# Table of Contents

# 1. AIR DRYER AND HEATED DRAIN VALVE

## 1.1. CIRCUIT FUNCTIONS

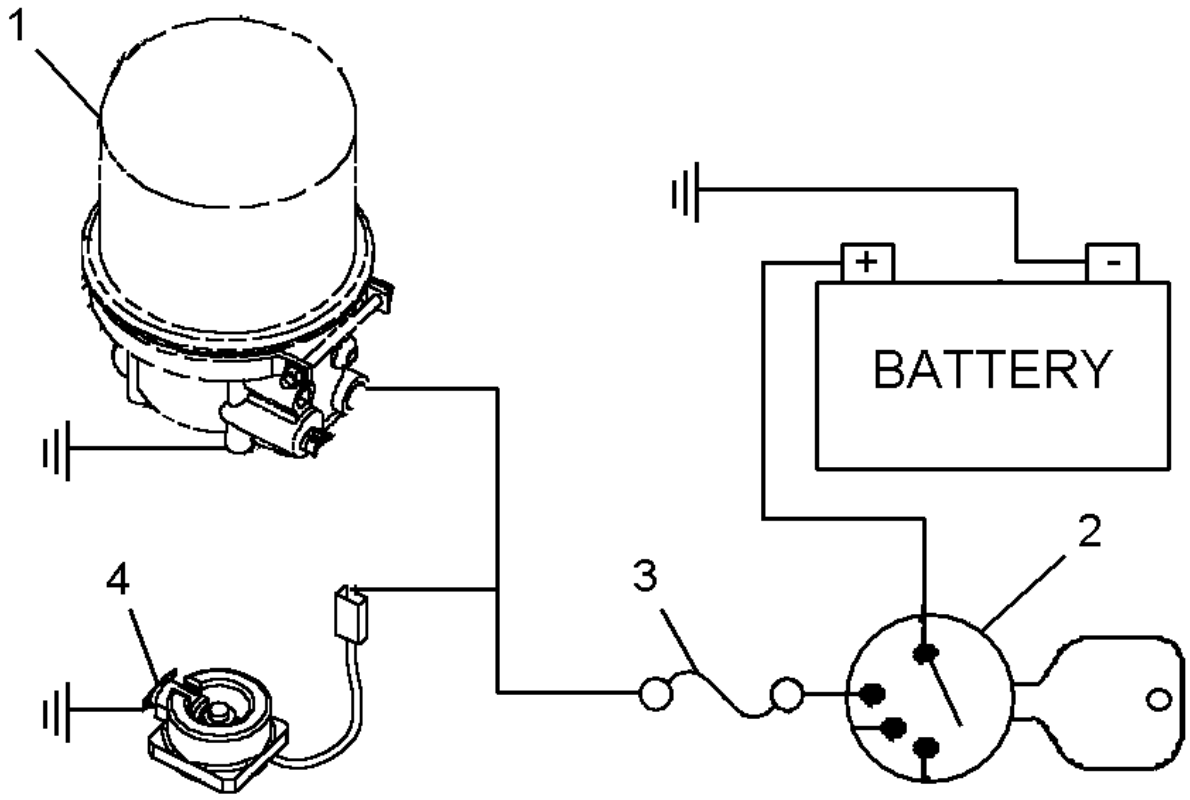



**Figure 311 Air Dryer And Heated Drain Valve Function Diagram**

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 205 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.

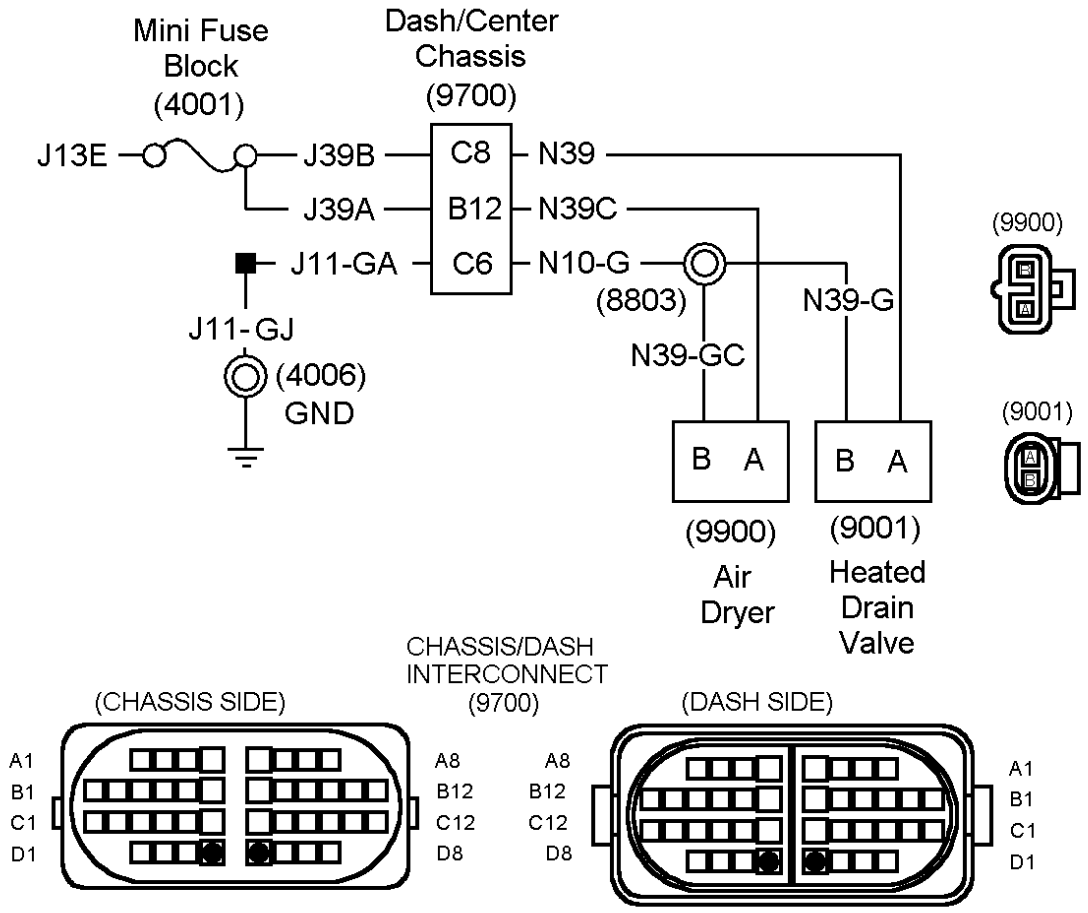



**Figure 312 Air Dryer And Heated Drain Valve Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION PANEL
(4006) GROUND STUD
LOCATED ABOVE ENGINE COMPARTMENT SIDE OF ESC
(8803) CHASSIS GROUND SPLICE PACK
(9001) HEATED DRAIN VALVE CONNECTOR
(9900) AIR DRYER CONNECTOR

**Table 206 Heated Drain Valve Connector Chart**

| Faults | | |
|---|---|---|
| There are no diagnostic trouble codes associated with the heated drain valve | | |
| **Heated Drain Valve Harness Connector (9001) Voltage Checks**<br><br>Check with ignition key on and heated drain valve disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Heated drain valve harness connector, pin A to ground | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between mini fuse block and heated drain valve connector.<br><br>Also insure fuse is not blown. |
| Heated drain valve harness connector, pin A to B | 12 ± 1.5 volts | If voltage is missing, check for open in circuits between ground and heated drain valve connector.<br><br>If voltage is correct and heated drain valve is still inoperative, replace heated drain valve assembly. |

**Table 207 Air Dryer Connector Chart**

| Faults | | |
|---|---|---|
| There are no diagnostic trouble codes associated with the air dryer circuits | | |
| **Air Dryer Harness Connector (9900) Voltage Checks**<br><br>Check with ignition key on and air dryer disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Air Dryer harness connector, pin A to ground | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between mini fuse block and Air Dryer connector.<br><br>Also insure fuse is not blown. |
| Air Dryer harness connector, pin A to B | 12 ± 1.5 volts | If voltage is missing, check for open in circuits between ground and Air Dryer connector.<br><br>If voltage is correct and Air Dryer is still inoperative, replace Air Dryer assembly. |

## Extended Description

Refer to air dryer and heated drain valve circuits.

The automatic drain valve and air dryer receive battery voltage from a 20 amp fuse in the engine power distribution center, when the key switch is placed in the start or ignition position. Ground for the heated drain valve and the air dryer is supplied from chassis ground splice pack (8803).

## 1.4. COMPONENT LOCATIONS

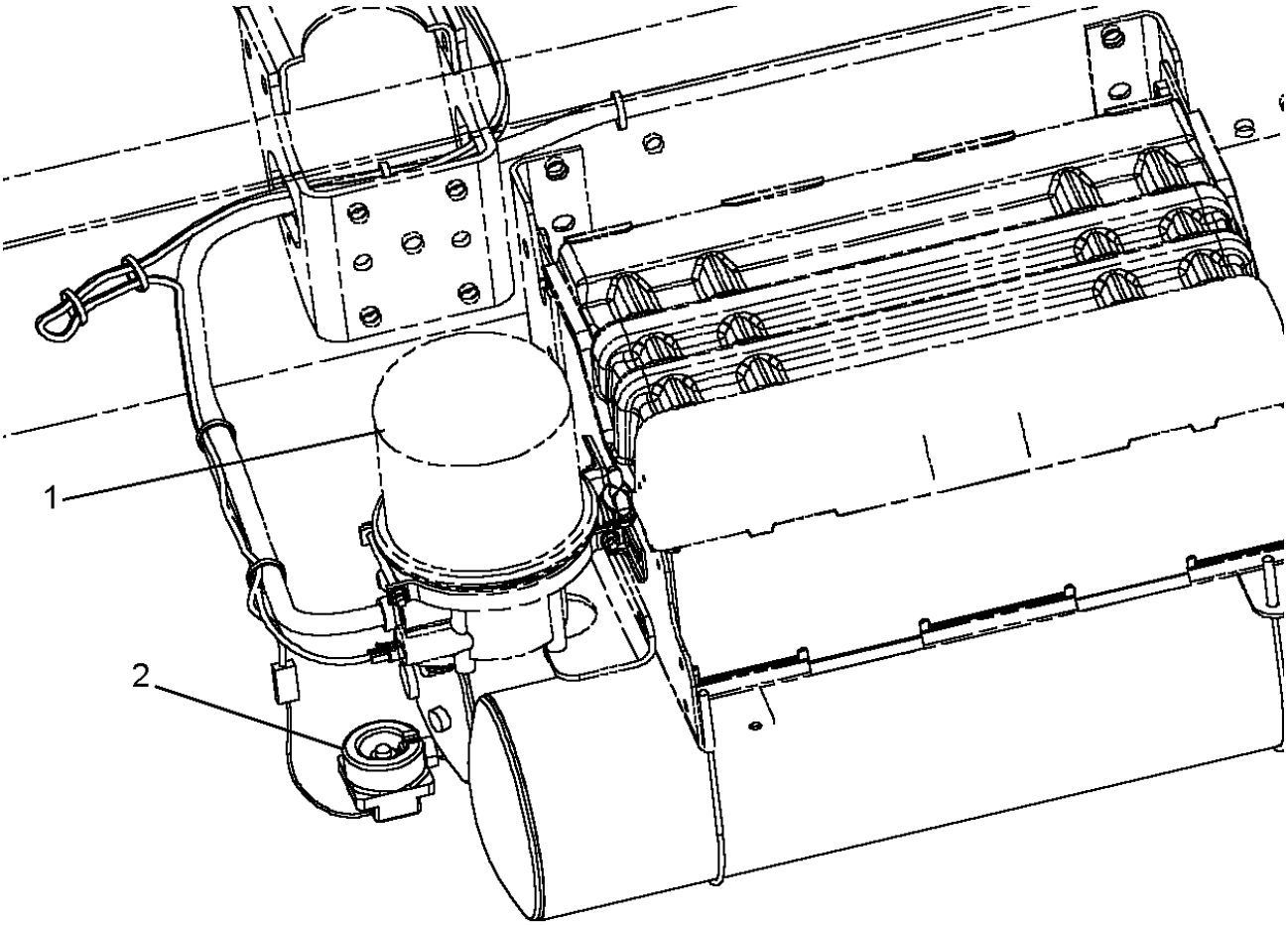



**Figure 313 Air Dryer And Heated Drain Valve Wiring (Right Side Shown)**

1. AIR DRYER
2. HEATED DRAIN VALVE

# 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

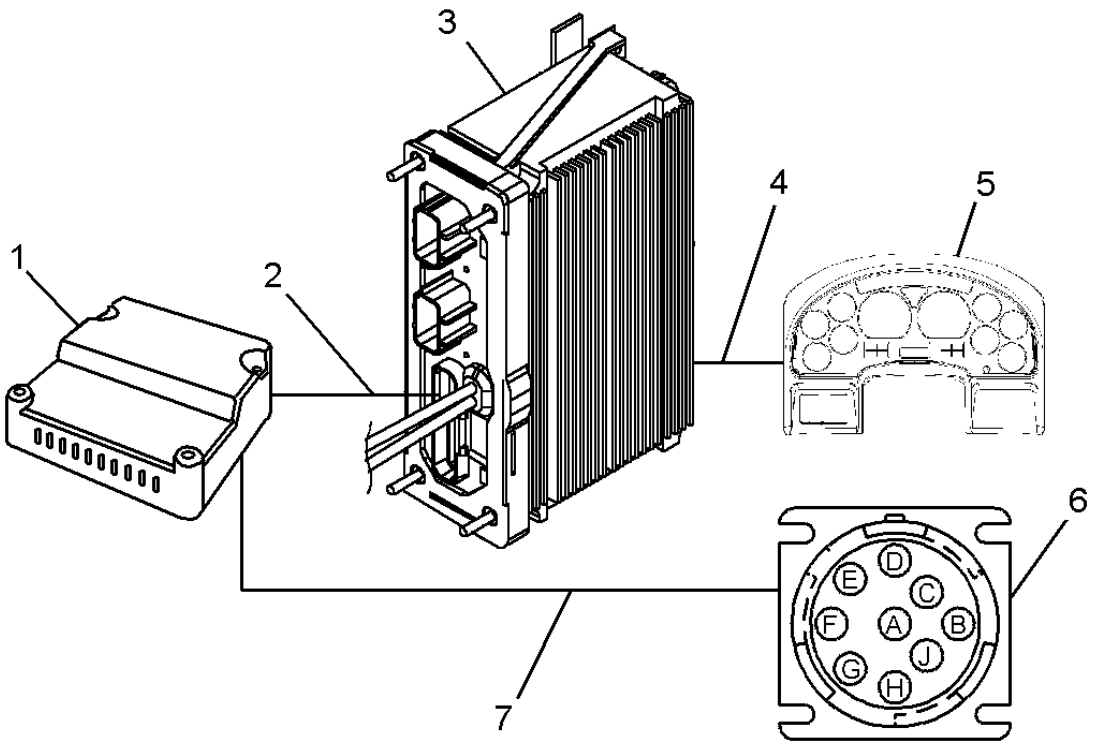



**Figure 314 Air ABS Function Diagram**

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 208 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 208 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 624) | 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 625) |
| 5. | On | Check for ABS diagnostic trouble codes. (See ABS Diagnostic Trouble Codes, page 625) | 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 625) | 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 209 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.<br><br>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.<br><br>Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 625) | |
| 2023 14 150 8<br><br>or<br><br>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).<br><br>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.<br><br>Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 625) | |

### 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 60) 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.

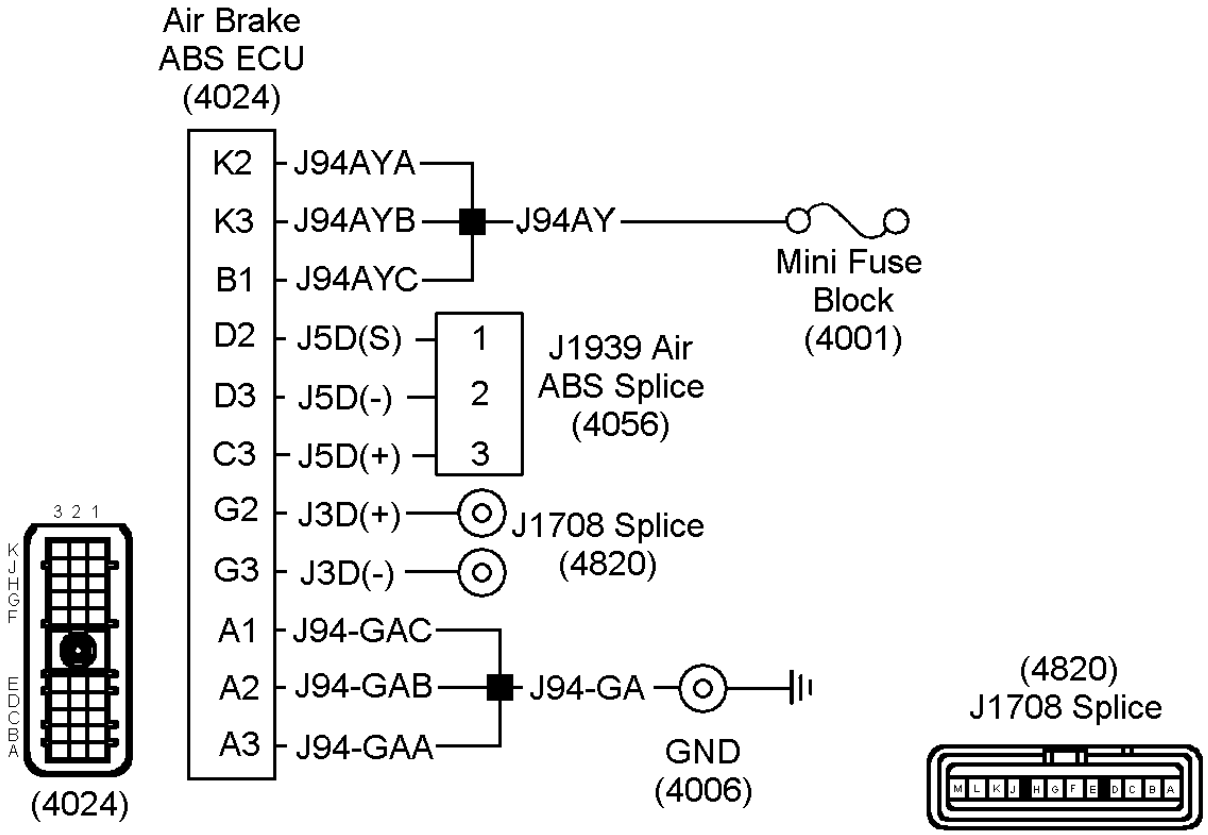



**Figure 315 Air ABS Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4006) GROUND STUD
LOCATED ABOVE ESC ON DASH PANEL
(4024) AIR ABS ECU 30 WAY CONNECTOR
LOCATED ON ABS ECU
(4056) J1939 AIR ABS SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
(4820) J1708 SPLICE
LOCATED NEAR WIPER MOTOR BRACKET

**Table 210 Air ABS Voltage Check Chart**

| ESC DTC's | |
|---|---|
| 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. | |
| 2023 14 150 8<br><br>or<br><br>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).<br><br>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.<br><br>Refer to Air ABS Power and data link Circuits.(See AIR ABS POWER AND DATA LINK CIRCUITS, page 625) | |
| **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 Connector (4024) Voltage Checks**<br><br>Check with ignition key on, (4024) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | |

| Test Points | Spec. | Comments |
|---|---|---|
| ECU connector (4024) cavity K2 to ground. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuits J94AYA, J94AY. |
| ECU connector (4024) cavity K3 to ground. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuits J94AYB, J94AY. |
| ECU connector (4024) cavity B1 to ground. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuits J94AYC, J94AY. |
| ECU connector (4024) cavity B1 to A1. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GAC to ground. |
| ECU connector (4024) cavity B1 to A2. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GAB to ground. |
| ECU connector (4024) cavity B1 to A3. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GAA to ground. |
| 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 211 Air ABS Data Link Voltage Check Chart**

| ABS Connector (4024) Drivetrain J1939 Data Link Checks<br><br>Check with ignition key on and (4024) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| ECU connector (4024) cavity C3 to ground. | >2 volts | If voltage is incorrect, check for open or short in drivetrain 1939 data link (+) circuits. |
| ECU connector (4024) 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. | | |
| **ABS Connector (4024) 1708 Data Link Checks**<br><br>Check with ignition key on and (4024) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**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 75)** | | |
| Test Points | Spec. | Comments |
| ECU connector (4024) cavity G2 to ground. | Approximately 4 volts. | If voltage is incorrect, check for open or short in 1708 Data Link (+) circuits. |
| ECU connector (4024) cavity G3 to ground. | Approximately .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 (4024) pins B1, K2 and K3.

Ground for the ECU is supplied to pins A1, A2 and A3 from ground stud (4006).

Refer to the Air ABS Circuits.

The ABS ECU is connected to the drivetrain 1939 data link at pins C3 and D3. The data link shield is connected to pin D2.

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

## 2.4. COMPONENT LOCATIONS

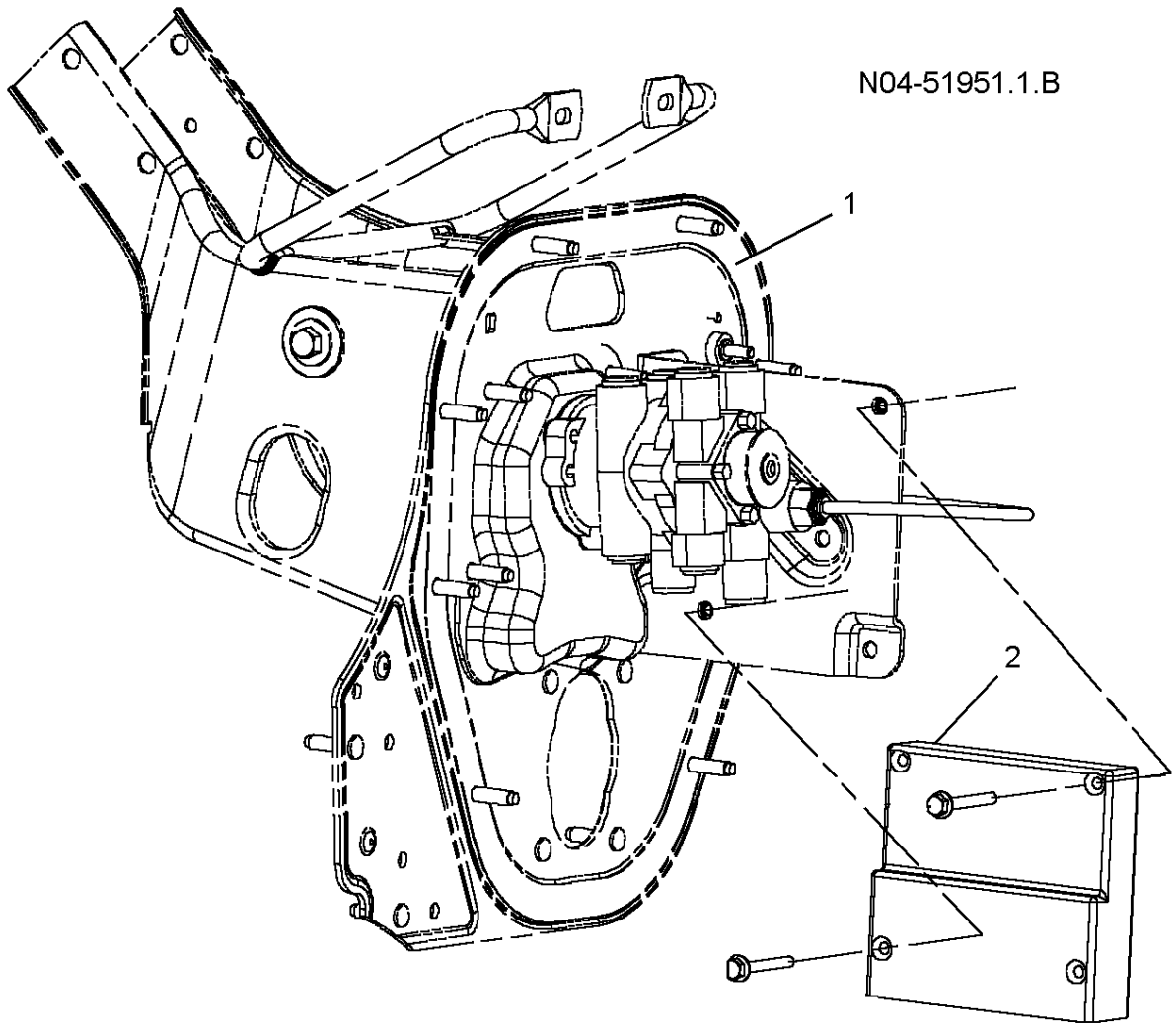



**Figure 316 Air ABS ECU Location**

1. DRIVER CONTROL MODULE
2. EC-30 ABS ECU

# 3. WABCO HYDRAULIC ABS

## 3.1. CIRCUIT FUNCTIONS

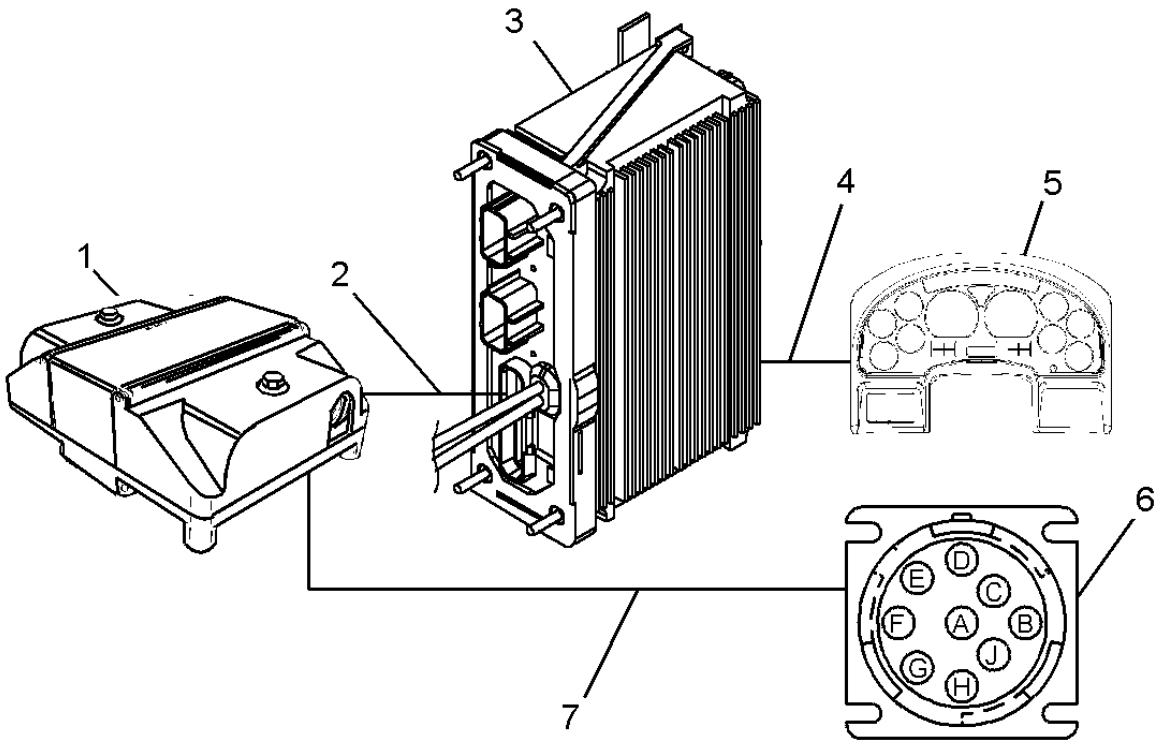



**Figure 317 Hydraulic ABS Function Diagram**

1. MERITOR WABCO “D” TYPE HYDRAULIC ABS ELECTRONIC CONTROL UNIT
2. ABS CIRCUITS TO ESC
3. ELECTRICAL SYSTEM CONTROLLER
4. 1939 DATA LINK (WARNING LAMP COMMAND)
5. ELECTRONIC GAUGE CLUSTER
6. DIAGNOSTIC CONNECTOR
7. 1708 DATA LINK (PRIMARILY FOR DIAGNOSTICS AND PROGRAMMING)

Discussion of the hydraulic antilock braking system, in this section, is limited to power circuits, data link connectivity and relay operation. For detailed information on ABS operation and troubleshooting, refer to Meritor WABCO hydraulic ABS for medium-duty trucks, buses and motor home chassis maintenance manual 39.

The Meritor WABCO Hydraulic Anti-lock Braking System (ABS) is an electronic wheel speed monitoring and control system used on medium-duty vehicles equipped with a hydraulic brake system. International vehicles use the D version, frame-mounted ECU.

The ABS interacts with the ESC on a circuit to activate the ABS warning Lamp and a circuit to monitor an ABS event.

## 3.2. DIAGNOSTICS

Should a failure occur in the hydraulic ABS, the hydraulic ABS warning lamp will illuminate. ABS braking will be inoperative but normal braking will still be available.

Problems in the hydraulic ABS circuits can be can be attributed to short circuits, open circuits, a blown fuse, a failed relay or a failed ECU.

The ESC will only log a fault for problems on the ABS warning lamp input circuit.

The hydraulic 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 with blink codes on the ABS warning lamp. Refer to the Meritor WABCO hydraulic ABS for medium-duty trucks, buses and motor home chassis maintenance manual 39 for details on ABS diagnostic trouble codes.

To initiate hydraulic ABS blink codes set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch simultaneously for 2 seconds.

When no problems are detected, the hydraulic ABS warning lamp will blink once, off and blink once again (1+1).

To clear hydraulic ABS blink codes set the parking brake and turn the Ignition key “ON”. Then press the Cruise “ON” switch and the Cruise “Resume” switch simultaneously for 5 seconds.

An electronic service tool, running the Meritor WABCO "TOOLBOX" diagnostic software, can also be used to read and clear ABS diagnostic trouble codes. See the diagnostic software manual for details on using the software. See the Meritor WABCO maintenance manual 39 for details on using the “TOOLBOX” software.

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 641)

### Hydraulic ABS Preliminary Check

**Table 212 Hydraulic 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 illuminate 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.) |

**Table 212 Hydraulic ABS 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 632) | Read display on odometer. | No ESC diagnostic trouble codes for ABS are active. | Go to next step. | Go to HYDRAULIC ABS CIRCUITS. (See HYDRAULIC ABS POWER CIRCUITS , page 633) |
| 5. | On | Check for ABS diagnostic trouble codes. (See Diagnostic Trouble Codes, page 632) | Read diagnostic trouble codes from blink codes or ECU lights. | No ABS diagnostic trouble codes are active. | Go to Hydraulic ABS Warning Lamp Relay. (See HYDRAULIC ABS WARNING LIGHT CIRCUITS, page 635) | Refer to Meritor WABCO maintenance manual 39. |

## 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 213 Hydraulic ABS Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 2033 14 11 1 | ABS warning lamp circuit overloaded. |
| 2033 14 11 2 | ABS warning lamp open circuit |
| 2033 14 11 3 | ABS warning lamp circuit shorted to ground. |
| One of these DTC's will be are logged when there is a problem on the ABS warning lamp circuit between the ESC and the ABS ECU.<br><br>Refer to Hydraulic ABS Warning Light Circuits. (See HYDRAULIC ABS WARNING LIGHT CIRCUITS, page 635) | |

## 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 no ABS warning light DTC's will be active. Blink code activation will not be possible when there is no power to the ECU.

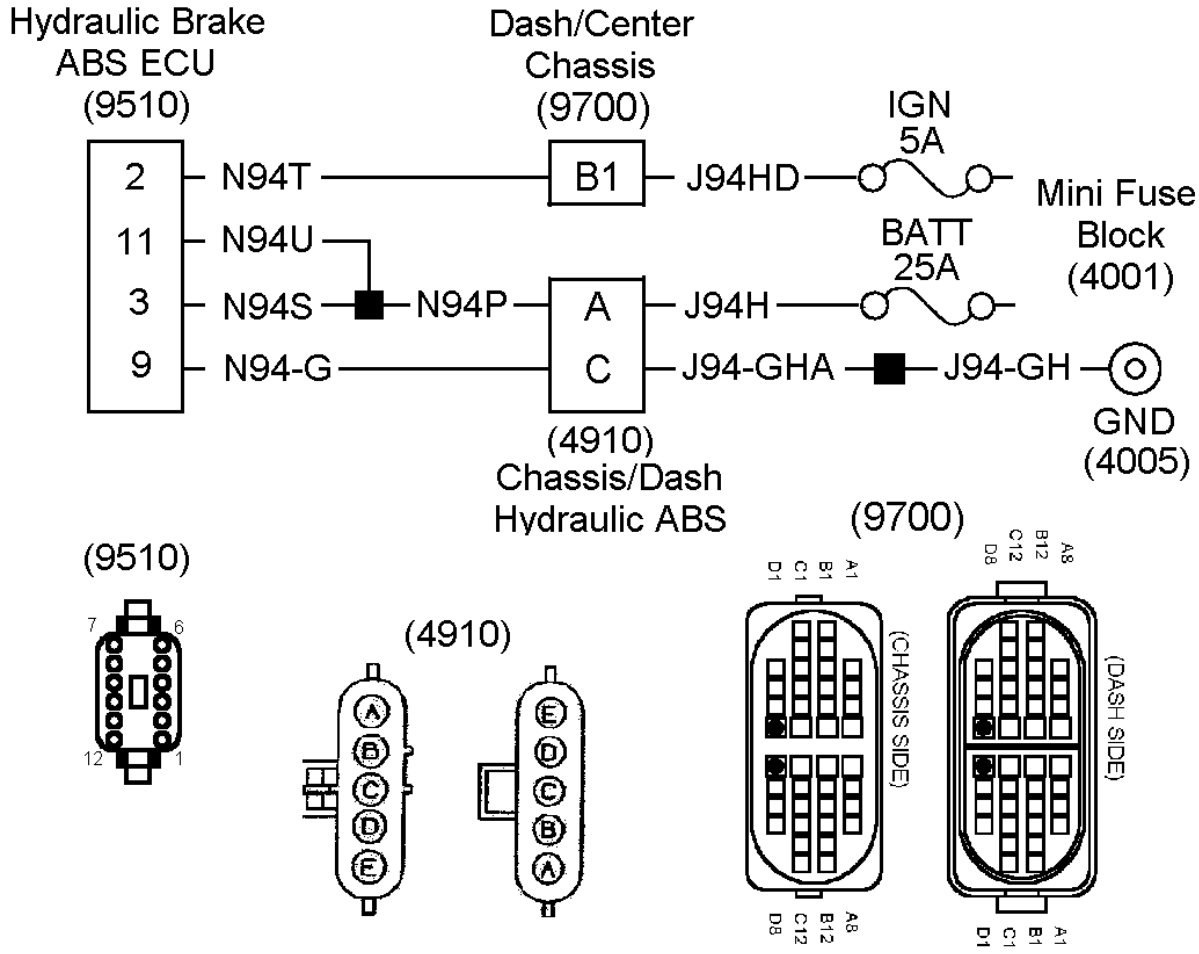



**Figure 318 Hydraulic ABS Power Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4005) GROUND STUD
LOCATED ABOVE ESC ON DASH PANEL
(4910) HYDRAULIC ABS CHASSIS/DASH CONNECTOR
LOCATED ON CHASSIS, IN ENGINE COMPARTMENT, NEAR LEFT RAIL
(9510) HYD ABS ECU CONNECTOR
LOCATED ON ABS ECU
(9700) CHASSIS/DASH INTERCONNECT
LOCATED NEAR WIPER MOTOR BRACKET

**Table 214 Hydraulic ABS ECU Power**

| **Hydraulic ABS Harness Connector (9510)**<br><br>Check with ignition key on and (9510) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |

**Table 214 Hydraulic ABS ECU Power (cont.)**

| | | |
|---|---|---|
| ECU harness connector (9510) cavity 2 to ground | Checks Ignition power. 12 ± 1.5 volts. | If voltage is incorrect, check for blown 5 amp fuse or open or short in circuit N94T or J94HD. |
| ECU harness connector (9510) cavity 2 to cavity 9 | Checks ground circuit. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit N94–G, J94–GHA or J94–GH to ground stud (4005). |
| ECU harness connector (9510) cavity 3 to cavity 9 | Checks battery power circuit. 12 ± 1.5 volts. | If voltage is incorrect, check for blown 25 amp fuse or open or short in circuit N94S, N94P, N94U or J94H. |
| ECU harness connector (9510) cavity 11 to cavity 9 | Checks battery power circuit. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit N94U. |

### Extended Description

The hydraulic ABS ECU receives battery power to connector (9510) cavity 2 on circuits N94T and J94HD from a 5 amp fuse in the engine power distribution center.

Ignition power is supplied to (9510) cavity 11 and 3 on circuits N94U, N94S, N94P and J94H from a 25 amp fuse in the engine power distribution center.

Ground for the ECU is supplied to (9510) cavity 9 on circuits N94–G and J94–GHA from ground stud (4005)

## 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.**

The hydraulic ABS warning light circuits provide an input to the ESC which will instruct the ESC to turn on the ABS warning light. The ABS warning light relay insures the warning light is turned on if power is lost to the ECU or the ECU has a an internal failure that would prevent the ECU from commanding the light on.

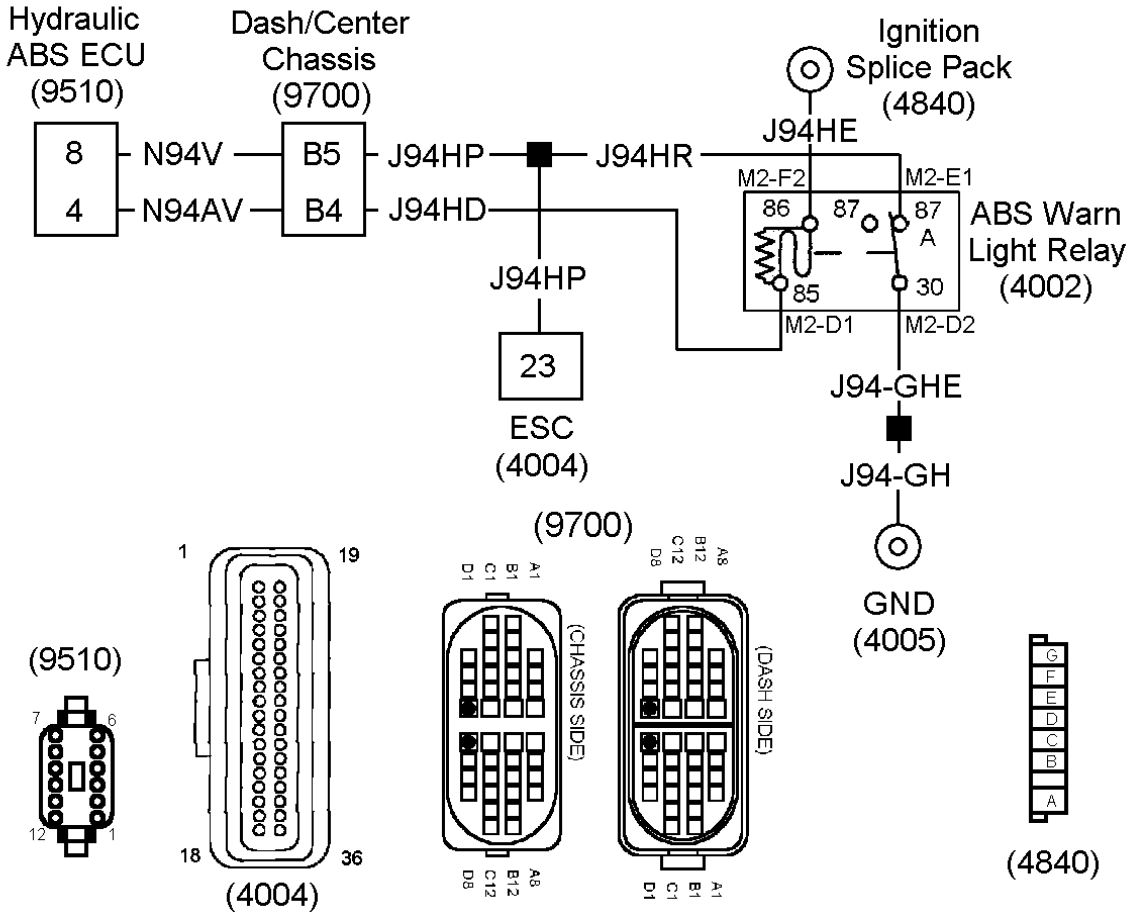



**Figure 319 Hydraulic ABS Warning Light Input Circuits to ESC—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4004) 36–WAY ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4005) GROUND STUD
LOCATED ABOVE ESC ON DASH PANEL
(4840) IGNITION SPLICE
LOCATED NEAR WIPER MOTOR BRACKET
(9510) HYD ABS ECU CONNECTOR
LOCATED ON ABS ECU
(9700) CHASSIS/DASH INTERCONNECT
LOCATED NEAR WIPER MOTOR BRACKET

**Table 215 Hydraulic ABS Warning Light Circuits**

| Hydraulic ABS Warning Light Relay Socket<br><br>Check with ignition key on and ABS warning light relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Micro relay socket cavity M2–F2 to ground. | Checks ignition voltage to relay. 12 ± 1.5 volts. | If voltage is incorrect, check for missing voltage from ignition splice (4840) or open or short in circuit J94HE. |
| Micro relay socket cavity M2–F2 to M2–D2. | Checks ground to relay. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GH or J94–GHE to ground stud (4005). |
| Micro relay socket cavity M2–F2 to M2–D1. | Checks energizing circuit to relay. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94HD or N94AV. If circuits check good consider replacing ECU. |
| Micro relay socket cavity M2–E1 to ground. | Checks ABS warning light circuit to ESC. 12 ± 1.5 volts. | If voltage is incorrect, check for open or short in circuit J94HR, J94HP or N94V. If circuits check good, consider replacing ABS ECU. |

### Extended Description

The de-energized relay supplies a ground to the ABS warning light input (4004) terminal 23 through the normally closed contacts of the relay. This will illuminate the ABS warning light.

Ignition power is supplied to the relay coil on circuit J94HE.

When the ECU is powered up and is working correctly it will supply a ground to the other side of the relay coil on circuit J94HD. This will energize the relay and remove the ground from the ESC input turning the ABS warning light off.

If the ABS ECU detects a fault it will request illumination of the warning lamp by directly applying a ground to the ESC input on circuit J94HP.

## 3.5. HYDRAULIC ABS EVENT RELAY 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 ABS event relay is energized by a high signal generated by the ABS ECU during an ABS event. The energized relay applies a high signal input to the ESC.

This signal notifies the ESC of an ABS event so the ESC can notify the engine controller or transmission to disable any installed retarders.

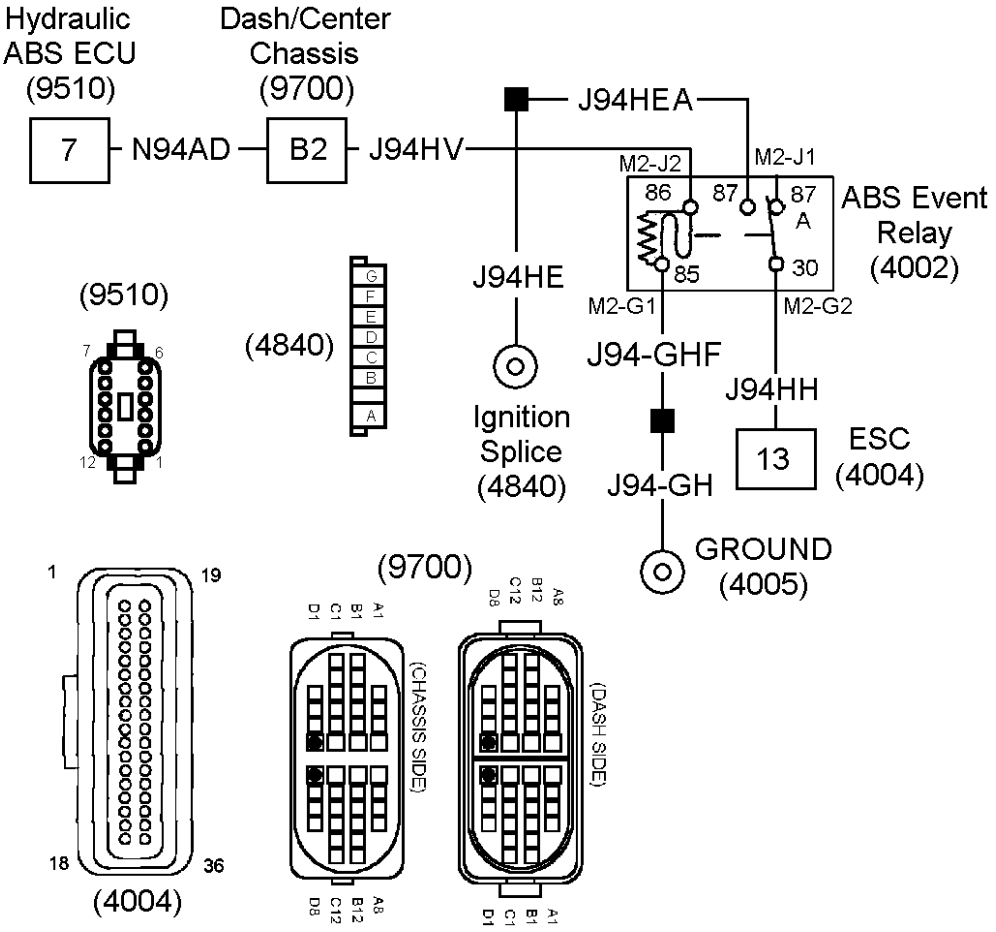



**Figure 320 Hydraulic ABS Event Relay Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4002) ABS EVENT RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(4005) GROUND STUD
LOCATED ON DASH PANEL ABOVE ESC
(4840) IGNITION SPLICE
LOCATED INSIDE ENGINE POWER DISTRIBUTION CENTER
(9510) ABS ECU CONNECTOR
LOCATED ON WABCO HYDRAULIC ABS ECU
(9700) CHASSIS/DASH INTERCONNECT
LOCATED NEAR WIPER MOTOR BRACKET

**Table 216 Hydraulic ABS Event Relay Circuits**

| Hydraulic ABS Event Relay Socket<br><br>Check with ignition key on and ABS event relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Micro relay socket cavity M2–G2 to ground. | Checks circuit to ABS event input to ESC. 3 ± .5 volts. | If voltage is incorrect, check for open or short in circuit J94HH. If circuit checks good, check signal from ESC. |
| Micro relay socket cavity M2–J1 to ground. | Checks voltage to normally open contact of relay from ignition splice. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94HEA or J94HE. If circuit checks good, check for missing voltage to splice pack (4840). |
| Micro relay socket cavity M2–J1 to M2–G1. | Checks ground to relay. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GH or J94–GHF. |
| Micro relay socket cavity M2–G2 to M2–J2. | Checks circuit from ECU to the relay. 3 ± 5 volts<br><br>**Verify the voltage on this line** | If voltage is incorrect, check for open or short in circuit J94HV or N94D. If circuits check good, consider replacing ABS ECU. |

### Extended Description

Ground is supplied to the ABS event relay coil on circuit J94–GH and J94–GHF from ground stud (4005).

The relay will be energized by a high signal from the ABS ECU on circuit J94HV.

The energized relay will apply 12 volts, from the ignition splice pack on circuit J94HE and J94HEA, to the hydraulic ABS event input terminal 13 of ESC connector (4004).

## 3.6. HYDRAULIC MODULATOR RELAY 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 energized hydraulic modulator relay will supply battery voltage the modulator assembly pump motor. The relay energizes when a high signal is applied from the ABS ECU.

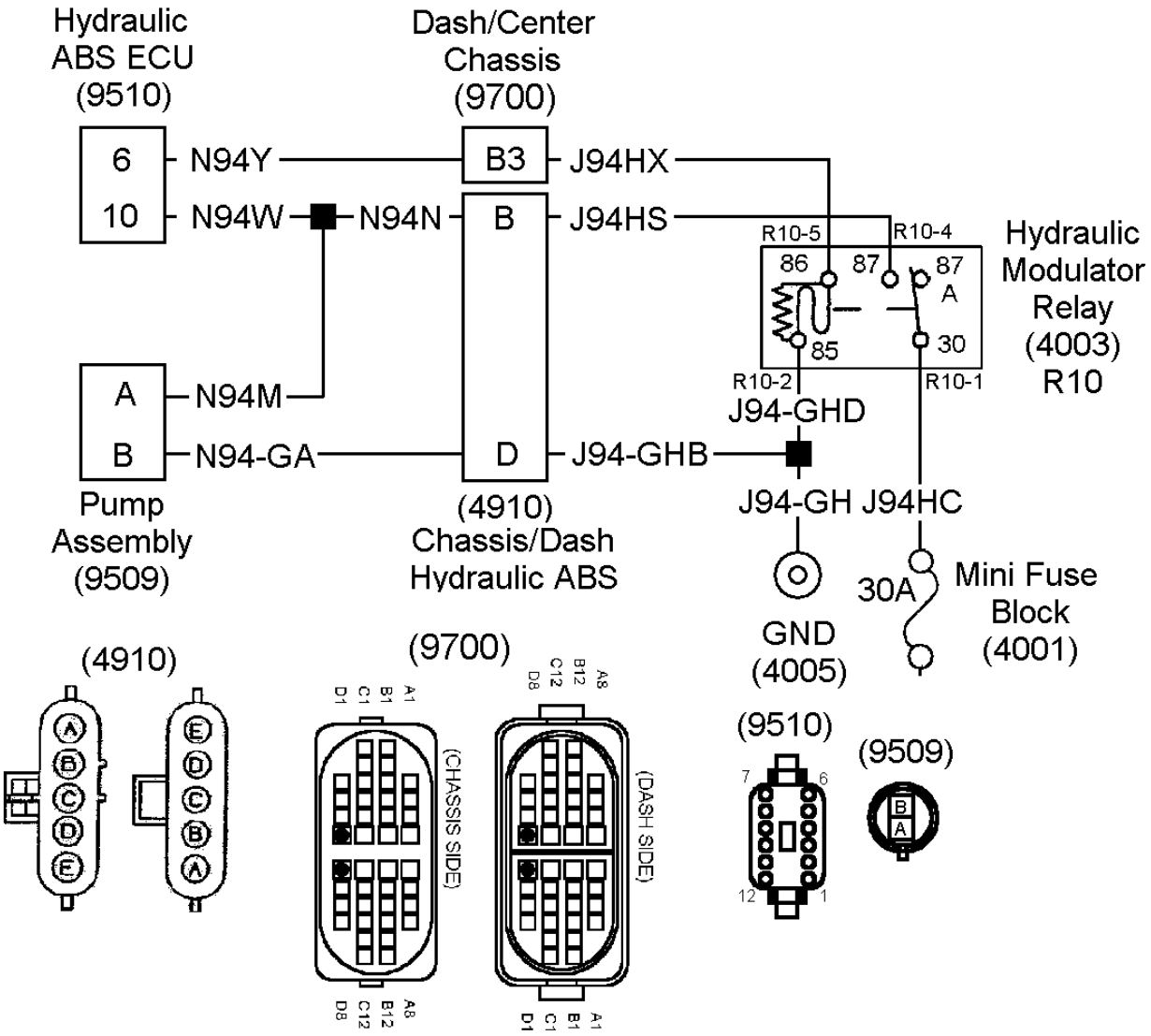



**Figure 321 Hydraulic Modulator Relay Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) R10 HYDRAULIC MODULATOR RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4005) GROUND STUD
LOCATED ON DASH PANEL ABOVE ESC
(4910) HYDRAULIC ABS CHASSIS/DASH CONNECTOR
LOCATED ON CHASSIS, IN ENGINE COMPARTMENT, NEAR LEFT RAIL
(9509) ABS PUMP ASSEMBLY CONNECTOR
LOCATED ON WABCO HYDRAULIC ABS MODULATOR ASSEMBLY
(9510) ABS ECU CONNECTOR
LOCATED ON WABCO HYDRAULIC ABS ECU
(9700) DASH/CENTER CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 217 Hydraulic ABS Modulator Relay Circuits**

| Hydraulic ABS Modulator Relay Socket<br><br>Check with ignition key on and ABS modulator relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays.<br>(See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| ISO Relay socket R10 cavity 1 to ground. | Checks battery voltage to relay R10. 12 ± 1.5 volts. | If voltage is incorrect, check for blown 30 amp fuse or open or short in circuit J94HC. |
| Relay socket R10 cavity 1 to cavity 2. | Checks ground to relay R10. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94–GHD or J94–GH to ground stud (4005). |
| Relay socket R10 cavity 1 to cavity 5. | Checks modulator relay enable signal from ECU to relay R10. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit N94Y or J94HX to ECU connector (9510) terminal 6. If circuits check good, consider replacing ECU. |
| Relay socket R10 cavity 1 to cavity 4. | Checks circuit from relay to ECU and pump assembly. 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J94HS, N94N or N94M to pump assembly connector (9509) terminal A and ground circuits for pump assembly. Also check circuit N94W to ABS ECU. |

### Extended Description

Ground is supplied to the hydraulic modulator relay coil on circuit J94–GHF from ground stud (4005).

The relay will be energized by a high signal from the ABS ECU on circuit J94HX.

The energized relay will apply battery voltage from a 30 amp fuse in the engine compartment power distribution center on circuit J94HC to the modulator pump assembly. 12 volts will also be applied to ABS ECU connector (9510) terminal 10. This allows the ECU to monitor the pump motor circuits.

## 3.7. 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.

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

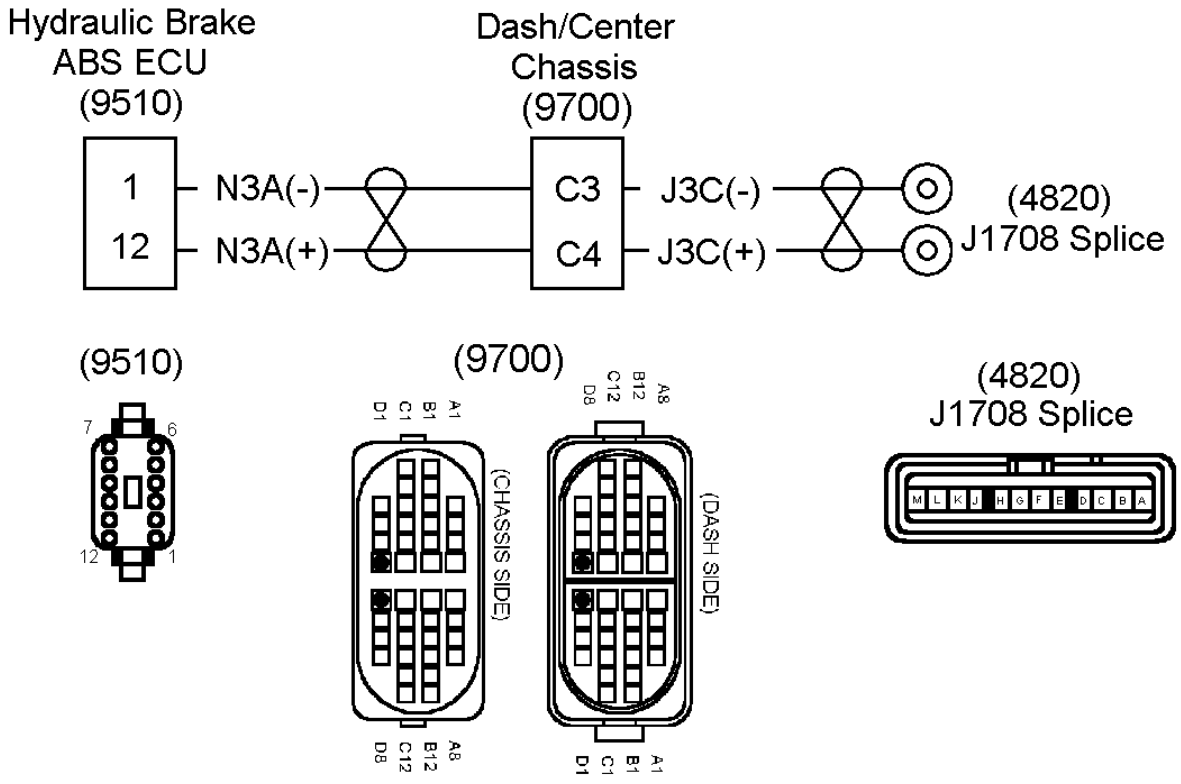



**Figure 322 Hydraulic ABS Data Link Circuits— Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4820) 1708 DATA LINK SPLICE
LOCATED NEAR WIPER MOTOR BRACKET
(9510) ABS ECU CONNECTOR
LOCATED ON WABCO HYDRAULIC ABS ECU
(9700) DASH/CENTER CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 218 Hydraulic ABS Data Link Circuits Connector Chart**

| Data link circuits at ABS ECU Connector (9510)<br><br>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.<br><br>Check with ignition key on and ABS ECU connector (9510) removed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| ECU harness connector (9510) cavity 12 to ground. | Checks positive data link circuit to ground.<br><br>Approximately 4 volts | (+) data link circuit. If voltage is low check for open or short to ground in circuit N3A(+) or J3C(+) to J1708 splice (4820). |
| ECU harness connector (9510) cavity 1 to ground. | Checks negative data link circuit to ground.<br><br>Approximately 1 volt | (-) data link circuit. If voltage is low check for open or short to ground in circuit N3A(-) or J3C(-) to J1708 splice (4820). If voltage is high check for crossed data link circuits.<br><br>If circuits check good, consider replacing the ECU. |

## Extended Description

The Hydraulic ABS data link circuits connect to the 1708 data link at J1708 splice connector (4820).

## 3.8. COMPONENT LOCATIONS

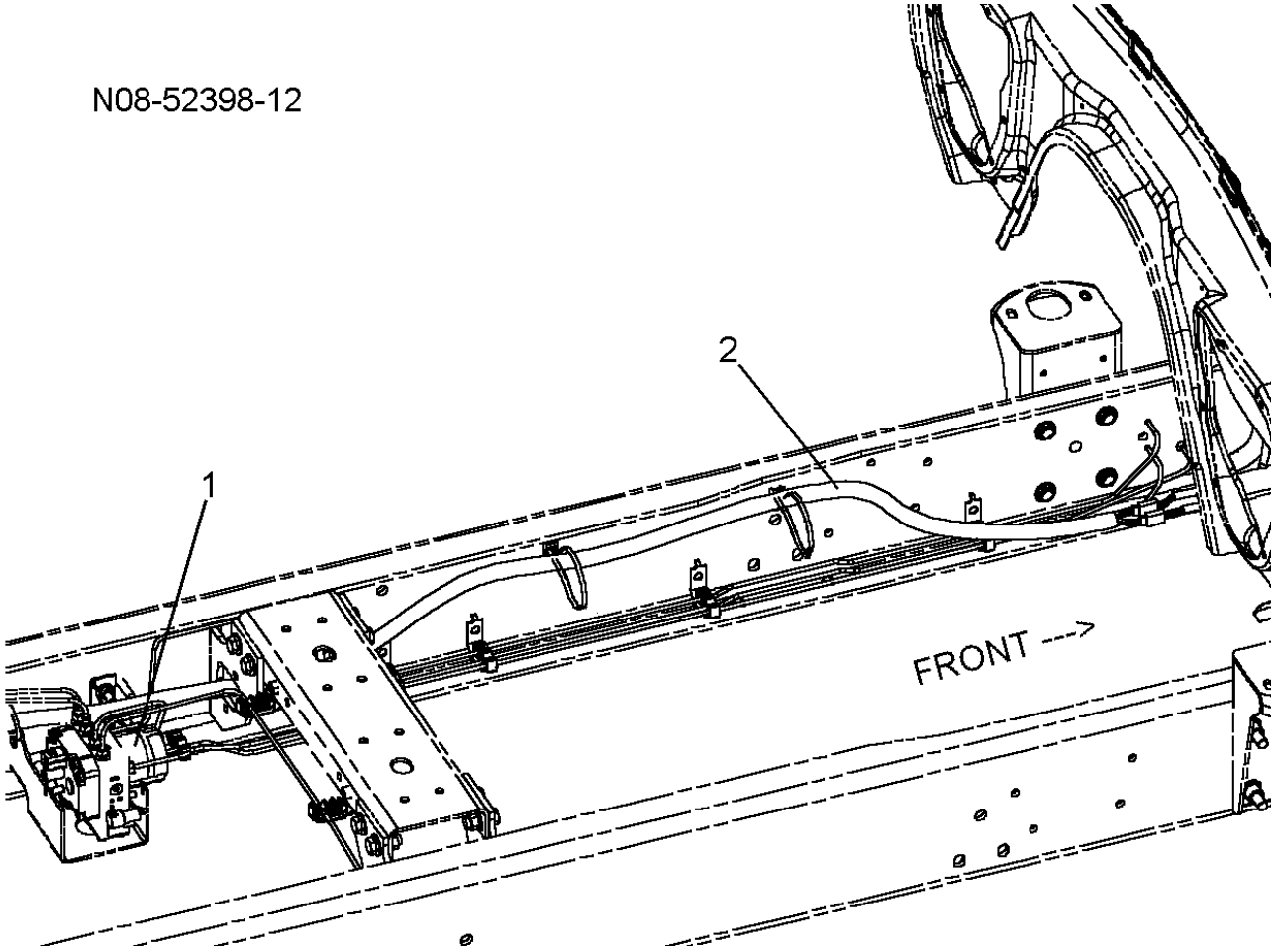



**Figure 323 Hydraulic ABS Wiring**

1. MERITOR WABCO “D” TYPE HYDRAULIC ABS ELECTRONIC CONTROL UNIT
2. CENTER CHASSIS HARNESS

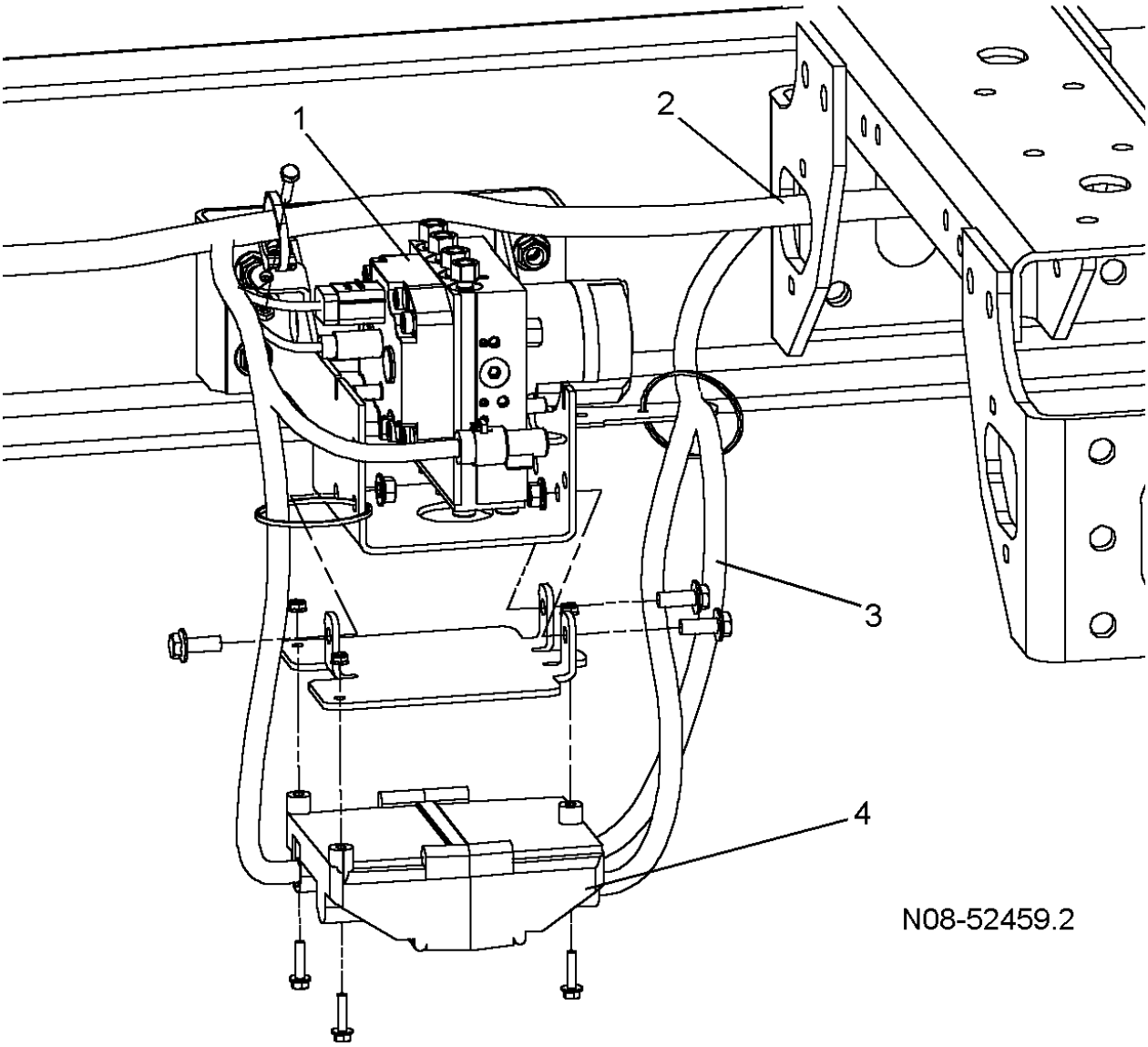



**Figure 324 Hydraulic ABS ECU Location**

1. HYDRAULIC ABS PUMP
2. CENTER CHASSIS HARNESS
3. HYDRAULIC ABS ECU/PUMP HARNESS
4. MERITOR WABCO “D” TYPE HYDRAULIC ABS ELECTRONIC CONTROL UNIT

# 4. TWO SPEED AXLE SWITCH (WITH MANUAL TRANSMISSION)

## 4.1. CIRCUIT FUNCTIONS

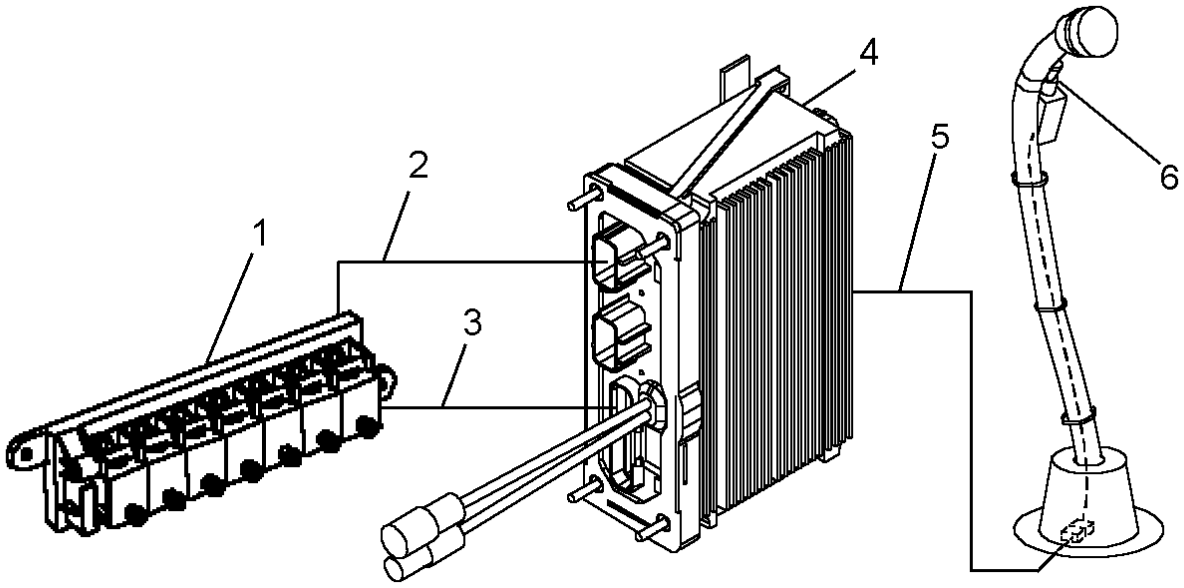



**Figure 325 Two Speed Axle Switch Function Diagram (7 Pack Air Solenoid Shown)**

1. 7 PACK AIR SOLENOID
2. SOLENOID POWER CIRCUIT
3. BODY BUILDER 1939 DATA LINK
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. 2 SPEED AXLE SWITCH (ON SHIFTER)

This system uses an electronically controlled air solenoid to supply pilot air to a larger air solenoid which will control the two speed axle.

The switch on the shifter is a direct input to the ESC. The ESC will send signals to a remote air solenoid module containing the relay configured to operate the feature. Two different solenoid packs may be used to control the air pressure. The 7 solenoid version is controlled by J1939 messages and the 4 solenoid version by discrete wire.

The two speed axle feature allows the rear axle to shift to a much reduced gear ratio for the transportation of heavy loads. For manual transmissions the switch will be on the shifter with high range being up and low range being down. The normal operating position would be high. If the power divider lock (PDL) feature is installed on the vehicle, it must be off in order for a shift to occur.

The 2-speed axle is spring loaded to the low range gear, requiring air to shift to high gear. With the key off, the vehicle will stay or return to low range.

When shifting from high range to low range the shifter switch will be in the high axle (up) position. When the shifter switch is set to low (down) position and the vehicle speed is less than the programmable maximum allowed shifting speed (default 3.2 kmh/2 mph) and the PDL is not on, an air solenoid shifts the axle into low gear. The PDL can be engaged in either high or low speed axle, but is not allowed to be on during the shift. Some other countries such as Mexico may need the maximum allowed shifting speed set much higher as it is often used as a hi/lo splitter as the vehicle is up shifted.

When shifting from low range to high range the shifter switch will be in the low speed axle (down) position. When the shifter switch is set to high (up) position and the PDL is not locked, an air solenoid shifts the axle into high gear. Note the PDL can be engaged in either high or low speed axle but is not allowed to be on during the shift. The vehicle speed restriction does not apply when shifting from low to high range.

If a switch or speed error occurs, the two speed axle will remain in its current range for that ignition cycle. When the ignition is turned off, the solenoids turn off. Upon key on, if a switch or speed error is active, the two speed axle will again remain in its current range for that ignition cycle. In the event of an air solenoid failure due to a shorted solenoid, this feature will request the ESC to turn off power to the air solenoid pack (or packs) to prevent uncontrolled operation of the solenoid.

A switch indicator lamp is currently not available, but when introduced the switch indicator will blink slowly for errors and quickly when the feature is inhibited. If this feature commands its driven solenoid to turn on and the solenoid pack power has been turned off, this feature will blink the switch indicator slowly to communicate an error has prevented this feature from functioning.

## 4.2. DIAGNOSTICS

Should the two speed axle 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.

There are no diagnostic codes associated with the two speed axle 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.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to activate the two speed axle circuits and monitor activation of the two speed axle switch. See the diagnostic software manual for details on using the software.

### Two Speed Axle Switch 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 219 Two Speed Axle Switch 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.<br><br>Verify two speed axle is inoperative. | Visually check two speed axle. | Two speed axle is inoper-ative. | Go to next step. | Two speed axle operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.) |

**Table 219 Two Speed Axle Switch Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 2. | On | Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.) | Visually check for other 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. (See Diagnostic Trouble Codes, page 648) | Read display on odometer. | Diagnostic trouble codes are not active. | Go to next step. | Go to section for the 4–pack air solenoid. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 733)<br><br>Go to section for the 7–pack air solenoid. (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742) |
| 4. | Check for air pressure to solenoid and plumbing to air solenoid.<br><br>If air plumbing is correct, go to Two speed axle switch circuits to ESC. (See TWO SPEED AXLE SWITCH CIRCUITS TO ESC, page 649) | | | | | |

## 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 220 Two Speed Axle Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 2033 14 10 1 | 2 speed Axle/4 Pack Air Solenoid Channel #1 overloaded. Connector 4004 pin 22 current overload. Too much load attached, short to battery voltage, defective relay or defective 4 pack air solenoid module. |

**Table 220 Two Speed Axle Diagnostic Trouble Codes (cont.)**

| | |
|---|---|
| 2033 14 10 2 | 2 speed Axle/4 Pack Air Solenoid Channel #1 open circuit. Connector 4004 Pin 22 open. Open circuit, defective relay or 4 pack air solenoid module. |
| 2033 14 10 3 | 2 speed Axle/4 Pack Air Solenoid Channel #1 shorted to ground. Connector 4004 Pin 22 shorted to ground. Short to battery voltage, defective relay or defective 4 pack air solenoid module. |
| For 2034 or 2234 series diagnostic trouble codes, when using the 7–pack air solenoid, go to section for the 7–pack air solenoid. (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742) | |

## 4.3. TWO SPEED AXLE SWITCH 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 two speed axle switch circuits may be apparent when the axle doesn't shift to low range or will not shift out of low range and there no DTC's. Problems in the two speed axle switch circuits can be caused by open or short circuits between the two speed axle switch and the ESC, a failed switch, or a problem in the ESC.

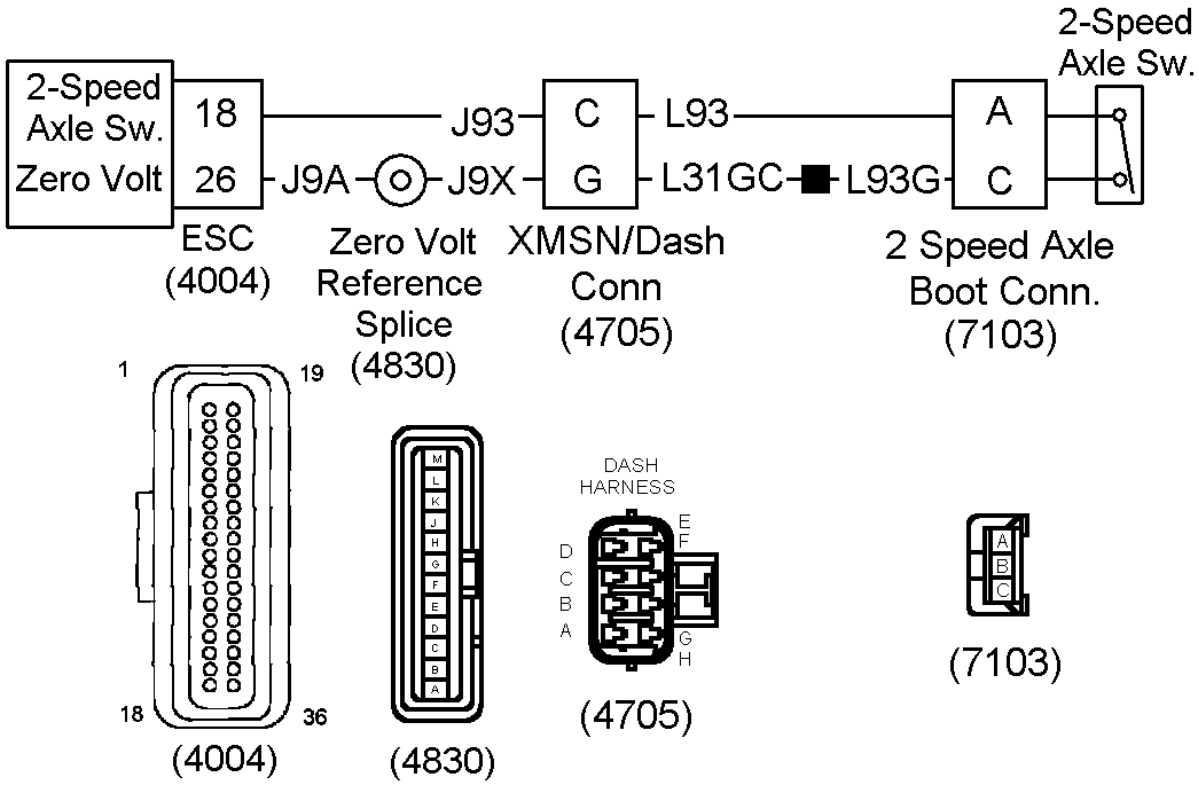



**Figure 326 Two Speed Axle Switch Circuits to ESC—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4004) ESC CONNECTOR
LOCATED ON ESC
(4705) TRANSMISSION/DASH CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR WIPER MOTOR BRACKET
(4830) ZERO VOLT REFERENCE SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
(7103) 2 SPEED AXLE SWITCH BOOT CONNECTOR
LOCATED BELOW SHIFT LEVER BOOT

**Table 221 Two Speed Axle Switch Tests**

| Two Speed Axle Switch Voltage Checks<br><br>Check with ignition on, Two Speed Axle Switch (7103) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| (7103) cavity A to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J93 or L93 to ESC connector (4004) cavity 18.<br><br>If circuits check good, check for missing 12 volt signal from ESC. |
| (7103) cavity A to C. | 12 ± 1.5 volts | If voltage is present replace or repair two speed axle switch.<br><br>If voltage is missing, check for open in circuits L93G, L31GC, J9X or J9A to ESC connector (4004) cavity 26.<br><br>If circuits check good, check for missing zero volt reference from ESC. |
| **Two Speed Axle Switch Resistance Checks**<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Resistance across the switch should be < 1 ohm with the switch closed and > 50K ohms when the switch is open. | | |

## Extended Description

12 volts from ESC connector (4004) terminal 18 is supplied to the two speed axle switch boot connector (7103) terminal A through circuit J93 and L93.

A zero volt reference is supplied from ESC connector (4004) terminal 26 to the two speed axle switch boot connector (7103) terminal C through circuit J9A, J9X, L31GC and L93G.

## 4.4. COMPONENT LOCATIONS

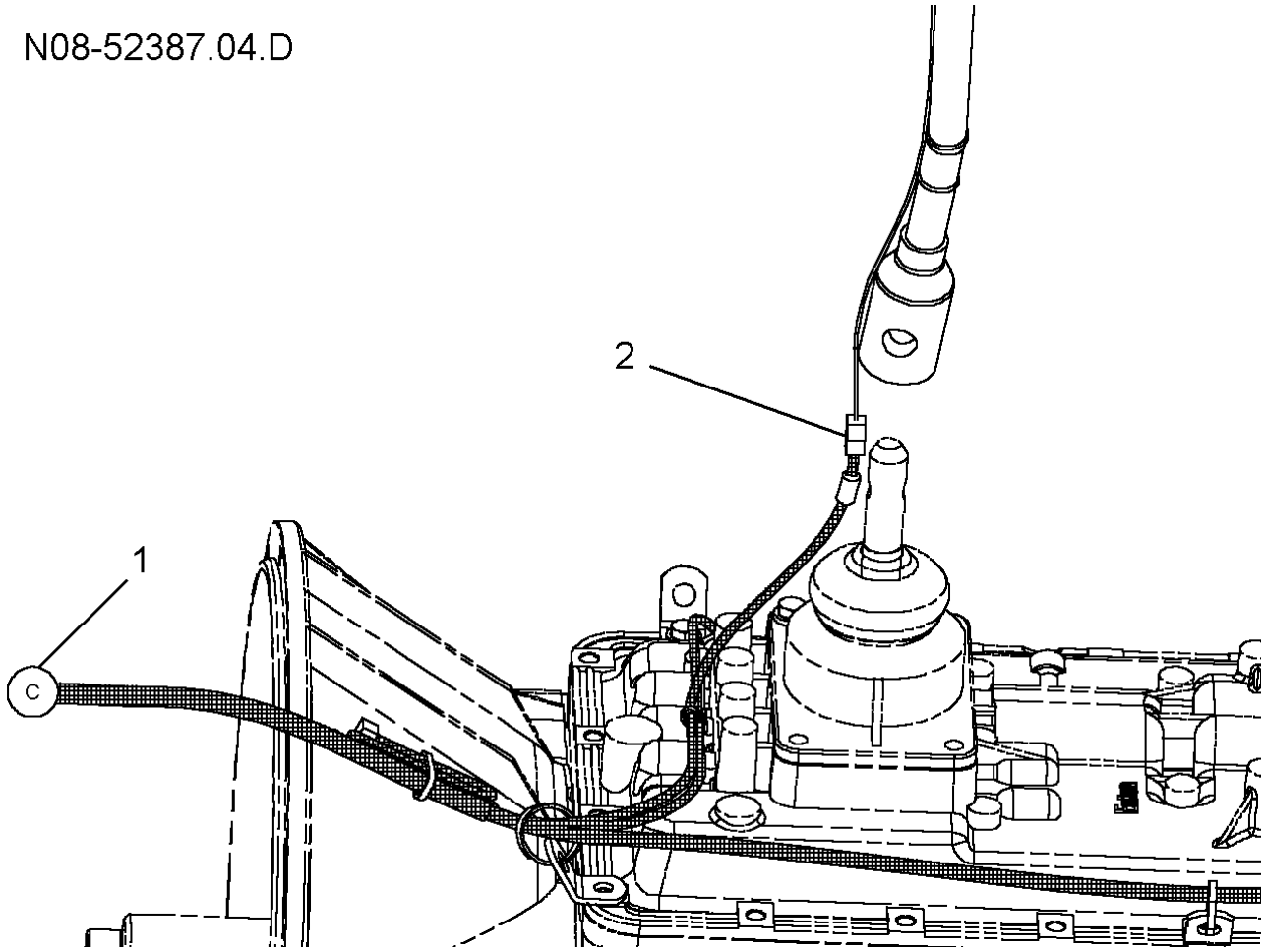



**Figure 327 Two Speed Axle Switch Wiring**

1. HARNESS TO TRANSMISSION/DASH CONNECTOR (4705)
2. TWO SPEED AXLE BOOT CONNECTOR (7103)

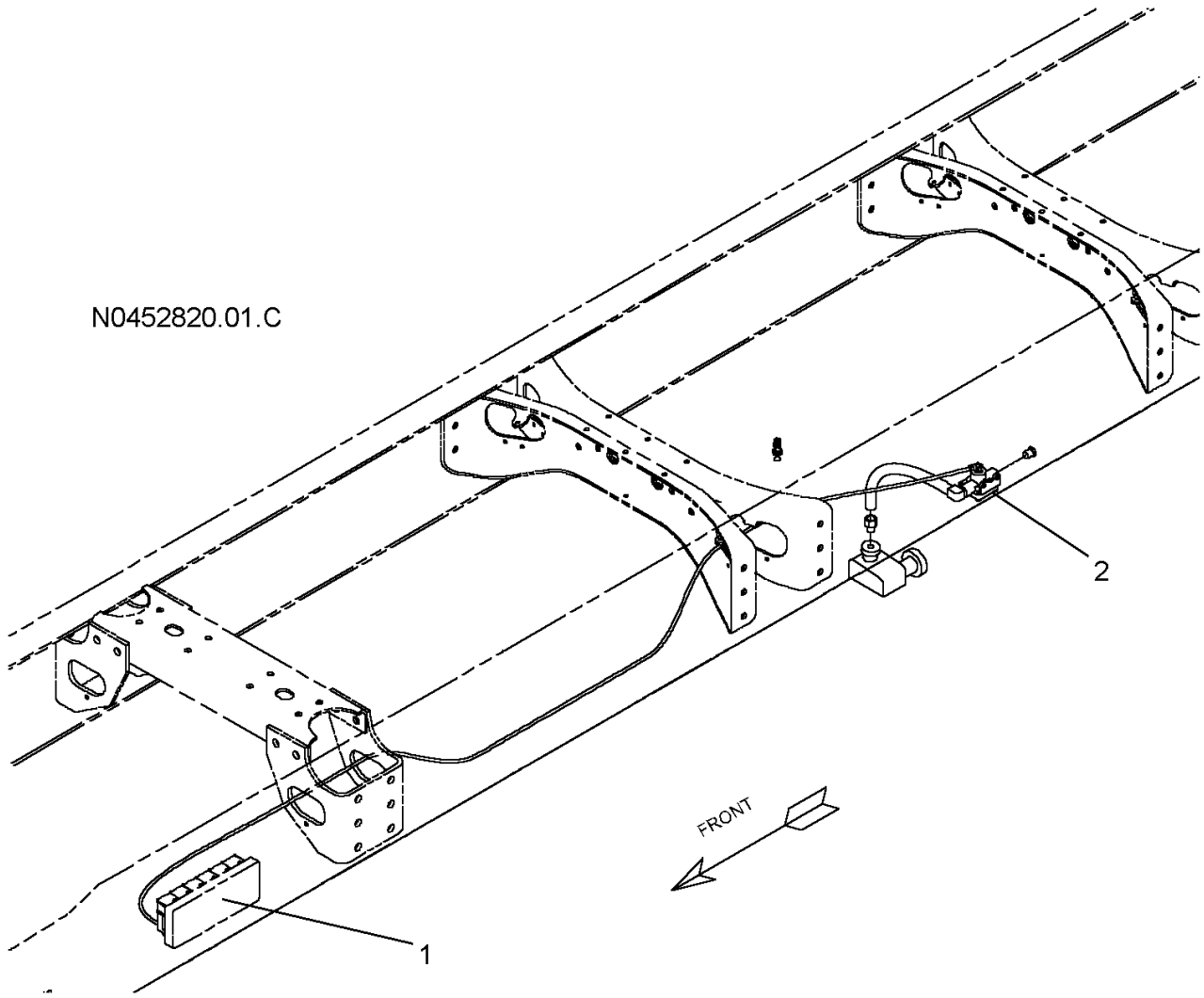



**Figure 328 Two Speed Axle Air Line Location**

1. AIR SOLENOID MODULE
2. TWO SPEED AXLE AIR SOLENOID

# 5. TWO SPEED AXLE SWITCH (WITH AUTOMATIC TRANSMISSION)

## 5.1. CIRCUIT FUNCTIONS

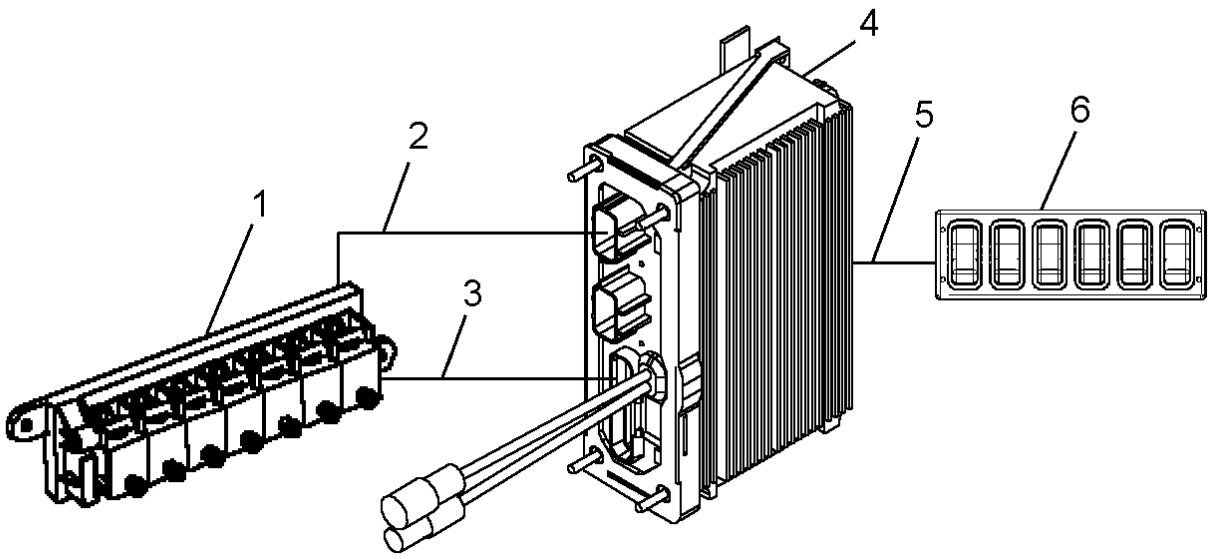



**Figure 329 Two Speed Axle Switch (With Automatic Transmission) Function Diagram**

1. 7 PACK AIR SOLENOID
2. SOLENOID POWER CIRCUIT
3. BODY BUILDER 1939 DATA LINK
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. 2 SPEED AXLE SWITCH ON DASH PANEL

This system uses an electronically controlled air solenoid to supply pilot air to a larger air solenoid which will control the feature.

The position of the switch on the dash panel is communicated to the ESC. The ESC will send signals to a remote air solenoid module containing the relay configured to operate the feature. Two different solenoid packs may be used to control the air pressure. The 7 solenoid version is controlled by J1939 messages and the 4 solenoid version by discrete wire.

The two speed axle feature allows the rear axle to shift to a much reduced gear ratio for the transportation of heavy loads. For automatic transmissions a switch in the dash labeled “2 speed LO” on bottom and “2 speed HI” on top allows the driver to select high or low rear axle ratio. The normal operating position would be high. If present the power divider lock (PDL) must be off in order for a shift to occur.

The 2-speed axle is spring loaded to the low range gear, requiring air to shift to high gear. With the key off, the vehicle will stay or return to low range. When shifting from high range to low range the dash switch will be in the high axle (up) position. When the dash switch is set to low (down) position and the vehicle speed is less than the programmable maximum allowed shifting speed (default 3.2 kmh/2 mph) and the PDL lock is not on,

an air solenoid shifts the axle into low gear. Some countries such as Mexico may need the maximum allowed shifting speed set much higher as it is often used as a hi/lo splitter as the vehicle is up shifted.

The PDL can be engaged in either high or low speed axle but is not allowed to be on during the shift. When shifting from low range to high range the dash switch will be in the low speed axle (down) position. When the dash switch is set to high (up) position and the PDL lock is not On, an air solenoid shifts the axle into high gear. PDL can be engaged in either high or low speed axle but is not allowed to be on during the shift. The vehicle speed restriction does not apply when shifting from low to high range. If a switch or speed error occurs, the two speed axle will remain in its current range for that ignition cycle. When the ignition is turned off, this feature turns the solenoids off. Upon key on, if a switch or speed error is active, the two speed axle will again remain in its current range for that ignition cycle. In the event of an air solenoid failure due to a shorted solenoid, this feature will request the ESC to turn off power to the air solenoid pack (or packs) to prevent uncontrolled operation of the solenoid. A switch indicator lamp is currently not available, but when introduced the switch indicator will blink slowly for errors and quickly when the feature is inhibited. If this feature commands its driven solenoid to turn on and the solenoid pack power has been turned off, this feature will blink the switch indicator slowly to communicate an error has prevented this feature from functioning.

## 5.2. DIAGNOSTICS

Should the two speed axle fail to operate, the problem could be attributed to a problem in the switch pack, the remote air solenoid module (RASM) or a malfunction in the ESC.

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

### Two Speed Axle Switch 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 222 Two Speed Axle Switch 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.<br><br>Two speed axle is inoperative. | Visually check two speed axle. | Two speed axle is inoperative. | Go to next step. | Two speed axle is operating. Problem does not exist or is intermittent. (Check for inactive diagnostic trouble codes.) |
| 2. | On | Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.) | Visually check for other malfunctioning features. | No other features are malfunctioning. | Go to next step. | Identify and repair condition causing several features to be inoperative. |

**Table 222 Two Speed Axle Switch 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 656) | 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. | For 2034 or 2234 series diagnostic trouble codes, when using the 7–pack air solenoid, go to section for the 7–pack air solenoid. (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742)<br><br>For 2033 series diagnostic trouble codes, when using the 4–pack air solenoid, go to section for the 4–pack air solenoid. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 733)<br><br>For 625 series diagnostic trouble codes, refer toSwitch Pack Modules (See SWITCH PACK MODULES, page 124) | | | | | |

## 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 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 223 Two Speed Axle Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 2033 14 10 1 | 2 speed Axle/4 Pack Air Solenoid Channel #3 overloaded. Connector 4004 pin 22 current overload. Too much load attached, short to battery voltage, defective relay or defective 4 pack air solenoid module. |
| 2033 14 10 2 | 2 speed Axle/4 Pack Air Solenoid Channel #3 open circuit. Connector 4004 Pin 22 open. Open circuit, defective relay or 4 pack air solenoid module. |

**Table 223 Two Speed Axle Diagnostic Trouble Codes (cont.)**

| | |
|---|---|
| 2033 14 10 3 | 2 speed Axle/4 Pack Air Solenoid Channel #3 shorted to ground. Connector 4004 Pin 22 shorted to ground. Short to battery voltage, defective relay or defective 4 pack air solenoid module. |
| For 2034 or 2234 series diagnostic trouble codes, when using the 7–pack air solenoid, go to section for the 7–pack air solenoid. (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742)<br><br>For 625 series diagnostic trouble codes, refer toSwitch Pack Modules (See SWITCH PACK MODULES, page 124) | |

## 5.3. COMPONENT LOCATIONS

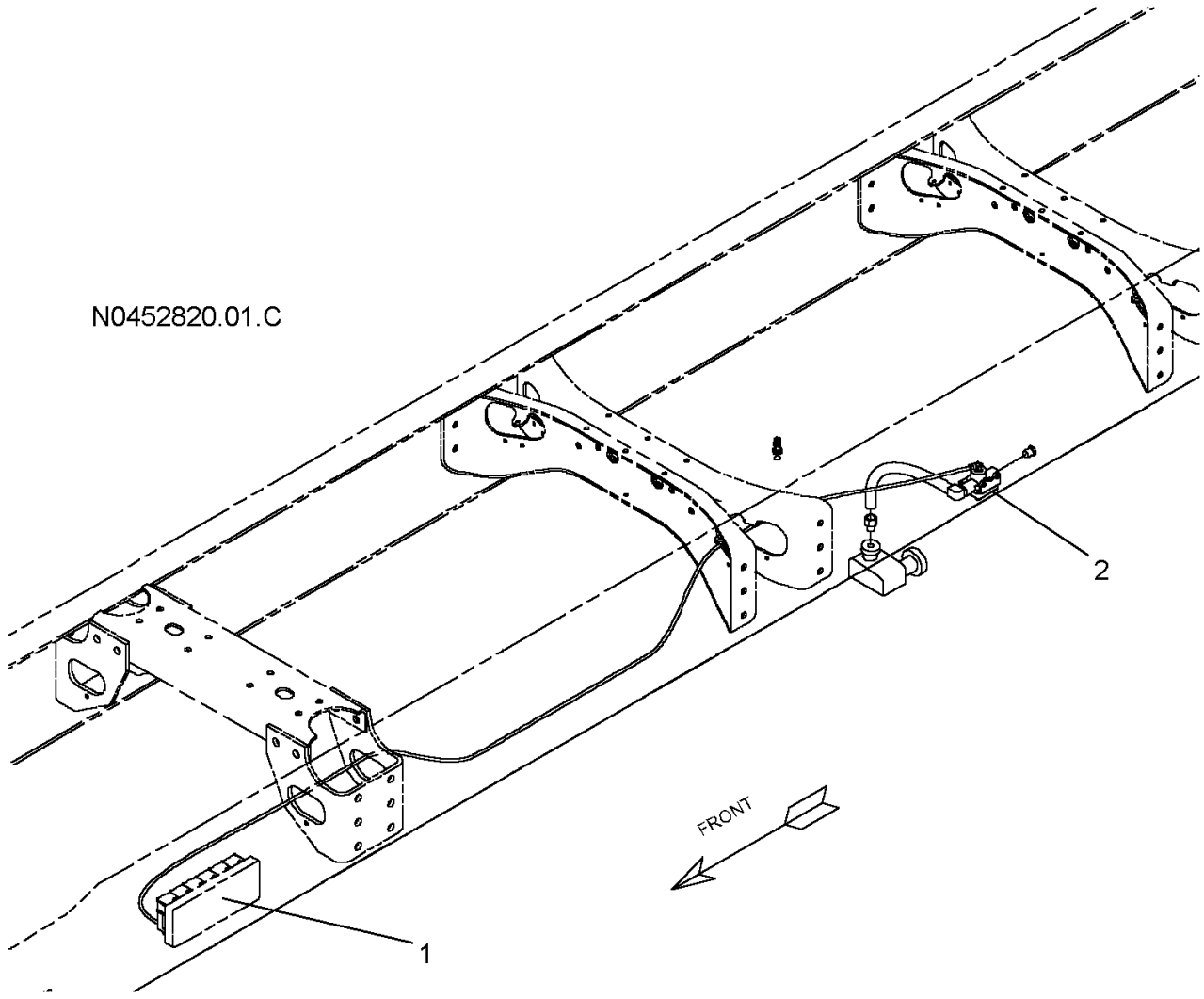



**Figure 330 Two Speed Axle Air Line Location**

1. AIR SOLENOID MODULE
2. TWO SPEED AXLE AIR VALVE

# 6. FUEL HEATER

## 6.1. 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.

## 6.2. 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 224 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 658) | | | | |

## 6.3. 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.

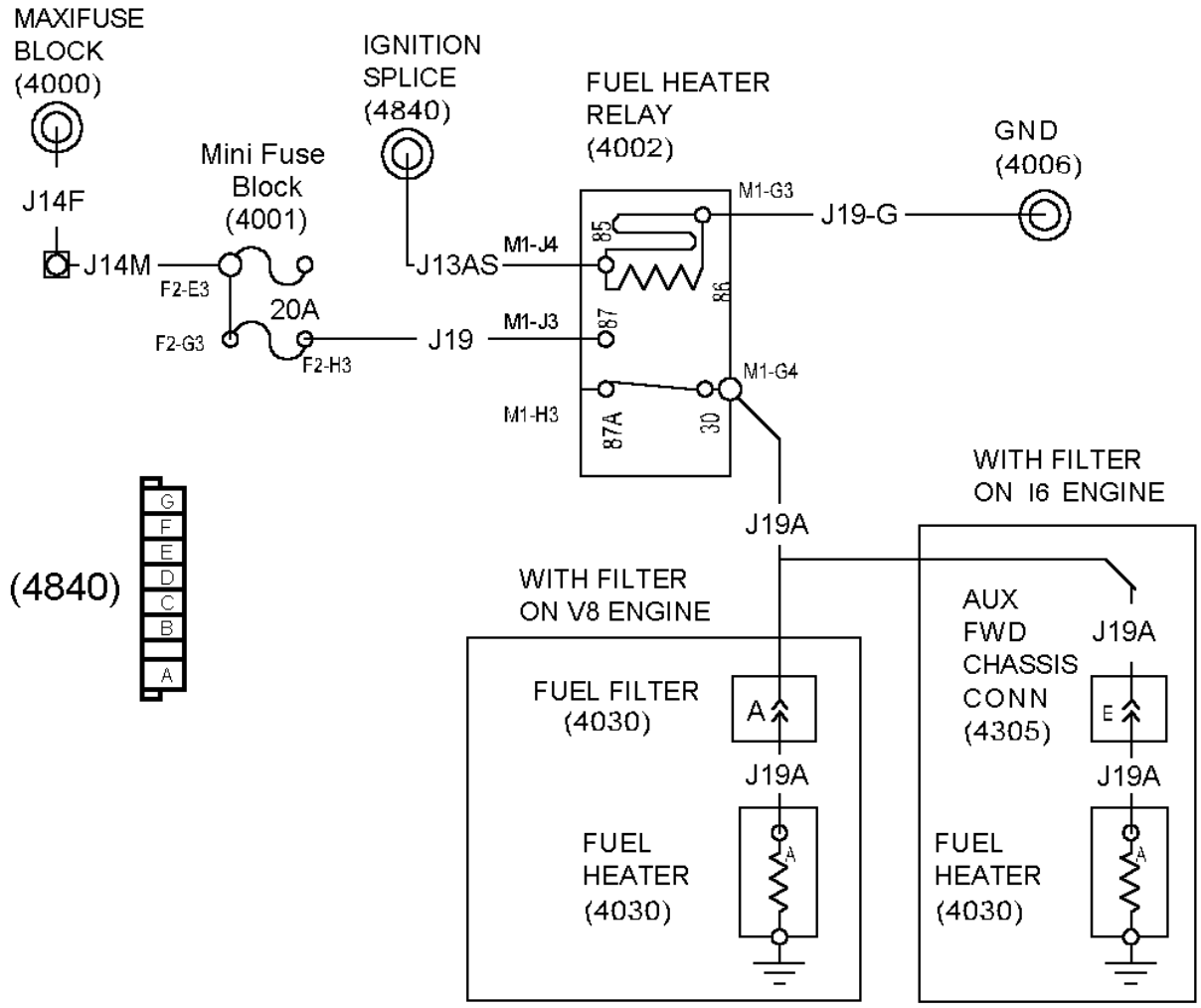



**Figure 331 Fuel Heater Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4002) FUEL HEATER RELAY
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4030) V8 FUEL FILTER CONNECTOR
LOCATED AT FUEL FILTER
(4305) AUXILIARY FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4840) RELAY COIL IGNITION SPLICE
LOCATED INSIDE ENGINE POWER DISTRIBUTION CENTER

**Table 225 Fuel Heater Connector Chart**

| Fuel Heater Relay (4002) Socket Voltage Checks<br><br>Check with ignition on and Fuel Heater relay removed.<br><br>Insure temperature is below 10°C/50°F<br><br>Bench check relay and replace if it has failed.(See BENCH TESTING RELAYS, page 29) | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Socket cavity M1–J3 to ground. | 12 ± 1.5 volts. | If voltage is incorrect, check for blown 20A fuel heater fuse or open or short in circuit J19. |
| Socket cavity M1–J3 to M1–G3. | 12 ± 1.5 volts. | If voltage is incorrect, check for open in circuit J19–G to ground stud (4006). |
| Socket cavity M1–J4 to M1–G3. | 12 ± 1.5 volts. | If voltage is incorrect, check for open or short to ground in circuit J13AS to ignition splice (4840). |
| **Heater Harness Connector (4030) Checks**<br><br>Check with ignition key on and (4030) removed from fuel heater.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| (4030) terminal A | 12 ± 1.5 volts. | If voltage is missing check for voltage from fuel heater relay. Also check for open or short to ground in circuit J19A. |

## 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.

## 6.4. COMPONENT LOCATIONS

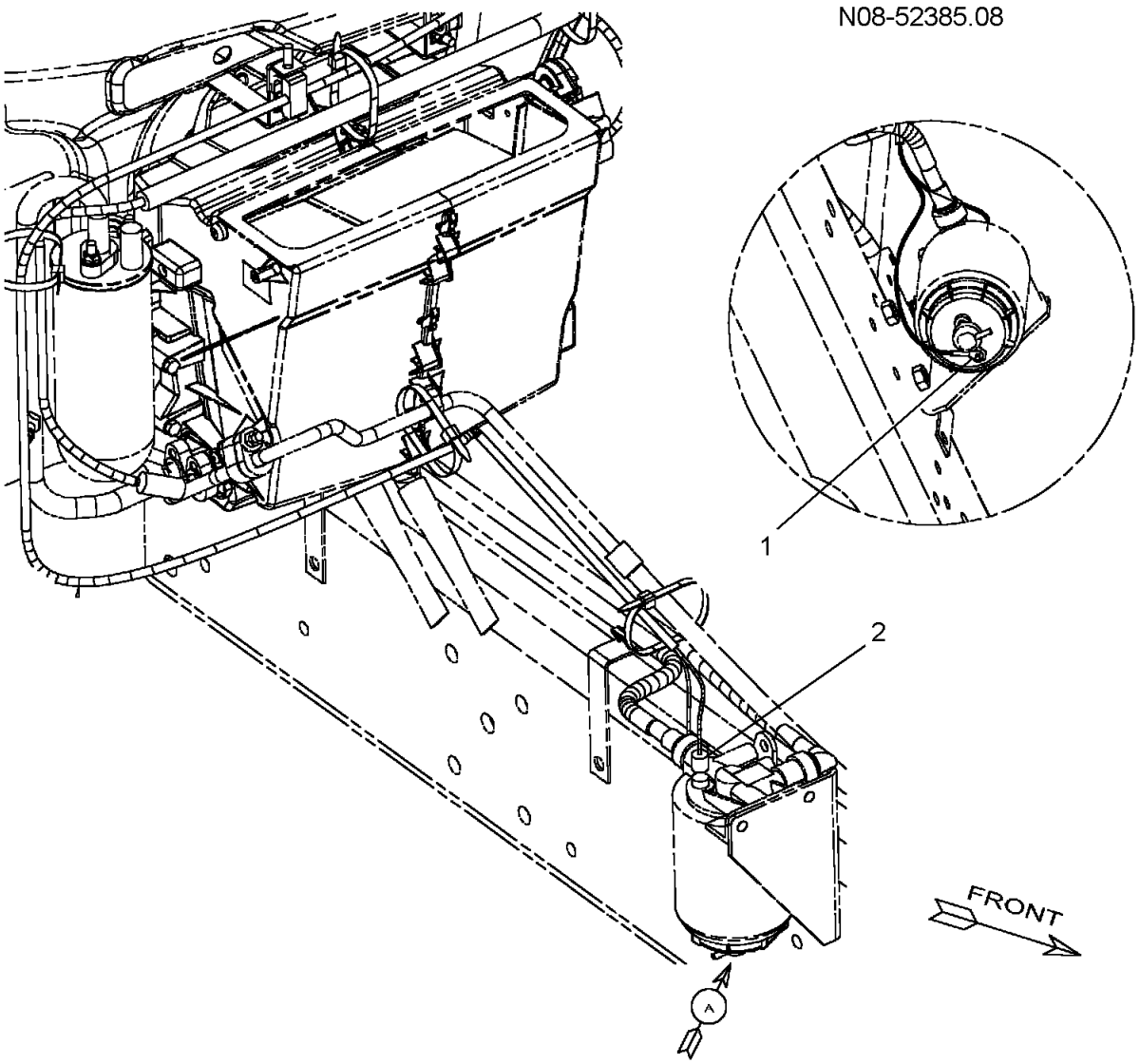



**Figure 332 Fuel Heater Wiring**

1. WATER IN FUEL LIGHT CONNECTION
2. FUEL HEATER CONNECTION

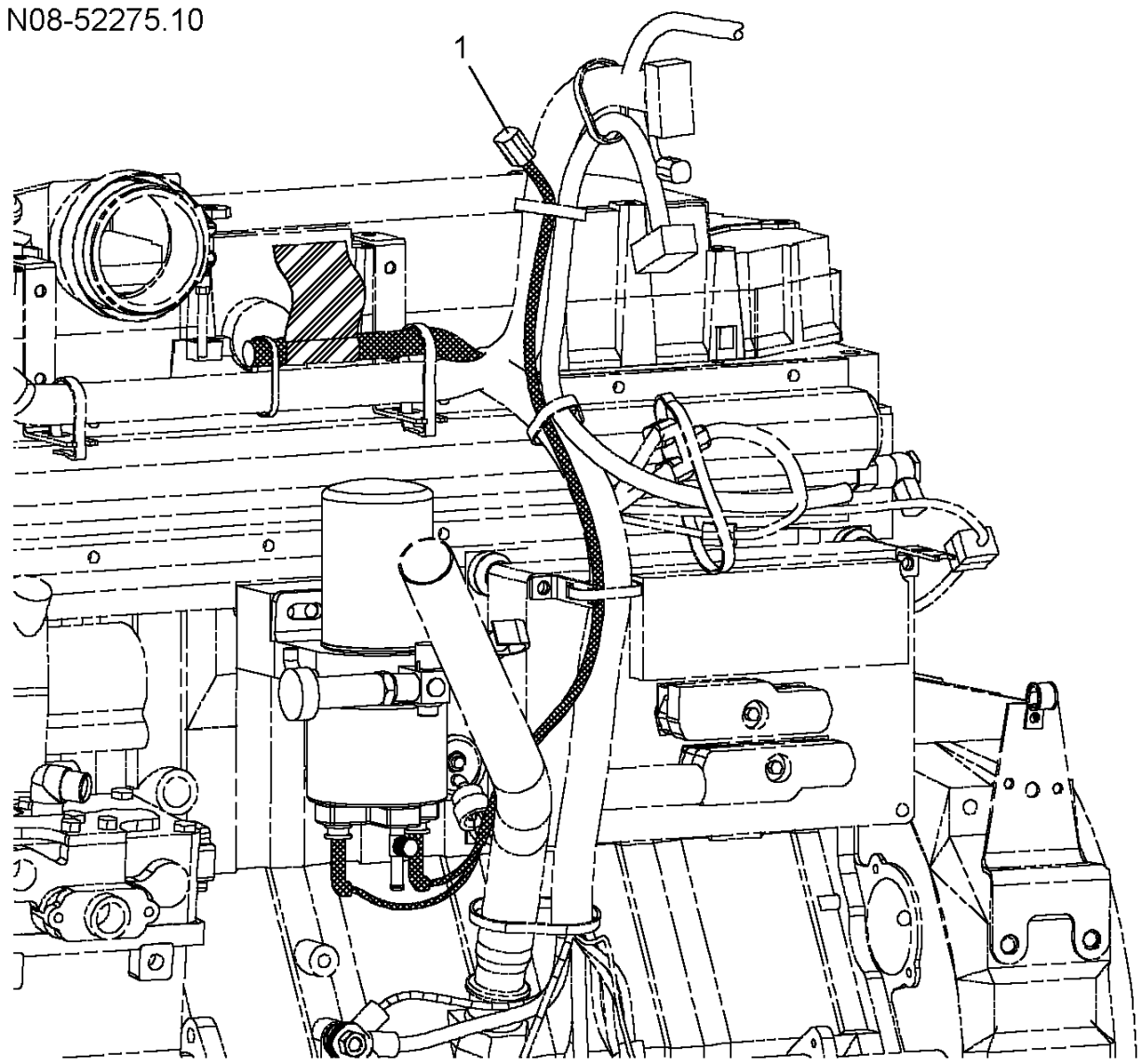



**Figure 333 Davco Fuel Heater Location**

1. DAVCO FUEL HEATER CONNECTION

# 7. HYDRAULIC (HYDRO-MAX II) BRAKE SYSTEM

## 7.1. CIRCUIT FUNCTIONS

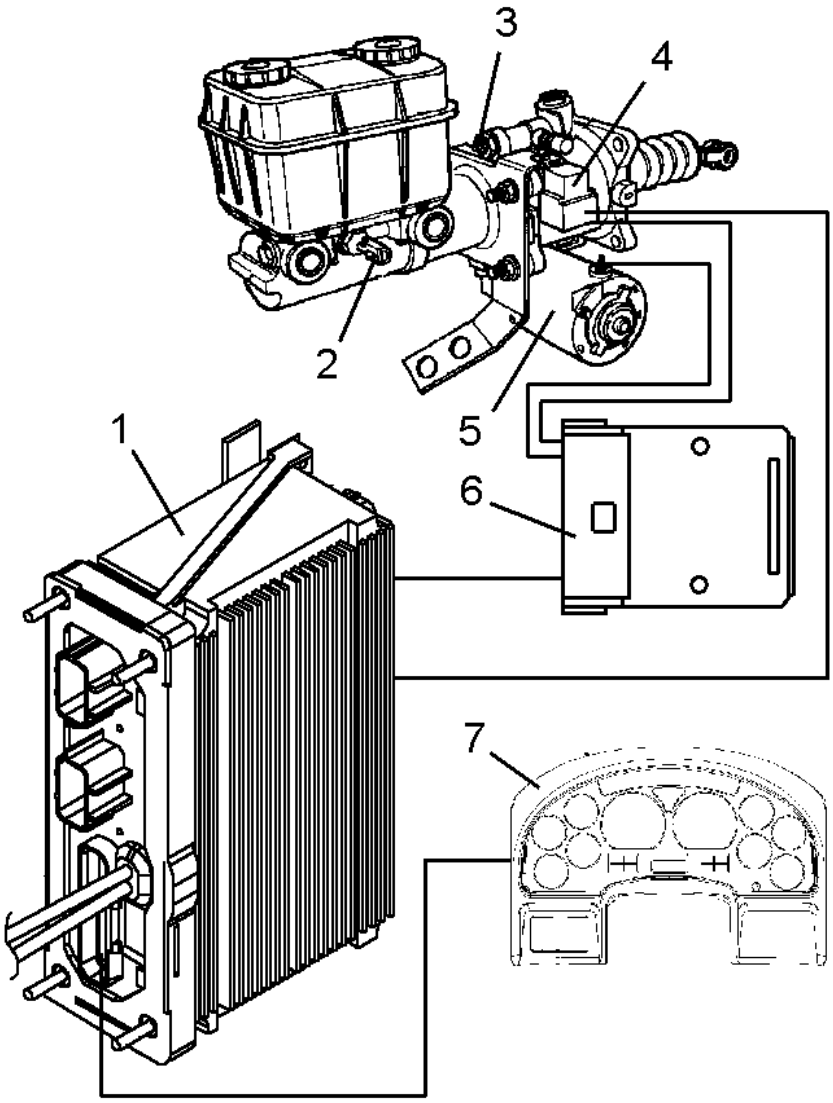



**Figure 334 Hydraulic (Hydro-Max) Brake Function Diagram**

1. ELECTRICAL SYSTEM CONTROLLER
2. DIFFERENTIAL PRESSURE SWITCH
3. FLOW SWITCH
4. HYDROMAX PUMP RELAY
5. HYDROMAX PUMP
6. HYDROMAX BRAKE MODULE
   LOCATED BEHIND INSTRUMENT PANEL
7. ELECTRONIC GAUGE CLUSTER

Refer to the Hydraulic (Hydro-Max) Brake Function Diagram.

The Bendix Hydromax hydraulic brake booster is standard on all vehicles with hydraulic brakes. It powers a split system which protects against total brake failure by using separate fluid lines to feed the front and rear axle brakes. The master cylinder provides fluid pressurized by the power steering pump and the Hydro-Max II booster to activate the brake pads against the discs. It is a dual mode system which will automatically provide reduced back-up brake power, from an electric/hydraulic pump, should there be a loss of power steering pump pressure. The electric/hydraulic pump also provides brake power when the engine is not running.

The Hydromax system is a supplementary backup for hydraulic brake systems. It is meant to be active when there is a problem with the power steering system that normally provides the brake pressure. The electrical system controller provides battery voltage to the Hydromax pump relay coil when the key is on. It will also provide battery voltage to the relay coil when the key is off and the brake pedal is engaged. The relay is energized when a ground is applied to the other side of the coil when the flow switch closes (loss of power steering fluid flow) or the differential pressure switch closes (pressure difference in master cylinder). The ESC also monitors a digital signal from the Hydromax module and will send a request to turn on the warning light and buzzer to the electronic gauge cluster as required.

The Hydro-Max II hydraulic brake system uses hydraulic pressure from the power steering pump. If the flow is inadequate or interrupted, the flow switch will close, cause the pump relay to energize, and start the reserve pump. The monitor module is fed a signal from the flow switch, causing the monitor to request the ESC to turn on the brake pressure warning light.

The reserve pump and brake warning light are also activated when the differential pressure switch (4032) is tripped due to a pressure loss in one half of the brake system.

The module continuously monitors the continuity of the reserve pump motor and power supplied to it. A signal path, circuit J90HA, a minifuse, circuit J90H, pass through connector (4014) and circuit A90N to brake monitor module connector (1400) pin G provides information to the module. The module will request activation of the alarm and warning light under the following conditions:

- The ignition is on and flow switch is not open. (It is normal for alarm and lamp to activate when key is in ignition position and engine is not running.)
- If the pump motor winding opens up.
- If the Hydro-Max II pump relay (4033) remains closed (provides power to circuit J90F and the reserve pump motor) after the engine is running, and the flow switch opens.
- If no power is supplied to the pump motor when the flow switch or differential pressure switch contacts are closed.

When the brake monitor module has sensed the pump has been activated or a failure has occurred it will provide a ground from (1400) pin F to system controller connector (1600) pin 9. The ESC will communicate a message on the drivetrain data link to the EGC instructing it to turn on the brake pressure warning lamp.

## 7.2. DIAGNOSTICS

Should the hydraulic brake system (Hydro-Max) fail to operate correctly, the problem could be attributed to a failed brake monitor module, a problem in the EGC, open or shorted wiring, a problem in the ESC, a failed pump relay, a failed pump motor, a blown fuse, or a failed brake switch.

No diagnostic trouble codes are logged for Hydro-max circuit problems. Faults will be logged for a stuck brake switch or short/open brake switch circuits.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to retrieve diagnostic trouble codes, clear diagnostic trouble codes, check operation of the brake pressure warning light and monitor activation of the brake switch. See the diagnostic software manual for details on using the software.

## Hydraulic Brake System Preliminary Check

**Table 226 Hydraulic Brake (Hydro-Max) System Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | With engine off, verify Hydromax pump motor is operating. | Listen for operation of pump motor. | Pump motor is operating. | Go to next step. | Go to Hydro-Max II pump control circuits (See HYDROMAX PUMP CONTROL CIRCUITS, page 667) |
| 2. | On | With engine off, verify brake pressure warning lamp is illuminated and alarm is operating. | Check for illumination of brake pressure warning lamp and operation of alarm. | Brake pressure warning lamp illumi-nates and alarm operates. | Go to next step. | Go to monitor module and warning circuits (See MONITOR MODULE AND WARNING CIRCUIT INPUTS TO ESC, page 670) |
| 3. | On | Start engine | Insure warning light and alarm turn off. | Warning light turns off. | Go to next step. | **Go to check why warning lamp and alarm do not shut off. Check power steering. Check flow switch. Check differential switch. Check circuits.** Check for diagnostic trouble codes |
| 4. | Off | With ignition off, press brake pedal. Insure pump motor runs. | Listen for running of pump motor while brake is engaged. | Pump motor runs when brake is pressed. | Go to next step. | Check for brake switch diagnostic trouble codes (See Diagnostic Trouble Codes, page 666) |
| 5. | Off | With ignition off and brake pedal released, Insure pump motor **does not** run. | Listen for running of pump motor while brake is not engaged. | Pump motor does not run when brake is not pressed. | Go to step 7. | Go to next step. |

**Table 226 Hydraulic Brake (Hydro-Max) System Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 6. | Off | Remove cab fuse block ignition relay. | Listen for Pump to stop running. | Pump motor shuts off when relay is removed. | Ignition relay is stuck or ignition voltage is applied to relay when the key is off. | Zener diode in brake switch is defective. Replace brake switch(es). Brake switch diagnostic codes are not generated for this condition. |
| 7. | Hydromax system is operating correctly. Problem does not exist or is intermittent. | | | | | |

## 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 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 227 Hydraulic Brake System Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 597 14 1 0 | Brake switch is stuck in the open or closed position<br><br>Occurs if the wheel based vehicle speed increases from 0 kph to 72 kph two times without the brake switch opening or decreases from 72 kph to 0 kph two times without the brake switch closing.<br><br>Defective brake switch |
| 597 14 2 0 | Brake switch inputs do not match<br><br>Occurs if the comparison of the inputs indicates a mismatch in the analog and digital signals.<br><br>Occurs if there is a high resistance in the wire harness, defective brake switch or a defective Electronic System Controller (ESC). |
| Sets when the vehicle has decelerated to a stop, without brake switch activation. | |

**Table 227 Hydraulic Brake System Diagnostic Trouble Codes (cont.)**

| | |
|---|---|
| 612 14 1 1 | Brake switch out of range low<br><br>Shorted to ground. |
| Refer to hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 892) or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 895) in the Light Systems section of this manual. | |
| 612 14 1 2 | Brake switch out of range high<br><br>Shorted high or open circuit |
| Refer to hydraulic brake switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 892) or air brake switch (See AIR BRAKE SWITCH INPUTS TO ESC, page 895) in the Light Systems section of this manual. | |

## 7.3. HYDROMAX PUMP CONTROL 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.**

Refer to Hydromax Pump Control Circuits.

A fault in the Hydromax pump control circuits will be apparent if the pump doesn't come on when expected or doesn't shut off when expected. When the key is on and the engine is not running the pump should turn on. When the engine is running the pump should not be on unless there is a failure in the power steering system or pressure difference in the brake master cylinder.

The ESC will not log any diagnostic trouble codes for Hydromax pump circuits. Problems in the Hydromax pump circuits can be attributed to missing voltage from the ESC (when the key is on or the brake pedal is pressed), circuits shorted to ground, open circuits, a blown megafuse, a failed relay, a failed flow switch, a failed differential pressure switch, or a failed pump motor.

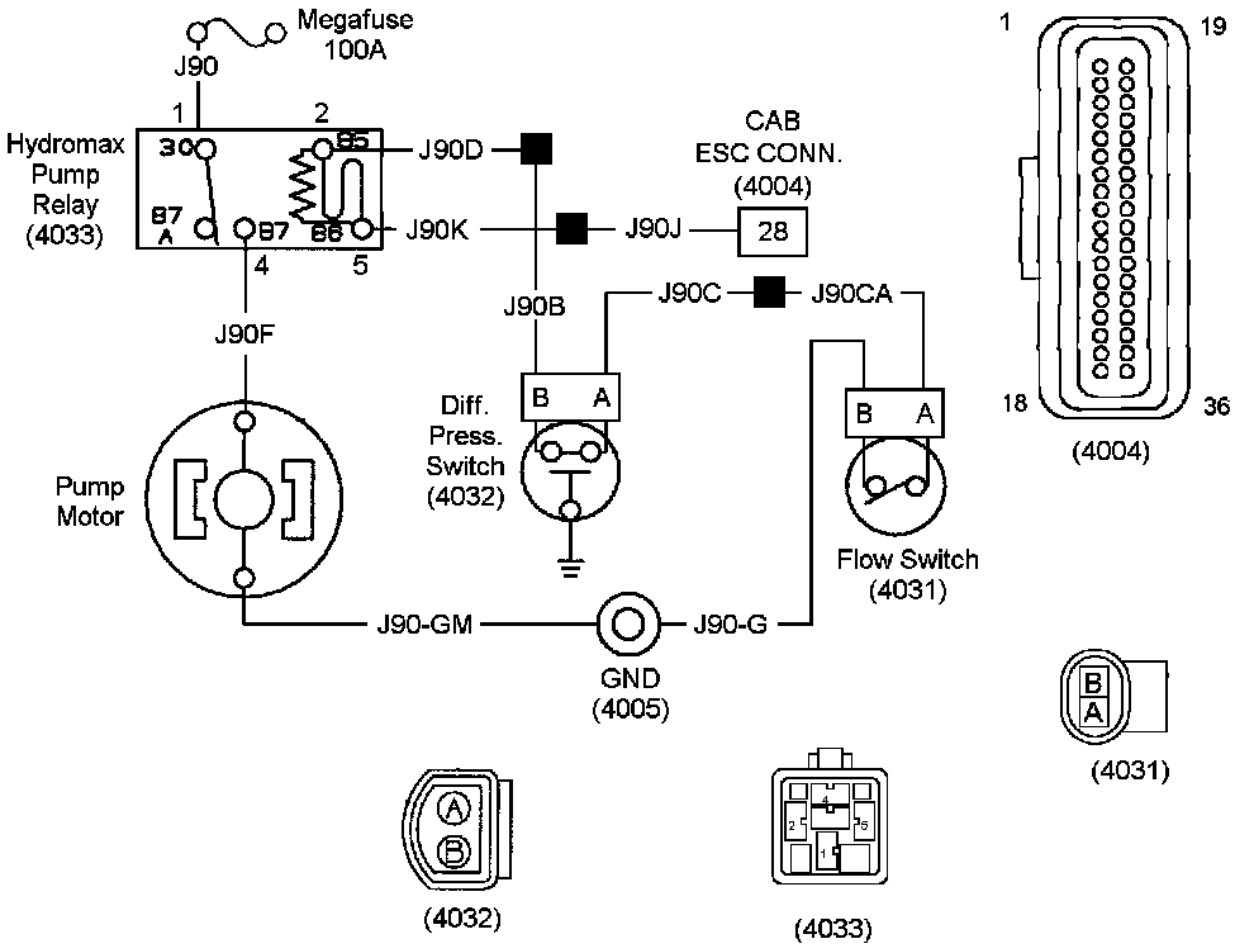



**Figure 335 Hydromax Pump Control Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4004) 36–WAY ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4005) GROUND STUD
(4031) FLOW SWITCH CONNECTOR
LOCATED ON HYDROMAX BOOSTER ASSEMBLY
(4032) DIFFERENTIAL PRESSURE SWITCH CONNECTOR
LOCATED BELOW BRAKE FLUID RESERVOIR ASSEMBLY
(4033) HYDROMAX RELAY
LOCATED ON HYDROMAX BOOSTER ASSEMBLY

**Table 228 Hydromax Pump Control Circuits Connector Chart**

| Faults | | |
|---|---|---|
| There are no diagnostic trouble codes associated with the Hydromax pump control circuits. | | |
| **Hydromax Pump Relay Resistance Checks**<br><br>**NOTE – Verify power steering is working. Fix power steering before proceeding.**<br><br>**NOTE – Verify fluid levels are correct in the brake master cylinder. Fix failure in brake system before proceeding.**<br><br>Check with relay removed, ignition key on and engine running.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Hydromax relay socket cavity 5 (relay 86) to ground. | >50K ohms | If resistance is incorrect, check for failed flow switch, failed differential pressure switch, or shorts in circuits between relay socket ground. |
| **Hydromax Pump Relay Voltage Checks**<br><br>Check with relay removed, ignition key on and engine off.<br><br>Bench check relay and replace if it has failed.(See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Hydromax relay socket cavity 1 (relay 30) to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between relay socket and megafuse. |
| Hydromax relay socket cavity 2 (relay 85) to ground. | 12 ± 1.5 volts | Voltage to relay coil from ESC.<br><br>If voltage is missing, check for open or shorts in circuits between ESC and relay socket.<br><br>Also insure proper voltage out of ESC connector (4004) pin 28. |
| Hydromax relay socket cavity 2 (relay 85) to cavity 5 (relay 86). | 12 ± 1.5 volts | Check ground to relay coil through closed flow switch and differential switch contacts.<br><br>If voltage is missing, check for open in circuits between ground and relay socket. |
| **Pump Motor Voltage Check**<br><br>Check with relay installed, motor terminal disconnected, ignition key on and engine off.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |

**Table 228 Hydromax Pump Control Circuits Connector Chart (cont.)**

| Test Points | Spec. | Comments |
|---|---|---|
| Hydromax motor circuit J90F to ground. | 12 ± 1.5 volts | Check circuits from relay to pump motor.<br><br>If voltage is missing, check for open in circuits between motor and relay socket.<br><br>If voltage is correct and the pump motor fails to operate, replace the motor. |

### Extended Description

The common contact of the Hydro-Max II relay is supplied battery voltage from the megafuse.

Battery voltage is supplied to one side of the relay coil from the ESC, when the ignition is on or the brake pedal is pressed, on connector (4004) pin 28.

The flow switch closes anytime there is no flow from the power steering pump. This occurs when the engine is not running or when the engine is running and there is a problem in the power steering system.

When the flow switch closes a ground will be supplied through the flow switch and the differential pressure switch to the other side of the relay coil, causing the relay to energize.

The differential pressure switch will also supply ground to the relay, causing the relay to energize, when a pressure difference exists in the master cylinder.

The energized relay will supply battery voltage to the pump motor, causing the motor to run.

## 7.4. MONITOR MODULE AND WARNING CIRCUIT INPUTS TO ESC

### Fault Detection Management

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

A fault in the monitor module and warning circuits will be apparent when the brake pressure warning light doesn't come on or doesn't turn off when expected. Problems in the monitor module and warning circuits can be attributed to a failed monitor module, burned out lamps, a short, an open, a blown fuse, a failed diode in assembly (1404), a failed switch, a problem in the ESC or a problem in the EGC.

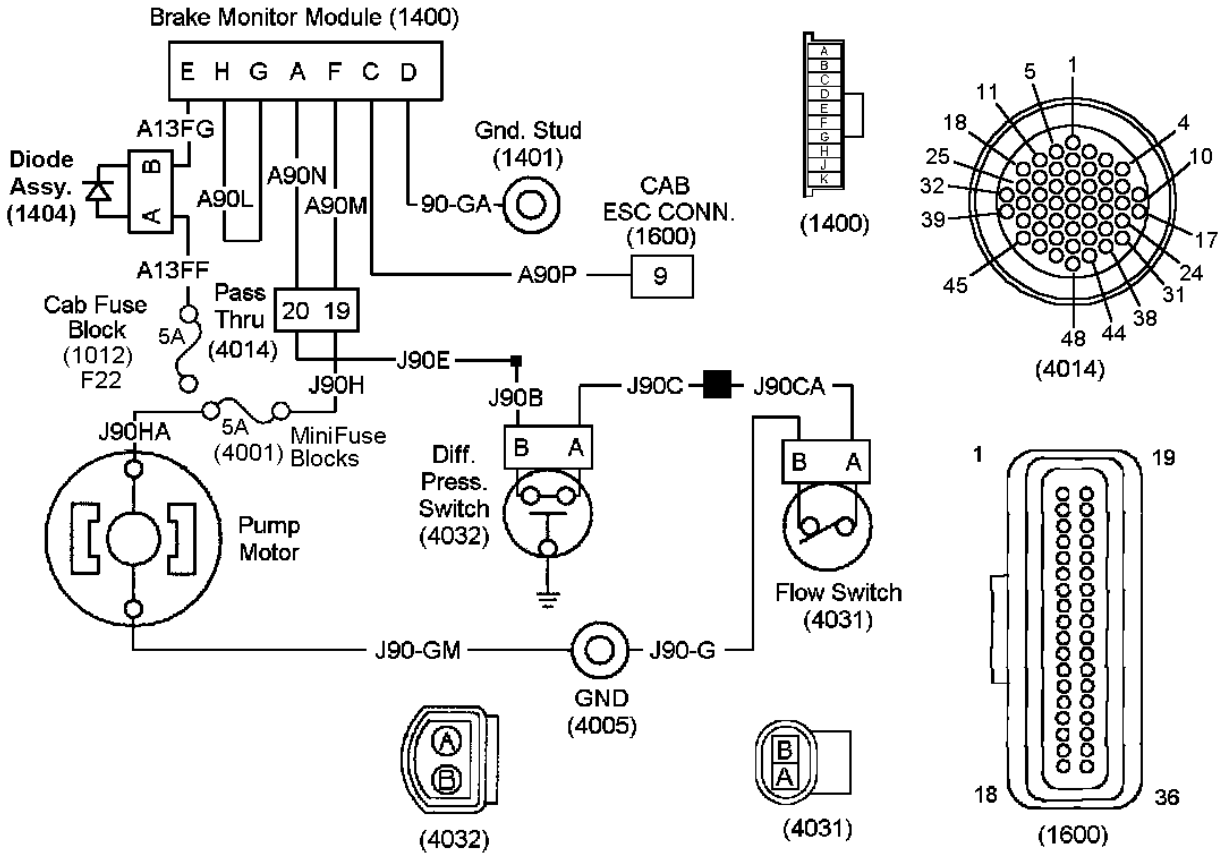



**Figure 336 Hydromax Monitor Module And Warning Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(1012) F22 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1400) HYDROMAX MONITOR MODULE
STRAPPED TO WIRE HARNESS, BEHIND KEY SWITCH
(1401) AND (4005) GROUND STUDS
(1404) DIODE ASSEMBLY 467404C91
LOCATED BEHIND INSTRUMENT PANEL NEAR KEY SWITCH
(1600) 36–WAY ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(4001) MINI FUSE BLOCKS
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
(4031) FLOW SWITCH CONNECTOR
LOCATED ON HYDROMAX BOOSTER ASSEMBLY
(4032) DIFFERENTIAL PRESSURE SWITCH CONNECTOR
LOCATED BELOW BRAKE FLUID RESERVOIR ASSEMBLY

**Table 229 Monitor Module And Warning Circuits Connector Chart**

| Faults |
|---|
| There are no diagnostic trouble codes associated with the Hydro-Max II monitor module and warning circuits. |

**Table 229 Monitor Module And Warning Circuits Connector Chart (cont.)**

| **Monitor Module Voltage Checks**<br><br>Check with Monitor Module removed, ignition key on and engine off.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Brake monitor module connector pin E to ground. | 12 ± 1.5 volts | Ignition voltage to module.<br><br>If voltage is missing, check for open or shorts in circuits between fuse F22 and pin E. Also check for open or missing diode assembly (1404). |
| Brake monitor module connector pin E to pin D. | 12 ± 1.5 volts | Ground to module.<br><br>If voltage is missing, check for open in circuits between ground stud (1401) and pin D. |
| Brake monitor module connector pin E to pin A. | 12 ± 1.5 volts | Flow switch and differential switch, monitored circuits.<br><br>If voltage is missing, check for open in circuits between differential pressure switch and pin A. |
| Brake monitor module connector pin F to ground. | 12 ± 1.5 volts | Pump motor, monitored circuits.<br><br>If voltage is missing, check for open in circuits, shorted motor windings, or blown fuse between pump motor and pin F.<br><br>**NOTE – A blown fuse in this circuit could be caused by a short in the circuit between the fuse and the monitor module.** |
| Brake monitor module connector pin C to ground. | 12 ± 1.5 volts | Circuit between module and ESC.<br><br>If voltage is missing, check for open in circuits between ESC connector (1600) pin 9 and module connector pin C.<br><br>Also insure proper voltage out of ESC.<br><br>**NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** |

### Extended Description

Ignition voltage from fuse F22, in the cab power distribution panel, is supplied through diode assembly (1404) to brake monitor module (1400) cavity E.

Ground for the brake monitor module is supplied from ground stud (1401) to connector (1400) cavity D.

The module continuously monitors the continuity of the reserve pump motor and power supplied to it. The signal path is from circuit J90HA, through mini-fuse blocks (4001), circuit J90H, pass through connector (4014)) and circuit A90N to brake monitor module connector (1400) pin G.

The brake monitor module will sense closing of the flow switch or differential pressure switch from circuit J90E on monitor module connector (1400) cavity A.

When the brake monitor module has sensed the pump has been activated or a failure has occurred it will provide a ground from (1400) pin F to system controller connector (1600) pin 9. The ESC will communicate a message on the drivetrain data link to the EGC instructing it to turn on the brake pressure warning lamp.

## 7.5. COMPONENT LOCATIONS

Refer to Hydromax Booster.

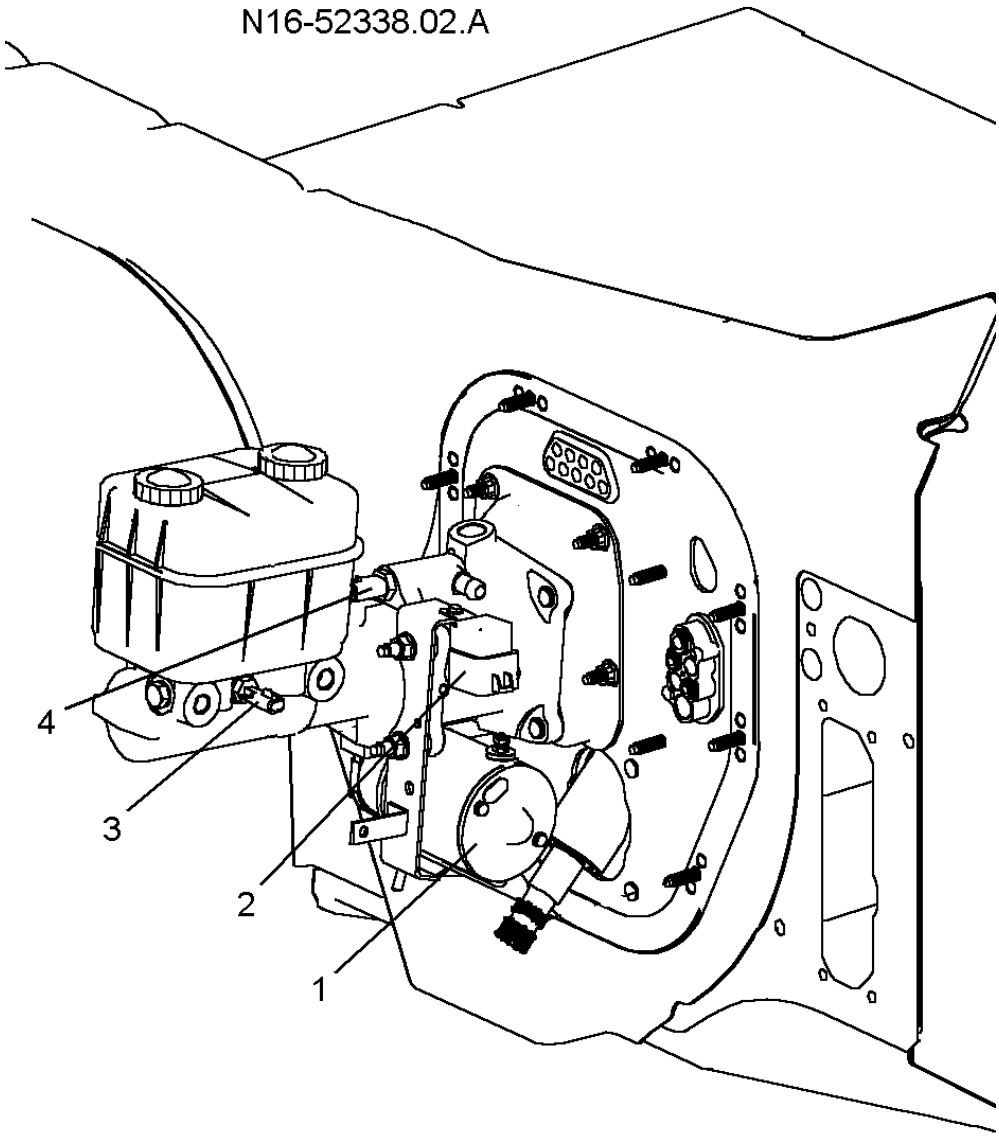



**Figure 337 Hydromax Booster**

1. PUMP MOTOR
2. PUMP RELAY
3. DIFFERENTIAL PRESSURE SWITCH
4. FLOW SWITCH

# 8. FUEL TRANSFER PUMP SYSTEM

## 8.1. CIRCUIT FUNCTIONS

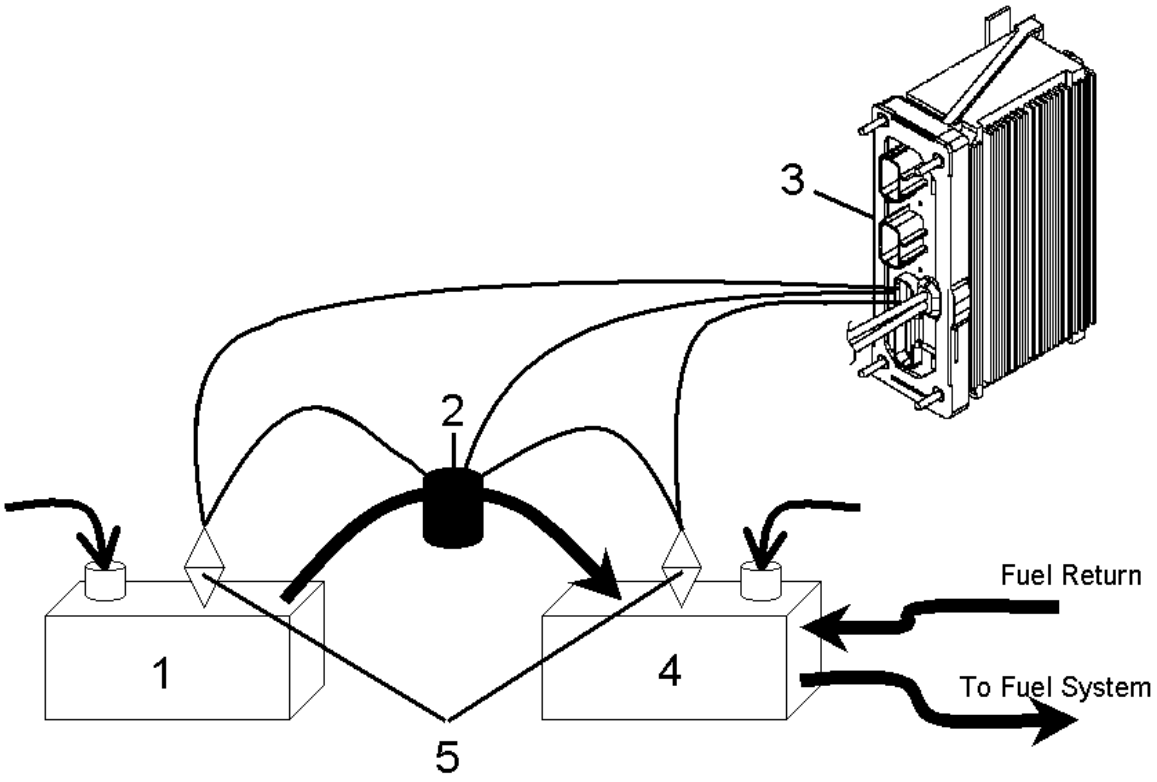



**Figure 338 Fuel Transfer Pump Function Diagram**

1. LEFT FUEL TANK
2. FUEL TRANSFER PUMP
3. ESC
4. RIGHT FUEL TANK
5. FUEL LEVEL SENSORS

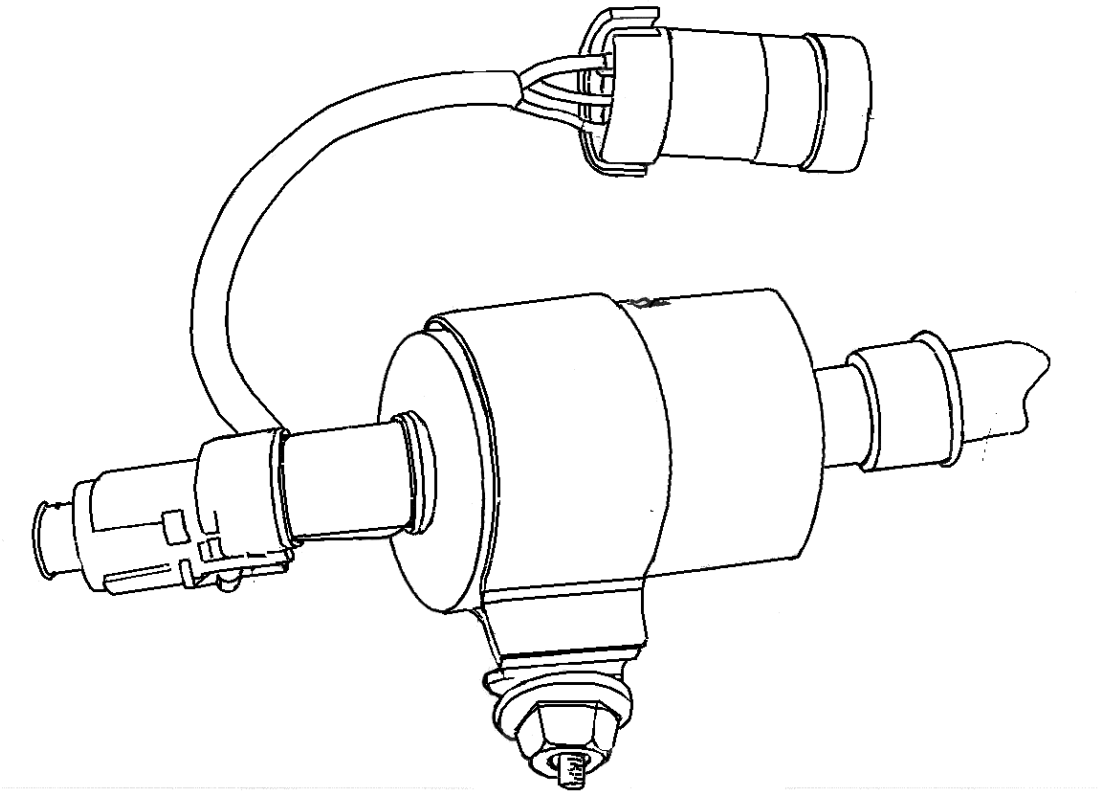


**Figure 339 Fuel Transfer Pump (5 pin pump)**

Refer to the Fuel Transfer Pump Function Diagram.

With two fuel tanks on the same truck, there is an equalizing pump that balances the fuel between the two tanks. The pump can only move the fuel from the left tank to the right tank and only when the engine is running.

The dual tank, fuel sensing and display feature takes data from two fuel level sensors located on the top of each of the fuel tanks. The data displayed on the fuel gauge is the reading from the sensor in the right tank only. The sensors are connected to inputs on the ESC and to the fuel transfer pump module. The same fuel level sensors are used, regardless of the size, number and shape of the fuel tanks on the vehicle, however the position of the sensors in the tanks and the lengths of the swing-arms change.

There are several error conditions that can occur with the fuel sensor circuits or the sensor itself:

- An open condition where the resistance is infinite across the two sensor terminals.
- A short condition where the resistance is zero across the two sensor terminals.
- An open in circuits N37A or J37D between the pump and the ESC.

There are mechanical problems that can occur with the fuel sensor:

- A float falls off the sensor (The sensor will read empty permanently)
- The sensor arm sticks in one position.

**NOTE – The transfer pump pumps from the left (driver side tank) to the right tank and is mounted above the right tank. A sticker with an arrow indicating flow direction will be on the pump. The words "in" and "out" are also stamped on appropriate ends of the pump.**

## 8.2. DIAGNOSTICS

### Fuel Transfer Pump Preliminary Check

**Table 230 Fuel Transfer Pump Circuits Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify fuel transfer pump is inoperative. | Check fuel level between tanks. | Fuel level in each tank is approx-imately the same. | Fuel transfer pump is operating. Problem does not exist or is intermittent. | Go to next step. |
| 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 | Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 678) | Read display on odometer. | **No** fuel level sensor diag-nostic trouble codes are active. | Go to Fuel Transfer Pump Fault Detection (5 pin pump). (See FUEL TRANSFER PUMP FAULT DETECTION MANAGEMENT (5 pin pump), page 681)<br><br>Go to Fuel Transfer Pump Fault Detection (2 pin pump). (See FUEL TRANSFER PUMP FAULT DETECTION MANAGEMENT (2 pin pump), page 687) | Go to Fuel Level Sensor Fault Detection Management (5 pin pump). (See FUEL LEVEL SENSOR FAULT DETECTION MANAGEMENT (5 pin pump), page 678)<br><br>Go to Fuel Level Sensor Fault Detection Management (2 pin pump). (See FUEL LEVEL SENSOR FAULT DETECTION MANAGEMENT (2 pin pump), page 684) |

### 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 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 231 Fuel Level Sensor Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 612 14 23 1 | Fuel level sensor out of range low for single tanks<br><br>This code applies to the driver side tank with dual fuel tanks.<br><br>Shorted to ground |
| 612 14 23 2 | Fuel level sensor out of range high for single tanks<br><br>This code applies to the driver side tank with dual fuel tanks.<br><br>Shorted high or open circuit |
| 612 14 25 1 | Passenger side fuel level sensor out of range low with dual fuel tanks.<br><br>Shorted to ground |
| 612 14 25 2 | Passenger side fuel level sensor out of range high with dual fuel tanks.<br><br>Shorted high or open circuit |

## 8.3. FUEL LEVEL SENSOR FAULT DETECTION MANAGEMENT (5 PIN PUMP)

A fault in the fuel sensor circuits will be apparent when fuel sensor diagnostic trouble codes are present. This will also prevent the fuel transfer pump from working correctly.

Problems in sensor circuits could be the result of open or shorted sensors, open circuits, shorted circuits, a short in the fuel transfer pump module, or a failed ESC.

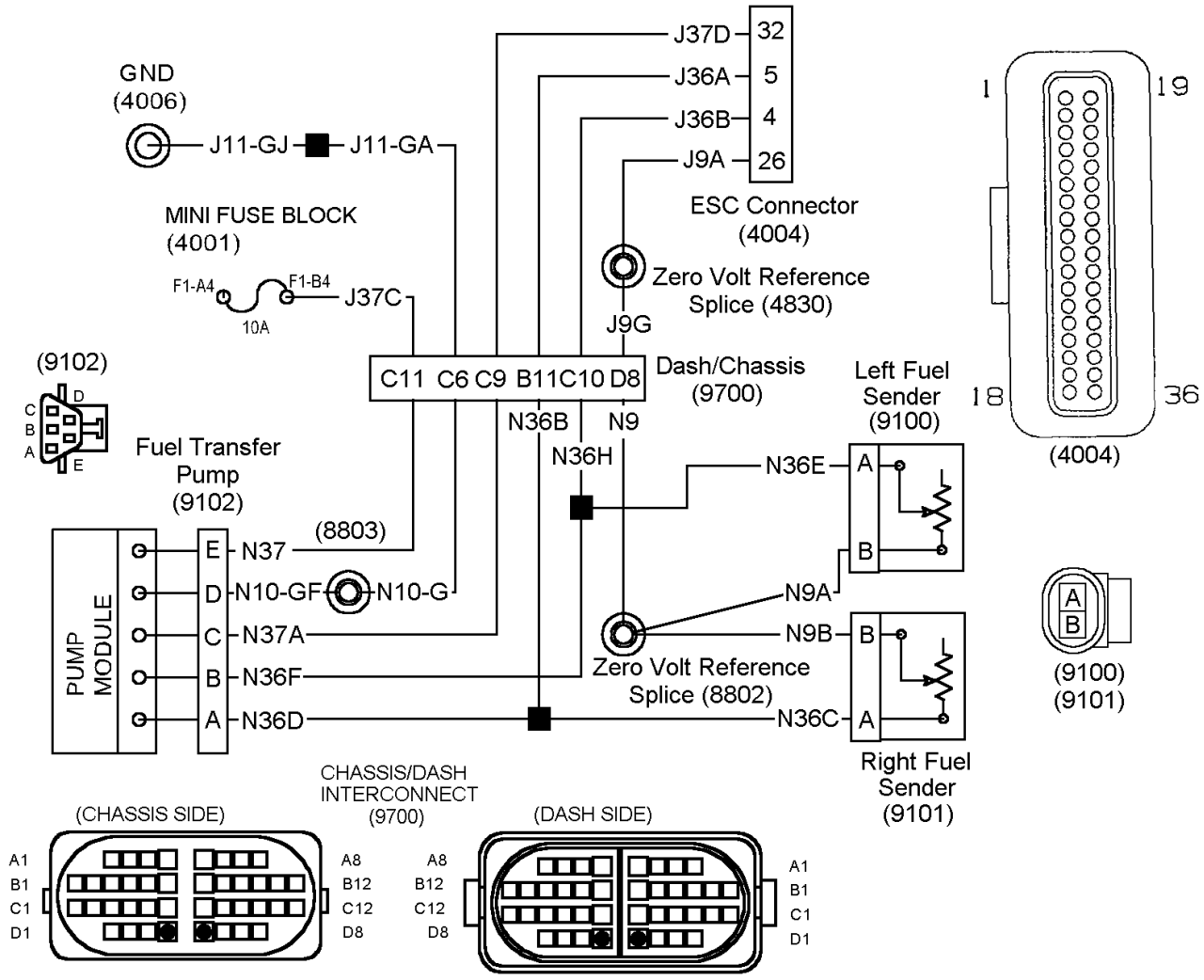



**Figure 340 Fuel Level Sensor (5 pin pump) Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4830), (8802) ZERO VOLT REFERENCE SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
(8803) CHASSIS GROUND SPLICE
(9100) LEFT FUEL SENSOR
LOCATED ON LEFT FUEL TANK
(9101) RIGHT FUEL SENSOR
LOCATED ON RIGHT FUEL TANK
(9102) FUEL TRANSFER PUMP MODULE CONNECTOR
LOCATED ABOVE RIGHT FUEL TANK
(9700) DASH/CHASSIS CONNECTOR

**Table 232 Fuel Level Sensor Tests (5 pin pump)**

| | | |
|---|---|---|
| **Left Fuel Level Sensor Voltage Checks**<br><br>Check with ignition on, transfer pump connector (9102) disconnected and fuel level sensor (9100) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
| Test Points | Spec. | Comments |
| (9100) cavity A to ground. | 10 ± 1 volts | If voltage is missing, check for open or shorts in circuit N36E, N36H or J36 B to ESC connector (4004) cavity 4.<br><br>Also check for short in circuit N36F to transfer pump (9102) cavity B.<br><br>If circuits check good, check for missing 10 volt signal from ESC. |
| (9100) cavity A to B. | 10 ± 1 volts | If voltage is present replace or repair fuel sensor<br><br>If voltage is missing, check for open in circuits N9A, N9, J9G or J9A to ESC connector (4004) cavity 26.<br><br>If circuits check good, check for missing zero volt reference from ESC. |
| **Right Fuel Level Sensor Voltage Checks**<br><br>Check with ignition on, transfer pump connector (9102) disconnected and fuel level sensor (9101) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
| Test Points | Spec. | Comments |
| (9101) cavity A to ground. | 10 ± 1 volts | If voltage is missing, check for open or shorts in circuit N36C, N36B or J36 A to ESC connector (4004) cavity 5.<br><br>Also check for short in circuit N36D to transfer pump (9102) cavity B.<br><br>If circuits check good, check for missing 10 volt signal from ESC. |
| (9101) cavity A to B. | 10 ± 1 volts | If voltage is present replace or repair fuel sensor.<br><br>If voltage is missing, check for open in circuits N9B, N9, J9G or J9A to ESC connector (4004) cavity 26.<br><br>If circuits check good, check for missing zero volt reference from ESC. |

**Table 232 Fuel Level Sensor Tests (5 pin pump) (cont.)**

| Fuel Level Sensor Resistance Checks<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** |
|---|
| Resistance across full sensor should be 29–37 ohms when tank is full and 234–246 ohms when tank is empty. |

## 8.4. FUEL TRANSFER PUMP FAULT DETECTION MANAGEMENT (5 PIN PUMP)

**NOTE – Check for a mechanical sensor problem, such as a stuck sensor arm, before looking for electrical problems.**

A fault in the fuel transfer circuits will be apparent when the fuel transfer pump is not operating. Fuel levels in each tank will equalize when the pump is operating correctly.

Problems in fuel transfer pump circuits could be the result of a blown fuse, open circuits, shorted circuits, or a short in the fuel transfer pump module.

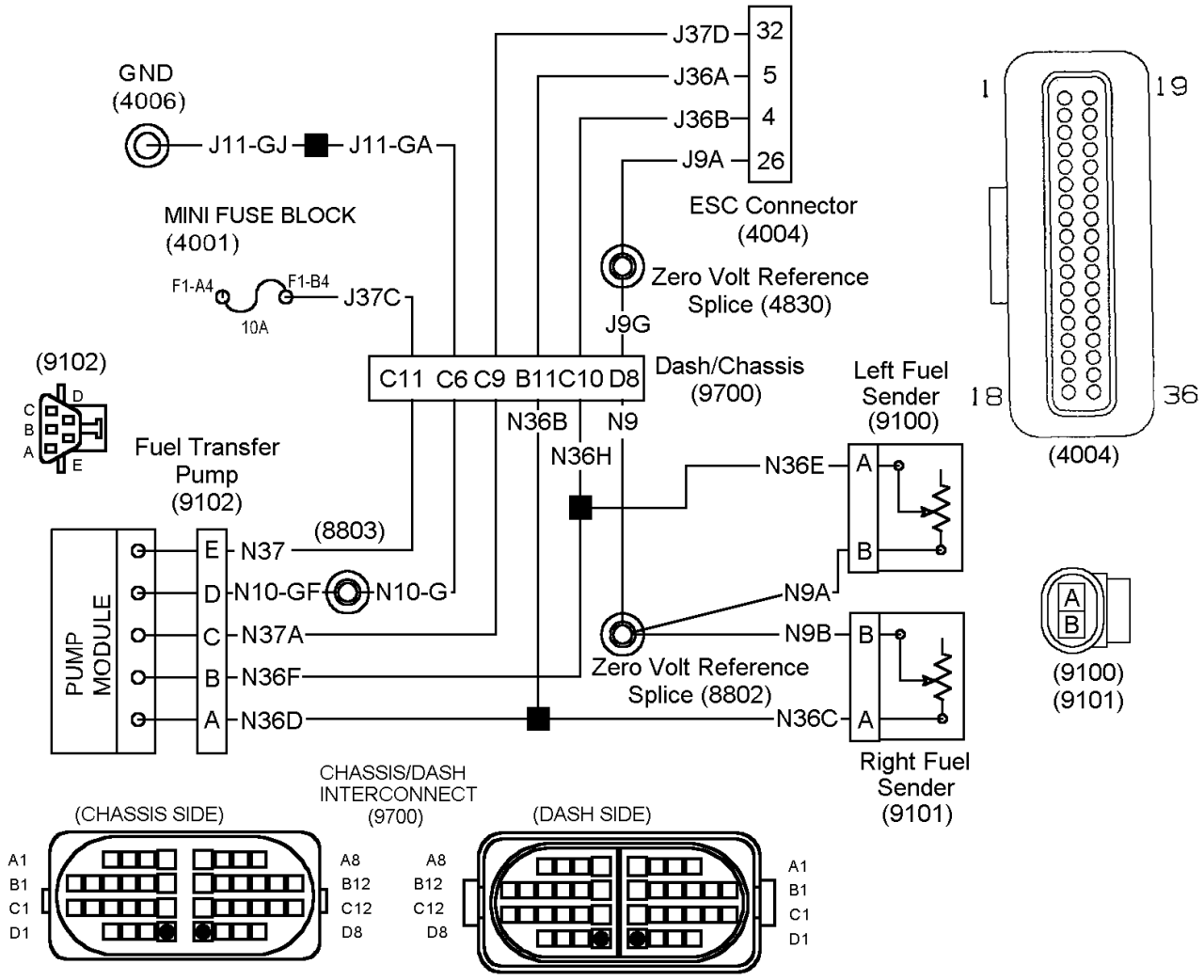



**Figure 341 Fuel Transfer Pump (5 pin pump) Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4830), (8802) ZERO VOLT REFERENCE SPLICES
LOCATED NEAR POWER DISTRIBUTION CENTER
(8803) CHASSIS GROUND SPLICE
(9100) LEFT FUEL SENSOR
LOCATED ON LEFT FUEL TANK
(9101) RIGHT FUEL SENSOR
LOCATED ON RIGHT FUEL TANK
(9102) FUEL TRANSFER PUMP MODULE CONNECTOR
LOCATED ON FRAME RAIL NEAR RIGHT FUEL TANK
(9700) DASH/CHASSIS CONNECTOR

**Table 233 Fuel Transfer Pump Circuit Tests (5 pin pump)**

**Fuel Transfer Pump Voltage Checks**

Check for blown transfer pump fuse in engine compartment power distribution panel before performing checks.

Check with ignition on and transfer pump connector (9102) 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 |
|---|---|---|
| (9102) cavity E to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit N37, or J37C to mini fuse block. |
| (9102) cavity E to cavity D. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits N10–GF, N10–G, J11–GA or J11–GJ to ground connector (4006).<br><br>If voltage is present, Power circuits to fuel transfer pump are good. |
| (9102) cavity A to ground. | Voltage in proportion to right tank fuel level. | If voltage is missing, check for open or shorts in circuit N36C, or N36D to fuel level sensor. |
| (9102) cavity B to ground. | Voltage in proportion to left tank fuel level. | If voltage is missing, check for open or shorts in circuit N36E, or N36F to fuel level sensor. |
| With engine running, (9102) cavity C to ground. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits N37A or J37D to ESC connector (4004) terminal 32.<br><br>If all voltages are present, circuits to fuel transfer pump are good. Replace failed pump. |

**When replacing fuel transfer pump insure new pump is installed with the same orientation as the old pump. It is possible to install the pump backwards.**

The transfer pump pumps from left (driver side tank) to the right tank and is mounted above the right tank. A sticker with an arrow indicating flow direction will be on the pump. The words "in" and "out" are also stamped on appropriate ends of the pump.

## 8.5. EXTENDED DESCRIPTION (5 PIN PUMP)

Ignition voltage is supplied to fuel transfer pump connector (9102) cavity E from a 10 amp fuse in the engine compartment power distribution center.

Chassis ground to the module is supplied to (9102) cavity D from ground stud (4006).

The voltage from the left fuel tank sensor (9100) terminal A is supplied to (9102) cavity B.

The voltage from the right fuel tank sensor (9101) terminal A is supplied to (9102) cavity A.

A signal from the ESC connector (4004) pin 32 is supplied to (9102) cavity C. This signal should be 12 volts when the engine is running.

## 8.6. FUEL LEVEL SENSOR FAULT DETECTION MANAGEMENT (2 PIN PUMP)

A fault in the fuel sensor circuits will be apparent when fuel sensor diagnostic trouble codes are present. This will also prevent the fuel transfer pump from working correctly.

Problems in sensor circuits could be the result of open or shorted sensors, open circuits, shorted circuits, a short in the fuel transfer pump module, or a failed ESC.

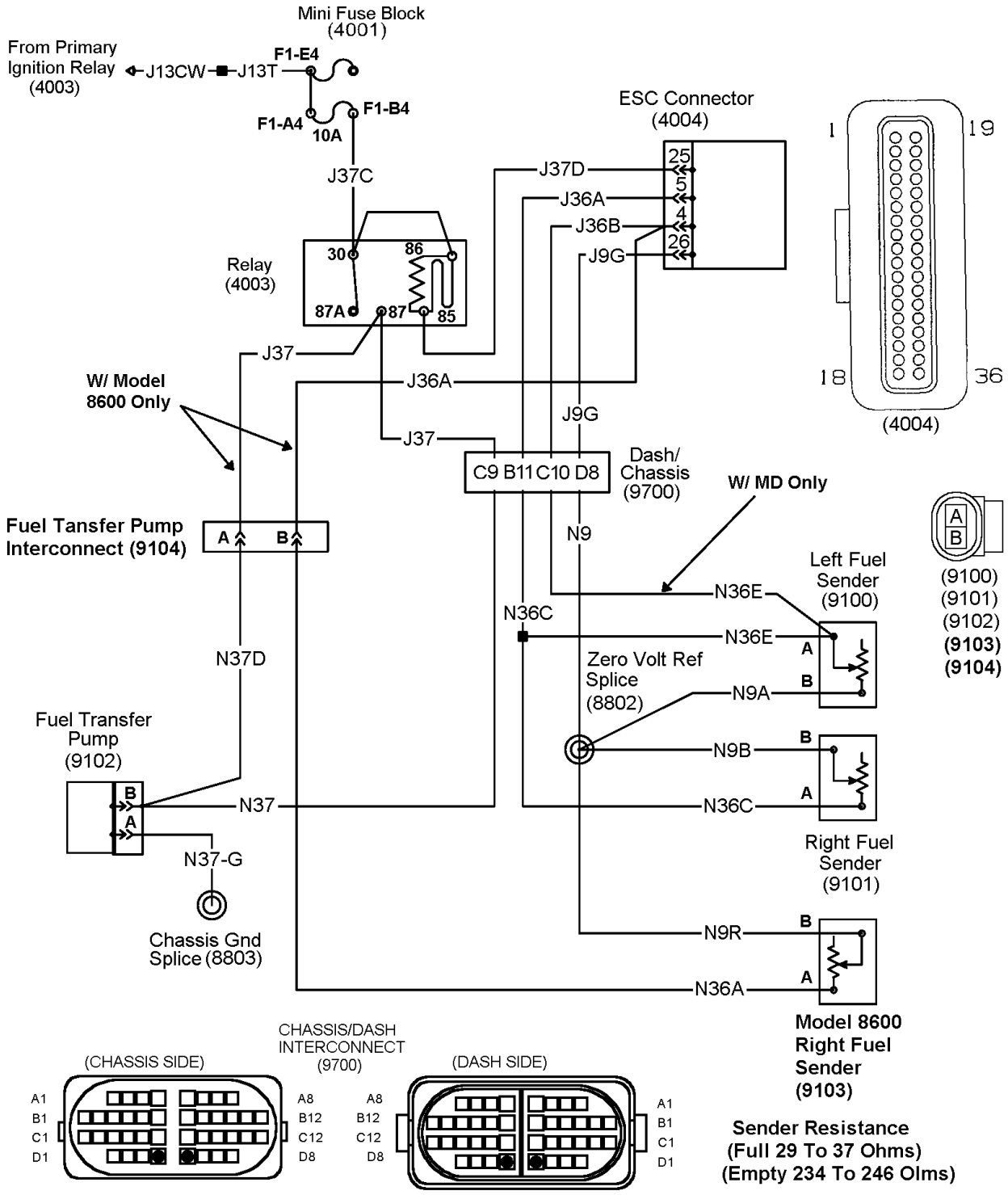



**Figure 342 Fuel Level Sensor (2 pin pump) Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(8802) ZERO VOLT REFERENCE SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
(8803) CHASSIS GROUND SPLICE
(9100) LEFT FUEL SENSOR
LOCATED ON LEFT FUEL TANK
(9101) RIGHT FUEL SENSOR
LOCATED ON RIGHT FUEL TANK
(9102) FUEL TRANSFER PUMP MODULE CONNECTOR
LOCATED ABOVE RIGHT FUEL TANK
(9700) DASH/CHASSIS CONNECTOR

**Table 234 Fuel Level Sensor Tests (2 pin pump)**

| **Left Fuel Level Sensor Voltage Checks**<br><br>Check with ignition on, fuel level sensor (9100) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| (9100) cavity A to ground. | 10 ± 1 volts | If voltage is missing, check for open or shorts in circuit N36E or J36 B to ESC connector (4004) cavity 4.<br><br>If circuits check good, check for missing 10 volt signal from ESC. |
| (9100) cavity A to B. | 10 ± 1 volts | If voltage is present replace or repair fuel sensor<br><br>If voltage is missing, check for open in circuits N9A, N9 or J9G to ESC connector (4004) cavity 26.<br><br>If circuits check good, check for missing zero volt reference from ESC. |
| **Right Fuel Level Sensor Voltage Checks**<br><br>Check with ignition on, fuel level sensor (9101) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
| Test Points | Spec. | Comments |
| (9101) cavity A to ground. | 10 ± 1 volts | If voltage is missing, check for open or shorts in circuit N36C or J36 A to ESC connector (4004) cavity 5.<br><br>If circuits check good, check for missing 10 volt signal from ESC. |

**Table 234 Fuel Level Sensor Tests (2 pin pump) (cont.)**

| | | |
|---|---|---|
| (9101) cavity A to B. | 10 ± 1 volts | If voltage is present replace or repair fuel sensor.<br><br>If voltage is missing, check for open in circuits N9B, N9 or J9G to ESC connector (4004) cavity 26.<br><br>If circuits check good, check for missing zero volt reference from ESC. |
| **Fuel Level Sensor Resistance Checks**<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Resistance across full sensor should be 29–37 ohms when tank is full and 234–246 ohms when tank is empty. | | |

## 8.7. FUEL TRANSFER PUMP FAULT DETECTION MANAGEMENT (2 PIN PUMP)

**NOTE – Check for a mechanical sensor problem, such as a stuck sensor arm, before looking for electrical problems.**

A fault in the fuel transfer circuits will be apparent when the fuel transfer pump is not operating. Fuel levels in each tank will equalize when the pump is operating correctly.

Problems in fuel transfer pump circuits could be the result of a blown fuse, open circuits, shorted circuits, or a short in the fuel transfer pump module.

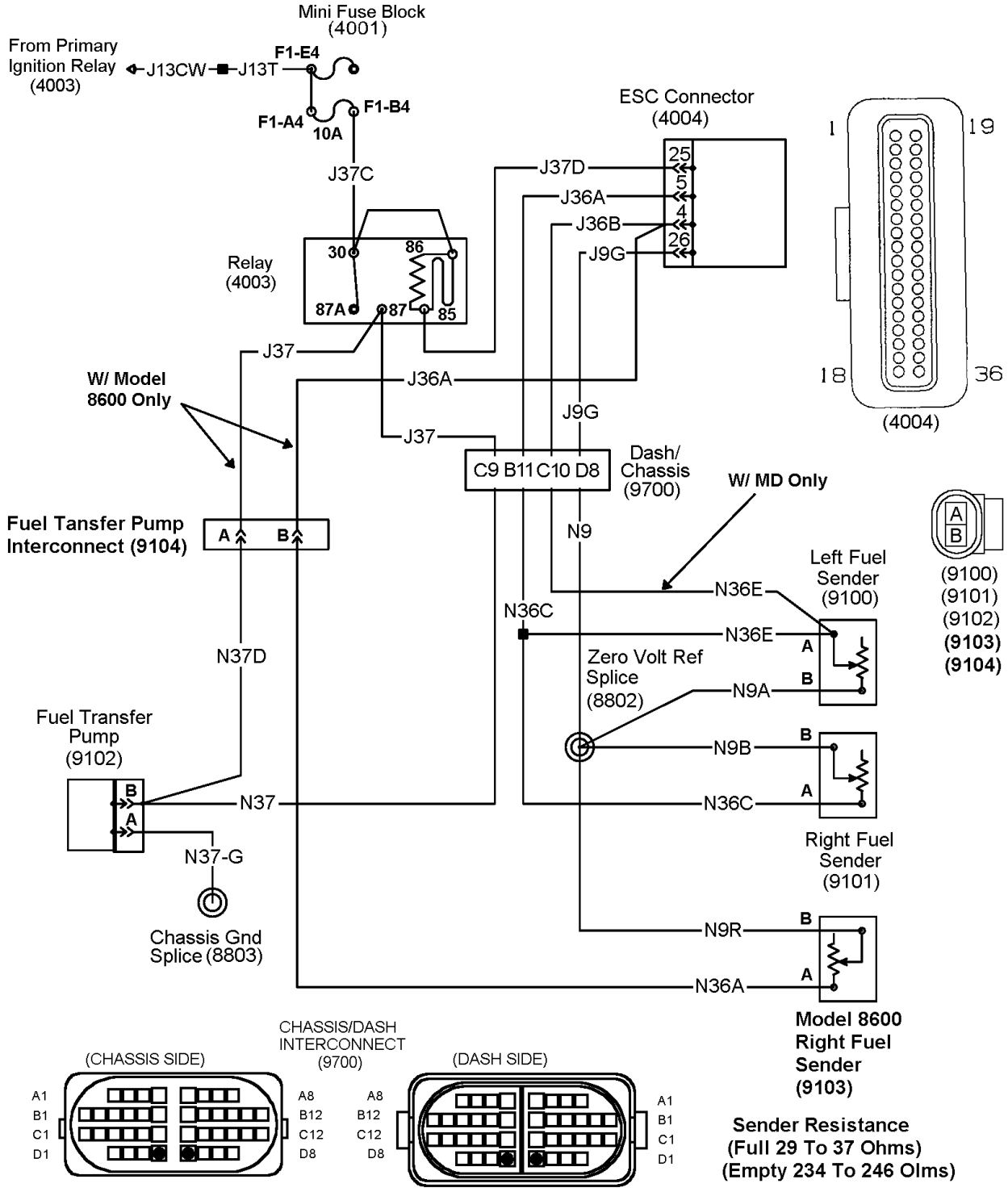



**Figure 343 Fuel Transfer Pump (2 pin pump) Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(8802) ZERO VOLT REFERENCE SPLICES
LOCATED NEAR POWER DISTRIBUTION CENTER
(8803) CHASSIS GROUND SPLICE
(9100) LEFT FUEL SENSOR
LOCATED ON LEFT FUEL TANK
(9101) RIGHT FUEL SENSOR
LOCATED ON RIGHT FUEL TANK
(9102) FUEL TRANSFER PUMP MODULE CONNECTOR
LOCATED ON FRAME RAIL NEAR RIGHT FUEL TANK
(9700) DASH/CHASSIS CONNECTOR

**Table 235 Fuel Transfer Pump Circuit Tests (2 pin pump)**

**Fuel Transfer Pump Voltage Checks**

Check for blown transfer pump fuse in engine compartment power distribution panel before performing checks.

Check with ignition on and transfer pump connector (9102) 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 |
|---|---|---|
| (9102) cavity B to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits N37, J37, J37C to relay (4003) and mini fuse block. |
| (9102) cavity B to cavity A. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits N37–G to ground connector (8803).<br><br>If voltage is present, Power circuits to fuel transfer pump are good. |
| With engine running, (9102) cavity B to ground. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J37, relay (4003), J37C or J37D to ESC connector (4004) terminal 25.<br><br>If all voltages are present, circuits to fuel transfer pump are good. Replace failed pump. |

**When replacing fuel transfer pump insure new pump is installed with the same orientation as the old pump. It is possible to install the pump backwards.**

The transfer pump pumps from left (driver side tank) to the right tank and is mounted above the right tank. A sticker with an arrow indicating flow direction will be on the pump. The words "in" and "out" are also stamped on appropriate ends of the pump.

## 8.8. EXTENDED DESCRIPTION (2 PIN PUMP)

Ignition voltage is supplied to fuel transfer pump connector (9102) cavity B from relay (4003) and a 10 amp fuse in the engine compartment power distribution center.

Chassis ground to the module is supplied to (9102) cavity A from ground stud (8803).

A gnd signal from the ESC connector (4004) pin 25 is supplied to (9102) cavity B energizes relay (4003). This signal should be 12 volts when the engine is running.

## 8.9. COMPONENT LOCATIONS

Refer to Fuel Transfer Pump Location.

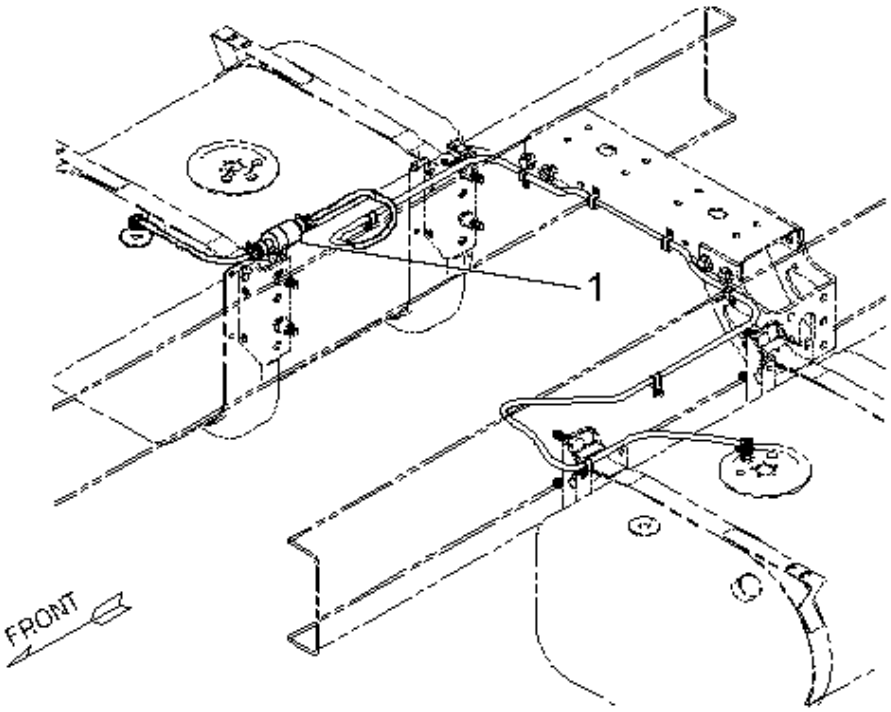



**Figure 344 Fuel Transfer Pump Location**

1. FUEL TRANSFER PUMP

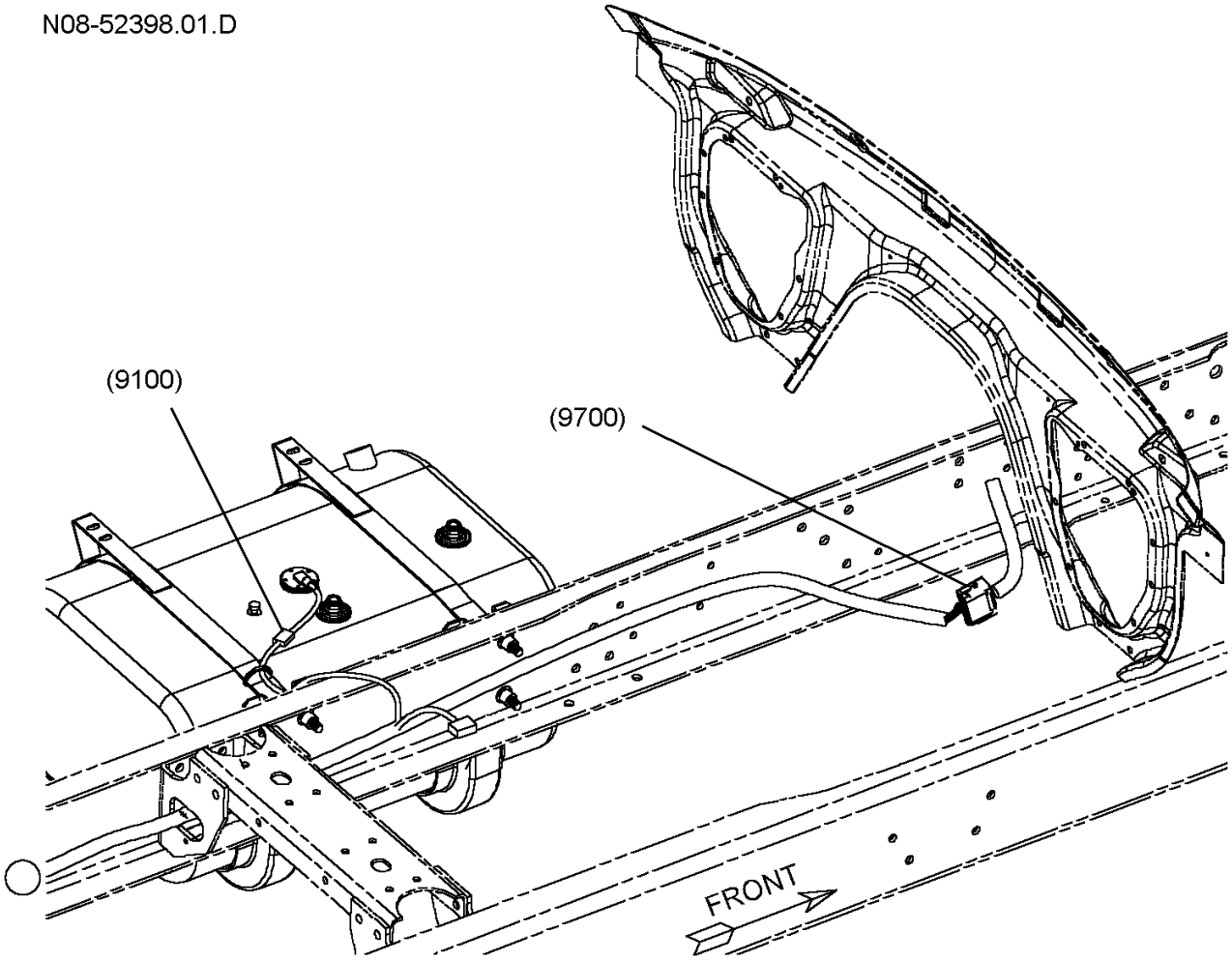



**Figure 345 Fuel Sensor Connector Locations**

(9100) FUEL LEVEL SENSOR CONNECTOR
(9700) REAR CHASSIS CONNECTOR

# 9. BODY ACCESSORY RELAY

## 9.1. CIRCUIT FUNCTIONS

The body accessory relay provides battery voltage to body builder lighting connector (4450) and (4450A). The relay is energized when the key is in the “ACCESSORY” or “IGNITION” positions.

## 9.2. DIAGNOSTICS

### Body Accessory Relay Preliminary Check

**Table 236 Body Accessory Relay Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify all body builder components connected to the body accessory relay (R3) are inoperative. | Check body builder components. | All body builder components are inoperative. | Go to next step. | Body builder components are operating or individual components are malfunctioning. |
| 2. | On | Determine if any other features are malfunctioning that may have common circuits. (Example: Missing ground common to several features.) | Visually check for other malfunctioning features. | No other features are malfunctioning. | Go to next step. | Identify and repair condition causing several features to be inoperative. |
| 3. | On | Go to Fault detection management. (See FAULT DETECTION MANAGEMENT, page 692) | | | | |

## 9.3. FAULT DETECTION MANAGEMENT

A fault in body accessory relay circuits will be apparent when all components connected to connector (4450A) cavity F are inoperative.

Problems in body accessory relay circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

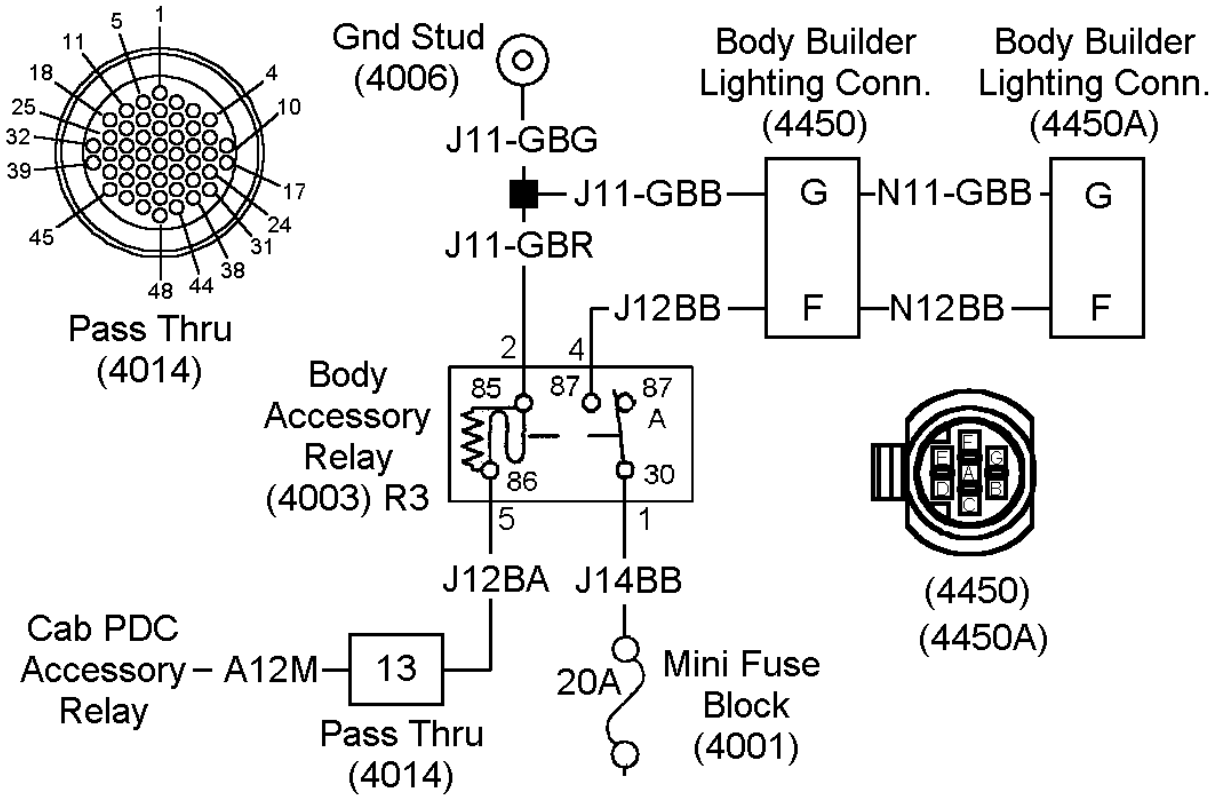



**Figure 346 Body Accessory Relay Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4003) R3 BODY ACCESSORY RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
(4450) BODY BUILDER LIGHTING CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4450A) BODY BUILDER LIGHTING CONNECTOR
LOCATED BACK OF CAB NEAR LEFT FRAME RAIL

**Table 237 Body Accessory Relay Circuit Tests**

| **Body Accessory Relay Input Circuit Tests** |
|---|
| Check for blown body accessory relay fuse in engine compartment power distribution panel before performing checks. |
| Check with ignition on and (4003) R3 body accessory relay removed. |
| Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29) |

**Table 237 Body Accessory Relay Circuit Tests (cont.)**

| **NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J14BB or open fuse. |
| Relay socket cavity 30 to cavity 85. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J11–GBR or J11-GBG to ground connector (4006). |
| Relay socket cavity 86 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J12BA or A12M to cab power distribution center accessory relay.<br><br>If all voltages are present, circuits to body accessory relay are good. |
| **Body Accessory Relay Output Circuit Tests**<br><br>Check for blown body accessory relay fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on, body builder lighting connector (4450A) disconnected and (4003) R3 body accessory relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Body builder lighting connector (4450A) cavity F to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J12BB or N12BB. |
| Body builder lighting connector (4450A) cavity F to cavity G. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J11–GBB or N12–GBB.<br><br>If voltage is present and body builder features are not operating troubleshoot circuits installed by body builder. |

## 9.4. EXTENDED DESCRIPTION

The common contact of the body accessory relay is supplied battery voltage from a 20 amp fuse in the engine compartment PDC.

Ground is supplied to one side of the relay coil from ground stud 4006.

Battery voltage is supplied to one side of the relay coil from the accessory relay in the cab PDC, when the key is in the accessory or ignition position. This energizes the relay.

Battery voltage from the normally open contact will be applied to cavity F of body builder lighting connector (4450A).

Ground for the body builder connector is supplied from ground stud (4006).

## 9.5. COMPONENT LOCATIONS

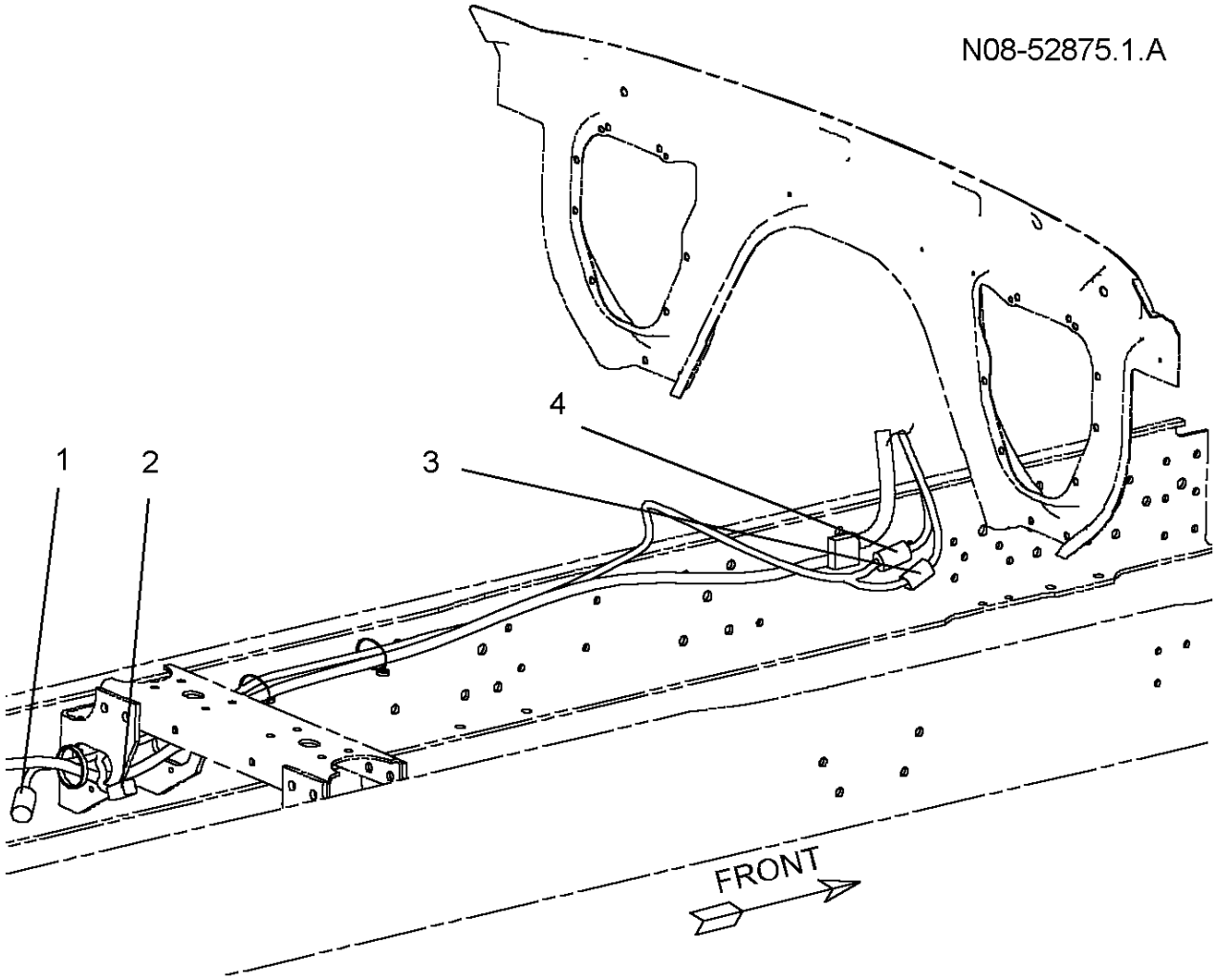



**Figure 347 Typical Body Builder Connector Location**

1. BODY BUILDER LIGHTING CONNECTOR (4450A)
2. BODY BUILDER TURN/STOP CONNECTOR (4460A)
3. BODY BUILDER TURN/STOP CONNECTOR (4460)
4. BODY BUILDER LIGHTING CONNECTOR (4450)

# 10. BODY, TRAILER MARKER AND TAIL LIGHT RELAY

## 10.1. CIRCUIT FUNCTIONS

When the park lights are turned on the ESC will energize the body, trailer marker and tail light relay. The energized relay provides battery voltage to body builder lighting connector (4450) and (4450A) and the trailer socket.

## 10.2. DIAGNOSTICS

A failure in the body, trailer marker and tail light relay circuits should be suspected when all of the body marker or trailer marker and tail lights are inoperative. The ESC will log a diagnostic trouble code when there is an overload, open or short to ground in the relay or the circuit between the ESC and the relay.

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

### Body, Trailer Marker and Tail Light Relay Preliminary Check

**Table 238 Body, Trailer Marker and Tail Light Relay Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify all body, trailer marker & tail lights are inoperative. | Check body, trailer marker & tail lights. | All body, trailer marker & tail lights are inoperative. | Go to next step. | Body, trailer marker & tail lights are operating or individual components are malfunctioning.<br><br>Check fuses and circuits to individual lights. |
| 2. | On | Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 696) | Read display on odometer. | Diagnostic trouble codes are active. | Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 697) | Go to next step. |
| 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 malfunctioning features. | No other features are malfunctioning. | Go to next step. | Identify and repair condition causing several features to be inoperative. |
| 4. | On | Go to Fault detection management. (See FAULT DETECTION MANAGEMENT, page 697) | | | | |

### 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 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 239 Body, Trailer Marker and Tail Light Relay Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 2033 14 6 1 | Trailer Marker Relay overloaded. Connector 4004 pin 17 current overload. To much load attached or defective relay. |
| 2033 14 6 2 | Trailer Marker Relay open circuit. Connector 4004 Pin 17 open. Open circuit or defective relay. |
| 2033 14 6 3 | Trailer Marker Relay shorted to ground. Connector 4004 Pin 17 shorted to ground. Shorted to ground or defective relay. |

## 10.3. FAULT DETECTION MANAGEMENT

A fault in the body, trailer marker and tail light relay circuits will be apparent when all body or trailer marker and tail lights are inoperative.

Problems in the body, trailer marker and tail light relay circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

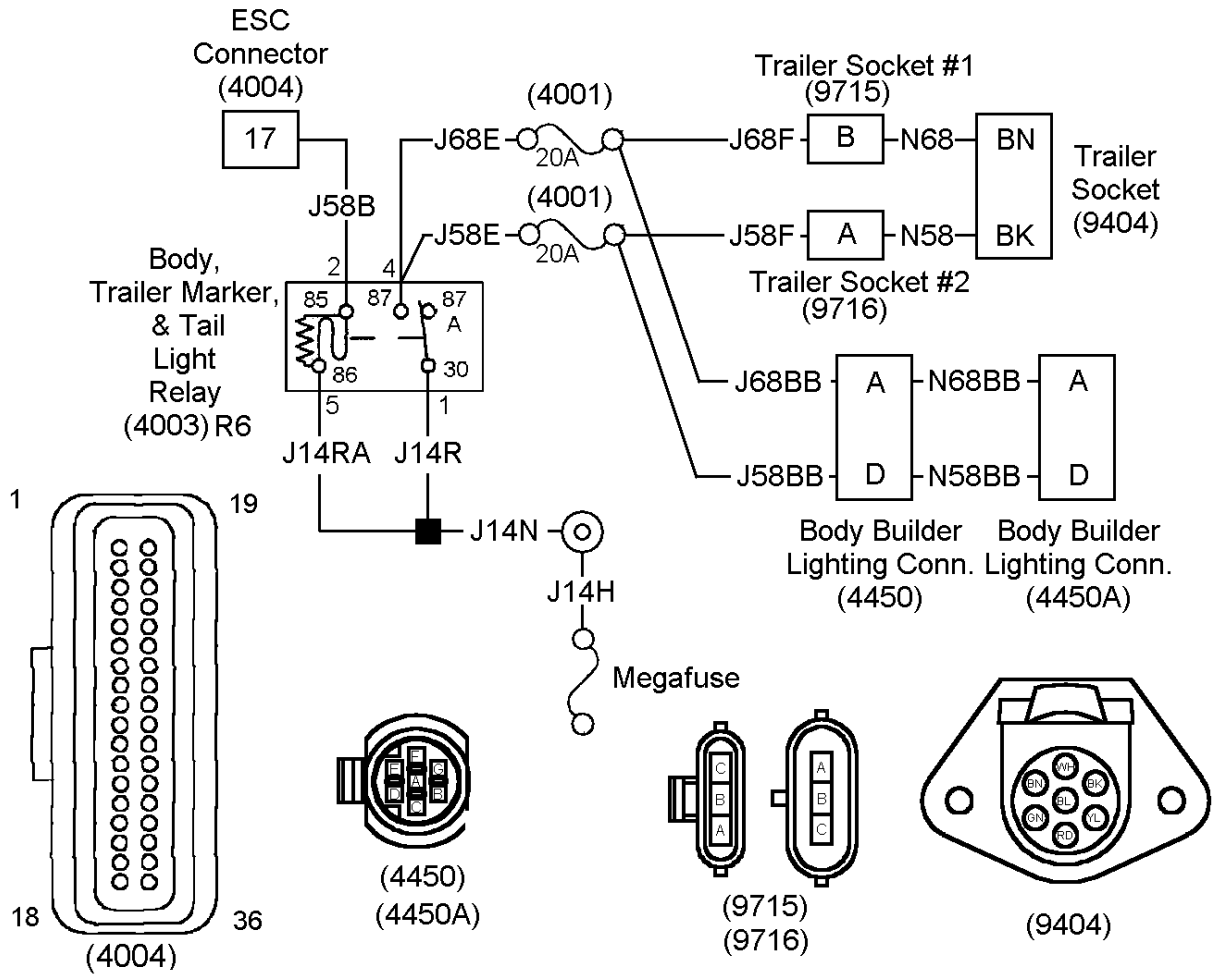



**Figure 348 Body, Trailer Marker and Tail Light Relay Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT PDC
(4003) R6 BODY, TRAILER MARKER & TAIL LIGHT RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4004) ESC CONNECTOR
LOCATED ON ESC
(4450) BODY BUILDER LIGHTING CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4450A) BODY BUILDER LIGHTING CONNECTOR
LOCATED BACK OF CAB NEAR LEFT FRAME RAIL
(9404) TRAILER SOCKET
LOCATED ON BACK OF CAB OR END OF FRAME
(9715) TRAILER SOCKET #1
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(9716) TRAILER SOCKET #2
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 240 Body, Trailer Marker and Tail Light Relay Circuit Tests**

| Body, Trailer Marker and Tail Light Relay Input Circuit Tests<br><br>Check for blown marker or tail light fuses in engine compartment power distribution panel before performing checks.<br><br>Check with park lights on and (4003) R6 body, trailer marker & tail light relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J14R, J14N or J14H to the megafuse. |
| Relay socket cavity 86 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J14RA. |
| Relay socket cavity 85 to ground. | 12 ± 1.5 volts with park lights on. | If voltage is missing, check for open in circuits J58B to ESC.<br><br>If circuit checks good, consider replacing the ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 123). |
| **Body Marker & Tail Light Relay Output Circuit Tests**<br><br>Check for blown marker or tail light fuses in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on, body builder lighting connector (4450A) disconnected and (4003) R6 body, trailer marker & tail light relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Body builder lighting connector (4450A) cavity A to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J86E, J68BB or N68BB.<br><br>If voltage is present and body builder tail lights are not operating troubleshoot circuits installed by body builder. |
| Body builder lighting connector (4450A) cavity D to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J58E, J58BB or N58BB.<br><br>If voltage is present and body builder features are not operating troubleshoot circuits installed by body builder. |

**Table 240 Body, Trailer Marker and Tail Light Relay Circuit Tests (cont.)**

| Trailer Marker & Tail Light Circuit Tests<br><br>Check for blown marker or tail light fuses in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on, trailer connector removed from trailer socket and (4003) R6 body, trailer marker & tail light relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Trailer socket connector (9404) brown cavity to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between trailer socket and relay.<br><br>If voltage is present and trailer tail lights are not operating troubleshoot trailer circuits. |
| Trailer socket connector (9404) black cavity to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between trailer socket and relay.<br><br>If voltage is present and trailer tail lights are not operating troubleshoot trailer circuits. |

## 10.4. COMPONENT LOCATIONS

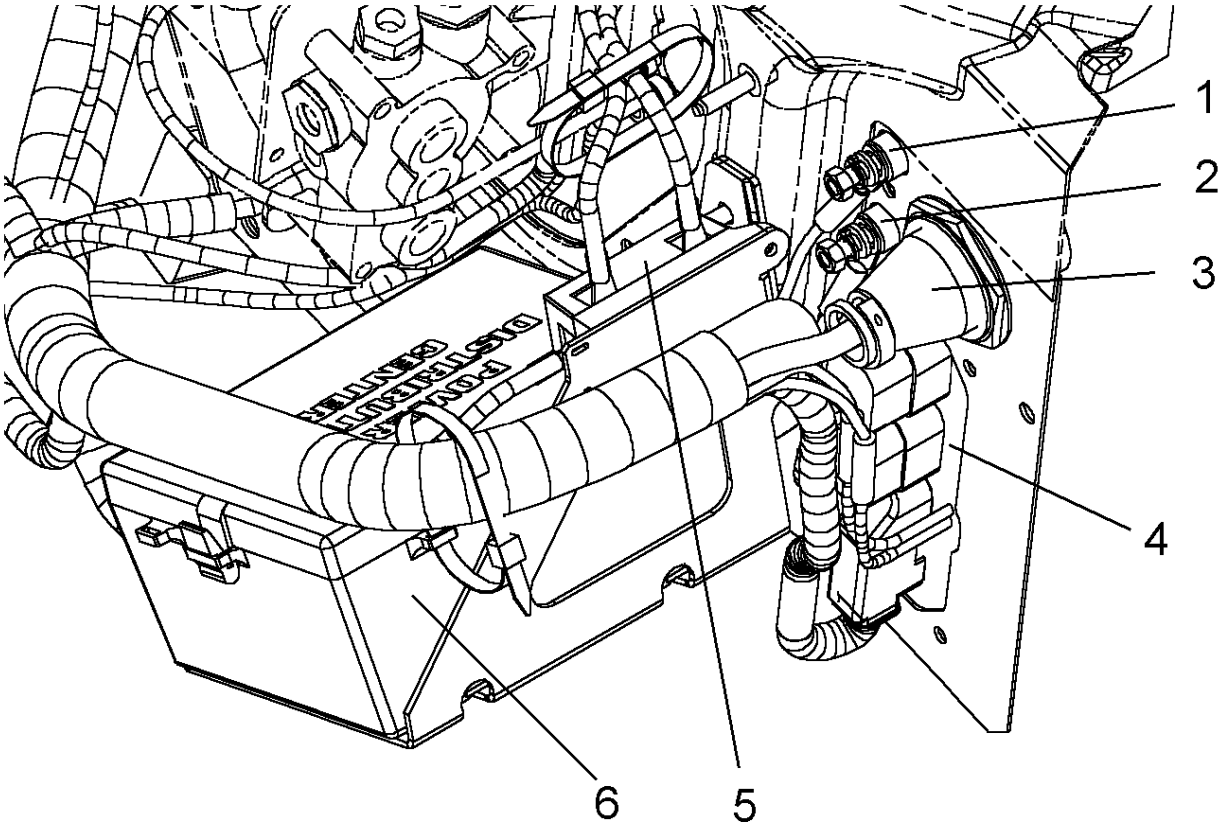



**Figure 349 Power Distribution Center (Viewed From Engine Compartment)**

1. GROUND STUD
2. GROUND STUD
3. (4014) PASS THROUGH CONNECTOR
4. ELECTRICAL SYSTEM CONTROLLER
5. MEGAFUSE
6. POWER DISTRIBUTION CENTER

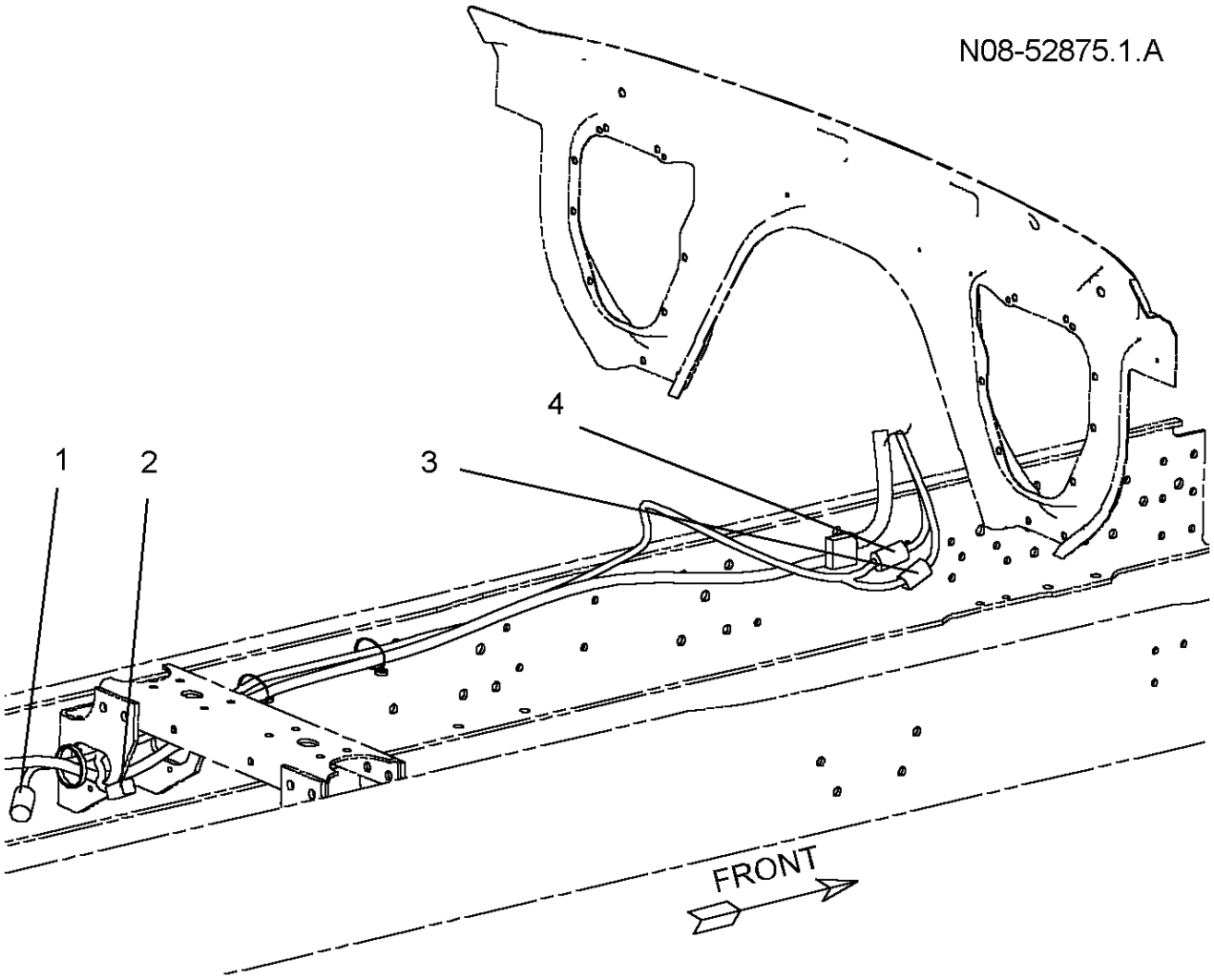



**Figure 350 Typical Body Builder Connector Location**

1. BODY BUILDER LIGHTING CONNECTOR (4450A)
2. BODY BUILDER TURN/STOP CONNECTOR (4460A)
3. BODY BUILDER TURN/STOP CONNECTOR (4460)
4. BODY BUILDER LIGHTING CONNECTOR (4450)

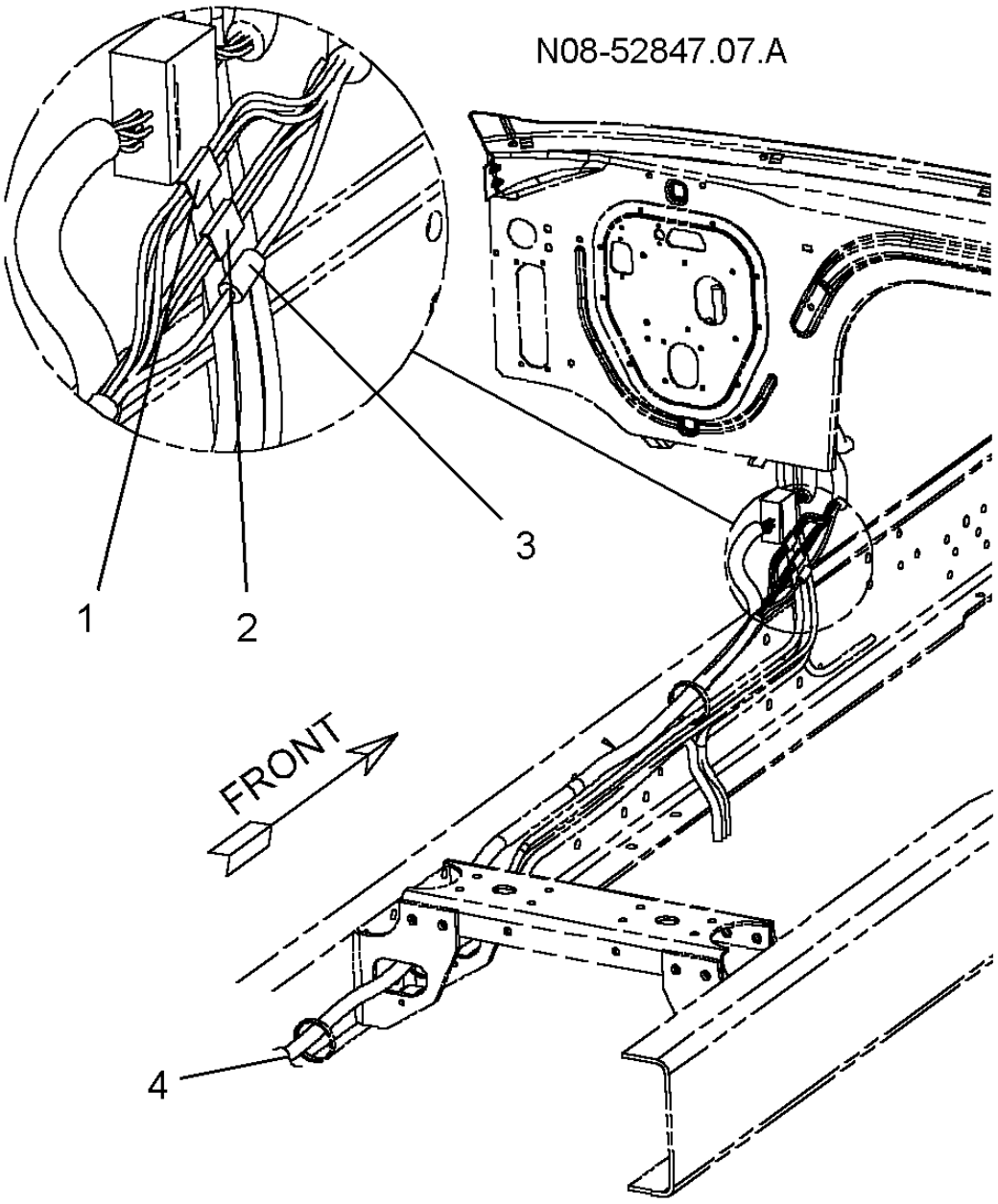



**Figure 351 Typical Trailer Socket Connector Location**

1. TRAILER SOCKET #1 (9715)
2. TRAILER SOCKET #2 (9716)
3. TRAILER SOCKET GROUND (9717)
4. HARNESS TO TRAILER SOCKET

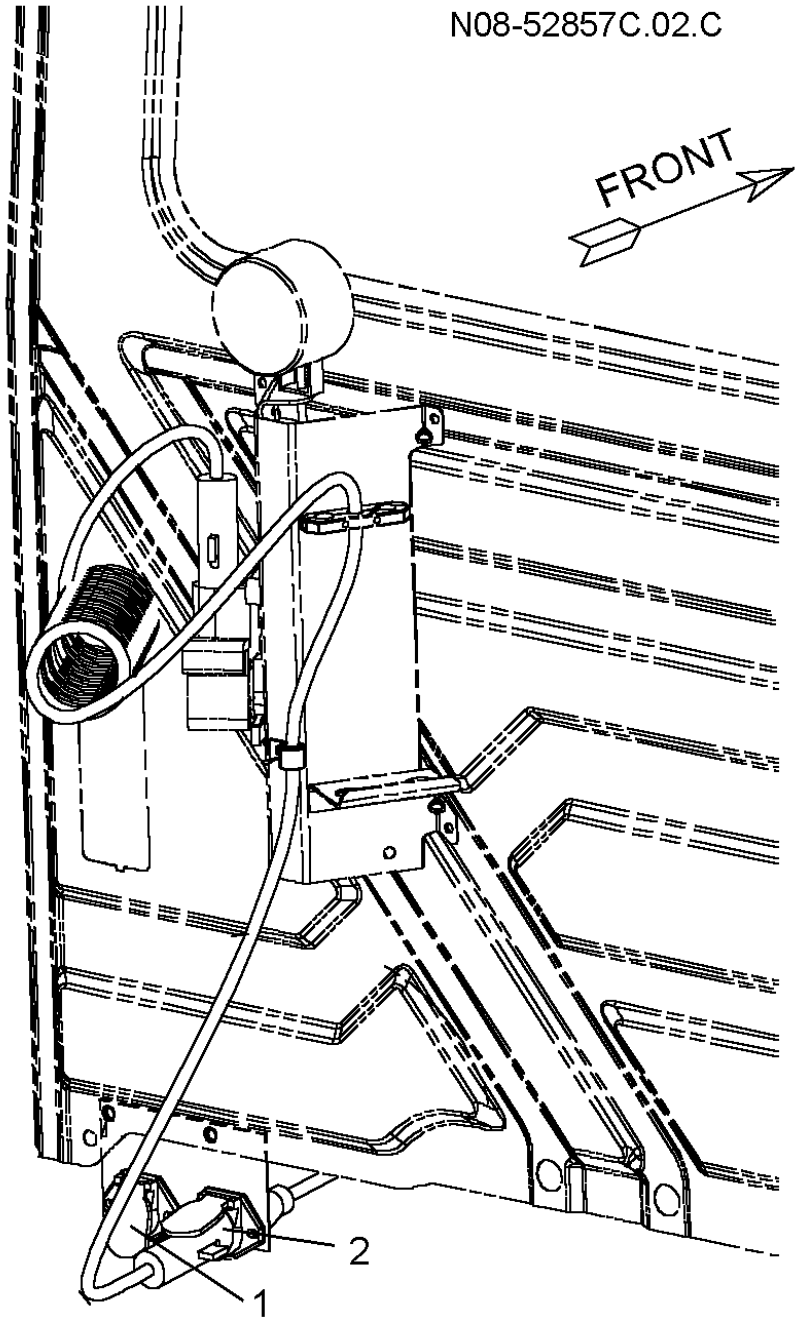



**Figure 352 Typical Trailer Socket Connector Location (Back of Cab)**

1. AUXILIARY TRAILER SOCKET
2. TRAILER SOCKET

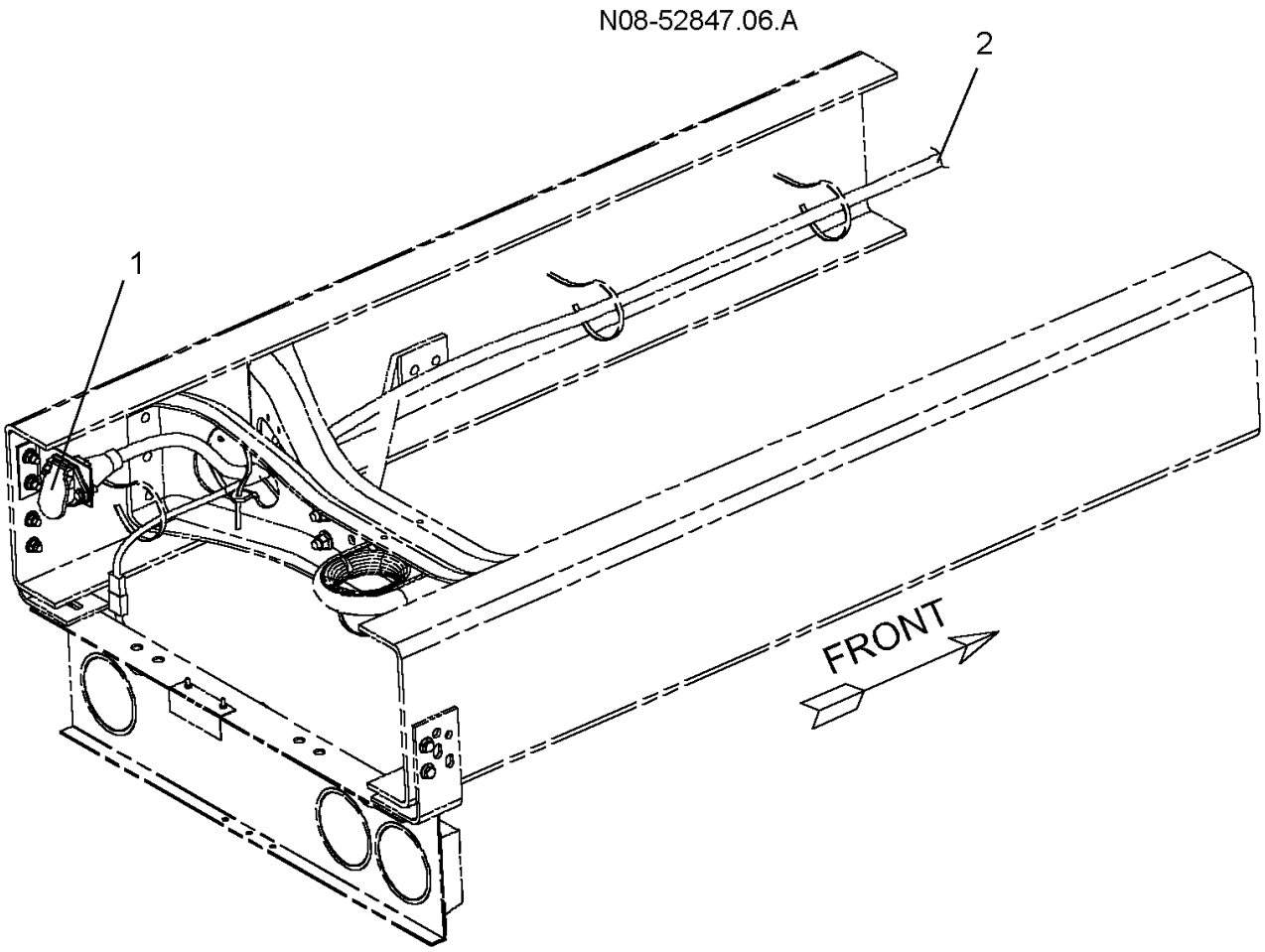



**Figure 353 Typical Trailer Socket Connector Location (End of Frame)**

1. TRAILER SOCKET
2. HARNESS TO TRAILER SOCKET CONNECTORS

# 11. BODY AND TRAILER STOP LIGHT RELAY

## 11.1. CIRCUIT FUNCTIONS

When the brake pedal is applied a signal from the ESC will energize the body and trailer stop light relay. The energized relay provides battery voltage to body builder turn/stop connector (4460) and (4460A) and the trailer socket.

## 11.2. DIAGNOSTICS

A failure in the body and trailer stop light relay circuits should be suspected when all of the body stop lights or trailer stop lights are inoperative. The ESC will log a diagnostic trouble code when there is an overload, open or short to ground in the relay or the circuit between the ESC and the relay.

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

## Body And Trailer Stop Light Relay Preliminary Check

**Table 241 Body And Trailer Stop Light Relay Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify all body and trailer stop lights are inoperative. | Check body and trailer stop lights. | All body and trailer stop lights are inoperative. | Go to next step. | Body and trailer stop lights are operating or individual components are malfunctioning.<br><br>Check fuses and circuits to individual lights. |
| 2. | On | Check for diagnostic trouble codes. (See Diagnostic Trouble Codes, page 706) | Read display on odometer. | Diagnostic trouble codes are active. | Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 707) | Go to next step. |
| 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 malfunctioning features. | No other features are malfunctioning. | Go to next step. | Identify and repair condition causing several features to be inoperative. |
| 4. | On | Go to Fault detection management. (See FAULT DETECTION MANAGEMENT, page 707) | | | | |

## 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 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 242 Body And Trailer Stop Light Relay Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 2033 14 9 1 | Body and trailer stop light relay overloaded. Connector 4004 pin 21 current overload. To much load attached or defective relay. |

**Table 242 Body And Trailer Stop Light Relay Diagnostic Trouble Codes (cont.)**

| | |
|---|---|
| 2033 14 9 2 | Body and trailer stop light relay open circuit. Connector 4004 Pin 21 open. Open circuit or defective relay. |
| 2033 14 9 3 | Body and trailer stop light relay shorted to ground. Connector 4004 Pin 21 shorted to ground. Shorted to ground or defective relay. |

## 11.3. FAULT DETECTION MANAGEMENT

A fault in the body and trailer stop light relay circuits will be apparent when all body or trailer marker and tail lights are inoperative.

Problems in the body and trailer stop light relay circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

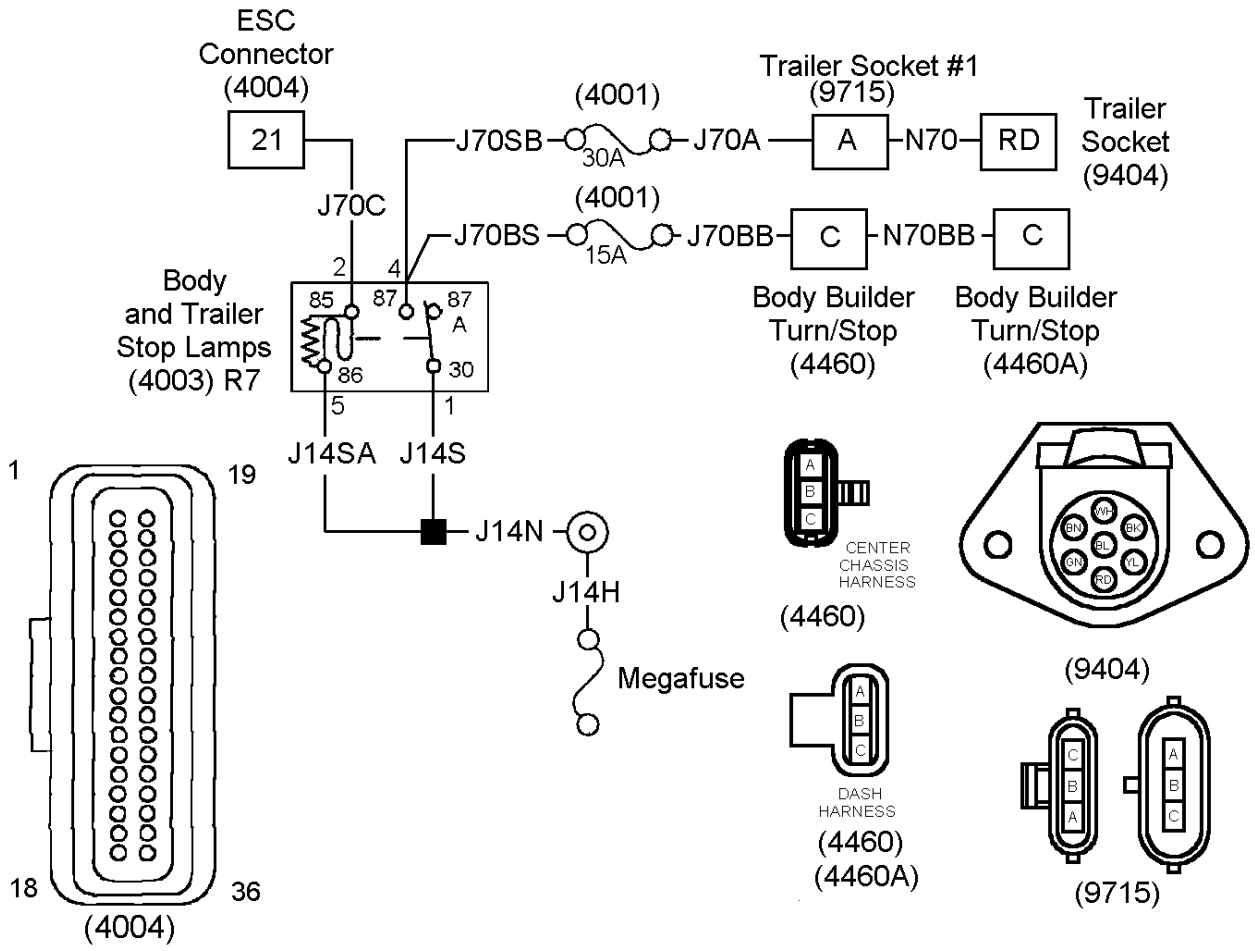



**Figure 354 Body And Trailer Stop Light Relay Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT PDC
(4003) R7 BODY AND TRAILER STOP LIGHT RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4004) ESC CONNECTOR
LOCATED ON ESC
(4460) BODY BUILDER TURN/STOP CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4460A) BODY BUILDER TURN/STOP CONNECTOR
LOCATED BACK OF CAB NEAR LEFT FRAME RAIL
(9404) TRAILER SOCKET
LOCATED ON BACK OF CAB OR END OF FRAME
(9715) TRAILER SOCKET #1
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 243 Body And Trailer Stop Light Relay Circuit Tests**

| Body And Trailer Stop Light Relay Input Circuit Tests<br><br>Check for blown body stop or trailer stop fuses in engine compartment power distribution panel before performing checks.<br><br>Check with brake applied and (4003) R7 body and trailer stop light relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J14S, J14N or J14H to the megafuse. |
| Relay socket cavity 86 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J14SA. |
| Relay socket cavity 85 to ground. | 12 ± 1.5 volts with brake applied. | If voltage is missing, check for open in circuits J70C to ESC.<br><br>If circuit checks good, consider replacing the ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 123). |
| **Body Stop Light Relay Output Circuit Tests**<br><br>Check for blown body builder turn/stop fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on, body builder turn/stop connector (4460A) disconnected and (4003) R7 body and trailer stop light relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Body builder lighting connector (4460A) cavity C to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J70BS, J70BB or N70BB.<br><br>If voltage is present and body builder tail lights are not operating troubleshoot circuits installed by body builder. |

**Table 243 Body And Trailer Stop Light Relay Circuit Tests (cont.)**

| Trailer Stop Light Circuit Tests<br><br>Check for blown marker or tail light fuses in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on, trailer connector removed from trailer socket and (4003) R7 body and trailer stop light relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Trailer socket connector (9404) red to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits between trailer socket and relay.<br><br>If voltage is present and trailer stoplights are not operating troubleshoot trailer circuits. |

## 11.4. COMPONENT LOCATIONS

Refer to Power Distribution Center. (See Figure 349, page 701)

Refer to Typical Body builder Connector Location. (See Figure 350, page 702)

Refer to Typical Trailer Socket Connector Location. (See Figure 351, page 703)

Refer to Typical Trailer Socket Connector Location (Back of Cab). (See Figure 352, page 704)

Refer to Typical Trailer Socket Connector Location (End of Frame). (See Figure 353, page 705)

# 12. TRAILER LEFT TURN RELAY

## 12.1. CIRCUIT FUNCTIONS

The trailer left turn relay is energized, when the left turn signal is activated, by a left turn signal from the ESC. Depending on the configuration of the vehicle, this may be the combined turn/stop signal or the standard turn only signal. The energized relay provides battery voltage to the trailer socket left turn “yellow” cavity.

## 12.2. DIAGNOSTICS

A failure in the left turn relay circuits should be suspected when trailer left turn lights are inoperative and all other vehicle left turn signals are working correctly. The ESC will log a diagnostic trouble code (DTC) when there is an overload or short to ground in any of the left turn signal circuits connected to the ESC (this includes circuits to the relay). A DTC will also be set for an open circuit between the ESC and the left turn splice pack.

The "INTUNE" diagnostic software can be used to monitor the status of the left turn signal to the relay and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

### Trailer Left Turn Relay Preliminary Check

**Table 244 Trailer Left Turn Relay Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify trailer left turn lights are inoperative. | Check trailer left turn lights. | Trailer left turn lights are inoperative. | Go to next step. | Trailer Left Turn lights are operating. |
| 2. | On | Are all other vehicle left turn lights operating. | Check vehicle left turn lights. | Vehicle left turn lights are working. | Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 711) | Go to the Truck Stop/ Turn Signal/ Hazard Light section of this manual. (See TRUCK STOP/TURN SIGNAL/HAZARD LIGHT, page 884) |

## 12.3. FAULT DETECTION MANAGEMENT

A fault in the trailer left turn relay circuits will be apparent when the trailer left turn lamp is inoperative, the vehicle left turn lights are working and the trailer bulb is not burned out.

Problems in the body and trailer stop light relay circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

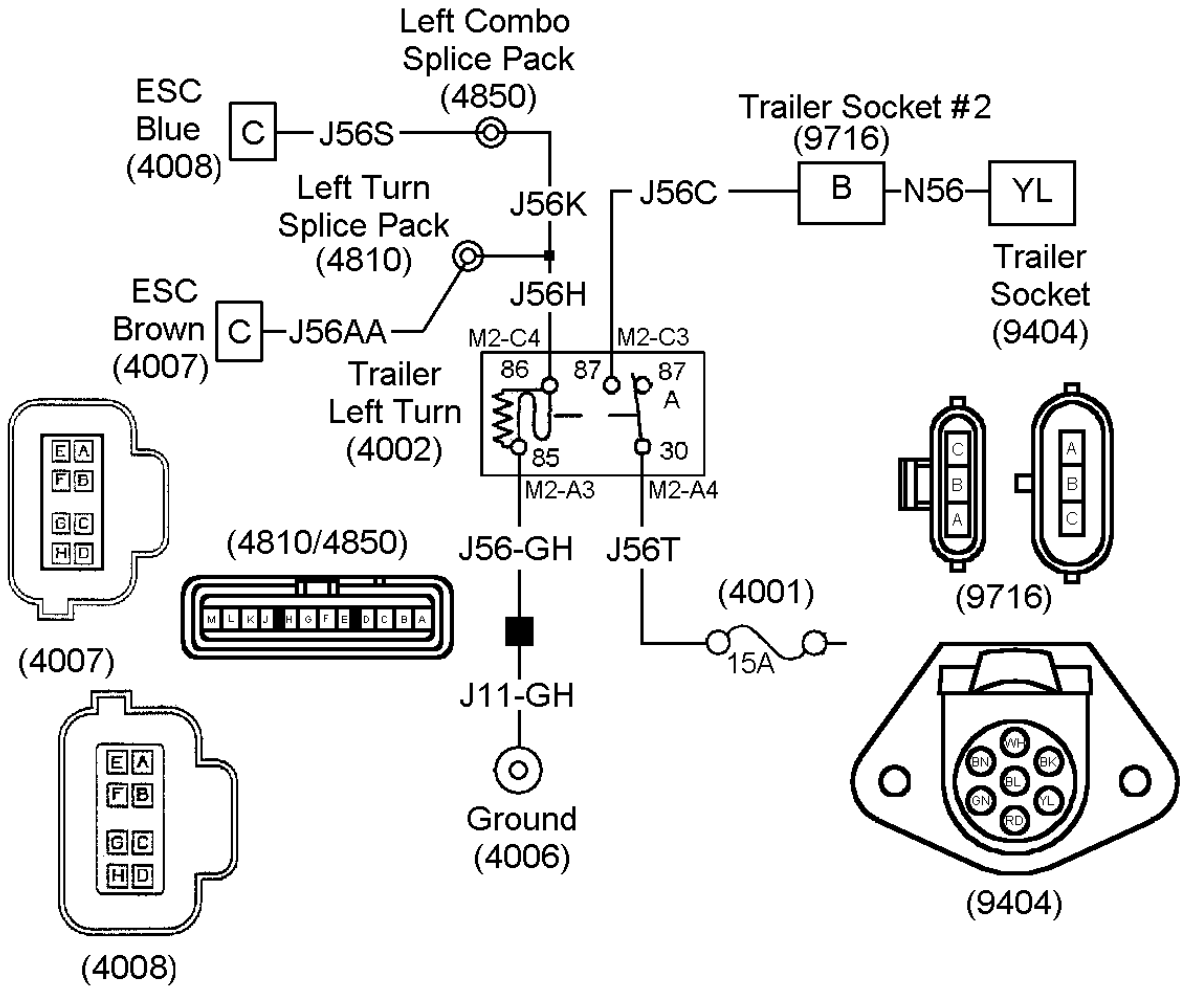



**Figure 355 Trailer Left Turn Relay Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT PDC
(4002) BODY AND TRAILER STOP LIGHT RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4007) BROWN ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4810) LEFT TURN SPLICE PACK
LOCATED NEAR ENGINE COMPARTMENT PDC
(4850) LEFT COMBO TURN STOP SPLICE PACK
LOCATED NEAR ENGINE COMPARTMENT PDC
(9404) TRAILER SOCKET
LOCATED ON BACK OF CAB OR END OF FRAME
(9716) TRAILER SOCKET #2
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 245 Trailer Left Turn Relay Circuit Tests**

| **Trailer Left Turn Relay Input Circuit Tests**<br><br>Check for blown Trailer Left Turn Relay fuses in engine compartment power distribution panel before performing checks.<br><br>Check with left turn signal on and trailer left turn relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J56T to the trailer left turn relay fuse. |
| Relay socket cavity 30 to 85. | 12 ± 1.5 volts | If voltage is missing, check for open in circuit J56–GHT or J11–GH to ground stud (4006). |
| Relay socket cavity 86 to ground. | Switching from 12 ± 1.5 volts to 0 volts. | If voltage is missing, check for open or shorts in circuit J56H or J56K to left turn splice pack or left combo turn stop splice. |
| **Trailer Left Turn Relay Output Circuit Tests**<br><br>Check for blown trailer left turn relay fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on and trailer left turn relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Trailer socket Yellow connector to ground. | Switching from 12 ± 1.5 volts to volts. | If voltage is missing, check for open or shorts in circuits J56C, N56A, N56B or N56.<br><br>If voltage is present trailer left turn circuits are operating correctly. |

## 12.4. COMPONENT LOCATIONS

Refer to Power Distribution Center. (See Figure 349, page 701)

Refer to Typical Body builder Connector Location. (See Figure 350, page 702)

Refer to Typical Trailer Socket Connector Location. (See Figure 351, page 703)

Refer to Typical Trailer Socket Connector Location (Back of Cab). (See Figure 352, page 704)

Refer to Typical Trailer Socket Connector Location (End of Frame). (See Figure 353, page 705)

# 13. TRAILER RIGHT TURN RELAY

## 13.1. CIRCUIT FUNCTIONS

When the right turn signal is activated the ESC will energize the trailer right turn relay. Depending on the configuration of the vehicle, this may be the combined turn/stop signal or the standard turn only signal. The energized relay provides battery voltage to the trailer socket right turn “green” cavity.

## 13.2. DIAGNOSTICS

A failure in the right turn relay circuits should be suspected when trailer right turn lights are inoperative and all other vehicle right turn signals are working correctly. The ESC will log a diagnostic trouble code (DTC) when there is an overload or short to ground in any of the right turn signal circuits connected to the ESC (this includes circuits to the relay). A DTC will also be set for an open circuit between the ESC and the right turn splice pack.

The "INTUNE" diagnostic software can be used to monitor the status of the right turn signal to the relay and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

### Trailer Right Turn Relay Preliminary Check

**Table 246 Trailer Right Turn Relay Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify trailer right turn lights are inoperative. | Check trailer right turn lights. | Trailer right turn lights are inoperative. | Go to next step. | Trailer Right Turn lights are operating. |
| 2. | On | Are all other vehicle right turn lights operating. | Check vehicle right turn lights. | Vehicle right turn lights are working. | Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 714) | Go to the Truck Stop/ Turn Signal/ Hazard Light section of this manual. (See TRUCK STOP/TURN SIGNAL/HAZARD LIGHT, page 884) |

## 13.3. FAULT DETECTION MANAGEMENT

A fault in the trailer right turn relay circuits will be apparent when the trailer right turn lamp is inoperative, the vehicle right turn lights are working and the trailer bulb is not burned out.

Problems in the body and trailer stop light relay circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

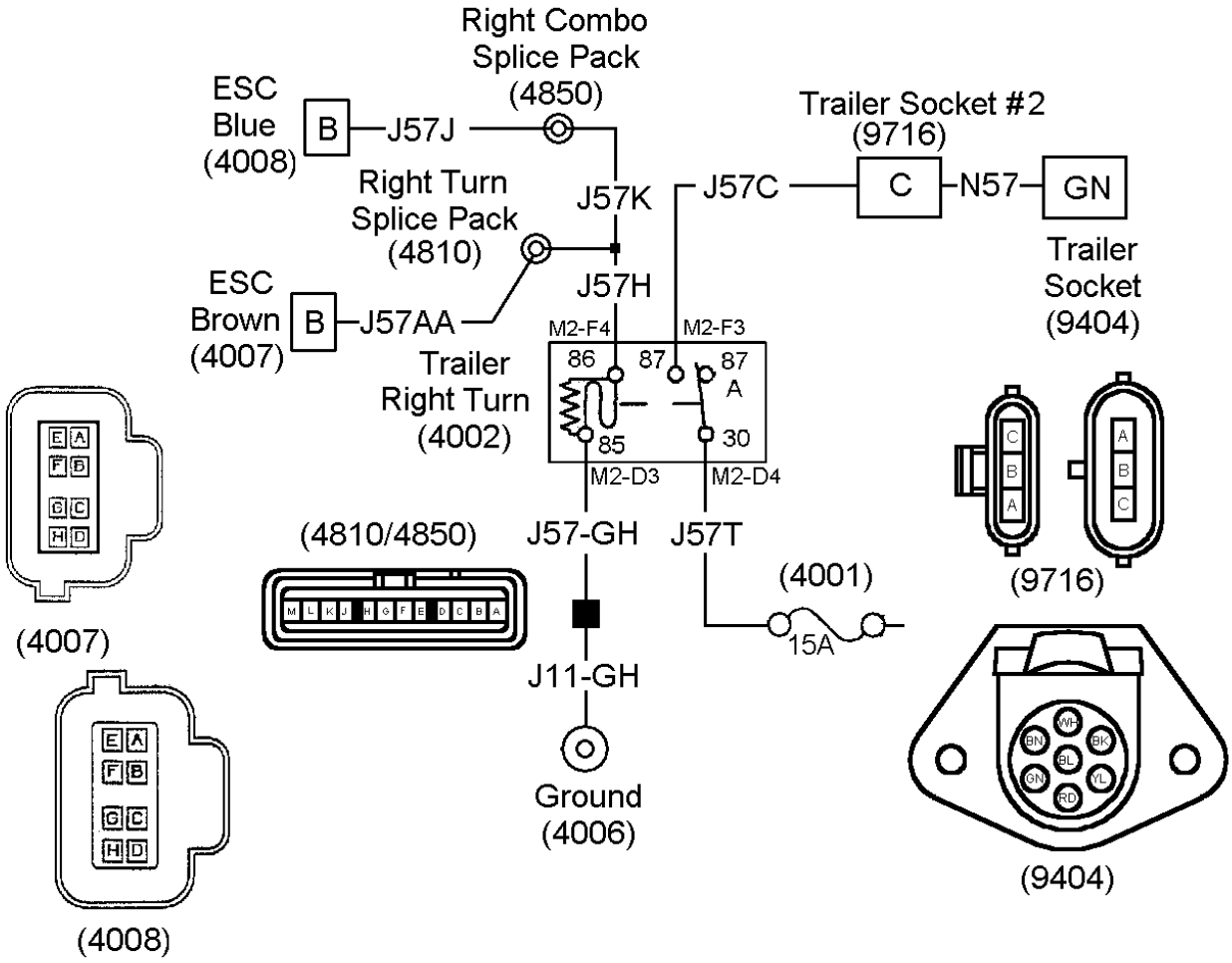



**Figure 356 Trailer Right Turn Relay Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT PDC
(4002) BODY AND TRAILER STOP LIGHT RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4007) BROWN ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4810) RIGHT TURN SPLICE PACK
LOCATED NEAR ENGINE COMPARTMENT PDC
(4850) RIGHT COMBO TURN STOP SPLICE PACK
LOCATED NEAR ENGINE COMPARTMENT PDC
(9404) TRAILER SOCKET
LOCATED ON BACK OF CAB OR END OF FRAME
(9716) TRAILER SOCKET #2
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 247 Trailer Right Turn Relay Circuit Tests**

| Trailer Right Turn Relay Input Circuit Tests<br><br>Check for blown Trailer Right Turn Relay fuses in engine compartment power distribution panel before performing checks.<br><br>Check with right turn signal on and trailer right turn relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J57T to the trailer right turn relay fuse. |
| Relay socket cavity 30 to 85. | 12 ± 1.5 volts | If voltage is missing, check for open in circuit J57–GHT or J11–GH to ground stud (4006). |
| Relay socket cavity 86 to ground. | Switching from 12 ± 1.5 volts to 0 volts. | If voltage is missing, check for open or shorts in circuit J57H or J57K to right turn splice pack or right combo turn stop splice. |
| **Trailer Right Turn Relay Output Circuit Tests**<br><br>Check for blown trailer right turn relay fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on and trailer right turn relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Trailer socket Green connector to ground. | Switching from 12 ± 1.5 volts to 0 volts. | If voltage is missing, check for open or shorts in circuits J57C, N57A, N57B or N57.<br><br>If voltage is present trailer right turn circuits are operating correctly. |

## 13.4. COMPONENT LOCATIONS

Refer to Power Distribution Center. (See Figure 349, page 701)

Refer to Typical Body builder Connector Location. (See Figure 350, page 702)

Refer to Typical Trailer Socket Connector Location. (See Figure 351, page 703)

Refer to Typical Trailer Socket Connector Location (Back of Cab). (See Figure 352, page 704)

Refer to Typical Trailer Socket Connector Location (End of Frame). (See Figure 353, page 705)

# 14. TRAILER AUXILIARY POWER CIRCUITS

## 14.1. CIRCUIT FUNCTIONS

The trailer auxiliary center pin relay provides battery voltage to the auxiliary trailer socket to provide power for trailer accessories. The relay is energized when the auxiliary trailer switch mounted in the dash panel is turned on.

## 14.2. DIAGNOSTICS

### Trailer Auxiliary Power Circuits Preliminary Check

**Table 248 Trailer Auxiliary Power Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | With key on and trailer auxiliary switch on check voltage at auxiliary trailer socket, blue (center pin) connector. | Check auxiliary trailer socket, blue connector. | Battery voltage should be available at blue connector. | Trailer auxiliary circuits are working. | Go to next step. |
| 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 Fault detection management. (See FAULT DETECTION MANAGEMENT, page 717) | | | | |

## 14.3. FAULT DETECTION MANAGEMENT

A fault in trailer auxiliary power circuits will be apparent if battery power is not available at the blue connector when the key is on and the trailer auxiliary power switch is on.

Problems in trailer auxiliary power circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

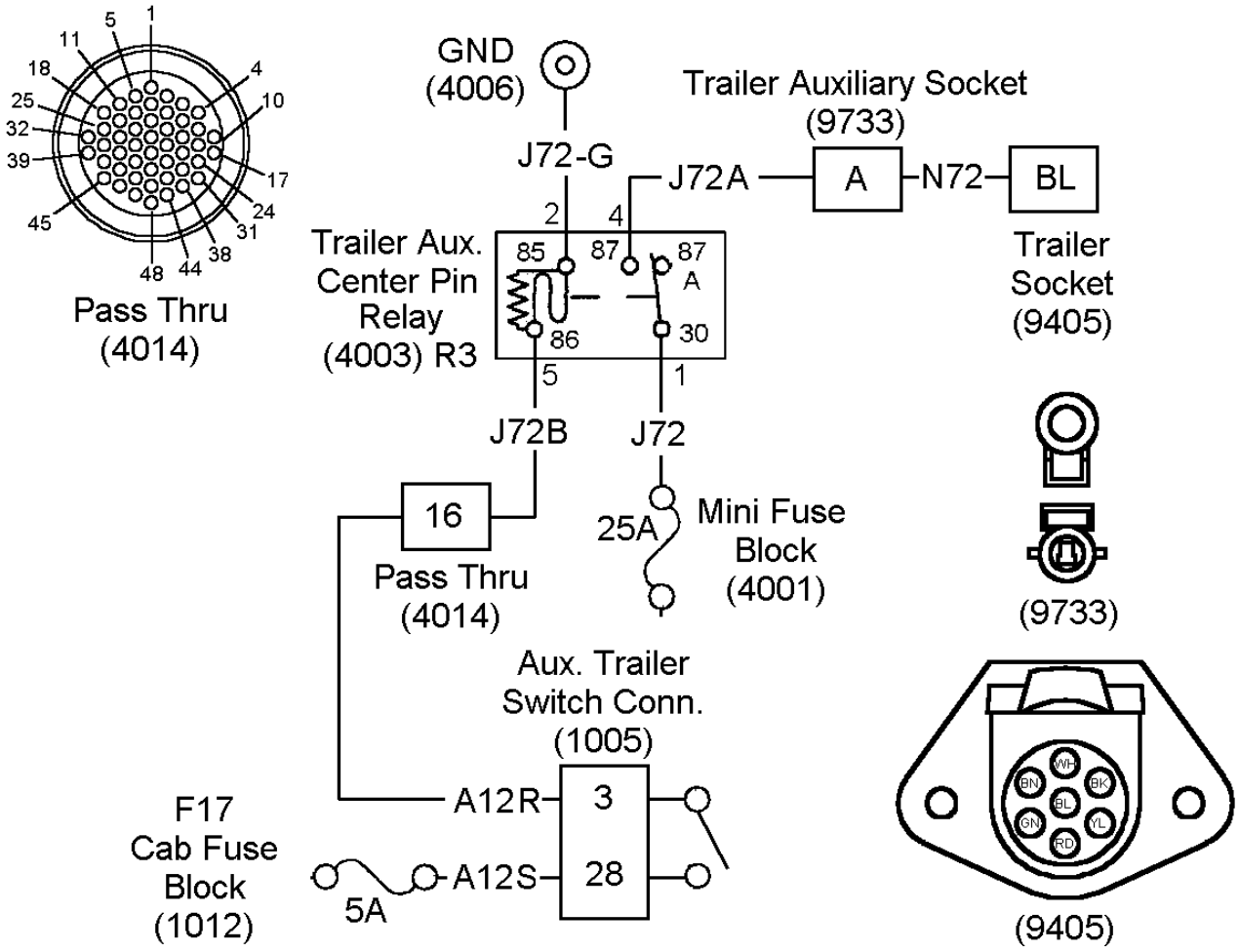



**Figure 357 Trailer Auxiliary Power Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(1005) AUXILIARY TRAILER SWITCH
LOCATED ON INSTRUMENT PANEL
(1012) F17 TRAILER/ROOF AUXILIARY FUSE
LOCATED IN CAB POWER DISTRIBUTION CENTER
(4001) MICRO FUSE PANEL
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) R3 TRAILER AUXILIARY CENTER PIN RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
(9733) TRAILER AUXILIARY SOCKET CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(9405) AUXILIARY TRAILER SOCKET
LOCATED ON END OF FRAME

**Table 249 Trailer Auxiliary Power Circuit Tests**

| Trailer Auxiliary Power Relay Circuit Tests<br><br>Check for blown trailer auxiliary power relay fuse in engine compartment power distribution panel or blown F17 in cab power distribution center before performing checks.<br><br>Check with ignition on, auxiliary trailer switch on and (4003) R3 trailer auxiliary relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J72 or open fuse. |
| Relay socket cavity 30 to cavity 85. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J72–G to ground connector (4006). |
| Relay socket cavity 86 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J72B or A12R to cab auxiliary power switch.<br><br>Also check power to switch and switch operation.<br><br>If all voltages are present, circuits to trailer auxiliary center pin relay are good. |
| **Trailer Auxiliary Center Pin Relay Output Circuit Tests**<br><br>Check for blown trailer auxiliary power relay fuse in engine compartment power distribution panel or blown F17 in cab power distribution center before performing checks.<br><br>Check with ignition on, auxiliary trailer switch on and (4003) R3 trailer auxiliary relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Auxiliary trailer socket center pin (blue) to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J72A or N72. |

## 14.4. EXTENDED DESCRIPTION

The common contact of the trailer auxiliary center pin relay is supplied battery voltage from a 25 amp fuse in the engine compartment PDC.

Ground is supplied to one side of the relay coil from ground stud 4006.

Battery voltage is supplied to one side of the relay coil from the auxiliary trailer power switch on the instrument panel, when the key is in the accessory or ignition position. This energizes the relay.

Battery voltage from the normally open contact will be applied to the center pin of the auxiliary trailer socket (9405).

Ground for the white trailer socket connector is supplied from ground stud (4006).

## 14.5. COMPONENT LOCATIONS

Refer to Power Distribution Center. (See Figure 349, page 701)

Refer to Typical Body builder Connector Location. (See Figure 350, page 702)

Refer to Typical Trailer Socket Connector Location. (See Figure 351, page 703)

Refer to Typical Trailer Socket Connector Location (Back of Cab). (See Figure 352, page 704)

Refer to Typical Trailer Socket Connector Location (End of Frame). (See Figure 353, page 705)

# 15. TRAILER ABS POWER

## 15.1. CIRCUIT FUNCTIONS

The Trailer ABS Center Pin relay provides battery voltage to the center pin of the trailer socket. The provides power for the trailer ABS module. The relay is energized when the key is in the “ACCESSORY” or “IGNITION” positions.

## 15.2. DIAGNOSTICS

### Trailer ABS Power Preliminary Check

**Table 250 Trailer ABS Power Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | With key on check voltage at trailer socket, blue (center pin) connector. | Check trailer socket, blue connector. | Battery voltage should be available at blue connector. | Trailer ABS power circuits are working. | Go to next step. |
| 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 Fault detection management. (See FAULT DETECTION MANAGEMENT, page 720) | | | | |

## 15.3. FAULT DETECTION MANAGEMENT

A fault in trailer ABS power circuits will be apparent when the trailer ABS warning lamp is on and the applicable code is set code is set by the air ABS ECU. Problems in the trailer ABS power circuits could be the result of a blown fuse, open circuits, shorted circuits, or a failed relay.

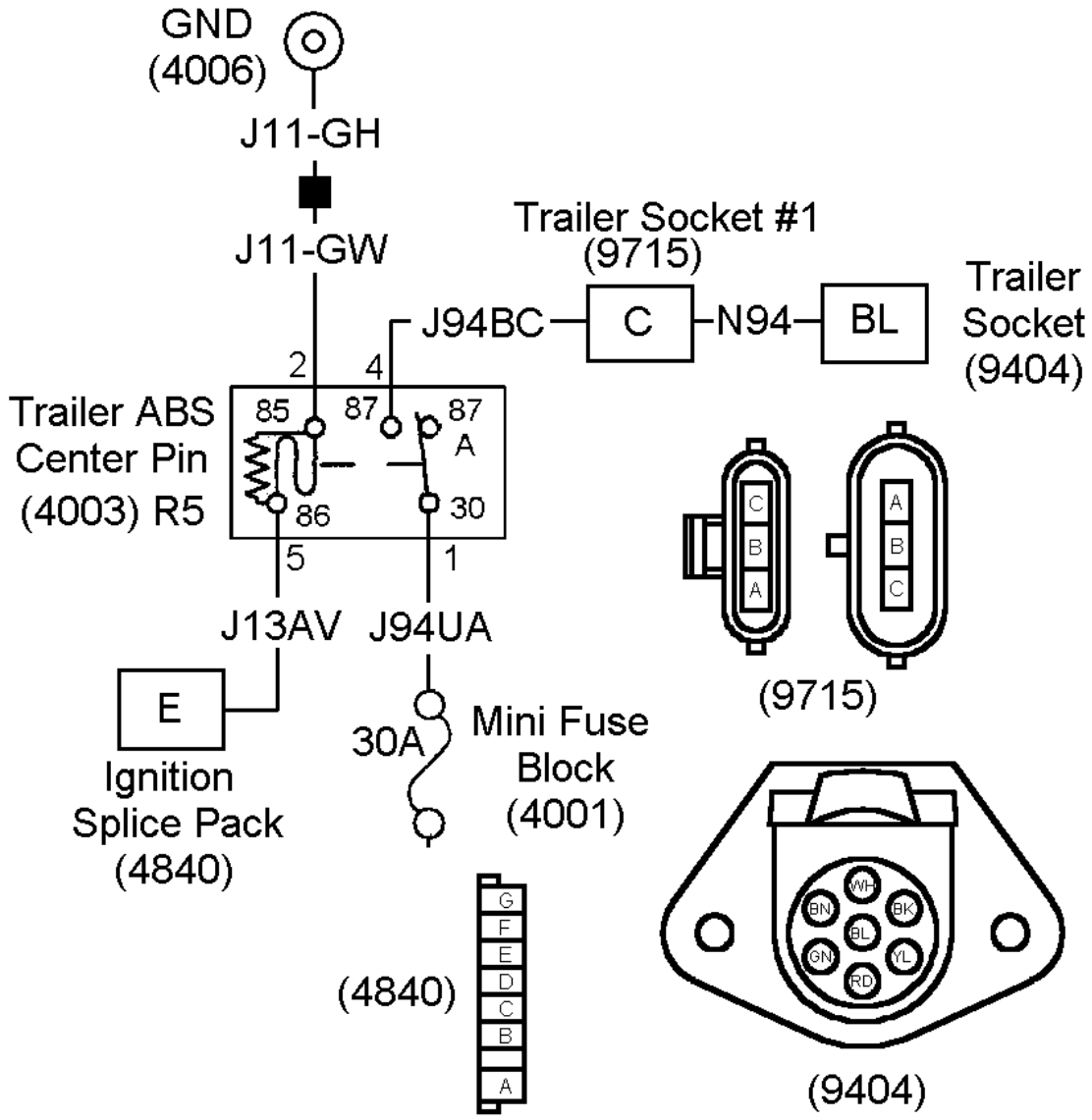



**Figure 358 Trailer ABS Power Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT PDC
(4003) R5 BODY TRAILER ABS CENTER PIN RELAY
LOCATED IN ENGINE COMPARTMENT PDC
(4006) GROUND STUD
LOCATED ABOVE ESC
(4840) RELAY COIL IGNITION SPLICE
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(9404) TRAILER SOCKET
LOCATED ON BACK OF CAB OR END OF FRAME
(9715) TRAILER SOCKET #1
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 251 Trailer ABS Power Circuit Tests**

| Trailer ABS Center Pin Relay Input Circuit Tests<br><br>Check for blown body accessory relay fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on and (4003) R5 trailer ABS center pin relay removed.<br><br>Bench check relay and replace if it has failed. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Relay socket cavity 30 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J94AU or open fuse. |
| Relay socket cavity 30 to cavity 85. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J11–GW or J11-GH to ground connector (4006). |
| Relay socket cavity 86 to ground. | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J13AV to ignition splice pack.<br><br>If all voltages are present, circuits to trailer ABS center pin relay are good. |
| **Trailer ABS Center Pin Relay Output Circuit Tests**<br><br>Check for blown trailer ABS center pin relay fuse in engine compartment power distribution panel before performing checks.<br><br>Check with ignition on and (4003) R5 trailer ABS center pin relay installed.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Test Points | Spec. | Comments |
| Trailer socket (9404) ABS center pin (blue) to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuits J94BC or N94. |

## 15.4. EXTENDED DESCRIPTION

The common contact of the trailer ABS center pin is supplied battery voltage from a 30 amp fuse in the engine compartment PDC.

Ground is supplied to one side of the relay coil from ground stud 4006.

Battery voltage is supplied to one side of the relay coil from the ignition splice pack in the engine compartment power distribution center, when the key is in the accessory or ignition position. This energizes the relay.

Battery voltage from the normally open contact will be applied to the center pin of the trailer socket.

Ground for the white connector of the trailer socket is supplied from ground stud (4006).

## 15.5. COMPONENT LOCATIONS

Refer to Power Distribution Center. (See Figure 349, page 701)

Refer to Typical Body builder Connector Location. (See Figure 350, page 702)

Refer to Typical Trailer Socket Connector Location. (See Figure 351, page 703)

Refer to Typical Trailer Socket Connector Location (Back of Cab). (See Figure 352, page 704)

Refer to Typical Trailer Socket Connector Location (End of Frame). (See Figure 353, page 705)

# 16. ESC– SOLENOID POWER CIRCUIT

## 16.1. CIRCUIT FUNCTIONS

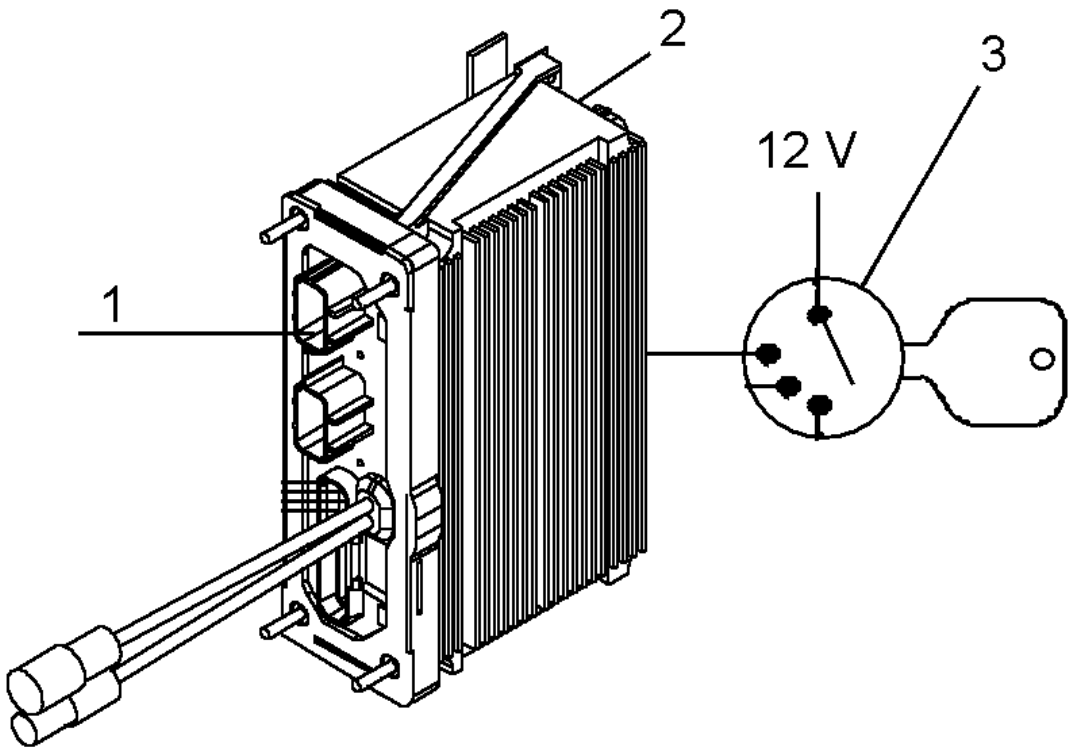



**Figure 359 Solenoid Power Function Diagram**

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.

## 16.2. 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 "INTUNE" 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 252 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. (See Diagnostic Trouble Codes (DTC), page 725) | 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 | Read display on odometer. | Solenoid power diagnostic | Go to Solenoid Power | Other DTC's are present. Go to the section on this |

**Table 252 Solenoid Power Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| | | Diagnostic Trouble Codes (DTC), page 731) | | trouble codes are present. | Circuits From ESC. (See SOLENOID POWER CIRCUITS FROM ESC, page 726) | 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 253 Solenoid Power Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 611 14 2 1 | Solenoid power under current<br><br>The current from this output is below 0.5 A<br><br>Open circuit |
| 611 14 2 2 | Solenoid power over current<br><br>The output behaves like a 20 amp type III circuit breaker<br><br>Short to ground or overload |
| 611 14 2 3 | Solenoid power less than normal low current but more than open circuit |
| 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 |

## 16.3. 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 "INTUNE" 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.

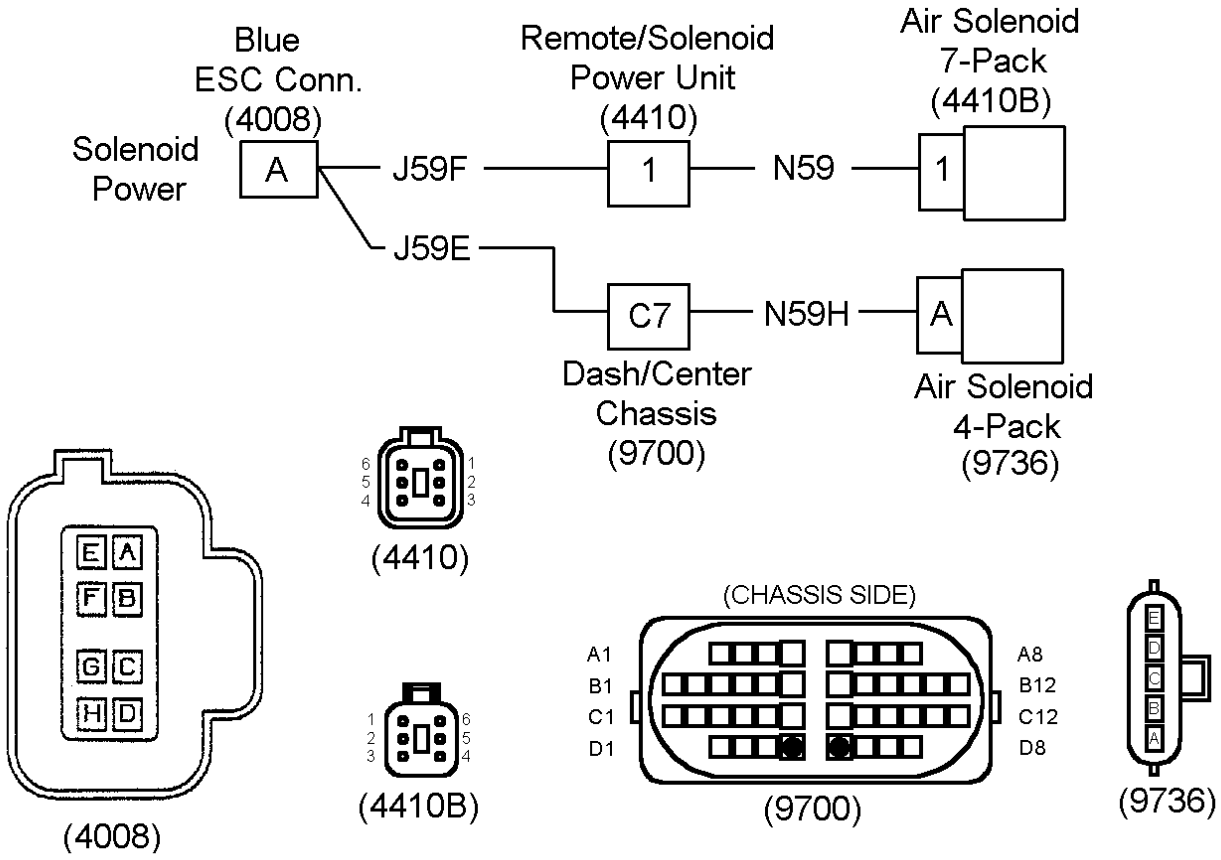



**Figure 360 Solenoid Power Circuits (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4410) REMOTE/SOLENOID POWER UNIT CONNECTOR
LOCATED ON OVER ENGINE COMPARTMENT
(4410B) 7–PACK AIR SOLENOID CONNECTOR
LOCATED ON FWD CHASSIS FRAME
(9700) DASH/CENTER CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(9736) 4–PACK AIR SOLENOID CONNECTOR
LOCATED ON FWD CHASSIS FRAME

**Table 254 Solenoid Power Circuit Tests**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 611 14 2 1 | Solenoid power under current<br><br>The current from this output is below 0.5 A<br><br>Open circuit |
| 611 14 2 3 | Solenoid power less than normal low current but more than open circuit |

**Table 254 Solenoid Power Circuit Tests (cont.)**

| | |
|---|---|
| 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 |
| 611 14 2 2 | Solenoid power over current<br><br>The output behaves like a 20 amp type III circuit breaker<br><br>**NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.**<br><br>Short to ground or overload |
| This fault is logged when there is a short between the air solenoid power output circuits of the ESC and ground or an overload on the circuit. | |
| **Remote Solenoid Harness Connector (4410B) Voltage Checks (With 7–Pack Air Solenoid Module)**<br><br>Check with ignition key on and remote solenoid harness connector (4410B) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | |

| Test Points | Spec. | Comments |
|---|---|---|
| (4410B) Harness connector, pin 1 to ground | 12 ± 1.5 volts | If voltage is missing, check for open or short to ground in circuits J59F and N59.<br><br>If circuits check good and fault is still present, verify voltage out of ESC.<br><br>**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 and remote solenoid power unit connector (4410) 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 to ground in circuits J59E and N59H.<br><br>If circuits check good and fault is still present, verify voltage out of ESC.<br><br>**NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** |

### Extended Description

Under normal conditions, when the key is in the accessory or ignition position, the ESC will supply 12 volts from system controller blue connector (4008) terminal A to 7–pack remote solenoid module connector (4410B) terminal 1 or 4–pack remote solenoid module connector (9736) terminal A. A fault in the air solenoid modules or circuits to the air solenoid modules will cause the ESC to turn off this voltage.

# 17. AIR SOLENOID MODULE (4–PACK)

## 17.1. CIRCUIT FUNCTIONS

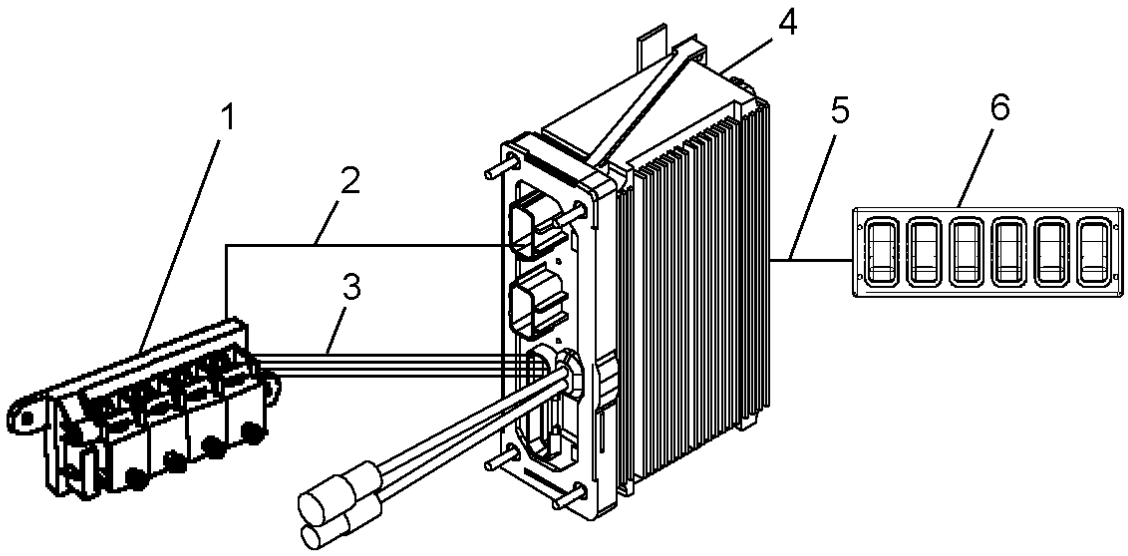



**Figure 361 4– Pack Air Solenoid Module Function Diagram**

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.

**NOTE – When more than four air driven features are installed on the vehicle the seven pack air solenoid module must be used. Refer to Air Solenoid Module (7–Pack).(See REMOTE AIR SOLENOID MODULE (7–PACK), page 742)**

## 17.2. 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 "INTUNE" 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 "INTUNE" 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 255 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.<br><br>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.) |

**Table 255 4–Pack Air Solenoid Module Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 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. (See Diagnostic Trouble Codes (DTC), page 731) | 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 731) | Read display on odometer. | 4–pack air solenoid module diagnostic trouble codes are present. | Go to 4-Pack Air Solenoid Circuits From ESC. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 733) | 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 256 4–pack Air Solenoid Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 611 14 2 1 | Solenoid power, from ESC connector (4008), under current<br><br>The current from this output is below 0.5 A<br><br>Open circuit |
| 611 14 2 2 | Solenoid power, from ESC connector (4008), over current<br><br>The output behaves like a 20 amp type III circuit breaker<br><br>Short to ground or overload |
| 611 14 2 3 | Solenoid power less than normal low current but more than open circuit |
| 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 |
| 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 |
| 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 |

## 17.3. 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 doesn't 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.

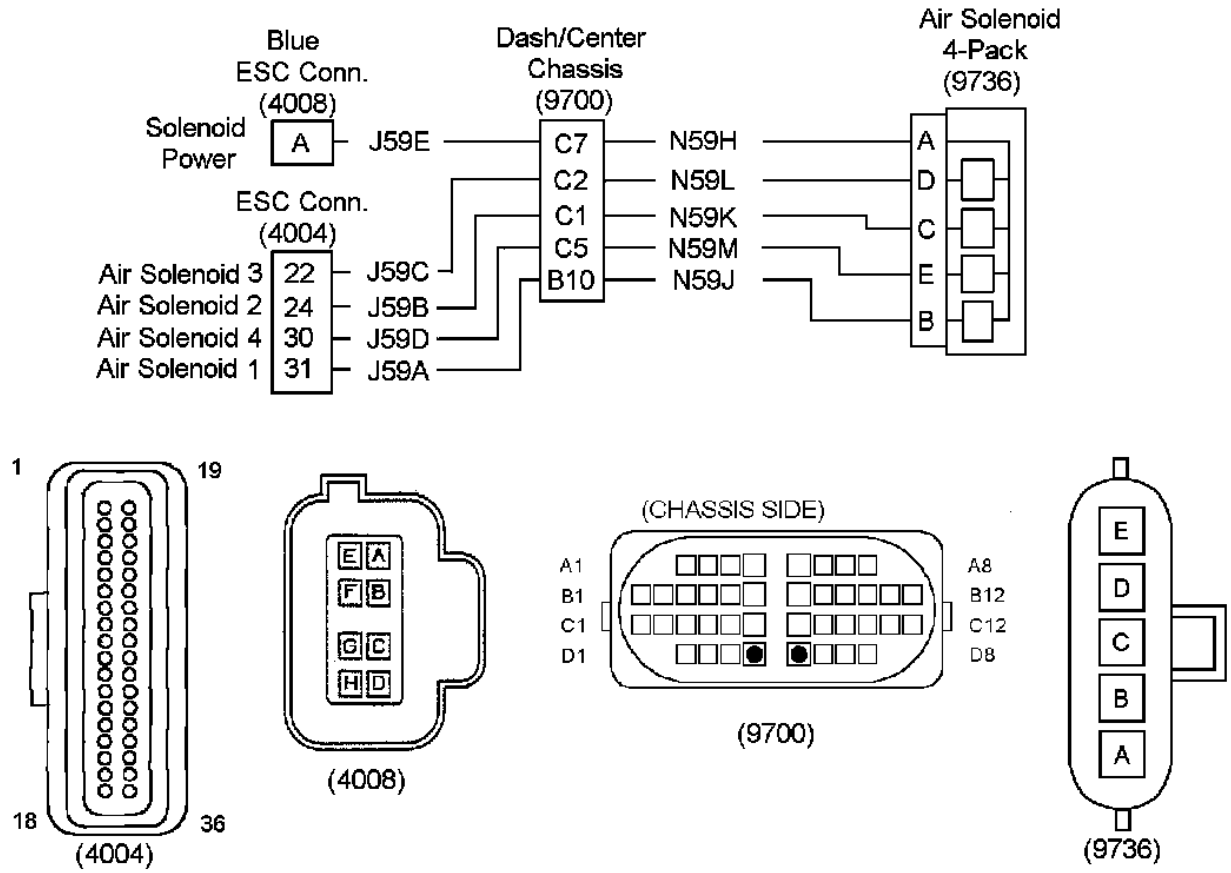



**Figure 362 Typical 4–Pack Air Solenoid Circuits (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4004) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(9700) DASH/CENTER CHASSIS HARNESS CONNECTOR
LOCATED ON OVER ENGINE COMPARTMENT
(9736) 4–PACK AIR SOLENOID CONNECTOR
LOCATED ON FWD CHASSIS FRAME

**Table 257 4 Pack Air Solenoid Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 611 14 2 2 | Solenoid power, from ESC connector (4008), over current<br><br>The output behaves like a 20 amp type III circuit breaker<br><br>Short to ground or overload |

**Table 257 4 Pack Air Solenoid Diagnostic Trouble Codes (cont.)**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 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 |
| These DTC's are logged when there is a short in the circuits between the 4–pack air solenoid and the ESC.<br><br>**NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.**<br><br>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 doesn't go previously active there is a short in the circuits between the ESC connector (4004) and the air solenoid module.<br><br>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 doesn't go previously active there is a short inside the ESC. | |
| 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.<br><br>**NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.**<br><br>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 doesn't go previously active there is an overload in the circuits between the ESC and air solenoid or in the ESC.<br><br>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 doesn't go previously active there is a short inside the ESC. | |
| 611 14 2 1 | Solenoid power under current<br><br>The current from this output is below 0.5 A<br><br>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 |

**Table 257 4 Pack Air Solenoid Diagnostic Trouble Codes (cont.)**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 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.<br><br>Check for open circuits or open solenoid coils.<br><br>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 |
| 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 258 4 Pack Air Solenoid Tests**

| **4–Pack Air Solenoid Harness Connector (9736) Voltage Checks**<br><br>Check with ignition key on and air solenoid connector (9736) disconnected.<br><br>4 open circuit DTC's will be logged when (9736) is disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**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 shorts in circuits J59E and N59H between blue ESC connector (4008) and the air solenoid pack.<br><br>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 12 volts from system controller blue connector (4008) terminal A to 4–pack air solenoid connector (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 (4004). 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.

## 17.4. 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.

## 17.5. 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.

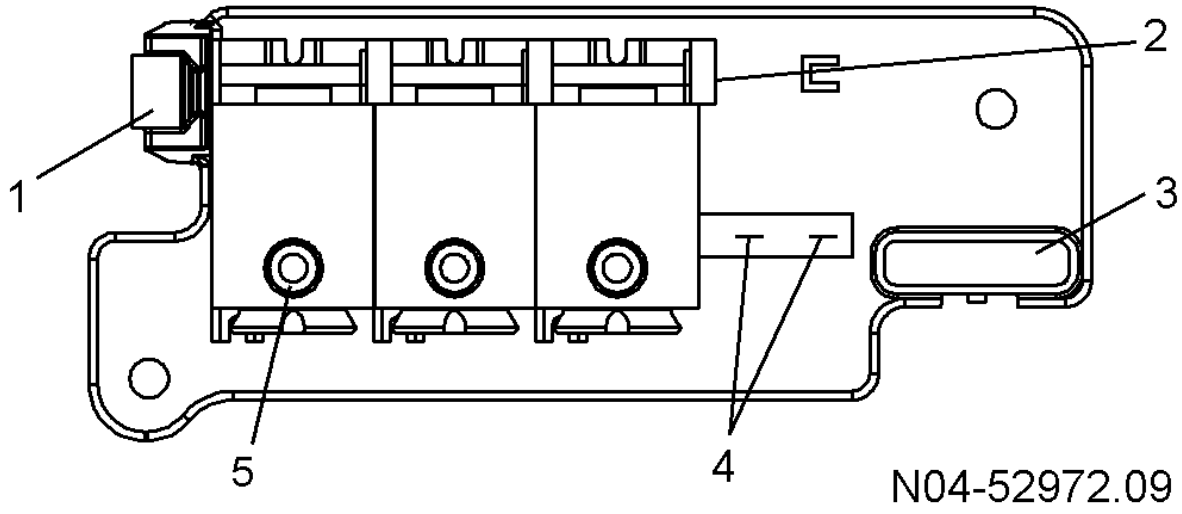



**Figure 363 4–Pack Remote Air Solenoid Module (Shown With last Solenoid Location Empty)**

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.

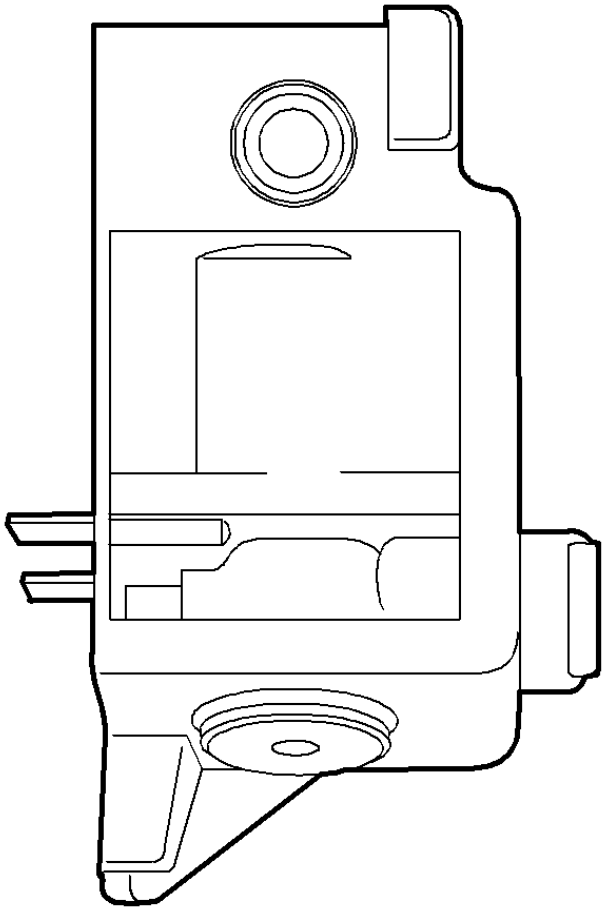


**Figure 364 Air Solenoid**

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.

If more than four air driven features are installed on the vehicle, the 4 pack solenoid module will need to be replaced with a 7 pack module. Refer toAir Solenoid Module (7–Pack) (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742).

This involves removing the 4 pack solenoid module and installing the 7 pack module. The circuits to the 4 pack module must also be removed and replaced with the harness for the 7 pack module. Refer to the circuit diagram book for circuit information.

Individual solenoids from the 4–pack module can be saved for use in the 7–pack module.

## 17.6. COMPONENT LOCATIONS

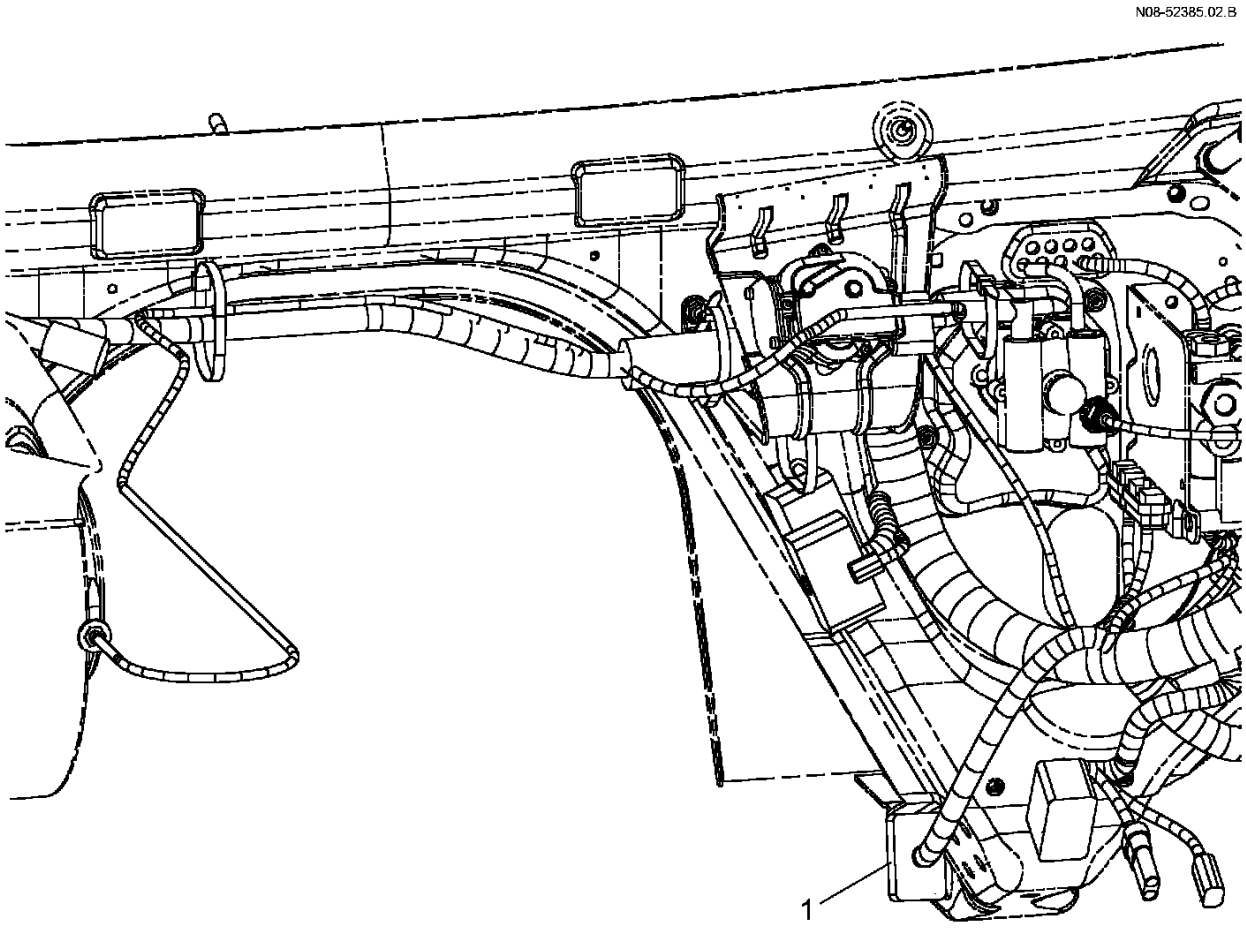



**Figure 365 Remote Air Solenoid Module Dash Harness Wiring**

1. (9700) DASH/CENTER CHASSIS CONNECTOR

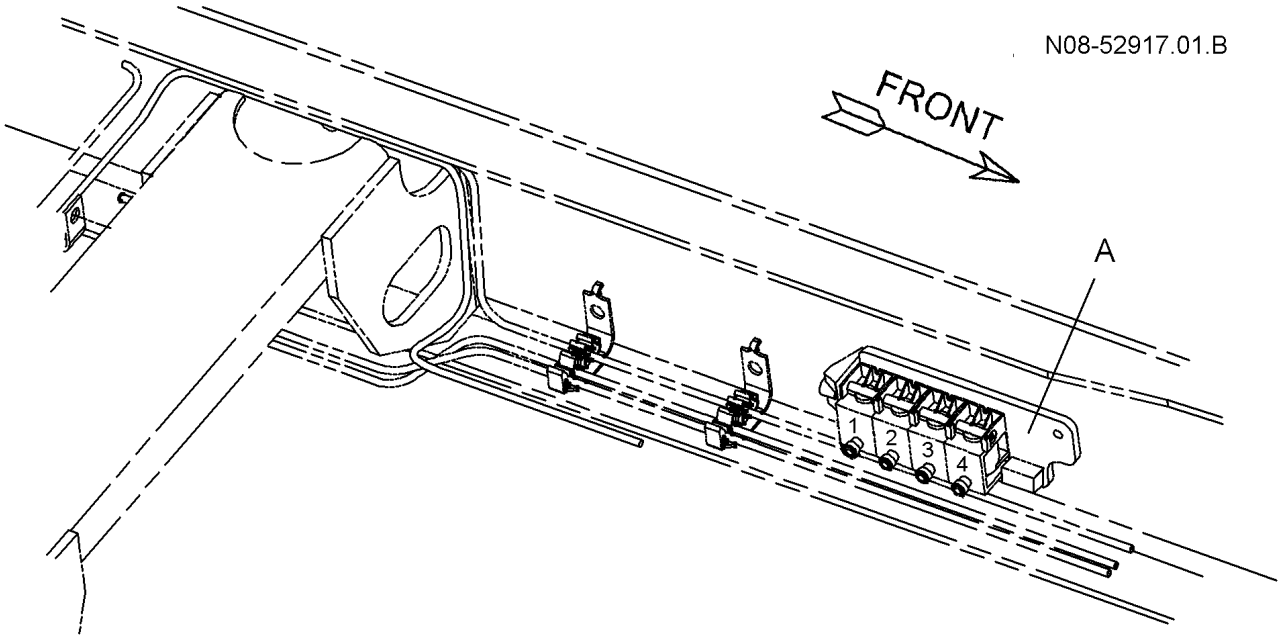



**Figure 366 Typical 4–Pack Remote Air Solenoid Location (Located Below Cab)**

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

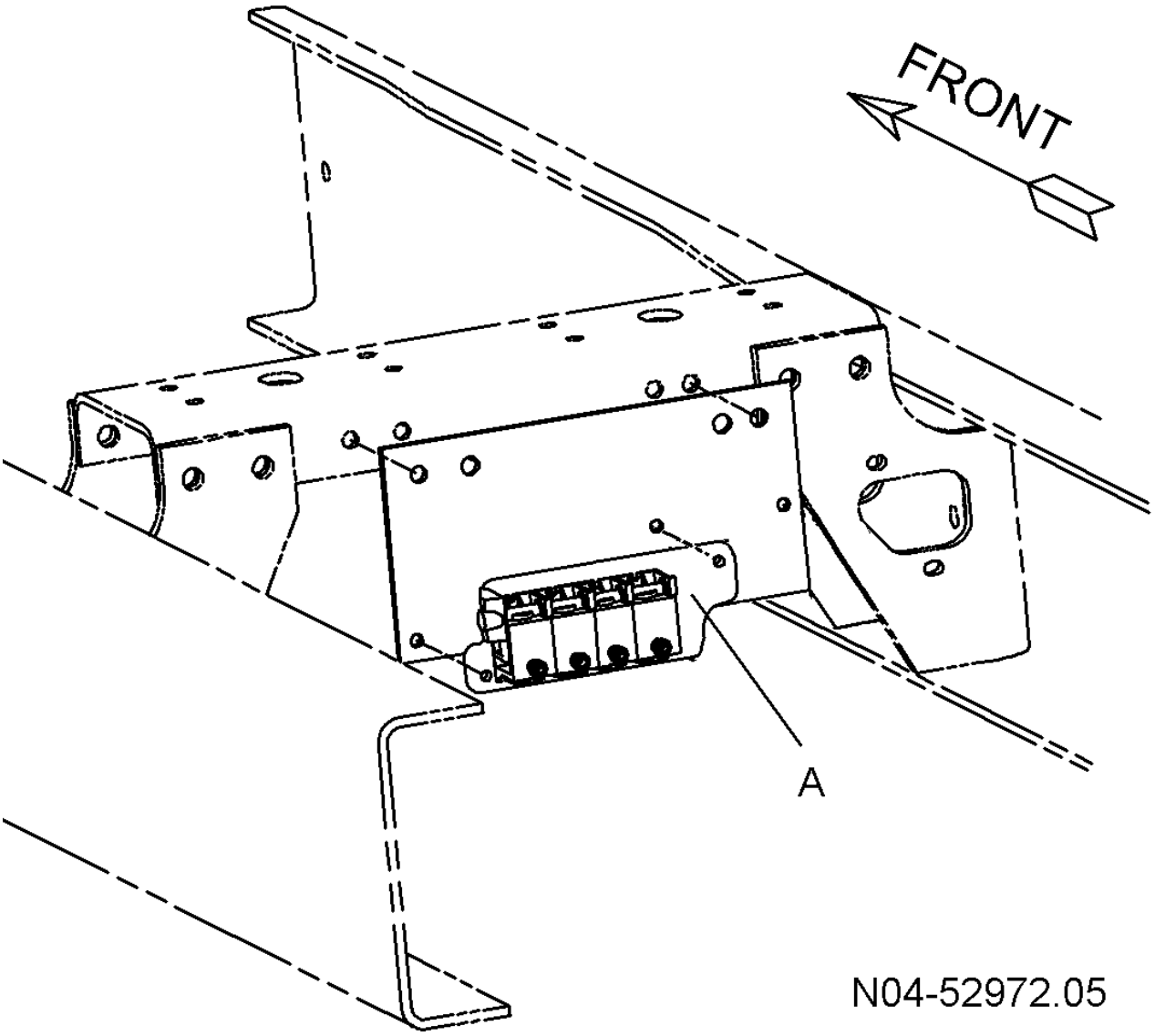



**Figure 367 Typical 4–Pack Remote Air Solenoid Location (Located On Cross Member)**

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

# 18. REMOTE AIR SOLENOID MODULE (7–PACK)

## 18.1. CIRCUIT FUNCTIONS

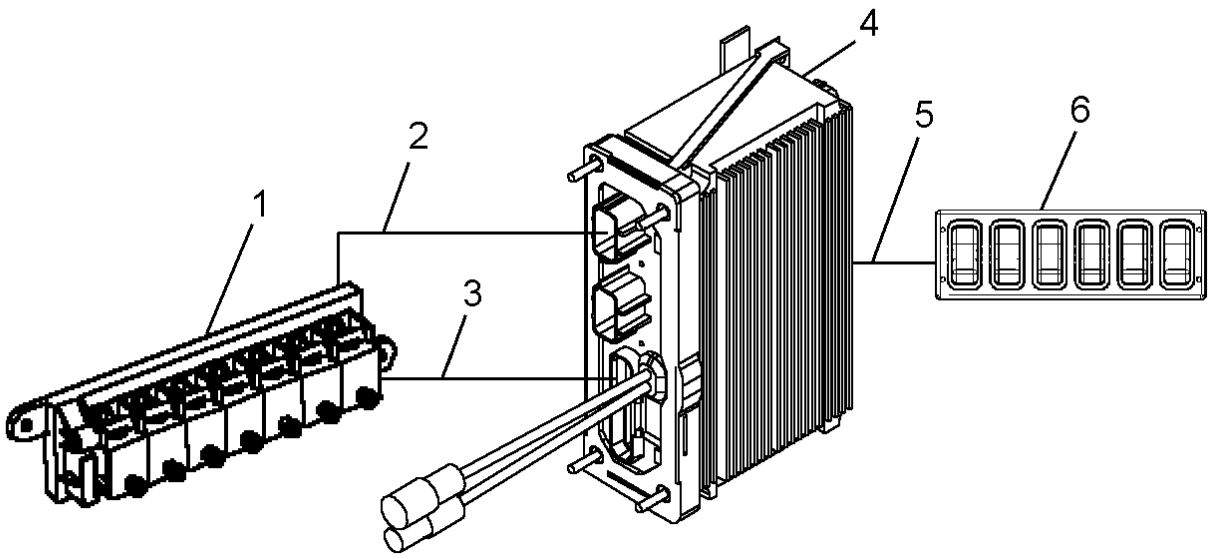



**Figure 368 7– Pack Air Solenoid Module Function Diagram**

1. 7 PACK 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

The 7–Pack Remote Air Solenoid Module (RASM) is an optional feature that provides switched air valve solenoids on the chassis. Up to two Modules may be installed on the vehicle allowing up to 14 air driven features to be installed on the vehicle. The ESC must be programmed to operate these solenoids with inputs from the 6 switch packs in the cab.

The RASM communicates with the Electrical System Controller (ESC) via the body builder data link. The air solenoid valves in the Air Solenoid Module are typically normally closed valves.

The RASM switches provided in the cab are 2-position. The “ICAP” programming software will determine which available switch positions control the air solenoids on the RASM. These switches are windowed to allow user to assign switch names as desired. Pressing a switch up will result in the corresponding ASM valve being opened to let air flow. Pressing a switch down will result in the corresponding ASM air valve to be switched off and stopping the flow of air. The indicator in the switch-pack will illuminate when the corresponding ASM air valve is switched on using the panel mounted switches 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.

The normal operation of this feature is defined as follows:

A. When the key is in Accessory, all outputs will be turned off.

B. The switch status from the panel-mounted switches will be polled to determine if an output should be turned on or off.

C. The status of errors will then be considered. If a panel mounted switch error is present, the given output will be turned off. If the Air Solenoid Module indicates that a valve is off when it should be on, the indicator will remain off. However, if the Air Solenoid Module indicates that a valve is on when the valve had been commanded off, the ignition signal to the Air Solenoid Module will be turned off and the indicator on the panel mounted switch will flash quickly.

D. The resulting command will be sent to the Air Solenoid Module via the body builder data link.

E. The outputs will also be turned off when the Accessory has been turned off.

The air solenoid module software feature will attempt to shut off the air valves if it has detected that an air valve is on when it had been commanded off. Likewise, under this condition, the solenoid ignition will also be turned off to disable the function of the Air Solenoid Module solenoids.

## 18.2. DIAGNOSTICS

A failure in the 7–pack 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 7–pack air solenoid module or the circuits to the module.

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.

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 "INTUNE" 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 "INTUNE" diagnostic software can also monitor switch inputs to the ESC and display diagnostic trouble codes. See the diagnostic software manual for details on using the software.

### 7–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 259 7–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.<br><br>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. | Check for diagnostic trouble codes. (See DIAGNOSTICS, page 1023) | Identify and repair condition causing several features to be inoperative. |

## 18.3. 7– PACK REMOTE AIR SOLENOID MODULE 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 circuits from the ESC should be suspected when an air controlled feature doesn't operate or an air solenoid fault is present. The ESC will log a diagnostic trouble code when there is a short in a circuit between the air solenoid and ground. A diagnostic trouble code will also be logged if there is a communication on the body builder data link. Problems in the air solenoid circuits could be attributed to an open circuit a short, a faulty 7–pack, a problem in the ESC, or a data link communication error.

Refer to 7–Pack Air Solenoid Circuits.

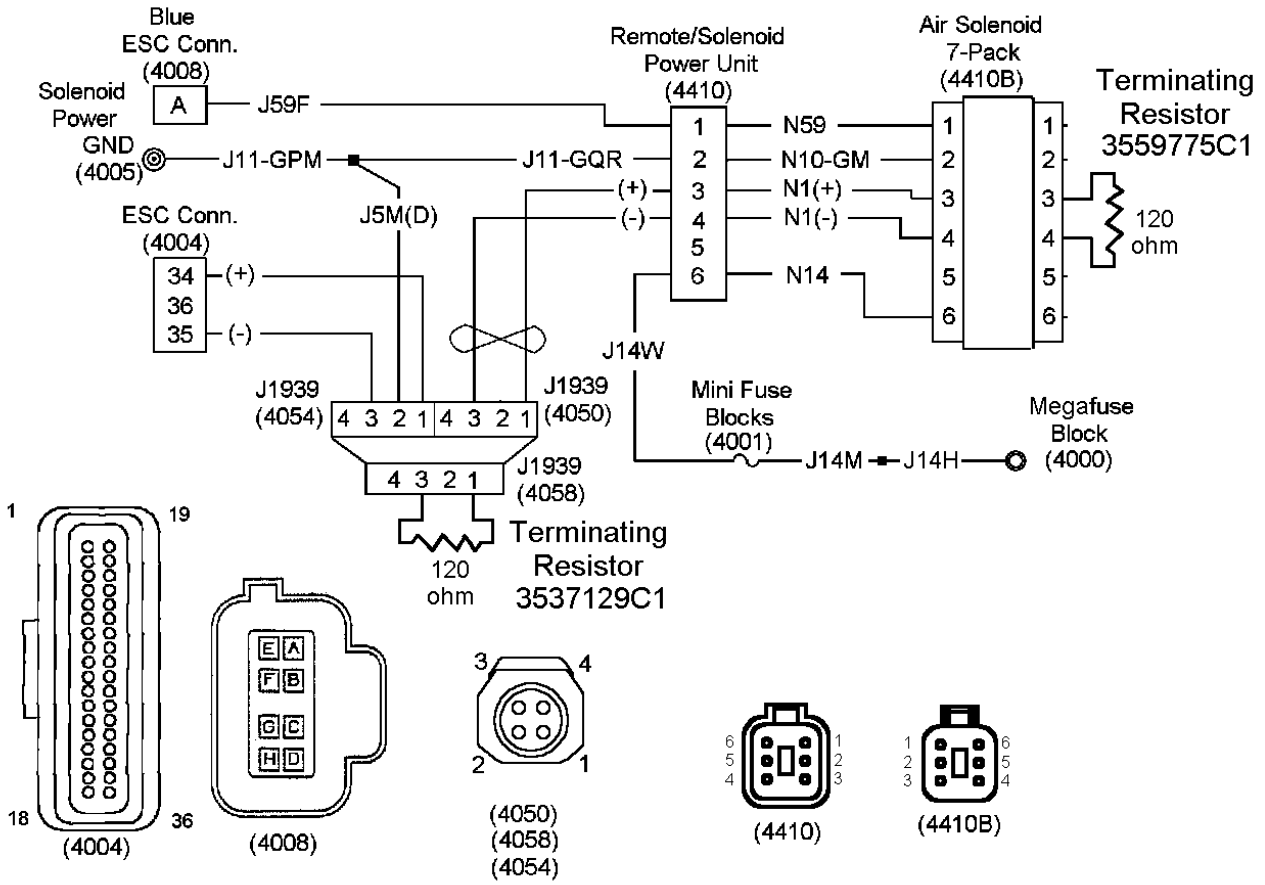



**Figure 369 7–Pack Air Solenoid Circuits (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4000) MEGA FUSE BLOCK
LOCATED IN INSTRUMENT PANEL FUSE BLOCK
(4001) MINIFUSE BLOCK
LOCATED IN INSTRUMENT PANEL FUSE BLOCK
(4004) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4005) GROUND
LOCATED ON ENGINE COMPARTMENT
(4008) BLUE ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4050), (4054), (4058) J1939 DATA LINK CONNECTOR
LOCATED AT BODY BUILDER DATA LINK “Y” CONNECTORS
(4410) REMOTE/SOLENOID POWER UNIT CONNECTOR
LOCATED ON OVER ENGINE COMPARTMENT
(4410B) 7–PACK AIR SOLENOID CONNECTOR
LOCATED ON FWD CHASSIS FRAME

**Table 260 7 Pack Air Solenoid Tests**

| 7–Pack Air Solenoid Harness Connector (4410B) Voltage Checks<br><br>Check with ignition key on and air solenoid connector (4410B) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| (4410B) Harness connectors, pin 1 to ground | 12 ± 1.5 volts | If voltage is missing, check for open in circuits J59F and N59.<br><br>If voltage is present and fault is still present after connector is reconnected, verify relay and assembly body.<br><br>**NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** |
| (4410B) Harness connectors, pin 1 to pin 2 | 12 ± 1.5 volts | If voltage is missing, check for open in ground circuits J11–GQR, J11–GPM and N10–GM. |
| (4410B) Harness connectors, pin 6 to ground | 12 ± 1.5 volts | If voltage is missing, check for open in circuits N14, J14W, mini fuse block (4001), J14M and J14F. |
| If voltages check good and communication fault with ESC is still active, refer to Body Builder Data Link. (See BODY BUILDER DATA LINK, page 69) | | |

### Extended Description

When the key is in the accessory or ignition position and there are no air solenoid faults, the ESC will supply a solenoid power voltage from system controller blue connector (4008) terminal A to 7–pack air solenoid connector (4410B) terminal 1.

The ESC will command each solenoid on, depending on messages form the switch pack to the ESC, to allow air to flow through the solenoid valve.

## 18.4. 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.

## 18.5. 7–PACK 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. When more than four features are to be installed the 7–pack air solenoid module must be used. If more than seven features are added an additional 7–pack air solenoid must be installed

Refer to Component Locations for 7–pack RASM mounting locations.(See COMPONENT LOCATIONS, page 749)

The primary air source is connected to the collar on the left side of the module. An air collar on the front of each air solenoid is used to connect the air line to the air driven device. The electrical circuits are connected to the connectors on the right side of the module. Overlay harnesses are available to complete the electrical connections.

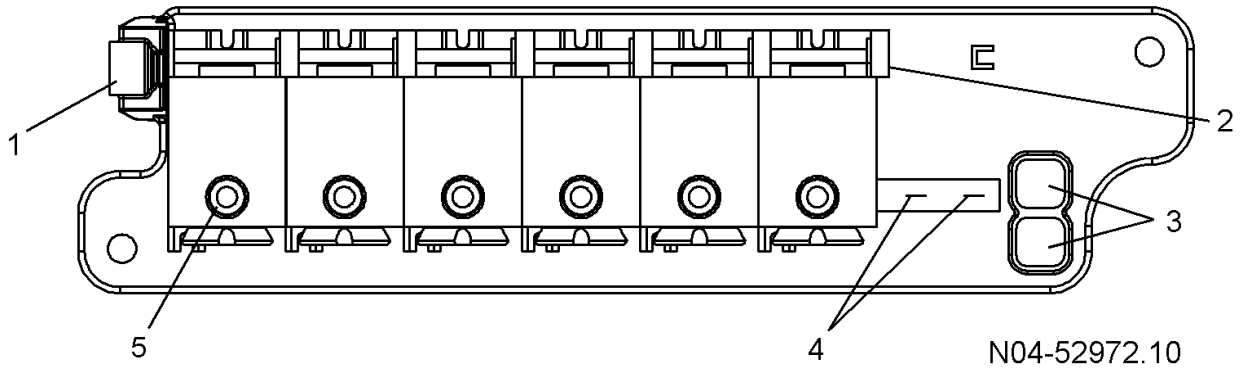



**Figure 370 7–Pack Remote Air Solenoid Module (Shown With last Solenoid Location Empty)**

1. PRIMARY AIR INPUT
2. PORT PLUG (INSTALLED ON LAST SOLENOID)
3. ELECTRICAL CONNECTORS (EITHER CONNECTOR MAY BE USED. THE UNUSED CONNECTOR MUST HAVE A TERMINATING RESISTOR INSTALLED.)
4. SOLENOID MATING CONTACTS (BENEATH FOAM STRIP)
5. AIR OUTPUT FROM SOLENOID
6. LOCATION OF JUMPER TO CUT TO CONVERT FIRST RASM TO SECOND RASM CONFIGURATION (UNDERNEATH FIRST SOLENOID ON MODULE)

If more than seven features are added an additional 7–pack air solenoid must be installed. The additional 7–pack air solenoid module. A jumper is located beneath the location of the first solenoid, buried under potting material. The jumper must be cut to modify the solenoid module to operate as the second solenoid module. The cut jumper must be covered with an RTV sealant to prevent corrosion. An overlay harness is available to connect the first 7–pack air solenoid module to the second. The terminating resistor must be removed from the first ASM and installed in the second. Then the overlay harness must be connected between the open connector of the first module and the open connector in the second.

The 7–pack ASM communicates with the ESC on the body builder data link. The ASM must be connected to the data link correctly to operate. If the vehicle isn't already configured with a body builder data link, circuits will have to be added. This includes connecting the ESC connector, adding a "Y" connector, installing overlay harnesses and insuring terminating resistors are installed. Refer to Body Builder Data Link(See BODY BUILDER DATA LINK, page 69) and the circuit diagram book for details.

### Installing Additional Solenoids

Individual solenoids are only installed on the module as required to support the features on the vehicle. If five air driven features are installed on the vehicle, only five solenoids 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.

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.

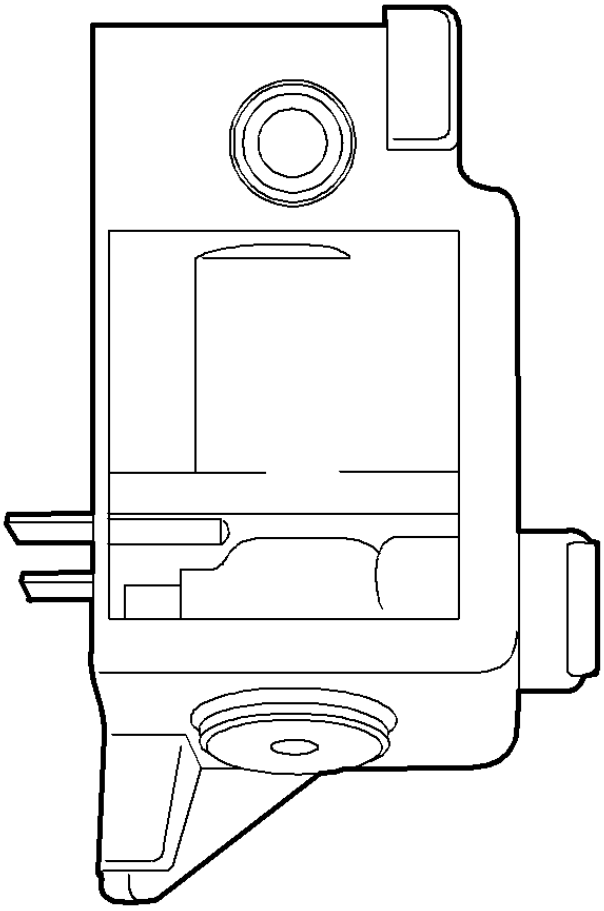


**Figure 371 Air Solenoid**

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.

The ICAP software will determine the order of installation for the solenoids.

## 18.6. COMPONENT LOCATIONS

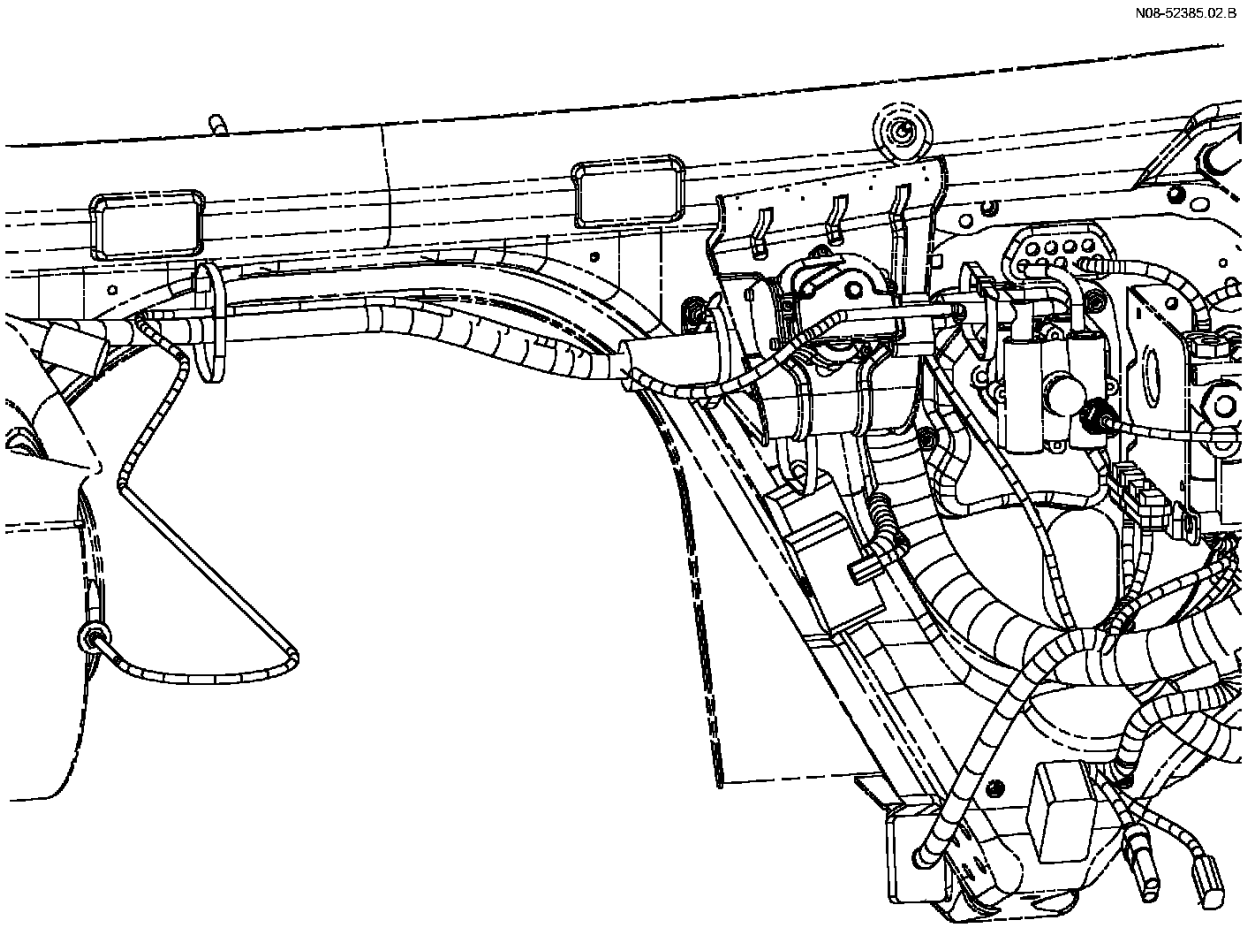



**Figure 372 Air Solenoid Dash Harness Wiring**

1. (4410) REMOTE/SOLENOID POWER UNIT CONNECTOR

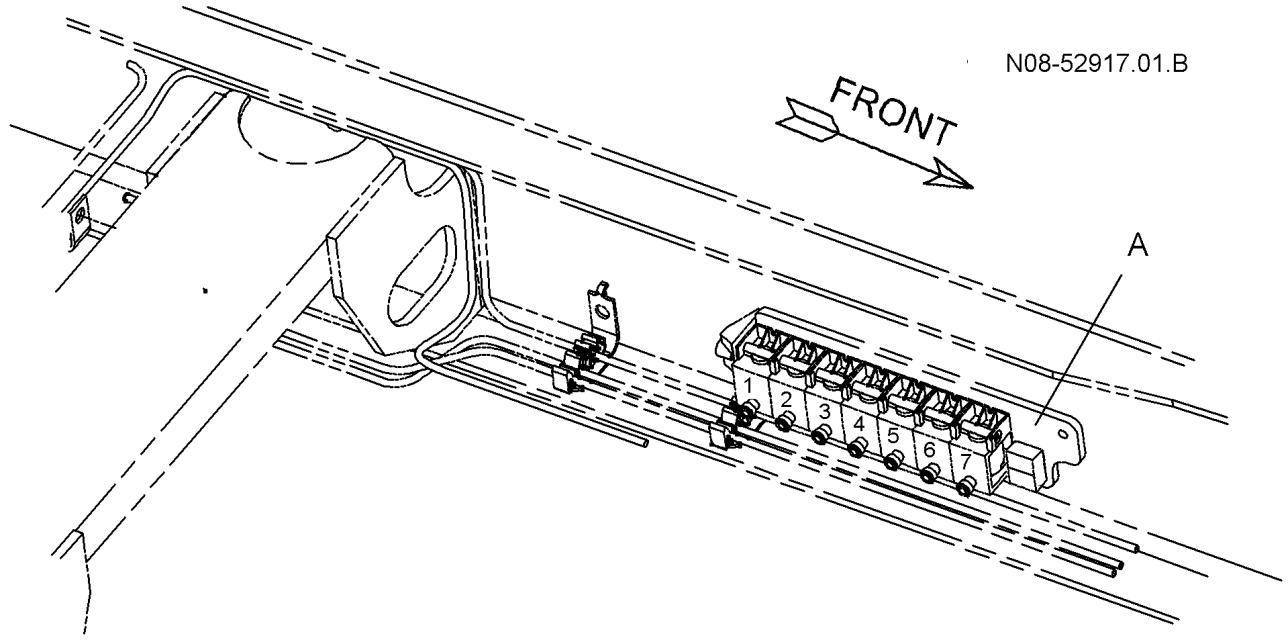



**Figure 373 Typical 7–Pack Air Solenoid Location (Located Below Cab)**

A. 7–PACK AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

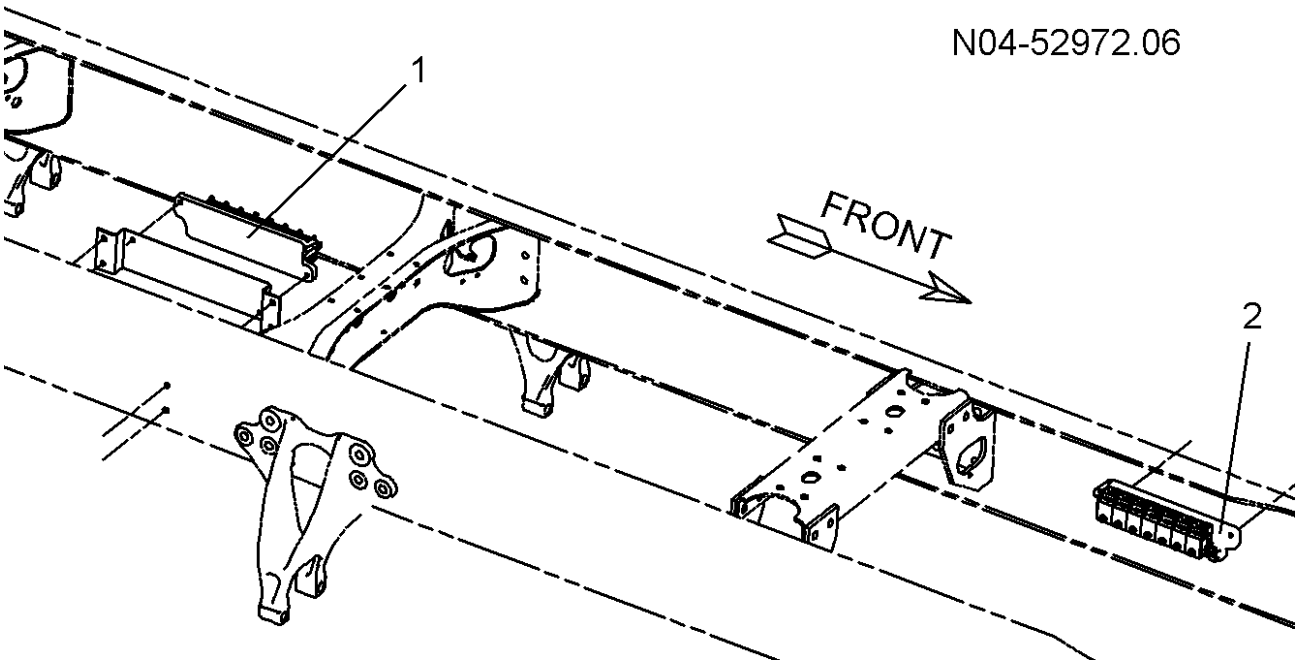



**Figure 374 Typical Second 7–Pack Air Solenoid Location**

1. SECOND 7–PACK AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)
2. FIRST 7–PACK AIR SOLENOID MODULE (LOCATED UNDER CAB)

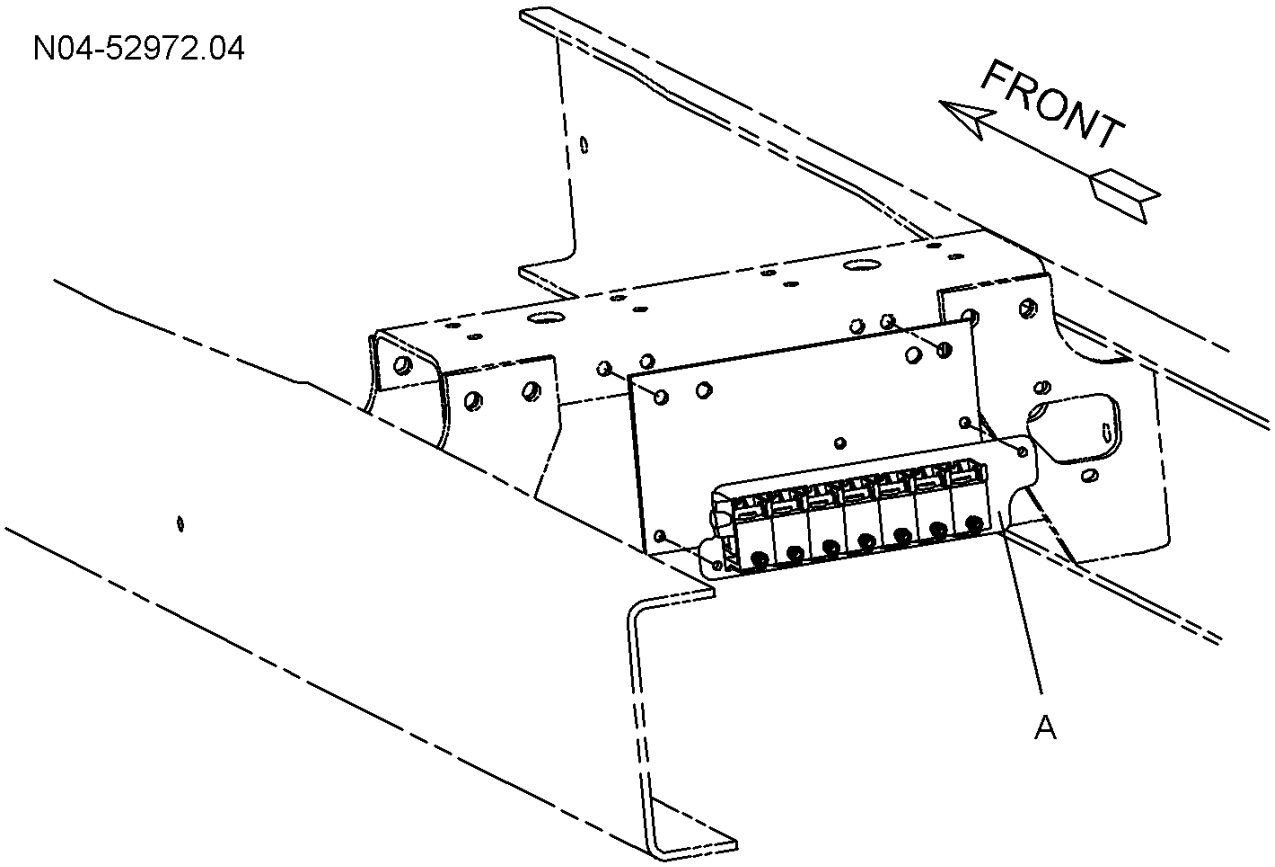



**Figure 375 Typical 7–pack Air Solenoid Location (Located On Cross Member)**

A. 7–PACK AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)

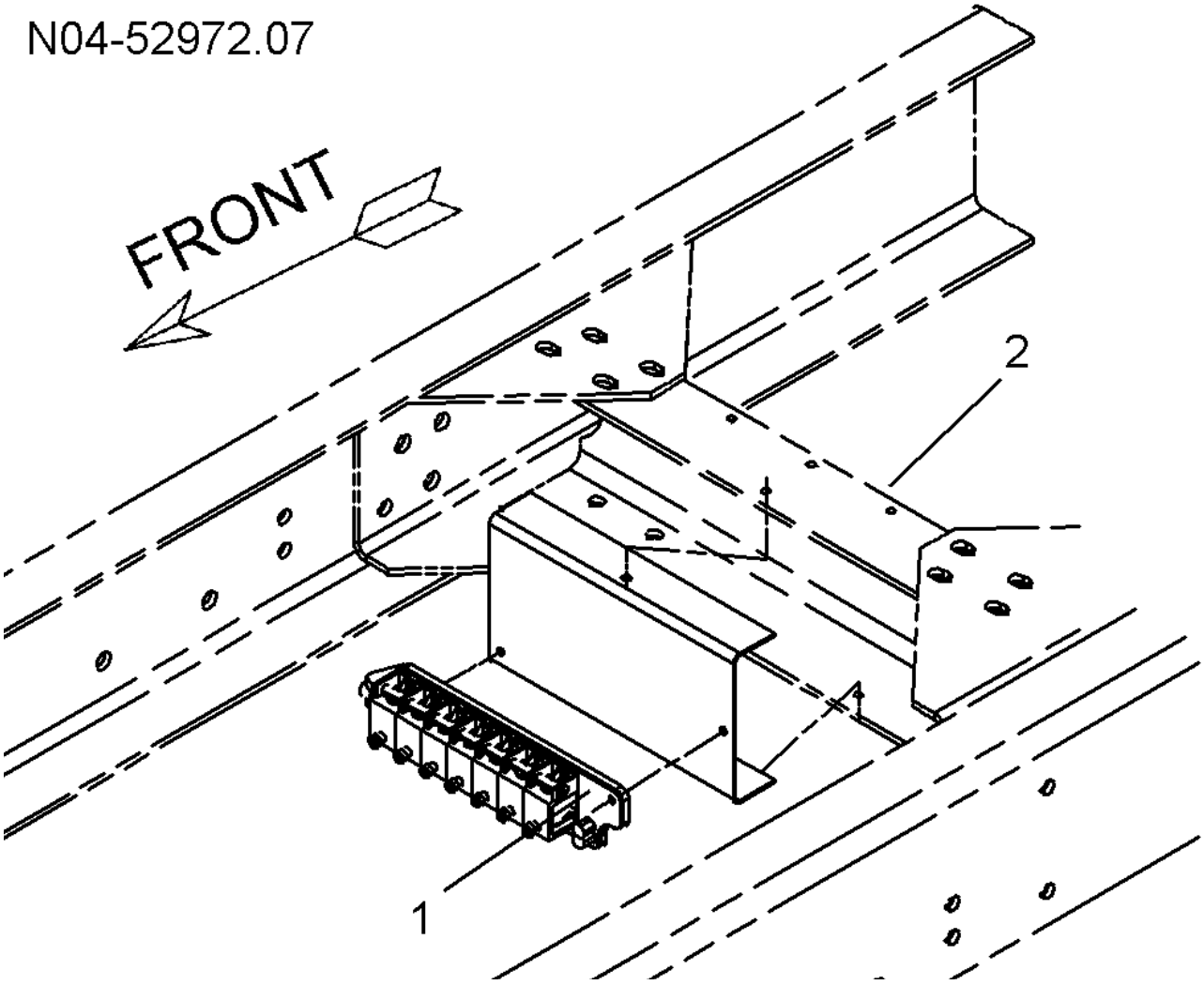



**Figure 376 Typical Second 7–pack Air Solenoid Location (Located On Cross Member)**

1. SECOND 7–PACK AIR SOLENOID MODULE (SOME SOLENOID LOCATIONS MAY BE VACANT)
2. LOCATION OF FIRST 7–PACK AIR SOLENOID MODULE (END OF FRAME)

# 19. REMOTE POWER MODULE

## 19.1. CIRCUIT FUNCTIONS

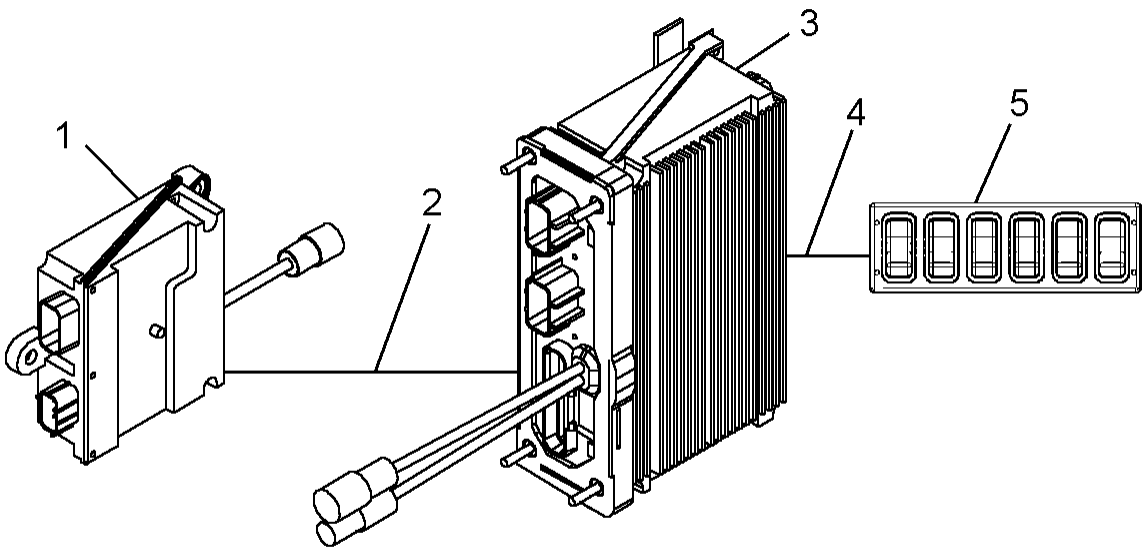



**Figure 377 Remote Power Module Function Diagram**

1. REMOTE POWER MODULE
2. BODY BUILDER DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. SWITCH DATA LINK
5. SWITCH PACK

The Remote Power Module (RPM) is used to provide power to electrical features, outside the cab, without running individual wires from each switch to the feature. This module is used to distribute and control power to various devices on the vehicle from switches inside the cab. The RPM communicates with the electronic system controller over the Body Builder J1939 data link.

RPM outputs are protected by field effect transistors (FET). If an overload occurs on the circuit the FET will act like a type 3 circuit breaker. To reset the FET the feature must be commanded off then back on again.

**NOTE – The virtual fuse (FET) in the RPM will trip during a short on the output circuits. Cycling the assigned control switch will reset the fuse.**

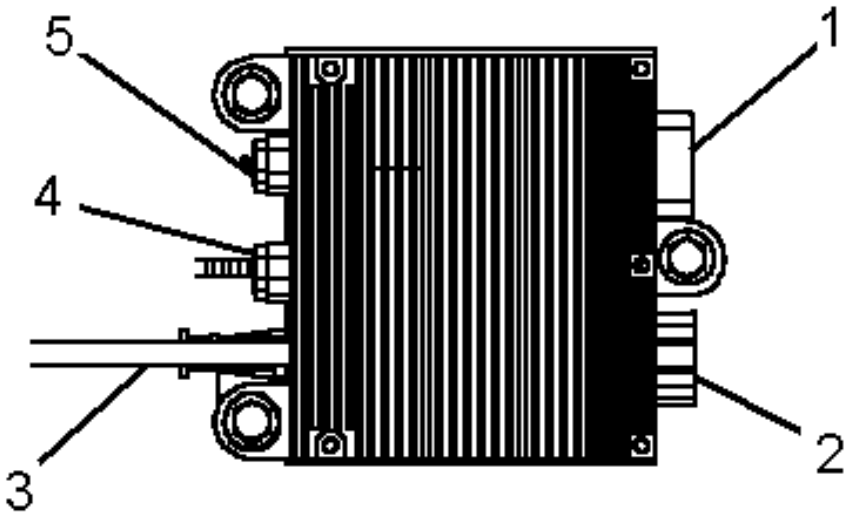



**Figure 378 Connectors**

1. 23–WAY SIGNAL CONNECTOR
2. 8–WAY DEVICE POWER CONNECTOR
3. MODULE POWER FEED (DIRECT FROM BATTERY OR STARTER STUD)
4. INPUT DATA LINK AND POWER CONNECTOR
5. OUTPUT DATA LINK AND POWER CONNECTOR

Each module receives power from a 4 gauge cable, protected by a fusible link, connected to the battery stud of the starter motor. Each RPM has the ability to operate up to 6 devices of 20 amps or less not to exceed 80 amps for the entire module.

A maximum of 3 RPM's may be connected to the vehicle, which allows a total of 18 devices to be controlled as long as the 80 amps per module is not exceeded.

Each RPM comes with a six pack of switches that is inserted into the center section of the instrument panel. Each switch controls 1 output of the RPM. The switch mapping is one to one with the RPM; i.e., switch one controls output channel one on the RPM. The switch pack is connected to the switch data link that communicates switch operation to the Electronic System Controller. The ESC communicates that operation to the RPM.

Each switch pack has six or twelve rocker switches. Each momentary rocker switch is stable in the center position. The upper section of each switch has an indicator light to provide the status of each power output channel. Pressing the upper section of the switch will latch the respective power output channel on and illuminate the indicator. Pressing the lower section of the switch will latch the power output channel off and turn the indicator off.

The RPM also has inputs on the module itself that can be wired to control the outputs. The output channels may be controlled remotely by using a three position momentary single pole, double throw switch on each remote switch input. In this case, battery volts should be connected to one pole of the switch and ground should be connected to the other. Applying battery volts to the remote switch input shall turn the output channel "ON". Applying ground to the remote switch input shall turn the output channel off.

The lamp indicator on the instrument panel switch will always display the current status of the output channel as long as the ignition key is in the "RUN" or "ACCESSORY" position.

The Remote Power Module is an optional feature that provides switched electrical loads on the chassis, up to 20 amps per load and 80 amps, maximum, per module (Several Remote Power Modules, as well as 7–pack air solenoids and a remote engine speed controller pack may be chained together). These loads can be switched using a switch pack in the cab or by using tri-state switches connected directly to the Remote Power Module. Virtual fuses protect the circuits of the Remote Power Module from current overload. These virtual fuses may be rated up to 20 amps.

**NOTE – The virtual fuse in the RPM will trip during a short. To reset the fuse, the switch controlling the feature must be cycled off then back on.**

The Remote Power Module communicates with the Electrical System Controller (ESC) via the body builder data link. The Remote Power Module switches provided in the cab are 3-position, center stable. These switches are windowed to allow user to assign switch names as desired. Pressing a switch up will result in the corresponding Remote Power Module output to be switched on. Pressing a switch down will result in the corresponding Remote Power Module output to be switched off. When the switch is in the stable state (center), the present state of the output will be maintained. The tri-state inputs at the Remote Power Module may be optionally used to control the outputs of the Remote Power Module. If a conflict exists between the cab control and the Remote Power Module tri-state inputs, where neither switch is in the center stable position, the Remote Power Module output will be switched off. The indicator in the switch-pack will illuminate when the corresponding Remote Power Module output is switched on and no errors are detected. If the Remote Power Module detects an over current situation, then the switch indicator will flash quickly

The normal operation of this feature is defined as follows:

1. When the ignition is turned on, all outputs will be turned off unless a programmable parameter specifies that a particular output be turned on with the ignition. These outputs will be on during engine-crank.

2. The switch status from the panel-mounted switches and Remote Power Module tri-state inputs will be polled to determine if an output should be turned on or off.

3. The status of errors will then be considered. If a panel-mounted switch error is present, the given output will be turned off. If an over current situation is detected, the output request will remain on, but the indicator on the panel-mounted switches will flash quickly.

4. The resulting command will be sent to the Remote Power Module via the body builder data link.

5. The remote power module software feature will send an "off command" to any output of the physical Remote Power Module when there is a conflict between the respective tri-state input switches from the Remote Power Module and the respective panel-mounted switches of the ESC.

Likewise, the outputs of the Remote Power Module will be commanded to the off position, when a Switch Data Link error and body builder data link error is detected. If a Switch Data Link error occurs, the switches will be ignored. If a body builder data link error occurs, the tri-state inputs will be ignored. The outputs will also be turned off when the ignition has been turned off. If an output is latched on by the either switch being in the ON position, the output will immediately be turned back on.

The remote power module software feature will attempt to turn off the outputs of the Remote Power Module by commanding them off if an error is detected on the Switch Data Link or body builder data link.

In an over current state, the indicator on the panel-mounted switches will flash while the condition exists. A diagnostic trouble code will also be set while the over current condition exists.

## 19.2. DIAGNOSTICS

Should a feature connected to a remote power module fail to operate, the problem could be attributed to a failed switch in the switch pack, a failed switch pack, open or shorted wiring between the ESC and the switch pack, an open circuit between the ESC and the remote power module, a failure in the remote power module or failures in circuits between the RPM and the load device.

### Remote Power Module Preliminary Check

**Table 261 Remote Power Module Preliminary Check**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 1. | On | Verify a feature controlled by a remote power module is not operating correctly. | Attempt to operate the suspect feature. | Suspect feature is **not** operating correctly. | Go to next step. | 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 | Check for remote power module diagnostic trouble codes. (See Diagnostic Trouble Codes, page 757) | Read display on odometer. | No remote power module diag- nostic trouble codes are active. | Check for open circuits between RPM output and inoper- ative device. (See MARKER, PARK AND TAIL LIGHT INPUTS TO ESC, page 827) | Go to next step. |

**Table 261 Remote Power Module Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| 4. | On | Are there DTC's starting with SPN 1231 present for RPM's? | | DTC starting with SPN 1231 is present . | Go to RPM Addressing (See RPM ADDRESSING, page 761) | Go to next step. |
| 5. | On | Are there DTC's starting with SPN 2225, 2226, 2228 or 2231 present for RPM's? | | DTC starting with SPN 2225, 2226, 2228 or 2231 is present. | Go to RPM POWER, GROUND AND DATA LINK CIRCUITS (See RPM POWER, GROUND AND DATA LINK CIRCUITS, page 757) | |

### 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 by putting the key switch in the accessory position, turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Refer to the Diagnostic Trouble Code List (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025)to identify the DTC's.

## 19.3. RPM POWER, GROUND 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.**

Battery voltage to operate the RPM is provided from a 5 amp fuse in the engine power distribution center.

Each module also receives power from a 4 gauge cable, protected by a fusible link, connected to the battery stud of the starter motor or the positive battery post. Each RPM has the ability to operate up to 6 devices of 20 amps or less not to exceed 80 amps for the entire module.

Refer to RPM Power Diagram.

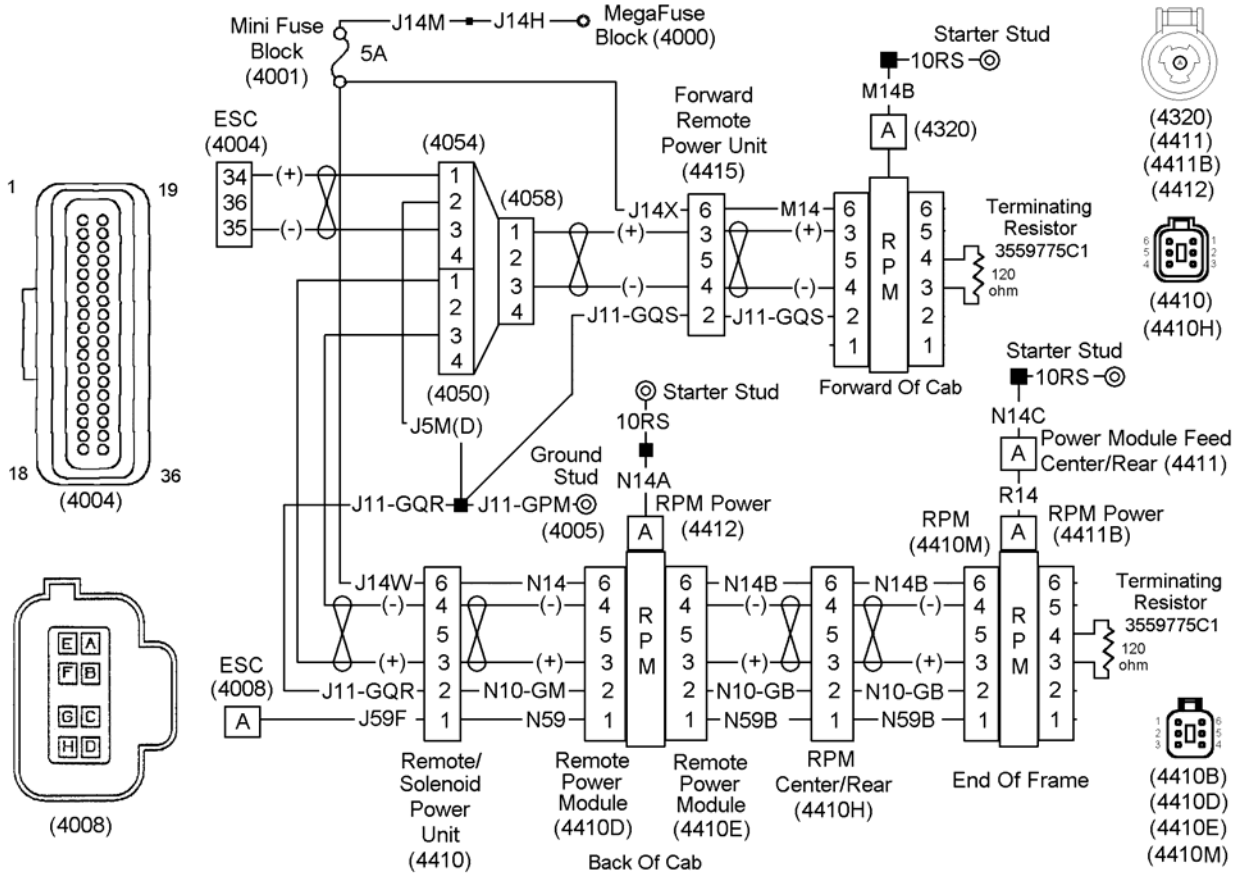



**Figure 379 RPM Power, Ground and Data Link Simplified Diagram (Back of Cab RPM Shown)–Always Refer To Circuit Diagram Book For Latest Circuit Information**

(4000) MEGA FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4001) MINI FUSE BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4004) 36– WAY ESC CONNECTOR
LOCATED ON EXTERIOR DASH PANEL LEFT SIDE (ESC)
(4005) GROUND STUD
LOCATED ON EXTERIOR DASH PANEL LEFT SIDE (ESC)
(4008) BLUE 8–WAY ESC CONNECTOR
LOCATED ON EXTERIOR DASH PANEL LEFT SIDE (ESC)
(4050), (4054), (4058) DATA LINK CONNECTORS
LOCATED NEAR POWER DISTRIBUTION CENTER
(4320) REMOTE POWER MODULES FEED
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4410) REMOTE SOLENOID POWER MODULE
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(4410B) REMOTE POWER MODULES
LOCATED UNDER CAB BY LEFT RAIL
(4410D), (4410E), (4410M) REMOTE POWER MODULES
LOCATED BACK OF CAB
(4410H) REMOTE POWER MODULES CENTER/REAR
LOCATED BACK OF CAB
(4411), (4411B), (4412) REMOTE POWER MODULES FEED
LOCATED BACK OF CAB
(4415) FORWARD REMOTE POWER MODULE
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 262 RPM Input Connector (4410D) Voltage Checks**

| **RPM Input Connector (4410D) Voltage Checks (Check with RPM connector disconnected and Ignition Key “On”)** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Harness connector cavity 6 to ground. | 12 ± 1.5 volts | If voltage is incorrect, check for blown 5 amp fuse in mini fuse block or an open or short in circuit N14 or J14W to fuse. |
| Harness connector cavity 6 to 2. | 12 ± 1.5 volts | If voltage is incorrect, check for open in circuit N10–GM or 11–GQR to ground. |
| Checks voltage from ESC (4008) A.<br><br>Harness connector cavity 1 to 2. | 12 ± 1.5 volts | If voltage is incorrect, check for an open or short in circuit N59 or J59F to ESC (4008) pin A.<br><br>If circuits check good, check for missing voltage from ESC. |
| If voltages check good verify connection to the data link. Refer to Body Builder Data Link. (See DRIVETRAIN 1939 DATA LINK, page 60) | | |

**Table 263 RPM Connector (4412) Voltage Check**

| RPM Connector (4412) Voltage Checks (Check with RPM connector disconnected) | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Harness connector cavity A to ground. | 12 ± 1.5 volts | If voltage is incorrect, check for open fusible link or an open or short in circuit between connector and battery or starter stud. |

### Extended Description

**NOTE – Circuit and connector numbers will vary determined by the number and location of RPM's installed on the vehicle. Refer to the circuit diagram book and the literature provided by the body builder.**

Battery voltage to connector (4410) pin 6 of the remote power module(s) is provided from a 5 amp fuse in the engine power distribution center.

Battery voltage is also supplied on a 4 gage circuit to a pigtail connector on the remote power module(s) from the positive battery stud or the starter stud. A fusible link is used in the circuit to protect components from an over current.

System ground to connector (4410) pin 6 of the remote power module(s) is provided on circuits connected to ground stud (4005).

The body builder data link is connected to the remote power module(s) on connector 4410 pins 3, 4 and 5.

## 19.4. REMOTE POWER MODULE INSTALLATION

### Installing Remote Power Modules

The "ICAP" ESC programming software must be used to allow the ESC to recognize the installed RPM. The ESC software will automatically configure the 6 switch pack associated with the RPM. The programming software will configure the RPM to be identified as RPM #1, RPM #2, RPM #4 or RPM #7. The ESC diagnostics will use these designations in the diagnostic trouble codes.

Refer to Component Locations for remote power module mounting locations.(See COMPONENT LOCATIONS, page 766)

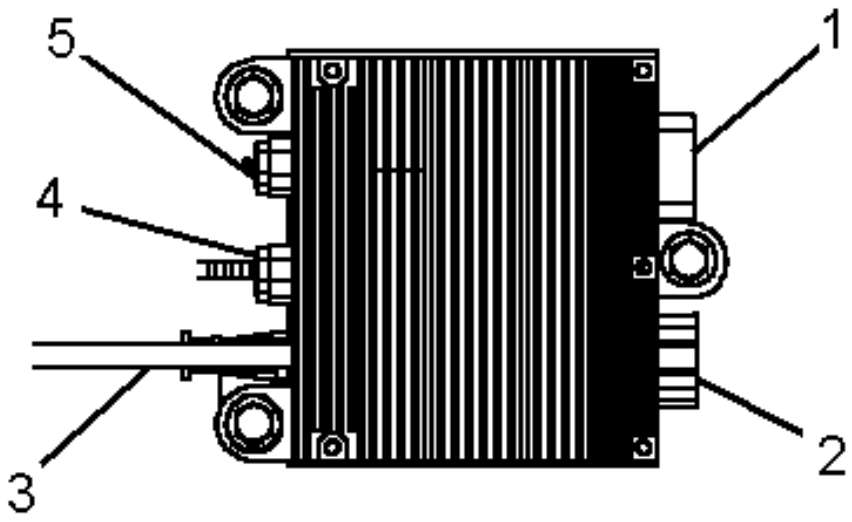



**Figure 380**

1. 23–WAY SIGNAL CONNECTOR
2. 8–WAY DEVICE (OUTPUT) POWER CONNECTOR
3. MODULE POWER FEED (DIRECT FROM BATTERY OR STARTER STUD)
4. INPUT DATA LINK AND POWER CONNECTOR
5. OUTPUT DATA LINK AND POWER CONNECTOR OR TERMINATING RESISTOR (3559775C1)

An overlay harness is available to connect the RPM to the body builder data link. The overlay harness must be connected between the open connector of the first module and the open connector in the second.

The RPM communicates with the ESC on the body builder data link. The RPM must be connected to the data link correctly to operate. If the vehicle isn't already configured with a body builder data link, circuits will have to be added. This includes connecting the ESC connector, adding a "Y" connector, installing overlay harnesses and insuring terminating resistors are installed. Refer to Body Builder Data Link(See BODY BUILDER DATA LINK, page 69) and the circuit diagram book for details.

## RPM ADDRESSING

**NOTE – When the address of an existing RPM is changed or an additional RPM is added, the ESC programming must be changed accordingly.**

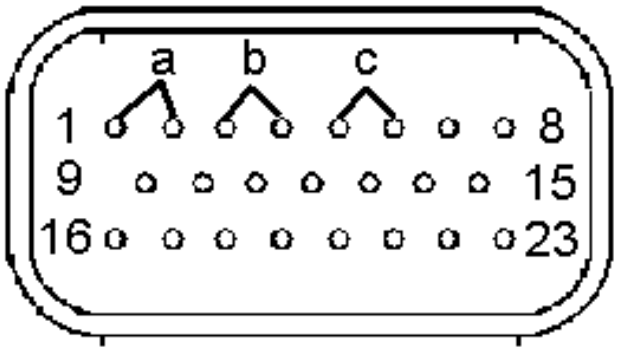
Each RPM has a data link "address" established by way of the first six pins of the 23 pin signal connector, location J4 shown in the jumper location table (See Table 264, page 762). Although the electrical multiplex system allows many signals to be communicated through two wires, strict rules for addressing of these multiplexed modules must be followed. In this system, all RPM modules are identical, but the addressing jumpers in the 23 pin connector customizes each module with a unique address so communication with the Electrical System Control module can be properly decoded.

Any RPM installed by International should already have the proper "addressing jumper wires" installed in the 23 pin signal connector. The technician must be careful to re-install the 23 pin signal connector to the same RPM if the connector was temporarily removed to install remote switch input wires.

The RPM system will not operate with the 23 pin connector removed and will log a diagnostic trouble code (DTC).

The 23 pin signal connector has a weather sealed membrane on the rear of the connector as long as connector pins have not been installed. If connector pins are installed and then removed, the membrane will be compromised and weather sealed pins need inserted into the cavities that previously had wires installed. Test remote module operation when wiring modifications are complete.

**Table 264 Jumper Locations**

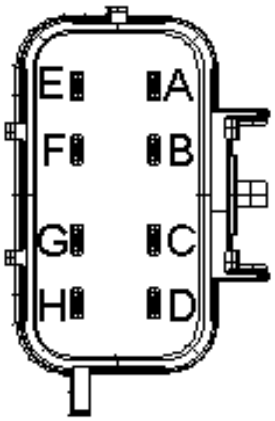



| RPM Location | Jumper Location a. | Jumper Location b. | Jumper Location c. |
|---|---|---|---|
| First RPM back of cab or under cab (RPM #1) | X, pins 1 and 2 | | |
| Second RPM back of cab or under cab (RPM #2) | | X, pins 3 and 4 | |
| RPM end of frame rail (RPM #4) | | | X, pins 5 and 6 |
| RPM forward frame rail (RPM #7) | X, pins 1 and 2 | X, pins 3 and 4 | X, pins 5 and 6 |

## RPM Output Power Connector Circuits

**NOTE – The virtual fuse in the RPM will trip during a short. Cycling the assigned control switch will reset the fuse.**

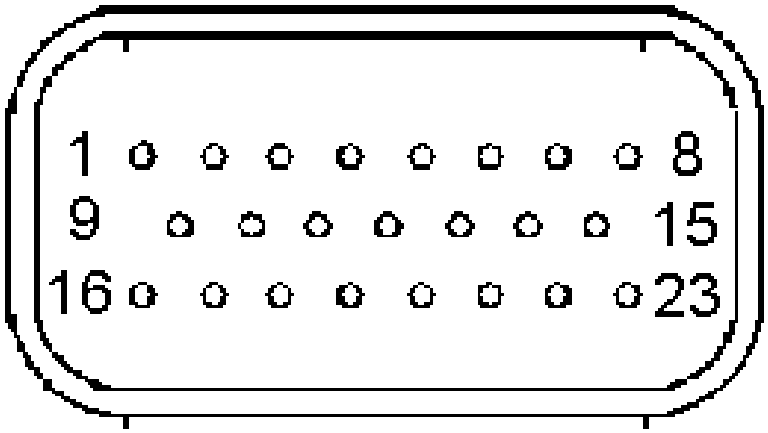
**Table 265 RPM Output Power Connector**

| Power Connector | | |
|---|---|---|
|  | | |
| Pin | Signal Name | Signal Direction |
| A | Output #1 | Output |
| B | Output #2 | Output |
| C | Output #3 | Output |
| D | Output #4 | Output |
| E | Output #5 | Output |
| F | Not Used | |
| G | Not Used | |
| H | Output #6 | Output |

## CHASSIS SWITCH INPUTS TO RPM'S

The RPM has inputs on the module itself that can be programmed to control the outputs. The output channels may be controlled remotely by using a three position momentary single pole, double throw switch on each remote switch input. In this case, battery volts should be connected to one pole of the switch and ground should be connected to the other. Applying battery volts to the remote switch input shall turn the output channel "ON". Applying ground to the remote switch input shall turn the output channel off.

**Table 266 Remote Power Module Signal Connector**

| Signal Connector |
|---|
|   |

| Pin | Signal Name | Signal Direction |
|---|---|---|
| 18 | Input # 1 | Switch input |
| 19 | Input # 2 | Switch input |
| 20 | Input # 3 | Switch input |
| 21 | Input # 4 | Switch input |
| 22 | Input # 5 | Switch input |
| 23 | Input # 6 | Switch input |

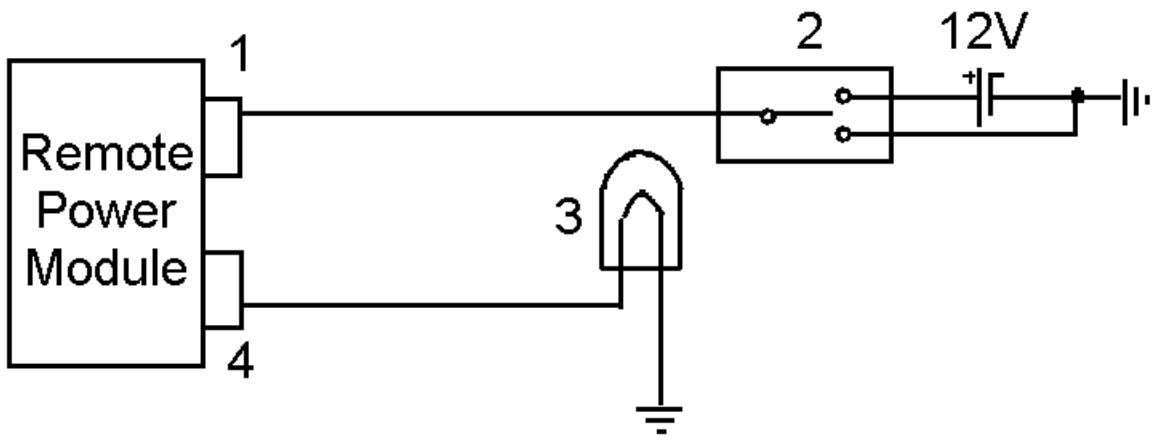



**Figure 381 RPM–Chassis Switch Circuits**

1. RPM 23–WAY SIGNAL CONNECTOR
2. USER PROVIDED SWITCH
3. USER PROVIDED LOAD DEVICE
4. RPM 8–WAY DEVICE (OUTPUT) POWER CONNECTOR

## 19.5. COMPONENT LOCATIONS

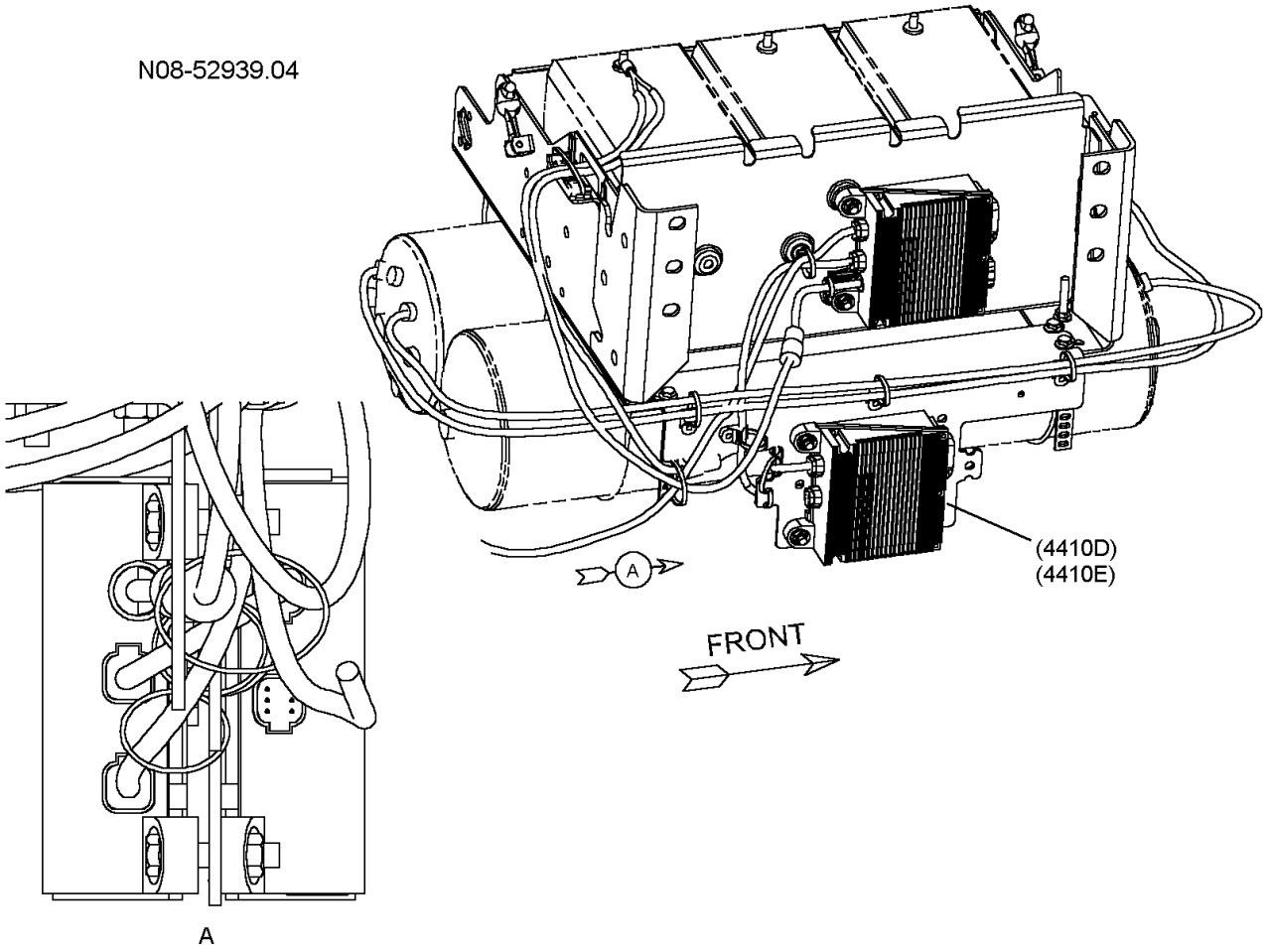



**Figure 382 Remote Power – Back of Cab Location**

(4410D), (4410E) REMOTE POWER MODULES

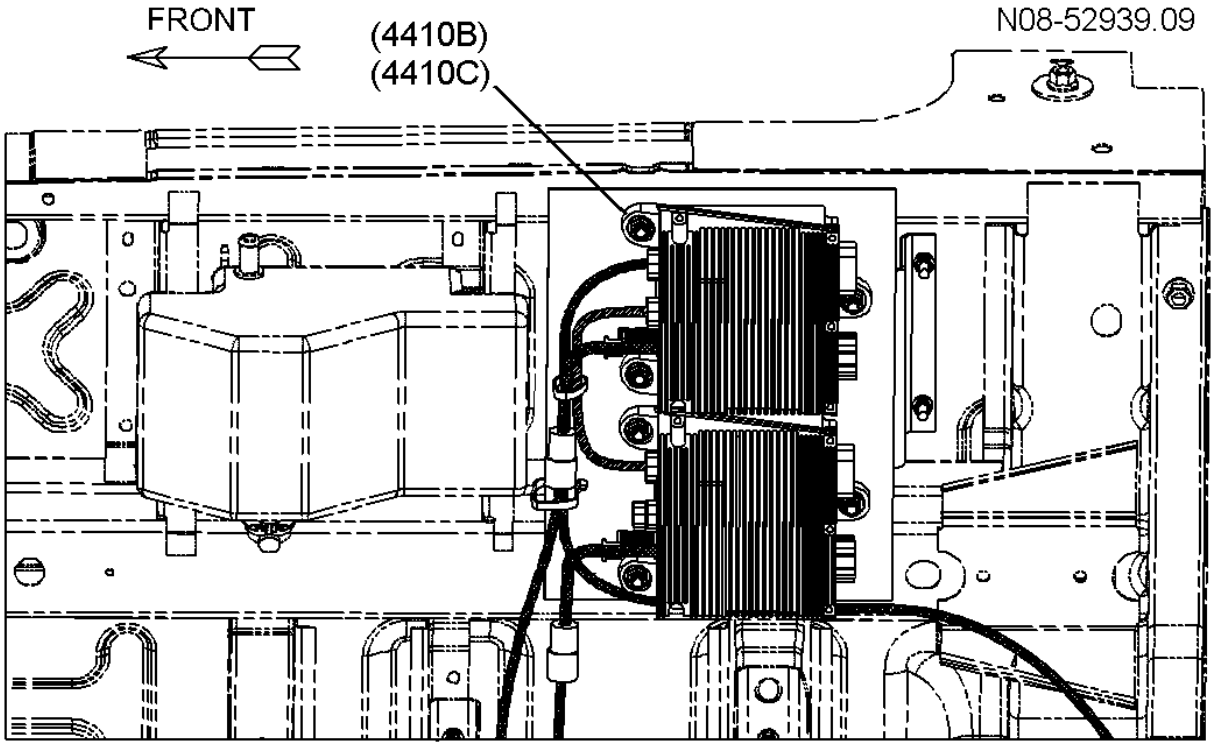



**Figure 383 Remote Power Module – Under Cab Location**

(4410B), (4410C) REMOTE POWER MODULES

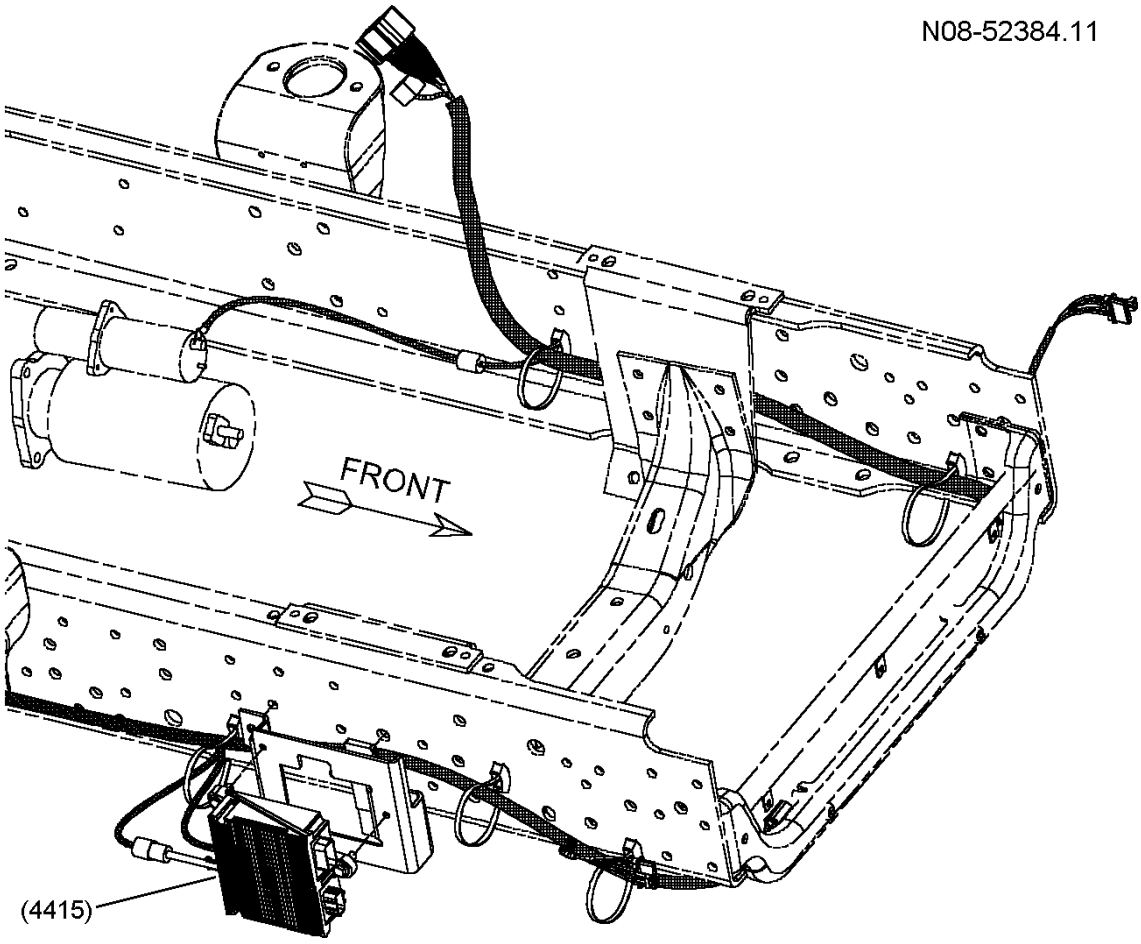



**Figure 384 Remote Power – Front Location**

(4415) FORWARD REMOTE POWER MODULE

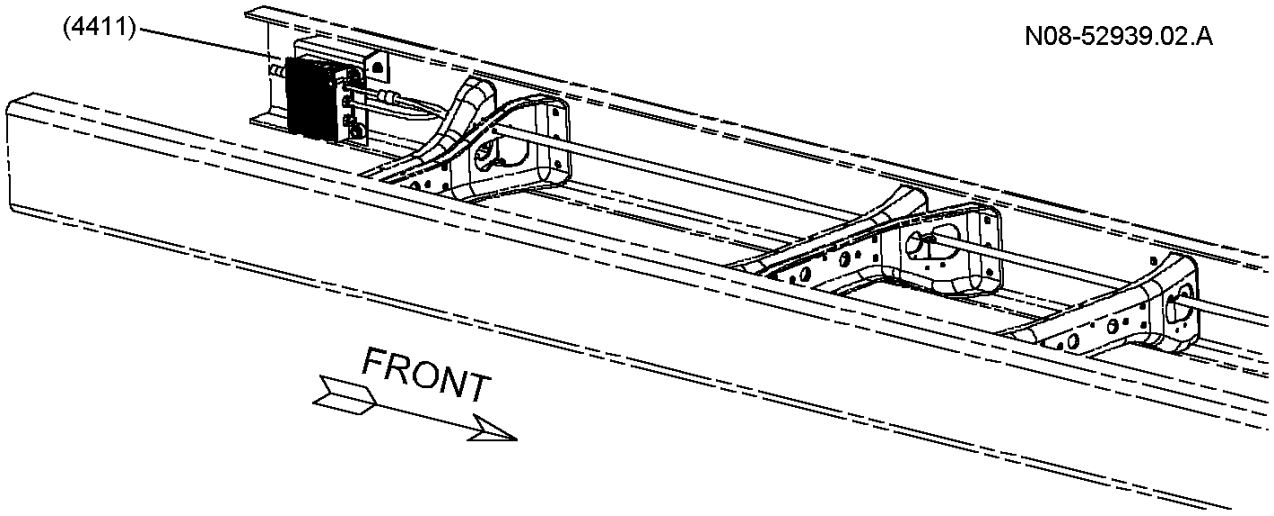



**Figure 385 Remote Power Module – Rear Location**

(4411) REMOTE POWER MODULES FEED

# 20. SUSPENSION DUMP

## 20.1. CIRCUIT FUNCTIONS

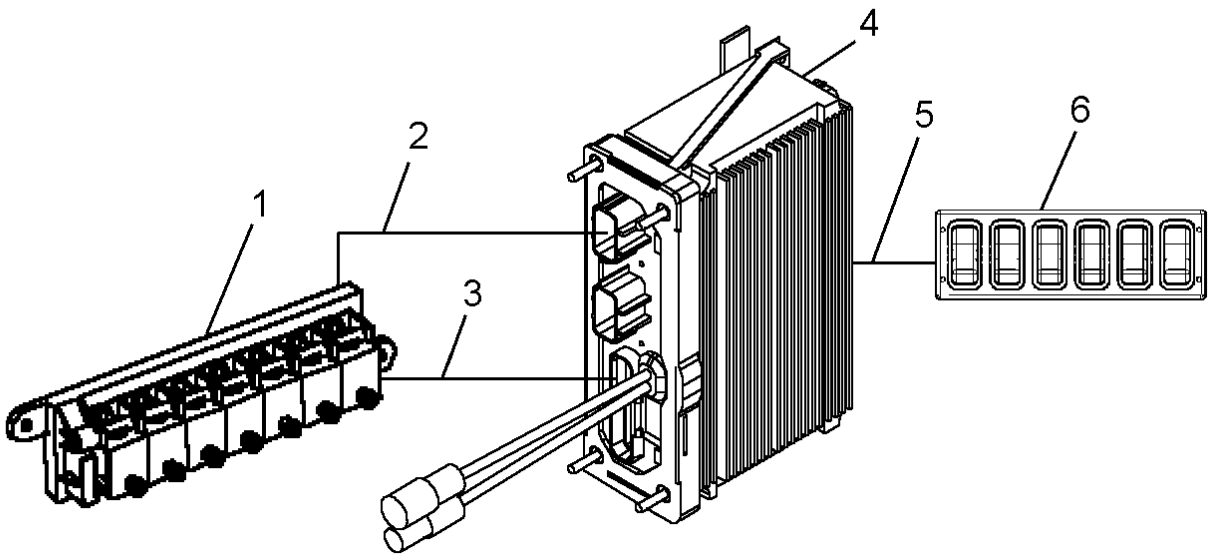



**Figure 386 Suspension Dump Function Diagram**

1. 7 PACK 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.

## 20.2. 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 124). The ESC will also log DTCs for problems in the 4–pack remote air solenoid module (RASM), (See AIR SOLENOID MODULE (4–PACK), page 729) or the 7–pack RASM, (See REMOTE AIR SOLENOID MODULE (7–PACK), page 742).

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

An electronic service tool, running the "INTUNE" 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 267 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.<br><br>Turn on suspension dump. | Observe suspension | Suspension air bags should deflate | Suspension 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 267 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 772) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

## 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 1025)

## 20.3. COMPONENT LOCATIONS

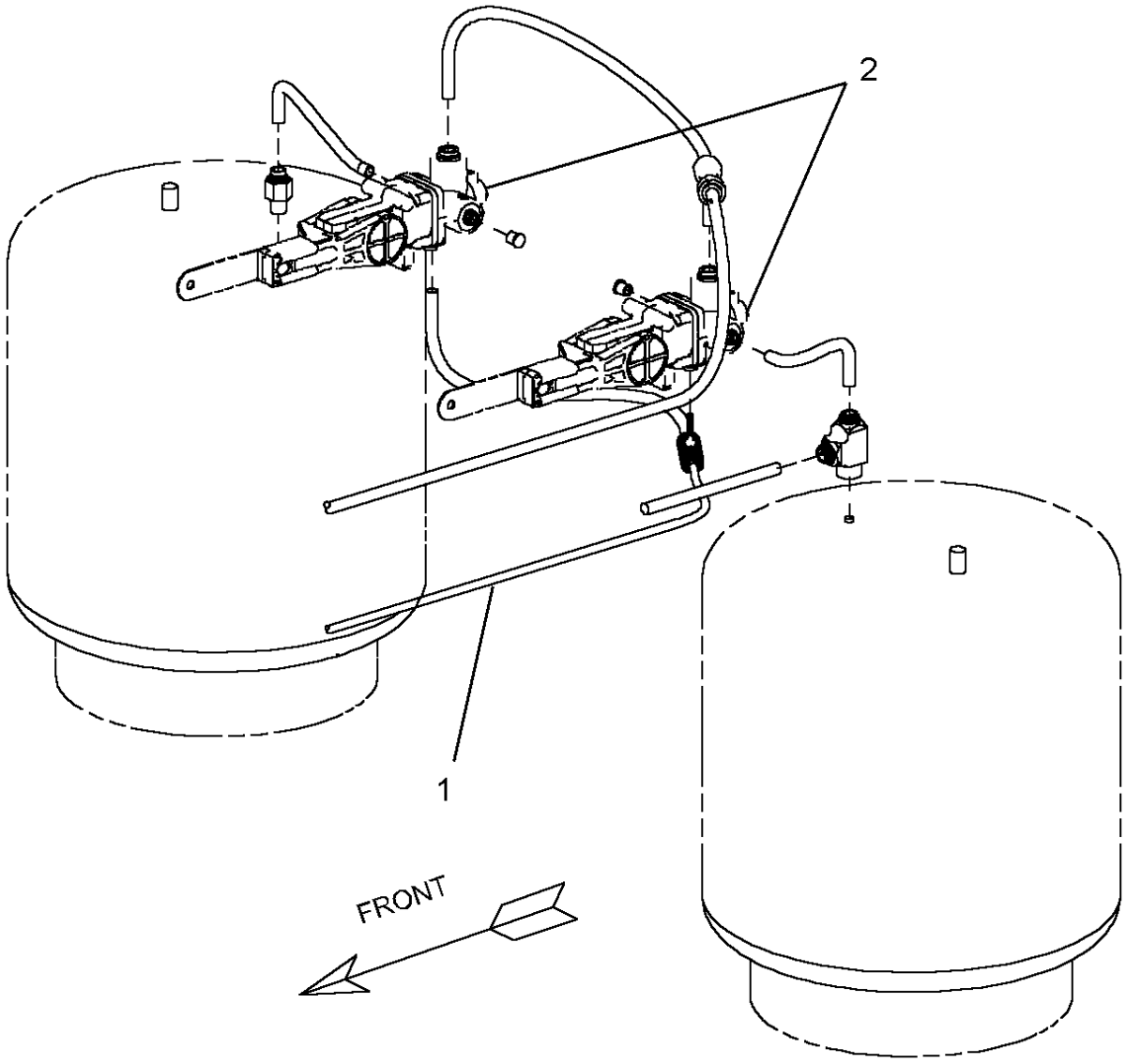



**Figure 387 Air Suspension Valves**

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

# 21. AIR SUSPENSION SOLENOID

## 21.1. CIRCUIT FUNCTIONS

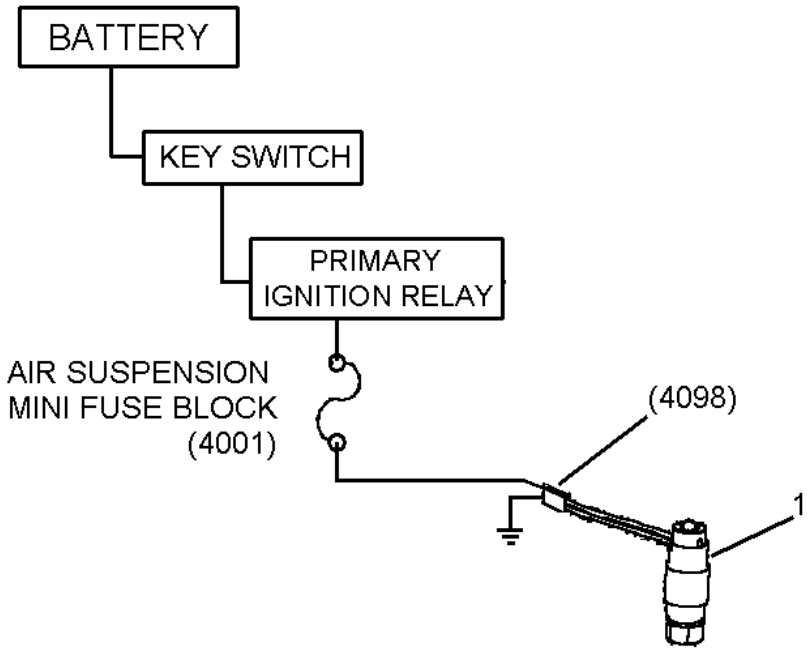



**Figure 388 Air Suspension Function Diagram**

1. AIR SUSPENSION SOLENOID AND SV1 VALVE
(4001) AIR SUSPENSION MINI FUSE BLOCK
(4098) AIR SUSPENSION SOLENOID HARNESS CONNECTOR

The air suspension solenoid and the SV1 valve prevents the air suspension from re-inflating dumped air bags after the ignition is turned off.

## 21.2. DIAGNOSTICS

A failure in the air suspension solenoid electrical circuits would prevent the suspension air bags from inflating.

### Air Suspension 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 268 Air Suspension 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.<br><br>Air suspension dump off. | Observe suspension air bags. | Air bags should inflate. | Air suspension solenoid is working correctly. | Go to next step. |
| 2. | On | Verify problem is not caused by an air plumbing problem. If it appears that the air suspension solenoid is not operating, go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 775) | | | | |

## 21.3. FAULT DETECTION MANAGEMENT

A fault in the air suspension solenoid circuits will be apparent when the air bags will not inflate when the ignition is on and the suspension dump switch is off.

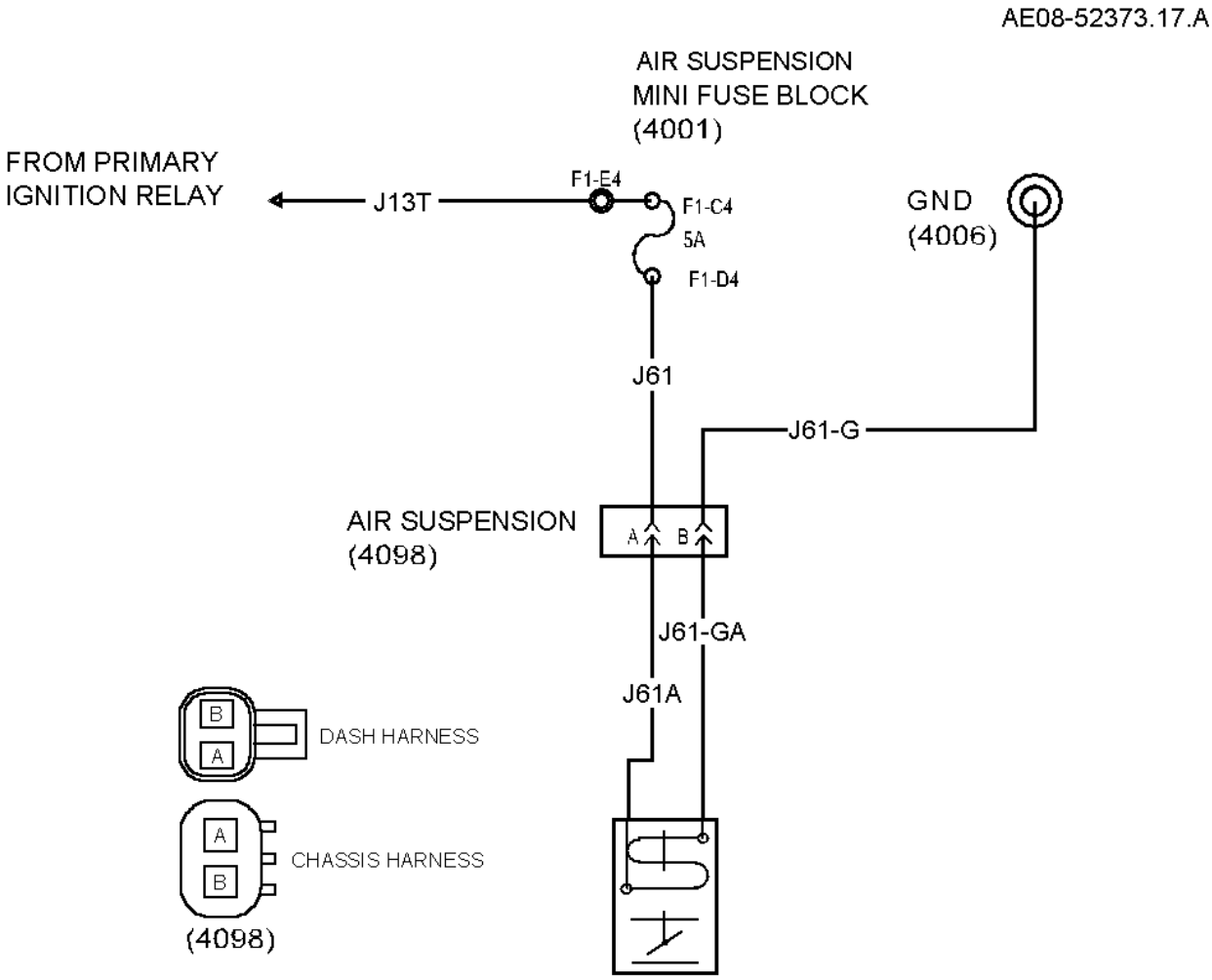



**Figure 389 Air Suspension Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information**

1. AIR SUSPENSION SOLENOID
   LOCATED ON CROSSMEMBER OF THE FRAME

(4001) AIR SUSPENSION MINI FUSE BLOCK
   LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER

(4006) GROUND CHASSIS TERMINAL
   LOCATED NEAR ENGINE COMPARTMENT POWER DISTRIBUTION CENTER

(4098) AIR SUSPENSION SOLENOID HARNESS CONNECTOR
   LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

**Table 269 Air Suspension Solenoid Connector (4098) Voltage Checks**

| Air Suspension Solenoid Connector (4098) Voltage Checks — Check with (4098) disconnected and Ignition Key “On”)<br><br>Check for blown 5 amp fuse in engine compartment power distribution center | | |
|---|---|---|
| Test Points | Spec. | Comments |
| Harness connector cavity A to ground. | 12 ± 1.5 volts | If voltage is incorrect, check for blown 5 amp fuse in mini fuse block or an open or short in circuit J61 to fuse. |
| Harness connector cavity A to B. | 12 ± 1.5 volts | If voltage is incorrect, check for open in circuit J61–G to ground.<br><br>If voltages check good, consider replacing air solenoid. |

## 21.4. COMPONENT LOCATIONS

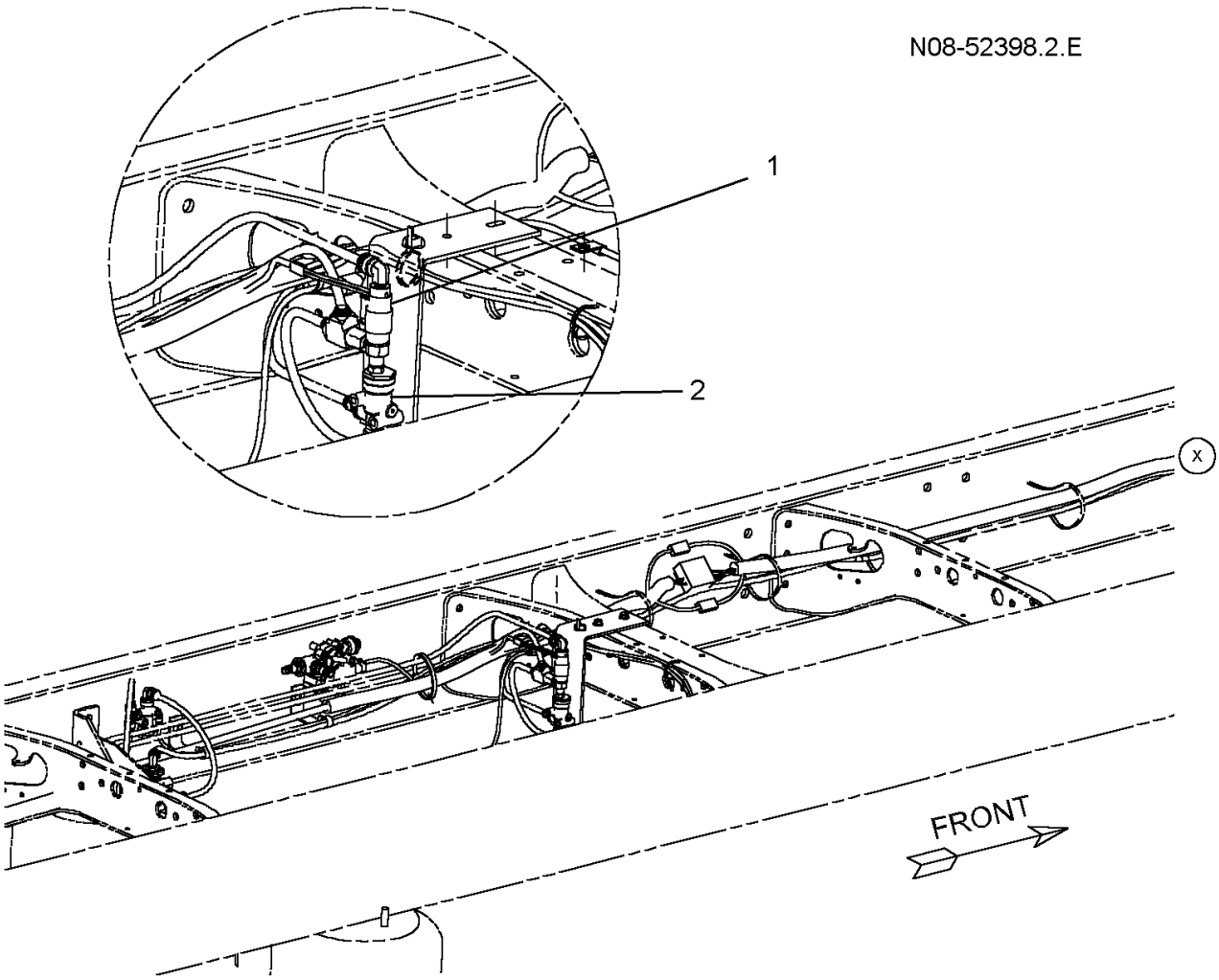



**Figure 390 Air Suspension Solenoid Location**

1. AIR SUSPENSION SOLENOID
2. SV1 VALVE

# 22. AUXILIARY AIR SUSPENSION

## 22.1. CIRCUIT FUNCTIONS

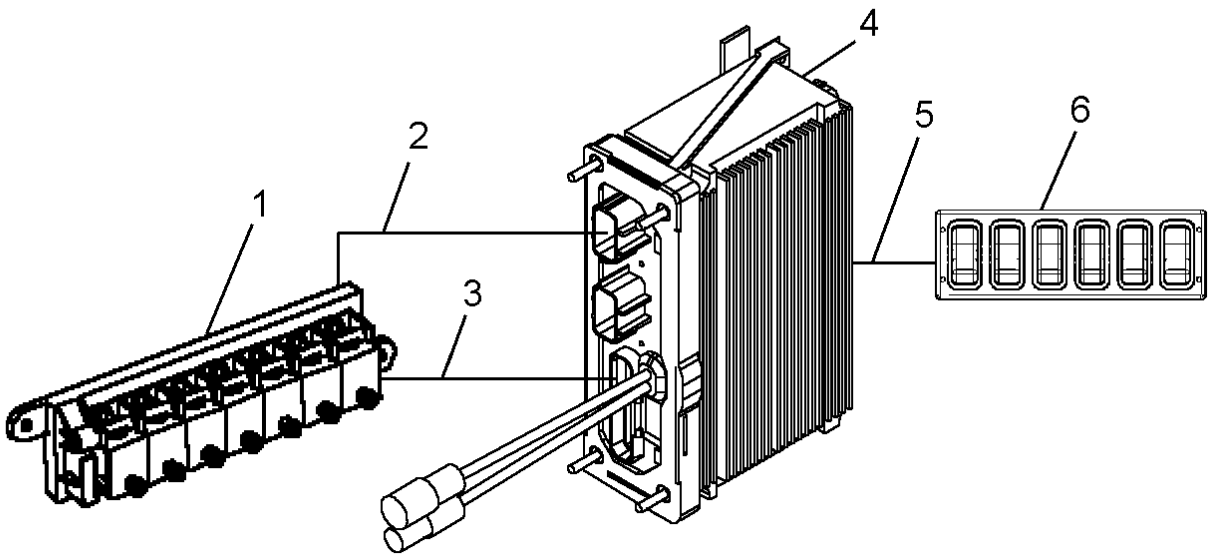



**Figure 391 Auxiliary Air Suspension Function Diagram**

1. 7 PACK 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

The auxiliary air suspension is for use on vehicles that are occasionally not balanced from side to side, such as a dump truck that has a side wing plow attached during the winter. This system would have an appropriately sized air bag in the front corner that would adjust for the extra weight. The driver would then have a switch on the dash to energize (inflate) or de-energize (deflate) the system. This switch would be an input to the ESC that would then drive an air solenoid, on a remote air solenoid module, for the air bag. This feature only operates with the ignition on.

In the event of a switch error, the resultant would be transmitted as off. In the event of an air solenoid failure due to shorting, this feature will request the ESC to turn off power to the air solenoid pack (or packs) to prevent uncontrolled operation of the solenoid.

In the event of a switch error, the indicator in the switch will be set to a slow blink if the ignition is on, but due to constraints the indicator will only flash when the key is in the "run" position. If this feature commands its driven solenoid to turn on and the solenoid pack power has been turned off, this feature will blink the switch indicator slowly to communicate an error has prevented this feature from functioning.

## 22.2. DIAGNOSTICS

### Auxiliary Air Suspension 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 270 Auxiliary Air Suspension 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.<br><br>Attempt to operate the auxiliary air suspension. | Observe suspension | Suspension air bag should inflate or deflate. | Auxiliary suspension is working. | Go to next step. |
| 2. | On | With auxiliary air suspension 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. |
| 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 780) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

### 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 1025)

## 22.3. COMPONENT LOCATIONS

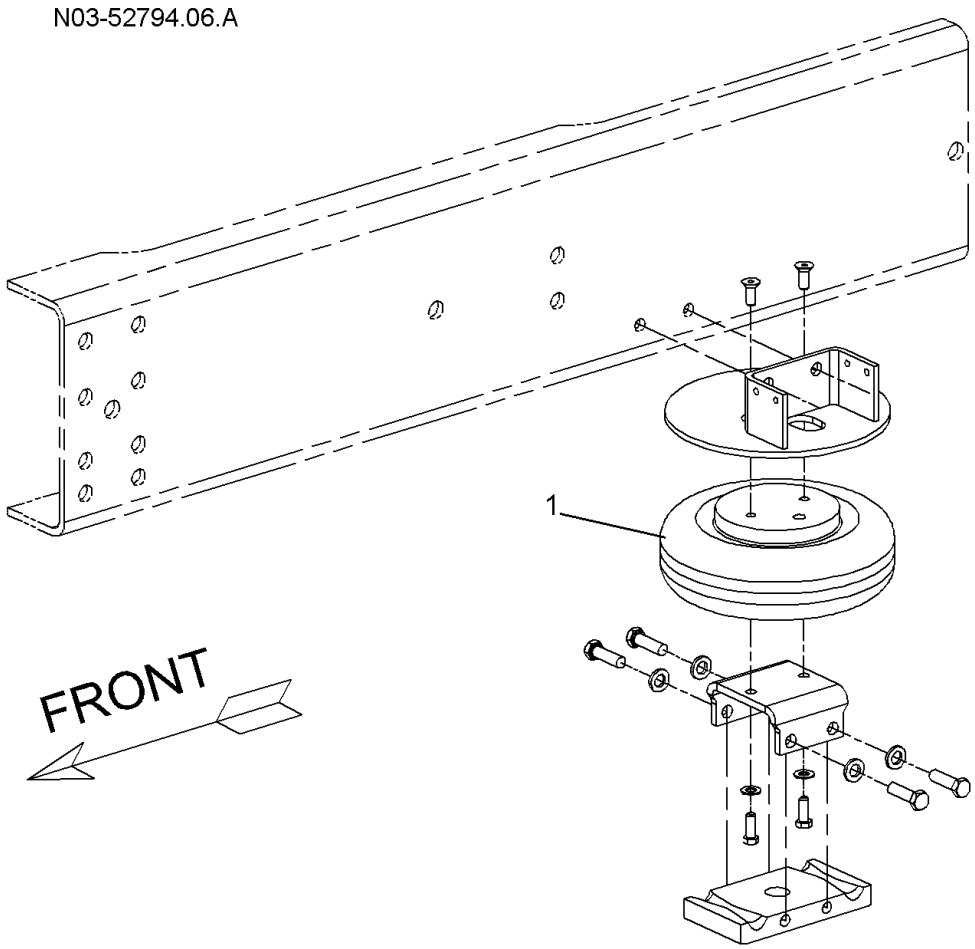



**Figure 392 Auxiliary Air Suspension Location (Left Front Shown)**

1. AIR BAG AIR SOLENOID

# 23. DIFFERENTIAL LOCK

## 23.1. CIRCUIT FUNCTIONS

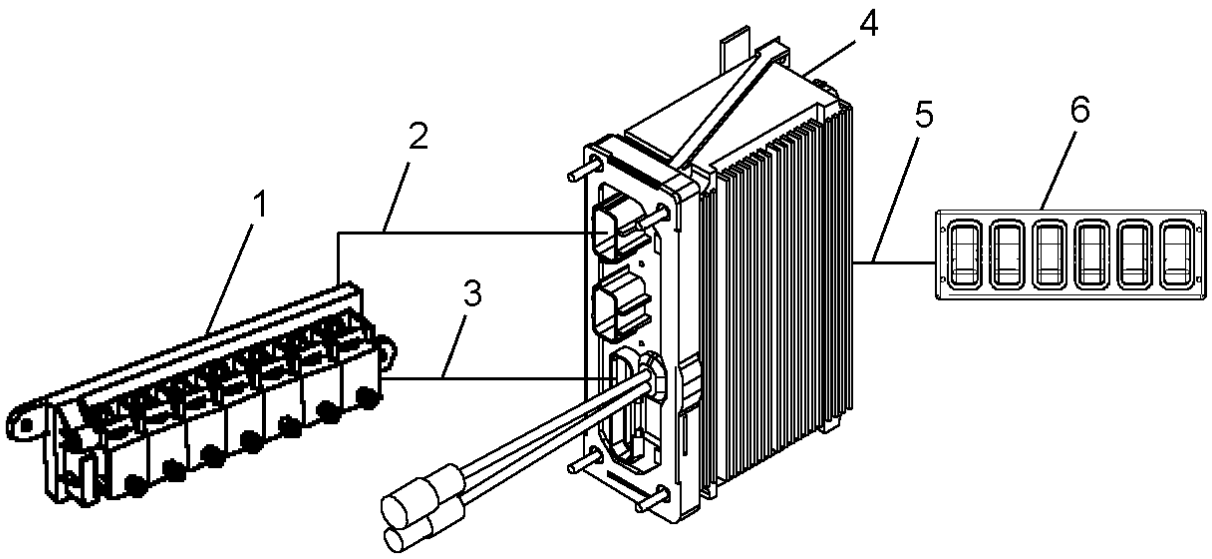



**Figure 393 Differential Lock Function Diagram**

1. 7 PACK 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

Driver controlled locking differential, when engaged helps prevent one side tire taking the majority of the power while slipping. Locking differential can only be engaged below maximum differential lock engagement speed (default 25 mph/40 Km). It will also disengage when the vehicle is speed is greater that maximum differential lock speed (default 25 mph/40 Km).

When the “differential lock” switch is turned on (flipped up), the vehicle is below maximum differential locking engagement speed (default 25 mph/40 Km), and no errors or flags are present, the ESC will command the air solenoid to engage the locking differential. When the vehicle exceeds maximum differential lock speed, the differential lock will disengage.

Locking differential disengaged (Off) is the default and fail-safe range. If the differential lock switch is set to On (up position) but the vehicle speed is greater than maximum allowed differential locking speed the locking differential will not engage. If the locking differential is engaged and the vehicle exceeds the maximum differential locking speed the ESC will command (remove power) disengagement of the locking differential. When the vehicle decreases speed to maximum differential locking speed or less the differential lock will not re-engage until the driver re-initiates differential lock (turns off then back on).

If the switch is set On but the vehicle is speed is greater than (default 25 mph/40 Km), 5 short beeps will be generated and the switch ON light will continuously flash at a fast rate until differential lock is turned Off. Even if vehicle speed is reduced the Differential Lock switch light will continue to fast flash until the differential lock switch is turned Off. If the dash switch is malfunctioning or the vehicle speed message is not received, the switch ON light will continuously flash at a slow rate.

## 23.2. DIAGNOSTICS

### Differential Lock 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 271 Differential Lock 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.<br><br>Attempt to operate the differential lock. | | Differential locks. | Differential lock is working. | Go to next step. |
| 2. | On | With differential lock 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. |
| 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 783) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

### 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 1025)

## 23.3. COMPONENT LOCATIONS

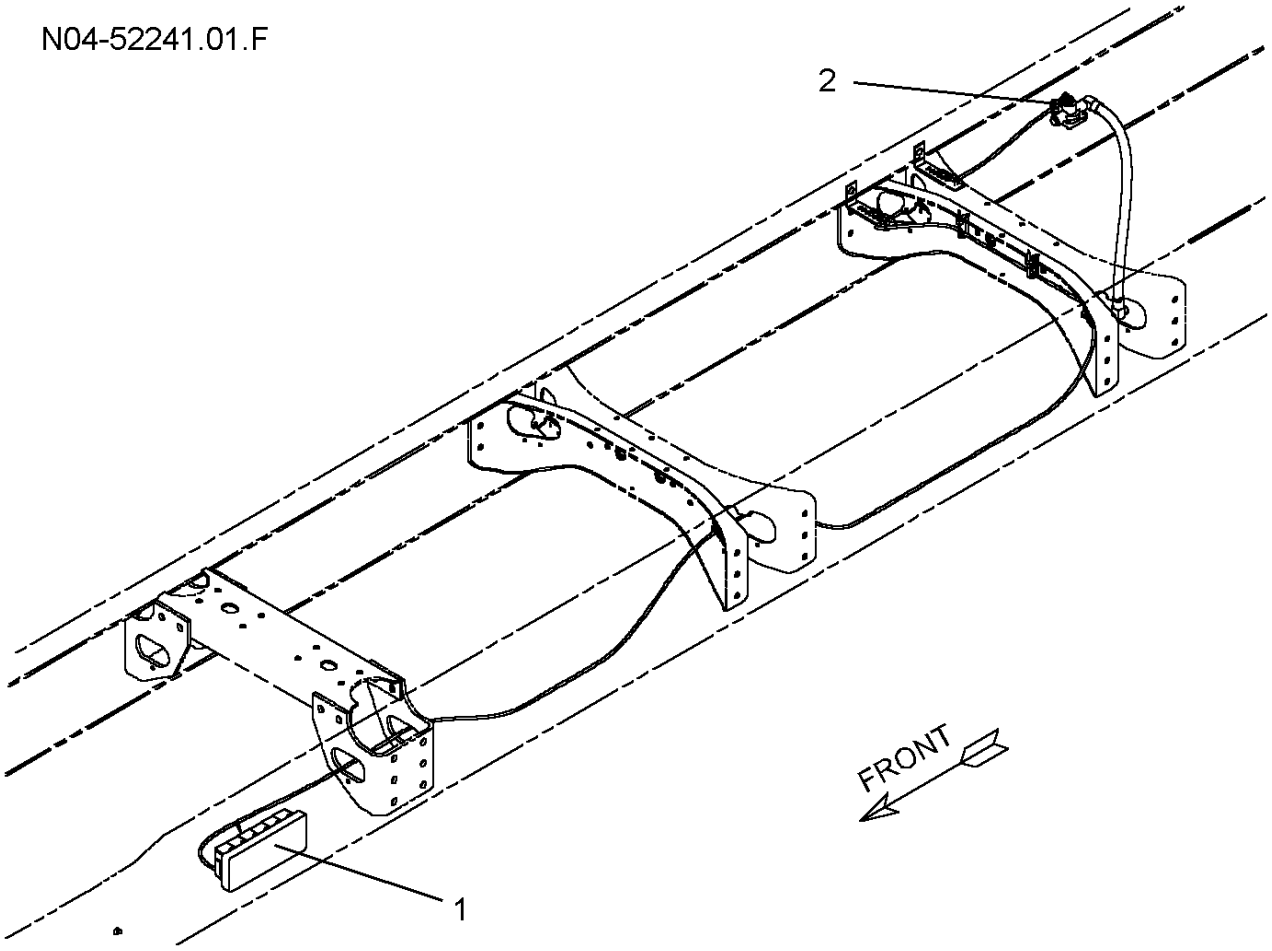



**Figure 394 Typical Differential Lock Air Solenoid Location**

1. REMOTE AIR SOLENOID PACK
2. DIFFERENTIAL LOCK AIR SOLENOID

# 24. POWER DIVIDER LOCK

## 24.1. CIRCUIT FUNCTIONS

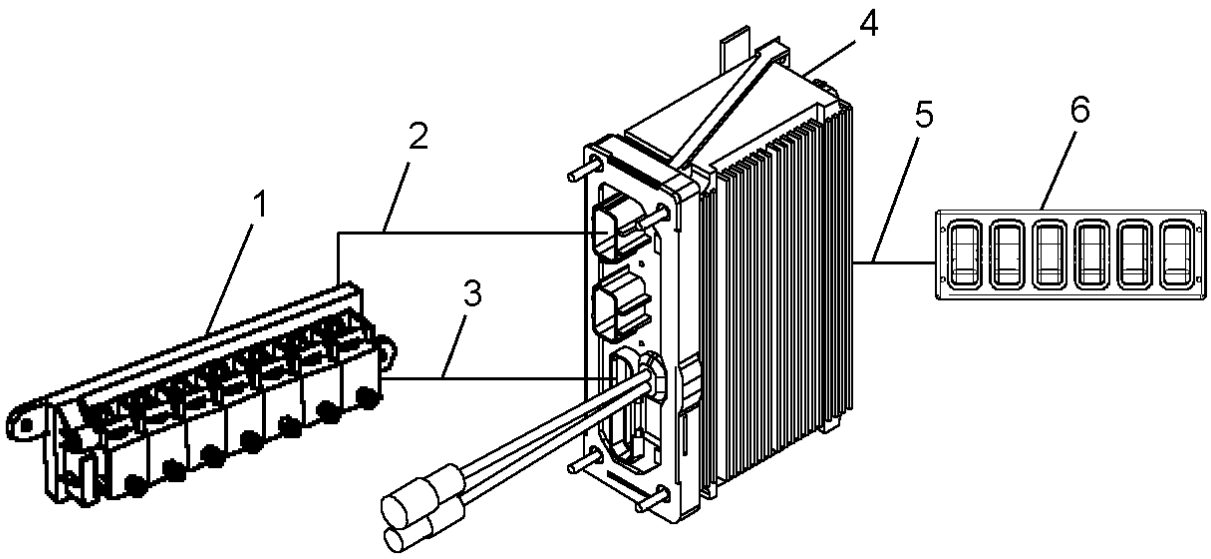



**Figure 395 Power Divider Lock Function Diagram**

1. 7 PACK 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 system uses an electronically controlled air solenoid to supply pilot air to a larger air solenoid which will control the feature.

The position of the switch on the dash panel is communicated to the ESC. The ESC will send signals to a remote air solenoid module containing the relay configured to operate the feature. Two different solenoid packs may be used to control the air pressure. The 7 solenoid version is controlled by J1939 messages and the 4 solenoid version by discrete wire.

Driver controlled Power Divider Lock (PDL) when engaged, can lock the front axle and the rear axle of a tandem axle. This helps prevent one axle from taking the majority of the power while slipping. Some drivers may desire (as an option) a visual warning when the vehicle has exceeded a set speed. This is referred to as the PDL warning speed (default set at 160kph/100mph ).

When the PDL Lock switch is turned on (flipped up) the ESC will command the air solenoid to engage the PDL.

Power Divider Lock disengaged (Off) is the default and fail-safe range. If the PDL switch fails (error condition exists) PDL will disengage or not engage.

If the switch is set on but the vehicle is speed is greater than PDL warning speed the switch ON light will continuously fast flash and 5 beeps will occur until the speed is reduced 3 kph below PDL warning speed or the PDL switch is turned off. If the dash switch is malfunctioning or the vehicle speed message is not received, the switch ON light will continuously slow flash.

## 24.2. DIAGNOSTICS

### Power Divider Lock (PDL) 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 272 Power Divider Lock (PDL) 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.<br><br>Attempt to operate the Power Divider Lock (PDL). | | (PDL) locks. | (PDL) is working. | Go to next step. |
| 2. | On | With (PDL) 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. |
| 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 783) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

## 24.3. COMPONENT LOCATIONS

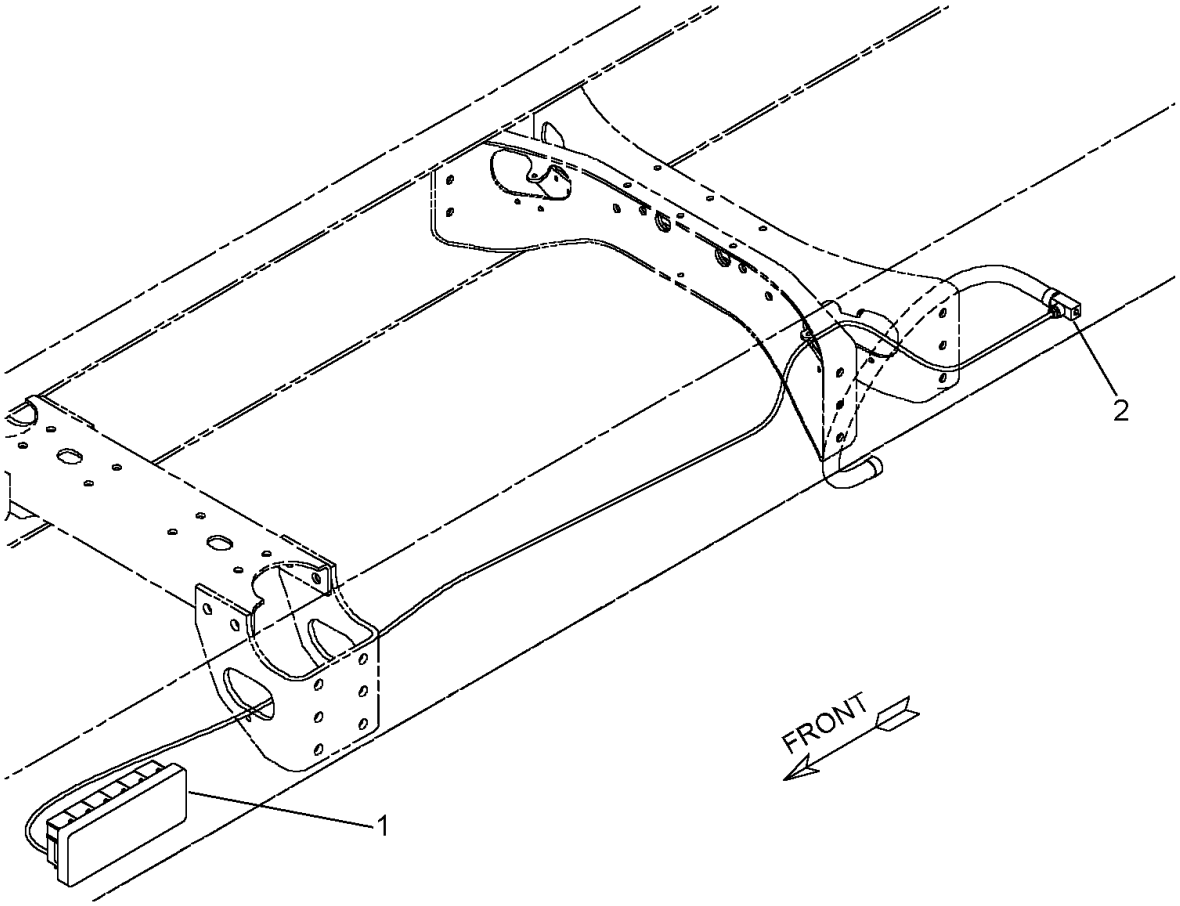



**Figure 396 Typical Power Divider Lock (PDL) Air Solenoid Location**

1. REMOTE AIR SOLENOID PACK
2. POWER DIVIDER LOCK (PDL) AIR SOLENOID

# 25. 5TH WHEEL SLIDE, AIR CONTROLLED

## 25.1. CIRCUIT FUNCTIONS

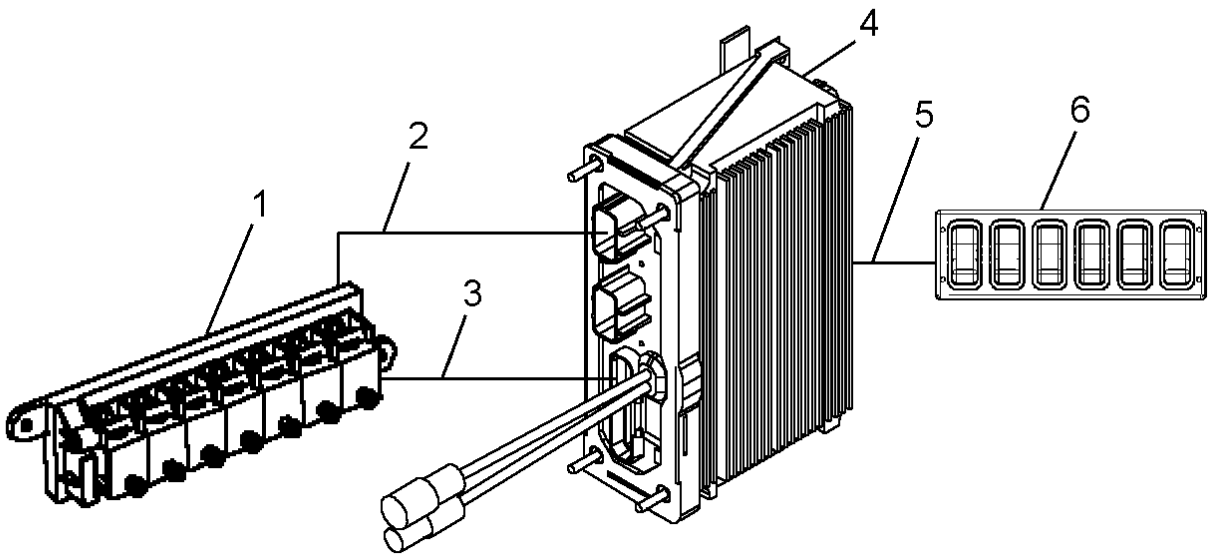



**Figure 397 5th Wheel Slide Function Diagram**

1. 7 PACK 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 system uses an electronically controlled air solenoid to supply pilot air to a larger air solenoid which will control the feature.

The position of the switch on the dash panel is communicated to the ESC. The ESC will send signals to a remote air solenoid module containing the relay configured to operate the feature. Two different solenoid packs may be used to control the air pressure. The 7 solenoid version is controlled by J1939 messages and the 4 solenoid version by discrete wire.

The 5th Wheel Slide feature provides the operator with the ability to release and lock a sliding 5th wheel via switches in the cab.

This feature allows the operator to release the 5th wheel in order to adjust its position forward or backward in order to adjust the distribution of the trailer weight over the rear axle(s). In addition, this feature allows the operator to move the 5th wheel towards the tractor. This increases the maximum allowable length for the trailer.

Whenever the 5th wheel is released, the 5th wheel slide switch indicator shall be illuminated. Adjustment of the 5th wheel slide will be prohibited and the 5th wheel slide will be locked if the vehicle speed exceeds the vehicle speed as specified by a programmed parameter.

Whenever movement of the 5th wheel slide is prohibited due to excessive speed, the switch indicator will flash slowly. Once this feature is in the inhibited state, the 5th wheel slide shall remain locked until the 5th wheel slide switch is cycled, the vehicle speed is reduced to below the maximum allowable vehicle speed, and there are no relevant switch or data link errors present.

Upon the occurrence of a switch error or J1939 data link error, the 5th wheel will be locked regardless of the physical state of the switches.

The 5th wheel slide shall be locked when the 5th Wheel Slide switch is set to OFF.

The 5th wheel slide shall be released when the following requirements have been met:

- The key is in the run position.
- There is no 5th wheel slide switch error present.
- The vehicle speed is below the maximum allowable speed default of 2 MPH
- There is no 1939 data link vehicle speed error present.
- The 5th wheel slide is not currently inhibited.

While the 5th wheel is released, detection of any of the following conditions shall cause the 5th wheel slide to be locked and inhibited and shall remain locked and inhibited until the 5th wheel slide switch has been cycled. Loss of communication with the 1708 switch pack that is providing the 5th wheel slide switch information. Loss of communication with the Drive Train J1939 data link that carries the vehicle speed information. Vehicle speed exceeds the maximum allowable speed default of 2 MPH. The 5th wheel slide switch indicator shall be set to ON steady, while the 5th wheel slide is released. The 5th wheel slide switch indicator shall be set to flash slowly when the release of the 5th wheel slide has been requested and power to the air solenoids has been interrupted due to a solenoid error. The 5th wheel slide switch indicator shall be set to flash slow whenever the operator has requested the 5th wheel slide to be released but the use of the 5th wheel slide is prohibited. The 5th wheel slide switch indicator shall be set to OFF when the 5th wheel slide switch is set to OFF. The 5th wheel slide will be locked and the 5th wheel slide switch indicator will be off when the key is not in the run position.

Detection of any of the following conditions shall cause the 5th wheel slide to be locked. Loss of communication with the 1708 switch pack that is providing the 5th wheel slide switch information. Loss of communication with the Drive Train J1939 data link that carries the vehicle speed information. Vehicle speed exceeds the maximum allowable speed as specified per a parameter. A 5th wheel slide switch error is detected. The key is not in the run position.

Detection of any of the following conditions shall cause this feature to generate a request to interrupt the power to the air solenoid module and thus disabling all solenoids. The 5th Wheel slide solenoid status as reported by private J1939 data link indicates a short. This is requirement is applicable for the ASM 7 pack module. The 5th wheel slide solenoid status as reported by the SSC feedback indicates a short. This requirement is applicable when this feature is implemented using a 4 -pack ASM module.

## 25.2. DIAGNOSTICS

### 5th Wheel Slide 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 273 5th Wheel Slide 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.<br><br>Attempt to operate the 5th Wheel Slide. | | 5th Wheel Slides. | 5th Wheel Slide is working. | Go to next step. |
| 2. | On | 5th Wheel Slide switch on, check switch lamp. | Visually check 5th Wheel Slide switch lamp. | Switch lamp stays on. | Problem is in air system. Check air lines. | Go to next step. |
| 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 790) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

### 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 1025)

## 25.3. COMPONENT LOCATIONS

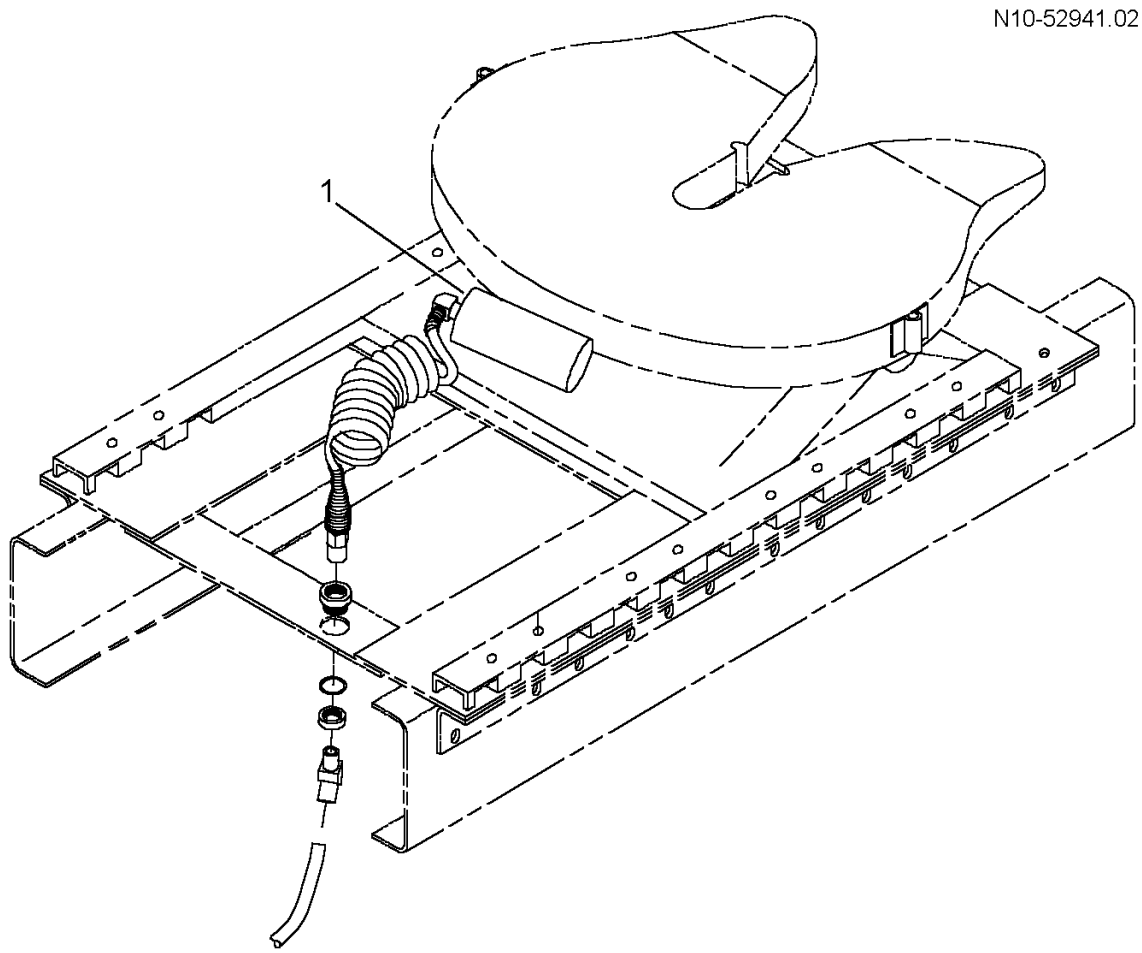



**Figure 398 5th Wheel Slide Location**

1. 5TH WHEEL LOCKING AIR SOLENOID

# 26. POWER TAKE OFF (PTO)

## 26.1. CIRCUIT FUNCTIONS

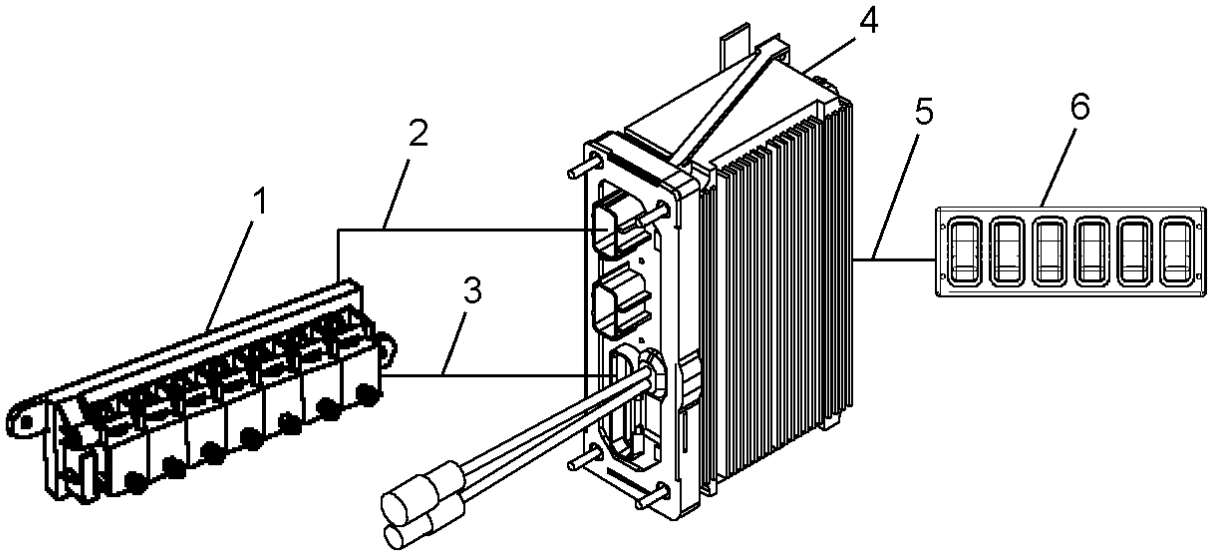



**Figure 399 PTO Electrical Function Diagram**

1. 7 PACK 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 use of external Power Take-Off provisions (i.e. salt spreaders, dump trucks, garbage haulers). This feature provides a dash switch and an output signal. The body builder will add the PTO hardware.

The speed of the engine will control the speed of the PTO through cruise control buttons.

When the PTO switch is in the up position, the PTO air solenoid will be energized while accessories are on. When the accessories are turned off or the PTO switch is put in the down position, the PTO air solenoid will be de-energized. The switch indicator will follow the solenoid command signal. In the event of switch data link failure or switch failure, the PTO air solenoid will be de-energized and the switch indicator will flash slowly. Likewise, if a short is detected in the PTO air solenoid, power to the solenoid pack will be removed. If power to the solenoid pack is removed, the indicator will flash slowly when a request is made to energize the solenoid.

## 26.2. DIAGNOSTICS

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the POWER TAKE OFF (PTO) and monitor activation of the POWER TAKE OFF (PTO) switch. See the diagnostic software manual for details on using the software.

### Power Take Off (PTO) 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 274 Power Take Off (PTO) 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.<br><br>Attempt to operate the Power Take Off (PTO). | | (PTO) operate. | (PTO) is working. | Go to next step. |
| 2. | On | With (PTO) 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. |
| 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 793) | 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 123) |
| 5. | Cross reference the DTC to the applicable section from the DTC table.(See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025) | | | | | |

### 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 1025)

# 27. PYROMETER/AMMETER MODULE (PAM)

## 27.1. 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), and/or the Auxiliary Gauge Switch Pack (AGSP) via the drivetrain J1939 data link. The information eventually is used to drive the ammeter.

## 27.2. 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 275 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.<br><br>Refer to DTC list (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025). | Read display on odometer. | DTC for PAM or gauge is active. | Follow the reference in the DTC list.<br><br>If references return you to this table, go to next step. | Go to next step. |

**Table 275 Pyrometer/Ammeter Module (PAM) Preliminary Check (cont.)**

| STEP | KEY | ACTION | TEST POINTS | SPEC. | YES - IN SPEC. | NO - OUT OF SPEC. |
|---|---|---|---|---|---|---|
| | | The PAM DTC is also described in the PAM DTC table in this section. | | | | |
| 2. | On | Verify datalink connections to PAM (4087–7, 8, & 9) are clean, tight and functional. | 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.<br><br>**NOTE – Loose or dirty connections in the sensing or charging circuits may cause inaccurate high readings on the ammeter.** | PAM circuit connections | Connections to PAM sensing and charging circuits are clean, tight and functional. | Trouble-shoot PAM.<br><br>Refer to Pyrometer/Ammeter Tests.(See Table 277, page 796) | Repair circuit connections, then recheck operation. |

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 table. (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 1025)

**Table 276 Pyrometer/Ammeter Module Diagnostic Trouble Codes**

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

## Pyrometer/Ammeter Module Tests

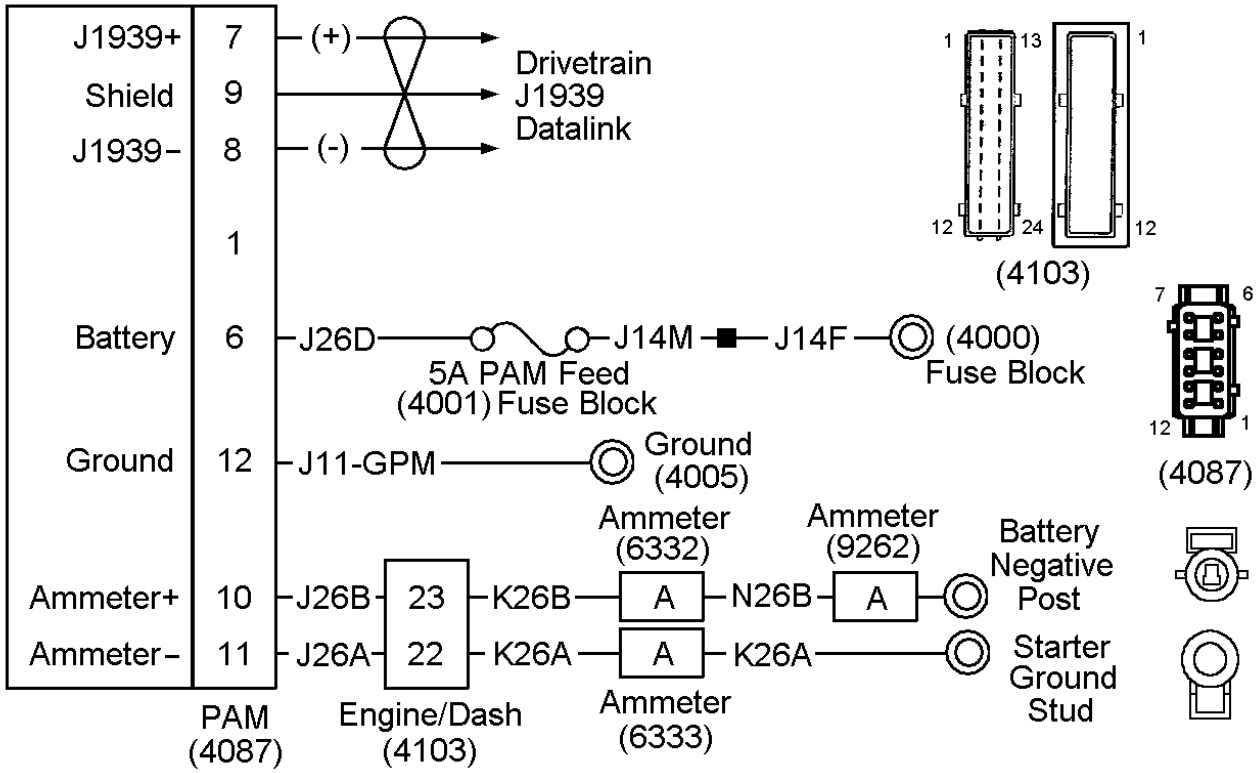



**Figure 400 Pyrometer/Ammeter Module Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(4001) PAM IGN & PAM FEED FUSES IN MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4005) GROUND
(4087) PAM MODULE CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR AIR FILTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET

**Table 277 Pyrometer/Ammeter Module Tests**

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

**Table 277 Pyrometer/Ammeter Module Tests (cont.)**

| | | |
|---|---|---|
| (4087) cavity 7 to cavity 12. | 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 “5A PAM FEED” fuse in mini fuse block. Also check for open or shorts in circuit J26D, J14M or J14F. |
| (4087) cavity 6 to cavity 12. | 12 ± 1.5 volts | If voltage is missing, check for open in circuit J11-GPM to ground stud (4005). |
| (4087) cavity 6 to cavity 10. | 12 ± 1.5 volts | If voltage is missing, check for open in circuit J26B, K26B or N26B.<br><br>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 J26A or K26A.<br><br>Verify connections are tight and corrosion free.<br><br>If all voltages are present, circuits to PAM are good. Replace PAM. |

## 27.3. COMPONENT LOCATIONS

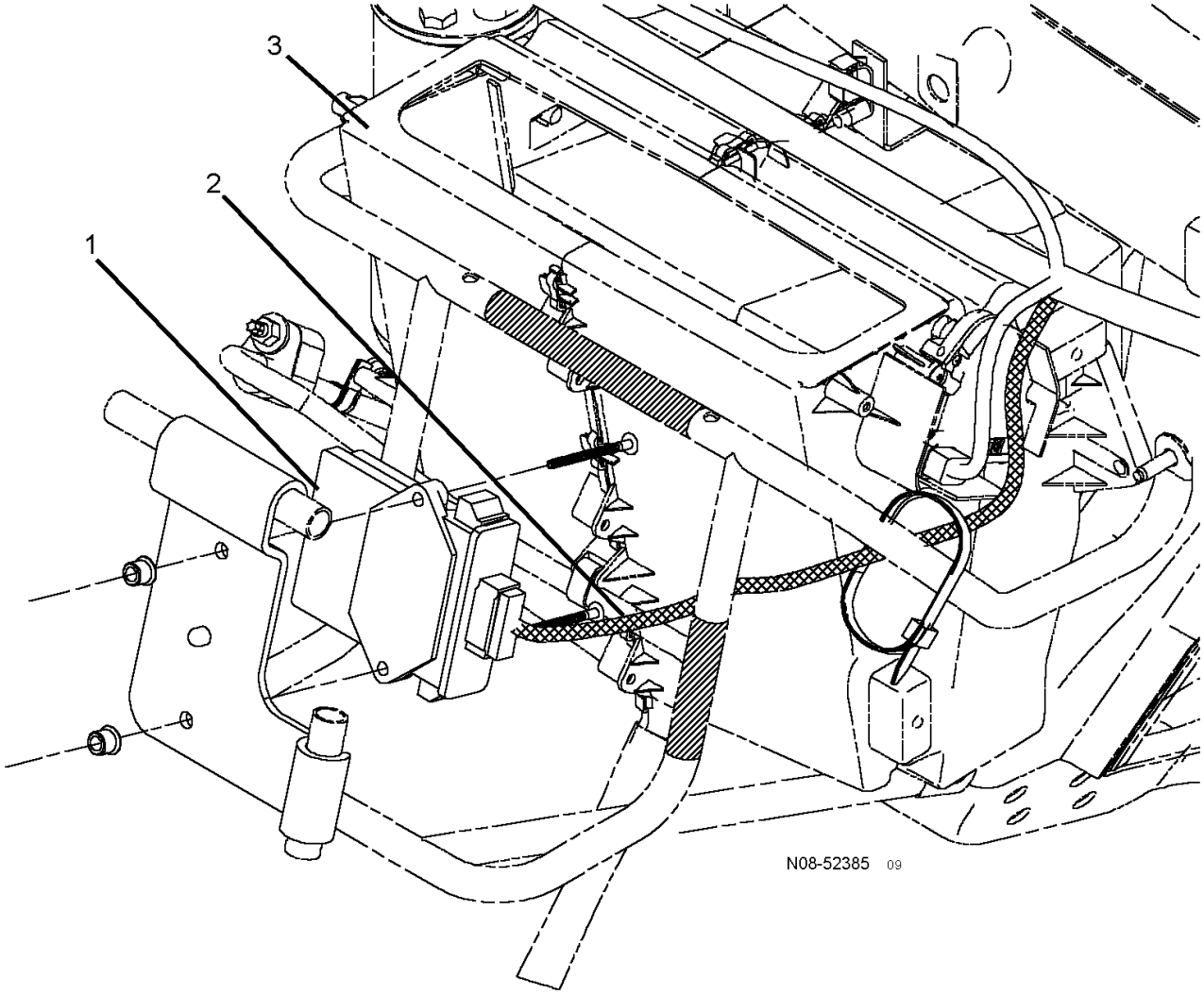



**Figure 401 Pyrometer Ammeter Module (PAM)**

1. PYROMETER AMMETER MODULE (PAM)
2. ENGINE HARNESS
3. HVAC AIR INLET / EVAPORATOR HOUSING

# 28. LIFT AXLES

Refer to Group 14 in the ISIS® Master Service Manual, Lift Axle Service Manual Section S14019 for information on the lift axle electrical system.

# 29. AIR ACTUATED PARK BRAKE

## 29.1. CIRCUIT FUNCTIONS

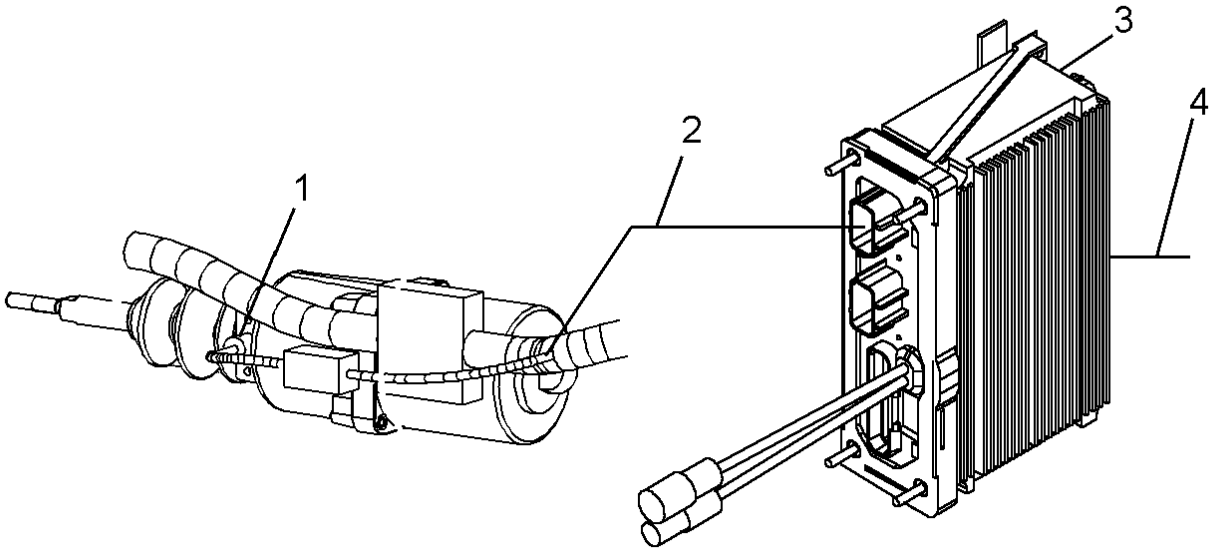



**Figure 402 Air Actuated Park Brake Function Diagram**

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.

## 29.2. 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 "INTUNE" 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 278 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.<br><br>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 278 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 801) | 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 733) |
| 4. | Check for air pressure to solenoid and plumbing to air solenoid.<br><br>If air plumbing is correct, go to air actuated park brake circuits to ESC. (See Air Actuated Park Brake CIRCUITS TO ESC, page 801) | | | | | |

### 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 279 Air Actuated Park Brake Diagnostic Trouble Codes**

| DIAGNOSTIC TROUBLE CODE | FAULT DESCRIPTION |
|---|---|
| 70 14 1 0 | Air Powered Park Brake is stuck.<br><br>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.<br><br>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. |

## 29.3. 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 doesn't 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.

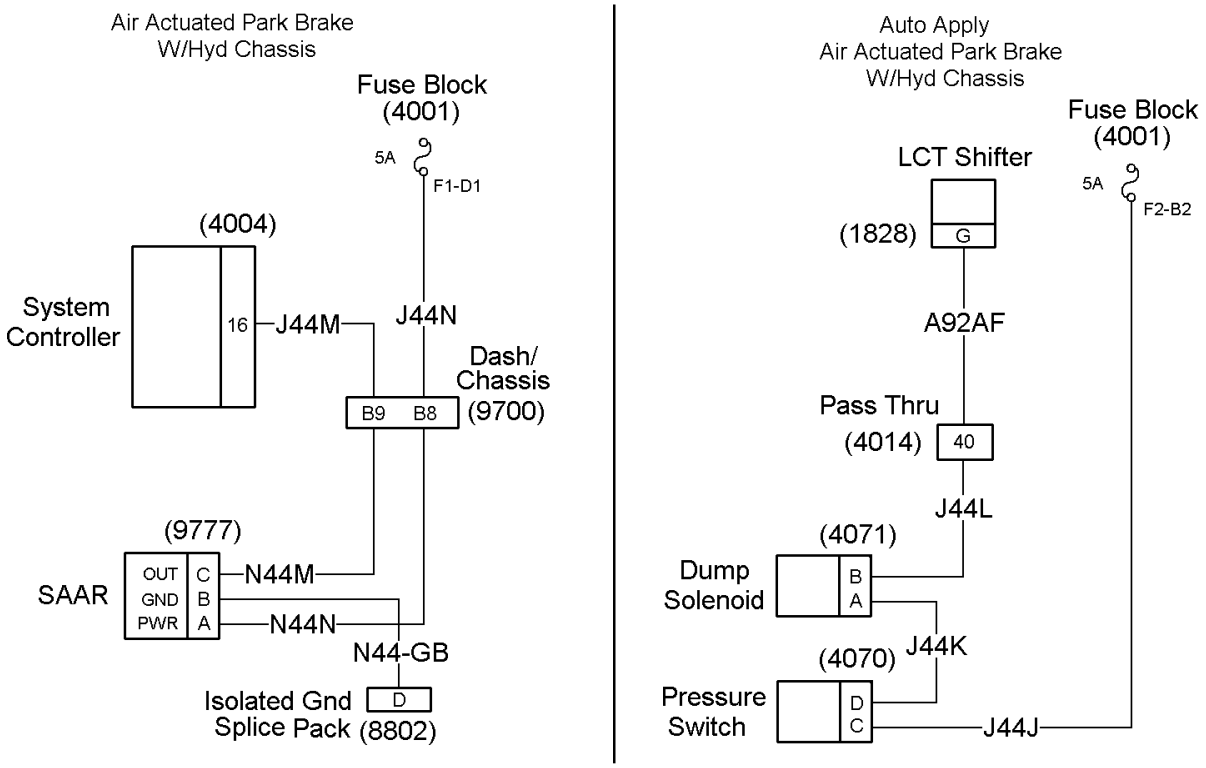



**Figure 403 Air Actuated Park Brake Circuits to ESC—Always Refer to Circuit Diagram Book for Latest Circuit Information**

(1828) LCT SHIFTER
LOCATED IN INSTRUMENT PANEL
(4001) FUSE BLOCK
LOCATED NEAR POWER DISTRIBUTION CENTER
(4004) ESC CONNECTOR
LOCATED ON ESC
(4014) PASS THRU CONNECTOR
LOCATED IN DASH PANEL LEFT SIDE
(4070) PRESSURE SWITCH
LOCATED IN ENGINE COMPARTMENT
(4071) DUMP SOLENOID
LOCATED IN ENGINE COMPARTMENT
(8802) ISOLATED GND SPLICE PACK
LOCATED IN ENGINE COMPARTMENT
(9700) CHASSIS/DASH INTERCONNECTOR
LOCATED IN DASH WALL
(9777) SAAR AIR ACTUATED PARK BRAKE CONNECTOR
LOCATED ON FRAME RAIL

**Table 280 Air Actuated Park Brake Tests**

| air actuated park brake Voltage Checks<br><br>Check with ignition on, air actuated park brake switch (9777) disconnected.<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.**<br><br>**Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** | | |
|---|---|---|
| Test Points | Spec. | Comments |
| (9777) cavity A to ground. | 12 ± 1.5 volts | If voltage is missing, check for open or shorts in circuit J44N or N44N to ESC connector (4004) cavity 16.<br><br>If circuits check good, check for missing 12 volt signal from fuse block (4001). |
| (9777) cavity A to C. | 12 ± 1.5 volts | If voltage is present replace or repair air actuated park brake switch.<br><br>If voltage is missing, check for open in circuits J44M or N44M to ESC connector (4004) cavity 16.<br><br>If circuits check good, check for missing zero volt reference from ESC. |
| **Air Actuated Park Brake Switch Resistance Checks**<br><br>**NOTE – Always check connectors for damage and pushed–out terminals.** | | |
| Resistance across the switch should be < 1 ohm with the switch closed and > 50K ohms when the switch is open. | | |

## Extended Description

12 volts from fuse block connector (4001) is supplied to the air actuated park brake switch boot connector (9777) terminal A through circuit J44N and N44N.

A zero volt reference is supplied from ESC connector (4004) terminal 16 to the air actuated park brake switch boot connector (9777) terminal C through circuit J44M and N44M.

## 29.4. COMPONENT LOCATIONS

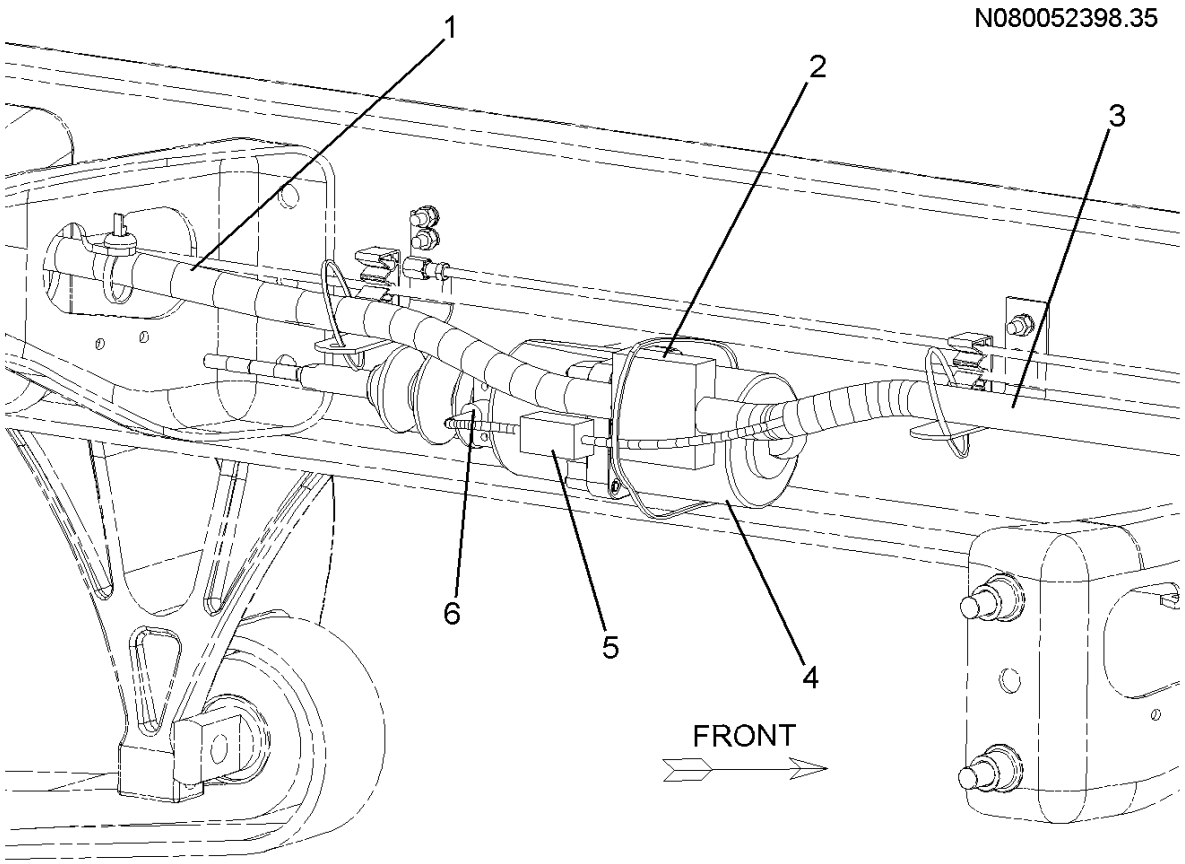



**Figure 404 Air Actuated Park Brake Wiring**

1. REAR CHASSIS HARNESS
2. CENTER CHASSIS/REAR CHASSIS CONNECTOR (9800)
3. CENTER CHASSIS HARNESS
4. SAAR
5. SAAR AIR ACTUATED PARK BRAKE CONNECTOR (9777)
6. SAAR TRAVEL SENSOR

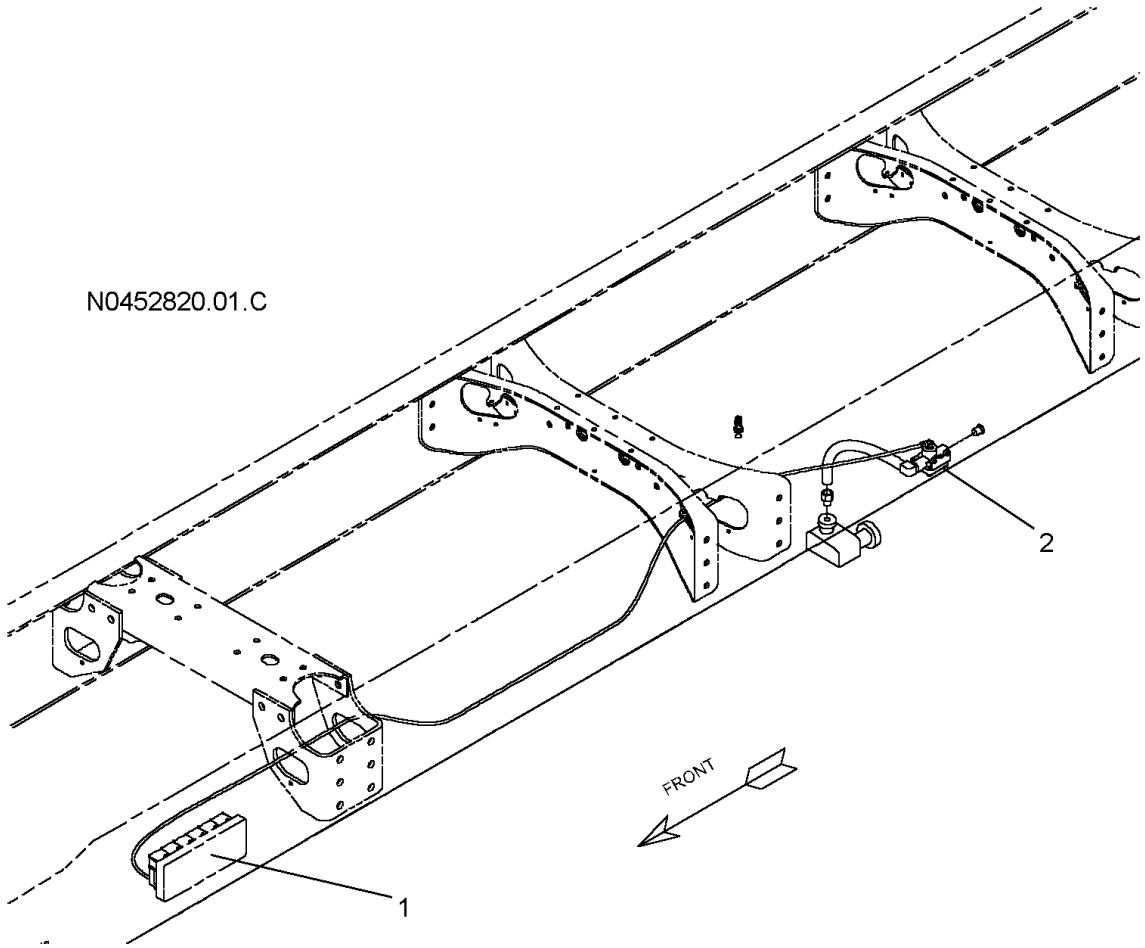



**Figure 405 Air Actuated Park Brake Air Line Location**

1. AIR SOLENOID MODULE
2. SAAR AIR SOLENOID