



## GESTIONE ELETTRONICA MOTORI DIESEL

290/295 - Ducato FL 2014

# DIESEL ENGINES 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.

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 version with 4 valves per cylinder, the "COMMON RAIL" injection system uses "MultiJet II" technology.

In the previous MultiJet versions, the injector - capable of carrying out 5 consecutive injections during the same combustion cycle - was based on a hydraulic servo valve with unbalanced shutter, which required reduced sealing diameters and longer travels.

In the new MultiJet II injection system, the injector shutter is hydraulically balanced resulting in greater sealing diameters and reduced shutter travels. Thanks to this new servo valve, the quantity of fuel injected in the combustion chamber can be controlled more precisely and quickly. Up to 8 consecutive injections can be managed with very precise measurement.

This new injection mode ensures considerable advantages in terms of reduction of noise, fuel consumption and emissions.

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 control module.

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 respect the latest emissions control regulation (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, the new EGR module fitted on this engine makes it possible to choose whether to cool the exhaust gases or exclude the cooling process by means of a by-pass.

This operation, managed entirely by the engine management control unit, makes it possible to ensure optimum operation of the EGR in terms of nitrogen oxide reduction without adversely affecting hydrocarbon (HC) and carbon monoxide (CO) 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.

## E5070 PARTICULATE 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.

The system is also controlled by dedicated relay switches 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.

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 54 of connector B of M010.

Pins 2, 4 and 6 of connector B of M010 are connected to the injection control unit earth C060. The water in diesel filter sensor integrated in filter K101 and the engine oil sensor signal control unit M186 (pin 4) are connected to the same earth.

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.

This relay switch is energised by an (earth) control signal from pin 28 of connector B of the Powertrain Control Module M010 and then forwards a power supply:

- to pins 3 and 5 of connector B of the control unit via a line protected by fuse F22 of B001 (pin 18 of connector C);
- to pin 1 of connector B of the control unit (engine control unit supply) through the line protected by fuse F11 of B001 (pin 7 of connector C);
- to the wastegate solenoid valve L037, to the oxygen sensor heating resistance K040, to the air flow meter K041, to the heat exchanger water delivery actuator control solenoid valve for EGR L103, to the throttle body solenoid valve N075 and to the heater plug control unit M015 (pin 4 of connector A), through the line protected by fuse F17 of B001 (pin 31 of connector C).

Fuel pump relay switch T10 of B001 receives a direct battery supply through the line protected by fuse F21 of junction unit B001 itself.

The coil is energised by pin 75 of connector B of the Powertrain Control Module 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 electric fuel pump N040 and the additional electric heating pump N044.

E6015 ADDITIONAL HEATER

## **DIESEL ENGINES ELECTRONIC MANAGEMENT - FUNCTIONAL DESCRIPTION**

Powertrain Control Module M010 receives signals from the various sensors, thereby keeping all the engine operating parameters under control.

The engine rpm sensor K046 provides engine rpm information via a frequency signal sent to pins 59 (positive) and 44 (negative) of connector A of control unit M010.

Timing sensor K047 is supplied from pin 13 of connector A of M010; this receives a reference earth from pin 28 of connector A, and sends a signal with frequency corresponding to the phase to pin 14 of connector A of the control unit.

Engine coolant temperature sensor/sender unit K036 receives a reference earth from pin 58 of connector A of Powertrain Control Module M010 and sends a signal proportional to engine coolant temperature to pin 57 of connector A of the control unit itself.

The air flow meter K041 receives a reference earth from pin 20 of connector B of control unit M010 and sends a signal proportional to the air flow rate to pin 21 of connector B.

An air temperature sensor inside K041 also sends an air temperature signal to pin 19 of connector B of M010.

Accelerator pedal K055 contains two built-in potentiometers (a main one and a safety one). The former receives power and earth respectively from pins 16 and 38 of connector B of M010 and sends a corresponding signal to pin 60 of the same connector. The latter receives power supply and earth respectively from pins 17 and 39 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 a signal from pin 20 of connector A on M010. Pins 21 and 22 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 30 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 65 of connector B of control unit M010 and sends a fuel temperature signal to pin 87.

Sensor K044 measures the air pressure and the temperature in the intake chamber, downstream of the turbocharger. It is supplied by pin 10 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 40 of connector A of control unit M010. An air temperature sensor, housed in K044, sends a signal to pin 55 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 respectively from pins 11 and 26 of connector A of Powertrain Control Module M010 and then sends a pressure signal to pin 41 of the same connector.

The oxygen sensor K040 sends signals to pins 63, 64 and 86 of connector B of control unit M010 while pin 85 supplies a reference earth. Sensor K040 is heated by a coil to ensure efficient operation even when cold. The resistance is supplied by the line protected by fuse F17 of B001 and receives an earth signal from pin 7 of connector B of control module M010.

The fuel pressure regulator N077 on the pump controls the high pressure produced by the pump itself; the two control signals come from pins 60 (negative) and 15 (positive) of connector A of control unit M010.

The EGR solenoid valve L030 controls the exhaust gas recirculation. The EGR solenoid valve L030 is controlled by two signals (positive and negative) from pins 50 and 35 of connector B of M010; the position sensor integrated into the solenoid valve L030 receives a power supply and earth from pins 9 and 24 and returns a position signal to pin 39 of connector B of M010.

The wastegate solenoid valve L037 adjusts the turbocharger operation according to the engine load: it is controlled by a negative signal from pin 93 of connector B of control unit M010.

Water supply actuator solenoid valve and EGR heat exchanger. L103 is controlled by a negative signal from pin 19 of connector A on M010.

The control unit M010 receives - at pin 54 of connector A - a signal from the minimum engine oil pressure sensor K030.

The engine oil sensor signals control unit M186 receives an ignition-operated power supply (INT) at pin 1, through the line protected by fuse F51 of 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 6 and 5 of connector A respectively).

Powertrain Control Module M010 controls the opening of the individual injectors N070, via appropriate signals (positive and negative respectively) sent from pins 16-32 (cyl.1), 2-46 (cyl.2), 1-31 (cyl.3), 17-48 (cyl.4) of connector A.

The heater plug control unit M015 is supplied at pin 5 of connector A, directly from the battery through the line protected by fuse F02 of the engine compartment junction unit B001 (pin B of connector B) Pin 3 of connector A of M015 receives a reference earth to manage the pre-heating function from the Powertrain Control Module M010 (pin 89 of connector B).

Control unit M015 exchanges command and control (feedback) signals from pins 2 and 1 of connector A with pins 26 and 67 of connector B of control unit M010 which controls the timed delay.

Connector B of M015 is connected to the heater plugs A040.

Pin 88 of connector B of control unit M010 receives an NO signal from the switch on brake pedal I030, provided by an ignition-operated 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.

The clutch pedal switch I031, with analogue potentiometer, receives supply and reference earth respectively from pins 15 and 37 of connector B of the Powertrain Control Module M010 and provides the pedal position signal (from maximum extension with pedal pressed to pedal released position) to pin 59 of the same connector.

The control unit M010 is then connected via the CAN - pins 24 and 25 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 and corresponding icon on display (where provided) lit up for the failure of the engine oil pressure sensor or the operation of the inertia switch.

#### 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 48 and 49 of connector B for managing the engine cooling fans;

#### E5020 ENGINE COOLING

- from pins 12, 34, 56 and 94 of connector B for managing the compressor engagement function;

#### E6021 COMPRESSOR ENGAGEMENT

- from pins 14, 36, 58, 83 and 84 of connector B, to manage the particulate filter function;

#### E5070 PARTICULATE FILTER SYSTEM

- from pin 36 of connector A, with the alternator A010 for management of the insufficient battery charge/alternator fault (D+) signal;

#### E5010 STARTING AND RECHARGING

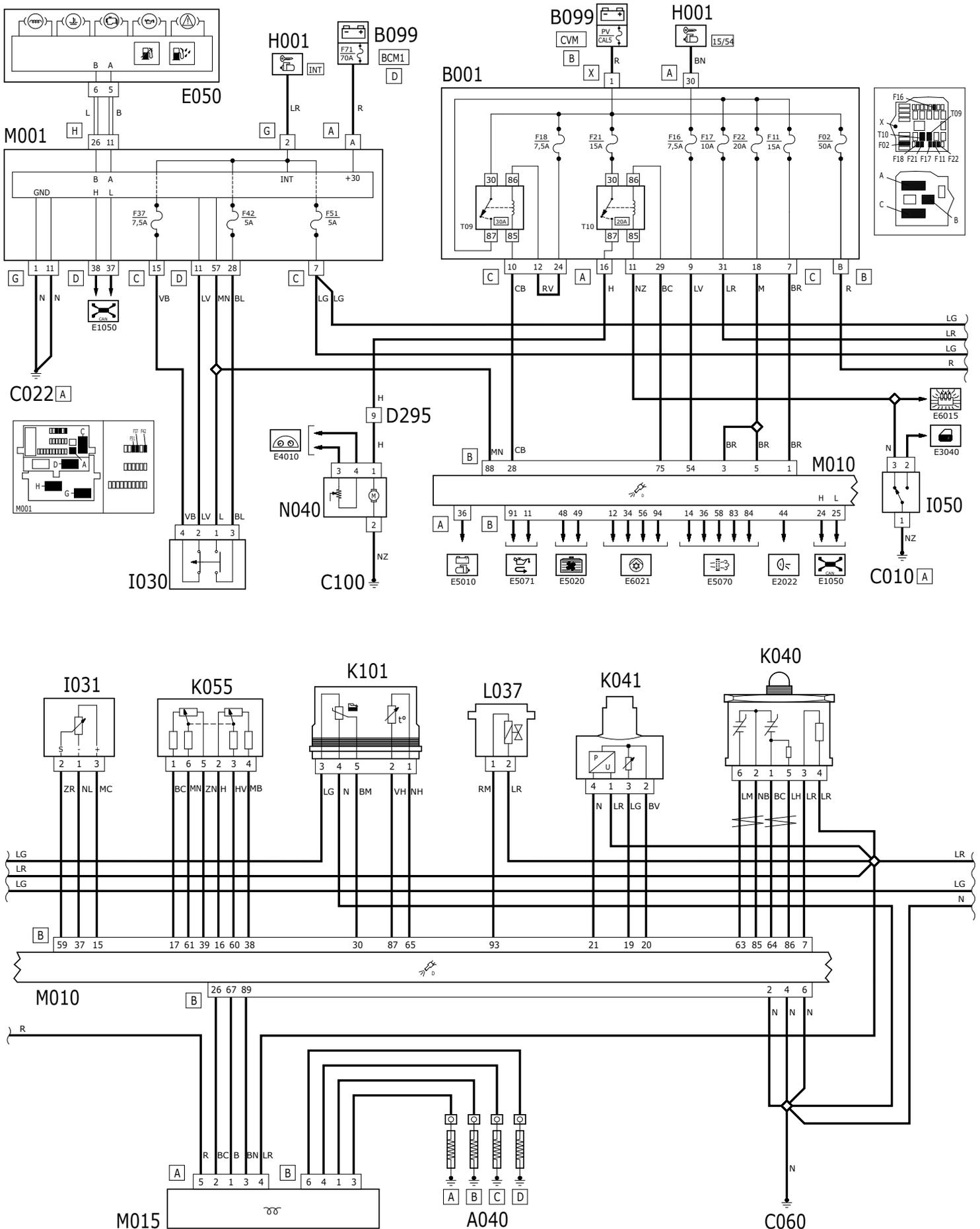
- from pin 44 of connector B, with the reversing switch I020.

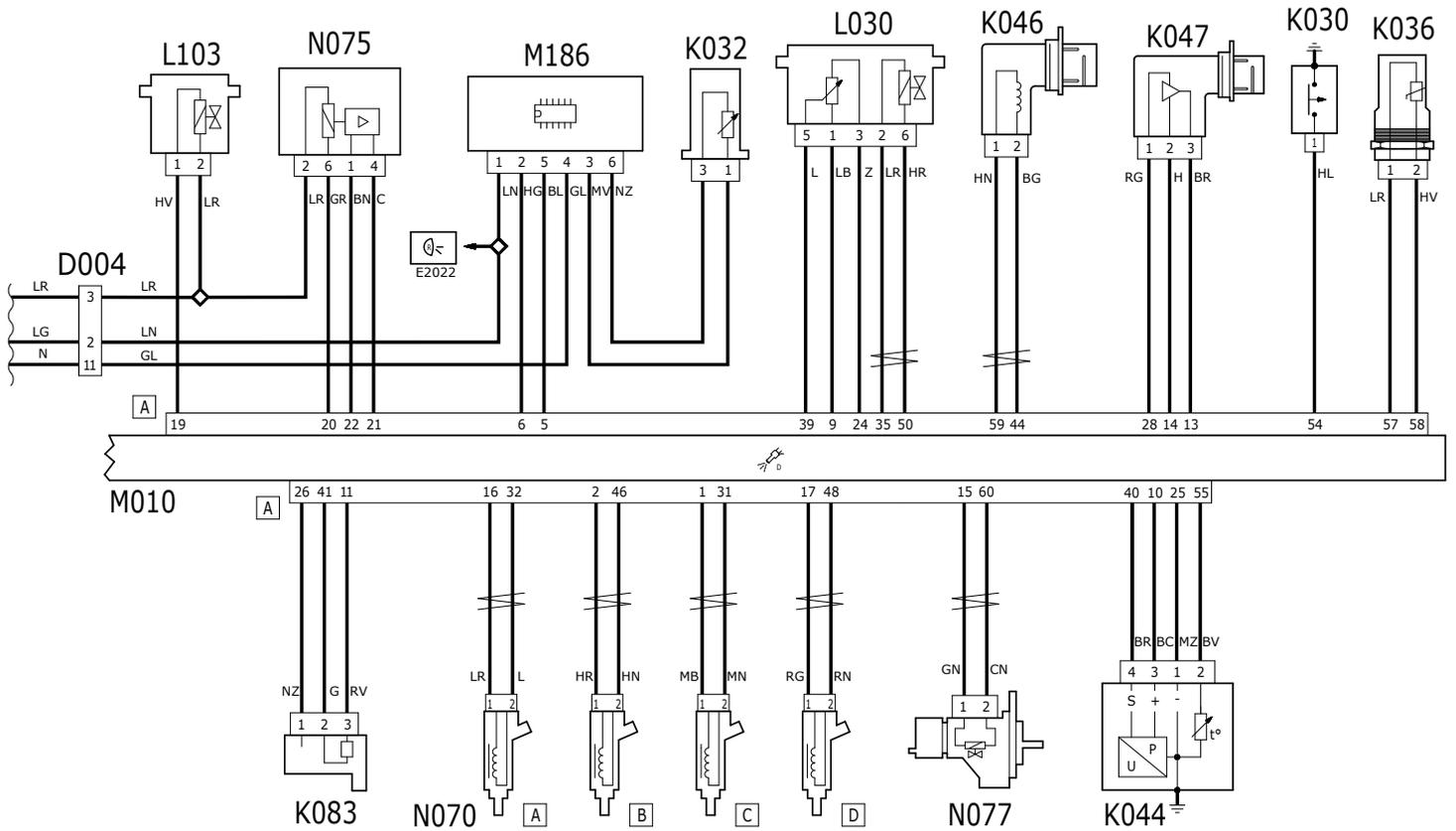
#### E2022 REVERSING LIGHTS

- from pins 9 and 11 of connector B for the management of the blow-by oil vapour heating function.

#### E5071 OIL VAPOUR HEATING SYSTEM

# DIESEL ENGINES ELECTRONIC MANAGEMENT - WIRING DIAGRAM





# DIESEL ENGINES ELECTRONIC MANAGEMENT - COMPONENT LOCATION

