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E5010 - STARTING AND RECHARGING [AUTOMATIC TRANSMISSION][START&STOP]

APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION, START&STOP 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 engine 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 drivers 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 accessibility of the on board services.

In safety conditions, the powertrain is turned on and off through appropriate operation of the accelerator and brake pedals and the automatic transmission lever.

The vehicle also implements a safety strategy that only allows the engine to be started with the key when the gear lever is in the P (Parking) or N (Neutral) position.

The engine control module, automatic transmission lever and Body Computer exchange the signals, information and commands required to implement the Start&Stop system, through discrete connections or via 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 warning lights, icons and possibly messages on the display.

The engine control module 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 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 engine control module, summarises the status of this collection of systems and notifies the engine control module of the enabling 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 engine 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 power brake vacuum sensor (that communicates directly with the braking system control unit);
- the voltage stabilizer (only for versions with radio setup);
- the system exclusion button located on the left control panel.

The battery charge status sensor - IBS - on the negative battery pole includes a pin which, through a quick-release negative terminal ("RADSOK" type connector), is connected to the power ground of the body. 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.

E1020 VOLUMES

On versions with radio setup, the voltage stabilizer prevents the voltage drop noticeable during the initial engine starting stages which leads to a loss of Infotainment functions/services.

E3510 RADIO

The information related to the state of the vacuum sensor in the power brake circuit reaches the Body Computer and the engine control module through the CAN from the braking system control unit to which the sensor is directly connected.

E7023 ESP/ESC

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 to early wear and a much shorter battery life as well as reduced availability of the Start&Stop system.

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

The starter windings are supplied through two dedicated relays, one located in the additional fusebox and inside the Body Computer, operated respectively by the engine control module and the Body Computer's internal logic in both starting conditions (key in extreme position -AVV- or automatically through the Start&Stop line), 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.

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

Furthermore, this version has adopted the intelligent alternator (IAM - Intelligent Alternator Module). It is an electronically-controlled alternator that continuously dialogues with the engine control module through a LIN serial line and recharges the battery according to the driving style and the vehicle conditions.

On the basis of a mutual exchange of information on the LIN line, the voltage regulator, allows the alternator output voltage to be regulated according to the parameters requested by the engine control unit during driving.

The modules involved in the management of this system are:

- the engine control module, that send the commands to the voltage regulator inside the alternator via the LIN serial line;
- the alternator voltage regulator, that sends the feedback messages related to its own state to the engine control module on the LIN line;
- the battery charge sensor (IBS) which sends information on the battery state to the Body Computer through the LIN serial line;
- the Body Computer, which sends signals from the battery charge sensor (IBS) to the engine control module through the C-CAN.

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 insufficient voltage or a current generation system fault is detected, the corresponding warning light or icon on the instrument panel switches on and a dedicated message is displayed. In these cases, automatic restart by the Start&Stop system is disabled.

APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION, START&STOP FUNCTIONAL DESCRIPTION

The ignition switch H001 (pin 2 of connector A) is supplied directly from the battery via the line protected by fuse F53 of the Body Computer M001 (pin 5 of connector G).

Turning the key in the ignition switch H001 to the end position (AVV), the cranking signal (50) is sent from pin 3 of connector A to the Body Computer M001 (pin 25 of connector H).

The relay integrated in the Body Computer which manages the engine cranking logic (T39 - not replaceable -) receives power (pin 20 of connector C of M001) from the line protected by fuse F03 of the engine compartment unit B001 (pin 31 of connector A).

From pin 1 of connector C, the Body Computer M001 provides power to the power contact of the cranking enable relay T55 of additional fusebox B046 (pin 25 of connector B).

If the ignition conditions are met (by key or automatic through the Start&Stop system), the coil of relay switch T55, connected to the front left ground C010 (connector A), is energized by a positive signal (pin 19 of connector B of B046) supplied from 72 of connector A of the engine control module M010.

The relay switch T55 (pin 23 of connector B) supplies the power supply for the starter A020 (connector B) electromagnet (50) winding. The same signal is supplied to pin 85 of connector A of the engine control

module M010 as feedback for actually powering the starter motor and to voltage stabilizer M192 (pin 4) for managing of its functions related to the vehicle sound system.

Pin +30 (connector A) of starter motor A020 receives power directly from the battery, through the line protected by the specific fuse F70 of the battery fusebox B099 (connector A) through the maxi-fuse box B005 located on the front left side of the engine compartment (unprotected line) and the junction terminal board A005 located near the engine compartment junction control module.

During recharging instead, the direct current generated by alternator A010 is sent through the connection between connector A of the alternator (B+) and connector A of starter motor A020, to battery A001 (connector A of B099).



For the Minibus versions, the maxifuse control unit on the battery and the power connections of the starting and charging circuit are partially different than what is described above; for further details refer to the specific electrical function:

E1010 POWER SUPPLY

From pin 1 of connector B the regulator inside the intelligent alternator IAM A010 communicates through the LIN serial line with the Engine Control Module M010 (pin 83 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 information is sent, through the C-CAN, from the control module M010 (pins 13 and 14 of connector A) to the Body Computer M001, to the instrument panel E050 and made available to the network.

E1050 CAN CONNECTION LINES

Having detected a fault, the instrument panel E050 will control the operation of the “insufficient battery recharging/alternator fault” warning light.

The main automatic engine starting and stopping conditions are managed by the sensors and the control logic described below through the Start&Stop system.

The automatic transmission gear selector M053 sends the lever in P or N position signal via C-CAN1 (pins 8–10 and pins 7–9). This signal is needed to stop and then restart the engine via the Start&Stop system.

Pin 21 of connector D of the Body Computer M001 receives an NO signal from the switch on the brake pedal I030, powered directly by the battery along the line protected by fuse F53 of the Body Computer (pin 6 of connector G). In the same way, the Body Computer M001 receives on pin 11 of connector D an N.C. signal from the switch on the brake pedal I030, which is powered with the key in the “MAR” position (INT), through the line protected by fuse F42 of the Body Computer (pin 30 of connector D). The latter will forward these signals to the gear selector control unit M053 and automatic transmission control unit M055 via the C-CAN. In fact, it is necessary to press the brake pedal to select the various drive modes (P, R, N, D).

E7050 AUTOMATIC TRANSMISSION

The vacuum sensor in the power brake circuit K105 receives power from the brake system control unit M051 (pin 22) and supplies the relative signal to pin 36 of M051 itself; this information is made available on the C-CAN and is then taken in by the Body Computer M001 and the engine control module M010. For versions with electric parking brake, the vacuum sensor in the brake servo circuit K105 receives power from the braking system control module M051 (pin 41) and supplies the respective signal to pin 38 of M051 itself.

E7023 ESP/ESC

The battery charge state sensor K059 (connector A) is powered by the direct battery line protected by fuse F33 of the Body Computer M001 (pin 19 of connector E).

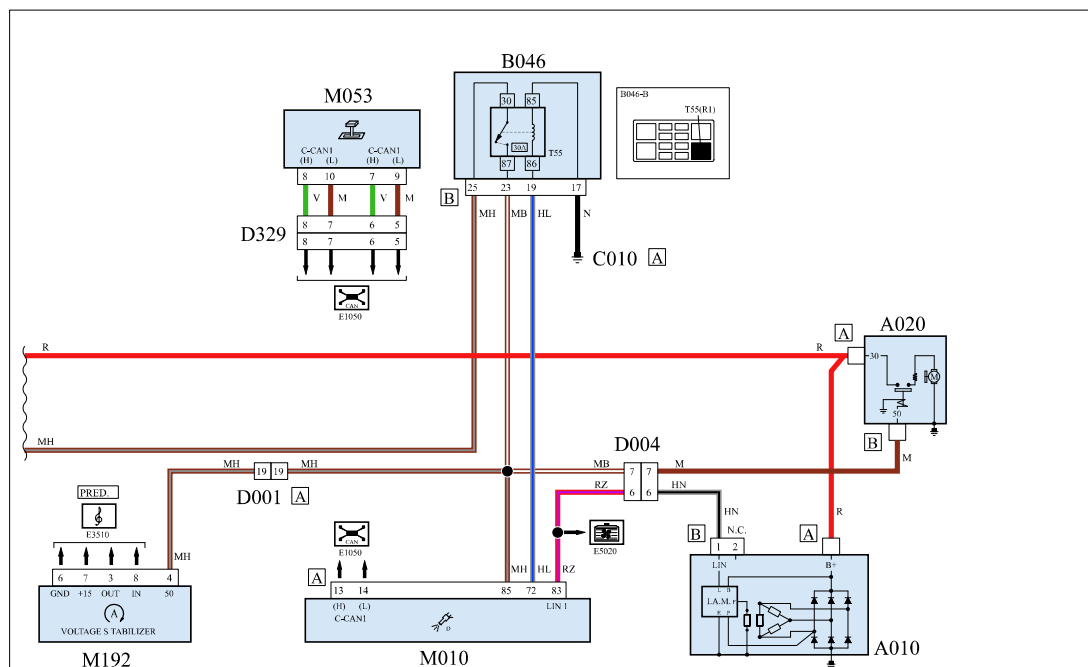
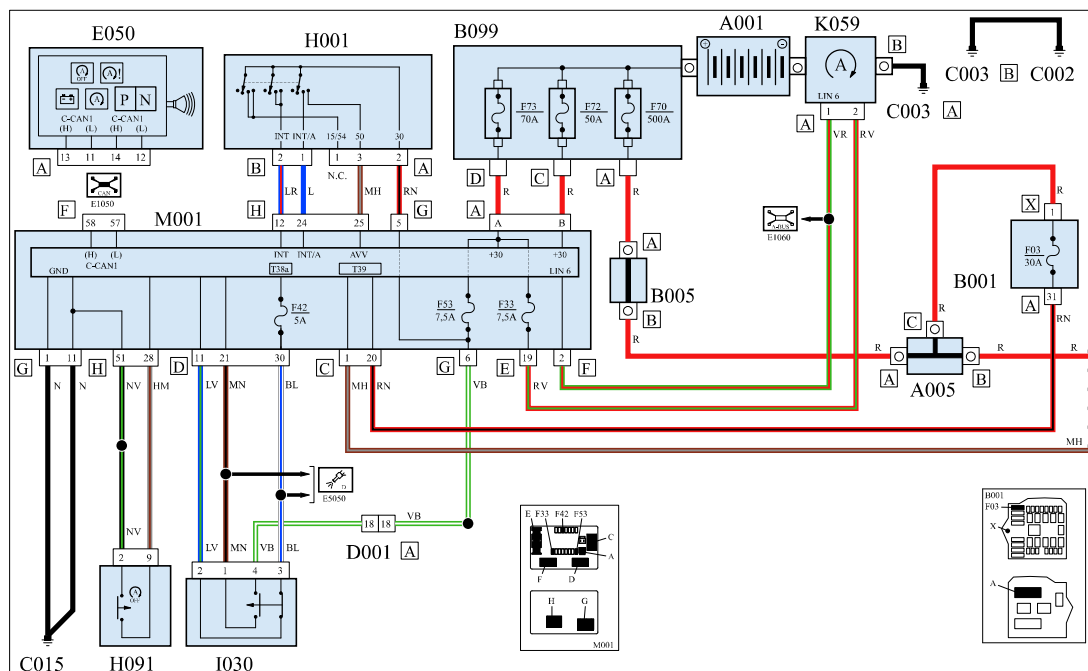
It exchanges the signals on the LIN serial line that allow the Start&Stop system to be disabled with the battery level below a certain threshold (75%) with the Body Computer M001 (pin 2 of connector F).

The exclusion button of the Start&Stop device is in left control module H091: the latter - pin 2 - receives an ground reference from pin 51 of connector H of Body Computer M001 and sends - pin 9 - the negative exclusion request signal to pin 28 of the connector H of the Body Computer itself.

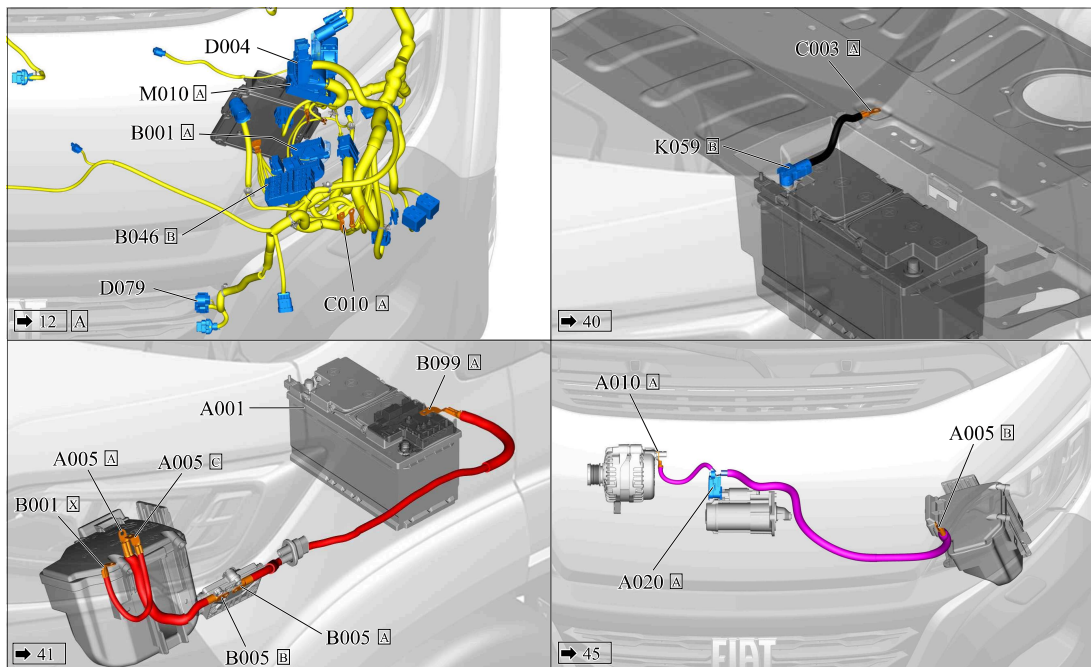
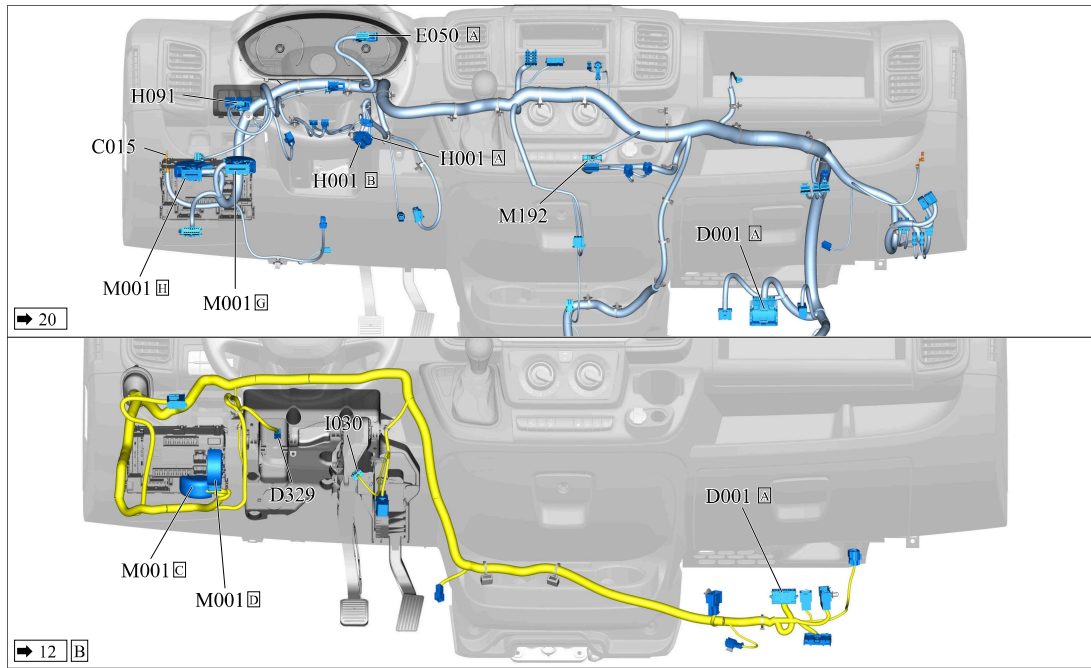
All Start&Stop device operating, inhibition and exclusion interventions are displayed through dedicated icons, warning lights and, where present, messages available on the instrument panel display E050. In particular, the following are managed:

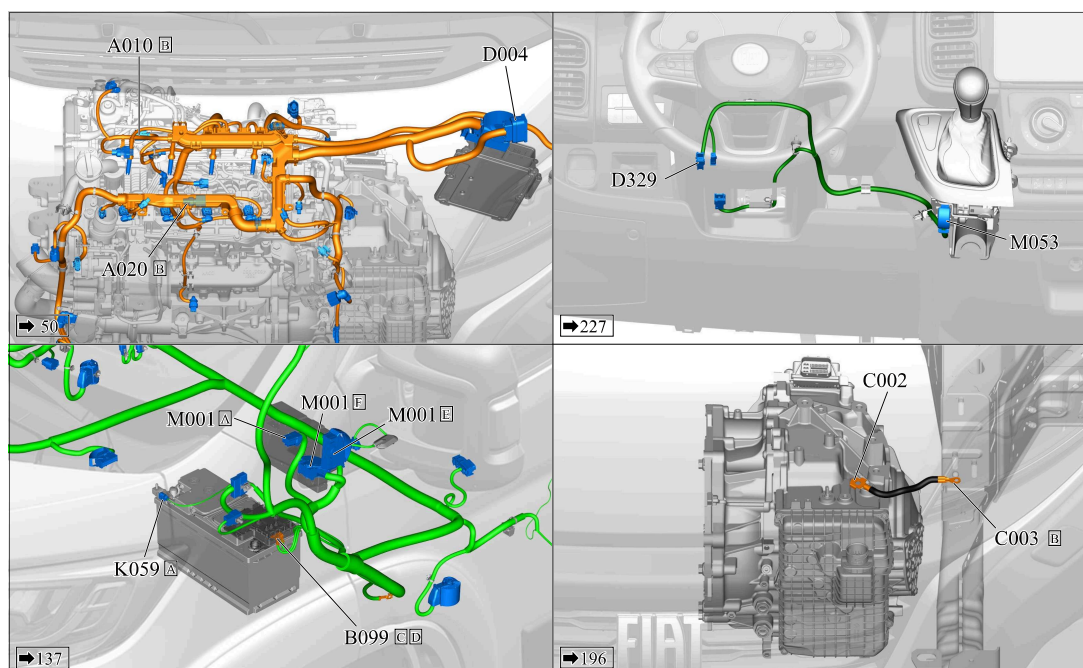
- the “Start&Stop system disabled” warning light, to indicate that the system has been excluded (automatically or manually by the user);
- the “Start&Stop system intervention” icon, to indicate that the system has turned off the engine;
- the “Start&Stop system failure” icon, to indicate the system is not available.

APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION, START&STOP WIRING DIAGRAM



APPLICABLE TO VERSIONS WITH: AUTOMATIC TRANSMISSION, START&STOP COMPONENT LOCATIONS





COMPONENTS

COMPONENT CODE	REFERENCE TO THE OPERATION
<u>A001 BATTERY</u>	<u>5530B10 BATTERY - R.R.</u> <u>PRELIMINARY DIAGNOSIS INCLUDED</u>
<u>A005 TERMINAL BOX</u>	-
<u>A010 ALTERNATOR</u>	<u>5530A10 ALTERNATOR - R.R.</u>
<u>A020 STARTER MOTOR</u>	<u>5520B10 STARTER MOTOR - R.R.</u>
<u>B001 ENGINE COMPARTMENT JUNCTION UNIT</u>	-
<u>B005 MAXI FUSE BOX-1</u>	-
<u>B046 ADDITIONAL SYSTEM FUSE BOX</u>	-
<u>B099 MAXI FUSE BOX ON BATTERY</u>	<u>5530B40 SUPPLY BOX ON BATTERY (LINK BATTERY AND FUSE BOX) - R.R.</u>
<u>C002 BATTERY EARTH ON ENGINE (ENGINE GEARBOX EARTH HARNESS)</u>	<u>5530B20 BATTERY EARTH LEAD ON POWER UNIT - R.R.</u>
<u>C003 BATTERY EARTH ON BODY</u>	<u>5530B20 BATTERY EARTH LEAD ON POWER UNIT - R.R.</u> <u>5530B22 BATTERY EARTH LEAD - R.R.</u>
<u>C010 FRONT LEFT EARTH</u>	-
<u>C015 DRIVER SIDE DASHBOARD EARTH (DASHBOARD)</u>	-
<u>D001 FRONT/DASHBOARD COUPLING</u>	-
<u>D004 FRONT/ENGINE COUPLING (ELECTRIC PROPULSION SYSTEM)</u>	-
<u>D329 AUTOMATIC TRANSMISSION GEAR LEVER COUPLING (AUTOMATIC TRANSMISSION LEVER HARNESS)</u>	-

<u>E050 INSTRUMENT PANEL</u>	<u>5560B10 INSTRUMENT PANEL - R.R.</u>
<u>H001 IGNITION SWITCH</u>	<u>5520A10 IGNITION SWITCH ASSEMBLY - R.R.</u>
<u>H091 DRIVER'S SIDE CONTROL ASSEMBLY</u>	<u>7040A82 DASHBOARD SWITCH UNIT LEFT SIDE - R.R.</u>
<u>I030 BRAKE PEDAL SWITCH</u>	<u>5550D10 BRAKE LIGHT SWITCH - R.R.</u>
<u>K059 BATTERY CHARGE STATUS SENSOR</u>	<u>5520D01 BATTERY STATUS MONITORING SENSOR - R.R.</u>
<u>M001 BODY COMPUTER</u>	<u>5505A35 MAIN BODY COMPUTER/JUNCTION UNIT - R.R.</u>
<u>M010 ENGINE CONTROL MODULE</u>	<u>1060G80 DIESEL ELECTRONIC INJECTION CONTROL UNIT - R.R.</u>
<u>M053 AUTOMATIC TRANSMISSION GEAR SELECTOR CONTROL UNIT (AUTOMATIC TRANSMISSION LEVER HARNESS)</u>	-
<u>M192 VOLTAGE STABILISER (DASHBOARD)</u>	5520D03