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E5010 - STARTING AND RECHARGING [AUTOMATIC TRANSMISSION]**APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION****DESCRIPTION**

The device called **Start&Stop** makes it possible to automatically switch off the engine when traffic conditions mean that the vehicle is stopped and to restart the power unit when the driver is about to engage a gear.

The Start&Stop system improves the efficiency of the vehicle by reducing consumption, the emission of harmful gases and noise pollution. The operating logic is managed, in the main, by the Powertrain Control Module and the Body Computer.

The device is essentially based on a starting system (battery and starter) capable of restarting the engine quickly and quietly. The device can do this a far greater number of times than a normal production system would need to.

The goals of the starting system in terms of driveability, starting responsiveness (when warm), reliability, durability and safety involve the adoption of a more powerful and robust starting system: this is guaranteed by the use of a larger battery and starter.

The system contains other components (mainly sensors and control strategies) that manage the stopping and restarting operations without requiring the driver to change their driving style drastically, ensuring the safety, driveability and energy balance aspects of the vehicle with a minimum impact on climate comfort and the functionality of the on-board services.

In safe conditions, the power unit is switched on and off by operating the accelerator, brake and clutch pedals and the automatic transmission selector lever in specific ways.

The controls, signals and information necessary to activate the Start&Stop system reach or come from, as described above, the engine control module and the Body Computer through discreet connections or via the CAN.

The two electronic units communicate constantly to establish whether, moment by moment, there are Start&Stop system "integrity" conditions, whether the system is enabled or whether, on the other hand, it is temporarily or permanently deactivated. The instrument panel allows the operation, inhibition and exclusion conditions of the device to be displayed through the relevant icons, warning lights and messages on the display.

The engine control module is the master control unit which controls the stopping and the restarting of the engine on the basis of the information, acquired directly or indirectly through the CAN, on the status of the vehicle and the components relevant for the Start&Stop system.

The Body Computer, on the other hand, acquires some of the information relating to the status of all the vehicle systems that interact with the Start&Stop system and are not monitored directly by the Powertrain Control Module, summarises the status of this collection of systems and notifies the Powertrain Control Module of the enablement or inhibition (temporary or permanent) in order to switch the engine off, request the restarting of the power unit or, in conditions where safety is at risk, impose the "irreversible" switching off of the power unit on the Powertrain Control Module in the sense that it can only be restarted later using the key.

The main Start&Stop system components, in addition to those mentioned previously, are:

- the battery charge status sensor - IBS - (located on the negative battery pole);
- the brake servo vacuum sensor;
- the voltage stabilizer;
- the system exclusion button on the left control panel.

The adoption of the battery charge status sensor IBS on the negative battery terminal led to the use of a pin ("dummy pole" - contact board) on which, through a quick-release negative terminal ("RADSOK" type connector), the sensor is connected to the body power earth. With this solution there is no connection on the negative battery pole. In this way all current consumption is detected by the IBS sensor: otherwise the battery status could not be evaluated correctly.

The voltage stabiliser prevents the voltage drop noticeable during the initial engine starting stages which leads to a loss of Infotainment functions/services.

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As described previously, the ignition and recharging circuit comprises the battery, starter and alternator. The battery (12 V) is the heavy duty type equipped for greater electrical stress.



Replacing a heavy duty battery with a regular type of battery may lead, in addition to a reduced availability of the Start&Stop system, to the early wear and a much shorter life of the battery.

The Body Computer acquires the battery voltage value via the signal supplied (LIN line) by the status sensor located on the negative battery pole.

The starter consists of a d.c. motor supplied by the battery and an excitation electromagnet.

For this car, which is equipped with automatic transmission, ignition is enabled only when the gear lever is in the P (Park) or N (Neutral) position with the brake pedal fully pressed.

E7050 AUTOMATIC TRANSMISSION

The starter windings are supplied through the adoption of two dedicated relay switches located in the engine compartment junction unit and operated respectively by the Powertrain Control Module and the Body Computer in both starting conditions (key in extreme position -AVV- or automatically via the Start&Stop line), the windings of the motor are supplied, producing the electromagnetic forces that rotate the starter pinion. This simultaneously energises the electromagnet which operates the mechanism that causes the pinion to mesh with the flywheel ring gear and thus turn the crankshaft.

This version has adopted the intelligent alternator (IAM - Intelligent Alternator Module). It is an electronically-controlled alternator that continuously communicates with the engine control module, and recharges the battery according to the driving style and vehicle conditions; thanks to the introduction of this component, CO2 emissions can be reduced.

The new voltage regulator on the intelligent alternator communicates with the Powertrain Control Module by means of an interface on the LIN serial line. The voltage regulator, on the basis of a mutual exchange of information, allows the alternator output voltage to be regulated according to the parameters requested by the control unit during driving.

The modules involved in the management of this system are:

- the Powertrain Control Module, LIN master control unit, which sends the commands to the regulator inside the alternator;
- the voltage regulator inside the alternator which sends feedback messages on its condition to the Powertrain Control Module through the LIN;
- the Body Computer, which sends signals from the battery charge sensor (IBS) to the engine control module through the C-CAN;
- the battery charge sensor (IBS) which sends information on the battery condition to the Body Computer through the LIN serial line.

A car equipped with Start&Stop system and intelligent alternator (IAM) uses the following logic:

- during deceleration, the alternator reference voltage is adjusted to a high value, in order to exploit the surplus kinetic energy to charge the battery to maximum voltage;
- when a high torque is requested, the reference voltage of the alternator is adjusted to a low value, in order to decrease the torque absorbed by the alternator itself;
- outside of the acceleration and deceleration stages (in normal rpm conditions), the voltage reference value is adjusted in order to reach an optimal state of charge which ensures high efficiency, both during the charge and the discharge stages.

The (maximum and minimum) voltage limits are calculated according to the state of the battery and the engine load.

In the event of failure or loss of communication, a set of parameters inside the regulator represents a recovery solution which returns the alternator to an operation similar to traditional applications.

If the car's driving profile is divided in the following stages:

- strong acceleration and/or car uphill (considerable driving torque requested),
- braking and/or car downhill (no driving torque requested),
- driving at constant speed,
- car stationary with engine idling or S&S deactivated,
- engine stopping/starting.

Various operating strategies can be distinguished, in particular:

- PASSIVE BOOST
- REGENERATIVE BRAKING
- STATIC VOLTAGE CONTROL

PASSIVE BOOST

This strategy is implemented when the driver requests a considerable torque increase (e.g. high acceleration) and/or the vehicle has to climb: this request is managed by reducing the electrical power (in the most extreme case to zero) supplied from the alternator. The amount of mechanical power no longer absorbed by the alternator can be used to improve performance during acceleration or can be saved. The electrical loads are entirely supplied by the battery and the system voltage stabilises at lower values than those reached when the strategy is not active.

REGENERATIVE BRAKING

This strategy maximises the amount of mechanical energy recovered in the battery during the cut off stage (with or without the brake pedal pressed) after subtracting friction due to: advancement, braking system, engine brake. The adjustment voltage is set to a high value to obtain greater recharging. The magnetic field created by the voltage inside the alternator opposes its motion and therefore creates a higher resistance which helps the vehicle to slow down.

STATIC VOLTAGE CONTROL

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FUNCTIONAL DESCRIPTION

If the starting conditions are met (automatic transmission in the P or N position and brake pedal pressed), when the key in the starter switch H001 is turned to the end position (AVV), the contact (30) of relay switch T55 on the control unit B046 (pin 25 of connector B) - start enable from the engine control unit - and the contact (87) of relay switch T57 of the control unit B046 (pin 26 of connector B) - start enable from the Body Computer, are powered from pin 3 of connector A; both of these relay switches control the starter system in one of two possible modes: by key or automatically via the Start&Stop system.

The coil for relay switch T55 is energised by a positive signal supplied from pin 72 of connector B of the M010 engine Control unit.

The following are therefore supplied from contact (87) of T55:

- the power supply for the starter A020 solenoid (50) (connector B) electromagnet winding;
- the diagnosis signal for relay switch T57 operation (open again after the key is returned to the MAR position) and for relay switch T55 at pin 82 of connector B of control unit M010;
- the vehicle starting signal (CRANK) useful for the voltage stabilizer M192 (pin 4) for the management of its own operation.

The ignition switch H001 (pin 2 of connector A) is supplied directly from the battery via the line protected by fuse F03 of the engine compartment junction unit B001 (pin 31 of connector A).

This power supply is used also by contact (30) of the relay switch T57 of the control unit B046 (pin 24 of connector B) to allow, when enabled (closed) from Body computer M001 (negative signal from pin 49 of D connector), automatic restart of the heat engine after stopping the car (with the key at MAR and through the new closing of the remote control switch T55 of B046).

The coil of relay switch T57 receives an ignition-operated power supply (15/54) from the line protected by fuse F16 of B001 (pin 8 of connector C).

Pin +30 (connector A) for the starter motor A020 receives a supply directly from the battery, via the line protected by the dedicated fuse F70 of the fuse box on the battery B099 (pin 1 connector B) and the shunt fuse for contact board A005 (battery positive).

During the recharging phase, on the other hand, the direct current generated by the alternator A010 is sent, via the direct connection between connector A of the alternator itself (B+), connector A of the starter A020 and, lastly, the battery A001.

The regulator inside the intelligent alternator IAM A010 (pin 1 of connector B) communicates through the LIN serial line with the Powertrain Control Module M010 (pin 15 of connector A). The mutual exchange of information, parameters and operation feedback allows the alternator output voltage to be regulated according to the parameters requested by the control unit during driving.

This signal is sent, via C-CAN, from control unit M010 (pins 30 and 31 of connector A) to Body Computer M001 (pins 38 and 37 of connector D) and made available to the network.

Once a fault has been found, Body Computer M001 will turn on the "low battery charge/alternator fault" warning light on instrument panel E050 through the B-CAN.

The main automatic engine starting and stopping conditions are managed by the sensors and the control logic described below.

The brake servo vacuum sensor K105 is powered by the ignition-operated line (INT) protected by fuse F51 in Body Computer M001 (pin 7 of connector C), and provides pin 85 of connector B on M010 with the corresponding signal.

The battery charge status sensor K059 (connector A), supplied by the direct battery line protected by fuse F33 of Body Computer M001 (pin 19 of connector E), provides the Body computer itself (pin 14 of connector F) with the signal which permits, with the battery level below a certain threshold (75%), the deactivation of the Start&Stop system (via appropriate A-BUS serial line).

The Start&Stop device deactivation button inside the left control panel H091, connected to the central dashboard earth C022 (connector A), sends a negative signal to pin 34 of connector H of the Body Computer M001. The latter sends a positive signal to switch on the LED on the deactivation button from pin 6 of the same connector.

All operating, inhibition and exclusion conditions of the Start&Stop device are indicated through dedicated warning lights and messages available in the instrument panel display E050 and in some cases ("safety function") also through an acoustic signal.

The voltage stabiliser M192 manages the functions connected to the audio system during the starting stage. In detail:

- it receives an ignition-operated supply (INT) at pin 6, via the line protected by fuse F49 of the Body Computer M001 (pin 15 of connector G);
- it is connected to the central dashboard earth C022 at pin 16 (connector A);
- from pin 3, it provides a diagnosis signal to the Body Computer M001 (pin 47 of connector H) relating to its own operation;
- from pins 8 (+30 power supply input) and 1 (+30 power supply output) it is connected to the radio system.

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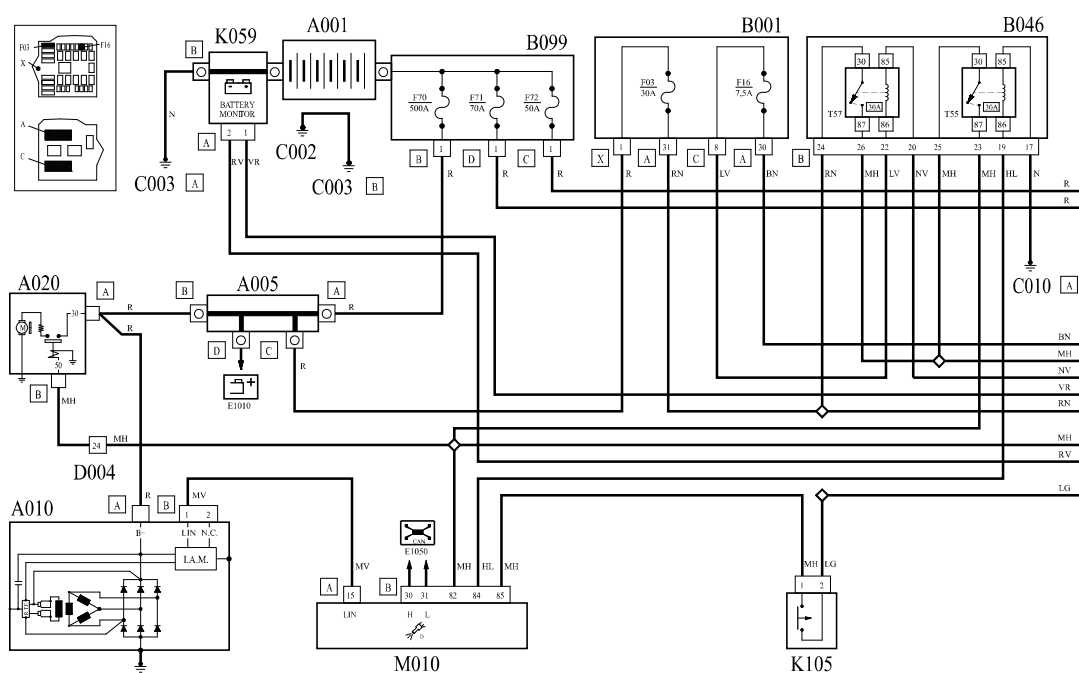
The Body Computer M001 receives direct battery supply at pins A and B of connector A. These supplies are protected upstream by fuses F71 and F72 of the maxifuse control unit on the battery B099 (connectors D and C).

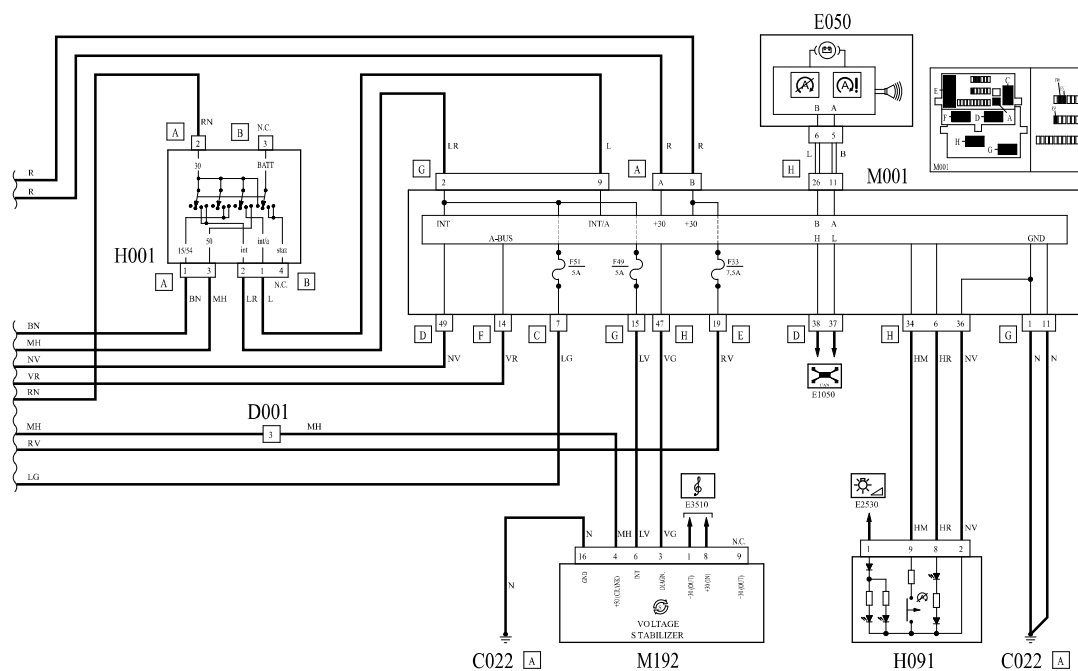
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The Body computer M001 also receives two ignition-operated (INT and INT/A) supplies respectively at pins 2 and 9 of connector G.

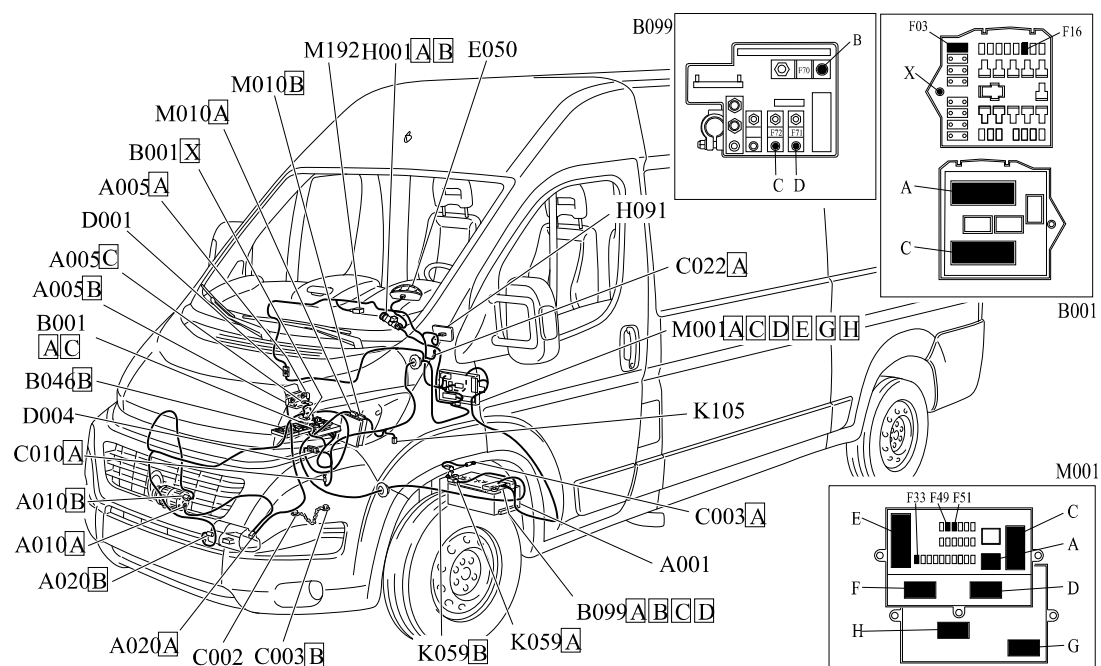
The Body Computer M001 is also connected to the central dashboard earth C022 (connector A) via pins 1 and 11 of connector G.

APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION WIRING DIAGRAM





APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION



COMPONENTS

| COMPONENT CODE | ASSEMBLY REFERENCE |
|--|--|
| <u>A001 BATTERY</u> | <u>5530B BATTERY AND LEADS</u> |
| <u>A005 TERMINAL BOX</u> | <u>5530B BATTERY AND LEADS</u> |
| <u>A010 ALTERNATOR</u> | <u>5530A ALTERNATOR AND COMPONENTS</u> |
| <u>A020 STARTER MOTOR</u> | <u>5520B STARTER AND COMPONENTS</u> |
| <u>B001 ENGINE COMPARTMENT JUNCTION UNIT</u> | <u>5505A MULTI-FUNCTION COMPONENTS</u> |
| <u>B046 ADDITIONAL SYSTEM FUSE BOX</u> | - |
| <u>B099 MAXI FUSE BOX ON BATTERY</u> | <u>5530B BATTERY AND LEADS</u> |
| <u>C002 BATTERY EARTH ON ENGINE (BATTERY NEGATIVE)</u> | - |
| <u>C003 BATTERY EARTH ON BODY</u> | - |
| <u>C010 FRONT LEFT EARTH</u> | - |
| <u>C022 CENTRAL DASHBOARD EARTH</u> | - |
| <u>D001 FRONT/DASHBOARD COUPLING (FRONT)</u> | - |
| <u>D004 FRONT/ENGINE COUPLING (ENGINE)</u> | - |
| <u>E050 INSTRUMENT PANEL (DASHBOARD)</u> | <u>5560B ANALOGUE CONTROL PANEL</u> |
| <u>H001 IGNITION SWITCH</u> | <u>5520A IGNITION SWITCH</u> |
| <u>H091 DRIVER'S SIDE CONTROL ASSEMBLY (DASHBOARD)</u> | <u>7040A PASSENGER COMPARTMENT TRIMS</u> |
| <u>K059 BATTERY CHARGE STATUS SENSOR</u> | <u>5520D START & STOP SYSTEM</u> |
| <u>K105 BRAKE SERVO VACUUM SENSOR (FRONT)</u> | <u>5520D START & STOP SYSTEM</u> |
| <u>M001 BODY COMPUTER</u> | <u>5505A MULTI-FUNCTION COMPONENTS</u> |
| <u>M010 ENGINE CONTROL MODULE</u> | <u>1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL</u> |
| <u>M192 VOLTAGE STABILISER (DASHBOARD)</u> | <u>5520D START & STOP SYSTEM</u> |