CASCADIA™

Electrical and Electronic System Guide for Freightliner Dealers

MECHATRONICS ENGINEERING

Daimler Trucks North America

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Section 1:

- **Coverage**

Coverage

This guide provides information on the Cascadia™ electrical and electronic system. The information will give the reader a general understanding of how this system works, and how it differs from traditional, vehicular electrical systems.

The Cascadia electrical and electronic system is a multiplexing system. This type of system transmits multiple electronic messages through the same wire, and uses electronic control units to operate the system.

One provision of the multiplexing system is the use of Freightliner proprietary parameters. Parameters allow customers to choose how a particular feature or function will work on their vehicle. Features that have parameters are described in this guide.

Two features, Powernet Management and Emergency Power Supply, provide the driver with a measure of convenience and safety in the event of a loss of power, or during certain failure modes. These safety features are explained in detail in this guide.

Also covered are the processes used in labeling the wires and in consistently using specific connector cavities, as well as designing wiring harnesses for the maximum number of options.

This guide covers the multiplexing system with software R6.0, and EPA 2010 engines and aftermarket devices that meet the U.S. Environmental Protection Agency diesel emission regulations.

Function Paths

Function paths of features, such as the headlights and the windshield wiper and washer, provide the reader with a concise depiction of the electrical path between the initial input and the output load. The function paths can be used to determine what components are involved during potential failure modes; however, the function paths do not reflect the parameters that may be associated with the features.

Aftermarket Components

There are several power sources available to customers when they want to add aftermarket components. The locations and specifications of these power sources are provided in **Section 13**, *Adding Aftermarket Components*.

Parameter Part Numbers and Data Codes

A brief description of some of the features available on the Cascadia, and the parameter part numbers and data codes associated with those features are provided in **Section 14**. This information should assist the readers in providing their customers with the specific features they want for their vehicle.

Section 2:

- **What It Does and How It Works**
- **Parameters**
- **Components of the Multiplexing System**
- **Diagnostic Features**

What It Does and How It Works

The Cascadia electrical and electronic system is a multiplexing system that replaces traditional power distribution devices with electronic control units (ECU) that communicate over the vehicle datalinks. The ECUs control power distribution to the vehicle's electrical loads by monitoring inputs—such as sensors and switches—and supplying power to outputs such as lighting, displays, gauges, and indicators.

The multiplexing system reduces the number of interconnected wires and allows more precise control of the electrical system by allowing multiple control or diagnostic commands on a two-wire datalink.

The multiplexing system serves three main functions:

- Transmits multiple electronic messages through the same wire;
- Performs tasks and monitors components simultaneously;
- Uses ECUs to operate the system, such as interpreting different messages being transmitted on the same wire.

The multiplexing system continuously monitors the status of all input devices and transmits messages over the diagnostics CAN (controller area network), the cabin CAN, and SAE J1939 and SAE J1708/J1587 datalinks to control outputs. The diagnostics CAN facilitates communication between the service tool and the CAN ECUs. The cabin CAN is a proprietary datalink that facilitates communication between the ECUs that are connected to it.

Parameters

One provision of the multiplexing system is the use of Freightliner proprietary parameters. A parameter is a specific value that is assigned to a feature or function of the vehicle, and allows the customer to choose how that particular feature or function will work on the vehicle.

Each parameter is assigned a part number. The parameter part number is programmed to the SAM Cab, SAM Chassis, or other electronic component. The parameter part numbers can be found in designated primary modules within the bills of material on a vehicle specification, but not all primary modules have parameter part numbers. See **Table 2-1** for the primary modules that are associated with parameter part numbers.

One example of a feature that has parameters is the type of lighting used for the overhead console dome and reading lights, which are located inside the cab. Step-up and step-down lighting is standard for the overhead console dome and reading lights, but a customer has the option of ordering theater (premium) lighting for these lights. Step-up and step-down lighting has no noticeable ramp time when the lights are switched on or off. Theater lighting provides a gradual illumination of the lights when they are turned on and a gradual loss of illumination when they are turned off. Separate parameter part numbers exist for the step-up/step-down lighting features and the theater lighting features. For more information on this feature, see **Section 6**, *Interior Lighting Parameters*.

Freightliner Primary Modules Associated with Parameter Part Numbers			
Module Number	**Description**	**Module Number**	**Description**
12C	Wiring-Alternator Accessories	34B	Wiring-Transmission
127	Wiring-Fuel Water Separator	35H	Switch/Wiring, Backup/Reverse
129	Wiring-Retarder Controls	353	Wiring-Vehicle, Body Builder
149	Cruise Control-Vehicle Speed	3R3	Aftertreatment Control Module Parameters (Detroit Diesel)
156	Starter Control-Manual, Driver	3RD	Common Powertrain Controller Parameters (Detroit Diesel and Cummins)
158	Starter Control-Automated	47Z	Motor Control Module Parameters (Detroit Diesel)
199	Wiring-Air Intake/Cleaner	48A	Wiring-Air Dryer
264	Controls/Wiring-Horn/Audible Warning	67E	Wiring-Entry/Access/Step
284	Power Outlet/Wiring, Sleeper/Cab, Interior	70B	Wiring-HVAC, Main
296	Wiring-Primary Receptacle	70C	Wiring-HVAC, Auxiliary
30A	Wiring-Marker Light	725	Restraint System-Supplemental
301	Wiring-Turn/Stop/Taillights	74E	Wiring-Mirror
306	Battery Isolator/Control	81B	Wiring-Dash Panel Light
308	Wiring–Supplemental Receptacle	835	Multiplexing Interface Unit
31J	Wiring Light, Utility	847	Sender/Wiring-Fuel Level
311	DRL/Headlight-Controls/Wiring	860	Wiring–to CNTR Dash and Multiplex
313	Wiring-Road/Fog Light	87B	Wiring-Driver Control Traction Device
32B	Wiring-Light, Internal, Forward	877	Wiring-Service/Park Brake
32C	Wiring-Light, Internal, Sleeper/Baggage	885	Wiring/SW-Pump/PTO Controls

Table 2-1: Freightliner Primary Modules Associated with Parameter Part Numbers

Components of the Multiplexing System

The multiplexing system has at least eight electronic control units, or modules, and a junction block:

- central gateway (CGW)
- SAM Cab (signal detect and actuation module)
- SAM Chassis
- modular switch field (MSF)
- engine control modules
- pneumatic ABS module
- instrumentation control unit
- cab climate control panel

- star point junction block
- aftertreatment modules

See **Section 12** for information on the following non-cabin CAN ECUs:

- common powertrain controller
- cab and sleeper HVAC systems
- collision warning systems
- engine control module
- instrumentation control unit
- pneumatic ABS module
- supplemental restraint system
- transmission control unit
- aftertreatment control module (see **Section 15**)

Central Gateway

The central gateway serves as the focal point for all diagnostic communications with the cabin CAN ECUs. It routes messages among multiple datalinks with different protocol or message sets. The CGW is located in the cab behind the lower cover dash panel. See **Figure 2-1**.

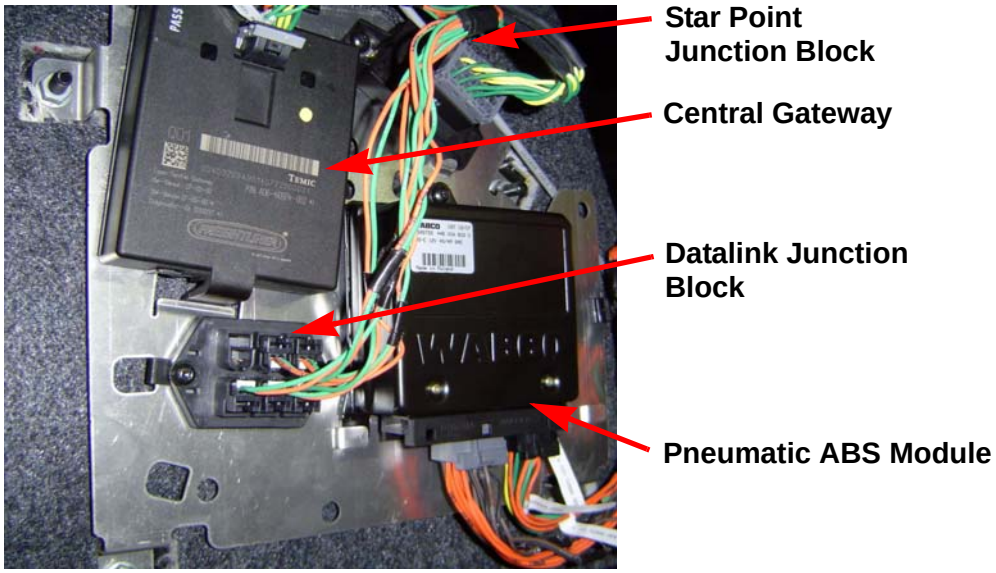


Figure 2-1: Central Gateway Location

SAM Cab and SAM Chassis

The signal detect and actuation module (SAM) provides power and circuit protection to other modules and components in the multiplexing system. The SAM reads inputs from the sensors and switches, and drives outputs by means of field effect transistors (FET) or switched relay loads.

SAM Cab

The SAM Cab controls all switching and detecting functions for cab controls and the front of the vehicle. The SAM Cab is located behind the glove box. See **Figure 2-2**.

Figure 2-2: SAM Cab Location

SAM Chassis

The SAM Chassis controls the chassis electrical devices and all trailer devices. The SAM Chassis is located on the engine side of the frontwall in the lower left (driver side) corner, with access to five of the connectors from inside the cab. See **Figure 2-3**.

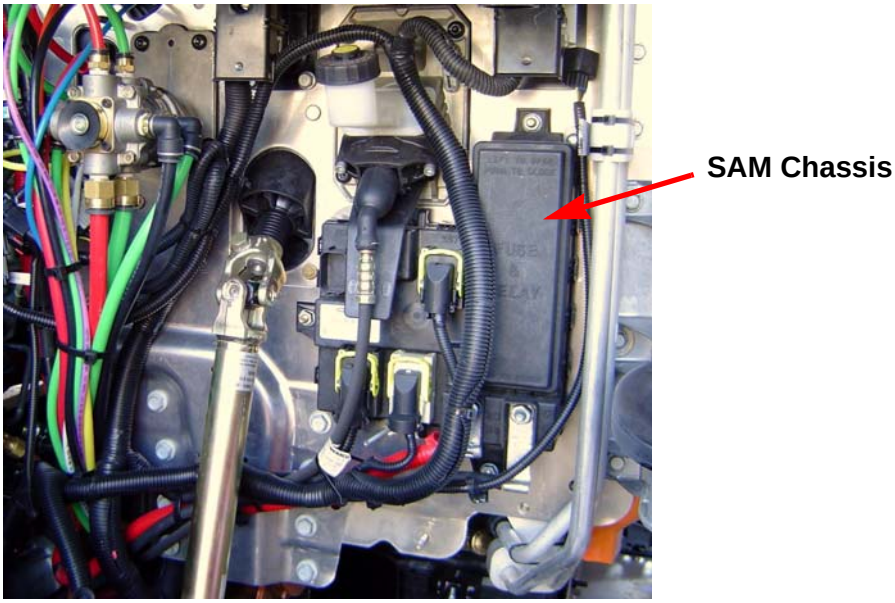


Figure 2-3: SAM Chassis Location

Optional Circuit Protection for Trailer Circuits

Some SAM Chassis modules may be equipped with optional positive temperature coefficient (PTC) or PolySwitch devices that provide circuit-breaker-like protection on trailer circuits to handle intermittent faults caused by faulty trailer wiring.
A PolySwitch is an auto-resetting circuit protection device. The semi-crystalline polymer melts and expands when the circuit is in a trip event due to an overcurrent or short-circuit condition. This expansion of the polymer causes the device to change to a high-resistance state in order to protect the circuit attached to the device. The device is held in the high-resistance state until the supply power to the device is removed, or the overcurrent/short has been removed and the device has had enough time (typically two minutes) to cool to the low-resistance state.

PTCs are shown in **Figure 2-4**. See **Figure 2-5** for a SAM Chassis module with fuses in all positions; see **Figure 2-6** for a SAM Chassis module with PTCs installed in the trailer circuits.

Figure 2-4: Positive Temperature Coefficient Devices

Figure 2-5: SAM Chassis Module With Fuses in All Positions

Figure 2-6: SAM Chassis Module With PTCs in All Positions

Modular Switch Field

The modular switch field (MSF) is a system of multiplexed switches. The MSF consists of a master control module and one or more slave modules and subbus switches.

Master Control Module

The master control module monitors all the switches connected to the multiplexing system. This module consists of the hazard lights switch and two additional switches. The two additional switches are subbus switches. See **Figure 2-7**.

The master control module has a cabin CAN connection. The cabin CAN is a proprietary datalink that connects the central gateway, the modular switch field, the SAM Cab, and the SAM Chassis, and facilitates communication between these ECUs.

The switches on the steering wheel, stalk switch, and headlight switch are hard-wired to the master control module.

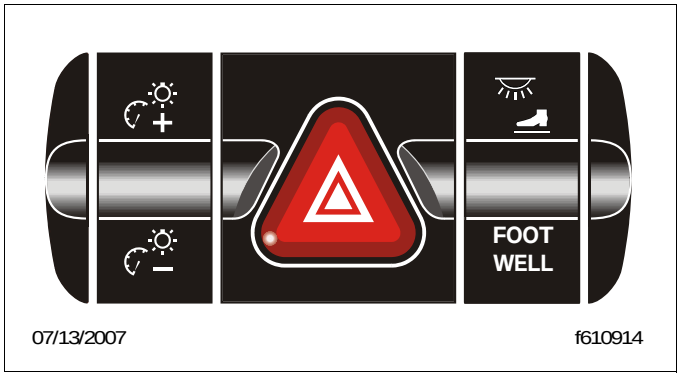


Figure 2-7: Master Control Module

Slave Module

The switches in the slave module communicate with, and connect to, the master control module using a proprietary subbus. The slave module is a passive device that can house up to four individual subbus switches. See **Figure 2-8**.

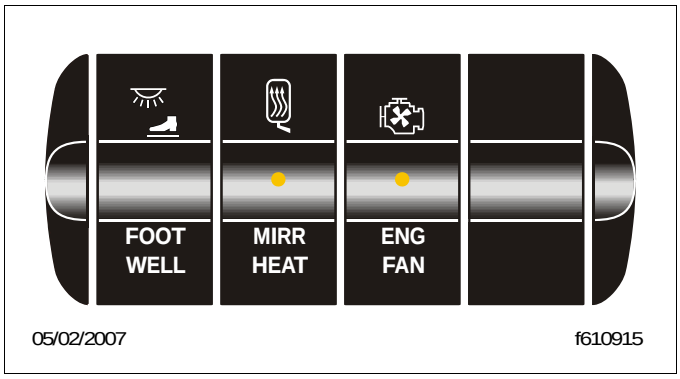


Figure 2-8: Slave Module

Subbus Switches

There are two types of subbus switches that plug into the master control module or slave module:

- multiplexed or signal
- hard-wired or load interrupting

A multiplexed switch's position—such as up, down, or not pressed—is read by the master control module and communicated to the other cabin CAN ECUs. The multiplexed switch's position can also be read by a service tool. A hard-wired switch's position can be detected only by looking at it or the component it controls.

Each subbus switch in the MSF system, whether multiplexed or hard-wired, has a parameter part number associated with it. The parameter part number follows the switch part number in a bill of material. The P3 Modular Switch Field Parameter Crossover List provides switch part numbers and the associated parameter part numbers. Daimler Trucks North America employees can access this list by following these steps:

1. Open Internet Explorer and login to the Daimler Employee Portal.

2. Click on the **Work** tab at the top of the screen.
3. On the left side of the screen under the **Engineering Info Navigator** heading, click on **CorpWiki Engineering Open**.
4. Scroll down and highlight **Standard Dash Switches**.
5. Scroll down and highlight **Switches for P3**.
6. Scroll down to the **Switch Parameters** heading and click on the link to **Switch Parameters**.

Subbus Switch Diagnostics

Subbus switches have a unique identification recognized by the master control module. This identification is monitored and compared to the parameter configuration by the master control module. The result of this comparison determines the absence or presence of a switch, and reports a “missing” and/or “extra” switch fault.

Star Point Junction Block

The star point junction block is a device that provides an electrical termination point to the cabin CAN. See **Figure 2-1** and **Figure 2-2**.

Diagnostic Features

Diagnostics for the Cascadia has five additional ECU features that are utilized by ServiceLink® and the Datalink Monitor templates within ServiceLink.

NOTE: All mention of ECUs in this section refers only to the SAM Cab, SAM Chassis, modular switch field, and central gateway, which are connected to the cabin CAN datalink.

The following information regards only the **additional** features available on ServiceLink for troubleshooting Cascadia vehicles.

1. Enhanced **ECU identification** includes:
   - the software version—with a YY.WW.PPP (year, week, patch level) format—being used by the ECU
   - hardware and software part numbers
   - ECU serial number

2. **I/O control**: Datalink Monitor templates, available in ServiceLink, allow the technician to control the input or output of an electronic component without activating the switch or other activation device. This feature is used to turn a pin on or off, which helps the technician determine if the path between the ECU output pin and the output load (such as a bulb) is working.

   For example, if the utility light switch is off and an I/O control is applied to the utility light output pin and the utility light output is activated, the technician can be sure that the wiring is correct. In this case, the ECU parameters shall be double checked.

   A technician can also use I/O control, via Datalink Monitor templates, to check the vehicle for failure conditions.

NOTE: As a safety feature, Daimler Trucks North America has implemented an I/O control interlock feature. This feature prevents the I/O control from being used under certain conditions. The I/O control feature can only be used when the park brake is set or the vehicle speed is less than 5 mph (8 km/h).

3. **Values**: Datalink Monitor templates, available in ServiceLink, allow the user to determine the current value, or status, of certain pins on an ECU. When used with I/O control, the technician requests a specific output and reads the value to verify that the output turned on. This feature can also be used to monitor a particular datalink message—such as system voltage—or sensor input, such as outside air temperature.

4. **ECU reprogramming**: Flash reprogramming the software and configuring the parameters both affect the functionality of the ECU, and are therefore important elements in diagnosing the ECU. Flash reprogramming allows the ECUs to be programmed with a specific version of software using ServiceLink. During the reprogramming process, the latest parameters that are specified for that particular vehicle are applied to the ECU. Flash reprogramming allows the ECU to be kept up-to-date with additional features and improvements throughout its service life.

   The SAM Cab, SAM Chassis, modular switch field, and central gateway can all be reprogrammed.

   Determining if the correct parameters have been applied to the ECU is an important part of the diagnostic process. A perceived problem—such as the vehicle not responding the way it is expected to respond—may occur because an incorrect parameter was applied to the vehicle. A technician can solve such an issue by using ServiceLink to apply the correct parameter, independent of flash reprogramming.

5. **Fault memory**: The ECUs are capable of detecting and storing fault conditions such as short to ground, short to battery, or open load. Fault codes can be read by the technician using ServiceLink, which will also display detailed fault information, such as fault occurrences and detailed error descriptions. Fault codes are also displayed on the LCD display on the instrumentation control unit (ICU), but each ECU can display only one fault on the ICU at a time.

ServiceLink

ServiceLink is accessed through www.AccessFreightliner.com. To request a ServiceLink account or to get information on ServiceLink, contact the dealer help desk at:

- Dealer.HelpDesk@Freightliner.com
- 1-855-639-8680 for Freightliner dealers, fleets, and customers

There are several ways to obtain training on how to use ServiceLink. Web-Based Training and the *ServiceLink User Guide* are available through the Help menu in ServiceLink.

Training Resources

Training that covers service, warranty, and parts topics is available on the Aftermarket Resource Center at www.dtnaarc.com. On the Aftermarket Resource Center home page, enter your user name and password, then click on the **My Learning** tab. In the

drop-down menu, click on **Available Courses**. Enter a course name or keyword in the **Search Text** field.

Training courses specifically for Cascadia vehicles include:

- Introduction to the Cascadia
- New Systems and Serviceability
- New Electronics Systems
- ServiceLink Diagnostics
- Introduction to ParkSmart Auxiliary HVAC Training

Section 3:

- **Wires**
- **Connectors**
- **Wiring Harnesses**
- **Subsystem Wiring Diagrams**

Wires

Freightliner uses color-coded wires on the Cascadia for ease of identification. See **Table 3-1** for the color-coding used on Cascadia vehicles.

The wires are also identified with both Freightliner and SAE J2191 circuit numbers. For example, a wire stamped with 295A # 2001 indicates a 295A Freightliner circuit number and a 2001 SAE circuit number.

Color-Coded Wires Used on Cascadia Vehicles		
Color	**Abbreviation**	**Usage**
Black	BK	Ground
Black-white	BK-W	Clean or isolated ground
Brown	BR	Marker lights, taillights, panel lights
Dark blue	DKBL	Backup, windshield wiper, trailer auxiliary
Dark green	DKG	Turn signal-RH, driver's display, data record, J1587+, J1939–
Dark green-white	DKG-W	Starting aids, fuel heaters, material dump controls, winch, liftgate
Gray	GY	Electronic engine
Gray-white	GY-W	Generator, auxiliary
Light blue	LTBL	HVAC, circulation fans, J1922+
Light blue-white	LTBL-W	Water/oil gauge and indicator (engine and transmission)
Light green	LTG	Headlight, fog light, DRL
Light green-white	LTG-W	Axle controls and indicators, suspension, fifth wheel
Orange	O	ABS, EBS, J1587–
Pink	PK	Start control, ignition, charging, volt and ammeter, J1922–
Pink-white	PK-W	Fuel control and indicators, shutdown, speed limiter
Purple	PRP	Engine fan, PTO, auto lube and oil
Purple-white	PRP-W	Utility light, spot light, ad light, interior light, emergency lights
Red	R	Power distribution, battery power
Red-white	R-W	Brake, pneumatic, hydraulic, retarder, stop
Tan	T	mph/rpm signals, horn, flasher, pyro, turbo
Tan-white	T-W	Audio, video, security, window, computer, seat, mirror, cab tilt, tire inflation and pressure
White	W	Transmission
Yellow	Y	Turn signal-LH, J1939+
Yellow-white	Y-W	Air bag and SPACE

Table 3-1: Color-Coded Wires Used on Cascadia Vehicles

3 Wires, Connectors, and Wiring Harnesses

Connectors

Each bulkhead and inline connector in a Cascadia vehicle has a specific cavity for every circuit. Each individual circuit of a specific component resides in the same location regardless of the type of cab or options on the vehicle. For example, if technicians want to diagnose the fuel gauge, they would locate pin 7 of connector B on any Cascadia vehicle.

NOTE: The connectors for the instrumentation control unit telltales have floating pins.

The bulkhead and interface connectors have wires that belong to multiple modules. Refer to Daimler Trucks North America module number 280 for the engineering drawing that identifies the cavity numbers, circuit numbers, circuit descriptions, and module numbers associated with those connectors.

Wiring Harnesses

The Cascadia wiring harnesses were developed for the maximum number of options that could possibly be used on a vehicle. By designing for the maximum number of options, space for additional wires is already provisioned within the wiring harness regardless of the number of options chosen by the customer. This design provides a cleaner main harness and is meant to eliminate the need for wiring overlays.

Most—if not all—of the wiring harnesses and air lines are routed inside the left frame rail between the front axle and the center of the rear tandem axle.

Subsystem Wiring Diagrams

The subsystem wiring diagrams contain the circuit information for all wiring harnesses. More than one wiring diagram may be needed to represent a single subsystem. The drawing number for a subsystem wiring diagram begins with G06; these drawings are sometimes referred to as G-O-sixes.

Each subsystem has a primary module number associated with it. Typically, G-O-sixes can be found in a primary module. See **Table 3-2** for the primary module numbers, subsystem descriptions, and subsystem abbreviations.

Primary Module Numbers and Subsystem Descriptions		
Primary Module	**Subsystem Description**	**Subsystem Abbreviation**
337	A/C power and power inverter	PWR_AC
28F	Aftertreatment device	ATD
48A	Air dryer	AIR_DRY
199	Air intake and cleaner indicators	ENG_INTK

Table 3-2: Primary Module Numbers and Subsystem Descriptions

Primary Module Numbers and Subsystem Descriptions		
Primary Module	**Subsystem Description**	**Subsystem Abbreviation**
12C	Alternator volt, amp, and charging	ALT_CHG
330	Antilock brake system, elec brake	ABS
74D	Audio and sound system	AUDIO
71W	Auxiliary circulation fan	AFAN
865	Axle instrumentation and wiring	AXLE_IND
87F	Axle lift, pusher, and tag controls	AXLE_LIFT
87B	Axle lock, DCDL, left to right	AXLE_LKD
87A	Axle lock, interaxle, forward to rear	AXLE_LKI
87C	Axle shift, two-speed axle, AWD	AXLE_SHF
306	Battery, battery cables, and isolators	BAT
593	Body dump/tilt/material controls	MATL_CTRL
670	Cab/hood lift	TILT
748	CB radio	CB
738	Clock, cab and sleeper	CLOCK
736	Collision avoidance and warning system	CAWS
160	Datalink and diagnostic	DL
813	Data recording and logging	DRCDG
787	Door locks, keyless entry, and security system	DR_LOCK
81B	Driver’s information module and panel lamps	DIM
158	Engine, automatic, start/stop system	ENG_AUTO
140	Engine block and oil heater	ENG_BLK_HTR
129	Engine brake, retarder	ENG_BK
283	Engine controls, electronic engine	ENG_CTRL
149	Engine cruise control, vehicle speed	ENG_CC
154	Engine ether starting aid	ENG_AID
276	Engine fan	ENG_FAN
152	Engine instrumentation, shutdown and warning	ENG_IND
132	Engine intake and grid heater	ENG_HTR
148	Engine rpm control, hand or remote	ENG_RPM
156	Engine start and stop	ST_SP
87E	Fifth wheel control and indicators	FIFTH_WHL
127	Fuel heater and water in fuel	FUEL_HTR
847	Fuel instrumentation and warning	FUEL_IND
845	Gauge fuel filter restriction	FUEL_RSTR
280	Ground	GND

Table 3-2: Primary Module Numbers and Subsystem Descriptions

Primary Module Numbers and Subsystem Descriptions		
Primary Module	**Subsystem Description**	**Subsystem Abbreviation**
70C	Heater and air conditioning auxiliary	HVAC_AUX
70B	Heater, ventilation, and air conditioning	HVAC
264	Horn, audible warning	HORN
33A	Lighting and visual emergency devices	LT_EMER
319	Lighting exterior, advertising, top of cab	LT_AD
35H	Lighting exterior, backup lamp and alarm	LT_BKUP
311	Lighting exterior, head lamp, tail lamp, and DRL	LT_HDLP
30A	Lighting exterior, marker	LT_MKR
313	Lighting exterior, road and fog lamp	LT_RDLP
30G	Lighting exterior spot	LT_SPOT
301	Lighting exterior, turn lamp and alarm	LT_TRN
31J	Lighting exterior, utility and work	LT_UTIL
32B	Lighting interior, dome, reading, forward	LT_DOME
32C	Lighting interior, sleeper dome reading and baggage	LT_SLPR
74E	Mirror heat and power control	MIR
860	Multiplex controls and module wiring	MUX_CTRL
48B	Oil and lubrication automation	LUBE
87G	Optional air, controls, and wiring	OPT_AIR
329	Optional switch and wiring	OPT_WRG
789	Phone	PHONE
285	Power distribution system	PWR
284	Power outlet and receptacle	PWR_RCPT
885	Power takeoff controls	PTO
74F	Seat power	SEAT
725	Secondary restraint system (air bag)	SRS
877	Service and park brake system and lighting	BK_SVCE
153	Starter-disable controls	ST_DISABL
54C	Steering control	STRG
308	Supplemental trailer receptacle	TRLR_SUPPL
87D	Suspension	SPNSN
49D	Tire inflation	TIRE
296	Trailer	TRLR
34B	Transmission	TRANS_CTRL
34C	Transmission, auxiliary controls	TRANS_AUX
863	Transmission instrumentation and warning	TRANS_IND

Table 3-2: Primary Module Numbers and Subsystem Descriptions

Primary Module Numbers and Subsystem Descriptions		
Primary Module	**Subsystem Description**	**Subsystem Abbreviation**
737	TV and video	VIDEO
67E	Vehicle entry, access	ENTRY
353	Vehicle interface wiring	VEH_INTFC
786	Vehicle tracking and guidance system	TGS
73H	Visual monitoring and tracking systems	IMAG
66A	Window power	WDO
66B	Windshield wiper	WIPE
42Y	Wiring–secondary transmissions	TRANS_SEC

Table 3-2: Primary Module Numbers and Subsystem Descriptions

Section 4:

- Powernet Architecture Schematic
- Powernet Distribution Box
- Main Ground Junction Block
- Powertrain Distribution

Powernet Architecture Schematic

See **Figure 4-1** for the Cascadia powernet architecture schematic.

Powernet Distribution Box

Main Powernet Distribution Box

The main powernet distribution box (PNDB) provides high-amp fused power to the powertrain power distribution module (PT-PDM), the SAM Cab, and the SAM Chassis. It also provides fused continuous power to the aftertreatment control module, emergency power, the radio and clock, and the alternator remote sense.

The PNDB is located on the engine side (or front side) of the front wall near the SAM Chassis. See **Figure 4-2**. A seven-position PNDB is available with or without an integral disconnect switch. The PNDB without an integral disconnect switch is standard; a PNDB with an integral disconnect switch is optional.

The PNDB has two distribution buses. The first distribution bus consists of three separately protected circuits each greater than 100 amps on the load side of the disconnect switch. The second distribution bus consists of four separately protected circuits each 30 amps or less on the source side of the disconnect switch. See **Figure 4-3** for the fuse positions, and **Table 4-1** for the designated usage and the amperage for each fuse.

Daimler Trucks North America recommends that the midi fuse rating not exceed 200 amps.

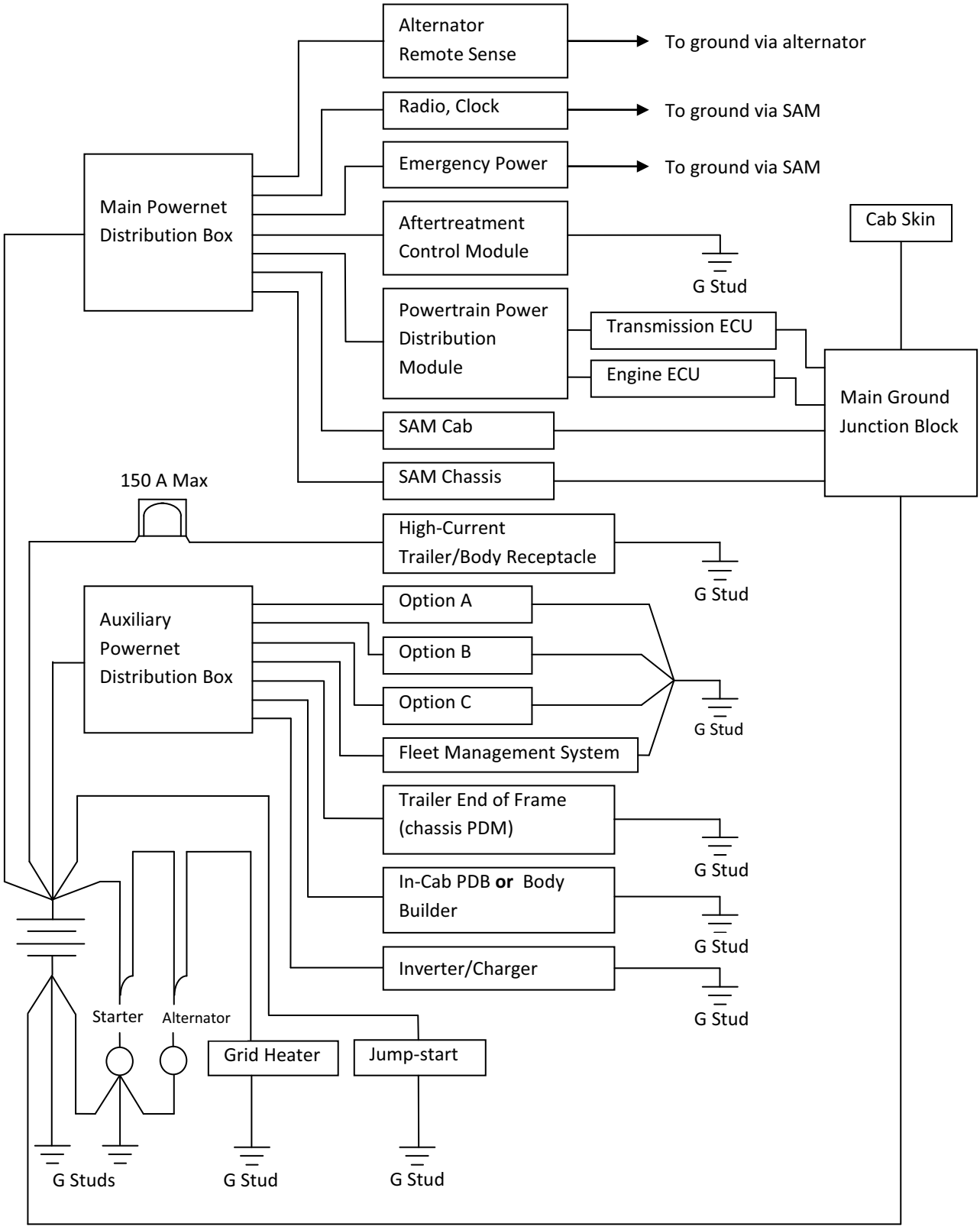


Figure 4-1: Powernet Architecture Schematic

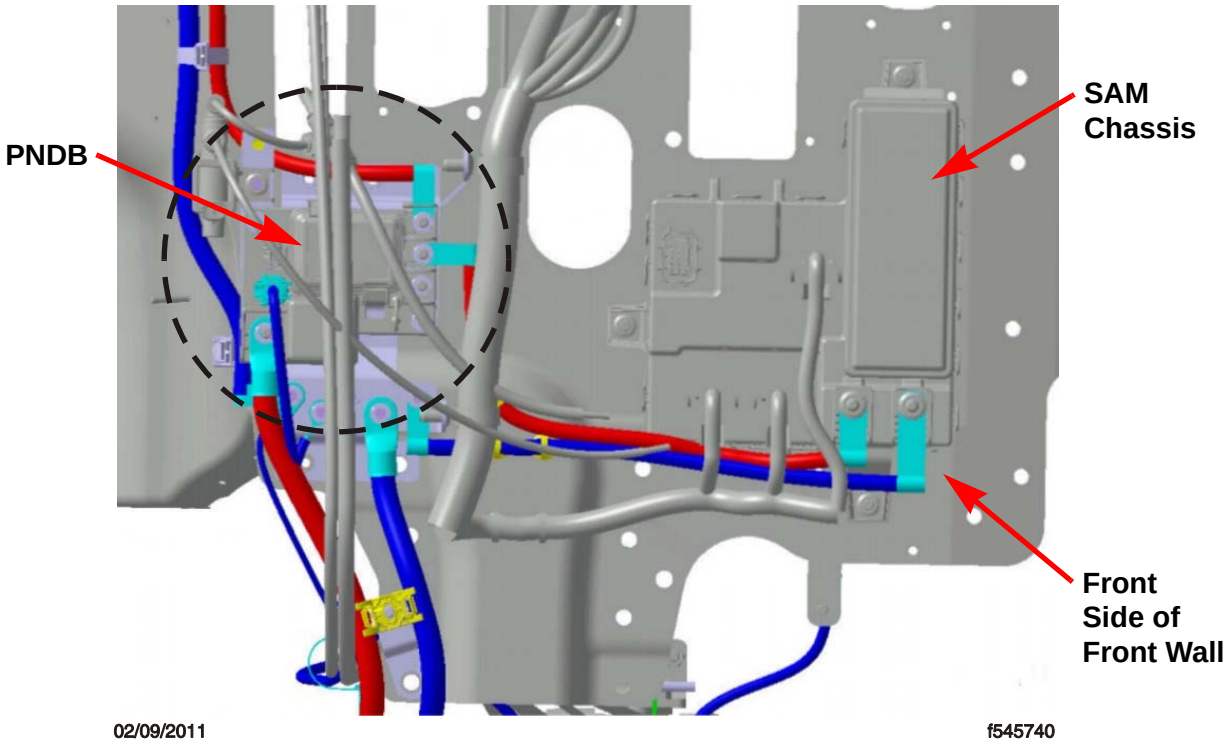


Figure 4-2: Location of the Main Powernet Distribution Box

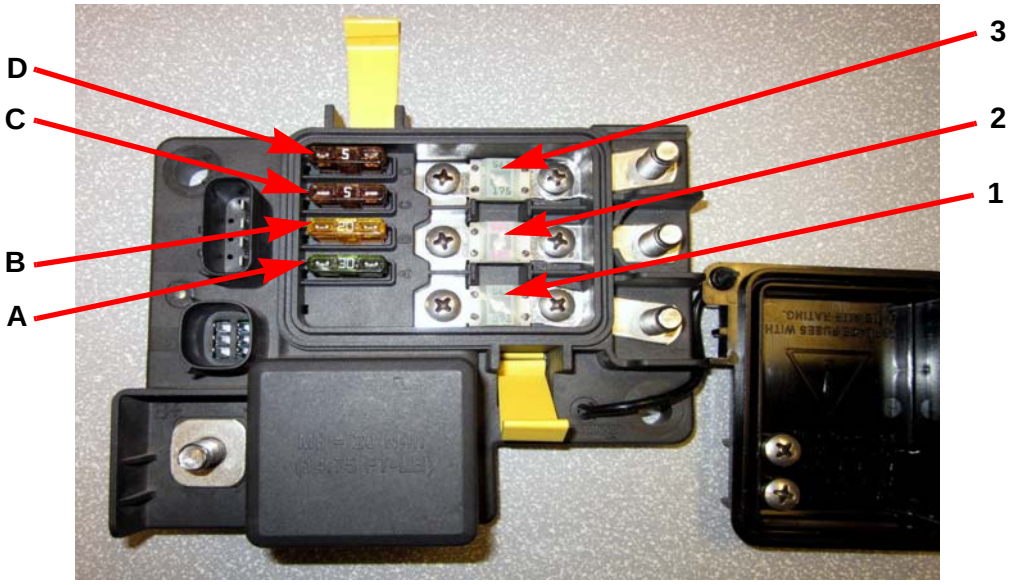


Figure 4-3: Fuse Positions for the Main and Auxiliary Powernet Distribution Boxes

Amperage Values for the Main Powernet Distribution Box With or Without the Integral Disconnect Switch		
Position	**Designated Use**	**Amperage**
A	Aftertreatment control module	30 A
B	Emergency power	20 A
C	Radio, Clock	5 A
D	Alternator remote sense	5 A
1	Powertrain PDM	125/175 A
2	SAM Chassis	125 A
3	SAM Cab	175 A

Table 4-1: Amperage Values for the Main Powernet Distribution Box With or Without the Integral Disconnect Switch

Auxiliary Powernet Distribution Box

An auxiliary PNDB is available for vehicles that require additional high-amp fused power for trailer wiring, in-cab PDM, body builder, or an inverter/charger. The auxiliary PNDB is located on the frame rail near the battery box.

When the main and auxiliary powernet distribution boxes both have an integral disconnect switch, they are controlled by the same disconnect switch.

The auxiliary PNDB has two distribution buses. The first distribution bus consists of three separately protected circuits each greater than 100 amps on the load side of the disconnect switch. The second distribution bus consists of four separately protected circuits—of which only one is used—on the source side of the disconnect switch. See **Figure 4-3** for the fuse positions, and **Table 4-2** for the designated usage and the amperage for each fuse.

Amperage Values for the Auxiliary Powernet Distribution Box		
Position	**Designated Use**	**Amperage**
A	Not used	0
B	Not used	0
C	Not used	0
D	Fleet management system	20 A
1	Trailer end of frame (chassis PDM)	125 A
2	In-cab PDM or body builder	30/150 A
3	Inverter/charger	200 A

Table 4-2: Amperage Values for the Auxiliary Powernet Distribution Box

Main Ground Junction Block

The main ground junction block (MGJB), located below the powernet distribution box, is a tin-plated copper plate where the following circuits are grounded:

- SAM Cab
- SAM Chassis
- engine and transmission (powertrain PDM)
- battery negative
- antilock brake system
- cab skin ground
- spare 1
- spare 2

See **Figure 4-4** for the locations of the ground cables on the main ground junction block.

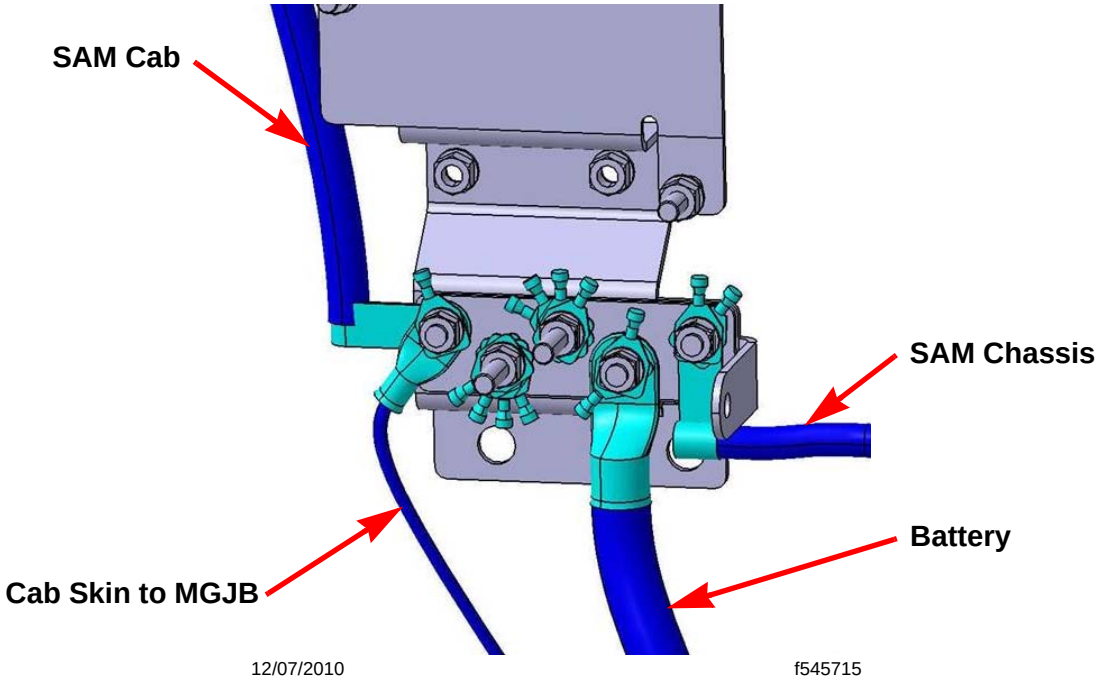


Figure 4-4: Ground Cable Locations on the Main Ground Junction Block

Powertrain Distribution

Common Powertrain Controller

The common powertrain controller (CPC) is provided on Detroit Diesel engines. It is located in the cab behind the auxiliary instrument dash panel. See **Figure 4-5**.

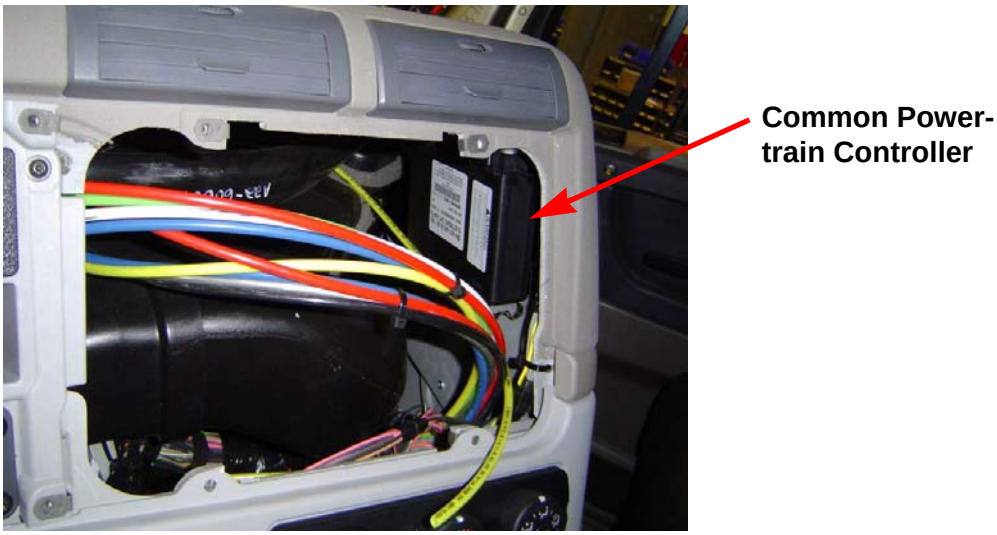


Figure 4-5: Common Powertrain Controller Location

Powertrain Power Distribution Module

The powertrain power distribution module (PDM) is used to house the large number of circuit protection devices for powertrain components. It is located on the left inner fender. See **Figure 4-6**.

The powertrain PDM provides:

- battery power to the engine control module (ECM) and transmission control unit (if equipped)
- ignition power to the ECM, transmission control unit (if equipped), and related devices
- a fused battery sense circuit for a progressive low-voltage disconnect (PLVD) system and/or a remote sense for the alternator

NOTE: The powertrain PDM should not be used or modified when installing a body builder option on a vehicle. For information on the body builder connector, see **Section 7**.

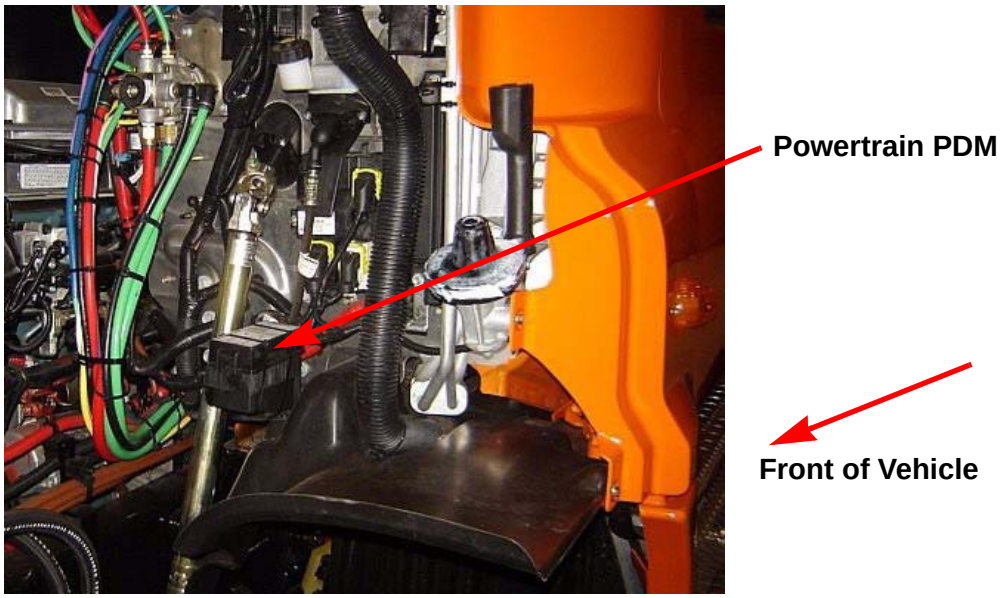


Figure 4-6: Powertrain PDM Location

Redundant Ground Return System

The redundant ground return system is a standard feature on the Cascadia. In this system there is a dedicated ground cable between the starter and the battery box. In addition there is a ground between the frame rail and the battery box, as well as a ground cable from frame rail to frame rail. See **Figure 4-7** for a schematic of the redundant ground return system with the starter on the left side of the vehicle; see **Figure 4-8** for a schematic of the redundant ground return system with the starter on the right side of the vehicle.

When circuits are added to the vehicle after production, a ground return should be installed. Circuits external to the cab should utilize the SAM Chassis, SAM Cab, or main ground junction block for the ground return. Circuits internal to the cab should utilize the SAM Chassis, SAM Cab, or dash ground splice pack for the ground return.

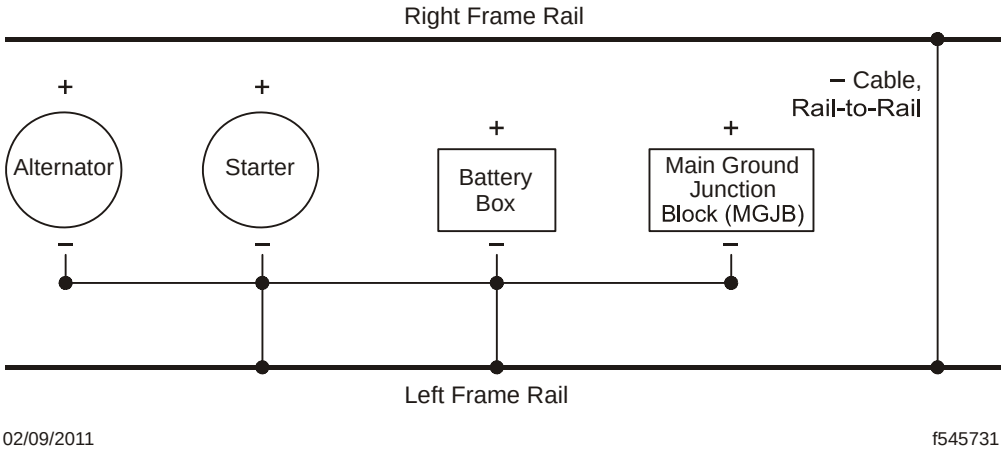


Figure 4-7: Redundant Ground Return System With Starter on Left Side

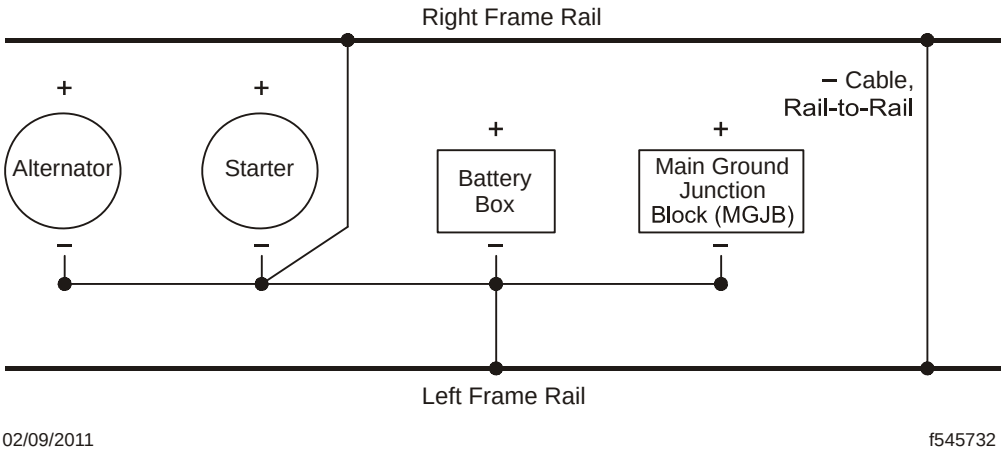


Figure 4-8: Redundant Ground Return System With Starter on Right Side

Section 5:

- Exterior Lights Fault Reporting
- Daytime Running Lights
- Fog Lights, Cornering Lights, and Auxiliary High-Beam Lights
- Follow Me Home
- Hazard Lights
- Headlights
- Marker Lights
- Stop Lights, Turn Signal Lights, and Backup Lights
- Turn Signal Lights
- Turn Tip
- Utility Lights

Exterior Lights Fault Reporting

Exterior lights fault reporting is a feature that communicates to the driver that an exterior light is out. The parameter part number indicates which exterior light is out. The fault reporting parameter part number is in the module of the function that is reporting the fault.

A vehicle without exterior lights fault reporting is required to have a parameter part number with no content in the bill of material to disable diagnostics and functionality for the unspec'd feature.

Daytime Running Lights

Daytime running lights (DRL) are exterior lights that automatically illuminate when the vehicle meets certain conditions. Parameters are used to specify which lights are used for DRL, and which conditions activate the DRL feature. The DRL feature is controlled by the SAM Cab.

Daytime running lights are required for vehicles domiciled in Canada, and are standard for vehicles domiciled anywhere other than Canada.

The front turn signal lights are the standard lights used for DRL. There are two groups of lights that are optional for DRL:

1. Front turn signal lights, marker lights, taillights, and the license plate light
2. Low-beam headlights, marker lights, taillights, and the license plate light

NOTE: Only the front turn signal lights are used for DRL, not the side or rear turn signal lights. See **Figure 5-1**.

When daytime running lights are on and the right or left turn signal is activated, the corresponding front turn signal light flashes in response to the turn signal request. The opposite front turn signal light continues to be controlled by DRL. This applies only when the front turn signal lights are used for the standard DRL or as part of the optional DRL.

When the hazard light switch is activated, both front turn signal lights flash in response to the hazard light request, taking precedence over the DRL feature.

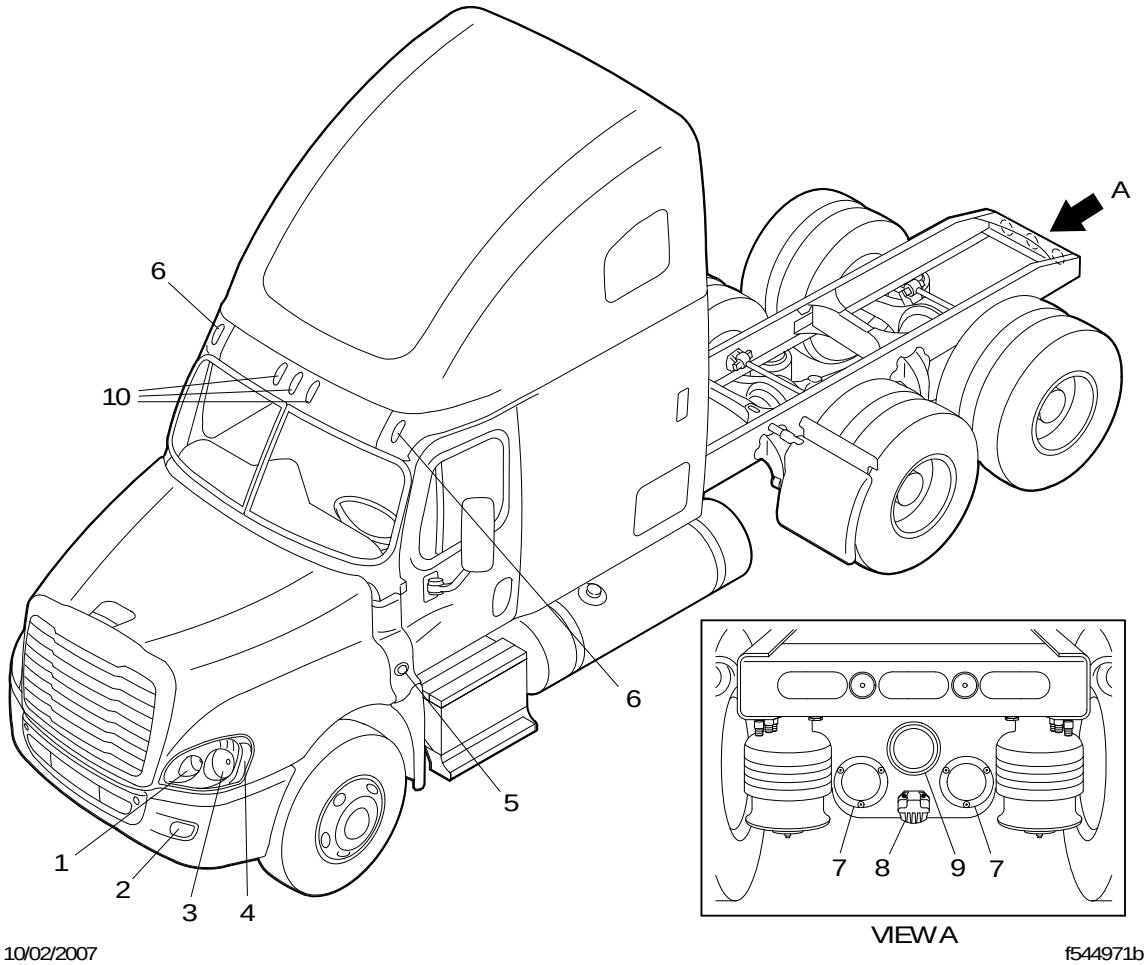
An option to have the daytime running lights shut off when the vehicle speed is less than 10 mph (16 km/h) is available. This is a courtesy feature that is useful when the vehicle is approaching a weigh station.

See **Figure 5-2** for the function path of the daytime running lights.

DRL Override Switch

An optional DRL override (DRL OVRD) switch is available on vehicles domiciled anywhere other than Canada. The DRL override switch is a momentary switch that enables the driver to deactivate the DRL. When the DRL override switch is activated, the indicator on the switch illuminates. See **Figure 5-3**.

See **Figure 5-4** for the function path of the DRL override switch.



1. High-Beam Headlight
2. Fog Light or Auxiliary High-Beam Light
3. Low-Beam Headlight
4. Front Turn Signal Light and Marker Light
5. Side Turn Signal Light and Marker Light
6. Clearance Light
7. Stop Light, Taillight, and Rear Turn Signal Light
8. License Plate Light
9. Backup Light
10. Identification Light

Figure 5-1: Exterior Lights

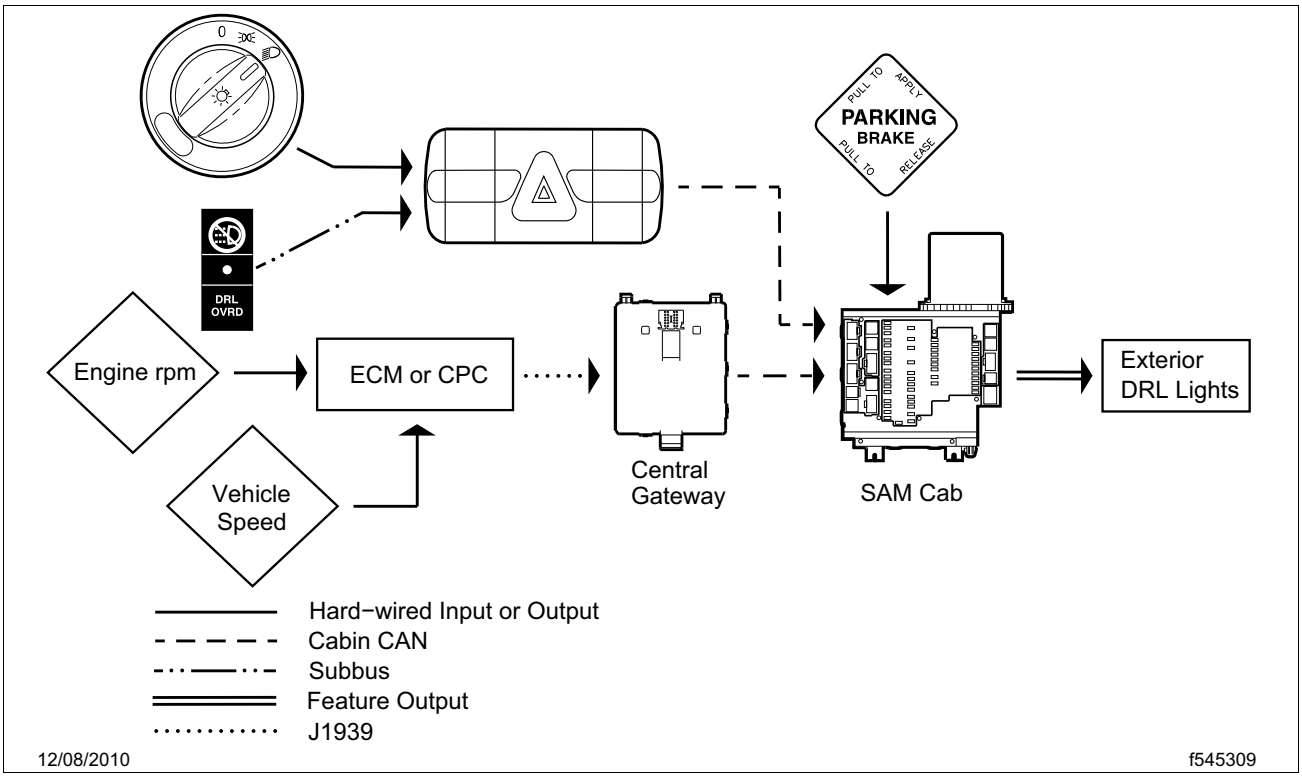


Figure 5-2: Function Path of the Daytime Running Lights

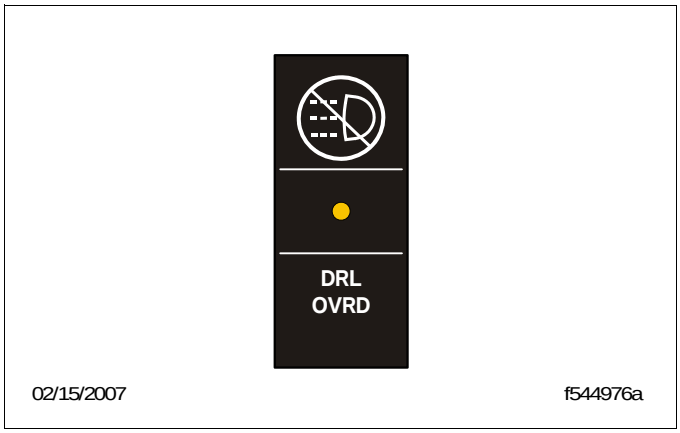


Figure 5-3: DRL Override Switch

Conditions for DRL Activation

To activate the DRL, the following conditions must be met:

- ignition switch is in the ON position
- headlight switch is off
- park brake is disengaged
- engine is operating at greater than 400 rpm
- vehicle is moving at 10 mph (16 km/h) or greater when cutout speed is present
- DRL override switch, if present, is not activated

NOTE: See **Follow Me Home** in this section for more information on this new feature, which is related to the DRL feature.

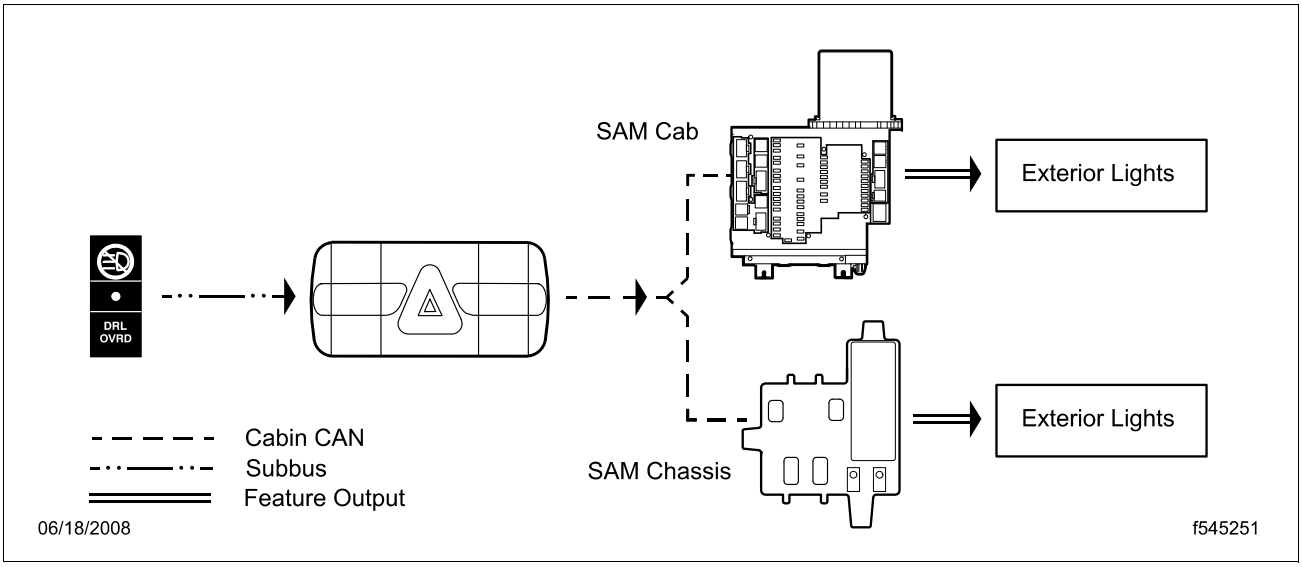


Figure 5-4: Function Path of the DRL Override Switch

Feature and Parameter Specifications for DRL												
Parameter Description	Parameter Part Number										Module Number	Module
	003 447 10 58	003 447 11 58	003 447 12 58	003 447 13 58	003 447 14 58	003 447 15 58	003 447 16 58	003 447 17 58	004 447 73 58	004 447 74 58		
DRL	X	X	X	X	X	X	X	X	—	—	311	SAM Cab
Turn signals	X	X	X	X	X	X	X	X	—	—		
Follow Me Home	—	X	—	X	—	X	—	X	—	X		
Marker lights/tail-lights/license plate light	—	—	X	X	—	—	X	X	—	—		
Headlights	—	—	—	—	—	—	—	—	X	X		
10 mph (16 km/h) cutoff	—	—	—	—	X	X	X	X	—	—		
Type of Feature S: Standard O: Optional	O	S	O	O	O	O	O	O	O	O	—	—

Table 5-1: Feature and Parameter Specifications for DRL

Fog Lights, Cornering Lights, and Auxiliary High-Beam Lights

Fog lights, cornering lights, and auxiliary high-beam lights are optional features. A customer can choose to have either fog lights or auxiliary high-beam lights, but not both.

Fog Lights

When the vehicle is equipped with fog lights, they are mounted in the bumper. See **Figure 5-1**.

To activate the fog lights, the headlight switch must be in the marker lights or headlights position and the switch must be pulled out. See **Figure 5-5**. The fog lights are deactivated when the high-beam headlights are activated.

See **Figure 5-6** for the function path of the fog lights.

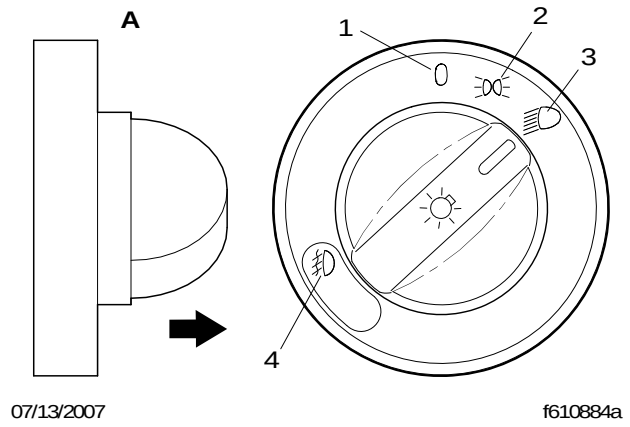
Cornering Lights

Cornering lights are an optional feature that is available when fog lights are ordered. The cornering lights feature activates the left or right fog light when the corresponding turn signal is activated and the vehicle is traveling less than 12 mph (20 km/h).

Auxiliary High-Beam Lights

When the vehicle is equipped with auxiliary high-beam lights, they are mounted in the bumper. See **Figure 5-1**. The auxiliary high-beam lights can be activated only when the high-beam headlights are activated. Press the auxiliary high-beam (AUX HIGH) switch to activate the auxiliary high-beam lights. See **Figure 5-7**.

See **Figure 5-6** for the function path of the auxiliary high-beam lights.



A. Headlight switch pulled out to activate the fog lights.

1. Off
2. Marker Lights
3. Headlights
4. Fog Lights

Figure 5-5: Headlight Switch Positions and Icons on a Vehicle With Fog Lights

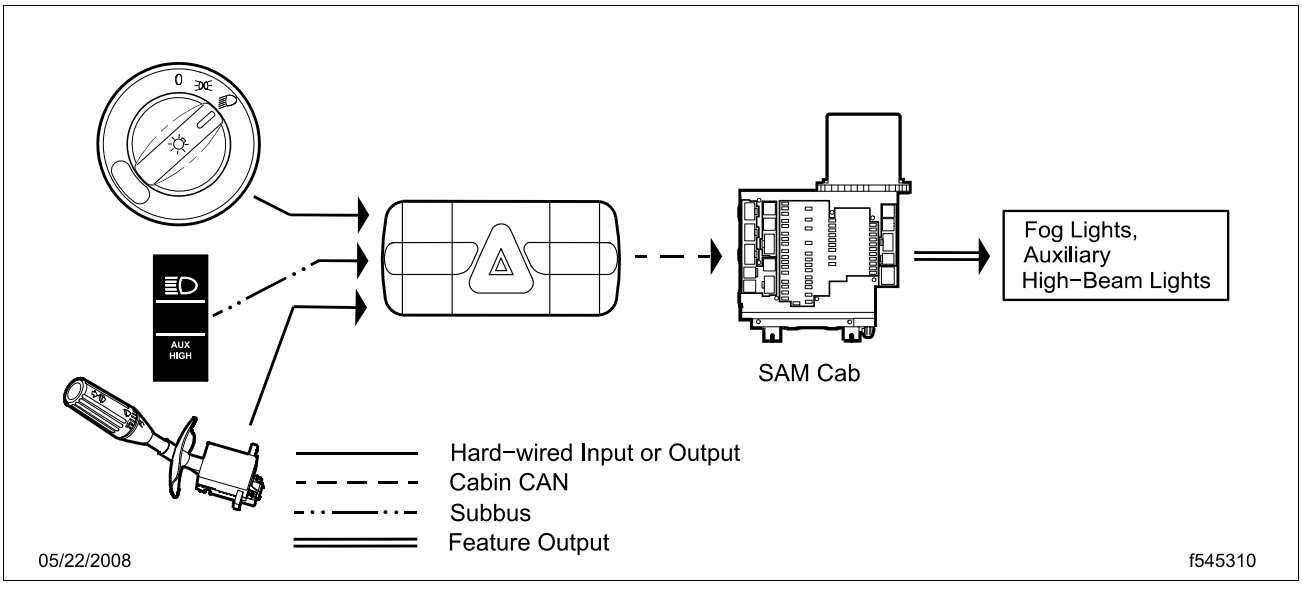


Figure 5-6: Function Path of the Fog Lights and Auxiliary High-Beam Lights

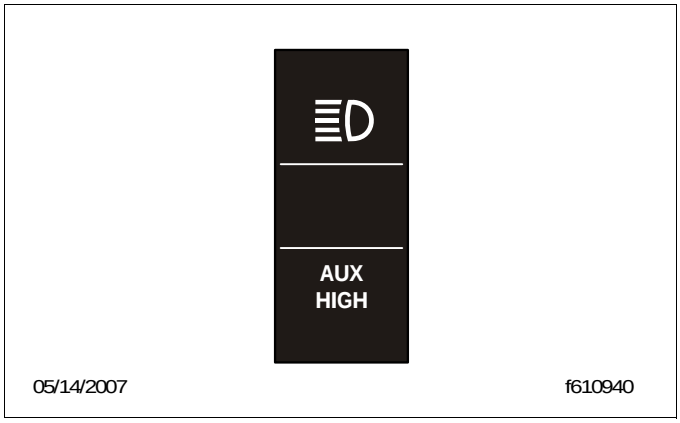


Figure 5-7: Auxiliary High-Beam Light Switch

Feature and Parameter Specifications for Fog Lights and Auxiliary High-Beam Lights					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	002 447 35 58	**002 447 37 58**	**003 447 20 58**		
Fog lights not present	X	X	—	313	SAM Cab
Fog lights disabled when high-beam headlights are activated	—	—	X		
Auxiliary high-beam lights not present	X	—	X		
Auxiliary high-beam lights present	—	X	—		
Type of Feature S: Standard O: Optional	S	O	O	—	—

Table 5-2: Feature and Parameter Specifications for Fog Lights and Auxiliary High-Beam Lights

Feature and Parameter Specifications for Cornering Lights					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	003 447 96 58	**003 447 97 58**	**003 447 98 58**		
Cornering lights not present	X	—	—	313	SAM Cab
Cornering lights under 12 mph (20 km/h) without turn tip	—	X	—		
Cornering lights under 12 mph (20 km/h) with turn tip	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	—	—

Table 5-3: Feature and Parameter Specifications for Cornering Lights

Feature and Parameter Specifications for Fog Lights and Auxiliary High-Beam Lights Fault Reporting						
Parameter Description	**Parameter Part Number**				**Module Number**	**Module**
	002 447 01 58	**004 447 03 58**	**004 447 05 58**	**004 447 06 58**		
No fault reporting	X	—	—	—	313	SAM Cab
Short to ground	—	X	X	X		
Open load	—	—	—	X		
Fog lights	X	—	X	X		
Auxiliary high-beam lights	X	X	—	—		
Type of Feature S: Standard O: Optional	S	O	O	O	—	—

Table 5-4: Feature and Parameter Specifications for Fog Lights and Auxiliary High-Beam Lights Fault Reporting

Follow Me Home

The follow-me-home feature temporarily activates the low-beam headlights and/or the fog lights after the engine is turned off. This feature provides temporary lighting in the path of the headlights while walking away from the vehicle.

The condition for activation of this feature is that the headlight switch has been turned from the on position to the off position, and the ignition switch is turned off within 30 seconds of turning the headlight switch off.

Once the follow-me-home feature is activated and there is no change to the position of the door—it remains closed or open—the headlights stay on for 10 seconds. When a change is made to the position of the door within the 10-second period, the 10-second timer stops and the headlights stay on for an additional 15 seconds.

The follow-me-home feature can be temporarily disabled by turning the ignition switch on, or by cycling the headlight switch from the off position to one of the other two positions.

See **Figure 5-8** for the function path of the follow-me-home feature.

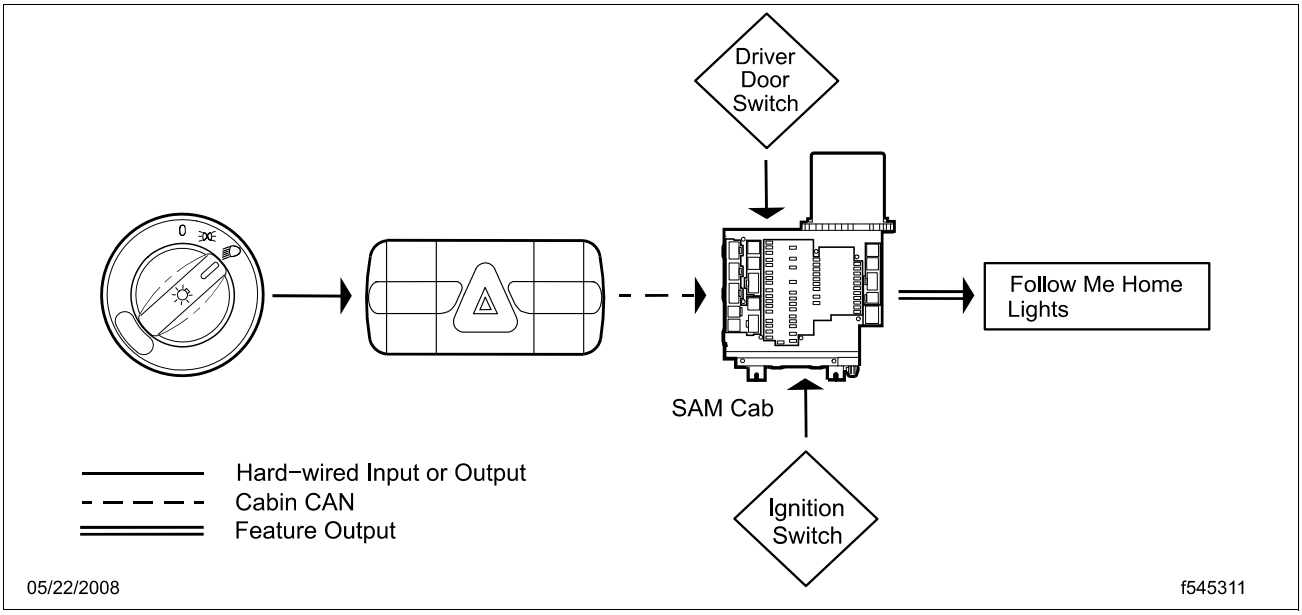


Figure 5-8: Function Path of the Follow-Me-Home Feature

Hazard Lights

All the turn signal lights on the vehicle and trailer, as well as the turn signal indicators in the instrumentation control unit (ICU), flash simultaneously when the hazard lights are activated. The hazard lights are activated when the hazard lights switch is pressed, resulting in a request by the modular switch field (MSF).

The hazard lights can be activated regardless of the ignition switch position. When the ignition switch is in the off position and the hazard lights switch has been pressed, the amount of time the hazard lights flash on is shorter than when the ignition switch is in any other position. This decreased amount of time helps to reduce the drain on the battery.

Figure 5-9 shows the hazard lights switch in the master control module.

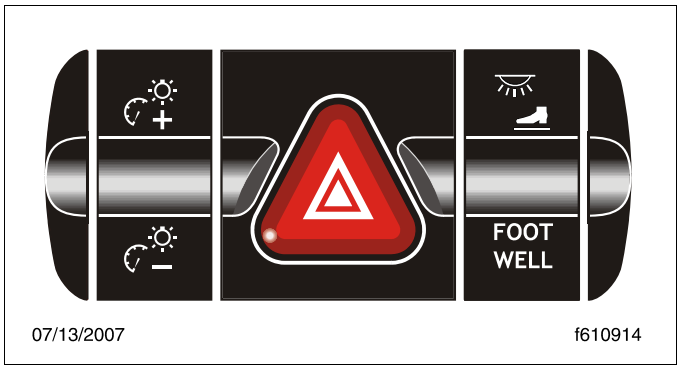


Figure 5-9: Hazard Lights Switch in the Master Control Module

See **Figure 5-10** for the function path of the hazard lights.

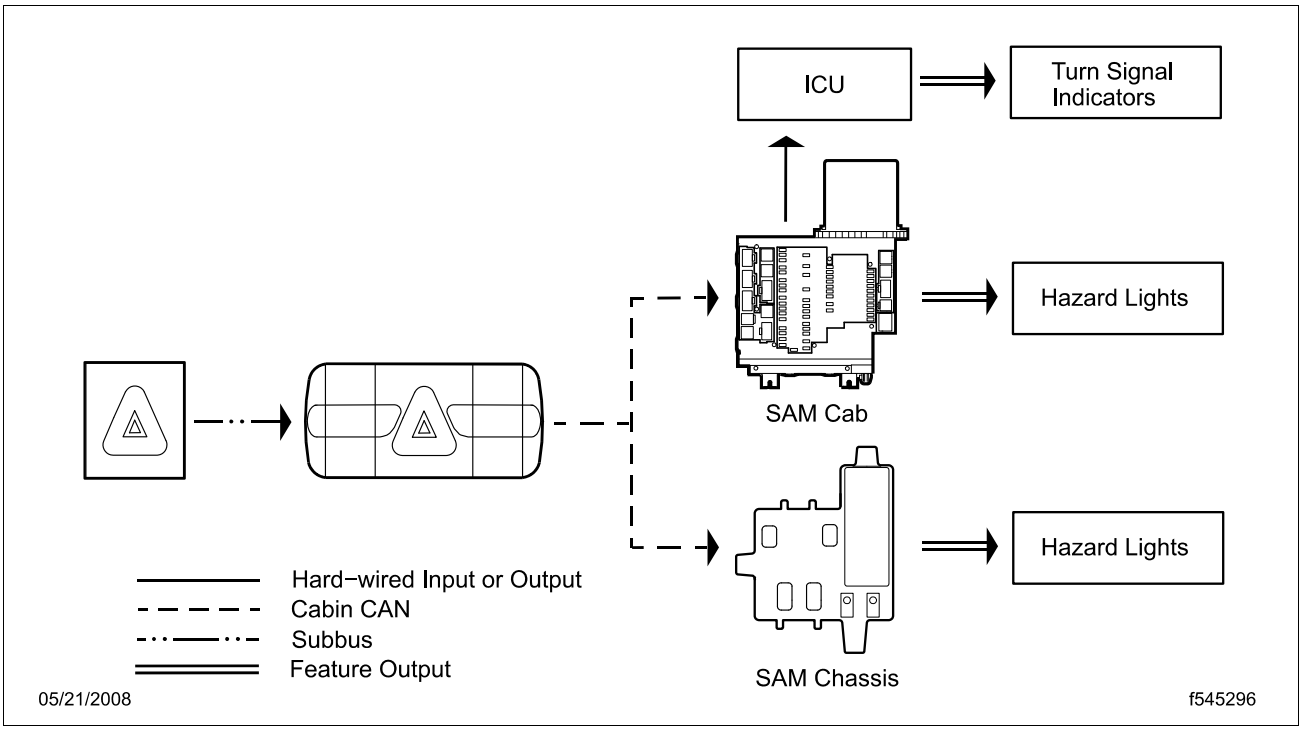


Figure 5-10: Function Path of the Hazard Lights

Headlights

The low-beam headlights have a soft-start feature. When the low-beam headlights are turned on, it takes 2.5 seconds for the headlights to reach full illumination.

The headlights can be illuminated regardless of the ignition switch position.

The headlight switch has three positions: off, marker lights, and headlights. On a vehicle equipped with fog lights, the switch must be pulled out to activate the fog lights. See **Figure 5-5** and **Figure 5-11**.

When the headlight switch is turned to the marker lights position, the following lights illuminate:

- clearance
- identification
- front marker
- side marker
- taillights
- trailer taillights
- trailer marker
- license plate

When the headlight switch is turned to the headlights position, the low-beam or low-beam and high-beam headlights illuminate depending on the position of the stalk switch, which is located on the steering column.

- When the stalk switch is in the neutral position, the low-beam headlights illuminate.
- When the stalk switch has been pushed away from the driver, the low-beam and high-beam headlights illuminate. The high-beam indicator in the ICU illuminates when the high-beam headlights are on.

If the fog lights are on when the high-beam headlights are activated, the fog lights turn off regardless of how the high-beam headlights are activated.

NOTE: The ignition switch must be in the ON (ignition) or Start (crank) position for the high-beam headlights to function.

When the headlight switch is in the headlights position, the ignition switch is in the off position, and the driver door is open, a warning buzzer sounds.

See **Figure 5-12** for the function path of the headlights, marker lights, and high-beam headlights.

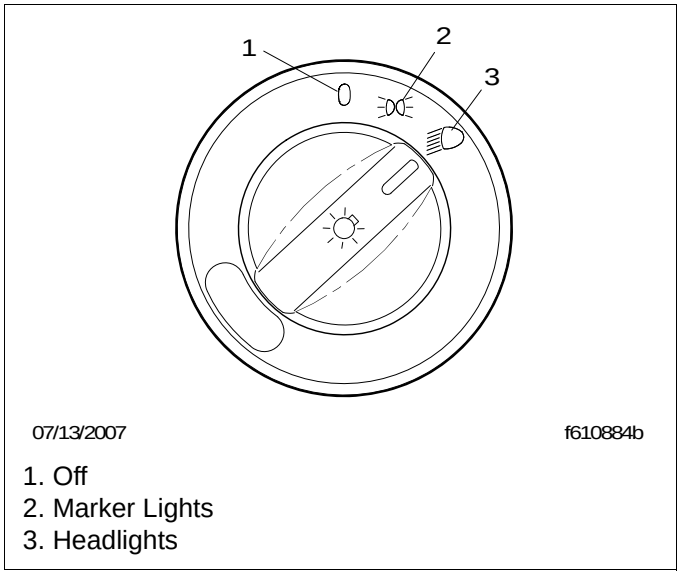


Figure 5-11: Headlight Switch Positions on a Vehicle Without Fog Lights

Flash to Pass

The flash-to-pass feature momentarily illuminates the high-beam headlights. Pulling the stalk switch toward the driver illuminates the high-beam headlights regardless of what position the headlight switch is in. However, if the fog lights are on when the flash-to-pass feature is activated, the fog lights will momentarily turn off.

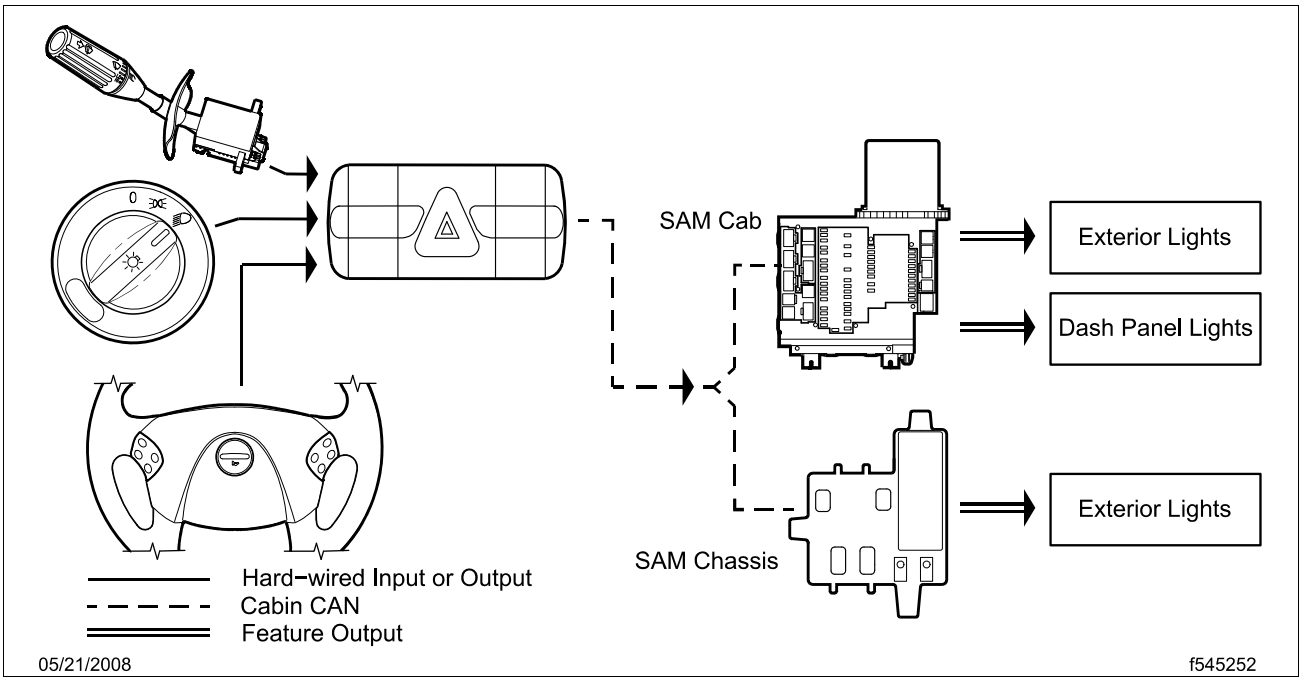


Figure 5-12: Function Path of the Headlights, Marker Lights, and High-Beam Headlights

Feature and Parameter Specifications for Headlight Fault Reporting					
Parameter Description	Parameter Part Number			Module Number	Module
	003 447 93 58	003 447 94 58	003 447 95 58		
No fault reporting	X	—	—	311	SAM Cab
Short to ground	—	X	X		
Open load	—	—	X		
Type of Feature S: Standard O: Optional	O	O	S	—	—

Table 5-5: Feature and Parameter Specifications for Headlight Fault Reporting

Marker Lights

The marker interrupt switch temporarily turns the marker lights on or off. When the headlights are on and the marker interrupt (MRKR INT) switch is pressed, the marker lights momentarily turn off. When the headlights are off and the marker interrupt switch is pressed, the marker lights momentarily turn on. See **Figure 5-13**.

The lights affected by the marker interrupt feature include:

- clearance
- identification
- front marker
- side marker
- taillights
- trailer taillights
- trailer marker
- dash panel

The marker interrupt feature can currently be ordered with one momentary interrupt or two momentary interrupts. In the future an option for three momentary interrupts will be available. The feature with one momentary interrupt works differently from the features with two or three momentary interrupts.

When the marker interrupt feature has one momentary interrupt and the marker interrupt switch is pressed and continues to be pressed, the lights will remain in the on or off state as long as the switch remains pressed. When the marker interrupt feature has two or three momentary interrupts, the lights will be interrupted two or three times regardless of how long the switch is pressed.

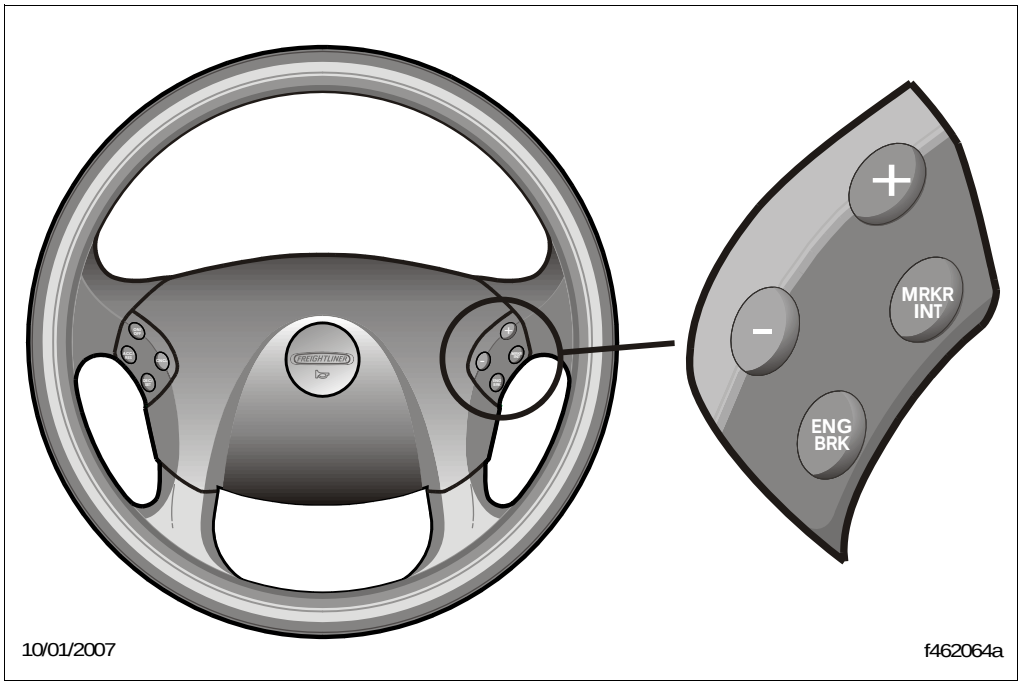


Figure 5-13: Marker Interrupt Switch

Feature and Parameter Specifications for the Marker Interrupt Feature									
Parameter Description	Parameter Part Number							Module Number	Module
	002 447 63 58[1]	003 447 04 58[1]	002 447 64 58	002 447 65 58[1]	003 447 07 58[1]	002 447 86 58	003 447 06 58[1]		
Marker interrupt feature not present	X	X	—	—	—	—	—	30A	SAM Cab
Marker interrupt feature present with one interrupt	—	—	X	—	—	—	—		
Marker interrupt feature present with three interrupts	—	—	—	X	X	—	—		
Marker interrupt feature present with two interrupts	—	—	—	—	—	X	X		
Type of Feature S: Standard O: Optional	O	O	S	O	O	O	O	—	

Table 5-6: Feature and Parameter Specifications for the Marker Interrupt Feature

1. This parameter is unavailable at the time of publication.

Feature and Parameter Specifications for Marker Lights Fault Reporting						
Parameter Description	**Parameter Part Number**					**Module Number**
	003 447 83 58	**003 447 84 58**	**003 447 85 58**	**004 447 67 58**	**000 447 61 61**	
No fault reporting	X	—	—	—	X	30A
Short to ground	—	X	X	X	—	
Short to battery (clearance and identification lights)	—	—	—	X	—	
Open load	—	—	X	X	—	
Marker lights	X	X	X	X	X	
Clearance lights	X	X	X	X	—	
Identification lights	X	X	X	X	—	
Type of Feature S: Standard O: Optional	O	O	S	O	S	—
Module SC: SAM Cab SCH: SAM Chassis	SC	SC	SC	SC	SCH	—

Table 5-7: Feature and Parameter Specifications for Marker Lights Fault Reporting

Feature and Parameter Specifications for Taillights and License Plate Light Fault Reporting					
Parameter Description	Parameter Part Number			Module Number	Module
	000 447 73 61	000 447 74 61	000 447 75 61		
Taillight no fault reporting	X	—	—	301	SAM Chassis
License plate light no fault reporting	X	X	X		
Taillight fault reporting	—	X	X		
Short to ground	—	X	X		
Open load	—	—	X		
Type of Feature S: Standard O: Optional	O	O	S	—	—

Table 5-8: Feature and Parameter Specifications for Taillight and License Plate Light Fault Reporting

Stop Lights, Turn Signal Lights, and Backup Lights

The Cascadia can have either combination stop and turn signal lights, or separate stop and turn signal lights.

See **Section 8** under the heading *Trailer Receptacles* for the wiring of a typical trailer receptacle.

Combination Stop and Turn Signal Lights

One combination stop light and turn signal light assembly on each side of the vehicle is a standard feature for the rear lighting. With this feature the stop light also acts as a turn signal light.

If the stop and turn signal lights are activated at the same time, the turn signal light takes priority. In this situation the combined stop and turn signal light will be flashing rather than steady on. When the brake pedal is depressed and the turn signal is not being used, the combined stop and turn signal light will be steady on. See **Figure 5-14** for the lighting states of the combined stop and turn signal lights under brake, turn, and brake and turn conditions.

When the hazard lights switch is pressed, the hazard lights take priority over the stop light function on the combination stop and turn signal light assembly. However, the hazard lights and turn signal lights will activate according to the last request received.

The combination stop and turn signal assembly has two lighting circuits. One lighting circuit is used for the stop and turn signal light; the second lighting circuit is used for the taillight.

Separate Stop and Turn Signal Lights

Separate stop and turn signal lights require at least two assemblies for each side of the vehicle. One light assembly is used for the stop light and taillight; the other light assembly is used for the turn signal light. See **Figure 5-15** for the lighting states of the separate stop and turn signal lights under brake, turn, and brake and turn conditions.

See **Figure 5-16** for the function path of the stop lights, and **Figure 5-17** for the function path of the turn signal lights.

Backup Lights

The backup lights provide a visual indication that the transmission is in reverse gear.

A vehicle with a manual transmission or automated transmission is equipped with a backup switch. When the transmission is put in reverse, the hard-wired backup switch provides the input that is read by the SAM Chassis.

A vehicle with an automatic transmission does not have a backup switch. When the transmission is put in reverse, the datalink signal from the transmission control unit provides the input that is read by the SAM Chassis.

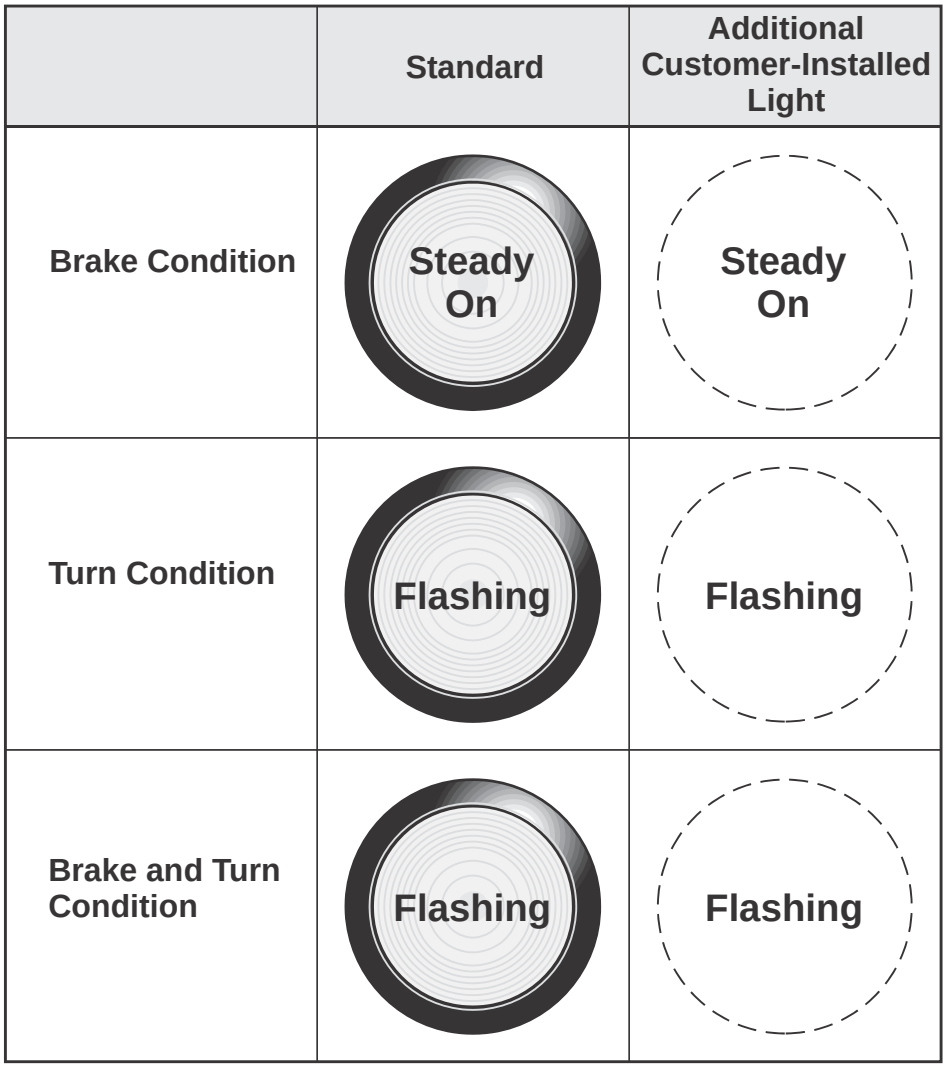


Figure 5-14: Combination Stop and Turn Signal Lights (left side of vehicle)

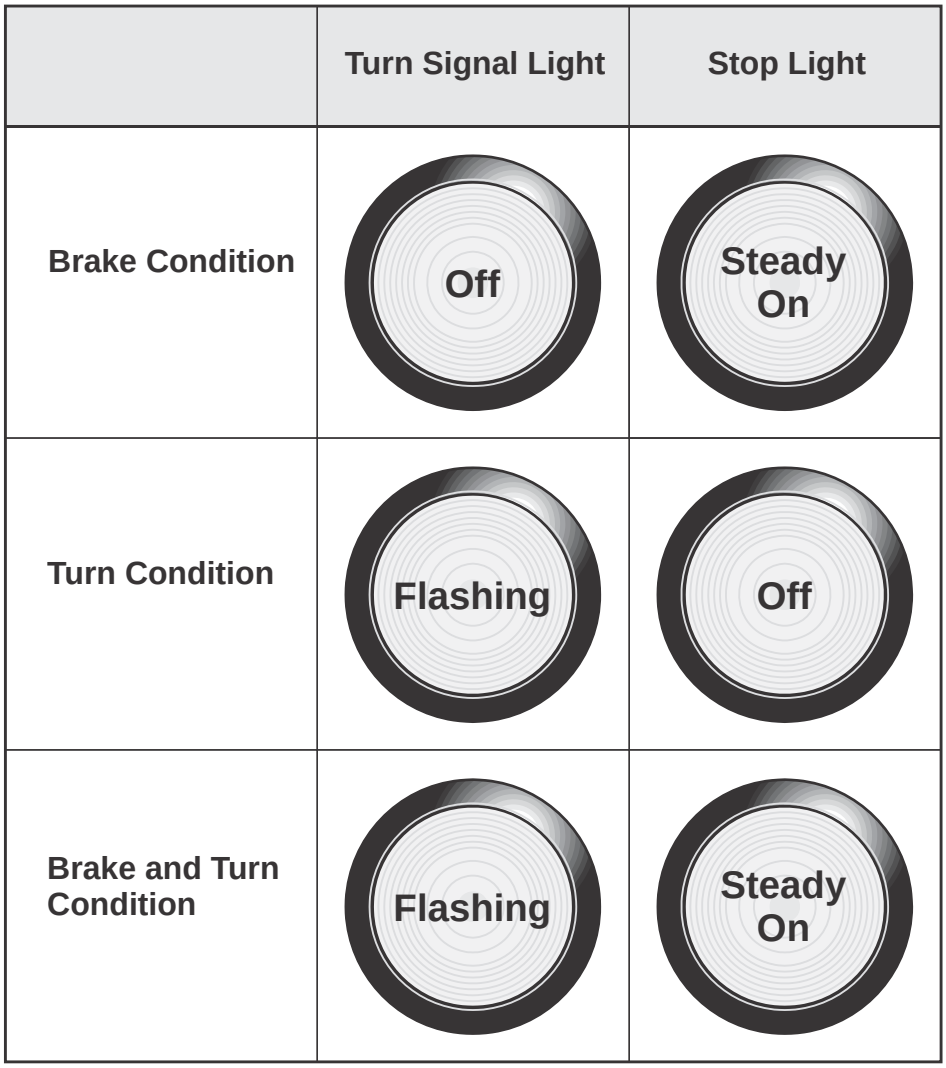


Figure 5-15: Separate Stop and Turn Signal Lights (left side of vehicle)

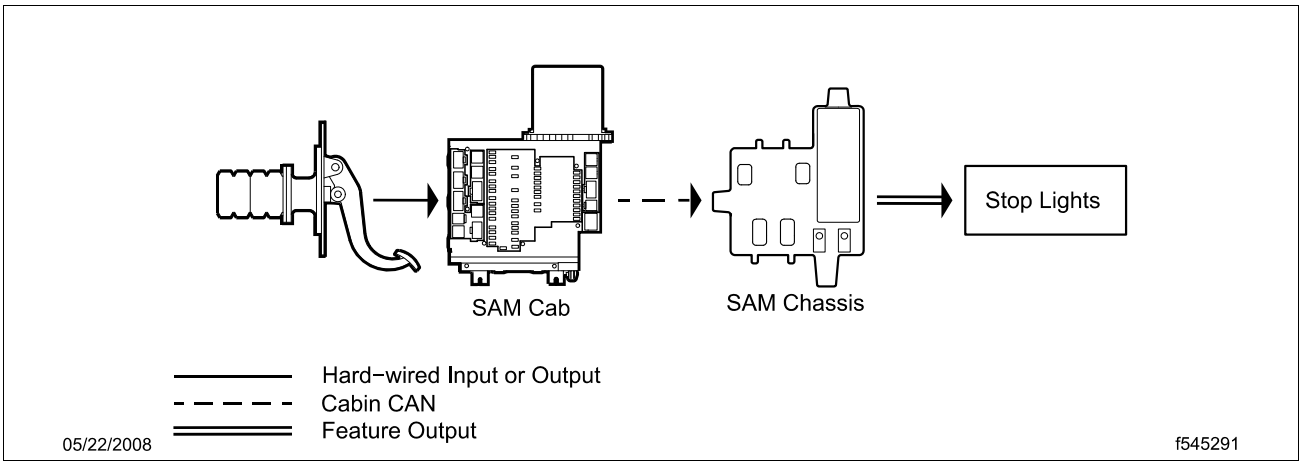


Figure 5-16: Function Path of the Stop Lights

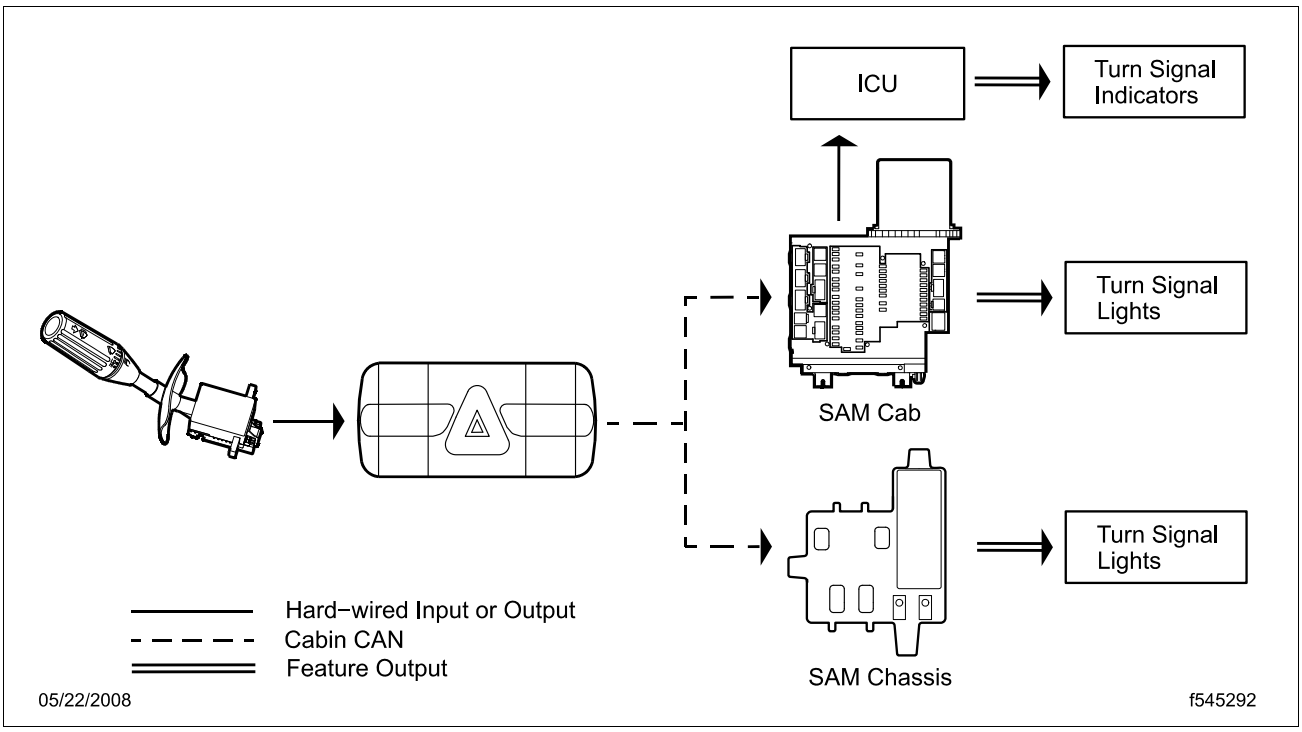


Figure 5-17: Function Path of the Turn Signal Lights

Feature and Parameter Specifications for Stop Lights and Backup Lights								
Parameter Description	**Parameter Part Number**						**Module Number**	**Module**
	000 447 79 61	**000 447 80 61**	**000 447 13 61**	**000 447 14 61**	**000 447 13 61**	**000 447 14 61**		
Combination stop and turn signal lights	X	—	—	—	—	—	301	SAM Chassis
Separate stop and turn signal lights	—	X	—	—	—	—		
Manual transmission	—	—	X	—	—	—	35H	
Backup switch present	—	—	X	—	X	—		
Backup switch not present	—	—	—	X	—	X		
Automatic transmission with J1939 electronic transmission controller 2 (ETC2)	—	—	—	X	—	—		
Automated manual transmission without J1939 electronic transmission controller 2 (ETC2)	—	—	—	—	X	—		
Automated manual transmission with J1939 electronic transmission controller 2 (ETC2)	—	—	—	—	—	X		
Type of Feature S: Standard O: Optional	S	O	S	O	O	O	—	—

Table 5-9: Feature and Parameter Specifications for Stop Lights and Backup Lights

Feature and Parameter Specifications for Stop Lights and Turn Signal Fault Reporting							
Parameter Description	Parameter Part Number					Module Number	Module
	000 447 68 61	000 447 69 61	000 447 70 61	004 447 71 61	000 447 72 61		
Stop light no fault reporting	X	—	—	—	—	301	SAM Chassis
Turn signal no fault reporting	X	—	—	X	X		
Stop light fault reporting	—	X	X	X	X		
Turn signal fault reporting	—	X	X	—	—		
Short to ground	—	X	X	X	X		
Open load	—	—	X	—	X		
Type of Feature S: Standard O: Optional	O	O	O	O	S	—	—

Table 5-10: Feature and Parameter Specifications for Stop Lights and Turn Signal Fault Reporting

Feature and Parameter Specifications for Backup Light Fault Reporting					
Parameter Description	Parameter Part Number			Module Number	Module
	000 447 68 61	000 447 69 61	000 447 70 61		
No fault reporting	X	—	—	35H	SAM Chassis
Short to ground	—	X	X		
Open load	—	—	X		
Type of Feature S: Standard O: Optional	O	O	S	—	—

Table 5-11: Feature and Parameter Specifications for Backup Light Fault Reporting

See **Figure 5-18** for the function path of the backup lights with a manual/automated transmission, and **Figure 5-19** for the function path of the backup lights with an automatic transmission.

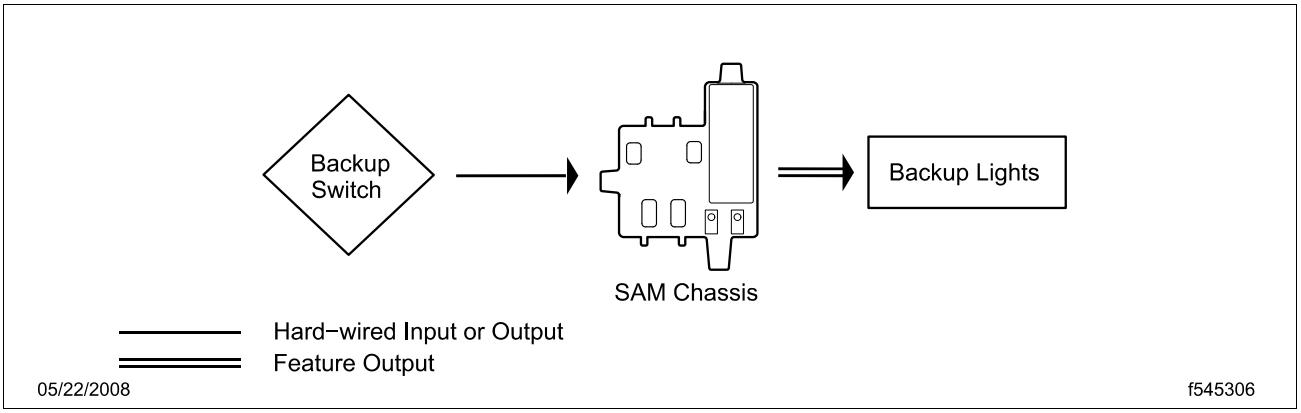


Figure 5-18: Function Path of the Backup Lights With Manual/Automated Transmission

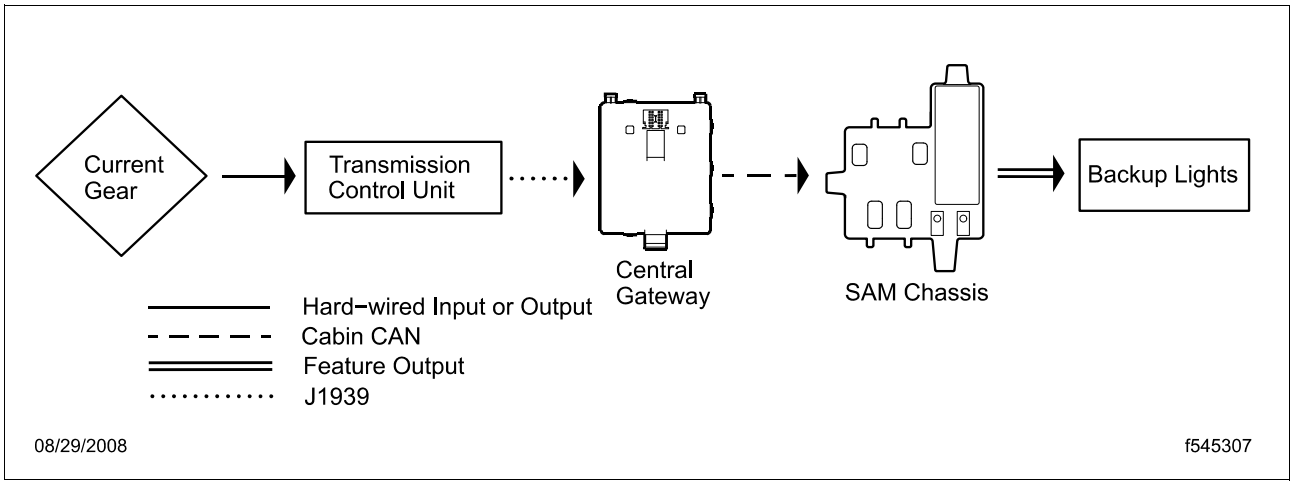


Figure 5-19: Function Path of the Backup Lights With Automatic Transmission

Turn Signal Lights

Moving the stalk switch up or down activates the right or left turn signal lights respectively, as well as the right or left turn signal indicators on the ICU. There are three sets of turn signal lights on the tractor: one in the integral headlight unit, one on the sides of the vehicle, and one at the end of frame. See **Figure 5-1**.

See *Daytime Running Lights* in this section for more information on turn signal lights when they are used for DRL.

See *Turn Tip* in this section for more information on the function of the turn signal lights.

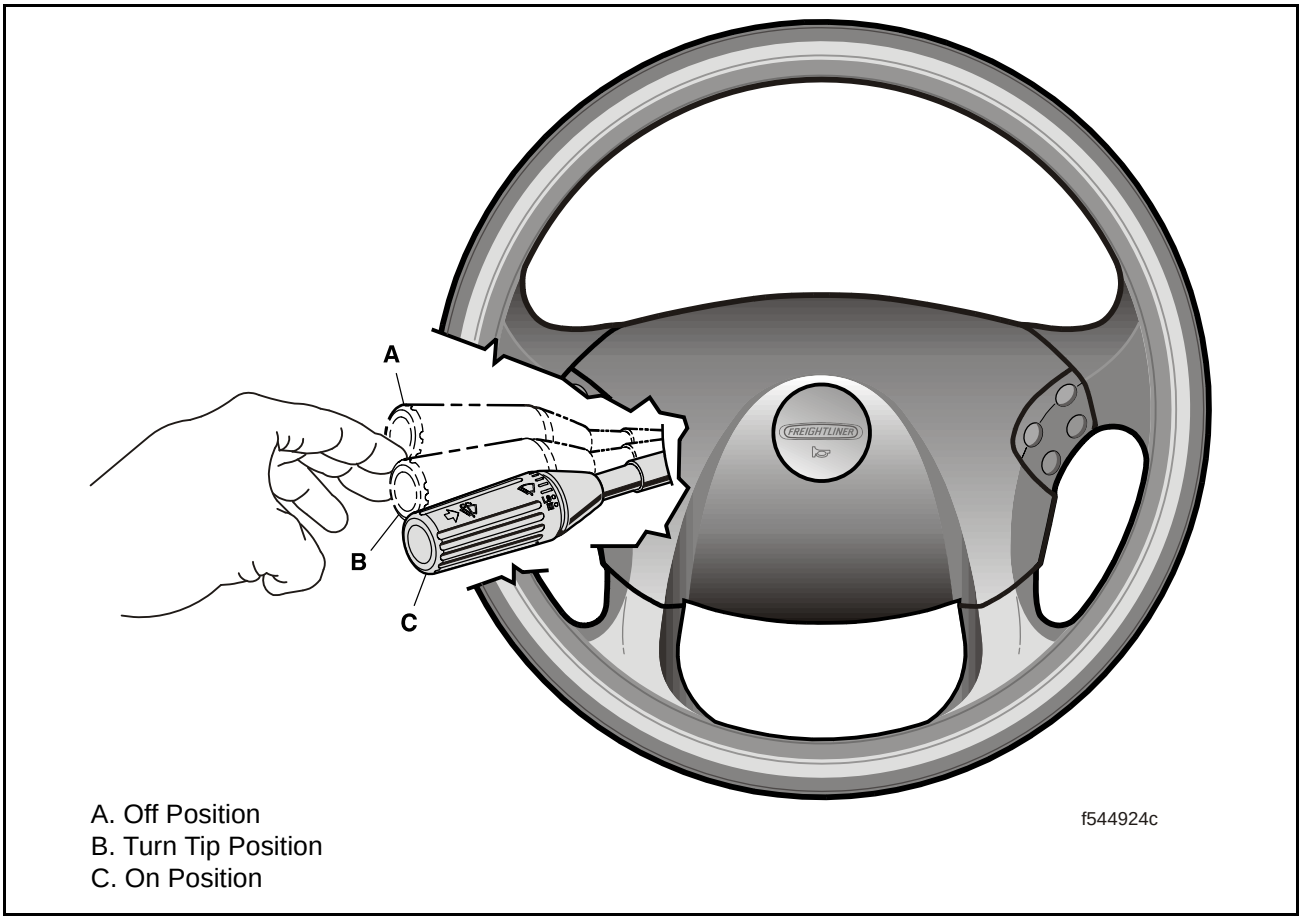
See **Figure 5-17** for the function path of the turn signal lights.

Turn Tip

The turn-tip feature allows the driver to activate the turn signal lights by momentarily pressing the stalk switch up or down. See **Figure 5-20**. When the turn-tip feature is used, the turn signal lights flash a predetermined number of times. The number of times the turn signal lights flash is determined by a parameter.

The turn-tip feature is advantageous in lane change situations when the steering wheel does not travel far enough to cancel a conventional turn signal request. After flashing for a number of times, the turn signal lights stop flashing; the driver does not have to manually cancel the turn signal switch.

Activation of the turn-tip feature is immediately canceled when a request for the turn signal in the opposite direction is made. In this situation the turn signal lights in the opposite direction flash.



A. Off Position
B. Turn Tip Position
C. On Position

Figure 5-20: Turn Signal Switch Positions for a Left Turn

Feature and Parameter Specifications for Turn Tip					
Parameter Description	Parameter Part Number			Module Number	Module
	002 447 02 58[1]	002 447 03 58[1]	002 447 85 58		
Turn tip not present	X	—	—	301	SAM Cab
Turn tip present with 5 flashes	—	X	—		
Turn tip present with 3 flashes	—	—	X		
Type of Feature S: Standard O: Optional	O	O	S	—	—

Table 5-12: Feature and Parameter Specifications for Turn Tip

1. This parameter is unavailable at the time of publication.

Utility Lights

Two flush-mounted back-of-cab or back-of-sleeper utility lights are standard. See **Figure 5-21**. Two additional swivel utility lights mounted on the back of cab or on the inside of the side extenders are an option. The utility light switch (UTLY LAMP) is used to illuminate the utility lights. See **Figure 5-22**.

A new feature turns off the utility lights when the vehicle is moving faster than 10 mph (16 km/h). The 10-mph cutoff speed feature only applies when the transmission is in a forward gear, not when it is in reverse or neutral. The utility lights can be turned on again when the vehicle is moving faster than 10 mph by turning the switch off, then back on.

The utility lights can be illuminated by pressing the utility light switch when the ignition switch is in the off, accessory, or ON position. However, if the utility light switch is left on, and the vehicle is not moving, and the utility lights are not on (due to either a progressive low-voltage disconnect situation or because the vehicle had been moving faster than 10 mph), the utility lights will turn on when the ignition switch is moved back to the ON position.

The utility lights are designated as house loads in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 5-23** for the function path of the utility lights.

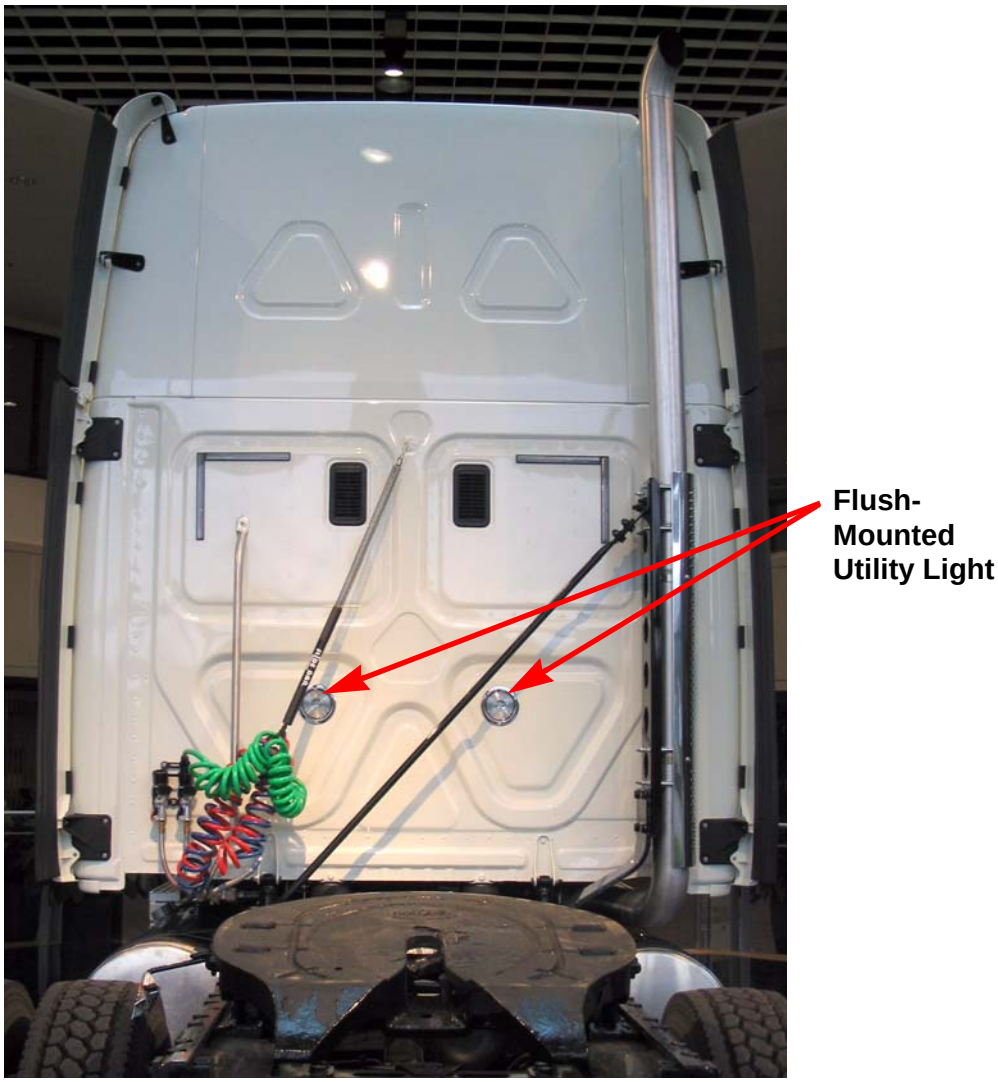


Figure 5-21: Utility Lights

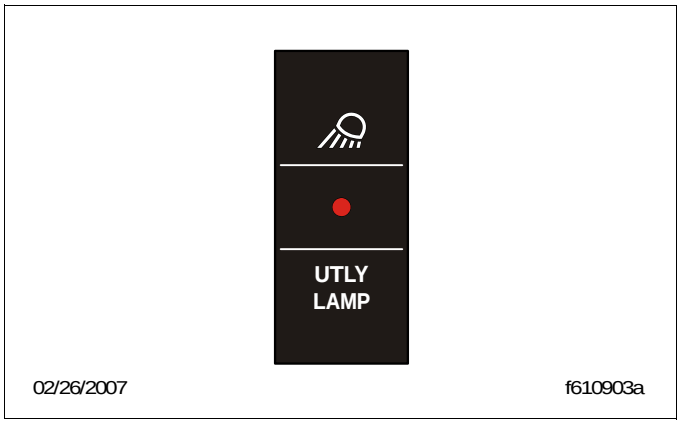


Figure 5-22: Utility Light Switch

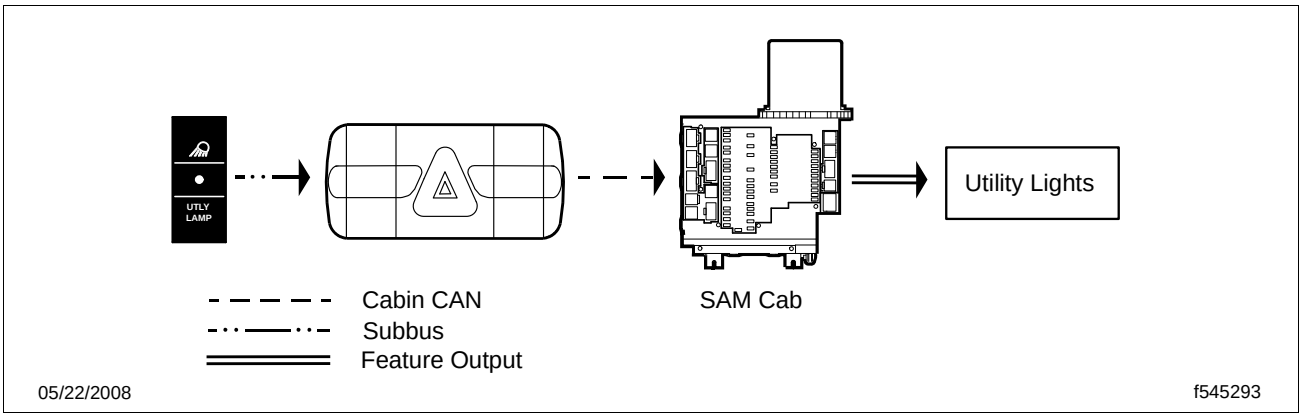


Figure 5-23: Function Path of the Utility Lights

Feature and Parameter Specifications for Utility Lights					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	002 447 60 58	**002 447 61 58**	**002 447 62 58**		
Utility light not present	X	—	—	31J	SAM Cab
Utility light present with 10 mph (16 km/h) cutoff	—	X	—		
Utility light present without 10 mph (16 km/h) cutoff	—	—	X		
Type of Feature S: Standard O: Optional	O	S	O	—	—

Table 5-13: Feature and Parameter Specifications for Utility Lights

Feature and Parameter Specifications for Utility Lights Fault Reporting					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	004 447 13 58	**004 447 14 58**	**004 447 15 58**		
No fault reporting	X	—	—	31J	SAM Chassis
Short to ground	—	X	X		
Open load	—	—	X		
Type of Feature S: Standard O: Optional	O	O	S	—	—

Table 5-14: Feature and Parameter Specifications for Utility Lights Fault Reporting

Section 6:

- Interior Lights
- Lighting Options
- Lighting Controls
- Dash Panel Backlighting
- Entrance Lighting
- Footwell Lighting
- Front Cab Dome Lighting
- Sleeper Lighting

Interior Lights

See **Figure 6-1** for the interior lights in a raised roof sleeper cab.
See **Figure 6-2** for the interior lights in a midroof sleeper cab.
See **Figure 6-3** for the interior lights in a day cab.

Lighting Options

Freightliner offers the following lighting options:
- standard cab lighting
- standard sleeper lighting
- premium theater cab and sleeper lighting
- premium dimmable cab and sleeper lighting

NOTE: Premium sleeper lighting requires premium cab lighting. Standard sleeper lighting is only available with standard cab lighting.

Premium Theater Lighting

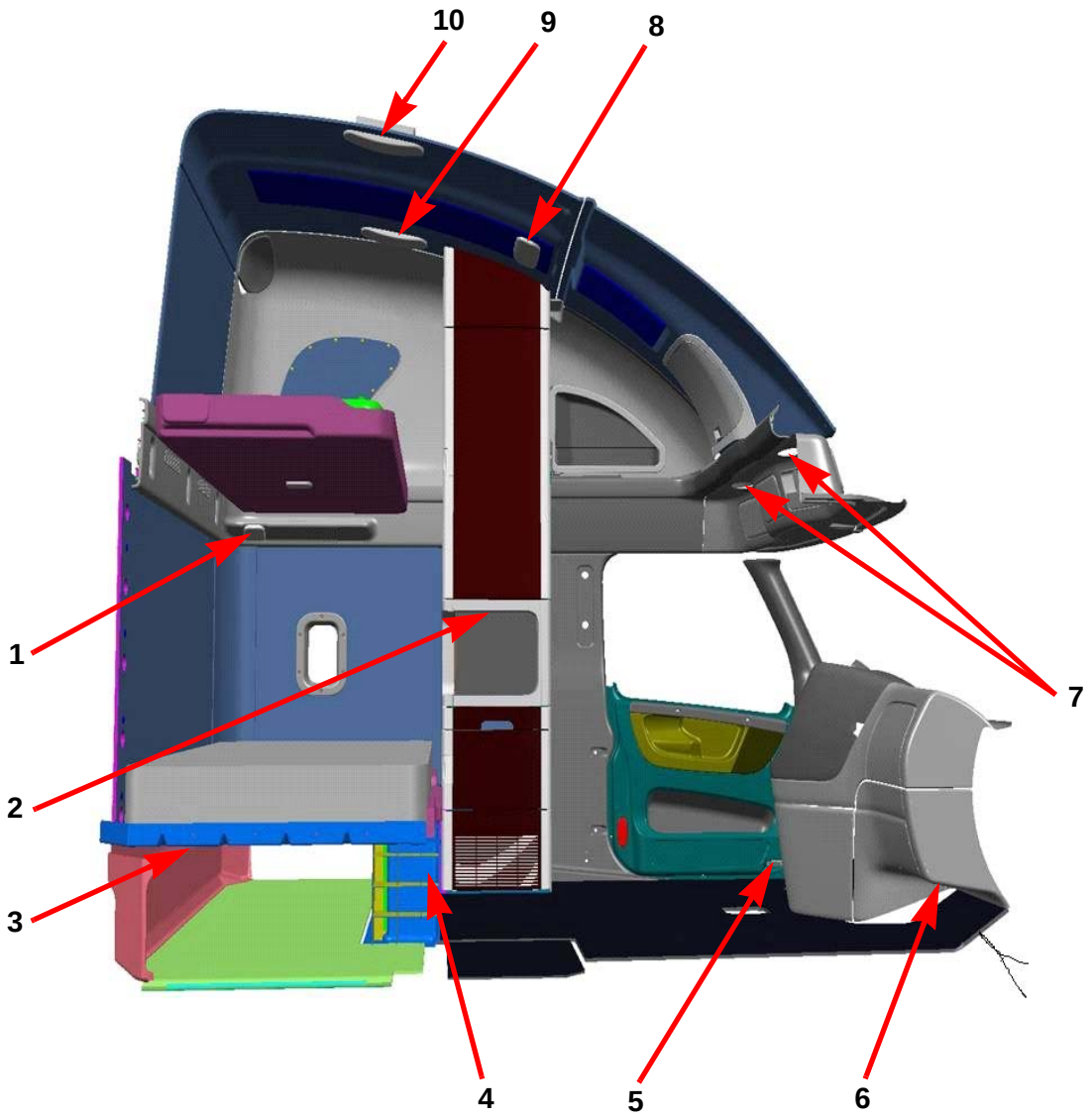
Premium theater lighting on a day cab includes the following lights:
- dome light in the overhead console
- footwell lights
- rear dome light

Premium theater lighting on a sleeper cab includes the following lights:
- dome light in the overhead console
- footwell lights
- lower-left (and lower-right if present) reading light in the sleeper
- forward dome light
- rear dome light/upper bunk reading light
- rear dome light
- rear footwell lights

Premium Dimmable Lighting

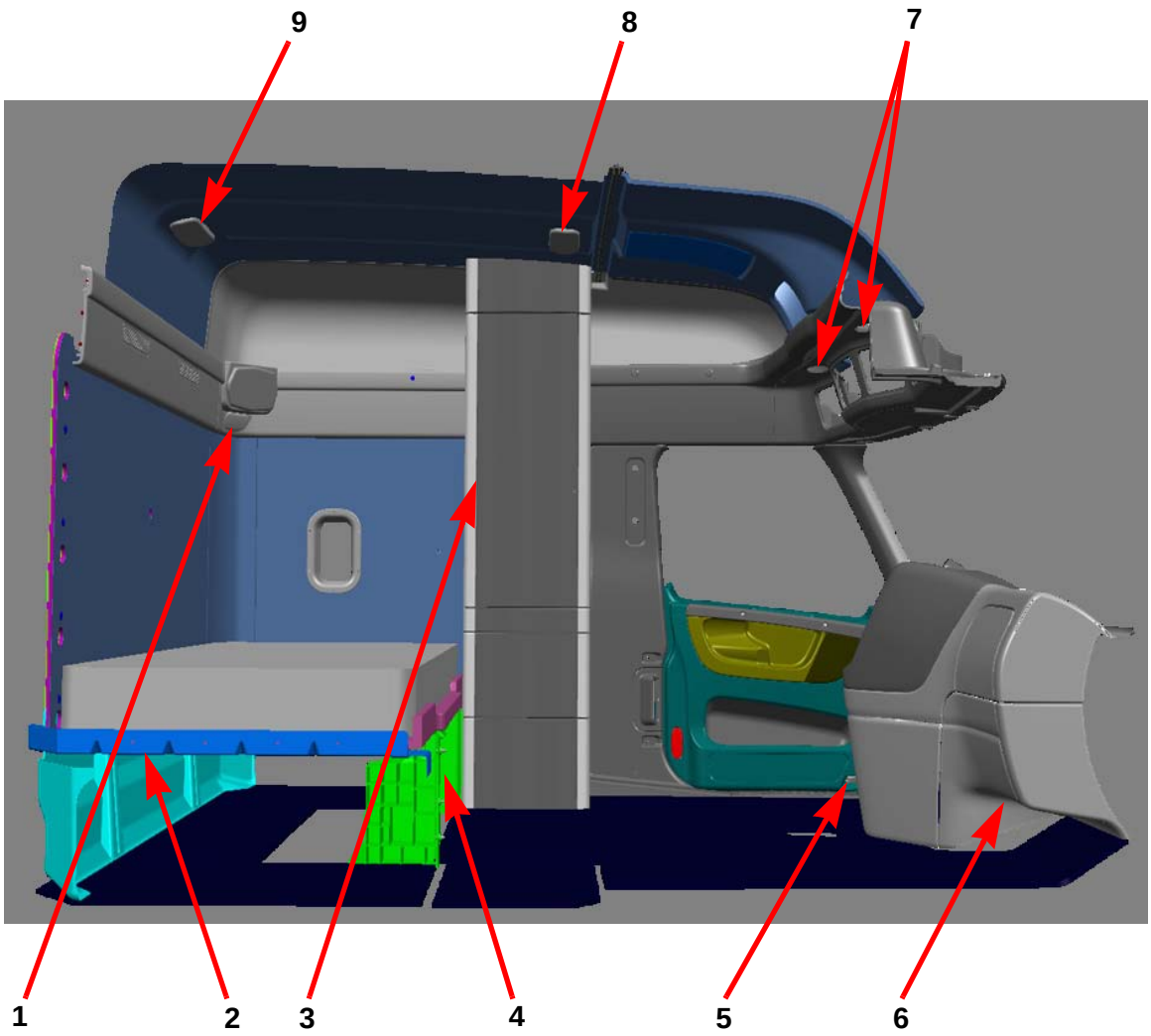
Premium dimmable lighting on a day cab is available on the following lights:
- dome lights in the overhead console
- rear dome light

Premium dimmable lighting on a sleeper cab is available on the following lights:
- lower-left reading light
- lower-right reading light (if equipped)
- forward dome light



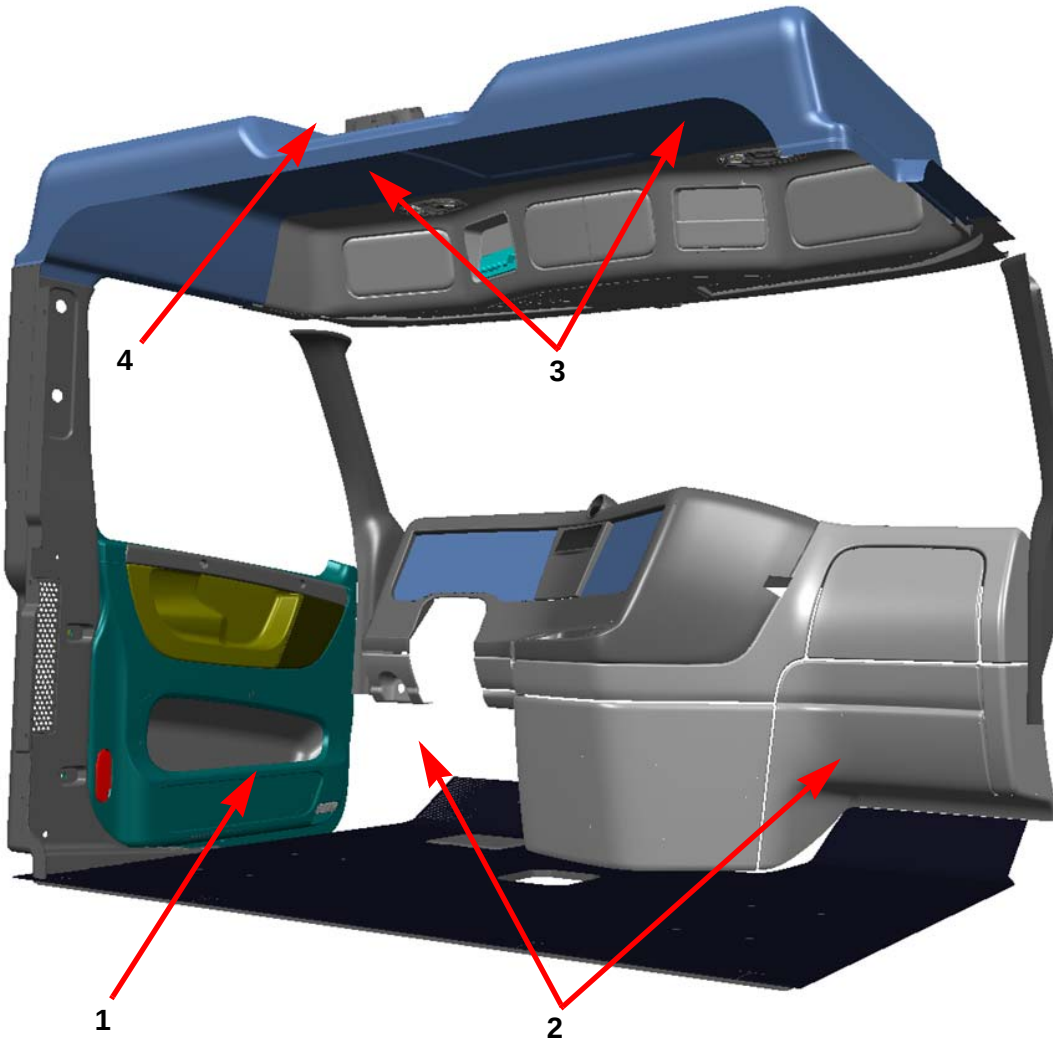
1. Lower-Left Reading Light (lower-right reading light located on opposite wall for premium lighting only)
2. Work Surface Light (premium lighting only)
3. Baggage Compartment Lights
4. Rear Footwell Lights (premium lighting only)
5. Doorsill Light
6. Footwell Lights, Driver and Passenger
7. Overhead Console Dome and Reading Lights
8. Forward Dome Light
9. Rear Dome Light/Upper Bunk Reading Light
10. Rear Dome Light

Figure 6-1: Interior Lights in a Raised Roof Sleeper Cab



1. Lower-Left Reading Light (optional lower-right reading light located on opposite wall for premium lighting only)
2. Baggage Compartment Lights
3. Work Surface Light (premium lighting only) or Snake Light
4. Rear Footwell Light
5. Doorsill Light
6. Footwell Lights, Driver and Passenger
7. Overhead Console Dome and Reading Lights
8. Forward Dome Light
9. Rear Dome Light

Figure 6-2: Interior Lights in a Midroof Sleeper Cab



1. Doorsill Light
2. Footwell Lights, Driver and Passenger
3. Overhead Console Dome and Reading Lights
4. Rear Dome Light (premium lighting only)

Figure 6-3: Interior Lights in a Day Cab

Lighting Controls

Four types of controls are used for the interior lights:

- locally switched lights
- SAM switched lights
- theater lighting
- dimmable lighting

Locally Switched Lights

Locally switched lights can be turned on or off using a switch that is connected in series with the light bulb. For example, the switch and light bulb are in an integrated unit. The SAM Cab supplies battery power to the switch.

SAM Switched Lights

SAM switched lights can be turned on or off by the SAM Cab. The SAM Cab receives an input from a remote momentary switch or a datalink message. There are two steady-state levels, on or off. The switching behavior is step-up and step-down, meaning there is no noticeable ramp time when the light is switched on or off.

Some SAM switched lights are timed—that is, they will go off after a prescribed period of time. The entrance lighting and baggage compartment lights are timed. See *Entrance Lighting* in this section for more information.

The SAM switched interior lights—other than the entrance lighting and baggage compartment lights—are not timed; they will be turned off when the load is shed during progressive low-voltage disconnect (PLVD).

Theater Lighting

Theater lighting can be turned on or off by the SAM Cab. The SAM Cab receives an input from a remote momentary switch or a datalink message. There are two steady-state levels, on or off.

Lights controlled by theater lighting are ramped on or off as they are switched on or off. Ramped lighting means that the lights gradually come on to their full illumination when turned on, and gradually lose their illumination when turned off.

Ramp time is controlled by a parameter. The parameter range for ramp time is 400 to 5380 milliseconds (ms). When the parameter is set to imitate a step behavior, the lights will reach full illumination or gradually lose their illumination in less than 100 ms. Ramp-up and ramp-down times can have the same duration or a different duration.

In a vehicle with standard lighting, all the lights operate as SAM switched lights by setting the parameters to step-up and step-down. In a vehicle with premium lighting, the footwell lights, rear dome light, forward dome light, rear dome light/upper bunk reading light, rear footwell lights, and the reading lights are theater lighting by default.

Dimmable Lighting

Dimmable lighting allows the driver to dim the brightness of some interior lights. On a day cab, the dome lights in the overhead console and the rear dome light (premium lighting only) can be dimmed. On a sleeper cab the lower-left reading light, the lower-right reading light (if equipped), and the forward dome light can be dimmed.

On a day cab, the overhead console dome lights and rear dome light switch (**Figure 6-4**, item B) is used to dim the lights. On a sleeper cab, the lower-left reading light switch (**Figure 6-5**, item A), the lower-right reading light switch (**Figure 6-5**, item C), the forward dome light switch (**Figure 6-4**, item C), and the forward dome light switch (**Figure 6-5**, item E) are used to dim the lights.

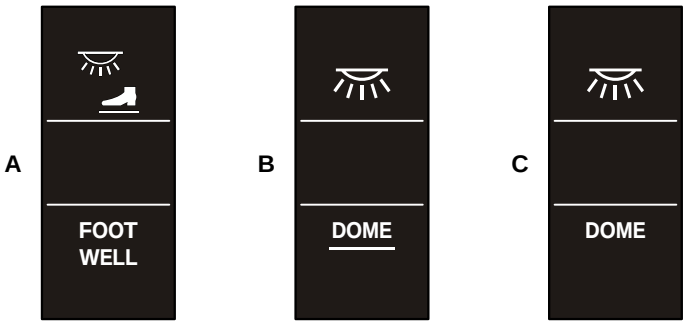
See **Figure 6-6** for the rear dome light/upper bunk reading light switch installed on the upper control panel in a raised roof sleeper cab.

The following lights are dimmable or theater lighting:
- overhead console dome light (day cab)
- rear dome light (day cab)
- forward dome light (sleeper)
- lower-left reading light (sleeper)
- lower-right reading light (sleeper)

Parameters can be used to modify any or all dimmable lighting so that the lighting also has the attributes of theater lighting. Any dimmable lighting modified this way will have the ramped lighting—or theater—feature.

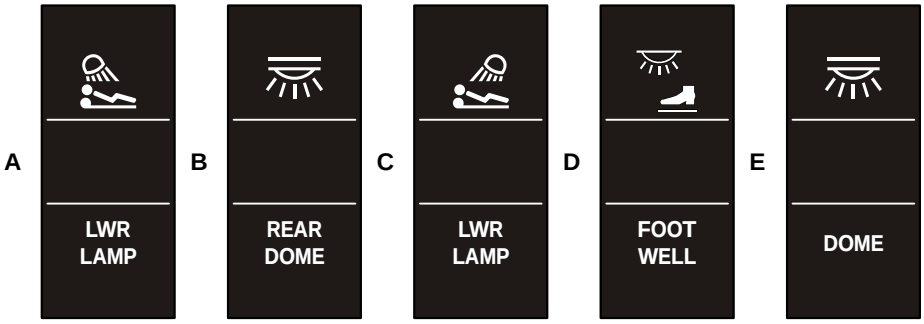
To dim the lights, the driver presses and holds the switch that activates one of the previously mentioned lights. While the switch is being pressed, the light decreases and increases in brightness until the switch is released. The amount of luminosity at the time the switch is released is stored as a value.

Press the switch to turn the lights off. When the switch is pressed again, the lights will display the amount of brightness they were set to.



A. Footwell Light Switch
B. Overhead Console Dome Lights and Rear Dome Light Switch (day cab only)
C. Forward Dome Light Switch (sleeper cab only)

Figure 6-4: Dash Panel Light Switches



A. Lower-Left Reading Light Switch
B. Rear Dome Light and Rear Dome Light/Upper Bunk Reading Light Switch
C. Lower-Right Reading Light Switch (optional)
D. Rear Footwell Light Switch (premium lighting only)
E. Forward Dome Light Switch

Figure 6-5: Lower Control Panel Switches

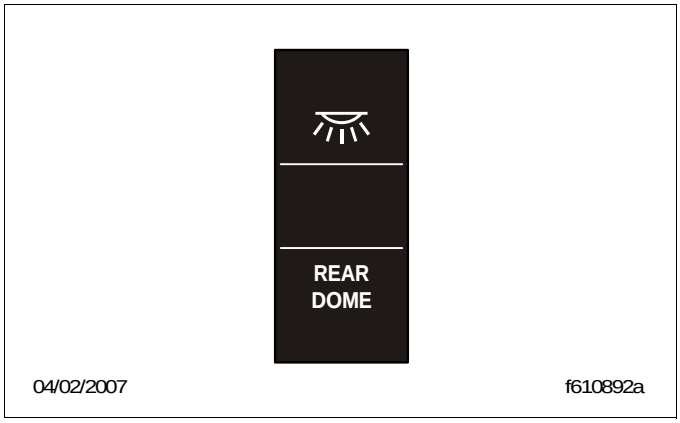


Figure 6-6: Rear Dome Light/Upper Bunk Reading Light Switch on the Upper Control Panel

Dash Panel Backlighting

The dash panel backlighting has four lighting modes:

- daytime mode
- nighttime mode
- accessory mode
- marker interrupt mode

Each lighting mode has a specific value for dimming the dash panel backlighting. The SAM Cab generates a pulse width modulated (PWM) output for the dash panel backlighting based on the corresponding dim value. The SAM Cab broadcasts the dim value on the cabin CAN datalink.

The dim value is controlled by the increment/decrement switch for daytime and nighttime modes. See **Figure 6-7**. The increment/decrement switch status is broadcast from the modular switch field (MSF) on the datalink to the SAM Cab.

See **Figure 6-8** for the function path of the dash panel backlighting.

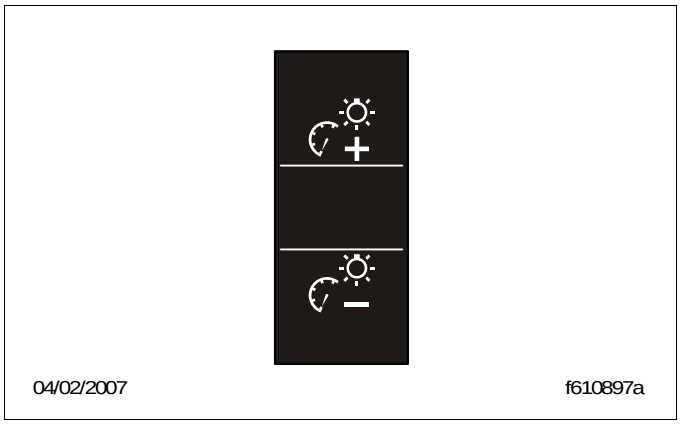


Figure 6-7: Increment/Decrement Switch

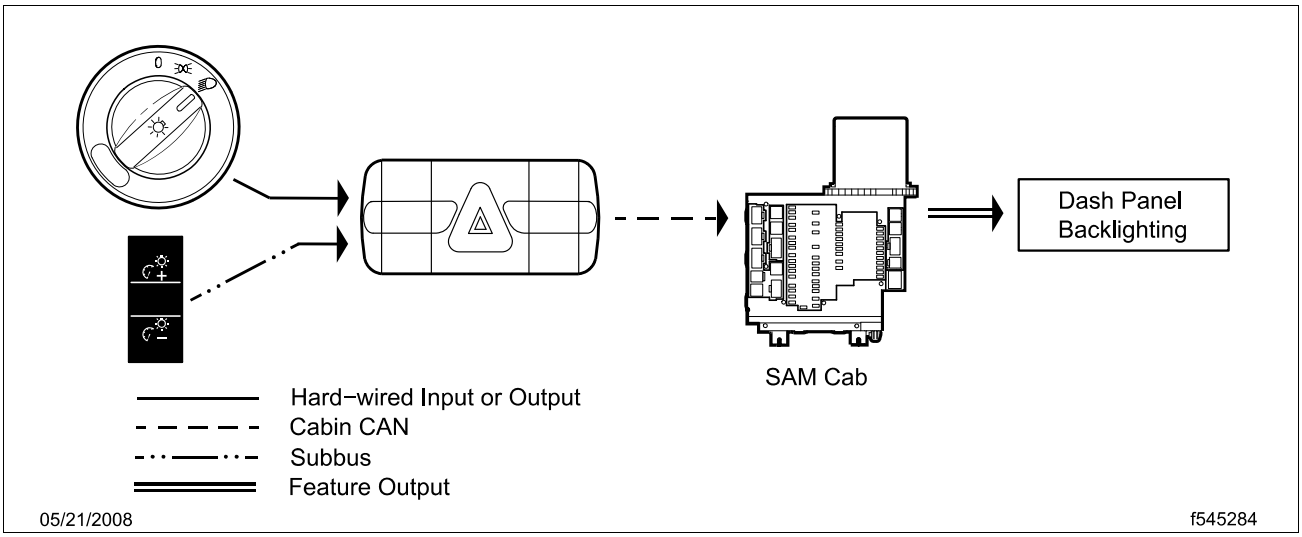


Figure 6-8: Function Path of the Dash Panel Backlighting

Daytime Mode

The daytime mode is active when the headlight switch is in the off position, and the ignition switch is in the ON position. The dash panel backlighting is illuminated at a brightness specified by the daytime mode dim value. The dim value for this mode is stored in the memory of the SAM Cab.

Nighttime Mode

The nighttime mode is active when the headlight switch is **not** in the off position, and the ignition switch is in the ON position. The dash panel backlighting is illuminated at a brightness specified by the nighttime mode dim value. The dim value for this mode is stored in the memory of the SAM Cab.

Accessory Mode

The accessory mode is active when the ignition switch transitions from off to accessory. The dash panel backlighting is illuminated at a brightness specified by the accessory mode dim value.

Marker Interrupt Mode

The marker interrupt mode is activated by pressing the marker interrupt switch, which is located on the steering wheel. This causes the dash panel backlighting to momentarily turn on when the dash panel lights are off prior to pressing the marker interrupt switch. Conversely, the dash panel backlighting turns off when the dash panel lights are on prior to pressing the marker interrupt switch.

Entrance Lighting

Entrance lighting consists of all the lights that are illuminated when one or both of the cab doors is opened. These lights include the overhead console dome lights, footwell

lights, and the doorsill light of the door that is opened. Entrance lighting uses theater lighting controls when the premium lighting option is chosen.

When the door is closed and the ignition switch is in the off or accessory position, the entrance lighting turns off after 15 seconds. When the ignition switch is in the on position, the entrance lighting turns off immediately after both doors are closed. If one or both of the cab doors is left open or ajar, the entrance lighting turns off after 15 minutes.

The overhead console dome and reading lights are designated as house loads in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 6-9** for the function path of the entrance lighting.

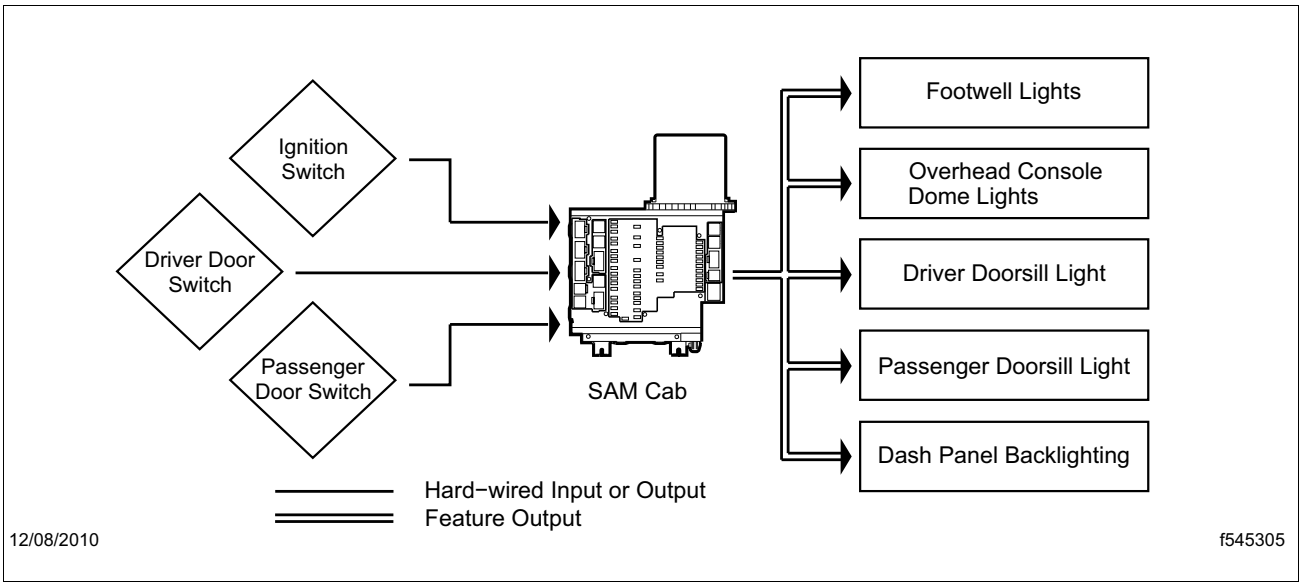


Figure 6-9: Function Path of the Entrance Lighting

Footwell Lighting

Footwell lights light the floor and lower dash directly in front of the driver and passenger seats. The SAM Cab receives a message from the MSF to activate the footwell lighting.

The footwell lights use theater lighting controls when the premium lighting option is chosen.

The footwell lights are designated as a comfort load in the powernet management feature. See **Section 9** for more information on powernet management.

For information on the rear footwell lights, see *Sleeper Lighting* in this section.

See **Figure 6-10** for the function path of the footwell lighting.

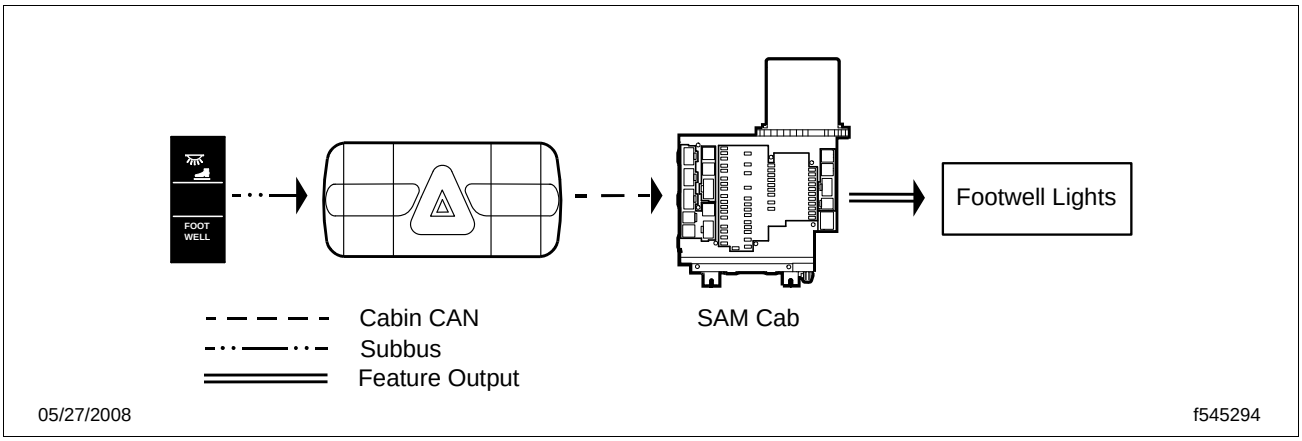


Figure 6-10: Function Path of the Footwell Lighting

Front Cab Dome Lighting

Day cabs and sleeper cabs have two dome and reading light assemblies in the overhead console, one for the driver and one for the passenger. See **Figure 6-1**, **Figure 6-2**, and **Figure 6-3** for the location of the overhead console dome and reading lights. Each dome and reading light assembly has a center dome light, and a reading light on each side of the dome light; one of the reading lights is red, the other is amber. See **Figure 6-11**. The day cab has one rear dome light centered in the ceiling of the cab when the premium lighting option is chosen.

Pressing the lens of the red or amber reading light turns the reading light on or off. The overhead console dome light can be turned on in three different ways. When the driver or passenger door is closed, pressing the lens of the dome light turns the dome light on using a progressive low-voltage disconnect (PLVD) house BAT source, similar to the overhead console reading lights. Pressing the lens again gives control back to entrance lighting; the dome light can then be turned on or off using the overhead console dome light switch (**Figure 6-4**, item B).

See **Figure 6-4** for the light switches that may be installed on the dash panel.

The dome and reading lights are designated as a house load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 6-12** for the function path of the overhead console dome lights and rear dome light in a day cab.

Figure 6-11: Overhead Console Dome and Reading Lights (driver side shown)

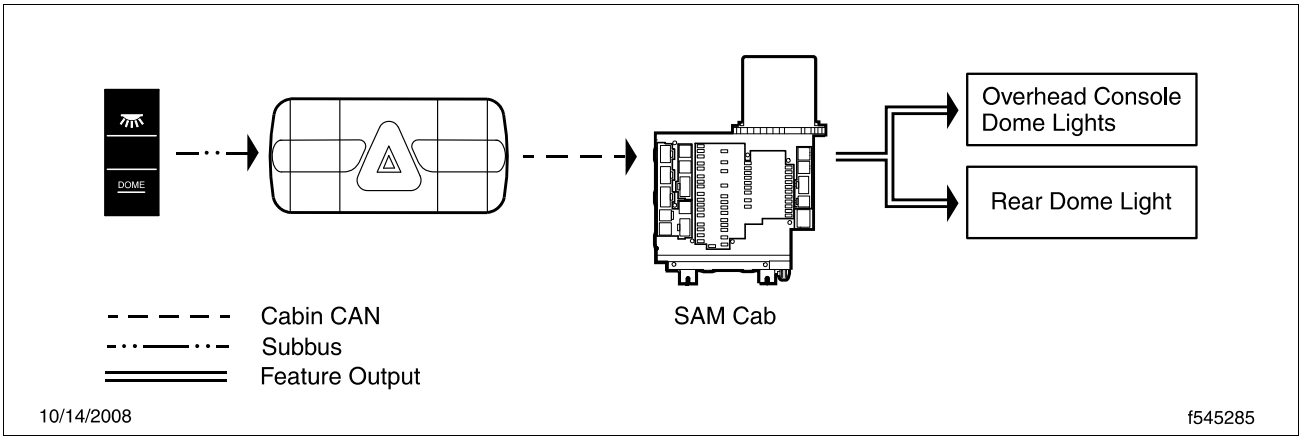


Figure 6-12: Function Path of the Overhead Console Dome Lights and Rear Dome Light in a Day Cab

Sleeper Lighting

Baggage Compartment Lights

The three baggage compartment lights are SAM switched lights. These lights are illuminated when one of the baggage compartment doors is opened, or when the lower bunk is raised. When either of the baggage compartment doors is open or the lower bunk is raised for 30 minutes, the baggage compartment lights will go off. See **Figure 6-1** and **Figure 6-2**.

The baggage compartment lights are designated as a comfort load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 6-13** for the function path of the baggage compartment lights.

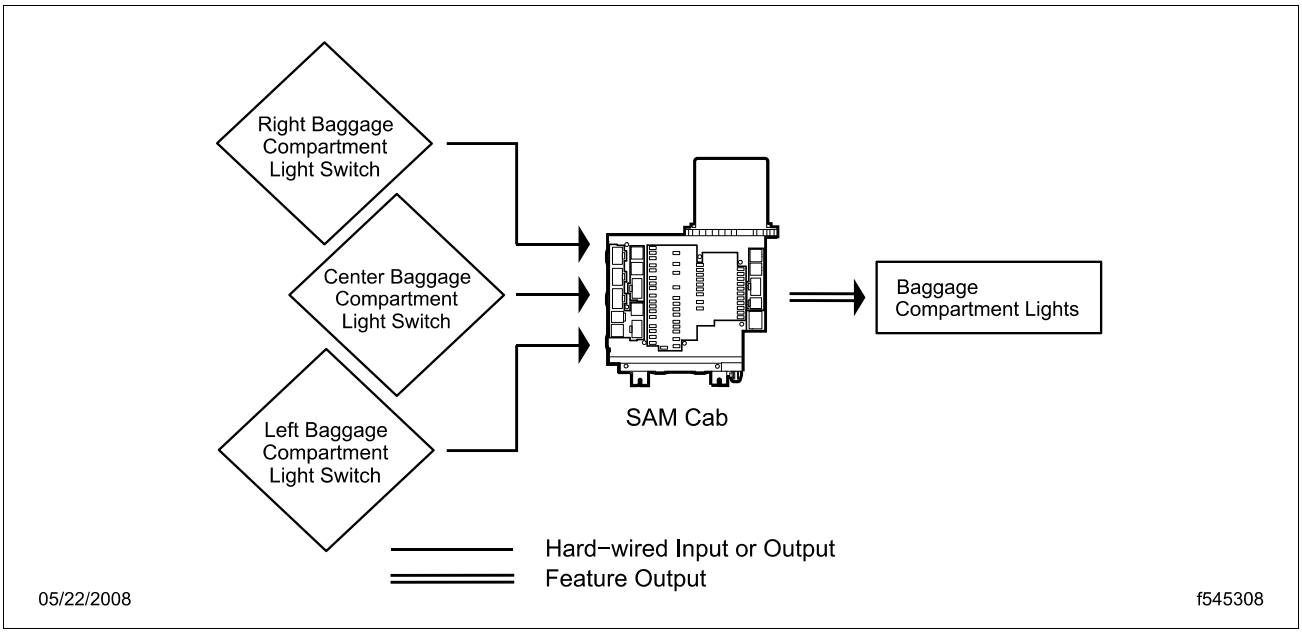


Figure 6-13: Function Path of the Baggage Compartment Lights

Sleeper Dome Lights

There are three dome lights in a raised roof sleeper cab (**Figure 6-1**):
- forward dome light
- rear dome light/upper bunk reading light
- rear dome light

There are two dome lights in a midroof sleeper cab (**Figure 6-2**):
- forward dome light
- rear dome light

The SAM Cab receives a datalink message from the MSF on the lower control panel or, if equipped, on the upper control panel, which activates the rear dome light on both a raised roof sleeper cab and a midroof sleeper cab, and the rear dome light/upper bunk reading light on a raised roof sleeper cab. The forward dome light has theater lighting and dimmable lighting controls.

See **Figure 6-6** for the rear dome light/upper bunk reading light switch installed on the upper control panel.

The dome sleeper lighting is designated as a comfort load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 6-14** for the function path of the sleeper lighting.

Rear Footwell Lights

Two rear footwell lights, located below the lower bunk, are part of the premium sleeper lighting package. The rear footwell lights have theater lighting controls.

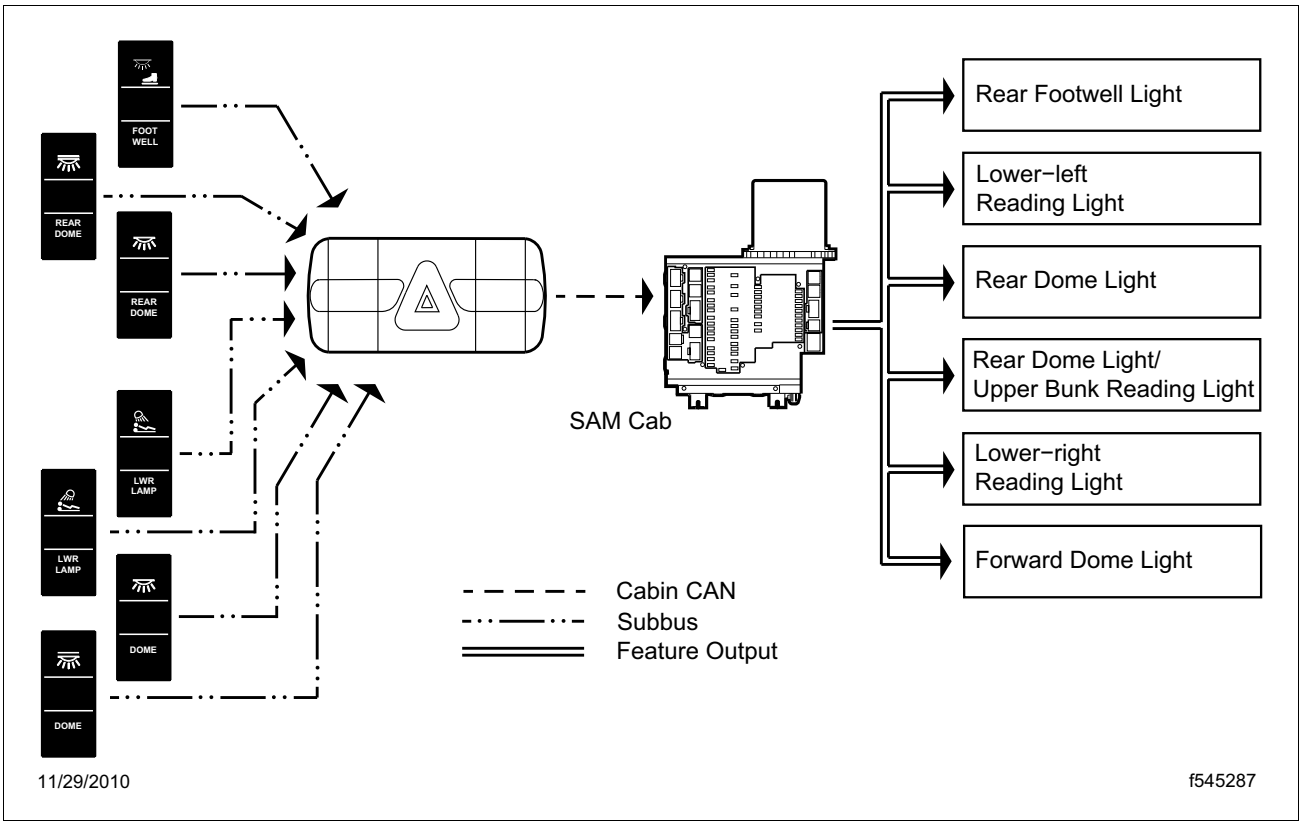


Figure 6-14: Function Path of the Sleeper Lighting

Lower-Left and Lower-Right Reading Lights

The lower-left reading light is located in the lower bunk area on the driver side of the vehicle. The optional lower-right reading light is located on the opposite wall of the lower-left reading light.

The lower-left and lower-right reading lights use theater lighting controls when the premium lighting option is chosen, and are controlled by switches on the lower control panel. When the theater lighting option is not chosen, the lower-left and lower-right reading lights use SAM switched controls. See **Figure 6-5** for the light switches that may be installed on the lower control panel(s).

The lower-left and lower-right reading lights are designated as comfort loads in the powernet management feature. See **Section 9** for more information on powernet management.

Work Surface Light

Press the lens of the work surface light to activate the light.

Feature and Parameter Specifications for Forward Interior Lights						
Parameter Description	**Parameter Part Number**				**Module Number**	**Module**
	002 447 87 58	**004 447 17 58**	**002 447 89 58**	**004 447 16 58**		
Standard lighting	X	—	—	X	32B	SAM Cab
Premium theater lighting	—	X	—	—		
Premium dimmable lighting	—	—	X	—		
Day cab	X	—	X	—		
Sleeper cab	—	X	—	X		
Type of Feature S: Standard O: Optional	S	O	O	O	—	—

Table 6-1: Feature and Parameter Specifications for Forward Interior Lights

Feature and Parameter Specifications for Entry, Access, and Step Interior Lights				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	002 447 92 58	**002 447 93 58**		
Standard lighting	X	—	67E	SAM Cab
Premium theater lighting	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 6-2: Feature and Parameter Specifications for Entry, Access, and Step Interior Lights

Feature and Parameter Specifications for Footwell Lights				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	002 447 08 58	**002 447 13 58**		
Standard lighting	X	—	32B	SAM Cab
Premium theater lighting	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 6-3: Feature and Parameter Specifications for Footwell Lights

Feature and Parameter Specifications for Dash Panel Lights				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	003 447 39 58	**003 447 43 58**		
ICU backlighting on delay with door open and off delay with door closed	X	X	81B	SAM Cab
Standard lighting	X	—		
Premium lighting	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 6-4: Feature and Parameter Specifications for Dash Panel Lights

Feature and Parameter Specifications for Sleeper and Baggage Lights						
Parameter Description	**Parameter Part Number**				**Module Number**	**Module**
	002 447 94 58	**002 447 15 58**	**002 447 84 58**	**002 447 17 58[1]**		
Standard lighting	X	X	—	—	32C	SAM Cab
Premium theater lighting	—	—	X	—		
Premium dimmable lighting	—	—	—	X		
Disabled for use in day cab	X	—	—	—		
Sleeper cab	—	X	X	X		
Reading lights	—	X	X	X		
General sleeper lights	—	X	X	—		
Baggage compartment lights	—	X	X	—		
Type of Feature S: Standard O: Optional	S	S	O	O	—	—

Table 6-5: Feature and Parameter Specifications for Sleeper and Baggage Lights

1. This parameter is unavailable at the time of publication.

Feature and Parameter Specifications for Rear Footwell Lights					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	004 447 22 58	**004 447 23 58**	**004 447 24 58**		
Standard lighting	X	X	—	32C	SAM Cab
Premium theater lighting	—	—	X		
Day cab	X	—	—		
Sleeper cab	—	X	X		
Type of Feature S: Standard O: Optional	S	S	O	—	—

Table 6-6: Feature and Parameter Specifications for Rear Footwell Lights

Section 7:

- Air Filter Restriction Input
- Air Horn
- Alternator Charging
- Auxiliary Heater
- Body Builder Connector
- Cab HVAC Power
- Cruise Control Disengage
- DC Power Receptacles
- Door Module
- Fleet Management and CB Radio
- Heated Mirrors
- Interior Temperature Sensor
- Optimized Idle
- Power Takeoff
- Service Brake Switch
- Spare Function Pins
- Starter Relay
- Supplemental Restraint System

Air Filter Restriction Input

Restriction in the air filter is currently measured by the intake air restriction indicator. The intake air restriction indicator measures the vacuum on the engine side of the air cleaner at the air cleaner outlet.

In the future, the air filter restriction input will be part of the multiplexing system. Until the air filter restriction input is part of the multiplexing system, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for Air Filter Restriction Input				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Air filter restriction, no content	002 447 29 58	199	SAM Cab	Standard

Table 7-1: Feature and Parameter Specifications for Air Filter Restriction Input

Air Horn

The pneumatic air horn is activated by pulling down on the overhead lanyard, which opens a spring-loaded valve that directs air to the horn. When the lanyard is released, the valve closes.

An electrically controlled air horn is not currently available. Until the air horn is part of the multiplexing system, a parameter part number describing the air horn and foot switch as being not present is required in the bill of material. This part number is required to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for the Air Horn				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Air horn and foot switch not present	001 447 94 58	264	SAM Cab	Standard

Table 7-2: Feature and Parameter Specifications for the Air Horn

Alternator Charging

When the alternator fails or is not generating enough current, the NO CHARGE indicator in the instrumentation control unit (ICU) illuminates. The NO CHARGE indicator is activated by way of a hard-wired output from the SAM Cab.

The SAM Cab monitors the charging status from the alternator D+ terminal, and reports the status of the alternator to the ICU.

The alternator charging status feature is activated when the ignition switch is in the ON or start (crank) position.

See **Figure 7-1** for the function path of the alternator charging.

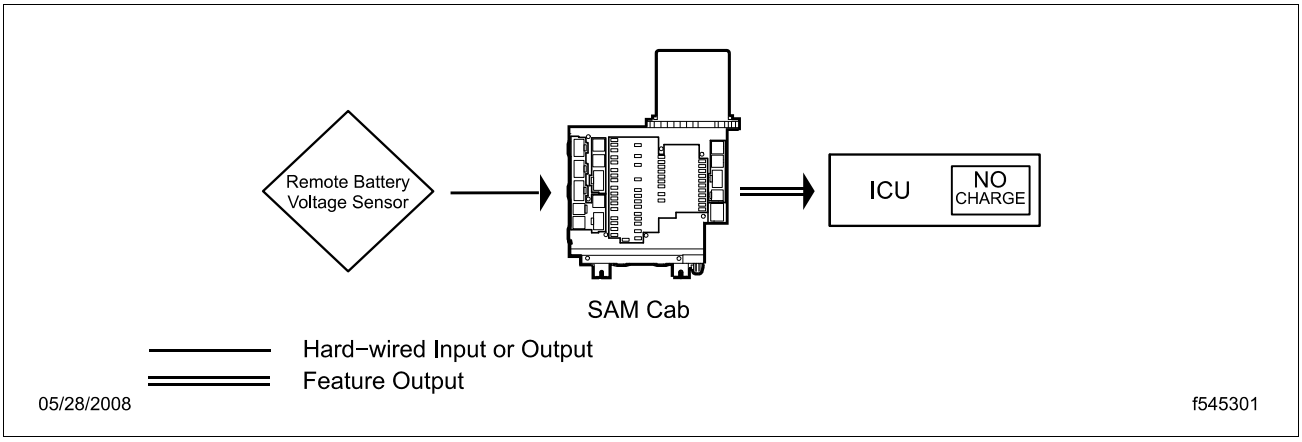


Figure 7-1: Function Path of the Alternator Charging

Feature and Parameter Specifications for Alternator Charging				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	002 447 49 58	**002 447 50 58[1]**		
Alternator charging disable	X	—	12C	SAM Cab
Alternator charging enable	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 7-3: Feature and Parameter Specifications for Alternator Charging

1. This parameter is not available at the time of publication.

Auxiliary Heater

There are three types of auxiliary heaters:
- diesel-fired air heater
- diesel-fired coolant heater
- ParkSmart® HVAC system

The auxiliary heaters can be controlled by progressive low-voltage disconnect (PLVD) or not controlled by PLVD, depending on how they are configured. If the auxiliary heater is not controlled by PLVD, an external low-voltage disconnect (LVD) device is recommended. See **Section 9** for more information on PLVD.

There are four pins on the SAM Cab for the auxiliary heaters, two battery and two low-current enable pins. Both battery pins and one low-current enable pin are not controlled by PLVD, with one low-current enable pin functioning as a basic load. Both low-current enable pins are on when the ignition key is in the OFF or ACC position. This design guarantees that the auxiliary heaters are not active when the vehicle is being operated.

The diesel-fired heaters are designed to operate when the engine is not running. The ParkSmart HVAC system can be operated when the engine is on or off.

The ParkSmart HVAC system is designated as a house load in the powernet management feature since this heater is powered by the vehicle's conventional electrical system. See **Section 9** for more information on powernet management.

See **Figure 7-2** for the function path of the auxiliary heater.

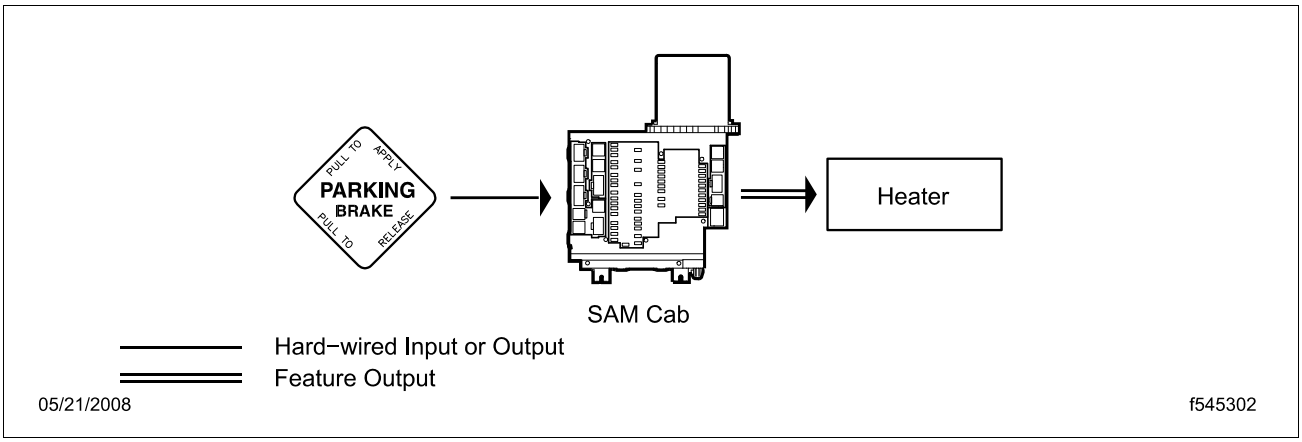


Figure 7-2: Function Path of the Auxiliary Heater

Diesel-Fired Air Heater

Diesel-fired air heaters provide heating in the cab and sleeper without idling the engine. The heated air is distributed through the cab and sleeper through the ducts provided by the air heater vendor.

Diesel-Fired Coolant Heater

Diesel-fired coolant heaters heat and maintain the engine coolant at a predetermined temperature without idling the engine. The generated heat is distributed through the cab and sleeper using the existing HVAC ducts. The warm engine coolant also assists in engine starting in cold weather.

ParkSmart HVAC System

The ParkSmart HVAC system can be used to heat or cool the sleeper when the engine is on or off. When the engine is on, the air conditioning is powered electrically by the vehicle alternator, the heater is powered conventionally using the engine coolant, and the absorbed glass mat (AGM) batteries are recharged by the alternator. The AGM batteries are isolated from the vehicle starting batteries.

When the engine is off, the air conditioning is powered by four AGM batteries, the heater is diesel-fired, and the coolant pump is electrically powered by the AGM batteries. The AGM batteries are recharged by the alternator during normal driving conditions. The ParkSmart system can maintain the set temperature for 8 to 10 hours.

The ParkSmart system meets anti-idling regulations and is approved by the California Air Resources Board (CARB).

See **Figure 7-3** for the ParkSmart climate control panel, which is mounted on the side of the cabinet on the left side of the sleeper. When the engine is off and the brakes are set, press the PARK button to start the ParkSmart system. When the ParkSmart system is running, the amber indicator on the PARK button is illuminated.

The ParkSmart system is turned off when the engine is started, the PARK button is pressed and the amber indicator is off, or the AMG batteries are depleted.

See *Cab HVAC Power* in **Section 7** for information on the cab and sleeper HVAC systems.

Figure 7-3: ParkSmart Climate Control Panel

Body Builder Connector

The body builder connector is a 19-pin connector that provides access to the following signals:

- ignition
- stop lights
- taillights
- park brake
- turn signal lights
- marker lights
- backup lights
- engine speed
- vehicle speed
- ground
- ground return power

The body builder circuits are controlled by low-current SAM Cab outputs. A power distribution module (PDM) is required to provide the circuits with high-current capacity.

The current location of the body builder connector is at the back of the cab. More locations will be available in the future. The body builder PDM is located on the right side of the frontwall under the hood. See **Figure 7-4** and **Figure 7-5**.

See **Table 7-4** for the body builder connector specifications.

When a vehicle does not have a body builder connector, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unspec'd feature.

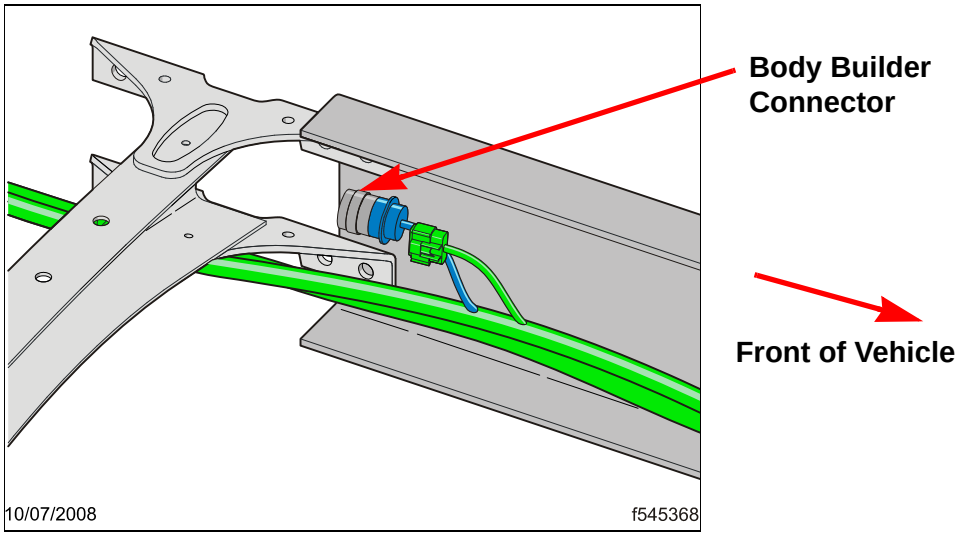


Figure 7-4: Body Builder Connector at Back of Cab

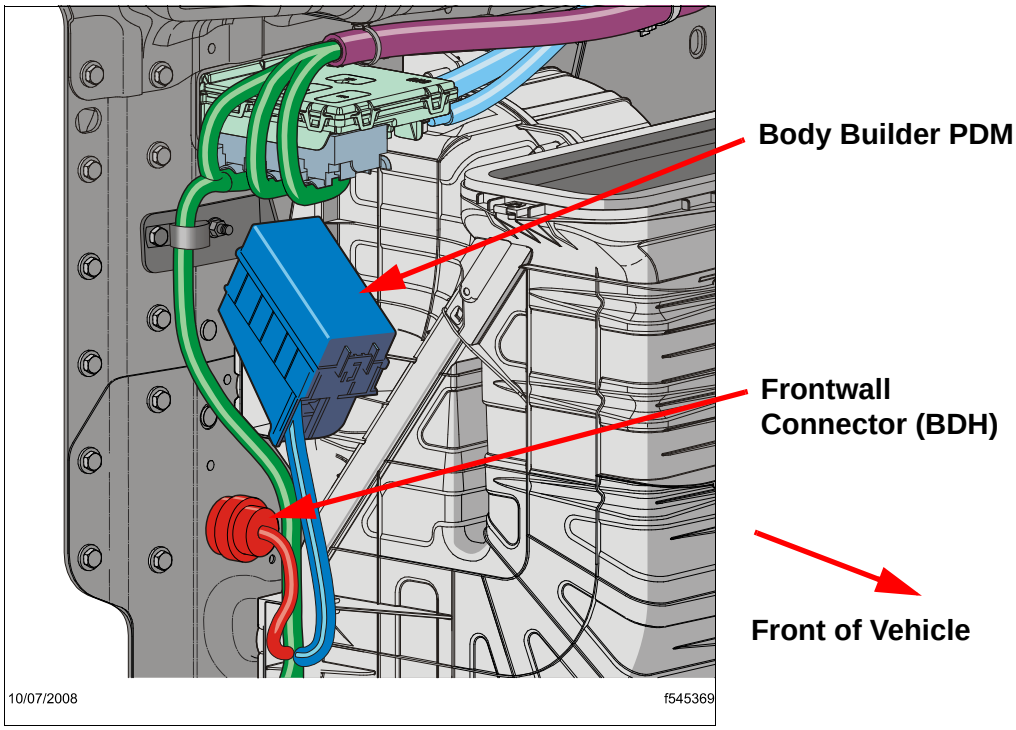


Figure 7-5: Body Builder Power Distribution Module

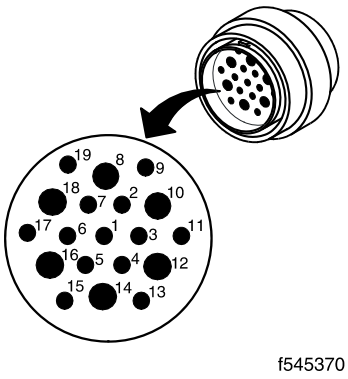
Body Builder Connector Specifications					
SAM Cab Connector X9 Cavity No.	SAM Cab Pin No.	Body Builder Connector Cavity No.	Body Builder Connector Pin Description 	Load Capacity	Source
10	52	13	Marker lights	30 A	SAM Cab, low-side driver
9	54	4	Backup lights	20 A	SAM Cab, low-side driver
8	56	15	GNDE	0.8 A	—
11	57	9	IGN	0.5 A	SAM Cab, low-side driver
14	59	17	Left turn signal lights	20 A	SAM Cab, low-side driver
4	60	5	Park brake	0.04 A	SAM Cab, high-side driver
1	61	7	Engine speed	0.01 A	SAM Cab, high-side driver
13	62	11	Right turn signal lights	20 A	SAM Cab, low-side driver
15	63	16	Stop lights	30 A	SAM Cab, low-side driver
12	64	14	Taillights	20 A	SAM Cab, low-side driver
2	65	6	Vehicle speed	0.01 A	SAM Cab, high-side driver
—	—	10 & 12	Body builder, ground return power	#4 AWG	Main ground junction block

Table 7-4: Body Builder Connector Specifications

Feature and Parameter Specifications for the Body Builder Connector				
Parameter Description	Parameter Part Number	Module Number	Module	Type of Feature
Body builder connector, no content	002 447 70 58	353	SAM Cab	Standard
Body builder fault reporting, no content	004 447 36 58			

Table 7-5: Feature and Parameter Specifications for the Body Builder Connector

Cab HVAC Power

The cab climate control panel is mounted in the dashboard and is used to control the functions of the heating, ventilating, and air conditioning (HVAC) system in the cab. See **Figure 7-6** and **Figure 7-7** for the cab climate control panel for a day cab and a sleeper cab respectively.

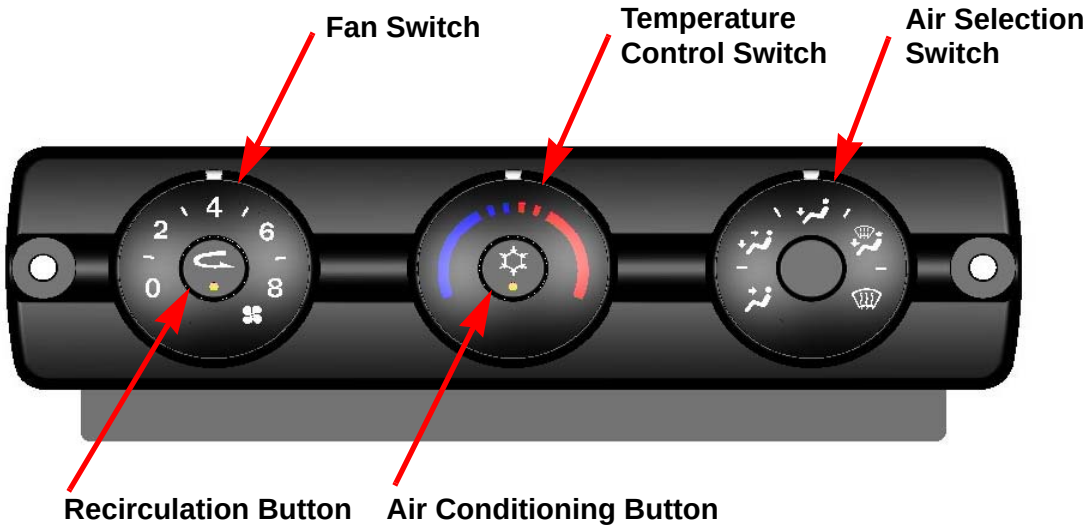


Figure 7-6: Cab Climate Control Panel in a Day Cab

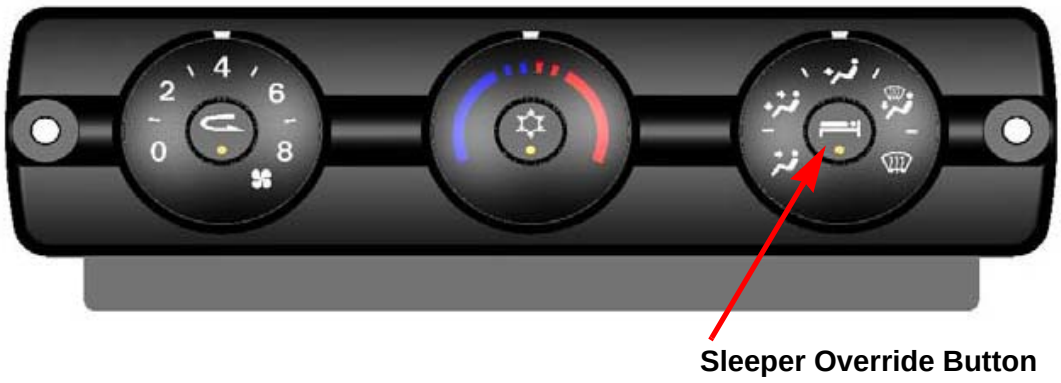


Figure 7-7: Cab Climate Control Panel in a Sleeper Cab

The sleeper climate control panel is standard on a sleeper cab and is used to control the heating and air conditioning functions in the sleeper. The sleeper climate control panel is mounted on the side of the cabinet on the left side of the sleeper. See **Figure 7-8** for the sleeper climate control panel.

An optional ParkSmart HVAC system replaces the standard auxiliary control unit used to control the temperature in the sleeper. See *Auxiliary Heater* in **Section 7** for information on the ParkSmart system.

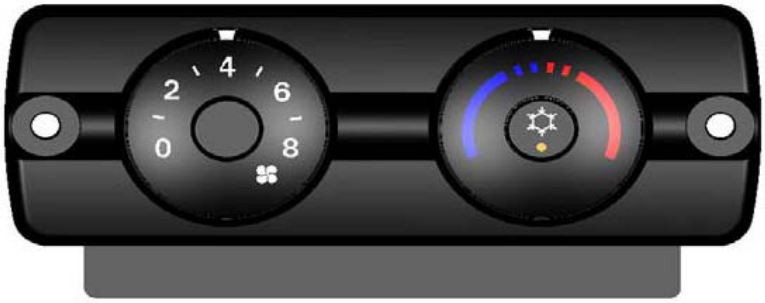


Figure 7-8: Sleeper Climate Control Panel

The cab and sleeper climate control panels control the fan speed and temperature in the cab and sleeper. The cab climate control panel also controls the direction of air flow. The fan motor(s) in the HVAC system does not work when the ignition switch is in the start (crank) position or OFF position.

Constant outlet temperature control (COTC) is a standard feature on both the cab and sleeper HVAC systems. COTC provides a stable air temperature when the air is discharged from the HVAC ducts based on a reference temperature for each of the 21 settings on the temperature control switch. The control head modulates the temperature door in order to reach and maintain the reference temperature.

The cab climate control panel requests A/C compressor clutch activation. The SAM Cab responds to the request by engaging the A/C compressor clutch.

The SAM Cab:
- supplies battery, ground, and a hard-wired wake-up to the cab and sleeper climate control panels;
- supplies battery and ground to the cab and sleeper fan motors;
- reads the outside ambient air temperature for the cab and sleeper climate control panels;
- reads the HVAC pressure transducer.

The wake-up conditions for the HVAC climate control panels are:
- ignition switch is in the accessory or ON position
- vehicle battery voltage is within the normal operating range of 9 to 16 volts

The outside ambient air temperature sensor is mounted behind the right side of the front bumper, and is connected to the SAM Cab.

The cab and sleeper climate control panels are both designated as house loads in the powernet management feature. See **Section 9** for more information on powernet management.

Sleeper Climate Control Panel Override

The sleeper climate control panel override feature allows the driver to override the settings of the sleeper climate control panel using the cab climate control panel. The override feature is a momentary system that allows the driver control of the sleeper HVAC system. The override feature is implemented on the J1939 datalink.

The override feature is activated when the cab climate control panel is active, and the sleeper override button (with bed icon and yellow indicator), located in the center of the air selection switch, has been pressed to the on position.

When in override mode, the sleeper climate control panel automatically conforms to the fan speed and temperature settings on the cab climate panel at the time the override mode is activated. Further changes of the cab climate control settings will not alter the settings of the sleeper climate control panel. The constant outlet temperature control feature is active in the override mode.

The override mode is disabled when the fan switch or temperature control switch on the sleeper climate control panel is manually set to a different setting. The override mode is also disabled when the sleeper override button is pressed to the off position.

Park Brake Interlock Feature

The park brake interlock feature is standard on a sleeper HVAC system, and is activated only when the park brake is set. When the park brake is set and the fan switch or temperature control switch on the sleeper climate control panel is manually set, the cab climate control panel automatically conforms to the settings on the sleeper climate control panel.

When the park brake is set and the fan switch or temperature control switch on the sleeper climate control panel is manually set, and the cab climate control panel is subsequently set by a person in the driver or passenger seat, the settings made on the cab climate control panel affect only the front of the cab, not the sleeper area.

HVAC Pressure Transducer

The SAM Cab interfaces with the pressure transducer in the HVAC system. The SAM Cab senses the voltage at the pressure transducer, averages the readings, and reports a percentage voltage value to the climate control panel via a CAN (controller area network) signal. The SAM Cab is not involved in converting the voltage readings to a pressure value.

See **Figure 7-9** for the function path of the HVAC pressure transducer.

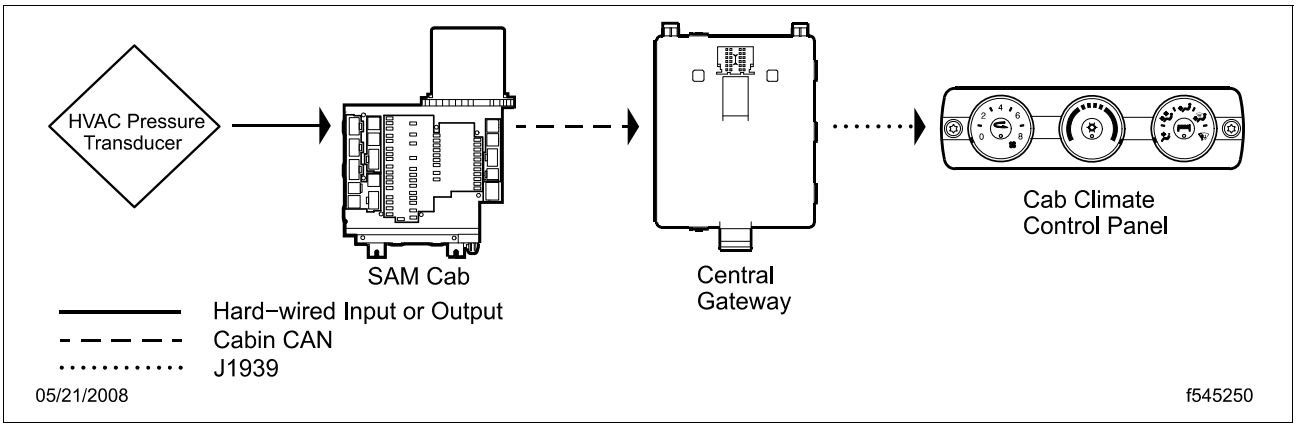


Figure 7-9: Function Path of the HVAC Pressure Transducer

Manual Calibration Procedure

If one of the following conditions exists, perform a manual calibration of the cab climate control panel.

- A whistling, or other unusual noise, is coming from the cab HVAC ducts.
- The airflow is not coming through the outlet that the air selection switch is set to.
- The temperature of the airflow coming through the outlet is different from the temperature control switch setting.

If one of the following situations occurs, it is recommended that a manual calibration be performed.

- The battery cables have been disconnected, then reconnected.
- The air selection switch or temperature control switch was repositioned while the load disconnect switch was off.

Use the following instructions to perform the calibration procedure.

1. Turn the engine off.
2. Turn the ignition switch to the ON position while keeping the engine off.
3. Set the fan switch to the off position.
4. Set the temperature control switch to the full clockwise position (warmest setting).
5. Set the air selection switch to the full counterclockwise position (face setting).
6. Press the air conditioning button and the recirculation button simultaneously for more than five seconds.

NOTE: The calibration process begins when the indicators on the air conditioning and recirculation buttons begin to flash, and continues until the indicators stop flashing.

Feature and Parameter Specifications for Cab HVAC Power				
Parameter Description	**Parameter Part Number**			**Module**
	002 447 45 58	**002 447 47 58**	**002 447 12 58**	
Day cab configuration	X	—	—	SAM Cab
Sleeper cab with secondary heater	—	X	—	
HVAC transducer present	—	—	X	
Type of Feature S: Standard O: Optional	S	S	S	—
Module Number	70C	70C	70B	—

Table 7-6: Feature and Parameter Specifications for Cab HVAC Power

Cruise Control Disengage

The cruise control disengage feature is an optional safety feature that disengages the cruise control when any **one** of the following conditions occurs:

- the headlights are on
- the hazard lights are on
- the windshield wipers are on

Disengagement of the cruise control is accomplished by sending the cruise control pause request CAN signal.

See **Figure 7-10** for the function path of the cruise control disengage.

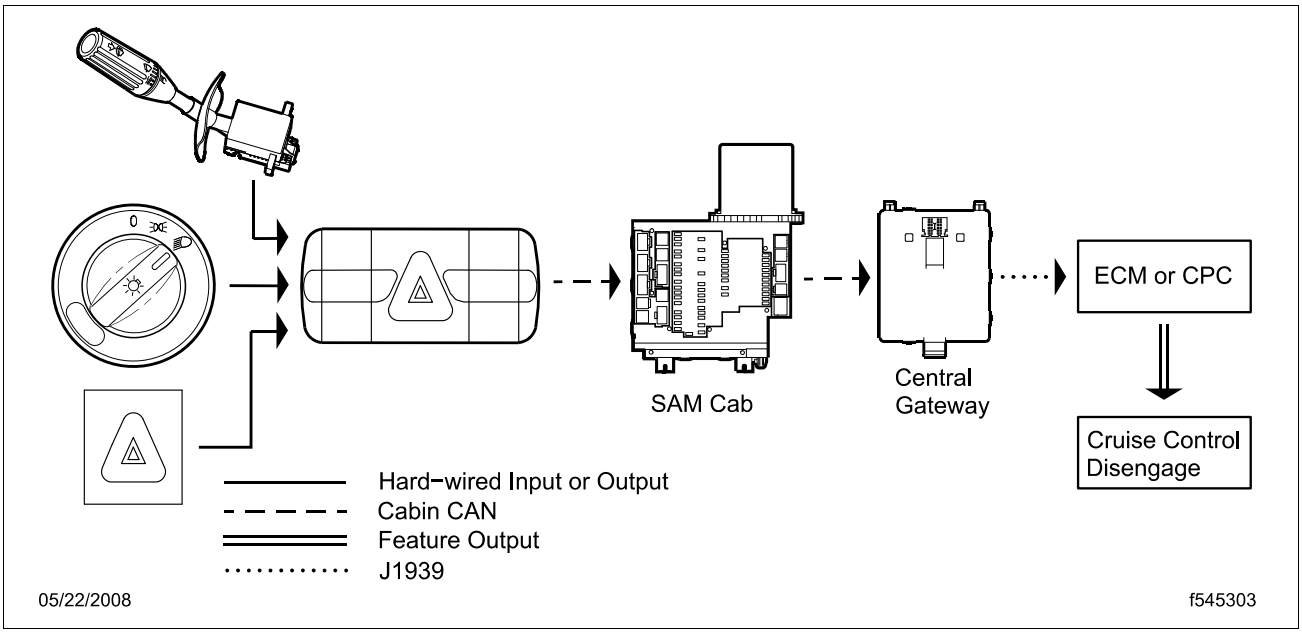


Figure 7-10: Function Path of the Cruise Control Disengage

Feature and Parameter Specifications for Cruise Control Disengage										
Parameter Description	**Parameter Part Number**								**Module Number**	**Module**
	002 447 18 58	**002 447 19 58**	**002 447 20 58**	**002 447 21 58[1]**	**003 447 76 58**	**003 447 77 58[1]**	**003 447 78 58[1]**	**003 447 79 58**		
Cruise control disengage input not present	X	—	—	—	X	—	—	—	149	SAM Cab
Disengage with hazard lights on	—	X	X	X	—	—	X	—		
Disengage with headlights on	—	X	—	X	—	X	—	X		
Disengage with wipers on	—	X	X	—	X	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	O	O	O	O	O	—	—

Table 7-7: Feature and Parameter Specifications for Cruise Control Disengage

1. This parameter is unavailable at the time of publication, and will not be available on a Cummins engine.

DC Power Receptacles

Two DC power receptacles are located in the dashboard on a day cab and a sleeper cab. One to six DC power receptacles are available in the sleeper cab, depending on the cab size and cabinet configuration. The DC power at the receptacles is approximately 12 V, but that voltage varies depending on the battery voltage. Receptacle power is available regardless of the ignition switch position.

The following power receptacles are designated as basic loads in the powernet management feature:

- DC power receptacle 1, battery, dash (**Figure 7-11**)
- DC power receptacle 2, dash (**Figure 7-11**)

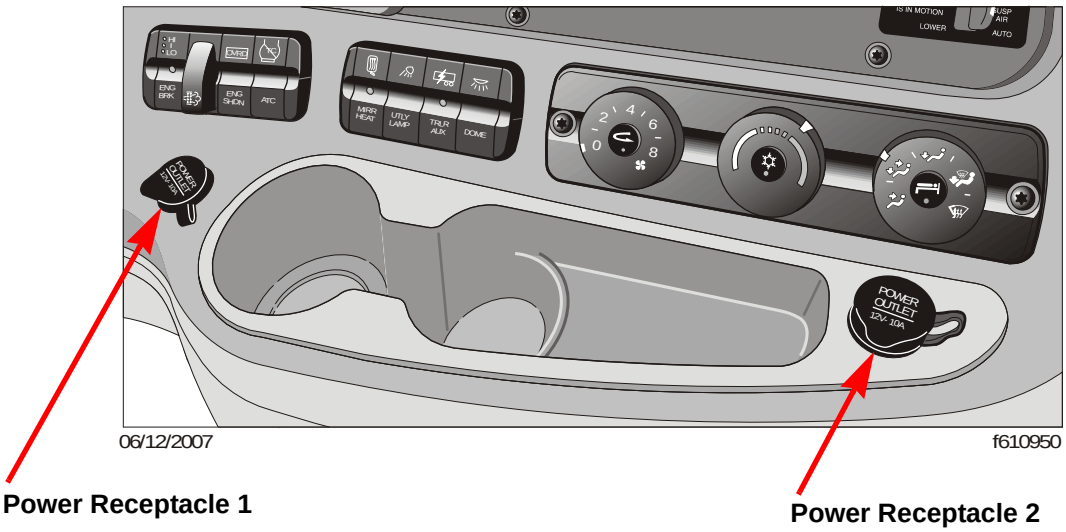


Figure 7-11: Dash Power Receptacles

The following power receptacles are designated as house loads in the powernet management feature:

- DC power receptacle 3, battery, on sleeper control panel in 60-inch and 72-inch midroof and raised roof sleepers (**Figure 7-12**); near sleeper control panel in 48-inch midroof sleeper (**Figure 7-13)**
- DC power receptacle 6A, forward bunk partition (**Figure 7-14**)
- DC power receptacle 6B, forward bunk partition (**Figure 7-14**)

The following power receptacles are designated as comfort loads in the powernet management feature:

- DC power receptacle 4, battery, right-side cabinet in 48-inch midroof sleeper, and in 60-inch and 72-inch midroof and raised roof sleepers (**Figure 7-15**)
- DC power receptacle 5A, battery, right-side cabinet in 72-inch midroof and raised roof sleepers (**Figure 7-15**)
- DC power receptacle 5B, left-side cabinet in a 72-inch midroof sleeper and in 60-inch and 72-inch raised roof sleepers (**Figure 7-12**)
- DC power receptacle 5C, left-side cabinet in a 72-inch raised roof sleeper (**Figure 7-12**)

See **Section 9** for more information on powernet management.

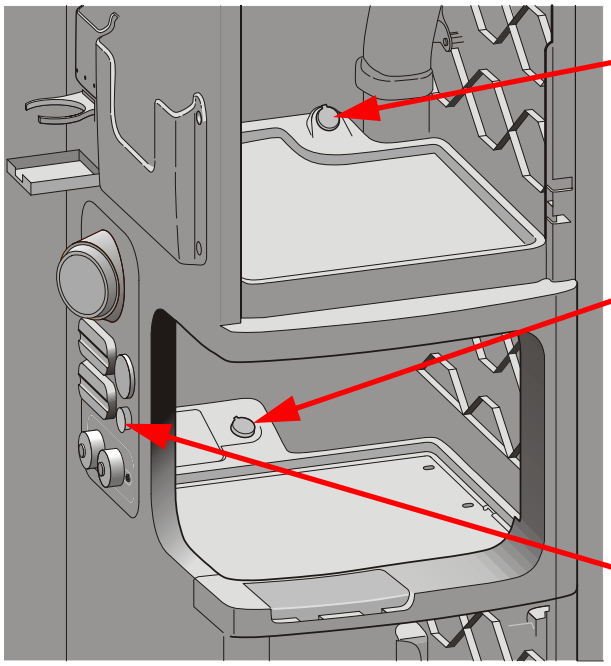


Figure 7-12: Left-Side Cabinet Power Receptacles

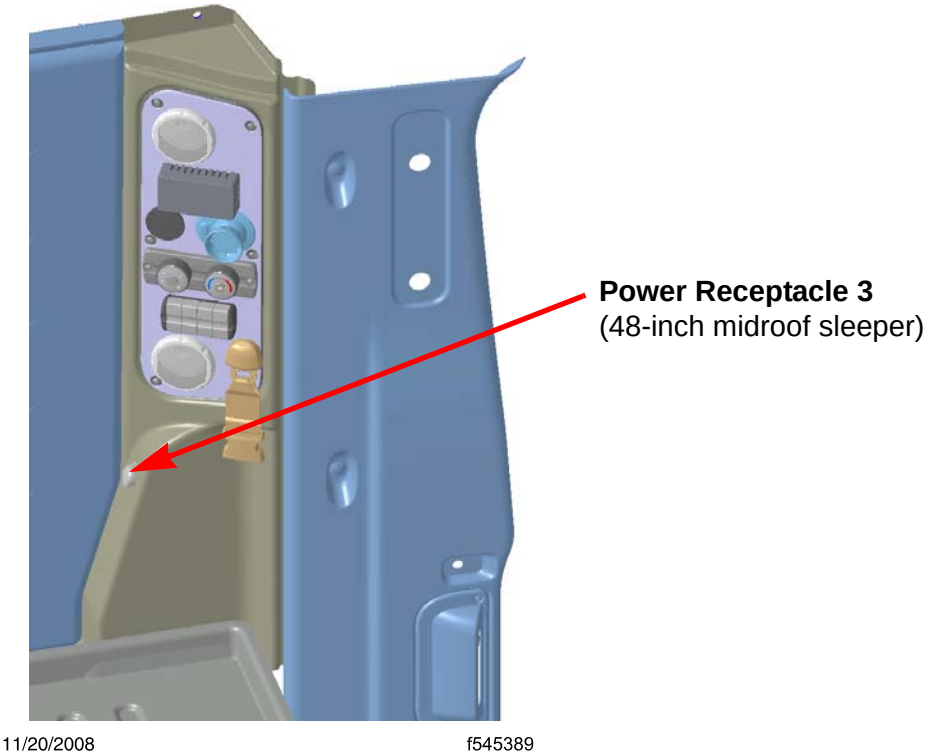


Figure 7-13: Left-Corner Power Receptacle

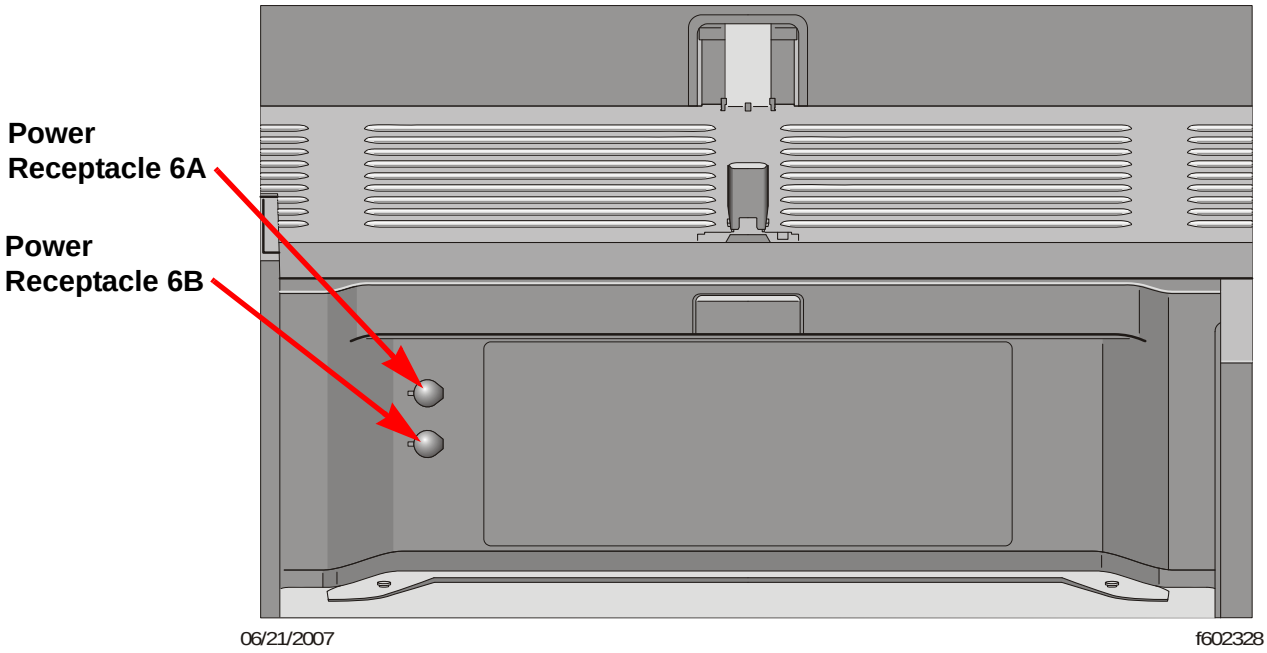


Figure 7-14: Forward Bunk Partition Power Receptacles

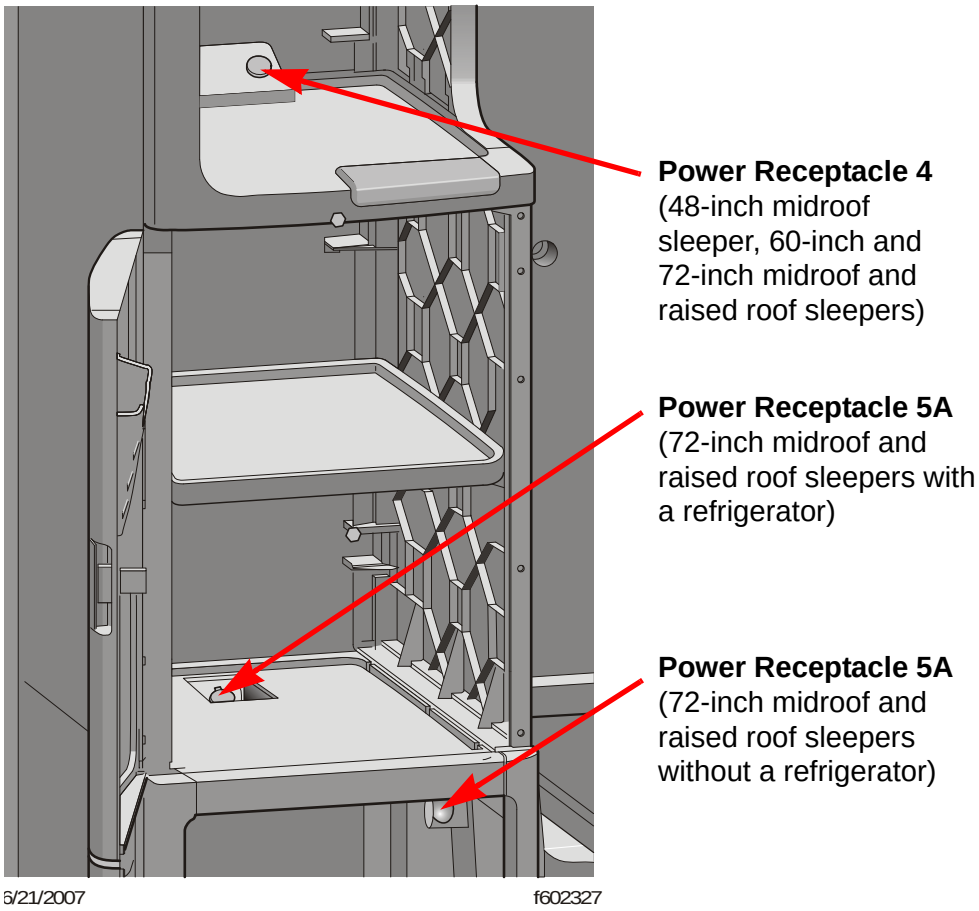


Figure 7-15: Right-Side Cabinet Power Receptacles

Feature and Parameter Specifications for DC Power Receptacles				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Power receptacle 6	002 447 52 58	284	SAM Cab	Standard

Table 7-8: Feature and Parameter Specifications for DC Power Receptacles

Door Module

In the future, a door electronic control module that controls the power windows, heated mirrors, door locks, doorsill lights, and mirror adjust will be available. The door module will also provide the capability for antitheft and keyless entry. Until the door module is part of the multiplexing system, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for the Door Module				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Door module, no content	002 447 69 58	67E	SAM Cab	Standard

Table 7-9: Feature and Parameter Specifications for the Door Module

Fleet Management and CB Radio

Fleet management is a system that allows a fleet to track and communicate the location of its vehicles using a land-based or satellite-based communication system. Freightliner offers several fleet management systems; Qualcomm and GeoLogic Solutions are two such systems.

The inclusion of the fleet management system and the CB radio in PLVD is determined by the position of fuse F14. When the fuse is placed in position F14_1, the fleet management system and the CB radio function as a basic load. When fuse F14 is placed in position F14_2, the loads will not be deactivated by PLVD. See **Section 9** for more information on PLVD.

NOTE: The fleet management system and CB radio cannot be separated for the purpose of inclusion or exclusion in PLVD functionality.

Heated Mirrors

The heated mirror feature is used to clear ice and frost from the side mirrors and, if installed, the hood-mounted mirrors. The driver activates the mirror heat elements on the driver and passenger side mirrors by pressing the mirror heat (MIRR HEAT) switch. See **Figure 7-16**.

The mirror heat switch is a momentary switch. When the mirror heat switch is pressed, the amber indicator illuminates. The heating elements remain on for 30 minutes, at which time the SAM Cab checks the outside air temperature. If the temperature is 60°F (16°C) or higher, the mirror heat switch turns off. If the temperature is less than 60°F, the SAM Cab leaves the mirror heat on for another 30 minutes and then checks the outside air temperature again.

The SAM Cab reads the heated mirror signal input from the modular switch field (MSF) over the cabin CAN to activate the driver and passenger heated mirror elements.

The heated mirrors are designated as a house load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 7-17** for the function path of the heated mirrors.

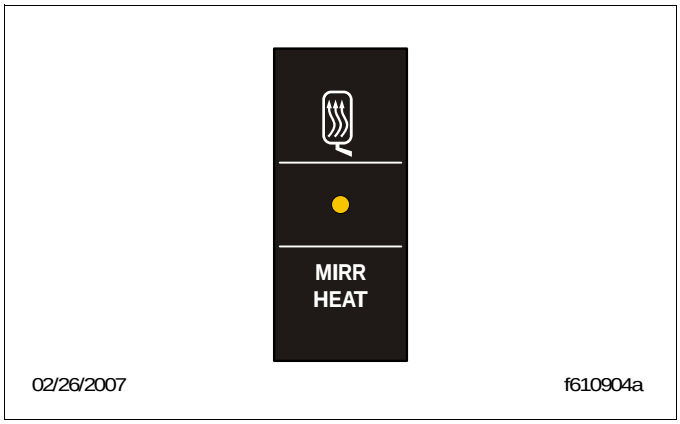


Figure 7-16: Mirror Heat Switch

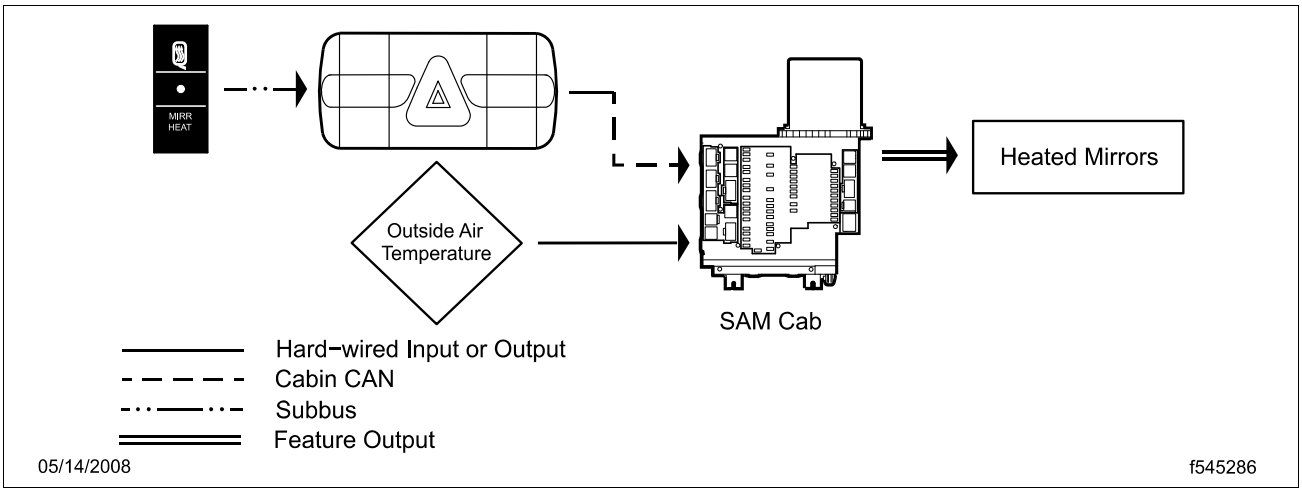


Figure 7-17: Function Path of the Heated Mirrors

Feature and Parameter Specifications for Heated Mirrors				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	002 447 56 58[1]	**004 447 45 58**		
Heated mirrors not present	X	—	74E	SAM Cab
Heated mirrors present	—	X		
Type of Feature S: Standard O: Optional	O	S	—	—

Table 7-10: Feature and Parameter Specifications for Heated Mirrors

1. This parameter is not available at the time of publication.

Feature and Parameter Specifications for Heated Mirrors Fault Reporting					
Parameter Description	**Parameter Part Number**			**Module Number**	**Module**
	004 447 30 58	**004 447 31 58**	**004 447 32 58**		
No fault reporting	X	—	—	74E	SAM Cab
Short to battery	—	—	X		
Short to ground	—	X	X		
Type of Feature S: Standard O: Optional	O	S	O	—	—

Table 7-11: Feature and Parameter Specifications for Heated Mirrors Fault Reporting

Interior Temperature Sensor

The interior temperature sensor is currently not available. When it is available, the HVAC system could use the temperature sensor for its operation. Until the interior temperature sensor is available, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for the Interior Temperature Sensor				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
No interior temperature sensor, no content	002 447 67 58	81B	SAM Cab	Standard

Table 7-12: Feature and Parameter Specifications for the Interior Temperature Sensor

Optimized Idle

The optimized idle feature is an option on Detroit Diesel engines. Optimized idle allows the engine to automatically turn on or off depending on its calculations of ambient temperature, battery voltage, and driver input to maintain the vehicle in good working condition while minimizing idle time.

Optimized idle operates in two modes: engine and thermostat. The engine mode keeps the battery charged and the engine oil temperature within 60 to 104°F (16 to 40°C). In addition to maintaining the batteries and the engine oil temperature, the thermostat mode keeps the cab at the temperature set by the user. The engine mode is always activated when the optimized idle feature is activated. The thermostat mode is activated when the thermostat is turned on.

A vehicle without the optimized idle feature is required to have a parameter part number with no content in the bill of material to disable diagnostics and functionality for the unspec'd feature.

The optimized idle input to the SAM Cab to disable certain loads may be multiplexed or hard-wired. The correct parameter must be chosen for the intended functionality.

Feature and Parameter Specifications for Optimized Idle					
Parameter Description	Parameter Part Number			Module Number	Module
	002 447 22 58	003 447 81 58	002 447 23 58		
Optimized idle, no content	X	—	—	158	SAM Cab
Optimized idle enabled, hard-wired	—	X	—		
Optimized idle enabled, CAN	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	—	—

Table 7-13: Feature and Parameter Specifications for Optimized Idle

Power Takeoff

The provisions for a power takeoff (PTO) are currently hard-wired. In the future, the PTO will be controlled by the SAM Cab. Until the PTO feature is part of the multiplexing system, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for Power Takeoff				
Parameter Description	Parameter Part Number	Module Number	Module	Type of Feature
Power takeoff, no content	002 447 83 58	885	SAM Cab	Standard

Table 7-14: Feature and Parameter Specifications for Power Takeoff

Service Brake Switch

The service brake switch is connected to the brake system to detect air pressure when the service brake is depressed by the driver. The SAM Cab reads the service brake switch input and transmits the switch status on the CAN datalink.

Feature and Parameter Specifications for the Service Brake Switch				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Air pressure switch present	002 447 11 58	877	SAM Cab	Standard

Table 7-15: Feature and Parameter Specifications for the Service Brake Switch

Spare Function Pins

Spare function pins can be used to accommodate custom designs. There are four spare function pins, each of which operates separately from the others. Each spare function pin can have up to four cabin CAN messages as inputs; the output is hard-wired.

See **Table 7-16** for the spare function pin specifications. Connector X9 is located on the topside of the SAM Cab.

Contact Customer Application Engineering for information on how to use spare function pins for custom designs.

When one or more spare function pins are not used, parameter part numbers with no content are required in the bill of material to disable the diagnostics.

Spare Function Pin Specifications			
Spare Function Pin	**Connector No.**	**Pin No.**	**Load Capacity**
1	X9	3	200 ma
2		5	
3		7	
4		6	

Table 7-16: Spare Function Pin Specifications

Feature and Parameter Specifications for Spare Function Pins										
Parameter Description	Parameter Part Number								Module Number	Module
	002 447 75 58	002 447 76 58	002 447 77 58	002 447 78 58	002 447 79 58	002 447 80 58	002 447 81 58	002 447 82 58		
Spare function pin, 1.1, no content	X	—	—	—	—	—	—	—	353	SAM Cab
Spare function pin, 1.2, no content	—	X	—	—	—	—	—	—		
Spare function pin, 2.1, no content	—	—	X	—	—	—	—	—		
Spare function pin, 2.2, no content	—	—	—	X	—	—	—	—		
Spare function pin, 3.1, no content	—	—	—	—	X	—	—	—		
Spare function pin, 3.2, no content	—	—	—	—	—	X	—	—		
Spare function pin, 4.1, no content	—	—	—	—	—	—	X	—		
Spare function pin, 4.2, no content	—	—	—	—	—	—	—	X		
Type of Feature S: Standard O: Optional	S	S	S	S	S	S	S	S	—	—

Table 7-17: Feature and Parameter Specifications for Spare Function Pins

Feature and Parameter Specifications for Spare Function Pins Fault Reporting					
Parameter Description	Parameter Part Number			Module Number	Module
	004 447 25 58	004 447 26 58	004 447 27 58		
No fault reporting	X	—	—	353	SAM Cab
Short to battery	—	—	X		
Short to ground	—	X	X		
Type of Feature S: Standard O: Optional	S	O	O	—	—

Table 7-18: Feature and Parameter Specifications for Spare Function Pins Fault Reporting

Starter Relay

Unlike previous Freightliner vehicles, the ignition switch is decoupled from the starter relay on the Cascadia. The SAM Cab activates an output to drive the starter relay. There may be other interlocks and control mechanisms between the SAM Cab and starter relay depending on the make of the engine and transmission. On a vehicle with an Eaton automated transmission, a safety interlock relay is provided between the SAM Cab starter relay output and the starter relay.

Three criteria determine when the starter motor can be turned on:
- safety
- user control
- reliability

Safety–One or more of the following three conditions must be met in order to activate the starter motor:
- bottom-of-clutch switch must be engaged
- the neutral switch must be closed
- a CAN message from the transmission ECU indicates that it is safe to activate the starter motor

The safety condition used is dependent on which parameters have been programmed on the vehicle.

User Control–The driver requests an engine start by turning the ignition switch.

Reliability–The SAM Cab provides antigrinding protection and thermal protection to the starter motor. When certain conditions exist that may damage the starter motor, the

SAM Cab prevents cranking for a predetermined period of time to protect the starter motor.

Antigrinding Protection Rules

- The engine speed must be less than 55 rpm to initiate a crank cycle.
- The crank cycle is terminated when the engine speed exceeds 450 rpm.

Thermal Protection Rules

- If the engine speed does not exceed 55 rpm during the crank cycle, cranking is terminated after a maximum of five seconds, even if the driver continues to hold the ignition key in the start (crank) position. Cranking can be initiated again after a 30-second cool-down period. This situation can occur when the engine is stalled due to a mechanical failure and excessive heat builds up in the starter motor.
- If the engine speed exceeds 55 rpm but does not exceed 150 rpm during the crank cycle, cranking is terminated after a maximum of 15 seconds (or 20 seconds if the outside air temperature is less than 14°F [–10°C]), even if the driver holds the ignition key in the start (crank) position. Cranking can be initiated again after a 30-second cool-down period. This situation can occur when the engine is slow in turning due to cold weather, or is not firing due to lack of fuel and moderate heat builds up in the starter motor.
- When the engine speed exceeds 150 rpm but does not exceed 450 rpm during the crank cycle, cranking is terminated after a maximum of 15 seconds, even if the driver holds the ignition key in the start (crank) position. Cranking can be initiated again after a 30-second cool-down period. This situation can occur when the engine is running and turning properly, but cranking is still initiated. The termination of cranking protects the starter after the engine has fired.

See **Figure 7-18** for the function path of the starter relay with manual transmission.
See **Figure 7-19** for the function path of the starter relay with automatic transmission.

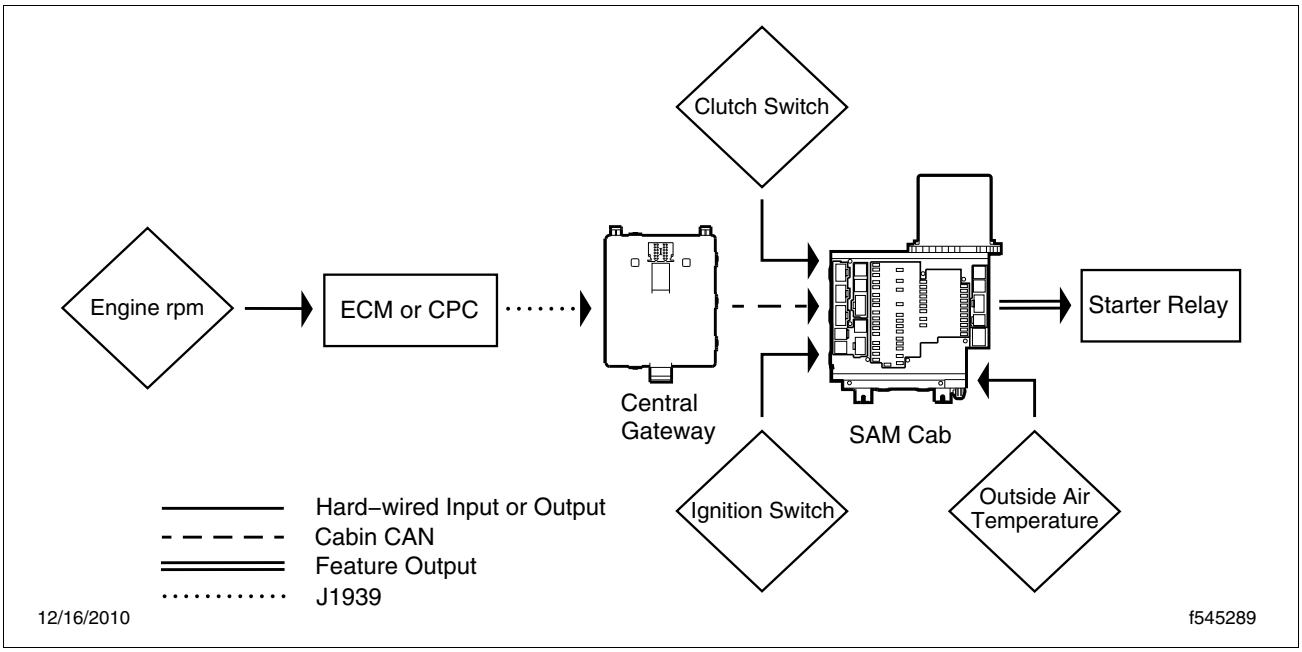


Figure 7-18: Function Path of the Starter Relay With Manual Transmission

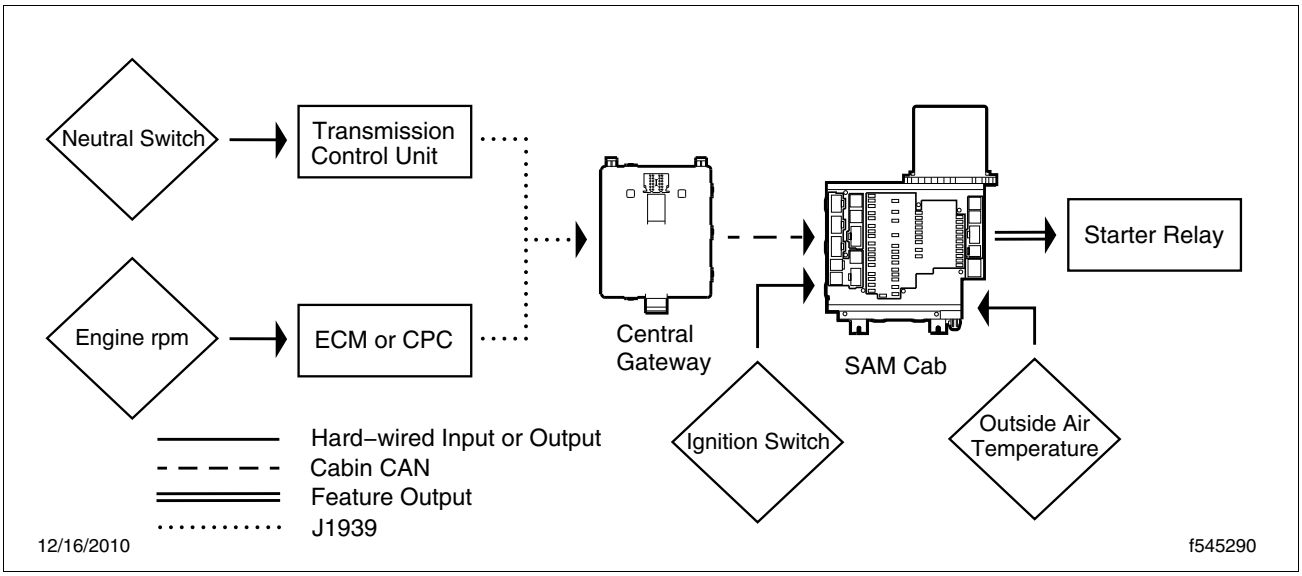


Figure 7-19: Function Path of the Starter Relay With Automatic Transmission

Feature and Parameter Specifications for the Starter Relay												
Parameter Description	Parameter Part Number										Module Number	Module
	002 447 24 58	002 447 25 58	002 447 26 58[1]	002 447 27 58	002 447 28 58	004 447 46 58	004 447 47 58	004 447 48 58	004 447 49 58	004 447 50 58		
Manual and Eaton AS transmission with bottom-of-clutch switch	X	—	—	—	—	—	—	—	—	—	156	SAM Cab
Manual transmission with neutral switch	—	X	—	—	—	—	—	—	—	—		
Manual transmission with neutral switch and bottom-of-clutch switch	—	—	X	—	—	—	—	—	—	—		
Allison Automatic transmission with J1939 ETC7	—	—	—	X	—	—	—	—	—	—		
Eaton DM automatic transmission with transmission ECU interlock	—	—	—	—	X	—	—	—	—	—		
Manual and Eaton AS transmission with bottom-of-clutch switch and crank interlock	—	—	—	—	—	X	—	—	—	—		
Manual transmission with neutral switch and crank interlock	—	—	—	—	—	—	X	—	—	—		
Manual transmission with neutral switch and bottom-of-clutch switch and crank interlock	—	—	—	—	—	—	—	X	—	—		
Allison Automatic transmission with J1939 ETC7 and crank interlock	—	—	—	—	—	—	—	—	X	—		
Eaton DM automatic transmission with transmission ECU interlock and crank interlock	—	—	—	—	—	—	—	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	O	O	S	O	O	O	O	—	—

Table 7-19: Feature and Parameter Specifications for the Starter Relay

1. This parameter is not available at the time of publication.

Supplemental Restraint System

In the future, when a vehicle has been in a severe crash, the supplemental restraint system will react by sending a message that a crash has occurred to the SAM Cab, SAM Chassis, and other electronic systems. These systems will then respond to the message by controlling the electric loads to minimize risk to the occupants of the vehicle.

Until this feature is available, two parameter part numbers with no content are required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for the Supplemental Restraint System			
Parameter Description	**Parameter Part Number**		**Module Number**
	002 447 30 58	**000 447 02 61**	
Supplement restraint system, no content	X	X	725
Type of Feature S: Standard O: Optional	S	S	—
Module SC: SAM Cab SCH: SAM Chassis	SC	SCH	—

Table 7-20: Feature and Parameter Specifications for the Supplemental Restraint System

Section 8:

- Air Dryer/Heater
- Differential Lock
- Engine Brake
- Fuel Level Sender
- Fuel Water Separator Sensing
- Low Air Pressure Warning System
- Neutral Switch
- Trailer Receptacles

Air Dryer/Heater

The air dryer removes moisture from the pneumatic system. The air dryer/heater is activated when the ignition switch is in the accessory or ON position.

The air dryer/heater is designated as a house load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 8-1** for the function path of the air dryer.

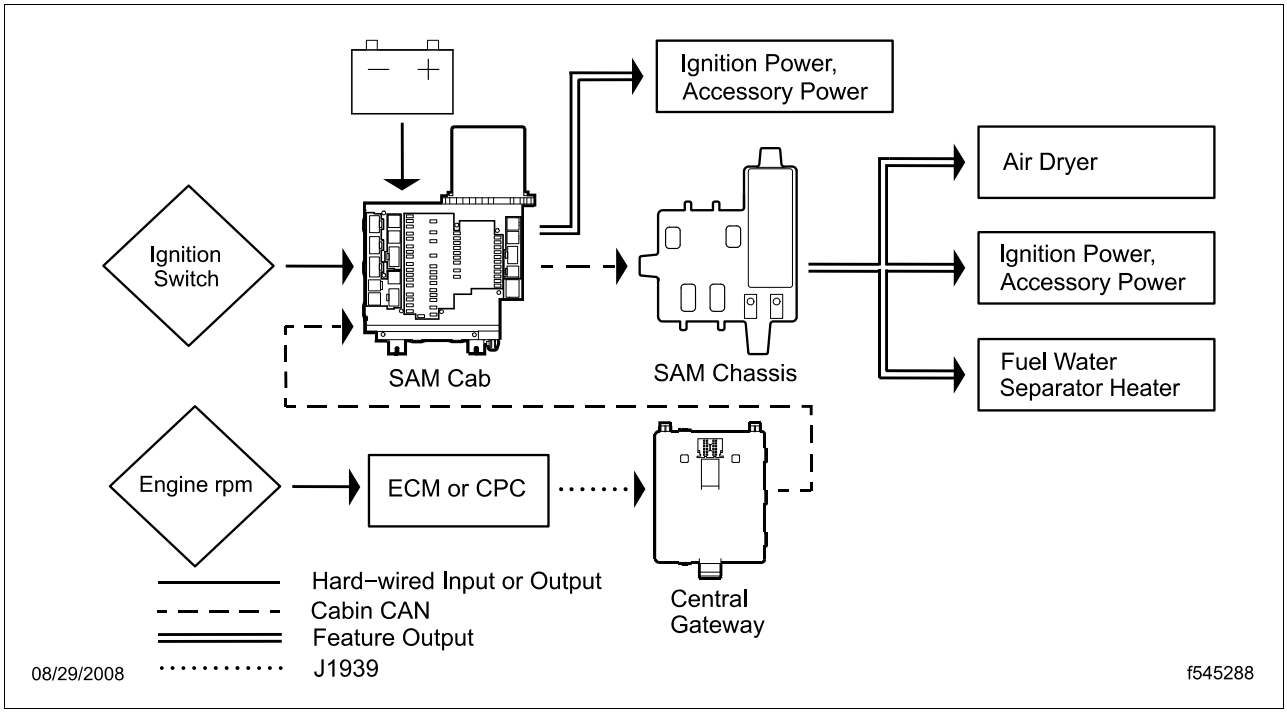


Figure 8-1: Function Path of Powernet Management, Air Dryer, and Fuel Water Separator Heater

Feature and Parameter Specifications for the Air Dryer/Heater				
Parameter Description	Parameter Part Number		Module Number	Module
	000 447 07 61	000 447 08 61		
Air dryer/heater not present	X	—	48A	SAM Chassis
Air dryer/heater present	—	X		
Type of Feature S: Standard O: Optional	O	S	—	—

Table 8-1: Feature and Parameter Specifications for the Air Dryer/Heater

Differential Lock

The differential lock is not currently part of the multiplexing system. Until the differential lock is part of the multiplexing system, a parameter part number with no content is required in the bill of material. This part number is required to disable diagnostics and functionality for the unavailable feature.

Feature and Parameter Specifications for the Differential Lock				
Parameter Description	Parameter Part Number	Module Number	Module	Type of Feature
Differential lock, no content	000 447 22 61	87B	SAM Chassis	Standard

Table 8-2: Feature and Parameter Specifications for the Differential Lock

Engine Brake

The engine brake is used to slow the vehicle, but it is not a substitute for the service brake—except in an emergency—because it does not provide the precise control available from the service brake.

Engine brake operation is determined by the options chosen by the dealer, Cascadia customer, or Freightliner customer application engineer. These options control how the engine brake operates under certain conditions.

Activation of the stop lights when the engine brake is applied is an optional feature. Activation of the stop lights occurs when the engine brake level selection switch is in the HI position and the engine is applying at least 70 percent of its braking power.

The information under the *Engine Brake Operation* heading explains how the engine brake is activated and how it operates, regardless of the make and model of the engine.

See **Figure 8-2** for the function path of the engine brake.

Basic Information

A Jacobs Engine Brake® is standard on **Detroit Diesel** DD13, DD15, and DD16 engines. The **Cummins** Intebrake™ engine brake is standard on the 14.9L ISX engine.

Engine brake operation in the Cascadia is dependent on:

- make and model of the engine
- make and type of the engine brake
- default electronic parameters
- customer selected data codes

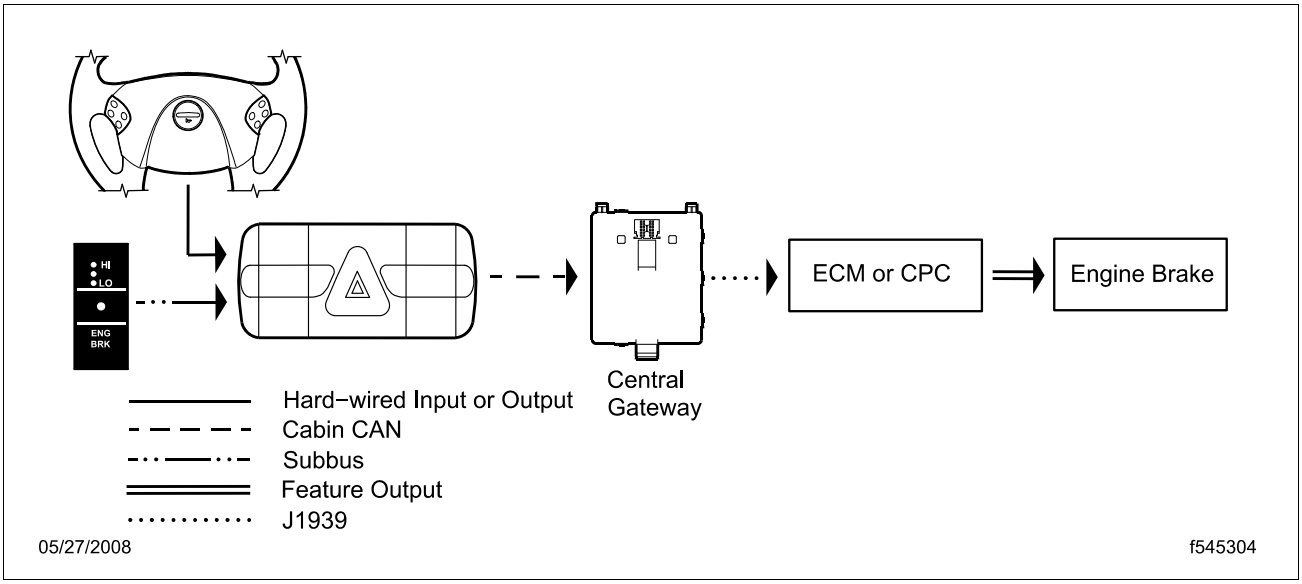


Figure 8-2: Function Path of the Engine Brake

Engine Brake Operation

The engine brake is enabled by pressing the engine brake (ENG BRK) switch on the steering wheel. See **Figure 8-3**. When the ENG BRK switch is enabled, the indicator on the engine brake level selection switch and the engine brake indicator on the ICU (instrumentation control unit) illuminate. See **Figure 8-4** and **Figure 8-5**.

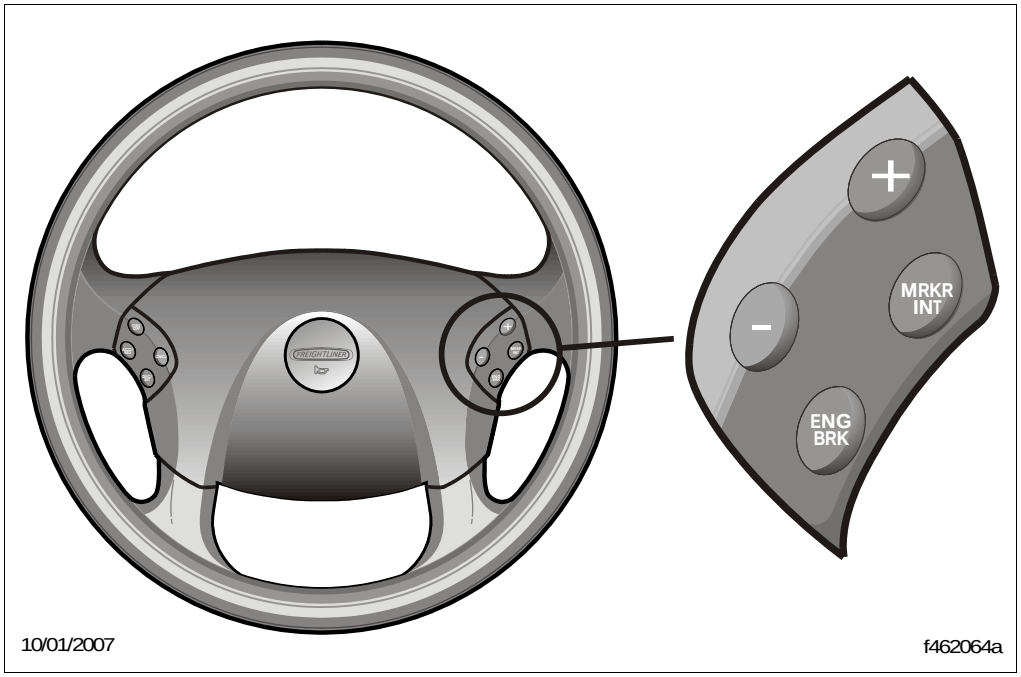


Figure 8-3: Engine Brake Switch

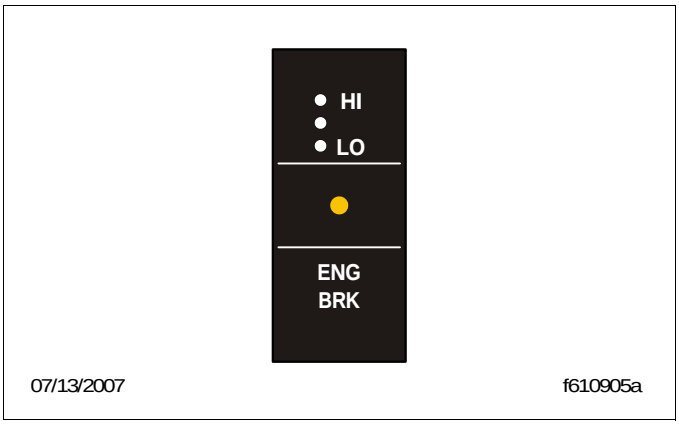


Figure 8-4: Engine Brake Level Selection Switch

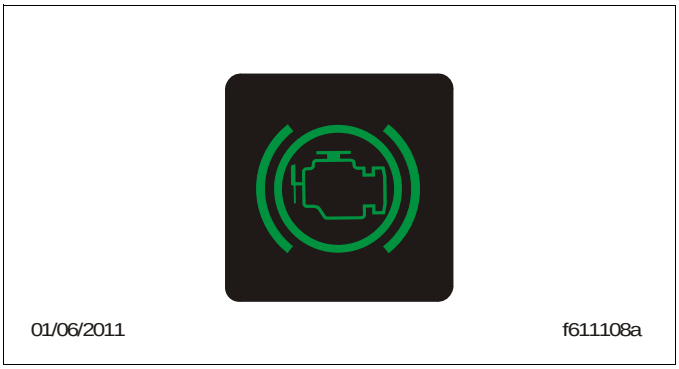


Figure 8-5: Engine Brake Indicator

The level selection switch is a multiplexed switch that controls the amount of engine braking applied to the vehicle. The level selection switch has three positions that provide approximately the following amounts of engine braking:

- LO: 33 percent
- Medium: 66 percent
- HI: 100 percent

When the ENG BRK switch is enabled, the amount of engine braking applied to the vehicle is determined by the position that the level selection switch is set at—LO, medium, or HI.

After the ENG BRK switch is enabled, the level of engine braking can be changed by pressing the level selection switch. When the ENG BRK switch is off, the amount of engine braking is zero.

The engine control module (ECM) must be programmed to respond to the engine brake request from the modular switch field (MSF).

Pressing the ENG BRK switch a second time turns off the engine brake. The indicator on the level selection switch and in the ICU turn off when the ENG BRK switch is disabled.

Parameters

A parameter is a specific value that is assigned to a feature or function of the vehicle and allows the customer to choose how that particular feature or function will work on the vehicle. Parameters are programmed to the SAM Cab, SAM Chassis, or modular switch field (MSF).

The selection of parameters is determined by the data codes chosen by the customer, dealer, or engineer in Customer Application Engineering. Each parameter is assigned a part number, which becomes part of the bill of material.

There are two parameters for the engine brake. One parameter is used when an engine brake is not present. The other parameter is used to activate the stop lights when the engine brake is applied. Activation of the stop lights occurs only when the engine brake level selection switch is in the HI position, and the engine is applying at

least 70 percent of its braking power. See **Table 8-3** for the parameter specifications for the engine brake.

NOTE: A data code represents a specific option available to the customer when a vehicle is ordered. Data codes are also known as sales codes. A data code consists of a three-digit numeric or alphanumeric figure followed by a hyphen and another three-digit numeric or alphanumeric figure.

Feature and Parameter Specifications for the Engine Brake				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	000 447 09 61	**000 447 45 61**		
Retarder not present	X	—	129	SAM Chassis
Retarder with stop light activation	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 8-3: Feature and Parameter Specifications for the Engine Brake

Jacobs Engine Brake

The Jacobs engine brake will operate only when the following conditions are met:

- Throttle position is less than 4 percent
- Driveline disengaged–engine speed is greater than 1100 rpm
- Driveline engaged–engine speed is greater than 800 rpm
- Road speed is greater than 0 mph (programmable)
- ABS is not active
- Clutch pedal is released (if equipped)
- Engine is not in PTO mode
- Torque converter is in lockup (automatic transmission)

Cummins Intebrake

The Cummins Intebrake will operate only when the following conditions are met:

- Throttle position is at 0 percent
- Clutch pedal is released (if equipped)
- Engine brake switch is enabled
- Service brake has been depressed (if engine brake service brake activation is the chosen option)
- Engine is not in PTO mode
- Vehicle speed is greater than engine brake minimum vehicle speed
- Torque converter is in lockup (automatic transmission)
- No active vehicle speed sensor faults
- Cruise control is not in autoresume

- Engine speed is greater than engine brake minimum rpm
- Boost pressure is less than the value set by Cummins

Engine Brake Options

Engine brake programming options are available on the Detroit Diesel and Cummins engine controllers. These options—such as engine brake on cruise control overspeed, engine fan with retarder, and engine brake minimum vehicle speed—control the behavior of the engine brake. Contact the engine manufacturer or representative for information on these, and other, options.

Fuel Level Sender

The fuel level sender is hard-wired directly to the instrumentation control unit. In the future, the fuel level sender will be part of the multiplexing system. Until the fuel level sender is part of the multiplexing system, a parameter part number is required to disable diagnostics and functionality for the unavailable multiplexed feature.

Feature and Parameter Specifications for the Fuel Level Sender				
Parameter Description	**Parameter Part Number**	**Module Number**	**Module**	**Type of Feature**
Hard-wired fuel level sender	000 447 18 61	847	SAM Chassis	Standard

Table 8-4: Feature and Parameter Specifications for the Fuel Level Sender

Fuel Water Separator Sensing

The fuel water separator separates water from the fuel within the fuel water separator. The fuel water separator may be equipped with a sensor to detect water in the fuel. When water is detected in the fuel, the water-in-fuel indicator on the instrumentation control unit (ICU) illuminates, indicating that the water must be drained from the fuel water separator. See **Figure 8-6**.

See **Figure 8-7** for the function path of the fuel water separator sensor.

Figure 8-6: Water-in-Fuel Indicator

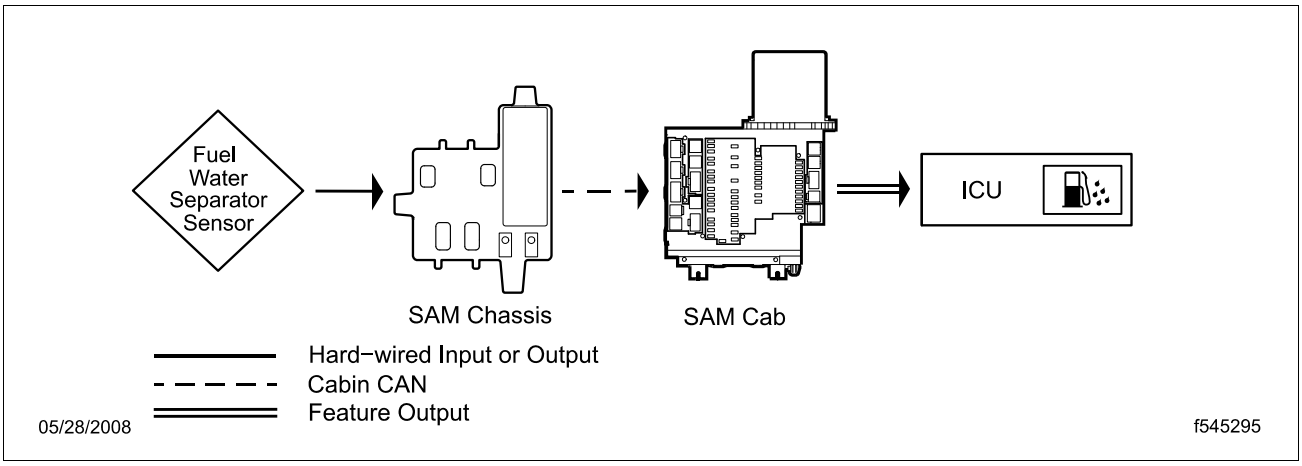


Figure 8-7: Function Path of the Fuel Water Separator Sensor

Feature and Parameter Specifications for the Fuel Water Separator Sensing				
Parameter Description	**Parameter Part Number**		**Module Number**	**Module**
	000 447 03 61	**000 447 37 61**		
Sensor not present	X	—	127	SAM Chassis
Sensor present	—	X		
Type of Feature S: Standard O: Optional	S	O	—	—

Table 8-5: Feature and Parameter Specifications for the Fuel Water Separator Sensing

Low Air Pressure Warning System

The low air pressure warning system consists, in part, of two pneumatically actuated, normally open electrical switches wired in series, and is enabled when the ignition switch is in the ON position.

The low air pressure warning indicator and the buzzer are activated by the SAM Cab anytime the ignition switch is on the ON position and the air pressure falls to 70 ±5 psi (483 ±34 kPa). The SAM Cab also transmits the low air pressure status on the cabin CAN.

See **Figure 8-8** for an illustration of the low air pressure indicator located on the ICU.

See **Figure 8-9** for the function path of low air pressure system.

See **Figure 8-10** for a schematic of the air supply circuit.

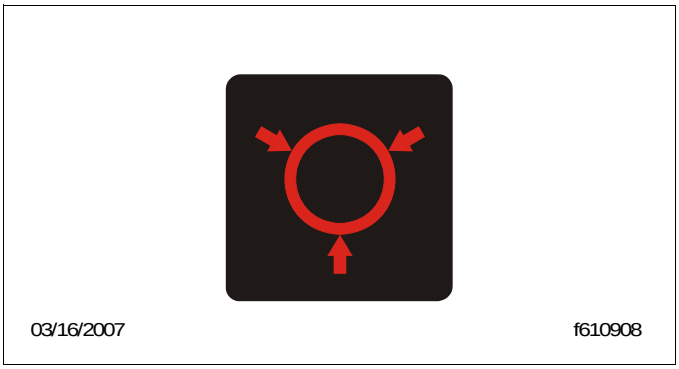


Figure 8-8: Low Air Pressure Indicator

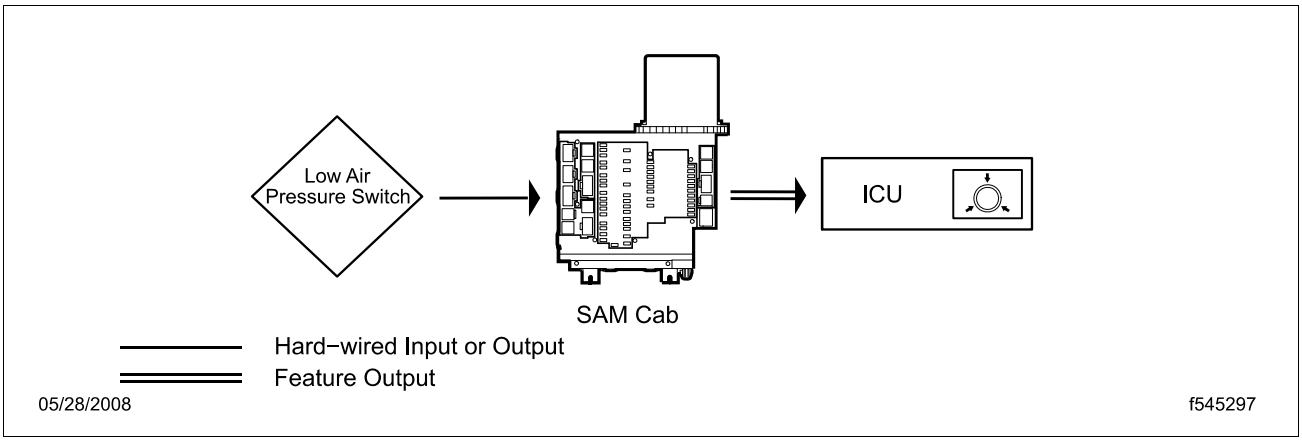


Figure 8-9: Function Path of the Low Air Pressure System

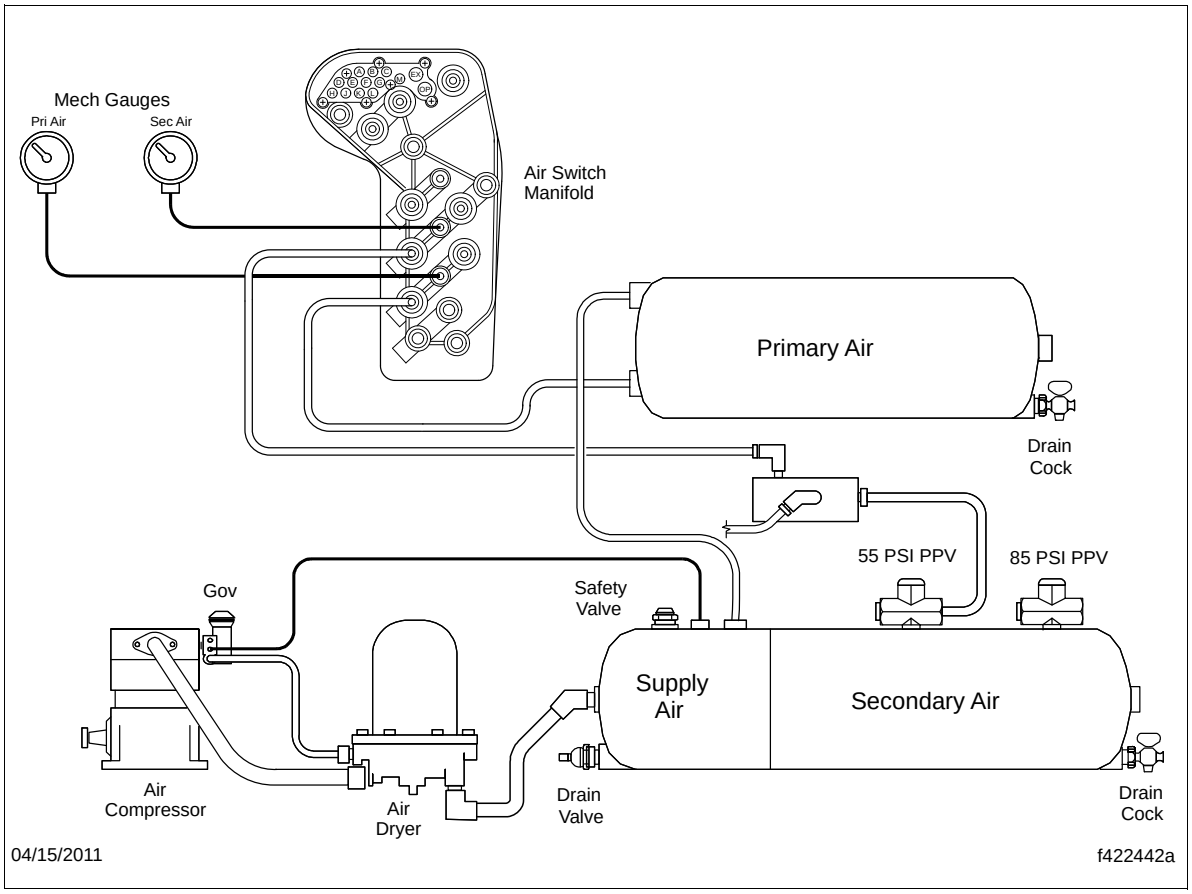


Figure 8-10: Air Supply Circuit

Feature and Parameter Specifications for the Low Air Pressure Warning System				
Parameter Description	**Parameter Part Number**			**Module Number**
	002 447 11 58	**000 447 15 61[1]**	**000 447 16 61**	
Air pressure switch present	X	—	—	877
Stop lights activate with low air pressure	—	X	—	
Stop lights do not activate with low air pressure	—	—	X	
Type of Feature S: Standard O: Optional NA: Not available	S	NA	S	—
Module SC: SAM Cab SCH: SAM Chassis	SC	SCH	SCH	—

Table 8-6: Feature and Parameter Specifications for the Low Air Pressure Warning System

1. This parameter is not available for vehicles in the NAFTA region; it will only be available for vehicles outside NAFTA if it complies with the rules and regulations of the non-NAFTA region.

Neutral Switch

The neutral switch transmits to the vehicle, via the SAM Chassis, that the transmission is either in neutral or not in neutral. The neutral switch—if present on a manual transmission—is hard-wired to the SAM Chassis. The neutral switch on an automatic or automated transmission is connected to the transmission; the transmission broadcasts to the J1939 datalink.

Feature and Parameter Specifications for the Neutral Switch							
Parameter Description	**Parameter Part Number**					**Module Number**	**Module**
	000 447 11 61	**000 447 12 61**	**000 447 12 61**	**000 447 11 61**	**000 447 11 61**		
Neutral switch not present; manual transmission with bottom-of-clutch switch	X	—	—	—	—	34B	SAM Chassis
Manual transmission with neutral switch present	—	X	—	—	—		
Manual transmission with neutral switch present and bottom-of-clutch switch	—	—	X	—	—		
Neutral switch not present; automatic transmission with J1939 ETC7	—	—	—	X	—		
Neutral switch not present; automatic transmission with transmission ECU interlock	—	—	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	O	O	—	—

Table 8-7: Feature and Parameter Specifications for the Neutral Switch

Trailer Receptacles

Primary Receptacle

The primary receptacle is a 7-pin connector that is located on the back of cab, on the chassis near the back of cab, or at the end of the frame rails. The connector serves as an interface between the tractor and the trailer and is used to supply the trailer with:

- marker lights
- stop lights
- taillights
- left- and right-turn signal lights
- ignition power or battery power (center pin)
- a ground

The center pin (pin 7) of the primary receptacle is ignition powered or battery powered. When the center pin is ignition powered, the ignition switch must be in the ON position for power to be provided to the primary receptacle.

When replacing the relay on the SAM Chassis for the primary receptacle center pin, determine if the center pin is ignition powered or battery powered. If the center pin is

ignition powered, a four-prong, normally open relay for R8 must be used. If the center pin is battery powered, a four-prong, normally closed relay for R8 must be used.

The multiplexed trailer auxiliary (TRLR AUX) switch, which is located on the dash panel, is an optional feature that disconnects the ignition power to the center pin on the primary receptacle. See **Figure 8-11**. When the ignition switch is in the ON position and the trailer auxiliary is in the on position, the indicator on the trailer auxiliary switch will be on.

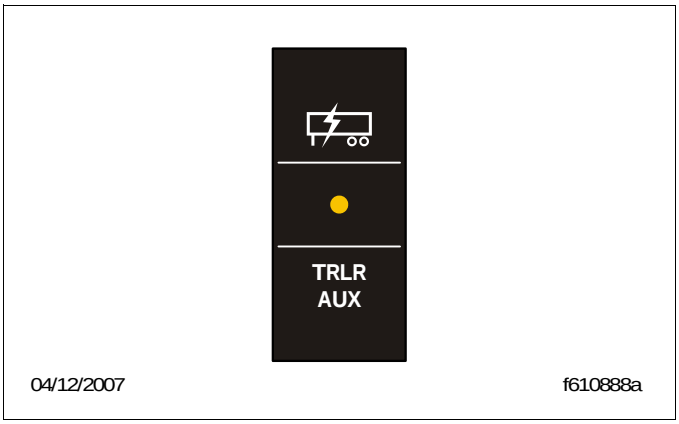


Figure 8-11: Trailer Auxiliary Switch

When the trailer auxiliary switch is specified, the trailer power source comes from the ignition. The trailer auxiliary switch is not available when the center pin on the primary receptacle is battery powered. The trailer auxiliary switch is read by the MSF and a datalink message is transmitted to the SAM Chassis.

The SAM Chassis supplies the outputs for the trailer functions.

Trailer receptacles may be wired to meet the needs of the user; however, a typical primary trailer receptacle is wired as shown in **Table 8-8**.

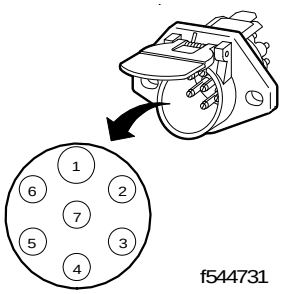
Wiring for a Typical Primary Trailer Receptacle		
		
Pin Number	**Signal Name**	**Circuit Color**
1	Ground	White
2	Clearance, marker, and identification lights	Black
3	Trailer left-turn light	Yellow
4	Trailer stop light	Red
5	Trailer right-turn light	Green
6	Trailer taillight	Brown
7	Auxiliary and ABS	Blue

Table 8-8: Wiring for a Typical Primary Trailer Receptacle

Supplemental Receptacle

The supplemental, or ABS, receptacle is a 7-pin connector that serves as an interface between the tractor and the trailer and is located with the primary receptacle.

When the supplemental receptacle is present, the center pin (pin 7) on the receptacle provides a 30-amp ignition switched supply and ground to the trailer ABS system—a provision of the primary receptacle when the vehicle is equipped with only the primary receptacle.

The receptacle has an outlet that drives a trailer ABS indicator in the instrumentation control unit. The remaining pins in the supplemental receptacle are available for the vehicle's optional features.

Feature and Parameter Specifications for the Primary Receptacle											
Parameter Description	**Parameter Part Number**									**Module Number**	**Module**
	000 447 23 61	**000 447 24 61**	**000 447 25 61**	**000 447 26 61**	**000 447 27 61**	**000 447 28 61**	**000 447 29 61**	**000 447 30 61**	**000 447 31 61**		
Mounted left side back of cab	X	X	X	—	—	—	—	—	—	296	SAM Chassis
Mounted on chassis aft of cab or end of frame	—	—	—	X	X	X	—	—	—		
Mounted left side back of cab and end of frame	—	—	—	—	—	—	X	X	X		
Trailer auxiliary switch present	X	—	—	X	—	—	X	—	—		
Ignition-powered center pin	—	X	—	—	X	—	—	X	—		
Battery-powered center pin	—	—	X	—	—	X	—	—	X		
Type of Feature S: Standard O: Optional	O	S	O	O	O	O	O	O	O	—	—

Table 8-9: Feature and Parameter Specifications for the Primary Receptacle

Feature and Parameter Specifications for End of Frame Supplemental Receptacle												
Parameter Description	**Parameter Part Number**										**Module Number**	**Module**
	000 447 86 61	**000 447 87 61**	**000 447 88 61**	**000 447 89 61**	**000 447 90 61**	**000 447 91 61**	**000 447 92 61**	**000 447 93 61**	**000 447 94 61**	**000 447 95 61**		
Not present	X	—	—	—	—	—	—	—	—	—	308	SAM Chassis
ACC_1 with switch	—	X	—	—	—	—	—	—	—	—		
ACC_2 with switch	—	—	X	—	—	—	—	—	—	—		
IGN_1 with switch	—	—	—	X	—	—	—	—	—	—		
IGN_2 with switch	—	—	—	—	X	—	—	—	—	—		
Backup	—	—	—	—	—	X	—	—	—	—		
ACC_1 only	—	—	—	—	—	—	X	—	—	—		
ACC_2 only	—	—	—	—	—	—	—	X	—	—		
IGN_1 only	—	—	—	—	—	—	—	—	X	—		
IGN_2 only	—	—	—	—	—	—	—	—	—	X		
Type of Feature S: Standard O: Optional	S	O	O	O	O	O	O	O	O	O	—	—

Table 8-10: Feature and Parameter Specifications for End of Frame Supplemental Receptacle

Feature and Parameter Specifications for Trailer Fault Reporting										
Parameter Description	**Parameter Part Number**								**Module Number**	**Module**
	000 447 54 61	**000 447 55 61**	**000 447 56 61**	**000 447 57 61**	**000 447 58 61**	**000 447 59 61**	**000 447 60 61**	**000 447 85 61**		
Back of cab no fault reporting	X	—	—	X	X	—	—	—	296	SAM Chassis
Back of cab short to battery	—	—	X	—	—	—	—	X		
Back of cab short to ground	—	X	—	—	—	X	X	X		
End of frame short to battery	X	X	X	—	X	—	X	X		
End of frame short to ground	—	—	—	X	—	X	X	X		
Type of Feature S: Standard O: Optional	S	O	O	O	O	O	O	O	—	—

Table 8-11: Feature and Parameter Specifications for Trailer Fault Reporting

Section 9:

- **Powernet Management**

Powernet Management

The powernet management feature protects the batteries from discharging too much by temporarily turning off the outputs to conserve power. This ensures that in the event of a drop in voltage, the battery draining process is slowed.

Progressive low-voltage disconnect (PLVD) is used to implement the powernet management feature. When the battery voltage drops below a parameterized value, loads designated as comfort loads are turned off first. Then loads designated as house loads are turned off. If necessary, basic loads are turned off last.

The progressive shutoff of loads from comfort loads, to house loads, to basic loads allows the driver to continue using critical loads while noncritical loads are temporarily unavailable. A time delay is also implemented for the shutoff and reactivation of loads to avoid unnecessary cycling of loads when battery voltage is close to the shutoff thresholds.

The multiplexing system with software R6.0 allows the voltage levels for PLVD to be configured as needed using parameters; however, the changes must be approved and released by Freightliner engineering.

Calculations for disconnecting loads are based on battery voltage, ignition switch status, and engine rpm and are performed by the SAM Cab. The battery voltage sense comes from the starter, via the powertrain PDM. The fuse for the PLVD voltage sense is located in the powertrain PDM.

One minute before the comfort loads and house loads are turned off, an alarm sounds for 10 seconds. No alarm sounds before the basic loads are turned off.

If the interior lights have been turned off by PLVD, pressing one of the interior light switches (if equipped) brings the interior lights back on. If an interior light is overridden by pressing the switch to turn it back on, the light turns off if another, lower PLVD threshold is crossed. If an interior light is overridden when the PLVD feature has disconnected the basic loads, the light is not automatically turned off.

Bistable Relays

All relays that—in the past—were normally closed (NC) are now bistable relays. Bistable relays are magnetically latched relays that do not require steady-state current to hold the relay open. Current is only required for 100 milliseconds (ms) when the relay state is changed. If a relay state change is not possible due to an electrical or mechanical failure, the SAM Cab will try five times at 100-ms intervals to change the state of the relay. If all five tries fail, the SAM will stop trying and set a fault code.

When the ignition switch is turned to the on/run position, the state of all relays is checked against the value as determined by the powernet management feature. If a mismatch is detected, the state of the relay is corrected. If a fault code existed for a bistable relay and the SAM was able to set the relay to the correct state, the fault code will be cleared. When replacing a bistable relay, it is important to cycle the ignition switch from off to on/run after the bistable relay has been replaced in order to correctly set the state of the newly installed relay.

Designated Comfort, House, and Basic Loads

See **Table 9-1** for the type of loads turned off under specific conditions and standard values.

See **Table 9-2** for the loads that are designated as comfort.

See **Table 9-3** for the loads that are designated as house.

See **Table 9-4** for the loads that are designated as basic.

NOTE: Letter prefixes used for the switching devices listed in **Table 9-2**, **Table 9-3**, and **Table 9-4** represent the following components:

- **T** transistors
- **IC** integrated circuits
- **RE** relay SAM Chassis
- **R** relay SAM Cab
- **BR** bistable relay SAM Cab

The NC and NO abbreviations used in these tables represent “normally closed” and “normally open” respectively.

See **Figure 9-1** for the function path of powernet management.

Type of Loads Turned Off Under Specific Conditions and Standard Values				
Engine State and Voltage Value[1]	**Ignition Position**			
	Off	**Accessory**	**On (ignition)**	**Start (crank)**
Engine On and Voltage Less Than 12.5 Volts	Not applicable	Not applicable	Comfort loads	Not applicable
Engine Off and Voltage Less Than 12.3 Volts	Comfort and house loads	Comfort loads	Comfort loads	Not applicable
Engine Off and Voltage Less Than 12.05 Volts	Comfort, house, and basic loads	Comfort and house loads	Comfort and house loads	Not applicable

Table 9-1: Type of Loads Turned Off Under Specific Conditions and Standard Values

1. The voltage values are standard, or default, values since the values may be changed by parameters.

Designated Comfort Loads			
Connector ID	**Cavity No.**	**Function**	**Switching Device**
X1	12	Heated seats, IGN_X	R3
	13	Auxiliary circulation fan, sleeper, BAT	BR25
X3	3	12 V power receptacle 4 (sleeper, cigar), BAT	BR25
	9	Amplifier power, ACC_X	R9
X12	3	Footwell lamp, zone 2, PWM	IC6560_2
	6	Reading lamp 1, zone 9, PWM	IC6550_2
	9	Sleeper dome lamp, zone 4B, PWM	T6520
	12	Rear baggage compartment lights	IC6570_2
	13	Sleeper footwell lamp, zone 10, PWM	IC6540_2
	16	Reading lamp 2, zone 5, PWM	IC6580_1
X14	1	12 V power receptacle 5, BAT	BR25
X16	13	Reading lamp 4 (switched locally), BAT	BR25

Table 9-2: Designated Comfort Loads

Designated House Loads			
Connector ID	**Cavity No.**	**Function**	**Switching Device**
X1	10	Cab HVAC controller, ACC_X	IC2510_1
	15	Sleeper HVAC controller, ACC_X	IC2500_1
X2	15	Area lighting (lower bunk and sleeper work surface), BAT	BR24
X3	4	Advertising light, ACC_X	T6500
	7	Utility light	T2540/T2541
	15	12 V power receptacle 3 (sleeper, cigar), BAT	BR22
X5	1	Power feed spare output 2, BAT	BR22
	2	Power feed spare output 4, BAT	BR22
X8	8	Mirror heating, driver	R10
X10	18	Radio, ACC_X	IC6560_1
X12	7	Mid-dome lamp, zone 4A, PWM	IC6550_1
	17	Sleeper dome lamp, zone 4C, PWM	IC6580_2
X14	2	12 V power receptacle 6, BAT	BR24
X16	5	Auxiliary circulation fan, windshield, ACC_X	T2560
	7	Dome light cab, BAT	BR24
	10	Auxiliary mirror heating (mirror on hood)	R10
	11	Dome lamp, forward overhead, zone 1, PWM	T2530
	14	Dome lamp, forward overhead, zone 1,PWM	T2530
	17	Baggage compartment light switch supply, BAT	BR24
X17	2	Mirror heating, passenger	R10
X57	4	Air dryer, ACC_X	T302/T303
	15	Fuel water separator heater element, IGN_X	RE1

Table 9-3: Designated House Loads

Designated Basic Loads			
Connector ID	**Cavity No.**	**Function**	**Switching Device**
X2	1	Auxiliary cab heater, enable	T2570/BR23
X4	1	Power feed spare output 1, BAT	BR21
	2	Power feed spare output 3, BAT	BR21
X6[1]	2	Fleet management system, BAT	BR23
	3	CB radio, BAT	BR23

Table 9-4: Designated Basic Loads

1. The PLVD functionality of pins 2 and 3 is affected by the installation of fuse F14. For more information, see *Fleet Management and CB Radio* in **Section 7**.

Feature and Parameter Specifications for Progressive Low-Voltage Disconnect							
Parameter Description	**Parameter Part Number**						**Module Number**
	000 447 20 61	**000 447 21 61**	**002 447 53 58**	**002 447 54 58**	**003 447 89 58**	**004 447 38 58**	
Progressive low-voltage disconnect not present	X	—	X	—	—	—	306
Progressive low-voltage disconnect present	—	X	—	X	—	—	
Progressive low-voltage disconnect at 12.3 V	—	—	—	—	X	—	
Progressive low-voltage disconnect at 12.1 V	—	—	—	—	—	X	
Type of Feature S: Standard O: Optional	O	S	O	S	S	O	—
Module SC: SAM Cab SCH: SAM Chassis	SCH	SCH	SC	SC	SC	SC	—

Table 9-5: Feature and Parameter Specifications for Progressive Low-Voltage Disconnect

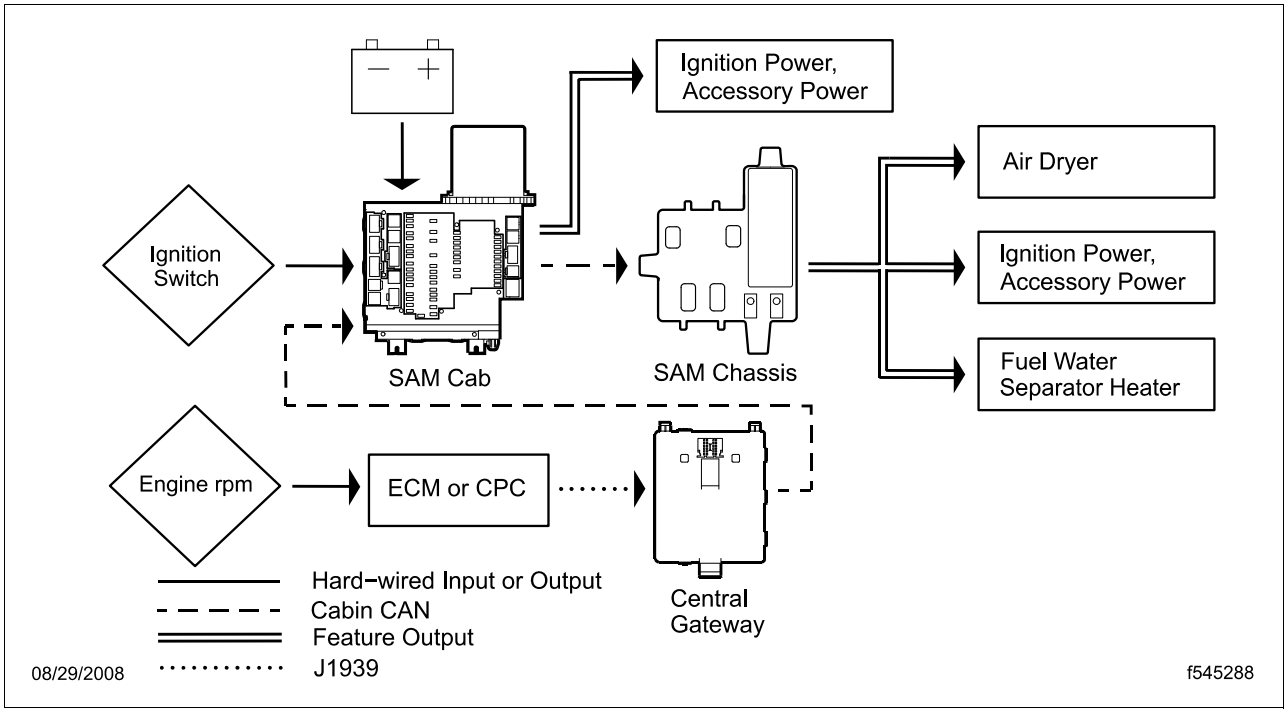


Figure 9-1: Function Path of Powernet Management, Air Dryer, and Fuel Water Separator Heater

Section 10:

- **Emergency Power Supply**

Emergency Power Supply

The emergency power supply feature provides basic functionality to the SAM during failure modes.

- **Power Failure**–loss of main power supply to SAM Cab or SAM Chassis
- **SAM Microprocessor Failure**–nonfunction of the main microprocessor due to microprocessor component failure, memory damage, or crystal damage
- **CAN Communication Failure**–cabin CAN communication failure between the SAM Cab and SAM Chassis due to a damaged cable, loose connections, application failure, or damage to a transceiver

The emergency power supply feature ensures that in the event of a SAM failure, the vehicle can be driven off the road and kept conspicuous until help arrives. The driver has control of this feature in that, when the ignition switch is in the ON position, the emergency power outputs remain on in their predefined states as listed in **Table 10-1**, **Table 10-2**, **Table 10-3**, and **Table 10-4**. When the ignition switch is turned off, the outputs are shut off as listed in **Table 10-5**.

When the SAM Cab fails, all gauges in the instrumentation control unit (ICU) drop to zero because power to the ICU is lost. Do not shut off the engine until the vehicle is safely off the highway; the engine cannot be restarted when the SAM Cab fails.

When the SAM Chassis fails, the turn signal indicators flash alternately. The engine can be restarted when the SAM Chassis fails.

Load Disconnect Switch

The load disconnect switch (LDS) is an optional feature that is used to break (or open) the connection between the battery and the powernet distribution box (PNDB), and the connection between the battery and the auxiliary powernet distribution box (if equipped). The load disconnect switch has one or two LEDs, depending on the number of PNDB with cutoff devices it switches. The LEDs are marked MAIN or AUXILIARY (if equipped). Rotating the LDS knob from OFF to ON causes the contacts to close and turns on the LED light, confirming that the contacts have closed. Rotating the LDS knob from ON to OFF causes the contacts to open and turns off the LED light, confirming that the contacts have opened.

Rotate the load disconnect knob to OFF when the vehicle will be parked for more than three days to avoid excessive draw on the battery. It is important that the ignition switch be in the off position before turning the load disconnect knob.

NOTE: When the load disconnect switch is opened, the clock and radio settings are lost.

The load disconnect switch is mounted in one of three locations:
- on the floor of the cab to the left of the driver's seat (**Figure 10-1**)
- near the battery box
- at the back of the cab

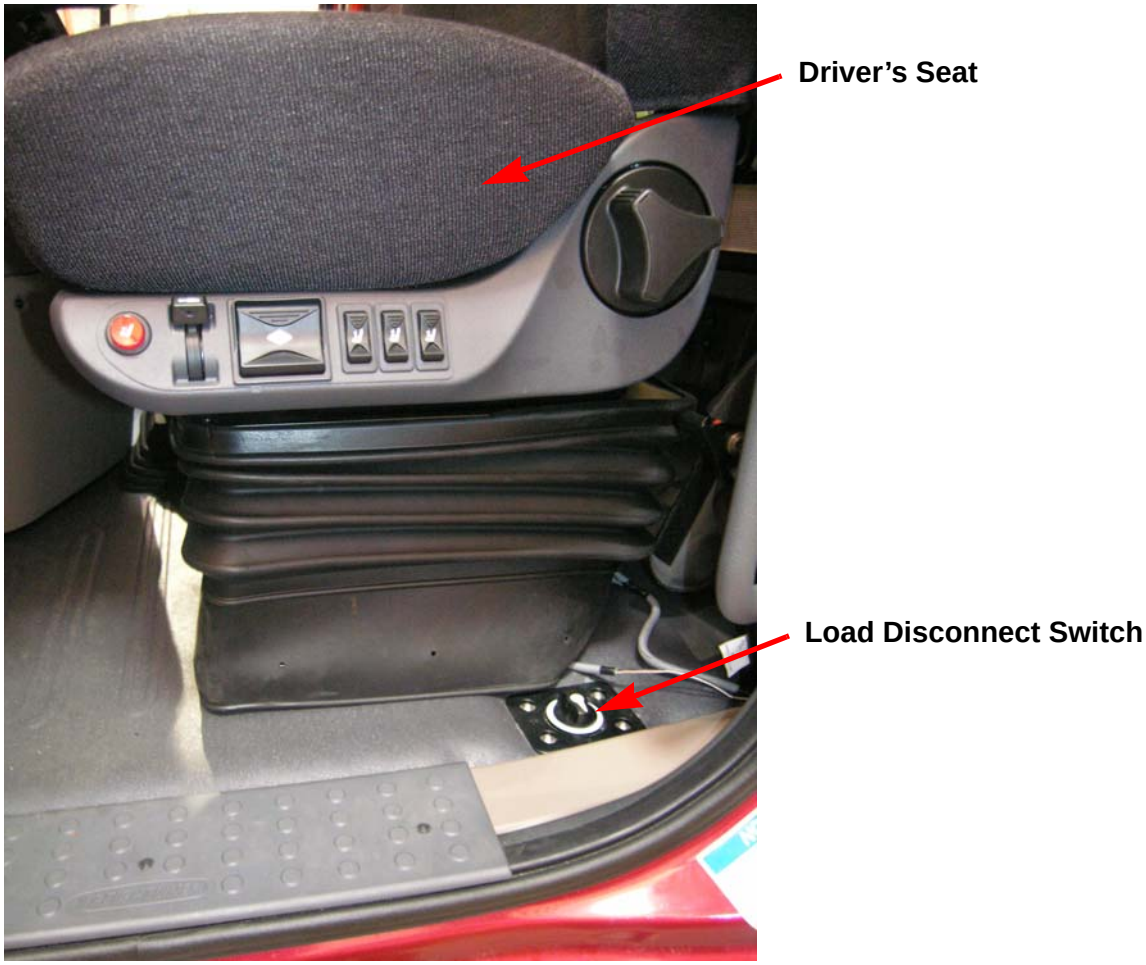


Figure 10-1: Location of the Load Disconnect Switch Inside the Cab

Output Responses to a SAM Failure

The SAM Cab and SAM Chassis have specific output responses to each type of failure mode.

See **Table 10-1** for the SAM Cab and SAM Chassis output responses when the:

- ignition switch is in the ON position, and the SAM Cab has lost main power supply **or**
- ignition switch is in the ON position, and the SAM Cab is not working due to a microprocessor failure

SAM Output Responses to a SAM Cab Failure		
Module	**Output**	**Response**
SAM Cab	Dash panel lights, 12 V	Flashing
	Low-beam headlights	On
	Clearance lights	Flashing
	Identification lights	Off
	Side marker lights	Flashing
	Engine ECU (powertrain PDM), ignition	On
	Starter relay	Cannot start vehicle
	Turn signal indicators, ICU	Off
SAM Chassis	Trailer taillights	Flashing
	Rear stop lights	Flashing

Table 10-1: SAM Output Responses to a SAM Cab Failure

See **Table 10-2** for the SAM Cab and SAM Chassis output responses when the:
- ignition switch is in the ON position, and the SAM Chassis has lost main power supply **or**
- ignition switch is in the ON position, and the SAM Chassis is not working due to a microprocessor failure

SAM Output Responses to a SAM Chassis Failure		
Module	**Output**	**Response**
SAM Cab	Dash panel lights, 12 V	Flashing
	Low-beam headlights	On
	Clearance lights	Flashing
	Identification lights	Flashing
	Side marker lights	Flashing
	Engine ECU (powertrain PDM), ignition	On
	Starter relay	Can start vehicle
	Turn signal indicators, ICU	Flashing alternately
SAM Chassis	Trailer taillights	Flashing
	Rear stop lights	Flashing

Table 10-2: SAM Output Responses to a SAM Chassis Failure

See **Table 10-3** for the SAM Cab and SAM Chassis output responses when the ignition switch is in the ON position, and the SAM Cab and SAM Chassis are unable to communicate with each other.

Cabin CAN Datalink Failure		
Module	**Output**	**Response**
SAM Cab	Dash panel lights, 12 V	Flashing
	Low-beam headlights	On
	Clearance lights	Flashing
	Identification lights	Flashing
	Side marker lights	Flashing
	Engine ECU (powertrain PDM), ignition	On
	Starter relay	Can start vehicle
	Turn signal indicators, ICU	Flashing alternately
SAM Chassis	Trailer taillights	Flashing
	Rear stop lights	Flashing

Table 10-3: Cabin CAN Datalink Failure

See **Table 10-4** for the SAM Cab and SAM Chassis output responses when the:
- SAMs are functioning normally
- ignition switch is in the ON position **and**
- load disconnect switch is open (off position)

SAM Output Responses When the Load Disconnect Switch is Open		
Module	**Output**	**Response**
SAM Cab	Dash panel lights, 12 V	Flashing
	Low-beam headlights	On
	Clearance lights	Flashing
	Identification lights	Off
	Side marker lights	Flashing
	Engine ECU (powertrain PDM), ignition	On
	Starter relay	Cannot start vehicle
	Turn signal indicators, ICU	Off
SAM Chassis	Trailer taillights	Off
	Rear stop lights	Off

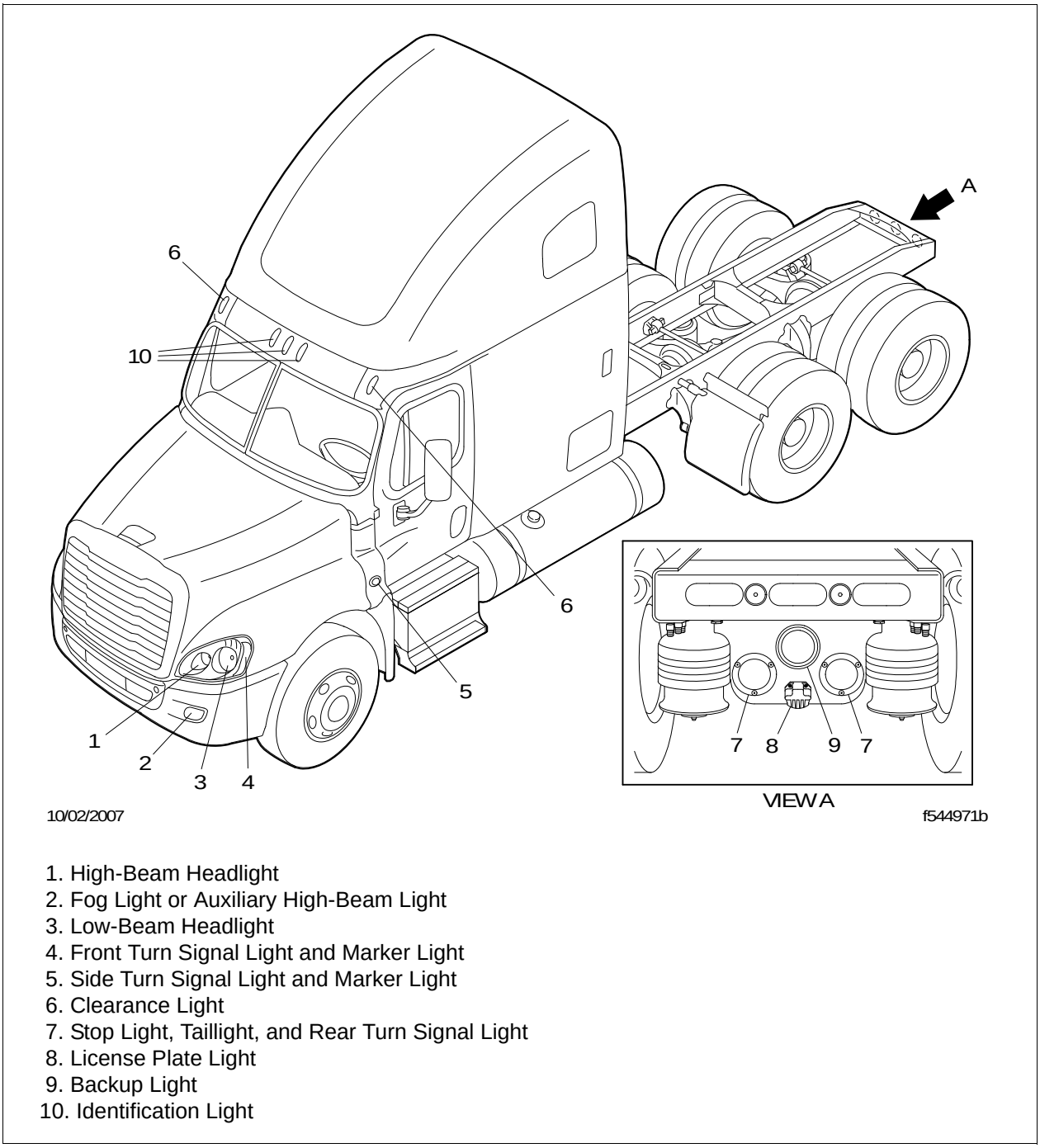
Table 10-4: SAM Output Responses When the Load Disconnect Switch is Open

See **Table 10-5** for the SAM Cab and SAM Chassis output responses when the ignition switch is in the off position. Regardless of the previous failure mode, the emergency power supply feature is deactivated when the ignition switch is in the off position.

SAM Output Responses When the Ignition Switch is in the Off Position		
Module	**Output**	**Response**
SAM Cab	Dash panel lights, 12 V	Off
	Low-beam headlights	
	Clearance lights	
	Identification lights	
	Side marker lights	
	Engine ECU (powertrain PDM), ignition	
	Starter relay	
	Turn signal indicators, ICU	
SAM Chassis	Rear turn signal lights	Off
	Trailer taillights	
	Rear stop lights	

Table 10-5: SAM Output Responses When the Ignition Switch is in the Off Position

See **Figure 10-2** for the location of the exterior lights.



1. High-Beam Headlight
2. Fog Light or Auxiliary High-Beam Light
3. Low-Beam Headlight
4. Front Turn Signal Light and Marker Light
5. Side Turn Signal Light and Marker Light
6. Clearance Light
7. Stop Light, Taillight, and Rear Turn Signal Light
8. License Plate Light
9. Backup Light
10. Identification Light

Figure 10-2: Exterior Lights

Section 11:

- Collision Warning Systems and Adaptive Cruise Control
- Fuel Water Separator Heater
- Ignition Power and Accessory Power
- Mirror Adjust
- Park Brake Switch
- Power Windows
- Shore Power
- Windshield Wiper and Washer

Collision Warning Systems and Adaptive Cruise Control

WABCO Adaptive Cruise Control and Collision Mitigation System

The WABCO Adaptive Cruise Control (ACC) uses a vehicle on-board radar device to warn the driver of a potentially dangerous situation by means of audio and visual warnings. The ACC attempts to slow the vehicle by defueling the engine, applying the engine brake, and/or applying the tractor and trailer service brakes. The WABCO Adaptive Cruise Control is available without the Collision Mitigation System, but the CMS is not available without the ACC.

The Collision Mitigation System (CMS) uses the vehicle service brakes to slow the vehicle when a potential frontal impact situation is detected. The CMS may not be turned off or overridden by the driver.

The WABCO ACC consists of two major components:
- forward looking radar (FLR) device
- dash display unit (DDU)

The FLR is mounted on the front of the vehicle; it identifies and tracks the nearest detected object in the vehicle's lane of travel. The DDU is mounted in the dash panel; it provides audio and visual warnings and messages. The DDU also acts as a user interface to the ACC by allowing the driver to select menus. The menus include volume control, headway range adjustment, system status, manual alignment, and diagnostics, among others. Both the FLR and DDU communicate on the J1939 datalink.

The ACC attempts to maintain the vehicle's headway (the time to the nearest detected object in the vehicle's lane of travel) by interacting with the engine and brakes when the conventional cruise control is activated. When the collision warning system identifies a 3-second, 2-second, 1-second, or 0.5-second headway, a visual and/or audio warning is emitted from the DDU. If the headway is less than the set headway range value, the ACC defuels the engine. If the headway is less than 50 percent of the set headway range value, the ACC also applies the engine brake and/or the service brake.

The driver may take evasive action by applying the service brake, which will disable the cruise control and also the ACC. If the ACC determines that the driver brake demand is insufficient during a single event, the ACC continues in its attempt to slow the vehicle. The driver may choose to press the accelerator pedal to override the ACC and fuel the engine.

When the cruise control is activated, the adaptive cruise control system automatically activates if the vehicle is equipped with ACC. When the vehicle is equipped with the cruise control disengage feature, and this feature disengages the cruise control, the adaptive cruise control is also deactivated.

The SAM Cab provides switched battery (or ignition power) and ground to the adaptive cruise control module.

11 Features Without Parameters

Autoresume Feature

The autoresume feature on a vehicle with manual transmission allows automatic resumption of the cruise control after a shift in the gear is made with a single clutch or double clutch. When the cruise control is set and a shift in gear is made, the cruise control feature is temporarily suspended when the clutch is disengaged. The temporary suspension of the cruise control causes the Adaptive Cruise Control to become inactive.

The autoresume feature, which is configured on the engine control module, is dependent on the cruise control switch remaining in the on position and the cruise control not being disrupted by any means while the shift in gear is being made.

When a shift in gear is completed, the autoresume feature allows the cruise control to activate. The Adaptive Cruise Control can then activate if there is a target in the range of the forward looking radar.

Takata SafeTraK and Drowsy Driver

The Takata SafeTraK system monitors the lane markings on the roadway and alerts the driver with an audible warning when the vehicle is about to stray outside its lane, provided that the vehicle is moving at least 37 mph (60 km/h) and the turn signal is not on.

The Takata SafeTraK system consists of a camera, an on-board computer, and software. The Takata system tracks the visible lane markings and provides the data to the computer. This data is then combined with other vehicle data. Using image recognition software and proprietary software, the system can detect when the vehicle begins to drift toward an unintended lane change. When this occurs, the system emits an audible warning.

The drowsy driver feature monitors the lane markings on the roadway and alerts the driver with a long, audible warning when erratic driving is detected.

Eaton VORAD VS-400 and SmartCruise

The Eaton VORAD VS-400 collision warning system (CWS) uses a vehicle on-board radar device to warn the driver of a potentially dangerous situation by means of audio and visual warnings. Eaton's SmartCruise® is an adaptive cruise control system that attempts to slow the vehicle by defueling the engine or by applying the engine brake. The Eaton VORAD VS-400 is available without SmartCruise, but SmartCruise is not available without the Eaton VORAD VS-400.

The Eaton VORAD VS-400 collision warning system and SmartCruise consist of two major components:

- forward looking radar (FLR) device
- driver interface unit (DIU)

The FLR is mounted on the front of the vehicle; it identifies and tracks the nearest detected object in the vehicle's lane of travel. The DIU is mounted in the dash panel; it provides audio and visual warnings and messages. The DIU also acts as a user interface to the CWS by allowing the driver to select menus. The menus include volume

control, headway range adjustment, system status, and diagnostics, among others. Both the FLR and DIU communicate on the J1939 datalink.

SmartCruise attempts to maintain the vehicle's headway (the time to the nearest detected object in the vehicle's lane of travel) by interacting with the engine when the conventional cruise control is activated. The headway range value can be set to between 3.25 and 2.25 seconds in 0.25-second increments when the vehicle is equipped with both the Eaton VORAD VS-400 CWS and SmartCruise, and the headway range adjustment is enabled on the DIU.

When the collision warning system identifies a 3-second, 2-second, 1-second, or 0.5-second headway, a visual and/or audio warning is emitted from the DIU. If the headway is less than the set headway range value, SmartCruise defuels the engine. If the headway is less than 50 percent of the set headway range value, SmartCruise also applies the engine brake. The driver may take evasive action by applying the service brake, which will disable the cruise control and also SmartCruise. The driver may choose to press the accelerator pedal to override SmartCruise and fuel the engine.

When the cruise control is activated, the adaptive cruise control system automatically activates if the vehicle is equipped with SmartCruise. When the vehicle is equipped with the cruise control disengage feature, and this feature disengages the cruise control, the adaptive cruise control is also deactivated.

The SAM Cab provides switched battery (or ignition power) and ground to the adaptive cruise control module.

Autoresume Feature

The autoresume feature on a vehicle with manual transmission allows automatic resumption of the cruise control after a shift in the gear is made with a single clutch or double clutch. When the cruise control is set and a shift in gear is made, the cruise control feature is temporarily suspended when the clutch is disengaged. The temporary suspension of the cruise control causes the SmartCruise to become inactive. The autoresume feature, which is configured on the engine control module, is dependent on the cruise control switch remaining in the on position and the cruise control not being disrupted by any means while the shift in gear is being made.

When a shift in gear is completed, the autoresume feature allows the cruise control to activate. The SmartCruise can then activate if there is a target in the range of the forward looking radar.

Eaton Side Object Detection System

The Eaton side object detection system (SODS) uses a vehicle on-board radar device to warn the driver of a vehicle or object in the driver's blind spot. Currently, Daimler Trucks North America offers this system only for detection of objects on the right side of the vehicle.

The side object detection system is available with or without the VS-400 collision warning system. The SODS has no electrical connections to, or interactions with, the VS-400 system.

The side object detection system consists of a side sensor and a side sensor display. The side sensor is mounted on the outboard, right side of the vehicle. The side sensor display is mounted inside the cab on the right-side A-pillar. A wire routes from the side sensor to the right turn signal.

The side sensor receives power from the vehicle electrical system. The side sensor then provides filtered power and ground return to the side senor display.

The side sensor display communicates warnings to the driver. When no object is detected by the side sensor, the yellow light-emitting diode (LED) illuminates. When an object is detected, the red LED illuminates. If the right turn signal is activated when an object is detected, an audio warning is transmitted.

Iteris Lane Departure Warning System

The Iteris® lane departure warning (LDW) system monitors the lane markings on the roadway and alerts the driver with an audible warning when the vehicle is about to stray outside its lane, provided that the vehicle is moving at least 37 mph (60 km/h) and the turn signal is not on.

The LDW system consists of a camera, an on-board computer, and software. The LDW system tracks the visible lane markings and provides the data to the computer. This data is then combined with other vehicle data. Using image recognition software and proprietary software, the system can detect when the vehicle begins to drift toward an unintended lane change. When this occurs, the system emits an audible warning.

Fuel Water Separator Heater

The fuel water separator heater has two functions:
- heats the fuel within the fuel water separator heater
- separates water from the fuel within the fuel water separator heater

These functions prevent the separated water from freezing in order to ensure proper engine operation in cold-weather conditions.

The fuel water separator heater is designated as a house load in the powernet management feature. See **Section 9** for more information on powernet management.

See **Figure 11-1** for the function path of the fuel water separator heater.

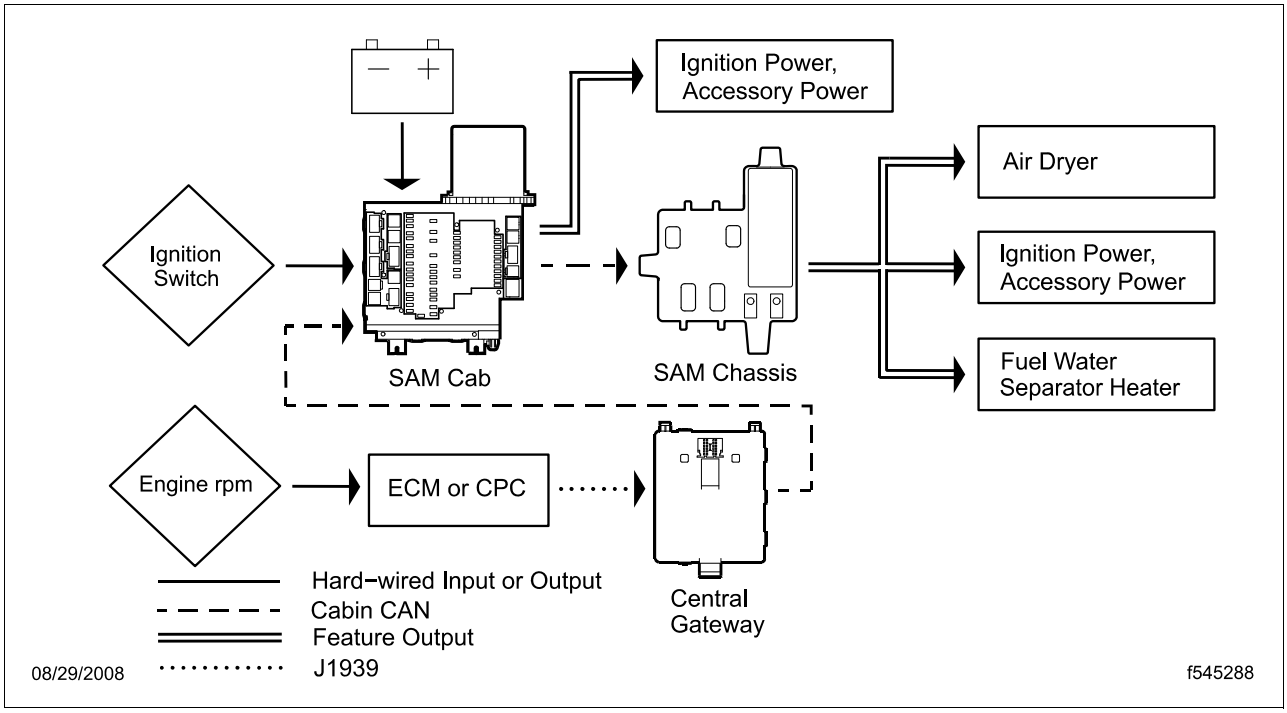


Figure 11-1: Function Path of Powernet Management, Air Dryer, and Fuel Water Separator Heater

Ignition Power and Accessory Power

The ignition power feature and accessory power feature identify and describe a group of pins that have similar activation and deactivation conditions.

See **Figure 11-1** for the function path of ignition power and accessory power.

See **Table 11-1** to determine whether the virtual bus is activated or not activated based on the position of the ignition switch and the progressive low-voltage disconnect level.

See **Table 11-2** for the designated virtual bus activation for each function. The NO abbreviation in this table represents “normally open.”

NOTE: Letter prefixes used for the switching devices listed in **Table 11-2** represent the following components:

- **T** transistors
- **IC** integrated circuits
- **RE** relay SAM Chassis
- **R** relay SAM Cab

Ignition Power and Accessory Power				
Physical or Logical Position of Ignition Switch	Virtual Bus Activation			
	ACC_1[1]	ACC_2	IGN_1	IGN_2
Accessory	On	On	Off	Off
Off	Off	Off	Off	Off
On (ignition)	On	On	On	On
Start (crank)	On	Off	On	Off

Table 11-1: Ignition Power and Accessory Power

1. The Cascadia does not have any ACC_1.

Function and Designated Virtual Bus Activation				
Function	Virtual Bus	Connector ID	Cavity No.	Switching Device
Air dryer (pneumatic, electrically heated), accessory	ACC_2	X57	4	T311 and T321
Sleeper climate control panel, accessory		X1	15	IC5700
Cab climate control panel, accessory			10	IC5750
Auxiliary circulation fan–windshield, accessory		X16	5	T5480
Inside temperature sensor, propeller control, accessory; mirror adjust switch supply, accessory		X10	2	—
Power window, driver side, accessory		X8	7	R15 (micro)
Power window, passenger side, accessory		X17	1	
Advertising light, accessory		X3	4	T5440
Radio, accessory (clamp 15R)		X10	18	IC5800
Amplifier power, accessory		X3	9	R9 (NO PLVD)
Power feed electrical air processing unit/water in fuel sensor, ignition	IGN_1	X57	1	RE3
Power feed ABS/brake system, ignition		X52	6	
Lane guidance, ignition		X16	2	—
Temperature sensor outside, air gauge, ignition		X20	13	IC5400
Instrument cluster, ignition		X6	16	R8 (micro)
Power feed sleeper thermostat, ignition (optimized idle)		X10	10	IC5400
Air intake warmer/grid heater, ignition		X19	11	—

Table 11-2: Function and Designated Virtual Bus Activation

Function and Designated Virtual Bus Activation				
Function	**Virtual Bus**	**Connector ID**	**Cavity No.**	**Switching Device**
Engine ECU, ignition	IGN_1	X19	18	—
Diagnostics connector, ignition		X2	9	R8 (micro)
Common powertrain controller (CPC), ignition			4	—
Collision avoidance system, ignition			14	R8 (micro)
Supplemental restraint system air bag, ignition		X3	6	
Dash splice, ignition		X1	4	
Trailer ABS 7-pin connector, ignition		X54	1	RE6
Transmission temperature gauge and shift selector, ignition		X1	1	R8 (micro)
Body builder connector, ignition	IGN_2	X9	11	—
Power feed gauge axle temperature, ignition		X6	10	R7 (micro)
Rear view camera, ignition	IGN_1	X53	3	RE3
Power feed driver information system, ignition (signal)	IGN_2	X6	5	R7 (micro)
Power feed gauge engine oil temperature, ignition		X6	11	
Power feed gauge pyrometer, ignition		X6	8	
Fuel water separator heater element, ignition		X57	15	RE1
Heated seats, ignition		X1	12	R3 (micro)
Fleet management system, ignition		X6	6	R7 (NO micro)
Global positioning system, ignition (signal)		X3	10	R7 (micro)
Tire pressure monitoring, ignition		X10	1	IC5840
Trailer power, battery or ignition		X55	1	RE8
Air filter restriction sensor, ignition	Logic	X19	13	—
Ether start power, ignition		X19	20	—

Table 11-2: Function and Designated Virtual Bus Activation

Mirror Adjust

Although the interior temperature sensor is currently not available, one of the SAM Cab pins for the sensor connector is used to drive the mirror adjust power and to protect the mirror switch.

See **Figure 11-2** for the function path of mirror adjust.

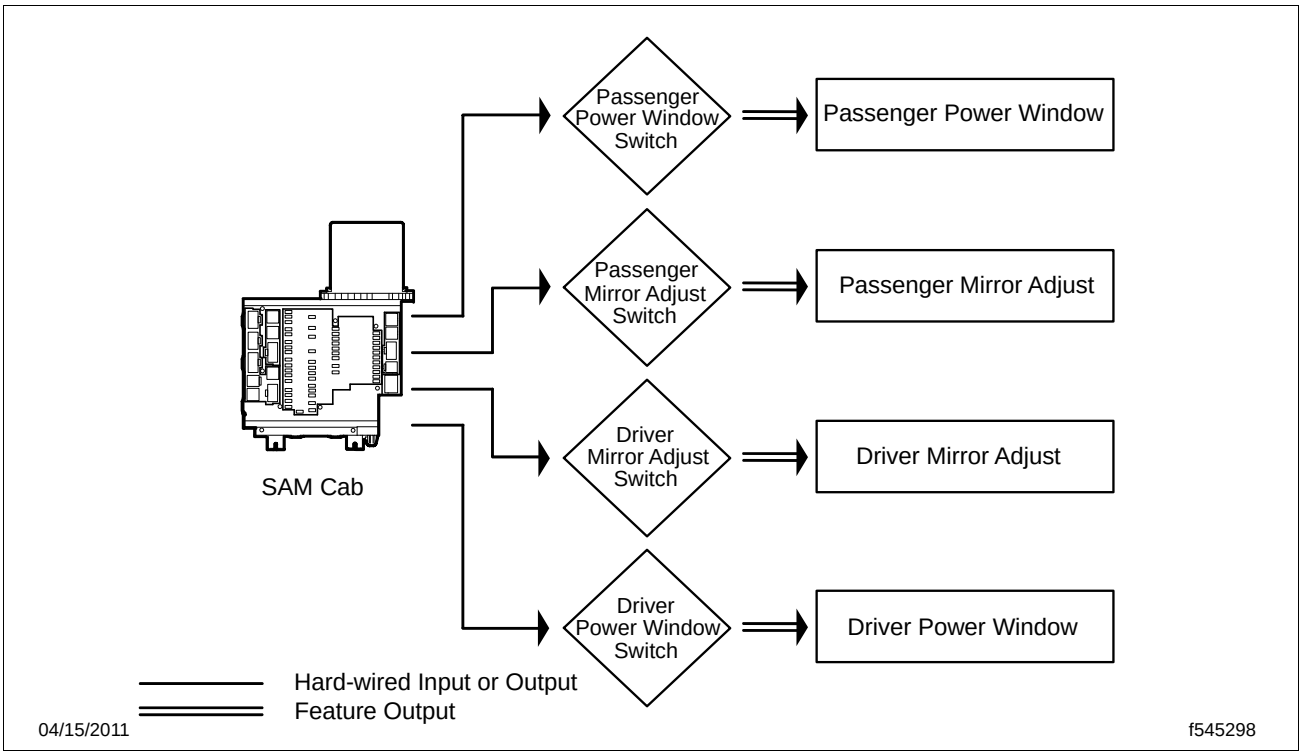


Figure 11-2: Function Path of Mirror Adjust and Power Windows

Park Brake Switch

The park brake switch is a pneumatic switch located at the air switch manifold. Park brake switch inputs and outputs are controlled by the SAM Cab.

When the park brake is set, the park brake switch is closed and the SAM Cab illuminates the park brake indicator on the instrumentation control unit. See **Figure 11-3**. When the park brake is set and the vehicle is moving at 2 mph (3km/h) or more, the park brake indicator illuminates and the light bar control unit (LBCU) activates a buzzer. The buzzer shuts off when the vehicle is moving slower than 2 mph.

The LBCU activates a friendly chime when the door is open and the park brake is not set. This feature is activated when the ignition switch is in the ON or off position.

See **Figure 11-4** for the function path of the park brake.

Figure 11-3: Park Brake Indicator

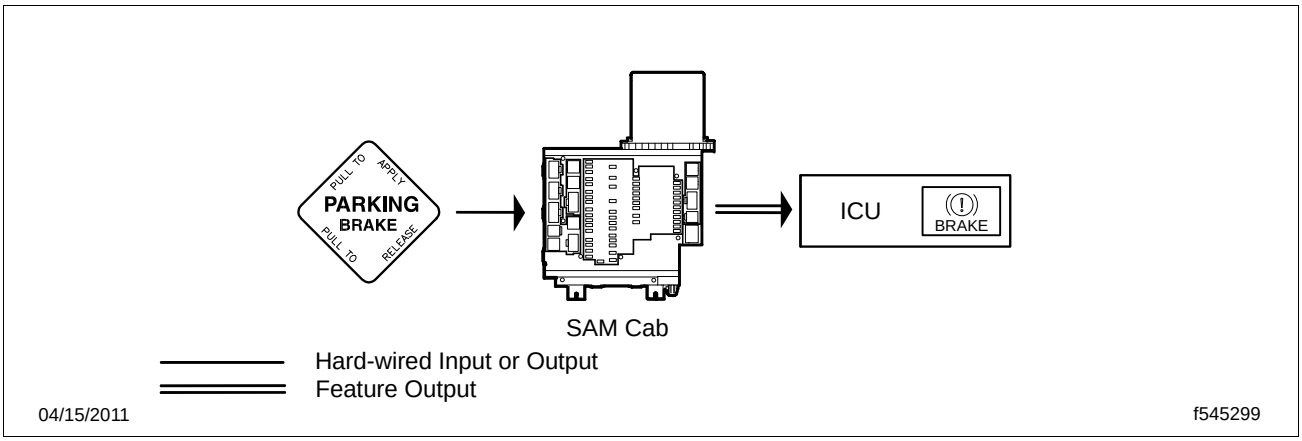


Figure 11-4: Function Path of the Park Brake

Power Windows

The driver and passenger door windows are controlled by the power window switch(es) mounted on the doors. See **Figure 11-5**. The driver's door has two switches that control the windows on both the driver's door and passenger's door. The passenger's door has one switch that controls the passenger's window.

When the concave, or front, part of the switch is pressed, the window lowers. When the convex, or back, part of the switch is pressed, the window raises.

An express-down feature allows the window on the driver's door to completely lower when the concave part of the switch is pressed for more than one second, then released. The express-down feature applies only to the window on the driver's door, not the window on the passenger's door. There is no express-up feature, only an express-down feature.

The power windows can be activated when the ignition switch is in the accessory or ON position. The power for the window switches is provided by the SAM Cab.

See **Figure 11-2** for the function path of the power windows.

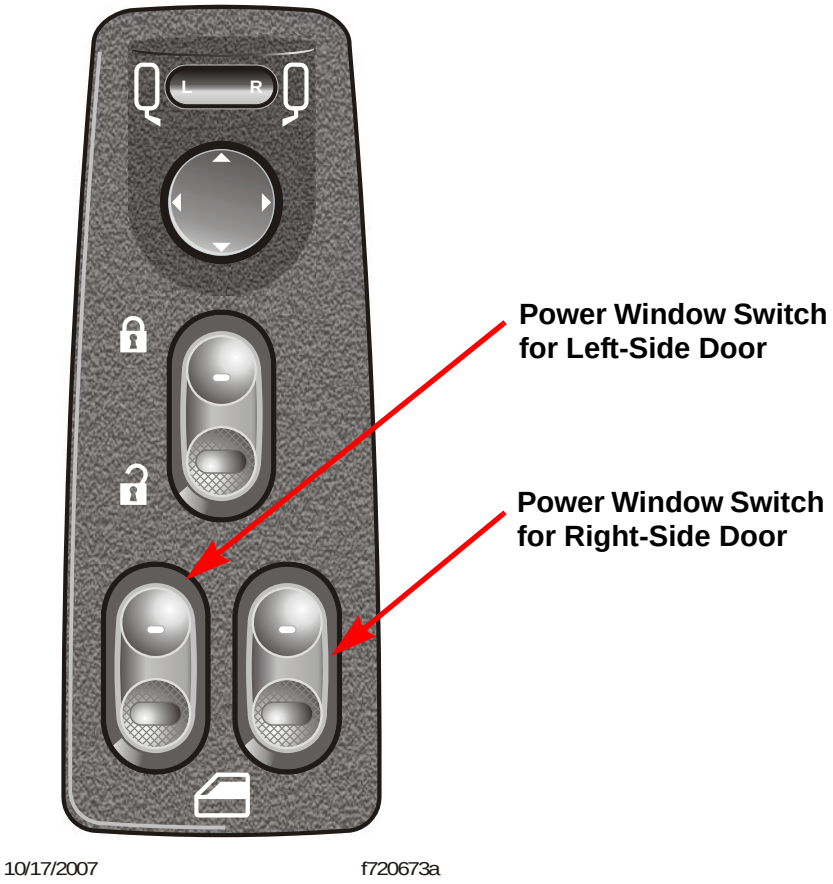


Figure 11-5: Power Window Switches on Driver's Door

Shore Power

Shore power is an optional feature that provides 120 volts of alternating current to the vehicle, and allows the driver to power appliances such as a heater, microwave oven, refrigerator, computer, and engine heater without idling the engine.

The shore power system consists of one or two 120-volt power inlets on the exterior of the cab, and one or two power receptacles inside the cab depending on the cab height. Sixty-inch and 72-inch raised roof sleeper cabs have two power receptacles; the 48-inch raised roof sleeper cab has one power receptacle. See **Figure 11-6** and **Figure 11-7** for the locations of the power inlets.

An inverter/charger may also be spec'd as part of the cab shore power system. When an inverter/charger is present, 120 V AC appliances can be powered from the batteries or, as an option, from an external 120 V AC while simultaneously charging the batteries.

An optional 120 V indicator on the ICU illuminates when the shore power system is being used. See **Figure 11-8**.

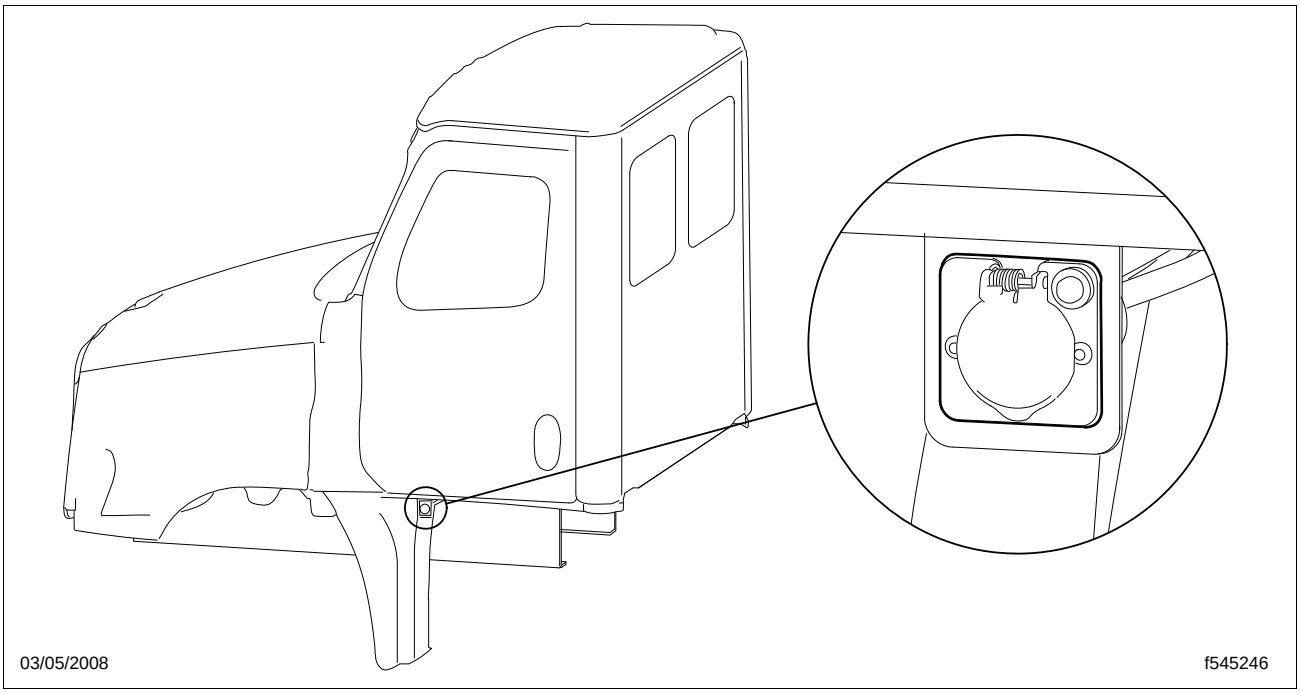


Figure 11-6: Power Inlet Under the Left-Side Door

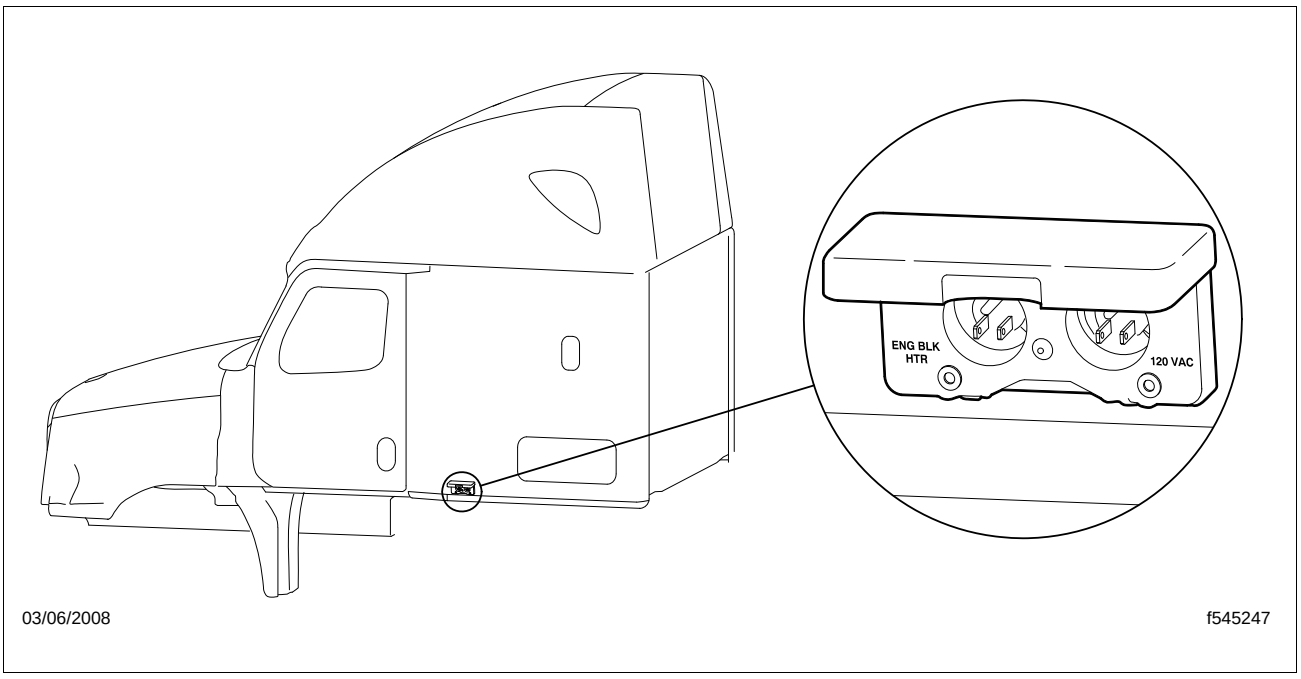


Figure 11-7: Power Inlet Aft of the Left-Side Door

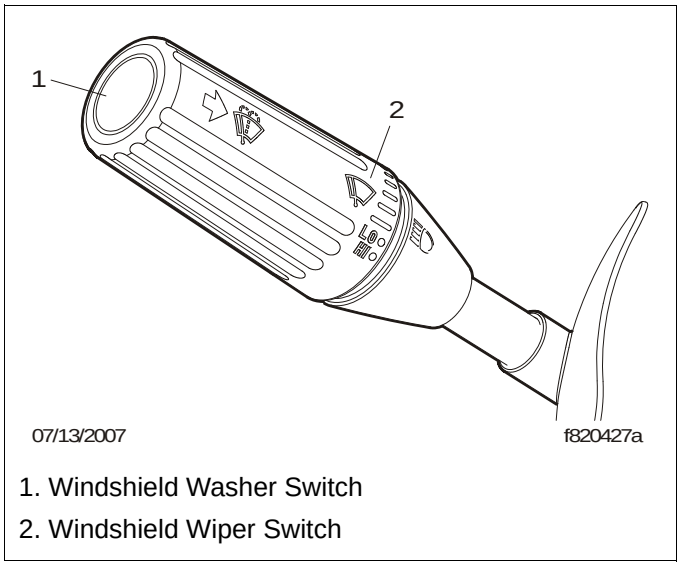
Figure 11-8: 120 V Indicator

Windshield Wiper and Washer

Momentary Wiping

The momentary wiping feature provides one wipe of the windshield wipers at low speed without activation of the windshield washer. The momentary wiping feature is activated by pressing the windshield washer switch for less than one-half second, and is available when the windshield wiper switch is in the off or intermittent position. See **Figure 11-9**.

See **Figure 11-10** for the function path of the windshield wiper and washer.



1. Windshield Washer Switch
2. Windshield Wiper Switch

Figure 11-9: Windshield Wiper and Windshield Washer Switches

After Wiping

The after wiping feature provides one or three wipes of the windshield wipers at low speed depending on how long the windshield washer switch is pressed. This feature clears remaining washer fluid from the windshield after the windshield washer switch is released.

When the windshield washer switch is pressed for more than one-half second but less than two seconds, then released, the windshield wipers continue at low speed for one wipe. When the windshield washer switch is pressed for more than two seconds, then released, the windshield wipers continue at low speed for three wipes.

See **Table 11-3** for a summary of the momentary wiping and after wiping features.

Momentary Wiping and After Wiping Features		
Amount of Time Windshield Washer Switch is Pressed	**Wiper at Low Speed**	**Washer**
0.5 second or less	1 wipe	Not active
More than 0.5 to less than 2 seconds	Continuous wipe while the switch is pressed; 1 wipe after release	Active until switch is released
2 seconds or more	Continuous wipe while the switch is pressed; 3 wipes after release	Active until switch is released

Table 11-3: Momentary Wiping and After Wiping Features

Windshield Washer

The windshield washer pump sprays washer fluid on the windshield. The pump is activated by pressing the windshield washer switch for more than one-half second.

Washer Fluid Level

The SAM Cab monitors the washer fluid level and sends a message regarding the current state of the washer fluid level to the instrumentation control unit. When the fluid level is low on a vehicle with an ICU3, the WASH FLUID indicator illuminates; on a vehicle with an ICU4 or ICU4M, the WSHR FLUID indicator illuminates.

Parked and Unparked Wiper Positions

Anytime the windshield wipers are turned off before the ignition switch is turned to the start (crank) or ON position, the wipers should park.

When the windshield wipers are on and the ignition switch is turned to the accessory position, the wipers stop immediately. If the windshield wipers are in an unparked position after the ignition switch has been turned off, the wipers will move to the parked position when the ignition switch is subsequently turned to the start or ON position.

When the windshield wiper switch is in the intermittent or on position, the wipers continue to wipe after the ignition switch is turned to the start or ON position. If the wind-

shield wiper switch is turned off after the ignition switch has been turned to the start or ON position, the wipers will move to the parked position.

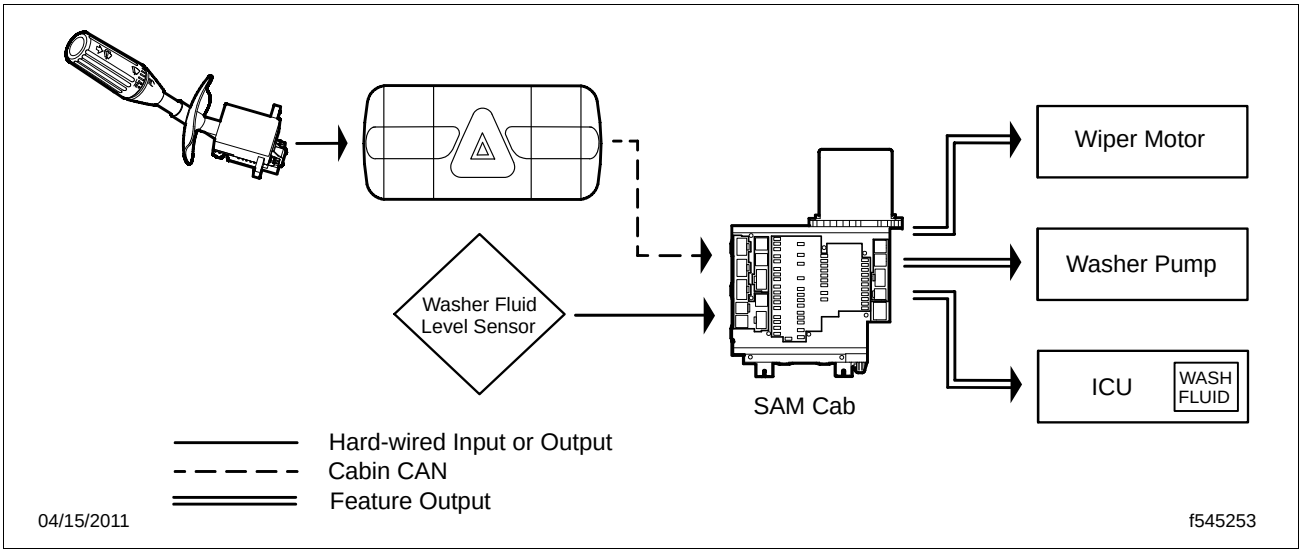


Figure 11-10: Function Path of the Windshield Wiper and Washer

Section 12:

- Cab and Sleeper HVAC Systems
- Collision Warning Systems
- Common Powertrain Controller
- Engine Control Module
- Instrumentation Control Unit
- Pneumatic ABS Module
- Supplemental Restraint System
- Transmission Control Unit

Cab and Sleeper HVAC Systems

See **Section 7** for information on the cab and sleeper HVAC systems.

Collision Warning Systems

See **Section 11** for information on the Eaton VORAD VS-400, SmartCruise, and Iteris® lane departure warning system.

Common Powertrain Controller

See **Section 4** for information on the common powertrain controller.

Engine Control Module

The engine control module (ECM) controls the operation of the engine. On Caterpillar engines the ECM is located on the engine.

On Detroit Diesel and Mercedes-Benz engines a motor control module (MCM) is located on the engine, but the common powertrain controller (CPC) acts as the primary ECM for these engines. See **Section 4** for more information on the location of the CPC.

Refer to the engine operator's manual for service and feature functionality.

Instrumentation Control Unit

The instrumentation control unit (ICU) houses the gauges, warning and indicator lights, and a driver message display. Three ICUs are available for the Cascadia:

- ICU3-P3
- ICU4-P3
- ICU4M-P3

The gauges in the ICU3-P3 are integral to the unit. There is space on either side of the ICU3-P3 for individual satellite gauges.

The ICU4-P3 and ICU4M-P3 have individual gauges that can be replaced or moved, and a higher number of gauges than the ICU3-P3. Individual gauges can also be located on the auxiliary instrument panel.

Each of the ICUs has a driver message display that displays the odometer reading, trip miles, ambient air temperature, active fault codes, and other data. For more information on the drive message displays and the data they provide, see the applicable driver's manual.

Pneumatic ABS Module

The pneumatic ABS module uses input from the wheel speed sensors to regulate the air pressure during braking to prevent wheel lockup. The pneumatic ABS module is located in the cab behind the lower cover dash panel. See **Figure 12-1**.

Refer to the Meritor WABCO ABS maintenance manual, or service and technical literature, for service and feature functionality.

Supplemental Restraint System

See **Section 7** for information on the supplemental restraint system.

Transmission Control Unit

The transmission control unit (TCU) is an optional component that uses data from the ECM and other vehicle sensors to calculate when to shift gears for optimum performance. When the vehicle is equipped with an Allison transmission, the TCU is located on the engine side of the frontwall on the left side of the vehicle. See **Figure 12-2**. On Eaton automated manual transmissions the TCU is mounted directly to the transmission.

Refer to the transmission operator's manual for service and feature functionality.

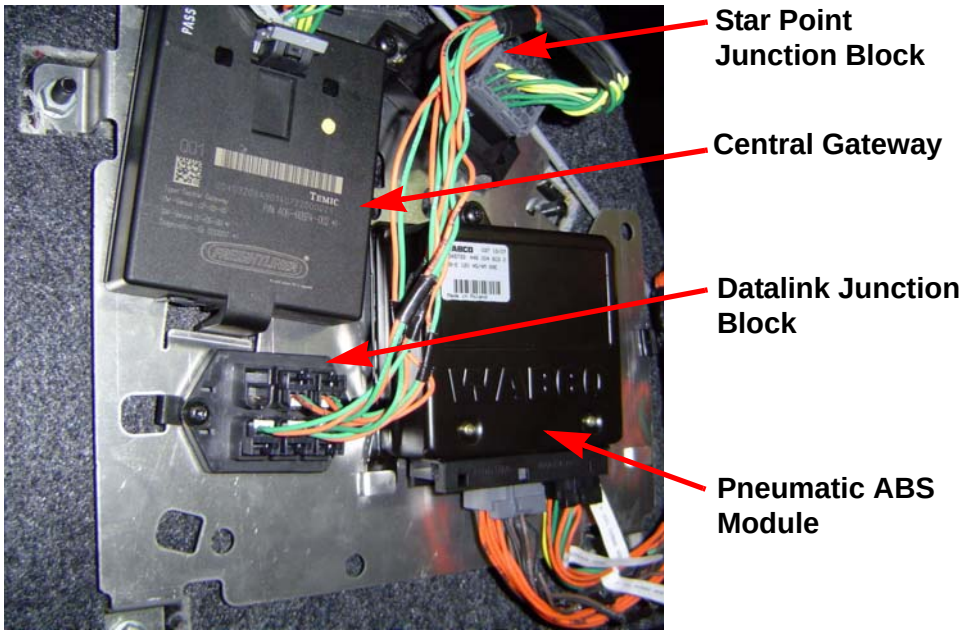
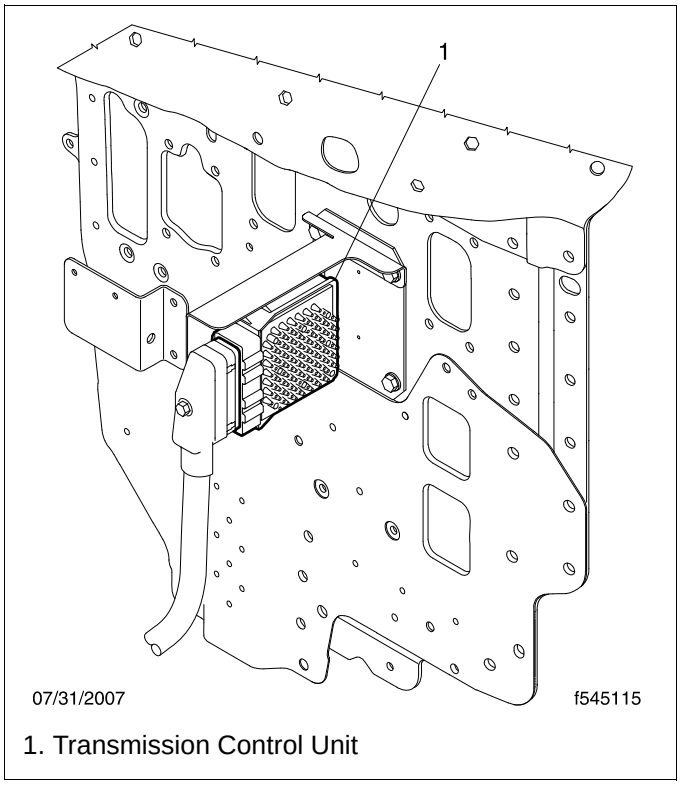


Figure 12-1: Pneumatic ABS Module Location



1. Transmission Control Unit

Figure 12-2: Transmission Control Unit on a Vehicle With an Allison Transmission

Section 13:

- Power Sources
- Additional Connections
- Grounding Locations

Power Sources

When a customer wants to add aftermarket components to a Cascadia vehicle, there are several power sources that the customer can access to power the components:

- splice packs
- power feed spare outputs
- auxiliary powernet distribution box (if equipped)
- positive cables
- in-cab auxiliary powernet distribution box (PDB)

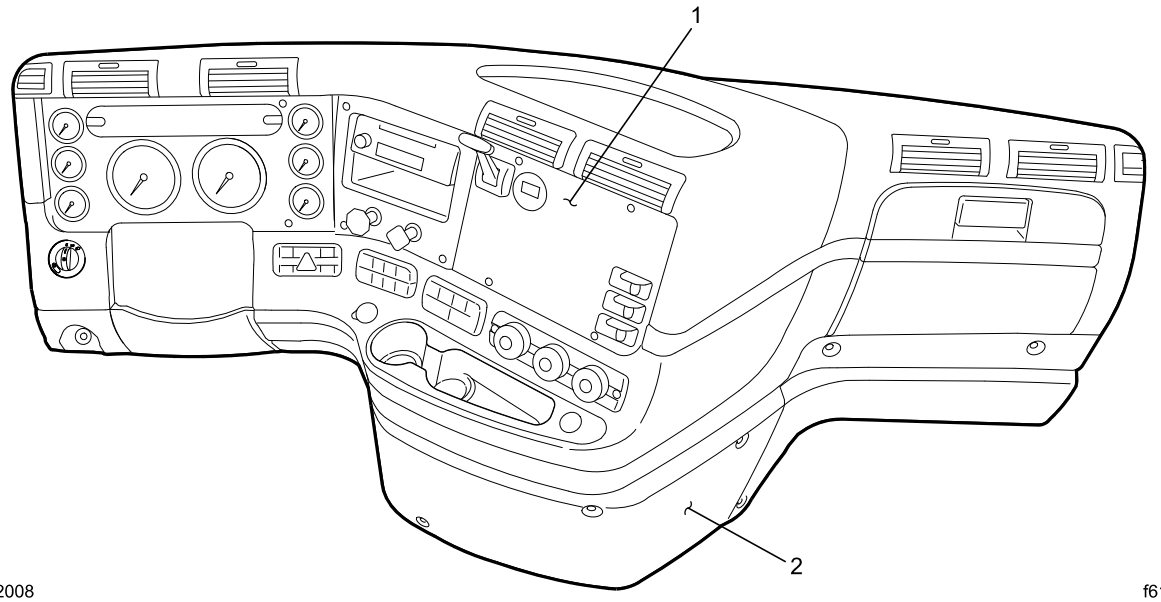
IMPORTANT: Anytime a connection is made to a power source, the customer must be responsible for adding in-line circuit protection.

Splice Packs

A minimum of nine 12-pin splice packs are located on the main dash harness. These splice packs can be used for ignition power, backlighting, engine ground, and vehicle ground. One 4-pin splice pack is available for nonpulse-width modulation dash panel backlighting.

Access the splice packs by removing the auxiliary instrument panel. See **Figure 13-1**, **Figure 13-2**, and **Figure 13-3**.

See **Table 13-1** for the splice pack specifications.



1. Auxiliary Instrument Panel
2. Lower Cover Dash Panel

Figure 13-1: Cascadia Dash Panels

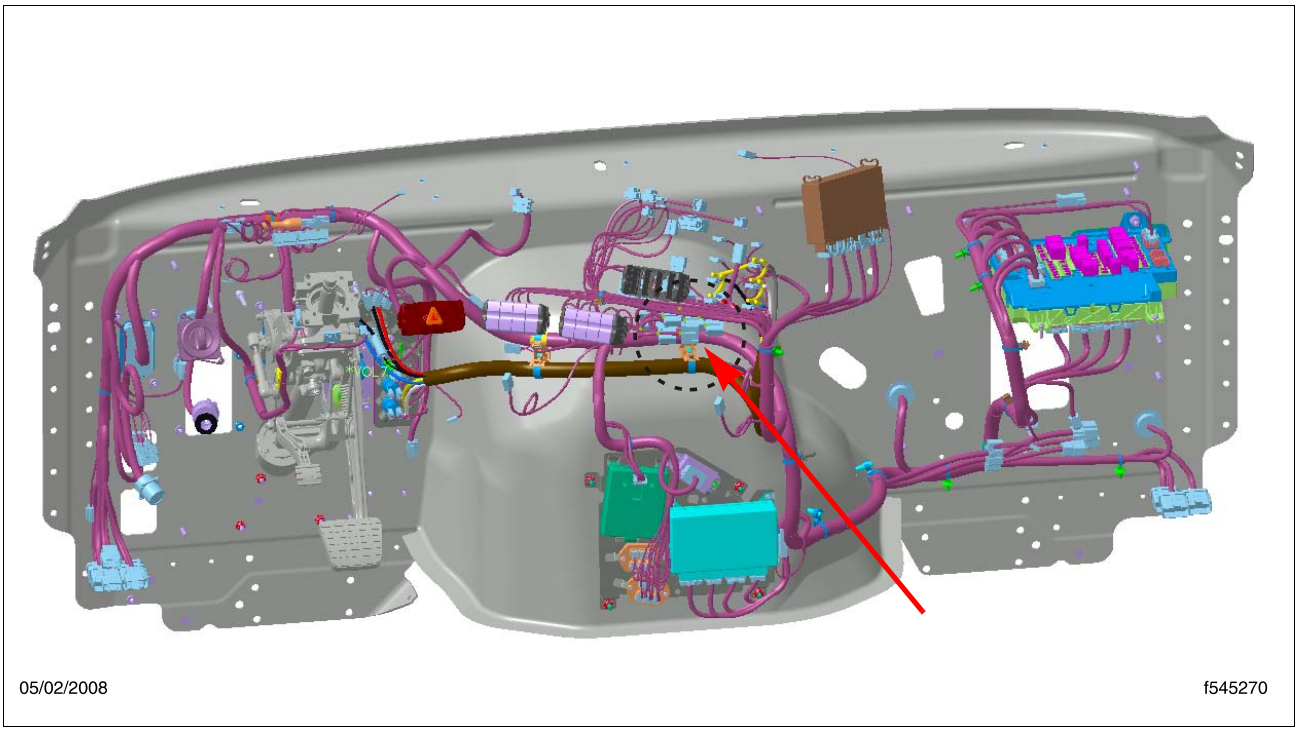


Figure 13-2: Location of Splice Packs on the Main Dash Harness

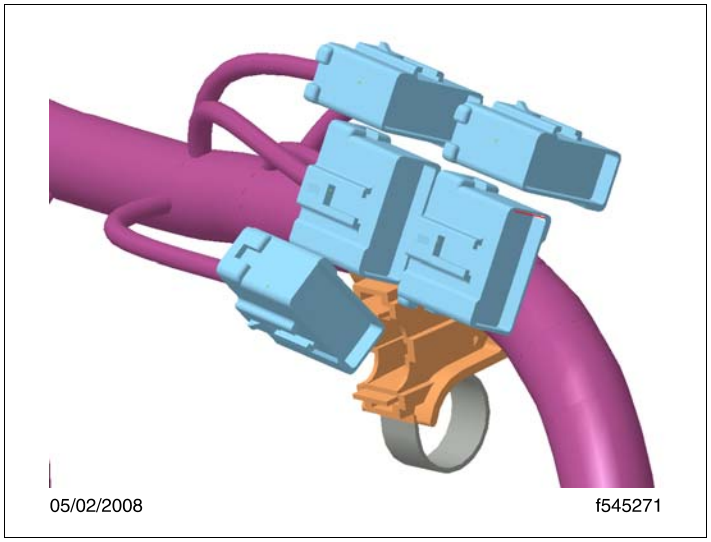


Figure 13-3: Main Dash Harness Splice Packs

Splice Pack Specifications				
Splice Pack Description	**Capacity**	**SAE Circuit Number**	**DTNA Wire Number**	**Wire Color**
Ground splice pack 1	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A	1204	GND	black
Ground splice pack 2	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A			
Ground splice pack 3	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A			
Dash panel backlighting 1	The capacity for each pin must be less than or equal to 1 A; the total capacity for all the pins cannot exceed 1 A	1304	29A	brown
Dash panel backlighting 2	The capacity for each pin must be less than or equal to 1 A; the total capacity for all the pins cannot exceed 1 A			
Dash panel nonpulse-width modulation back-lighting splice pack 1	The total capacity for all the pins is 1.8 A			
Ignition power splice pack 1	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A	1102	81C	pink
Ignition power splice pack 2	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A			
Ignition power splice pack 3	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A			
Engine common ground	The capacity for each pin must be less than or equal to 3 A; the total capacity for all the pins cannot exceed 3 A	1206	440G	black-white

Table 13-1: Splice Pack Specifications

Power Feed Spare Outputs

The SAM Cab provides battery power through a total of six power feed spare outputs. These outputs are controlled by optional hard-wired switches on the dash. One, two, or three additional switches—each with an indicator—can be spec'd when the vehicle is ordered, or added to the vehicle in the aftermarket. See **Figure 13-4**.

Each switch has a wiring harness that is routed along the chassis and ends at the back of the cab or sleeper.

Power feed spare outputs I, II, III, and IV are controlled by powernet management. In a progressive low-voltage disconnect (PLVD) situation these outputs are turned off to conserve power, along with the other house loads. See **Section 9** for more information on powernet management.

Power feed spare outputs V and VI are not controlled by powernet management.

See **Table 13-2** for the power feed spare output specifications.

Power Feed Spare Output Specifications			
Outputs	**SAM Cab Connector Number**	**Pin Numbers**	**Fuse Capacity**
I and III are grouped on fuse 1	X4	1 and 2	30 A
II and IV are grouped on fuse 3	X5	1 and 2	30 A
V and VI are grouped on fuse 32	X15	1 and 2	25 A

Table 13-2: Power Feed Spare Output Specifications

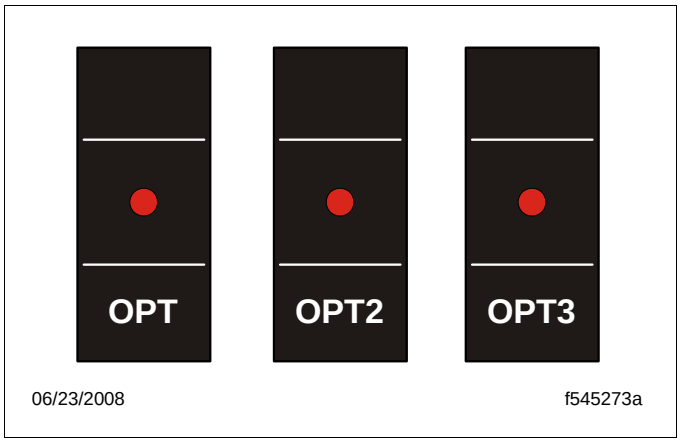


Figure 13-4: Optional Switches

Auxiliary Powernet Distribution Box

See **Section 4** for information on the auxiliary powernet distribution box.

NOTE: Not all vehicles have an auxiliary powernet distribution box.

Positive Connections

Connections can be made at several points in the starting and charging system:

- auxiliary powernet distribution box
- positive 12 V battery terminal
- starter
- alternator

NOTE: Disturbing any high-power/high-current connection is discouraged since unnecessary resistance may be added, and the reliability of the connection is compromised. Use the auxiliary powernet distribution box to make a high-power/high-current connection whenever possible. See **Section 4** for information on the auxiliary powernet distribution box.

See **Figure 4-1** for the starting and charging system within the Cascadia powernet architecture schematic.

IMPORTANT: Follow these guidelines when connecting to a positive source:

- In-line circuit protection must be added as close to the battery connection point as possible.
- Do not add loads that will drain the battery.
- The capacity for each connection must not exceed 50 A; the total capacity for all the connections must be less than or equal to 75 A.
- Do not add loads that exceed the design limits of the harnesses.

See **Table 13-3** for positive connection specifications.

Positive Connection Specifications		
Connection Location	**Load Disconnect Switch**	
	Source Side of LDS	**Load Side of LDS**
Battery power before LDS	X	—
Battery power after LDS	—	X
Starter	X	—
Alternator	—	X

Table 13-3: Positive Connection Specifications

In-Cab Auxiliary PDB

An in-cab auxiliary powernet distribution box (PDB) is spec'd when the options or components chosen by the customer warrant an additional PDB. Auxiliary PDB 1 or 2, along with three harnesses, can be installed aftermarket to provide the customer with 30 A to power components inside or outside the cab. There is no power provided to auxiliary PDB 3. This PDB is available for options that require a fuse or a relay position only.

On a 125-inch BBC Cascadia, the auxiliary PDBs are located inside the cab behind the lower cover dash panel. They are mounted on the engine tunnel bracket, and piggy-back the pneumatic ABS module. See **Figure 13-1** and **Figure 13-6**.

On a 113-inch BBC Cascadia, the auxiliary PDBs are located inside the cab behind the auxiliary instrument panel. Auxiliary PDB 1 and 2 are mounted on the bracket; PDB 3 is mounted on the HVAC duct. See **Figure 13-1** and **Figure 13-7**.

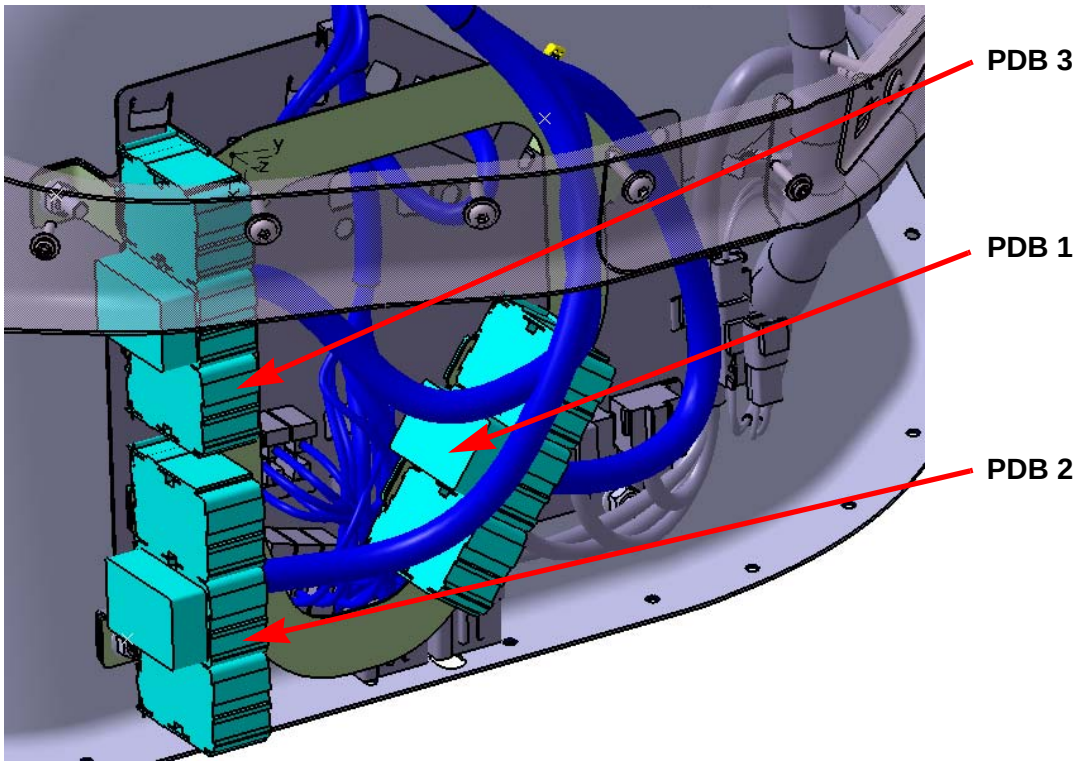


Figure 13-5: In-Cab Auxiliary PDMs Mounted Behind the Lower Cover Dash Panel

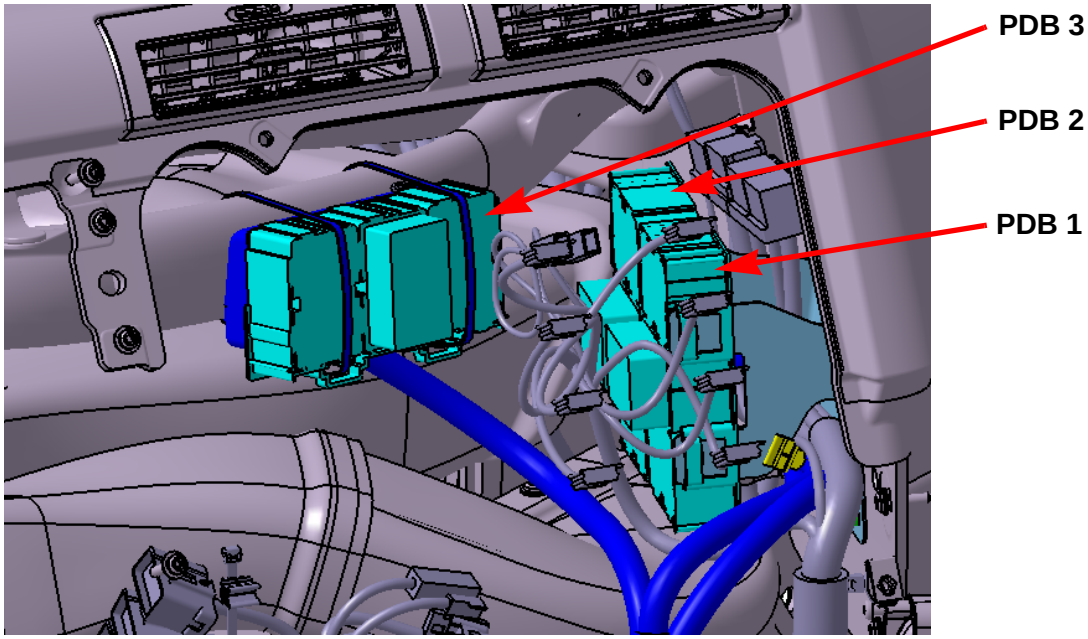


Figure 13-6: In-Cab Auxiliary PDMs Mounted Behind the Auxiliary Instrument Panel

Additional Connections

Additional connections for routing wires or accommodating custom designs include:

- frontwall connectors
- body builder connector
- spare function pins

Frontwall Connectors

Any unused pins on four frontwall connectors can be used to route wires in and out of the cab:

- aft chassis connector (BHC, optional)
- forward chassis connector (BHB)
- engine/transmission connector (BHA)
- frontwall connector (BHD, optional)

The aft chassis connector (if equipped), forward chassis connector, and engine/transmission connectors are located on the left side of the engine side of the frontwall. See **Figure 13-8**. The frontwall connector (if equipped) is located on the right side of the engine side of the frontwall.

If the aft chassis connector or frontwall connector is not present, a Deutsch HDP20 series connector can be installed.

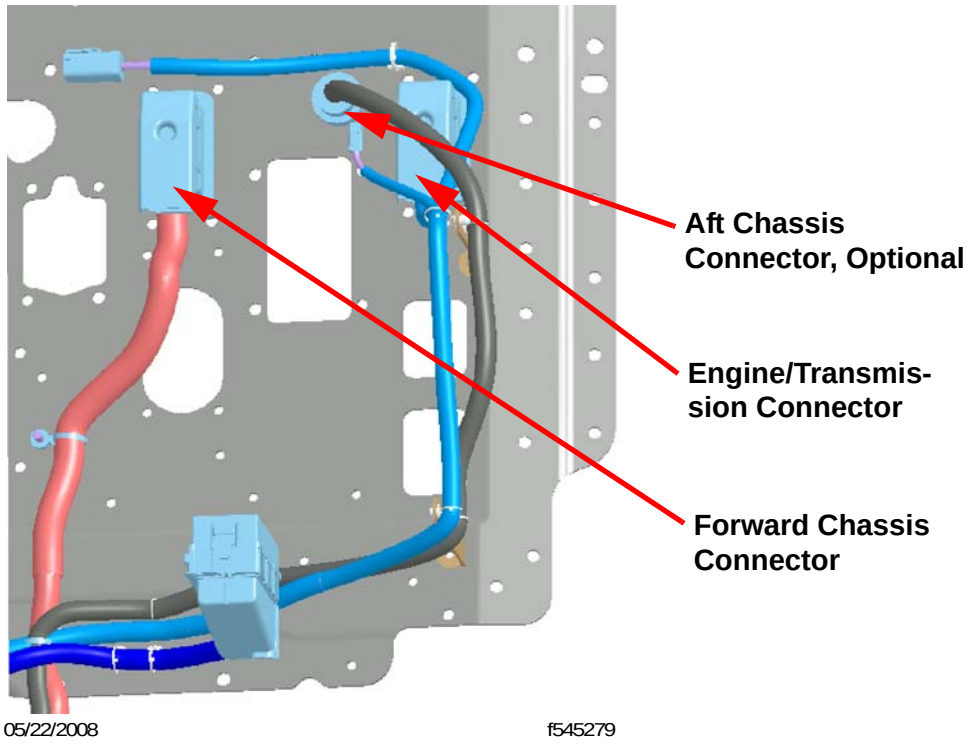


Figure 13-7: Frontwall Connectors

Body Builder Connector

The body builder connector is a 19-pin connector that provides a body builder access to specific signals. See **Section 7** for information and specifications on this connector.

Spare Function Pins

Spare function pins can be used to accommodate custom designs. See **Section 7** for information and specifications on spare function pins.

Ignition Switch

The four wires that route to the ignition switch are dedicated for use by the ignition switch; no additional load can be attached to these wires. If an additional load is added to any of the ignition switch wires, a fault code is generated.

If an ignition signal is required, use the splice packs on the main dash harness for ignition power.

Grounding Locations

The main ground junction block (MGJB), battery negative post, and starter negative post can be used for ground. The frame rail can also be used for ground, but this

option is not recommended. The main ground junction block is located on the engine side of the front wall below the powernet distribution box. See **Figure 13-9** for the locations of the ground cables and the maximum capacity of the ground studs.

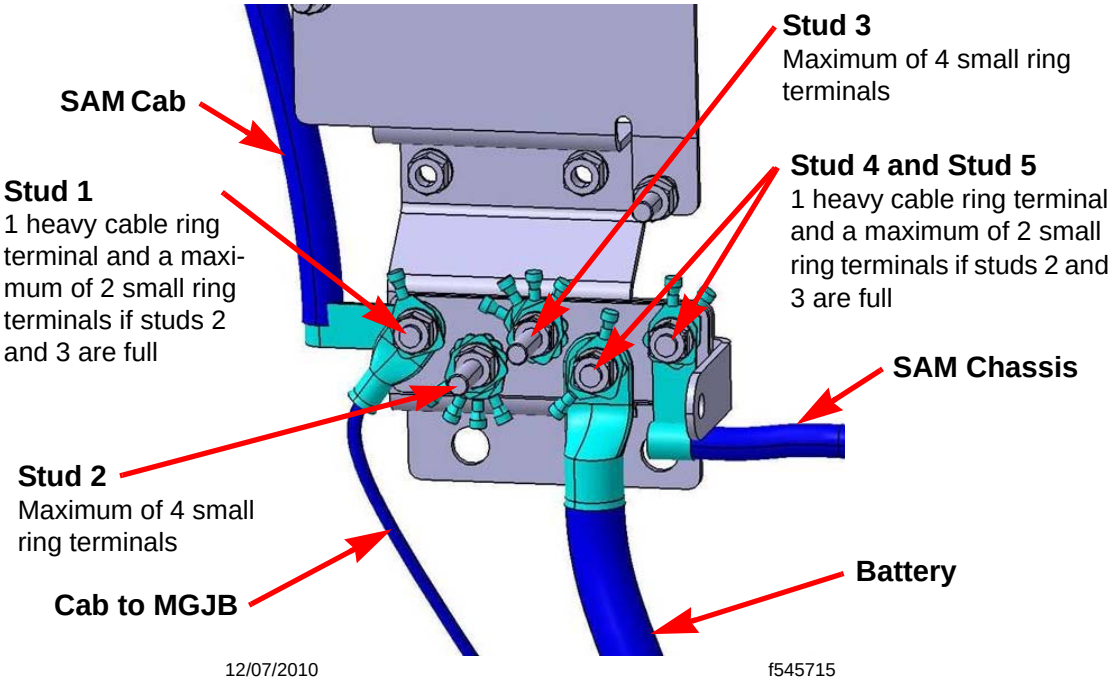


Figure 13-8: Locations of the Ground Cables

Section 14:

- **Parameter Part Numbers and Data Codes**

Parameter Part Numbers and Data Codes

This section provides a brief description of some of the features that have been identified for use on the Cascadia. Most of these features are currently available; some features will be available at a later date. The parameter part numbers and data codes associated with these features, and the availability of these features are also provided.

In **Table 14-1** the standard features and their respective data codes are in bold. The features are grouped together in three categories:

- Exterior Lighting Features
- Cab Features
- Chassis Features

These categories correspond to **Section 5**, **Section 7**, and **Section 8** in this guide.

Some parameter part numbers require more than one data code. When there is more than one data code associated with a parameter part number, choose one data code for each module number. For example, for the following feature choose data code 314-998 and either 315-005 or 315-808:

- Fog lights present but disabled when high-beam headlights are activated; auxiliary high-beam lights not present; fault detection disabled

Some of the features in **Table 14-1** have a description of “no content.” Features with “no content” are currently not available. Until the feature is part of the multiplexing electrical system, a parameter part number with no content is required in the bill of material to disable diagnostics and functionality for the unavailable feature.

Not all of the parameter part numbers are mutually exclusive in their associations with data codes.

Cascadia Features, Parameter Part Numbers, and Data Codes				
Feature Name and Description	**Parameter Part Number**	**Data Code**	**Available[1]**	
			Yes	**No**
Exterior Lighting Features				
DRL: turn signals; fault detection disabled, **Follow Me Home**	003 447 11 58	**311-001**	X	—
Fog lights; **auxiliary high-beam lights** not present	002 447 35 58	**314-998** 315-005 315-808	X	—
Marker interrupt feature present with one interrupt	002 447 64 58	302-073 **302-072**	X	—
Marker interrupt feature present with three interrupts	002 447 65 58	—	—	X
Marker interrupt feature present with three interrupts	003 447 07 58	—	—	X
Marker interrupt feature present with two interrupts	002 447 86 58	—	X	—
Marker interrupt feature present with two interrupts	003 447 06 58	—	—	X
Turn tip not present	002 447 02 58	301-001	—	X
Turn tip present with three flashes	002 447 85 58	—	—	X
Utility light not present	002 447 60 58	318-998	X	—
Utility light present; disable above 10 mph	002 447 61 58	318-1CN 318-059 318-061 318-085 318-1AD 318-1B8 **318-004**	X	—
Utility light present without being disabled above 10 mph	002 447 62 58	—	—	X
Cab Features				
Body builder connector, no content	002 447 70 58	353-998	X	—
Cab HVAC power; **Auxiliary heater** without park brake interlock; day cab	002 447 45 58	**689-998**	X	—
Cab HVAC power; **Auxiliary heater** without park brake interlock; sleeper cab	002 447 47 58	**689-003**	X	—
Cruise control disengage input not present	002 447 18 58	**149-015**	X	—
Cruise control disengage with hazard lights, head-lights, or wipers on	002 447 19 58	149-031	X	—
Cruise control disengage with hazard lights or wipers on	002 447 20 58	149-036	—	X
Cruise control disengage with hazard lights or head-lights on	002 447 21 58	—	—	X

Table 14-1: Cascadia Features, Parameter Part Numbers, and Data Codes

Cascadia Features, Parameter Part Numbers, and Data Codes				
Feature Name and Description	**Parameter Part Number**	**Data Code**	**Available[1]**	
			Yes	**No**
DC power receptacle present	002 447 52 58	**785-014** 785-015	X	—
Optimized idle, no content	002 447 22 58	156-007	X	—
Supplemental restraint system, no content	002 447 30 58 and 000 447 02 61	725-001 725-010 725-011 725-012 725-013 725-998	X	—
Chassis Features				
Primary receptacle mounted left side back of cab; trailer auxiliary switch present	000 447 23 61	296-008 303-998	X	—
Primary receptacle mounted left side back of cab; ignition-powered center pin	000 447 24 61	**296-010** 303-998	X	—
Primary receptacle mounted left side back of cab; battery-powered center pin	000 447 25 61	296-011 303-998	X	—
Primary receptacle mounted on chassis aft of cab or end of frame; trailer auxiliary switch present	000 447 26 61	297-005 297-001 296-008	X	—
Primary receptacle mounted on chassis aft of cab or end of frame; ignition-powered center pin	000 447 27 61	297-005 297-001 **296-010**	X	—
Primary receptacle mounted on chassis aft of cab or end of frame; battery-powered center pin	000 447 28 61	297-005 297-001 296-011	X	—
Primary receptacle mounted left side back of cab and end of frame; trailer switch present	000 447 29 61	296-008 303-001	X	—
Primary receptacle mounted left side back of cab and end of frame; ignition-powered center pin	000 447 30 61	**296-010** 303-001	X	—
Primary receptacle mounted left side back of cab and end of frame; battery-powered center pin	000 447 31 61	296-011 303-001	X	—

Table 14-1: Cascadia Features, Parameter Part Numbers, and Data Codes

1. When the feature is not available, it is supported by the SAM but is not currently available as an option.

Section 15:

- **EPA 2010 Engines**

EPA 2010 Engines

The U.S. Environmental Protection Agency (EPA) implemented new diesel emission regulations for heavy-duty highway vehicles effective January 2010. The EPA 2010 emission regulations apply to vehicles domiciled in the United States and Canada.

The EPA 2010 emission regulations reduce exhaust emissions of particulate matter (soot and ash) and nitrogen oxide (NOx). The new emission regulations are being met through cleaner engine combustion and the use of an exhaust aftertreatment device.

The Detroit Diesel DD13, DD15, and DD16 engines, and the Cummins ISX engine are designed to meet the EPA 2010 emission regulations.

Engine Electronic Control Unit Configuration

The common powertrain controller on a Detroit Diesel DD13, DD15, or DD16 engine, and the engine control module on a Cummins ISX engine can be configured to meet the customers' needs. The electronic control units (ECU) are configured through the use of parameter part numbers.

See **Table 15-1** for the primary modules associated with the parameter part numbers used to configure EPA 2010 ECUs.

NOTE: Module 80P is used for fleet specific parameters.

Freightliner Primary Modules Associated With ECU Parameter Part Numbers		
Module Number	**Module Description**	**Engine Manufacturer**
3RB	Common Powertrain Controller hardware, software and diagnostic part numbers	Detroit Diesel
3RD	Common Powertrain Controller parameters	
	Engine Control Module parameters	Cummins
3R0	Aftertreatment Control Module hardware, software, and diagnostic part numbers	Detroit Diesel
	Doser Control Unit hardware part numbers	Cummins
3R3	Aftertreatment Control Module fuel map and setup parameters	Detroit Diesel
47Y	Motor Control Module hardware[1], software, and diagnostic part numbers	
47Z	Motor Control Module fuel map and setup parameters	
79A–79G	Modules associated with data codes that are used to configure the electronic control units	Detroit Diesel and Cummins
79I–79Z		
80A–80Z		

Table 15-1: Freightliner Primary Modules Associated With ECU Parameter Part Numbers

1. Reference only; cannot be configured by the customer.

Aftertreatment Device

The aftertreatment device is designed to reduce the level of engine emissions to meet the EPA 2010 emission regulations for nitrogen oxide (NOx) and particulate matter. The aftertreatment device is comprised of a diesel oxidation catalyst and a diesel particulate filter.

When the exhaust gases leave the engine, they flow into the diesel oxidation catalyst, then into the diesel particulate filter. The filter traps soot particles, where the heat from the exhaust converts the soot to ash. This process is called regeneration.

When the engine is running under load and a regeneration occurs without input, a passive regeneration has occurred. If the engine isn't running hot enough, the electronic controls may initiate an active regeneration by injecting fuel into the exhaust stream prior to it reaching the diesel particulate filter. The injected fuel superheats the soot trapped in the filter, which turns it to ash.

If the vehicle is operating under a reduced engine load, soot accumulates in the diesel particulate filter. When this occurs, the diesel particulate filter indicator illuminates indicating that a regeneration must be performed by either bringing the vehicle up to highway speed to increase the load, or by parking the vehicle and initiating a parked regeneration. See **Figure 15-1**.

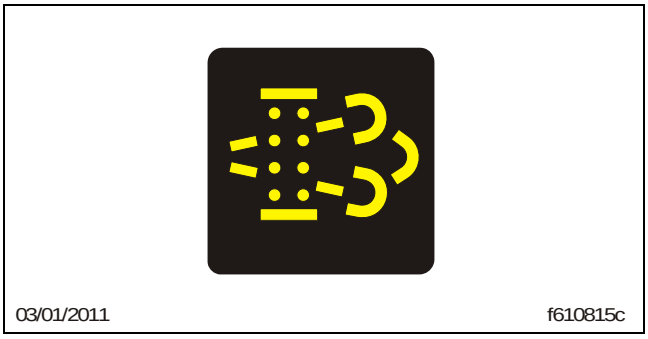


Figure 15-1: Diesel Particulate Filter Indicator

Diesel Exhaust Fluid and Tank

After the exhaust stream passes through the aftertreatment device, it flows through a canister that houses the selective catalytic reduction (SCR) device. A controlled amount of diesel exhaust fluid (DEF) is injected into the exhaust stream where heat converts it to ammonia gas. The ammonia gas reacts with the nitrogen oxide in the exhaust to produce harmless nitrogen and water vapor, which are emitted from the tailpipe.

The diesel exhaust fluid, also referred to as urea, is stored in a tank that is usually located behind the battery box, or in front of the fuel tank on a day cab. The amount of DEF in the tank is indicated on an integrated diesel fuel and DEF gauge. The four squares under the DEF on the integrated gauge indicate the amount of diesel exhaust fluid in the tank. See **Figure 15-2**.

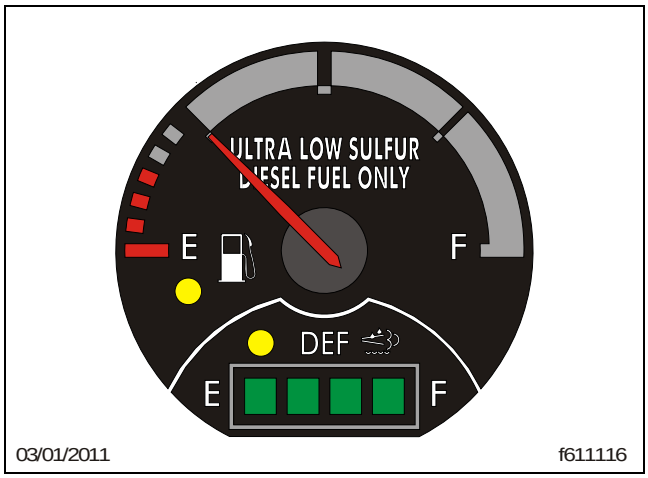


Figure 15-2: Integrated Diesel Fuel and DEF Gauge

- When four squares are illuminated green, the tank is 80 to 100 percent full.
- When three squares are illuminated green, the tank is 55 to 80 percent full.
- When two squares are illuminated green, the tank is 30 to 55 percent full.
- When one square is illuminated green, the tank is 20 to 30 percent full. See **Figure 15-3**.
- When one square and the DEF warning indicator are illuminated yellow, the tank is 10 to 20 percent full. See **Figure 15-4**.
- When one square flashes red, the DEF warning indicator flashes yellow, and the malfunction indicator illuminates, the tank is empty or less than 10 percent full. See **Figure 15-5** and **Figure 15-6**.

NOTE: When the aftertreatment system is purging, noises from the system may be heard, but this is no cause for concern.

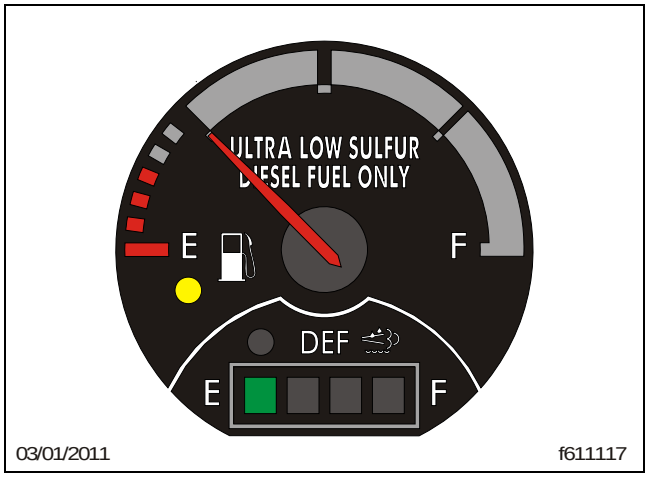


Figure 15-3: DEF Gauge at 20 to 30 Percent Full

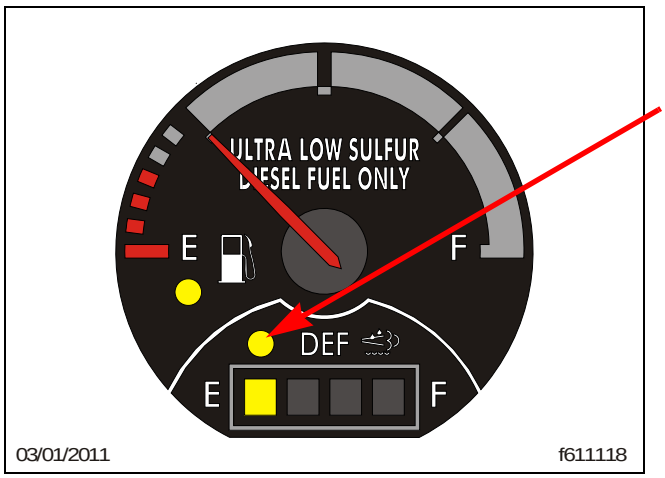


Figure 15-4: DEF Gauge at 10 to 20 Percent Full

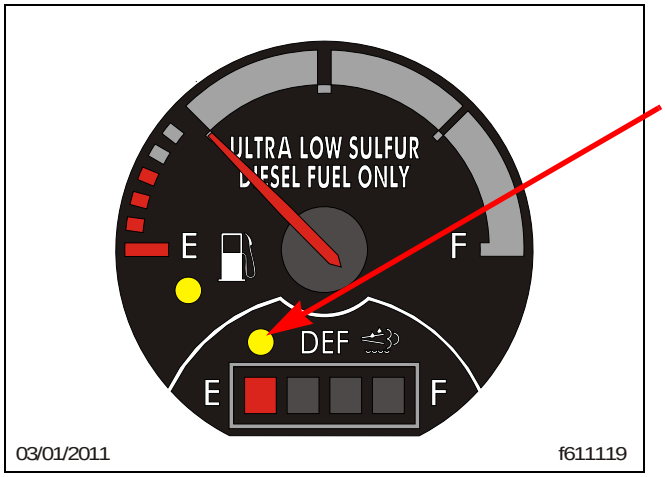


Figure 15-5: DEF Gauge Empty or Less Than 10 Percent Full

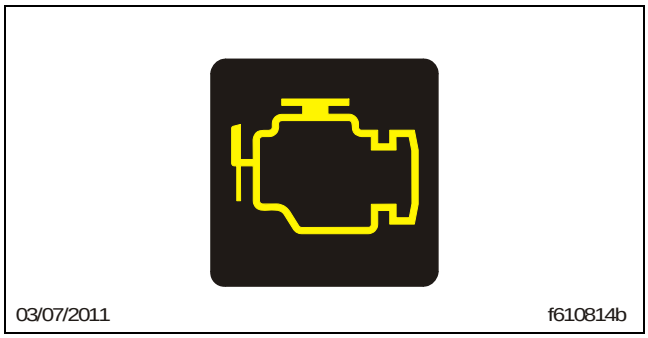


Figure 15-6: Malfunction Indicator

Section 16:

- **Glossary**

Glossary

Auxiliary Powernet Distribution Box An auxiliary powernet distribution box is available for vehicles that require additional high-amp fused power for trailer wiring, in-cab PDM, body builder, or an inverter/charger.

Cabin CAN A proprietary datalink that connects the central gateway, the modular switch field, the SAM Cab, and the SAM Chassis.

Central Gateway (CGW) Connects the J1939, J1708, cabin CAN, and diagnostic CAN datalinks, and transmits the multiple electronic messages between the datalinks.

Constant Outlet Temperature Control (COTC) Provides a stable air temperature inside the cab when the air is discharged from the HVAC ducts based on a reference temperature for each of the 21 settings on the temperature control switch.

Datalink A collection of wires that connects system component, and through which data is transmitted.

Electronic Code A specific value that is assigned to a feature or function of a component on the vehicle, and is programmed to the engine control module and some transmissions. Electronic codes are also known as ecodes, data codes, and sales codes.

Electronic Control Unit (ECU) A device that controls an electrical subsystem in the vehicle and communicates on a datalink.

Engine Control Module An electronic device that assists the control of multiple aspects of the engine operation system.

Follow Me Home A feature that temporarily activates the low-beam headlights after the engine is turned off.

Function Path A depiction of the electrical path of a feature between the initial input and the output load.

Load Disconnect Switch (LDS) An optional feature that is used to break (or open) the connection between the battery and the powernet distribution box, and the connection between the battery and the auxiliary powernet distribution box (if equipped).

Main Ground Junction Block Provides a standard location for the ground wires.

Modular Switch Field (MSF) A system of multiplexed switches. The MSF consists of a master control module and one or more slave modules.

Multiplexing System Replaces traditional power distribution devices with ECUs that communicate over the vehicle datalink. The ECUs control power distribution to the vehicle's electrical loads by monitoring inputs—such as sensors and switches—and supplying power to outputs, such as lighting, displays, gauges, and indicators.

Parameter A specific value that is assigned to a feature or function of the vehicle that allows the customer to choose how that particular feature or function will work on the vehicle.

Powernet Distribution Box (PNDB) Provides high-amp fused power to the powertrain power distribution module (PT-PDM), the SAM Cab, and the SAM Chassis. It also provides continuous power to the aftertreatment control module, emergency power, the radio and clock, and the alternator remote sense.

Powernet Management Protects the batteries from discharging too much by temporarily shutting down loads from the power supply. This ensures that in the event of a drop in voltage, the battery draining process is slowed.

Powertrain PDM Used to house the large number of circuit protection devices for powertrain components.

Progressive Low-Voltage Disconnect (PLVD) Used to implement the powernet management feature.

SAM signal detect and actuation module

SAM Cab The cab signal detect and actuation module controls all switching and detecting functions for cab controls and the front of the vehicle.

SAM Chassis The chassis signal detect and actuation module controls all trailer and chassis electrical devices located under or aft of the cab.

Theater Lighting Ramped interior lighting that is used to gradually bring lights to their full illumination when turned on, and gradually reduce their illumination when turned off.

Turn Tip A feature that allows the driver to temporarily activate the turn signal lights by momentarily pressing down the multifunction turn signal switch.

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