Self Study Program 811213

The High-Voltage System in the ID.4

Tablet Format

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Table of Contents

Introduction

The ID.4 High-Voltage System

The high-voltage system in the ID.4 is completely redesigned to integrate seamlessly with the MEB platform architecture. The battery is a part of the vehicle chassis, mounted low in the vehicle to provide a lower center of gravity.

The ID.4 will initially be offered with an 82 kWh (gross) battery and a rear-mounted motor with 201 horsepower and 228 pound-feet of torque. Prior to launch, the Environmental Protection Agency (EPA) estimated 250 miles of range on ID.4 1st Edition and ID.4 Pro 82 kWh rear-wheel-drive models on a single battery charge. An all-wheel-drive version with 302 hp will follow later in 2021.

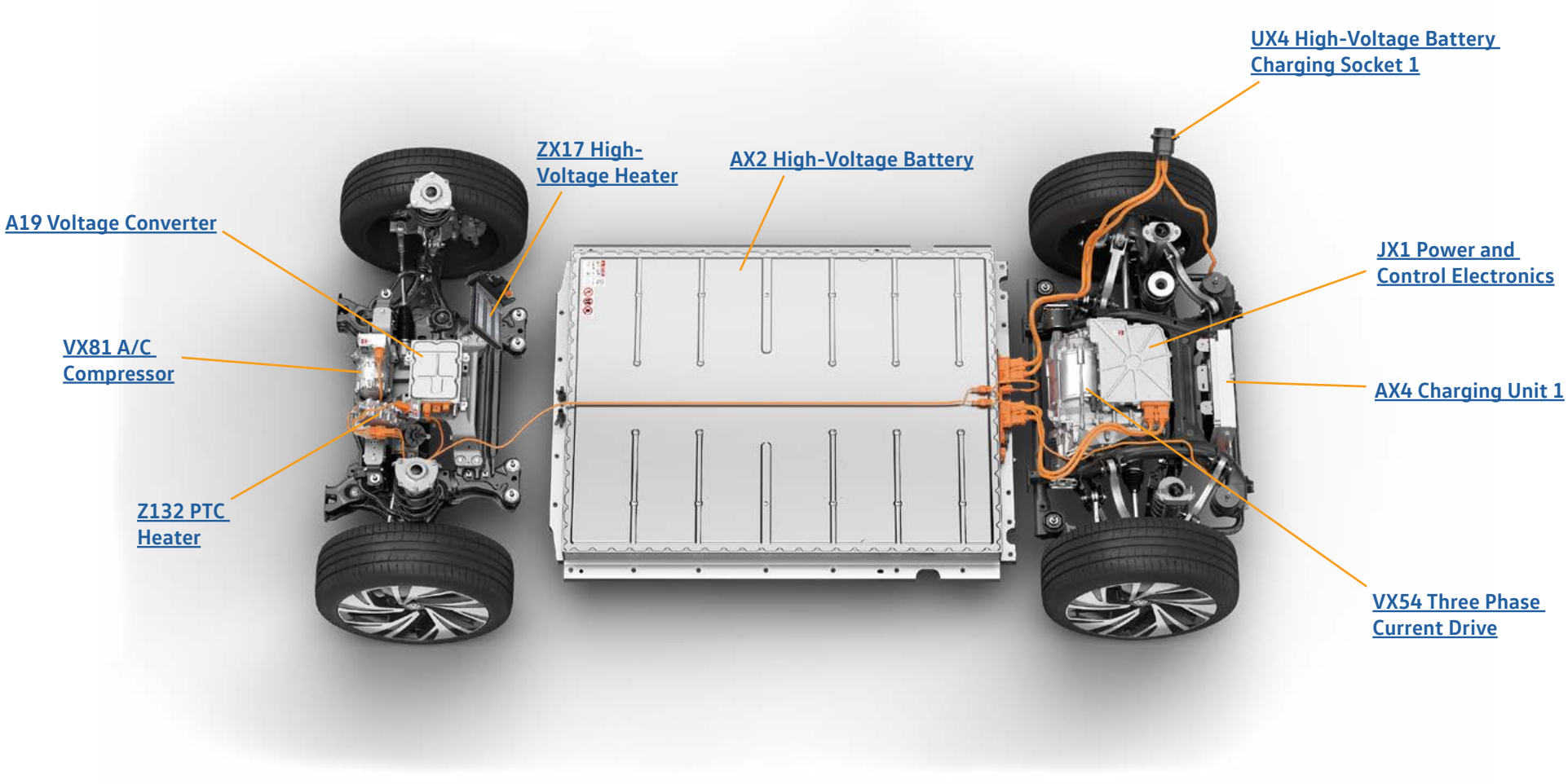
At market introduction the ID.4 will be equipped with a 82 kWh battery. A 62 kWh variant will be available later. The 82 kWh battery has 288 cells in 12 modules. It is housed in a lightweight aluminum structure that is bolted to the body of the ID.4, helping to improve rigidity.

The ID.4 can be charged with both alternating current (AC) and direct current (DC) fast-charging capability. The onboard charger allows the ID.4 to charge the battery up to 33 miles in about one hour, and charges to full in around seven and a half hours at a home or public Level 2 charger. At a DC fast-charging station, with 125 kW charging, the ID.4 can go from five to 80 percent charged in about 38 minutes.

The ID.4 High-voltage System Overview

Component Location and Information

Selecting a component will hyperlink you to the page in this SSP with additional information.

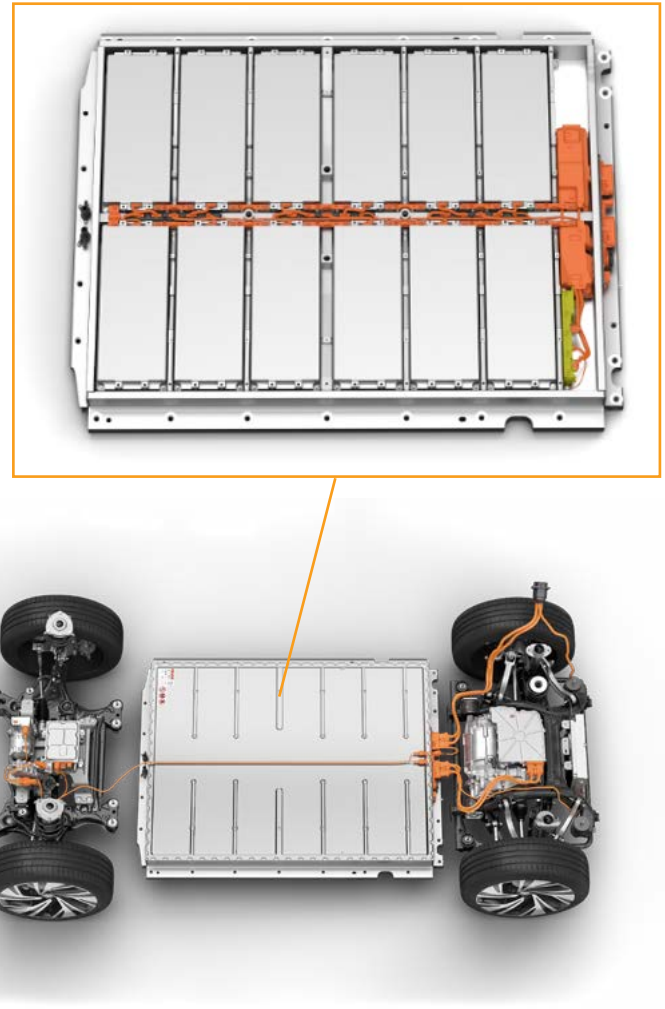


The ID.4 High-voltage System Overview

High-Voltage Battery 1 AX2

AX2 Specifications:

Weight	842 - 1109 lb (382 - 503 kg)
Net Energy Content	58 kWh to 77 kWh
Nominal Voltage	400 V
Cell Technology	Li-ion prismatic/pouch
Number of Modules	9 - 12
Capacity	156 Ah to 234 Ah
Cooling System	Liquid Cooling
Operating Range	-18 to 140° F (-28° to 60° C)
Protection Range	IP6K7, IP6K9K



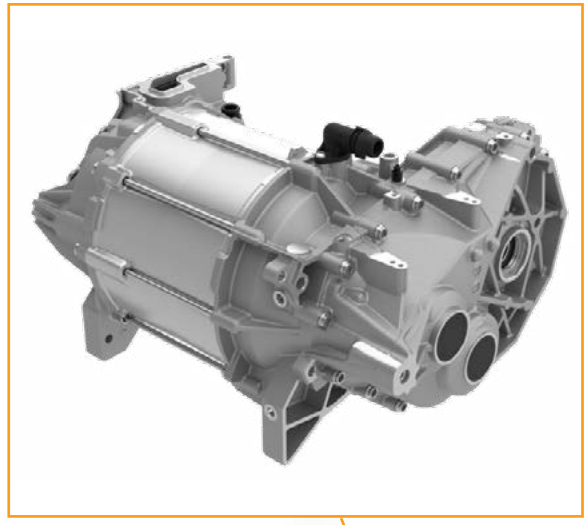
Return to the Basic Component Location and Information Page

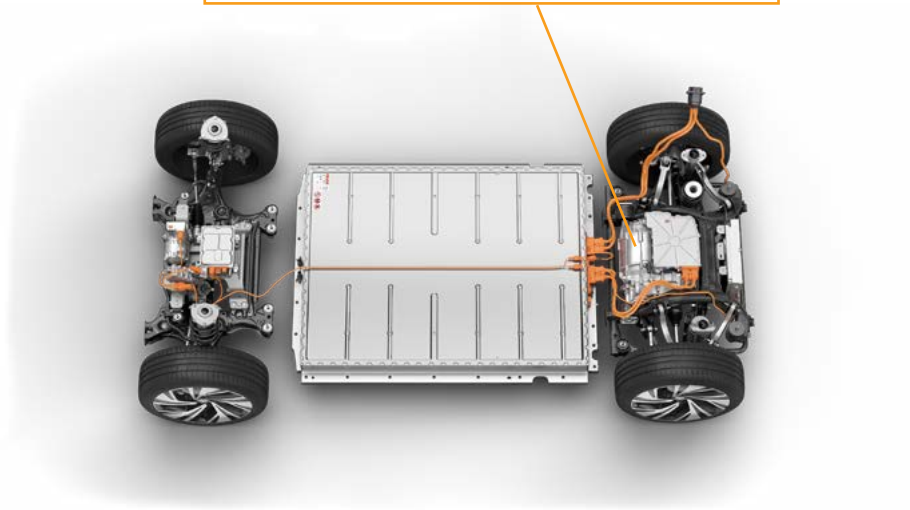
The ID.4 High-voltage System Overview

Three-phase Current Drive VX54 with One-speed Transmission 0MH

VX54 Specifications:

Weight	198 lb (90 kg) including JX1
Output	Maximum 201 hp (150 kW)
Torque	Maximum 228 lb/ft (310 Nm)
Max. Engine Speed	0 - 16,000 rpm
Transmission Ratio	12.976:1
Drive Shafts	Inserted
Manufacturer	Volkswagen Kassel





Return to the Basic Component Location and Information Page

The ID.4 High-voltage System Overview

High-Voltage Battery Charging Socket 1 UX4

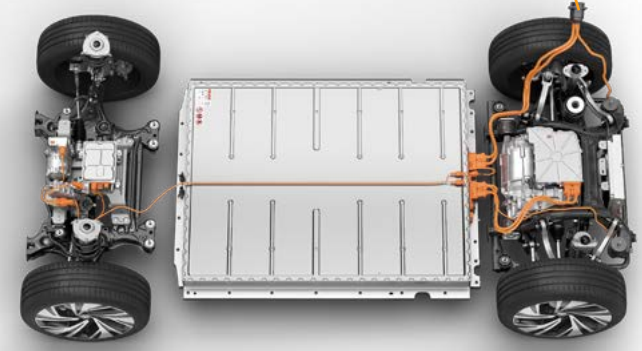
UX4 Specifications:

AC

- Connector J1772
- Number of Phases 2-3
- Max. AC Charging capacity 7.2 kW - 11 kW

DC

- Connector CCS (Combined Charging System)
- Max. DC Charging capacity 50 kW - 125 kW
- Communication:
  - PLC (Power Line Communication) communication with the charging station / charging cable
  - HLC (High Level Communication) for communication with the vehicle



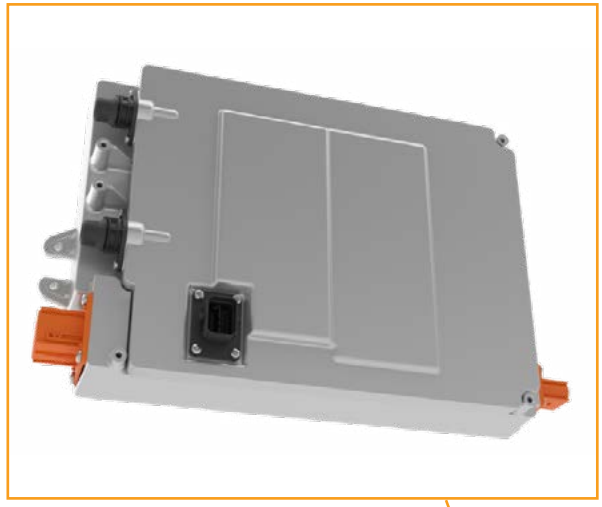
Return to the Basic Component Location and Information Page

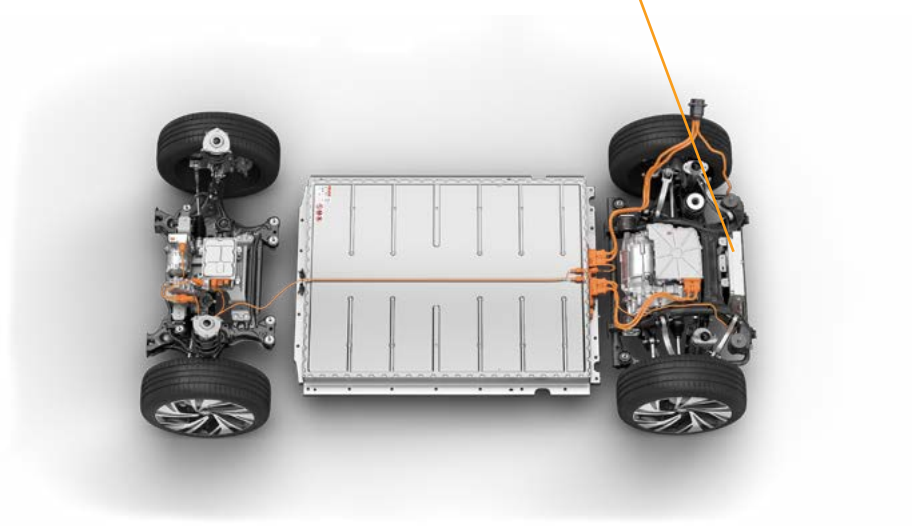
The ID.4 High-voltage System Overview

Charging Unit 1 for High-Voltage Battery AX4

Charging Unit 1 Specifications:

– Input	78 V to 272 V 16 A to 50 A
– Output	220 V to 470 V
– Number of Phases	Two
– Max. AC Charging capacity	7.2 kW - 11 kW
– Efficiency	94%
– Operating Range	-40° F to 149° F (- 40° C - 65° C)





Return to the Basic Component Location and Information Page

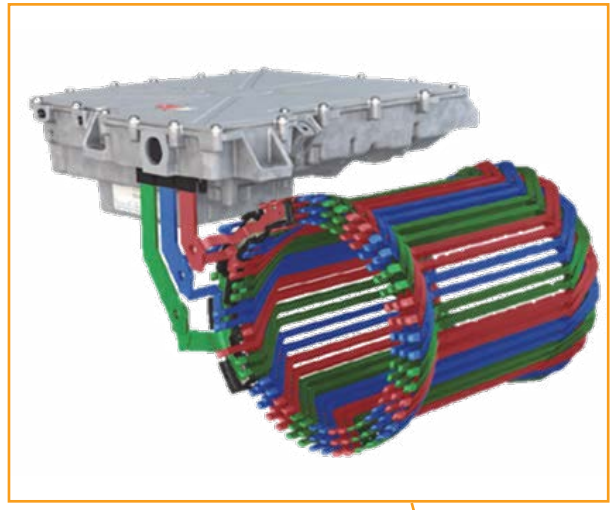
The ID.4 High-voltage System Overview

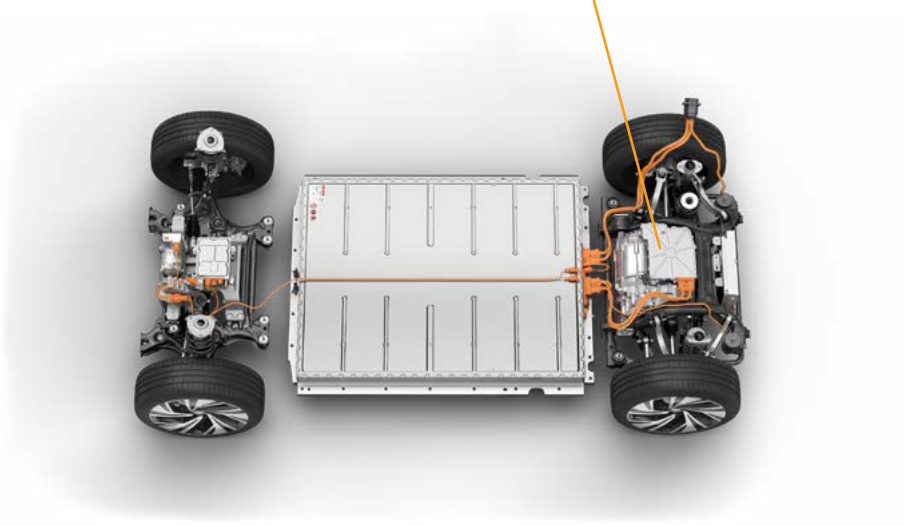
Power and Control Electronics for Electric Drive JX1

JX1 Specifications:

- Voltage Range 150 V to 475 V
- Maximum Current 450 A
- Frequency 9 Hz to 10 Hz

This component has an integrated capacitor, which is why a secondary voltage check is required when de-energizing the high-voltage system.





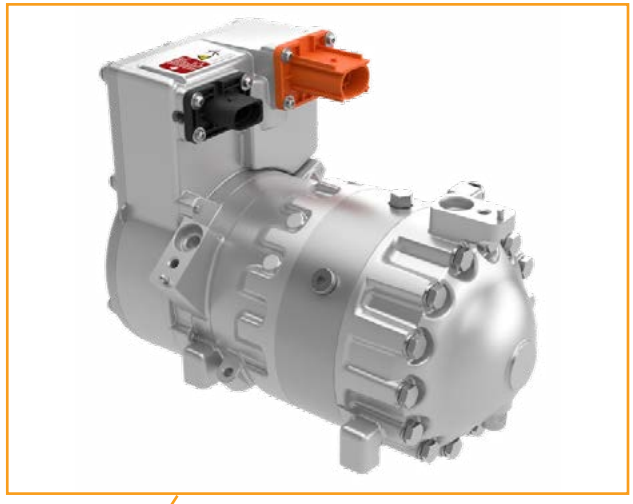
Return to the Basic Component Location and Information Page

The ID.4 High-voltage System Overview

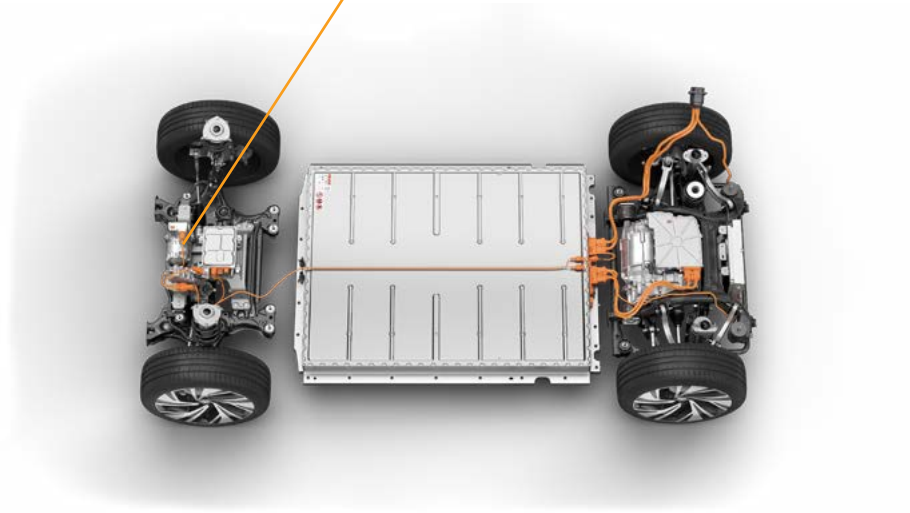
Air Conditioner Compressor VX81

VX181 Specifications:

- Type — Scroll Compressor
- Voltage — 195 V to 470 V
- Functional Engine Speed — 600 to 8,600 rpm
- Max. Power Consumption — 5.5 kW
- Ambient Temperature:
  - Air Conditioning Mode — 23° F to 158° F (-5° C to 70° C)
  - Capable of Communication — -40° F to 158° F (-40° C to 70° C)
- Refrigerant for USA — R1234yf
- Refrigerant for Canada — R744



For more information regarding refrigerants used, refer to SSP 881213 The Air Conditioning and Heat Pump Systems in MEB vehicles



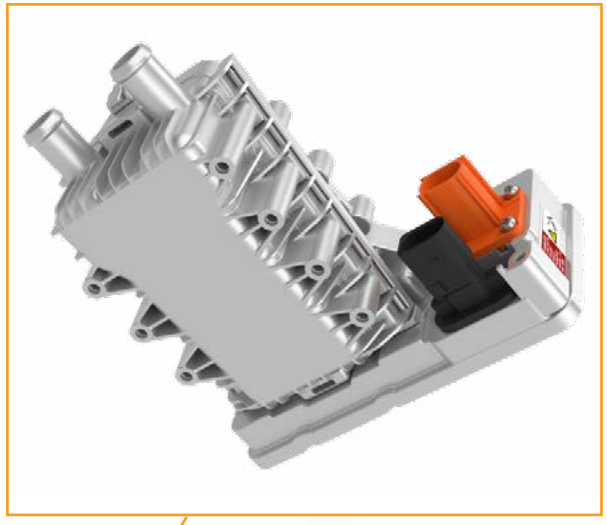
Return to the Basic Component Location and Information Page

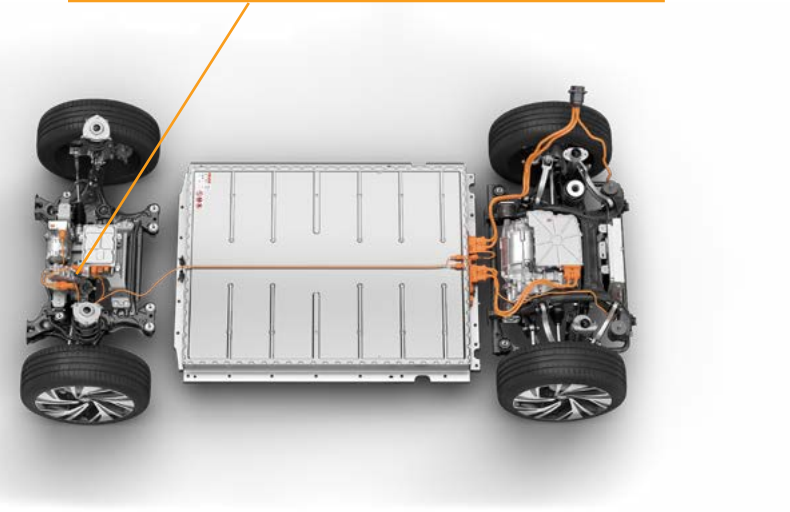
The ID.4 High-voltage System Overview

PTC Heater Element 3 Z132

Z132 Specifications:

– Nominal Voltage	150 V to 475 V
– Activation	0 - 100 %
– Max. Power Consumption	5.5 kW
– Input Current	Maximum 30 A
– Communication	LIN-bus





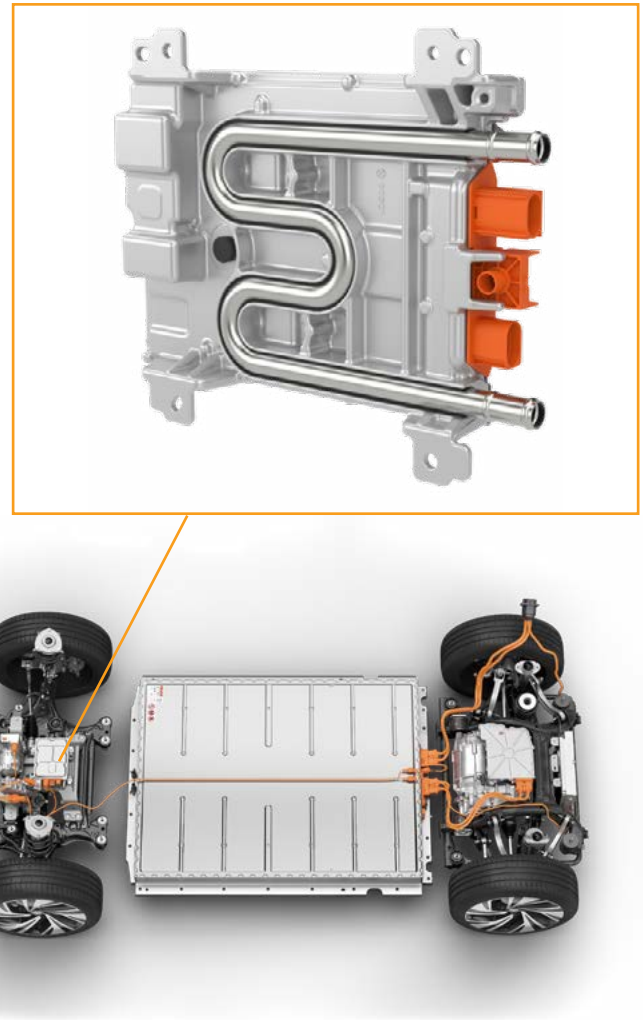
Return to the Basic Component Location and Information Page

The ID.4 High-voltage System Overview

Voltage Converter A19

A19 Specifications:

- Nominal Input Voltage 150 V to 475 V
- Charging Power 12 V 3 kW
- Diagnostic Address 8105



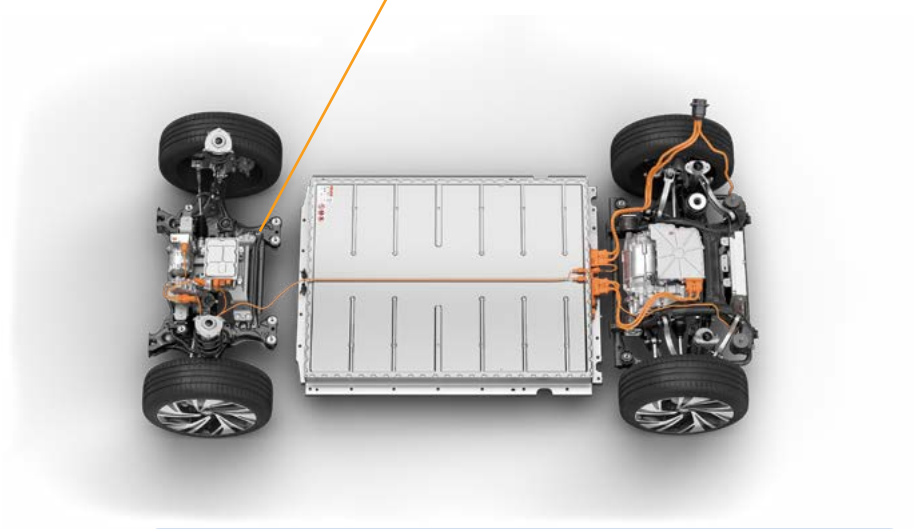
Return to the Basic Component Location and Information Page

The ID.4 High-voltage System Overview

High-Voltage Heater (PTC) ZX17

ZX17 Specifications:

– Nominal Voltage	150 V to 475 V
– Activation	0 - 100 %
– Maximum Power Input	6 kW
– Input Current	Maximum 21 A
– Weight	4 lb (1.9 kg)
– AC/DC Isolation	> 10 MOhm
– Communication	LIN-bus



Return to the Basic Component Location and Information Page

The ID.4 Wiring and Connector Concept

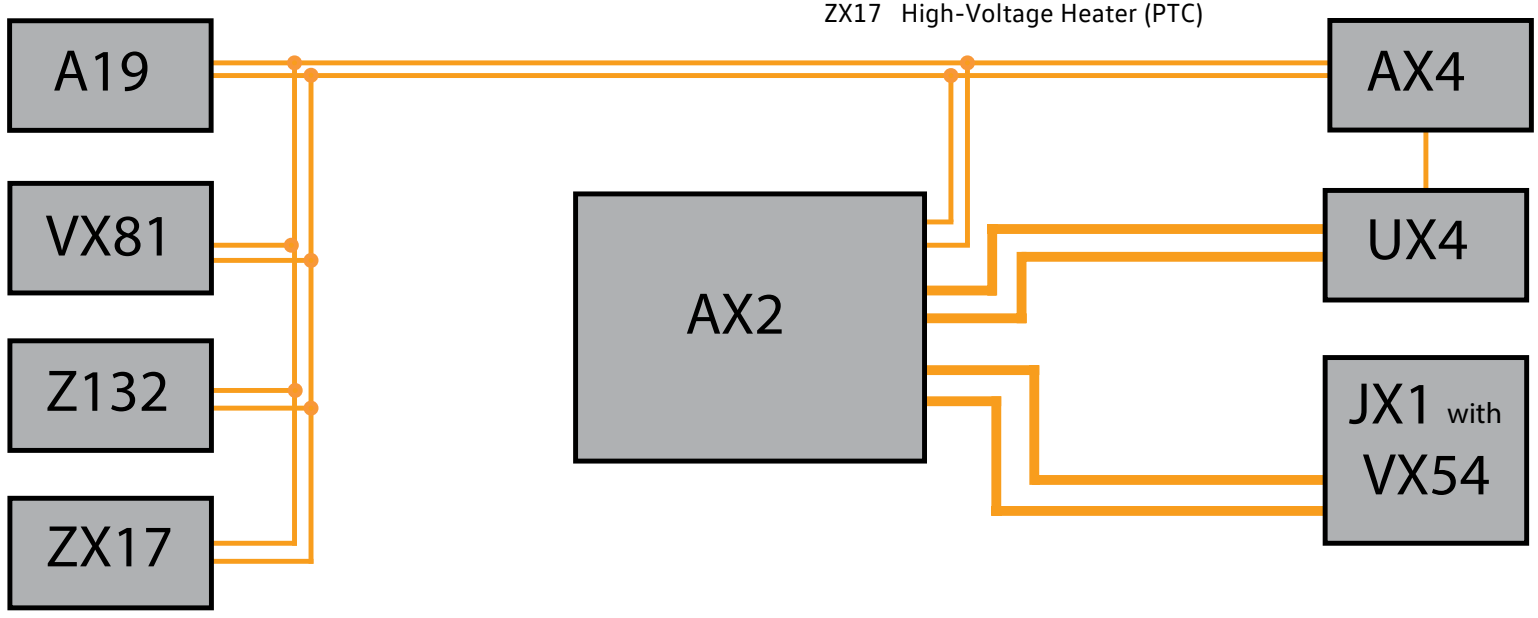
Wiring Concept

A new high-voltage wiring concept is being use in Modular Electric Drive Matrix (MEB) vehicles.

Thanks to the revised electromagnetic compatibility (EMC), shielded cables are not necessary. The EMC filters are adapted to the individual requirements of the different high-voltage components. They can be made of capacitors, restrictors or more complex circuitry.

Key

A19	Voltage Converter
AX2	High-Voltage Battery 1
AX4	High-Voltage Battery Charger 1
JX1	Electric Drive Power and Control Electronics
UX4	High-Voltage Battery Charging Socket 1
VX54	Three-Phase Current Drive
VX81	A/C Compressor
Z132	Heating Element (PTC) 3
ZX17	High-Voltage Heater (PTC)



The ID.4 Wiring and Connector Concept

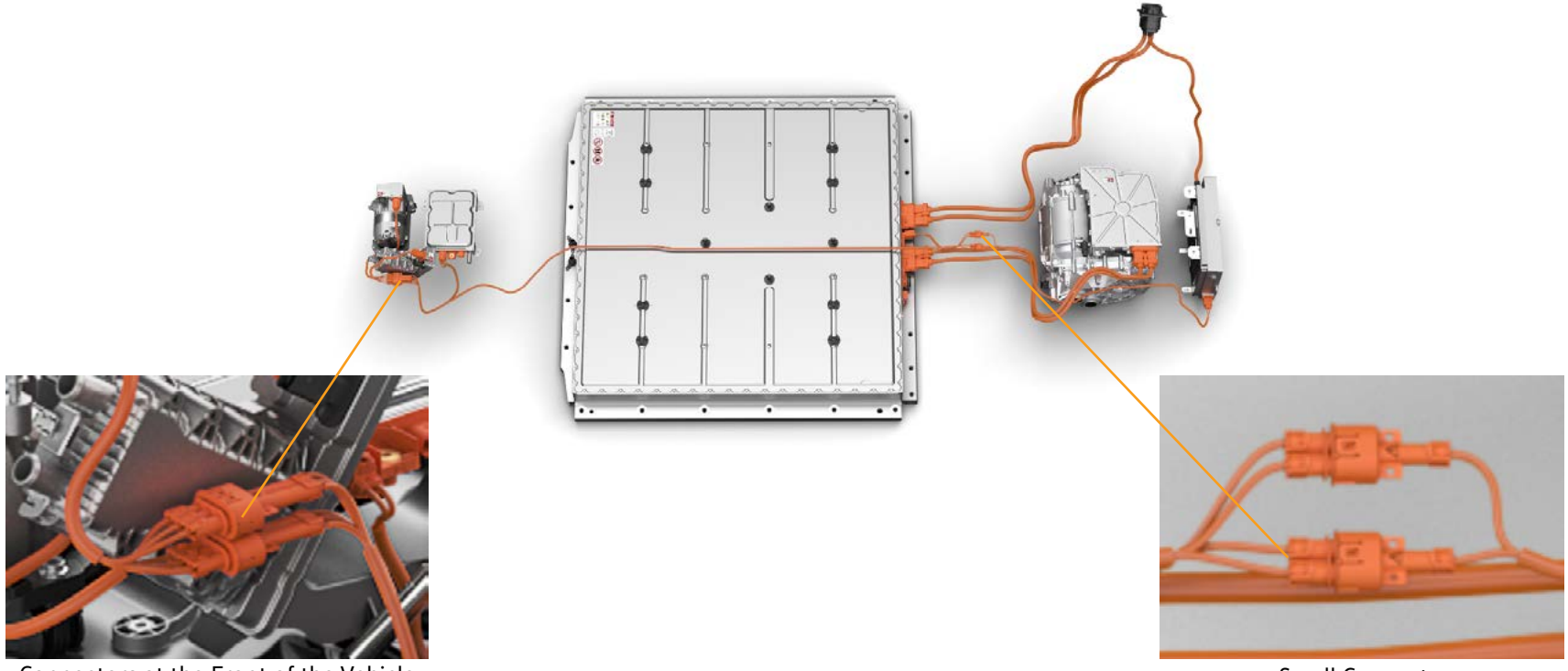
Wiring Junctions

The components do not require power distribution panels. They are replaced by wiring junctions in the high-voltage wiring harnesses.

The wiring junctions in the rear area connect AX4 High-Voltage Battery Charger 1 to AX2 High-Voltage Battery 1 and the high-voltage components in the front of the vehicle.

The wiring junction in the front of the vehicle connects the Z132 Heating Element (PTC) 3, the VX81 A/C Compressor, the A19 Voltage Converter and the ZX17 High-Voltage Heater (PTC) to the components in the rear of the vehicle.

The small connectors in the high-voltage circuit are glued during production and cannot be separated.



Connectors at the Front of the Vehicle

Small Connectors
Do Not Separate!

The ID.4 Wiring and Connector Concept

Connector Concept

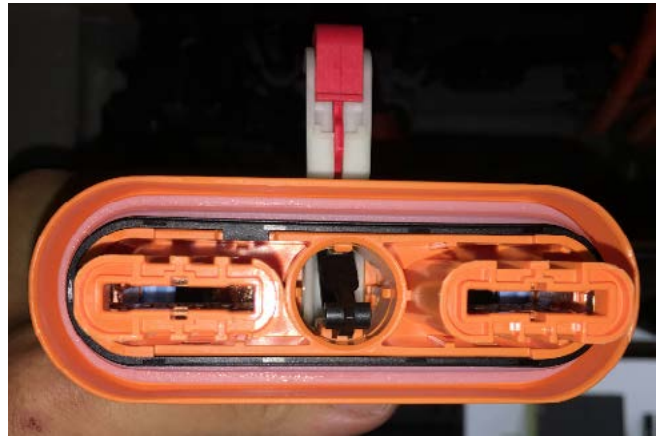
The connectors of high-voltage components are required to protect against foreign objects touching the contacts that carry life-threatening voltage. This is known as Ingress Protection (IP).

The connectors on MEB vehicles have been designed with a higher ingress protection standard to ensure a greater degree of protection against penetration of a solid object (such as a finger).

Because of this new connector concept with heightened touch protection, there is no longer need for a “pilot line” between all components in the high-voltage system.

All HV wires in the ID.4 are connected mechanically. No screw connections on the wires are used.

The electrical connectors are a new component developed for advanced accidental contact protection.



To ensure that the contacts still have the necessary cross-sections, the connectors are wide.

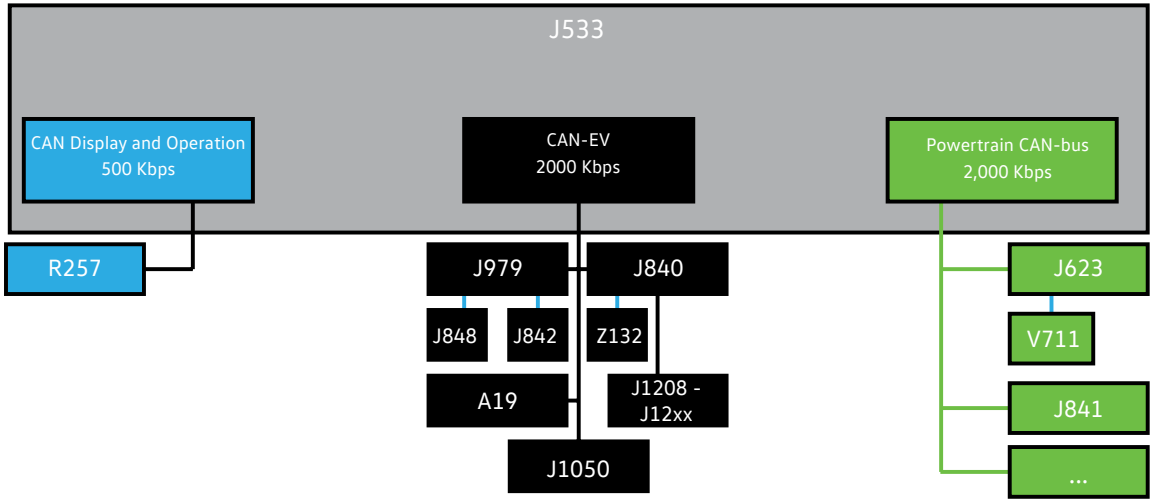
High-voltage System Components

Network

The control units for the high-voltage components are connected to two data-bus systems. Both are 2,000 kBaud, ensuring high-speed information exchange.

- CAN EV
- Powertrain CAN bus

Actuator 1 for Engine Sound Generator R257 is controlled by the CAN Display and Operation unit.



Key

A19 Voltage Converter
J623 Engine/Motor Control Module
J840 Battery Regulation Control Module
J841 Electric Drive Control Module
J842 A/C Compressor Control Module
J848 High-Voltage Heater (PTC) Control Module
J979 Heating and Air Conditioning Control Module
J1050 High-Voltage Battery Charger Control Module
J1208 Battery Module Control Module
R257 Engine Sound Generator Actuator 1
V711 Radiator Blind Adjustment Motor
Z132 Heating Element (PTC) 3

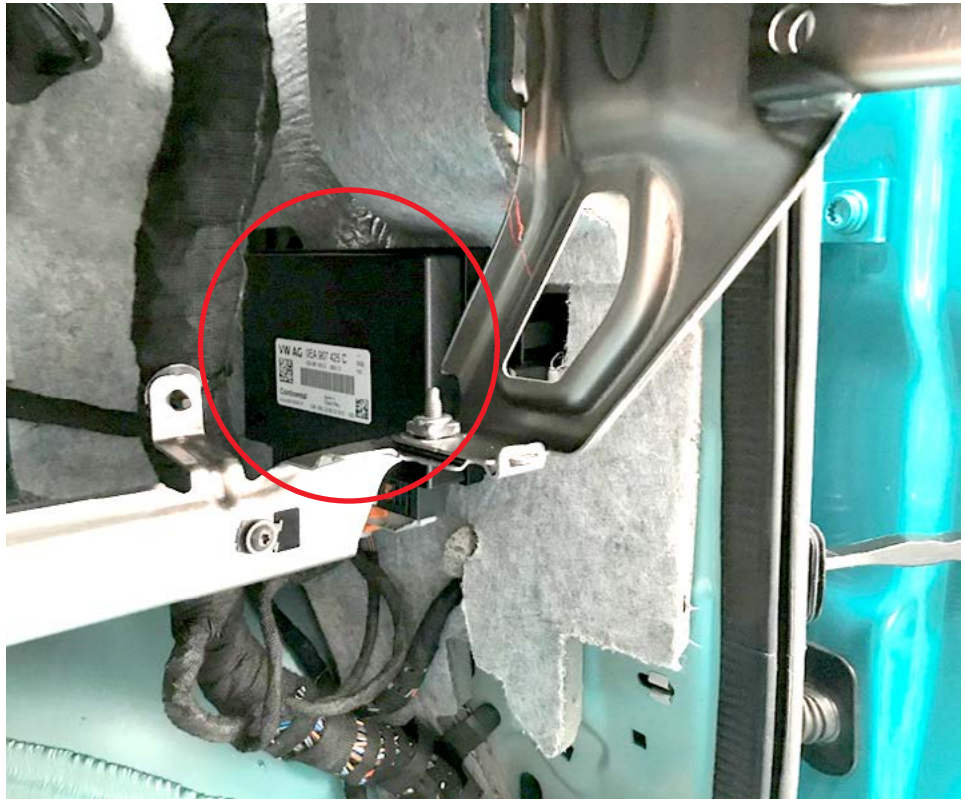
High-voltage System Components

J623 Engine Control Module - Location and Functions

The ECM is located on the right A-pillar in the vehicle interior.

It has the following key functions:

- Implementation of driver assist systems
- Management of the torque requirement
- Management of energy recovery intensity
- Thermal management
- Monitoring the high-voltage components (high-voltage coordination)



The ECM performs the same functions as it does in all other high-voltage vehicles. The new central processor does not require the hybrid data-bus. The components are divided up into three different systems (CAN-EV, powertrain CAN-bus and CAN display and operating unit).

The following components are connected directly to the ECM:

- Accelerator Pedal Module GX2
- Temperature Sensor G18
- Radiator Fan VX57
- Control Motor for Radiator Roller Blind V711 (LIN-Bus)
- Coolant Pump for Low-temperature Circuit V468

When energy recovery is performed, the CAN-Bus sends a signal to the Onboard Supply Control Module J519 that controls the brake lights.

J623 Engine Control Module - High-Voltage Coordination

The high-voltage coordinator in the J623 manages the activation and deactivation sequence for the high-voltage system, and also prevents a system start if any anomalies occur in high-voltage components.

Its functions are:

- Coordination of all high-voltage sub-systems and networks involved
- Implementation of defined operating states
- Interface between the high-voltage functions and the other vehicle systems

High-voltage sub-systems refer to high-voltage functions that only require individual high-voltage components for implementation. For example:

- The High-Voltage Battery 1 AX2 and the Charging Unit 1 for High-Voltage Battery AX4 are responsible for the charging process
- The High-Voltage Battery 1 AX2, the Air Conditioner Compressor VX81 and the High-Voltage Heater (PTC) ZX17 are responsible for the air conditioning

High-voltage System Components

Engine Sound Generators

The ID.4 has two engine sound generators to make the vehicle noticeable to pedestrians. One sound generator is located at the front of the vehicle, and one is located in the rear. The front sound generator is covered on this page, and the rear sound generator is covered on the next page.

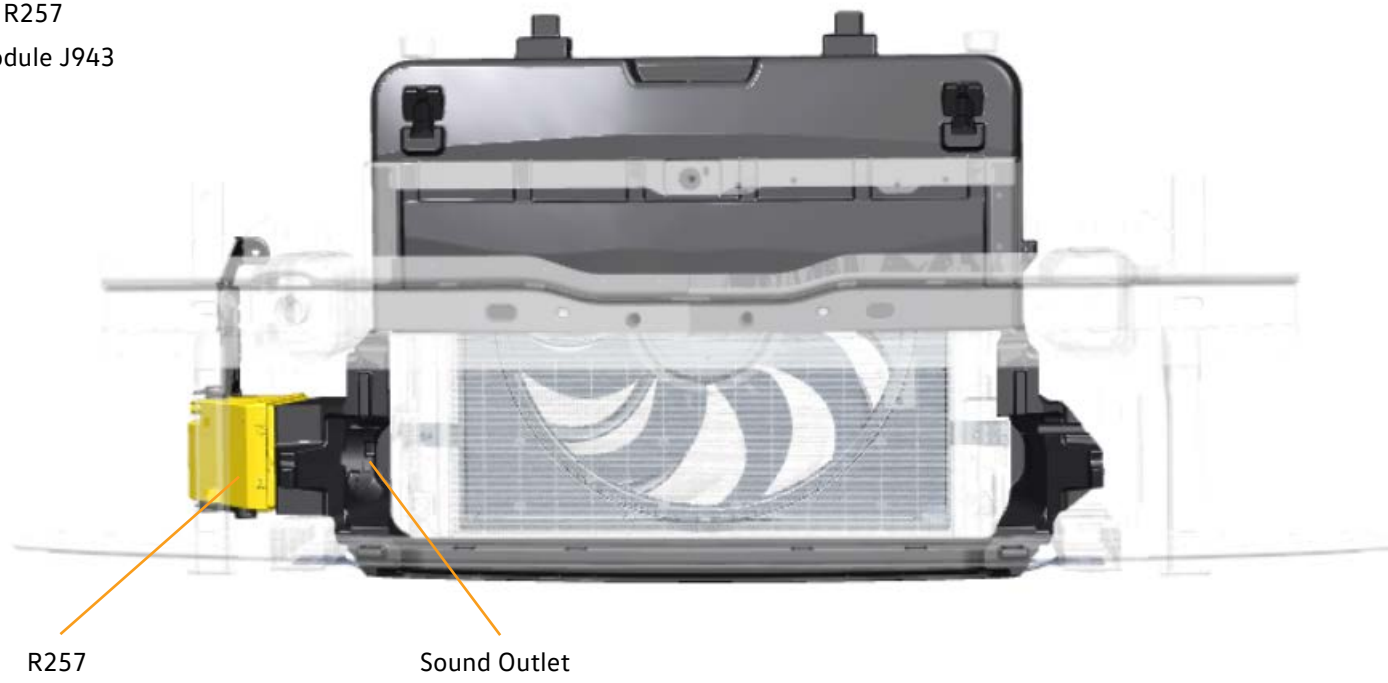
Sound is generated:

- When the vehicle is stationary with a forward or reverse gear selected
- in vehicle operation at speeds up to approximately 20 mph (25 km/h) in both forward and reverse

Engine Sound Generator Actuator 1 RX21 - Location and Function

The Actuator 1 for Engine Sound Generator RX21 is located on the front right side of the vehicle behind the bumper. Sound is generated out the front of the vehicle. It is made up of:

- The Engine Sound Generator Actuator 1 R257
- The Engine Sound Generator Control Module J943



High-voltage System Components

Engine Sound Generator Module 2 RX22 - Location and Function

The Actuator for Engine Sound Generator Module 2 RX22 is located on the rear right side of the vehicle behind the bumper. Sound is generated out the rear of the vehicle when a forward or reverse gear is selected. Sound output is directed towards the road surface.

It is made up of:

- The Engine Sound Generator Actuator 2 R258
- The Engine Sound Generator Control Module 2 J1167

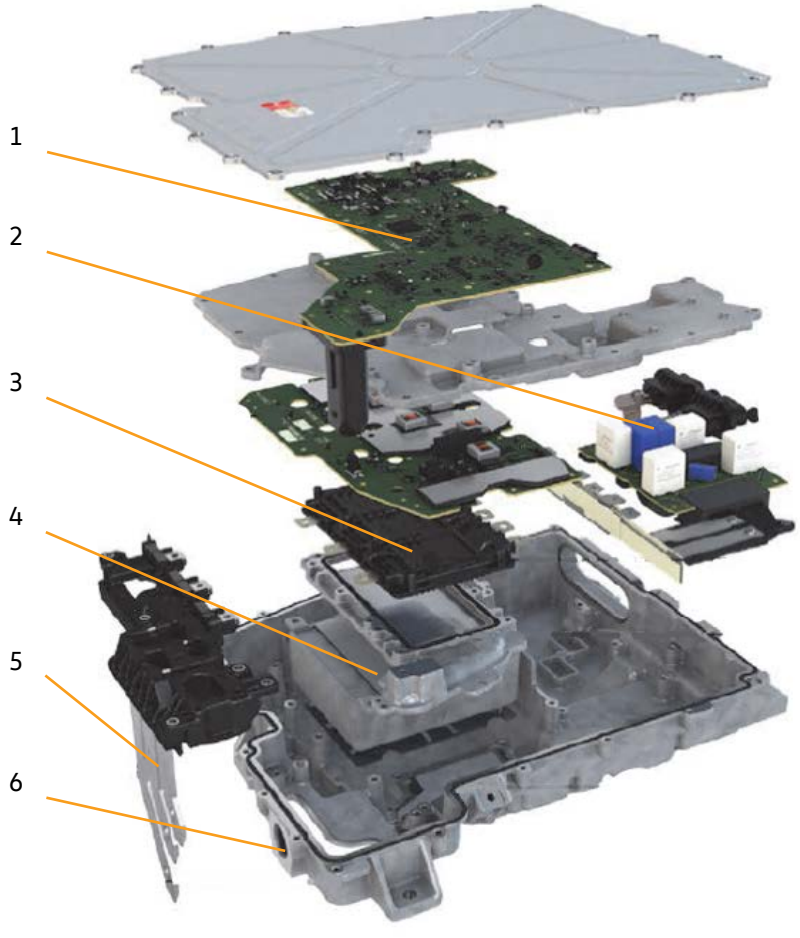
JX1 Electric Drive Power and Control Electronics - Location and Design

The Power and Control Electronics for Electric Drive JX1 are located on the three-phase current drive. They consist of the following components:

1. J841 Electric Drive Control Module
2. EMC and suppression filter
3. A37 Drive Motor Inverter
4. C25 Intermediate Circuit Capacitor 1
5. V141 Electric Drive Motor
6. Connections for coolant

The JX1 Electric Drive Power and Control Electronics are cooled using the VX54 Three-Phase Current Drive in the low-temperature cooling circuit.

The JX1 is new and has improved current carrying capacity and continuous output. It has a watertight connection to the VX54 that can be replaced separately. The power electronics and e-machine are a single unit. If they are separated for any service procedures, a tightness test must be performed when assembling. No components in the JX1 can be replaced.



JX1 Electric Drive Power and Control Electronics - Functions

The J841 Electric Drive Control Module is located inside of the JX1 and cannot be replaced separately.

It has the following functions:

- Implementation of the driver's request
- Monitoring the three-phase current drive temperature
- Rotor position identification

The following components are connected to the control module:

- G712 Drive Motor Temperature Sensor
- G713 Drive Motor Rotor Position Sensor 1

It regulates and monitors the three-phase current drive and controls the A37 DC/AC Converter for Drive Motor for the three-phase alternating voltage.

JX1 Electric Drive Power and Control Electronics - Functions

The J841 Electric Drive Control Module uses G713 Drive Motor Rotor Position Sensor 1 to determine the speed and the position of the rotor in the V141 Electric Drive Motor. This data is used for exact activation of the electric drive motor.

The G712 Drive Motor Temperature Sensor is used to determine the temperature of the V141.

The component temperatures are determined using internal temperature sensors in the JX1 in the J841.

VX54 Three-Phase Current Drive - Location

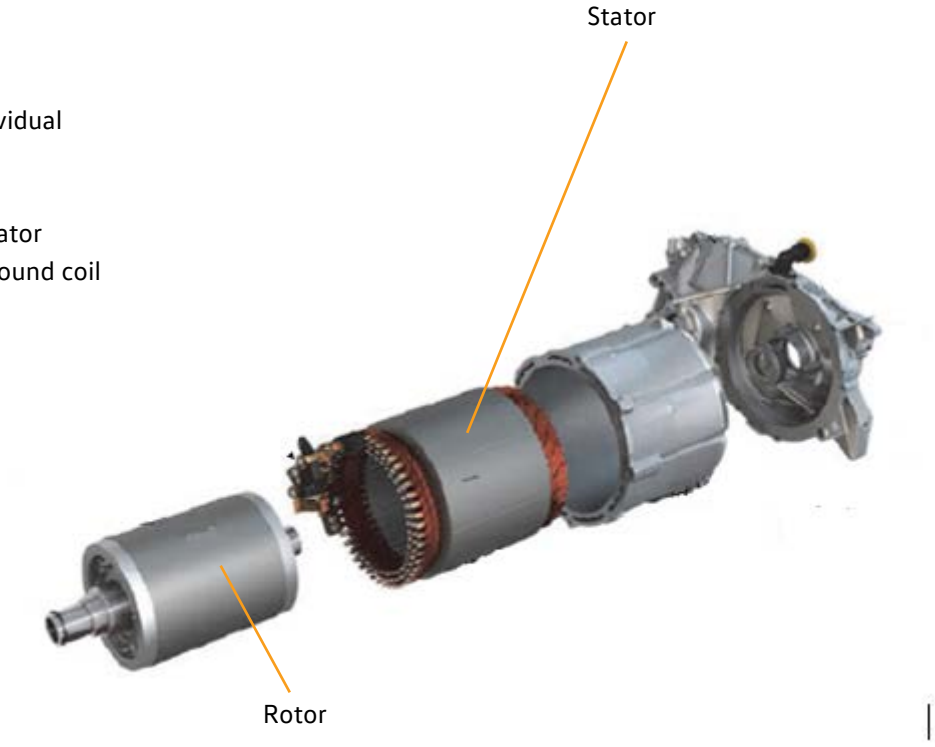
The three-phase current drive is located in the rear of the vehicle together with the JX1 Electric Drive Power and Control Electronics. It is connected to the low-temperature cooling circuit.

It has the following components:

- V141 Electric Drive Motor (rotor and stator)
- G712 Drive Motor Temperature Sensor
- G713 Drive Motor Rotor Position Sensor 1

The stator for the V141 is manufactured using the hairpin method. The individual stator elements look like hair pins, which is where the name comes from.

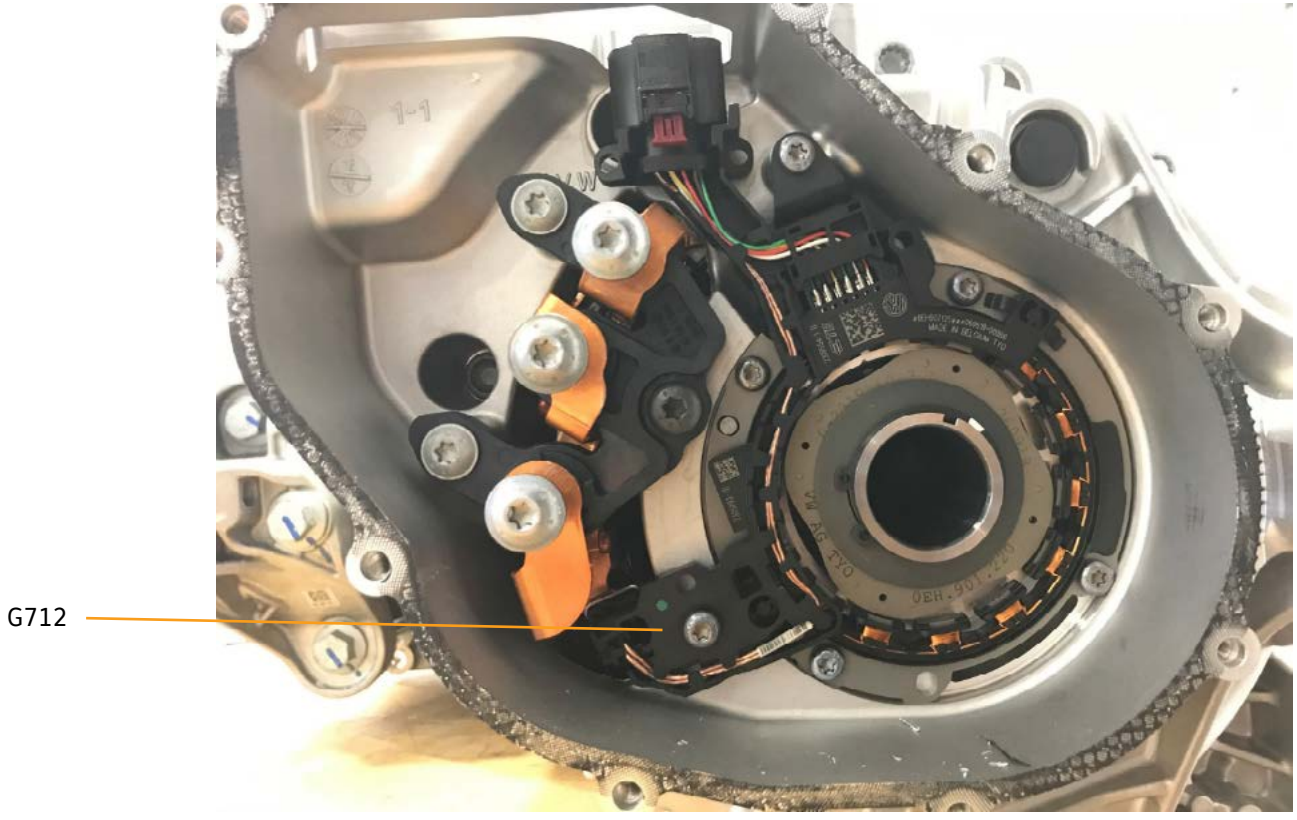
In addition to the advantages for automated high volume production, the stator features better heat dissipation and lower rotor losses when compared to wound coil designs.



VX54 Three-Phase Current Drive - G712 Drive Motor Temperature Sensor

The G712 Drive Motor Temperature Sensor is located between two stator solenoids to improve signal detection. It is a Negative Thermal Coefficient (NTC) sensor and reports the temperature to the JX1 Electric Drive Power and Control Electronics.

The signal is needed to prevent overheating of the V141 Electric Drive Motor. The de-rating of VX54 begins at approx. 160°C

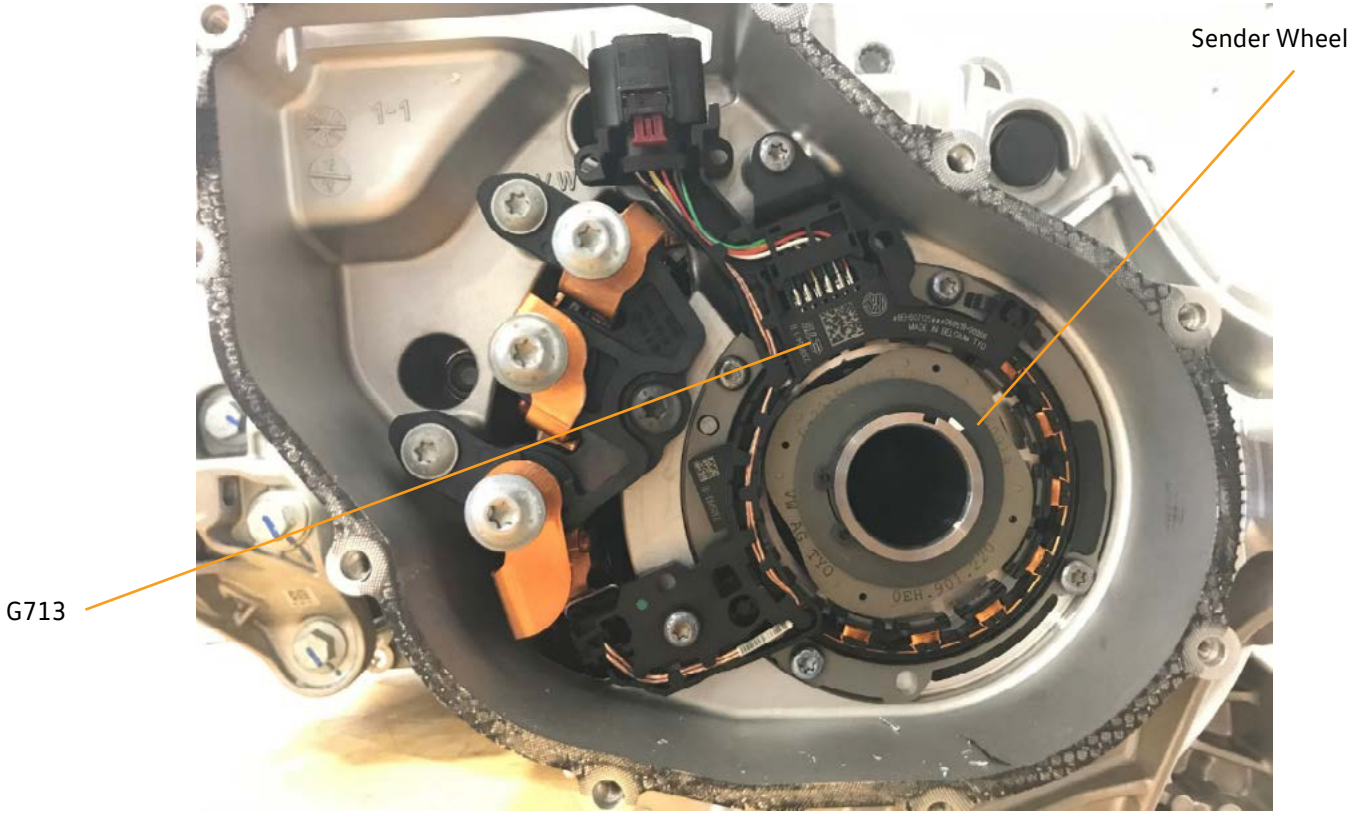


VX54 Three-Phase Current Drive - G713 Drive Motor Rotor Position Sensor 1

G713 Drive Motor Rotor Position Sensor 1 is installed on the VX54 Three-Phase Current Drive and functions as an inductive sender with advanced evaluation.

The sensor wheel is attached to the rotor of the electric drive motor, which drives it. The G713 determines the position, the direction of rotation and component tolerances.

It has a direct connection to the JX1 Electric Drive Power and Control Electronics.



High-voltage System Components

AX4 High-Voltage Battery Charger 1

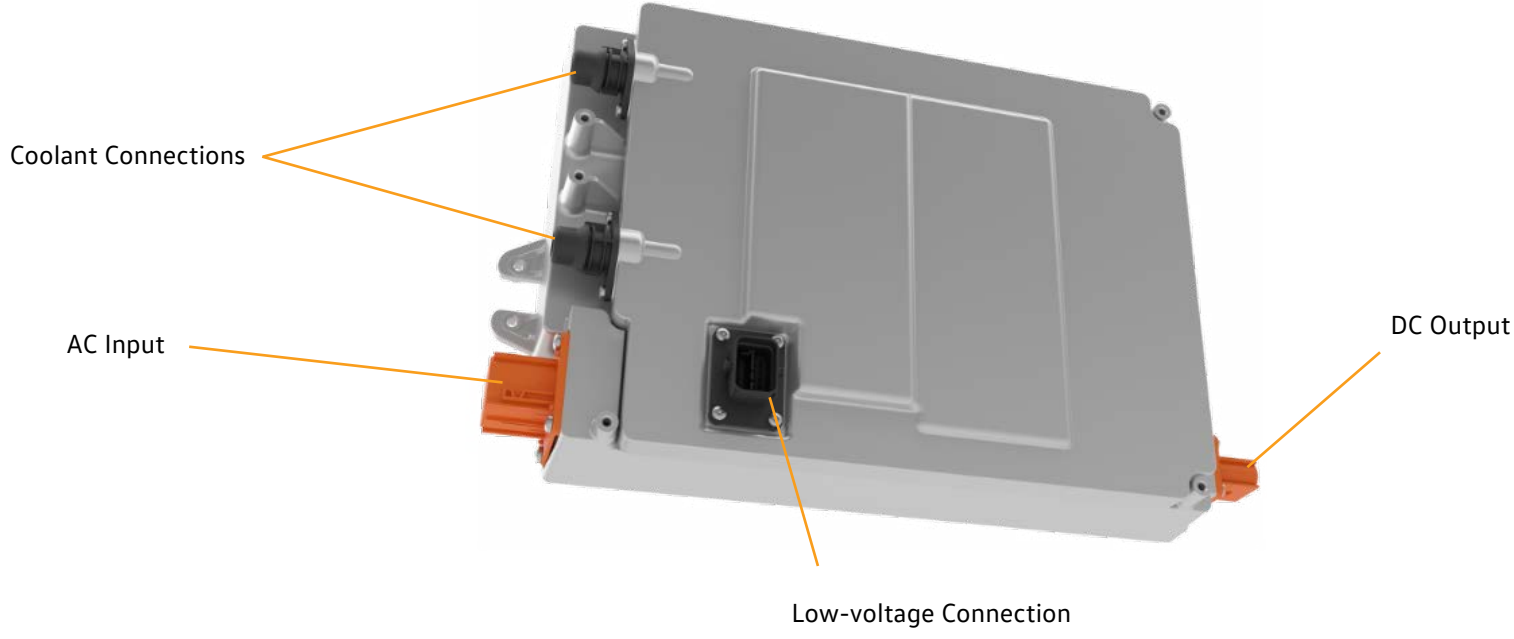
The AX4 is located in the rear of the vehicle. It converts any Alternating Current (AC) into Direct Current (DC) for the high-voltage battery.

The charging unit is regulated by the J1050 High-Voltage Battery Charger Control Module, which monitors and regulates the charging process.

The DC charging process is also monitored and regulated by the J1050. A maximum DC charging rate of 125 kW is possible for the 82 kWh battery.

These components have a direct connection to AX4:

- F496 High-Voltage Charge Door Lock 1 Adjuster
- L263 Charging Socket 1 LED Module
- F498 High-Voltage Charging Connector Lock 1 Adjuster
- UX4 High-Voltage Battery Charging Socket 1 with G853 Charging Socket Temperature Sensor 1
- G1151 Charging Socket 2 Temperature Sensor 1
- G1152 Charging Socket 3 Temperature Sensor 1



A19 Voltage Converter - Location and Functions

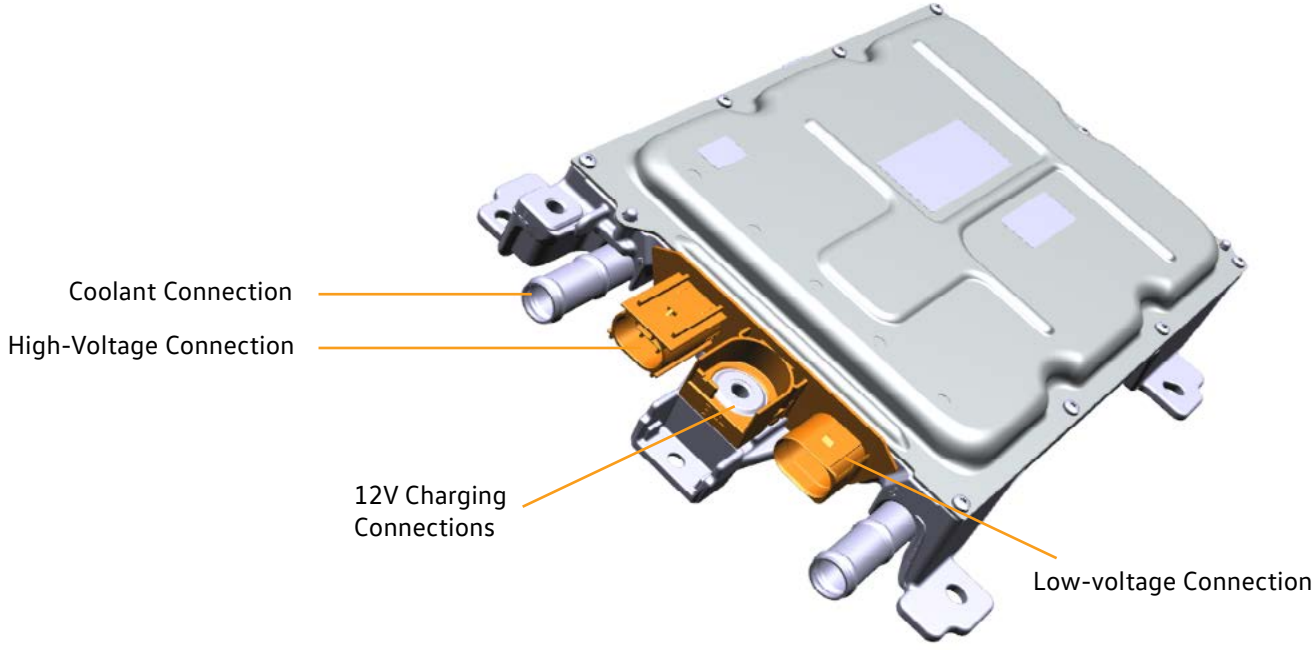
The A19 is located in the front of the vehicle and supplies the 12 V electrical system with energy. It has a maximum power of 16 V.

The A19 uses bidirectional operation to charge and discharge the C25 Intermediate Circuit Capacitor 1 located in the JX1. This is why it is an additional source of high-voltage to supplement the AX2 High-Voltage Battery 1. It must also be checked to ensure it is de-energized when the high-voltage system is deactivated. It is cooled by coolant.

The bidirectional operation of the voltage converter is only used for charging/discharging the C25. Recharging the high-voltage battery is not possible.

Connections:

- Terminal 30, 30 A
- Terminal 31
- HV-positive and HV-negative
- CAN-EV

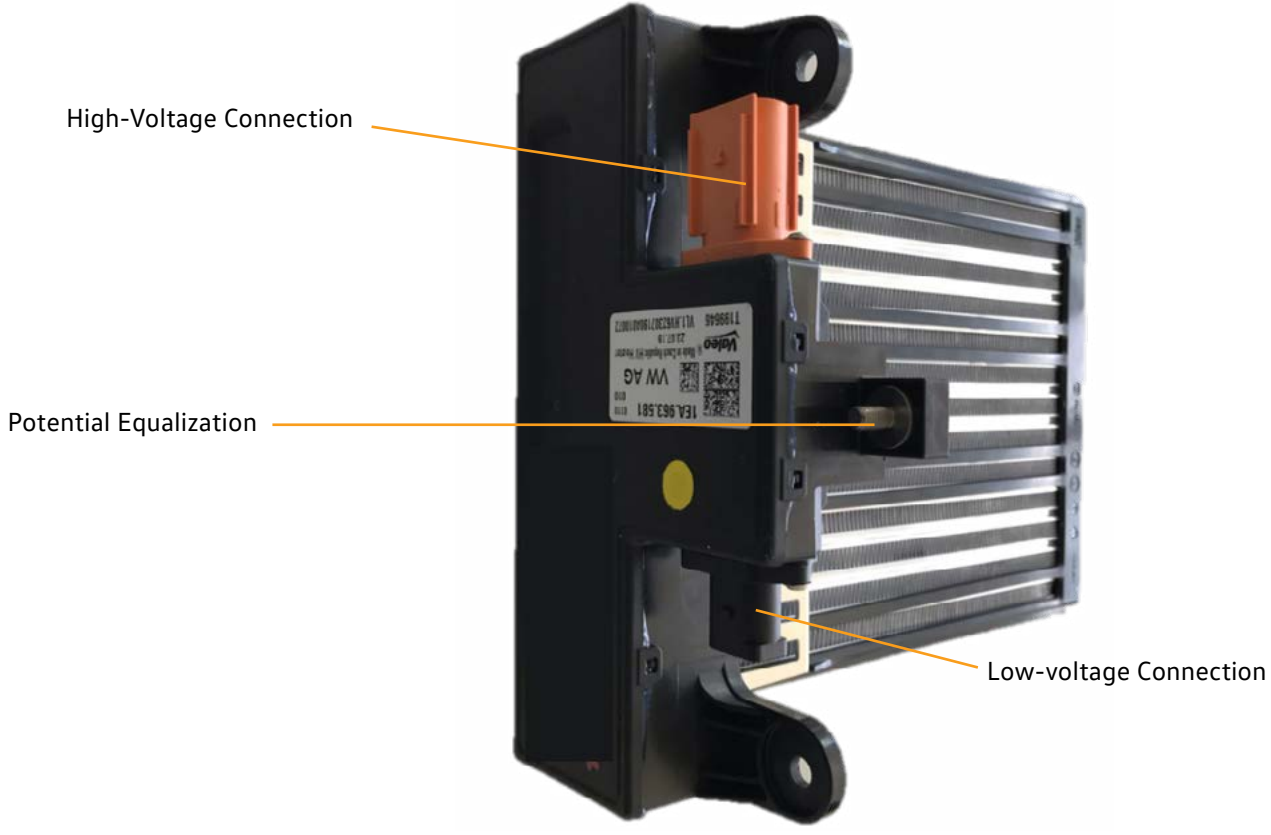


High-voltage System Components

ZX17 High-Voltage Heater (PTC) - Location and Functions

The ZX17 is installed in the air-conditioning box in the ID.4. It heats the interior air and is infinitely variable using Pulse-Width Modulation (PWM).

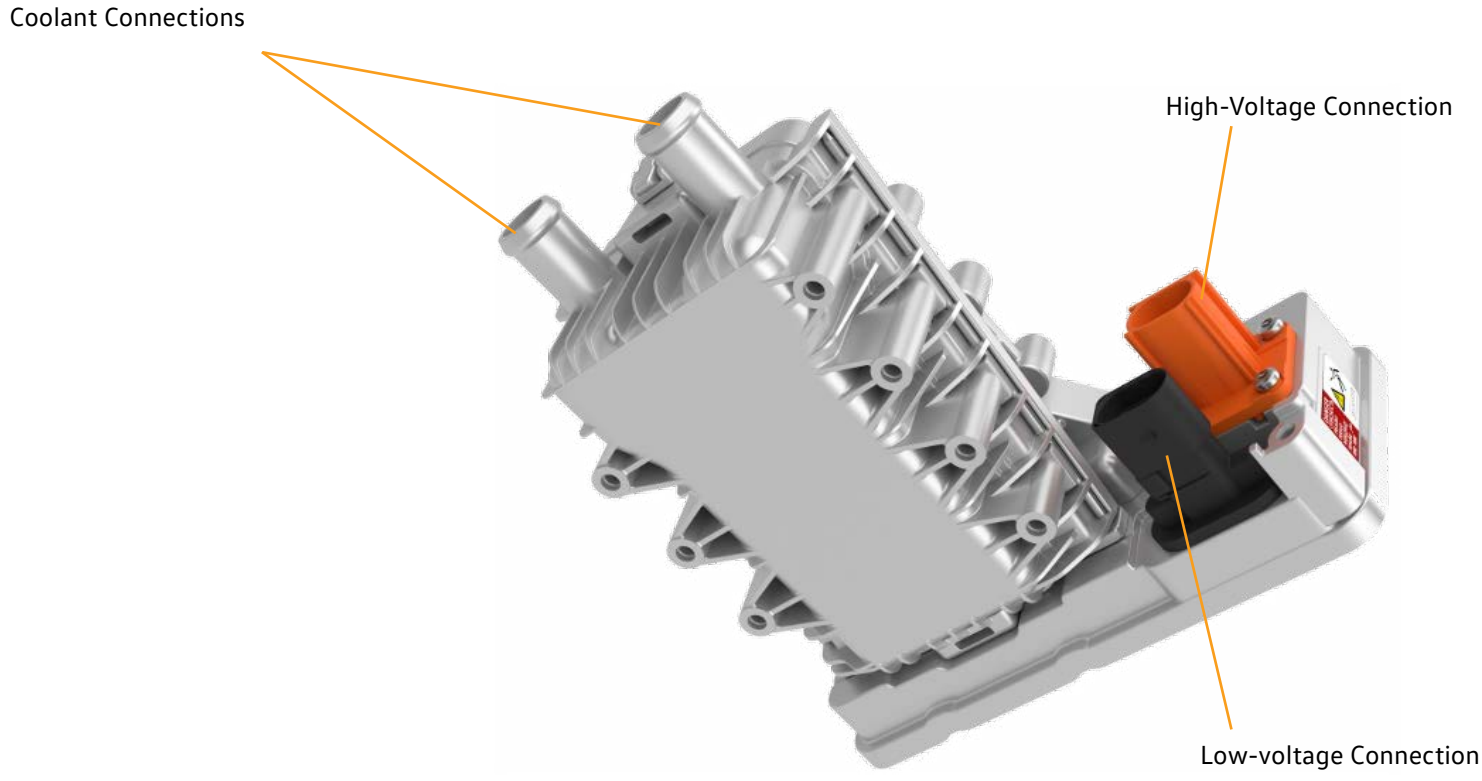
The High-Voltage Heater has a J848 High-Voltage Heater (PTC) Control Module of its own. This is controlled and monitored by the J979 Heating and Air Conditioning Control Module by means of LIN-Bus.



Z132 Heating Element (PTC) 3 - Location and Function

The Z132 is located in the front end of the ID.4. It heats up the coolant for the high-voltage battery and is infinitely variable using Pulse-Width Modulation (PWM). Temperature sensors are located in the coolant inlet and outlet.

The Z132 is connected to the J840 Battery Regulation Control Module by LIN-Bus.

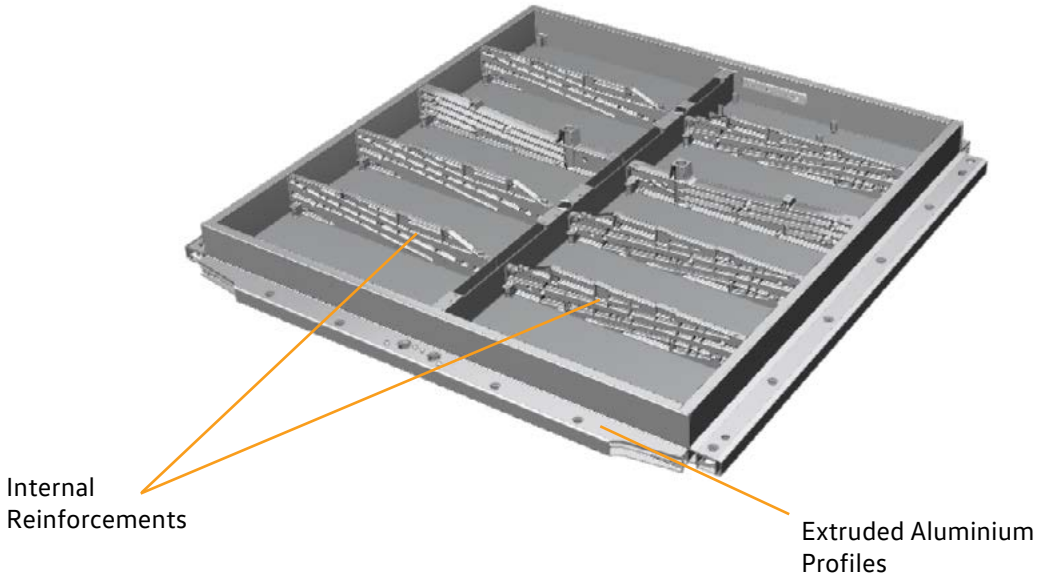


AX2 High-Voltage Battery 1 - Location

The AX2 is located between the axles under the vehicle.

The battery housing is made of aluminium. Reinforcements have been installed inside the housing to provide the battery modules with the best possible protection in the event of an accident, both in the longitudinal and the lateral directions. There are additional lateral reinforcements below the housing.

The housing is surrounded by solid extruded aluminium profiles.



Make sure nobody enters the vehicle after the high-voltage battery is removed because the battery contributes to the overall body rigidity. Once the high-voltage battery has been removed, there is a risk of vehicle body damage due to distortion.

High-voltage System Components

AX2 High-Voltage Battery 1 - Battery Designs

There are two versions of the AX2 used in the ID.4 due to size and energy content. Only the 82 kWh battery will be available at launch.

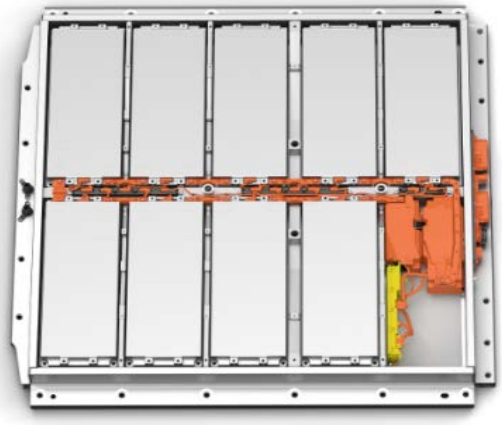
The maximum AC charge rate for each battery is:

- 7.2 kW for the 62 kWh battery
- 11 kW for the 82 kWh battery

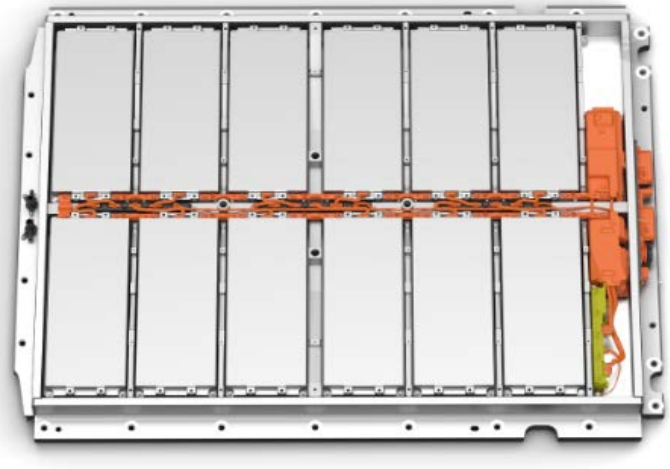
The maximum DC charge rate for each battery is:

- 50 kW for the 62 kWh battery
- 125 kW for the 82 kWh battery

9 battery modules
62 kWh gross
58 kWh net

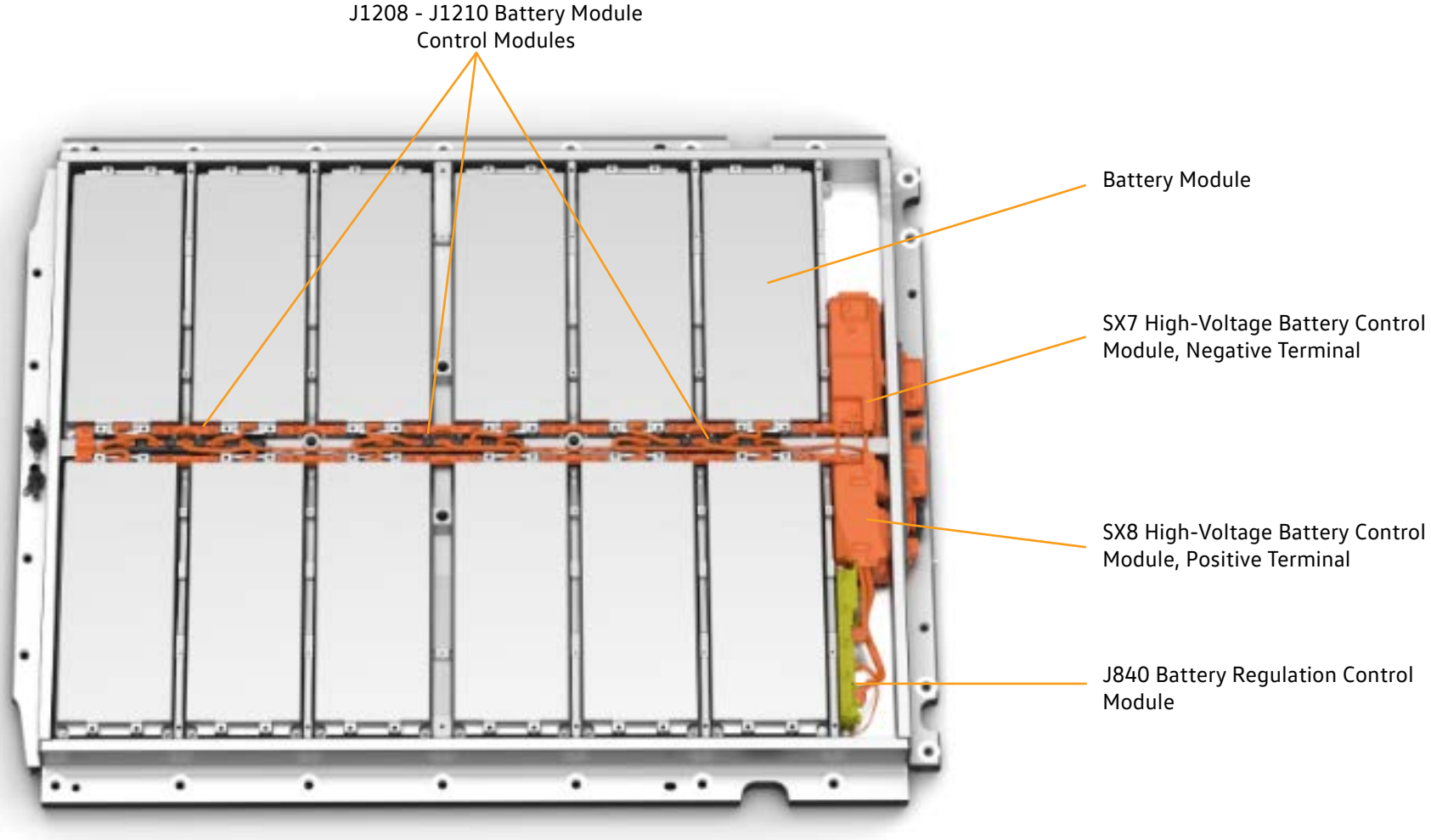


12 battery modules
82 kWh gross
77 kWh net



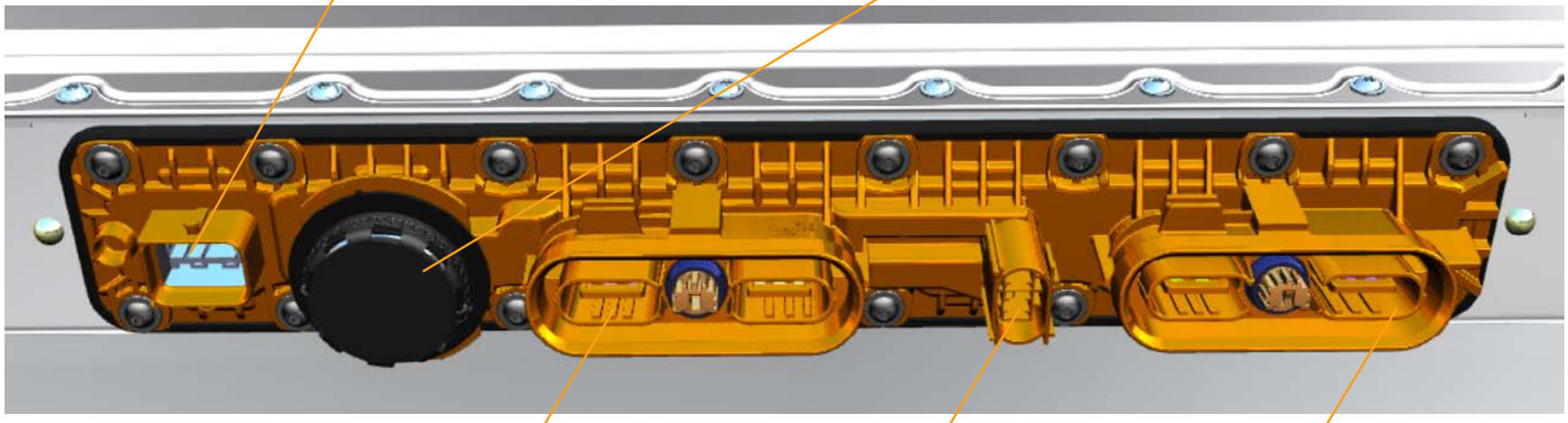
AX2 High-Voltage Battery 1 - Components

This is the ID.4 with an energy content of 82 kWh. The components in the 62 kWh battery are similar. Many battery components can be replaced for service procedures.



High-voltage System Components

AX2 High-Voltage Battery 1 - Electrical Connections in the AX2



Assignment of the low-voltage connection T32g:

- Terminal 30
- Terminal 30C
- Terminal 31
- J234 Airbag Control Module
- G898 High-Voltage Battery Coolant Temperature Sensor 1
- G899 High-Voltage Battery Coolant Temperature Sensor 2
- Pilot line
- Z132 Heating Element (PTC) 3
- Powertrain CAN bus
- V590 High-Voltage Battery Coolant Pump
- V683 Mixing Valve for High-Voltage Battery Warming
- V696 Mixing Valve 2 for High-Voltage Battery Warming

High-voltage System Components

AX2 High-Voltage Battery 1 - Battery Module

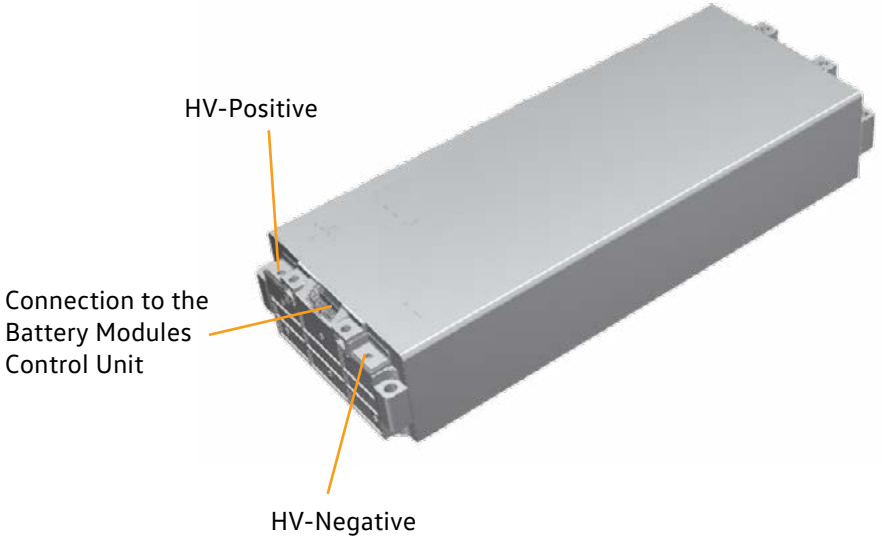
The battery modules of the ID.4 may have either prismatic cells or pouch cells. Prismatic lithium-ion cells made by LG will be used upon launch. Other suppliers may be added, depending on the market and date of use. Battery modules with different cell types will not be used in one battery.

The battery modules are configured as 8 in series and 3 in parallel in the battery with 82 kWh. For the 62 kWh battery, the modules are arranged as 12 in series and 2 in parallel

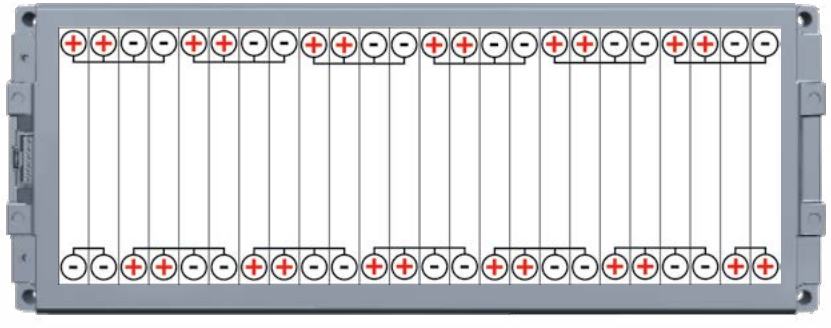
Due to the encapsulated aluminum housing, internal module circuit configuration can't be determined. The difference is only indicated by the part number.

Technical Data

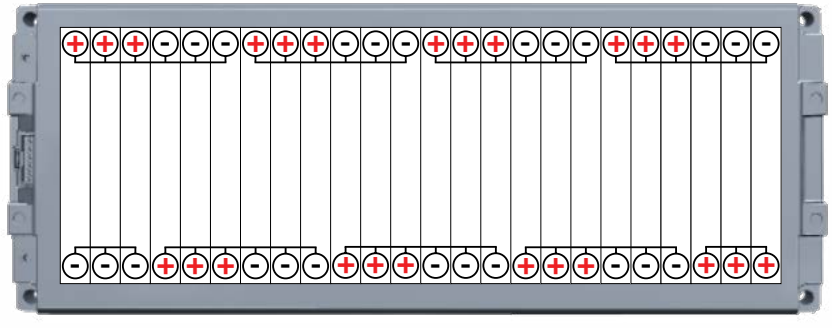
	62 kWh	82 kWh
Cell technology	Lithium-ion	Lithium-ion
Cell type	Prismatic	Prismatic
Manufacturer	LG	LG
Capacity per battery cell	78 Ah	78 Ah
Number of cells	24	24
Circuitry of the module	12 in series, 2 in parallel	8 in series, 3 in parallel
Number of modules in battery	9	12
Capacity of the module	156 Ah	234 Ah
Nominal voltage of the module	44.4 V	29.6 V
Energy content of the module	6.926 kWh	6.926 kWh
Weight per module	approx. 66 lbs (30 kg)	approx. 66 lbs (30 kg)



62 kWh Battery Module



82 kWh Battery Module

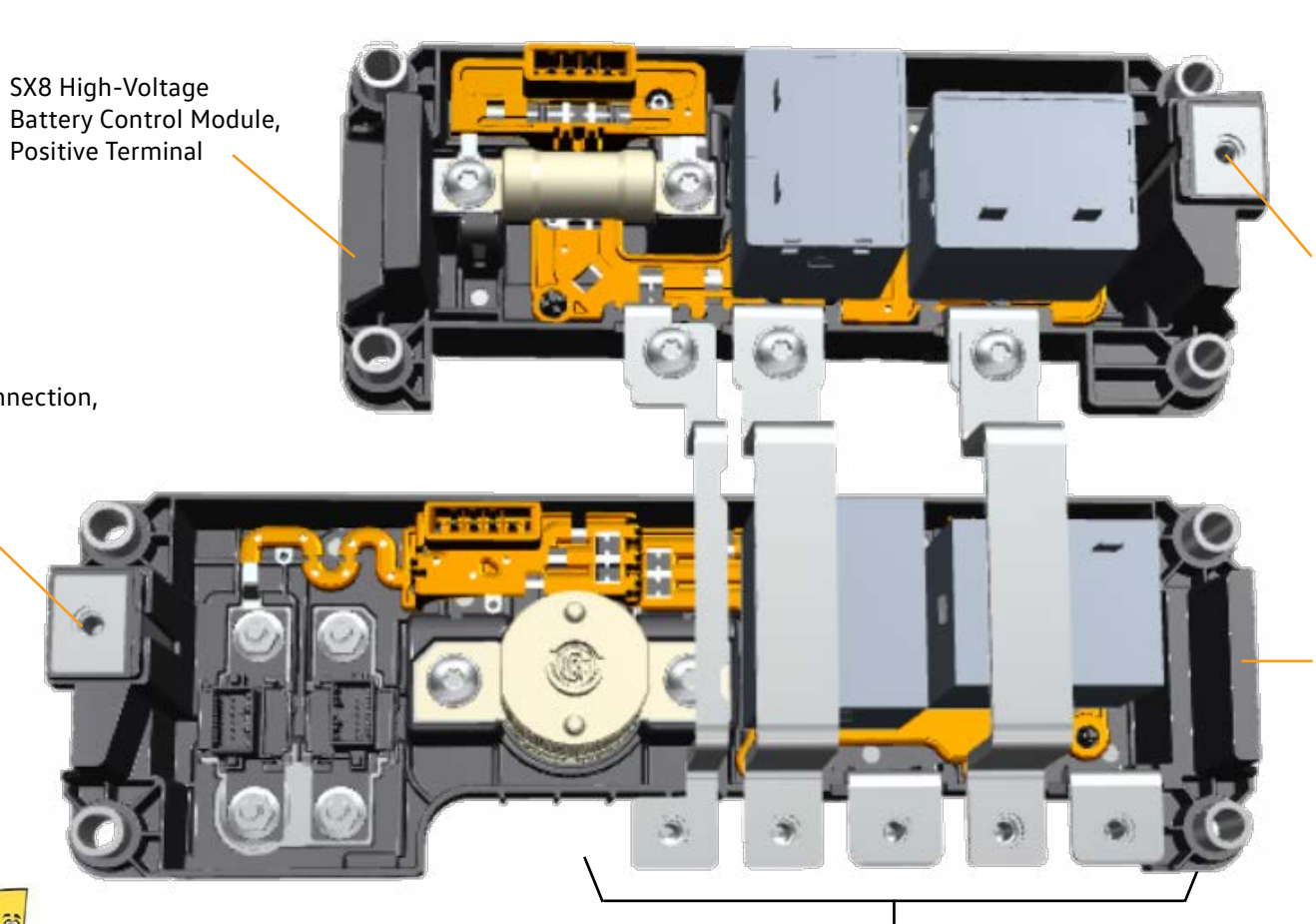


High-voltage System Components

AX2 High-Voltage Battery 1 - Switching Units

The components and functions have been divided up between two switching units. This allows them to fit into the different spaces required by the different high-voltage batteries.

The intermediate circuit capacitor 1 C25 in the JX1 Electric Drive Power and Control Electronics in the ID.4 is pre-charged by the A19 Voltage Converter. This eliminates the need for a pre-charge relay and a pre-charge resistor.



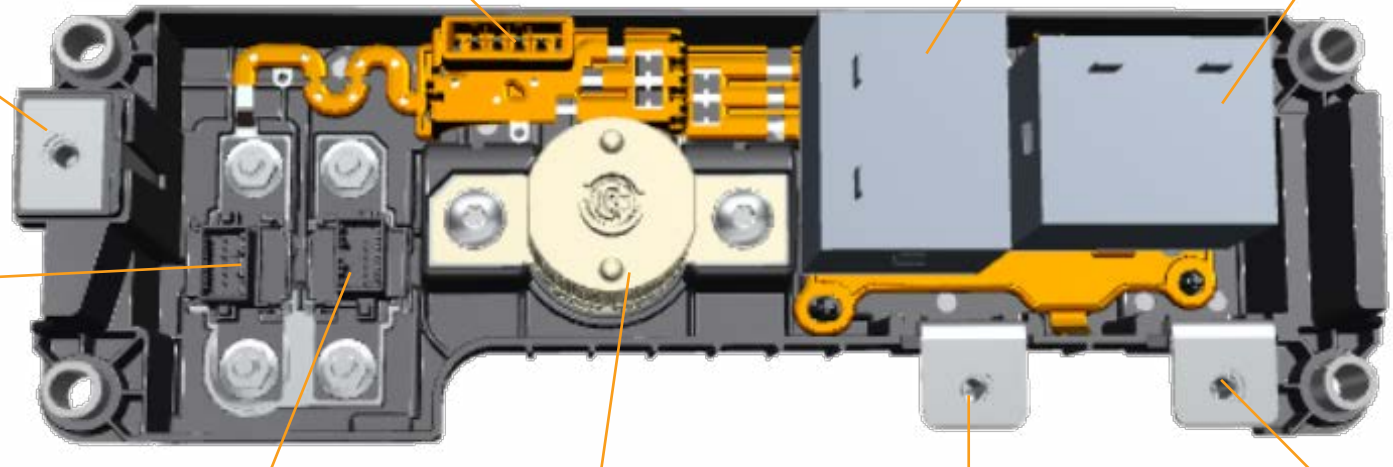
62 kWh battery configuration shown.

High-voltage System Components

AX2 High-Voltage Battery 1 - Switching Unit for SX7 High-Voltage Battery Control Module, Negative Terminal

The S415 Fuse for High-Voltage Battery Interruption is a pyrotechnic fuse and increases the level of safety in the high-voltage system. In the event of a fault, it can trip faster than a high-voltage relay. If the fuse has tripped, the entire SX7 unit must be replaced. It cannot be replaced or reset.

There are voltage taps on the high-voltage connectors. The J840 Battery Regulation Control Module uses these to monitor the high-voltage connectors.

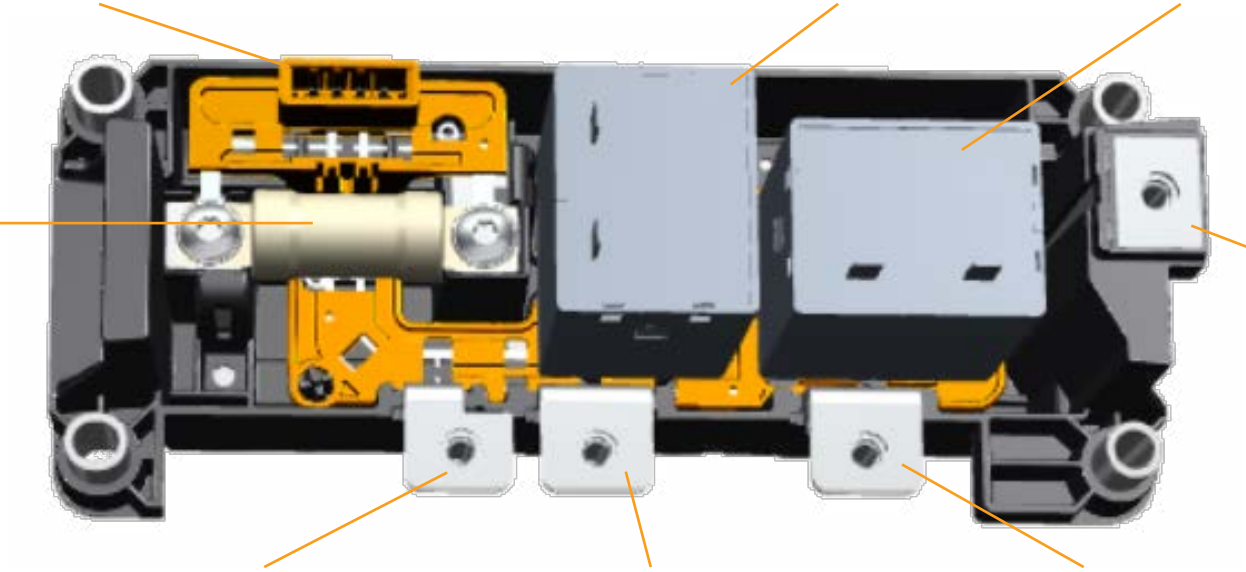


High-voltage System Components

AX2 High-Voltage Battery 1 - Switching Unit for SX8 High-Voltage Battery Control Module, Positive Terminal

The SX8 unit has an internal S352 High-Voltage System Fuse 2. Once tripped, this fuse cannot be replaced or reset, requiring replacement of the entire SX8 unit. This fuse protects the following high-voltage sub-components

- AX4 High-Voltage Battery Charger 1
- Z132 Heating Element (PTC) 3
- ZX17 High-Voltage Heater (PTC)
- VX81 A/C Compressor
- A19 Voltage Converter



AX2 High-Voltage Battery 1 - J840 Battery Regulation Control Module

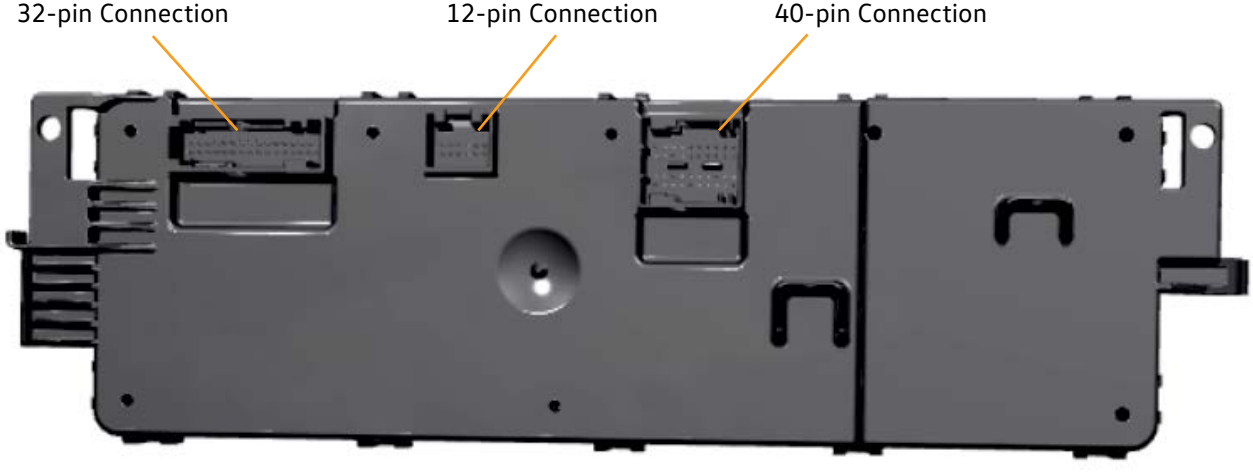
Functions of the J840:

- Communication using the powertrain CAN-bus
- Master control unit for the internal data-bus system
- Monitoring and controlling the switching units in the high-voltage battery
- Monitoring of the pilot line
- Insulation resistance monitoring
- Provision of measured values for the high-voltage battery
- Activation of the S415 Fuse for High-Voltage Battery Interruption in the event of a fault

AX2 High-Voltage Battery 1 - J840 Battery Regulation Control Module

Pin assignment on the J840:

- 32-pin connection:
  - Connection to the low-voltage connector on the battery housing (see electrical connections for AX2)
  - Connection to the J1208–J1210 Battery Modules Control Modules (CAN-bus and LIN-bus)
  - Additional Ground connection to the battery housing
- 12-pin connection:
  - Voltage signals before and after the high-voltage connectors in the switching units for high-voltage battery
- 40-pin connection:
  - S415 Fuse for High-Voltage Battery Interruption
  - G1132 Temperature Sensor 1 for High-Voltage Battery High-Voltage Heater
  - G1133 Temperature Sensor 2 for High-Voltage Battery High-Voltage Heater
  - G848 High-Voltage Battery Voltage Sensor
  - G1131 High-Voltage Battery Voltage Sensor 2



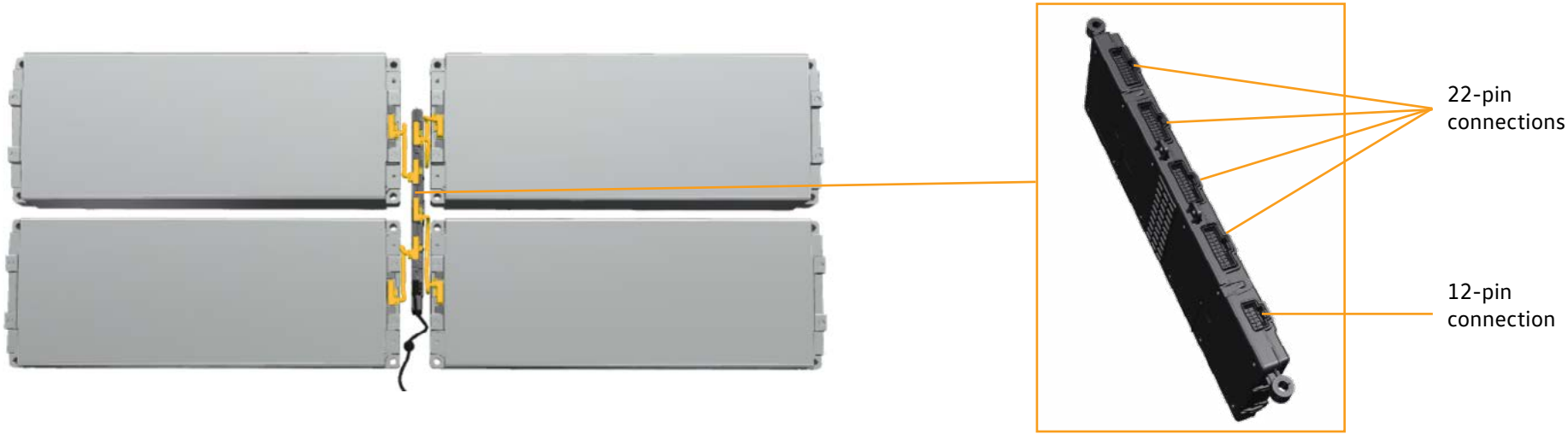
AX2 High-Voltage Battery 1 - J1208–J1210 Battery Module Control Modules

A maximum of four battery modules are connected to each battery module control unit. Two or three control units are used, depending on the size of the battery.

Functions of the J840 Battery Regulation Control Module (through the J1208-J1210):

- Monitoring the cell voltages
- Monitoring the module temperatures
- Cell balancing

The 22-pin connections connect the battery modules control units to the individual battery modules. The 12-pin connection is used for connecting other battery modules control units or the J840. The ID.4 battery cells have passive balancing. This means that all battery cells are discharged to the voltage level of the weakest battery cell using resistors.



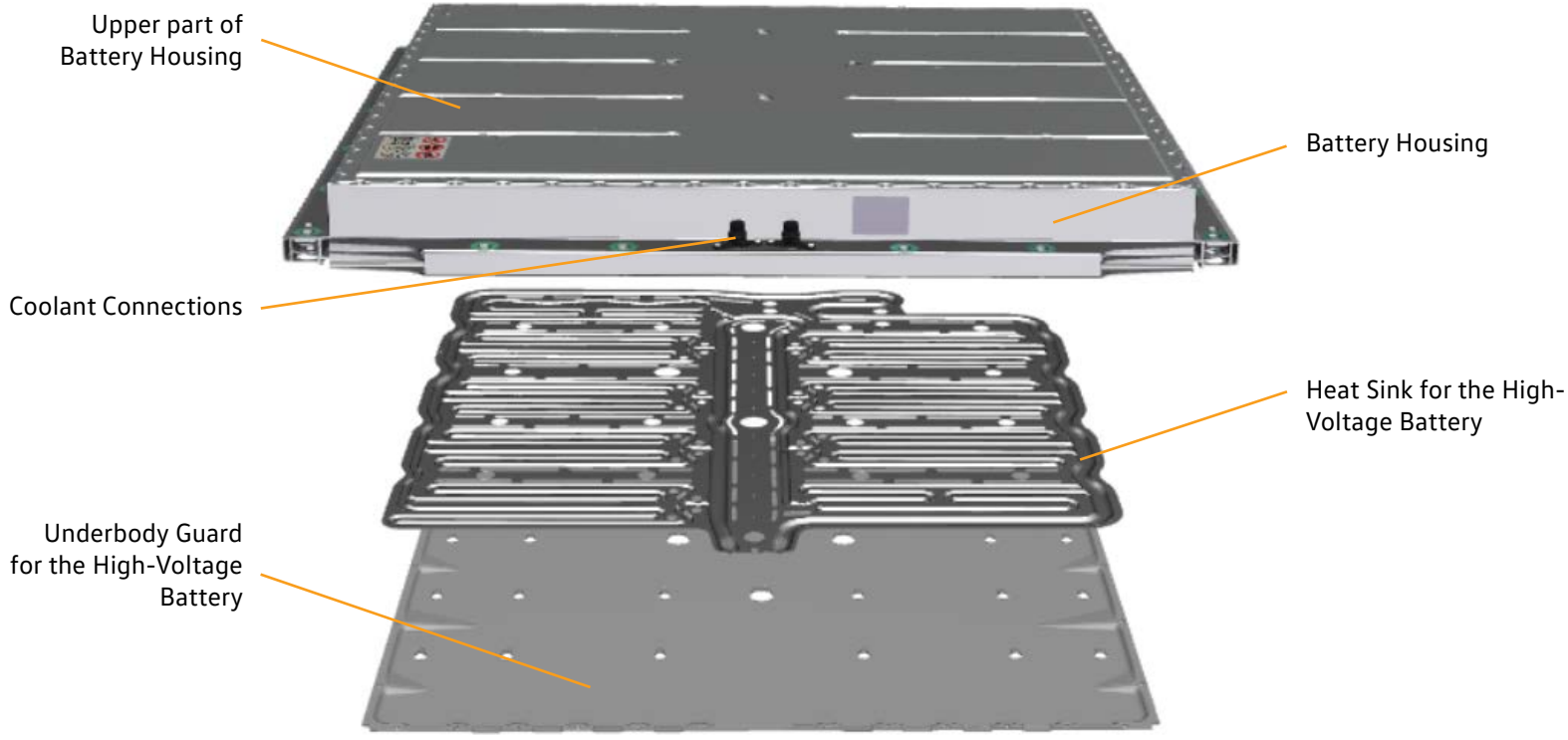
Thermal Management

Battery

All high-voltage batteries in the ID.4 have an active thermal management system. The aluminium heat sink is located outside of the battery housing. This prevents contact between coolant and the high-voltage components inside of the battery housing.

The high-voltage battery modules are connected to the base of the battery housing by a thermally conductive paste. The aluminium heat sink is also connected to the housing base with a thermally conductive paste.

The solid aluminum underbody guard protects the heat sink from mechanical damage.



Thermal Management

Battery

The coolant temperature sensors are connected directly to the J840 Battery Regulation Control Module. The control unit uses the sensor information to regulate the V590 High-Voltage Battery Coolant Pump.

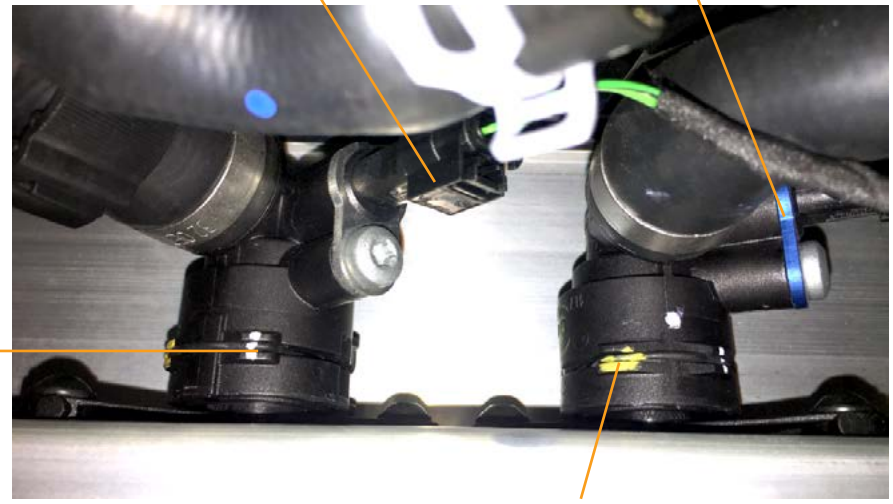
The battery cooling not only occurs when the vehicle is moving, but can also be activated during charging. This significantly reduces battery temperature increases, especially when using DC charging. This allows for a faster charging rate, even for repeated charging processes.

The high-voltage battery can be both actively cooled and heated. This happens depending on the internal battery temperature.

- < 46°F: heating by the Z132 Heating Element (PTC) 3
- > 95°F (in vehicle operation): cooling by the heat exchanger for heat condenser
- > 86°C (during charging): cooling by the heat exchanger for heat condenser

It can also be integrated into the low-temperature cooling circuit.

Different operating states are shown on the following pages.



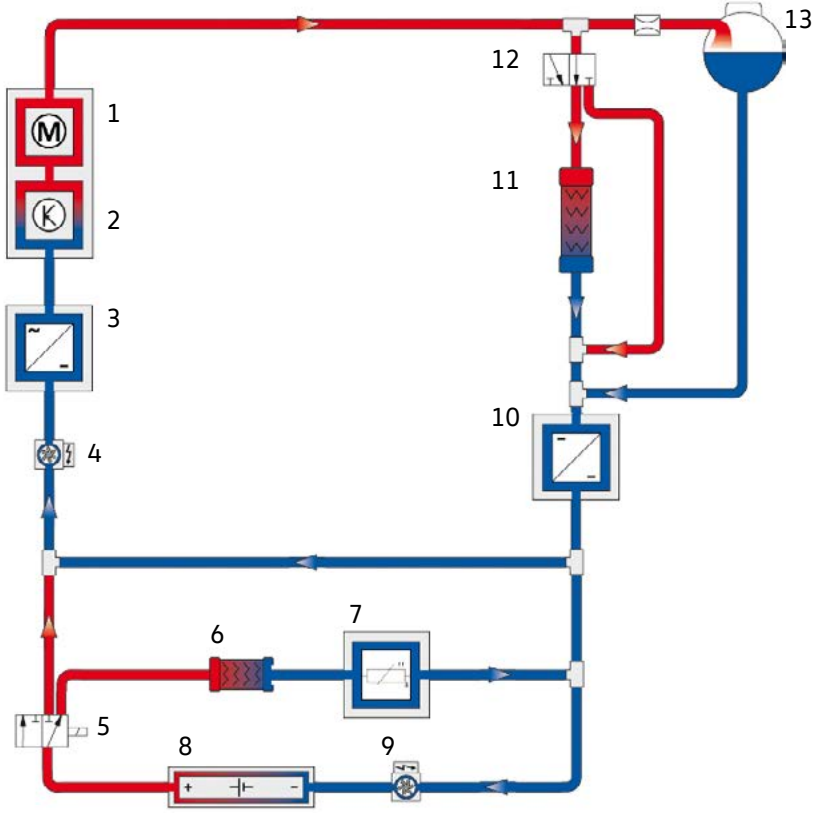
The Coolant Circuit without a Heat Pump

At a temperature of 59°F (15°C) or higher the thermostat opens, allowing coolant to flow to the radiator.

The mixing valve can be used to integrate the battery into the low-temperature circuit, or to maintain the correct temperature in a separate circuit with the Z132 Heating Element (PTC) 3.

The J840 Battery Regulation Control Module controls thermal management of the high-voltage battery. In the version without a heat pump, it regulates the V683 Mixing Valve for High-Voltage Battery Warming and the V590 High-Voltage Battery Coolant Pump.

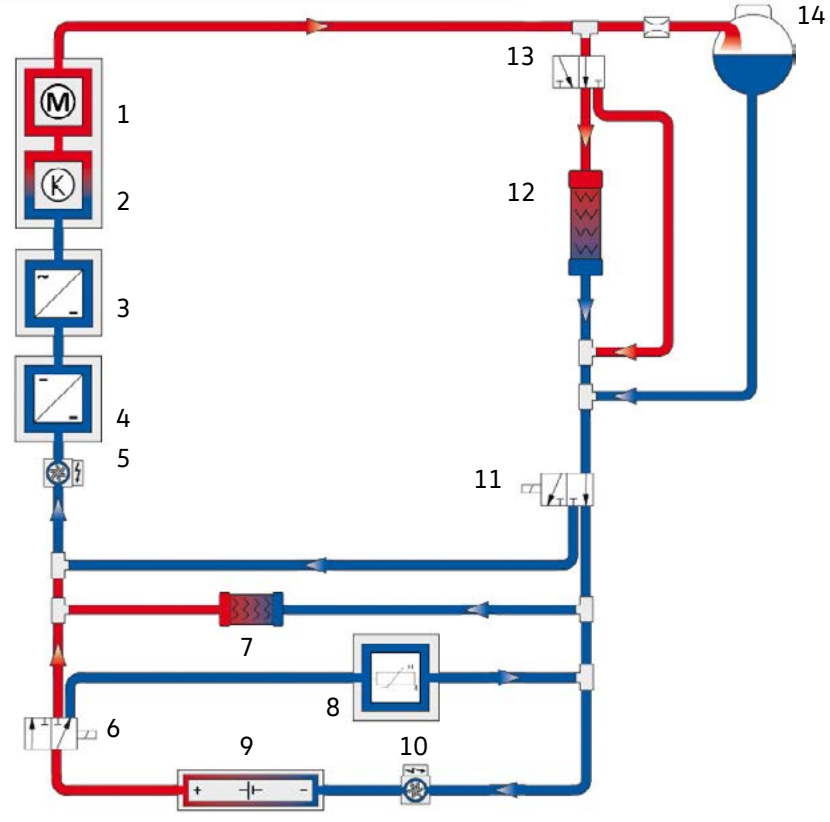
The V468 Low Temperature Circuit Coolant Pump is always activated by the J623 Engine Control Module.



1. VX54 Three-Phase Current Drive
2. JX1 Electric Drive Power and Control Electronics
3. AX4 High-Voltage Battery Charger 1
4. V468 Low Temperature Circuit Coolant Pump
5. V683 Mixing Valve for High-Voltage Battery Warming
6. Heat Exchanger for Heat Condenser
7. Z132 Heating Element (PTC) 3
8. AX2 High-Voltage Battery 1
9. V590 High-Voltage Battery Coolant Pump
10. A19 Voltage Converter
11. Radiator
12. Thermostat
13. Coolant Expansion Tank

The Coolant Circuit with a Heat Pump (not for US vehicles)

The coolant circuit has been adapted for the ID.4 with a heat pump, including the V696 Mixing Valve 2 for High-Voltage Battery Warming. The heat exchanger for heat condenser and the Z132 Heating Element (PTC) 3 are now installed in branches of the coolant circuit that can be separately controlled. This is necessary to allow the heat exchanger for heat condenser to be activated individually when the heat pumps are operating, and to heat the battery using the Z132 Heating Element (PTC) 3 at the same time.



The J840 Battery Regulation Control Module controls thermal management of the high-voltage battery. In the version with a heat pump, it regulates the V683 Mixing Valve for High-Voltage Battery Warming, V696 Mixing Valve 2 for High-Voltage Battery Warming and the V590 High-Voltage Battery Coolant Pump.

The V468 Low Temperature Circuit Coolant Pump is always activated by the J623. A number of potential switch variants are shown on the following pages.

1. VX54 Three-Phase Current Drive
2. JX1 Electric Drive Power and Control Electronics
3. AX4 High-Voltage Battery Charger 1
4. A19 Voltage Converter
5. V468 Low Temperature Circuit Coolant Pump
6. V683 Mixing Valve for High-Voltage Battery Warming
7. Heat Exchanger for Heat Condenser
8. Z132 Heating Element (PTC) 3
9. AX2 High-Voltage Battery 1
10. V590 High-Voltage Battery Coolant Pump
11. V696 Mixing Valve 2 for High-Voltage Battery Warming
12. Radiator
13. Thermostat
14. Coolant Expansion Tank

Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator bypass active - Battery is not cooled or heated

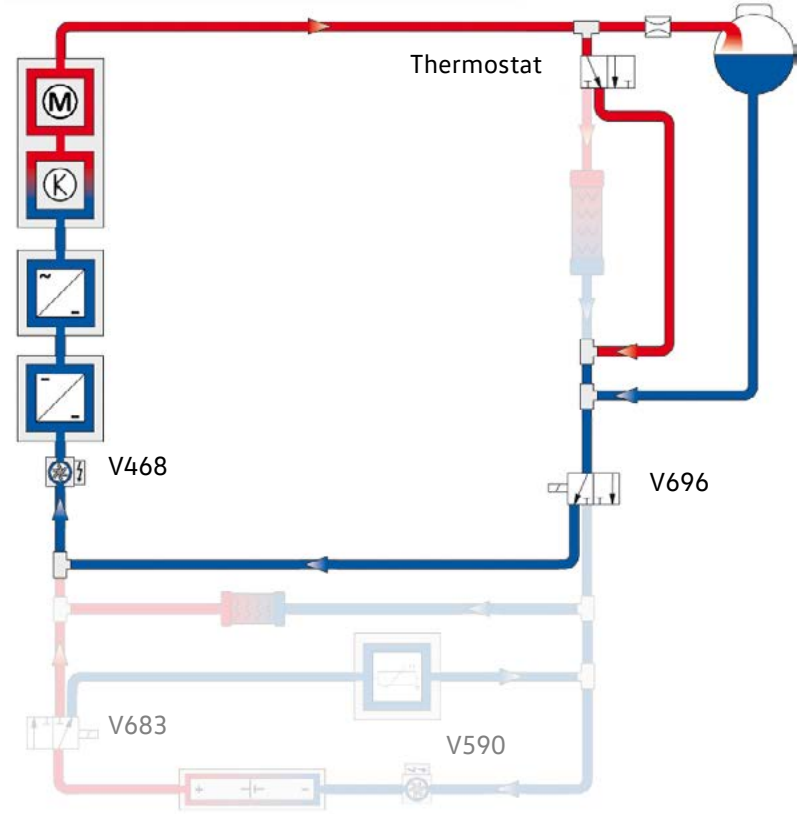
Prerequisites:

- Temperature at the thermostat < 59°F (15°C)
- Battery temperature 47°F (8°C) to 95°F (35°C)
- No demand by the heat pump

The thermostat opens the radiator bypass. The V696 Mixing Valve 2 for High-Voltage Battery Warming activates the minimum possible low-temperature cooling circuit.

The V468 Low Temperature Circuit Coolant Pump is activated when the heat pumps are operating, and to heat the battery using the Z132 Heating Element (PTC) 3 at the same time.

The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.



Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator bypass active - Battery is heated

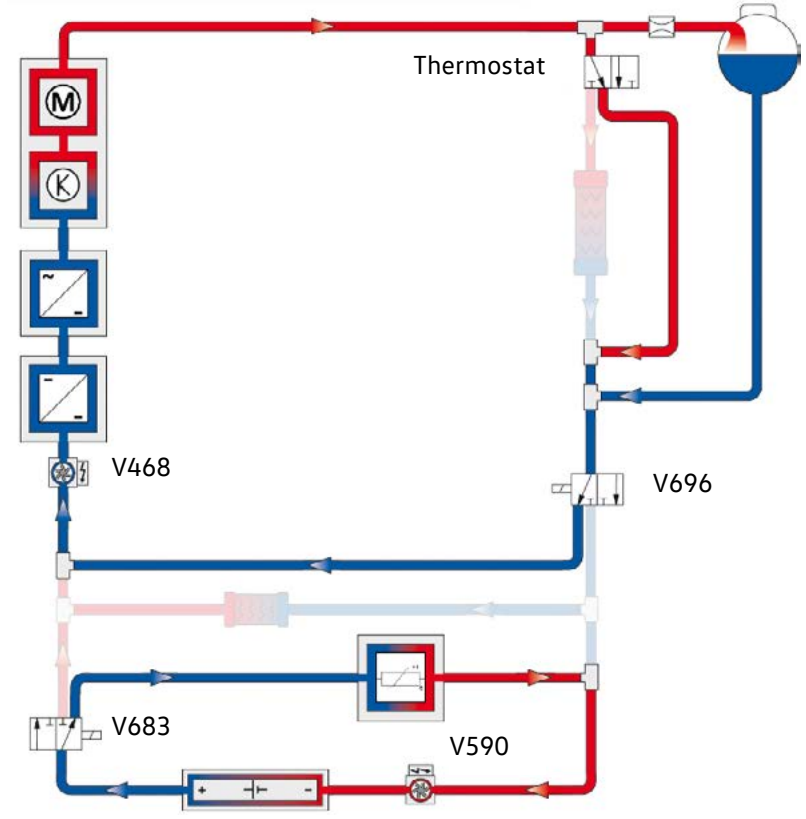
Prerequisites:

- Temperature at the thermostat < 59°F (15°C)
- Battery temperature < 47°F (8°C)
- No demand by the heat pump

The thermostat opens the radiator bypass, then the V696 Mixing Valve 2 for High-Voltage Battery Warming activates the minimum possible low-temperature cooling circuit.

The V683 Mixing Valve for High-Voltage Battery Warming activates the battery heating circuit. Both coolant pumps are activated.

The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.



Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator flow - Battery is not cooled or heated

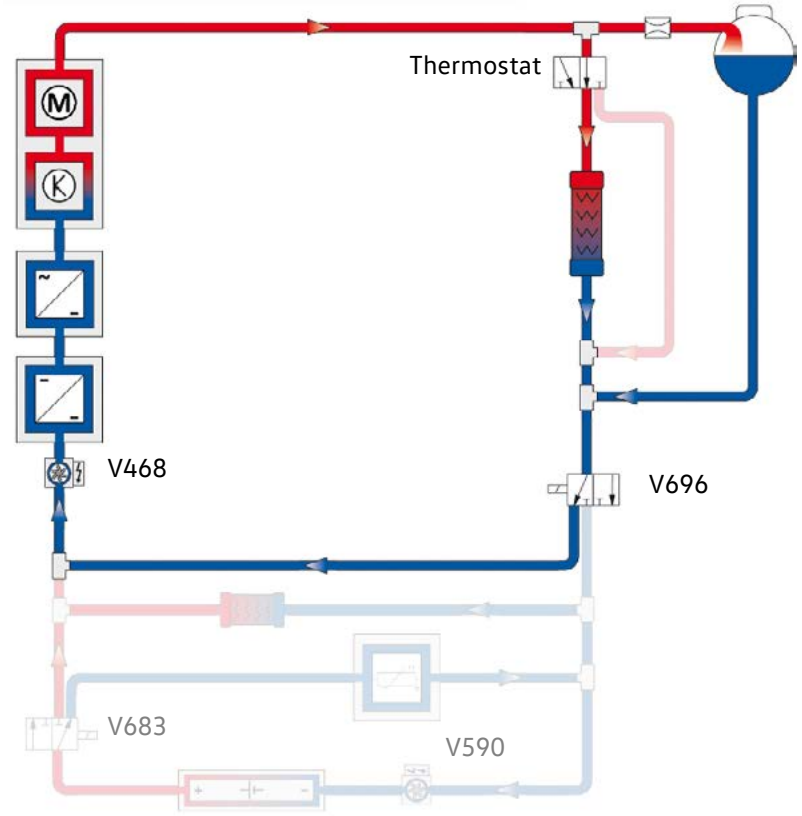
Prerequisites

- Temperature at the thermostat < 59°F (15°C)
- Battery temperature 47°F (8°C) to 95°F (35°C)
- No demand by the heat pump

The thermostat closes the radiator bypass, then the V696 Mixing Valve 2 for High-Voltage Battery Warming activates the minimum possible low-temperature cooling circuit.

Only the coolant pump for V468 Low Temperature Circuit Coolant Pump is activated.

The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.



Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator flow - The battery is cooled by the heat exchanger for heat condenser

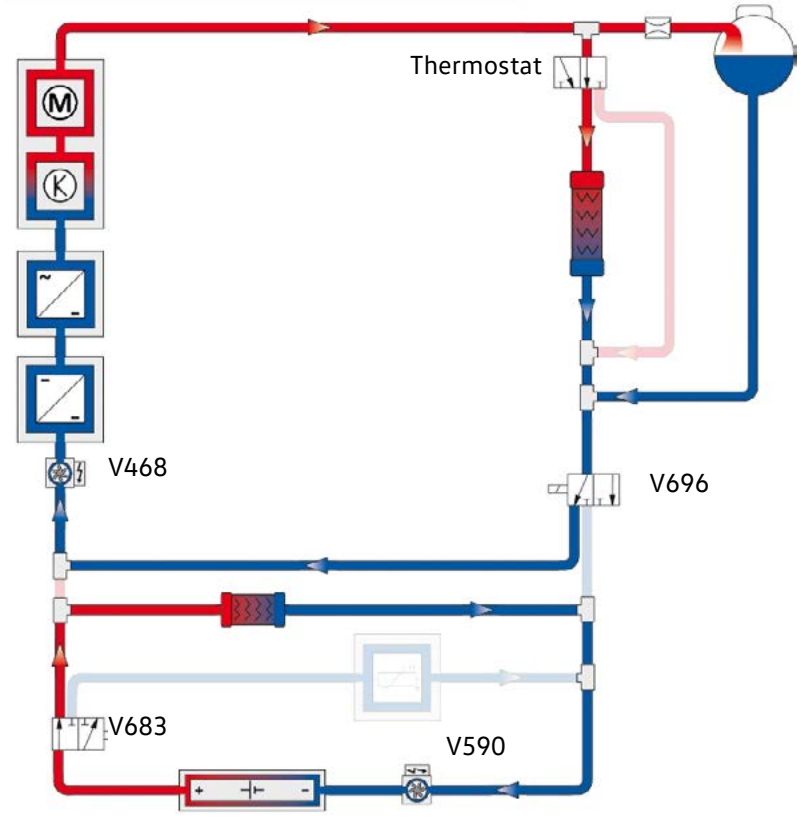
The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.

Prerequisites:

- Temperature at the thermostat < 59°F (15°C)
- Battery temperature > 95°F (35°C) in vehicle operation
- Battery temperature > 86°F (30°C) when charging
- No demand by the heat pump

The thermostat closes the radiator bypass, then the V696 Mixing Valve 2 for High-Voltage Battery Warming activates the minimum possible low-temperature cooling circuit.

The V683 Mixing Valve for High-Voltage Battery Warming activates the battery coolant circuit. Both coolant pumps are activated.



Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator flow - Battery is cooled by low-temperature circuit

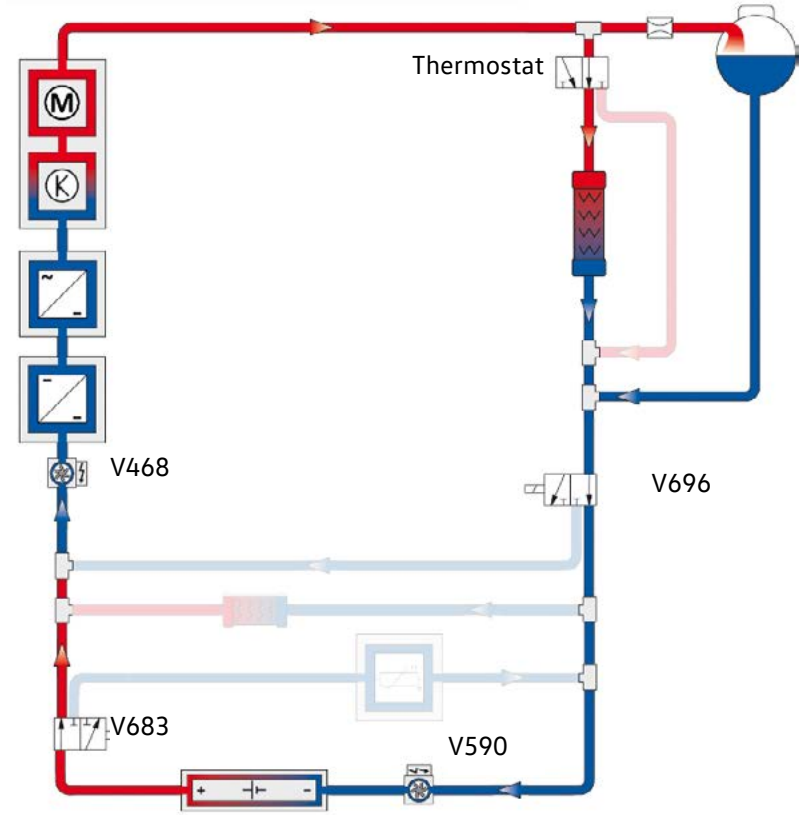
Prerequisites:

- Temperature at the thermostat > 59°F (15°C)
- Battery temperature > 86°F (30°C)
- No demand by the heat pump

The thermostat closes the radiator bypass, then the V696 Mixing Valve 2 for High-Voltage Battery Warming opens the connection to the battery.

The V683 Mixing Valve for High-Voltage Battery Warming activates the battery coolant circuit. Both coolant pumps are activated.

The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.



Cooling and Heating Strategies for Vehicles with a Heat Pump (not for US Vehicles)

Radiator flow - Battery is not cooled or heated

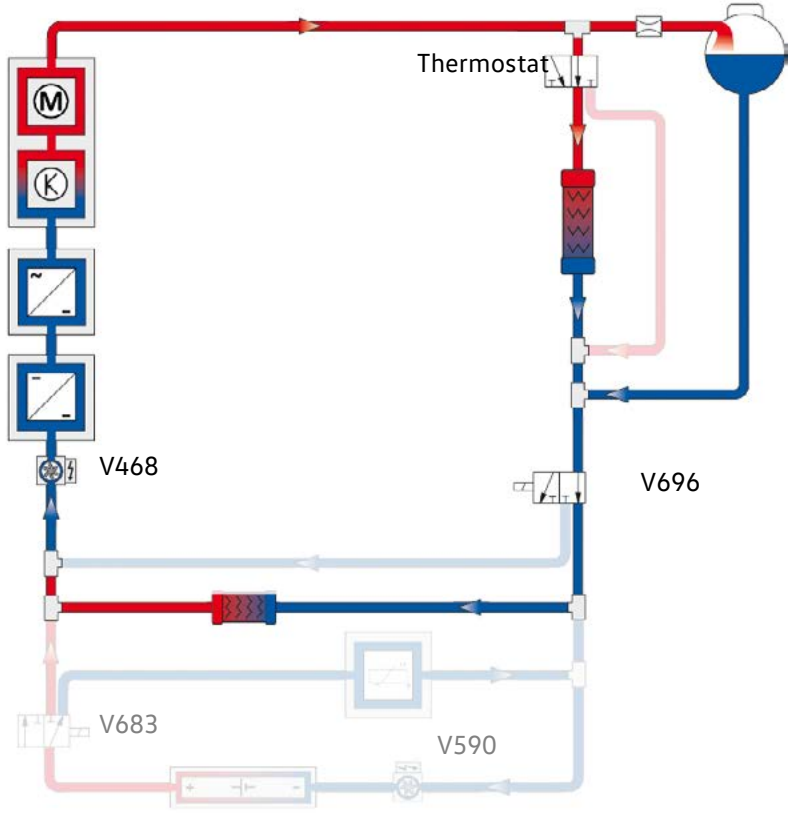
Prerequisites:

- Temperature at the thermostat > 59°F (15°C)
- Battery temperature 47°F (8°C) to 86°F (30°C)
- Demand by the heat pump

The thermostat closes the radiator bypass, then the V696 Mixing Valve 2 for High-Voltage Battery Warming opens the connection to the battery.

The V683 Mixing Valve for High-Voltage Battery Warming activates the battery heating circuit. Only the V468 Low Temperature Circuit Coolant Pump is activated.

The versions shown here do not show all possible operating modes. Other ambient conditions, customer requirements and component temperatures may require other operating modes.



High-voltage Safety Concept

Safety Measures

The high-voltage safety concept was modified for the ID.4. Some of these are carryover from the previous high-voltage concept.

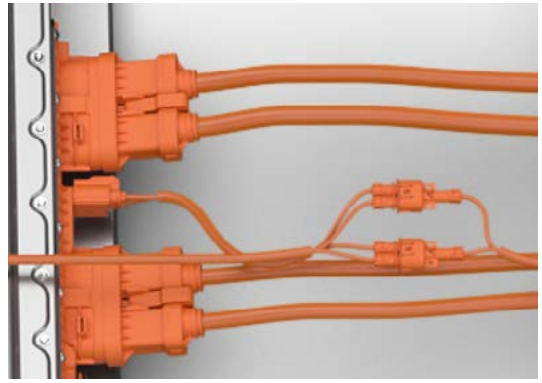
Safety measure overview:

- Color coding of the high-voltage wiring and connectors
- Safety markings on all high-voltage components
- Accidental contact protection
- Emergency cut-out connections: Maintenance connector for high-voltage system Fuse on the A-pillar with a small “flag”
- Pilot line
- Insulation resistance monitoring
- Electrical isolation between high-voltage system and body (terminal 31)
- Active discharging
- Passive discharging
- Crash shutdown
- Monitoring of the high-voltage relays
- Short-circuit test
- Short-circuit shutdown
- Detection of open circuits in high-voltage wires

Marking

Color coding of the wiring and connectors

All high-voltage connectors and wiring are orange to make identification easier.



Safety markings on all high-voltage components

All high-voltage components are marked with warning stickers. There is an additional high-voltage warning on the lock carrier in the engine compartment with a yellow background. These warning stickers are relevant for the vehicle safety inspection.

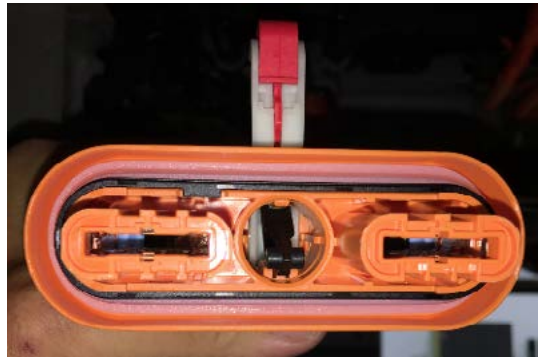
Accidental Contact Protection

All high-voltage connectors are equipped with improved accidental contact protection (IPXXB+, touch-proof). A smaller test finger is used.

High-voltage potentials inside of the components are sealed off by a cover with coded screws and cannot be opened during service work.

Accidental contact protection has also been used inside the high-voltage battery.

The Electromagnetic Compatibility (EMC) filters are adapted to the individual requirements of the different high-voltage components. They can be made of capacitors, restrictors or more complex circuitry.

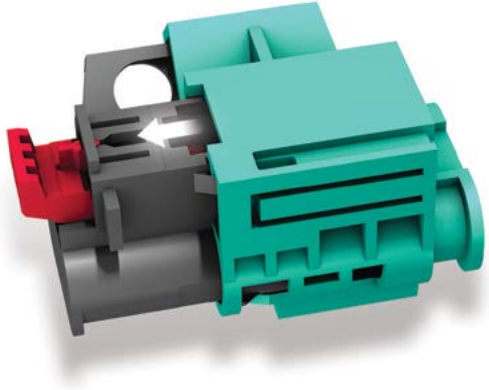


Shielding of the high-voltage wires is not required. The EMC measures are implemented in the high-voltage components by the EMC filter.

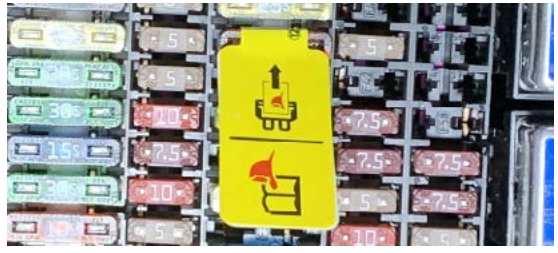
Emergency Cut-out Connections

The emergency cut-out connections are the TW Maintenance Connector for High-Voltage System in the left side of the engine compartment, and the SC28 Fuse 28 (on Fuse Panel C) on the left A-pillar.

The TW Maintenance Connector for High-Voltage System disconnects terminal 30 A and pilot line.



The fuse SC28 has a small “flag” on it. When removed, terminal 30 A is disconnected. The small “flag” is attached to allow quick removal without tools. The small “flag” can be replaced separately and the fuse is commercially available.



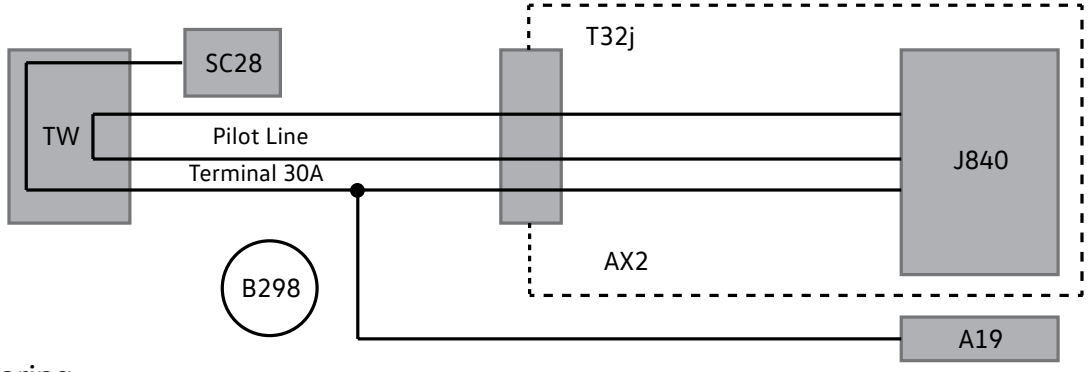
Terminal 30 A (previously terminal 30 C) in the ID.4 supplies both the voltage for the high-voltage relay in AX2 High-Voltage Battery 1 and the supply voltage for the A19 Voltage Converter.

There is also a Bowden cable located in the trunk to release the charge plug if there is a problem.

Pilot Line and Insulation Resistance Monitoring

Pilot Line

The pilot line is now only routed to the TW Maintenance Connector. It was removed from other areas because all high-voltage connectors have improved accidental contact protection. It is monitored by the J840 Battery Regulation Control Module.



Insulation Resistance Monitoring

The insulation monitoring checks the electrical isolation of the high-voltage potentials to the chassis. When the value falls below a threshold of 510 kOhm, a yellow warning lamp illuminates on the instrument cluster.

A red lamp appears when the value falls below 90 kOhm. DC charging is either deactivated or prevented.

The insulation resistance monitoring is initiated by the J623 Engine Control Module and performed by the J840. Among other things, it is part of high-voltage system activation, which is monitored by the high-voltage coordinator. Its function and circuitry is similar to the insulation resistance monitoring in the e-Golf.

A19 – Voltage Converter
AX2 – High-Voltage Battery 1
B298 – Positive Connection 2 (30) (in Main Wiring Harness)
J840 – Battery Regulation Control Module
SC28 – Fuse 28 (on Fuse Panel C)
TW – High-Voltage System Maintenance Connector
T32j – 32-pin Connector, Onboard Supply Connection, on AX2 High-Voltage Battery 1

Active and Passive Discharging

Active Discharging

If there is an emergency shutdown of the high-voltage system, such as if a crash or the TW Maintenance Connector is removed, the high-voltage system is discharged within five seconds. Active discharging is performed in the JX1 Electric Drive Power and Control Electronics.

Passive Discharging

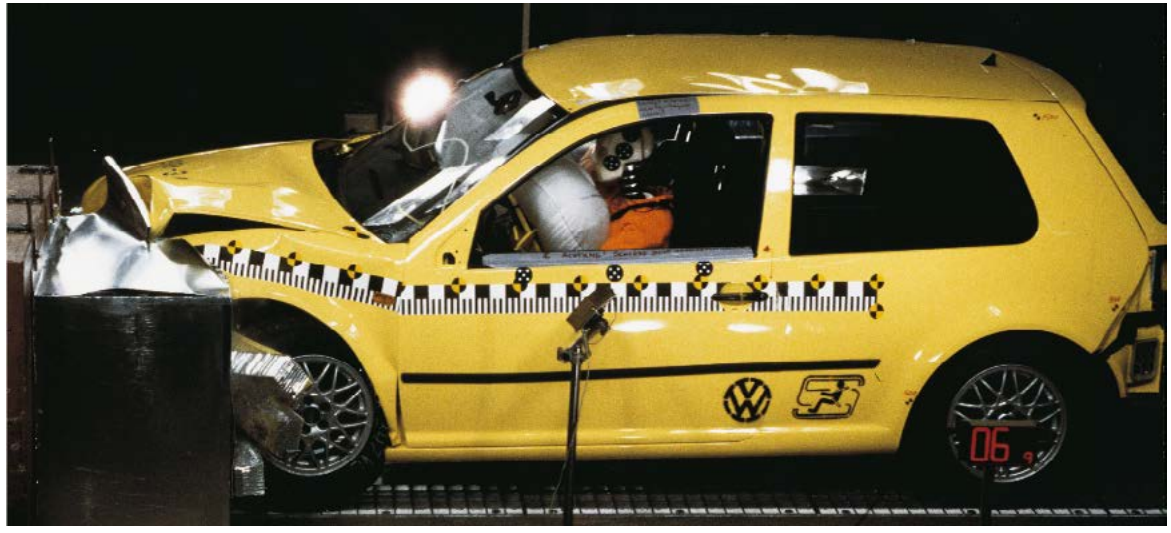
High-voltage components have capacitors in their circuitry. Passive discharge guarantees that the voltage falls to < 60 V within two minutes of disconnecting the components from the high-voltage battery.

Crash Shutdown

Following an accident that may damage components in the high-voltage system, the high-voltage system is shut down and actively discharged.

Because a number of high-voltage components in the ID.4 are installed very close to the outer body shell, severe and minor accidents are treated the same. This means that in case of an accident, the high-voltage potential is immediately disconnected (by pyrotechnic means). This can be repaired in the workshop.

The pyrotechnic disconnection is performed by the S415 Fuse for High-Voltage Battery Interruption in the switching unit for SX7 High-Voltage Battery Control Module, Negative Terminal.



Monitoring of the High-Voltage Relays and Short-Circuit Test

Monitoring of the High-Voltage Relays

- Each high-voltage relay has a voltage tap before and after the relay
- If an unintended condition is identified to be affecting one of the high-voltage relays, the high-voltage system is deactivated until the defect is eliminated
- A lamp is illuminated in the instrument cluster

Short-circuit Test

- When C25 Intermediate Circuit Capacitor 1 is being pre-charged, a current measurement is performed

Short-circuit Shutdown

- If a short circuit occurs during pre-charging, it is isolated and the high-voltage system is not activated
- If a short circuit is detected when the high-voltage system is already activated, the high-voltage system is turned off
- A lamp is illuminated in the instrument cluster

Driving Mode Selection

Overview

The ID.4 features multiple driving mode selections:

- ECO - The maximum speed is 130 km/h and the power output and A/C is reduced by approximately 30%
- Convenience - On average, all systems are balanced
- Sport - All systems are tuned for sporty characteristics
- Individual - All systems can be configured individually

Low Voltage Modes

The vehicle does not switch into ECO mode when the high-voltage battery is discharged. Instead, a yellow turtle is displayed in the dash panel insert and the power output is reduced.

Yellow turtle (reserve mode):

- A yellow turtle lamp appears in the ID display and an acoustic warning sounds.
- Power output is reduced significantly, and may continue to be reduced.
- The convenience functions of the A/C are reduced to extend the range

Red turtle (absolute reserve mode):

- After starting, the temperature or charge level of the high-voltage battery is too low. Only movement up to 7 km/h is possible. An emergency start of the vehicle can still be performed twice to allow movement over a short distance. The vehicle key must be in the center console compartment for an emergency start. When the charge level increases again, the warning lamp goes out.

During vehicle operation:

- If the charge level of the high-voltage battery is too low during operation, the vehicle may stop operating. Park the vehicle safely or drive to the next charging station if possible. When the charge level increases again, the warning lamp goes out.

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