Service Manual: STARTING - SERVICE INFORMATION

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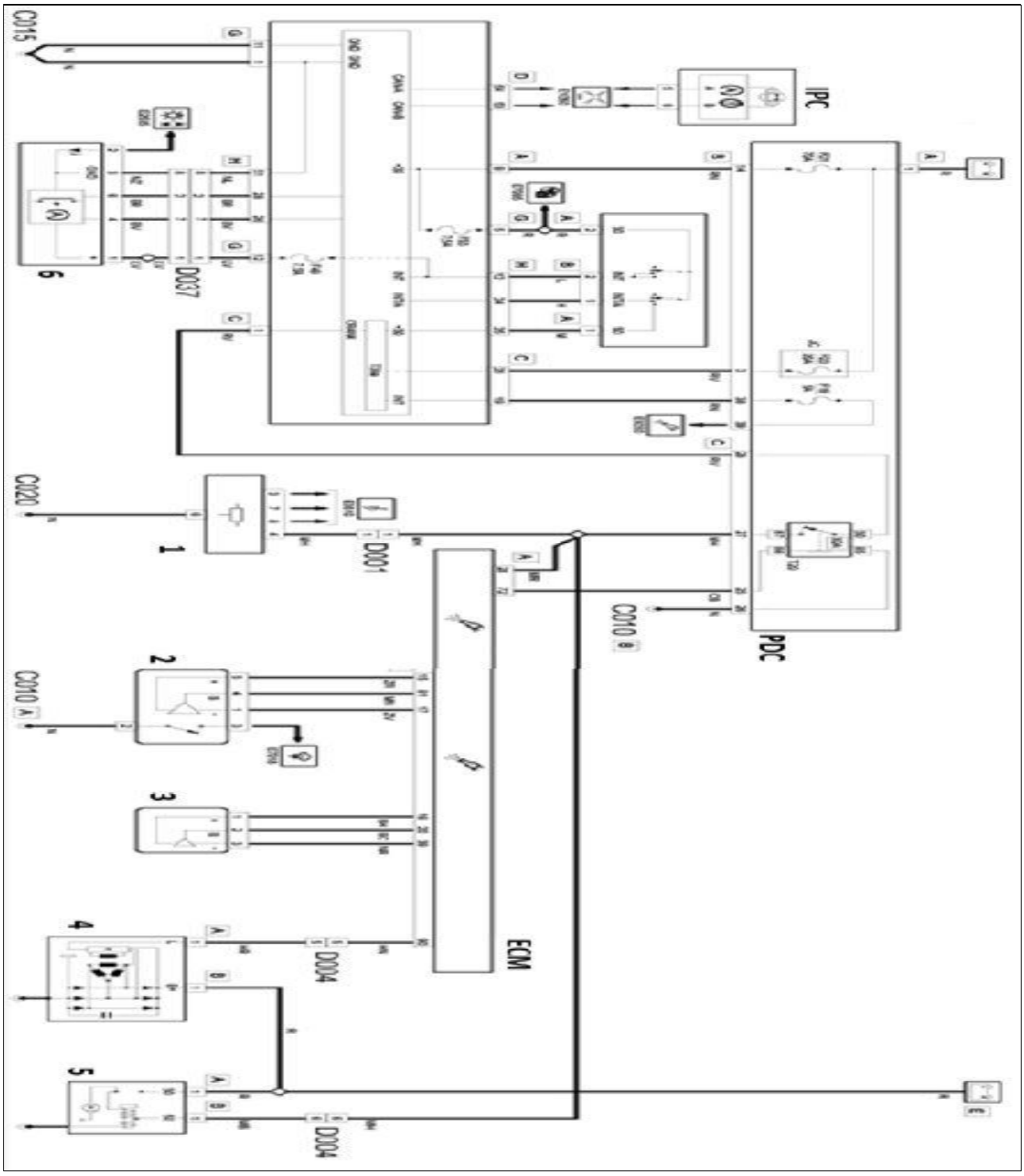
Starting and recharging wiring diagram with Stop/Start.

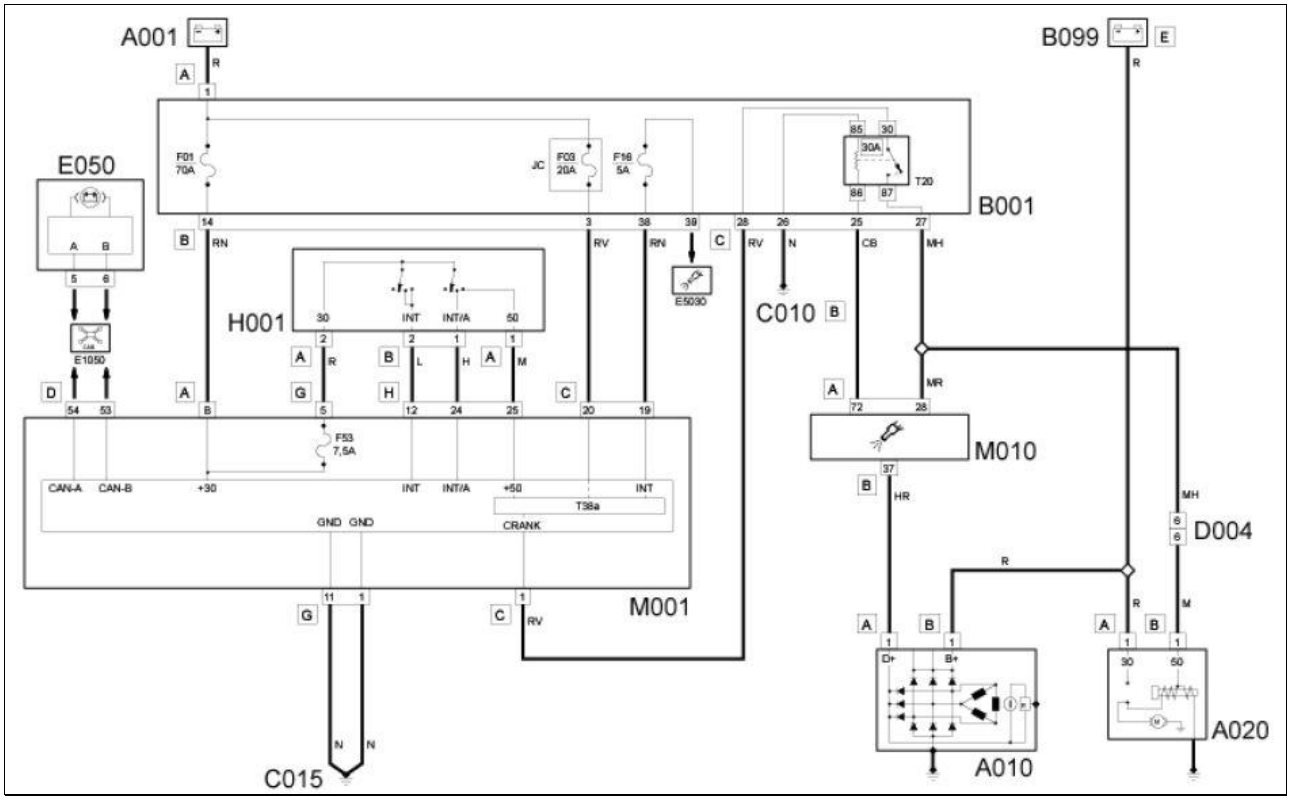
Fig 1: Starting & Recharging With Stop/Start - Wiring Diagram



1. Voltage stabilizer
2. Clutch Pedal Switch
3. Gear lever position switch
4. Generator
5. Starter
6. Stop/Start button

> *NOTE: Stop/Start is not available on NAFTA-version vehicles.*

Fig 2: Starting & Recharging Without Stop/Start - Wiring Diagram



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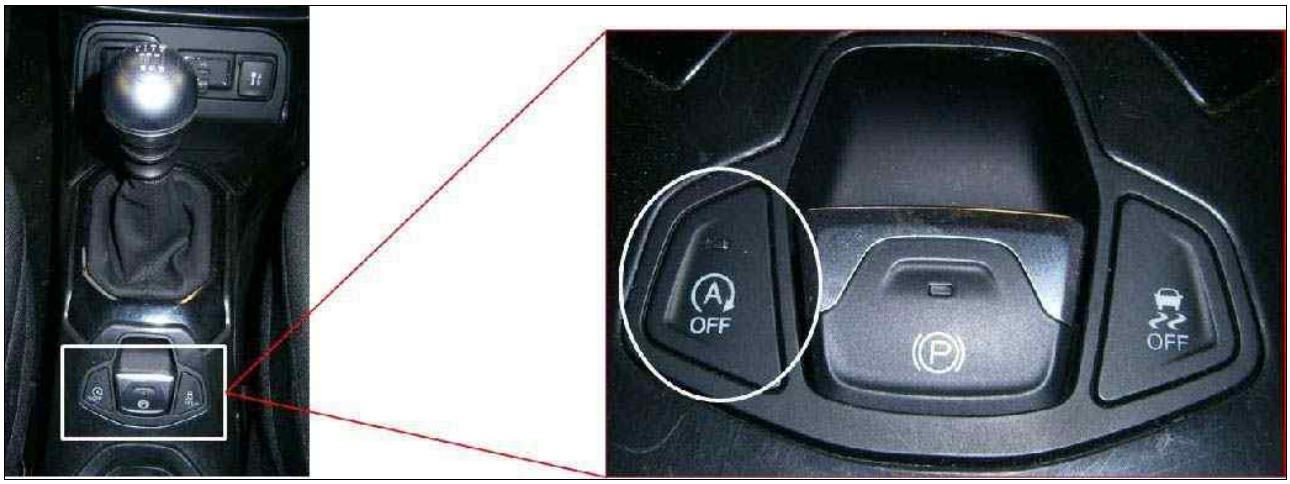
Analyzing the wiring diagram of both configurations (with and without Stop/Start), the starter is always operated by a single relay positioned in the front PDC and activated by the ECM. The activation signal (+50 with key without remote control or digital signal via CAN line with keyless go system) reaches the BCM, which will activate an internal relay of its own, which sends +30 to the relay located in the front PDC and activated by the ECM. When the ECM module activates relay T20, signal 87 (12 V) arrives at the solenoid of the starter, which will trigger the anchor and activate the starter. In the first moments, after the engine has started, the ECM reactivates relay T20 to check whether there is voltage at output 87. Should there be voltage at output 87 of relay T20, this would indicate a fault on the internal relay of the BCM. The ECM will set the correct fault codes and deactivate the Stop & Start function if present.

STOP/START SYSTEM - The STOP & START (S/S) device automatically stops the engine whenever the vehicle is stopped and restarts it when the driver wants to start driving again. This improves the

efficiency of the vehicle by reducing fuel consumption, the emission of harmful gases and noise pollution.

Fig 3: S/S Button



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Manual activation and deactivation - The S/S device can be activated/deactivated through the S/S button positioned on the central tunnel near the electric parking brake button. The deactivation of the system is indicated through a message on the instrument panel. When it is deactivated, the button's LED is off. When the system is active, the LED is on.

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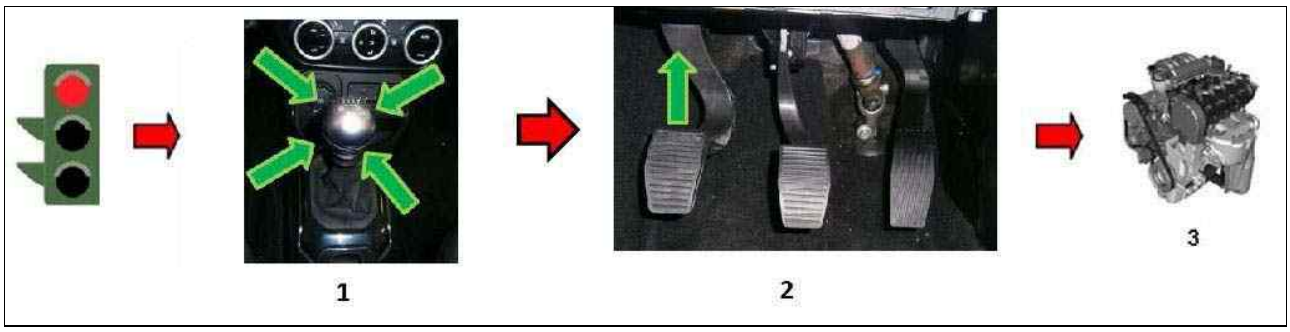
Fig 1: Engine Stopping Mode With Manual Gearbox Operation



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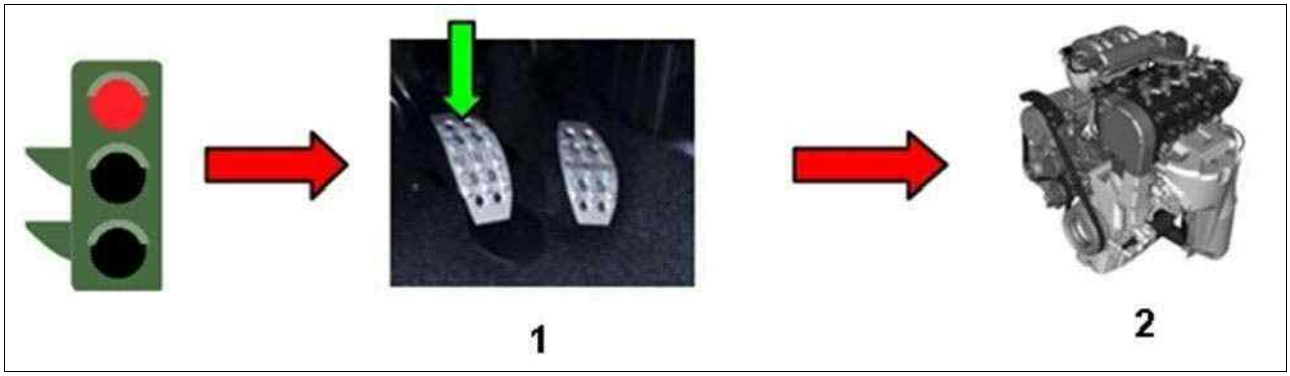
Engine stopping mode with manual gearbox

With the vehicle stationary, the engine (3) stops with the gearbox in neutral (1) and the clutch pedal (2) released. The engine can be stopped at speeds below 7 km/h.

Fig 2: Engine Restarting Mode With Manual Gearbox Operation



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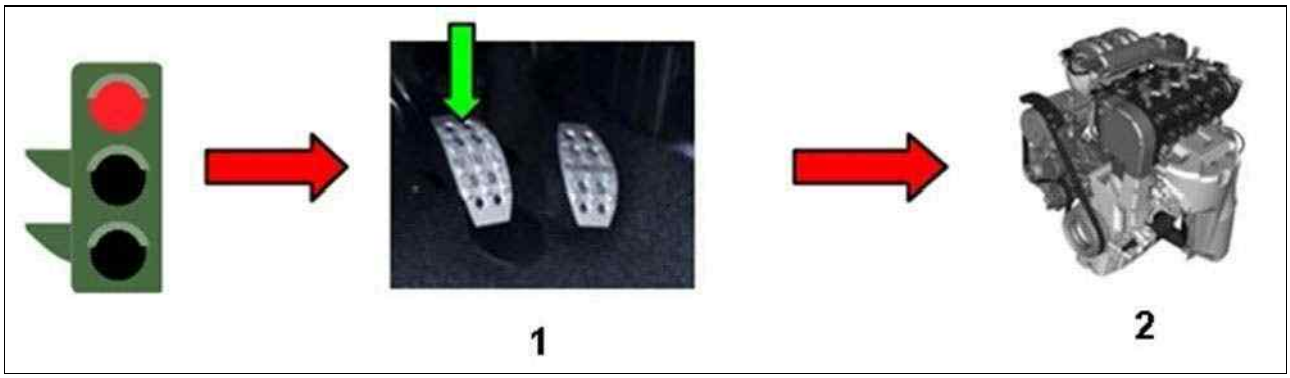
Engine restarting mode with manual gearbox

Press the clutch pedal (4) to restart the engine (5).

Fig 3: Engine Stopping Mode With Automatic Transmission Operation



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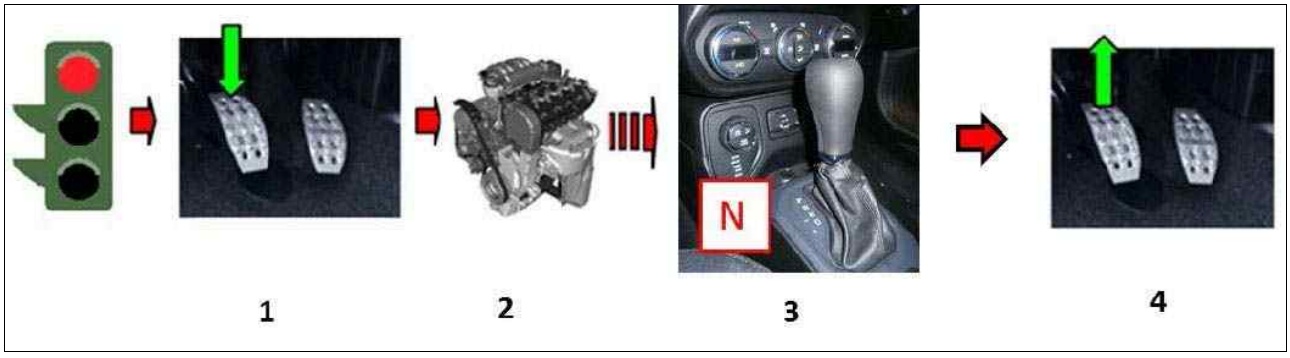
Engine stopping mode with automatic transmission

The engine cuts out if the car stops with the brake pedal (1) pressed.

Fig 4: Keeping Engine Stopped With Automatic Transmission Operation



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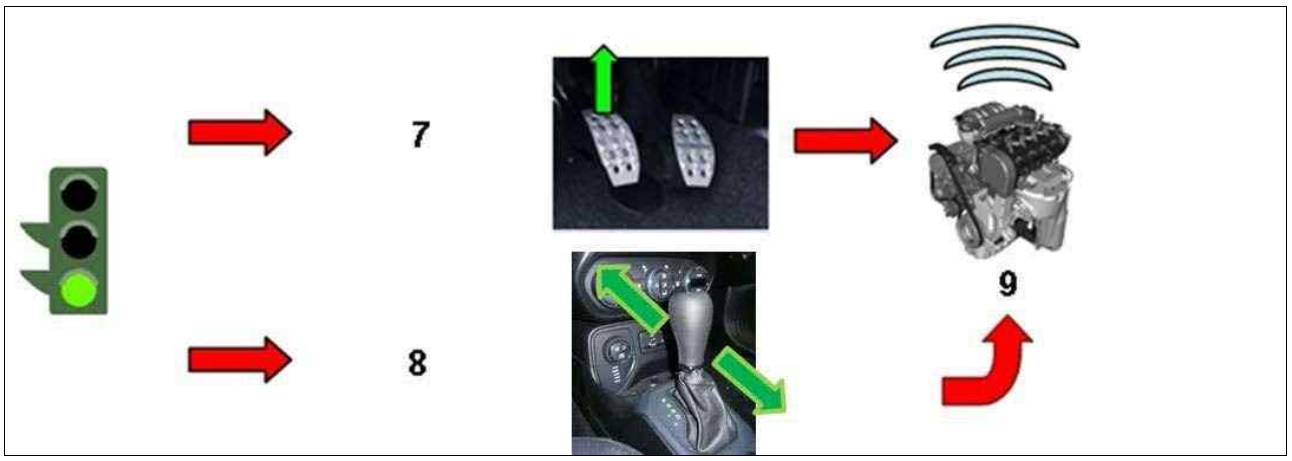
Keeping the engine stopped with automatic transmission

With the brake pedal pressed (3) and the engine at standstill (4), position the gear lever at N (5) and release the brake pedal (6).

Fig 5: Engine Restarting Mode With Automatic Transmission Operation



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Engine restarting mode with automatic transmission

If the gear lever is at N, place it in any gear position (8); otherwise, release the brake pedal (7) or move the gear lever in a position other than N. The engine starts again (9)

Failed engine cut out conditions

- When the device is operating, due to comfort, emission control and safety reasons, the engine may not stop in some conditions, among which:

- Engine still cold.
- Battery not sufficiently charged.
- Windscreen wiper at max. speed.
- Particulate trap regeneration in progress (only for diesel engines).
- Driver's door not shut
- Driver's seat belt not fastened.
- Reverse engaged (for example parking operation).
- With automatic climate control, if a suitable level of thermal comfort has not yet been reached.
- 4WD low Active
- Heated windscreen active

In the above case, an informative message is shown on the panel.

Automatic restarting conditions

- Due to comfort, emission control and safety reasons, the engine can restart automatically without any intervention by the driver, under special conditions, such as:

- Battery not sufficiently charged.
- Low braking system vacuum (for example after the brake pedal has been pressed repeatedly).
- Car moving (for example on roads with a gradient).
- Engine stopped by the S/S for more than three minutes.

With a gear engaged, the automatic restarting of the engine is only permitted by fully depressing the clutch pedal. This operation is requested through a message on the instrument panel.

> *NOTE:*
>
> *If the clutch is not pressed, when three minutes have elapsed since the engine was stopped, the engine can only be restarted using the key.*

In the case of an undesired engine stopping as a result of sudden clutch pedal release with gear engaged, if the S/S system is active, the engine can be automatically restarted by fully pressing the clutch pedal or placing the gearbox in neutral.

Safety functions - When the engine is stopped by the S/S system, if the driver releases their seat belt and opens the driver side or passenger side door, the engine can be restarted only using the key.

"**Energy saving" function** - If, as a result of the engine automatic restarting, the driver does not execute any action on the car for a long time, the S/S system stops the engine once and for all, to prevent fuel consumption. In this case restarting requires the key.

Important

-

- The car should always be left after the key has been removed or turned to the OFF position.
- Before opening the hood, make sure that the car is switched off and the key is in the OFF position. It is advisable to remove the key when there are other people in the car.
- When refuelling, make sure that the car is switched off with the key in the OFF position. It is advisable to remove the key when there are other people in the car.
- If you want to make the most of climate comfort, the S/S system can be deactivated to allow continuous operation of the climate control system.

Irregular operation - In the case of malfunction the system is deactivated. The driver is informed about the switching on of the warning light for general failure and, where provided, by the information message and by the icon of system failure on the instrument panel.

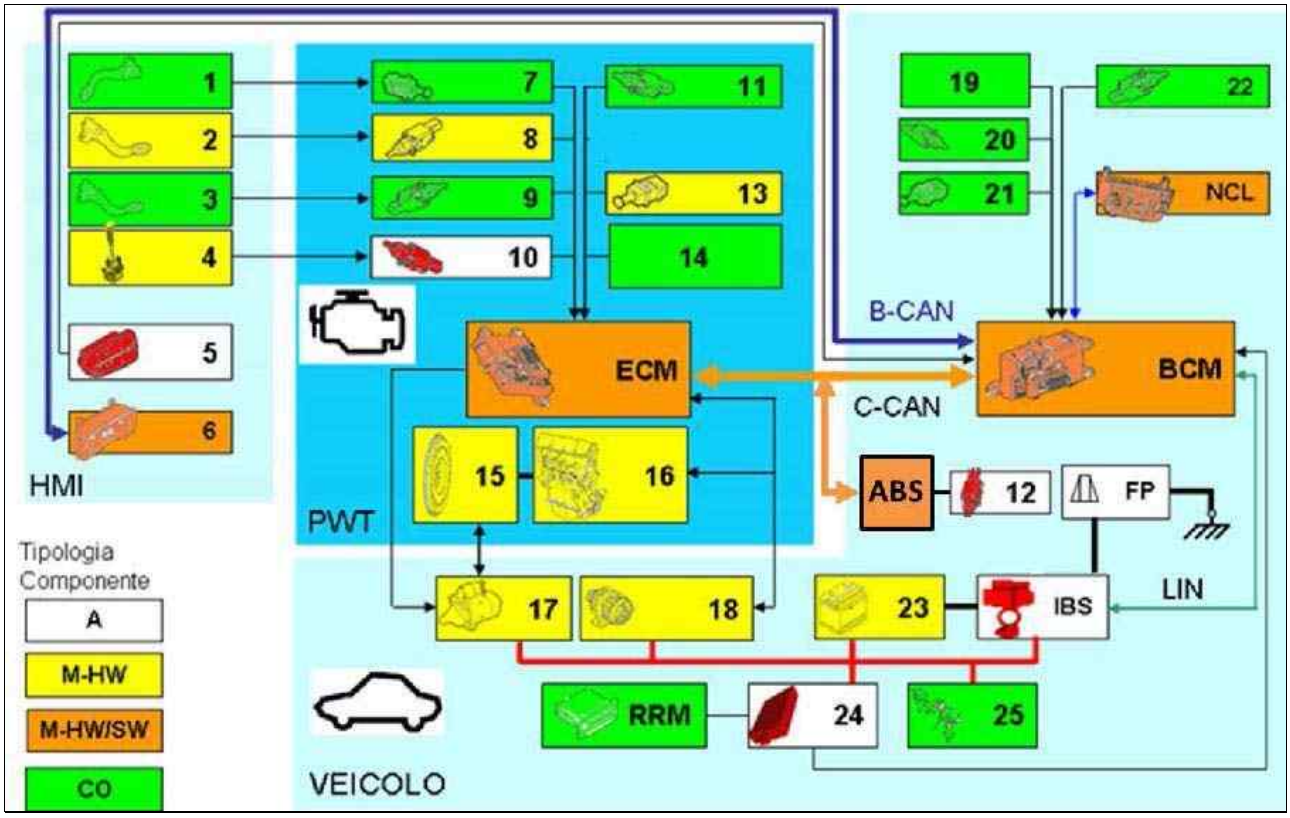
Components involved in operation

- The parts or components involved in the operation can be subdivided into four groups as follows:

- Additional components: components that are new or have been added to operate this type of device.

- Components with modified hardware.
- Components with modified hardware and/or software.
- "Carry over" components: components that are not new but have already been used on other cars or are already fitted on the car.

Fig 6: S/S Function - Block Diagram



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The following is a block diagram of the car, divided by area. Each area shows the main components involved in carrying out the S/S function. In particular, the following are highlighted:

- **-A:** white, additional components;
- **-M-HW:** yellow, components with modified hardware or mechanics as compared to those normally present;
- **-M-HW/SW:** orange, components with modified hardware and/or software as compared to those normally present;
- **-CO:** green, components which have not been changed or adapted as compared to the originals.

Key:

- A: added components.
- HW: components with modified hardware.
- HW/SW: components with modified hardware/software.

- CO: Carry Over components (not modified).

HMI area (Human Machine Interface)

- 1: accelerator pedal.
- 2: clutch pedal.
- 3: brake pedal.
- 4: gearbox control.
- 5: S/S push-button.
- 6: instrument panel.

PWT area (powertrain)

- 7: accelerator potentiometer.
- 8: clutch sensor.
- 9: brake sensor.
- 10: gearbox sensor.
- 11: engine temperature sensor.
- 12: braking system vacuum sensor.
- 13: engine rpm sensor.
- 14: other (handbrake, catalytic converter, etc).
- 15: flywheel.
- 16: engine.

ECM: engine control module (engine control node)

CAR area

- 17: starter
- 18: Generator.
- 19: various loads (heated rear window, windscreen wiper, etc.).
- 20: seat belt fastened sensors.
- 21: door sensors.
- 22: outside temperature sensor.
- 23: battery.
- 24: voltage stabilizer for radio and Hi-Fi.
- 25: various electrical loads.

- RRM/ HI-FI: radio receiver/Hi-Fi node.
- IBS: Intelligent Battery Sensor (battery monitor).
- FP: dummy pole.
- NCL: Climate control node.
- BCM: Body Computer Module (Body Computer Node)

Added components (white)

- 5: S/S function activation/deactivation button.
- 10: gearbox sensor.
- 12: brake servo vacuum sensor.
- 24: voltage stabilizer for radio and info-telematics supply.
- FP: dummy negative battery pole with wiring.
- IBS: Intelligent battery sensor (battery monitor control unit).

Components with modified hardware (yellow)

- 2: clutch pedal with clutch sensor.
- 13: engine rpm sensor.
- 16: engine.
- 15: flywheel.
- 17: starter.
- 18: Generator.
- 23: battery.

Components with modified hardware and/or software (orange)

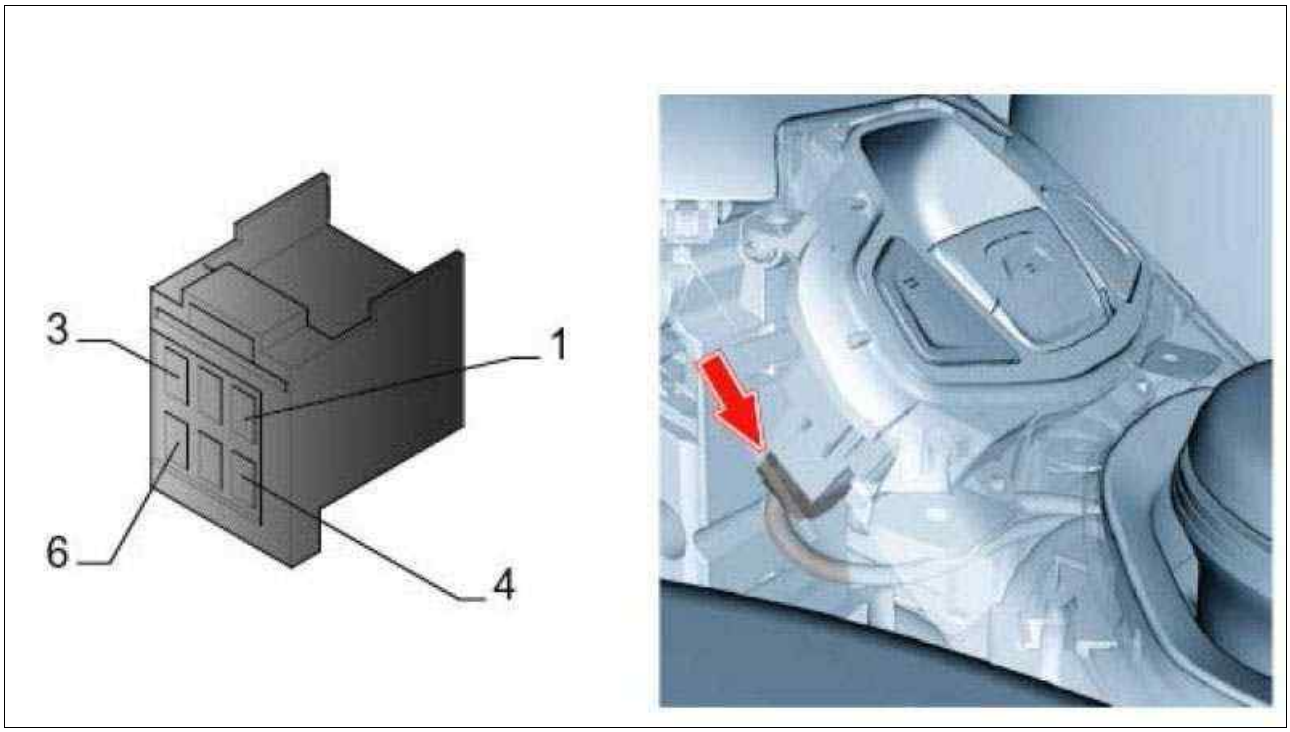
- 6: instrument panel.
- ECM: (Engine Control Node).
- BCM: (Body computer node).
- NCL: (Automatic climate control node).
- ABS (Braking system control module)

Carry over components (green)

- 1: accelerator pedal with accelerator sensor.
- 3: brake pedal with brake sensor.
- 11: engine coolant temperature sensor.

- 20: belt sensors.
- 21: door sensors.
- 22: outside temperature sensor.
- 14: other (handbrake, catalytic converter, DPF, heated rear window, windscreen wiper, general electrical loads, etc.) RRM: Hi-Fi radio.

Fig 7: S/S Activation Button Pinout



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S/S activation button

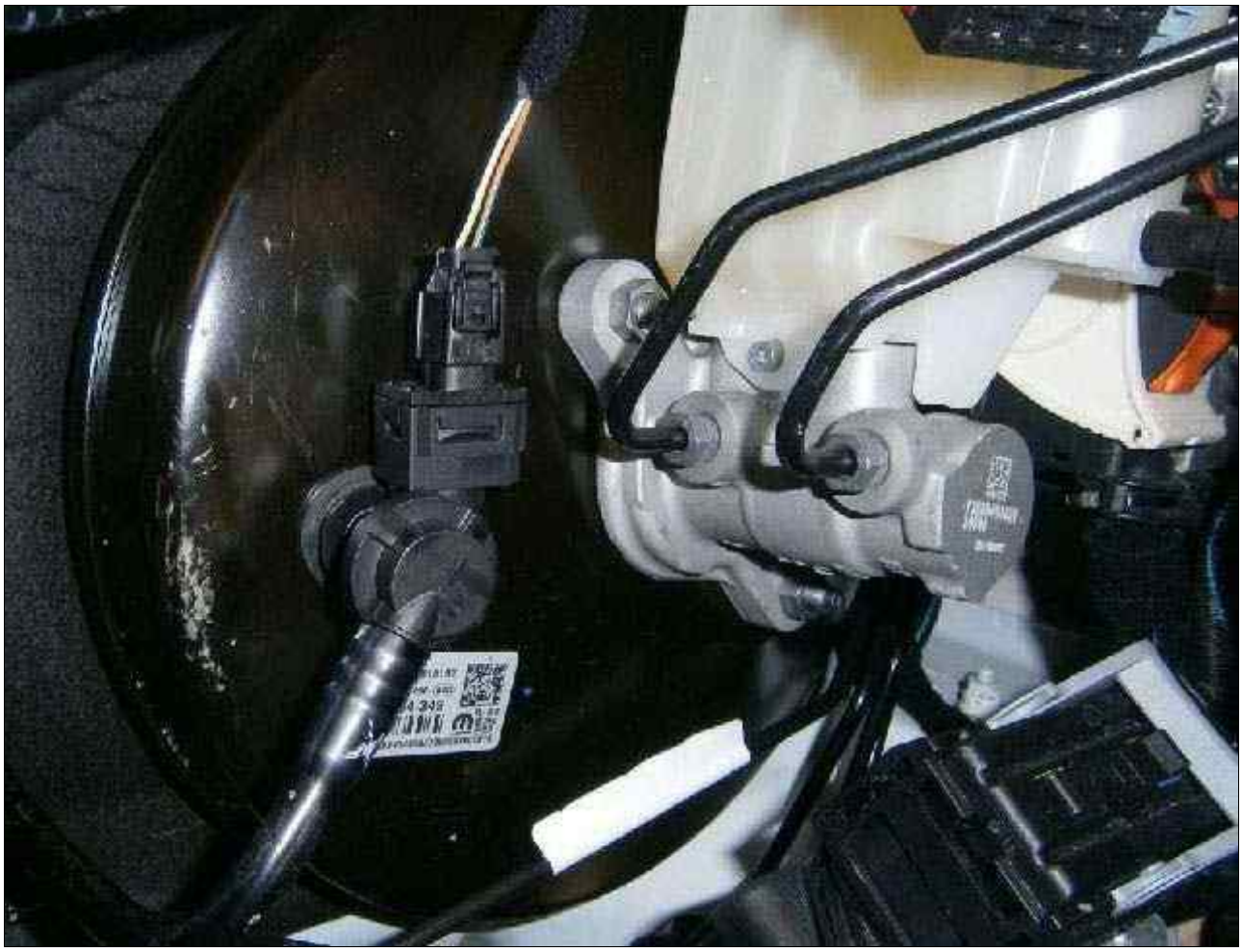
Pinout	
1	Ignition-operated power supply
2	LED control for backlighting
3	Earth
4	Switch signal
5	n.c.
6	Switch signal

Sensor for gearbox in neutral:

- The gearbox sensor is fitted on the gear lever unit and transmits to the ECM a signal enabling the system to recognize the position of the lever corresponding to the "gearbox in neutral" condition.
- The condition of gearbox in neutral is essential for the engine automatic starting.

- The gearbox sensor generates a PWM signal with a duty cycle between 33% and 67% when the gearbox is in neutral.

Fig 8: Vacuum Sensor On Brake Servo



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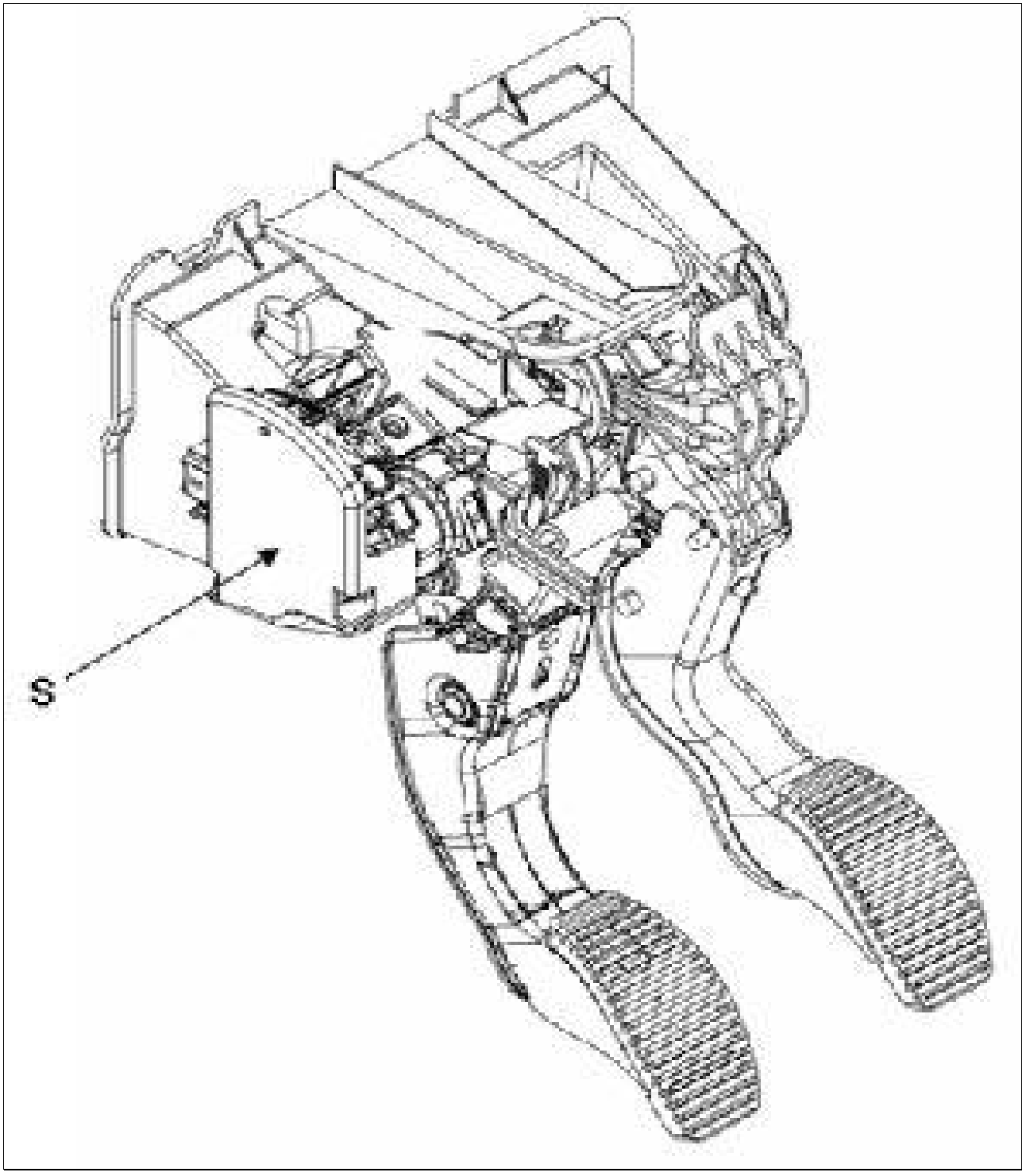
Vacuum sensor on brake servo - The vacuum sensor on the brake servo informs the system that the vacuum in the circuit is not enough to guarantee an efficient braking with the engine off, due to the missing brake servo intervention. In this case the engine is restarted or is not stopped if it was already running.

The sensor is connected to the ABS module and is provided with a normally closed contact: in other words the contact is closed if the absolute pressure of the circuit is low enough (about 400-500 mbar).

Fig 9: Clutch Sensor



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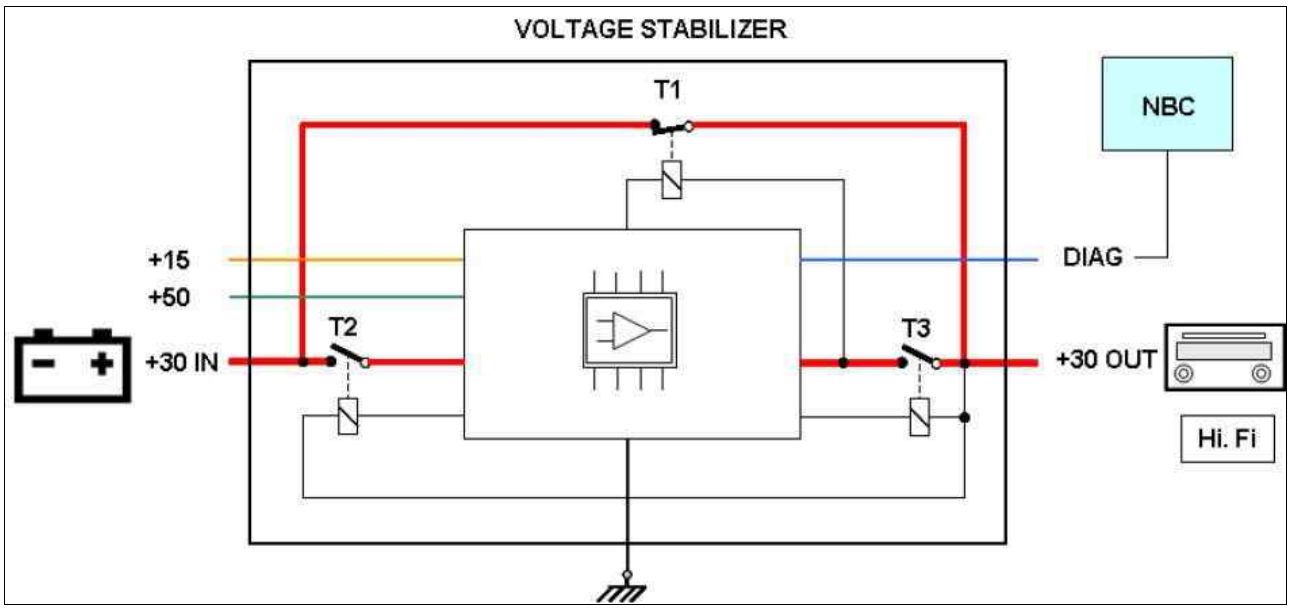
Clutch sensor - The clutch sensor S (no. 8 in the block diagram) plays a primary role for the Stop & Start function because, in combination with the gearbox sensor, enables the automatic starting of the engine. The sensor is fixed directly on the pedal unit. The sensor is rotary type and communicates to the ECM both whether the pedal is released or pressed and also if the pedal is not fully depressed. In this way the system can recognize the pedal position unambiguously.

The ECM receives from the rotary sensor associated to the clutch pedal a value which can be HIGH

(pedal not pressed), MIDDLE (pedal partly pressed), LOW (pedal pressed) or ERROR (sensor error).

Fuel pump - When the S/S system is activated, during the engine stopping stages the fuel pump remains active. This guarantees the supply system filling and a ready start-up. When the engine does not run for a certain period of time, the pump is switched off.

Fig 10: Voltage Stabilizer - Circuit Diagram



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Voltage stabilizer

-

- The voltage stabilizer maintains the supply voltage of some devices (the radio receiver in particular) within values which guarantee that the supply voltage is maintained during the engine start-up stages.
- The voltage stabilizer consists of an electronic unit directly connected to the battery.
- It is positioned under the dashboard, on the right side, as shown in the figure.

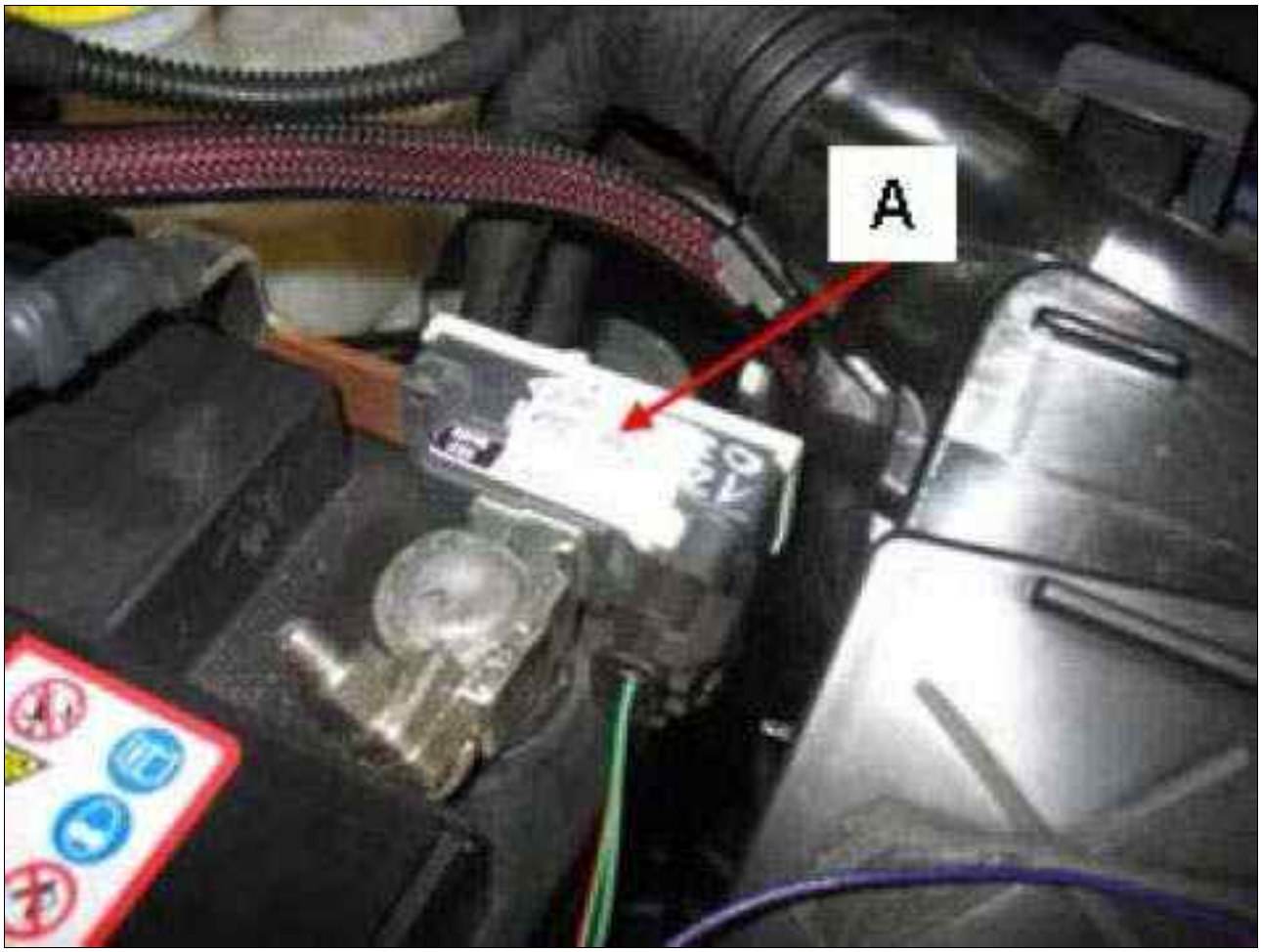
Operation - With the key at STOP: the T1 relay switch is closed and the device is completely bypassed. In these conditions the battery positive is applied to +30 of the radio and to the entire Hi-Fi system, if present. With the key at MAR (+15 present) and during the start-up stage (+50 present), the T1 relay switch is opened and the T2 and T3 relay switches are closed. In this way +30 of the battery can pass through the voltage stabilizer because in this condition a voltage drop can cause a temporary audio interruption or the stored channels can be lost.

Diagnosis - The diagnosis is performed through the NBC to which the diagnosis cable (DIAG) is connected. The fault status is signalled to the NBC by means of a low digital signal.

NOTE:

Two types of stabilizers are available: 90 W if the car is only equipped with the radio and 180 W if it has both the radio and the Hi-Fi system.

Fig 11: Intelligent Battery Sensor (IBS)



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IBS (Intelligent Battery Sensor or Battery Monitor) and dummy negative pole - The IBS (Intelligent battery sensor) (A) is an electronic unit which informs the BCM of the battery operating conditions. This prevents an engine shutdown in the case the charge conditions or health of the battery are inadequate.

The information produced by the IBS and sent to the BCM through the LIN is used for the management of the Start & Stop function 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, to activate or deactivate 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 start-up capacity becomes too low.

The Stop/Start function is also deactivated if a possible IBS fault does not allow the effective battery

status to be determined: an internal error signal is generated in the BCM to this end.

The Stop/Start is primarily managed by the ECM which decides whether to activate/deactivate the Stop/Start taking a great deal of information into consideration, including data coming from the IBS (through the BCM).

> *NOTE:*
>
> *The BCM and ECM can also deactivate the Stop/Start function as a result of vehicle conditions not connected to the IBS.*

For more details on other conditions that can deactivate an automatic stop or cause automatic restarting of the engine, refer to the appropriate Service Information .

IBS - Operation

- The IBS performs the following measurements:

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

The control unit processes these values and calculates the following parameters expressing the battery status:

- **SOC** : (State Of Charge) percentage of the battery residual charge as compared to its rated capacity. In other words it indicates the charge of the battery.
- **SOH** : (State Of Health) "age" of the battery or, better, percentage of the battery real capacity as compared to the rated capacity. This condition has to be considered because the battery undergoes an irreversible ageing process with time, reducing its ability to be fully recharged and therefore the possibility to supply all the energy it could store when new.
- **SOF** : (State Of Function) minimum voltage peak that can be reached during the start-up stage, in volt.

These parameters identify the starting capacity of the battery.

In the case of insufficient SOC or SOH, the battery could not be able to restart the engine any more. In the case of insufficient SOF, the battery voltage during starting may reach such low values that the standard operating conditions of the various electronic units of the car are no longer guaranteed.

Calibration of the IBS - When the IBS is connected to the power supply for the first time or is reconnected after a service operation, it enters the recalibration.

During recalibration, the battery efficiency status (SOC, SOH and SOF) is calculated in a less accurate way and with broader tolerances for a certain period of time during which the IBS must recognize the type of battery it is connected to, its voltage and its efficiency status. During this period, the S/S system may not stop/restart the engine to prevent the risk of an insufficient energy level remaining in the battery.

Whenever the IBS is removed from/refitted to the power supply or the battery is replaced, when the connections are restored a calibration processes is started to store the battery efficiency status again.

The following table illustrates the calibration process logic.

CALIBRATION PROCESS LOGIC TABLE

	Restoring supply	First start-up	First period of inactivity > 4 hours and engine start-up	5 time for 8 hours of inactivity, followed by car starting
SOC	Out of range	Out of range	Tolerance O.K.	Tolerance O.K.
SOF	Out of range	Tolerance O.K.	Tolerance O.K.	Tolerance O.K.
SOH	Out of range	Out of range	Out of range	Tolerance O.K.
	CALIBRATION		STANDARD OPERATION	

When the power supply is restored - all parameters are out of range because the system is not able to determine the battery status yet.

At the first starting - it performs the SOF calibration, considering immediately the minimum voltage already reached at the first starting. The other parameters cannot be taken into account yet.

After a period of inactivity longer than 4 hours and at least a starting cycle - the SOC parameter is also considered, which determines the battery charge status after a certain period of time has elapsed. The state of health - SOH - is not considered yet because it is still necessary to alternate start-up cycles and inactivity periods. The real efficiency status of a battery can be determined if also the elapsed operation time is considered.

After 5 inactivity periods of at least 8 hours, combined with a series of starting attempts - the cycle ends and the SOH parameter is acquired and stored

If the IBS does not recognize the values of the above mentioned parameters, the system will appropriately limit the engine stopping and starting cycles to ensure that the battery recharges correctly.

Conclusion: The IBS exits the calibration stage when the SOC and SOF evaluations are within the tolerances, as shown in CALIBRATION PROCESS LOGIC TABLE . This occurs **after a rest stage (engine off) of at least 4 hours followed by a starting.**

Use of information supplied by the IBS

In engine on conditions, the BCM uses the information received from the IBS to activate or deactivate a possible automatic stop on the basis of the battery starting capacity estimated by the IBS.

As already mentioned, the starting capacity of the battery is usually evaluated through 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 taken into account.

The request to enable/disable an automatic stop by the BCM is translated into a signal produced by the BCM and sent, through the C-CAN, to the ECM.

The following flow-chart describes the strategy used by the BCM to manage the information from the IBS and the automatic stop enabling/disabling.

When the engine automatic 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 engine automatic stop is disabled by the BCM, the ECM is not enabled to automatically switch off the engine, even 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

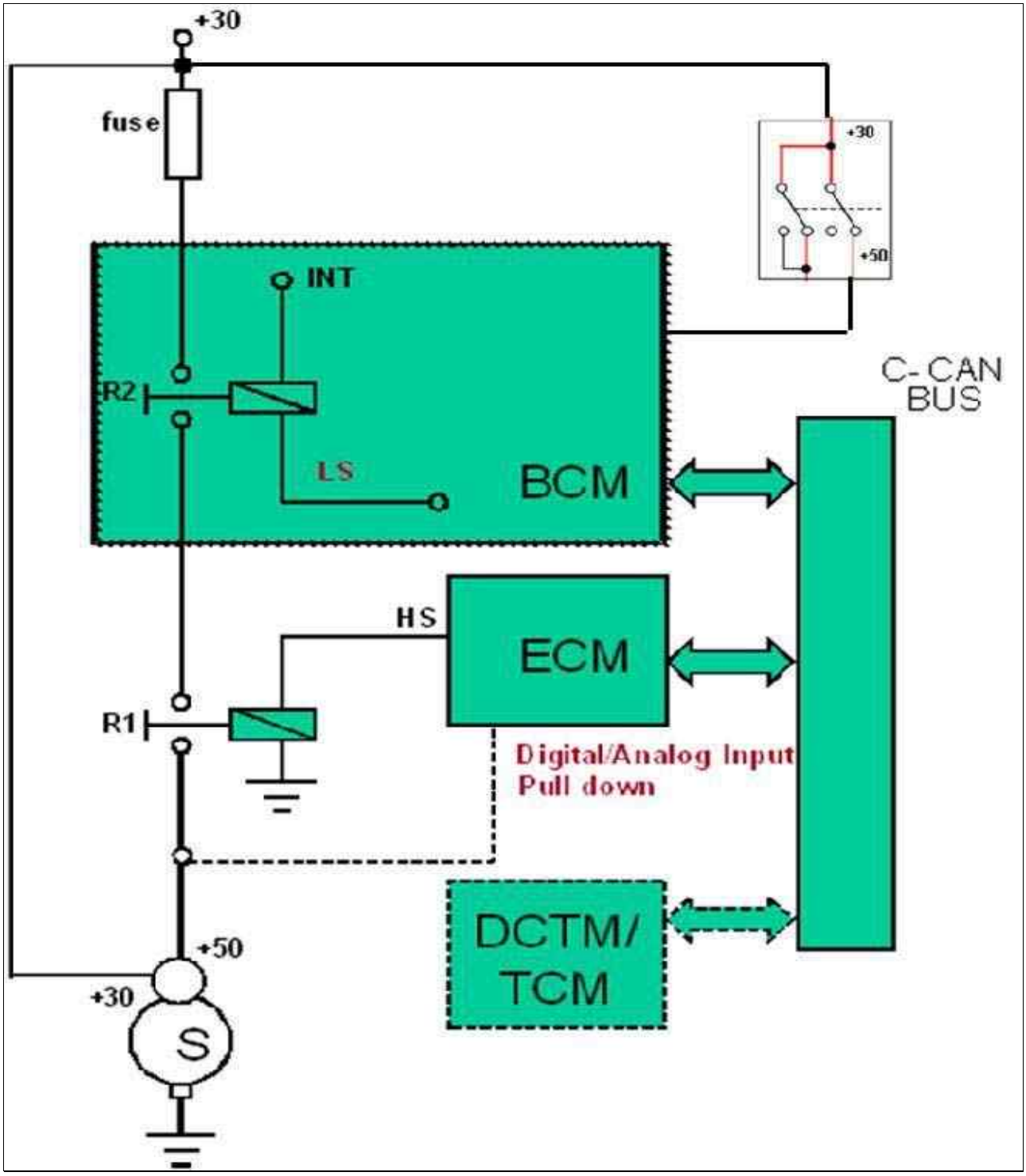
When the engine has been automatically switched off for the Stop/Start function, a request can be generated by a device/control unit, which requires the automatic restarting of the engine.

The BCM collects the information coming from the vehicle and, if necessary, requires the ECM to automatically restart the engine (the ECM checks first whether safe automatic restarting conditions are satisfied).

The decision to request or not request an automatic stop by the BCM is translated into a signal produced by the BCM and sent, through the C-CAN, to the ECM.

The following flowchart describes the strategy used by the BCM to manage the information from the IBS and the procedure for asking/not asking for an automatic stop.

Fig 12: Automatic Stop System - Flowchart



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Cranking

Key start-up is controlled by the user by placing the key in the starting position: under these circumstances starting is managed by BCM, and by ECM.

Inside the BCM is a relay, R2, the power line of which is in series with the power line of relay R1 managed by the ECM.

When the engine is started, both relays are closed. At the end of starting, the engine management module opens relay R2 and immediately afterwards orders brief closure of the same relay to diagnose the body computer relay: if the voltage level downstream of the relay is low, relay R1 has not become stuck. If instead the level is high, relay R1 has become stuck. A fault code will be set and the stop/start is disabled.

Starting by stop/start occurs according to the same logic as key starting, with the sole difference that the starting signal (+50) arrives at the BCM from the CAN and not from the switch.

In normal conditions, both relays are controlled only when the engine is started, both by key and by Stop/Start.

Failed engine cut out conditions - Conditions managed by the ECM

When the Stop/Start is activated, under certain circumstances the engine does not stop automatically due to comfort, emission control and safety reasons. These conditions leading to a failed automatic engine cut-out can be detected and managed by the BCM or by the ECM.

Engine cold : the automatic engine cut-out is not allowed if the signal from the engine coolant temperature sensor is outside of a range from Temp_H20_min (about 40°C) and Temp_H20_max.: (about 100°C). In this case the consumption and emission reduction derived from the Stop/Start is not guaranteed. Refer to CALIBRATION PROCESS LOGIC TABLE for the details.

Reverse engaged : if reverse gear is engaged, the Powertrain Control Module does not allow the automatic stopping of the engine. In this way the driveability during parking maneuvers is not compromised.

Clutch switch operation check not performed yet : This check takes place following a complete clutch pedal cycle (release and pressing or pressing and release) with the engine on

Malfunction or fault detected in at least one of the following sensors or systems:

- Accelerator pedal.
- Brake pedal.
- Vacuum sensor on brake servo.
- Gearbox control unit.
- Water temperature sensor in the engine.
- Wheel speed sensors.
- Clutch switch.
- Engine rpm sensor.
- Camshaft sensor.
- Reverse switch.
- Engine or Powertrain Control Module (with MIL on).
- **Braking system low vacuum:** the ECM prevents the automatic engine cut-out if the vacuum sensor (see paragraph on the sensors detected by the ECM for details on the sensors) transmits a LOW value.

- The BCM asked to prevent the engine automatic stopping by sending a C_CAN message if one or more conditions managed by the BCM occur
- **For Diesel engines only.** Particulate filter regeneration in progress; the Powertrain Control Module does not allow the automatic engine cut-out if the DPF is carrying out the regeneration of the filter.

Conditions managed by the BCM - Battery not sufficiently charged or flat:

The BCM receives information from the IBS on the status of the battery charge. If the IBS is being recalibrated, the engine cut-out is not allowed if one of the following conditions occurs:

- the battery Function Status (SOF) is below 8.3 V
- the battery temperature is below ?23°C

If the IBS is not being recalibrated, the engine cut-out is not allowed if one of the following conditions occurs:

- the battery Charge Status (SOC) is below 75%
- the battery Health Status (SOH) is below 60%
- the battery Function Status (SOF) is below 8.2 V
- the battery temperature is below 23°C

IBS failure: the automatic engine cut-out is not allowed if an IBS malfunction occurs.

Voltage Stabilizer failure: the automatic engine cut-out is not allowed if Voltage Stabilizer malfunction occurs.

Driver's door not closed: the automatic engine cut-out is not allowed if the driver's door is open

Driver's seat belt unfastened: the engine automatic cut-out is not allowed if the driver's seat belt is unfastened.

Outside temperature sensor:

when the outside temperature sensor is fitted, the automatic engine cut-out is not allowed if:

- the outside temperature is lower than the limit Temp_min_1 (?14°C)
- the outside temperature is higher than the limit Temp_max_1 (80°C)

> *NOTE:*
>
> *The temperature limits that have been set on the outside temperature sensor are "extreme" and therefore must always be respected.*

Automatic climate control: the automatic engine cut-out is not allowed if the difference between the climate control temperature set by the customer and the temperature inside the passenger compartment is greater than ± 4°C. In the case of manual air conditioning, the engine can always be stopped.

Generator fault: the automatic engine cut-out is not allowed in the case of Generator malfunction.

Engine hood open: if the hood switch is fitted, the automatic engine cut-out is not allowed if the hood is open.

Logistic Mode status active: the automatic engine cut-out is not allowed if the Logistic Mode status is active.

SPM semi-automatic parking system: when the semi-automatic parking system is fitted, the automatic engine cut-out is not allowed if the system is active.

Failure on BCM relay: the automatic engine cut-out is not allowed in the case of malfunction of the start-up circuit relay operated by the BCM.

Automatic restarting - When the Stop/Start is operational, under certain circumstances the engine may restart automatically without any intervention by the driver due to comfort, emission control and safety reasons. These conditions leading to the engine automatic restarting can be detected and managed by the BCM or by the ECM.

Conditions managed by the ECM -

- **Braking system low vacuum:** an automatic engine restart is forced if the vacuum sensor (see paragraph on the sensors detected by the ECM for details on the individual sensors) transmits a LOW value. This prevents undesired movements of the car with the engine off on a gradient due to a possible brake servo failure.
- **Moving vehicle:** An automatic engine restart is forced if the car speed is higher than a certain threshold, named V_th_start (about 5 km/h). This condition avoids dangerous situations due to a failure of the engine brake on gradients.
- **Engine cut-off by the Stop/Start system** for a time longer than t_timeout_stop_1 (160 seconds).
- **Engaged reverse:** if the driver engages reverse gear during an engine stop by the Stop/Start, the Powertrain Control Module automatically restarts the engine. In this way the driveability during parking maneuvers is not compromised.
- **Cold engine:** the NCM forces the automatic engine restart if the signal from the engine water temperature sensor is below the threshold Temp_H20_min_ON (about 30°C). In this case the reduction in consumption and emissions derived from the Stop/Start is not guaranteed.
- **The BCM requested the automatic engine restart without any action by the driver** and transmitted this information to the ECM by means of a specific message on C_CAN. (STATUS_B_CAN2.BCMAutoStopStaySts = 0).
- **Catalytic converter temperature below a given threshold** (temp_catalist).
- **The handbrake is applied whilst the car is moving (either forwards or in reverse) with the engine stopped at a speed higher than the threshold V_th_start_HndBrk. (about 3 km/h).** This is a further safety measure to avoid dangerous situations due to a failure of the engine brake on gradients
- **For Diesel engines only.** Particulate filter regeneration in progress: the Powertrain Control Module automatically reactivates the engine if the DPF is carrying out the regeneration of the filter.

Conditions managed by the BCM

Battery not sufficiently charged or flat:

The BCM receives information from the IBS on the status of the battery charge. If the IBS is being recalibrated, the engine is automatically restarted without any driver's intervention if one of the following conditions occurs:

- the battery Function Status (SOF) is below 7.6 V
- the battery temperature is below ?24°C

If the IBS is not being recalibrated, the engine is automatically restarted if one of the following conditions occurs:

- 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 battery temperature is below 24°C

IBS fault: The engine is automatically restarted without any action by driver if an IBS malfunctioning occurs

Outside temperature sensor:

If an outside temperature sensor is fitted, the engine is automatically restarted without any action by driver if:

- the outside temperature is lower than the limit Temp_min_2 (14°C).
- the outside temperature is higher than the limit Temp_max_2 (80°C).

NOTE: the temperature limits that have been set on the outside temperature sensor are "extreme" and therefore must always be respected.

Automatic climate control: The engine is automatically restarted without any action by the driver if the difference between the climate control temperature set by the customer and the temperature in the passenger compartment is greater than ± 7°C.

NOTE: in the case of manual air conditioning, the engine remains off.

Logistic Mode status active: The engine is automatically restarted without any action by driver if the Logistic Mode status is activated.

Semi-automatic parking system SPM : When the semi-automatic parking system is fitted, the engine is automatically restarted without any action by driver if the parking system is activated during the engine stopping stage.

Disabling of automatic restarting (safety function) - In some cases, after an automatic engine cut-out through the Stop/Start, it is possible that the automatic restart requested by the driver is not carried out. In these circumstances, restarting is only possible through manual intervention by the driver on the key, to restore the behavior of the vehicle to that of a traditional car without S/S. The management of this function is transferred to the ECM and the BCM.

Conditions managed by the ECM -

Too many unsuccessful attempts at automatic starting - The threshold Max_cranking_attempts (5 times) has been exceeded. The threshold indicates the maximum number of failed automatic engine restart attempts. This threshold is set to prevent damage to the starter by too many start-up attempts close together. Refer to CALIBRATION PROCESS LOGIC TABLE on the threshold values.

The BCM requested to prevent the engine automatic restart. Malfunction or fault detected in at least one of the following sensors or systems:

- Accelerator pedal
- Brake pedal
- Brake servo vacuum sensor
- Engine coolant temperature sensor
- Vehicle speed
- Gearbox/transmission control unit
- Clutch switch
- Neutral sensor
- Engine rpm sensor
- Camshaft sensor
- Reverse switch
- Engine or Powertrain Control Module (with MIL on).

The driver has been requested to perform an action but did not perform it in time - Engine at standstill timeout set by the threshold T_immo (175 seconds). If an automatic engine restart attempt is unsuccessful as a result of a failure to press the clutch or because the gearbox is not in neutral and the driver is then requested to allow automatic restart by pressing the clutch or engaging neutral, the engine can only be restarted using the key after T_immo (175 seconds) has elapsed from the engine restart attempt.

Conditions managed by the BCM

- **Engine hood open:** when the hood switch is fitted, automatic engine restarting is not allowed if the hood is open.
- **Driver's or passenger's door not closed and driver's seat belt unfastened:** automatic engine restarting is not allowed if the driver's door or the passenger's door is open and, at the same time, the driver's seat belt is not fastened.
- **Failure on BCM relay:** automatic engine restarting is not allowed in the case of malfunction of relay T20 controlled by the BCM.

DESCRIPTION AND OPERATION > DESCRIPTION AND OPERATION > OPERATION > OPERATION

1.4L / 2.4L

The starting and charging system comprises the battery, starter motor and the generator.

The starter consists of a DC motor powered by the battery and an electromagnet exciter.

With the ignition key in the ON position, the generator indicator light (LED) on the instrument panel turns on and power is transmitted to the voltage regulator in the generator.

In these conditions, the exciter circuit (rotor) is enabled to ground provided by the Powertrain Control Module (PCM).

With the generator in rotation, a magnetic field is generated on the electric circuit (stator) that allows a three phase AC voltage to be delivered by the diode bridge to the B+ terminal.

The battery is then charged and the PCM receives voltage from the generator hen it reaches the calibrated specification (13.7 - 14.2 V).

The efficiency of the charging system is controlled by the Body Control Module (BCM):

- The PCM sends the voltage signal to the BCM which controls the efficiency of the generator charging by detecting two parameters: the voltage signal coming from the generator itself, and the starter motor signal which is also received on the CAN network by the PCM.
- The BCM signals the cluster to turn on the insufficient charging warning when the ignition is switched ON until the voltage is above 5.5 volts. If the voltage drops below 4.5 volts with the engine above 700 RPMs, the indicator will turn on accompanied by a display message in the information center of the cluster.

The startup logic is also implemented by PCM located in the engine compartment.

1.6L / 2.0L With STOP / START

The starting and charging system comprises the battery, starter motor and the generator.

The starter consists of a DC motor powered by the battery and an electromagnet exciter.

With the ignition key in the ON position, the generator indicator light (LED) on the instrument panel turns on and power is transmitted to the voltage regulator in the generator.

In these conditions, the exciter circuit (rotor) is enabled to ground provided by the Powertrain Control Module (PCM).

With the generator in rotation, a magnetic field is generated on the electric circuit (stator) that allows a three phase AC voltage to be delivered by the diode bridge to the B+ terminal.

The battery is then charged and the PCM receives voltage from the generator hen it reaches the calibrated specification (13.7 - 14.2 V).

This engine uses an electronically controlled generator, equipped with a controller that receives commands from the PCM: in this way you get the best performance in terms of:

- Reduction in fuel consumption and emissions
- Improvement of powertrain performance and vehicle dynamics

The Start & Stop system automatically shuts down the engine whenever the vehicle is stationary and restarts it when the driver intends to resume driving.

The system is essentially based on a starter system (battery and starter) being able to perform, quickly and relatively quiet, the restarting of the engine and to support a number of starts much higher than that required for a traditional system.

Strategies for implementation and monitoring of the shutdown and restart of the system is managed by the PCM and the Body Control Module (BCM) directly or via the CAN network.

The starter is upgraded to a heavy duty cycle starter, and the generator is also upgraded increasing the capabilities of current delivery.

Besides the changes on the battery, in order to incorporate Start & Stop strategies, an Intelligent Battery Sensor (IBS) is used. The IBS has the function to monitor the status of the battery and communicate it to the network nodes or to enable an optimal management of the battery in the framework of the Start & Stop strategies.

The IBS is located on the negative battery terminal.

A Neutral Position Sensor is mounted on the gearbox providing output from the sensor to a controller concerning gear range position.

Automatic shutdown and restart of the motor are marked by a specific indicator on the instrument cluster. If the indicator is flashing, this indicates a possible fault with the Start & Stop system.

The device is activated / deactivated manually via the switch between the controls next to the gear lever.

The startup logic is also implemented by PCM located in the engine compartment.

DIAGNOSIS AND TESTING > STARTING SYSTEM

The battery, starting, and charging systems operate in conjunction with one another, and must be tested as a complete system. For correct starting/charging system operation, all of the components involved in these three systems must perform within specifications.

STARTING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE	1. Battery discharged or inoperative	1. Charge and test battery (Refer to DIAGNOSIS AND TESTING). Replace battery, if required.
	2. Starter motor or solenoid inoperative	2. Test the starter motor and solenoid (Refer to DIAGNOSIS AND TESTING). Replace starter motor, if required.
	3. Starter relay inoperative	3. See appropriate SYSTEM WIRING DIAGRAMS article. Test and replace the starter relay, if required
	4. Clutch pedal position switch inoperative (if equipped with manual transmission)	4. See Clutch Pedal Position Switch. Test and adjust or replace switch, if required.

	5. Park/Neutral position switch inoperative (if equipped with automatic transmission)	5. See Park/Neutral Position Switch. Test and adjust or replace switch, if required.
	6. Ignition switch inoperative	6. Test the Ignition Switch and Key Lock Cylinder. Replace ignition switch if required.
	7. Starting circuit wiring inoperative	7. See appropriate SYSTEM WIRING DIAGRAMS article. Test and repair starter feed and/or control circuits, if required.
STARTER ENGAGES, BUT FAILS TO TURN ENGINE	1. Battery discharged or inoperative	1. Charge and test battery (Refer to DIAGNOSIS AND TESTING). Replace battery if required.
	2. Starter motor or solenoid inoperative	2. Test the starter motor and solenoid (Refer to DIAGNOSIS AND TESTING). Replace starter motor if required.
	3. Starting circuit wiring inoperative	3. See appropriate SYSTEM WIRING DIAGRAMS article. Test and repair starter feed and/or control circuits, if required.
	4. Engine seized	4. See 9 - Engine. Test and repair engine as required.
STARTER ENGAGES, BUT THEN DISENGAGES BEFORE ENGINE STARTS	1. Starter motor or solenoid inoperative	1. Test the starter motor and solenoid (Refer to DIAGNOSIS AND TESTING). Replace starter motor, if required.
	2. Starter ring gear damaged	2. Remove starter motor and inspect starter ring gear (Refer to REMOVAL AND INSTALLATION). Replace starter ring gear, if required.
STARTER DOES NOT DISENGAGE	1. Starter motor incorrectly installed or solenoid inoperative	1. Inspect and test the starter motor and solenoid (Refer to DIAGNOSIS AND TESTING). Replace starter motor, if required.
	2. Starter relay inoperative	2. See appropriate SYSTEM WIRING DIAGRAMS article. Test and replace the starter relay, if required.
	3. Ignition switch inoperative	3. Test the Ignition Switch and Key Lock Cylinder. Replace ignition switch, if required.

SPECIFICATIONS > STARTER

STARTER SPECIFICATIONS TABLE

	1.4 Turbo MultiAir	2.4 MultiAir	1.6 16V Multijet	2.0 16V Multijet
Type	Hitachi S114-943A Bosch SCL70S	Mitsubishi 5450B	Bosch S74L	Bosch S78M

Voltage (V)	12			
Rated output (kW)	1.0	1.3	-	-
Pinion side rotation	clockwise			
Pole number	6	-	6	6

SPECIFICATIONS > TORQUE SPECIFICATIONS

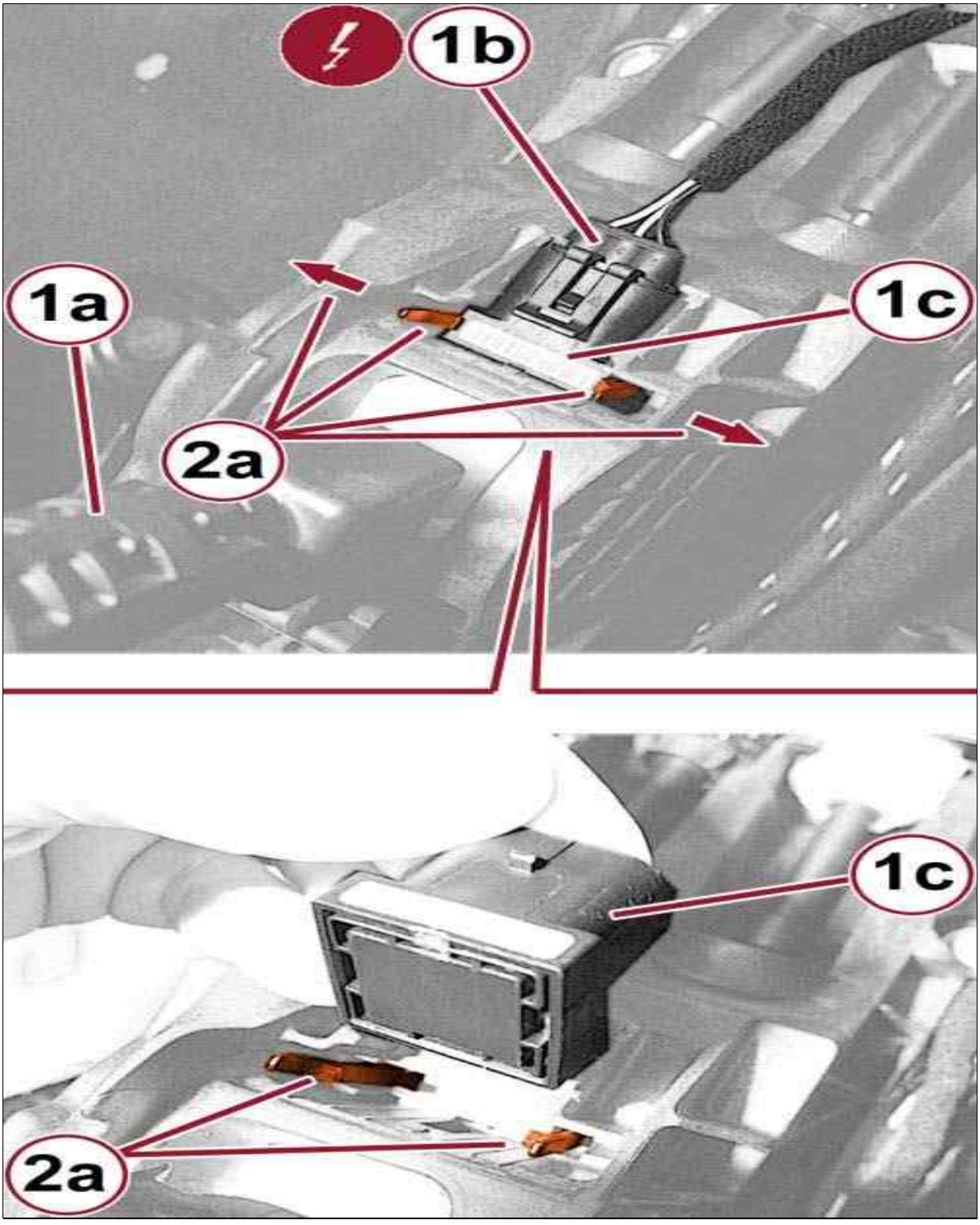
TORQUE SPECIFICATIONS TABLE

COMPONENT	FASTENER	Ø	VALUE (nm)	VALIDITY
Ignition switch in the steering column	Trim Screw	M8	20	-
Starter	Screw	M8	26	1.4L Turbo MultiAir 1.6L Turbo Diesel 2.0L Turbo Diesel
Starter-upper screw	Screw	M10	47	2.4L MultiAir
Starter-lower screw	Screw	M10	61	2.4L MultiAir
Starter wiring	Nut	M8	15	1.4L Turbo MultiAir
Glow plug	-	M9	8	1.6L Turbo Diesel 2.0L Turbo Diesel

SENSOR, NEUTRAL POSITION > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION > NEUTRAL POSITION SENSOR - REMOVAL

1. Disconnect and isolate the negative battery cable.
2. Remove the floor console trim. Refer to CONSOLE, FLOOR, REMOVAL AND INSTALLATION .

Fig 1: Removing Neutral Position Sensor



Courtesy of CHRYSLER GROUP, LLC

3. Working in front of the transmission shifter control (1a), disconnect the sensor (1c) electrical connector (1b) of the sensor (1c).
4. Release the retainers (2a) and remove the sensor (1c) by lifting. If necessary, insert a tool under the bottom of the sensor and apply light pressure to disengage from the seat.

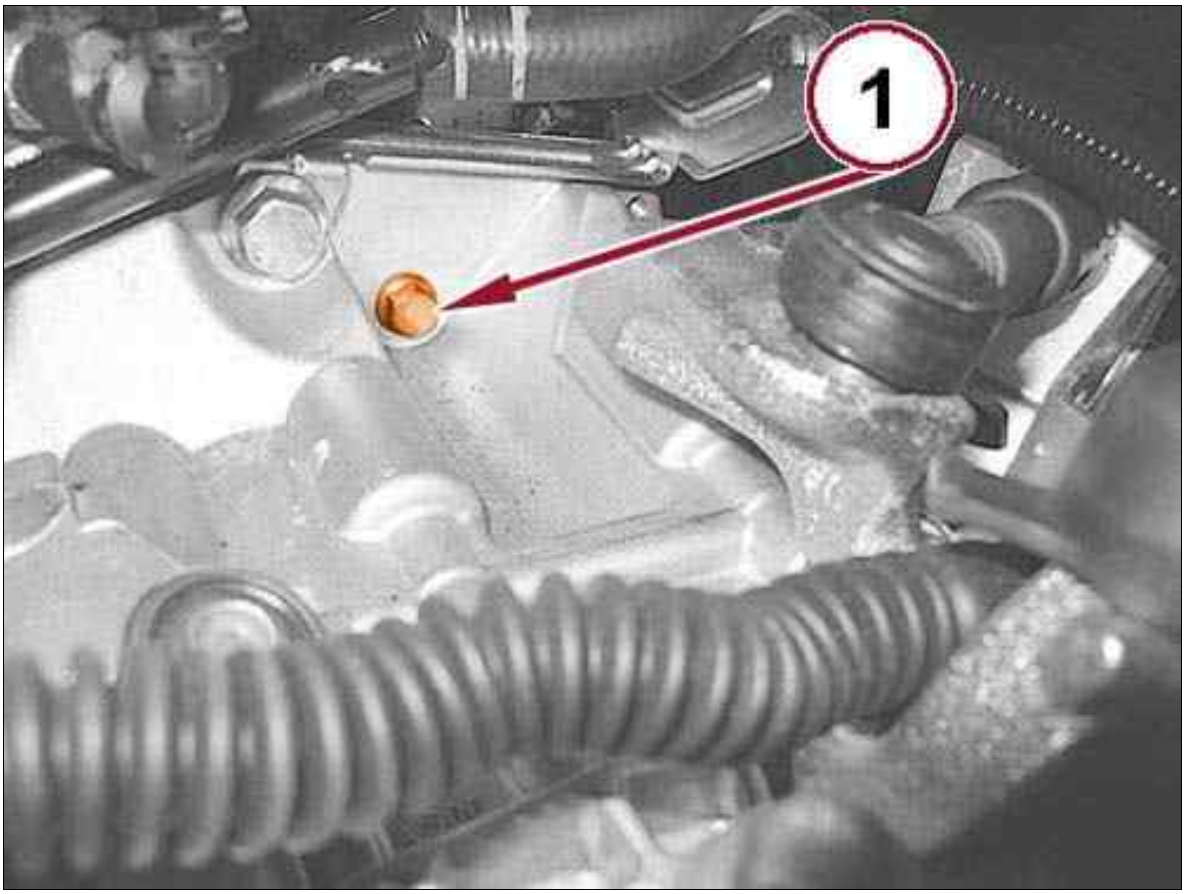
SENSOR, NEUTRAL POSITION > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION > NEUTRAL POSITION SENSOR - INSTALLATION

1. Check that the sensor is not damaged.
2. Position the sensor then engage the retainers.
3. Connect the sensor electrical connector.
4. Connect the diagnostic tool. Go to the ECM "Miscellaneous Functions" menu and launch the self learning neutral position sensor procedure.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 1.4L > REMOVAL

1. Disconnect and isolate the negative battery cable.
2. Raise and support the vehicle.

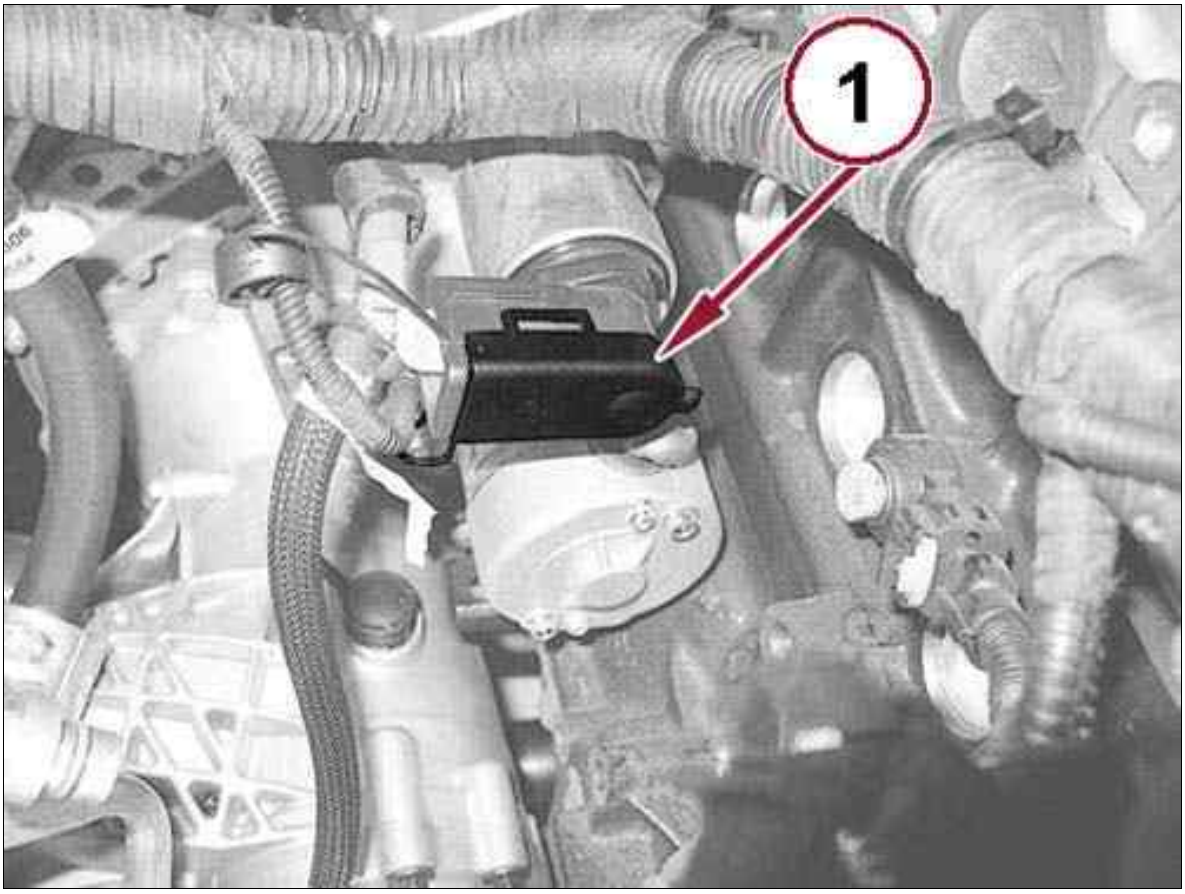
   Fig 1: Upper Starter Bolt



   Courtesy of CHRYSLER GROUP, LLC

3. Remove the upper starter bolt.

Fig 2: Connector Cover



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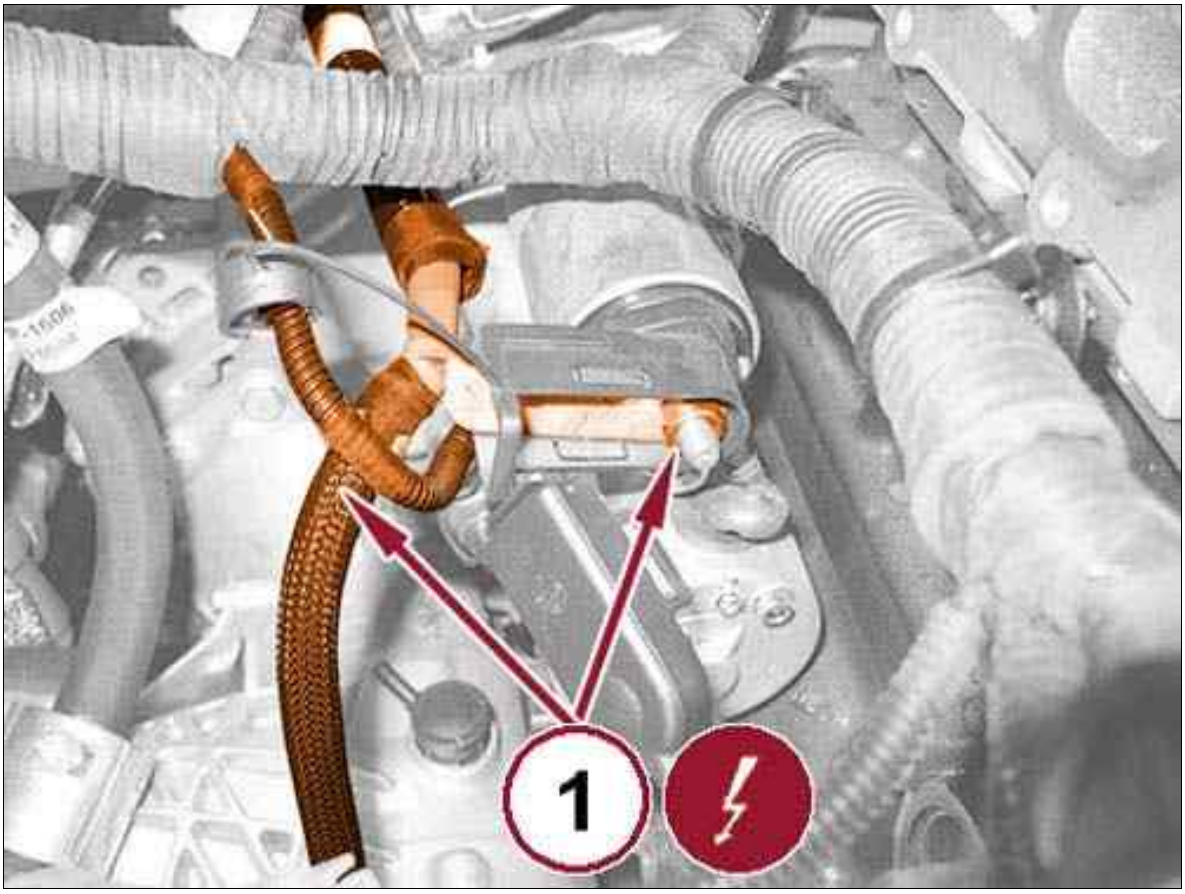
4. Open the connector cover (1).

Fig 3: Wiring Connector & Nut



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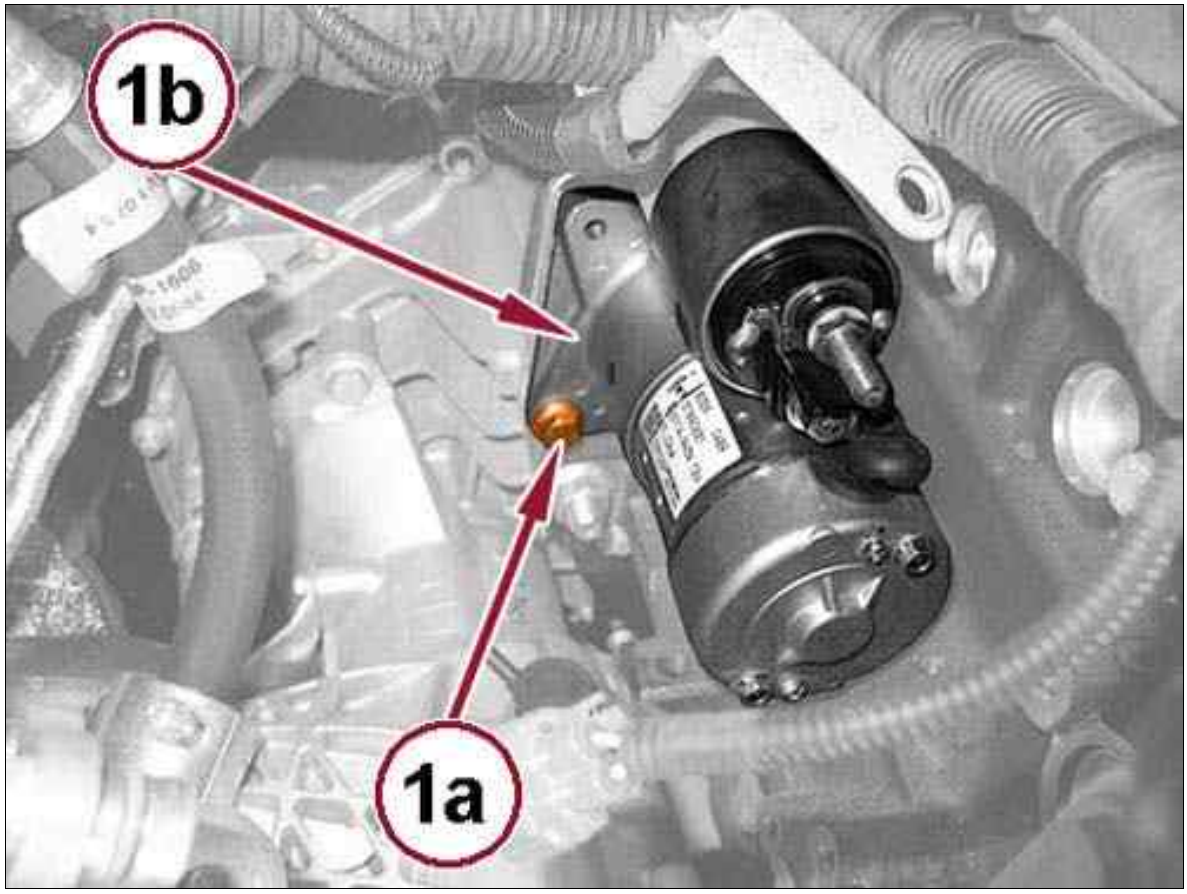
5. Remove the nut (1) and disconnect the wiring connector from the start motor.

Fig 4: Starter & Lower Starter Bolt



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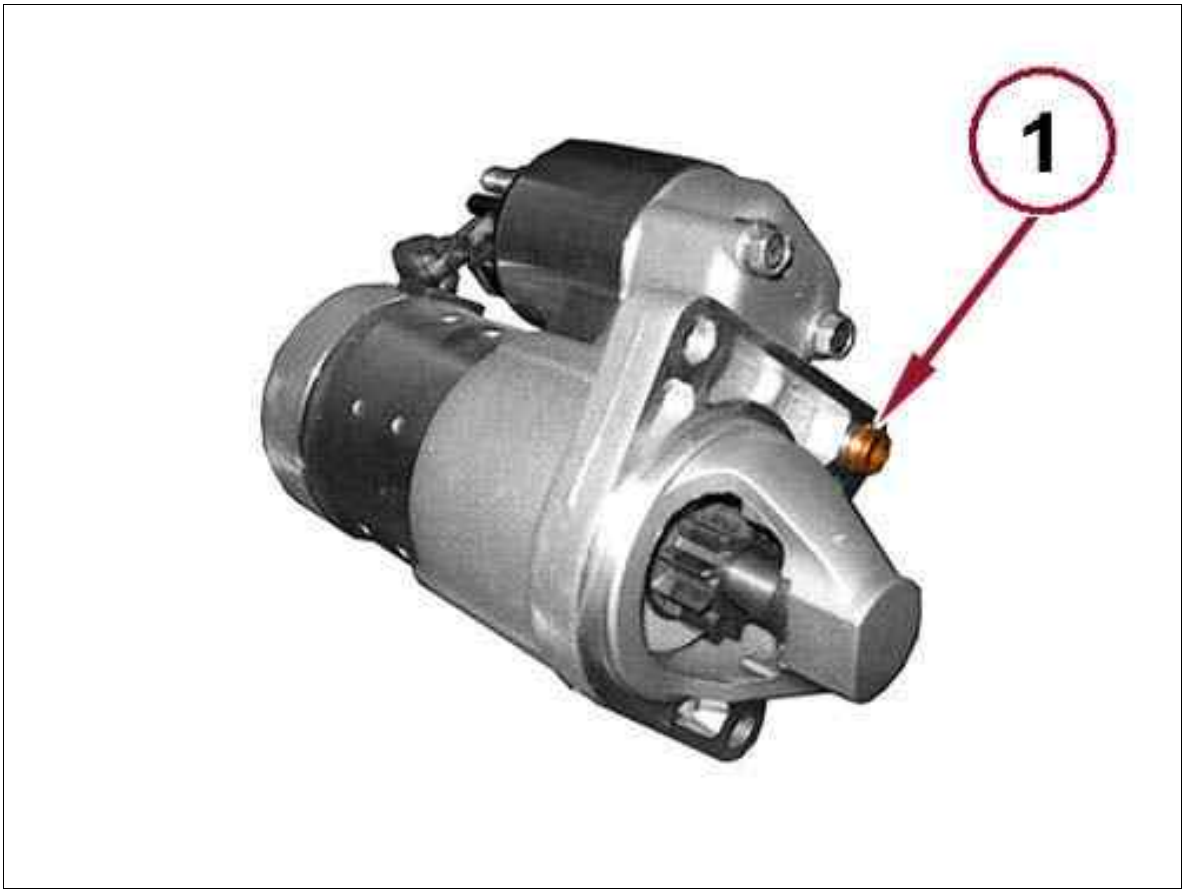
6. Remove the lower starter bolt (1a).
7. Remove the starter (1b).

Fig 5: Starter Bushing



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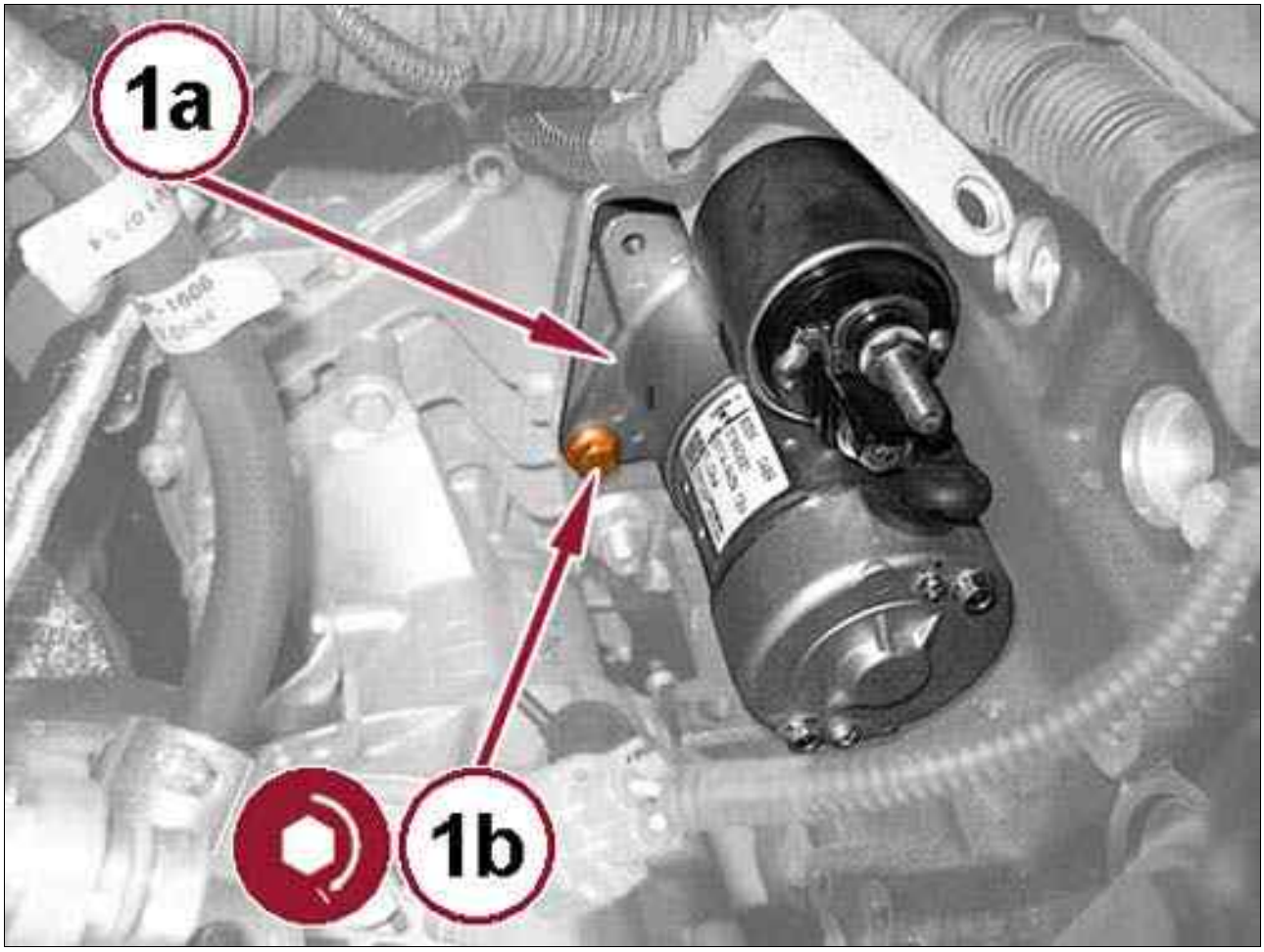
8. Check the integrity of the starter bushing (1).
9. Check that the starter motor is not damaged.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 1.4L > INSTALLATION

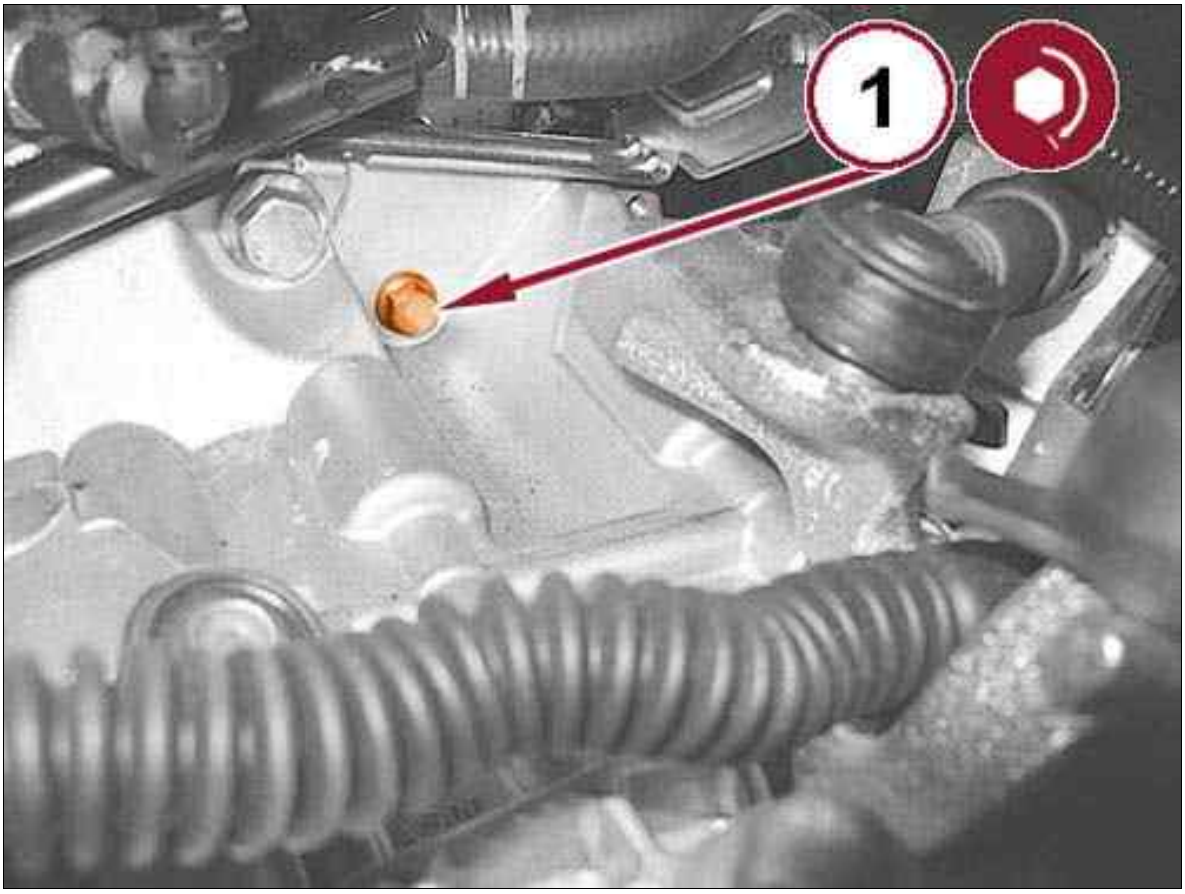
Fig 1: Starter Motor & Lower Screw



Courtesy of CHRYSLER GROUP, LLC

1. Put into place the starter motor (1a) and tighten the lower screw (1b) to the proper SPECIFICATIONS .
2. Connect the wiring harness starter motor, tighten the nut and close the connector cover.

Fig 2: Upper Mounting Bolt



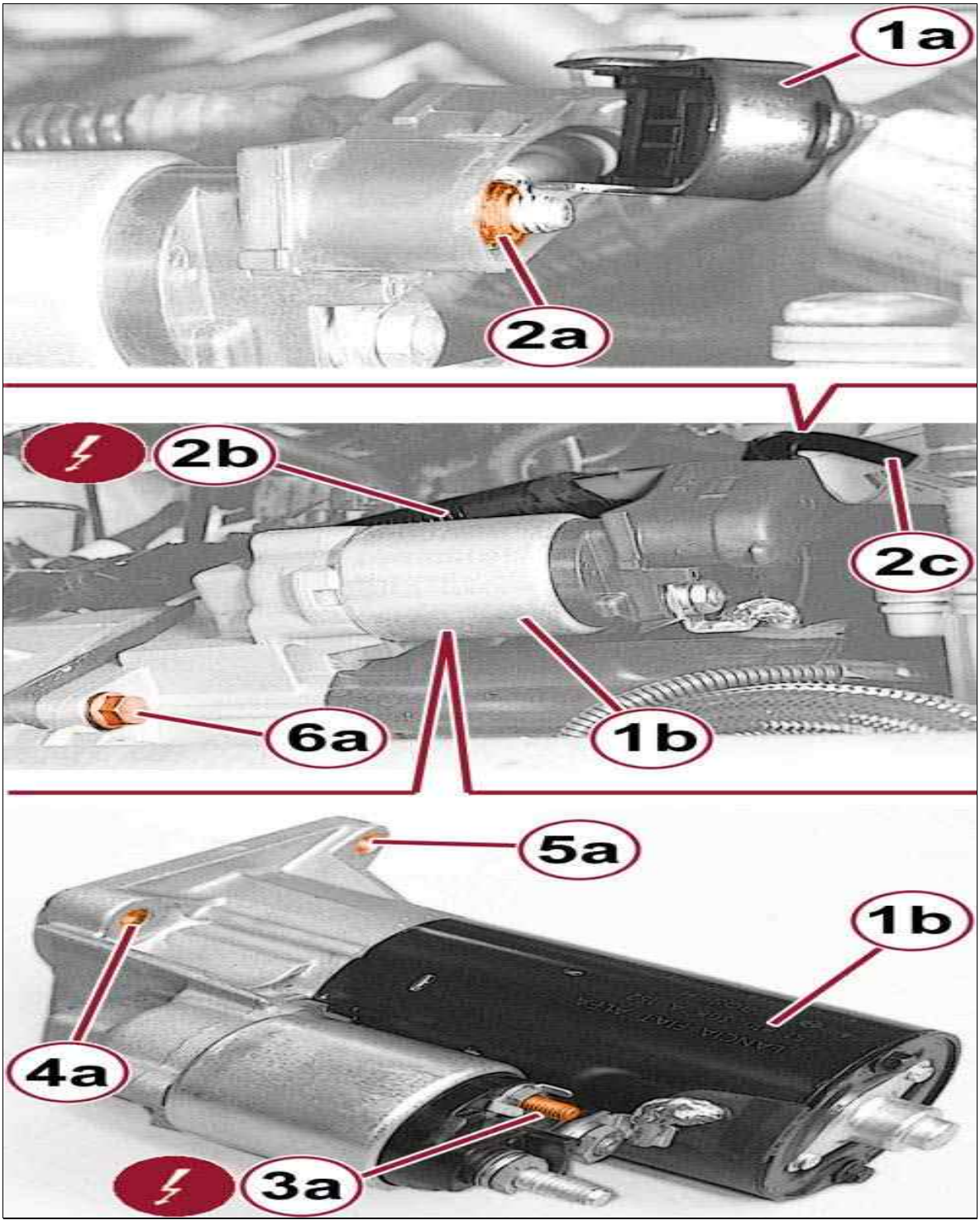
Courtesy of CHRYSLER GROUP, LLC

3. Install and tighten the upper mounting bolt (1) for the starter to the proper SPECIFICATIONS .
4. Remove the vehicle from the hoist.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 1.6L > REMOVAL

1. Disconnect and isolate the negative battery cable.
2. Raise and support the vehicle.

Fig 1: Removing Starter



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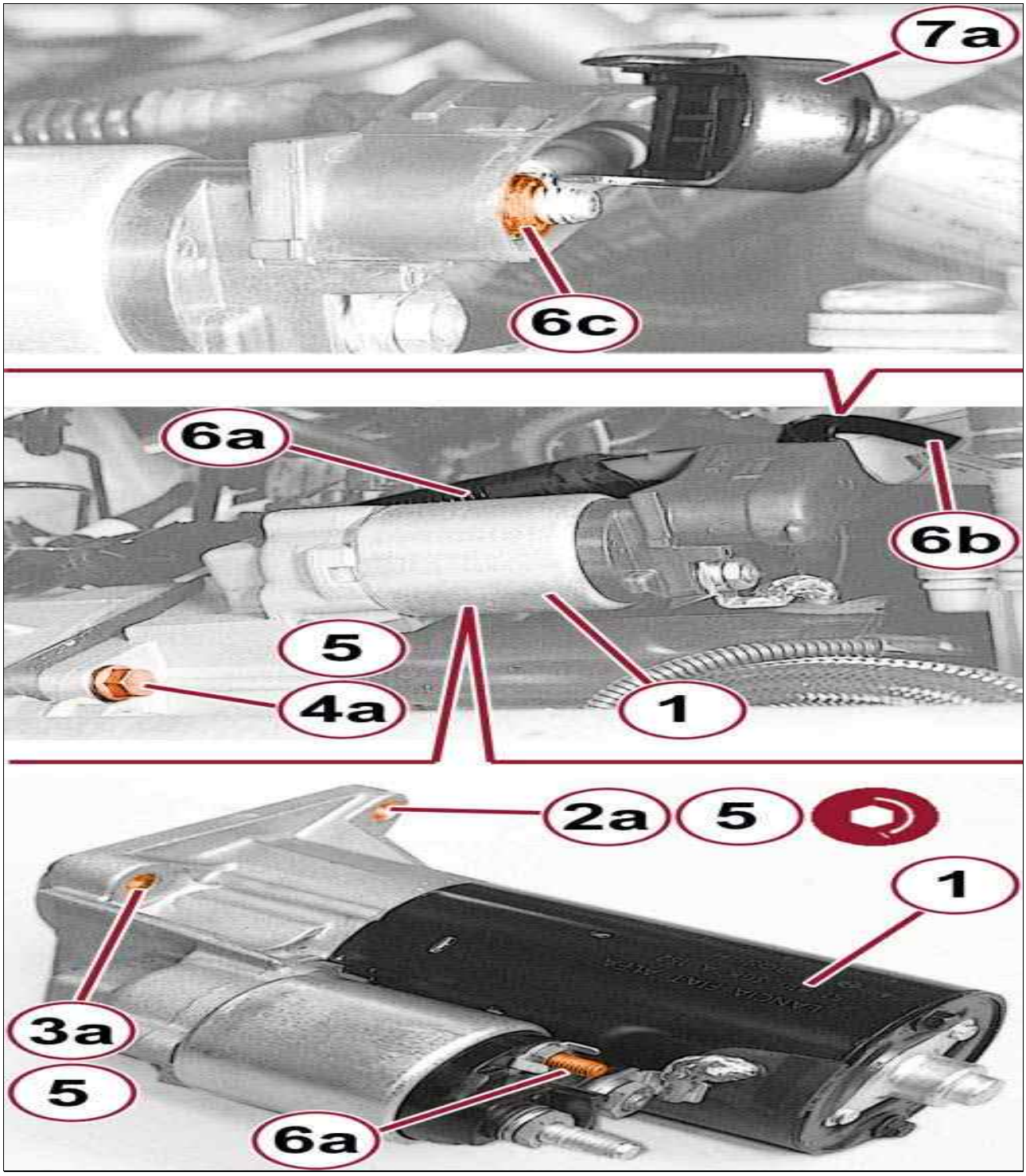
3. Open the starter connector cover (1a) at the starter motor (1b).
4. Remove the nut (2a) and disconnect the battery (2b) and generator (2c) wiring electrical connections.
5. Remove the nut and disconnect the electrical connector (3a).
6. Remove the starter bolt (4a). Move the seat support bracket wiring.

7. Remove the starter bolt (5a).
8. Remove the lower starter bolt (6a) and then remove the starter (1b).
9. Check that the starter motor is not damaged.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 1.6L > INSTALLATION

Fig 1: Installing Starter



Courtesy of CHRYSLER GROUP, LLC

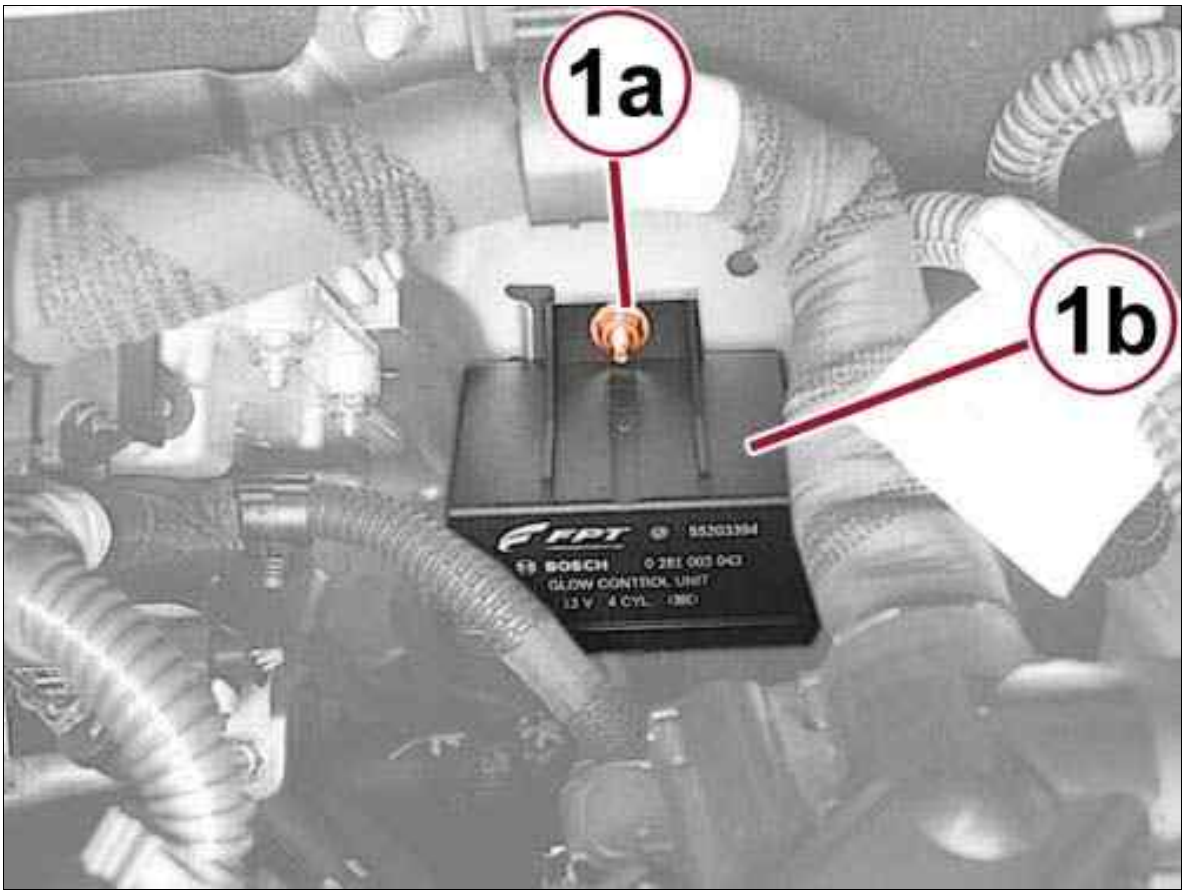
1. Position the starter for installation.
2. Install the top (2a) starter bolt.
3. Position the bracket wiring support and install the top (3a) starter bolt.
4. Install the lower starter bolt.

5. Tighten all installed bolts to the proper SPECIFICATIONS .
6. Connect the wiring connection from the battery (6a), from the generator (6b) and secure with the nut (6c).
7. Close the starter wiring harness connector cover (7a).
8. Lower the vehicle.
9. Connect the negative battery cable.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 2.0L > REMOVAL

1. Disconnect and isolate the negative battery cable.

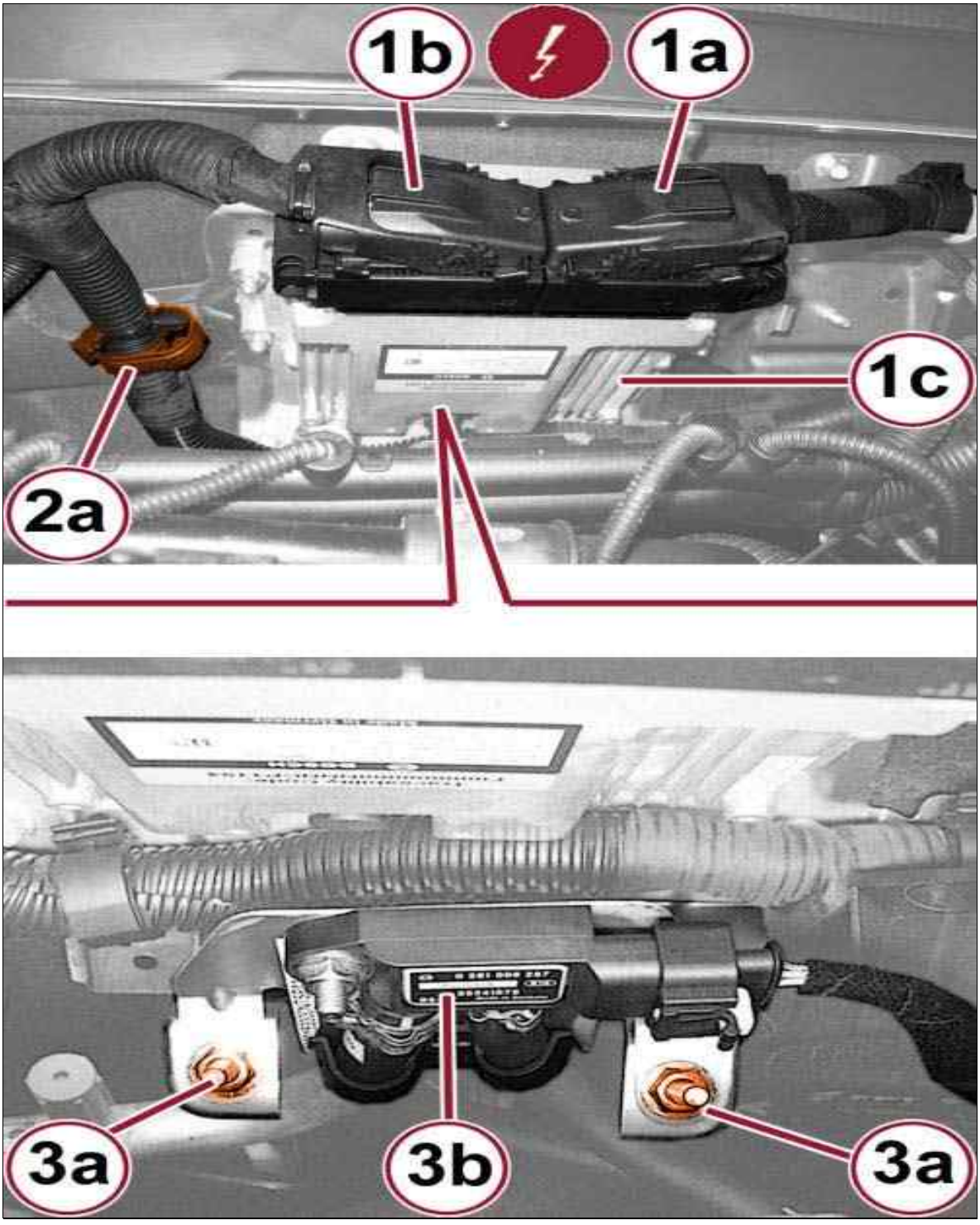
   Fig 1: Plug Control Unit & Nut



Courtesy of CHRYSLER GROUP, LLC

2. Working behind the engine, remove the nut (1a) and position the plug control unit (1b) out of the way.

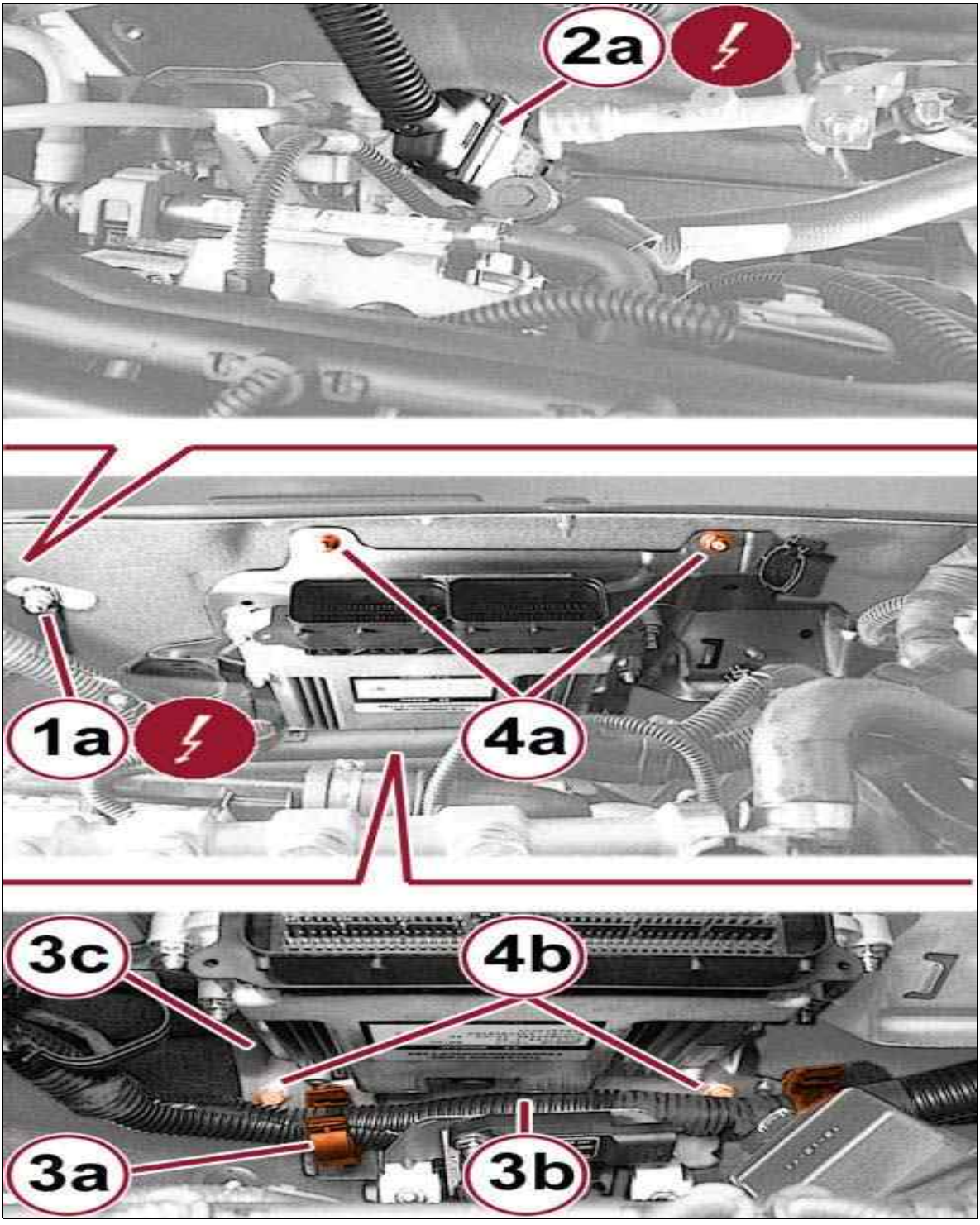
Fig 2: Repositioning Particulate Filter Pressure Sensor



Courtesy of CHRYSLER GROUP, LLC

3. Disconnect the electrical connections (1a, 1b) of the injection ECU (1c).
4. Open the clamp (2a) of the wiring.
5. Remove the nuts (3a) and reposition the particulate filter pressure sensor (3b), complete with bracket.

Fig 3: Removing Injection Control Unit Media



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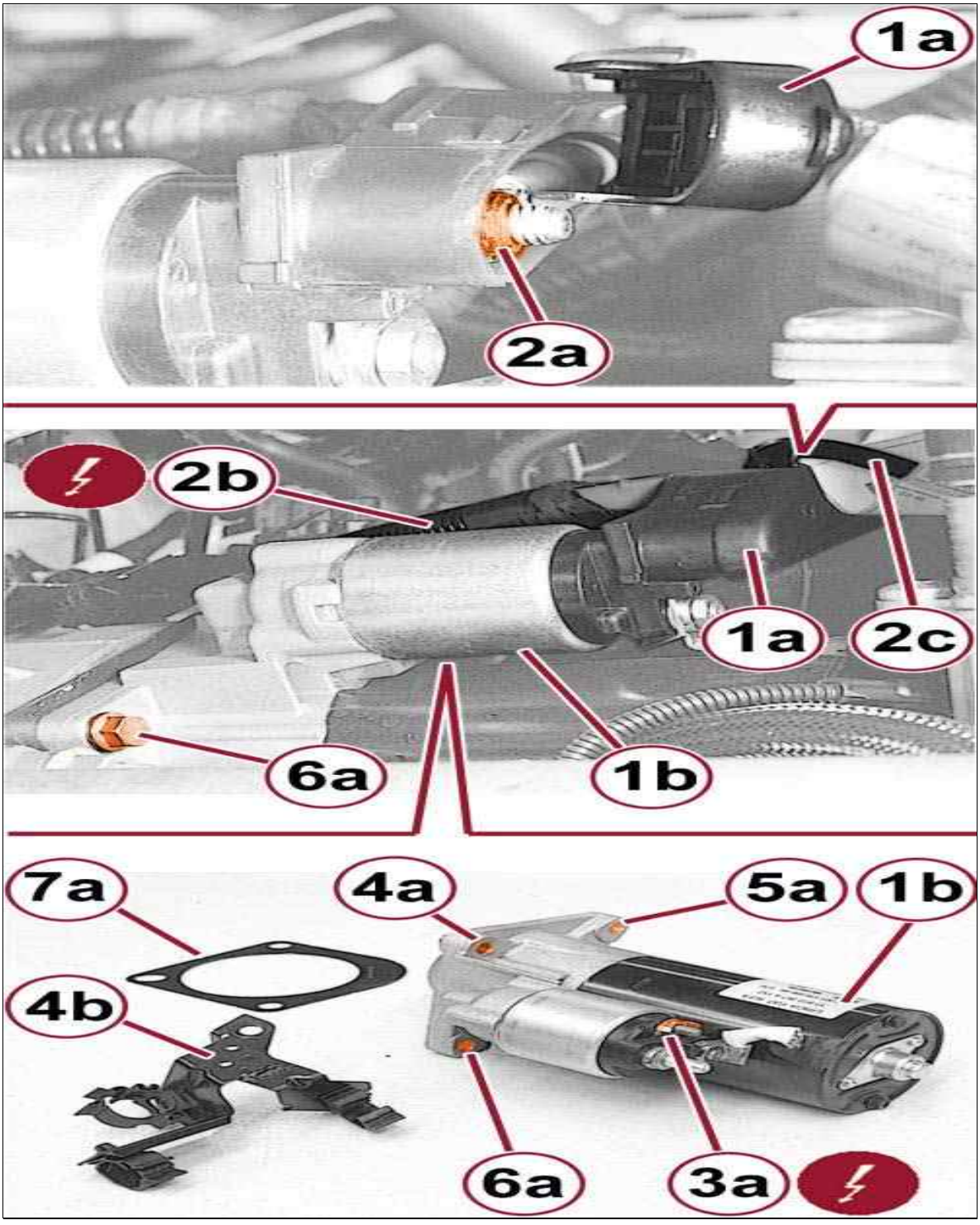
6. Disconnect the ground wire from the terminal (1a).
7. Disconnect the electrical connection (2a) from the junction of the PTU power cord.
8. Open the various retainer clips (3a) and free the wiring (3b) from the injection control unit support (3c).
9. Loosen the nuts (4a) and the screws (4b), then remove the injection control unit media (3c).

Fig 4: Remove/Install Starter



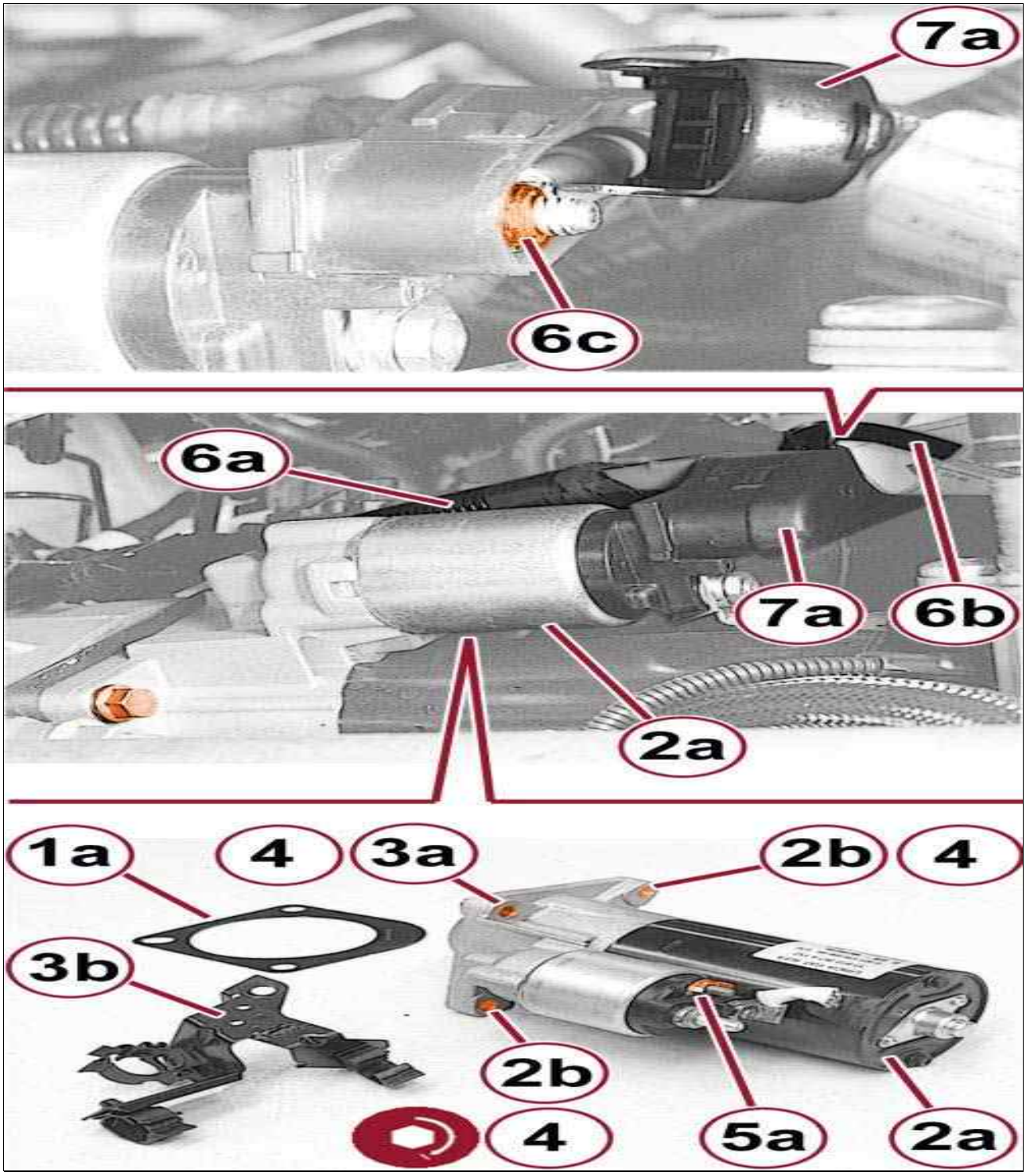
Courtesy of CHRYSLER GROUP, LLC

10. Working from the top of the engine, open the starter motor electrical protection cover (1a) of the starter motor (1b).
11. Remove the nut (2a) and disconnect the wiring electrical connections from the battery (2b) and from the generator (2c).
12. Disconnect the electrical connector (3a) after removing the nut.

13. Remove the starter bolt (4a). Reposition the wiring support from the seat bracket (4b).
14. Remove the starter bolt (5a).
15. Remove the lower starter bolt (6a).
16. Remove the starter (1b).
17. Remove the spacer (7a).
18. Check that the starter motor is not damaged.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 2.0L > INSTALLATION

Fig 1: Installing Starter

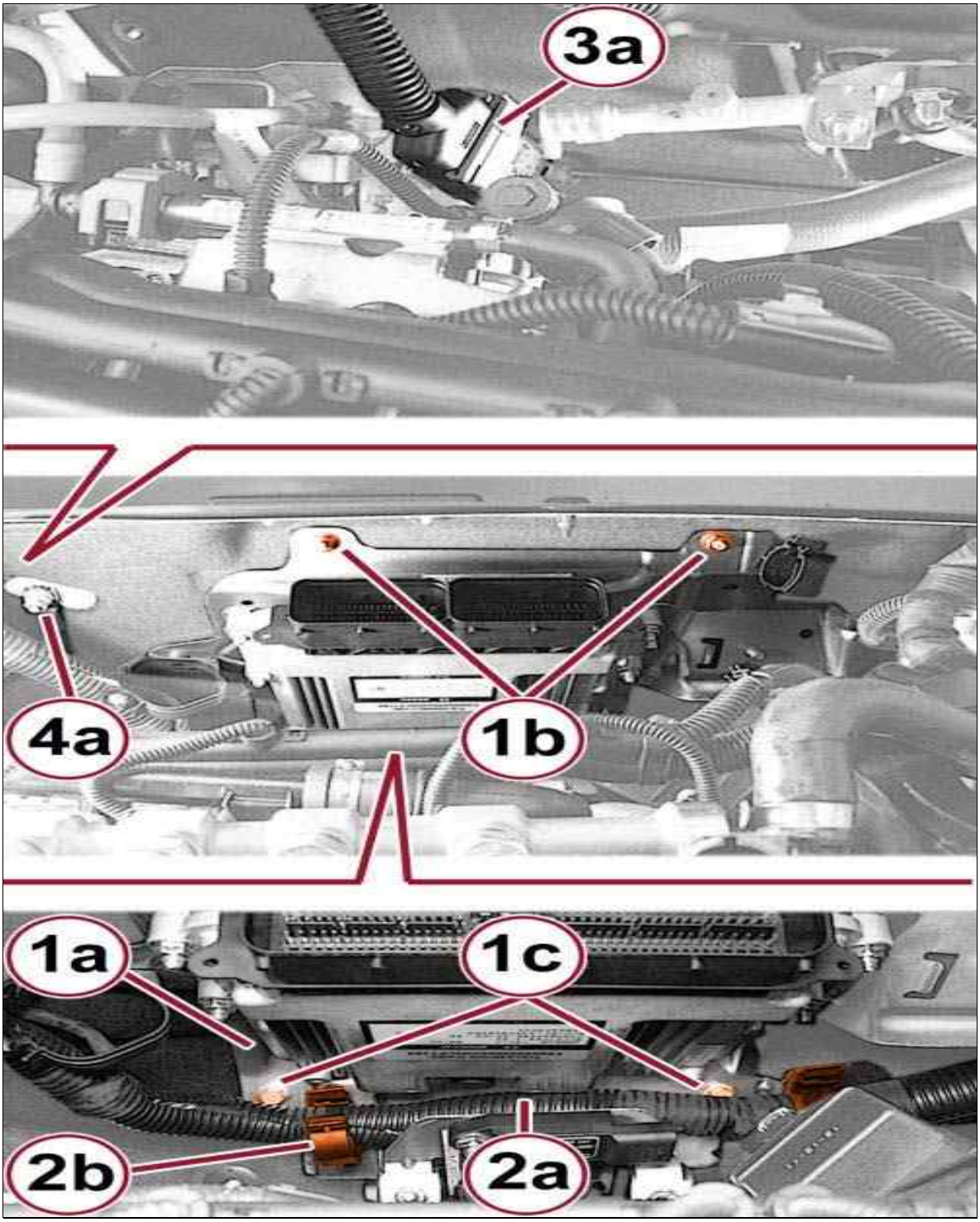


Courtesy of CHRYSLER GROUP, LLC

1. Place the spacer (1a).
2. Place the starter (2a) and pull the screws in the holes (2b).
3. Position the wiring (3b) bracket support (3a) and then tighten the upper starter bolt.
4. Tighten to torque the screws securing the starter motor.

5. Connect the electrical connector (5a) and then tighten the nut.
6. Connect the wiring connection from the battery (6a), from the generator (6b) and secure with the nut (6c).
7. Close the starter wiring harness connector cover (7a).

Fig 2: Installing Injection Control Unit Media



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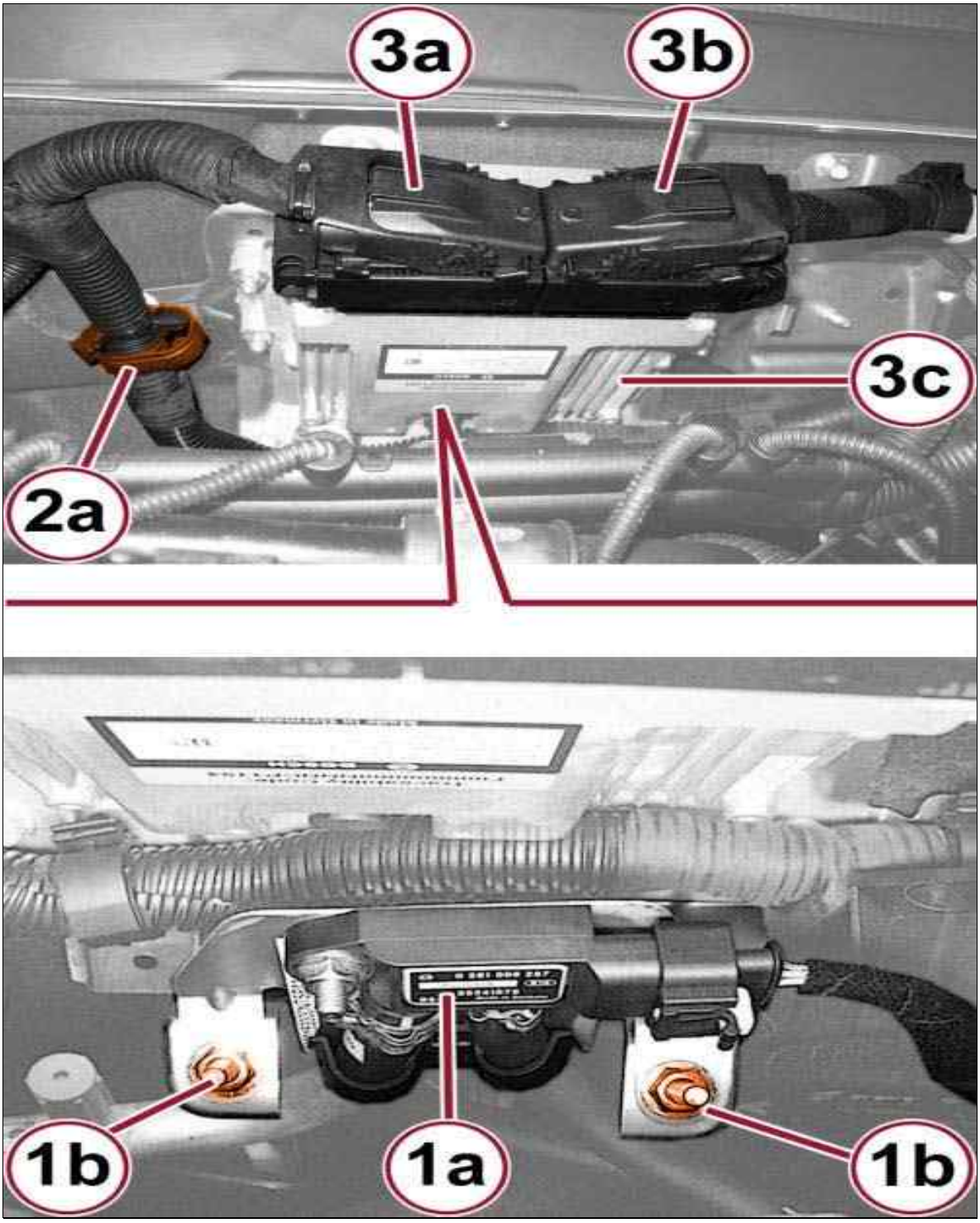
8. Place the injection control unit support (1a) and tighten the nuts (1b) and screws (1c).

9. Connect the wiring (2a) to the injection ECU support (1a) and apply various retaining straps (2b).
10. Connect the PTU power cord electrical connector (3a), and then engage it to its support.
11. Connect the (4a) ground wire and tighten the nut.

    Fig 3: Placing Particulate Filter Pressure Sensor



Courtesy of CHRYSLER GROUP, LLC

12. Place the particulate filter pressure sensor (1a), complete with bracket, then screw the nuts

(1b).

13. Place the harness and apply the retaining clip (2a).
14. Connect the injection control unit (3c) electrical connections (3a, 3b).
15. Place the plug unit and tighten.
16. Connect the negative battery cable.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 2.4L > REMOVAL

1. Disconnect and isolate the negative battery cable.
2. Disconnect the electrical connectors from the starter motor.
3. Remove the lower starter bolt.
4. Remove and disengage the gear selector retaining bracket (1).
5. Remove the upper starter bolt (2)
6. Remove the starter motor.

STARTER > REMOVAL AND INSTALLATION > REMOVAL AND INSTALLATION - 2.4L > INSTALLATION

1. Position the starter and install the top starter retaining bolt. Tighten the bolt to the proper SPECIFICATIONS .
2. Install the gear shift retaining bracket.
3. Install the lower start bolt and tighten the bolt to the proper SPECIFICATIONS .
4. Connect the start electrical connectors.
5. Lower the vehicle from the hoist.
6. Connect the negative battery cable.

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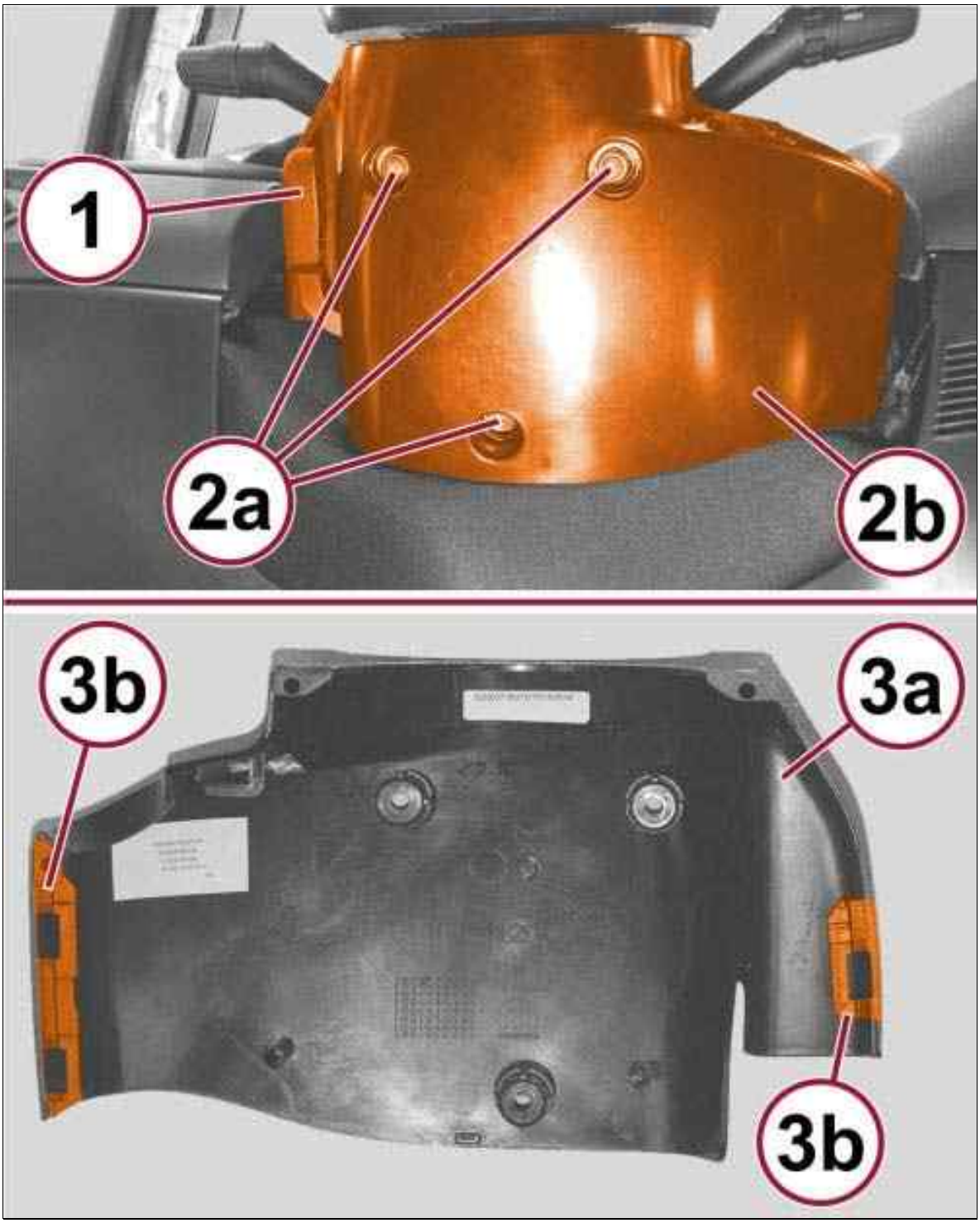
NOTE:

For mechanical key ignition, refer to SWITCH, IGNITION, REMOVAL AND INSTALLATION .

1. Disconnect and isolate the negative battery cable.
2. Remove the instrument cluster bezel from the instrument panel. Refer to BEZEL, INSTRUMENT CLUSTER, REMOVAL AND INSTALLATION .

   Fig 1: Removing Steering Column Bottom Cover



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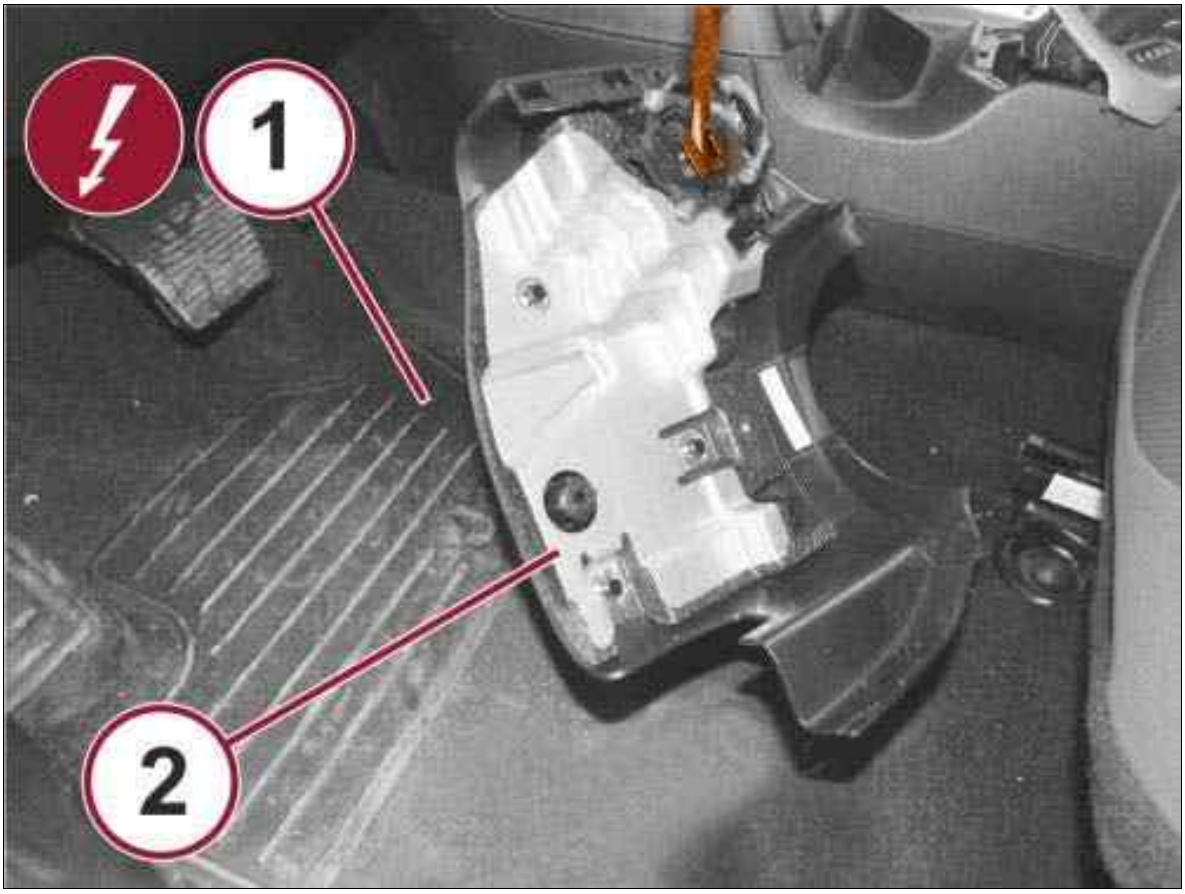
3. Lower the steering wheel position lever (1).
4. Remove the screws (2a) securing the bottom cover (2b) of the steering column.

5. Remove the bottom cover (3a) by disengaging the retainers (3b).

Fig 2: Steering Wheel Bottom Cover & Electrical Connector



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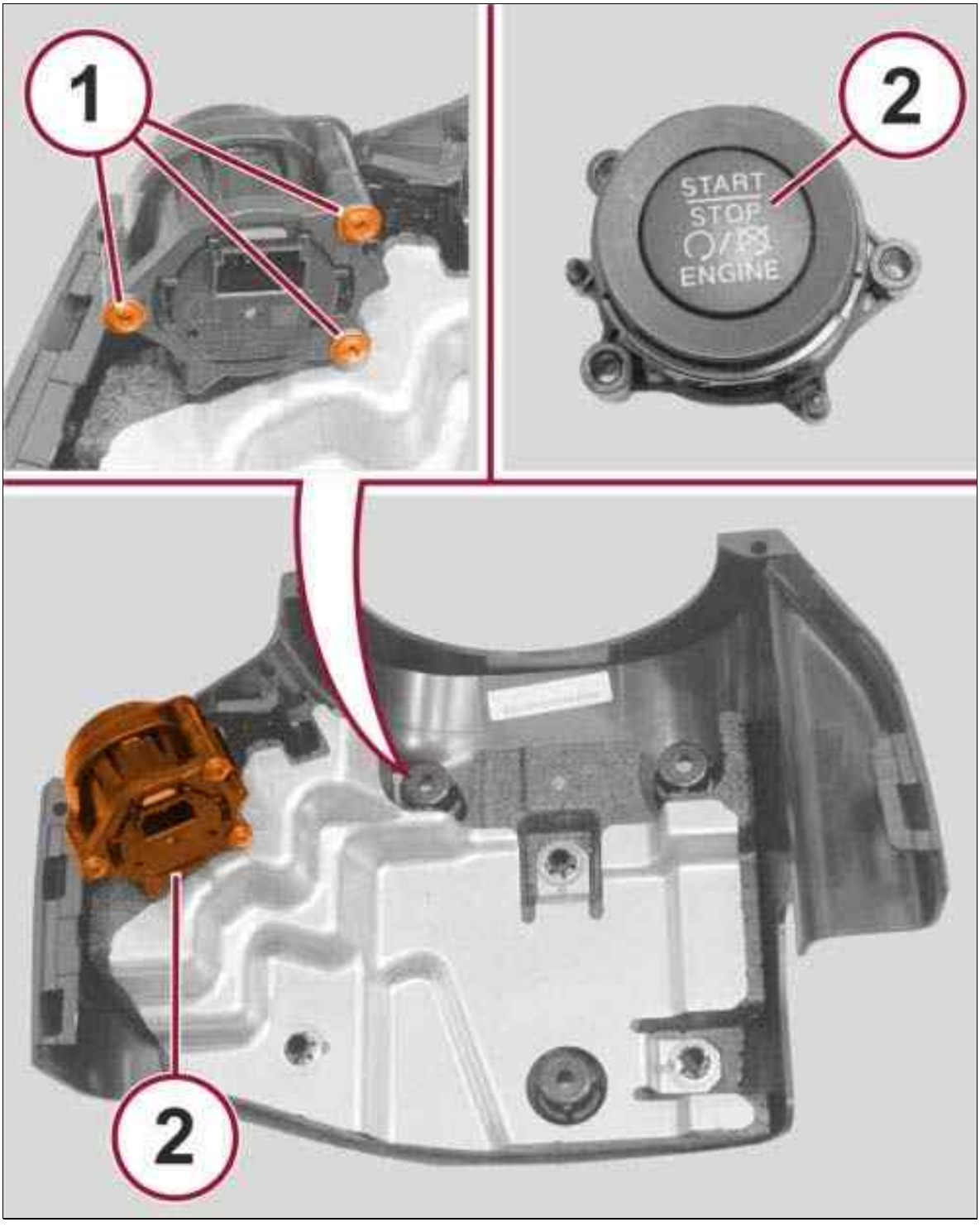
6. Disconnect the electrical connector.
7. Remove the bottom cover (2) of the steering column.

Fig 3: Ignition Push Button Switch & Mounting Screws



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8. Remove the mounting screws (1).
9. Remove the ignition push button switch (2).

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INSTALLATION > INSTALLATION

NOTE:

For mechanical key ignition, refer to SWITCH, IGNITION, REMOVAL AND INSTALLATION .

1. Check that the ignition push button switch is not damaged.
2. Place the ignition push button switch and tighten the screws.
3. Connect the switch electrical connector.
4. Install the lower steering column cover.
5. Turn the steering wheel to the middle position and secure it with the position lever.
6. Install the instrument cluster bezel to the instrument panel. Refer to BEZEL, INSTRUMENT CLUSTER, REMOVAL AND INSTALLATION .
7. Connect the negative battery cable.