



GESTIONE ELETTRONICA MOTORI DIESEL

250/251 - Ducato

DIESEL ENGINE ELECTRONIC MANAGEMENT - DESCRIPTION

An electronic control system supervises and governs all engine parameters to optimise performance and fuel consumption by means of a real-time response to different operation conditions.

The power unit is available in 2 configurations:

- 130 HP with fixed geometry turbine;
- 150 HP with variable geometry turbine (VGT).

Diesel engines are equipped with a COMMON RAIL type injection system.

This features the use of an electronically controlled high injection pressure. The supply of fuel, known as the pilot injection, is optimised by the electronic control unit by means of the injector, rather than being managed by the pump.

In this 4 valve per cylinder version, the COMMON RAIL injection system uses MULTIJET technology: i.e. during each engine stroke, it carries out more than the two injections normally used: it performs two pre-injections (before the piston is at top dead centre), one main and two post-injections.

This solution improves fuel consumption, emissions, noise levels and performance because it allows better control of temperature in the combustion chamber by lowering the maximum value and extending the optimum combustion area.

The throttle body is also controlled electronically by the control unit: the throttle opening is calculated in accordance with a specific logic inside the engine management control unit.

Depending on the signals received from numerous sensors, the control unit manages the injectors connected to it, handling the following systems:

- fuel supply;
- air delivery;
- glow plugs;
- accelerator pedal;
- engine cooling;
- emission control (oxygen sensor and particulate filter);
- exhaust gas recirculation control (EGR).

To comply with the latest emissions control regulations (EURO 5), the most recent electronic on-board management version is used, comprising new components (injectors, pressure regulator and high pressure pump, digital flow meter) and the adoption of an oxygen sensor.

The oxygen sensor improves the air/fuel mixture in the combustion chamber regulating the flow of air: with the throttle open the power supply is at a maximum; closing the throttle gradually reduces the load, the engine rpm and also the emissions.

In addition to the oxygen sensor a DPF (Diesel Particulate Filter) is used: it is a mechanical filter, inserted in the exhaust pipes, which traps the carbon particles present in the Diesel engine exhaust gas. The filter makes it possible to almost totally eliminate the emission of carbon particles in line with current legislation.

See E5070 PARTICLE FILTER SYSTEM

Thanks to the electronic management described above, this engine carries out a continuous check according to the EOBD system (European On Board Diagnosis): this system allows continuous diagnosis of emission-related car components and notifies the driver if any of the components should deteriorate by turning on a warning light in the instrument panel.

The aim of the system is to:

- monitor system efficiency;
- indicate an increase in emissions due to vehicle malfunction;
- indicate the need to replace damaged components.

For more details,

See descriptions 1060 DIESEL INJECTION FUEL SYSTEM

The system is also controlled by dedicated relays in the engine compartment junction control unit. Lines supplying the control unit and various system components (sensors and actuators) are protected by dedicated fuses that are also located inside the engine compartment junction unit.

DIESEL ENGINE ELECTRONIC MANAGEMENT - FUNCTIONAL DESCRIPTION

Engine management control unit M010 controls and governs the entire electronic ignition and injection system.

The ignition-operated power supply (15/54) arrives through a line protected by fuse F16 of the engine compartment junction unit B001 (pin 9 of connector C) at pin 88 of connector B of M010.

The main injection relay switch T09 of the control unit B001 manages the whole system: its coil is directly supplied by the battery through the line protected by fuse F18 of the engine compartment junction unit. The same supply reaches pin 50 of connector B of M010.

This relay switch is energised by an (earth) control signal from pin 33 of connector B of the engine management control unit M010 and then forwards a power supply:

- to pins 3, 5 and 6 of connector B of the control unit via a line protected by fuse F22 of B001 (pin 18 of connector C);
- to the oxygen sensor heating resistance K040, to the flow meter K041 and to the relay switch T22 of the additional system fuse box B046 (optional blow-by system), through the line protected by fuse F17 of B001 (pin 31 of connector C);
- to pin 29 of connector B of M010, to pin 6 of the heater plug control unit M015 and to the variable geometry solenoid valve L036 (only 150 HP versions), through the line protected by fuse F11 of B001 (pin 7 of connector C).

The oil vapour heating resistance (blow-by) O007 is controlled by relay switch T22 of B046. The relay switch coil is activated by a negative signal supplied by pin 75 of connector B of M010. Pin 20 of B046 supplies resistance O007 and the relative engagement signal (feedback) is sent to the engine management control unit M010 (pin 24 of connector B) so that this can diagnose the operation of the resistance.

The heater plug control unit M015 (pin 11) also receives a direct battery power supply via the line protected by fuse F02 of the engine compartment junction unit B001 (pin B of connector B).

The fuel pump relay T10 of junction unit B001 provides a direct battery power supply to the fuel pump N040 - pin 1 - along the line protected by fuse F21 of the engine compartment junction unit B001 (pin 16 of connector A).

The coil is energised by pin 94 of connector B of the engine management control unit M010; the coil for relay switch T10 receives a reference earth, via pin 11 of connector C of the engine compartment junction unit B001, coming from the NC contact for the inertia switch I050 (pin 3).

In the case of an impact the inertia switch opens, no longer supplying the reference earth to the coil for relay switch T10 and thereby interrupting the activation of the fuel pump N040 and the additional heating pump N044.

See E6015 ADDITIONAL HEATER

In the same way, for the MINIBUS versions, pressing the button for automatic intervention in dangerous conditions H134 (if present) interrupts this earth signal.

The intervention of the inertia switch I050 and/or pressing the button for automatic intervention in dangerous conditions H134 (if present) also causes the electrical power supply for the injection system to be cut off and the activation of several safety functions.

See E1010 POWER SUPPLY

Pins 1, 2 and 4 of connector B of the engine management control unit M010 are connected to the injection control unit earth C060; the heater plug control unit M015 (pin 7), the water in diesel filter sensor integrated in filter K101, the oil vapour heating resistance O007 (where provided) and the engine oil sensor signal control unit M186 (pin 4) are connected to the same earth.

The casing of the engine control unit M010 (connector C) is connected to the radio frequency earth on strut C103.

The heater plug control unit M015 is connected, via pins 1, 2, 3 and 4 to the heater plugs A040, A, B, C and D and via pins 9 and 10 to pins 19 (preheating time/fault detection feedback) and 32 (heater plug signal) of connector B of the engine management control unit M010.

The engine management control unit M010 receives signals from the various sensors, thereby keeping all the engine operating parameters under control.

The engine management control unit M010 controls with an earth signal from pin 73 of connector B, the heater inside the oxygen sensor K040 (pin 3).

The control unit M010 sends a "pumping" current, from pin 65 of connector B, to the oxygen sensor K040 (pin 2), which is compared with the "setting" one received from pin 64 of connector B (at pin 1 of K040). The oxygen sensor receives a reference earth, at pin 6, from pin 87 of connector B of M010 and sends a voltage signal, from pin 4, proportional to the percentage of oxygen measured in the exhaust gases to pin 86 of connector B of control unit M010.

EGR solenoid valve L030 controls the exhaust gas recirculation. The EGR solenoid valve L030 is controlled by two signals (positive and negative) from pins 45 and 60 of connector A of M010; the position sensor integrated into the solenoid valve L030 receives power supply and earth from pins 21 and 24 and returns a position signal to pin 43 of connector A of M010.

The engine oil sensor signals control unit M186 receives an ignition-controlled power supply (INT) at pin 1, through the line protected by fuse F51 located in the Body Computer M001 (pin 7 of connector C); it receives the information from the engine oil level sensor K032, at pins 3 (positive) and 6 (negative) and sends these signals, from pins 2 (oil level signal) and 5 (earth signal) to the control unit M010 (pins 12 and 8 of connector A respectively).

The engine rpm sensor K046 supplies, through frequency signals exchanged with pins 14 (negative) and 29 (positive) of connector A of M010, information on engine speed.

Timing sensor K047 is supplied from pin 53 of connector A of control unit M010; this receives a reference earth from pin 7 of connector A, and sends a signal with frequency corresponding to the phase to pin 13 of connector A of the control unit.

The engine coolant sensor K036 receives a reference earth from pin 10 of connector A of control unit M010 and sends a signal proportional to engine coolant temperature to pin 39 of connector A of the control unit.

The control unit M010 receives - at pin 57 of connector A - a signal from the minimum engine oil pressure sensor K030.

The air flow meter K041 receives a reference earth from pin 23 of connector A of control unit M010 and sends a signal proportional to the air flow rate to pin 28 of connector A. An air temperature sensor inside K041 also sends an air temperature signal to pin 44 of connector A of M010.

Accelerator pedal K055 contains two built-in potentiometers (a main one and a safety one). The former receives power and earth signals from pins 12 and 42 of connector B of M010 and sends a corresponding signal to pin 82 of the same connector. The latter receives power and earth signals from pins 13 and 40 of connector B of M010 and sends a corresponding signal to pin 61 of the same connector.

According to the signal from accelerator pedal K055, control unit M010 controls the throttle opening by means of a motor built into throttle body N075. The internal solenoid valve chokes and closes the throttle for example when the engine is turned off. It is controlled by two signals from pins 15 and 30 of connector A of M010. Pins 9, 22 and 56 of connector A of M010 manage the solenoid valve control function.

The water in diesel filter sensor, integrated in the diesel filter K101, receives an ignition-operated supply (INT) from fuse F51 of the Body Computer M001 (pin 7 of connector C) and is connected to the earth C060, sending the corresponding signal to pin 26 of connector B of control unit M010.

The fuel temperature sensor, incorporated in the diesel filter K101, detects the temperature of the incoming diesel fuel. It receives a reference earth from pin 56 of connector B of control unit M010 and sends a fuel temperature signal to pin 80.

Sensor K044 measures the air pressure and the temperature in the intake chamber, downstream of the turbocharger. It is supplied by pin 36 of connector A of control unit M010 and receives a reference earth from pin 25 of the same connector. The signal corresponding to the pressure value is sent to pin 55 of connector A of control unit M010. An air temperature sensor, housed in K044, sends a signal to pin 58 of connector A of M010.

Fuel pressure sensor K083 supplies the injection control unit with a feedback signal to modulate injection pressure and duration. It receives power and a reference earth from pins 6 and 20 of connector A of engine control unit M010 and then sends a pressure signal to pin 42 of the same connector.

The fuel pressure regulator on the N077 pump controls the high pressure produced by the pump itself; the two control signals come from pins 3 and 19 of connector A of control unit M010.

The turbine variable geometry control solenoid valve L036 (only present in the 150 HP version) adjusts turbine operation according to the engine load: it is controlled by a negative signal from pin 51 of connector B of control unit M010.

The turbine variable geometry control solenoid valve is also controlled by a feedback signal from a dedicated sensor K206 which sends the control unit a signal relating to the effective position of the turbine vanes governed by the valve itself.

The variable geometry position sensor K206 receives power supply from pin 37 of connector A of the control unit M010 and receives a reference earth from pin 37 of connector A; it sends a signal relating to the geometry of the turbine to pin 41 of connector A of M010.

The engine management control unit M010 controls the opening of the individual injectors N070, through dedicated signals sent from pins 2-17 (cyl. 1), 32-47 (cyl. 2), 31-36 (cyl. 3), 1-16 (cyl. 4) of connector A.

Pin 83 of connector B of control unit M010 receives an NO signal from the switch on brake pedal I030, provided by an ignition-controlled supply (INT) via a line protected by fuse F42 of the Body Computer M001. The latter receives the same signal at pin 57 of connector D.

Body Computer M001 receives an NC signal from the switch on brake pedal I030 at pin 11 of connector D. This also has an ignition-operated supply (INT) via a line protected by fuse F37 of the Body Computer. The latter forwards this signal to the control unit M010 through the C-CAN.

At pin 23 of connector B, the control unit M010 receives the signal from the clutch pedal switch I031, which (pin 4) receives an ignition-operated supply (INT) through the line protected by fuse F51 of the Body Computer M001 (pin 4 of connector C).

The control unit M010 is then connected via the CAN - pins 69 and 70 of connector B - to the Body Computer M001 - pins 38 and 37 of connector D - and to the other network nodes; information is sent, via this connection, for the management of the indicators and warning lights in the instrument panel E050, in particular for the management of:

- engine coolant temperature gauge and warning light;
- rev counter;
- minimum engine oil pressure warning light;
- heater plug warning light;
- water in diesel filter sensor;
- Injection system/EOBD failure warning light;
- "general failure" warning light lit up for the failure of the engine oil pressure sensor or the operation of the inertia switch.

See E4010 INSTRUMENT PANEL

The control unit M010 receives a speedometer signal generated by the braking system control unit M051 via the C-CAN.

It is also connected:

- from pins 9, 10 and 74 of connector B to manage the engine cooling fans;

See E5020 ENGINE COOLING

- from pins 35, 41, 81 and 30 of connector B for managing the compressor engagement function;

See E6021 COMPRESSOR ENGAGEMENT

- from pins 14, 43, 54, 57, 39, 58 and 60 of connector B, to manage the particulate filter function;

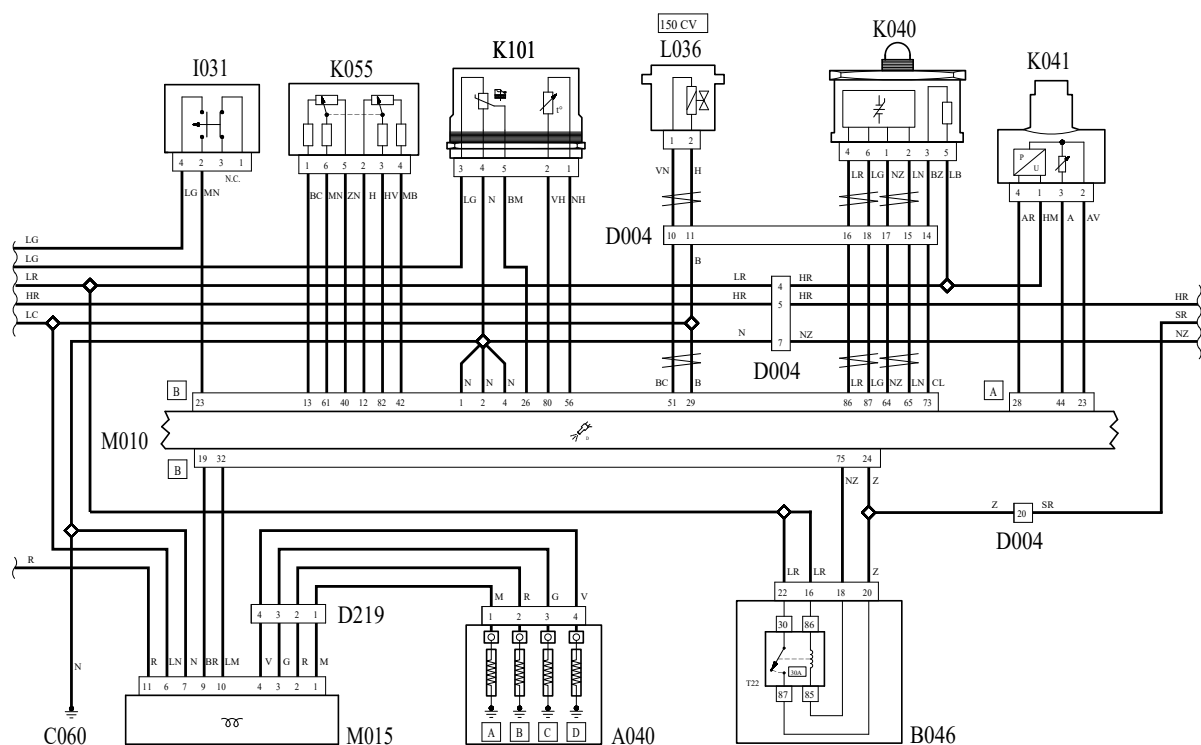
See E5070 PARTICLE FILTER SYSTEM

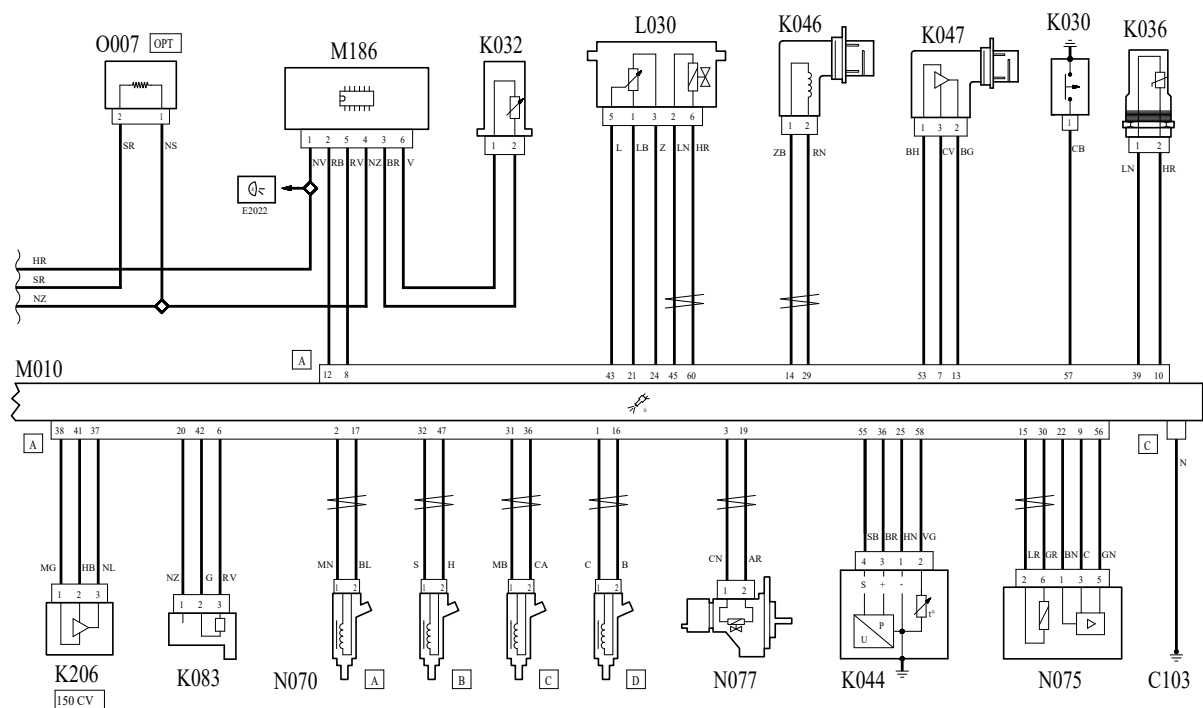
- from pin 11 of connector A, with the alternator A010 for management of the insufficient battery charge/alternator fault (D+) signal;

See E5010 STARTING AND RECHARGING

- from pin 46 of connector B, with the reversing switch I020.

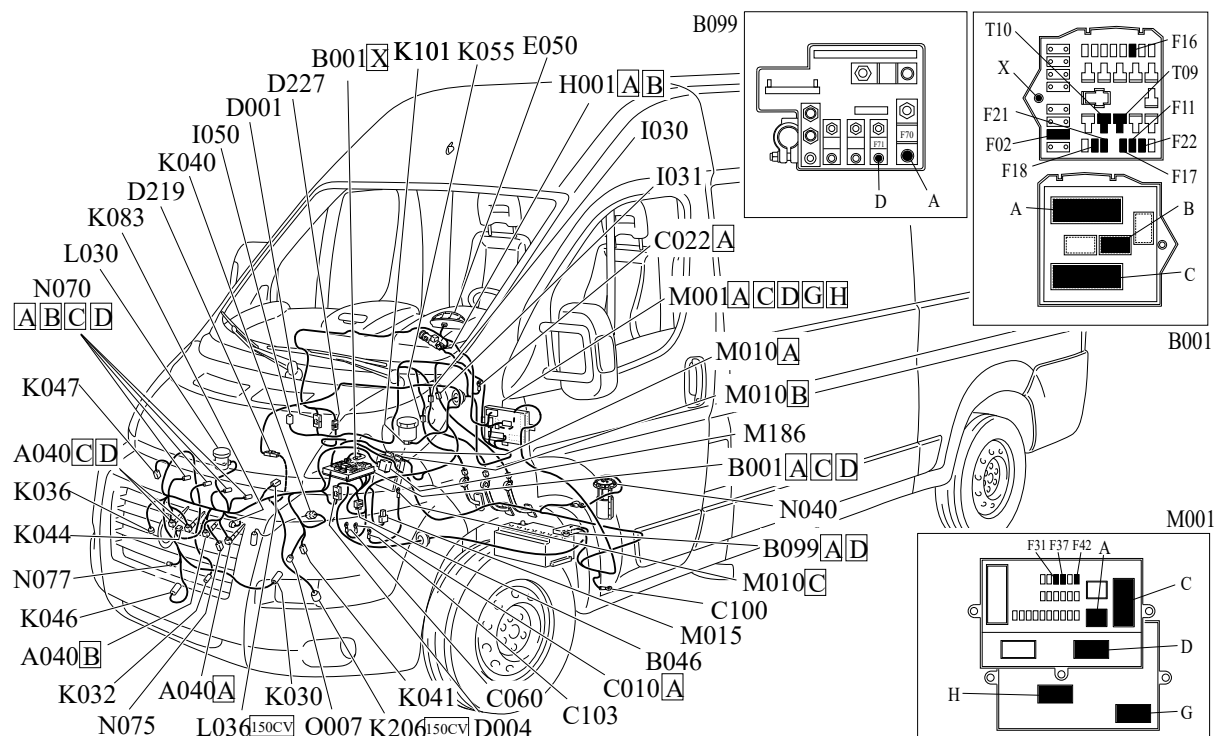
See E2022 REVERSING LIGHTS





| Component code | Name | Assembly reference |
|----------------|--|---|
| A040 | HEATER PLUGS | Op. 5520C COLD STARTING SYSTEM (DIESEL ENGINES) |
| B001 | JUNCTION UNIT | Op. 5505A MULTI-FUNCTION COMPONENTS |
| B046 | ADDITIONAL SYSTEM FUSE BOX | - |
| B099 | MAXI FUSE BOX ON BATTERY | Op. 5530B BATTERY AND LEADS |
| C010 | LEFT FRONT EARTH | - |
| C022 | Centre dashboard earth | - |
| C060 | INJECTION CONTROL UNIT EARTH | - |
| C100 | CAB EARTH | - |
| C103 | MASSA SU PUNTONE (BRIGLIA MASSE CENTRALINE) | - |
| D001 | FRONT/DASHBOARD COUPLING | - |
| D004 | FRONT/ENGINE COUPLING | - |
| D219 | HEATER PLUGS COUPLING | - |
| D227 | CAB/DASHBOARD COUPLING | - |
| E050 | INSTRUMENT PANEL | Op. 5560B ANALOGUE CONTROL PANEL |
| H001 | IGNITION SWITCH | Op. 5520A IGNITION SWITCH |
| I030 | BRAKE PEDAL SWITCH | Op. 5550D BRAKE AND REVERSING LIGHTS |
| I031 | CLUTCH PEDAL SWITCH | Op. 5580A CRUISE CONTROL SYSTEM |
| I050 | INERTIA SWITCH | Op. 1040A FUEL TANK AND COMPONENTS |
| K030 | ENGINE OIL PRESSURE SENSOR (SWITCH) | Op. 1084A SIGNALLING/CONTROL DEVICES |
| K032 | ENGINE OIL LEVEL SENSOR | Op. 1084A SIGNALLING/CONTROL DEVICES |
| K036 | ENGINE COOLANT TEMPERATURE SENSOR/SENDER UNIT | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K040 | LAMBDA SENSOR | Op. 1080B EXHAUST EMISSION CONTROL SYSTEM |
| K041 | AIR FLOW METER | Op. 1048A VACUUM AIR CIRCUIT |
| K044 | AIR TEMPERATURE/PRESSURE SENSOR | Op. 1072B INTAKE MANIFOLDS |
| K046 | RPM SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K047 | TIMING SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K055 | ACCELERATOR PEDAL POTENTIOMETER | Op. 1068A ACCELERATOR PEDAL CONTROL |
| K083 | FUEL PRESSURE SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K101 | FUEL TEMPERATURE AND WATER IN FUEL FILTER SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K206 | VARIABLE GEOMETRY TURBINE POSITION SENSOR | Op. 1064A TURBOCHARGER ASSEMBLY |
| L030 | EGR SOLENOID | Op. 1080C EXHAUST GAS RECIRCULATION (E.G.R.) |
| L036 | TURBINE VARIABLE GEOMETRY CONTROL SOLENOID VALVE | Op. 1064B CONTROL/SAFETY DEVICES |
| M001 | BODY COMPUTER | Op. 5505A MULTI-FUNCTION COMPONENTS |
| M010 | ENGINE MANAGEMENT CONTROL UNIT | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| M015 | HEATER PLUGS CONTROL UNIT | Op. 5520C COLD STARTING SYSTEM (DIESEL ENGINES) |
| M186 | ENGINE OIL SENSOR SIGNAL CONTROL UNIT | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| N040 | FUEL PUMP AND LEVEL GAUGE | Op. 1040A FUEL TANK AND COMPONENTS |
| N070 | INJECTOR | Op. 1060F INJECTORS AND PIPES |
| N075 | INTEGRATED THROTTLE BODY ACTUATOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| N077 | FUEL PRESSURE REGULATOR | Op. 1060E DIESEL PRESSURE PUMP AND CONTROL |
| O007 | OIL VAPOUR HEATING RESISTANCE | - |

DIESEL ENGINE ELECTRONIC MANAGEMENT - COMPONENT LOCATION



| Component code | Name | Assembly reference |
|----------------|--|---|
| A040 | HEATER PLUGS | Op. 5520C COLD STARTING SYSTEM (DIESEL ENGINES) |
| B001 | JUNCTION UNIT | Op. 5505A MULTI-FUNCTION COMPONENTS |
| B046 | ADDITIONAL SYSTEM FUSE BOX | - |
| B099 | MAXI FUSE BOX ON BATTERY | Op. 5530B BATTERY AND LEADS |
| C010 | LEFT FRONT EARTH | - |
| C022 | Centre dashboard earth | - |
| C060 | INJECTION CONTROL UNIT EARTH | - |
| C100 | CAB EARTH | - |
| C103 | MASSA SU PUNTONE (BRIGLIA MASSE CENTRALINE) | - |
| D001 | FRONT/DASHBOARD COUPLING | - |
| D004 | FRONT/ENGINE COUPLING | - |
| D219 | HEATER PLUGS COUPLING | - |
| D227 | CAB/DASHBOARD COUPLING | - |
| E050 | INSTRUMENT PANEL | Op. 5560B ANALOGUE CONTROL PANEL |
| H001 | IGNITION SWITCH | Op. 5520A IGNITION SWITCH |
| I030 | BRAKE PEDAL SWITCH | Op. 5550D BRAKE AND REVERSING LIGHTS |
| I031 | CLUTCH PEDAL SWITCH | Op. 5580A CRUISE CONTROL SYSTEM |
| I050 | INERTIA SWITCH | Op. 1040A FUEL TANK AND COMPONENTS |
| K030 | ENGINE OIL PRESSURE SENSOR (SWITCH) | Op. 1084A SIGNALLING/CONTROL DEVICES |
| K032 | ENGINE OIL LEVEL SENSOR | Op. 1084A SIGNALLING/CONTROL DEVICES |
| K036 | ENGINE COOLANT TEMPERATURE SENSOR/SENDER UNIT | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K040 | LAMBDA SENSOR | Op. 1080B EXHAUST EMISSION CONTROL SYSTEM |
| K041 | AIR FLOW METER | Op. 1048A VACUUM AIR CIRCUIT |
| K044 | AIR TEMPERATURE/PRESSURE SENSOR | Op. 1072B INTAKE MANIFOLDS |
| K046 | RPM SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K047 | TIMING SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K055 | ACCELERATOR PEDAL POTENTIOMETER | Op. 1068A ACCELERATOR PEDAL CONTROL |
| K083 | FUEL PRESSURE SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K101 | FUEL TEMPERATURE AND WATER IN FUEL FILTER SENSOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| K206 | VARIABLE GEOMETRY TURBINE POSITION SENSOR | Op. 1064A TURBOCHARGER ASSEMBLY |
| L030 | EGR SOLENOID | Op. 1080C EXHAUST GAS RECIRCULATION (E.G.R.) |
| L036 | TURBINE VARIABLE GEOMETRY CONTROL SOLENOID VALVE | Op. 1064B CONTROL/SAFETY DEVICES |
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| M015 | HEATER PLUGS CONTROL UNIT | Op. 5520C COLD STARTING SYSTEM (DIESEL ENGINES) |
| M186 | ENGINE OIL SENSOR SIGNAL CONTROL UNIT | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| N040 | FUEL PUMP AND LEVEL GAUGE | Op. 1040A FUEL TANK AND COMPONENTS |
| N070 | INJECTOR | Op. 1060F INJECTORS AND PIPES |
| N075 | INTEGRATED THROTTLE BODY ACTUATOR | Op. 1060G DIESEL INJECTION PRESSURE PUMP ELECTRONIC CONTROL |
| N077 | FUEL PRESSURE REGULATOR | Op. 1060E DIESEL PRESSURE PUMP AND CONTROL |
| O007 | OIL VAPOUR HEATING RESISTANCE | - |