

Instruction Sheet

FIRST RESPONDER GUIDE - IC Bus® Electric CE Series

NAVISTAR®

4328785R2


Purpose


The purpose of this document is to provide detailed instruction on the following for first responders:


- Safety information
- High-voltage labels
- Personal Protection Equipment (PPE)
- Identify the vehicle: exterior
- Identify the vehicle: interior
- Identify the vehicle: under hood
- Overview: vehicle systems and components
- High-voltage batteries
- Drive motor
- High-voltage cables
- Immobilization
- Disable direct hazards
- Stored energy / liquids
- Hazardous material emergency cleanup
- In case of fire
- In case of submersion
- Towing / transportation / storage
- Important additional information


Safety Information

NOTE: Certain warnings may be repeated throughout this manual.


 **WARNING:** To prevent personal injury and / or death, remove all jewelry such as watches, necklaces, and earrings. Remove all metal objects that are conductors of electricity.


 **WARNING:** To prevent personal injury and / or death, **ALWAYS** approach the vehicle from the sides whenever possible to stay out of potential travel path. It may be difficult to determine if the vehicle is running due to lack of engine noise.


 **WARNING:** To prevent personal injury and / or death, or damage to property, remove any charge cable from the vehicle, turn vehicle OFF, set parking brake, and install wheel chocks to prevent vehicle from moving in either direction during further action.


 **WARNING:** To prevent personal injury and / or death, do not touch the high-voltage system, including any ORANGE cable or any device with high-voltage a safety label without wearing appropriate high-voltage Personal Protection Equipment (PPE). The PPE should include:


- a. Class 0 electrical insulating gloves, safety goggles, and Electrical Hazard (EH) rated safety shoes or boots, which must be at least appropriate up to 1,000 volts.
- b. A non-conductive object, about 5 ft (1.5 m) long, to safely push someone away from the vehicle if they accidentally come in contact.


 **WARNING:** To prevent personal injury and / or death, turn OFF the 12V disconnect switch and high-voltage disconnect switch before interacting with a damaged vehicle.


 **WARNING:** To prevent personal injury and / or death, **ALWAYS REMEMBER** the 12 Volt Battery Disconnect Switch only disables the vehicle 12 volt system, **NOT** the high-voltage battery system.

 **WARNING:** To prevent personal injury and / or death, **ALWAYS REMEMBER** that turning OFF the high-voltage disconnect switch will not dissipate voltage inside the high-voltage batteries or in level 2 or 3 high-voltage cables. **ALWAYS ASSUME** the high-voltage batteries, high-voltage cables, and high-voltage components remain live and dangerous. Contact with the high-voltage battery pack or high-voltage component internals may result in serious personal injury or death.

 **WARNING:** To prevent personal injury and / or death, handle a submerged vehicle with appropriate Personal Protection Equipment (PPE). Consider the entire vehicle as energized.

 **WARNING:** To prevent personal injury and / or death, always wear full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) when fire is involved. Fires in crash-damaged electric vehicles could emit toxic or combustible gasses. Small amounts of eye, skin, or lung irritants may be present. If exposed, rinse with large amounts of water for 10-15 minutes. Consider the entire vehicle as energized.

 **WARNING:** To prevent personal injury and / or death, **NEVER** cut or attempt to breach high-voltage batteries, high-voltage components, or high-voltage wiring.

 **WARNING:** To prevent personal injury and / or death, pay attention to secondary fire events. Even days later secondary fire events cannot be excluded.

High-Voltage Labels



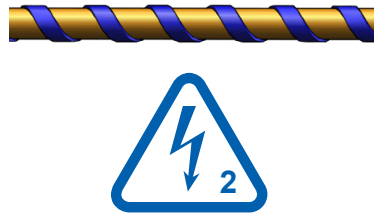
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Figure 1. Extract of Available High-Voltage Labels Throughout the Entire Vehicle

Various high-voltage components are installed throughout the entire vehicle. A triangle with a lightning bolt is used to identify high-voltage components. The lightning triangle can be single or part of a combination. Also, high-voltage cables are ORANGE in color and / or ORANGE with stripes.

High-voltage components in the vehicle are divided into three levels / zones. Only components at level 1 / zone 1 are isolated after the high-voltage disconnect switch is turned OFF. Components in zone 2 and zone 3 remain live.

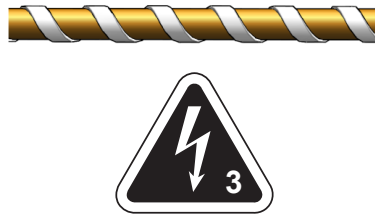
High-Voltage Labels (cont.)



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Figure 2. Level 2 / Zone 2 Safety Flag

Level 2 / zone 2 high-voltage cables are ORANGE with BLUE striping and have WHITE and BLUE safety flags.



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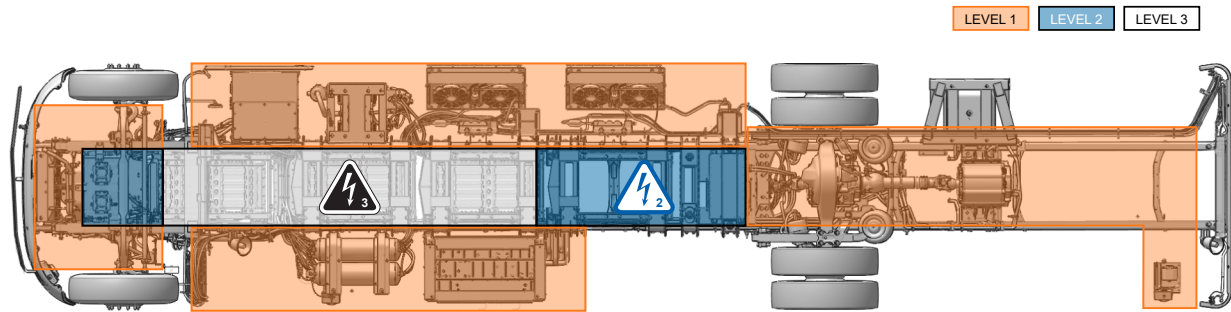
Figure 3. Level 3 / Zone 3 Safety Flag

Level 3 / zone 3: high-voltage cables are ORANGE with WHITE striping and have BLACK and WHITE safety flags.

! WARNING: To prevent personal injury and / or death, ALWAYS REMEMBER that turning OFF the high-voltage disconnect switch will not dissipate voltage inside the high-voltage batteries or in level 2 or 3 high-voltage cables. ALWAYS ASSUME the high-voltage batteries, high-voltage cables, and high-voltage components remain live and dangerous unless high voltage is isolated and the isolation is verified. Contact with the high-voltage battery pack or high-voltage component internals may result in serious personal injury or death.

Components in high-voltage zone 2 and high-voltage zone 3 remain live after the high-voltage disconnect switch is turned OFF. These zones are mostly located between the frame rails on the underside of the vehicle and are labeled as indicated in Figure 2 and Figure 3. However, the exact location of zones 2 and 3 varies by location and number of batteries installed.

High-Voltage Labels (cont.)

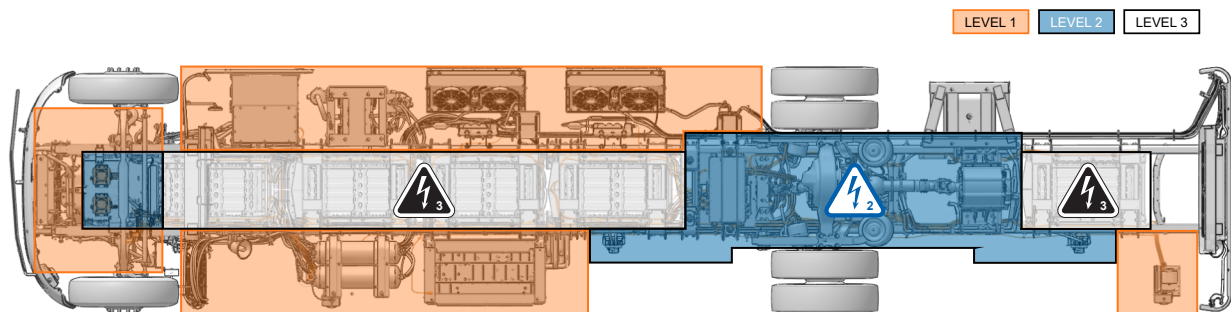


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Figure 4. High-Voltage Isolation Levels / Zones for 2-String Vehicles (Viewed from Bottom)

If there are no high-voltage battery stacks between the rear wheels of the vehicle and the rear bumper, the level 1, 2, and 3 zones are located as shown in Figure 4. This is called a 2-string configuration.

NOTE: The earliest buses made do not have the front pair of MSDs near the forward axle. On such buses, this area is level 1, not level 2.




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Figure 5. High-Voltage Isolation Levels / Zones for 3-String Vehicles (Viewed from Bottom)

If there is a battery stack between the rear wheels of the vehicle and the rear bumper, the level 1, 2, and 3 zones are located as shown in Figure 5. This is called a 3-string configuration.

NOTE: The earliest buses made do not have the front pair of MSDs near the forward axle. On such buses, this area is level 1, not level 2.

Personal Protection Equipment (PPE)

 **WARNING:** To prevent personal injury and / or death, remove all jewelry such as watches, necklaces, and earrings. Remove all metal objects that are conductors of electricity.

 **WARNING:** To prevent personal injury and / or death, do not touch the high-voltage system, including any **ORANGE** cable or any device with high-voltage a safety label without wearing appropriate high-voltage Personal Protection Equipment (PPE). The PPE should include:

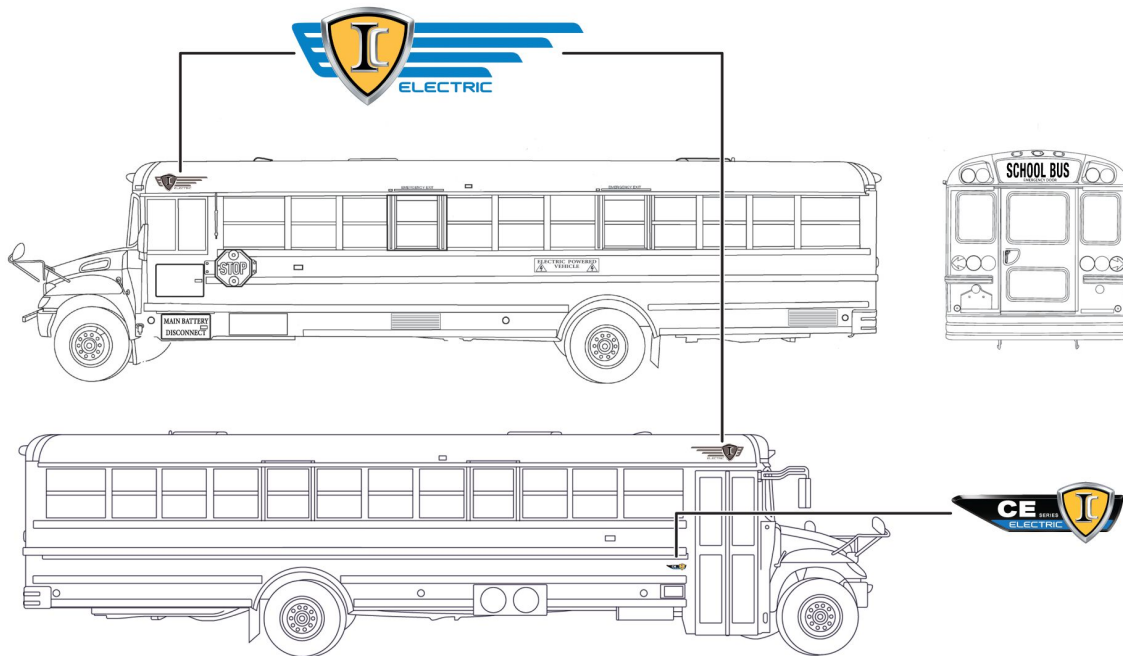
- a. Class 0 electrical insulating gloves, safety goggles, and Electrical Hazard (EH) rated safety shoes or boots, which must be at least appropriate up to 1,000 volts.
- b. A non-conductive object, about 5 ft (1.5 m) long, to safely push someone away from the vehicle if they accidentally come in contact.

A vehicle with **DAMAGED** high-voltage components or with **UNKNOWN** safety status should only be handled by specially trained and equipped personnel. The Personal Protection Equipment must be at least appropriate up to 1,000 volts. Consider the entire vehicle as energized.

Always wear full appropriate Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA), when fire is involved or the vehicle was submerged due to the high risk of reignition.

On an IC Bus® Electric CE Series **WITHOUT** any damage, the ignition, 12V disconnect switch, and high-voltage disconnect switch are designed to be operated without any special high-voltage Personal Protection Equipment (PPE). Do not touch any **ORANGE** cable or any device with a high-voltage safety label.

Identify the Vehicle: Exterior

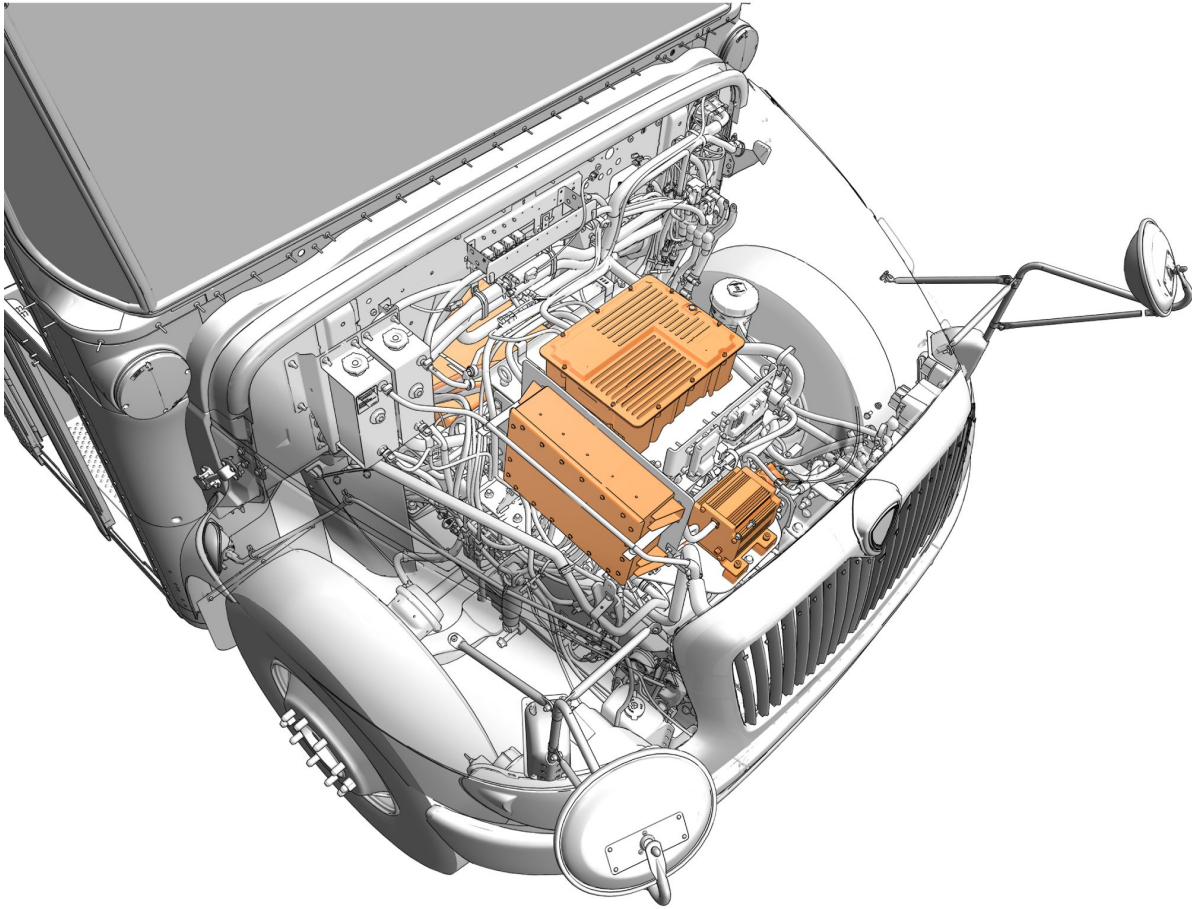


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Figure 6. Exterior Badges

The IC Bus® Electric CE Series can be distinguished on the exterior from common bus models by the badges over the entrance door and over the driver-side window. In addition to the YELLOW IC Bus® logo, the badge will have BLUE stripes and the word **ELECTRIC** in BLUE lettering. Additionally, there is an IC Bus® Electric CE Series badge on the left side of the entrance door and an ELECTRIC POWERED sticker on both the front bumper and the rear bumper.

Identify the Vehicle: Under the Hood

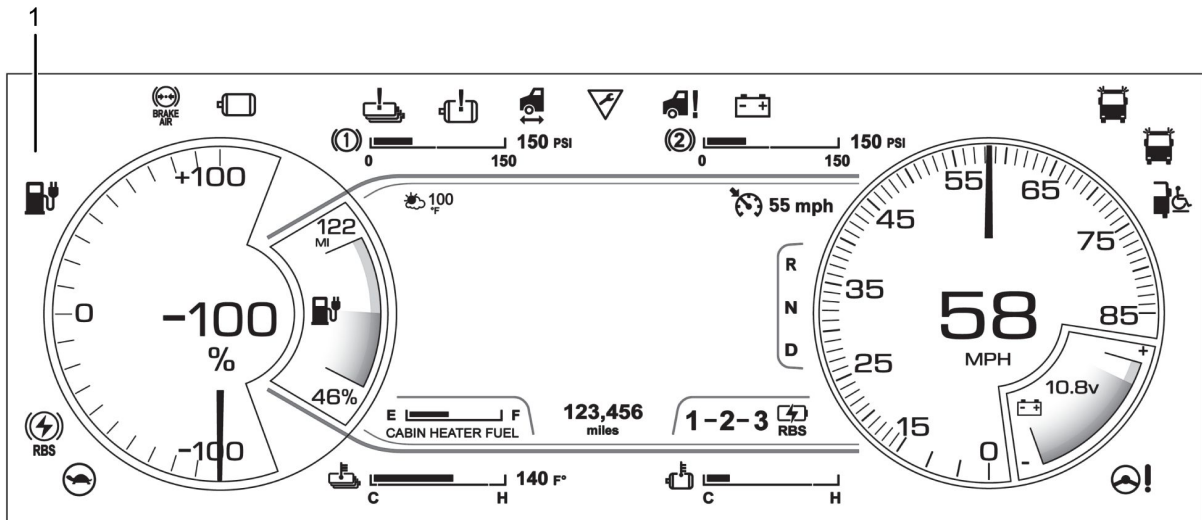


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Figure 7. Under the Hood

Under the hood, the IC Bus® Electric CE Series has several high-voltage modules, which can be distinguished by the ORANGE cables and high-voltage labels.

Identify the Vehicle: Interior



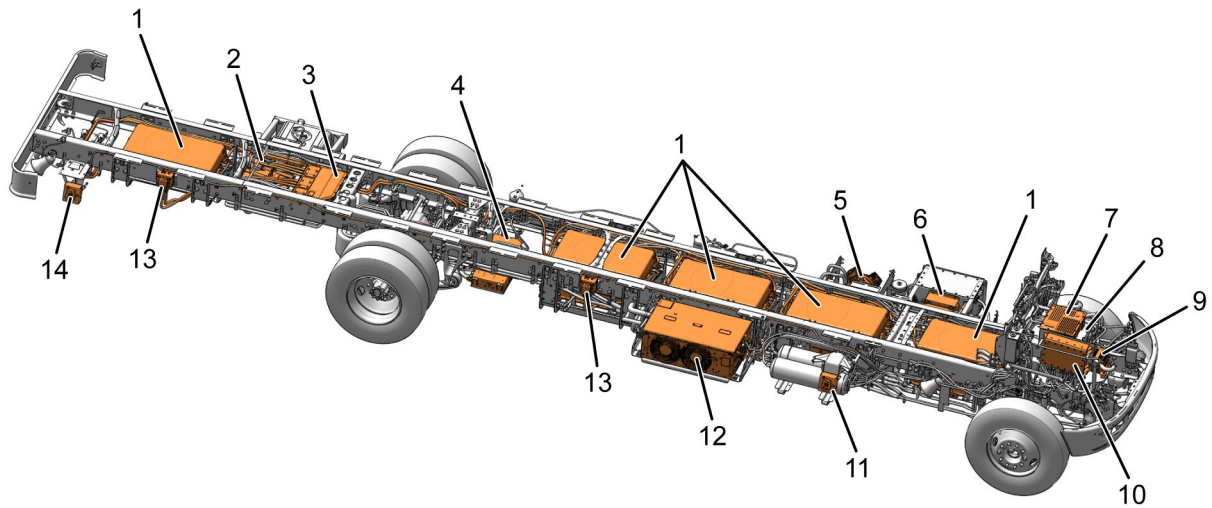
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Figure 8. Cluster

1. Charging station icon

The IC Bus® Electric CE Series can be distinguished from non-electric school bus models by the charging station icon (Figure 8, Item 1) on the top left corner of the instrument cluster.

Vehicle Systems and Components

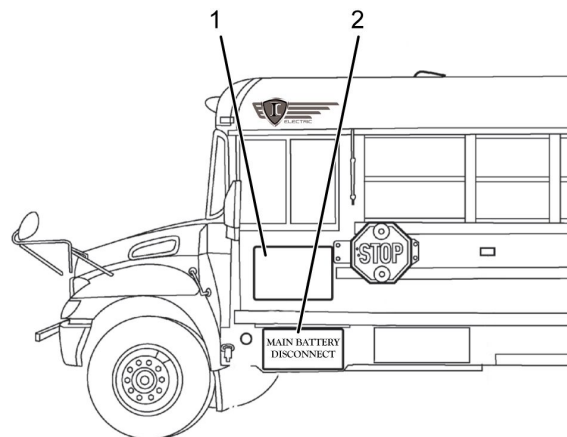


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Figure 9. Vehicle Overview

1. High-voltage battery pack (up to five total, dependent on vehicle options)
2. Drive motor
3. Traction Power Inverter Module (TPIM)
4. S-box and High-Voltage Distribution Module (HVDM)
5. High-voltage air compressor
6. DCDC converters (DCDC) and 12V batteries
7. 2-in-1 inverter
8. On-Board Charger (OBC) (2) (under Item 7)
9. High-voltage power steering pump (located behind front cooling system)
10. High-Voltage Distribution Unit (HVDU)
11. Charge port front (AC & DC) and Onboard Charging Interface (OCI) module
12. Battery Thermal Management System (BTMS)
13. Level 2 Manual Service Disconnect (MSD) (2). The two pictured are present on 3-string vehicles only. Four other MSDs are not pictured. See Figure 17 for all locations
14. Charge port rear (AC & DC) and Onboard Charging Interface (OCI) Module

Vehicle Systems and Components (cont.)



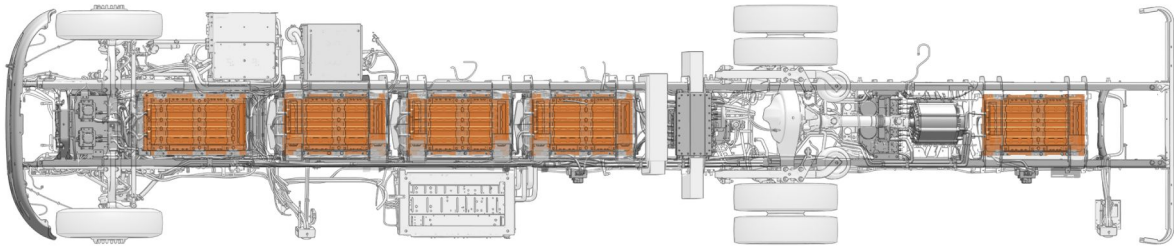
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Figure 10. Service Access Covers

1. High-voltage disconnect cover
2. 12V battery disconnect cover

The high-voltage and 12V battery disconnect covers (Figure 10, Items 1 & 2) are located on the driver side of the vehicle. Each cover is equipped with a lock. In an emergency situation, if keys are not available, access covers must be opened by force.

High-Voltage Batteries

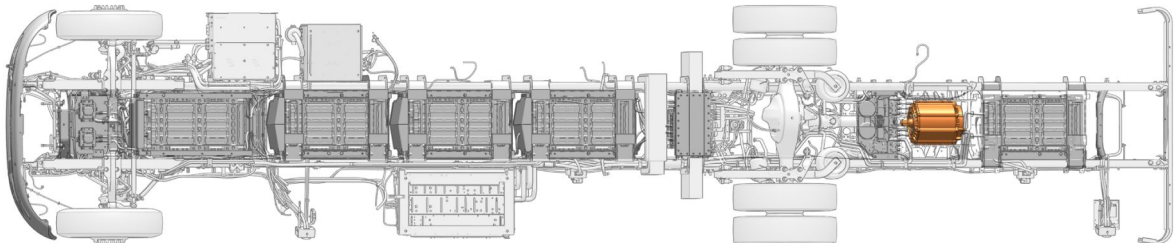


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Figure 11. High-Voltage Batteries

The high-voltage batteries are located under the bus cabin between the frame rails. The IC Bus® Electric CE Series may be equipped with up to five high-voltage battery stacks. Four battery stacks may be installed between the axles and one may be located behind the drive motor. However, the two rearmost battery stacks are optional. The three (or four) battery stacks between the axles will each contain two vertically stacked high-voltage batteries. If present, the battery stack to the rear of the drive motor is always a single battery.

Drive Motor

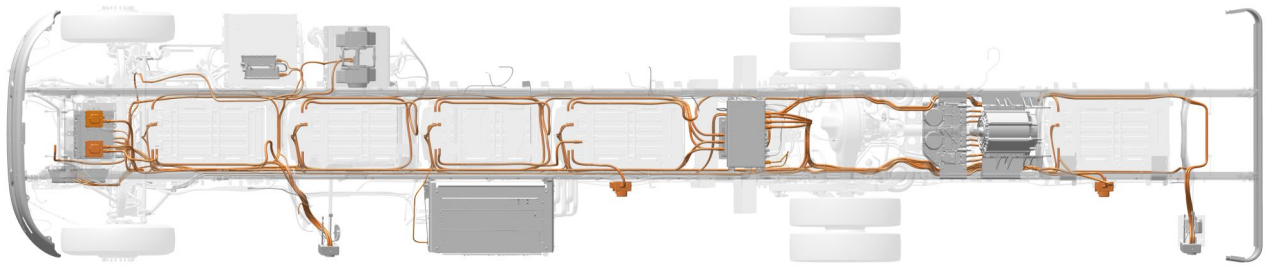


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Figure 12. Drive Motor

The drive motor is located behind the rear axle and is powered by 6-phase alternating current (AC). The drive motor and the differential are connected by a drive shaft.

High-Voltage Cables



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Figure 13. High-Voltage Cables

⚠ WARNING: To prevent personal injury and / or death, NEVER cut or attempt to breach high-voltage batteries, high-voltage components, or high-voltage cables when high voltage is present.

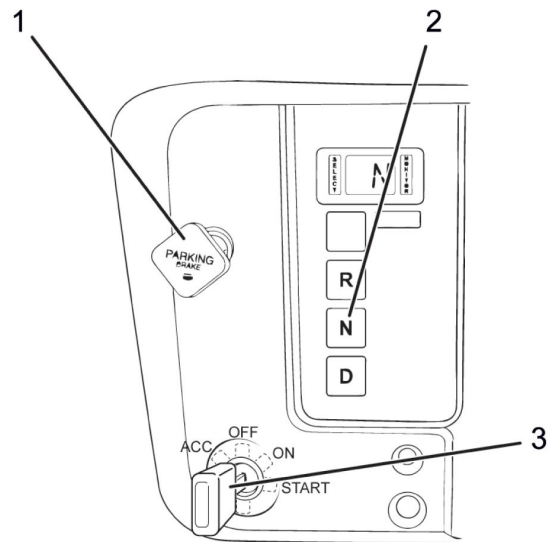
High-voltage cables are colored in ORANGE and / or ORANGE with stripes. DO NOT cut, breach, or stress ORANGE high-voltage components unless high-voltage in the corresponding zone has been isolated:

- High voltage in zone 1 is isolated when Level 1 Manual Service Disconnects (MSDs) are disconnected.
- High voltage in zone 2 is isolated when Level 2 MSDs are disconnected.
- NEVER cut or attempt to breach high-voltage batteries, high-voltage components, or high-voltage cables in zone 3.

Refer to *Disable Direct Hazards* on the following pages for detailed instructions.

Disable Direct Hazards

Turning OFF the Vehicle



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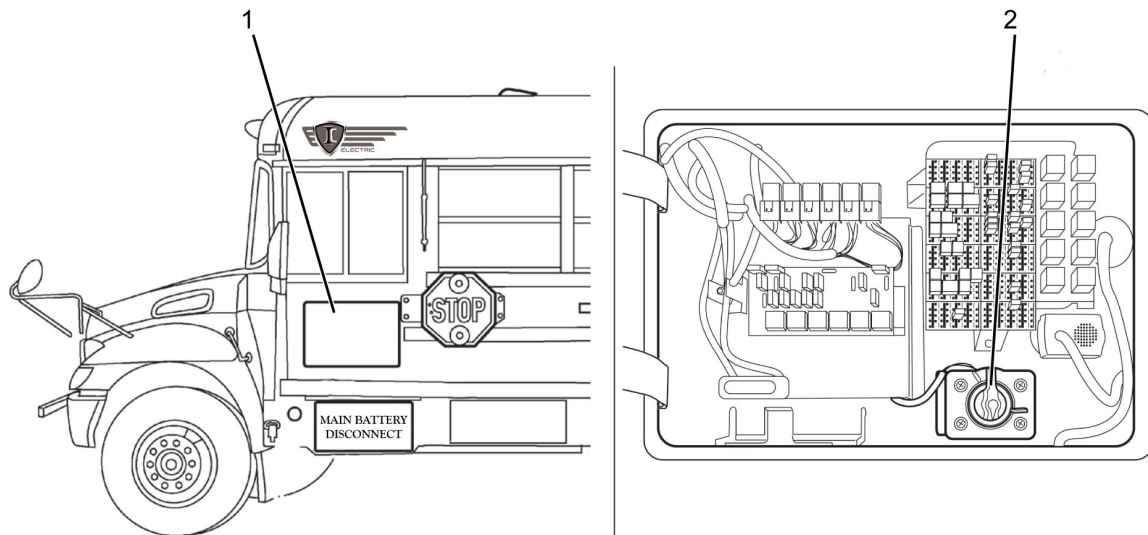
Figure 14. Dashboard

1. Parking brake knob (park position)
2. Neutral selector button
3. Vehicle key (OFF position)

1. Push Neutral (N) button (Figure 14, Item 2).
2. Pull the PARKING BRAKE knob (Figure 14, Item 1).
3. Turn the key (Figure 14, Item 3) to the left to turn vehicle OFF.
4. Remove the key.

Disable Direct Hazards (cont.)

Turning Off the High-Voltage Disconnect Switch



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Figure 15. High-Voltage Disconnect Switch Location

1. High-voltage disconnect cover
2. High-voltage disconnect switch (OFF position)

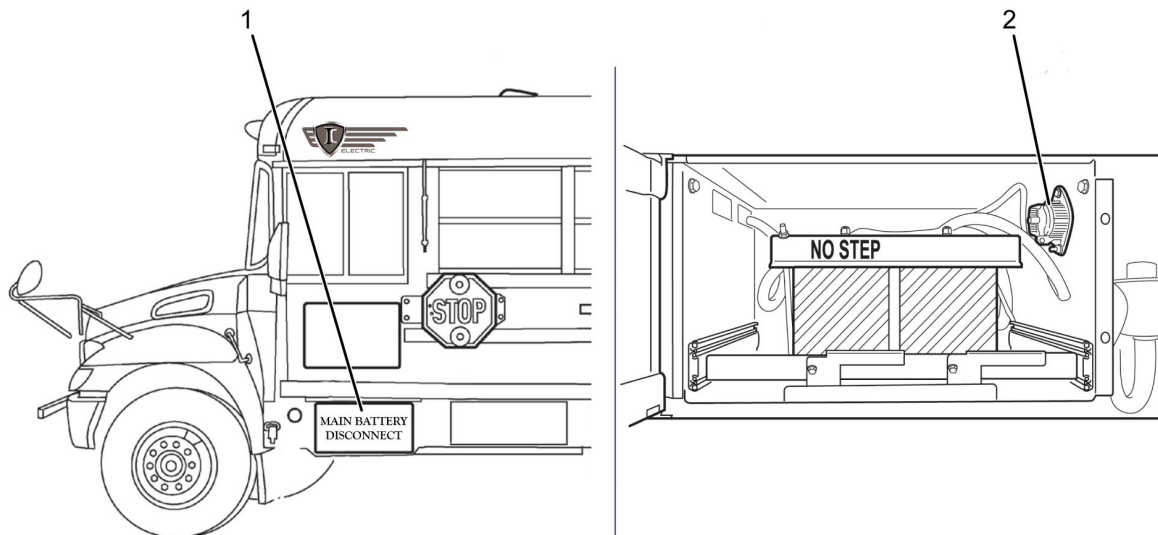
⚠ WARNING: To prevent personal injury and / or death, ALWAYS REMEMBER the High-Voltage Disconnect Switch only isolates high-voltage from components after the S-Box. The High-Voltage Disconnect Switch does NOT disconnect high-voltage in the S-Box, the high-voltage batteries, or the cables between these items. Also, the vehicle 12 volt system could still be energized. ALWAYS shut OFF both the High-Voltage Disconnect Switch and the 12V Disconnect Switch whenever interacting with a damaged vehicle. NEVER touch ORANGE cables without wearing appropriate high-voltage Personal Protection Equipment (PPE).

1. Open the high-voltage disconnect switch cover (Figure 16, Item 1). The cover has a lock. In an emergency and if keys are not available, open by force.
2. Turn the BLACK high-voltage service disconnect switch to OFF position (Figure 16, Item 2).
3. Lock the switch with a padlock to prevent anyone from turning it back ON.

Components in high-voltage zone 2 and high-voltage zone 3 remain live after the high-voltage disconnect switch is turned OFF. These zones are located primarily between the frame rails on the underside of the vehicle and are labeled as indicated in Figure 2 and Figure 3.

Disable Direct Hazards (cont.)

Turning Off the 12 Volt Battery Disconnect Switch



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Figure 16. 12 Volt Battery Disconnect Switch Location

1. 12 volt battery disconnect cover
2. 12 volt battery disconnect switch (OFF position)

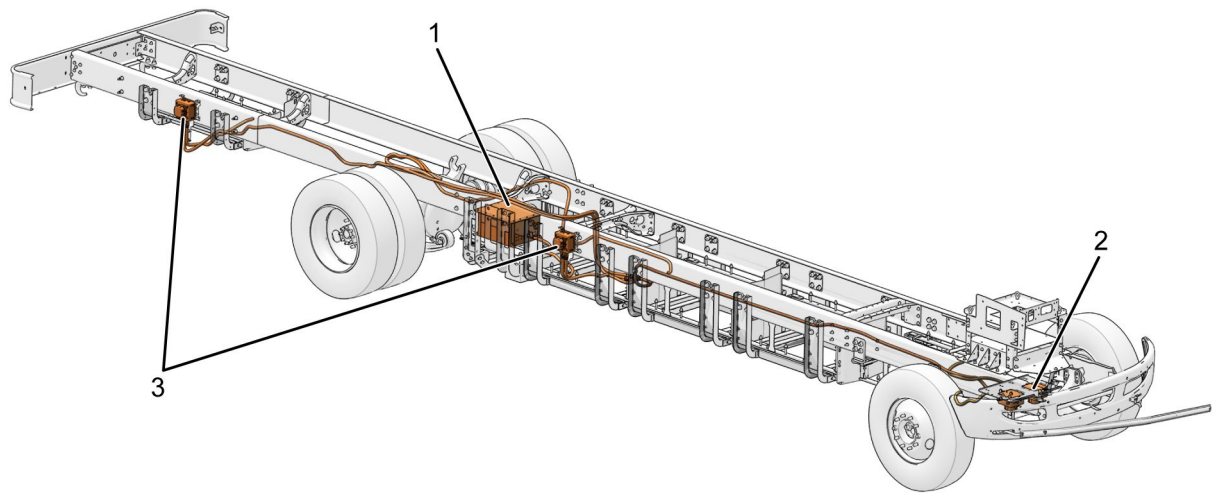
! WARNING: To prevent personal injury and / or death, turn OFF the high-voltage disconnect switch first and then turn OFF the 12V disconnect switch before interacting with a damaged vehicle.

! WARNING: To prevent personal injury and / or death, ALWAYS REMEMBER the 12V disconnect switch only disables the vehicle 12 volt system, NOT the high-voltage battery system.

1. Open the 12 volt battery disconnect cover (Figure 15, Item 1). The cover has a lock. In an emergency and if keys are not available, open by force.
2. Turn the RED 12 volt battery disconnect switch to OFF position (Figure 15, Item 2).
3. Lock the switch with a padlock to prevent anyone from turning it back ON.

Disable Direct Hazards (cont.)

Disconnecting Manual Service Disconnects (MSD)



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Figure 17. MSD Locations

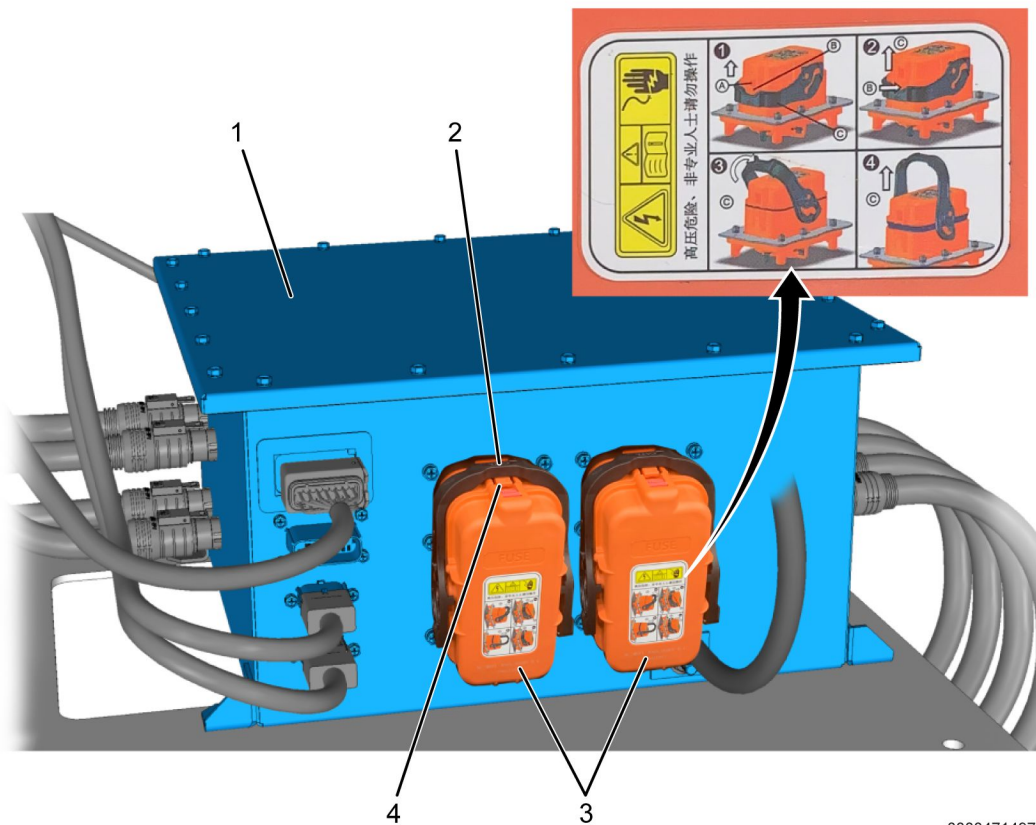
1. S-box (2 MSDs on driver side)
2. Level 2 MSDs on underside front (2)
3. Level 2 MSDs on frame rail (2) (3-string vehicles only)

There are up to three pairs of MSDs on the vehicle. They should be disconnected in the following order:

1. The level 1 MSDs, located on the S-box (Figure 17, Item 2).
2. The level 2 MSDs, located on the underside front of the vehicle (Figure 17, Item 1).
3. Buses with the 3-string configuration will also have two additional level 2 MSDs located on the passenger-side frame rail (Figure 17, Item 3).

NOTE: The level 2 MSDs are not present on the earliest buses built. On such buses, high-voltage will remain in zones 2 and 3 even after all level 1 MSDs are disconnected.

Disable Direct Hazards (cont.)



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Figure 18. Level 1 Manual Service Disconnects (MSDs)

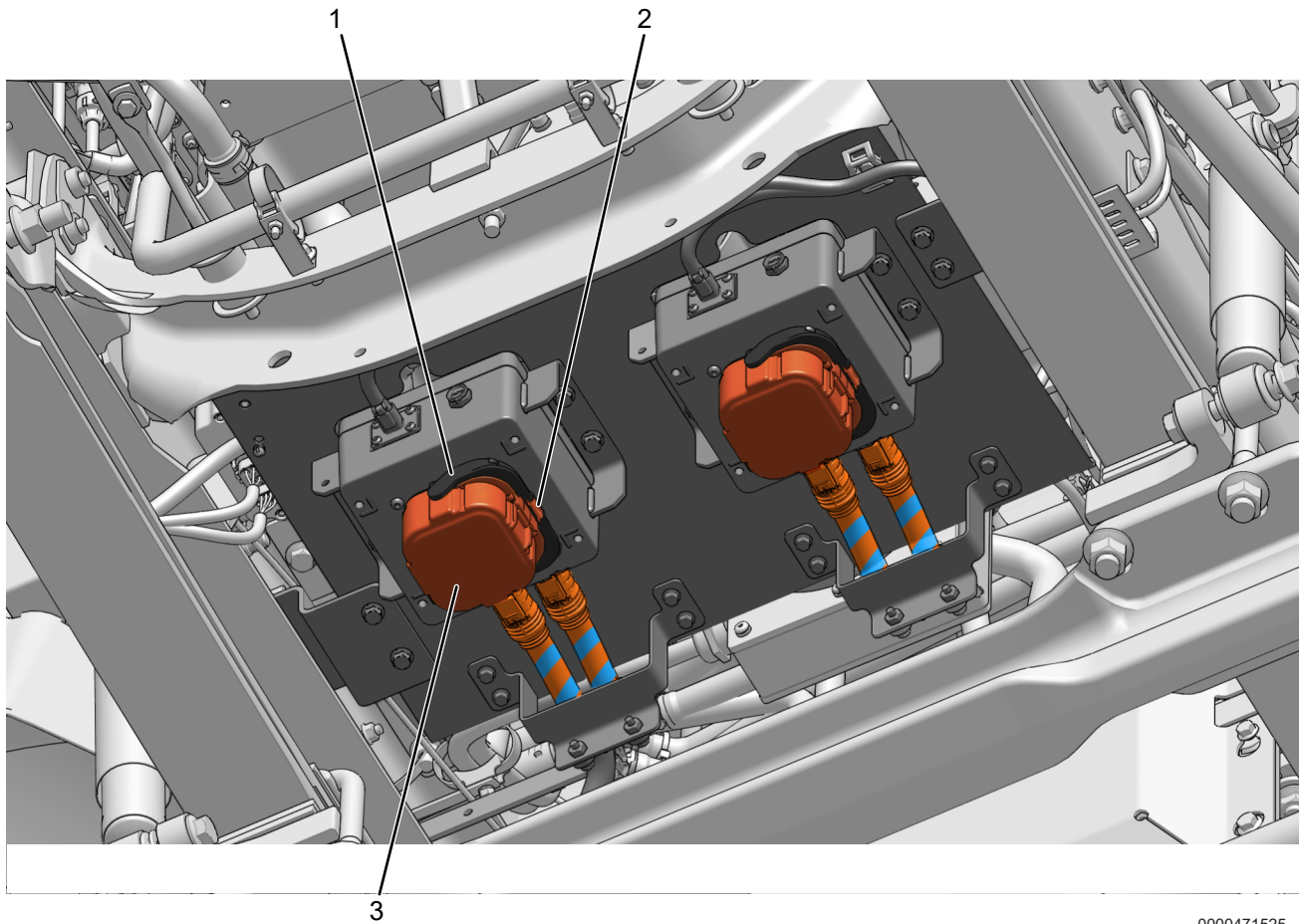
1. S-box
2. Lever release tab
3. MSD (2 total)
4. RED locking tab

The Level 1 MSDs (Figure 18, Item 3) are located on the S-box (Item 1) and can be accessed from the driver side of the vehicle.

Each level 1 MSD can be removed by pulling the RED locking tab (Item 4) out, pressing the lever release tab (Item 2), and then pulling the release handle downward approximately 45 degrees.

Removing these two MSDs physically disconnects high voltage after the S-box, isolating high voltage away from high-voltage isolation zone 1. High voltage will still exist in high-voltage isolation zones 2 and 3.

Disable Direct Hazards (cont.)



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Figure 19. Level 2 Manual Service Disconnects (MSDs) On Underside Front of Bus

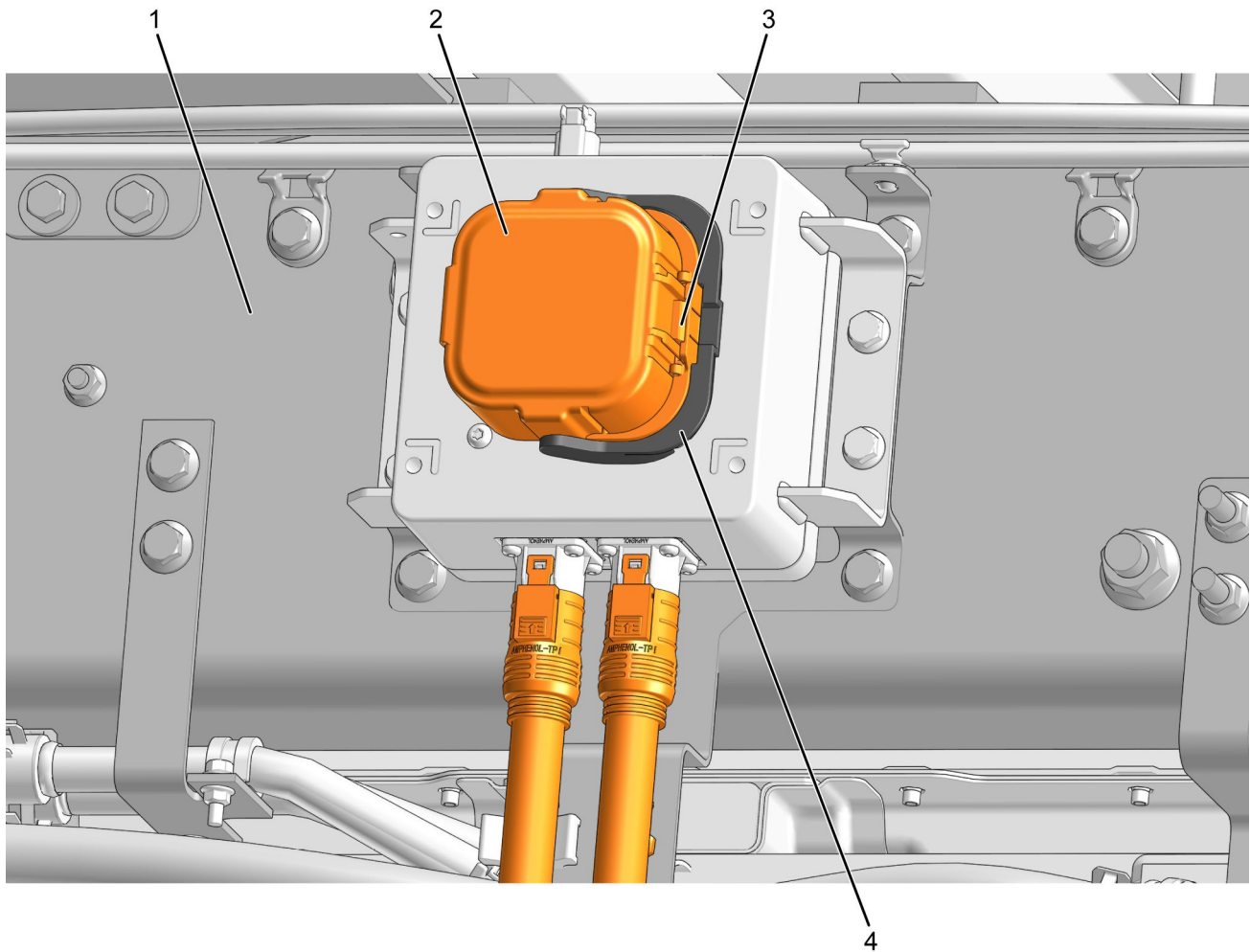
1. Release lever
2. Orange tab
3. Level 2 Manual Service Disconnects (MSD) (2)

On all but the earliest buses built, two Level 2 MSDs (Figure 19, Item 3) are located under the vehicle, just forward of the front axle.

To remove each of these MSDs, unlock the release lever (Item 1) by pulling up the ORANGE tab (Item 2) and then pressing the tab onto the release lever. The MSD can then be removed by rotating the release lever.

Removing all Level 2 MSDs physically disconnects high voltage between the S-box and the battery stacks, isolating high voltage away from high-voltage isolation zone 2. High voltage will still exist in high-voltage isolation zone 3 (the high-voltage batteries and level 3 cables).

Disable Direct Hazards (cont.)



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Figure 20. Level 2 Manual Service Disconnects (MSDs) On Frame Rail (3-String Vehicles Only)

1. Frame rail
2. Level 2 Manual Service Disconnect (MSD) (1 of 2)
3. ORANGE tab
4. Release lever

On 3-string buses, two additional Level 2 manual service disconnects are located on the passenger side of the frame rail (Figure 20, Item 1).

To remove each of these MSDs, unlock the release lever (Item 4) by pulling up the ORANGE tab (Item 3) and then pressing the tab onto the release lever. The MSD can then be removed by rotating the release lever.

Removing all Level 2 MSDs physically disconnects high voltage between the S-box and the battery stacks, isolating high voltage away from high-voltage isolation zone 2. High voltage will still exist in high-voltage isolation zone 3 (the high-voltage batteries and level 3 cables).

Stored Energy / Liquids


Lithium iron phosphate batteries are used in the high-voltage system. These cells are dry cells. Most of the electrolyte stored in these batteries is absorbed by active materials. There is only a small amount of fluid, which may leak if damaged. Leaking electrolyte will occur in drops, not puddles. The fluid is clear in color with a sweet ether-type odor. The smell may indicate a battery leak. Call the fire department immediately.


The high-voltage batteries, On-Board Chargers, DC-DC converters, Traction Power Inverter Module (TPIM), and drive motor are liquid cooled with a glycol-based coolant. This liquid is RED in color and may leak if the cooling system.

Hazardous Material Emergency Cleanup

Following an electric vehicle accident / incident, hazardous materials need to be cleaned up appropriately. Contact your local and state authorities for more information regarding proper response and cleanup of hazardous materials.

In Case of Fire

 **WARNING: To prevent personal injury and / or death, always wear full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) when fire is involved. Fires in crash-damaged electric vehicles could emit toxic or combustible gasses. Small amounts of eye, skin, or lung irritants may be present. If exposed, rinse with large amounts of water for 10-15 minutes. Consider the entire vehicle as energized.**

 **WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. There is a high risk of reignition after fire is extinguished.**


Flames, smoke, arcing, or hot spots like melted plastic may indicate fire or the presence of high voltage. A thermal camera or infrared (IR) temperature probe may be useful to identify hot spots. If signs of fire are noted, call the local fire department immediately. Clear the area around the vehicle if possible and open the vehicle doors to avoid build-up of gases in the passenger compartment. If a battery has started burning, it will try to burn to completion. Cool down the batteries with direct and large amounts of water. If possible, remove combustible materials from around the vehicle to prevent fire growth.


Batteries must be completely cooled down before releasing the vehicle to second responder. Advise second responder that there is always a risk of reignition.


In Case of Submersion

In case of submersion, secondary impact damage can never be excluded. Damaged high-voltage components pose an increased electrical shock hazard. Stay away from damaged high-voltage components. Handle any fully or partially submerged vehicle while wearing the appropriate Personal Protection Equipment (PPE).

A submerged vehicle **without** impact damage has a low electrical shock hazard risk. Small bubbles may be noticed exiting the vehicle. This is due to electrolysis of the water and does not create a higher risk of shock hazard.

 **WARNING: To prevent personal injury and / or death, consider the entire vehicle as energized. Always wear full Personal Protection Equipment (PPE).**

 **WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. There is a high risk of reignition due to damage and corrosion. Saltwater increases this risk for electrical shorts post incident. Keep full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) ready.**

 **WARNING: To prevent personal injury and / or death, avoid any contact with a submerged high-voltage system. Do not attempt to disable the High-Voltage Service Disconnect switch while the vehicle is submerged. The vehicle key may be turned to the OFF position.**

1. Turn the vehicle OFF (if possible).
2. Recover the vehicle.
3. Drain the water out of the vehicle.
4. Turn the high-voltage disconnect switch to the OFF position.

Towing / Transportation / Storage

Towing

The preferred method is to tow the vehicle with the front wheels suspended. If towed with the rear wheels on the ground, the drive shaft / propeller shaft must be removed between the drive motor and rear axle.

To improve traffic safety, the IC Bus® Electric CE Series may be slowly (maximum of 5 mph [8 km/h]) moved anytime over very short distances. The electric drive motor is connected to the wheels and generates electric voltage as the wheels are rotated. Higher speed could cause damage to the drive motor, the high-voltage system and represents a potential hazard.

Transportation

Inform the tow truck driver that reignition is possible at any time with a damaged high-voltage system. If possible, use a thermal or infrared camera to check whether the battery stacks are cold before towing the truck. To ensure that electric motor is not rotating, remove the drive shaft / propeller shaft before towing the vehicle to the next location.

Storage

Damaged vehicles should be isolated outdoors until inspected. Open windows and doors during isolation to avoid build-up of gases in the compartment. Separate the vehicle from all combustibles and structures by a distance of at least 50 ft (15 m).

Towing / Transportation / Storage (cont.)



WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. Even days later secondary fire events cannot be excluded.

Please note, high voltage may still be present in high-voltage batteries and cables in zone 3. To eliminate high-voltage entirely, refer to high-voltage battery Removal procedures located in the IC Bus® Electric CE Series Technician Manual.

Important Additional Information

Additional information about accident assistance and recovery of vehicle with high-voltage systems can be found at:

- www.nfpa.org/Training-and-Events/By-topic/Alternative-Fuel-Vehicle-Safety-Training
- www.vda.de/en/services/Publications/rescue-and-towing-of-vehicles-with-high-voltage-systems.html
- SAE J2990 Hybrid and EV First and Second Responder Recommended Practice
- National Transportation Safety Board (NTSB) www.nts.gov