



Body Builder, General Guidelines and Certification VNR Electric

Introduction

The information in this document was developed to assist our customers throughout the body planning and installation process. This information will assist with the required specifications and guidelines for completion for your specific applications.

The information in this document does not include each and every unique situation that you may encounter when working on Volvo vehicles. Volvo Trucks North America cannot possibly know, evaluate, or advise someone on all the types of work that can be done on a Volvo vehicle and all the appropriate ways to do such work. This includes all of the possible consequences of performing such work in a certain manner. Therefore, any situations or methods of working on a Volvo vehicle that are not addressed in this document are not necessarily approved by Volvo Trucks North America.

In the event that you require additional assistance, please contact Volvo Body Builder Support at 877-770-7575.

Unless otherwise stated, following the recommendations listed in this document does not automatically guarantee compliance with applicable government regulations. Compliance with applicable government regulations is your responsibility as the party making the additions/modifications. Please be advised that the Volvo Trucks North America vehicle warranty does not apply to any Volvo vehicle that has been modified in any way, which in Volvo's judgment might affect the vehicles stability or reliability. The information, specifications, and illustrations in this document are based on information that was current at the time of publication. Please note that illustrations are typical and may not reflect the exact arrangement of every component installed on a specific vehicle.

All data provided is based on information that was current at time of release. However, this information is subject to change without notice.

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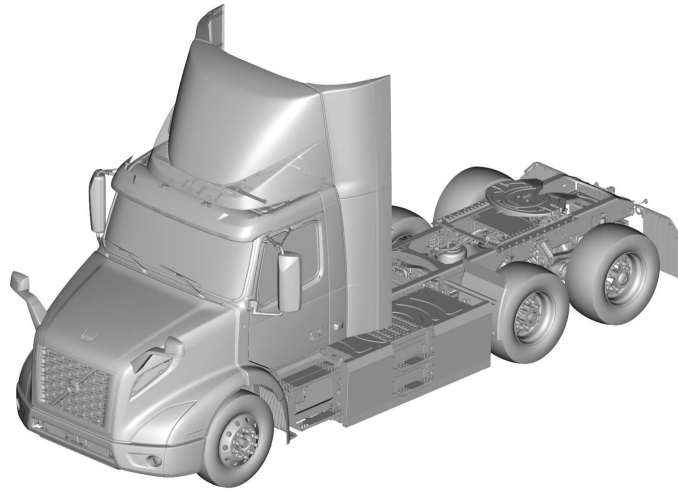
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BEV (Battery-Electric Vehicle)

General

Introduction

This document includes the information that is specific to the truck model VNR ELECTRIC. For all other information related to VNR truck, refer the relevant VOLVO Body Builder Manual.



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Over view of battery-electric vehicle

General warnings

DANGER

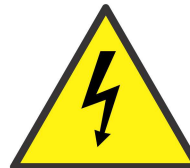
Risk of electrical discharge

Traction voltage system, 600 V (nominal value)

Can cause dangerous electric shocks, arcing or burns, which can result in serious personal injury or death.

Service and installation must be carried out by qualified personnel. Always use correct personal protection equipment when working on the vehicle.

The components that contain traction voltage are marked with the warning decal.



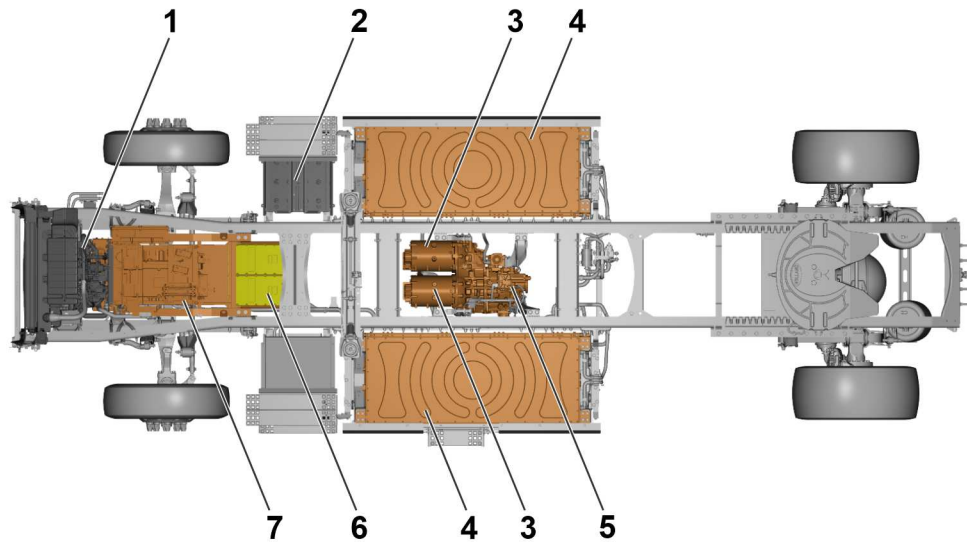
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General description

BEV (Battery-Electric Vehicle) Layout

VNR 42T (ESS265K)

Model	Axle arrangement	Wheelbase	Vehicle maximum load capacity (including trailer)	Number of traction batteries	ESS Total Energy Capacity
VNRE42T	4x2	4242 mm (167 inches)	36 t (72,000 lb)	4	265 kwh

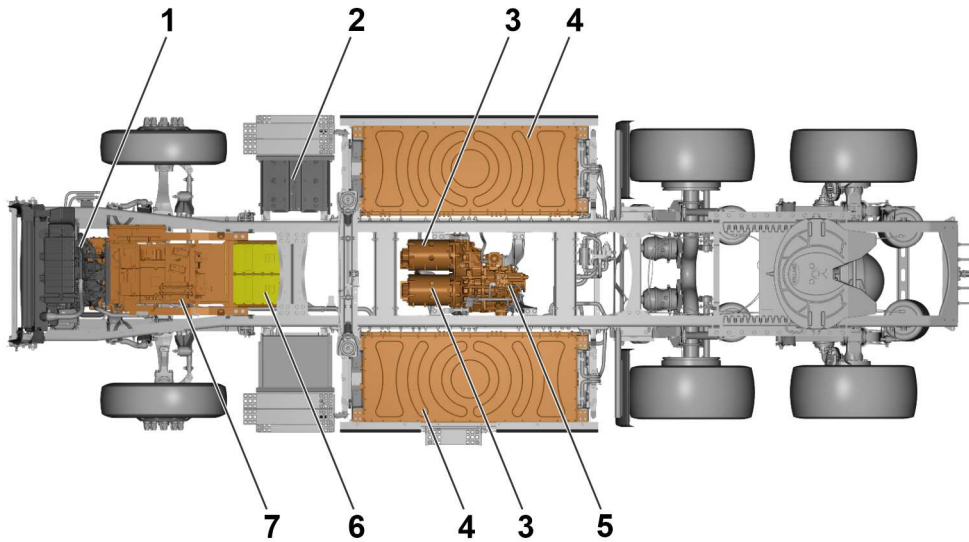


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- 1 Electric cooling system
- 2 24 V system batteries
- 3 EM (Electric Motor)
- 4 Traction batteries
- 5 Transmission
- 6 EMD (Electric Motor Drive)
- 7 MPB (Modular Power Box)

VNR 62T (ESS265K)

Model	Axle arrangement	Wheelbase	Vehicle maximum load capacity (including trailer)	Number of traction batteries	ESS Total Energy Capacity
VNRE62T	6x2	4928 mm (194 inches) Or 5563 mm (219 inches)	41 t (82,000 lb)	4	265 kwh

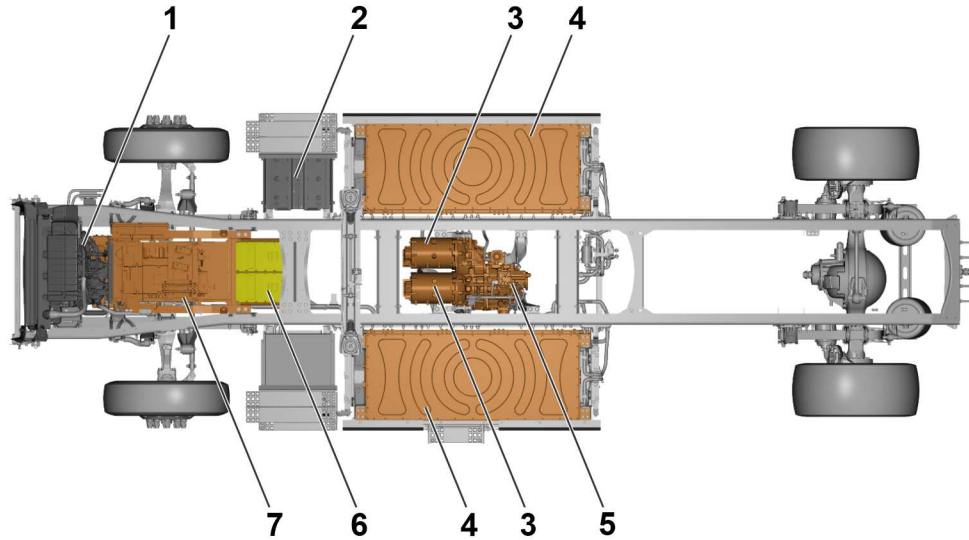


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- 1 Electric cooling system
- 2 24 V system batteries
- 3 EM (Electric Motor)
- 4 Traction batteries
- 5 Transmission
- 6 EMD (Electric motor Drive)
- 7 MPB (Modular Power Box)

VNR 42R (ESS265K)

Model	Axle arrangement	Wheelbase	Vehicle maximum load capacity	Number of traction batteries	ESS Total Energy Capacity
VNRE42R	4x2	Totally 45 wheelbases are applicable for 4x2 rigid. Starting from 4250 mm (167 inches) to 6600 mm (260 inches) in the interval of 2 inches.	16.5 t (33,000 lb)	4	265 kwh



T0164948

- 1 Electric cooling system
- 2 24 V system batteries
- 3 EM (Electric Motor)
- 4 Traction batteries
- 5 Transmission
- 6 EMD (Electric Motor Drive)
- 7 MPB (Modular Power Box)

Electromobility related terminology

ABS	Anti-lock Braking System
ATVSA	Automatic Traction Voltage System Activation
BMU	Battery Management Unit (in the ESS)
CAN	Control Area Network
CCS	Combined Charging System
CSU	Charging Switch Unit
Commissioning	Reversing the electrical safety process in order to return the vehicle to service.
Decommissioning	Making the vehicle and personnel electrically safe before carrying out an operation.
ECC/MCC	Electronic Climate Control/ Manual Climate Control
ECS	Electronically Controlled Suspension
EM	Electric Motor
EMD	Electric Motor Drive
ESS	Energy Storage System
EVCN	Electromobility Vehicle Control Module
FAS	Front Active Steering
FAS-GW	Front Active Steering-Gateway
FLC	Forward Looking Camera
FLR	Forward Looking Radar
HVIL	Hazardous Voltage Interlock Loop
LCM	Light Control Module
LCS	Lane Change System
LECM	Living Environment Control Module
LIN	Local Interconnect Network
OBD	On-board Diagnostic
PCM	Powertrain Control Module
SACU	Side Airbag Control Unit (RollTek)
SDP	Safety Direct Processor
SEM	Services and Entertainment Module
SOC	State of charge
SRS	Supplementary Restraint System
TGW	Telematics Gateway
TPMS	Tire Pressure Monitoring System
TVJB	Traction Voltage Junction Box
TVS	Traction Voltage System
VECU	Vehicle Electronic Control Unit

The traction voltage system

The traction voltage system (600 V), which is used to drive the vehicle contains hazardous voltages. To avoid the risk of electric shock or hazardous electrical burn, follow the instructions and safety precautions.

The electric driveline, includes the electric motor and the transmission that are located between the frame rails and to the rear of the cab. The traction batteries are situated between the vehicle chassis and the side protectors, on either side of the vehicle. In these two areas, and also in the area underneath the cab, there are numerous electrical components (600 V), cables and connectors.

DANGER

Risk of electrical discharge

Incorrect handling of the traction voltage system (>60 V DC (Direct Current)) can cause electric shocks and arcs resulting in serious burns or death.

“Do not repair, dismantle, remove or replace any component, cable, connector, cover or electrical traction protection. Any operation must only be carried out by personnel with adequate training according to **Safety regulations, electric vehicles.**”

Decommissioning and commissioning must only be carried out by personnel with adequate certification according to **Safety regulations, electric vehicles.**

Always use Personal Protective Equipment (PPE) as described in the **Safety regulations, electric vehicles.**

Always use appropriate measuring tools as described in the **Safety regulations, electric vehicles.**

CAUTION

It is strictly forbidden to connect to the 600 V circuit.

CAUTION

It is strictly forbidden to move any of the 600 V elements.

DANGER

Risk of electrical discharge

Do not touch or go near any damaged traction voltage components, cables or connectors.

WARNING

Risk of serious personal injury

The fans for cooling the traction batteries and other components in the traction voltage system can be energized automatically without any warning, even when the key is removed from the starter switch and the truck is parked.

WARNING

Risk of component damage

Decommissioning incorrectly can result in substantial damage, requiring costly repairs. For this reason, the decommissioning must be performed by a personnel who have received the necessary training (obtained at the Volvo Trucks dealer or market company).

Note: The **Safety regulations, electric vehicles** information can be found in IMPACT, under function group 30 and info-type “Repair”.

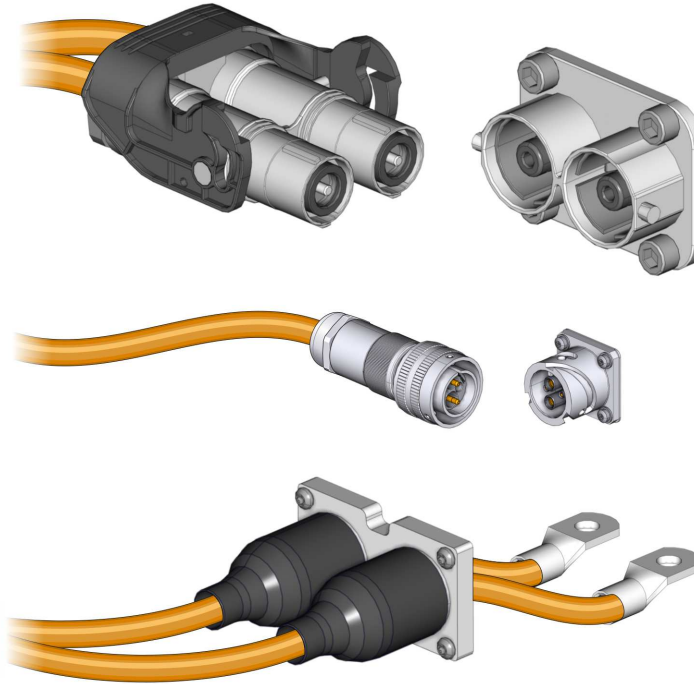


DANGER

Risk of electrical discharge

Do not remove any covers, hatches or similar components that are marked with the warning decal.

TVS cables and connectors:



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Note: All orange colored cables in the vehicle are traction voltage (600 V) cables.

24 V system



CAUTION

Set the chassis switch in off position, before performing any work on the 24 V system batteries (two 12 V batteries connected in series).

For any other work related to 24 V and 12 V systems, normal regulation and recommendations apply. Contact Volvo Trucks dealer for more information.

Note: It is recommended not to perform any additional installation on 24 V system.

Chassis switch

600 V can be distributed based on few possibilities in the vehicle, for example:

- Key in + after START position, then motor starts
- During traction battery recharging with an off-board charger
- When the temperature of the traction batteries is maintained

A switch is installed in the chassis to stop the possible 600 V distributions in the vehicle (through a controlled shutdown sequence).

CAUTION

To perform any work in the commissioned vehicle, set the chassis switch to off position.

CAUTION

Setting the chassis switch to off position, does not mean that the vehicle safety decommissioning procedure has been carried out.

CAUTION

Decommissioning and commissioning must only be carried out by personnel with adequate certification.

Position of chassis switch

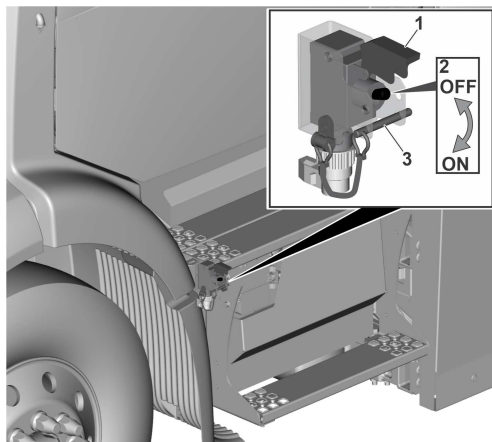
DANGER

If the chassis switch is in the on position, the ATVSA (Automatic Traction Voltage System Activation) function can be automatically activated without any special action being taken and irrespective of the position of the ignition key or of the connection to the offboard charger. There are various reasons why the 600 V circuit may be reactivated (to maintain charge in the 24 V system batteries, to maintain temperature of traction batteries etc.)

CAUTION

The voltage system of the electrical traction network is not energized when the chassis switch is in the off position.

The chassis switch is located on the left-hand side of the truck, next to the vehicle offboard charging interface and near to the footsteps.

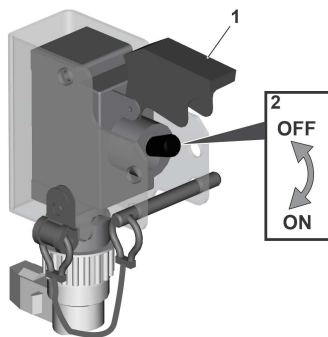


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- 1 Cap
- 2 Chassis switch
- 3 Lockout pin

When performing any work on the vehicle, to avoid accidental movement of chassis switch from off position to on position, follow the steps:

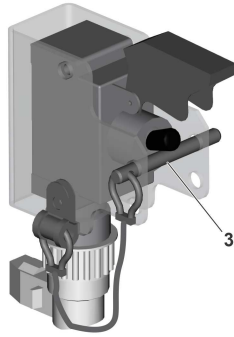
- 1 Open the cap (1) and move the chassis switch (2) from on position to off position.



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Position ON

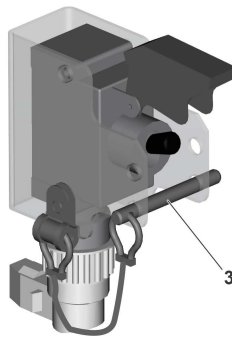
2 Pull the lockout pin (3) from lower hole of the bracket and insert it into the upper hole of the bracket.



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Once the work is completed:

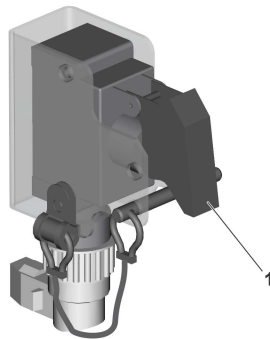
1 Remove the lockout pin (3) from upper hole and secure it in lower hole of the bracket.



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2 Set the chassis switch to on or off position (based on your needs).

3 Close the cap (1).



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The lockout pin in upper hole of the bracket is to seize the movement of chassis switch from off position to on position. The lower hole position is to secure the lockout pin when the vehicle is parked or being driven.

Fire safety

Basic principles – Working with lithium-ion batteries

Lithium-ion batteries are electrochemical storage system that use lithium in an ionic form. The battery cells contain electrodes, an electrolyte (lithium hexafluorophosphate (LiPF₆) dissolved in a mixture of organic solvents) and different products providing different chemical and physical characteristics.

Thermal risk

An internal event such as a shutdown (a quality problem, overload, failure in electronic components, etc.) or an external event (excessive external temperature, external fire start, mechanical shock, etc.) may be the origin of a thermal runaway. A battery cell is damaged when its temperature reaches 75 °C. Exothermic decomposition reactions may result, leading to fire and/or explosion.

Chemical risk

The chemicals products in battery cells can be dangerous to human health and the environment. Decomposition or combustion products may also present a hazard to human health and the environment. These include hydrofluoric acid, phosphoric acid, fluorine compounds, carbon monoxide and carbon dioxide. The nature and quantity of the flammable and toxic gases emitted depend on numerous parameters such as the composition of the battery cell (cathode, solvents and electrolyte salt, additives, etc.), the state of charge, the mode of failure, inflammation or not of the gases emitted, etc.

In the event of a fire, smoke or suspicious smell in the truck, it is important to take the correct actions. See the following instructions.

Guidelines for Electrical Accident

One of Volvo's core values is safety. This is also reflected in the design of the electric vehicles. Provided that the correct routines are followed and appropriate protective measures are taken, there is virtually no risk of electrical accidents.

Although such accidents are unlikely, it is still good to know what to do in case an electrical accident occurs. The following is a general guideline for how to handle such situation.

- 1 **Shut off the electric power:** This could be done by using the emergency chassis cut-off switch.
- 2 **Attend to the injured and notify rescue services:** Follow local procedures for emergency situations.
- 3 **Report the accident:** This is an important step in preventing the accident from happening again.



T3170874

Guidelines for Fire Incident

The following guidelines are to be considered general recommendations in case of thermal incidents related to electric vehicles.

In specific cases other procedures may be more appropriate. Always follow local guidelines and regulations when dealing with thermal incidents.

In case of fires involving electric vehicles:

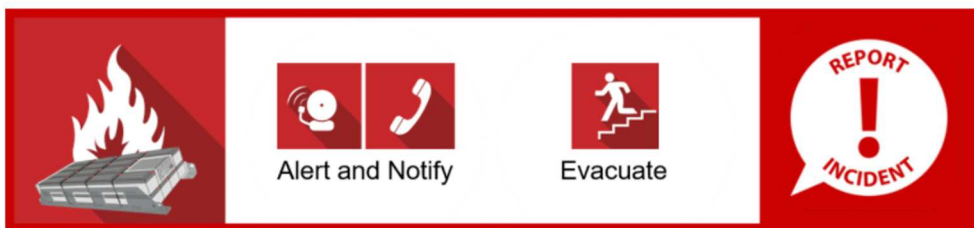
- 1 Alert nearby personnel and notify rescue services.
- 2 Prevent the fire from spreading to the traction batteries if possible. If not possible, evacuate the area.
- 3 Report the incident according to current reporting procedure.



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In case of fire in the traction batteries:

- 1 Alert nearby personnel and notify rescue services.
- 2 Evacuate the area.
- 3 Report the incident according to current reporting procedure.



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Fire, smoke, or suspicious smell in or near the traction batteries

DANGER

Risk of serious personal injury or death
Do not try to extinguish the fire yourself.

DANGER

Risk of serious personal injury or death
Do not inhale the smoke, it is very toxic.

If there is a fire in or near the traction batteries, or if smoke is coming from the traction batteries or the area around them, do the following:

- 1 Evacuate the truck immediately and quickly move away from the truck.
- 2 Alert anyone that is nearby and secure the area around the truck.
- 3 Contact the emergency service in the country you are in. Inform them that you have an electric truck.

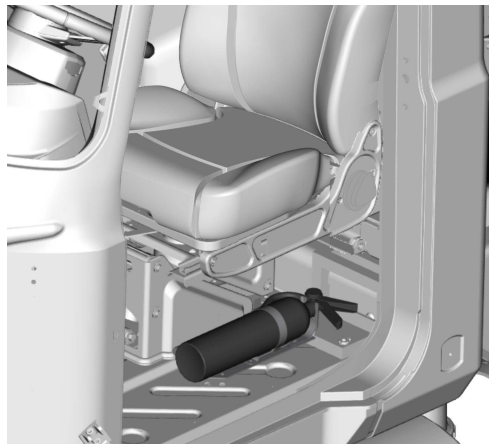
Fire in another part of the truck

If there is a fire in another part of the truck (not in or near the traction batteries), do the following:

- 1 Get out of the truck immediately.
- 2 Contact the emergency service in the county you are in. Inform them that you have an electric truck.
- 3 If you think that it is safe, extinguish the fire using ABC (powder) extinguisher other than traction battery area.
- 4 If the fire reaches the traction battery area, move away from the truck immediately.

The fire extinguisher is located next to the driver's seat, in the door opening.

The fire extinguisher can be removed from its position even if the driver door is closed.



Chassis

Welding

DANGER

Risk of serious personal injury or death

Welding directly on the ESS is not permitted as this can cause dangerous electric shocks, arcing or burns, which can result in serious personal injury or death.

WARNING

Risk of component damage

Failure to follow the following instructions can result in damage to electrical components.

It is not permitted to weld in the wheelbase area because of the traction voltage (600 V/400 V) components.

It is permitted to weld outside the wheelbase area, in the rear overhang.

The welding process that applies to conventional trucks, also applies to electric trucks.

CAUTION

It is not permitted to weld on this vehicle without decommissioning.

CAUTION

Decommissioning and commissioning must only be carried out by personnel with adequate certification.

- Carry out the vehicle safety decommissioning procedure.
- Welding directly onto electrical components is not permitted.
- Electric components must be given adequate protection if the welding is carried out close to them.
- Ground the welding equipment as close as possible to the welding area.
- Protect the vehicle from splashing, which may occur during welding.

Drilling

The drilling process that applies to conventional trucks, also applies to electric trucks.

DANGER

Risk of serious personal injury or death

When drilling, make sure that there are no traction voltage (400/600 V) circuit components that could be damaged.

CAUTION

It is not permitted to drill on this vehicle without decommissioning.

CAUTION

Decommissioning and commissioning must only be carried out by personnel with adequate certification.

Painting

Contact the vehicle manufacturer before carrying out any painting work.

CAUTION

It is not permitted to paint the BEV without decommissioning and also in an enclosed area.

CAUTION

Decommissioning and commissioning must only be carried out by personnel with adequate certification.

CAUTION

To avoid damage to the traction battery (600 V battery), do not exceed the following drying process of the paint:

- The maximum drying temperature (80° C).
- The maximum drying time (40 minutes).

If the BEV is painted with more than one color, allow the BEV to cool down to room temperature (20° C) before it is sent to drying oven.

The orange colored cables in the truck are traction voltage (600 V) cables. It is not permitted to paint the orange cables or in any other way changing their colors.

Towing and shunting



CAUTION

The vehicle may only be towed or shunted with the propeller shaft disconnected.

Please see the driver's handbook for more information on towing the vehicle.

Washing



CAUTION

Do not wash the truck if any connectors in the traction voltage system are not fully connected or if the truck is disassembled in any other way.



CAUTION

Before washing the truck, make sure that the cover for the charging inlet is securely fastened and fully covers the charging inlet.

General

Regular cleaning helps maintain the value of your truck. Wash the truck more often in winter conditions or other dirty driving conditions.

The waste water from cleaning the truck contains chemicals and pollutants that are bad for the environment. Use environmental friendly detergents and ensure that the truck is cleaned in a facility where the waste water is collected.

Notes

Washing with high pressure

Be careful when washing the truck with a high-pressure washer. If water and dirt penetrate into components, then that can cause damage over time.

Do not use a high-pressure washer to clean the following:

- Traction batteries
- Components in the traction voltage system
- Universal joint crosses
- Support bearings
- Sliding interfaces
- Joints
- Sealings
- Connectors
- Electrical components
- Air inlets
- Ventilation, for example transmission and oil reservoirs

Tires and air suspension bellows can be cleaned with a high-pressure washer, but do not use pulsating high pressure as it can damage them. The damage is not visible but may eventually cause tires or bellows to rupture.

The radiator can also be cleaned with high pressure, but, be careful as the radiator fins can be easily damaged.

Note: Minimum distance between the high-pressure nozzle and the washing surface:

Approximately 70 cm with a round concentrated jet.

Approximately 30 cm with a flat widespread jet.

Washing the cab



CAUTION

When washing the windshield, ensure that the windshield wipers are switched off. Otherwise there is a risk of fingers being trapped by the wiper blades.

The truck should be washed when it is dirty. Especially in winter when road salt and moisture can cause corrosion.

The following points must be followed to avoid paint damage and to achieve good results when washing:

- **Washing method:** Use a pressure washer primarily. For the dirt that cannot be removed using this method, try to remove with a brush or sponge with a best suited cleaning agent for the type of dirt. There is a risk of scratching the paint using brush washing without high pressure washing or washing in brush washers that are poorly maintained (worn, dirty brushes etc.).
- **Washing chemicals, general:** Different agents are recommended for different types of dirt. Always follow the manufacturer's recommendations for use, dosage and maximum temperature.
- **Avoid chemicals drying into the paint surface.**
- **Washing detergent:** Avoid using strong alkaline agents (pH >12). Do not wash the truck in direct sunlight. Rinse with plenty of cold water before chemicals are applied. If the temperature is above (30°), wash small areas and then rinse clean so that long exposure times or drying chemicals is avoided.

Washing the chassis

Both chassis and cab should be washed when they are dirty. Be careful with high pressure washing of axles, joints and other moving parts, where water and dirt can be forced in. Avoid flushing away lubricant. Should this still happen, make sure to re-lubricate the components.

Washing detergent: Avoid using strong alkaline agents (pH >12). Do not wash the truck in direct sunlight. Rinse with plenty of cold water before chemicals are applied. If the temperature is above (30°), wash small areas and then rinse clean so that long exposure times or drying chemicals is avoided. Always rinse with plenty of water after using washing detergent.

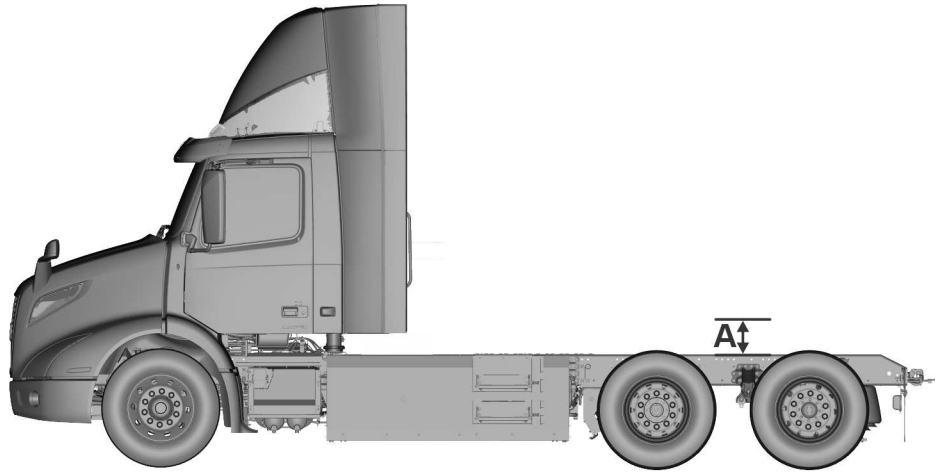
Note: Never spray water directly onto the traction batteries or other components in the traction voltage system. Also, do not spray water directly onto sealings, gaskets or electric equipment (such as cables or connectors) in the 24 V system.

Subframe height

A minimal subframe height (A) is required for traction battery maintenance.

- 140 mm for distribution type truck

Note: Do not install any element just above the traction batteries. Maintain minimum 140 mm subframe height to install any element above the traction batteries.



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Notes

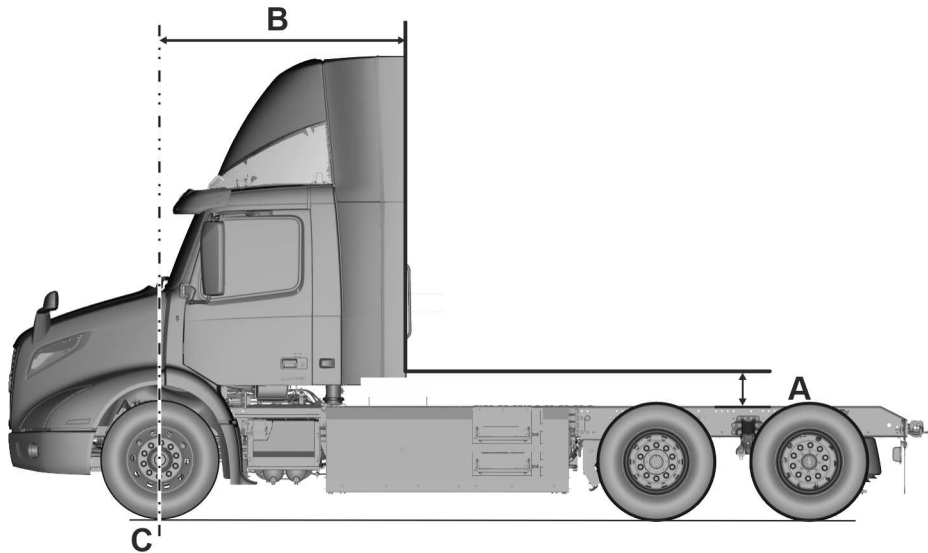
Body attachments

For information about Body Attachments refer the Volvo Body Builder manual section 7. <https://www.volvotrucks.us/parts-and-services/services/body-builder-support/manuals/>

Body start dimensions

A minimal subframe height (**A**) is required for traction battery maintenance.

Body builder must maintain a minimum body start distance (**B**) from the centerline to the end of the cab.



T3170633

- **A:** 140 mm
- **B:** 1716 mm
- **C:** Centerline of front axle

Electrical/Electronic information



CAUTION

If the vehicle is to be at a standstill position for a long period, set the chassis switch to the OFF position. In addition, the SOC of the traction batteries must be checked every month. If the low SOC warning light comes on, recharge the traction batteries.

Battery Charging

24 V System Batteries Charging

The 24 V system has two 12 V batteries connected in series to provide 24 V output. A battery analyzer is used to equalize the voltage between two 12 V batteries.

The traction batteries charge the 24 V system batteries through DC/DC converter. The DC/DC converter is used to step-down the 600 V from traction batteries to 24 V to charge the 24 V system batteries. When the 24 V system batteries are fully discharged, ALWAYS disconnect the battery cables and charge each battery separately. This will prevent the voltage coming into the battery from damaging other system circuits.

Traction Battery Charging



CAUTION

If the vehicle is to be at a standstill position for a long period, set the chassis switch to the OFF position. In addition, the SOC of the traction batteries must be checked every month. If the low SOC warning light comes on, recharge the traction batteries.

Note: If the 24 V system batteries are fully discharged due to any unnoticed battery consumption or for any other reasons, then it is important to charge the 24 V system batteries before charging the traction batteries.

Charging

There are two ways to charge the traction batteries:

- Charging while driving, by recovery of braking energy (refer driver's handbook)
- DC charging – can provide up to 150 kW.

The actual time it takes to fully charge the traction batteries depends on the following conditions:

- The capacity of the traction batteries
- The current state of charge of the traction batteries
- The capacity of the charging station and the charging infrastructure
- The ambient temperature

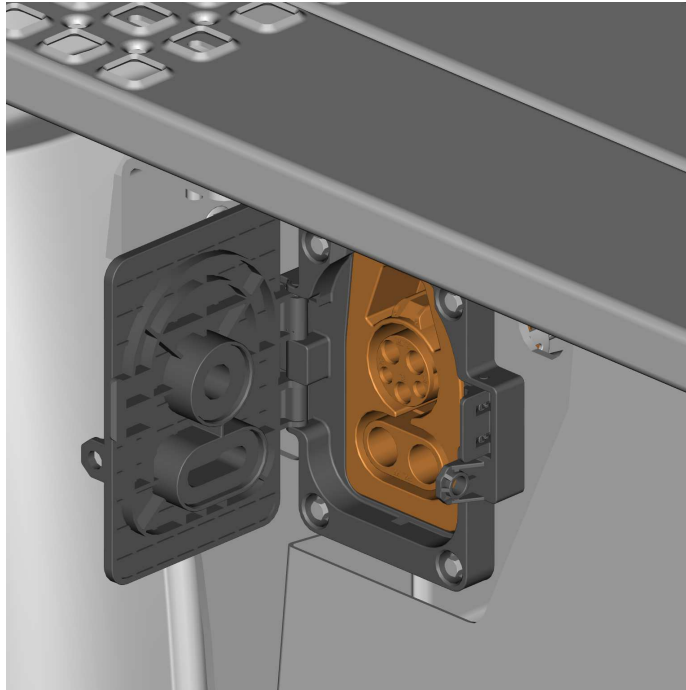
The optimum charging strategy for the truck depends on the truck specification and how it is used. Contact Volvo Trucks dealer for more information.

Charging Interface

A vehicle may have any one of the following charging interface.

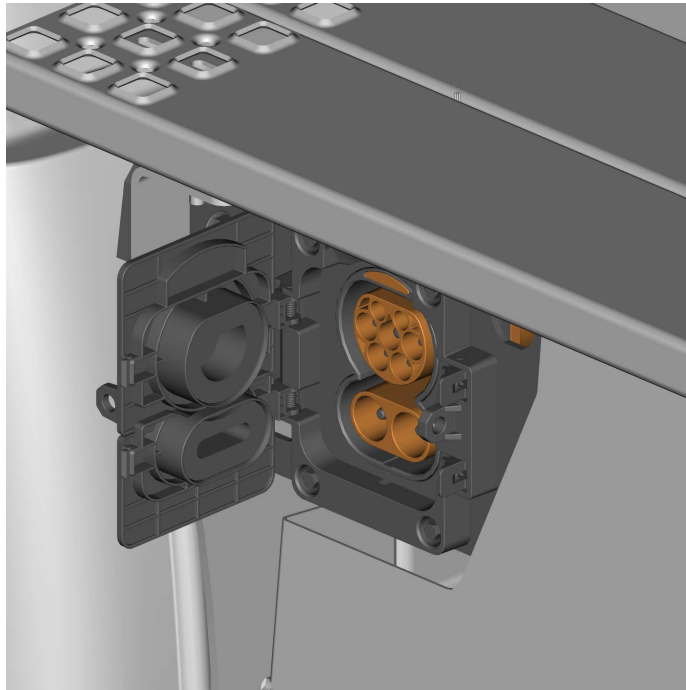
The charging interface is provided for recharging the traction batteries. There are two types of charging interface:

- CCS1 – only supports DC charging.



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- CCS2 – supports both AC and DC charging (AC charging option is not applicable for VNR electric).

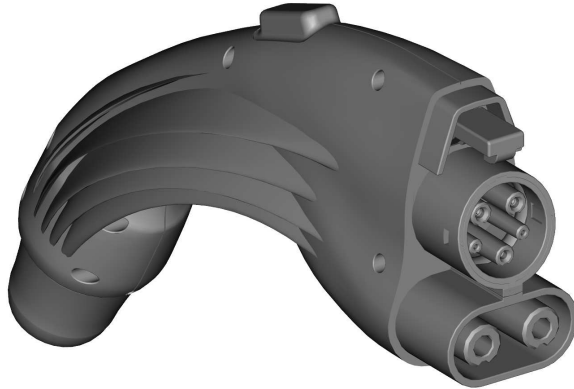


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Charging Connectors

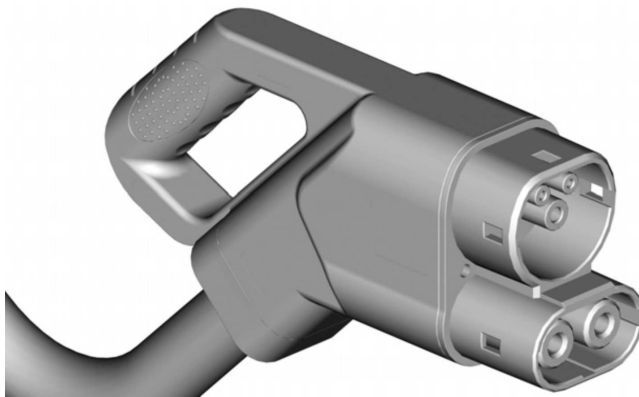
There are two types of charging connectors: Combo-1 and Combo-2.

- The charging interface CCS1 uses Combo-1 charging connector and supports only for DC charging.
Combo-1 connector (DC charging)



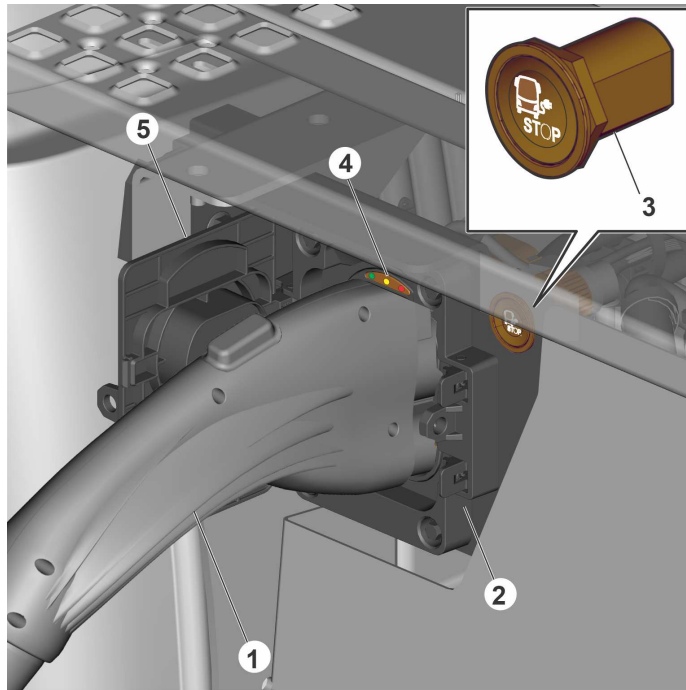
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- The charging interface CCS2 uses Type-2 charging connector for AC charging (not applicable for VNR Electric) and Combo-2 charging connector for DC charging.
Combo-2 connector (DC charging)



T3166322

Start charging



T3166320

- 1 Charging connector
- 2 Charging inlet
- 3 Charging stop button
- 4 Indicator lamp
- 5 Charging inlet cover

The following conditions must be met to start charging the traction batteries:

- The truck is stationary
- The parking brake is applied
- The chassis switch in ON position



WARNING

Make sure that the charging cable, connector and charging inlet are not damaged, dirty or wet. Do not use charging equipment that is in bad condition.



WARNING

If the charging inlet is dirty, do not clean it yourself. Contact the Volvo Trucks dealer.

- 1 Make sure that the charging cable is properly connected to the charging station or power outlet.
- 2 Remove the cover from the charging inlet.
- 3 Align the connector with the charging inlet and push the connector fully into the charging inlet.

The connector is locked in position by a locking pin. This initiates charging procedure. During this procedure, the indicator lamp next to the charging inlet flashes yellow.

Note: It can take up to 15 seconds for the truck to prepare for charging.

- 4 If the charging starts automatically, wait for the indicator lamp to switch to a green, flashing light.

If the charging does not start automatically, wait for the indicator lamp to switch to a yellow, steady light, then start the charging from the charging station.

- 5 During charging, the indicator lamp flashes green. When the traction batteries are fully charged, it changes to a green, steady light.

Note: During charging, it is normal that the connector and the charging inlet become warm. If the connector or the charging inlet appears to be warmer than normal, stop the charging immediately. Contact the authorized Volvo dealer.

Stop charging

- 1 Press the stop button (located next to the charging inlet).

The indicator lamp turns on with yellow, steady light. The charging is stopped and the locking pin is retracted.

- 2 Wait until the indicator lamp turns off, then pull the connector straight out from the charging inlet.

If the connector cannot be pulled out, retract the locking pin manually.

- 3 Install the charging inlet cover.



WARNING

Make sure that the cover is installed correctly and it fully covers the charging inlet. The charging inlet must be protected from dirt and water.

Signals during charging

The indicator lamp next to the charging inlet gives basic information about the charging.

Yellow, flashing

Meaning: A charging cable is connected to the charger inlet but the charging has not started yet.

Action: Wait for the charging to start automatically or, if needed, start the charging from the charging station.

Green, flashing

Meaning: Charging is about to start or charging.

Action: No action is needed.

Green, steady

Meaning: The traction batteries are fully charged.

Action: Disconnect the charging cable if you want to drive away, otherwise no action is needed.

Yellow, steady

Meaning: Charging is paused or delayed.

Action: If possible, start the charging from the charging station. If it is not possible to start the charging, wait for the scheduled charging to begin.

Red, flashing

Meaning: The conditions for start of charging are not met.

Action: Check that the parking brake is applied.

Red, steady

Meaning: A fault prevents charging.

Action: Check that all charging equipments are in good condition and properly connected. Also check that the charging station is connected to the mains and is working. Contact the authorized Volvo dealer, if the fault remains.

Accident While Charging

If the vehicle is involved in an accident while charging:

- Unlock the cab.
- Press the charging stop button and wait for steady yellow light.
- Once the yellow light goes off, pull the charging plug from the charging inlet.
- If the charging plug cannot be pulled out, perform the procedure given in “Manually retracting the locking pin” section.

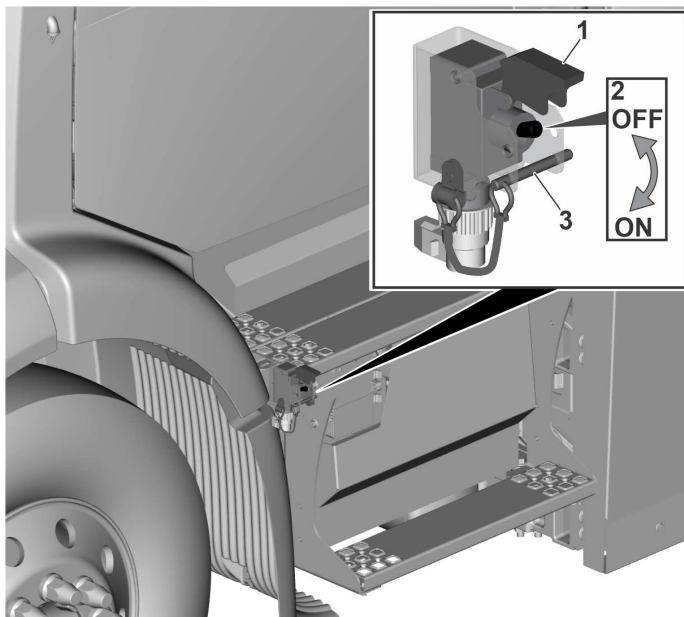
Manually retracting the locking pin

If the locking pin does not retract automatically when the stop button is pressed, then manually retract the lock pin.

WARNING

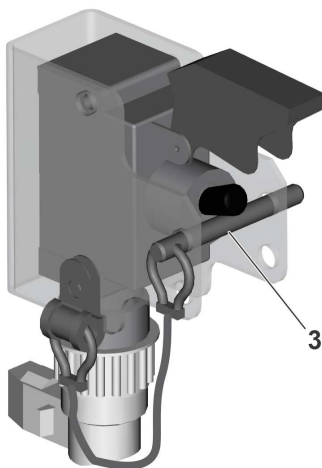
Risk of arc flash. Position the chassis switch in OFF position before manually retracting the locking pin.

- 1 Open the cap (1) and position the chassis switch (2) in OFF position.



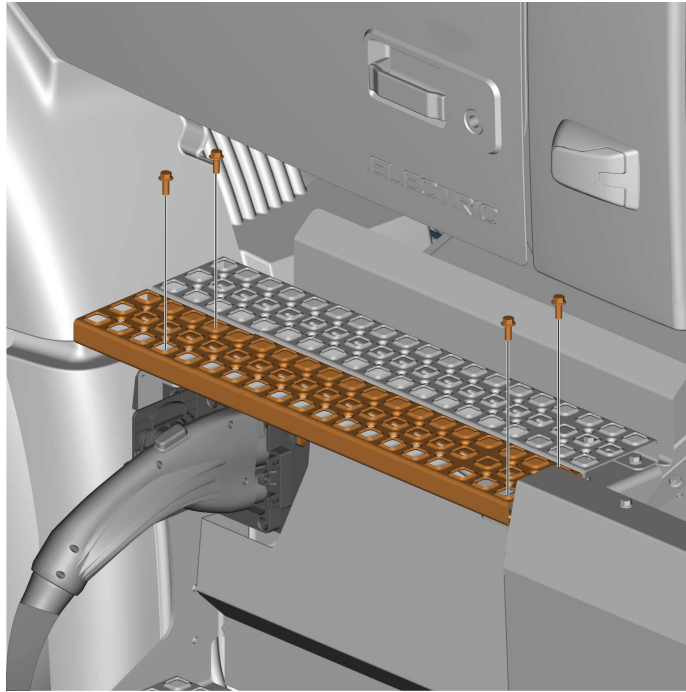
T3166323

- 2 Pull the lockout pin (3) from the lower hole of bracket and insert it into upper hole of the bracket.



T3169687

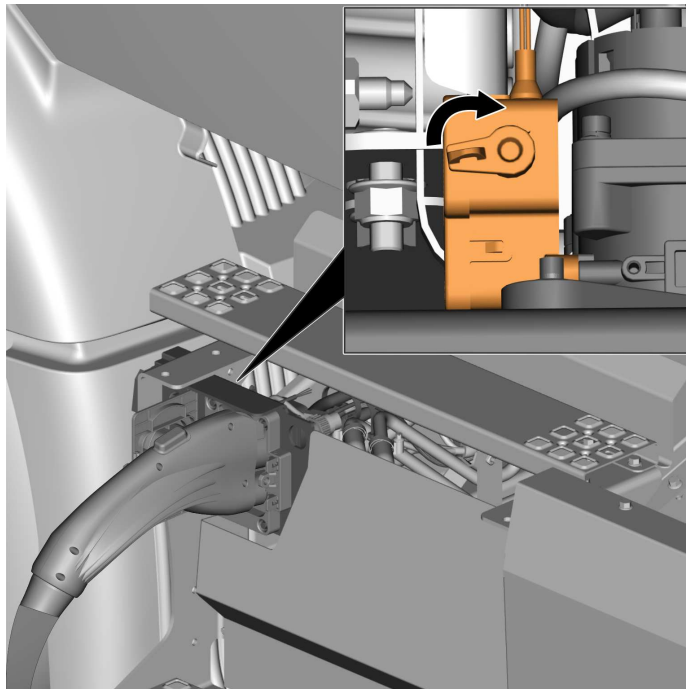
3 Remove the screws and remove the step.



T3166317





4 Rotate the lever and remove the charging plug.

Charging interface CCS1



T3166318

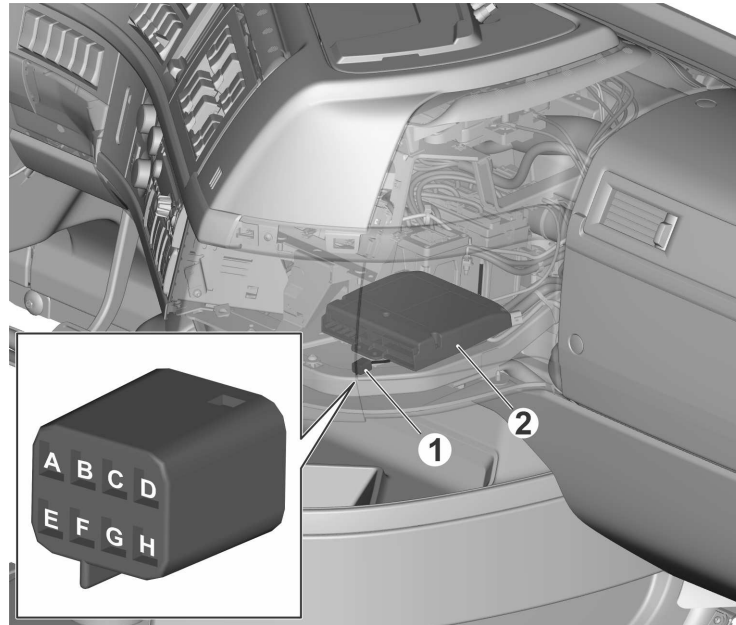
Parking recommendation

Description	Action when parking	Action when start
Parking the truck less than eight hours	<p>Check the SOC (SOC must be minimum 50%). If the SOC is less than the minimum, charge the traction batteries to 50% and disconnect the charger from truck before parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p> <p>or</p> <p>Connect the charger to the truck during parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p>	<p>If the truck is connected to the charger, disconnect the charger</p> <div style="border: 1px solid black; padding: 5px;">  CAUTION </div> <div style="border: 1px solid black; padding: 5px;"> <p>Charge the traction batteries as soon as possible if the SOC warning lamp turns on in the instrument cluster.</p> </div>
Parking the truck less than two days	<p>Check the SOC (SOC must be minimum 75%). If the SOC is less than the minimum, charge the traction batteries to 75% and disconnect the charger from truck before parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p> <p>or</p> <p>Connect the charger to the truck during parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p>	<div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">  WARNING </div> <div style="border: 1px solid black; padding: 5px;"> <p>Do not start the truck if the SOC warning lamp flashes in the instrument cluster. Charge the traction batteries immediately.</p> </div>
Parking the truck less than one week	<p>Ambient Temperature above -10°C (14°F): Check the SOC (SOC must be 100%). If the SOC is less than the 100%, charge the traction batteries to 100% and disconnect the charger from truck before parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p> <p>or</p> <p>Connect the charger to the truck during parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch.</p>	<p>If the truck is connected to the charger, disconnect the charger</p> <div style="border: 1px solid black; padding: 5px;">  CAUTION </div> <div style="border: 1px solid black; padding: 5px;"> <p>Charge the traction batteries as soon as possible if the SOC warning lamp turns on in the instrument cluster.</p> </div> <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">  WARNING </div> <div style="border: 1px solid black; padding: 5px;"> <p>Do not start the truck if the SOC warning lamp flashes in the instrument cluster. Charge the traction batteries immediately.</p> </div>
	<p>Ambient Temperature below -10°C (14°F): Check the SOC (SOC must be 100%). If the SOC is less than the 100%, charge the traction batteries to 100% and disconnect the charger from truck before parking. Do not disconnect the 24 V system batteries. Do not turn-off the chassis switch. check the SOC of the traction batteries once in every two</p>	<p>To restart the vehicle after a week long parking at ambient temperature of below -10°C (14°F): Connect the charger to the vehicle at least 12 hours before operation. Ensure that the chassis switch is on position.</p>

Body builder connector (X194)

The body builder connector X194 is located in the inside dashboard on the ECU electric center. The body builder connector is connected to the vehicle CAN via TGW (Telematics Gateway unit).

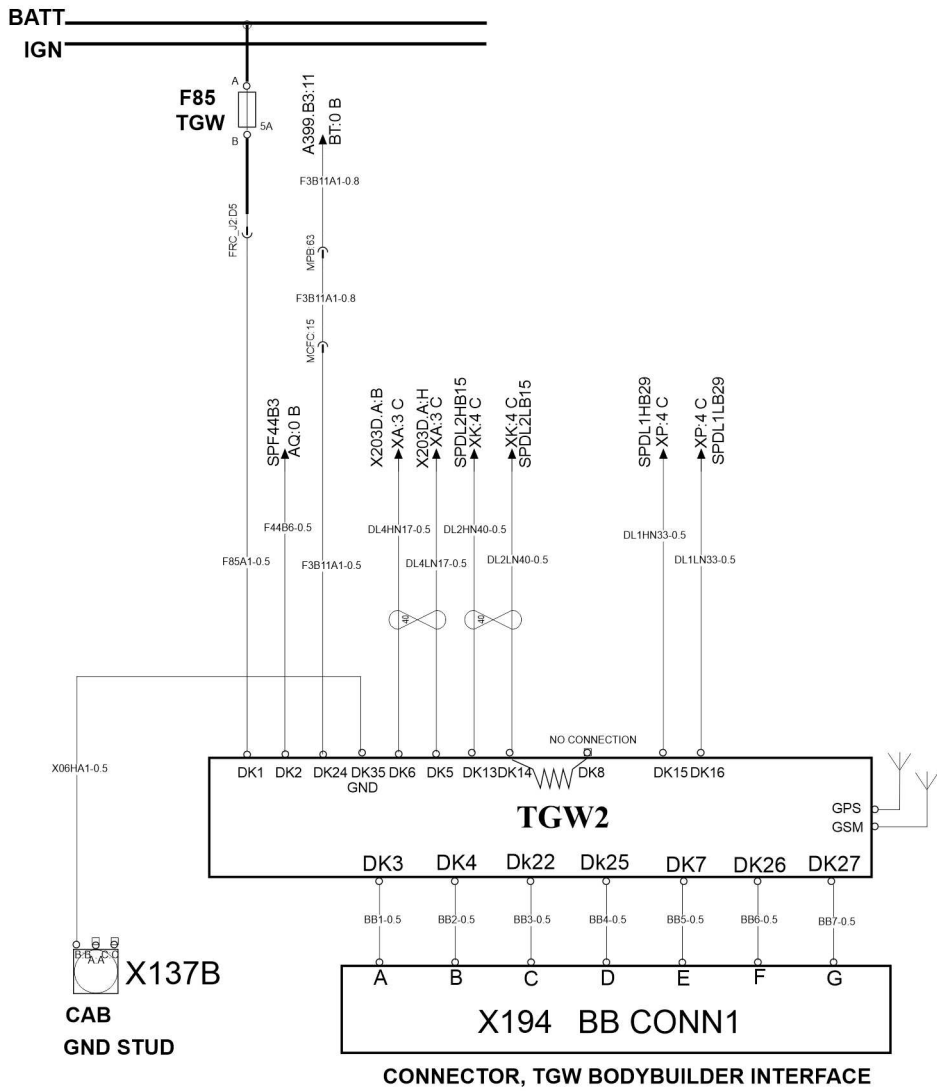
Part name	Part number
Body Builder Connector (X194)	8082087



T3168780

- 1 Body Builder Connector (X194)
- 2 TGW (Telematics Gateway) unit

Pin No.	Signal Name	Description	Intended use	Direction (from ECU)
A	D_IN1	Digital Input1	Spare	Input
B	Vehicle CAN2_High	CANH (J1939)	Vehicle connection and diagnose	Input/output
C	Vehicle CAN2_High Strap	CANH (J1939)	Vehicle connection and diagnose	Input/output
D	Assistance button	Digital input, assistance request button, active low	Emergency assistance call	Input
E	Assistance button	Digital output (source), assistance request feedback light (on button)	Emergency assistance call feedback to driver	Output
F	D_out1	Digital output (sink)	Spare	Output
G	Info_IF	Serial input digital/analogue tachograph	Driver Activity	Input
H	No connection	—	—	—

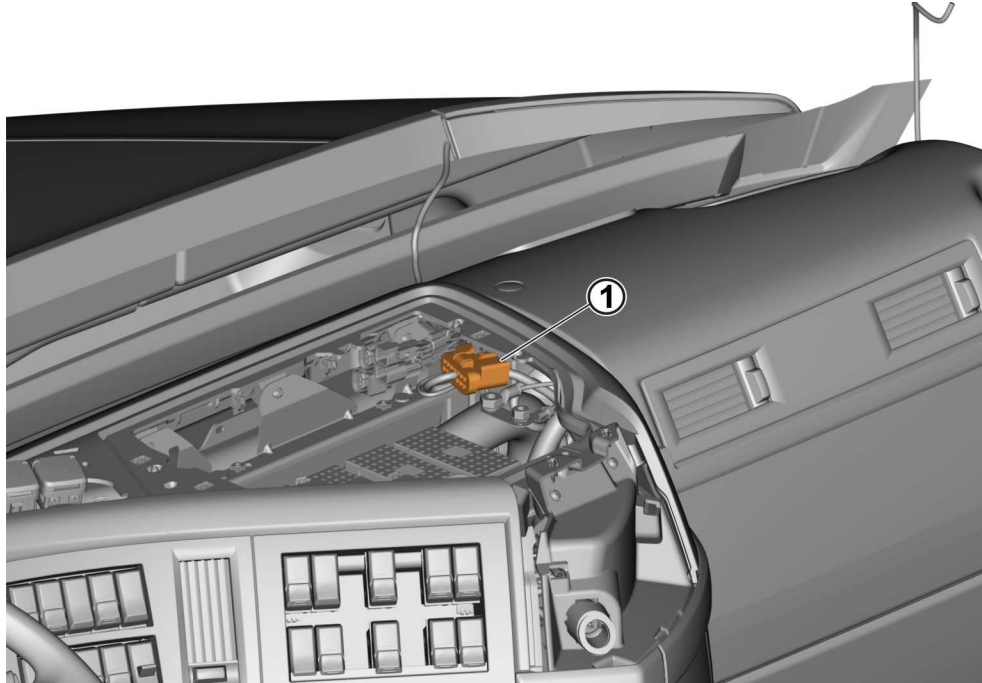


T3168781

Vehicle Accessory Connector (RP1226)

A TMP RP1226 Connector is located under the dashboard and can be connected to aftermarket Fleet Management devices. Examples of these include telematics devices, data logging equipment, tire pressure monitors and electronic logging devices (ELDs) used for hours-of-service recording.

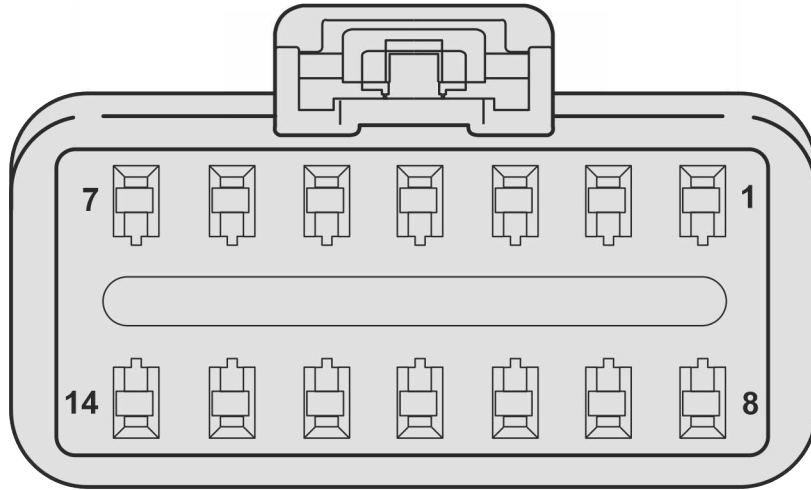
Part name	Part number
Vehicle Accessory Connector (RP1226)	20734993



T0169408

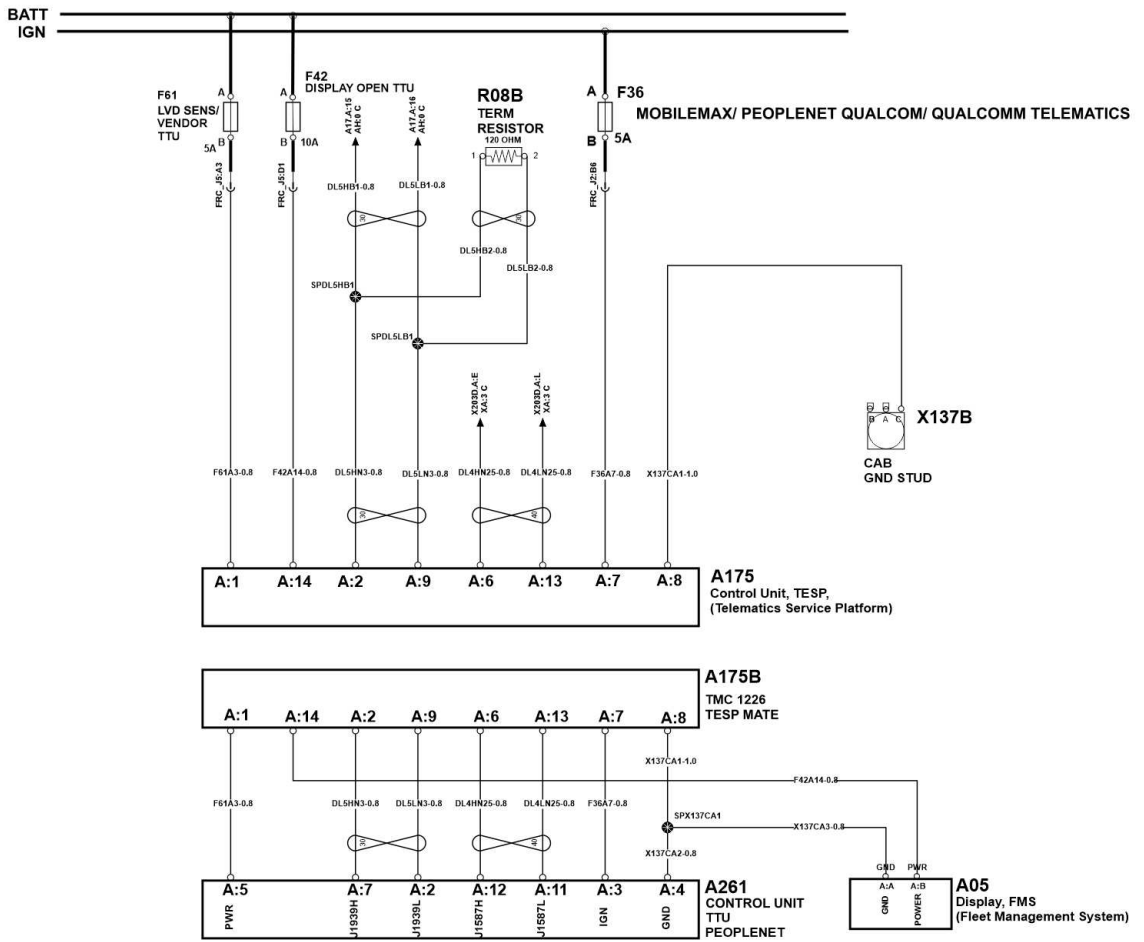
1 Vehicle Accessory Connector (RP1226)

TMC RP1226 Connector



T3159520

Pin numbers	Description
1	+12 V After battery switch (10 A shared)
2	CAN-1 High
3	—
4	—
5	—
6	J1708A
7	+12 V After ignition (10 A shared)
8	Ground
9	CAN-1 Low
10	—
11	—
12	—
13	J1708B
14	+12 V Battery (10 A shared)

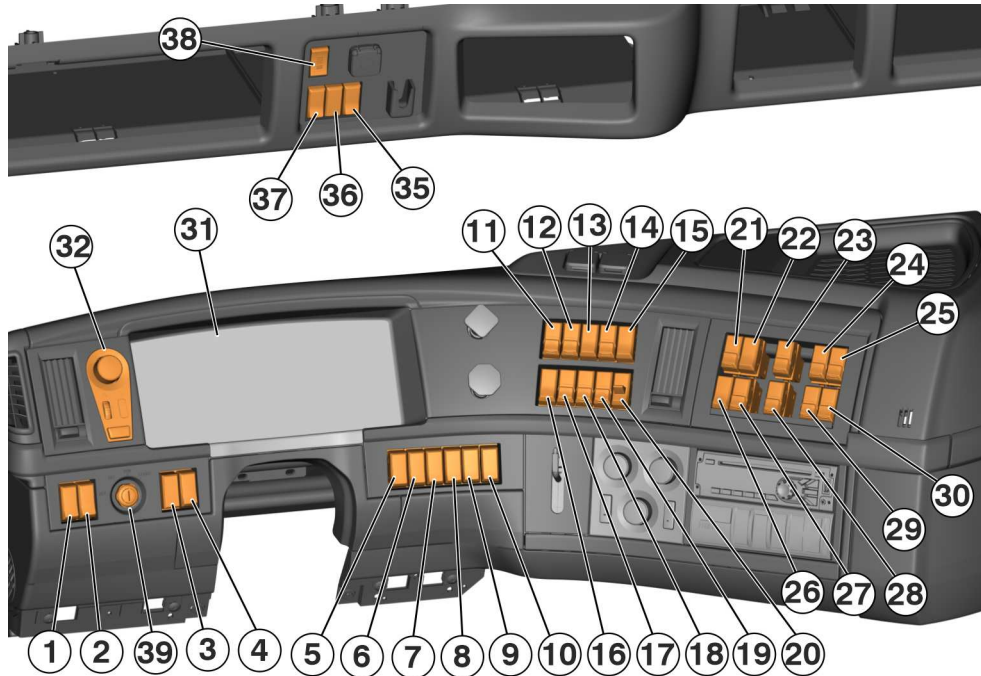


T3169445

Notes

Switches

Dashboard Switch Locations (Layout-1)



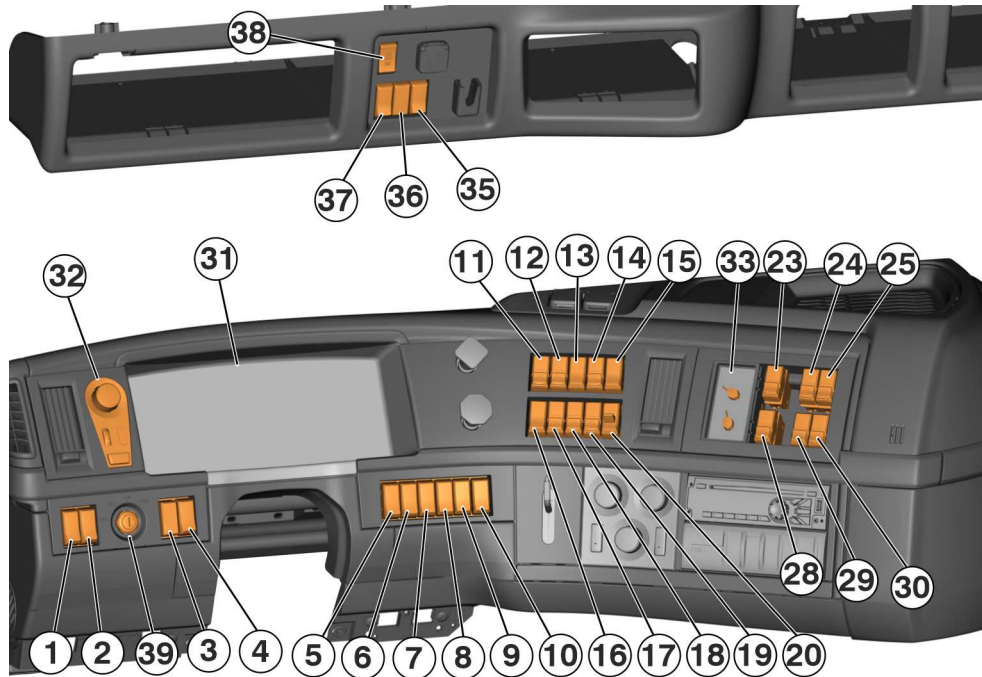
T3169196

Position	Description
1	Back of Cab light
2	Pre-trip inspection
3	Bright work lights
4	Blank
5	Blank
6	AUX
7	AUX
8	AUX
9	AUX
10	Floor light
11	Bogie control/ Without bogie lift
12	ECS ON/OFF
13	ECS UP/DOWN
14	Interwheel Diff. lock
15	ATC MUD/SNOW+ATC OFF
16	Drive/Reverse
17	Neutral switch
18	Blank
19	Fifth wheel slide/Blank
20	Hill Start assist/5th wheel unlock

21	Snow Plow
22	Beacon light
23	Blank
24	Blank
25	Blank
26	Blank
27	Blank
28	Blank
29	Blank
30	Blank
31	Instrument Cluster
32	Light switch
33	Blank
34	Blank
35	LDWS disable switch/ Blank
36	Blank
37	DRL Override
38	Blank
39	Ignition Switch

Notes

Dashboard Switch Locations (Layout-2)



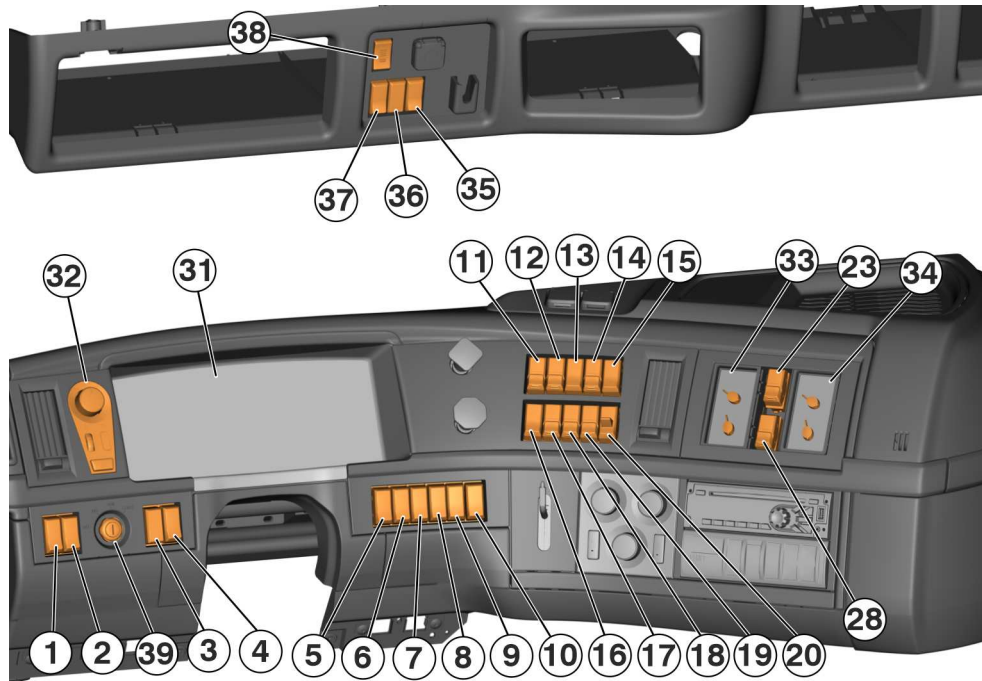
T3169198

Position	Description
1	Back of Cab light
2	Pre-trip inspection
3	Bright work lights
4	Blank
5	Blank
6	AUX
7	AUX
8	AUX
9	AUX
10	Floor light
11	Bogie control/ Without bogie lift
12	ECS ON/OFF
13	ECS UP/DOWN
14	Interwheel Diff. lock
15	ATC MUD/SNOW+ATC OFF
16	Drive/Reverse
17	Neutral switch
18	Blank
19	Fifth wheel slide/Blank
20	Hill Start assist/5th wheel unlock
21	Snow Plow

22	Beacon light
23	Blank
24	Blank
25	Blank
26	Blank
27	Blank
28	Blank
29	Blank
30	Blank
31	Instrument Cluster
32	Light switch
33	Secondary Gauges
34	Blank
35	LDWS disable switch/ Blank
36	Blank
37	DRL Override
38	Blank
39	Ignition Switch

Notes

Dashboard Switch Locations (Layout-3)



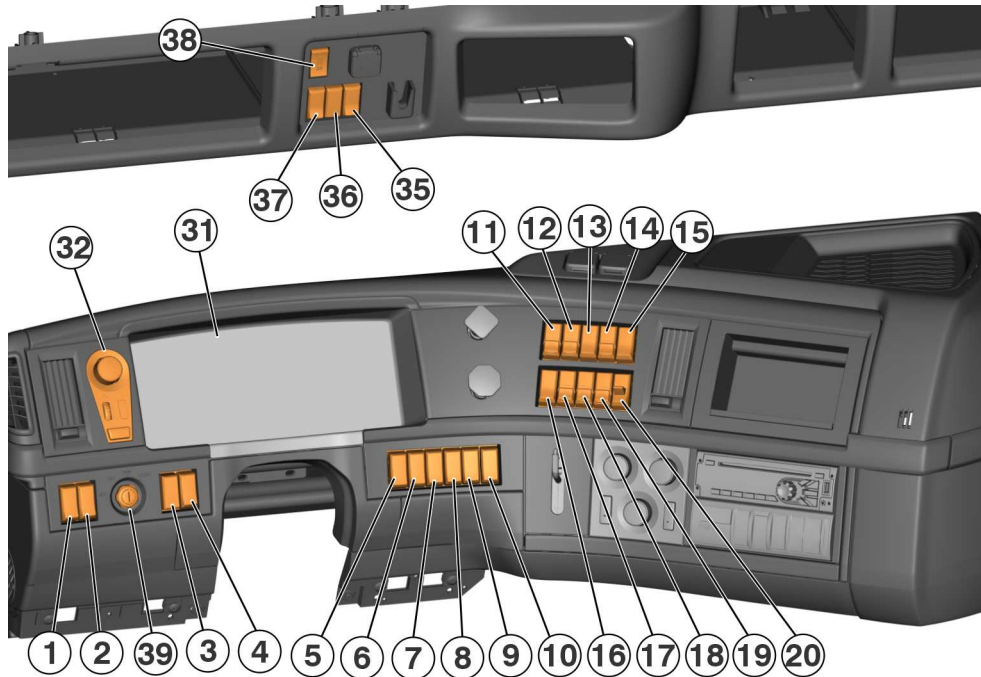
T3169197

Position	Description
1	Back of Cab light
2	Pre-trip inspection
3	Bright work lights
4	Blank
5	Blank
6	AUX
7	AUX
8	AUX
9	AUX
10	Floor light
11	Bogie control/ Without bogie lift
12	ECS ON/OFF
13	ECS UP/DOWN
14	Interwheel Diff. lock
15	ATC MUD/SNOW+ATC OFF
16	Drive/Reverse
17	Neutral switch
18	Blank
19	Fifth wheel slide/Blank
20	Hill Start assist/5th wheel unlock
21	Snow Plow

22	Beacon light
23	Blank
24	Blank
25	Blank
26	Blank
27	Blank
28	Blank
29	Blank
30	Blank
31	Instrument Cluster
32	Light switch
33	Secondary Gauges
34	Secondary Gauges
35	LDWS disable switch/ Blank
36	Blank
37	DRL Override
38	Blank
39	Ignition Switch

Notes

Dashboard Switch Locations (Layout-4)



T3169199

Position	Description
1	Back of Cab light
2	Pre-trip inspection
3	Bright work lights
4	Blank
5	Blank
6	AUX
7	AUX
8	AUX
9	AUX
10	Floor light
11	Bogie control/ Without bogie lift
12	ECS ON/OFF
13	ECS UP/DOWN
14	Interwheel Diff. lock
15	ATC MUD/SNOW+ATC OFF
16	Drive/Reverse
17	Neutral switch
18	Blank
19	Fifth wheel slide/Blank
20	Hill Start assist/5th wheel unlock
21	Snow Plow

22	Beacon light
23	Blank
24	Blank
25	Blank
26	Blank
27	Blank
28	Blank
29	Blank
30	Blank
31	Instrument Cluster
32	Light switch
33	Blank
34	Blank
35	LDWS disable switch/ Blank
36	blank
37	DRL Override
38	Blank
39	Ignition Switch

Notes

Fuse and relay box



WARNING

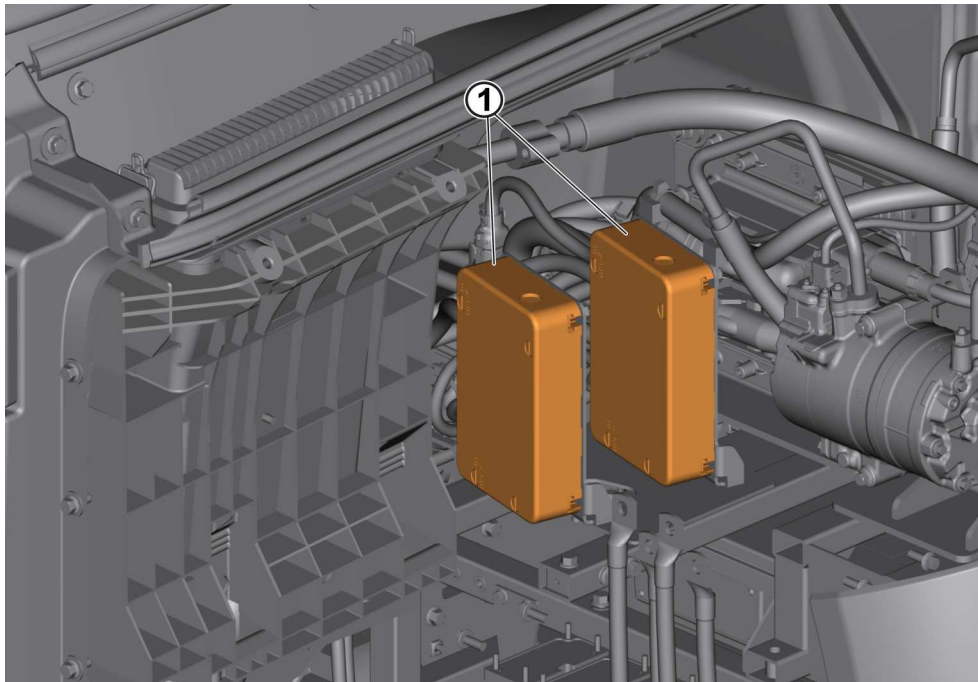
Always use fuses with the correct rating when changing. Never overfuse. Never install a fuse higher than the instructed rating.

The truck's fuses are designed to protect the electrical system's circuits from overload and are usually only tripped as a result of a short circuit. For this reason, if a fuse has blown you should always have an authorized Volvo workshop determine the cause.

Fuse box

Fuse box (FM-20 & FM-21)

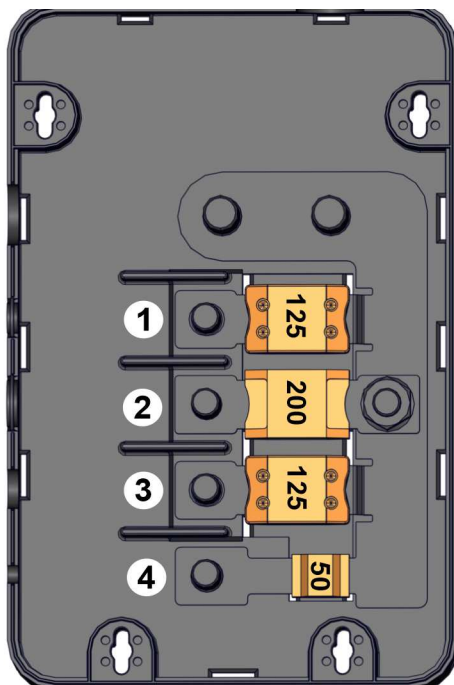
The fuse box is an enclosed structure contains fuses to protect the electric components from damage due to short circuit and overload. Fuse boxes FM-20 and FM-21 are located on the Modular Power Box (MPB).



T3169903

1- Fuse boxes (FM-20 & FM-21)

Layout (Fuse box FM-20)



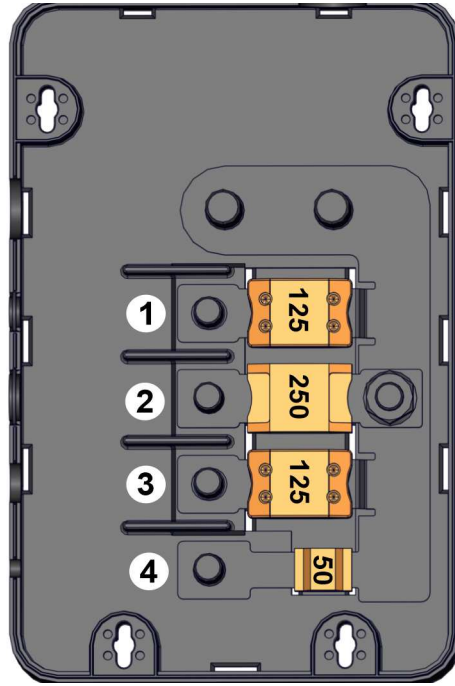
T3171089

Fuse positions

Positon	Rated current	Function
1	Fuse 125 A	Heater 1
2	Fuse 200 A	
3	Fuse 125 A	Heater 2
4	Fuse 50 A	Climate

Notes

Layout (Fuse box FM-21)



T3169909

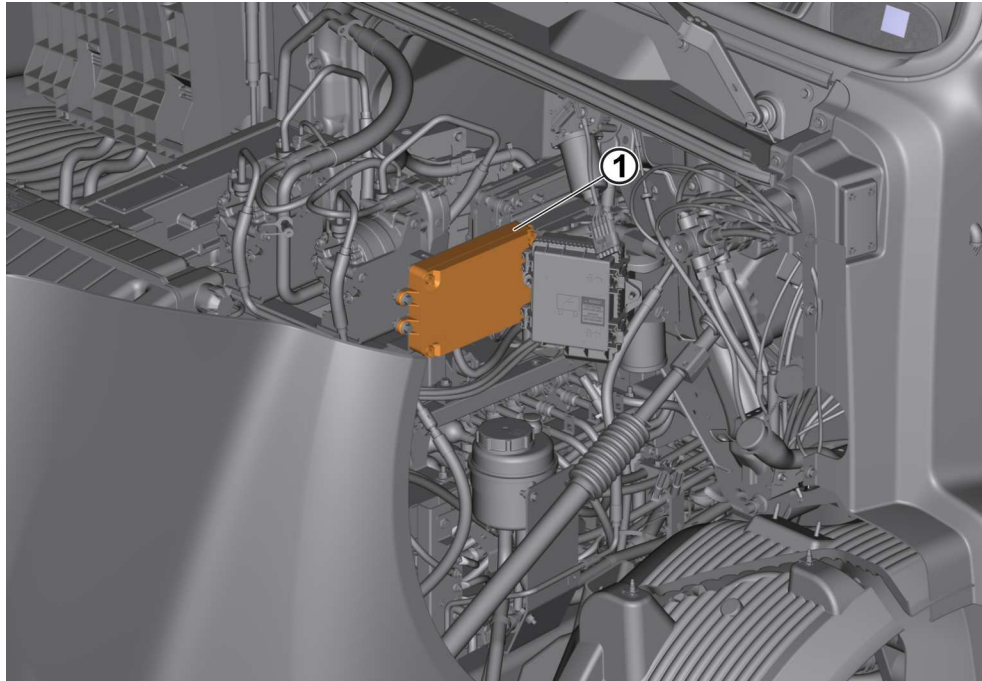
Fuse positions

Positon	Rated current	Function
1	Fuse 125 A	Heater 4
2	Fuse 250 A	EHPSI
3	Fuse 125 A	Heater 3
4	Fuse 50 A	AC Compressor 2

Notes

Main fuse box (FM-22)

This main fuse box is located under the hood toward the driver's side of the truck, and near the fuse panel (EFRC). The main fuse amperage is 150. Normally, the main fuse lasts for the lifetime of the vehicle. If the fuse does blow then the truck should be taken to an authorized Volvo workshop for inspection of the electrical system.

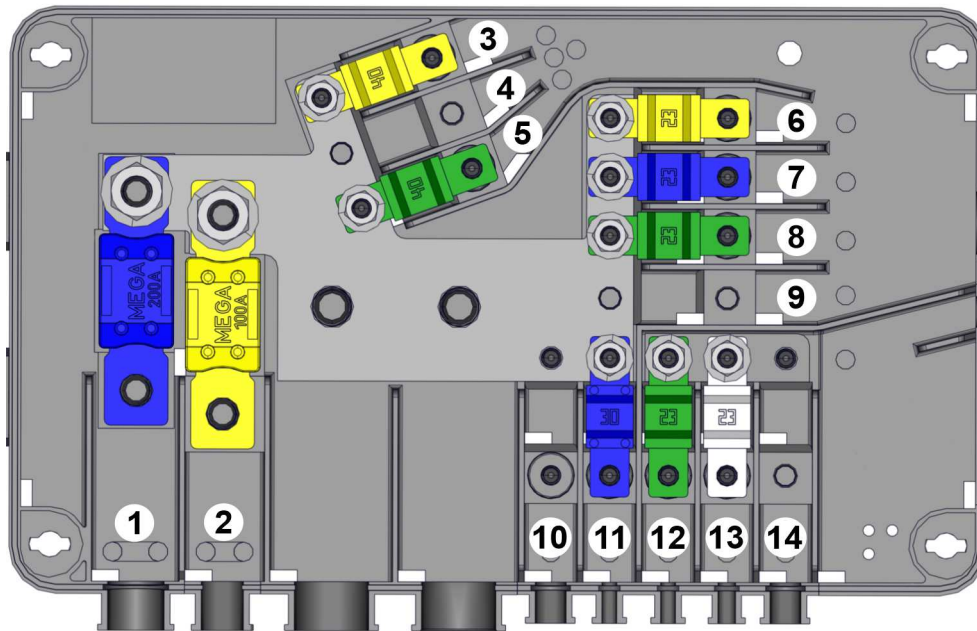


T3169902

1– Main fuse box

Notes

Layout (Fuse box FM-22)



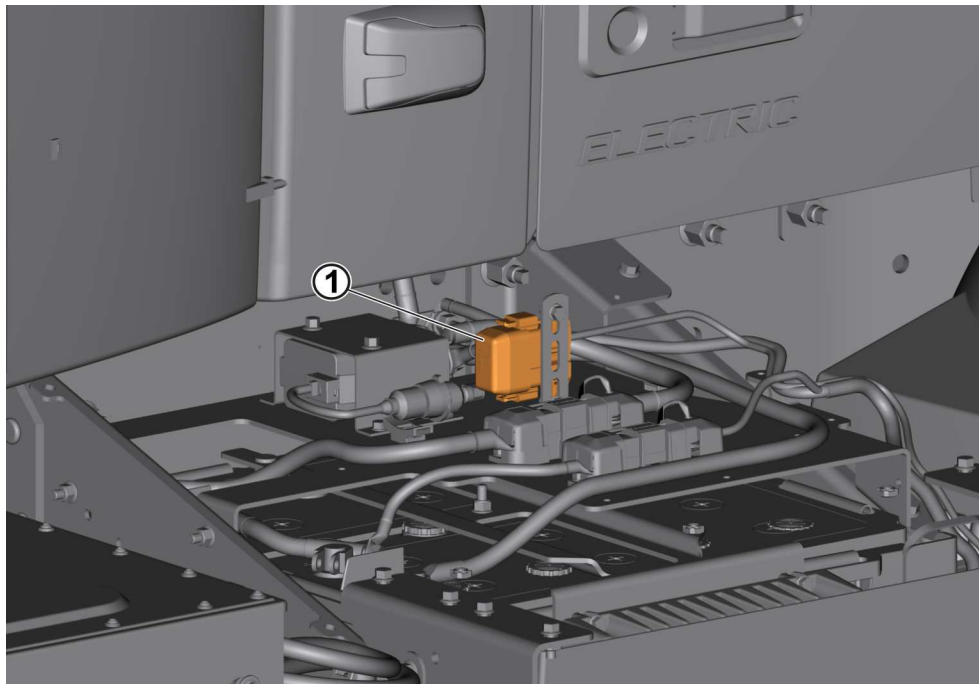
T3169907

Fuse positions

Position	Rated current	Functions
1	Mega fuse 250 A	EHPSI
2	Mega fuse 125 A	Heater 4
3	Fuse 40 A	
4	Fuse 40 A	
5	Fuse 40 A	
6	Fuse 50 A	
7	Fuse 30 A	
8	Fuse 30 A	ECEC Main 1
9	Fuse 30 A	ECEC Main 2
10	Fuse 100 A	Main Cab
11	Fuse 23 A	Oil pump
12	Fuse 23 A	Aux Cab
13	Fuse 40 A	
14	Fuse 50 A	

Fuse box (FM-23)

The fuse box is an enclosed structure contains fuse to protect the electric components from damage due to short circuit and overload. Fuse box FM-23 is located on the 24 V system batteries.



T3169904

1– Fuse box FM-23

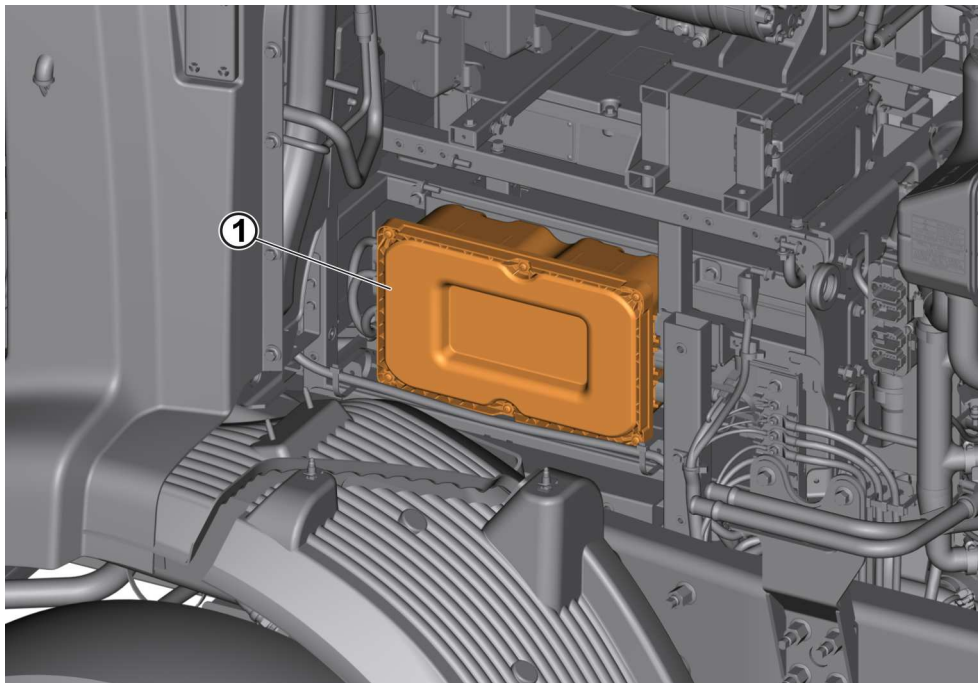
Layout (Fuse box FM-23)

Fuse positions

Position	Rated current	Functions
1	Fuse	
2	Fuse	
3	Fuse 40 A	
4	Fuse 30 A	

Electromobility Chassis Electric Centre (ECEC)

Electromobility Chassis Electric Centre is located on the right-hand side of the Modular Power Box (MPB). It acts as an electrical hub contains all fuses and relays connected to the different electrical and electronic components.

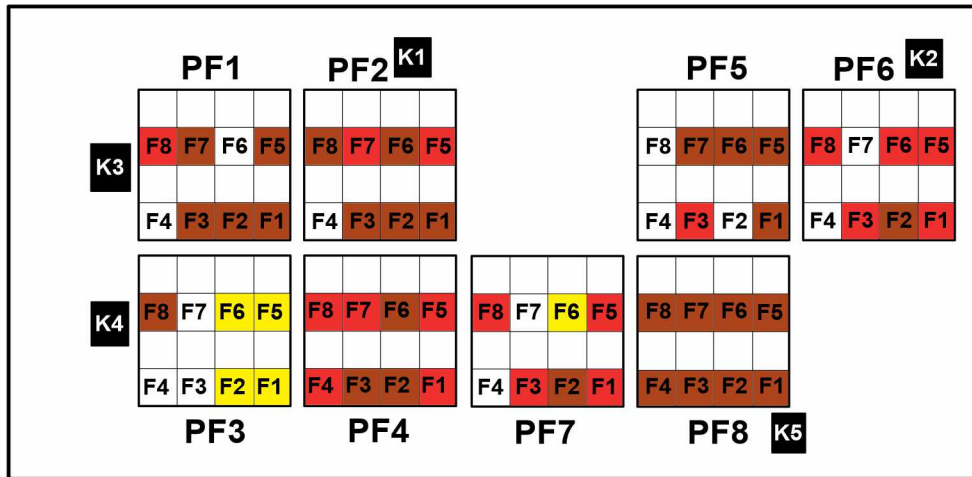
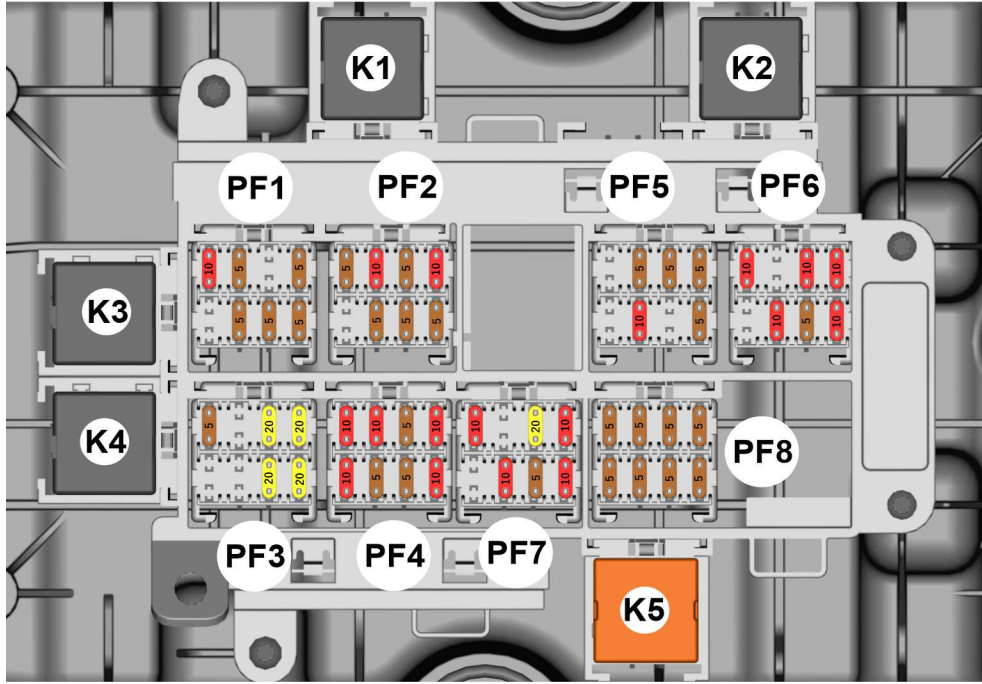


T3169905

1– Electromobility Chassis Electric Control (ECEC)

Notes

ECEC Layout



T3169906

ECEC Fuse positions

Module	Position	Rated current	Function
PF1	F1	5 A	Supply, Main 24 V
	F2	5 A	Enable 15C K2
	F3	5 A	Supply, Main 24 V
	F4		
	F5	5 A	Supply, Main 24 V
	F6		Supply K5 (IDEM main)
	F7	5 A	Enable 15C K2
	F8	10 A	Supply K5 (IDEM main)
PF1	F1	5 A	Supply, Main 24 V
	F2	5 A	Enable 15C K2
	F3	5 A	Supply, Main 24 V
	F4		
	F5	10 A	Supply, Main 24 V
	F6	5 A	Enable 15C K2
	F7	10 A	Supply K5 (IDEM main)
	F8	5 A	Measure, Direct 24 V
PF3	F1	20 A	Supply, Main 24 V
	F2	20 A	Supply, Main 24 V
	F3		
	F4		
	F5	20 A	Supply, Main 24 V
	F6	20 A	Supply, Main 24 V
	F7		
	F8	5 A	Enable 15C K2
PF4	F1	10 A	Supply, Main 24 V
	F2	5 A	Enable 15C K2
	F3	5 A	Enable 15C K2, TGW
	F4	10 A	24 V Direct Supply for BB
	F5	10 A	Supply, Direct 24 V
	F6	5 A	Supply, Direct 24 V
	F7	10 A	Supply, K3
	F8	10 A	Supply, K4
PF5	F1	5 A	Enable, 15 K1
	F2		Enable, 15 K1
	F3	10 A	Supply, K1
	F4		Enable K1

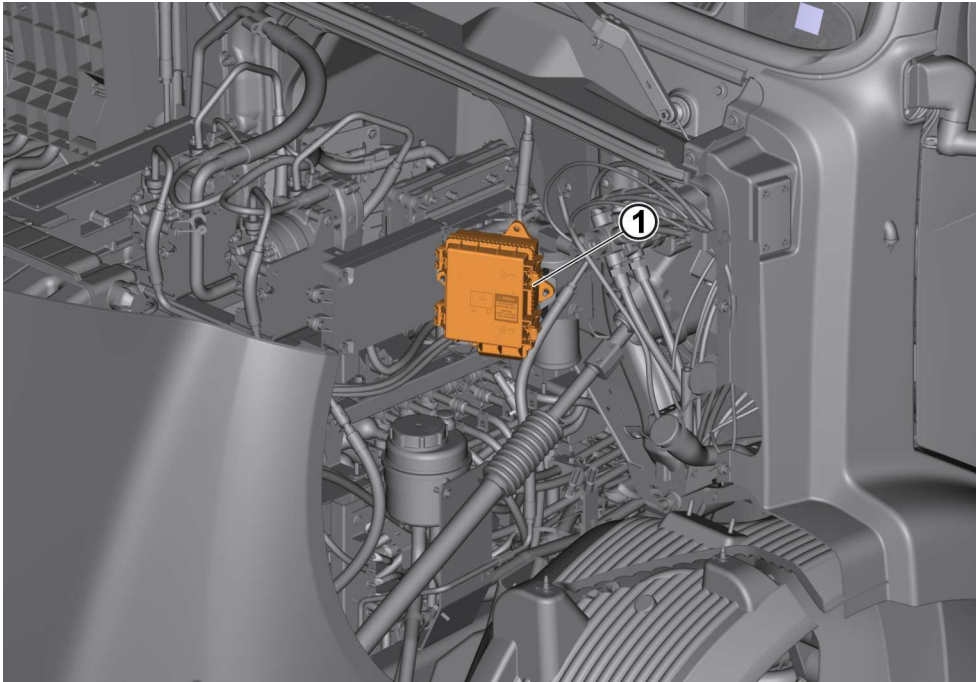
	F5	5 A	Enable K1
	F6	5 A	Supply, Direct 24 V
	F7	5 A	Enable 15C K2
	F8		Supply, Direct 24 V
PF6	F1	10 A	Enable 15C K2
	F2		Supply, Direct 24 V
	F3	10 A	Enable 15C K2
	F4	10 A	Supply, Direct 24 V
	F5		Enable 15C K2
	F6	10 A	New
	F7	5 A	New
	F8	10 A	New
PF7	F1	10 A	Supply, Direct 24 V
	F2	5 A	Enable 15C K2
	F3	10 A	Supply, Direct 24 V
	F4		Enable 15C K2
	F5	10 A	Supply, Direct 24 V
	F6	20 A	Supply, Main 24 V
	F7		Supply, Main 24 V
	F8	10 A	Enable 15C K2
PF8	F1	5 A	Supply, Main 24 V
	F2	5 A	Enable 15C K2
	F3	5 A	Supply, Main 24 V
	F4	5 A	Enable 15C K2
	F5	5 A	Supply, Main 24 V
	F6	5 A	Enable 15C K2
	F7	5 A	Supply, Main 24 V
	F8	5 A	Enable 15C K2

Relays

Position	Rated current	Function
K1	20 A	
15CK2	20 A	
K3	20 A	
K4	20 A	
K5	40 A	

External Fuse and Relay Center (EFRC)

This fuse panel (EFRC) is located under the hood toward the driver's side of the truck. The fuse and relay locations are etched into the inside cover. Normally the fuses and relays last for the truck's entire service life without blowing. If a fuse does blow then the truck should be taken to an authorized Volvo workshop for inspection of the electrical system.

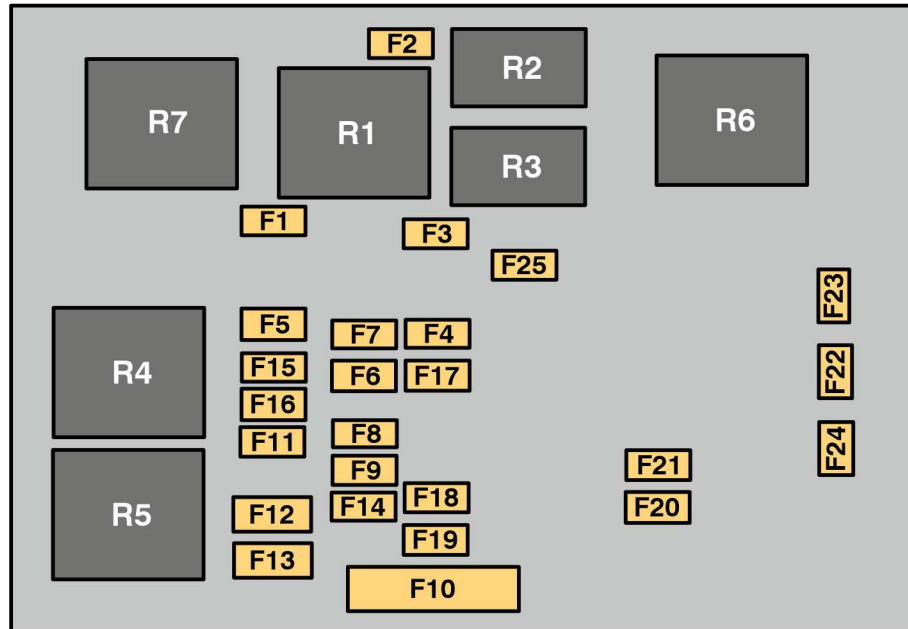
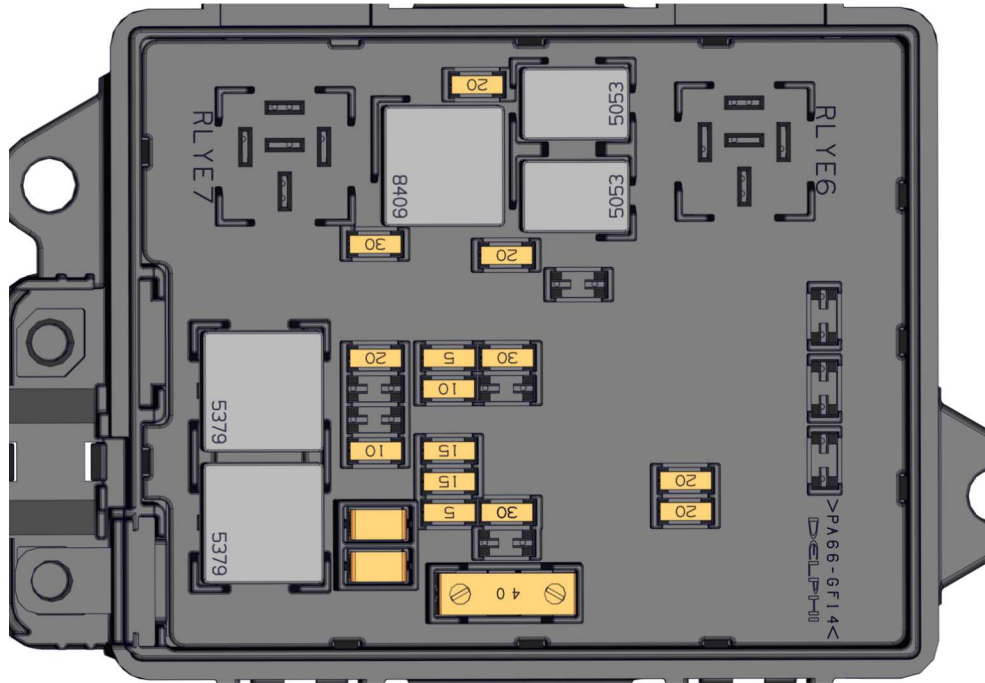


T3169911

1– External Fuse and Relay Center (EFRC)

Notes

EFRC Layout



T3169908

External Fuse and Relay Center (EFRC)

EFRC Fuse & Relay positions

Position	Rated current	Function
F1	30 A	Trailer stop lamps
F2	20 A	Trailer clearance lamps
F3	20 A	Trailer marker lamps
F4	30 A	Spare
F5	20 A	Spare
F6	10 A	VECU
F7	5 A	Body builder module
F8	15 A	Spare
F9	15 A	Spare
F10	40 A	Trailer Auxiliary
F11	10 A	ABS
F12	20 A	Spare
F13	15 A	Air dryer
F14	5 A	TPM
F15	10 A	Spare
F16	10 A	Spare
F17	20 A	Spare
F18	30 A	Spare
F18	20 A	Spare
F19	15 A	Auto transmission
F20	20 A	Trailer turn L
F21	20 A	Trailer turn R
F22	30 A	Spare
F23	30 A	Spare
F24	30 A	Spare
F25	30 A	-
R1	-	Trailer stop lamps
R2	-	Trailer clearance lamps
R3	-	Trailer marker lamps
R4	-	Spare
R5	-	Start power
R6	-	Spare
R7	-	Spare

Fuses and Relays Center (FRC) Instrument Panel



WARNING

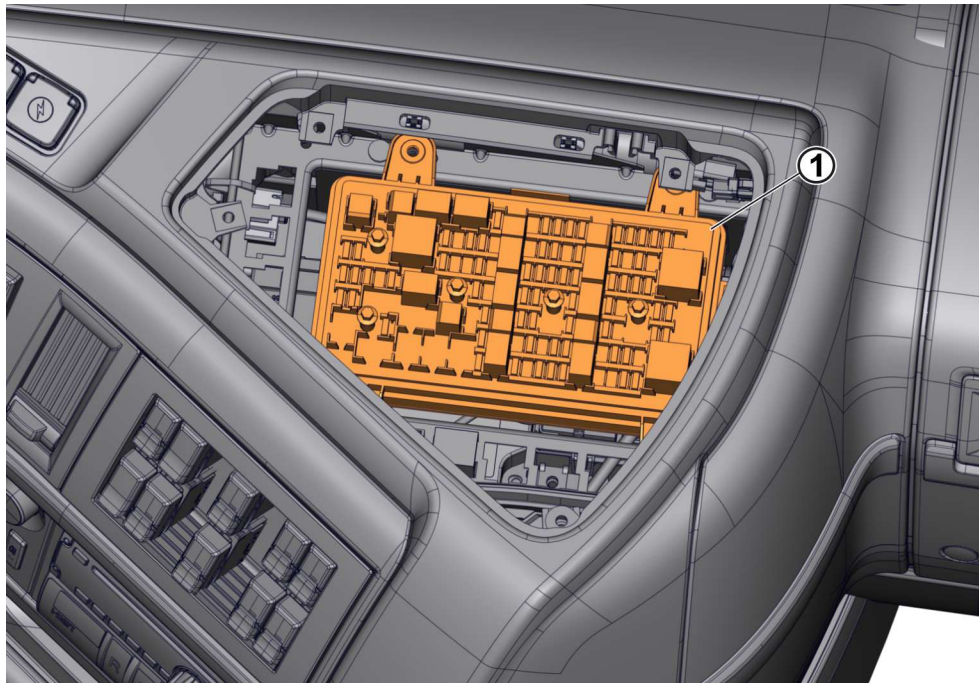
Always use fuses with the correct rating when changing. Never overfuse. Never install a fuse higher than the instructed rating.

Note: Set the electrical component in the "OFF" position if possible, before changing the fuse. The fuse holder can be burned, if the voltage remains switched on.

The truck's fuses and relays are located under the cover in the center of the instrument panel.

There are decals under the cover, which show the location of fuses and relays and what they are used for.

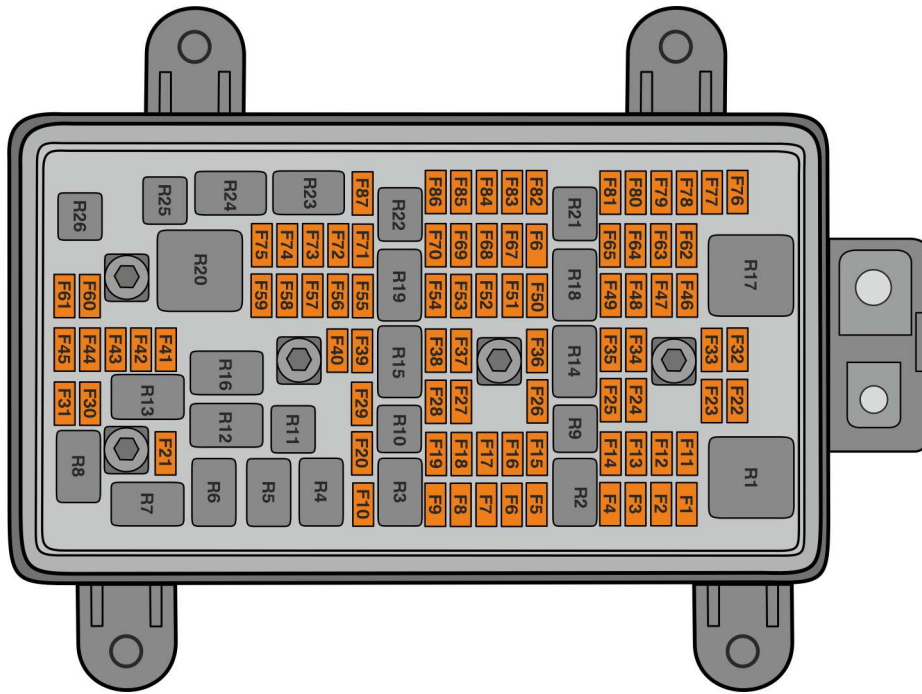
The vehicle's normal exterior lighting is controlled by control units. These include control functions for each respective lighting circuit. Should a circuit be broken, due to overload or short circuit for example, then you will be notified with a message on the instrument cluster. The function is reset when the fault has been corrected.



T3169901

1– Fuses and Relays Center (FRC)

FRC Layout



T3169910

Fuses

Position	Rated current	Function
F1	20 A	RH window/Mirrors
F2	10 A	HVAC
F3	20 A	Driver heated seat/Cooler
F3	25 A	Driver 7-pass heated seats
F4	10 A	Radio
F4	25 A	Radio with amplifier
F5	30 A	Open
F6	20 A	RH sleeper power ports
F7	20 A	LH sleeper power ports
F8	15 A	Auxiliary switches 1
F8	30 A	Auxiliary switches 2
F9	10 A	USB charge ports
F10	10 A	Customer LVD2
F11	10 A	Open
F12	20 A	Dashboard power ports
F13	20 A	LH window/Mirrors
F14	10 A	Open
F15	30 A	Open
F16	20 A	Overhead socket

F17	15 A	Auxiliary switches 3
F17	30 A	Auxiliary switch 3 & 4
F18	30 A	HVAC fan
F19	10 A	Roof sign
F19	30 A	Open
F20	10 A	Horn
F21	5 A	Qualcom
F22	20 A	CB power studs
F23	10 A	Customer IGN3
F24	30 A	Open
F25	5 A	Open
F26	10 A	Dome/Door interior lamps
F27	20 A	Open
F28	10 A	Customer LVD1
F29	5 A	EFRC
F30	5 A	Open
F31	5 A	Open
F32	15 A	Customer IGN1
F33	10 A	Air solenoid/switch
F34	10 A	Open
F35	15 A	BB IGN-X
F36	5 A	Telematics
F37	5 A	Open
F38	5 A	Aux AC
F39	10 A	Volvo Dynamic Steering
F40	5 A	Light control module (LCM)
F41	30 A	ABS
F42	10 A	Telematics trans unit display/RP1226
F43	15 A	Open
F44	20 A	Key switch
F45	5 A	Open
F46	15 A	BBI IGN-Z/Camera prep
F47	15 A	BB IGN-Y
F48	10 A	Heated windshield
F49	15 A	Reverse lamps/Lift axles
F50	20 A	Open
F51	10 A	GECU
F52	10 A	Instrument Cluster

F53	5 A	Open
F54	10 A	Transmission
F55	10 A	Open
F56	10 A	Bendix fusion lane departure
F57	15 A	Snow plow lamps LH
F58	15 A	Snow plow lamps RH
F59	10 A	Seat SRS
F60	30 A	HVAC blower
F61	5 A	LVD sensor/Vendor telematics
F62	10 A	Open
F63	10 A	Customer (Ignition 2 Bus)
F64	15 A	Open
F65	5 A	Open
F66	30 A	Open
F67	10 A	PCC (Predictive Cruise Control)
F68	10 A	Radio
F69	10 A	VECU
F70	10 A	Open
F71	10 A	Open
F72	5 A	SRS
F73	5 A	ACC/Side sensor/ECS
F74	10 A	Open/TABS6
F75	25 A	Wiper
F76	30 A	Open
F77	10 A	Bendix fusion
F78	25 A	LCM2
F79	25 A	LCM4
F80	10 A	Diagnostic connector
F81	20 A	LCM1
F82	20 A	LCM6
F83	20 A	LCM5
F84	15 A	Power door locks
F85	5 A	Telematic gateway
F86	10 A	Electronically Controlled Suspension (ECS)
F86	15 A	Beacon lamp
F87	15 A	Customer use (Battery 1 BUS)

Relays

Position	Function
R1	Accessory power
R2	Radio wake
R3	Roof marker
R4	Open/Vendor start enable
R5	Open
R6	Open
R7	Open
R8	Open
R9	Dome/Door lamps
R10	City horn
R11	Start enable
R12	Open/Remote start
R13	Open
R14	Lift axle/Reverse signal
R15	Body builder
R16	Body builder
R17	Power ignition 1 BUS
R18	Transmission power
R19	Open
R20	Start+ BUS
R21	Open
R22	ECS power
R23	Intermittent wiper
R24	Intermittent wiper
R25	Remote throttle DEC
R26	Remote throttle INC

External relays

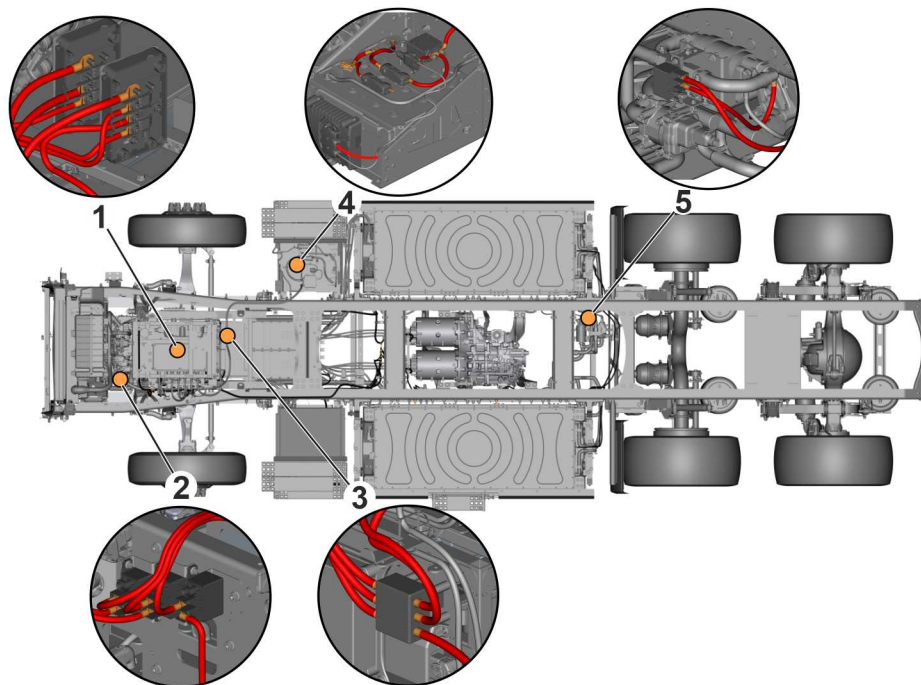
Position	Function
ER1	Open
ER2	Open
ER3	Open
ER4	Open
ER5	Open
ER6	Open
ER6	Open
ER7	Open
ER8	Open
ER9	Open

Expansion

Position	Function
F28	Customer LVD1
F10	Customer LVD2
F87	BAT1
F32	Customer IGN1
F63	Customer IGN2
F23	Customer IGN3

Notes

24 V Power Supply



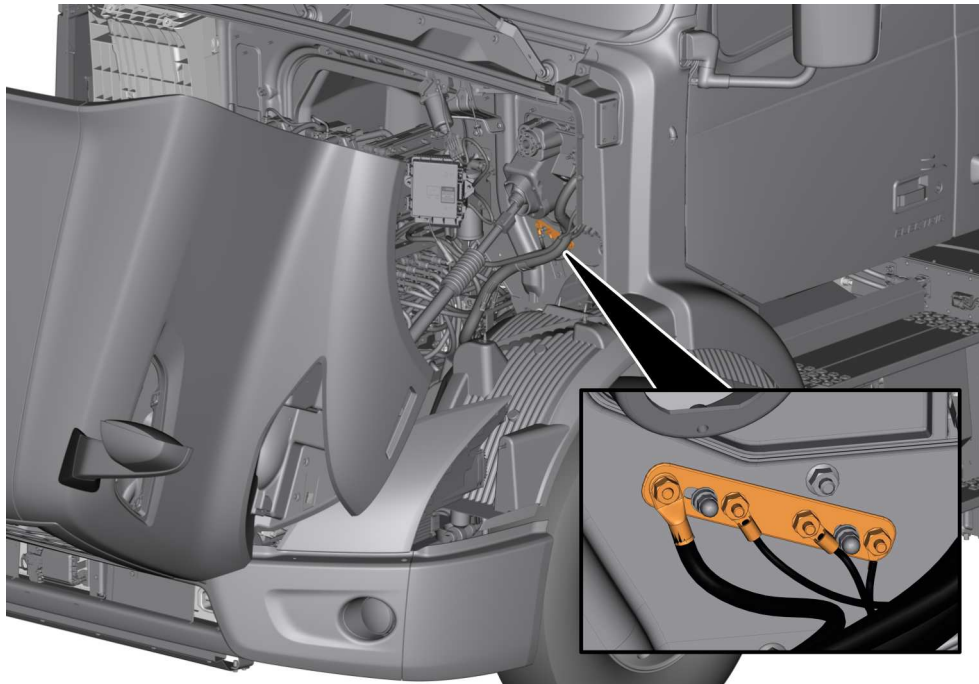
T3169912

- 1 Fuse box
- 2 Heater relay front
- 3 Six way junction box
- 4 24 V system batteries
- 5 Heater relay middle

Notes

Grounding locations

Grounding location in the cab

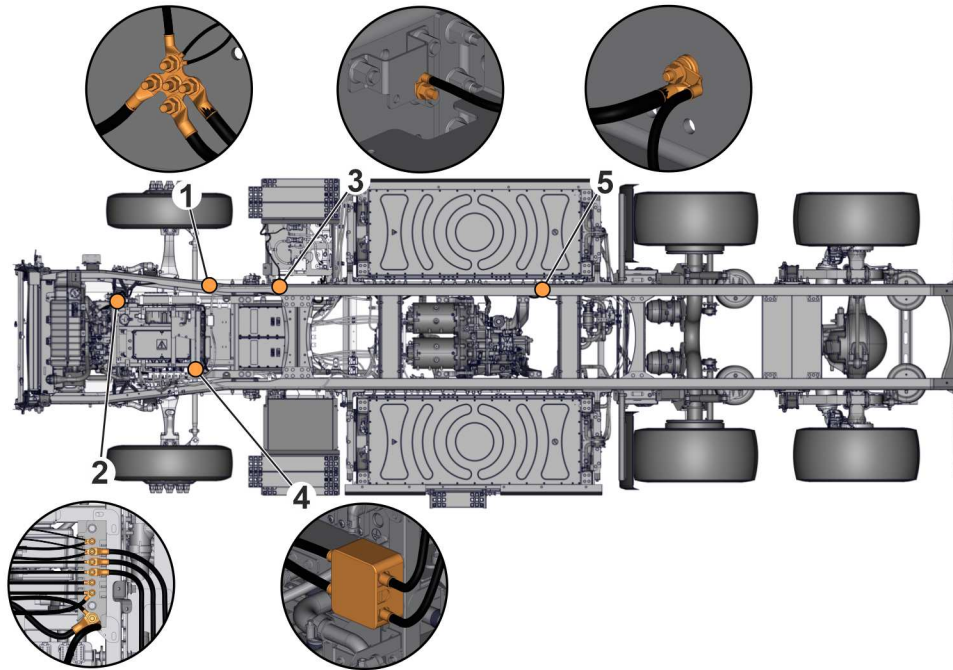


T3166515

Notes

Grounding locations on chassis

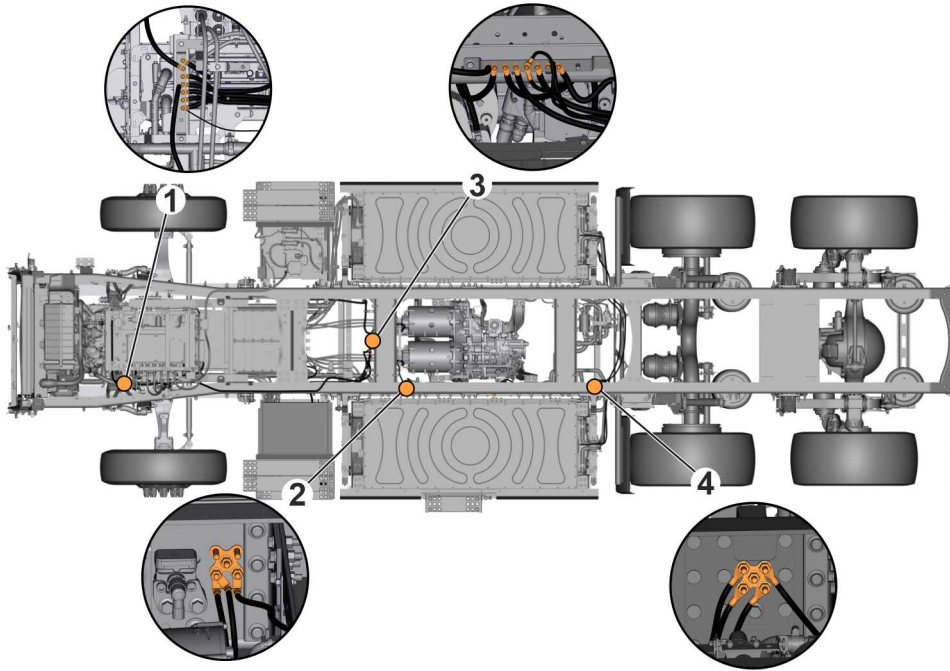
24 V Grounding locations



T3166516

- 1 Chassis ground front right (X911)
- 2 Chassis junction front right (X209)
- 3 Chassis ground right (X912)
- 4 Six way junction box (X86)
- 5 Chassis ground mid right (X913)

600 V Grounding locations



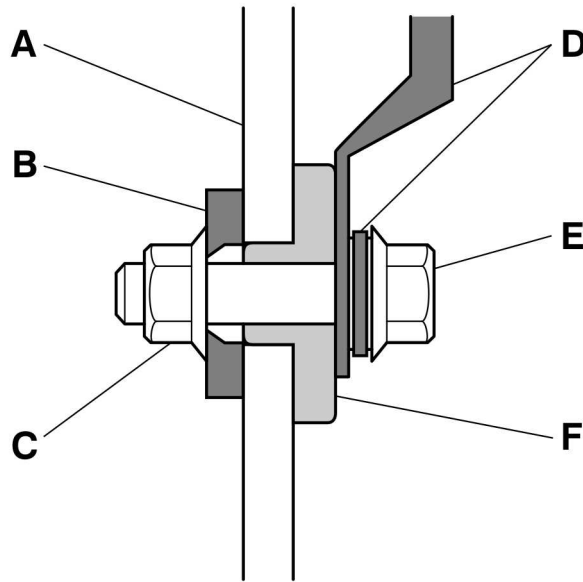
T3166514

- 1 Grounding bar Modular Power Box (MPB) front (X244)
- 2 Grounding bar chassis mid left (X246)
- 3 Grounding bar chassis center (X245)
- 4 Grounding chassis rear left (X247)

Notes

Connection to chassis frame

The connection to the chassis should be done according to below.



T9008529

A = frame rail

B = Washer, ground connection. Part number: 20704406

C = Nut, Part number: 990194

D = Ground terminal (Max 3 at the same ground point)

E = Bolt, Part number: 991614

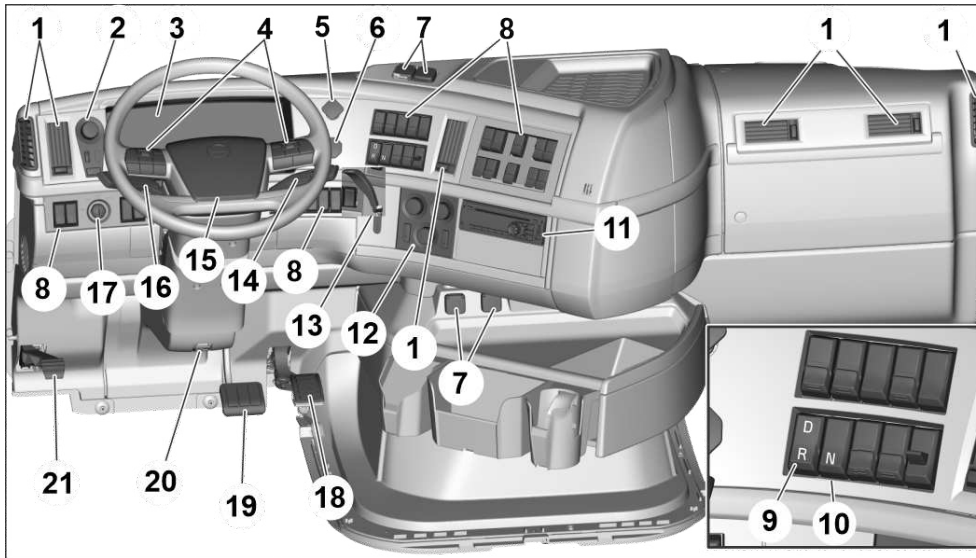
F = Press washer. Part number: 20592579

Tightening torque: 45 ± 9 Nm

Notes

Instrument Panel

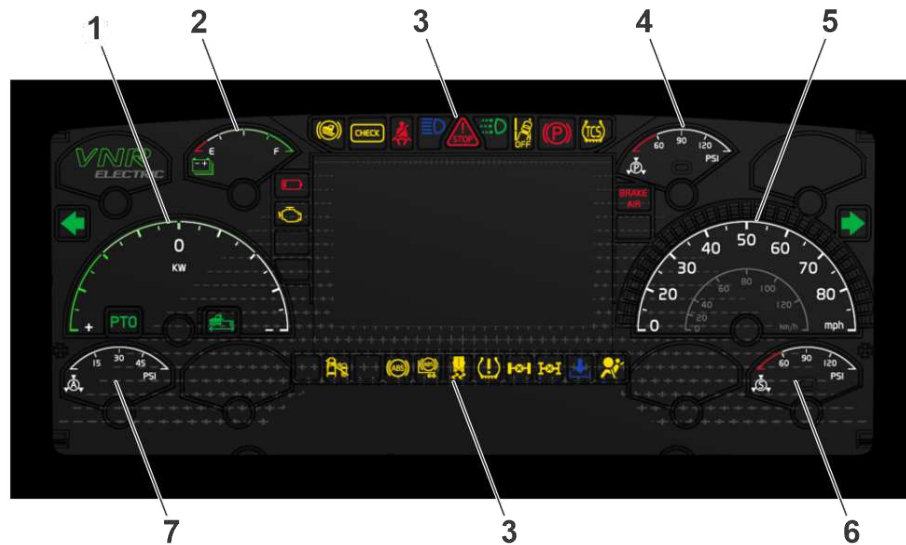
Before start working on this vehicle, locate the instruments and controls, and become thoroughly familiar with their operation. Ensure that the instrument readings are normal.



T3167587

1. Air Vent	12. Climate Control Unit
2. Light Control Panel	13. Trailer Hand Brake
3. Instrument Cluster	14. Stalk Switch Control Lever (RHS)
4. Steering Wheel Controls	15. Horn
5. Trailer Air Supply	16. Stalk Switch Control Lever (LHS)
6. Tractor Parking Brake	17. Ignition Key
7. Accessory Power Outlet/USB Port	18. Accelerator Pedal
8. Dashboard Switches	19. Brake Pedal
9. Drive/Reverse Switch	20. Hood Latch
10. Neutral Switch	21. Steering Column Tilt Control Pedal
11. Radio	

Instrument Cluster

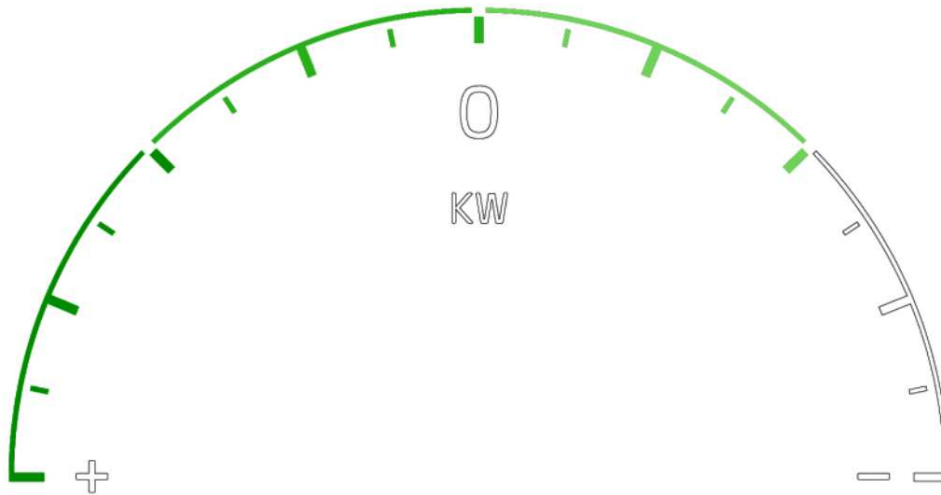


T3167588

- 1 Power Meter
- 2 Traction Battery State of Charge
- 3 Tell-tale Indicators
- 4 Primary Air Pressure Gauge (P)
- 5 Speedometer
- 6 Secondary Air Pressure Gauge (S)
- 7 Brake Application Air Pressure Gauge (A)

Notes

Power Meter



T3167589

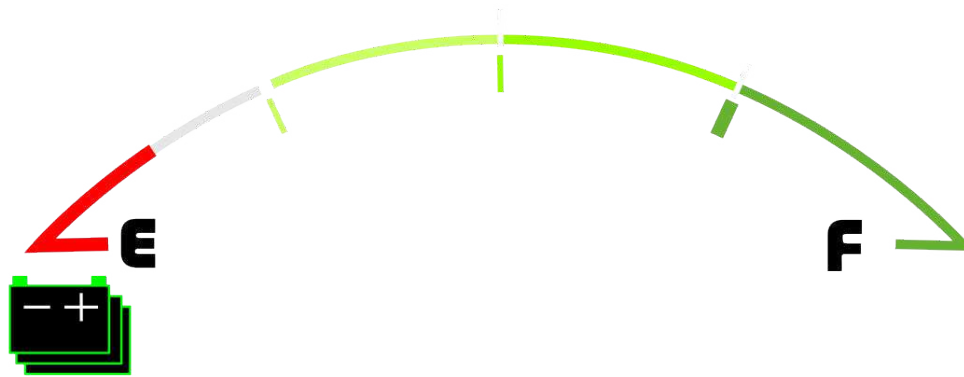
The power meter shows the instantaneous use of energy for propelling the truck. The scale of the power meter is divided into two parts - negative to the right and positive to the left. Negative means that the propulsion system consumes energy from the traction batteries. Positive means that energy is recuperated.

During braking, the digital meter indication moves to the left, showing the intensity of braking energy recovery. A gentle braking gives a higher braking-energy recovery than a heavy braking.

During acceleration, the digital meter indication moves to the right. The more energy that is consumed, the farther to the right the digital indication goes.

Notes

State of charge

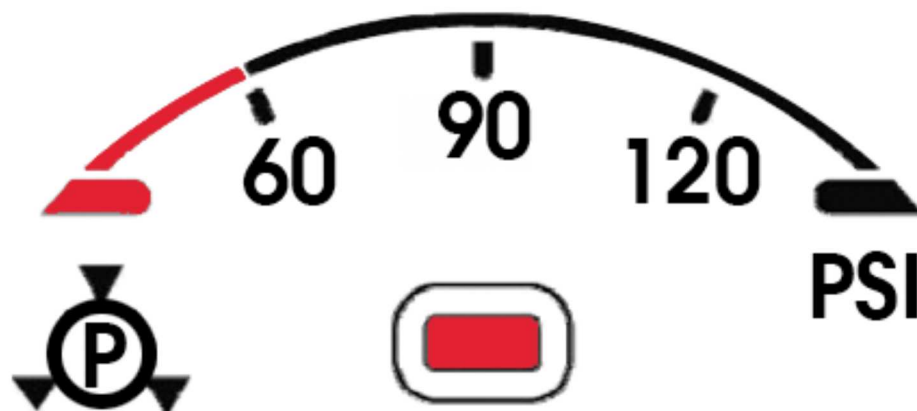


T3167590

The state of charge (SOC) gauge shows the amount of energy stored in the traction batteries. When the energy stored is 15% of the traction batteries' capacity, the red warning lamp next to the gauge goes on with a steady light. Charge the traction batteries as soon as possible. When only 5% remains, the red warning lamp flashes. Charge the traction batteries immediately.

The levels for when the warning lamp goes on with a steady or flashing light can be changed to your needs. Contact an authorize Volvo workshop.

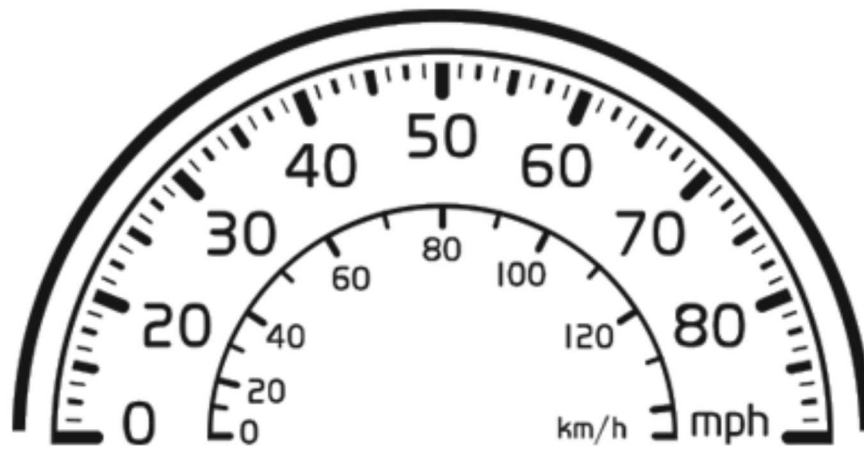
Primary Air Pressure Gauge (P)



T3167708

The primary air pressure gauge (P) displays the pressure of the air stored in the primary air tank. The primary and secondary air pressure gauges should display equal pressures under normal operating conditions.

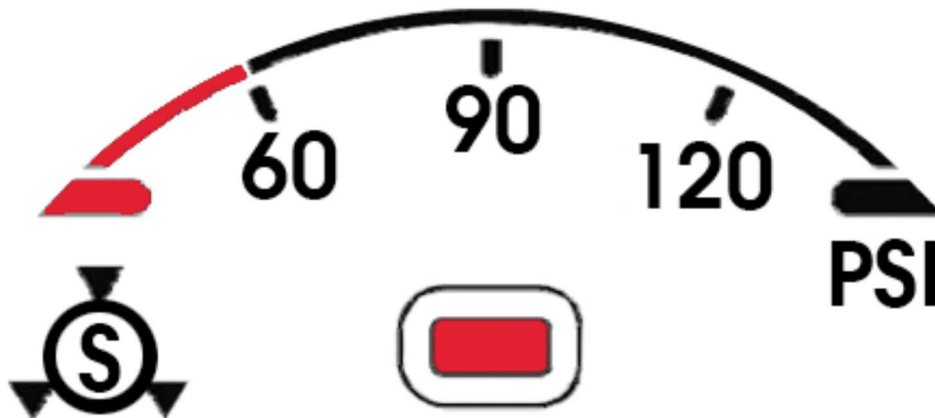
Speedometer



T3167709

Indicates the speed of the vehicle. The speedometer is driven by the vehicle's electronic system.

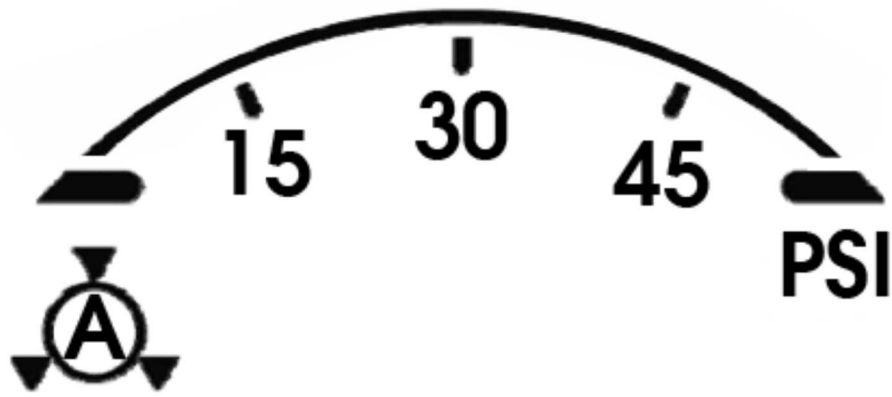
Secondary Air Pressure Gauge (S)



T3167710

The secondary air pressure gauge (S) displays the pressure of the air stored in the secondary air tank. The primary and secondary tank air pressure gauges should display equal pressures under normal operating conditions.

Application Air Pressure Gauge (A)



T3167711

The application air pressure gauge (A) is connected to the air brake system via sensors. It indicates the brake application pressure from either the front, rear or trailer circuit pressure. The gauge will not register air pressure until the footbrake pedal is depressed or the trailer hand brake is applied.

Notes







Tell-tale Indicators










A tell-tale is a display that indicates the actuation of a device, a correct or defective condition, or a failure to function. The operator should become familiar with these symbols in order to recognize and react (if necessary) to the indicated condition. Tell-tale symbols are shown in the instrument panel cluster.










Colors:


To promote visual recognition internationally, specific colors for tell-tales have been established. Unless governmental regulations (in the area where the vehicle is to be used) or engineering directives specify otherwise, the standard colors are:

- Steady Blue — high-beam headlights
- Flashing Green — turn signals
- Flashing Red — hazard condition involving the safety of personnel
- Steady Green — system in operation
- Steady Red — warning, immediate action required
- Amber — early warning, such as Anti-Lock Brake System (ABS) malfunction

	Tell-tale	Meaning	Description
1	 T3167687	Malfunction Indicator Lamp	Indicates that a government Regulation on-board diagnostic (OBD) fault exists
2	 T3167688	Hill Assist Indicator	Indicates the Hill Start Assist is active
3	 T3167690	Stop	<p>Illuminates when conditions require the driver to stop the vehicle. This usually occurs when vehicle conditions fall below designated standards for operation.</p> <div style="border: 1px solid black; background-color: black; color: white; padding: 5px;">  DANGER </div> <p>Failure to take necessary action when the STOP tell-tale is on can ultimately result in automatic shutdown and loss of power steering assist. Vehicle crash can occur, resulting in personal injury or death.</p>
4	 T3167691	Interaxle lock	Illuminates when the interaxle lock is engaged
5		Differential lock (Interwheel)	Illuminates when the differential lock is engaged

	T3167692		
6	 T3167693	Turn Signal Indicator	Flashes when the turn signals are active
7	 T3167694	Parking Brake engaged	Indicates that the parking brake is engaged
8	 T3167695	Safety Belts Reminder	Indicates that a safety belt needs to be fastened
9	 T3167696	ABS Malfunction Trailer	Indicates a Trailer Anti-lock Braking System (ABS) malfunction
10	 T3167697	ABS Malfunction Tractor	Indicates a Tractor Anti-lock Braking System (ABS) malfunction
11	 T3167698	High Beam Indicator	Illuminates when the high beam lights are engaged
12	 T3167699	Check Indicator	Illuminates when there is an electrical issue
13	 T3167700	Traction Control System (TCS) Indicator	Indicates the Traction Control System (TCS) is active
14	 T3167701	Lane Departure Warning System (LDWS) Indicator	Indicates the Lane Departure Warning System (LDWS) is off

15	 T3167702	Power take-off (PTO) Indicator Note: PTO option is not applicable. The ICON will not be powered ON.	Indicates that the power take-off (PTO) is active
16	 T3167703	Electronic Stability Control (ESC) Indicator	Indicates that the Electronic Stability Control (ESC) system is active
17	 T3167704	Daytime Running Light (DRL) Indicator	Indicates that the Daytime Running Lights (DRL) are active
18	 T3167705	Lane Changing System (LCS) Indicator	Indicates that the Lane Change System (LCS) is off or disabled
19	 T3167706	Airbag Indicator	Indicates that there is an airbag error. Maintenance is required
20	 T3167707	Tire pressure monitoring System (TPMS) Indicator Note: TPMS feature is not applicable. The ICON will not be powered ON.	Indicates that there is an issue with the vehicle's tire pressure. Maintenance is required
21	 T3167595	Driveline Engaged	Indicates that the propulsion system is on and the vehicle speed is below 3 mph (5 km/h)
22	 T3167591	Software Download In Progress	Indicates that the software download in progress
23	 T3167592	Traction Battery Low	Indicates that the traction battery is low and needs to recharge

24	 T3167593	Brake System Pressures (Metric)	Indicates that the air pressure in the brake system is low
25	BRAKE AIR T3167594	Brake System Pressures (English)	Indicates that the air pressure in the brake system is low

Suspension

For suspension related information, refer to Section-6 of Heavy Duty Body Builder Information.

Lighting

For lighting information, refer to Section-3 of Heavy Duty Body Builder Information (subsection – “Add-on Exterior Lighting”).

Notes

ECU Functions and Parameter Programming

This section lists functions, which will be of interest to Body Builders and others needing to modify certain (programmable) aspects of the ECUs. If an ECU is not included in this section, it is because there are no adjustable functions which can be modified in the field.

Not all functions or parameters listed in this document may apply to the vehicle you have, because of running changes and improvements made over time. Using each component's Main Software part number, the Premium Tech Tool knows which parameters apply, and show only those which are adjustable for that particular vehicle.

Whenever working on the electrical system of the vehicle, certain ECUs such as the Airbag (SRS) ECU, need special handling to avoid damage. Refer to the appropriate ECU sections, and to the individual ECU service manual, for the appropriate precautions.

All ECUs use some form of Input and Output devices to perform their functions. These devices may include switches, sensors, solenoids, and relays. DO NOT tie or splice into an existing sensor or input device used by an ECU, or else proper operation of that sensor may be affected. Likewise, DO NOT tie into an Output device that is controlled by an ECU unless authorized to do so in this document.

Always observe proper Electrostatic Discharge (ESD) precautions while working around the ECUs, as outlined in the "Service Procedures" portion of this document.

The Inputs and Outputs (I/O) of the ECUs follow a certain "logic" that are important to understand when interfacing to the ECUs. The following information explains the terminology used in this document:

Input/Output Type	Definition
Active High (or Active +V)	<p>This input is typically configured with a switch wired to + Voltage. The input has two states; either floating (switch open), or +V (switch closed). The input is considered active when +V is applied.</p> <div> <p style="text-align: right;">W9000629</p> </div>
Active Low (or Active ground)	<p>This input is typically configured with a switch wired to ground. The input has two states; either floating (switch open), or grounded (switch closed). The input is considered active when grounded.</p> <div> <p style="text-align: right;">W9000630</p> </div>
NC switch to +V	<p>This input type typically has a Normally Closed (NC) switch contact connected to +V. The input becomes active when the switch is opened or the circuit is otherwise broken.</p>

Input/Output Type	Definition
	<div> </div> <p>W9000631</p>
NC switch to ground	<p>This input type typically has a Normally Closed (NC) switch contact connected to the ground. The input becomes active when the switch is opened or the circuit is otherwise broken.</p> <div> </div> <p>W9000632</p>

I/O Type	Definition
OUTPUTS	
Active High	<p>This output source current (the voltage goes high) when active. The other side of the load or controlled device is connected to ground.</p> <div> </div> <p>W9000633</p>
Active Low	<p>This output sinks current (the voltage goes low, usually to the ground) when active. The other side of the load-controlled device must be connected to +V.</p> <div> </div> <p>W9000634</p>

Many of the functions on today's vehicles are shared among different ECUs. Use the following guide to help decide which ECU controls which functions:

Feature/Function	ECU
Road Speed Limit Parameters	PCM
Auto Neutral Parameter	EVCN
Cruise Control Parameters	VECU
Regenerative Brake Levels	(not adjustable)
ATVSA disable/enable	HPCU
TVS Inhibition	HPCU

Road speed limit

Function

This function gives ability to limit the vehicle speed. This limit is separate from all other vehicle speed limits (such as CC max set speed, max Road Speed Governor, etc.). When multiple road/vehicle speed limits are imposed, the lowest will have priority. It can be used on refuse trucks to limit the speed, if a man is standing on the back of the vehicle.

PCM- Road speed limit Parameters

Parameter code	Parameter caption	Parameter description	Minimum	Default value	Maximum	Unit
P1RWB	Vehicle acceleration limiter configuration (Pedal Control)	Vehicle acceleration limiter configuration (Pedal Control)	0	0	2	—
AI	Cruise control max speed	The maximum speed that can be set in the cruise control.	30	130	140	km/h
P1ALV	Legal Road Speed Limit	The legal RSL that is set to the vehicle.	30	?	140	km/h
P1AOC	Customer Road Speed Limit	<p>Specifies the customer selectable maximum speed the vehicle can operate on level road. The vehicle speed will be limited by the lowest of the following:</p> <ul style="list-style-type: none"> Customer Road Speed Limit (P1AOC) Road Speed Limit (P1ALV) Secondary Road Speed Limit (Request via CAN-signal from Body Builder Module) if available <p>For markets that use performance bonus: Any additional speed granted by the Performance Bonus feature will be added to the Customer Road Speed Limit (P1AOC) value, as (so) long as the overall maximum of 140 km/h (87 MPH) is not exceeded. Any speed penalty imposed by the Differential Road Speed Governor will be subtracted from this maximum value.</p>	30	Not applicable	140	km/h

		Maximum Cruise Control Speed must be set less than or equal to the accelerator-pedal maximum specified by the Customer Road Speed Limit (P1AOC) value.				
P1I16	RSL With Pedal	The pedal vehicle speed limit, which is used to set a higher or lower pedal vehicle speed. Its intended to be used together with Road speed limit function to make the driver want to use cruise control.	0	Not applicable	140	km/h
P1KB7	Soft top default vehicle speed limit	Passing speed limit for soft top mode (legal setting).	0	Not applicable	6553.5	km/h
P1KB8	Soft top vehicle speed limit	Default speed limit for soft top mode (legal setting).	0	Not applicable	6553.5	km/h
P1KB9	Soft top expiration distance	Expiration mileage after which soft top mode is no longer active (legal setting).	0	Not applicable	429496-7295	m
P1KCA	Soft top current available time	Current available minutes to use for soft top mode operation.	-21474-83648	Not applicable	214748-3648	Seconds
P1KCB	Soft top daily time	Time permitted in soft top mode per day (10 hours) of operation (soft top factor) (legal setting).	0	Not applicable	65535	minutes
P1KCC	Soft top total time	Total time spent in soft top operation.	0	Not applicable	429496-7295	Seconds
P1KJ8	Cab type for soft top speed limit	Cab type: 0 = Day Cab 1 = Sleeper 2 = Not available	0	Based on cab type	255	—
P1MG2	RSL difference between loaded and unloaded vehicle	Difference in Road Speed Limit between loaded and unloaded vehicle. The lowered speed limit is relative to the Customer Road Speed Limit.	0	Not applicable	6553.5	km/h
P1MG3	Use lower road speed limit on loaded vehicle	Select if the negative offset shall be applied on loaded or unloaded vehicle. No: The offset is applied on unloaded vehicle. Yes: The offset is applied on loaded vehicle. For weight Road Speed Limit, the offset is relative to the Customer Road Speed Limit (P1AOC).	0	Not applicable	1	—

P1MG4	Bellows pressure threshold for loaded vehicle	For weight-based Road Speed Limit, the vehicle is considered loaded if the pressure in the suspension bellows is above this value.	0	Not applicable	6553.5	kPa
P1Y0M	RSL reverse driving configuration	Configures the maximum vehicle speed used for reversing. The vehicle speed will be limited by the lowest value of this configuration parameter and all other road speed limits when the vehicle is reversing. This configuration parameter will not affect the vehicle speed limit when the vehicle is driving forward.	5	Not applicable	140	km/h

Cruise Control

The Cruise Control function will maintain a pre-set vehicle speed regardless of terrain or other vehicle load conditions.

Pin/Connector Information

This function uses the Cruise Control stalk switches. See the VECU I/O table for pin locations of the Cruise Control On/Off, Resume, and Set + / Set - button inputs.

Prerequisites / Conditions for Activation

- The function is enabled in the VECU
- Cruise Control stalk switch set to the On position
- Current vehicle speed is between Cruise Control MAX and MIN vehicle speed parameters
- Brake pedal is released
- No Vehicle Speed Sensor (VSS) related faults
- No J1939 control data link related faults in the VECU or PCM

Press either the SET+ or SET- switch to select the current vehicle speed as the "set" speed. A Cruise Control ("CC") icon will appear in the instrument cluster while the Cruise Control governor is engaged. Once active, the SET buttons may be used to adjust the CC set speed within programmed limits. Speed changes may be made either as a "ramp" (by holding the SET+ or SET- button), or as a "step" change (by tapping the buttons).

The Cruise Control Maximum Set Speed is the maximum vehicle speed allowed while in CC mode; note that it may be different (higher or lower) than the overall maximum vehicle speed limit set in the PCM, but the overall speed limit will be enforced if it is lower than the CC Maximum Set Speed.

If disengaged for any reason (any of the prerequisites above are no longer met), the Cruise Control RESUME button will re-engage Cruise Control and restore the last "set" speed.

If load or terrain conditions are such that the vehicle speed is reduced below the Minimum Governed Speed while the Cruise Control is engaged, the Cruise Control governor will drop out.

Parameter codes (VECU 4)

Parameter Name	Code	Default Value	Range	Description
F_ENABLE_CRUISE_CONTROL	AG	1	0/1	Enables the CC Function
CC Maximum Set Speed	AI	130 km/h (81 m/h)	30 km/h ~ 140 km/h (19 m/h ~ 87 m/h) must be > BK	Maximum CC Set speed allowed
CC Minimum Set Speed	BK	30 km/h (19 m/h)	30 km/h ~ 140 km/h (19 m/h ~ 87 m/h) must be < AI	Minimum CC Set speed allowed
CC Minimum Governed Speed	BL	15 km/h (9 mph)	15 km/h ~ 30 km/h (9 m/h ~ 19 m/h)	Vehicle speed below which the Cruise governor will no longer attempt to maintain preset speed
Cruise Trim Factor	GP	2 km/h per second (1 mph/ per second)	0 km/h ~ 10 km/h (0 m/h ~ 6 m/h) per second	Specifies the speed change ramp (in km/h per second) that will be requested when the SET+ button is held
Cruise Trim Factor Minus	RR	2 km/h per second (1 mph/ per second)	0 km/h ~ 10 km/h (0 m/h ~ 6 m/h) per second	Specifies the speed change ramp (in km/h per second) that will be requested when the SET- button is held
Cruise Step Factor	RS	2 km/h (1 mph)	0 km/h ~ 10 km/h (0 m/h ~ 6 m/h)	Specifies the step speed change (in km/h) that will be requested when 'tapping' either the SET+ or SET- buttons

Notes

Auto Neutral

Auto neutral will put the transmission into neutral when the parking brake is set. Once the parking brake is released, the shifter will need to be placed in drive (D) for the transmission to go back into gear. Auto neutral improves job-site safety for a variety of applications.

ATVSA Enable/Disable

When the chassis switch is in the ON position, the ATVSA (Automatic Traction Voltage System Activation) function can be activated automatically without any special action being taken and irrespective of the position of the Starting key or of the connection to the offboard charger. There are various reasons why the 600 V circuit may be reactivated:

- To maintain charge in the 24 V system batteries to have the vehicle ready to run for next key cycle or starting cycle (when the truck is parked).
- To maintain the cell temperature of the traction batteries by preconditioning them both by cooling and heating. Preconditioning improves the SOH (State Of Health) of the traction batteries.
- To maintain the cell temperature of the traction batteries by post conditioning (after-run mode) them both by cooling and heating. Post condition improves the SOH the traction batteries.
- To activate 600 V power distribution for body builder function when requested, example fridge body.

The electromobility system periodically wakes-up the 24V system to check the 24 V system battery charge level and battery cell temperature of the traction batteries. After the preconditioning assessment, the traction voltage supply is enabled if required or else remain disabled.

When body builder wants to use the vehicle with chassis switch in on position and key OFF, the ATVSA function has to be disabled to avoid automatic activation of cooling fans, heater, and other components etc. The ATVSA can be enabled or disabled using Premium Tech Tool operation “3650-05-03-01 Automatic Traction Voltage system Activation, control”.

Note: “3650-05-03-01 Automatic Traction Voltage system Activation, control” disables or enables both the ATVSA and TVS together. ATVSA functionality cannot be disabled without inhibiting TVS.

HPCU - ATVSA Parameter

Parameter code	Parameter description	Minimum	Default value	Maximum	Unit
P1R0B	Electric Vehicle, ATVSA Function, Enable/Disable	0	1	1	—

TVS (Traction Voltage System) Inhibition

TVS has to be inhibited before performing certain diagnostic operations that are otherwise prevented from being performed. Follow the TVS inhibition routine provided in Premium Tech Tool.

HPCU-Routine

DOID code	DOID description
R1DYO	Traction Voltage System, Force Shutdown

Preconditions: The vehicle shall be in key on (Pre-running) but not running vehicle mode.

Test Sequence:

- 1 Check that the preconditions are fulfilled.
- 2 Run the routine. The TVS is commanded to de-energize.
- 3 When the routine is complete, check that P1V2F reports False meaning that the TVS is de-energized.

Note: The parameter P1V2F is not editable or programmable. The parameter is to check the TVS status.

System Behavior: The TVS will de-energize safely (if energized) and not re-energize until the starter key position changes.

TVS can be inhibited using Premium Tech Tool operation "3650-05-03-01 Automatic Traction Voltage system Activation, control".

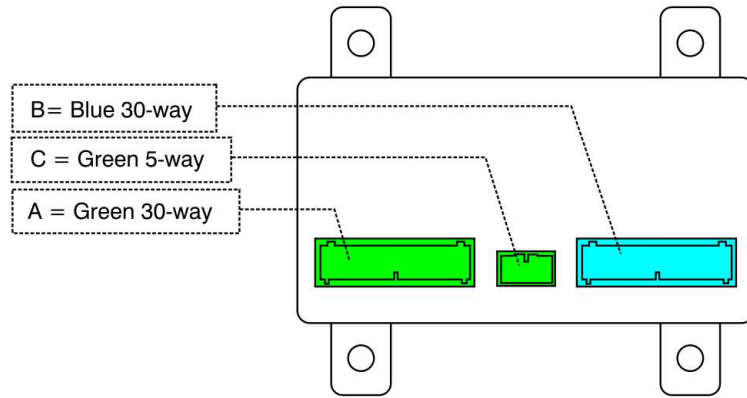
Note: "3650-05-03-01 Automatic Traction Voltage system Activation, control" disables or enables both the ATVSA and TVS together. TVS cannot be inhibited without disabling ATVSA.

Notes

Vehicle Electronic Control Unit (VECU)

There are many programmable features of the VECU; the functions listed here are included because they will be of particular interest to body builders and others needing to modify certain aspects of the VECU. For a complete list of all programmable parameters, see the appropriate Premium Tech Tool parameter and reprogramming information.

Description of VECU Signals (VECU 4)



W3088359

VECU Connector A (Green)

Pin	Pin Name/Description	I/O	Type	Comment
A1	CC Set (-) SW	Input	Active High	
A2	CC Set (+) SW	Input	Active High	
A3	CC On/Off SW	Input	Active High	
A4	SPARE	SPARE	SPARE	
A5	Brake Pedal Microswitch	Input	NC Switch to +V	NO SWITCH INSTALLED. WIRED TO +V
A6	Key Switch: START	Input	Active High	
A7	Key Switch: Preheat	Input	Active High	—
A8	No Connection	—	—	—
A9	Spare	Input	Active High	
A10	Spare	Input	Active High	
A11	Starter Control	Input	Active High	—
A12	ECU Ground	ECU Main Power Ground		
A13	ECU Main Power	Input	ECU Main Power	

Pin	Pin Name/Description	I/O	Type	Comment
A14	Key switch: RUN	Input	Active High	
A15	CAN2-High (J1939H) DL5	Bidirectional Data Link		
A16	CAN2-Low (J1939L) DL5	Bidirectional Data Link		
A17	No Connection	—	—	—
A18	Idle Validation Switch-2	Input	Active High	Not used
A19	Empty	—	—	—
A20	No Connection	—	—	—
A21	No Connection	—	—	—
A22	Not Used	Input	Active High	Do not connect; special use only
A23	Idle Validation Switch-1	Input	Active High	
A24	AC Hi-pressure Fan Switch Input	Input	NC Switch to Ground	Open Switch = High AC Pressure = Fan Requested
A25	Not Used	—	—	—
A26	Spare	Input	Active Low	
A27	No Connection	—	—	—
A28	Not Used	Input	Active Low	Do not connect; special use only
A29	No Connection	—	—	—
A30	CC Resume Switch	Input	Active High	

Notes

VECU Connector B (Blue)

Pin	Pin Name/Description	I/O	Type	Comment
B1	ECAD Regeneration Control	Output	Active Low	Air Dryer ECADS
B2	Starting Relay	Output	Active Low	
B3	No Connection	—	—	—
B4	ECAD Compressor Control	Output	Active Low	Air Compressor ECADS
B5	Output Supply # 4 (-V batt)	Output	Switch Power	
B6	Vehicle Speed Sensor (+)	Input	Analog	
B7	No Connection	—	—	—
B8	Accelerator Pedal	Input	Analog Sensor	
B9	Air Tank Pressure	Input	Analog Sensor	ECADS
B10	Accelerator Pedal Supply-1 (~5 V)	Output	Sensor Power	
B11	Parking Brake	Input	Active Low	Ground connected N.C. air switch (No air = switch closed = PB applied)
B12	Spare	Input	Active Low	
B13	Spare	Input	Active Low	
B14	Not Used	Input	Analog Sensor	Do not connect; special use only
B15	ECU Power Relay Control	Output	Active Low	
B16	No Connection	—	—	—
B17	Buffered Idle Validation Switch-1	Output	Active High	
B18	Not Used	Output	Active Low	Do not connect; special use only
B19	Output Supply # 3 (~Vbatt)	Output	Switch Power	
B20	Vehicle Speed Sensor (-)	Input	Analog	
B21	Not Used	Input	Active High	Do not connect; special use only
B22	Analog Ground	ECU Sensor Ground		
B23	Analog Ground	ECU Sensor Ground		
B24	Retarder Stalk Switch?	Input	Analog Sensor	
B25	No Connection	—	—	—
B26	Output Supply # 2 (~5 V)	Output	Sensor Power	
B27	Brake Pressure Switch	Input	Analog/ Active Low	Analog Input used to read ground-connected normally. Open Brake Pressure Switch (Not Sensor)
B28	No Connection	—	—	—
B29	Not Used	Input	Active Low	Do not connect; special use only
B30	Spare	Input	Active High	

VECU Connector C (Green)

Pin	Pin Name/Description	I/O	Type	Comment
C1	J1587/1708 Information Data Link (B) (SAE J1708 (A))		Bidirectional Data link	J1587/1708 Information Data Link (Slow Speed)
C2	J1587/1708 (A) (SAE J1708 (B))			
C3	No connection	—	—	—
C4	J1939 Control Data Link/A (CAN_H)		Bidirectional Data link	J1939 Control Data Link (High Speed)
C5	J1939 Control Data Link/B (CAN_L)			

Notes

Data Link

The VNR Electric contains many Electronic Control Units (ECUs) for operating many of the vehicle's functions. Most ECUs are linked together using one or more data links for sharing information.

Some ECUs operate independently of each other, but most rely on interaction with other ECUs to properly perform their functions.

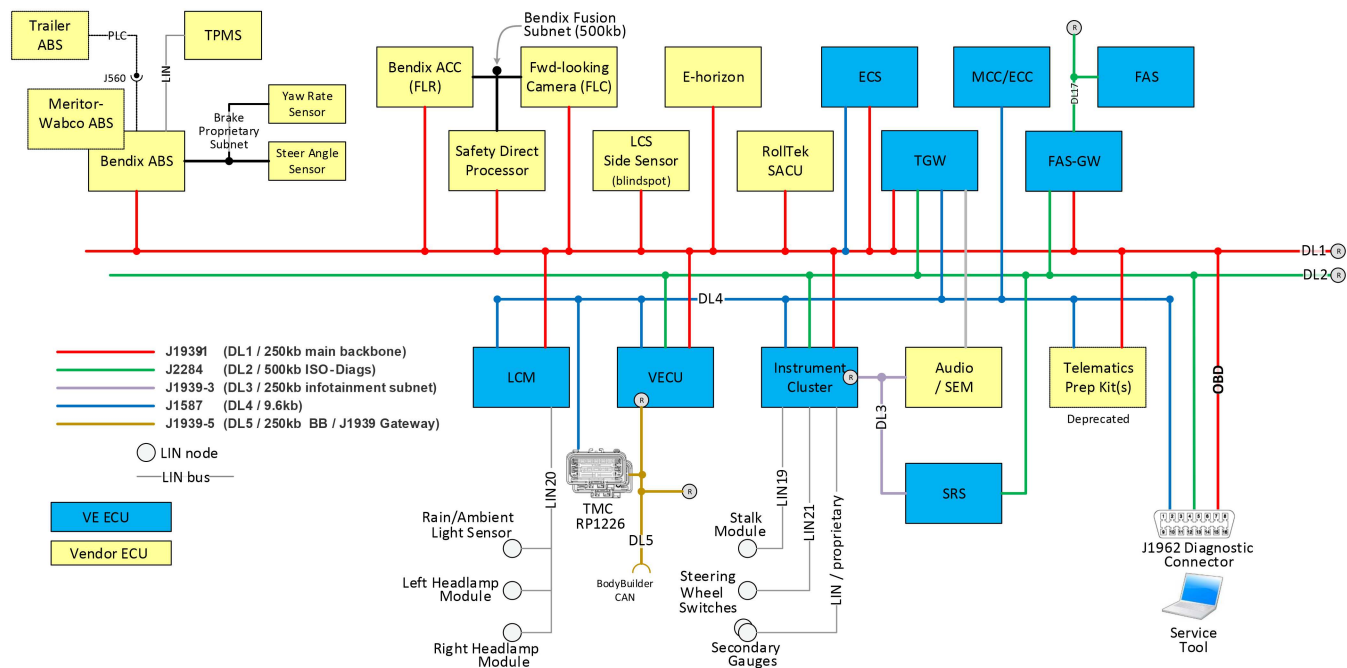
All ECUs use some form of Input and Output devices to perform their functions. These devices may include switches, sensors, solenoids, and relays. **NEVER** tie or splice into a sensor or input device used by an ECU. This could affect the proper operation of the sensor. Likewise, never tie into an output device, which is controlled by an ECU, unless authorized to do so elsewhere in this document.

Data Link Communication

Communication between the different ECUs take place via the three data links: the SAE (Society of Automotive Engineers) J1939 data link, J1587/1708 data link and J2284 data link. Generally, networks with SAE J1939 have a communication speed of 250 kbit/s, SAE J1587/1708 of 9.6 kbit/s and SAE J2284 of 500 kbit/s. All data links and most subnets use CAN bus communication.

CAN is a message-based protocol with twisted-pair cabling between control units. All the units within a CAN can initiate communication but only one can send data at a given time.

Data link Link Flow

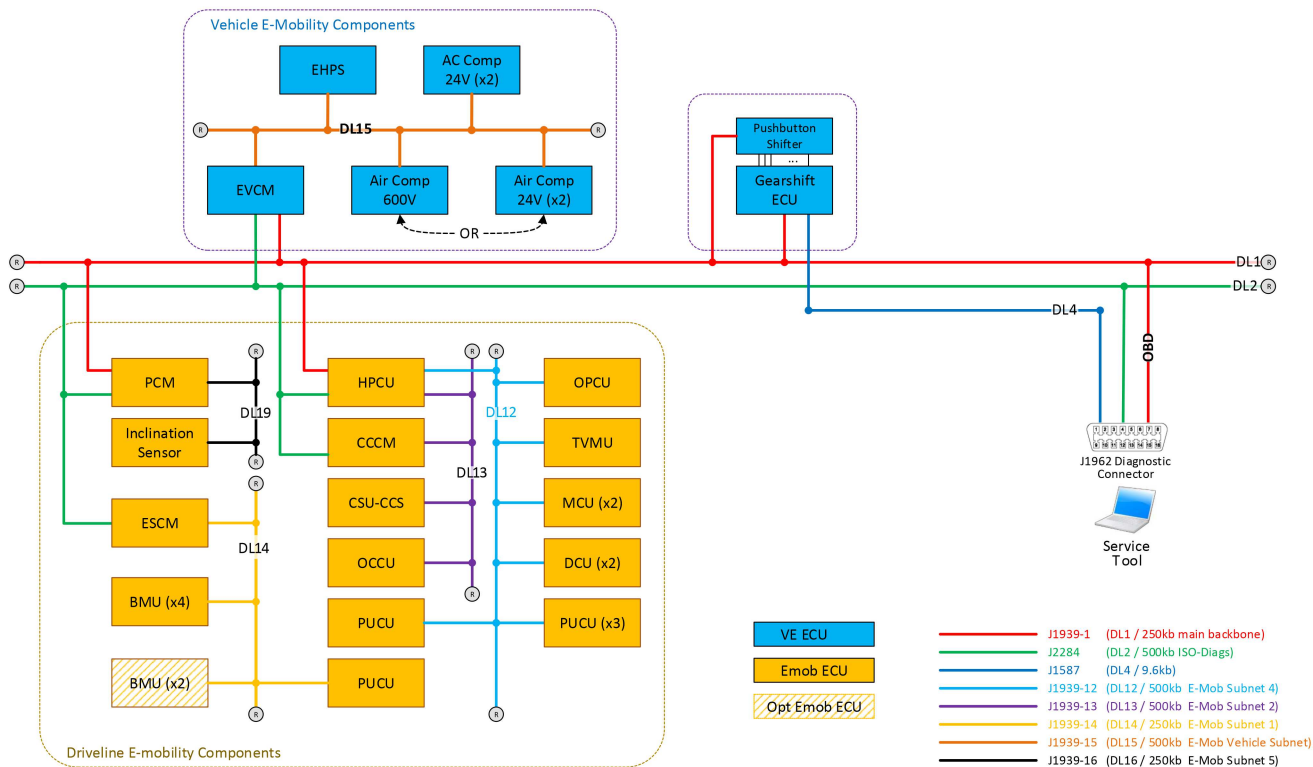


T3168066

Electronic Control Unit (ECU)	Description
ABS	Anti-lock Braking System
CAN	Control Area Network
ECC/MCC	Electronic Climate Control/ Manual Climate Control
ECS	Electronically Controlled Suspension
FAS	Front Active Steering

Electronic Control Unit (ECU)	Description
FAS-GW	Front Active Steering-Gateway
FLC	Forward Looking Camera
FLR	Forward Looking Radar
LCM	Light Control Module
LCS	Lane Change System
LIN	Local Interconnect Network
OBD	On-board Diagnostic
SACU	Side Airbag Control Unit (RollTek)
SDP	Safety Direct Processor
SEM	Services and Entertainment Module
SRS	Supplementary Restraint System
TGW	Telematics Gateway
TPMS	Tire Pressure Monitoring System
VECU	Vehicle Electronic Control Unit

Notes



T3168067

Acronym	Description
AC	Air Condition
BB	Body Builder
BMU	Battery Monitoring Unit
CAN	Control Area Network
CCCM	Combined Charging system Control Module
CSU-CCS	Charging Switch Unit- Combined Charging system
DCU	Direct Current Unit
ECU	Electronic Control Unit
EHPS	Electro-Hydraulic Power Steering
ESCM	Energy Storage Control Module
EVCN	Electromobility Vehicle Control Module
HPCU	Hybrid Powertrain Control Unit
MCU	Motor Control Unit
PCM	Powertrain Control Module
PUCU	Pump Control Unit
OCCU	On-board Charger Control Unit (Not applicable)
OPCU	Oil Pump Control Unit
TVMU	Traction Voltage Monitoring Unit

SAE J1939 Control Data Link

The system's **control signals** are sent via this link.

The J1939 link is fast, operating at 250 K bits per second (250K Baud rate). This operating speed allows the system to function more effectively and adapt quickly to changing conditions and vehicle requirements.

The link complies with SAE standards, and consists of two twisted wires: a green wire (CAN_H), and a yellow wire (CAN_L). The twisted wire set [0.89 twists per 25.4 mm (1 inch) or 33 twists per meter (3.28 feet)] is used to protect the link from electrical interference.



CAUTION

No modifications or connections should be made to wires CAN_H (yellow), or CAN_L (green). These wires carry the high-speed communications between the electronic systems in the vehicle. **Any modification, connection to, or damage to these wires can result in the failure of the vehicle's electronic systems.**

Terminating Resistor

Terminating resistors are wired into each end of the J1939 (DL1) data link.

Only two terminating resistors are used in a data link. Never install three in a data link. If more than two terminating resistors exist in the J1939 circuit, damage to the ECU electronics can occur over time. You can easily check to see if you have two resistors by measuring the resistance between circuits CAN_H and CAN_L, at the diagnostic connector, with the ignition OFF. The correct resistance is 50 - 70 Ω .

The purpose of these resistors is to prevent data link signal reflections. They must remain connected for the system to function properly.

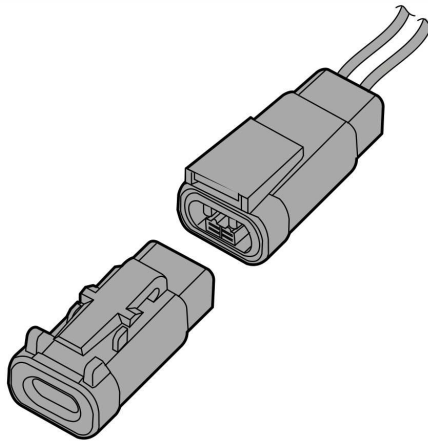


Fig. 1 J1939 Terminating Resistor

SAE J2284 Control Data Link

The system's **control signals** are sent via this link.

The J2284 link is very fast, operating at 500 K bits per second (500 K Baud rate). This operating speed allows the system to function more effectively and adapt quickly to changing conditions and vehicle requirements.

The link complies with SAE standards, and consists of two twisted wires: a green wire (CAN_H), and a yellow wire (CAN_L). The twisted wire set [0.89 twists per 25.4 mm (1 inch) or 33 twists per meter (3.28 feet)] is used to protect the link from electrical interference.



CAUTION

No modifications or connections should be made to wires CAN_H (yellow), or CAN_L (green). These wires carry the high-speed communications between the electronic systems in the vehicle. **Any modification, connection to, or damage to these wires can result in the failure of the vehicle's electronic systems.**

Terminating Resistor

Terminating resistors are wired into each end of the J2284 (DL2) data link.

Only two terminating resistors are used in a data link. Never install three in a data link. If more than two terminating resistors exist in the J2284 circuit, damage to the ECU electronics can occur over time. You can easily check to see if you have two resistors by measuring the resistance between circuits CAN_H and CAN_L, at the diagnostic connector, with the ignition OFF. The correct resistance is 50 - 70 Ω .

The purpose of these resistors is to prevent data link signal reflections. They must remain connected for the system to function properly.

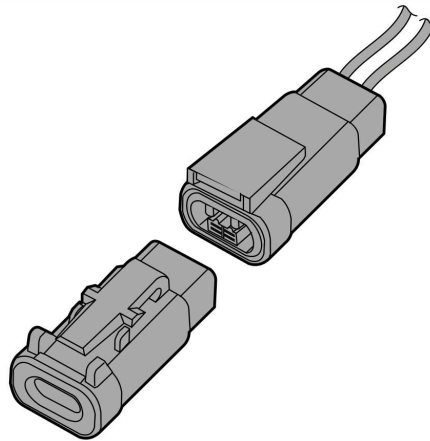


Fig. 2 J2284 Terminating Resistor

Diagnostic Connector

The diagnostic connector is located in the driver's side kick panel. The diagnostic connector is connected to the ISO information link and gives the system a way to communicate with an external PC or diagnostic tool.

With a PC or diagnostic tool connected, error codes can be read from all the control units. This is important in fault tracing to carry out basic checks of all the vital parts of the vehicle's electronics.

Some programming can also be done via the diagnostic connector.

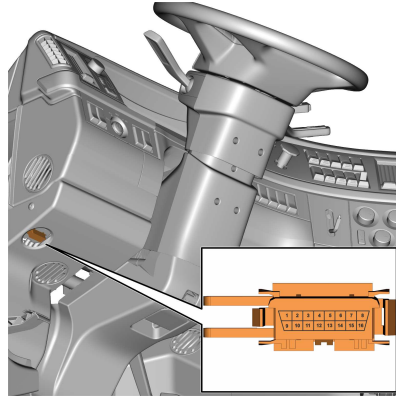


Fig. 3 Diagnostic Connector (16 Pin)

Pin Allocation for the 2013 SAE J1962 16-pin Vehicle Diagnostic Connector (Global Commonality)

16 Pin Diagnostic Connector (OBD 13) Definitions

16 Pin Diagnostic Connector (OBD 13 SAE J1962-Type A Connector)	
PIN	Definition
1	OEM discretionary (assigned as: Key switch – ignition signal for AM tool)
2	Bus positive line of SAE J1850 (Not Used)
3	OEM discretionary (assigned as: SAE J1939-15_CAN_H)
4	Chassis ground
5	Signal ground 6 CAN_H line of ISO
6	CAN_H line of ISO 15765-4
7	K line of ISO 9141-2 and ISO 14230-4 (Not Used)
8	OEM discretionary (Not assigned)
9	OEM discretionary (Not assigned)
10	Bus negative line of SAE J1850 (Not Used)
11	OEM discretionary (assigned as: SAE J1939-15_CAN_L)
12	OEM discretionary (assigned as: SAE J1708 / J1587 positive)
13	OEM discretionary (assigned as: SAE J1708 / J1587 negative)
14	CAN_L line of ISO 15765-4
15	L line of ISO 9141-2 and ISO 14230-4 (Not Used)
16	Battery positive voltage

Body Builder Can Gateway

This function opens a CAN interface to the truck internal CAN connections and makes it possible to monitor the truck via the CAN bus, by sending/receiving J1939 standard messages.

Body builder equipment should comply with the standards defined for the following types of communication bus:

- SAE J1939-11 (twisted wires)
- SAE J1939 (physical layers)
- SAE J1939-71 (functional layers)

Note: The body builder CAN includes a 120-Ohm terminal resistor inside the VECU.

The external equipment installer is responsible for ensuring that the CAN connection has the correct terminal.

For more detailed information, refer to standard SAE J1939.

Multiplexing Body Builder DL5 J1939 CAN

The multiplexing system BB J1939 CAN is used to provide control and communication between all major functional areas on a vehicle. The system offers simplified communication between the body builder module and other related electrical systems. Multiple signals are sent over a single pair of twisted wires, as opposed to individual wires for each function. The J1939 data link is used to send these signals.

The benefit of this arrangement is fewer wires, sensors and connections are required for communication purposes between systems. Also, there is greater signal consistency and reliability.

Multiplexing Parameters

SAE	CAN Network	Source of Message	Receiver of Message	Update Rate	PGN Signal Names (SPN)
ACC1 (65135)	J1939-X	VECU (as ACB)	Ext CAN	100 ms	Forward vehicle speed Forward vehicle distance ACC Set Speed ACC Mode ACC set distance mode Road curvature ACC Target Detected ACC System Shutoff Warning ACC Distance Alert Signal
ACC Status (65296)	J1939-X	VECU (as ACB)	Ext CAN	100 ms	(Proprietary message from ACB) Audible Following Distance Alert Visual Following Distance Alert Vehicle Following Distance Vehicle Following Interval ACB tell-tale Indicator Status
ACB Critical Events (PGN 65297)	J1939-X	VECU (as ACB)	Ext CAN	100 ms	CMT Intervention Impact Alert
AIR1	J1939-X	VECU	Ext CAN	1 second	Pneumatic Supply Pressure 46
AMB (65269)	J1939-X	VECU (as EMS)	Ext CAN	1 second	Ambient Air Temperature, Barometric pressure
B	J1939-X	VECU (as IC)	Ext CAN	1 second	Brake Application Pressure (SPN 116) Brake Primary Pressure (SPN 117) Brake

SAE	CAN Network	Source of Message	Receiver of Message	Update Rate	PGN Signal Names (SPN)
					Secondary Pressure (SPN 118) Parking Brake Red Warning Signal (SPN 3557)
CCVS (65265)	J1939-X	VECU	Ext CAN	100 ms	Vehicle speed, etc.
CI (PGN 65259)	J1939-X	VECU (as EMS)	Ext CAN	On Request	Component ID, etc.
CVW (PGN 65136)	J1939-X	VECU (per reply)	Ext CAN	On Request	Weights
DD (65276)	J1939-X	VECU (as IC)	Ext CAN	1 second	Washer Fluid Level (SPN 80)
DM1	J1939-X	VECU (as received)	Ext CAN	1 second	Fault lamps, etc.
EBC1 (PGN 61441)	J1939-X	VECU (as ABS)	Ext CAN	100 ms	Anti-Lock Braking (ABS) Active, etc.
EBC1 (PGN 61441)	J1939-X	Ext CAN	VECU	100 ms	Remote Accelerator Pedal Enable Switch, Accelerator Interlock Switch
EBC1 (PGN 61441)	J1939-X	VECU	Cummins	100 ms	Remote Accelerator Pedal Enable Switch (SPN 969), Accelerator Interlock Switch (SPN 972)
EBC2 (WSI PGN 65215)	J1939-X	VECU (as ABS)	Ext CAN	100 ms	Wheel speeds
EBC5 (PGN 64964)	J1939-X	VECU (as ABS)	Ext CAN	100 ms	Hill Holder Mode
EEC2 (61443)	J1939-X	VECU	Ext CAN	50 ms	Accelerator Pedal Position
EEC2 (61443)	J1939-X	Ext CAN	VECU	50 ms	Remote Accelerator Pedal Position
ETC1	J1939-X	VECU (as TECU)	Ext CAN	10 ms	Driveline engaged status
ETC2	J1939-X	VECU (as TECU)	Ext CAN	100 ms	Current gear status, requested gear status
ETC7	J1939-X	VECU (as TECU)	Ext CAN	100 ms	Shift and mode indicators, etc.
HRW (PGN 65134)	J1939-X	VECU (as ABS)	Ext CAN	20 ms	Wheel speeds
LC (PGN 65089)	J1939-X	VECU (as LCM)	Ext CAN	1 second and change of state	Light switches, etc.

SAE	CAN Network	Source of Message	Receiver of Message	Update Rate	PGN Signal Names (SPN)
LC (PGN 65089)	J1939-X	VECU (as LCM)	Ext CAN	1 second and change of state	Light switches, etc.
OEL (PGN 64972)	J1939-X	VECU (as IC)	Ext CAN	1 second and change of state	Main Light Switch 2872 Turn Signal Switch 2876 Hazard Light Switch 2875 High-Low Beam Switch 2874 Operators Desired Back-light 2878
Request	J1939-X	Ext CAN	VECU		PGN
Request	J1939-1	VECU	As received	As received in most cases	PGN
SERV (PGN 65216)	J1939-X	VECU	Ext CAN	On request	Service component identification Service distance (associated to upper Service component ID) Service component identification Service delay/calendar time based (associated to upper Service component ID) Service component identification Service delay/operational time based (associated to upper Service component ID)
SOFT (PGN 65242)	J1939-1	VECU	Ext CAN	On request	Variable length
TCFG (PGN 65250)	J1939-1	VECU	Ext CAN	On request	Number of Reverse Gear Ratios 958 Number of Forward Gear Ratios 957 Transmission Gear Ratio 581
TD (PGN 65254)	J1939-X	VECU (as IC)	Ext CAN	On Request	Time & date
VD (PGN 65248)	J1939-X	VECU (as IC)	Ext CAN	1 second	Total Vehicle Distance 245 Convert from VDHR
VDC1 (PGN 65103)	J1939-X	VECU (as ABS)	Ext CAN	100 ms	VDC Information Signal, etc.
VDHR (PGN 65217)	J1939-X	VECU (as IC)	Ext CAN	1 second	High-Resolution Total Vehicle Distance 917
VH (PGN 65255)	J1939-X	VECU	Ext CAN	On request	Total Vehicle Hours 246 Total power take-off Hours 248
VI (PGN 65260)	J1939-X	VECU (as EMS)	Ext CAN	On request	VIN
VW (PGN 65258)	J1939-X	VECU (as ECS)	Ext CAN	1 second	Weights (note this is multiframe so is difficult to respond to so will gateway at received rate)
VDC1 (PGN 65103)	J1939-X	VECU (as ACB)	Ext CAN	100 ms	VDC Information Signal, etc.

SAE	CAN Network	Source of Message	Receiver of Message	Update Rate	PGN Signal Names (SPN)
VP60	J1939-1	VECU	TECU (I-Shift)	100 ms	Reverse Inhibit, Inhibit gear engaged
VEP1 (PGN 65271)	J1939-X	VECU (as IC)	Ext CAN	1 second	SPN 168 Battery Potential/Power Input 1

Note: Although the VECU sends output messages, the source address is set as the ECU originating the information.

Note: Messages that rates “on request” are requested by the J1939 request PGN 59904 described in J1939-21. For example, requesting engine hours is done by sending EAFF or EA00 with data E5 FE 00 (hex values).

Note: Not all messages are supported on all vehicles. For example, GFC is currently not available, even for natural gasoline engines. However, GFC support could be available for these engines in the future.

Commands Accepted on the DL5 Body Builder Connector J1939

Message	Update Rate	Content
EBC1 (PGN 61441)	100 ms	Remote Accelerator Pedal Enable Switch Accelerator Interlock Switch
EEC2 (61443)	50 ms	Accelerator Pedal Position 2 Remote Accelerator Pedal Position

Application Notes

By default, these commands are not accepted. To enable commands:

- QIW (VECU4) = 1 Bridge on J-1939 for Body Builder Enable (1) Level 4 Dealer Programmable
- QKH (VECU4) = 1 External CAN Control Enable (1) Level 4 Dealer Programmable
- QKX (VECU4) = 229 (Body Builder must use this Source address 229)
- A Terminating resistor for the network needs to be installed.

For safety, the accelerator and speed command signals will be overridden by a brake pedal application by default. If necessary, this option can be turned off with parameter QKD. Perform a safety analysis of the application before disabling.

Although the VECU accepts these messages, the destination address (DA) needs to be 0x00 for TSC1 and 0x03 for TC1.

The engine speed command can be sent either through the accelerator command or by direct engine speed command.

VOLVO

Volvo Trucks North America

<http://www.volvotrucks.com>