate assembly is activated when the Red Pupil Warning Lights are activated. It is designed so that pedestrians are not lost in the front end blind spot by forcing them to cross in front of the bus with enough distance for the driver to see them.

The assembly consists of the crossing gate, a motor and a magnet.

11.2. DIAGNOSTICS

Should the crossing gate fail to operate, the problem could be attributed to a failed relay, an open or shorted circuit or a failed heating element/switch assembly.

Table 221 Crossing Gate Assembly Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 31 1	Crossing Gate disable out of range low.
612 14 31 2	Crossing Gate disable out of range high.

Crossing Gate Preliminary Check

Table 222 Crossing Gate Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify crossing gate is inoperative.	Check crossing gate.	Crossing gate is inoperative.	Go to next step.	Crossing gate is operating. 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 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	Go to Crossing Gate Assembly Circuits.				

11.3. CROSSING GATE ASSEMBLY CIRCUITS

Fault Detection Management

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

A fault in the crossing gate assembly circuits will be apparent when the crossing gate fails to operate.

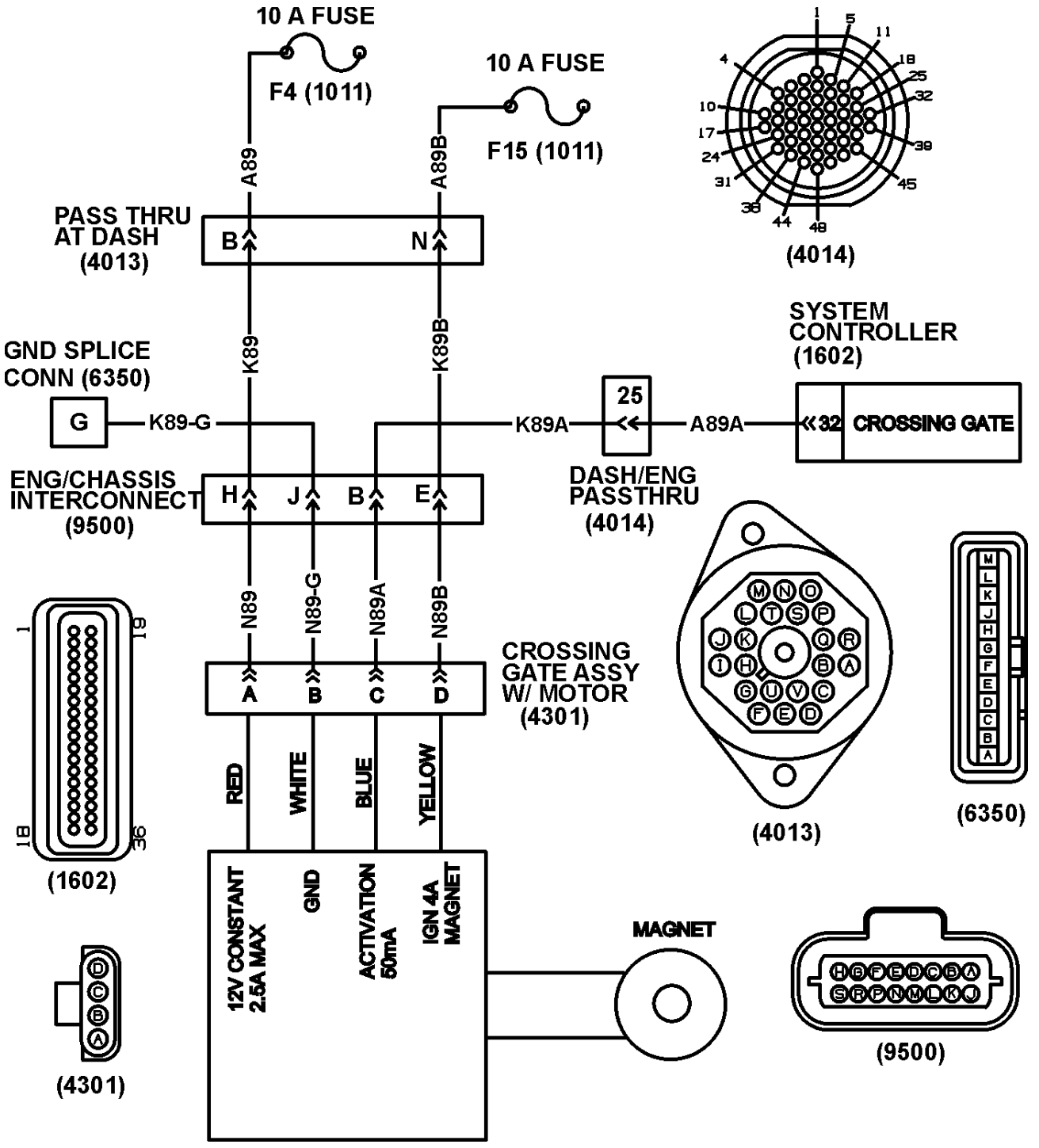

Figure 368 Crossing Gate Assembly Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
(4013) PASS THRU AT DASH
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4014) DASH/ENGINE PASS THRU
LOCATED AT INSIDE LEFT SIDE DASH PANEL
(4301) CROSSING GATE ASSEMBLY W/MOTOR
LOCATED AT RIGHT SIDE NEAR FRONT BUMPER
(9500) ENGINE/CHASSIS INTERCONNECT
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

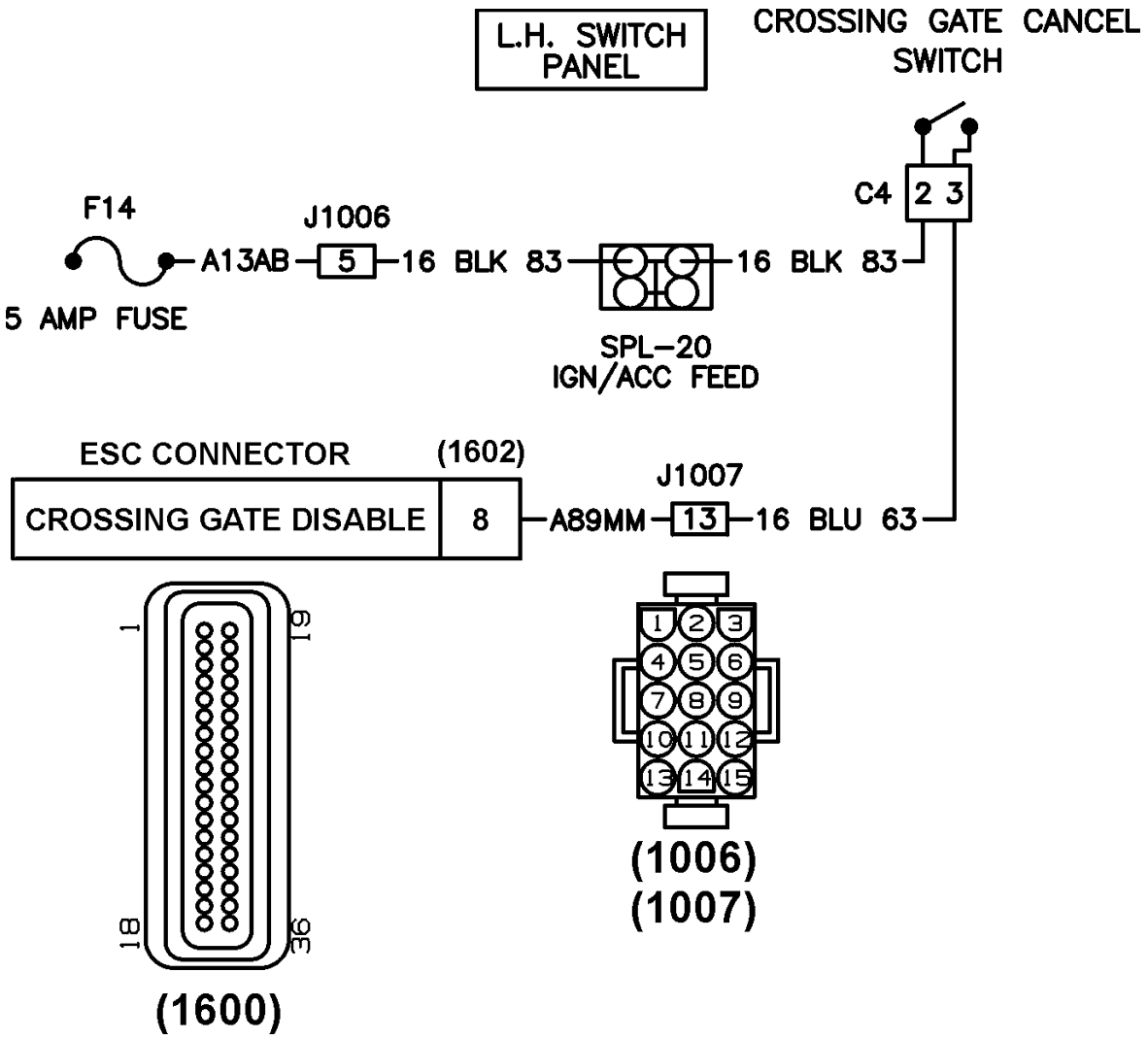

Figure 369 Crossing Gate Disable Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) (1007) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1602) SYSTEM CONTROLLER
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
SPL-20 IGNITION ACCESSORY FEED SPLICE

Table 223 Crossing Gate Assembly Circuit Chart

Crossing Gate Assembly w/Motor Voltage Checks Check with ignition on and Crossing Gate Assembly w/Motor connector (4301) removed. **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
(4301) pin D to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown 10A fuse F15 or open or short in circuits N89B, K89B and A89B.
(4301) pin A to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown 10A fuse F4 or open or short in circuits N89, K89 and A89.
(4301) pin A to pin B.	12 ± 1.5 volts	If voltage is incorrect, check for open or short to high in circuits N89–G and K89–G.
(4301) pin A to pin C.	0 volts	If voltage is present, check for short on circuits N89A, K89A and A89A. Also ensure that system controller (1602) pin 32 is not producing a ground signal. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
While multimeter is connected to (4301) pin A to pin C, activate grossing gate motor by activating the red pupil warning lights.		
(4301) pin A to pin C.	12 ± 1.5 volts	If voltage is missing, check for open or short to high on circuits N89A, K89A and A89A. Also ensure that system controller (1602) pin 32 is producing the proper ground signal. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** If circuits test good and crossing gate fails, replace crossing gate assembly.
Crossing Gate Disable Circuits Voltage Checks Check with ignition on, Crossing Gate Assembly w/Motor connector (4301) connected and crossing gate cancel switch (C4) 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

Table 223 Crossing Gate Assembly Circuit Chart (cont.)

Crossing gate cancel switch (C4) cavity 2 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown chassis fuse F14. Also check for open or short on circuits 16 BLK 83 and A13AB.
Crossing gate cancel switch (C4) cavity 2 to cavity 3.	12 ± 1.5 volts	If voltage is incorrect, check for open or short to high on circuits 16 BLU 83 and A89MM. Also ensure proper input signal from system controller (1600) pin 8. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** Refer to the ESC Replacement section of this manual. If circuits check good and failure still exists, replace crossing gate cancel switch.

Extended Description

When the ignition is on, the voltage will be supplied from fuse F4 to power the gate assembly and from fuse F15 to power the magnet.

The Crossing Gate Assembly is activated by a signal from the ESC when the red flashers are activated.

11.4. COMPONENT LOCATIONS

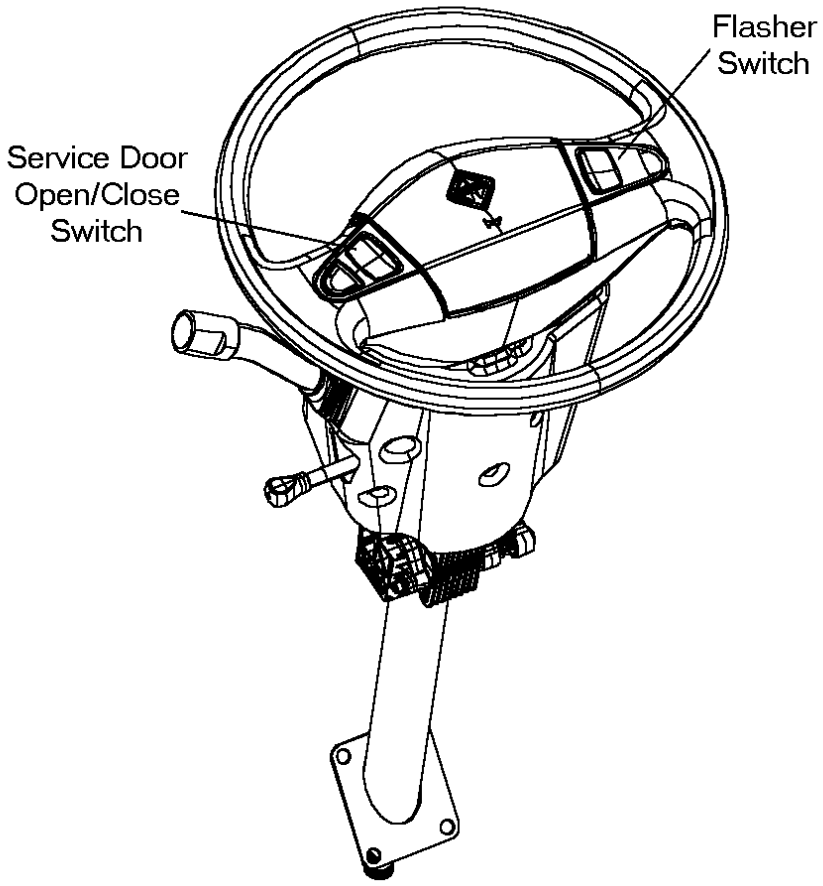

Figure 370 Steering Wheel Switches

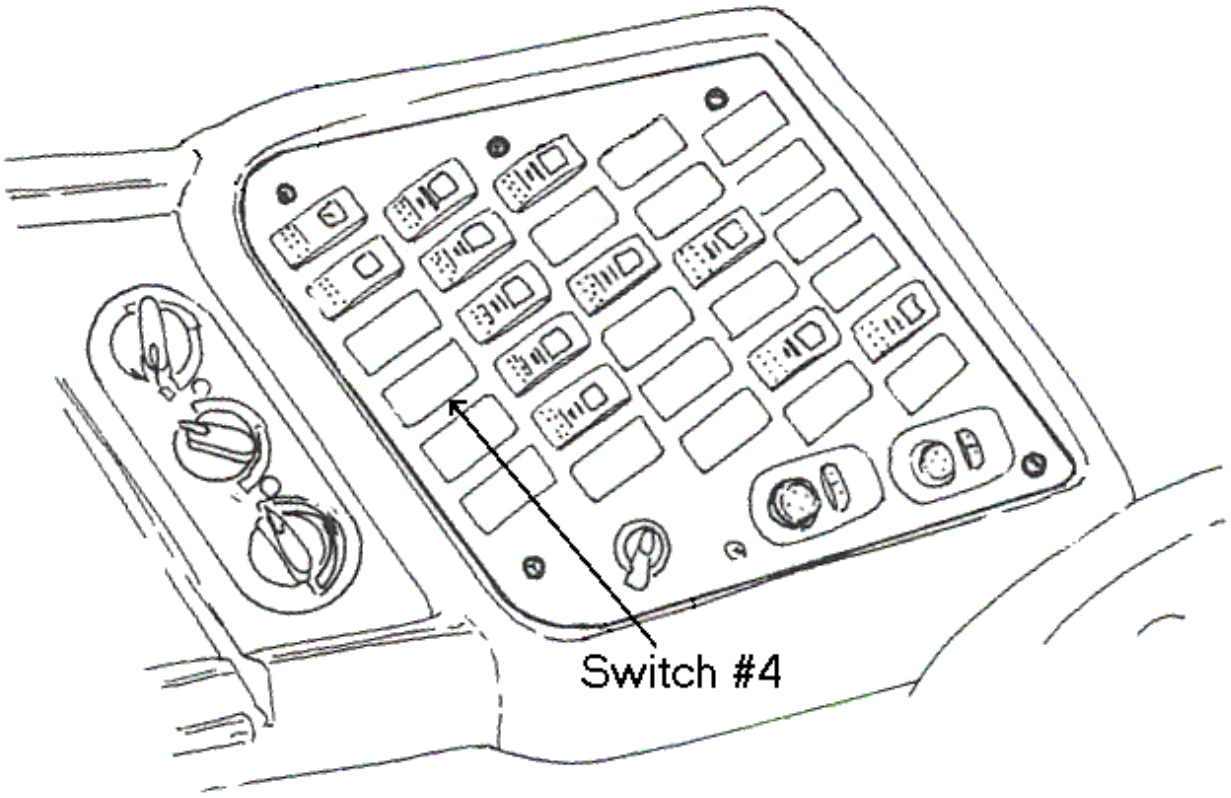

Figure 371 Left Hand Switch Panel

SWITCH #4 — CROSSING GATE CANCEL SWITCH

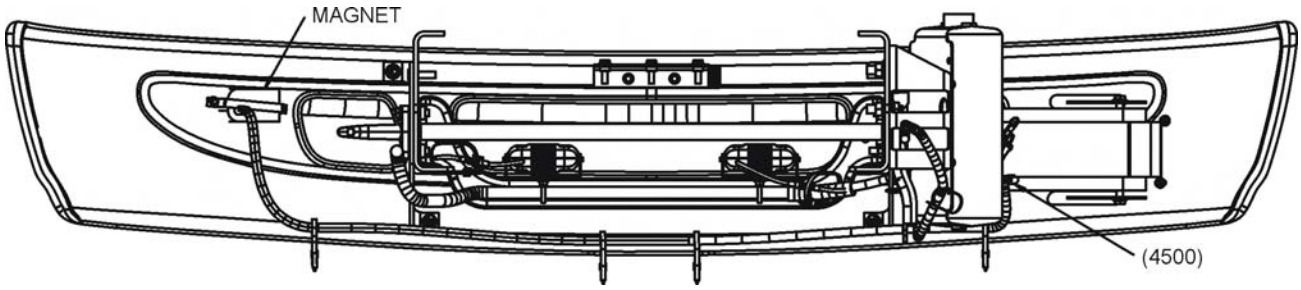

Figure 372 Crossing Gate Assembly Wiring

(4500) WINDSHIELD WASHER PUMP

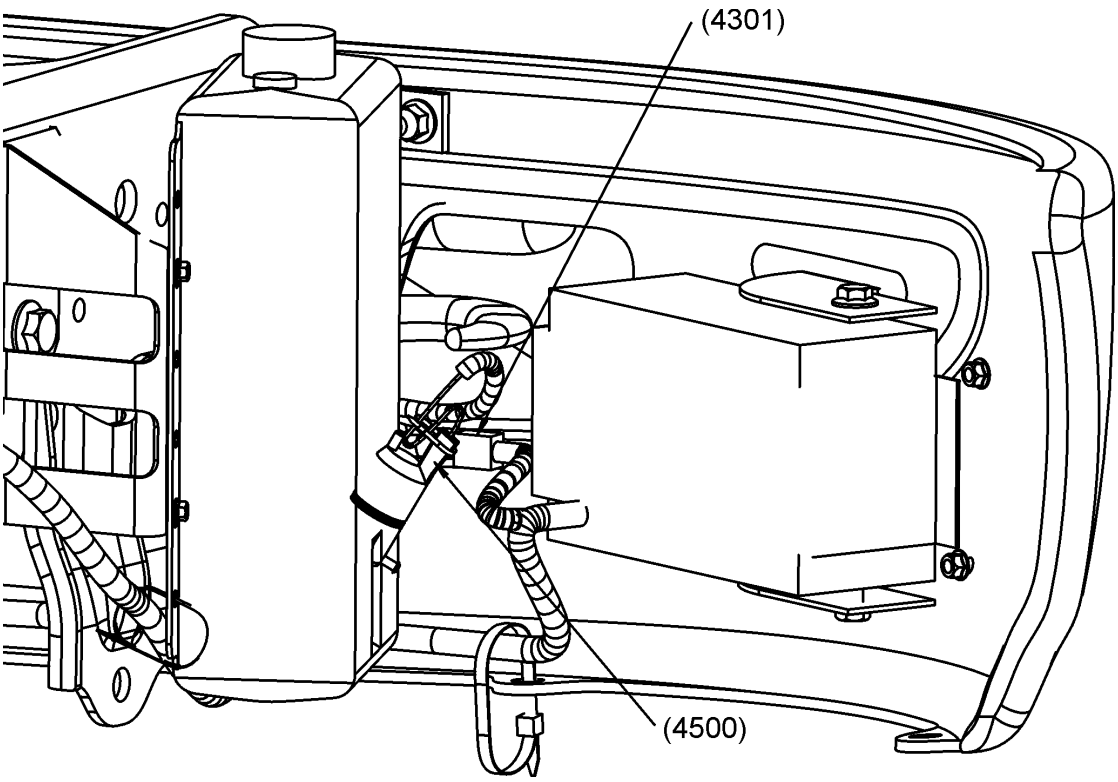

Figure 373 Crossing Gate Assembly Connector

(4301) CROSSING GATE ASSEMBLY W/MOTOR
(4500) WINDSHIELD WASHER PUMP

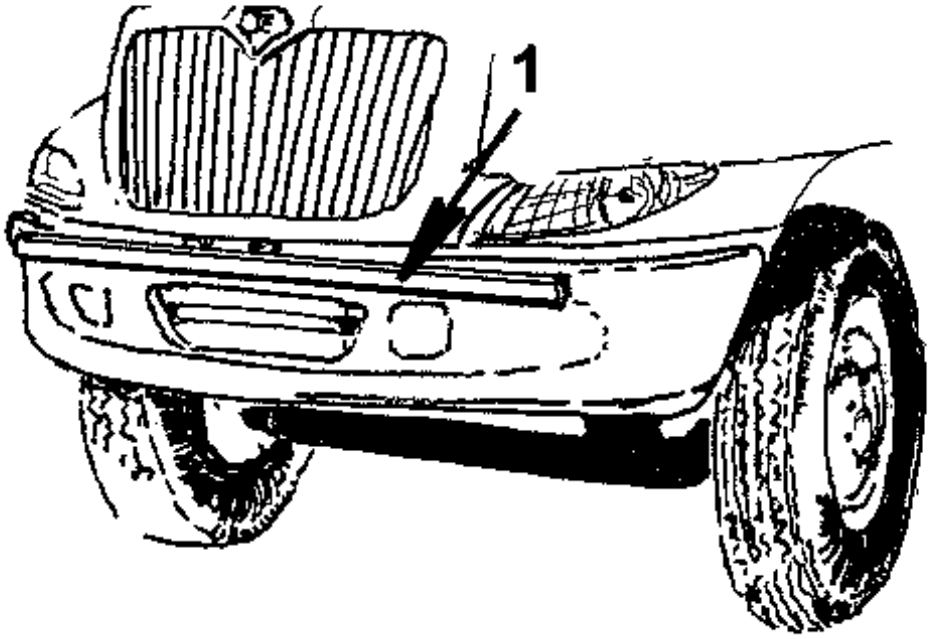

Figure 374 Crossing Gate

CROSSING GATE

12. REVERSE MOTION SENSOR

12.1. CIRCUIT FUNCTIONS

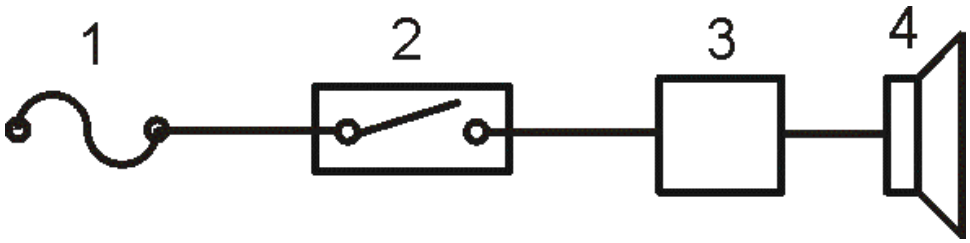

Figure 375 Reverse Motion Sensor Function Diagram

1. POWER SOURCE
2. TRANSMISSION BACKUP SWITCH
3. ECCO DS1500 REVERS MOTION SENSOR
4. BACK-UP ALARM

The reverse motion sensor will detect any reverse motion of the drive shaft when the ignition is turned off. When reverse motion is detected the backing alarm will sound giving an audible indication that the vehicle is moving.

12.2. DIAGNOSTICS

Should the reverse motion sensor fail to operate, the problem could be attributed to an open or shorted circuit or a faulty sensor or a fault back-up alarm.

There are no diagnostic trouble codes associated with the Reverse motion sensor.

For proper installation documentation, refer to the DS1500 Directional Sensor Installation and Operation Manual available through Electronic Controls Co. (ECCO).

Reverse Motion Sensor Preliminary Check

Table 224 Reverse Motion Sensor Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify reverse motion sensor is inoperative.	Visually check reverse motion sensor.	Reverse motion sensor is inoperative.	Go to next step.	Reverse motion sensor is operating. 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 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	Go to Reverse Motion Sensor Circuits. (See Reverse Motion Sensor Circuits, page 735)				

12.3. REVERSE MOTION SENSOR CIRCUITS

Fault Detection Management

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

WARNING – Before performing this test, which could result in property damage, personal injury or death, be sure that the front and rear of the vehicle are clear of any personnel. Also ensure vehicle will not move during test by chocking all wheels.

A fault in the reverse motion sensor circuits will be apparent when the backup alarm fails to operate with reverse bus motion.

Reverse Motion Sensor w/LCT Transmission

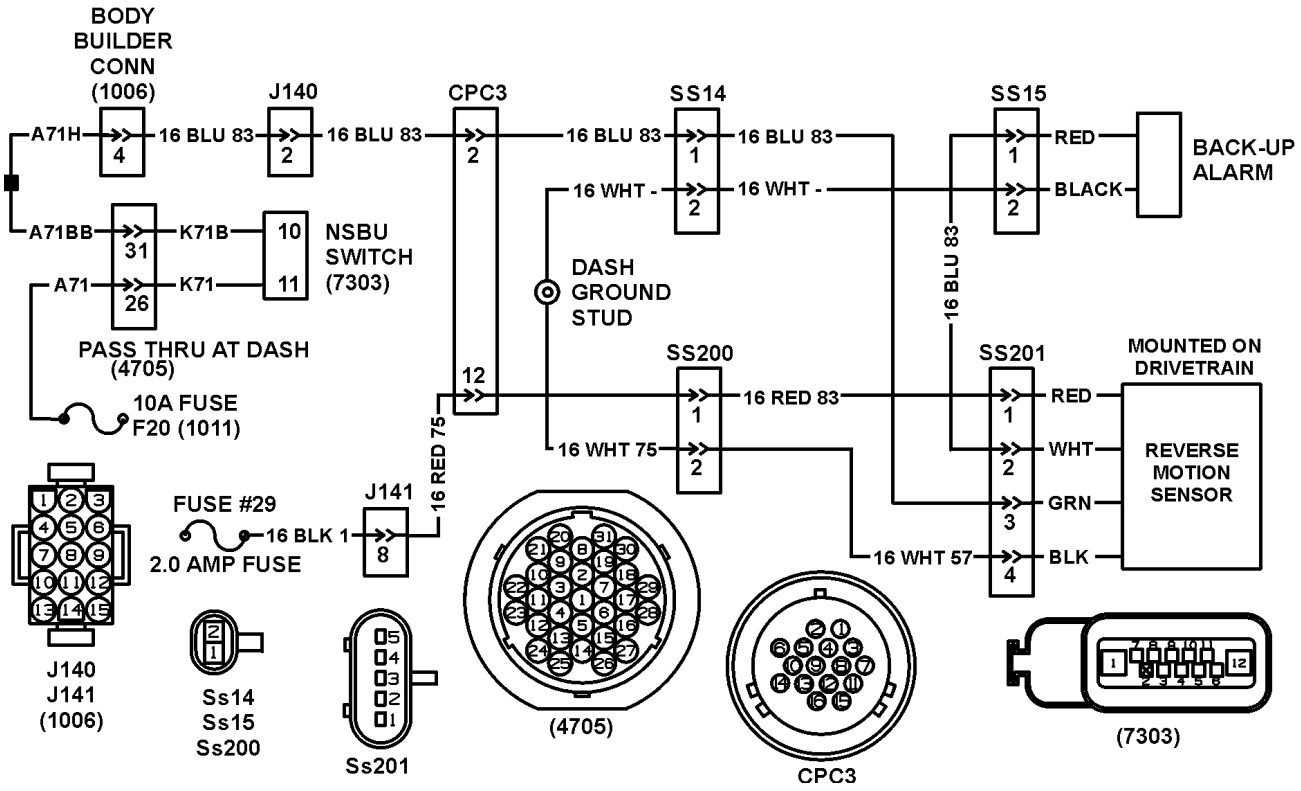

Figure 376 Reverse Motion Sensor w/LCT Transmission Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4705) PASS THRU AT DASH
LOCATED AT INSIDE DASH PANEL LEFT SIDE
(7303) NSBU SWITCH
LOCATED AT ENGINE COMPARTMENT TRANSMISSION
CPC3 DASH AND TOE HARNESS TO SEALED ENGINE HARNESS
J140 J141 FLASHER PLATE TO DASH AND TOE
SS14 SEALED ENGINE HARNESS TO BACK-UP HORN TRANSITION HARNESS
SS15 BACK-UP TRANSITION HARNESS TO BACK-UP HORN
SS200 SEALED ENGINE HARNESS TO REVERSE MOTION SENSOR TRANSITION
SS201 REVERSE MOTION SENSOR TRANSITION HARNESS TO REVERSE MOTION SENSOR

Table 225 Reverse Motion Sensor Circuit Chart

Reverse Motion Sensor Connector (SS201) Voltage Checks Check with ignition on, transmission in park, parking brake set and reverse motion sensor connector (SS201) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Reverse motion sensor connector (SS201) cavity 1 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse #29. Also check for open or short in circuits 16 BLK 1, 16 RED 75 and 16 RED 83.
Reverse motion sensor connector (SS201) cavity 1 to 4.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit 16 WHT 57.
Reverse motion sensor connector (SS201) cavity 3 to ground.	0 volts	If voltage is incorrect, check for open or short to high in circuits 16 BLU 83, A71H, A71BB and K71B.
WARNING – To avoid property damage, personal injury or death, ensure that parking brake is set and active and service brake is applied BEFORE shifting transmission into gear. While meter is connected to reverse motion sensor connector (SS201) pin 3 to ground, shift transmission into reverse gear.		
Reverse motion sensor connector (SS201) cavity 3 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20. Also check for open or short to high on circuits 16 BLU 83, A71H, A71BB, K71B, K71 and A71. If circuits check good, trouble shoot the LCT Transmission Back-Up Lights (See BACK-UP LIGHTS, page 747)and LCT Transmission (See LCT TRANSMISSION, page 1123)sections of this manual.
Reverse motion sensor connector (SS201) cavity 3 to 2.	12 ± 1.5 volts	If voltage is missing, check for open or short on circuits 16 BLU 83 and 16 WHT —. If all circuits check good and reverse motion sensor is still faulty, replace reverse motion sensor.

Reverse Motion Sensor w/MD Transmission

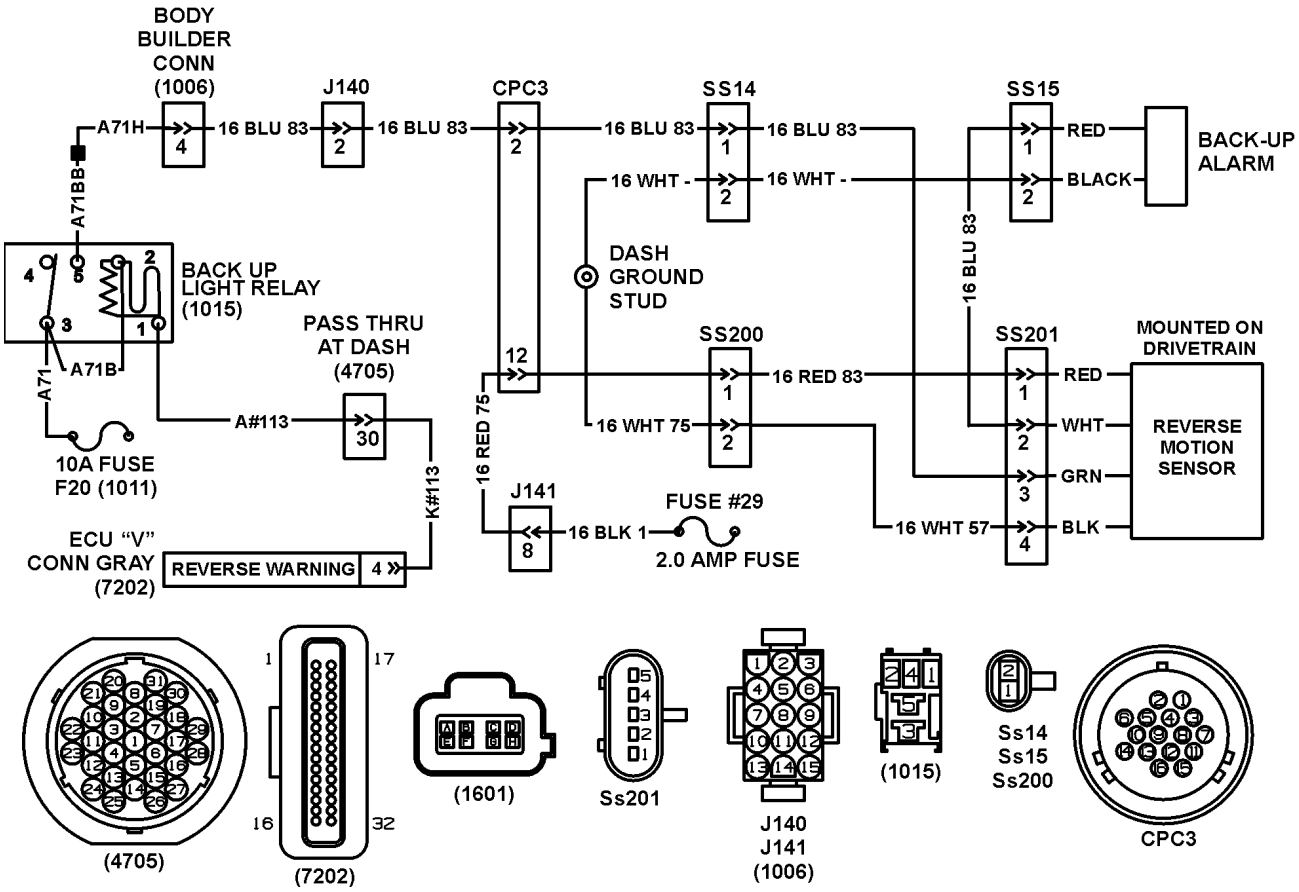

Figure 377 Reverse Motion Sensor wMD Transmission Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1006) BODY BUILDER CONNECTOR
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1011) FUSE BLOCK
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(1015) BACK UP LIGHT RELAY
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
(4705) PASS THRU AT DASH
LOCATED AT INSIDE DASH PANEL LEFT SIDE
(7202) MD ECU "V" CONNECTOR GRAY
LOCATED AT ENGINE COMPARTMENT TRANSMISSION
CPC3 DASH AND TOE HARNESS TO SEALED ENGINE HARNESS
J140 J141 FLASHER PLATE TO DASH AND TOE
SS14 SEALED ENGINE HARNESS TO BACK-UP HORN TRANSITION HARNESS
SS15 BACK-UP TRANSITION HARNESS TO BACK-UP HORN
SS200 SEALED ENGINE HARNESS TO REVERSE MOTION SENSOR TRANSITION
SS201 REVERSE MOTION SENSOR TRANSITION HARNESS TO REVERSE MOTION SENSOR

Table 226 Reverse Motion Sensor Circuit Chart

Reverse Motion Sensor Connector (SS201) Voltage Checks Check with ignition on, transmission in park, parking brake set and reverse motion sensor connector (SS201) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Reverse motion sensor connector (SS201) cavity 1 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse #29. Also check for open or short in circuits 16 BLK 1, 16 RED 75 and 16 RED 83.
Reverse motion sensor connector (SS201) cavity 1 to 4.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuit 16 WHT 57.
Reverse motion sensor connector (SS201) cavity 3 to ground.	0 volts	If voltage is incorrect, check for open or short to high in circuits 16 BLU 83, A71H and A71BB.
WARNING – To avoid property damage, personal injury or death, ensure that parking brake is set and active and service brake is applied BEFORE shifting transmission into gear. While meter is connected to reverse motion sensor connector (SS201) pin 3 to ground, shift transmission into reverse gear.		
Reverse motion sensor connector (SS201) cavity 3 to ground.	12 ± 1.5 volts	If voltage is missing, check for blown fuse F20. Also check for open or short to high on circuits 16 BLU 83, A71H, A71BB, K71B, A71, A71B A#113 and K#113. If circuits check good, trouble shoot the MD Transmission Back-Up Lights (See BACK-UP LIGHTS, page 747)and MD Transmission (See ALLISON® MD TRANSMISSION, page 1107)sections of this manual.
Reverse motion sensor connector (SS201) cavity 3 to 2.	12 ± 1.5 volts	If voltage is missing, check for open or short on circuits 16 BLU 83 and 16 WHT —. If all circuits check good and reverse motion sensor is still faulty, replace reverse motion sensor.

Extended Description

Power is always supplied to the reverse motion sensor on pin 1 from fuse #29.

When the transmission is shifted into reverse, voltage is supplied to pin 3 from fuse F20. The reverse motion sensor will then sound the back-up alarm.

When the reverse motion sensor detects reverse motion on the drivetrain, voltage will be supplied on pin 2 to sound the back-up alarm.

12.4. COMPONENT LOCATIONS

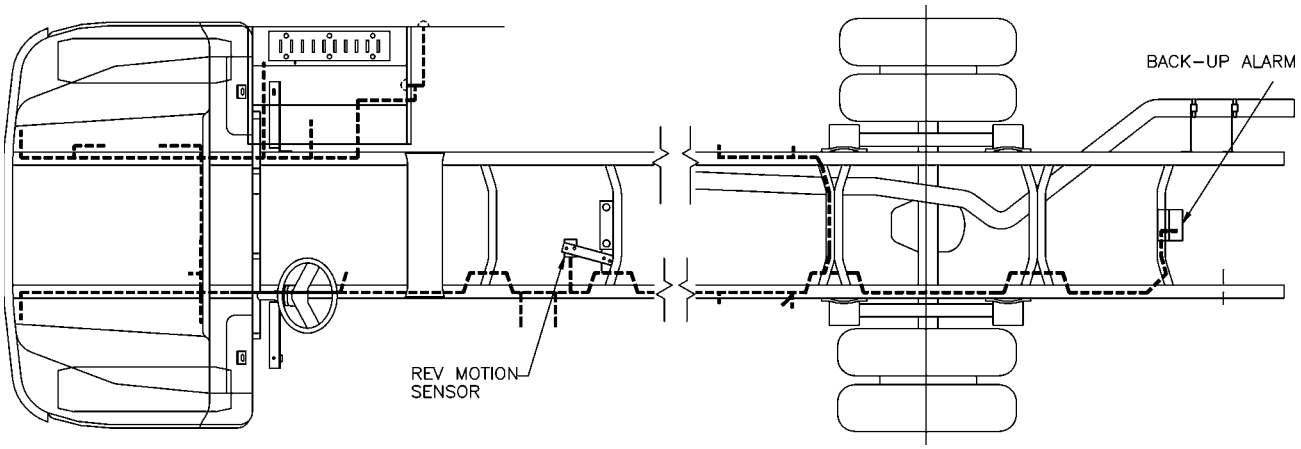

Figure 378 Reverse Motion Sensor Location