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1. FAN WIRING — INTERNATIONAL ENGINES

1.1. FAN SOLENOID CIRCUIT FUNCTIONS

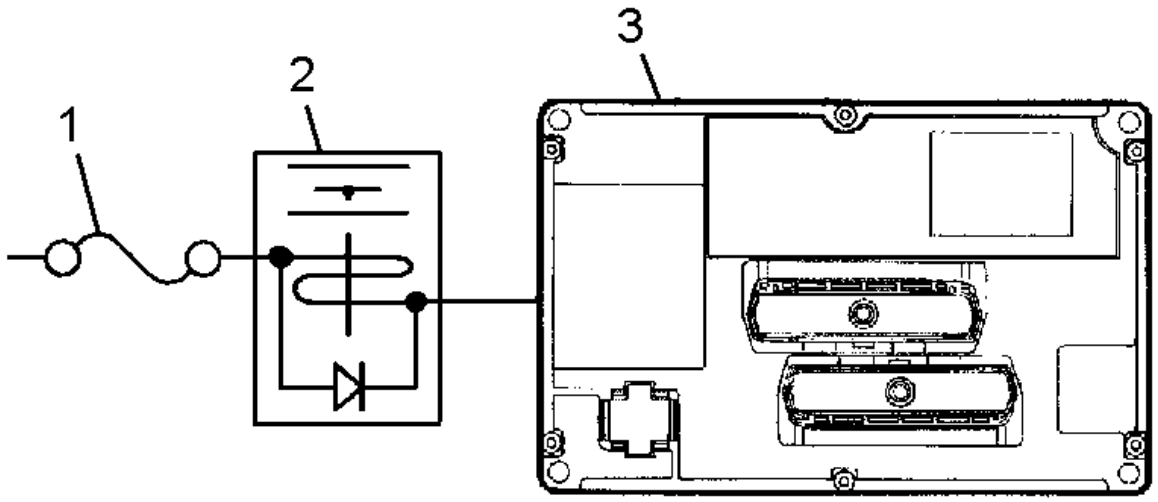

Figure 162 Fan Solenoid Function Diagram

1. 10 AMP FUSE W/SOLENOID OR 5 AMP FUSE W/CLUTCH IN ENGINE POWER DISTRIBUTION CENTER
2. FAN SOLENOID
3. ENGINE CONTROLLER

On vehicles with optional air activated fans (The majority of the vehicles are built with standard viscous drive fans that have no electrical controls). The engine controller monitors engine coolant, intake manifold temperature, and air conditioning head pressure. When any of these systems operate beyond their set parameters, the engine controller will control turning the fan off by energizing a solenoid to control air pressure to the fan. In the event of a solenoid circuit fault the fan will remain on continuously.

The engine controller turns the fan on under the following conditions:

If the engine speed is less than 2250 RPM or the engine is running **and any of the following conditions exists:**

Coolant temperature sensor is greater than 96°C (205°F) **or**

There is an active engine diagnostic code for the coolant temperature sensor **or**

The retarder solenoid signal is active (high mode) for more than 10 seconds with coolant temperature sensor greater than 80°C (176°F) **or**

The ESC sends a command, on the drivetrain 1939 data link, to the engine controller (required when high AC compressor pressure is sensed).

The engine controller turns the fan off under the following conditions:

Engine speed is greater than 2300 RPM **and all of the following conditions exists:**

Coolant temperature sensor is less than 92°C (198°F) **and**

No active coolant temperature sensor diagnostic code **and**

Retarder solenoid signal is active (high mode) with coolant temperature sensor less than 75°C (167°F) **and**

The ESC is not sending a command to the engine controller (high AC compressor pressure is not sensed) **and**

The engine has been running at least two seconds.

NOTE – Once the engine controller has turned the fan on, the fan will remain on for a minimum of 180 seconds to avoid unnecessary fan clutch cycling (except at engine start-up — it will run for only two seconds after the engine starts). The 180 second time interval is a programmable feature in the engine controller.

1.2. DIAGNOSTICS

Should the fan solenoid fail to shut off the fan when expected, the problem could be attributed to open or shorted wiring in the power circuits from the fuse, an open or short in the circuit between the fan air solenoid and the Engine controller, a blown fuse, a failed solenoid or a missing signal from the engine controller.

The ESC will not log any faults for the fan solenoid circuits. However, an open circuit or short to ground in the fan solenoid circuitry can be detected by the engine controller while retrieving “flash codes”.

Fan Solenoid Preliminary Check

Table 114 Fan Solenoid Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Test drive vehicle to insure fan is not shutting off as expected.	Check fan operation.	Fan is not operating correctly.	Go to next step.	Fan is operating correctly. Problem does not exist or is intermittent.
2.	On	Retrieve “flash codes” and check for code 246. Go to Engine Controller Diagnostic Trouble Codes. (See ENGINE CONTROLLER DIAGNOSTIC TROUBLE CODES , page 333)	Count flashes on check engine warning lamp.	“Flash code” 246 is not active.	Go to next step.	“Flash code” is active. Go to FAULT DETECTION MANAGEMENT I6 WITH FAN SOLENOID(See FAULT DETECTION MANAGEMENT I6 WITH FAN SOLENOID, page 334)or FAULT DETECTION MANAGEMENT V8–AVNT WITH FAN CLUTCN(See FAULT DETECTION MANAGEMENT

Table 114 Fan Solenoid Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
						V8–AVNT with Fan Clutch, page 336)
3.	On	Are other engine diagnostic trouble codes are active?	Check warning lamps for other diagnostic trouble codes.	No other engine diagnostic trouble codes are active.	Go to next step.	Refer to the appropriate engine manual to troubleshoot condition setting the code.
4.	On	If the fan never shuts off and no diagnostic trouble codes are active, check for air pressure to solenoid and through solenoid when it is energized.	Check air pressure through solenoid.			

1.3. ENGINE CONTROLLER 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 for at least 3 seconds. The diagnostic trouble codes are read by counting the number of light flashes. The following sequence occurs:

The red "ENGINE" light will flash one time. This indicates the beginning of Active diagnostic trouble codes.

The yellow "ENGINE" light will flash repeatedly signaling the active diagnostic trouble codes. All codes are three digits. The number of flashes should be counted in sequence. At the end of each digit of the code there will be a short pause. For example, the code 246 will be sent as two flashes, (a pause), four flashes, (a pause), and six flashes.

After each active code is displayed, the red "ENGINE" light will flash once to indicate the next active code.

Once all active codes have been displayed, the red "ENGINE" light will flash twice to indicate the beginning of Inactive codes.

Inactive codes will be displayed in the same manner as active codes. Once the Inactive codes have been displayed, the red "ENGINE" light will flash three times to indicate that all the stored diagnostic trouble codes have been displayed.

After all repairs have been made, the engine 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 for 3 seconds.

Table 115 Fan Solenoid Codes

FAULT CODE	FAULT DESCRIPTION
246	Fan Output Circuit Check Fault
This fault is logged when there is a short to ground or an open in the in the circuits from the engine controller, through the fan solenoid to battery voltage. Go to FAULT DETECTION MANAGEMENT I6 WITH FAN SOLENOID(See FAULT DETECTION MANAGEMENT I6 WITH FAN SOLENOID, page 334)or FAULT DETECTION MANAGEMENT V8–AVNT WITH FAN CLUTCN(See FAULT DETECTION MANAGEMENT V8–AVNT with Fan Clutch, page 336)	

1.4. FAULT DETECTION MANAGEMENT I6 WITH FAN SOLENOID

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 failure in the I6 fan solenoid circuits will be apparent when the fan doesn't turn off as expected. The ESC will not log any faults for the fan solenoid circuits. However, an open circuit or short to ground in the fan solenoid circuits can be detected by the engine controller during an "on demand" engine standard test. See the appropriate engine manual for details.

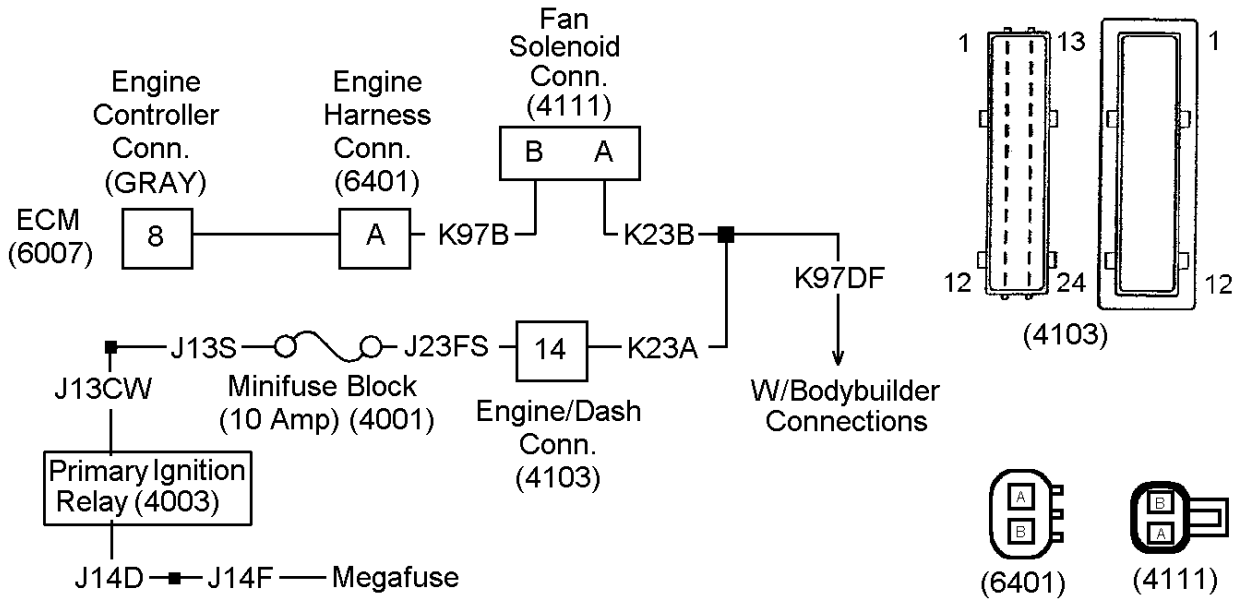

Figure 163 I6 with Fan Solenoid Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(4001) FAN SOLENOID FUSE, 10 AMP W/SOLENOID
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4003) PRIMARY IGNITION RELAY
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH HARNESS CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4111) FAN AIR SOLENOID CONNECTOR
LOCATED NEAR ENGINE FAN DRIVE
(6007) (GRAY) ENGINE CONTROLLER (ECM) CONNECTOR
CONNECTS TO ENGINE CONTROLLER
(6401) MELROSE ENGINE HARNESS CONNECTOR
LOCATED NEAR ENGINE FAN DRIVE

Table 116 I6 with Fan Solenoid Wiring Harness Connector Checks

International Engine Controller Diagnostic Trouble Codes		
246	The Engine Fan Control relay failed the output circuit check during a Key On Engine Off Standard Test. **NOTE: For test purposes EFC solenoid can be turned On/Off through the Output State Test.**	
Key on Engine Off - Voltage Checks at Fan Air Solenoid Connector (4111)		
Check with fan solenoid Disconnected, Ignition Key ON (Engine Off).		
Test Points	Spec.	Comments
B to Ground.	0 v	If voltage present, check for short to power
A to Ground.	12 ± 1.5 volts	If voltage is missing, check fuse and/or circuit or open/shorts If voltage is present, check for open in circuits between engine controller and solenoid.
NOTE: Normal fan on temperature is 212°F (100°C). Normal fan off temperature is 207.5°F (97.5°C)		

1.5. EXTENDED DESCRIPTION

When the key is on, the fan solenoid is supplied battery voltage at connector (4111) from a 10 amp fuse in the engine compartment power distribution center and powered through closed contacts of the energized primary ignition relay (4003).

The engine controller will supply a ground to connector (4111) to energize the solenoid, turning off the fan.

1.6. FAULT DETECTION MANAGEMENT V8–AVNT WITH FAN CLUTCH

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 failure in the V8–AVNT fan clutch circuits will be apparent when the fan doesn't turn off as expected. The ESC will not log any faults for the fan solenoid circuits. However, an open circuit or short to ground in the fan solenoid circuits can be detected by the engine controller during an "on demand" engine standard test. See the appropriate engine manual for details.

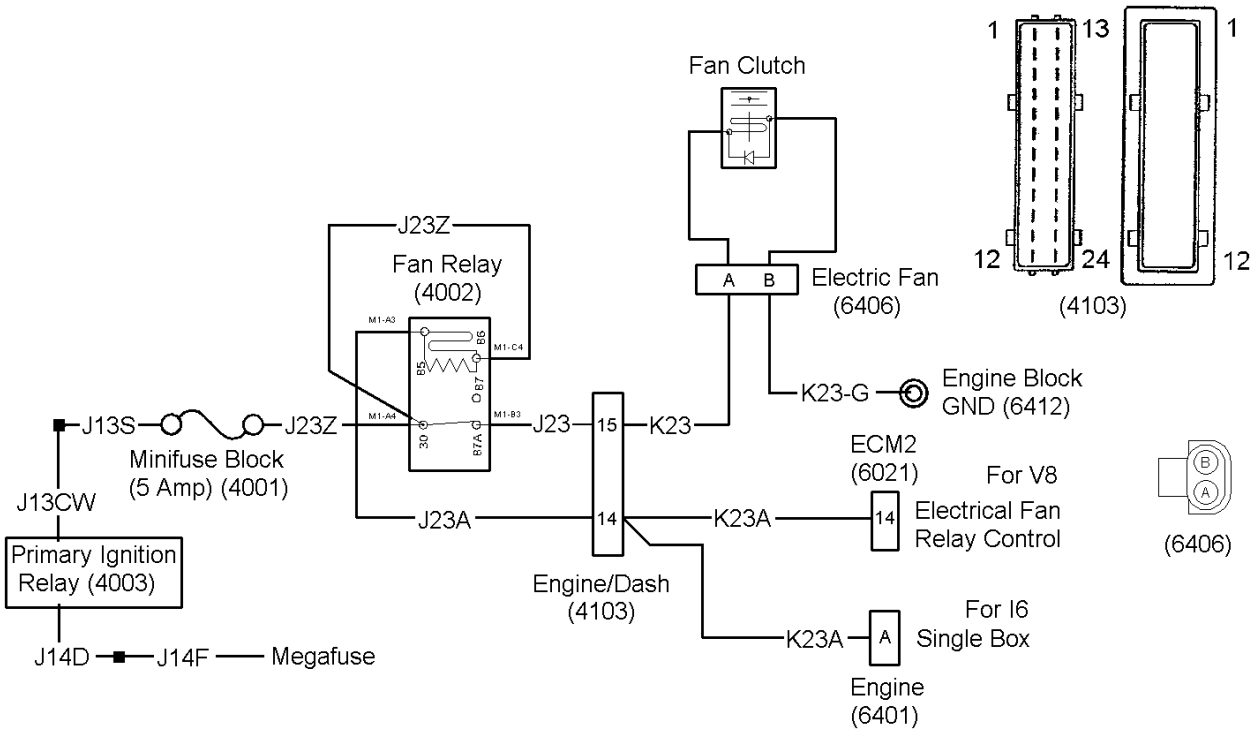

Figure 164 V8–AVNT with Fan Clutch Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(4001) FAN CLUTCH FUSE, 5 AMP W/CLUTCH
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4002) FAN RELAY
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4003) PRIMARY IGNITION RELAY
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH HARNESS CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6021) ECM2 ELECTRIC FAN RELAY CONTROL CONNECTOR
CONNECTS TO ENGINE CONTROLLER
(6312) ENGINE BLOCK GND
CONNECTS TO ENGINE
(6406) ELECTRIC FAN CLUTCH DRIVE CONNECTOR
LOCATED ON ENGINE FAN DRIVE

Table 117 V8–AVNT with Fan Clutch Wiring Harness Connector Checks

International Engine Controller Diagnostic Trouble Codes		
246	The Engine Fan Control relay failed the output circuit check during a Key On Engine Off Standard Test. **NOTE: For test purposes EFC solenoid can be turned On/Off through the Output State Test.**	
Key on Engine Off - Voltage Checks at Fan Clutch Connector (6406)		
Check with Fan Clutch Disconnected, Ignition Key ON (Engine Off).		
Test Points	Spec.	Comments
B to Ground.	0 v	If voltage present, check for short to power
A to Ground.	12 ± 1.5 volts	If voltage is missing, check fuse and/or circuit or open/shorts If voltage is present, check for open in circuits between engine controller and solenoid.
NOTE: Normal fan on temperature is 212°F (100°C). Normal fan off temperature is 207.5°F (97.5°C)		

1.7. EXTENDED DESCRIPTION

When the key is on, the fan clutch is supplied battery voltage at connector (6406) through closed contacts of the deenergized fan relay (4002) from a 5 amp fuse in the engine compartment power distribution center and powered the through closed contacts of the energized primary ignition relay (4003).

The engine controller will supply a ground to energize fan relay (4002) opening the contacts of the fan relay (4002), removing power from connector (6406) to deenergize the clutch, turning off the fan.

1.8. COMPONENT LOCATIONS

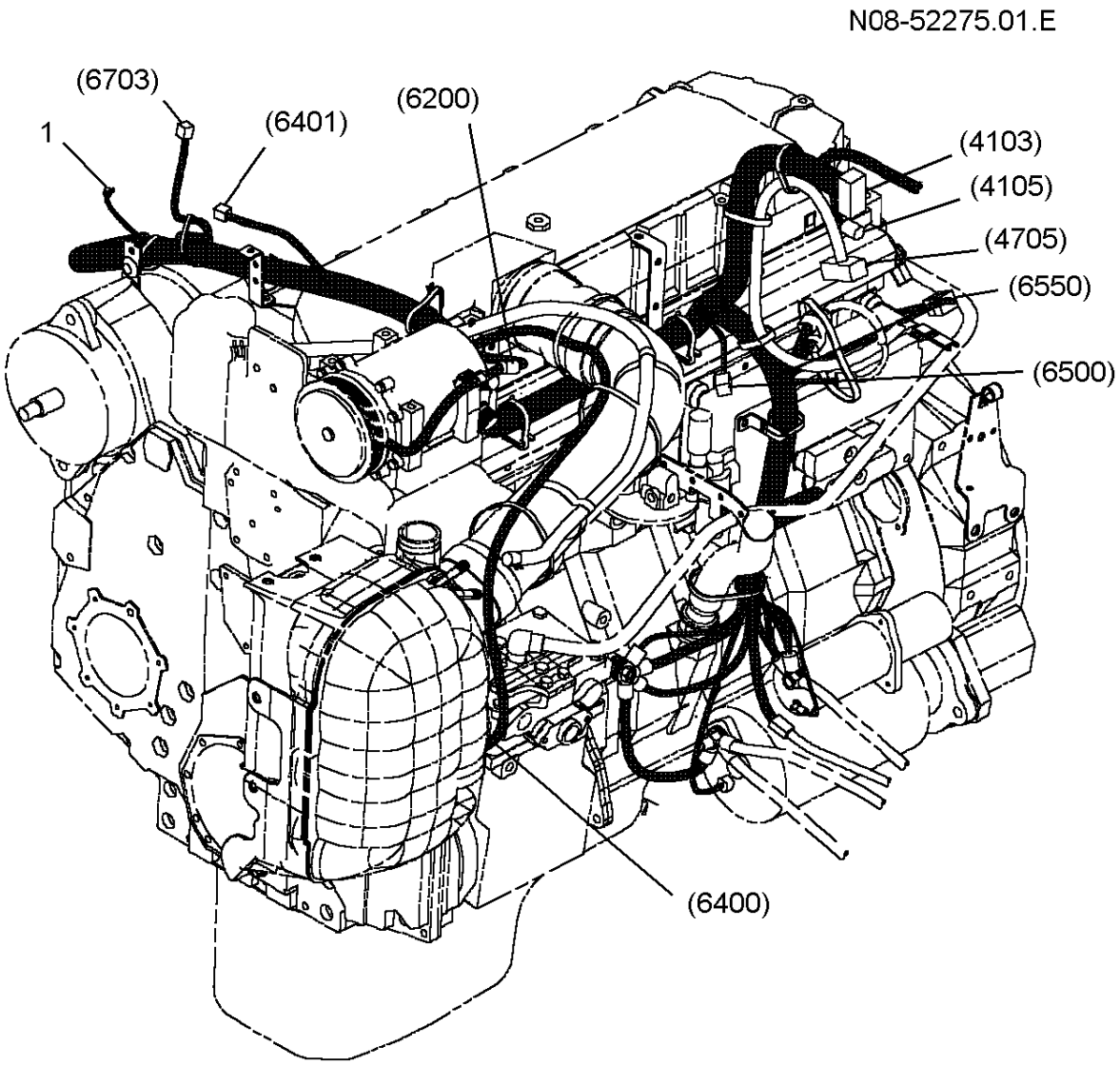

Figure 165 Engine Wiring

1. CIRCUIT TO OPTIONAL ALTERNATOR WARNING LIGHT
(4103) ENGINE/DASH CONNECTOR
(4105) ECM POWER/STARTER CONNECTOR
(4705) 8–WAY OR 24– WAY TRANSMISSION/DASH CONNECTOR
(6200) AIR CONDITIONER COMPRESSOR CLUTCH CONNECTOR
(6400) LOW COOLANT LEVEL SENSOR CONNECTOR
(6401) MELROSE ENG HARN CONNECTOR
(6500) EXHAUST BRAKE CONNECTOR
(6550) ETHER START THERMOSTATIC SWITCH CONNECTOR
(6703) AMBIENT AIR TEMP SENSOR CONNECTOR

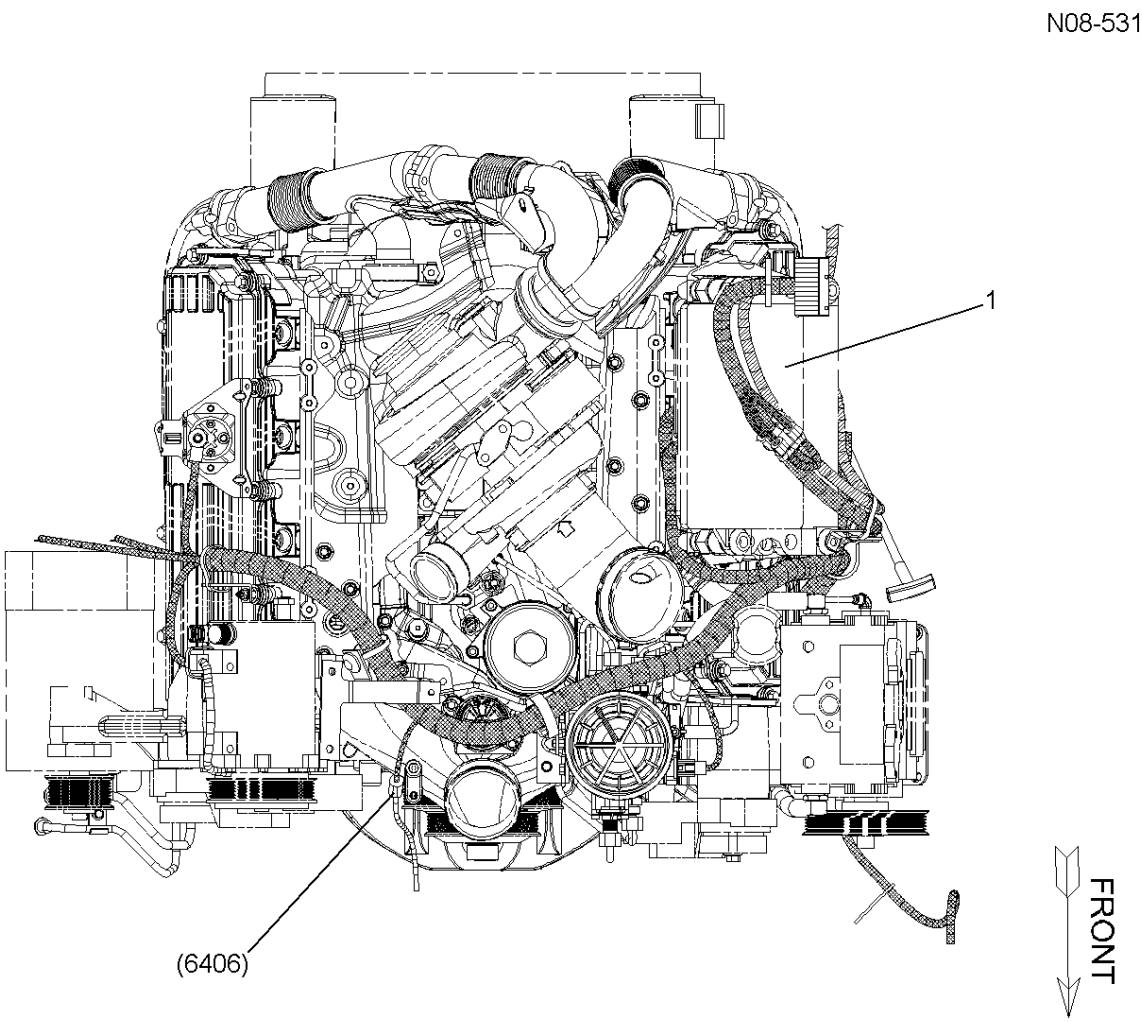

Figure 166 V8–AVNT with Fan Clutch

1. (6021) ENGINE CONTROLLER MODULE ECM2
(6406) ELECTRICAL MAGNETIC FAN CIRCUIT K23–G OF ENGINE HARNESS TO FAN PIGTAIL

2. ETHER START

2.1. CIRCUIT FUNCTIONS

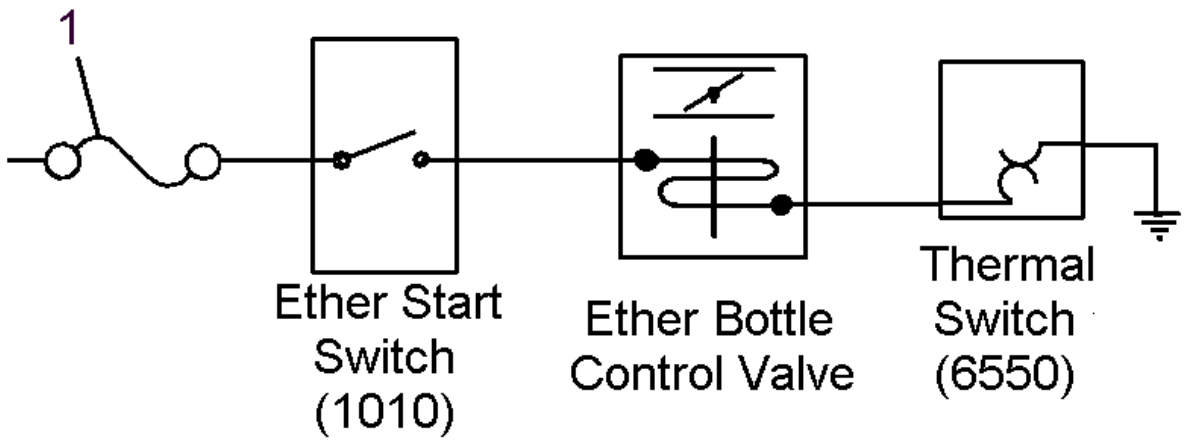

Figure 167 Ether Start Function Diagram

1. 10 AMP (F33) FUSE BLOCK #3 (1013) IN CAB POWER DISTRIBUTION CENTER
2. (8400) ETHER START
3. (1010) ETHER START SWITCH
4. ETHER BOTTLE CONTROL VALVE
5. (6550) THERMAL SWITCH

When the ether start system is activated a measured amount of ether will be injected into the engine intake. This will assist starting the engine during cold weather.

The system will only function if engine temperature is less than 4.4°C (40°F).

The ether bottle control valve is directly controlled by the ether start switch on the instrument panel. A thermal switch will prevent the valve from activating when the temperature is too high.

2.2. DIAGNOSTICS

The ESC will not log any faults for the ether start circuits.

Ether Start Preliminary Check

Table 118 Ether Start Preliminary Check Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the ether injection system is not working.	Check system operation.	Ether is not injected when engine temperature is in the allowed range.	Go to next step.	Ether injector is working.
2.	Off	Check if ether bottle is empty.		Ether bottle is empty.	Replace ether bottle.	Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 342)

2.3. FAULT DETECTION MANAGEMENT

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

A failure in the ether start circuits will be apparent when the ether bottle doesn't inject ether during cold starting.

Insure the ether bottle is not empty before troubleshooting this system.

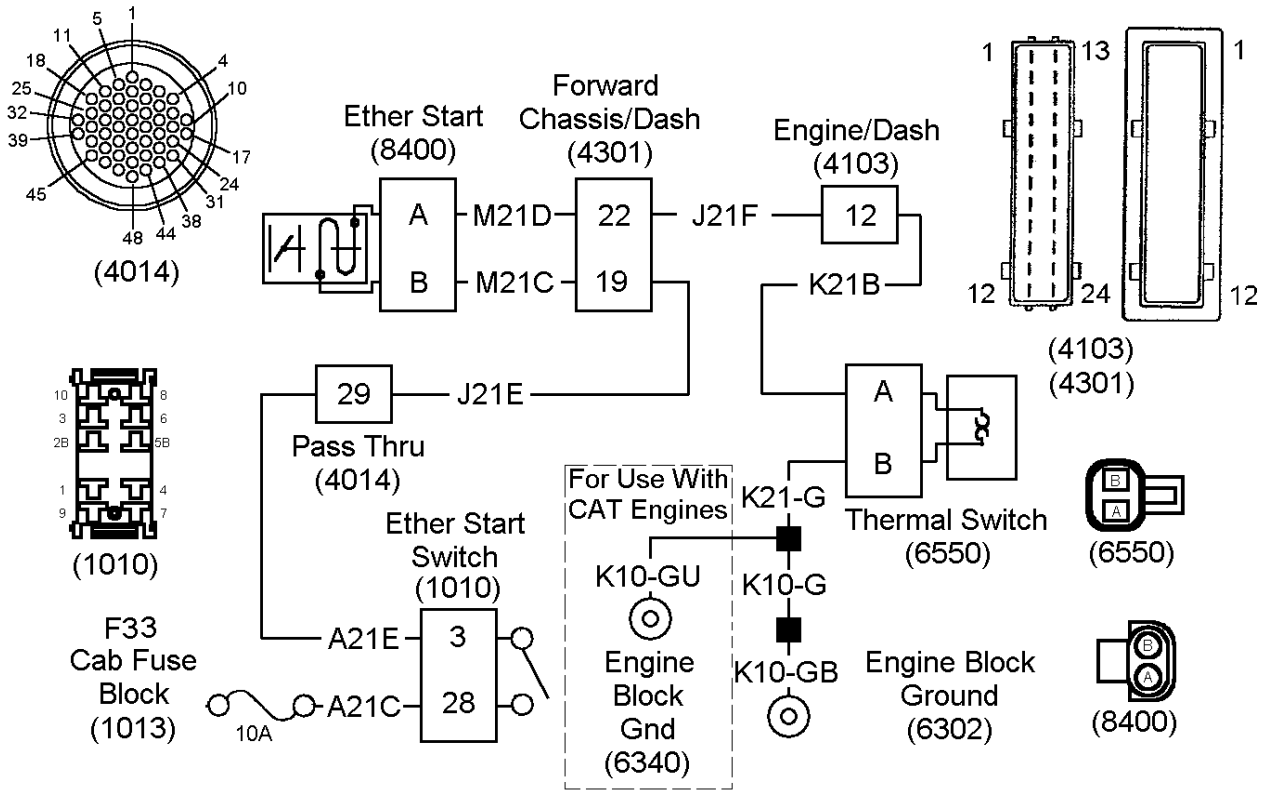

Figure 168 Ether Start Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

F33 CAB FUSE BLOCK #3 (1013)
IN CAB POWER DISTRIBUTION CENTER
(1010) ETHER START SWITCH
LOCATED ON INSTRUMENT PANEL
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
(4103) ENGINE/DASH HARNESS CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4301) FORWARD CHASSIS/DASH PASS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(6302), (6340) ENGINE BLOCK GND
CONNECTS TO ENGINE
(6550) THERMAL SWITCH
LOCATED NEAR ENGINE ECM
(8400) ETHER START
LOCATED ON ETHER CONTROL VALVE

Table 119 Ether Start Wiring Harness Connector Checks

Check with Ether Start Harness Connector (8400) Disconnected, Ignition Key ON (Engine Off). **NOTE – This feature will not work if the temperature is above 4.4°C (40°F). A jumper must be installed between the cavities of thermal switch connector (6550) to bypass the thermal switch when the temperature is to high.**		
Test Points-	Spec.	Comments
Ether start connector (8400) cavity B to ground, with ether switch activated.	12 ± 1.5 volts	If voltage is incorrect, check for open or short to ground in circuits between cavity B and the ether start switch terminal 3. Also check for defective switch, failed circuits to the switch from the fuse or a blown fuse.
Ether start connector (8400) cavity B to A, with ether switch activated.	12 ± 1.5 volts	If voltage is missing, check for open in circuits between cavity A and the thermal switch. Also check for failed thermal switch or failed circuits between the thermal switch and ground. If voltage is present, ether start circuits check good. Consider replacing the ether start valve.

2.4. EXTENDED DESCRIPTION

If the engine temperature is below 4.4°C (40°F), a ground from the engine block ground (6302) (with CAT engines (6340)) will be applied to ether start valve connector (8400).

When the key is on and the ether start switch is activated, battery voltage will be supplied from fuse F33 to ether start valve connector (8400). This will open the valve which will inject a measured shot of ether into the intake manifold.

2.5. COMPONENT LOCATIONS

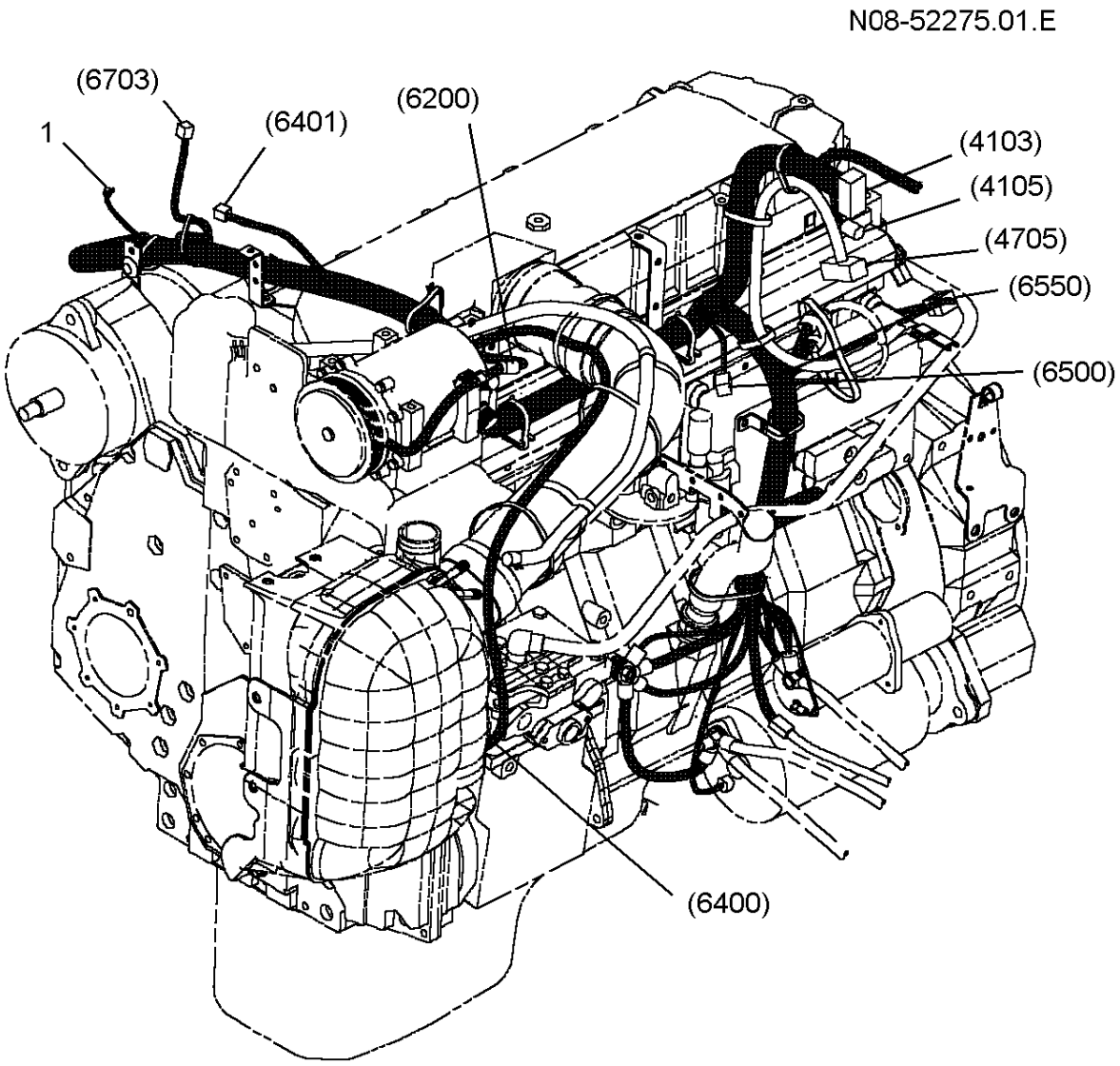

Figure 169 Engine Wiring

1. CIRCUIT TO OPTIONAL ALTERNATOR WARNING LIGHT
(4103) 24– WAY ENGINE CONNECTOR
(4105) 3–WAY ENGINE CONNECTOR
(4705) 8–WAY OR 24– WAY TRANSMISSION CONNECTOR
(6200) AIR CONDITIONER COMPRESSOR CLUTCH CONNECTOR
(6400) COOLANT LEVEL SENSOR CONNECTOR
(6401) MELROSE CONNECTOR (TO AIR FAN SOLENOID)
(6500) EXHAUST BRAKE CONNECTOR
(6550) ETHER START THERMOSTATIC SWITCH CONNECTOR
(6703) 24– WAY ENGINE CONNECTOR

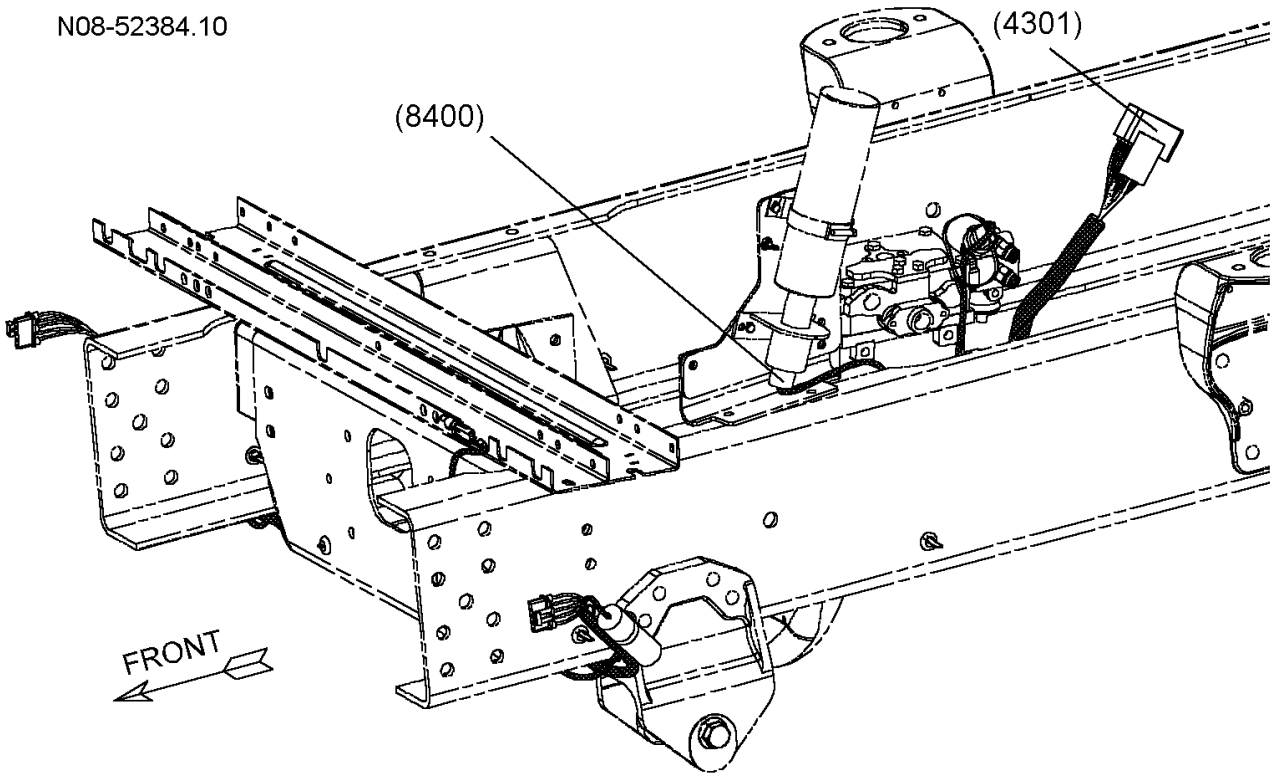

Figure 170 Typical Ether Start Bottle Location

(4301) FORWARD CHASSIS/DASH CONNECTOR
(8400) ETHER BOTTLE CONTROL VALVE CONNECTOR

3. SNOW VALVE (ENGINE INTAKE)

3.1. CIRCUIT FUNCTIONS

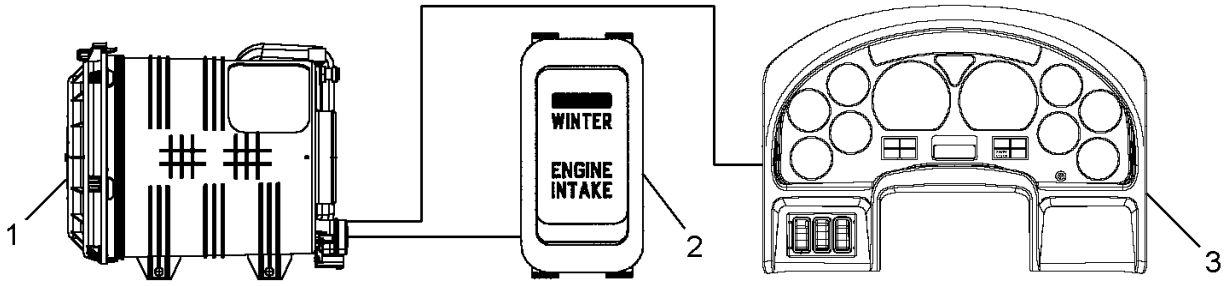

Figure 171 Snow Valve (Engine Intake) Functional Diagram

1. AIR INTAKE FILTER
2. SNOW VALVE (WINTER/ENGINE INTAKE/SUMMER) SWITCH
3. ELECTRONIC GAUGE CLUSTER

The snow valve (engine intake) feature turns a drum inside the air cleaner to divert air intake from outside of the vehicle to inside the engine compartment. This prevents heavy snow from clogging the air intake.

The feature is controlled by a Winter/Engine Intake/Summer switch on the instrument panel connected directly to the snow valve module.

A snow valve warning light in the instrument cluster, directly controlled by the snow valve module, should illuminate when the snow valve is turning or movement is blocked. The switch indicator will light when the valve is completely closed.

The snow valve motor is protected by a thermal switch.

The snow valve module is not repairable. If it fails, it will have to be replaced.

3.2. DIAGNOSTICS

The ESC will not log any diagnostic trouble codes for snow valve circuits.

Snow Valve Preliminary Check

Table 120 Snow Valve Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the snow valve is not working.	Check system operation.	Snow valve warning light does not correspond to switch position or intake air is not redirected.	Go to next step.	Snow valve is working.
2.	Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 347)					

3.3. FAULT DETECTION MANAGEMENT

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

A failure in the snow valve circuits will be apparent when the snow valve warning lamp doesn't illuminate when the show valve Winter/Engine Intake/Summer switch is on, or the lamp doesn't go out when the snow valve Winter/Engine Intake/Summer switch is off.

Failures in snow valve circuits could be attributed to a mechanical blockage, a blown fuse, a burned out indicator lamp, open circuits, circuits shorted to ground, or a failed module.

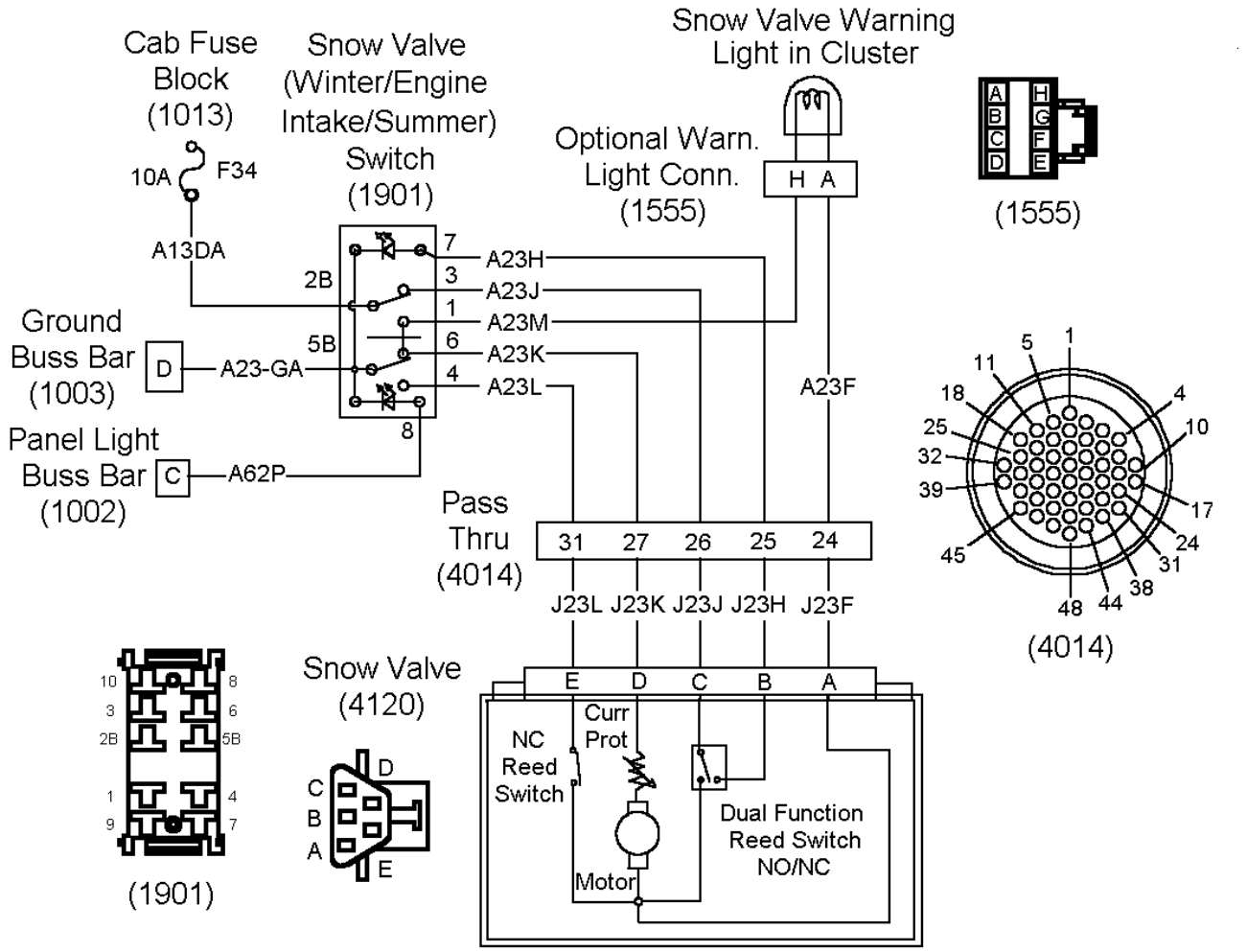

Figure 172 Snow Valve Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

F34 CAB FUSE BLOCK #3 (1013)
IN CAB POWER DISTRIBUTION CENTER
(1002) PANEL LIGHT BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1003) GROUND BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1555) OPTIONAL WARNING LIGHT CONNECTOR
LOCATED ON INSTRUMENT CLUSTER
(1901) SNOW VALVE (WINTER/ENGINE INTAKE/SUMMER) SWITCH
LOCATED ON INSTRUMENT PANEL
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
(4120) SNOW VALVE CONNECTOR
LOCATED ON AIR CLEANER

Table 121 Snow valve Module Wiring Harness Connector Checks

Check with Snow Valve Harness Connector (4120) Disconnected, Ignition Key ON. Insure snow valve fuse F34 is not blown		
Test Points-	Spec.	Comments
Snow valve harness connector (4120) cavity C to ground.	12 ± 1.5 volts with switch ON. 0 volts with switch OFF.	If voltage is incorrect, check for open or short to ground in circuits between (4120) cavity C and snow valve switch (1901) terminal 3. Also check for defective switch, failed circuits to the switch from the fuse or a blown fuse.
Snow valve harness connector (4120) cavity C to D.	12 ± 1.5 volts with switch ON. 0 volts with switch OFF.	If voltage is incorrect, check for open or short to ground in circuits between (4120) cavity D and snow valve switch (1901) terminal 6. Also check for defective switch or failed circuits to the switch from ground buss.
Snow valve harness connector (4120) cavity A to ground.	12 ± 1.5 volts with switch OFF. 0 volts with switch ON.	If voltage is incorrect, check for open or short to ground in circuits between (4120) cavity A and snow valve switch (1901) terminal 7. Also check for defective switch, Burned out warning lamp, failed circuits to the switch from the fuse, or a blown fuse.
Snow valve harness connector (4120) cavity A to E.	12 ± 1.5 volts with switch OFF. 0 volts with switch ON.	If voltage is incorrect, check for open or short to ground in circuits between (4120) cavity E and snow valve switch (1901) terminal 4. Also check for defective switch or failed circuits to the switch from ground buss.
Snow valve harness connector (4120) cavity A to B.	12 ± 1.5 volts with switch OFF. 0 volts with switch ON.	If voltage is incorrect, check for open or short to ground in circuits between (4120) cavity B and snow valve switch (1901) terminal 7. Also check for defective switch, open indicator LED or failed circuits to the switch from ground buss.
If voltages check good and there is no mechanical obstructions, consider replacing the snow valve.		

3.4. EXTENDED DESCRIPTION

The snow valve switch (1901) receives battery voltage from fuse F34 on terminal 2B.

The switch receives ground from ground buss bar (1002) on terminal 5B.

When the switch is OFF, battery voltage is applied to terminal C of the snow valve module and the snow valve motor. The switch also applies ground to terminal A, to D and the other side of the motor. This will spin the drum inside the air cleaner to open the valve until it opens a reed switch to open the circuit.

When the switch is ON, battery voltage is applied through the warning light to terminal A of the snow valve module and the snow valve motor. The switch also applies ground to terminal E and the other side of the motor. This will spin the drum inside the air cleaner to close the valve until it opens a reed switch to open the circuit.

3.5. COMPONENT LOCATIONS

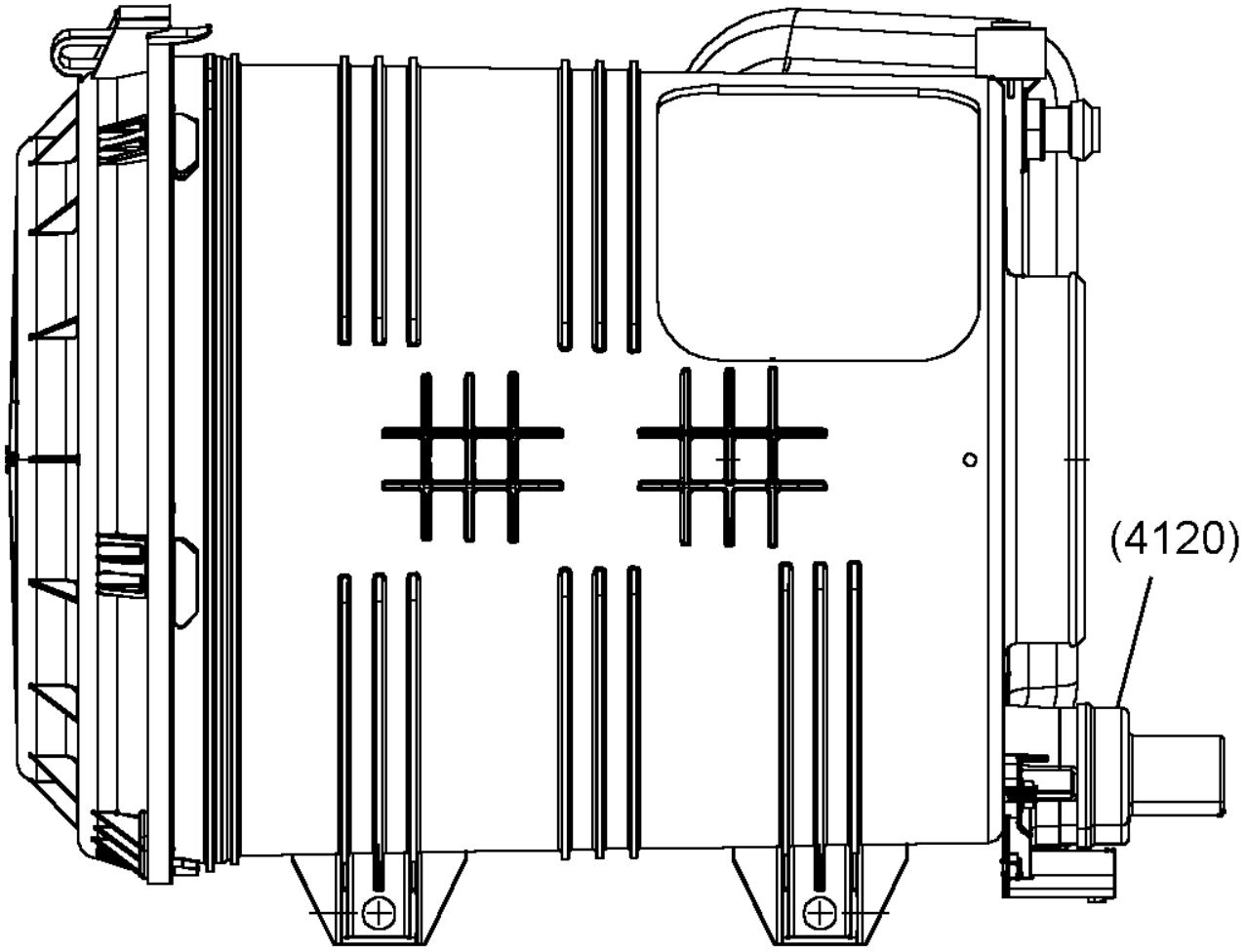

Figure 173 Air Intake Filter with Snow Valve

(4120) SNOW VALVE MODULE

4. FAN WIRING — CAT AND CUMMINS

4.1. FAN SOLENOID CIRCUIT FUNCTIONS

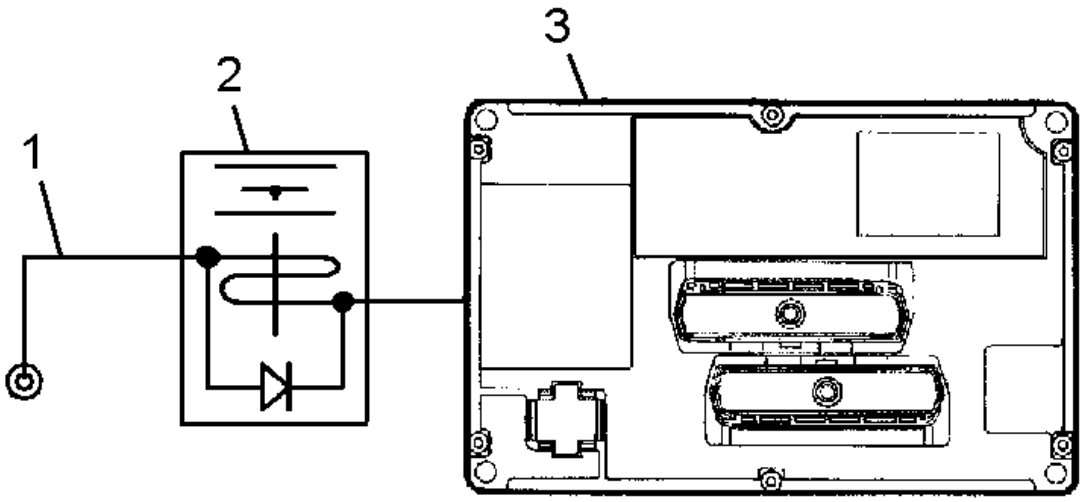

Figure 174 Fan Solenoid Function Diagram

1. ENGINE BLOCK GROUND
2. FAN SOLENOID
3. ENGINE CONTROLLER

On vehicles with optional air activated fans (the majority of the vehicles are built with standard viscous drive fans that have no electrical controls). The engine controller monitors engine coolant, intake manifold temperature, and air conditioning head pressure. When any of these systems operate beyond their set parameters, the engine controller will control turning the fan off by energizing a solenoid to control air pressure to the fan. In the event of a solenoid circuit fault the fan will remain on continuously.

The engine controller turns the fan on under the following conditions:

If the engine speed is less than 2250 RPM or the engine is running **and any of the following conditions exists:**

Coolant temperature sensor is greater than 96°C (205°F) **or**

There is an active engine diagnostic code for the coolant temperature sensor **or**

The retarder solenoid signal is active (high mode) for more than 10 seconds with coolant temperature sensor greater than 80°C (176°F) **or**

The ESC sends a command, on the drivetrain 1939 data link, to the engine controller (required when high AC compressor pressure is sensed).

The engine controller turns the fan off under the following conditions:

Engine speed is greater than 2300 RPM **and all of the following conditions exists:**

Coolant temperature sensor is less than 92°C (198°F) **and**

No active coolant temperature sensor diagnostic code **and**

Retarder solenoid signal is active (high mode) with coolant temperature sensor less than 75°C (167°F) **and**

The ESC is not sending a command to the engine controller (high AC compressor pressure is not sensed) **and**

The engine has been running at least two seconds.

NOTE – Once the engine controller has turned the fan on, the fan will remain on for a minimum of 180 seconds to avoid unnecessary fan clutch cycling (except at engine start-up — it will run for only two seconds after the engine starts). The 180 second time interval is a programmable feature in the engine controller.

4.2. DIAGNOSTICS

Should the fan solenoid fail to shut off the fan when expected, the problem could be attributed to open or shorted wiring in the ground circuits to the engine block ground, an open or short in the circuit between the fan air solenoid and the Engine controller, a failed solenoid or a missing signal from the engine controller.

The ESC will not log any faults for the fan solenoid circuits. However, an open circuit or short to ground in the fan solenoid circuitry can be detected by the engine controller while retrieving “flash codes”.

Fan Solenoid Preliminary Check

Table 122 Fan Solenoid Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Test drive vehicle to insure fan is not shutting off as expected.	Check fan operation.	Fan is not operating correctly.	Go to next step.	Fan is operating correctly. Problem does not exist or is intermittent.
2.	On	Retrieve “flash codes” and check for code 246. Go to Engine Controller Diagnostic Trouble Codes. (See ENGINE CONTROLLER DIAGNOSTIC TROUBLE CODES , page 353)	Count flashes on check engine warning lamp.	“Flash code” 246 is not active.	Go to next step.	“Flash code” is active. Go to FAULT DETECTION MANAGEMENT (See FAULT DETECTION MANAGEMENT, page 354)

Table 122 Fan Solenoid Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Are other engine diagnostic trouble codes are active?	Check warning lamps for other diagnostic trouble codes.	No other engine diagnostic trouble codes are active.	Go to next step.	Refer to the appropriate engine manual to troubleshoot condition setting the code.
4.	On	If the fan never shuts off and no diagnostic trouble codes are active, check for air pressure to solenoid and through solenoid when it is energized.	Check air pressure through solenoid.			

4.3. ENGINE CONTROLLER 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 for at least 3 seconds. The diagnostic trouble codes are read by counting the number of light flashes. The following sequence occurs:

The red "ENGINE" light will flash one time. This indicates the beginning of Active diagnostic trouble codes.

The yellow "ENGINE" light will flash repeatedly signaling the active diagnostic trouble codes. All codes are three digits. The number of flashes should be counted in sequence. At the end of each digit of the code there will be a short pause. For example, the code 246 will be sent as two flashes, (a pause), four flashes, (a pause), and six flashes.

After each active code is displayed, the red "ENGINE" light will flash once to indicate the next active code.

Once all active codes have been displayed, the red "ENGINE" light will flash twice to indicate the beginning of Inactive codes.

Inactive codes will be displayed in the same manner as active codes. Once the Inactive codes have been displayed, the red "ENGINE" light will flash three times to indicate that all the stored diagnostic trouble codes have been displayed.

After all repairs have been made, the engine 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 for 3 seconds.

Table 123 Fan Solenoid Codes

FAULT CODE	FAULT DESCRIPTION
246	Fan Output Circuit Check Fault
This fault is logged when there is a short to ground or an open in the in the circuits from the engine controller, through the fan solenoid to battery voltage. Go to FAULT DETECTION MANAGEMENT (See FAULT DETECTION MANAGEMENT, page 354)	

4.4. 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 failure in the Caterpillar or Cummins ISM Engine fan solenoid circuits will be apparent when the fan doesn't turn off as expected. The ESC will not log any faults for the fan solenoid circuits. However, an open circuit or short to ground in the fan solenoid circuits can be detected by the engine controller during an "on demand" engine standard test. See the appropriate engine manual for details.

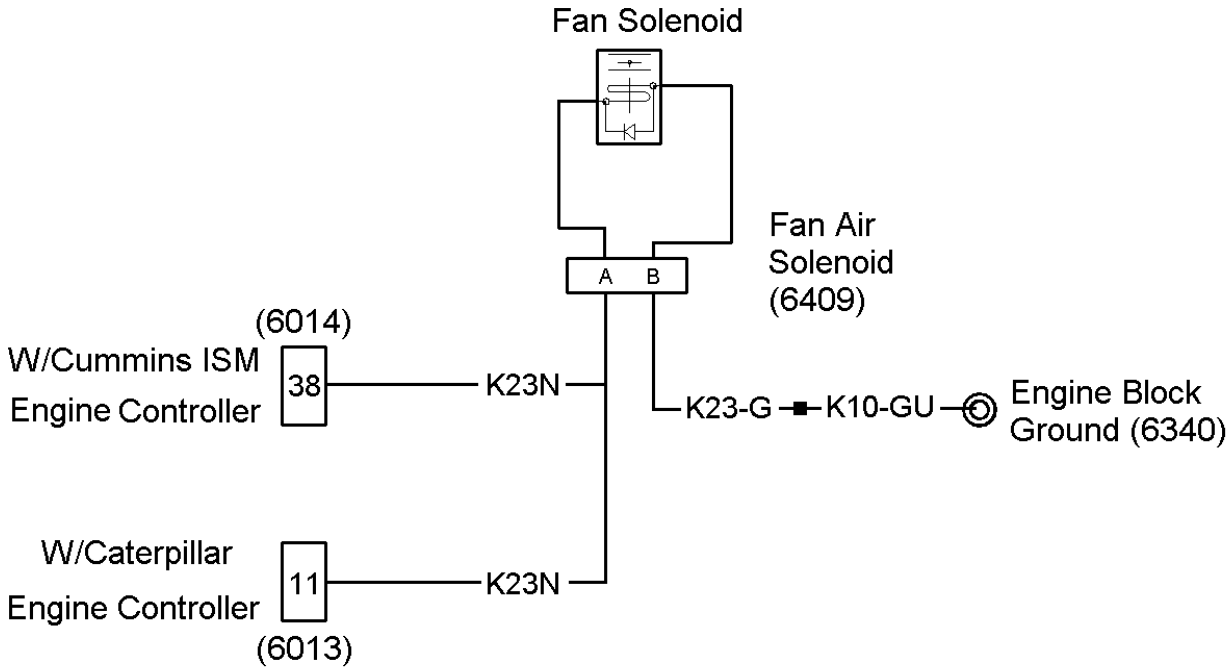

Figure 175 Caterpillar or Cummins ISM Engine with Fan Solenoid Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(6013) W/CATERPILLAR ENGINE CONTROLLER CONNECTOR
CONNECTS TO ENGINE CONTROLLER
(6014) W/CUMMINS ISM ENGINE CONTROLLER CONNECTOR
CONNECTS TO ENGINE CONTROLLER
(6409) FAN AIR SOLENOID CONNECTOR
LOCATED NEAR ENGINE FAN DRIVE
(6340) ENGINE BLOCK GROUND
LOCATED NEAR ENGINE ECM

Table 124 Caterpillar or Cummins ISM Engine with Fan Solenoid Wiring Harness Connector Checks

Caterpillar or Cummins ISM Engine Controller Diagnostic Trouble Codes		
246	The Engine Fan Control relay failed the output circuit check during a Key On Engine Off Standard Test. **NOTE: For test purposes EFC solenoid can be turned On/Off through the Output State Test.**	
Key on Engine Off - Voltage Checks at Fan Air Solenoid Connector (6409)		
Check with fan solenoid Disconnected, Ignition Key ON (Engine Off).		
Test Points	Spec.	Comments
B to Ground.	0 v	If voltage present, check for short to power
A to Ground.	12 ± 1.5 volts	If voltage is missing, check fuse and/or circuit or open/shorts If voltage is present, check for open in circuits between engine controller and solenoid.
NOTE: Normal fan on temperature is 212°F (100°C). Normal fan off temperature is 207.5°F (97.5°C)		

4.5. EXTENDED DESCRIPTION

When the key is on, the fan solenoid is supplied battery voltage at connector (6409) from a fuse in the engine compartment power distribution center.

The engine controller will supply a ground to connector (6409) to energize the solenoid, turning off the fan.

4.6. COMPONENT LOCATIONS

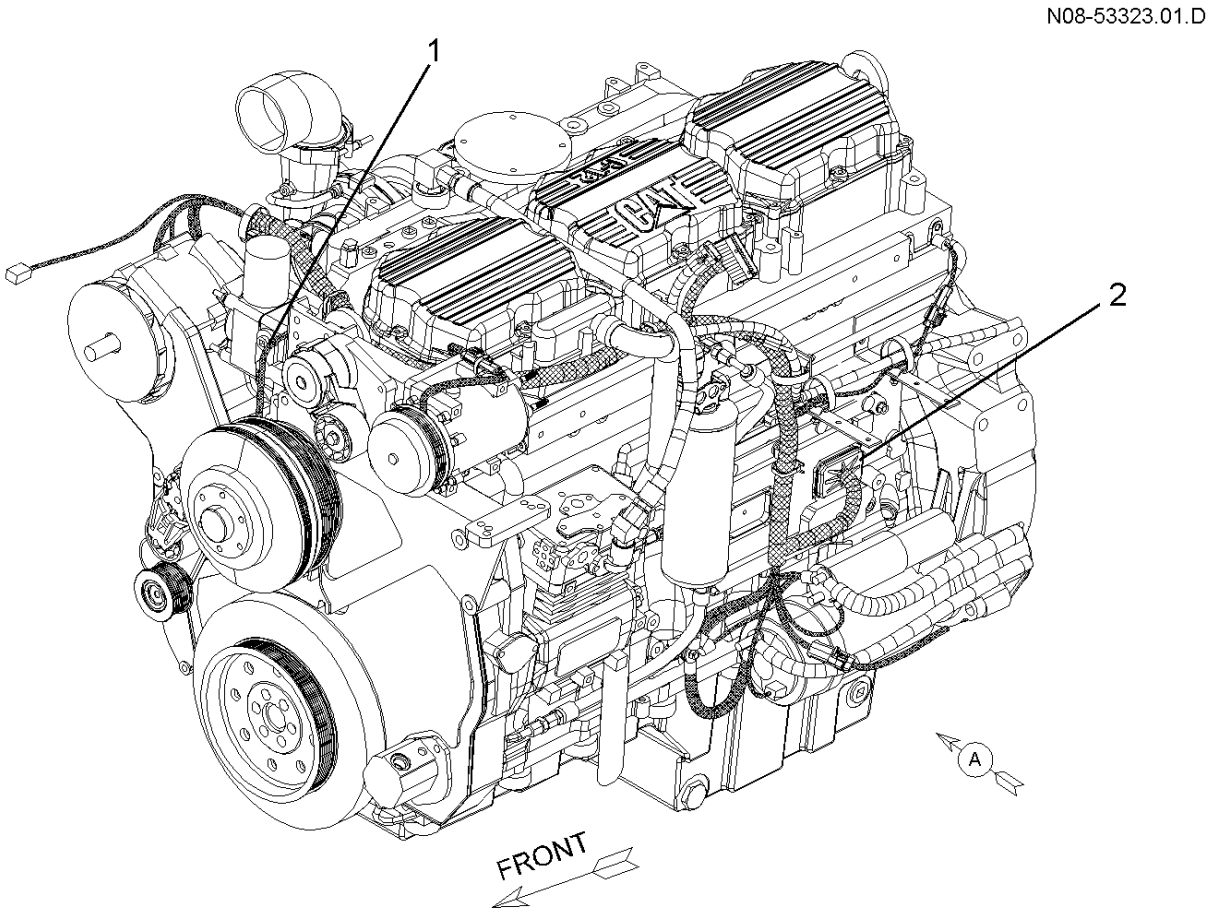

Figure 176 Caterpillar Engine Wiring

1. (6409) ELECTRICALMAGNETIC FAN CIRCUIT K23–G OF ENGINE HARNESS TO FAN PIGTAIL
2. (6013) ENGINE ECM

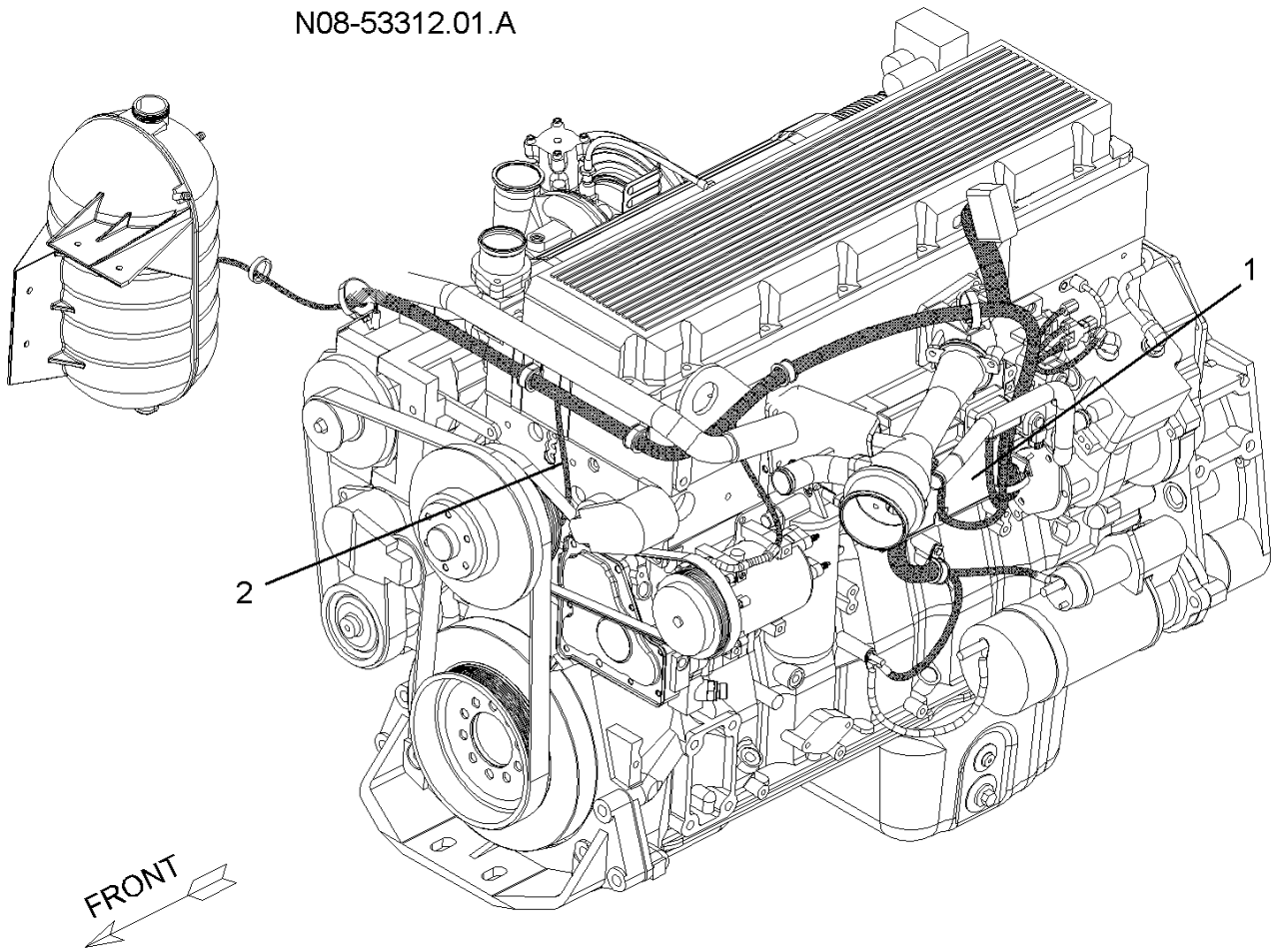

Figure 177 Cummins ISM Engine Wiring

1. (6014) ENGINE ECM
2. (6409) ELECTRICALMAGNETIC FAN CIRCUIT K23–G OF ENGINE HARNESS TO FAN PIGTAIL

5. I6-HEUI EXHAUST BRAKE

5.1. CIRCUIT FUNCTIONS

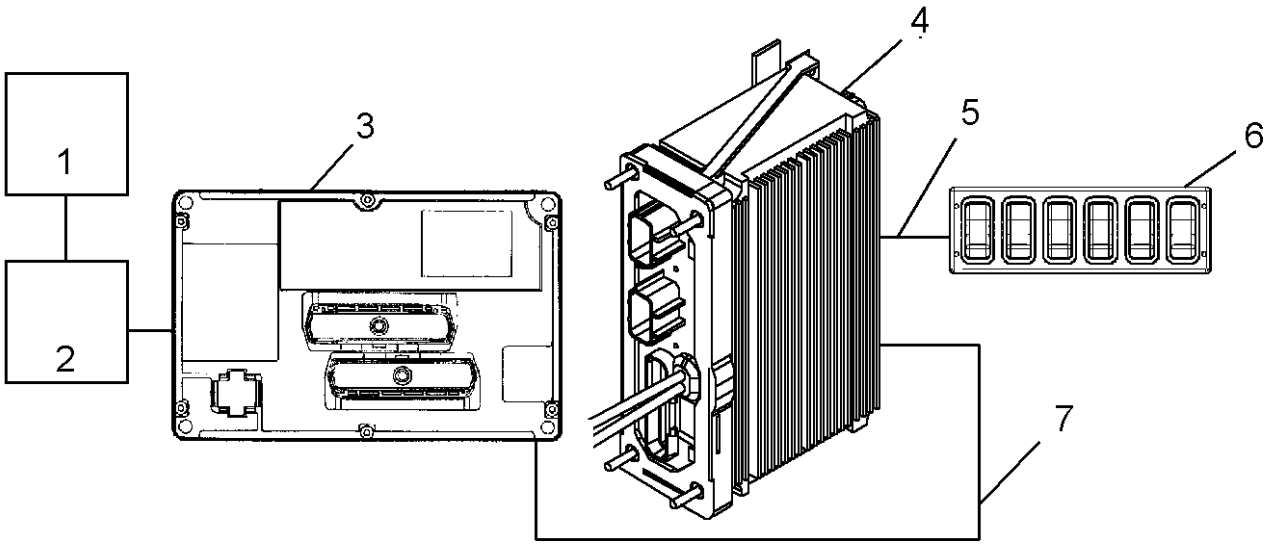

Figure 178 Exhaust Brake Functional Diagram

1. EXHAUST BRAKE SOLENOID
2. EXHAUST BRAKE RELAY
3. ENGINE CONTROL MODULE
4. ELECTRICAL SYSTEM CONTROLLER
5. SWITCH DATA LINK
6. SWITCH PACK
7. DRIVETRAIN 1939 DATA LINK

The exhaust brake uses exhaust to create back pressure in the cylinders, which makes the engine less efficient, thereby slowing the vehicle down.

When the exhaust brake switch in the cab is activated the switch pack will communicate with the ESC on the switch data link. The ESC will send a J1939 message to the engine controller requesting that the engine retarder be enabled. The engine ECM determines when the exhaust brake relay is energized. When the relay energizes, air pressure will be applied to the exhaust brake closing a valve and restricting exhaust flow.

The indicator of the exhaust brake switch should be “ON” if the switch is on and ignition is on. This will indicate that the exhaust brake is enabled. If a switch error occurs the indicator light on the switch should flash.

5.2. DIAGNOSTICS

The ESC will not log any diagnostic trouble codes for exhaust brake circuits. The ESC will diagnose switch errors in the switch pack.

The EZ-Tech running the "INTUNE" diagnostic software can be used to monitor commands into and out of the ESC. See the diagnostic software manual for details on using the software.

The engine controller will detect faults in the circuits to the exhaust brake relay coil. Refer to the applicable engine manual.

Exhaust Brake Preliminary Check

Table 125 Exhaust Brake Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify the exhaust brake is not working.	Check system operation.	Exhaust brake does not activate during deceleration or the indicator on the switch is not steadily illuminated.	Go to next step.	Exhaust brake is working.
2.	On	Is exhaust brake switch indicator steadily illuminated when the switch is on?	Check switch indicator.	Switch indicator is steadily illuminated.	Go to next step.	Refer to the Switch Pack Module section of this manual.(See SWITCH PACK MODULES, page 124)
3.	Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 347)					

5.3. FAULT DETECTION MANAGEMENT

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

A failure in the exhaust brake circuits will be apparent when the indicator on the exhaust brake switch doesn't illuminate when the exhaust brake switch and ignition are on, or the exhaust brake doesn't activate when the vehicle decelerates.

Failures in exhaust brake circuits could be attributed to a mechanical problem, a blown fuse, a burned out indicator lamp, open circuits, circuits shorted to ground, a failed relay or a problem with the engine controller.

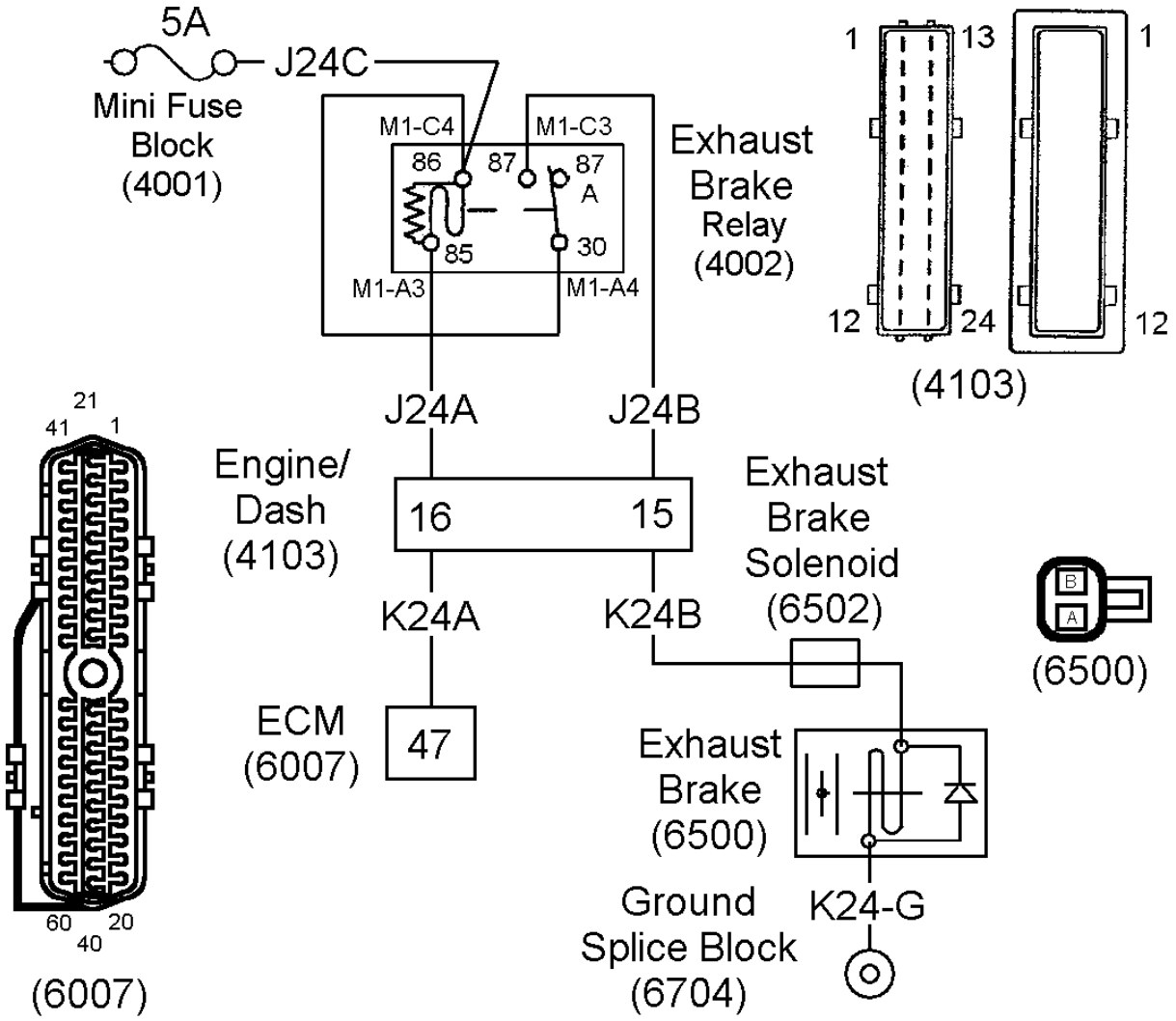

Figure 179 Exhaust Brake Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(4001) MINI FUSE BLOCK 5 AMP EXHAUST BRAKE FUSE
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION PANEL
(4002) EXHAUST BRAKE MICRO RELAY BLOCK
LOCATED IN ENGINE COMPARTMENT POWER DISTRIBUTION PANEL
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6007) ECM CONNECTOR
LOCATED ON ECM
(6500) EXHAUST BRAKE SOLENOID CONNECTOR
LOCATED ON EXHAUST BRAKE SOLENOID
(6502) EXHAUST BRAKE SOLENOID CONNECTOR
LOCATED ON EXHAUST BRAKE SOLENOID
(6704) GROUND SPLICE BLOCK
LOCATED NEAR ENGINE ECM

Table 126 Exhaust Brake Relay Connector Checks

Check with Exhaust Brake Relay Removed and Ignition Key ON. Insure 5A exhaust brake relay fuse in engine compartment PDC is not blown. Bench check relay and replace if it has failed.(See BENCH TESTING RELAYS, page 29)		
Test Points-	Spec.	Comments
Socket cavity C4 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short to ground in circuit J24C to the fuse. Also check for a blown fuse.
Socket cavity A4 to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short in circuit between A4 and C4.
Socket cavity A4 to C3.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short to ground in circuits from C3 through exhaust brake solenoid (6502) and exhaust brake solenoid (6500) to the ground splice block.
Socket cavity A3 to ground.	12 ± 1.5 volts with exhaust brake inactive. 0 volts with exhaust brake active. Ground from ECM energizes relay.	If voltage is incorrect, check for open or short to ground in circuits between A3 the ECM. Also check for missing voltage from ECM.
If relay and voltages check good, relay circuits are good. Refer to the engine manual for further troubleshooting.		

5.4. EXTENDED DESCRIPTION

The exhaust brake relay fuse supplies ignition voltage to exhaust brake relay cavity C4 (relay coil) and A4 (relay common contact).

When the engine ECM determines the exhaust brake should be activated, the ECM will supply a ground to cavity A3 (relay coil) energizing the relay.

The energized relay will apply ignition voltage to the exhaust brake solenoid terminal A, causing the solenoid to energize.

The energized solenoid will apply air pressure to the exhaust brake.

5.5. COMPONENT LOCATIONS

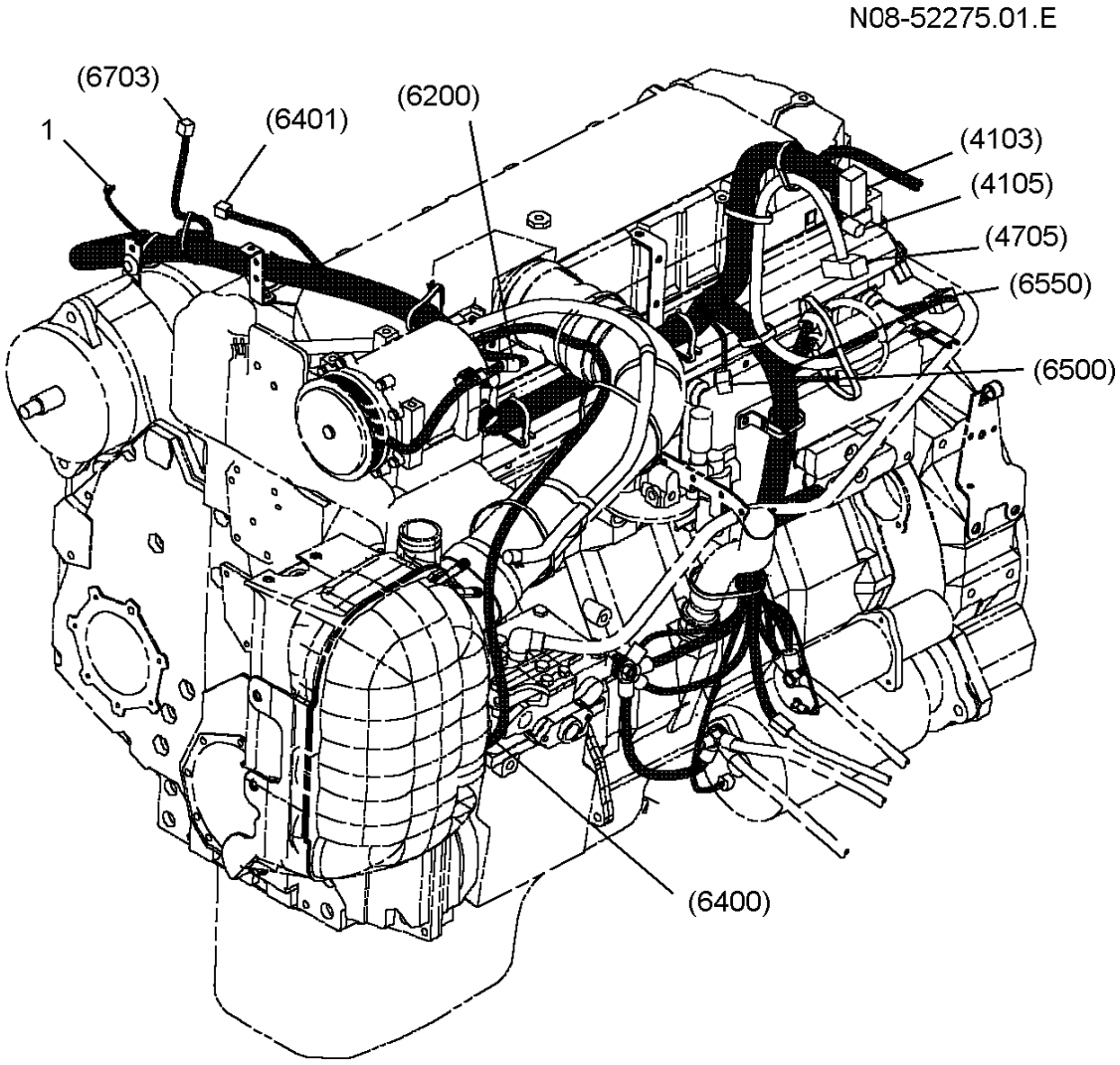

Figure 180 I6 Engine Wiring

1. CIRCUIT TO OPTIONAL ALTERNATOR WARNING LIGHT
(4103) 24– WAY ENGINE CONNECTOR
(4105) 3–WAY ENGINE CONNECTOR
(4705) 8–WAY OR 24– WAY TRANSMISSION CONNECTOR
(6200) AIR CONDITIONER COMPRESSOR CLUTCH CONNECTOR
(6400) COOLANT LEVEL SENSOR CONNECTOR
(6401) MELROSE CONNECTOR (TO AIR FAN SOLENOID)
(6500) EXHAUST BRAKE CONNECTOR
(6550) ETHER START THERMOSTATIC SWITCH CONNECTOR
(6703) 24– WAY ENGINE CONNECTOR

Table of Contents

1. BATTERY

Use with the applicable circuit diagram book for the vehicle being serviced.

1.1. BATTERY POWER

There are three main functions of the storage battery:

A. To supply power to the starter and ignition system so the engine can be cranked and started.

B. To supply extra power required when the vehicle's load requirements exceed the supply from the charging system.

C. To act as a voltage stabilizer by smoothing out or reducing temporary high voltage within the electrical system.

Vehicle batteries are connected in parallel with the positive battery cable connected to the cranking motor solenoid (B) terminal. Depending upon battery quantity and box location, some vehicles have two positive cables to the cranking motor solenoid. The additional cable reduces voltage drop during cranking.

The negative battery terminals are connected to the cranking motor ground stud (G).

In some cases, the negative battery terminals are also connected directly to the frame rail. The engine block ground, the cab, and the frame are also connected by ground cables or circuits to the cranking motor ground.

Remote Start Terminal

The remote starter terminal allows an external battery power source to either charge the vehicle batteries or assist in cranking the engine. Connect the external source positive cable to the remote start terminal and the external source negative cable to vehicle frame rail.

1.2. BATTERIES AND CABLES

Battery systems for these vehicles consist of two 12 volt maintenance free batteries or three 12 volt maintenance free batteries. Any optional batteries installed are also the maintenance free type.

WARNING – When handling batteries, always wear face or eye protection, have water supply available, assure good ventilation, and be sure no open flames are present.

A. Before beginning these test procedures, make sure the vehicle batteries are at 75% state of charge (SOC) or higher. This represents an open circuit voltage (OCV) of 12.4 volts. Batteries with an OCV of 12 volts or less are either completely discharged or have a dead cell.

B. Before beginning these test procedures, check any light or indicator lamp filaments that are suspected of being open (burned out). This is done to avoid unnecessary extensive circuit checks.

C. Before beginning these test procedures, inspect all connectors for loose or damaged pins, wires, etc. Refer to TEST EQUIPMENT AND CONNECTOR REPAIR section in Group 08 Electrical in the ISIS® Master Service Manual.

D. When the technician determines that a fuse is blown, while checking its condition, he is directed to locate the cause of the overload condition and to repair it. While no further instruction on this procedure is listed in the diagnostic tables, the common procedure is as follows: isolate sections of the circuit, by disconnecting connectors, and measure the resistance to ground to find the circuit that is shorted to ground. Then locate the damaged spot in the wire or connector and repair.

E. Diagnostics for circuits that are malfunctioning by sticking in the on position are generally not covered in detail. It is assumed that the technician knows to check for a malfunctioning switch, relay, or solenoid.

Battery Test Procedure

Test each battery separately.

1. Disconnect both battery terminal cables at each battery. Check each battery visually.

2. Examine the hydrometer eye (if no eye go to step 3).
   a. Eye shows green - go to step 4.
   b. Eye shows dark - recharge, then go to step 4.
   c. Eye shows yellow - replace battery.

3. Apply a 300A load for 15 seconds. Turn off load and wait one minute.
   a. If 12.4 volts or more - go to step 4.
   b. If less than 12.4 volts - recharge, then repeat step 3. If battery will not store charge above 12.4 volts, replace it.

4. Apply a test load equal to 50% of the battery CCA rating at 17.8°C (0°F). After 15 seconds,**with the load still applied**, measure and record terminal voltage _____. Turn the load off.

5. Estimate the battery temperature. If measured voltage does not meet or exceed the value shown in the following table, replace the battery.

Table 127 Battery Temperature Table

Temp.	21.1°C	10°C	–1.1°C	–9.4°C	-17.8° C
Temp.	70°F	50°F	30°F	15°F	0°F
Min. Volts	9.6	9.4	9.1	8.8	8.5

6. Clean all cable ends and terminals of the battery with a wire brush And reconnect battery.

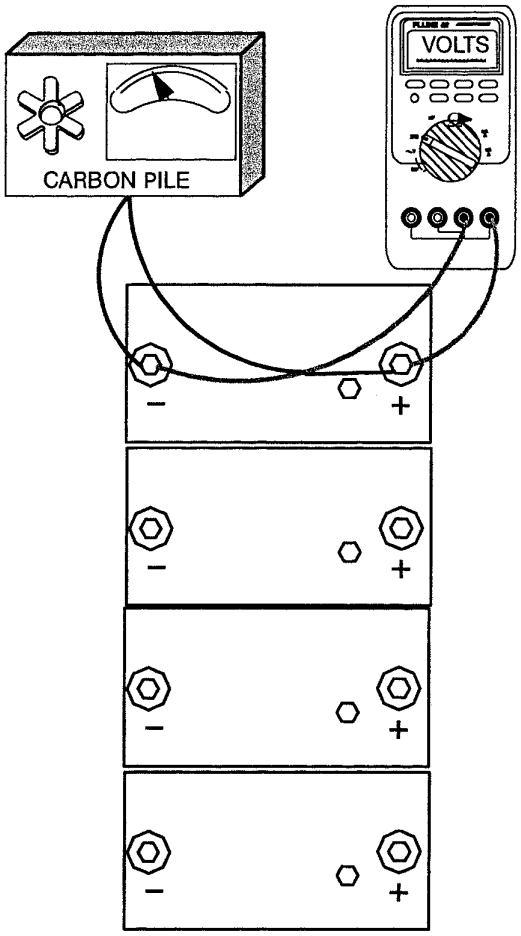

Figure 181 Battery Test Configuration

Battery Cable Voltage Loss Test

Slow cranking is often caused by high resistance in the battery cables or connections, especially in cold weather. After all batteries check good (Battery Test Procedure) and terminals are clean and tight, check the battery cables. To check battery cables place a specific load on the batteries at the starter and measure the voltage drop in each cable. This load will be supplied by the adjustable carbon pile.

The voltage drop in the positive cable plus the voltage drop in the negative cable equals the difference between the battery voltage and the starter voltage due to the cables. The maximum acceptable loss has been calculated only for the specific load specified in the test.

1. Tighten nuts holding battery cables to the solenoid and starter terminals.

   NOTE – The solenoid BAT terminal is at battery voltage when batteries are connected.

2. Connect carbon pile positive lead to start solenoid BAT terminal and negative lead to starter ground terminal.

3. Connect voltmeter from the starter solenoid “B” terminal to battery positive post.

4. Turn carbon pile on and adjust load to 500A. Read and record positive cable voltage drop. Turn off the load and allow carbon pile to cool.

5. Connect voltmeter from negative battery post to starter ground terminal. Attach leads directly to ground studs and not the cables.

6. Turn carbon pile on and adjust load to 500A. Read and record negative cable voltage drop. Turn off the load.

Positive Cable Voltage Loss (step 4) _____

plus Negative Cable Voltage Loss (step 6) _____

equals Total Cable Loss _____.

If system loss **is 0.6V or less**, go toStarting Motor System Circuits And Components.

If system loss**is greater than 0.6V**, repair or replace cable(s) with excessive voltage loss and retest.

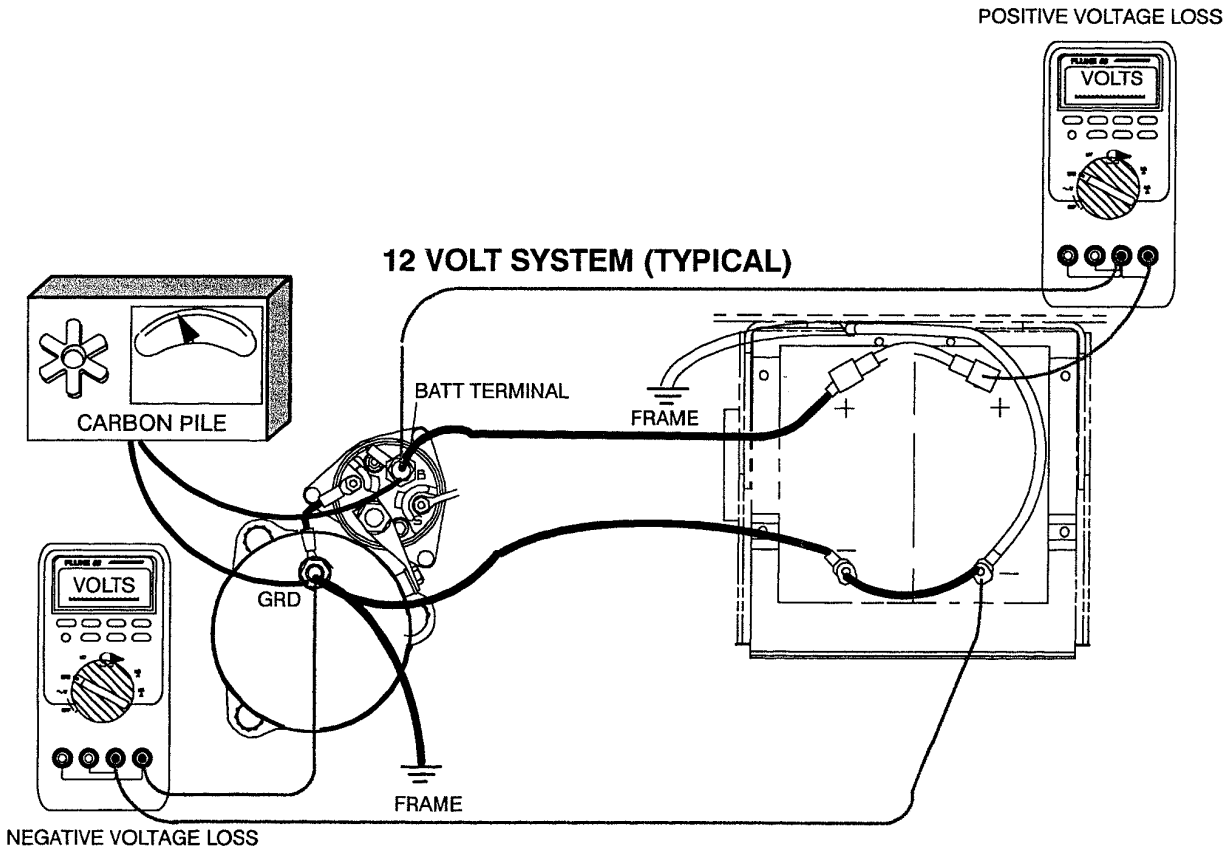

Figure 182 Battery Cable Voltage Loss Test

1.3. COMPONENT LOCATIONS

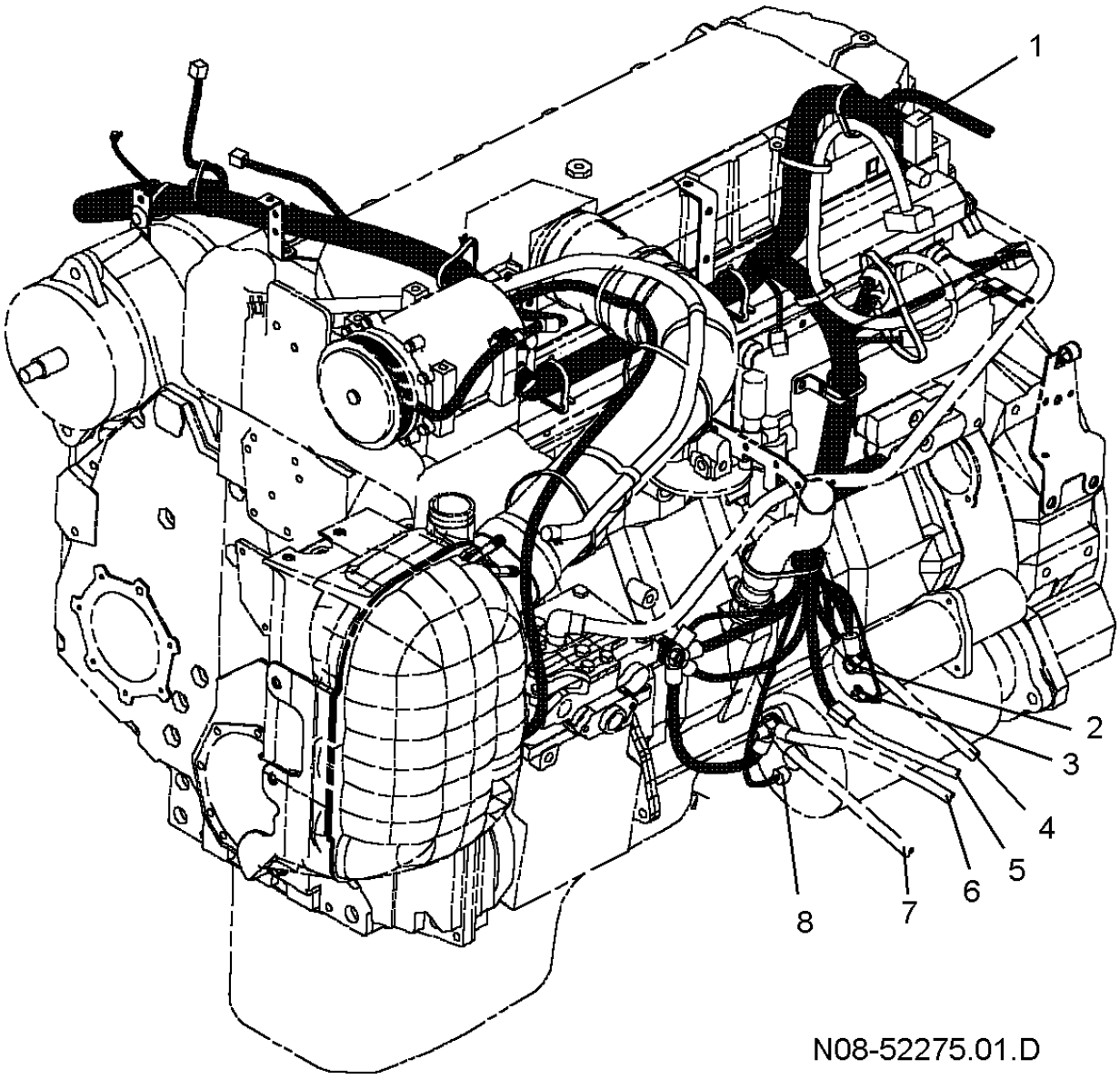

Figure 183 Cranking Motor Location

1. ENGINE/DASH CONNECTOR (4103)
2. B TERMINAL OF CRANKING MOTOR SOLENOID
3. S TERMINAL OF CRANKING MOTOR SOLENOID
4. TO BATTERY POSITIVE TERMINAL
5. ENGINE CONTROLLER CLEAN POWER AND GROUND
6. TO BATTERY NEGATIVE TERMINAL
7. TO FRAME GROUND
8. THERMAL OVERCRANK PROTECTION (6316)

2. CHARGING

The alternator generates alternating current which is subsequently converted to direct current. The function of the alternator is to supply power to the vehicle electrical system. Any current above the needs of the vehicle components is used to charge the batteries.

2.1. CHARGING CIRCUITS

For a complete discussion on operating principles for alternators, refer to Group 08 Electrical in the ISIS® Master Service Manual for the specific alternator being serviced.

International Engines

When the vehicle is running, the alternator supplies power through the alternator or (BAT) terminal, and circuit K2 to a splice. From the splice, current flows through 2 fusible links, K2–FL and K2A-FL to the crank motor solenoid battery stud. From this stud, current flows to the batteries through the positive battery cable. Power is also applied to maxi fuse block (4000) through circuit J14H and circuit J14F.

The alternator is grounded through the (GRD) terminal and circuit K2–G to the starter motor ground stud (G).

2.2. VEHICLE CHARGING SYSTEM

Batteries Undercharged

Before beginning test procedures: check battery cables and alternator wiring (especially grounds) for clean, tight connections. Wires and connectors should not be damaged or corroded.

Perform the following checks before removing the alternator from the vehicle.

1. Accessories having been left on for an extended time.

2. Check alternator drive belt tension (refer to GROUP 12 - ENGINE, Cooling in the ISIS® Master Service Manual for belt tension specifications). As a general rule, if the alternator fan can be rotated by pulling on the fan with one finger, the belt is too loose.

3. Inspect for defective batteries as described in Group 08 Electrical in the ISIS® Master Service Manual.

4. Wiring defects. Visually check wiring, clamps, and connections for clean, tight connections, free of damage and corrosion.

5. With the engine off, check voltage to ground at the BAT terminal of the alternator. A zero reading indicates an open in circuit 2, between the alternator and batteries.

6. A defective component or wiring defect may be causing a small current drain that is less than the fuse rating for the circuit so the fuse does not open. To locate the unwanted current drain:

   NOTE – Batteries should be fully charged for the following test.

   a. KEY OFF- Turn all accessories and controls off. Disconnect circuit 2 from the alternator B terminal.

   b. To check the entire system for current drains, insert the DMM leads in the COM and 10A fused jack on the meter. Set the meter to DC amps. Connect the meter in series with the alternator. If the meter leads are not connected with correct polarity, a (-) amp reading will be present.

c. Some current draw will be present. If the current draw is less than 0.3A move the lead from the 10A jack to the 320mA jack to read the exact current flow.

d. Refer to the Battery Power Distribution circuit diagrams in S08285. Remove the battery feed fuses one at a time, while monitoring the meter for any change in current flow. Note that some circuits (such as clock or radio or engine computer, etc.) should be drawing some current. Look for current draw in circuits that should not be active.

7. Perform Alternator Wiring Test — Part 1 below.

Alternator Tests

The alternator output must reach the batteries and accessory loads with a minimum amount of voltage loss. Any loss slows the rate of charge to the batteries and can cause the batteries to be undercharged. Discharged batteries can damage the starter and cause vehicle electrical components to operate improperly.

Most alternators control the maximum system voltage using a voltage regulator. Maximum voltage output is available at the alternator BAT terminal, but if any voltage is lost in the wiring, something less than the maximum will reach the batteries and load devices. The greatest losses occur when the charging system is outputting at the maximum rated level (amps).

Alternator Wiring Test — Part 1

Instead of using alternator current output, this test (and Alternator Wiring Test — Part 2 below) uses the same amount of current but draws it from the batteries (must be fully charged). Using the carbon pile load, the current flows in reverse through the circuit without the engine running.

1. Without the engine running, connect the carbon pile to the alternator output terminal and ground.

   NOTE – Alternator output is at battery voltage.

2. Connect voltmeter across battery.

3. Adjust the carbon pile to alternator rated output (amps). Rated output is stamped on the case or on a tag.

4. Measure and record BATTERY VOLTAGE. Turn the carbon pile off.

5. Move the voltmeter to the alternator, but do not connect to carbon pile clamps. Adjust carbon pile to rated output (amps) of the alternator.

6. Measure and record ALTERNATOR VOLTAGE. Turn carbon pile off.

BATTERY Voltage (step 4) _____

minus ALTERNATOR Voltage (step 6) _____

equals System Loss _____

If system loss **is 0.7 volt or less**, go to Alternator Replacement Test.

If system loss **is greater than 0.7 volt** go to Alternator Wiring Test — Part 2.

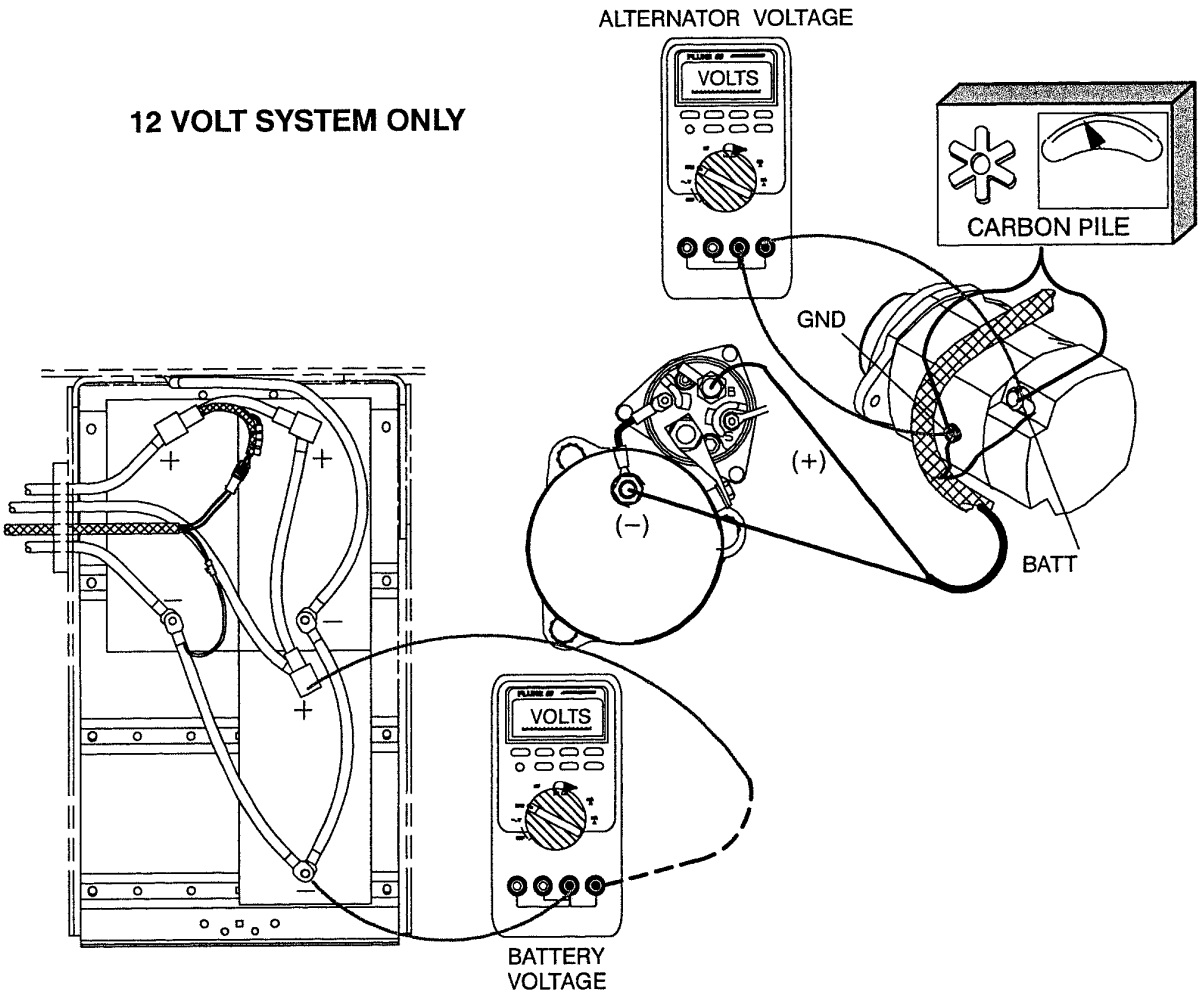

Figure 184 Alternator Wiring Test — Part 1

Alternator Wiring Test — Part 2 (12 volt System Only)

If system voltage is MORE than 0.7 volt in Alternator Wiring Test — Part 1, above, perform this test.

1. With the carbon pile still connected, connect Fluke 88 meter to alternator BAT terminal and to the positive battery terminal.

2. Adjust carbon pile to alternator rated output (amps). Measure and record POSITIVE CIRCUIT LOSS. Turn carbon pile off.

3. Connect the meter to the alternator ground and to the battery negative terminal.

4. Adjust the carbon pile to alternator rated output (amps). Measure and record NEGATIVE CIRCUIT LOSS. Turn carbon pile off.

   POSITIVE CIRCUIT LOSS (step 2) _____

plus NEGATIVE CIRCUIT LOSS (step 4) _____

equals TOTAL SYSTEM LOSS _____

If system loss **is 0.7 volt or less,** go to Alternator Replacement Test, below.

If system loss **is greater than 0.7 volt** , repair circuit(s) defects, then go to Alternator Replacement Test, below.

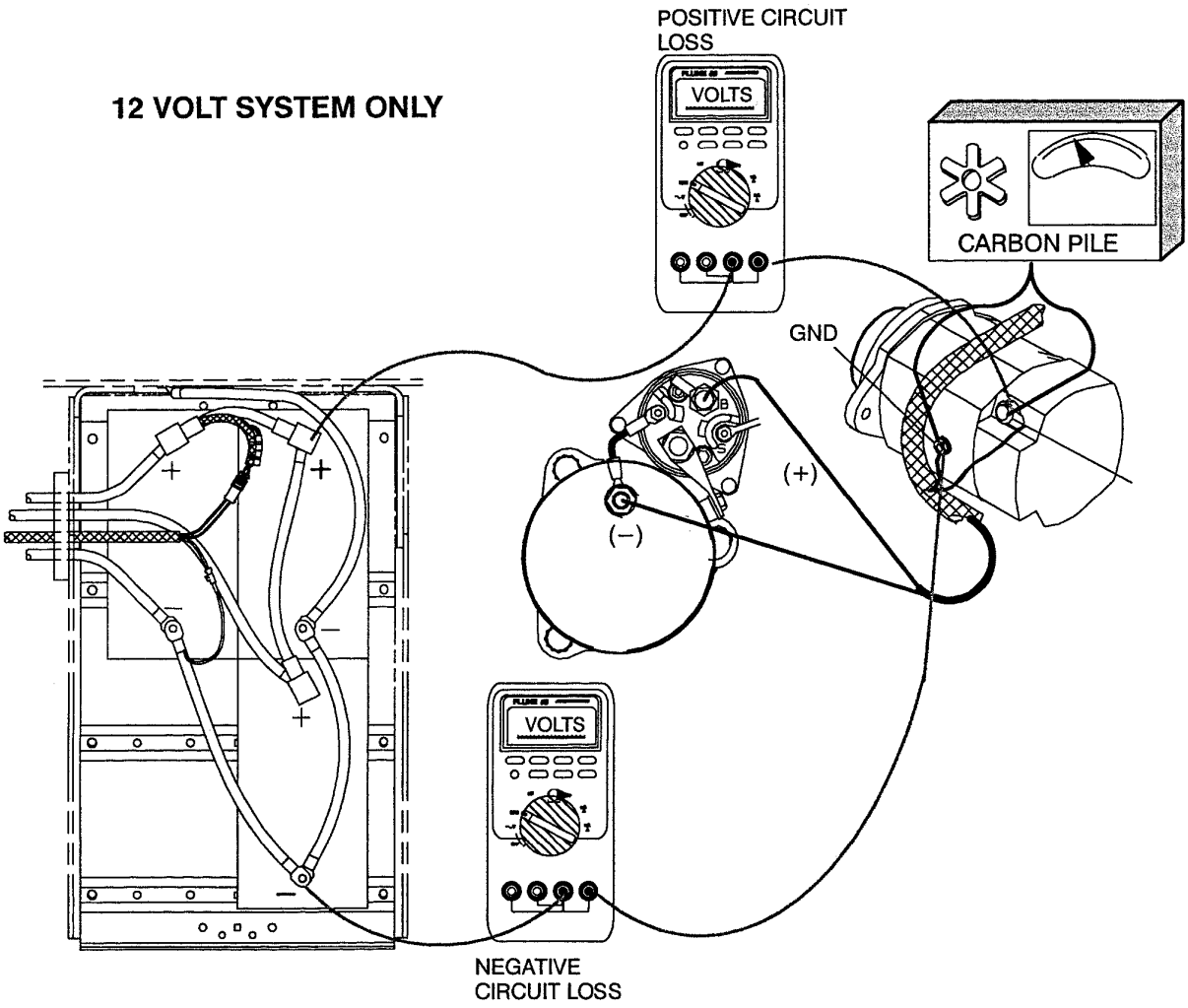

Figure 185 Alternator Wiring Test — Part 2 (12 volt System Only)

Alternator Replacement Test (12 volt System Only)

1. If the wiring tests have been performed (circuits OK), adjust alternator belt and tighten mounting bolts and ground connections.

2. With vehicle at shop temperature, connect the carbon pile and the ammeter as shown. To use an ammeter without induction clamp, connect meter leads to same terminals as the carbon pile.

3. With NO electrical loads turned on, start the engine. Fast idle until voltage stabilizes (does not increase for 2 minutes). Voltage then should not exceed 15 volts.

4. Speed up the engine and turn on the carbon pile until the ammeter shows output has reached the highest value. Record the value _____A. Turn off carbon pile and the engine.

5. Rated output is stamped on the alternator case or on a tag. If current output measured is not within 10% of rated output or the voltage exceeds 15 volts, replace the alternator.

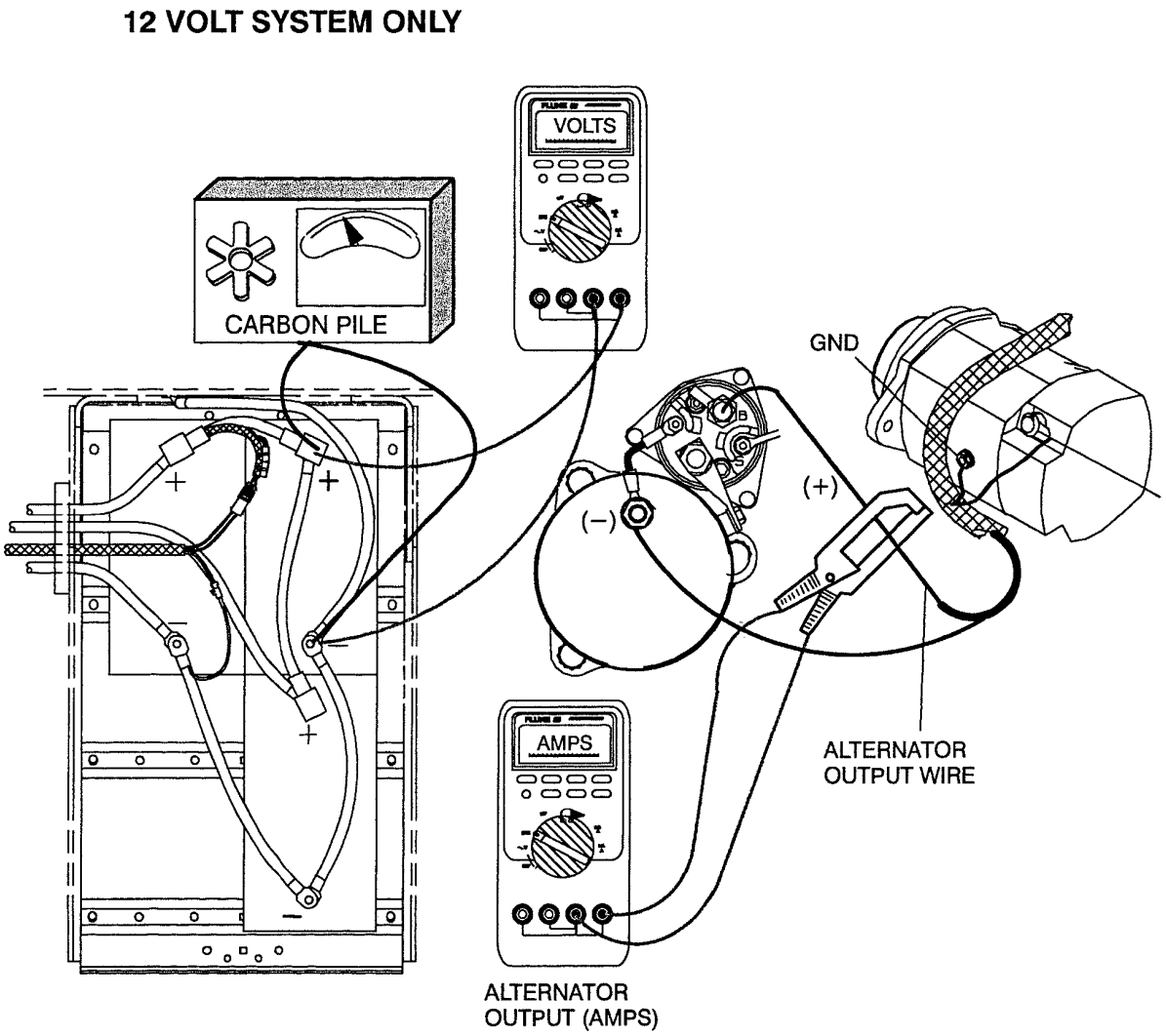

Figure 186 Alternator Replacement Test (12 Volt System Only)

2.3. COMPONENT LOCATIONS

N08-52775.03.B

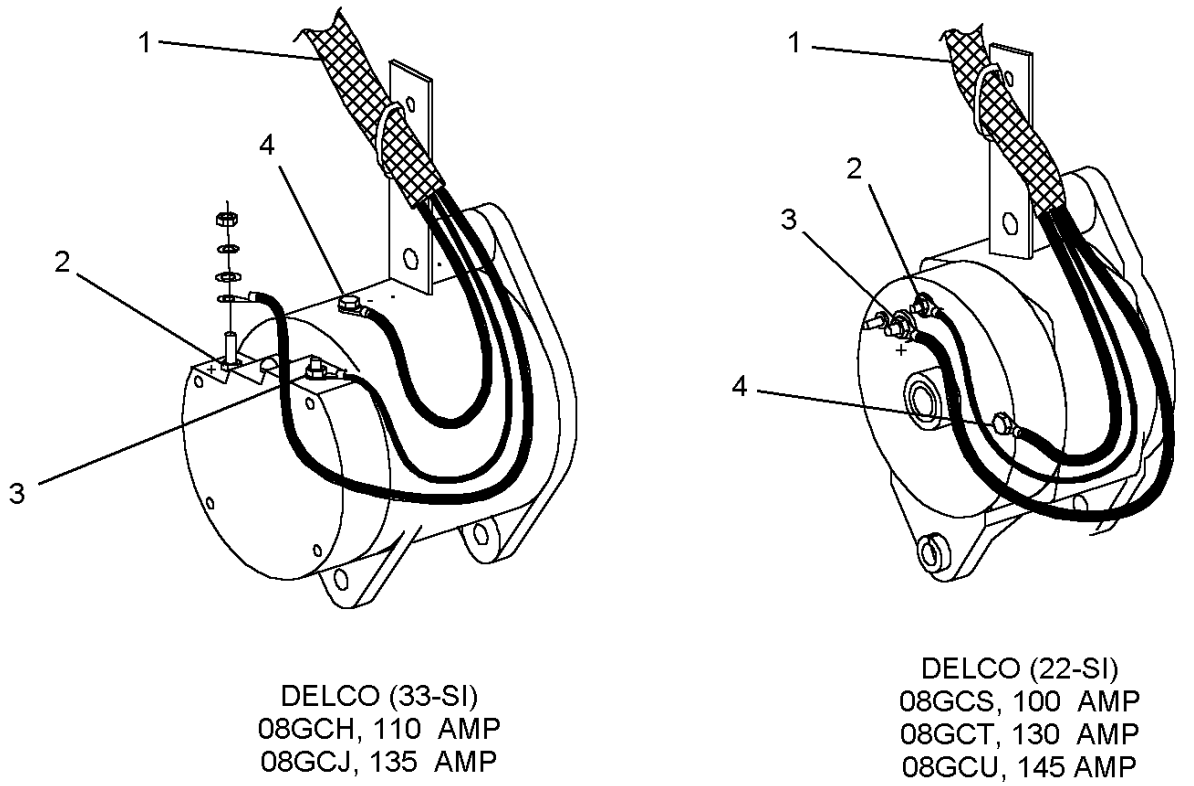

Figure 187 Delco Alternator Wiring With International Engines

1. ENGINE HARNESS
2. POSITIVE TERMINAL, CIRCUIT K2
3. NEGATIVE TERMINAL, CIRCUIT K2–G
4. I TERMINAL, CIRCUIT

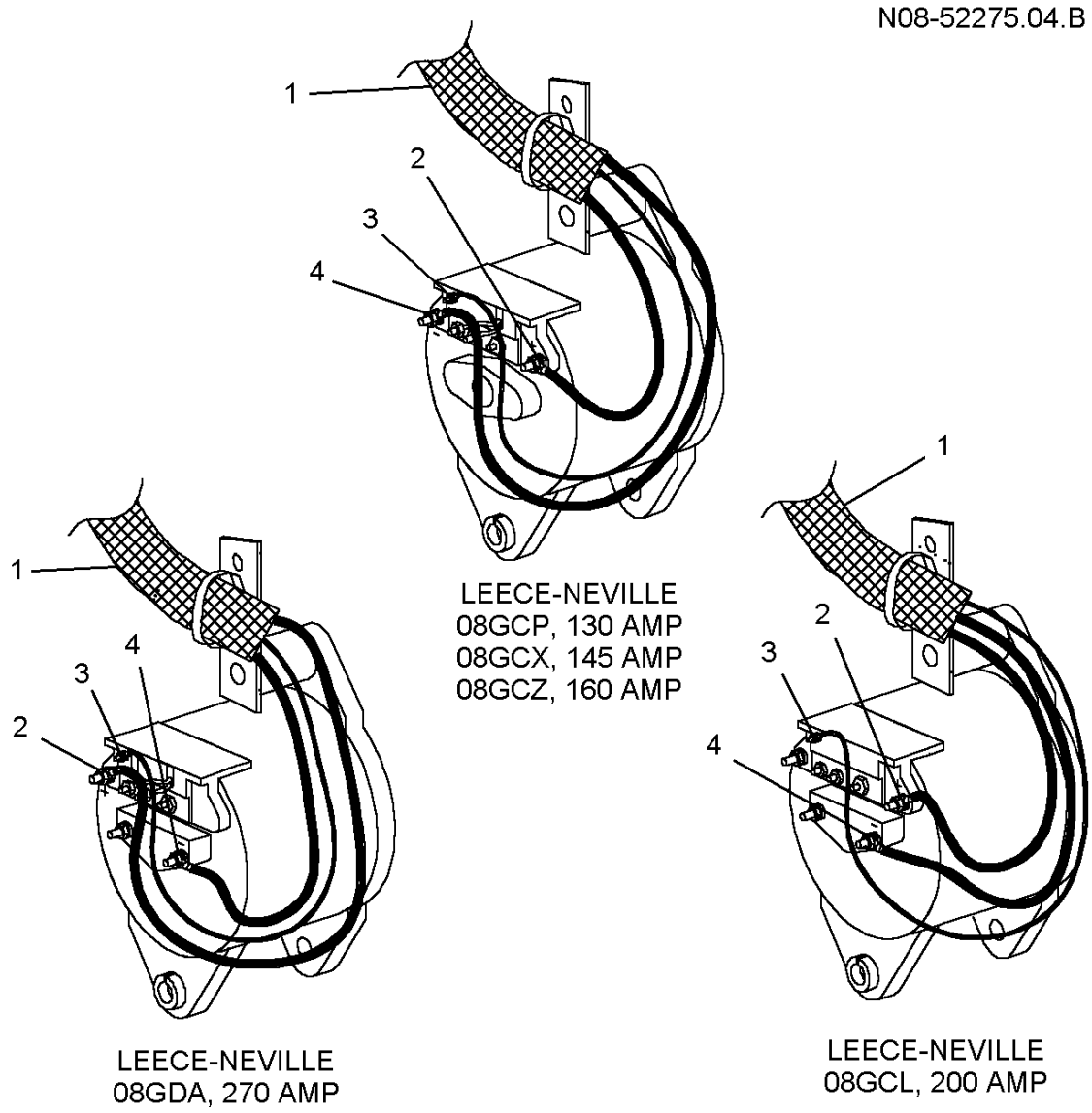

Figure 188 Leece–Neville Alternator Wiring With International Engines

3. ENGINE CRANKING

3.1. CIRCUIT FUNCTIONS

The cranking motor provides the rotation of the engine crankshaft, through the flywheel, that is needed to start the engine.

The cranking motor circuits provide power to the cranking motor to turn over the crankshaft of the engine. If all other systems are operational, the engine will start.

Components of the system with International engines consist of the crank motor and solenoid, the key start switch (or push button), starter ISO & power relay, the engine electronic control module (ECM), and a clutch switch with a manual transmission or a neutral position signal with an automatic transmission.

NOTE – Vehicles with the Auto Neutral feature will also use a crank inhibit relay.

When the clutch pedal is pushed, or the automatic transmission is in park or neutral, or the EATON Autoshift transmission in neutral the engine controller will provide a ground to the starter ISO & power relay . When the key is in the start position, 12 volts will be applied to the relay causing it to energize. The energized relay will supply 12 volts to the cranking motor solenoid causing it to energize and apply battery voltage to the cranking motor.

NOTE – Cranking motors ending in a type 50, like 350 or 450, contain thermal overcrank protection.

On vehicles using starters with thermal overcrank protection, excessive cranking will cause cranking motor temperature to reach a pre-set thermal overcrank limit. The thermal switch will then open causing the motor to disengage. When the thermal switch opens it interrupts a ground signal from the engine controller to the coil of the starter relay, preventing it from energizing. When the crank motor cools, the switch closes, permitting the crank motor to operate again.

3.2. DIAGNOSTICS

Table 128 Cranking System Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify cranking system is inoperative.	Attempt to start vehicle.	Cranking motor is turning engine.	Engine cranks. Problem may be 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.)	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	Measure voltage at cranking motor solenoid while key is in start position?	Cranking motor solenoid terminal “S”.	12 ± 1.5 volts	Go to next step.	Go to Starter ISO & Power Relay Circuits. (See STARTER ISO & POWER RELAY CIRCUITS, page 381)
4.	Off	Measure voltage at cranking motor solenoid while key is in off position?	Cranking motor solenoid terminal “B”.	12 ± 1.5 volts	Go to Cranking Motor System Circuits And Components. (See CRANKING MOTOR SYSTEM CIRCUITS AND COMPONENTS, page 383)	Identify and repair cause of incorrect voltage to cranking motor “B” terminal from batteries.

3.3. STARTER ISO & POWER RELAY CIRCUITS

For complete information on operation and servicing cranking motors used on these vehicles, refer to Group 08 Electrical in the ISIS® Master Service Manual or the manufacturers service manual.

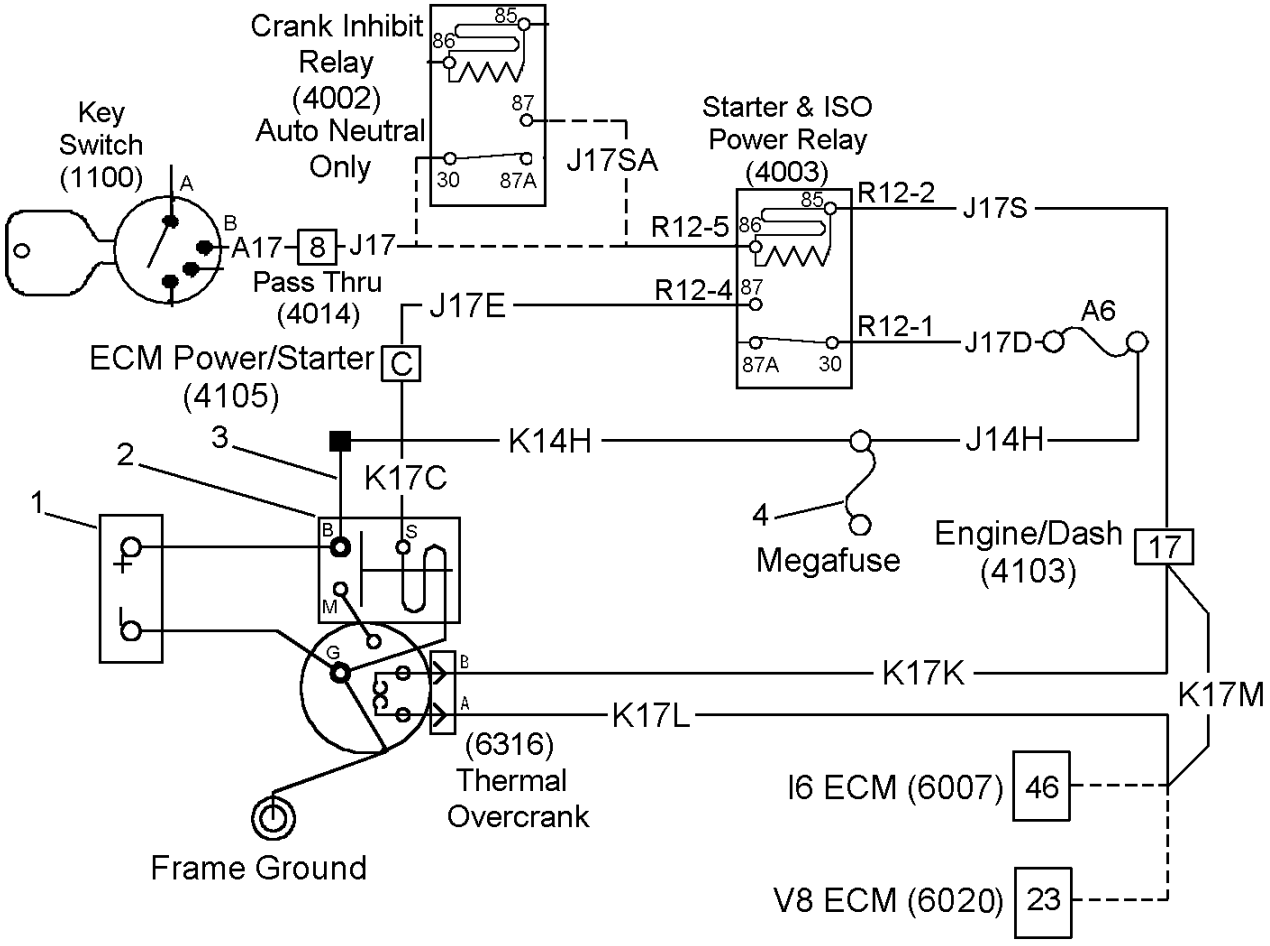

Figure 189 Starting Power Distribution Diagram

1. BATTERY
2. STARTER SOLENOID
   LOCATED ON STARTER
3. FUSIBLE LINK
4. MEGAFUSE

(1011), (1012), (1013), (1014) CAB FUSE BLOCKS
   LOCATED IN CAB PDC
(1100) KEY SWITCH CONNECTOR
(4000) A1-A6 MAXIFUSES
   LOCATED IN ENGINE PDC
(4002) CRANK INHIBIT MICRO RELAY USED WITH AUTO NEUTRAL ONLY
   LOCATED IN ENGINE PDC
(4003) START & ISO POWER RELAY R12
   LOCATED IN ENGINE PDC
(6316) THERMAL OVERCRANK
   LOCATED ON STARTER

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 power is always present at the crank motor solenoid (B) terminal through the positive battery cable. Power from the (B) terminal is supplied to start relay (R12) terminal through a fusible link, circuit K14H, circuit J14H, maxifuse A5 and circuit J17D.

On I6 engines the ground signal for starter and ISO relay (4003) R12 terminal 2 is supplied from engine controller connector (6007) terminal 46. The engine controller supplies a ground when the engine is not running. The clutch switch (depressed) or transmission circuits (in neutral) apply 12 volts to (6007) pin 26. On starters with thermal over crank protection, the thermal relay will open this circuit.

On V8 engines, ground signal for starter and ISO relay (4003) R-12 terminal 2 is supplied from engine controller connector (6020) terminal 23. The engine controller supplies a ground when the engine is not running. The clutch switch (depressed) or transmission circuits (in neutral) apply 12 volts to (6020) pin 8

The ground signal from the engine controller will be supplied when the clutch is engaged, or the automatic transmission is in neutral, or the EATON Autoshift transmission is in neutral.

On vehicles **without the auto neutral feature**, when the key switch (1100) is turned to the start position power is applied through circuit A17, through pass thorough connector (4014) and circuit J17 to starter relay R12 terminal 5. If the ground signal from the engine controller is present at R12 terminal 2, the relay will energize.

On vehicles **with the auto neutral feature**, when the key switch (1100) is turned to the start position power is applied through circuit A17, through pass thorough connector (4014) and circuit J17 to crank inhibit micro relay. When the crank inhibit relay is energized by signals from the transmission controller, power will be applied to starter relay R12 terminal 5. If the ground signal from the engine controller is present at R12 terminal 2, the relay will energize.

With the start relay energized, power flows through the ISO & power relay (4003) R12 contacts terminal 4, circuit J17E, ECM power starter connector (4101), and circuit K17C, to the (S) terminal of the crank motor solenoid which energizes the crank motor solenoid.

As long as the engine is running, the engine controller will not allow the cranking motor to be engaged.

Table 129 Starter ISO & Power Relay Circuit Tests

Starter ISO & Power Relay Connector (4003) R12 Voltage Checks Check with R12 removed and ignition on. Bench check relay and replace if it has failed.(See BENCH TESTING RELAYS, page 29) **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
	Bench test starter ISO & power relay.	If relay fails replace relay. If relay passes test, go to next step.

Table 129 Starter ISO & Power Relay Circuit Tests (cont.)

(4003) R12 cavity 1 to ground	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits between (4003) R12 and maxifuse A5. Also insure maxifuse has voltage to it and is not blown.
(4003) R12 cavity 1 to cavity 4	12 ± 1.5 volts	If voltage is missing, check for open in circuits between (4003) R12 cavity 4 and ground through the cranking motor solenoid.
(4003) R12 cavity 1 to cavity 2	With clutch pedal depressed, or automatic transmission in park, or autoshift transmission in neutral voltage should be 12 ± 1.5 volts	If voltage is missing, check for open in circuits between (4003) R12 cavity 2 and engine ECM or open/short in clutch switch or transmission circuits to the engine controller. Also check for open thermal switch if overcrank feature is installed.
Information on clutch and neutral circuits to the engine controller is provided at the following areas: Manual transmissions, refer to Clutch Switch Circuits. (See CLUTCH SWITCH, page 558) LCT transmissions, refer to Neutral and Back-Up Light Circuits. MD transmissions, refer to Neutral Signal Circuits. (See AUTOSHIFT RELAY CIRCUITS, page 1009) EATON Autoshift transmissions, refer to Autoshift Relay Circuits. (See AUTOSHIFT RELAY CIRCUITS, page 1009)		
(4003) R12 cavity 5 to ground	With key switch in ignition position, 12 ± 1.5 volts	If voltage is missing, check for open in circuits between (4003) R12 cavity 5 and key switch (1100) circuit A17. On vehicles with auto neutral, check crank inhibit relay and circuits.

3.4. CRANKING MOTOR SYSTEM CIRCUITS AND COMPONENTS

Cranking Motor Solenoid Circuit Test - Part 1 (With International Engine)

Refer to Cranking Motor Solenoid Circuit Test - Part 1 (With International Engine)

Starter shifting in and out, or not pulling in, is often caused by high resistance in the cranking motor solenoid circuit. When the solenoid circuit has excessive voltage loss, the cranking motor pinion may not engage the flywheel. If it does engage, it may drop out too soon when battery voltage drops. The solenoid circuit includes the starter ISO & power relay (located in the engine power distribution center) and circuits connected to the cranking motor solenoid.

On vehicles with **overcrank protection**, refer to Testing Thermal Overcrank Protection System **before performing this test**.

1. Disconnect starter relay circuit K17C from the starter solenoid “S” terminal.

2. Connect the carbon pile positive lead to circuit K17C and the negative lead to the cranking motor ground. Connect the positive lead of a DMM voltmeter to the solenoid “B” terminal. Connect negative lead of voltmeter to switch wire lead K17C (not to carbon pile clamp). Meter will show battery voltage.

3. Have an assistant turn the key switch to the start position or push start button. Voltmeter reading should be zero. You should hear the starter relay energize with a clicking sound. If the switch doesn't "click," either the starter relay switch is defective or there is no voltage from the key switch circuit (refer to Starter ISO & power relay circuits (See STARTER ISO & POWER RELAY CIRCUITS, page 381).

4. Turn on and adjust the carbon pile to 50 amp load (for no more than 10 seconds). Read and record _____voltage on voltmeter. Release start switch. Turn off and disconnect carbon pile and voltmeter.

If circuit loss **is 0.5 volt or less,** Starter solenoid circuitry is OK.

If circuit loss **is more than 0.5 volt**, go to Cranking Motor Solenoid Circuit Test — Part 2 (See Cranking Motor Solenoid Circuit Test - Part 2 (Wire Voltage Loss), page 385)

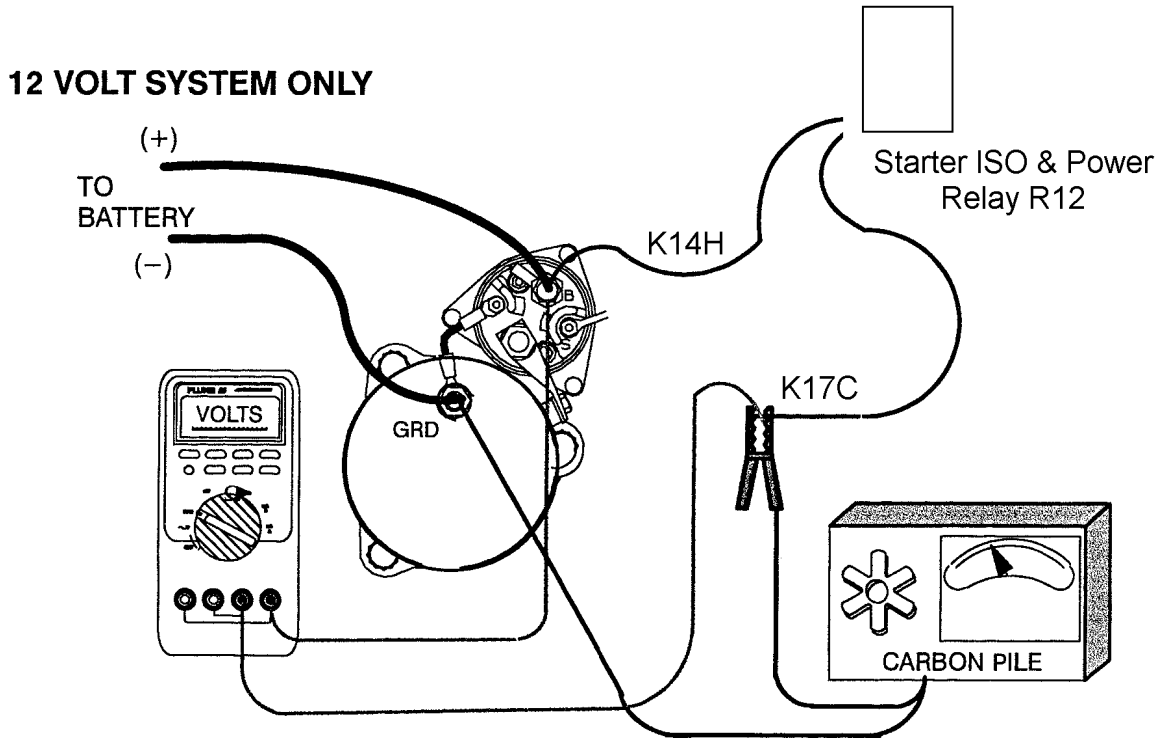

Figure 190 Cranking Motor Solenoid Circuit Test — Part 1 (With International Engine)

Cranking Motor Solenoid Circuit Test - Part 2 (Wire Voltage Loss)

Refer to Cranking Motor Solenoid Circuit Test - Part 2 (Wire Voltage Loss)

If the voltage loss in the previous Test was more than 0.5 volt, the loss is excessive. The loss may be from loose terminals, corrosion, or a worn out starter ISO & power relay. To locate the problem:

1. Disconnect circuit K17C from “S” terminal at Cranking Motor solenoid. Connect carbon pile to circuit K17C and to cranking motor ground terminal. Turn the carbon pile on (will show 0 amps).

2. Disconnect starter ISO & power relay R12 and install a jumper lead to R12 cavity 1, circuit J17D.

   NOTE – Test lead will be at battery voltage.

   Connect DMM from solenoid BAT terminal to starter ISO & power relay R12 cavity 1, circuit J17D (will show zero volts).

3. At relay connector, install other end of jumper lead to cavity 4 circuit J17E. Turn on and adjust carbon pile to 50 amp load (no more than 10 seconds). Read and record first wire voltage loss. Disconnect DMM.

4. At relay connector, connect DMM from cavity 1, J17E to circuit J17E at carbon pile. Connect to terminal and not to carbon pile clamp.

5. Turn on and adjust carbon pile to 50 amp load (no more than 10 seconds). Read and record second wire voltage loss. Disconnect and remove jumper lead and DMM.

First Wire Loss (step 3) _____

plus Second Wire Loss (step 5) _____

equals Total Wiring Loss = _____(0.4V maximum loss)

If wiring loss is **0.4 volt or less**, repair or replace wire(s), and retest per Cranking Motor Solenoid Circuit Test — Part 1, above.

If wiring loss is **more than 0.4 volt**, repair or replace wire(s), and retest per Part 1.

If retest results are still above 0.5 volt loss, replace starter relay and retest per Part 1.

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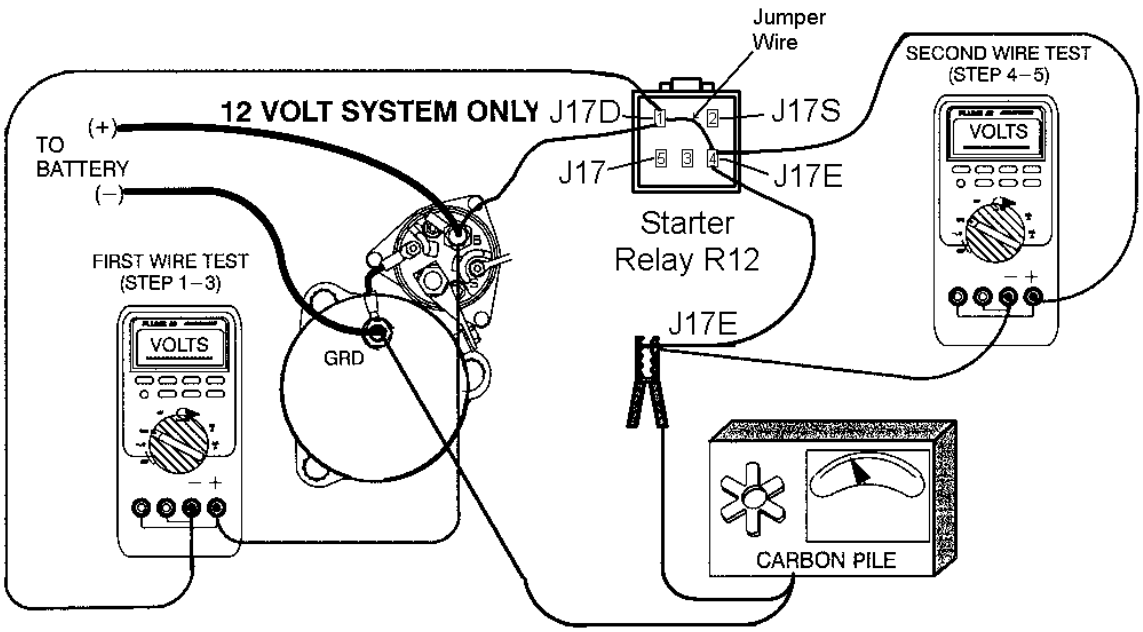

Figure 191 Cranking Motor Solenoid Circuit Test - Part 2 (Wire Voltage Loss) (With International Engine)

Cranking Motor Replacement Test

Refer to Cranking Motor Replacement Test.

A. COLD WEATHER START MAGNETIC SWITCH PROBLEMS

The start relay can fail to “hold in” during cold weather cranking due to low voltage, even though the switches and circuits check good. This failure sounds as though the cranking motor is failing to stay engaged to the flywheel. It is caused by low system voltage releasing the relay.

If this condition exists, momentarily install jumper wire from circuit J17D to 17E at starter ISO & power relay connector R12.

> **CAUTION – The studs or terminals are at battery voltage and the engine should crank when the jumper is connected. Remove jumper to stop cranking.**

If the engine cranks properly with jumper in place, replace the relay.

B. CHECKING AVAILABLE VOLTAGE AT CRANKING MOTOR

If all previous tests have been performed, the vehicle batteries and cranking motor wiring have been checked. If the engine still cranks slowly, check available voltage at the cranking motor.

1. While cranking engine, measure voltage between the cranking motor solenoid “BAT” stud and cranking motor ground.
   a. If voltage is 9.0 volts or more, the problem must be in the cranking motor (or engine). Replace the cranking motor.
   b. If the voltage is less than 9.0 volts, go to step 2.

2. Check the interconnecting cable between the batteries. While cranking, measure the terminal voltage of each battery by touching voltmeter leads to the post of each battery.
   a. If the difference between any two battery readings in the same battery box is more than 0.5 volt or any cable is warm to the touch, replace the interconnecting cables.
   b. If cables check OK, the problem must be in the Cranking Motor (or engine). Replace the Cranking Motor.

F08266TS5

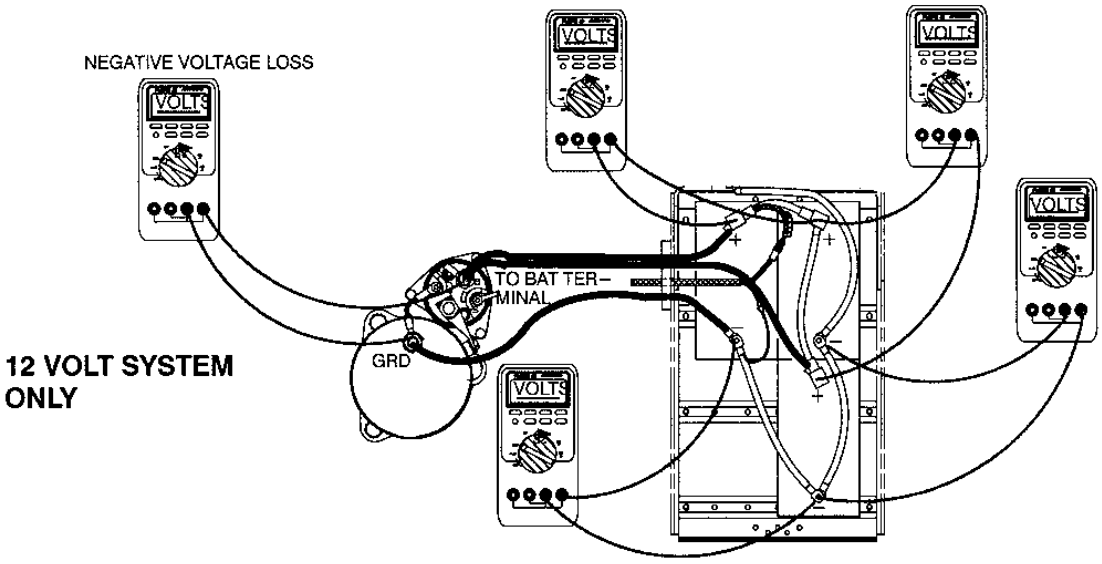

Figure 192 Cranking Motor Replacement Test

Testing Thermal Overcrank Protection System

The thermal overcrank circuit interrupts the ground signal from the engine controller to the starter ISO & power relay when the engine has been cranking to long and the starter is overheating. Problems with the circuits could be the result of a failed thermal switch or open or shorted circuits.

Table 130 Thermal Overcrank Circuit Tests

Thermal Overcrank Circuit Check with (6316) removed, key in start position and clutch pedal depressed or automatic transmission in PARK. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Thermal overcrank connector on starter motor.	Resistance across terminals should be < 2 ohms when starter is cool.	If resistance is high, replace thermal switch. If relay passes test, go to next step.
(6316) harness connector R12 cavity B to ground.	12 ± 1.5 volts	If voltage is missing, check for open or short in circuits K17K or J17S between (6316) and starter relay (4003).
(6316) harness connector R12 cavity B to cavity A.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K17L to engine controller. If circuit checks good refer to engine manual to troubleshoot missing ground from engine controller.

3.5. COMPONENT LOCATIONS

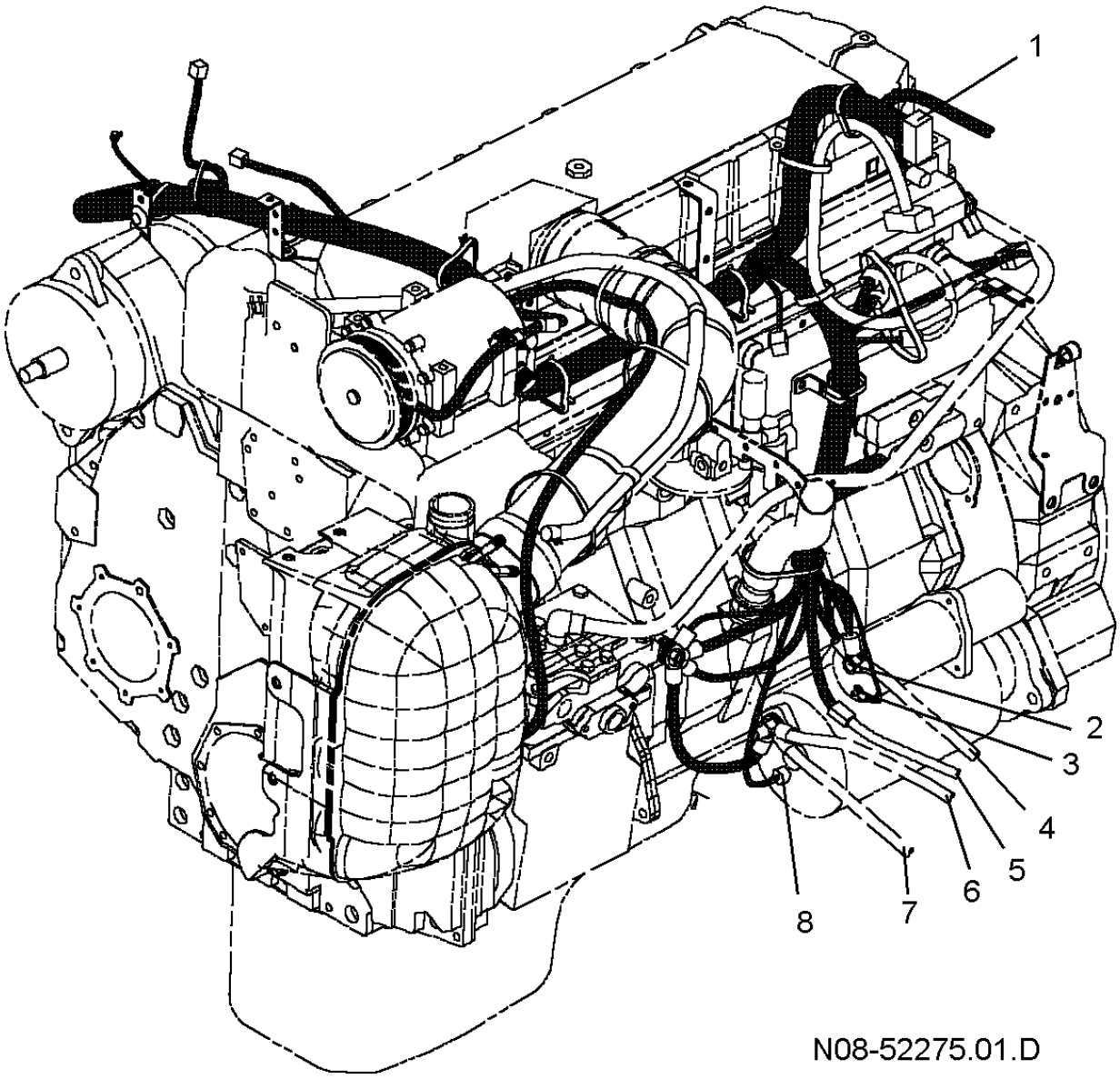

Figure 193 Cranking Motor Location

1. ENGINE/DASH CONNECTOR (4103)
2. B TERMINAL OF CRANKING MOTOR SOLENOID
3. S TERMINAL OF CRANKING MOTOR SOLENOID
4. TO BATTERY POSITIVE TERMINAL
5. ENGINE CONTROLLER CLEAN POWER AND GROUND
6. TO BATTERY NEGATIVE TERMINAL
7. TO FRAME GROUND
8. THERMAL OVERCRANK PROTECTION (6316)

Table of Contents

DESCRIPTION

Discussion of the engines, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The “CHECK ELEC SYSTEM “ warming lamp will illuminate when communication with the engine controller is lost. Diagnostic trouble codes (DTC’s) will also be logged. This could be the result of a communication problem, a power problem to the engine controller or an internal engine controller problem.

The engine controllers have their own diagnostic systems. For detailed information on engine diagnostics, refer to the appropriate engine manuals.

1. I6–HEUI ENGINES

Discussion of the I6–HEUI Engine, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The engine controller has its own diagnostic system and uses flash codes displayed by the ENGINE warning lights. For detailed information on engine diagnostics, refer to International Engine Diagnostic Manual EGES–230.

1.1. ENGINE CONTROL MODULE (ECM) POWER AND GROUND

Circuit Functions

The Electronic Engine Control Module (ECM) receives switched ignition voltage, through a 5 amp fuse, from the primary ignition relay, R9, in the engine compartment power distribution panel. The (ECM) also receives 12 volt operating power, with the key switch in the ignition position, through the ECM power relay from the battery. The circuitry is protected by a 40 amp fuse that is part of the battery cable assembly. The ECM ground is from the negative post of the batteries.

Diagnostics

A problem with power to the ECM will be apparent when the vehicle will not crank and the “CHECK ELEC SYS” warning lamp in the gauge cluster is constantly on.

The problem could be attributed to open or shorted wiring between the ECM and related power circuits, a blown fuse, a failed relay or a failure inside the ECM.

Several ESC diagnostic trouble codes (DTC’s) will be logged when there is no communication on the drivetrain 1939 data link between the ECM and the ESC or the EGC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to view diagnostic trouble codes. Refer to the “INTUNE” software manual

Table 131 Engine Electronic Control Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify “CHECK ELEC SYS” warning lamp	Visually check “CHECK	Engine cranks.	Go to Drivetrain 1939	Go to Fault Detection Management.(See Fault Detection

Table 131 Engine Electronic Control Module Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
		is on and ECM is inoperative.	ELEC SYS" warning lamp and attempt to start vehicle.		Data Link(See DRIVETRAIN 1939 DATA LINK, page 60)	Management, page 394)

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 ECM power circuits will be apparent when the engine will not start and there is no communication between the ECM and the ESC or EGC. Problems in the ECM power circuits could be attributed to a blown fuse, a short or an open circuit.

Refer to ECM Power Circuits.

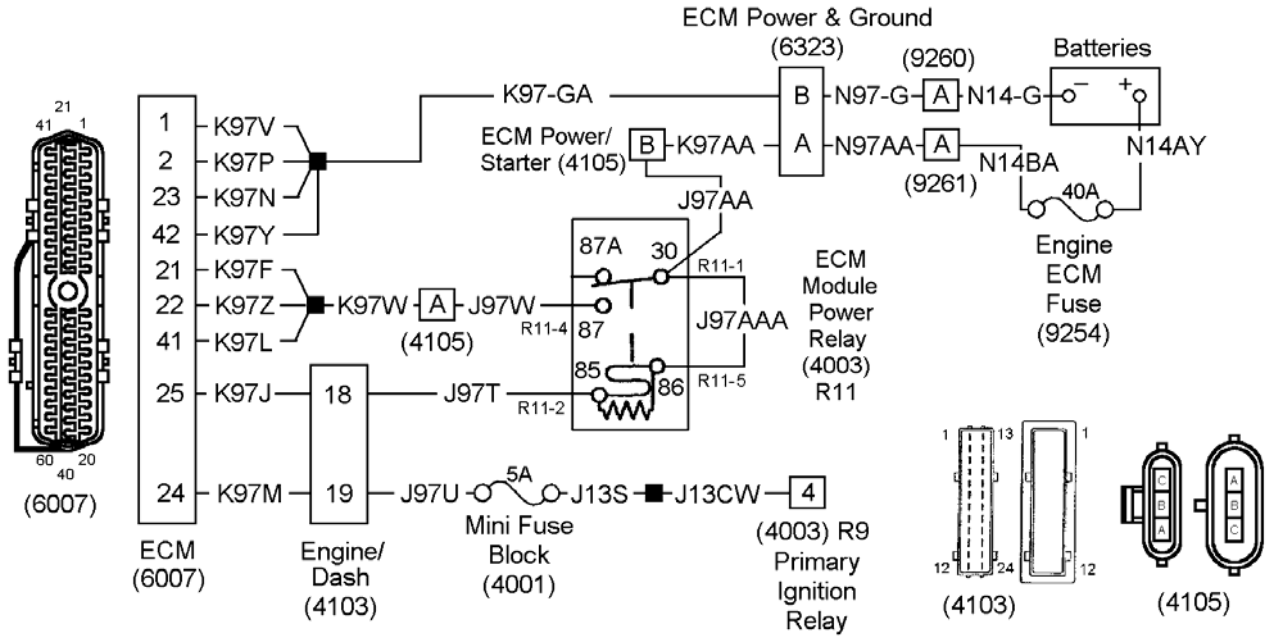

Figure 194 ECM Power Circuits

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) (R11) ECM MODULE POWER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4105) ECM POWER/STARTER SOLENOID CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6007) ENGINE ECM CONNECTOR
LOCATED ON ENGINE ECM
(6323) ENGINE MODULE POWER AND GROUND
LOCATED NEAR START MOTOR
(9254) ENGINE ECM FEED FUSE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9260) BATTERY ECM NEGATIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9261) BATTERY ECM POSITIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT

Table 132 ECM Power Circuit Tests

Diagnostic Trouble Codes	
639 14 4 240	Engine speed not communicated to the ESC
1705 14 150 2 (EGC Version 8.7)	Engine Controller not communicating with the EGC. Loss of communication in excess of 10 seconds. Bad drivetrain J1939 data link.

Table 132 ECM Power Circuit Tests (cont.)

2023 14 150 2 or 2023 14 250 2 (EGC Version 9.3 and later)	Engine Controller not communicating with the primary EGC (150) or secondary EGC (250) Loss of communication in excess of 10 seconds Bad drivetrain J1939 data link.
Due to the inaccessibility of ECM connector (6007), voltage checks will be performed at other connector locations. **ECM Power & Ground Connector (6323) Voltage Checks** Check with (6323) disconnected.	
Test Points	Spec. / Comments
(6323) harness to battery connector, cavity A to ground	12 ± 1.5 volts Positive battery feed to ECM If voltage is missing, check for blown fuse (9254) and short or open in circuit N97AA. A blown fuse could be the result of a short in any circuits between (6007) and the fuse.
(6323) harness to battery connector, cavity A to cavity B	12 ± 1.5 volts Negative battery feed to ECM If voltage is missing, check for open in circuit N97–G.
Due to the inaccessibility of ECM connector (6007), voltage checks will be performed at other connector locations. **Engine/Dash Connector (4103) Voltage Checks** Check with (6323) connected, ignition on, and (4103) disconnected.	
Test Points	Spec. / Comments
(4103) Harness to dash connector, pin 19 to ground	12 ± 1.5 volts Ignition feed to ECM If voltage is missing, check for blown fuse and short or open in circuit J97U.
(4103) Harness to dash connector, pin 18 to ground	12 ± 1.5 volts Battery voltage through ECM power relay coil. If voltage is missing check for open relay coil, open circuits or short to ground.
Due to the inaccessibility of ECM connector (6007), voltage checks will be performed at other connector locations. **ECM Power/Starter Solenoid Connector (4105) Voltage Checks** Check with (4103) connected, ignition on, and (4105) disconnected.	
Test Points	Spec. / Comments

Table 132 ECM Power Circuit Tests (cont.)

(4105) Harness to dash connector, pin A to ground	12 ± 1.5 volts	Battery feed to ECM from ECM power relay R11. Check for defective ECM Module Power relay R11 (4003).
ECM Module Power relay R11 (4003) Voltage Checks Check with relay removed, ignition key on and engine off. Bench check relay and replace if it has failed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
ECM Module Power relay R11 (4003) 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 fuse.
ECM Module Power relay R11 (4003) socket cavity 2 (relay 85) to ground.	12 ± 1.5 volts	Voltage to relay coil from ESC. If voltage is missing, check for open or shorts in circuits between ECM and relay socket. Also insure proper voltage out of ECM connector (6007) pin 25.
ECM Module Power relay R11 (4003) socket cavity 2 (relay 85) to cavity 5 (relay 86).	12 ± 1.5 volts	Check ground to relay coil through ECM connector (6007) pin 25. If voltage is missing, check for open in circuits between ground and relay socket. If all voltages are good and the ECM is still not functioning, check for open circuits or shorts to ground at connector (6007). ECM may have failed. Refer to the Engine Diagnostic Manual EGES–230.

Extended Description

When the key is switched to the ignition position, the primary ignition relay R9 in the engine compartment should energize and apply voltage through the 5 amp minifuse to ECM connector (6007) pin 24. The ECM will then apply a ground to energize the ECM power relay R11. The contacts of the relay will apply battery voltage from engine ECM 40 amp fuse (9254) to ECM connector (6007) pins 21, 22, and 41.

Ground for the ECM is supplied from the negative terminal of the battery to ECM ECM connector (6007) pins 1, 2, 23, and 42.

Component Locations

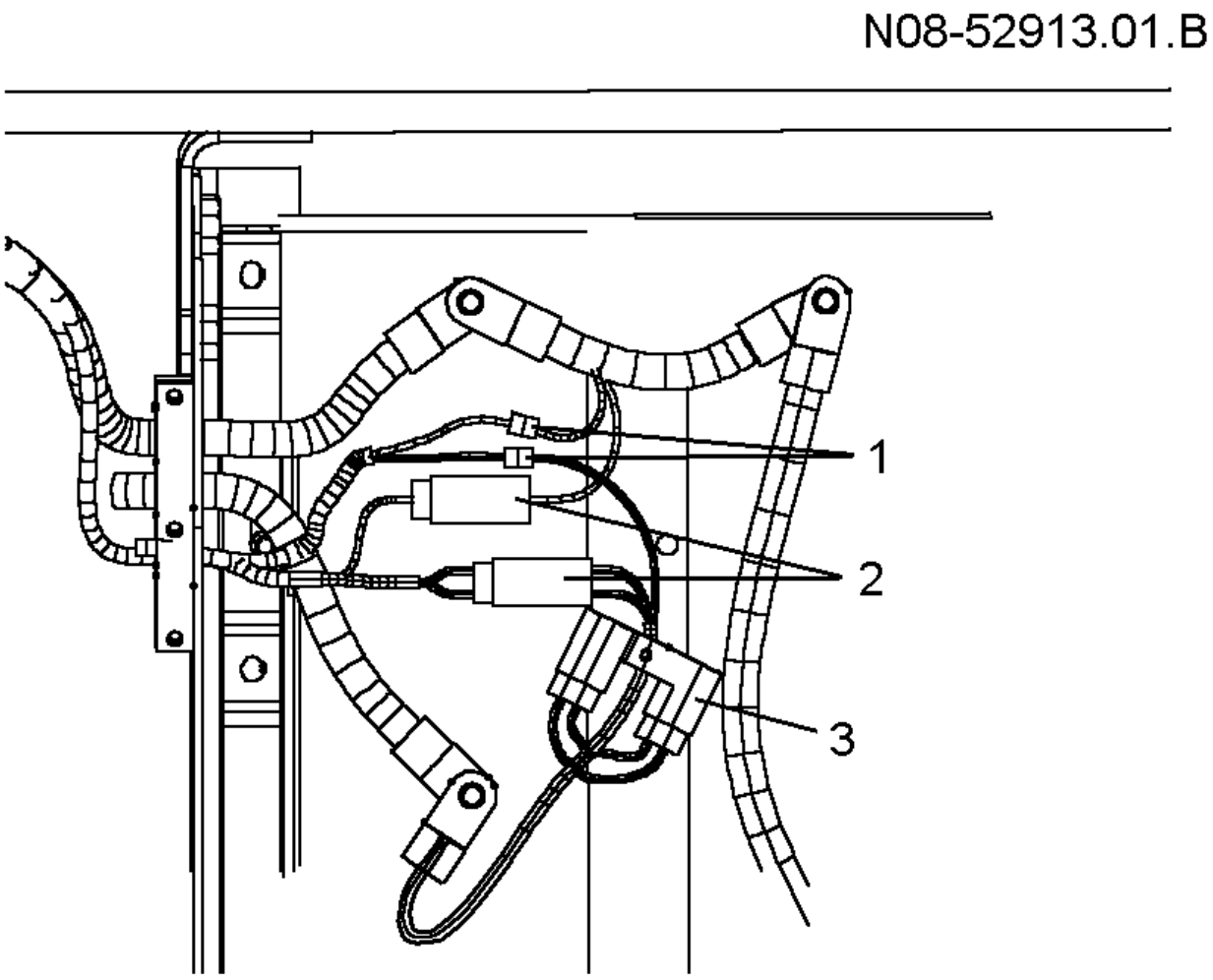

Figure 195 Engine ECM Power Battery Box Connectors (Typical)

1. 2–WAY RADIO CIRCUITS, N14HC TO POSITIVE AND N14–GD TO NEGATIVE TERMINALS ON THE BATTERY.
2. ENGINE ECM CLEAN POWER FEED.
3. 40 AMP FUSE FOR I6.

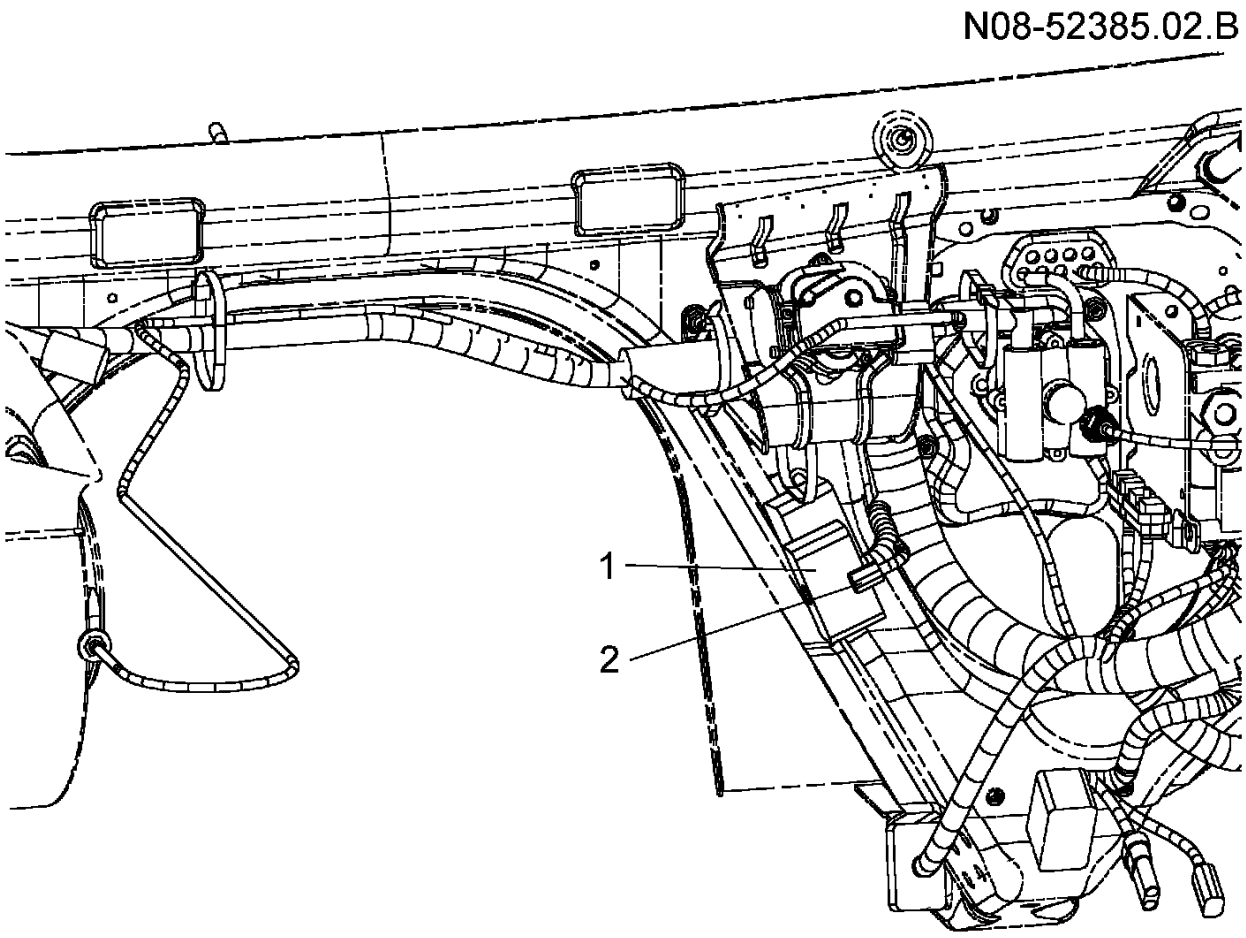

Figure 196 Engine Connector Locations

1. ENGINE/DASH CONNECTOR (4103)
2. ECM POWER/STARTER CONNECTOR (4105)

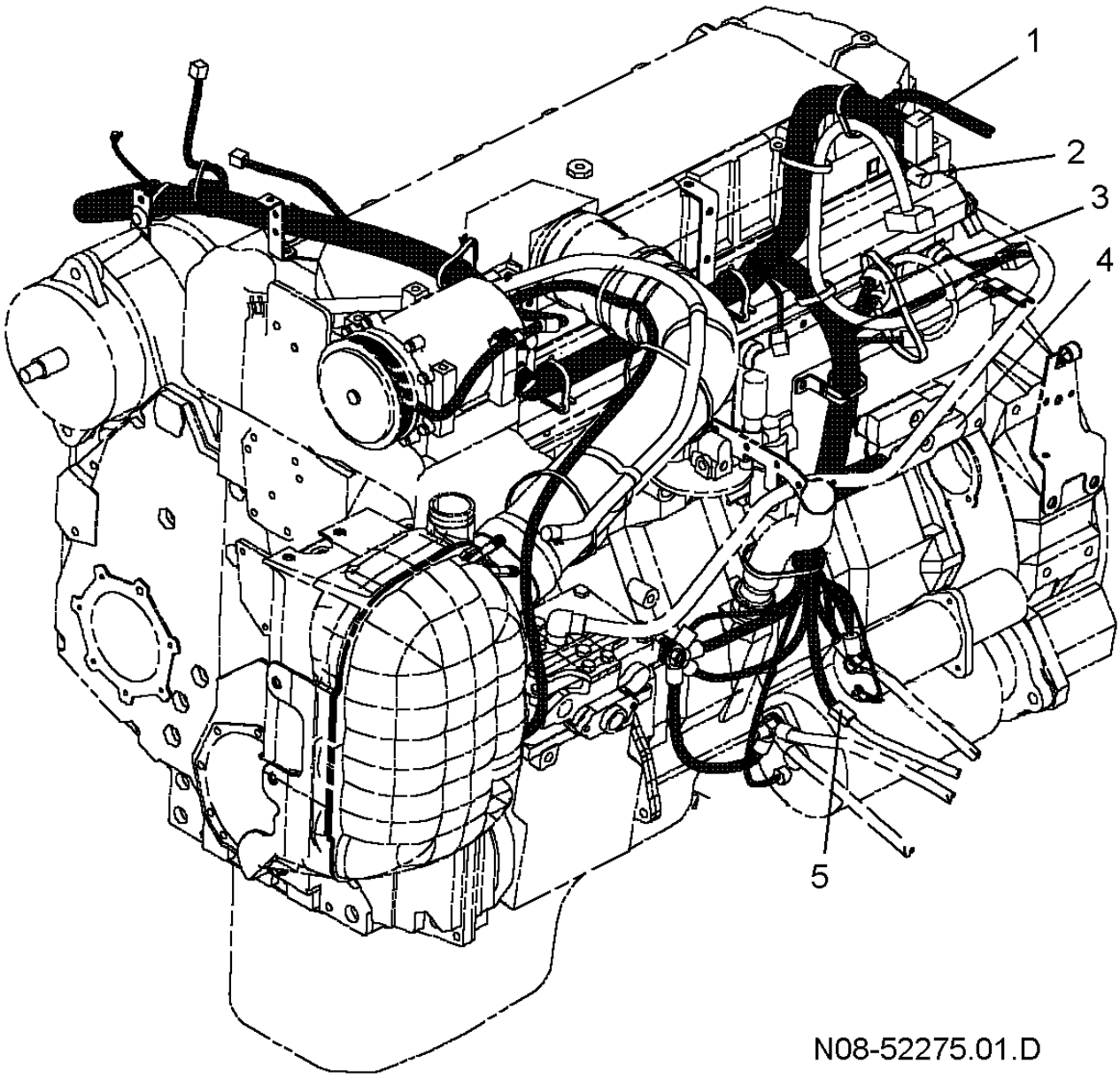

Figure 197 Engine ECM Location

1. ENGINE/DASH CONNECTOR (4103)
2. ECM POWER/STARTER (4105)
3. DRIVETRAIN 1939 DATALINK “Y” CONNECTOR
4. ECM CONNECTOR (6007)
5. ENGINE MODULE POWER AND GROUND (6323)

1.2. ENGINE DATA LINK CIRCUITS

Circuit Functions

The engine electronic control module communicates on the drivetrain 1939 data link and the 1708 data link.

Communication on the drivetrain 1939 data link allows the ECM to send and receive messages to the ESC, the EGC and other controllers on the vehicle. Refer to Drive Train 1939 Data Link in the Multiplexing (Data Links) section of this manual. (See DRIVETRAIN 1939 DATA LINK, page 60)

The 1708 data link is primarily used for diagnostics and programming. The 1708 data link connection is also used with the hydraulic ABS (hydraulic ABS doesn't have a J1939 interface). Refer to 1708 Data Link in the Multiplexing (Data Links) section of this manual. (See 1708 DATA LINK, page 75)

1.3. CRUISE CONTROL

Circuit Functions

Cruise control and engine speed for PTO operations are selected with the cruise switches on the steering wheel. These switches are inputs to the ESC. The ESC generates commands to the engine controller on the Drivetrain 1939 data link.

Refer to Cruise Control Circuitsin the Cab Section of this manual.

1.4. REMOTE ENGINE SPEED CONTROL MODULE (RESCM)

Circuit Functions

The I6 engine has optional feature codes that allow controlling the engine from a remote location outside the cab. This is accomplished by connecting to the discrete wiring of the engine ECM. When one of these feature codes, 012VVW (Provision for Remote Throttle Control) or 012VWY (Hydraulic Pressure Governor) is ordered, a harness pigtail with the engine control circuits is strapped to the engine harness.

Refer to Body Builder Manual CT-471 or the applicable engine manual for more details.

Component Locations

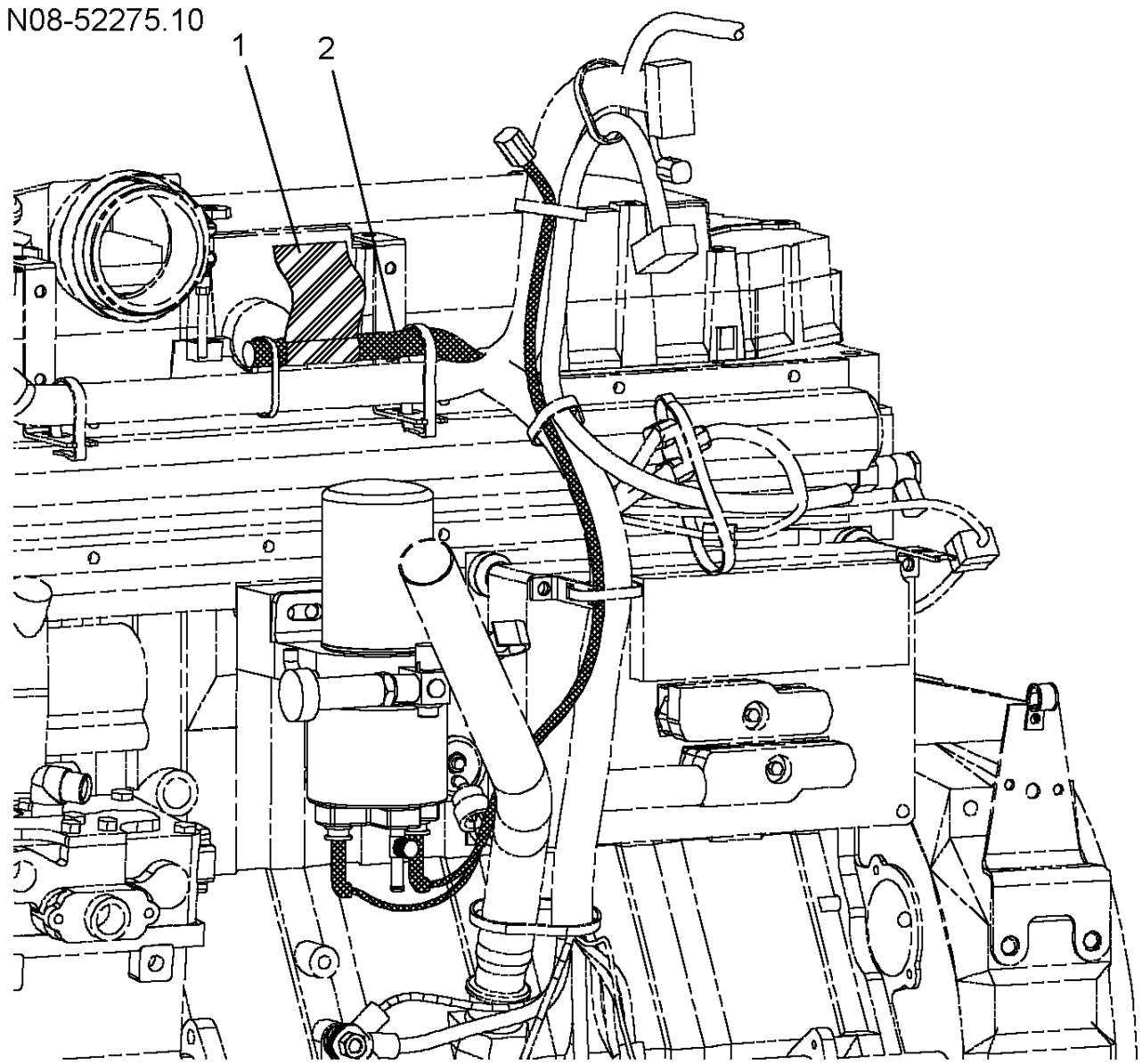

Figure 198 Engine Body Builder Location

1. BODY BUILDER PRODUCT
2. ENGINE BODY BUILDER HARNESS

2. V8–AVNT ENGINES

Discussion of the V8–AVNT Engine, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The engine controller has its own diagnostic system and uses flash codes displayed by the ENGINE warning lights. For detailed information on engine diagnostics, refer to the applicable International Engine Diagnostic Manual EGES–190.

2.1. ENGINE CONTROL MODULE (ECM) POWER AND GROUND

Circuit Functions

Diagnostics

A problem with power to the ECM will be apparent when the vehicle will not crank and the “CHECK ELEC SYS” warning lamp in the gauge cluster is constantly on.

The problem could be attributed to open or shorted wiring between the ECM and related power circuits, a blown fuse, a failed relay or a failure inside the ECM.

Several diagnostic trouble codes (DTC’s) will be logged when there is no communication on the drivetrain 1939 data link between the ECM and the ESC or the EGC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to view diagnostic trouble codes. Refer to the “INTUNE” software manual

Table 133 Engine Electronic Control Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify “CHECK ELEC SYS” warning lamp is on and ECM is inoperative.	Visually check “CHECK ELEC SYS” warning lamp and attempt to start vehicle.	Engine cranks.	Go to Drivetrain 1939 Data Link(See DRIVETRAIN 1939 DATA LINK, page 60)	Go to Fault Detection Management.(See Fault Detection Management, page 403)

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 ECM power circuits will be apparent when the engine will not start and there is no communication between the ECM and the ESC or EGC. Problems in the ECM power circuits could be attributed to a blown fuse, a short or an open circuit.

Refer to ECM Power Circuits.

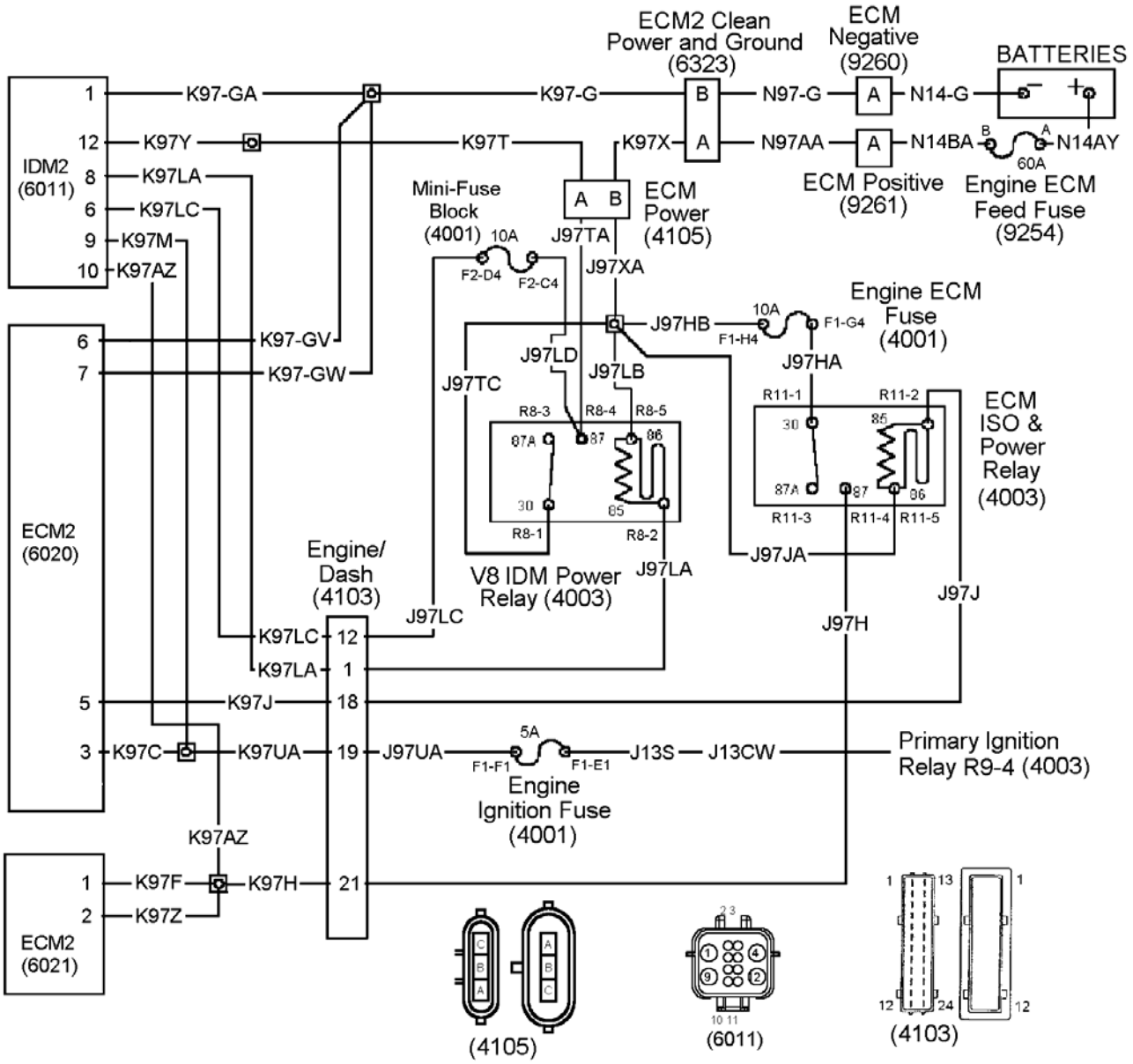

Figure 199 ECM Power Circuits

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) (R8) V8 IDM POWER AND (R11) ECM ISO & POWER RELAYS
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4105) ECM POWER/STARTER SOLENOID CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6011) IDM2, (6020) ECM2 AND (6021) ECM2 ENGINE ECM CONNECTORS
LOCATED ON ENGINE ECM
(6323) ENGINE MODULE POWER AND GROUND
LOCATED NEAR START MOTOR
(9254) ENGINE ECM FEED FUSE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9260) BATTERY ECM NEGATIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9261) BATTERY ECM POSITIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT

Table 134 ECM Power Circuit Tests

<table>
<tr><th colspan="3">Diagnostic Trouble Codes</th></tr>
<tr><td colspan="2">639 14 4 240</td><td>Engine speed not communicated to the ESC</td></tr>
<tr><td colspan="2">1705 14 150 2 (EGC Version 8.7)</td><td>Engine Controller not communicating with the EGC

Loss of communication in excess of 10 seconds

Bad drivetrain J1939 data link.</td></tr>
<tr><td colspan="2">2023 14 150 2 or 2023 14 250 2 (EGC Version 9.3 and later)</td><td>Engine Controller not communicating with the primary EGC (150) or secondary EGC (250)

Loss of communication in excess of 10 seconds

Bad drivetrain J1939 data link.</td></tr>
<tr><td colspan="3">Due to the inaccessibility of ECM connectors (6011), (6020) and (6021) voltage checks will be performed at other connector locations.

ECM Power & Ground Connector (6323) Voltage Checks

Check with (6323) disconnected.</td></tr>
<tr><td>Test Points</td><td>Spec.</td><td>Comments</td></tr>
<tr><td>(6323) harness to battery connector, cavity A to ground</td><td>12 ± 1.5 volts</td><td>Positive battery feed to ECM

If voltage is missing, check for blown fuse (9254) and short or open in circuit N97AA.

A blown fuse could be the result of a short in any circuits between (6011) and the fuse.</td></tr>
</table>

Table 134 ECM Power Circuit Tests (cont.)

(6323) harness to battery connector, cavity A to cavity B	12 ± 1.5 volts	Negative battery feed to ECM If voltage is missing, check for open in circuit N97–G.
Due to the inaccessibility of ECM connector (6011), (6020) and (6021) voltage checks will be performed at other connector locations. **Engine/Dash Connector (4103) Voltage Checks** Check with (6323) connected, ignition on, and (4103) disconnected.		
Test Points	Spec.	Comments
(4103) Harness to dash connector, pin 19 to ground	12 ± 1.5 volts	Ignition feed to ECM If voltage is missing, check for blown fuse and short or open in circuit J97UA.
(4103) Harness to dash connector, pin 18 to ground	12 ± 1.5 volts	Battery voltage through ECM power relay coil R11. If voltage is missing check for open relay coil, open circuits or short to ground.
(4103) Harness to dash connector, pin 1 to ground	12 ± 1.5 volts	Battery voltage through IDM power relay coil R8. If voltage is missing check for open relay coil, open circuits or short to ground.
(4103) Harness to dash connector, pin 12 to ground	12 ± 1.5 volts	IDM2 feed from mini-fuse block (4001). If voltage is missing, check for blown fuse and short or open in circuit J97LC, J97LD.
Due to the inaccessibility of ECM connector (6011), (6020) and (6021) voltage checks will be performed at other connector locations. **ECM Power/Starter Solenoid Connector (4105) Voltage Checks** Check with (4103) connected, ignition on, and (4105) disconnected.		
Test Points	Spec.	Comments
(4105) Harness to dash connector, pin B to ground	12 ± 1.5 volts	Battery feed to IDM2 and ECM power relays R8 and R11. Check for defective Power relay R8 or R11(4003).
IDM Power Relay R8 and ECM Power Relay R11 (4003) Voltage Checks Check with relays removed, ignition key on and engine off. Bench check relay and replace if it has failed. **NOTE – Always check connectors for damage and pushed–out terminals.**		

Table 134 ECM Power Circuit Tests (cont.)

Test Points	Spec.	Comments
Power relays R8 and R11 (4003) 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 fuse.
Power relays R8 and R11 (4003) socket cavity 2 (relay 85) to ground.	12 ± 1.5 volts	Voltage to relay coil from ESC. If voltage is missing, check for open or shorts in circuits between ECM and relay socket. Also insure proper voltage out of ECM connector (6011).
Power relays R8 and R11 (4003) socket cavity 2 (relay 85) to cavity 5 (relay 86).	12 ± 1.5 volts	Check ground to relay coil through ECM connector (6011). If voltage is missing, check for open in circuits between ground and relay socket. If all voltages are good and the ECM is still not functioning, check for open circuits or shorts to ground at connector (6011). ECM may have failed. Refer to the Engine Diagnostic Manual EGES–190.

Extended Description

When the key is switched to the ignition position, the primary ignition relay R9 in the engine compartment should energize and apply voltage through the 5 amp minifuse to ECM connector (6011) pin 9. The ECM will then apply a ground to energize the ECM power relay R11. The contacts of the relay will apply battery voltage from engine ECM 60 amp fuse (9254) to IDM2 and ECM2 connectors (6011), (6020) and (6021).

Ground for the ECM is supplied from the negative terminal of the battery to ECM ECM connector (6011) pin 1 and (6011) pins 6 and 7.

Component Locations

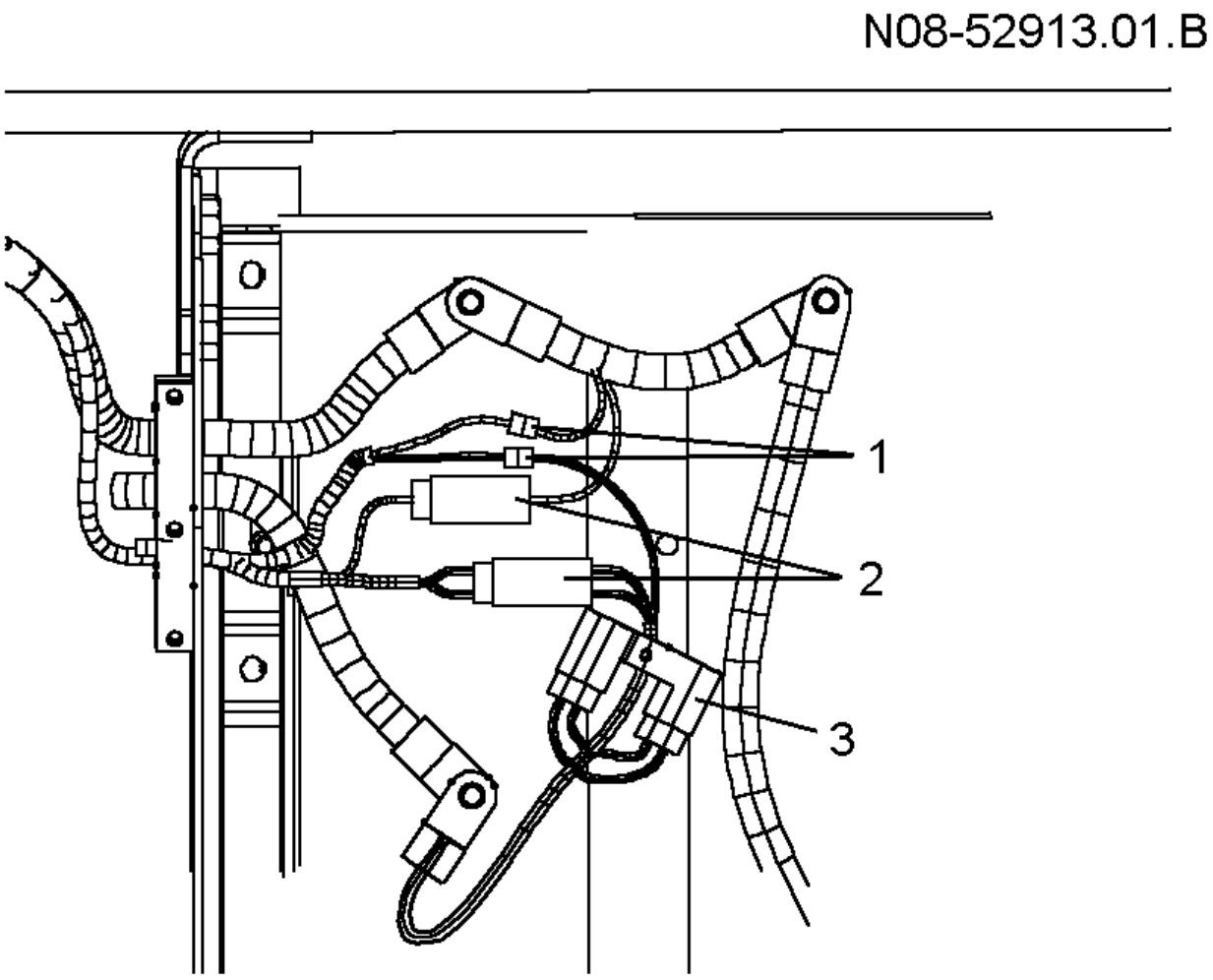

Figure 200 Engine ECM Power Battery Box Connectors (Typical)

1. 2–WAY RADIO CIRCUITS, N14HC TO POSITIVE AND N14–GD TO NEGATIVE TERMINALS ON THE BATTERY.
2. ENGINE ECM CLEAN POWER FEED.
3. 60 AMP FUSE FOR V8.

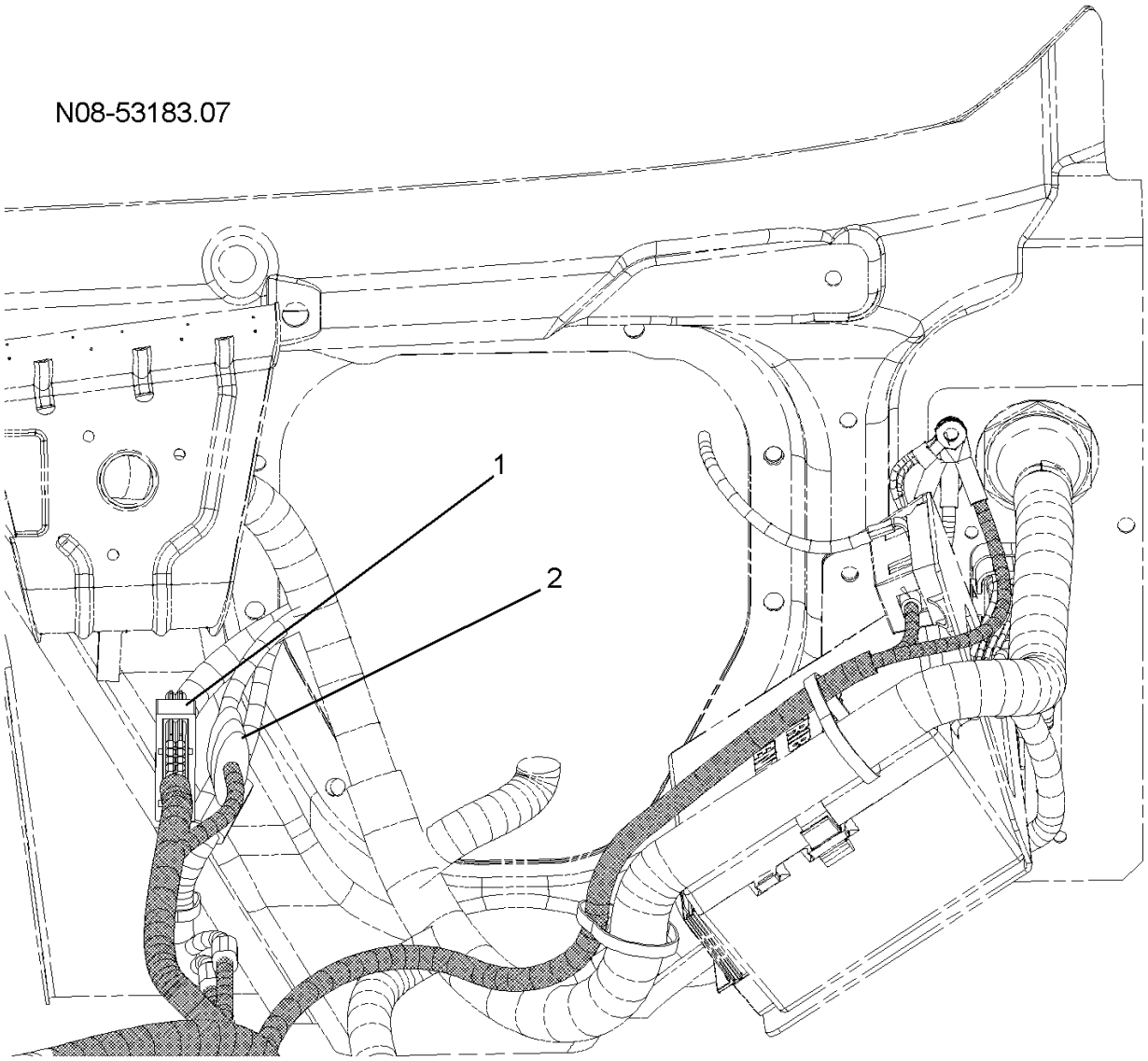

Figure 201 Engine Connector Locations

1. ENGINE/DASH CONNECTOR (4103)
2. ECM POWER/STARTER (4105)

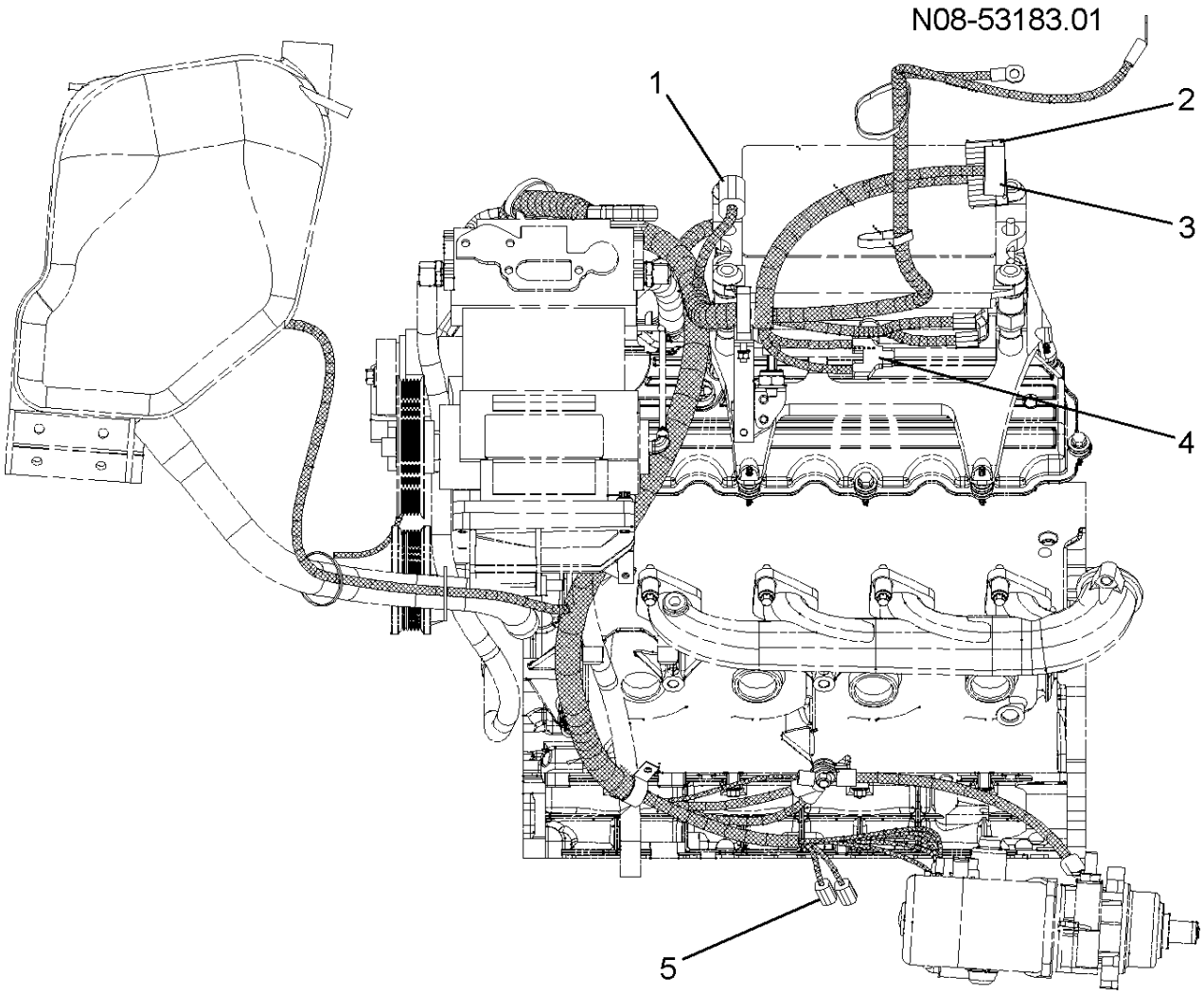

Figure 202 Engine ECM Location

1. IDM ECM CONNECTOR (6011), (6020) AND (6021)
2. ENGINE/DASH CONNECTOR (4103)
3. ECM POWER/STARTER (4105)
4. DRIVETRAIN 1939 DATALINK “Y” CONNECTOR
5. ENGINE MODULE POWER AND GROUND (6323)

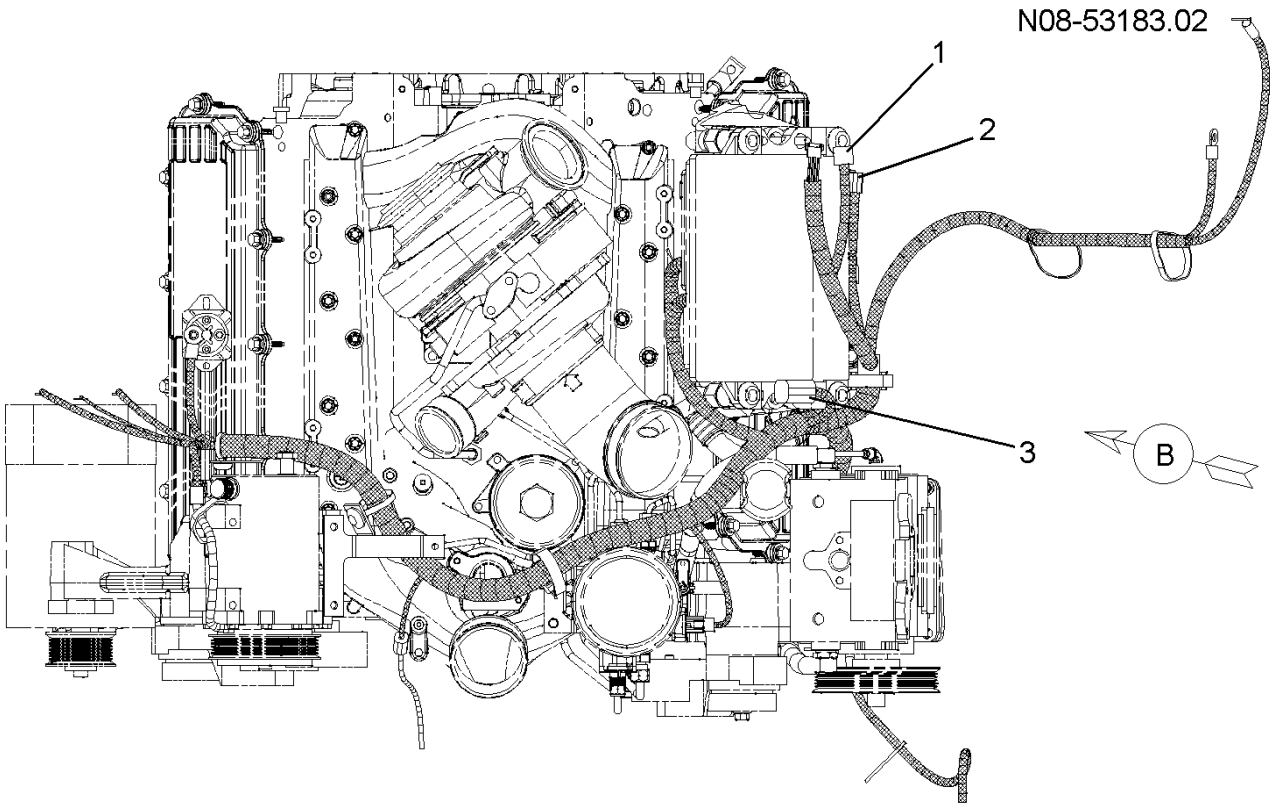

Figure 203 Engine ECM Location

1. ENGINE/DASH CONNECTOR (4103)
2. ECM POWER/STARTER (4105)
3. ECM CONNECTOR (6011), (6020) AND (6021)

2.2. ENGINE DATA LINK CIRCUITS

Circuit Functions

The engine electronic control module communicates on the drivetrain 1939 data link and the 1708 data link.

Communication on the drivetrain 1939 data link allows the ECM to send and receive messages to the ESC, the EGC and other controllers on the vehicle. Refer to Drive Train 1939 Data Link in the Multiplexing (Data Links) section of this manual. (See DRIVETRAIN 1939 DATA LINK, page 60)

The 1708 data link is primarily used for diagnostics and programming. The 1708 data link connection is also used with the hydraulic ABS (hydraulic ABS doesn't have a J1939 interface). Refer to 1708 Data Link in the Multiplexing (Data Links) section of this manual. (See 1708 DATA LINK, page 75)

2.3. CRUISE CONTROL

Circuit Functions

Cruise control and engine speed for PTO operations are selected with the cruise switches on the steering wheel. These switches are inputs to the ESC. The ESC generates commands to the engine controller on the Drivetrain 1939 data link.

Refer to Cruise Control Circuits in the Cab Section of this manual.

2.4. REMOTE ENGINE SPEED CONTROL MODULE (RESCM)

Circuit Functions

The V8 engine has an optional feature code that allows the engine to be controlled a remote location outside of the cab. This is accomplished by using a remote engine speed control module (RESCM).

The remote engine speed control is an interface for body builders to use for remote operation of the engine. The RESCM interfaces to the ESC on the Body Data Link via J1939 proprietary messages. In most cases the information simply needs to pass through the ESC to the ECM. But, because of the proprietary nature of the communication between the RESCM and the ESC, some data conversion will be necessary.

The RESCM provides 4 switch functions, a speedometer, a tachometer, two warning lights and a remote accelerator. The RESCM is also capable of providing pressure governor features covered by the Pressure Governor ESC feature.

More specifically the RESCM includes:

- A variable PTO enable switch (digital)
- A preset PTO enable switch (digital)
- A Set / Coast speed switch (duplicates the in-cab control)
- A Resume / Accel speed switch (duplicates the in-cab control)
- An amber warn engine lamp (digital)
- A red stop engine lamp (digital)
- A speedometer (data link to electronic signal output)
- A tachometer (data link to electronic signal output)
- A remote accelerator (analog input)

NOTE – The Body Builder provides the actual hardware that is connected to the RESCM unit.

If communications should happen to be lost between the RESCM and the ESC, the sensor inputs normally received from the RESCM will be sent to the engine as unavailable and switch inputs will be sent to the engine as off.

Refer to Body Builder Manual CT-471 or the applicable engine manual for more details.

Component Locations

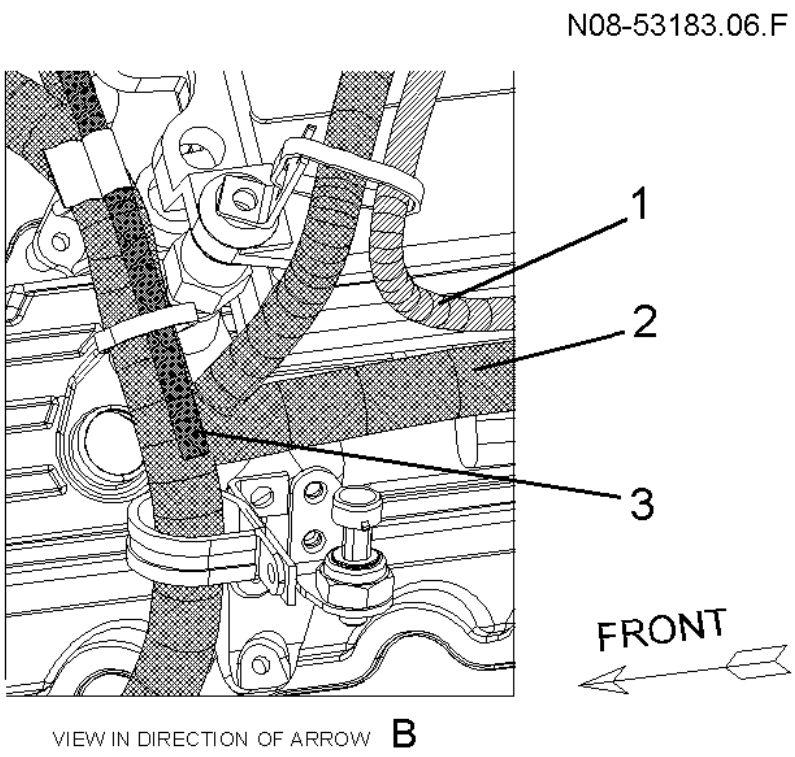

Figure 204 RESCM Location

1. TRANSMISSION HARNESS
2. ENGINE HARNESS
3. BODY BUILDER CIRCUIT

3. CUMMINS ISM ENGINES

Discussion of the Cummins ISM Engine, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The engine controller has its own diagnostic system and uses flash codes displayed by the ENGINE warning lights. For detailed information on Cummins engine diagnostics, refer to the appropriate Cummins Manual.

3.1. ENGINE CONTROL MODULE (ECM) POWER AND GROUND

Circuit Functions

Diagnostics

A problem with power to the ECM will be apparent when the vehicle will not crank and the “CHECK ELEC SYS” warning lamp in the gauge cluster is constantly on.

The problem could be attributed to open or shorted wiring between the ECM and related power circuits, a blown fuse, a failed relay or a failure inside the ECM.

Several diagnostic trouble codes (DTC’s) will be logged when there is no communication on the drivetrain 1939 data link between the ECM and the ESC or the EGC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to view diagnostic trouble codes. Refer to the “INTUNE” software manual

Table 135 Engine Electronic Control Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify “CHECK ELEC SYS” warning lamp is on and ECM is inoperative.	Visually check “CHECK ELEC SYS” warning lamp and attempt to start vehicle.	Engine cranks.	Go to Drivetrain 1939 Data Link(See DRIVETRAIN 1939 DATA LINK, page 60)	Go to Fault Detection Management.(See Fault Detection Management, page 414)

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 ECM power circuits will be apparent when the engine will not start and there is no communication between the ECM and the ESC or EGC. Problems in the ECM power circuits could be attributed to a blown fuse, a short or an open circuit.

Refer to ECM Power Circuits.

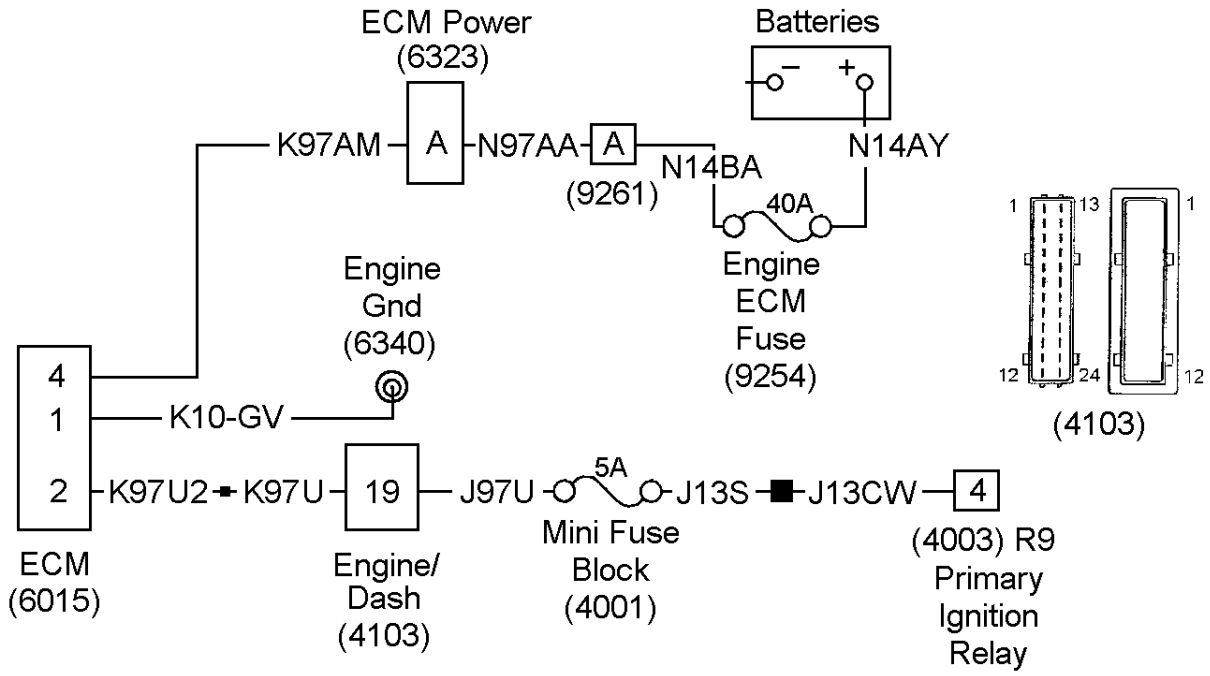

Figure 205 ECM Power Circuits

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) (R9) PRIMARY IGNITION RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6015) ENGINE ECM CONNECTOR
LOCATED ON ENGINE ECM
(6323) ENGINE MODULE POWER AND GROUND
LOCATED NEAR START MOTOR
(9254) ENGINE ECM FEED FUSE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9261) BATTERY ECM POSITIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT

Extended Description

Component Locations

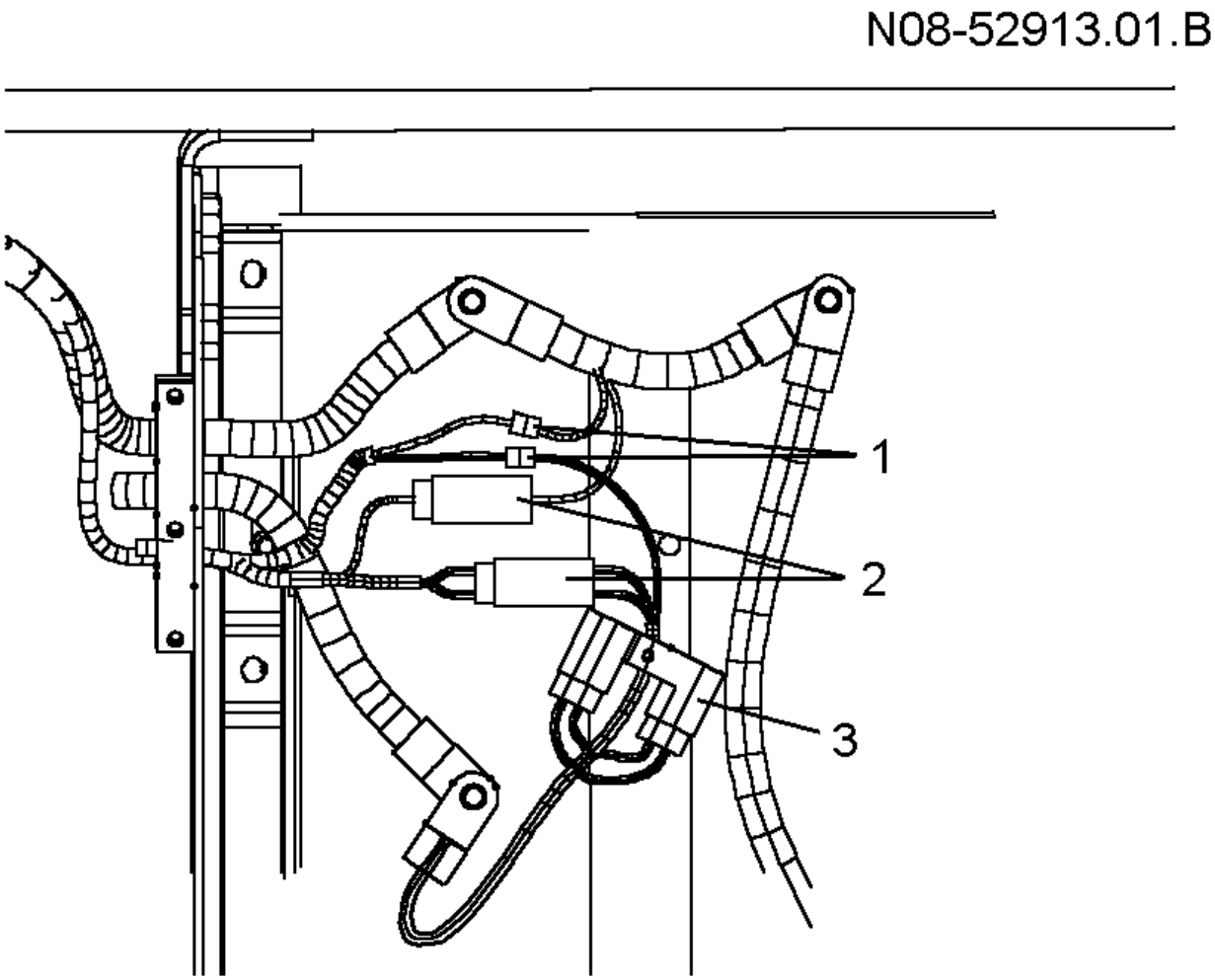

Figure 206 Engine ECM Power Battery Box Connectors (Typical)

1. 2–WAY RADIO CIRCUITS, N14HC TO POSITIVE AND N14–GD TO NEGATIVE TERMINALS ON THE BATTERY.
2. ENGINE ECM CLEAN POWER FEED.
3. ENGINE ECM FUSE

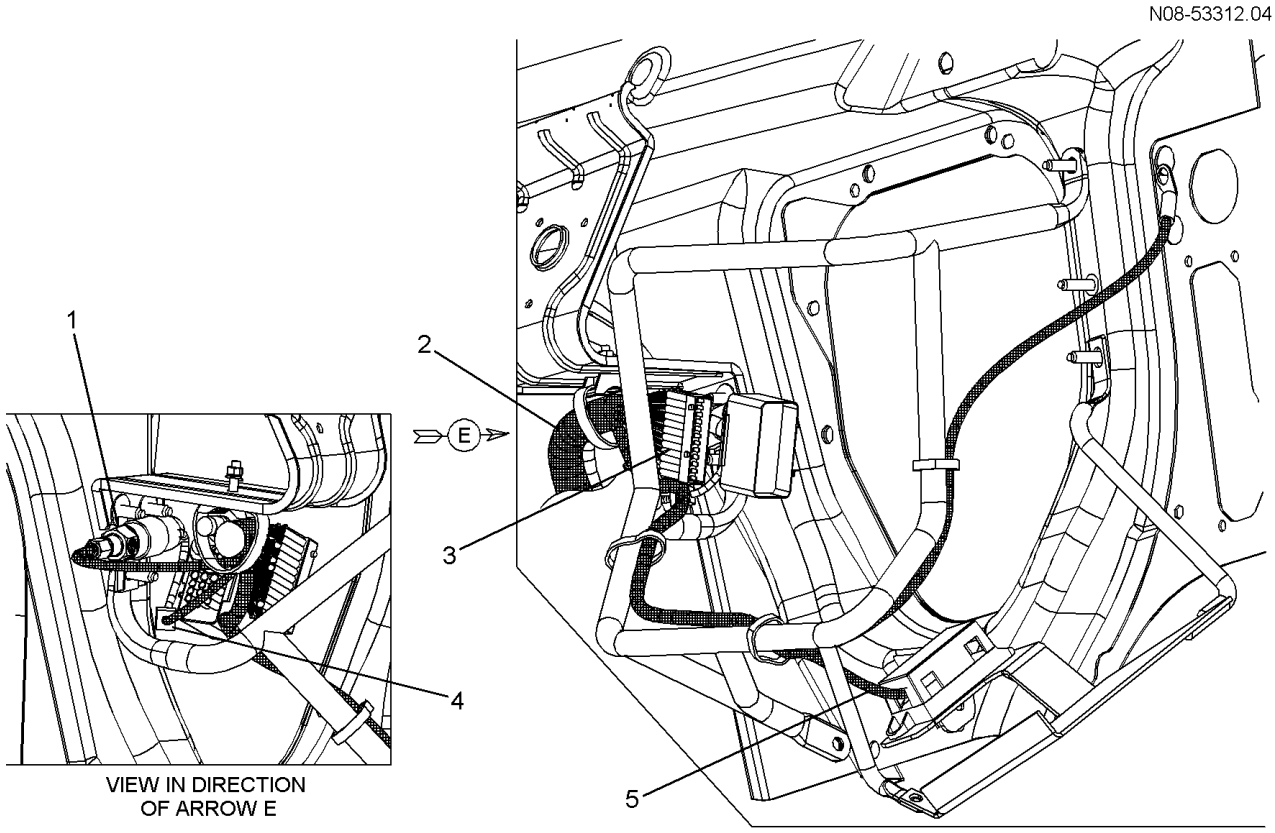

Figure 207 Engine Connector Locations

1. AIR SOLENOID
2. ENGINE HARNESS
3. ENGINE/DASH CONNECTOR (4103)
4. AIR SOLENOID CONNECTOR TO ENGINE HARNESS
5. ENGINE HARNESS CIRCUIT N14BA TO ENGINE ECM FEED FUSE (9254)

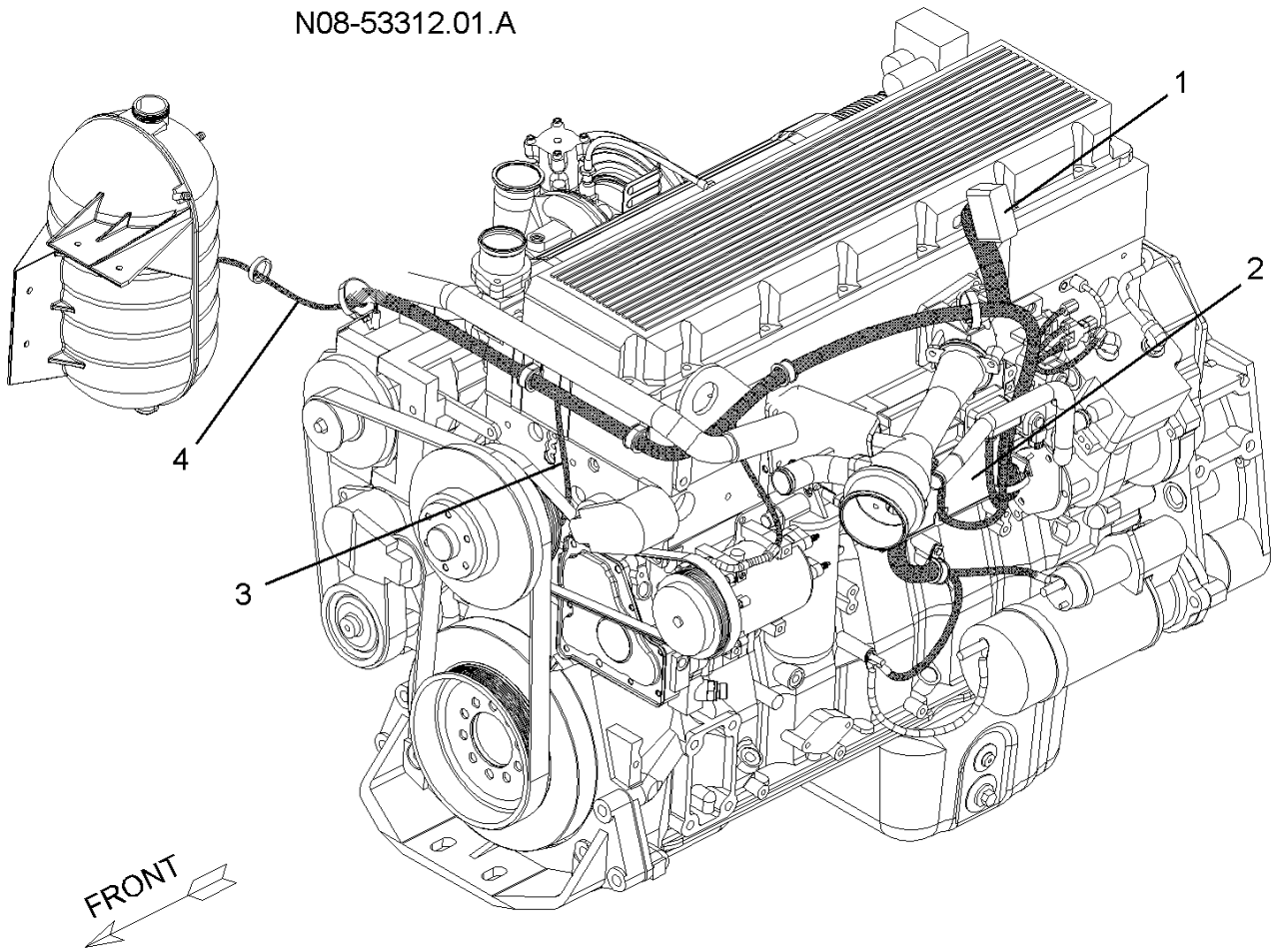

Figure 208 Engine ECM Location

1. ENGINE HARNESS CONNECTOR
2. ENGINE ECM
3. AIR LINE TO FAN DRIVE
4. COOLANT LEVEL SENSOR CIRCUITS

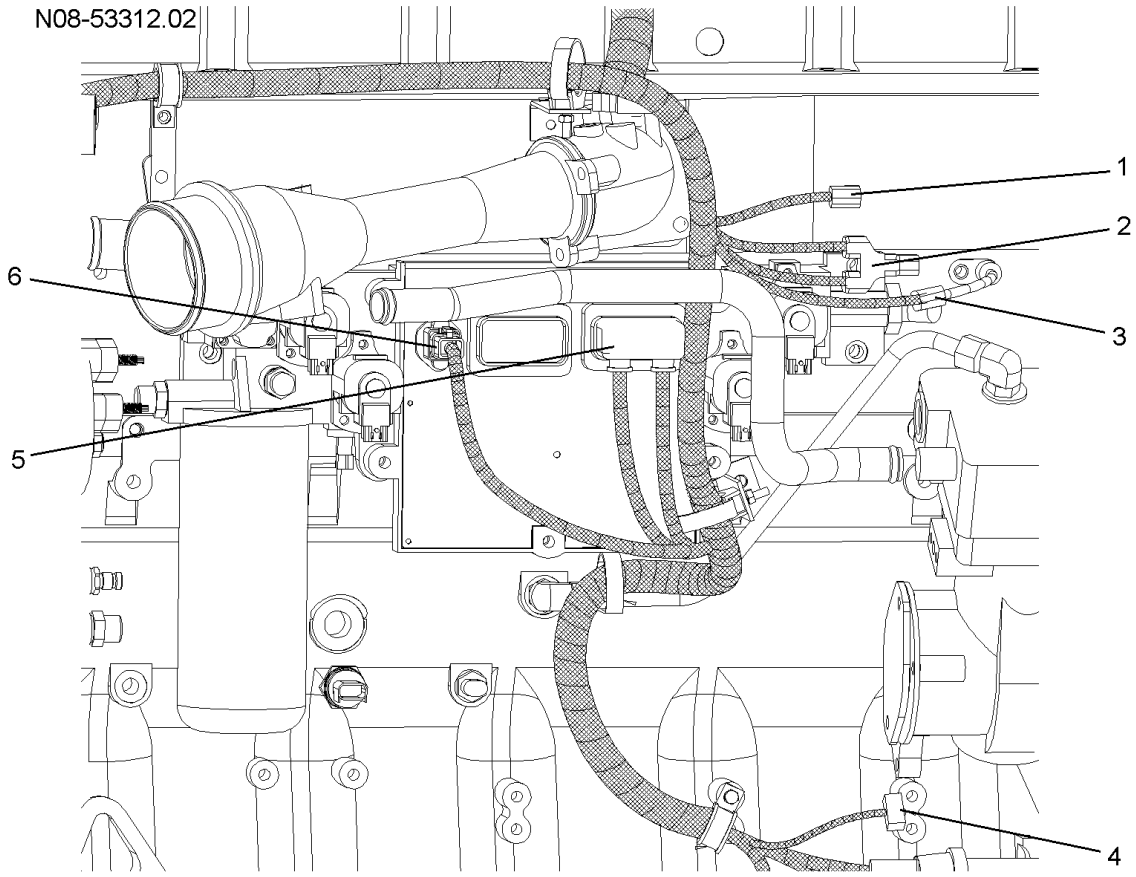

Figure 209 Engine ECM Location

1. 3–WAY ENGINE HARNESS CONNECTOR
2. DRIVETRAIN 1939 DATALINK “Y” CONNECTOR
3. ENGINE THERMOSTAT SWITCH
4. 2–WAY ECM BATTERY POWER CONNECTOR (6323)
5. ECM CONNECTOR
6. ECM CONNECTOR

3.2. ENGINE DATA LINK CIRCUITS

Circuit Functions

The engine electronic control module communicates on the drivetrain 1939 data link and the 1708 data link.

Communication on the drivetrain 1939 data link allows the ECM to send and receive messages to the ESC, the EGC and other controllers on the vehicle. Refer to Drive Train 1939 Data Link in the Multiplexing (Data Links) section of this manual. (See DRIVETRAIN 1939 DATA LINK, page 60)

The 1708 data link is primarily used for diagnostics and programming. The 1708 data link connection is also used with the hydraulic ABS (hydraulic ABS doesn’t have a J1939 interface). Refer to 1708 Data Link in the Multiplexing (Data Links) section of this manual. (See 1708 DATA LINK, page 75)

3.3. CRUISE CONTROL

Circuit Functions

Cruise control and engine speed for PTO operations are selected with the cruise switches on the steering wheel. These switches are inputs to the ESC. The ESC generates commands to the engine controller on the Drivetrain 1939 data link.

Refer to Cruise Control Circuitsin the Cab Section of this manual.

3.4. REMOTE ENGINE SPEED CONTROL MODULE (RESCM)

Circuit Functions

The I6 engine has optional feature codes that allow controlling the engine from a remote location outside the cab. This is accomplished by connecting to the discrete wiring of the engine ECM. When one of these feature codes, 012VVW (Provision for Remote Throttle Control) or 012VWY (Hydraulic Pressure Governor) is ordered, a harness pigtail with the engine control circuits is strapped to the engine harness .

Refer to Body Builder Manual CT-471 or the applicable engine manual for more details.

4. CATERPILLAR C10, C12 ENGINES

Discussion of the Caterpillar C10, C12 Engine, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The engine controller has its own diagnostic system and uses flash codes displayed by the ENGINE warning lights. For detailed information on Caterpillar engine diagnostics, refer to the appropriate Caterpillar Manual.

4.1. ENGINE CONTROL MODULE (ECM) POWER AND GROUND

Circuit Functions

Diagnostics

A problem with power to the ECM will be apparent when the vehicle will not crank and the “CHECK ELEC SYS” warning lamp in the gauge cluster is constantly on.

The problem could be attributed to open or shorted wiring between the ECM and related power circuits, a blown fuse, a failed relay or a failure inside the ECM.

Several diagnostic trouble codes (DTC’s) will be logged when there is no communication on the drivetrain 1939 data link between the ECM and the ESC or the EGC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to view diagnostic trouble codes. Refer to the “INTUNE” software manual

Table 136 Engine Electronic Control Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify “CHECK ELEC SYS” warning lamp is on and ECM is inoperative.	Visually check “CHECK ELEC SYS” warning lamp and attempt to start vehicle.	Engine cranks.	Go to Drivetrain 1939 Data Link(See DRIVETRAIN 1939 DATA LINK, page 60)	Go to Fault Detection Management.(See Fault Detection Management, page 421)

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 ECM power circuits will be apparent when the engine will not start and there is no communication between the ECM and the ESC or EGC. Problems in the ECM power circuits could be attributed to a blown fuse, a short or an open circuit.

Refer to ECM Power Circuits.

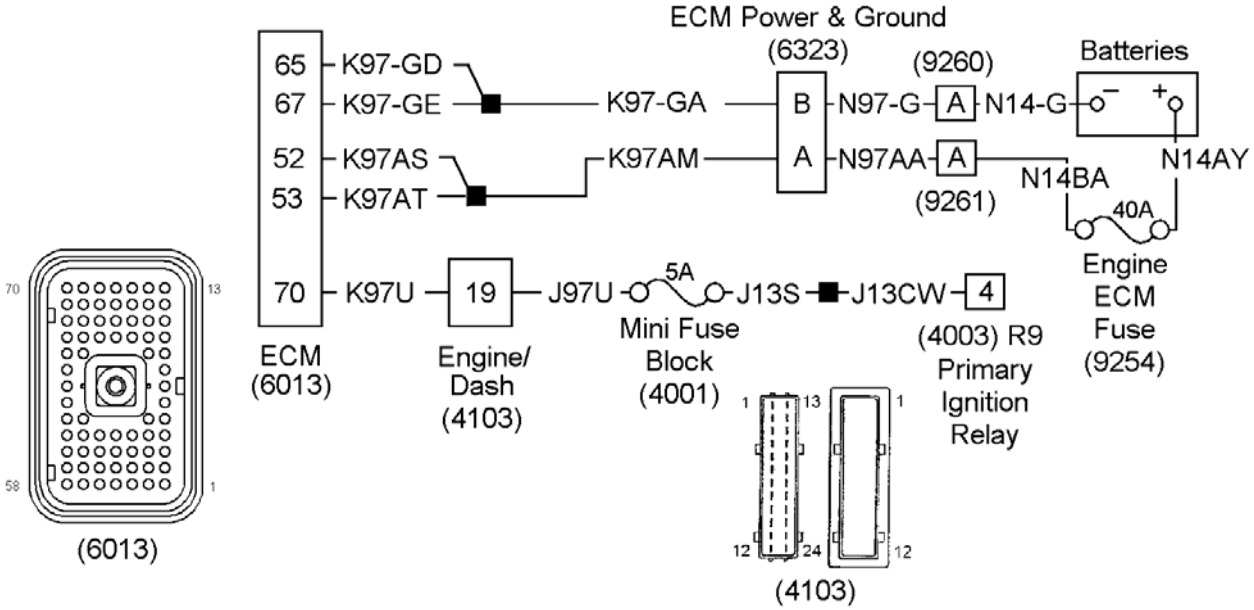

Figure 210 ECM Power Circuits

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) (R11) ECM MODULE POWER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4105) ECM POWER/STARTER SOLENOID CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6013) ENGINE ECM CONNECTOR
LOCATED ON ENGINE ECM
(6323) ENGINE MODULE POWER AND GROUND
LOCATED NEAR START MOTOR
(9254) ENGINE ECM FEED FUSE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9260) BATTERY ECM NEGATIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9261) BATTERY ECM POSITIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT

Extended Description

Component Locations

N08-53323.05.B

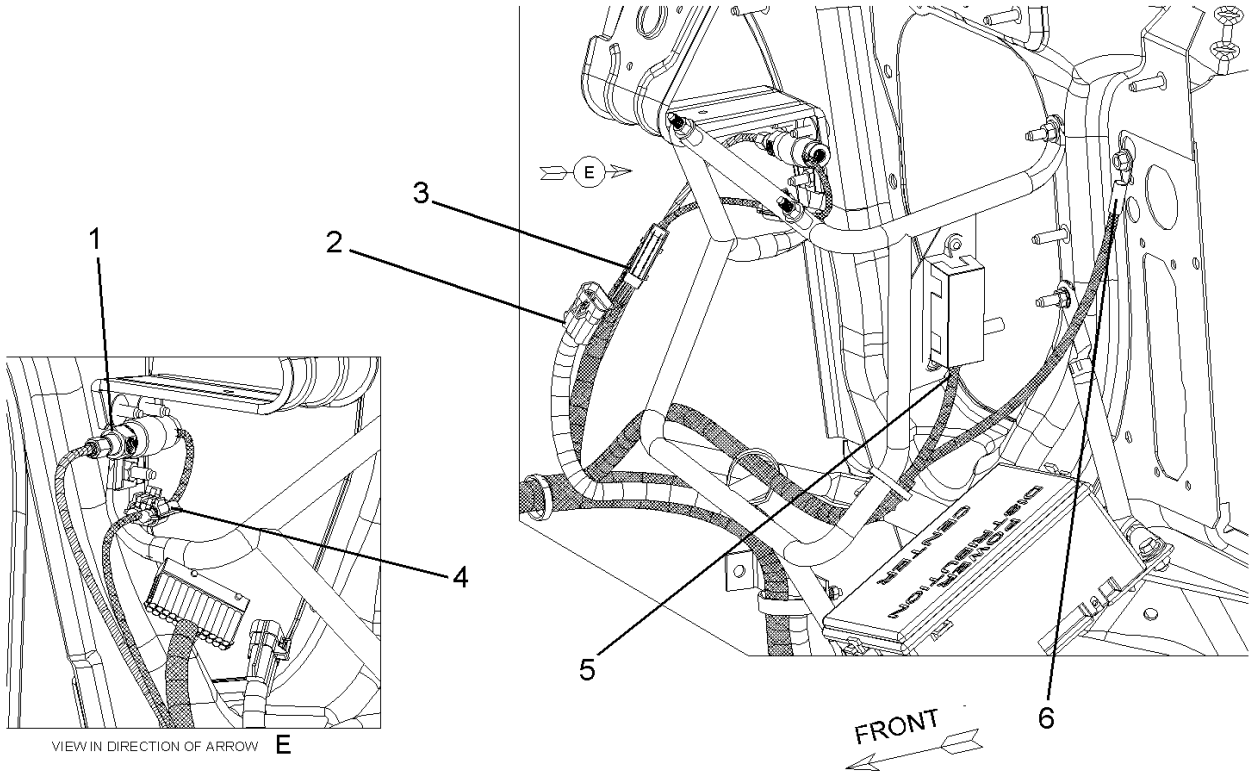

Figure 211 Engine Connector Locations

1. AIR SOLENOID
2. TRANSMISSION HARNESS
3. ENGINE/DASH CONNECTOR (4103)
4. AIR SOLENOID CONNECTOR TO ENGINE HARNESS
5. ENGINE HARNESS CIRCUIT N14BA TO ENGINE ECM FEED FUSE (9254)
6. ENGINE HARNESS CIRCUIT N14–G TO GROUND CONNECTOR (9260)

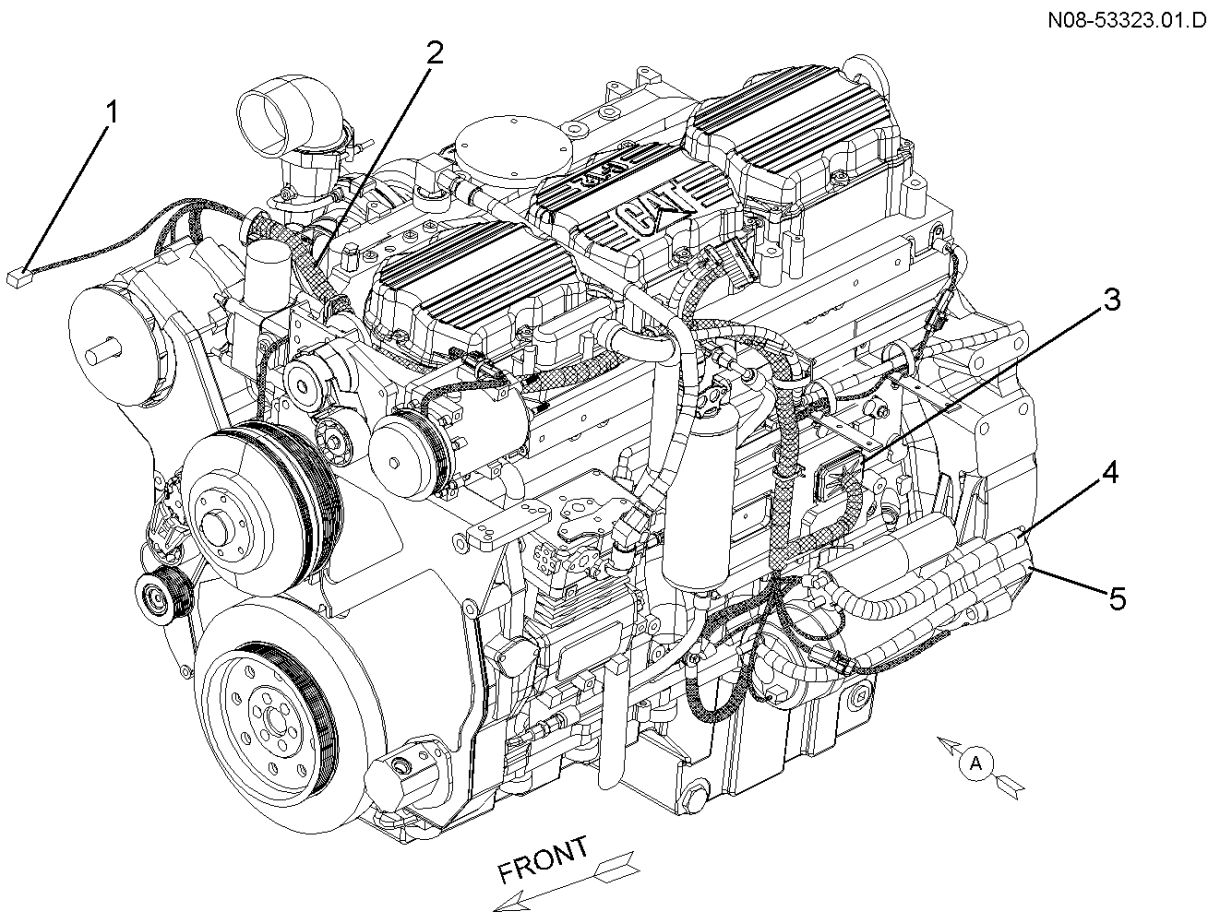

Figure 212 Engine ECM Location

1. TO SURGE TANK
2. ENGINE HARNESS
3. ENGINE ECM
4. TO BATTERY POSITIVE
5. TO BATTERY NEGATIVE

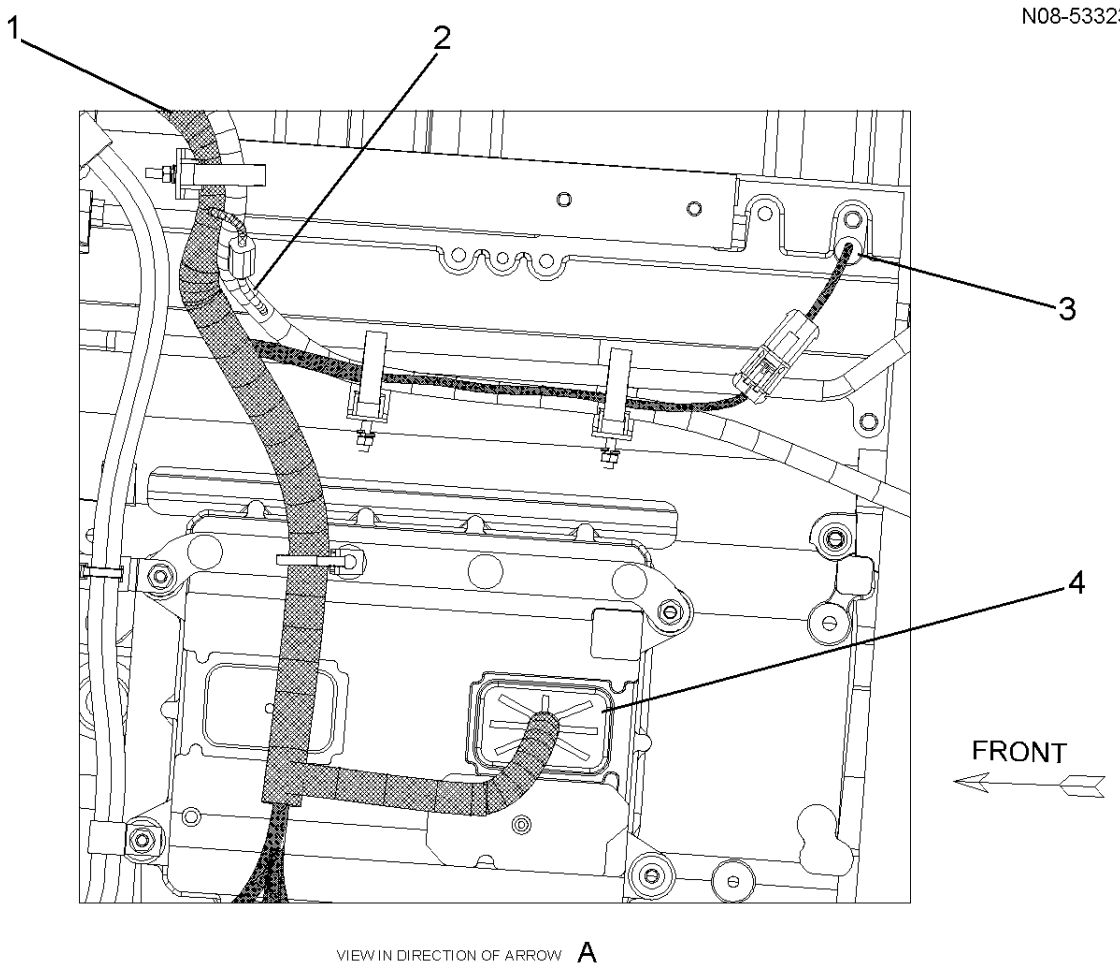

Figure 213 Engine ECM Location

1. ENGINE HARNESS
2. TRANSMISSION HARNESS
3. ENGINE ETHER START THERMOSTAT SWITCH
4. ECM CONNECTOR (6013)

4.2. ENGINE DATA LINK CIRCUITS

Circuit Functions

The engine electronic control module communicates on the drivetrain 1939 data link and the 1708 data link.

Communication on the drivetrain 1939 data link allows the ECM to send and receive messages to the ESC, the EGC and other controllers on the vehicle. Refer to Drive Train 1939 Data Link in the Multiplexing (Data Links) section of this manual. (See DRIVETRAIN 1939 DATA LINK, page 60)

The 1708 data link is primarily used for diagnostics and programming. The 1708 data link connection is also used with the hydraulic ABS (hydraulic ABS doesn't have a J1939 interface). Refer to 1708 Data Link in the Multiplexing (Data Links) section of this manual. (See 1708 DATA LINK, page 75)

4.3. CRUISE CONTROL

Circuit Functions

Cruise control and engine speed for PTO operations are selected with the cruise switches on the steering wheel. These switches are inputs to the ESC. The ESC generates commands to the engine controller on the Drivetrain 1939 data link.

Refer to Cruise Control Circuitsin the Cab Section of this manual.

4.4. REMOTE ENGINE SPEED CONTROL MODULE (RESCM)

Circuit Functions

The I6 engine has optional feature codes that allow controlling the engine from a remote location outside the cab. This is accomplished by connecting to the discrete wiring of the engine ECM. When one of these feature codes, 012VVW (Provision for Remote Throttle Control) or 012VWY (Hydraulic Pressure Governor) is ordered, a harness pigtail with the engine control circuits is strapped to the engine harness.

Refer to Body Builder Manual CT-471 or the applicable engine manual for more details.

Component Locations

5. DETROIT DIESEL ENGINES

Discussion of the Detroit Diesel Engine, in this section, is limited to the engine electronic control module (ECM) power circuits and data link connectivity. The engine controller has its own diagnostic system and uses flash codes displayed by the ENGINE warning lights. For detailed information on Caterpillar engine diagnostics, refer to the appropriate Caterpillar Manual.

5.1. ENGINE CONTROL MODULE (ECM) POWER AND GROUND

Circuit Functions

Diagnostics

A problem with power to the ECM will be apparent when the vehicle will not crank and the “CHECK ELEC SYS” warning lamp in the gauge cluster is constantly on.

The problem could be attributed to open or shorted wiring between the ECM and related power circuits, a blown fuse, a failed relay or a failure inside the ECM.

Several diagnostic trouble codes (DTC’s) will be logged when there is no communication on the drivetrain 1939 data link between the ECM and the ESC or the EGC.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to view diagnostic trouble codes. Refer to the “INTUNE” software manual

Table 137 Engine Electronic Control Module Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify “CHECK ELEC SYS” warning lamp is on and ECM is inoperative.	Visually check “CHECK ELEC SYS” warning lamp and attempt to start vehicle.	Engine cranks.	Go to Drivetrain 1939 Data Link(See DRIVETRAIN 1939 DATA LINK, page 60)	Go to Fault Detection Management.(See Fault Detection Management, page 427)

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 ECM power circuits will be apparent when the engine will not start and there is no communication between the ECM and the ESC or EGC. Problems in the ECM power circuits could be attributed to a blown fuse, a short or an open circuit.

Refer to ECM Power Circuits.

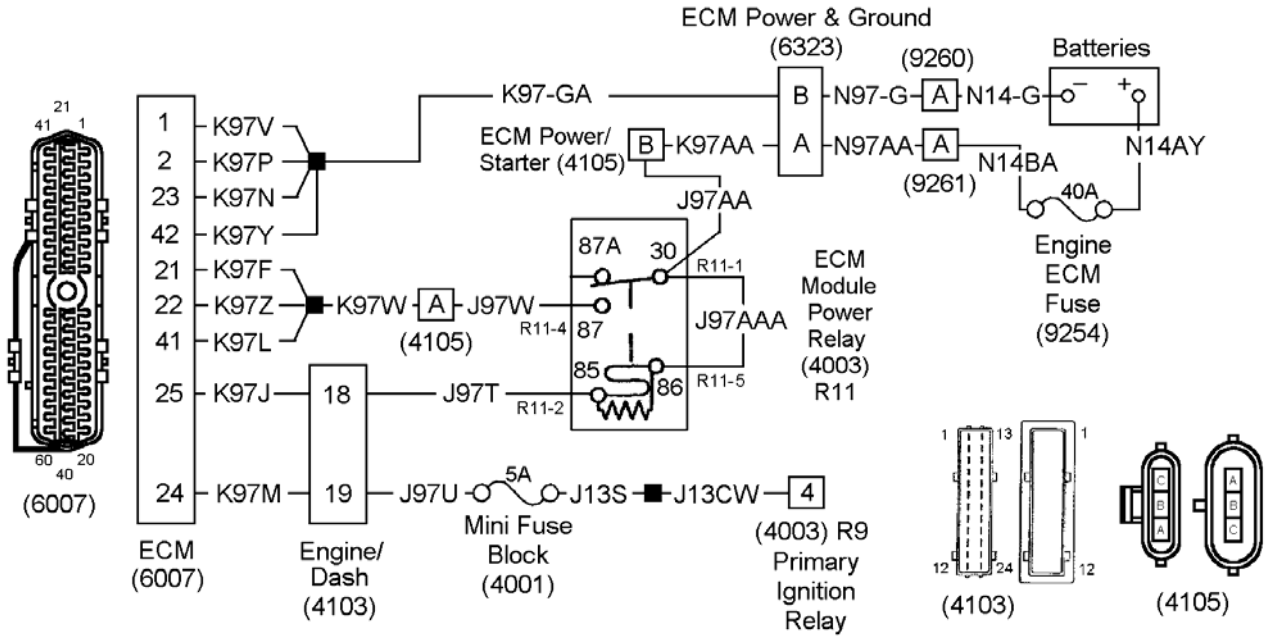

Figure 214 ECM Power Circuits

(4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4003) (R11) ECM MODULE POWER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4103) ENGINE/DASH CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(4105) ECM POWER/STARTER SOLENOID CONNECTOR
LOCATED NEAR WIPER MOTOR BRACKET
(6007) ENGINE ECM CONNECTOR
LOCATED ON ENGINE ECM
(6323) ENGINE MODULE POWER AND GROUND
LOCATED NEAR START MOTOR
(9254) ENGINE ECM FEED FUSE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9260) BATTERY ECM NEGATIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT
(9261) BATTERY ECM POSITIVE CONNECTOR
LOCATED IN BATTERY COMPARTMENT

Extended Description

Component Locations

N08-53345.06

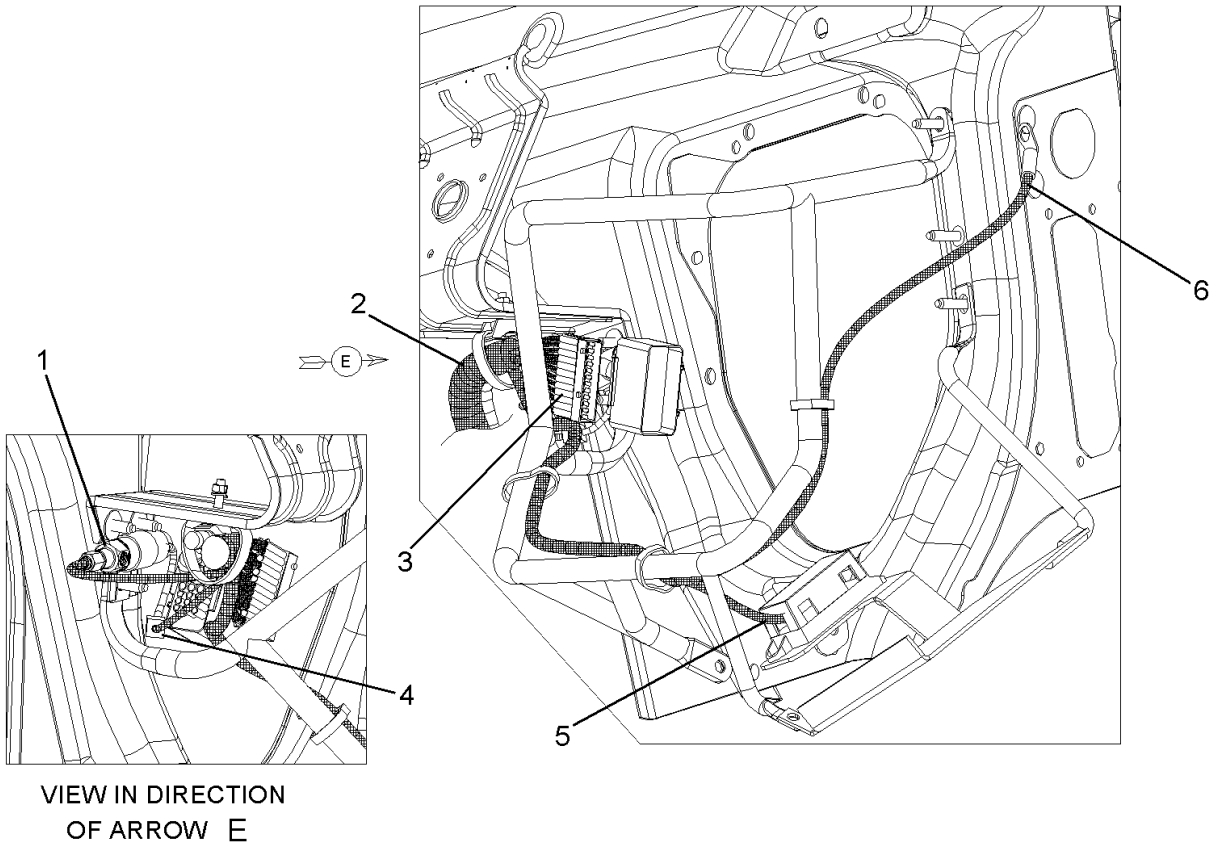

Figure 215 Engine Connector Locations

1. AIR SOLENOID
2. ENGINE HARNESS
3. ENGINE/DASH CONNECTOR (4103)
4. AIR SOLENOID CONNECTOR TO ENGINE HARNESS
5. ENGINE HARNESS CIRCUIT N14BA TO ENGINE ECM FEED FUSE (9254)
6. ENGINE HARNESS CIRCUIT N14–G TO GROUND CONNECTOR (9260)

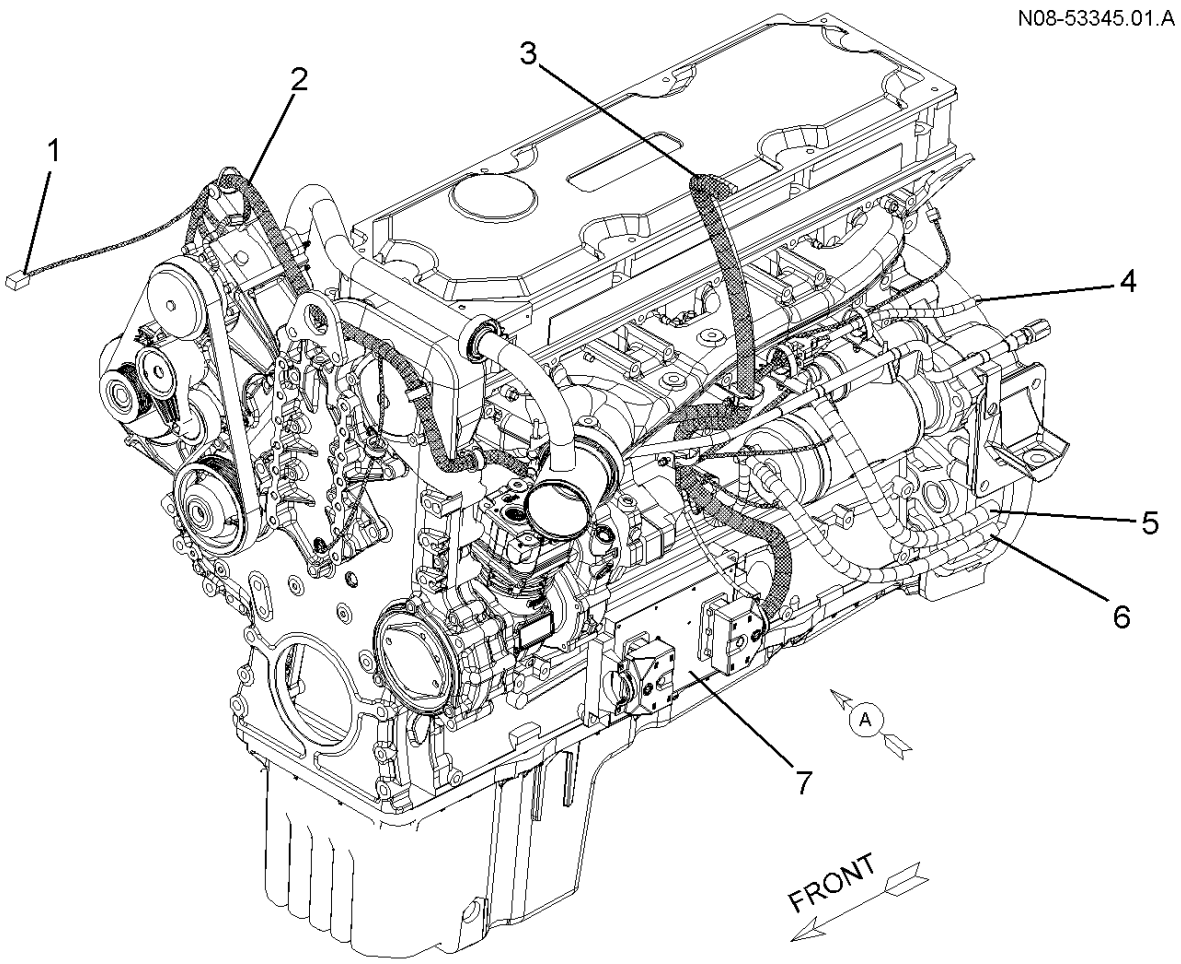

Figure 216 Engine ECM Location

1. TO SURGE TANK
2. ENGINE HARNESS
3. TO DASH HARNESS
4. TRANSMISSION HARNESS
5. TO BATTERY POSITIVE
6. TO BATTERY NEGATIVE
7. ENGINE ECM

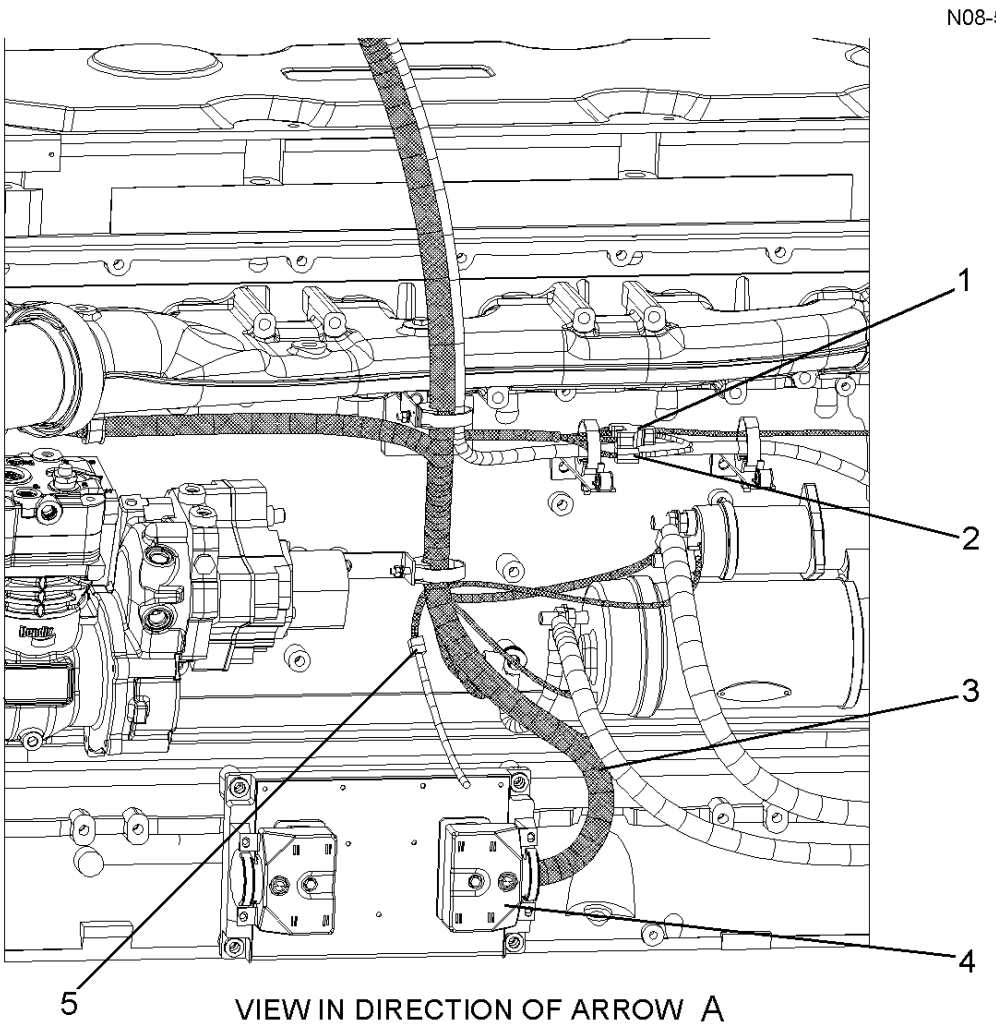

Figure 217 Engine ECM Location

1. DRIVETRAIN 1939 DATALINK “Y” CONNECTOR
2. 3–WAY ENGINE HARNESS CONNECTOR
3. ENGINE HARNESS
4. 2–WAY ECM BATTERY POWER CONNECTOR
5. ECM CONNECTOR

5.2. ENGINE DATA LINK CIRCUITS

Circuit Functions

The engine electronic control module communicates on the drivetrain 1939 data link and the 1708 data link.

Communication on the drivetrain 1939 data link allows the ECM to send and receive messages to the ESC, the EGC and other controllers on the vehicle. Refer to Drive Train 1939 Data Link in the Multiplexing (Data Links) section of this manual. (See DRIVETRAIN 1939 DATA LINK, page 60)

The 1708 data link is primarily used for diagnostics and programming. The 1708 data link connection is also used with the hydraulic ABS (hydraulic ABS doesn't have a J1939 interface). Refer to 1708 Data Link in the Multiplexing (Data Links) section of this manual. (See 1708 DATA LINK, page 75)

5.3. CRUISE CONTROL

Circuit Functions

Cruise control and engine speed for PTO operations are selected with the cruise switches on the steering wheel. These switches are inputs to the ESC. The ESC generates commands to the engine controller on the Drivetrain 1939 data link.

Refer to Cruise Control Circuits in the Cab Section of this manual.

5.4. REMOTE ENGINE SPEED CONTROL MODULE (RESCM)

Circuit Functions

The I6 engine has optional feature codes that allow controlling the engine from a remote location outside the cab. This is accomplished by connecting to the discrete wiring of the engine ECM. When one of these feature codes, 012VVW (Provision for Remote Throttle Control) or 012VWY (Hydraulic Pressure Governor) is ordered, a harness pigtail with the engine control circuits is strapped to the engine harness.

Refer to Body Builder Manual CT-471 or the applicable engine manual for more details.

Component Locations

Table of Contents

1. CIGAR LIGHTER AND POWER FEEDS

1.1. CIRCUIT FUNCTIONS

Refer to Cigar Lighter And Power Feeds Function diagram.

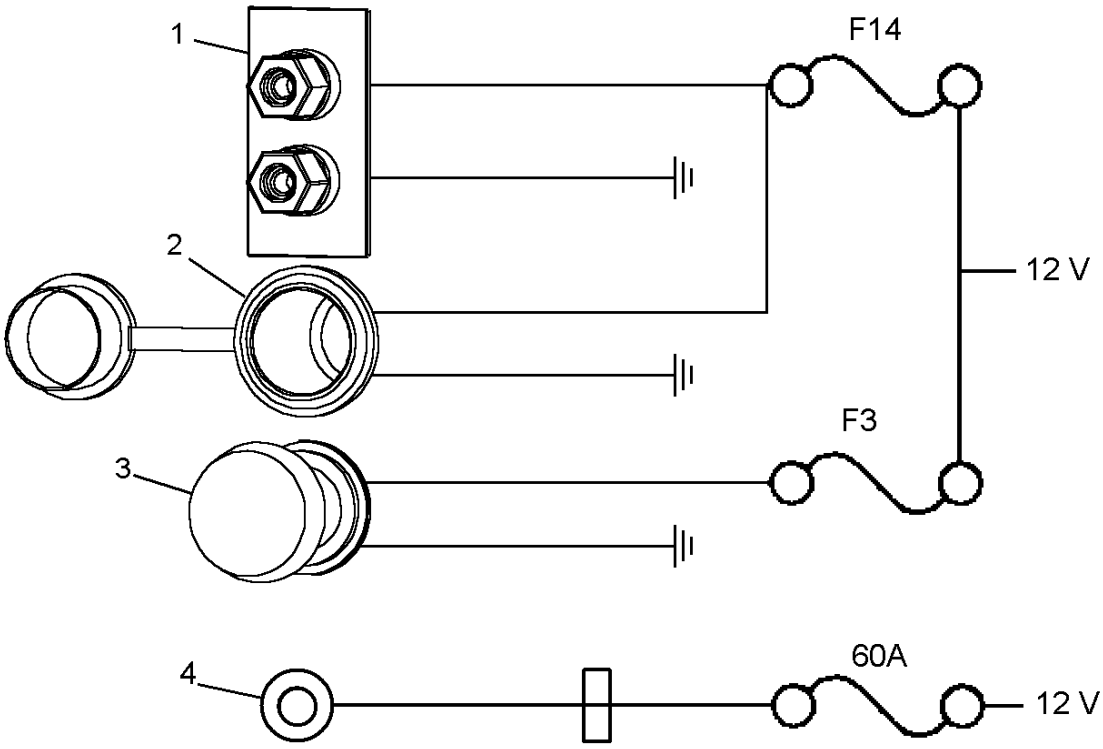

Figure 218 Cigar Lighter and Power Feeds Function Diagram

1. TWO POST POWER SOURCE
2. CIGAR LIGHTER POWER SOURCE
3. CIGAR LIGHTER
4. BODY BUILDER 60 AMP POWER FEED

The cigar lighter circuits provide power to the cigar lighter or accessories plugged into the lighter socket.

The cigar lighter power source circuits provide power to accessories plugged into the lighter socket.

The two post power source circuits provide power for accessories.

The 60 amp power feed for the body builder connecter.

1.2. DIAGNOSTICS

Should the cigar lighter or power feeds fail to operate, the problem could be attributed to open or shorted wiring between the power circuits, an open ground circuit or a blown fuse.

An open element in the cigar lighter would also keep the lighter from working.

There are no diagnostic trouble codes associated with the cigar lighter and power feed circuits.

Cigar Lighter and Power Feed Preliminary Check

Table 138 Cigar Lighter and Power Feed Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	Off	Verify cigar lighter or any power feed is inoperative.	Check cigar lighter and power feeds.	Cigar light or power feeds are inoperative.	Go to next step.	Cigar lighter and power feeds are operating. Problem does not exist or is intermittent.
2.	Off	Determine if any other 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.	Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 440)	Identify and repair condition causing several features to be inoperative.

1.3. FAULT DETECTION MANAGEMENT

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

A failure in the cigar lighter and power feed circuits will be apparent when the cigar lighter and power feeds are inoperative. The electrical system controller (ESC) will not log any diagnostic trouble codes for cigar lighter and power feeds.

Should the cigar lighter or power feeds fail to operate, the problem could be attributed to open or shorted wiring in the power circuits, an open ground circuit or a blown fuse.

Refer to Cigar Lighter And Power Feed Circuits.

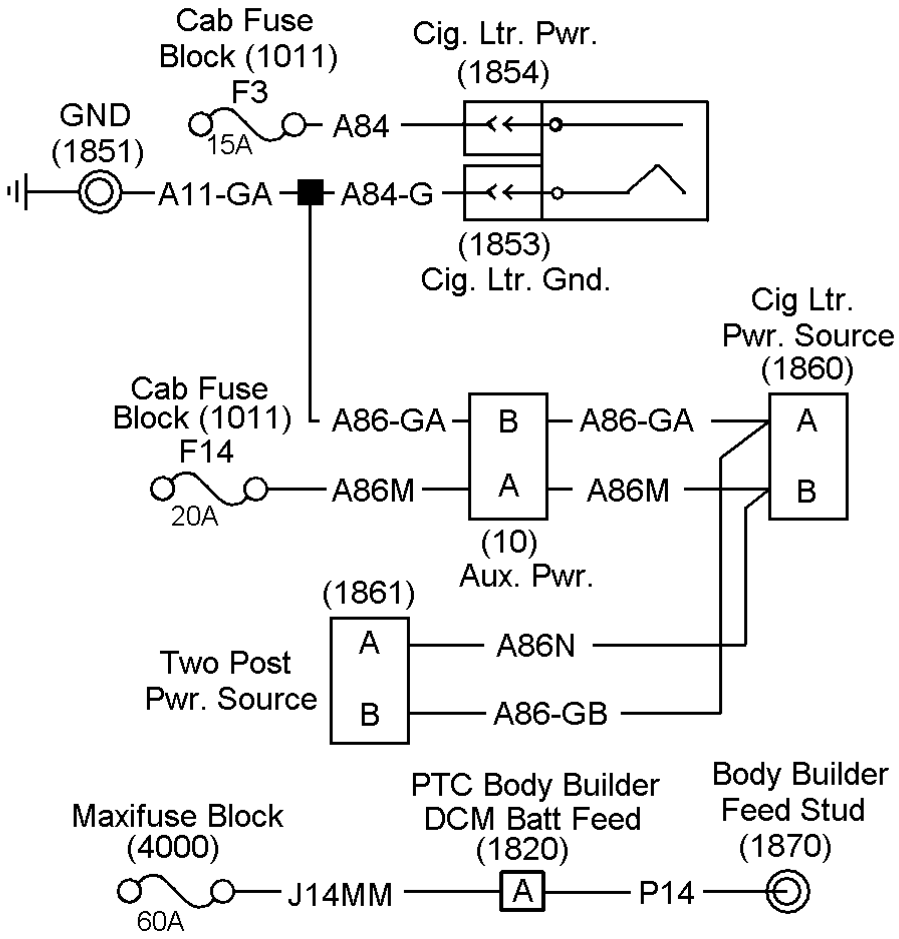

Figure 219 Cigar Lighter And Power Feed Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(10) AUXILIARY POWER CONNECTOR
LOCATED BEHIND INSTRUMENT PANEL
(1820) PTC BODY BUILDER DCM BATT FEED
LOCATED AT BODY BUILDER CONNECTOR
(1851) NEGATIVE STUD
LOCATED ABOVE ESC
(1853) CIGAR LIGHTER GROUND CONNECTOR
LOCATED AT BACK OF CIGAR LIGHTER
(1854) CIGAR LIGHTER POWER CONNECTOR
LOCATED AT BACK OF CIGAR LIGHTER
(1860) CIGAR LIGHTER POWER SOURCE CONNECTOR
LOCATED AT BACK OF CIGAR LIGHTER POWER SOURCE
(1861) TWO POST POWER SOURCE CONNECTOR
LOCATED AT BACK OF TWO POST POWER SOURCE
(1870) BODY BUILDER 60 AMP POWER FEED STUD
LOCATED AT BODY BUILDER CONNECTOR

Table 139 Cigar Lighter And Power Feed Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the cigar lighter circuits.		
Cigar Lighter Voltage Checks **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Cigar lighter power connector (1854) circuit A84 to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A84 or blown fuse F3.
Cigar lighter power connector (1854) circuit A84 to connector (1853) circuit A84–G.	12 ± 1.5 volts	If voltage is missing, check for open in circuits A84–G or A11–GA to ground. If voltage is present, power to cigar lighter socket is good.
Cigar Lighter Power Source Voltage Checks **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Cigar lighter power source connector (1860) cavity B to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86M or blown fuse F14.
Cigar lighter power source connector (1860) cavity B to cavity A	12 ± 1.5 volts	If voltage is missing, check for open in circuits A86–GA or A11–GA to ground. If voltage is present, power to cigar lighter is good.
Two Post Power Source Voltage Checks **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Two post power source connector (1861) cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86N or blown fuse F14.
Cigar lighter power source connector (1860) cavity A to cavity B	12 ± 1.5 volts	If voltage is missing, check for open in circuits A86–GB, A86–GA or A11–GA to ground. If voltage is present, power to two post power is good.
Body Builder Feed Stud Power Source Voltage Checks **NOTE – Always check connectors for damage and pushed–out terminals.**		

Table 139 Cigar Lighter And Power Feed Tests (cont.)

Test Points	Spec.	Comments
Body builder feed stud power source connector (1870) stud to ground.	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits P14, J14MM, conn. (1820) or blown maxifuse block (4000). If voltage is present, power to body builder feed stud power is good.

1.4. EXTENDED DESCRIPTION

The cigar lighter receives power from cigar lighter fuse F3 on circuit A84. Ground is supplied from negative stud (1851) on circuits A11–GA and A84–G.

The cigar lighter power source receives power from auxiliary power source fuse F14 on circuit A86M. Ground is supplied from negative stud (1851) on circuits A11–GA and A86–GA.

The two post power source receives power from auxiliary power source fuse F14 on circuit A86M and A86N. Ground is supplied from negative stud (1851) on circuits A11–GA, A86–GA and A86–GB.

The body builder feed stud (1870) power source receives power from the maxifuse block (4000) on circuits P14 and J14MM.

1.5. COMPONENT LOCATIONS

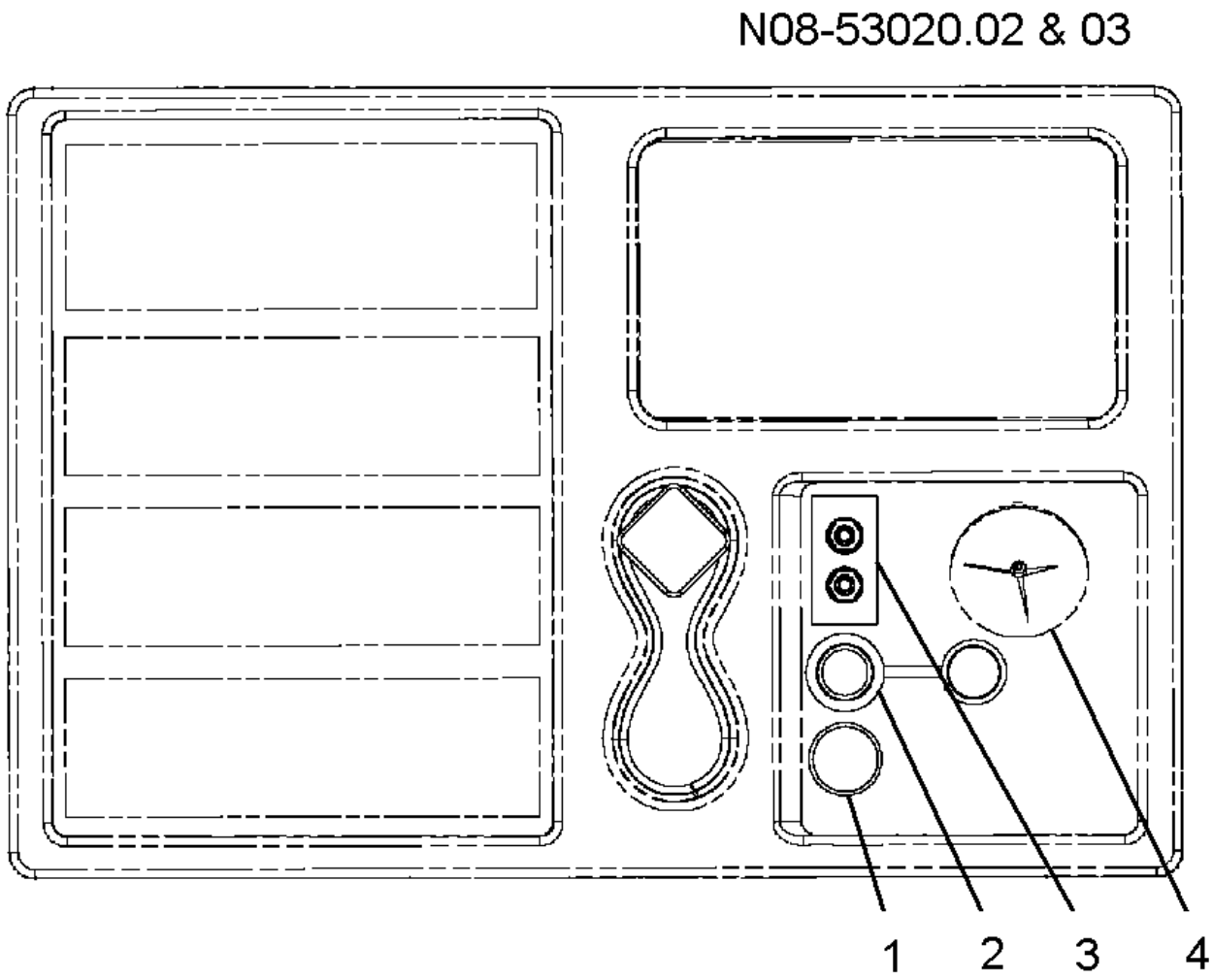

Figure 220 Cigar Lighter

1. CIGAR LIGHTER
2. CIGAR LIGHTER POWER SOURCE
3. TWO POST POWER SOURCE
4. CLOCK

2. C.B. RADIO POWER

2.1. CIRCUIT FUNCTIONS

Refer to C.B. radio power function diagram.

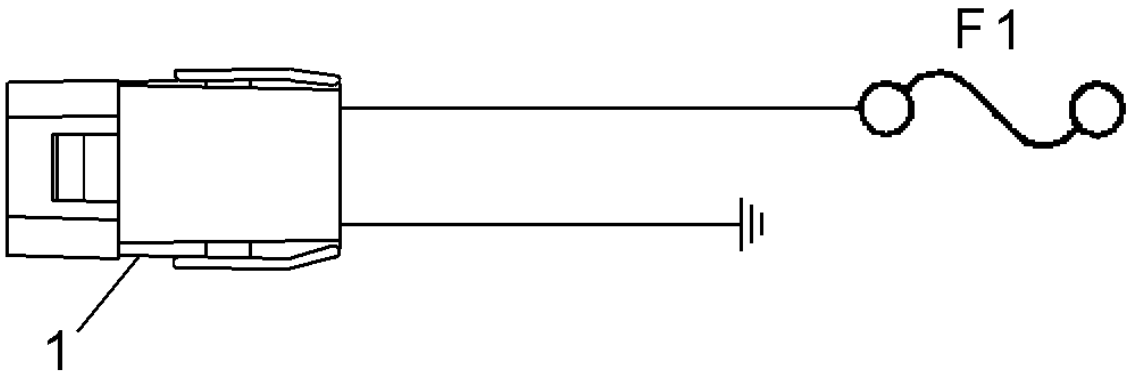

Figure 221 C.B. Radio Power Function Diagram

1. C.B. RADIO POWER CONNECTOR

The C.B. Radio power circuits provide power to the operator provided C.B. radio installed in the overhead console.

2.2. DIAGNOSTICS

Should the C.B. radio power source fail to operate, the problem could be attributed to open or shorted wiring in the power circuits, an open ground circuit or a blown fuse.

There are no diagnostic trouble codes associated with the C.B. radio power source circuits.

C.B. Radio Power Source Preliminary Check

Table 140 C.B. Radio Power Source Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify C.B. radio power source is inoperative.	Check C.B. radio power source.	C.B. radio power source is inoperative.	Go to next step.	C.B. radio power source is operating. Problem does not exist or is intermittent.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or ground common to several features.)	Visually check for other malfunc-tioning features.	No other features are malfunc-tioning.	Go to C.B. radio Fault Detection Manage-ment. (See FAULT DETECTION MANAGEMENT, page 445)	Identify and repair condition causing several features to be inoperative.

2.3. FAULT DETECTION MANAGEMENT

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

A failure in the C.B. radio power source circuits will be apparent when the C.B. radio power source is inoperative. The ESC will not log any diagnostic trouble codes for the C.B. radio power source.

Should the C.B. radio power source fail to operate, the problem could be attributed to open or shorted wiring between the power circuits, an open ground circuit or a blown fuse.

Refer to C.B. Radio Power Source Circuits.

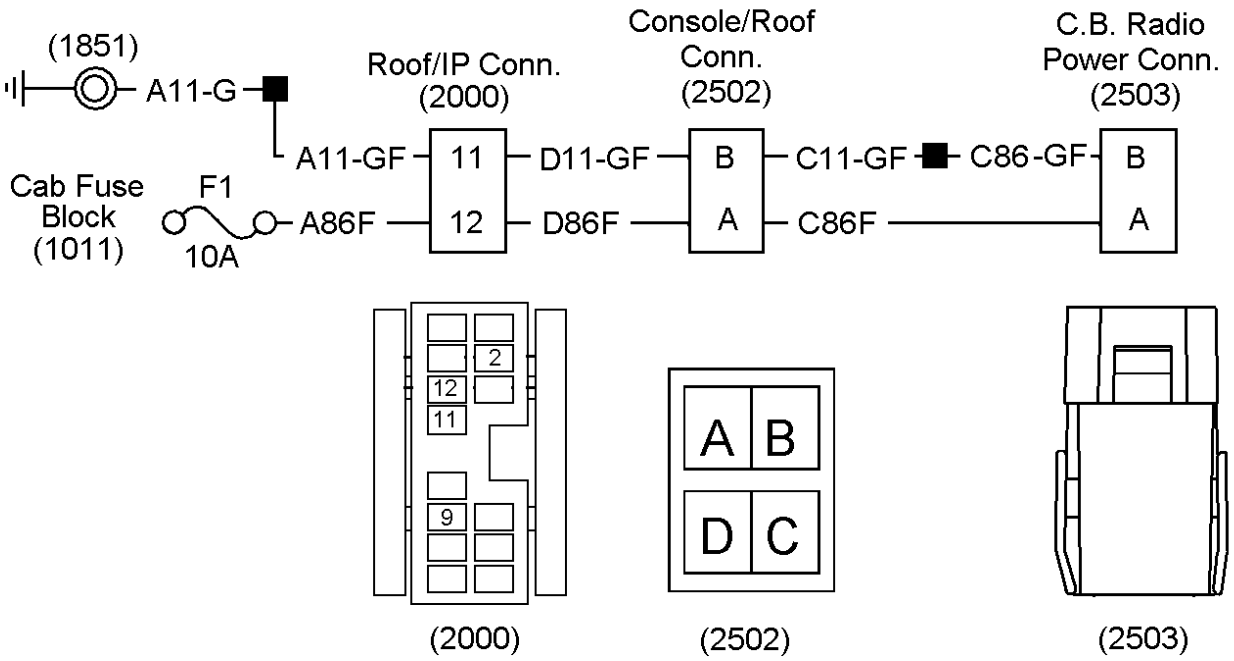

Figure 222 C.B. Radio Power Source Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(1851) NEGATIVE STUD
LOCATED ABOVE ESC
(2000) ROOF INSTRUMENT PANEL CONNECTOR
LOCATED UNDER INSTRUMENT PANEL NEAR LEFT “A” PILLAR
(2303) C.B. RADIO POWER CONNECTOR
LOCATED AT BACK OF C.B. RADIO SLOT IN HEADER
(2502) CONSOLE ROOF CONNECTOR
LOCATED AT TOP OF LEFT “A” PILLAR

Table 141 C.B. Radio Power Tests

Diagnostic Trouble Codes
There are no diagnostic trouble codes associated with the C.B. radio power circuits.
C.B. Radio Power Voltage Checks Check with ignition on **NOTE – Always check connectors for damage and pushed–out terminals.**

Table 141 C.B. Radio Power Tests (cont.)

Test Points	Spec.	Comments
C.B. radio power connector (2303) circuit C86F to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86F or blown fuse F1.
C.B. radio power connector (2303) circuit C86F to circuit C86–CF.	12 ± 1.5 volts	If voltage is missing, check for open in circuits C86–CF or C11–GF to ground. If voltage is correct, power to the C.B. radio is good.

2.4. EXTENDED DESCRIPTION

The C.B. Radio Power connector receives power from C.B. Radio Power fuse F1 on circuit A86F. Ground is supplied from negative stud (1851) on circuits A11–G, A11–GF, D11–GF, C-11GF and C86–GF.

2.5. COMPONENT LOCATIONS

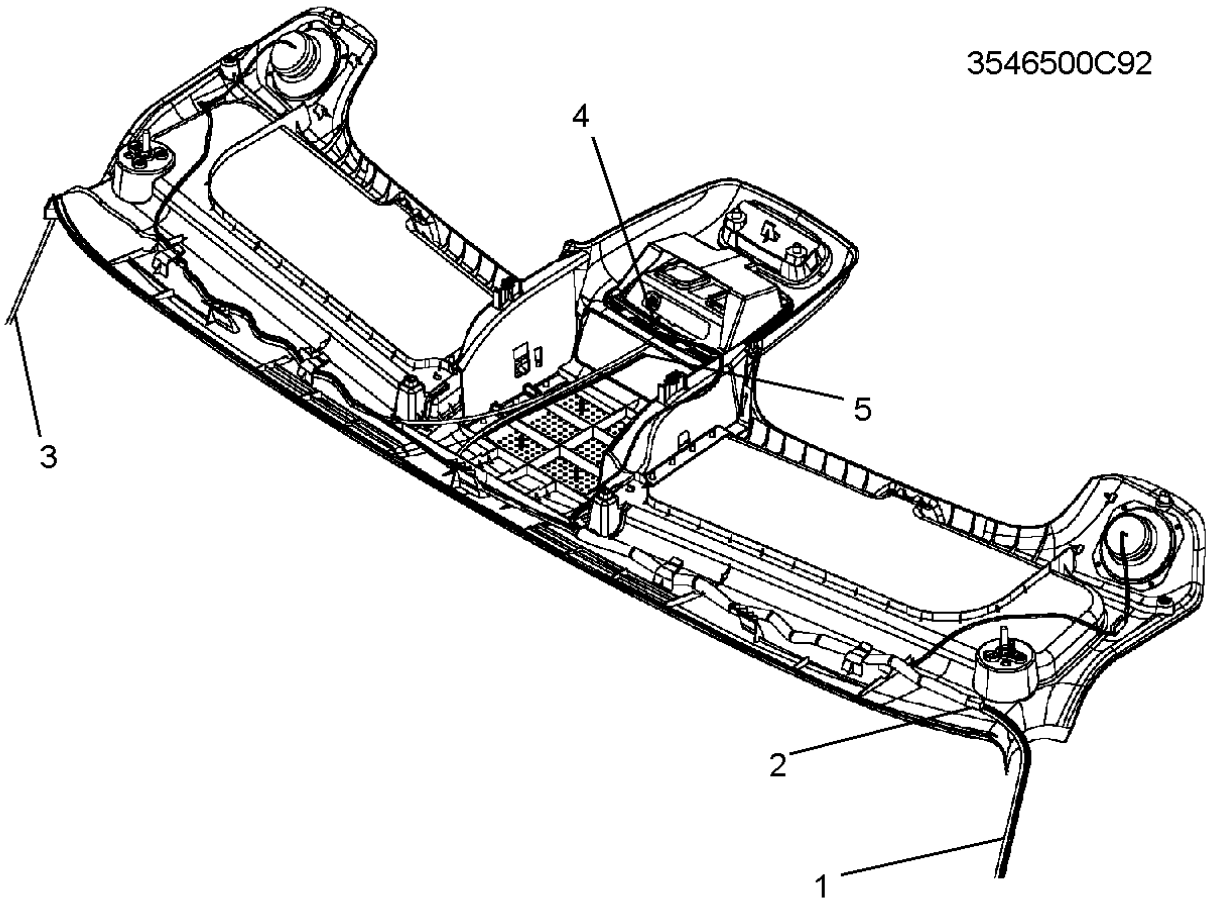

Figure 223 Overhead Console (Viewed From Inside Console)

1. LEFT C.B. ANTENNA CABLE AND POWER HARNESS
2. CONSOLE ROOF CONNECTOR (2502)
3. RIGHT C.B. ANTENNA CABLE
4. COMPASS/TEMPERATURE MODULE CONNECTOR
5. C.B. RADIO POWER CONNECTOR

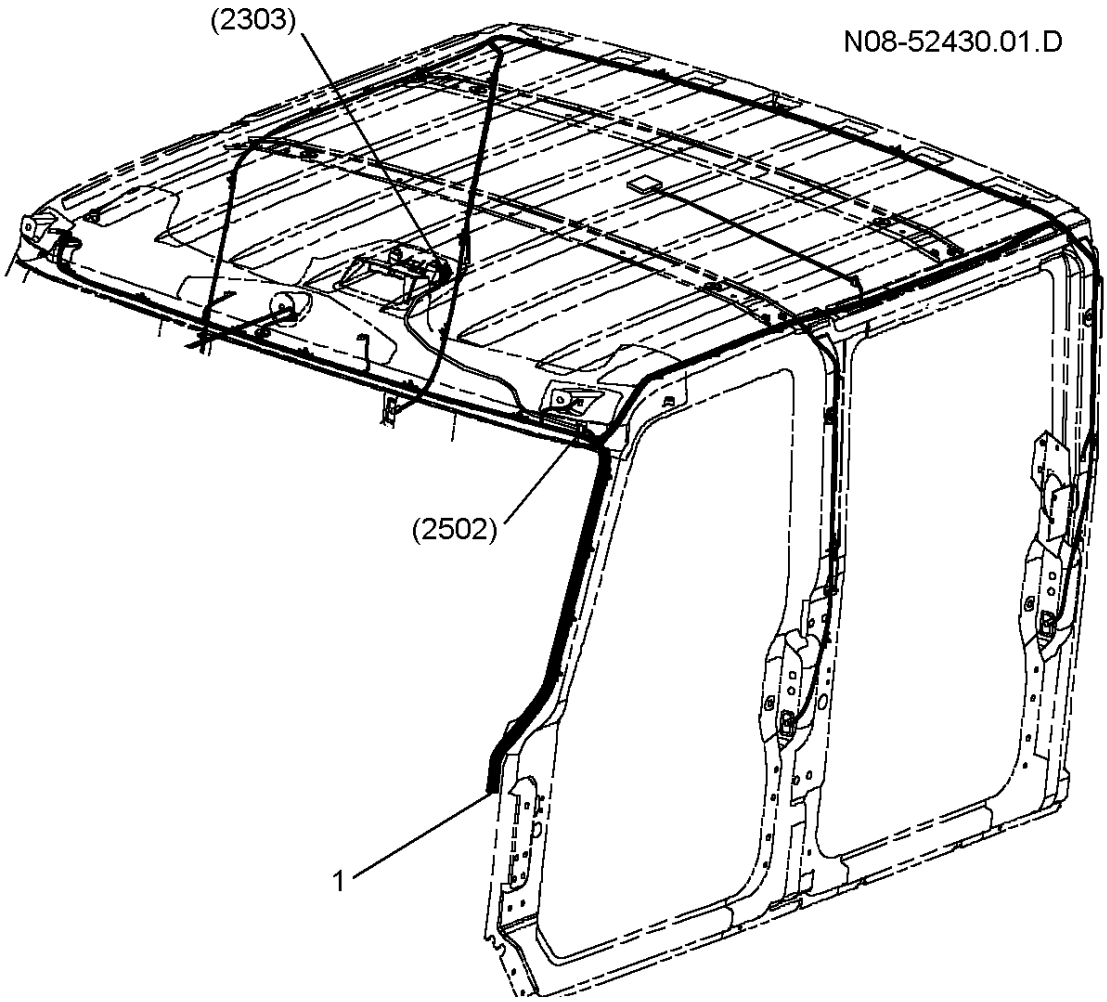

Figure 224 C.B. Radio Power Source

1. ROOF HARNESS TO ROOF/IP CONNECTOR AND CAB HARNESS
(2303) C.B. RADIO POWER CONNECTOR
(2502) CONSOLE ROOF CONNECTOR

3. COMPASS AND TEMPERATURE DISPLAY

3.1. CIRCUIT FUNCTIONS

Refer to Compass/Temperature Display Function Diagram.

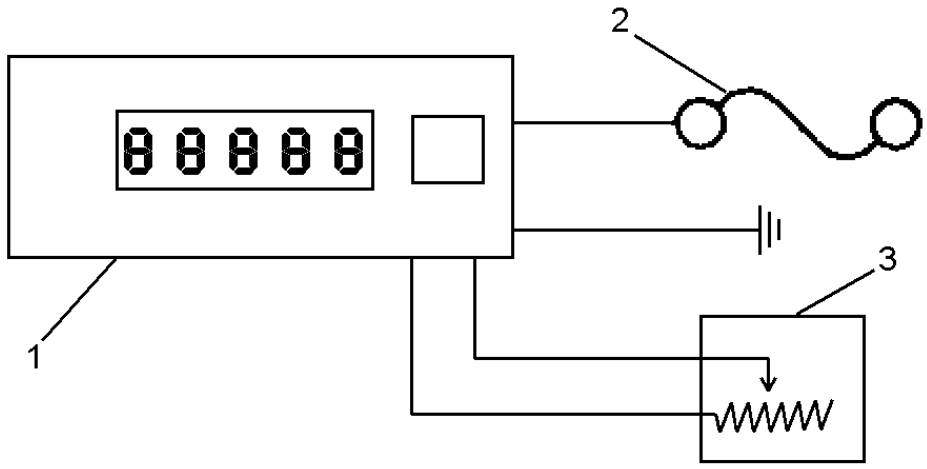

Figure 225 Compass/Temperature Display Function Diagram

1. COMPASS/TEMPERATURE DISPLAY
2. FUSE F23
3. TEMPERATURE SENDER

The compass/temperature display provides the operator with outside temperature information as well as compass information.

The unit uses a temperature sender mounted in the front bumper to sense the outdoor temperature.

Pressing the button mounted on the unit will switch the display between Fahrenheit and Centigrade temperature readouts.

If the outside temperature is 37°F (3°C) or lower, ICE will appear on the display once per ignition cycle. This is a warning that road conditions may be icy, and appropriate precautions should be taken.

WARNING – Temperatures just above the displayed ICE indication feature 37°F (3°C), do not guarantee that the road surface is free of ice.

3.2. DIAGNOSTICS

Should the compass/temperature display fail to operate, the problem could be attributed to open or shorted wiring in the power circuits, an open ground circuit or a blown fuse.

An incorrect temperature readout could be attributed to a faulty temperature sender.

If the display reads "OC", there is an open in one of the circuits between the sender and the unit, the sender is open internally or the sender has been disconnected.

If the display reads "5C" or "SC", the two sensor wires are shorted together somewhere between the unit and the sensor.

To check the accuracy, place the sensor in a glass of ice and fill with water. Allow at least 5 minutes for the sensor to cool, stirring occasionally. The display should read 32°F or 0°C. The accuracy of the temperature readout is ± 2 degrees C.

There are no ESC diagnostic trouble codes associated with the compass/temperature display circuits.

Compass/Temperature Display Preliminary Check

Table 142 Compass/Temperature Display Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify compass/ temperature display is inoperative.	Check compass/ temperature display.	Compass/ temperature display is inoperative.	Go to next step.	Compass/ temperature display is operating. Problem does not exist or is intermittent.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or ground common to several features.)	Visually check for other malfunc-tioning features.	No other features are malfunc-tioning.	Go to Compass/ Tempera-ture Unit Fault Detection Manage-ment. (See FAULT DETECTION MANAGEMENT, page 451)	Identify and repair condition causing several features to be inoperative.

3.3. FAULT DETECTION MANAGEMENT

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

A failure in the compass/temperature display will be apparent when the unit is inoperative or has an incorrect readout. The ESC will not log any diagnostic trouble codes for the C.B. radio power source.

If the display reads "OC", there is an open in one of the circuits between the sender and the unit, the sender is open internally or the sender has been disconnected.

If the display reads "5C" or "SC", the two sensor wires are shorted together somewhere between the unit and the sensor.

To check the accuracy, place the sensor in a glass of ice and fill with water. Allow at least 5 minutes for the sensor to cool, stirring occasionally. The display should read 32°F or 0°C. The accuracy of the temperature readout is ± 2 degrees C.

Should the compass/temperature display fail to operate, the problem could be attributed to open or shorted wiring between the power circuits, an open ground circuit or a blown fuse.

Refer to Compass/Temperature Display Circuits.

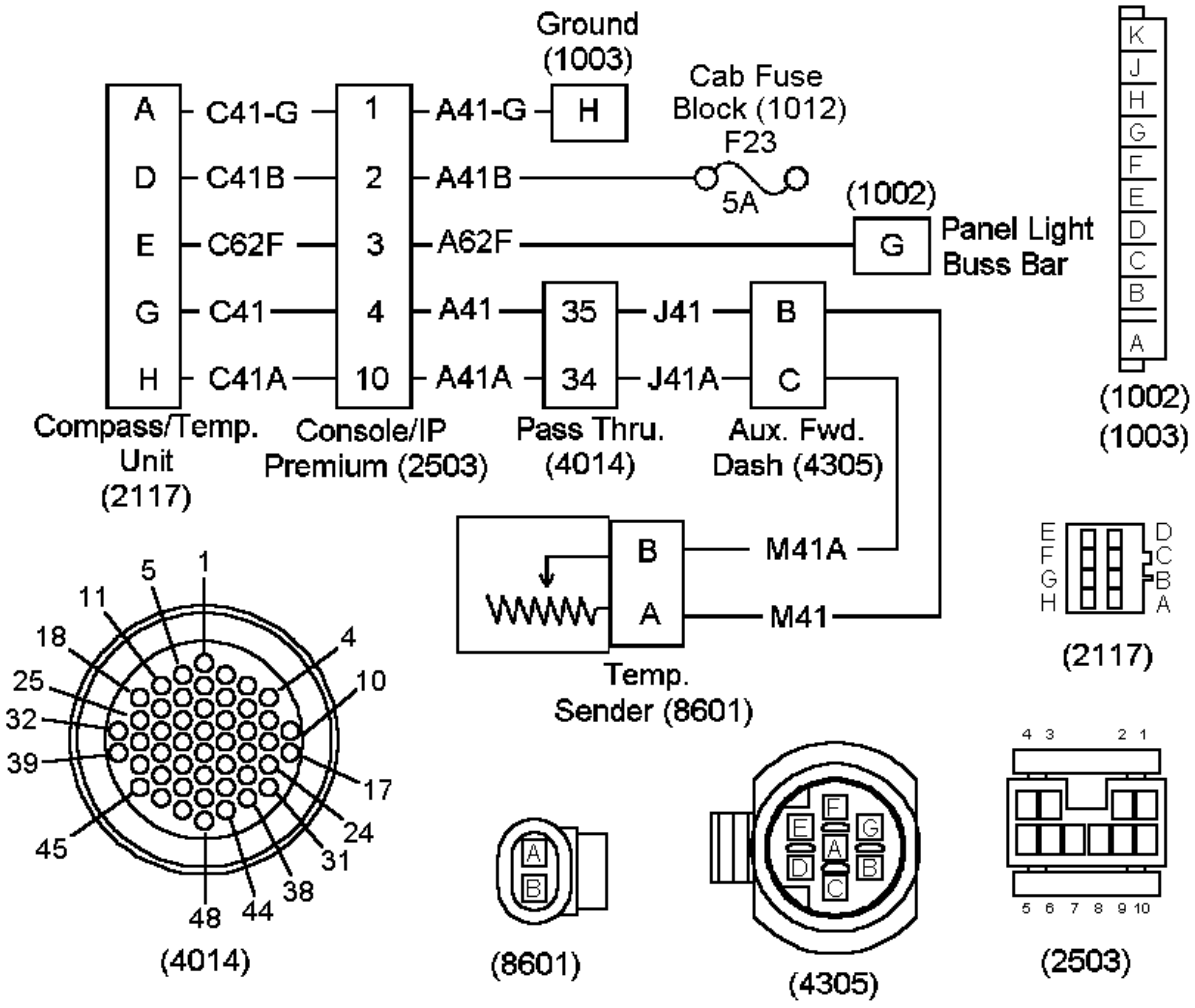

Figure 226 Compass/Temperature Display Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

(1002) PANEL LIGHT BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1003) GROUND ADAPTER
LOCATED IN INSTRUMENT PANEL
(2117) COMPASS/TEMPERATURE UNIT
LOCATED BEHIND COMPASS/TEMPERATURE UNIT
(2503) PREMIUM CONSOLE/INSTRUMENT PANEL CONNECTOR
LOCATED AT TOP OF LEFT “A” PILLAR
(4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL, ABOVE ESC
(4305) AUXILIARY FORWARD DASH CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
(8601) TEMPERATURE SENDER CONNECTOR
LOCATED ON RADIATOR HOUSING

Table 143 Compass/Temperature Display Tests

Diagnostic Trouble Codes		
If the display reads "OC", there is an open in one of the circuits between the sender and the unit, the sender is open internally or the sender has been disconnected.		
If the display reads "5C" or "SC", the two sensor wires are shorted together somewhere between the unit and the sensor.		
Compass/Temperature Display Voltage Checks Check with ignition on and (2117) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Compass/ temperature display connector (2117) cavity D to ground.	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit C41B or A41B or blown fuse F23.
Compass/ temperature display connector (2117) cavity D to cavity A.	12 ± 1.5 volts	If voltage is missing, check for open in circuits C41–G or A41–G to ground. If voltage is present, power to display is good.
With park lights on, compass/ temperature display connector (2117) cavity E to cavity A.	Panel light voltage (>10 volts with panel lights turned up).	If voltage is missing, check for open in circuits C62F or A62F. If voltage is present, panel light power to display is good.
Temperature Sender Voltage Checks Check with ignition on and temperature sender connector (8601) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Temperature Sensor connector (8601) cavity A to ground.	5 ± 1 volts	If voltage is missing, check for open or shorts in circuits between sender and compass/temperature display. If circuits are good and voltage is missing, replace display.
Temperature Sensor connector (8601) cavity A to cavity B.	5 ± 1 volts	If voltage is missing, check for open in circuits between sender and compass/temperature display unit. If circuits are good and voltage is missing, replace display.

3.4. EXTENDED DESCRIPTION

The compass/temperature display receives power from fuse F23 on circuit A41B and C41B. Ground is supplied from ground adapter (1003) on circuits A41–G and C41–G.

3.5. COMPONENT LOCATIONS

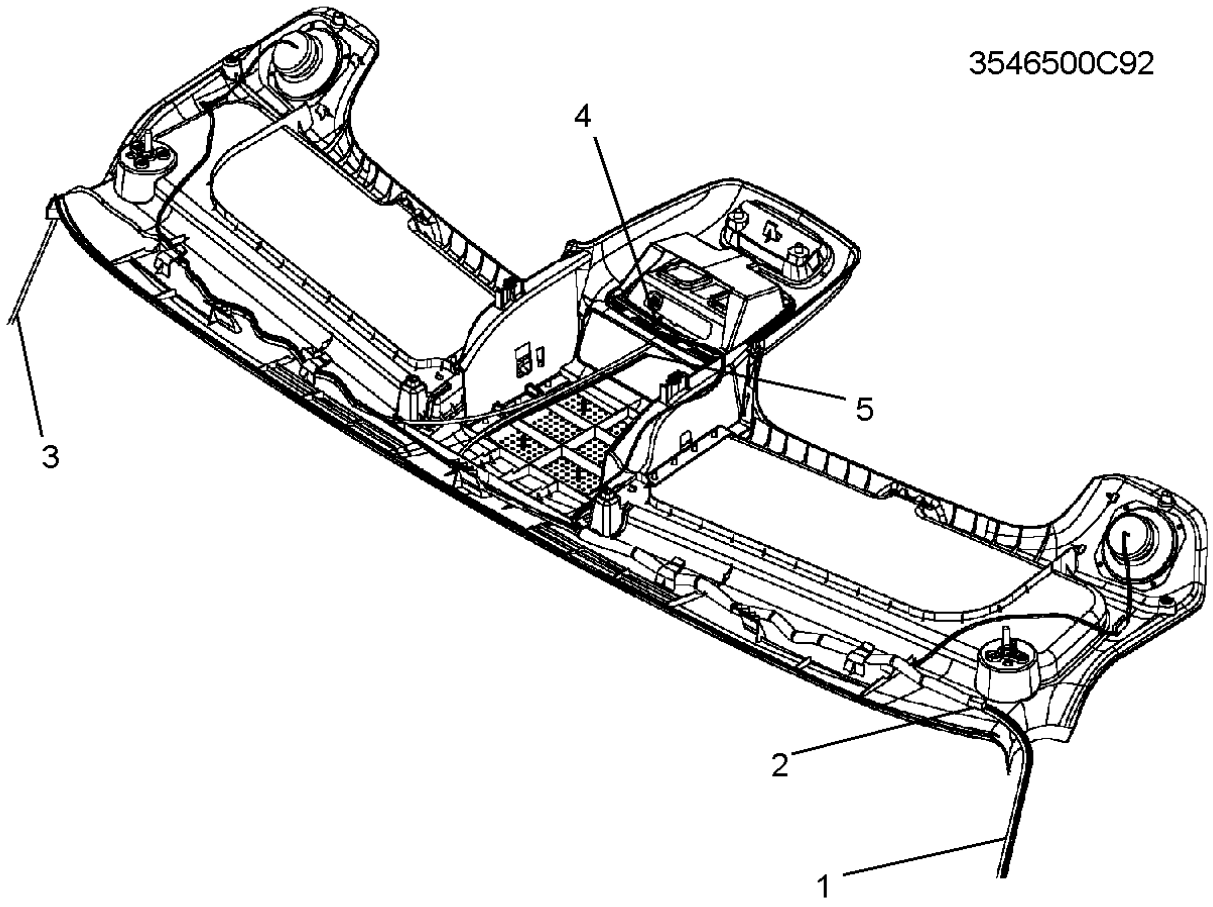

Figure 227 Overhead Console (Viewed From Inside Console)

1. LEFT C.B. ANTENNA CABLE AND POWER HARNESS
2. CONSOLE ROOF CONNECTOR (2503)
3. RIGHT C.B. ANTENNA CABLE
4. COMPASS/TEMPERATURE MODULE CONNECTOR
5. C.B. RADIO POWER CONNECTOR

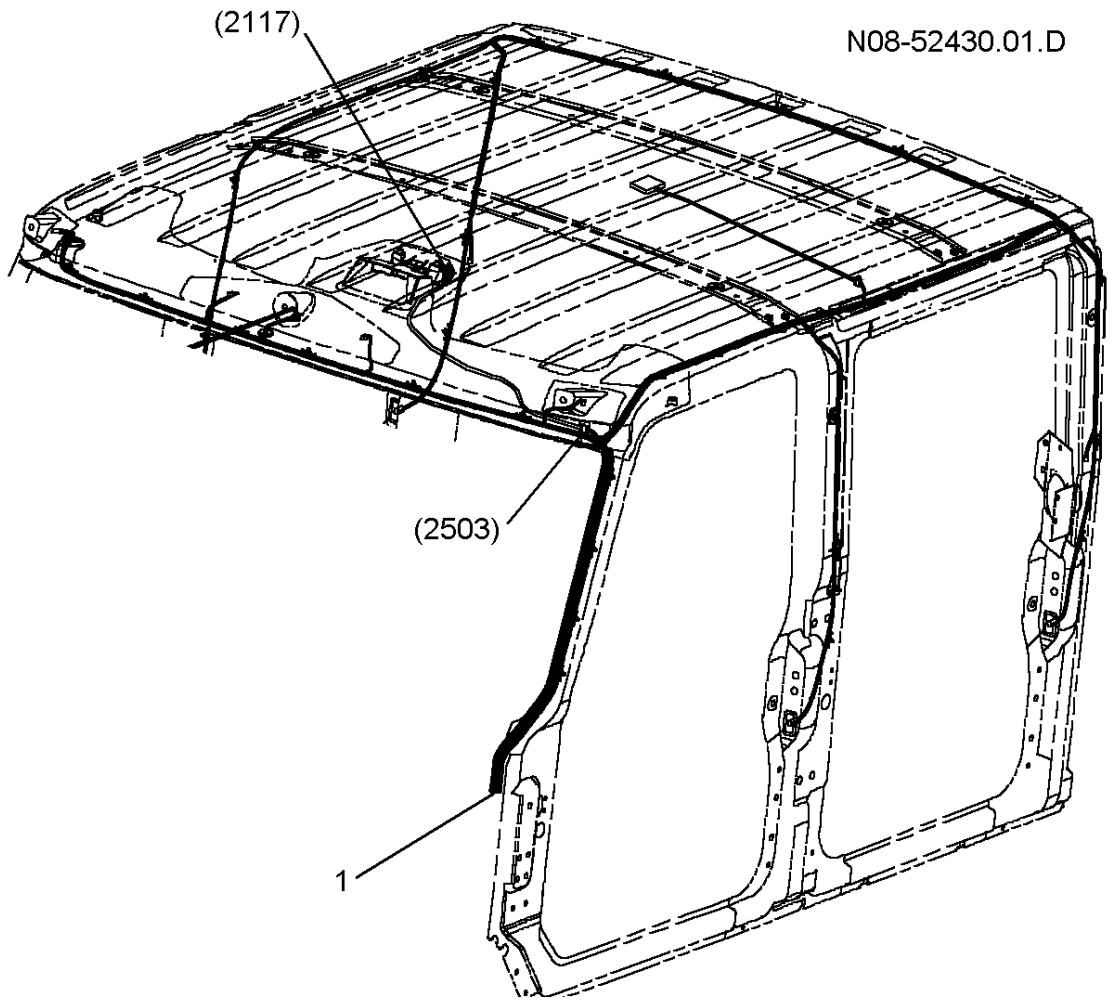

Figure 228 Roof Harness

1. ROOF HARNESS TO ROOF/IP CONNECTOR AND CAB HARNESS
(2117) COMPASS/TEMPERATURE UNIT
(2503) PREMIUM CONSOLE/INSTRUMENT PANEL CONNECTOR

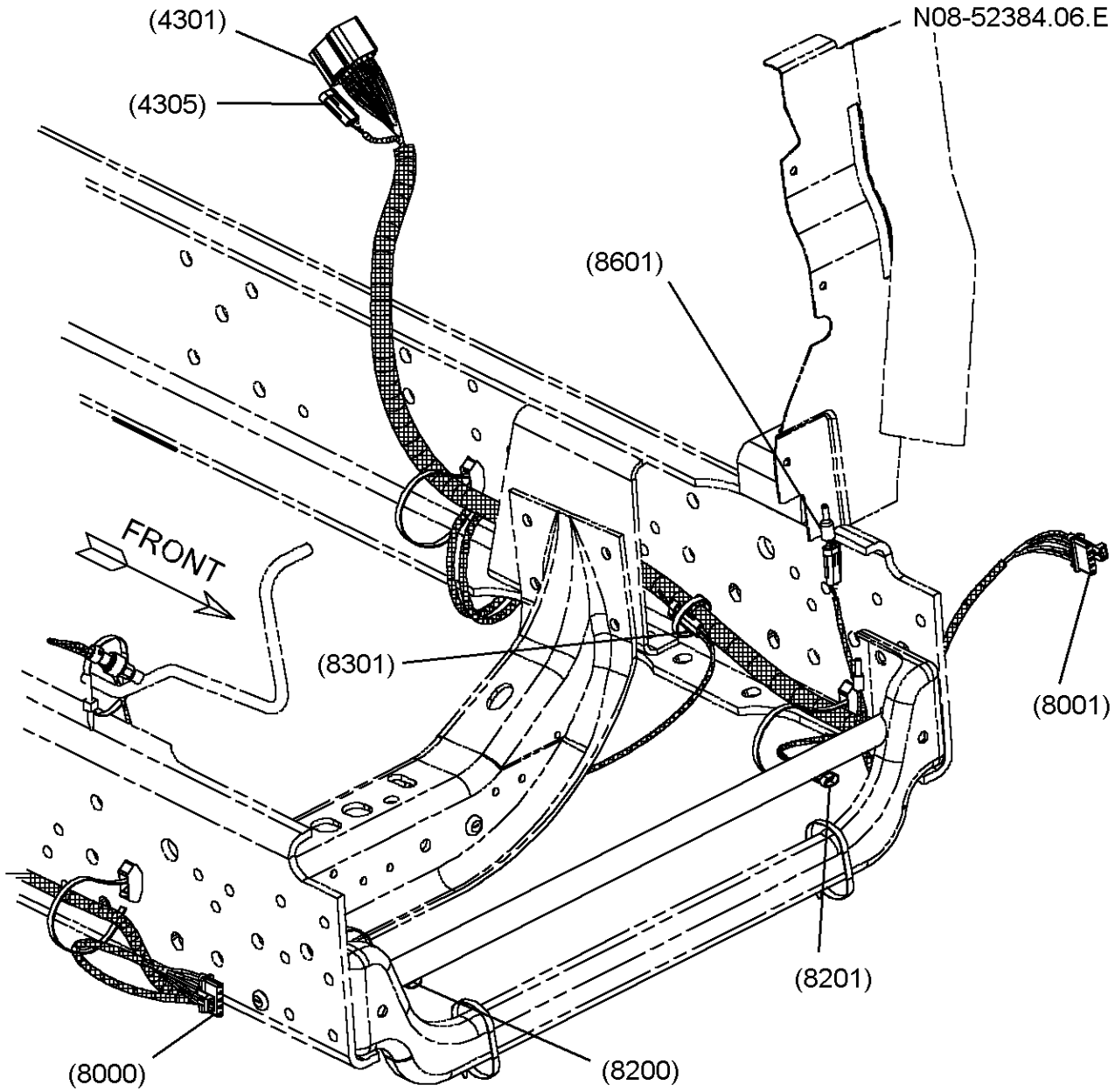

Figure 229 Temperature Sender Location

(4305) AUXILIARY FORWARD CHASSIS CONNECTOR
(8601) TEMPERATURE SENDER

4. FRONT DOORS WINDOWS AND LOCKS (POWER)

4.1. CIRCUIT FUNCTIONS

Refer to Front Doors Power Windows And Locks Function Diagram.

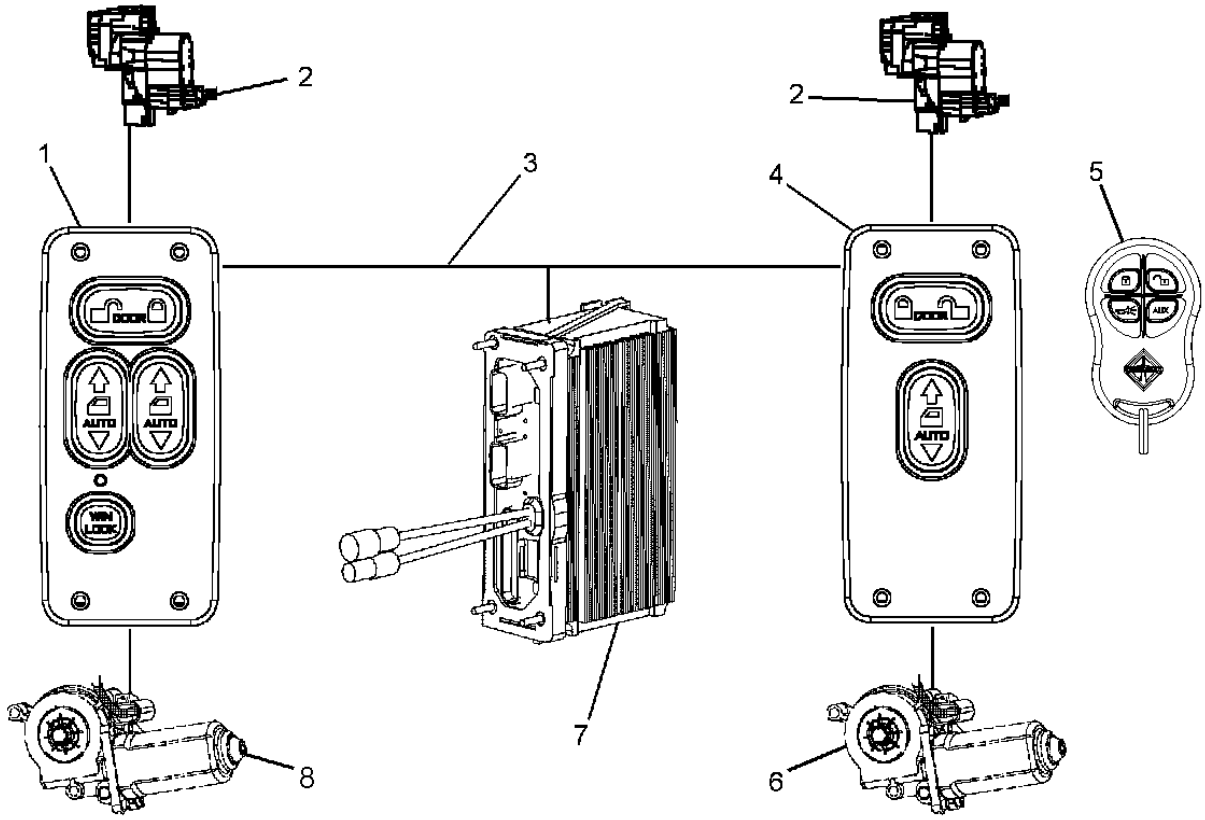

Figure 230 Front Doors Power Windows and Locks Function Diagram

1. DRIVERS SIDE DOOR POD
2. POWER LOCK MOTOR
3. SWITCH DATA LINK
4. PASSENGER SIDE DOOR POD
5. REMOTE KEYLESS ENTRY (RKE) TRANSMITTER
6. POWER WINDOW MOTOR
7. ELECTRICAL SYSTEM CONTROLLER (ESC)
8. POWER WINDOW MOTOR

A door pod on each door houses the switches and contains the electronics required to control the power windows and locks.

NOTE – A malfunctioning pod must be replaced. Individual parts of the pod are not replaceable.

The door pods communicate with each other and the ESC on the switch data link. This allows the driver side pod to control all windows in the vehicle. It also allows all pods to control all locks.

The door pods will not operate the power windows when the ignition is off.

The ESC also sends commands to the pods to control the pod backlighting.

If the remote keyless entry (RKE) option is installed on the vehicle, the key FOB transmitter communicates with the passenger front door pod to unlock or lock the doors. The door pod also communicates with the ESC, on the switch data link, to request the other remote keyless entry functions.

The International Keyless Entry System uses electronic door pods in the driver and passenger side doors which also operate the power door locks and the power windows. If equipped with RKE, the memory in the receiver (front passenger door pod) learns the transmitter codes from the key FOBS (transmitters) and only recognizes those which it has learned in the programming process. Each vehicle's passenger side door pod has the ability to learn up to six transmitter codes allowing the vehicle to be accessed by six different key FOBS. Each key FOB has a unique code which can be learned by any number of RKE equipped vehicles.

4.2. DIAGNOSTICS

Failures in the front power windows and locks system are apparent when the front power windows or locks do not operate correctly. The ESC will log a diagnostic trouble code when there is a window motor failure, a lock motor failure or a door pod failure.

A problem with either power window or lock operation in an individual door could be attributed to an open or short in circuits between a door pod and the window or lock motor. The problem could also be attributed to a failure in the door pod, the window motor or the lock motor.

A problem with both power window and lock operation in an individual door could be attributed to an open or short in power or ground circuits to a door pod or a failure in the door pod.

When locks or windows in one door do not operate correctly from a door pod in another door, the problem may be in either door pod or in the switch data link between the pods.

The door pods may be swapped from side to side in order to isolate internal door pod failures. Do not swap the driver door pod from front to back.

If equipped with RKE, failure of the receiver (front passenger door pod) or the key FOBS (transmitters) when the locks do not operate.

Power Windows And Locks Preliminary Check

Table 144 Power Windows And Locks Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify power windows or locks are operating incorrectly.	Attempt to operate power windows and locks.	Power windows or locks are **not** operating correctly.	Go to next step.	Power windows or locks are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)

Table 144 Power Windows And Locks 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 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 460)	Read display on odometer.	**No** diagnostic trouble codes are active.	If the power windows or locks are inoper-ative, some diagnostic code should be logged. Replace door pod.	Go to next step.
4.	On	Check for power window or lock diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 460)	Read display on odometer.	Power window or locks diagnostic trouble codes are active.	Go to power windows and locks fault detection management. (See FAULT DETECTION MANAGEMENT, page 462)	Other DTC's are present. Go to the section on this manual associated with the DTC. If no DTCs, go to next step.
5.	On	Check for RKE transmitter power lock operating incorrectly.	RKE	Power locks.	Go to SERVICE PROCEDURE RKE TRANSMITTERS (See SERVICE PROCEDURE RKE TRANSMITTERS, page 461)	Replace RKE. Program new RKE.

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 145 Front Doors Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
625 14 130 0	Driver side front door pod not communicating with ESC.
625 14 130 7	Driver side front window motor failure
625 14 130 8	Driver side front door lock motor failure
625 14 130 9	Driver side front door pod failure
625 14 64 0	Passenger side front door pod not communicating with ESC.
625 14 64 7	Passenger side front window motor failure
625 14 64 8	Passenger side front door lock motor failure
625 14 64 9	Passenger side front door pod failure

4.3. SERVICE PROCEDURE RKE TRANSMITTERS

Replacement Key Fobs/Transmitters can be obtained from Service Parts by ordering part number 3544938C2.

Transmitter Learning And Erasing

Before the transmitter can be used for the first time, it has to be "learned" by the receiver. Up to 6 transmitters with different identification codes can be learned by a single RKE Pod.

These procedures are designed for manual learning/erasing operations on a complete vehicle. They can be used for learning replacement transmitters, for using up to six transmitters for accessing the same vehicle, or for accessing any number of vehicles using the same transmitter. If RKE is being added to the vehicle, additional programming of the Electrical System Controller is required to operate the horn, panic, and dome light functions with RKE.

Procedure For Erasing All Learned Transmitters

1. Cycle the Ignition from Off to On. Step 2. must be initiated (all four buttons pressed) within 10 seconds of this Ignition event.

2. On the Driver Door Pod do the following:

   While holding down the Driver Window-Up, Driver Window-Down, and Unlock Switches depress and hold the Lock switch. All four switches must be held for at least 5 seconds. 6 or 7 seconds is recommended. After the 5 seconds the Door Pod RKE unit will erase all learned transmitters and the RKE will be disabled. At this point the erase procedure is finished and a new Ignition cycle must be initiated to perform any transmitter learning.

Procedure For Learning A Transmitter

NOTE – This learning procedure cannot be performed during the same Ignition cycle as the "erase all learned transmitters" procedure. If necessary, the erase procedure should be completed before this procedure is started.

3. Cycle the Ignition from Off to On (leaving the Ignition on will not work, it must be cycled). Step 4. must be initiated (all four buttons pressed) within 10 seconds of this Ignition event.

4. On the Passenger Door Pod do the following:

   While holding down the Window-Up, Window-Down, and Unlock switches, depress and hold the Lock switch. All four switches must be held for at least 5 seconds. 6 or 7 seconds is recommended.

5. After the 5 seconds the Door Pod RKE unit will enter "Learn Mode" and stay there for 10 seconds (or until a transmitter is learned). Once the RKE enters the "Learn Mode", the four buttons can be released. During the ten second "Learn Mode" any function on the new FOB/transmitter must be keyed at least twice (See Note 1).

   NOTE – 1. After the transmitter is learned the next keying of the new transmitter will perform the indicated function. It is recommended that the transmitter be successively keyed until the selected key's function is actually performed; i.e., pressing the Lock Button on the transmitter two times should learn its code, on the third push it should lock the door and momentarily beep the city horn. This is a good way to quickly confirm the success of the learning.

   NOTE – 2. Steps 1. through 5. of the learning process must be repeated for each transmitter to be learned.

4.4. 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 EZ-Tech running the "INTUNE" diagnostic software can be used to activate the power windows and locks and to monitor window and lock activation requests from the pods. See the diagnostic software manual for details on using the software.

Problems with the power window and lock systems will be apparent when the windows, locks, pod backlights or remote keyless entry (RKE) are inoperative.

Inoperative power windows or locks could be attributed to an open or short in the switch data link, a faulty door pod, missing power or ground to a door pod, open or shorted circuits, or a malfunctioning power window motor or lock motor.

The ESC will also log active and history diagnostic trouble codes when a window motor fails, a lock motor fails, or the pod fails.

Refer to Front Power Window And Lock Circuits And Connectors.

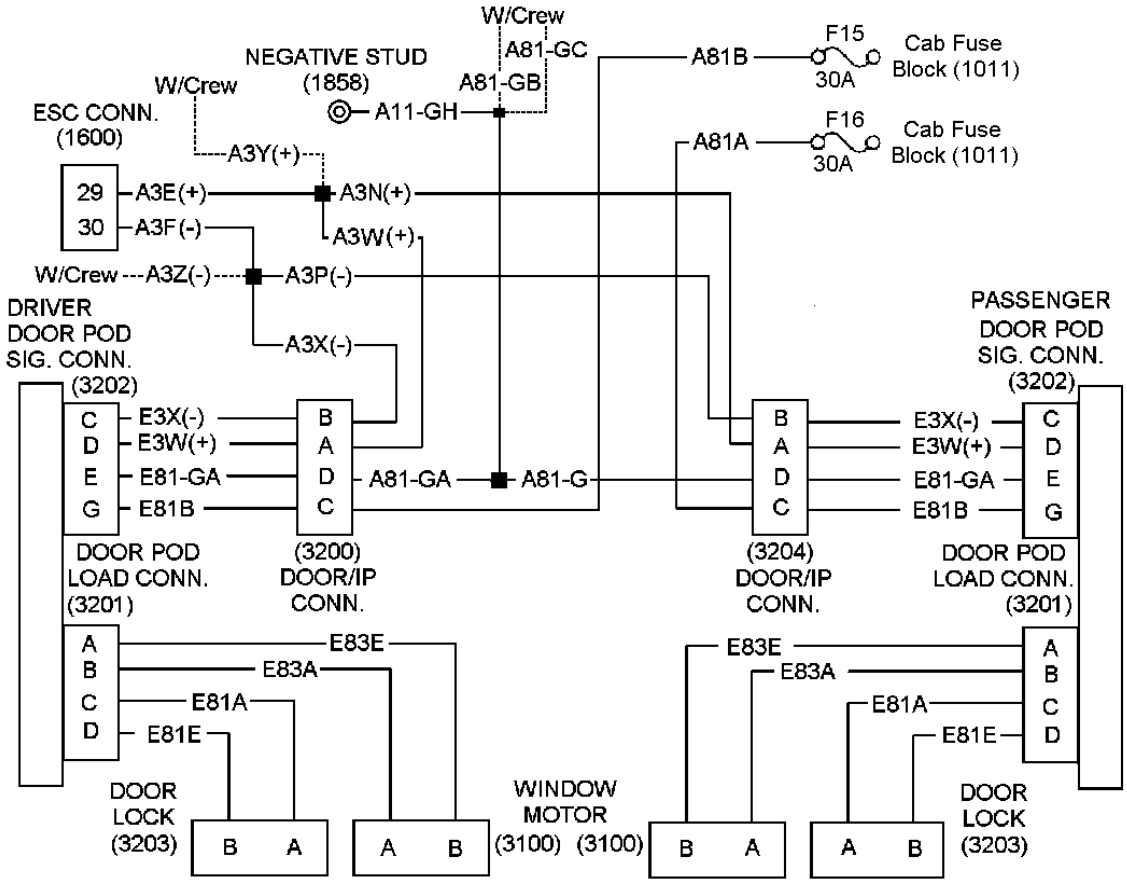

Figure 231 Front Power Window And Lock Circuits (Connectors Viewed From Mating End) — Always Refer To Circuit Diagram Book For Latest Circuit Information

(1600) 36 WAY SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1850) GROUND STUD
LOCATED IN CAB
(3200) 6 WAY DRIVER DOOR CONNECTOR
LOCATED IN INSTRUMENT PANEL NEAR DRIVER “A” PILLAR
(3202) 7 WAY DRIVER DOOR POD CONNECTOR
ON BOTTOM OF DOOR POD
(3201) 4 WAY DRIVER DOOR POD LOAD CONNECTOR
ON BOTTOM OF DOOR POD
(3203) 2 WAY DRIVER DOOR LOCK MOTOR CONNECTOR
AT DOOR LOCK MOTOR
(3100) 2 WAY DRIVER DOOR WINDOW MOTOR CONNECTOR
AT WINDOW MOTOR
(3204) 6 WAY PASSENGER DOOR CONNECTOR
LOCATED IN INSTRUMENT PANEL NEAR PASSENGER “A” PILLAR
F15 30 AMP FUSE FOR DRIVER DOOR POD (LOCATED IN CAB FUSE PANEL)
F16 30 AMP FUSE FOR PASSENGER DOOR POD (LOCATED IN CAB FUSE PANEL)

Table 146 Front Doors Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
625 14 130 0	Driver side front door pod not communicating with ESC.
The door pod is not communicating on the data link. Fault could be attributed to lack of power to pod, data link problems or bad connection to data link.	
625 14 130 7	Driver side front window motor failure
An open or short window motor circuit or defective window motor is setting the code	
625 14 130 8	Driver side front door lock motor failure
An open or short door lock motor circuit or defective door lock motor is setting the code	
625 14 130 9	Driver side front door pod failure
The door pod has an internal failure. The pod must be replaced.	
625 14 64 0	Passenger side front door pod not communicating with ESC.
The door pod is not communicating on the data link and is setting the code. Fault could be attributed to lack of power to pod, data link problems or bad connection to data link.	
625 14 64 7	Passenger side front window motor failure
An open or short window motor circuit or defective window motor is setting the code	
625 14 64 8	Passenger side front door lock motor failure
An open or short door lock motor circuit or defective door lock motor is setting the code	
625 14 64 9	Passenger side front door pod failure
The door pod has an internal failure. The pod must be replaced.	

Table 147 Driver Side Door Pod Connector Tests

Door Pod Signal Harness Connector (3202) Voltage Checks This test assumes there is power to fuse F15 from the maxi fuse and fuse is not blown. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
Pin G to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse or open or short in circuits E81B or A81B to fuse block.
Pin E to G	12 ± 1.5 volts	If voltage is missing, check for open circuit E81–GA, A81–GA or A11–GH to negative stud (1858). If voltage is present, power to door pod is good.
Pin D to ground	Approximately 4 volts	(+) data link circuit. If voltage is low check for open in circuit E3W(+), A3W(+) or A3E(+).
Pin C to ground	Approximately .4 volts	(-) data link circuit. If voltage is low check for open in circuit E3X(-), A3X(-) or A3F(-). If voltage is high check for crossed data link wires. If power and data link circuits check good and DTC is still present, replace door pod.

Table 148 Driver Side Door Power Window Connector Tests

Door Window Motor Connector (3100) Voltage Checks (Check At Window Motor Harness Connector) This test assumes the voltages on door pod signal harness connector (3202) are correct and (3202) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing window down button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.
With ignition on, while pushing window up button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.

Table 149 Driver Side Door Lock Connector Tests

Door Lock Motor Connector (3203) Voltage Checks (Check At Door Lock Harness Connector) This test assumes the voltages on door pod signal harness connector (3202) are correct and (3202) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing unlock button, cavity A to B.	Momentary ± 12 ± 1.5 volts	The door pod supplies a short duration pulse to the lock. This is very difficult to measure. Try using the “hold” feature of the meter or watch for a jump on the analog display. If voltage is missing, replace door pod If voltage is present, bench check lock motor before replacing. Insure lock failure is not mechanical.

Table 150 Passenger Side Door Pod Connector Tests

Door Pod Signal Harness Connector (3202) Voltage Checks This test assumes there is power to fuse F16 from the maxi fuse and fuse is not blown. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
Pin G to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse or open or short in circuits E81B or A81A to fuse block.
Pin E to G	12 ± 1.5 volts	If voltage is missing, check for open circuit E81–GA, A81–G or A11–GH to negative stud (1858). If voltage is present, power to door pod is good.
Pin D to ground	Approximately 4 volts	(+) data link circuit. If voltage is low check for open in circuit E3W(+), A3N(+) or A3E(+).
Pin C to ground	Approximately .4 volts	(-) data link circuit. If voltage is low check for open in circuit E3X(-), A3P(-) or A3F(-). If voltage is high check for crossed data link wires. If power and data link circuits check good and DTC is still present, replace door pod.

Table 151 Passenger Side Door Power Window Connector Tests

Door Window Motor Connector (3100) Voltage Checks (Check At Window Motor Harness Connector) This test assumes the voltages on door pod signal harness connector (3202) are correct and (3202) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing window down button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.
With ignition on, while pushing window up button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.

Table 152 Passenger Side Door Lock Connector Tests

Door Lock Motor Connector (3203) Voltage Checks (Check At Door Lock Harness Connector) This test assumes the voltages on door pod signal harness connector (3202) are correct and (3202) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing unlock button, cavity A to B.	Momentary ± 12 ± 1.5 volts	The door pod supplies a short duration pulse to the lock. This is very difficult to measure. Try using the “hold” feature of the meter or watch for a jump on the analog display. If voltage is missing, replace door pod If voltage is present, bench check lock motor before replacing. Insure lock failure is not mechanical.

4.5. EXTENDED DESCRIPTION

Driver Side Power Window and Lock

The switch data link is connected to driver side pod signal connector (3202) terminal D and C. The circuit path from the ESC connector (1600) is on twisted pair A3F(-)/A3E(+), to circuits A3X(-)/A3W(+), through door/IP connector (3200) terminals B and A, to circuits E3X(-) and E3W(+).

Battery voltage to the driver side pod signal connector (3202) terminal G is provided from fuse block (1011), F15. The circuit path from the fuse block is circuit A81B, through door/IP connector (3200) terminal C, and E81B.

System ground to the driver side pod signal connector (3202) terminal E is provided from negative stud (1858). The circuit path from the negative stud is circuit A11–GH, A81–GA, through driver door pod (3200) terminal D, and E81–GA.

Control voltage to driver window motor (3100) terminals A and B is supplied from driver pod load connector (3201) terminals B and A on circuits E83A and E83E.

Control voltage to driver power lock (3203) terminals A and B is supplied from driver pod load connector (3201) terminals C and D on circuits E81A and E81E.

Pressing the power window button will cause the pod to apply voltage to the power window motor until the motor reaches its mechanical limit. Pressing the passenger side power window button on the driver pod will cause the pod to send a message on the switch data link commanding the passenger pod to apply voltage to the window motor.

Pressing the power lock button will cause the pod to momentarily apply voltage to the power lock motor in the driver door. The pod will also sends a message on the switch data link commanding the pods in the other door(s) with power locks to apply voltage to their lock motor.

Passenger side

The switch data link is connected to passenger side pod signal connector (3202) terminal D and C. The circuit path from the ESC connector (1600) is on twisted pair A3F(-)/A3E(+), to circuits A3P(-)/A3N(+), through door/IP connector (3204) terminals B and A, to circuits E3X(-) and E3W(+).

Battery voltage to the passenger side pod signal connector (3202) terminal G is provided from fuse block (1011), F16. The circuit path from the fuse block is circuit A81A, through passenger door pod (3204) terminal C, and E81B.

System ground to the passenger side pod signal connector (3202) terminal E is provided from negative stud (1858). The circuit path from the negative stud is circuit A11–GH, A81–G, through passenger door pod (3204) terminal D, and E81–GA.

Control voltage to passenger window motor (3100) terminals A and B is supplied from passenger pod load connector (3201) on circuits E83A and E83E.

Control voltage to driver power lock (3203) terminals A and B is supplied from driver pod load connector (3201) terminals C and D on circuits E81A and E81E.

Pressing the power window button will cause the pod to apply voltage to the power window motor until the motor reaches it’s mechanical limit.

Pressing the power lock button will cause the pod to momentarily apply voltage to the power lock motor in the passenger door. The pod will also send a message on the switch data link, commanding the pods in the other door(s) to apply voltage to their lock motor.

4.6. COMPONENT LOCATIONS

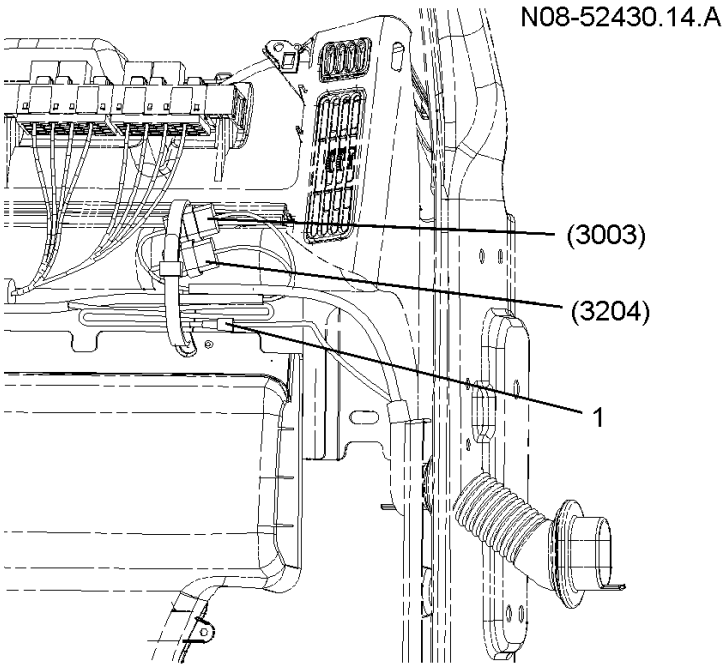

Figure 232 Door Harness Connections (Passengers Side Shown)

(3204) POWER MIRROR CONNECTOR
(3003) POWER DOOR CONNECTOR
1. CB ANTENNA CONNECTOR

N08-52388.01

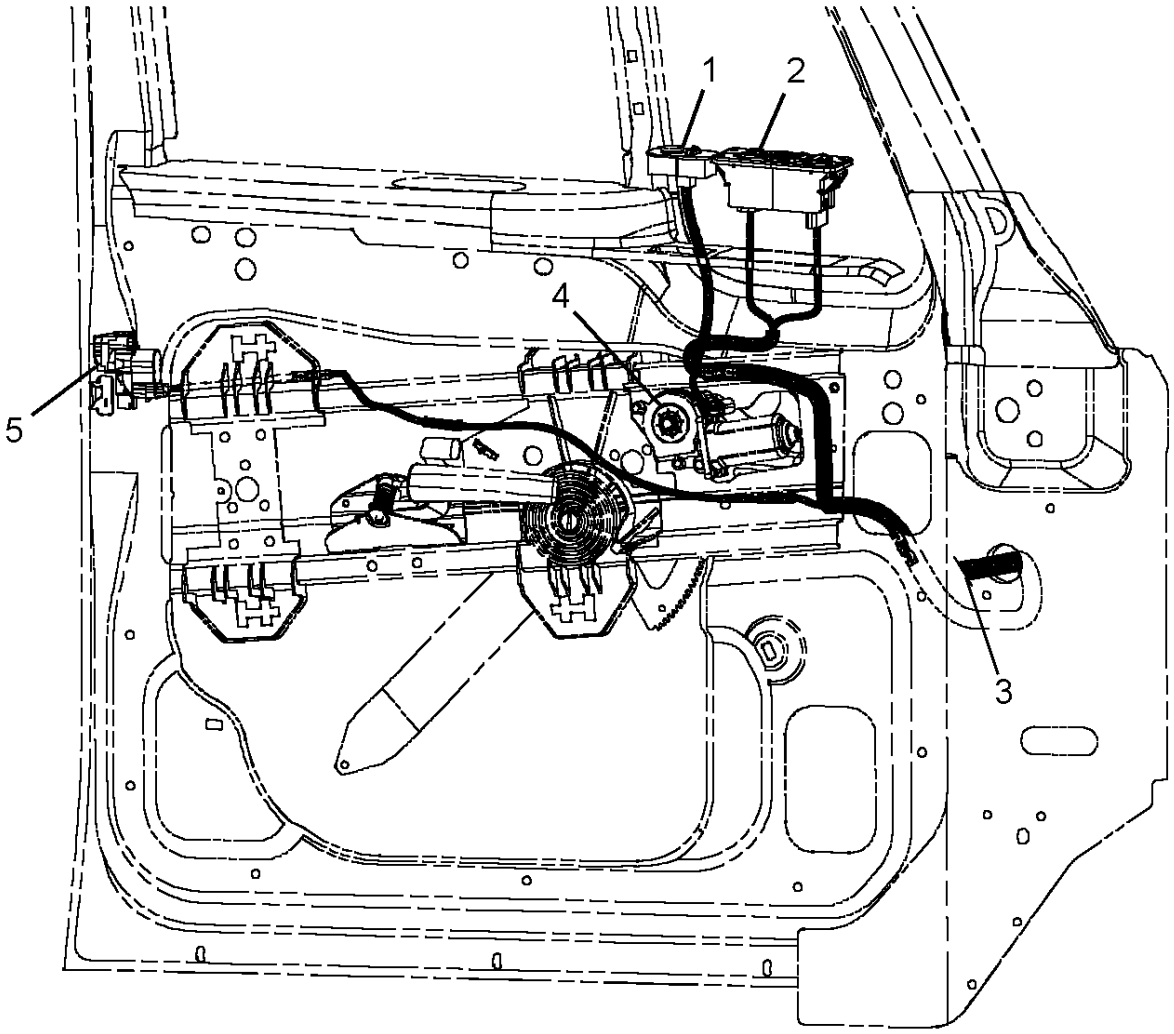

Figure 233 Power Window and Lock Wiring (Drivers Side Shown)

1. POWER MIRROR CONTROL (ONLY ON DRIVERS DOOR)
2. DOOR POD
3. DOOR HARNESS TO DOOR CONNECTOR
4. POWER WINDOW MOTOR
5. POWER LOCK MOTOR

5. CREW DOORS WINDOWS AND LOCKS, TRAVEL CREW (POWER)

5.1. CIRCUIT FUNCTIONS

Refer to Crew Doors Power Windows and Locks, Travel Crew Function Diagram.

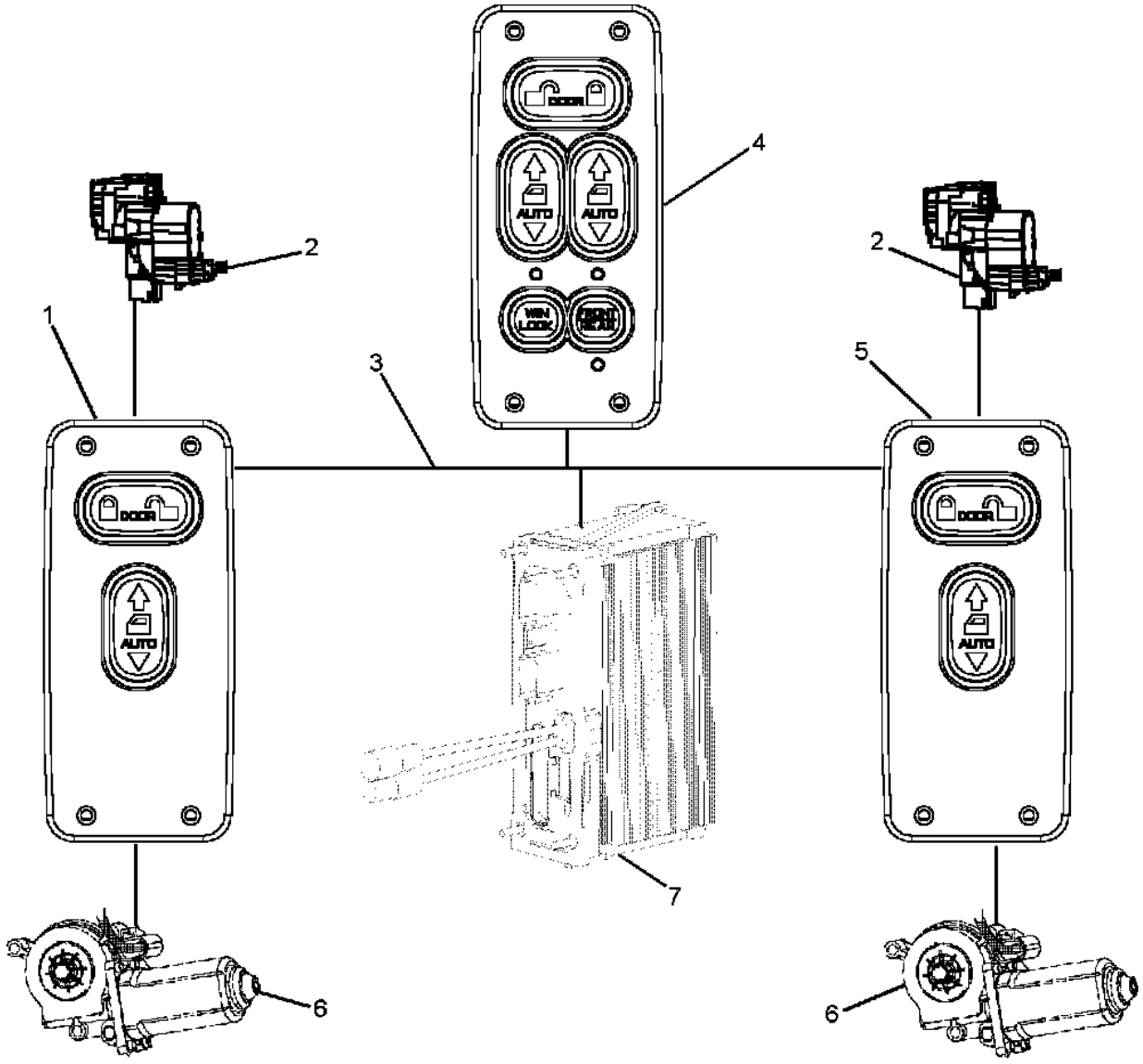

Figure 234 Crew Doors Power Windows and Locks, Travel Crew Function Diagram

1. REAR DRIVERS SIDE CREW DOOR POD
2. POWER LOCK MOTOR
3. SWITCH DATA LINK
4. DRIVER DOOR POD
5. REAR PASSENGER SIDE CREW DOOR POD
6. POWER WINDOW MOTOR
7. ELECTRICAL SYSTEM CONTROLLER (ESC)

The door pod on each door houses the switches and contains the electronics required to control the rear power windows and locks.

The door pods communicate with each other and the ESC on the switch data link. This allows all pods to control all locks.

The door pods will wait for an “ignition on” message to be transmitted from the ESC on the switch data link before they allow the power windows to operate.

The ESC will also send commands to the pod to control the pod back lighting.

5.2. DIAGNOSTICS

Failures in the rear power windows and locks system are apparent when the rear power windows or locks do not operate correctly. The ESC will log a diagnostic trouble code (DTC) when there is a window motor failure, a lock motor failure or a door pod failure.

A problem with either power window or lock operation in an individual door could be attributed to an open or short in circuits between a door pod and the window or lock motor. The problem could also be attributed to a failure in the door pod, the window motor or the lock motor.

A problem with both power window and lock operation in an individual door could be attributed to an open or short in power or ground circuits to a door pod or a failure in the door pod.

When locks or windows in one door do not operate correctly from a door pod in another door, the problem may be in either door pod or in the switch data link between the pods.

The door pods may be swapped from side to side in order to isolate internal door pod failures. Do not swap the driver door pod from front to back.

Rear Power Windows And Locks Preliminary Check

Table 153 Rear Power Windows And Locks Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify power windows or locks are operating incorrectly.	Visually check power windows or locks	Power windows or locks are operating incorrectly.	Go to next step.	Power windows or locks are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or 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 153 Rear Power Windows And Locks Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 473)	Read display on odometer.	**No** diagnostic trouble codes are active.	If the power windows or locks are inoperative, some diagnostic code should be logged. Replace door pod.	Go to next step.
4.	On	Check for power window or lock diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 473)	Read display on odometer .	Power window or locks diagnostic trouble codes are active.	Go to power window or locks fault detection manage- ment. (See FAULT DETECTION MANAGEMENT, page 474)	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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 154 Rear Doors Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
625 14 66 0	Driver side rear door pod not communicating with ESC.
625 14 66 7	Driver side rear window motor failure
625 14 66 8	Driver side rear door lock motor failure
625 14 66 9	Driver side rear door pod failure
625 14 65 0	Passenger side rear door pod not communicating with ESC.
625 14 65 7	Passenger side rear window motor failure
625 14 65 8	Passenger side rear door lock motor failure
625 14 65 9	Passenger side rear door pod failure

5.3. FAULT DETECTION MANAGEMENT

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

The EZ-Tech running the "INTUNE" diagnostic software can be used to manipulate the power windows and locks. See the diagnostic software manual for details on using the software.

Problems with the power window and lock systems will be apparent when the windows, locks, pod backlights or remote keyless entry are inoperative.

An inoperative power window or lock could be attributed to an open or short in the switch data link, faulty door pods, missing power or ground to a door pod, open or shorted circuits, or a malfunctioning power window motor or lock motor.

The ESC will also log active and history diagnostic trouble codes when a window motor fails, a lock motor fails, or the pod fails to communicate on the switch data link.

Refer to crew door pod circuits and connectors.

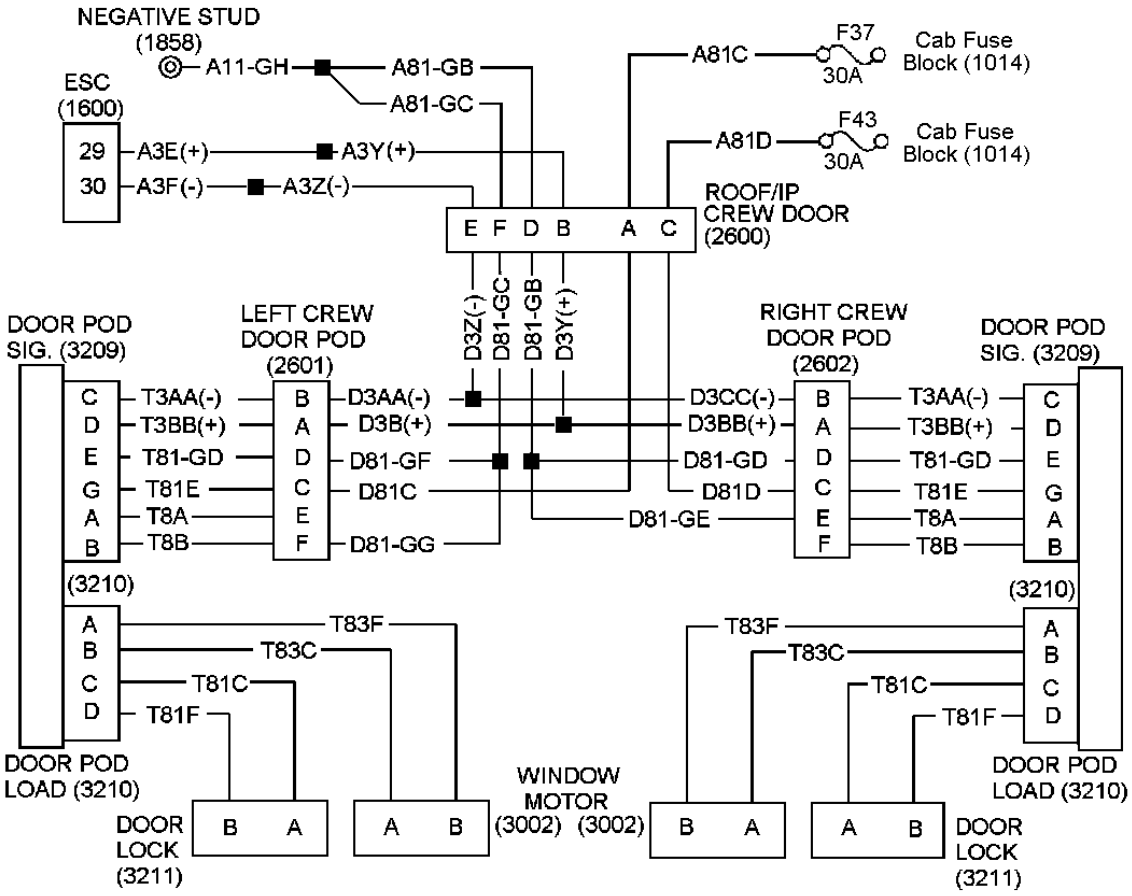

Figure 235 CREW REAR DOOR POD CIRCUITS AND CONNECTORS

(1600) 36 WAY SYSTEM CONTROLLER CONNECTOR.
(1858) GROUND STUD
(2600) ROOF/IP CREW DOOR CONNECTOR
(2601) 6 WAY LEFT CREW DOOR POD CONNECTOR
(3209) 7 WAY DOOR POD SIGNAL CONNECTOR
(3210) 4 WAY DOOR POD LOAD CONNECTOR
(3211) 2 WAY DOOR LOCK MOTOR CONNECTOR
(3002) 2 WAY WINDOW MOTOR CONNECTOR
(2602) 6 WAY RIGHT CREW DOOR POD CONNECTOR
F37 30 AMP FUSE FOR LEFT DOOR POD (LOCATED IN CAB FUSE PANEL)
F43 30 AMP FUSE FOR RIGHT DOOR POD (LOCATED IN CAB FUSE PANEL)

Table 155 Rear Doors Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
625 14 66 0	Driver side rear door pod not communicating with ESC.
The door pod is not communicating on the data link and is setting the code. Fault could be attributed to lack of power to pod, data link problems or bad connection to data link.	
625 14 66 7	Driver side rear window motor failure
An open or short window motor circuit or defective window motor is setting the code	
625 14 66 8	Driver side rear door lock motor failure
An open or short door lock motor circuit or defective door lock motor is setting the code	
625 14 66 9	Driver side rear door pod failure
The door pod has an internal failure and must be replaced.	
625 14 65 0	Passenger side rear door pod not communicating with ESC.
The door pod is not communicating on the data link and is setting the code. Fault could be attributed to lack of power to pod, data link problems or bad connection to data link.	
625 14 65 7	Passenger side rear window motor failure
An open or short window motor circuit or defective window motor is setting the code	
625 14 65 8	Passenger side rear door lock motor failure
An open or short door lock motor circuit or defective door lock motor is setting the code	
625 14 65 9	Passenger side rear door pod failure
The door pod has an internal failure and must be replaced.	

Table 156 Driver Side Rear Door Pod Connector Tests

Door Pod Signal Harness Connector (3209) Voltage Checks

This test assumes there is power to fuse F37 from the maxi fuse and fuse is not blown.

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

Test Points	Spec.	Comments
Pin G to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse or open or short in circuits T81E, D81C or A81C to fuse block.
Pin E to G	12 ± 1.5 volts	If voltage is missing, check for open circuit T81–GD, D81–GF, D81–GC, A81–GC or A11–GH to negative stud (1858).
Pin D to ground	Approximately 4 volts	(+) data link circuit. If voltage is low check for open in circuit T3BB(+), D3B(+), D3Y(+), A3Y(+) or A3E(+).
Pin C to ground	Approximately .4 volts	(-) data link circuit. If voltage is low check for open in circuit T3AA(-), D3AA(-), D3Z(-), A3Z(-) or A3F(-). If voltage is high check for crossed data link wires.

Table 157 Driver Side Rear Door Power Window Connector Tests

Door Window Motor Connector (3002) Voltage Checks (Check At Window Motor Harness Connector) This test assumes the voltages on door pod signal harness connector (3209) are correct and (3209) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing window down button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.
With ignition on, while pushing window up button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.

Table 158 Driver Side Rear Door Lock Connector Tests

Door Lock Motor Connector (3211) Voltage Checks (Check At Door Lock Harness Connector) This test assumes the voltages on door pod signal harness connector (3209) are correct and (3209) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing unlock button, cavity A to B.	Momentary ± 12 ± 1.5 volts	The door pod supplies a short duration pulse to the lock. This is very difficult to measure. Try using the “hold” feature of the meter or watch for a jump on the analog display. If voltage is missing, replace door pod If voltage is present, bench check lock motor before replacing. Insure lock failure is not mechanical.

Table 159 Passenger Side Rear Door Pod Connector Tests

Door Pod Signal Harness Connector (3209) Voltage Checks This test assumes there is power to fuse F43 from the maxi fuse and fuse is not blown. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
Pin G to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse or open or short in circuits T81E, D81D or A81D to fuse block.
Pin E to G	12 ± 1.5 volts	If voltage is missing, check for open circuit T81–GB, D81–GD, D81–GB, A81–GB or A11–GH to negative stud (1858).
Pin D to ground	Approximately 4 volts	(+) data link circuit. If voltage is low check for open in circuit T3BB(+), D3BB(+), D3Y(+), A3Y(+) or A3E(+).
Pin C to ground	Approximately .4 volts	(-) data link circuit. If voltage is low check for open in circuit T3AA(-), D3CC(-), D3Z(-), A3Z(-) or A3Z(-). If voltage is high check for crossed data link wires.

Table 160 Passenger Side Rear Door Power Window Connector Tests

Door Window Motor Connector (3002) Voltage Checks (Check At Window Motor Harness Connector) This test assumes the voltages on door pod signal harness connector (3209) are correct and (3209) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing window down button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.
With ignition on, while pushing window up button, cavity A to B.	± 12 ± 1.5 volts	If voltage is incorrect, check for missing voltage from pod, missing “ignition on” message from ESC, short or open circuits between motor and pod. If voltage is correct the window motor may need replaced. Bench check motor before replacing. Insure window failure is not mechanical.

Table 161 Passenger Side Rear Door Lock Connector Tests

Door Lock Motor Connector (3211) Voltage Checks (Check At Door Lock Harness Connector) This test assumes the voltages on door pod signal harness connector (3209) are correct and (3209) is connected to the pod. **NOTE – Always check connectors for damage and pushed– in terminals.**		
Test Points	Spec.	Comments
With ignition on, while pushing unlock button, cavity A to B.	Momentary ± 12 ± 1.5 volts	The door pod supplies a short duration pulse to the lock. This is very difficult to measure. Try using the “hold” feature of the meter or watch for a jump on the analog display. If voltage is missing, replace door pod If voltage is present, bench check lock motor before replacing. Insure lock failure is not mechanical.

5.4. EXTENDED DESCRIPTION

Left Side Power Window and Lock

The switch data link is connected to left side pod signal connector (3209) terminal C and D. The circuit path from ESC connector (1600) is on twisted pair A3F(-)/A3E(+), to circuits A3Z(-)/A3Y(+), through roof/IP connector (2600) terminals E and B, to circuits D3Z(-)/D3Y(+) and D3AA(-)/D3B(+), through left crew door pod connector (2601) terminals B and A, to circuits T3AA(-) and T3BB(+).

Battery voltage to the left side pod signal connector (3209) terminal G is provided from fuse block (1014), F37. The circuit path from the fuse block is circuit A81C, through roof/IP connector (2600) terminal A, circuit D81C, through door connector (2601) terminal C, and circuit T81E.

System ground to the left side pod signal connector (3209) terminal E is provided from negative stud (1858). The circuit path from the negative stud is circuit A11–GH, A81–GC, through roof/IP connector (2600) terminal F, circuits D81–GC and D81–GF through left crew door pod connector (2601) terminal D, and circuit T81–GD.

Ground is also supplied to (3209) terminal B on circuit T8B from circuit D81–GG through (2601) terminal F. This sets the addressing for the pod so it identifies itself, to the ESC, as the left crew door pod.

Control voltage to left window motor (3002) terminals A and B is supplied from left pod load connector (3210) terminals B and A on circuits T83C and T83F.

Control voltage to left power door lock (3211) terminals A and B is supplied from pod load connector (3210) terminals C and D on circuits T81C and T81F.

Pressing the door power window button will cause the pod to apply voltage to the power window motor.

Pressing the power lock button will cause the pod to apply voltage to the power lock motor in the left door. The pod will also sends a message on the switch data link commanding the pods in the other door(s) with power locks to apply voltage to their lock motor.

Right Side Power Window and Lock

The switch data link is connected to right side pod signal connector (3209) terminal C and D. The circuit path from ESC connector (1600) is on twisted pair A3F(-)/A3E(+), to circuits A3Z(-)/A3Y(+), through roof/IP connector (2600) terminals E and B, to circuits D3Z(-)/D3Y(+) and D3CC(-)/D3BB(+), through right crew door pod connector (2602) terminals B and A, to circuits T3AA(-) and T3BB(+).

Battery voltage to the right side pod signal connector (3209) terminal G is provided from fuse block (1014), F43. The circuit path from the fuse block is circuit A81D, through roof/IP connector (2600) terminal C, circuit D81D, through door connector (2602) terminal C, and circuit T81E.

System ground to the right side pod signal connector (3209) terminal E is provided from negative stud (1858). The circuit path from the negative stud is circuit A11–GH, A81–GB, through roof/IP connector (2600) terminal D, circuits D81–GB and D81–GD through right crew door pod connector (2602) terminal D, and circuit T81–GD.

Ground is also supplied to (3209) terminal A on circuit T8A from circuit D81–GE through (2602) terminal E. This sets the addressing for the pod so it identifies itself, to the ESC, as the right crew door pod.

Control voltage to right window motor (3002) terminals B and A is supplied from right pod load connector (3210) terminals A and B on circuits T83F and T83C.

Control voltage to right power door lock (3211) terminals A and B is supplied from pod load connector (3210) terminals C and D on circuits T81C and T81F.

Pressing the door power window button will cause the pod to apply voltage to the power window motor.

Pressing the power lock button will cause the pod to apply voltage to the power lock motor in the right door. The pod will also sends a message on the switch data link commanding the pods in the other door(s) with power locks to apply voltage to their lock motor.

5.5. COMPONENT LOCATIONS

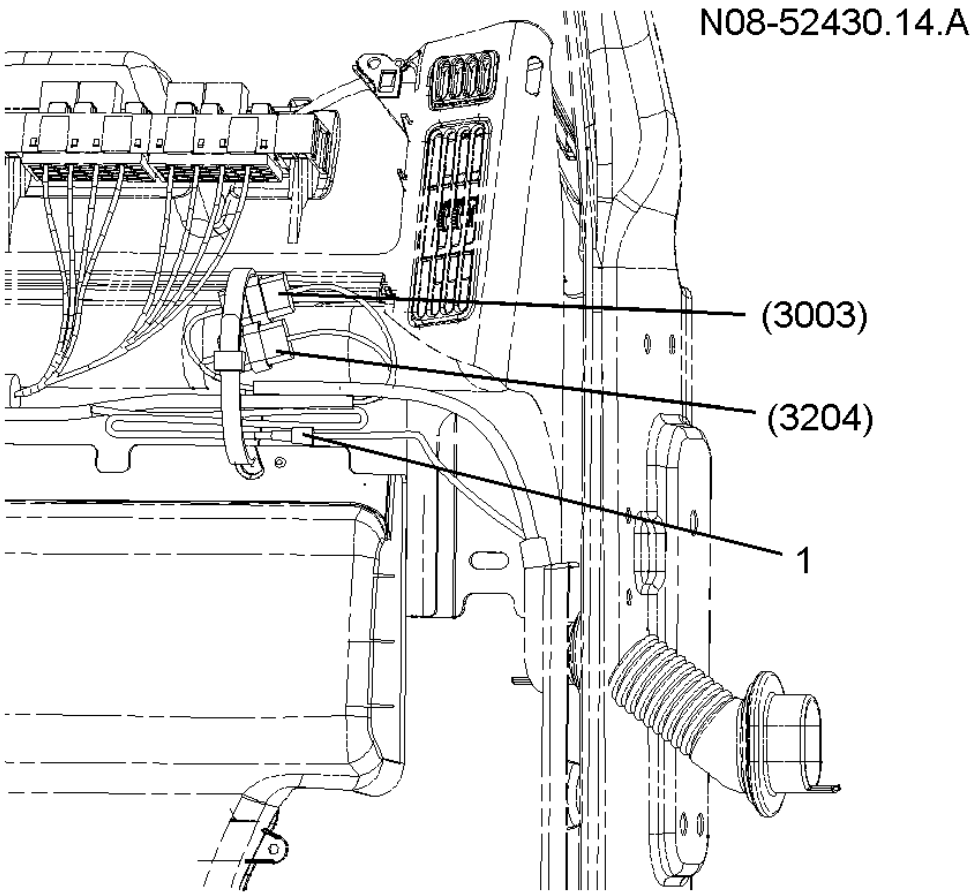

Figure 236 Door Harness Connections (Passengers Side Shown)

1. POWER MIRROR CONNECTOR
2. POWER DOOR CONNECTOR
3. CB ANTENNA CONNECTOR

N08-52388.01

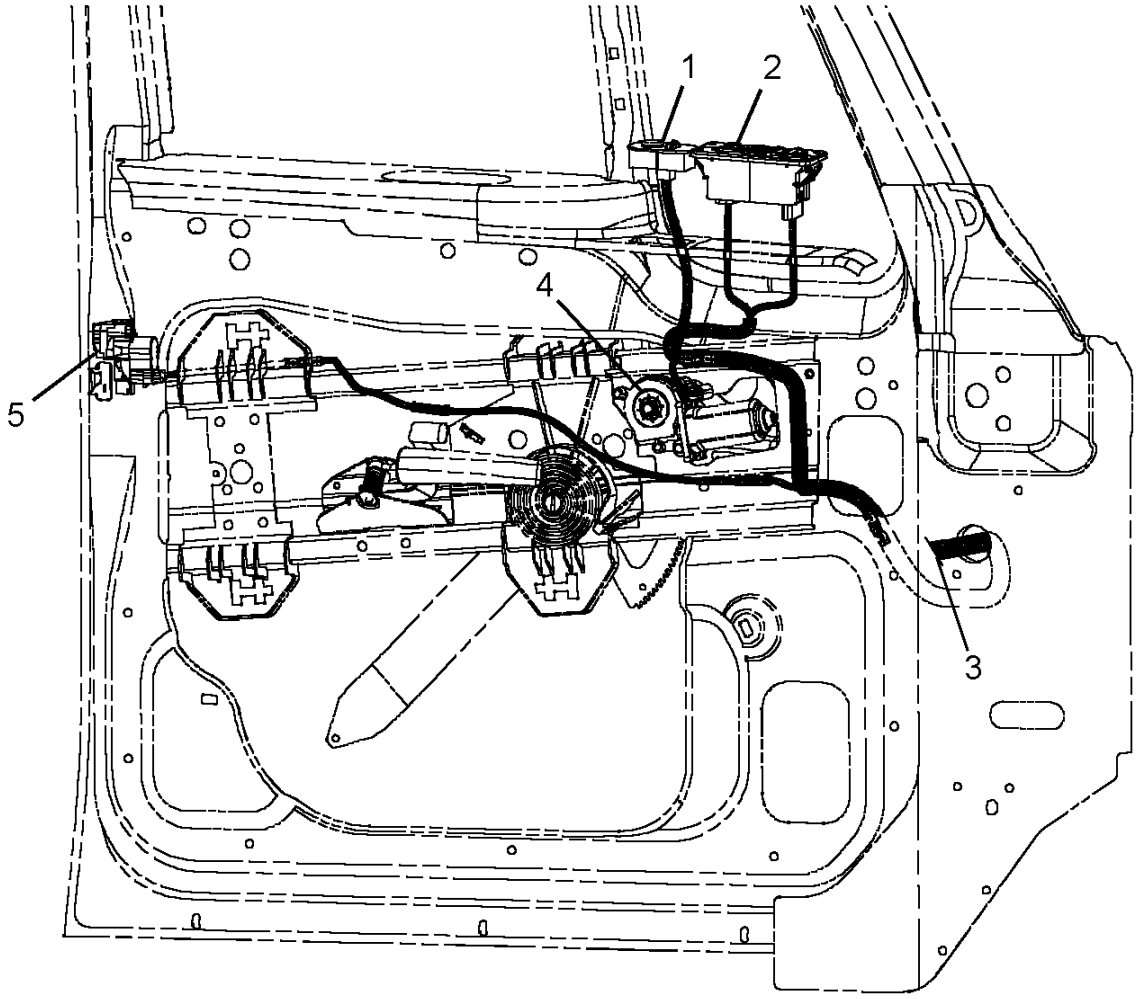

Figure 237 Power Window and Lock Wiring (Drivers Side Shown)

1. POWER MIRROR CONTROL (ONLY ON DRIVERS DOOR)
2. DOOR POD
3. DOOR HARNESS TO DOOR CONNECTOR
4. POWER WINDOW MOTOR
5. POWER LOCK MOTOR

6. CRUISE CONTROL

6.1. CIRCUIT FUNCTION

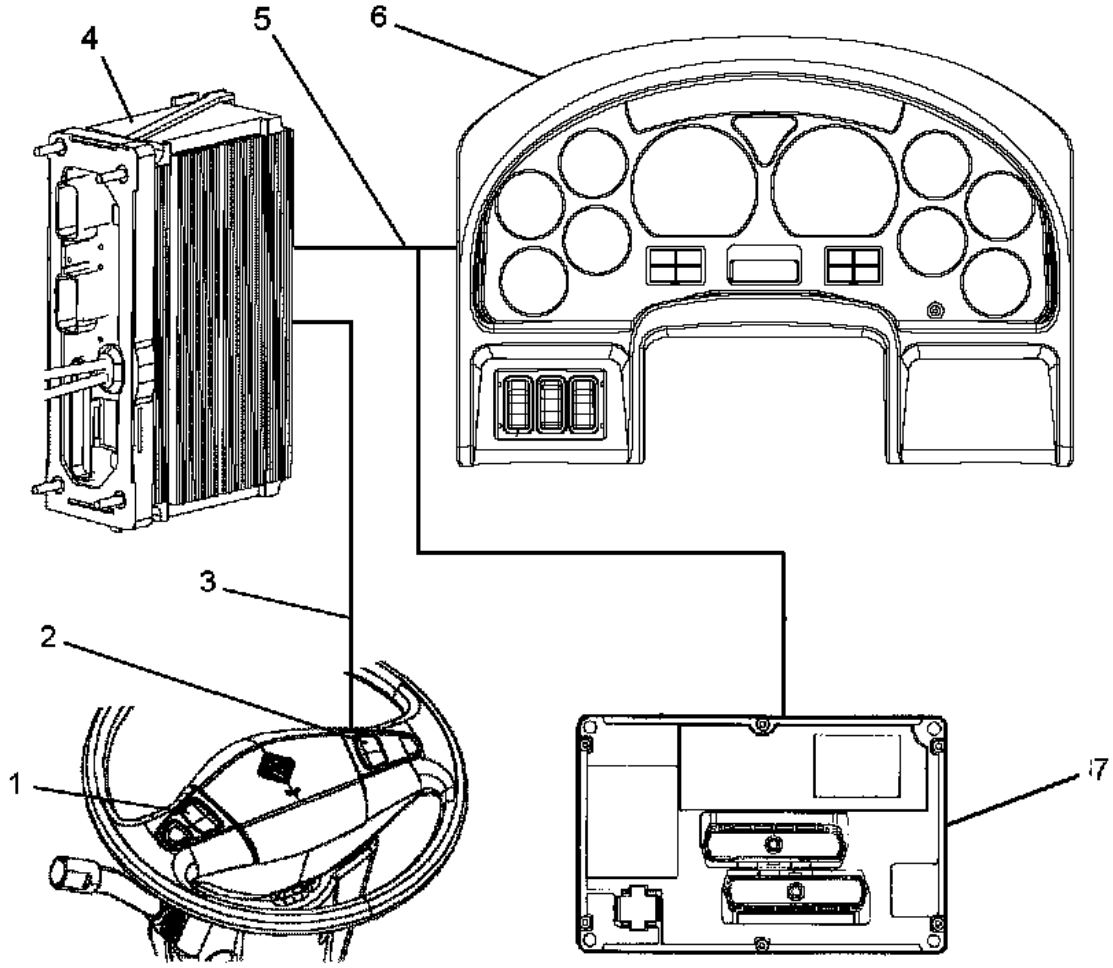

Figure 238 Cruise Control Function Diagram

1. CRUISE ON/OFF SWITCH
2. CRUISE SET/RESUME SWITCH
3. DIRECT CIRCUITS TO ESC
4. ESC
5. DRIVETRAIN 1939 DATA LINK
6. ELECTRONIC GAUGE CLUSTER (EGC)
7. ENGINE CONTROLLER
8. BRAKE AND CLUTCH SWITCH CIRCUITS (NOT SHOWN)

The engine controller activates the cruise control when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC generates this message when it receives input from the cruise control switches on the steering wheel.

The key must be in the accessory or run position for the cruise control to work.

The ESC will command the cruise to be deactivated when the brake or clutch is activated.

The ESC will also command the cruise to be deactivated when a brake or clutch switch DTC is set or an ABS or traction control event has occurred.

See the engine diagnostic manual for detailed information on troubleshooting cruise control problems not related to the truck circuits.

6.2. DIAGNOSTICS

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to illuminate all of the warning lamps and monitor inputs to the ESC from the cruise control switches on the steering wheel.

The EGC cannot be put in diagnostic mode when there is a fault in these circuits. The INTUNE software must be used to view this DTC.

Faults in the brake, clutch, ABS and drivetrain data link will set DTC's and will effect cruise control operation.

Table 162 Cruise Control Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On, with engine running	Verify cruise control is inoperative. Insure the brake and clutch are released, there are no active brake or clutch DTC's and no ABS/ATC events.	Test cruise control.	Cruise control is inoperative.	Go to next step.	Cruise control is operating. Problem does not exist or is intermittent.
2.	On, with engine off	Determine if any other 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	Connect diagnostic tool (EZ-Tech) to the diagnostic connector. Turn key to ignition position. Start the "INTUNE" diagnostic software. Verify operation of the cruise control switch input to ESC.		INTUNE software shows switches are operating.	Cruise switches are working. Go to next step.	Go to Cruise Switch Fault Detection/ Management. (See CRUISE SWITCH FAULT DETECTION/ MANAGEMENT, page 485)

Table 162 Cruise Control Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
4.	On	Use the "INTUNE" diagnostic software to verify the brake or clutch switches are not active inputs to the ESC.		INTUNE software shows switches are not active.	Brake and clutch switches are not disabling cruise control.	Go to Cruise Switch Fault Detection/ Management. (See CRUISE SWITCH FAULT DETECTION/ MANAGEMENT, page 485)
5.	On	Use "INTUNE" diagnostic software to verify cruise commands from the ESC to the engine controller.		Cruise commands are being generated by the ESC.	Go to next step.	Message from ESC is not being transmitted. Consider replacing ESC. (See INDIVIDUAL SWITCHES, page 129)
6.	On	ESC is processing switch inputs and generating cruise commands to the engine controller. Refer to the engine troubleshooting manual for the engine installed in the vehicle.				

6.3. CRUISE SWITCH FAULT DETECTION/ MANAGEMENT

Refer to Cruise Switch Circuits

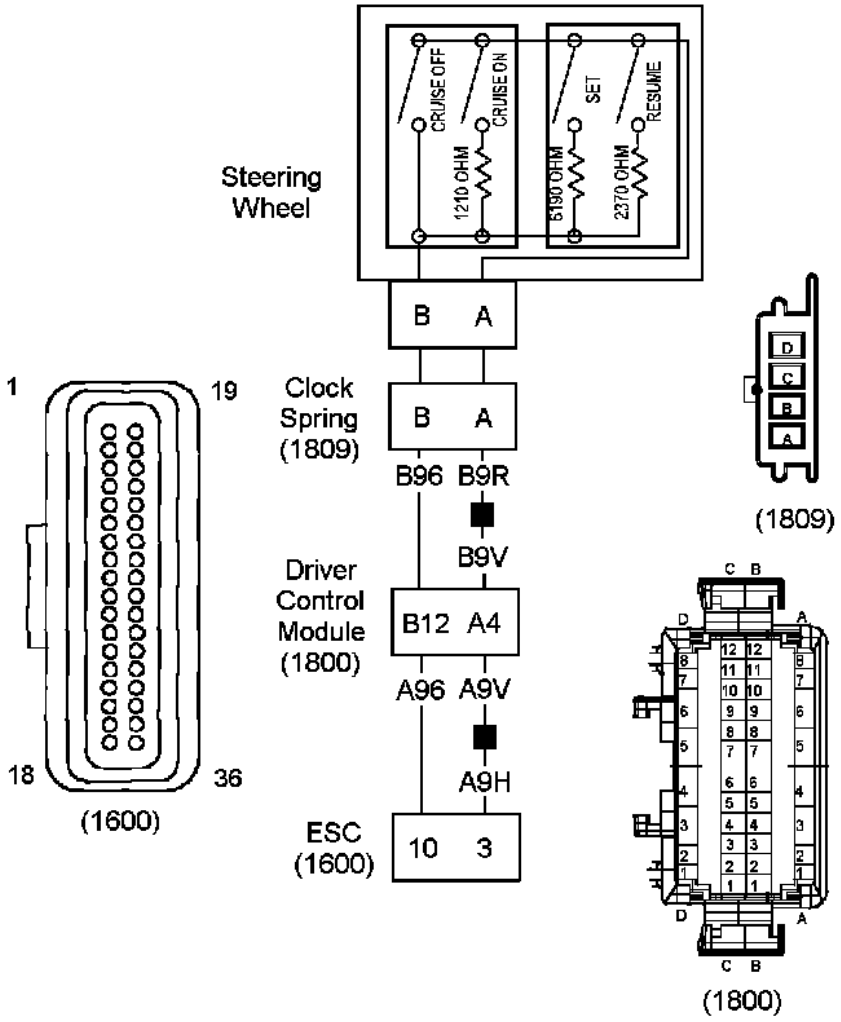

Figure 239 Cruise Switch Circuits—Always refer to Circuit Diagram Book for Latest Circuit Information

(1600) SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN
(1809) CLOCK SPRING CONNECTOR
LOCATED IN STEERING COLUMN

Table 163 Cruise Control Switch Voltage Tests

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 5 1	Analog cruise switch out of range low Shorted to ground or open circuit
612 14 5 2	Analog cruise switch out of range high Shorted high

Cruise Control Switch Voltage Checks

Remove horn switch cover.

Check with ignition key on and steering wheel switch connector removed.

NOTE – Voltage to the switch will be approximately 5 volts with the key off.

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

Steering wheel switch harness connector cavity B to ground.	12 ± 1.5 volts.	If voltage is incorrect, check for open or short in clock spring or circuits to ESC connector (1600) pin 10. Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin B to B. Repair or replace circuits.
Steering wheel switch harness connector cavity A to B.	12 ± 1.5 volts.	If voltage is incorrect, check for open in clock spring or circuits to ESC connector (1600) pin 3. Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin A to A. Repair or replace circuits.

If voltage is correct the circuits between the ESC and the cruise switches are functioning properly. Check switch resistances.

If voltage is incorrect and there are no open or shorted circuits the ESC may need replaced.

Cruise Control Switch Resistance Checks

Check with ignition key off and steering wheel switch connector removed.

Test Points	Spec.	Comments
Steering wheel switch connector cavity A to B, no switches pushed.	>100K ohms.	If resistance is incorrect there is a short in one of the switches.
Steering wheel switch connector cavity A to B, resume switch pushed.	2.4K ± 470 ohms.	If resistance is incorrect replace the set/resume switch.
Steering wheel switch connector cavity A to B, set switch pushed.	6.2K ± 1200 ohms.	If resistance is incorrect replace the set/resume switch.

Table 163 Cruise Control Switch Voltage Tests (cont.)

Steering wheel switch connector cavity A to B, cruise on switch pushed.	1.2K ± 250 ohms.	If resistance is incorrect replace the on/off switch.
Steering wheel switch connector cavity A to B, cruise off switch pushed.	<2 ohms.	If resistance is incorrect replace the on/off switch. If all resistances check good the switches are functioning properly.

6.4. EXTENDED DESCRIPTION

The zero volt reference level from ESC connector (1600) pin 3 is supplied to steering wheel switch connector pin A.

Battery voltage from ESC connector (1600) pin 10 is supplied to steering wheel switch connector pin B.

Each cruise control switch is connected to a resistor with a different resistance. The switch and resistor are connected in parallel with the other switches and resistors. When a switch is pressed the ESC will sense the voltage drop across the switch and the resistor. This will signal the ESC to generate the appropriate cruise commands to the engine controller.

7. ELECTRIC HORNS

7.1. CIRCUIT FUNCTIONS

Refer to electric horn function diagram.

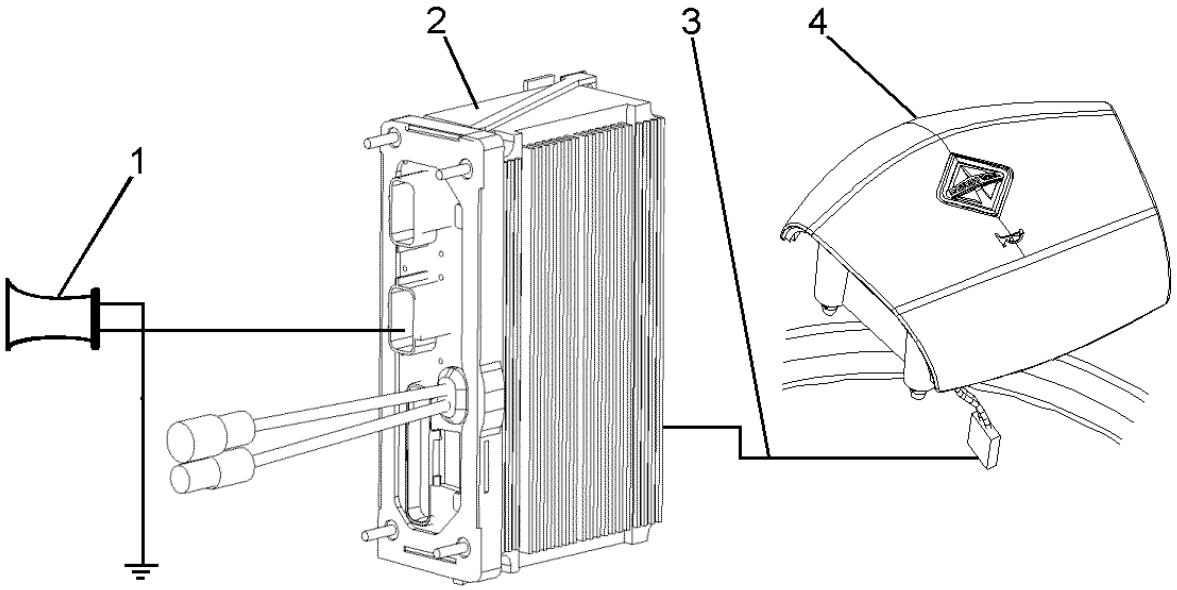

Figure 240 Electric Horn Function Diagram

1. ELECTRIC HORNS, RIGHT SIDE #2 (8312) & LEFT SIDE #1 (8311)
2. ELECTRICAL SYSTEM CONTROLLER
3. CIRCUITS TO ESC CONNECTOR (1600)
4. ELECTRIC HORN SWITCH IN STEERING WHEEL

The electric horns provide the driver audio warning to warn others.

The electric horn switch is a direct input (not multiplexed) to the ESC. When the horn button is pushed the ESC provides voltage to the horns. The circuits from the steering wheel travel through a clock spring assembly which is used instead of a slip ring assembly. Its winds and unwinds as the wheel is turned.

7.2. DIAGNOSTICS

Should the electric horns fail to operate, the problem could be attributed to a faulty switch in the steering wheel, open or shorted circuits between the horn switch and ESC or open or shorted output wiring between the ESC and the horns.

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

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 both electric horns.

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

Electric Horns Preliminary Check

Table 164 Electric Horns Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify electric horns are inoperative.	Attempt to operate electric horns.	Electric horns are inoperative.	Go to next step.	Electric horns are operating. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other 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	If more than one electric horn is connected to this circuit, are all horns inoperative?	Check if all electric horns are inoperative.	All electric horns are inoperative.	Go to next step.	Check specific circuits of the inoperative horn for open circuits.
4.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 490)	Read display on odometer.	No electric horns diagnostic trouble codes are active.	Go to electric horns input circuits to the ESC. (See ELECTRIC HORN CIRCUIT INPUTS TO ESC, page 491)	Go to electric horns circuit outputs from ESC. (See ELECTRIC HORN CIRCUIT OUTPUTS FROM ESC, page 494)

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 165 Electric Horn Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 12 1	Electric horn open circuit
611 14 12 2	Electric horn over current
611 14 12 3	Electric horn, less than normal low current but more than open circuit
611 14 12 4	Electric horn, greater than normal high current and less than fusing current
611 14 12 6	Electric horn has current flow when output commanded off

7.3. ELECTRIC HORN 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 input circuits will be apparent when the horns don't come on and no active diagnostic trouble codes are present. The ESC will not log any diagnostic trouble codes for electric horn input circuits to the ESC. Problems in the electric horn input circuits could be attributed to a short circuit between the horn switch and the ESC, an open circuit between the horn switch and the ESC, a faulty switch, or a problem in the ESC.

Refer to electric horn and ESC input circuits.

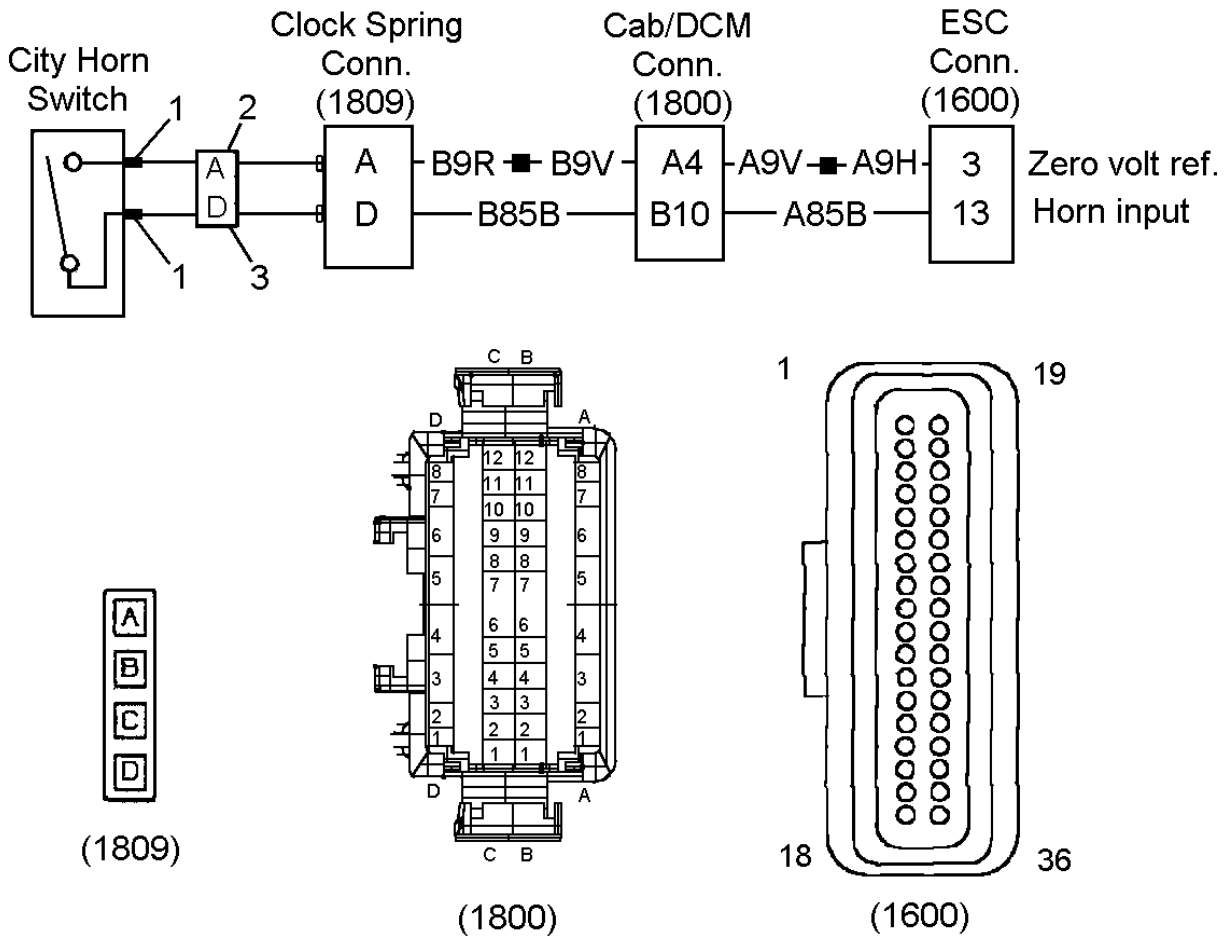

Figure 241 Electric Horn and ESC Input Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

1. CITY HORN SWITCH CONTACT
   LOCATED ON HORN BUTTON
2. JUMPER TO HORN CONTACT FROM CLOCK SPRING CONNECTOR (1809) PIN A.
   LOCATED IN STEERING COLUMN
3. JUMPER TO HORN CONTACT FROM CLOCK SPRING CONNECTOR (1809) PIN D.
   LOCATED IN STEERING COLUMN

(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC

(1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER

(1809) CLOCK SPRING CONNECTOR
LOCATED IN STEERING COLUMN

Table 166 Horn Switch Voltage Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the steering column horn switch.		
A mechanically defective electric horn switch could also prevent the electric horn from operating. Remove the steering column horn switch and use jumper wire between the two harness connectors to the clock spring connector (1809) pins A and D. If the electric horns sound, the mechanical switch assembly should be replaced.		
Steering Wheel Switch Harness Horn Switch Voltage Check Remove Horn Switch Cover. Check with ignition key on and horn switch disconnected. **NOTE – Voltage to the switch will be approximately 12 volts with the key off.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Steering wheel switch harness cavity D to ground.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits B85B and A85B, through the horn switch harness, the clock spring connector (1809) and ESC connector (1600). Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin D to D. Repair or replace circuits.
Steering wheel switch cavity A to D.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits B9R, B9V, A9V and A9H, through the horn switch harness, the clock spring connector (1809) and ESC connector (1600). Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin A to A. Repair or replace circuits.
If voltage is correct the circuits between the ESC and the horn switch are functioning properly. Check switch resistances. If voltage is incorrect and there are no open or shorted circuits the ESC may need replaced.		
Horn Switch Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Steering wheel switch connector cavity A to D, horn switch not pushed.	>100K ohms.	If resistance is incorrect there is a short in the horn switch.
Steering wheel switch connector cavity A to D, horn switch pushed.	<1 ohm.	If there is no continuity, replaced the horn switch.

Extended Description

The electric horn switch is wired directly to the ESC. When the electric horn switch is turned on, 0 volt reference on pin 3 from the ESC will pass through the switch to pin 13 back to the ESC. This will cause the ESC to send 12 volts to the air solenoid pack to operate the horn.

7.4. ELECTRIC HORN CIRCUIT OUTPUTS FROM ESC

Fault Detection Management

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

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

A fault in the electric horn output circuits from the ESC will be apparent when the horns don't come on and an active electric horn fault is active. The ESC will log a fault when there is a short in any of the circuits between the ESC and the electric horn or when there is an open in a circuit between the electric horn and ground. Problems in the electric horn circuits could be attributed to a short, an open, a faulty switch or a problem in the ESC.

Refer to electric horn outputs from ESC.

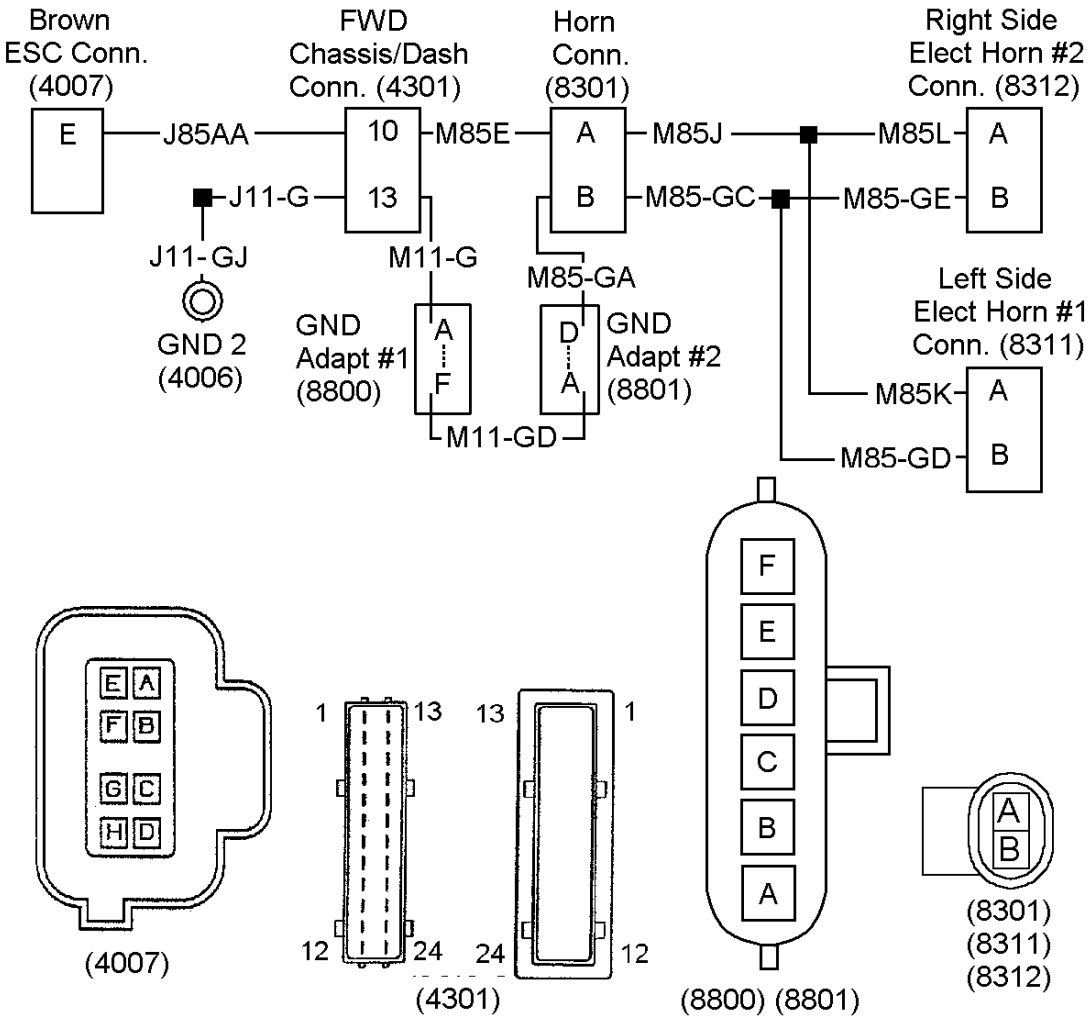

Figure 242 Electric Horn Outputs from ESC (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information

(4006) GROUND #2 STUD
LOCATED ON ENGINE COMPARTMENT OF CAB
(4007) BROWN ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE COMPARTMENT SIDE OF ESC
(4301) FWD CHASSIS HARNESS CONNECTOR
LOCATED ON FWD CHASSIS UNDER ENGINE
(8301) ELECTRIC HORN HARNESS CONNECTOR
LOCATED ON FWD CHASSIS UNDER ENGINE
(8311) LEFT SIDE ELECTRIC HORN #1 CONNECTOR
LOCATED ON FWD CHASSIS FRAME CROSSMEMBER
(8312) RIGHT SIDE ELECTRIC HORN #2 CONNECTOR
LOCATED ON FWD CHASSIS FRAME CROSSMEMBER
(8800) GND ADAPTER #1 CONNECTOR
LOCATED ON FWD CHASSIS
(8801) GND ADAPTER #2 CONNECTOR
LOCATED ON FWD CHASSIS

Table 167 Electric Horn Tests

<table>
<tr><th colspan="3">Diagnostic Trouble Codes</th></tr>
<tr><td colspan="2">611 14 12 3</td><td>Electric horn, less than normal low current but more than open circuit</td></tr>
<tr><td colspan="2">611 14 12 4</td><td>Electric horn, greater than normal high current and less than fusing current</td></tr>
<tr><td colspan="2">611 14 12 6</td><td>Electric horn has current flow when output commanded off</td></tr>
<tr><td colspan="2">611 14 12 2</td><td>Electric horn over current</td></tr>
<tr><td colspan="3">This fault is logged when there is a short in the circuits between the electric horn and the ESC or an excessive load on the circuit attributed to too many accessories on the electric horn circuits.

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

Disconnect electric horns right side connector (8312) and left side connector (8311). Cycle key switch and clear DTC’s. Then turn on the electric horn switch and check for fault. If the fault does not reoccur, there is a short or an overload in the electric horn. If the fault reoccurs there is a short in the circuits between the ESC and horn switch or in the ESC.

Disconnect brown ESC connector (4007). Cycle key switch and clear DTC’s. Turn on electric horn switch and check for fault. If the fault does nor reoccur, there is a short in the circuits between the ESC and electric horns. If the fault reoccurs there is a short inside the ESC.</td></tr>
<tr><td colspan="2">611 14 12 1</td><td>Electric horn open circuit</td></tr>
<tr><td colspan="3">This fault is due to an open in circuits between the electric horn output of the ESC or the horn and ground.

Check for open circuits

Electric Horn Harness Connectors (8311) and (8312) Voltage Checks

Check with ignition key off, electric horn on, and electric horn connectors (8311) and (8312) disconnected.

NOTE – Always check connectors for damage and pushed–out terminals.</td></tr>
<tr><td>Test Points</td><td>Spec.</td><td>Comments</td></tr>
<tr><td>Horn on. (8311) and (8312) Harness connectors, pin A to ground</td><td>12 ± 1.5 volts</td><td>If voltage is missing, check for open in circuits J85AA, M85E, M85J, M85L or M85K.

If circuits check good and problem is still present, verify voltage out of ESC.

NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</td></tr>
<tr><td>(8311) and (8312) Harness connectors, pin A to pin B</td><td>12 ± 1.5 volts</td><td>If voltage is missing, check for open in ground circuits J11–GJ, J11–G, M11–G, M11–GD, M85–GA, M85–GC, M85–GD or M85–GE.

If voltage is present and horn is inoperative, replace horn.</td></tr>
</table>

Extended Description

The ESC will supply 12 volts from system controller brown connector (4007) terminal E to electric horn connectors (8311) and (8312) terminals A.

Ground for the electric horn is supplied from ground stud (4006) to electric horn connector (8311) and (8312) terminals B.

7.5. COMPONENT LOCATIONS

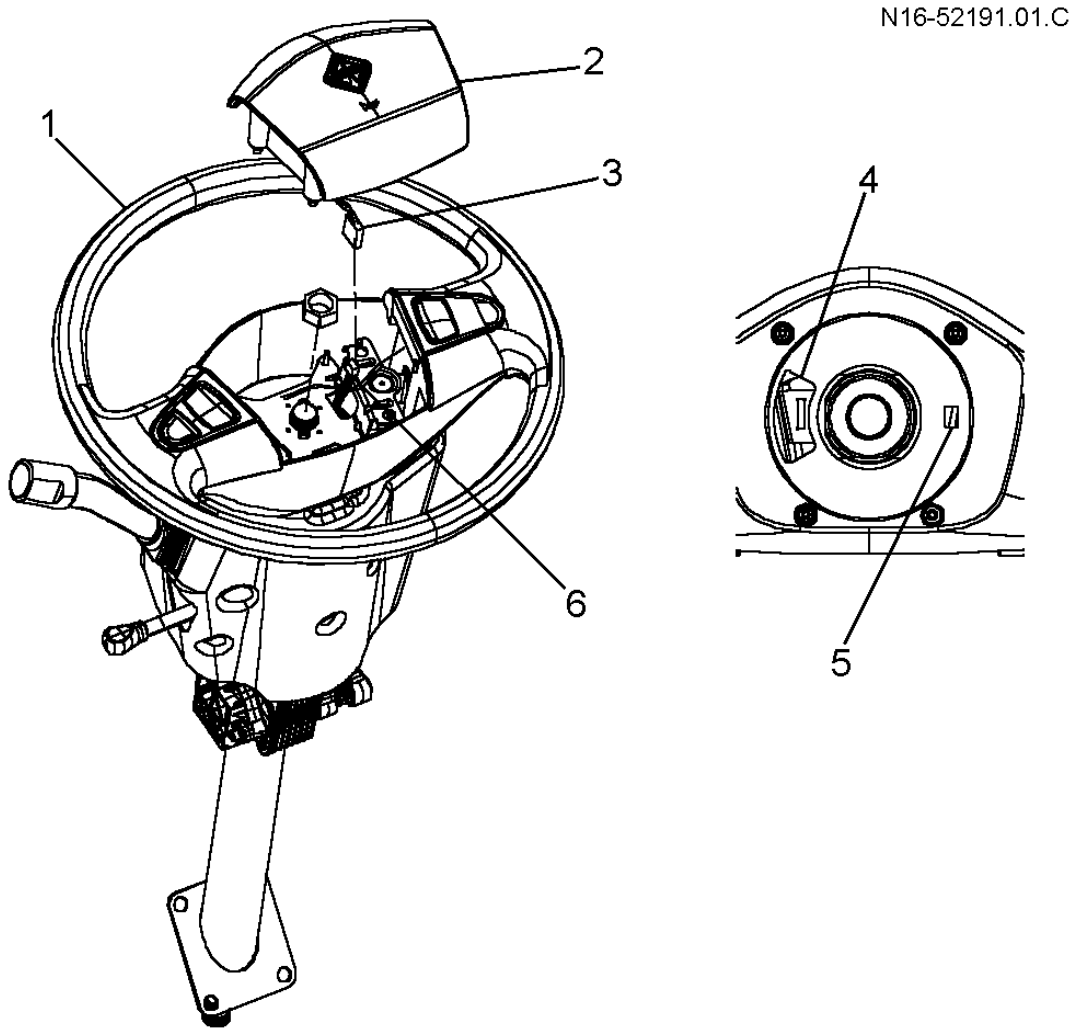

Figure 243 Electric Horn Wiring Steering Column

1. STEERING WHEEL
2. CITY HORN SWITCH
3. HARNESS TO HORN SWITCH
4. (1809) CLOCK SPRING CONNECTOR FOR CAB HARNESS
5. CLOCK SPRING TANG
6. CLOCK SPRING CONNECTOR TO HORN SWITCH AND CRUISE CONTROL SWITCHES

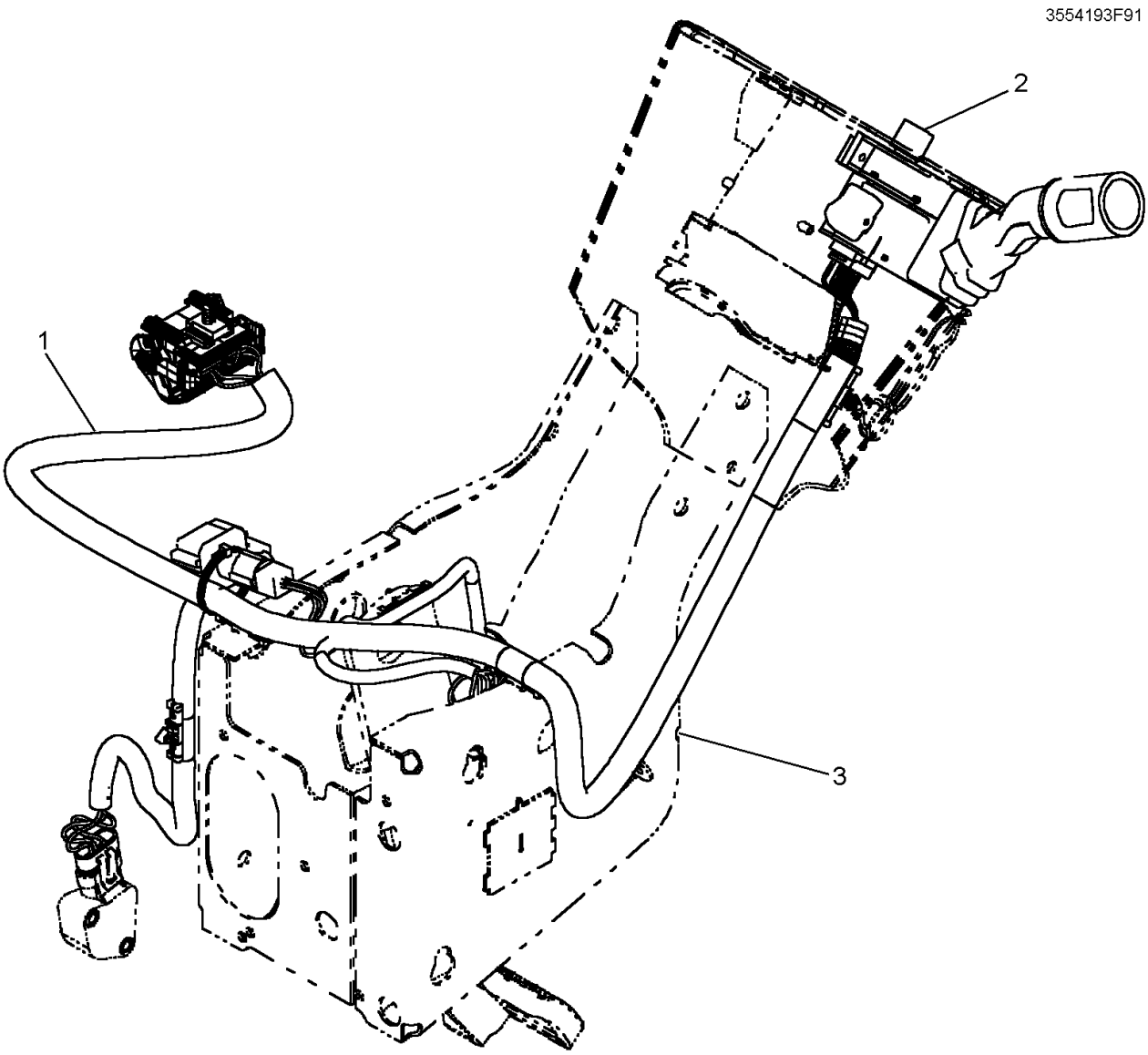

Figure 244 Steering Column Wiring

1. CAB HARNESS
2. (1809) CLOCK SPRING CONNECTOR
3. STEERING COLUMN WIRING

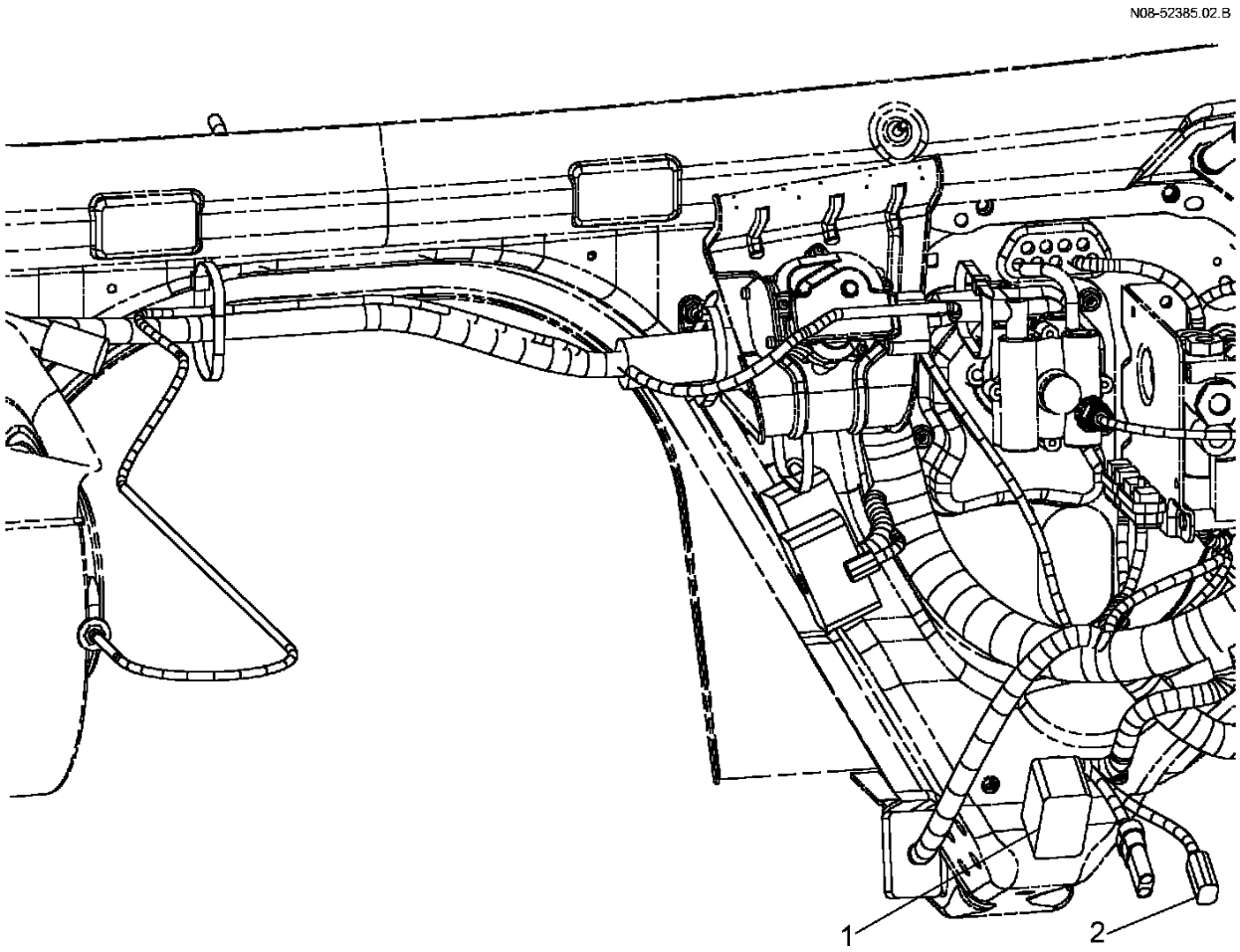

Figure 245 Electric Horn Dash Harness Wiring

1. (4301) FWD CHASSIS/DASH CONNECTOR
2. (4410) REMOTE/SOLENOID POWER UNIT CONNECTOR

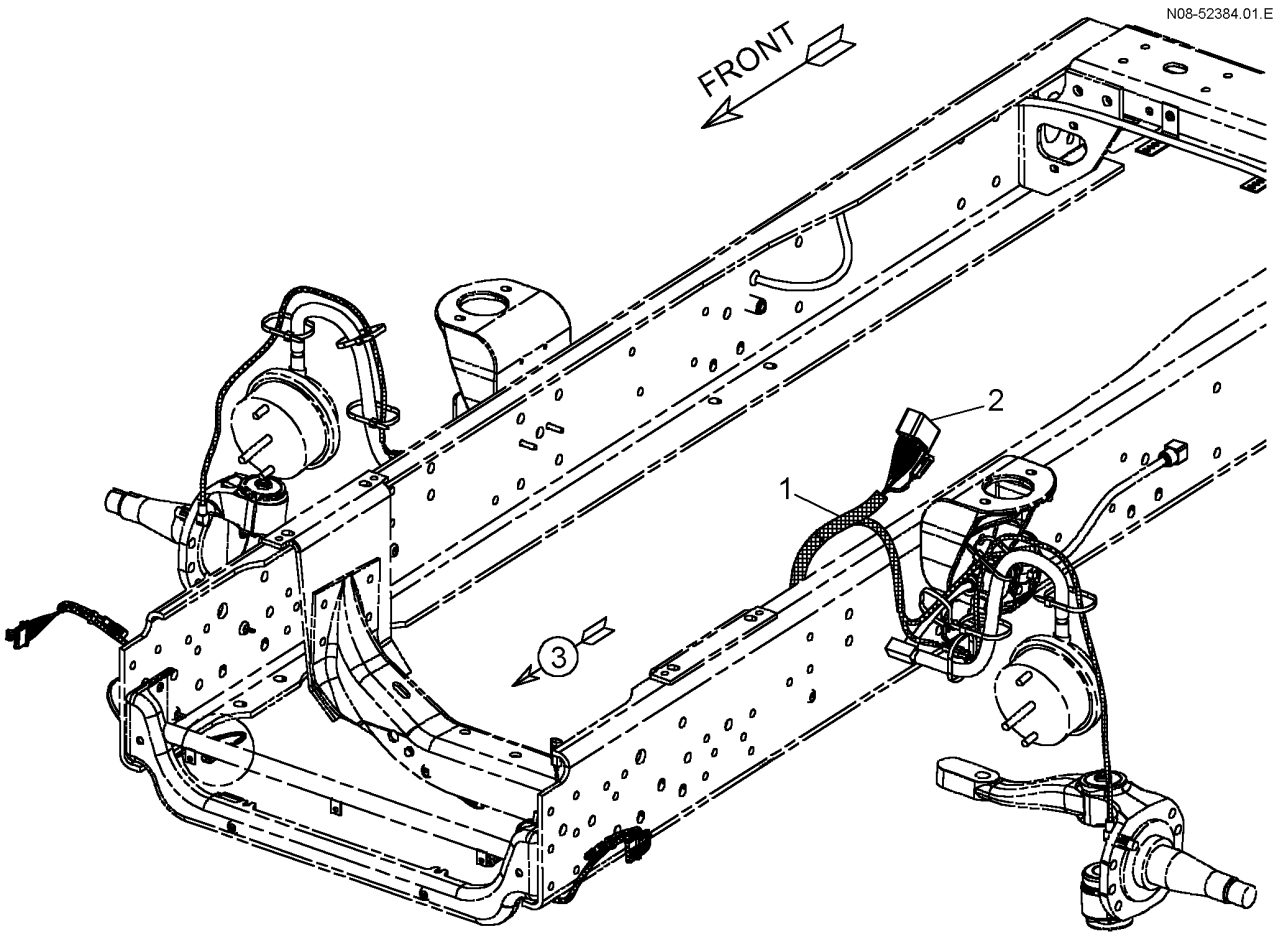

Figure 246 Electric Horn FWD Chassis Wiring

1. FWD CHASSIS HARNESS
2. (4301) TO FWD CHASSIS/DASH HARNESS AND ELECTRICAL SYSTEM CONTROLLER
3. ARROW 3, SEE NEXT FIGURE, ELECTRIC HORN FWD CHASSIS WIRING CROSSMEMBER

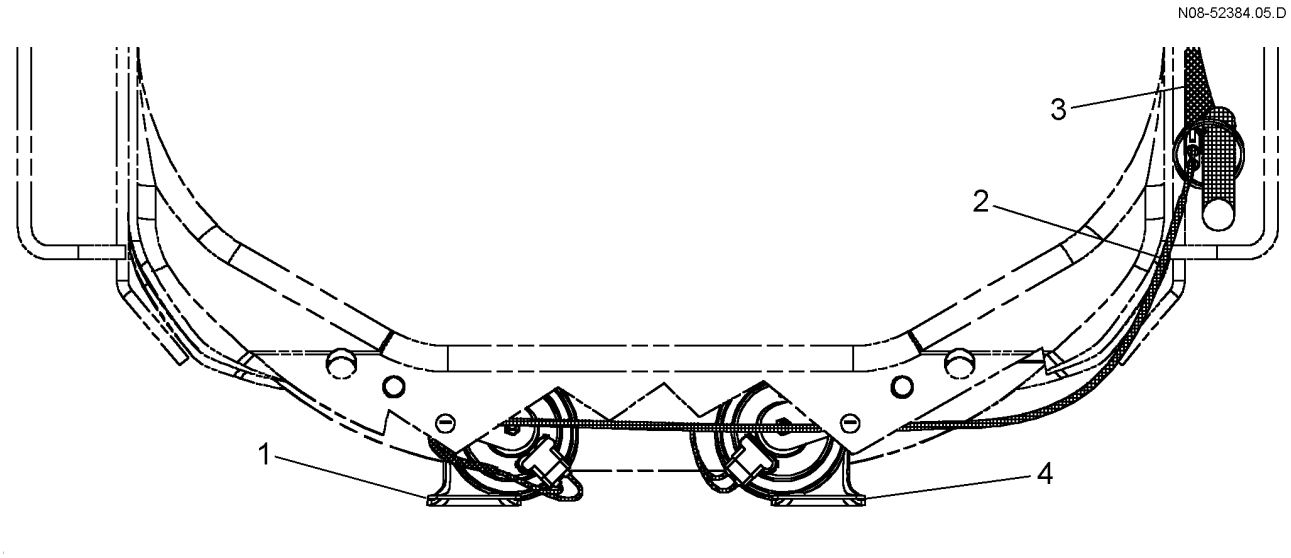

Figure 247 Electric Horn FWD Chassis Wiring Crossmember

1. (8312) RIGHT ELECTRIC HORN #2
2. (8301) HORN HARNESS
3. FWD CHASSIS HARNESS
4. (8311) LEFT ELECTRIC HORN #1

8. AIR HORNS

8.1. CIRCUIT FUNCTIONS

Refer to air horn function diagram.

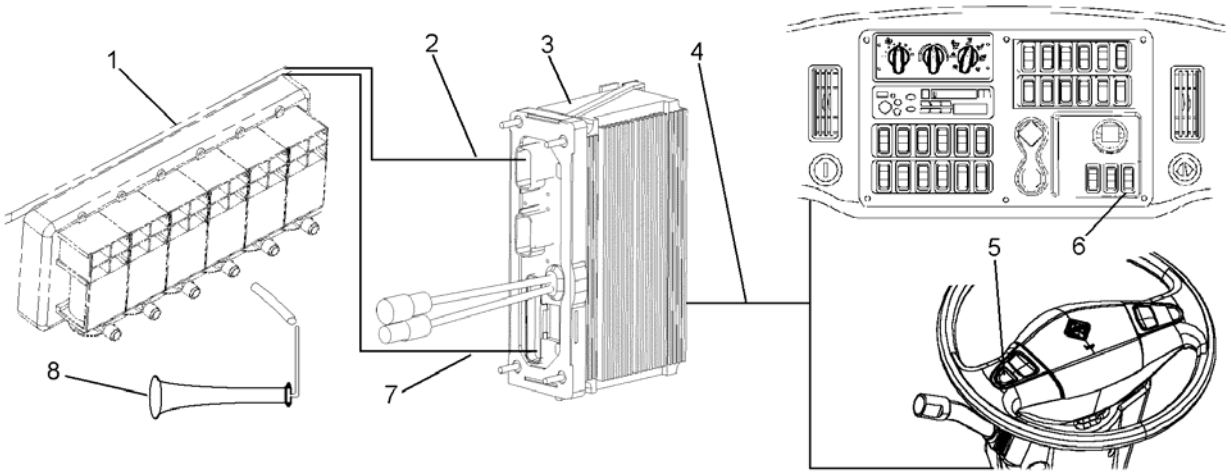

Figure 248 Air Horn Function Diagram

1. AIR SOLENOID 4–WAY PACK (9736) (NOT SHOWN)
1. AIR SOLENOID 7–WAY PACK (4410B)
2. AIR SOLENOID 4–WAY PACK SSC CIRCUITS FROM ESC (BLUE) CONNECTOR (4008)
2. AIR SOLENOID 7–WAY PACK DATA LINK CIRCUITS FROM ESC (BLUE) CONNECTOR (4008)
3. ELECTRICAL SYSTEM CONTROLLER
4. CIRCUITS TO ESC CONNECTOR (1600)
5. AIR HORN SWITCH IN STEERING WHEEL
6. AIR HORN SWITCH IN INSTRUMENT PANEL (1018)
7. AIR SOLENOID 4–WAY PACK SSC CIRCUITS FROM ESC CONNECTOR (4004)
7. AIR SOLENOID 7–WAY PACK DATA LINK CIRCUITS FROM ESC CONNECTOR (4004)
8. AIR HORN

The air horn provides the driver audio warning to warn others.

The air horn switch is a direct input (not multiplexed) to the ESC. When the horn button is pushed the ESC provides voltage to the air solenoid (4–pack or 7–pack air solenoids) to operate the air horn. The circuits from the steering wheel travel through a clock spring assembly, which is used instead of a slip ring assembly. It winds and unwinds as the wheel is turned. The instrument panel air horn switch is provided for the passenger to operate the air horn.

When the horn is connected to the 4–pack, the ESC provides voltage and direct SSC circuits for the 4–pack air horn air solenoids.

When the horn is connected to the 7–pack, the ESC will communicate on the body builder 1939 data link to command the applicable air solenoid on.

8.2. DIAGNOSTICS

Should the air horn fail to operate, the problem could be attributed to:

- A faulty switch in the steering wheel.
- Open or shorted circuits between the horn switch and ESC.
- A failure in the ESC.

- Open or shorted output wiring between the ESC and the air horn air solenoid (4–pack or 7–pack air solenoids).
- A failure in the 4–pack or 7–pack modules.
- An open or shorted solenoid in the 4–pack or 7–pack modules. (Individual solenoids can be replaced).

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.

When the 4–pack air solenoid module is used, a diagnostic trouble code will be logged if there is a short to ground, a short to voltage, or an open in the circuits between the ESC and air horn air solenoid.

When the 7–pack air solenoid module is used, a diagnostic trouble code will be only be logged if there is a short to ground in an individual solenoid.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the air horn and monitor activation of the air horn switch. See the diagnostic software manual for details on using the software. The “INTUNE” software can also be used to identify the configuration of the air horn (which air solenoid is controlling the horn).

Air Horns Preliminary Check

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

Table 168 Air Horns Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Insure there is air pressure to the air solenoid pack. Verify air horn is inoperative.	Check air horn.	Air horn is inoperative.	Go to next step.	Air horn is operating. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or ground common to several features.)	Visually check for other malfunc-tioning features.	No other features are malfunc-tioning.	Go to next step.	Identify and repair condition causing several features to be inoperative.

Table 168 Air Horns Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
3.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 504)	Read display on odometer.	No air horn air solenoid diagnostic trouble codes are active.	Go to next step	Go to air horn air solenoid circuit outputs from ESC. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 740)
4.	At this point it is difficult to determine whether the problem is in the switch circuits, an open solenoid (with 7–pack only), an inoperative air horn, or a problem with the ESC. The “INTUNE “ diagnostic software can be used to monitor activation of the horn switch and command the ESC to operate the horn. To manually eliminate possibilities start by checking the horn circuits to the ESC. Go to Air Horn Input circuits to the ESC. (See AIR HORN CIRCUIT INPUTS TO ESC, page 508)					

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 169 4 Pack Air Solenoid Diagnostic Trouble Codes

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

Table 169 4 Pack Air Solenoid Diagnostic Trouble Codes (cont.)

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

Table 170 7 Pack Air Solenoid Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2034 14 1 1	Remote Air Solenoid Module #1 - Output #1 - Valve ON when commanded OFF.
2034 14 1 2	Remote Air Solenoid Module #1 - Output #1 - Valve OFF when commanded ON.
2034 14 1 3	Remote Air Solenoid Module #1 - Output #1 - Open Circuit coil or valve not installed.
2034 14 1 4	Remote Air Solenoid Module #1 - Output #1 - Unknown remote air solenoid.
2034 14 2 1	Remote Air Solenoid Module #1 - Output #2 - Valve ON when commanded OFF.
2034 14 2 2	Remote Air Solenoid Module #1 - Output #2 - Valve OFF when commanded ON.
2034 14 2 3	Remote Air Solenoid Module #1 - Output #2 - Open Circuit coil or valve not installed.
2034 14 2 4	Remote Air Solenoid Module #1 - Output #2 - Unknown remote air solenoid.
2034 14 3 1	Remote Air Solenoid Module #1 - Output #3 - Valve ON when commanded OFF.
2034 14 3 2	Remote Air Solenoid Module #1 - Output #3 - Valve OFF when commanded ON.
2034 14 3 3	Remote Air Solenoid Module #1 - Output #3 - Open Circuit coil or valve not installed.
2034 14 3 4	Remote Air Solenoid Module #1 - Output #3 - Unknown remote air solenoid.
2034 14 4 1	Remote Air Solenoid Module #1 - Output #4 - Valve ON when commanded OFF.
2034 14 4 2	Remote Air Solenoid Module #1 - Output #4 - Valve OFF when commanded ON.
2034 14 4 3	Remote Air Solenoid Module #1 - Output #4 - Open Circuit coil or valve not installed.
2034 14 4 4	Remote Air Solenoid Module #1 - Output #4 - Unknown remote air solenoid.

Table 170 7 Pack Air Solenoid Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2034 14 5 1	Remote Air Solenoid Module #1 - Output #5 - Valve ON when commanded OFF.
2034 14 5 2	Remote Air Solenoid Module #1 - Output #5 - Valve OFF when commanded ON.
2034 14 5 3	Remote Air Solenoid Module #1 - Output #5 - Open Circuit coil or valve not installed.
2034 14 5 4	Remote Air Solenoid Module #1 - Output #5 - Unknown remote air solenoid.
2034 14 6 1	Remote Air Solenoid Module #1 - Output #6 - Valve ON when commanded OFF.
2034 14 6 2	Remote Air Solenoid Module #1 - Output #6 - Valve OFF when commanded ON.
2034 14 6 3	Remote Air Solenoid Module #1 - Output #6 - Open Circuit coil or valve not installed.
2034 14 6 4	Remote Air Solenoid Module #1 - Output #6 - Unknown remote air solenoid.
2034 14 7 1	Remote Air Solenoid Module #1 - Output #7 - Valve ON when commanded OFF.
2034 14 7 2	Remote Air Solenoid Module #1 - Output #7 - Valve OFF when commanded ON.
2034 14 7 3	Remote Air Solenoid Module #1 - Output #7 - Open Circuit coil or valve not installed.
2034 14 7 4	Remote Air Solenoid Module #1 - Output #7 - Unknown remote air solenoid.
2234 14 1 1	Remote Air Solenoid Module #2 - Output #1 - Valve ON when commanded OFF.
2234 14 1 2	Remote Air Solenoid Module #2 - Output #1 - Valve OFF when commanded ON.
2234 14 1 3	Remote Air Solenoid Module #2 - Output #1 - Open Circuit coil or valve not installed.
2234 14 1 4	Remote Air Solenoid Module #2 - Output #1 - Unknown remote air solenoid.
2234 14 2 1	Remote Air Solenoid Module #2 - Output #2 - Valve ON when commanded OFF.
2234 14 2 2	Remote Air Solenoid Module #2 - Output #2 - Valve OFF when commanded ON.
2234 14 2 3	Remote Air Solenoid Module #2 - Output #2 - Open Circuit coil or valve not installed.
2234 14 2 4	Remote Air Solenoid Module #2 - Output #2 - Unknown remote air solenoid.

Table 170 7 Pack Air Solenoid Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2234 14 3 1	Remote Air Solenoid Module #2 - Output #3 - Valve ON when commanded OFF.
2234 14 3 2	Remote Air Solenoid Module #2 - Output #3 - Valve OFF when commanded ON.
2234 14 3 3	Remote Air Solenoid Module #2 - Output #3 - Open Circuit coil or valve not installed.
2234 14 3 4	Remote Air Solenoid Module #2 - Output #3 - Unknown remote air solenoid.
2234 14 4 1	Remote Air Solenoid Module #2 - Output #4 - Valve ON when commanded OFF.
2234 14 4 2	Remote Air Solenoid Module #2 - Output #4 - Valve OFF when commanded ON.
2234 14 4 3	Remote Air Solenoid Module #2 - Output #4 - Open Circuit coil or valve not installed.
2234 14 4 4	Remote Air Solenoid Module #2 - Output #4 - Unknown remote air solenoid.
2234 14 5 1	Remote Air Solenoid Module #2 - Output #5 - Valve ON when commanded OFF.
2234 14 5 2	Remote Air Solenoid Module #2 - Output #5 - Valve OFF when commanded ON.
2234 14 5 3	Remote Air Solenoid Module #2 - Output #5 - Open Circuit coil or valve not installed.
2234 14 5 4	Remote Air Solenoid Module #2 - Output #5 - Unknown remote air solenoid.
2234 14 6 1	Remote Air Solenoid Module #2 - Output #6 - Valve ON when commanded OFF.
2234 14 6 2	Remote Air Solenoid Module #2 - Output #6 - Valve OFF when commanded ON.
2234 14 6 3	Remote Air Solenoid Module #2 - Output #6 - Open Circuit coil or valve not installed.
2234 14 6 4	Remote Air Solenoid Module #2 - Output #6 - Unknown remote air solenoid.
2234 14 7 1	Remote Air Solenoid Module #2 - Output #7 - Valve ON when commanded OFF.
2234 14 7 2	Remote Air Solenoid Module #2 - Output #7 - Valve OFF when commanded ON.
2234 14 7 3	Remote Air Solenoid Module #2 - Output #7 - Open Circuit coil or valve not installed.
2234 14 7 4	Remote Air Solenoid Module #2 - Output #7 - Unknown remote air solenoid.

8.3. AIR HORN 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 input circuits will be apparent when the horn doesn't operate and no diagnostic trouble codes are present. The ESC will not log any diagnostic trouble codes for air horn input circuits to the ESC. Problems in the air horn input circuits could be attributed to a short circuit between the horn switch and the ESC, an open circuit between the horn switch and the ESC, a faulty switch, or a problem in the ESC.

Refer to air horn and ESC input circuits.

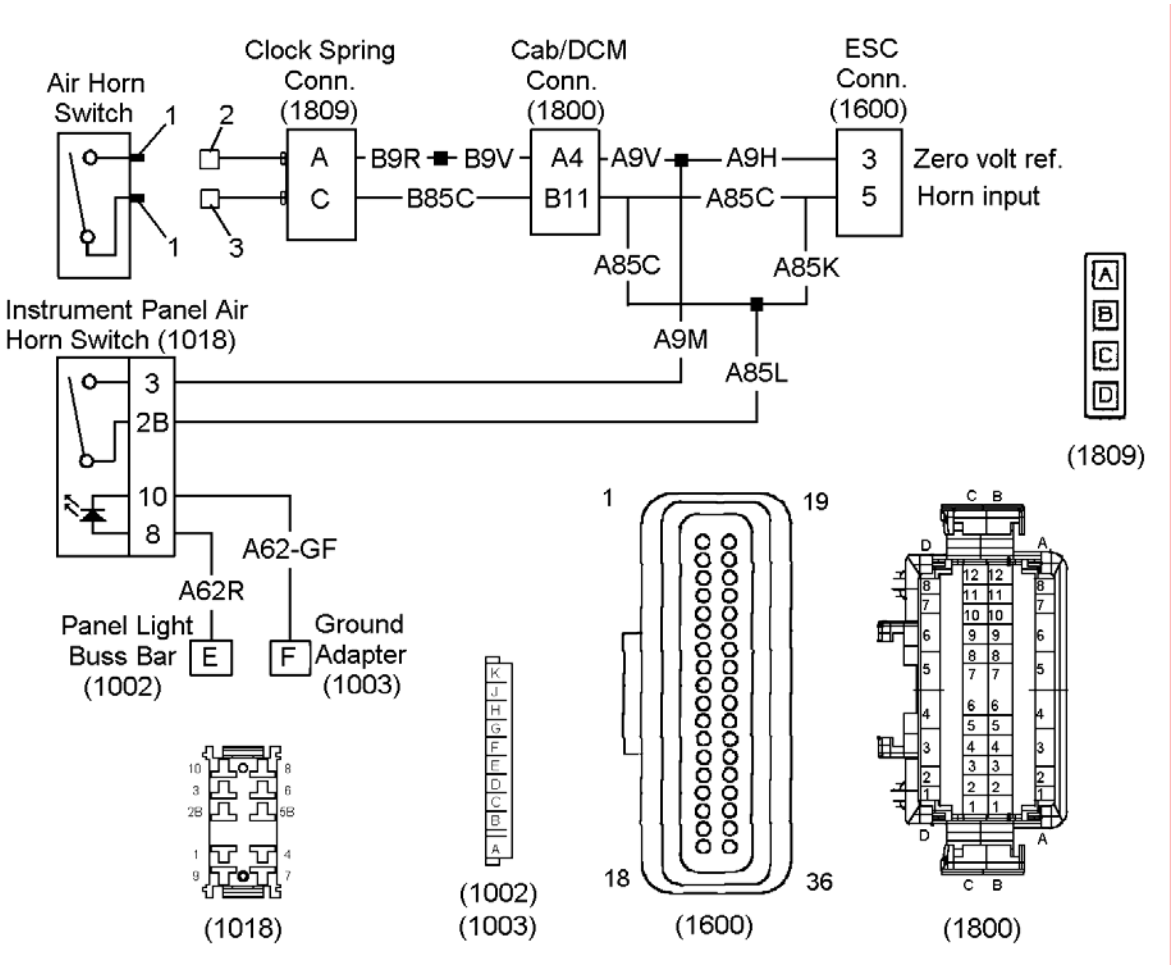

Figure 249 Air Horn and ESC Input Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

1. AIR HORN SWITCH CONTACT
   LOCATED IN STEERING WHEEL
2. JUMPER TO HORN SWITCH CONTACT FROM CLOCK SPRING CONNECTOR (1809) PIN A.
   LOCATED IN STEERING WHEEL
3. JUMPER TO HORN SWITCH CONTACT FROM CLOCK SPRING CONNECTOR (1809) PIN C.
   LOCATED IN STEERING WHEEL

(1002) PANEL LIGHT ADAPTER
LOCATED IN INSTRUMENT PANEL

(1003) GROUND ADAPTER
LOCATED IN INSTRUMENT PANEL

(1018) INSTRUMENT PANEL AIR HORN SWITCH
LOCATED IN INSTRUMENT PANEL

(1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC

(1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER

(1809) CLOCK SPRING CONNECTOR
LOCATED IN STEERING COLUMN

Table 171 Horn Switch Clock Spring Connector To ESC Connector (1600) Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the steering column horn switch.		
A mechanically defective air horn switch could also prevent the air horn from operating. Remove the steering column horn switch and use jumper wire between the two harness connectors to the clock spring connector (1809) pins A and C. If the air horn sounds, the mechanical switch assembly should be replaced.		
Horn Switch Harness Through The Clock Spring Connector (1809) To The ESC Connector (1600) Voltage Check Check with ignition key on and horn switch disconnected. **NOTE – Voltage to the switch will be approximately 5 volts with the key off.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Horn switch harness through the clock spring connector (1809), pin C to ground.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits B85C and A85C, through the horn switch harness, the clock spring connector (1809) and ESC connector (1600). Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin C to C. Repair or replace circuits.
Two horn switch harnesses through each clock spring connector (1809), pin C to pin A.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits B9R, B9V, A9V and A9H, through the horn switch harness, the clock spring connector (1809) and ESC connector (1600). Resistance check of clock spring, disconnect connector (1809) from bottom of clock spring, check continuity between pin A to A. Repair or replace circuits. If circuits check good, check for voltage from ESC connector (1600). Repair or replace circuits. If voltage is present and the air horn switch is good, check air solenoid. Go to air horn air solenoid circuit outputs from ESC. (See 4-PACK AIR SOLENOID CIRCUITS FROM ESC, page 740)
Horn Switch Clock Spring Connector To ESC Connector (1600) Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Checking for continuity connector (1600) between pins 3 and 5, when the horn switch is on.	<1 ohm.	If there is no continuity, the steering column horn clock spring, Cab/DCM (1800), or ESC connector (1600) needs to be repaired or replaced.

Table 172 Instrument Panel Horn Switch Connector To ESC Connector (1600) Chart

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the instrument panel horn switch.		
A mechanically defective air horn switch could also prevent the air horn from operating. Remove the instrument panel horn switch and use jumper wire between the two harness connectors to the instrument panel connector (1018) pins 2B and 3. If the air horn sounds, the mechanical switch assembly should be replaced.		
The Instrument Panel Horn Switch Connector (1018) To The ESC Connector (1600) Voltage Check Check with ignition key on and horn switch disconnected. **NOTE – Voltage to the switch will be approximately 5 volts with the key off.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
The instrument panel horn switch connector (1018), pin 2B to ground.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits A85C, A85K and A85L, instrument panel horn switch connector (1018) and ESC connector (1600). Repair or replace circuits.
The instrument panel horn switch connector (1018), pin 2B to pin 3.	12 ± 1.5 volts.	If voltage is missing, check for open or shorts in circuits A9M, A9V and A9H, instrument panel horn switch connector (1018) and ESC connector (1600). Repair or replace circuits. If circuits check good, check for voltage from ESC connector (1600). Repair or replace circuits.
The Instrument Panel Horn Switch Connector (1018) To ESC Connector (1600) Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Checking for continuity connector (1600) between pins 3 and 5, when the instrument panel horn switch is on.	<1 ohm.	If there is no continuity, the instrument panel horn switch (1018), Cab/DCM (1800), or ESC connector (1600) needs repair or replaced.

Extended Description

The air horn switch is wired directly to the ESC. When the air horn switch is turned on, 0 volt reference on pin 3 from the ESC will pass through the switch to pin 5 back to the ESC. This will cause the ESC to send voltage to the air solenoid direct circuit for 4–pack air solenoid. When the 7–pack is used, the ESC will transmit a message on the body builder data link requesting the air solenoid connected to the air horn to be energized.

8.4. AIR HORN CIRCUIT OUTPUTS FROM ESC

For vehicles with a 4–pack air solenoid module refer to Air Solenoid (4–Pack). (See AIR SOLENOID MODULE (4–PACK), page 737)

For vehicles with a 7–pack air solenoid module refer to Air Solenoid (7–Pack). (See REMOTE AIR SOLENOID MODULE (7–PACK), page 750)

8.5. COMPONENT LOCATIONS

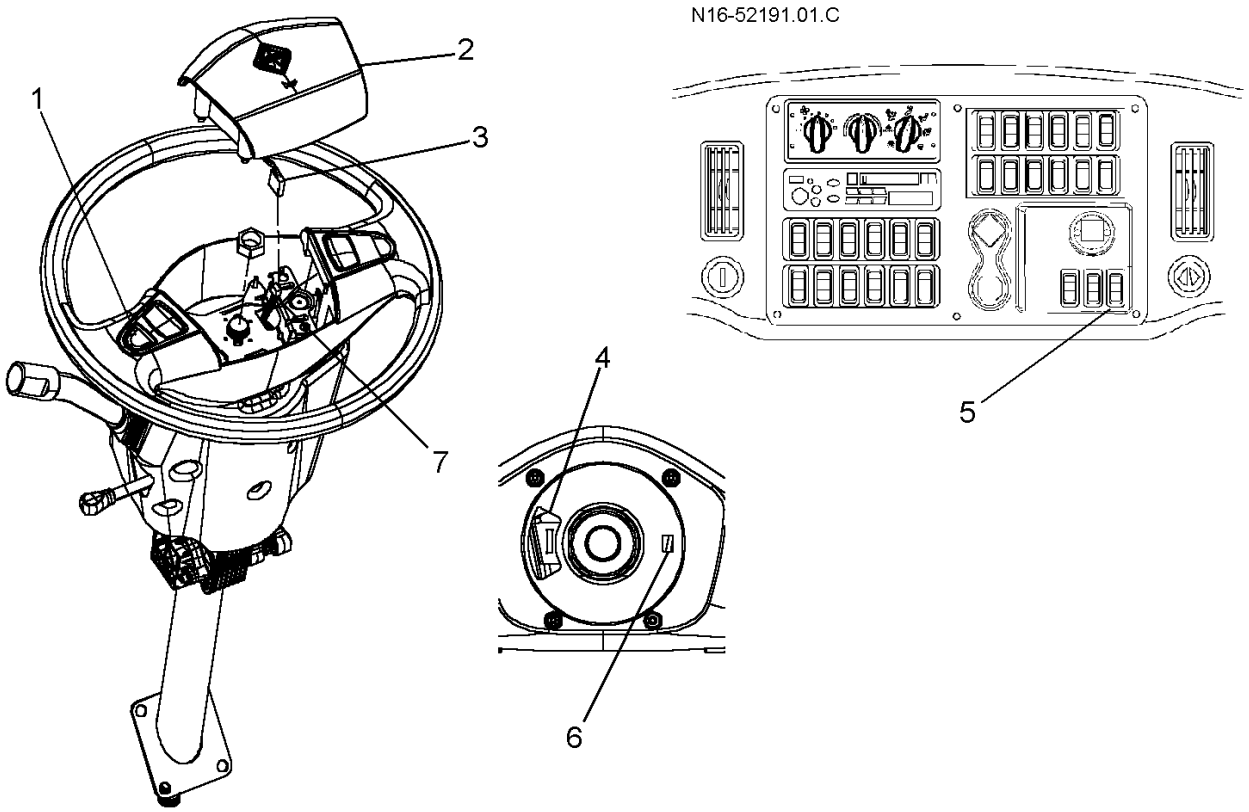

Figure 250 Air Horn Wiring In Steering Wheel And Instrument panel

1. AIR HORN SWITCH IN STEERING WHEEL
2. CITY HORN SWITCH
3. HARNESS TO CITY HORN SWITCH
4. (1809) CLOCK SPRING CONNECTOR FOR CAB HARNESS
5. (1018) INSTRUMENT PANEL AIR HORN SWITCH
6. CLOCK SPRING TANG
7. CLOCK SPRING CONNECTOR TO AIR HORN SWITCH AND CRUISE CONTROL SWITCHES

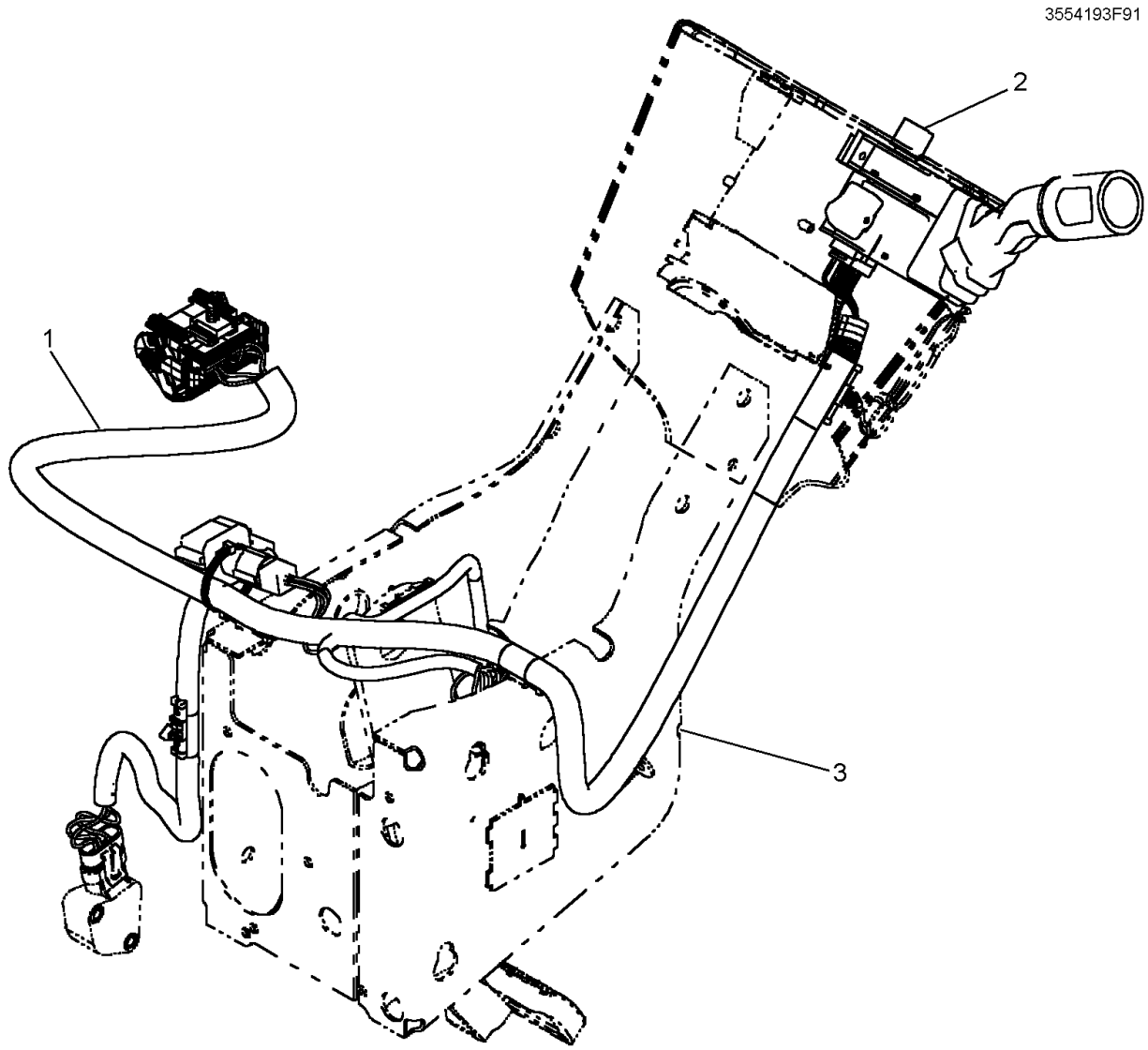

Figure 251 Steering Column Wiring

1. CAB HARNESS
2. (1809) CLOCK SPRING CONNECTOR
3. DRIVER CONTROL MODULE

9. HEATED MIRRORS

9.1. CIRCUIT FUNCTIONS

Refer to heated mirror function diagram.

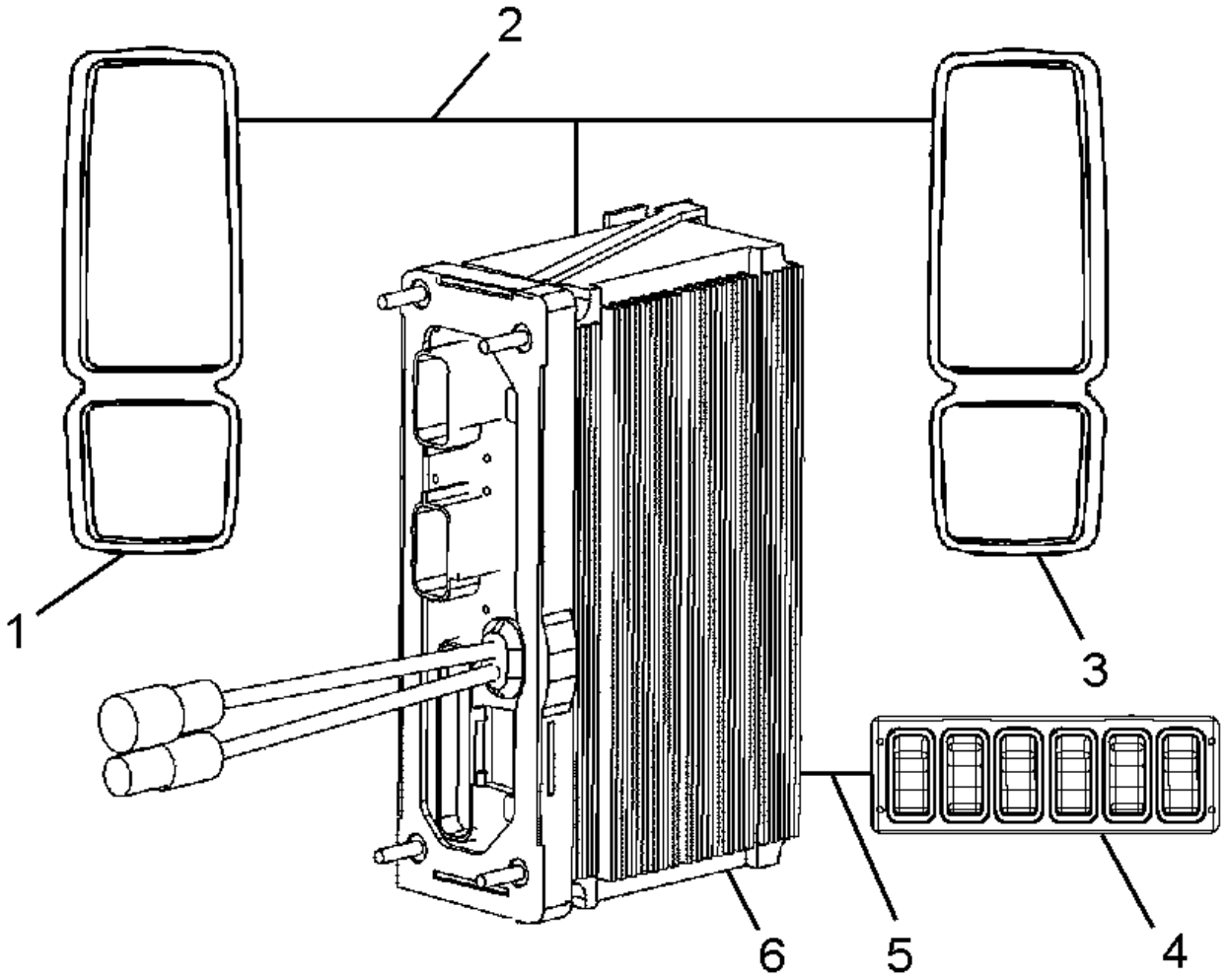

Figure 252 Heated Mirror Function Diagram

1. LEFT MIRROR
2. POWER MIRROR CIRCUITS
3. RIGHT MIRROR
4. INSTRUMENT PANEL SWITCHES
5. SWITCH DATA LINK CIRCUITS
6. ELECTRICAL SYSTEM CONTROLLER

This function controls the heated mirrors. The mirrors turn on and off with the appropriate panel mounted, momentary switch. The ESC can be programmed to turn off the heated mirror(s) after a set amount of time. The Timer function is programmable through the use of EZ-Tech or equivalent software tool. This feature will only work when the ignition is ON.

The heated mirror switch is located in the instrument panel switch pack. When selected, the switch pack will send a message on the switch data link to the ESC. The ESC will provide voltage to the heated mirror circuits and will also send a message back to the switch pack to illuminate the heated mirror switch “on” light.

If there is a switch error, the heated mirrors will be on constantly, the indicator will flash, and the switch position will not change this status until the switch status is back to normal.

A diagnostic trouble code will also be set for a switch error.

9.2. DIAGNOSTICS

Should the mirror heat fail to operate, the problem could be attributed to a blown fuse, open or shorted wiring between the ESC and mirror circuits, a problem in the ESC, faulty heat elements in a mirror or problems between the heated mirror switch and the ESC.

The ESC will set a diagnostic trouble code if there is an open in a circuit common to both mirrors. The ESC will also set a diagnostic trouble code if there is a short in a circuit between the ESC and heated mirror fuse F13 or F18.

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

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

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

Heated Mirror Preliminary Check

Table 173 Heated Mirror Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify heated mirrors operate incorrectly.	Check heated mirror operation.	Heated mirrors operate incorrectly.	Go to next step.	Heated mirrors operate correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or 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.
3.	On	Are all heated mirrors inoperative?	Check if all heated mirrors are inoperative.	All heated mirrors are inoperative.	Go to next step.	Check specific circuits of the inoperative mirrors for open circuits.

Table 173 Heated Mirror Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
4.	On	Check for heated mirror diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 516)	Read display on odometer.	No heated mirror diagnostic trouble codes are active.	Go to next step	Go toheated mirror circuits from ESC.(See HEATED MIRROR CIRCUITS FROM ESC , page 517)
5.		Problem may be in multiplexed switches. Check for switch diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 516)		No multiplexed switch diagnostic trouble codes are active.	Go to heated mirror circuits from ESC. (See HEATED MIRROR CIRCUITS FROM ESC , page 517)	Refer to the Switch Pack Module section of this manual.(See SWITCH PACK MODULES, page 124)

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 174 Heated Mirror Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
Code starting with 625	These are switch pack diagnostic trouble codes
Refer to the Switch Pack Module section of this manual.(See SWITCH PACK MODULES, page 124)	
611 14 1 1	Heated mirror open circuit
This fault is due to an open in circuits between the heated mirrors and the ESC or an open in circuits between the heated mirrors and ground. As long as a circuit to one mirror is good, an open fault will not be logged.	
611 14 1 2	Heated mirror over current

Table 174 Heated Mirror Diagnostic Trouble Codes (cont.)

This fault is logged when there is a short in the circuits between the heated mirror fuses and the ESC. **NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** A short in a circuit to one mirror only will cause the fuse for that mirror to blow and no fault will be generated.	
611 14 1 3	Heated mirror, less than normal low current but more than open circuit
611 14 1 4	Heated mirror, greater than normal high current and less than fusing current
611 14 1 6	Heated mirror has current flow when output commanded off

9.3. HEATED MIRROR 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 a heated mirror circuit will be apparent when a heated mirror is inoperative.

Should the mirror heat fail to operate, the problem could be attributed to a blown fuse, open or shorted wiring between the ESC and mirror circuits, a problem in the ESC, faulty heat elements in a mirror or a malfunction in the heated mirror switch.

Refer to heated mirror circuits.

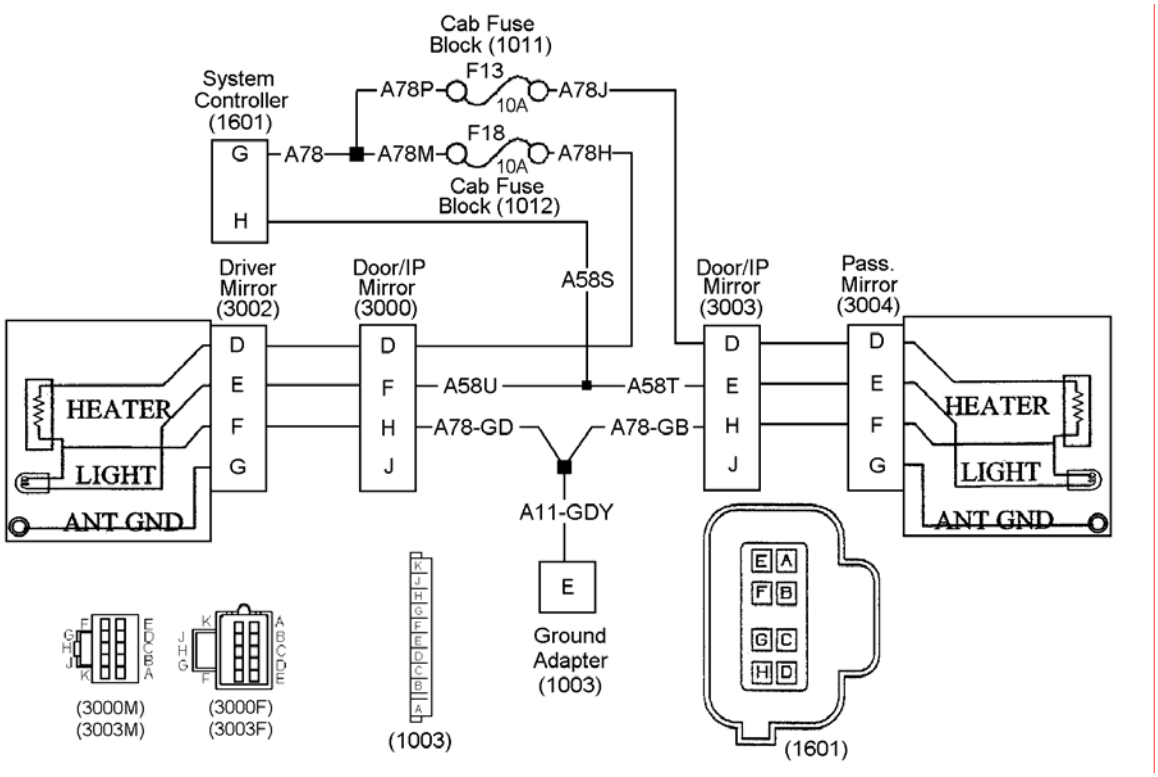

Figure 253 Heated Mirror Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1601) SYSTEM CONTROLLER
LOCATED ON SYSTEM CONTROLLER
(1003) GROUND ADAPTER
LOCATED BEHIND INSTRUMENT PANEL
(3000) DOOR/INSTRUMENT PANEL MIRROR CONNECTOR
LOCATED BELOW INSTRUMENT PANEL NEAR DRIVERS “A” PILLAR
(3002) DRIVER MIRROR CONNECTOR
LOCATED ON DRIVERS MIRROR
(3003) DOOR/INSTRUMENT PANEL MIRROR CONNECTOR
LOCATED BELOW INSTRUMENT PANEL NEAR PASSENGER “A” PILLAR
(3004) PASSENGER MIRROR CONNECTOR
LOCATED ON PASSENGER MIRROR
F13 RIGHT MIRROR HEATER CAB FUSE BLOCK (1011)
LOCATED IN CAB POWER DISTRIBUTION CENTER
F18 LEFT MIRROR HEATER CAB FUSE BLOCK (1012)
LOCATED IN CAB POWER DISTRIBUTION CENTER

Table 175 Power Mirror Connector—Heated Mirror

Diagnostic Trouble Codes	
611 14 1 3	Heated mirror, less than normal low current but more than open circuit
611 14 1 4	Heated mirror, greater than normal high current and less than fusing current

Table 175 Power Mirror Connector—Heated Mirror (cont.)

611 14 1 6	Heated mirror has current flow when output commanded off
611 14 1 2	Heated mirror over current
This fault is logged when there is a short in the circuits between the ESC and the heated mirror fuses F13 or F18. **NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** A short in a circuit to one mirror only will cause the fuse for that mirror to blow and no fault will be generated.	
611 14 1 1	Heated mirror open circuit
This fault is due to an open in circuits between the heated mirrors and the ESC or an open in circuits between the heated mirrors and ground. An open in a circuit to one mirror only will not log a fault.	

Driver Power Mirror (3002), Harness Connector Voltage Checks

Check with ignition key on and driver power mirror connector disconnected.

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

NOTE – To remove a mirror, tilt the bottom in and sliding the mirror up and out.

Test Points	Spec.	Comments
With mirror heat turned on, harness connector (3002), Cavity D to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits between ESC and mirror connector. Also check for blown fuse F18. If voltage is present and mirror heater is inoperative, the mirror heater or circuits inside the mirror assembly may need to be replaced.
With mirror heat turned on, harness connector (3002), Cavity D to cavity F.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits between ground adapter (1003) and mirror connector.

Passenger Power Mirror (3004), Harness Connector Voltage Checks

Check with ignition key on and driver power mirror connector disconnected.

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

Test Points	Spec.	Comments

Table 175 Power Mirror Connector—Heated Mirror (cont.)

With mirror heat turned on, harness connector (3004), Cavity D to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits between ESC and mirror connector. Also check for blown fuse F13. If voltage is present and mirror heater is inoperative, the mirror heater or circuits inside the mirror assembly may need to be replaced.
With mirror heat turned on, harness connector (3004), Cavity D to cavity F.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for open in circuits between ground adapter (1003) and mirror connector. Replace heated mirror

Extended Description

The heated mirror switch is located in the switch pack on the instrument panel. The switch communicates with the ESC, on the switch data link, to request the mirror heat to be turned on. The ESC will also send a message back to the switch pack to illuminate the heated mirror switch “on” light.

The ESC supplies voltage from ESC connector (1601) terminal G to separate fuses F13 (passenger) or F18 (driver) for the mirrors.

From each fuse the voltage is supplied to driver mirror connector (3002) and passenger mirror connector (3004) terminal D.

Ground for each mirror is supplied from ground adapter (3002) to terminal F of driver mirror connector (3002) and passenger mirror connector (3004).

9.4. COMPONENT LOCATIONS

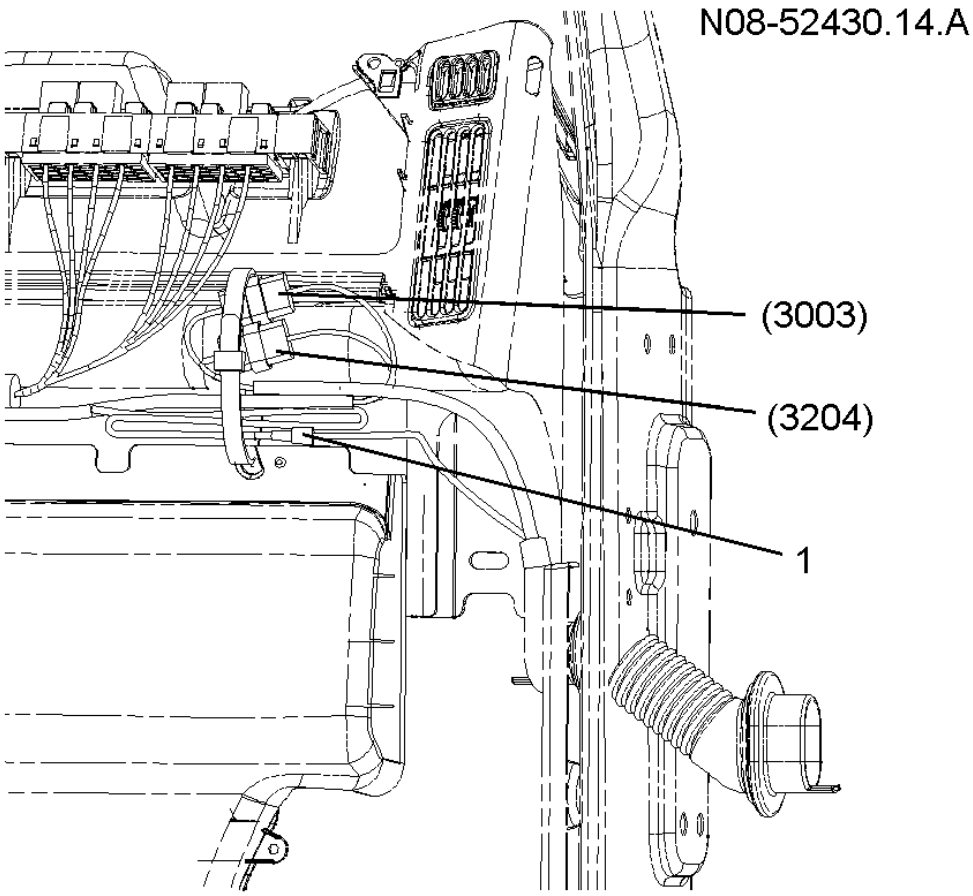

Figure 254 Door Harness Connections (Passengers Side Shown)

1. POWER MIRROR CONNECTOR
2. POWER DOOR CONNECTOR
3. CB ANTENNA CONNECTOR

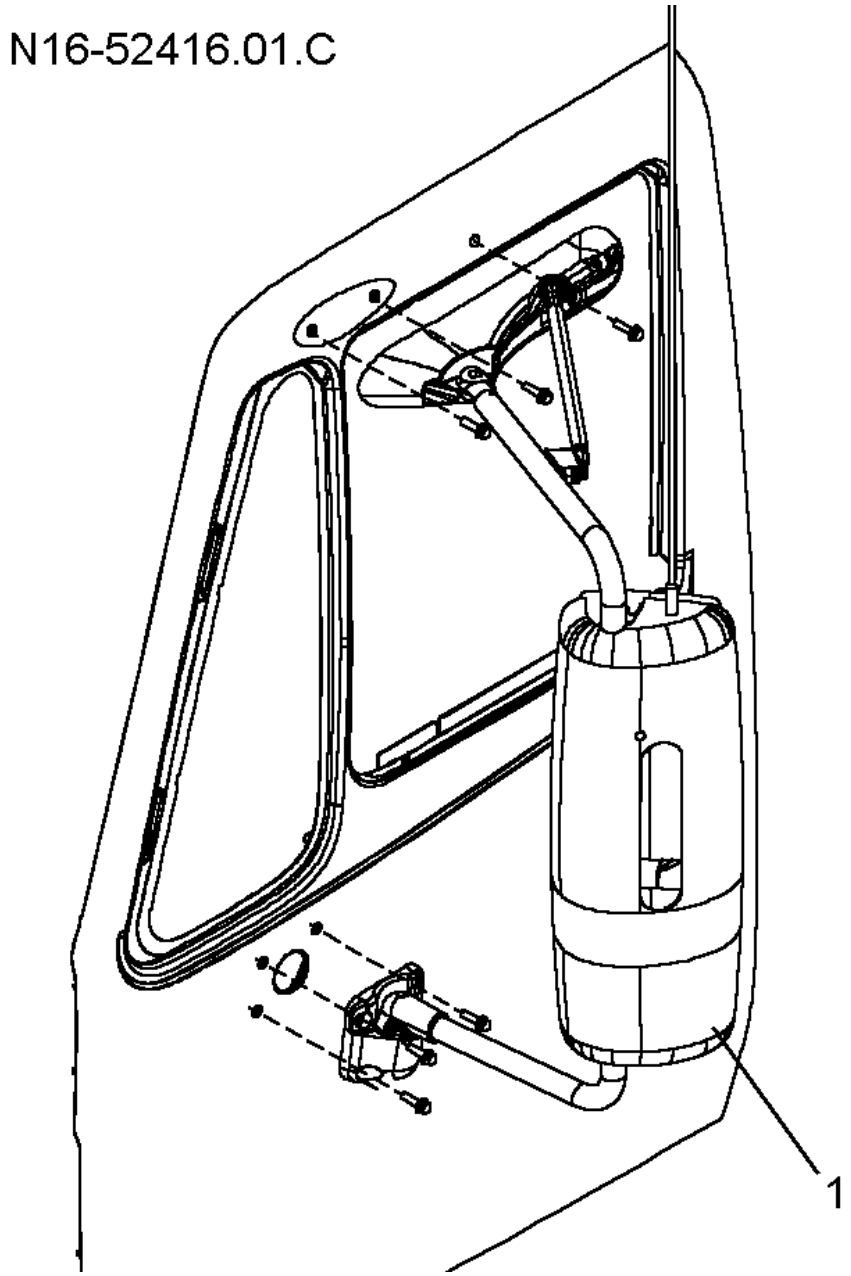

Figure 255 Heated Mirror

1. MIRROR HEATER

10. POWER MIRRORS

10.1. CIRCUIT FUNCTIONS

Refer to power mirror function diagram.

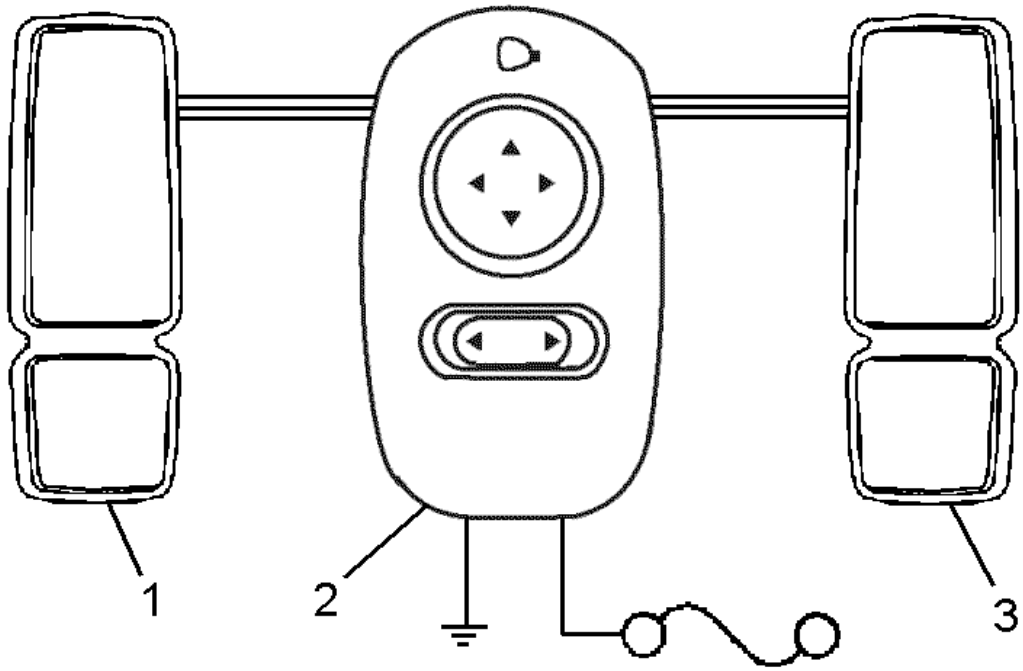

Figure 256 Power Mirrors Function Diagram

1. LEFT MIRROR
2. POWER MIRROR SWITCH
3. RIGHT MIRROR

The power mirror feature allows the driver to adjust the upper mirrors for optimal viewing.

The power mirror switch is directly wired to both mirrors. The mirror controlled by the switch is selected with the left/right selector.

10.2. DIAGNOSTICS

Should the power mirrors fail to operate, the problem could be attributed to a blown fuse F36 (1013), a faulty power mirror switch, a faulty motor in the mirror, open or shorted wiring between the switch and the mirror, or missing power or ground to the switch.

There are no diagnostic trouble codes associated with the power mirror feature.

Power Mirror Preliminary Check

Table 176 Power Mirror Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify power mirrors operate incorrectly.	Check power mirror operation.	Power mirrors operate incorrectly.	Go to next step.	Power mirrors operate correctly. Problem does not exist or is intermittent.
2.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or 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.
3.	On	Does manipulation of the mirror switch operate either mirror at all?	Check if either mirror could be controlled from the switch.	The switch will not control either mirror in any position.	Problem is most likely in power circuits to switch.	Go to next step.
4.	On	Does the left mirror respond correctly to activation of the mirror switch?	Check if the left mirror could be controlled correctly from the switch.	Left mirror responds correctly to activation of the mirror switch.	Go to next step.	Problem is most likely in circuits between switch and left mirror or mirror motor(s).
5.	On	Does the right mirror respond correctly to activation of the mirror switch?	Check if the right mirror could be controlled correctly from the switch.	Right mirror responds correctly to activation of the mirror switch.	Power mirrors operate correctly. Problem does not exist or is intermittent.	Problem is most likely in circuits between switch and right mirror or mirror motor(s).

10.3. POWER MIRROR 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 failure in the power mirror circuits will be apparent when the power mirrors do not operate correctly.

Problems in the power mirror could be attributed to a blown fuse, a faulty power mirror switch, a faulty motor in the mirror, open or shorted wiring between the switch and the mirror, or missing power or ground to the switch.

Refer to power mirror circuits.

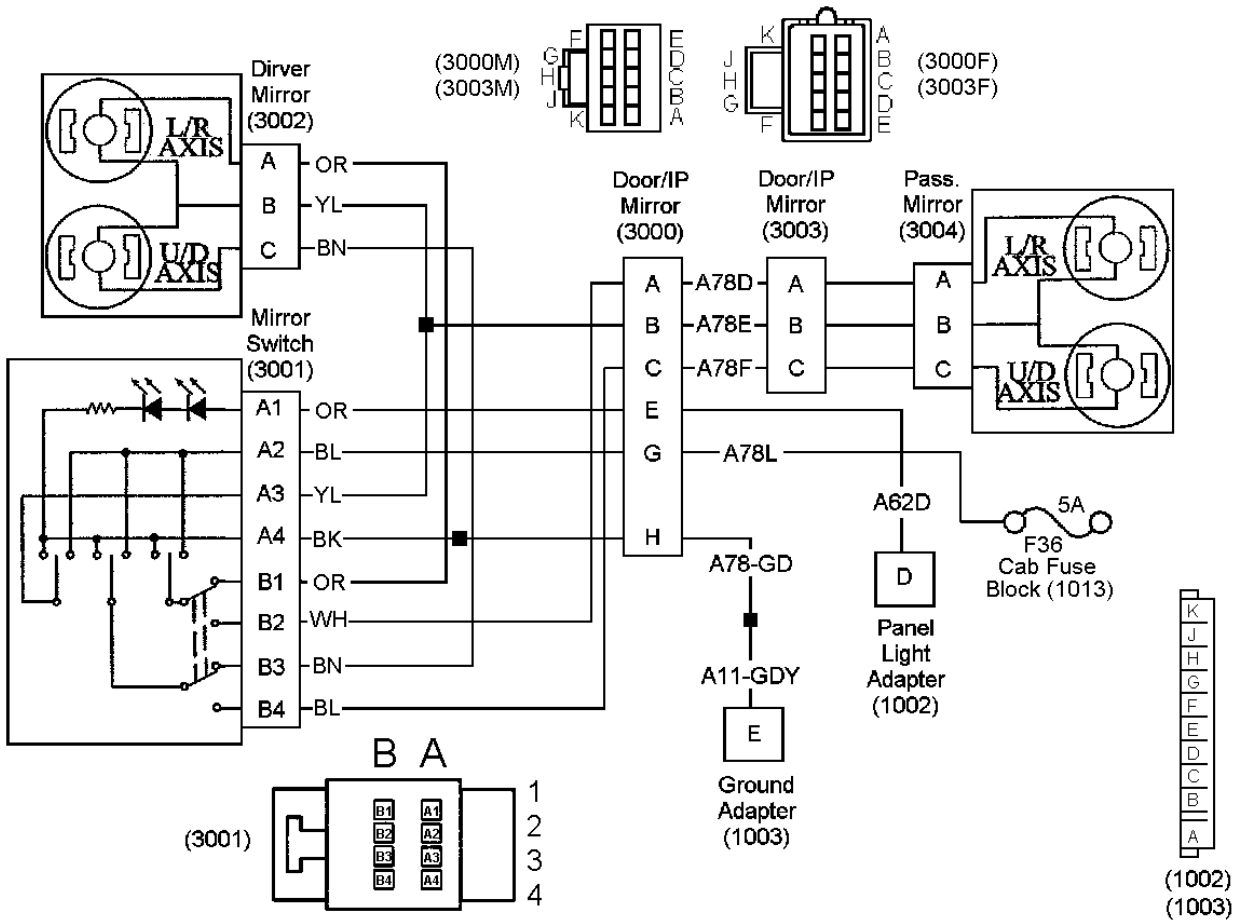

Figure 257 Power Mirror Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1002) PANEL LIGHT ADAPTER
LOCATED BEHIND INSTRUMENT PANEL
(1003) GROUND ADAPTER
LOCATED BEHIND INSTRUMENT PANEL
(3000) DOOR/INSTRUMENT PANEL MIRROR CONNECTOR
LOCATED BELOW INSTRUMENT PANEL NEAR DRIVERS “A” PILLAR
(3001) MIRROR SWITCH
LOCATED ON PASSENGER DOOR
(3002) DRIVER MIRROR CONNECTOR
LOCATED ON DRIVERS MIRROR
(3003) DOOR/INSTRUMENT PANEL MIRROR CONNECTOR
LOCATED BELOW INSTRUMENT PANEL NEAR PASSENGER “A” PILLAR
(3004) PASSENGER MIRROR CONNECTOR
LOCATED ON PASSENGER MIRROR
F36 POWER MIRROR CAB FUSE BLOCK (1013)
LOCATED IN CAB POWER DISTRIBUTION CENTER

Table 177 Power Mirror Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the power windows.		
Power Mirror Switch (3001), Harness Connector Voltage Checks Check with ignition key on and power mirror switch disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Mirror switch harness connector (3001), Cavity A2 to ground.	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between fuse and mirror switch connector. Also check for blown fuse F36.
Mirror switch harness connector (3001), Cavity A4 to ground.	0 volts	Ground circuit. No voltage expected.
Mirror switch harness connector (3001), Cavity A2 to A4.	12 ± 1.5 volts	If voltage is missing, check for open in circuits between ground adapter (1003) and mirror switch connector.
Mirror switch harness connector (3001), Cavity A1 to A4.	Panel light voltage (>10 volts with panel lights turned up).	If voltage is missing, check for open in circuit A62D to panel light adapter (1002). If voltage is present and backlighting doesn't work, replace switch.
Mirror Switch Resistance Check **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Mirror switch connector (3001) cavity A2 to A3.	<1 ohm with up/down left/right switch activated.	If there is no continuity with switch activated, replace mirror switch module.
Mirror switch connector (3001) cavity A2 to A4.	<1 ohm with up/down left/right switch activated.	If there is no continuity with switch activated, replace mirror switch module.
Mirror switch connector (3001) cavity A2 to B1.	<1 ohm with up/down left/right switch activated for driver.	If there is no continuity with switch activated, replace mirror switch module.
Mirror switch connector (3001) cavity A2 to B3.	<1 ohm with up/down left/right switch activated for driver.	If there is no continuity with switch activated, replace mirror switch module.
Mirror switch connector (3001) cavity A2 to B2.	<1 ohm with up/down left/right switch activated for pass.	If there is no continuity with switch activated, replace mirror switch module.
Mirror switch connector (3001) cavity A2 to B4.	<1 ohm with up/down left/right switch activated for pass.	If there is no continuity with switch activated, replace mirror switch module.

Table 177 Power Mirror Tests (cont.)

Driver Power Mirror (3002), Harness Connector Voltage Checks Check with ignition key on and driver power mirror connector disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.** **NOTE – To remove a mirror, tilt the bottom in and sliding the mirror up and out.**		
Test Points	Spec.	Comments
While activating mirror switch to move driver mirror left then right, mirror harness connector (3002), Cavity A to B.	± (12 ± 1.5) volts	If voltage is missing, check for open in circuits between switch and mirror connector. If voltage is present and mirror is inoperative in left/right axis, the mirror motor needs replaced.
While activating mirror switch to move driver mirror up then down, mirror harness connector (3002), Cavity C to B.	± (12 ± 1.5) volts	If voltage is missing, check for open in circuits between switch and mirror connector. If voltage is present and mirror is inoperative in up/down axis, the mirror motor needs replaced.
Passenger Power Mirror (3004), Harness Connector Voltage Checks Check with ignition key on and driver power mirror connector disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
While activating mirror switch to move passenger mirror left then right, mirror harness connector (3004), Cavity A to B.	± (12 ± 1.5) volts	If voltage is missing, check for open in circuits between switch and mirror connector. If voltage is present and mirror is inoperative in left/right axis, the mirror motor needs replaced.
While activating mirror switch to move passenger mirror up then down, mirror harness connector (3004), Cavity C to B.	± (12 ± 1.5) volts	If voltage is missing, check for open in circuits between switch and mirror connector. If voltage is present and mirror is inoperative in up/down axis, the mirror motor needs replaced.

Extended Description

The power mirror switch is supplied voltage at (3001) terminal A2 from power mirror fuse F36 (1013). Ground is supplied at (3001) terminal A4 from ground buss bar (1003).

When the mirror switch is in the driver mirror control position, activating the mirror left/right control will apply voltage and ground to power mirror circuit A78E. The polarity of the voltage on these circuits is reversed between left and right selection.

When the mirror switch is in the driver mirror control position, activating the mirror up/down control will apply voltage and ground to power mirror circuit A78E. The polarity of the voltage on these circuits is reversed between up and down selection.

When the mirror switch is in the passenger mirror control position, activating the mirror left/right control will apply voltage and ground to power mirror circuits A78D and A78E. The polarity of the voltage on these circuits is reversed between left and right selection.

When the mirror switch is in the passenger mirror control position, activating the mirror up/down control will apply voltage and ground to power mirror circuits A78E and A78F. The polarity of the voltage on these circuits is reversed between up and down selection.

Panel light voltage for the power mirror switch lights is provided on terminal A1 from panel light bus bar (1002).

10.4. COMPONENT LOCATIONS

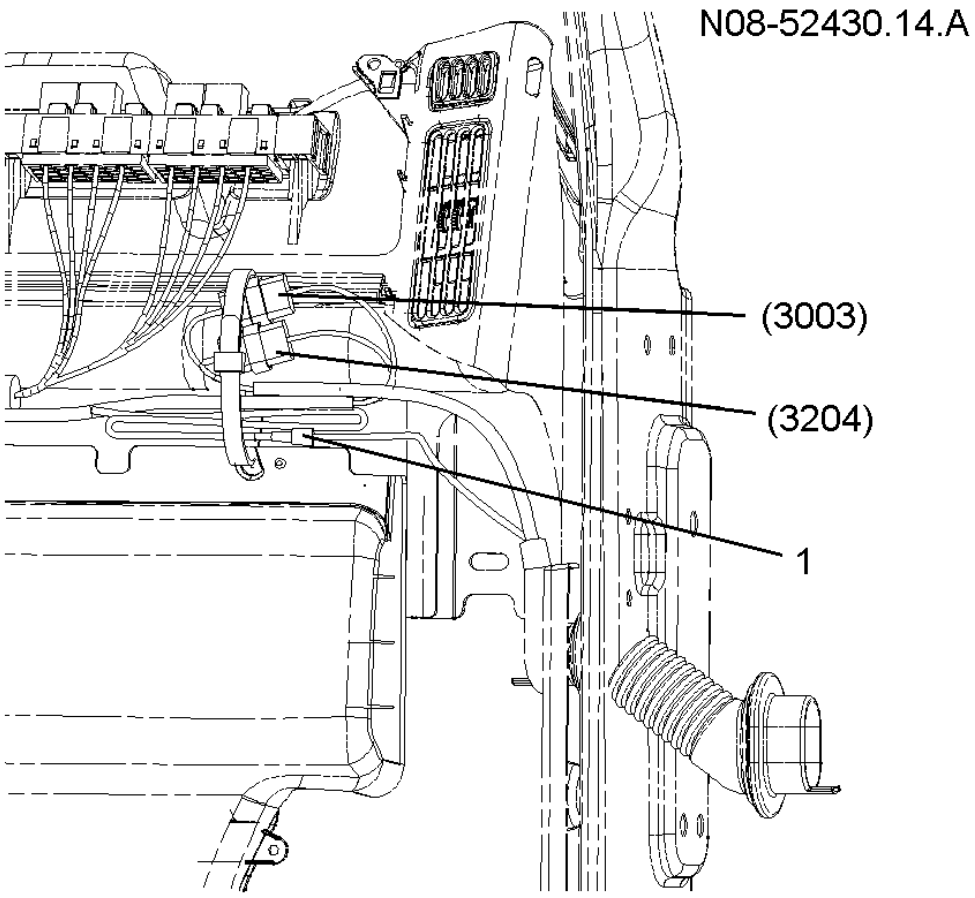

Figure 258 Door Harness Connections (Passengers Side Shown)

1. POWER MIRROR CONNECTOR
2. POWER DOOR CONNECTOR
3. CB ANTENNA CONNECTOR

N08-52388.01

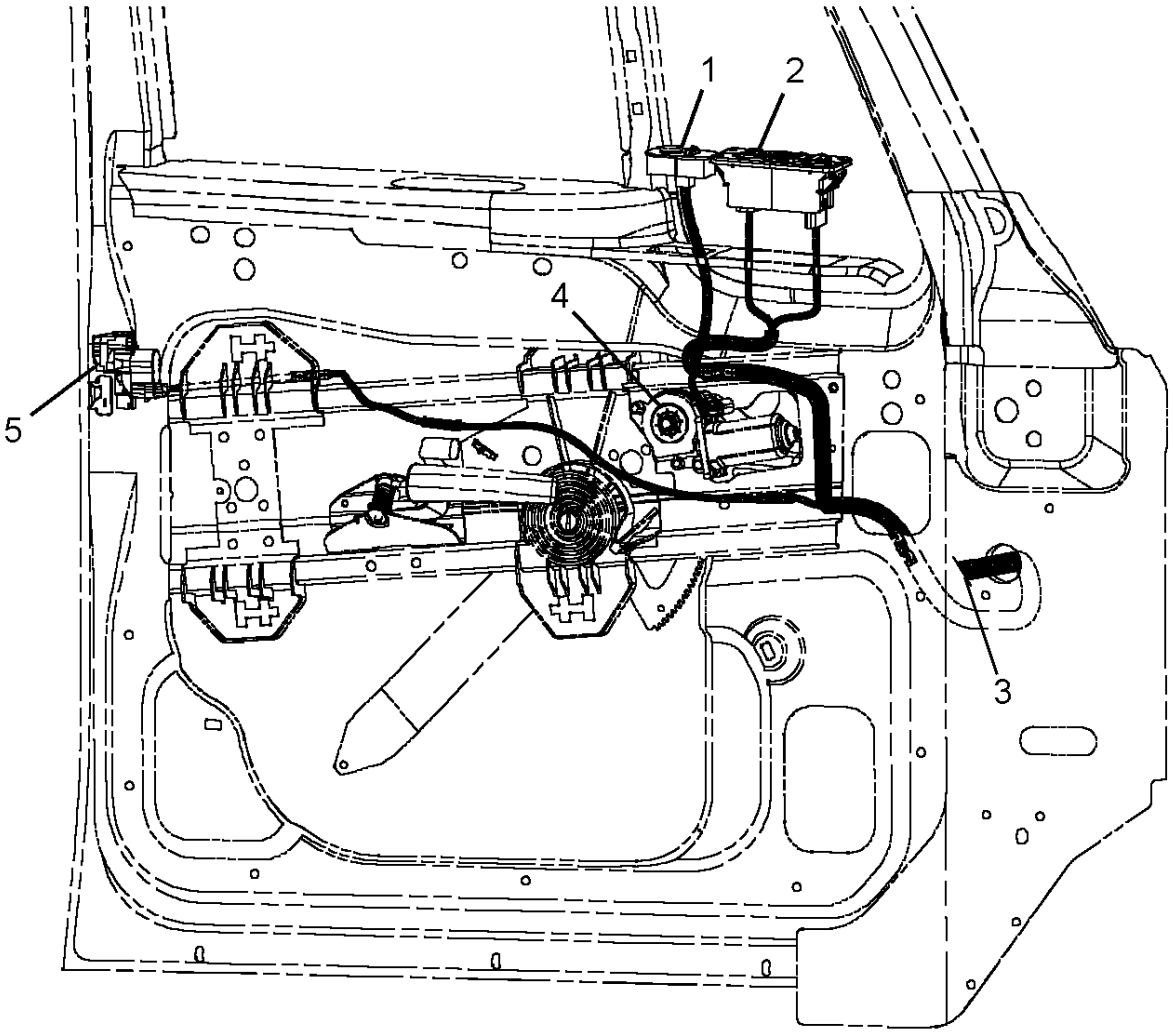

Figure 259 Power Window and Lock Wiring (Drivers Side Shown)

1. POWER MIRROR CONTROL (ONLY ON DRIVERS DOOR)
2. DOOR POD
3. DOOR HARNESS TO DOOR CONNECTOR
4. POWER WINDOW MOTOR
5. POWER LOCK MOTOR

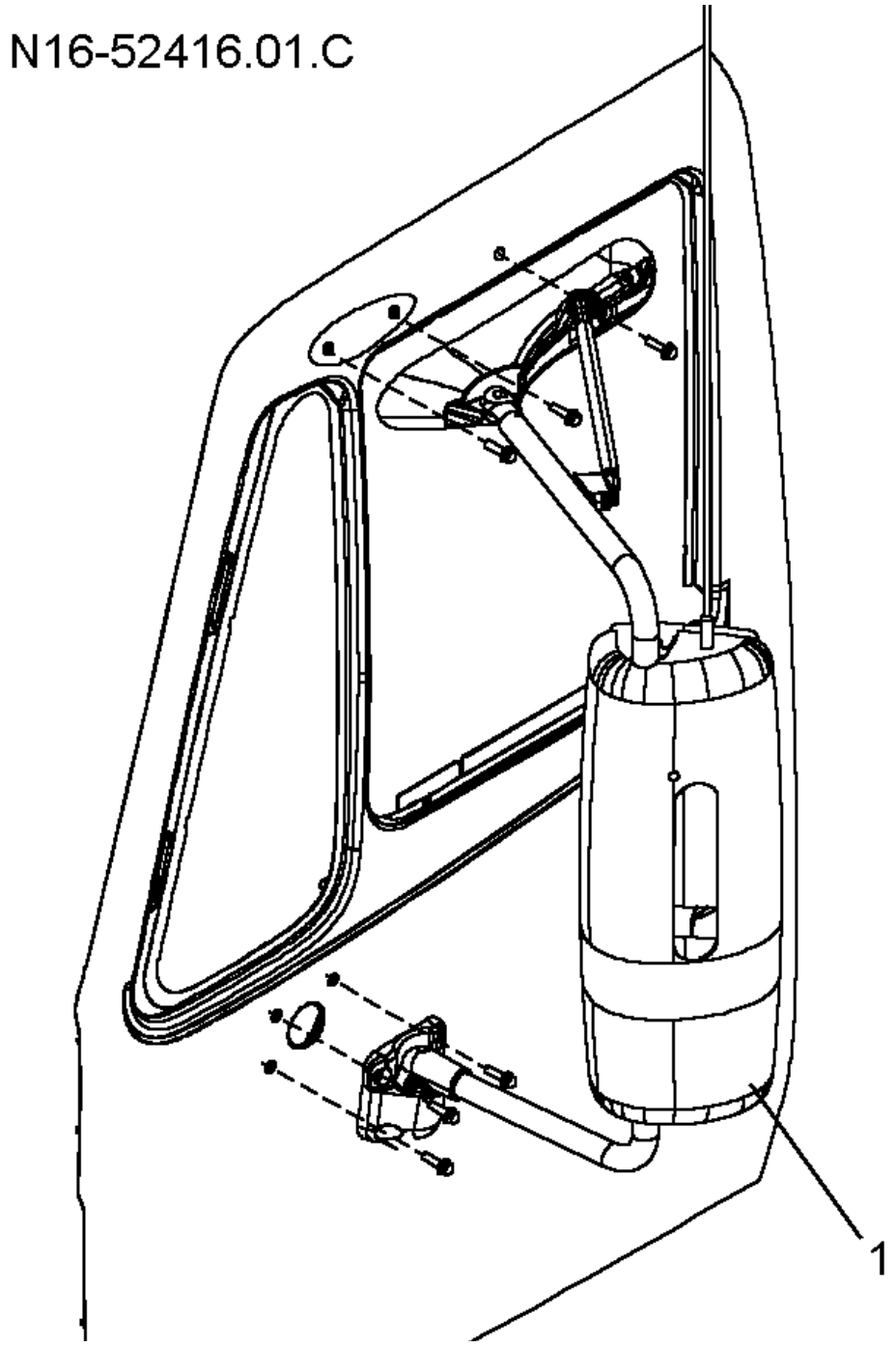

Figure 260 Power Mirror

1. POWER MIRROR MOTORS

11. RADIO (ENTERTAINMENT), SPEAKERS

11.1. CIRCUIT FUNCTIONS

Refer to entertainment radio function diagram.

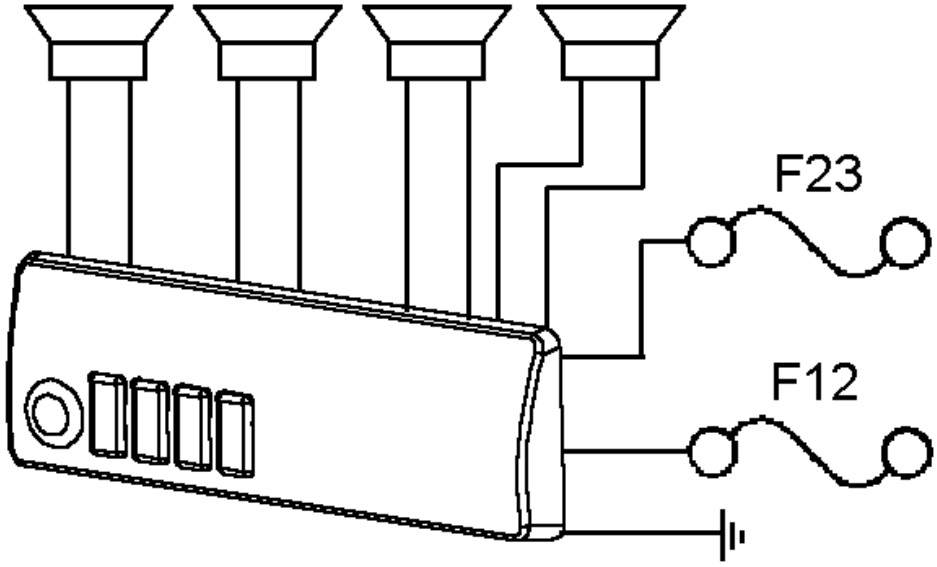

Figure 261 Entertainment Radio Function Diagram

1. ENTERTAINMENT RADIO

The entertainment radio is permanently installed and operates from the vehicle 12 volt system using an external antenna and speakers.

The radio is supplied switched battery voltage to allow it to operate when the key is on. The radio also receives battery voltage to provide power from the radio memory.

Panel light voltage is supplied to the radio for backlighting.

11.2. DIAGNOSTICS

Should the radio fail to operate, the problem could be attributed to open or shorted wiring in power or ground circuits to the radio or a failure in the radio.

There are no diagnostic trouble codes associated with the radio circuits.

Entertainment Radio Preliminary Check

Table 178 Entertainment Radio Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify radio is inoperative.	Check radio operation.	Radio is not operating correctly.	Go to next step.	Radio is operating. Problem does not exist or is intermittent.

Table 178 Entertainment Radio 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 power or 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	Is radio operating but missing sound from one or more, but not all, speakers?	Check if some speakers are inoperative.	All speakers are inoperative.	Go to next step.	Check specific circuits of the inoperative speakers for open or shorted circuits. Also check for broken speakers.
4.	On	Is radio display active when power is turned on.	Check radio display.	Radio display is active when power is turned on.	Remove radio and bench check. Replace radio if it fails bench check.	Go to radio power circuits. (See ENTERTAINMENT RADIO POWER CIRCUITS, page 533)

11.3. ENTERTAINMENT RADIO 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.

A fault in the radio power circuits will be apparent when the radio display is not active when the radio is turned on.

Problems in the radio power circuits could be attributed to blown fuses, shorted or open circuits to power or ground, or a failed radio.

Refer to entertainment radio power circuits.

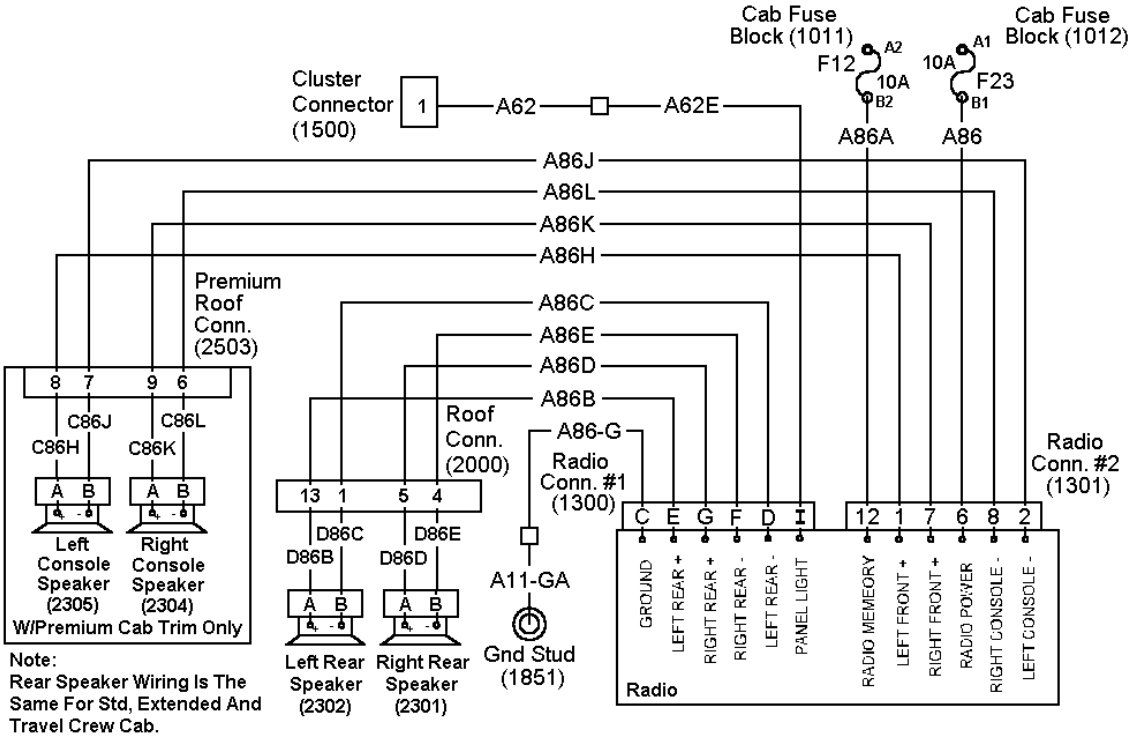

Figure 262 Entertainment Radio Power Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1300) RADIO CONNECTOR #1
LOCATED BEHIND RADIO
(1301) RADIO CONNECTOR #2
LOCATED BEHIND RADIO
(1500) CLUSTER CONNECTOR (PANEL LIGHT VOLTAGE)
LOCATED BEHIND ELECTRONIC GAUGE CLUSTER
(1851) GROUND STUD
LOCATED ABOVE ESC
F12 CAB FUSE BLOCK (1011)
LOCATED IN CAB POWER DISTRIBUTION CENTER
F23 CAB FUSE BLOCK (1012)
LOCATED IN CAB POWER DISTRIBUTION CENTER

Table 179 Entertainment Radio Tests

Diagnostic Trouble Codes
There are no diagnostic trouble codes associated with the entertainment radio.
Radio Connectors (1300) & (1301) Voltage Checks Check with ignition key on and radio connectors disconnected. The radio adapter harness may have the two connectors into one connector. **NOTE – Always check connectors for damage and pushed–out terminals.**

Table 179 Entertainment Radio Tests (cont.)

Test Points	Spec.	Comments
Radio (1301) pin 6 or (1300) pin B to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86 between F23 and connector. Also insure fuse is not blown.
Radio (1301) pin 12 or (1300) pin O to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86A between F12 and connector. Also insure fuse is not blown.
Radio (1300) pin C to Radio (1301) pin 12	12 ± 1.5 volts	If voltage is incorrect, check for open or shorts in circuits between Radio (1300) and ground.
Radio (1300) pin I to ground (With panel dimmer turned up)	>10 volts.	If voltage is missing, check for open in circuit A62E to electronic gauge cluster.
Replace the radio adapter harness or entertainment radio.		

Extended Description

The entertainment radio receives radio memory power at radio connectors (1300) pin O or (1301) pin 12 from fuse F12. Operating power is provided at radio connectors (1300) pin B or (1301) pin 6 from fuse F23.

Ground for the radio is supplied at radio connectors (1300) pin C or (1301) pin 5 from ground stud (1851).

Panel light dimmer voltage is supplied at radio connector (1300) pin I from electronic gauge cluster connector (1500) cavity 1.

11.4. COMPONENT LOCATIONS

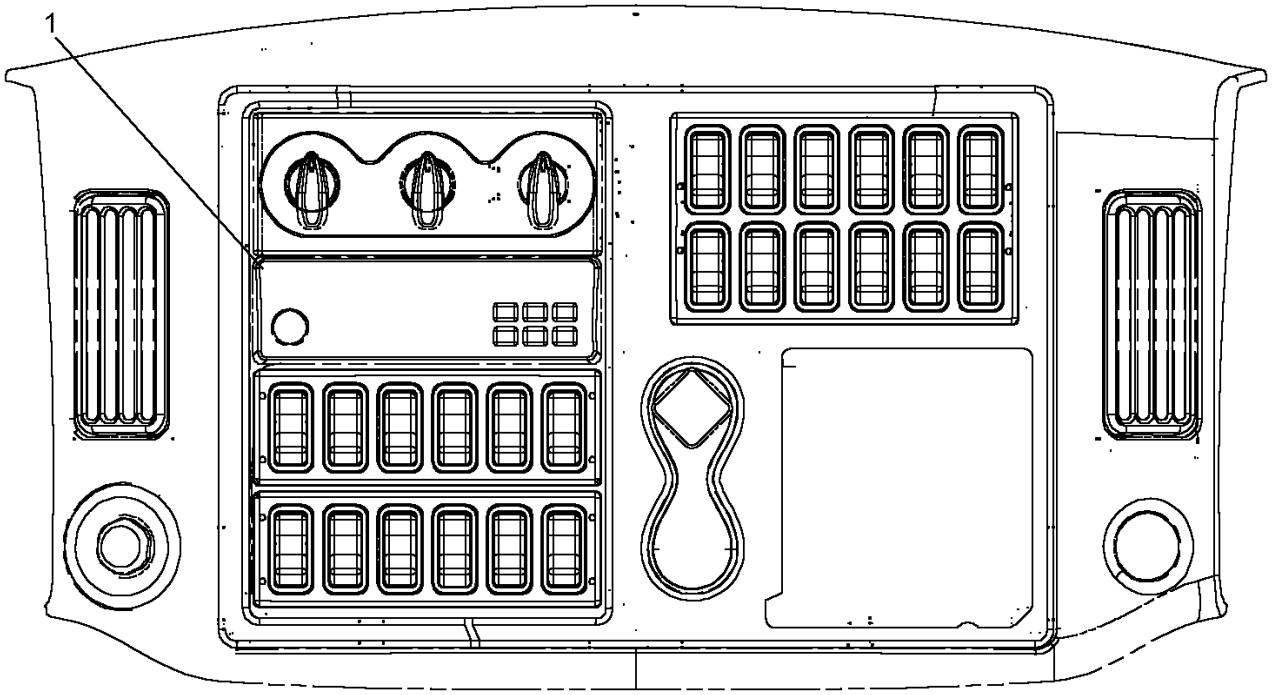

Figure 263 Entertainment Radio Location

1. ENTERTAINMENT RADIO

12. WINDSHIELD WIPER AND WASHER PUMP

12.1. CIRCUIT FUNCTIONS

Circuit Functions

Refer to Washer and Wiper function diagram.

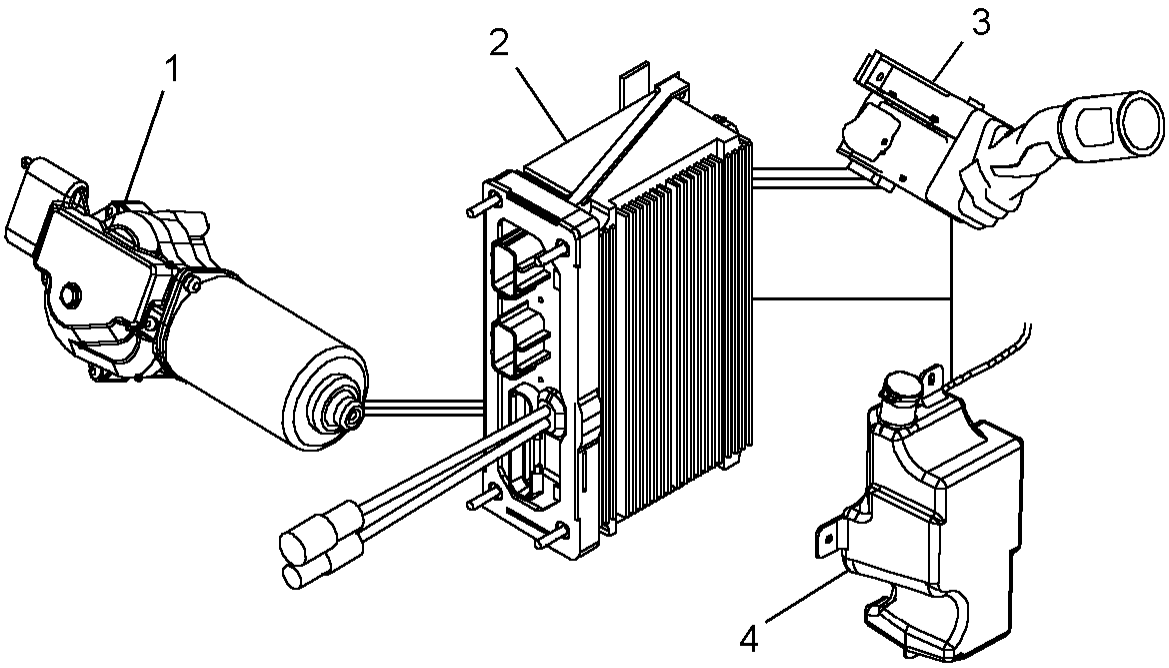

Figure 264 Washer and Wiper Function Diagram

1. WIPER MOTOR
2. ELECTRICAL SYSTEM CONTROLLER
3. TURN SIGNAL WASHER/WIPER CONTROL
4. WASHER BOTTLE (WITH WASHER PUMP MOTOR)

Windshield wiper functions Include, low wipers, high wipers, intermittent wipers, wiper park, windshield washer and washer fluid level.

The wiper switches are direct inputs to the ESC (not multiplexed). The switches determine the speeds controlled by the ESC.

The ESC provides battery voltage on a 20 amp circuit to the wiper motor park circuits and two wiper control relays.

The wiper power relay switches control of the wiper motor from park circuit control to ESC circuit control.

While the ignition is on, the windshield washer will always come on when the washer switch is activated. The washer pump is directly connected to the washer switch and is not controlled by the ESC. There is also an input from the washer switch to the ESC. If the windshield washer is requested and the current wiper speed is not high, the wipers shall be set to low speed and stay in low speed for a set amount of time after the request. If the windshield washer is requested and the current wiper speed is high, the wipers speed will remain high.

The windshield wipers have eight speeds: off, high, low, and five different intermittent speeds. These are determined by the condition of the three wiper switches in the turn signal assembly.

When the wipers are turned off, while the ignition is on, the wipers will automatically park. The wiper park circuits also control the cycle of the intermittent wiper sweep.

12.2. DIAGNOSTICS

Faults with the wiper and washer systems are apparent when the wiper or washers do not operate correctly. The ESC will also log diagnostic trouble codes for some types of failures.

There is no shortcut available to identify if a problem is caused by failures with inputs to the ESC or failures in circuits out of the ESC. The “INTUNE” software can identify if switch inputs are reaching the ESC. It can also override switch inputs to test outputs from the ESC. Using the software will allow you to quickly identify if the problem is with an input to the ESC or an output from the ESC. If the software is not available check output circuits, then check switch input circuits to the ESC.

A problem with wiper operation could be attributed to an open or short in the wiper switch, missing power or ground to the wiper motor, open or shorted wires, a failed relay, a bad wiper motor or an internal problem in the ESC.

A problem with washer operation could be attributed to an open or short in the washer switch, missing power or ground to the washer pump motor, open or shorted wires, or a bad washer pump motor.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to request operation of the wiper motor and monitor activation of the wiper switches. See the diagnostic software manual for details on using the software.

Wiper and Washer Preliminary Check

Table 180 Wiper and Washer Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify washer or wipers are not operating incorrectly.	Attempt to operate washer and wipers.	Washer or wipers are **not** operating correctly.	Go to next step.	Washer and wipers are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
2.	On	Determine if any other 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 if washer is operating correctly.	Attempt to operate washer.	Washer is operating correctly.	Go to next step.	Go to washer circuits. (See WASHER CIRCUITS, page 540)

Table 180 Wiper and Washer Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
4.	On	Are wipers working correctly except for wiper parking?	Visually check if wipers work correctly except for wiper parking.	Wipers work correctly except for wiper parking.	Go to wiper park circuits. (See WIPER PARK CIRCUITS, page 551)	Go to next step.
5.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 539)	Read display on odometer.	No wiper diagnostic trouble codes are active.	Go to next step.	Go to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
6.	There is no shortcut available to identify if a problem is caused by failures with switch inputs to the ESC or failures in circuits out of the ESC. The “INTUNE” software can identify if switch inputs are reaching the ESC. It can also override switch inputs to test outputs from the ESC. Using the software will allow you to quickly identify if the problem is with an input to the ESC or an output from the ESC. If the software is not available check output circuits, then check switch input circuits to the ESC. Go to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545) Go to Wiper Input Circuits to the ESC. (See WIPER CIRCUIT INPUTS TO ESC, page 542)					

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 181 Wiper Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
611 14 6 1	Wiper power under current. 4008 pin F. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)

Table 181 Wiper Diagnostic Trouble Codes (cont.)

611 14 6 2	**NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** Wiper power over current. 4008 pin F. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
611 14 6 3	Wiper power, less than normal low current but more than open circuit
611 14 6 4	Wiper power, greater than normal high current and less than fusing current
611 14 6 6	Wiper power has current flow when output commanded off
2033 14 8 1	Wiper high–low relay circuit overloaded. Connector 4004 pin 20 current overload. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
2033 14 8 2	Wiper high–low relay circuit open circuit. Connector 4004 Pin 20 open. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
2033 14 8 3	Wiper high–low relay circuit shorted to ground. Connector 4004 Pin 20 shorted to ground. Shorted to ground or defective relay. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
2033 14 14 1	Wiper on relay circuit overloaded. Connector 4004 pin 29 current overload. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
2033 14 14 2	Wiper on relay circuit open circuit. Connector 4004 Pin 29 open. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)
2033 14 14 3	Wiper on relay circuit shorted to ground. Connector 4004 Pin 29 shorted to ground. Shorted to ground or defective relay. Refer to Wiper Motor Circuits. (See WIPER MOTOR CIRCUITS, page 545)

12.3. WASHER 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 washer system will be apparent when the washers do not operate correctly. There are no diagnostic trouble codes associated with the washer circuits.

A problem with washer operation could be attributed to an open or short in the washer switch, missing power to the washer pump motor, open or shorted wires or a failed washer pump motor.

Refer to washer pump circuits.

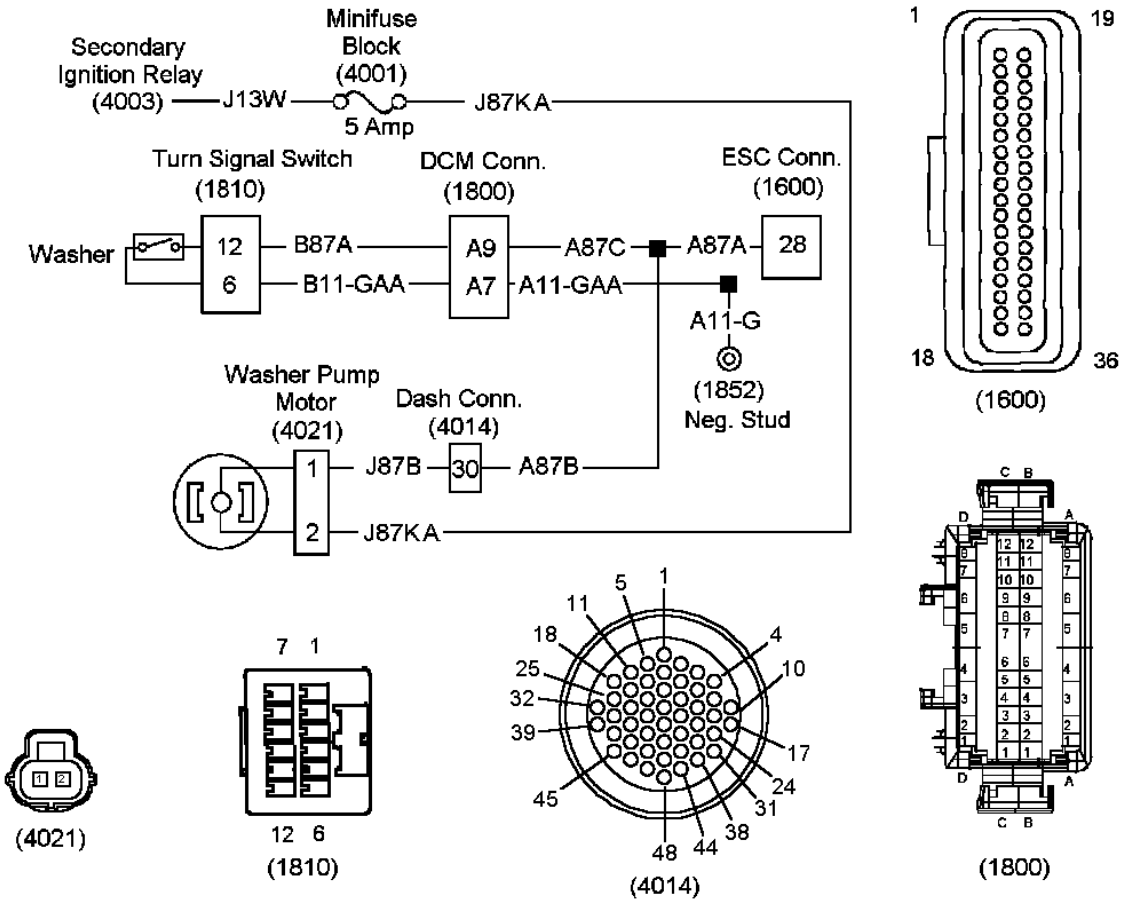

Figure 265 Washer Pump Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

J13W TO SECONDARY IGNITION RELAY
(1600) 36–WAY SYSTEM CONTROLLER CONNECTOR
(1800) CAB HARNESS/DCM CONNECTOR
(1810) TURN SIGNAL SWITCH CONNECTOR
(1852) NEGATIVE STUD
(4001) MINIFUSE BLOCK
(4003) SECONDARY IGNITION RELAY
(4014) DASH PASS THROUGH CONNECTOR
(4021) WASHER PUMP CONNECTOR (ON WASHER BOTTLE)

Table 182 Washer Connector Tests

Washer Pump Connector (4021) Voltage Checks Check with ignition on and pump connector (4021) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Pump harness connector (4021) cavity 2 to ground	12 ± 1.5 volts	If voltage is missing, check for blown fuse or open or short in circuit J87KA to mini fuse block.
Without washer switch activated, pump harness connector (4021) cavity 1 to ground	12 ± 1.5 volts	Tests circuit between ESC and pump motor. If voltage is missing, check for open or short in circuit J87B, A87B, A87A or A87C. Also check for incorrect voltage from ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.** A short to ground would cause the washer to operate continuously.
With washer switch activated, Pump harness connector (4021) cavity 1 to cavity 2.	12 ± 1.5 volts	Tests circuits from ground through washer switch to washer pump motor. If voltage is incorrect check for open circuits from (4021) cavity 1, through closed washer switch, to ground. Disconnect (1810) and jumper pins 12 to 6, if voltage is correct, replace washer switch. Repair circuits. If voltage is correct and washers are inoperative, replace washer pump motor.

Extended Description

The washer pump motor is wired directly to the washer switch, in the turn signal switch assembly. 12 volts to the washer pump motor is provided from a 5 amp fuse in the minifuse block, within the engine compartment power distribution panel. When the washer switch is depressed, a ground will be supplied to the washer pump motor. This will cause the pump to run until the washer switch is released. The ground from the washer switch is also applied to ESC connector (1600) terminal 28. This will signal the ESC that the washer has been activated. The ESC will activate the low speed wipers for several wipes.

12.4. WIPER 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 wiper circuit inputs to the ESC will be apparent when the wipers don't operate correctly and there are no active wiper diagnostic trouble codes. Problems in the wiper input circuits could be attributed to short circuits, open circuits, a faulty switch or a problem in the ESC.

NOTE – Open circuits or failed switches may cause high speed wipers to operate when they haven't been selected.

Refer to wiper switch input circuits.

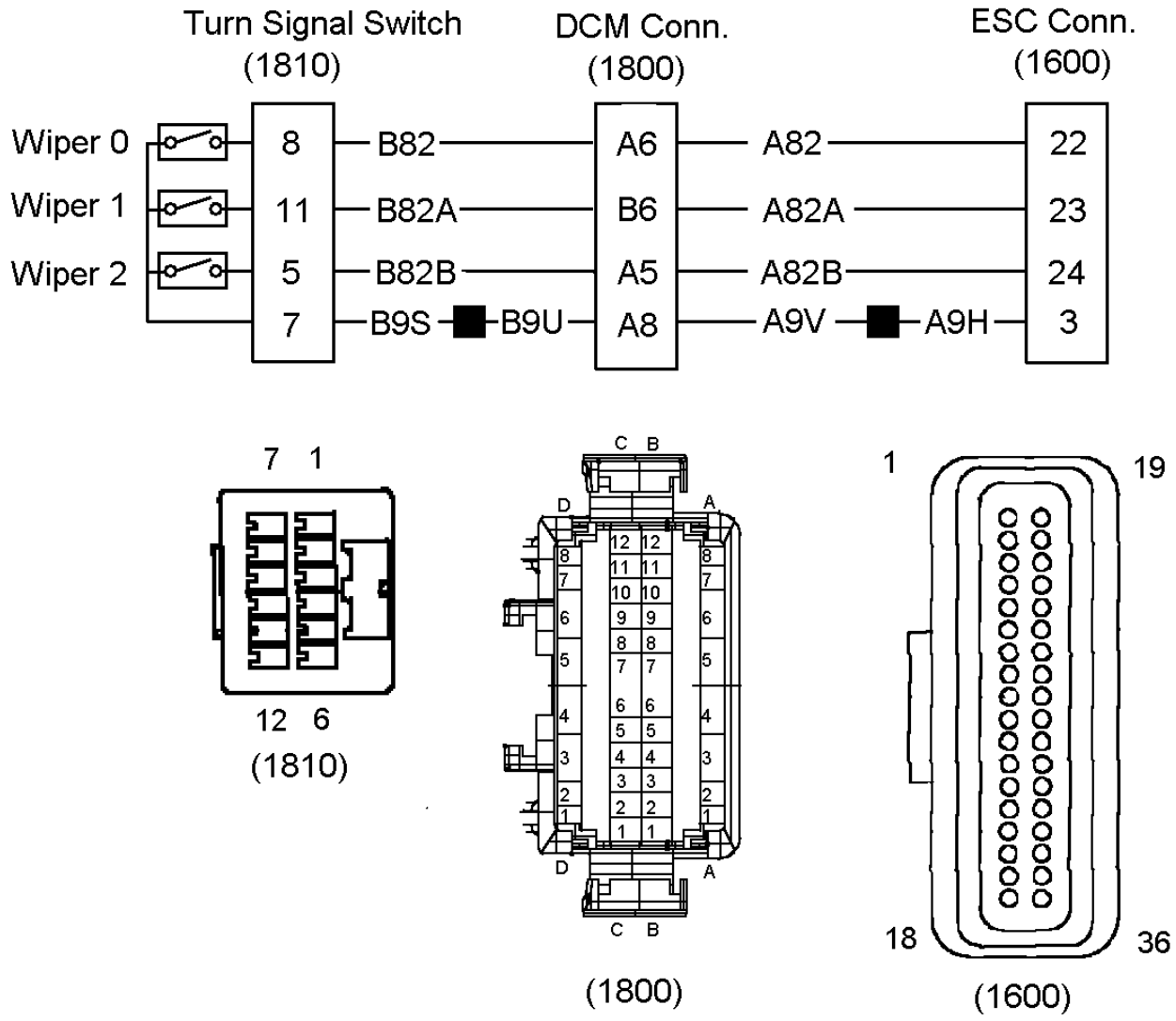

Figure 266 Wiper Switch Input Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1600) 36–WAY SYSTEM CONTROLLER CONNECTOR
(1800) DCM CONNECTOR—DRIVER CONTROL MODULE HARNESS SHOWN
(1810) TURN SIGNAL SWITCH CONNECTOR

Table 183 Wiper Switch Input Tests

Turn signal switch Harness Connector (1810) Voltage Checks Check with ignition key on and connector (1810) removed. **NOTE – Voltage to the switch will be approximately 5 volts with the key off.** **NOTE – The high speed wipers and head lights should come on when connector (1810) is disconnected. Disconnect wiper motor connector (4015) to disable wiper during checks.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
(1810) harness connector, pin 8 to ground	11 ± 1.5 volts	If voltage is missing, check for open in circuits B82 or A82. If circuits check good and problem is still present, verify voltage out of ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
(1810) harness connector, pin 11 to ground	11 ± 1.5 volts	If voltage is missing, check for open in circuits B82A or A82A. If circuits check good and problem is still present, verify voltage out of ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
(1810) harness connector, pin 5 to ground	11 ± 1.5 volts	If voltage is missing, check for open in circuits B82B or A82B. If circuits check good and problem is still present, verify voltage out of ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
(1810) harness connector, pin 7 to ground	<2 Volts	Zero volt reference level. No voltage expected. If voltage is incorrect, check for shorts to voltage or incorrect output from ESC.
Reconnect wiper motor connector (4015). Reconnect turn signal switch harness connector (1810) and wiper stops operating. Ignition key off and on, ESC turns off headlights. Operate wiper speed control in the turn signal switch through all eight speeds, if wiper fails to operate and no diagnostic trouble codes are generated, replace switch.		

Table 183 Wiper Switch Input Tests (cont.)

Wiper Speed Control Switch in the Turn Signal Switch Connector (1810) Resistance Checks Check with ignition key off and turn signal connector (1810) removed. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Operate wiper speed control to the OFF position, check for continuity between pin 7 and pins 5, 8, and 11.	<1 ohm	If there is no continuity, replace turn signal switch.
Operate wiper speed control to the HI position, check for continuity between pin 7 and pins 5, 8, and 11.	>100K ohms	If there is continuity, replace turn signal switch.

Extended Description

The three wiper switches, in the turn signal assembly, are wired directly to the ESC. When the three wiper switches are turned on, 0 volt reference on pin 3 from the ESC will pass through the wiper switch 0 to pin 22 in the ESC, the wiper switch 1 to pin 23 in the ESC and the wiper switch 2 to pin 24 in the ESC. This will cause the ESC to send 12 volts to the windshield wipers and operate eight speeds (off, high, low, and five different intermittent speeds).

12.5. WIPER MOTOR 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 wiper motor circuits will be apparent when the high or low speed wipers don't work. The ESC will log an active diagnostic trouble code when there is a short or open in the wiper power relay R1 circuits or the wiper high-low relay circuits. Problems in the wiper circuits could be attributed to a failed relay, a failed motor, a tripped wiper motor circuit breaker, a short, an open or a problem in the ESC.

Refer to wiper circuits.

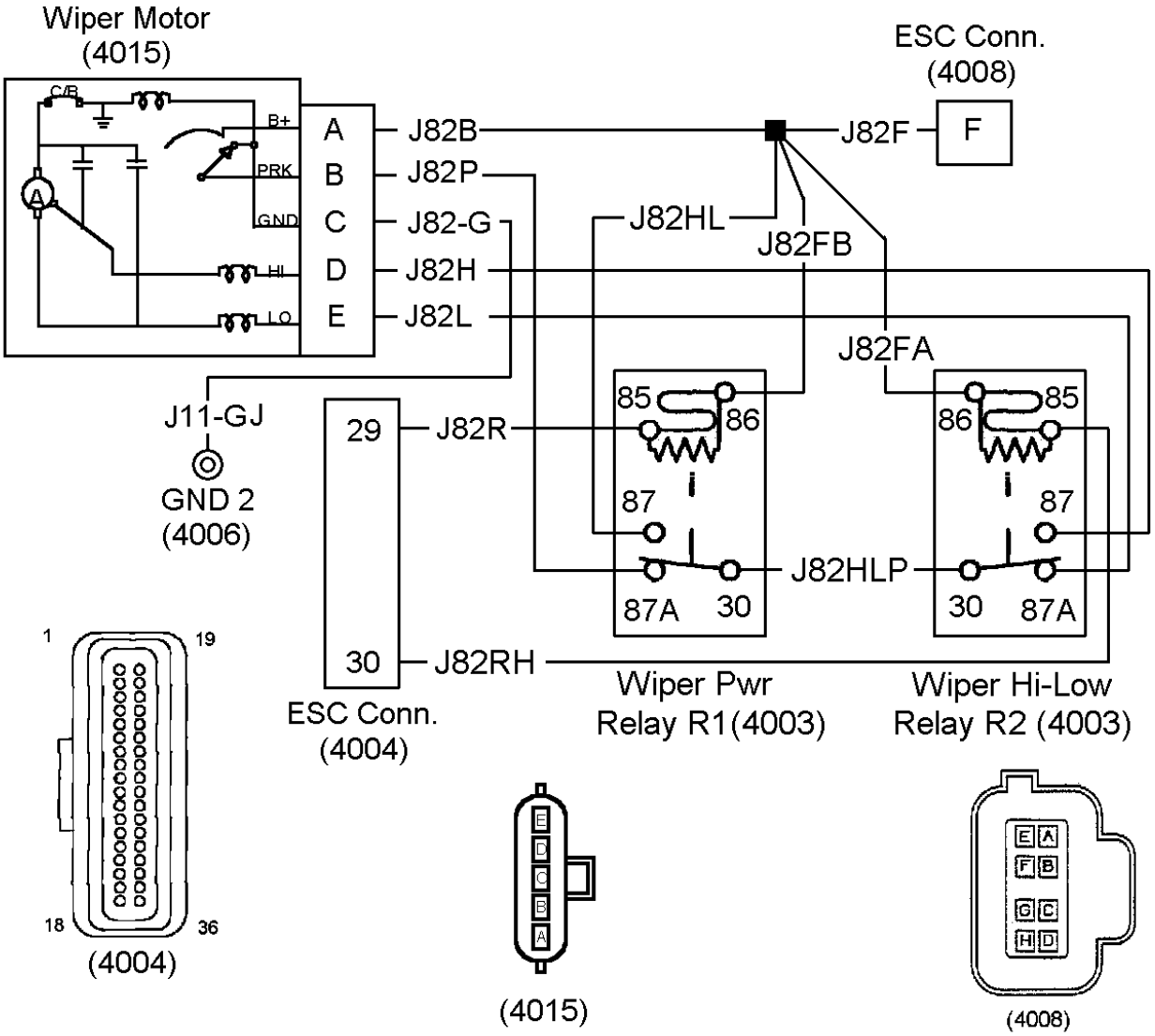

Figure 267 Wiper Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

R1 (4003) WIPER POWER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
R2 (4003) WIPER HIGH–LOW RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) 36–WAY SYSTEM CONTROLLER CONNECTOR
(4008) 8–WAY BLUE SYSTEM CONTROLLER CONNECTOR
(4006) GROUND STUD
(4015) WIPER MOTOR CONNECTOR

Table 184 Wiper Motor Diagnostic Trouble Codes

Diagnostic Trouble Codes	
611 14 6 3	Wiper power, less than normal low current but more than open circuit
611 14 6 4	Wiper power, greater than normal high current and less than fusing current
611 14 6 6	Wiper power has current flow when output commanded off
611 14 6 2	Wiper power over current
This diagnostic trouble code is logged when there is a short to ground or an excessive load in a circuit connected to the wiper power output of ESC connector (4008) pin F. **NOTE – The virtual fuse in the ESC will trip during a short. To reset the fuse, the key switch must be cycled.** **NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.** Turn off wipers and disconnect wiper motor connector (4015). Cycle key switch and clear diagnostic trouble code codes. Turn on the high speed wipers. If the diagnostic trouble code doesn't reoccur, there is a short or an overload in the wiper motor. If the diagnostic trouble code reoccurs, there is a short in the circuits to the wiper relays or between the ESC and the wiper motor, or in the ESC. Disconnect blue ESC connector (4008). Cycle key switch and clear diagnostic trouble code codes. Turn on the high speed wiper and check for diagnostic trouble codes. If the diagnostic trouble code doesn't reoccur, there is a short in the circuits between the ESC and the wiper motor. If the diagnostic trouble code reoccurs, there is a short inside the ESC. Check high speed wiper voltage between harness connector (4015) pin D and C.	
611 14 6 1	Wiper power under current
This diagnostic trouble code is logged when the wipers are turned on and there is an open in circuits between the high speed wiper motor output of the ESC, through the motor, and ground. Check for open circuits or tripped wiper motor circuit breaker. Check high speed wiper voltage between harness connector (4015) pin D and C with high speed wiper switch on.	
2033 14 14 1	Wiper on relay driver overloaded. Connector 4004 pin 29 current overload. To much load attached or defective relay.

Table 184 Wiper Motor Diagnostic Trouble Codes (cont.)

This diagnostic trouble code is logged when there is an overload in the circuits between wiper power relay R1 and the ESC, an excessive load on the circuit or a high resistance in the relay coil. **NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.** Remove wiper power relay R1. Clear diagnostic trouble code codes and turn on the high speed wipers. If the diagnostic trouble code doesn't reoccur, there is a short or an overload in the relay. If the diagnostic trouble code reoccurs, there is a short in the circuits between the relay socket and the ESC, or in the ESC. Disconnect ESC connector (4004), and clear diagnostic trouble codes. Turn on the high speed wiper and check for diagnostic trouble codes. If the diagnostic trouble code doesn't reoccur, there is an overload in the circuits between the ESC and the relay. If the diagnostic trouble code reoccurs, there is an overload inside the ESC.	
2033 14 14 2	Wiper on relay driver circuit open circuit.
Connector 4004 Pin 29 open. Open circuit or defective relay. This diagnostic trouble code is logged when wipers are turned on and there is an open in circuits between ESC connector (4004) pin 29, through the wiper power relay, and ground. Check for open circuits or open relay coil.	
2033 14 14 3	Wiper on relay driver circuit shorted. Connector 4004 pin 29 shorted to ground. short circuit or defective relay.
This diagnostic trouble code is logged when there is a short in the circuits between wiper power relay R1 and the ESC, an excessive load on the circuit or a short in the relay coil. **NOTE – Disconnecting connectors will cause new open circuit diagnostic trouble codes to be logged. Clear all diagnostic trouble codes after connections have been restored.** Remove wiper power Relay R1. Clear diagnostic trouble code codes and turn on the high speed wipers. If the diagnostic trouble code doesn't reoccur, there is a short or an overload in the relay. If the diagnostic trouble code reoccurs, there is a short in the circuits between the relay socket and the ESC, or in the ESC. Disconnect ESC connector (4004), and clear diagnostic trouble codes. Turn on the high speed wiper and check for diagnostic trouble codes. If the diagnostic trouble code doesn't reoccur, there is a short in the circuits between the ESC and the relay. If the diagnostic trouble code reoccurs, there is a short inside the ESC.	
2033 14 8 1	Wiper high–low relay driver overloaded. Connector 4004 pin 20 current overload. To much load attached or defective relay.

Table 184 Wiper Motor Diagnostic Trouble Codes (cont.)

<table>
<tr><td colspan="2">This diagnostic trouble code is logged when there is an overload in the circuits between wiper power relay R2 and the ESC, an excessive load on the circuit or a high resistance in the relay coil.

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

Remove high–low relay R2. Clear diagnostic trouble code codes and turn on the high speed wipers. If the diagnostic trouble code doesn't reoccur, there is a short or an overload in the relay. If the diagnostic trouble code reoccurs, there is a short in the circuits between the relay socket and the ESC, or in the ESC.

Disconnect ESC connector (4004), and clear diagnostic trouble codes. Turn on the high speed wiper and check for diagnostic trouble codes. If the diagnostic trouble code doesn't reoccur, there is an overload in the circuits between the ESC and the relay. If the diagnostic trouble code reoccurs, there is an overload inside the ESC.</td></tr>
<tr><td>2033 14 8 2</td><td>Wiper high–low relay driver circuit open circuit.</td></tr>
<tr><td colspan="2">Connector 4004 Pin 20 open. Open circuit or defective relay.

This diagnostic trouble code is logged when high wipers are turned on and there is an open in circuits between ESC connector (4004) pin 20, through the wiper power relay, and ground.

Check for open circuits or open relay coil.</td></tr>
<tr><td>2033 14 8 3</td><td>Wiper high–low relay driver circuit shorted. Connector 4004 pin 20 shorted to ground, short circuit or defective relay.</td></tr>
<tr><td colspan="2">This diagnostic trouble code is logged when there is a short in the circuits between wiper high–low relay R2 and the ESC, an excessive load on the circuit or a short in the relay coil.

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

Remove wiper high–low relay R2. Clear diagnostic trouble code codes and turn on the high speed wipers. If the diagnostic trouble code doesn't reoccur, there is a short or an overload in the relay. If the diagnostic trouble code reoccurs, there is a short in the circuits between the relay socket and the ESC, or in the ESC.

Disconnect ESC connector (4004), and clear diagnostic trouble codes. Turn on the high speed wiper and check for diagnostic trouble codes. If the diagnostic trouble code doesn't reoccur, there is a short in the circuits between the ESC and the relay. If the diagnostic trouble code reoccurs, there is a short inside the ESC.</td></tr>
</table>

Table 185 Wiper Motor Voltage Checks

Wiper Motor Harness Connector (4015) Voltage Checks Check with ignition on and (4015) disconnected. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
(4015) Harness connector, pin A to ground	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for short or open in circuit J82B or J82F. If circuits check good check for voltage from ESC connector (4008) pin F. **NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage from pin F.** If voltage is missing consider replacing ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 123)
(4015) Harness connector, pin A to pin C.	12 ± 1.5 volts	If voltage is missing, check for open in circuits J82–G or J11–GJ to ground.
With wiper switch in low selection (4015) Harness connector, pin E to ground	With low speed wiper switch on, 12 ± 1.5 volts. With low speed wiper switch off and wipers parked, 0 volts.	If voltage is incorrect, check for open or short in circuit J82L and perform wiper relay R1 and R2 circuit checks. If circuit and relays check good, verify voltage out of ESC.
(4015) Harness connector, pin D to ground	With high speed wiper switch on, 12 ± 1.5 volts With low speed wiper switch off, 0 volts	If voltage is incorrect, check for open or short in circuit J82H and perform wiper relay R1 and R2 circuit checks. If circuit and relays check good, verify voltage out of ESC.

Extended Description

When the key is on the ESC will supply battery voltage to blue connector (4008) pin F. This voltage is applied to wiper motor connector (4015) cavity A, wiper power relay R1 pins 4 and 5, and wiper high–low relay R2.

When high or low wipers are selected the ESC will supply a ground from system controller connector (4004) terminal 29 to wiper power relay 94003) R1 terminal 2. This will energize the wiper power relay and apply 12 volts to the common contact of wiper high–low relay (4003) R2.

When low speed wipers are selected the wiper high-low relay will remain de-energized and the voltage at the common contact will pass through the normally closed contact to the low speed wiper motor windings.

When high speed wipers are selected the wiper high-low relay will energize and the voltage at the common contact will pass through the normally open contact to the high speed wiper motor windings.

Ground for the wiper motor is supplied from ground stud 2 (4006) to wiper motor connector (4015) terminal C.

12.6. WIPER PARK 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.

When the high and low speed wipers are turned off and the ignition is on, The wipers should return to the parked position.

A fault in the wiper park circuits will be apparent when the wipers don't park, after they are turned turn off and the intermittent wipers are inoperative (low wipers should still operate when selected). There are no diagnostic trouble codes associated with the wiper parking circuits. Problems in the wiper parking circuits could be attributed to, a short to ground, an open, faulty circuits in the motor or a problem in the ESC.

Refer to Wiper Park Circuits.

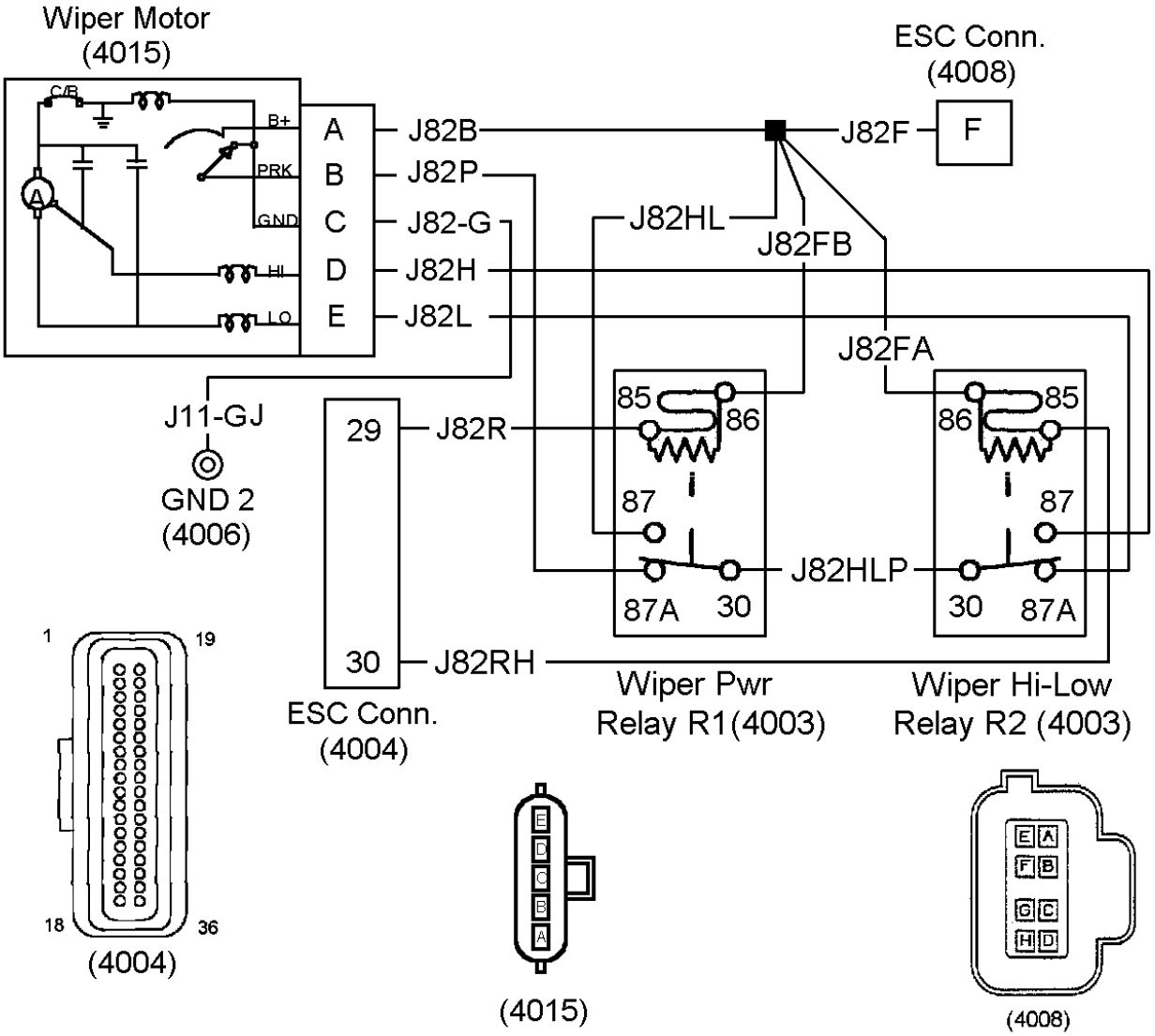

Figure 268 Wiper Park Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

R1 (4003) WIPER POWER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
R2 (4003) WIPER HIGH–LOW RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) 36–WAY SYSTEM CONTROLLER CONNECTOR
(4008) 8–WAY BLUE SYSTEM CONTROLLER CONNECTOR
(4006) GROUND STUD
(4015) WIPER MOTOR CONNECTOR

Table 186 Park Circuits Tests

Diagnostic Trouble Codes		
There are no specific diagnostic trouble codes associated with the wiper park circuits.		
Wiper Motor Harness Connector (4015) Park Circuit Voltage Checks Check with ignition on and (4015) disconnected. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
(4015) Harness connector, pin A to ground.	**NOTE – A load device, such as a test light, must be used in parallel with voltmeter probes to read an accurate voltage.** 12 ± 1.5 volts	If voltage is missing, check for short or open in circuit J82B or J82F. If circuits check good check for voltage from ESC.
Wiper Motor Harness Connector (4015) Park Circuit Resistance Checks Check with ignition off and (4015) disconnected.		
(4015) Harness connector, pin B to pin E.	< 1 ohm	If resistance is high check for open in circuits J82P, J82HLP and J82L. Also check for failed normally closed contacts of wiper power relay R1 and wiper high low relay R2.
If voltages and resistances check good, consider replacing wiper motor.		

Extended Description

When the high and low speed wipers are turned off and the ignition is on, the wipers should return to the parked position.

When the key is on the ESC will supply battery voltage to blue connector (4008) pin F. This voltage is applied to wiper motor connector (4015) cavity A, wiper power relay R1 pins 4 and 5, and wiper high–low relay R2.

When the wipers are off and the wipers are not parked, the voltage at (4015) pin A will pass through the wiper motor park contact to (4015) pin B and the normally closed contact of wiper power relay. This voltage will also be applied to the wiper power relay common contact, wiper high–low relay normally closed contact, and the wiper motor low speed winding.

When the wipers reach the park position a ground will replace the voltage causing the wipers to stop at the parked position.

12.7. COMPONENT LOCATIONS

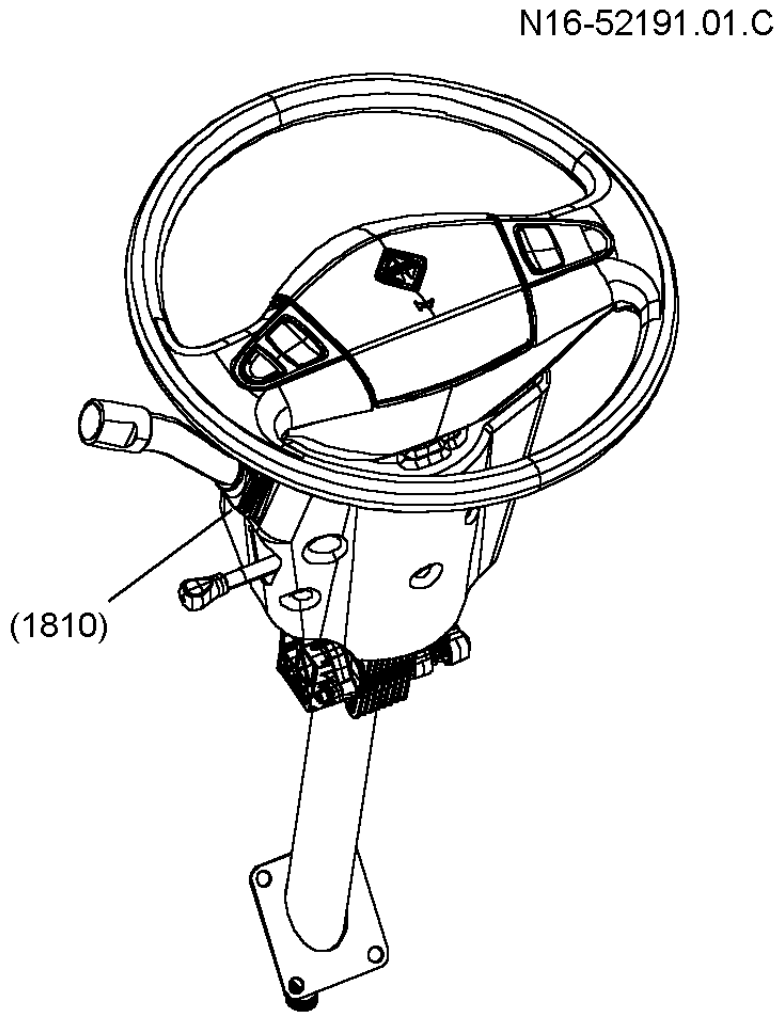

Figure 269 Turn Signal Assembly (Wiper Switch)

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

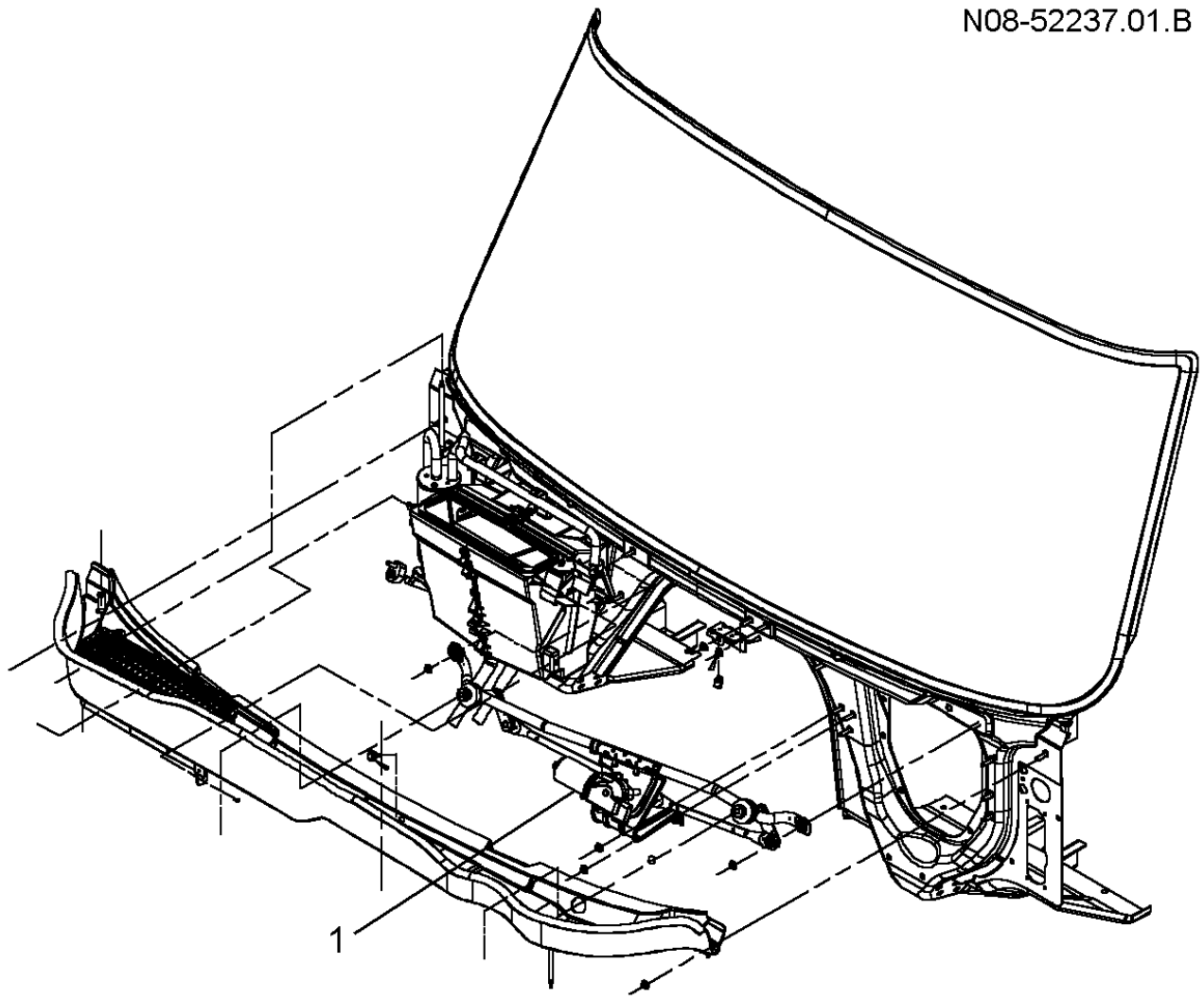

Figure 270 Wiper Motor Location

1. WIPER MOTOR

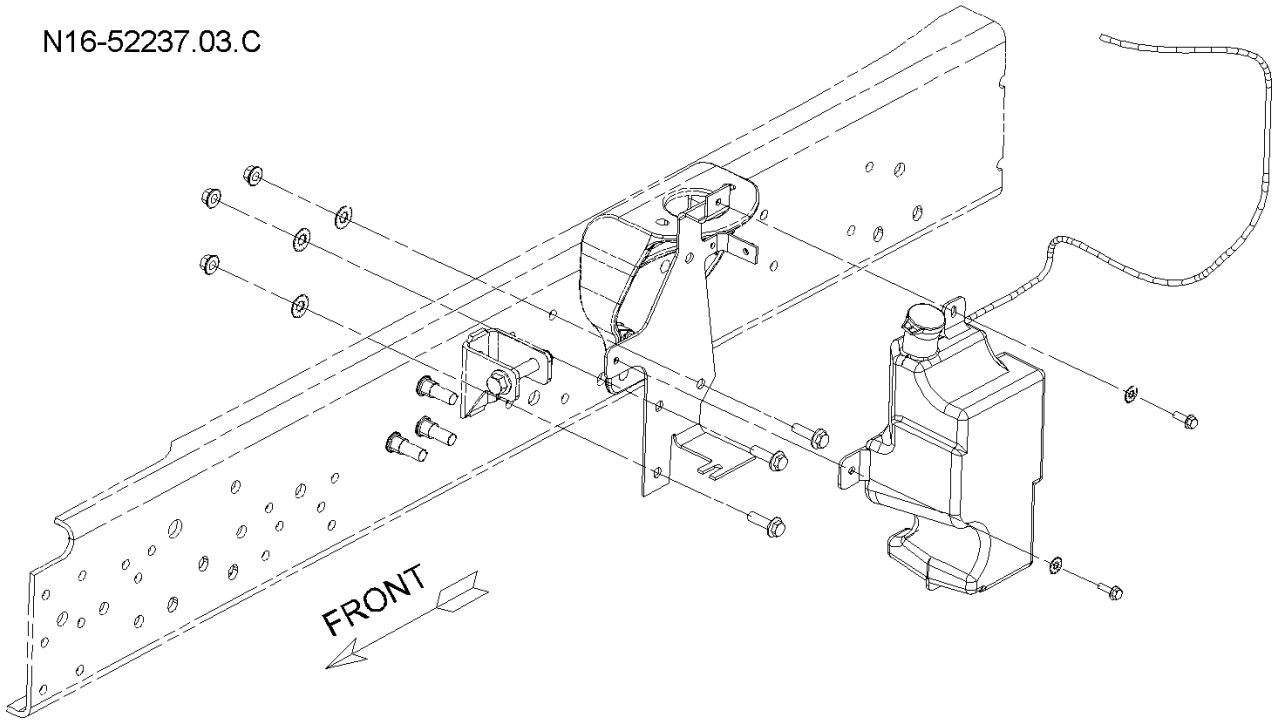

Figure 271 Washer Pump Location (Medium Duty)

1. WIPER MOTOR

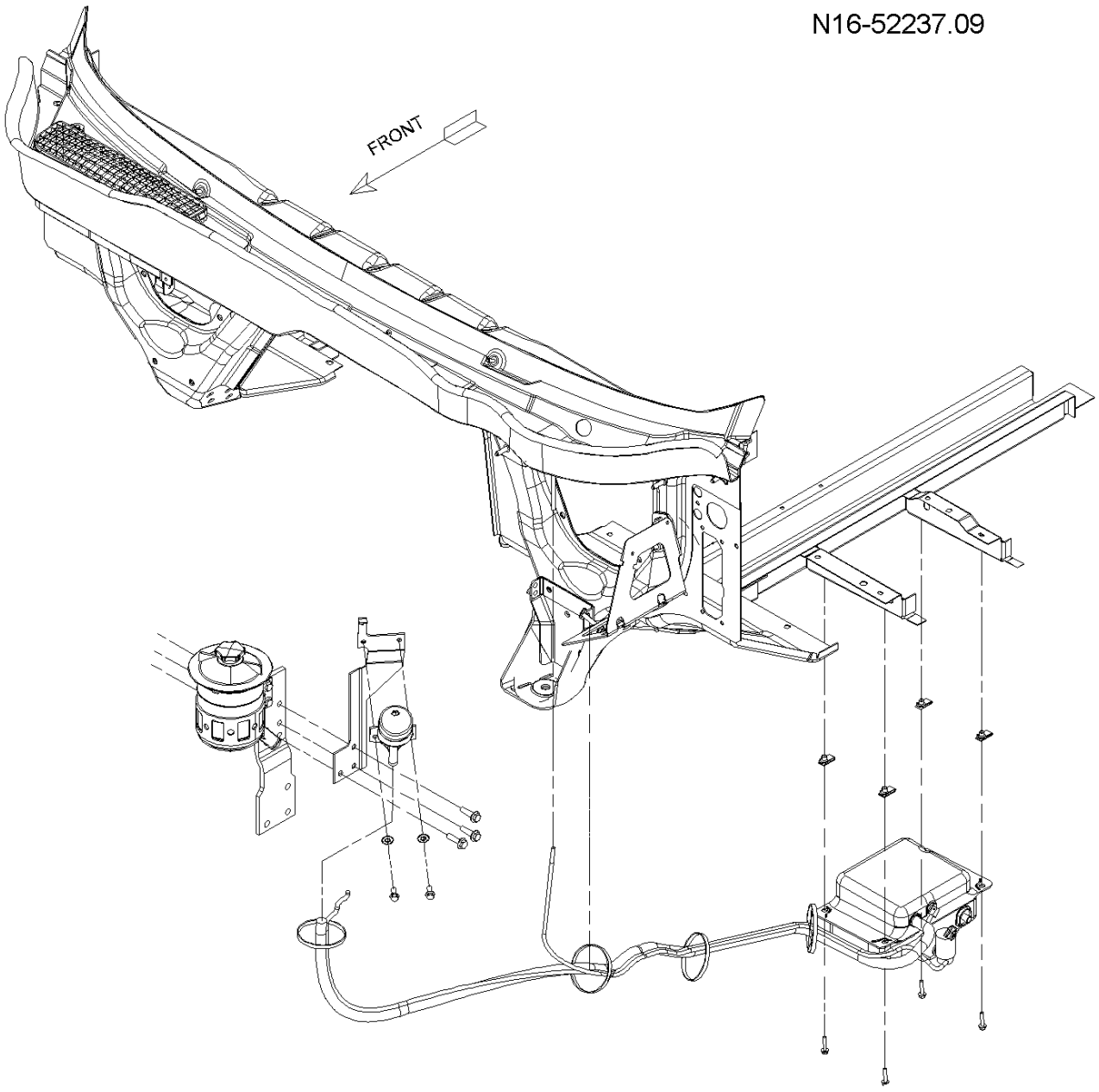

Figure 272 Washer Pump Location (Regional Haul and Severe Service)

1. WIPER MOTOR

13. CLUTCH SWITCH

13.1. CIRCUIT FUNCTIONS

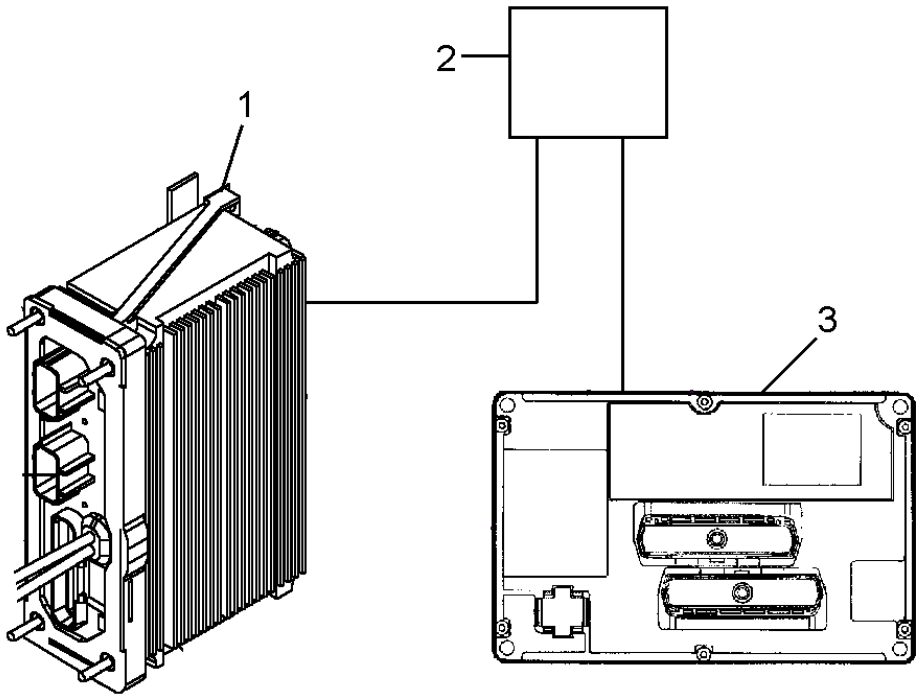

Figure 273 Clutch Switch Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER
2. CLUTCH SWITCH MODULE
3. ENGINE CONTROL MODULE

Refer to Clutch Switch Function Diagram.

The clutch switch module contains two clutch switches. One switch is an input to the ESC and senses clutch pedal position to disengage the cruise control. The other clutch switch is an input to the engine controller and senses clutch pedal position to enable engine cranking.

Both switches are magnetic and require no adjustment.

13.2. DIAGNOSTICS

A failure of the clutch switch to the ESC should be suspected if the cruise control doesn't engage or disengage when the clutch pedal is pushed. A diagnostic trouble code (DTC) for this switch will be logged if there is an open or short in circuits to the switch. A (DTC) will also be logged if the switch is stuck in the open or closed position.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the clutch switch to the ESC. See the diagnostic software manual for details on using the software.

A failure of the clutch switch to the engine controller should be suspected if the engine doesn't crank when the key is in the start position.

An electronic service tool, running the "Master Diagnostics" diagnostic software, can be used to check operation of the clutch switch to the engine controller. See the diagnostic software manual for details on using the software.

Clutch Switch Preliminary Check

Table 187 Clutch Switch Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Attempt to crank engine with clutch pedal depressed.		Engine cranks.	Go to next step.	Refer to the Engine Cranking section of this manual. (See ENGINE CRANKING, page 379)
2.	On	Start engine and operate cruise control. Attempt to disengage cruise control by depressing clutch pedal.		Cruise control does not engage or does not disengage when clutch pedal is depressed.	Go to next step.	Clutch Switches are operating correctly. Problem does not exist or is intermittent. (Check for previously active diagnostic trouble codes.)
3.	On	Determine if any other 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.
4.	On	Check for diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 559)	Read display on odometer.	**No** clutch switch diagnostic trouble codes are active.	Go to next step.	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 560)
5.	On	Clutch switch is operating correctly.				

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 188 Clutch Switch Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
598 14 1 0	Upper Clutch Switch stuck in the open or closed position Occurs if the vehicle speed increases from 0 kph to 72 kph without a change in state of the clutch switch. Defective upper clutch switch Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 560)
612 14 2 1	Upper Clutch Switch out of range low Shorted to ground Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 560)
612 14 2 2	Upper Clutch Switch out of range high Shorted high or open circuit Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 560)

13.3. FAULT DETECTION MANAGEMENT

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

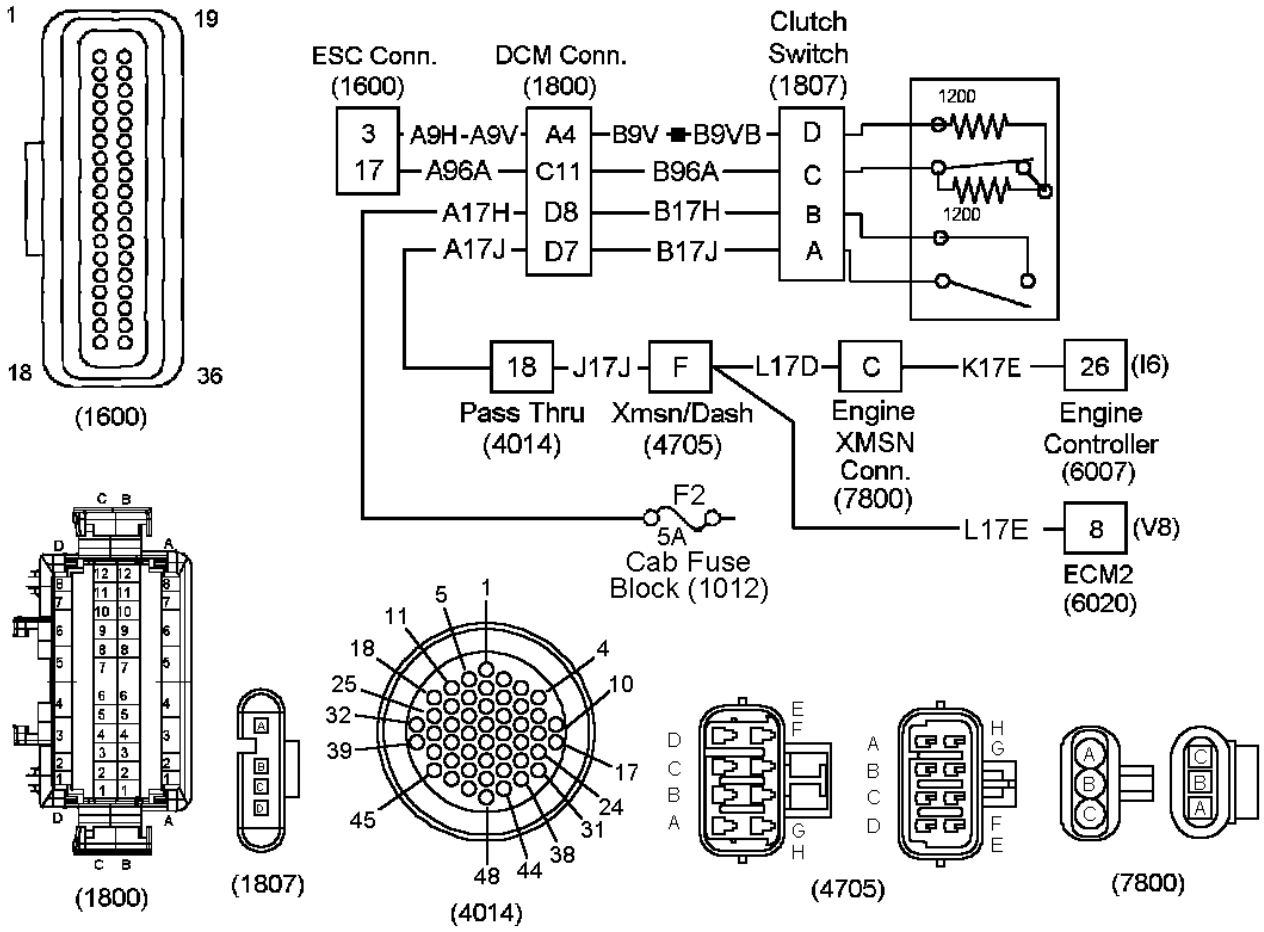

Figure 274 Clutch Switch Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1600) SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO RIGHT OF LOWER STEERING COLUMN
(1807) CLUTCH SWITCH CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN
(4014) 48–WAY PASS THROUGH CONNECTOR
LOCATED ABOVE ESC
(4705) TRANSMISSION/DASH CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR WIPER MOTOR BRACKET
(6007) I6 ENGINE ECM CONNECTOR
LOCATED ON ENGINE
(6020) V8 ENGINE ECM2 CONNECTOR
LOCATED ON ENGINE
(7800) ENG/TRANS CONNECTOR
LOCATED ON TRANSMISSION

Refer to Clutch Switch Circuits.

Table 189 Clutch Switch Circuit Tests

Clutch Switch Harness Connector (1807) Voltage Checks Check with ignition key on and connector (1807) removed. **NOTE – Voltage to the switch will be approximately 5 volts with the key off.** **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
(1807) harness connector, pin B to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits B17H or A17H. Also check for blown fuse F2.
(1807) harness connector, pin B to A	12 ± 1.5 volts	If voltage is good. Bench check clutch switch. Replace if defective. If voltage is missing, check for open in circuits between clutch switch and engine controller. If circuits check good and voltage is still missing, verify signal (low) out of engine controller. Refer to the applicable engine manual.
(1807) harness connector, pin C to ground	6 ± .5 volts	If voltage is missing, check for open or shorts in circuits B96A or A96A.
(1807) harness connector, pin C to pin D	6 ± .5 volts	If voltage is correct, bench check clutch switch. Replace if defective. If voltage is missing, check for open in circuit B9VB or circuits to ESC (1600) cavity 3. If circuits check good and voltage is not present present, verify zero volt reference level from ESC. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**
Clutch Switch Module Resistance Checks Check with clutch switched removed. **NOTE – Always check connectors for damage and pushed–out terminals.** This is a magnetic switch. To activate the switch put a piece of steel (such as a wrench) against the switch face.		
Test Points	Spec.	Comments

Table 189 Clutch Switch Circuit Tests (cont.)

Clutch switch connector (1807) cavity A to B.	<1 ohm with switch activated. >10K ohms with switch not activated.	If there is no continuity with switch activated or continuity with switch activated, replace clutch switch module.
Clutch switch connector (1807) cavity C to D.	Approximately 1200 ohms with switch activated. Approximately 2400 ohms with switch not activated	If switch module resistances are not correct, replace clutch switch module.

13.4. EXTENDED DESCRIPTION

Clutch Switch to ESC

The ESC supplies approximately 6 volts to Pin C of the clutch switch module and the zero volt reference signal to pin D.

When nothing is in front of the switch module face, the switch will be closed and the ESC will sense the voltage drop across one 1200 ohm resistor.

When steel is passed in front of the switch module face, the switch will open and the ESC sense the voltage drop across two 1200 ohm resistors.

The ESC will use this information to enable or disable the cruise control.

These resistors, one in series with the switch and one in parallel with the switch, allow the ESC to monitor the switch and its circuits for opens or shorts to ground.

An open circuit or short to ground will cause the voltage drop to be out of rang and the ESC will log the appropriate DTC.

Clutch Switch to Engine Controller

Battery voltage is supplied to pin B of the clutch switch. When steel is passed in front of the switch module face, the switch will close and the voltage will connect to pin A and will be applied to the engine controller.

13.5. COMPONENT LOCATIONS

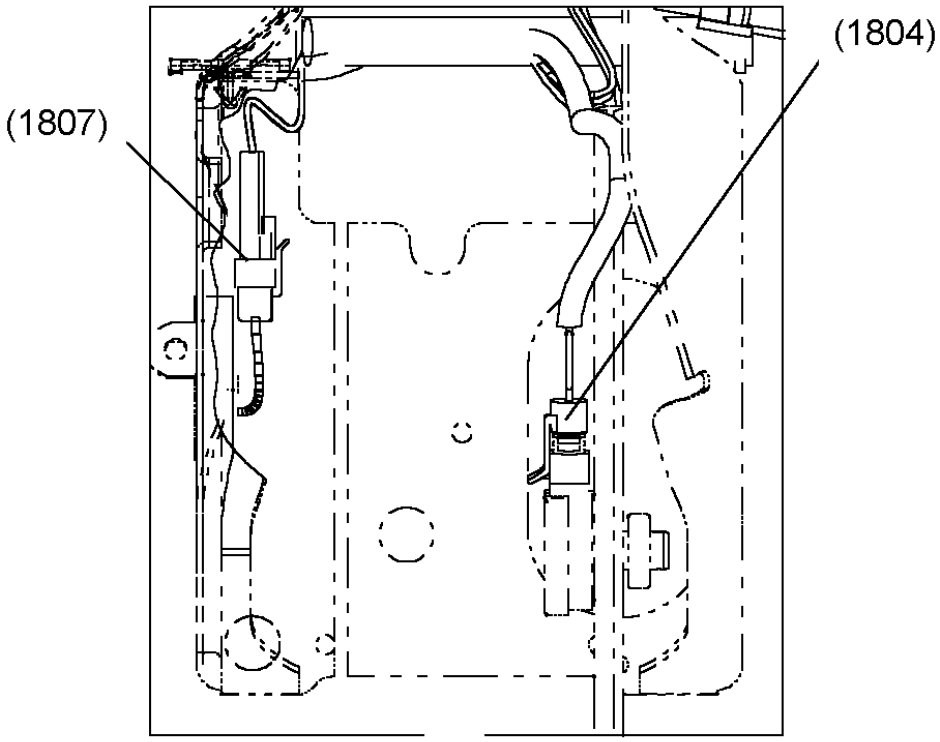

Figure 275 Clutch Switch Connector Location

(1804) ACCELERATOR PEDAL POSITION SENSOR/IDLE VALIDATION SWITCH CONNECTOR
(1807) CLUTCH SWITCH CONNECTOR

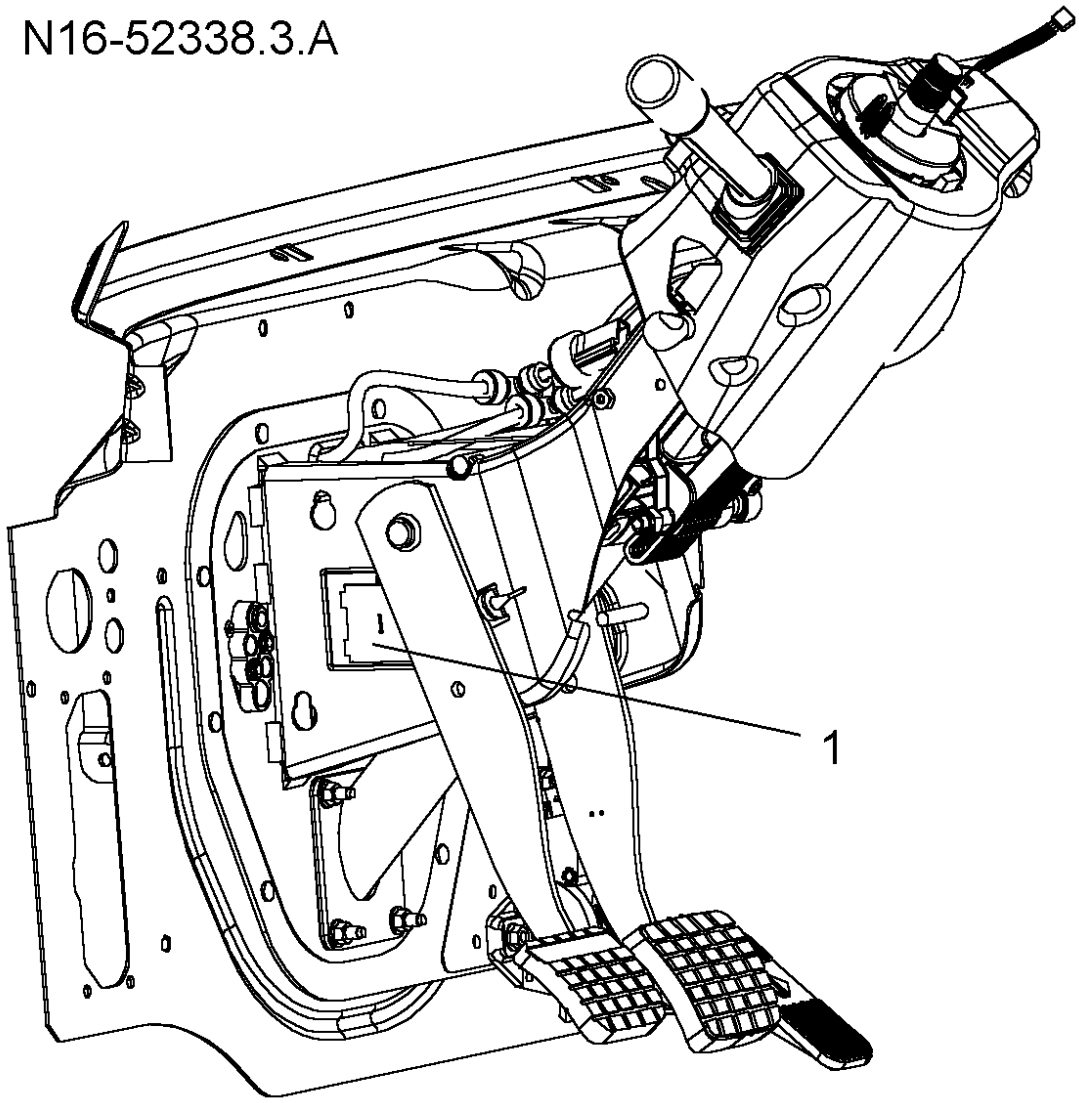

Figure 276 Clutch Switch Location

1. CLUTCH SWITCH

14. PARK BRAKE SWITCH

14.1. CIRCUIT FUNCTIONS

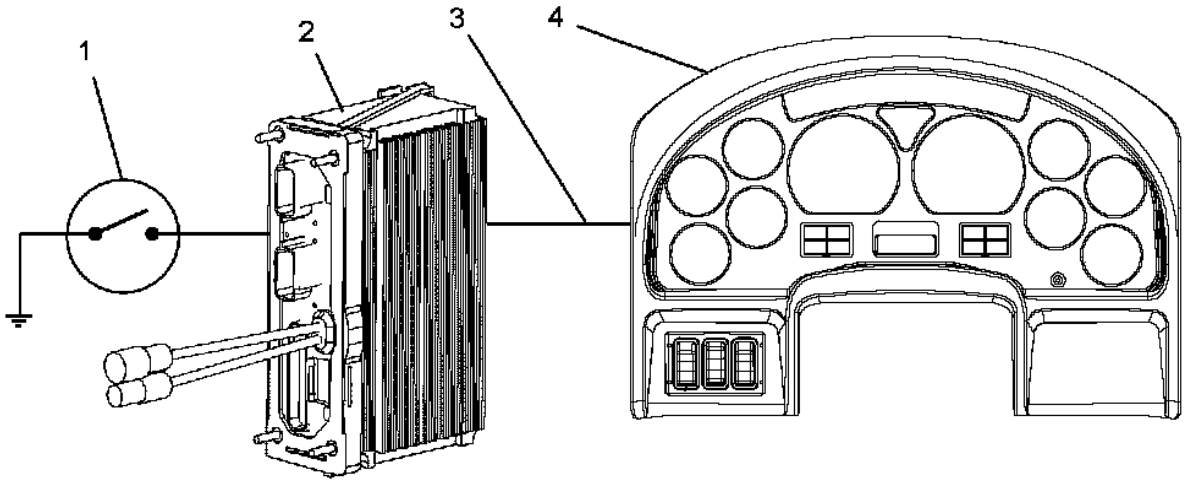

Figure 277 Park Brake Switch Function Diagram

1. PARK BRAKE SWITCH
2. ELECTRONIC SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

The ESC uses the park brake switch input for the following functions:

- To determine when to turn on the park lamp on the EGC.
- To turn off the daytime running lights when the headlights are off, the engine is not running and the key is in the ignition position.
- To enable the diagnostic trouble code retrieval procedure.
- Used as an input to generate the command to the transmission controller to shift to neutral (used with auto neutral feature only).

14.2. DIAGNOSTICS

A failure of the park brake switch inputs to the ESC should be suspected if the park indicator lamp in the EGC doesn’t illuminate when the park brake is set and the EGC cannot be put in diagnostic mode.

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

Park Brake Switch Preliminary Check

Table 190 Park Brake Switch Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify park brake switch operation.	Set and release park brake	Park indicator on EGC Illuminates with brake set and goes out with brake off.	Park brake switch is functioning.	Go to next step.
2.	On	Attempt to put EGC in diagnostic mode.	Set park brake and press cruise “ON” and RESUME” simultaneously.	EGC displays fault messages.	Go to next step.	Go to Fault Detection Management. (See FAULT DETECTION MANAGEMENT, page 567)
3.	On	Determine if any other features are malfunctioning that may have common circuits. (Example: Missing power or 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 Park Brake Warning Lamp. (See PARK BRAKE WARNING LAMP, page 212)				

14.3. FAULT DETECTION MANAGEMENT

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

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to monitor park brake switch operation. See the diagnostic software manual for details on using the software.

If the park indicator on the EGC stays on continuously or doesn’t come on when the park brake is on, the problem may be in ESC/EGC programming, ESC/EGC hardware, the park brake switch or the park brake switch wiring to the ESC.

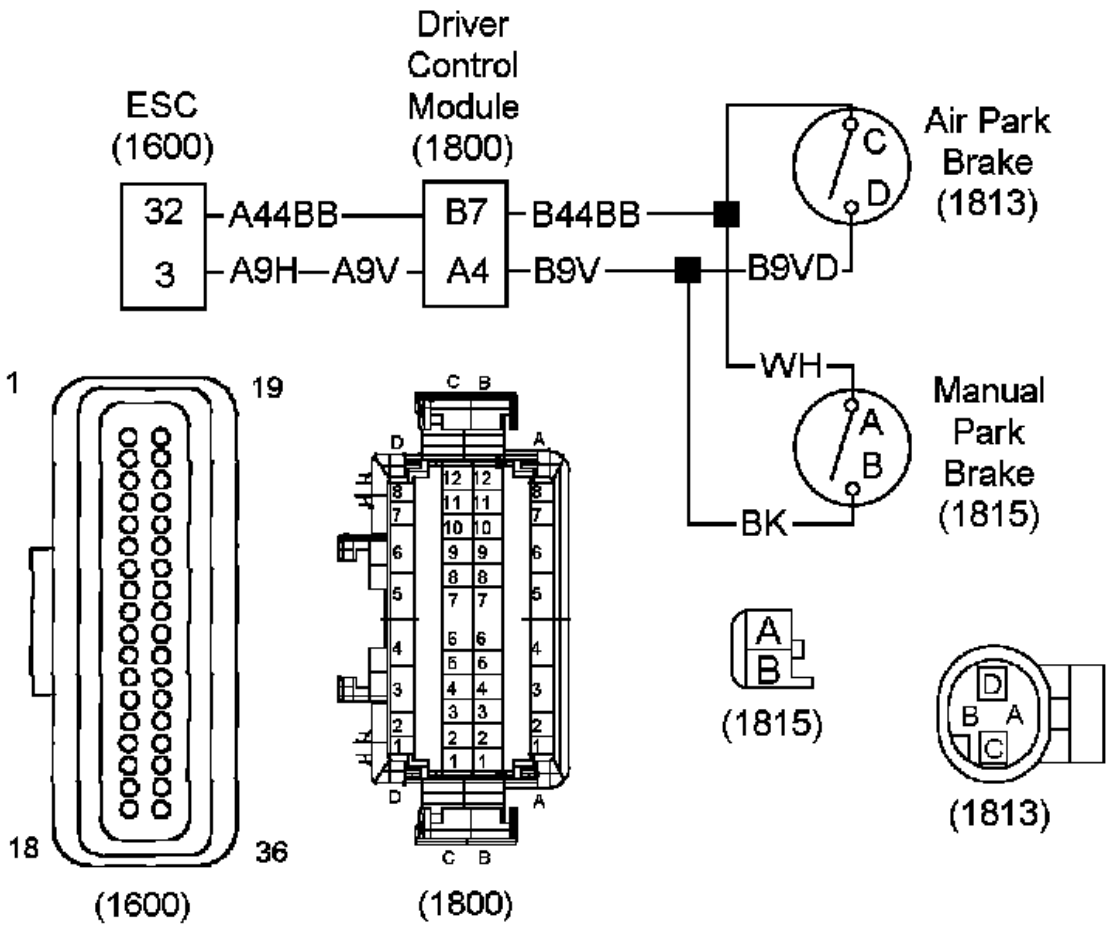

Figure 278 Park Brake Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1600) ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
(1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO THE RIGHT OF STEERING COLUMN
(1813) PARK BRAKE SWITCH (WITH AIR BRAKES)
LOCATED NEAR ENGINE CONTROLLER
(1815) PARK BRAKE SWITCH (WITH HYDRAULIC BRAKES)
LOCATED NEAR ENGINE CONTROLLER

Table 191 Park Brake Switch Circuits Voltage Check Chart

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the park brake switch.		
Park Brake Switch Connector (1813) or (1815) Voltage Checks (Check with Brake Switch Disconnected and the Ignition Key "On")		
Test Points	Spec.	Comments
(1813) harness connector, cavity C or (1815) cavity A to ground.	12 ± 1.5 volts	If voltage is incorrect, check circuit B44BB or A44BB for open or short circuits. If circuits check good voltage is missing from ESC connector (1600) pin 32.
(1813) harness connector, cavity C or (1815) cavity A to (1813) cavity D or (1815) cavity B.	12 ± 1.5 volts	If voltage is correct and condition still exists, the brake switch has failed. Replace brake switch. If voltage is incorrect, check circuit B9V, A9V or A9H for an open circuit or good connection to ground.
There are no diagnostic trouble codes associated with the park brake switch.		

14.4. EXTENDED DESCRIPTION

On vehicles with hydraulic brakes, the zero volt reference level is supplied from ESC connector (1600) terminal 3 to park brake switch connector (1815) terminal B.

On vehicles with air brakes, the zero volt reference level is supplied from ESC connector (1600) terminal 3 to park brake switch connector (1813) terminal C.

When the park brake is engaged the switch is closed and the zero volt reference level is supplied to ESC connector (1600) terminal 32 signaling the ESC that the park brake has been applied.

14.5. COMPONENT LOCATIONS

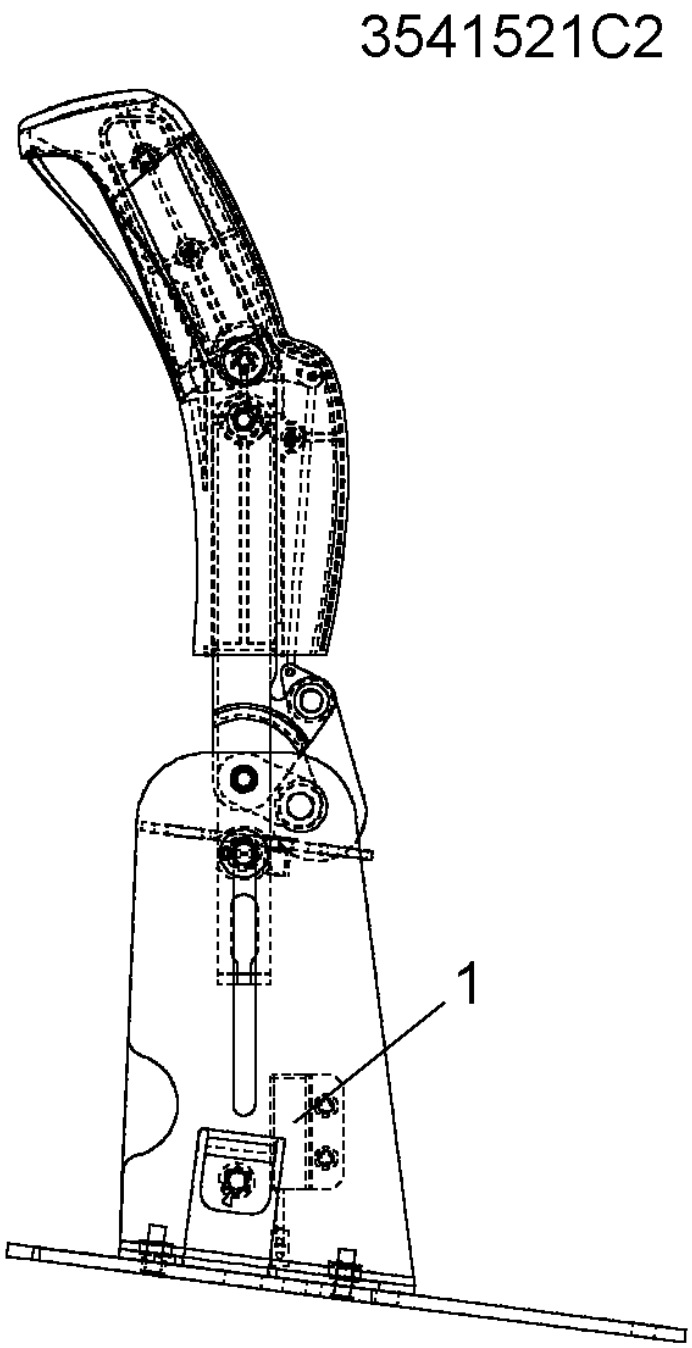

Figure 279 Park Brake Switch Location (With Hydraulic Brakes)

1. PARK BRAKE SWITCH

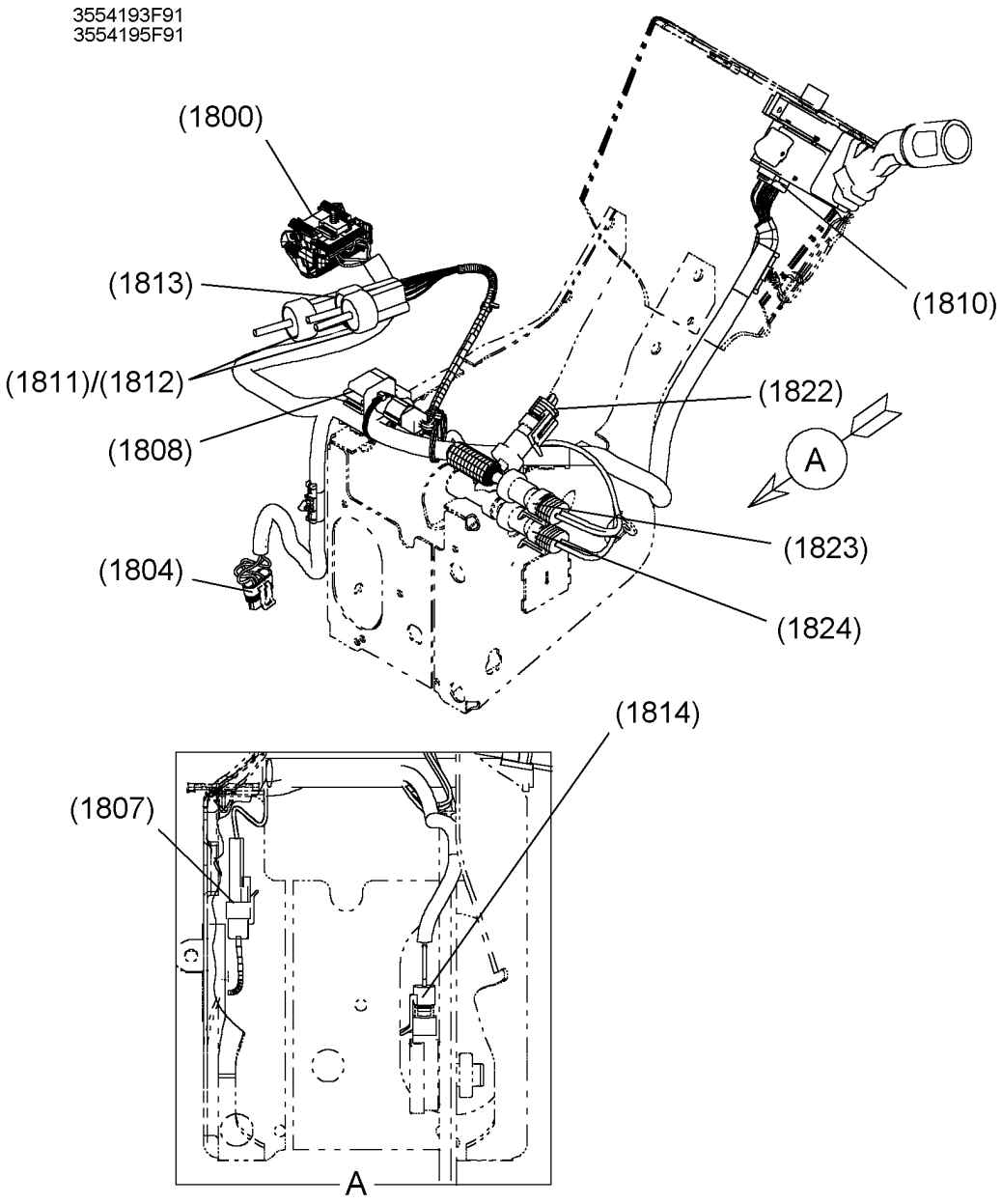

Figure 280 Air Park Brake Switch Location (Steering Column Support View)

(1813) PARK INDICATION PRESSURE SWITCH
(1800) DRIVER CONTROL MODULE (DCM) CONNECTOR

15. 2–WAY RADIO

15.1. CIRCUIT FUNCTIONS

Refer to 2– way radio function diagram.

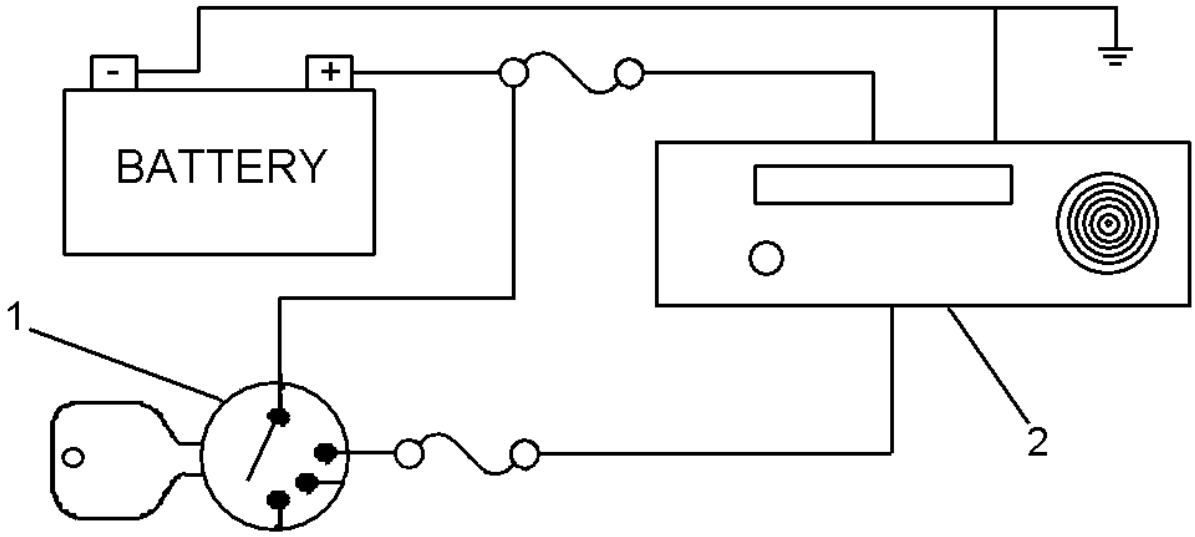

Figure 281 2– Way Radio Function Diagram

1. IGNITION SWITCH
2. 2–WAY RADIO

The optional circuits for 2–way radio power provide fused voltage and ground directly from the battery and fused voltage from the bad power distribution center.

The location of the 2–way radio is not standard as the radio is not installed at the factory.

15.2. 2–WAY RADIO 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.

A fault in the power circuits will be apparent when the radio doesn’t work.

Should the radio fail to operate, the problem could be attributed to open or shorted wiring in power or ground circuits to the radio or a failure in the radio.

Refer to 2– way radio power circuits.

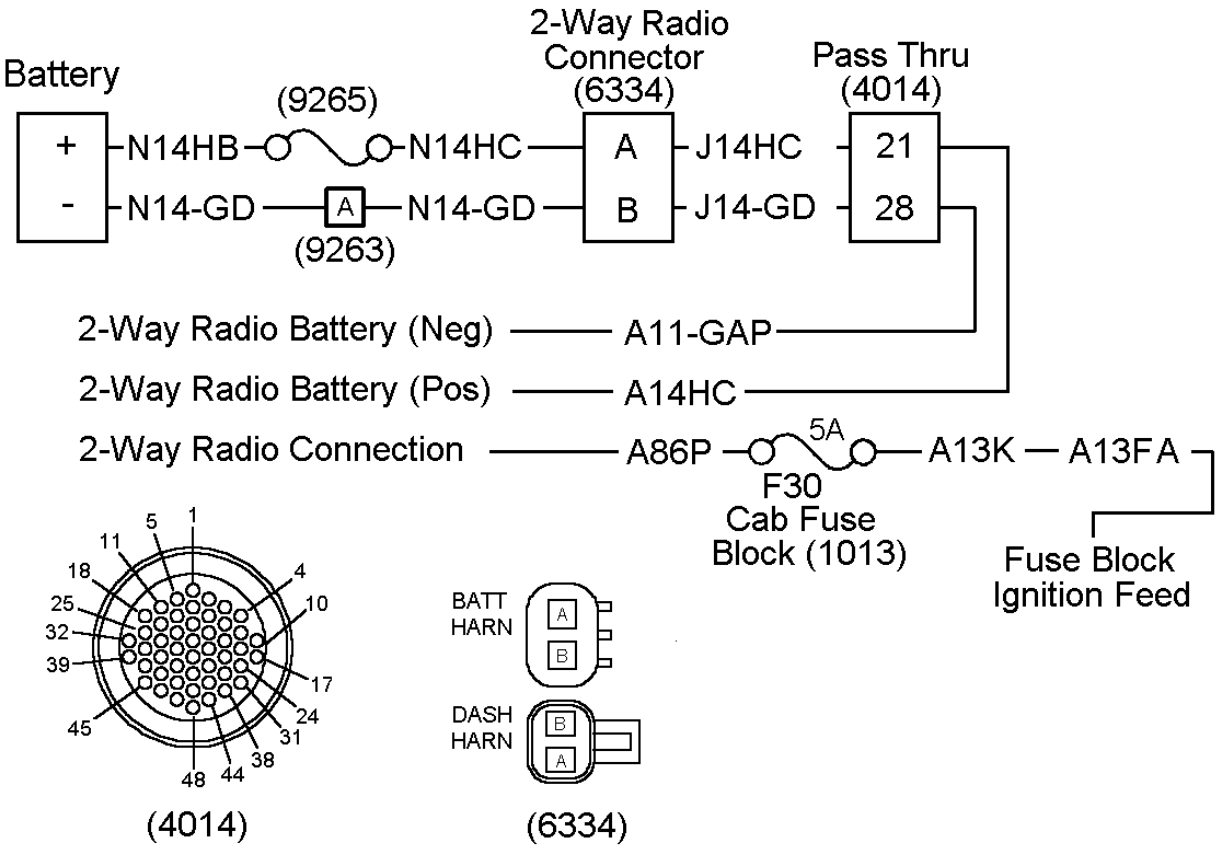

Figure 282 2–Way Radio Power Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1013) F30 2–WAY RADIO CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(4014) 48–WAY PASS THROUGH CONNECTOR
LOCATED ABOVE ESC
(6334) 2–WAY RADIO CONNECTOR
LOCATED NEAR STARTER MOTOR

Table 192 2–Way Radio Power Circuits Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the 2–way radio power circuits.		
2–way radio power Harness Connector Voltage Checks Check with ignition key on and 2–way radio disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
2–way radio power circuit A14AH to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between A14AH and positive battery terminal. Also check for blown fuse (9265).
2–way radio power circuit A14AH to A11–GAP	12 ± 1.5 volts	If voltage is missing, check for open in circuits between A11–GAP and negative battery terminal.
2–way radio power circuit A86P to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between A86P and fuse F30 (1013). Also check for blown fuse F30 (1013).

Extended Description

The 2–way radio receives power from 2–way radio fuse (9265) on circuits A14AH, J14HC, N14HC and N14HB. Ground is supplied from negative battery terminal on circuits A11–GAP, J14–GD and N14–GD.

The 2–way radio receives power from fuse block ignition feed through fuse F30 (1013) on circuits A86P, A13K and A13FA.

15.3. COMPONENT LOCATIONS

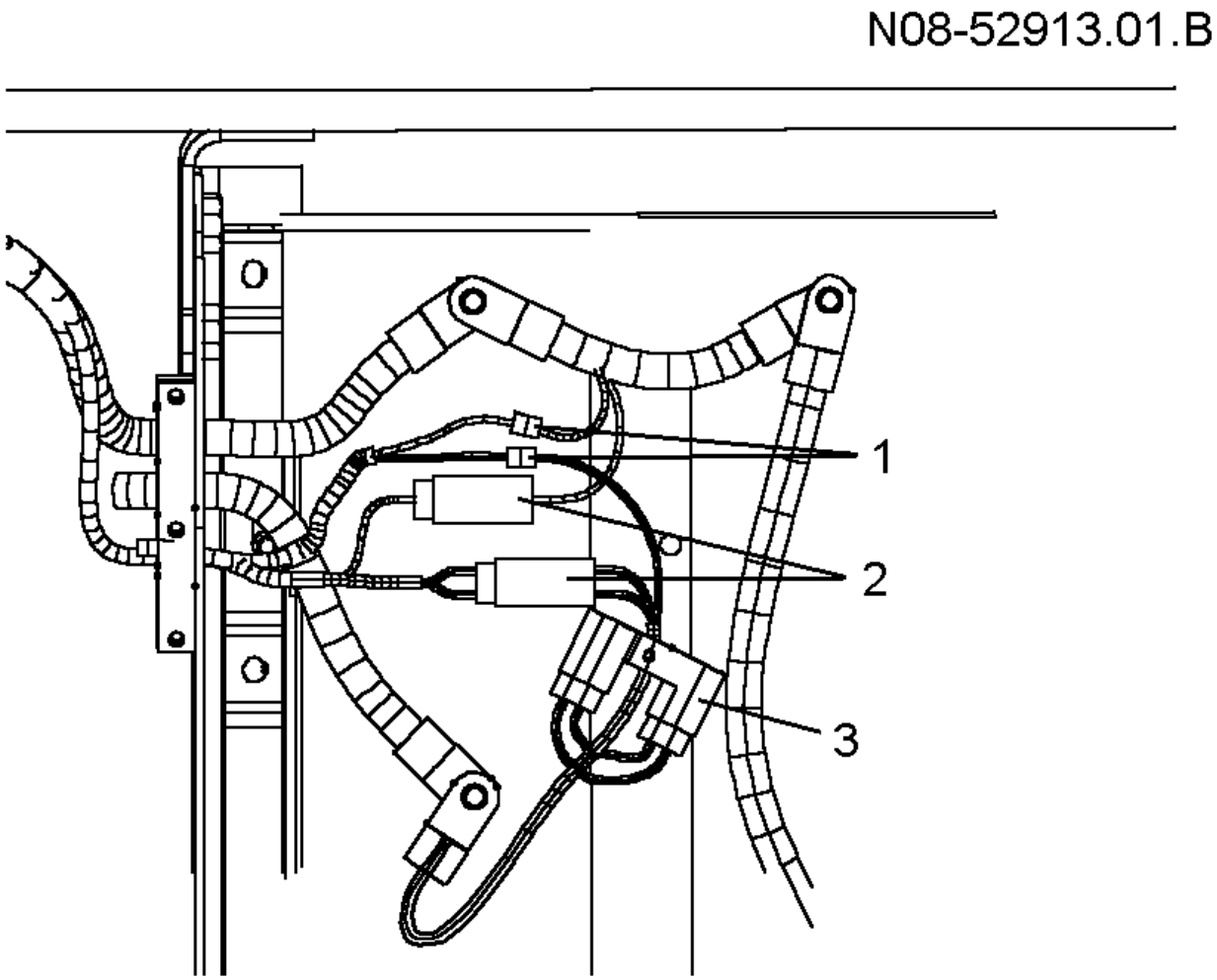

Figure 283 2–Way Radio Power Battery Box Connectors (Typical)

1. 2–WAY RADIO CIRCUITS, N14HC TO POSITIVE AND N14–GD TO NEGATIVE TERMINALS ON THE BATTERY.
2. ENGINE ECM CLEAN POWER FEED.
3. 40 AMP FUSE FOR I6 OR 60 AMP FUSE FOR V8.

16. DIAGNOSTIC CONNECTOR

16.1. CIRCUIT FUNCTIONS

Refer to diagnostic connector function diagram.

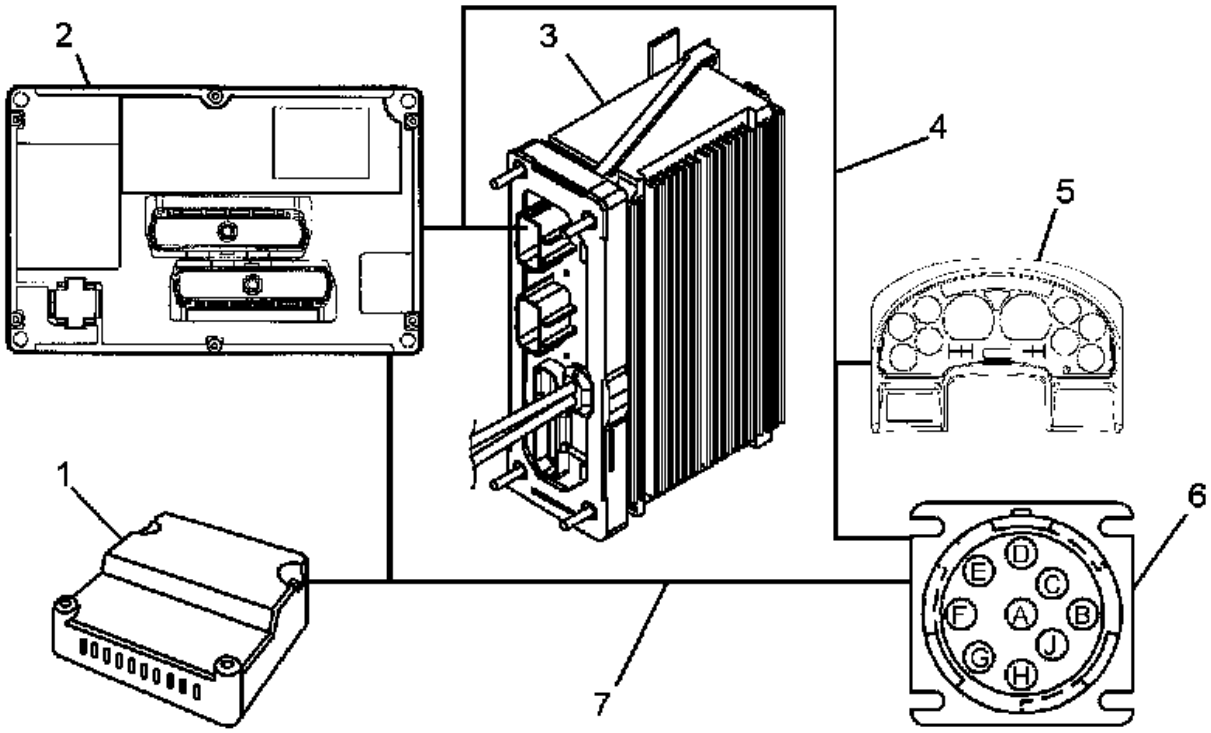

Figure 284 Diagnostic Connector Function Diagram

1. ABS CONTROLLER (OTHER CONTROLLERS ALSO CONNECTED)
2. ENGINE ECM
3. ESC
4. DRIVETRAIN 1939 DATA LINK
5. EGC
6. (1650) DIAGNOSTIC CONNECTOR
7. 1708 DATA LINK

The diagnostic connector provides an connection to the vehicle drivetrain 1939 data link, the 1708 data link, battery voltage and ground.

The diagnostic connector provides an interface between the vehicle and an electronic service tool (EST) such as the EZ-Tech.

16.2. DIAGNOSTIC CONNECTOR CIRCUITS

Fault Detection Management

A fault in the diagnostic connector circuits will be apparent when the EST (EZ-Tech) is not able to communicate with any devices communicating on the data links.

Should the diagnostic connector fail to provide an interface with the vehicle electronic controllers, the problem could be attributed to open or shorted wiring in power or ground circuits to the diagnostic connector or a failure in data link circuits.

Refer to diagnostic connector circuits.

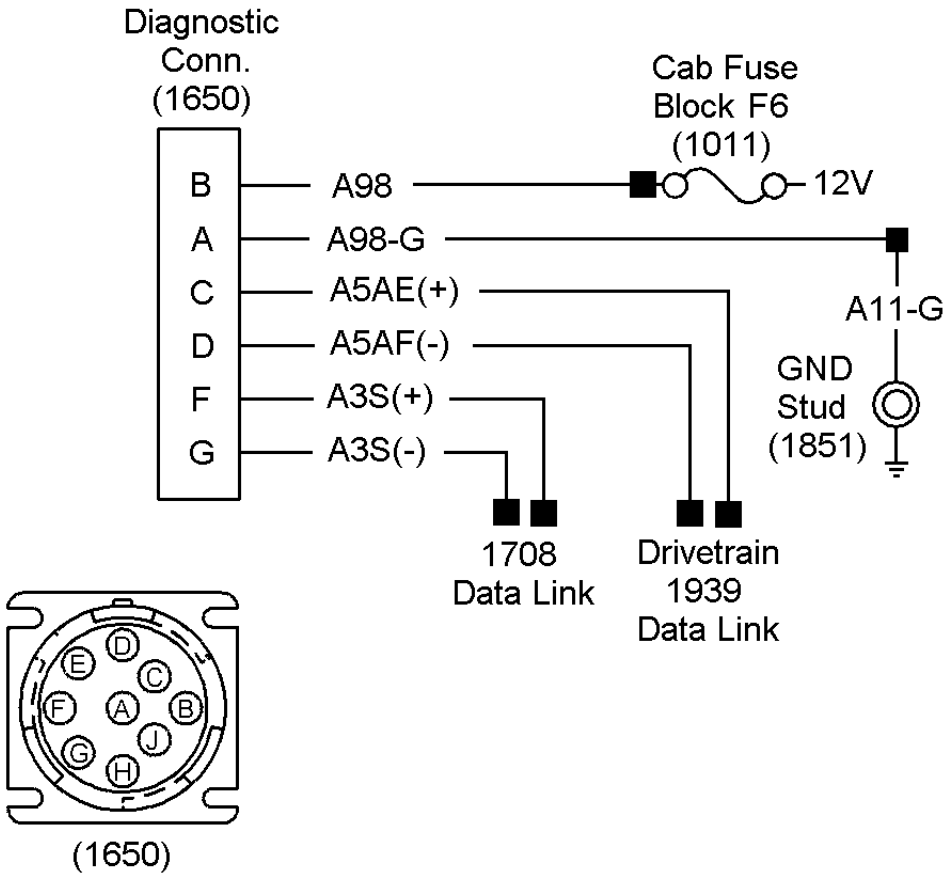

Figure 285 Diagnostic Connector Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) F6 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1650) DIAGNOSTIC CONNECTOR
LOCATED ABOVE ESC ON DASH PANEL
(1851) GROUND STUD CONNECTOR
LOCATED ABOVE ESC ON DASH PANEL
DRIVETRAIN 1939 DATA LINK (CAB)
1708 DATA LINK

Table 193 Diagnostic Connector Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the diagnostic connector circuits.		
Diagnostic Connector Voltage Checks **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Diagnostic connector cavity B to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between diagnostic connector and F6. Also check for blown fuse F6.
Diagnostic connector cavity B to cavity A	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits between diagnostic connector and ground stud (1851). If voltage is correct diagnostic connector is inoperative, the diagnostic connector should be replaced.
Diagnostic connector cavity C to cavity A	2.5 ± .5 volts	If voltage is missing, check for open in circuits between diagnostic connector and 1939 data link circuits.
Diagnostic connector cavity D to cavity A	2.5 ± .5 volts	If voltage is missing, check for open in circuits between diagnostic connector and 1939 data link circuits.
(1650) Pin F to ground	Approximately 4 volts	(+) data link circuit. If voltage is low check for open in positive data link circuits.
(1650) Pin G to ground	Approximately 1 volt	(-) data link circuit. If voltage is low check for open in ngeative data link circuits. If voltage is high check for crossed data link circuits.

Extended Description

Battery voltage, required to operate the diagnostic circuits, is supplied from fuse F6 on circuit A98 to diagnostic connector (1650) pin B. Ground is supplied from ground stud connector (1851) to diagnostic connector (1650).

16.3. COMPONENT LOCATIONS

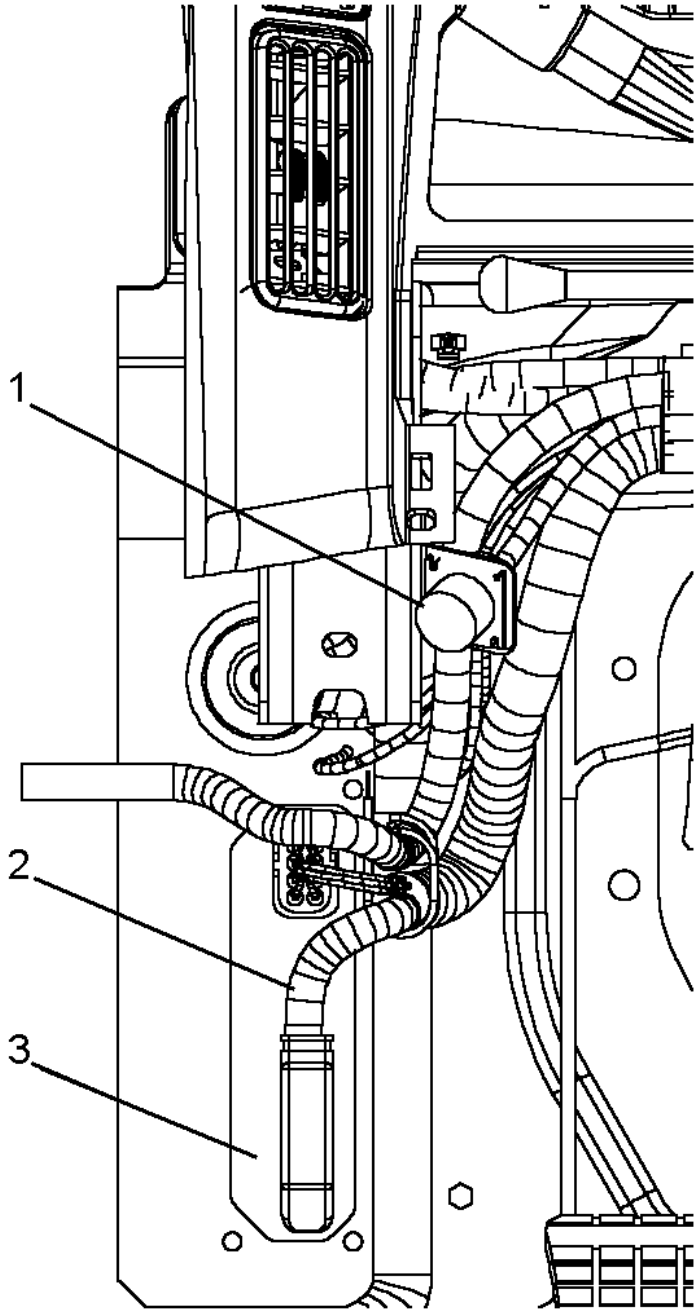

Figure 286 Diagnostic Connector Location

1. DIAGNOSTIC CONNECTOR
2. MAIN CAB HARNESS
3. ESC

17. LIGHTED AIR SHIELD

17.1. CIRCUIT FUNCTIONS

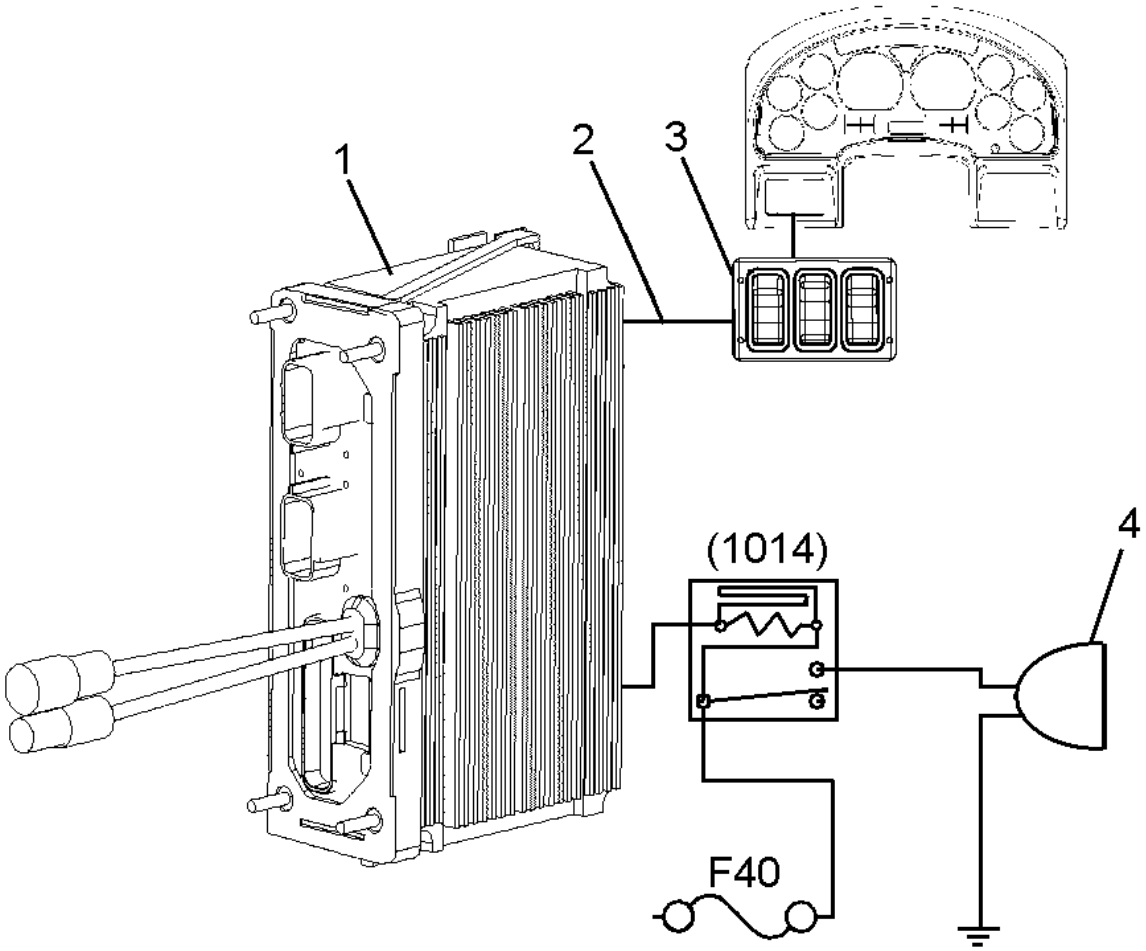

Figure 287 Lighted Air Shield Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER (ESC)
2. DRIVETRAIN J1939 DATA LINK
3. HEADLIGHT PARK LIGHT SWITCH (MOUNTED ON ELECTRONIC GAUGE CLUSTER)
4. CAB ROOF AIR SHIELD LIGHT
5. (1014) LIGHTED AIR SHIELD RELAY
6. (F40) LIGHTED AIR SHIELD FUSE, CAB FUSE BLOCK (1014)

The lighted air shield illuminates when the headlights and/or park lights, and ACC are turned on. The ESC will energize the air shield light relay to provide power to the lights.

17.2. DIAGNOSTICS

A failure in the lighted air shield circuits should be suspected. A diagnostic trouble code (DTC) for this switch will be logged if there is an open or short in circuits to the switch.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the park light or headlight switch and the lighted air shield relay to the ESC. See the diagnostic software manual for details on using the software.

Lighted Air Shield Preliminary Check

Table 194 Lighted Air Shield Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	With headlights “ON” verify operation of lighted air shield.	Visually check lighted air shield.	Air shield does not light.	Go to next step.	Lighted air shield is operating correctly.
2.	On	Determine if any other 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 581)	Read display on odometer.	**No** Lighted air shield diagnostic trouble codes are active.	Go to next step.	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)
4.	On	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)				

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 195 Lighted Air shield Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 4 0	There is a load on this pin that has been configured as unused. An unexpected load is attached to this pin.
2033 14 4 1	Overloaded Connector 1600 pin 6 current overload Too much load attached or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)
2033 14 4 2	Open circuit. Connector 1600 Pin 6 open. Open circuit or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)
2033 14 4 3	Shorted to ground. Connector 1600 Pin 6 shorted to ground. Shorted to ground or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)

17.3. FAULT DETECTION MANAGEMENT

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

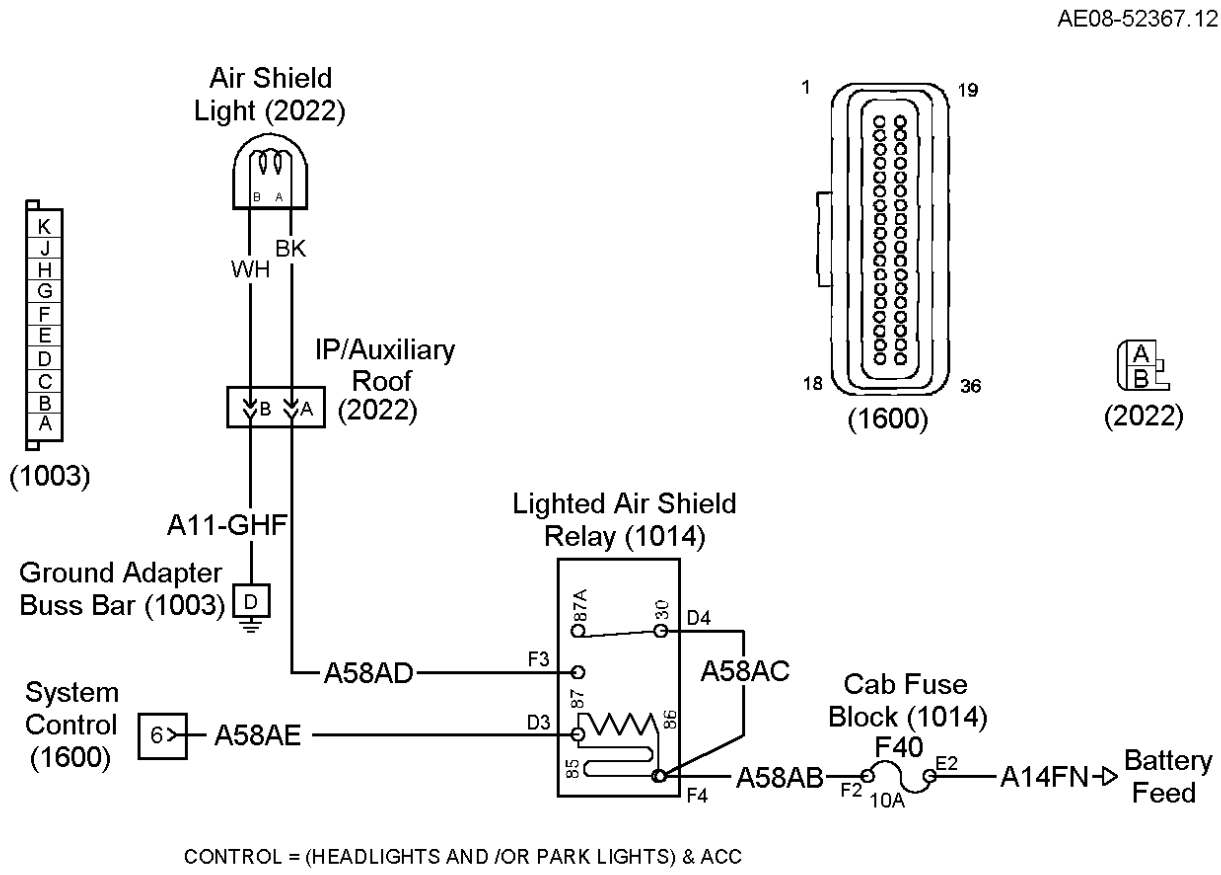

Figure 288 Lighted Air Shield Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1003) GROUND ADAPTER BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1014) F40 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1014) LIGHTED AIR SHIELD RELAY
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1600) SYSTEM CONTROLLER CONNECTOR
LOCATED ON CAB SIDE OF ESC
(2022) HARNESS ROOF WIRING, LIGHTED AIR SHIELD ROOF/IP CONNECTOR
LOCATED IN CAB AND LEFT ROOF PILLAR

Refer to Lighted Air Shield Circuits.

Table 196 Lighted Air Shield Circuit Tests

Lighted Air Shield Relay Checks Check with lighted air shield relay removed, key in ignition position and headlight switch on. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Bench check lighted air shield relay. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)	Relay energizes and there is continuity thorough the closed contacts.	If a relay tests bad, replace it.
Measure voltage between lighted air shield relay socket cavity F4 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A58AB or blown cab fuse F40.
Measure voltage between lighted air shield relay socket cavity D4 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A58AC.
Measure voltage between lighted air shield relay socket cavity F4 and F3.	12 ± 1.5 volts.	If voltage is missing, check for open A58AD, air shield light or A11–GAF to ground.
Measure voltage between lighted air shield relay socket cavity D3 and F4.	12 ± 1.5 volts with headlight switch “on”.	If voltage is missing, check for open or short in circuit A58AE or missing signal from ESC connector (1600) pin 6.

17.4. EXTENDED DESCRIPTION

When park lights or headlights are requested, the ESC will supply ground to the coil of lighted air shield relay.

This will cause the relay to energize, supplying power to the air shield light.

17.5. COMPONENT LOCATIONS

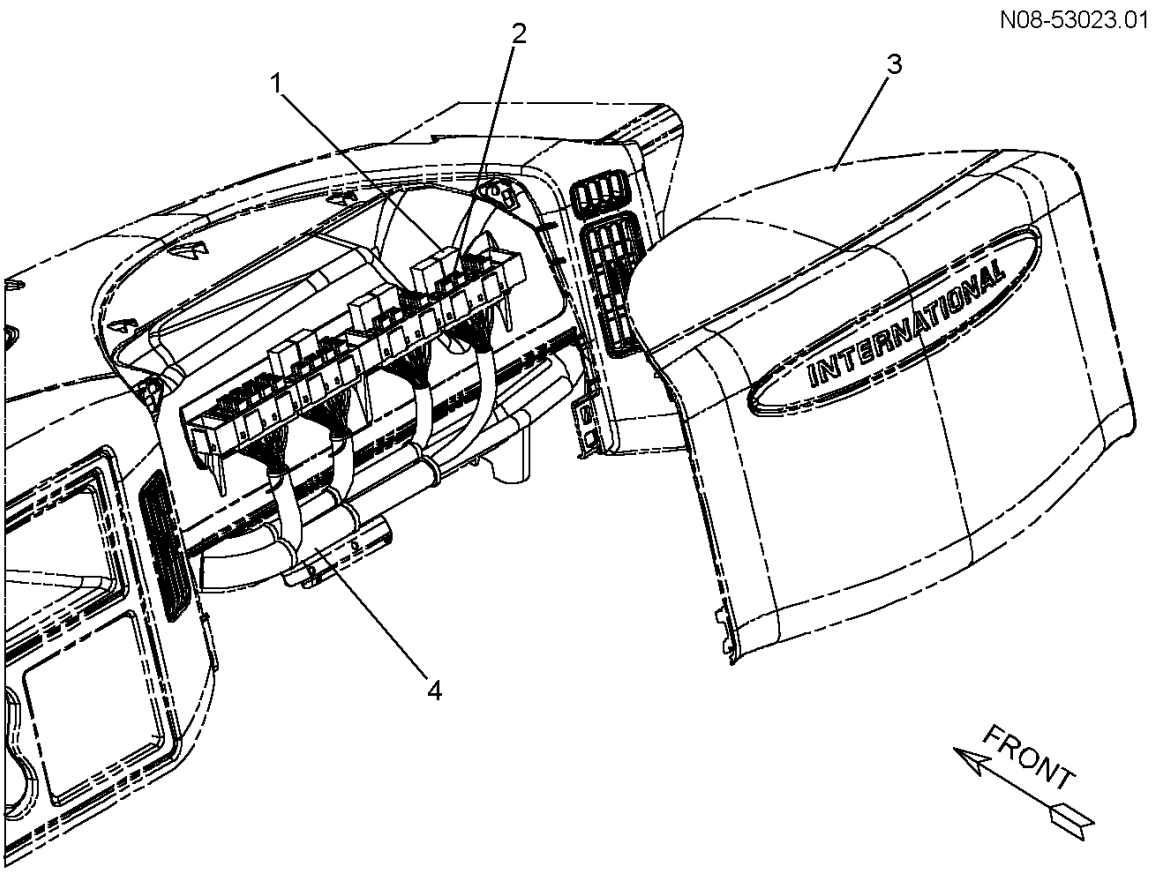

Figure 289 Lighted Air Shield Relay and Fuse Location (Cab Power Distribution Center)

1. (1014) LIGHTED AIR SHIELD RELAY
2. (1014) F40 (10A) LIGHTED AIR SHIELD FUSE
3. FUSE COVER
4. CAB HARNESS LIGHTED AIR SHIELD ROOF/INSTRUMENT PANEL

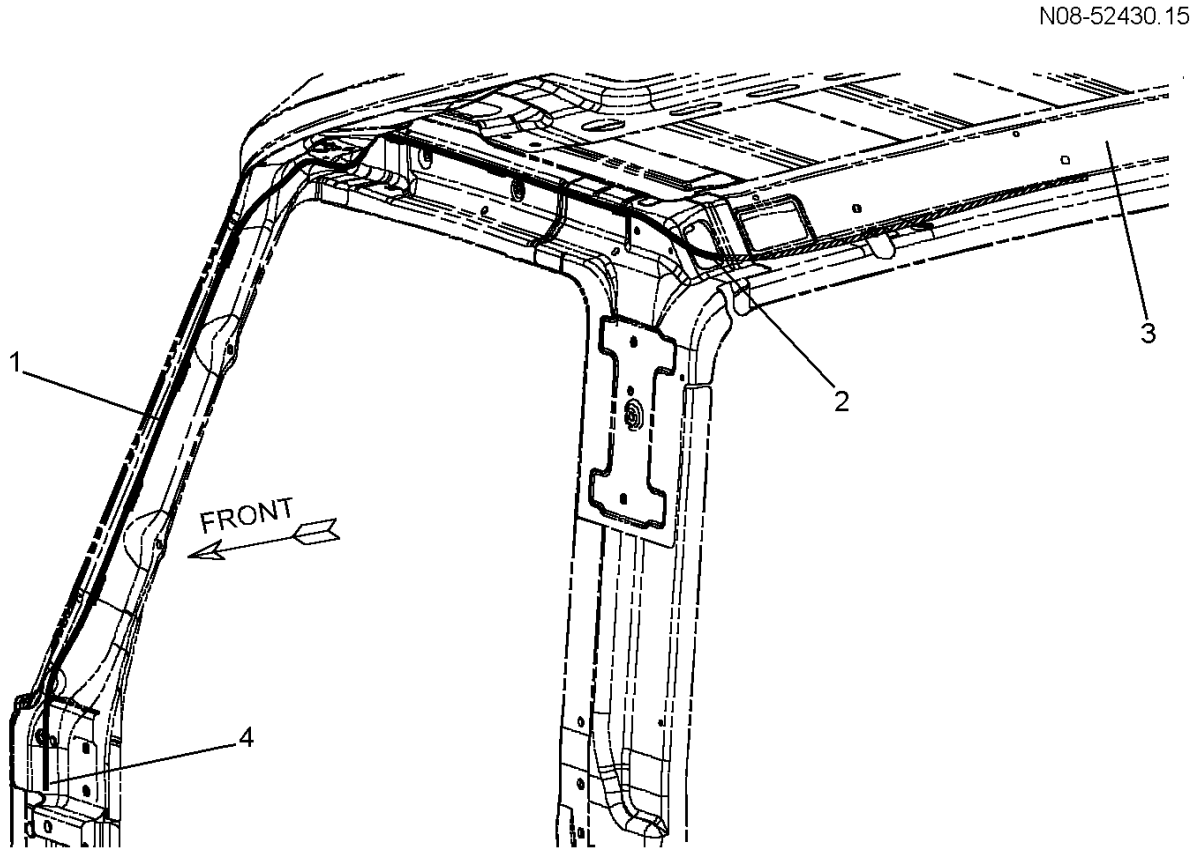

Figure 290 Lighted Air Shield Cab Wiring

1. HARNESS, ROOF WIRING LIGHTED AIR SHIELD
2. HARNESS TO THE ROOF AIR SHIELD LIGHT
3. ROOF REAR HEADER
4. TO (2022) AUXILIARY ROOF/INSTRUMENT PANEL CONNECTOR

18. ROOF AUXILIARY LOAD

18.1. CIRCUIT FUNCTIONS

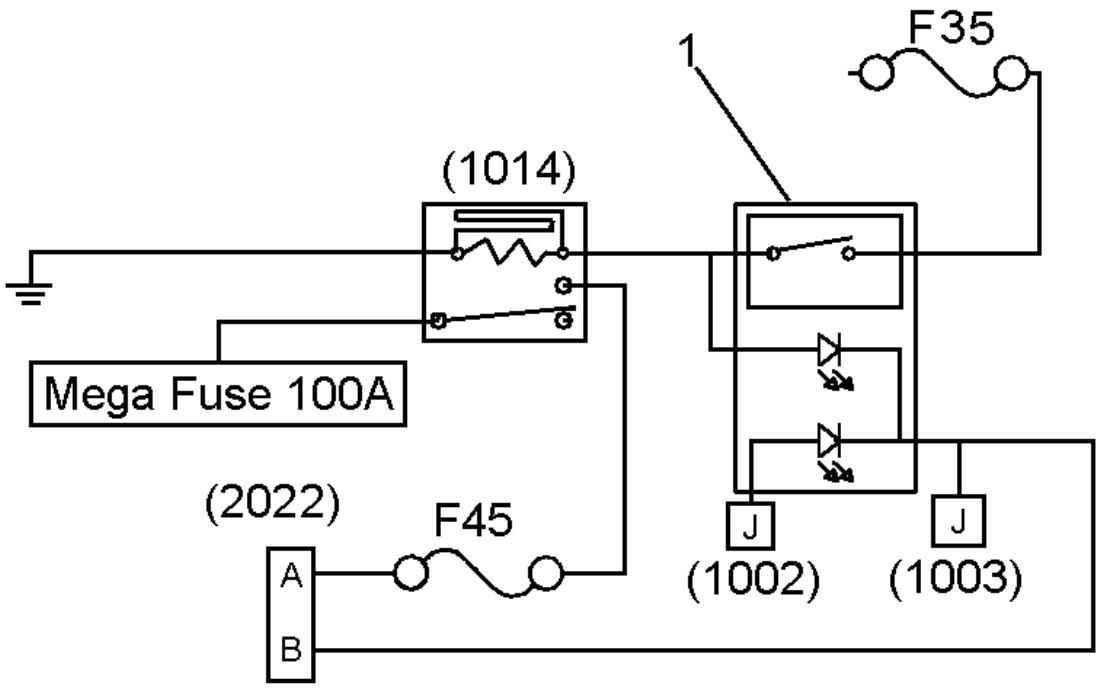

Figure 291 Roof Auxiliary Load Function Diagram

1. AUXILIARY ROOF LOAD SWITCH CONNECTOR (1915)
(1002) PANEL LIGHT ADAPTER BUSS BAR
(1003) GROUND ADAPTER BUSS BAR
(1014) AUXILIARY ROOF LOAD RELAY
(2022) HARNESS CAB WIRING, IP/AUXILIARY ROOF CONNECTOR
(F35) AUXILIARY ROOF LOAD SWITCH FUSE, CAB FUSE BLOCK (1013)
(F45) AUXILIARY ROOF LOAD FUSE, CAB FUSE BLOCK (1014)

The auxiliary roof load switch is turned on, this will energize the auxiliary roof load relay to provide power to the IP/Auxiliary roof lights. The panel lights switch is adjusted, the IP/Auxiliary roof lights are adjusted.

18.2. DIAGNOSTICS

A failure in the roof auxiliary load circuits should be suspected. No diagnostic trouble code (DTC) for this switch circuit.

Roof Auxiliary Load Preliminary Check

Table 197 Roof Auxiliary Load Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	With auxiliary roof load switch and panel light “ON” verify operation of auxiliary roof load.	Visually check auxiliary roof load.	Auxiliary roof load does not light.	Go to next step.	Auxiliary roof load is operating correctly.
2.	On	Determine if any other 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	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 588)				

18.3. FAULT DETECTION MANAGEMENT

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

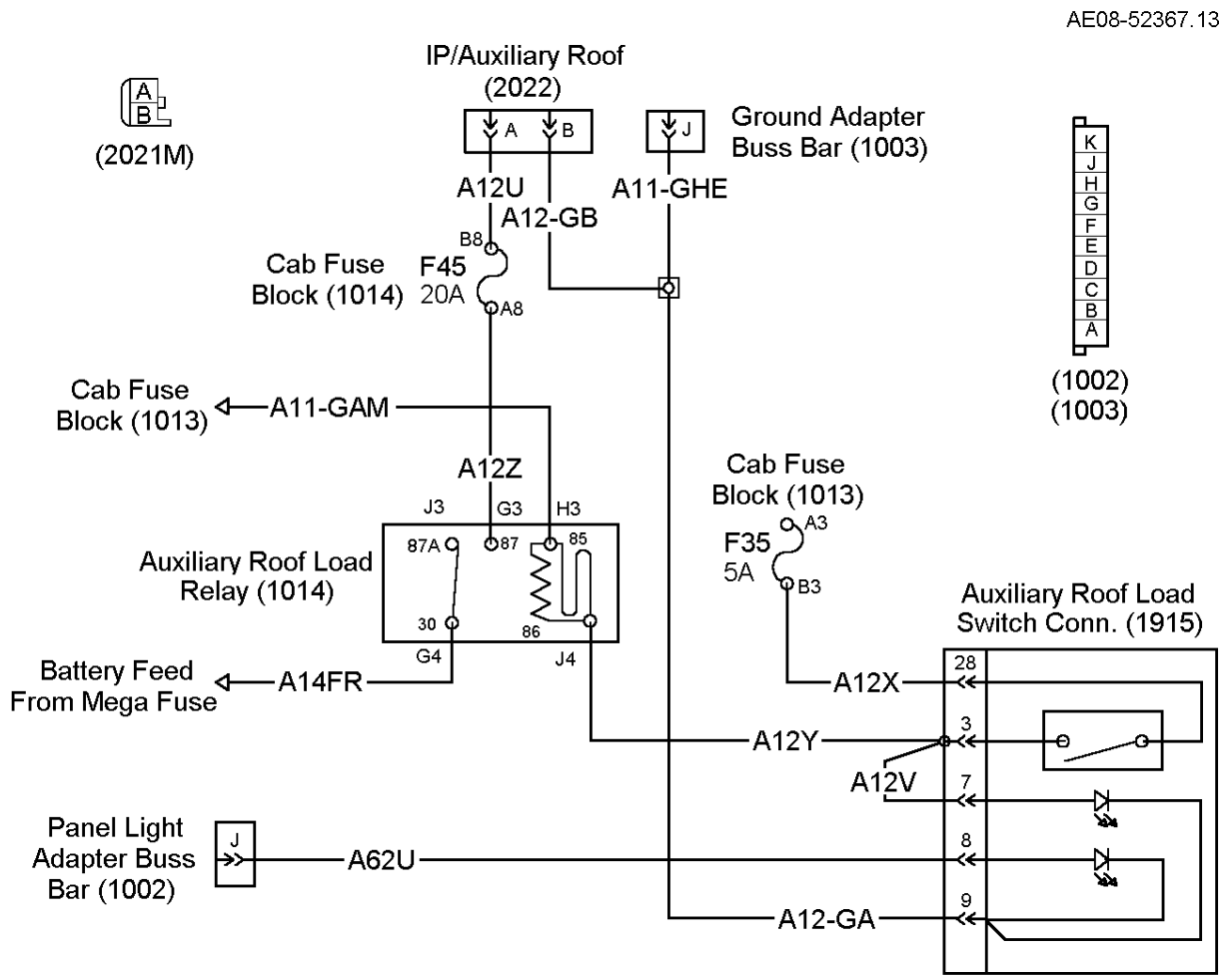

Figure 292 Roof Auxiliary Load Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1002) PANEL LIGHT ADAPTER BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1003) GROUND ADAPTER BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1013) F35 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1014) F45 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1014) AUXILIARY ROOF LOAD RELAY
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1915) AUXILIARY ROOF LOAD SWITCH CONNECTOR
LOCATED IN CAB ON INSTRUMENT PANEL
(2022) HARNESS CAB WIRING, IP/AUXILIARY ROOF CONNECTOR
LOCATED IN INSTRUMENT PANEL TO CAB POWER DISTRIBUTION CENTER

Refer to Roof Auxiliary Load Circuits.

Table 198 Roof Auxiliary Load Circuit Tests

Roof Auxiliary Load Relay Checks Check with auxiliary roof load relay removed, key in ignition position and auxiliary roof load switch on. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Bench check auxiliary roof load relay. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)	Relay energizes and there is continuity thorough the closed contacts.	If a relay tests bad, replace it.
Measure voltage between auxiliary roof load relay socket cavity J4 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in auxiliary roof load switch (1915), circuit A12Y, A12X or blown cab fuse F35.
Measure voltage between auxiliary roof load switch connector (1915) cavity 3 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in auxiliary roof load switch (1915), circuit A12V, LED, check for open A12–GA, A12–GB or A11–GHE to ground.
Measure voltage between auxiliary roof load relay socket cavity G3 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A12Z, A12U or cab fuse F45.
Measure voltage between auxiliary roof load relay socket cavity J4 and H3.	12 ± 1.5 volts.	If voltage is missing, check for open A11–GAM to ground.

18.4. EXTENDED DESCRIPTION

When auxiliary roof load switch and park lights are requested, the auxiliary roof load switch will supply 12 volts to the coil of auxiliary roof load relay.

This will cause the relay to energize, supplying power to the auxiliary roof load.

18.5. COMPONENT LOCATIONS

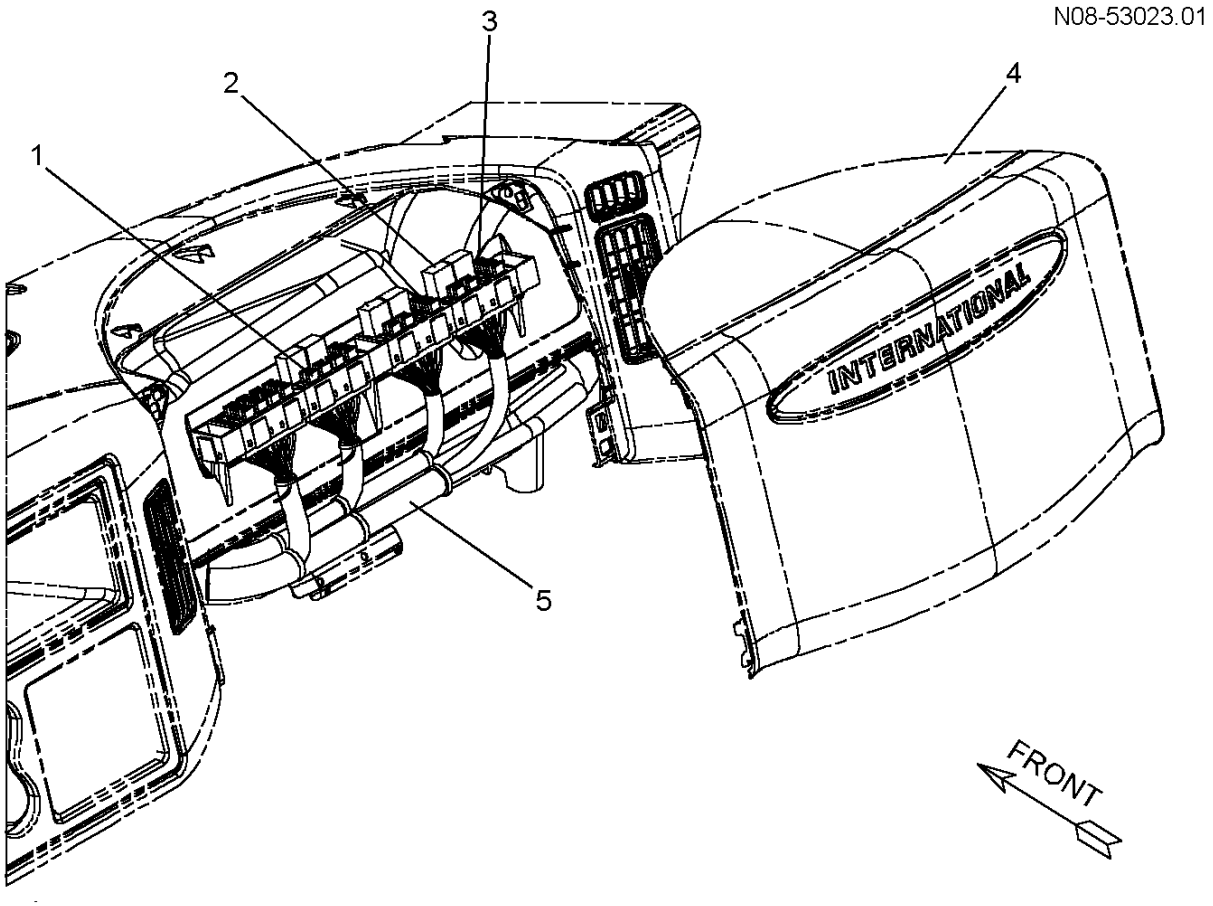

Figure 293 Roof Auxiliary Load Relay and Fuse Location (Cab Power Distribution Center)

1. (1013) F35 (5A) ROOF AUXILIARY FUSE
2. (1014) AUXILIARY ROOF LOAD RELAY
3. (1014) F45 (20A) ROOF AUXILIARY FUSE
4. FUSE COVER
5. CAB HARNESS, AUXILIARY ROOF LOAD INSTRUMENT PANEL

N08-52430.11

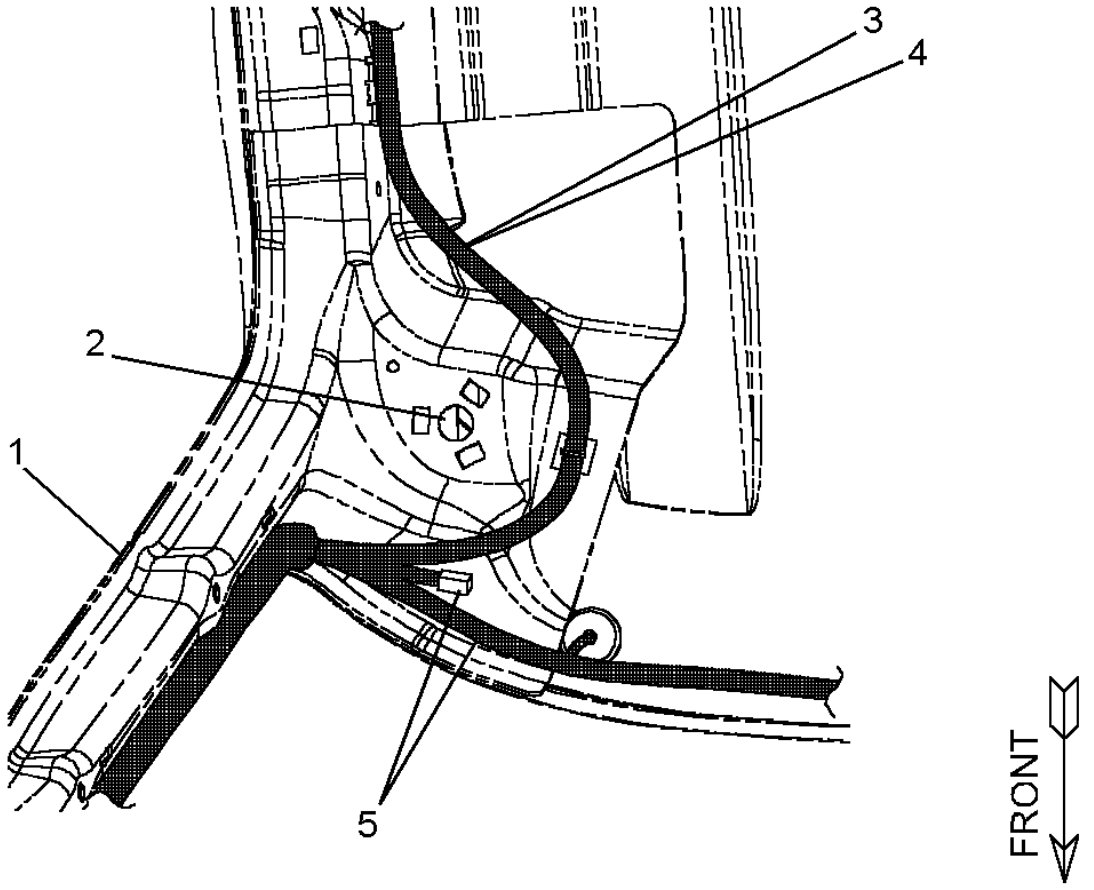

Figure 294 Roof Auxiliary Load Cab Wiring

1. LEFT “A” PILLAR
2. VISOR MOUNT
3. HARNESS, ROOF WIRING, ROOF LEFT “A” PILLAR
4. HARNESS, ROOF AUXILIARY LOAD, RIGHT “A” PILLAR
5. ON LEFT SIDE ONLY

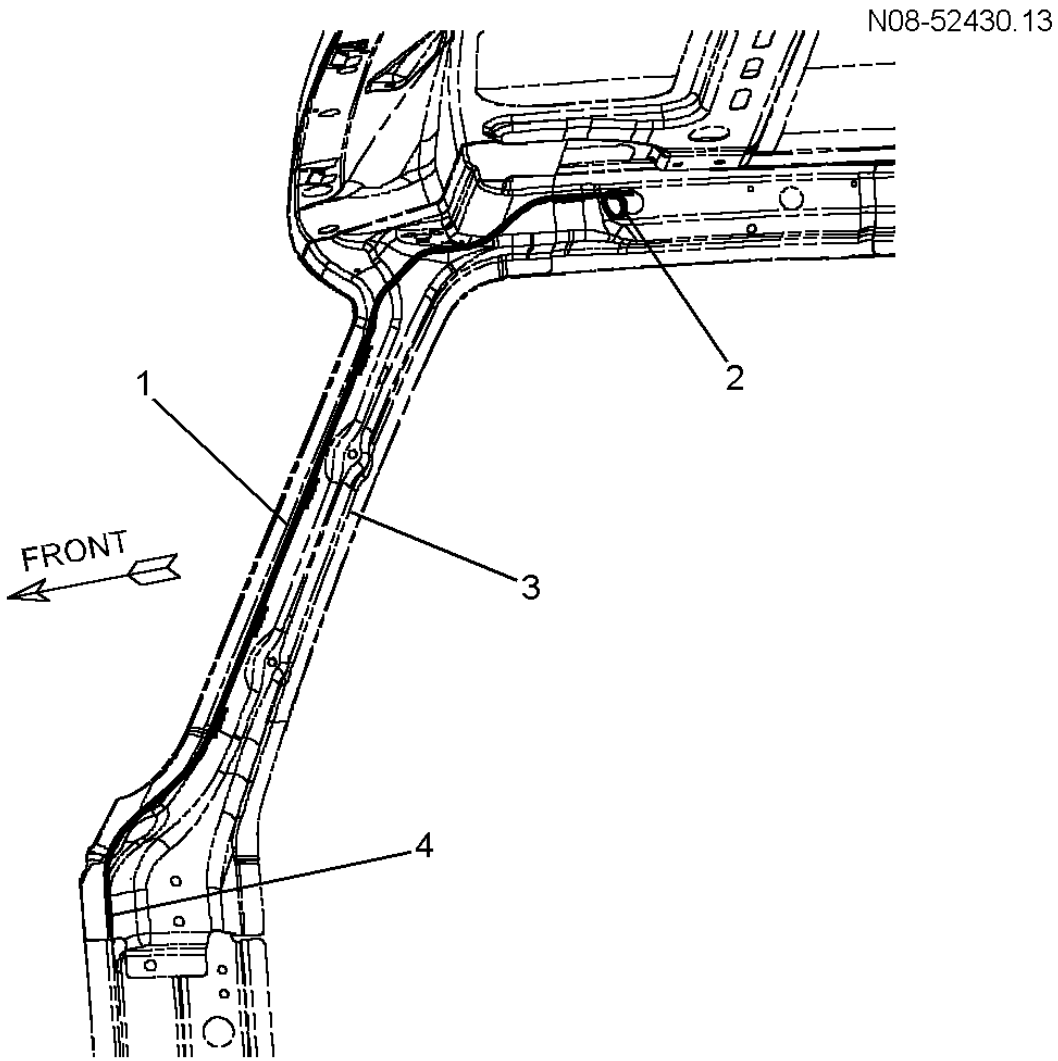

Figure 295 Roof Auxiliary Load Cab Wiring

1. HARNESS, ROOF AUXILIARY LOAD
2. HARNESS TO THE ROOF AUXILIARY LOAD
3. RIGHT “A” PILLAR
4. TO (2022) AUXILIARY ROOF/INSTRUMENT PANEL CONNECTOR

19. SATELLITE COMMUNICATION QUALCOMM MCT OR IMCT SYSTEM

19.1. CIRCUIT FUNCTIONS

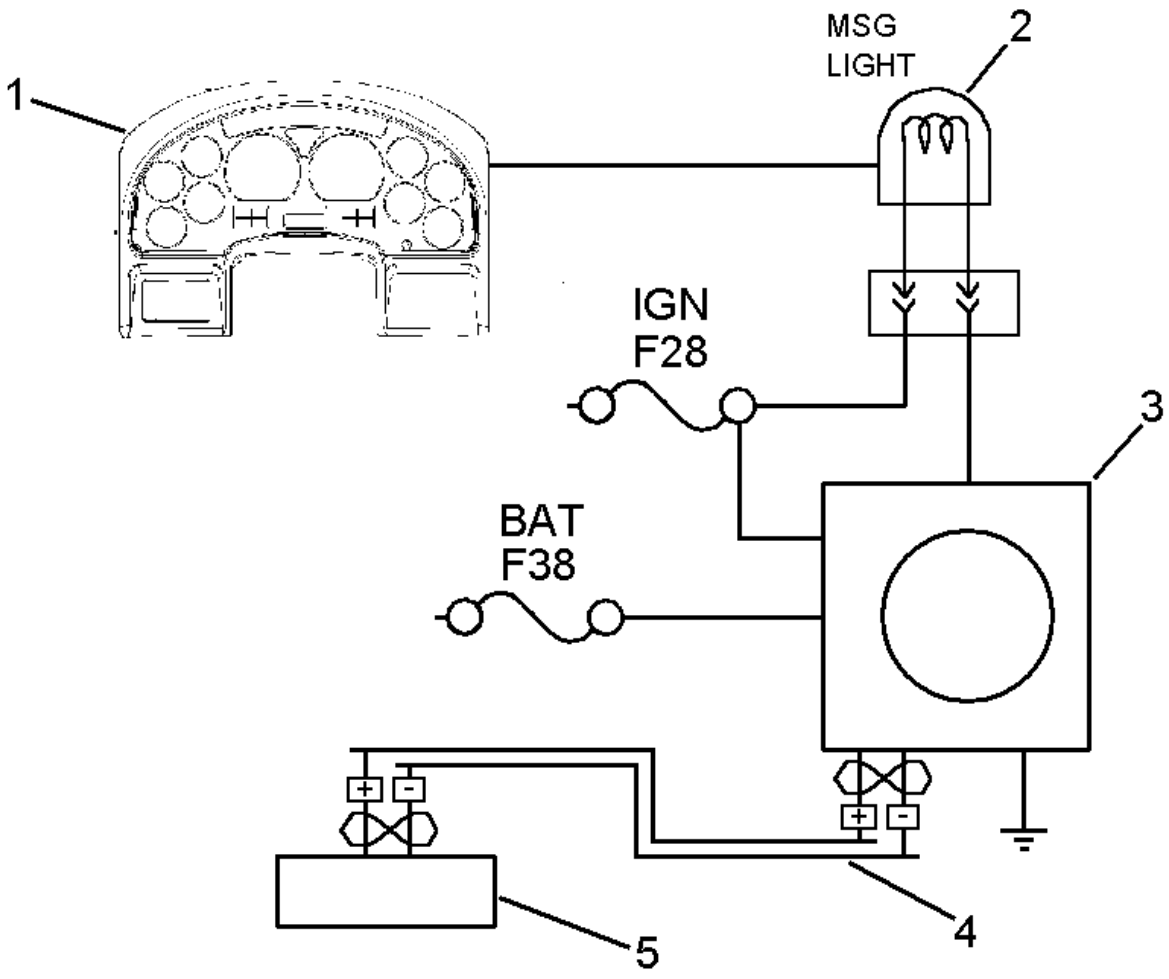

Figure 296 Satellite Communication QUALCOMM MCT Or IMCT System Function Diagram

1. ELECTRONIC GAUGE CLUSTER (EGC)
2. QUALCOMM MSG LIGHT (1555M)
3. MOBILE COMMUNICATIONS TERMINAL (MCT) OR INTEGRATED MOBILE COMMUNICATIONS TERMINAL (IMCT) SYSTEM QUALCOMM SATELLITE COMMUNICATION SYSTEM
4. DRIVETRAIN J1708 DATA LINK
5. ENGINE ELECTRONIC CONTROL MODULE (ECM)

F28 (10A) IGNITION & F38 (10A) BATTERY SATELLITE COMMUNICATION SYSTEM FUSES (1014)

The MSG light illuminates, in the cluster, when the satellite communication QUALCOMM Mobile Communications Terminal (MCT) or Integrated Mobile Communications Terminal (IMCT) system is turned

on by the power thourgh fuses F28 and F38. The ECM will provide engine information to the IMCT satellite communication system.

19.2. DIAGNOSTICS

A failure in the satellite communication system power circuits should be suspected when the ECM engine information is not provided to the satellite communication system. No diagnostic trouble code (DTC) for this satellite communication system power circuit.

Satellite Communication QUALCOMM MCT Or IMCT System Preliminary Check

Table 199 Satellite Communication QUALCOMM MCT Or IMCT System Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify operation of satellite communication system.	Visually check satellite communication system.	Satellite communication system does not operate.	Go to next step.	Satellite communication system is operating correctly.
2.	On	Determine if any other 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	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 595)				

19.3. FAULT DETECTION MANAGEMENT

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

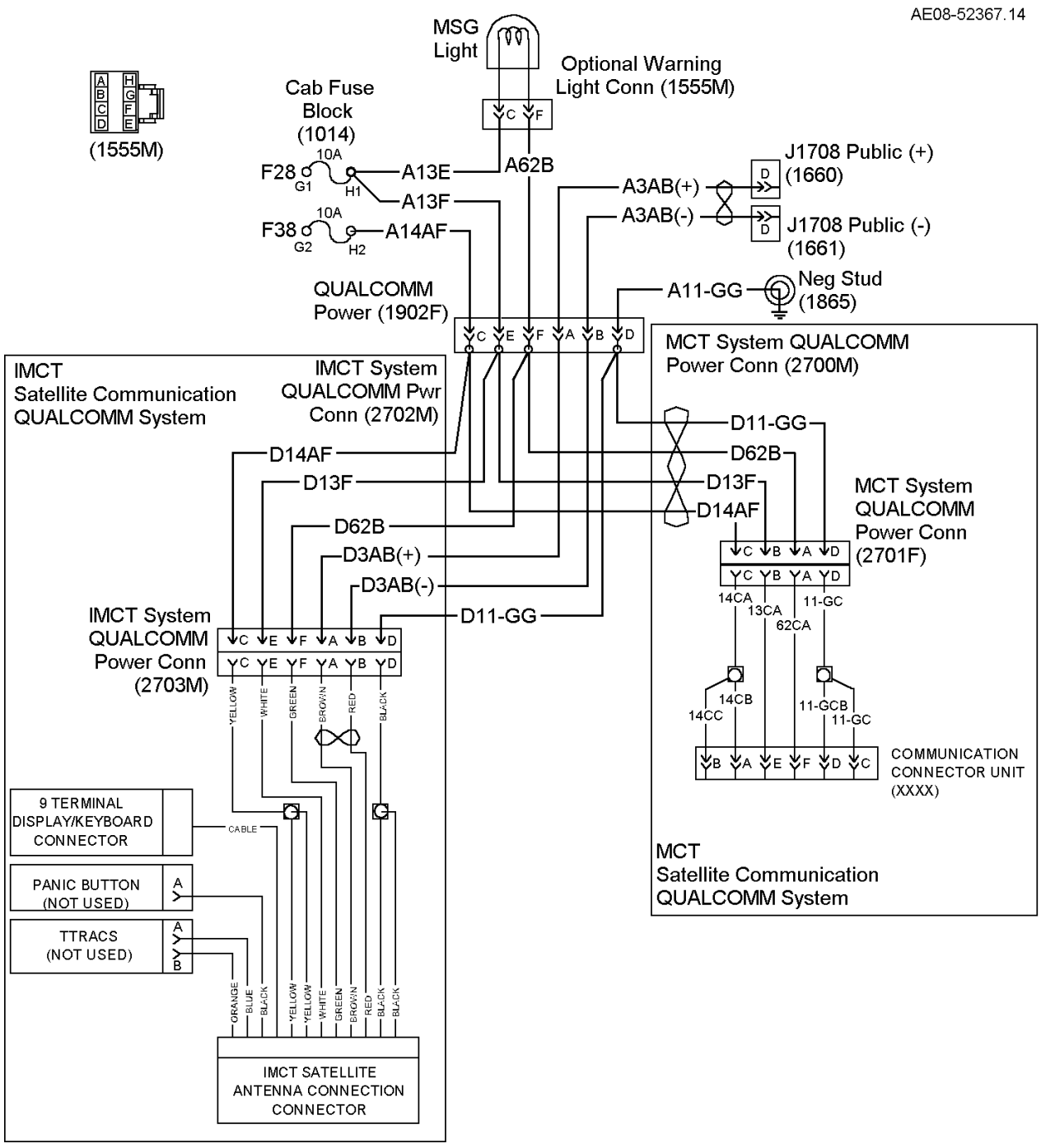

Figure 297 Satellite Communication QUALCOMM MCT Or IMCT System Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(1014) F28 (10A) & F38 (10A) SATELLITE COMMUNICATION SYSTEM FUSES
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1555M) QUALCOMM MSG LIGHT
LOCATED IN ELECTRONIC GAUGE CLUSTER
(1660) AND (1661) DRIVETRAIN J1708 DATA LINK
LOCATED TO ENGINE ECM
(1865) GROUND ADAPTER BUSS BAR
LOCATED IN INSTRUMENT PANEL
(1902F) QUALCOMM POWER SATELLITE COMMUNICATION SYSTEM/INSTRUMENT PANEL CAB HARNESS
LOCATED IN INSTRUMENT PANEL TO RIGHT ROOF PILLAR
IMCT SYSTEM QUALCOMM POWER CONNECTOR (2702M) OR MCT SYSTEM QUALCOMM POWER CONNECTOR (2700M) SATELLITE COMMUNICATION SYSTEM HARNESS
LOCATED IN CAB AND RIGHT ROOF PILLAR AND BEHIND SEAT
IMCT SYSTEM QUALCOMM POWER CONNECTOR (2703M) OR MCT SYSTEM QUALCOMM POWER CONNECTOR (2701F) SATELLITE COMMUNICATION SYSTEM HARNESS
LOCATED IN CAB BEHIND SEAT
IMCT SYSTEM QUALCOMM ACU COMPUTER POWER OR MCT SYSTEM QUALCOMM COMPUTER POWER HARNESS
LOCATED IN CAB BEHIND SEAT
MCT SYSTEM QUALCOMM ANTENNA HARNESS
LOCATED IN CAB BEHIND SEAT
IMCT SYSTEM QUALCOMM DISPLAY CABLE ASSEMBLY OR MCT SYSTEM QUALCOMM DISPLAY CABLE ASSEMBLY
LOCATED IN CAB BEHIND SEAT

Refer to Satellite Communication QUALCOMM MCT or IMCT System Circuits.

Table 200 Satellite Communication QUALCOMM MCT Or IMCT System Circuit Tests

Satellite Communication QUALCOMM MCT or IMCT System Power Circuit Checks Check with MCT or IMCT system QUALCOMM power connector (2701F) or (2703M) disconnected and key in ignition position on. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Measure voltage between MCT (2701F) or IMCT (2703M) cavity C and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A14AF, D14AF or blown cab fuse F38.
Measure voltage between MCT (2701F) cavity B or IMCT (2703M) cavity E and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A13F, D13F or blown cab fuse F28.

Table 200 Satellite Communication QUALCOMM MCT Or IMCT System Circuit Tests (cont.)

Measure voltage between MCT (2701F) cavity A or IMCT (2703M) cavity F and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A62B, D62B, A13E or blown cab fuse F28. QUALCOMM MSG LIGHT lamp and connector (1555M)
Measure voltage between MCT (2701F) or IMCT (2703M) cavity D and cavity C.	12 ± 1.5 volts.	If voltage is missing, check for open circuits A11–GG or D11–GG to NEG stud (1865).
Measure voltage between IMCT (2703M) cavity A and cavity B.	3.5 ± .5 volts.	If voltage is missing, check for open in ground circuits between IMCT connector (2703M) and 1708 data link circuits.

19.4. EXTENDED DESCRIPTION

Voltage is supplied to the satellite communication QUALCOMM MCT or IMCT system circuits through fuses F28 and F38 in the cab power distribution center.

Chassis ground for the satellite communication QUALCOMM MCT or IMCT system circuits through negative stud (1865).

The satellite communication QUALCOMM MCT or IMCT will illuminate the MSG light (1555M) in the electronic gauge cluster.

The satellite communication QUALCOMM IMCT will receive engine ECM information through the 1708 data link circuit connectors (1660) and (1661).

19.5. COMPONENT LOCATIONS

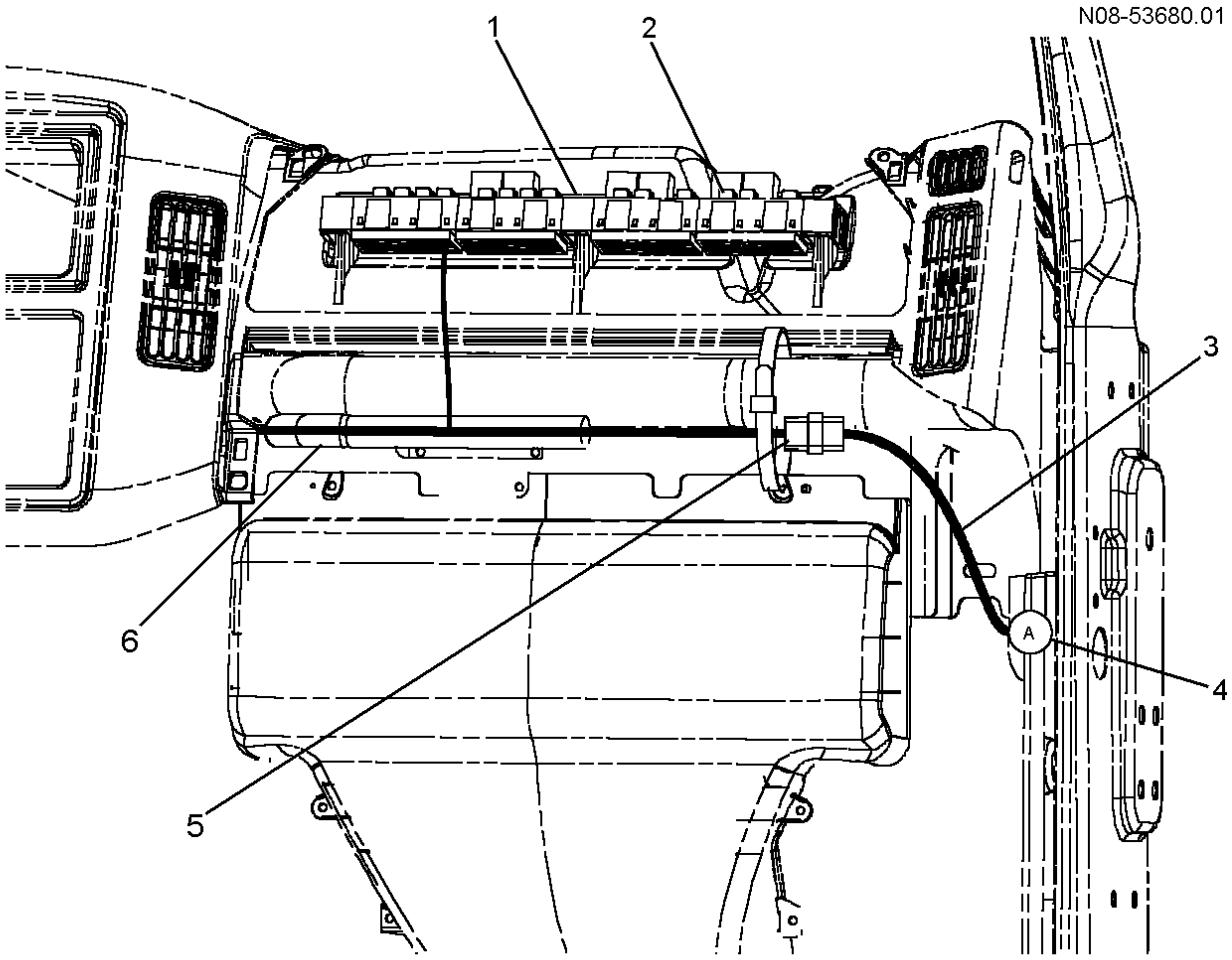

Figure 298 Satellite Communication QUALCOMM MCT Or IMCT System Relay and Fuse Location (Cab Power Distribution Center)

1. (1011), (1012), (1013) & (1014) CAB FUSE PANELS
2. (1014) F28 (10A) & F38 (10A) SATELLITE COMMUNICATION SYSTEM FUSES
3. IMCT SYSTEM QUALCOMM POWER CONNECTOR (2702M) OR MCT SYSTEM QUALCOMM POWER CONNECTOR (2700M) TO ROOF SATELLITE COMMUNICATION SYSTEM HARNESS
4. (A) SEE NEXT FIGURE
5. (1902F) QUALCOMM POWER SATELLITE COMMUNICATION SYSTEM/INSTRUMENT PANEL CAB HARNESS
6. CAB HARNESS

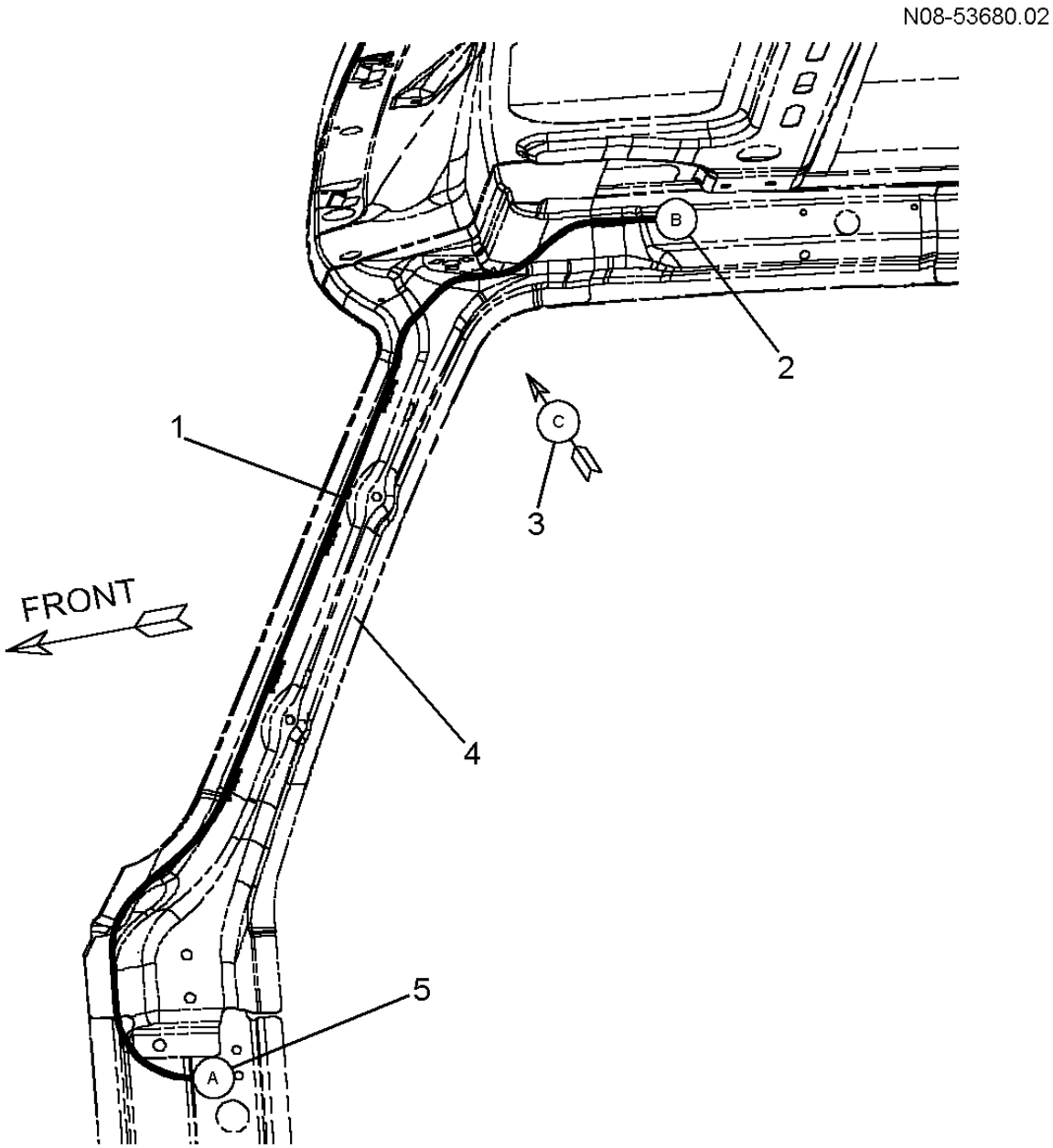

Figure 299 Satellite Communication QUALCOMM MCT Or IMCT System Cab Wiring

1. IMCT SYSTEM QUALCOMM POWER OR MCT SYSTEM QUALCOMM POWER TO ROOF SATELLITE COMMUNICATION SYSTEM HARNESS
2. (B) SEE NEXT FIGURE
3. (C) SEE NEXT FIGURE
4. RIGHT “A” PILLAR
5. (A) FROM LAST FIGURE

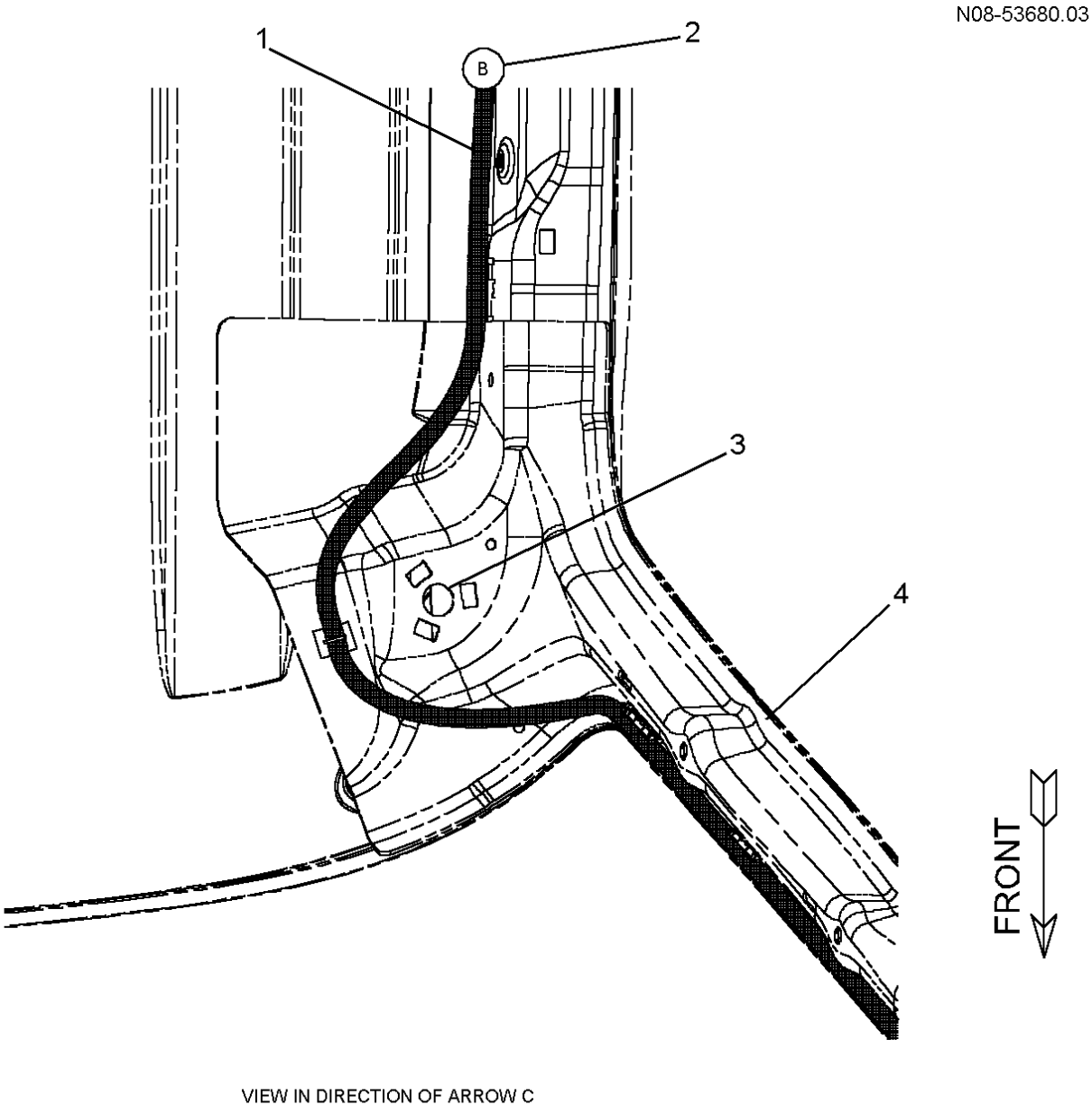

Figure 300 Satellite Communication QUALCOMM MCT Or IMCT System Relay and Fuse Location (Cab Power Distribution Center)

1. IMCT SYSTEM QUALCOMM POWER OR MCT SYSTEM QUALCOMM POWER TO ROOF SATELLITE COMMUNICATION SYSTEM HARNESS
2. (B) SEE NEXT FIGURE
3. VISOR MOUNT
4. RIGHT “A” PILLAR

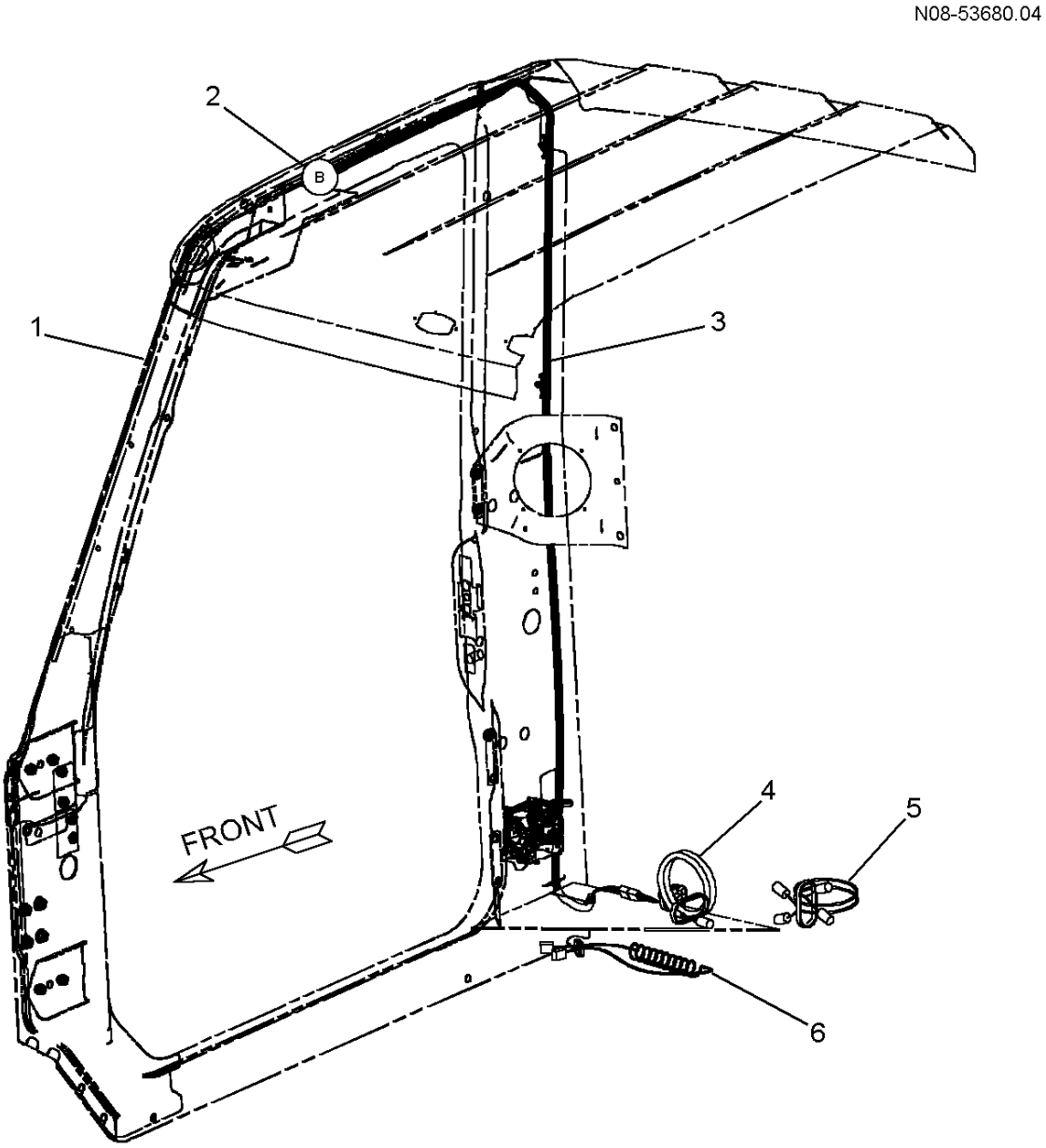

Figure 301 Satellite Communication QUALCOMM MCT Or IMCT System Cab Wiring

1. RIGHT “A” PILLAR
2. (B) FROM LAST FIGURE
3. IMCT SYSTEM QUALCOMM POWER CONNECTOR (2703M) OR MCT SYSTEM QUALCOMM POWER CONNECTOR (2701F) SATELLITE COMMUNICATION SYSTEM HARNESS
4. IMCT SYSTEM QUALCOMM ACU COMPUTER POWER OR MCT SYSTEM QUALCOMM COMPUTER POWER HARNESS
5. MCT SYSTEM QUALCOMM ANTENNA HARNESS
6. IMCT SYSTEM QUALCOMM DISPLAY CABLE ASSEMBLY OR MCT SYSTEM QUALCOMM DISPLAY CABLE ASSEMBLY

20. SELF CONTAINED AIR SEAT

20.1. CIRCUIT FUNCTIONS

Refer to Self contained air seat function diagram.

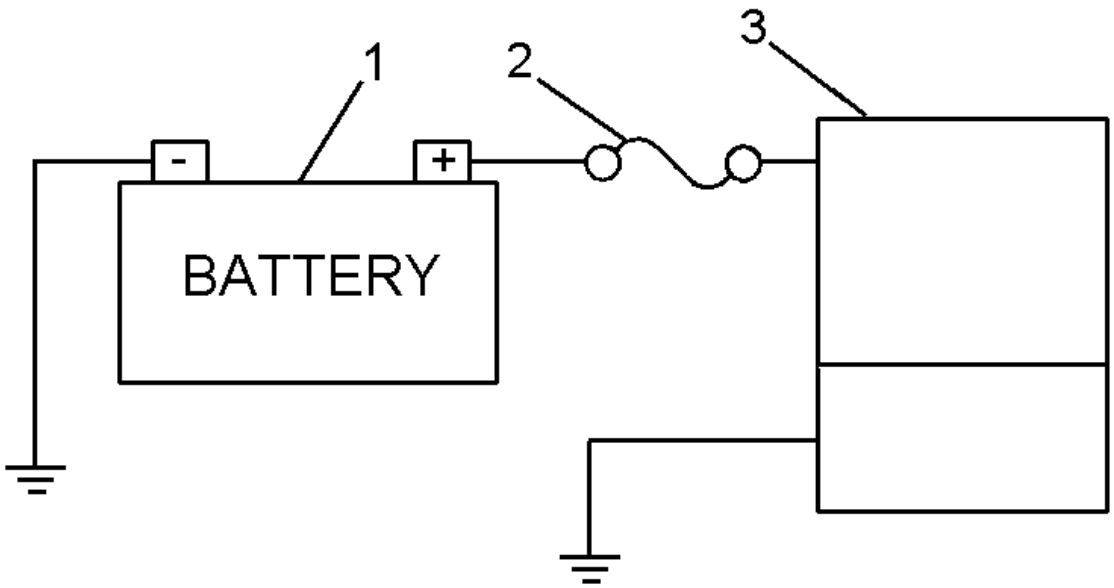

Figure 302 Self Contained Air Seat Function Diagram

1. VEHICLE BATTERY
2. CAB FUSE F38
3. SELF CONTAINED AIR SEAT

The self contained air seat is generally used in applications where the standard seat is not installed in the vehicle.

The self contained air seat is power by battery voltage.

20.2. SELF CONTAINED AIR SEAT 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 self contained air seat circuits will be apparent when the seat is inoperative.

Should the self contained air seat fail to operate, the problem could be attributed to open or shorted wiring in power or ground circuits to the seat or a failure in the seat.

Refer to self contained air seat circuits.

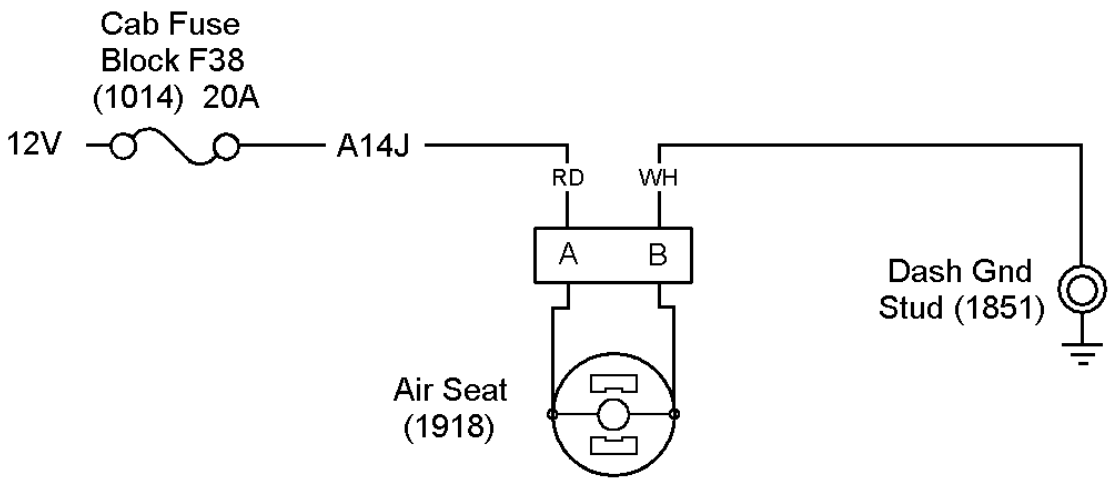

Figure 303 Self Contained Air Seat Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1014) F38 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1918) SELF CONTAINED AIR SEAT CONNECTOR
LOCATED IN CAB
(1851) DASH GROUND STUD CONNECTOR
LOCATED ABOVE ESC ON DASH PANEL

Table 201 Self Contained Air Seat Harness Connector Tests

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the self contained air seat circuits.		
Self Contained Air Seat Harness Connector Voltage Checks Check with self contained air seat connector (1918) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**		
Test Points	Spec.	Comments
Self contained air seat connector cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuits between self contained air seat connector and F38. Also check for blown fuse F38.
Self contained air seat connector cavity A to cavity B	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits between self contained air seat connector and dash ground stud. If voltage is correct the self contained air seat is inoperative, the seat should be replaced.

Extended Description

Battery voltage, required to operate the self contained air seat, is supplied from fuse F38 on circuit A14J to self contained air seat connector (1918) pin A. Ground is supplied from dash ground stud connector to self contained air seat connector (1918) pin B.

20.3. COMPONENT LOCATIONS

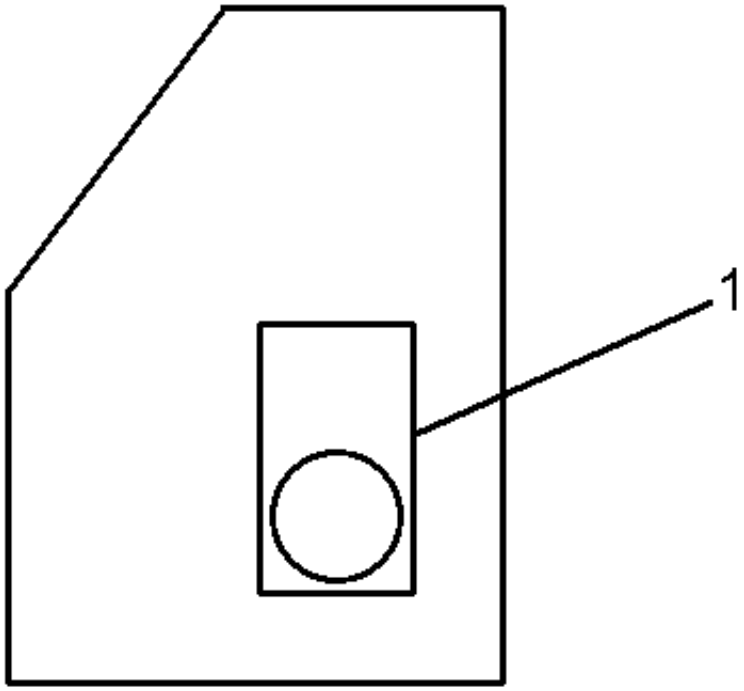

Figure 304 Self Contained Air Seat Location

1. SELF CONTAINED AIR SEAT

21. DIGITAL CLOCK PTC

21.1. CIRCUIT FUNCTIONS

Refer to digital clock PTC function diagram.

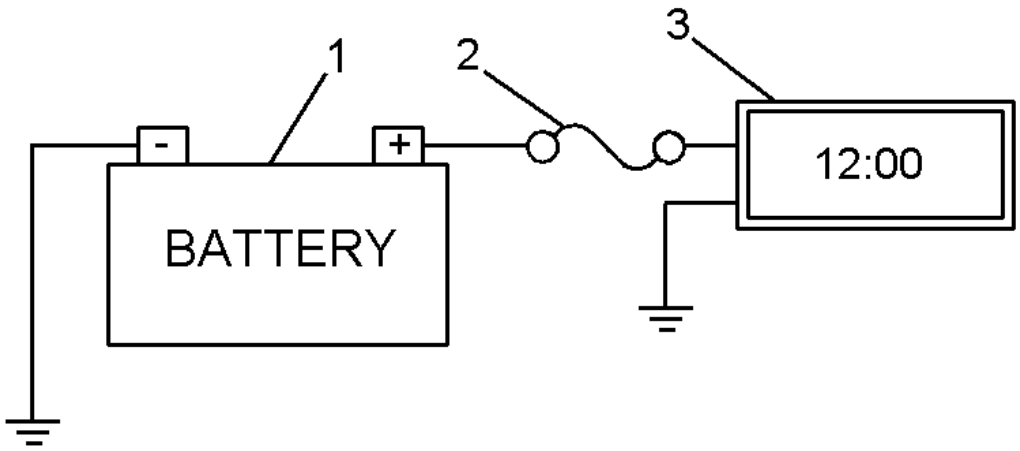

Figure 305 Digital Clock PTC Function Diagram

1. VEHICLE BATTERY
2. CAB FUSE F12
3. DIGITAL CLOCK PTC

The digital clock PTC is generally used in applications where the optional entertainment radio is not installed on the vehicle.

The digital clock PTC is power by battery voltage and is backlit by panel light dimmer voltage from the Gauge cluster.

21.2. DIGITAL CLOCK PTC 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 digital clock PTC circuits will be apparent when the clock is inoperative or the clock backlights are inoperative.

Should the clock fail to operate, the problem could be attributed to open or shorted wiring in power or ground circuits to the clock or a failure in the clock.

Refer to digital clock PTC circuits.

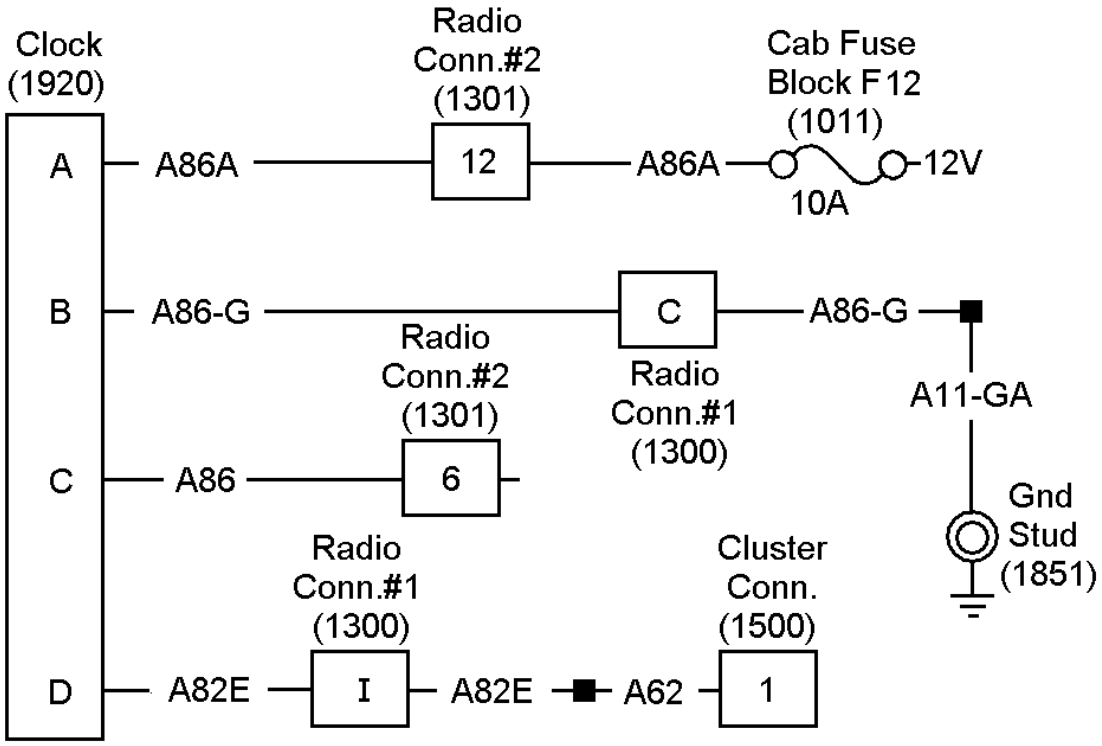

Figure 306 Digital Clock PTC Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

(1011) F12 CAB FUSE BLOCK
LOCATED IN CAB POWER DISTRIBUTION CENTER
(1300) RADIO CONNECTOR
LOCATED ON BACK OF RADIO
(1301) RADIO CONNECTOR
LOCATED ON BACK OF RADIO
(1500) ELECTRONIC GAUGE CLUSTER CONNECTOR (PANEL LIGHT VOLTAGE)
LOCATED ON BACK OF ELECTRONIC GAUGE CLUSTER
(1851) GROUND STUD CONNECTOR
LOCATED ABOVE ESC ON DASH PANEL
(1920) DIGITAL CLOCK PTC CONNECTOR
LOCATED ON BACK OF CLOCK

Table 202 Digital Clock PTC Harness Connector Tests

Diagnostic Trouble Codes
There are no diagnostic trouble codes associated with the digital clock PTC circuits.
Digital Clock PTC Harness Connector Voltage Checks Check with clock connector (1920) disconnected. **NOTE – Always check connectors for damage and pushed–out terminals.**

Table 202 Digital Clock PTC Harness Connector Tests (cont.)

Test Points	Spec.	Comments
Clock connector (1920) cavity A to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86A between clock connector (1920) cavity A, radio connector (1301) cavity 12 and F12. Also check for blown fuse F12.
Clock connector (1920) cavity A to cavity B	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits A86–G and A11–GA between clock connector (1920) cavity B, radio connector (1300) cavity C and ground stud (1851). If voltage is correct an clock is inoperative, the clock should be replaced.
Clock HI connector (1920) cavity C to ground	12 ± 1.5 volts	If voltage is missing, check for open or shorts in circuit A86 between clock HI connector (1920) cavity C and radio connector (1301) cavity 6.
Clock LOW connector (1920) cavity D to ground.	12 ± 1.5 volts	If voltage is missing, check for open in ground circuits A82E aqnd A82 between clock connector (1920) cavity D, radio connector (1300) cavity I and gauge cluster connector (1500) cavity 1. If voltage is correct and backlight is inoperative, replace burnt out lamp.

Extended Description

Battery voltage, required to operate the clock, is supplied from fuse F12 on circuit A86A to clock connector (1920) terminal A. Ground is supplied from ground stud connector (1851) circuits 11–GA and A86–GA to clock connector (1920) terminal B.

Panel light voltage for the clock light is supplied from EGC connector (1500) terminal 1 circuits A62 and A82E to clock LOW connector (1920) terminal D. Voltage for the clock HI is supplied from radio connector (1301) terminal 6 on circuit A86 to clock HI connector (1920) terminal C.

21.3. COMPONENT LOCATIONS

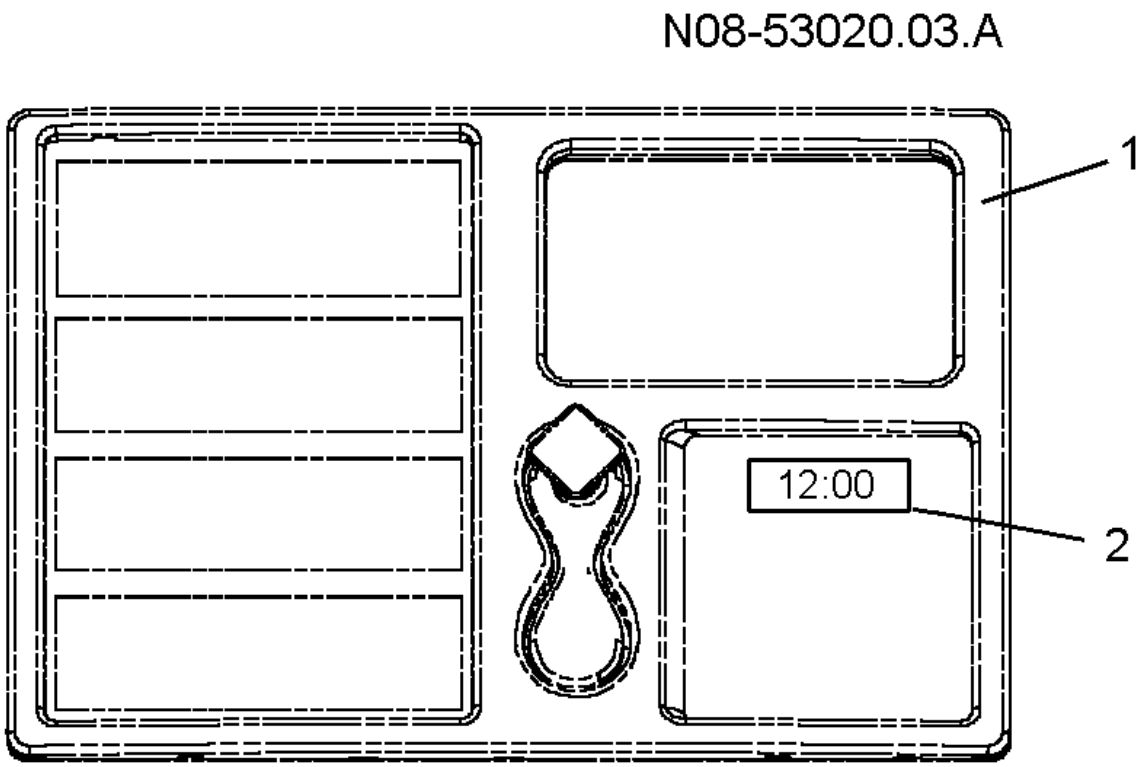

Figure 307 Digital Clock PTC Location

1. INSTRUMENT PANEL-CENTER PANEL
2. DIGITAL CLOCK PTC

22. BRAKE SWITCH / STOP LIGHT SWITCH

22.1. CIRCUIT FUNCTION

The brake switch(es) sense when the driver is pressing the brake pedal to apply the brakes and thus signal the ESC to turn on the stop lights and turn off the cruise control.

On vehicles with hydraulic brakes the stop light signal to the ESC comes from a switch activated by the brake pedal. The switch also signals the ESC to activate the brake booster pump when the engine is off and/or a failure in the brake system has occurred.

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

Refer to Hydraulic Brake Switch (See HYDRAULIC BRAKE SWITCH INPUTS TO ESC, page 906)or Air Brake Switch(See AIR BRAKE SWITCH INPUTS TO ESC, page 909) for more details.

23. XMSN ALLISON LCT COLUMN SHIFTER

23.1. CIRCUIT FUNCTIONS

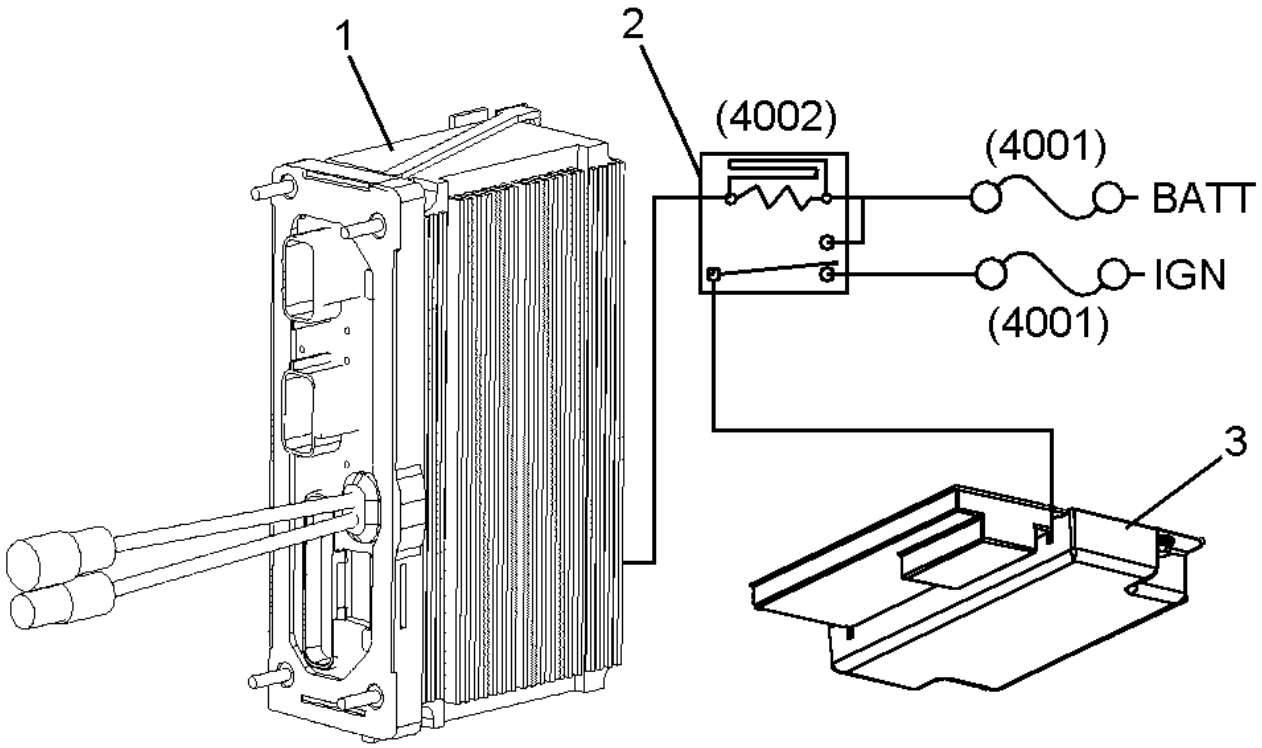

Figure 308 XMSN Allison LCT Column Shifter Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER (ESC)
2. (4002) MICRO RELAY
3. LCT TRANSMISSION CONTROL MODULE (TCM)
4. (4001) BATT AND IGN FUSES

The XMSN Allison LCT Column Shifter. The ESC will energize the Micro relay to provide power to the ECU “J1” Gray connector (7305) and NSBU switch vehicle connector (7301).

23.2. DIAGNOSTICS

A failure in the XMSN Allison LCT Column Shifter circuits should be suspected. A diagnostic trouble code (DTC) for this switch will be logged if there is an open or short in circuits to the switch.

An electronic service tool, running the "INTUNE" diagnostic software, can be used to check operation of the micro relay to the ESC. See the diagnostic software manual for details on using the software.

XMSN Allison LCT Column Shifter Preliminary Check

Table 203 XMSN Allison LCT Column Shifter Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES - IN SPEC.	NO - OUT OF SPEC.
1.	On	Verify operation of XMSN Allison LCT Column Shifter.	Visually check XMSN Allison LCT Column Shifter.	XMSN Allison LCT Column Shifter does not operate.	Go to next step.	XMSN Allison LCT Column Shifter is operating correctly.
2.	On	Determine if any other 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 611)	Read display on odometer.	**No** XMSN Allison LCT Column Shifter diagnostic trouble codes are active.	Go to next step.	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 612)
4.	On	Go to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 612)				

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, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 204 XMSN Allison LCT Column Shifter Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2033 14 7 0	There is a load on this pin that has been configured as unused. An unexpected load is attached to this pin.
2033 14 7 1	Overloaded Connector 4004 pin 19 current overload Too much load attached or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 612)
2033 14 7 2	Open circuit. Connector 4004 pin 19 open. Open circuit or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 612)
2033 14 7 3	Shorted to ground. Connector 4004 pin 19 shorted to ground. Shorted to ground or defective relay. Refer to Fault Detection Management (See FAULT DETECTION MANAGEMENT, page 612)

23.3. FAULT DETECTION MANAGEMENT

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

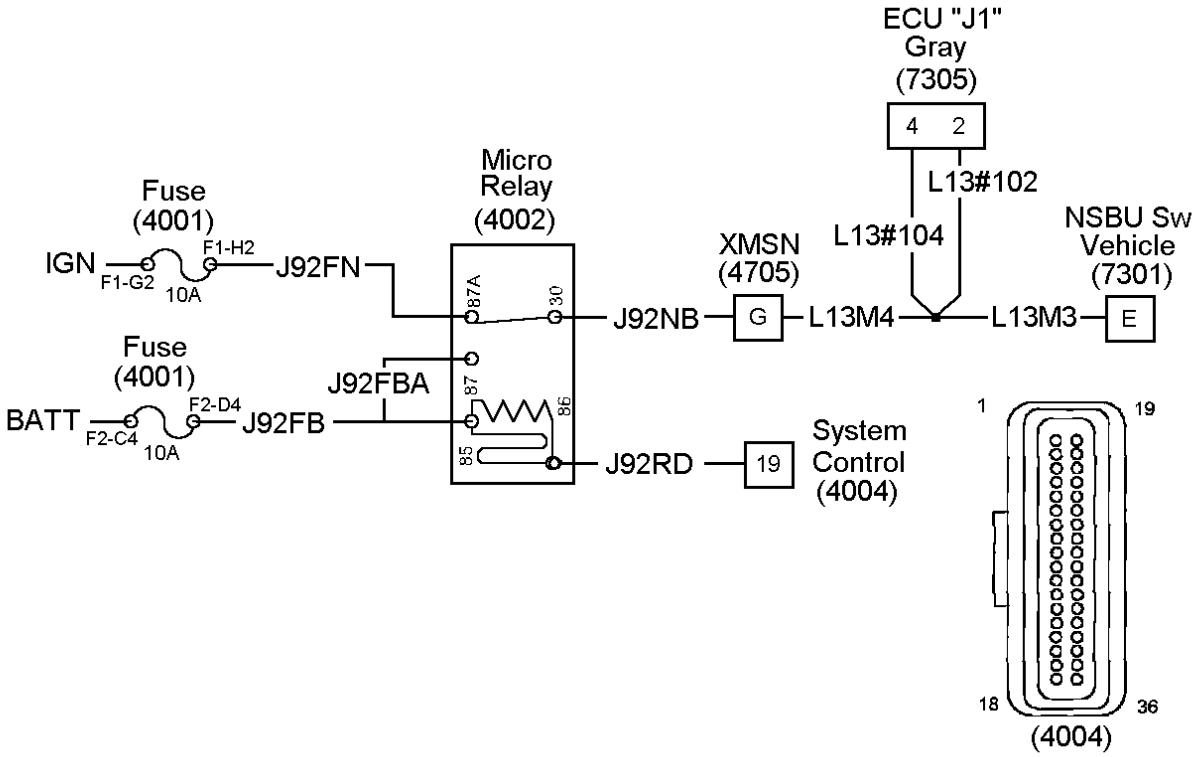

Figure 309 XMSN Allison LCT Column Shifter Circuits (Connectors Viewed From Mating End) — Always Refer to the Circuit Diagram Book for Latest Circuit Information

(4001) BATT AND IGN FUSES
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4002) XMSN ALLISON LCT COLUMN SHIFTER MICRO RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
(4004) SYSTEM CONTROLLER CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
(4705) XMSN CONNECTOR
LOCATED ON LCT TRANSMISSION
(7301) NSBU SW VEHICLE CONNECTOR
LOCATED IN LCT TRANSMISSION CONTROL MODULE (TCM)
(7305) ECU “J1” CONNECTOR
LOCATED IN LCT TRANSMISSION CONTROL MODULE (TCM)

Refer to XMSN Allison LCT Column Shifter Circuits.

Table 205 XMSN Allison LCT Column Shifter Circuit Tests

XMSN Allison LCT Column Shifter Relay Checks Check with XMSN Allison LCT Column Shifter relay removed, key in ignition position switch on. **NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.**		
Test Points	Spec.	Comments
Bench check XMSN Allison LCT Column Shifter relay. Refer to Bench Checking Relays. (See BENCH TESTING RELAYS, page 29)	Relay energizes and there is continuity thorough the closed contacts.	If a relay tests bad, replace it.
Measure voltage between XMSN Allison LCT Column Shifter relay socket cavity 85 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A92FB or blown cab fuse BATT (4001).
Measure voltage between XMSN Allison LCT Column Shifter relay socket cavity 87 and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A92FBA.
Measure voltage between XMSN Allison LCT Column Shifter relay socket cavity 87A and ground.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit A92FN or blown cab fuse IGN (4001).
Measure voltage between XMSN Allison LCT Column Shifter relay socket cavity 87A and 30.	12 ± 1.5 volts.	If voltage is missing, check for open J92NB, L13NB, L13M4, L13M3 to NSBU SW Vehicle (7301) or L13#102, L13#104 to ECU”J1” Gray (7305).
Measure voltage between XMSN Allison LCT Column Shifter relay socket cavity 85 and 86.	12 ± 1.5 volts.	If voltage is missing, check for open or short in circuit J92RD or missing signal from ESC connector (4004) pin 19.

23.4. EXTENDED DESCRIPTION

When XMSN Allison LCT Column Shifter is requested, the ESC will supply ground to the coil of XMSN Allison LCT Column Shifter relay.

This will cause the relay to energize, supplying power to the XMSN Allison LCT Column Shifter.

23.5. COMPONENT LOCATIONS

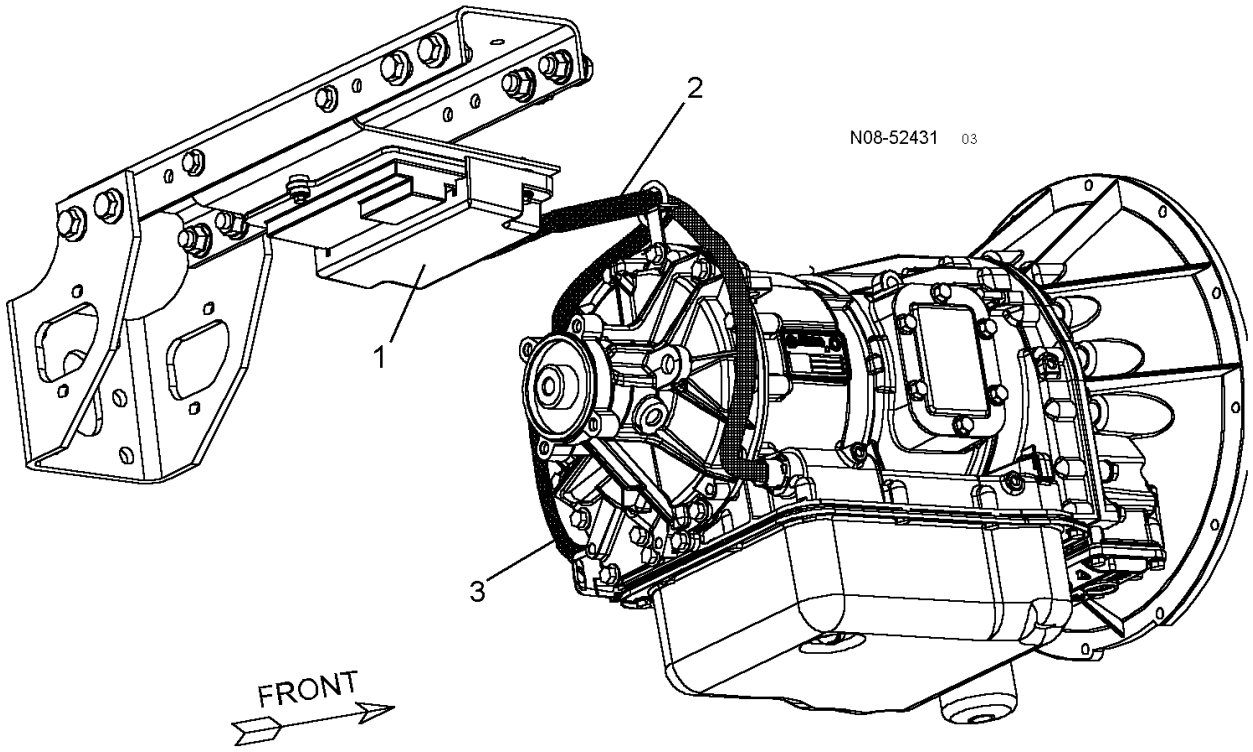

Figure 310 XMSN Allison LCT Column Shifter Cab Wiring

1. LCT TRANSMISSION CONTROL MODULE (TCM)
2. HARNESS TO TCM (7305)
3. HARNESS TO THE XMSN ALLISON LCT COLUMN SHIFTER