



HV High Voltage HYBRID system Important procedure!

Please strictly follow the correct steps when installing the product, otherwise you will irreparably damage the parts! After installation no returns are accepted.

Please refer for installation to the complete installation description from Mercedes Benz.

Please check if you received the correct item, and inspect the item carefully.

Returning a product is not possible after usage, installation, connecting or service of the product of any kind, noted by breaking the seal. Please check the conditions that apply to the sale and returns.



Reading this document signifies your agreement to our terms and conditions. Work should only be performed by a trained mechanic else damage might be caused to the vehicle. The HV (High-Voltage) system is working under voltage of over 130 Volts and 310 Amperes, taking the wrong installation steps can have serious consequences. You are responsible for studying the official service manual and the necessary safety proceedings that should be taken before working on, and raising the vehicle as when errors are made serious injuries and death can occur. Mercedes Benz diagnostic tools and software is required to diagnose the system correctly.

Please contact us if you have questions

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The **Mercedes Benz S400 HYBRID** is the first series production passenger car featuring a traction lithium-ion battery pack. The S400 Hybrid uses a hybrid system with a small 15 kW electric motor connected to the crankshaft between the motor and transmission, along with a Lithium-ion battery pack for energy storage. Although the motor seems small from a power output perspective, “for the given architecture it turned out that the maximum fuel reduction occurred at electrification of 15-16 kW”.

The high torque of the e-motor at low speeds offsets the reduction in low-end torque resulting from applying the Atkinson cycle to the combustion engine. A more powerful e-motor would increase the weight of the hybrid system and fuel consumption. Also at a higher electrical to combustion power ratio, the e-motor operates increasingly in less efficient areas of the performance map as maximum requirements increase. Although relatively low in power, the e-motor delivers rated torque of 160 Nm contributing to a combined system torque of 385 Nm.

The operating strategy of the S400 hybrid is based around start/stop, regenerative braking, boost and load point shifting—i.e., moving the load point of the combustion engine to less consumption-intensive ranges while offsetting the torque deficit with the e-motor.

When providing support for load-point shifting, the operating strategy only allows shallow discharge cycle of the Li-ion battery to maintain the cycle strength. Fuller deployment of the electrical support is only provided based on the driver’s request, as indicated by accelerator pedal position and a large pedal value gradient.

There are two (2) types of electrical systems being implemented in a hybrid system. One is the 12 volts electrical system powered by a 12 volts on-board battery. The 12-volt system powers almost 90 percent of the car, including lights, entertainment, horn, etc.

The high voltage electrical system is powered by a high voltage battery with >100 volts DC. A hybrid Battery or High Voltage (HV) battery powers the Hybrid’s electric motor. Its primary purpose is to power the Hybrid electric motor to help the Internal combustion engine with its load. It also acts as a starter for the Internal Combustion Engine.

The Mercedes-Benz S400 HYBRID system can fail due to different reasons, leading to not being able to start the car, or the car starts intermittently. The most common issues are described below.

To find out why your S400 Hybrid won't start, you must read the Battery Management System module's fault codes. It is also essential to run a full system scan to determine fault codes in other modules.

For a proper diagnose of the problem, Mercedes Benz Star Diagnostic equipment with Xentry is necessary.

There is a high risk of injury or death due to electric shock from the High Voltage System. We only recommend that trained mechanics work on the high voltage hybrid system. Working on the high voltage system without powering down the system can cause injuries and even death.

Hybrid power inverter (power electronic module)

The power inverter is a control unit which acts as the master of the system and a power unit that converts the direct current generated by the battery. The function of this module is to receive commands from hybrid ECM via CAN-BUS Network and control inverter energy flow to and from the battery and engine. It can control the speed and timing of an electric motor in union with the internal combustion engine. It also controls and monitors other components like battery charging, and other related modules.



The power electronics can cope with continuous currents of 150A, and short-term as high as 310A. The power inverter is situated in the engine compartment in the location of the conventional starter motor, on the side of the engine/transmission, below the right exhaust manifold, passenger side and is cooled by a separate circuit. Because the Power inverter is mounted next to the exhaust manifold, the chances of a unit failing eventually remain high.

The three-phase electrical connector melts, which means that you can no longer start the engine since the electrical motor is used for starting as the S400 hybrid has no starter; instead, it uses the electric motor mounted in front of the torque converter.

A faulty power inverter module triggers these codes, the fault codes will be stored in Power inverter Module (SG-EM) and Engine Control Unit (ECU).

- U011000 - Communication with control unit Electric machine A has a malfunction.
- U011081 - Communication with control unit Electric machine A has a malfunction. Incorrect data were received.

Note: The power inverter module should not be confused with the DC/DC converter.

Note: A new power inverter unit does not need to be programmed. After the repair, fault codes will need to be cleared.

Part numbers:

A0009064703
A0009064001
A0009065802
A2215404450
A004549701

Hybrid HV-Battery

The hybrid high voltage (HV) battery is a lithium-ion battery pack. The compact 0.8 kWh Li-ion pack, developed by Continental and JCS Saft, comprises 35 cells and provides 19 kW of power, with a capacity of 6.5 Ah at 128 V. The battery uses 35 cylindrical Li-ion cells in series of nominal 3.7 to maximum 4.1 Volts each, regulated by a BMS. The battery is charged by a load control module and is connected to the vehicle air conditioning circuit so it can be cooled independent from the engine.



Cut-off valves are integrated into the system that allows the customer to switch off the air conditioning without interrupting battery cooling. When the engine is not running, the electric A/C compressor not only provides air conditioning but also guarantees that the battery's operating temperature limits are not exceeded. Battery pack temperatures do not increase above 50 °C in any operating state to prevent serious damage.

Common fault codes that show up as stored or current in the battery management module (SG-BMS):

- 180F00 - The high voltage battery has a malfunction during the recovery phase.
- 0BBD00 - The limit value for the difference between cell voltages in the high voltage battery module has been exceeded.
- 0BBE00 - The cell voltages in the high voltage battery module are different.
- 0A7D00 - The charge level of the high voltage battery module is low.
- 180C00, 180500 - The hardware monitoring function has detected a fault in the control unit.
- 0A1F04 - There is an internal fault in the control unit Battery. There is an internal fault.
- 0AE886 - The temperature sensor D of the high voltage battery has an electrical fault. There is an incorrect signal.
- 0ACA86 - The temperature sensor C of the high voltage battery has an electrical fault. There is an incorrect signal.
- 0AC586 - The temperature sensor B of the high voltage battery has an electrical fault. There is an incorrect signal.
- 0A9B86 - The temperature sensor A of the high voltage battery has an electrical fault. There is an incorrect signal.
- 0A1F96 - There is an internal fault in the control unit Battery. There is an internal component fault.
- 0A1F00 - There is an internal fault in the control unit Battery.
- 0A7F00 - Hybrid Battery Pack Deterioration
- 161A52 - [ECU](#) In-Plant Mode Active not activated
- 0AE500 - Hybrid Battery Negative Contactor Control Circuit Range Performance
- 0ADA00 - Hybrid Battery Positive Contactor Control Circuit Range Performance
- 0ADE00 Hybrid Battery Negative Contactor Control Circuit Range Performance

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The BMS monitors the status of the interlock circuit, the temperature of the cells, the voltage of the hybrid battery and balanced charging, and the contractors' status.

To make a proper diagnose it is important to check **why** the system is failing. The battery report can point towards; low insulation values, BMS defect, contactor stuck (contactors open and close the high voltage circuit), precharge too long, battery grid voltage too low, internal 30A pyro fuse damaged, etc.

The ideal charge level for the hybrid battery is not 100%. Li-ion and LiPo batteries' ideal charge levels are 50%-70% of maximum capacity. In this range, the HV Li-ion performs the best and lasts the longest. Do not expect to see a 100% charge on a hybrid vehicle. Even on fully electric vehicles, regularly charging the battery to 100% is not recommended, or the battery's life will decrease significantly. For the hybrid system to be charged and discharged normally, typical values are 45-75% displayed in normal driving situations, and more than 90% may be reached in downhill sections. When the battery has been falling below 35% is a dangerous low signal. Once it is lower than 28%, the vehicle will no longer be able to start, and it will be difficult to charge the battery without professional equipment.

For an Internal Combustion Engine to start, the HV battery should at least have 15% of charge. You can check the charge level via the command by going to System > Hybrid Charge.

The HV battery cannot be charged with a normal battery charger as the BMS controls also the exact procedure to charge internal all cells evenly. **It is not advised to perform any charging attempts.** A critical function of the BMS is to ensure that each of the 35 li-ion cells is balance-charged, which means that none of the cells should have a high or low charge level than the rest. To be balance charged, all the cells must be within 0.03 Volt of each other.

After replacing a battery, all fault codes should be cleared, and the hybrid system can be charged and discharged normally (45% - 75% are normal values) with no fault codes, **which is a perfect operation.** If the fault code cannot be cleared, the vehicle can start, but the capacity of the battery has been declining. Please pause the operation and conduct detailed inspection (for example, the DC / DC could be damaged).

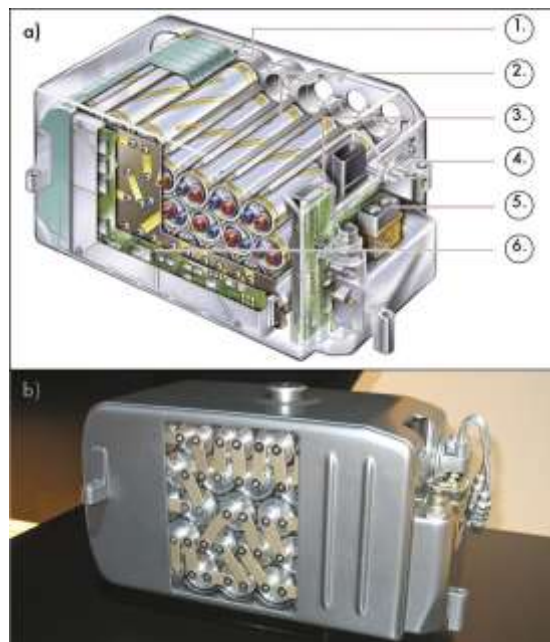
Part Numbers;

A2213400300
A2213400400
A2213400500
A2213400600
A2213430300
A2213430400
A2213430500
A2213430600
A2213430900
A2213431100
A221343060070
A221343060080
A2219021000
A2219021300
A0555455928
A0005844147

Even if there is damage or burn to the board, the reader can access the module and determine the error.

- Connect the scanner to the OBD port.
- Use Electronic Motor Control Unit Menu to check Motor ECM faults.
- Procedures for using a scanner to diagnose HV battery not charging.
- Connect the charger's positive terminal to the 12V battery input and connect the negative to the ground.
- Connect the scanner to the ODB2 port and turn on the ignition.
- Check the "Status of Contractor on the menu." If the contractor is open, then most probably, this is the cause of the battery not charging.
- Check above via DC-to-DC converter Control unit Menu.
- Read Data Stream
- Check the operating state status; if the status is passive, the system is not charging the HV hybrid battery.
- Verify the status of "Voltage of High voltage On-Board Electrical System." It should be between 48 v to 120.
- Follow the procedures to charge the HV system if the "Voltage of High voltage On-Board Electrical System" status equals 0.
 - Clear the codes
 - Go to the battery management system.
 - Go to actuation test.
 - Go to actuation of contractors menu.
 - Press f4

These procedures will generally change the status of contractors from open to close if there is no other error is associated with it. You will see the "Voltage of High voltage On-Board Electrical System" would slowly rise.



DC/DC Converter

When the DC/DC converter fails, it cannot transfer 130 Volt to 12 Volts and vice versa.

DC/DC converter might have a blown a fuse.

It can have inverter failures that can cause a no-start.

A faulty unit can cause the battery not to charge



To replace the unit:

-Use diagnostic equipment to power down the high voltage system. Disconnect the 12-volt battery in the trunk.

-Loosen the lug nuts for the front right wheel. Jack up the front right of the vehicle and secure it with jack stands

-Remove the rear splash shield in the front passenger wheel well. Several 10mm nuts need to be removed to be able to take off the splash shield. Locate the DC/DC converter mounted on the frame of the vehicle.

-Unplug the electrical connector that connects to the N83/1 module. You will need to lift the top part of the connector. As you lift the top part, the connector starts to pull out.

-Disconnect the high voltage orange cable connected to the high voltage battery known as HV Battery(A100). Lift the black/blue ring, then pull out the line. Disconnect the positive cable at the bottom of the DC/DC converter.

-Use channel lock pliers to pull down the clamps for the cooling hoses. Remove the cooling hoses and plug them so that you don't lose all the coolant. Some coolant will be lost, which you will need to add when replacing the DC/DC converter.

-Remove the bolt that connects to the ground wire. Remove all the 8mm nuts that secure the DC/DC converter to the frame. Remove the DC/DC converter from the vehicle and replace it.

-Reconnect the 12-volt battery. Re-energize the high volt system with a scanner. Clear any fault codes present in the Engine Control Unit, DC/DC control unit, and Battery Management Control unit.

-Check the engine coolant level and add engine coolant. The level will be slightly low due to the coolant you lose.

AC DC Compressor

The AC compressor is the heart of the air conditioning system. In Internal Combustion engine cars, the engine can operate normally with a faulty AC compressor. In a Hybrid system, however, the refrigerant from the AC compressor's serves as a cooling mechanism for the battery

A Hybrid AC Compressor is also operated by a High Voltage DC rather than a belt to a pulley from an Internal Combustion engine.

The electronic power inverter control module protects the battery from overheating by monitoring the AC status and taking actions such as taking the CAN-BUS communication off when the problem is detected.



Another problem with the S400 can be a defective A/C compressor, preventing the engine from starting.

The yellow cable runs from the hybrid battery to Power Electronic Module and AC compressor. There is a 60A inline fuse mounted on top of the transmission. The 60A fuse only protects the AC compressor, not the Power Electronic module.

Any problem that would stop the AC from functioning, such as a blown fuse, is regarded by ECM as a severe error and would take out the CAN-BUS communication offline.

After changing the AC compressor, we recommend to vacuum and then add 1000ml of refrigerant (4 bottles of 250ml) and 150ml-250ml of refrigeration oil (to lubricate the internal working parts of the compressor), and then run for a period of time, the noise of the compressor will be very small. It is recommended to use the original Mercedes-Benz or Sanden brand.

Other issues

An S400 may not start for other reasons as well, sometimes not related to the hybrid system. For example, other reasons why a Mercedes-Benz S-Class won't start include:

- Ignition Switch - EIS,
- Intelligent Servo Module - ISM,
- Engine Control Unit - ECU
- Weak or dead 12-volt battery.
- Stored fault codes that need to be cleared.

Safety

There is a high risk of injury or death due to electric shock from the High Voltage System. We only recommend that trained mechanics work on the high voltage hybrid system. Working on the high voltage system without powering down the system can cause injuries and even death.

Non-contact electric shock can also happen due to the High voltage. Also, special safety gear is needed before you can work on the S-400 Hybrid. Below are a sample of procedures in just disconnecting the High Voltage System:

1. Use diagnostic equipment to power down the high voltage system

With your scanner, go to Battery Management Control Module, then select Deactivate High Voltage System. This option may be under the Acuations menu. This step is highly recommended. Working on the high voltage system without powering down the system can cause injuries and even death.

2. Locate the onboard 12 volts battery.
3. Disconnect 12v onboard battery ground line.
4. Ensure that no voltage is passing from the charging point of the pre-fuse box and the ground by using a voltage tester.
5. This would ensure that no transient voltage is stuck between the onboard and auxiliary batteries.
6. It would also ensure that vehicle does not continue to be supplied by the auxiliary battery.
7. Wear your protective equipment, including electric-resistant globes, an anti-arc jacket, and a helmet with a face shield.
8. You can now disconnect the High Voltage connection from the high voltage battery module.
9. Safely stick a tape on the High Voltage connector and, as much as possible, label it with a warning.
10. You may now connect the onboard battery for diagnostic procedures.

Note:

1. The power electronic module is equipped with three or more high voltage capacitors, be sure to discharge capacitors to avoid electric shock.
2. You can discharge an HV capacitor by shorting its negative and positive leads using a screwdriver, or you can also use a high resistor with a high Ohm rating and a plier.

