START & STOP SYSTEM INTRODUCTIONINTRODUCTION

The Stop&Start function allows the vehicle, when it is stationary, to automatically stop the engine and restart it, also automatically, when the driver intends to engage a gear.
The aim of the Stop&Start is to increase the efficiency of the vehicle, reducing consumption and gas emissions, especially for urban use of the vehicle.
Another advantage of the system is the increase in acoustic comfort in situations where the engine is stopped automatically.

Glossary

The following expressions will be used in this description:

- Vehicle stop: stage in which the engine is automatically stopped
- Starter: starter motor
- Jump-Start: emergency vehicle starting using an outside battery and special leads
- S&S button: button for deactivating the Stop&Start function
- First vehicle starting: every vehicle start up controlled by the key

Acronyms- IBS: Intelligent Battery Sensor- BCM: Body Computer Module- ECM: Engine Control Module.

Warnings

Battery charge status for vehicles with s&s

One of the conditions for the full operation of the Stop&Start function is that the battery charge is more than 75%; therefore when the vehicle is handed over to the customer after a service operation it is strongly recommended to check that the battery is at least 80% charged.
If the battery is not sufficiently charged, it is strongly recommended to recharge it, making sure that the charge is above the 80% limit.

Inactivity of the vehicle

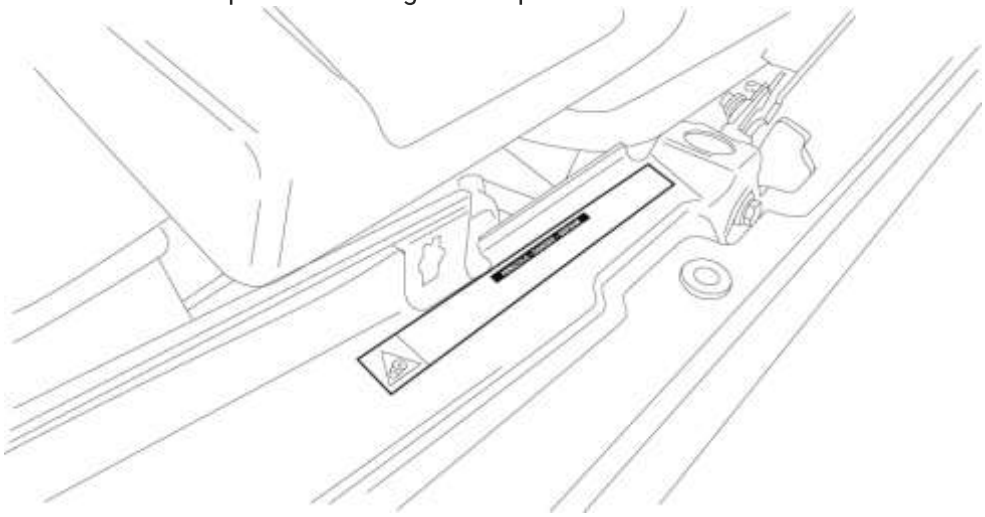
For disconnecting the battery during long periods of inactivity for the vehicle, refer to the section in which the IBS is described.

Battery recharging and emergency starting

For recharging the battery and emergency starting (jump-start) refer to the section in which the IBS is described.

Bonnet opening

Before opening the bonnet, make sure that the car is switched off and the key is in the OFF position. Follow the instructions on the dedicated plate in the engine compartment.



Refuelling

When refuelling, make sure that the car is switched off with the key in the OFF position.

Interaction with hill holder

The Hill Holder function (where fitted) is only activated with the engine running. Therefore when the engine is automatically stopped, the Hill Holder is not activated.

Leaving the vehicle

The car should always be left after the key has been removed or turned to the OFF position.

Main components

In order to guarantee reliability that is the same as or better than vehicles without the Stop&Start function, the components most involved in the operation have been strengthened during the design stage of the system. in particular, all the components involved in the numerous automatic starting stages after the vehicle has been stopped.

Engine

The sub components listed below have been strengthened:

- Flywheel

Starter motor

Various mechanical and electrical aspects of the starter have been modified with the following aims in mind:

- to guarantee a vastly superior number of start ups, by modifying the materials;:
- to reduce noise during starting, by modifying the materials and geometry;
- to reduce the starting time, by modifying the geometry and increasing the power of the starter.

Battery

Compared with a battery installed on a vehicle without Stop&Start, the battery on a vehicle with this feature is subjected to greater electrical stress due to the increased number of start ups as well as the current supply when the vehicle is stopped (stages in which the alternator is off).

To ensure reliability that is the same as or better than a battery installed on a vehicle without Stop&Start, the following modifications have been introduced:

- the construction technology of the battery has been altered, introducing a heavy duty type battery suitable for increased electrical stress;
- the capacity of the battery has been increased where needed.

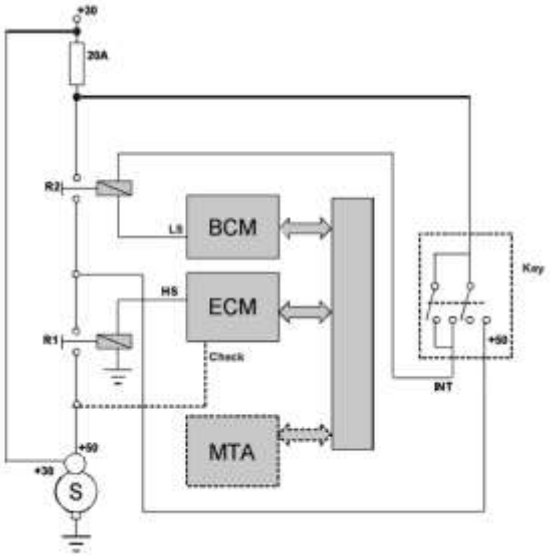
Replacing a heavy duty battery with a regular type of battery may lead, in addition to a reduced availability of the Stop&Start function to the battery becoming worn very quickly and a much shorter life.

Alternator

Compared with the alternator fitted on a vehicle without Stop&Start, the alternator on Stop&Start versions has an increased current supply capacity.

Starting system

The vehicle starting system has to manage both the start ups managed by the user (using the key) and automatic engine restarting as part of the Stop&Start system.
The starting system is illustrated in the diagram below:



S - Starter motor, with control (+50) and power (+30) connections
20A - Starting control circuit protective fuse
ECM - Engine management control unit
BCM - Body Computer Control Unit
MTA - Robotized transmission control unit (for versions with robotized transmission)
Relay R1 - controlled by the ECM via the HS output
Relay R2 - controlled by the BCM via the LS output
Key - Key
C-CAN - Communication line
Check - Voltage measurement line

There are two types of starting:

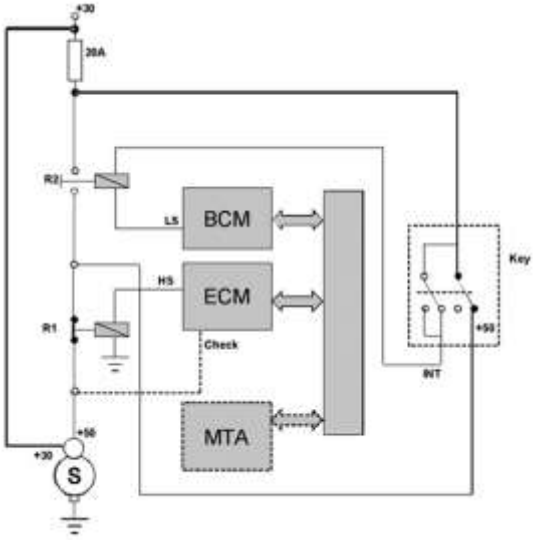
- Key starting: controlled by the user directly using the ignition key.
- Automatic starting: managed by the Stop&Start function in order to restart the engine after the vehicle has been stopped

The procedure is different depending on the type of starting.

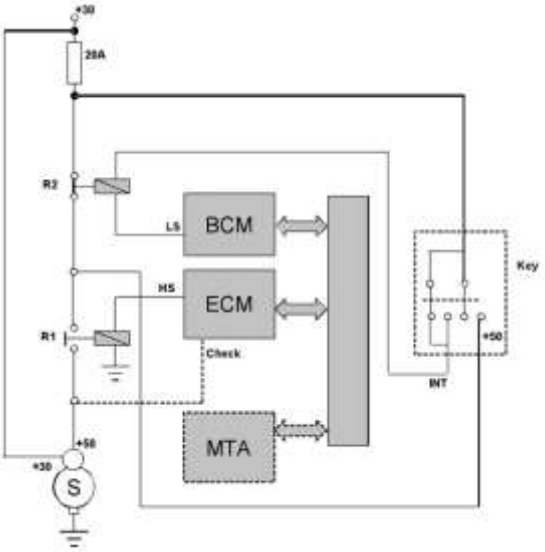
Key starting

Key starting is controlled by the user by placing the key in the starting position: under these circumstances starting is managed by the BCM, ECM, MTA (where present) according to the following procedure:

1. In key OFF conditions both starting relays are supplied and therefore open
2. When the key is placed in the ON position both relays are opened by the respective control units.
3. When the key is placed in the starting position, the ECM control unit (after having waited for the enablement of the MTA control unit, if present) closes relay R1 thereby supplying the starter motor.



4) When the key is released in the ON position, the ECM opens relay R1 and carries out a fault diagnosis on both relays; depending on the results of this fault diagnosis, the following conditions may be verified:
4a) Both relays working normally: BCM closes R2 and the operation of the Stop&Start is enabled.

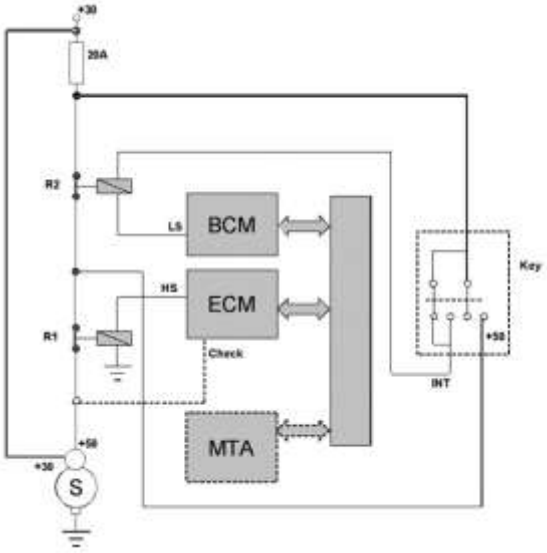


4b) Relay R1 is diagnosed as stuck: R2 is kept open and the Stop&Start is disabled (the corresponding DTC will be present in the ECM)
4c) Relay R2 is diagnosed as stuck: R1 is kept open and the Stop&Start is disabled (the corresponding DTC will be present in the BCM)
The relay status during manual starting stages is given in the table below.

STAGE	DESCRIPTION	KEY POSITION	RELAY R1 STATUS	RELAY R2 STATUS
1	Key OFF	OFF	Open	Open
2	Key ON	ON	Open	Open
3	Key in starting position	AVV	Closed	Open
4a	Key release when starting has taken place	ON	Open	Closed
4b	Key release when starting has taken place, relay R1 stuck	ON	Closed	Open
4c	Key release when starting has taken place, relay R2 stuck	ON	Open	Open

Automatic starting

When, as a result of the action of the user or for operating requirements, the Stop&Start strategy determines that automatic starting must take place, the engine is started according to the following procedure without the user having to use the key:
1) The Stop&Start strategy determines that the engine must be restarted automatically.
2) Relay R1 is closed via the ECM: relay R2 has already been closed at the end of the starting procedure using the key so the starter power supply is controlled as illustrated in the diagram below.



3) Once the engine is started, the ECM controls the opening of R1 and it carries out a fault diagnosis on R1 later on; depending on the results of this fault diagnosis the following conditions may be verified:
3a) R1 is diagnosed as open, as controlled: the Stop&Start function is enabled
3b) R1 is diagnosed as closed (stuck): relay R2 is opened and the Stop&Start function is disabled.
The relay status during automatic starting stages is given in the table below.

STAGE	DESCRIPTION	KEY POSITION	RELAY R1 STATUS	RELAY R2 STATUS
1	Vehicle STOPPED	ON	Open	Closed
2	Engine starting stage	ON	Closed	Closed
3a	Starting has taken place correctly	AVV	Open	Closed
3b	Starting has taken place but R1 is stuck: R2 is opened	ON	Closed	Open

Battery status sensor

In addition to modifications to the battery, in order to integrate it with the Stop&Start strategies, a battery sensor (IBS) has been introduced that has the task of monitoring the battery status and notifying the vehicle (in particular the BCM) to allow the optimum management of the battery within the framework of the Stop&Start strategies.
For more information on the IBS, refer to the documents in this section specially devoted to it.

Voltage stabilizer

The voltage stabilizer is designed to keep the voltage at devices that are sensitive to decreases in voltage constant: in particular, it is used to supply loads such as the radioreceiver which could cut out or reset during starting; the voltage stabilizer ensures that the supply voltage during starting is kept at limits where no power supply problems will occur.
The voltage stabilization function is not, on the other hand, guaranteed during starting using the key.
The BCM receives a signal from the voltage stabilizer which provides information relating to a possible fault in the component. In the case of a voltage stabilizer malfunction, the BCM sets a DTC.
A possible malfunction in the voltage stabilizer may lead to the radioreceiver cutting out or being reset during a restarting stage.

OPERATING MODE

Whilst driving the user deploys the Stop&Start function using the brake, clutch and accelerator pedals without having to carry out manoeuvres that will have a great effect on their style of driving.

Manual gearbox

Automatic stopping of the engine

On versions with a manual gearbox the engine is stopped automatically, where the Stop&Start system is enabled, with the vehicle almost stationary (v , 3 km/h for more than 0.5 seconds) and with the accelerator pedal released, if the following manoeuvres are carried out:

- gearbox in neutral,
- clutch pedal released.

Automatic restarting of the engine

On versions with a manual gearbox, the engine is automatically restarted when the following manoeuvre is carried out:

- Pressing the clutch.

When the gearbox is not in neutral (caused by the forced engagement of a gear whilst the engine is stopped), the clutch should be fully depressed, whilst if the gearbox is in neutral restarting takes place with the clutch not yet fully depressed in order to facilitate quick starting.
Nothing changes during normal driving: once the user has decided to set off, they will press the clutch to re-engage gear: at this point the engine will already have been restarted and the vehicle is ready to set off again.

Automatic engine restarting without any action by the user

For reasons of comfort, limiting pollutant emissions and safety purposes, the power unit can restart automatically without any action on behalf of the driver.
With a gear engaged, in case the system needs to carry out automatic restarting; the driver is asked about this operation through a message in the instrument panel and, where present, the flashing of a warning light in the instrument panel illustrated below.

If the clutch is not pressed in these conditions, when about three minutes have elapsed since the engine was stopped, the engine can only be restarted using the key.

Robotized transmission

Automatic stopping of the engine

The stopping condition is as follows for versions with robotized transmission: if the Stop&Start is enabled, with the vehicle almost stationary (v < 3 km/h for more than 0.5 seconds) the engine is automatically stopped in the following conditions:

- brake pedal pressed
- lever in D.

It should be noted that to continue with stopping the vehicle that has been switched off without having to keep the brake pedal pressed, simply place the gear lever in N and then release the brake pedal.

Automatic restarting of the engine

On versions with robotized transmission the engine is automatically restarted when the user performs one of the following actions:

- if the gear lever is not in position N, release the brake pedal

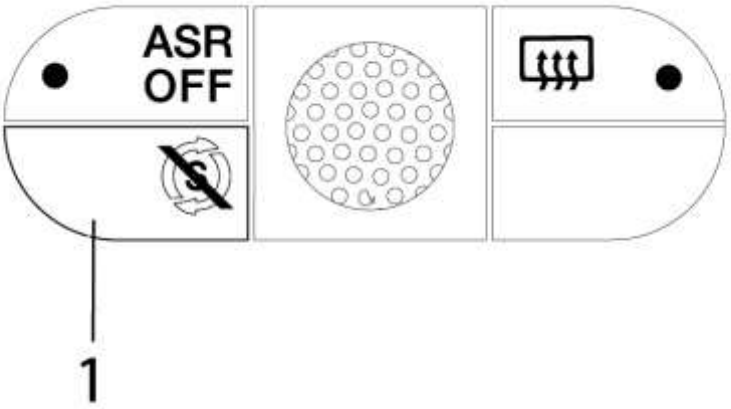
or

- move the gear lever.

These actions are usually carried out by the user to restart the vehicle in everyday driving conditions.

MANUAL ACTIVATION AND DEACTIVATION

The Stop&Start manual deactivation button (S&S button the dashboard) allows the user to manual deactivate/activate the operation of the system.



1. Start&Stop function deactivation/activation button

The Stop&Start system is activated each time the vehicle is first started up.
The BCM acquires the signal relating to the Stop&Start button operation. When the vehicle is turned on, in normal system operating conditions, the Stop&Start default setting is activated.
When the system is deactivated the "Start&Stop OFF" warning light is visible in the dashboard.

In addition, on some versions additional information concerning the deactivation or activation of the Start&Stop is given through a message in the display
With robotized transmission, if the Start&Stop system is on, the gearbox automatically assumes the Economy gear change mode and, if the system is deactivated, the gearbox automatically assumes the Normal gear change mode.

Effect on stop&start operation

The deactivation of the Stop&Start function by pressing the S&S button causes the following system behaviour:

- In conditions where the engine is on, deactivation using the S&S button does not allow the engine to stop automatically

- In conditions where the vehicle is stopped, deactivation using the S&S button causes the engine to be automatically restarted (if the gearbox is not in neutral the driver will be asked to press the clutch).

FAILED ENGINE CUT OUT CONDITIONS

With the S&S device activated, the engine cannot be automatically stopped on account of a series of conditions due to the operation of the engine and the vehicle linked to safety and comfort conditions and reducing emissions.
The ECM controls the engine directly and therefore is delegated to managing stopping and restarting and therefore decides when and whether to stop the engine automatically; the BCM communicates with the ECM and can ask not to switch the engine off in certain conditions.
Below is a list of all the conditions in which the engine is not stopped, divided into those managed directly by the ECM and those managed by the BCM.

Conditions managed by the ecm

The following conditions managed by the ECM prevent the engine being stopped with the vehicle stationary:
ECM 1) Engine cold:
the engine cannot be automatically stopped if the engine coolant temperature sensor signal is outside of a range of 40°C - 100°C: the reduction in consumption and emissions gained by the Stop&Start system is not guaranteed outside of this range.
ECM 2) Reverse gear engaged:
if reverse gear is engaged, the engine management control unit does not allow the automatic stopping of the engine. This measure has been adopted in order not to adverse affect driveability during parking manoeuvres.
ECM 3) Check on operation of clutch switch not yet performed.
This check takes place following a complete clutch pedal cycle (release and pressing or pressing and release) with the engine on.
ECM 4) Malfunction or fault detected in at least one of the following sensors or systems:

- Accelerator pedal
- Brake pedal
- Brake servo vacuum sensor
- Gearbox control unit
- Water temperature sensor in the engine
- Wheel speed sensors
- Clutch switch
- Engine rpm sensor
- Camshaft sensor
- Reversing switch
- Engine or engine management control unit (with MIL on).
- Fault at ECM starting relay

ECM 5) Reduced braking system vacuum;
the ECM prevents the engine being automatically stopped if the vacuum sensor indicates that the pressure in the braking system is too low.
ECM 6) Particulate filter regeneration in progress (diesel engines only);
the engine management control unit does not allow automatic stopping of the engine if the DPF is carrying out the regeneration of the filter.
ECM 7) Request by the BCM
The BCM has requested the automatic stopping of the engine to be prevented by sending a special signal on the C-CAN. For more details, refer to the paragraph below.

Conditions managed by the bcm

The BCM can detect conditions that may lead to a request to the ECM, communicated via the C-CAN, to not allow the automatic stopping of the engine.
BCM 1) Battery not sufficiently charged
The BCM receives information coming from the IBS on the status of the battery charge: if the battery status does not guarantee the restarting of the engine then the automatic stopping of the engine is not permitted.
If the IBS is being recalibrated, the engine cannot be stopped if one of the following conditions is verified:
- the battery Function Status (SOF) is below the limit of 8.3 V
- the temperature of the battery is less than -23°C
If the IBS is not being recalibrated (normal operation), the engine cannot be stopped if one of the following conditions is verified:
- the battery Charge Status is below 75%

- the battery Health Status is below 60%
- the battery Function Status is below 8.2 V
- the temperature of the battery is less than -23°C

BCM 2) Malfunction at the IBS
The engine cannot be automatically stopped if a malfunction at the IBS is detected.
BCM 3) Voltage Stabilizer malfunction
The engine cannot be automatically stopped if a voltage stabilizer malfunction is detected.
BCM 4) Heated rear windscreen activated
The engine cannot be automatically stopped if the heated rear windscreen is on. In this case, assuming the driver wishes to demist the windows, it is advisable for the engine to remain running in order to have hot air and/or air conditioning available.
BCM 5) Windscreen wipers working at the maximum speed for longer than a certain time
The engine cannot be automatically stopped if the windscreen wipers are set at the maximum speed continuously for more than 4 seconds. This is because presumably the weather conditions are adverse and so it is preferable to have the maximum driving comfort.
BCM 6) Driver's door not shut:
The engine cannot be automatically stopped if the driver's door is open.
BCM7) Driver's seat belt not fastened:
The engine cannot be automatically stopped if the driver's seat belt is not fastened.
BCM 8) Climate control requirements
On versions with automatic air conditioning the engine cannot be stopped automatically if there is a difference between the temperature of the climate control set by the customer and the temperature inside the passenger compartment of more than ± 4°C.

 In the case of manual air conditioning, the engine can always be stopped.

BCM 9) Alternator malfunction
The engine cannot be automatically stopped if there is an alternator malfunction.
BCM 10) Bonnet open
On versions where there is a bonnet switch, the engine cannot be automatically stopped if the bonnet is open.
BCM 11) Fault at the BCM relay
The engine cannot be automatically stopped if there is a malfunction at the starting circuit relay operated by the BCM.

AUTOMATIC RESTARTING CONDITIONS

In vehicle stop conditions, for reasons of comfort, safety and limiting emissions, in certain conditions the engine can restart automatically without any action on behalf of the driver.
The conditions that lead to the automatically restarting of the engine can be detected and managed by the BCM or the ECM, but the automatic restarting is always controlled and managed by the ECM.
On versions with a manual gearbox, if the gearbox is not in neutral, the driver is asked, via the instrument panel, to press the clutch pedal to allow safe engine restarting.

Conditions managed by the ecm

The conditions managed by the ECM that cause the automatic restarting of the engine when the vehicle is stopped are as follows:
ECM 1) Reduced braking system vacuum
Automatic engine restarting is forced if the vacuum sensor supplies a LOW reading, indicating that there may be a deterioration in the braking capacity. This prevents undesired movements of the vehicle with the engine off on a gradient due to a possible brake servo failure.
ECM 2) Vehicle moving
Automatic engine restarting is forced if the speed of the vehicle is move than 5 km/h.
This condition avoids dangerous situations due to a failure of the engine brake on gradients.
ECM 3) The vehicle is stopped for too long
The engine is restarted if it has been stopped by the Stop&Start system for more than 160 seconds.
ECM 4) Reverse gear engaged
If the driver engages reverse gear whilst the engine has been stopped by the Start&Stop, the engine management control unit automatically restarts the engine.
This measure has been adopted in order not to adverse affect driveability during parking manoeuvres.
ECM 5) Engine cold
The ECM forces the automatic restarting of the engine if the engine coolant temperature sensor signal is less than about 30°C, because in this case the reduction in consumption and emissions derived from the Start&Stop system is not guaranteed.
ECM 6) Catalytic converter temperature too low

Catalytic converter temperature below 0°C.
ECM 7) Handbrake applied with vehicle moving
If the handbrake is applied whilst the vehicle is moving (either forwards or in reverse) with the engine stopped at a speed of more than 3 km/h. This is a further safety measure to prevent dangerous situations due to engine brake failures on a gradient.
ECM 8) Particulate filter regeneration in progress (diesel engines only)
The engine management control unit automatically restarts the engine if the DPF activates the rengeneration of the filter.
ECM 9) Request by the BCM
The BCM can request engine starting by communicating this information to the ECM via a signal on the C-CAN.

Conditions managed by the bcm

In situations where the vehicle is stopped, the BCM can ask the ECM to restart the engine using a dedicated C-CAN signal; the following conditions determine this request:
BCM 1) Battery not sufficiently charged
The BCM receives information coming from the IBS on the status of the battery charge. (for more details, refer to the description of the IBS in this section).
If the IBS is being recalibrated, the engine is automatically restarted without the driver doing anything if one of the following conditions is verified:
- the battery Function Status (SOF) is below 7.6 V
- the temperature of the battery is less than -24°C.

If the IBS is not being recalibrated, the engine is automatically restarted if one of the following conditions is verified:
- the battery Charge Status (SOC) is below 70%
- the battery Health Status (SOH) is below 59%
- the battery Function Status (SOF) is below 7.3 V
- the temperature of the battery is less than -24°C.

BCM 2) Fault at the IBS
The engine is automatically restarted without any action on behalf of the driver if a malfunction at the IBS is confirmed.
BCM 3) Outside temperature sensor
If an outside temperature sensor is fitted, the engine is automatically restarted without any action on behalf of the driver if:
- the outside temperature is below -14°C
- the outside temperature is above 80°C.

The temperature limits that have been set at the outside temperature sensor are "extreme" and therefore must always be respected.

BCM 4) Climate control requirements
If there is automatic air conditioning, the engine is automatically restarted without any action on behalf of the driver if there is a difference between the climate control temperature set by the customer and the temperature in the passenger compartment of more than ± 7°C.

in the case of manually operated air conditioning, the engine is never restarted for reasons relating to the climate control.

BCM 5) Windscreen wipers working at the maximum speed for a certain time
The engine is automatically restarted without any action on behalf of the driver if the windscreen wipers are set at the maximum speed continuously for more than 4 seconds.
This is because presumably the weather conditions are adverse and so it is preferable to have the maximum driving comfort.

FURTHER FUNCTIONS

Change of mind

If, after there has been a request to stop the engine and the ECM has already commanded the switching off of the actual engine, the driver requests the engine to be restarted using the appropriate controls, there are two possible situations:

- if the engine revs are fairly high, the ECM is capable of not switching the engine off by controlling a new injection of fuel into the cylinders,

- if the engine revs are low, the ECM is not capable of preventing the engine from being switched off so it waits for the engine to stop completely (rpm=0) and then immediately controls the automatic restarting by means of the starter. In this case the driver may notice a delay in relation to their restarting command.

Restarting after the engine has stalled

On vehicles with a manual gearbox, in cases when the engine stops and this is not desired, due for example to the clutch pedal being released sharply with a gear engaged (engine stalling), if the Start&Stop system is activated, the engine can be restarted by fully depressing the clutch pedal or by placing the gear lever in neutral.
There are, however, some conditions (listed below) in which if the engine has stalled restarting can only be carried out through an action by the driver using the key.
It should be noted that in this case vehicles with Stop&Start behave in the same way as vehicles without this device.

- Start&Stop function deactivated using the button.
- Check on operation of clutch switch not yet performed. This check takes place following a complete clutch pedal cycle (release and pressing or pressing and release) with the engine on.
- Engine coolant temperature below about 15°C.
- The BCM has requested the prevention of the automatic engine restarting, notifying the ECM of this via a C-CAN message.
- Malfunction of fault errors in at least one of the following sensors or systems:
- Accelerator pedal
- Brake pedal
- Brake servo vacuum sensor
- Gearbox control unit
- Water temperature sensor in the engine
- Vehicle speed
- Clutch switch
- Neutral sensor
- Engine rpm sensor
- Camshaft sensor
- Reversing switch
- Engine or engine management control unit (with MIL on).

Disabling of automatic restarting (safety function)

In some cases, after the engine has been automatically stopped through the intervention of the Start&Stop, it is possible that the automatic restarting requested by the driver is not carried out.
In these circumstances, restarting is only possible through manual intervention by the driver using the key, restoring the behaviour of the vehicle to that of one without a Start&Stop system.
The management of this function is transferred to the ECM and the BCM.

Conditions managed by the ecm

The conditions that prevent automatic restarting for safety reasons managed by the ECM are:
ECM 1) Too many unsuccessful attempts at automatic starting
The maximum number (5) of failed automatic engine restarting attempts has been exceeded. This level is set to prevent damage to the starter by too many starting attempts close together.
ECM 2) Malfunction or fault detected in at least one of the following sensors or systems:
- Accelerator pedal
- Brake pedal
- Brake servo vacuum sensor
- Water temperature sensor in the engine
- Vehicle speed
- Gearbox control unit
- Clutch switch
- Neutral sensor
- Engine rpm sensor
- Camshaft sensor
- Reversing switch

- Engine or engine management control unit (with MIL on).

ECM 3) The driver has been asked to perform an action but they have not done so in time:

There has been an engine time out of 175 seconds. When there has been an unsuccessful attempt at automatically restarting the engine as a result of a failure to press the clutch or because the gearbox is not in neutral and the driver is then asked to allow automatic restarting by pressing the clutch or engaging neutral, the engine can only be restarted using the key 175 seconds after the attempt at engine restarting.

ECM 4) Request by the BCM

The BCM has requested the prevention of the automatic engine restarting, notifying the ECM of this via a C-CAN message.

Conditions managed by the bcm

The conditions that prevent automatic restarting for safety reasons managed by the BCM are:

BCM 1) Bonnet open

Where there is a bonnet switch, automatic engine restarting is not permitted if the bonnet is open.

BCM 2) Driver's door or passenger door not shut and driver's seat belt not fastened

Automatic engine restarting is not permitted if the driver's door or the passenger door is open and, at the same time, the driver's seat belt is not fastened.

BCM 3) Fault at the BCM relay

Automatic restarting of the engine is not permitted if a malfunction is detected relating to the starting relay controlled by the BCM.

Energy saving function

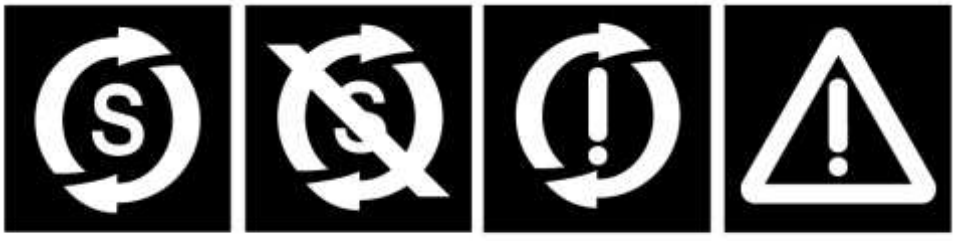
The system can also disable the automatic restarting of the engine saving reasons: to prevent the engine remaining on, even though there is no driver on board, a timer starts as soon as the Start&Stop system automatically restarts it.

After about 3 minutes have elapsed without any action by the driver on the controls (accelerator, clutch, brake) the engine is switched off again and subsequent restarting can only take place through intervention by the driver on the ignition key.

INFORMATION FROM THE INSTRUMENT PANEL

All the information from the instrument panel relating to this function is given below.

The information is provided via a text message, the warning lights and/or symbols coming on and the activation of the buzzer. The mode is specific for each of the three types of instrument panel fitted.



COMFORT PANEL

TEXT MESSAGE	SYMBOL	WARNING LIGHT	BUZZER	MEANING
"Stop&Start not available"	none	4	no	S&S faulty
None	1	none	no	Engine automatically stopped
"Press clutch"	1	none	no	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
"Press clutch"	1	none	yes	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
"Stop&Start not available"	none	none	no	S&S temporarily not available (the engine does not stop, or it restarts automatically without a request from the driver)

"Stop&Start not available"	none	none	yes	Temporary unavailability of the S&S (the engine cannot be automatically restarted and needs to be restarted using the key)
"Stop&Start switched off"	none	none	no	S&S deactivated by pressing the dedicated button
"Stop&Start on"	none	none	no	S&S reactivated by pressing the dedicated button

MATRIX PANEL

TEXT MESSAGE	SYMBOL	WARNING LIGHT	BUZZER	MEANING
"Stop&Start not available"	3	none	no	S&S faulty
None	1	none	no	Engine automatically stopped
"Press clutch"	1	none	no	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
"Press clutch"	1	none	yes	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
"Stop&Start not available"	none	none	no	S&S temporarily not available (the engine does not stop, or it restarts automatically without a request from the driver)
"Stop&Start not available"	none	none	yes	Temporary unavailability of the S&S (the engine cannot be automatically restarted and needs to be restarted using the key)
"Stop&Start switched off"	2	none	no	S&S deactivated by pressing the dedicated button
"Stop&Start on"	none	none	no	S&S reactivated by pressing the dedicated button

MODAL PANEL

TEXT MESSAGE	SYMBOL	WARNING LIGHT	BUZZER	MEANING
None	none	3 or 4	no	S&S faulty
None	1	none	no	Engine automatically stopped
“Start”	1 flashing	none	no	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
“Start”	1 flashing	none	yes	The clutch must be pressed because the S&S system needs to restart the engine but cannot do so because a gear is engaged
“OFF”	1 flashing	none	no	S&S temporarily not available (the engine does not stop, or it restarts automatically without a request from the driver)
“OFF”	1 flashing	none	yes	Temporary unavailability of the S&S (the engine cannot be automatically restarted and needs to be restarted using the key)
None	none	none	no	S&S deactivated by pressing the dedicated button
None	none	none	no	S&S reactivated by pressing the dedicated button

SUBSYSTEMS

Further sensors acquired by the ecm for stop&start

Brake servo vacuum sensor

the ECM acquires information on the vacuum in the brakeservo circuit by means of a vacuum sensor. The sensor is the on/off switch type.

Neutral sensor

the ECM acquires information on the engagement of neutral from a dedicated sensor fitted on the gearbox.

Clutch sensor

the ECM receives a value, from the rotary sensor at the clutch pedal, which can be HIGH (pedal not pressed), MIDDLE (pedal partly pressed), LOW (pedal pressed) or ERROR (sensor error).

IBS (INTELLIGENT BATTERY SENSOR) INTRODUCTION GENERAL INFORMATION

The IBS (Intelligent Battery Sensor) is a device that checks the battery status and sends information to an ECU. In the Stop&Start configuration this ECU is the BCM and the information sent by the IBS is used to allow appropriate management of the battery within the Stop&Start strategies.

Measures taken by the ibs

The IBS takes certain measures, using its internal sensors:

- Battery voltage (V)
- Battery current (A)
- Battery temperature (°C)

Ibs output status information

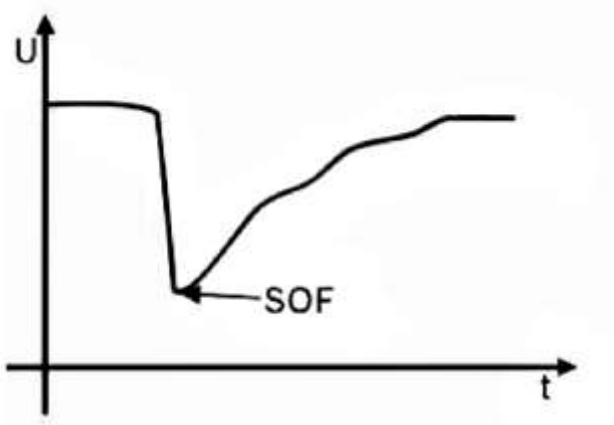
The measures illustrated in the previous paragraph are processed inside the IBS, which calculates the parameters that express the battery status:

- **SOC = Battery charge status:** it represents the residual battery charge, as a %, in relation to the rated capacity. In practice, it indicates the battery charge.
- **SOH = Battery health status:** this is an indication of the ageing of the battery. It indicates the actual battery capacity, as a %, in relation to the rated capacity. The reading is due to the fact that, during operation, the battery is subject to irreversible processes that reduce its capacity to be recharged and supply energy (ageing of the battery).
- **SOF = Battery function status:** this represents the forecast for the minimum peak voltage that will be reached during the subsequent starting of the engine, in V (see **Error. The original reference has not been found**.)

The above mentioned parameters identify the starting capacity of the battery:

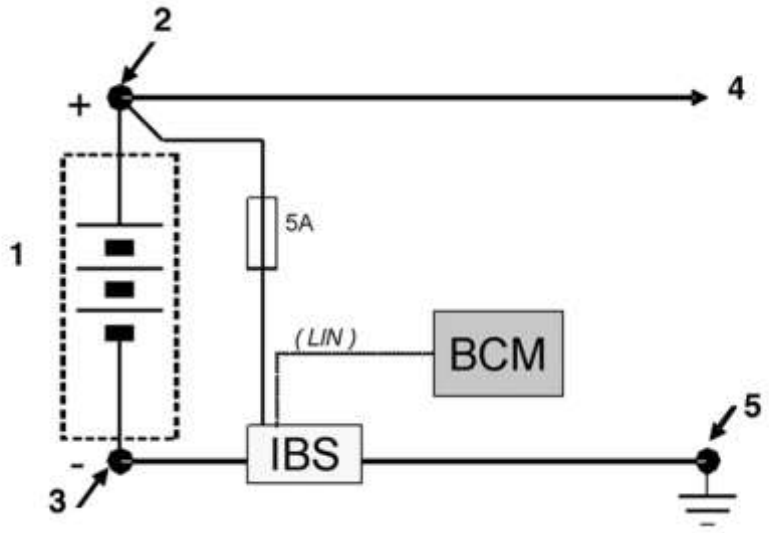
- in the case of a low SOC or SOH the battery might not be able to restart the engine
- in the case of a low SOF the battery voltage during starting may be too low for the correct operation of the vehicle electronic control units.

The Operating status (SOF) is illustrated below



INTERFACES

The diagram illustrates the installation of the IBS in the vehicle's electrical system.

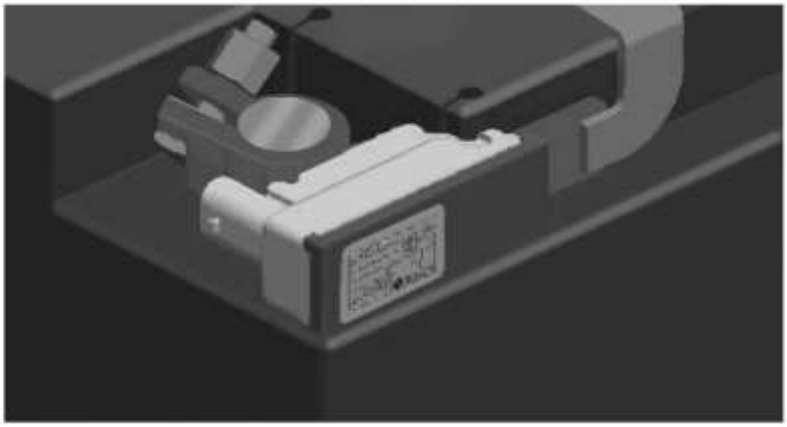


1. Battery
2. Positive battery pole
3. Negative battery pole
4. To the vehicle's electrical system
5. Negative false pole

The IBS should only be installed on heavy duty type batteries which say "HEAVY DUTY" on the label.

Negative battery pole

The IBS is connected directly to the battery negative pole.
There should be no other connection at the negative pole (see **Error. The original reference has not been found**.)



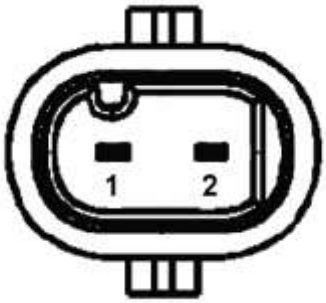
The connection described in this way prevents any current take up not detected by the IBS current sensor: if this is not the case, the estimate of the battery status will not be accurate.

Positive battery pole

The IBS receives a power supply via a dedicated cable connected to the positive battery pole; this input is also used as a measurement input for the IBS voltage sensor.
In this case too therefore, this power supply should not provide power for other devices in order to avoid a current take up not detected by the IBS which would cause an inaccurate estimate of the battery status.
This line is protected by a fuse (usually 5A).

Lin communication line

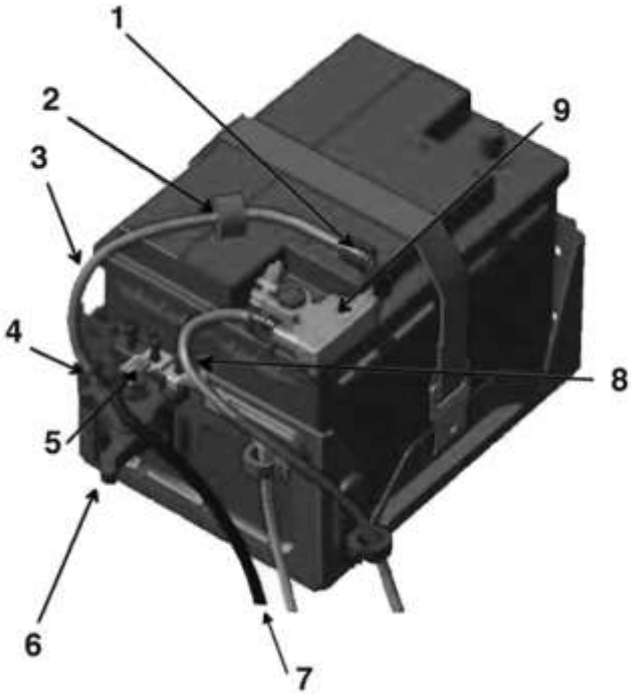
The two way connector is also used for the LIN communication line.
The connector is illustrated in the diagram below and the table shows the pin out.



PIN NUMBER	DESCRIPTION
1	LIN communication line
2	Voltage measurement and power supply

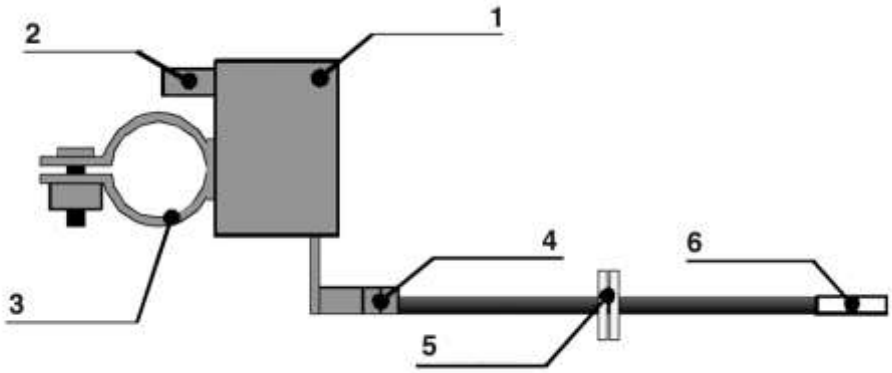
Installation

The 3D model of the IBS installed on the battery is illustrated below.



1. Terminal
2. Vibration damper rubber mounting (if fitted).
3. IBS earth lead
4. Terminal with eyelet
5. Distribution terminal
6. Quick release terminal
7. Earth lead
8. Communication and power supply lead
9. IBS (Intelligent Battery Sensor)

The IBS assembly is illustrated below.

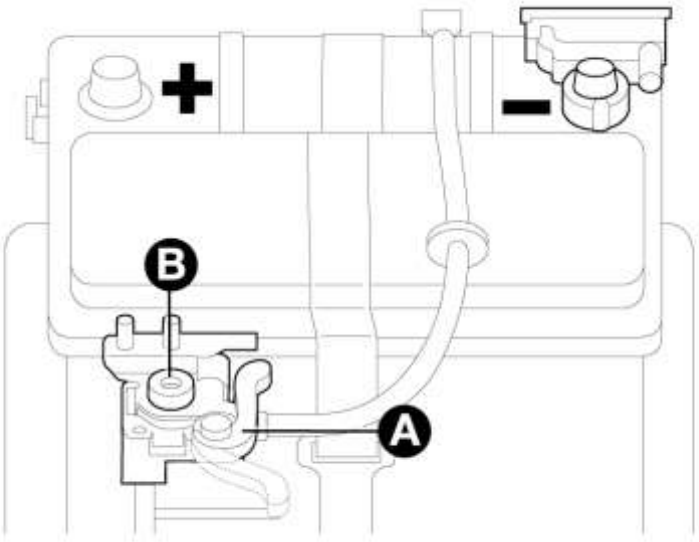


1. Sensor
2. LIN connector and power supply (+)
3. Connection at the battery pole (-)
4. Terminal
5. Damper rubber mounting
6. Terminal with eyelet

A 3D model of the IBS assembly, connected to the negative false pole is illustrated below.

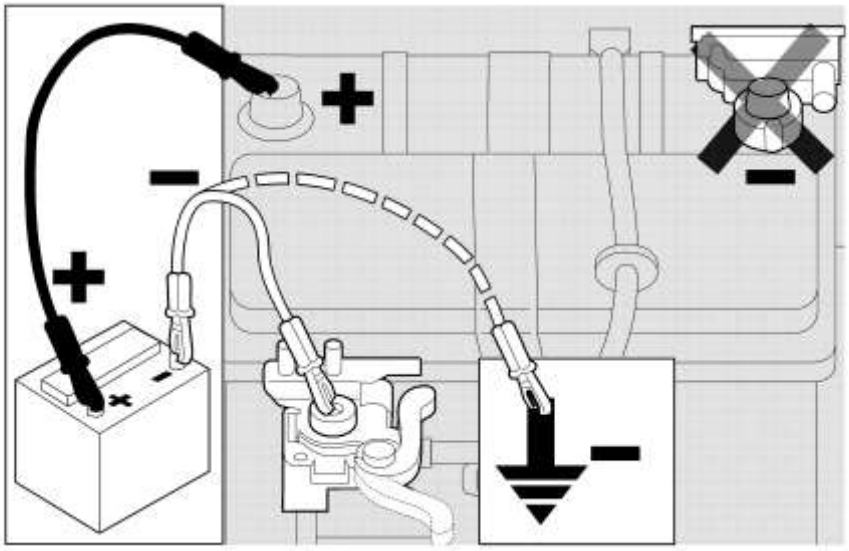
Disconnection of the negative pole

To disconnect the negative pole, adjust the quick release terminal A disconnecting it from the negative false pole B.



BATTERY RECHARGING AND EMERGENCY STARTING

For recharging the battery and for emergency starting (jump-start), the negative lead should be connected to the vehicle earth or to the false pole (not to the negative battery terminal).
The (positive and negative) terminals for emergency starting and recharging the battery are illustrated below.



The use of the false pole as a negative terminal is due to the fact that the IBS should measure the entire current, both when charging and discharging, in order to avoid inaccurate calculations of the battery status variables.

FIRST CONNECTION/DISCONNECTION: RECALIBRATION

When the IBS receives a power supply for the first time or receives a power supply after a break in supply, it enters a so-called "recalibration" stage in which the IBS must recognize the type of battery, its specifications and its status.
During this stage the tolerances for the status variables (SOC, SOF, SOH) are higher than in normal operating conditions.
The table below shows the accuracy of the measurement compared with the specification tolerances, in different operating conditions, for a battery with the same capacity as the original one, with the type identified in a message sent by the IBS to the BCM.

	RESET	1ST ENGINE STARTING	1 REST STAGE >4H FOLLOWING ENGINE STARTING	5X8H REST STAGES FOLLOWING ENGINE STARTING

SOC	Outside tolerance	Outside tolerance	Tolerance OK	Tolerance OK
SOF	Outside tolerance	Tolerance OK	Tolerance OK	Tolerance OK
SOH	Outside tolerance	Outside tolerance	Outside tolerance	Tolerance OK
	RECALIBRATION		NORMAL OPERATION	

The IBS exits the calibration stage when the SOC and SOF evaluations are within the tolerances: as shown in the previous table this takes place after a rest stage (engine off) of at least 4 hours following starting.

COMMUNICATION NETWORK

The IBS is connected to the BCM via a LIN communication line; the LIN may, on some versions, be shared with other devices. The Body Computer is the master for the LIN, whilst the IBS is the slave.
Some of the signals sent via the LIN by the IBS are sent via the CAN (B-CAN and C-CAN) by the BCM which, in this case, acts as a gateway.

HOW THE INFORMATION SUPPLIED BY THE IBS IS USED BY THE STOP&START

The information produced by the IBS and sent to the BCM via the LIN is used for the management of the Stop&Start function in order to take the battery starting capacity into consideration.
In particular, this information is used, in conjunction with other information coming from other vehicle devices/control units, in order to activate or deactivation the Stop&Start function.
The general concept is that, whilst the engine is on it should not be stopped automatically if the capacity of the battery is not sufficient to start it and, during an automatic stopping stage, the engine should be restarted if the battery starting capacity becomes too low.
The Stop&Start function is also deactivated if a possible IBS fault does not allow the effective status of the battery to be determined: an internal error signal is produced for this purpose in the BCM.
The main manager of the Stop&Start is the ECM. The ECM decides whether to enable/disable the Stop&Starr taking a great deal of information into consideration, including that coming from the IBS (via the BCM).
It should be noted that the BCM and ECM can also disable the Stop&Start function as a result of vehicle conditions not connected to the IBS.
For more details on other conditions that can disable an automatic stop or cause automatic restarting of the engine, refer to the previous description in this section.

Engine on conditions

In engine on conditions, the BCM uses the information received from the IBS to enable or disable a possible automatic stop on the basis of the battery starting capacity estimated by the IBS.
It should be noted that the BCM and ECM can also disable the Stop&Start function as a result of vehicle conditions not connected to the IBS.
For more details on other conditions that can disable an automatic stop, refer to the previous description in this section.

The information concerning the battery or IBS status managed by the BCM is:

- Calibration stage in progress
- Battery SOC
- Battery SOH
- Battery SOF
- Battery temperature
- Fault present at the IBS (yes/no)

The starting capacity of the battery is usually evaluated via the battery status, expressed as SOC, SOF, SOH and temperature; when, on the other hand, the IBS is being recalibrated, some status variables are not reliable and therefore only the SOF and the battery temperature are taking into consideration.
The request to enable/disable an automatic stop by the BCM is summarized in a signal produced by the BCM and sent, via the C-CAN, to the ECM.
When the automatic engine stop is enabled by the BCM, the ECM is enabled to automatically switch off the engine if the driving conditions (actions on the brake, clutch and accelerator pedals) are satisfied in the same way as the other conditions controlled by the ECM.

When the automatic engine stop is disabled by the BCM, the ECM is not enabled to automatically switch off the engine if the driving conditions (actions on the brake, clutch and accelerator pedals) are satisfied in the same way as the other conditions controlled by the ECM.

Engine automatically switched off conditions

When the engine has been automatically switched off for the Stop&Start function, a request can be produced, by a device/control unit, which requires automatic restarting of the engine.
The BCM collects the information coming from the vehicle and, if necessary, asks the ECM to automatically restrart the engine (the ECM checks first whether safe automatic restarting conditions have been verified).
It should be noted that the BCM and ECM can also request the automatic restarting of the engine as a result of vehicle conditions not connected to the IBS.
For more details on other conditions that can cause the automatic restarting of the engine, refer to the previous description in this section.

As for engine on conditions, with the engine stopped the information regarding the battery or the IBS status managed by the BCM is:

- Calibration stage in progress (yes/no)
- Battery SOC
- Battery SOH
- Battery SOF
- Battery temperature
- Fault present at the IBS (yes/no)

The starting capacity of the battery is usually evaluated via the battery status, expressed as SOC, SOF, SOH and temperature; when, on the other hand, the IBS is being recalibrated, some status variables are not reliable and therefore only the SOF and the battery temperature are taking into consideration.
The information relating to a possible fault in the IBS is used to request the automatic restarting of the engine.
The request to ask/not ask for an automatic stop by the BCM is summarized in a signal produced by the BCM and sent, via the C-CAN, to the ECM.