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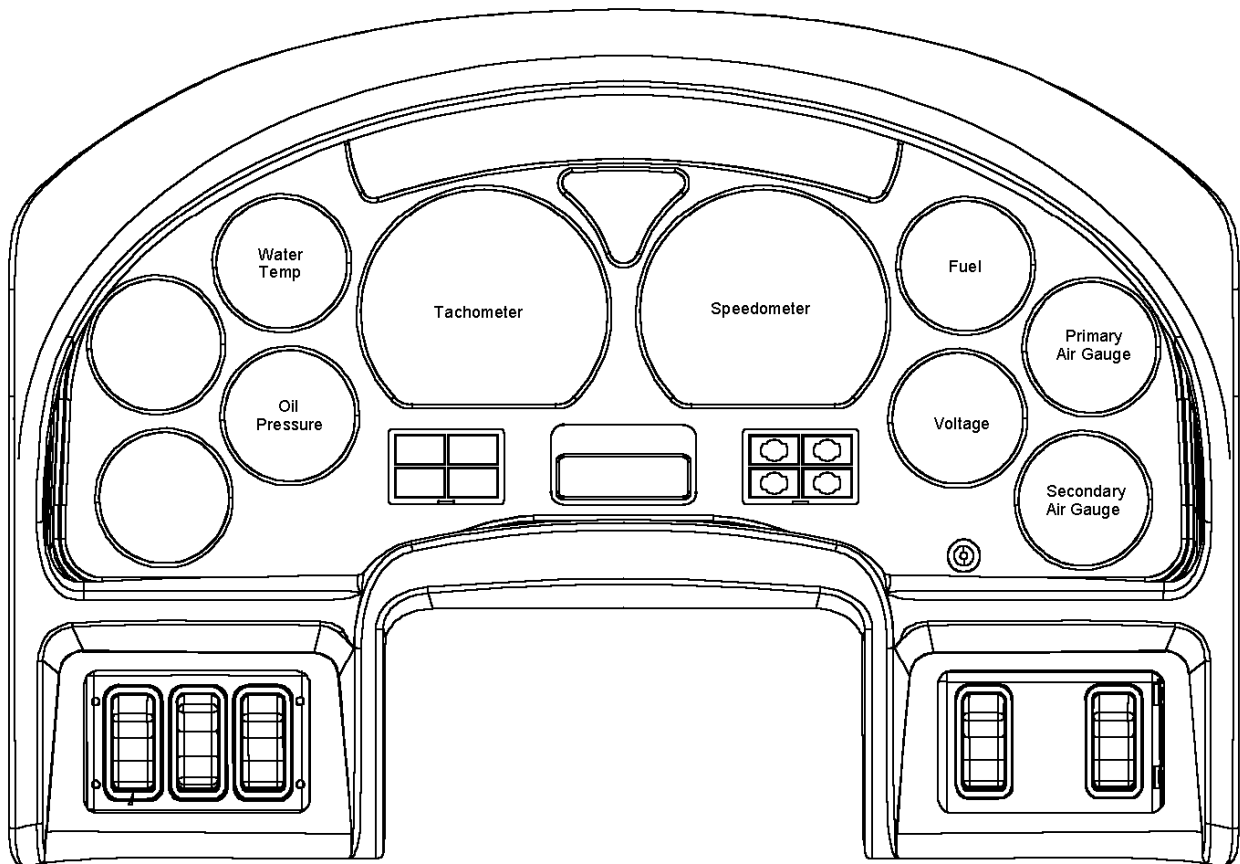
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## 1. DESCRIPTION

The Electronic Gauge Cluster (EGC) components include gauges, warning lamps, an alarm, a digital display, a display set/reset button, and a switch pack containing up to three switches.

The EGC communicates with the electrical system controller (ESC) and other controllers connected to the Drivetrain 1939 data link.



**Figure 74 Electronic Gauge Cluster**

### 1.1. GAUGES

The EGC has locations for 10, stepper motor driven, gauges. Refer to Gauge Locations. The speedometer, tachometer, fuel level gauge, engine oil pressure gauge, engine coolant temperature gauge, and voltmeter gauge are in fixed locations. The other gauges, as required, may be placed in other EGC locations as programmed in the ESC. Most gauges have their own warning light which signals the operator when a gauge reading is outside of preset limits.

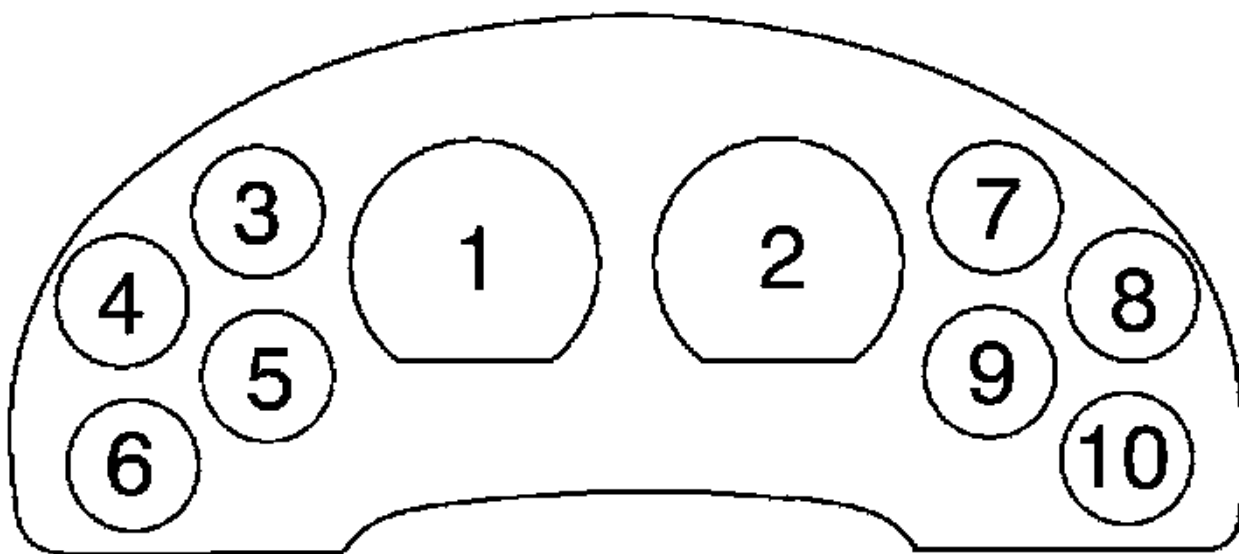


Figure 75 Gauge Locations

Table 22 Gauge Table

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
Voltmeter Gauge with Integral Warning Light	Standard	9	10/16 Volts	<12 or >15.0 VDC and Engine Speed >325 RPM	Vehicle electric power: Electrical potential (voltage)	Voltmeter (See VOLTMETER, page 203)
Engine Coolant Temperature Gauge with Integral Warning Light	Standard	3	140/260 °F (60/126°C)	>230 °F (>110 °C)	Engine temperature: Engine coolant temperature	Engine Coolant Temperature Gauge (See ENGINE COOLANT TEMPERATURE GAUGE, page 206)
Pyrometer Gauge	Optional	Varies	300/1500 °F (149/815°C)	1500 °F (815°C)	Inlet/exhaust conditions: Exhaust gas temperature	Pyrometer Gauge (See PYROMETER GAUGE, page 212)

Table 22 Gauge Table (cont.)

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
Speedometer	Standard	2	0/85 MPH (0/137 KPH)	N/A	Cruise control/vehicle speed: wheelbased vehicle speed.	Speedometer (See SPEEDOMETER, page 214)
Tachometer	Standard	1	0/3000 RPM	N/A	Electronic engine controller #1: Engine speed	Tachometer (See TACHOMETER, page 217)
Fuel Level Gauge with Integral Warning Light	Standard	7	Empty/ Full	<12.8%	Dash display: Fuel level	Fuel Level Gauge (See FUEL LEVEL GAUGE, page 220)
Primary Air Pressure Gauge with Integral Warning Light	Optional	8	0/150 PSI (1034 KPa)	<70 PSI (482 KPa)	Brakes: brake primary pressure	Primary Air Pressure Gauge (See PRIMARY AIR PRESSURE GAUGE, page 229)
Secondary Air Pressure Gauge with Integral Warning Light	Optional	10	0/150 PSI (1034 KPa)	<70 PSI (482 KPa)	Brakes: brake secondary pressure	Secondary Air Pressure Gauge (See SECONDARY AIR PRESSURE GAUGE, page 238)
Boost Pressure Gauge with Integral Warning Light	Optional	Varies	0/50 PSI	N/A	Inlet/ exhaust conditions: boost pressure	Boost Pressure Gauge (See BOOST PRESSURE GAUGE, page 247)

Table 22 Gauge Table (cont.)

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
Ammeter Gauge with Integral Warning Light	Optional	Varies	-150/+150 Amps	N/A	Vehicle electrical power: Net battery current or Vehicle electrical power: alternator current	Ammeter Gauge (See AMMETER GAUGE, page 249)
Ammeter Gauge (High Resolution) with Integral Warning Light	Optional	Varies	-300/+300 Amps	N/A	Vehicle electrical power: Net battery current or Vehicle electrical power: alternator current	Ammeter Gauge (See AMMETER GAUGE, page 249)

## 1.2. WARNING LIGHTS

The EGC also contains warning and indicator lamps to monitor conditions not monitored by the gauges.

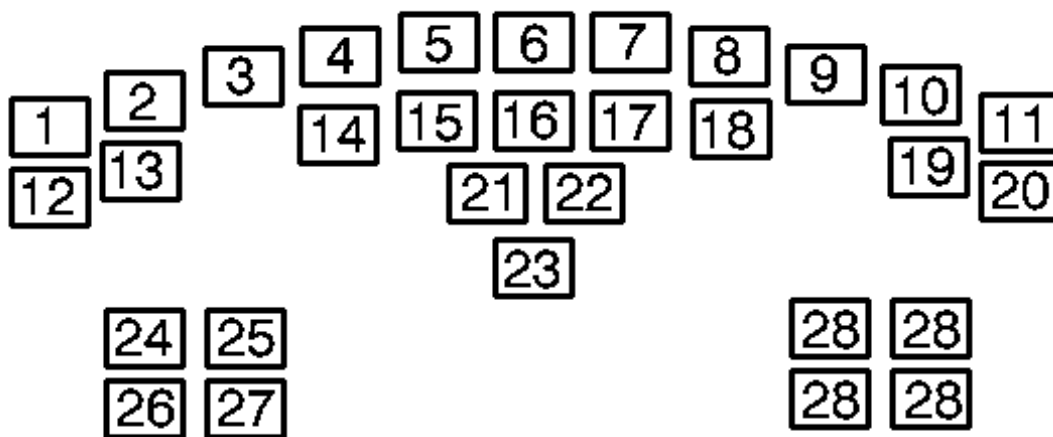


Figure 76 Warning and Indicator Lamps



Table 23 Warning Lamp Table

WARNING LIGHT	REPRESENTATION	COLOR	DRIVEN BY	Loc. Num.	Troubleshooting Cross Reference
Range inhibited	RANGE INHIBITED	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from transmission controller.	1	Range inhibited (See RANGE INHIBITED WARNING LAMP, page 157)
Economy Mode	ECONOMY (ECON) [icon]	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from transmission controller.	2	Economy Mode(See ECONOMY MODE WARNING LAMP, page 159)
Fuel Filter	FUEL FILTER	Yellow	ON when fuel filter input to ESC from fuel filter.	3	Fuel Filter(See CIRCUIT FUNCTIONS, page 461)
Warn Engine	ENGINE	Yellow	Status transmitted on Drivetrain 1939 data link from engine controller.	4	Warn Engine (See "YELLOW" ENGINE WARNING LAMP, page 161)
Stop Engine	ENGINE	Red	Status transmitted on Drivetrain 1939 data link from engine controller.	5	Stop Engine (See "RED" ENGINE WARNING LAMP, page 162)
Brake Pressure	BRAKE PRESSURE	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from Hydromax hydraulic brake monitor.	6	Brake Pressure (See BRAKE FLUID WARNING LAMP, page 164)
Brake Fluid	BRAKE FLUID	Red	This warning lamp is not implemented at this time.	7	
Wait to Start	WAIT TO START	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from engine controller.	8	Wait to Start (See WAIT TO START WARNING LAMP, page 198)
Check Transmission	CHECK TRANS	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from transmission controller.	9	Check Transmission (See CHECK TRANSMISSION LAMP, page 169)
Lift Gate is not parked	LIFT GATE	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from lift gate proximity switch.	10	

Table 23 Warning Lamp Table (cont.)

WARNING LIGHT	REPRESENTATION	COLOR	DRIVEN BY	Loc. Num.	Troubleshooting Cross Reference
Washer Fluid Low	WASHER FLUID	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from washer reservoir probe.	11	
Left Turn	Left Turn Signal Icon	Green	Status transmitted from ESC on Drivetrain 1939 data link. Input to ESC from turn signal switch.	12	Turn Signal(See TURN SIGNAL/ HAZARD SWITCH INPUTS TO ESC, page 582)
Traction Control	TRAC CTRL	Green	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from ABS controller.	13	Traction Control (See TRACTION CONTROL LAMP, page 167)
Water in Fuel	WATER IN FUEL	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from fuel filter.	14	Water in Fuel (See WATER IN FUEL WARNING LAMP, page 171)
Service Park Brake	SERVICE PARK BRAKE (SERVICE) [icon]	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from SAAR park brake.	15	Service Park Brake (See SERVICE PARK BRAKE WARNING LAMP, page 191)
Check Electrical System	CHECK ELEC SYS	Yellow	On when there is no communication on drivetrain 1939 data link from engine controller or ESC is inactive for more than 10 seconds. Will also come on for one minute when an active fault occurs.	16	Check Electrical System (See CHECK ELECTRICAL SYSTEM WARNING LAMP, page 156)
Park Brake	PARK BRAKE	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from park brake switch.	17	Park Brake (See PARK BRAKE WARNING LAMP, page 177)
Cruise Control Active	CRUISE	Green	Active Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from cruise switch.	18	Cruise Control (See CRUISE CONTROL LAMP, page 194)
Antilock Braking system	ABS Icon	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from ABS controller.	19	ABS (See ABS WARNING LAMP, page 196)

**Table 23 Warning Lamp Table (cont.)**

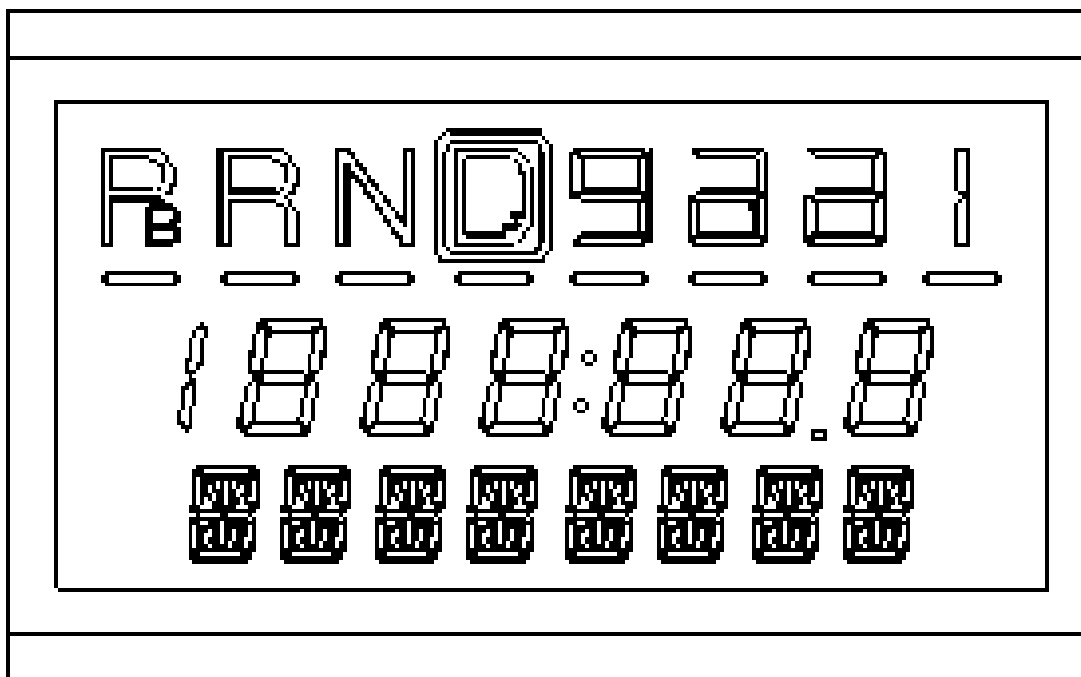
<b>WARNING LIGHT</b>	<b>REPRESENTATION</b>	<b>COLOR</b>	<b>DRIVEN BY</b>	<b>Loc. Num.</b>	<b>Troubleshooting Cross Reference</b>
Right Turn	Right Turn Signal Icon	Green	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from turn signal switch.	20	Turn Signal(See TURN SIGNAL/ HAZARD SWITCH INPUTS TO ESC, page 582)
Coolant Level	COOLANT LEVEL	Red	Status transmitted on Drivetrain 1939 data link from ESC. On when Coolant Level < 25%. Input to ESC from surge tank.	21	Coolant Level (See COOLANT LEVEL WARNING LAMP , page 175)
Emergency Exit	EMERG EXIT	Red	Status transmitted on Drivetrain 1939 data link from ESC.	22	
High Beam	High Beam Icon	Blue	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from high beam switch.	23	
Amber Flasher	AMBER FLSHR	Yellow	Status transmitted on Drivetrain 1939 data link from ESC.	24	Pupil Warning Lights(See red and amber pupil warning lights, page 607)
Red Flasher	RED FLSHR	Red	Status transmitted on Drivetrain 1939 data link from ESC.	25	Pupil Warning Lights(See red and amber pupil warning lights, page 607)
Retard Over Heat	RETARD OVRHEAT	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from transmission controller.	26	Retard Over Heat (See RETARD OVERHEAT WARNING LAMP, page 200)
Optional Warning Lamps	Varies	Yellow	These are optional hard wired warning lamps. Example: Alternator Warning, Snow Valve, Optimized Idle or Differential locks.	28	Refer to the applicable section for the feature associated with the warning lamp.

### 1.3. DIGITAL DISPLAY

The digital display is an LCD located in the bottom-center of the EGC.

The three lines of the digital display provide a transmission shift display, a numeric display, and an alphanumeric line.

The display will dim to match the back lights when the park lights are switched on. The brightness of the display is adjusted with the panel light dimmer switch.



**Figure 77 Electronic Gauge Cluster Display**

EGC DISPLAY WITH ALLISON TRANSMISSIONS

#### Select/Reset Switch

The EGC includes a Select/Reset switch used to control the digital display. The switch interfaces directly with the EGC and is located on the lower right of the EGC lens. The switch allows the user to select modes within each major functional area of the display, as listed below, and perform reset functions. Each time the switch is momentarily depressed it will progress to the next mode. Depressing the switch for period of three seconds, while in the odometer mode, will switch the display between miles and kilometers. Depressing the switch for period of three seconds or more in other modes will clear the display or toggle between options depending upon the current mode. The reset function has no effect if the parameter cannot be reset.

#### Total Vehicle Distance

The EGC displays the total distance the vehicle has traveled. This value may be toggled between miles and kilometers by depressing the select/reset switch and holding it for 3 seconds while in this mode. The digital display visually indicates whether the current reading is in miles or kilometers. The display indicates the elapsed mileage from 0 to 1,999,999 miles in 1 mile/kilometer increments.

#### Trip Distance

The display function also includes trip distance. Trip distance is calculated as the total vehicle distance minus total vehicle distance when the trip distance was last cleared. Depressing the select/reset switch for at least three seconds while in this mode will clear the trip distance function and store the total vehicle distance. The digital display visually indicates whether the current reading is trip miles or trip kilometers based

upon the current odometer mode. The display indicates the elapsed mileage from 0 to 199,999.9 miles in 0.1 mile/kilometer increments.

#### Default Odometer Turn On Mode

The display remembers, after the power-on, the last miles or kilometers mode that it was set to before power-off. It will return to this mode upon the next start-up.

#### Hours Functions

The EGC display provides several engine hours modes.

#### Total Engine Hours

The hours display is based on engine hours extracted from the engine controller. The digital display visually indicates that the current reading is hours.

#### Trip Hours

The hours functions also includes trip hours. Trip hours are totaled as accumulated engine hours minus accumulated engine hours when the trip hours function was last cleared. By depressing the select/reset switch for at least three seconds while in this mode, trip hours function will be cleared.

#### Change Oil

Vehicles with International engines will display a "CHG OIL" message when a programmed engine hours or engine miles interval has been exceeded. Refer to the appropriate engine manual for information on programming the interval and clearing the message.

#### Diagnostic Message

The LCD is capable of displaying a diagnostic trouble code (DTC) message when requested by the ESC or service tool (EZ-Tech®). Refer to On-Line Diagnostics. (See ON-LINE DIAGNOSTICS, page 146)

**NOTE – Diagnostic messages from the engine controller, antilock brake system or transmission are not displayed on the electronic gauge cluster (EGC) digital display.**

#### Digital Display Lighting

The display will dim to match the back lights when the park lights are switched on. The brightness of the display is adjusted with the panel light dimmer switch.

### 1.4. AUDIBLE ALARM

The EGC contains an audible alarm that is capable of producing different beep counts and beep durations. The alarm type for each gauge is determined by the alarm code programmed for that gauge in the ESC.

Pressing and holding the top of the panel dimmer switch and the set/reset switch for 5 seconds shall disable the cluster alarm for all warning conditions until the engine speed reaches 325 RPM or the ignition is cycled.

#### One-time Five-short-beeps Alarm

An out of range value in any of the following gauges will trigger a one-time, five-short-beep, audible alarm and visual indicator light in the corresponding gauge. The alarm shall sound only once per gauge during each ignition cycle.

- Fuel level

- Voltmeter
- Engine oil pressure
- Engine coolant temperature
- Transmission oil temperature
- Engine oil temperature
- Boost pressure
- Fuel pressure
- Auxiliary air pressure
- Service Park Brake

#### **Repetitive One-long-beep Alarm**

An out of range value in any of the following gauges will trigger a repetitive one-long-beep audible alarm and visual indicator light in the corresponding gauge. The alarm shall stop as soon as normal conditions are reestablished.

- Primary air pressure
- Secondary air pressure

#### **One-time Ten-short-beeps Alarm**

The loss of communication to the EGC from the ESC or engine controller, on the Drivetrain 1939 data link, will trigger a one-time, ten-short-beep audible alarm.

#### **One-time Three-long-beeps Alarm**

A sensor fault error will result in the small gauge pointer being driven clockwise to the 6 o'clock position and a three long beep audible alarm. The gauge pointers in the speedometer and tachometer will repeat the following three times and then park the pointer at the minimum position until the sensor fault is no longer active.

- Go immediately to the zero position
- Sweep up to a 50% position
- Immediately sweep back to zero
- Pause

#### **Repetitive Short Duration Blips**

The turn signal shall be accompanied by a sequence of short blips synchronized with the flashing of the lamps. This audio indicator repeats each time the ESC requests that the EGC turn on the turn signal lights. The audio indicator does not accompany the application of the hazard lights.

### **1.5. ELECTRONIC GAUGE CLUSTER SWITCHES**

The EGC houses up to three user switches. Each switch is interfaced to the gauge cluster microprocessor. The microprocessor transmits the switch status to the ESC on the drivetrain 1939 data link.

### Head Lamp/Park Lamp Switch

The EGC directly interfaces with a head lamp switch. The head lamp switch has a latched off position, a latched 'park lamp' position, and a latched 'head lamp' position. The 'head lamp' switch does not have a center off position. Each position of the switch position is back lighted in yellow.

### Panel Dimmer

The panel dimmer switch is located in the center position of the left pack of switches. The switch is back lighted in yellow. The panel light dimmer control is a momentary push up/push down, or a press and hold rocker switch. The dimmer retains its brightness level after the key is cycled, but will default to 100% 'on' after a hard reset.

### Mode and Select/Reset Switch

The switch allows the user to select modes within each major functional area of the display and perform reset functions. Momentarily depressing the switch will cause the display to scan through the various modes. Depressing the switch for a period of three seconds or more will clear the display or toggle between options depending upon the current mode. The reset function has no effect if the parameter cannot be reset.

## 1.6. FAIL SAFE STRATEGIES

The EGC provides fail-safe strategies to provide safe vehicle operation during certain malfunctions in the electrical system.

1. If communication between the EGC and electrical system controller is lost for more than five seconds, the EGC will illuminate the CHECK ELEC SYS warning light and maintain the status of all the other warning lights for as long as the ignition key is in the on position and communication is interrupted.
2. If communication from the electrical system controller is lost for more than two seconds, the EGC will enable a single control circuit between the EGC and the ESC. This circuit will enable control of the park and low beam headlights for as long as the ignition key is in the on position and communication between the EGC and ESC is interrupted.
3. If the cluster itself dies, the CHECK ELEC SYS warning lamp will illuminate.

## 2. PROGRAMMING

When gauge configurations are changed, or the ESC is replaced, the ESC must be programmed with the "ICAP" programming software. The ESC will store the current configuration and update the configuration after changes are made. The new configuration will have to be uploaded to International Truck and Engine. This is accomplished by dialing in and uploading the updated programming. A copy of the programming is stored at International Truck and Engine and updated each time there is a change. This is required in case there is a need to download the programming for ESC replacement. Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)

The EGC faults, with electronic gauge cluster version 8.7, the diagnostic trouble code will display SPN field "1705" and with electronic gauge cluster version 9.3 and later, the diagnostic trouble code will display SPN field "2023".

### 3. DIAGNOSTICS

#### 3.1. GAUGE SWEEP

After the ignition is turned on, a gauge sweep of the EGC will be performed. Each gauge must sweep from zero to maximum to zero in unison. All of the gauge warning lights will illuminate along with the panel warning lights that are applicable to features installed on the vehicle. The yellow and red "ENGINE" warning lamps should also illuminate (they are turned on by the engine controller not the gauge cluster test). The alarms associated with each gauge warning light do not sound. All of the segments of the EGC LCD should display while the gauges sweep. At the end of the sweep the LCD will turn off all segments for .5 seconds, display the firmware version number, then return to operational mode. The lights controlled by the panel dimmer in the EGC will also come on during the gauge sweep.

A gauge that points between the 9 and 10 o'clock position is most likely connected to the wrong location on the circuit board inside the EGC.

If the instrument cluster or any of the remote modules experience a system fault, they will transmit a fault message to the ESC.

#### 3.2. ON-LINE DIAGNOSTICS

On-line Diagnostics are automatically performed by the ESC while the key is in the accessory or ignition position. Any faults encountered will be entered in the active fault list.

On power up the check electrical system light will turn on then off after the gauge sweep. If there is an active fault the light will stay on for an extra minute. If a fault occurs during operation of the vehicle the light will come on for 1 minute. This will alert the driver that an active fault exists.

If the check electrical system light comes on and stays on after the gauge sweep is completed then the EGC is not communicating with the engine controller and/or the ESC.

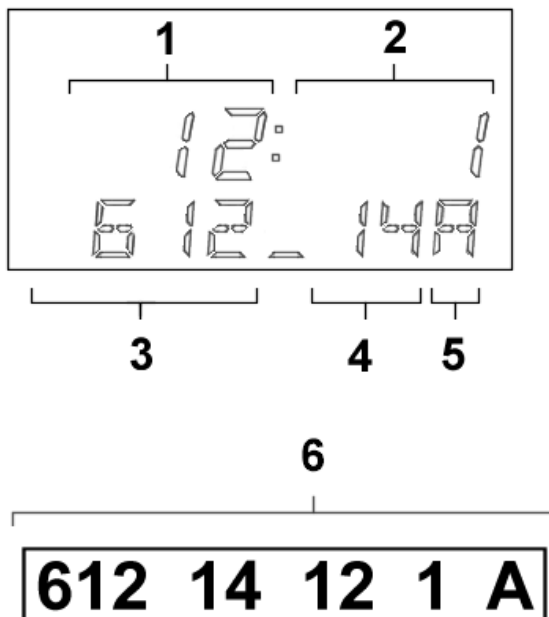
If the EGC loses communication with the ESC or engine controller during vehicle operation, the check electrical system light will turn on and stay on. The light will be accompanied by 10 short beeps from the EGC alarm.

Diagnostic trouble codes will be moved to the "previously active" list after the condition creating the fault is repaired.

Placing the EGC in diagnostic mode will allow the EGC to display up to 40 active and previously active diagnostic messages from the ESC.

To engage the diagnostic mode turn the Ignition key "ON" (or in accessory) then press the Cruise "ON" switch and the Cruise "RESUME" switch simultaneously. If no faults are present, the gauge cluster display will read "NO FAULT". If faults are present, the gauge cluster will display a message with the number of faults followed by the diagnostic codes. Refer to Diagnostic Trouble Code Display. The display will show each DTC for 10 seconds then automatically scroll to the next entry and continue to cycle through the faults. To manually cycle through the fault list, press the cluster display selector button.





**Figure 78 Diagnostic Trouble Code Display**

1. BYTE 7 FIELD
2. BYTE 8 FIELD
3. SPN FIELD
4. FMI FIELD
5. ACTIVE/PREVIOUSLY ACTIVE STATUS INDICATOR
6. COMPILED FORMAT OF DIAGNOSTIC TROUBLE CODE

Refer to the Diagnostic Trouble Code List. (See DIAGNOSTIC TROUBLE CODE (DTC) LIST, page 663)

While in the diagnostic mode, diagnostic trouble codes may be cleared by turning the left turn signal on and pressing the cruise "ON" switch and the cruise "SET" switch simultaneously. All previously active faults will be cleared. Active faults will reappear as the ESC updates faults once a second.

To exit the diagnostic mode, cycle the key switch or release the parking brake.

The diagnostic service tool, running the Diamond Logic Builder™ software, can be used to view diagnostic trouble codes and occurrence counts. The tool can also be used to clear previous active ESC diagnostic trouble codes. Other diagnostic software can be used to view and clear engine controller, ABS and transmission diagnostic trouble codes. Refer to the appropriate software manual for details.

### 3.3. GAUGE DATA

The EGC continuously monitors incoming gauge data for out-of-range or data-not-present conditions. If the data is out of range, the Cluster or gauge pack will turn on the LED embedded in the respective gauge.

Missing data to a small gauge in the EGC will cause the needle to be driven clockwise to the 6 o'clock position. Missing data to the speedometer or tachometer will cause the gauge to repeat the following three times:

- Go immediately to the zero position

- Sweep up to the 50% position
- Sweep back to zero
- Pause

### 3.4. LOSS OF DATA LINK

If the EGC loses the connection with the data link, all gauges will sweep to zero and the check electrical system indicator will light.

If communication between the ESC and EGC is lost but the EGC is able to communicate with the engine controller, information from the engine controller will continue to be displayed. The check electrical system indicator will light.

If a communication between the EGC and the engine controller is lost but the EGC is able to communicate with the ESC, information from the ESC will continue to be displayed. The check electrical system indicator will light.

### 3.5. THE "DIAMOND LOGIC BUILDER™" DIAGNOSTIC SOFTWARE

The "Diamond Logic Builder™" diagnostic software can be run on the EZ–Tech®. An interface cable is required to connect the EZ–Tech® to the diagnostic connector of the truck.

The "Diamond Logic Builder™" diagnostic software may be used to exercise individual gauges, and all programmed warning lights to verify their operation. See the "Diamond Logic Builder™" diagnostic software manual for instructions.

The "Diamond Logic Builder™" diagnostic software can also be used to check programmed cluster gauge locations.

## 4. TROUBLESHOOTING

- 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. 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. Inspect all connectors for loose or damaged pins, wires, etc. Refer to TEST EQUIPMENT AND CONNECTOR REPAIR section in GROUP 08 — ELECTRICAL in the 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.

### 4.1. IMPORTANT STEPS BEFORE TESTING

1. **Gather information** by talking to the driver if possible. Try to determine the exact symptoms by gathering relevant information:

- a. What happened, and when?
  - b. Under what conditions?
  - c. When did the symptoms begin?
  - d. What else occurred at that time?
2. **Verify the problem.** Is the complaint due to misunderstood customer selected parameters? Use an EST to review customer selected parameters.
3. **Check for and record** any logged diagnostic trouble codes.
  - a. Do the logged codes correlate to probable causes?
4. Were the codes logged about the same time as the symptoms appeared? Were the codes logged repeatedly? (This can only be checked with the EZ-Tech®.)
5. Are the logged codes related to other symptoms? Do they have a common cause?
6. **Avoid preconceived ideas!** Eliminate any non-electrical causes for the problem first (contaminated fuel, clogged air filters, etc.).

## 4.2. INSPECTING ELECTRICAL CONNECTORS

### Visual Inspection

The troubleshooting guide requires checking specific connectors. Use the following steps to determine if the connector is causing the problem. If a faulty condition is found, make the necessary corrections and continue the process.

1. **Check the connector lock mechanism or retaining screw.** Make sure the connector is capable of properly locking the connector together.
2. **Perform a 10 pound pull-test on each terminal/wire in the connector.** Each terminal/wire assembly should easily withstand 10 pounds of pull and remain in the connector. This test determines (A) if the wire is properly in the terminal and (B) if the terminal is properly inserted into the connector. Correct any faults noted.
3. **Visually inspect wiring.** Inspect for worn or damaged wires. Check for pinched or damaged harness.
4. **Visually inspect connectors.** Verify that pins and sockets are free of corrosion, dirt or any other contaminants, and damage. Verify correct alignment and location of terminals in the connector.
5. **Check individual pins and sockets.** This is especially important with an intermittent symptom. Using a new pin, insert the pin into each socket, one at a time, checking for a good grip on the pin by the socket. Repeat for each pin on the mating side of the connector, using a new female terminal for the test.
6. **Inspect Engine Ground Stud.** Inspect this ground and other related grounds for clean, tight connections that are free of corrosion and/or other faulty conditions.

### Replacing International Truck and Engine Components

When replacing electrical switches, connectors (including pins and sockets), relays or other components, use only approved International Truck and Engine replacement parts. Many of the switches have gold or silver

plated contacts and some of the connectors have gold plated terminals. By using correct replacement parts, you maintain the design integrity of the system.

### 4.3. EGC PRELIMINARY SYSTEM CHECK

Problems with EGC operation can be caused by a lack of power, a malfunctioning EGC, a malfunctioning ESC, a malfunctioning data link, incorrect or lost programming in the ESC, problems in the engine controller, problems in the ABS controller, problems in the transmission controller, or problems with wiring or sensors feeding the electronic controllers throughout the system.

#### EGC Preliminary System Check

The preliminary system check should guide the mechanic to a general area to start troubleshooting.

**Table 24 EGC Preliminary System Check**

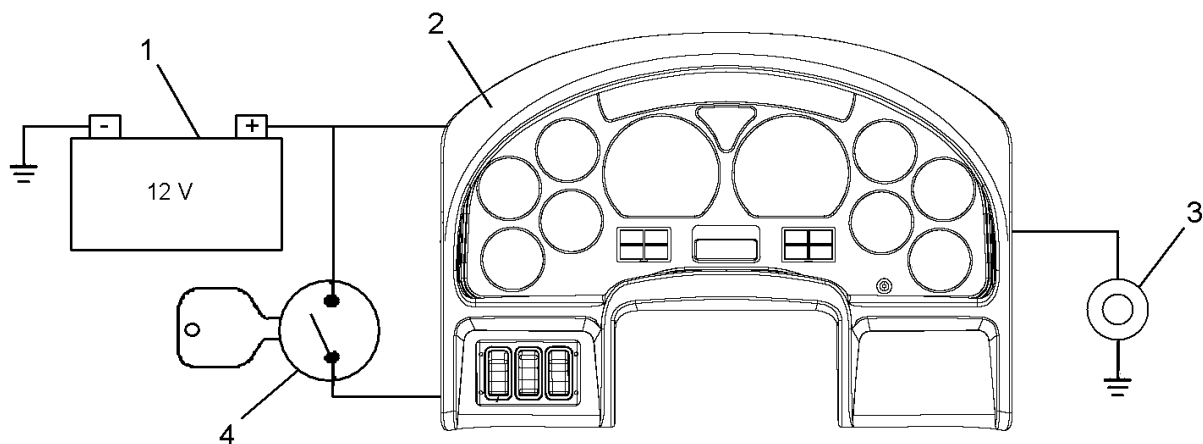
STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/ On	Turn key to ignition position while observing the EGC. Did the EGC have any response to key on?	EGC responds to key on.	Go to next step.	Go to EGC power and ground troubleshooting. (See EGC POWER AND DATA LINK CIRCUITS, page 151)
2.	Off/ On	Turn key to ignition position while observing the EGC. Does the gauge sweep perform without any errors? See gauge sweep	EGC gauge sweep performs without any errors.	Go to next step.	Go to troubleshooting malfunctioning EGC (See MALFUNCTIONING EGC , page 153)
3.	On	After the gauge sweep is finished and most warning lamps have gone out, does the check electrical system light illuminate for 1 second or remain lit.	Check electrical system light illuminate for 1 second or remain lit.	Go to next step.	Go to troubleshooting for the check electrical system light. (See CHECK ELECTRICAL SYSTEM WARNING LAMP, page 156)
4.	On	After the gauge sweep is finished, do any other warning lights remain illuminated for more than 15 seconds, without turning off?	No warning lamps illuminated.	Go to next step.	Go to troubleshooting for specific warning light. Cross reference from Warning Light Table. (See Table 23, page 139)
5.	On	After the gauge sweep or during vehicle operation, do any gauges point to the 6 o'clock position or provide an incorrect reading?	Gauges operate correctly.	Go to next step.	Go to troubleshooting for specific gauge. Cross reference from Gauge Table. (See Table 22, page 136)

**Table 24 EGC Preliminary System Check (cont.)**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
6.	On	Does Select/Reset button function correctly?	Select/ Reset button functions correctly?	Go to next step.	Go to troubleshooting for the Select/Reset switch. (See SELECT/RESET SWITCH, page 254)
7.	On	Do the headlight and dimmer switch work correctly?	Headlight and dimmer switch works correctly?	Go to next step.	Go to troubleshooting for the headlight and dimmer switch (See HEAD LAMP/PARK LAMP SWITCH, page 255)
8.	On	Does the audible alarm sound when a turn signal has been left on after traveling more than one mile?	Alarm sounds when a turn signal has been left on after traveling more than one mile?	EGC alarm is working correctly.	Go to troubleshooting for the alarm. (See AUDIBLE ALARM, page 253)

#### 4.4. EGC POWER AND DATA LINK CIRCUITS

##### Circuit function

**Figure 79 EGC Power And Ground Function Diagram**

1. BATTERY
2. ELECTRONIC GAUGE CLUSTER
3. GROUND STUD
4. KEY SWITCH

Refer to EGC Power And Ground Function Diagram.

The EGC receives battery power through fuse block (1011). Switched ignition power is supplied from the ignition relay in fuse block (1011).

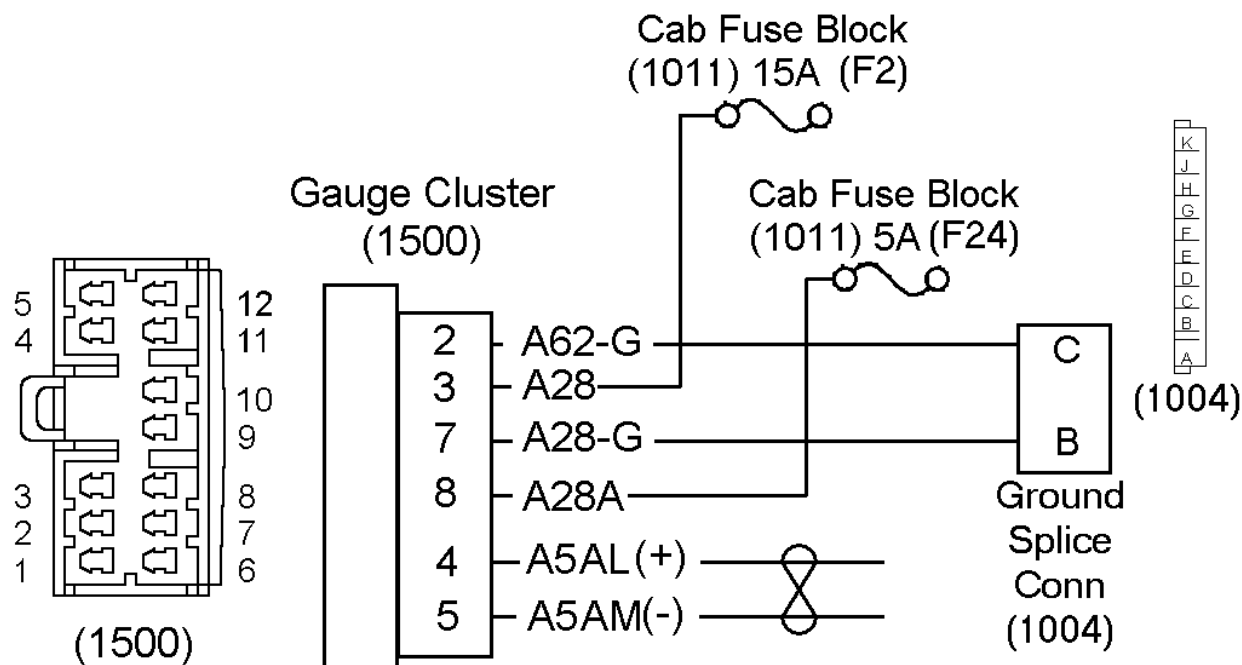
The EGC communicates with the ESC and the engine controller on the Drivetrain 1939 Data Link.

### Fault Detection/Management

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

Refer to EGC Power And Ground Simplified Diagram.

If the EGC is not receiving ignition power, it will not respond when the key switch is turned on.



**Figure 80 EGC Power And Ground Simplified Diagram—Always Refer To Circuit Diagram Book For Latest Circuit Information**

- F2 BATTERY FUSE (1011)
- F24 IGNITION FUSE (1011)
- (1004) GROUND SPLICE CONNECTION
- (1500) ELECTRONIC GAUGE CLUSTER CONNECTOR

**Table 25 EGC Power Voltage Check Chart**

<b>EGC Connector (1500) Voltage Checks</b>		
Check with EGC connector Disconnected and Ignition Key "On".		
This chart assumes there is power to fuse block (1011) F2 and (1011) F24 from the mega fuse and ignition relay is functioning properly.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
(1500) Cavity 3 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse (F2) or an open or short in circuit A28.
(1500) Cavity 8 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse (F24) or an open or short in circuit A28A.
(1500) Cavity 8 to 7.	12 ± 1.5 volts	If voltage is incorrect, check for an open in circuit A28-G and check for proper grounding of splice (1004).  If all voltages are correct and the EGC does not power up, the EGC should be replaced.
<b>EGC Connector (1500) Data Link Voltage Checks</b>		
Check with EGC connector Disconnected and Ignition Key "On".		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
(1500) Cavity 4 to ground.	Approximately 2.5 volts	If voltage is missing check for short to ground or open in circuit A5AL(+) to the cab harness.
(1500) Cavity 5 to ground.	Approximately 2.5 volts	If voltage is missing check for short to ground or open in circuit A5AM(-) to the cab harness.
If voltages are missing and the circuits are not shorted to ground or open, refer to Drivetrain Data Link Circuits		

**Extended Description**

Battery voltage to the instrument cluster connector (1500), terminal 3, is provided on circuit A28 from fuse (1011) F2.

Switched ignition voltage to the instrument cluster connector (1500), terminal 8, is provided on circuit A28A from (1011) F24.

System ground to EGC connector (1500), terminal 7, is provided on circuit A28–G to the ground splice connection (1004).

**4.5. MALFUNCTIONING EGC****Fault Detection/Management**

Malfunctions in the EGC can be caused by improper programming, an inoperative gauge, an inoperative warning lamp, an inoperative display panel, breaks in the circuit board, or a problem in the microprocessor.

The speedometer, tachometer, microprocessor and circuit board in the EGC are combined in one assembly. When there is a problem in one of these features the whole circuit board assembly must be replaced.

When an EGC is replaced, the current EGC programming will be taught to the new assembly by the ESC. No manual programming should be required.

**Table 26 Troubleshooting Malfunctioning EGC**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off	Has the preliminary system check been performed?	Preliminary system check performed.	Go to next step.	Go to preliminary system check. (See EGC PRELIMINARY SYSTEM CHECK, page 150)
2.	Off	Did all gauges sweep correctly?	All gauges swept correctly.	Go to step 4.	Go to next step.
3.	Off/ On	Swap a working gauge, from the same side of the cluster, with the inoperative gauge. Perform gauge sweep.	The gauge that worked previously still works in the new position.	Replace the faulty gauge.	Replace the circuit board assembly.
4.	On	Connect the EZ-Tech® and run the cluster the "Diamond Logic Builder™" diagnostic software. Check if the malfunctioning gauge is programmed.	Gauge is programmed.	Go to next step	Insure the gauge is supposed to be installed. Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
5.	On	Did all warning lamps, for installed features, light during gauge sweep.	Warning lamps on during gauge sweep.	Go to step 7.	Go to next step.
6.	Off	Replace the suspect warning lamp bulb.	Warning lamp works.	Go to next step.	Replace the EGC circuit board assembly.
7.	On	Did the panel lights illuminate while the gauges swept?	Panel lights illuminate during gauge sweep.	Go to step 9.	Go to next step.
8.	On	Replace the suspect panel light bulb.	Panel light works.		Replace the circuit board assembly. Refer to Remove & Install.page 256
9.	On	Did all LCD segments display while the gauges swept?	All LCD elements displayed during gauge sweep.	EGC is working correctly.	Go to next step.



**Table 26 Troubleshooting Malfunctioning EGC (cont.)**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
If the LCD is the only problem, the LCD is probably bad. If other problems occur along with the LCD, the circuit board assembly probably needs to be replaced.					
10.	On	Replace the LCD display. Perform gauge sweep	LCD display works during gauge sweep.	EGC is working correctly.	Replace the circuit board assembly. Refer to Remove & Install.page 256

**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 27 AGSP Diagnostic Trouble Codes**

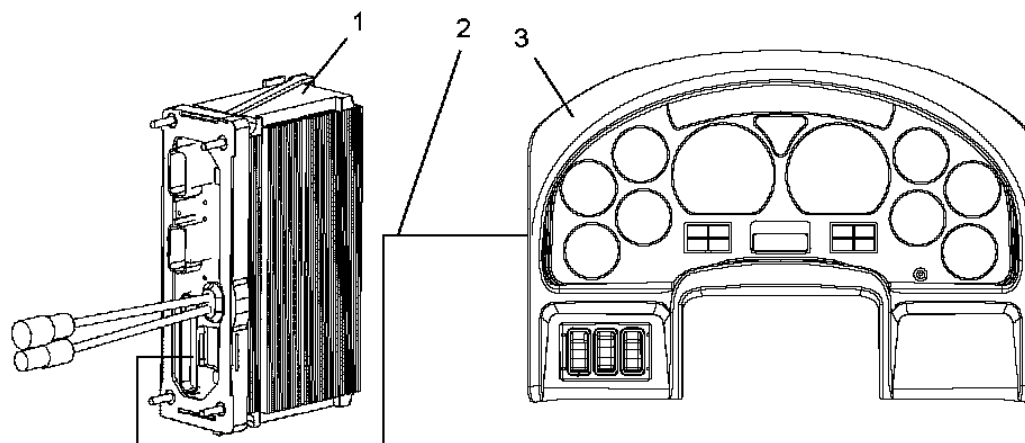
DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
614 14 1 1	Electronic Gauge Cluster #1 checksum error fixed by reflash.  The configuration checksum in the cluster did not match the teach/reflash checksum in the ESC. This situation was corrected by the teach/reflash operation.
614 14 1 2	Electronic Gauge Cluster #1 checksum error could not be fixed.  The configuration checksum in the cluster did not match the teach/reflash checksum in the ESC. This situation could not be corrected by the teach/reflash operation.
614 14 23 1	Electronic Gauge Cluster #1 checksum error fixed by reflash.  The configuration checksum in the cluster did not match the teach/reflash checksum in the ESC. This situation was corrected by the teach/reflash operation.
614 14 23 2	Electronic Gauge Cluster #1 checksum error could not be fixed.  The configuration checksum in the cluster did not match the teach/reflash checksum in the ESC. This situation could not be corrected by the teach/reflash operation.
639 14 33 239	EGC not communicating with ESC or AGSP not communicating with the ESC.
1705 14 150 1	ESC not communicating with the EGC.

**Table 27 AGSP Diagnostic Trouble Codes (cont.)**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 150 2	Engine Controller not communicating with the EGC.
2023 14 150 1 or 2023 14 250 1	Loss of data from ESC to primary EGC (150) or secondary (250). Loss of communication in excess of 10 seconds.
2023 14 150 2 or 2023 14 250 2	Engine Controller not communicating with the primary EGC (150) or secondary EGC (250). Loss of communication in excess of 10 seconds.

## 4.6. CHECK ELECTRICAL SYSTEM WARNING LAMP

### Circuit Function

**Figure 81 Check Electrical System Warning Lamp Function Diagram**

1. ELECTRICAL SYSTEM CONTROLLER (ESC)
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRONIC GAUGE CLUSTER (EGC)

The check electrical system warning lamp will light and stay on any time the EGC loses communication with the ESC or power to ESC power connector. The lamp will also light if communication from the engine controller is lost. The gauges controlled by the ESC will go to zero if communication between the EGC and ESC is lost. The gauges controlled by the engine controller will go to zero if communication between the EGC and engine controller is lost.

The check electrical system warning lamp should light during the EGC gauge sweep, after the key is turned to the ignition position. If the lamp does not light during the gauge sweep the lamp could be burned out or there may be a problem in the EGC.

The check electrical system warning lamp should come on for 1 minute when a fault is detected by the ESC.

### Fault Detection/Management

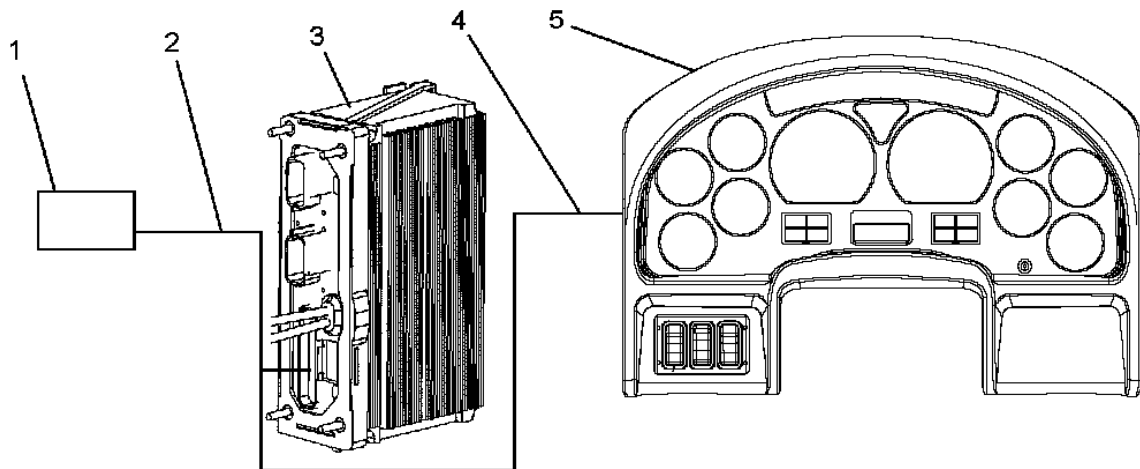
If the light stays on continuously and none of the gauges are working correctly after the gauge sweep, the EGC is not communicating on the Drivetrain 1939 Data Link or there is a problem with the data link. Refer to Drivetrain 1939 Data Link. (See DRIVETRAIN 1939 DATA LINK, page 63)

If the lamp stays on continuously when no active faults are present or does not come on when active faults are present, the problem may be in ESC/EGC programming or ESC/EGC hardware.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to turn all warning lamps on and off. The service tool can also be used to verify if the problem is limited to the ESC, EGC or the data link.

### 4.7. RANGE INHIBITED WARNING LAMP

#### System Function



**Figure 82 Range Inhibited Warning Lamp Function Diagram**

1. TRANSMISSION CONTROL MODULE (TCM)
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER (ESC)
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

If an Allison automatic transmission is installed on the vehicle, the range inhibited warning lamp should light during the EGC gauge sweep after the key is turned to the ignition position. If the lamp does not light during the gauge sweep the lamp could be burned out or there may be a problem in the EGC.

The range inhibited warning lamp lights when the transmission controller (only used with electronic transmissions) has restricted shifting.

This may be due to a problem in the transmission or use of a P.T.O.

See the manual for the specific transmission installed in the vehicle if a problem is suspected.

## Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the warning lamp.

The service tool (EZ-Tech®) running transmission diagnostic software can also be used to verify correct operation of the range inhibited warning lamp and check for faults logged in the transmission control module. See the appropriate transmission service manual for information on using the diagnostic software.

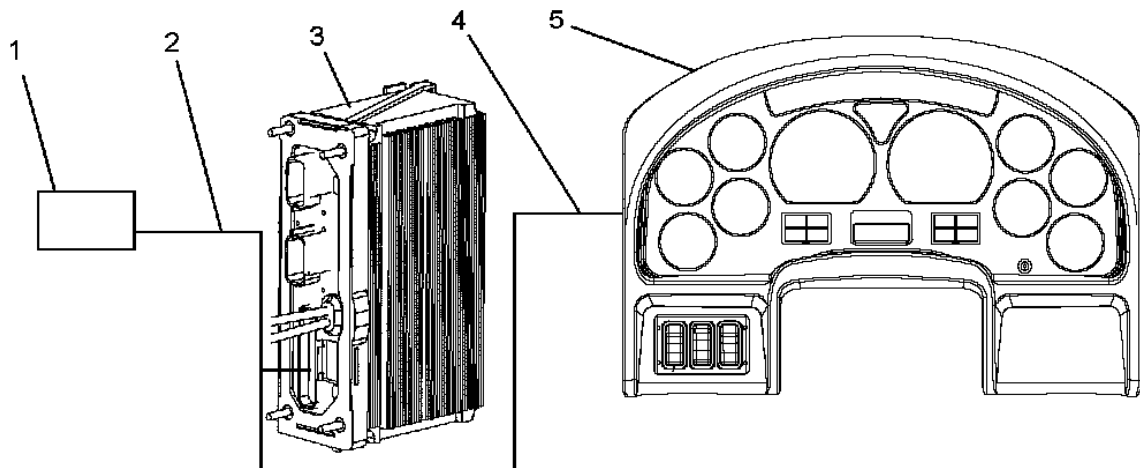
If the lamp stays on continuously or does not come on when commanded by the transmission controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

**Table 28 Range Inhibited Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify range inhibited warning lamp is malfunctioning.	Range inhibited warning lamp is on only when transmission range is inhibited.	Problem does not exist or is intermittent.	Go to next step.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programing in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
3.	On	Attempt to exercise the range inhibited warning lamp with the "Diamond Logic Builder™" diagnostic software.	Range inhibited warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256
4.	On	Use "Diamond Logic Builder™" diagnostic software to verify range inhibited commands from the transmission controller are being generated and match transmission status.	Commands from the transmission controller are being generated and match transmission status.	Go to next step.	Message from transmission controller is not being transmitted. Refer to the troubleshooting manual for the transmission installed in the vehicle.
5.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

## 4.8. ECONOMY MODE WARNING LAMP

### System Function



**Figure 83 Economy Mode Function Diagram**

1. TRANSMISSION CONTROL MODULE (TCM) FROM THE SHIFTER MODE BUTTON
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER (ESC)
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

The "ECON" lamp indicates the transmission is using its secondary shift schedule. The operator selects this shift schedule using a switch on the EGC.

If an Allison automatic transmission is installed on the vehicle, the economy mode warning lamp should light during the EGC gauge sweep after the key is turned to the ignition position. If the lamp does not light during the gauge sweep the lamp could be burned out or there may be a problem in the EGC.

The economy mode warning lamp lights when the transmission is using its secondary shift schedule.

See the manual for the specific transmission installed in the vehicle if a problem is suspected.

### Fault Detection/Management

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the warning lamp.

The MODE button is used. The activation of the button is communicated over existing shifter wiring. If the lamp does not turn on when requested, make sure the ECM is communicating to the ESC (fault code for missing trans message?), make sure the ESC is communicating to the cluster (fault code for missing cluster or ESC message?), and make sure the lamp in the cluster works (bulb check at gauge sweep or use diagnostic tool).

The service tool (EZ-Tech®) running transmission diagnostic software can also be used to verify correct operation of the economy mode warning lamp and check for faults logged in the transmission control module. See the appropriate transmission service manual for information on using the diagnostic software.

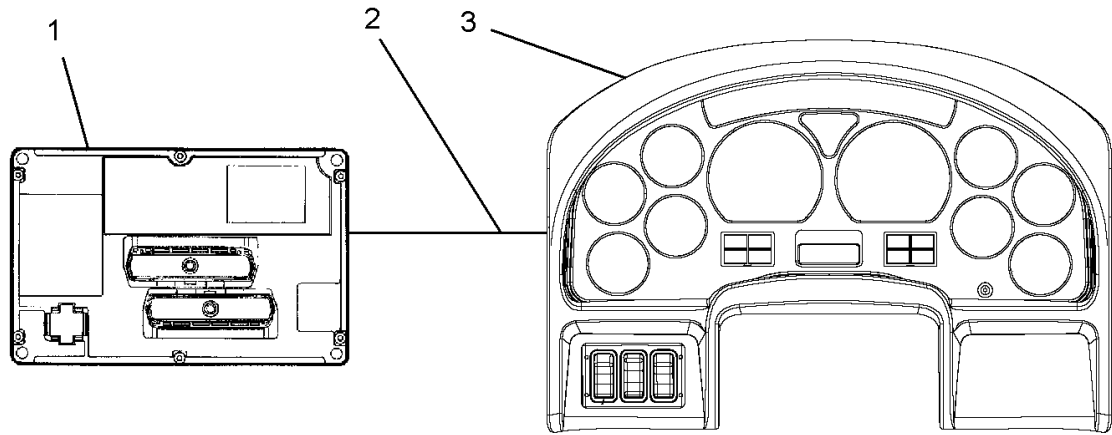
If the lamp stays on continuously or does not come on when commanded by the transmission controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

**Table 29 Economy Mode Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify Economy Mode lamp is malfunctioning.	Economy Mode lamp is on when running engine is cold.	Go to next step.	Problem does not exist or is intermittent.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
3.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256
4.	On	Use "Diamond Logic Builder™" diagnostic software to verify Economy Mode commands from the transmission controller are being generated and match transmission status.	Commands from the transmission controller are being generated and match transmission status.	Go to next step.	Message from transmission controller is not being transmitted. Refer to the troubleshooting manual for the transmission installed in the vehicle.
5.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

## 4.9. "YELLOW" ENGINE WARNING LAMP

### Circuit Function



**Figure 84 Yellow Engine Lamp Function Diagram**

1. ELECTRONIC ENGINE CONTROLLER
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRONIC GAUGE CLUSTER (EGC)

The "yellow" engine lamp should light should be commanded on by engine controller, during the EGC gauge sweep, after the key is turned to the ignition position.

The "yellow" engine lamp should light when the engine controller detects certain faults. The light will be accompanied with a message on the odometer display.

The light will go out when the fault is cleared from the engine controller.

If the lamp stays on continuously when not commanded by the engine controller or does not come on when commanded by the engine controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software will **not** check operation of the light.

The service tool (EZ-Tech®) running the Master Diagnostics software will list diagnostic trouble codes in the engine controller.

See the engine diagnostic manual on the engine installed in the truck for details.

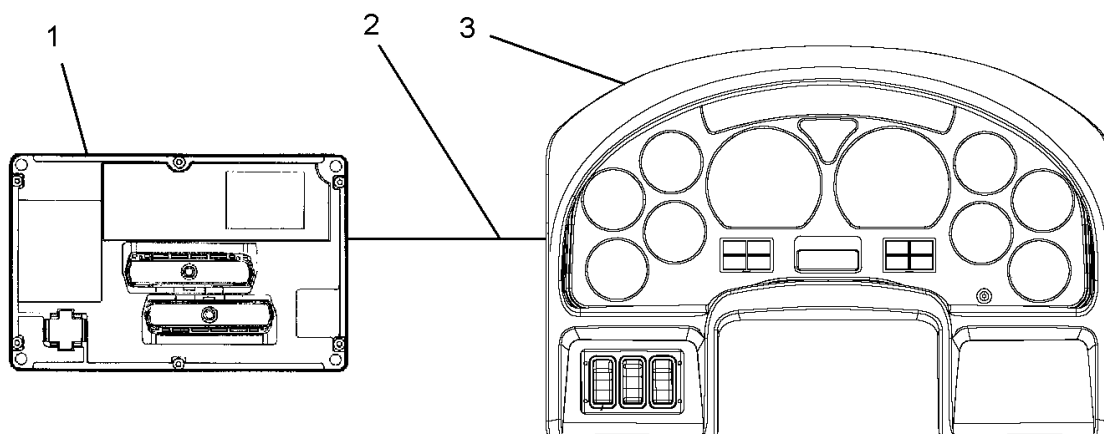
## Diagnostics

**Table 30 Yellow Engine Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Put the vehicle in diagnostic mode and check for activation of the warning lamp.	Warning lamp responds to EGC diagnostic mode.	Warning lamp is operating.	Go to next step.
2.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	If LED in warning lamp is good, replace circuit board on original EGC.	There is a problem in the engine controller. Refer to the troubleshooting manual for the engine controller installed on the bus.

## 4.10. "RED" ENGINE WARNING LAMP

### Circuit Function



**Figure 85 "Red" Engine Warning Lamp Function Diagram**

1. ELECTRONIC ENGINE CONTROLLER
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRONIC GAUGE CLUSTER (EGC)

The "red" engine warning lamp should light while the key is turned to the ignition position and the engine is not running.

If the lamp stays on continuously when not commanded by the engine controller or does not come on when commanded by the engine controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

The EGC activates the "red" engine warning indicator when it receives a message on the Drivetrain 1939 data link from the engine controller. The engine controller will send this message when warning thresholds for



coolant temperature, coolant level and/or low engine oil pressure have been exceeded. The indicator lamp will be accompanied by a message on the odometer display and the EGC alarm will sound.

The light will go out when the condition is resolved and the fault is cleared from the engine controller.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to turn on all of the warning lamps.

See the engine diagnostic manual, EGES 215, for detailed information on operation of this warning lamp.

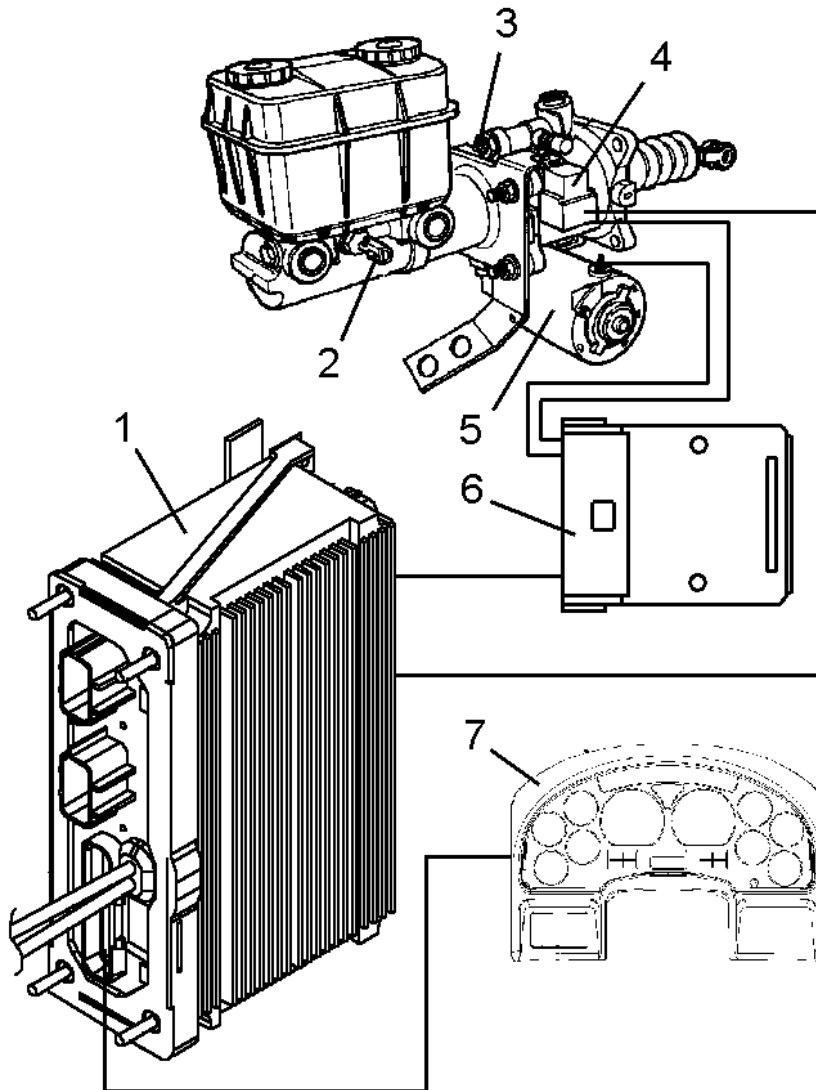
### Diagnostics

**Table 31 "Red" Engine Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Put the vehicle in diagnostic mode and check for activation of the warning lamp.	Warning lamp responds to EGC diagnostic mode.	Warning lamp is operating.	Go to next step.
2.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	If LED in warning lamp is good, replace circuit board on original EGC.	There is a problem in the engine controller. Refer to the troubleshooting manual for the engine controller installed on the bus.

## 4.11. BRAKE FLUID WARNING LAMP

### Circuit Function



**Figure 86 Brake Fluid Warning Lamp Function Diagram**

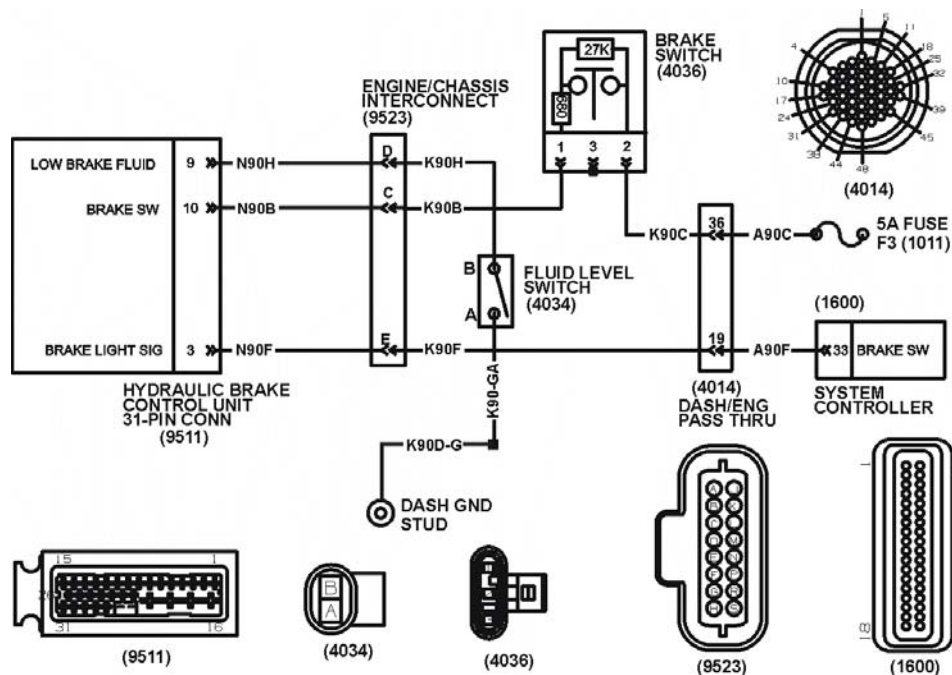
1. ELECTRICAL SYSTEM CONTROLLER
2. DIFFERENTIAL PRESSURE SWITCH
3. FLOW SWITCH
4. HYDROMAX PUMP RELAY
5. HYDROMAX PUMP
6. HYDROMAX BRAKE MODULE
7. ELECTRONIC GAUGE CLUSTER

The brake fluid warning lamp is only used with the hydraulic brake system. The EGC activates the brake fluid warning lamp when it receives a message on the Drivetrain 1939 data link from the ESC. An alarm should

sound while the lamp is illuminated. The ESC generates this information based on input from the Hydromax brake monitor module. The brake module monitors a circuit from the fluid level switch.

The light will go out when the condition is resolved.

The brake fluid warning lamp should light during the EGC gauge sweep, after the key is turned to the ignition position. If the lamp does not light during the gauge sweep the lamp could be burned out or there may be a problem in the EGC.



**Figure 87 Hydromax Monitor Module And Warning Circuits — Always Refer To Circuit Diagram Book For Latest Circuit Information**

- (1011) FUSE BLOCK  
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
- (1600) SYSTEM CONTROLLER CONNECTOR  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (4014) DASH/ENGINE PASS THROUGH CONNECTOR  
LOCATED AT INSIDE LEFT SIDE DASH PANEL
- (4034) HYDRAULIC FLUID LEVEL SWITCH  
LOCATED AT HYDRAULIC MASTER CYLINDER
- (4036) HYDRAULIC BRAKE SWITCH  
LOCATED AT HYDRAULIC MASTER CYLINDER
- (9523) ENGINE/CHASSIS INTERCONNECT  
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
- (9511) HYDRAULIC BRAKE CONTROL UNIT — HCU  
LOCATED AT INSIDE LEFT FRAME RAIL AT HCU

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

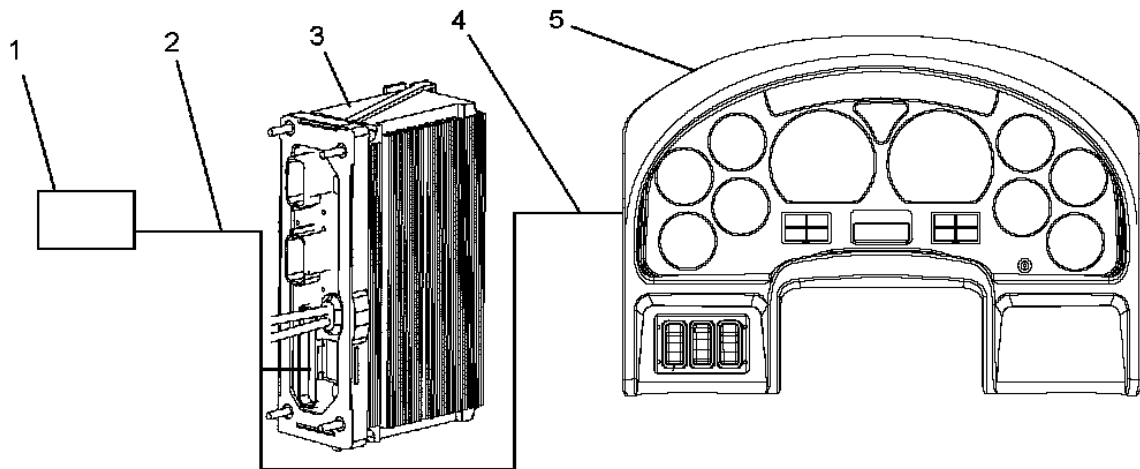
If the lamp illuminates when there are no problems in the brake system or does not illuminate when conditions exist that should turn it on, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the sensors or sensor wiring to the ESC.

**Table 32 Brake Pressure Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/ On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256
3.	On	Monitor the inputs to the ESC for the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Inputs are correct.	Go to next step.	Refer to Monitor Module and Warning Circuit Inputs To ESC. (See e-stroke module, page 440)
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

## 4.12. TRACTION CONTROL LAMP

### Circuit Function



**Figure 88 Traction Control Lamp Function Diagram**

1. AIR ABS ELECTRONIC CONTROL MODULE
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the traction control indicator when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC generates the command when it receives a command from the ABS controller. The ABS controller generates this information when traction control is activated.

The lamp should go out after the traction control event is corrected and cleared.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the sensors or sensor wiring to the traction control module.

See the appropriate section in this manual to troubleshoot the traction control module.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

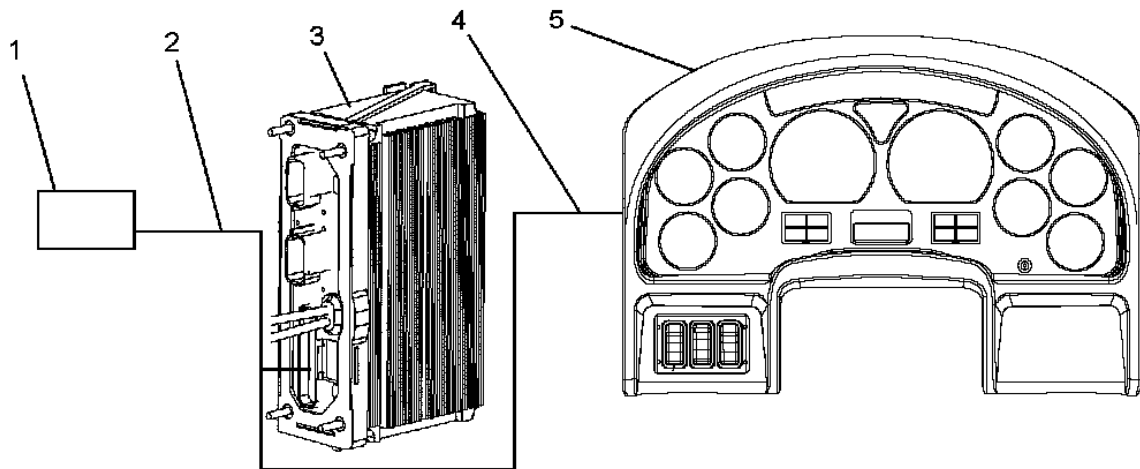
If the traction control lamp stays on continuously or does not come on when commanded by the ABS controller, the problem may be in ESC/EGC programming, ABS Controller/EGC hardware or problems with the sensors or sensor wiring to the ABS Controller.

**Table 33 Traction Control Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/ On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256
3.	On	Monitor the commands to the ESC from the ABS controller with the "Diamond Logic Builder™" diagnostic software.	Commands are correct.	Go to next step.	Refer to the troubleshooting manual for the specific ABS controller.
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

### 4.13. CHECK TRANSMISSION LAMP

#### Circuit Function



**Figure 89 Check Transmission Lamp Function Diagram**

1. TRANSMISSION CONTROL MODULE
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the check transmission lamp when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC generates this message when the transmission controller notifies it that a fault has been detected.

The lamp should go out after the fault is corrected and cleared.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the sensors or sensor wiring to the transmission controller.

See the appropriate troubleshooting manual for the particular transmission installed in the bus for details.

#### Diagnostics

The service tool (EZ-Tech®) running the “Diamond Logic Builder™” diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

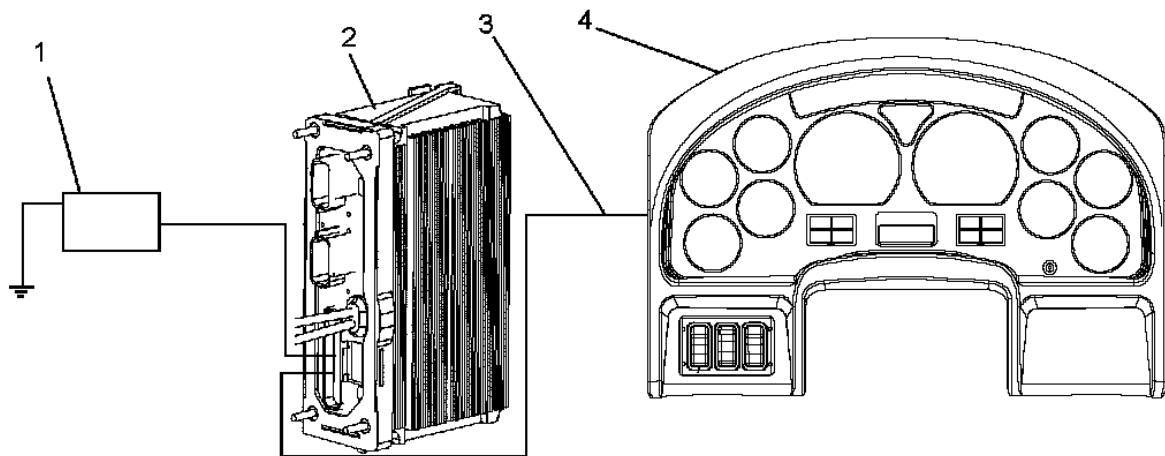
**Table 34** Check Transmission Lamp Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Check for transmission diagnostic codes. Refer to On-Line Diagnostics.(See ON-LINE DIAGNOSTICS, page 146)	<b>No</b> transmission diagnostic codes are present.	Go to next step.	Refer to the Transmission section of this manual.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programing in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
3.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256
4.	On	Monitor command from transmission controller to ESC with the "Diamond Logic Builder™" diagnostic software.	Commands are correct.	Go to next step.	Refer to the troubleshooting manual for the specific transmission installed on the truck.
5.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)



## 4.14. WATER IN FUEL WARNING LAMP

### Circuit Function



**Figure 90 Water In Fuel Warning Lamp Function Diagram**

1. WATER PROBE
2. ELECTRICAL SYSTEM CONTROLLER (ESC)
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the water in fuel indicator when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC will send this information based on input from the water probe.

A short in the water in fuel probe or wiring to the ESC can also cause the lamp to light.

### Diagnostics

There are no diagnostic trouble codes associated with this feature.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, EGC hardware or problems with the input circuits to the ESC from water probe.

**Table 35 Water in Fuel Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256
3.	On	Monitor inputs from the water in fuel module with the "Diamond Logic Builder™" diagnostic software.	Inputs are correct.	Go to next step.	Go to Fault Detection Management.
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

**Fault Detection/Management**

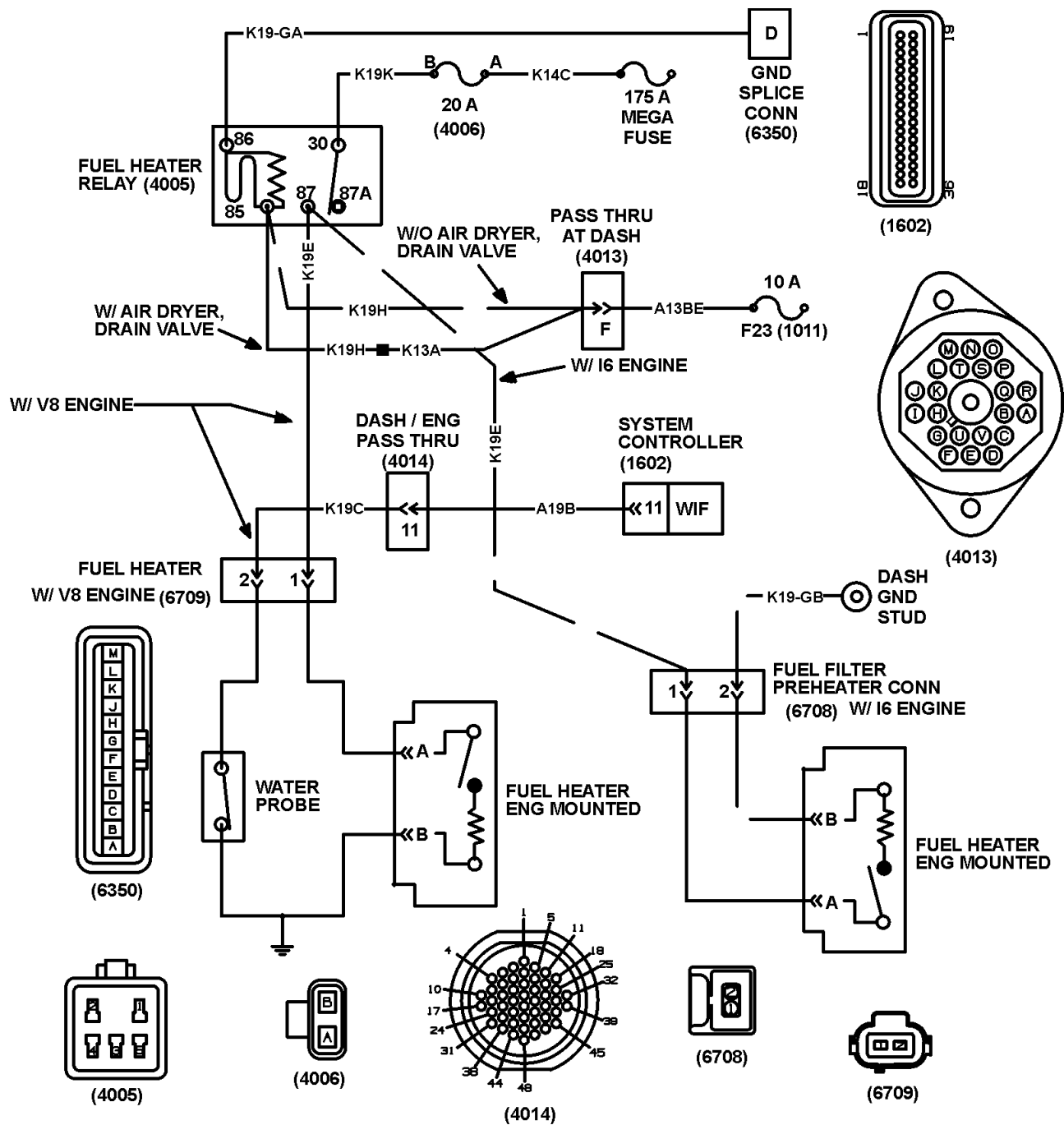


Figure 91 Water in Fuel Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (1011) FUSE BLOCK  
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
- (1602) SYSTEM CONTROLLER  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (4000) 175 AMP MEGA FUSE  
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
- (4005) FUEL HEATER RELAY  
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
- (4006) FUEL HEATER FUSE  
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
- (4013) PASS THRU AT DASH  
LOCATED AT INSIDE LEFT SIDE DASH PANEL
- (4014) DASH/ENGINE PASS THRU  
LOCATED AT INSIDE LEFT SIDE DASH PANEL
- (4016) AIR DRYER/DRAIN VALVE RELAY  
LOCATED AT OUTSIDE CENTER TOP DASH PANEL
- (6350) GROUND SPLICE PACK  
LOCATED AT ENGINE COMPARTMENT NEAR STARTER
- (6708) FUEL FILTER PREHEATER (I-6 ONLY)  
LOCATED AT ENGINE COMPARTMENT FUEL FILTER
- (6709) FUEL HEATER (V8 ONLY)  
LOCATED AT ENGINE COMPARTMENT FUEL FILTER

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the light.

To quickly verify operation of the water in fuel circuits with the V8 engine, remove the connector from the fuel heater (6709). When the key is on the WIF warning lamp should not be illuminated. Connect a jumper from the harness connector cavity 2 to ground. When the key is on the WIF lamp should illuminate. If both of these checks work, the problem is in the sensor.

If the lamp stays on continuously or does not come on when there is water in the fuel, the problem may be in ESC/EGC programming, ESC/EGC hardware, water in fuel probe, or wiring to the ESC.

**Table 36 Water in Fuel Warning Lamp Circuits Voltage Check Chart**

Fuel Heater (6709) (V8 Only) Voltage Checks		
Check with Fuel Heater Disconnected, Fuel Heater Relay (4005) Installed and the Ignition Key "On".		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
(4035) harness connector, cavity 1 to ground.	12 ± 1.5 volts	If voltage is incorrect, check circuit K19E for an open or short circuit.  Also bench test Fuel Heater Relay (4005) and check circuits K19K and K14C and check for blown fuses (4006) and (4000).

**Table 36 Water in Fuel Warning Lamp Circuits Voltage Check Chart (cont.)**

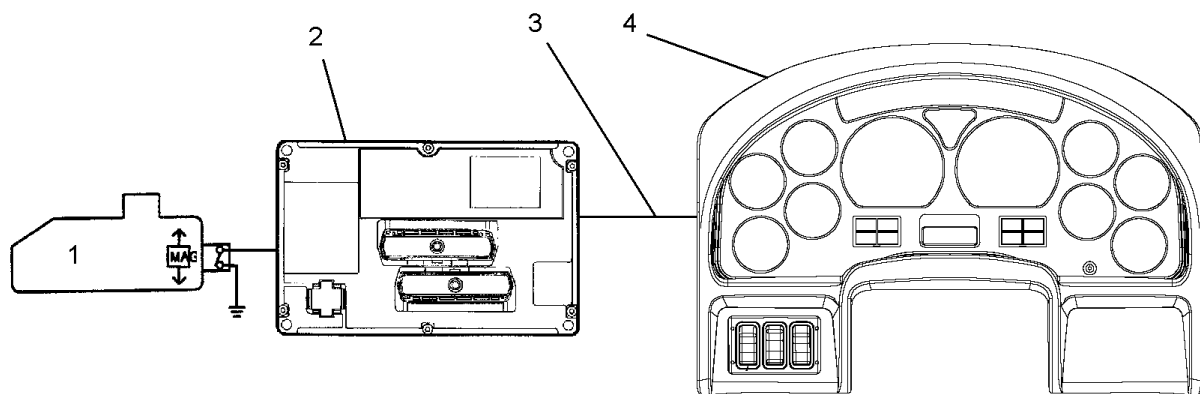
(4035) harness connector, cavity 2 to cavity ground.	12 ± 1.5 volts	If voltage is incorrect, check circuits A19B and K19C for an open or short circuit.  If no opens exist, check signal from ESC.
There are no diagnostic trouble codes associated with this feature.		

**Extended Description**

With the key on, 12 volts from fuel heater fuse (4006) is supplied on circuit K19K to K19E to the fuel heater connector (6709) terminal 1.

The ground path for the fuel heater (6709) is not a dedicated circuit. The fuel filter housing is grounded through its mounting bracket and whenever water builds up to an unacceptable level in the filter, the water completes the circuit between the probe contacts and the housing. This energizes the water-in-fuel circuit.

When the water-in-fuel circuit becomes energized, a ground signal is supplied on circuit K19C through the pass through (4014) to the ESC connector (1602) terminal 11. This will cause the ESC to send a message to the EGC to illuminate the warning lamp.

**4.15. COOLANT LEVEL WARNING LAMP****Circuit Function****Figure 92 Coolant Level Warning Lamp Diagram**

1. COOLANT SURGE TANK
2. ELECTRONIC ENGINE CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the coolant level indicator when it receives a message on the Drivetrain 1939 data link from the engine controller. The engine controller will generate this message based on input from the sensor in the coolant surge tank.

The lamp should go out when the coolant level is restored.

### Diagnostics

The Diamond Logic Builder™ diagnostic software can be used to command all of the warning lamps on and monitor the coolant level command from the engine controller.

The most probable cause of malfunctions with the warning lamps, besides burnt out lamps, is input circuits from sensors to the ESC or engine controller. Although unlikely, it is possible for the malfunction to be in the ESC or EGC.

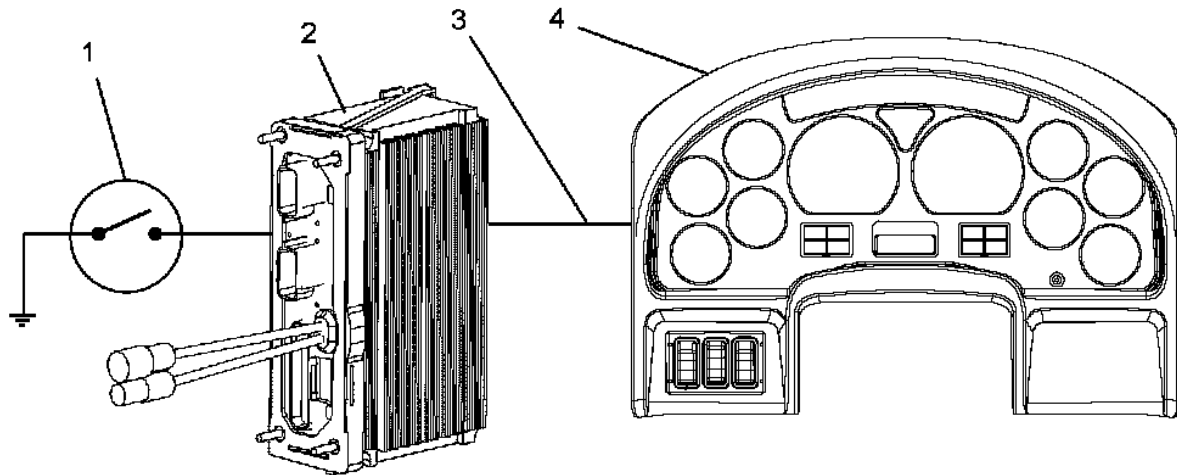
Refer to the engine manual on the specific engine installed in the vehicle for (sensor to engine controller) troubleshooting procedures.

**Table 37 Coolant Level Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify coolant warning lamp is malfunctioning. Check level in coolant tank.	Coolant warning lamp is on when coolant level is not low or lamp is off when coolant is low.	Go to next step.	Problem does not exist or is intermittent.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
3.	On	Attempt to exercise the coolant warning lamp with the "Diamond Logic Builder™" diagnostic software.	Coolant warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256
4.	On	Use "Diamond Logic Builder™" diagnostic software to verify coolant level commands from the engine controller are being generated and match coolant level.	Commands from the engine controller are being generated and match coolant level.	Go to next step.	Message from engine controller is not being transmitted. Refer to the engine troubleshooting manual for the engine installed in the vehicle.
5.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

## 4.16. PARK BRAKE WARNING LAMP

### Circuit Function



**Figure 93 Park Brake Warning Lamp Function Diagram**

1. PARK BRAKE SWITCH
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the park brake indicator when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC generates this message based on input from the park brake switch.

The light should go out when the park brake is released.

The park brake input to the ESC is also used in the diagnostic trouble code retrieval procedure and 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.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, EGC hardware or problems with the input circuits to the ESC from the park brake switch.

**Table 38 Park Brake Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256
3.	On	Check for Park Brake Warning Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 178)  Read display on odometer.	Park Brake Warning Lamp diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

**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.



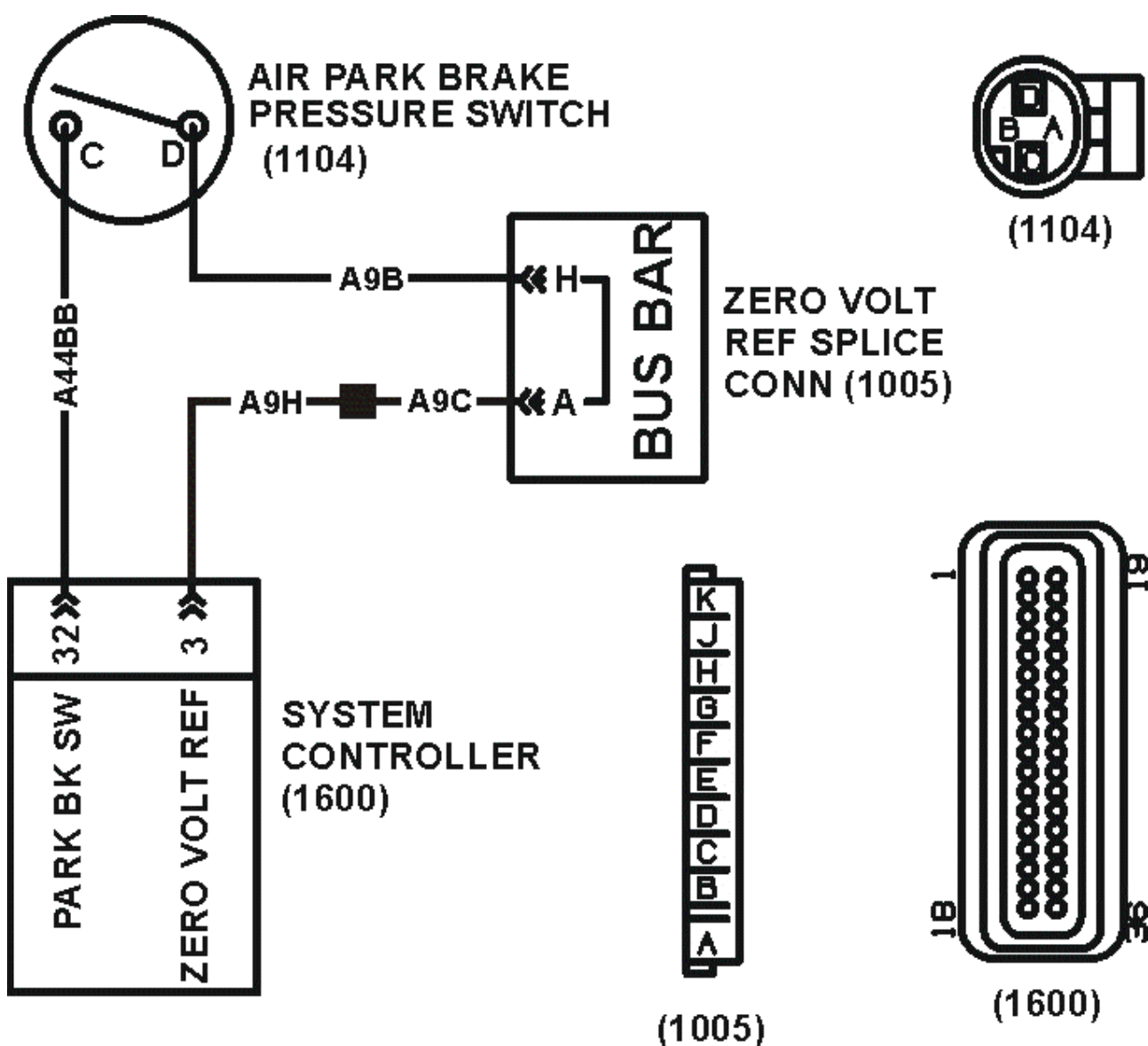
**Table 39 Park Brake Warning Lamp Diagnostic Trouble Codes**

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

**Fault Detection/ Management**

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link. See the diagnostic software manual for details on using the software.

If the lamp stays on continuously or does not 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 circuits to the ESC.



**Figure 94 Air Park Brake Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information**

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

**Table 40 Air Park Brake Lamp Circuits Voltage Check Chart**

Air Park Brake Pressure Switch Connector (1104) Voltage Checks		
Check with ignition in key switch position on and air park brake pressure switch connector (1104) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
(1104) harness connector cavity D to ground.	0 volts	<p>If voltage is incorrect, check for open or short on circuits A9B, A9C and A9H.</p> <p>Also ensure proper zero volt reference signal from system controller (1600) pin 3.</p> <p><b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b></p>
(1104) harness connector cavity D to cavity C.	0 volts	<p>If voltage is incorrect, check for open or short on circuit A44BB.</p> <p>Also ensure proper input signal from system controller (1600) pin 32.</p> <p><b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b></p> <p>If circuits check good and failure is still present, replace air park brake pressure switch.</p>
There are no diagnostic trouble codes associated with this feature.		

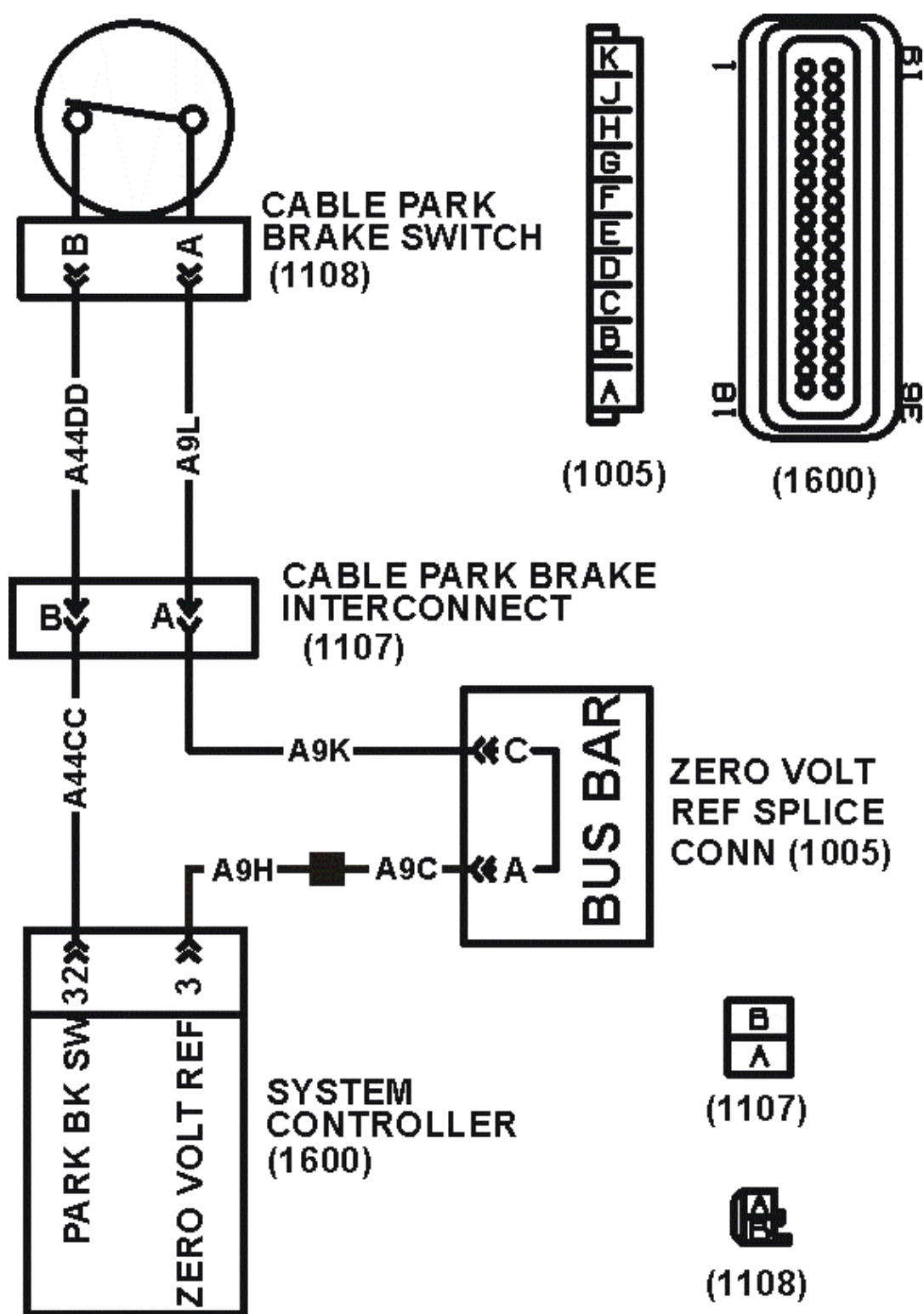
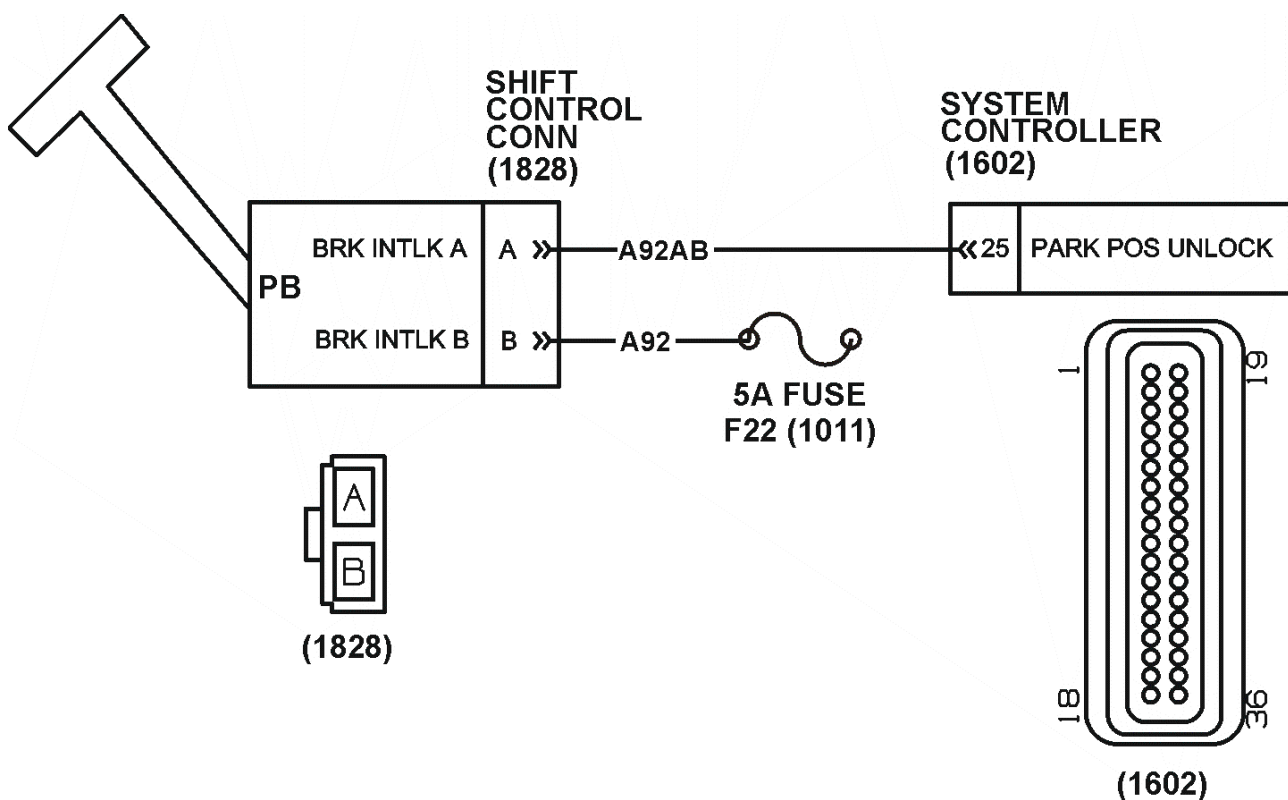


Figure 95 Cable Park Brake Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

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

**Table 41 Cable Park Brake Lamp Circuits Voltage Check Chart**

<b>Cable Park Brake Switch Connector (1108) Voltage Checks</b>		
Check with ignition in key switch position on and cable park brake switch connector (1108) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
Cable park brake switch connector (1108) cavity A to ground.	0 volts	<p>If voltage is incorrect, check for open or short on circuits A9L, A9K, A9C and A9H.</p> <p>Also ensure proper zero volt reference signal from system controller (1600) pin 3.</p> <p><b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b></p>
Cable park brake switch connector (1108) cavity A to cavity B.	0 volts	<p>If voltage is incorrect, check for open or short on circuit A44DD and A44CC.</p> <p>Also ensure proper input signal from system controller (1600) pin 32.</p> <p><b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b></p> <p>If circuits check good and failure is still present, replace cable park brake switch.</p>
<b>There are no diagnostic trouble codes associated with this feature.</b>		

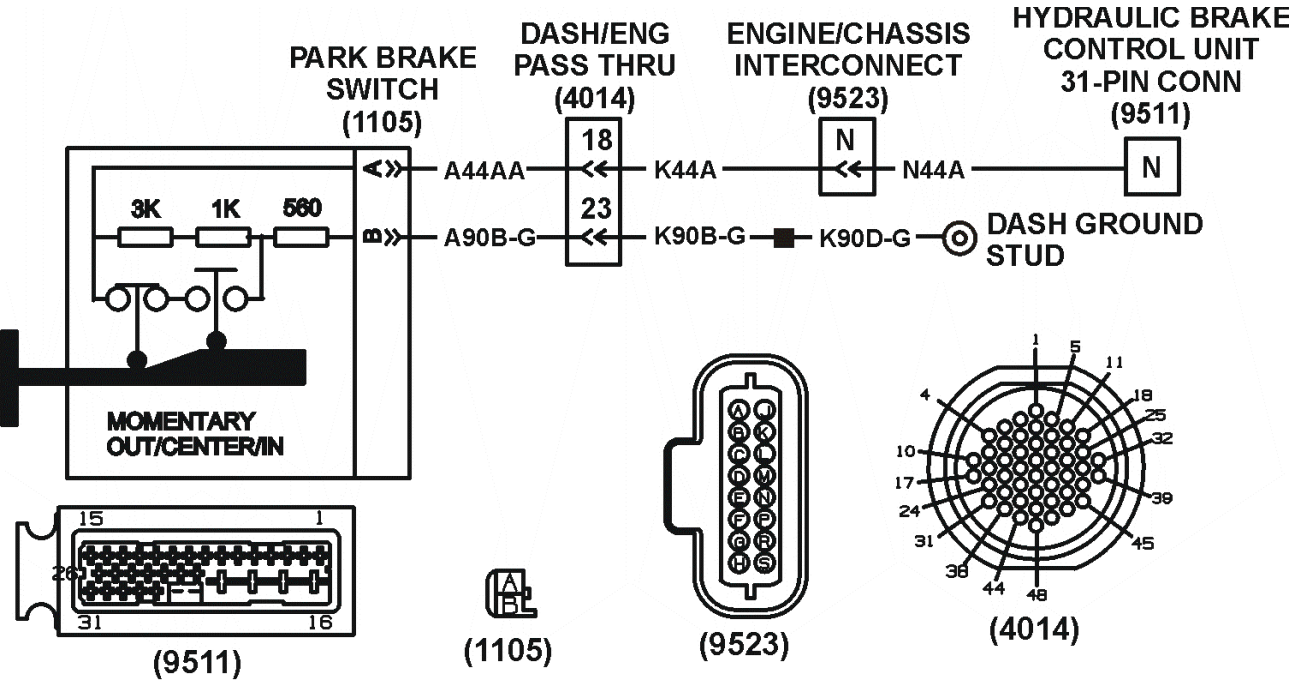


**Figure 96 Hydraulic Park Brake Circuits (w/Full Power Brakes) — Always Refer to Circuit Diagram Book for Latest Circuit Information**

- (1011) FUSE BLOCK  
LOCATED LEFT SIDE VEHICLE AT FLASHER PLATE
- (1602) SYSTEM CONTROLLER  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (1828) LCT SHIFT CONTROL  
LOCATED AT INSTRUMENT WING PANEL

**Table 42    Hydraulic Park Brake Lamp Circuits Voltage Check Chart**

<b>Shift Control Connector (1828)) Voltage Checks</b>		
Check with ignition in key switch position on and hydraulic park brake switch connector (1128) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
Shift control connector (1828) pin B to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse F22. Also check for open or short in circuit A92.
Shift control connector (1828) pin B to pin A.	12 ± 1.5 volts	<b>NOTE – Park Brake Light should illuminate.</b>  If voltage is correct check for open on circuit A92AB.  If circuits check good and Park brake light still fails, the problem could be a faulty EGC or faulty ESC. Refer to their respective sections in this manual for troubleshooting guides.
<b>There are no diagnostic trouble codes associated with this feature.</b>		



**Figure 97    Hydraulic Park Brake Circuits (w/Momentary Switch) — Always Refer to Circuit Diagram Book for Latest Circuit Information**

- (1105) HYDRAULIC PARK BRAKE SWITCH  
LOCATED AT INSTRUMENT WING PANEL
- (4014) DASH ENGINE PASS THRU  
LOCATED AT INSIDE LEFT SIDE DASH PANEL
- (9511) HYDRAULIC BRAKE CONTROL UNIT  
LOCATED AT INSIDE LEFT FRAME RAIL AT HCU
- (9523) ENGINE/CHASSIS INTERCONNECT  
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE

**Table 43    Hydraulic Park Brake Circuits (w/Momentary Switch) Voltage Check Chart**

Hydraulic Park Brake Switch (1105) Resistance Checks		
Check with hydraulic park brake switch connector (1105) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
Park brake switch connector (1105) cavity A to cavity B (with switch in “middle” position).	approx. 1.56 Kohms	If resistance is incorrect, replace park brake switch.
Park brake switch connector (1105) cavity A to cavity B (with switch in “out” position).	approx. 4.56 Kohms	If resistance is incorrect, replace park brake switch.



**Table 43 Hydraulic Park Brake Circuits (w/Momentary Switch) Voltage Check Chart (cont.)**

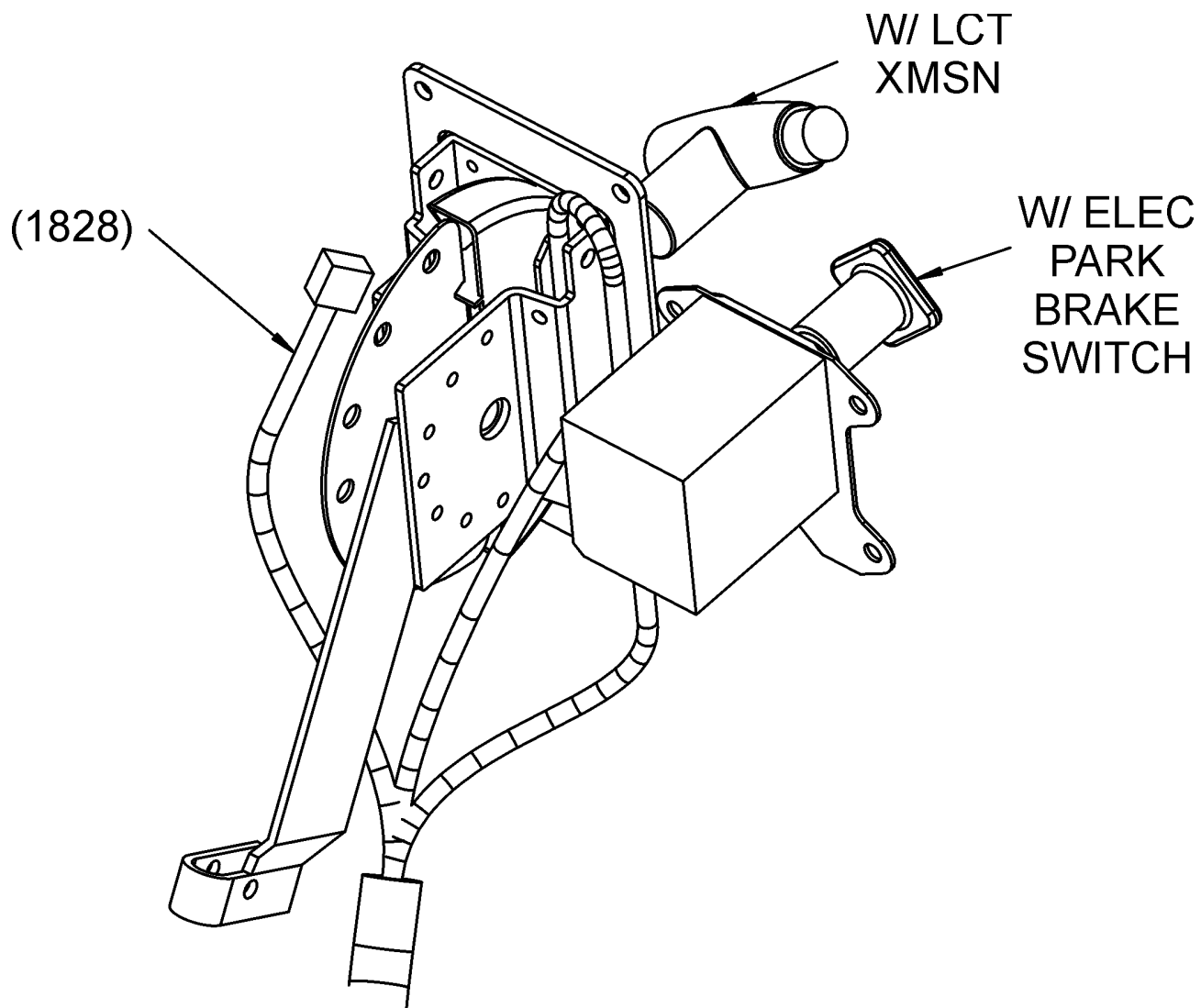
Hydraulic Park Brake Switch (1105) Resistance Checks		
Check with hydraulic park brake switch connector (1105) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
Park brake switch connector (1105) cavity A to cavity B (with switch in "in" position).	approx. 560 ohms	<p>If resistance is incorrect, replace park brake switch.</p> <p>If switch resistances are correct and failure still exists, the check for open or short on circuits N44A, K44A, A44AA, A90B-G, K90B-G and K90D-G.</p> <p>If all circuits check good, then hydraulic brake control unit may need replaced or reprogrammed.</p>
<b>There are no diagnostic trouble codes associated with this feature.</b>		

**Extended Description**

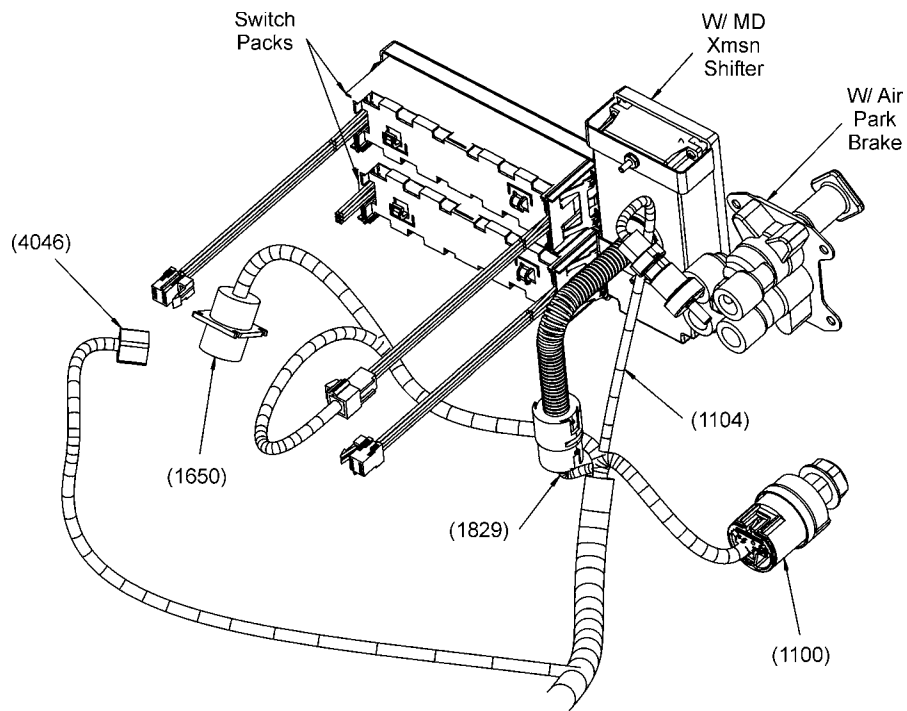
On vehicles with a hydraulic park brake, a 12 volt signal from fuse F22 is applied to the System Controller at connector (1602) pin 25 with the shifter is in the "PB" position. This tells the ESC that the park brake is engaged.

On vehicles with an air or cable park brake, the zero volt reference level is supplied from ESC connector (1600) terminal 3 to the zero volt reference splice connection (1005) to the park brake switch connector (1104) terminal D.

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.

**Component Locations**

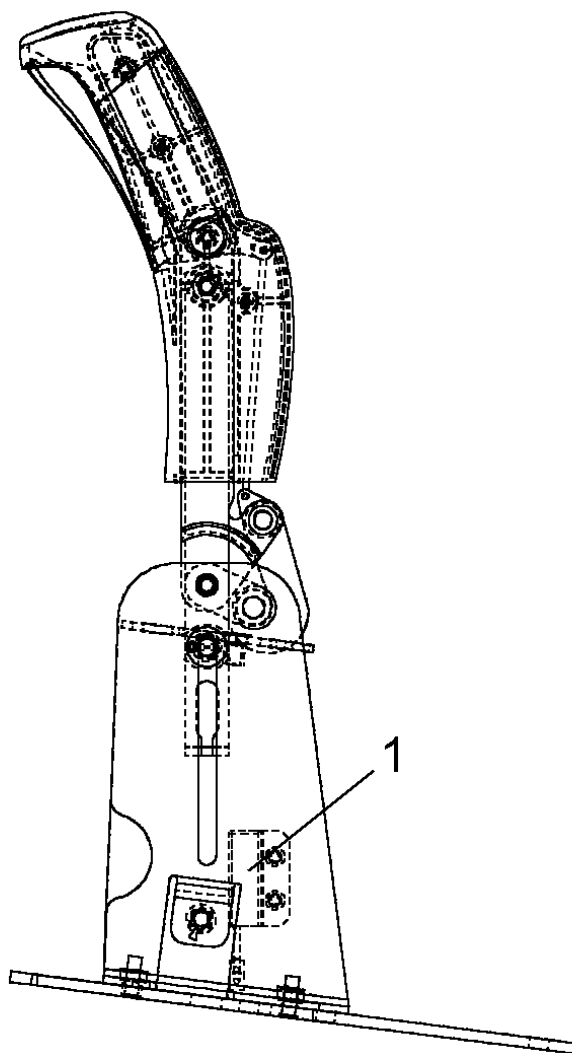
**Figure 98** Park Brake Switch Location (With Hydraulic Brakes)



**Figure 99 Air Park Brake Switch Location**

(1104) AIR PARK BRAKE PRESS SWITCH

3541521C2

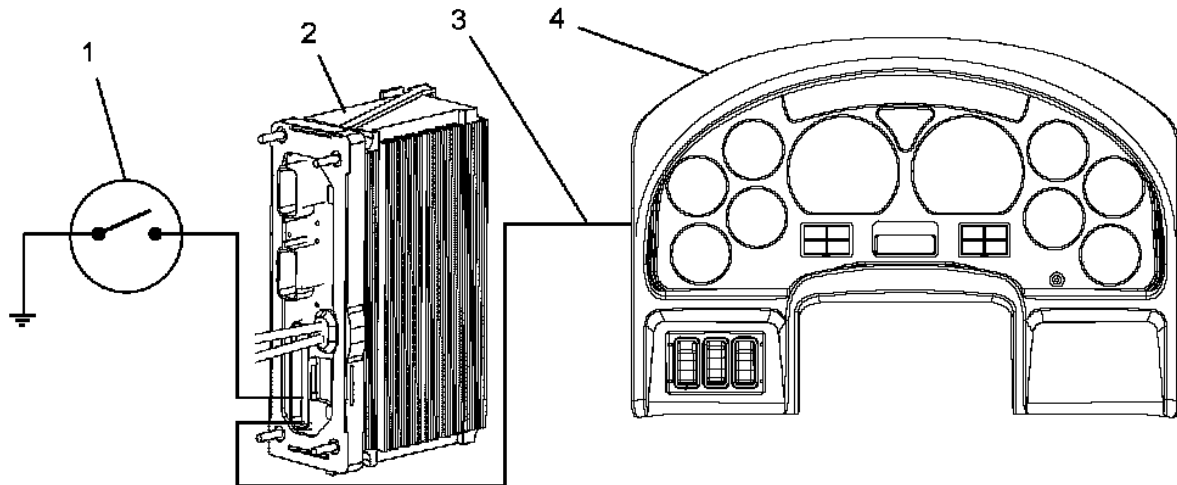


**Figure 100 Cable Park Brake Switch Location**

1. CABLE PARK BRAKE PRESS SWITCH

## 4.17. SERVICE PARK BRAKE WARNING LAMP

### Circuit Function



**Figure 101 Service Park Brake Warning Lamp Function Diagram**

1. HYDRAULIC ACTUATED PARK BRAKE SAHR TRAVEL SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

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

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

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

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

Outputs:

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

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

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

The EGC activates the Service Park Brake warning lamp when it receives a message on the Drivetrain 1939 data link from the ESC.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

The Service Park Brake Warning lamp is on when the Hydraulic Full Powered Park Brake is stuck. This occurs when the park brake switch does not match the spring apply hydraulic release (SAHR) chamber travel sensor. This indicates the park brake cannot be applied or cannot be released.

The Service Park Brake Warning lamp is on when the auto apply portion with the Hydraulic Powered Park Brake is not operating. This occurs when the park brake switch is not set within 5 seconds of the receipt of the Park as the requested gear. This failure would indicate a failure in the auto apply or in the hydraulic lines between the SAHR module and the rear reservoir.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, EGC hardware or problems with the input circuits to the ESC from the park brake switch.

**Table 44 Service Park Brake Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Lamp circuits from data link to EGC are working correctly.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256

**Table 44 Service Park Brake Warning Lamp Preliminary Check (cont.)**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
3.	On	Check for Service Park Brake Warning Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 193)  Read display on odometer.	Service Park Brake Warning Lamp diagnostic trouble codes are active.	Go to the Park Brake in the Chassis Features section of the manual. (See Air Actuated Park Brake, page 492)	Go to next step.
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Message from ESC is not being transmitted. Consider replacing ESC. (See ESC REPLACEMENT, page 117)

**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.

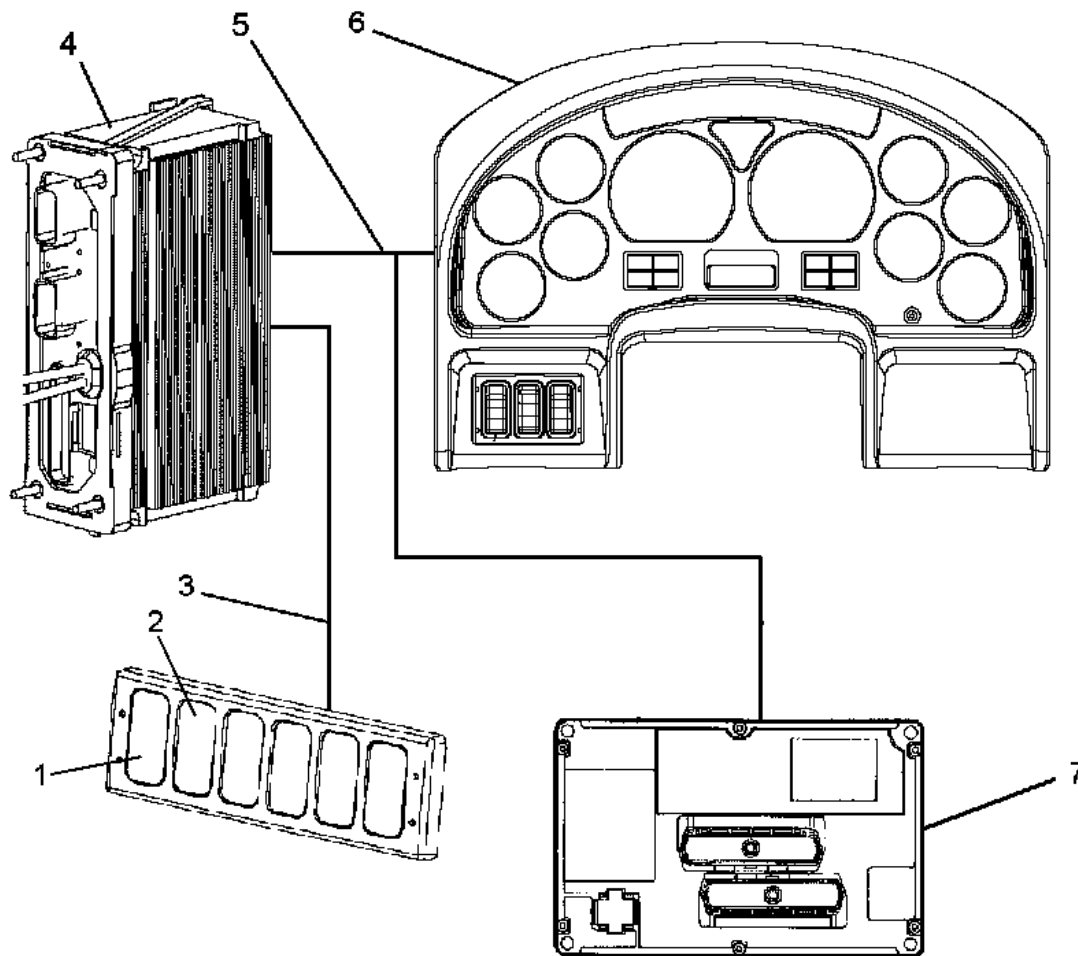
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 45 Service Park Brake Warning Lamp Diagnostic Trouble Codes**

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

## 4.18. CRUISE CONTROL LAMP

### Circuit Function



**Figure 102 Cruise Control Lamp 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 EGC activates the cruise control indicator when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC generates this message when it receives a cruise on message from the engine controller.



The light should go out when the cruise control is deactivated.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" 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.

A problem with the cruise lamp will be apparent when the cruise control is activated and the lamp does not illuminate or the lamp stays on when the cruise is deactivated.

For problems with the cruise control activating refer to Cruise Control.(See CRUISE CONTROL, page 335)

There are no diagnostic trouble codes for cruise control circuits.

If the lamp stays on continuously or does not come on when the cruise control is engaged, the problem may be in ESC/EGC programming, ESC/EGC hardware, engine controller.

**Table 46 Cruise Control Lamp Preliminary Check**

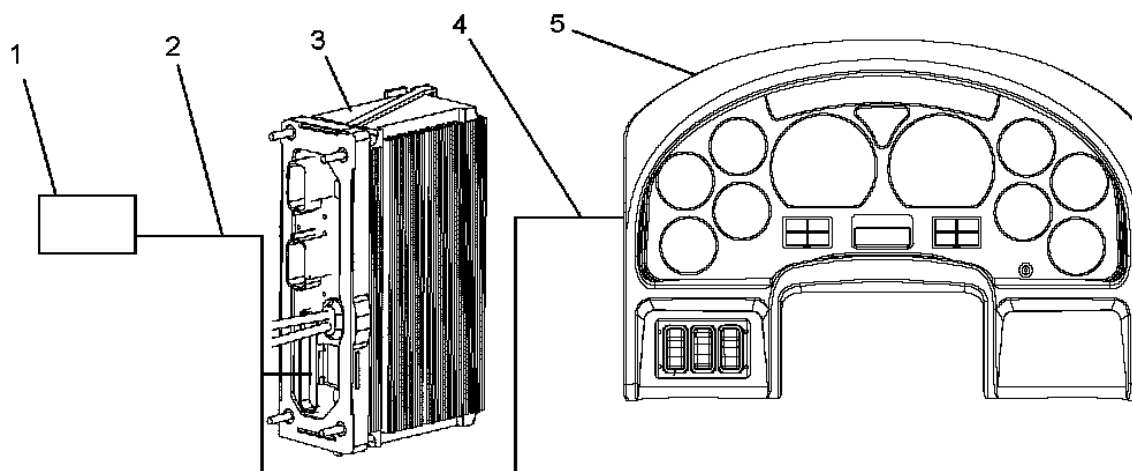
STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify cruise control is functioning. Insure the brake and clutch are released, there are no active brake or clutch DTC's and no ABS/ATC events.	Cruise control is functioning.	Go to next step.	Go to Cruise Control. (See CRUISE CONTROL LAMP, page 194)
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programing in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
3.	On	Attempt to exercise the cruise lamp with the "Diamond Logic Builder™" diagnostic software.	Cruise lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256

**Table 46 Cruise Control Lamp Preliminary Check (cont.)**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
4.	Off/On	Temporarily swap a known good cluster with the current cluster and check operation of the lamp. Activate cruise control and verify lamp operation.	Lamp operates correctly.	Message from ESC is being transmitted. Replace circuit board on original EGC.	Go to next step.
5.	On	Use "Diamond Logic Builder™" diagnostic software to verify cruise commands from the engine controller are being generated.		Message from ESC is not being transmitted. Consider replacing ESC . (See ESC REPLACEMENT, page 117)	Message from engine controller is not being transmitted. Refer to the engine troubleshooting manual for the engine installed in the vehicle.

## 4.19. ABS WARNING LAMP

### Circuit Function

**Figure 103 ABS Warning Lamp Function Diagram**

1. ABS ELECTRONIC CONTROL MODULE
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the ABS indicator when it receives a message on the Drivetrain 1939 data link from the electrical system controller (ESC). The ABS controller sends a message to the ESC requesting the lamp be turned on when ABS is activate or there is a failure in the ABS system.

The lamp should go out after the ABS event is over or the failure is repaired and the fault is cleared.

See the appropriate ABS manual for details.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

The EZ-Tech® can also run ABS diagnostic software to validate operation of the warning lamp. Refer to the applicable ABS manual for the vehicle.

If the lamp stays on continuously or does not come on when commanded by the ABS controller, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the ABS controller.

**Table 47 ABS Warning Lamp preliminary check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Lamp circuits from data link to EGC are working correctly.  Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256
3.	On	Check for ABS Warning Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 197)  Read display on odometer.	ABS Warning Lamp diagnostic trouble codes are active.	Go to fault detection management.	Go to next step
4.	On	Monitor the inputs for the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Inputs are correct.	Go to next step.	Refer to the troubleshooting manual for the specific ABS installed on the bus.

### 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.

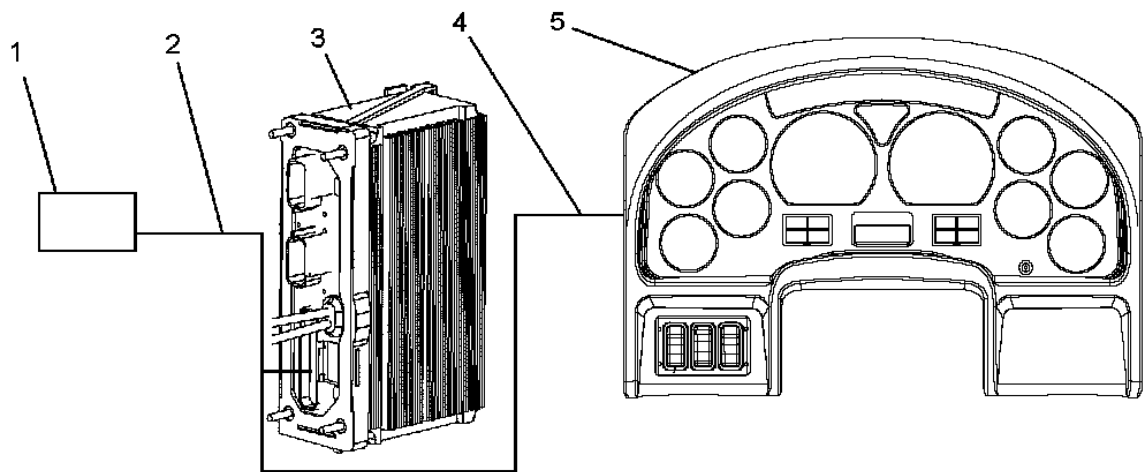
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 48   ABS Warning Lamp Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2023 14 150 8 or 2023 14 250 8	ABS warning light malfunction on primary EGC (150) or secondary EGC (250)

**4.20. WAIT TO START WARNING LAMP**

**Circuit Function**



**Figure 104   “Wait To Start” Warning Lamp Function Diagram**

- 1. ELECTRONIC ENGINE CONTROLLER
- 2. DRIVE TRAIN 1939 DATA LINK
- 3. ELECTRICAL SYSTEM CONTROLLER
- 4. DRIVE TRAIN 1939 DATA LINK
- 5. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the “wait to start” indicator when it receives a message on the drivetrain 1939 data link from the electrical system controller (ESC). The ESC will generate this message when it receives a message from any engine controller that requires a “wait to start” function.

The light should go out when the glow plugs have reached a sufficient temperature to start the engine.

### Fault Detection/Management

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

If the lamp stays on continuously or does not come on when the engine is cold, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the engine controller or wiring to the engine controller.

See the engine diagnostic manual for detailed information on troubleshooting problems with the "wait to start" warning lamp inputs.

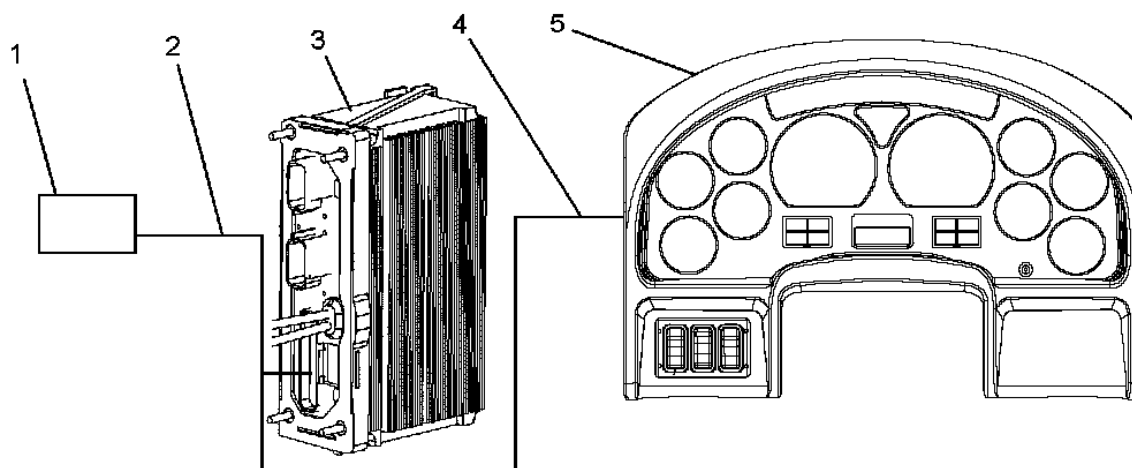
### Diagnostics

**Table 49 Wait To Start Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning Lamp responds to diagnostic input.	Lamp circuits from data link to EGC are working correctly.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install.page 256

## 4.21. RETARD OVERHEAT WARNING LAMP

### Circuit Function



**Figure 105 Retard Overheat Warning Lamp Function Diagram**

1. TRANSMISSION ELECTRONIC CONTROL MODULE
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. DRIVE TRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER (EGC)

The EGC activates the retard overheat warning lamp when it receives a message on the drivetrain 1939 data link from the electrical system controller (ESC). The ESC will generate this message when it receives a message from the transmission controller informing it that the retarder is overheating.

The lamp should go out after the retarder has cooled off.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

If the lamp stays on continuously or does not come on when the transmission retarder is overheating, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with engine controller circuits or the engine controller.

See the appropriate transmission manual for details.

**Table 50 Retard Overheat Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programing in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Lamp circuits from data link to EGC are working correctly.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256

**Diagnostics**

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can command the ESC to turn on all of the warning lamps. This will verify that the EGC is working and communicating on the data link.

If the lamp stays on continuously or does not come on when commanded by the ESC, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the sensors or sensor wiring to the transmission controller.

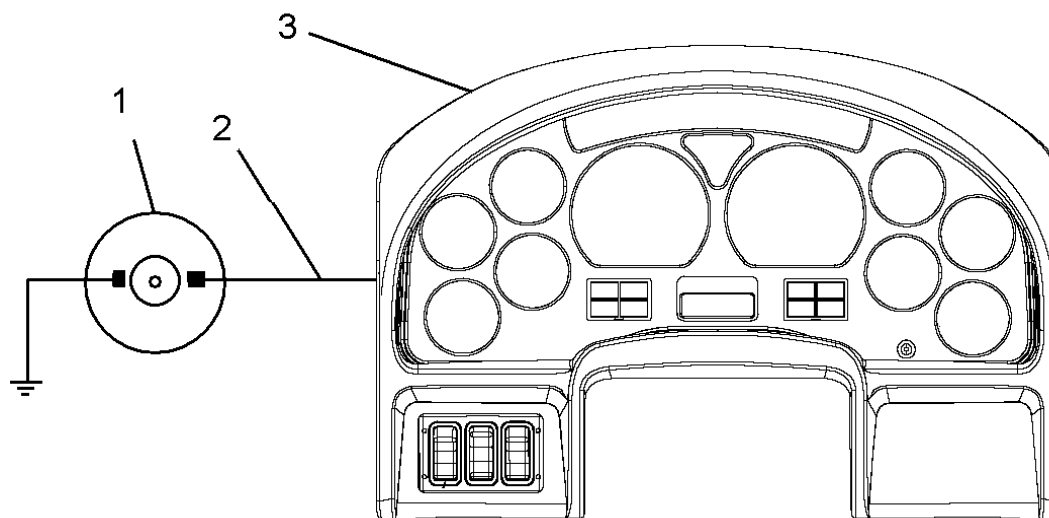
**Table 51 Retard Overheat Warning Lamp Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify warning lamp and warning lamp inputs are programmed to operate.	Warning lamp and warning lamp inputs are programmed to operate.	Go to next step.	Program the warning lamp with the "ICAP" software.  Refer to Programing in the Electrical System Controller section of this manual. (See PROGRAMMING, page 107)
2.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board. Refer to Remove & Install, page 256
3.	On	Attempt to exercise the warning lamp with the "Diamond Logic Builder™" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Lamp circuits from data link to EGC are working correctly.	Insure bulb is not burned out. Replace EGC circuit board.

## 4.23. ALTERNATOR WARNING LAMP

### Circuit Function

Refer to Alternator Warning Lamp Function Diagram.



**Figure 106 Alternator Warning Lamp Function Diagram**

1. ALTERNATOR
2. DIRECT CIRCUIT FROM ALTERNATOR TO WARNING LAMP
3. ELECTRONIC GAUGE CLUSTER (EGC)

The optional alternator warning lamp is directly controlled by the alternator.

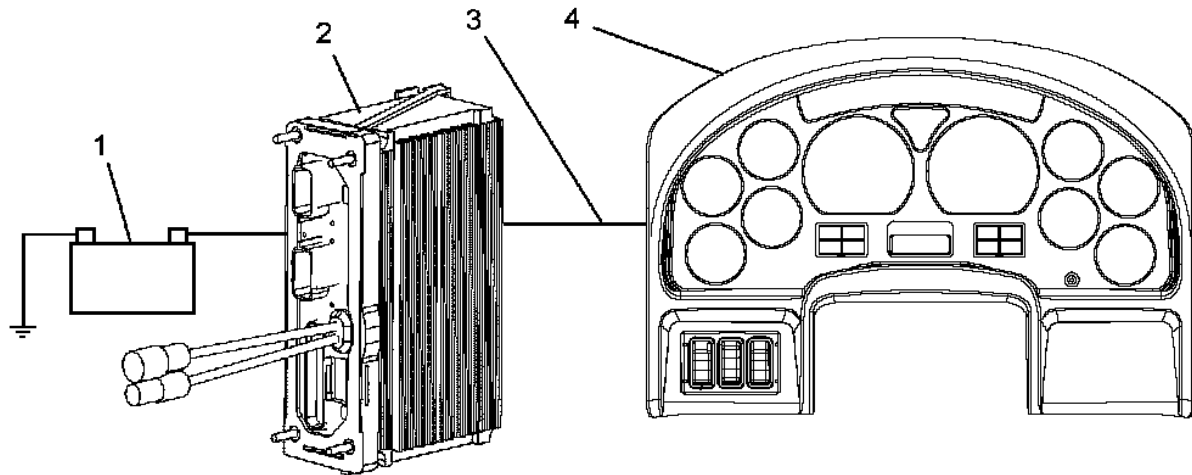
The light will illuminate when the output from the alternator is incorrect.

The light will go out when the output from the alternator is corrected.



## 4.24. VOLTMETER

### Circuit Function



**Figure 107 Voltmeter Function Diagram**

1. BATTERY
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information for the voltmeter is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on the system voltage.

**Assuming the gauge swept at gauge sweep. Check gauge with service tool (EZ-Tech®). If gauge responds to service tool (EZ-Tech®), data is not being transmitted from the ESC.**

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

A problem with the data link will demonstrate several problems on the EGC, as well as a diagnostic trouble code. If other gauges are not operating correctly, the problem is not isolated to the voltmeter inputs.

A gauge with an incorrect reading may be the result of incorrect programming, an incorrect jumper connection between the EGC circuit board and the gauge or a problem in the sensor circuitry for that gauge. The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 52 Voltmeter Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the gauge operate correctly during gauge sweep?	Gauge sweeps from minimum to maximum and back.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for Voltmeter gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 204)  Read display on odometer.	Voltmeter gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.	Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.	Gauge responds to "Diamond Logic Builder™" diagnostic input.	If gauge responds to diagnostic tool, but does not work during normal operations, replace the ESC.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board.
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)				

**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.

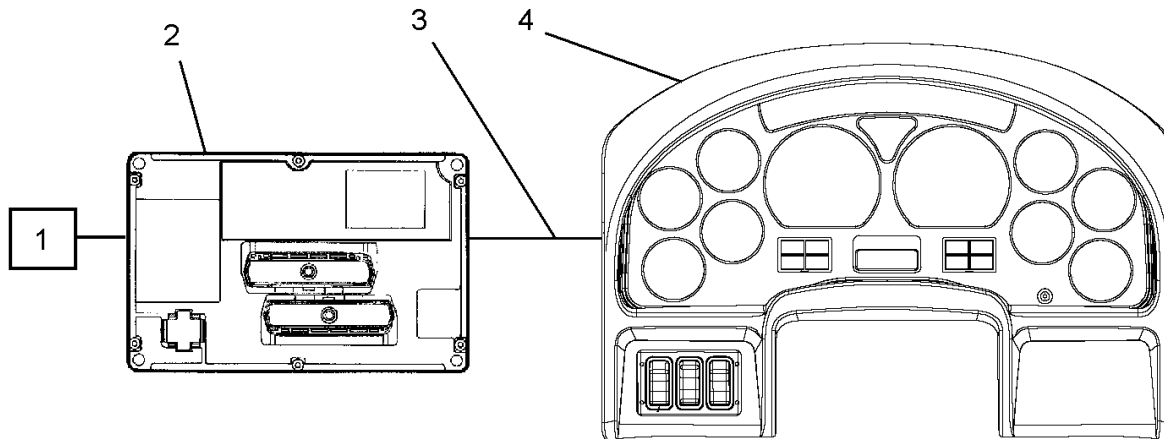
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 53 Voltmeter Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 109 3 (EGC Version 8.7)	EGC gauge location 9 (Voltmeter) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 109 4 (EGC Version 8.7)	EGC gauge location 9 (Voltmeter) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 109 5 (EGC Version 8.7)	EGC gauge location 9 (Voltmeter) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 109 6 (EGC Version 8.7)	EGC gauge location 9 (Voltmeter) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 109 5 or 2023 14 209 5 (EGC Version 9.3 and later)	EGC gauge location 9 (volts) sensor fault to primary EGC (109) or secondary EGC (209)  There is a problem with the sensor that provides the data for this gauge.
2023 14 109 6 or 2023 14 209 6 (EGC Version 9.3 and later)	EGC gauge location 9 (volts) data unavailable to primary EGC (109) or secondary EGC (209)  The data that this gauge displays should be, but is not available at this time.
2023 14 109 7 or 2023 14 209 7 (EGC Version 9.3 and later)	EGC gauge location 9 (volts) data missing to primary EGC (109) or secondary EGC (209)  The data for this gauge is not being transmitted on the datalink.

## 4.25. ENGINE COOLANT TEMPERATURE GAUGE

### Circuit Function



**Figure 108 Engine Coolant Temperature Gauge Function Diagram**

1. ENGINE COOLANT TEMPERATURE SENSOR
2. ELECTRONIC ENGINE CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information for the engine coolant temperature gauge is provided on the drivetrain 1939 data link from the engine controller. The engine controller generates this information based on input from a sensor on the engine.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

A problem with the data link will demonstrate several problems on the EGC, as well as a diagnostic trouble code. If other gauges are not operating correctly, the problem is not isolated to the engine coolant temperature gauge inputs.

See the engine diagnostic manual for detailed information on troubleshooting problems with the engine coolant temperature sensor circuits.

Problems with the engine coolant temperature gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the engine controller, a problem with the engine coolant temperature sensor or a problem with wiring to the sensor.

The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 54 Engine Coolant Temperature Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the gauge operate correctly during gauge sweep?	Gauge sweeps from minimum to maximum and back.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for Engine Coolant Temperature gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 207)  Read display on odometer.	Engine Coolant Temperature gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.	Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.	Gauge responds to "Diamond Logic Builder™" diagnostic input.	If gauge responds to diagnostic tool, but does not work during normal operations, replace the ESC.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board.
5.	Engine coolant temperature message is not being generated by the engine controller. Refer to the applicable engine troubleshooting manual for this vehicle.				
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)				

### 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.

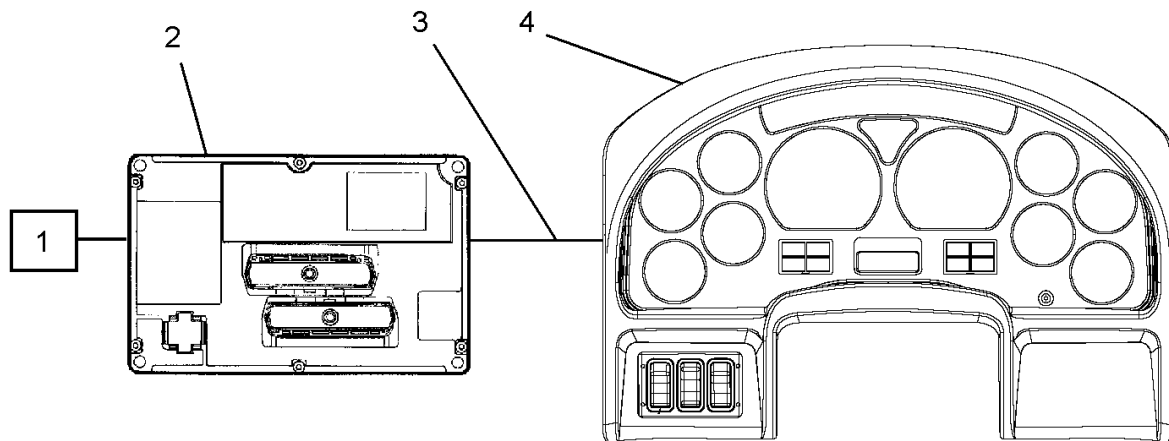
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 55 Engine Coolant Temperature Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 103 3 (EGC Version 8.7)	EGC gauge location 3 (Engine Coolant Temperature) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 103 4 (EGC Version 8.7)	EGC gauge location 3 (Engine Coolant Temperature) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 103 5 (EGC Version 8.7)	EGC gauge location 3 (Engine Coolant Temperature) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 103 6 (EGC Version 8.7)	EGC gauge location 3 (Engine Coolant Temperature) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 103 5 or 2023 14 203 5 (EGC Version 9.3 and later)	Engine Coolant Temperature sensor fault to primary EGC (103) or secondary EGC (203)  There is a problem with the sensor that provides the data for this gauge.
2023 14 103 6 or 2023 14 203 6 (EGC Version 9.3 and later)	Engine Coolant Temperature gauge data unavailable to primary EGC (103) or secondary EGC (203)  The data that this gauge displays should be, but is not available at this time.
2023 14 103 7 or 2023 14 203 7 (EGC Version 9.3 and later)	Engine Coolant Temperature gauge data missing to primary EGC (103) or secondary EGC (203)  The data for this gauge is not being transmitted on the datalink.

## 4.26. ENGINE OIL PRESSURE GAUGE

### Circuit Function



**Figure 109 Engine Oil Pressure Gauge Function Diagram**

1. ENGINE OIL PRESSURE SENSOR
2. ELECTRONIC ENGINE CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the engine oil pressure gauge is provided on the Drivetrain 1939 data link from the engine controller. The engine controller generates this information based on signals from sensors on the engine.

### Diagnostics

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

A problem with the data link will demonstrate several problems on the EGC, as well as a diagnostic trouble code. If other gauges are not operating correctly, the problem is not isolated to the engine oil pressure gauge inputs.

See the engine diagnostic manual for detailed information on troubleshooting problems with the engine coolant temperature inputs.

Problems with the engine oil pressure gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the engine controller, a problem with the engine oil pressure sensor or a problem with wiring to the sensor.

The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 56 Engine Oil Pressure Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the gauge operate correctly during gauge sweep?	Gauge sweeps from minimum to maximum and back.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for Engine Oil Pressure gauge diagnostic trouble codes.  Read display on odometer.	Engine Oil Pressure gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.	Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.	Gauge responds to "Diamond Logic Builder™" diagnostic input.	If gauge responds to diagnostic tool, but does not work during normal operations, replace the ESC.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board.
5.	Engine oil pressure message is not being generated by the engine controller. Refer to the applicable engine troubleshooting manual for this vehicle.				
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)				

### 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.



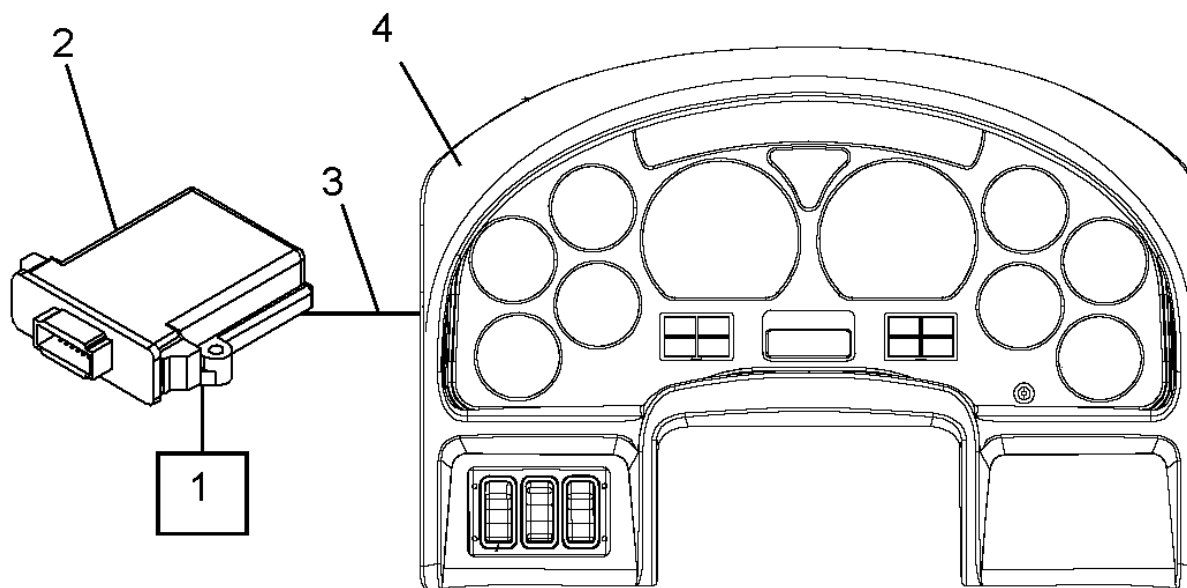
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 57 Engine Oil Pressure Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 105 3 (EGC Version 8.7)	EGC gauge location 5 (Engine Oil Pressure) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 105 4 (EGC Version 8.7)	EGC gauge location 5 (Engine Oil Pressure)) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 105 5 (EGC Version 8.7)	EGC gauge location 5 (Engine Oil Pressure) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 105 6 (EGC Version 8.7)	EGC gauge location 5 (Engine Oil Pressure) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 105 5 or 2023 14 205 5 (EGC Version 9.3 and later)	Engine Oil Pressure sensor fault to primary EGC (105) or secondary EGC (205)  There is a problem with the sensor that provides the data for this gauge.
2023 14 105 6 or 2023 14 205 6 (EGC Version 9.3 and later)	Engine Oil Pressure gauge data unavailable to primary EGC (105) or secondary EGC (205)  The data that this gauge displays should be, but is not available at this time.
2023 14 105 7 or 2023 14 205 7 (EGC Version 9.3 and later)	Engine Oil Pressure gauge data missing to primary EGC (105) or secondary EGC (205)  The data for this gauge is not being transmitted on the datalink.

## 4.27. PYROMETER GAUGE

### Circuit Function



**Figure 110 Pyrometer Gauge Function Diagram**

1. PYROMETER SENSOR
2. PYROMETER/AMMETER MODULE
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the pyrometer gauge is provided on the Drivetrain 1939 data link from the pyrometer/ammeter module (PAM). The module generates this information based on signals from sensors on the exhaust system.

### Diagnostics

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

A gauge with an incorrect reading may be due to incorrect programming, an incorrect jumper connection between the EGC circuit board and the gauge or a problem in the sensor circuitry for that gauge. The following procedures will provide guidance for determining why the gauge is malfunctioning.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

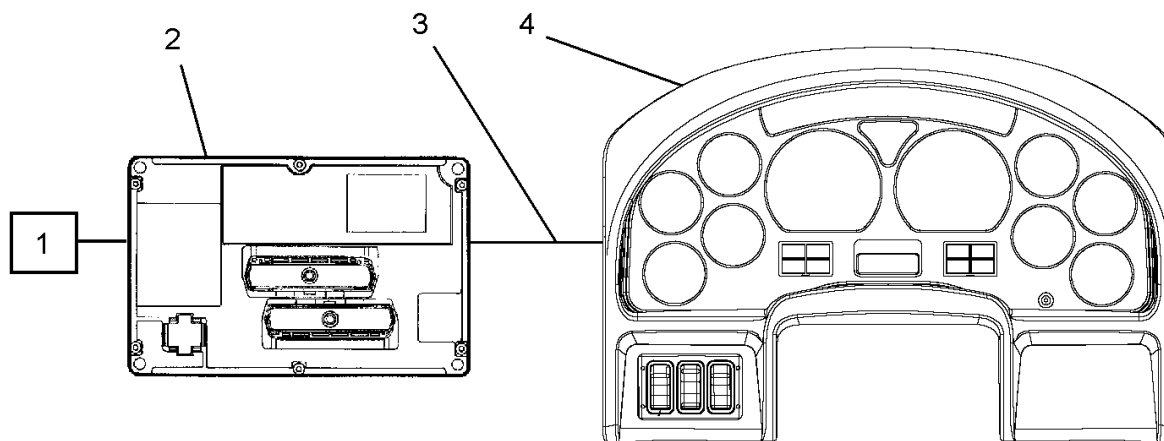
Problems with the pyrometer gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem with the pyrometer module, a problem with the sensor or a problem with wiring to the sensor.

Table 58 Pyrometer Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the pyrometer gauge operate during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness . If problem persists, replace EGC or AGSP circuit board.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
3.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install.page 256
4.	Troubleshoot pyrometer module and sensor inputs. Refer to the Pyrometer/ Ammeter Module (PAM) section of this manual. (See PYROMETER/AMMETER MODULE (PAM), page 487)					

## 4.28. SPEEDOMETER

### Circuit Function



**Figure 111 Speedometer Function Diagram**

1. VEHICLE SPEED SIGNAL (VSS)
2. ELECTRONIC ENGINE CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the speedometer is provided on the Drivetrain 1939 data link from the engine controller. The engine controller generates this information based on the vehicle speed signal from a sensor on the transmission or from the transmission control module.

### Diagnostics

If the speedometer goes to zero, sweeps up to 50% and returns to zero three times, there is a sensor error.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

A problem with the data link will demonstrate several problems on the EGC, as well as a diagnostic trouble code. If other gauges are not operating correctly, the problem is not isolated to the speedometer inputs.

Problems with the speedometer can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, a loss of programming, a problem in the engine controller or missing signal from the vehicle speed sensor (VSS) or transmission controller.

The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 59** Speedometer Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the gauge operate correctly during gauge sweep?	Gauge sweeps from minimum to maximum and back.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board.
2.	On	Check for Speedometer gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 215)  Read display on odometer.	Speedometer gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.	Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.	Gauge responds to "Diamond Logic Builder™" diagnostic input.	If gauge responds to diagnostic tool, but does not work during normal operations, replace the ESC.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board. Refer to Remove & Install, page 256
5.	Speedometer signal is not being transmitted from the engine controller. Refer to the applicable engine troubleshooting manual for this vehicle. Also refer to the appropriate transmission troubleshooting manual. Manual transmissions use the traditional vehicle speed sensor (VSS). Automatic transmissions transmit the signal from the transmission ECU.				
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)				

**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.

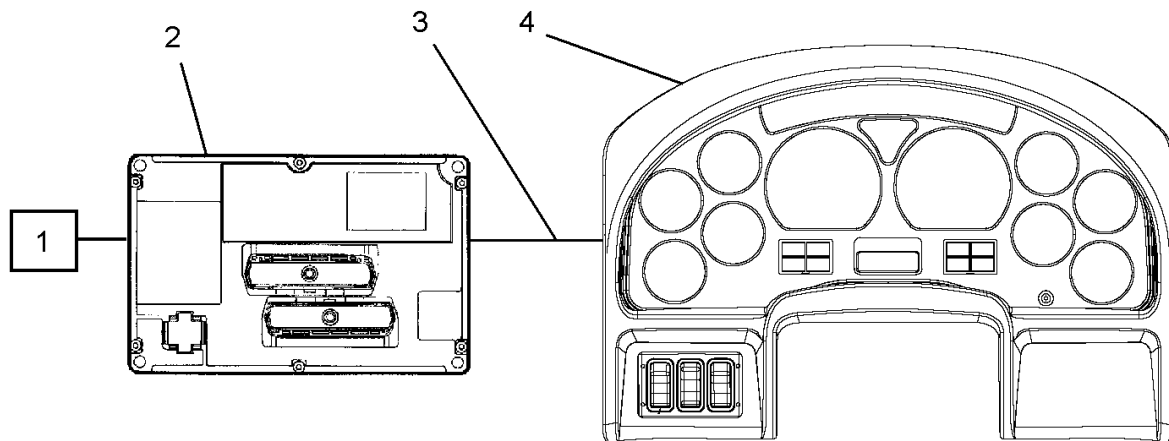
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 60** Speedometer Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 102 3 (EGC Version 8.7)	EGC gauge location 2 (Speedometer) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 102 4 (EGC Version 8.7)	EGC gauge location 2 (Speedometer) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 102 5 (EGC Version 8.7)	EGC gauge location 2 (Speedometer) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 102 6 (EGC Version 8.7)	EGC gauge location 2 (Speedometer) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 102 5 or 2023 14 202 5 (EGC Version 9.3 and later)	Speedometer sensor fault to primary EGC (102) or secondary EGC (202)  There is a problem with the sensor that provides the data for this gauge.
2023 14 102 6 or 2023 14 202 6 (EGC Version 9.3 and later)	Speedometer gauge data unavailable to primary EGC (102) or secondary EGC (202)  The data that this gauge displays should be, but is not available at this time.
2023 14 102 7 or 2023 14 202 7 (EGC Version 9.3 and later)	Speedometer gauge data missing to primary EGC (102) or secondary EGC (202)  The data for this gauge is not being transmitted on the datalink.

## 4.29. TACHOMETER

### Circuit Function



**Figure 112 Tachometer Function Diagram**

1. TACHOMETER SENSOR
2. ELECTRONIC ENGINE CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the tachometer is provided on the Drivetrain 1939 data link from the engine controller.

### Diagnostics

If the tachometer goes to zero, sweeps up to 50% and returns to zero three times, there is a sensor error.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

A problem with the data link will demonstrate several problems on the EGC, as well as a diagnostic trouble code. If other gauges are not operating correctly, the problem is not isolated to the tachometer inputs.

Problems with the tachometer can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, a loss of programming, a problem in the engine controller, a problem with the engine tachometer sensor or a problem with wiring to the sensor.

The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 61 Tachometer Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the gauge operate correctly during gauge sweep?	Gauge sweeps from minimum to maximum and back.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for Tachometer gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 218)  Read display on odometer.	Tachometer gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.	Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.	Gauge responds to "Diamond Logic Builder™" diagnostic input.	If gauge responds to diagnostic tool, but does not work during normal operations, replace the ESC.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board. Refer to Remove & Install.page 256
5.	Tachometer signal is not being transmitted from the engine controller. Refer to the applicable engine troubleshooting manual for this vehicle.				
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)				

**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.



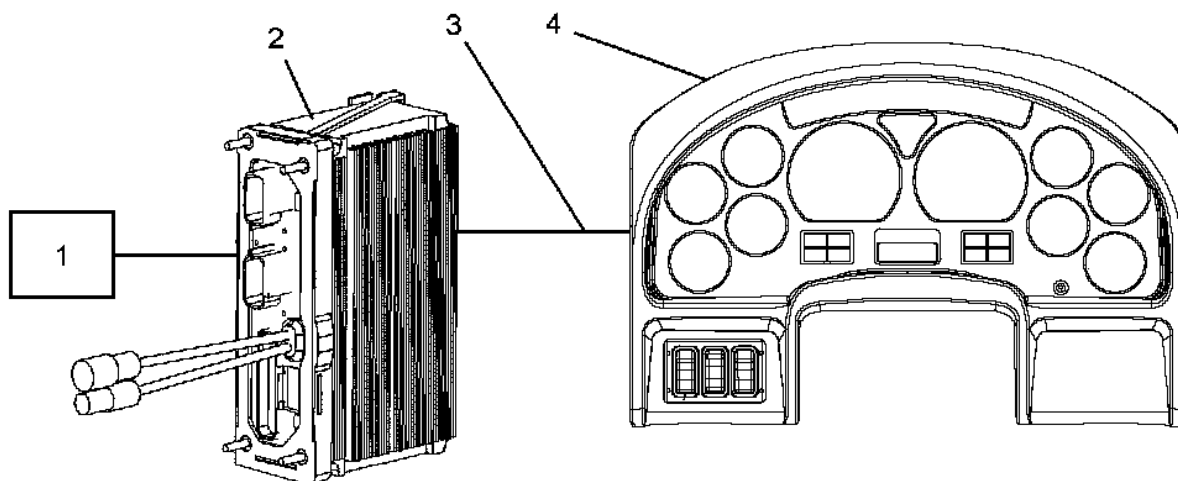
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

**Table 62 Tachometer Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
1705 14 101 3 (EGC Version 8.7)	EGC gauge location 1 (Tachometer) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 101 4 (EGC Version 8.7)	EGC gauge location 1 (Tachometer) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 101 5 (EGC Version 8.7)	EGC gauge location 1 (Tachometer) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 101 6 (EGC Version 8.7)	EGC gauge location 1 (Tachometer) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 101 5 or 2023 14 201 5 (EGC Version 9.3 and later)	Tachometer sensor fault to primary EGC (101) or secondary EGC (201)  There is a problem with the sensor that provides the data for this gauge.
2023 14 101 6 or 2023 14 201 6 (EGC Version 9.3 and later)	Tachometer gauge data unavailable to primary EGC (101) or secondary EGC (201)  The data that this gauge displays should be, but is not available at this time.
2023 14 101 7 or 2023 14 201 7 (EGC Version 9.3 and later)	Tachometer gauge data missing to primary EGC (101) or secondary EGC (201)  The data for this gauge is not being transmitted on the datalink.

## 4.30. FUEL LEVEL GAUGE

### Circuit Function



**Figure 113 Fuel Level Gauge Function Diagram**

1. FUEL LEVEL SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the fuel level gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from the fuel level sensor.

### Diagnostics

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

Problems with the fuel level gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the ESC, a problem with the fuel level sensor or a problem with wiring to the sensor. The following procedures will provide guidance for determining why the gauge is malfunctioning.

**Table 63 Fuel Level Gauge Preliminary Check**

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the fuel level gauge operate during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for fuel level gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 221)	Read display on odometer.	Fuel level gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 223)	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install.page 256
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)					

**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 64 Fuel Level Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 23 1	Storage tank, fuel level sensor out of range low  This code is associated with a short to ground on the fuel level sensor on the storage tank for dual tank vehicles.  Short to ground
612 14 23 2	Storage tank, fuel level sensor out of range high  This code is associated with a short to accessory or open circuit on the fuel level sensor on the storage tank for dual tank vehicles.  Shorted high or open circuit
612 14 25 1	Draw tank, fuel level sensor out of range low  This code is associated with a short to ground on the fuel level sensor on the draw tank for both single tank and dual tank vehicles.  Short to ground
612 14 25 1	Draw tank, fuel level sensor out of range high  This code is associated with a short to accessory or open circuit on the fuel level sensor on the draw tank for both single tank and dual tank vehicles.  Shorted high or open circuit
1705 14 107 3 (EGC Version 8.7)	EGC gauge location 7 (fuel level) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 107 4 (EGC Version 8.7)	EGC gauge location 7 (fuel level) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 107 5 (EGC Version 8.7)	EGC gauge location 7 (fuel level) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 107 6 (EGC Version 8.7)	EGC gauge location 7 (fuel level) data unavailable  The data that this gauge displays should be, but is not available at this time.

**Table 64 Fuel Level Gauge Diagnostic Trouble Codes (cont.)**

2023 14 107 5 or 2023 14 207 5 (EGC Version 9.3 and later)	Fuel gauge sensor fault to primary EGC (107) or secondary EGC (207)  There is a problem with the sensor that provides the data for this gauge.
2023 14 107 6 or 2023 14 207 6 (EGC Version 9.3 and later)	Fuel gauge data unavailable to primary EGC (107) or secondary EGC (207)  The data that this gauge displays should be, but is not available at this time.
2023 14 107 7 or 2023 14 207 7 (EGC Version 9.3 and later)	Fuel gauge data missing to primary EGC (107) or secondary EGC (207)  The data for this gauge is not being transmitted on the datalink.

**Fault Detection/ Management**

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

A fault in the fuel sensor circuits will be apparent when the fuel gauge points straight down. Fuel sensor diagnostic trouble codes will also be present.

Problems in sensor circuits could be the result of open or shorted sensors, open circuits, shorted circuits, or a failure in the ESC.

Refer to Fuel Sensor Circuits.

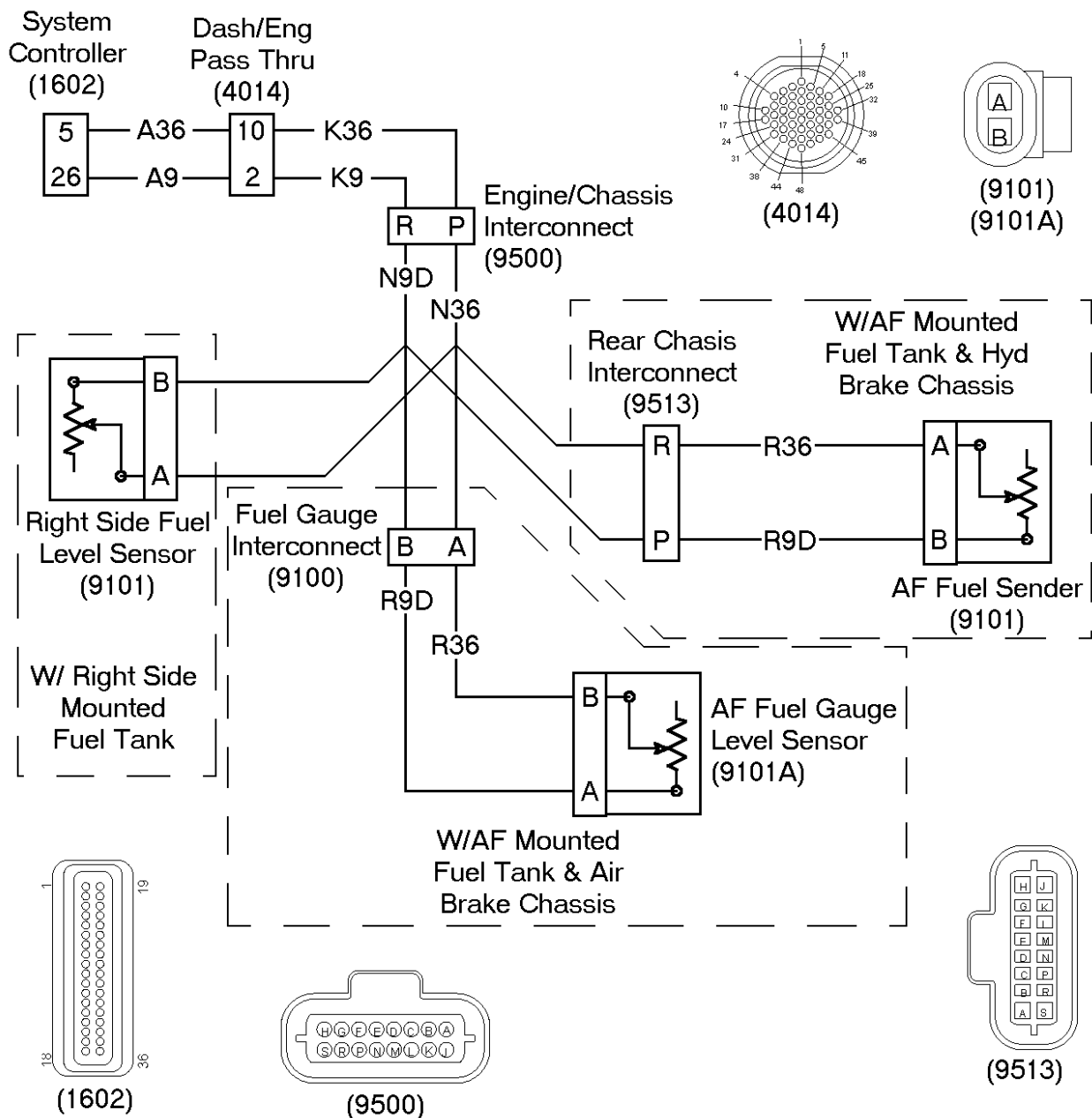


Figure 114 Fuel Sensor Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information

- (1602) SYSTEM CONTROLLER  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (4014) DASH/ENGINE PASS THRU  
LOCATED AT INSIDE LEFT SIDE DASH PANEL
- (9100) FUEL GAUGE INTERCONNECT  
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND HCU
- (9101) AF FUEL SENDER  
LOCATED AT REAR MOUNTED FUEL TANK
- (9101) RIGHT SIDE FUEL GAUGE LEVEL SENSOR  
LOCATED AT OUTSIDE RIGHT FRAME RAIL
- (9500) ENGINE/CHASSIS INTERCONNECT  
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND ENGINE
- (9513) REAR CHASSIS INTERCONNECT  
LOCATED AT INSIDE LEFT FRAME RAIL BEHIND HCU

**Table 65 Fuel Level Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 23 1	Storage tank, fuel level sensor out of range low  This code is associated with a short to ground on the fuel level sensor on the storage tank for dual tank vehicles.  Short to ground
612 14 23 2	Storage tank, fuel level sensor out of range high  This code is associated with a short to accessory or open circuit on the fuel level sensor on the storage tank for dual tank vehicles.  Shorted high or open circuit
612 14 25 1	Draw tank, fuel level sensor out of range low  This code is associated with a short to ground on the fuel level sensor on the draw tank for both single tank and dual tank vehicles.  Short to ground
612 14 25 1	Draw tank, fuel level sensor out of range high  This code is associated with a short to accessory or open circuit on the fuel level sensor on the draw tank for both single tank and dual tank vehicles.  Shorted high or open circuit
1705 14 107 3 (EGC Version 8.7)	EGC gauge location 7 (fuel level) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.

**Table 65 Fuel Level Gauge Diagnostic Trouble Codes (cont.)**

1705 14 107 4 (EGC Version 8.7)	EGC gauge location 7 (fuel level) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 107 5 (EGC Version 8.7)	EGC gauge location 7 (fuel level) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 107 6 (EGC Version 8.7)	EGC gauge location 7 (fuel level) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 107 5 or 2023 14 207 5 (EGC Version 9.3 and later)	Fuel gauge sensor fault to primary EGC (107) or secondary EGC (207)  There is a problem with the sensor that provides the data for this gauge.
2023 14 107 6 or 2023 14 207 6 (EGC Version 9.3 and later)	Fuel gauge data unavailable to primary EGC (107) or secondary EGC (207)  The data that this gauge displays should be, but is not available at this time.
2023 14 107 7 or 2023 14 207 7 (EGC Version 9.3 and later)	Fuel gauge data missing to primary EGC (107) or secondary EGC (207)  The data for this gauge is not being transmitted on the datalink.

**Table 66 Fuel Level Gauge Tests**

Fuel Level Gauge Voltage Checks		
Check with ignition on and fuel level sensor disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
(9100) and (9101) cavity A or (9513) cavity R to ground.	10 ± 1 volts	If voltage is missing, check for open or shorts in circuit N36, K36 or A36 to ESC connector (1602) cavity 5.  If circuits check good, check for missing 10 volt signal from ESC.
(9100) and (9101) cavity A to B or (9513) cavity R to P.	10 ± 1 volts	If voltage is present replace or repair fuel sensor.  If voltage is missing, check for open in circuits N9D, K9, or A9 to ESC connector (1602) cavity 26.



**Table 66 Fuel Level Gauge Tests (cont.)**

<b>Fuel Level Gauge Voltage Checks</b>		
Check with ignition on and fuel level sensor disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
		If circuits check good, check for missing zero volt reference from ESC.

**Extended Description**

A zero volt reference signal from ESC connector (1602) terminal 26 is supplied to fuel sensor connector (9100), (9101) terminal B or (9513) terminal P through circuit A9, Dash/Engine Pass Thru (4014), circuit K9, Engine/Chassis Interconnect (9500), and circuit N9D.

The signal from the fuel sensor is supplied from fuel sensor connector (9100), (9101) terminal A or (9513) terminal R to ESC connector (1602) terminal 5 through circuit N36, Engine/Chassis Interconnect (9500) terminal P, circuit K36, Dash/Engine Pass Thru (4010), and circuit A36.

## Component Locations

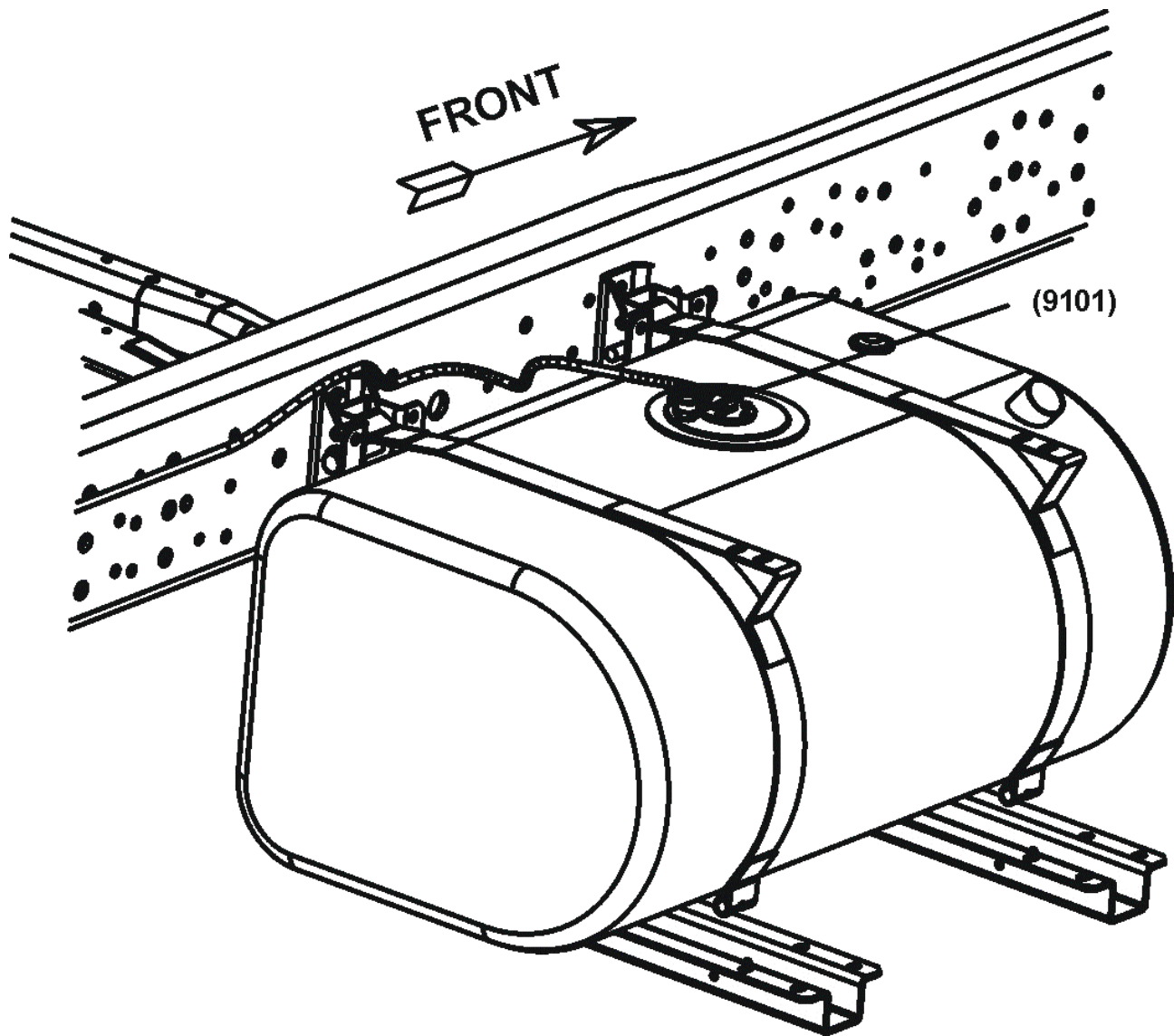
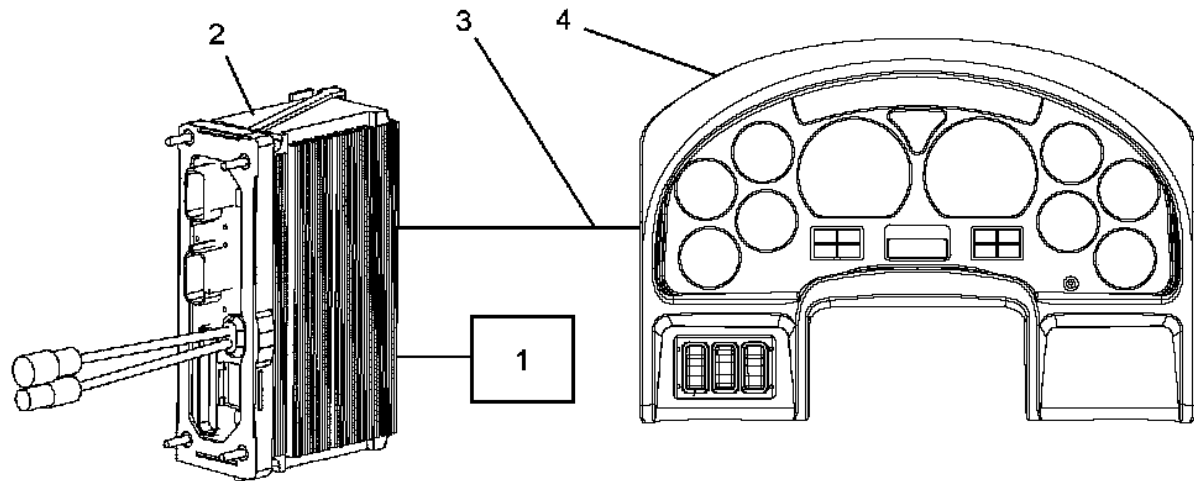


Figure 115 Fuel Sensor Connector Locations (Right Side Mount Fuel Tank Shown)

(9101) FUEL LEVEL SENSOR CONNECTOR

### 4.31. PRIMARY AIR PRESSURE GAUGE

#### Circuit Functions



**Figure 116 Primary Air Pressure Gauge Function Diagram**

1. PRIMARY AIR PRESSURE SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the primary air pressure gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a transducer connected to the air line.

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

#### Diagnostics

Problems with the primary air pressure gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the ESC, a problem with the air brake application transducer or a problem with wiring to the sensor.

**Table 67 Primary Air Pressure Gauge Preliminary Check**

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the primary air pressure gauge perform during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness. If problem persists, replace EGC circuit board. Refer to Remove & Install, page 256

**Table 67 Primary Air Pressure Gauge Preliminary Check (cont.)**

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	On	Check for primary air pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 230)	Read display on odometer.	Primary air pressure gauge diagnostic trouble codes are active.	Go to fault detection management.	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install. page 256
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)					

**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 68 Primary Air Pressure Gauge Diagnostic Trouble Codes**

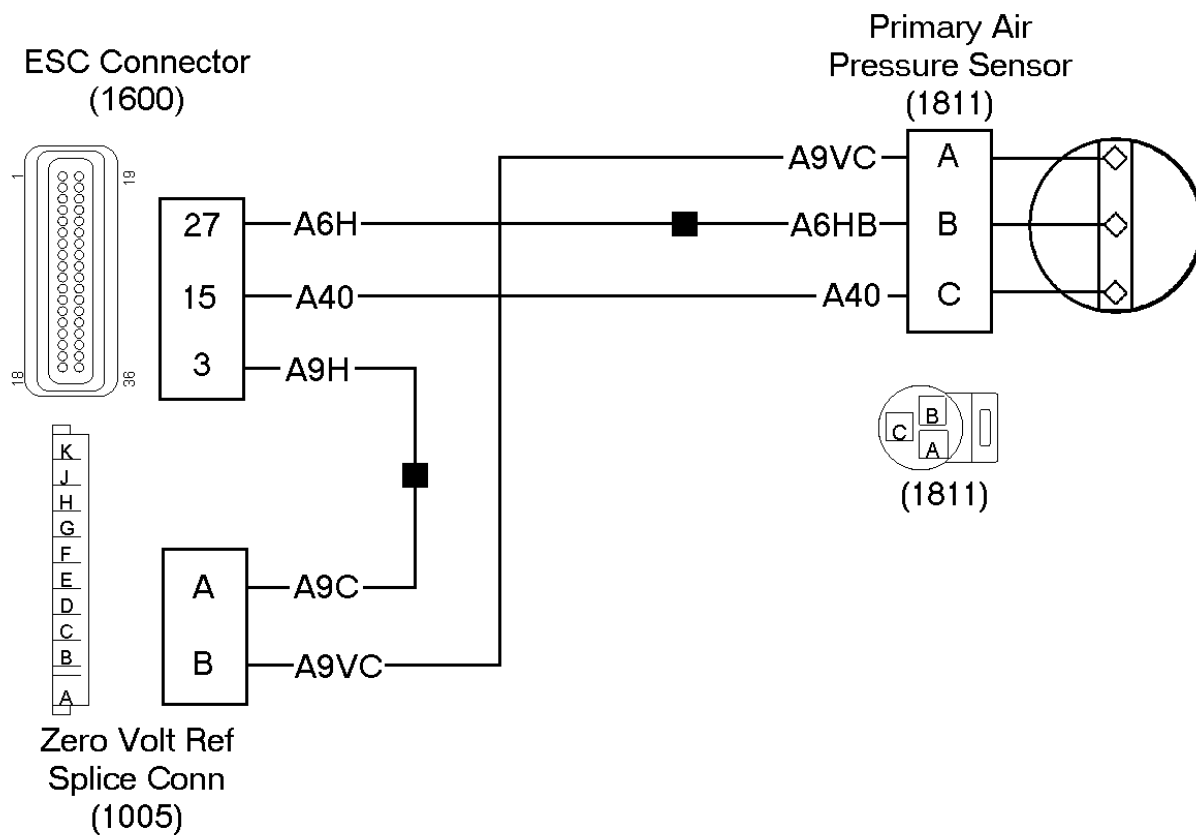
DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 4 1	Primary air sensor/ auxiliary air sensor out of range low Short to ground, open circuit or missing 5 volts from ESC
612 14 4 2	Primary air sensor/ auxiliary air sensor out of range high Shorted high
1705 14 108 3 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) out of range high Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 108 4 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) out of range low Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 108 5 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) sensor fault There is a problem with the sensor that provides the data for this gauge.
1705 14 108 6 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) data unavailable The data that this gauge displays should be, but is not available at this time.
2023 14 108 5 or 2023 14 208 5 (EGC Version 9.3 and later)	Primary air pressure gauge sensor fault to primary EGC (108) or secondary EGC (208) There is a problem with the sensor that provides the data for this gauge.
2023 14 108 6 or 2023 14 208 6 (EGC Version 9.3 and later)	Primary air pressure gauge data unavailable to primary EGC (108) or secondary EGC (208) The data that this gauge displays should be, but is not available at this time.
2023 14 108 7 or 2023 14 208 7 (EGC Version 9.3 and later)	Primary air pressure gauge data missing to primary EGC (108) or secondary EGC (208) The data for this gauge is not being transmitted on the datalink.

**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 "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

Refer to Primary Air Pressure Transducer Circuits.



**Figure 117 Primary Air Pressure Transducer Circuits — Always Refer To Circuit Diagram Book For Latest Circuit Information**

- (1005) ZERO VOLT REF SPLICE CONN  
LOCATED RIGHT SIDE INSTRUMENT PANEL
- (1600) SYSTEM CONTROLLER  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (1811) PRIMARY AIR PRESSURE SENSOR  
LOCATED NEAR BRAKE PEDAL

Table 69 Primary Air Pressure Gauge Tests

Diagnostic Trouble Codes	
612 14 4 1	Primary Air Pressure out of range low
612 14 4 2	Short to ground, open circuit or missing 5 volts from ESC
	Primary Air Pressure out of range high
1705 14 108 3 (EGC Version 8.7)	Shorted to high.
	EGC gauge location 8 (primary air pressure) out of range high Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 108 4 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) out of range low
	Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 108 5 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) sensor fault
	There is a problem with the sensor that provides the data for this gauge.
1705 14 108 6 (EGC Version 8.7)	EGC gauge location 8 (primary air pressure) data unavailable
	The data that this gauge displays should be, but is not available at this time.
2023 14 108 5 or 2023 14 208 5 (EGC Version 9.3 and later)	Primary air pressure gauge sensor fault to primary EGC (108) or secondary EGC (208)
	There is a problem with the sensor that provides the data for this gauge.

Table 69 Primary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
2023 14 108 6 or 2023 14 208 6 (EGC Version 9.3 and later)	Primary air pressure gauge data unavailable to primary EGC (108) or secondary EGC (208)	
	The data that this gauge displays should be, but is not available at this time.	
2023 14 108 7 or 2023 14 208 7 (EGC Version 9.3 and later)	Primary air pressure gauge data missing to primary EGC (108) or secondary EGC (208)	
	The data for this gauge is not being transmitted on the datalink.	
Primary Air Pressure Gauge Voltage Checks		
Check with ignition on and (1811) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals.		
NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(1811) cavity B to ground.	5 ± 0.5 volts	If voltage is missing, check for open or shorts in circuit A6HB, or A6H to ESC connector (1600) cavity 27.
		If circuits check good, check for missing 5 volt signal from ESC.



Table 69 Primary Air Pressure Gauge Tests (cont.)

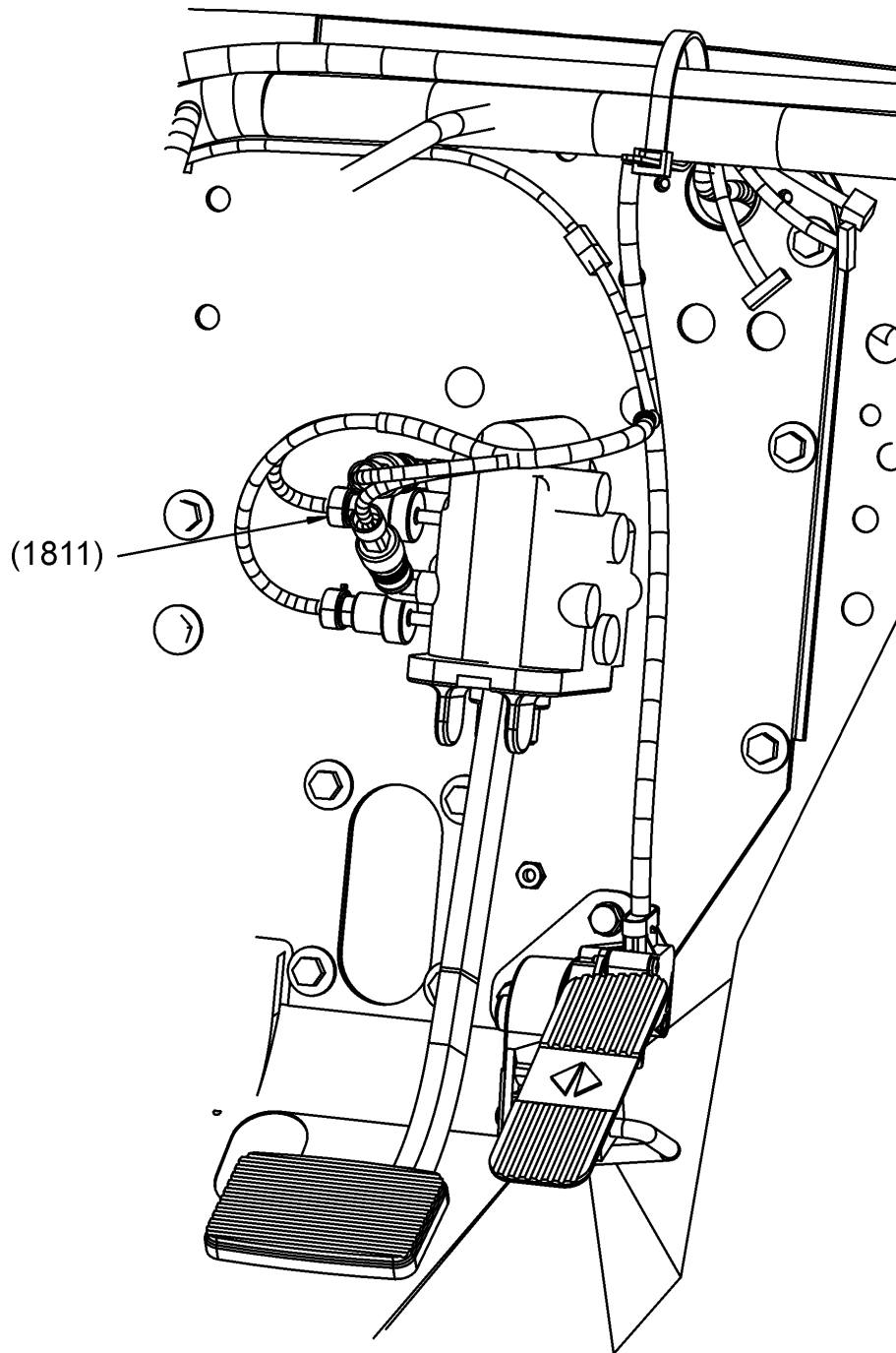
Diagnostic Trouble Codes		
(1811) cavity B to cavity A.	5 ± 0.5 volts	<p>If voltage is missing, check for open in circuit A9VC to zero volt reference splice connector (1005) or A9C and A9H to ESC connector (1600) cavity 3.</p> <p>If circuits check good, check for missing zero volt reference from ESC.</p>
(1811) cavity B to cavity C.	5 ± 0.5 volts	<p>If voltage is incorrect, check for open or short to voltage in circuit A40 to ESC connector (1600) cavity 15.</p> <p>If voltage is present, circuits to transducer are good. Replace transducer</p>

**Extended Description**

The 5 volt sensor supply signal is supplied to primary air pressure transducer connector (1811) pin B from ESC connector (1600) pin 27.

The zero volt reference signal is supplied to air brake application transducer connector (1811) pin A from the zero volt reference splice connector (1005) terminal B. The zero volt reference splice connector (1005) is supplied a zero volt signal on terminal A from ESC connector (1600) pin 3.

The pressure transducer acts like a potentiometer. The transducer will provide a voltage to ESC connector (1600) pin 15, which will vary with changes in applied pressure.

**Component Locations****Figure 118 Primary Air Gauge Transducer Location (Steering Column Support View)**

(1811) PRIMARY AIR PRESSURE SENSOR

4.32. SECONDARY AIR PRESSURE GAUGE

Circuit Function

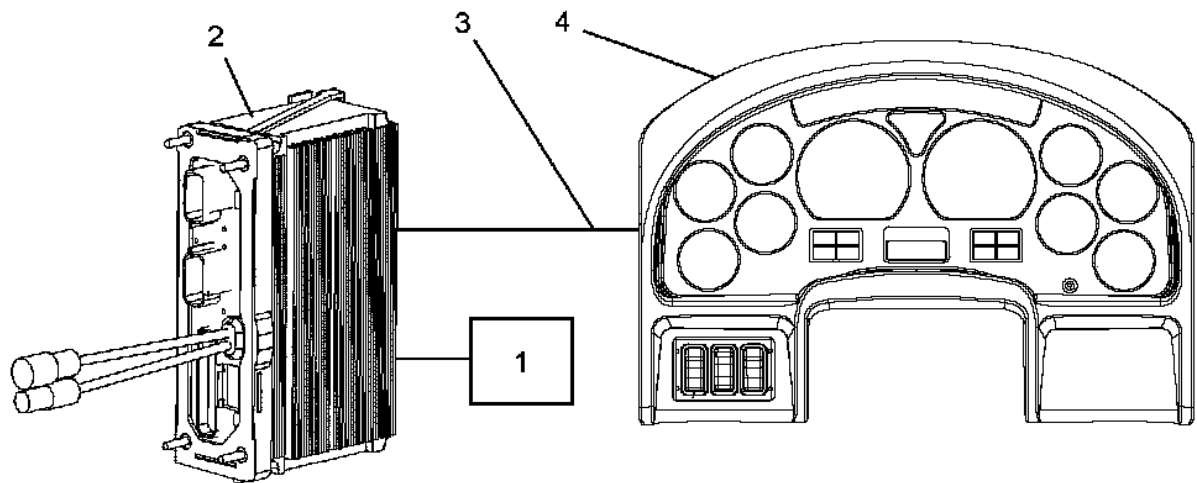


Figure 119 Secondary Air Pressure Gauge Function Diagram

- 1. SECONDARY AIR PRESSURE SENSOR
- 2. ELECTRICAL SYSTEM CONTROLLER
- 3. DRIVE TRAIN 1939 DATA LINK
- 4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the secondary air pressure gauge is provided on the drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a transducer connected to the air line.

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

Diagnostics

Problems with the secondary air pressure gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the ESC, a problem with the air brake application transducer or a problem with wiring to the sensor.

Table 70 Secondary Air Pressure Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the secondary air pressure gauge perform during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness . If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256

**Table 70 Secondary Air Pressure Gauge Preliminary Check (cont.)**

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	On	Check for secondary air pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 239)	Read display on odometer.	Secondary air pressure gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 240)	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install, page 256
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)					

**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 71 Secondary Air Pressure Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 3 1	Secondary Air Pressure out of range low  Short to ground, open circuit or missing 5 volts from ESC
612 14 3 2	Secondary Air Pressure out of range high  Shorted high
1705 14 110 3 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 110 4 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 110 5 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 110 6 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 110 5 or 2023 14 210 5 (EGC Version 9.3 and later)	Secondary air pressure gauge sensor fault to primary EGC (110) or secondary EGC (210)  There is a problem with the sensor that provides the data for this gauge.
2023 14 110 6 or 2023 14 210 6 (EGC Version 9.3 and later)	Secondary air pressure gauge data unavailable to primary EGC (110) or secondary EGC (210)  The data that this gauge displays should be, but is not available at this time.
2023 14 110 7 or 2023 14 210 7 (EGC Version 9.3 and later)	Secondary air pressure gauge data missing to primary EGC (110) or secondary EGC (210)  The data for this gauge is not being transmitted on the datalink.

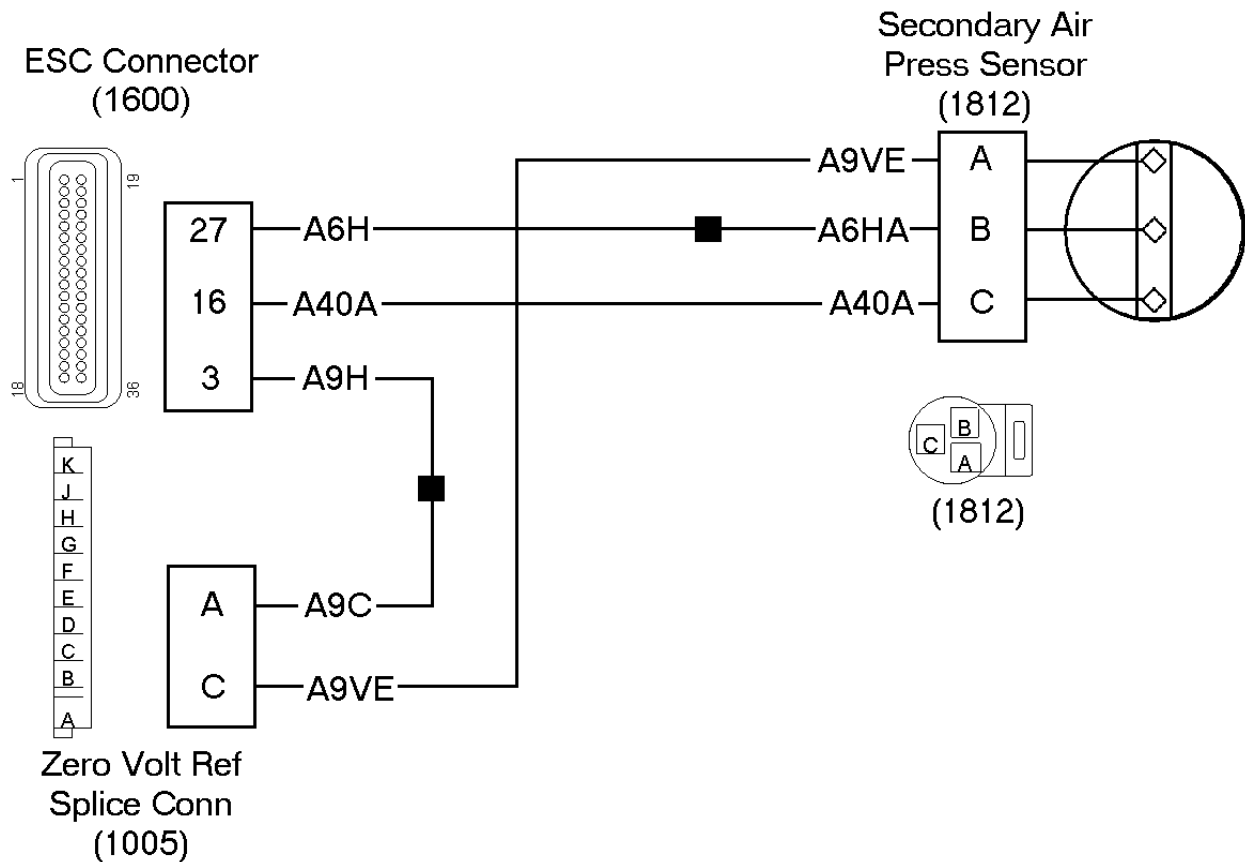
**Fault Detection/ Management**

**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 pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

Refer to Secondary Air Pressure Transducer Circuits.



**Figure 120 Secondary Air Pressure Transducer Circuits — Always Refer To Circuit Diagram Book For Latest Circuit Information**

- (1005) ZERO VOLT REF SPLICE CONNECTOR  
LOCATED RIGHT SIDE INSTRUMENT PANEL
- (1600) SYSTEM CONTROLLER  
LOCATED AT INSIDE RIGHT SIDE DASH PANEL
- (1812) SECONDARY AIR PRESSURE SENSOR  
LOCATED NEAR BRAKE PEDAL

Table 72 Secondary Air Pressure Gauge Tests

Diagnostic Trouble Codes	
612 14 3 1	Secondary Air Pressure out of range low
	Short to ground, open circuit or missing 5 volts from ESC
612 14 3 2	Secondary Air Pressure out of range high
	Shorted to high
1705 14 110 3 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) out of range high  Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
1705 14 110 4 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) out of range low  Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
1705 14 110 5 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) sensor fault  There is a problem with the sensor that provides the data for this gauge.
1705 14 110 6 (EGC Version 8.7)	EGC gauge location 10 (secondary air pressure) data unavailable  The data that this gauge displays should be, but is not available at this time.
2023 14 110 5 or 2023 14 210 5 (EGC Version 9.3 and later)	Secondary air pressure gauge sensor fault to primary EGC (110) or secondary EGC (210)  There is a problem with the sensor that provides the data for this gauge.



Table 72 Secondary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
2023 14 110 6 or 2023 14 210 6 (EGC Version 9.3 and later)	Secondary air pressure gauge data unavailable to primary EGC (110) or secondary EGC (210)	The data that this gauge displays should be, but is not available at this time.
2023 14 110 7 or 2023 14 210 7 (EGC Version 9.3 and later)	Secondary air pressure gauge data missing to primary EGC (110) or secondary EGC (210)	The data for this gauge is not being transmitted on the datalink.
<b>Secondary Air Pressure Gauge Voltage Checks</b> Check with ignition on and (1812) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
<b>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</b>		
Test Points	Spec.	Comments
(1812) cavity B to ground.	5 ± 0.5 volts	If voltage is missing, check for open or shorts in circuits A6HA, or A6H to ESC connector (1600) cavity 27.  If circuits check good, check for missing 5 volt signal from ESC.

Table 72 Secondary Air Pressure Gauge Tests (cont.)

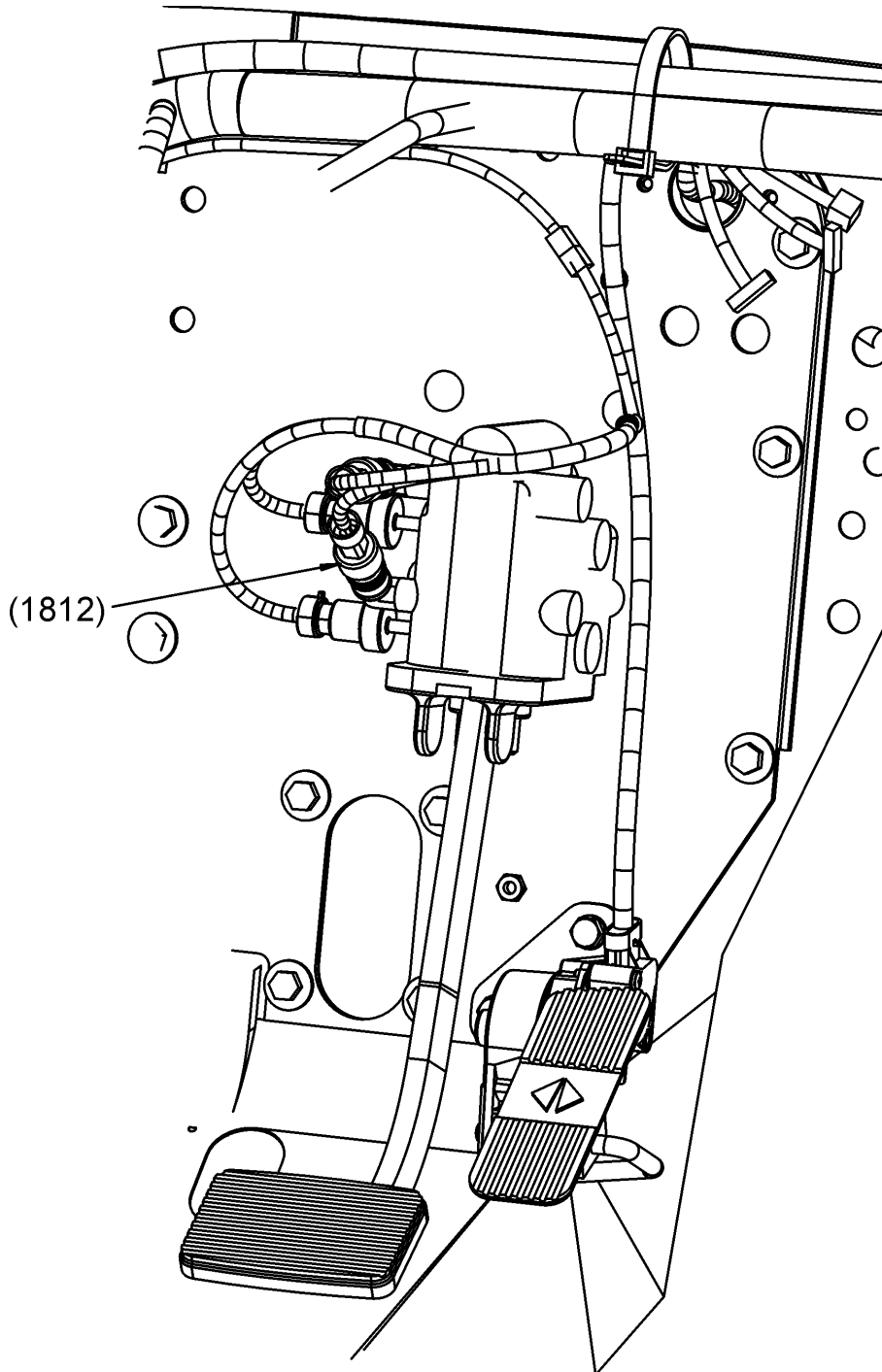
Diagnostic Trouble Codes		
(1812) cavity B to cavity A.	5 ± 0.5 volts	If voltage is missing, check for open in circuit A9EC to zero volt reference splice connector (1005) or A9C and A9H to ESC connector (1600) cavity 3.  If circuits check good, check for missing zero volt reference from ESC.
(1812) cavity B to cavity C.	5 ± 0.5 volts	If voltage is incorrect, check for open or short to voltage in circuit A40A to ESC connector (1600) cavity 16.  If voltage is present, circuits to transducer are good. Replace transducer

**Extended Description**

The 5 volt sensor supply signal is supplied to primary air pressure transducer connector (1812) pin B from ESC connector (1600) pin 27.

The zero volt reference signal is supplied to air brake application transducer connector (1812) pin A from the zero volt reference splice connector (1005) terminal C. The zero volt reference splice connector (1005) is supplied a zero volt signal on terminal A from ESC connector (1600) pin 3.

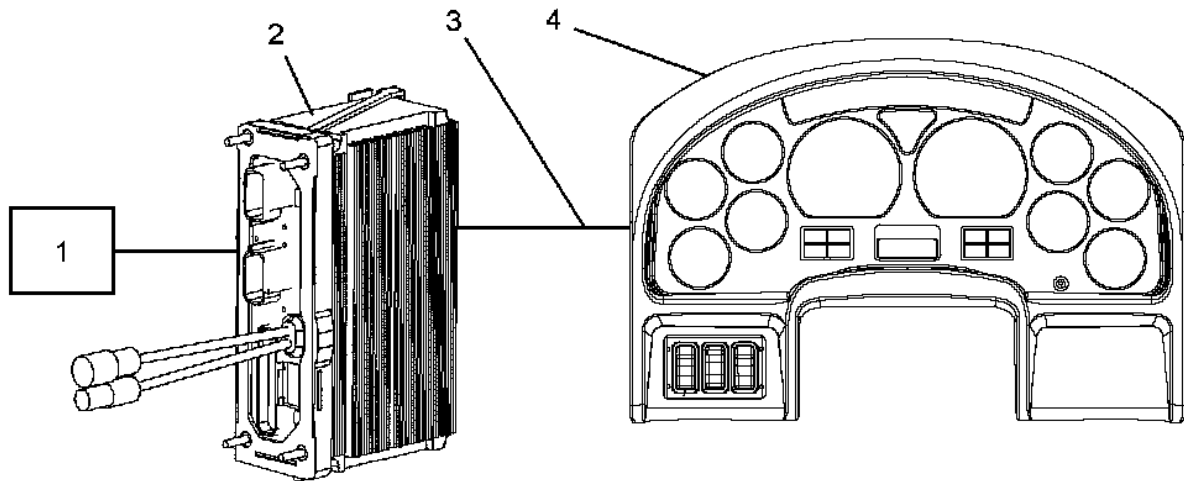
The pressure transducer acts like a potentiometer. The transducer will provide a voltage to ESC connector (1600) pin 16, which will vary with changes in applied pressure.

**Component Locations**

**Figure 121 Secondary Air Pressure Gauge Transducer Location (Steering Column Support View)**  
(1812) SECONDARY AIR PRESSURE SENSOR

### 4.33. BOOST PRESSURE GAUGE

#### Circuit Function



**Figure 122 Boost Pressure Gauge Function Diagram**

1. BOOST PRESSURE SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the boost pressure gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a sensor connected to the turbo charger.

#### Diagnostics

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

Problems with the turbo boost pressure gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the ESC, a problem with the boost sensor or a problem with wiring to the sensor.

**Table 73 Boost Pressure Gauge Preliminary Check**

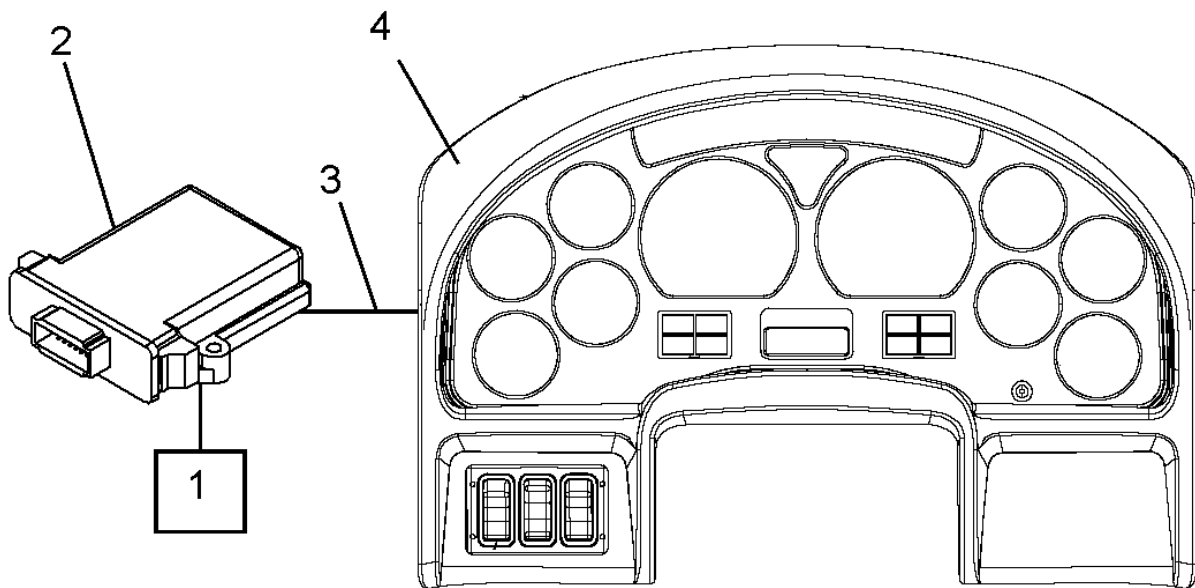
STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the turbo boost gauge operate during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness . If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256

**Table 73 Boost Pressure Gauge Preliminary Check (cont.)**

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
3.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install.page 256
4.	Consider replacing ESC. (See ESC REPLACEMENT, page 117)					

### 4.34. AMMETER GAUGE

#### Circuit Function



**Figure 123 Ammeter Gauge Diagram**

1. AMMETER SENSE CIRCUITS
2. PYROMETER/AMMETER MODULE (PAM)
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the ammeter gauge is provided on the Drivetrain 1939 data link from the pyrometer/ammeter module (PAM).

The PAM senses current flow from the negative battery stud to the starter ground stud.

Two ammeter gauges are used and the ranges are, -150/+150 amps and the -300/+300 amps high resolution.

#### Diagnostics

The pointer in a small gauge, pointing to the six o'clock position, indicates that there is a sensor error for that gauge. A gauge pointing to 10 o'clock is connected to an unprogrammed connector on the EGC circuit board.

The service tool (EZ-Tech®) running the "Diamond Logic Builder™" diagnostic software can be used to check operation of the gauge.

Problems with the ammeter gauge can be caused by a malfunctioning gauge, a malfunction in EGC circuitry, an incorrect connection inside the EGC, a loss of programming, a problem in the ammeter module or a problem with wiring to and from the module.

**Table 74** Ammeter Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the ammeter gauge operate during the gauge sweep?		Gauge performs during gauge sweep.	Go to next step.	Replace gauge and check jumper harness . If problem persists, replace EGC circuit board. Refer to Remove & Install.page 256
2.	On	Check for ammeter gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 250)	Read display on odometer.	Ammeter gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 251)	Go to next step.
3.	Off/On	Connect diagnostic tool (EZ-Tech®) to the diagnostic connector. Turn key to accessory position. Start the "ICAP" programming software. Verify gauge and gauge inputs are programmed correctly.		Gauge and gauge inputs are programmed correctly.	Go to next step.	Program the gauge with the "ICAP" software. Refer to the ICAP programming software manual for details.
4.	On	Attempt to exercise the gauge with the "Diamond Logic Builder™" diagnostic software.		Gauge responds to "Diamond Logic Builder™" diagnostic input.	Go to next step.	Insure gauge operates during gauge sweep. Insure jumper harness between gauge and circuit board is in correct location. If jumper is correct, replace EGC circuit board. Refer to Remove & Install.page 256
5.	Troubleshoot pyrometer module and sensor inputs. Pyrometer/ Ammeter Module (PAM). (See PYROMETER/AMMETER MODULE (PAM), page 487)					

**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 75    Ammeter Gauge Diagnostic Trouble Codes**

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
639 14 82 254	Pyrometer Ammeter not communicating to the ESC.
TBD	Ammeter Gauge out of range low Short to ground, open circuit or missing 5 volts from ESC
TBD	Ammeter Gauge out of range high Shorted high

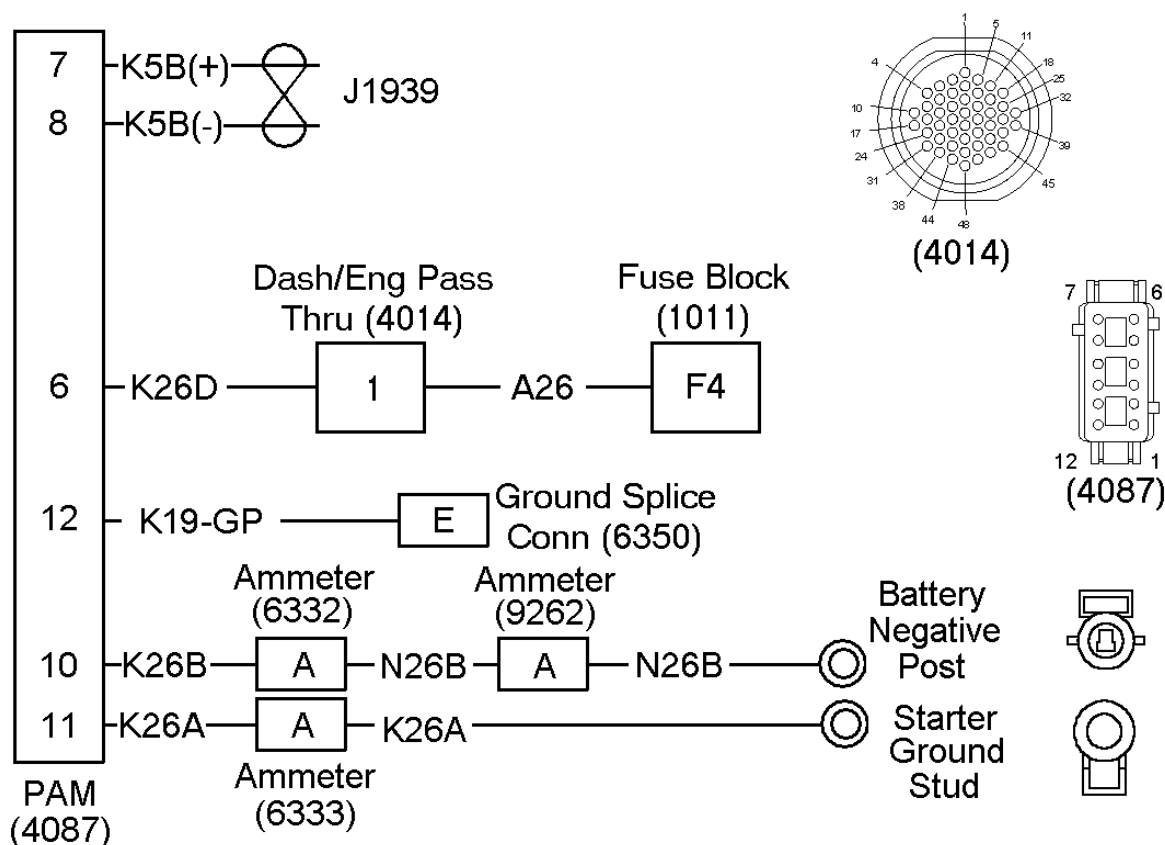
#### **Fault Detection/ Management**

**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 short in the ammeter gauge circuits will be apparent when the ammeter gauge points straight down. Pyrometer/Ammeter Module diagnostic trouble codes are not available.

Problems in ammeter circuits could be the result of open or shorted gauge, open circuits, shorted circuits, a failure in the ESC or a problem with the PAM.

Refer to Pyrometer/Ammeter Module Circuits.



**Figure 124 Pyrometer/Ammeter Module Circuits — Always Refer to Circuit Diagram Book for Latest Circuit Information**

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

Table 76 Pyrometer/Ammeter Module Tests

Pyrometer/Ammeter Module Voltage Checks		
Check with ignition on and PAM connector (4087) disconnected.		
<b>NOTE – Always check connectors for damage and pushed-out terminals.</b>		
Test Points	Spec.	Comments
(4087) cavity 6 to ground.	12 ± 1.5 volts	If voltage is missing, check for open 5A fuse F4 in fuse block (1011). Also check for open or shorts in circuit K26D, or A26.
(4087) cavity 6 to cavity 12.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K19–GP to ground splice (6350).
(4087) cavity 6 to cavity 10.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K26B, N26B or N26B.
(4087) cavity 6 to cavity 11.	12 ± 1.5 volts	If voltage is missing, check for open in circuit K26A.  If all voltages are present, circuits to PAM are good. Replace PAM.

### 4.35. AUDIBLE ALARM

#### Circuit Function

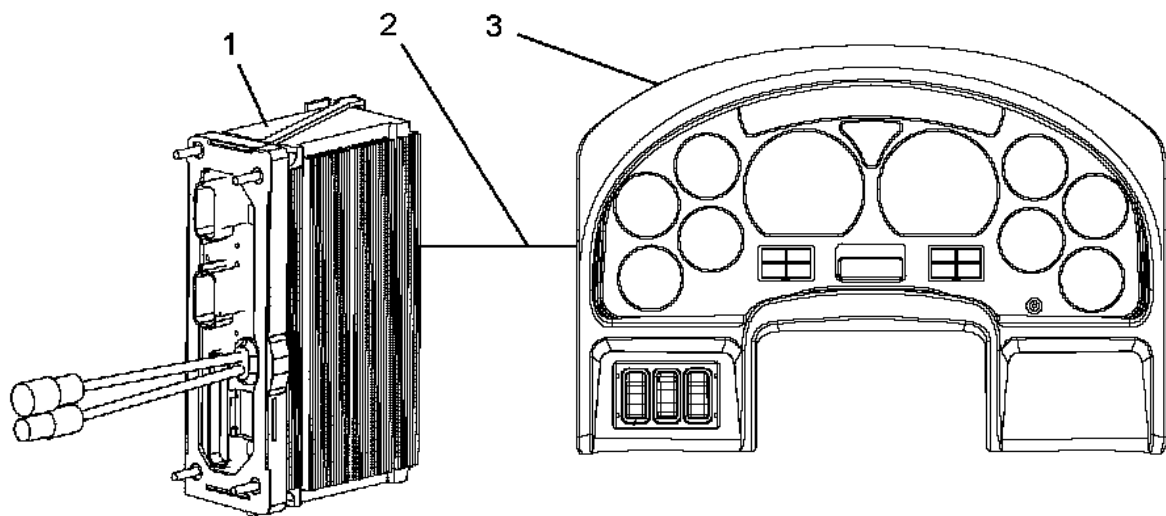


Figure 125 Audible Alarm Function Diagram

1. ELECTRICAL SYSTEM CONTROLLER
2. DRIVE TRAIN 1939 DATA LINK
3. ELECTRONIC GAUGE CLUSTER (EGC)

The audible alarm is controlled by the EGC.

The EGC will activate the alarm based on the data communicated on the Drivetrain 1939 data link from the ESC and the engine controller.

Diagnostics

An inoperative alarm can be caused by a malfunctioning alarm or a malfunction in EGC circuitry.

Table 77 Audible Alarm Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Test alarm by disconnecting fuel sender connector.	Alarm operates.	Alarm is working.	Replace the alarm. If problem persists, replace circuit board.

4.36. SELECT/RESET SWITCH

Circuit Function

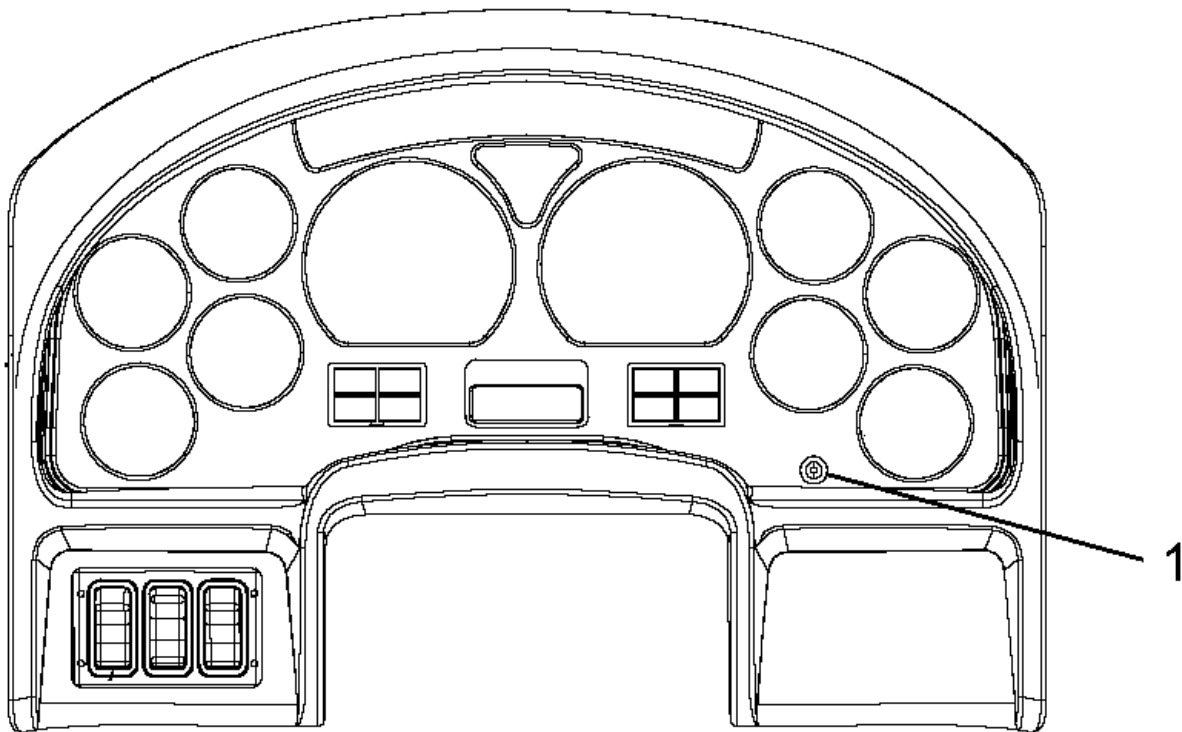


Figure 126 Select/Reset Switch Function Diagram

1. SELECT/RESET SWITCH

The Select/Reset switch controls the digital display.

The switch allows the user to select modes within each major functional area of the display and perform reset functions. Each time the switch is momentarily depressed it will scan through a different mode. Depressing the

switch for three seconds or more will clear the display or toggle between options depending upon the current mode. The reset function has no effect if the parameter cannot be reset.

### Diagnostics

Problems with the Select/Reset switch can be caused by a faulty switch, loose connection between the switch and the circuit board, or a faulty circuit board.

**Table 78 Select/Reset Switch Preliminary Check**

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify operation of the switch by observing odometer display while pushing button.	Display changes when button is pushed.	Switch is working correctly.	Go to next step.
2.	Off	Remove the Select/Reset switch and test with an ohmmeter.	Switch contacts should close while switch is pushed.	Replace circuit board.	Replace the Select/Reset switch. Refer to Remove & Install.page 256

### Fault Detection/ Management

A fault with Select/Reset switch operation will be apparent if the odometer display does not change when the button is pushed.

Check continuity through switch while button it is pressed.

If continuity is good replace circuit board.

If there is no continuity, replace switch.

### 4.37. HEAD LAMP/PARK LAMP SWITCH

See Headlight System in the Light Section of this manual. (See HEADLIGHT SYSTEM, page 552)

### 4.38. PANEL LIGHT SWITCH

See Panel Light in the Light Section of this manual. (See PANEL LIGHTS, page 568)

### 4.39. DIGITAL DISPLAY

#### Circuit Function

The EGC has an integral liquid crystal display (LCD).

The three lines of the digital display provide a PRNDL display, a numeric display, and a line to indicate the mode of the display.

### Diagnostics

Problems with the digital display can be caused by loose connections between the display and the circuit board, a failed display or a failed EGC circuit board.

**Table 79** Digital Display Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	During the gauge sweep all LCD elements of the display should be activated and the backlighting should illuminate.	Display elements are active and backlights work during gauge sweep.	Digital display is working. If problems continue, replace EGC circuit board.	Replace LCD display.

## 5. REMOVE AND INSTALL

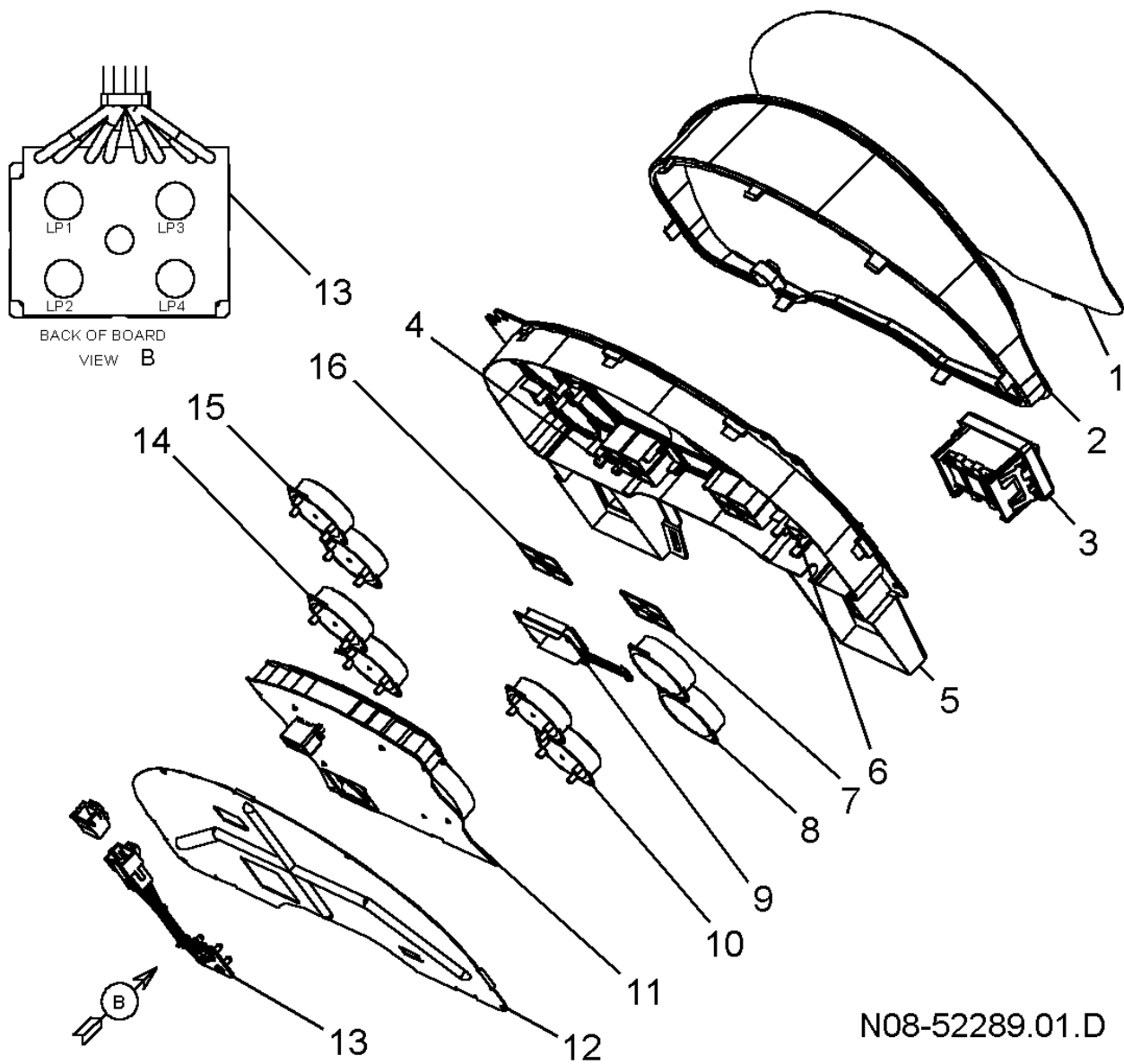


Figure 127 EGC Exploded View

1. GAUGE CLUSTER BEZEL
2. GAUGE CLUSTER SHIELD
3. 3-SWITCH PACK
4. SET/RESET SWITCH LOCATION
5. GAUGE CLUSTER HOUSING
6. BUZZER LOCATION
7. WARNING LAMP LENS
8. OPTIONAL SMALL GAUGES
9. LCD DISPLAY
10. STANDARD SMALL GAUGES
11. GAUGE CLUSTER CIRCUIT BOARD
12. GAUGE CLUSTER BACK PLATE
13. OPTIONAL (HARD WIRED) GAUGE CIRCUIT BOARD
14. STANDARD SMALL GAUGES
15. OPTIONAL SMALL GAUGES
16. OPTIONAL WARNING LAMP LENS

### 5.1. EGC FRONT BEZEL

Refer to EGC Exploded View.

Bezel removal is not required to remove or replace any other EGC components. Removal should only be required to replace a damaged bezel.

The front bezel snaps to the EGC body. To remove the bezel, remove the EGC shroud from the instrument panel. The bezel can be removed by gently pressing the seven clips on the bezel outer housing.

Installation of the bezel is accomplished by reversing the removal process.

### 5.2. REMOVE ELECTRONIC GAUGE CLUSTER

Refer to EGC Exploded View.

- A. Remove EGC shroud from instrument panel.
- B. Remove four screws which hold the EGC in place.
- C. Tilt the EGC forward to gain access to the back of the EGC.
- D. Remove the 12-way connector from the center of the EGC.
- E. Remove any additional connectors from the EGC.

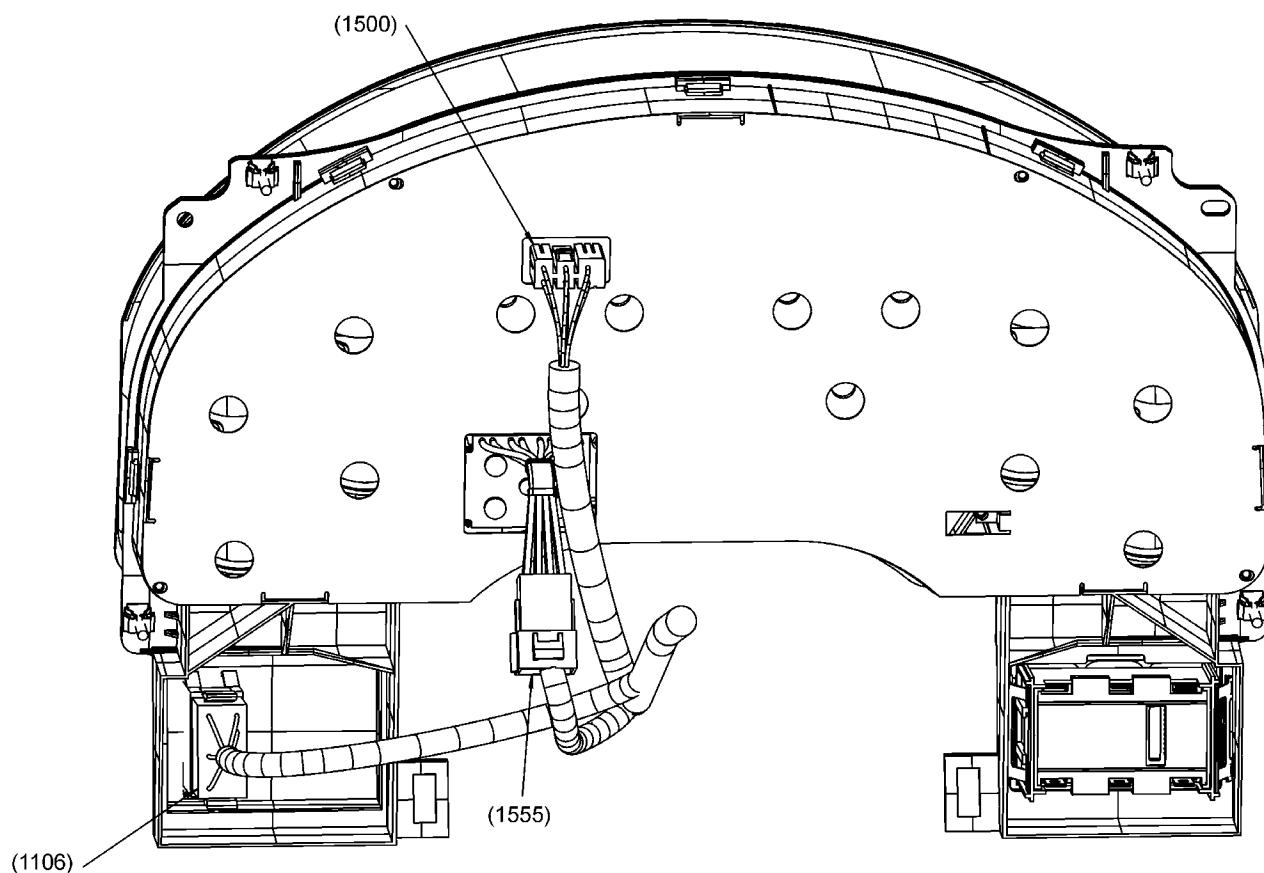
Installation of the gauge cluster is the reverse of the removal procedure.

### 5.3. FUEL, VOLTS, WATER OR ENGINE OIL GAUGES

Refer to EGC Exploded View.

The Fuel, Volts, Water and Engine Oil Gauges may be integral components of the EGC circuit board. If they are not separate gauges they can be removed and replaced by scoring the perforated line between the gauges and the main circuit board and snapping the circuit board. The replacement gauge is fastened to the EGC body with two screws and connected to the main circuit board with the supplied cable with connectors.





**Figure 128 Typical EGC Circuit Board Gauge Connector Location**

- (1106) ECONOMY SWITCH CONNECTOR
- (1500) INSTRUMENT PANEL CONNECTOR
- (1555) WARNING LIGHTS CONNECTOR

The speedometer and tachometer cannot be individually replaced. If the speedometer or tachometer fail, the entire circuit board must be replaced.

#### 5.4. OPTIONAL GAUGES

Refer to EGC Exploded View.

Refer to Typical EGC Circuit Board Gauge Connector Location.

##### Optional Gauges

- A. Remove the EGC from the instrument panel.
- B. Remove six screws holding the back cover of the EGC in place.
- C. Disconnect connectors for the optional gauge.
- D. Remove two screws holding the gauge to EGC body and remove the gauge.

Installation of the optional gauge is accomplished by reversing the removal procedure.

**NOTE –** When adding a gauge that was not previously installed in the cluster, the electrical system controller must be programmed to recognize the gauge before the gauge will function. Refer to the ICAP programming software manual for details.

### 5.5. CIRCUIT BOARD

Refer to EGC Exploded View.

- A. Remove six screws holding the back of the EGC in place.
- B. Disconnect all connectors connected to the circuit board.
- C. Remove six screws holding circuit board to EGC body.

Installation of the circuit board is accomplished by reversing the removal procedure.

**NOTE –** The replacement circuit board will not have any of the standard smaller gauges attached to it. It may be necessary to replace the smaller gauges when the circuit board is replaced.

### 5.6. LCD DISPLAY

Refer to EGC Exploded View.

- A. Remove six screws holding the back of the EGC in place.
- B. Remove the center circuit board.
- C. Remove four screws holding LCD to the EGC body and remove the display.

### 5.7. SELECT/RESET SWITCH

Refer to EGC Exploded View.

- A. Remove six screws holding the back of the EGC in place.
- B. Remove the connector for the switch from the center circuit board.
- C. Remove two screws holding the switch and remove the switch.

To install the switch, reverse the removal procedure.

### 5.8. AUDIBLE ALARM

Refer to EGC Exploded View.

- A. Remove six screws holding the back of the EGC in place.
- B. Remove the connector for the audible alarm from the center circuit board.
- C. Remove two screws holding the audible alarm and remove the alarm.

### 5.9. EGC PANEL LAMPS AND GAUGE BACKLIGHTING LAMPS

Refer to EGC Exploded View.

The EGC panel lamps are twist in lamps. To replace the lamps the failed lamp must be removed and replaced with a good lamp.

- A. Remove the EGC from the instrument panel.
- B. Remove six screws holding the back of the EGC in place and remove the back cover.
- C. Locate the failed lamp and remove it by twisting it out of the circuit board.
- D. Replace the removed lamp with a good twist in indicator lamp.

### 5.10. EGC WARNING LAMPS AND GAUGE WARNING LAMPS

Refer to EGC Exploded View.

The EGC warning lamps and warning lamps are integral parts of the EGC circuit board. To replace the lamps the failed lamp must be cut out of the circuit board and a twist in lamp must be used to replace it.

- A. Remove the EGC from the instrument panel.
- B. Remove six screws holding the back of the EGC in place and remove the back cover.
- C. Locate the failed lamp and cut it out of the circuit board.
- D. Replace the removed lamp with a twist in indicator lamp.

### 5.11. EGC SWITCH PACK

Refer to EGC Exploded View.

After the instrument panel shroud around the EGC has been removed, The EGC switch pack can be removed by using two DIN removal tools on each side of the switch pack. After the unit is removed from the cluster the connector on the switch pack may be removed. Removal may be easier if the back cover of the switch pack is removed. The back cover is removed by prying it off.

The switch pack is installed by simply reversing the removal process.

### 5.12. EGC SWITCH PACK SWITCHES

Refer to EGC Exploded View.

Switches are removed through the front of the switch pack. To remove a switch:

- A. Remove the back cover from the switch pack.
- B. Squeeze the switch release tabs, behind the switch pack.
- C. Push the switch out of the switch pack body.

To install a switch reverse the removal process.

### 5.13. EGC SWITCH PACK LAMPS

EGC switch pack lamps are accessed by removing the switch pack and the back cover of the switch pack. The lamps that are replaceable are removed by twisting the lamp and pulling it out. The backlight lamps for the headlight and dimmer switches are not replaceable. If these LED's fail, the switch pack will need to be replaced.

