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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.

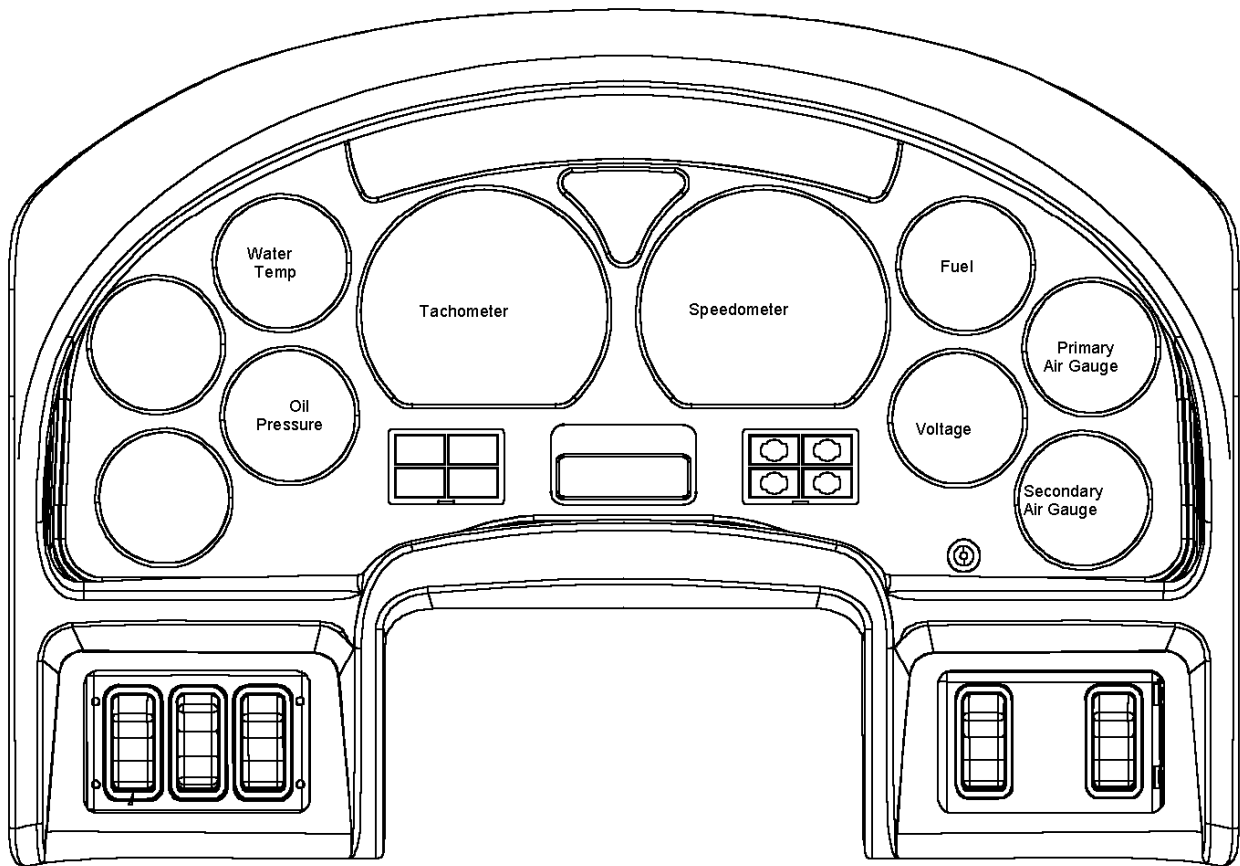


Figure 79 Electronic Gauge Cluster

The AGSP has locations for three gauges and also contains locations for 6 programmable switches.

The AGSP gauges and switches communicate with the electrical system controller (ESC) and other controllers on the Drivetrain 1939 Data Link.

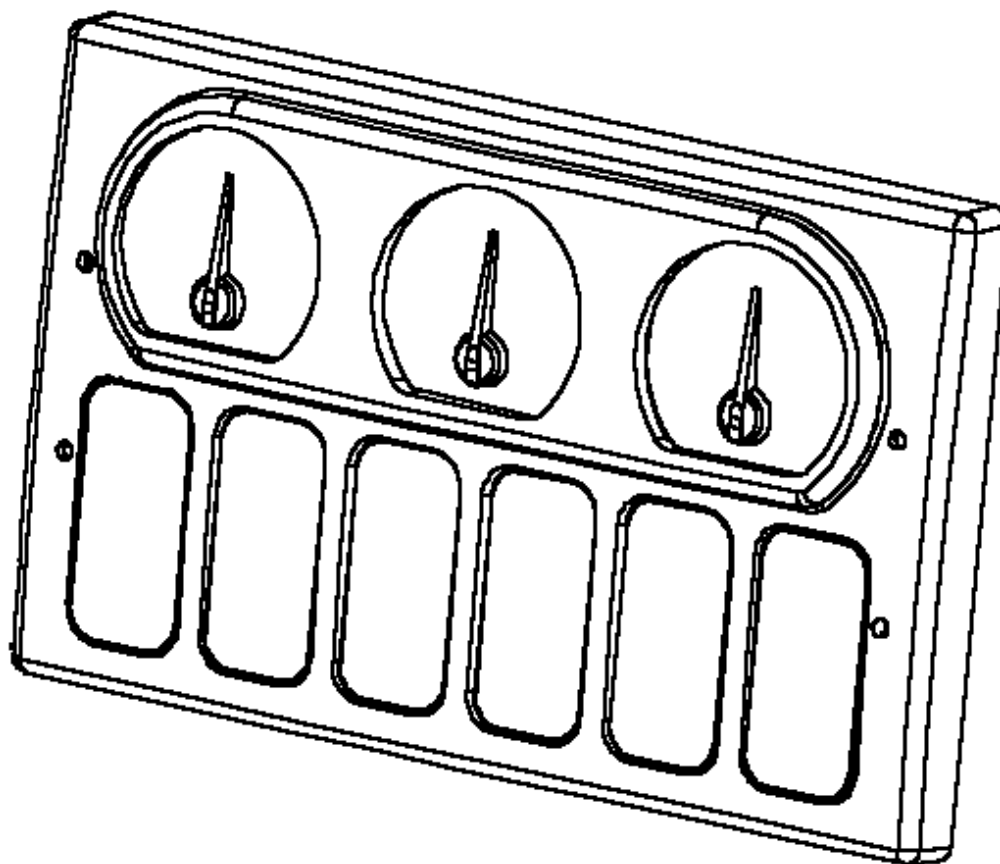


Figure 80 Auxiliary Gauge Switch Pack (AGSP)

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 or in an AGSP 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.

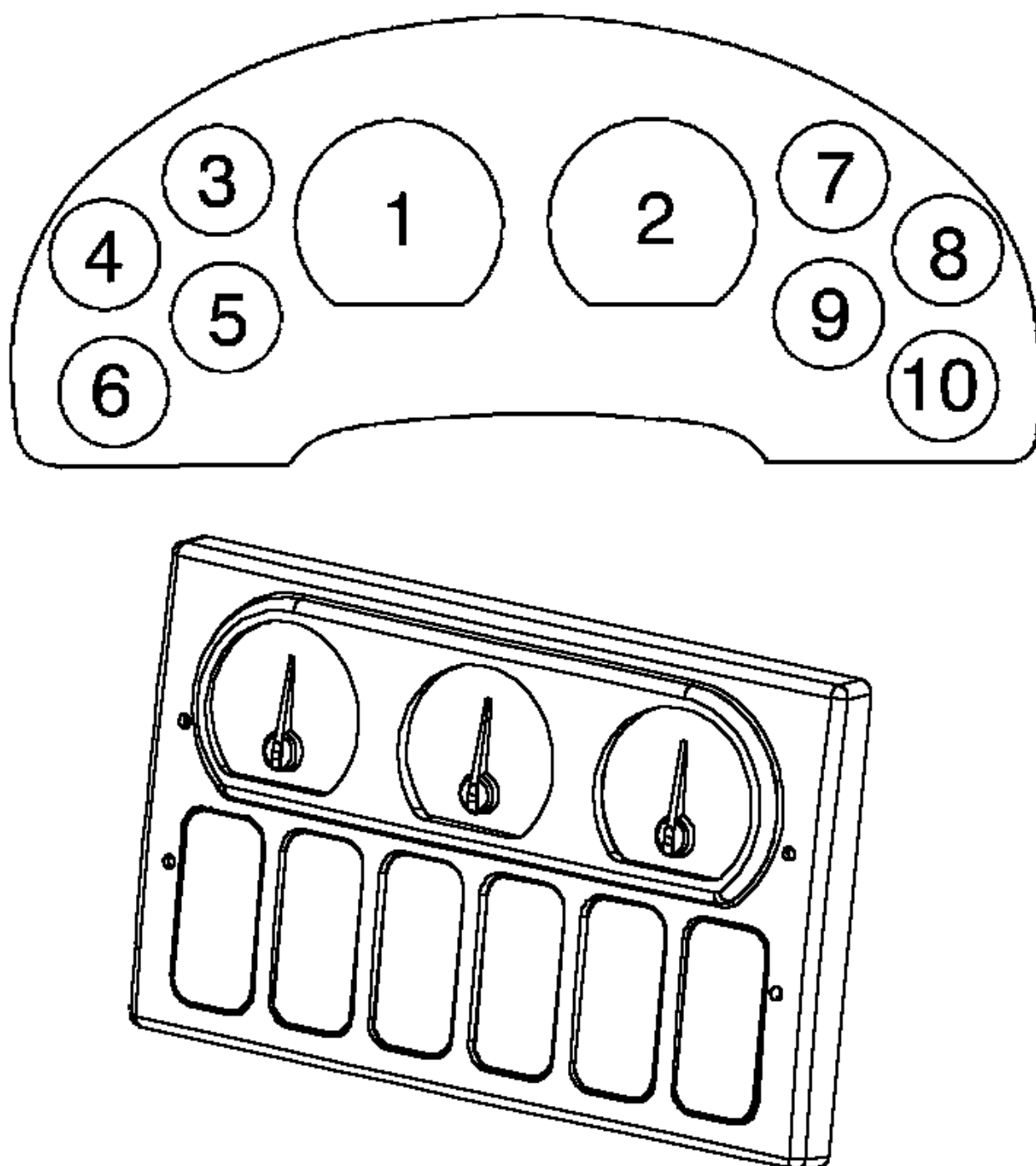


Figure 81 Gauge Locations

Table 23 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 240)
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 243)
Engine Oil Pressure Gauge with Integral Warning Light	Standard	5	0/100 PSI	<7 PSI and Engine Speed >325 RPM	Engine fluid level/pressure: Engine Oil Pressure	Engine Oil Pressure Gauge (See ENGINE OIL PRESSURE GAUGE, page 246)
Engine Oil Temperature Gauge with Integral Warning Light	Optional	Varies	100/300 °F (38/149 °C)	>230 °F (>110 °C)	Engine temperature: Engine oil temperature	Engine Oil Temperature Gauge (See ENGINE OIL TEMPERATURE GAUGE, page 249)
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 251)
Speedometer	Standard	2	0/85 MPH (0/137 KPH)	N/A	Cruise control/vehicle speed: wheelbased vehicle speed.	Speedometer (See SPEEDOMETER, page 253)
Tachometer	Standard	1	0/3000 RPM	N/A	Electronic engine controller #1: Engine speed	Tachometer (See TACHOMETER, page 256)

Table 23 Gauge Table (cont.)

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
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 259)
Transmission Oil Temperature Gauge with Integral Warning Light	Optional	Varies	100/400 °F (38/204 °C)	>250 °F (121 °C)	Transmission fluids: transmission oil temperature	Transmission Oil Temperature Gauge (See TRANSMISSION OIL TEMPERATURE GAUGE, page 267)
Rear-rear axle oil temperature gauge with Integral Warning Light	Optional	Varies	100/300 °F (38/149°C)	230 °F (110°C)	Rear-rear axle oil temperature gauge	Rear-rear axle oil temperature gauge (See REAR-REAR AXLE OIL TEMPERATURE GAUGE, page 273)
Forward-rear axle oil temperature gauge with Integral Warning Light	Optional	Varies	100/300 °F (38/149°C)	230 °F (110°C)	Forward-rear axle oil temperature gauge	Forward-rear axle oil temperature gauge (See FORWARD-REAR AXLE OIL TEMPERATURE GAUGE, page 278)
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 284)
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 293)

Table 23 Gauge Table (cont.)

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
Auxiliary Air Pressure Gauge with Integral Warning Light	Optional	Varies	0/150 PSI (1034 KPa)	<70 PSI (482 KPa)	Supply pressure: Auxiliary Equipment supply Pressure	Auxiliary Air Pressure Gauge (See AUXILIARY AIR PRESSURE GAUGE, page 302)
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 310)
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 312)
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 312)
Fuel Pressure Gauge with Integral Warning Light	Optional	Varies	0/150 PSI (1034 KPa)	N/A	Engine fluid level/ pressure: Fuel delivery pressure	Fuel Pressure Gauge (See FUEL PRESSURE GAUGE, page 316)

Table 23 Gauge Table (cont.)

Gauge Type	Standard/ Optional	Location	Gauge Min./ Gauge Max.	Warning Light Trip Point	Parameter Group Description	Troubleshooting Cross Reference
Suspension Air Gauge with Integral Warning Light	Optional	Varies	0/150 PSI (1034 KPa)	N/A	Supply pressure: air suspension supply pressure	Suspension Air Gauge (See SUSPENSION AIR GAUGE, page 318)
Air Application Gauge with Integral Warning Light	Optional	Varies	0/150 PSI (1034 KPa)	N/A	Brakes: Brake application pressure	Air Application Gauge (See AIR APPLICATION GAUGE, page 320)

1.2. WARNING LIGHTS

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

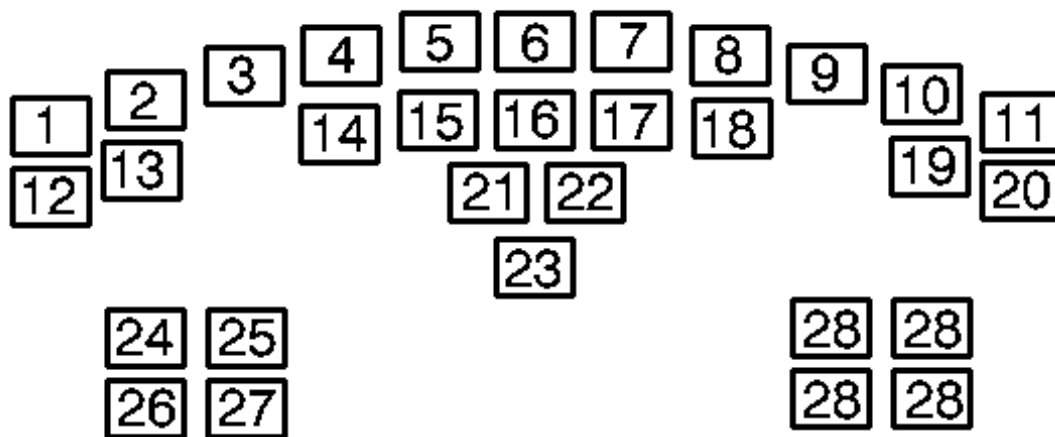
**Figure 82 Warning and Indicator Lamps**

Table 24 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 180)
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 182)
Fuel Filter	FUEL FILTER	Yellow	ON when fuel filter input to ESC from fuel filter.	3	Fuel Filter (See FUEL FILTER WARNING LAMP, page 184)
Warn Engine	ENGINE	Yellow	Status transmitted on Drivetrain 1939 data link from engine controller.	4	Warn Engine (See "YELLOW" ENGINE WARNING LAMP, page 190)
Stop Engine	ENGINE	Red	Status transmitted on Drivetrain 1939 data link from engine controller.	5	Stop Engine (See "RED" ENGINE WARNING LAMP, page 191)
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 PRESSURE WARNING LAMP, page 193)
Brake Fluid	Park Icon	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 228)
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 198)
Trailer ABS	Trailer ABS Icon	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from trailer ABS controller.	10	Trailer ABS (See TRAILER ABS LAMP, page 200)

Table 24 Warning Lamp Table (cont.)

WARNING LIGHT	REPRESENTATION	COLOR	DRIVEN BY	Loc. Num.	Troubleshooting Cross Reference
Washer Fluid Low	WASH FLUID LOW	Yellow	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from washer reservoir probe.	11	Washer Fluid Low (See WASHER FLUID LOW WARNING LAMP, page 203)
Left Turn	Left Turn Signal Icon	Green	Status transmitted from ESC on Drivetrain 1939 data link. Input to ESC from turn signal switch.	12	
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 196)
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 207)
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 220)
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 179)
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 213)
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 224)
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 226)

Table 24 Warning Lamp Table (cont.)

WARNING LIGHT	REPRESENTATION	COLOR	DRIVEN BY	Loc. Num.	Troubleshooting Cross Reference
Right Turn	Right Turn Signal Icon	Green	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from turn signal switch.	20	
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 211)
Seat Belt	SEAT BELT	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	
Check Air Conditioner	CHECK A/C	Yellow	Status transmitted on Drivetrain 1939 data link from ESC.	24	Check Air Conditioner (See CHECK A/C WARNING LAMP, page 230)
Retard Over Heat	RETARD OVER HEAT	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from transmission controller.	25	Retard Over Heat (See RETARD OVERHEAT WARNING LAMP, page 232)
PTO/Throttle	PTO/ THROTTLE	Red	Status transmitted on Drivetrain 1939 data link from ESC. Input to ESC from engine controller.	26	PTO/ Throttle (See PTO/ THROTTLE WARNING LAMP, page 233)
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.

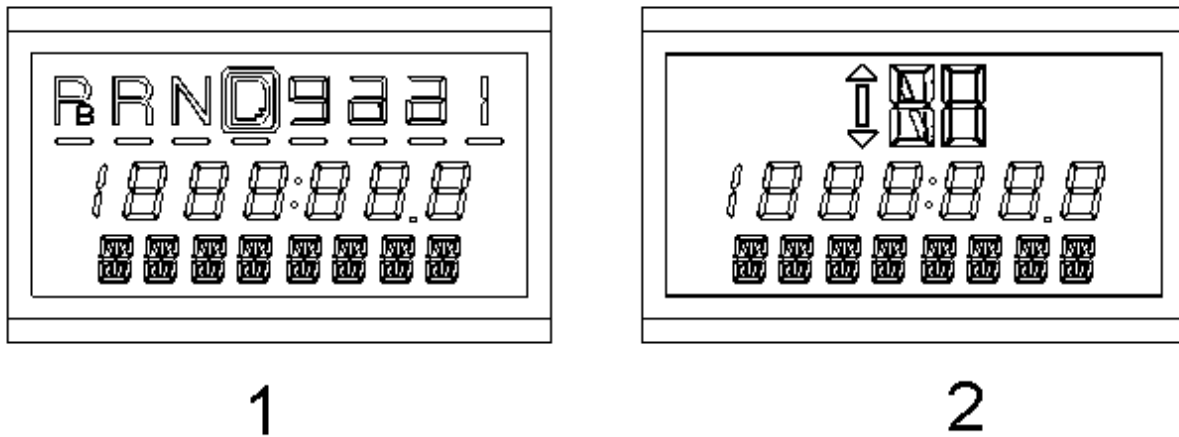


Figure 83 Electronic Gauge Cluster Display

1. EGC DISPLAY WITH ALLISON TRANSMISSIONS
2. EGC DISPLAY WITH EATON AUTOSHIFT TRANSMISSION

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 157)

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

- Rear axle temperature
- Front axle 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.

Work Light Switch

The work light switch is a momentary push up/push down rocker switch. The work light switch is located in the right position of the left bank of cluster switches. The work light switch is back lighted in yellow, the 'on' position is back lighted in green. Status of the work light switch is communicated to the electrical system controller.

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. This is accomplished by dialing in and uploading the updated programming. A copy of the programming is stored at International 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 114)

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 and AGSP 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.

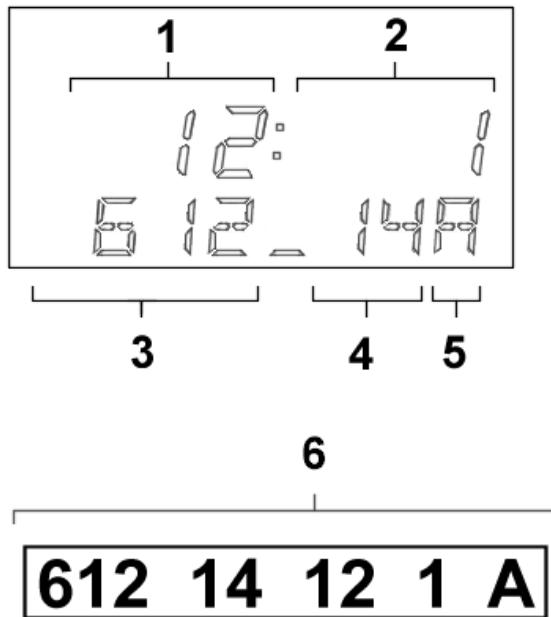


Figure 84 Diagnostic Trouble Code Display

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.

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 INTUNE 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 and AGSP continuously monitor 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 or AGSP 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 or AGSP 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 or AGSP and EGC is lost but the EGC or AGSP 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 or AGSP and the engine controller is lost but the EGC or AGSP 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 "INTUNE" DIAGNOSTIC SOFTWARE

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

The "INTUNE" 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 defective 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 defects 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 defective conditions.

Replacing International Components

When replacing electrical switches, connectors (including pins and sockets), relays or other components, use only approved International 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 25 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 164)
2.	Off/ On	Turn key to ignition position while observing the EGC. Does the gauge sweep perform without any errors? See gauge sweep (See GAUGE SWEEP, page 157)	EGC gauge sweep performs without any errors.	Go to next step.	Go to troubleshooting malfunctioning EGC (See MALFUNCTIONING EGC , page 166)
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 179)
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 24, page 150)

Table 25 EGC Preliminary System Check (cont.)

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
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 23, page 146)
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 327)
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 328)
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 326)

4.4. AGSP PRELIMINARY SYSTEM CHECK

Problems with AGSP operation can be caused by a lack of power, a malfunctioning AGSP, 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.

AGSP Preliminary System Check

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

Table 26 AGSP 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 AGSP. Did the AGSP have any response to key on?	AGSP responds to key on.	Go to next step.	Go to AGSP power and ground troubleshooting. (See AGSP POWER AND DATA LINK CIRCUITS, page 168)

Table 26 AGSP Preliminary System Check (cont.)

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	Off/ On	Turn key to ignition position while observing the AGSP. Does the gauge sweep perform without any errors? See gauge sweep (See GAUGE SWEEP, page 157)	AGSP gauge sweep performs without any errors.	Go to next step.	Go to troubleshooting malfunctioning AGSP. (See MALFUNCTIONING AGSP, page 170)
3.	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 23, page 146)
4.	On	Are all of the AGSP switches operating correctly?	AGSP switches operate correctly.	AGSP is operating correctly.	Go to Malfunctioning AGSP switches. (See MALFUNCTIONING AGSP SWITCHES, page 178)

4.5. EGC POWER AND DATA LINK CIRCUITS

Circuit function

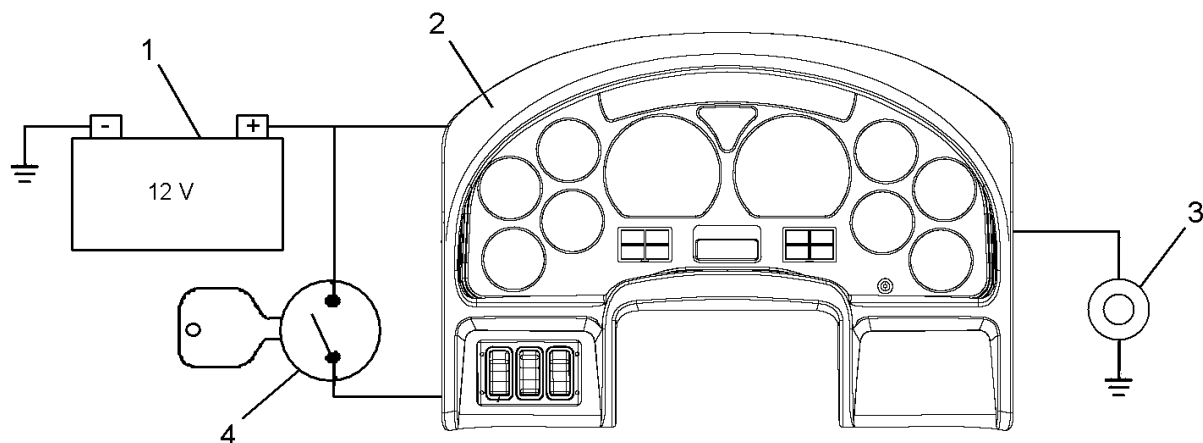


Figure 85 EGC Power And Ground Function Diagram

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 (1012). Switched ignition power is supplied from the ignition relay in fuse block (1012).

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.

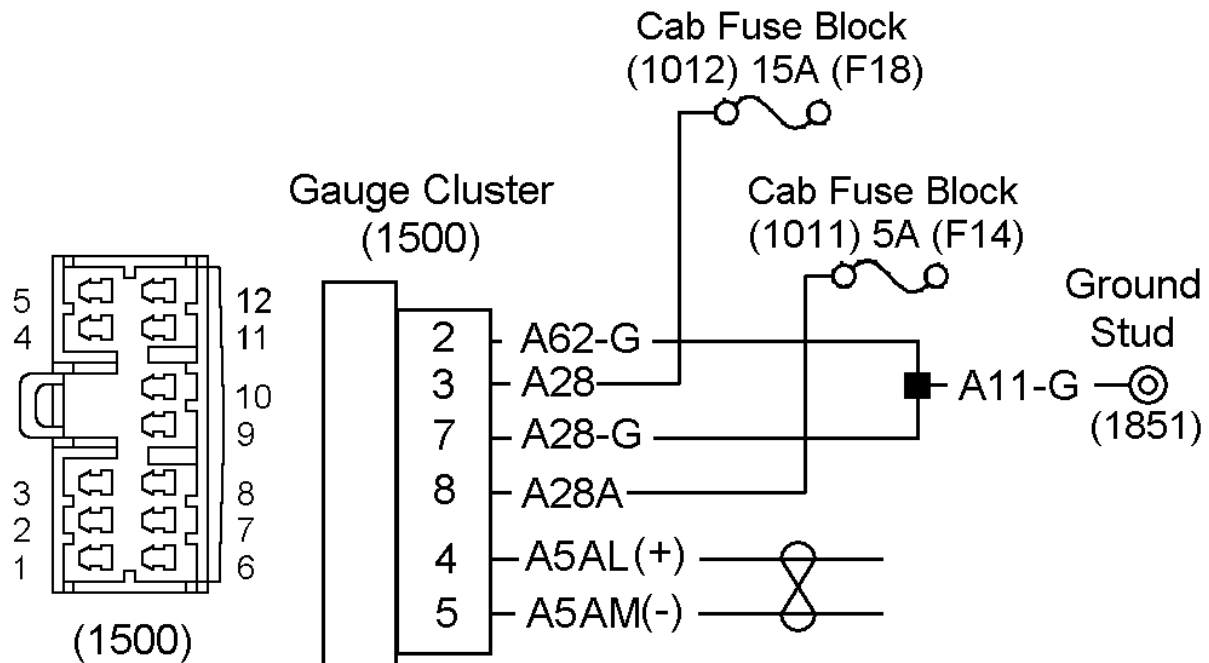


Figure 86 EGC Power And Ground Simplified Diagram—Always Refer To Circuit Diagram Book For Latest Circuit Information

F18 BATTERY FUSE (1012)

F14 IGNITION FUSE (1011)

(1500) ELECTRONIC GAUGE CLUSTER CONNECTOR

Table 27 EGC Power Voltage Check Chart

EGC Connector (1500) Voltage Checks (Check with EGC connector Disconnected and Ignition Key "On")		
This chart assumes there is power to fuse block (1011) F14 and (1012) F18 from the mega fuse and ignition relay is functioning properly.		
Test Points	Spec.	Comments
(1500) Cavity 3 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse (F18) 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 (F14) 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. If all voltages are correct and the EGC does not power up, the EGC should be replaced

Table 27 EGC Power Voltage Check Chart (cont.)

EGC Connector (1500) Voltage Checks (Check with EGC connector Disconnected and Ignition Key “On”)		
This chart assumes there is power to fuse block (1011) F14 and (1012) F18 from the mega fuse and ignition relay is functioning properly.		
Test Points	Spec.	Comments
EGC Connector (1500) Data Link Voltage Checks (Check with EGC connector Disconnected and Ignition Key “On”)		
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 (1012) F18.

Switched ignition voltage to the instrument cluster connector (1500), terminal 8, is provided on circuit A28A from (1011) F14. F4 receives power from the ignition relay.

System ground to EGC connector (1500), terminal 7, is provided on circuit A28–G from DS2 and circuit A11–G to the negative stud (1851).

4.6. 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 28 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 161)
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 defective gauge.	Replace the circuit board assembly.
4.	On	Connect the EZ-Tech and run the cluster the "INTUNE" 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.
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.
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.

4.7. AGSP POWER AND DATA LINK CIRCUITS

Circuit function

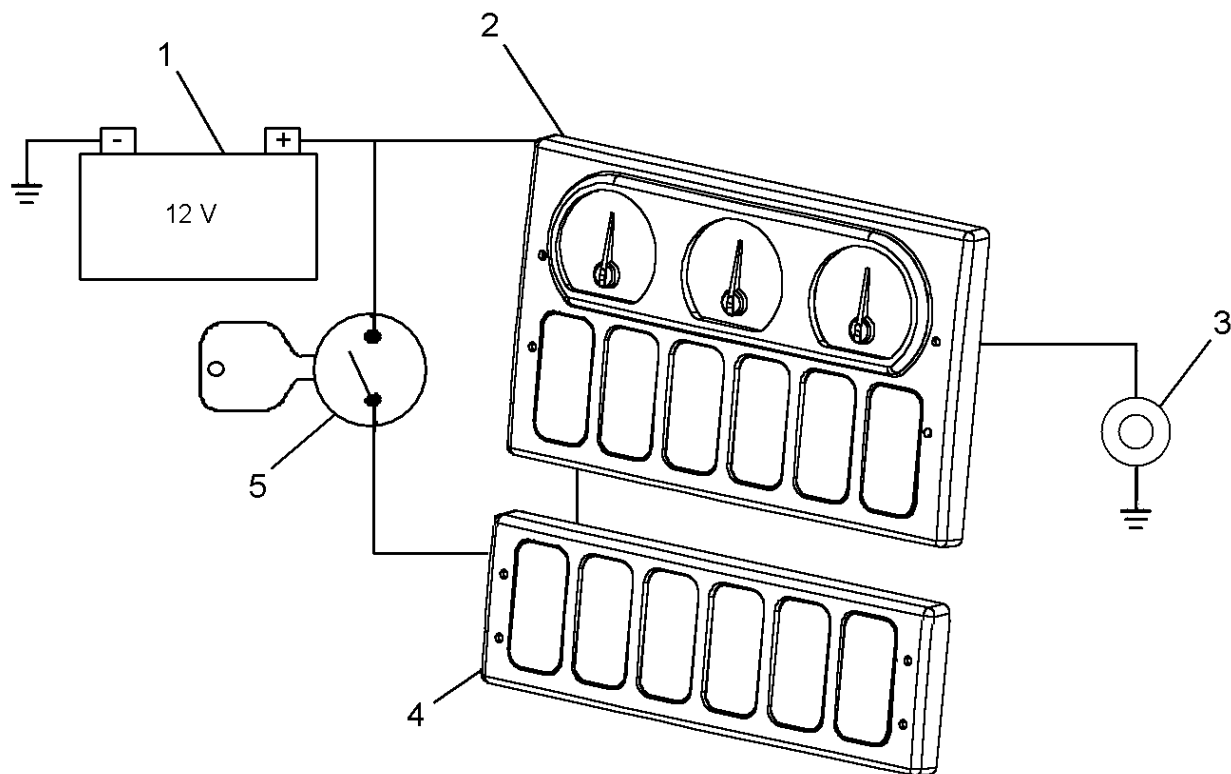


Figure 87 AGSP Power And Ground Function Diagram

1. BATTERY
2. AUXILIARY GAUGE SWITCH PACK (AGSP)
3. GROUND STUD
4. 6 SWITCH PACK
5. KEY SWITCH (ACCESSORY FEED)

Refer to AGSP Power And Ground Function Diagram.

The AGSP receives battery power through fuse block (1011) F12. Switched ignition power is supplied from the ignition relay in fuse block (1012) F19 through the 6 position or 12 position switch pack.

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 AGSP Power And Ground Simplified Diagram

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

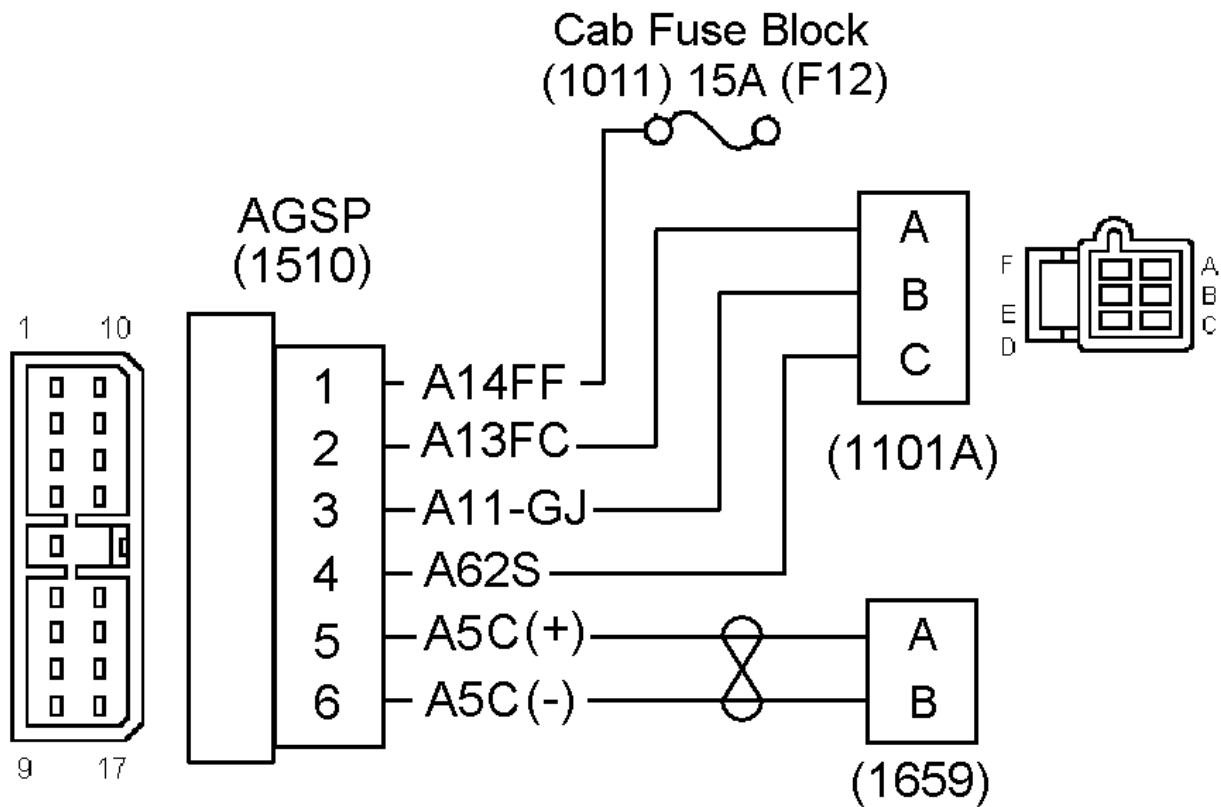


Figure 88 AGSP Power And Ground Simplified Diagram—Always Refer To Circuit Diagram Book For Latest Circuit Information

F12 BATTERY FUSE (1011)
(1510) AGSP CONNECTOR
(1101A) SWITCH PACK CONNECTOR
(1659) DRIVETRAIN 1939 DATA LINK CONNECTOR

Table 29 AGSP Power Voltage Check Chart

AGSP Connector (1510) Voltage Checks (Check with AGSP Connector Disconnected and Ignition Key “On”)		
Test Points	Spec.	Comments
(1510) Cavity 1 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse (F12) or an open or short in circuit A14FF.

Table 29 AGSP Power Voltage Check Chart (cont.)

AGSP Connector (1510) Voltage Checks (Check with AGSP Connector Disconnected and Ignition Key "On")		
Test Points	Spec.	Comments
(1510) Cavity 2 to ground.	12 ± 1.5 volts	If voltage is incorrect, check for blown fuse (F19) or an open or short in circuit A13FC and circuits through the switch packs. Refer to the Switch Pack Module section of this manual. (See SWITCH PACK MODULES, page 125)
(1510) Cavity 1 to 3.	12 ± 1.5 volts	If voltage is incorrect, check for an open in circuit A11-GJ and circuits through the switch packs. Refer to the Switch Pack Module section of this manual. (See SWITCH PACK MODULES, page 125)
If all voltages are correct and the AGSP does not function, the AGSP should be replaced.		

Extended Description

Battery voltage to the AGSP connector (1510), terminal 3, is provided on circuit A14FF from fuse (1011) F12.

Switched accessory voltage to the AGSP connector (1510), terminal 2, is provided on circuit A13FC from switch pack connector (1101A).

System ground to AGSP connector (1510), terminal 3, is provided on circuit A11-GJ from switch pack connector (1101A).

4.8. MALFUNCTIONING AGSP**Fault Detection/Management**

Malfunctions in the AGSP 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.

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

Table 30 Troubleshooting Malfunctioning AGSP

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 AGSP PRELIMINARY SYSTEM CHECK, page 162)
2.	On	Did any gauges sweep correctly?	Some gauges swept correctly.	Go to next step.	Replace AGSP circuit board.
3.	On	Did all gauges sweep correctly?	All gauges swept correctly.	Go to next step 5.	Go to next step.

Table 30 Troubleshooting Malfunctioning AGSP (cont.)

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
4.	Off/ On	Swap a working gauge with the inoperative gauge. Perform gauge sweep.	The gauge that worked previously still works in the new position.	Replace the defective gauge.	Replace the circuit board assembly.
5.	On	Check for AGSP diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 171) Read display on odometer.	AGSP diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 178)	Go to next step
6.	On	Connect the EZ-Tech and run the cluster the "INTUNE" 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.
7.	On	Did the panel lights illuminate while the gauges swept?	Panel lights illuminate during gauge sweep.	AGSP is working correctly.	Go to next step.
8.	On	Replace the suspect panel light bulb.	Panel light works.	AGSP is working correctly.	Replace the circuit board assembly.

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 31 AGSP Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
614 14 40 1	Auxiliary Gauge Switchpack #1 checksum error fixed by reteach. The configuration checksum in the AGSP did not match the teach/reteach checksum in the ESC. This situation was corrected by the teach/reteach operation.
614 14 40 2	Auxiliary Gauge Switchpack #1 checksum error could not be fixed. The configuration checksum in the AGSP did not match the teach/reteach checksum in the ESC. This situation could not be corrected by the teach/reteach operation.
2023 14 50 1, 2023 14 20 1, 2023 14 30 1 or 2023 14 40 1	ESC not communicating with AGSP 1 (50), AGSP 2 (20), AGSP 3 (30), AGSP 4 (40). Loss of communication in excess of 10 seconds. Drivetrain J1939 data link.
2023 14 50 10, 2023 14 20 10, 2023 14 30 10 or 2023 14 40 10	Ignition signal from datalink from ESC does not match hardwired ignition signal on AGSP 1 (50), AGSP 2 (20), AGSP 3 (30), AGSP 4 (40). Ignition Circuit to ESC/AGSP.
2023 14 1 5, 2023 14 11 5, 2023 14 21 5 or 2023 14 31 5	Gauge location 1 sensor fault on AGSP 1 (1), AGSP 2 (11), AGSP 3 (21), AGSP 4 (31). There is a problem with the sensor that provides the data for this gauge.
2023 14 1 6, 2023 14 11 6, 2023 14 21 6 or 2023 14 31 6	Gauge location 1 data unavailable on AGSP 1 (1), AGSP 2 (11), AGSP 3 (21), AGSP 4 (31). The data that this gauge displays should be, but is not available at this time.
2023 14 1 7, 2023 14 11 7, 2023 14 21 7 or 2023 14 31 7	Gauge location 1 data missing on AGSP 1 (1), AGSP 2 (11), AGSP 3 (21), AGSP 4 (31). The data for this gauge is not being transmitted on the datalink.

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2023 14 2 5, 2023 14 12 5, 2023 14 22 5 or 2023 14 32 5	Gauge location 2 sensor fault on AGSP 1 (2), AGSP 2 (12), AGSP 3 (22), AGSP 4 (32). There is a problem with the sensor that provides the data for this gauge.
2023 14 2 6, 2023 14 12 6, 2023 14 22 6 or 2023 14 32 6	Gauge location 2 data unavailable on AGSP 1 (2), AGSP 2 (12), AGSP 3 (22), AGSP 4 (32). The data that this gauge displays should be, but is not available at this time.
2023 14 2 7, 2023 14 12 7, 2023 14 22 7 or 2023 14 32 7	Gauge location 2 data missing on AGSP 1 (2), AGSP 2 (12), AGSP 3 (22), AGSP 4 (32). The data for this gauge is not being transmitted on the datalink.
2023 14 3 5, 2023 14 13 5, 2023 14 23 5 or 2023 14 33 5	Gauge location 3 sensor fault on AGSP 1 (3), AGSP 2 (13), AGSP 3 (23), AGSP 4 (33). There is a problem with the sensor that provides the data for this gauge.
2023 14 3 6, 2023 14 13 6, 2023 14 23 6 or 2023 14 33 6	Gauge location 3 data unavailable on AGSP 1 (3), AGSP 2 (13), AGSP 3 (23), AGSP 4 (33). The data that this gauge displays should be, but is not available at this time.
2023 14 3 7, 2023 14 13 7, 2023 14 23 7 or 2023 14 33 7	Gauge location 3 data missing on AGSP 1 (3), AGSP 2 (13), AGSP 3 (23), AGSP 4 (33). The data for this gauge is not being transmitted on the datalink.

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2040 14 1 1	<p>AGSP #1 Switch #1, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #1 to the default value.</p> <p>Replace switch actuator</p>
2040 14 1 2	<p>AGSP #1 Switch #1, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #1 to the default value.</p> <p>Replace faulty microswitch</p>
2040 14 1 3	<p>AGSP #1 Switch #1, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #1 to the default value.</p> <p>Replace switch actuator</p>
2040 14 1 4	<p>AGSP #1 Switch #1, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #1 to the default value.</p> <p>Replace switch actuator</p>
2040 14 1 5	<p>AGSP #1 Switch #1, This switch should be empty but one or both of the microswitches is pressed.</p> <p>The ESC sets the status of AGSP #1 Switch #1 to the default value.</p> <p>Replace switch actuator or faulty microswitch</p>
2040 14 2 1	<p>AGSP #1 Switch #2, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #2 to the default value.</p> <p>Replace switch actuator</p>
2040 14 2 2	<p>AGSP #1 Switch #2, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #2 to the default value.</p> <p>Replace faulty microswitch</p>

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2040 14 2 3	<p>AGSP #1 Switch #2, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #2 to the default value.</p> <p>Replace switch actuator</p>
2040 14 2 4	<p>AGSP #1 Switch #2, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #2 to the default value.</p> <p>Replace switch actuator</p>
2040 14 2 5	<p>AGSP #1 Switch #2, This switch should be empty but one or both of the microswitches is pressed.</p> <p>The ESC sets the status of AGSP #1 Switch #2 to the default value.</p> <p>Replace switch actuator or faulty microswitch</p>
2040 14 3 1	<p>AGSP #1 Switch #3, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #3 to the default value.</p> <p>Replace switch actuator</p>
2040 14 3 2	<p>AGSP #1 Switch #3, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #3 to the default value.</p> <p>Replace faulty microswitch</p>
2040 14 3 3	<p>AGSP #1 Switch #3, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #3 to the default value.</p> <p>Replace switch actuator</p>
2040 14 3 4	<p>AGSP #1 Switch #3, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #3 to the default value.</p> <p>Replace switch actuator</p>

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2040 14 3 5	<p>AGSP #1 Switch #3, This switch should be empty but one or both of the microswitches is pressed.</p> <p>The ESC sets the status of AGSP #1 Switch #3 to the default value.</p> <p>Replace switch actuator or faulty microswitch</p>
2040 14 4 1	<p>AGSP #1 Switch #4, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #4 to the default value.</p> <p>Replace switch actuator</p>
2040 14 4 2	<p>AGSP #1 Switch #4, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #4 to the default value.</p> <p>Replace faulty microswitch</p>
2040 14 4 3	<p>AGSP #1 Switch #4, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #4 to the default value.</p> <p>Replace switch actuator</p>
2040 14 4 4	<p>AGSP #1 Switch #4, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #4 to the default value.</p> <p>Replace switch actuator</p>
2040 14 4 5	<p>AGSP #1 Switch #4, This switch should be empty but one or both of the microswitches is pressed.</p> <p>The ESC sets the status of AGSP #1 Switch #4 to the default value.</p> <p>Replace switch actuator or faulty microswitch</p>
2040 14 5 1	<p>AGSP #1 Switch #5, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #5 to the default value.</p> <p>Replace switch actuator</p>

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2040 14 5 2	<p>AGSP #1 Switch #5, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #5 to the default value.</p> <p>Replace faulty microswitch</p>
2040 14 5 3	<p>AGSP #1 Switch #5, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #5 to the default value.</p> <p>Replace switch actuator</p>
2040 14 5 4	<p>AGSP #1 Switch #5, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #5 to the default value.</p> <p>Replace switch actuator</p>
2040 14 5 5	<p>AGSP #1 Switch #5, This switch should be empty but one or both of the microswitches is pressed.</p> <p>The ESC sets the status of AGSP #1 Switch #5 to the default value.</p> <p>Replace switch actuator or faulty microswitch</p>
2040 14 6 1	<p>AGSP #1 Switch #6, microswitch inputs are in an invalid state. Both microswitches are not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #6 to the default value.</p> <p>Replace switch actuator</p>
2040 14 6 2	<p>AGSP #1 Switch #6, microswitch inputs are in an invalid state. Both microswitches are depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #6 to the default value.</p> <p>Replace faulty microswitch</p>
2040 14 6 3	<p>AGSP #1 Switch #6, microswitch inputs are in an invalid state. Top microswitch depressed, bottom microswitch not depressed.</p> <p>The ESC sets the status of AGSP #1 Switch #6 to the default value.</p> <p>Replace switch actuator</p>

Table 31 AGSP Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2040 14 6 4	AGSP #1 Switch #6, microswitch inputs are in an invalid state. Top microswitch not depressed, bottom microswitch depressed. The ESC sets the status of AGSP #1 Switch #6 to the default value. Replace switch actuator
2040 14 6 5	AGSP #1 Switch #6, This switch should be empty but one or both of the microswitches is pressed. The ESC sets the status of AGSP #1 Switch #6 to the default value. Replace switch actuator or faulty microswitch

Fault Detection/ Management

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

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Air Application Gauge Transducer Circuits.

4.9. MALFUNCTIONING AGSP SWITCHES**Fault Detection/Management**

Malfunctions in the AGSP switches can be caused by improper programming, a broken switch actuator, breaks in the circuit board, or a problem in the microprocessor.

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

4.10. CHECK ELECTRICAL SYSTEM WARNING LAMP

Circuit Function

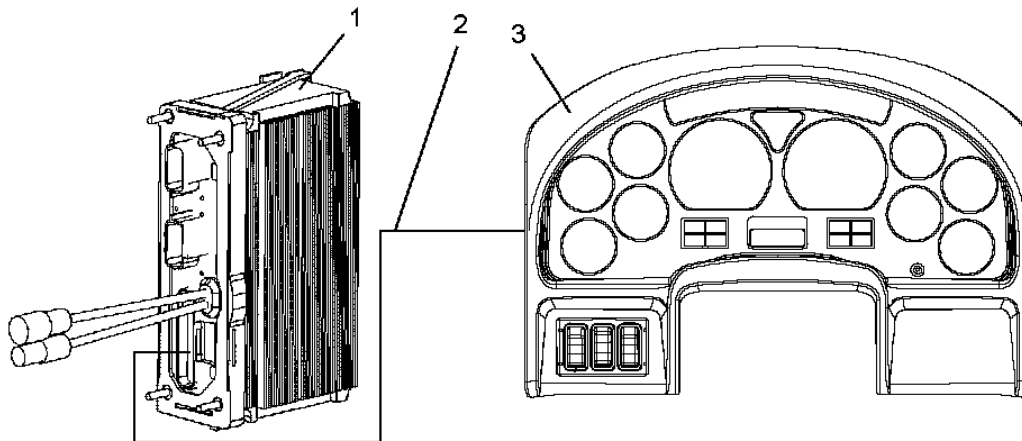


Figure 89 Check Electrical System Warning Lamp Function Diagram

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 connector (4009) or (4010). 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 doesn't 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 lamp 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 60)

If the lamp stays on continuously when no active faults are present or doesn't 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 "INTUNE" 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.

4.11. RANGE INHIBITED WARNING LAMP

System Function

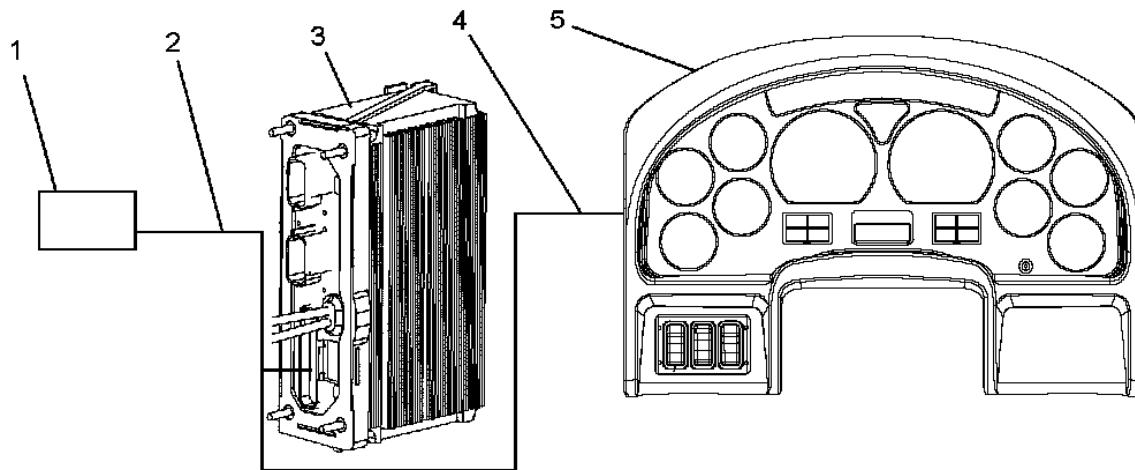


Figure 90 Range Inhibited Warning Lamp Function Diagram

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 doesn't 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 "INTUNE" 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 doesn't come on when commanded by the transmission controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

Table 32 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 doesn't 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 114)
3.	On	Attempt to exercise the range inhibited warning lamp with the "INTUNE" 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.
4.	On	Use "INTUNE" 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 124)

4.12. ECONOMY MODE WARNING LAMP

System Function

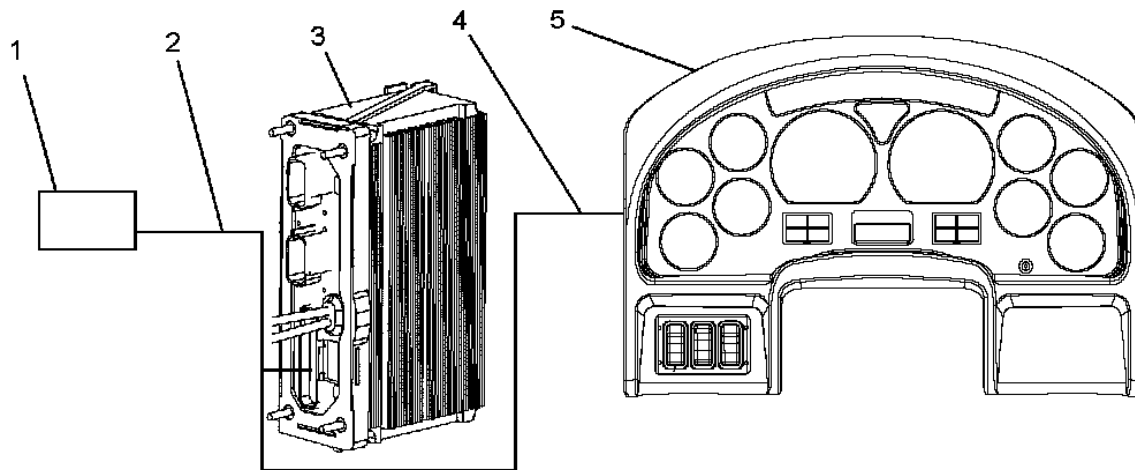


Figure 91 Economy Mode Function Diagram

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 button on the shifter. Normal function, you press the MODE button once, the ECON lamp turns on, you press the button again, the ECON lamp turns off.

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 doesn't 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 "INTUNE" diagnostic software can be used to check operation of the warning lamp.

For the WT's: The MODE button is used. The activation of the button is communicated over existing shifter wiring. If the lamp doesn't turn on when requested, make sure the shifter is communicating with the TCM (will the truck go into gear?), make sure the TCM 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).

For the LCT's: The button on the shift lever is used. The contacts on this button connect to two pins on the transmission controller. If the lamp doesn't turn on when requested, make sure the shifter is communicating with the TCM (do the wires at the TCM short and open with the switch is cycled?), make sure the TCM 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 doesn't come on when commanded by the transmission controller, the problem may be in ESC/EGC programming or ESC/EGC hardware.

Table 33 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 doesn't 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 114)
3.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
4.	On	Use "INTUNE" 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 124)

4.13. FUEL FILTER WARNING LAMP

Circuit Functions

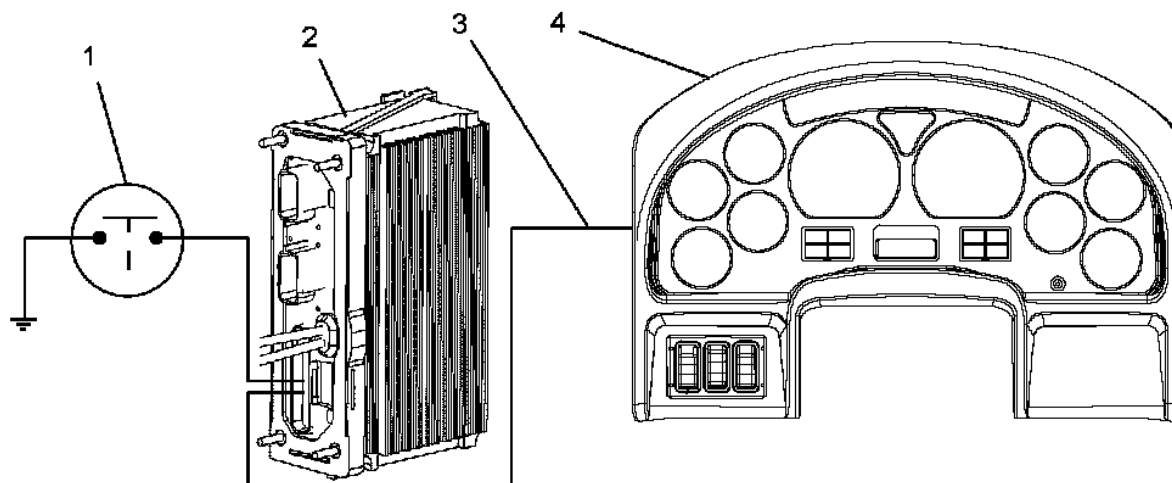


Figure 92 Fuel Filter Warning Lamp Function Diagram

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

The fuel filter warning lamp should light during the EGC gauge sweep, after the key is turned to the ignition position. If the lamp doesn't light during the gauge sweep the lamp could be burned out or there may be a problem in the EGC.

The fuel filter warning lamp lights when there is a restriction in the fuel filter system. A vacuum switch in the fuel filter provides a ground to the ESC which will generate the signal to activate the lamp. The light should go out when the fuel restriction is removed.

The most probable cause of a warning lamp malfunction, other than a burned out lamp, is a problem with the vacuum sensor.

Diagnostics

The electronic service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the light and monitor activation of the fuel filter vacuum switch.

Table 34 Fuel Filter Warning Lamp Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Fuel filter warning lamp is malfunctioning.	Fuel filter warning lamp is only on when fuel is restricted.	Problem doesn't 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 114)
3.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
4.	On	Use "INTUNE" diagnostic software to monitor vacuum switch circuit inputs to the ESC.	Vacuum switch circuit inputs to the ESC match fuel restriction.	Go to next step.	Go to Fault Detection Management. (See Fault Detection Management, page 185)
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 124)

Fault Detection Management

The electronic service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the light and monitor activation of the fuel filter vacuum switch.

If the lamp stays on when there is no restriction or doesn't come on when there is a fuel restriction, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the vacuum switch or wiring.

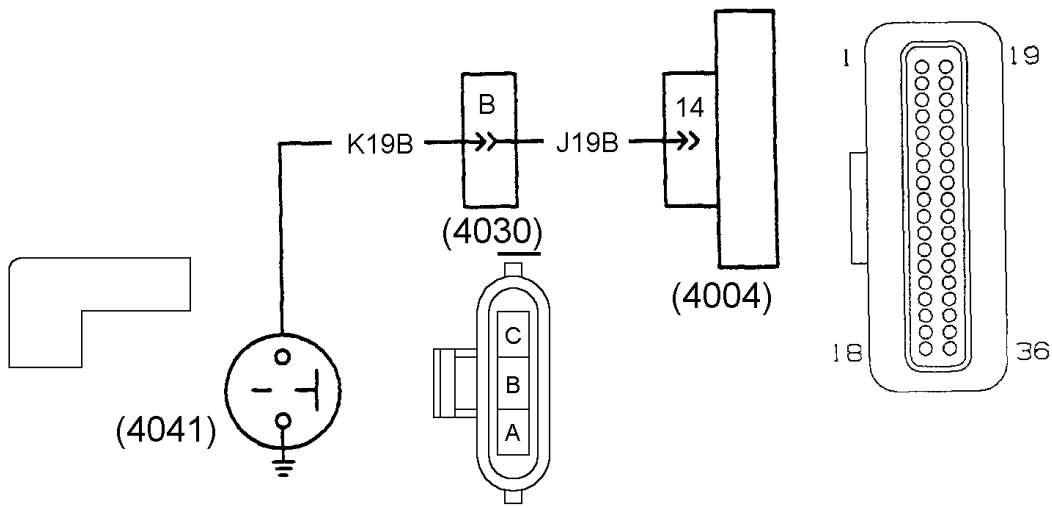


Figure 93 Fuel Filter Sensor Wiring to ESC

1. FUEL FILTER VACUUM SWITCH (4041)
LOCATED ON FUEL FILTER
2. FUEL FILTER WARNING LIGHT CONNECTOR (4030)
LOCATED AT FUEL FILTER
3. ELECTRICAL SYSTEM CONTROLLER CONNECTOR (4004)
LOCATED ON ENGINE SIDE OF ESC

Table 35 Fuel Filter Warning Lamp Voltage Check Chart

Fuel Filter Warning Lamp Connector (4041) Voltage Checks (Check with Vacuum Switch Pigtail Disconnected and the Ignition Key "On")		
NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(4041) harness connector, cavity B to ground.	12 ± 1.5 volts	<p>If voltage is correct the sensor is defective.</p> <p>If voltage is incorrect, check circuit J19B and K19B for an open or short.</p> <p>If no shorts or opens exist and voltage is not being supplied by ESC. Consider replacing ESC. Refer to ESC Replacement in this manual. (See ESC REPLACEMENT, page 124)</p>
Fuel Filter Warning Light Connector (4041) Resistance Checks (Check with Vacuum Switch Pigtail Disconnected and the Ignition Key "Off")		
Test Points	Spec.	Comments
(4041) connector on fuel filter, terminal A on vacuum switch to ground.	> 100K ohms.	If resistance is incorrect, the vacuum switch is stuck closed or there is a restriction in the fuel line.
There are no diagnostic trouble codes associated with this feature.		

Extended Description

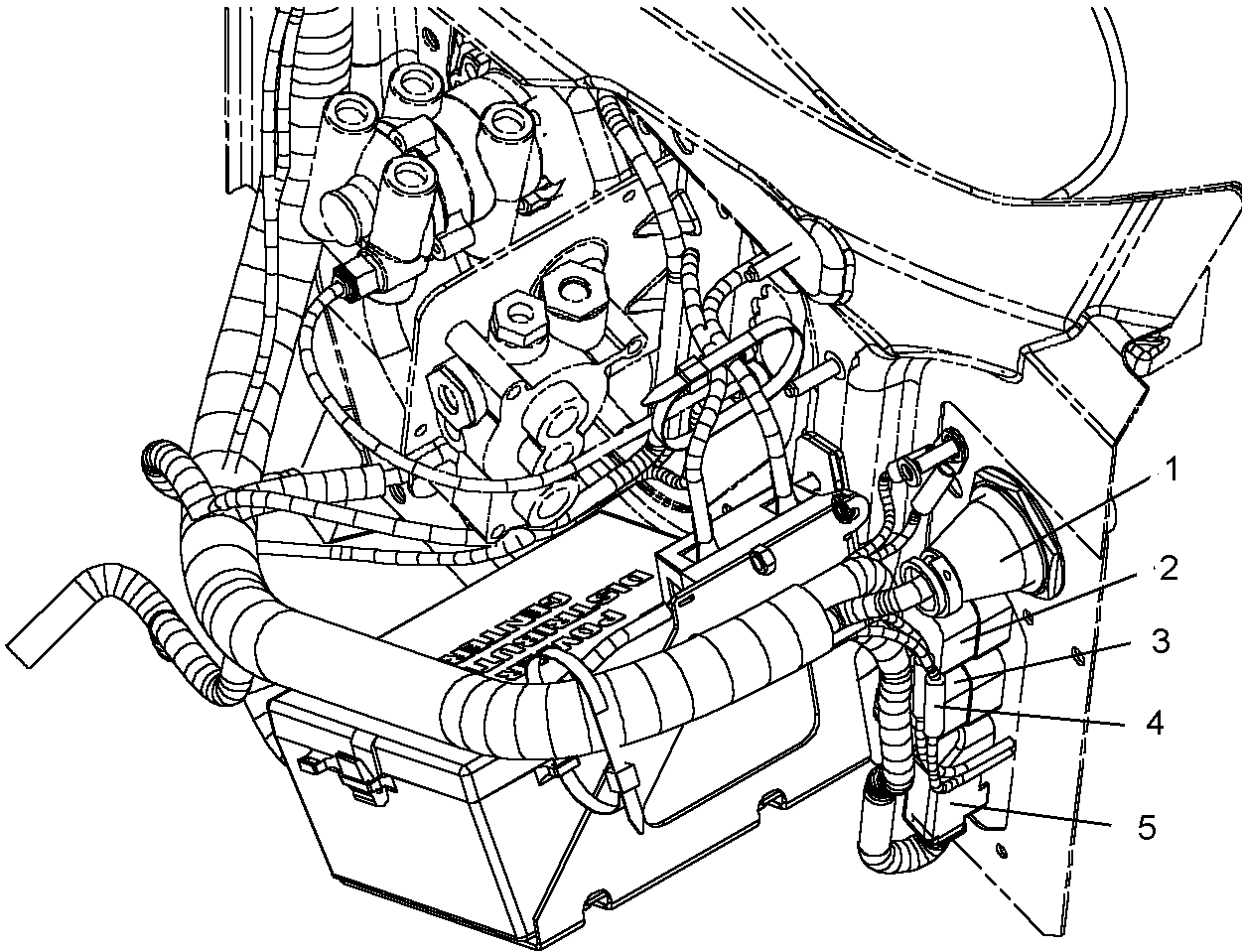
When there is a restriction in the fuel line, the fuel filter vacuum switch will close supplying ground through the switch, fuel warning light connector (4030) terminal B, and circuit J19B to system controller connector (4004) terminal 14.

The light will go out when the fuel filter has been replaced or the fuel restriction is removed.

The EGC activates the fuel filter indicator when it receives a message on the drivetrain 1939 data link from the ESC.

Component Locations

N08-52385.05

**Figure 94 Engine ESC Connector Location**

1. 48 WAY DASH CONNECTOR (4014)
2. 8 WAY (4008)
3. 8 WAY (4007)
4. POWER CONNECTORS (4009) & (4010)
5. 36 WAY CONNECTOR (4004)

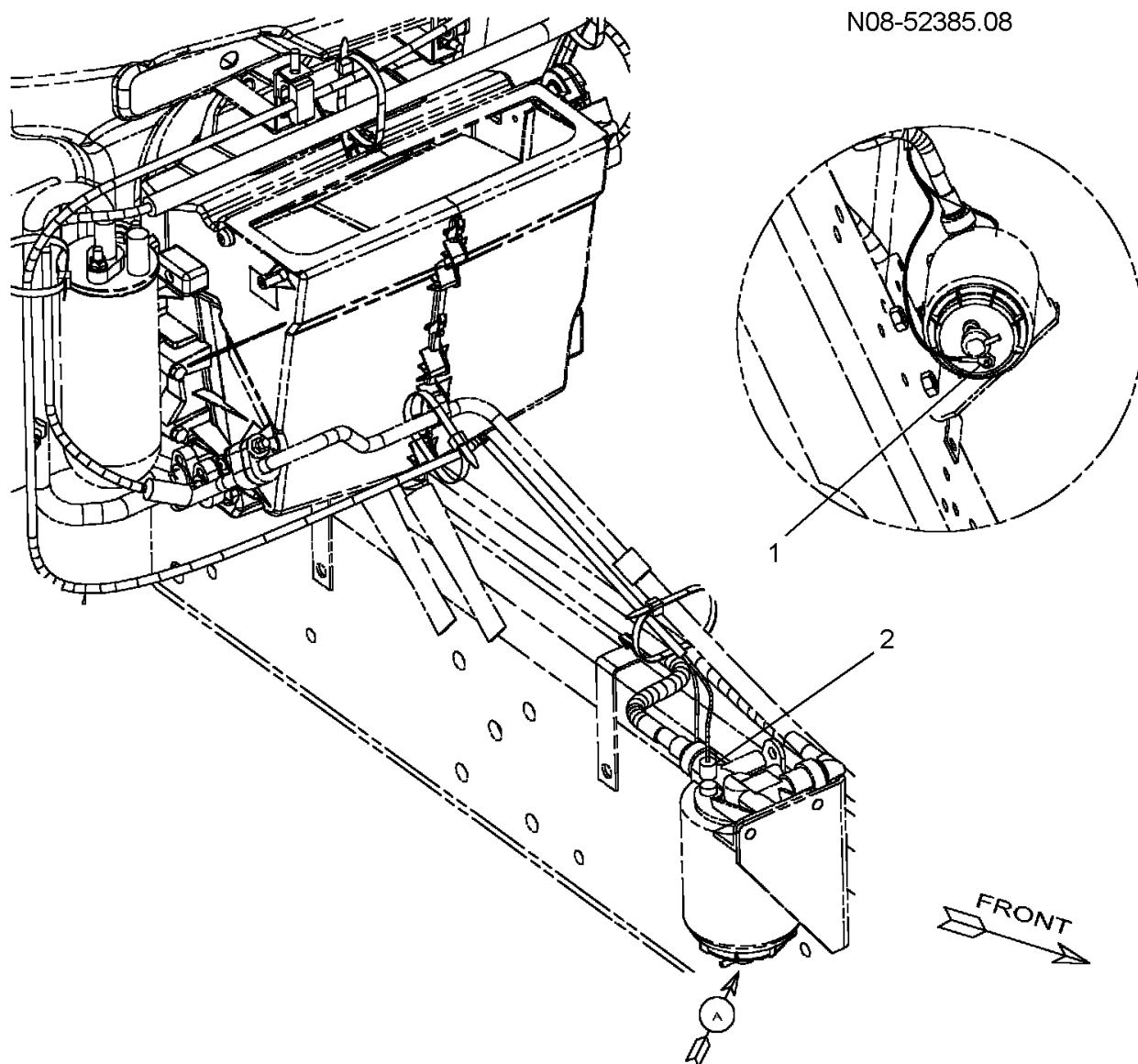


Figure 95 Fuel Filter Sensor Location

1. WIF LIGHT FUEL FILTER VACUUM SWITCH (4041)
2. FUEL HEATER CONNECTOR

4.14. "YELLOW" ENGINE WARNING LAMP

Circuit Function

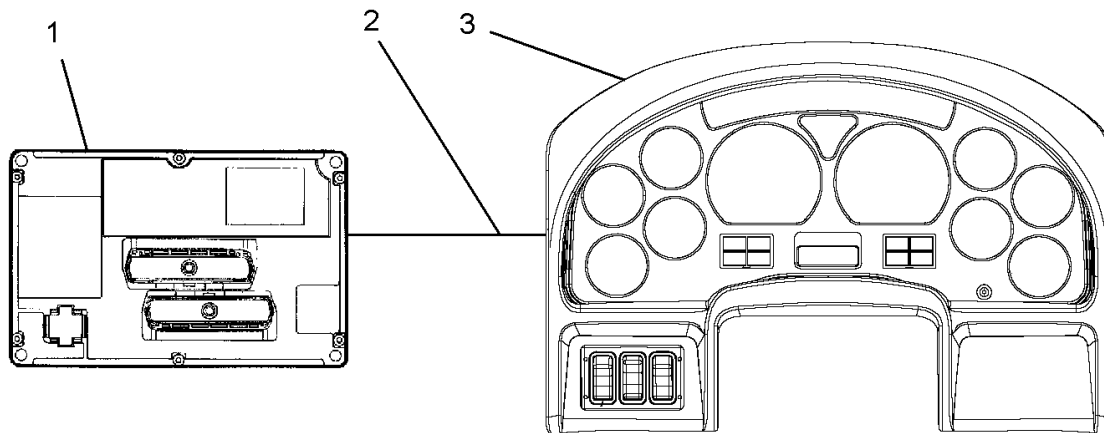


Figure 96 Yellow Engine Lamp Function Diagram

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 doesn't 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 "INTUNE" 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 36 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 truck.

4.15. "RED" ENGINE WARNING LAMP

Circuit Function

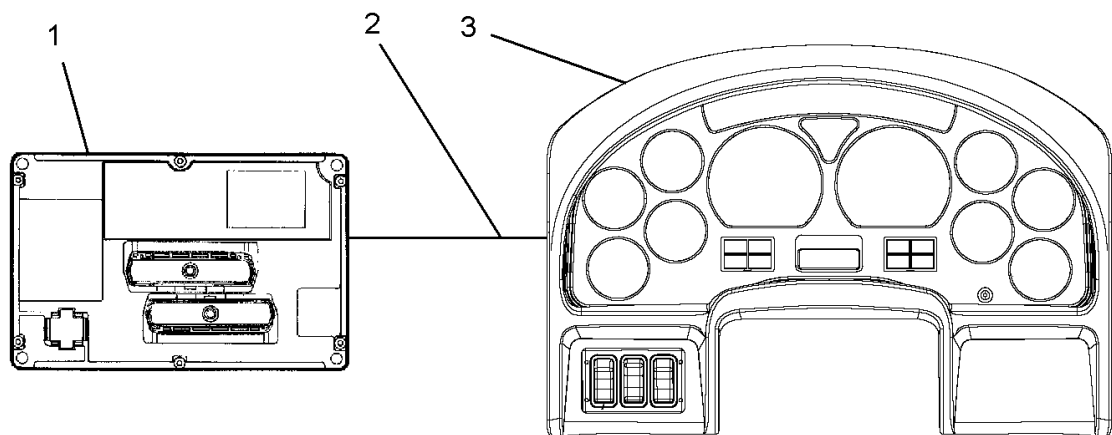


Figure 97 "Red" Engine Warning Lamp Function Diagram

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 doesn't 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 "INTUNE" 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 37 "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 truck.

4.16. BRAKE PRESSURE WARNING LAMP

Circuit Function

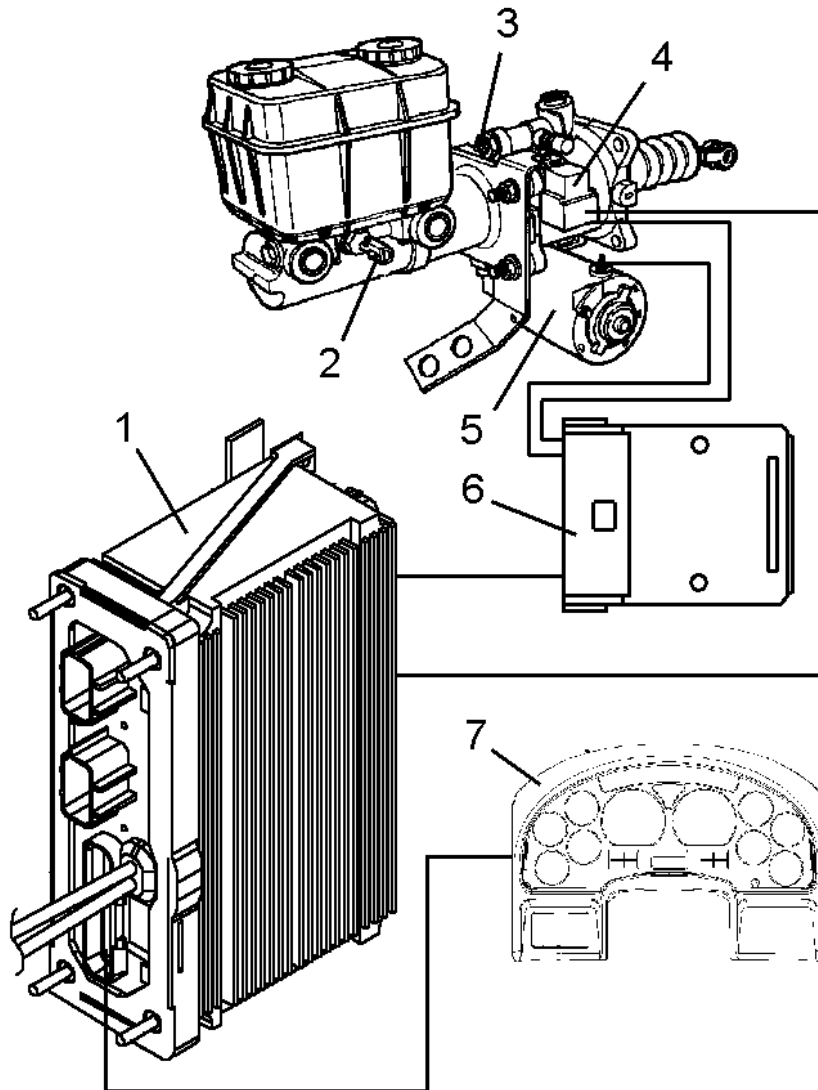


Figure 98 Brake Pressure Warning Lamp Function Diagram

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

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

If the lamp illuminates when there are no problems in the brake system or doesn't 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 38 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor the inputs to the ESC for the warning lamp with the "INTUNE" diagnostic software.	Inputs are correct.	Go to next step.	Refer to Monitor Module and Warning Circuit Inputs To ESC.
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 124)

4.17. TRACTION CONTROL LAMP

Circuit Function

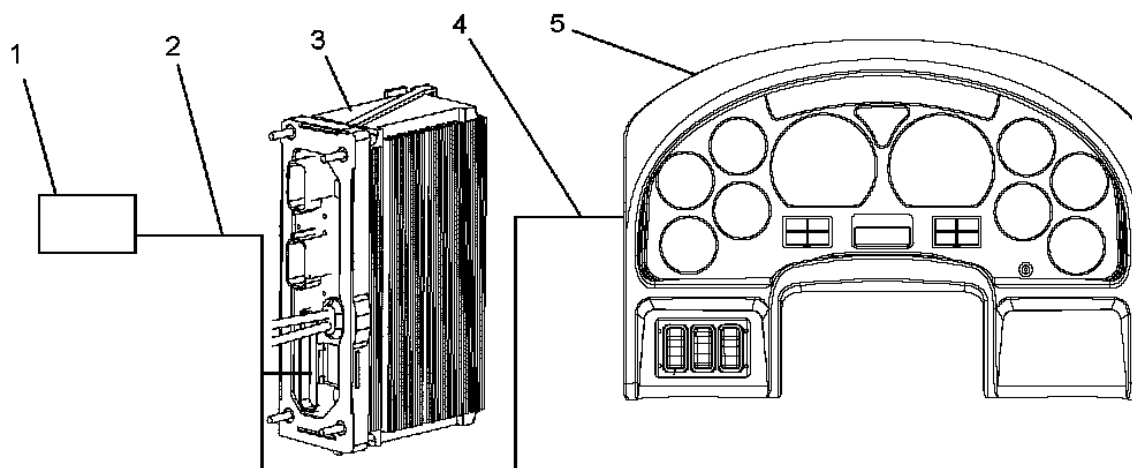


Figure 100 Traction Control Lamp Function Diagram

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.

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 doesn't 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 39 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor the commands to the ESC from the ABS controller with the "INTUNE" 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 124)

4.18. CHECK TRANSMISSION LAMP

Circuit Function

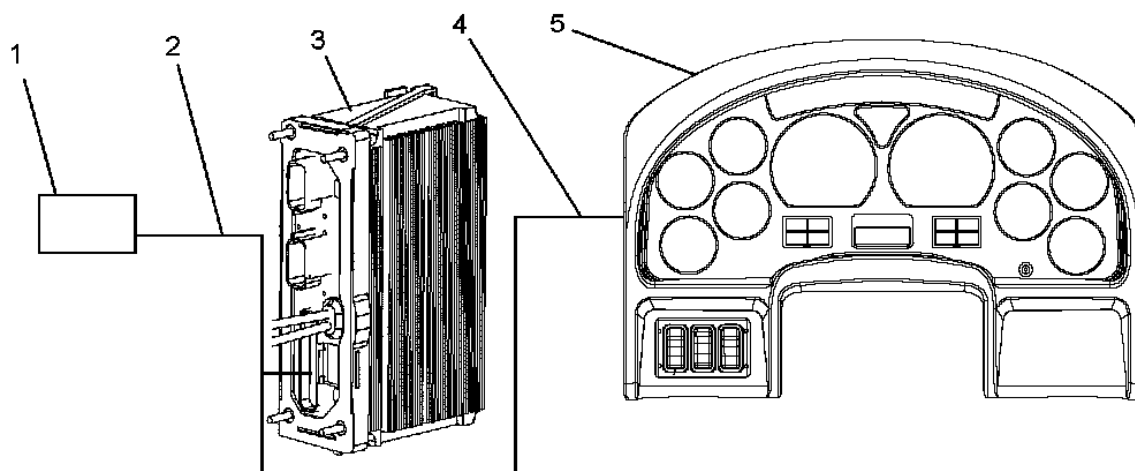


Figure 101 Check Transmission Lamp Function Diagram

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 doesn't 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 truck for details.

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 40 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 157)	No 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 114)
3.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
4.	On	Monitor command from transmission controller to ESC with the "INTUNE" 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 124)

4.19. TRAILER ABS LAMP

Circuit Function

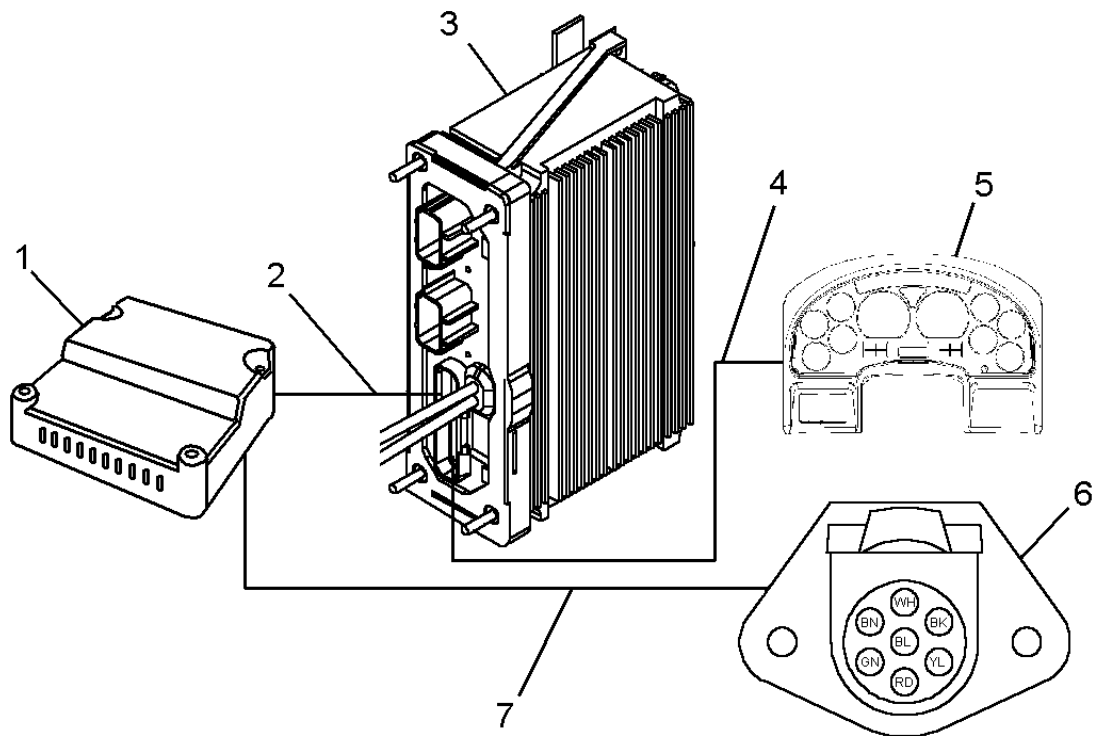


Figure 102 Trailer ABS Function Diagram

1. BENDIX EC-30 AIR ABS ELECTRONIC CONTROL UNIT
2. DRIVETRAIN 1939 DATA LINK
3. ELECTRICAL SYSTEM CONTROLLER
4. DRIVETRAIN 1939 DATA LINK
5. ELECTRONIC GAUGE CLUSTER
6. TRAILER SOCKET
7. POWER CIRCUITS TO AIR ABS CONTROLLER AND TRAILER SOCKET

Beginning March 1, 2001, all tractors used to tow trailers must have an in-cab trailer ABS warning lamp.

The request to illuminate this warning lamp originates from the air ABS controller and is communicated on the drive train 1939 data link. The air ABS controller also communicates with the trailer ABS controller over a power line carrier (PLC) on the blue wire of the trailer electrical socket.

The EGC activates the ABS warning lamp when it receives a message on the Drivetrain 1939 data link from the ESC. The ESC commands the EGC when it receives a message from the air ABS controller. The air ABS controller generates this information when it detects a fault from the trailer ABS controller or when trailer ABS is active.

The lamp should go out after the trailer ABS event is over, the fault is corrected and cleared or the trailer is disconnected.

See the appropriate air ABS and trailer ABS troubleshooting manuals for details.

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 doesn't come on when commanded by the trailer ABS controller, the problem may be in ESC/EGC programming, air ABS controller problems, EGC hardware or problems with the trailer ABS controller.

See the appropriate air ABS and trailer ABS troubleshooting manuals for details.

Table 41 Trailer ABS 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor commands from the ABS controller to the ESC with the "INTUNE" diagnostic software.	Commands from ABS controller are correct.	Go to next step.	Refer to the troubleshooting manual for the air ABS installed on the truck.
4.	On	Check for Trailer ABS Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 202) Read display on odometer.	Trailer ABS Lamp diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 202)	Go to next step
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 124)

Diagnostic Trouble Codes (DTC)

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

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

Table 42 Trailer ABS Lamp Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
2023 14 150 9 or 2023 14 250 9	Trailer ABS warning light malfunction on primary EGC (150) or secondary EGC (250)

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.

Extended Description

When the ignition is on the trailer ABS center pin relay will energize providing battery voltage to the blue connector of the trailer socket and the trailer ABS controller, when an ABS equipped trailer is connected.

The trailer ABS controller will transmit information to the air ABS controller over the battery power circuits.

When the air ABS controller receives a command from the trailer ABS controller the air ABS controller will transmit a message to the ESC to command the trailer ABS warning lamp on.

4.20. WASHER FLUID LOW WARNING LAMP

Circuit Function

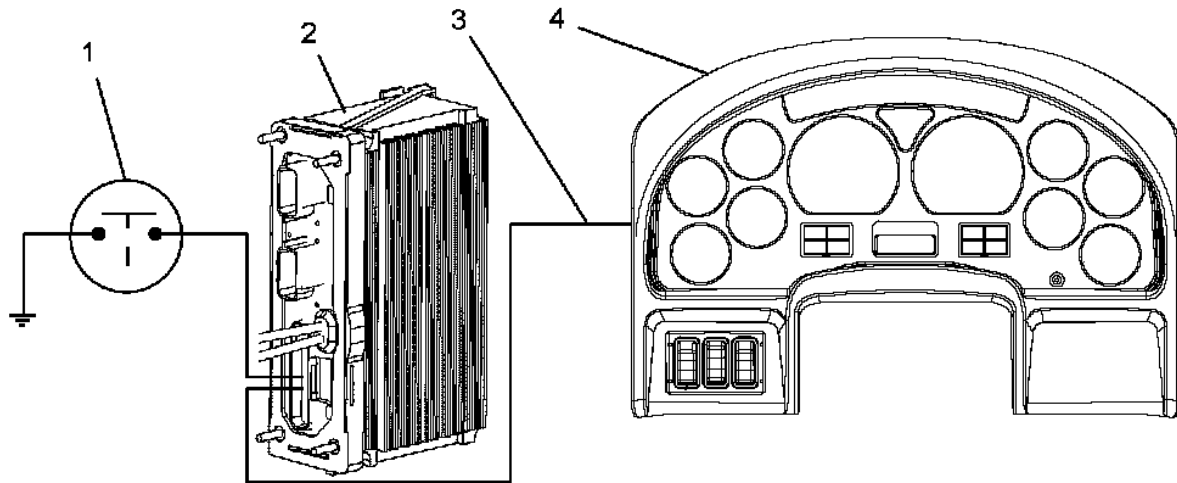


Figure 103 Washer Fluid Low Warning Lamp

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

The washer fluid low warning lamp lights when the washer fluid level is low.

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

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 doesn't 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 washer fluid sensor.

Table 43 Washer Fluid Low 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor inputs from the washer fluid sensor with the "INTUNE" diagnostic software.	Inputs are correct.	Go to next step.	Go to Fault Detection Management. (See Fault Detection Management, page 204)
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 124)

Fault Detection Management

The service tool (EZ-Tech) running the "INTUNE" 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 doesn't come on when the washer fluid level is low, the problem may be in ESC/EGC programming, ESC/EGC hardware or problems with the sensors or sensor wiring to the ESC.

Refer to Washer Fluid Level Sensor Circuits.

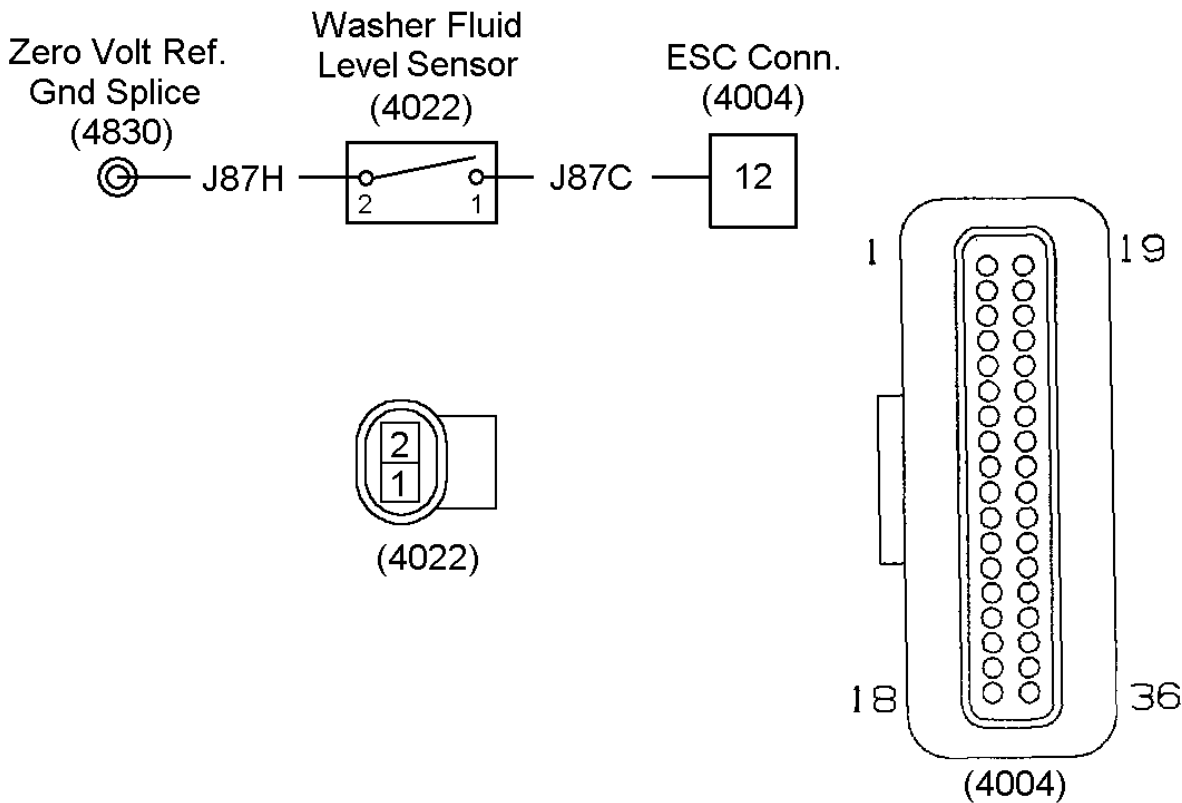


Figure 104 Washer Fluid Level Sensor Circuits

- (4004) 36-WAY SYSTEM CONTROLLER CONNECTOR ON ENGINE COMPARTMENT SIDE OF ESC
- (4022) WASHER FLUID LEVEL SENSOR CONNECTOR ON WASHER BOTTLE
- (4830) ZERO VOLT REFERENCE GROUND SPLICE LOCATED NEAR POWER DISTRIBUTION CENTER

Table 44 Washer Fluid Level Sensor Connector Chart

Diagnostic Trouble Codes		
There are no diagnostic trouble codes associated with the washer fluid level sensor circuits.		
Washer Fluid Level Sensor Harness Connector (4022) Voltage Checks		
Check with ignition on and (4022) disconnected.		
Test Points	Spec.	Comments

Table 44 Washer Fluid Level Sensor Connector Chart (cont.)

(4022) Harness connector, cavity 1 to ground	11 ± 1.5 volts	<p>If voltage is missing, check for open or short in circuit J87C.</p> <p>If circuits check good and fault is still present, verify voltage out of ESC.</p> <p>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</p>
<p align="center">Washer Fluid Level Sensor Harness Connector (4022) Resistance Checks</p> <p align="center">Check with (4022) disconnected.</p>		
Test Points	Spec.	Comments
(4022) Harness connector, cavity 2 to ground	<1 ohm	<p>If resistance is incorrect, check for open in circuit J87H.</p> <p>Also insure proper signal at (4830) from ESC.</p> <p>NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.</p>
<p align="center">Washer Fluid Level Sensor Resistance Checks</p> <p align="center">Check at sensor with (4022) disconnected.</p>		
Test Points	Spec.	Comments
Across washer fluid sensor terminals	<p>Washer bottle empty; >50K ohms</p> <p>Washer bottle full; <1 ohm</p>	If resistance is incorrect, replace failed sensor.

Extended Description

The ESC supplies 11 volts from system controller connector (4004) terminal 12 to washer fluid level sensor connector (4022) terminal 1.

Ground for the washer fluid level sensor is supplied from zero volt reference ground splice (4830) to washer fluid level sensor connector (4022) terminal 2.

When the washer fluid level drops below the switch, the switch will open removing the ground to the ESC. The ESC will send a message to the electronic gauge cluster commanding the washer fluid level warning light on.

4.21. WATER IN FUEL WARNING LAMP

Circuit Function

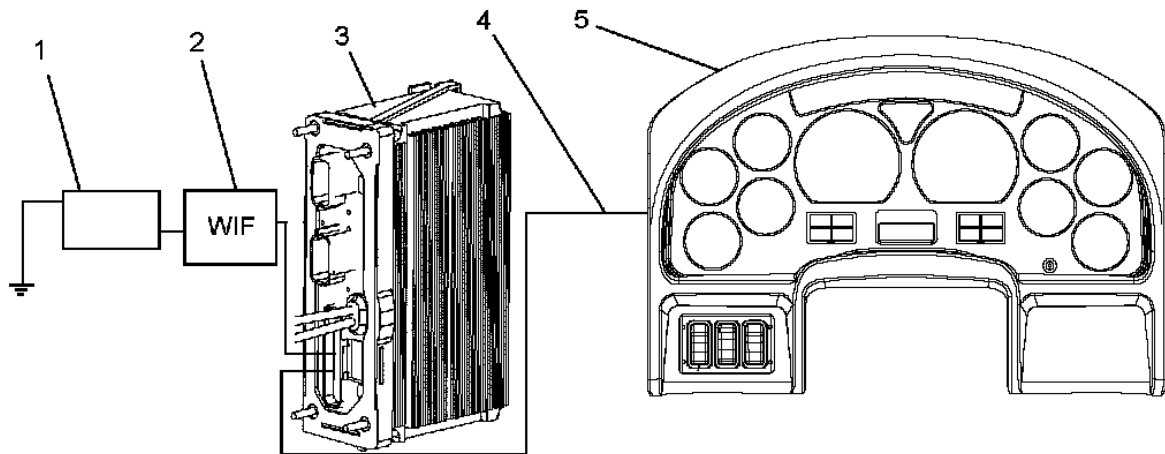


Figure 105 Water In Fuel Warning Lamp Function Diagram

1. WATER PROBE
2. WATER IN FUEL MODULE
3. ELECTRICAL SYSTEM CONTROLLER (ESC)
4. DRIVE TRAIN 1939 DATA LINK
5. 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 in fuel (WIF) module.

A short in the water in fuel probe, water in fuel (WIF) module 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 "INTUNE" 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 doesn't 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 in fuel module.

Table 45 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor inputs from the water in fuel module with the "INTUNE" diagnostic software.	Inputs are correct.	Go to next step.	Go to Fault Detection Management. (See Fault Detection/Management, page 209)
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 124)

Fault Detection/Management

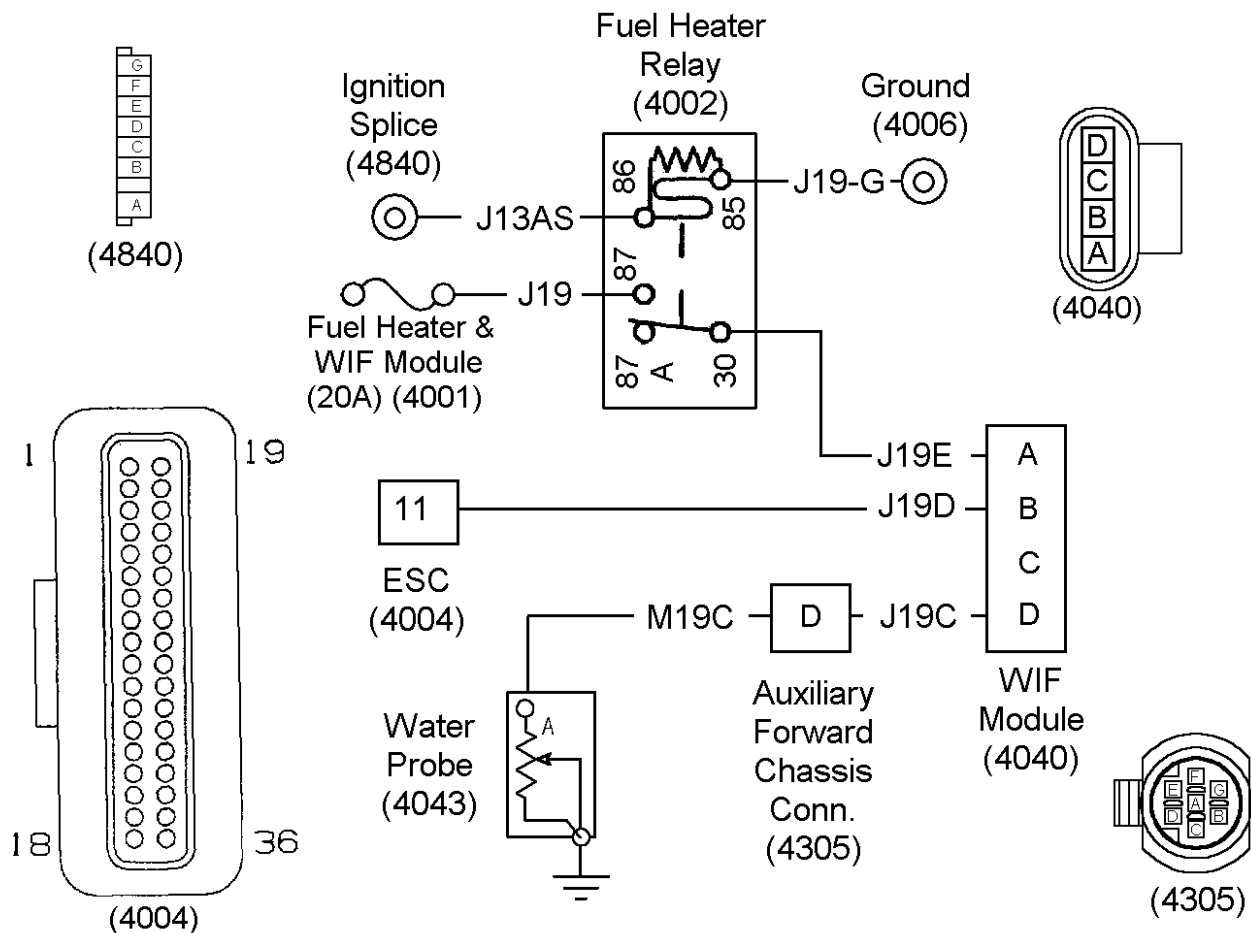


Figure 106 Water in Fuel Circuits (Frame Mounted Fuel Filter)—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (4001) MINI FUSE BLOCK
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
- (4002) FUEL HEATER RELAY
LOCATED IN ENGINE POWER DISTRIBUTION CENTER
- (4004) ELECTRICAL SYSTEM CONTROLLER (ESC) CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4006) GROUND
- (4040) WATER IN FUEL MODULE
LOCATED NEAR EXTERIOR DASH PANEL, LEFT SIDE
- (4043) WATER PROBE
LOCATED AT FUEL FILTER
- (4305) AUXILIARY FORWARD CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
- (4840) IGNITION SPLICE
LOCATED INSIDE POWER DISTRIBUTION CENTER

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the light.

To quickly verify operation of the water in fuel circuits, remove the connector from the water in fuel sensor. When the key is on the WIF warning lamp should not be illuminated. Connect a jumper from the sensor harness connector 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 doesn't come on when there is water in the fuel, the problem may be in ESC/EGC programming, ESC/EGC hardware, water in fuel probe, water in fuel (WIF) module or wiring to the ESC.

Table 46 Water in Fuel Warning Lamp Circuits Voltage Check Chart

Water in Fuel Module Connector (4040) Voltage Checks (Check with Water in Fuel Module Disconnected and the Ignition Key "On")		
NOTE – Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(4040) harness connector, cavity A to ground.	12 ± 1.5 volts	If voltage is incorrect, check for voltage from fuel heater relay. Also check circuit J19E for an open or short circuit.
(4040) harness connector, cavity A to cavity B.	12 ± 1.5 volts	If voltage is incorrect, check circuit J19D for an open circuit. If no opens exist, there is a problem with the ESC.
Water Probe Connector (4043) voltage Checks (Check with WATER in Fuel Module Connected, Water Probe Connector Disconnected and the Ignition Key "On")		
Test Points	Spec.	Comments
(4043) harness connector, terminal A to ground.	12 ± 1.5 volts	If voltage is incorrect, check for opens or shorts in circuits K19C or J19C. If no circuits are open or shorted, replace the WIF module. If voltage is correct and the feature is not operating correctly, replace the sensor.
There are no diagnostic trouble codes associated with this feature.		

Extended Description

With the key on, 12 volts from mini fuse block (4001) is supplied on circuit J19E to WIF module connector (4040) terminal A.

The ground path for the water-in-fuel module (432) 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 module.

When the water-in-fuel module becomes energized, power is supplied on circuit J19D to ESC connector (4004) terminal 11. This will cause the ESC to send a message to the EGC to illuminate the warning lamp.

4.22. COOLANT LEVEL WARNING LAMP

Circuit Function

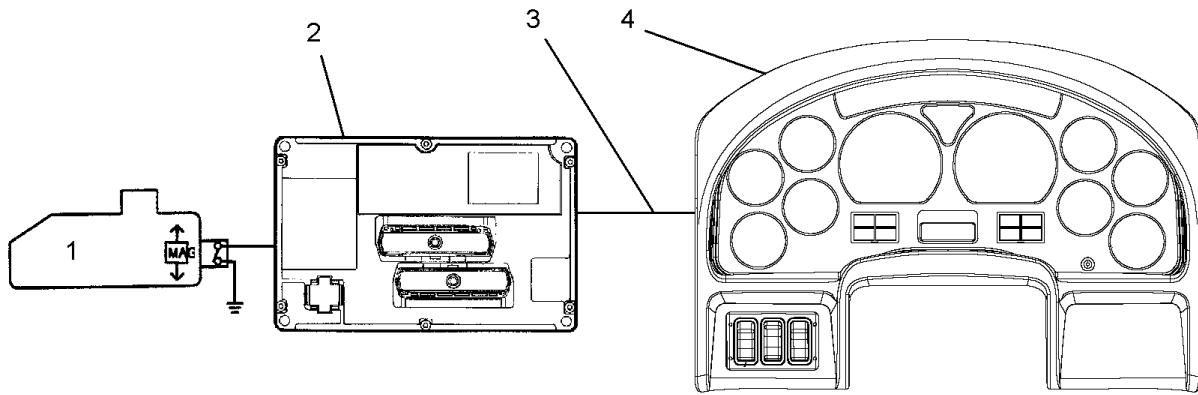


Figure 107 Coolant Level Warning Lamp Diagram

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 INTUNE 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 47 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 doesn't 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 114)
3.	On	Attempt to exercise the coolant warning lamp with the "INTUNE" diagnostic software.	Coolant warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
4.	On	Use "INTUNE" 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 124)

4.23. PARK BRAKE WARNING LAMP

Circuit Function

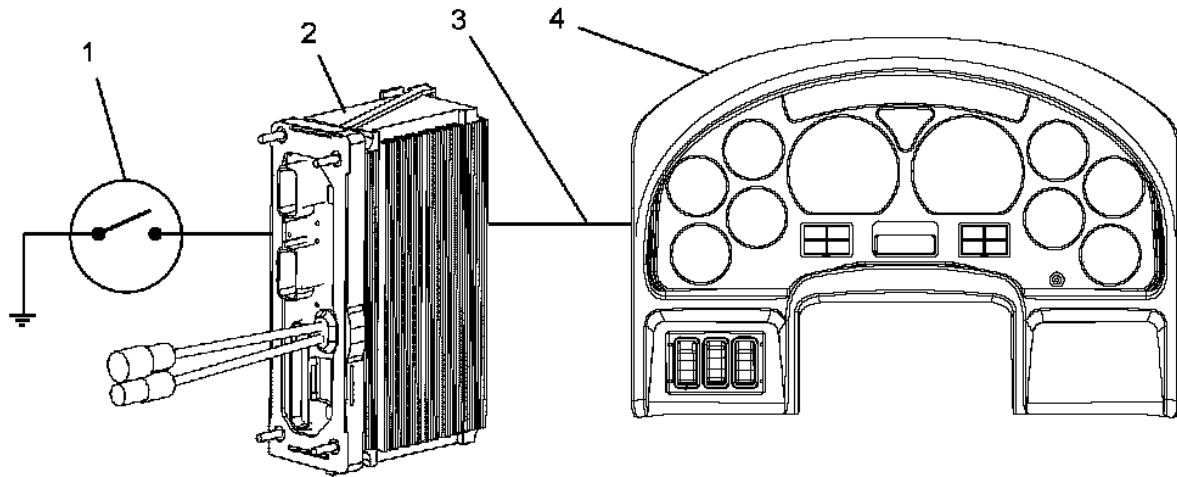


Figure 108 Park Brake Warning Lamp Function Diagram

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 "INTUNE" 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 doesn't 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 48 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning Lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Check for Park Brake Warning Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 214) Read display on odometer.	Park Brake Warning Lamp diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 215)	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 124)

Diagnostic Trouble Codes (DTC)

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

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

Table 49 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 "INTUNE" 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 doesn't come on when the park brake is on, the problem may be in ESC/EGC programming, ESC/EGC hardware, the park brake switch or the park brake switch wiring to the ESC.

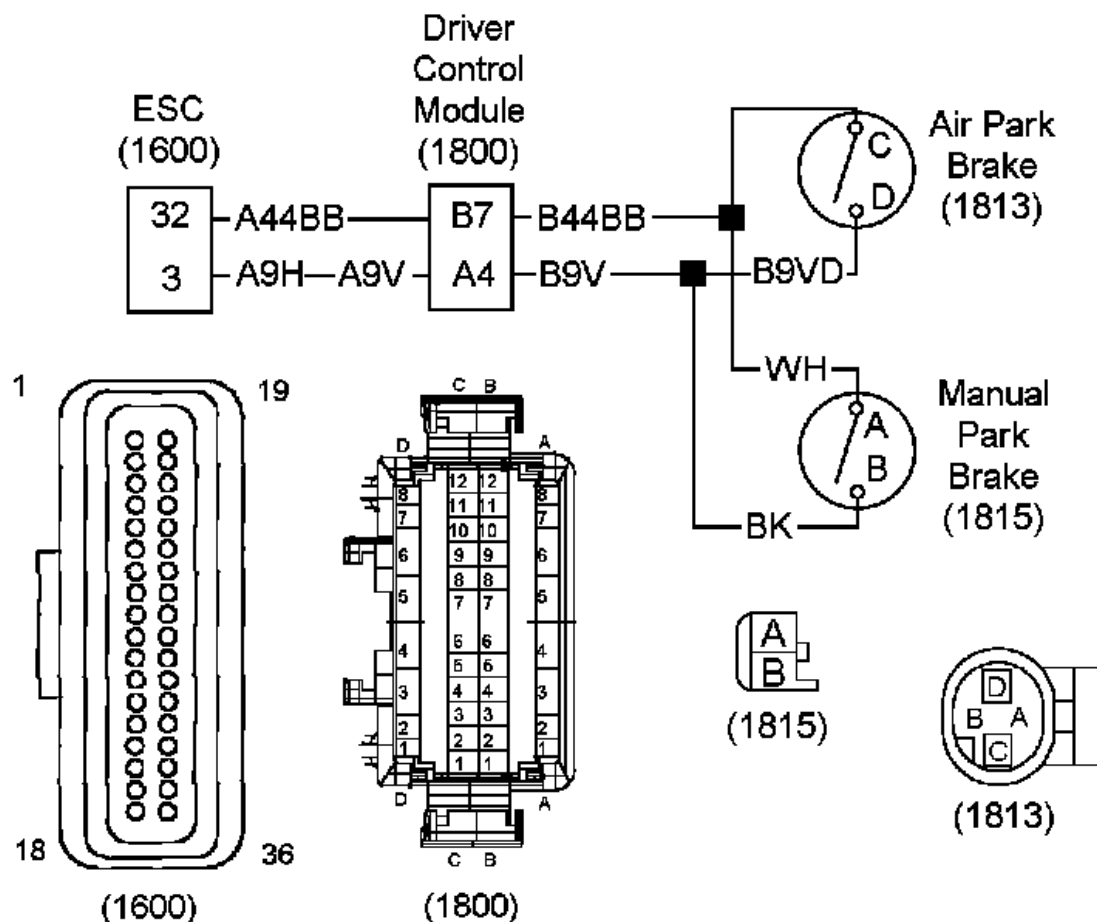


Figure 109 Park Brake Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (1600) ESC CONNECTOR
LOCATED ON CAB SIDE OF ESC
- (1800) DRIVER CONTROL MODULE CONNECTOR
LOCATED TO THE RIGHT OF STEERING COLUMN
- (1813) PARK BRAKE SWITCH (WITH AIR BRAKES)
LOCATED NEAR ENGINE CONTROLLER
- (1815) PARK BRAKE SWITCH (WITH HYDRAULIC BRAKES)
LOCATED NEAR ENGINE CONTROLLER

Table 50 Park Brake Lamp Circuits Voltage Check Chart

Park Brake Switch Connector (1813) or (1815) Voltage Checks (Check with Brake Switch Disconnected and the Ignition Key "On")		
Test Points	Spec.	Comments
(1813) harness connector, cavity C or (1815) cavity A to ground.	12 ± 1.5 volts	If voltage is incorrect, check circuit B44BB or A44BB for open or short circuits. If circuits check good voltage is missing from ESC connector (1600) pin 32.
(1813) harness connector, cavity C or (1815) cavity A to (1813) cavity D or (1815) cavity B.	12 ± 1.5 volts	If voltage is correct and condition still exists, the brake switch has failed. Replace brake switch. If voltage is incorrect, check circuit B9V, A9V or A9H for an open circuit or good connection to ground.
There are no diagnostic trouble codes associated with this feature.		

Extended Description

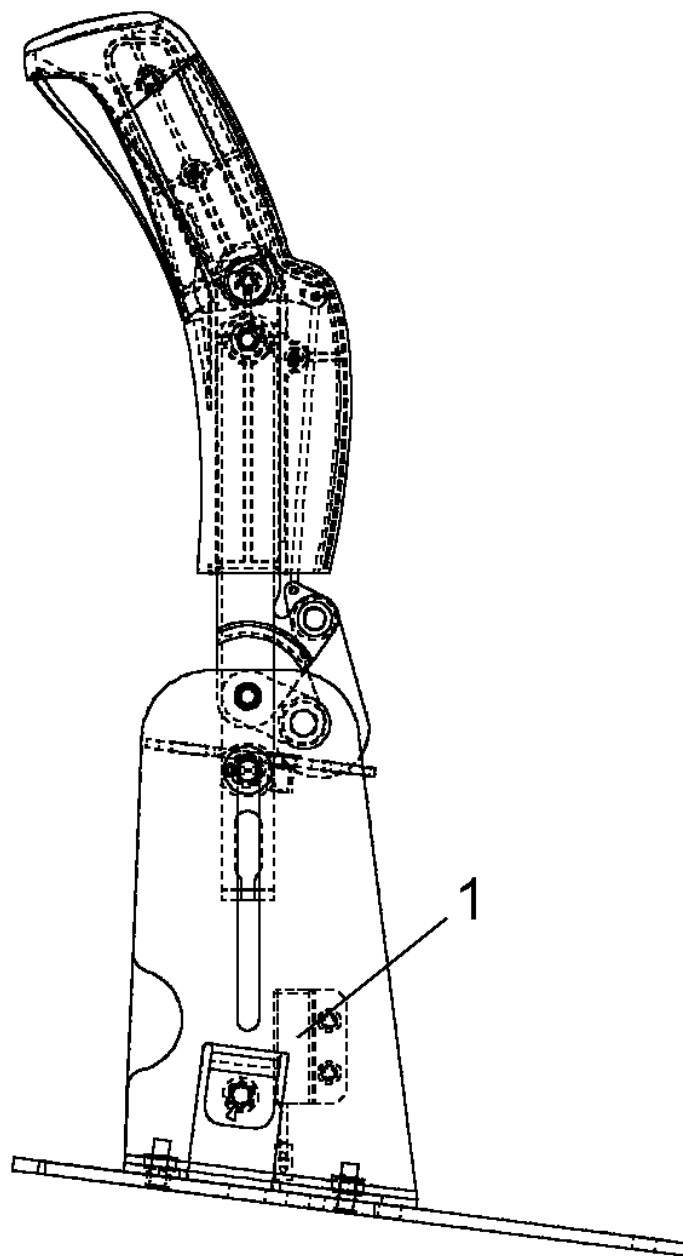
On vehicles with hydraulic brakes, the zero volt reference level is supplied from ESC connector (1600) terminal 3 to park brake switch connector (1815) terminal B.

On vehicles with air brakes, the zero volt reference level is supplied from ESC connector (1600) terminal 3 to park brake switch connector (1813) terminal C.

When the park brake is engaged the switch is closed and the zero volt reference level is supplied to ESC connector (1600) terminal 32 signaling the ESC that the park brake has been applied.

Component Locations

3541521C2

**Figure 110 Park Brake Switch Location (With Hydraulic Brakes)**

1. PARK BRAKE SWITCH

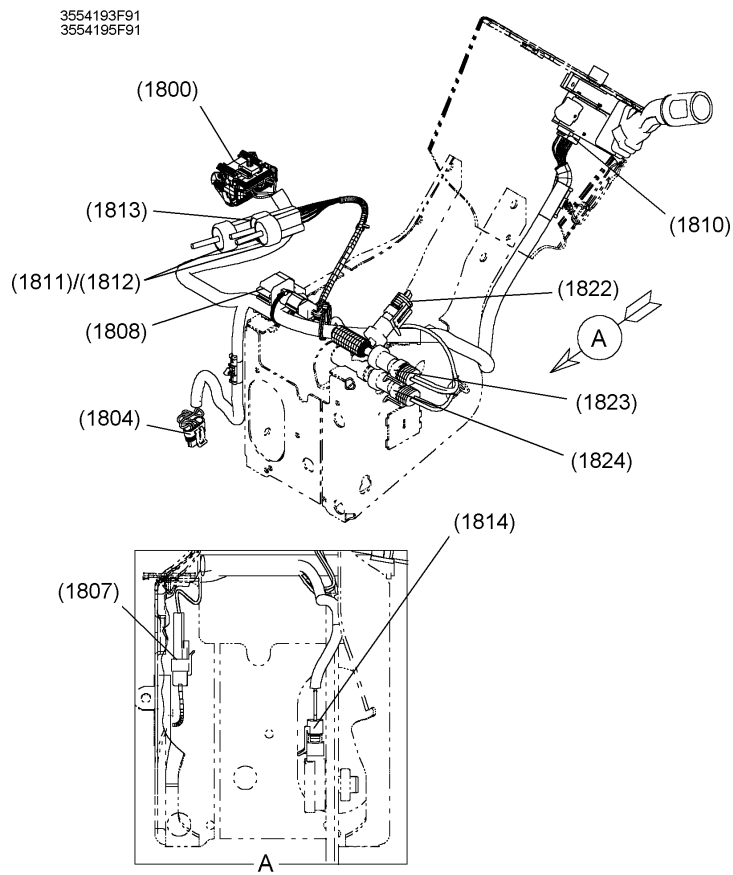


Figure 111 Air Park Brake Switch Location (Steering Column Support View)

(1813) PARK INDICATION PRESSURE SWITCH

(1800) DCM CONNECTOR

4.24. SERVICE PARK BRAKE WARNING LAMP

Circuit Function

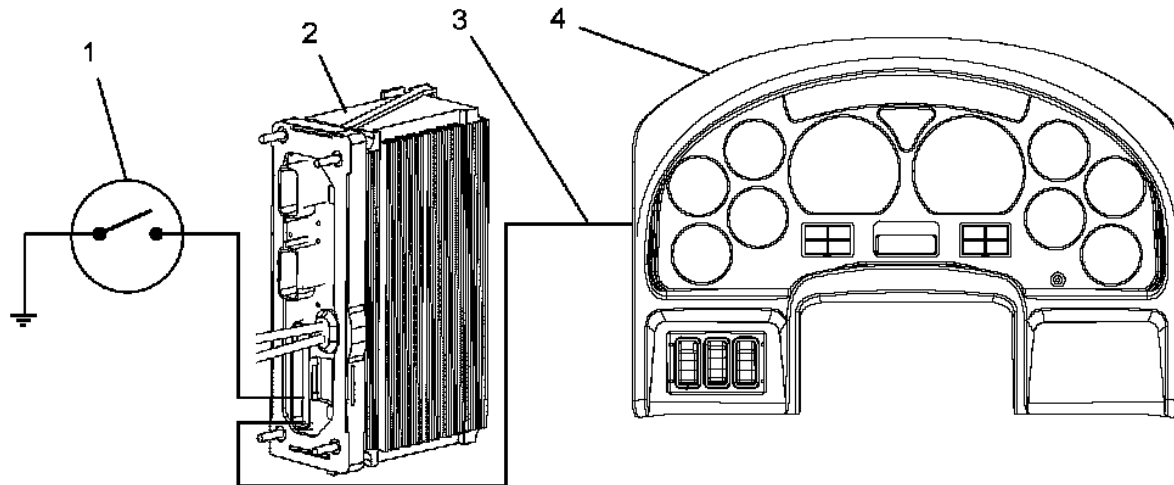


Figure 112 Service Park Brake Warning Lamp Function Diagram

1. AIR ACTUATED PARK BRAKE SAAR 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 / Air Release (SAAR) Chamber used on the powered park brake system. The powered park brake system is an option for vehicles equipped with a hydraulic park brake system.

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

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

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

Outputs:

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

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

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

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 "INTUNE" 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 Air Powered Park Brake is stuck. This 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.

The Service Park Brake Warning lamp is on when the auto apply portion with the Air 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 air lines between the auto apply relay and the Park Brake switch.

If the lamp stays on continuously or doesn't 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 51 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" 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.

Table 51 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 222) Read display on odometer.	Service Park Brake Warning Lamp diagnostic trouble codes are active.	Go to the Air Actuated Park Brake in the Chassis Features section of the manual.(See AIR Actuated Park Brake, page 815)	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 124)

Diagnostic Trouble Codes (DTC)

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

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

Table 52 Service Park Brake Warning Lamp Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
70 14 1 0	<p>Air Powered Park Brake is stuck.</p> <p>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.</p>
70 14 1 1	<p>The auto apply portion with the Air Powered Park Brake is not operating.</p> <p>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.</p>

4.25. CRUISE CONTROL LAMP

Circuit Function

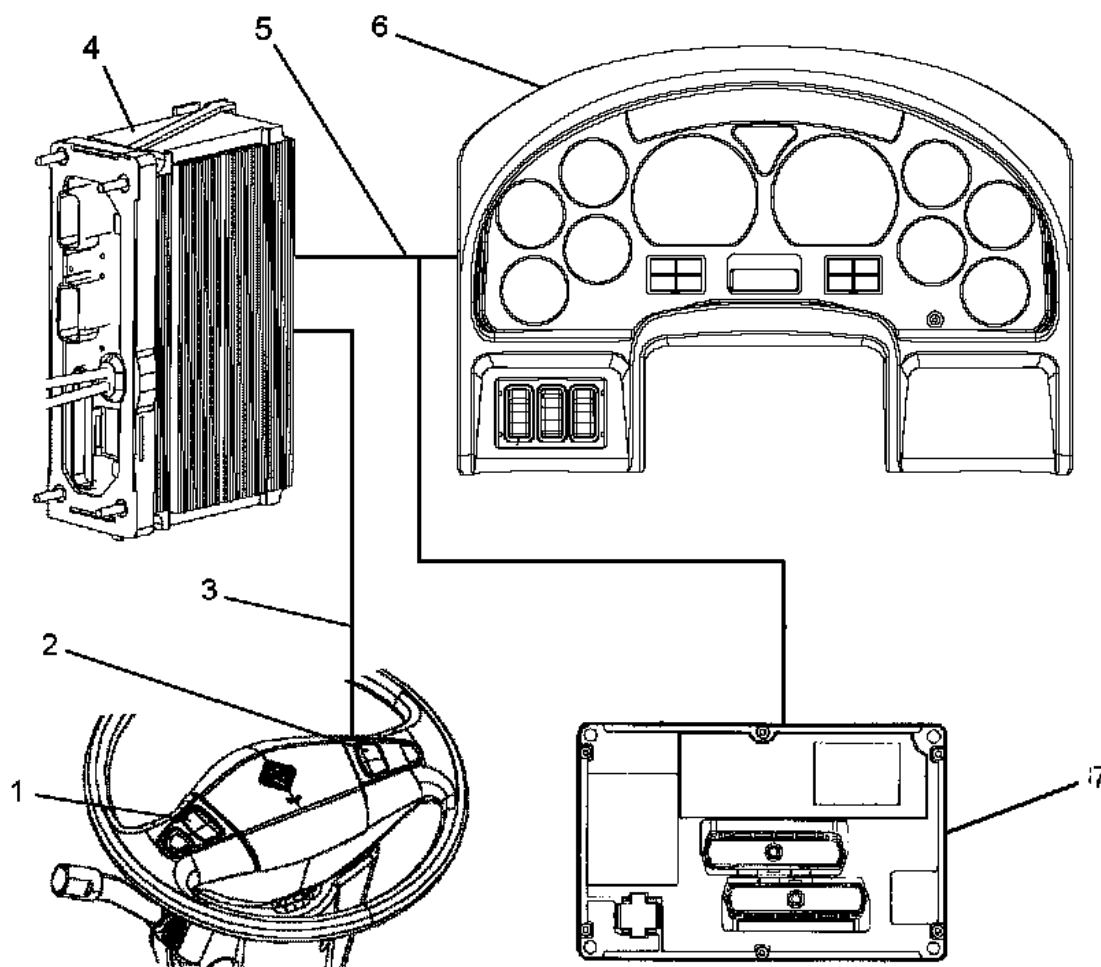


Figure 113 Cruise Control Lamp Function Diagram

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 "INTUNE" diagnostic software can be used to illuminate all of the warning lamps and monitor inputs to the ESC from the cruise control switches on the steering wheel.

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

For problems with the cruise control activating refer to Cruise Control.

There are no diagnostic trouble codes for cruise control circuits

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

Table 53 Cruise Control Lamp Preliminary Check

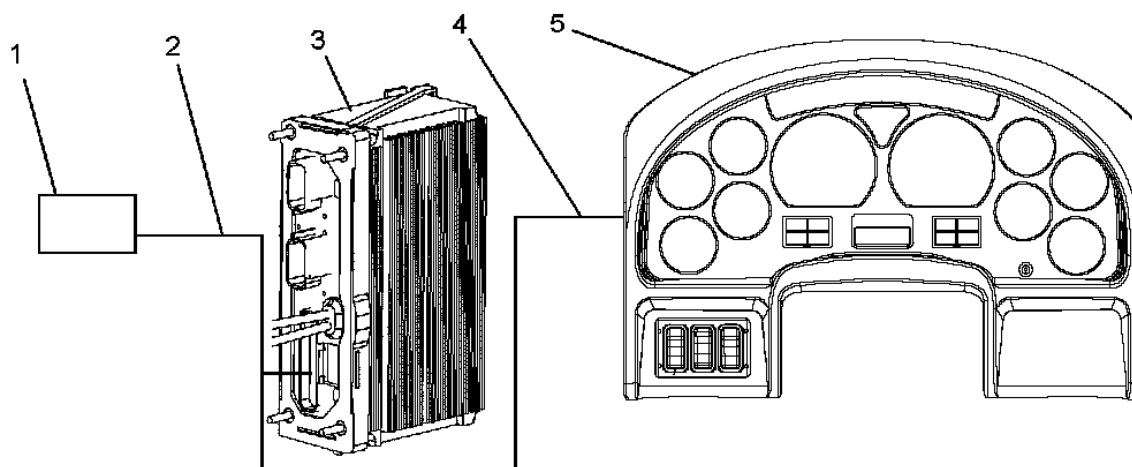
STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Verify cruise control is functioning. Insure the brake and clutch are released, there are no active brake or clutch DTC's and no ABS/ATC events.	Cruise control is functioning.	Go to next step.	Go to Cruise Control.
2.	Off/On	Connect diagnostic 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 114)
3.	On	Attempt to exercise the cruise lamp with the "INTUNE" diagnostic software.	Cruise lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.

Table 53 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 "INTUNE" 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 124)	Message from engine controller is not being transmitted. Refer to the engine troubleshooting manual for the engine installed in the vehicle.

4.26. ABS WARNING LAMP

Circuit Function

**Figure 114 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 "INTUNE" 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 doesn't 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 54 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" 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.
3.	On	Check for ABS Warning Lamp diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 227) Read display on odometer.	ABS Warning Lamp diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 228)	Go to next step
4.	On	Monitor the inputs for the warning lamp with the "INTUNE" diagnostic software.	Inputs are correct.	Go to next step.	Refer to the troubleshooting manual for the specific ABS installed on the truck.

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 **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)

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.

4.27. WAIT TO START WARNING LAMP

Circuit Function

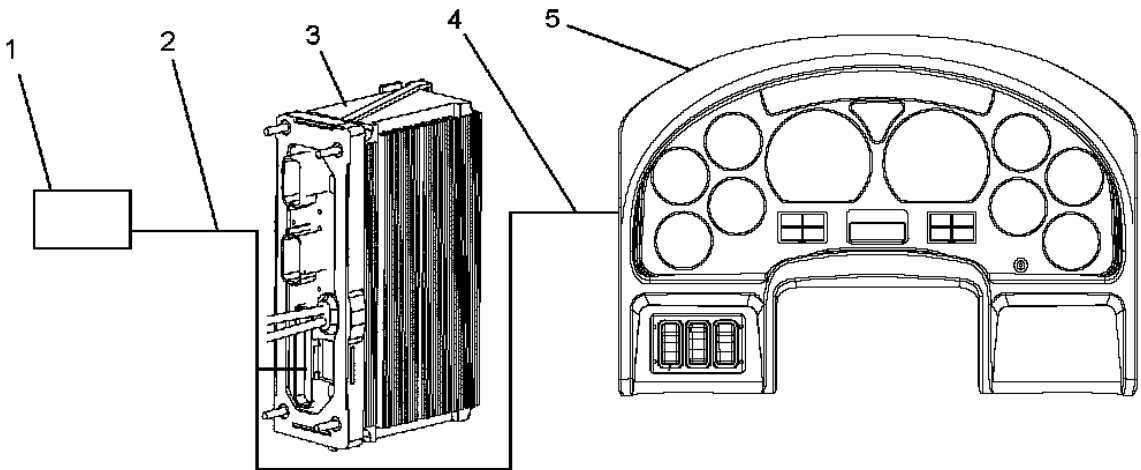


Figure 115 **“Wait To Start” Warning Lamp Function Diagram**

- 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 "INTUNE" 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 doesn't 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 56 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" 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.

4.28. CHECK A/C WARNING LAMP

Circuit Function

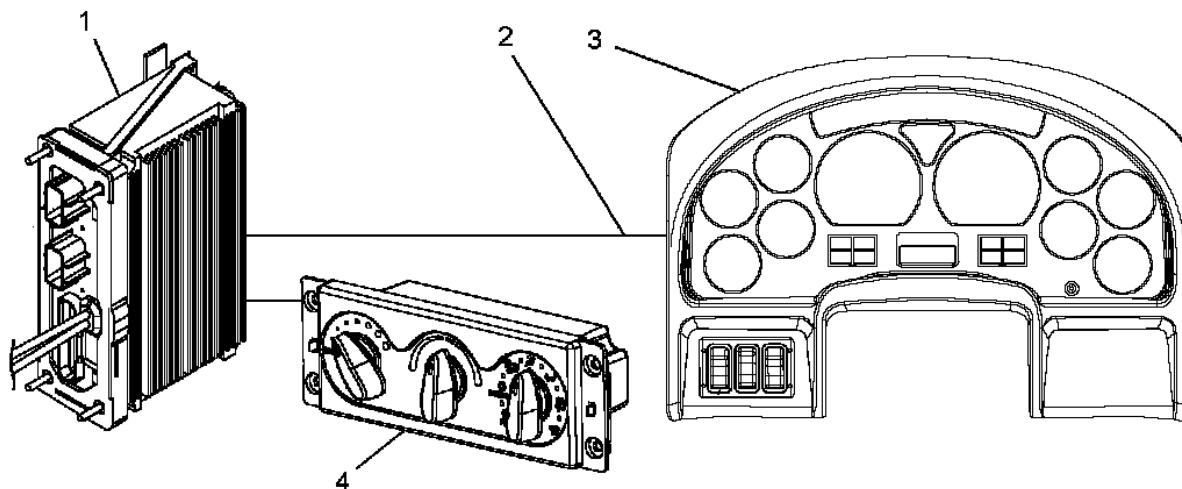


Figure 116 Check A/C Warning Lamp Function Diagram

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

The EGC activates the check A/C 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 determines there is a failure in the air conditioning system or the HVAC control head notifies it of an HVAC failure.

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 when there is not an HVAC system failure or doesn't come on when there is an HVAC system failure, the problem may be in ESC/EGC programming, ESC/EGC hardware, or problems with the HVAC control head or control head circuits.

Refer to the Heater and Air Conditioner (HVAC) section of this manual.

Table 57 Check A/C 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 114)
2.	On	Attempt to exercise the warning lamps with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Monitor the inputs to the ESC for the warning lamp with the "INTUNE" diagnostic software.	Inputs are correct.	Go to next step.	Refer to AC Compressor Circuits in the HVAC service manual section S160253.
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 124)

4.29. RETARD OVERHEAT WARNING LAMP

Circuit Function

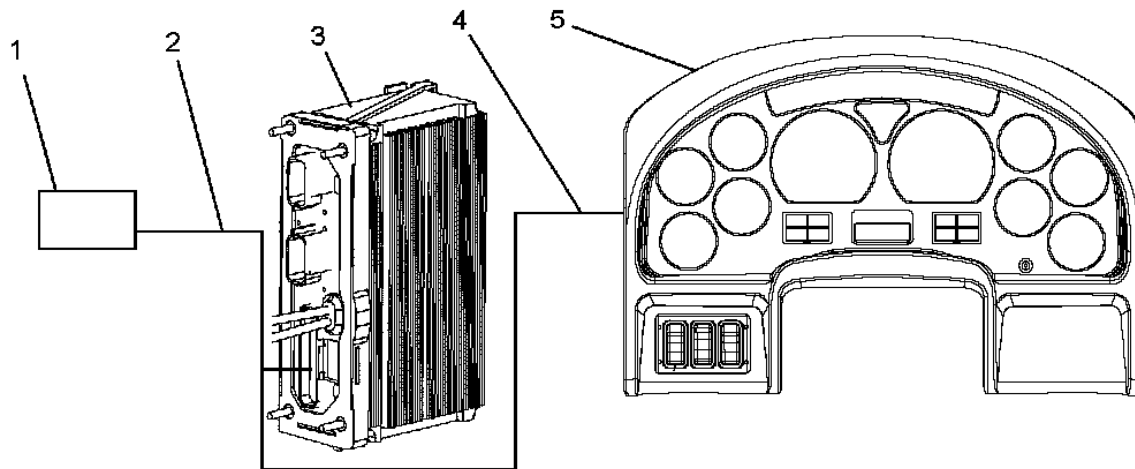


Figure 117 Retard Overheat Warning Lamp Function Diagram

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 "INTUNE" 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 doesn't 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.

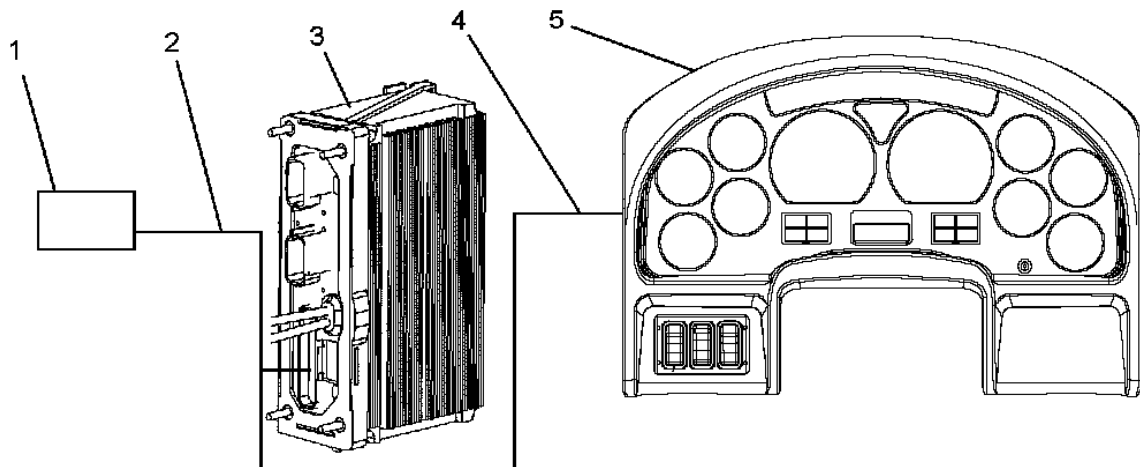
See the appropriate transmission manual for details.

Table 58 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 Programming in the Electrical System Controller section of this manual. (See PROGRAMMING, page 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" 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.

4.30. PTO/ THROTTLE WARNING LAMP

Circuit Function

**Figure 118 PTO/Throttle 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 PTO/throttle warning lamp when it receives a message on the drivetrain 1939 data link from the ESC. The ESC will generate this message when it receives a message from the engine controller that the PTO is engaged.

The lamp should go out when PTO is disengaged.

Diagnostics

The service tool (EZ-Tech) running the "INTUNE" 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 doesn't 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 engine manual for details on PTO operation.

Table 59 PTO/throttle 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 114)
2.	On	Attempt to exercise the warning lamp with the "INTUNE" diagnostic software.	Warning lamp responds to EGC diagnostic input.	Go to next step.	Insure bulb is not burned out. Replace EGC circuit board.
3.	On	Attempt to exercise the warning lamp with the "INTUNE" 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.

4.31. ALTERNATOR WARNING LAMP

Circuit Function

Refer to Alternator Warning Lamp Function Diagram.

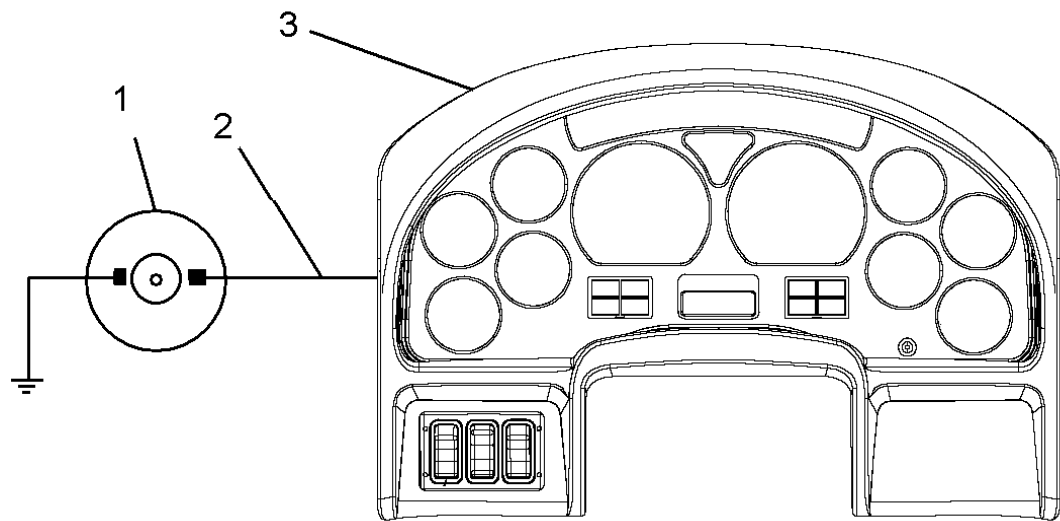


Figure 119 Alternator Warning Lamp Function Diagram

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.

4.32. DIFFERENTIAL LOCK WARNING LAMP

Circuit Function

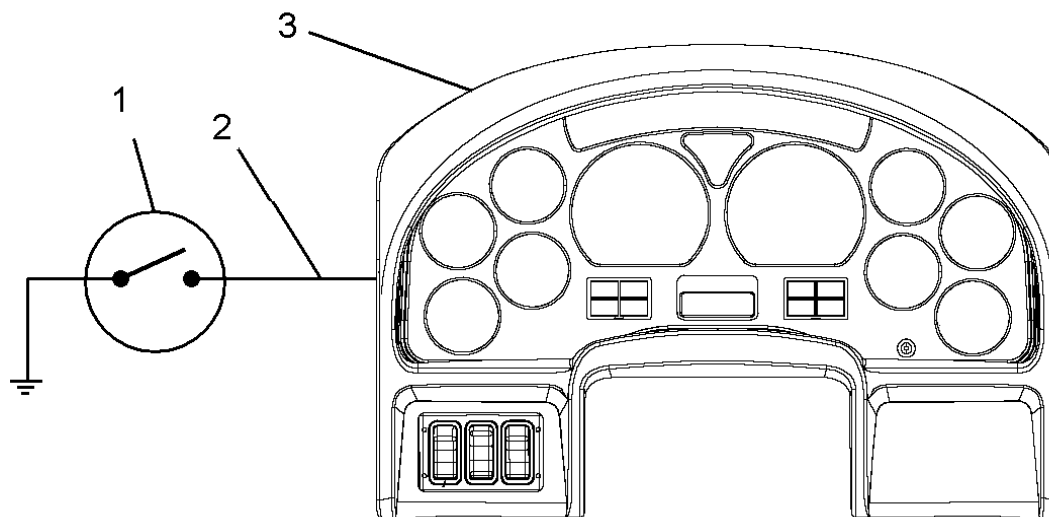


Figure 120 Differential Lock Warning Lamp Function Diagram

1. DIFFERENTIAL LOCK SWITCH (ON DIFFERENTIAL)
2. DIRECT CIRCUIT FROM DIFFERENTIAL TO WARNING LAMP
3. ELECTRONIC GAUGE CLUSTER (EGC)

The optional differential lock warning lamp is directly controlled by the switch on the axle differential. There is no interaction with the ESC.

On vehicles with dual rear axles, a separate warning lamp is provided for each axle.

Diagnostics

When the key is in ignition position, the light will illuminate when the differential is locked. The light will go out when the differential lock is released.

Table 60 Differential Lock Warning Lamp Preliminary Check

STEP	KEY	ACTION	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	On	Turn on differential lock switch.	Warning Lamp should come on.	Go to next step.	Insure bulb is not burned out. Check for open circuits between lamp and axle switch.
2.	On	Warning lamp should go out.	Warning lamp turns off.	Warning lamp is operating correctly.	Check for short to ground in circuits between lamp and axle switch. Also check for failed axle switch.

Fault Detection/Management

A fault in the differential lock warning lamps will be evident when the lamps fail to illuminate.

When the key is in ignition position, the light will illuminate when the differential is locked. The light will go out when the differential lock is released.

If the lamp fails to illuminate the bulb could be burned out or there could be a an open or shorted circuit between the axle switch and the lamp.

Refer to Differential Lock Warning Lights Circuit.

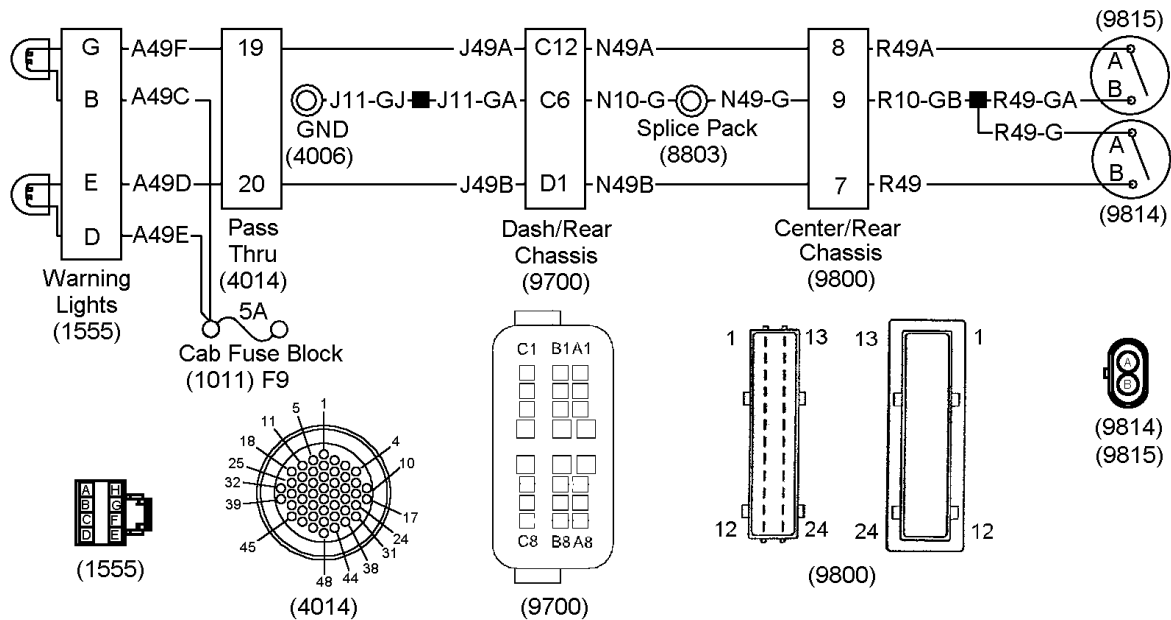


Figure 121 Differential Lock Warning Lights Circuit (Connectors Viewed From Mating End) — Always Refer to Circuit Diagram Book for Latest Circuit Information

- (1555) OPTIONAL WARNING LIGHT CONNECTOR
LOCATED ON EGC
- (4006) GROUND STUD
LOCATED ON DASH PANEL ABOVE ESC
- (4014) PASS THROUGH CONNECTOR
LOCATED ON DASH PANEL ABOVE ESC
- (8803) CHASSIS GROUND SPLICE PACK
LOCATED NEAR LEFT FRAME RAIL
- (9700) DASH/CENTER CHASSIS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME
- (9800) CENTER/REAR CHASSIS CONNECTOR
LOCATED BY LEFT FRAME RAIL NEAR REAR AXLES
- (9814) FRONT REAR AXLE DIFFERENTIAL LOCK SWITCH CONNECTOR
LOCATED ON AXLE
- (9815) REAR-REAR AXLE DIFFERENTIAL LOCK SWITCH CONNECTOR
LOCATED ON AXLE
- F9 OPTIONAL WARNING LIGHT FUSE
LOCATED ON FUSE BLOCK 1 OF CAB POWER DISTRIBUTION PANEL

Table 61 Rear-Rear Differential Lock Warning Light Voltage Check

Rear-Rear Warning Light Switch Connector (9815) Voltage Checks (Check with switch disconnected and the ignition key "On")		
Test Points	Spec.	Comments
(9815) harness connector, cavity A to ground.	12 ± 1.5 volts	Insure fuse and lamp are not open. If voltage is incorrect, check for open or short in circuits R49A, N49A, J49A or A49F.
(9815) harness connector, cavity A to B.	12 ± 1.5 volts	If voltage is incorrect, check for an open in circuits R49-GA, R10-GB, N49-G, N10-G, J11-GA or J11-GJ to ground. If voltage is correct and lamps do not light when the differential is locked, the axle switch has failed or is not actuating. Replace axle switch if it is faulty.

Table 62 Front Rear Differential Lock Warning Light Voltage Check

Front Rear Warning Light Switch Connector (9814) Voltage Checks (Check with switch disconnected and the ignition key "On")		
Test Points	Spec.	Comments
(9814) harness connector, cavity A to ground.	12 ± 1.5 volts	Insure fuse and lamp are not open. If voltage is incorrect, check for open or short in circuits R49, N49B, J49B or A49D.
(9814) harness connector, cavity A to B.	12 ± 1.5 volts	If voltage is incorrect, check for an open in circuits R49-G, R10-GB, N49-G, N10-G, J11-GA or J11-GJ to ground. If voltage is correct and condition still exists, the axle switch has failed or is not actuating. Replace axle switch.

Extended Description

Battery voltage is applied to the warning light lamps from fuse F9 when the key is in the ignition position.

When the rear axle(s) are locked the axle switch(es) will close supplying a ground to the lamp(s) causing them to illuminate.

Snow Valve Warning Lamp

Refer to Snow Valve (Engine Intake). (See SNOW VALVE (ENGINE INTAKE), page 354)

Optimized Idle

This feature is not implemented.

4.33. VOLTMETER

Circuit Function

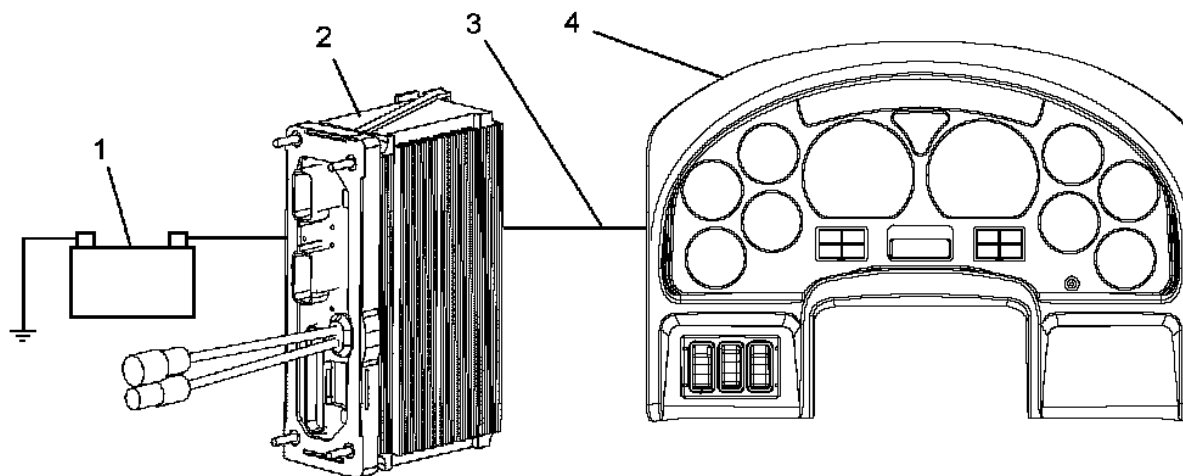


Figure 122 Voltmeter Function Diagram

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 "INTUNE" 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 63 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 and Install.
2.	On	Check for Voltmeter gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 241) Read display on odometer.	Voltmeter gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 242)	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 "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	If gauge responds to diagnostic tool, but doesn't 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 124)				

Diagnostic Trouble Codes (DTC)

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

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

Table 64 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)	Voltmeter 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)	Voltmeter gauge 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)	Voltmeter gauge data missing to primary EGC (109) or secondary EGC (209) 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.

4.34. ENGINE COOLANT TEMPERATURE GAUGE

Circuit Function

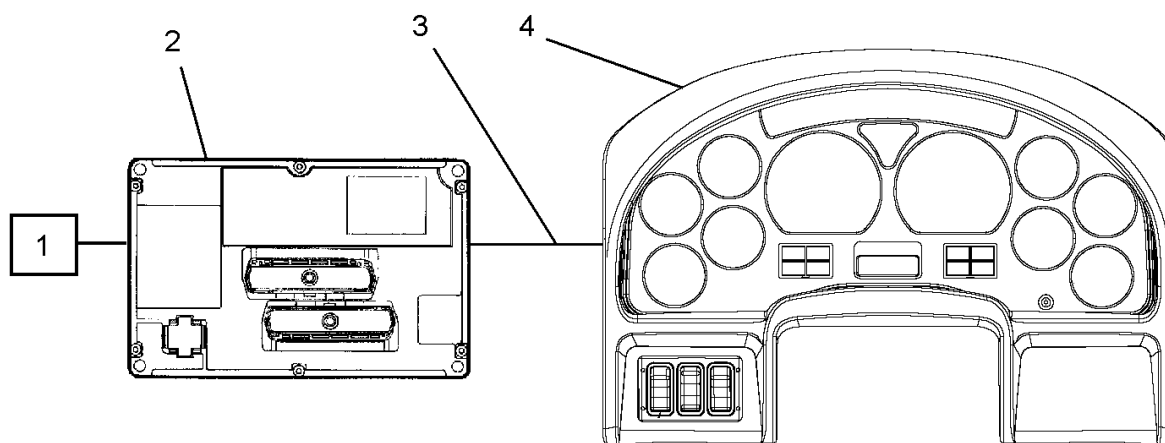


Figure 123 Engine Coolant Temperature Gauge Function Diagram

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 "INTUNE" 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 65 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 and Install.
2.	On	Check for Engine Coolant Temperature gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 244) Read display on odometer.	Engine Coolant Temperature gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 245)	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 "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	If gauge responds to diagnostic tool, but doesn't 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 124)				

Diagnostic Trouble Codes (DTC)

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

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

Table 66 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.

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.

4.35. ENGINE OIL PRESSURE GAUGE

Circuit Function

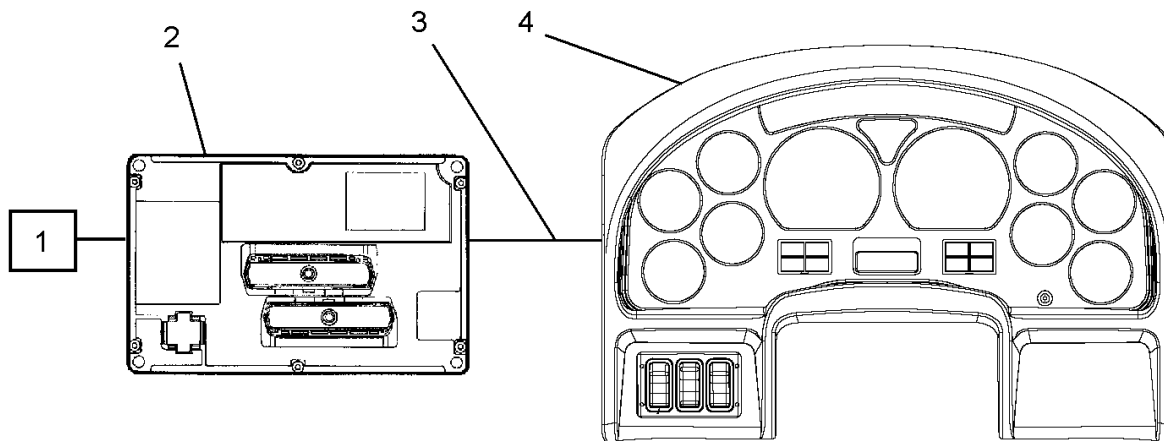


Figure 124 Engine Oil Pressure Gauge Function Diagram

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 "INTUNE" 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 67 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 and Install.
2.	On	Check for Engine Oil Pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 247) Read display on odometer.	Engine Oil Pressure gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 248)	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 "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	If gauge responds to diagnostic tool, but doesn't 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 124)				

Diagnostic Trouble Codes (DTC)

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

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

Table 68 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.

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.

4.36. ENGINE OIL TEMPERATURE GAUGE

Circuit Function

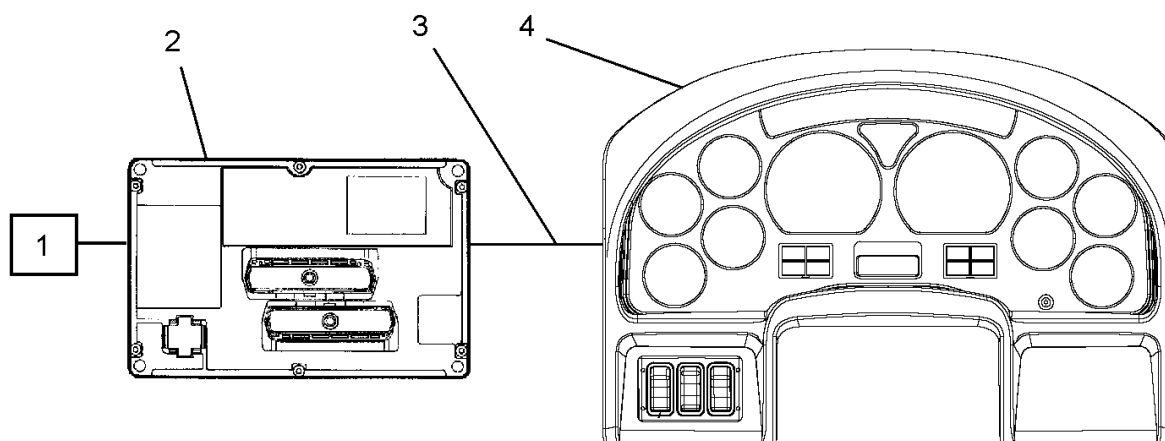


Figure 125 Engine Oil Temperature Gauge Function Diagram

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

Information driving the engine oil temperature 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 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 "INTUNE" diagnostic software can be used to check operation of the gauge.

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

Problems with the engine oil 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 oil temperature sensor or a problem with wiring to the sensor.

Table 69 Engine Oil Temperature Gauge 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 and Install.
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	Check for Engine Oil Temperature Gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 250) Read display on odometer.	Engine Oil Temperature Gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 251)	Go to next step
4.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	Go to next step.	Verify jumper harness between gauge and circuit board is in correct locations. If jumper locations are correct, replace EGC circuit board.
5.	On	Engine oil temperature message is not being generated by the engine controller. Refer to the applicable engine troubleshooting manual for this vehicle.			

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.

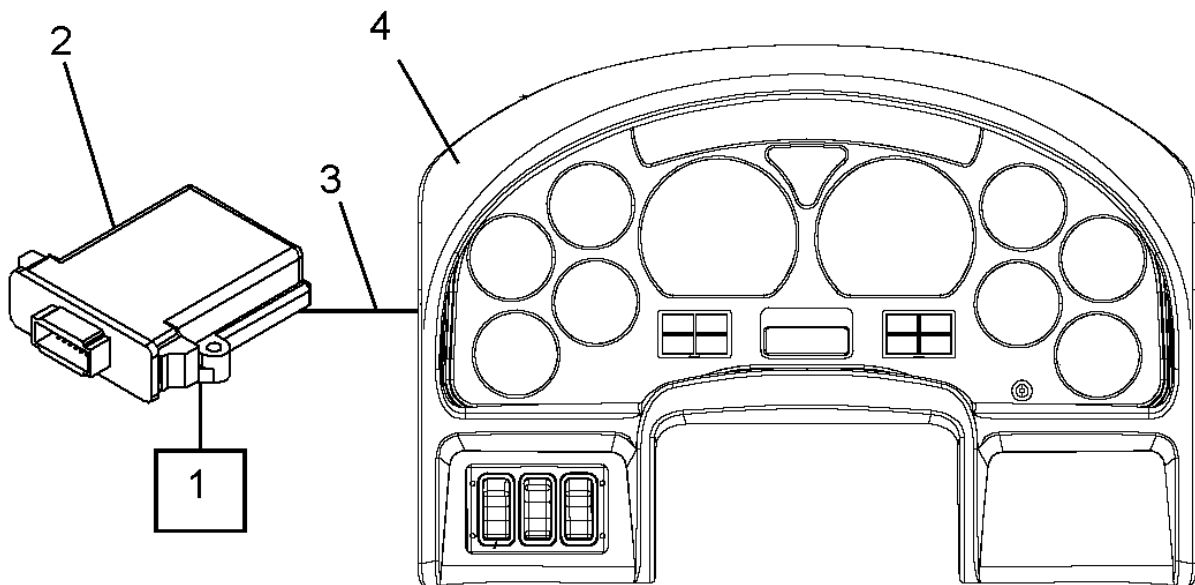
The previously active diagnostic trouble codes may be cleared, while in the diagnostic mode, by turning on the left turn signal and pressing the cruise on and set switches simultaneously.

Table 70 Engine Oil Temperature Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 33 1	Engine Oil Temperature/Power Park Brake out of range low Short to ground or open circuit
612 14 33 2	Engine Oil Temperature/Power Park Brake 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.

4.37. PYROMETER GAUGE**Circuit Function****Figure 126 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 "INTUNE" 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 71 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. Refer to Remove and Install.
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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
4.	Troubleshoot pyrometer module and sensor inputs. Pyrometer/ Ammeter Module (PAM)(See PYROMETER/AMMETER MODULE (PAM), page 811)					

4.38. SPEEDOMETER

Circuit Function

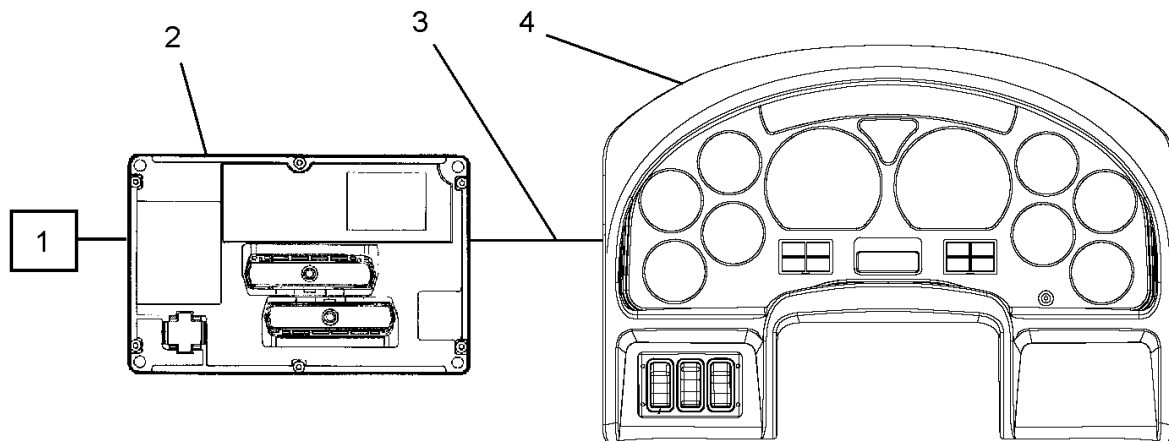


Figure 127 Speedometer Function Diagram

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 go to zero, sweep up to 50% and return to zero three times, there is a sensor error.

The service tool (EZ-Tech) running the "INTUNE" 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 72 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. Refer to Remove and Install.
2.	On	Check for Speedometer gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 254) Read display on odometer.	Speedometer gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 255)	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 "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	If gauge responds to diagnostic tool, but doesn't 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.	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 124)				

Diagnostic Trouble Codes (DTC)

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

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

Table 73 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.

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.

4.39. TACHOMETER

Circuit Function

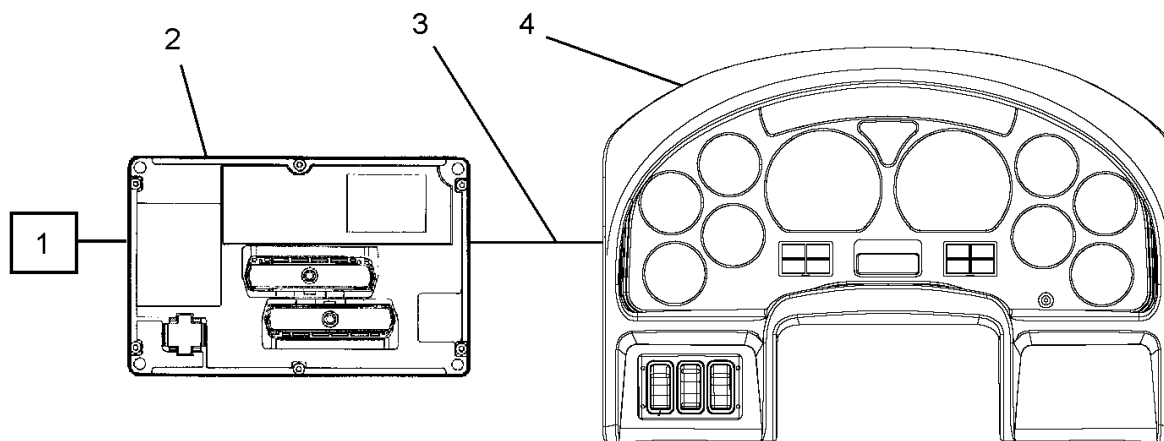


Figure 128 Tachometer Function Diagram

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 "INTUNE" 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 74 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 and Install.
2.	On	Check for Tachometer gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 257) Read display on odometer.	Tachometer gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 258)	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 "INTUNE" diagnostic software.	Gauge responds to "INTUNE" diagnostic input.	If gauge responds to diagnostic tool, but doesn't 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.	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 124)				

Diagnostic Trouble Codes (DTC)

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

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

Table 75 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.

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.

4.40. FUEL LEVEL GAUGE

Circuit Function

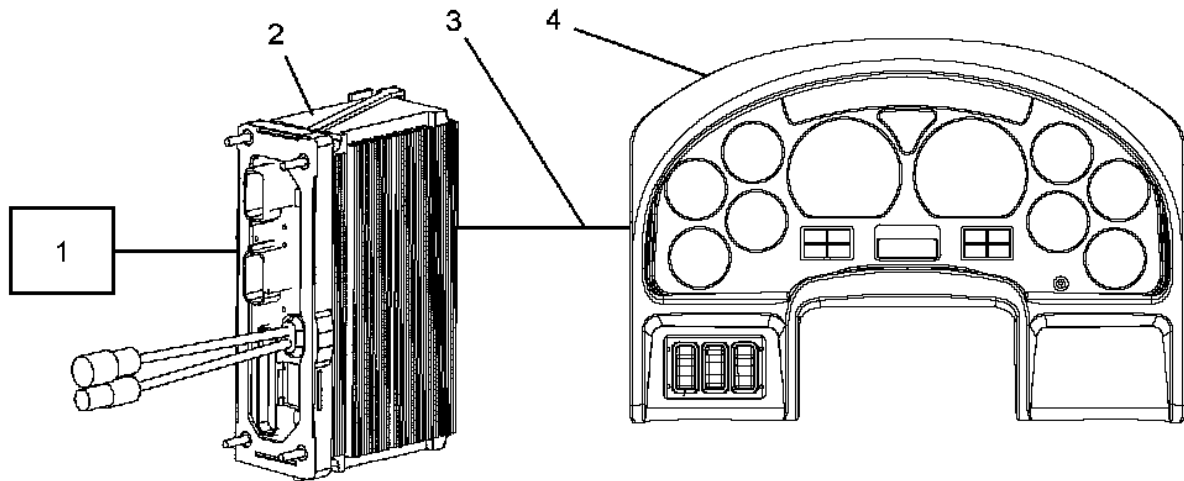


Figure 129 Fuel Level Gauge Function Diagram

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 "INTUNE" 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 76 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 and Install.
2.	On	Check for fuel level gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 260)	Read display on odometer.	Fuel level gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 262)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 77 Fuel Level Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 23 1	Driver fuel level sensor out of range low Short to ground
612 14 23 2	Driver fuel sensor out of range high Shorted high or open circuit
612 14 25 1	Passenger fuel level sensor out of range low Short to ground
612 14 25 2	Passenger fuel level sensor out of range high 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.
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.

NOTE – For vehicles with dual fuel tanks refer to the Fuel Transfer section of this manual. (See FUEL TRANSFER PUMP SYSTEM, page 689) The transfer pump circuits can affect fuel gauge operation.

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.

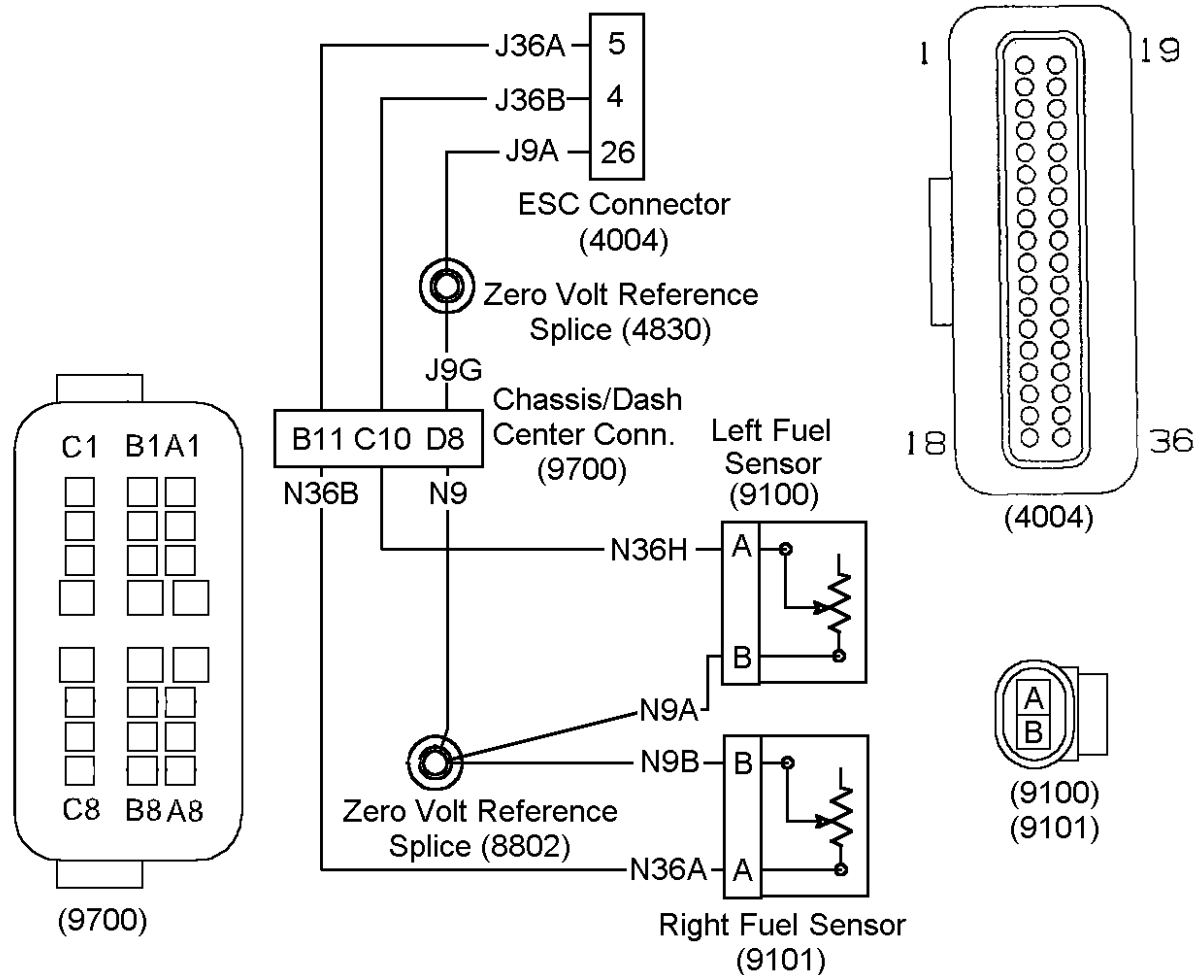


Figure 130 Fuel Sensor Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (4004) ELECTRICAL SYSTEM CONTROLLER (ESC) CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4830) ELECTRONIC REF GROUND SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
- (8802) ISOLATED GROUND SPLICE PACK
LOCATED CHASSIS
- (9100) LEFT FUEL SENSOR CONNECTOR
LOCATED IN LEFT DUAL FUEL TANKS
- (9101) RIGHT FUEL SENSOR CONNECTOR
LOCATED IN RIGHT DUAL FUEL TANKS
- (9700) CHASSIS/DASH INTERCONNECT
LOCATED IN REAR CHASSIS

Table 78 Fuel Level Gauge Diagnostic Trouble Codes

612 14 23 1	Driver fuel level sensor out of range low Short to ground
612 14 23 2	Driver fuel sensor out of range high Shorted high or open circuit
612 14 25 1	Passenger fuel level sensor out of range low Short to ground
612 14 25 2	Passenger fuel level sensor out of range high 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.
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 79 Fuel Level Gauge Tests

Left Fuel Level Gauge Voltage Checks Check with ignition on and fuel level sensor disconnected. NOTE – Always check connectors for damage and pushed-out terminals. Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(9100) cavity A to ground.	10 ± 1 volts	If voltage is missing, check for open or shorts in circuit N36E, N36H or J36B to ESC connector (4004) cavity 4. If circuits check good, check for missing 10 volt signal from ESC.
(9100) cavity A to B.	10 ± 1 volts	If voltage is present replace or repair fuel sensor If voltage is missing, check for open in circuits N9A, N9, J9G or J9A to ESC connector (4004) cavity 26. If circuits check good, check for missing zero volt reference from ESC.

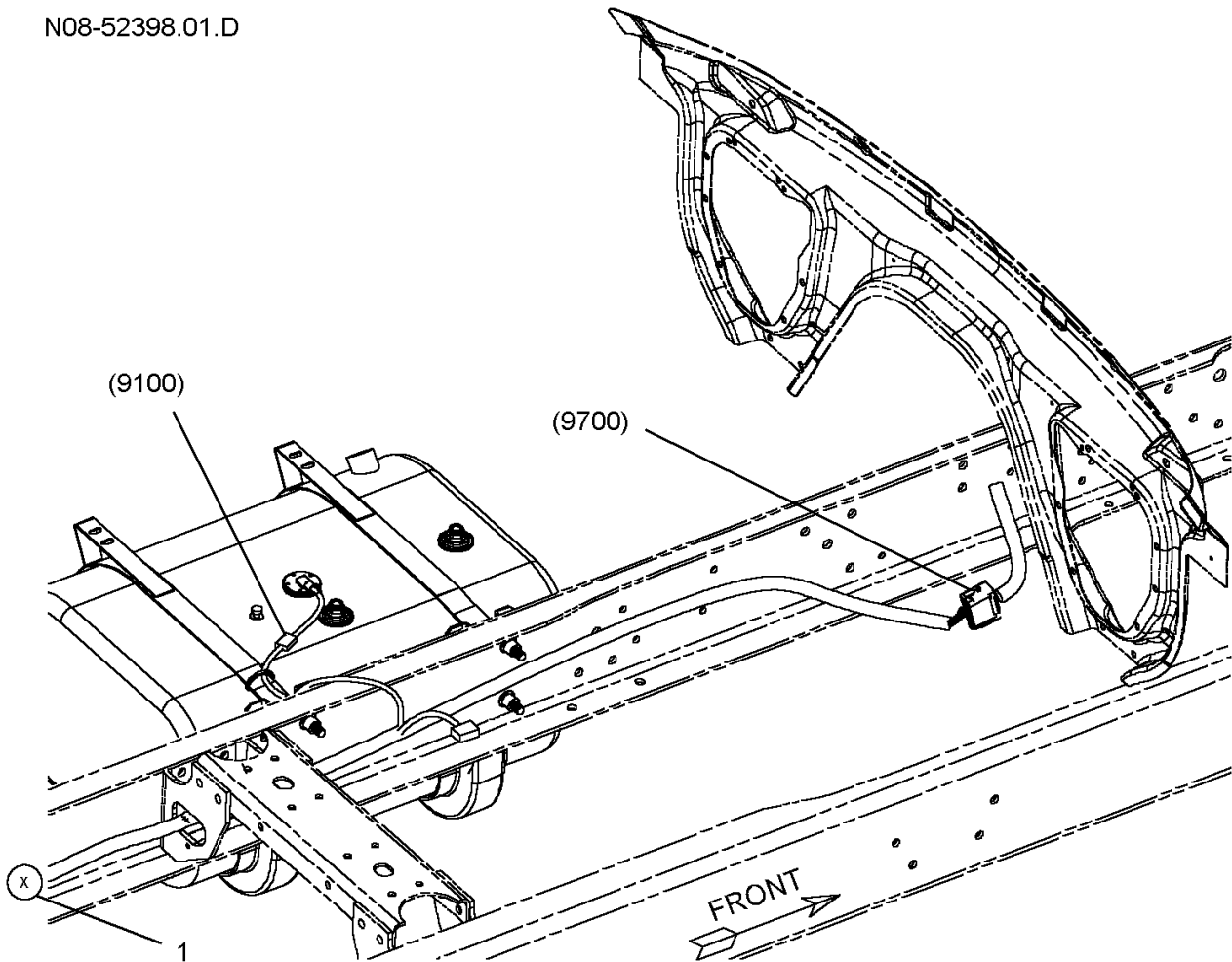
Extended Description

A zero volt reference signal from ESC connector (4004) terminal 26 is supplied to fuel sensor connector (9100) terminal B through circuits J9A, J9G, Dash/Chassis connector (9700) terminal D8, circuit N9 and N9A.

The signal from the fuel sensor is supplied from fuel sensor connector (9100) terminal A to ESC connector (4004) terminal 4 through circuit N36E, Dash/Chassis connector (9700) terminal C10, and circuit J36B.

Component Locations

N08-52398.01.D

**Figure 131 Fuel Sensor Connector Locations**

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

4.41. TRANSMISSION OIL TEMPERATURE GAUGE

Circuit Function

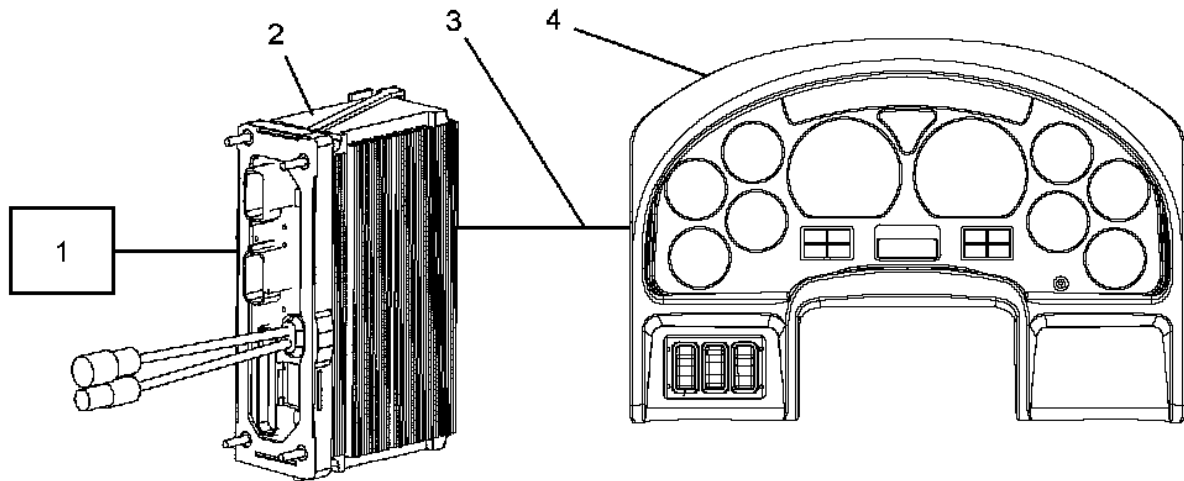


Figure 132 Transmission Oil Temperature Gauge Function Diagram

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

On a vehicle with a manual transmission, information driving the transmission oil temperature gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a sensor on the transmission.

On a vehicle with an automatic transmission manual transmission, information driving the transmission oil temperature gauge is provided on the Drivetrain 1939 data link from transmission electronic control Unit (ECU)

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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Problems with the transmission oil 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 ESC, a problem with the transmission oil temperature sensor or a problem with wiring to the sensor.

Table 80 Transmission Oil Temperature Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the transmission temperature 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 and Install.
2.	On	Check for transmission temperature gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 269)	Read display on odometer.	Transmission temperature gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 269)	Go to next step.
3.	On	There are no DTC's for an open in sensor circuits. Does gauge read minimum when it should obviously be reading a higher temperature.	Observe gauge temperature reading when transmission is hot.	Transmission temperature gauge reads minimum when transmission is hot.	Go to fault detection management. (See Fault Detection/ Management, page 269)	Go to next step.
4.	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.

Table 80 Transmission Oil Temperature Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
5.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
6.	<p>On a vehicle with a manual transmission, Consider replacing ESC. (See ESC REPLACEMENT, page 124)</p> <p>On a vehicle with automatic transmission, refer to the applicable transmission manual.</p>					

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 81 Transmission Temperature Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 36 1	Transmission temperature sensor shorted to ground

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 transmission temperature sensor circuits will be apparent when the temperature gauge points straight down. Transmission temperature sensor diagnostic trouble codes will also be present.

The ESC and EGC are not able to recognize an open circuit to the temperature sensor or an open sensor. There is no DTC for this condition.

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

Refer to Manual Transmission Temperature Sensor Circuits.

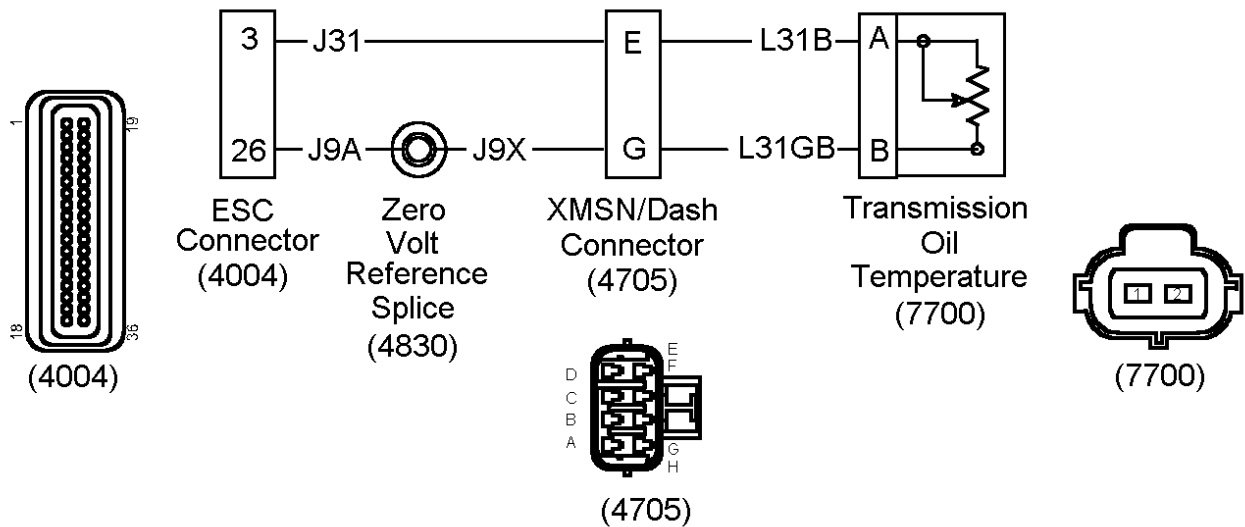


Figure 133 Manual Transmission Temperature Sensor Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (4004) ESC CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4705) TRANSMISSION/DASH CONNECTOR
- (4830) ZERO VOLT REFERENCE SPLICE
LOCATED ON CAB SIDE OF ESC
- (7700) TRANSMISSION OIL TEMPERATURE
LOCATED ON MANUAL TRANSMISSION

Table 82 Transmission Oil Temperature Gauge Diagnostic Trouble Codes

612 14 36 1	Transmission temperature sensor shorted to ground
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Table 83 Transmission Oil Temperature Gauge Tests

Transmission Oil Temperature Gauge Voltage Checks		
Check with ignition on and transmission oil temperature sensor (7700) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals.		
Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments

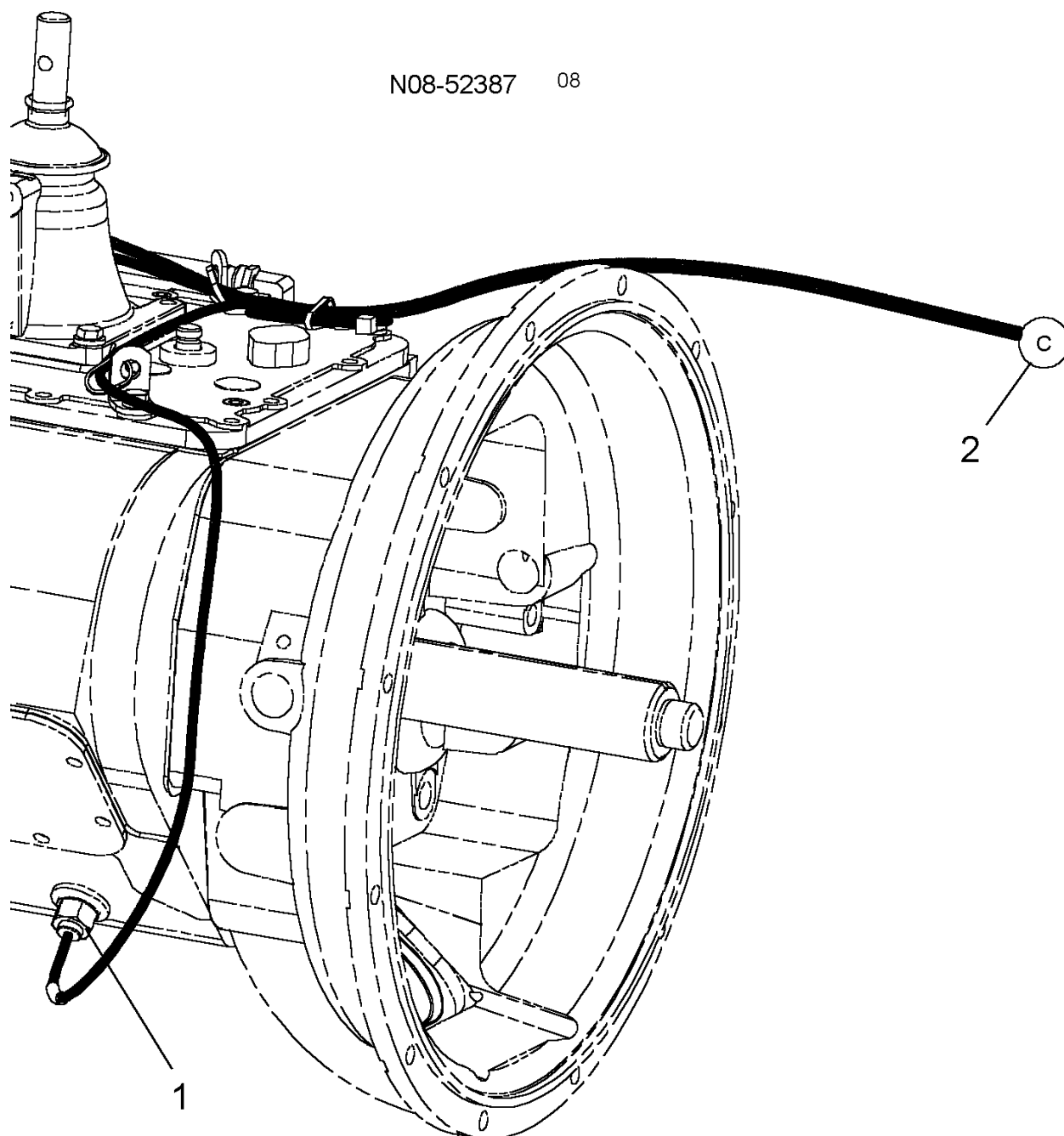
Table 83 Transmission Oil Temperature Gauge Tests (cont.)

(7700) cavity A to ground.	10 ± 1 volts	<p>If voltage is missing, check for open or shorts in circuit L31B or J31 to ESC connector (4004) cavity 3.</p> <p>If circuits check good, check for missing 10 volt signal from ESC.</p>
(7700) cavity A to cavity B.	10 ± 1 volts	<p>If voltage is missing, check for open in circuits L31GB, J9X or J9A to ESC connector (4004) cavity 26.</p> <p>If circuits check good, check for missing zero volt reference from ESC.</p> <p>If voltage is present, circuits to temperature sensor are good. Replace sensor.</p>

Extended Description

A zero volt reference signal is supplied from ESC connector (4004) terminal 26 to transmission oil temperature sensor connector (7700) terminal B through circuit J9A, J9X and L31–GB.

10 volts from ESC connector (4004) terminal 3 is supplied to the transmission oil temperature sensor connector (7700) terminal through circuit J31 and L31B. This voltage will drop across the sensor providing the ESC with temperature information.

Component Locations**Figure 134 Typical Manual Transmission Oil Temperature Sensor Location**

- 1. MANUAL TRANSMISSION OIL TEMPERATURE SENSOR
- 2. TRANSMISSION HARNESS

4.42. REAR-REAR AXLE OIL TEMPERATURE GAUGE

Circuit Function

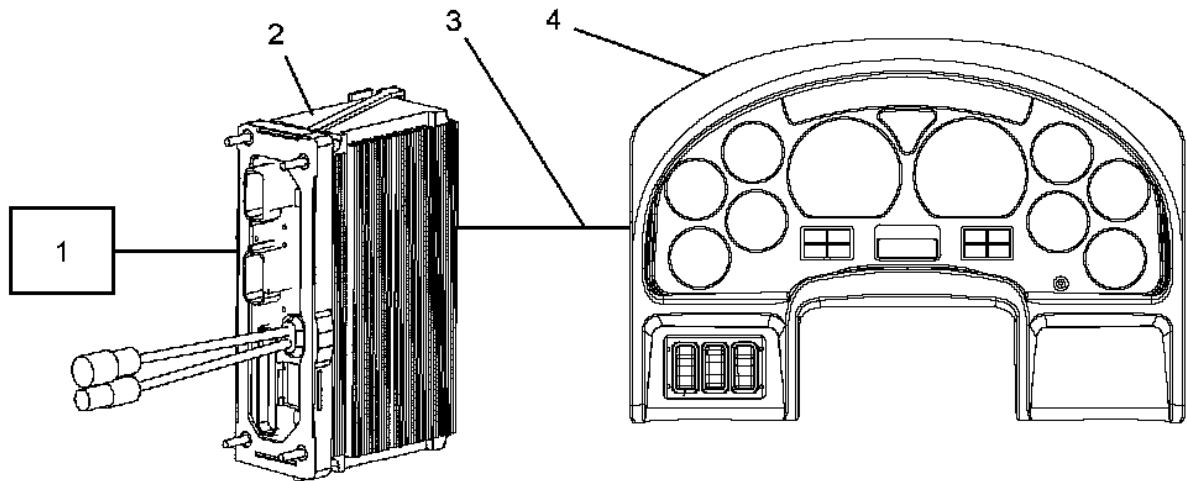


Figure 135 Rear-Rear Axle Oil Temperature Gauge Function Diagram

1. REAR-REAR AXLE OIL TEMPERATURE SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the rear-rear axle oil temperature gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a sensor on the rear-rear axle.

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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Problems with the rear-rear axle 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 ESC, a problem with the rear-rear axle temperature sensor or a problem with wiring to the sensor.

Table 84 Rear-Rear Axle Oil Temperature Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the rear-rear axle oil temperature 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 and Install.
2.	On	Check for rear-rear axle oil temperature gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 275)	Read display on odometer.	Rear-rear axle oil temperature gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 275)	Go to next step.
3.	On	There are no DTC's for an open in sensor circuits. Does gauge read minimum when it should obviously be reading a higher temperature.	Observe gauge temperature reading when axle is hot.	Rear-rear axle temperature gauge reads minimum when axle is hot.	Go to fault detection management. (See Fault Detection/ Management, page 275)	Go to next step.
4.	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.

Table 84 Rear-Rear Axle Oil Temperature Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
5.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 85 Rear-Rear Axle Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 32 1	Rear Axle Oil Temperature out of range low Shorted to ground or open circuit.
612 14 32 2	Rear Axle Oil Temperature 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 Rear—rear axle oil temperature sensor circuits will be apparent when the temperature gauge points straight down. Transmission temperature sensor diagnostic trouble codes will also be present.

The ESC and EGC are not able to recognize an open circuit to the temperature sensor or an open sensor. There is no DTC for this condition. A gauge with an open sensor circuit will always read minimum.

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

Refer to Rear–Rear Axle Temperature Sensor Circuits.

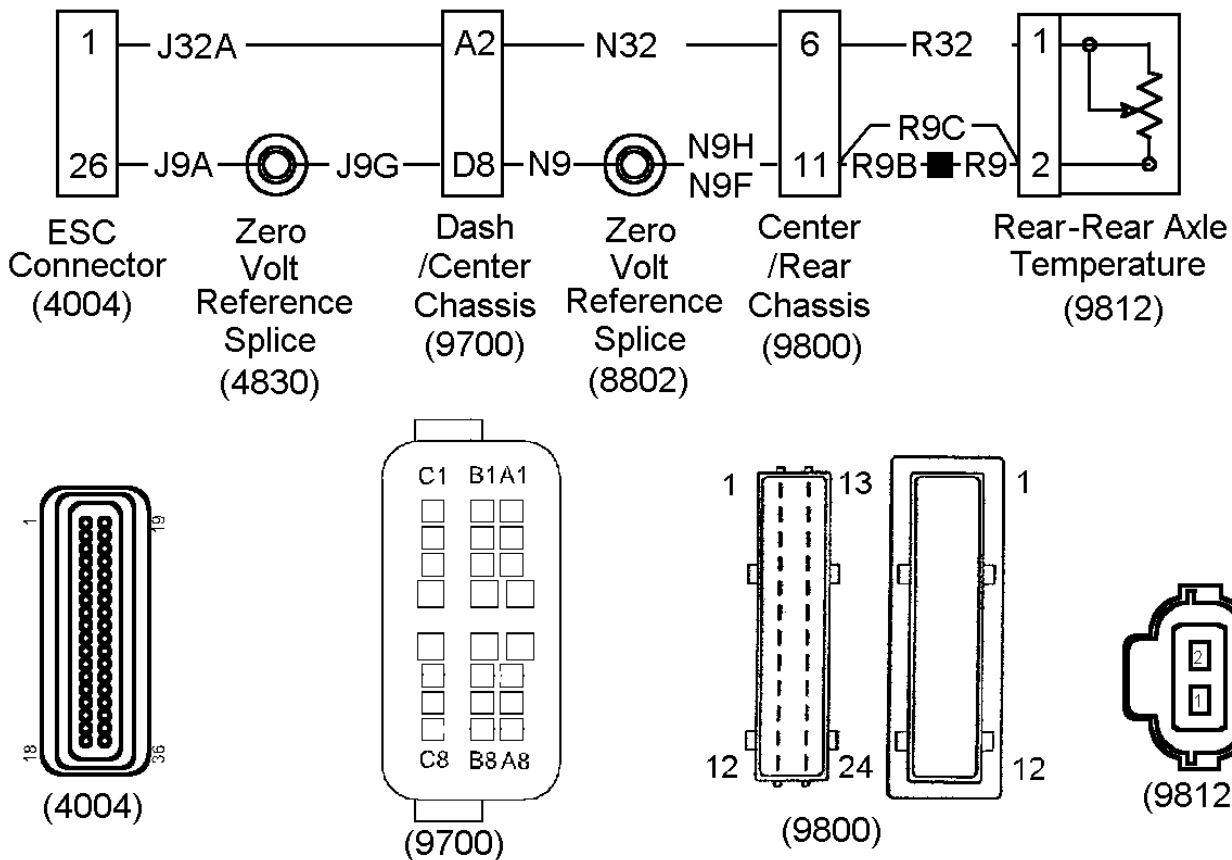


Figure 136 Rear–Rear Axle Oil Temperature Sensor Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (4004) ELECTRICAL SYSTEM CONTROLLER (ESC) CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4830) ELECTRONIC REF GROUND SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
- (8802) ISOLATED GROUND SPLICE PACK
LOCATED CHASSIS
- (9100) LEFT FUEL SENSOR CONNECTOR
LOCATED IN LEFT DUAL FUEL TANKS
- (9101) RIGHT FUEL SENSOR CONNECTOR
LOCATED IN RIGHT DUAL FUEL TANKS
- (9700) CHASSIS/DASH INTERCONNECT
LOCATED IN REAR CHASSIS
- (9800) CENTER/REAR CHASSIS CONNECTOR
LOCATED BY LEFT FRAME RAIL NEAR REAR AXLES
- (9812) REAR–REAR AXLE OIL TEMPERATURE
LOCATED ON REAR–REAR AXLE DIFFERENTIAL

Table 86 Rear–Rear Axle Oil Temperature Gauge Diagnostic Trouble Codes

612 14 32 1	Rear Axle Oil Temperature out of range low Shorted to ground or open circuit.
612 14 32 2	Rear Axle Oil Temperature out of range high Shorted high.

Table 87 Rear–Rear Axle Oil Temperature Gauge Tests

Rear–Rear Axle Oil Temperature Gauge Voltage Checks		
Check with ignition on and rear–rear axle oil temperature sensor (9812) disconnected.		
NOTE – Always check connectors for damage and pushed–out terminals.		
Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(9812) cavity 1 to ground.	10 ± 1 volts	If voltage is missing, check for open or shorts in circuit R32, N32 or J32A to ESC connector (4004) cavity 1. If circuits check good, check for missing 10 volt signal from ESC.
(9812) cavity 1 to 2.	10 ± 1 volts	If voltage is missing, check for open in circuits R9X, N9X, J9G or J9A to ESC connector (4004) cavity 26. If circuits check good, check for missing zero volt reference from ESC. If voltage is present, circuits to temperature sensor are good. Replace sensor.

Extended Description

The zero volt reference signal from the ESC is supplied from ESC connector (4004) terminal 26 to rear–rear axle temperature sensor connector (9812) terminal 2.

10 volts from ESC connector (4004) terminal 1 is supplied to rear–rear axle temperature sensor connector (9812) terminal 1. This voltage will drop across the sensor providing the ESC with temperature information.

Component Locations

N08-52398.10

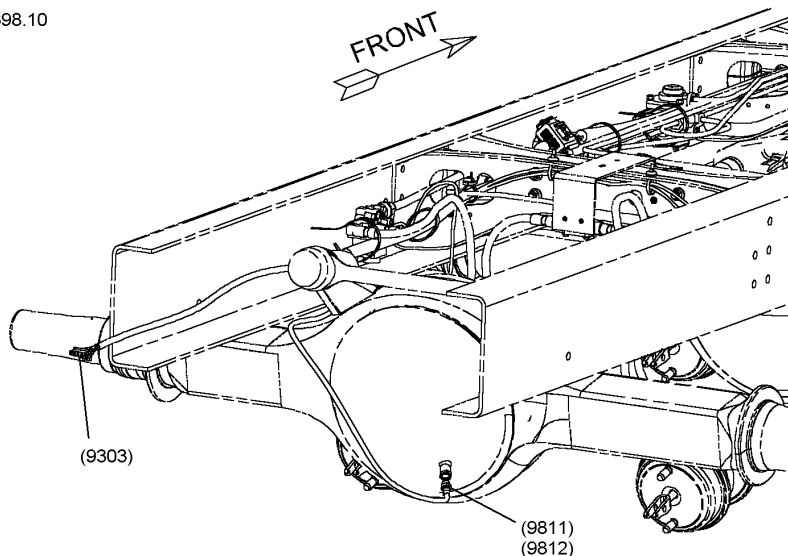


Figure 137 Axle Oil Temperature Sensor Location

(9812) REAR-REAR AXLE OIL TEMPERATURE SENSOR

4.43. FORWARD-REAR AXLE OIL TEMPERATURE GAUGE

Forward-Rear Axle Oil Temperature Gauge

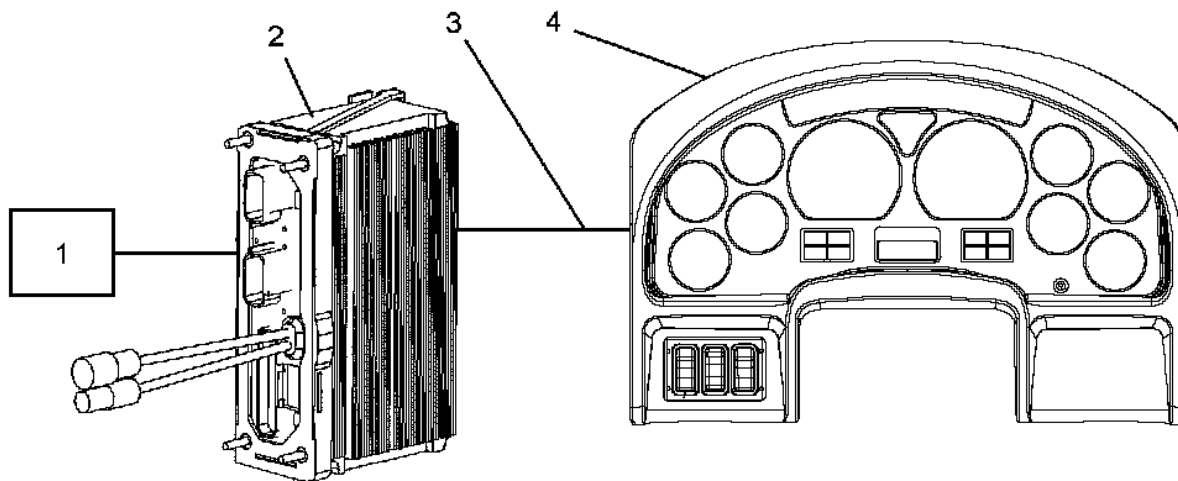


Figure 138 Forward-Rear Axle Oil Temperature Gauge Function Diagram

1. FORWARD-REAR AXLE OIL TEMPERATURE SENSOR
2. ELECTRICAL SYSTEM CONTROLLER
3. DRIVE TRAIN 1939 DATA LINK
4. ELECTRONIC GAUGE CLUSTER (EGC)

Information driving the forward-rear axle oil temperature gauge is provided on the Drivetrain 1939 data link from the ESC. The ESC generates this information based on input from a sensor on the forward-rear axle.

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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Problems with the forward-rear axle oil 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 ESC, a problem with the forward-rear axle oil temperature sensor or a problem with wiring to the sensor.

Table 88 Forward-Rear Axle Oil Temperature Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the forward-rear axle oil temperature 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 and Install.
2.	On	Check for forward-rear axle oil temperature gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 280)	Read display on odometer.	Forward—rear axle oil temperature gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 281)	Go to next step.
3.	On	There are no DTC's for an open in sensor circuits. Does gauge read minimum when it should obviously be reading a higher temperature.	Observe gauge temperature reading when axle is hot.	Forward-rear axle oil temperature gauge reads minimum when axle is hot.	Go to fault detection management. (See Fault Detection/Management, page 281)	Go to next step.

Table 88 Forward-Rear Axle Oil Temperature Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
4.	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.
5.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
6.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 89 Forward-Rear Axle Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 34 1	Forward-Rear Axle Oil Temperature out of range low Shorted to ground or open circuit.
612 14 34 2	Forward-Rear Axle Oil Temperature 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 forward–rear oil temperature sensor circuits will be apparent when the temperature gauge points straight down. Transmission temperature sensor diagnostic trouble codes will also be present.

The ESC and EGC are not able to recognize an open circuit to the temperature sensor or an open sensor. There is no DTC for this condition. A gauge with an open sensor circuit will always read minimum.

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

Refer to Forward–Rear Axle Oil Temperature Sensor Circuits.

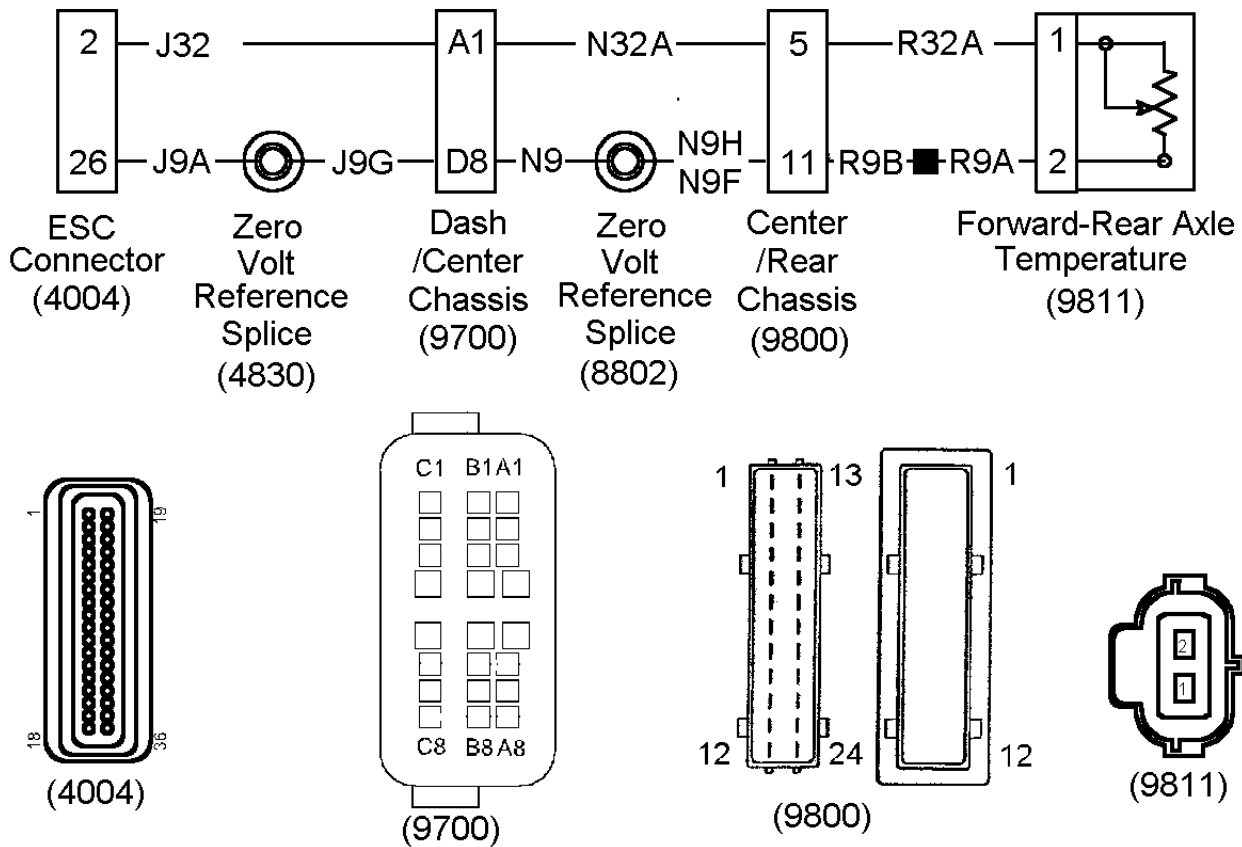


Figure 139 Forward-Rear Axle Oil Temperature Sensor Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

- (4004) ELECTRICAL SYSTEM CONTROLLER (ESC) CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4830) ELECTRONIC REF GROUND SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
- (8802) ISOLATED GROUND SPLICE PACK
LOCATED CHASSIS
- (9100) LEFT FUEL SENSOR CONNECTOR
LOCATED IN LEFT DUAL FUEL TANKS
- (9101) RIGHT FUEL SENSOR CONNECTOR
LOCATED IN RIGHT DUAL FUEL TANKS
- (9700) CHASSIS/DASH INTERCONNECT
LOCATED IN REAR CHASSIS
- (9800) CENTER/REAR CHASSIS CONNECTOR
LOCATED BY LEFT FRAME RAIL NEAR REAR AXLES
- (9811) FORWARD-REAR AXLE OIL TEMPERATURE
LOCATED ON FORWARD-REAR AXLE DIFFERENTIAL

Table 90 Forward–Rear Axle Oil Temperature Gauge Diagnostic Trouble Codes

612 14 34 1	Forward–rear axle oil temperature sensor shorted to ground
612 14 34 2	Forward-Rear Axle Oil Temperature out of range high. Shorted high.

Table 91 Forward–Rear Axle Oil Temperature Gauge Tests

Forward–Rear Axle Oil Temperature Gauge Voltage Checks		
Check with ignition on and forward–rear axle oil temperature sensor (9811) disconnected.		
NOTE – Always check connectors for damage and pushed–out terminals.		
Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(9811) cavity 1 to ground.	10 ± 1 volts	If voltage is missing, check for open or shorts in circuit R32A, N32A or J32 to ESC connector (4004) cavity 2. If circuits check good, check for missing 10 volt signal from ESC.
(9811) cavity 1 to 2.	10 ± 1 volts	If voltage is missing, check for open in circuits R9A, R9B, J9G, N9H, N9. J9G or J9A to ESC connector (4004) cavity 26. If circuits check good, check for missing zero volt reference from ESC. If voltage is present, circuits to temperature sensor are good. Replace sensor.

Extended Description

The zero volt reference signal from the ESC is supplied from ESC connector (4004) terminal 26 to forward-rear axle oil temperature sensor connector (9811) terminal 2.

10 volts from ESC connector (4004) terminal 2 is supplied to forward-rear axle temperature sensor connector (9811) terminal 1. This voltage will drop across the sensor providing the ESC with temperature information.

Component Locations

N08-52398.10

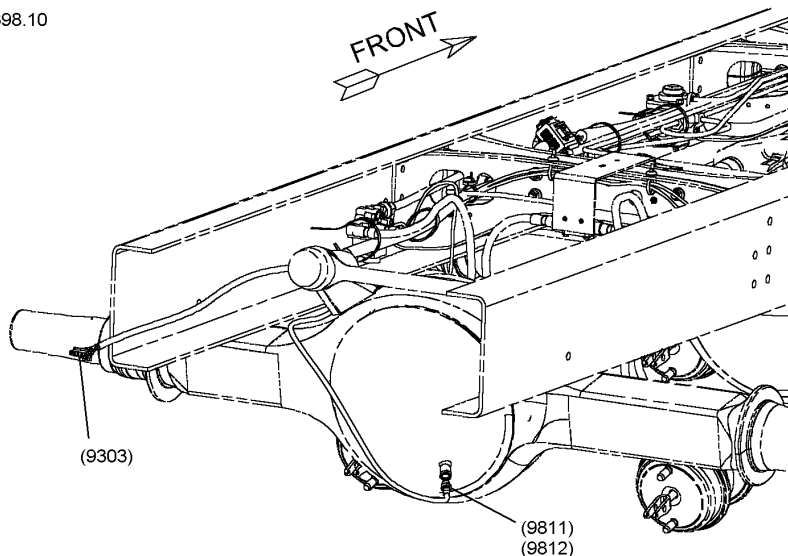


Figure 140 Axle Oil Temperature Sensor Location

(9811) FORWARD-REAR AXLE OIL TEMPERATURE SENSOR

4.44. PRIMARY AIR PRESSURE GAUGE

Circuit Functions

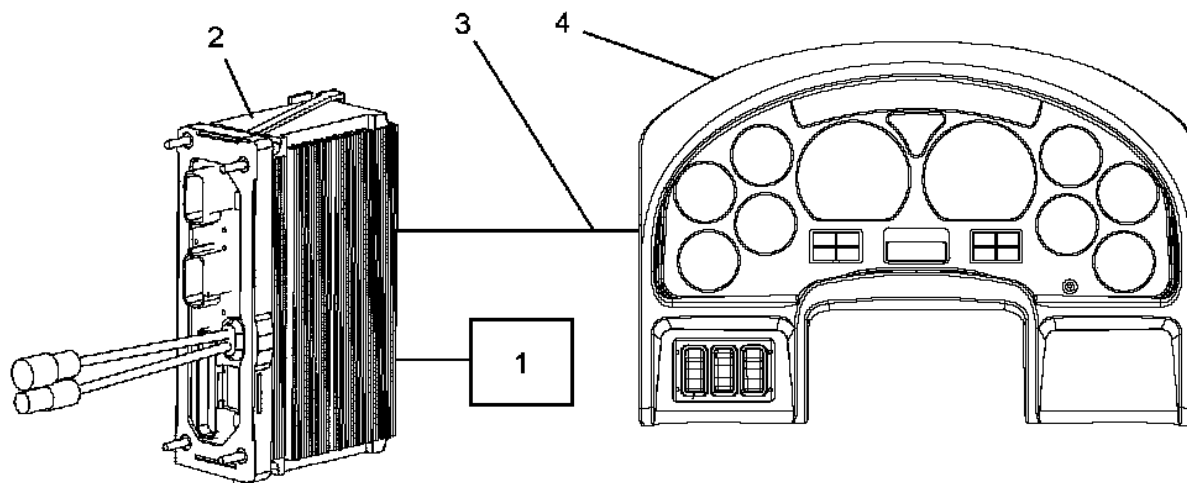


Figure 141 Primary Air Pressure Gauge Function Diagram

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 92 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 and Install.
2.	On	Check for primary air pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 286)	Read display on odometer.	Primary air pressure gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 287)	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.

Table 92 Primary Air Pressure Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
4.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 93 Primary Air Pressure Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 4 1	Primary air pressure out of range low Short to ground, open circuit or missing 5 volts from ESC
612 14 4 2	Primary air pressure 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.

Table 93 Primary Air Pressure Gauge Diagnostic Trouble Codes (cont.)

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Primary Air Pressure Transducer Circuits.

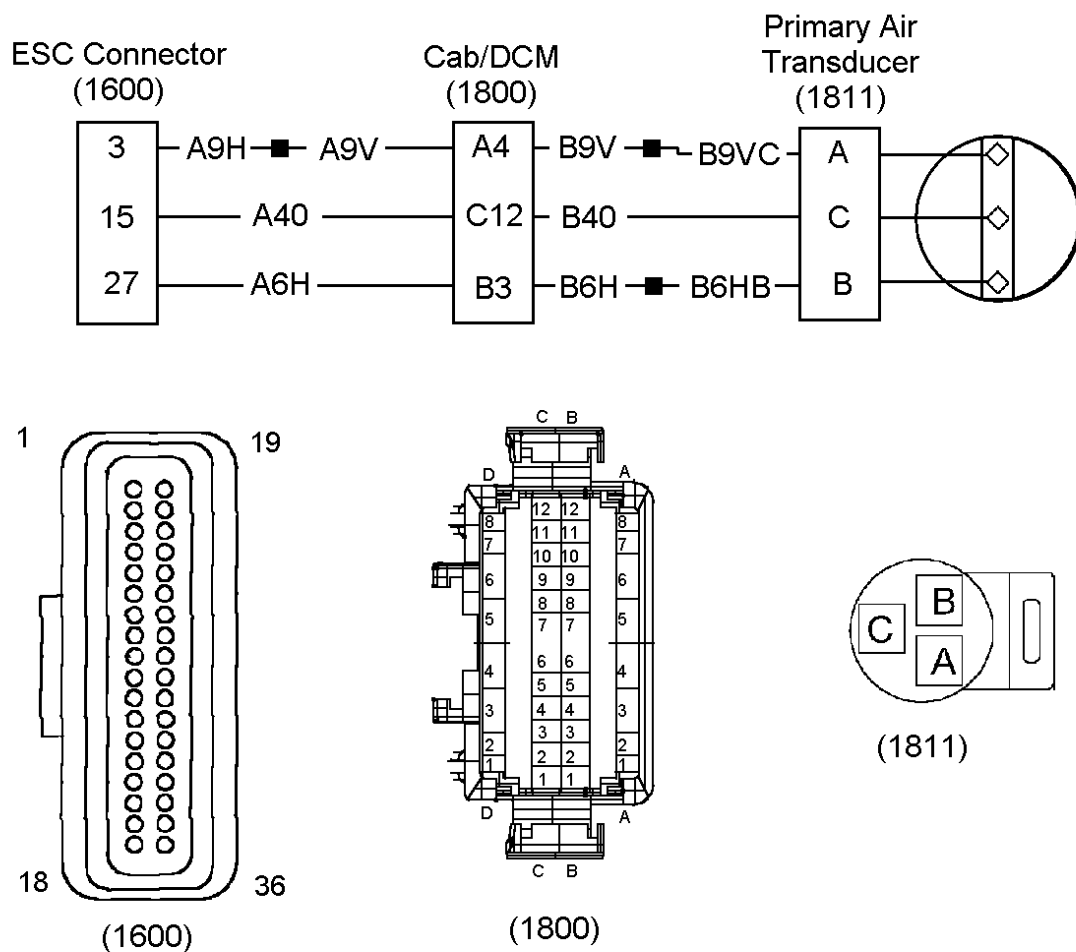


Figure 142 Primary Air Pressure Transducer Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

- (1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC
- (1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER
- (1811) PRIMARY AIR PRESSURE TRANSDUCER CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN

Table 94 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
1705 14 108 4 (EGC Version 8.7)	Data for this gauge is above the value that the gauge can display. For example: a value exceeding the gauge maximum scale value.
	EGC gauge location 8 (primary air pressure) out of range low
1705 14 108 5 (EGC Version 8.7)	Data for this gauge is below the minimum value the gauge can display. For example: the lowest scale value on the gauge.
	EGC gauge location 8 (primary air pressure) sensor fault
1705 14 108 6 (EGC Version 8.7)	There is a problem with the sensor that provides the data for this gauge.
	EGC gauge location 8 (primary air pressure) data unavailable
2023 14 108 5 or 2023 14 208 5 (EGC Version 9.3 and later)	The data that this gauge displays should be, but is not available at this time.
	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 94 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.		
Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(1811) cavity B to ground.	5 ± .5 volts	If voltage is missing, check for open or shorts in circuit B6HB, B6H or A6H to ESC connector (1600) cavity 27.
		If circuits check good, check for missing 5 volt signal from ESC.

Table 94 Primary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
(1811) cavity B to cavity A.	5 ± .5 volts	If voltage is missing, check for open in circuits B9VC, B9V, A9V or A9H to ESC connector (1600) cavity 3.
		If circuits check good, check for missing zero volt reference from ESC.
(1811) cavity B to cavity C.	5 ± .5 volts	If voltage is incorrect, check for open or short to voltage in circuits B40, or A40 to ESC connector (1600) cavity 15.
		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 (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 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

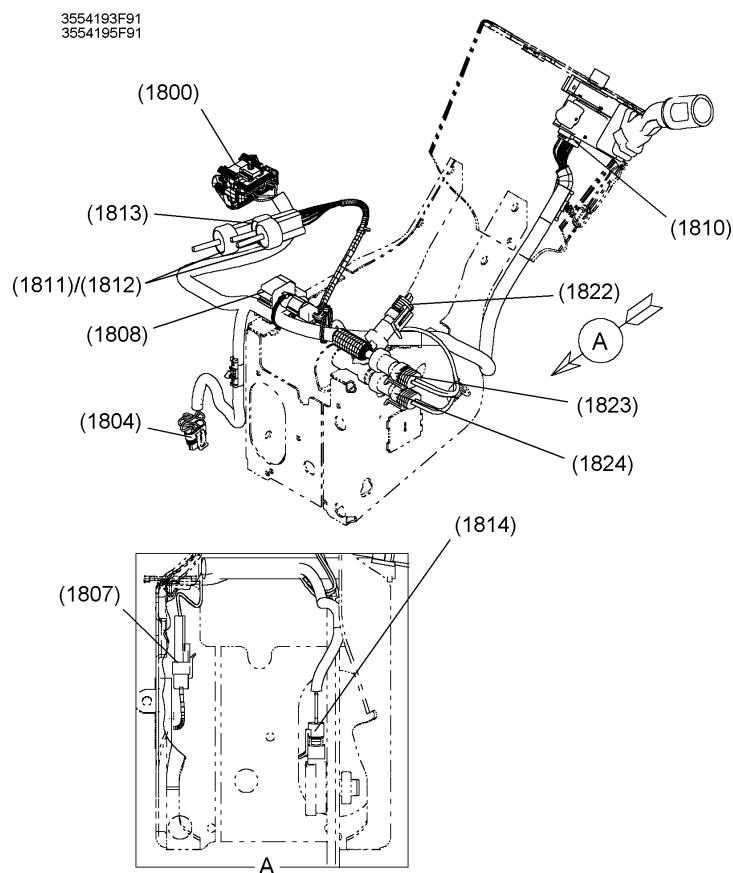


Figure 143 Primary Air Gauge Transducer Location (Steering Column Support View)

- (1800) DRIVER CONTROL MODULE (DCM) CONNECTOR
- (1811) PRIMARY AIR TRANSDUCER
- (1812) SECONDARY AIR TRANSDUCER
- (1822) AIR APPLICATION TRANSDUCER

4.45. SECONDARY AIR PRESSURE GAUGE

Circuit Function

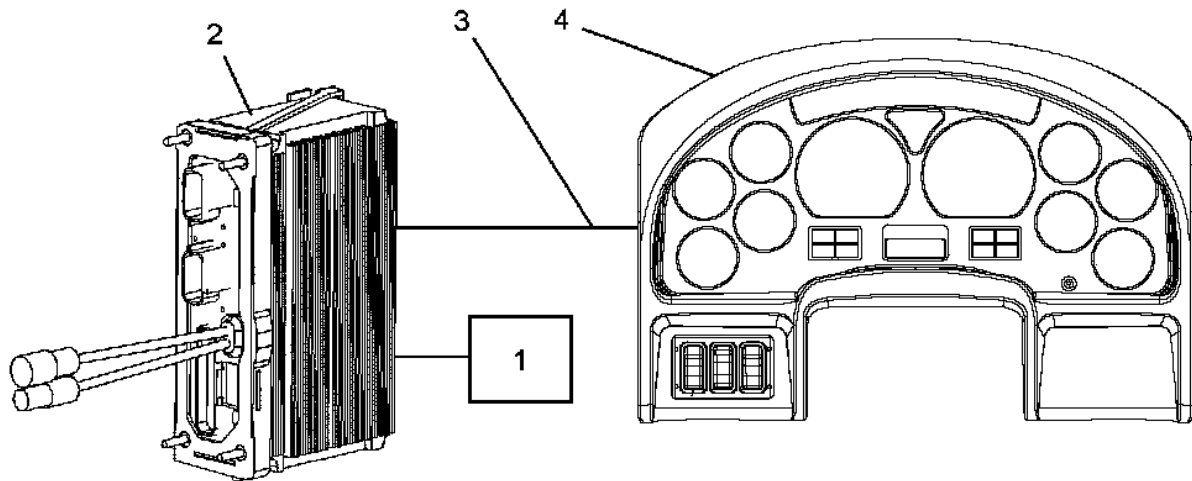


Figure 144 Secondary Air Pressure Gauge Function Diagram

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 95 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 and Install.
2.	On	Check for secondary air pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 294)	Read display on odometer.	Secondary air pressure gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 296)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC . (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 96 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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Secondary Air Pressure Transducer Circuits.

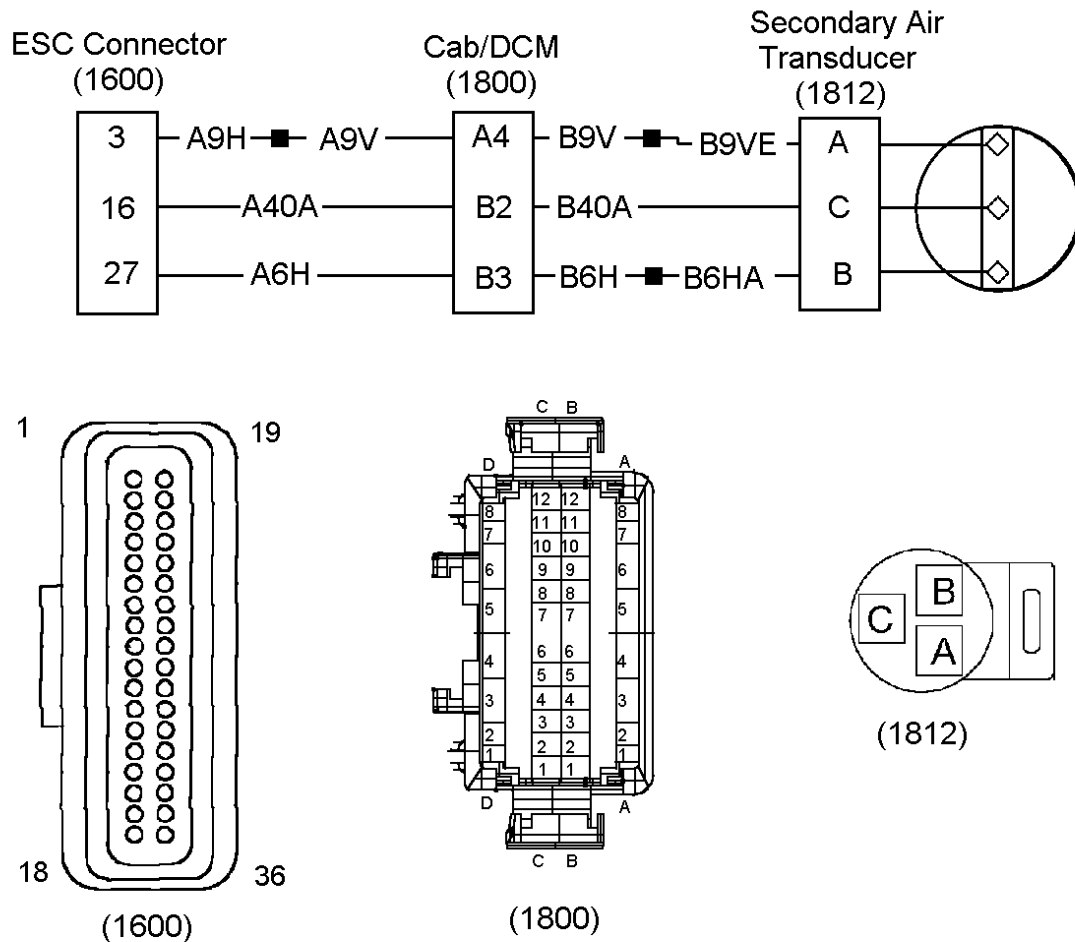


Figure 145 Secondary Air Pressure Transducer Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

- (1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC
- (1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER
- (1812) SECONDARY AIR PRESSURE TRANSDUCER CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN

Table 97 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 97 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.
Secondary Air Pressure Gauge Voltage Checks Check with ignition on and (1812) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals. Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(1812) cavity B to ground.	5 ± .5 volts	If voltage is missing, check for open or shorts in circuit B6HA, B6H or A6H to ESC connector (1600) cavity 27. If circuits check good, check for missing 5 volt signal from ESC.

Table 97 Secondary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
(1812) cavity B to cavity A.	5 ± .5 volts	If voltage is missing, check for open in circuits B9VE, B9V, A9V or 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 ± .5 volts	If voltage is incorrect, check for open or short to voltage in circuits B40A or 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 secondary 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 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

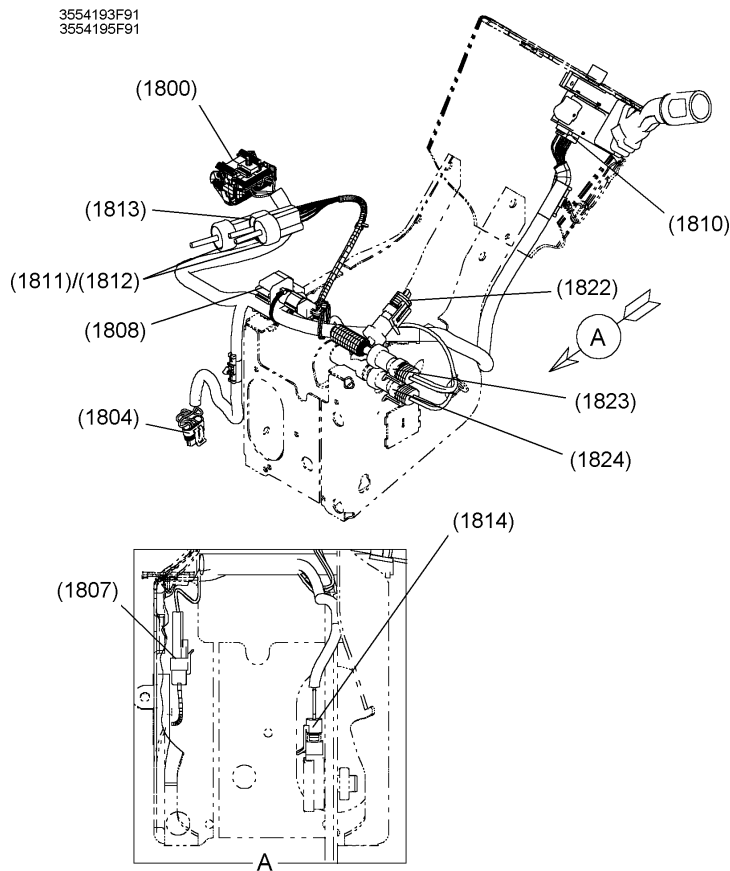


Figure 146 Secondary Air Pressure Gauge Transducer Location (Steering Column Support View)

- (1800) DRIVER CONTROL MODULE (DCM) CONNECTOR
- (1811) SECONDARY AIR PRESSURE TRANSDUCER
- (1812) SECONDARY AIR TRANSDUCER
- (1822) AIR APPLICATION TRANSDUCER

4.46. AUXILIARY AIR PRESSURE GAUGE

Auxiliary Air Pressure Gauge

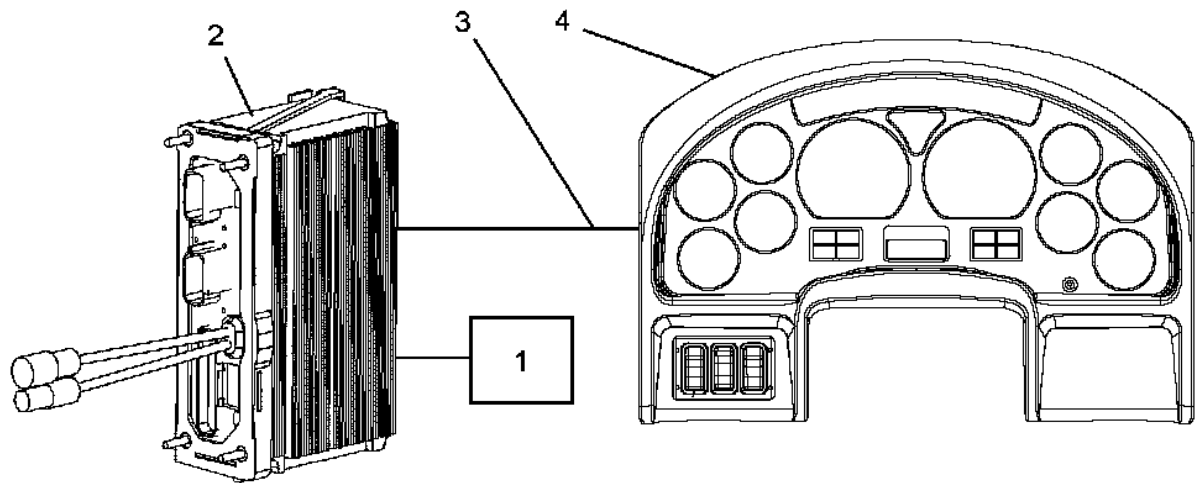


Figure 147 Auxiliary Air Pressure Gauge Function Diagram

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

Information driving the auxiliary 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 auxiliary 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 auxiliary air pressure transducer or a problem with wiring to the sensor.

Table 98 Auxiliary Air Pressure Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the auxiliary 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 and Install.

Table 98 Auxiliary Air Pressure Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	On	Check for auxiliary air pressure gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 303)	Read display on odometer.	Auxiliary air pressure gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 304)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC . (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 99 Auxiliary Air Pressure Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 4 1	Auxiliary Air Pressure out of range low Short to ground, open circuit or missing 5 volts from ESC
612 14 4 2	Auxiliary Air Pressure out of range high Shorted high
1705 14 108 3 (EGC Version 8.7)	EGC gauge location 8 (auxiliary 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 (auxiliary 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 (auxiliary 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 (auxiliary 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)	Auxiliary 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)	Auxiliary 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)	Auxiliary 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 "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Auxiliary Air Pressure Gauge Transducer Circuits.

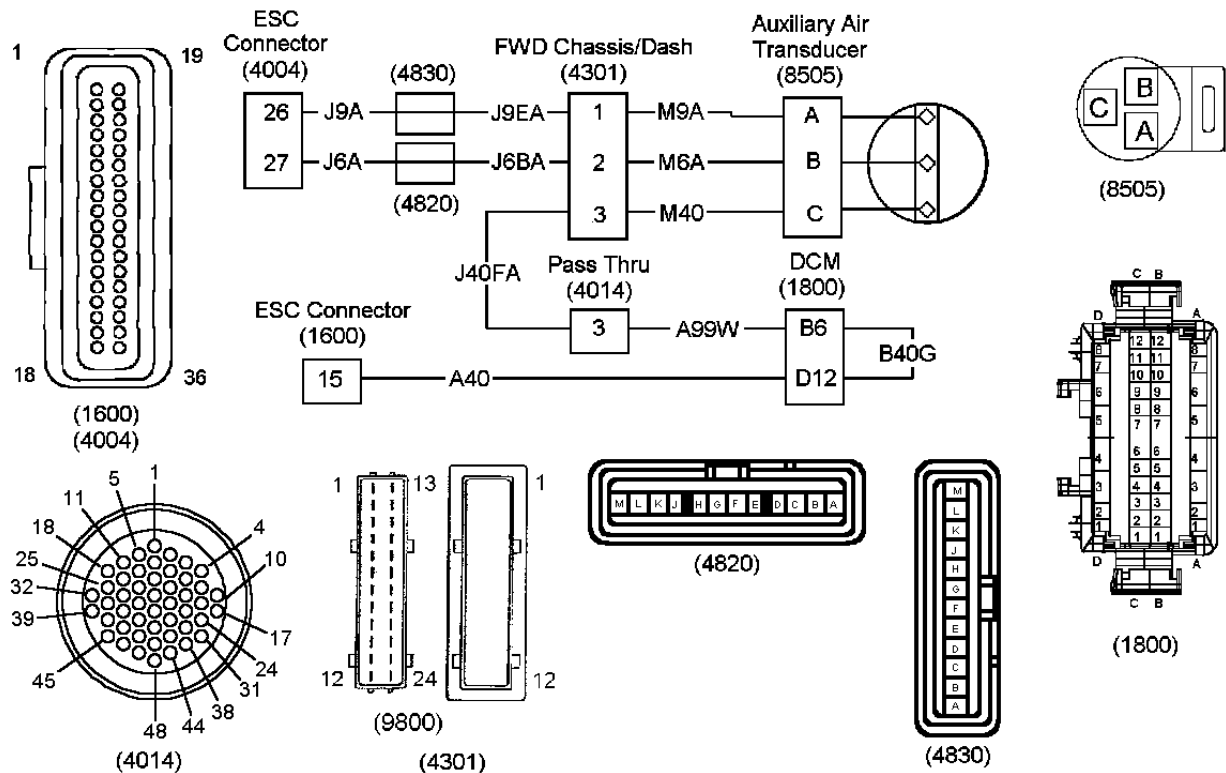


Figure 148 Auxiliary Air Pressure Gauge Transducer Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

- (1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC
- (1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER
- (4004) ELECTRICAL SYSTEM CONTROLLER (ESC) CONNECTOR
LOCATED ON ENGINE SIDE OF ESC
- (4014) DASH PASS THRU CONNECTOR
LOCATED ABOVE ESC
- (4301) FORWARD CHASSIS/DASH PASS CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL
- (4820) J1708 & 5 VOLT REF SPLICE
LOCATED NEAR WIPER MOTOR BRACKET
- (4830) ELECTRONIC REF GROUND SPLICE
LOCATED NEAR POWER DISTRIBUTION CENTER
- (8505) AUXILIARY AIR TRANSDUCER CONNECTOR
LOCATED IN ENGINE COMPARTMENT NEAR LEFT FRAME RAIL

Table 100 Auxiliary Air Pressure Gauge Tests

Diagnostic Trouble Codes	
612 14 4 1	Auxiliary Air Pressure out of range low Short to ground, open circuit or missing 5 volts from ESC
612 14 4 2	Auxiliary Air Pressure out of range high Shorted to 12 volts.
1705 14 108 3 (EGC Version 8.7)	EGC gauge location 8 (auxiliary 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 (auxiliary 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 (auxiliary 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 (auxiliary 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)	Auxiliary 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 100 Auxiliary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
2023 14 108 6 or 2023 14 208 6 (EGC Version 9.3 and later)	Auxiliary 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)	Auxiliary 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.
Auxiliary Air Pressure Gauge Voltage Checks Check with ignition on and (8505) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals. Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(8505) cavity B to ground.	5 ± .5 volts	If voltage is missing, check for open or shorts in circuit M6A, J6BA or J6A to ESC connector (4004) cavity 27. If circuits check good, check for missing 5 volt signal from ESC.

Table 100 Auxiliary Air Pressure Gauge Tests (cont.)

Diagnostic Trouble Codes		
(8505) cavity B to cavity A.	5 ± .5 volts	If voltage is missing, check for open in circuits M9A, J9EA or J9A to ESC connector (4004) cavity 26. If circuits check good, check for missing zero volt reference from ESC.
(8505) cavity B to cavity C.	5 ± .5 volts	If voltage is incorrect, check for open or short to voltage in circuits B40F, A40F or J40F to ESC connector (1600) cavity 15. If voltage is present, circuits to transducer are good. Replace transducer

Extended Description

The 5 volt sensor supply signal is supplied to auxiliary air pressure transducer connector (8505) pin B from ESC connector (4004) pin 27.

The zero volt reference signal is supplied to auxiliary air pressure transducer connector (8505) pin A from ESC connector (4004) pin 26.

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

Component Locations

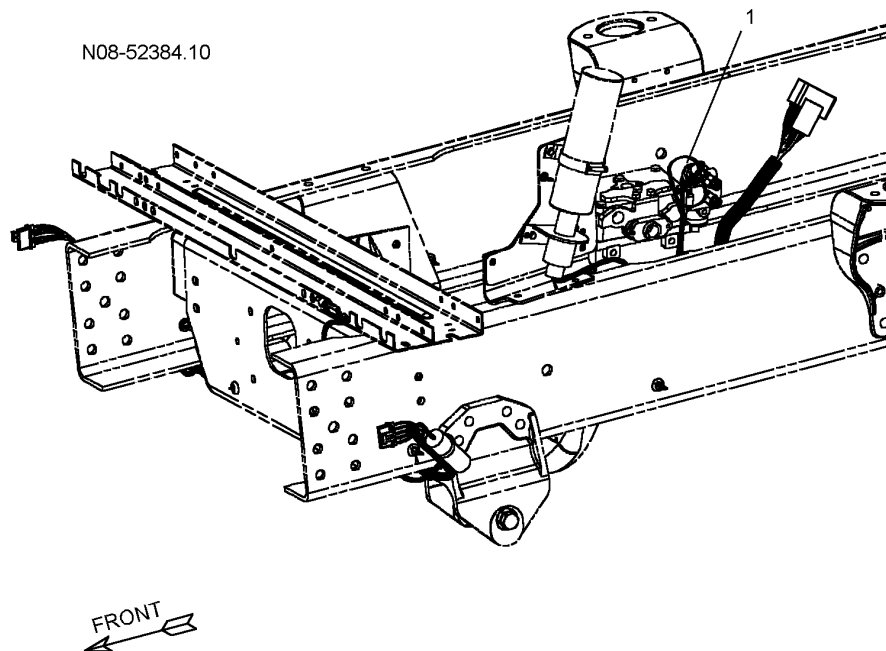


Figure 149 Auxiliary Air Pressure Gauge Transducer Location

1. AIR PRESSURE TRANSDUCER

4.47. BOOST PRESSURE GAUGE

Circuit Function

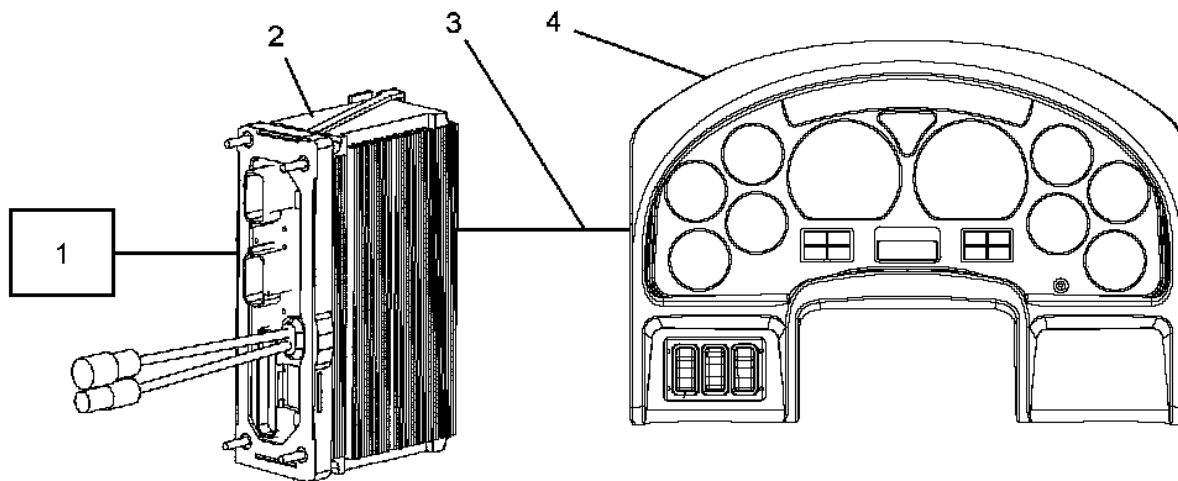


Figure 150 Boost Pressure Gauge Function Diagram

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 "INTUNE" 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 101 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 and Install.
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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
4.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

4.48. AMMETER GAUGE

Circuit Function

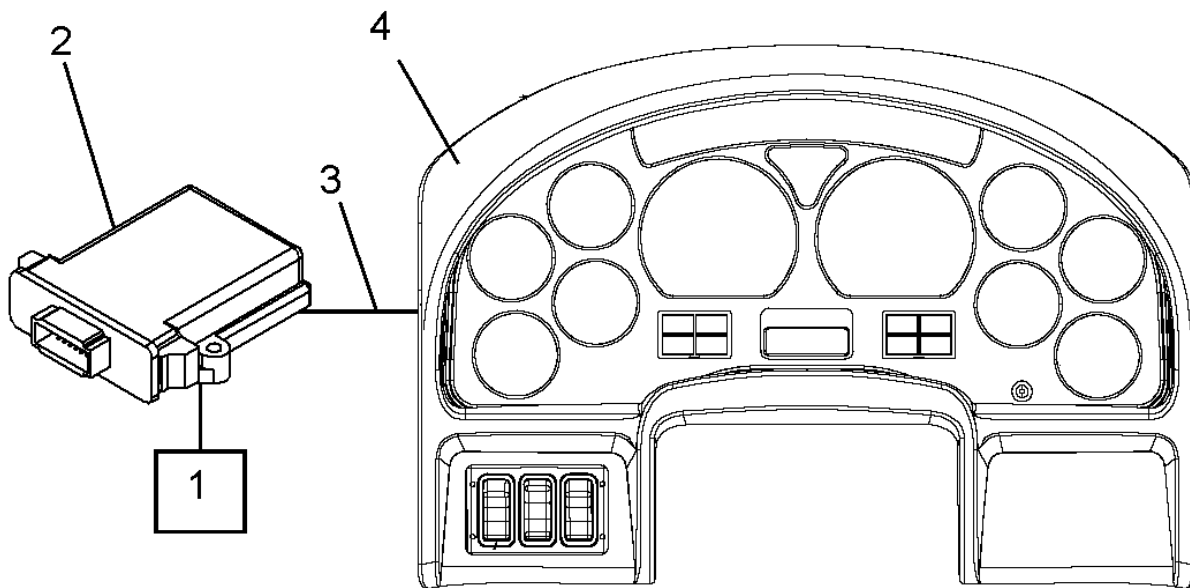


Figure 151 Ammeter Gauge Diagram

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 "INTUNE" 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 102 **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 and Install.
2.	On	Check for ammeter gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 313)	Read display on odometer.	Ammeter gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 314)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Troubleshoot pyrometer module and sensor inputs. Pyrometer/ Ammeter Module (PAM)(See PYROMETER/AMMETER MODULE (PAM), page 811)					

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 103 Ammeter Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
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.

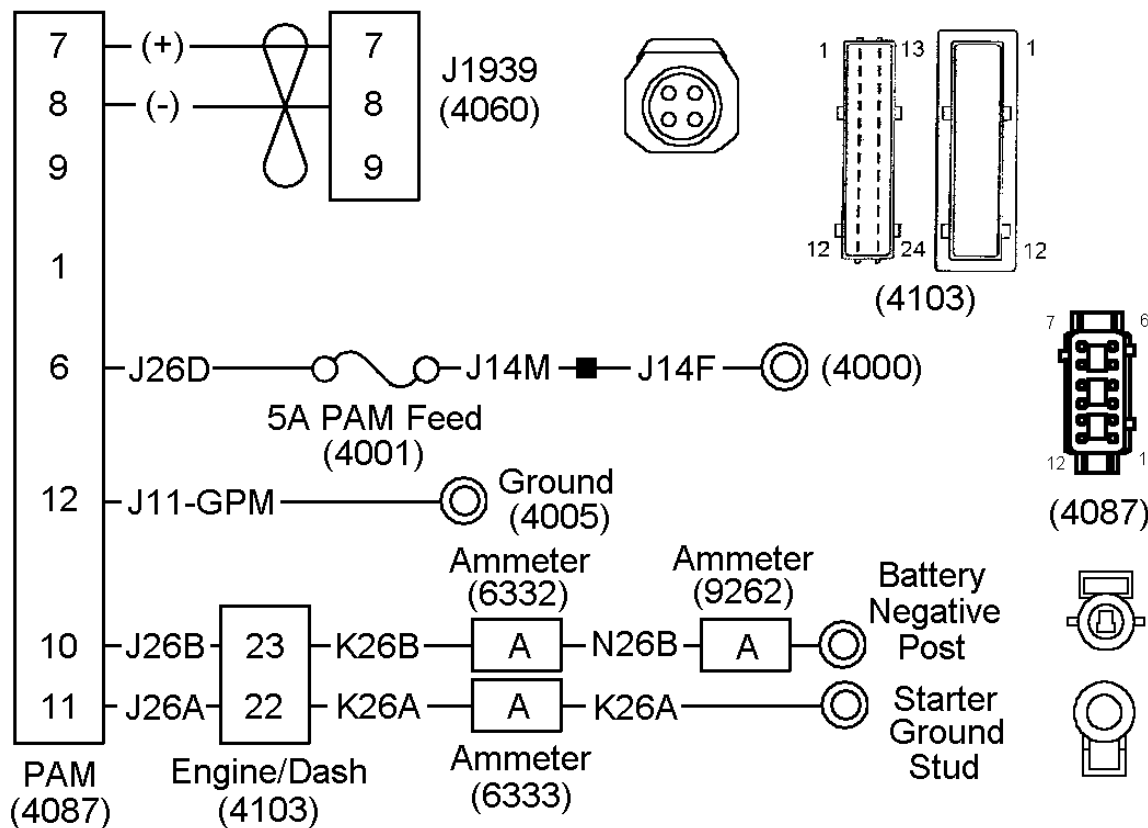


Figure 152 Pyrometer/Ammeter Module Circuits—Always Refer to Circuit Diagram Book for Latest Circuit Information

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

Table 104 Pyrometer/Ammeter Module Tests

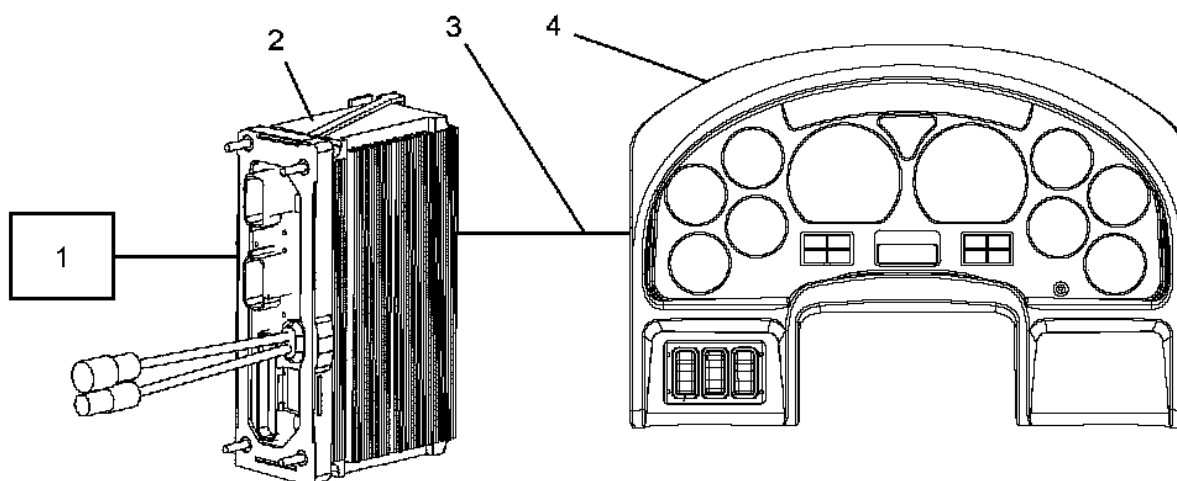
Pyrometer/Ammeter Module Voltage Checks		
Check with ignition on and PAM connector (4087) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals.		
Test Points	Spec.	Comments
(4087) cavity 6 to ground.	12 ± 1.5 volts	If voltage is missing, check for open “5A PAM FEED” fuse in mini fuse block. Also check for open or shorts in circuit J26D, J14M or J14F.

Table 104 Pyrometer/Ammeter Module Tests (cont.)

(4087) cavity 6 to cavity 12.	12 ± 1.5 volts	If voltage is missing, check for open in circuit J11–GPM to ground stud (4005).
(4087) cavity 6 to cavity 10.	12 ± 1.5 volts	If voltage is missing, check for open in circuit J26B, K26B or N26B
(4087) cavity 6 to cavity 11.	12 ± 1.5 volts	If voltage is missing, check for open in circuit J26A or K26A. If all voltages are present, circuits to PAM are good. Replace PAM.

4.49. FUEL PRESSURE GAUGE

Circuit Function

**Figure 153 Fuel Pressure Gauge Function Diagram**

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

Information driving the fuel 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 fuel system.

Diagnostics

Problems with the fuel 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 fuel pressure sensor or a problem with wiring to the sensor.

Table 105 Fuel Pressure Gauge 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 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.
2.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.	Gauge responds to "INTUNE" 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.
3.	On	Attempt to exercise the gauge with the "INTUNE" diagnostic software.	Gauge responds to ESC diagnostic input.	Consider replacing ESC.(See ESC REPLACEMENT, page 124)	Replace EGC.

Fault Detection/ Management

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

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 "INTUNE" diagnostic software can be used to check operation of the gauge.

4.50. SUSPENSION AIR GAUGE

Circuit Function

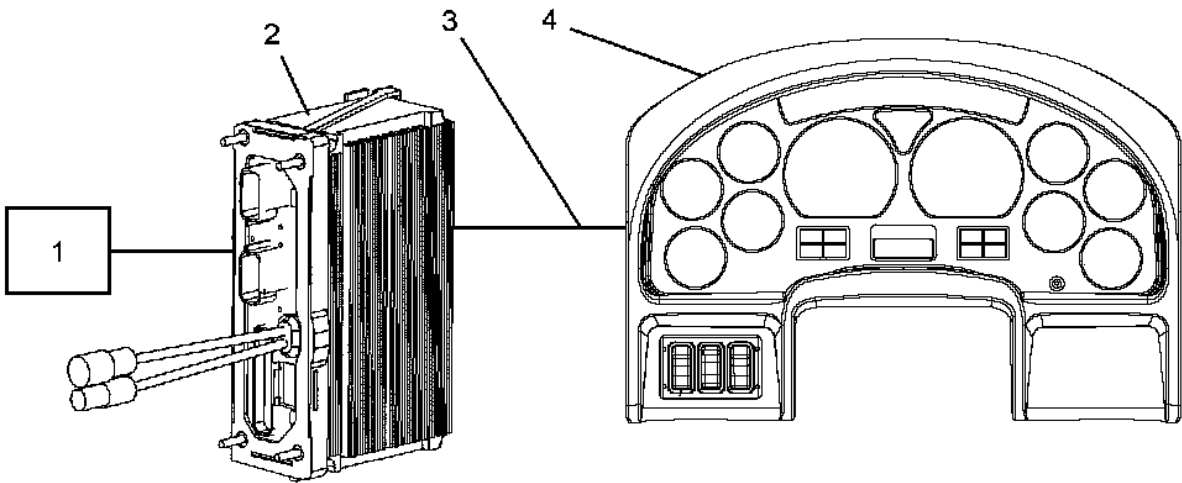


Figure 154 Suspension Air Gauge Function Diagram

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

Information driving the suspension air 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 air suspension system.

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 air suspension 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 suspension air transducer or a problem with wiring to the transducer.

Table 106 Air Suspension Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the air suspension 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 and Install.

Table 106 Air Suspension Gauge Preliminary Check (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
2.	On	Check for air suspension gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 319)	Read display on odometer.	Suspension gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/Management, page 320)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC . (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 107 Air Suspension Gauge Diagnostic Trouble Codes

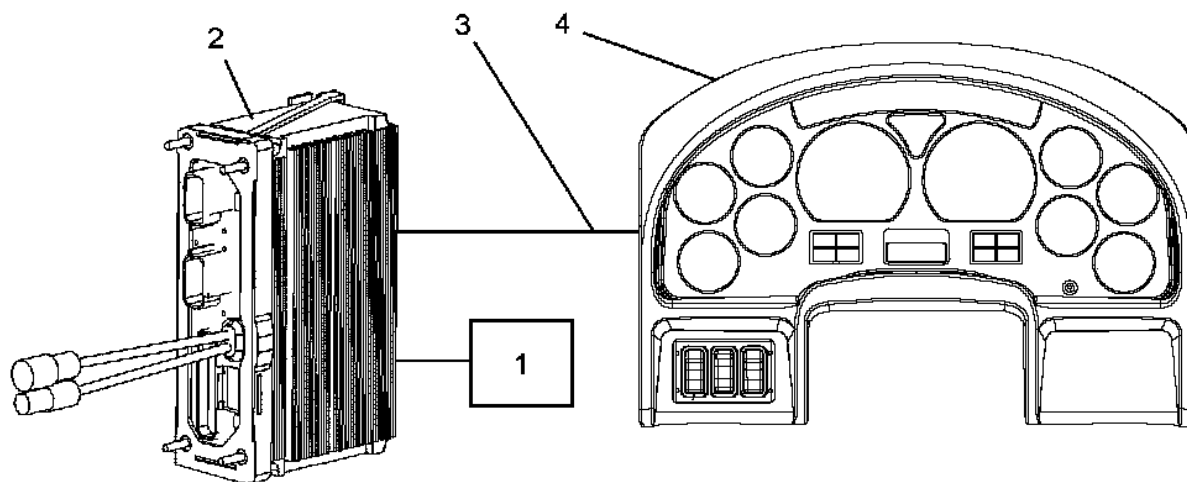
DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
TBD	Air Suspension Gauge out of range low Short to ground, open circuit or missing 5 volts from ESC
TBD	Air Suspension Gauge out of range high Shorted high

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.

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Air Suspension Solenoid Circuits in the Chassis Features section.

4.51. AIR APPLICATION GAUGE**Circuit Function****Figure 155 Air Application Gauge Function Diagram**

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

Information driving the air application 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 application system.

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 air application 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 108 Air Application Gauge Preliminary Check

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES-IN SPEC.	NO-OUT OF SPEC.
1.	Off/On	Does the air application 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 and Install.
2.	On	Check for air application gauge diagnostic trouble codes. (See Diagnostic Trouble Codes (DTC), page 322)	Read display on odometer.	Air application gauge diagnostic trouble codes are active.	Go to fault detection management. (See Fault Detection/ Management, page 322)	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 "INTUNE" diagnostic software.		Gauge responds to "INTUNE" 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.
5.	Consider replacing ESC. (See ESC REPLACEMENT, page 124)					

Diagnostic Trouble Codes (DTC)

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

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

Table 109 Air Application Gauge Diagnostic Trouble Codes

DIAGNOSTIC TROUBLE CODE	FAULT DESCRIPTION
612 14 35 1	Brake application air out of range low Short to ground or open circuit.
612 14 35 2	Brake application air 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.

The service tool (EZ-Tech) running the "INTUNE" diagnostic software can be used to check operation of the gauge.

Refer to Air Application Gauge Transducer Circuits.

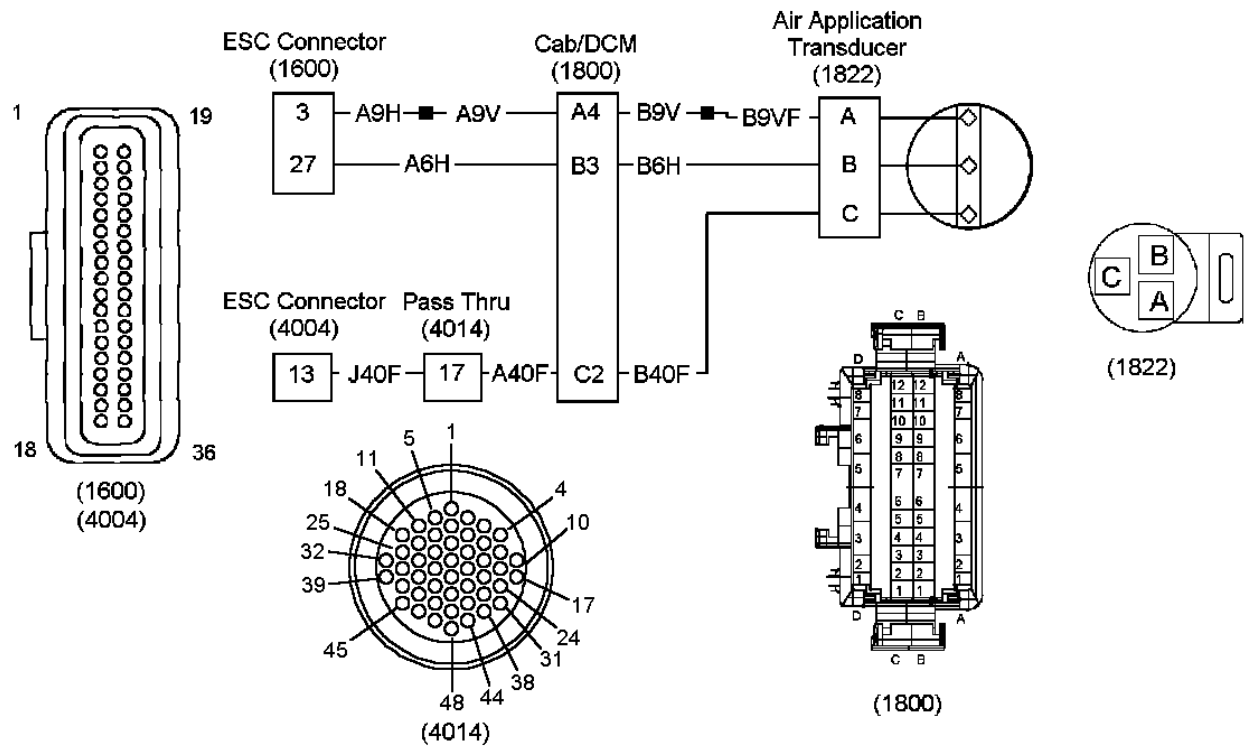


Figure 156 Air Application Gauge Transducer Circuits—Always Refer To Circuit Diagram Book For Latest Circuit Information

- (1600) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN DASH COMPARTMENT SIDE OF ESC
- (1800) CAB/DCM CONNECTOR
LOCATED BEHIND CLUSTER
- (1822) AIR APPLICATION GAUGE TRANSDUCER CONNECTOR
LOCATED TO LEFT OF LOWER STEERING COLUMN
- (4004) ELECTRICAL SYSTEM CONTROLLER CONNECTOR
LOCATED IN CAB SIDE OF ESC
- (4014) DASH PASS THRU CONNECTOR
LOCATED ABOVE ESC

Table 110 Air Application Gauge Tests

Diagnostic Trouble Codes	
612 14 35 1	Brake application air out of range low Short to ground or open circuit.
612 14 35 2	Brake application air out of range high Shorted high.

Table 110 Air Application Gauge Tests (cont.)

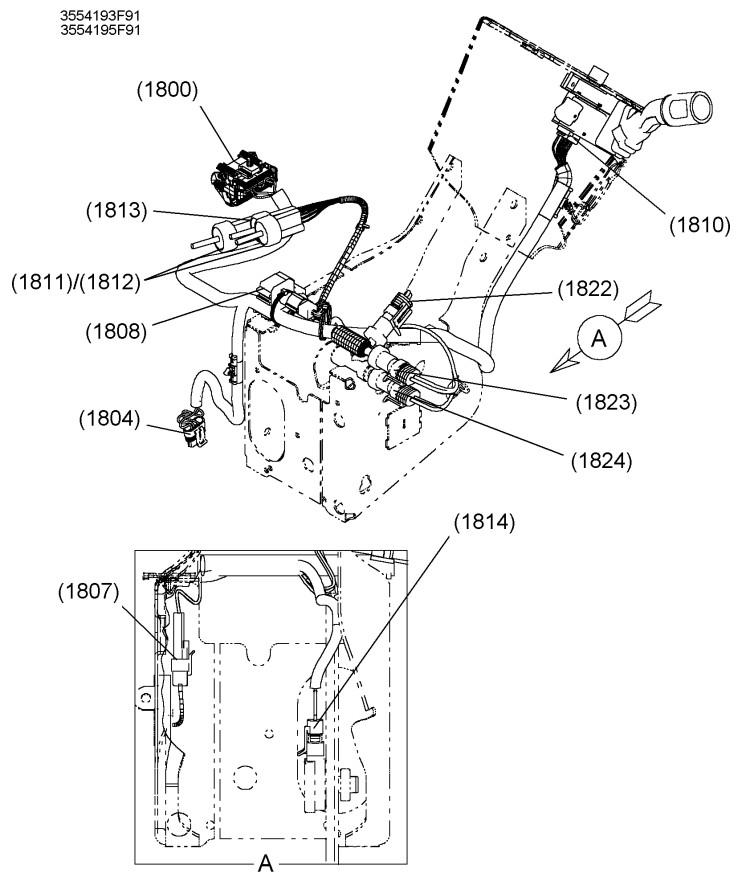
Air Application Gauge Voltage Checks		
Check with ignition on and (1822) disconnected.		
NOTE – Always check connectors for damage and pushed-out terminals.		
Always use breakout box ZTSE 4477 to take measurements on ESC connectors.		
Test Points	Spec.	Comments
(1822) cavity B to ground.	5 ± .5 volts	If voltage is missing, check for open or shorts in circuit B6HC, B6H or A6H to ESC connector (1600) cavity 27. If circuits check good, check for missing 5 volt signal from ESC.
(1822) cavity B to cavity A.	5 ± .5 volts	If voltage is missing, check for open in circuits B9VF, B9V, A9V or A9H to ESC connector (1600) cavity 3. If circuits check good, check for missing zero volt reference from ESC.
(1822) cavity B to cavity C.	5 ± .5 volts	If voltage is incorrect, check for open or short to voltage in circuits B40F, A40F or J40F to ESC connector (4004) cavity 13. If voltage is present, circuits to transducer are good. Replace transducer

Extended Description

The 5 volt sensor supply signal is supplied to air application transducer connector (1822) pin B from ESC connector (1600) pin 27.

The zero volt reference signal is supplied to air application transducer connector (1822) pin A from ESC connector (1600) pin 3.

The pressure transducer acts like a potentiometer. The transducer will provide a voltage to ESC connector (4004) pin 13, which will vary with changes in applied pressure.

Component Locations**Figure 157 Air Application Gauge Transducer Location (Steering Column Support View)**

- (1800) DRIVER CONTROL MODULE (DCM) CONNECTOR
- (1811) PRIMARY AIR TRANSDUCER
- (1812) SECONDARY AIR TRANSDUCER
- (1822) AIR APPLICATION TRANSDUCER

4.52. AUDIBLE ALARM

Circuit Function

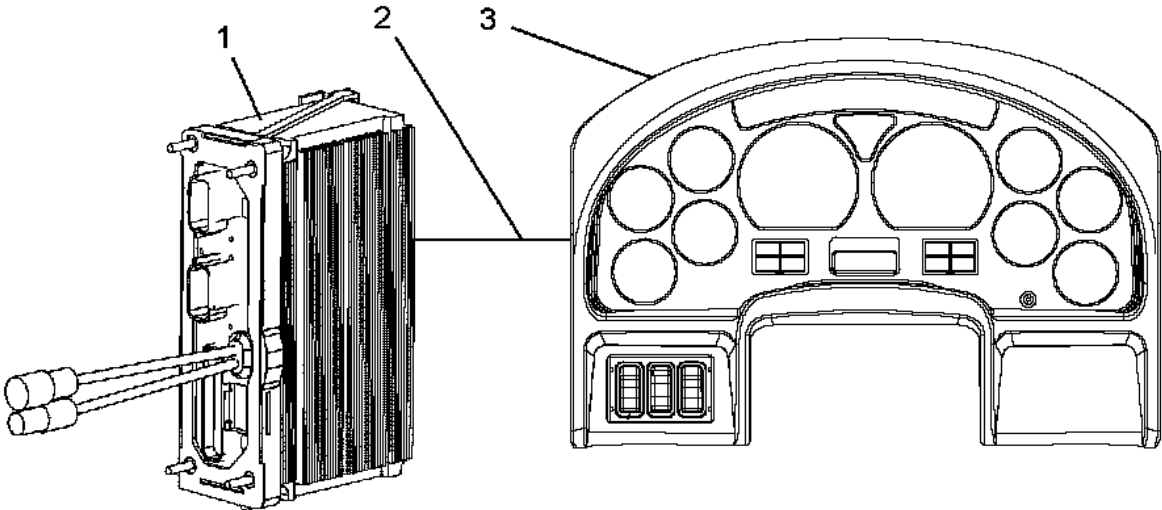


Figure 158 Audible Alarm Function Diagram

- 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 111 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.

4.53. SELECT/RESET SWITCH

Circuit Function

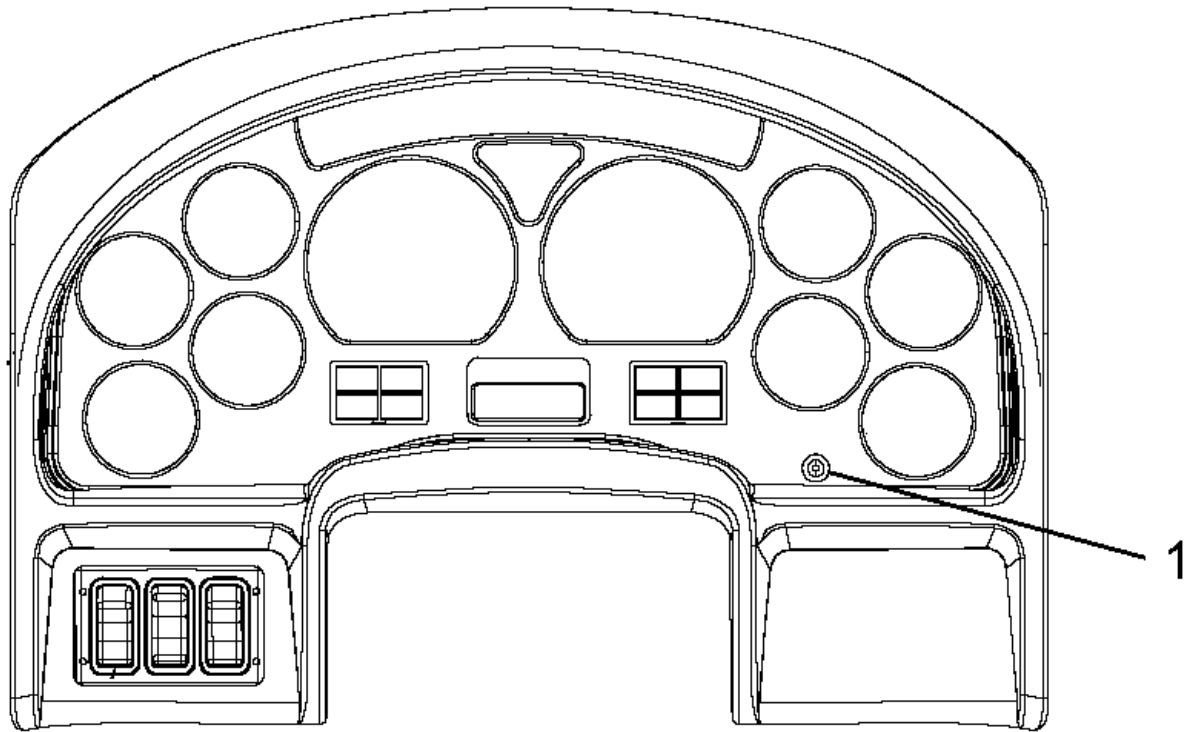


Figure 159 Select/Reset Switch Function Diagram

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 112 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.

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.

4.54. HEAD LAMP/PARK LAMP SWITCH

See Headlight System in the Light Section of this manual. (See HEADLIGHT SYSTEM, page 878)

4.55. PANEL LIGHT SWITCH

See Panel Light in the Light Section of this manual. (See PANEL LIGHTS, page 895)

4.56. WORK LIGHT SWITCH

See Work Light in the Light Section of this manual. (See WORK LIGHTS, page 939)

4.57. 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 113 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

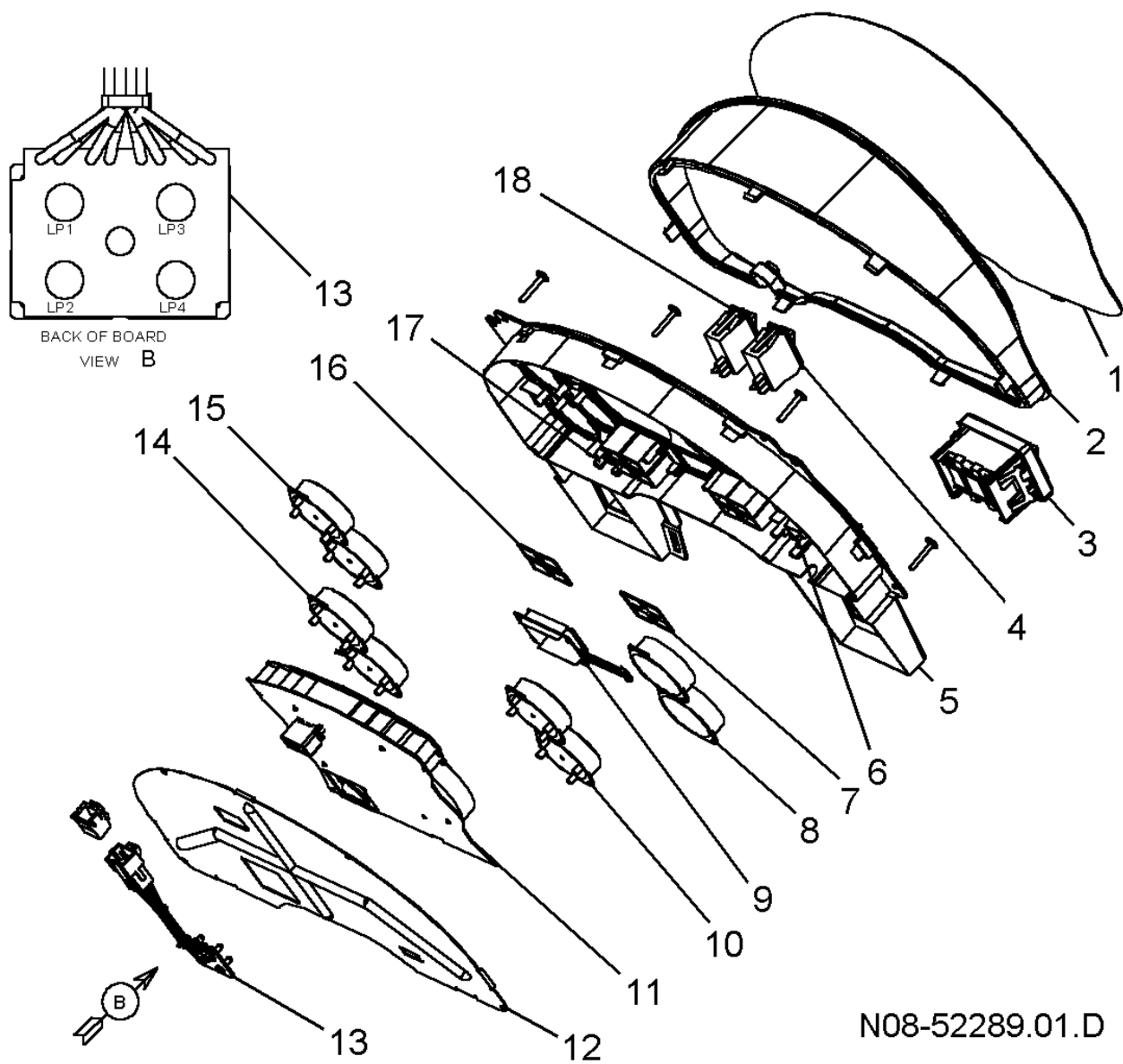


Figure 160 EGC Exploded View

1. GAUGE CLUSTER BEZEL
2. GAUGE CLUSTER SHIELD
3. 3-SWITCH PACK
4. ETHER START SWITCH
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
17. SET/RESET SWITCH LOCATION
18. ROCKER START SWITCH

5.1. EGC FRONT BEZEL

Refer to EGC Exploded View. (See Figure 160, page 330)

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. (See Figure 160, page 330)

- 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. (See Figure 160, page 330)

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.

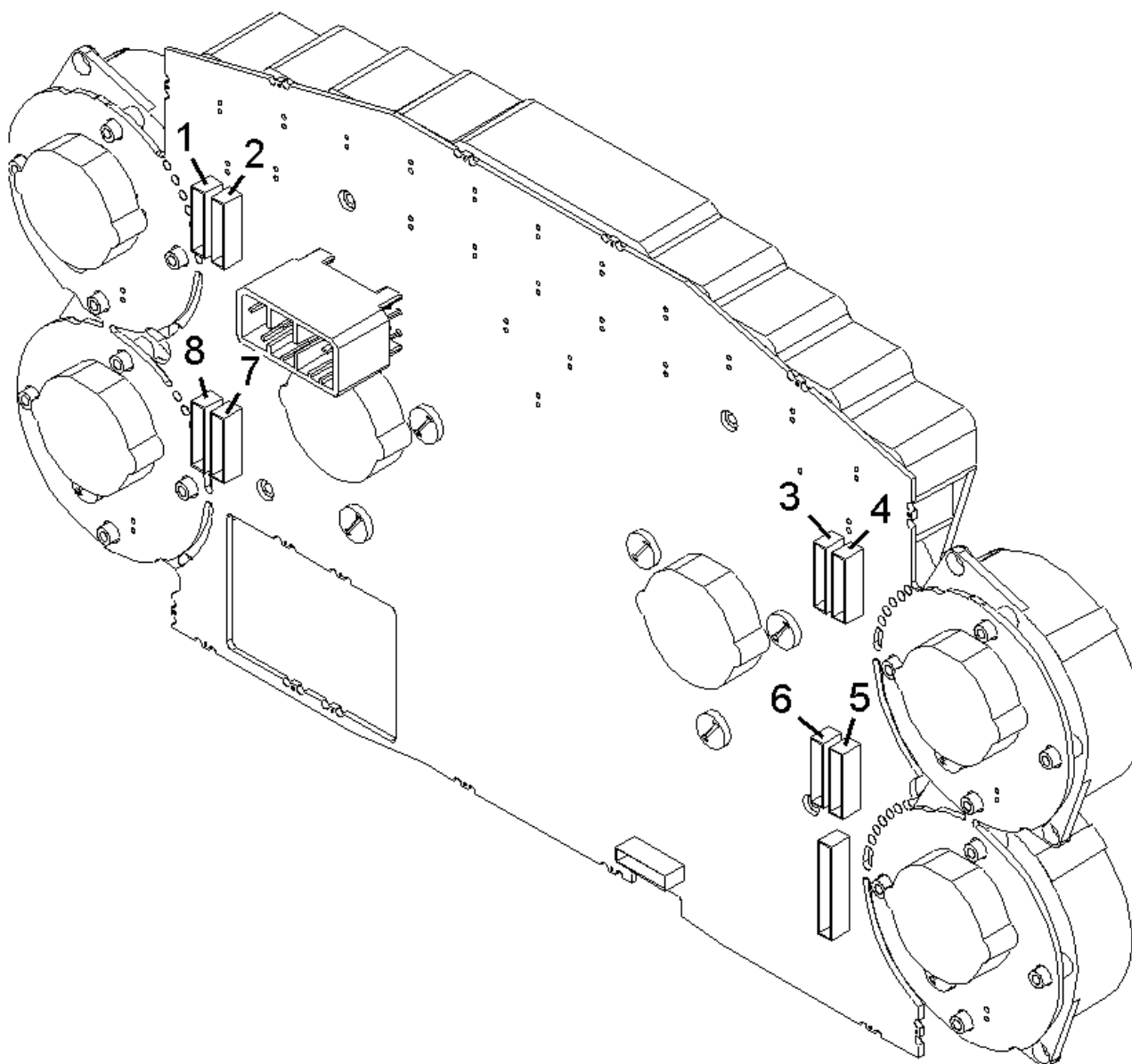


Figure 161 Typical EGC Circuit Board Gauge Connector Location

1. FUEL GAUGE CONNECTOR LOCATION
2. TOP OUTSIDE GAUGE LOCATION
3. TOP OUTSIDE GAUGE LOCATION
4. WATER TEMPERATURE GAUGE CONNECTOR LOCATION
5. OIL PRESSURE GAUGE CONNECTOR LOCATION
6. BOTTOM OUTSIDE GAUGE LOCATION
7. BOTTOM OUTSIDE GAUGE LOCATION
8. VOLTAGE GAUGE CONNECTOR LOCATION

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. (See Figure 160, page 330)

Refer to Typical EGC Circuit Board Gauge Connector Location (See Figure 161, page 332)

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. (See Figure 160, page 330)

- 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. (See Figure 160, page 330)

- 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. (See Figure 160, page 330)

- 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. (See Figure 160, page 330)

- 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. (See Figure 160, page 330)

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. (See Figure 160, page 330)

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. (See Figure 160, page 330)

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. (See Figure 160, page 330)

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.

