ENGINE MANAGEMENT SYSTEMS

VAZ-2111 (1.5 L, 8V.) AND VAZ-2112 (1.5 L, 16V.), VAZ-21214-36 (1,7 L, 8 V.)

SEQUENTIAL FUEL INJECTION TO MEET EURO-3 EMISSION STANDARDS

(ELECTRONIC CONTROL MODULE MP7.0HFM BOSCH)

SERVICE AND REPAIR MANUAL

AO AVTOVAZ

2001

This manual is designed by the Department of Technical Development of AO AVTOVAZ automobile plant and is intended for engineers and mechanics of service outlets and garages. The manual can also be helpful in training technical personnel entrusted with vehicle repair.

This manual covers the Electronic Control Module MP7.0HFM (***2111-1411020-50*** for 2111 engine, ***2112-1411020-50*** for 2112 engine and ***21214-1411020*** for 21214-36 engine).

The Manual describes design and repair only of the Engine Management Systems VAZ-2111, VAZ-2112 and VAZ-21214-36, sequential fuel injection, as of December, 2001. Refer to the respective car Service and Repair Manual for information on other vehicle or engine units and components.

Main sections of the manual describe the Engine Management System (2111) for car models VAZ-21102, 2111 and 21122. Details of design and repair specific for engine management system (2111) of VAZ-21083, 21093 and 21099 as well as engine management system (2112) of VAZ-21103, 21113, 2112 and VAZ-21214-36 engine of VAZ-21214 are given in sections 3 and 4 respectively.

Abbreviations

A/C	-	**Air Conditioning**
ADC	-	**Analog-To-Digital Converter**
°CA	-	**Crankshaft Position Angle**
CKP	-	**Crankshaft Position (Sensor)**
CMP	-	**Camshaft Position (Sensor)**
DLC	-	**Data Link Connector**
DTC	-	**Diagnostic Trouble Code**
EMS	-	**Engine Management System**
ECM	-	**Electronic Control Module**
ECT	-	**Engine Coolant Temperature (Sensor)**
EEPROM	-	**Electrically Erasable Programmable Read Only Memory**
EVAP	-	**Evaporative Emission Control (system)**
G-Sensor	-	**Rough Road Sensor**
HO_2S 1	-	**Fuel Control Heated Oxygen Sensor**
HO_2S 2	-	**Catalyst Monitor Heated Oxygen Sensor**
HT	-	**High Tension (leads)**
IAC	-	**Idle Air Control (Valve)**
IAT	-	**Intake Air Temperature (Sensor)**
IT	-	**Ignition Timing**
KS	-	**Knock Sensor**
MAF	-	**Mass Air Flow (Sensor)**
MIL	-	**Malfunction Indicator Lamp (CHECK ENGINE light)**
RAM	-	**Random Access Memory**
ROM	-	**Read Only Memory**
TDC	-	**Top Dead Center**
TP	-	**Throttle Position (Sensor)**
VSS	-	**Vehicle Speed Sensor**
VTD	-	**Vehicle Theft Deterrent (System)**
WOT	-	**Wide Open Throttle**

Wire Color Codes

Б	-	**white**
Г	-	**blue**
Ж	-	**yellow**
З	-	**green**
К	-	**brown**
О	-	**orange**
П	-	**red**
Р	-	**pink**
С	-	**grey**
Ф	-	**violet**
Ч	-	**black**
ГБ	-	**blue with white tracer**
ГП	-	**blue with red tracer**
ГЧ	-	**blue with black tracer**
ЗБ	-	**green with white tracer**
ЗЖ	-	**green with yellow tracer**
ЗП	-	**green with red tracer**
ОЧ	-	**orange with black tracer**
РЧ	-	**pink with black tracer**
СП	-	**grey with red tracer**
ЧБ	-	**black with white tracer**
ЧП	-	**black with red tracer**
ПЧ	-	**red with black tracer**

Service And Repair Manual
Engine Management Systems VAZ-2111, -2112 and -21214-36 Sequential Fuel Injection (ECM MP7.0HFM) To Meet EURO-3 Emission Standards And EOBD

CONTENTS

1. Design And Repair

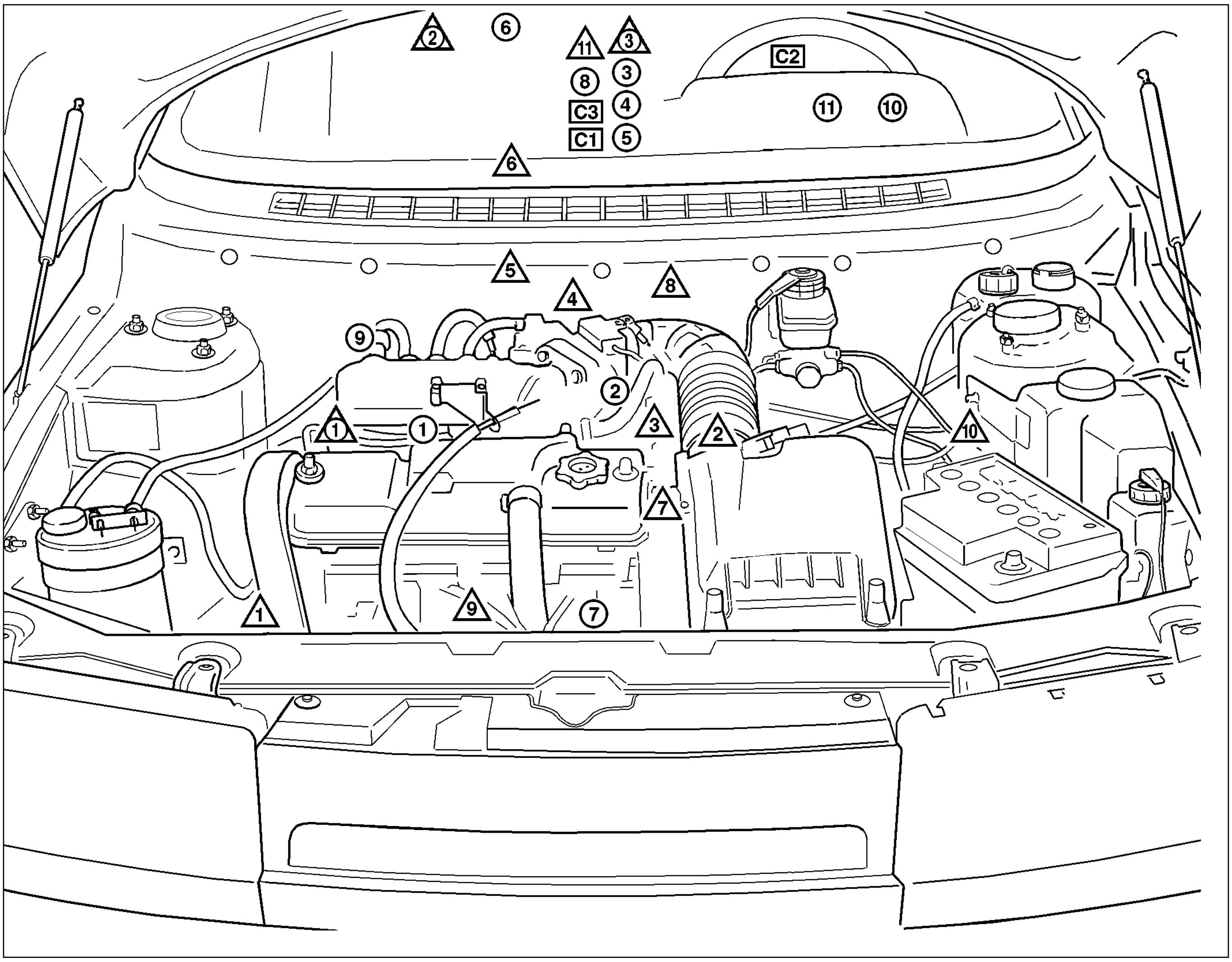
General Description

The engine management system (EMS) consists of sensors, wich monitor various parameters of engine and vehicle operation, electronic control module (ECM) and controlled devices (see EMS functional diagram below).

SENSORS	ECM: Input Parameters	ECM: Control Function	CONTROLLED DEVICES
Synchronization Sensors:			
Crankshaft Position (CKP) Sensor	Crankshaft Position Engine Speed	Fuel Delivery	Electric Fuel Pump Relay Electric Fuel Pump Fuel Injectors
Camshaft Position (CMP) Sensor	Camshaft Position	Ignition	Ignition Module High Tension (HT) Leads Spark Plugs
Load Sensors:			
Throttle Position (TP) Sensor	Throttle Position	Idle Speed	Idle Air Control (IAC) Valve
Mass Air Flow (MAF) Sensor	Mass Air Flow	Canister Purge	EVAP Purge Valve
Temperature Sensors			
Engine Coolant Temperature (ECT) Sensor	Engine Coolant Temperature	Radiator Blowing	Fan Relay Fan Motor
Intake Air Temperature (IAT) Sensor	Intake Air Temperature		
Feedback Sensors:		Fuel Trim	
Heated Oxygen Sensor 1 (HO_2S 1)	Pre-Catalyst Oxygen Content	HO_2S 1 Heating	HO_2S 1 Heater
Heated Oxygen Sensor 2 (HO_2S 2)	Post-Catalyst Oxygen Content	HO_2S 2 Heating	HO_2S 2 Heater
Knock Sensor (KS)	Knock Level	Ignition Advance	
Vehicle Motion Sensors:			
Vehicle Speed Sensor (VSS)	Vehicle Speed	Vehicle Speed Indication	Trip Computer
Rough Road Sensor	Load Variations	Fuel Consumption Indication	
Miscellaneous:			
Air Conditioner (A/C) control button*	A/C Request	A/C activation	A/C Clutch Relay
Ignition Key	Ignition Key Position	EMS power supply	Main Relay
Electric System	System Voltage		
		Tachometer control	Tachometer
		Malfunction Indication	Malfunction Indicator Lamp
Immobilizer Control Module*		Interaction with Immobilizer	
Diagnostic Scan Tool (DST)**		Interaction with Plug-in Diagnostic Tools	

* Optional

** Connected only during diagnostics



ECM HARNESS

C1. Electronic Control Module (ECM)* (In instrument panel console)
C2. Data Link Connector (DLC)*
C3. Fuse/Relay Block*

MISCELLANEOUS

1. Fuel Pressure Test Fitting
2. Fuel Filter
3. Vehicle Theft Deterrent System (Immobilizer) Control Module* (In instrument panel console)

*Located inside vehicle

CONTROLLED DEVICES

1. Fuel Injectors
2. Idle Air Control Valve
3. Main Relay*
4. Fuel Pump Relay*
5. Cooling Fan Relay*
6. Fuel Pump (Located inside fuel tank)
7. Ignition Module
8. Trip Computer*
9. EVAP Purge Valve
10. Tachometer*
11. Malfunction Indicator Lamp (CHECK ENGINE light)*

INFORMATION SENSORS

1. Crankshaft Position (CKP) Sensor
2. Mass Air Flow (MAF) Sensor
3. Engine Coolant Temperature (ECT) Sensor
4. Throttle Position (TP) sensor
5. Fuel Control Heated Oxygen Sensor (HO_2S 1) (pre-catalyst)
6. Catalyst Monitor Heated Oxygen Sensor (HO_2S 2) (post-catalyst)
7. Camshaft Position (CMP) Sensor
8. Vehicle Speed Sensor (VSS) (Mounted on transmission gearbox)
9. Knock Sensor (KS)
10. Rough Road Sensor (G-Sensor)
11. Vehicle Theft Deterrent (Immobilizer) Key fob reader*

1.1 ECM and Sensors

Electronic Control Module

The Electronic Control Module (ECM) (Fig. 1.1-01) is the control center of the EMS. It receives information from the sensors and monitors numerous functions, thus ensuring optimal engine operation for the vehicle parameters programmed. The ECM (1) is mounted on a bracket (2) inside the instrument panel console (Fig. 1.1-02).

The ECM controls output circuits such as the injectors, ignition module, IAC, HO_2S heaters, EVAP purge valve and various relays.

The ECM supplies battery voltage to system components (except electric fuel pump, ignition module, cooling fan, Immobilizer control module and key reader) through the main relay. The ECM activates the main relay when ignition is switched on. When ignition is switched off, the ECM deactivates the main relay with a delay necessary to prepare for the next activation (e.g. to finish computations, to set IAC in the position ready for the engine start).

At ignition switch-on the ECM, except performing the above mentioned functions, also communicates with the VTD system (if fitted and active, refer to Section 1.2). This communication session lasts about 2 seconds. If the ECM receives the Fuel Enable signal it proceeds to control engine operation, otherwise engine operation is blocked.

Notice: If the immobilization function is not active, the ECM will not control output circuits within the first five seconds after ignition is switched on following the disconnection/reconnection of the battery.

The ECM also performs the system diagnostic function. It can recognize operational problems, alert the driver through the MIL (Check Engine light), and store diagnostic trouble codes (DTCs) which identify the problem areas to aid the technician in making repairs. Refer to Section 2 «Diagnosis» for more information on using the diagnostic function of the ECM.

Warning: The ECM is a complex electronic unit that can be repaired by the manufacturer only. Never attempt to dismantle the ECM during vehicle operation or technical service.

The ECM supplies either 5 or 12 volts to power various devices. In some cases this is done through resistors in the ECM which are so high in value that a test light will not illuminate when connected to the circuit. In most cases, even an ordinary shop voltmeter with low resistance will not give an accurate reading.

Therefore, a digital volt/ohm meter with at least 10 MOhms input impedance is required to ensure accurate voltage readings.

ECM Memory

The ECM has three kinds of memory: Read-Only Memory (ROM), Random Access Memory (RAM) and Electrically Erasable Programmable Read-Only Memory (EEPROM).

Read-Only Memory

ROM stores the control program which contains operation instructions and calibration data. Calibration data provides control over injection, ignition, idle, etc. and depends on the vehicle weight, engine type and capacity, gear ratios, etc.

ROM is a nonvolatile type of memory, i.e. information is not lost when the power is off.

Random Access Memory

RAM is used by the microprocessor for temporary storage of the input parameters, calculation results and DTCs. Data can be written into or read from RAM by the microprocessor as needed.

RAM is a volatile type of memory. When power is cut off DTCs and calculation results will be lost.

Electrically Erasable Programmable Read-Only Memory (EEPROM)

EEPROM is used for temporary storage of the Immobilizer codes. These codes are input to the ECM from the Immobilizer module and compared to those stored in the EEPROM. Microprocessor then alters codes as pre-programmed.

EEPROM is a nonvolatile type of memory, i.e. it can store information without power supply to the ECM.

ECM Replacement

Warning: To avoid damage to the ECM while disconnecting the battery negative cable or the ECM harness connector ignition must be OFF.

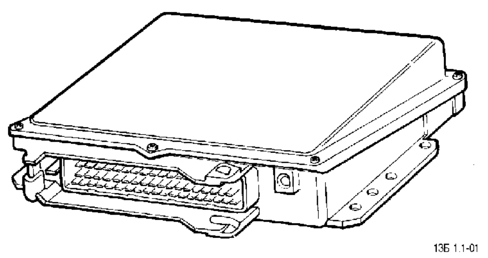


Fig. 1.1-01. Electronic Control Module (ECM)

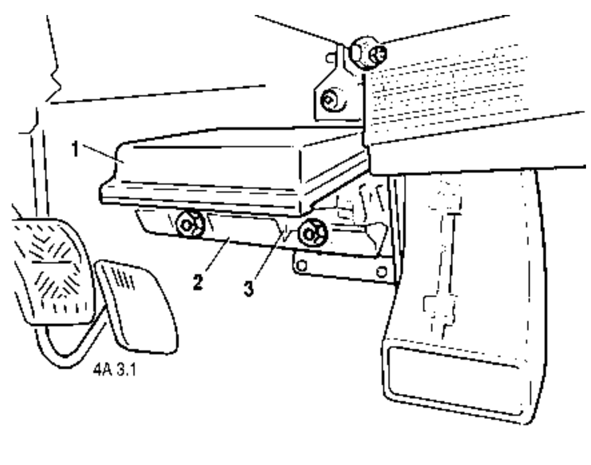


Fig. 1.1-02. ECM location view:
1 - ECM; 2 - bracket; 3 - ECM bracket (insulated)

ECM Removal

1. Ignition OFF.

2. Disconnect the battery negative cable.

3. Undo the attaching screws and remove the instrument panel console right and left boards.

4. Unscrew the nuts of the retaining bolts holding bracket 3 to bracket 2, disconnect the ECM harness connector and remove the ECM (1) (see Fig. 1.1-02).

5. Unscrew retaining nuts and remove the ECM (1) from the bracket (3).

ECM Refitting

1. Install the new ECM (1) onto the bracket (3).

Notice: In case of a faulty ECM the replacement ECM must be in a new state. Refer to Section 1.2 «Vehicle Theft Deterrent System».

2. Connect the ECM harness connector and install onto the bracket (2).

3. Install the instrument panel console side boards.

4. Connect the battery negative cable.

ECM Functional Check

1. Ignition ON.

2. Perform diagnostic test (refer to Chart A «Diagnostic Circuit Check»)

Important: When performing diagnostics first time after power cutoff (battery disconnection) start the engine and then stop it by turning ignition OFF. Connect DST-2M after 10-15 seconds.

Mass Air Flow (MAF) Sensor Intake Air Temperature (IAT) Sensor

The system features a thermoanemometer type mass airflow sensor (Fig. 1.1-03). It is located between the air cleaner and the air intake pipe (Fig. 1.1-04).

The MAF sensor signal is a DC voltage signal which depends on the amount and direction of airflow passing through it. Direct airflow (Fig. 1.1-03) causes the signal to vary within 1...5 volts. Reverse airflow causes the signal to vary within 0...1 volt. DST-2M reads this signal and displays it in kilograms per hour (kg/h). The MAF value for warm engine must be 6.5...11.5 kg/h at idle and increase with the engine speed.

If the MAF sensor circuit is faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to inform the driver of the fault detected. Once a DTC is set, the ECM will use engine speed and TP sensor signal to calculate MAF value.

The MAF sensor has an in-built IAT unit. Its pick-up is a thermistor (a resistor which changes value based on temperature) mounted in the intake air stream. The IAT signal varies within 0...5 volts DC depending on the temperature of the air which passes through the sensor. The ECM uses IAT signal to calculate injection pulse width, which is especially important during engine start-up.

If the IAT sensor circuit is faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to inform the driver of the fault. In this case the ECM resets to a default value of IAT (45°C)

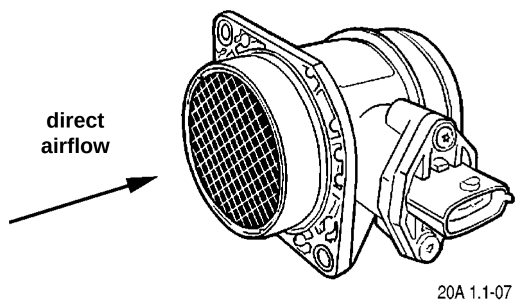


Fig. 1.1-03. Mass Air Flow (MAF) Sensor

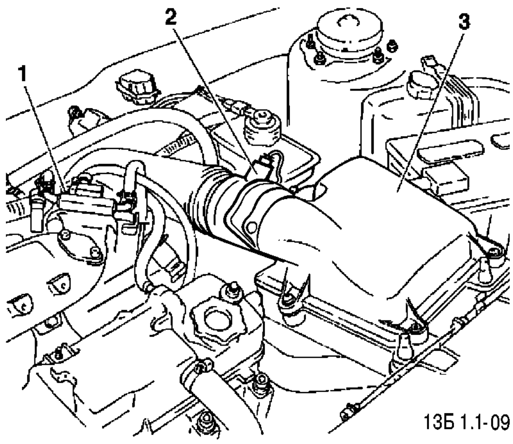


Fig. 1.1-04. MAF sensor location view:
1 - throttle body; 2 - Mass Air Flow (MAF) sensor; 3 - air cleaner

MAF Sensor Removal

1. Ignition OFF.

2. Disconnect the MAF sensor harness connector.

3. Disconnect the air intake pipe from the sensor.

4. Undo screws holding the MAF sensor to the air cleaner housing. Remove the MAF sensor.

MAF Sensor Refitting

1. Install a sealing bushing on the sensor full way.

2. Fasten the MAF sensor to the air cleaner housing using two mounting screws. Tighten the screws to 3...5 N•m.

3. Connect the air intake pipe to the MAF sensor. Fix it with a clamp.

4. Connect the MAF sensor harness connector.

Important: The engine may run rough due to the lack of the sealing bushing. Care must be taken when handling the MAF sensor. Be certain that nothing falls inside the sensor. Damage to the sensor will affect proper operation of the EMS.

Throttle Position (TP) Sensor

The Throttle Position Sensor (Fig. 1.1-05) is mounted on the side of the throttle body opposite the throttle linkage lever assembly (Fig. 1.1-06).

TP sensor is a potentiometer. The ECM 5 volts reference voltage is supplied to one of its terminals. The second terminal of the potentiometer is shorted to the ECM ground. The third terminal connected to the TP sensor moving contact is the TP signal output to the ECM.

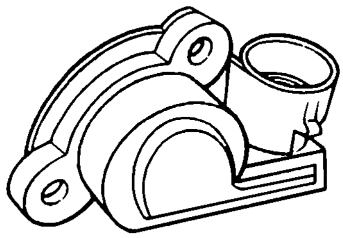


Fig. 1.1-05. Throttle Position (TP) Sensor

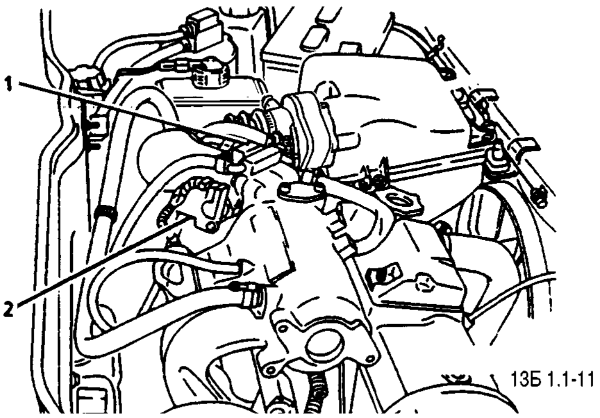


Fig. 1.1-06. Throttle Position (TP) Sensor location view:
1 - throttle body; 2 - Throttle Position Sensor (TP)

As the throttle angle changes in response to movement of the accelerator pedal, the throttle shaft transfers its rotational movement to the TP sensor, changing the TP sensor output signal voltage.

When the throttle valve is closed the TP sensor output signal should read within 0.35...0.7 volts. As the throttle valve opens, the output voltage increases. At WOT (76-81% of throttle opening displayed on DST-2M) the output signal should read within 4.05...4.75 volts.

By monitoring TP signal voltage, the ECM determines current throttle position. Based on throttle position angle the ECM calculates ignition timing and injection pulses.

The ECM monitors signal voltage to determine whether the throttle is opening or closing. Rapid rise of the signal voltage indicates that more fuel should be supplied. The ECM does so by increasing injection pulses.

No adjustments can be made to the TP sensor. The lowest TP signal at idle is used by the ECM as a reference (TP angle 0%).

A broken or loose sensor may cause rough idle, because in this case the ECM will not receive the TP signal.

If the TP sensor circuit is faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to inform the driver of the fault detected. Once a DTC is set, the ECM will use engine RPM to calculate throttle position value.

TP Sensor Removal

1. Ignition OFF.
2. Disconnect the battery negative cable.
3. Disconnect the TP sensor electrical connector.
4. Undo two screws holding the TP sensor to the throttle body. Remove the TP sensor.

TP Sensor Refitting

1. Install the TP sensor to the throttle body. Throttle valve must be normally closed.
2. Tighten the TP sensor two mounting screws to 2 N•m.
3. Connect the TP sensor electrical connector.
4. Connect the battery negative cable.
5. Check the TP sensor output signal as follows:

- Connect DST-2M and select: «1 - Parameters; 5 - ADC Channels»;
- With ignition ON and the throttle valve closed the output voltage of the sensor should be 0.35...0.7 volts. If the voltage is not within its normal range, replace the sensor.

Engine Coolant Temperature (ECT) Sensor

The ECT sensor (Fig. 1.1-07) is mounted in the engine coolant stream on the water jacket return pipe on the cylinder head (Fig. 1.1-08).

The engine coolant temperature sensor pick-up is a thermistor, i.e. a resistor which changes value based on temperature.

High coolant temperature produces low resistance (70 ohms at 130°C) while low temperature causes high resistance (100,700 ohms at -40°C).

The ECM supplies to ECT sensor 5 volts through an ECM-housed resistor of constant value.

By measuring the voltage drop at the ECT sensor, the ECM calculates the engine coolant temperature. The voltage drop will be relatively high if the engine is

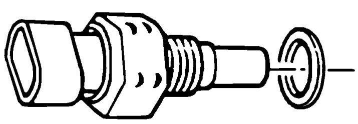


Fig. 1.1-07. Engine Coolant Temperature (ECT) Sensor

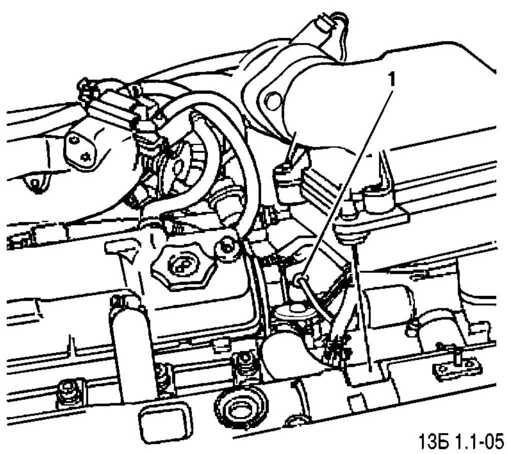


Fig. 1.1-08. Engine Coolant Temperature (ECT) Sensor location view:
1 - Engine Coolant Temperature Sensor (ECT)

cold and low if the engine is warm. Engine coolant temperature affects most systems the ECM controls.

If the ECT sensor circuit is faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to inform the driver of the fault detected. In this case the ECM will use a special algorithm to calculate the ECT value.

ECT Sensor Removal

1. Ignition OFF.
2. Disconnect the ECT sensor electrical connector.
3. Carefully back out the sensor.

Important: Care must be taken when handling engine coolant temperature sensor. Damage to the engine coolant temperature sensor will affect proper operation of the fuel injection system.

ECT Sensor Refitting

1. Screw the ECT sensor into the water jacket return pipe. Tighten to 9...15 N•m.
2. Connect the ECT sensor electrical connector.
3. Add coolant as needed.

Knock Sensor (KS)

The knock sensor (Fig. 1.1-09) is mounted on the cylinder block (Fig. 1.1-10). The knock sensor has a piezo-ceramic pick-up that generates an AC voltage signal when it detects vibration. The amplitude and frequency of the signal depend on the amplitude and frequency of engine vibration.

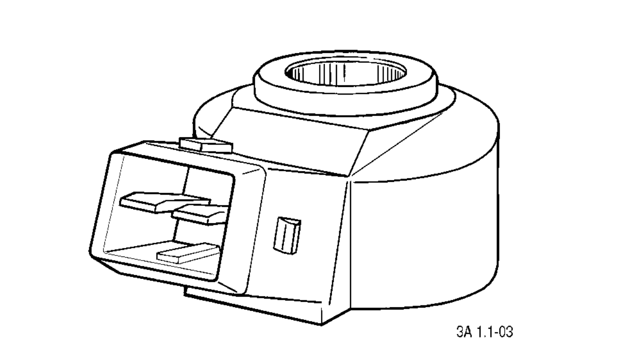


Fig. 1.1-09. Knock Sensor (KS)

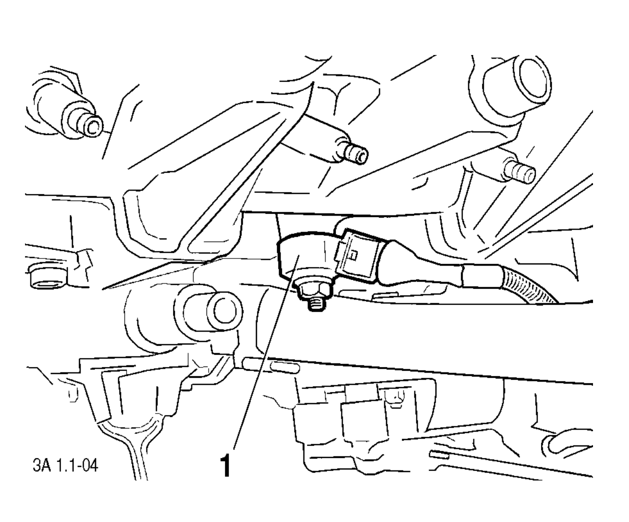


Fig. 1.1-10. Knock Sensor (KS) location view
1 - Knock Sensor

When detonation occurs, the amplitude of a certain vibration frequency rises. The ECM then adjusts ignition timing to reduce spark knock.

If the KS circuit is faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to indicate a fault. Use the relevant diagnostic chart to detect and repair the fault.

Knock Sensor Removal

1. Ignition OFF.
2. Disconnect the KS electrical connector.
3. Unscrew the attaching nut and remove the washer and the KS from the stud.

Knock Sensor Refitting

1. Install the sensor and the washer on the stud.
2. Tighten the nut to 20...27.5 N•m.
3. Connect the KS electrical connector.

Fuel Control Heated Oxygen Sensor (HO_2S 1)

The lowest level of exhaust emissions on petrol engines is achieved at the air/fuel ratio 14.6...14.7:1. This ratio (called stoichiometric) provides the most effective reduction of hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NO_x) content in the exhaust by the catalytic converter (refer to Section 1.10). Closed loop operation mode, which provides the ECM with the feedback information from the HO_2S, is used to ensure the most effective functioning of the catalytic converter.

The ECM uses mass airflow value, engine speed, engine coolant temperature and other parameters to calculate injection pulse width. To adjust fuel injection pulse width the ECM uses the signal from the HO_2S 1 (Fig. 1.1-11).

The HO_2S 1 is mounted in the exhaust manifold (Fig. 1.1-12) before (pre-) the catalytic converter with its sensitive tip in the exhaust stream. The HO_2S 1 generates voltage varying from 50 mV to 900 mV. This output signal depends on the oxygen content in the exhaust gas and on the HO_2S 1 temperature.

The ECM supplies 450 mV reference voltage to the HO_2S 1. When the HO_2S 1 is cold its resistance is very high (several MOhms). Voltage in the HO_2S 1 signal circuit reads 300...600 mV. As the sensor warms up its resistance decreases, which makes it possible for the sensor to generate varying voltage beyond this range. By monitoring this signal change the ECM detects if the HO_2S 1 is warm and its signal can be used for closed loop fuel control.

The HO_2S 1 temperature should be 300°C or higher for the sensor to work effectively. For faster warming after the engine start-up the HO_2S 1 has an internal electric heater controlled by the ECM.

Under normal closed loop conditions (Refer to Section 1.3 Fuel Metering System) the HO_2S 1 signal changes from low (50...200 mV) to high (700...900 mV). Low signal indicates lean condition (high oxygen), high signal indicates rich condition (low oxygen). Using this data the ECM maintains stoichiometric composition of the air/fuel mixture.

The HO_2S 1 can be poisoned by either the use of leaded petrol or assembling the engine parts with a sealant containing considerable amount of highly volatile silicone. Due to high volatility of silicone sealant, silicone vapors can be drawn into the crankcase ventilation system and introduced into the combustion process. Presence of lead or silicone in the exhaust gas can render the oxygen sensor inoperative.

An open in the HO_2S 1 signal circuit or ground circuit, a faulty, cold or poisoned sensor may cause the HO_2S 1 signal to remain within 300...600 mV over an extended period of time. The ECM will then set a DTC and switch into open loop operation.

If the ECM receives a signal, indicating continuing lean condition, it will set a respective DTC. The fault may be caused by short to ground in the HO_2S 1 signal circuit, leaking air inlet system or low fuel pressure.

If the ECM receives a signal, indicating continuing rich condition, it will set a respective DTC. The fault may be caused by short to voltage in the HO_2S 1 signal circuit or high pressure in the fuel rail.

If any of the HO_2S 1 DTCs is set, the ECM will switch to open loop operation.

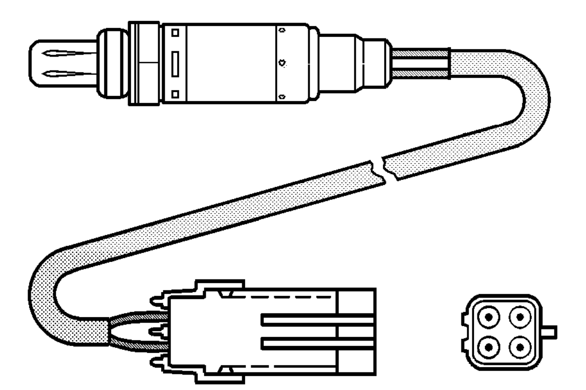


Fig. 1.1-11. Fuel Control Heated Oxygen Sensor (HO_2S 1)

HO_2S 1 Servicing

Replace the entire sensor if the HO_2S 1 harness, electrical connector or its pins are damaged. Neither the harness nor the connector or its pins can be repaired. For normal operation the HO_2S 1 should have a connection to ambient air provided by the sensor harness. A repaired harness, connector or pin may cut off ambient air and affect proper operation of the sensor.

Observe the following rules when servicing the oxygen sensor:

Keep the sensor and its electrical connector free from pin cleaning liquids or other materials, since they can penetrate into the sensor and result in its failure. Avoid damage to wire insulation.

Never twist or bend excessively the HO_2S 1 harness or the car wiring harness attached to it, for it can disrupt the air access to the sensor.

Avoid damage to the connector sealing which may cause water in the sensor.

HO_2S 1 Removal

1. Ignition OFF.
2. Disconnect the HO_2S 1 electrical connector.
3. Carefully back out the heated oxygen sensor.

Warning: The heated oxygen sensor may be difficult to remove when engine temperature is below 40°C. Excessive force may damage threads in the exhaust pipe.

Take care when handling a new heated oxygen sensor. The in-line electrical connector and louvered end must be kept free from grease, dirt or other contaminants.

HO_2S 1 Refitting

1. Coat threads of the heated oxygen sensor with anti-seize compound.
2. Install HO_2S 1. Tighten it to 25...45 N•m.
3. Connect the HO_2S 1 electrical connector.

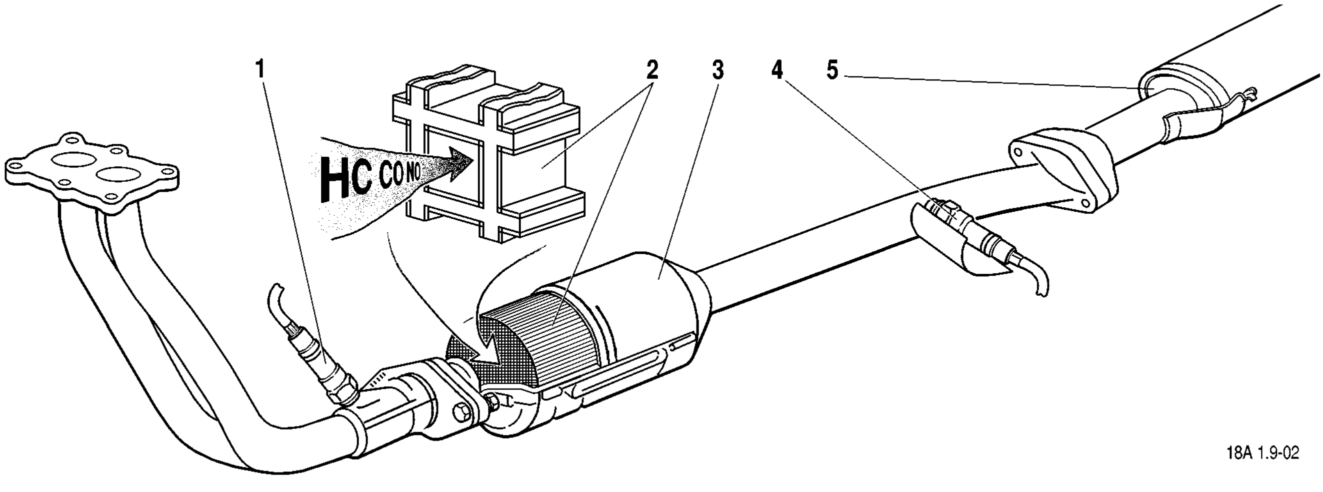


Fig. 1.1-12. Heated Oxygen Sensors (HO_2S) location view:
1 - fuel control heated oxygen sensor (HO_2S 1); 2 - ceramic substrate; 3 - catalytic converter; 4 - catalyst monitor heated oxygen sensor (HO_2S 2); 5 - auxiliary muffler

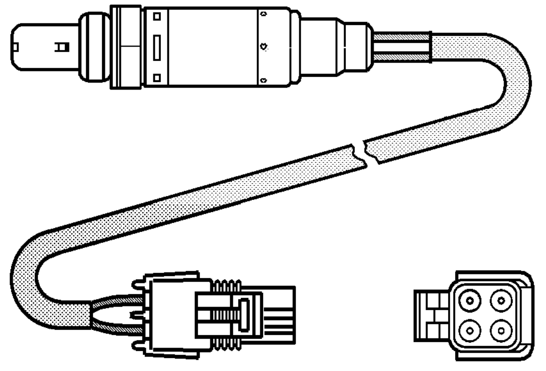


Fig. 1.1-13. Catalyst Monitor Heated Oxygen Sensor (HO_2S 2)

Catalyst Monitor Heated Oxygen Sensor (HO_2S 2)

To control emissions of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), a catalytic converter is used (Refer to Section 1.10). The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas, converting them into harmless water vapor and carbon dioxide. The catalyst also reduces NOx, converting it to nitrogen. The ECM has the ability to monitor this process using the catalyst monitor heated oxygen sensor (Fig. 1.1-13) installed after (post-) the catalytic converter (Fig. 1.1-12).

The HO_2S 2 uses the same operational principle as the HO_2S 1. Whereas the HO_2S 1 signal indicates pre-catalyst oxygen content in the exhaust gas, the HO_2S 2 signal indicates its post-catalyst content in the exhaust. If the catalyst is operating effectively, the HO_2S 1 and HO_2S 2 signals should be significantly different.

The output signal of the warmed-up HO_2S 2 in a closed loop mode should read 590...750 mV if the catalyst is OK.

If the HO_2S 2 or its circuits are faulty, the ECM will set a DTC and illuminate the MIL (Check Engine light) to indicate the fault.

The HO_2S 2 should be serviced or replaced in the same way as the HO_2S 1.

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (Fig. 1.1-14) produces pulses informing the ECM of the vehicle speed. It is mounted on transmission gearbox (Fig. 1.1-15).

When the drive wheels rotate the vehicle speed sensor produces 6 pulses per each meter of vehicle motion. The ECM determines the vehicle speed based on the pulse frequency.

A faulty VSS circuit will set a DTC and illuminate the MIL to indicate the fault.

VSS Removal

1. Ignition OFF.
2. Disconnect the VSS electrical connector.
3. Carefully back out the VSS.

VSS Refitting

1. Install the VSS.
2. Connect the VSS electrical connector.

Crankshaft Position (CKP) Sensor

The crankshaft position sensor (Fig. 1.1-16) is located on the oil pump cover bracket (Fig. 1.1-17) at approximately **0.7...1.1** mm from the reluctor wheel on the crankshaft.

The reluctor wheel is an integral part of the crankshaft pulley that drives the alternator belt. It is designed for tooth pitch of 6° and has two of its teeth missing for synchronization. Thus, the reluctor wheel has only 58 teeth. When the center of the first-after-the-slot tooth is aligned against the CKP sensor, the crankshaft is 114° (19 teeth) before TDC of #1 and #4 cylinders.

As the reluctor wheel rotates it produces a change of magnetic flow in the CKP sensor, allowing it to generate an AC signal. This signal is used by the ECM to determine the position and speed of the crankshaft necessary to control the ignition module and for calculation of ignition timing and injection pulses.

The CKP sensor leads are protected from outside noise by a shield which is connected to ground.

If the CKP sensor circuit is faulty, the engine will stop, the ECM will set a DTC and illuminate the MIL to indicate the fault.

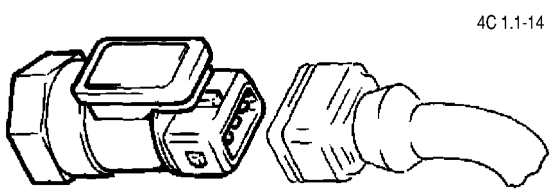


Fig. 1.1-14. Vehicle Speed Sensor (VSS)

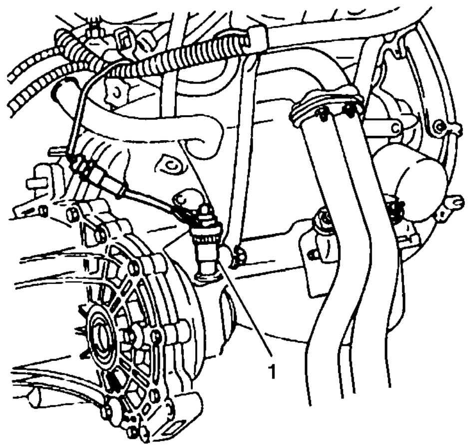


Fig. 1.1-15. Vehicle Speed Sensor (VSS) location view:
1 - Vehicle Speed Sensor (VSS)

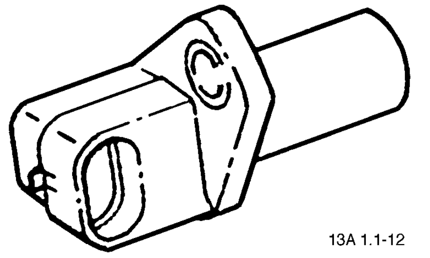


Fig. 1.1-16. Crankshaft Position (CKP) Sensor

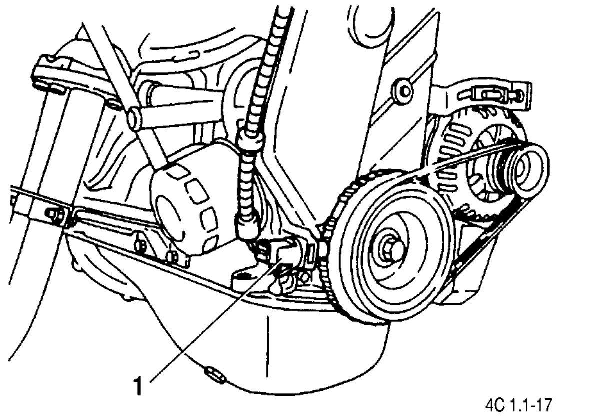


Fig. 1.1-17. Crankshaft Position (CKP) Sensor location view:
1 - Crankshaft Position (CKP) Sensor

CKP Sensor Removal

1. Ignition OFF.
2. Disconnect the CKP sensor electrical connector.
3. Undo the screw holding the CKP sensor to the oil pump cover and remove the sensor.

CKP Sensor Refitting

1. Install the CKP sensor to the oil pump cover. Tighten the mounting screw to 8...12 N•m.
2. Connect the CKP sensor electrical connector.

Camshaft Position (CMP) Sensor

The camshaft position sensor (Fig. 1.1-18) located on the cylinder head plug (Fig. 1.1-19) is Hall-effect type design.

The camshaft features a special pin. When it passes by the CMP sensor the latter genarates the «ground» signal (about 0 volts) indicating that the 1st cylinder is on the compression stroke.

The ECM uses the CMP signal to control sequential fuel injection according to the cylinder firing order.

If the CMP sensor or its circuits are faulty the ECM will set a respective DTC and illuminate the MIL to indicate the fault.

CMP Sensor Removal

1. Ignition OFF.
2. Disconnect the CMP sensor electrical connector.
3. Undo the screw holding the CMP sensor to the cylinder head and remove the sensor.

CMP Sensor Refitting

1. Install the CMP sensor onto the cylinder head.
2. Connect the CMP sensor electrical connector.

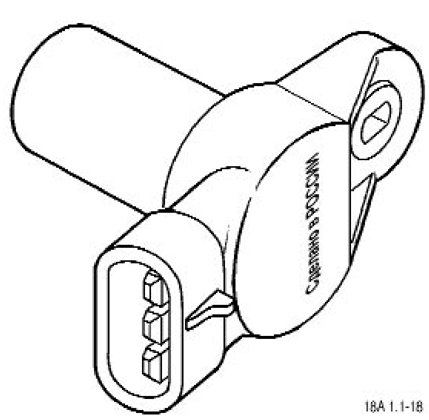


Fig. 1.1-18. Camshaft (CMP) Position Sensor

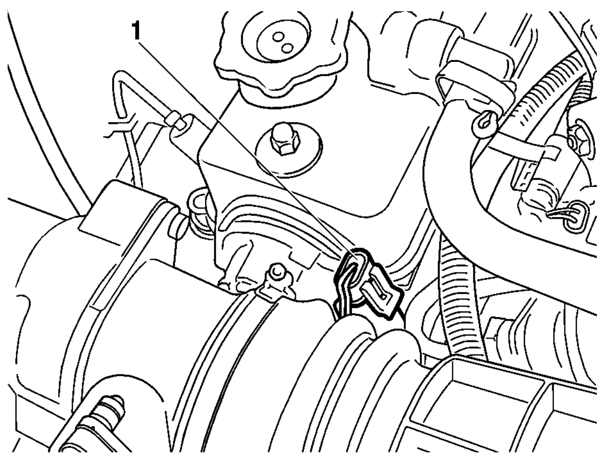


Fig. 1.1-17. Camshaft Position (CMP) Sensor location view:
1 - Camshaft Position (CMP) Sensor

Rough Road Sensor

The rough road sensor (Fig. 1.1-20) is located on the left strut underhood (Fig. 1.1-21). Its operation is based on piezo effect.

Rough road driving can cause momentarily changes in the cranckshaft rotational velocity. This may be detected as false misfire. To avoid this error the ECM will disable misfire detection if the rough road sensor voltage is beyond its threshold value.

If the rough road sensor or its circuits are faulty the ECM will set a respective DTC and illuminate the MIL to indicate the fault.

Rough Road Sensor Removal

1. Ignition OFF.
2. Disconnect the rough road sensor electrical connector.
3. Undo the screws holding the rough road sensor to the bracket and remove the sensor.

Rough Road Sensor Refitting

1. Install the rough road sensor onto the bracket.
2. Connect the rough road sensor electrical connector.

1.2. Vehicle Theft Deterrent System (Immobilizer Module)

The vehicle theft deterrent (VTD) system (immobilizer) includes immobilizer control module (1) (Fig. 1.2-

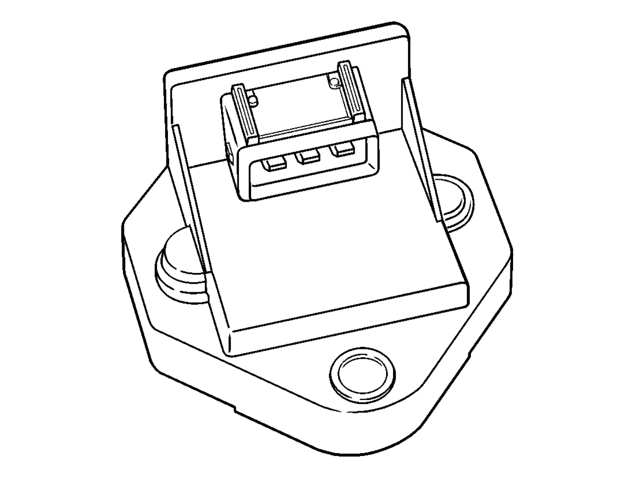


Fig. 1.1-20. Rough Road Sensor

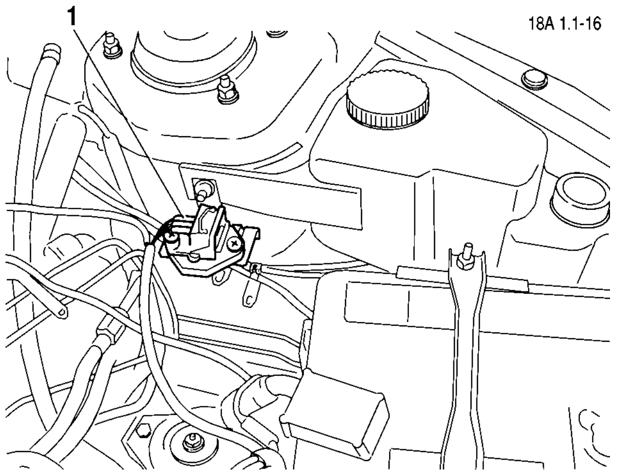


Fig. 1.1-21. Rough Road Sensor location view:
1 - Rough Road Sensor

01), key reader (immobilizer status indicator) (2), two black key fobs (3), one red key fob and the relevant part of the ECM firmware. Operational mode and VTD system status are indicated by the LED in the instrument panel and the beeper inside the immobilizer module. The immobilizer module and the key reader (status indicator) location is shown in Fig. 1.2-02, 1.2-03.

The immobilizer module interacts with the ECM through the diagnostic line. The immobilizer module has an in-built relay that connects or disconnects the data link connector (DLC) from the ECM. If DST-2M is not plugged into the DLC, the relay opens the diagnostic circuit allowing to use the line for immobilizer module to ECM communication. If DST-2M is plugged into the DLC, the relay closes the circuit, allowing data interchange between the ECM and the scan tool. However, the immobilizer module has a higher priority over the scan tool and can interrupt its communication with the ECM (e.g., for data exchange with the ECM at engine start-up).

The ECM and the immobilizer module can be in either of the two states:

- immobilization not active (new state). In this state the immobilizer module and the ECM do not make up a single system and the engine can start without the Fuel Enable signal to the ECM from the immobilizer module;

- immobilization activated (learnt). In this state the engine can run only if the ECM has received the Fuel Enable signal from the immobilizer module.

The immobilizer system is activated (learnt) for the first time using a Red key Fob. This procedure is called «Exit From Service Mode And Programming Black Key Fobs» (see below).

Once the procedure has been performed correctly, the ECM will be learnt to the vehicle immobilizer system and returning them to a new state will be impossible.

The Red key Fob stores the system code and can be used only for learning purposes which include:

- entrance into the service mode and exit from it. Exiting service mode will also programme the ECM, the immobilizer control module and the Black key Fobs;

- immobilizer by-pass mode programming;

- reactivation of the immobilizer system after replacement of either the ECM or the immobilizer module.

During any of the above procedures the system generates a new code, which is stored in the non-volatile memory of the ECM and the immobilizer module. It will also be rewritten into the Red key Fob. Thus, if the vehicle owner suspects that the code from his Red key Fob might have been read, one or several learning procedures should be performed (e.g., entrance into service mode and exit from it) to make the old system code invalid.

Warning: The Red key Fob cannot be used to activate any alien immobilizer module and ECM, since a new code will be written in the Red key Fob and the old one will be lost. This will make it impossible for the vehicle owner to perform any of the programming procedures for the native immobilizer module. In this case, or if the Red key Fob is lost, it is necessary to replace both the immobilizer module and the ECM. Always use the ECM and the immobilizer in a new state for replacement.

Activation of the immobilizer system also includes programming of the Black key Fobs, which will later be used by the ECM to enable fuel injection pulses. For more information on immobilizer system operation refer to Operation Manual.

If the Black key Fobs are lost, a set of new Black key Fobs can be programmed (provided that the native Red key Fob is not lost). To do that first enter immobilizer module Service Mode (Refer to «Service Mode») then exit it (Refer to «Exit From Service Mode»). Performing these procedures will programme Black key Fobs.

Service Mode

Immobilizer module Service Mode can be activated or deactivated. In this mode the immobilizer does not inhibit the engine start. This mode can be used if you want to let another person drive your vehicle without handing over the Black key Fobs, and also for servicing when it can not be performed with immobilization active. In this mode the ECM continues to request Fuel Enable signal from the immobilizer module and will not start the engine if the immobilizer module or its connection is faulty.

To enter or exit Service Mode use the Red key Fob and the following procedure:

1. Immobilizer system is in the armed (sleep) mode. The LED flashes every 2.5 seconds.
2. Ignition ON. The LED flashes twice a second indicating that the system is in the reading mode waiting for a proper Black key Fob signal.
3. Put the original Red key Fob in front of the key reader and switch ignition OFF (the Red key Fob remains in front of the reader). The LED will illuminate and a short beep will be heard. Remove the Red key Fob from the key reader.
4. Within 3...5 seconds after ignition is off the LED will start flashing at a faster rate of 10 times per second with a stop after each second.
5. Once again put the Red key Fob in front of the key reader. The LED will illuminate and a beep will be heard (about 1 second long).
6. Within 10 seconds after the LED illuminates cycle ignition ON for 1-2 seconds and then OFF. If the operation was successful, the LED will go off after 1...5 seconds and a short beep will be heard.
7. Ignition ON. The LED will illuminate continuously indicating that Service Mode is now active.

If the LED flashes once every two seconds, switch ignition OFF and after 15 seconds ON again. The LED will be on steadily and the engine will start.

If any of the steps above is incorrectly performed or timed, the immobilizer will return to its regular mode of operation.

In this case the LED will flash twice a second over a two second period.

If all steps have been performed correctly, the immobilizer will enter Service Mode.

Exit From Service Mode

Once the Service Mode has been entered, the information in the Black key Fobs is lost. Therefore Black key Fobs need to be programmed anew for immobilizer system when it exits Service Mode.

Either new Black key Fobs (never used on a vehicle before) can be used for that purpose or those that you have already used with that very immobilizer system.

To programme key Fobs and exit Service Mode perform the following procedure:

1. Ignition ON. The LED should illuminate continuously, indicating that the system is in Service Mode.
2. Put the original Red key Fob in front of the key reader and switch ignition OFF (Red key Fob remains in front of the key reader). The LED will remain on and a short beep will be heard.
3. Remove the Red key Fob from the key reader. Within 3-5 seconds after ignition is switched OFF the LED will start flashing 10 times per second, indicating that the Black key Fobs can now be programmed.
4. Within the next 10 seconds a Black key Fob should be placed in front of the key reader. After the Fob has been programmed a beep will be heard during one second when the LED is off.

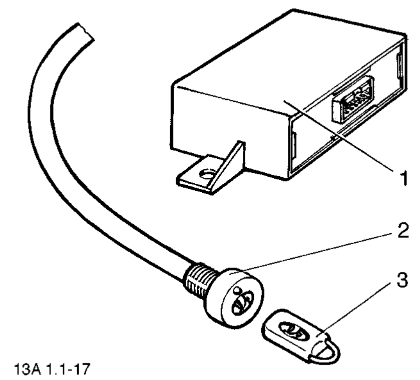


Fig. 1.2-01. Vehicle Theft Deterrent (VTD) System (Immobilizer):
1 - immobilizer module; 2 - key reader; 3 - key fob

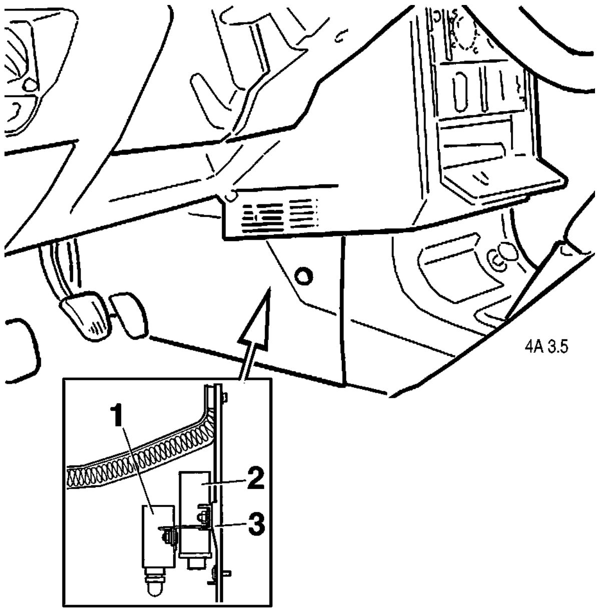


Fig. 1.2-02. Immobilizer Module location view (VAZ-2110 passenger compartment):
1 - immobilizer module; 2 - door lock system control module; 3 - bracket

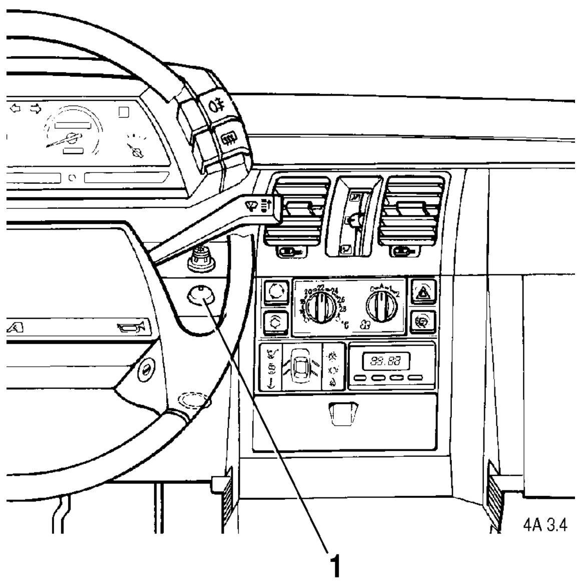


Fig. 1.2-03. Key reader location view (VAZ-2110 instrument panel):
1 - key reader

5. After one Black key Fob has been programmed, the same operation (step 4) can be repeated for another key Fob within the next 10 seconds.

6. After all Black key Fobs have been programmed the system remains in the programming mode for another 10 seconds (LED flashes 10 times per second). Within this period put the Red key Fob in front of the key reader and hold it there until a beep (about one second long) is heard. The LED will illuminate continuously for 10 seconds. Remove the Red key Fob from the key reader.

7. During the 10 second LED on-period cycle ignition ON for 1-2 seconds and then OFF. If the operation was successful, the LED will go off and a short beep will be heard, indicating that the system is now in its regular mode of operation.

If any of the steps above is incorrectly performed or timed, the immobilizer will return to Service Mode and the whole procedure must be performed again. This abnormal ending will be indicated by the LED flashing twice a second over a two second period.

If the procedure has been performed without programming any Black key Fobs, the VTD system will exit service mode but you will not be able to disarm it because there is no Black key Fob. In this case re-enter service mode and exit it programming the required number of Black key Fobs.

After the programming is complete the ECM and the Immobilizer system codes might need to be correlated. To do that disarm the immobilizer system and switch ignition ON. If the LED is flashing once every second, switch ignition OFF for 15 seconds. Next time ignition is ON the LED should not indicate in that manner and the engine should start.

Replacement Of Activated ECM

Always use for replacement an ECM in a new state. To recontinue the immobilizer system functioning after the ECM replacement use the following procedure:

1. Check the replacement ECM for being in a new state as described below:

a) Ignition ON. The LED will flash twice a second (the immobilizer is in the reading mode waiting for a proper key Fob).

b) Put the Black key Fob in front of the key reader. A beeping sound will be heard twice and the LED will go off. Switch ignition OFF.

c) Switch ignition ON after 15 seconds. The LED will:

- illuminate continuously for 20 seconds and then go off (it can flash for the first 5 seconds), indicating that the ECM is in a new state and the procedure can be continued; or

- illuminate continuously without going off after 20 seconds, indicating that the ECM and the immobilizer module are in a new state. In this case skip step 2 and proceed to step 3; or

- flash for over than 5 seconds without illuminating continuously. Cycle ignition OFF for 15 seconds and then ON. If the LED continues to flash, the replacement ECM is not in a new state and the immobilizer system will be disabled.

d) Ignition OFF. Open and close the driver's door. During the next 2 minutes the immobilizer system will go into armed (sleep) mode. Once the system is in armed (sleep) mode the LED will flash once every 2,5 seconds.

2. Activate the immobilizer system service mode (see above).

3. Programme the Black key Fobs and exit service mode (see above).

Attention: Always use the original Red key Fob while performing this procedure.

Replacement Of Activated Immobilizer Module

If the immobilizer module is faulty perform the following procedure:

1. Replace the immobilizer control module for a new one (not learnt).

2. Programme the Black key Fobs and exit service mode (see above).

Attention: Always use the original Red key Fob while performing this procedure.

Immobilizer By-Pass Mode

Immobilizer By-Pass Mode allows to start the engine without Fuel Enable signal from the immobilizer module.

In By-Pass Mode the accelerator pedal is used to input a preprogrammed code.

Immobilizer By-Pass Mode Programming

Immobilizer By-Pass Mode programming includes choosing a By-Pass code containing 6 numbers.

1. Ignition ON. The LED will flash twice a second indicating that the system is in the reading mode waiting for a proper key Fob.

2. Put the original Red key Fob in front of the key reader and switch ignition OFF (the Red key Fob remains in front of the reader). The LED will illuminate and a short beep will be heard. Remove the Red key Fob from the key reader.

3. Within 3-5 seconds after ignition is off the LED will start flashing at a faster rate of 10 times per second with a stop after each second.

4. Ignition ON.

5. During the first 4 minutes the MIL (Check Engine light) flashes once every 2 seconds, indicating that you can now programme the By-Pass Mode code.

6. After that the MIL will go off for 1 minute. During that period enter the first number (recommended range from 1 to 9) by depressing the accelerator pedal full way. Each time the pedal is depressed the MIL flashes and the number increases by 1.

7. To enter the remaining numbers of the code repeat steps 5 and 6 five more times.

If the accelerator pedal is not depressed, the programming procedure will be cancelled. In this case the engine cannot be started using the By-Pass Mode and the MIL will start flashing in a faster mode (once a second).

Starting The Engine Using By-Pass Mode

If fuel injection pulses are not enabled after ignition has been switched on, the engine can be started using the By-Pass Mode.

To start the engine perform the following procedure:

1. Ignition ON.

2. The MIL (Check Engine light) is on during 4 minutes.

3. After that the MIL goes off for 1 minute. During this period enter the first number of the preprogrammed code using the accelerator pedal. Depressing the accelerator pedal full way will illuminate the MIL and increase the number by 1.

If the accelerator pedal is not depressed or an incorrect number has been entered the By-Pass Mode start-up procedure will be terminated. The engine will not start and the MIL will flash (once a second).

4. To enter the remaining numbers of the code repeat steps 2 and 3 five more times.

This procedure allows to start the engine only once per trip. That means that within 10 seconds after ignition is off, the engine will stop and the fuel injection pulses will be disabled. The By-Pass Mode start-up procedure can only be used once.

1.3. Fuel Metering System

General Description

The basic function of the fuel metering system is to control fuel delivery to the engine in all engine operation modes. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold.

Fuel metering system (Fig. 1.3-01) includes:

- Electric fuel pump
- Fuel pump relay
- Fuel filter
- Fuel supply and fuel return lines
- Fuel rail:
  - Fuel injectors
  - Fuel pressure regulator
  - Fuel pressure test fitting

The in-tank fuel pump supplies fuel to the fuel rail through the filter and the supply line.

The fuel pressure regulator maintains constant pressure drop between the fuel rail supply line and the intake manifold. Fuel is supplied to the injectors at 284...325 kPa with ignition ON and the engine not running. Unused fuel is returned to the fuel tank by a separate fuel return line.

The ECM operates fuel injectors sequentially. Each injector is enabled every 720° of crankshaft rotation.

The ECM controls injectors by pulse signal. Pulse width depends on the amount of fuel required by the engine. Each pulse opens the injectors at a given moment of crankshaft rotation depending on the engine operation mode.

Pulse signal opens the normally closed injector valve to supply pressurized fuel into the intake duct.

Since the pressure drop is maintained constant the amount of fuel delivered depends on the duration of injector on-time (pulse width). The ECM maintains optimal air/fuel ratio by controlling pulse width.

The longer is the injection pulse width, the more fuel is delivered to the cylinders (rich mixture). The shorter is the injection pulse width, the smaller amount of fuel is delivered to the cylinders (lean mixture).

Caution: In order to reduce the risk of personal injury and vehicle damage that may be caused by accidental engine start-up during dismantling the fuel metering system components always disconnect the battery negative cable before servicing and reconnect it after the servicing is completed.

It is necessary to relieve the fuel system pressure before servicing fuel system components (Refer to Fuel Pressure Relief Procedure).

Cover fuel pipe fittings with a shop towel before disconnecting the fuel pipes in order to catch any fuel that may leak out. Place the towel in an approved container when disconnection is completed.

Fuel Pressure Relief Procedure

1. Place transmission in neutral and apply parking brake.

2. Disconnect the fuel pump harness connector (Fig. 1.3-03).

3. Start the engine and allow to idle until the engine stops running for lack of fuel.

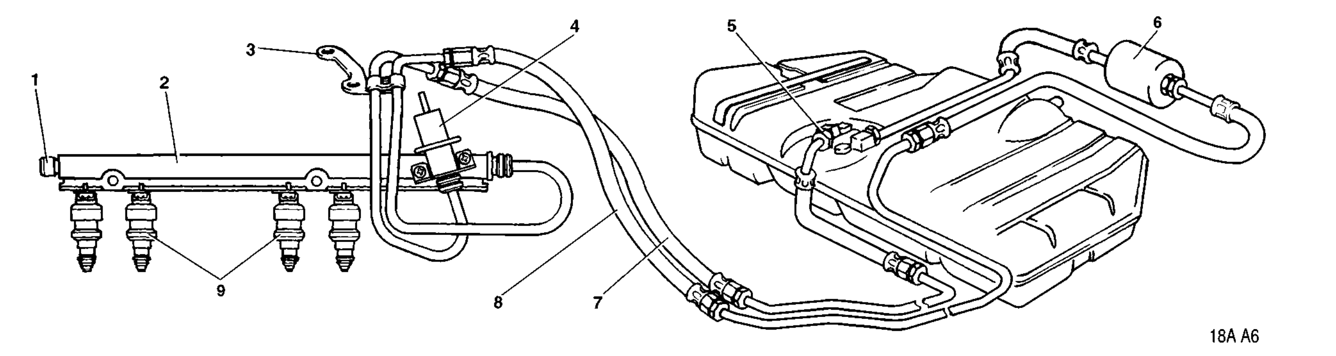


Fig. 1.3-01. Sequential Fuel Injection System:
1 - fuel pressure test fitting; 2 - fuel rail; 3 - fuel lines mounting bracket; 4 - fuel pressure regulator; 5 - electric fuel pump; 6 - fuel filter; 7 - fuel return line; 8 - fuel supply line; 9 - injectors

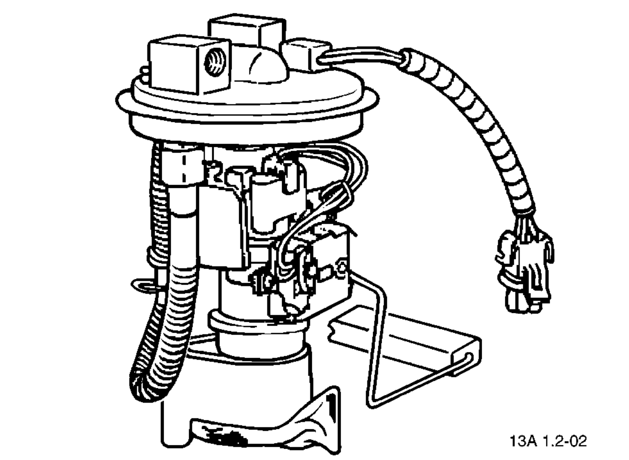


Fig. 1.3-02. Electric Fuel Pump Assembly

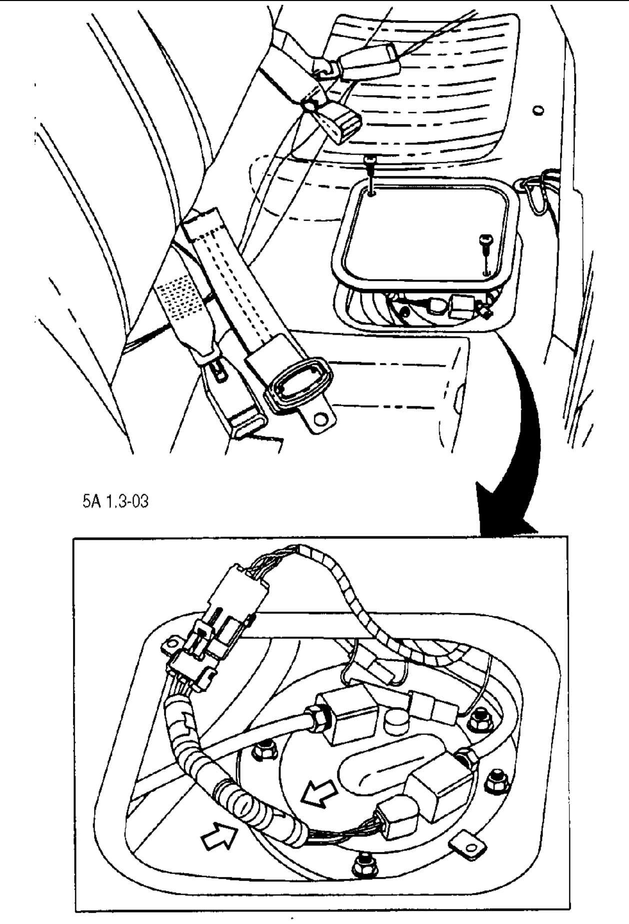


Fig. 1.3-03. Electric Fuel Pump Assembly location view

4. Engage starter for three seconds to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.

5. After the fuel pressure is relieved and the subsequent servicing is completed reconnect the fuel pump harness connector.

Electric Fuel Pump Assembly

The fuel pump assembly (Fig. 1.3-02) comprises the turbine type fuel pump, rough fuel filter and fuel level sensor.

The fuel pump is designed to deliver fuel from the fuel tank through the in-line filter into the fuel rail. Unused fuel is returned to the fuel tank by a separate fuel return line.

The ECM energizes the fuel pump through a relay. When the ignition switch position is changed from «OFF» to «Ignition ON» the ECM energizes the relay for 2 seconds to boost pressure in the fuel rail to a required level. If during these two seconds when the pump is operating the engine does not start cranking, the ECM will deenergize the fuel pump relay and expect for the engine to crank. After the engine starts cranking the ECM will re-energize the relay.

If ignition is switched on after less than 15 seconds off-period, the fuel pump will start only with the engine cranking.

Fuel Pump Assembly Removal

1. Fold rear seat forward.
2. Remove the fuel tank access cover (Fig. 1.3-03) and disconnect the fuel pump harness connector.
3. Relieve fuel system pressure (see above).
4. Disconnect fuel lines from the fuel pump.
5. Unscrew the retaining nuts. Carefully remove the fuel pump assembly from the fuel tank.

Important: Caution must be taken while removing the fuel pump assembly to prevent bending of the fuel level sensor lever and resulting false fuel level reading.

Fuel Pump Assembly Refitting

1. Make sure that the seal between the fuel tank and the fuel pump is not missing or incorrectly positioned.
2. Install the fuel pump assembly to the fuel tank, align marks on the fuel pump and the fuel tank and fix the fuel pump with retaining nuts.

Important: Caution must be taken while refitting the fuel pump assembly to prevent bending of the fuel level sensor lever and resulting false fuel level reading.

3. Check the fuel lines O-rings for damage. Reconnect the fuel lines. Tighten the attaching nuts to 20...34 N•m.
4. Connect the fuel pump electrical connector.
5. Turn the fuel pump on by applying +12 volts to terminal «11» of the DLC and check the fuel system for leaks.
6. Replace the fuel pump access cover.
7. Return the rear seat to normal position.

Fuel Filter

The fuel filter (Fig. 1.3-04) is located in the underbody near the fuel tank (Fig. 1.3-05). The fuel filter is connected into the supply line between the fuel pump and the fuel rail.

The filter has a steel body with threaded fittings on its both sides. The paper filter element is designed to entrap particles which may otherwise cause fuel injection system malfunctioning.

Fuel Filter Removal

1. Relieve fuel system pressure (see above).

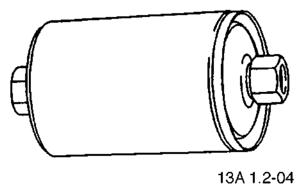


Fig. 1.3-04. Fuel Filter

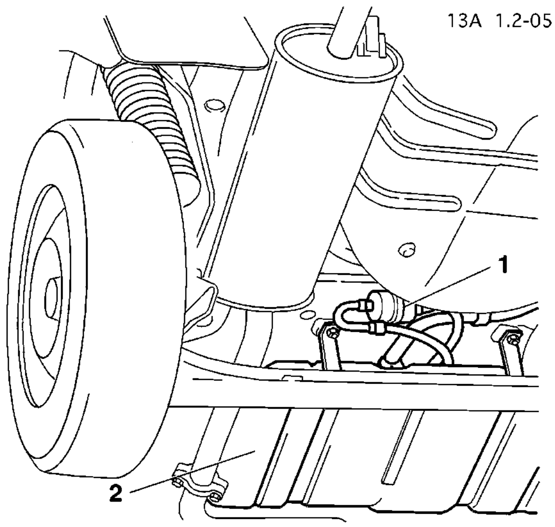


Fig. 1.3-05. Fuel Filter location view:
1 - fuel filter; 2 - fuel tank

2. Unscrew the fuel lines to filter attachment nuts. Be careful not to lose O-rings that are installed between the fuel filter and fuel lines.

Attention: Always use another wrench to hold the filter fittings while unscrewing the nuts.

3. Loosen the bolt of the fuel filter hold down strap and remove the fuel filter.

Fuel Filter Refitting

Check the O-rings for cuts, scuffs or dents. Replace as necessary.

1. Install the fuel filter. The arrow on the fuel filter body should point in the direction of fuel flow. Secure the filter with the strap.
2. Attach the fuel lines to the filter. Tighten the fuel lines nuts to 20...34 N•m.

Attention: Always use another wrench to hold the filter fittings while tightening the nuts.

3. Turn the fuel pump on by applying +12 volts to terminal «11» of the DLC and check the fuel system for leaks.

Fuel Rail

The Fuel Rail (Fig. 1.3-06 and 1.3-07) is a receptacle for fuel with injectors and fuel pressure regulator attached to it. It is mounted on the intake manifold and fixed to it with two mounting screws.

Fuel is fed under pressure into the fuel rail and further to the intake manifold through the fuel injectors.

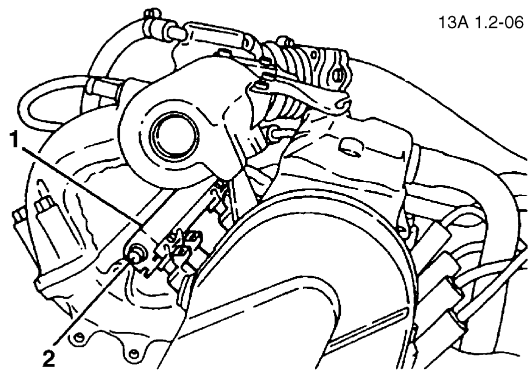


Fig. 1.3-06. Fuel Rail location view:
1 - fuel rail; 2 - fuel pressure test fitting

The fuel rail has a fuel pressure test fitting (1) (Fig. 1.3-07) covered with a threaded cap.

A number of diagnostic procedures carried out while servicing or fault finding require the fuel pressure to be tested. This can be done using a fuel pressure gauge connected to the easy to reach test fitting.

Fuel Rail Removal

Care must be taken when removing the fuel rail to avoid damaging connector pins or injector nozzles.

When servicing the fuel rail assembly, precautions must be taken to prevent dirt and other contaminants from entering the fuel passages. It is recommended that the fittings be capped, and the holes be plugged during servicing.

Before removing the fuel rail clean it with a spray engine cleaner. Do not immerse the fuel rail into any cleaning solvent.

1. Relieve fuel system pressure (Refer to Fuel Pressure Relief procedure).
2. Ignition OFF.
3. Disconnect the battery negative cable.
4. Disconnect throttle linkage from the throttle body and the intake plenum.
5. Disconnect the intake pipe from the throttle body unit.
6. Unscrew the mounting nuts holding the throttle body unit to the intake plenum. Leave the coolant hoses connected and remove the throttle body from the intake plenum.
7. Disconnect the fuel supply and return pipes from the fuel rail, fuel pressure regulator and the mounting bracket on the intake plenum.

Attention: Always use another wrench to hold the fuel rail fittings while loosening the nuts.

8. Disconnect the vacuum hose from the fuel pressure regulator.
9. Unscrew the mounting nuts and remove plenum from the intake manifold.
10. Disconnect the injector harness electrical connectors and remove the injector harness.
11. Unscrew the fuel rail and withdraw it.

Important: If an injector becomes separated from the fuel rail and remains in the intake manifold, both injector O-ring seals and the retainer clip must be replaced.

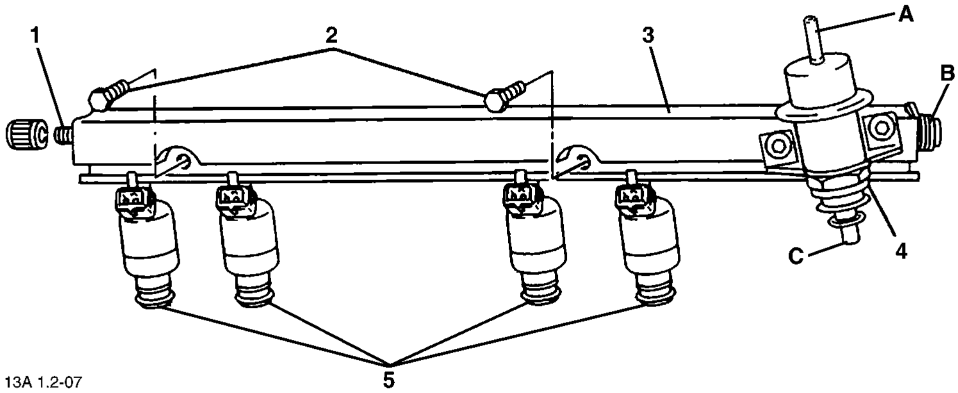


Fig. 1.3-07. Fuel Rail Assembly:
1 - fuel pressure test fitting; 2 - fuel rail mounting screws; 3 - fuel rail; 4 - fuel pressure regulator; 5 - injectors; A - intake manifold vacuum line fitting; B - fuel supply fitting; C - fuel return line fitting

Fuel Rail Refitting

1. Lubricate new injector O-ring seals with clean engine oil, and install on injectors. Install the fuel rail assembly to the intake manifold and fix it with mounting screws. Tighten the screws to 9...13 N•m.
2. Connect the injector harness electrical connectors.
3. Install the intake plenum.
4. Connect the fuel supply and return pipes. Tighten the nuts attaching the pipes to the pressure regulator and to the fuel rail to 10...20 N•m.

Important: Check the O-rings for cuts, scuffs or dents. Replace as necessary.

Attention: Always use another wrench to hold the fuel rail fittings while tightening the nuts.

5. Connect the vacuum hose to the pressure regulator.
6. Install the throttle body unit to the intake plenum and secure it with mounting nuts.
7. Connect the intake pipe to the throttle body.
8. Connect the throttle linkage and check its functionality.
9. Connect the battery negative cable.
10. Turn the fuel pump on by applying +12 volts to terminal «11» of the DLC and check the fuel system for leaks.

Fuel Injectors

The fuel injector (Fig. 1.3-08) is a solenoid operated device controlled by the ECM, which delivers measured amounts of pressurized fuel into the intake manifold.

Injectors are held to the fuel rail by retaining clips (4). The upper and the lower ends of the injector are sealed with O-rings (6), which must be replaced each time the injectors are removed/refitted.

The ECM energizes the solenoid inside the injector which allows the fuel to pass through the valve onto the plate forming the spray pattern.

Fuel passes through the holes in the plate and is sprayed in a conical pattern.

The fuel cone is directed to the intake valve, but before the fuel is delivered to the combustion chamber it evaporizes mixing with the air.

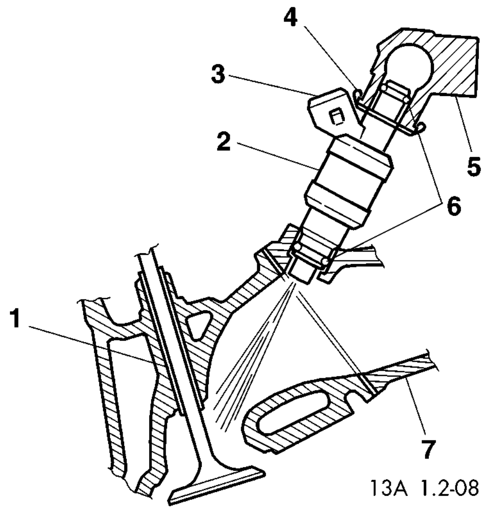


Fig. 1.3-08. Fitting the injector:
1 - intake valve; 2 - fuel injector; 3 - electrical connector; 4 - retaining clip; 5 - fuel rail; 6 - O-rings; 7 - intake manifold

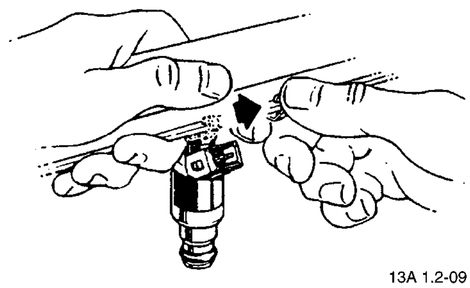


Fig. 1.3-09. Removing fuel injector retaining clip

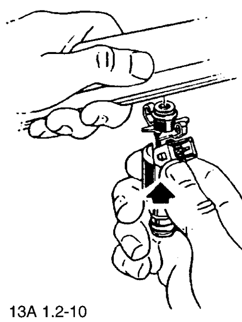


Fig. 1.3-10. Fitting the injector

A fuel injector which is stuck partly open will cause a loss of fuel pressure after engine shut down, causing long crank times to be noticed on some engines. It may also cause engine run-on because fuel delivery will continue after engine shut down.

Fuel Injector Removal

1. Remove the fuel rail (Refer to Fuel Rail Removal).
2. Remove injector retaining clip(s) (Fig. 1.3-09).
3. Remove the injector(s).
4. Remove both injector sealing O-rings and discard.

Notice: Use care in removing the fuel injectors to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. The fuel injector is serviced as a complete assembly only.

The fuel injector is an electrical component and should not be immersed in any type of cleaner as damage to the fuel injector may result.

Precautions must be taken to prevent engine oil from getting inside the fuel injector.

Fuel Injector Refitting

1. Lubricate new injector O-ring seals with clean engine oil, and install on injector(s).
2. Install injector(s) retaining clip(s).
3. Install injector(s) into fuel rail injector socket(s) (Fig. 1.3-10), with electrical connector facing upward. Push the injector into its socket far enough to engage retainer clip with groove on rail.
4. Install the fuel rail assembly (Refer to Fuel Rail Refitting).
5. Turn the fuel pump on by applying +12 volts to terminal «G» of the DLC and check the fuel system for leaks.

Fuel Pressure Regulator

The fuel pressure regulator (Fig. 1.3-11) is a diaphragm-operated relief valve with fuel pump pressure on one side and regulator spring and manifold pressure (vacuum) on the other. It is mounted on the fuel rail (Fig. 1.3-06) and may not be serviced separately.

The function of the fuel pressure regulator is to maintain the fuel pressure available to the fuel injectors. Adjustment for engine load is achieved through increasing fuel pressure when the intake manifold pressure increases (throttle valve opens).

When the intake manifold pressure decreases (throttle valve closes) the regulator decreases fuel pressure by opening its relief valve to return unused fuel to the fuel tank.

With ignition on, engine not running and the fuel pump on the fuel pressure should be 284...325 kPa.

If the fuel pressure is too low, engine poor performance could result.

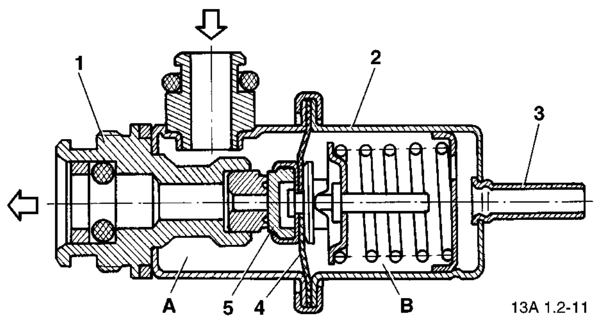


Fig. 1.3-11. Fuel Pressure Regulator:
1 - body; 2 - housing; 3 - vacuum line fitting; 4 - diaphragm; 5 - valve; A - fuel chamber; B - vacuum chamber

Fuel Pressure Regulator Removal

1. Relieve fuel system pressure (Refer to Fuel Pressure Relief procedure).
2. Ignition OFF.
3. Disconnect the battery negative cable.
4. Disconnect the vacuum hose from the fuel pressure regulator.
5. Disconnect the fuel return pipe from the fuel pressure regulator.
6. Undo the pressure regulator mounting screws, lift and twist the fuel pressure regulator in order to remove it from the fuel rail.

Fuel Pressure Regulator Refitting

1. Apply motor oil to the O-ring. Install fuel pressure regulator to the fuel rail and fix it with mounting screws. Tighten the mounting screws to 8...11 N•m.
2. Connect the fuel return pipe. Tighten the attaching nut to 10...20 N•m.
3. Connect the vacuum hose.
4. Connect the battery negative cable.
5. Turn the fuel pump on by applying +12 volts to terminal «11» of the DLC and check the fuel system for leaks.

Fuel Supply Control Modes

Fuel delivery is regulated by the ECM.

Fuel can be supplied using either of the following methods: synchronous method, i.e depending on the crankshaft position, or asynchronous, i.e. without synchronizing it to the crankshaft position.

Synchronous method is used predominantly.

Synchronization of injectors operation is achieved throught the use of CKP and CMP sensors (Refer to Section 1.1)

The ECM calculates timing for each injector, which injects fuel once per complete operating cycle of its cylinder. This method provides a more precise fuel metering for each cylinder and secures lower emission level.

Asynchronous method is used during engine start-up and dynamic driving.

The ECM processes data from sensors, determines the engine mode of operation and calculates the injection pulse width.

Fuel delivery increases when pulse width increases and decreases when pulse width decreases.

Fuel injection pulse width can be monitored using DST-2MM.

Fuel is delivered under one of several conditions called modes described below.

Fuel Cutoff Mode

No fuel is delivered under the following conditions:

- Ignition OFF (this prevents surface ignition);
- Engine not running (no reference pulses from the CKP sensor are detected);
- Engine braking;
- Engine speed exceeds its rated value (about 6200 rpm).

Starting Mode

When ignition is turned on, the ECM energizes through a relay the fuel pump, which pumps up fuel into the fuel rail pressurizing it.

The ECM checks the Engine Coolant Temperature (ECT) sensor in order to determine the proper injection pulse width for starting.

When the engine starts cranking the ECM forms an asynchronous injection pulse signal. Its width depends on ECT voltage. At low temperatures the pulse width increases to increase the amount of fuel delivered, at high temperatures the pulse width decreases. This is called «initial fuel injection» designed to facilitate engine startup. Further on fuel is injected synchronously.

The injectors are activated in pairs: first is activated the pair of injectors for cylinders #1 and #4, then, after the crankshaft turns 180°, the second pair of injectors is energized (cylinders #2 and #3) etc. Thus, each injector is activated once per crankshaft revolution, or twice per engine duty cycle.

The engine continues to operate in the starting mode until its speed reaches certain value (desired idle), which depends on ECT.

Important: For the engine to startup its cranking speed should exceed 80 rpm and the system voltage should not be less then 6 volts.

After the start-up injectors are activated in turn one after another each 180° of crankshaft rotation according to the firing order (1-3-4-2). Thus, each injector is activated once per two crankshaft revolutions.

Open Loop Mode

After the engine startup and until all conditions for closed loop mode are met the engine operates in open loop mode. In this mode the ECM controls fuel delivery regardless of the HO_2S 1 signal. Pulse width is calculated based on signals from CKP, MAF, ECT and TP sensors.

Power Enrichment Mode

The ECM monitors voltage from the TP sensor and engine speed to determine the moment when engine maximum power is required.

For maximum engine power the air/fuel mixture must be rich, this is achieved through increasing injection pulse width.

Deceleration Fuel Cutoff Mode

No fuel is delivered during deceleration with throttle fully closed and engaged gear and clutch (engine braking).

Deceleration fuel cutoff mode parameters can be monitored using DST-2MM.

Fuel cutoff and subsequent recontinuation of fuel supply are controlled with regard to the following parameters:

- engine coolant temperature (ECT);
- engine speed;
- vehicle speed;
- throttle position;
- load parameter.

System Voltage Correction Mode

When the system voltage is low the ignition coils need longer dwell time and the injector mechanical movement takes longer to open.

ECM will compensate for the system voltage drop by increasing ignition dwell time and injection pulse width.

Likewise, when the system voltage is high the ECM will decrease ignition dwell time and injection pulse width.

Closed Loop Mode

The closed loop mode is activated when all of the following conditions are met:

1. The HO_2S 1 is hot enough to operate properly.
2. The ECT is above 35°C.
3. A specific amount of time has elapsed since starting the engine (this depends on ECT at startup).
4. The engine is not operating in one of the following modes: Starting Mode, Fuel Cutoff or Power Enrichment Mode.
5. The engine load is within specified range.

When in Closed Loop, the ECM calculates the fuel injector on-time based on the same sensor inputs as in the Open Loop (basic calculation). There is, however, a difference: the ECM uses HO_2S 1 input signal to make final adjustment of injection pulse width in order to ensure the best performance of the catalytic converter.

Fuel trimming, or adjustment, can be done in either of the following ways: short-term (current) trimming or using the ECM learning ability (long-term fuel trim). Short-term trim value is calculated based on the signal from the HO_2S 1 and can vary fast enough to compensate for minor deviations of the air/fuel ratio from its stoichiometric optimum. The second way (using the ECM learning ability) suggests that fuel trim values are calculated for each «rpm/load» combination based on short-term value and are rather slow to change.

Short-term fuel trim value is zeroed each time ignition is OFF. Long-term fuel trim values are stored in the ECM memory as long as the battery is connected.

The purpose of long term fuel trimming is to compensate for deviations from stoichiometric ratio, which may result from variation of specifications of the EMS components, tolerances for production of engines and also from engine parameter spread throughout its service life (wear, carbonization etc.).

To provide a more precise compensation the entire range of engine operation is divided into 4 zones:

- idle;
- high rpm at low load;
- part load;
- high load.

In each zone the fuel injection pulse width is corrected in a specified way until the optimum air/fuel ratio is reached.

When the engine leaves any of the zones, the learning process in this zone stops and its last fuel trim value is stored in the ECM RAM. This is repeated for every zone.

Fuel trim values are specific for each engine and are used in open loop mode and starting mode without being changed.

No closed loop control is required if the fuel trim value is 1 (or 0 for long term value at idle). Any deviation from 1(0) indicates that the injection pulse width is being changed using HO_2S 1 feedback signal. If the fuel trim value in closed loop is greater than 1(0), the injection pulse width will increase (i.e. more fuel will be delivered). If the fuel trim value in closed loop is lower than 1(0), the injection pulse width will decrease (i.e. less fuel will be delivered). Fuel trim values for short (current) and long (with learning) term may vary within 1±0.25 (±0.45).

A fuel trim value, which is beyond rich or lean threshold, indicates a fault in the engine or the EMS (incorrect fuel pressure, air inleaks, leaking exhaust system etc.).

The ECM learning on vehicles, equipped with catalytic converter, continues over the vehicle's life and ensures meeting stringent exhaust emission regulations.

When the battery is disconnected the fuel trim values are zeroed and the learning process resets (starts anew when the system is in the closed loop again).

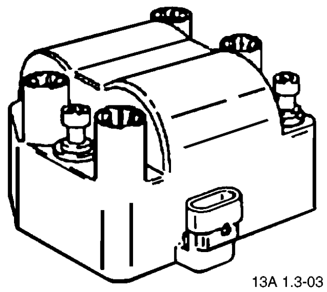


Fig. 1.4-02. Ignition module

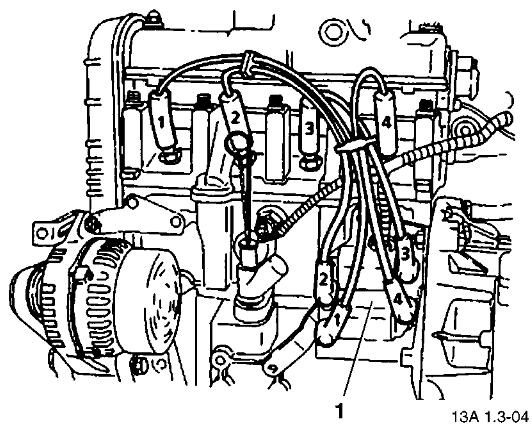


Fig. 1.4-03. Ignition module and HT leads location view:
1 - ignition module

1.4. Ignition System

General Description

The ignition system (Fig. 1.4-01) features the ignition module, which consists of a double-channel electronic commutator and two double-terminal ignition coils. The ignition system has no moving parts and therefore requires no servicing. Ignition timing is not adjustable, since it is controlled electronically.

The ECM controls ignition using signals from a number of sensors.

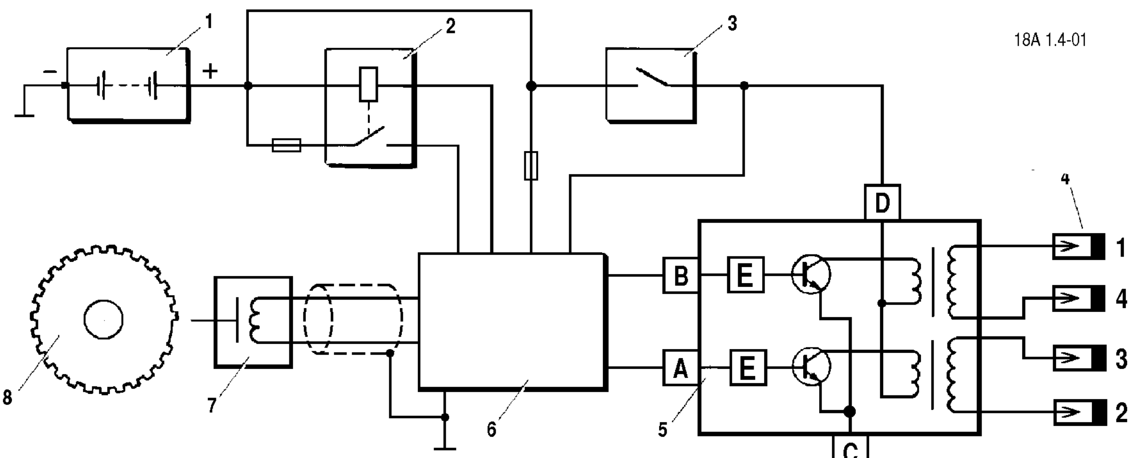


Fig. 1.4-01. Electronic Ignition System:
1 - storage battery; 2 - main relay; 3 - ignition switch; 4 - spark plugs; 5 - ignition module; 6 - ECM; 7 - crankshaft position (CKP) sensor; 8 - reluctor wheel; E - coil driver

The method used in this system is called waste spark ignition. Each cylinder is paired with the cylinder that is opposite it (1-4, 2-3) and plugs fire simultaneously in two cylinders: in the cylinder on compression (event cylinder) and in the cylinder on exhaust (waste cylinder).

Since the polarity of the ignition coil primary and secondary windings is fixed, one spark plug always fires with normal polarity and its companion plug fires with reverse polarity.

Ignition Module

The ignition module (Fig. 1.4-02 and 1.4-03) contains two ignition coils and two power transistor switches for energizing ignition coils primary winding.

The ignition module has the following 4 circuits (Fig. 1.4-01):

Power circuit (Ignition feed circuit)

System voltage is supplied to terminal «D» of the ignition module through the ignition switch.

Ground Circuit

The ground circuit connects the cylinder head with the terminal «C» of the ignition module.

Ignition control circuit for cylinders #1 and #4.

The ECM supplies ignition signal to the terminal «B» of the ignition module. This signal is used to energize the ignition coil primary winding and supply high voltage to cylinder #1 and #4 spark plugs.

Ignition control circuit for cylinders #2 and #3.

The ECM supplies ignition signal to the terminal «A» of the ignition module. This signal is used to energize the ignition coil primary winding and supply high voltage to cylinder #2 and #3 spark plugs.

The ignition module must be replaced as a complete unit, should any of its components become faulty.

Ignition Module Removal

1. Ignition OFF.
2. Disconnect the ignition module harness connector.
3. Disconnect plug wires.
4. Unscrew the retaining nuts and remove the ignition module.

Ignition Module Refitting

1. Install the ignition module onto the engine and fasten it with retaining nuts. Tighten the nuts to 7...9 N•m.
2. Connect the plug wires.
3. Connect the ignition module harness connector.

Knock Sensor System

Continuous knock (detonation) may cause serious damage to the engine components. To eliminate this condition the ECM retards spark timing.

To detect knock condition a knock sensor (KS) is used (Refer to Section 1.1).

The ECM analyzes the KS signal and retards spark timing using a special algorithm if knock is present (indicated by increased amplitude of engine vibrations within certain frequency range).

Spark timing correction, aimed at knock elimination, is individual for each cylinder, i.e. the ECM detects where knock occurs and retards spark timing only for the trouble cylinder.

A faulty KS will store a DTC and illuminate the MIL (Check Engine light). The ECM will also retard spark timing depending on the engine's mode of operation to eliminate possible knock.

1.5. Air Conditioning System

The air conditioning (A/C) system is made up of an air conditioning cycling switch, high/low pressure switch, high coolant temperature switch, compressor clutch control relay, control unit relay, condenser fan relay, blower switch, the compressor and instrument panel switch.

The ECM monitors the air conditioning request input signal. This signal informs the ECM that the A/C system has been requested (commanded by the driver) ON. The signal is supplied to the ECM from the A/C instrument panel switch through a number of switches, which react to temperature and pressure changes.

On receiving the air conditioning request input signal the ECM regulates the IAC valve position to compensate for the air conditioning compressor load on the engine, then the ECM energizes the compressor clutch control relay by providing a ground path to the relay coil. The relay contacts close allowing voltage to operate the A/C compressor clutch.

At A/C switch-on the idle speed increases to compensate for the extra load. Idle speed should remain within 900 rpm for a warm engine.

The A/C compressor is switched on if:

- A/C request is present;
- more than 5 seconds elapsed since the engine start-up;
- throttle opening is not greater than 68%;
- system voltage does not exceed 16.5 volts.

1.6. Cooling System Electric Fan

The ECM controls the cooling system electric fan relay (Fig. 1.6-01). The fan may be commanded ON only with the engine running. The cooling fan cycles ON/OFF depending on the coolant temperature.

The cooling fan switches ON when the engine coolant temperature is above 105°C.

The cooling fan will turn OFF when the coolant temperature falls below 101°C, or the engine is stopped.

If the A/C compressor is ON, the cooling fan will also turn ON, whatever the coolant temperature is.

If any of the ECT sensor active DTCs is present, the cooling fan will start and continue to operate until the DTC is cleared or the engine is stopped.

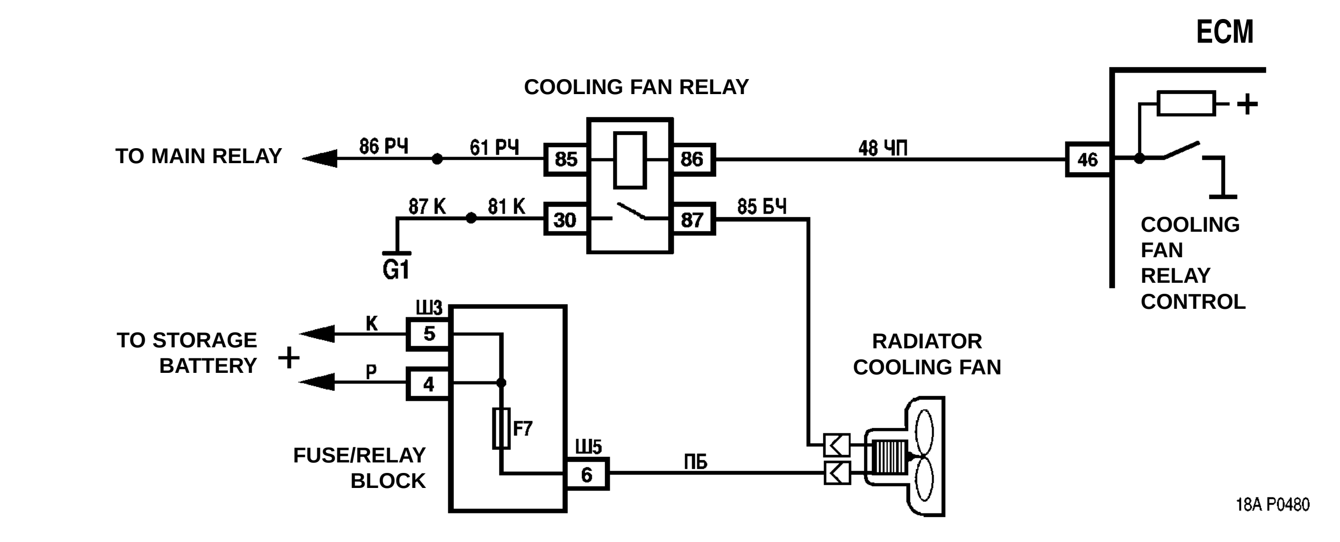


Fig. 1.6-01. Cooling fan wiring diagram

1.7. Crankcase Ventilation System

The crankcase ventilation system (Fig. 1.7-01) is used to provide scavenging of the crankcase vapors. Unlike some ventilation systems, the sequential fuel injection system does not supply fresh air to the crankcase.

The crankcase ventilation system has three hoses. The first hose (large) is used to supply crankcase vapors to the oil separator (See diagram).

The second and the third hoses (one small and one large) make up the primary and the secondary circuits. These circuits enable the vapors that have come through the oil separator to return to the combustion chamber via the throttle body. The oil separator is mounted in the cylinder head cover.

The primary circuit has a metered orifice in the throttle body. A small hose runs from this orifice and into the oil separator. A large (secondary circuit) hose runs from the oil separator and into the air intake pipe (throttle body air intake duct).

At idle all crankcase vapors are directed through the primary circuit orifice (small hose). High manifold vacuum characteristic for this mode draws crankcase vapors into the downstream side of the throttle. The metered orifice limits the amount of crankcase vapors passing through it to secure engine stable idle.

Under heavy load, when the throttle is wide/part open, a small amount of the crankcase vapors is passed through the primary system orifice. However, most of the vapors pass through the secondary system (large hose) into the air intake pipe (throttle body air intake duct) and are burned in the combustion chamber.

Results of Incorrect Operation

A plugged or damaged orifice or hose may cause the following conditions:

- higher than normal idle air control valve steps;
- oil leaks;
- oil in MAF sensor or air cleaner;
- sludge in the engine.

1.8. Air Intake System

Air Cleaner

The air cleaner is mounted in the front part of the underhood on the rubber supports (6) (Fig. 1.8-01). The air cleaner has a paper filter element with large filtering surface.

The outside air is drawn through the intake branch, located under the air cleaner housing, and passes through the air cleaner, mass air flow (MAF) sensor, intake pipe and the throttle body.

After the throttle body the air is directed into the intake plenum, intake manifold, cylinder head and into the cylinders.

Filter Element Replacement

1. Unscrew the bolts and lift the upper air cleaner housing with the MAF sensor and the intake pipe.

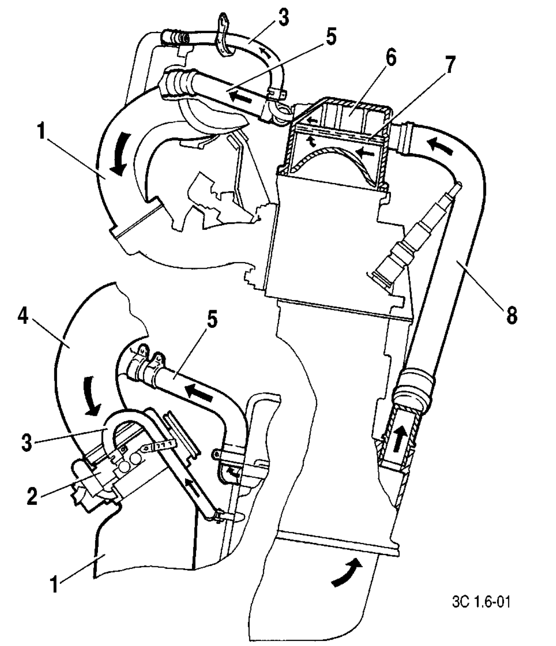


Fig. 1.7-01. Crankcase Ventilation System:
1 - plenum; 2 - throttle body; 3 - hose, primary line; 4 - air intake pipe; 5 - hose, secondary line; 6 - cylinder head cover; 7 - oil separator; 8 - suction hose

2. Replace the filter element with a new one. Its corrugation should run parallel to the arrows inside the lower air cleaner housing.

3. Install the air cleaner upper housing and bolt it on.

Air Cleaner Removal

1. Unscrew the attaching bolts and disconnect the MAF sensor from the air cleaner.

2. Cut off the three rubber supports holding the air cleaner to the vehicle body and remove the air cleaner.

Air Cleaner Refitting

1. Install new rubber supports of the air cleaner into the holes in the vehicle body.

2. Install the air cleaner on the rubber supports.

3. Using the attaching bolts fasten the MAF sensor with the intake pipe to the air cleaner.

Throttle Body Unit

The throttle body unit (Fig. 1.8-02) in the multipoint fuel injection system is mounted on the intake plenum (1) (Fig. 1.8-01). It meters the amount of air drawn into the intake manifold. Air intake to the engine is controlled by the throttle plate linked to the accelerator pedal.

The throttle body unit contains the throttle position (TP) sensor and the idle air control (IAC) valve. Vacuum ports located behind the throttle plate provide the vacuum needed by the crankcase ventilation system at idle (2) (Fig. 1.8-02) and the EVAP canister (6) (Fig. 1.8-02).

Replacement of the TP sensor or the IAC valve does not require removal of the throttle body unit from the engine.

Be sure to install a new gasket between the throttle body assembly and the intake manifold flange when replacing the throttle body.

Throttle Body Removal

1. Ignition OFF.

2. Disconnect the battery negative cable.

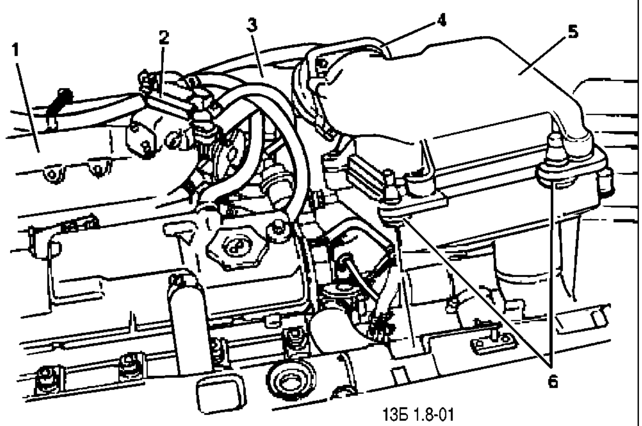


Fig. 1.8-01. Air Induction System (air cleaner elevated):
1 - plenum; 2 - throttle body; 3 - air intake pipe; 4 - mass air flow sensor; 5 - air cleaner; 6 - air cleaner rubber mounts

3. Drain the radiator coolant as needed to allow safe disconnection of the coolant hoses from the throttle body.

4. Disconnect the crankcase ventilation hose (3) and the EVAP canister purge hose (8) (Fig. 1.8-03).

5. Disconnect the IAC valve and the TP sensor electrical connectors.

6. Disconnect the air intake pipe (1).

7. Disconnect the coolant supply and return hoses.

8. Disconnect the throttle linkage.

9. Remove the throttle body retaining nuts. Remove the throttle body with the gasket.

It is essential that care be taken to prevent damage to the throttle valve or sealing surfaces while performing any service.

Throttle Body Cleaning

Cleaning of the throttle air duct and the throttle plate may be performed in-setu using a carburetor cleaning fluid and cloths.

Never use a solvent containing methylethylketon. This kind of solvent is too strong and cannot be used for this application.

To clean metal parts of the throttle body simply submerge them after disassembly into cold cleaning fluid.

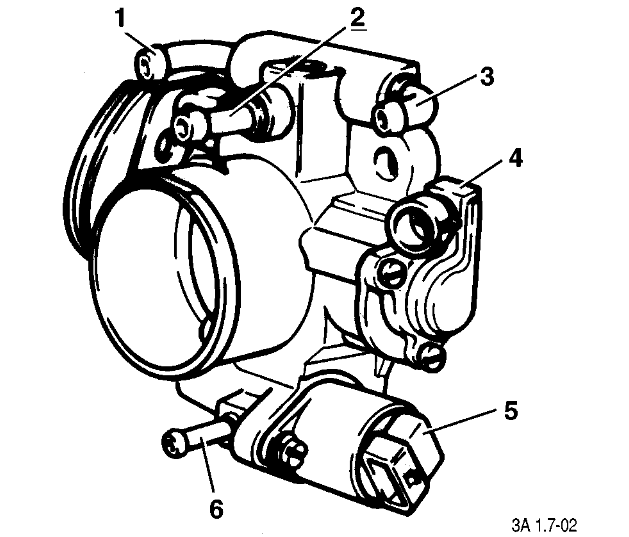


Fig. 1.8-02. Throttle Body Assembly:
1 - fitting, coolant supply; 2 - fitting, crankcase ventilation at idle; 3 - fitting, coolant return; 4 - throttle position (TP) sensor; 5 - idle air control (IAC) valve; 6 - fitting, canister purge

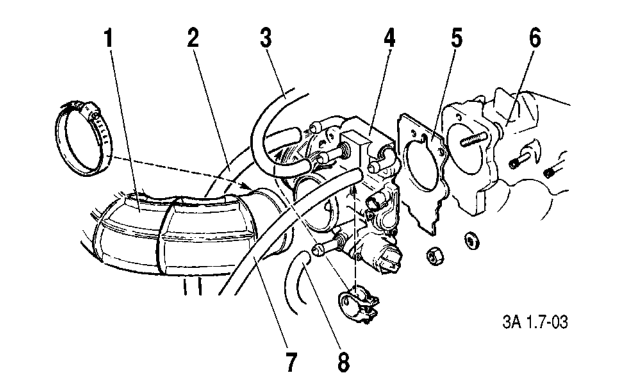


Fig. 1.8-03. Throttle Body Removal:
1 - air intake pipe; 2 - coolant supply hose; 3 - crankcase ventilation hose; 4 - throttle body; 5 - gasket; 6 - plenum; 7 - coolant return hose; 8 - canister purge hose

Precautions must be taken to prevent a solvent or cleaning fluid from getting onto the TP sensor or the IAC valve.

Use care in cleaning the sealing surfaces on the intake manifold and the throttle body assembly from the fragments of the gasket to avoid damage to the sealing surfaces.

Throttle Body Refitting

1. Install the throttle body unit with a new sealing gasket and fasten it with retaining nuts. Tighten the nuts to 15...23 N•m.
2. Connect the throttle linkage. Check throttle operation. The throttle should operate freely without binding between wide open and full closed throttle when the accelerator pedal is released.
3. Connect the coolant hoses.
4. Connect the air intake pipe and fasten it with a clamp.
5. Connect the IAC valve and the TP sensor electrical connectors.
6. Connect the crankcase ventilation hose.
7. Connect the EVAP canister purge hose.
8. Fill the radiator coolant.
9. Connect the battery negative cable.

Important: The IAC valve requires no regulation after throttle body installation. The ECM resets the IAC valve to its initial position.

Idle Air Control (IAC) Valve

The ECM controls engine idle speed through the idle air control (IAC) valve (Fig. 1.8-04). The IAC valve is a motor pintle.

The IAC valve is mounted in the air supply bypass channel of the throttle body. The IAC valve changes engine idle speed at closed throttle depending on the engine load parameter by controlling the amount of air bypassing the closed throttle plate.

Refer to Fig. 1.8-05 for the IAC valve operation diagram. To increase the idle speed the ECM opens the IAC valve, increasing the airflow bypassing the throttle valve. To decrease the idle speed the ECM closes the IAC valve, decreasing the bypassing airflow.

When the IAC pintle is fully extended (0 counts) closing the passage, no air bypasses the throttle valve. When the IAC pintle is retracted the airflow depends on the IAC valve counts.

DST-2MM receives information from the ECM on the IAC valve position in counts (steps).

The ECM controlled IAC valve increases or decreases idle speed depending on the engine load.

Except controlling the idle speed the IAC valve also has a limited role in controlling emissions level. When the throttle is closed rapidly during deceleration, the IAC valve increases bypass airflow providing a leaner air/fuel mixture. This helps to reduce hydrocarbons and carbon monoxide content in the exhaust which increases during rapid deceleration.

IAC Valve Removal

1. Ignition OFF.
2. Disconnect the IAC valve electrical connector.
3. Unscrew the IAC valve mounting screws and remove the IAC valve.

Important: Do not push or pull the IAC pintle as it can damage its worm gear drive.

Never submerge the IAC valve into any kind of cleaning fluid or solvent.

IAC Valve Cleaning And Functional Check

Clean the IAC valve O-ring, the pintle seat and the air duct.

Use a carburetor cleaning liquid and a brush to remove deposits. In case of heavy deposits in the air duct remove the throttle body unit and perform thorough cleaning.

Never use a solvent containing methylethylketon. This kind of solvent is too strong and cannot be used for this application.

Shiny spots on the pintle or its seat are normal and do not indicate misalignment or deformation of the valve stem.

Check the O-ring for cuts, cracks or deformation. Replace as necessary.

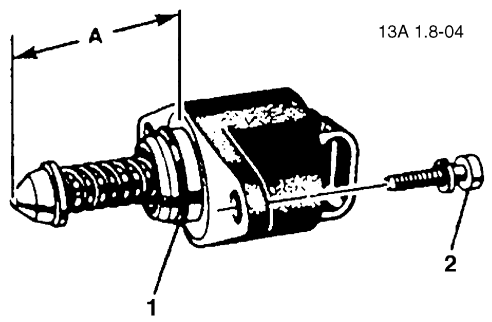


Fig. 1.8-04. Idle Air Control (IAC) Valve:
1 - O-ring; 2 - attaching screw; A - distance of pintle extension

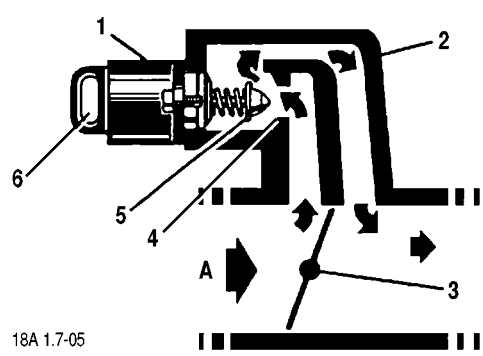


Fig. 1.8-05. IAC Valve functional diagram:
1 - step motor; 2 - throttle body; 3 - throttle valve; 4 - IAC valve seat; 5 - IAC valve pintle; 6 - electrical connector; A - air flow

IAC Valve Refitting

Before installing a new idle air control valve, measure the distance that the valve is extended (A) (Fig. 1.8-04). The measurement should be made from the idle air control valve motor housing to the end of the idle air control valve cone.

If the measured distance is greater than 23 mm, slowly retract the valve using the idle air control tester or DST-2MM.

The purpose of this adjustment is to avoid the IAC pintle pressing against its seat and to provide stable idle after engine restart.

1. Lubricate the O-ring with clean engine oil.
2. Install the IAC valve and fasten it with mounting screws. Tighten the screws to 3...4 N•m.

Notice: The IAC valve requires no adjustment after its installation.

1.9. Evaporative Emission (EVAP) Control System

The Evaporative Emission (EVAP) Control System consists of a charcoal canister, a purge solenoid and related piping.

Fuel vapor is transferred from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. Vapor is supplied to the canister through the connection marked «TANK» (Fig. 1.9-01).

The ECM controls the purge solenoid to purge fuel vapor with the intake air flow after a given period of engine operation in closed loop. The intake air is supplied through the connection marked «AIR» (Fig. 1.9-01) to the canister where it blends with the fuel vapor. The resulting mixture is then drawn into the intake manifold and consumed in the normal combustion process.

The ECM controls the purge depending on the engine mode of operation by supplying signal of variable frequency (16 Hz or 32 Hz).

DST-2MM displays EVAP purge in percent. 0% indicates that no purge is present. 100% indicates that purge is at maximum.

The ECM commands the EVAP purge solenoid on when the following conditions have been met:

- engine coolant temperature is above certain value;
- fuel cutoff mode is not active;
- vehicle is operating in closed loop fuel control;
- system is operative (no active DTCs are set).

Faults And Their Causes

Rough idle, stalling, high emissions and poor driveability can be caused by:

- malfunctioning purge solenoid;
- damaged canister;
- overfilled canister – more than 60 grams of fuel (a new canister should weigh not more than 1.1 kg);
- hoses/lines damaged and/or not connected properly.
- hoses/lines kinked or restricted.

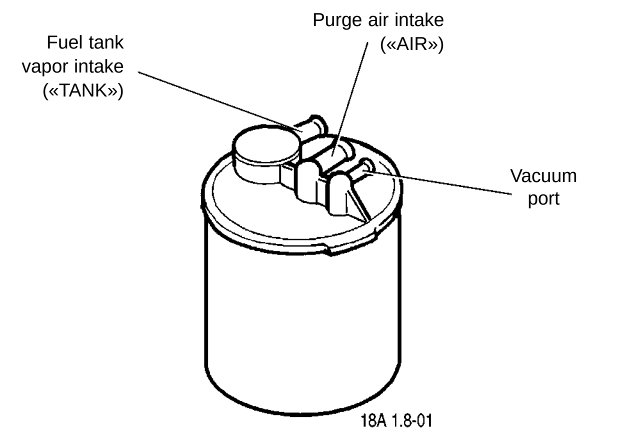


Fig. 1.9-01. Canister

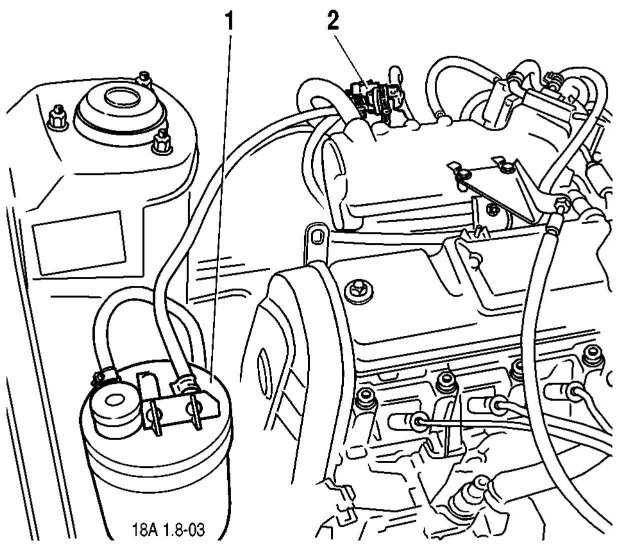


Fig. 1.9-02. EVAP system canister and canister purge valve location view:
1 - canister; 2 - canister purge valve

EVAP Canister And Purge Solenoid Visual Inspection

Visually inspect connecting hoses/lines and the EVAP canister (Fig. 1.9-02). If the canister is cracked or damaged, replace the EVAP canister.

If fuel leak is detected, first check hose connections. If fuel is leaking from the canister, replace the EVAP canister.

Check the EVAP purge solenoid for incorrect installation. Make sure that the vacuum lines are properly connected.

EVAP Canister Removal

1. Ignition OFF.
2. Disconnect the EVAP purge valve electrical connector.
3. Disconnect lines from the canister.
4. Undo the attaching bolt, slacken the clamp and remove the canister.

EVAP Canister Refitting

1. Fasten the canister using a clamp.
2. Connect lines to the canister.

3. Connect the purge valve electrical connector.

1.10. Catalytic Converter

Use of a catalytic converter ensures meeting stringent EURO-3 exhaust emission regulations.

A catalytic converter considerably reduces hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x) content in the exhaust, provided that combustion in the cylinders is closely controlled.

To promote chemical reactions, which convert the HC, CO and NO_x into nontoxic constituents, an oxidation and a reduction catalyst are used.

Platinum (Pt) is used as an active element of the oxidation catalyst. It promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas, converting them into harmless water vapor and carbon dioxide.

Rhodium (Rh) is used as an active element of the reduction catalyst. It reduces NO_x, converting it to nitrogen, which is one of air constituents (and, unlike its oxides, is harmles).

One of the products of NO_x reduction is oxygen, which is required for conversion of HC and CO. Therefore, effective operation of the catalytic converter depends on keeping the air/fuel ratio within a narrow range of variation. This is achieved through the use of HO_2S 1.

Excessive oxygen in the exhaust gas (when lean mixture is used) will hamper the reduction of NO_x. If the content of oxygen is low (when rich mixture is used) it hampers CO and HC oxidation. Thus, only that air/fuel ratio, which is close to the ratio theoretically required for complete combustion, may secure effective neutralization of all three pollutants.

Complete combustion and the most effective conversion of the described pollutants require that the air/fuel ratio be 14.6...14.7:1, i.e. 14.6...14.7 kg of air for 1 kg of fuel.

A malfunctioning engine may cause the catalytic converter to fail due to overheating (970°C and above) which it suffers during oxidation of excessive HC. Overheating may destroy (restrict) ceramic substrates, causing backpressure to rise.

A possible cause of the catalytic converter failure is the use of leaded petrol. Tetraethyl lead present in leaded fuel will very soon result in the catalyst poisoning and consequent dramatic decrease of its effectiveness.

Use of gaskets with silicone or not recommended motor oils with high content of sulphur and phosphorus may be another cause of the catalytic converter failure.

The ECM monitors operation of the catalytic converter by comparing signals from the pre- and post-catalyst oxygen sensors (Fig. 1.1-12). If the ECM detects that the catalyst has been deteriorated above the accepted level and can emmit pollutants beyond the EURO-3 specifications, it will set a relevant DTC and illuminate the MIL to indicate the fault.

2. Diagnosis

2.1. Introduction

Section 2 «Diagnosis» comprises the following sub-sections:

General Description

Information on diagnosing, safety measures and DST-2MM. This section also provides EMS wiring diagrams and terminal definitions for the ECM.

Section A and Diagnostic Charts A

This section contains basic information on diagnosing, including «Diagnostic Circuit Check», diagnostic charts for Check Engine light (MIL), measures to be taken when the engine does not start and other helpful charts.

DTC Charts

These charts are used if a DTC stored into the ECM memory has been detected during a Diagnostic Circuit Check. If more than one DTC has been stored always start with P0560 (System Voltage Malfunction) or P0562 (System Voltage Low).

Section B: Diagnostic Charts

If no DTCs are present or a DTC is intermittent this section will assist the technician in troubleshooting. In this case diagnosis should also start with Diagnostic Circuit Check.

Section C and Diagnostic Charts C (EMS components checks)

This section contains information on EMS components checks and servicing, e.g. fuel metering system, ignition system etc.

General Information

Diagnosing EMS may be quite easy, provided that its procedure is closely observed.

Diagnosing does not require special knowledge of electronics or computer. Basic knowledge of electrical engineering and ability to read wiring diagrams will suffice. Experience in using a multimeter and understanding of engine operation are also required.

Knowledge of basic operation of a system is the most important precondition for its successful diagnosing. Before attempting any repair one should get clear understanding of what is a faulty state and how it differs from the operating state.

Read carefully Section 1 «Design and Repair» before proceeding to work.

Test descriptions and diagnostic charts make references to some diagnostic tools (Appendix 2). These tools are designed for particular applications and the diagnostic charts stipulate that these very tools should be used.

Use of other tools makes successful diagnosing next to impossible.

You should also take into account that no diagnostic tool can be a substitute for a mechanic or do his job. Importance of diagnostic charts and test descriptions cannot be overestimated too.

Always remember that the EMS controls a regular internal combustion engine. Functionality of the EMS depends on good condition of the engine mechanical systems.

Below are given possible faults which can be mistaken for malfunctions of electronics:

- low compression;
- air inleaks;
- restricted exhaust system;
- incorrect valve timing caused by wear or incorrect assembly of parts;
- poor fuel quality;
- irregular servicing.

2.2. Safety Measures

Observe the following safety measures while working:

1. Disconnect the battery negative cable before removing the ECM.

2. Check storage battery connections for being tight and clear before starting the engine.

3. Do not disconnect the battery with the engine running.

4. Disconnect the battery from the system before recharging it.

5. Harness connections and battery connections must be kept tight and clear.

6. There is only one way to connect electrical harness connectors.

Correctly positioned halves will connect without much effort. Incorrect orientation of the connector halves may result in damaging the connector, ECM or other system components.

7. Never disconnect or reconnect the EMS component harness connector with ignition ON.

8. Disconnect the battery cables and the ECM harness connector before electric welding.

9. Do not direct water sprayer on the system components, while cleaning the engine, to avoid terminal corrosion.

10. Do not use diagnostic tools other than those specified in the charts to avoid diagnostic errors or damage to the system.

11. Use digital multimeter with 10 MOhms input impedance to check voltage.

12. If a diagnostic chart instructs you to use a test light, it should have a low-power bulb (up to 4 Watts). Never use high-power bulbs, e.g. headlamp bulbs. If the power of the test light is not specified, make sure that it is safe for testing purposes.

To check this connect a proven ammeter (digital multimeter with low input impedance) in series with the test light and feed it with the battery voltage (Fig. 2.2-01).

If the multimeter displays less than 0.25 A (250 mA), the test light is safe to use. If the reading is above 0.25 A, the test light should not be used.

13. Electronic components of the EMS are susceptible to damage caused by electrostatic discharge. Precautions must be taken to prevent such electronics failure.

Notice: To prevent possible electrostatic discharge damage do not disassemble the ECM metal housing or touch the control module connector pins.

2.3. General Description

Diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions based on elimination approach.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complimented by the diagnostic procedures contained in this manual.

The ECM informs the driver of the fault present by illuminating the Check Engine light (MIL).

When a malfunction is detected a diagnostic trouble code is stored in the ECM memory (Refer to table 2.3-01). A DTC can be displayed on DST-2MM.

Check Engine Light (Malfunction Indicator Lamp)

The MIL (Check Engine light) is located on the instrument cluster (Fig. 2.3-01).

An illuminated MIL informs the driver that the vehicle should be taken for service at the earliest opportunity. It does not indicate that the engine must be stopped immediately, but that the cause of the fault should be detected as soon as possible.

When ignition is switched on the MIL (Check Engine light) will go ON and then OFF after the engine is started, indicating that the diagnostic system is fault-free.

When a fault is detected a DTC is stored in the ECM memory and the MIL is illuminated. To avoid indication of nonexisting faults the MIL lights up with a certain lag in time and remains ON while at least one fault is present.

If a detected fault suddenly disappears, the MIL remains ON for a certain period and then goes OFF, however, the respective DTC will be stored in the ECM memory.

When the DTCs are cleared, the MIL goes OFF.

Important: A flashing MIL indicates that misfire has been detected, which may cause catalyst failure. To avoid damage to the catalyst the ECM may

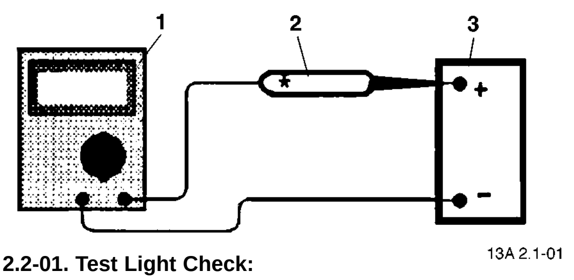


Fig. 2.2-01. Test Light Check:
1 - ammeter; 2 - test light; 3 - storage battery

cut off fuel delivery to the trouble cylinder(s). This fault must be corrected as soon as possible.

Reading Diagnostic Trouble Codes

The provision for communicating with the control module is the Data Link Connector (DLC) (Fig. 2.3-02).

DTCs stored in the ECM memory can be read using DST-2MM connected to the DLC.

Attention: If the vehicle does not feature the VTD system, jumper terminals 18 and 9 of the Immobilizer module harness connector before plugging in DST-2MM.

Diagnostic Procedure

Always start a diagnostic test with the Diagnostic Circuit Check.

The Diagnostic Circuit Check is an initial system diagnostic. It is a starting point of fault finding which directs the technician to a relevant diagnostic chart.

The same principle is used throughout the entire manual. According to it the Diagnostic Circuit Check refers the technician to relevant charts, which may contain further references.

Diagnostic procedures given in the charts should be closely observed. Failure to follow instructions could result in misdiagnosing and unnecessary repairs.

Diagnostic charts envisage that DST-2MM be used if applicable. DST-2MM provides a technician with information on the EMS current state.

DST-2MM is used to control the EMS. DST-2MM can read and display information transferred to it through the DLC.

Diagnostic Circuit Check

Following the underhood visual inspection, the Diagnostic Circuit Check (Refer to Section 2.9) must be the starting point for any diagnostic or verification of emission concerns.

To secure reliable diagnostic results perform the following steps:

1. On-Board Diagnostic System Check. To check functionality of the On-Board Diagnostic System perform the Diagnostic Circuit Check. Always start diagnostic tests with the Diagnostic Circuit Check.

If the OBD system is inoperative, the technician will be referred to a relevant diagnostic chart. If the OBD system is operative, proceed to step 2.

2. Check if any DTC is set. If a DTC is set go directly to the diagnostic chart of this DTC. This allows to verify whether the problem remains. If no DTC is set, proceed to step 3.

3. ECM Output Data Check. Using DST-2MM, connected to the DLC, read data from the ECM.

DST-2MM description and its typical parameters are given below. Typical parameter values for particular modes of operation are detailed in table 2.4-01.

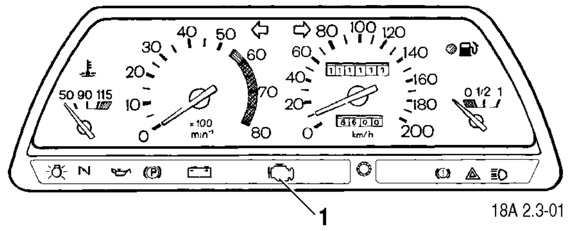


Fig. 2.3-01. MIL ("CHECK ENGINE" light) location view

2.4. Diagnostic Scan Tool (DST-2MM)

The ECM transfers data through terminal 10 of the DLC. Data is communicated at high rate and is processed by DST-2MM.

In case of driveability concerns or if the MIL is illuminated, connect DST-2MM to the DLC to acquire necessary information. If you suspect that the problem is related to some parameter that can be monitored using DST-2MM, checks should be made while the vehicle is moving.

If there is no obvious relation between a fault and any particular circuit, use the scan tool to monitor all parameters over a certain period to see if there are any changes which may indicate that the problem is intermittent (Refer to DST-2MM Operation Manual).

DST-2MM can display and record data when a failure occurs. This allows to duplicate Failure Records conditions later on to analyze the system operation. This mode is called «Data Collection».

DST-2MM Limitations

DST-2MM receives signal from the ECM and displays it in an easy-to-read form. If no signal is present, the «X» sign appears in the right upper corner of the screen. When the signal is present, you can see UP and DOWN arrows on the screen.

DST-2MM has a few limitations. If the scan tool displays an ECM command, it does not necessarily mean that the action commanded has been performed, since the command must be executed by the respective mechanism.

DST-2MM does not make the diagnostic charts redundant, neither can it precisely locate the circuit fault.

Using the scan tool saves time and allows to avoid unnecessary repairs or replacement of good parts. A key to effective application of DST-2MM is that the technician has an understanding of the system being diagnosed and also of the tool limitations.

Provided that the technician understands the information displayed, DST-2MM can supply him with the data, that otherwise cannot be acquired.

Parameters displayed by DST-2MM and their values are given below. Most diagnostic charts envisage that DST-2MM be used for diagnostic purposes.

DST-2MM can display information in English or Russian at your choice.

Table 2.3-01

MP7.0H Electronic Control Module DTCs

DTC	Description
P0102	Mass Air Flow, Signal Low
P0103	Mass Air Flow, Signal High
P0112	Intake Air Temperature Sensor, Signal Low
P0113	Intake Air Temperature Sensor, Signal High
P0116	Engine Coolant Temperature Sensor, Range
P0117	Engine Coolant Temperature Sensor, Signal Low
P0118	Engine Coolant Temperature Sensor, Signal High
P0122	Throttle Position Sensor, Signal Low
P0123	Throttle Position Sensor, Signal High
P0130	O2 Sensor 1, Malfunction
P0132	O2 Sensor 1, High Voltage
P0133	O2 Sensor 1, Slow Response
P0134	O2 Sensor 1, Circuit Inactive
P0135	O2 Sensor 1 Heater, Malfunction
P0136	O2 Sensor 2, Malfunction
P0137	O2 Sensor 2, Low Voltage
P0138	O2 Sensor 2, High Voltage
P0140	O2 Sensor 2, Circuit Inactive
P0141	O2 Sensor 2, Heater Malfunction
P0171	System Too Lean
P0172	System Too Rich
P0201	Injector Circuit Malfunction, Cylinder 1
P0202	Injector Circuit Malfunction, Cylinder 2
P0203	Injector Circuit Malfunction, Cylinder 3
P0204	Injector Circuit Malfunction, Cylinder 4
P0261	Injector Cylinder 1, Circuit Low
P0262	Injector Cylinder 1, Circuit High
P0264	Injector Cylinder 2, Circuit Low
P0265	Injector Cylinder 2, Circuit High
P0267	Injector Cylinder 3, Circuit Low
P0268	Injector Cylinder 3, Circuit High
P0270	Injector Cylinder 4, Circuit Low
P0271	Injector Cylinder 4, Circuit High
P0300	Random/Multiple Misfire Detected
P0301	Cylinder 1 Misfire Detected
P0302	Cylinder 2 Misfire Detected
P0303	Cylinder 3 Misfire Detected
P0304	Cylinder 4 Misfire Detected
P0327	Knock Sensor, Low Input
P0328	Knock Sensor, High Input
P0335	Crankshaft Position Sensor, Malfunction
P0336	Crankshaft Position Sensor, Range/Performance
P0340	Camshaft Position Sensor, Malfunction
P0422	Main Catalyst Efficiency, Below Threshold
P0443	EVAP Control, Purge Canister Valve, Malfunction
P0480	Cooling Fan 1 Control Circuit, Malfunction

Table 2.3-01 (continued)

MP7.0H Electronic Control Module DTCs	
DTC	**Description**
P0500	VSS Sensor, Malfunction
P0506	IDLE Control System, RPM Too Low
P0507	IDLE Control System, RPM Too High
P0560	System Voltage Malfunction
P0562	System Voltage Low
P0563	System Voltage High
P0601	Internal Check FLASH Memory, Check Sum Error
P0603	Internal Check RAM-External, Error
P0604	Internal Check RAM-Internal, Error
P1140	Load Calculation, Range/Performance
P1386	Knock Detection, Test Impulse/Zero Test, Malfunction
P1410	EVAP Control, Purge Canister Valve, Circuit High
P1425	EVAP Control, Purge Canister Valve, Circuit Low
P1426	EVAP Control, Purge Canister Valve, Circuit Interrupt
P1501	Fuel Pump Relay, Circuit Low
P1502	Fuel Pump Relay, Circuit High
P1509	Idle Control Valve Power Stage, Overload
P1513	Idle Control Valve Power Stage, Circuit Low
P1514	Idle Control Valve Power Stage, Circuit Malfunction
P1541	Fuel Pump Relays, Circuit Interrupt
P1570	Immobilizer, Not Positive Answer
P1602	Permanent Supply Voltage, Circuit Interrupt
P1606	Rough Road Sensor, Malfunction
P1616	Rough Road Sensor, Signal Low
P1617	Rough Road Sensor, Signal High
P1640	EEPROM Write-Read Test, Error
P1689	Fault Memory Functionality Check, Error

Parameters Displayed In «1 - Parameters; 1 - Vars list»

If DST-2MM is connected and the submenu «1 - Parameters; 1 - Vars list» has been selected, the controlled parameters will be displayed on the screen.

Mass Air Flow Sensor Signal – XMLHD (Volts)

Displays MAF Sensor voltage. High level MAF Sensor linear signal indicates high MAF value, whereas low level signal indicates low airflow.

Engine Load Signal – TL (msec)

Characterizes engine load through the base pulse width, i.e. injection pulse width without further corrections.

Battery Voltage – UB (Volts)

Displays system voltage supplied to ECM terminal #37.

Coolant Temperature – TMOT (°C)

The ECM monitors voltage drop at the Engine Coolant Temperature (ECT) sensor and displays it in °C.

The ECT value should be close to air temperature when the engine is cold, and rise as the engine warms up. After the engine start the ECT should rise gradually to 94÷104°C.

Spark Advance – ZWOUT (°CA)

Indicates spark advance in degrees of CKP before or after Top Dead Center (TDC).

Knock Retard – DWKR_Z (°CA)

Indicates the amount of spark the ECM is retarding from spark advance to prevent knock.

TPS Signal Relative To Throttle Zero Position – DKPOT (%)

TP is the degree of throttle opening, which is computed by the ECM from the TP sensor voltage. 0%

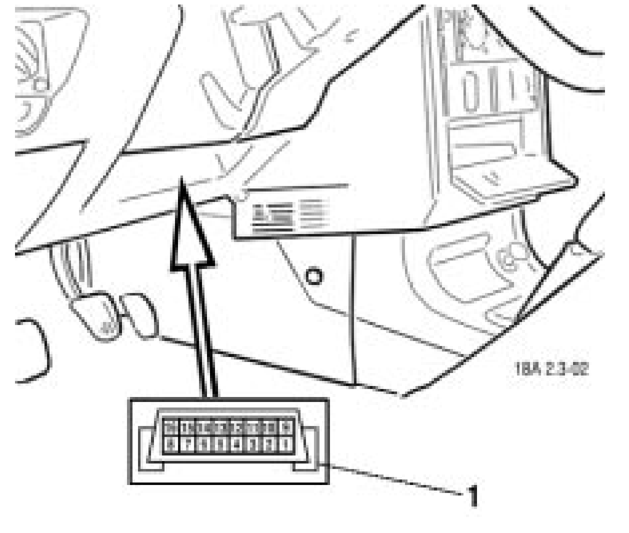


Fig. 2.3-02. Data Link Connector (DLC) location view:
1 - Data Link Connector (DLC)

indicates fully closed throttle, while 76÷81% indicates wide open throttle (WOT).

Vehicle Speed – VFZ (km/h)

The ECM displays the Vehicle Speed Sensor value ±2%.

Engine Speed With Resolution 40 rpm– N40 (rpm)

The ECM displays engine actual speed calculated from the CKP sensor voltage with resolution of 40 rpm.

Injection Time – TE1 (msec)

Indicates the amount of time the ECM is commanding each injector ON (milliseconds).

Idle Air Controller Position – MOMPOS (0-255 counts)

Indicates current idle air control valve position.

DST-2MM displays the IAC valve extension from its fully closed position in counts (steps). The number of counts represents the degree of IAC valve opening. The greater is the number, the bigger is the valve opening. After the engine start and during its warming up to normal operating temperature the number of counts should decrease.

With the engine idling, the gearbox in neutral position and the A/C system off, the number of counts should be within 25...55. If the engine load at idle increases, the number of counts should also increase.

Actual Idle Speed With Resolution 10 rpm – N10 (rpm)

The ECM displays engine actual idle speed calculated from the CKP sensor voltage with resolution of 10 rpm.

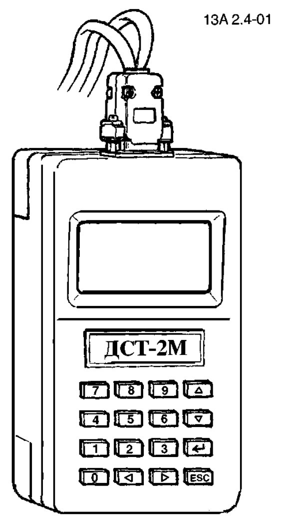


Fig. 2.4-01. DST-2MM – Diagnostic Scan Tool

IAC Integrator – IV (kg/h)

Displays extra MAF required for stabilization of engine idle speed.

IAC Block Learn – QADP (kg/h)

Displays adaptive learning correction value for the calculated mass air flow. The out of range correction value indicates a fault in the induction system.

Desired Idle Speed – NSOL (rpm)

The ECM controls engine speed at idle. Desired idle is the optimum idle speed computed by the ECM based on the ECT and IAT signals. As the temperature increases the desired idle speed decreases.

Desired Air Idle – QSOL25 (kg/h)

Displays theoretically calculated mass airflow corrected for engine speed, ECT and IAT.

Air Mass Flow – ML (kg/h)

Indicates the amount of air entering the engine in kg/h.

O2 Sensor 1 – USVK (Volts)

Displays the HO_2S 1 voltage in volts. If the HO_2S 1 is cold, its voltage remains at 0.45 volts. When the HO_2S 1 warms up its signal should fluctuate between 0.05 and 0.9 volts while the engine is running. With ignition ON and engine not running, the HO_2S 1 signal should fall gradually below 0.1 volts within few minutes.

Lambda Controller Output – FR

Indicates how many times the injection pulse width increases/decreases to compensate for the current deviations of air/fuel ratio from stoichiometric mixture.

Additive Adaptive Mixture Correction For Air Leakage – TRA (msec)

Indicates adaptive learning correction value, which is added to the pulse width at idle. It is calculated by the ECM based on the HO_2S signal when the system is operating in closed loop.

Multiplicative Adaptive Mixture Correction – FRA

Indicates adaptive learning correction value based on FR, by which the pulse width is multiplied at part load.

Duty Cycle For Canister Purge Valve – TATE (%)

Represents the ECM command duty cycle of the canister purge valve, which depends on engine load.

Downstream Oxygen Sensor Output Voltage – USHK (Volts)

Displays the HO_2S 2 voltage. If the catalyst is operating efficiently, the signal of the warmed-up HO_2S 2 at part load should fluctuate within 0.59...0.75 volts.

Oxygen Sensors Signal Ratio (Catalyst Efficiency) – AVKAT

This parameter represents efficiency of the catalyst. Its value can vary from 0 to 1. The lower is the ratio, the more efficient is the catalyst.

System Run Time – TIME (hours)

Displays the time of system operation without disconnection of power from the storage battery.

Dwell Angle – SW (°CA)

This parameter represents the degree of crankshaft rotation during which the ignition coil primary winding is energized.

Intake Air Temperature – TANS (°C)

Displays intake air temperature measured by the IAT sensor integrated into the MAF sensor.

Engine Temperature At Start – TMS (°C)

Displays engine coolant temperature at start-up. The value of this parameter is stored in the ECM memory.

Zero Filter Signal Acceleration Sensor – BSMW (g)

Displays filtered signal of the rough road sensor. The rough road sensor detects vertical acceleration (g) of the front strut indicating the rough road condition. This information is used only for disabling misfire detection.

Calculated Load Signal – TLW (msec)

This parameter represents calculated engine load through the injection pulse width.

Factor Altitude Adaptation – FDKHA

This parameter is an inderect representation of altitude above sea level. Drop in its value by 0.01 roughly corresponds to 100 meters increase of altitude.

Resistance Of LS-Shunt Catalyst Upstream – RHSV (Ohm)

This parameter describes status of the HO_2S 1 heater and its circuit.

Resistance Of LS-Shunt Catalyst Downstream – RHSH (Ohm)

This parameter reflects status of the HO_2S 2 heater and its circuit.

Sum Of Emission Relevant Misfirings – FZABGS

Used to detect percentage of misfires affecting vehicle’s emissions. Displays the number of misfires detected per 1000 crankshaft revolutions. When a misfire occurs the counter increases by 1. After every 1000 crankshaft revolutions the counter is reset to zero.

Sum Of Catalyst Damaging Misfirings – FZKATS

This parameter is used to calculate the percentage of misfire events which result in the catalyst deterioration. When a misfire occurs the counter increases by a value which depends on the engine mode of operation. After every 200 crankshaft revolutions the counter is reset to zero.

Normalized Reference Level, Cylinder 1 (2, 3, 4) – REFPN1 (2, 3, 4)

Displays KS signal voltage, measured over cylinder #1 (2, 3, 4) duty cycle.

Ignition Angle Cylinder 1 (2, 3, 4) – ZW_ZYL1 (2, 3, 4) (°CA)

Displays instantaneous value of spark advance angle for cylinder #1 (2, 3, 4). Comparing this parameter change for the suspect cylinder with the relevant value for other cylinders may hint if knock was present in the cylinder during previous power strokes and how severe it was.

Idle Air Controller – QREG (kg/h)

Indicates calculated change in airflow required to maintain stable idle.

Warm-Up Factor – FWL

Air-fuel mixture enrichment ratio during engine warming-up.

Limited Load – TLMXK (msec)

Indicates the maximum possible engine load adjusted for ECT, IAT and Altitude Adaptation Factor.

Total Te-Correction Factor Of Transient Control – TEUKG

Indicates injection pulse width correction factor adjusted for fuel left over after preceding injection cycle (fuel film on cylinder walls).

Monitor Engine Roughness Test Value – LUT_AP

If variation of RPM exceeds threshold value (LUR_AP), the system will register misfire.

Monitor Engine Roughness Reference Value – LUR_AP

This parameter depends on load parameter (TL), engine speed (N40) and engine coolant temperature (TMOT).

Adaptation Mean Value – ASA

This parameter is used to compensate for angular error of the damper toothed rim (reluctor whee 2110-1005058l) machining.

Additive Adaptative Mixture Correction For Injector Deviation – DTV (msec)

To maintain the air/fuel ratio at 14.6 while in the closed loop, the system will store in FRA, TRA and DTV cells the mismatch values, which depend on variation of component parameters and quality of their assembling. On completion of programming the cells will be used to adjust the air/fuel ratio. DTV cell stores mismatch values for those modes, where the air/fuel ratio adjustment for the HO_2S signal is most severely affected by the injectors.

Mixture Control Shift Term, Oxygen Compensation – DTVKA (msec)

This delay is used to enrich the air/fuel mixture following fuel cutoff for faster restoration of closed loop (HO_2S 2) operation. In other words, DTVK is used to clear the catalyst from excessive oxygen resulting from fuel cutoff.

Mixture Control Shift Term, Total Value – TVLR (msec)

This parameter is the sum total of all delays, calculated based on the table values, on the HO_2S 1 and HO_2S 2 signals.

Mixture Control Shift Through The Rear Oxygen Sensor – TVLRH (msec)

The HO_2S 2 signal is used to finely adjust air/fuel ratio and secure the lowest emissions adjusted for the current level of catalyst deterioration.

Closed Loop Control Cat. Downstream: Integrator – ATV (msec)

This parameter is a constituent of TVLRH and is a «slow» part of it.

Oxygen Sensor Signal Period (Catalyst Upstream) – TPLRVK (sec)

The HO_2S 1 signal has a sine wave form in the closed loop mode. The ECM calculates this wave period and stores its value in the TPLRVK cell.

Number Of Ignitions At Dynamics – DYNZLR

In dynamic modes the parameter is set to a calibrated value and then decreases with every ignition cycle. When the parameter value reaches zero the ECM stops dynamic adjustment of ignition timing for knock.

Full Engine Load Flag – B_VL (YES/NO)

Displays whether the power enrichment mode is active or inactive.

Idle Flag – B_LL (YES/NO)

Displays whether the idle mode is active or inactive.

Fuel Pump Relay – EKP (ON/OFF)

Displays the ECM command for fuel pump activation.

Vehicle Speed Pulse State – B_VFZ (YES/NO)

This parameter informs if the VSS is operating.

Hall Sensor (Engine Phase) – PHSOK (YES/NO)

This parameter informs if the CMP sensor is operating.

A/C Request Flag – S_AC (YES/NO)

Displays the ECM command for A/C system activation.

Radiator Cooling Request Flag – S_LF (ON/OFF)

Displays the ECM command for radiator cooling fan activation.

Diagnostic Light Request Flag – B_MILR (ON/OFF)

Displays whether the ECM requests the MIL (Check Engine light) ON or OFF.

Knock Control Enabled – B_KR (ON/OFF)

Indicates whether all preconditions for knock control are present.

Knock Protection Enabled – B_KS (ON/OFF)

Indicates if there is danger of engine damage due to knock, e.g. when the KS or its circuits are faulty. In this case the spark advance angle will be retarded by 6°.

Knock Control: Load Dynamics Detected – DYNFLG1 (ON/OFF)

When the throttle valve opens rapidly the parameter sets to ON and the ECM increases for a short period the knock detection threshold to avoid unwanted accumulation of spark reatard and thus improve vehicle dynamics.

Knock Control: Engine Speed Dynamics – DYNFLG2 (ON/OFF)

When the engine speed increases rapidly the parameter sets to ON and the ECM increases for a short period the knock detection threshold to avoid unwanted accumulation of spark reatard and thus improve vehicle dynamics.

Rough Road Detected – B_SWE (YES/NO)

This parameter is detected based on the rough road sensor signal. If B_SWE=1, the ECM disables knock detection.

A/C-Compressor Enabled – S_KOREL (YES/NO)

When the A/C system is requested ON, the ECM enables it provided that power take-off from the engine is not critical.

ECU Locked By Immobilizer – F_IMMOLO (YES/NO)

Indicates that the VTD system (Immobilizer) is in the armed mode (sleeping).

Immobilizer: Bypass Procedure Allowed – F_IMBYPAS (YES/NO)

Indicates if the engine can be started using the Immobilizer By-Pass Mode.

Immobilizer/ECU: Units Paired – F_IMMERY (YES/NO)

Indicates if the immobilization function is active, i.e. the ECM has been «learnt».

Engine Speed Pulse – F_TN (YES/NO)

If the ECM detects two missing teeth on the reluctor wheel, the parameter F_TN=1.

Variant Encoding – B_VAR (ON/OFF)

In engines with different management systems terminal #13 in harnes 26 may either be connected or disconnected from the system voltage.

O2 Sensor 1 Loop Activated – B_LR (YES/NO)

Transition from open loop to closed loop mode of controlling fuel delivery depends on time elapsed since engine startup, HO_2S 1 status and ECT.

O2 Sensor 2 Loop Activated – B_LRHK (YES/NO)

A number of conditions, including the HO_2S 2 readines to operate in closed loop mode, should be present for B_LRHK to read «YES».

Engine Start – B_ST (YES/NO)

From ignition switch-on and up to the engine startup the parameter reads 1.

Fuel Cut-Off – B_SA (YES/NO)

The parameter sets in case of sharp decelleration (engine bracking).

Misfire Detected – M_LUERKT (YES/NO)

Indicates that misfire has been detected.

Misfire Detection Disabled – B_LUSTOP (YES/NO)

The parameter reads 1 when the ECM stops misfire detection.

Oxygen Sensor Catalyst Upstream Ready – B_SBBVK (YES/NO)

The flag sets when the HO_2S 1 voltage deviates from the mean, while the sensor heating is on for at least 75 seconds.

Oxygen Sensor Catalyst Downstream Ready – B_SBBHK (YES/NO)

The flag sets when the HO_2S 2 voltage deviates from the mean, while the sensor heating is on for at least 75 seconds.

Basic Mixture Adaptation Enabled – B_LRA (ON/OFF)

When the flag is on, the FRA, TRA and DTV parameters will be programmed depending on the engine mode of operation.

Canister Purging Activated – B_TE (ON/OFF)

The purge valve opens to allow fuel vapors from the canister into the induction system.

Status Catalyst Tested For «Ready Byte» – B_KATRDY (READY/NOT READY)

If the parameter reads READY, it indicates that the catalyst diagnostic cycle has been completed for the current drive cycle. This, however, does not indicate whether the check has been completed successfully or not.

Status Purge System Tested For «Ready Byte» – B_TESRDY (READY/NOT READY)

If the parameter reads READY, it indicates that the canister purge valve functional check cycle has been completed for the current drive cycle. This, however, does not indicate whether the check has been completed successfully or not.

Status O2 Sensor Tested For «Ready Byte» – B_LSRDY (READY/NOT READY)

If the parameter reads READY, it indicates that the oxygen sensors functional check cycle has been completed for the current drive cycle. This, however, does not indicate whether the check has been completed successfully or not.

O2 Sensor Heating – B_HSRDY (READY/NOT READY)

If the parameter reads READY, it indicates that the HO_2S heaters functional check cycle has been completed for the current drive cycle. This, however, does not indicate whether the check has been completed successfully or not.

Condition For Sensor Wheel Adaptation Successful, Engine Speed Range 1 (2, 3, 4) – B_ZADRE1 (2, 3, 4)

ASA adaptation parameter is calculated at forced idle for 4 rpm ranges. If adaptation for one of the rpm ranges has been completed, the relevant bit B_ZADRE1...4 sets to 1.

Number Of DTCs Stored In ECUs Memory – num_err

Displays the total number of set DTCs.

First Registered Malfunction Code – ERROR1

Displays the 1st DTC stored in the ECM memory after the ECM has been reconnected to the battery voltage or after the DTCs have been cleared using DST-2MM.

Second Registered Malfunction Code – ERROR2

Displays the 2nd DTC stored in the ECM memory after the ECM has been reconnected to the battery voltage or after the DTCs have been cleared using DST-2MM.

Parameters Displayed In «1 - Parameters; 5 - ADC Channels»

Mass Air Flow Sensor – AIRSENS (Volts)

Displays MAF sensor voltage.

Engine Coolant Temperature Sensor – TCOLANT (Volts)

Displays ECT sensor voltage.

Throttle Position Sensor – TPS (Volts)

Displays TP sensor voltage.

System Voltage – UBAT (Volts)

Displays system voltage.

HO_2S 1 – O2SENS1 (Volts)

Displays fuel control HO_2S voltage.

HO_2S 2 – O2SENS2 (Volts)

Displays catalyst monitor HO_2S voltage.

Knock Sensor – KNOCK (Volts)

Displays Knock Sensor (KS) voltage.

Rough Road Sensor – ACCELSENS (Volts)

Displays rough road sensor voltage.

DST-2MM can also display in this mode some parameters from «1 - Parameters; 1 - Vars list».

Output Tests «2 - Control»

DST-2MM can give signals to ECM control circuits to actuate various mechanisms. This option allows to perform quick functionality tests of the system components.

Enter the «2 - Control» menu. Now you can choose one of the following output tests (with ignition ON and the engine running):

- IAC Step Motor.

This output test should be performed with ignition ON. It allows to check the IAC valve functionality (the valve is extended into fully closed position and then withdrawn to its initial position.);

- Idle Speed.

This test should be performed with the engine running. It allows to control IAC valve and increase or decrease idle speed. If the IAC valve is operative, the engine speed should change accordingly in response to DST-2MM commands;

- Injector 1 (2, 3, 4).

Allows to disable fuel injection pulses for one of the cylinders. By monitoring the engine speed drop the problem cylinder can be determined;

- Ignition Coil 1 (2).

This output test should be performed with ignition ON. It allows to determine if there is a spark on the spark tester;

- Fuel Pump Relay.

This test should be performed with ignition ON and the engine not running. DST-2MM is allowed only 10 seconds to operate the electric fuel pump relay. This command is useful for the fuel system diagnosis, e.g. for fuel pressure check or leak check;

- Cooling Fan 1.

Allows to check cooling fans operation by hearing;

- Cooling Fan 2.

Not available for this model;

- A/C Compressor.

Allows to check by hearing whether the A/C clutch engages when the engine is idling and the A/C switch is ON.

Parameters Displayed In «4 - DT Codes; 1 - Interpretation»

One of the ECM functions is to perform the engine management system diagnosis. It is carried out during a drive cycle, which begins 10 seconds after the engine start up and ends when the engine is stopped. If a fault is detected, the ECM stores a respective DTC and commands the MIL (Check Engine light) ON. To avoid indication of nonexisting faults the MIL lights up with a certain lag in time (FLC parameter) during which the fault is present.

If a detected fault suddenly disappears, the MIL remains ON for a certain period (HLC parameter) and then goes OFF, however, the respective DTC will be stored in the ECM memory until the codes are cleared.

Each code is characterized by a number of parameters:

• FLC (seconds or drive cycles)

Displays latency time between fault detection and MIL illumination. For different DTCs the FLC can be set in seconds or drive cycles.

When the fault is detected the preset value of the parameter begins to decrease. The MIL will illuminate when the FLC value reaches zero. When the fault disappears the FLC resets;

• HLC (drive cycles)

Displays latency time after the DTC becomes inactive (the fault disappears) and until the MIL goes OFF.

When the fault disappears the preset value of the parameter begins to decrease. The MIL will go off when the HLC value reaches zero;

• DLC (warming cycles)

Displays latency time after the DTC becomes inactive and until it is cleared from the ECM memory.

When the fault disappears the preset value of the parameter begins to decrease after each warming cycle. The warming cycle begins at engine start up and ends when the engine temperature reaches specified value. The DTC is cleared from the ECM memory when the DLC value reaches zero;

• HZ

Displays how many times the DTC has been set;

• TSF (sec.)

Displays time in seconds during which the code was active;

• Engine management system operating conditions at the moment when the DTC was set.

The operating conditions are characterized by three variables (Refer to table 2.4-01) and by the time when the fault occurred. Each DTC has its own set of variables. DST-2MM can display operating conditions only for four cases of faults;

• a set of flags in the form of icons (Fig. 2.4-02).

In the «4 - DT Codes; 1 - Interpretation» submenu the screen is divided into two sections. The left half of the screen displays the set of flags for the current DTC status. This information is refreshed when the DTC status changes.

The right half of the screen displays the set of flags for a confirmed DTC (a DTC is considered to be confirmed if the fault remains after the FLC time expires). This information is set only once and will not be refreshed until the DTCs are cleared.

Clearing Diagnostic Trouble Codes

There are two methods of clearing DTCs after the repair or to verify if the DTC resets. It can be done either by disconnecting the ECM battery power for at least 10 seconds, or using DST-2MM function «4 - DT Codes; 2 - Clear».

To disconnect the ECM power remove the battery negative cable. Remember that disconnecting the battery negative cable will also result in the loss of other ECM memory data.

Notice: To prevent damage to the ECM, the ignition key must be OFF when disconnecting or reconnecting battery power.

Typical Scan Tool Data Values

DST-2MM monitors parameters that are listed in the table 2.4-01 and can be used to test the EMS when no DTCs are set.

Using a faulty DST-2MM is not allowed since it may result in misdiagnosing or unnecessary replacement of good parts.

Only the listed parameters are used for diagnostic purposes.

If all the values are within their ranges, refer to Section 2.7B «Diagnostic Charts».

Table 2.4-01 Legend

1. Column «Parameter» corresponds to the submenu «1 - Data list; 1 - Vars list», displayed by DST-2MM.

2. Column «Unit or Status» describes the parameter unit or status.

3. Typical values are given in two columns which define operating conditions: «Ignition On» and «Engine Idling». The listed values are typical for a healthy vehicle.

First compare the displayed values with those in the «Ignition ON» column, for it can expedite fault finding.

Values in the «Engine Idling» column should be used as reference for parameters captured when the ignition switch is ON to check functionality of the system or its components.

4. Values in the «Ignition ON» column are typical values displayed by DST-2MM with ignition ON and engine not running.

Temperature sensors should be checked by comparing their readings with actual temperatures after a night stay. Use relevant diagnostic tables to convert resistance into temperature values.

5. Values in the «Engine Idling» are average typical values for healthy vehicles.

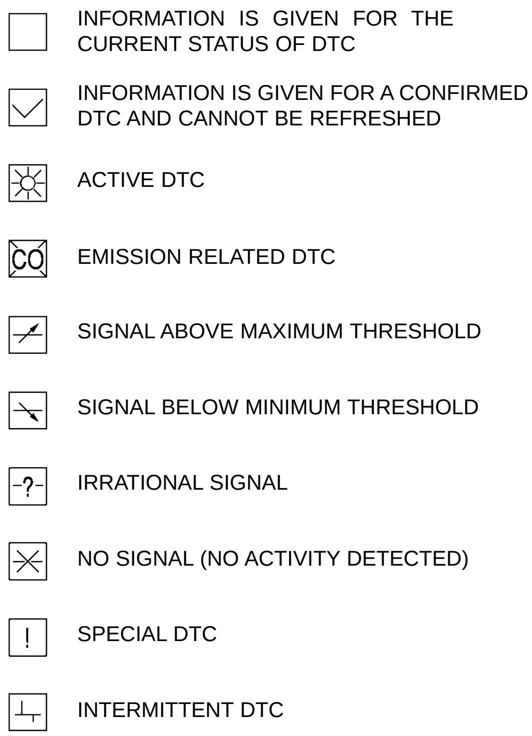


Fig. 2.4-02. Icons

Table 2.4-01

Typical Scan Tool Data Values For 2111 Engine

Parameter	Description	Unit or Status	Ignition ON	Engine Idling 800 rpm	Engine Idling 3000 rpm
TL	Engine Load Signal	msec	(1)	1,4-2,1	1,2-1,6
UB	Battery Voltage	Volt	11,8-12,5	13,2-14,6	13,2-14,6
TMOT	Coolant Temperature	°C	(1)	90-105	90-105
ZWOUT	Spark Advance	°CA	(1)	12±3	35-40
DKPOT	TPS Signal relative to Throttle Zero Position	%	0	0	4,5-6,5
N40	Engine speed with resolution 40 rpm	RPM	(1)	800±40	3000
TE1	Injection time	msec	(1)	2,5-3,8	2,3-2,95
MOMPOS	Idle Air Controller Position	step	(1)	40±15	70-85
N10	Actual Idle Speed with resolution 10 rpm	RPM	(1)	800±30	3000
QADP	IAC Block Learn	kg/h	±3	±4*	±1
ML	Air mass flow	kg/h	(1)	7-12	25±2
USVK	O2 Sensor 1	Volts	0,45	0,1-0,9	0,1-0,9
FR	Lambda Controller Output		(1)	1±0,2	1±0,2
TRA	Additive adaptive mixture correction for air leakage	msec	±0,4	±0,4*	(1)
FRA	multiplicative adaptive mixture correction		1±0,2	1±0,2*	1±0,2
TATE	Duty cycle for canister purge valve	%	(1)	0-15	30-80
USHK	Downstream oxygen sensor output voltage	Volt	0,45	0,5-0,7	0,6-0,8
TANS	Intake air temperature	°C	(1)	-20...+60	-20...+60
BSMW	Zero filter signal acceleration sensor	g	(1)	-0,048	-0,048
FDKHA	Factor Altitude Adaptation		(1)	0,7-1,03*	0,7-1,03
RHSV	Resistance of LS-Shunt catalyst upstream	Ohm	(1)	9-13	9-13
RHSH	Resistance of LS-Shunt catalyst downstream	Ohm	(1)	9-13	9-13
FZABGS	Sum of Emission Relevant Misfirings		(1)	0-15	0-15
QREG	Idle Air Controller	kg/h	(1)	±4*	(1)
LUT_AP	Monitor engine roughness test value		(1)	0-6	0-6
LUR_AP	Monitor engine roughness reference value		(1)	6-6,5 (6-7,5)***	6,5 (15-40)***
ASA	Adaptation mean value		(1)	0,9965-1,0025**	0,996-1,0025
DTV	Additive adaptive Mixture Correction for injector deviation	msec	±0,4	±0,4*	±0,4
ATV	Closed Loop Control Cat. Downstream: Integrator	sec	(1)	0-0,5*	0-0,5
TPLRVK	Oxygen Sensor Signal Period (Catalyst upstream)	sec	(1)	0,6-2,5	0,6-1,5
B_LL	Idle flag	YES/NO	NO	YES	NO
B_KR	Knock control enabled	ON/OFF	(1)	ON	ON
B_KS	Knock protection enabled	ON/OFF	(1)	OFF	OFF
B_SWE	Rough road detected	YES/NO	(1)	NO	NO
B_LR	O2 Sensor 1 Loop Activated	YES/NO	(1)	YES	YES
M_LUERKT	Misfire detected	YES/NO	(1)	NO	NO
B_LUSTOP	Misfire detection disabled	YES/NO	(1)	NO	NO
B_ZADRE1	Condition for sensor wheel adaptation successful, engine speed range 1	YES/NO	(1)	YES*	(1)
B_ZADRE3	Condition for sensor wheel adaptation successful, engine speed range 3	YES/NO	(1)	(1)	YES

(1) This value is not used for diagnosis.
** This parameter resets to zero when the battery cable is disconnected.*
*** This check is relevant only if B_ZADRE1=YES.*
**** The values in brackets represents typical range of the parameter in case ASA parameter has been specified.*

Note: The table lists parameters for the ambient temperature above zero.

2.5. Fuse And Relay Block Location

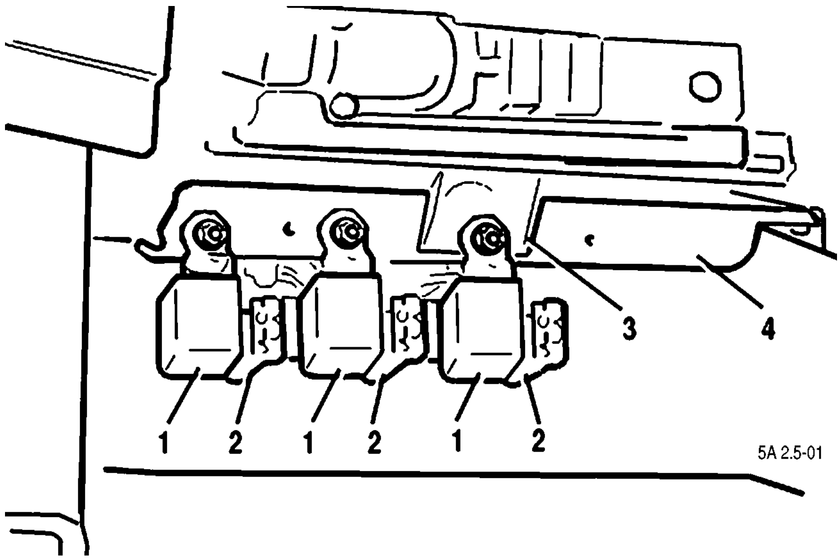


Fig. 2.5-01. EMS relays and fuses location view:
1 - EMS relays; 2 - EMS fuses; 3 - ECM support; 4 - mounting bracket

2.6. EMS Ground Connections

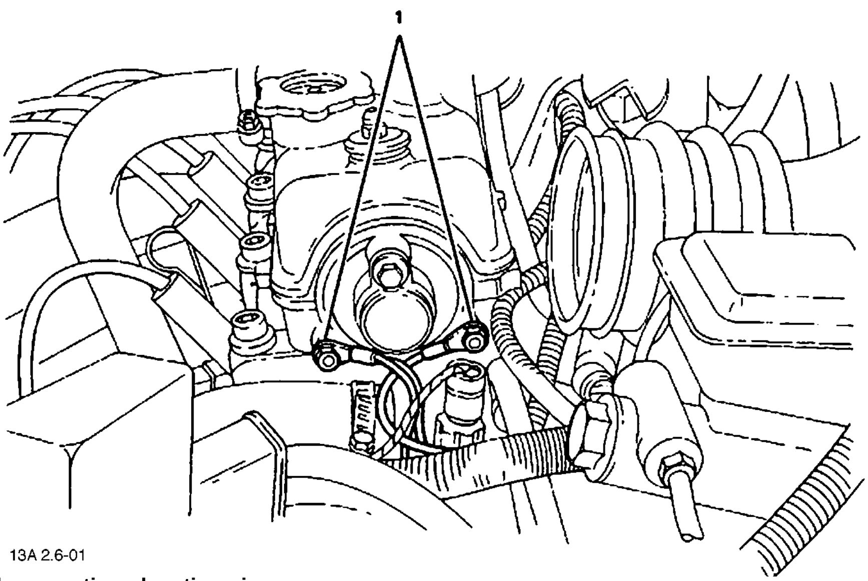
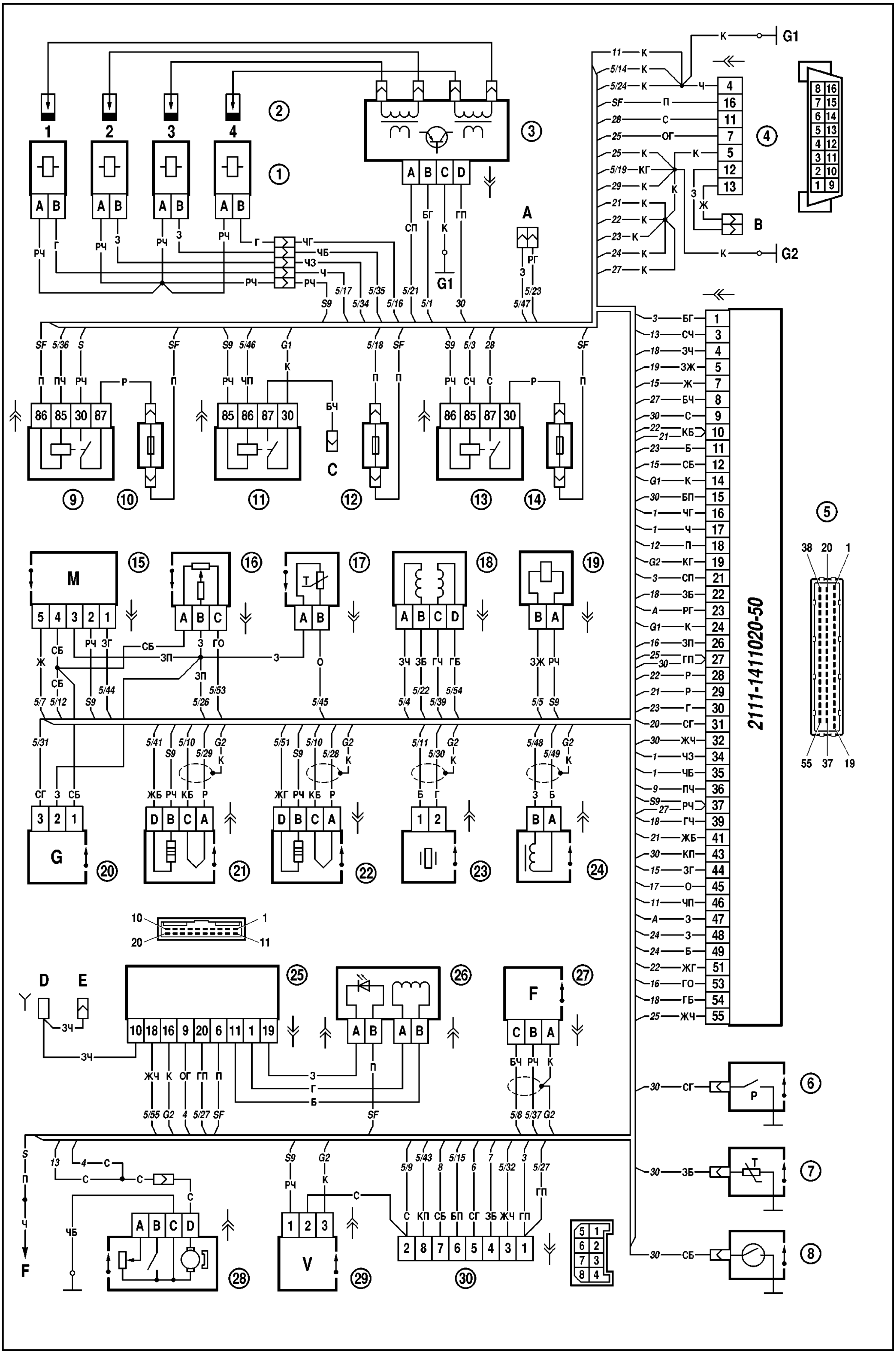


Fig. 2.6-01. EMS ground connections location view:
1 - Ground connections



2111-1411020-50
G1
G2
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2.7. Wiring Diagram For Sequential Fuel Injection Engine Management System

Fig. 2.7-01. Wiring diagram for engine 2111 management system, sequential fuel injection, to meet EURO-3 emission standards (ECM MP7.0H), designed for vehicles VAZ-21102, 2111, 21122:
1 - Injectors; 2 - Spark Plugs; 3 - Ignition Module; 4 - Data Link Connector (DLC); 5 - Electronic Control Module (ECM); 6 - Oil Pressure Control Light Sensor; 7 - Engine Coolant Temperature Gauge Sensor; 8 - Oil Level Sender; 9 - Main Relay; 10 - Fuse, to main relay; 11 - Cooling Fan Relay; 12 - Fuse, to cooling fan relay; 13 - Fuel Pump Relay; 14 - Fuse, to fuel pump relay; 15 - Mass Air Flow (MAF) Sensor; 16 - Throttle Position (TP) Sensor; 17 - Engine Coolant Temperature (ECT) Sensor; 18 - Idle Air Control (IAC) Valve; 19 - EVAP Purge Solenoid; 20 - Rough Road Sensor; 21 - Catalyst Monitor Heated Oxygen Sensor (HO_2S 2); 22 - Fuel Control Heated Oxygen Sensor (HO_2S 1); 23 - Knock Sensor (KS); 24 - Crankshaft Position (CKP) Sensor; 25 - Immobilizer Control Module; 26 - Immobilizer System Key Reader; 27 - Camshaft Position (CMP) Sensor; 28 - Electric Fuel Pump with Fuel Level Sensor; 29 - Vehicle Speed Sensor (VSS); 30 - Connector, to instrument panel harness;

A - Connector, to A/C harness; **B** - Connector, to internal ABS module; **C** - Connector, to electric fan harness; **D** - wiring to ignition switch (illumination light); **E** - Connector, to blue/white wire disconnected from the ignition switch; **F** - to battery terminal «+»; **G1**, **G2** - Ground Connections.

Alongside letter code of wire color this diagram also has digital marking indicating the number of electrical component to which the wire should be connected, e.g. «-5-». Marking «-S9-» or «-SF-» means that the wire should be connected to component #9 or F through the connection not shown on the diagram. Some markings also indicate pin number (after a slash), e.g. «-5/15-».
Important: A different sequence of fuses may be used while assembling the vehicle.

2.8. Electronic Control Module Terminals Defined

Pin	Circuit
1	**Electronic Spark Timing Control output. Cylinders #1 and #4.** The ECM sends pulse signals to ignition module terminal «B» to energize the ignition coil for cylinders #1 and #4.
2	**No Connection.**
3	**Fuel Pump Relay Control Output.** When the ignition switch is turned on, the ECM energizes the fuel pump relay. The ECM will deenergize the relay if no TP sensor signal is present for over than 2 seconds. If the ECM receives the TP sensor signal, it will operate the relay ON.
4	**Idle Air Control (IAC) Valve Control Output (Terminal «A»).** Voltage at this terminal is difficult to predict. Therefore it is not measured for servicing purposes.
5	**EVAP Purge Control Output.** The ECM energizes the EVAP Purge Valve by connecting it to ground. With the engine not running the voltage at this terminal should be equal to the battery voltage. When the engine is running the voltage should vary from 0 volts to system voltage.
6	**No Connection.**
7	**Mass Air Flow Sensor Input.** Mass Air Flow analog signal varies from 0 to 5 volts depending on the amount of air entering the engine.
8	**Camshaft Position (CMP) Sensor Input.** The ECM uses the CMP sensor signal to control fuel injection. The CMP sensor generates one pulse per each revolution of the camshaft, indicating that cylinder #1 is at compression stroke.
9	**Vehicle Speed Sensor (VSS) Input.** System voltage is supplied to this terminal through the ECM internal resistor. The sensor grounds the circuit in pulses. Frequency of these pulses depends on the vehicle speed. Signal from the VSS is also supplied to the trip computer.
10	**Heated Oxygen Sensors Ground Circuit.** The terminal is connected to the engine ground through the ECM.
11	**Knock Sensor (KS) Input.** The KS signal is AC voltage. Its amplitude and frequency depend on severity of knock.
12	**Sensors Power Voltage Output.** Supplies power to TP, MAF and Rough Road sensors. With ignition ON the voltage should be near +5 volts.
13	**Variant Coding Input Signal.** VAZ-21083, 21093 and 21099 vehicles have this terminal connected to system voltage.
14	**«System Ground» Input.** Voltage at the terminal should be close to zero.
15	**MIL (Check Engine light) Control Output.** The ECM turns the MIL on by connecting it to ground. When the MIL is ON, voltage at the terminal should be close to zero. When the MIL is OFF, system voltage should be present at the terminal.
16	**Cylinder #4 Injector Control Output.** System voltage is supplied to the terminal through the injector coil. The ECM shorts the circuit to ground in pulses once per each turn of the camshaft. Injector pulse width is determined by the engine operating mode.
17	**Cylinder #1 Injector Control Output.** System voltage is supplied to the terminal through the injector coil. The ECM shorts the circuit to ground in pulses once per each turn of the camshaft. Injector pulse width is determined by the engine operating mode.
18	**Battery Voltage Input (constant).** The ECM is always powered (through a fuse) by vehicle electrical system, even when ignition is OFF.
19	**«ECM Ground» Input.** Voltage at the terminal should be close to zero.
20	**No Connection.**
21	**Electronic Spark Timing Control output. Cylinders #2 and #3.** The ECM sends pulse signals to ignition module terminal «A» to energize the ignition coil for cylinders #2 and #3.
22	**Idle Air Control (IAC) Valve Control Output (Terminal «B»).** Voltage at this terminal is difficult to predict. Therefore it is not measured for servicing purposes.
23	**A/C Compressor Clutch Relay Control Output.** Connected to ground to energize the A/C compressor clutch relay. Voltage below 1 volt when the ECM energizes the relay. When the relay is not energized, system voltage should be present at the terminal.
24	**«System Ground» Input.** Voltage at the terminal should be close to zero.
25	**No Connection.**
26	**«Sensors Ground» Output.** Voltage at the terminal should be close to zero.
27	**Ignition Switch Signal Input.** Voltage signal from the ignition switch does not power the ECM, it simply informs the ECM that ignition is ON. Voltage at this terminal should be equal to system voltage when the ignition switch is in the «Ignition ON» or «STARTER» position.

Pin	Circuit
28	**Heated Oxygen Sensor 1 Input.** The Oxygen Sensor 1 has a heating element. When the engine is not running and the sensor is warmed up it will detect high oxygen content in the exhaust. Its output voltage will be below 200 mV. With the engine running, after the sensor is warmed up its voltage should change rapidly within 50...900 mV. If the sensor is not warmed up, voltage at the terminal will read 300...600 mV.
29	**Heated Oxygen Sensor 2 Input.** The Oxygen Sensor 2 has a heating element. Voltage of the warmed-up sensor operating in the closed loop mode at part engine load should change within 590...750 mV if the catalyst efficiency is normal. If the sensor is not warmed up, voltage at the terminal will read 300...600 mV.
30	**Knock Sensor (KS) Input.** The KS signal is AC voltage. Its amplitude and frequency depend on severity of knock.
31	**Rough Road Sensor Input.** 2.5 volts should always be present in the sensor circuit. Jolting of the vehicle body when driving on rough terrain causes variations of the sensor signal voltage.
32	**Fuel Consumption Output.** The ECM supplies low level voltage signal (about 0 volts) to the trip computer in pulses, each about 0.9 msec long. High level of the signal is equal to system voltage. Each pulse indicates consumption of 1/16000 litres of fuel, i.e. each litre corresponds to 16000 pulses.
33	**No Connection.**
34	**Cylinder #2 Injector Control Output.** System voltage is supplied to the terminal through the injector coil. The ECM shorts the circuit to ground in pulses once per each turn of the camshaft. Injector pulse width is determined by the engine operating mode.
35	**Cylinder #3 Injector Control Output.** System voltage is supplied to the terminal through the injector coil. The ECM shorts the circuit to ground in pulses depending on engine speed. Injector pulse width is determined by the engine operating mode.
36	**Main Relay Control Output.** System voltage is supplied to the terminal when the relay is OFF. The voltage should be close to zero when the relay is ON. The ECM energizes the main relay after receiving the ignition switch signal (ECM terminal 27). The ECM de-energizes the main relay with 10 seconds delay after ignition is switched OFF.
37	**Ignition Feed Input (ignition switch dependent).** System voltage is supplied through the normally open main relay.
38	**No Connection.**
39	**Idle Air Control (IAC) Valve Control Output (Terminal «C»).** Voltage at this terminal is difficult to predict. Therefore it is not measured for servicing purposes.
40	**No Connection.**
41	**Oxygen Sensor 2 Heater Control Output.** The ECM controls the oxygen sensor heater by connecting it to ground. Voltage in this case is close to zero. When no control signal is present, the terminal should have system voltage.
42	**No Connection.**
43	**Engine Speed Signal Output.** This is an output pulse signal to the tachometer. Its pulse rate is the doubled engine speed. High level of the signal corresponds to system voltage. Low level of the signal is about 0 volts. Signal duty/dwell (pulse period/low level signal duration) ratio is 3.
44	**Intake Air Temperature (IAT) Sensor Input.** The ECM uses this circuit to supply +5 volts through the internal resistor to the IAT sensor. The IAT sensor is a thermistor connected to ground through its second terminal. The sensor changes its resistance depending on the intake air temperature. Higher temperatures produce lower signal voltage.
45	**Engine Coolant Temperature (ECT) Sensor Input.** The ECM uses this circuit to supply +5 volts through the internal resistor to the ECT sensor. The ECT sensor is a thermistor connected to ground through its second terminal. The sensor changes its resistance depending on the engine coolant temperature. Higher temperatures produce lower signal voltage. If the coolant temperature is 0°C, signal voltage should be above +4 volts. At normal temperatures (85...100°C) signal voltage should be below 2 volts.
46	**Cooling Fan Relay Control Output.** The ECM energizes the relay by connecting it to ground. The voltage in this case is close to zero. When no control signal is present, the terminal should have system voltage.
47	**A/C Request Input Signal.** When the A/C switch at the instrument panel is in the OFF position, the voltage at the terminal should be close to zero. When the switch is in the ON position, system voltage is supplied to the ECM, provided that other circuit switches are closed (See Fig. 1.10-01).
48, 49	**Crankshaft Position (CKP) Sensor Input.** When the engine is cranking, the terminal is supplied with an AC voltage signal of sinusoidal form. Its frequency and amplitude are proportional to the engine rpm. With ignition ON and engine not running, voltage at the terminal should be zero if the circuit is OK, and about 1.5 volts if the circuit is open.
50	**No Connection.**
51	**Oxygen Sensor 1 Heater Control Output.** The ECM controls the oxygen sensor heater by connecting it to ground. The voltage in this case is close to zero. When no control signal is present, the terminal should have system voltage.
52	**No Connection.**
53	**Throttle Position (TP) Sensor Input.** DC voltage, which depends on throttle opening angle. This signal may change from 0 to +5 volts. Voltage is usually below 0.7 volts at idle and at wide open throttle (WOT) signal voltage should be above 4.1 volts.
54	**Idle Air Control (IAC) Valve Control Output (Terminal «D»).** Voltage at this terminal is difficult to predict. Therefore it is not measured for servicing purposes.
55	**Diagnostic Line «K».** This terminal is connected to terminal «18» of the immobilizer control module. At the ignition switch-on the ECM uses this line to communicate with the Immobilizer. If the ECM receives Fuel Enable signal from the Immobilizer, it enters normal mode of operation to control the system. Otherwise the ECM will not enable fuel injection pulses. During communication between the ECM and the Immobilizer module this line is disconnected from the DLC. After the communication is over, the Immobilizer module jumps its terminals «18» and «9», thus connecting the diagnostic line to terminal «10» of the DLC. This allows the ECM to exchange data with DST-2MM, using this line. Data is transferred as a series of voltage pulses varying from high level (system voltage) to low level (0 V).

2.9. Diagnostic Charts

Diagnostic charts provide a fast and efficient way to locate a fault in the EMS.

Each diagnostic chart consists of two pages: Additional Information and Trouble-Tree Chart. The additional information page contains code setting parameters, circuit diagrams and diagnostic aids.

Troubleshooting should be performed in accordance with the trouble-tree chart.

It is essential to use charts correctly. Always begin with the Diagnostic Circuit Check when diagnosing a problem.

The Diagnostic Circuit Check will refer to other charts. Do not go directly to the trouble-tree chart without performing the Diagnostic Circuit Check first, as this may result in false diagnosis or unnecessary repairs.

After eliminating the fault and clearing the DTCs, it is advisable to perform the Diagnostic Circuit Check again to verify repair.

An Example of the First Page of the Diagnostic Chart

(additional information)

2.9 A. Diagnostic Charts A

(Initial checks and DTC charts)

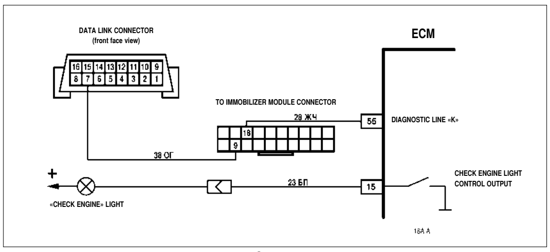

Chart A

Diagnostic Circuit Check

Circuit Description

The Diagnostic Circuit Check is an organized approach to identifying a problem in the engine management system. It should be the starting point for any driveability complaint diagnosis, because it will lead to the next logical step.

Understanding the chart and using it correctly will reduce diagnosis time and prevent unnecessary replacement of good parts.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks if the MIL (Check Engine light) is OK.
2. If the Check Engine light does not illuminate at ignition switch-on, use Chart A-1 to check power supply to ignition switch and to the ECM, and also the ECM ground connections.
3. Checks if the ECM can transfer serial data to DST-2. If there is no signal, the «X» sign will be indicated in the right upper corner of the display. If the signal is present, the UP and DOWN arrows will be indicated.
4. Checks if the engine can be started.
5. This test checks if there are any trouble codes stored in the ECM memory.
6. Checks for parameters deviation with ignition ON and the engine idling.
7. If the parameters are not within the range of their typical values, Diagnostic Charts from Section 2.9 C «Component Systems Charts» should be used to verify functionality of the suspect component or system.

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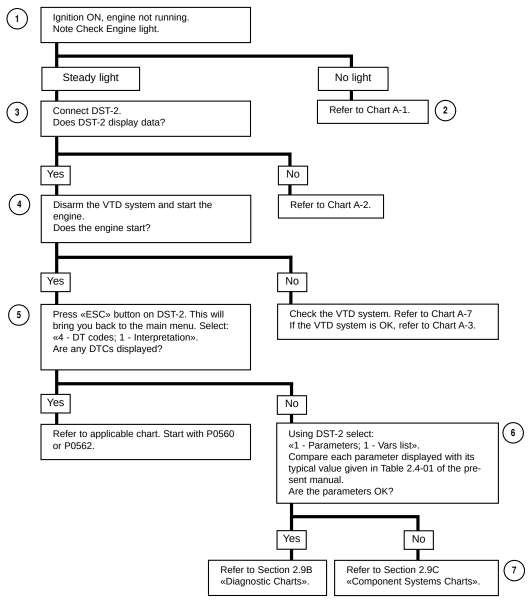
An Example of the Second Page of the Diagnostic Chart

(trouble-tree chart)

Chart A

Diagnostic Circuit Check



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2.9 A. Diagnostic Charts A

(Initial checks and DTC charts)

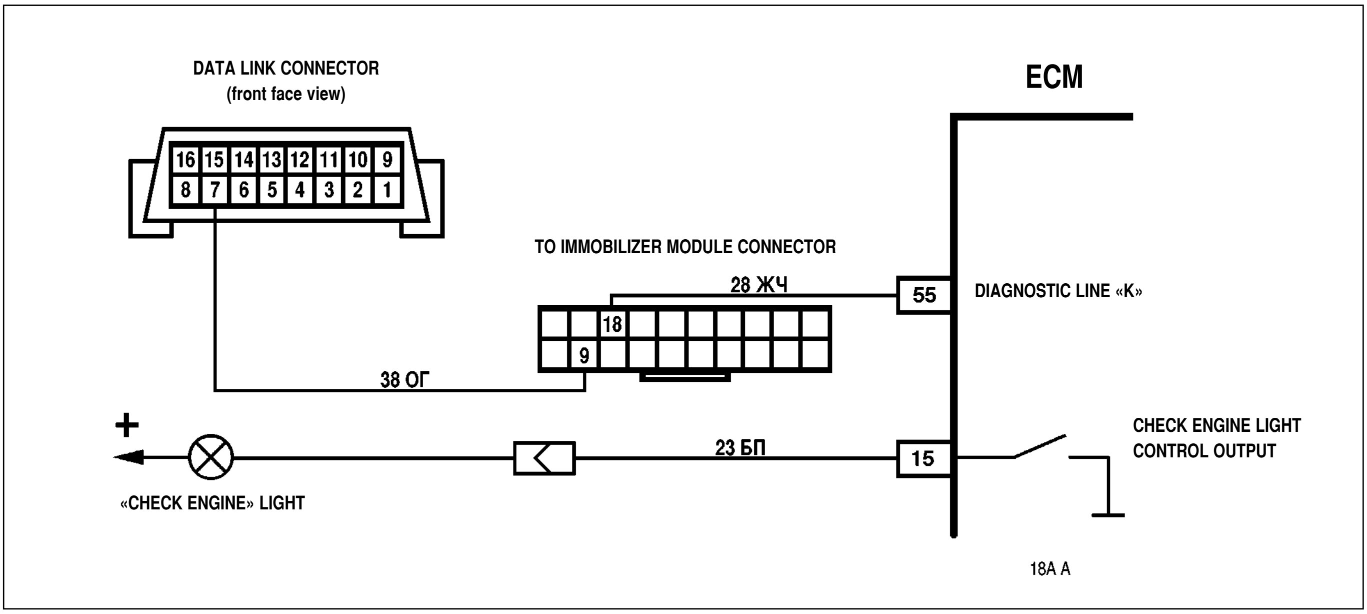

Chart A

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3. Checks if the ECM can transfer serial data to DST-2MM. If there is no signal, the «X» sign will be indicated in the right upper corner of the display. If the signal is present, the UP and DOWN arrows will be indicated.
4. Checks if the engine can be started.
5. This test checks if there are any trouble codes stored in the ECM memory.
6. Checks for parameters deviation with ignition ON and the engine idling.
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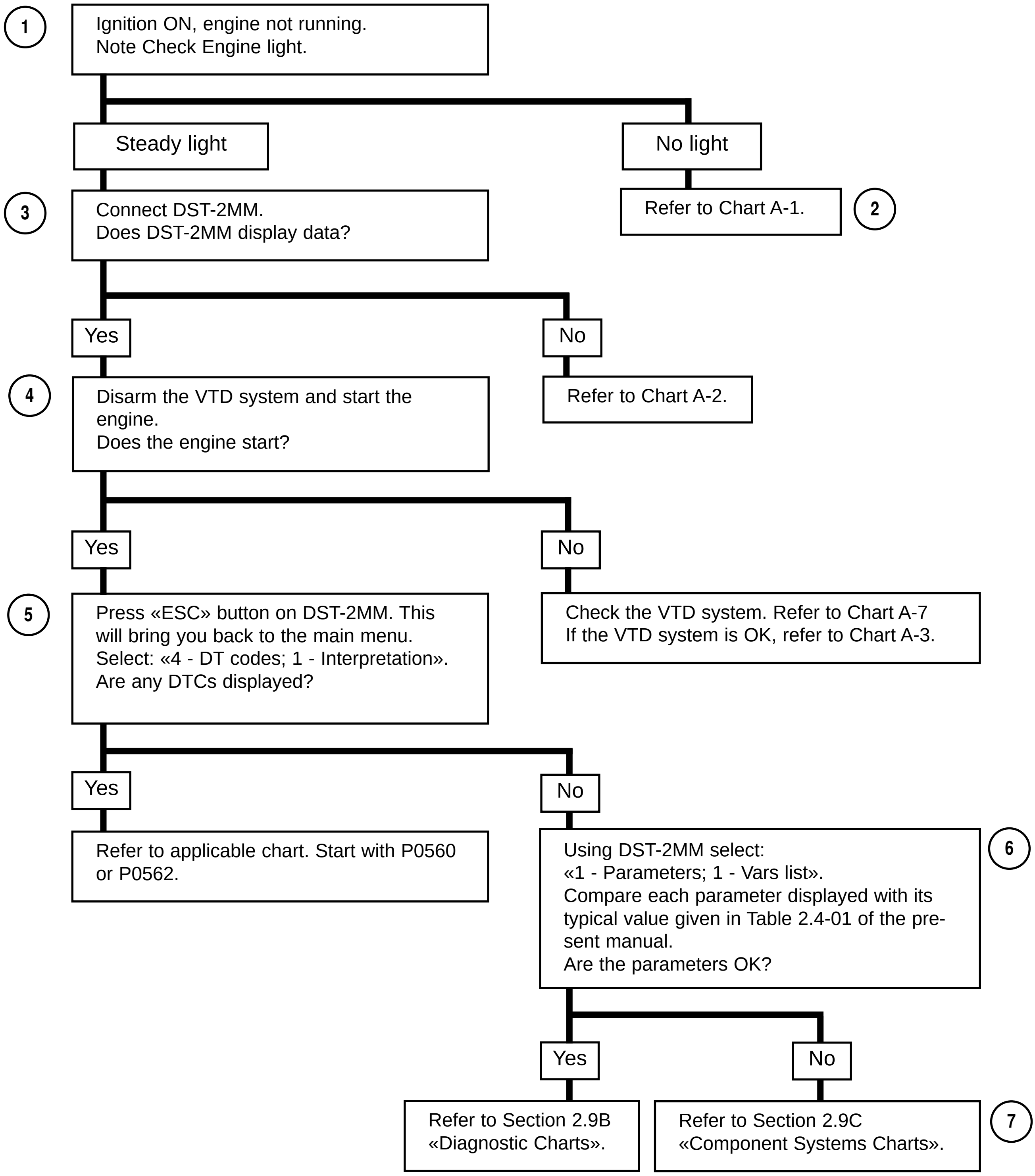
Chart A

Diagnostic Circuit Check



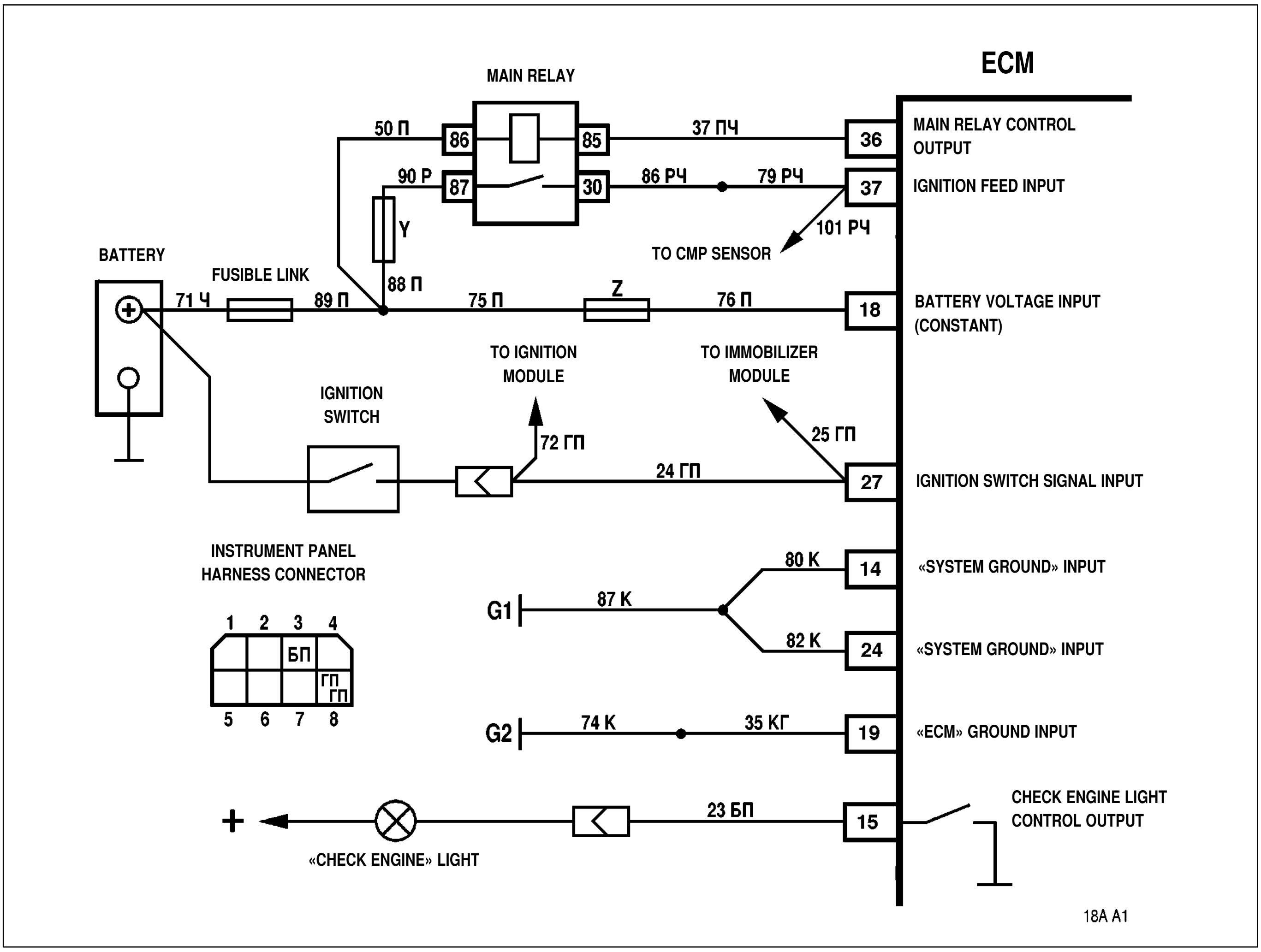


Chart A-1

No «CHECK ENGINE» Light

Circuit Description

The Check Engine light (MIL) should go ON when ignition is switched ON and go OFF after the engine is started.

After ignition is switched ON, voltage is supplied to one of the MIL terminals. The ECM commands the MIL ON/OFF by providing a ground path through the white/red wire to the ECM terminal «15».

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If the Check Engine light does not illuminate during this test, check the instrument panel harness to locate the fault.
2. Checks the 23 white/red wire for an open.
3. Checks the 23 white/red wire for a short to voltage.
4. Checks the ECM to engine block ground connections.
5. Checks power supply to the following ECM terminals: «18», «27» and «37».

Chart A-1

No «CHECK ENGINE» Light

Are fuses OK?

- **No** → Repair short circuits and replace blown fuses.
- **Yes** ↓

1 Ignition ON, engine not running.
With the test light connected to ground backprobe the instrument panel harness connector terminal «2».
Does the Check Engine light illuminate?

- **No** → Check for faulty MIL (Check Engine light) bulb and connections.
- **Yes** ↓

2 Ignition OFF.
Disconnect the ECM and instrument panel harness connectors.
Using a multimeter check the 23 white/red wire resistance. Resistance should read less than 1 Ohm, does it?

- **No** → 23 white/red wire open.
- **Yes** ↓

3 With the test light connected to ground backprobe terminal «15» of the harness connector disconnected from the ECM.
Does the test light illuminate?

- **Yes** → 23 white/red wire short to voltage.
- **No** ↓

4 With the test light connected to battery power backprobe terminals «14», «19» and «24» of the harness connector.
The test light should illuminate for all terminals, does it?

- **No** → Repair as necessary.
- **Yes** ↓

5 Use Chart A-4 to check the main relay and power circuit.
If the fault remains, replace the ECM.

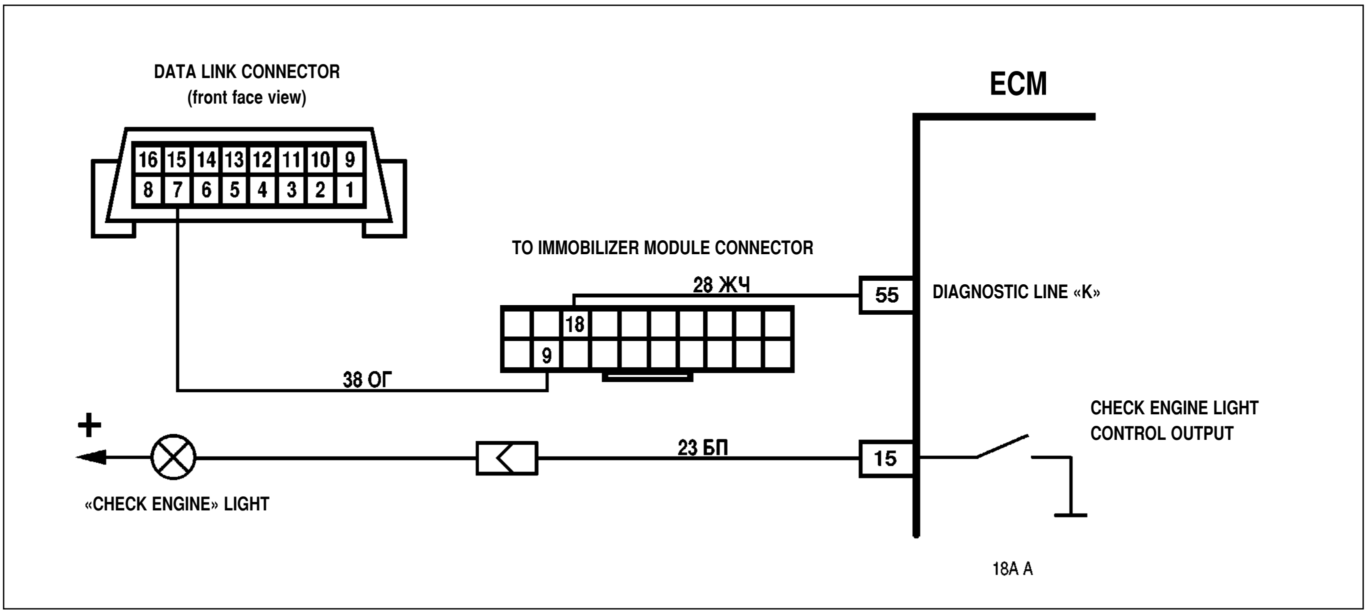


Chart A-2

No Data On The Data Link Connector (DLC)

Circuit Description

The circuit between terminals «9» and «18» of the Immobilizer module is normally open.

When DST-2MM is connected to the DLC and ignition is switched ON, the Immobilizer module closes the circuit.

The circuit reopens if the ECM communicates with the Immobilizer module at ignition switch-on/off.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If communication between the ECM and DST-2MM is reestablished after terminals «18» and «9» have been jumpered, check the VTD system (Immobilizer) components for being faulty.
2. Checks connection between the DLC (terminal «10») and the ECM (terminal «55»).

Chart A-2

No Data On The Data Link Connector (DLC)

Refer to Chart A.

1

Disconnect the Immobilizer module harness connector.
Jumper terminals «18» and «9» of the harness connector.
Is there communication between the ECM and DST-2MM?

Yes → VTD system (Immobilizer) is faulty. Refer to Chart A-7.

No ↓

2

Ignition OFF.
Remove the jumper.
Check the 28 yellow/black and 38 orange/blue wires for open or short to voltage.
Check for poor electrical connections.
Are the circuits and electrical connections OK?

No → Repair as necessary.

Yes ↓

Check DST-2MM on a vehicle known to be good.
If the scan tool functions properly, replace the ECM.

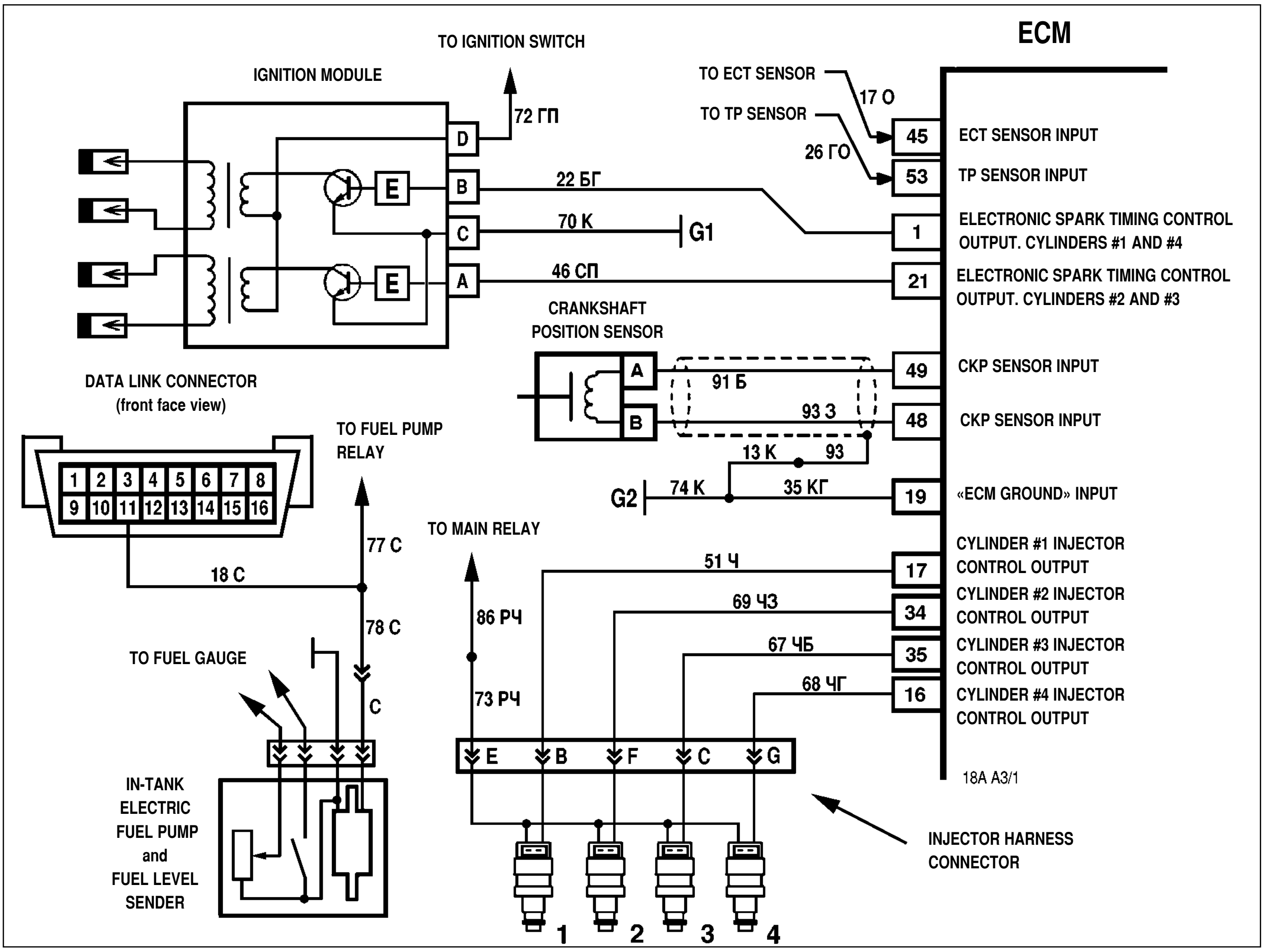


Chart A-3

(Page 1 of 2)

Engine Cranks But Will Not Run

«Diagnostic Circuit Check» must be performed prior to this chart check. If not, refer to Chart A.

Engine cranks but will not run, or engine may start but immediately stops running. System voltage and engine cranking speed are OK (Refer to Section 1.3, «Fuel Supply Control Modes») and there is adequate fuel in the tank.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If the TP signal is below 0.3 volts, the TP sensor power circuit may be shorted to ground.

DST-2MM should display engine speed above zero during cranking.

2. Because the secondary circuit of the ignition module coils (consists of two plugs and cables) is completed through the ground connection, the spark tester ground wire should be connected to the engine ground.

3. Low fuel pressure may result in lean air/fuel mixture. Refer to Chart A-6.

Diagnostic Aids

If the ambient temperature is below zero, the engine may not start because of water or other contaminants in the fuel.

Chart A-3
(Page 1 of 2)

Engine Cranks But Will Not Run

1

Check for fouled spark plugs or contaminated fuel.
Perform the Diagnostic Circuit Check (Chart A).
Connect DST-2MM. If there is no data displayed, refer to Chart A-2.
Use DST-2MM to check the following:
- if DTC P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P0335, P0336, P1501, P1502 or P1541 is set, refer to the diagnostic chart for this DTC;
- engine coolant temperature. If the displayed and the actual temperature values are not reasonably the same, refer to DTC P0117 and P0118 «Diagnostic Aids»;
- engine speed. If the scan tool displays no rpm while cranking – use diagnostic charts for DTCs P0335 and P0336.

Using DST-2MM select «1 - Parameters; 5 - ADC Channels» and check the TP sensor output signal. If the signal voltage is below 0.35 volts or above 0.7 volts with the throttle closed – use diagnostic charts for DTCs P0122 and P0123.
Activate the fuel pump using DST-2MM.
Does the fuel pump start?

Yes →

2

Using DST-2MM select: «2 - Control; Ignition Coil 1(2)».
Using a spark tester check the spark plug cables (HT leads) for spark.
Check cables one at a time with the tester ground wire connected to a good engine ground (away from any electronic components). Leave the other cables connected to spark plugs during this test.

- **Yes** → 3 Use fuel system diagnostic Chart A-6.
- **No** → Use Chart A-3 (page 2 of 2).

No → Use fuel system electrical circuit check Chart A-5.

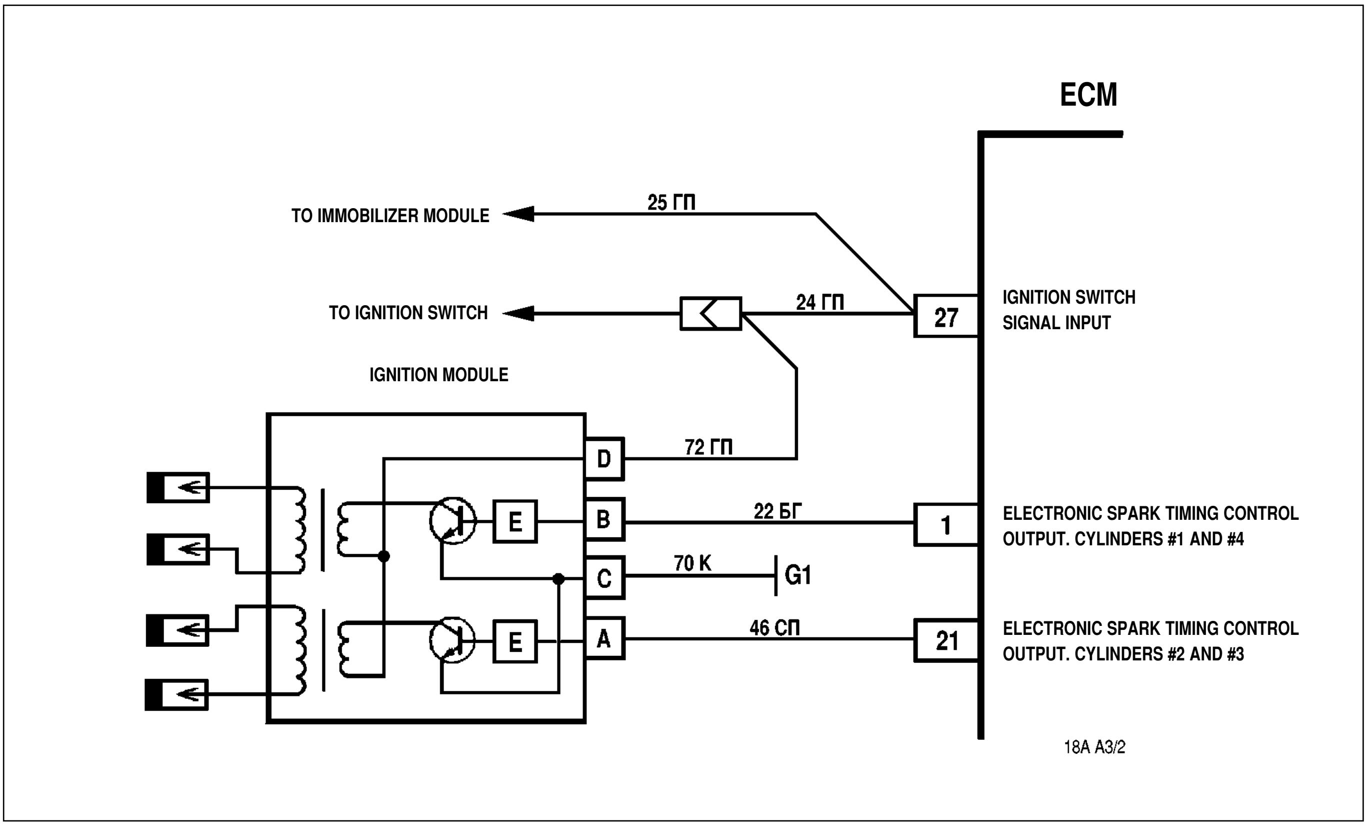


Chart A-3

(Page 2 of 2)

Engine Cranks But Will Not Run

Circuit description

The ignition system fitted on this engine does not use a conventional distributor.

The primary circuit consists of ignition coils primary windings and transistor switches in the ignition module. The secondary circuit consists of ignition coils secondary windings, spark plug cables (HT leads) and the spark plugs.

Test Description

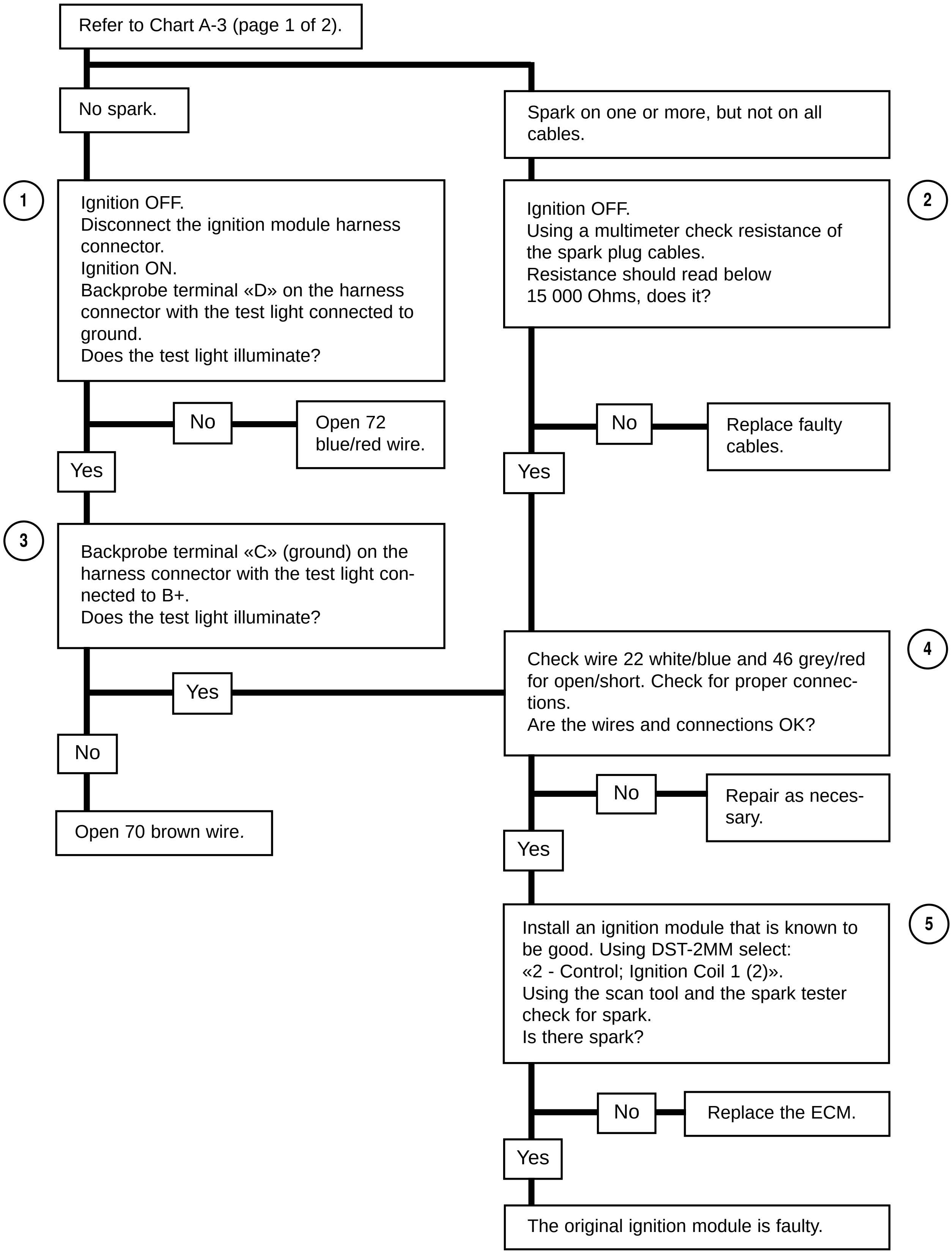
Number(s) below refer to circled number(s) on the diagnostic chart.

The ignition system uses two spark plugs and their cables to complete the circuit of each coil, therefore the spark tester ground wire should be connected to the engine ground to create a spark.

1. This test will determine if the power supply is available at ignition coil assembly.
2. The spark plug cables are checked for damage.
3. This test checks the ground circuit (wire 70 brown).
4. Checks if the ignition control harness is open/shorted.
5. This test will determine if the ECM or the ignition module is at fault.

Chart A-3
(Page 2 of 2)

Engine Cranks But Will Not Run



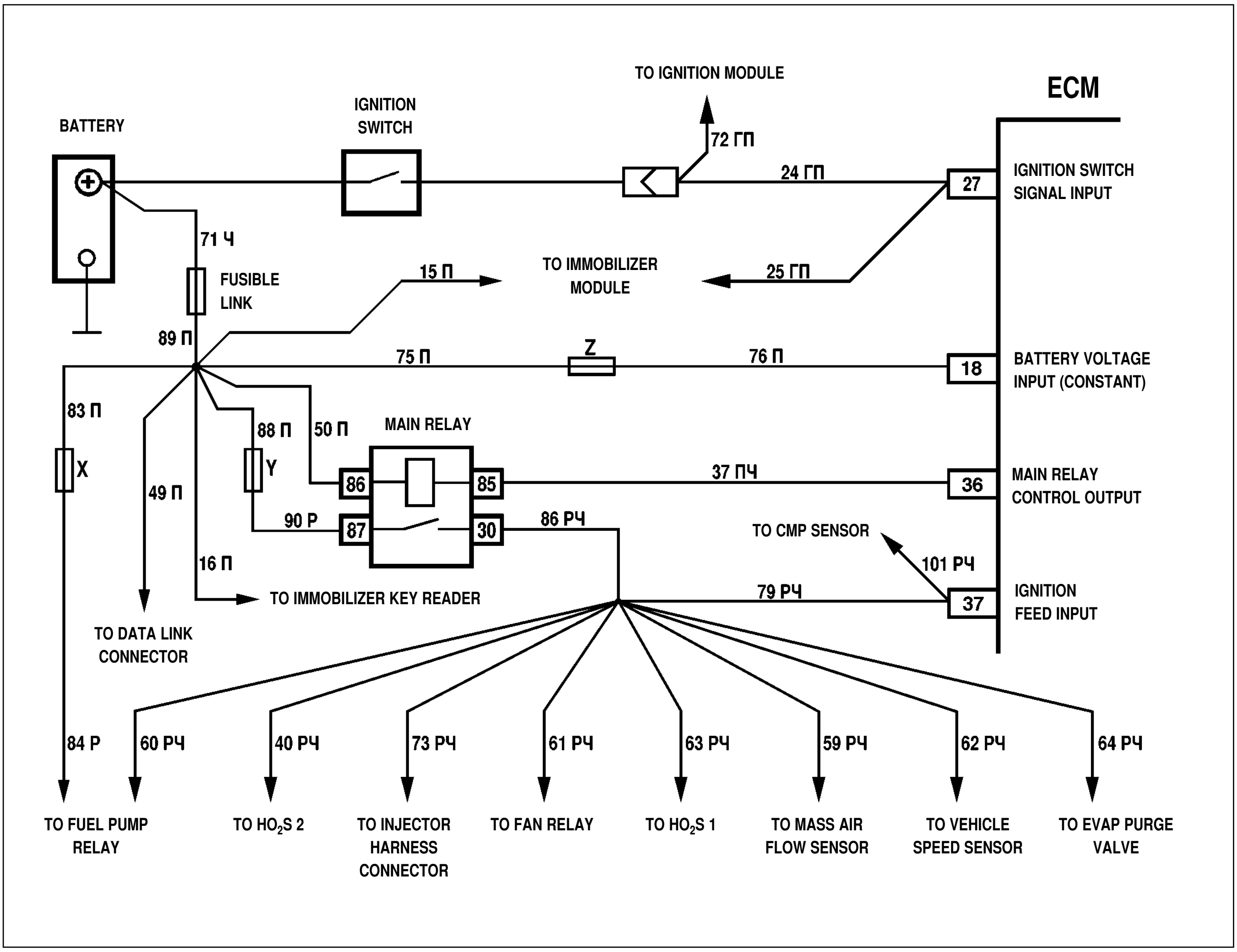


Chart A-4

Main Relay and Power Circuit Check

Circuit Description

The ECM terminal «18» receives power from the storage battery through a fusible link and a fuse.

When the ignition switch is turned ON its signal is supplied to ECM terminal «27». The ECM activates the main relay through its terminal «36». This allows voltage to ECM terminal «37», to sensors and other devices (EVAP canister purge valve, injectors and relays).

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. The ECM terminal «18» receives power from the storage battery through a fusible link and a fuse.
2. The ECM terminal «27» receives signal from the ignition switch.
3. DST-2MM displays system voltage measured at terminal «37». It should not differ by more than 1 volt from the battery voltage.
4. Battery voltage should be available at the harness connector terminals «86» and «87» (50 red and 90 pink wires). If voltage is present at both terminals, backprobing them should illuminate the test light.
5. The previous test checked voltage at the harness connector terminal «86» (50 red wire). This test checks the main relay control circuit that should be grounded by the ECM.
6. The main relay is checked for being faulty.

40, 59, 60, 61, 62, 63, 64 or 73 pink/black wires shorted to ground may cause incorrect reading of the system voltage monitored by the ECM at terminal «37».

Chart A-4

Main Relay and Power Circuit Check

Check fuse «Y» and the fusible link.
Are they OK?

- **No:** Repair short in the circuit and replace the fuse or the fusible link.
- **Yes:**

1 Disconnect the ECM harness connector. Backprobe terminal «18» on the harness connector using a test light connected to ground. Does the test light illuminate?

- **No:** Check the connection circuits between the ECM and the ignition switch for open/short.
- **Yes:**

2 Ignition ON.
Backprobe harness connector terminal «27» with a test light connected to ground.
Does the test light illuminate?

- **No:** Check the connection circuits between the ECM and the ignition switch for open/short.
- **Yes:**

3 Ignition OFF. Reconnect the ECM harness connector. Connect DST-2MM and select: «1 - Parameters; 2 - Groups preview».
Ignition ON.
Does the scan tool display system voltage close to battery voltage?

- **Yes:** No fault is present.
- **No:**

4 Remove the main relay.
Backprobe harness connector terminals «86» (wire 50 red) and «87» (wire 90 pink) with a test light connected to ground.
Does the test light illuminate?

- **The test light does not illuminate for one or both terminals.** Repair the open/short in the circuit(s) where the test light did not illuminate.
- **The test light illuminates for both terminals.**

5 Jumper harness connector terminals «85» and «86» with a test light.
Does the test light illuminate?

- **No:** 37 red/black wire open, or faulty ECM.
- **Yes:**

6 Close harness connector terminals «30» and «87» with a jumper wire.
Does the scan tool display system voltage close to battery voltage?

- **Yes:** Poor connection or faulty main relay.
- **No:** Wires 79/86 pink/black faulty, or faulty ECM.

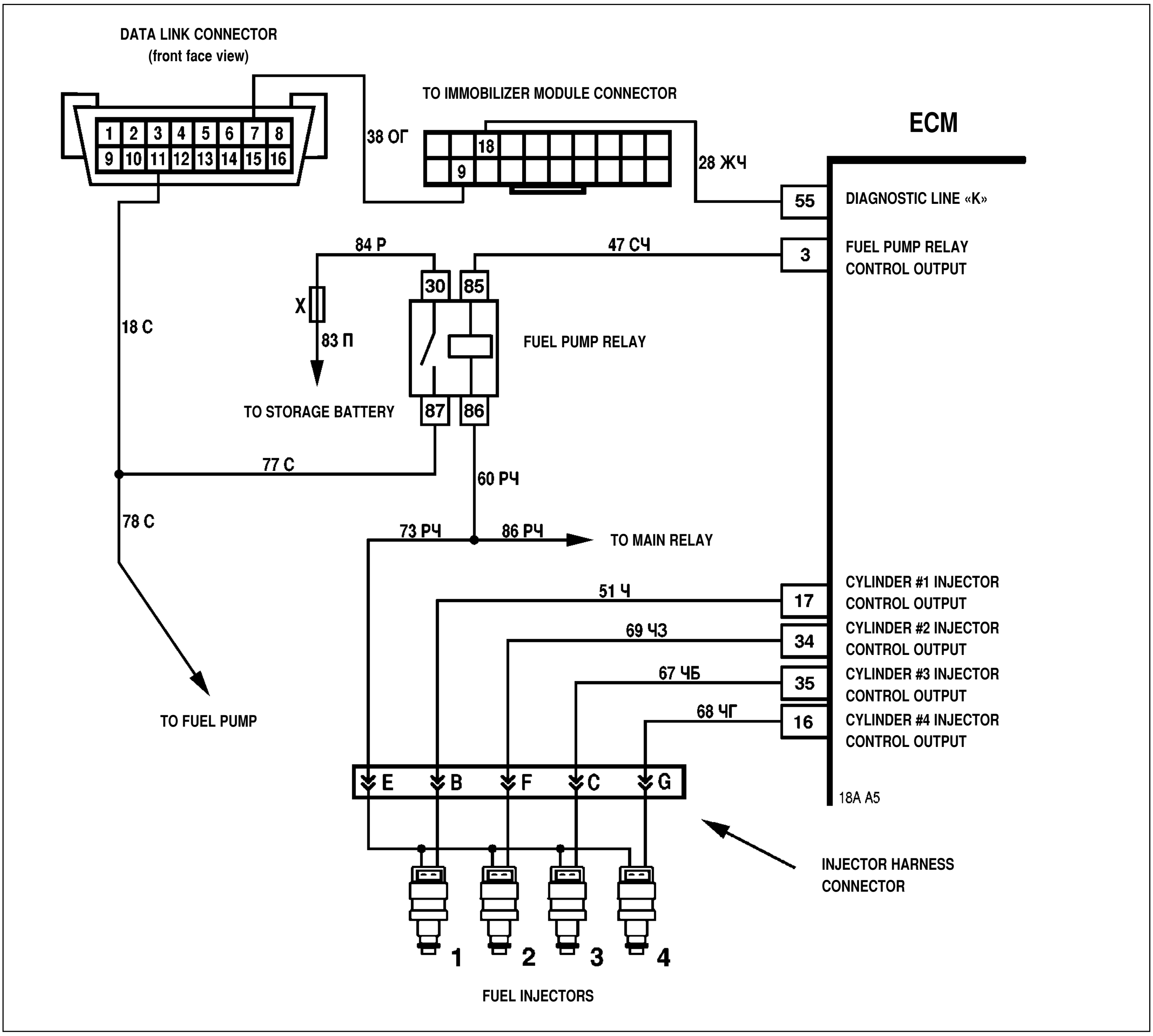


Chart A-5

Fuel System Electrical Circuit Check

Circuit Description

When the ignition switch is turned ON the ECM energizes the fuel pump relay to operate the fuel pump. When no reference pulses from the CKP sensor are present, the ECM will turn the fuel pump OFF two seconds after the ignition switch is turned ON.

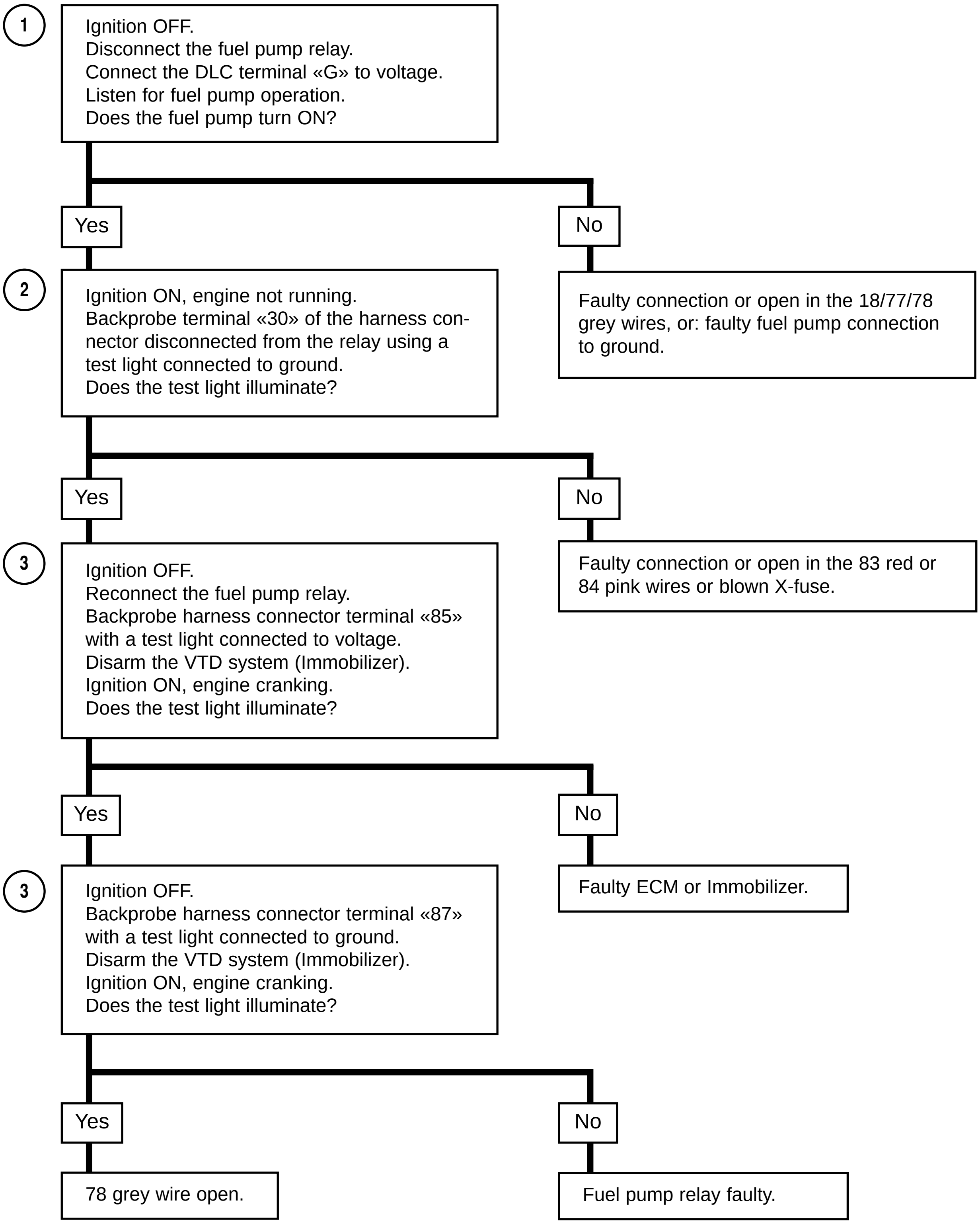
Test Description

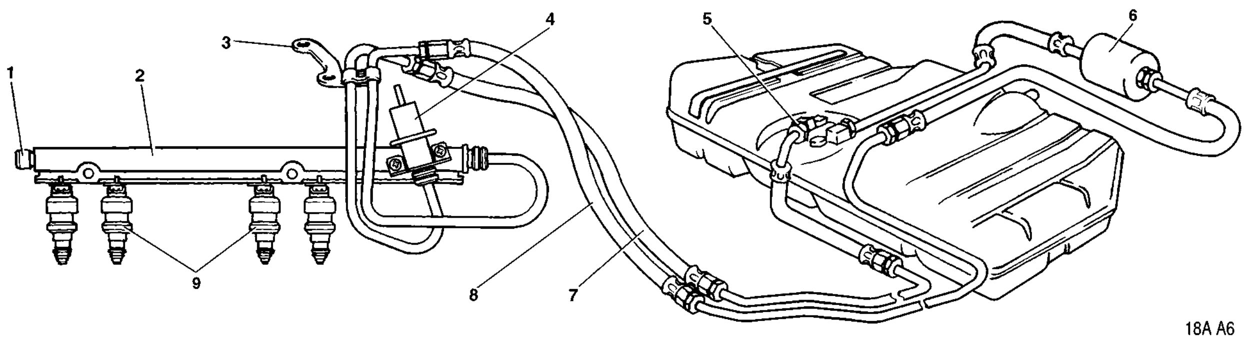
Number(s) below refer to circled number(s) on the diagnostic chart.

1. The fuel pump is commanded ON.
2. Checks if the power supply is present at the fuel pump relay terminals.
3. With ignition ON and engine cranking the ECM should activate the fuel pump.

Chart A-5

Fuel System Electrical Circuit Check





1 - fuel pressure test fitting
2 - fuel rail
3 - fuel lines mounting bracket
4 - fuel pressure regulator
5 - fuel pump
6 - fuel filter
7 - fuel return line
8 - fuel supply line
9 - fuel injectors

Chart A-6

(Page 1 of 2)

Fuel System Diagnosis

Circuit Description

When the ignition switch is turned ON the ECM activates the fuel pump. It will operate while the engine is cranking or running and the ECM receives reference pulses from the CKP sensor. If no reference pulses from the CKP sensor are present, the ECM will turn the fuel pump OFF two seconds after the ignition switch is turned ON.

The fuel pump supplies fuel to the fuel rail, where its pressure is maintained by the fuel pressure regulator. Unused fuel is returned to the fuel tank.

Terminal «G» of the DLC is used to diagnose the fuel pump. With ignition OFF and the engine not running the fuel pump may be activated by supplying power to this terminal.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks fuel pressure and system operation. Use DST-2MM or supply +12 volts to the DLC terminal «G» to operate the fuel pump.
2. Checks the fuel rail and connections between fuel supply and fuel return fittings. Also allows to check fuel pressure regulator operation and the fuel injectors for leaks.
3. Checks the line between the fuel pump and the fuel pressure regulator for leaks.
4. An injector sticking open can be best determined by checking for a fouled or saturated spark plug.

If a leaking injector cannot be determined by a fouled or saturated spark plug, the following procedure should be used:

- remove the fuel rail mounting screws and the screw holding the fuel lines to the mounting bracket (3). Leave the fuel lines connected to the fuel rail;
- lift the fuel rail just enough to leave the injector nozzles in their ports;
- activate the fuel pump to pressurize the fuel system and observe for injector(s) leaking.

Diagnostic Aids

Improper fuel system pressure can result in one of the following symptoms:

- engine cranks but will not run;
- engine stalls, may feel like ignition problem;
- poor fuel economy, loss of power;
- hesitation.

Chart A-6
(Page 1 of 2)

Fuel System Diagnosis

1 «Fuel System Electrical Circuit Check» must be performed using Chart-5 prior to this chart check.
Check if the fuel tank has sufficient fuel and fuel quality is OK.
Release fuel system pressure (Refer to Section 1.3)
Ignition OFF.
Connect a pressure gauge to the fuel pressure test fitting at the end of the fuel rail.
Activate fuel pump for 10 seconds by supplying power voltage to the DLC terminal «G» or using DST-2MM.
Fuel pressure should read 284-325 kPa during these 10 seconds, does it?

- **No** → Refer to Chart A-6 (Page 2 of 2).
- **Yes** → After the fuel pump stops running, pressure may decrease slightly and then should hold steady with no further drop (if engine is warm, a slow gradual increase of pressure is normal).
What does pressure do?

Pressure continues to drop.

2 Activate the fuel pump for another 10 seconds.
After the fuel pump stops running pinch completely shut the rubber section 8 of the fuel supply line near the fuel rail.
Does fuel pressure stabilize?

- **Yes** → Replace the fuel pump.
- **No** →

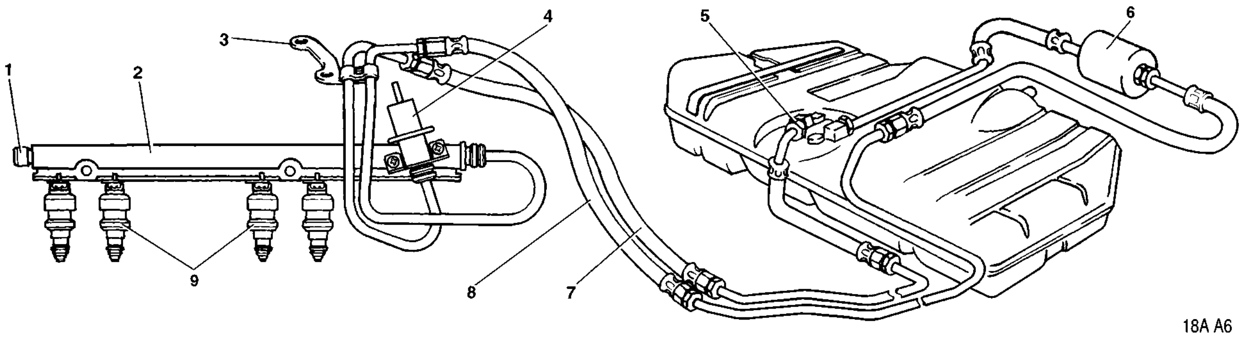
3 Activate the fuel pump for 10 seconds.
After the fuel pump stops running pinch completely shut the rubber section 7 of the fuel return line.
Does fuel pressure stabilize?

- **No** → **4** Locate and replace leaking fuel injector(s).
- **Yes** → Check for leaks and loose connections between the fuel tank and the fuel pressure regulator.
If no problems are found replace the fuel pressure regulator.

Pressure holds steady.

Start the engine and allow it to idle.
Does fuel pressure noted in step 1 drop by 21-69 kPa?

- **Yes** → Fault not found. Refer to Section «Symptoms».
- **No** → Disconnect vacuum hose from the fuel pressure regulator.
With the engine idling apply 300...350 mm Hg vacuum to the fuel pressure regulator.
Does pressure noted in step 1 drop by 21-69 kPa?
  - **No** → Replace fuel pressure regulator.
  - **Yes** → Locate and repair loss of vacuum supply to fuel pressure regulator.



1 - fuel pressure test fitting
2 - fuel rail
3 - fuel lines mounting bracket
4 - fuel pressure regulator
5 - fuel pump
6 - fuel filter
7 - fuel return line
8 - fuel supply line
9 - fuel injectors

Chart A-6

(Page 2 of 2)

Fuel System Diagnosis

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Activating the fuel pump and gradually pinching the return line allows to check if the fuel pump can provide fuel pressure on the injectors above 284 kPa.

NOTICE: Do not pinch the fuel return hose completely shut. This may damage the fuel pressure regulator.

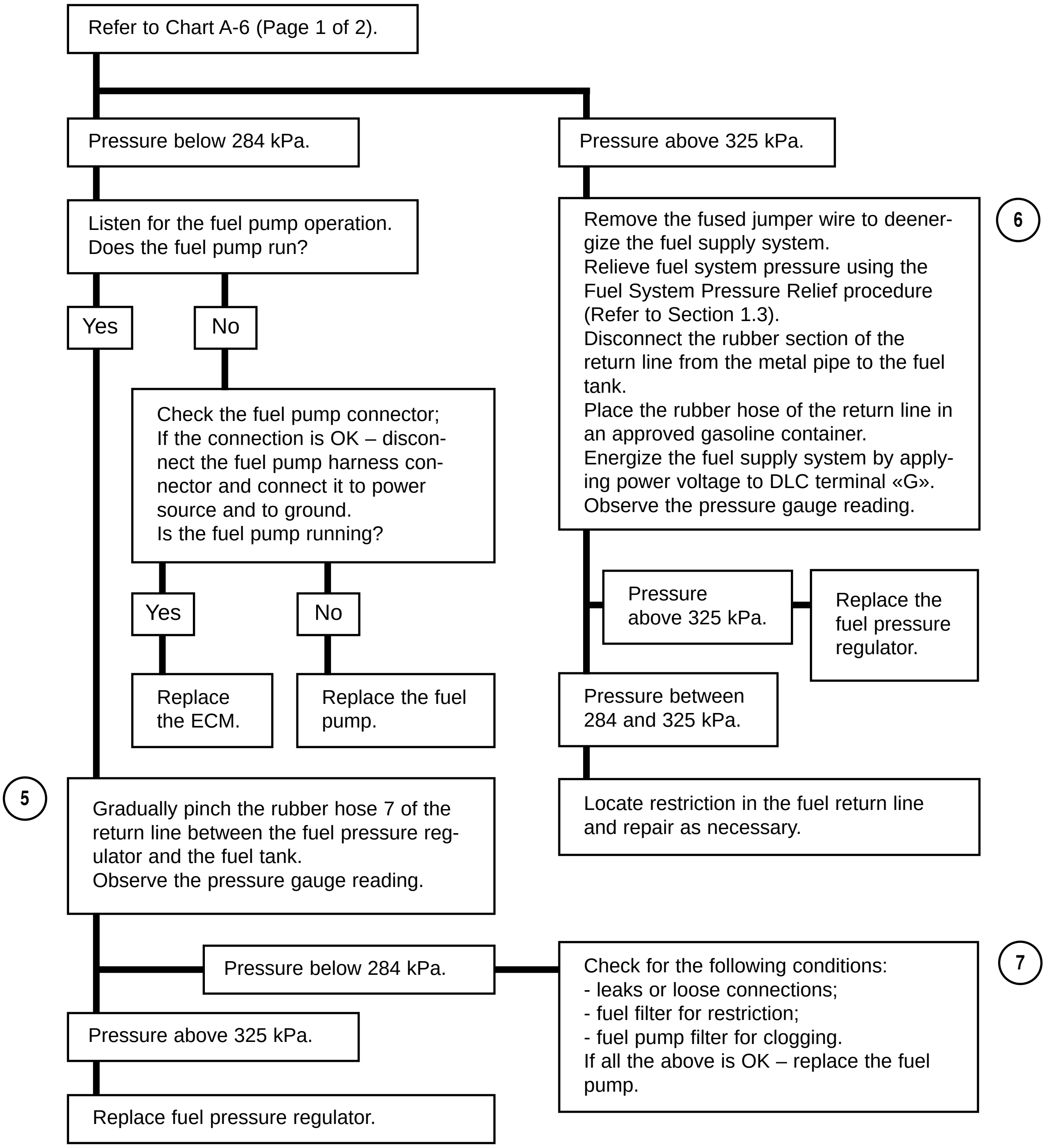
6. This test checks for possible cause of high pressure: restricted fuel return line or faulty fuel pressure regulator.

Apply battery voltage to the fuel pump test connector only long enough to get an accurate fuel pressure reading.

7. Check fuel pressure with the fuel filter removed to see if the filter is clogging. If fuel pressure reading differs from the previously measured value (step 1) by more than 14 kPa, the fuel filter should be replaced.

Chart A-6
(Page 2 of 2)

Fuel System Diagnosis



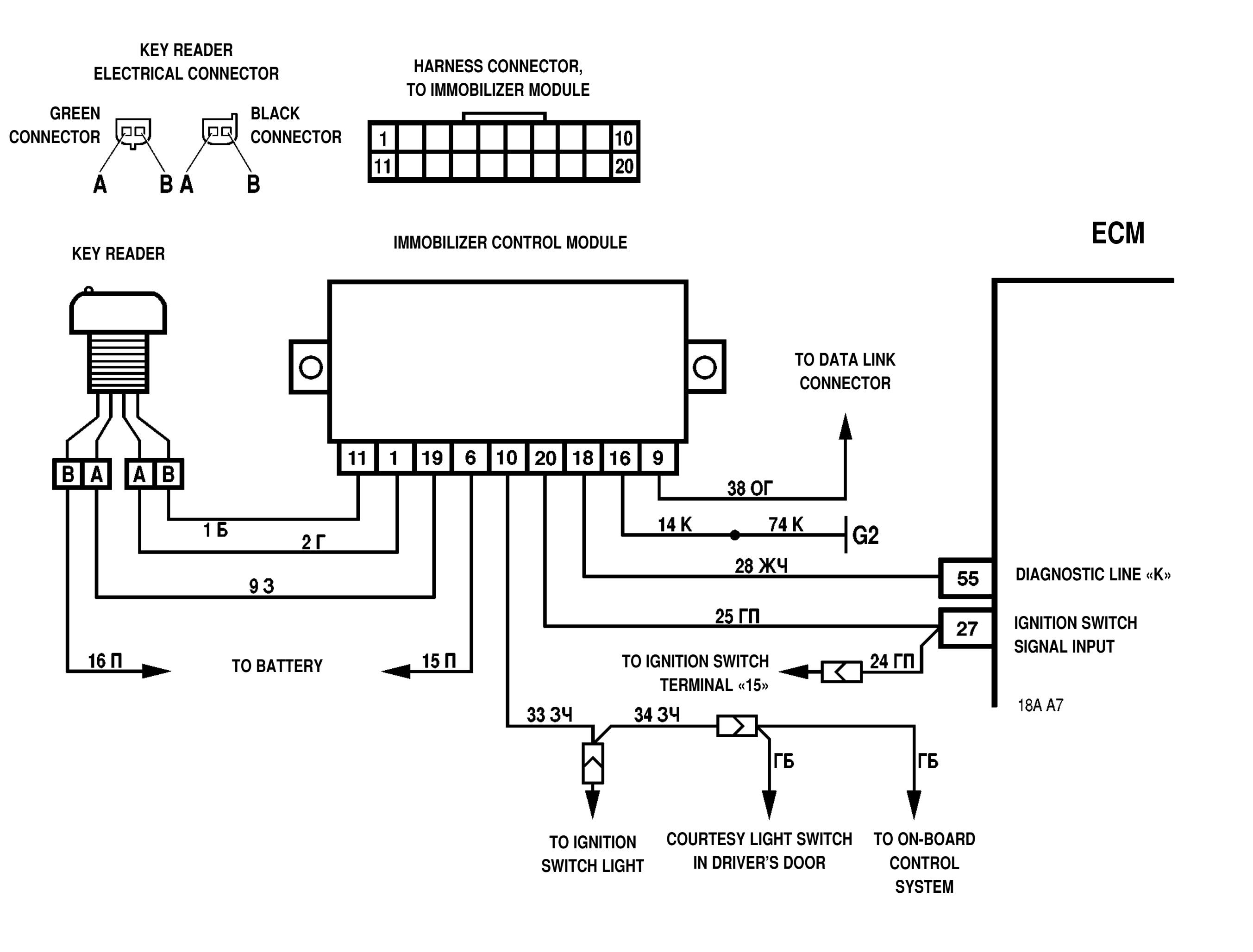


Chart A-7

(Page 1 of 2)

Vehicle Theft Deterrent (Immobilizer) System Diagnosis

Test Description

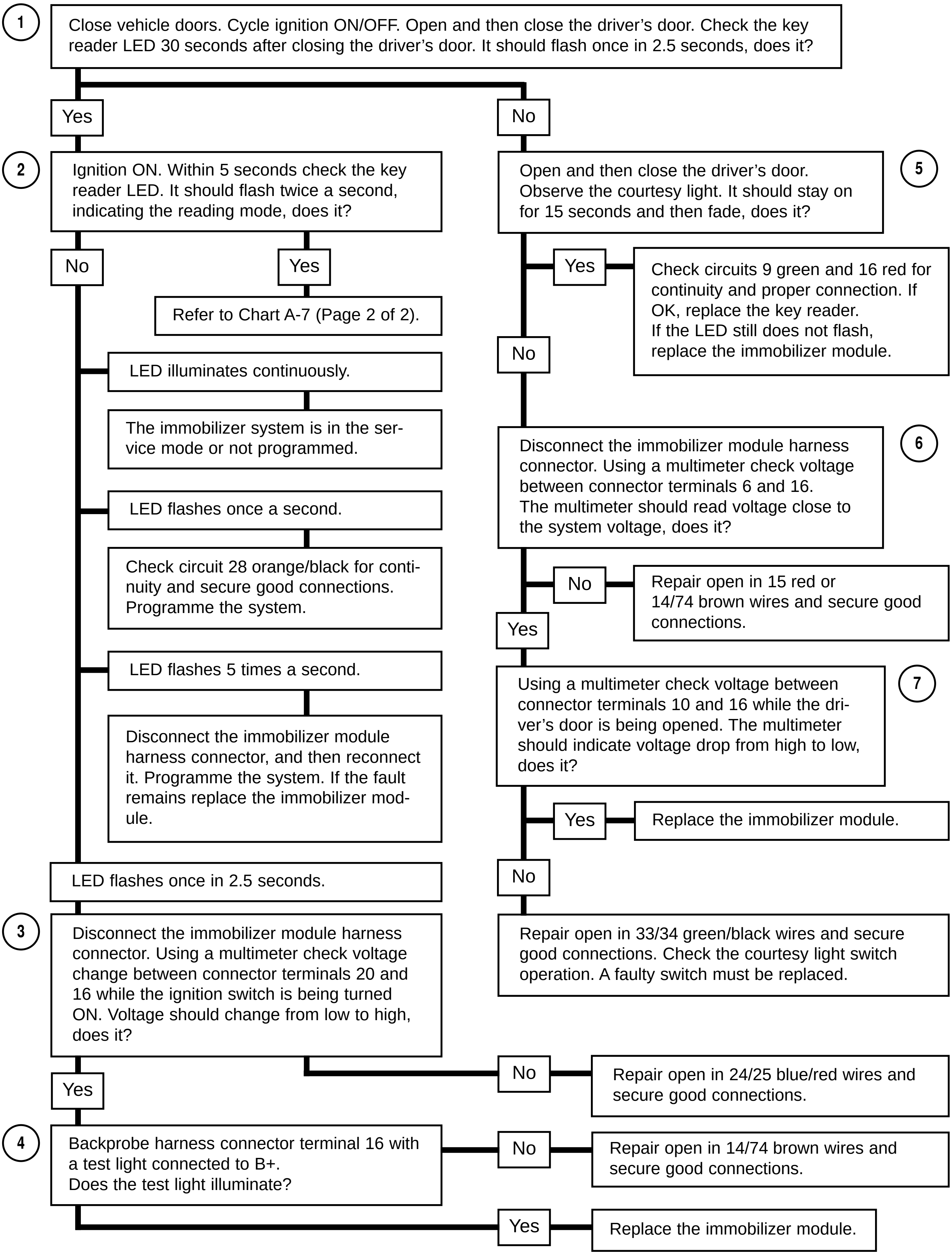
Number(s) below refer to circled number(s) on the diagnostic chart.

1. The VTD system (Immobilizer) is put into armed mode (sleeping). In this example the Immobilizer armed mode will be activated in 30 seconds.
2. This test checks if the Immobilizer reading mode can be activated by switching ignition ON.
3. This test checks the ignition switch signal circuit (24/25 blue/red) for a fault.
4. Checks the Immobilizer module ground circuit (14/74 brown) for a fault.
5. The immobilizer cannot be armed after the driver's door is closed. This test also checks operation of the courtesy light.
6. Checks power supply to the Immobilizer module.
7. Checks the courtesy light switch circuit (33/34 green/black) for a fault.

Chart A-7

(Page 1 of 2)

Vehicle Theft Deterrent (Immobilizer) System Diagnosis



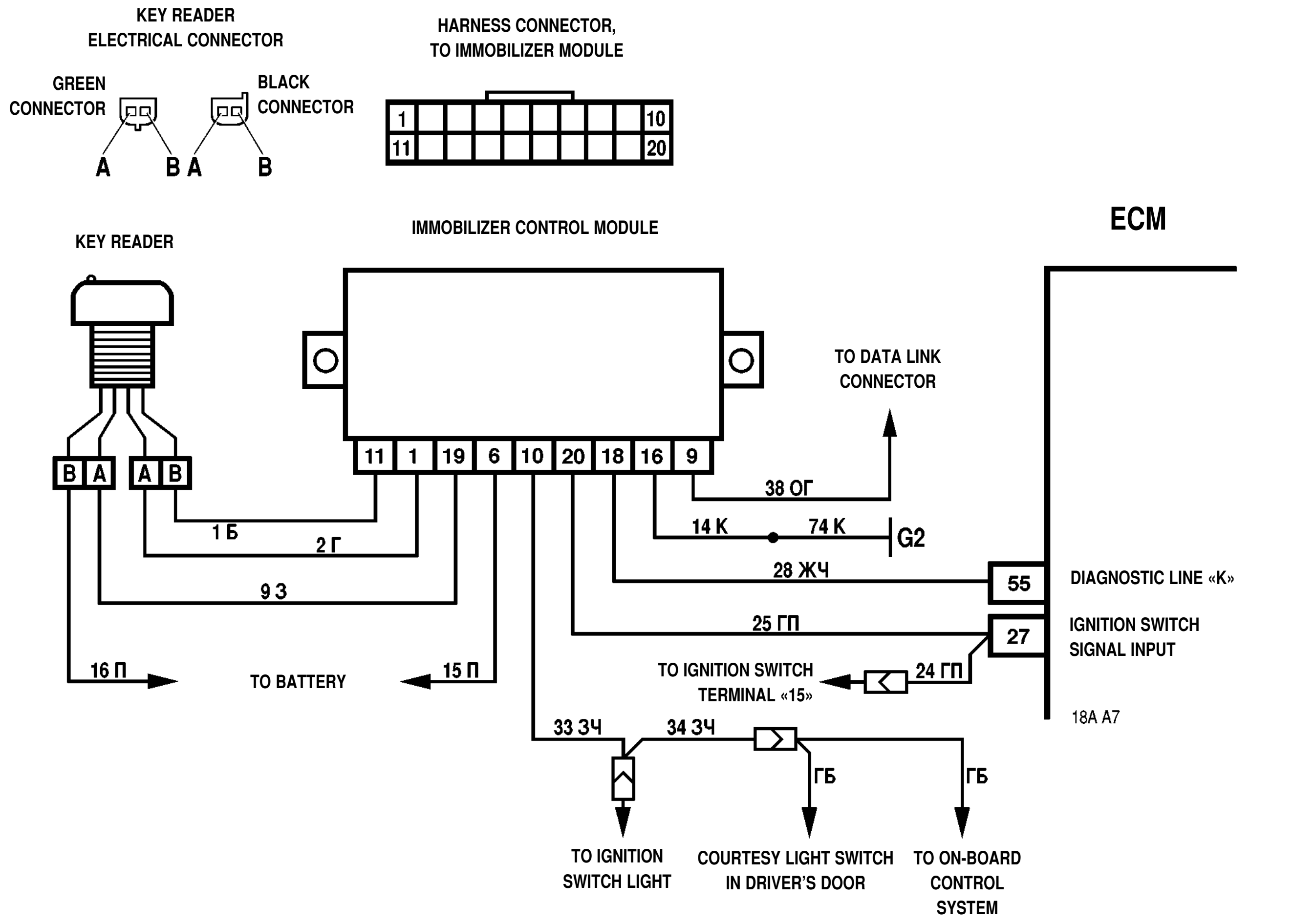


Chart A-7

(Page 2 of 2)

Vehicle Theft Deterrent (Immobilizer) System Diagnosis

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

8. This test checks if the VTD (Immobilizer) system can be disarmed using the Black key Fob #1.

9. Checks the courtesy light operation.

10. This test checks if the VTD (Immobilizer) system can be disarmed using the Black key Fob #2.

11. Checks engine start after the immobilizer system has been disarmed. During the first 1-3 seconds after ignition is switched ON the LED may flash (while the ECM is attempting to establish communication with the immobilizer control module).

12. This test checks if the VTD (Immobilizer) system can be disarmed using the Black key Fob #2.

13. Checks why the VTD (Immobilizer) system cannot be disarmed – Black key Fobs not programmed, faulty immobilizer system components or their connections.

Chart A-7

(Page 2 of 2)

Vehicle Theft Deterrent (Immobilizer) System Diagnosis

Refer to Chart A-7 (Page 1 of 2).

8 Put the Black key Fob #1 in front of the key reader. Two beep sounds will be heard and the LED will go off. Do the actions proceed as indicated?

- Yes → 9
- No → 12

9 Ignition OFF. Open the driver's door. The courtesy light should go on, does it?

- Yes → 10
- No → Perform test #7 (Refer to page 1 of Chart A-7).

10 Close the driver's door. In 30 seconds the Immobilizer system enters armed mode. LED should flash once in 2.5 seconds.
Open and then close the driver's door. In 30 seconds the Immobilizer system enters armed mode. LED should flash once in 2.5 seconds.
Open the driver's door. The immobilizer system reading mode will be activated. The LED should flash twice a second.
Put the Black key Fob #2 in front of the key reader. Two beep sounds will be heard and the LED will go off. Do the actions proceed as indicated?

- Yes → 11
- No → Programme the Black key Fobs.

11 Ignition ON. In 5 seconds check the LED indication. It should not illuminate. Does it?

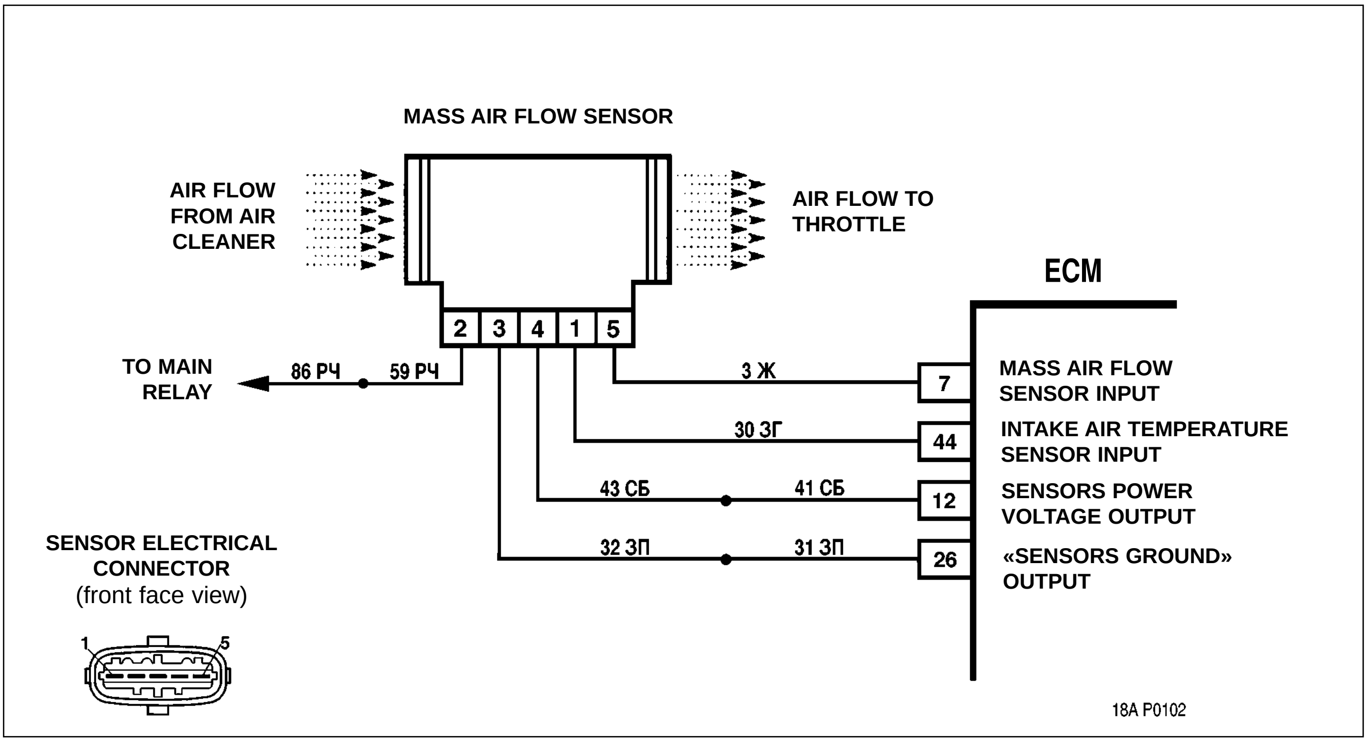
- Yes → LED flashes 5 times a second. → Disconnect and then reconnect the immobilizer module harness connector. Programme the system. If the fault remains replace the immobilizer module. If the fault remains replace the ECM.
- Yes → LED flashes once a second. → Check 28 orange/black wire for continuity and proper connections. Repair as necessary and programme the system.
If the wire and connections are OK replace the immobilizer module. If the fault remains replace the ECM.
- No → The immobilizer system is OK.

12 Put the Black key Fob #2 in front of the key reader. Two beep sounds will be heard and the LED will go off. Do the actions proceed as indicated?

- Yes → Ignition OFF.
Open and then close the driver's door. In 30 seconds the Immobilizer system enters armed mode. LED should flash once in 2.5 seconds.
Programme the Black key Fobs.
- No → 13

13 Ignition OFF.
Place the Red key Fob in front of the key reader. A beep sound will be heard and the LED will illuminate continuously. The LED can also start flashing 10 times a second.
Do the actions proceed as indicated?

- Yes → Switch ignition OFF for 15 seconds. Programme the Black key Fobs.
- No → Repair open in 1 white or 2 blue wires and secure good connections of the immobilizer system control module and the key reader. If the fault remains replace the key reader. If the fault still remains replace the immobilizer control module.



DTC P0102

Mass Air Flow, Signal Low

Conditions for setting DTC P0102:

- engine speed N40 is above 560 rpm;

- mass air flow is below 0.5 kg/h.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for power supply and reliable ground connection.

2. Checks resistance between harness connector terminal «5» and ground, which should read 4...6 kOhms.

Diagnostic Aids

An intermittent may be caused by a poor connection, misrouted harness, damaged wire insulation, a wire broken inside the insulation, poor sensor ground connection, or by additional power take-off devices connected to the harness.

Check for the following conditions:

Poor connection at the ECM connector terminals «7» and «12». Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it is not routed too close to high voltage wires.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Air cleaner clogging. Replace the air cleaner filter element as necessary.

DTC P0102

Mass Air Flow, Signal Low

Start the engine.
Plug-in DST-2M and select: «1 - Parameters; 2 - Groups Preview».
Does the ML parameter read below 0.5 kg/h?

- **Yes** → go to step 1
- **No** → DTC P0102 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

1

Ignition OFF. Disconnect the MAF sensor harness connector.
Ignition ON, engine not running.
Using a multimeter check voltage between the connector pins.
The multimeter should indicate:
- between terminals «2» and «3» – above 10 volts;
- between terminals «3» and «4» – 5 volts;
- between terminal «3» and ground – 0 volts.

Does the multimeter indicate as described?

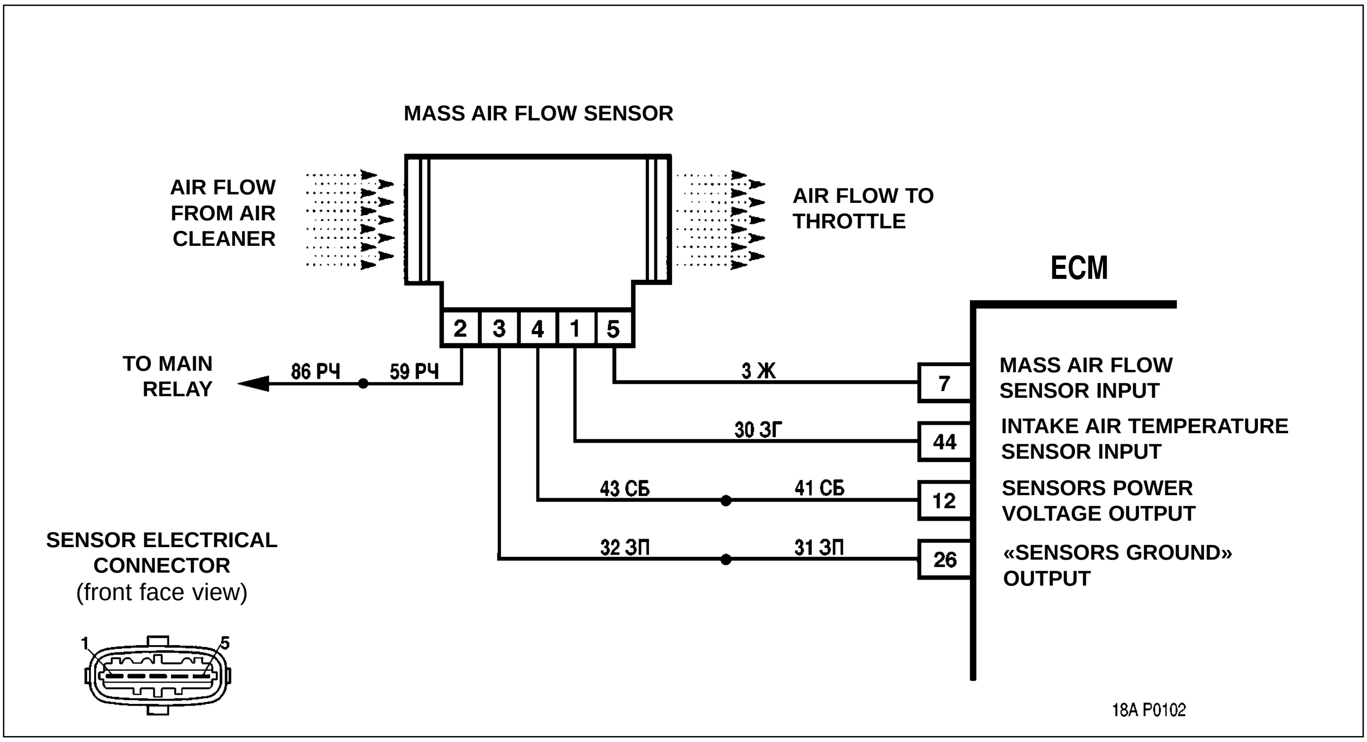
- **Yes** → go to step 2
- **No** → Repair open or short to ground as necessary.

2

Ignition OFF.
Using a multimeter check resistance between connector terminal «5» and ground.
Resistance should read 4...6 kOhms, does it?

- **Yes** → Faulty MAF sensor or connections.
- **No**:
  - About 0 Ohm. → 3 yellow wire short to ground or faulty ECM.
  - Above 100 kOhms. → 3 yellow wire open or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0103

Mass Air Flow, Signal High

DTC P0103 sets if airflow exceeds its threshold value, which depends on engine speed, for 1 second.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for power supply and reliable ground connection.
2. Checks voltage at harness connector terminal «5».

Diagnostic Aids

An intermittent may be caused by a poor connection, misrouted harness, damaged wire insulation, or a wire broken inside the insulation.

Check for the following conditions:

Poor connection at the ECM connector terminals «7» and «12». Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it is not routed too close to high voltage wires.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Poor MAF sensor ground connection. Check resistance between battery terminal «-» and terminal «3» of the MAF sensor harness connector with electric appliances ON (fan, heater, rear window demister). Resistance should not measure above 1 Ohm.

DTC P0103

Mass Air Flow, Signal High

Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

- **Yes** → go to step 1
- **No** → DTC P0103 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

1

Ignition OFF. Disconnect the MAF sensor harness connector.
Ignition ON, engine not running.
Using a multimeter check voltage between the connector pins.
The multimeter should indicate:
- between terminals «2» and «3» – above 10 volts;
- between terminals «3» and «4» – 5 volts;
- between terminal «3» and ground – 0 volts.

Does the multimeter indicate as described?

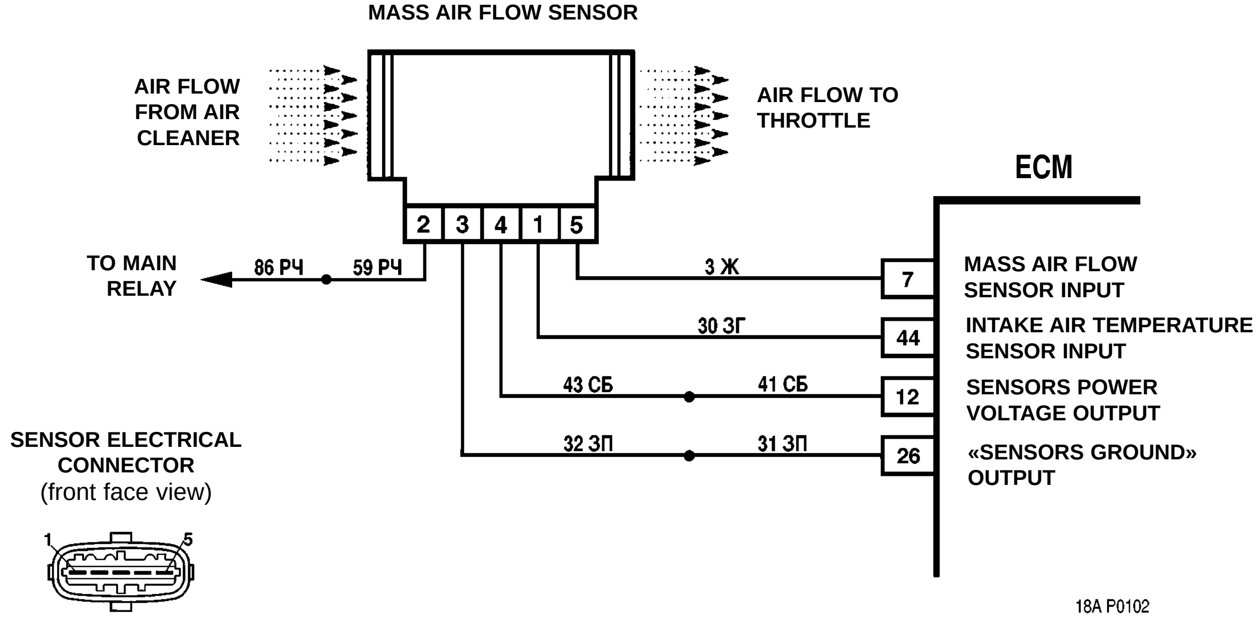
- **Yes** → go to step 2
- **No** → Repair open or short to ground as necessary.

2

Ignition ON.
Using a multimeter check voltage between harness connector terminal «5» and ground.
Multimeter should indicate 0 volts, does it?

- **Yes** → Faulty MAF sensor or connections.
- **No** → 3 yellow wire short to voltage or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0112

Intake Air Temperature Sensor, Signal Low

Conditions for setting DTC P0112:

- engine idling (B_LL=«YES»);

- fuel delivery enabled (B_SA=«NO»);

- sensor voltage indicates temperature above +120°C for 0.2 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks input signal circuit (30 grey/blue wire) for a fault.

Diagnostic Aids

When an IAT sensor fault is detected, the ECM resets to a default IAT value of 45°C.

An intermittent may be caused by a poor connection, misrouted harness, damaged wire insulation, or a wire broken inside the insulation.

Check for the following conditions:

Poor connection at the ECM connector terminals «12» and «44». Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it is not routed too close to high voltage wires.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

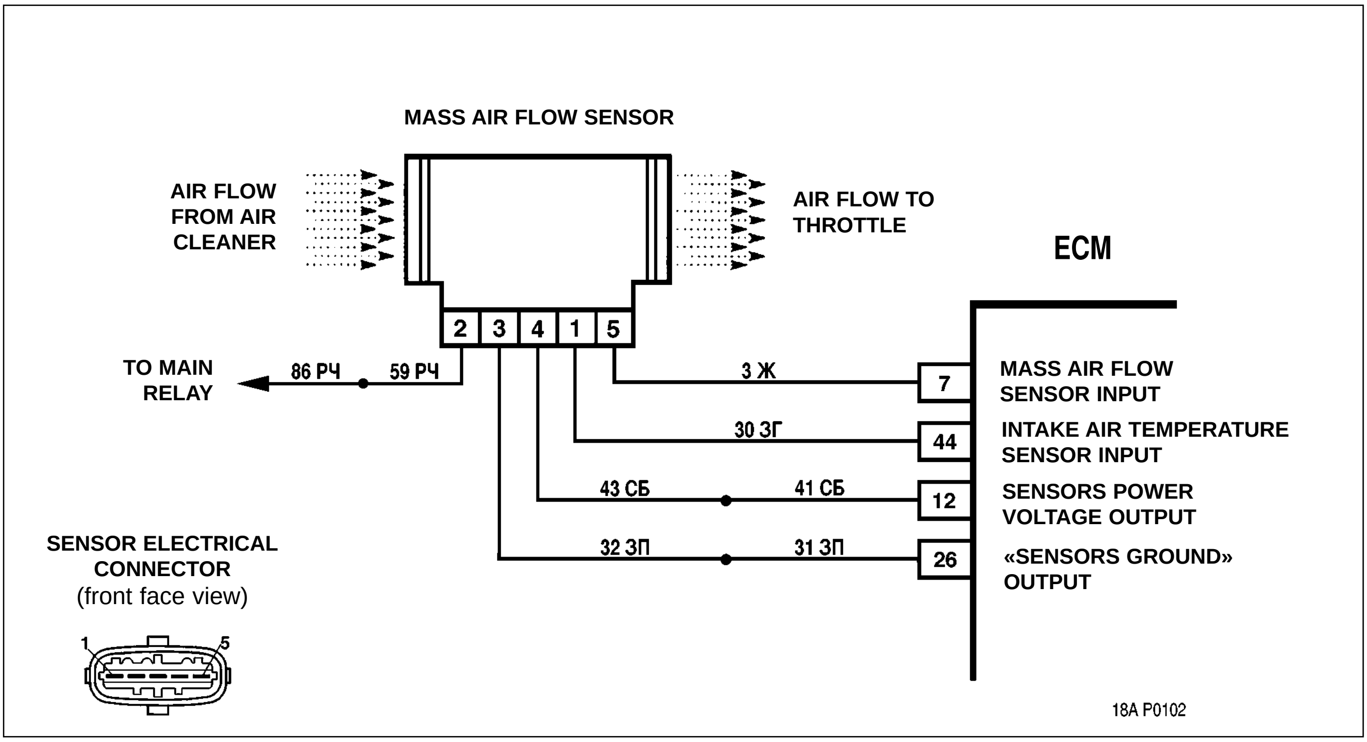
DTC P0112

Intake Air Temperature Sensor, Signal Low

Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is DTC P0102 set?

- **No** → Is DTC P0112 currently active?
  - **Yes** → (1) Ignition OFF.
    Disconnect the sensor harness connector.
    Ignition ON.
    Using a multimeter check voltage between connector terminals «1» and «3».
    The multimeter should indicate voltage about +5 volts, does it?
    - **Yes** → Replace the MAF sensor.
    - **No** → 30 grey/blue wire open or faulty ECM.
  - **No** → DTC P0112 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.
- **Yes** → Refer to DTC P0102 chart.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0113

Intake Air Temperature Sensor, Signal High

Conditions for setting DTC P0113:

- engine has been running for over 420 seconds after the start up;

- engine has been idling for 10 seconds (B_LL=«YES») and fuel delivery has not been cut off (B_SA=«NO»);

- sensor voltage indicates temperature below -39°C for 0.2 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks input signal circuit (30 grey/blue wire).

Diagnostic Aids

When an IAT sensor fault is detected, the ECM resets to a default IAT value of 45°C.

An intermittent may be caused by a poor connection, misrouted harness, damaged wire insulation, or a wire broken inside the insulation.

Check for the following conditions:

Poor connection at the ECM connector terminals «12» and «44». Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it is not routed too close to high voltage wires.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

DTC P0113

Intake Air Temperature Sensor, Signal High

Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes →

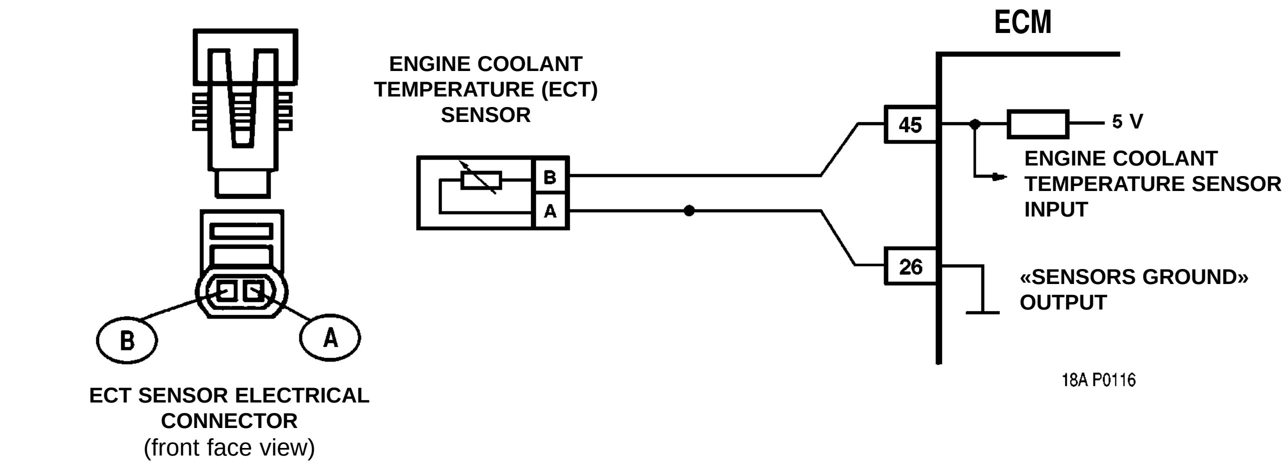
(1) Ignition OFF.
Disconnect the sensor harness connector.
Ignition ON, engine not running.
Using a multimeter check voltage between connector terminal «1» and ground.
The multimeter should indicate 4.8...5.2 volts, does it?

- **Yes** → Replace the MAF sensor.
- **No** → 30 grey/blue wire short to ground or faulty ECM.

No →

DTC P0113 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0116

Engine Coolant Temperature Sensor, Range

Conditions for setting DTC P0116:

- engine running;

- calculated temperature is greater than measured temperature by the threshold value.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks sensor input signal circuit.
2. Checks sensor ground circuit for a fault.
3. Checks the cause for setting DTC – faulty sensor or cooling system.

Diagnostic Aids

Check sensors ground circuit (6 green and 31 green/red wires) for damaged harness or connections. Inspect harness connectors for backed out terminals or improper mating.

DTC P0116 setting may be caused by a fault in the cooling system (an open thermostat etc.)

Engine Coolant Temperature Sensor

Temperature vs. Resistance Values

(Approximate)

Temperature °C	Resistance Ohm	Temperature °C	Resistance Ohm
100	177	20	3520
90	241	15	4450
80	332	10	5670
70	467	5	7280
60	667	0	9420
50	973	-4	12300
45	1188	-10	16180
40	1459	-15	21450
35	1802	-20	28680
30	2238	-30	52700
25	2796	-40	100700

DTC P0116

Engine Coolant Temperature Sensor, Range

1

Ignition OFF.
Disconnect the sensor harness connector.
Ignition ON.
Using a multimeter check voltage between connector terminal «B» and ground.
The multimeter should indicate 5 volts, does it?

- Yes → go to 2
- No → Faulty ECM or poor connection at the ECM.

2

Using a multimeter check resistance between connector terminal «A» and ground.
The multimeter should indicate resistance below 1 Ohm, does it?

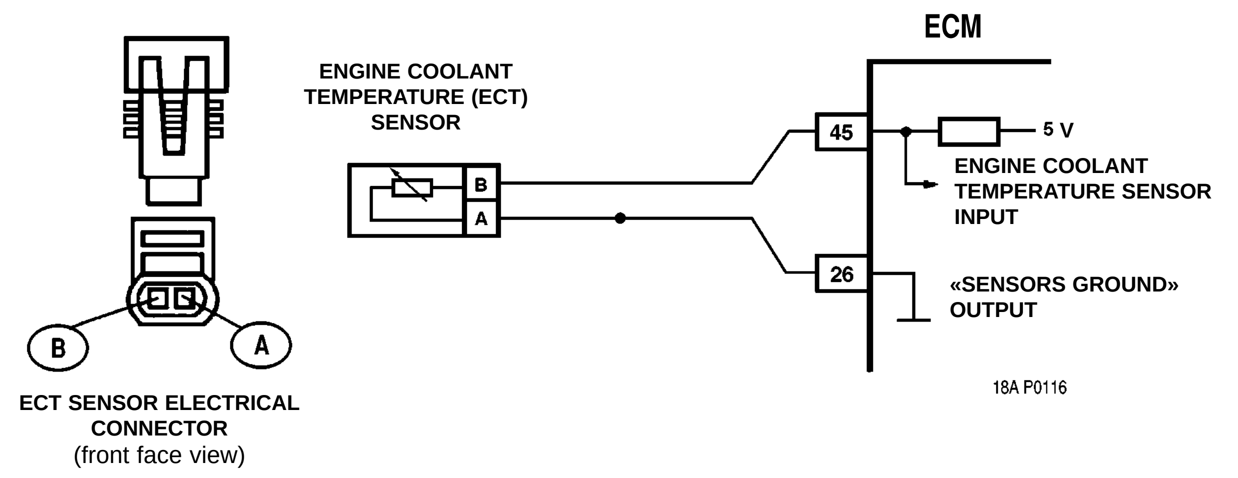
- Yes → go to 3
- No → Poor connection at the ECM or at the sensor.

3

Check sensor resistance for two coolant temperature values (for cold and warmed up engine).
Measurement results should be the same as in the table, are they?

- Yes → Cooling system faulty.
- No → Replace the ECT sensor.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0117

Engine Coolant Temperature Sensor, Signal Low

Conditions for setting DTC P0117:

- engine running;

- sensor voltage indicates temperature above +135°C for 0.2 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

1. 17 orange wire from the ECT sensor to ECM terminal «45» is checked for short to ground.

Diagnostic Aids

Check sensors ground circuit (6 green and 31 green/red wires) for damaged harness or connections. Inspect harness connectors for backed out terminals or improper mating.

DTC P0117

Engine Coolant Temperature Sensor, Signal Low

Ignition ON, engine not running.
Connect DST-2M.
Using DST-2M select: «1 - Parameters; 5 - ADC Channels».
DST-2M should indicate ECT sensor signal below 0.16 volts, does it?

Yes →

1 Disconnect the ECT sensor harness connector.
Does DST-2M display ECT sensor signal above 4.9 volts?

- **Yes** → Replace the ECT sensor.
- **No** → Wire 17 orange short to ground or to wire 6 green, 31 green/red, or faulty ECM.

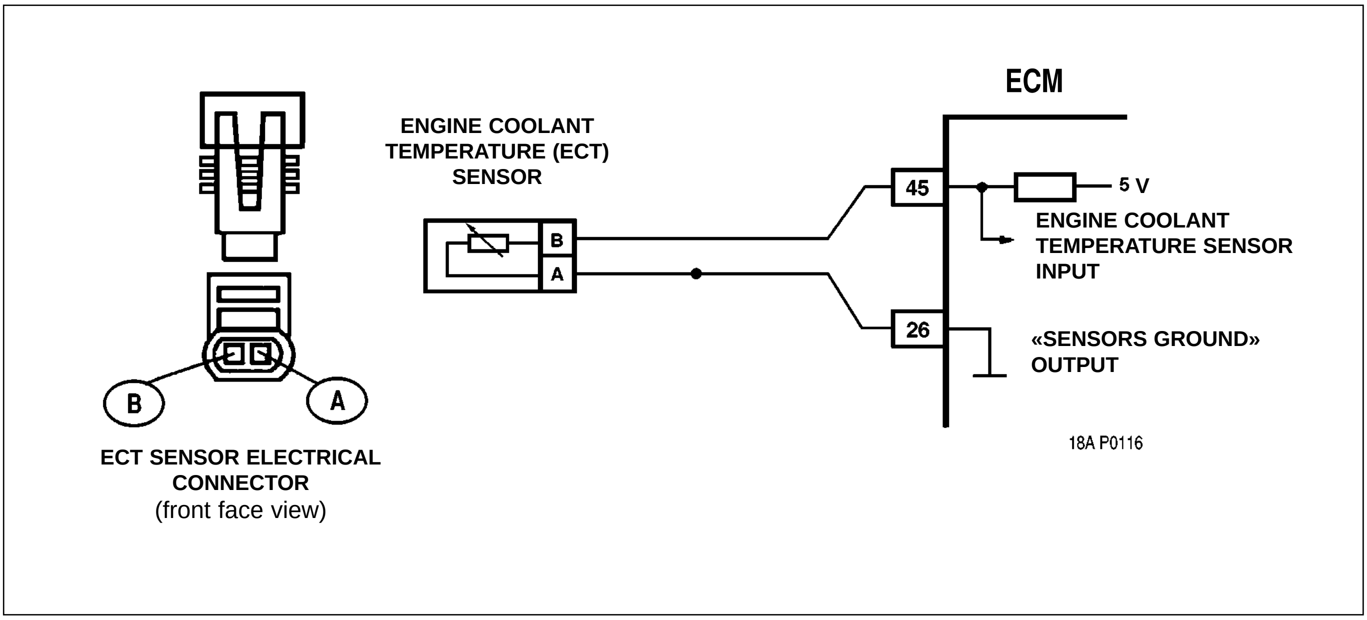
No → DTC P0117 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

Engine Coolant Temperature Sensor

Temperature vs. Resistance Values
(Approximate)

Temperature °C	Resistance Ohm	Temperature °C	Resistance Ohm
100	177	20	3520
90	241	15	4450
80	332	10	5670
70	467	5	7280
60	667	0	9420
50	973	-4	12300
45	1188	-10	16180
40	1459	-15	21450
35	1802	-20	28680
30	2238	-30	52700
25	2796	-40	100700

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0118

Engine Coolant Temperature Sensor, Signal High

Conditions for setting DTC P0118:

- engine running;

- sensor voltage indicates temperature below -42°C for 0.2 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

1. This test reproduces conditions for setting DTC P0117 – high temperature/low sensor resistance.

If the ECM receives low voltage signal (high temperature) and DST-2M displays 135°C or higher, the ECM and the sensor circuit are OK.

2. 17 orange wire from the ECT sensor to ECM terminal «45» is checked for open.

3. With the sensor disconnected voltage between the harness connector terminals «A» and «B» should read about +5 volts.

Diagnostic Aids

Check sensors ground circuit (6 green and 31 green/red wires) for damaged harness or connections. Inspect harness connectors for backed out terminals or improper mating.

Engine Coolant Temperature Sensor

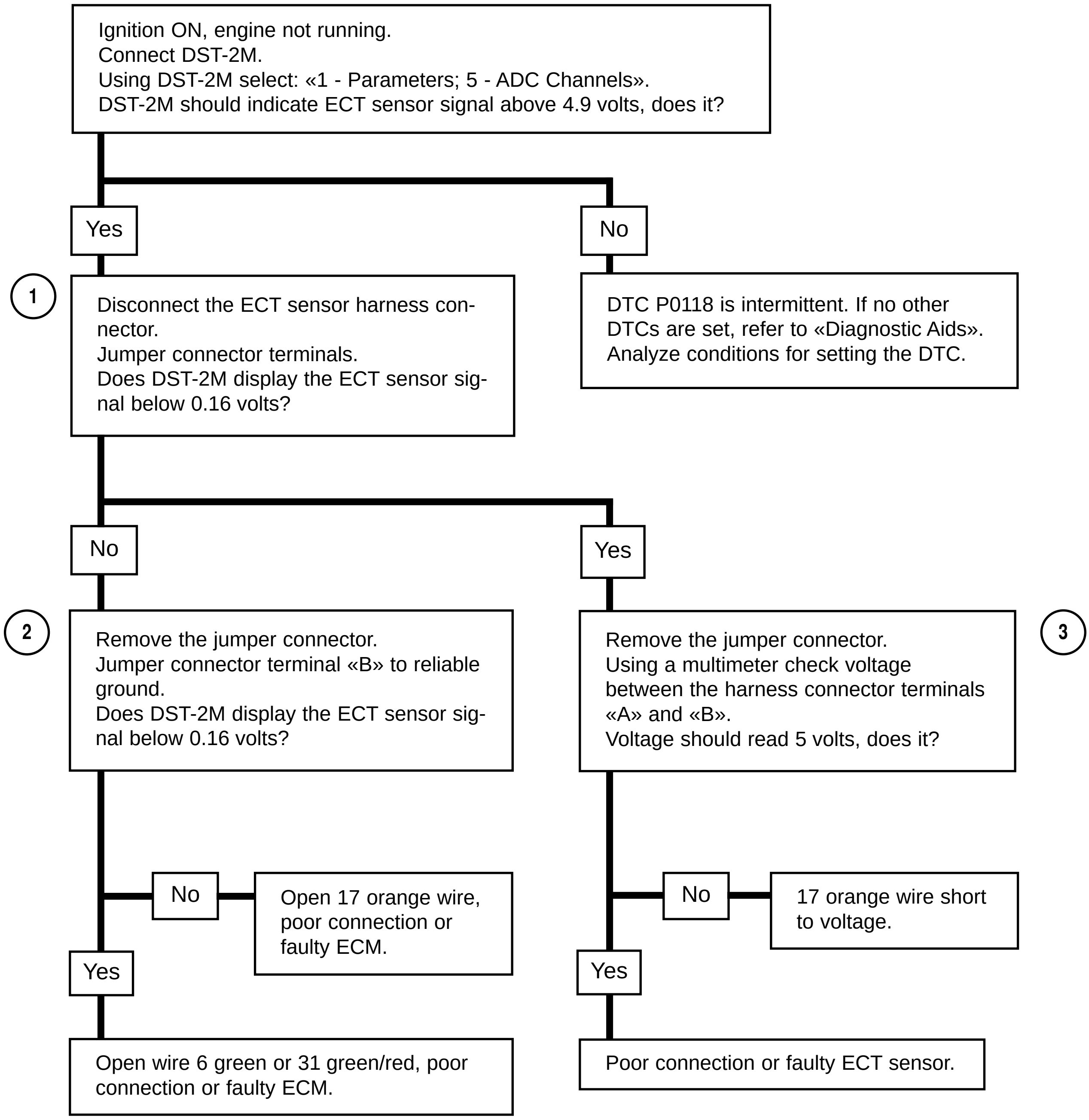
Temperature vs. Resistance Values

(Approximate)

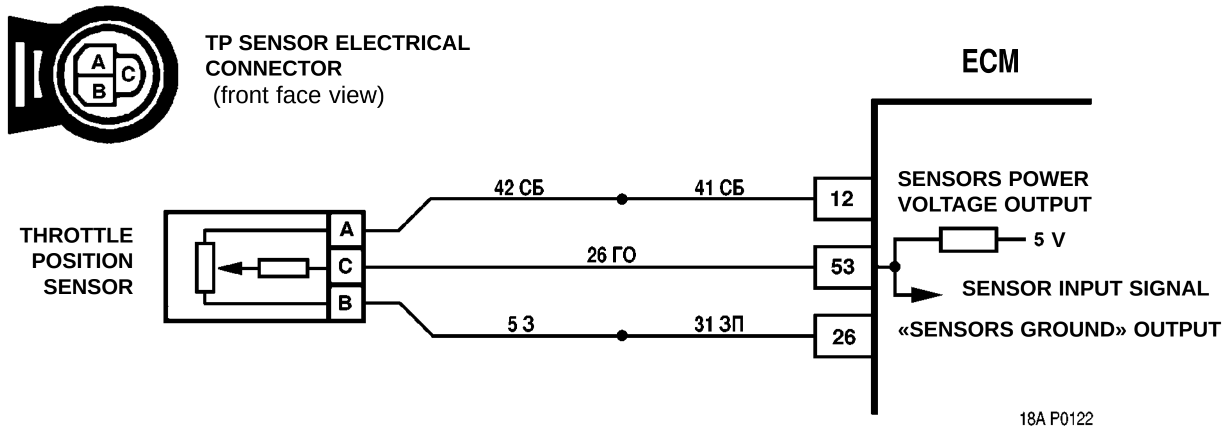
Temperature °C	Resistance Ohm	Temperature °C	Resistance Ohm
100	177	20	3520
90	241	15	4450
80	332	10	5670
70	467	5	7280
60	667	0	9420
50	973	-4	12300
45	1188	-10	16180
40	1459	-15	21450
35	1802	-20	28680
30	2238	-30	52700
25	2796	-40	100700

DTC P0118

Engine Coolant Temperature Sensor, Signal High



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0122

Throttle Position Circuit – Low Input

Conditions for setting DTC P0122:

- engine running;

- TP sensor voltage below 0.2 volts.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set. When ignition is switched ON DST-2M displays DKPOT 14%.

The TP sensor has an automatic zeroing function. If voltage reading is within the range of 0.35...0.7 volts, the ECM will use this value as closed throttle.

If voltage reading is out of the auto zero range at closed throttle, check for sticking throttle cable or damaged linkage. If OK, continue diagnosis.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks power supply.
2. Checks input signal circuit for a fault.

According to the ECM MP7.0H circuit engineering terminal «C» of the harness connector should read about +5±0.1 volts when the TP sensor is disconnected.

Diagnostic Aids

DST-2M («1 - Parameters; 5 - ADC Channels») displays throttle position in % and volts.

With ignition ON or at idle TP signal should be 0% (0.35...0.7 volts) with the throttle closed and increase at a steady rate as the throttle opens to 76–81% (4.05...4.75 volts).

If the output voltage signal at wide open or fully closed throttle is beyond the specified ranges, check the throttle cable and linkage operation. If OK, proceed with the diagnosis.

An open or short to ground in the sensor power circuit (41/42 grey/white) should set DTC P0122.

Refer to «Intermittents» in Section 2.9 B.

DTC P0122

Throttle Position Sensor, Signal Low

Connect DST-2M.
Ignition ON, engine running.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes →

1. Ignition OFF.
Disconnect the TP sensor harness connector.
Ignition ON.
Using a multimeter check voltage between connector terminal «A» and ground.
The multimeter should display 4.9...5.1 volts, does it?

   Yes →

   2. Using DST-2M select: «1 - Parameters; 5 - ADC Channels».
   TP sensor voltage should read 4.9...5.1 volts, does it?

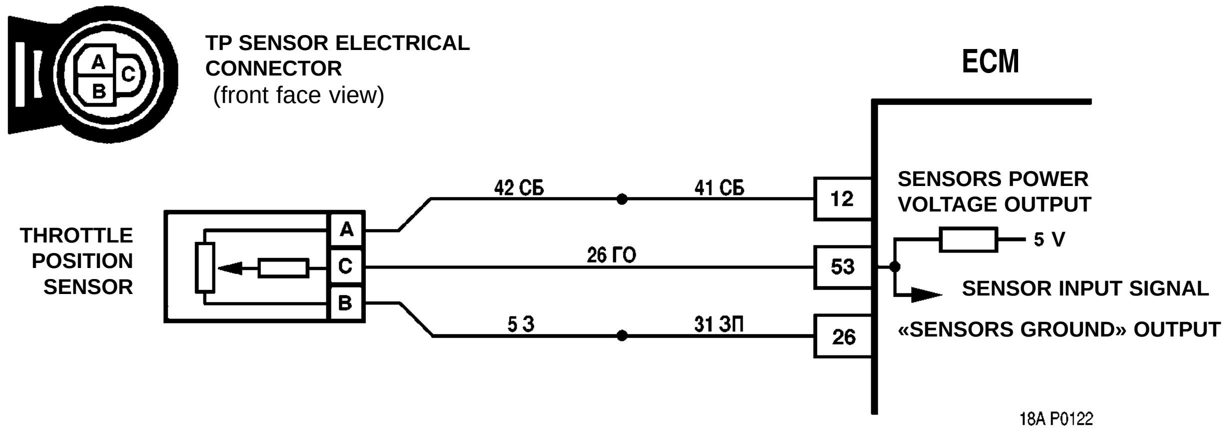
      No → 26 blue/orange wire short to ground or faulty ECM.

      Yes → Faulty sensor.

   No → Sensors power supply wires 41/42 grey/white open or short to ground, poor connections or faulty ECM.

No → DTC P0122 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.
Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0123

Throttle Position Sensor, Signal High

Conditions for setting DTC P0123:

- engine running;

- TP sensor voltage above 4.8 volts.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test uses a multimeter to check voltage at terminal «C» of the sensor connector.

According to the ECM MP7.0H circuit engineering terminal «C» of the harness connector should read about +5±0.1 volts when the TP sensor is disconnected.

2. This test uses a test light to check sensor ground circuit (5 green and 31 green/red wires).

Diagnostic Aids

DST-2M («1 - Parameters; 5 - ADC Channels») displays throttle position in % and volts.

With ignition ON or at idle TP signal should be 0% (0.35...0.7 volts) with the throttle closed and increase at a steady rate as the throttle opens to 76–81% (4.05...4.75 Volts).

If the output voltage signal at wide open or fully closed throttle is beyond the specified ranges, check the throttle cable and linkage operation. If OK, proceed with the diagnosis.

An open in the sensor ground circuit (5 green and 31 green/red) should set DTC P0123.

DTC P0123

Throttle Position Sensor, Signal High

Connect DST-2M.
Ignition ON, engine running.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes

1. Disconnect the TP sensor harness connector.
Using a multimeter check voltage between connector terminal «C» and ground.
What voltage does the multimeter display?

- **4.9...5.1 volts**

  2. Backprobe the connector terminal «B» with a test light connected to B+.
  Does the test light illuminate?

  - **Yes**: Faulty TP sensor.
  - **No**: 5 green or 31 green/red wires open or faulty ECM.

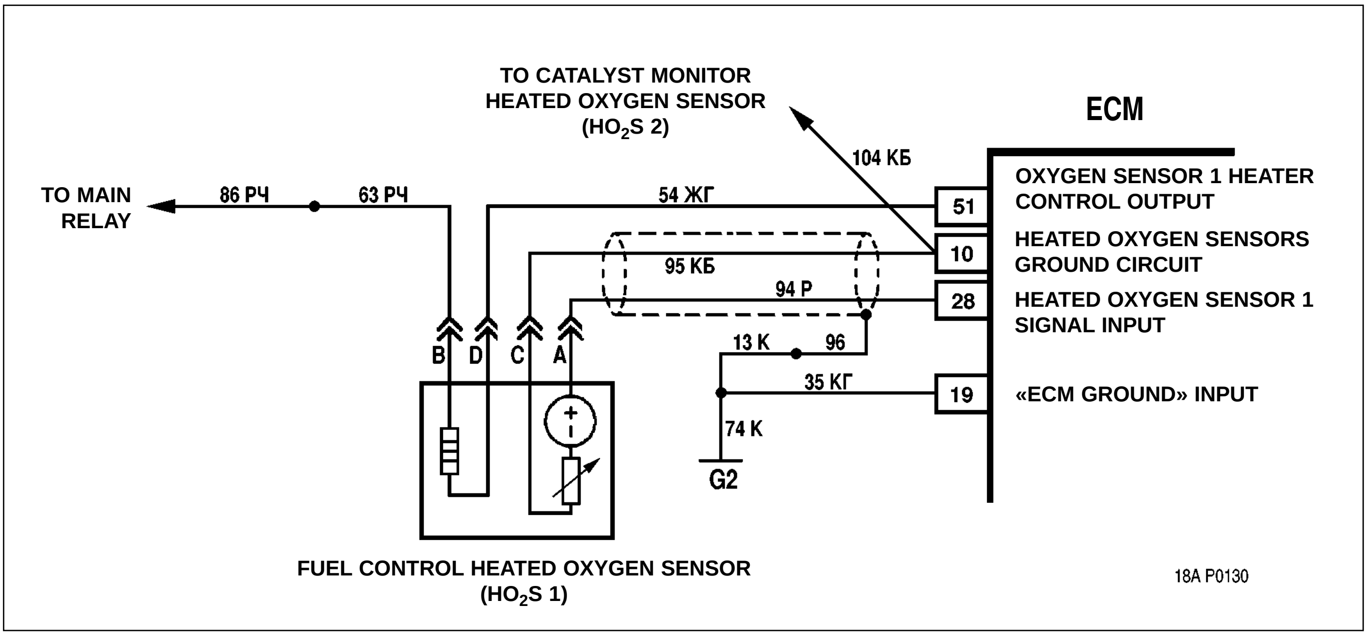
- **About 0 volts**: 26 blue/orange wire open or poor connection at the sensor connector.

- **Above 10 volts**: 26 blue/orange wire short to voltage or faulty ECM.

No

DTC P0123 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.
Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0130

O2 Sensor 1, Malfunction

Conditions for setting DTC P0130:

- engine has been running for more than 75 seconds;

- cold HO_2S 1 signal (USVK) below 40 mV for 0.5 seconds, or: warm HO_2S 1 signal is within 60 mV<USVK<390 mV, while the HO_2S 2 signal USHK>0.5 volts for 30 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the fuel control heated oxygen sensor signal voltage (USVK) using DST-2M.

2. Checks the heated oxygen sensor signal circuit for a fault.

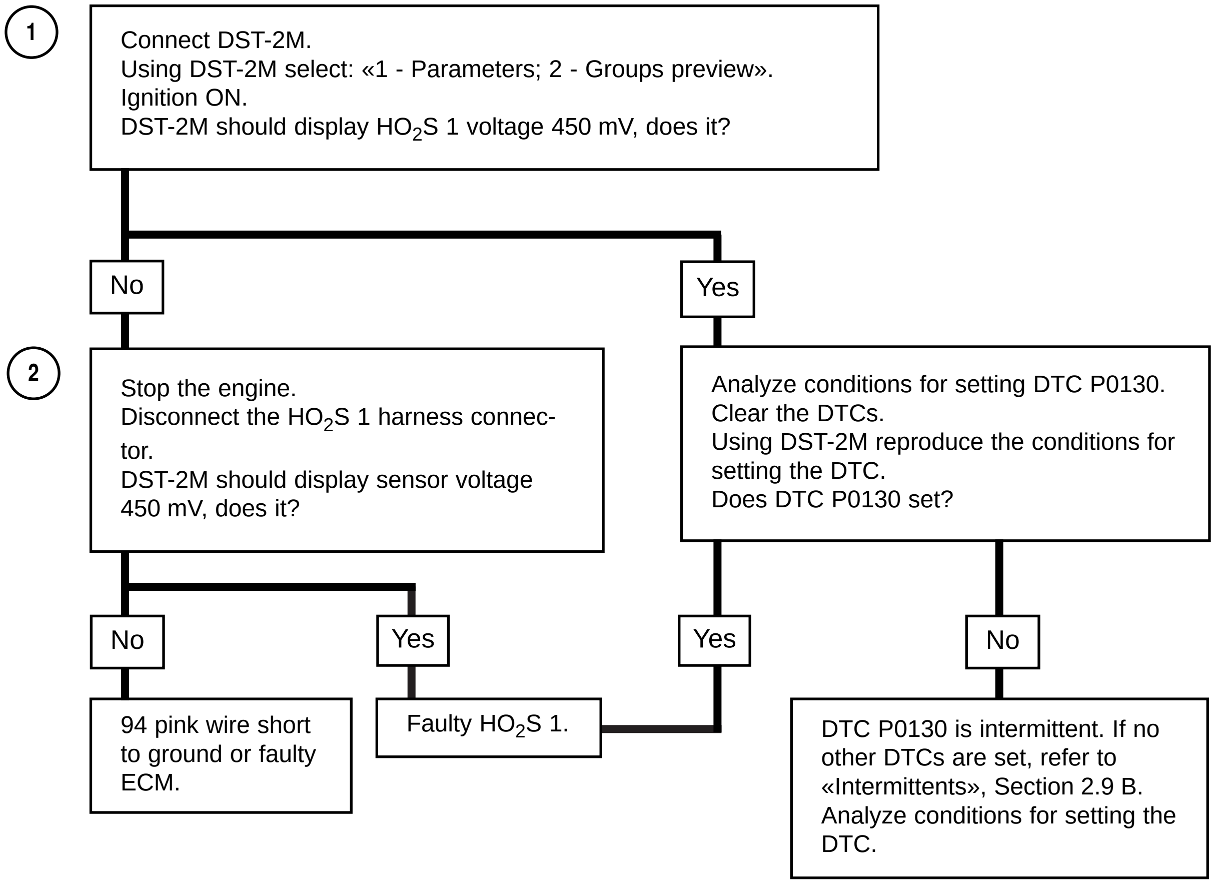
Diagnostic Aids

Voltage at the cold HO_2S terminal «A» should be 450 mV.

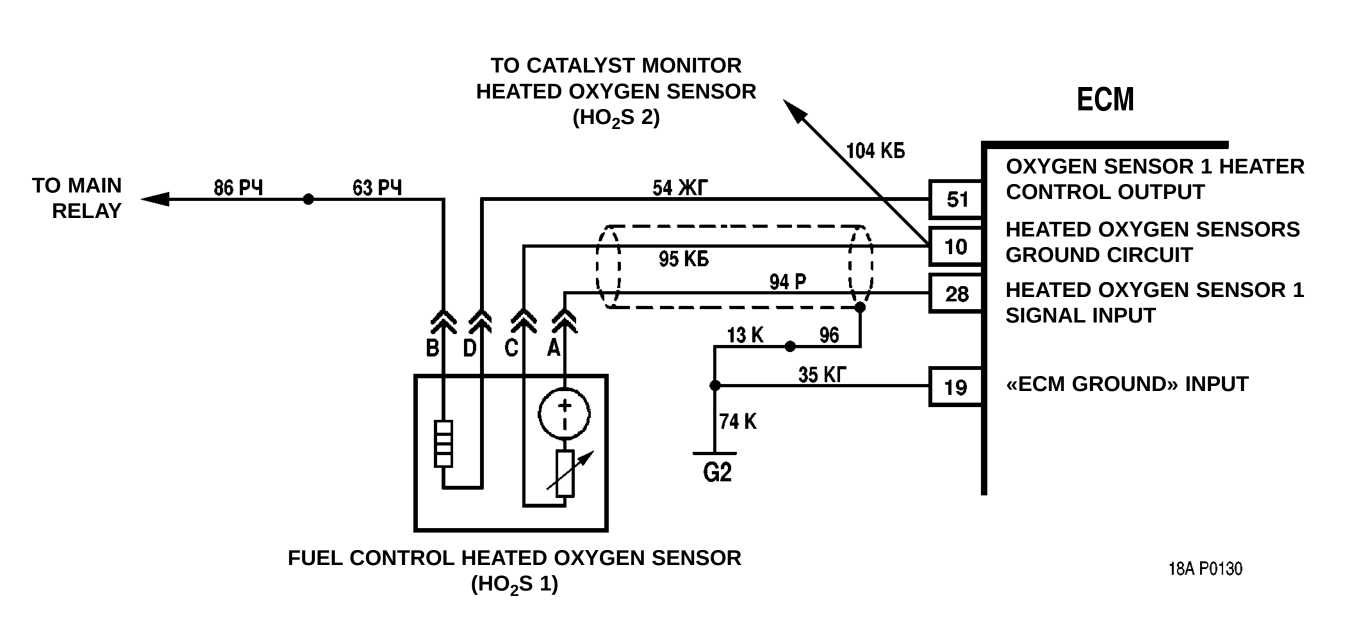
For a warmed up sensor voltage should range from 50 to 900 mV while in the closed loop.

DTC P0130

O2 Sensor 1, Malfunction



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0132

O2 Sensor 1, High Voltage

Conditions for setting DTC P0132:

- engine has been running for more than 5 minutes;

- HO_2S 1 signal USVK above 1.1 volts for 20 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test uses DST-2M to check the HO_2S 1 signal voltage.
2. Checks the sensor signal circuit for a fault.

Diagnostic Aids

An intermittent may be caused by poisoning of the HO_2S 1.

Voltage at the cold oxygen sensor terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 50 to 900 mV while in the closed loop.

DTC P0132

O2 Sensor 1, High Voltage

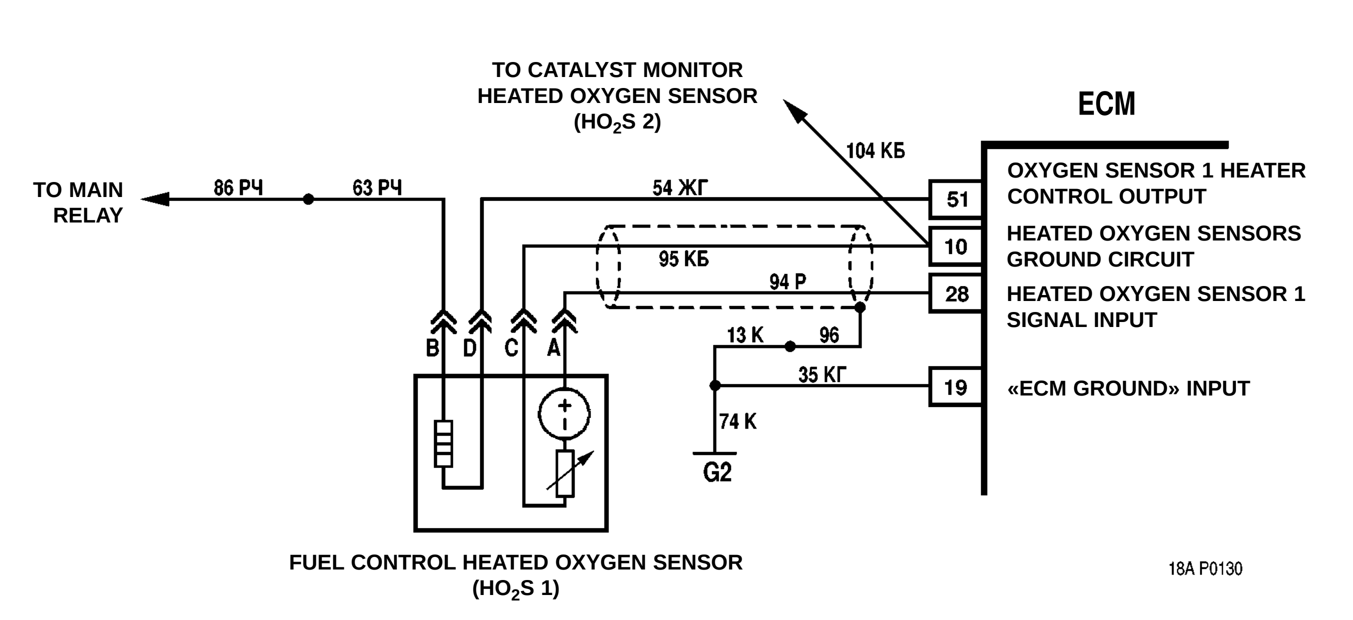
1 Connect DST-2M.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Ignition ON.
DST-2M should display HO_2S 1 voltage above 1.1 volts, does it?

- **Yes** → go to step 2.
- **No** → DTC P0132 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

2 Disconnect the HO_2S 1 harness connector.
DST-2M should display sensor voltage above 1.1 volts, does it?

- **No** → Faulty HO_2S 1.
- **Yes** → 94 pink wire short to voltage or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0133

O2 Sensor 1, Slow Response

Conditions for setting DTC P0133:

- filtered value of the HO_2S 1 signal switch period is more than 2 seconds;

- HO_2S 1 exceeded period counter is above 7;

- no DTC P0102, P0103, P0112, P0113, P0116, P0117, P0118 or P1140 is set;

- fuel delivery is controlled in the HO_2S 1 closed loop mode (B_LR=«YES»);

- the catalyst temperature calculated by the ECM is above 300°C (not displayed by DST-2M);

- engine speed is within 1600...2600 rpm;

- load parameter value (TL) is within 1.64...4 msec;

- more than 10 seconds have passed after the canister purge switch-off.

MIL (CHECK ENGINE light) illuminates two drive cycles in which the tests failed.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks if other faults are present.
2. Checks for a constant fault.
3. Checks if the DTC could have been stored due to a faulty exhaust system or poor connection.
4. Checks the sensor ground circuit for a fault.
5. Checks the sensor signal circuit for a fault.
6. Before replacing the sensor eliminate the possible cause of the problem: contaminated fuel, oil or coolant leakage.

Diagnostic Aids

An intermittent may be caused by a poor connection, misrouted harness, damaged wire insulation, or a wire broken inside the insulation.

Check for the following conditions:

Poor connection at the ECM or the sensor connectors. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving related connectors.

DTC P0133

O2 Sensor 1, Slow Response

1 Connect DST-2M.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Are any other DTCs set?

- Yes → Make necessary repairs for the detected DTCs.
- No → go to step 2.

2 Analyze information associated with DTC P0133.
Start the engine. Clear the DTCs.
Using DST-2M reproduce conditions for setting the DTC.
Does DTC P0133 set?

- No → Refer to «Diagnostic Aids».
- Yes → go to step 3.

3 Stop the engine.
Check the exhaust system. If a leakage is detected repair as necessary.
Check the HO_2S 1 for being firmly installed and intact. Check the HO_2S 1 harness connector for improperly formed or corroded terminals.
Disconnect the HO_2S 1 harness connector.
Using a test light connected to voltage probe terminal «C» of the harness connector.

- No → Wire 95 brown/white open.
- Yes → go to step 4.

4 Jumper terminal «C» of the harness connector to a reliable ground. Ignition ON.
DST-2M should display the HO_2S 1 signal voltage about 450 mV, does it?

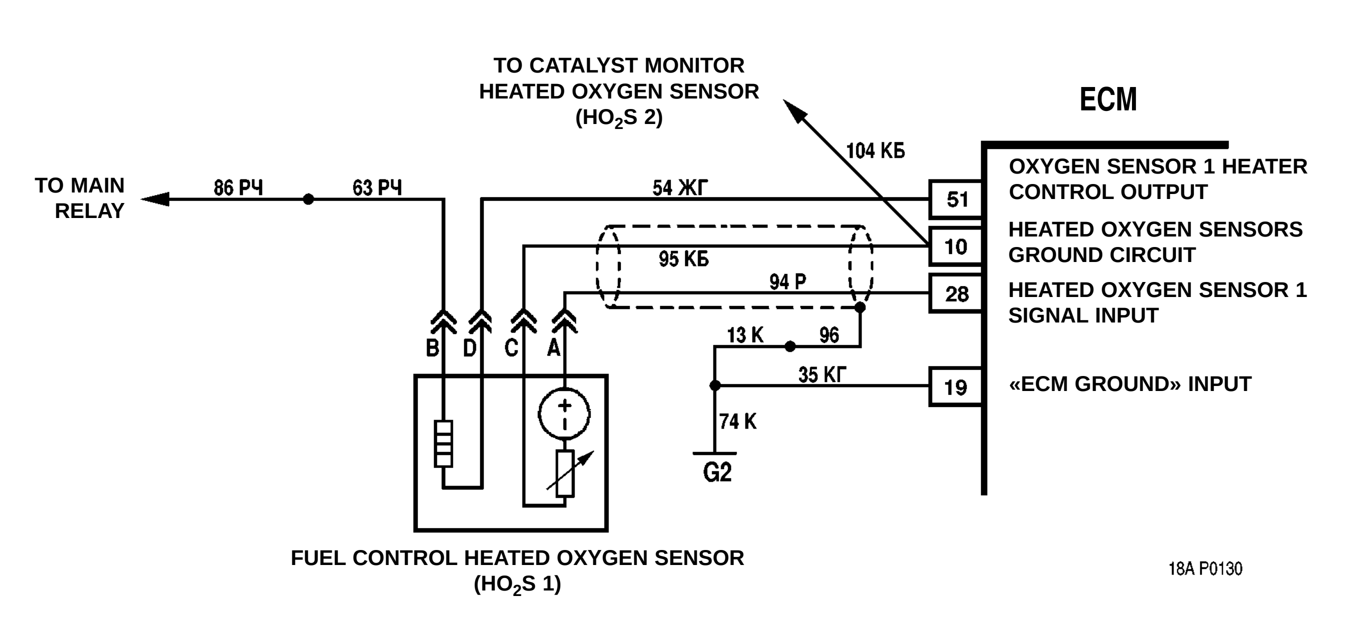
- No → Wire 94 pink short to ground or voltage.
- Yes → go to step 5.

5 Jumper terminals «C» and «A» of the harness connector to a reliable ground.
DST-2M should display HO_2S 1 signal voltage below 150 mV, does it?

- No → Wire 94 pink open or faulty ECM connection.
- Yes → go to step 6.

6 **Faulty** HO_2S 1.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0134

O2 Sensor 1, Circuit Inactive

Conditions for setting DTC P0134:

- engine has been running for more than 75 seconds;

- HO_2S 1 signal USVK remained within 400...580 mV during 5 seconds.

or:

- fuel delivery is off for more than 1 second (B_SA=«YES»)

- HO_2S 1 and HO_2S 2 signals (USVK and USHK respectively) is above 200 mV for 0.5 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. If the voltage reading is within the specified range, the HO_2S 1 is cold or its signal circuit is faulty.
2. Checks the sensor signal circuit for a fault by measuring voltage between terminal «A» of the harness connector and ground.
3. Checks the HO_2S 1 for a fault.

Diagnostic Aids

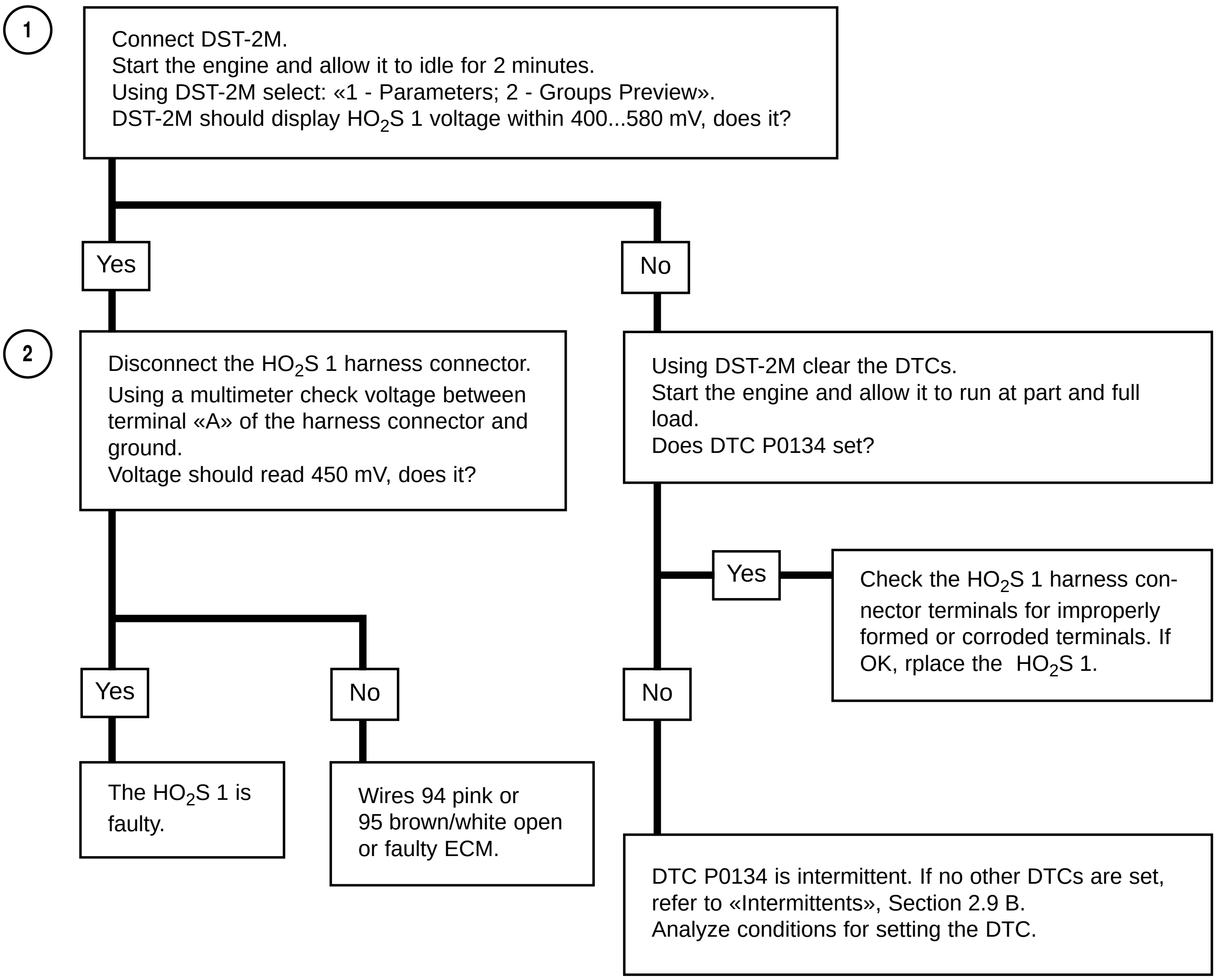
Voltage at the cold oxygen sensor terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 50 to 900 mV while in the closed loop.

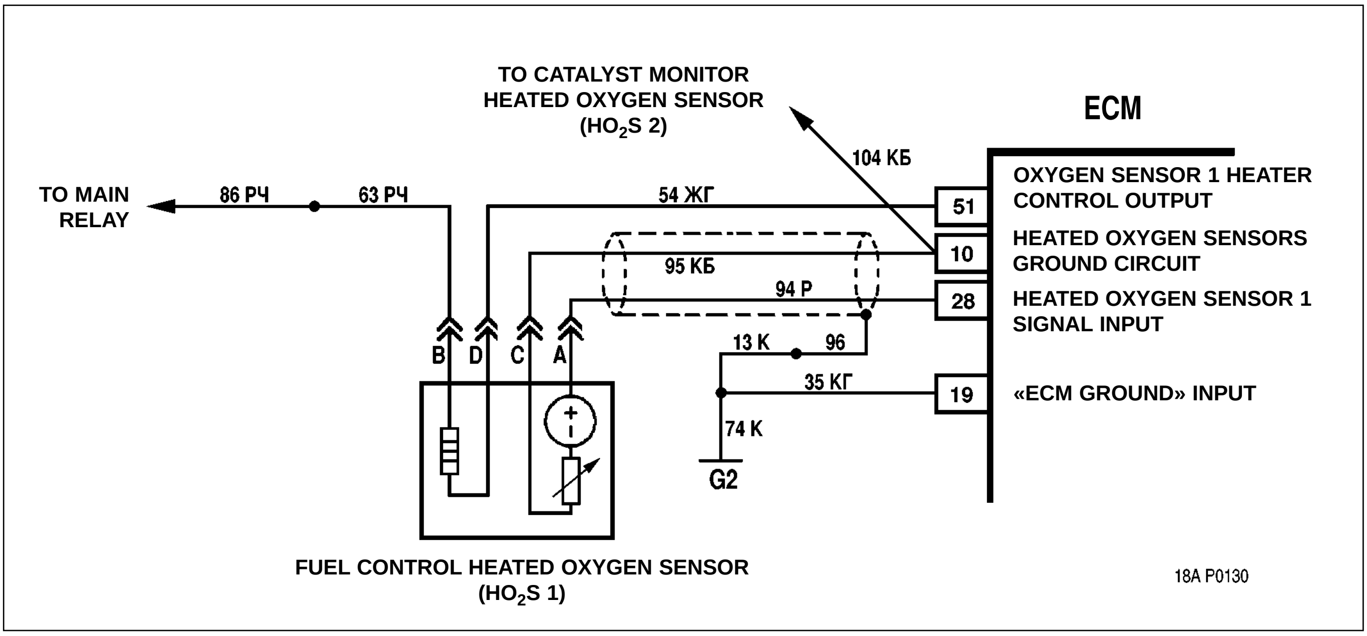
Setting of DTC P0134 1.5 minutes after the engine start-up (engine idling) could be caused by low power of the HO_2S 1 heater.

DTC P0134

O2 Sensor 1, Circuit Inactive



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0135

O2 Sensor 1, Heater Malfunction

Conditions for setting DTC P0135:

- engine is running;

- the ECM calculated temperature of the catalyst is above threshold;

- the ECM calculated resistance of the HO_2S 1 heater is above threshold.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

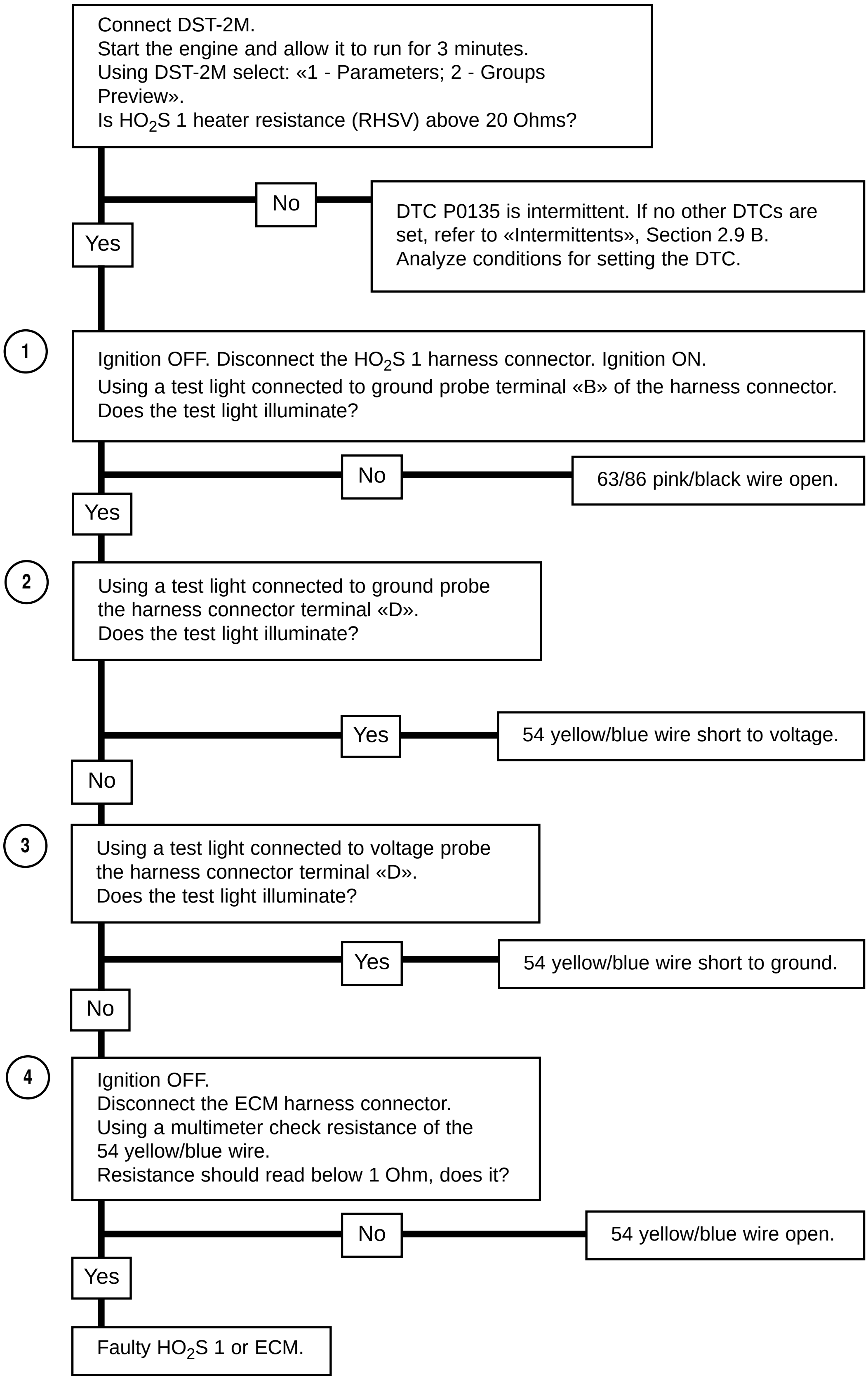
Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

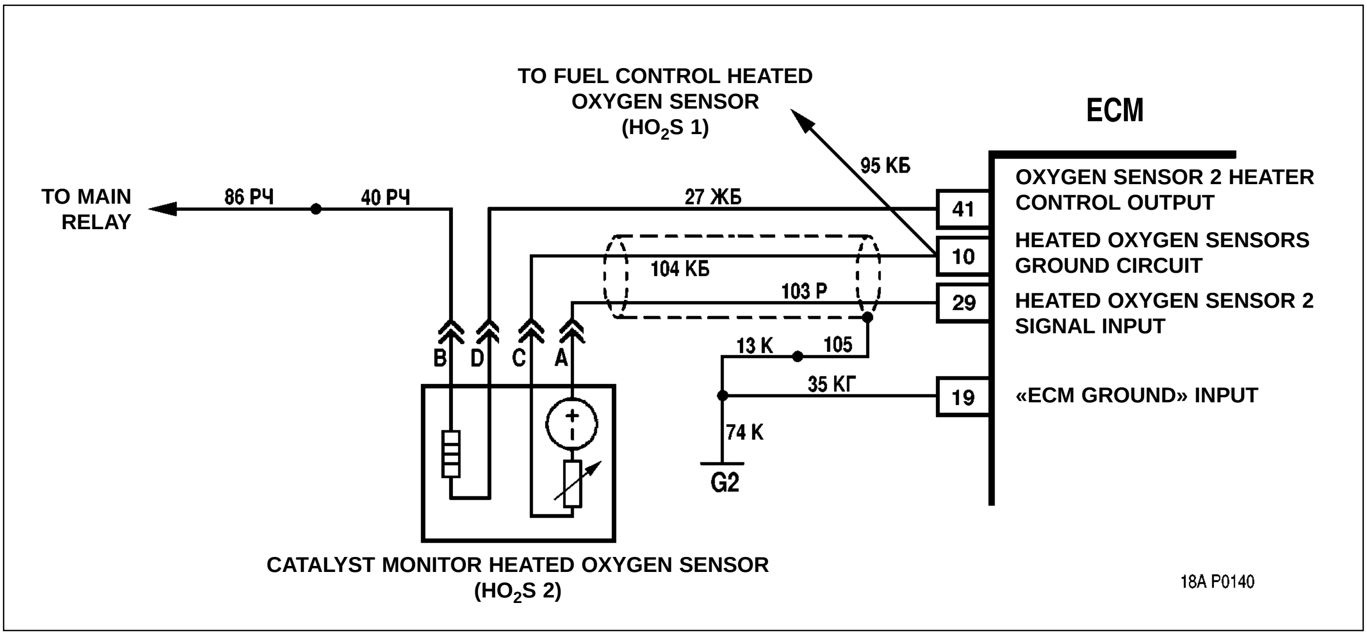
1. This test uses a test light connected to ground to check the HO_2S 1 heater power circuit for a fault.
2. This test uses a test light connected to ground to check the HO_2S 1 heater control circuit for a fault.
3. This test uses a test light connected to voltage to check the HO_2S 1 heater control circuit for a fault.
4. This test uses a multimeter to check the 54 yellow/blue wire for open.

DTC P0135

O2 Sensor 1, Heater Malfunction



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0136

O2 Sensor 2, Malfunction

Conditions for setting DTC P0136:

- system has been running in the HO_2S 2 closed loop mode (B_LRHK) more than 85 seconds;

- the HO_2S 2 signal voltage (USHK) is below 39.9 mV;

- the HO_2S 2 heater has been running continuously for 75 seconds;

- no DTC P0443, P1410, P1425 or P1426 is set.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for one of the possible causes of the fault – HO_2S 2 signal voltage is too low.
2. Checks for a constant fault.
3. Checks the sensor for a fault.

Diagnostic Aids

Voltage at the cold HO_2S 2 terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 590 to 750 mV while in the closed loop at part load with substantial catalyst efficiency.

An intermittent may be caused by the following conditions:

Misrouted harness. Inspect the sensor harness to ensure that it does not contact the exhaust system components.

Fuel System Too Lean. Perform diagnosis using the Fuel System Diagnosis Chart A-6.

DTC P0136

O2 Sensor 2, Malfunction

1

Connect DST-2M.
Start the engine and allow it to idle for 5 minutes.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
If the fault is present, DST-2M should display the HO_2S 2 signal voltage below 40 mV, does it?

- No → 2
- Yes → 3

2

read and record additional information for DTC P0136.
Clear the DTCs.
Using DST-2M reproduce conditions for setting the DTC.
Does DTC P0136 set?

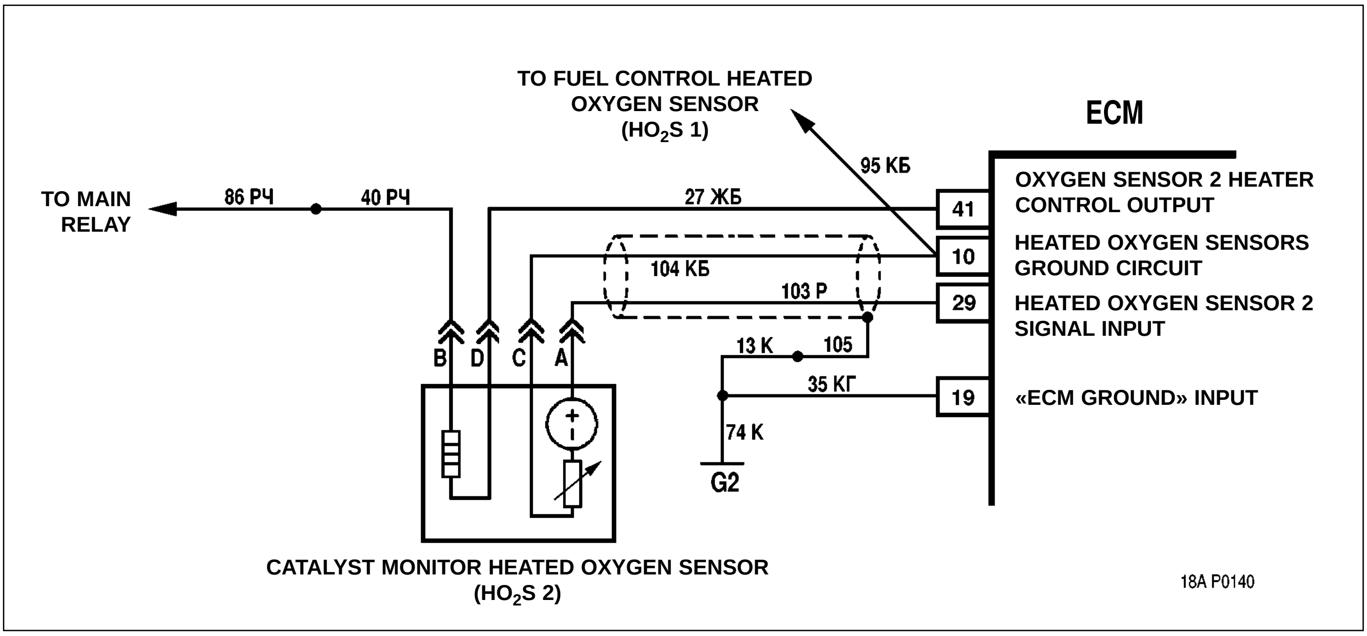
- Yes → 3
- No → DTC P0136 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».

3

Stop the engine.
Disconnect the HO_2S 2 harness connector.
Jumper connector terminal «C» to reliable ground.
Ignition ON.
DST-2M should indicate the HO_2S 2 signal about 450 mV, does it?

- Yes → The HO_2S 2 is faulty.
- No → Wire 103 pink short to ground or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0137

O2 Sensor 2, Low Voltage

Conditions for setting DTC P0137:

- the MAF value is above 50 kg/h;

- the HO_2S 2 signal voltage (USHK) is below 394 mV for 30 seconds;

- the HO_2S 2 heater has been running continuously for 75 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for one of the possible causes of the fault – HO_2S 2 signal voltage is too low.
2. Checks for a constant fault.
3. Checks the sensor for a fault.

Diagnostic Aids

Voltage at the cold HO_2S 2 terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 590 to 750 mV while in the closed loop at part load with substantial catalyst efficiency.

An intermittent may be caused by the following conditions:

Poor connection at the HO_2S 2 and the ECM connectors. Inspect the HO_2S 2 and the ECM harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it does not contact the exhaust system components.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

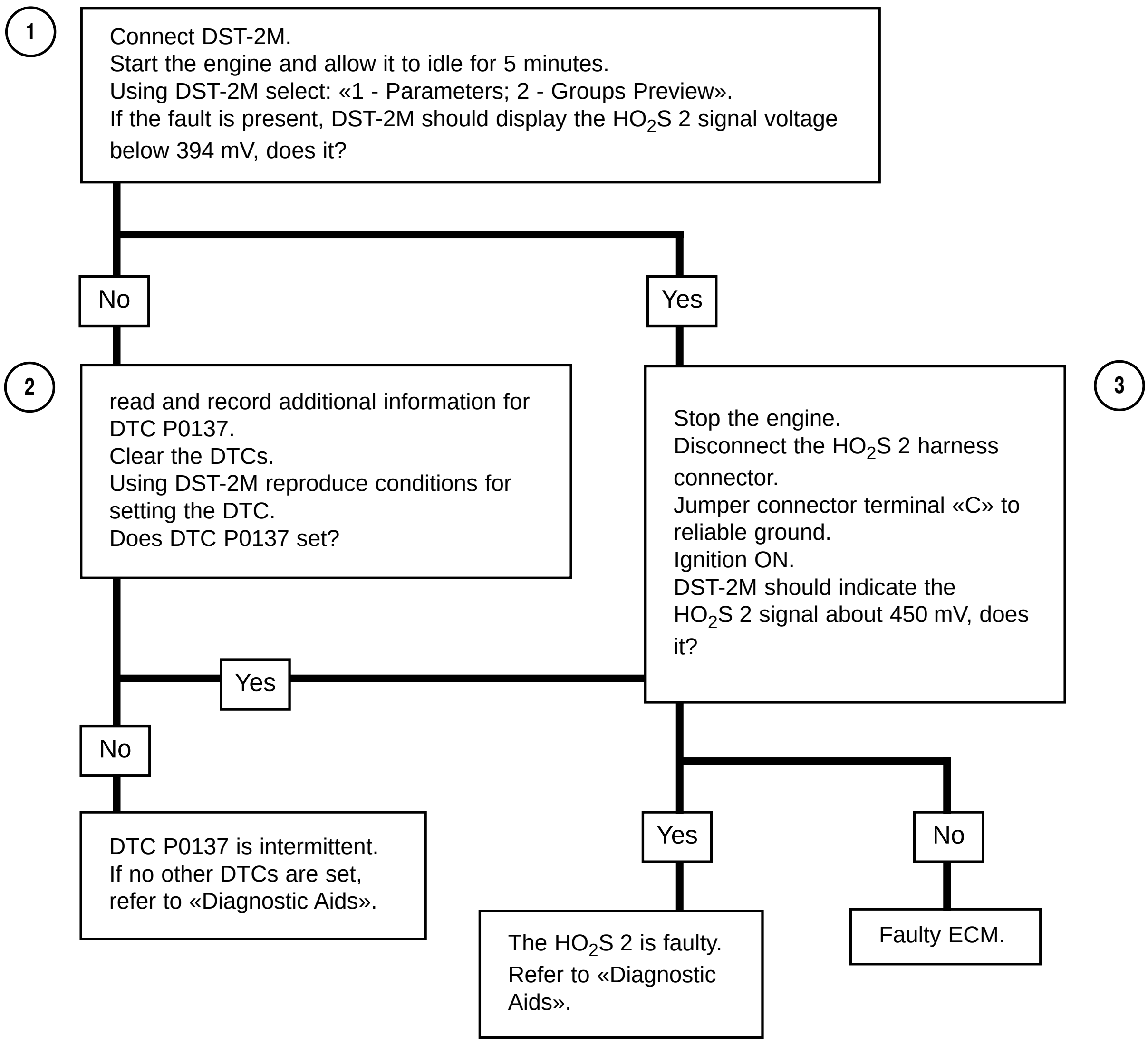
Poor ECM ground connection. Check the ECM ground connections at the cylinder block for being tight and clean (fig. 2.6-01).

Fuel System Too Lean. Perform diagnosis using the Fuel System Diagnosis Chart A-6.

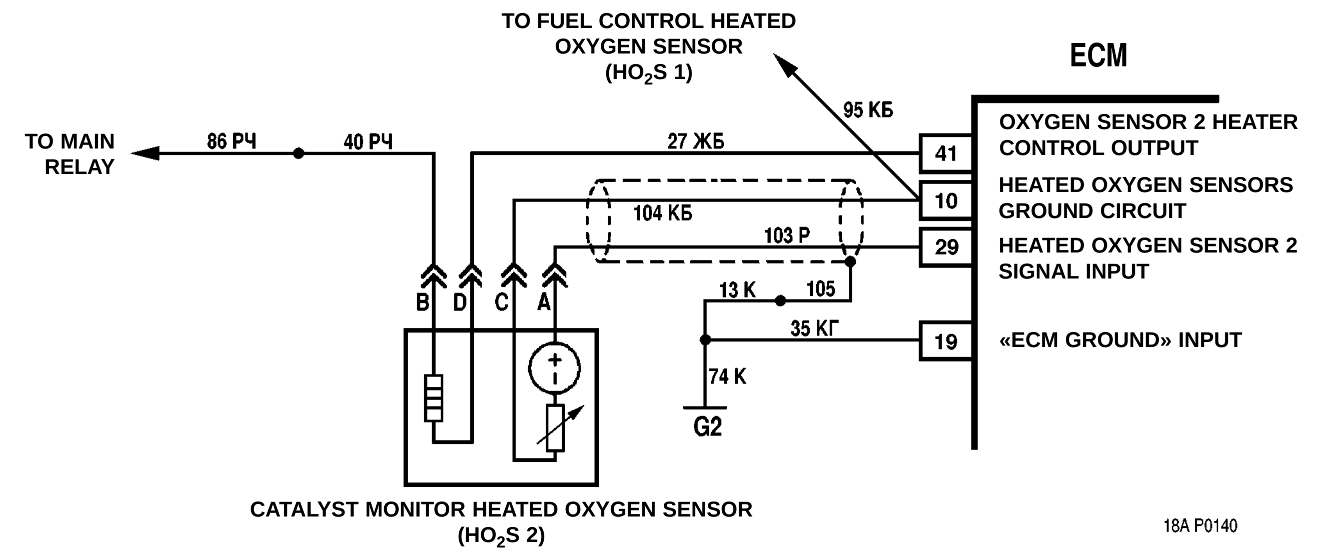
Leaking exhaust system. This fault may cause ambient air to come into the exhaust system, in which case the HO_2S 2 will detect excessive oxygen content in the exhaust. Ensure there are no leakages in the exhaust system.

DTC P0137

O2 Sensor 2, Low Voltage



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0138

O2 Sensor 2, High Voltage

Conditions for setting DTC P0138:

- the HO_2S 2 signal voltage (USHK) is above 1.1 volts for 20 seconds;

- the HO_2S 2 heater has been running continuously for 75 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for one of the possible causes of the fault – HO_2S 2 signal voltage is too low.
2. Checks for a constant fault.
3. Checks the sensor for a fault.

Diagnostic Aids

Voltage at the cold HO_2S 2 terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 590 to 750 mV while in the closed loop at part load with substantial catalyst efficiency.

An intermittent may be caused by the following conditions:

Misrouted harness. Inspect the sensor harness to ensure that it does not contact the exhaust system components.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Silicone contamination. Check the HO_2S 2 sensitive tip for white powdery deposits.

DTC P0138

O2 Sensor 2, High Voltage

1

Connect DST-2M.
Start the engine and allow it to idle for 5 minutes.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
If the fault is present, DST-2M should display the HO_2S 2 signal voltage above 1.1 volts, does it?

No → 2
Yes → 3

2

read and record additional information for DTC P0138.
Clear the DTCs.
Using DST-2M reproduce conditions for setting the DTC.
Does DTC P0138 set?

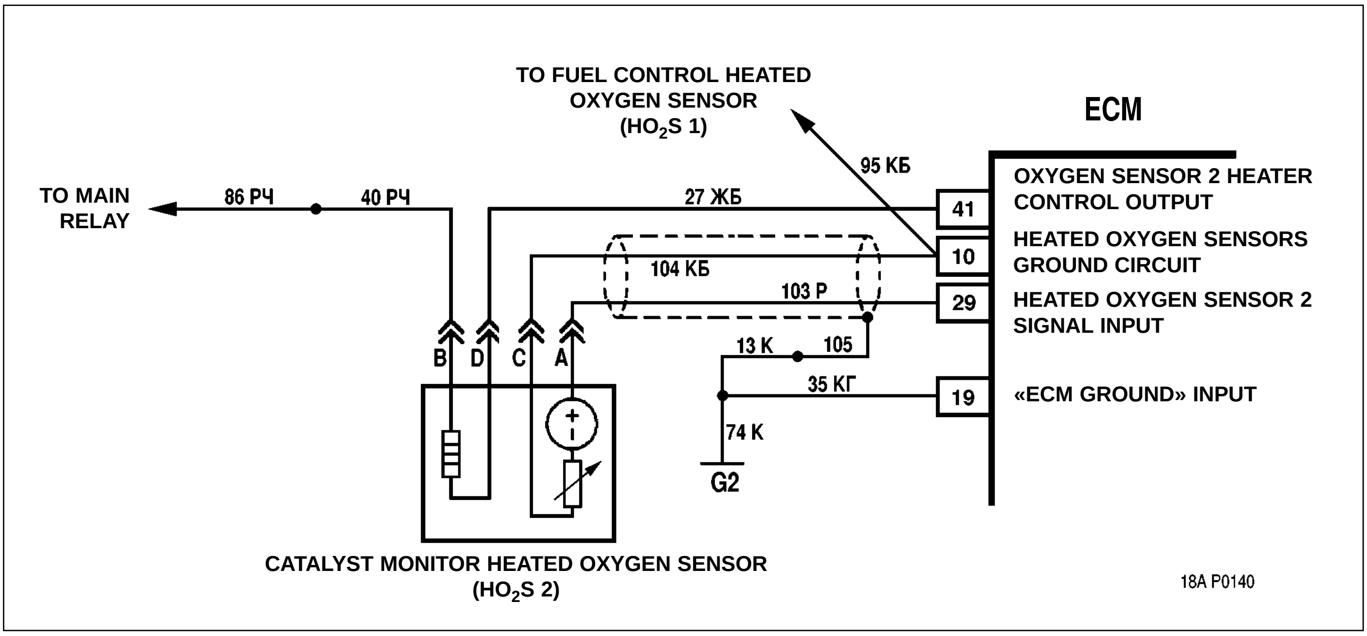
Yes → 3
No → DTC P0138 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».

3

Stop the engine.
Disconnect the HO_2S 2 harness connector.
Jumper connector terminal «C» to reliable ground.
Ignition ON.
DST-2M should indicate the HO_2S 2 signal about 450 mV, does it?

Yes → The HO_2S 2 is faulty. Refer to «Diagnostic Aids».
No → Wire 103 pink short to voltage, wire 104 brown/white open or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0140

O2 Sensor 2, Circuit Inactive

Conditions for setting DTC P0140:

- the engine has been running for more than 300 seconds;

- the HO_2S 2 signal voltage (USHK) is within 399...501 mV;

- the HO_2S 2 heater has been running continuously for 75 seconds;

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for one of the possible causes of the fault – HO_2S 2 signal voltage is too low.
2. Checks for a constant fault.
3. Checks the sensor for a fault.

Diagnostic Aids

Voltage at the cold HO_2S 2 terminal «A» should be 450 mV.

For a warmed up sensor voltage should range from 590 to 750 mV while in the closed loop at part load with substantial catalyst efficiency.

An intermittent may be caused by the following conditions:

Poor connection at the HO_2S 2 and the ECM connectors. Inspect the HO_2S 2 and the ECM harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

HO_2S 2 heater low power. Results of the following check may be used as indirect indication of the fault: allow the engine to idle while monitoring USHK (HO_2S 2 output voltage) and RHSH (HO_2S 2 heater resistance) values. A typical value of RHSH for a warmed-up sensor is 11 Ohms. If the resistance is in excess of this value and is within 15...20 Ohms and DTC P0140 is set (which should become inactive after awhile, indicating that electrical circuits are OK) than it is very likely that the HO_2S 2 heater lacks power.

DTC P0140

O2 Sensor 2, Circuit Inactive

1

Connect DST-2M.
Start the engine and allow it to idle for 5 minutes.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
DST-2M should display the HO_2S 2 signal voltage within 399...501 volts, does it?

- No → 2
- Yes → 3

2

read and record additional information for DTC P0140.
Clear the DTCs.
Using DST-2M reproduce conditions for setting the DTC.
Does DTC P0140 set?

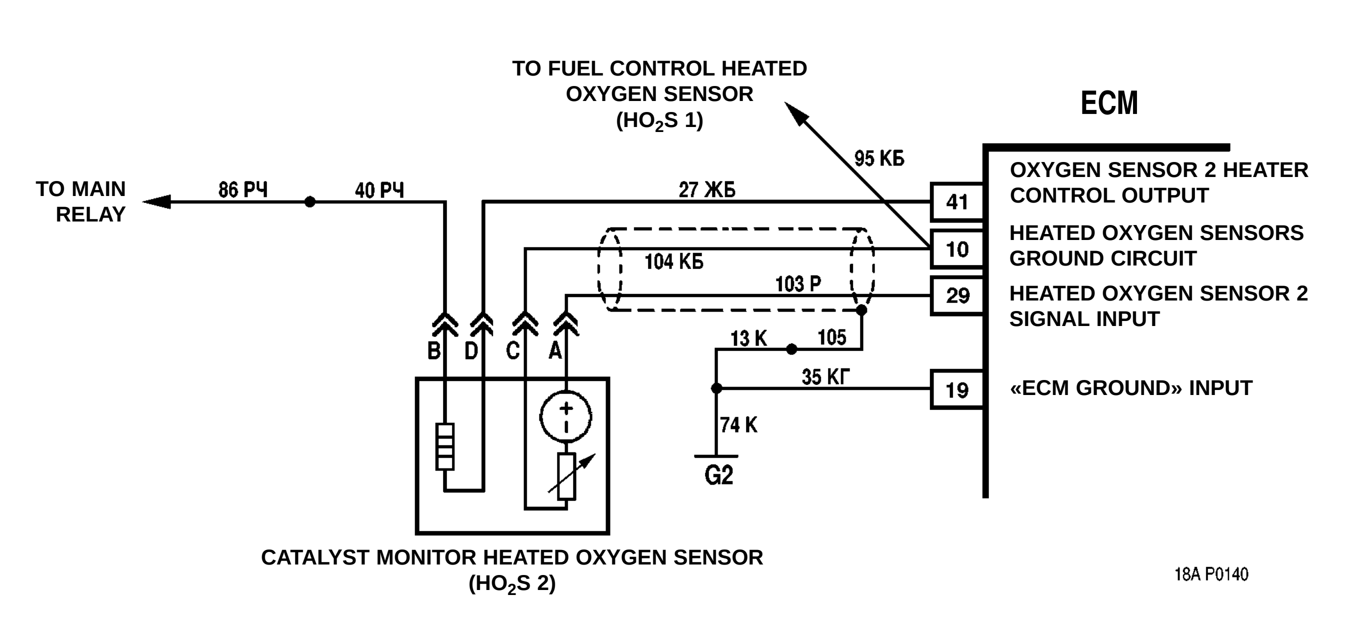
- Yes → 3
- No → DTC P0140 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».

3

Stop the engine.
Disconnect the HO_2S 2 harness connector.
Jumper connector terminals «C» and «A» to reliable ground.
Ignition ON.
DST-2M should indicate the HO_2S 2 signal below 150 mV, does it?

- Yes → The HO_2S 2 is faulty. Refer to «Diagnostic Aids».
- No → Wire 103 pink or 104 brown/white wire open or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0141

O2 Sensor 2, Heater Malfunction

Conditions for setting DTC P0141:

- engine is running;

- the ECM calculated temperature of the catalyst is above threshold;

- the ECM calculated resistance of the HO_2S 2 heater is above threshold.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test uses a test light connected to ground to check the HO_2S 2 heater power circuit for a fault.
2. This test uses a test light connected to ground to check the HO_2S 2 heater control circuit for a fault.
3. This test uses a test light connected to voltage to check the HO_2S 2 heater control circuit for a fault.
4. This test uses a multimeter to check the 27 yellow/white wire for open.

DTC P0141

O2 Sensor 1, Heater Malfunction

Connect DST-2M.
Start the engine and allow it to run for 10 minutes.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Is HO_2S 2 heater resistance (RHSH) above 20 Ohms?

- **No** → DTC P0141 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.
- **Yes** → go to step 1.

1 Ignition OFF. Disconnect the HO_2S 2 harness connector. Ignition ON.
Using a test light connected to ground probe terminal «B» of the harness connector.
Does the test light illuminate?

- **No** → 40/86 pink/black wire open.
- **Yes** → go to step 2.

2 Using a test light connected to ground probe the harness connector terminal «D».
Does the test light illuminate?

- **Yes** → 27 yellow/white wire short to voltage.
- **No** → go to step 3.

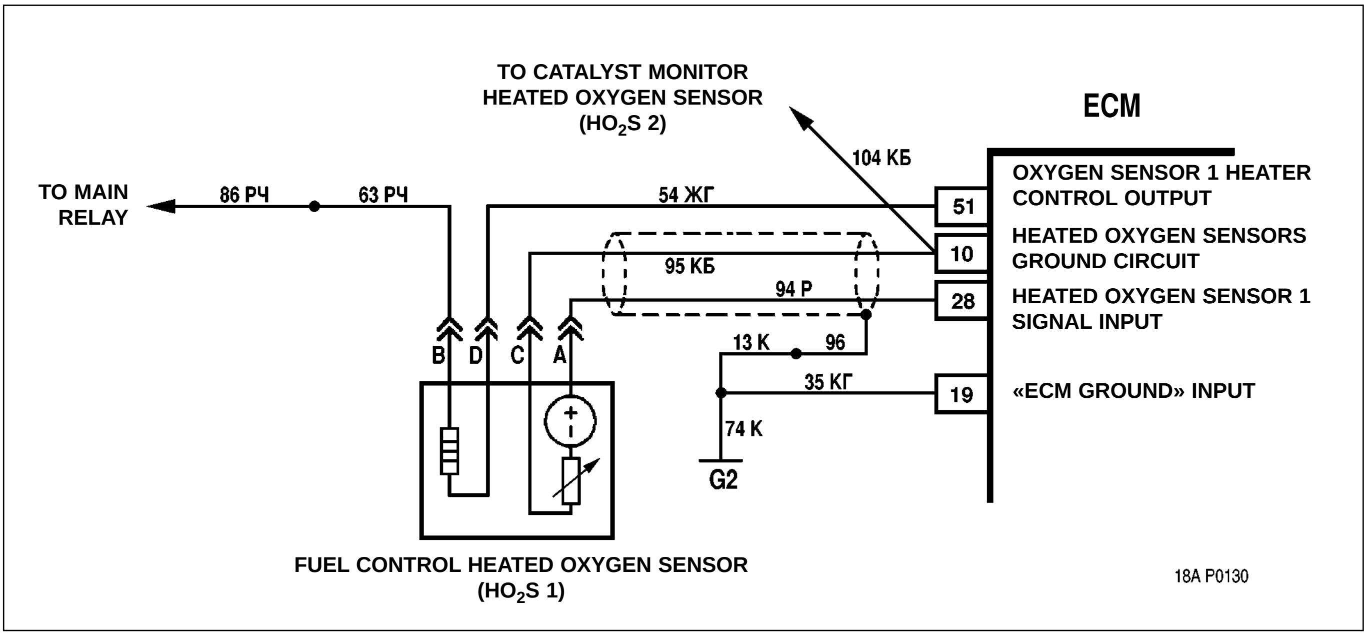
3 Using a test light connected to voltage probe the harness connector terminal «D».
Does the test light illuminate?

- **Yes** → 27 yellow/white wire short to ground.
- **No** → go to step 4.

4 Ignition OFF.
Disconnect the ECM harness connector.
Using a multimeter check resistance of the 27 yellow/white wire.
Resistance should read below 1 Ohm, does it?

- **No** → 27 yellow/white wire open.
- **Yes** → Faulty HO_2S 2 or ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0171

System Too Lean

Conditions for setting DTC P0171:

- engine is running;

- fuel delivery is controlled in the HO_2S 1 closed loop mode (B_LR=«YES»);

- the adaptive learning correction is active (B_LRA=«YES»);

- TRA, DTV or FRA values are above the upper threshold (above 0.45 for TRA and DTV, and above 1.225 for FRA).

MIL (CHECK ENGINE light) illuminates two drive cycles in which the tests failed.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test is used to analyze diagnostic information.
2. This test uses DST-2M to reproduce conditions for setting the DTC with the engine running.
3. This test checks components and subsystems for a fault which may set the DTC.
4. While repeating test #2 after the possible cause of the fault has been eliminated the FR reading should remain within 1±0.1.

Diagnostic Aids

An intermittent may be caused by the following conditions:

Poor connection at the HO_2S and the ECM connectors. Inspect the HO_2S and the ECM harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it does not contact the exhaust system components.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Poor ECM ground connection. Check the ECM ground connections at the cylinder block for being tight and clean (fig. 2.6-01).

HO_2S 1 poisoning.

DTC P0171

System Too Lean

1 Connect DST-2M.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation». Check for other DTCs. If any other DTC is set, refer to the relevant chart.
read and record additional information for DTC P0171.
Select: «1 - Parameters; 2 - Groups Preview». Compare TRA, FRA and DTV readings with the values in table 2.4-01.

2 Using DST-2M select: «5 - Misc. Tests; 1 - ECU First Init Reset». Reset the ECM.
Start the engine. Use DST-2M to reproduce conditions for setting DTC P0171.
Does DST-2M indicate FR above 1.2?

No → DTC P0171 is intermittent. Refer to «Diagnostic Aids».

Yes →

3 Stop the engine and check for the following:
- fuel for water or other contaminants;
- throttle valve for damage;
- all vacuum hoses for improper connection, damage or cracks.
Was the problem found?

Yes → After eliminating the fault repeat test #2. 4

No →

3 Disconnect the MAF sensor harness connector.
Repeat test #2.
Has the FR reading changed?

Yes → Replace the MAF sensor and repeat test #2. 4

No →

3 Check fuel pressure using Chart A-6.
Check injector balance using Chart C-3.
Was a problem found?

Yes → After eliminating the fault repeat test #2. 4

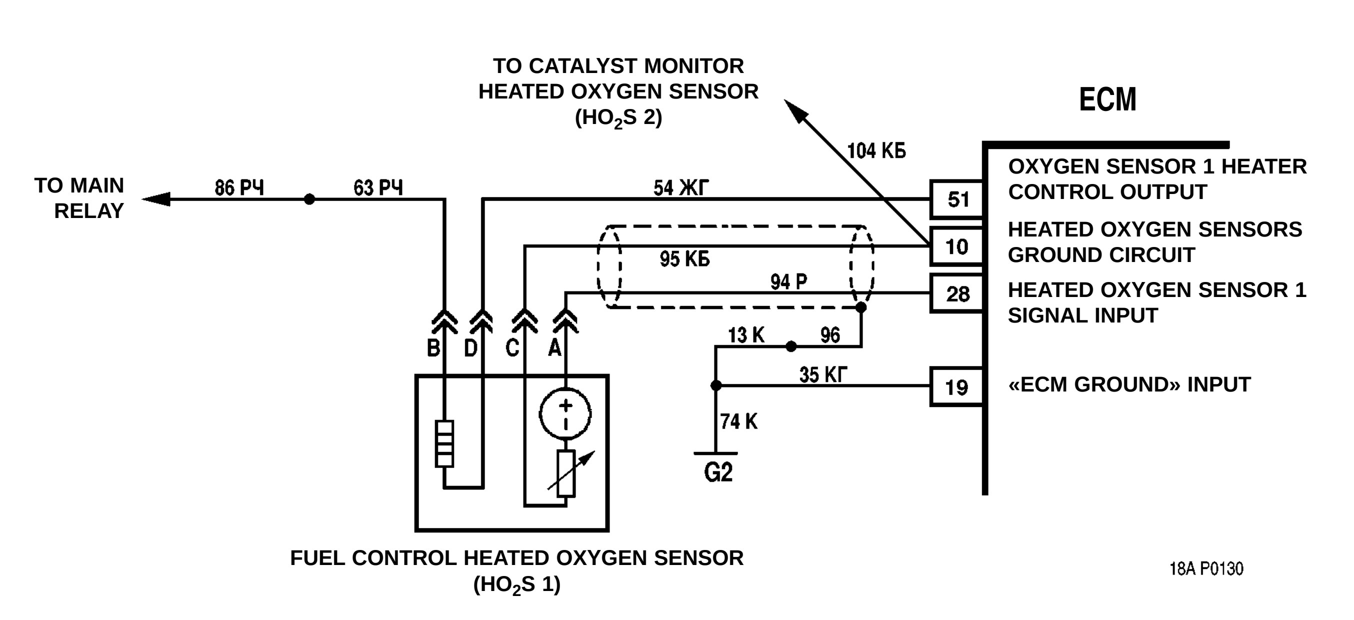
No →

3 Check the exhaust system for leakage.
Was a problem found?

Yes → After eliminating the fault repeat test #2. 4

No → Replace the HO_2S 1.
After replacement repeat test #2.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0172

System Too Rich

Conditions for setting DTC P0172:

- engine is running;

- fuel delivery is controlled in the HO_2S 1 closed loop mode (B_LR=«YES»);

- the adaptive learning correction is active (B_LRA=«YES»);

- TRA, DTV or FRA values are below the lower threshold (below -0.45 for TRA and DTV, and below 0.775 for FRA).

MIL (CHECK ENGINE light) illuminates two drive cycles in which the tests failed.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test is used to analyze diagnostic information.

2. This test uses DST-2M to reproduce conditions for setting the DTC with the engine running.

3. This test checks components and subsystems for a fault which may set the DTC.

4. While repeating test #2 after the possible cause of the fault has been eliminated the FR reading should remain within 1±0.1.

Diagnostic Aids

An intermittent may be caused by the following conditions:

Poor connection at the HO_2S and the ECM connectors. Inspect the HO_2S and the ECM harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it does not contact the exhaust system components.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Poor ECM ground connection. Check the ECM ground connections at the cylinder block for being tight and clean (fig. 2.6-01).

HO_2S 1 poisoning.

DTC P0172

System Too Rich

1 Connect DST-2M.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation». Check for other DTCs. If any other DTC is set, refer to the relevant chart.
read and record additional information for DTC P0172.
Select: «1 - Parameters; 2 - Groups Preview». Compare TRA, FRA and DTV readings with the values in table 2.4-01.

2 Using DST-2M select: «5 - Misc. Tests; 1 - ECU First Init Reset». Reset the ECM.
Start the engine. Use DST-2M to reproduce conditions for setting DTC P0172.
Does DST-2M indicate FR below 0.8?

- No → DTC P0172 is intermittent. Refer to «Diagnostic Aids».
- Yes ↓

3 Stop the engine and check for the following:
- air cleaner filter element for clogging;
- air intake pipe and throttle for restriction;

Was the problem found?

- Yes → **4** After eliminating the fault repeat test #2.
- No ↓

3 Start the engine and allow it to idle. Use DST-2M to compare readings for N10, ML, MOMPOS, TL, FR, QREG and QADP with the values from table 2.4-01.
Were any mismatches found?

- Yes → **4** Perform test using Chart C-4.
After eliminating the fault repeat test #2.
- No ↓

3 Disconnect the vacuum hose from the fuel pressure regulator. Check the hose for fuel.
Was the fuel found?

- Yes → **4** Replace the fuel pressure regulator.
- No ↓

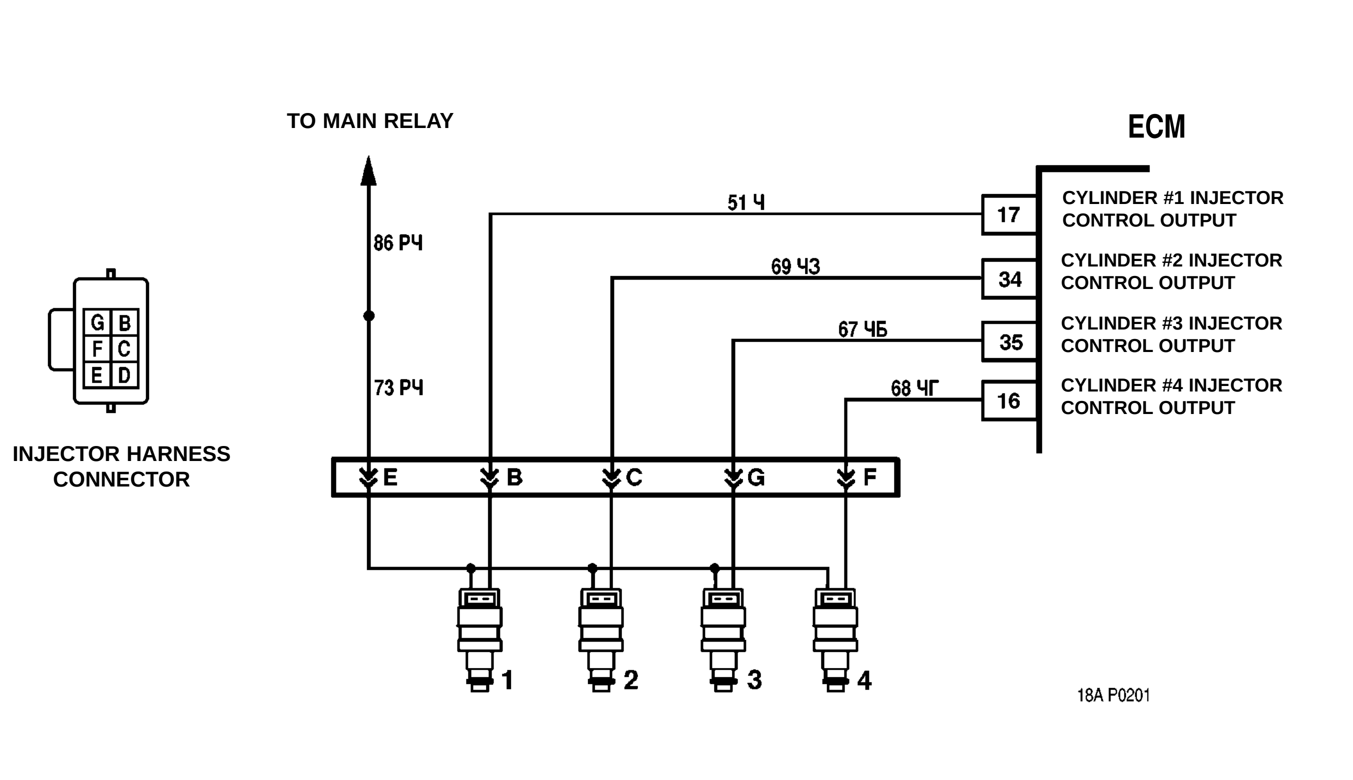
3 Disconnect the MAF sensor harness connector.
Repeat test #2.
Has the FR reading changed?

- Yes → **4** Replace the MAF sensor and repeat test #2.
- No ↓

3 Check fuel pressure using Chart A-6.
Check injector balance using Chart C-3.
Was a problem found?

- Yes → **4** After eliminating the fault repeat test #2.
- No → Replace the HO_2S 1.
After replacement repeat test #2.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0201 (P0202, P0203, P0204)

Injector Circuit Malfunction, Cylinder 1 (2, 3, 4)

Conditions for setting DTC P0201 (P0202, P0203, P0204):

- engine is running;

- injector driver self diagnostic has detected no load condition at one or several terminals.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks resistance between injector harness connector terminals.
2. Checks resistance of the circuit between the ECM connector and the injector harness connector.
3. Checks injector resistance for the faulty cylinder.

Diagnostic Aids

The ECM MP7.0H features injector driver, which has a self diagnostic function. It can detect such problems as injector control circuit open and short to ground or voltage.

DTC P0201 (P0202, P0203, P0204)

Injector Circuit Malfunction, Cylinder 1 (2, 3, 4)

Connect DST-2M.
Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes →

1 Stop the engine.
Disconnect the injector harness connector.
Using a multimeter check resistance between injector harness connector terminals «E» and «B» («C», «G», «F»).
Resistance should read within 11...15 Ohms, does it?

No →

DTC P0201 (P0202, P0203, P0204) is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

1 – Yes →

2 Disconnect the ECM harness connector.
Using a multimeter check injector control circuit resistance between the ECM harness connector and the injector harness connector for the faulty cylinder.
Resistance should read below 1 Ohm, does it?

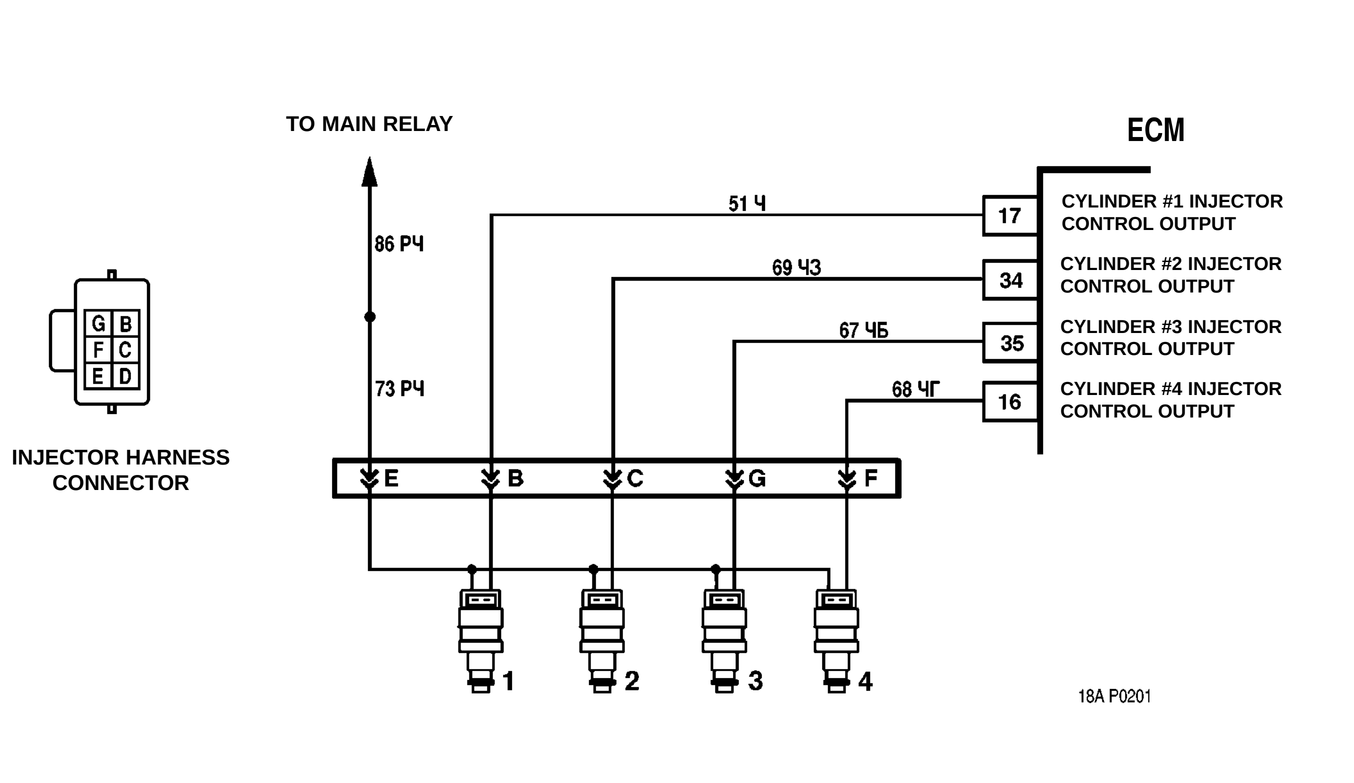
- **No** → Wire open between the injector harness connector and the ECM harness connector.
- **Yes** → Poor connection or faulty ECM.

1 – No →

3 Disconnect wiring from the faulty cylinder injector.
Using a multimeter check the injector resistance.
Resistance should read within 11...15 Ohms, does it?

- **No** → Faulty injector.
- **Yes** → Wire open in the injector harness or poor connection.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0261 (P0264, P0267, P0270)

Injector Cylinder 1 (2, 3, 4), Circuit Low

Conditions for setting DTC P0261 (P0264, P0267, P0270):

- engine is running;

- injector driver self diagnostic has detected one or several terminals shorted to ground.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks resistance between injector control circuit and ground with injector harness connector disconnected. This helps to detect short circuit in the injector harness.

2. If harness is OK, DTC setting may be caused by either an ECM internal fault or injector control circuit short to ground (51 black, 67 black/white, 68 black/blue or 69 black/green wires).

Diagnostic Aids

The ECM MP7.0H features injector driver, which has a self diagnostic function. It can detect such problems as injector control circuit open and short to ground or voltage.

DTC P0261 (P0264, P0267, P0270)

Injector Cylinder 1 (2, 3, 4), Circuit Low

Connect DST-2M.
Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes → go to step 1.

No → DTC P0261 (P0264, P0267, P0270) is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

1 Stop the engine.
Disconnect the injector harness connector.
Using a multimeter check resistance between injector control circuit for the faulty cylinder (51 black, 67 black/white, 68 black/blue or 69 black/green) and ground.
Resistance should read above 1 MOhm, does it?

No → go to step 2.

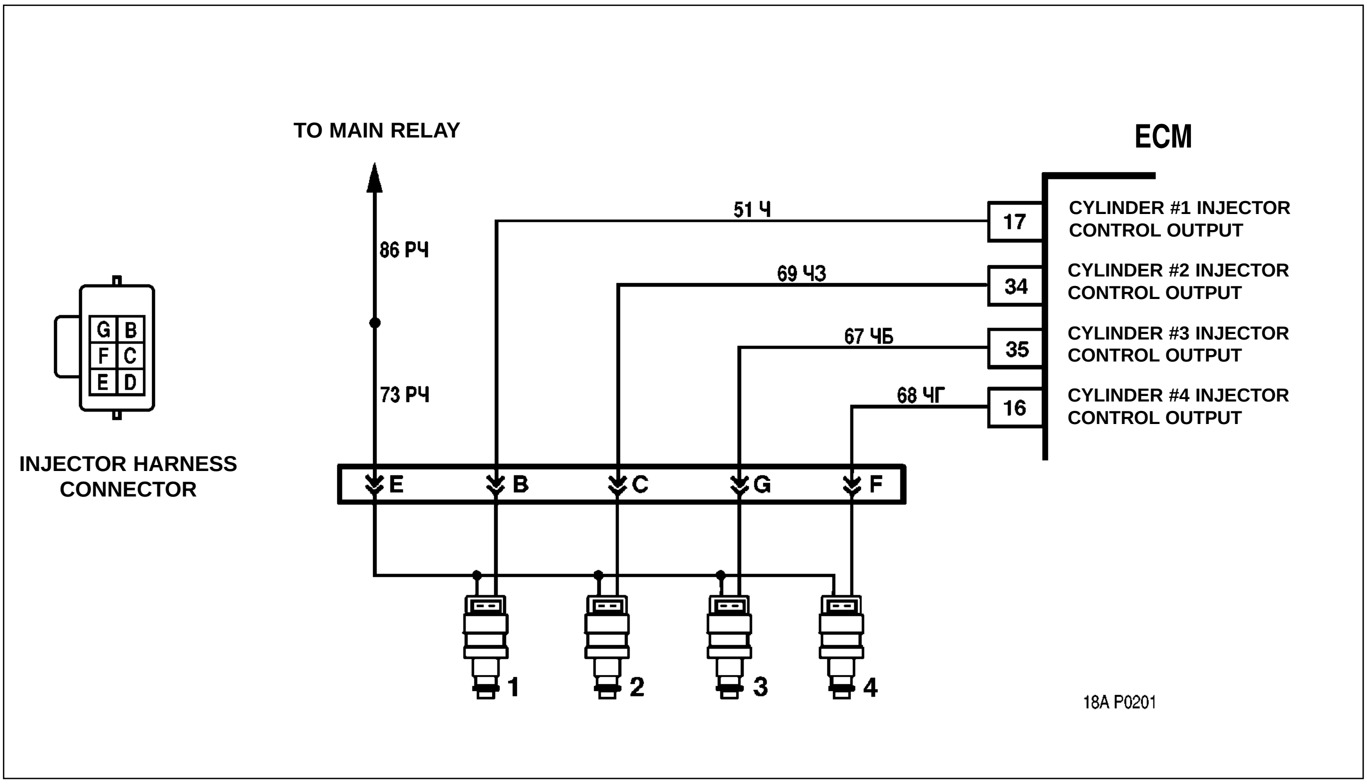
Yes → Short circuit in the injector harness.

2 Disconnect the ECM harness connector.
Using a multimeter check resistance between injector control circuit for the faulty cylinder (51 black, 67 black/white, 68 black/blue or 69 black/green) and ground.
Resistance should read above 1 MOhm, does it?

Yes → Faulty ECM.

No → Injector control circuit short to ground.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0262 (P0265, P0268, P0271)

Injector Cylinder 1 (2, 3, 4), Circuit High

Conditions for setting DTC P0262 (P0265, P0268, P0271):

- engine is running;

- injector driver self diagnostic has detected one or several terminals shorted to voltage.

MIL (CHECK ENGINE light) illuminates immediately after a constant fault has been detected.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks resistance of the circuit between the ECM harness connector and the injector harness connector.

Diagnostic Aids

The ECM MP7.0H features injector driver, which has a self diagnostic function. It can detect such problems as injector control circuit open and short to ground or voltage.

DTC P0262 (P0265, P0268, P0271)

Injector Cylinder 1 (2, 3, 4), Circuit High

Connect DST-2M.
Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

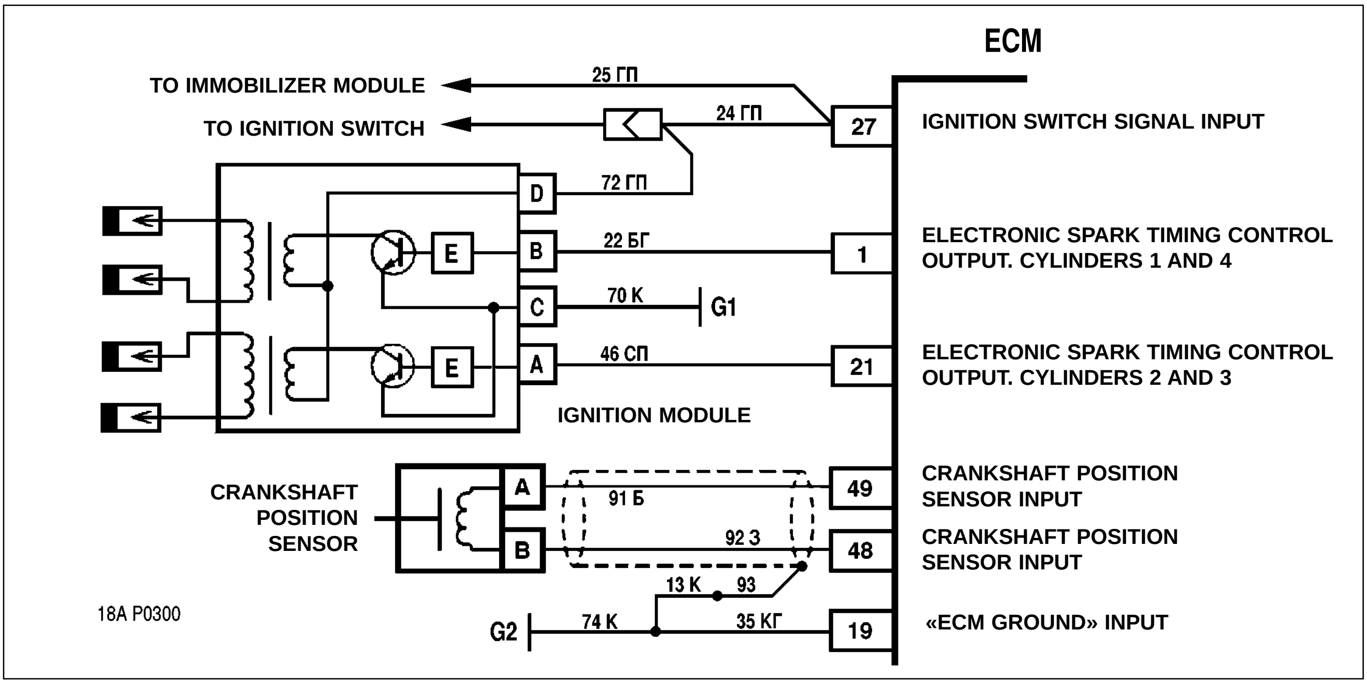
Yes →

1. Stop the engine.
Disconnect the injector harness connector.
Ignition ON.
Using a test light connected to ground check the injector control circuit for the faulty cylinder.
Does the test light illuminate?

- **Yes** → Injector control circuit short to voltage.
- **No** → Faulty injector or injector harness.

No → DTC P0262 (P0265, P0268, P0271) is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0300

Random/Multiple Misfire Detected

DTC P0301 (P0302, P0303, P0304)

Cylinder 1 (2, 3, 4) Misfire Detected

Conditions for setting DTCs P0300 and P0301 (P0302, P0303, P0304):

- engine is running;

- engine speed N40 is within 720...4800 rpm;

- misfire detection is active (B_LUSTOP=«NO»);

- the ECM calculated variation of engine speed is above threshold;

- no DTC P0201... P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271 or P0336 is set.

MIL (CHECK ENGINE light) illuminates two drive cycles after the system detects misfire that can result in increased engine emissions. MIL starts flashing immediately after the DTC related to a fault that can damage the catalyst is set. The ECM can cut off fuel delivery to the trouble cylinder (indicating misfire) to protect the catalyst.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a constant fault.
2. Use a spark tester to verify that adequate secondary voltage is available at the spark plug (above 22 000 volts).
3. In case of carbon tracking replace the ignition module and check the HT leads.

ATTENTION. In order to reduce the risk of personal injury always use insulated tools and observe safety requirements while handling ignition system secondary circuits.

Diagnostic Aids

In case of random misfire check for the following conditions:

- Poor ECM ground connection. Check the ECM ground connections at the cylinder block for being tight and clean (fig. 2.6-01);

- Air inleakage. Check the induction system for air inleakage after the MAF sensor. Check the vacuum hoses for damage or improper connection;

- Fuel metering system malfunction. Fuel filter clogging or faulty fuel pump may cause enleanment of the air/fuel mixture. Refer to Chart A-6. Also check injector balance using Chart C-3;

- Ignition system malfunction. Check for wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits (if the spark plugs are used for over than 30 000 km, replace the spark plugs). Check the HT leads and the ignition module casing for damage;

- Loose CKP sensor mounting;

- Excessive (above 0.4 mm) radial runout of the damper toothed rim (reluctor wheel). Check ASA value using DST-2M. If the value is below 0.996 replace the damper.

Temporary misfire may appear during cold engine start up (ECT below 10°C) due to fouling of the spark plugs. After the engine warms up the misfire will disappear.

DTC P0300

Random/Multiple Misfire Detected

DTC P0301 (P0302, P0303, P0304)

Cylinder 1 (2, 3, 4) Misfire Detected

1
Connect DST-2M.
Ignition ON. Start the engine.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Run the engine in the same mode, which showed misfire.
Is the FZABGS value changing?

- **No** → Refer to «Diagnostic Aids».
- **Yes** → go to step 2.

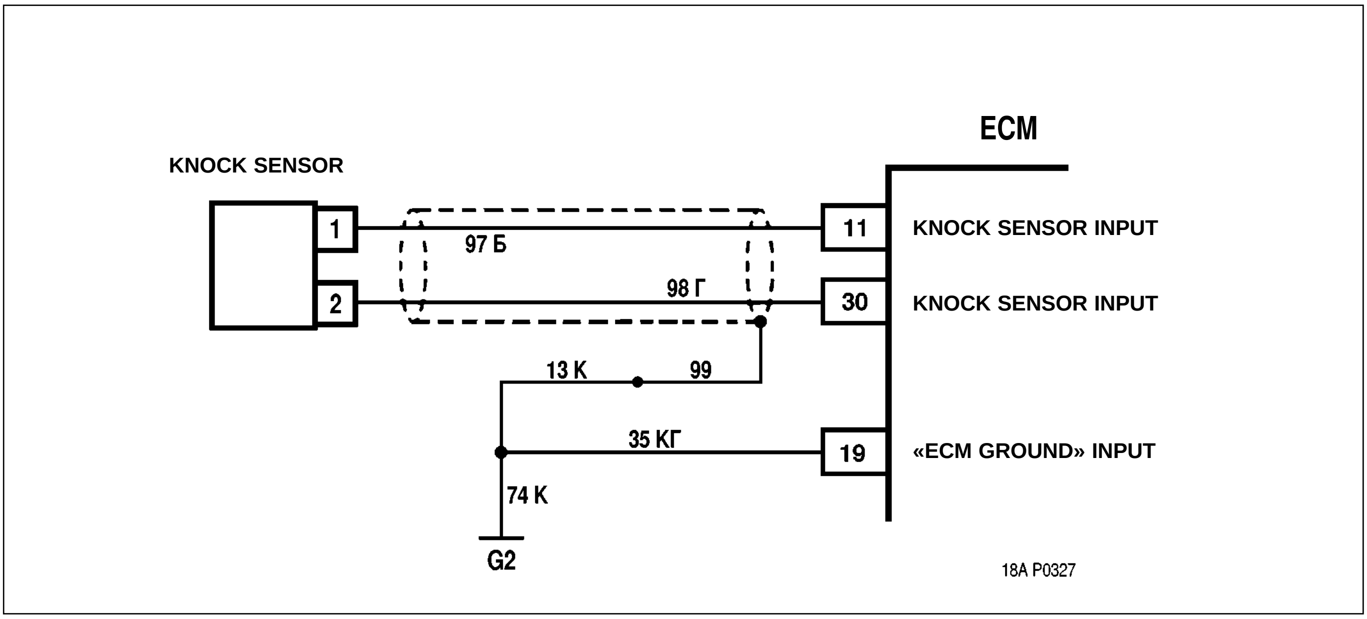
2
Using DST-2M select: «2 - Control; Ignition Coil 1 (2)».
Using a spark tester check for spark the spark plug cables (HT leads) to the trouble cylinder.
Connect the tester ground wire to a good engine ground (away from any electronic components). Leave the other cables connected to spark plugs during this test.
Is there spark on the cables?

- **No** → Use Chart A-3 (page 2 of 2).
- **Yes** → next step.

2
Check the ignition module for carbon tracking. Pay special attention to the HT leads to ignition module connections.
Was carbon tracking found?

- **No** → Replace the faulty spark plug.
If misfire continues check cylinder compression.
If compression is OK, check injector balance using Chart C-3.
- **Yes** → Replace the ignition module.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0327

Knock Sensor, Low Input

Conditions for setting DTC P0327:

- engine speed N40 is above 1800 rpm;

- engine coolant temperature TMOT is above 60°C;

- knock sensor signal amplitude is below threshold.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks conditions for setting DTC P0327.
2. Checks wires 97 white and 98 blue for a fault.

Diagnostic Aids

Check the Knock Sensor (KS) electrical connector for foreign liquids (e.g. motor oil), dirt or dust. In case of severe contamination clean with petrol or any other solvent that will not damage plastic parts and rubber sealings.

Refer to «Intermittents», Section 2.9 B.

Refer to «Knock Sensor System Check», Section 2.9 C, Chart C-5.

DTC P0327

Knock Sensor, Low Input

1

Connect DST-2M. Analyze conditions for setting the DTC.
Start the engine and allow it to warm up to 60°C.
Use DST-2M to reproduce conditions for setting the DTC.
Does the DTC set?

Yes → go to step 2.

No → DTC P0327 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

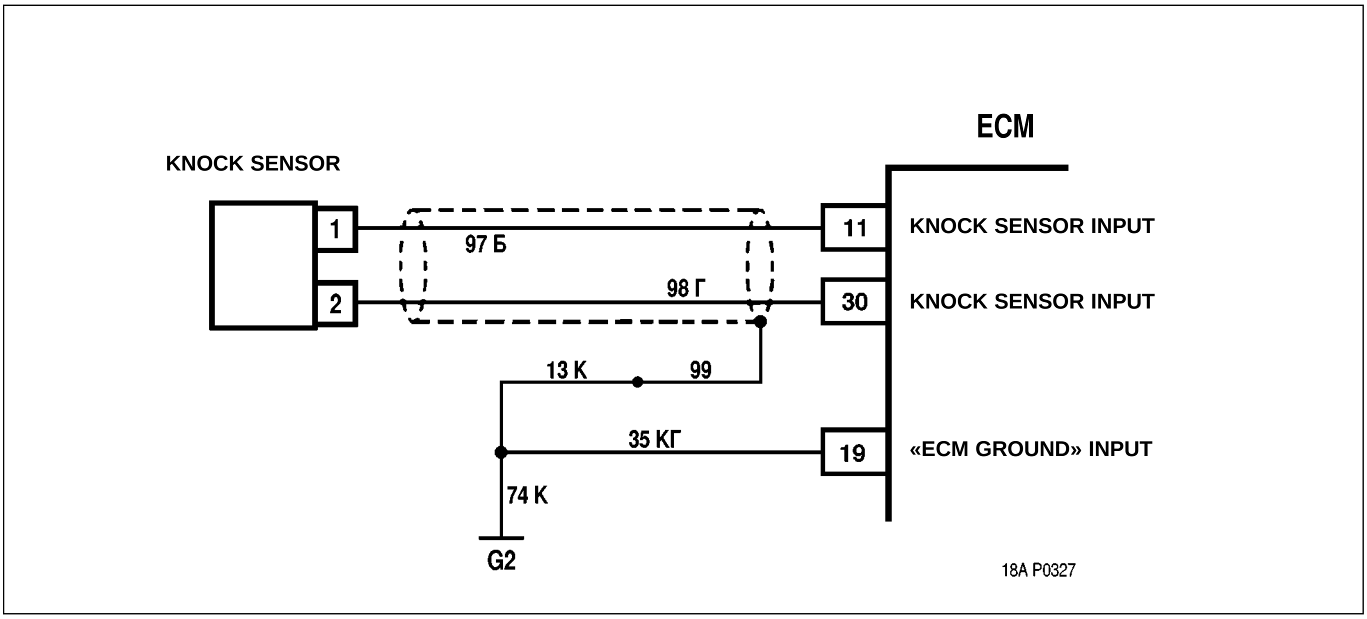
2

Ignition OFF.
Disconnect the ECM and KS electrical connectors.
Using a multimeter check resistance of 97 white and 98 blue wires.
Resistance should read below 1 Ohm, does it?

Yes → Faulty Knock Sensor or ECM, or poor electrical connections.

No → Repair the open.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0328

Knock Sensor, High Input

Conditions for setting DTC P0328:

- engine speed N40 is above 1300 rpm;

- engine coolant temperature TMOT is above 60°C;

- knock sensor signal amplitude is above threshold.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks conditions for setting DTC P0328.
2. Checks wires 97 white and 98 blue shield for a fault.

Diagnostic Aids

Check engine operation by listening for any foreign sound or ping (valvetrain maladjustment). Repair as necessary.

Make sure that the KS harness is not routed near high voltage leads.

Refer to «Knock Sensor System Check», Section 2.9 C, Chart C-5.

DTC P0328

Knock Sensor, High Input

1

Connect DST-2M. Analyze conditions for setting the DTC.
Start the engine and allow it to warm-up to 60°C.
Use DST-2M to reproduce conditions for setting the DTC.
Does the DTC set?

Yes → **2**

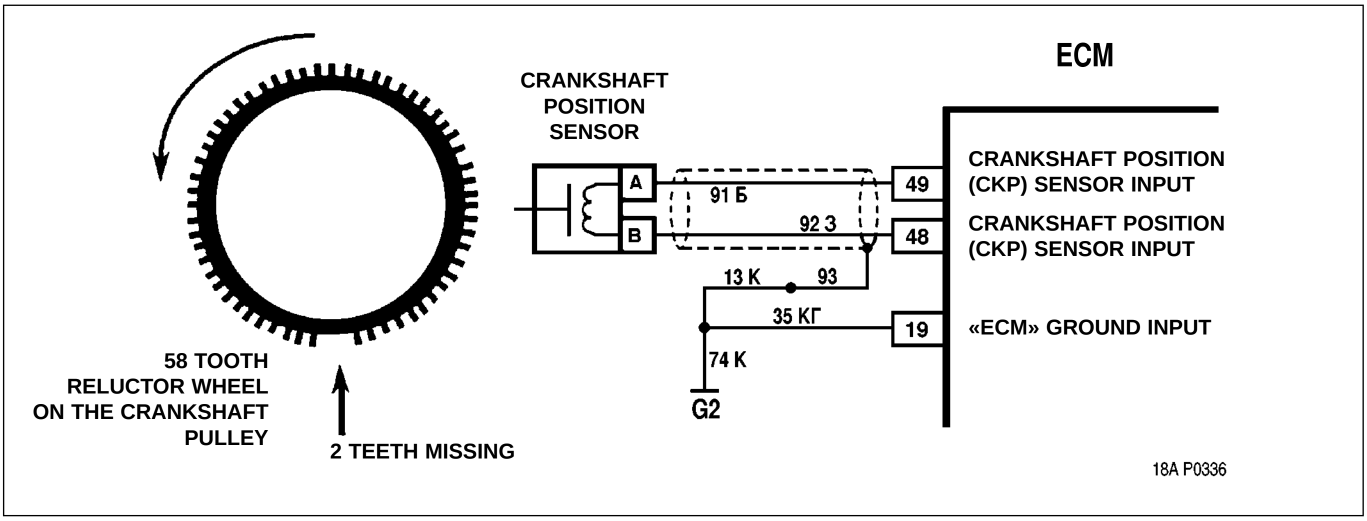
Check the shield and its ground connection for a fault.
Check KS mounting nut torquing.
Is a fault detected?

No → Faulty Knock Sensor or ECM.

Yes → Repair as necessary.

No → DTC P0328 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0335

Crankshaft Position Sensor, Malfunction

Conditions for setting DTC P0335:

- engine is cranking;

- engine speed N40 is below 15 rpm;

- fuel delivery is controled using the starting mode for more than 0.3 seconds;

- MAF sensor signal voltage is above 1196 mV;

- no DTC P0102, P0103 or P1140 is set.

The MIL (Check Engine light) will not illuminate when DTC P0335 sets.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the Crankshaft Position (CKP) Sensor resistance and wiring. Resistance may vary slightly as the temperature rises.

2. The Crankshaft Position (CKP) Sensor output signal voltage amplitude should measure about 0.3 volts AC at cranking.

Diagnostic Aids

Faulty connections at either the CKP sensor or the ECM connector may cause setting intermittent DTC P0335.

Intermittent DTC P0335 may also be set due to damaged sensor harness shield.

Check the crankshaft reluctor wheel for missing teeth, runout or other damage.

DTC P0335
Crankshaft Position Sensor, Malfunction

Using DST-2M clear the DTCs.
Crank the engine for 10 seconds or until the engine starts.
Does DTC P0335 set?

No

DTC P0335 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».
Analyze conditions for setting the DTC.

Yes

1

Ignition OFF.
Disconnect the ECM harness connector.
Using a multimeter check resistance between terminals «48» and «49» of the harness connector.
Resistance should read between 550 and 750 Ohms, does it?

No

550 Ohms or less.

Sensor wires shorted together, or faulty sensor.

750 Ohms or greater.

Faulty connections or sensor.

Yes

2

Set the multimeter to measure AC voltage.
Crank the engine and observe voltage reading between terminals «48» and «49» of the harness connector.
Voltage should read above 0.3 volts, does it?

No

Faulty connections or sensor.

Yes

Reconnect the ECM harness connector.
With the engine running use DST-2M to clear the DTCs.
Crank the engine for 10 seconds or until the engine starts.
If DTC P0335 resets, check the reluctor wheel condition. Refer to «Diagnostic Aids”.
Is the reluctor wheel OK?

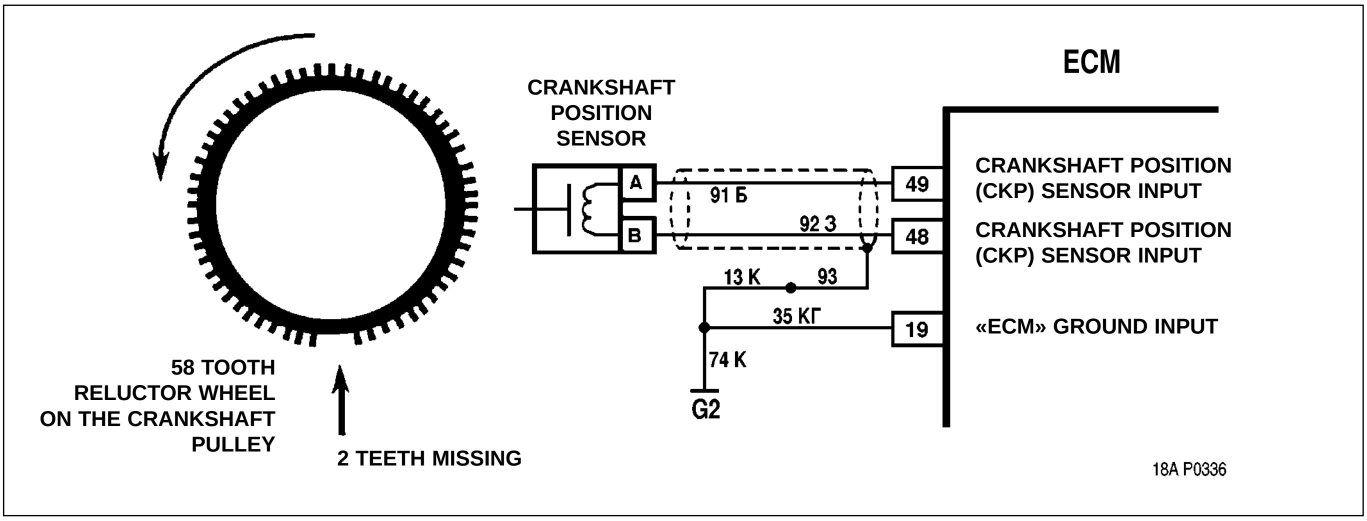
No

Replace the pulley with the reluctor wheel.

Yes

With the engine running clear the DTCs again using DST-2M.
Crank the engine for 10 seconds or until the engine starts.
If DTC P0335 resets, replace the ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0336

Crankshaft Position Sensor, Range/Performance

Conditions for setting DTC P0336:

- engine is cranking;

- the ECM detects that the reference mark has shifted during one turn of the crankshaft rotation.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the Crankshaft Position (CKP) Sensor resistance and wiring. Resistance may vary slightly as the temperature rises.

2. The Crankshaft Position (CKP) Sensor output signal voltage amplitude should measure about 0.3 volts AC at cranking.

Diagnostic Aids

Faulty connections at either the CKP sensor or the ECM connector may cause setting intermittent DTC P0336.

Intermittent DTC P0336 may also be set due to damaged sensor harness shield.

Check the crankshaft reluctor wheel for missing teeth, runout or other damage.

DTC P0336
Crankshaft Position Sensor, Range/Performance

Using DST-2M clear the DTCs.
Crank the engine for 10 seconds or until the engine starts.
Does DTC P0336 set?

Yes →

1 Ignition OFF.
Disconnect the ECM harness connector.
Using a multimeter check resistance between terminals «48» and «49» of the harness connector.
Resistance should read between 550 and 750 Ohms, does it?

- **Yes** →

  2 Set the multimeter to measure AC voltage.
  Crank the engine and observe voltage reading between terminals «48» and «49» of the harness connector.
  Voltage should read above 0.3 volts, does it?

  - **Yes** →

    Reconnect the ECM harness connector.
    With the engine running use DST-2M to clear the DTCs.
    Crank the engine for 10 seconds or until the engine starts.
    If DTC P0336 resets, check the reluctor wheel condition. Refer to «Diagnostic Aids».
    Is the reluctor wheel OK?

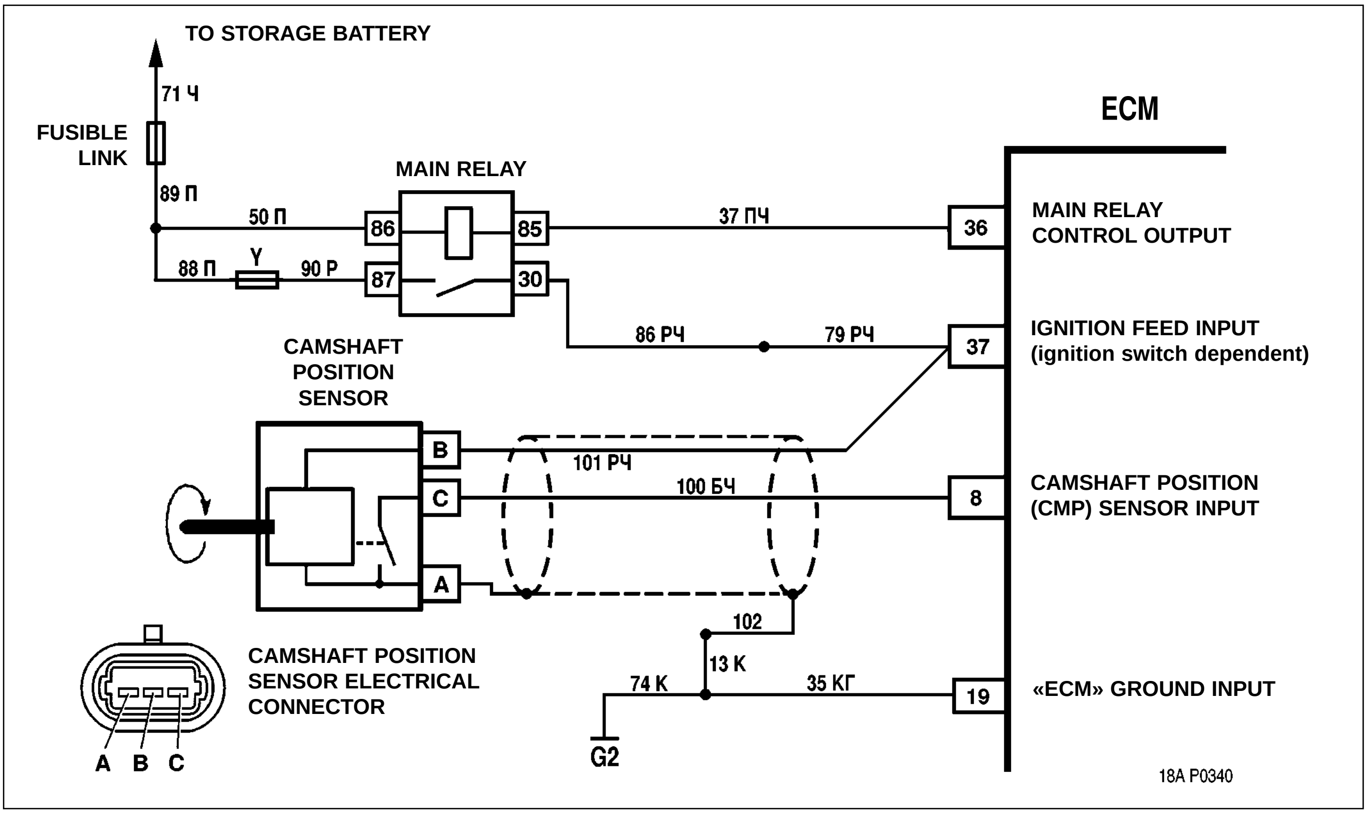
    - **Yes** → With the engine running clear the DTCs again using DST-2M.
      Crank the engine for 10 seconds or until the engine starts.
      If DTC P0336 resets, replace the ECM.
    - **No** → Replace the pulley with the reluctor wheel. → With the engine running clear the DTCs again using DST-2M. Crank the engine for 10 seconds or until the engine starts. If DTC P0336 resets, replace the ECM.

  - **No** → Faulty connections or sensor.

- **No** →
  - 550 Ohms or less. → Sensor wires shorted together, or faulty sensor.
  - 750 Ohms or greater. → Faulty connections or sensor.

No → DTC P0336 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0340

Camshaft Position Sensor, Malfunction

Conditions for setting DTC P0340:

- engine is cranking;

- engine speed N40 is above 100;

- no CMP signal is present or the series of pulses is irregular for 2 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles in which the tests failed.

After the DTC is set the ECM continues to control fuel injection in sequential mode.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if the DTC is set.
2. Checks the ECM for a fault.
3. Checks the sensor power and signal circuits for a fault.
4. Checks the CMP sensor for a fault.

Diagnostic Aids

An intermittent may be caused by the following conditions:

Poor connection at the ECM or the sensor connectors. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Misrouted harness. Inspect the sensor harness to ensure that it is not routed too close to high voltage wires.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Reviewing the vehicle kilometers since the DTC was set and analyzing the engine modes of operation may help to determine how often the condition that caused the DTC to be set occurs.

DTC P0340
Camshaft Position Sensor, Malfunction

1
Clear DTCs using DST-2M.
Start the engine.
Does DTC P0340 set 15 seconds after the engine start up?

No → DTC P0340 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».

Yes ↓

2
Ignition OFF.
Disconnect the ECM harness connector. Jumper connector terminals «36» and «19».
Set the multimeter to diode tester mode and connect to terminal «8» of the harness connector.
Cycle the starter ON/OFF several times while observing the multimeter reading.
Voltage should drop to no more than 50 mV with each rotation of the camshaft, does it?

Yes → Poor connection or faulty ECM.

No ↓

3
Connect the ECM harness connector. Disconnect the CMP sensor harness connector.
Ignition ON.
Using a multimeter check voltage between the terminals of the disconnected harness connector.
The multimeter should have the following readings:
- between terminals «A» and «B» – system voltage;
- between terminals «A» and «C» – 2-3 volts below system voltage.
Does the multimeter indicate as described?

No → Check the CMP sensor wiring connection. Repair the open or short to ground of relevant cercuits. If the wiring is OK, replace the ECM.

Yes ↓

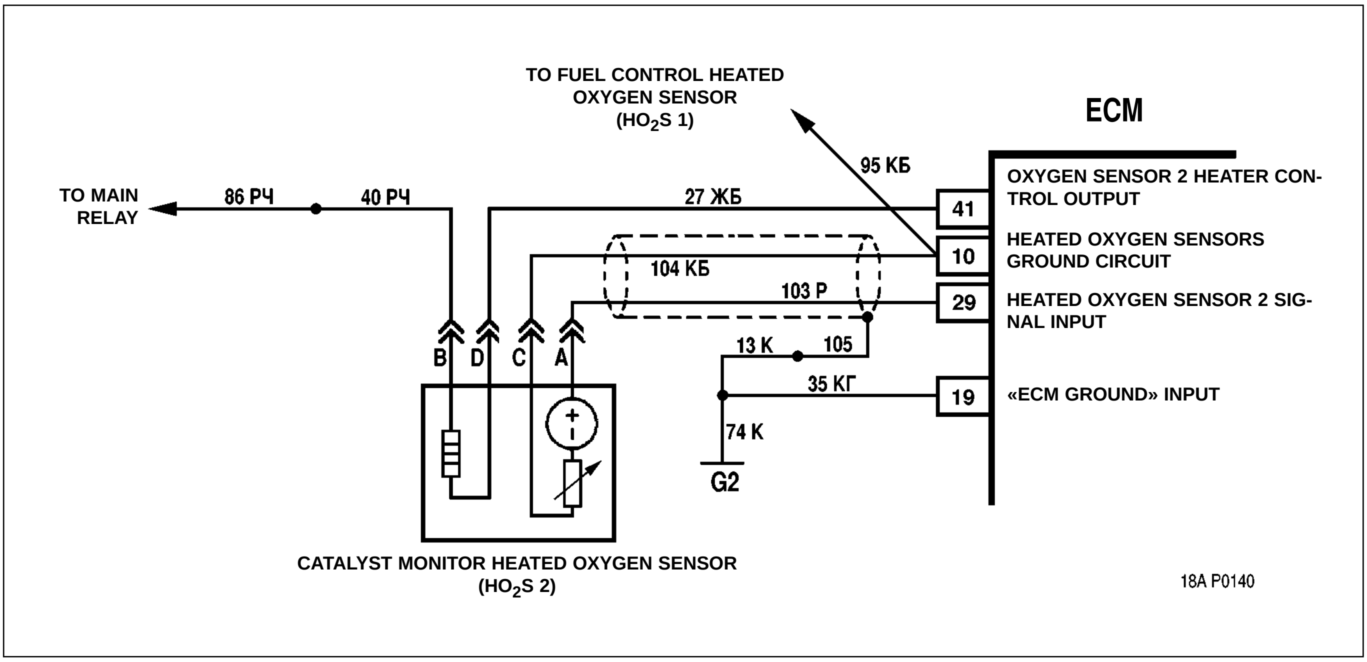
4
Ignition OFF.
Remove the sensor. Reconnect the sensor harness connector.
Disconnect the ECM harness connector. Jumper connector terminals «36» and «19».
Set the multimeter to diode tester mode and connect to terminal «8» of the harness connector.
Place a metal object, which can be drawn to a magnet, in front of the CMP sensor several times.
Voltage should drop to no more than 50 mV, does it?

Yes → Wire 102/13 brown/74 brown open or faulty CMP sensor.

No ↓

Check for missing or damaged pin at the camshaft.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0422

Main Catalyst Efficiency, Below Threshold

Conditions for setting DTC P0422:

- no DTC P0102, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0130, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0300, P0301, P0302, P0303, P0304, P0443, P0562, P0563, P1410, P1425 or P1426 is set;

- fuel delivery is controlled in the HO_2S 1 closed loop mode (B_LR=«YES»);

- conditions for catalyst diagnosis are present;

- the ECM detects that the oxygen content after the catalyst is above threshold.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Diagnostic Aids

A three-way catalytic converter is used to reduce hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x) content in the exhaust (refer to Section 1.10). The catalyst promotes a chemical reaction which oxidizes the HC and CO, converting them into harmless water vapor and carbon dioxide. It also reduces NO_x, converting it to nitrogen.

The ECM monitors reduction and oxidation efficiency of the catalyst using signals from the fuel control and catalyst monitor oxygen sensors, mounted before and after the catalyst. If the catalyst is operating efficiently, DST-2M should display AVKAT close to zero. The less efficient is the catalyst, the higher is the value of AVKAT.

The ECM diagnoses the catalyst if more than 120 seconds have elapsed since the engine start up and the following conditions were present for 285 seconds:

- ECT is higher than 70°C;
- IAT is above -12°C;
- MAF is within 20...120 kg/h;
- engine speed is within 1280...3500 rpm;
- engine load parameter (TL) remains stable within 1.5...6.5 msec.

This ensures that the catalyst is sufficiently hot for testing purposes. Once these conditions have been met, the ECM can begin running the catalyst diagnostic.

DTC P0422
Main Catalyst Efficiency, Below Threshold

Connect DST-2M and select: «1 - Parameters; 2 - Groups Preview». With the engine running check if the catalyst diagnostic cycle has been completed (B_KATRDY=»YES»).
Has the diagnostic cycle been completed?

No → Use DST-2M to set conditions for the diagnostic cycle.

Yes ↓

Check for other DTCs. If any other DTC is set, refer to the relevant chart.
Inspect the catalytuc converter for damage. During the inspection pay special attention to the following:
- dents, etc;
- severe discoloration caused by excessive temperatures;
- internal rattle, indicating the damage of the catalyst ceramic substrate.
Did your inspection reveal a problem?

Yes → Replace the catalytic converter.

No ↓

Inspect the exhaust system between the catalytic converter and the main muffler for air leaks, damage and for missing hardware.
Check the HO_2S 2 for damage and ensure that its harness and electrical connector do not contact the exhaust pipe or otherwise damaged.
Did your inspection reveal a problem?

No → Replace the catalytic converter.

Yes ↓

Repair as necessary.

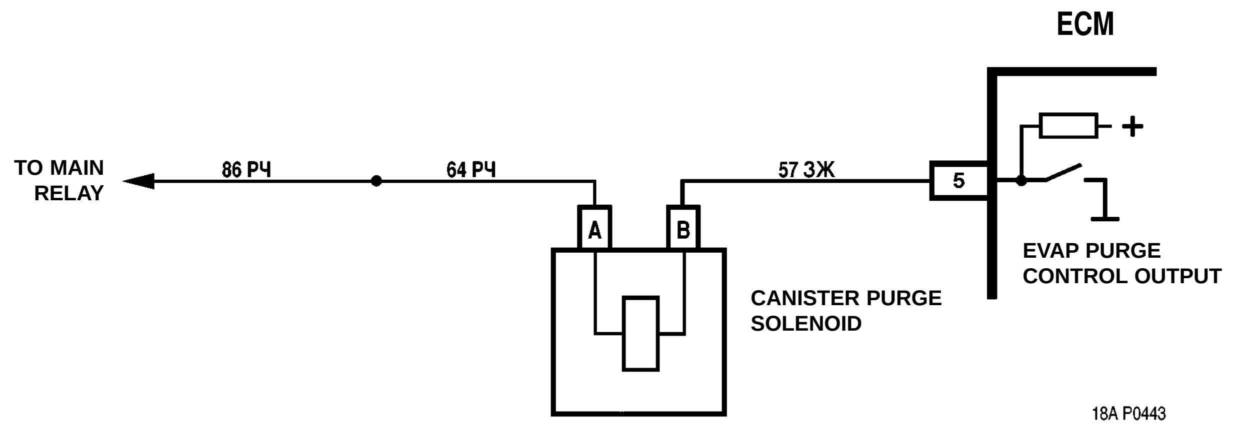
Review and record additional information for DTC P0422. Clear the DTCs.
Start the engine and allow it to warm up to at least 70°C.
Use DST-2M to set conditions for the catalyst efficiency diagnostic cycle.
Does DTC P0422 set after the diagnosis is complete?

No → Repair complete.

Yes ↓

Repeat the tests starting with step #2.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0443

EVAP Control, Purge Canister Valve, Malfunction

Conditions for setting DTC P0443:

- engine has been running for over 800 seconds;

- engine is idling;

- the EVAP purge valve driver self diagnostic has failed.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a constant DTC.
2. Checks the EVAP purge solenoid for a fault.

Diagnostic Aids

The following procedure is used for the EVAP purge solenoid diagnosis:

- with the engine idling command the EVAP purge valve to change gradually from 0% to 92% PWM;

- the ECM should control the air/fuel mixture composition and the MAF. If no changes are registered, the EVAP purge valve or connecting hoses are faulty.

The diagnosis is performed once per trip if it completes successfully, or twice if the first test fails. The test may be canceled if the engine runs rough.

Setting the DTC may be caused by the following:

- the EVAP purge valve is sticking open/closed and starts to operate at high PWM (above 70%).

- pinched or restricted hoses connecting the canister and the engine.

- vacuum leaks in the EVAP system.

DTC P0443
EVAP Control, Purge Canister Valve, Malfunction

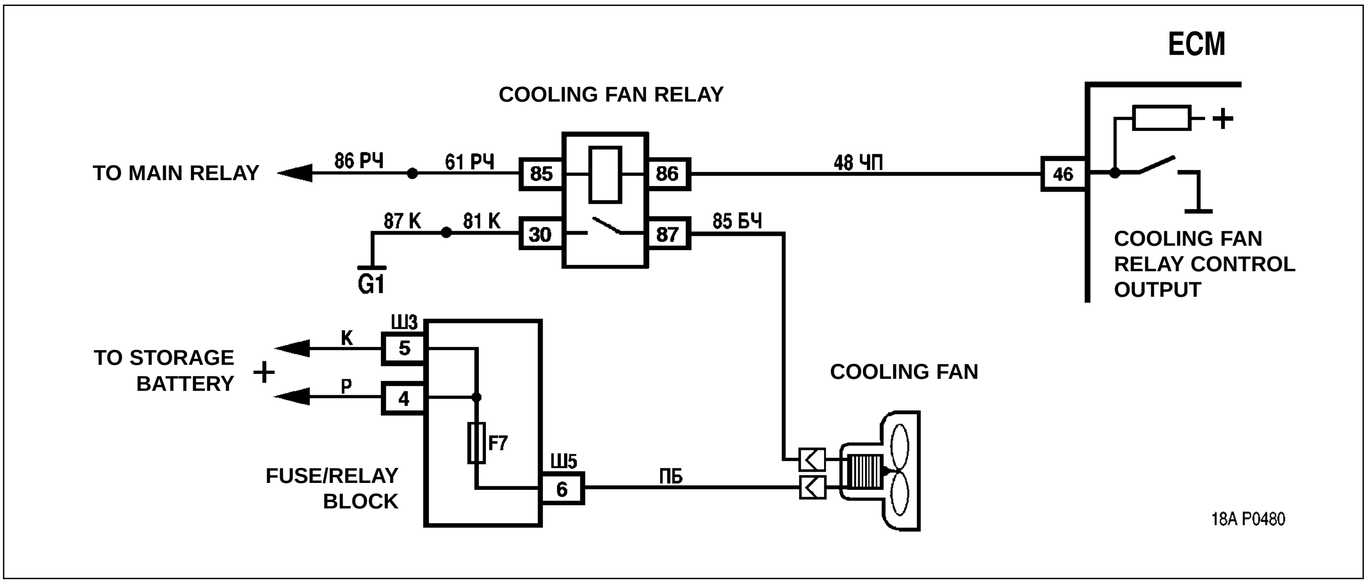
1 Check the hoses for proper connection.
If the hoses are OK, connect DST-2M and start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».

- **Yes** → go to step 2.
- **No** → Refer to «Diagnostic Aids».

2 Stop the engine.
Disconnect hoses, which connect the EVAP purge valve with the canister and the engine.
Check the hoses and the fitting at the throttle body.
Was a problem found (pinched or restricted hoses, etc.)?

- **Yes** → Repair as necessary.
- **No** → Replace the EVAP purge valve for another one known to be good and repeat the test.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0480

Cooling Fan 1 Control Circuit, Malfunction

Conditions for setting DTC P0480:

- engine is running;

- the cooling fan relay driver self diagnostic detects output short to ground or voltage, or no load condition.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test uses a multimeter to check voltage at harness connector terminals «85» and «86». Voltage reading is used to detect the fault.

Diagnostic Aids

The ECM MP7.0H features cooling fan relay driver, which has a self diagnostic function. It can detect such problems as relay control circuit open or short to ground or voltage.

Control circuit short to voltage can be detected when the ECM commands the fan ON.

DTC P0480
Cooling Fan 1 Control Circuit, Malfunction

Connect DST-2M.
Using DST-2M select: «4 - DT Codes». Clear the DTCs.
Start the engine and allow it to warm up until the cooling fan activates.
Does DTC P0480 set?

Yes →

1 Stop the engine.
Remove the cooling fan relay.
Ignition ON.
Using a multimeter check voltage at terminals «85» and «86» of the harness connector disconnected from the relay.
The multimeter should have the following readings:
- Terminal «86» – about +5 volts;
- Terminal «85» – close to system voltage.

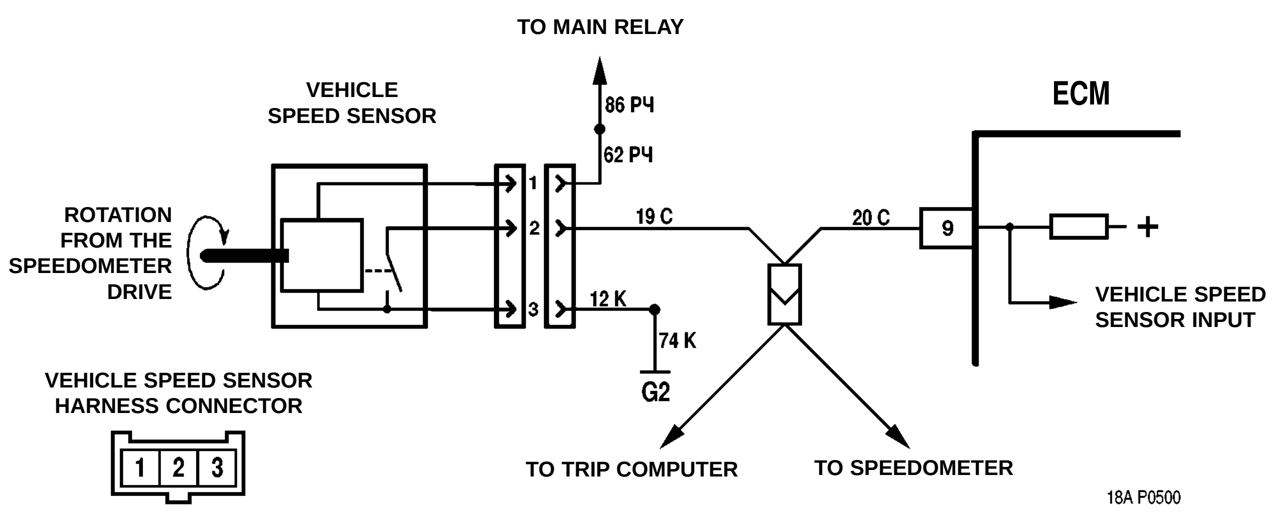
Does the multimeter indicate as described?

- **Yes** → Poor connection or faulty relay.
- **No** →
  - Voltage at terminal «85» below 1 volt. → Circuit 61/86 pink/black open.
  - Voltage at terminal «86» below 1 volt. → Circuit 48 black/red open or short to ground, or faulty ECM.
  - Voltage at terminal «86» above 10 volts. → Circuit 48 black/red short to voltage or faulty ECM.

No →

DTC P0480 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.
Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0500

VSS Sensor, Malfunction

Conditions for setting DTC P0500:

- engine speed N40 is above 1600 rpm;

- engine coolant temperature (TMOT) is above 80°C;

- vehicle speed signal (VFZ) indicates 5 km/h or less;

- load parameter (TL) is above 3 msec;

- the above conditions are present for 4 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the VSS operation using DST-2M.
2. Checks the VSS input signal circuit for short to ground or voltage.
3. By probing the VSS input signal circuit with the test light several times a second a VS signal should be generated and displayed on DST-2M.
4. Checks the 62/86 pink/black wire for a fault.
5. Checks the VSS to engine ground connection.

Diagnostic Aids

DST-2M should indicate vehicle speed with the drive wheels turning faster than 3 km/h.

An intermittent may be caused by moisture coming inside the VSS.

Refer to «Intermittents», Section 2.9 B.

DTC P0500
VSS Sensor, Malfunction

1 Connect DST2.
Using the DST-2M select: «1 - Parameters; 2 - Groups preview».
Raise the vehicle so that the front wheels can rotate freely.
With the engine idling in the first gear DST-2M should indicate speed above 0 km/h, does it?

- Yes → DTC P0500 is intermittent.
- No → go to 2.

2 Ignition ON. Engine not running.
Disconnect the VSS harness connector.
Using a multimeter check voltage at the harness connector terminal «2».
The multimeter should indicate voltage about 9 volts, does it?

- Yes → go to 3.
- No:
  - Multimeter indicates 0 volts. → Wires 19/20 grey open or short to ground, or faulty ECM.
  - Multimeter indicates about +12 volts. → Wires 19/20 grey short to voltage or faulty ECM.

3 Start the engine.
With the test light connected to ground touch the harness connector terminal «2» several times a second, while observing the vehicle speed reading on DST-2M.
DST-2M should indicate vehicle speed greater than 0 km/h, does it?

- Yes → go to 4.
- No → Faulty ECM.

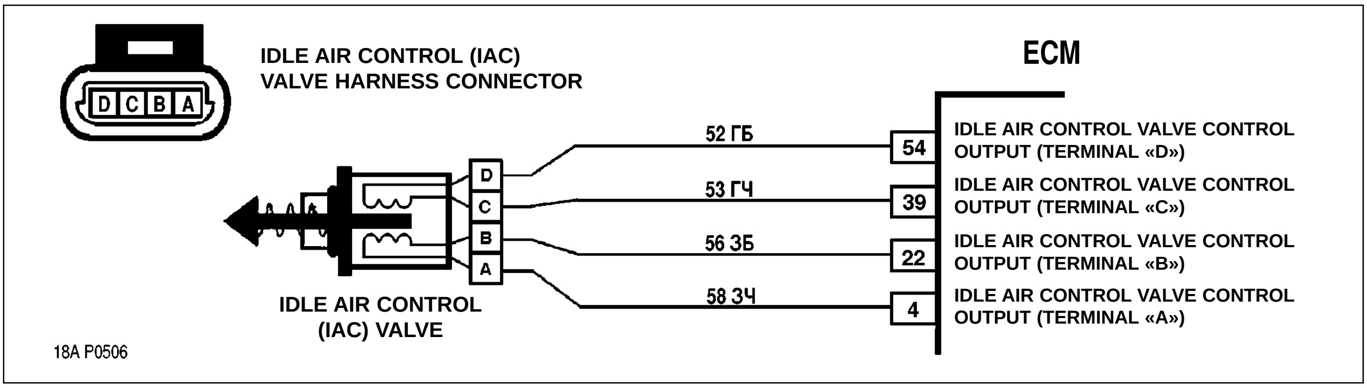
4 With the test light connected to ground probe the harness connector terminal «1».
Does the test light illuminate?

- Yes → go to 5.
- No → Wire 62/86 pink/black open.

5 With the test light connected to voltage probe the harness connector terminal «3».
Does the test light illuminate?

- Yes → Poor connection or faulty VS sensor.
- No → Wire 12/74 brown open.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0506

IDLE Control System, RPM Too Low

Conditions for setting DTC P0506:

- no DTC P0102, P0103, P0116, P0117, P0118, P0122, P0123, P0443, P1140, P01410, P1425, P1426, P1509, P1513 or P1514 DTCs is set;

- engine is idling;

- engine coolant temperature (TMOT) is above 84°C;

- engine speed N40 remains below 740 rpm for 3 seconds;

- current correction for MAF at idle (IV) is greater than 10 kg/h for 3 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the IAC valve using the tester ТДРХ–1 (Samara) or J-34730-3 (OTC, USA).

Diagnostic Aids

Low or unstable idle speed may be caused by a fault that cannot be overcome by the IAC valve.

The following checks must be made to repair a non idle control system problem:

System too lean. Idle speed may be low or unstable. Check the fuel metering system for low fuel pressure, water in the fuel or restricted injectors. Check the HO_2S for silicone, glycol or other contaminants.

System too rich. Low idle speed. Check the fuel metering system for high fuel pressure or leaking injectors. Check the HO_2S for silicone, glycol or other contaminants.

Throttle Body. Remove the IAC valve and check the bypass airduct for foreign matters.

Crankcase Ventilation System. Check for proper hose connections using Chart C-6. A fault in the crankcase ventilation system may cause unstable idle rpm.

Air Cleaner. Clogging air cleaner may result in unstable idle speed.

Refer to “Unstable Or Stalling”, Section 2.9 B.

DTC P0506

IDLE Control System, RPM Too Low

Connect DST-2M.
Start the engine and allow it to warm up at idle to 84°C.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Does DST-2M indicate IV above 5 kg/h?

Yes

Check the air cleaner for restriction.
Check for proper connection of the crankcase ventilation system hoses.
Was a problem found?

No

DTC P0506 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».
Analyze conditions for setting the DTC.

No

1 Disconnect the IAC valve harness connector.
Connect the IAC valve tester leads to the battery. Connect the tester harness connector to the IAC valve.
Start the engine.
Using the tester to control the IAC valve increase the idle speed.
Does the engine speed increase?

Yes

Repair as necessary.

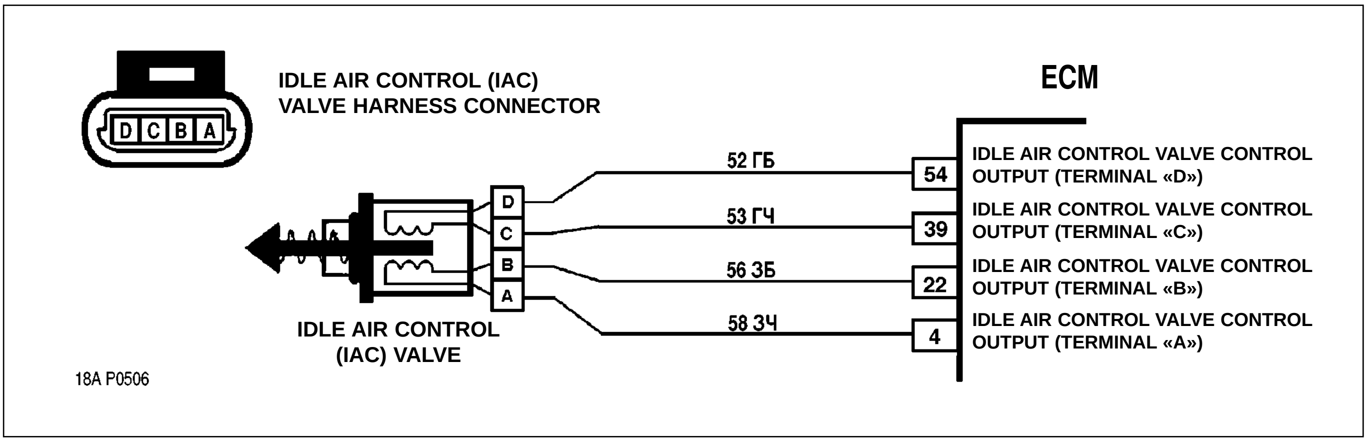
Yes

Replace the ECM.

No

Replace the IAC valve.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0507

IDLE Control System, RPM Too High

Conditions for setting DTC P0507:

- no DTC P0102, P0103, P0116, P0117, P0118, P0122, P0123, P0443, P1140, P01410, P1425, P1426, P1509, P1513 or P1514 DTCs is set;

- engine is idling;

- engine coolant temperature (TMOT) is above 84°C;

- engine speed N40 remains above 900 rpm for 3 seconds;

- current correction for MAF at idle (IV) is lower than -10 kg/h for 3 seconds.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the IAC valve using the tester ТДРХ–1 (Samara) or J-34730-3 (OTC, USA).

Diagnostic Aids

High idle speed may be caused by a fault that cannot be overcome by the IAC valve.

The following checks must be made to repair a non idle control system problem:

System too lean. Idle speed may be high or unstable. Check the fuel metering system for low fuel pressure, water in the fuel or restricted injectors. Check the HO_2S for silicone, glycol or other contaminants.

Crankcase Ventilation System. Check for proper hose connections using Chart C-6. A fault in the crankcase ventilation system may cause unstable idle rpm.

DTC P0507
IDLE Control System, RPM Too High

Connect DST-2M.
Start the engine and allow it to warm up at idle to 84°C.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Does DST-2M indicate IV below -5 kg/h?

Yes

Check the induction system for air inleakage.
Check for proper connection of the crankcase ventilation system hoses.
Was a problem found?

No

DTC P0507 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

No

1 Disconnect the IAC valve harness connector.
Connect the IAC valve tester leads to the battery. Connect the tester harness connector to the IAC valve.
Start the engine.
Using the tester to control the IAC valve decrease the idle speed.
Does the engine speed decrease?

Yes

Repair as necessary.

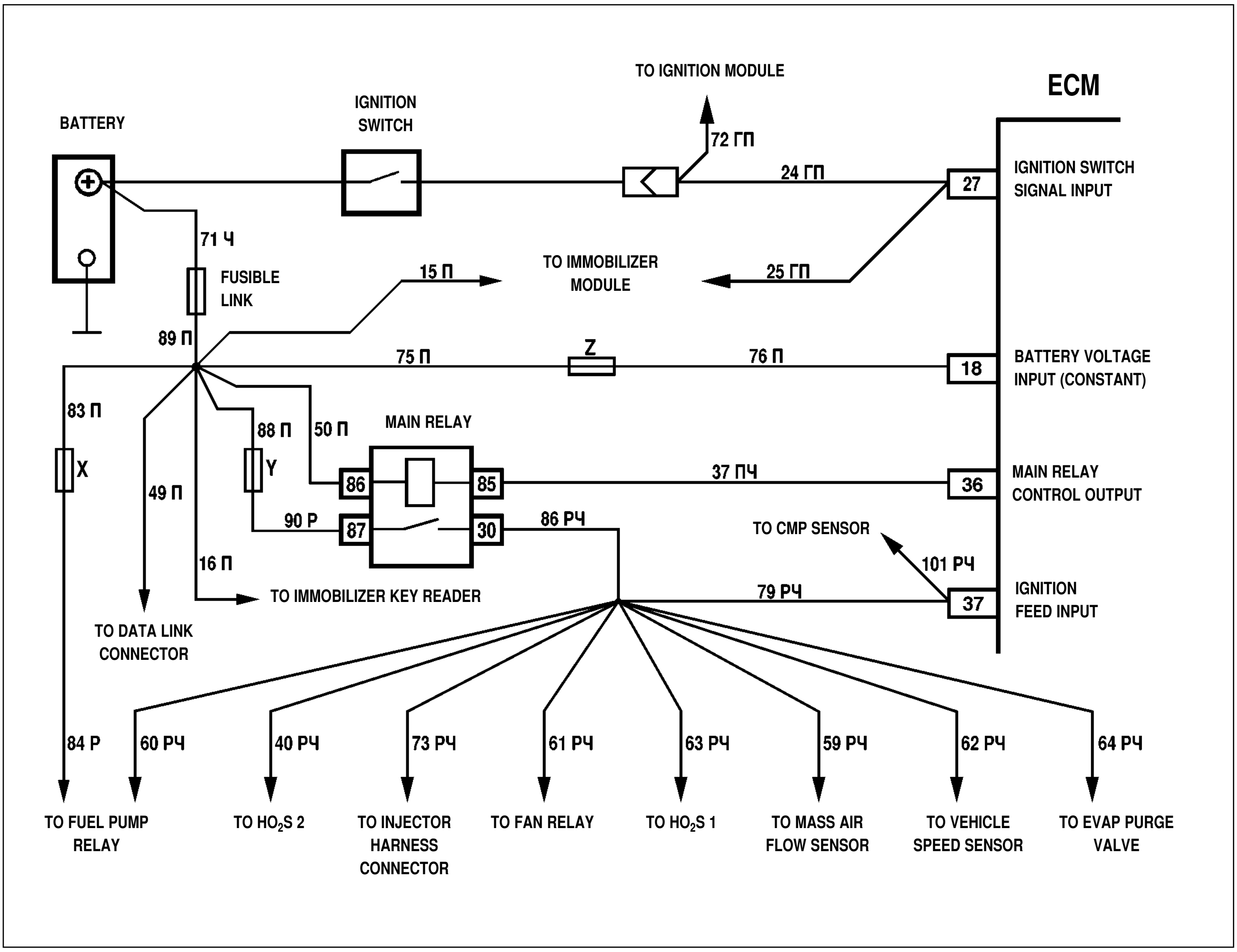
Yes

Replace the ECM.

No

Replace the IAC valve.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0560

System Voltage Malfunction

DTC P0560 sets when voltage at ECM harness connector terminal «37» is below 6.3 volts.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

The ECM MP7.0H monitors voltage supplied to its terminal «37».

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

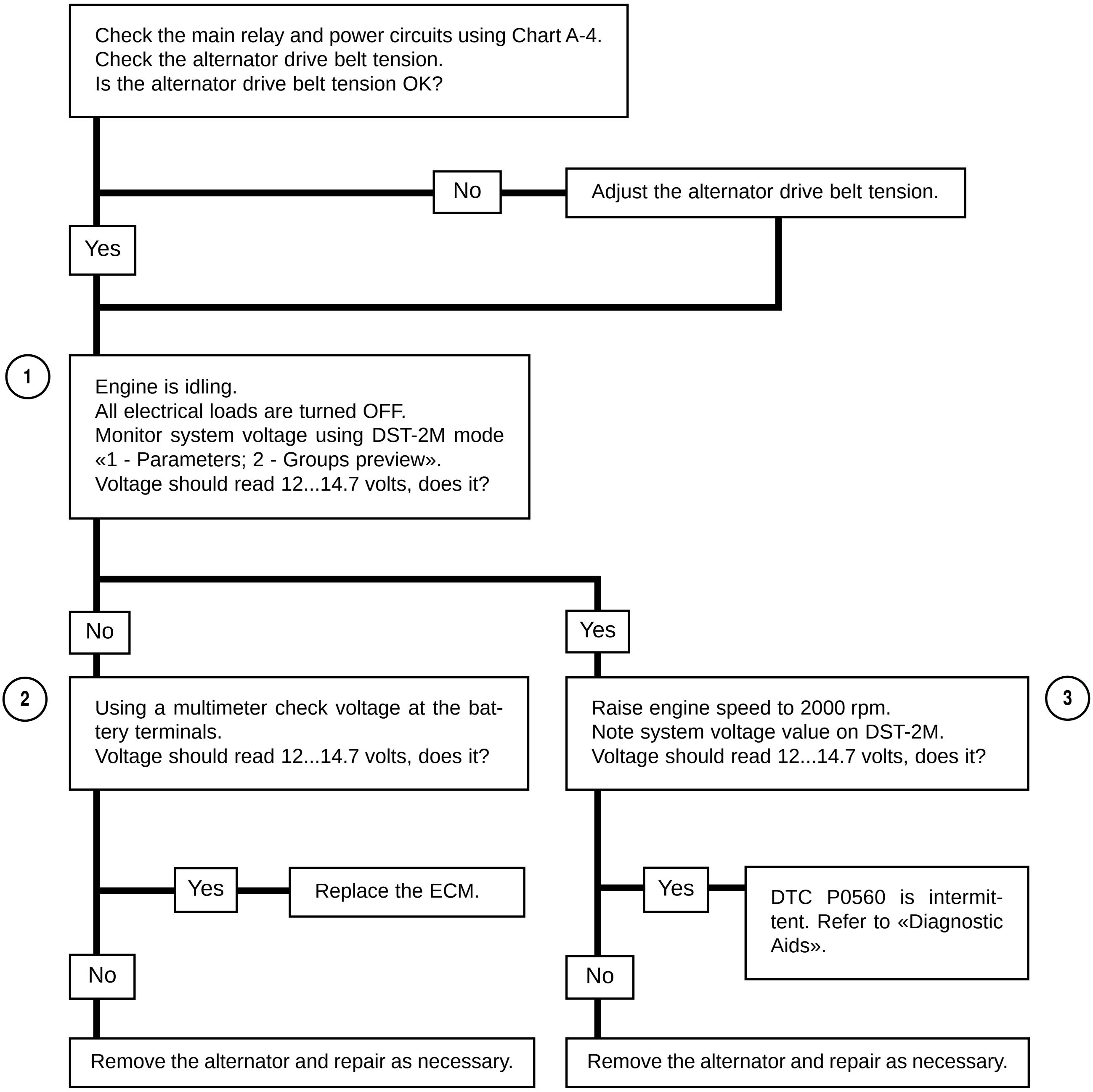
1. Checks system voltage using DST-2M.
2. Checks system voltage using a multimeter.
3. Checks alternator operation at high rpm.

Diagnostic Aids

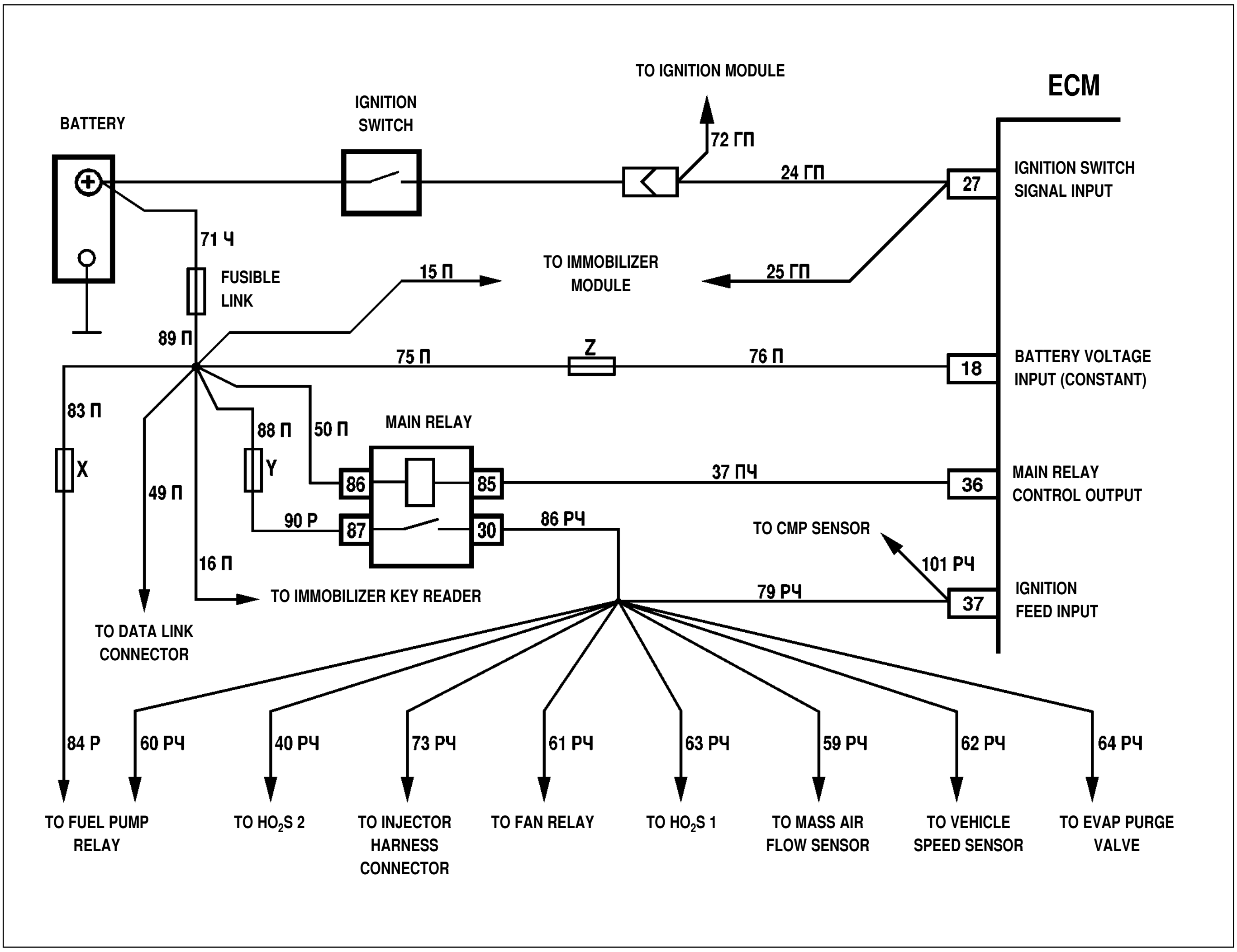
An intermittent may be caused by a discharged battery (voltage drop during cold start) or poor connection at the Y-fuse.

Refer to «Intermittents», Section 2.9 B.

DTC P0560
System Voltage Malfunction



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0562

System Voltage Low

Conditions for setting DTC P0562:

- engine has been running for more than 1 minute;

- voltage at ECM terminal «37» is less than 9 volts.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

The ECM MP7.0H monitors voltage supplied to its terminal «37».

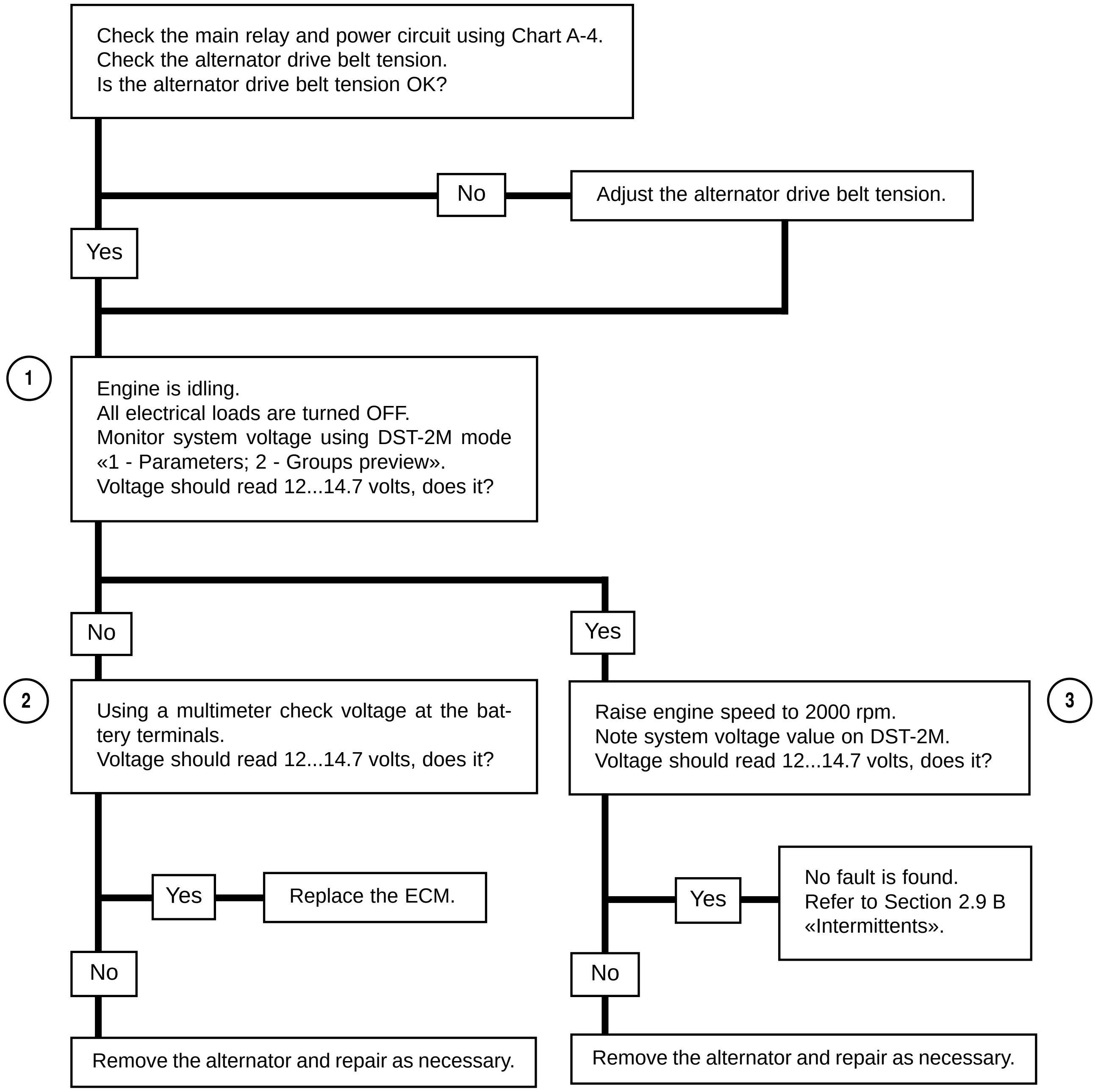
Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

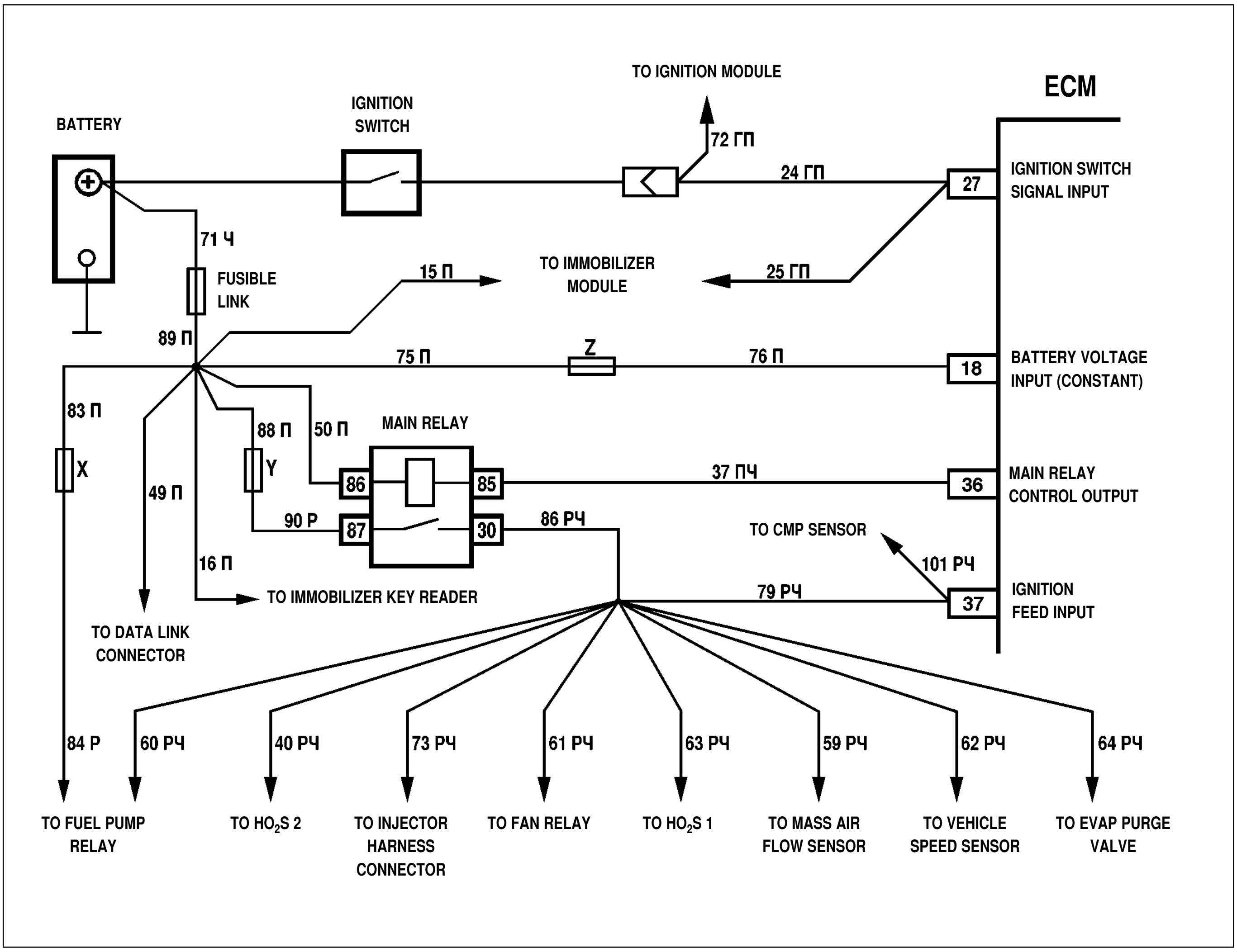
1. Checks system voltage using DST-2M.
2. Checks system voltage using a multimeter.
3. Checks alternator operation at high rpm.

DTC P0562

System Voltage Low



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P0563

System Voltage High

Conditions for setting DTC P0563:

- engine is running;

- voltage at ECM terminal «37» is greater than 16 volts.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

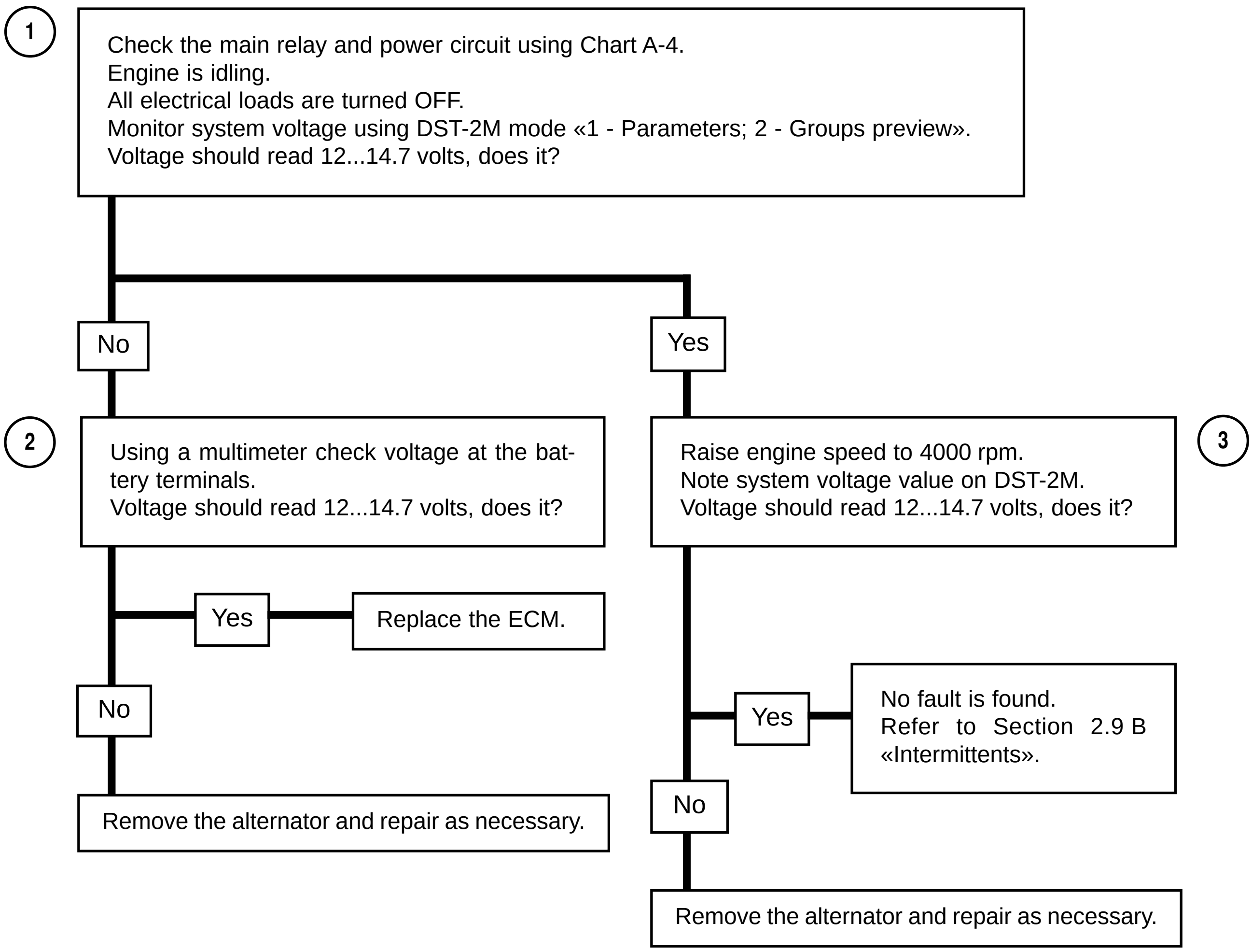
The ECM MP7.0H monitors voltage supplied to its terminal «37».

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks system voltage using DST-2M.
2. Checks system voltage using a multimeter.
3. Checks alternator operation at high rpm.

DTC P0563
System Voltage High



After repairs start the engine, clear DTCs and confirm no fault is present.

DTC P0601
Internal Check FLASH Memory, Check Sum Error

Conditions for setting DTC P0601:

- ignition OFF, but the main relay still ON (stop-phase);

- the EEPROM Checksum does not match the preprogrammed value.

Clear the DTCs using DST-2M.

If the DTC resets replace the ECM.

DTC P0603
Internal Check RAM-External, Error

Conditions for setting DTC P0603:

- RAM data was lost during the ECM internal read-write test.

Clear the DTCs using DST-2M.

If the DTC resets replace the ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.

DTC P0604
Internal Check RAM-Internal, Error

Conditions for setting DTC P0604:

- the ECM has been initialized;

- processor data was lost during the ECM internal read-write test.

Clear the DTCs using the DST-2M.

If the DTC resets replace the ECM.

DTC P1386
Knock Detection, Test Impulse/Zero Test, Malfunction

Conditions for setting DTC P1386:

- engine is running;

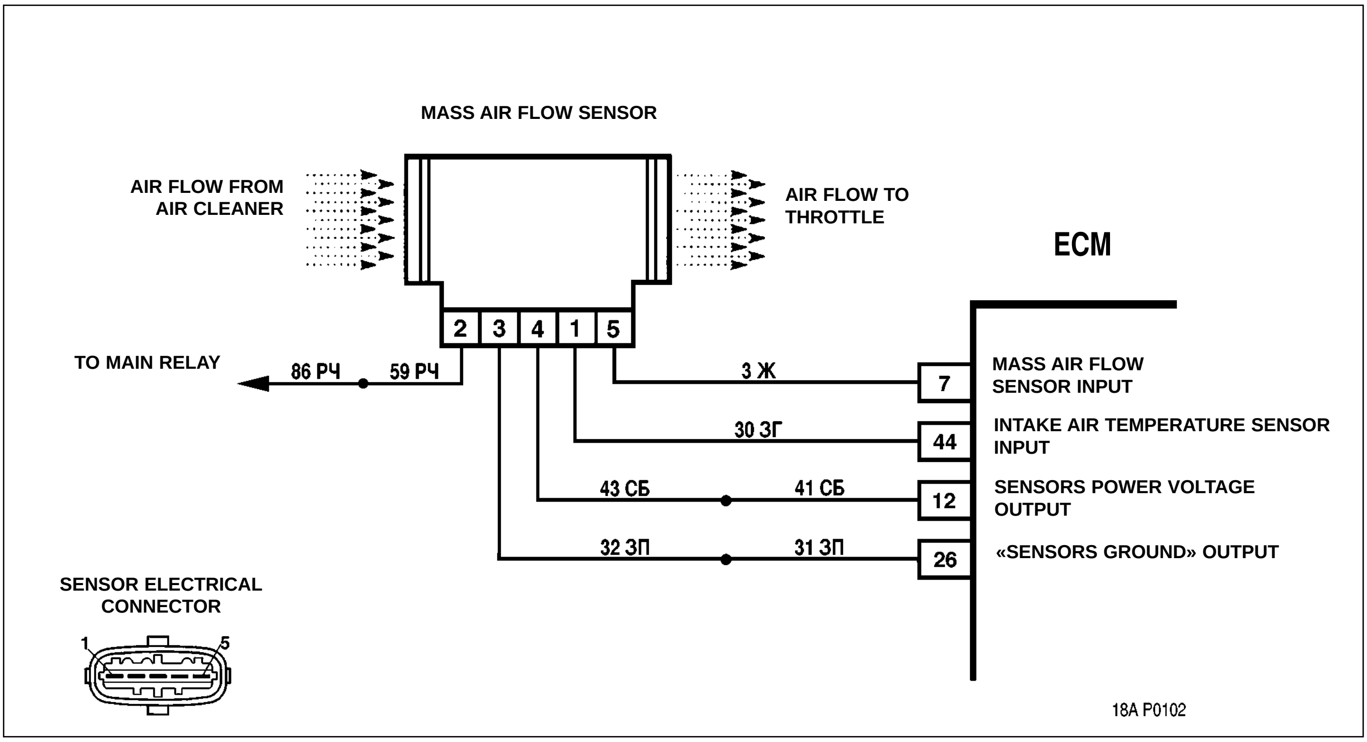
- engine coolant temperature is above 60°C;

- the ECM internal self diagnostic check detected knock sensor test pulse amplitude below threshold.

Clear the DTCs using DST-2M.

If the DTC resets replace the ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1140

Load Calculation, Range/Performance

Conditions for setting DTC P1140:

- engine is running;

- no DTC P0102, P0103, P0122, P0123, P1509, P1513 or P1514 is set;

- engine coolant temperature (TMOT) is above 80°C;

- engine speed N40 is within 2500...5000 rpm;

- load parameter is within 3.0...7.0 msec;

- measured load parameter differs from the ECM calculated value by the threshold value.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks conditions for setting the DTC.
2. Checks condition of the MAF sensor and the ECM harness connector terminals.

This test also refers to the Spare Parts Catalogue to varify that the induction system components used in the vehicle are the proper part number for this type of EMS.

3. Checks for possible fault of the MAF sensor or the Throttle Position (TP) sensor.

Diagnostic Aids

Possible causes for setting DTC P1140 are:

- faulty crankcase ventilation system;
- air inleakage;
- incorrect MAF sensor characteristic;
- incorrect TP sensor characteristic. Refer to Chart C-2;
- faulty ECM;
- poor connection at the sensor or the ECM harness connectors;
- the engine features some induction system components that are not meant for this type of engine management system;
- engine displacement does not match this type of engine management system.

DTC P1140
Load Calculation, Range/Performance

1

Connect DST-2M.
Start the engine and allow it to warm up to 80°C.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Gradually increase engine speed from 2500 to 5000 rpm.
Is the DTC currently active?

- Yes → 2
- No → DTC P1140 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

2

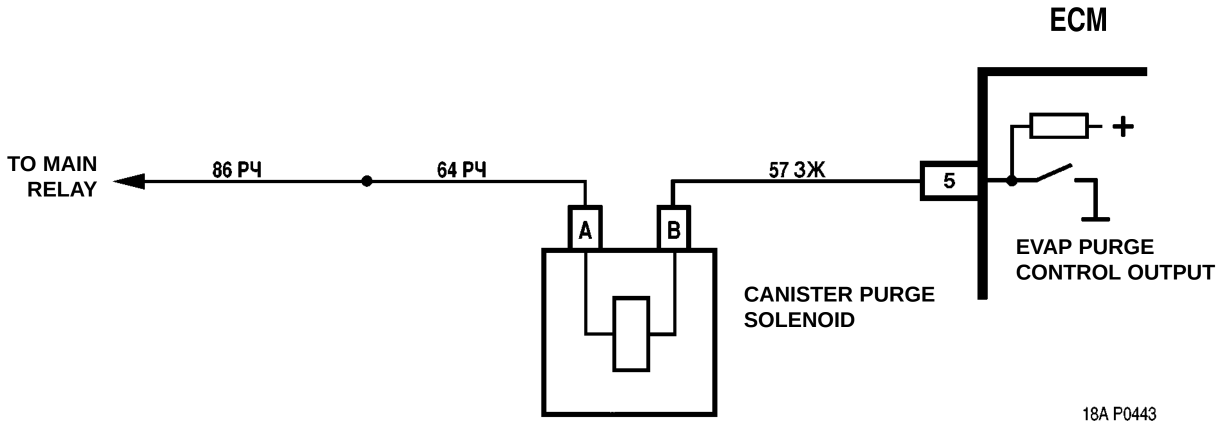
Check the crankcase ventilation system hoses for proper connection.
Check the induction system for air inleakage.
Check the EMS for proper component parts.
Check terminals at the MAF and TP sensors and the ECM harness connectors.
With the engine running gradually increase engine speed from 2500 to 5000 rpm.
Is the DTC currently active?

- Yes → 3
- No → DTC P1140 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids». Analyze conditions for setting the DTC.

3

Replace the MAF sensor for a known good sensor.
If DTC P1140 resets – replace the TP sensor for a known good sensor.
If DTC P1140 resets – replace the ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1410

EVAP Control, Purge Canister Valve, Circuit High

Conditions for setting DTC P1410:

- engine is running;

- the EVAP purge valve driver self diagnostic has detected output short to voltage.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a constant fault.
2. Checks the EVAP purge solenoid control circuit (57 green/yellow) for short to voltage.
3. Checks the EVAP purge solenoid for a fault.

Diagnostic Aids

The ECM MP7.0H features EVAP purge solenoid driver, which has a self diagnostic function. It can detect such problems as purge solenoid control circuit open or short to ground or voltage.

DTC P1410
EVAP Control, Purge Canister Valve, Circuit High

1

Connect DST-2M.
Start the engine and allow it to warm up to 80°C.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

- **Yes** → go to step 2.
- **No** → DTC P1410 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

2

Stop the engine.
Disconnect the EVAP purge valve harness connector.
Ignition ON.
With a test light connected to ground probe the harness connector terminal «B».
Does the test light illuminate?

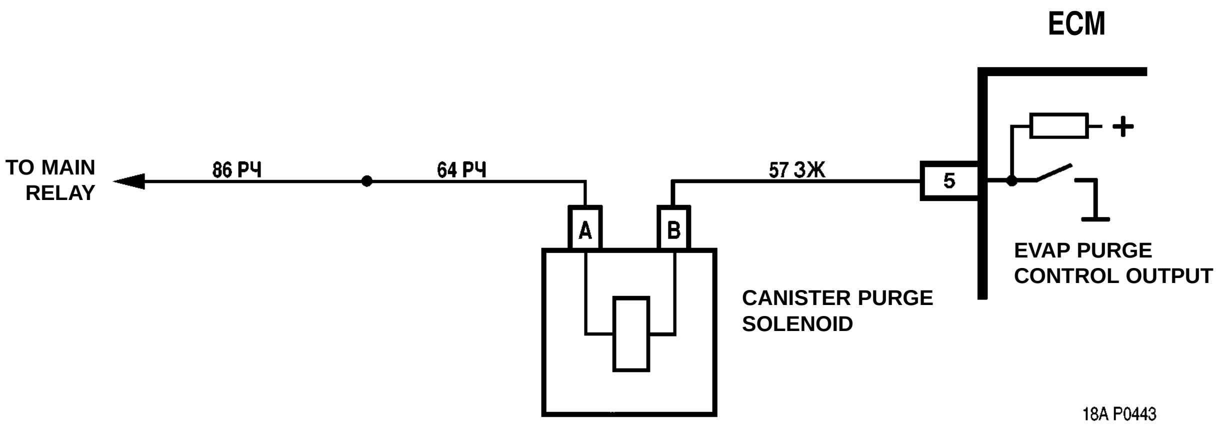
- **No** → go to step 3.
- **Yes** → Wire 57 green/yellow short to voltage or faulty ECM.

3

Using a multimeter check voltage between terminals «A» and «B» of the EVAP canister purge solenoid.
Does the multimeter indicate voltage above 20 Ohms?

- **No** → Faulty EVAP canister purge solenoid.
- **Yes** → Faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1425

EVAP Control, Purge Canister Valve, Circuit Low

Conditions for setting DTC P1425:

- engine is running;

- the EVAP purge valve driver self diagnostic has detected output short to ground.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks wire 57 green/yellow for short to ground.

Diagnostic Aids

The ECM MP7.0H features EVAP purge solenoid driver, which has a self diagnostic function. It can detect such problems as purge solenoid control circuit open or short to ground or voltage.

DTC P1425

EVAP Control, Purge Canister Valve, Circuit Low

Connect DST-2M.
Start the engine and allow it to warm up to 80°C.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes

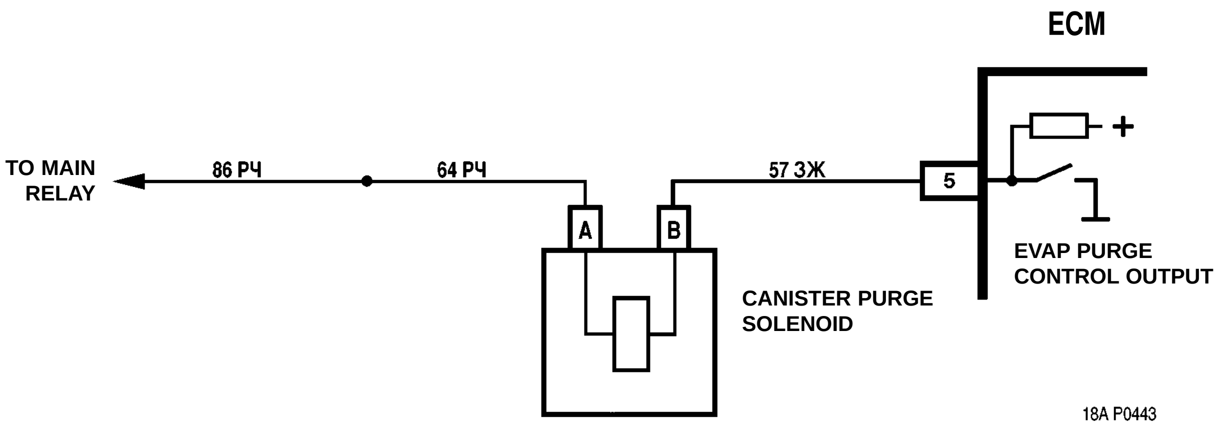
1. Stop the engine.
Disconnect the ECM harness connector.
Using a multimeter check resistance between harness connector terminal «5» and ground.
Resistance should read below 1 Ohm, does it?

- **Yes** – 57 green/yellow wire short to ground.
- **No** – Faulty ECM.

No

DTC P1425 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.
Analyze conditions for setting the DTC.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1426

EVAP Control, Purge Canister Valve, Circuit Low

Conditions for setting DTC P1426:

- engine is running;

- system voltage is within 8.5...17 volts;

- the EVAP purge valve driver self diagnostic has detected no load condition.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a constant fault.
2. Checks the EVAP purge solenoid power circuit (64/86 pink/black).
3. Checks the EVAP purge solenoid control circuit (57 green/yellow) for an open.
4. Checks the EVAP purge solenoid for a fault.

Diagnostic Aids

The ECM MP7.0H features EVAP purge solenoid driver, which has a self diagnostic function. It can detect such problems as purge solenoid control circuit open or short to ground or voltage.

DTC P1426
EVAP Control, Purge Canister Valve, Circuit Low

1
Connect DST-2M.
Start the engine and allow it to warm up to 80°C.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

- **Yes** → go to step 2
- **No** → DTC P1426 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B. Analyze conditions for setting the DTC.

2
Stop the engine.
Disconnect the EVAP purge valve harness connector.
Ignition ON.
With a test light connected to ground probe the harness connector terminal «A».
Does the test light illuminate?

- **Yes** → go to step 3
- **No** → Wires 64/86 pink/black open

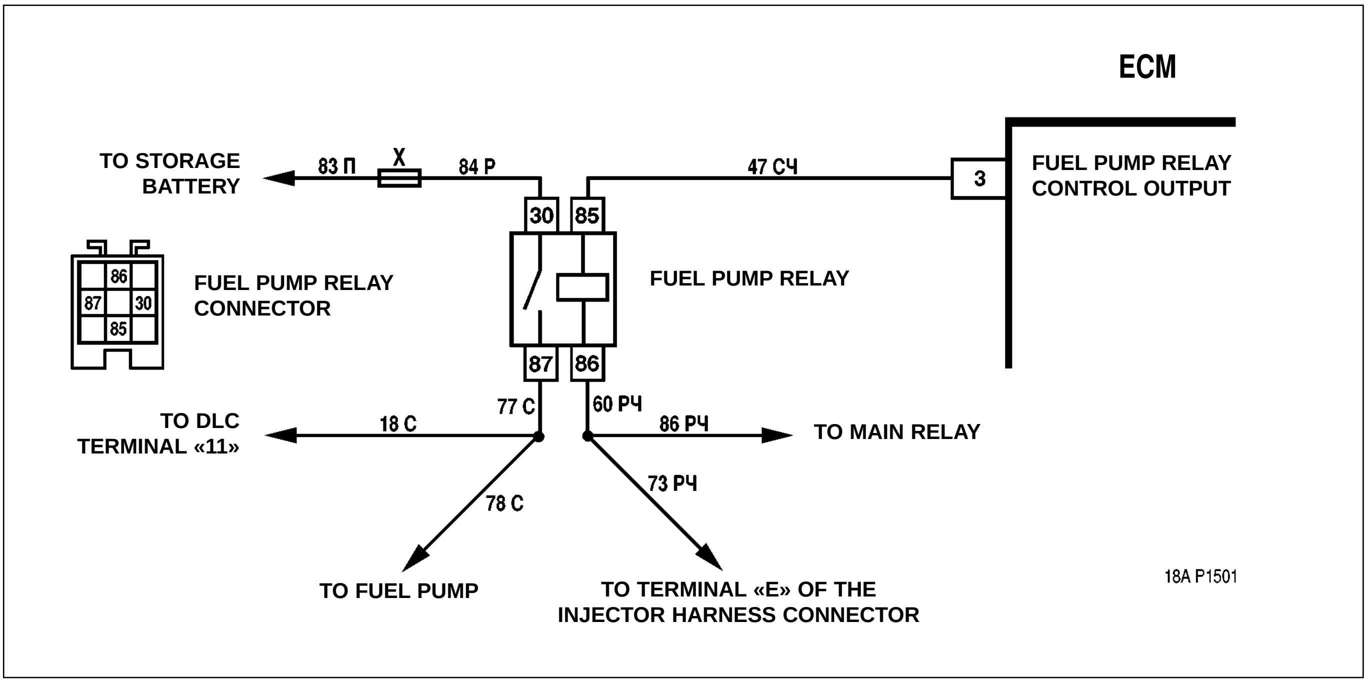
3
Connect a multimeter between harness connector terminal «B» and ground.
Does the multimeter indicate voltage below 2 volts?

- **No** → go to step 4
- **Yes** → Wire 57 green/yellow open or faulty ECM.

4
Using a multimeter check resistance between terminals «A» and «B» of the EVAP canister purge solenoid.
Does the multimeter indicate resistance above 1 MOhm?

- **Yes** → Faulty EVAP canister purge solenoid.
- **No** → Faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1501

Fuel Pump Relay, Circuit Low

Conditions for setting DTC P1501:

- ignition OFF, but the main relay still ON (stop-phase);

- fuel pump relay driver self diagnostic has detected output short to ground.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

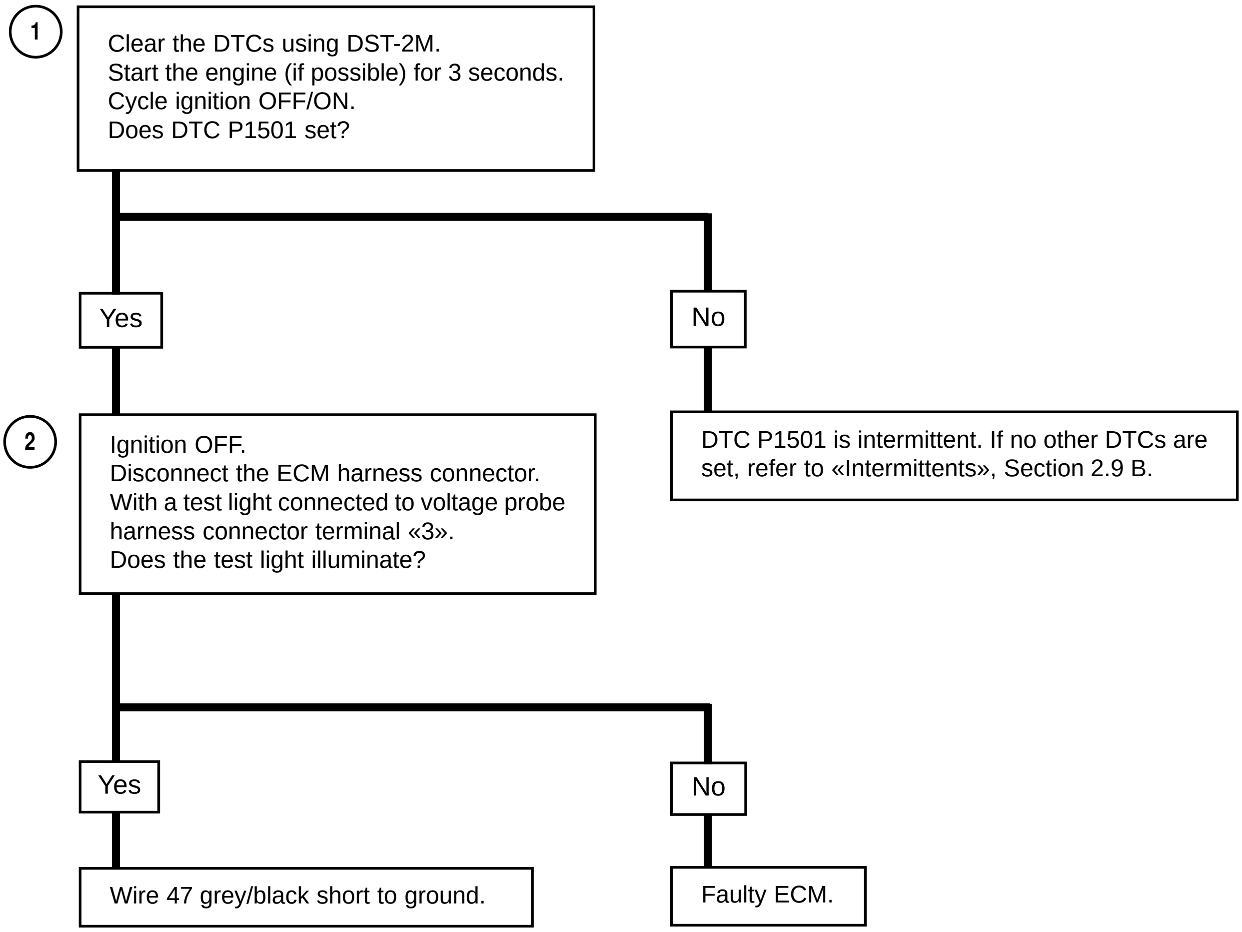
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if DTC P1501 is set.
2. Checks circuit 47 grey/black for a possible short to ground.

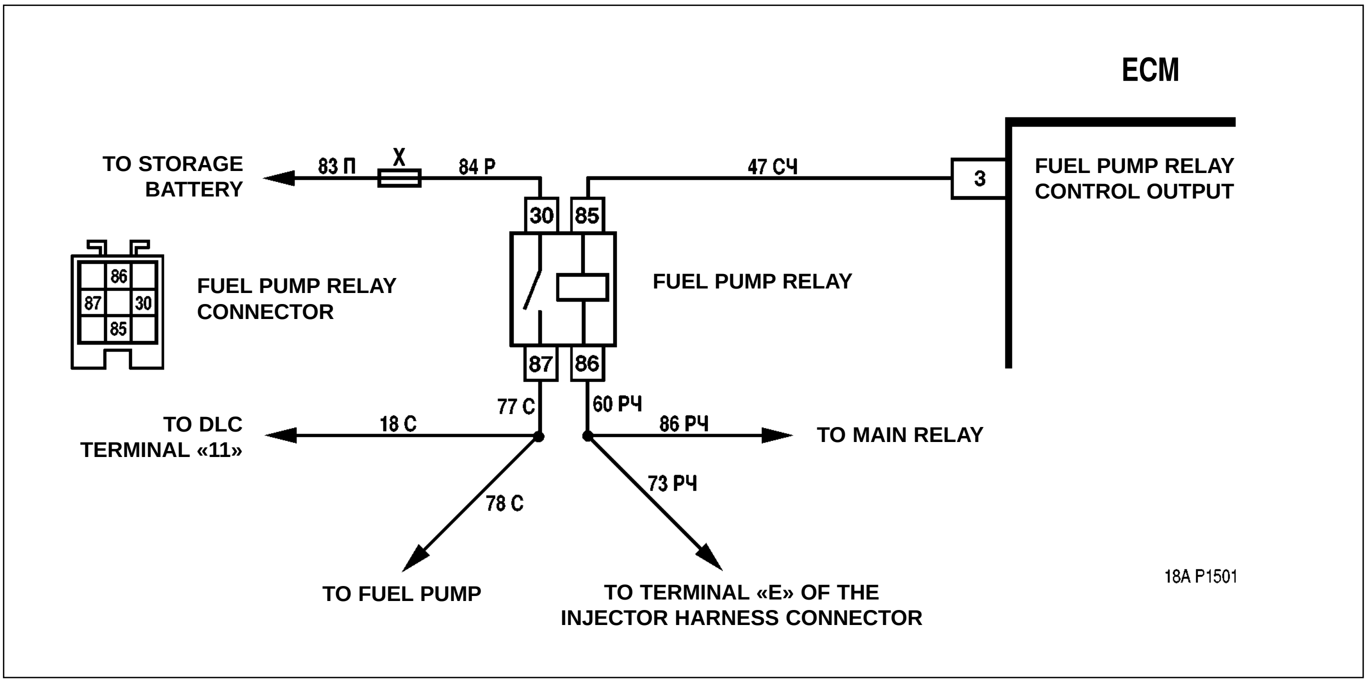
Diagnostic Aids

The ECM MP7.0H features fuel pump relay driver, which has a self diagnostic function. It can detect such problems as control circuit open or short to ground or voltage.

DTC P1501
Fuel Pump Relay, Circuit Low



After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1502

Fuel Pump Relay, Circuit High

Conditions for setting DTC P1502:

- engine is running or cranking;

- fuel pump relay driver self diagnostic has detected output short to voltage.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if DTC P1502 is set.
2. Checks the fuel pump relay control circuit for a fault.
3. Checks circuit 47 grey/black for a possible short to ground.

Diagnostic Aids

The ECM MP7.0H features fuel pump relay driver, which has a self diagnostic function. It can detect such problems as control circuit open or short to ground or voltage.

DTC P1502
Fuel Pump Relay, Circuit High

1 Clear the DTCs using DST-2M.
Start the engine (if possible) for 3 seconds.
Cycle ignition OFF/ON.
Does DTC P1502 set?

- **Yes** → go to 2
- **No** → DTC P1502 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.

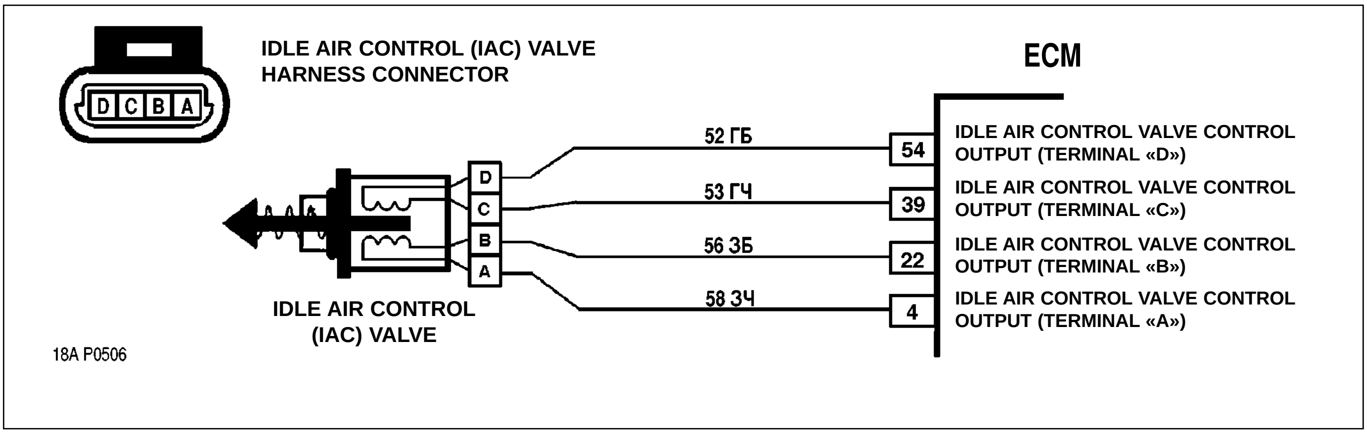
2 Ignition OFF.
Disconnect the fuel pump relay.
Ignition ON.
Using a test light connected to ground probe harness connector terminal «85».
Does the test light illuminate?

- **Yes** → go to 3
- **No** → Faulty fuel pump relay.

3 Ignition OFF.
Disconnect the ECM harness connector.
Ignition ON.
Using a test light connected to ground probe terminal «85» of the harness connector disconnected from the relay.
Does the test light illuminate?

- **Yes** → Circuit 47 grey/black short to voltage.
- **No** → Faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1509

Idle Control Valve Power Stage, Overload

Conditions for setting DTC P1509:

- engine is running;

- system voltage UBAT is within 7...16 volts;

- IAC valve driver self diagnostic has detected overload.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the IAC motor winding resistance.

Diagnostic Aids

The ECM MP7.0H features IAC valve driver, which has a self diagnostic function. It can detect such problems as control circuit open, short to ground or overload.

Refer to «Intermittents», Section 2.9 B.

DTC P1509
Idle Control Valve Power Stage, Overload

1

Ignition OFF.
Disconnect the IAC valve harness connector.
Using a multimeter check resistance of the IAC motor winding.
Resistance between the IAC valve terminals «A» and «B», «C» and «D» should measure 40...80 Ohms, does it?

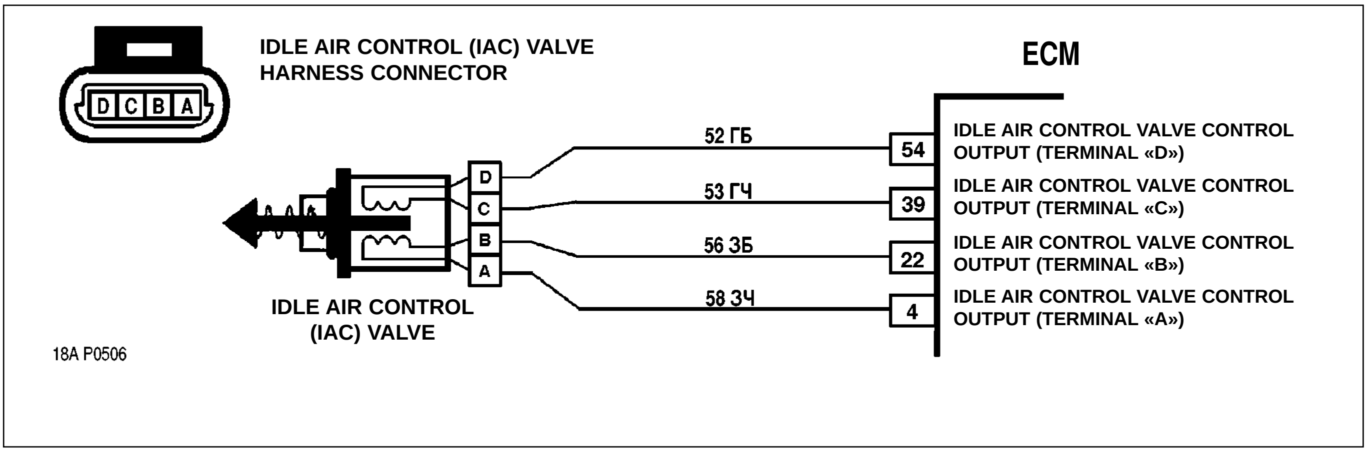
Yes

Using DST-2M clear the DTCs.
If DTC P1509 resets, replace the ECM.

No

Replace the IAC valve and repeat the check.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1513

Idle Control Valve Power Stage, Circuit Low

Conditions for setting DTC P1513:

- engine is running;

- system voltage UBAT is within 7...16 volts;

- IAC valve driver self diagnostic has detected output short to ground.

The MIL (Check Engine light) illuminates immediately after a fault is detected.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks voltage at the IAC valve harness connector terminals using a test light.

2. This test uses a test light to check voltage at the harness connector terminal(s) with the ECM harness connector disconnected. This allows to locate the control circuit short to ground – either the wire or the ECM.

Diagnostic Aids

The ECM MP7.0H features IAC valve driver, which has a self diagnostic function. It can detect such problems as control circuit open, short to ground or overload.

When DTC P1513 sets the driver discontinues to control the IAC valve.

After repairs the driver recontinues to control the IAC valve only after ignition has been cycled OFF/ON.

An intermittent may be caused by the IAC motor terminals touching the inner side of the IAC valve housing as a result of heavy vibration.

Refer to «Intermittents», Section 2.9 B.

DTC P1513

Idle Control Valve Power Stage, Circuit Low

Connect DST-2M.
Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

- **Yes** → go to step 1
- **No** → DTC P1513 is intermittent. If no other DTCs are set, refer to «Diagnostic Aids».

1

Ignition OFF.
Disconnect the IAC valve harness connector.
With a test light connected to voltage probe the harness connector terminals.
Does the test light illuminate?

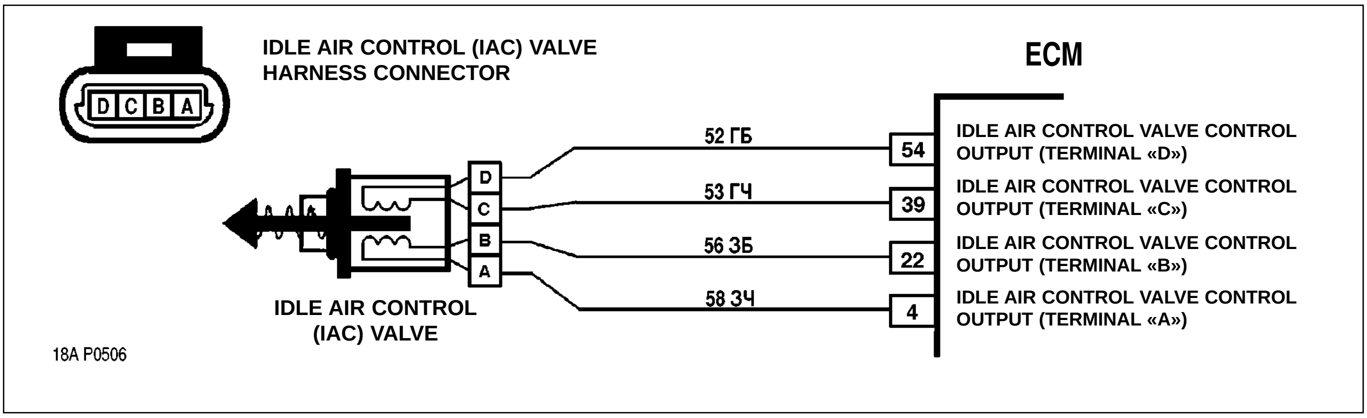
- **Yes** → go to step 2
- **No** → Faulty IAC valve.

2

Disconnect the ECM harness connector.
With a test light connected to voltage probe the harness connector terminal which illuminated the test light during the previous check.
Does the test light illuminate?

- **Yes** → Control circuit being checked is shorted to ground.
- **No** → Faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1514

Idle Control Valve Power Stage, Circuit Malfunction

Conditions for setting DTC P1514:

- engine is running;

- system voltage UBAT is within 7...16 volts;

- IAC valve driver self diagnostic has detected output short to ground or no load condition.

The MIL (Check Engine light) illuminates immediately after a fault is detected.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks resistance of the IAC motor winding.
2. Checks control circuits for a possible short to voltage.
3. This test uses a multimeter to check control circuits for an open.
4. This test uses a multimeter to check resistance of the faulty circuit. This allows to locate the control circuit open – either the harness or the ECM.

Diagnostic Aids

The ECM MP7.0H features IAC valve driver, which has a self diagnostic function. It can detect such problems as control circuit open, short to ground or overload.

When DTC P1514 sets the driver discontinues to control the IAC valve.

After repairs the driver recontinues to control the IAC valve only after ignition has been cycled OFF/ON.

DTC P1514
Idle Control Valve Power Stage, Circuit Malfunction

Connect DST-2M.
Start the engine.
Using DST-2M select: «4 - DT Codes; 1 - Interpretation».
Is the DTC currently active?

Yes →

1 Stop the engine.
Disconnect the IAC valve harness connector.
Using a multimeter check resistance of the IAC motor winding.
Resistance between the IAC valve terminals «A» and «B», «C» and «D» should measure 40...80 Ohms, does it?

No → DTC P1514 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.

Step 1:

Yes →

2 Disconnect the ECM harness connector.
With a test light connected to ground check voltage at all terminals of the disconnected IAC valve harness connector.
Does the test light illuminate?

No → Faulty IAC valve.

Step 2:

No →

3 Reconnect the ECM harness connector.
Ignition ON.
Using a multimeter check voltage between the connector terminals and ground.
All checks should indicate 4...6 volts, do they?

Yes → Control circuit short to voltage.

Step 3:

No →

4 Ignition OFF.
Disconnect the ECM harness connector.
Using a multimeter check circuit resistance between the terminal which did not indicate 4...6 volts and the corresponding terminal at the ECM harness connector.
Resistance should read less than 1 Ohm, does it?

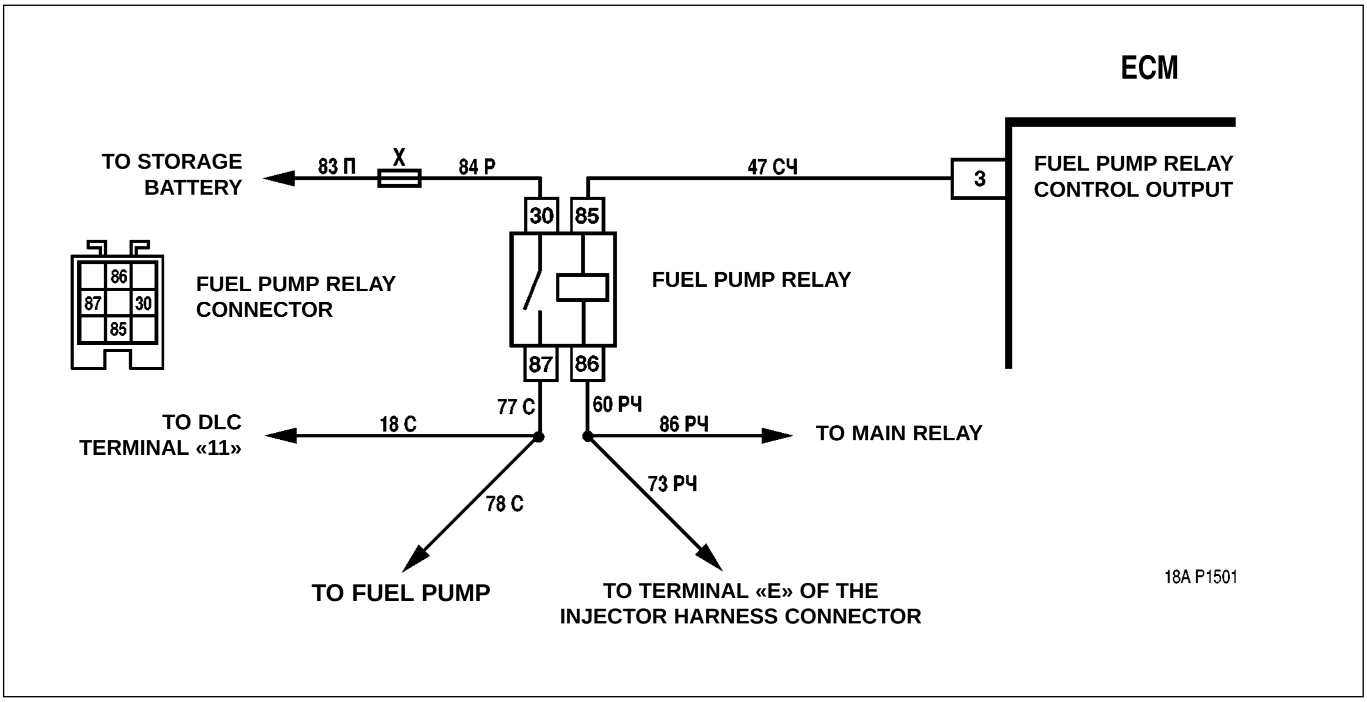
Yes → Poor connection at the IAC valve harness connector.

Step 4:

Yes → Faulty ECM.

No → Repair the open.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1541

Fuel Pump Relays, Circuit Interrupt

Conditions for setting DTC P1541:

- ignition OFF, but the main relay still ON (stop-phase);

- the fuel pump relay driver self diagnostic has detected no load condition.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if DTC P1541 is set.
2. This test uses a multimeter to check voltage at harness connector terminal «86».
3. This test uses a multimeter to check voltage at harness connector terminal «85».
4. This test uses a multimeter to check circuit 47 grey/black for an open.

Diagnostic Aids

The ECM MP7.0H features fuel pump relay driver, which has a self diagnostic function. It can detect such problems as control circuit open or short to ground or voltage.

DTC may set due to improper connection of an additional alarm system.

DTC P1541

Fuel Pump Relays, Circuit Interrupt

1

Clear the DTCs using DST-2M.
Start the engine (if possible) for 3 seconds.
Cycle ignition OFF/ON.
Does DTC P1541 set?

- **Yes** → go to 2
- **No** → DTC P1541 is intermittent. If no other DTCs are set, refer to «Intermittents», Section 2.9 B.

2

Ignition OFF.
Disconnect the fuel pump relay.
Ignition ON.
Using a multimeter check voltage at harness connector terminal «86».
Does the multimeter indicate voltage close to battery voltage?

- **Yes** → go to 3
- **No** → Wire 60 pink/black or 86 pink/black open.

3

Using a multimeter check voltage at harness connector terminal «85».
The multimeter should indicate about +5 volts, does it?

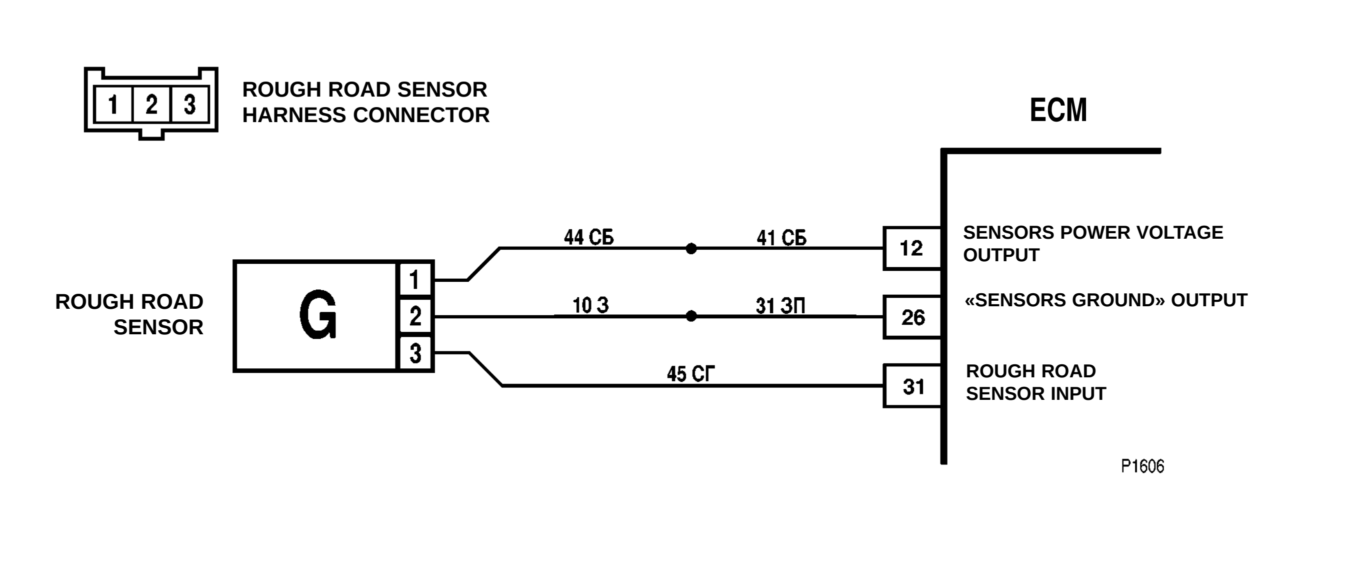
- **No** → go to 4
- **Yes** → Poor connection or faulty fuel pump relay.

4

Disconnect the ECM harness connector. Using a multimeter check resistance of the 47 grey/black wire.
Resistance should read less than 1 Ohm, does it?

- **Yes** → Poor connection or faulty ECM.
- **No** → Wire 47 grey/black open.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1606

Rough Road Sensor, Malfunction

Conditions for setting DTC P1606:

- engine is running;

- no DTC P0500 is set;

- vehicle speed (VFZ) is 0 km/h;

- ECM detects rough road conditions (B_SWE=«YES») for 20 seconds;

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a constant fault.
2. This test simulates the sensor signal circuit short to ground.
3. Checks the sensor power circuit for a fault.

Diagnostic Aids

When driving on a rough road (B_SWE=«YES») with a faulty VS sensor (VSS fault has not been detected by the diagnostic system yet) the ECM may diagnose a nonexisting fault of the rough road sensor.

An intermittent may be caused by the following conditions:

Poor connection at the ECM or the sensor connectors. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

DTC P1606
Rough Road Sensor, Malfunction

1

Connect DST-2M.
Ignition ON.
Review and record additional information for DTC P1606.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Start the engine.
Is BSMW value within -5...-1g?

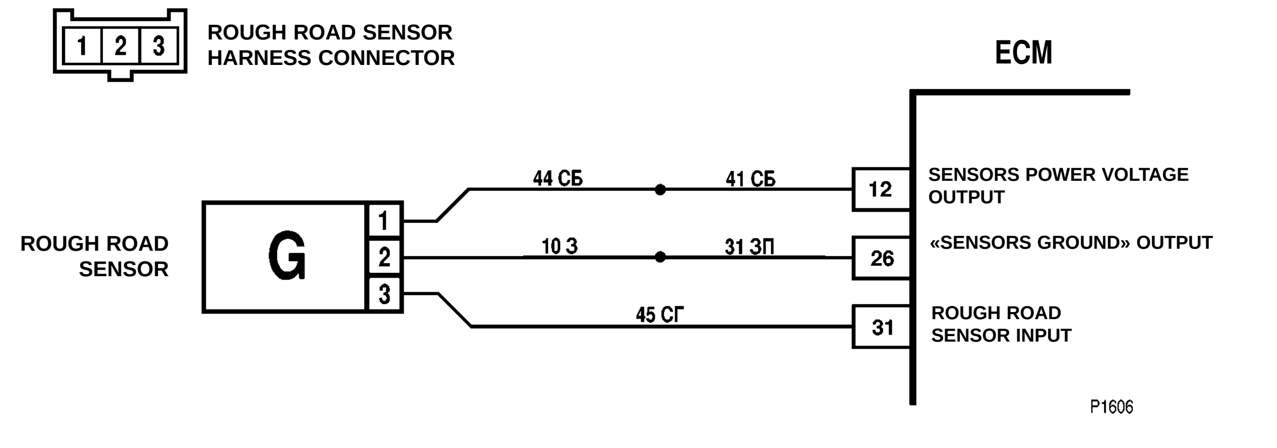
- **Yes** → go to step 2
- **No** → Check for proper and reliable fixing of the rough road sensor. Refer to «Diagnostic Aids».

2

Ignition OFF.
Disconnect the rough road sensor harness connector.
Start the engine and allow it to idle.
Is BSMW value above 6g?

- **Yes** → Check for proper connections of the rough road sensor. If no fault was found, replace the sensor.
- **No** → Faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1616

Rough Road Sensor, Signal Low

Conditions for setting DTC P1616:

- engine is running;

- acceleration filtered value BSMW, calculated using the rough road sensor signal, is below -4.5 g.

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a constant fault.
2. This test simulates the sensor signal circuit open.
3. Checks the sensor signal circuit for a fault.

Diagnostic Aids

The DTC may be caused by the sensor signal circuit (45 grey/blue) short to ground. Inspect the sensor and the ECM harness connectors and wiring.

Refer to «Intermittents», Section 2.9 B.

DTC P1616
Rough Road Sensor, Signal Low

1

Connect DST-2M.
Ignition ON.
Review and record additional information for DTC P1606.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Start the engine and allow it to idle for at least 10 seconds.
Is BSMW value below -4,5 g?

- **Yes** → go to step 2
- **No** → Check for proper and reliable mounting of the rough road sensor. Refer to «Diagnostic Aids».

2

Ignition OFF.
Disconnect the rough road sensor harness connector.
Start the engine and allow it to idle.
Does BSMW exceed 6 g after 8 seconds?

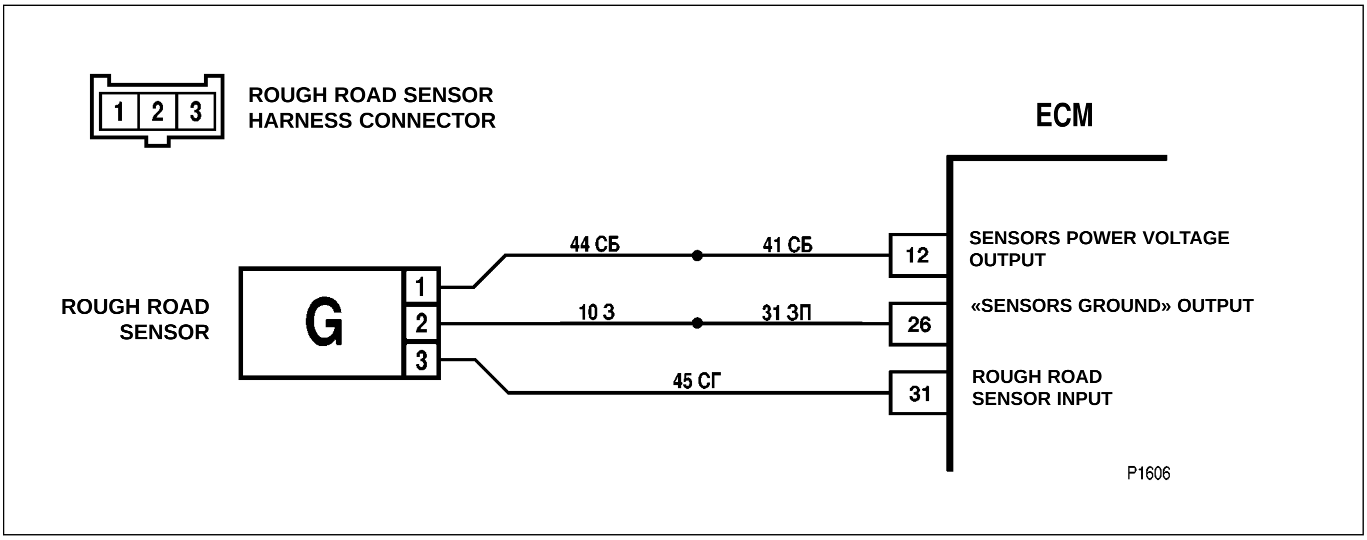
- **No** → go to step 3
- **Yes** → Replace the rough road sensor. Refer to «Diagnostic Aids».

3

Stop the engine.
Disconnect the ECM harness connector.
Using a multimeter check resistance between harness connector terminals «26» and «31».
Does the multimeter indicate above 1 MOhm?

- **Yes** → Faulty ECM.
- **No** → Wire 45 grey/blue short to ground.

After repairs start the engine, clear DTCs and confirm no fault is present.



DTC P1617

Rough Road Sensor, Signal High

Conditions for setting DTC P1617:

- engine is running;

- acceleration filtered value BSMW, calculated using the rough road sensor signal, is above 4.5 g;

MIL (CHECK ENGINE light) illuminates two drive cycles after the DTC is set.

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a constant fault.
2. This test simulates the sensor signal circuit short to ground.
3. Checks the sensor ground circuit for a fault.
4. Checks the sensor power circuit for a fault.

Diagnostic Aids

DTC P1617 may be caused by: the sensor power (41/44 grey/white), ground (10 green, 31 green/red) or signal (45 grey/blue) circuit open or the sensor signal circuit short to ground.

An intermittent may be caused by the following conditions:

Poor connection at the ECM or the sensor connectors. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Damaged harness. Inspect harness for damage. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harness related to the sensor.

Refer to «Intermittents», Section 2.9 B.

DTC P1617

Rough Road Sensor, Signal High

1
Connect DST-2M.
Ignition ON.
Review and record additional information for DTC P1617.
Using DST-2M select: «1 - Parameters; 2 - Groups Preview».
Start the engine and allow it to idle for at least 10 seconds.
Is BSMW value above 4,5 g?

- **Yes** → go to step 2.
- **No** → Check for proper and reliable mounting of the rough road sensor. Refer to «Diagnostic Aids».

2
Ignition OFF.
Disconnect the rough road sensor harness connector.
Start the engine and allow it to idle.
Jumper the harness connector terminal «C» to ground.
Is BSMW value below -6 g?

- **Yes** → go to step 3.
- **No** → Wire 45 grey/blue open or faulty ECM.

3
Stop the engine.
Ignition ON.
Using a test light connected to B+ probe harness connector terminal «B».
Does the test light illuminate?

- **Yes** → go to step 4.
- **No** → Wire 10 green or 31 green/red open.

4
Using a multimeter check voltage between harness connector terminal «A» and ground.
Does the multimeter indicate voltage above 4 volts?

- **Yes** → Inspect the harness connector terminals. If no problem is found, replace the rough road sensor.
- **No** → Wire 41/44 grey/white open or faulty ECM.

After repairs start the engine, clear DTCs and confirm no fault is present.

DTC P1570
Immobilizer, Not Positive Answer

Conditions for setting DTC P1570:

- the ECM and the Immobilizer module are programmed (learnt);

- the ECM does not receive signal from the Immobilizer control module.

Clear the DTCs using DST-2M.

If the DTC resets, replace the Immobilizer control module.

DTC P1602
Permanent Supply Voltage, Circuit Interrupt

Conditions for setting DTC P1602:

- ignition ON;

- the ECM detects RAM data loss.

Clear the DTCs using DST-2M.

If the DTC resets, check the battery power circuit to ECM terminal «18».

DTC P1640
EEPROM Write-Read Test, Error

DTC P1640 sets in case of EEPROM data loss during the ECM internal read-write test.

Clear the DTCs using DST-2M.

If the DTC resets replace the ECM.

DTC P1689
Fault Memory Functionality Check, Error

Clear the DTCs using DST-2M.

If the DTC resets, replace the ECM.

2.9 B. Diagnostic Charts

Important Preliminary Checks

Before using this section perform the Diagnostic Circuit Check.

Verify the customer complaint and determine symptoms more exactly.

If the engine cranks but will not start, use Chart A-3.

Diagnosing, repairing or trouble-finding call for careful visual inspection of the underhood. Sometimes it allows to correct the problem without further checks.

Check all vacuum hoses for incorrect routing, kinks, cuts or disconnection. Make sure to check hoses in the hard-to-reach places behind the air cleaner, air conditioner, A/C compressor, alternator, etc.

Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifold.

Before Starting

Check the EMS connections for being tight, and for proper connection. Give special attention to power and ground circuits.

Check vacuum hoses for splits, kinks or improper connections. Check thoroughly for any type of leak or restriction.

Check induction system for air inleakage.

Check the HT leads for cracks, improper routing or carbon tracking.

Check wiring for improper connection or damage.

Intermittents

Symptoms:

- Problem may or may not illuminate the MIL (Check Engine light) or store a DTC.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Diagnostic Charts, Section 2.9 A

DO NOT use the Diagnostic Trouble Code (DTC) Charts from Section 2.9 A for intermittent problems. The fault must be present to repair the problem. If the fault is intermittent, using diagnostic charts may result in replacing good parts.

Faulty Electrical Connections Or Wiring

Most intermittent problems are caused by faulty electrical connections or wiring. Check carefully for the following conditions:

- poor mating of the connector halves;
- improperly formed or damaged terminals;
- damaged or missing seals;
- poor terminal to wire connection.

Replace damaged terminals and seals as necessary.

Road Tests

If visual inspection fails to isolate the problem the vehicle may be driven with a voltmeter connected to a suspected circuit, or using DST-2M.

An abnormal voltmeter or DST-2M reading when malfunction occurs is a good indication that there is a fault in the circuit being monitored.

The scan tool has a special mode: «3 - DataCollection». This mode can be used to collect the ECM serial data at the moment when the problem occurs, and also to reproduce them later in step-by-step manner to detect any parameter deviation at the moment when the problem occurs.

For more information on this mode refer to DST-2M manual.

Intermittent MIL (Check Engine light)

An intermittent MIL (Check Engine light) with no stored DTC may be caused by the following:

- electrical system interference caused by a defected relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge (normally, the problem will occur when the faulty component is operated);
- improper installation of electrical options such as lights, radio etc.
- improper injection system wire routing. Wires should be kept away from the HT leads, ignition system components and alternator;
- ignition system secondary wiring short to ground;
- MIL (Check Engine light) circuit intermittent short to ground;
- EMS grounds are not clean, tight or properly connected (these leads are connected to the engine at the face of cylinder head cover. See Fig. 2.6-01).

Hard Start

Symptoms:

- Engine cranks OK, but does not start for a long time. Does eventually start but immediately dies.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Check to see if the driver is using the correct starting procedure, i.e. depressing and holding down the clutch pedal while the engine is cranking without depressing the accelerator pedal.

Check to see if the driver is using the correct procedure to disarm the immobilizer system.

Check the air cleaner filter element for excessive dust or clogging.

Main Checks

Sensors

Check the following items:

- Engine Coolant Temperature (ECT) Sensor. Using DST-2M compare the ECT value of the completely cool engine with the ambient temperature.

If the ECT of the completely cooled engine differs from the ambient temperature by more than 20°C, check resistance of the ECT sensor and its circuits. Compare resistance reading with the table value from the diagnostic charts for DTCs P0117 or P0118;

- Throttle Position (TP) Sensor. Refer to Chart C-2;

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01).

Fuel System Problems

Check the following items:

- fuel filter in the fuel line for restriction. Refer to Chart A-6 (page 2);

- fuel pressure. Refer to Chart A-6;

- check for contaminated fuel;

- fuel pump activation. Connect a test light between the DLC terminal «G» and ground. Cycle ignition OFF for at least 15 seconds and then ON without starting the engine. The test light should illuminate for 3 seconds and then go off. If not, refer to Chart A-5.

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;

- Crankshaft Position (CKP) Sensor resistance and connections;

- damaged HT leads insulation;

- ignition module connections;

- ignition system circuits. Refer to Chart A-3 (page 2).

Engine Mechanical Problems

Check the following items:

- compression;

- valve timing;

- check the camshaft for wear.

Starter And Battery Charge

Check for low cranking speed which may impair starting. Use DST-2M to monitor cranking speed.

Important: Cranking speed should be at least 80 rpm and system voltage at least 6.5 volts for the engine to start up.

Auxiliary Checks

Check the Idle Air Control (IAC) valve operation. Refer to Chart C-4.

Misses

Symptoms:

- steady pulsation or jerking when engine speed changes, more pronounced as the engine load increases;

- steady chugging at idle or low rpm.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Main Checks

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;

Fuel System Problems

Check the following items:

- injector balance. Refer to Chart C-3;

- check for contaminated fuel;

- fuel filter in the fuel line for restriction. Refer to Chart A-6 (page 2);

- fuel pressure. Refer to Chart A-6;

Engine Mechanical Problems

Check the following items:

- valve timing;

- remove the valve train cover. Check the valve springs for being broken or weak and camshaft for lobe wear. Repair as necessary. Refer to the vehicle repair manual;

- compression;

- check the intake and exhaust manifolds for casting flash.

Rough, Unstable, or Incorrect Idle, Stalling

Symptoms:

- engine runs unevenly at idle;

- severe engine vibration.

Engine idle speed may vary in RPM.

Either condition may be severe enough to stall the engine.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Check for vacuum leaks or air inleakage which may cause unstable idle.

Main Checks

Sensors

Check the following items:

- Throttle Position (TP) Sensor. Refer to Chart C-2;

- Engine Coolant Temperature (ECT) Sensor. Using DST-2M compare the ECT value of the completely cool engine with the ambient temperature.

If the ECT of the completely cooled engine differs from the ambient temperature by more than 20°C, check resistance of the ECT sensor and its circuits. Compare resistance reading with the table value from the diagnostic charts for DTCs P0117 or P0118;

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);

- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

EVAP System Problems

Check the following items:

- canister. Visually inspect canister and its hoses. If the canister housing is cracked or otherwise damaged replace the canister.

If fuel leaks are present check the hoses connection. If the canister is leaking fuel replace the canister.

Check EVAP solenoid for proper installation and vacuum hoses connection.

Check the EVAP Purge valve for a fault. To do that use the vacuum pump with the engine not running to supply 50 kPa vacuum to the vacuum port at a speed no grater than 100 cm^3/min. If the vacuum pump gage reading fails to reach 50 kPa, replace the valve.

Fuel System Problems

Check the following items:

- injectors for leaking.

With ignition ON and the engine not running energize the fuel pump relay by supplying battery power voltage to DLC terminal «G».

Remove the fuel rail mounting screws and the fuel lines mounting bracket retaining bolt. Leave fuel lines connected to the fuel rail.

Lift the fuel rail so that injector nozzles stay right above their ports.

Pressurize the fuel system and inspect injectors for leaks in the nozzle area. Replace leaking injectors.

- fuel pressure. Refer to Chart A-6;

- vacuum hose to the fuel pressure regulator for fuel. If fuel is present in the vacuum hose, replace the pressure regulator.

- injector balance. Refer to Chart C-3.

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;

- Crankshaft Position (CKP) Sensor resistance and connections using the chart for DTC P0335;

- damaged HT leads insulation;

- ignition module connections for being tight;

Auxiliary Checks

Check the following items:

- Idle Air Control (IAC) Valve operation. Refer to Chart C-4;

- battery and ground leads for proper and tight connections. Unstable power supply causes IAC valve position changes which result in poor idle;

- system voltage;

- crankcase ventilation system operation. Refer to Chart C-7;

- engine mounts condition;

- compression;

- valve timing. Remove the cylinder head cover. Check the valve springs for being broken or weak and camshaft for lobe wear. Repair as necessary. Refer to the vehicle repair manual;

- using DST-2M check if the ECM receives the A/C request. If the fault is present only when the A/C system is ON, check the A/C system for excessive or low refrigerant.

Surges and/or Stumble

Symptoms:
- engine power variation under steady throttle or cruise;
- feels like the vehicle speeds up and slows down with no change in the accelerator pedal.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Main Checks

Sensors

Check the following items:

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);

- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

Fuel System Problems

Check the following items:

- injectors for restriction. Check injector balance, refer to Chart C-3;

- fuel pressure when the fault is present. Refer to Chart A-6;

- fuel filter in the fuel line for restriction. Refer to Chart A-6 (page 2);

- check for contaminated fuel.

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary.

Auxiliary Checks

Check the following items:

- check ECM grounds for being clean, tight and properly connected. These leads are connected to the engine at the face of cylinder head cover;

- system voltage;

- vacuum hoses for damage or leaks.

Hesitation, Sag, Jerking

Symptoms:

- momentary lack of response as the accelerator pedal is pushed down.

Can occur at all vehicle speeds.

Usually most severe when starting from rest.

May stall the engine if severe enough.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Main Checks

Sensors

Check the following items:

- Throttle Position (TP) Sensor. Refer to Chart C-2;

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01).

Ignition System Problems

Check the following items:

- spark plug cables;

- spark plug condition;

- ignition system circuits. Refer to Chart A-3 (page 2).

EVAP System Problems

Visually inspect hoses and canister. If the canister housing is cracked or otherwise damaged replace the canister.

If fuel leaks are present check the hoses connection. If the canister is leaking fuel replace the canister.

Check EVAP solenoid for proper installation and vacuum hoses connection.

Check the EVAP Purge valve for a fault. To do that use the vacuum pump with the engine not running to supply 50 kPa vacuum to the vacuum port at a speed no grater than 100 cm^3/min. If the vacuum pump gage reading fails to reach 50 kPa, replace the valve.

Fuel System Problems

Check the following items:

- injector balance. Refer to Chart C-3;

- fuel filter in the fuel line for restriction. Refer to Chart A-6 (page 2);

- check for contaminated fuel;

- fuel pressure. Refer to Chart A-6;

Auxiliary Checks

Check the following items:

- intake valves for deposits;

- system voltage.

Lack of Power, Sluggish

Symptoms:

- engine delivers less than expected power;

- little or no increase in speed when accelerator pedal is depressed.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Check the air cleaner filter element for clogging.

Main Checks

Sensors

Check the following items:

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);

- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

Fuel System Problems

Check the following items:

- fuel filter in the fuel line for restriction. Refer to Chart A-6 (page 2);

- check for contaminated fuel.

- fuel pressure. Refer to Chart A-6;

Ignition System Problems

Check for proper ignition voltage output with the spark tester.

Engine Mechanical Problems

Check the following items:

- compression;

- valve timing;

- check the camshaft for wear.

Auxiliary Checks

Check the following items:

- check ECM grounds for being clean, tight and properly connected. These leads are connected to the engine at the face of cylinder head cover;

- exhaust system for backpressure. Refer to Chart C-1;

- A/C system operation. The A/C clutch should disengage at wide open throttle;

- system voltage;

- vehicle run-down;

- wheel sideslip.

Detonation

Symptoms:

- a mild to severe ping, usually worse under acceleration;

- the engine makes sharp metallic knocks that change with throttle opening.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Make sure that the defect is present.

Remove the air cleaner filter element and check it for clogging. Replace as necessary.

If DST-2M readings are normal (See «Typical Scan Tool Data Values») and there are no engine mechanical problems, fill fuel tank with a known quality and proper type gasoline and re-evaluate vehicle performance.

Main Checks

Cooling System Problems

Check the following items:

- cooling system fan operation. Refer to Chart C-6;

- engine coolant temperature is out of range;

- engine coolant level and composition;

- thermostat operation;

- engine coolant type.

Sensors

Check the following items:

- Knock Sensor (KS). Refer to Chart C-6;

- Engine Coolant Temperature (ECT) Sensor for being shifted in value. Check sensor resistance for two coolant temperatures (engine completely cool and engine warmed-up). Compare resistance readings with the table values in diagnostic charts for DTC P0115, P0117 or P0118;

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);

- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

Fuel System Problems

Check the following items:

- fuel pressure. Refer to Chart A-6;
- fuel quality and RON.

Ignition System Problems

Check the following items:

- ignition system cables for short circuit or damaged insulation;
- spark plugs identification code and torquing.

Engine Mechanical Problems

Check the following items:

- compression;
- incorrect installation of engine main components, such as camshaft, cylinder head, pistons etc;
- combustion chambers for deposits.

Excessive Exhaust Emissions or Odors

Symptoms:

- Vehicle fails an emission test.

Excessive odors do not necessarily indicate excessive emissions.

Preliminary Checks

Perform the Diagnostic Circuit Check.

Main Checks

Sensors

Check the following items:

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);
- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

EVAP System Problems

Check the canister for overflow. Using a gas analyzer measure hydrocarbons content at the «AIR» port of the canister and in the ambient (e.g. in the engine compartment). Hydrocarbons content at the «AIR» port exceeding that measured in the engine compartment indicates overflow. Replace the canister.

Fuel System Problems

Check the following items:

- fuel pressure. Refer to Chart A-6;
- injector balance. Refer to Chart C-3.

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;
- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;
- Crankshaft Position (CKP) Sensor resistance and connections;
- damaged HT leads insulation;
- ignition module connections for being tight.

Cooling System Problems

If DST-2M displays high coolant temperature and mixture is lean, check operation of the cooling system and cooling system fan. Refer to Chart C-6.

Engine Mechanical Problems

Check the following items:

- compression;
- combustion chambers for deposits.

Auxiliary Checks

Check the following items:

- induction system for air inleakage;
- crankcase ventilation system operation. Refer to Chart C-7;
- filler neck safety valve which prevents from filling leaded fuel;
- crankcase ventilation system passages for restriction;
- exhaust system for backpressure. Refer to Chart C-1;
- fuel in crankcase.

Run-on

Symptoms:

- Engine continues to run after ignition key is turned OFF, but runs very rough.

If engine runs smoothly, check ignition switch operation and the ignition switch output signal circuit for short to system voltage.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Main Checks

Fuel System Problems

Check the following items:

- injectors for leaking.

With ignition ON and the engine not running activate the fuel pump by supplying battery power voltage to DLC terminal «G».

Remove the fuel rail mounting screws and the fuel lines mounting bracket retaining bolt. Leave fuel lines connected to the fuel rail.

Lift the fuel rail so that injector nozzles stay right above their ports.

Pressurize the fuel system and inspect injectors for leaks in the nozzle area. Replace leaking injectors.

Ignition System Problems

Check spark plugs identification code.

Backfire

Symptoms:

- fuel ignites in the intake manifold, or in the exhaust system, making loud popping noise.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Main Checks

Ignition System Problems

Check the following items:

- check for proper ignition voltage output with the spark tester;

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;

- spark plug boots for damage and spark plug wires for proper connection;

Engine Mechanical Problems

Check the following items:

- compression;

- induction system for air inleakage;

- check the intake and exhaust manifolds for casting flash;

- valve timing;

Remove the valve train cover. Check the valve springs for being broken or weak and camshaft for lobe wear. Repair as necessary. Refer to the vehicle repair manual.

Fuel System Problems

Check the following items:

- fuel pressure. Refer to Chart A-6;

- injector balance. Refer to Chart C-3.

Sensors

Check the following items:

- Throttle Position (TP) sensor. Refer to Chart C-2.

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01).

Poor Fuel Economy

Symptoms:

- fuel economy, as measured by an actual road test, is noticeably lower than expected;

- economy is noticeably lower than it was on this vehicle as previously shown by an actual road test.

Preliminary Checks

Carefully perform visual/physical checks as described earlier in this section.

Check the air cleaner filter element for clogging.

Visually inspect vacuum hoses for damage, kinks or improper connections.

Perform the Diagnostic Circuit Check.

Check vehicle operation conditions:

- A/C on-time;

- tyre pressure;

- vehicle load;

- vehicle operation instructions are not observed.

Main Checks

Sensors

Check the following items:

- Engine Coolant Temperature (ECT) Sensor for being shifted in value. Check sensor resistance for two coolant temperatures (engine completely cool and engine warmed-up). Compare resistance readings with the table values in diagnostic charts for DTC P0115, P0117 or P0118;

- Mass Air Flow (MAF) Sensor. Using DST-2M monitor the mass air flow rate (ML) of the warm engine at idle and at stable 3000 rpm (Refer to Table 2.4-01);

- Fuel Control Heated Oxygen Sensor. Use DST-2M to monitor the sensor signal voltage USVK and injector pulse width modulation correction factors FR, TRA and FRA. Refer to Table 2.4-01.

The sensor should quickly respond to changes of oxygen content in the exhaust gasses. Upon reaching operating temperature the sensor signal should change rapidly within 50...900 mVolts.

If the sensor response is slow or its voltage remains at steady level, check the sensor for silicone, glycol or other contaminants. The sensor may have white powdery coating (silicone poisoning) or green coating (glycol poisoning) which result in a false voltage signal supplied to the ECM and driveability concerns.

Fuel System Problems

Check fuel pressure. Refer to Chart A-6;

Ignition System Problems

Check the following items:

- wet plugs, cracks, wear, improper gap, damaged electrodes, or heavy deposits. Repair or replace as necessary;

- ignition system wires for damaged insulation or improper connection.

Cooling System Problems

Check the following items:

- engine coolant level;

- thermostat operation (constantly open) and temperature range.

Auxiliary Checks

Check the following items:

- compression;

- brakes for drag;

- exhaust system for backpressure. Refer to Chart C-1;

- gearbox operation;

- induction and crankcase ventilation systems for air inleakage.

EMS Circuits Symptoms Chart

The table below is designed for more thorough diagnosis. Column «Voltage» provides voltage values for the EMS circuits with the ECM connected and no fault present. All measurements should be made using a digital multimeter and a special adapter Y 261 A24 300, Bosch.

Measurement results may vary due to low battery charge or other reasons, however, they should be reasonably close to the specified values.

The Following Conditions Must Be Met Before Testing:

- engine at operating temperature;
- engine at low idle (for «Eng. Run»);
- DST-2M not connected;
- air conditioning (if provided) OFF;
- multimeter negative lead connected to clean ground.

Notes:

(1) - Square pulses with amplitude below 5 volts and varying width.

(2) - Open or short.

(3) - Voltage is below 0.1 volts during the first two seconds after ignition is switched ON without engine cranking.

(4) - Short to ground.

(5) - With relay energized voltage should read below 0.1 volt. With relay de-energized it should be equal to system voltage.

(6) - Open.

(7) - If the vehicle is stopped, voltage should read below 1 volt or be equal to system voltage depending on the drive wheels position. If the vehicle is moving, square pulse signal should be present in the circuit. Its lower level should be below 1 volt and the upper level equal to system voltage. Frequency of the pulses depends on the vehicle speed (6 pulses per each meter of vehicle movement).

(8) - Voltage decreases as injection pulse width and frequency increase.

(9) - With the MIL illuminated voltage should read below 0.5 volts. If the MIL is OFF, system voltage should be present at the terminal.

(10) - Short to system voltage.

(11) - System voltage should be present if the A/C switch is in the «ON» position and the other A/C request circuit switches are closed, Refer to fig. 1.5-01. If A/C switch is in the «OFF» position, voltage should read below 0.1 volts.

(12) - Changes from system voltage to less than 1 volt depending on the dwell-duty cycle.

(13) - Voltage is not measured.

(14) - Voltage varies depending on the engine coolant temperature.

(15) - Sine wave signal. Its amplitude and frequency depend on engine speed.

(16) - When the engine is running square pulse signal should be present. Its lower level should be below 1 volt and the upper level equal to system voltage.

(17) - If the engine is stopped, voltage should read below 1 volt or be equal to system voltage depending on the camshaft position. If the engine is running, square pulse signal should be present in the circuit. Its lower level should be below 1 volt and the upper level equal to system voltage. The low level signal duty/dwell ratio is 9. Frequency of the pulses is equal to the frequency of the camshaft rotations.

(18) - 2.5 volts should be constantly present in the circuit. When driving on a rough road the vehicle body vibrations cause variations of the sensor signal voltage.

(19) - When the engine is running square pulse signal should be present. Its lower level should be below 1 volt and the upper level equal to system voltage. Low level pulse width is 900 mcsec. Frequency of the pulses depends on the fuel consumption (16 000 pulses per 1 litre).

(20) - Voltage changes depending on the air temperature.

(B+) - System voltage.

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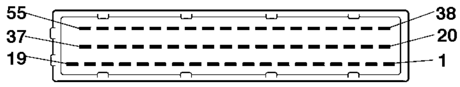
* - To perform diagnosis set the multimeter to measure DC voltage, range 0...15 volts.

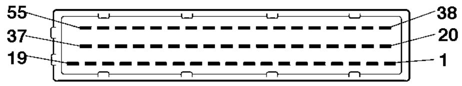
** - To perform diagnosis use an oscillograph set to measure DC voltage.

ECM Connector



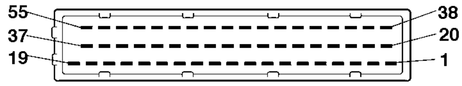
Pin	Wire Color	Pin Function	Connector Cavity	Voltage, Volts		DTC(s)	Possible Symptoms From Faulty Circuit
				Ignition ON	Eng. Run		
1	white/blue	Electronic Spark Timing Control Output. Cyl.#1, 4	Ignition Module, Terminal «B»	0*	(1)**	No	Unstable Idle, Low Power, Stalling – (2).
2		Not used	No Connection				
3	grey/black	Fuel Pump Relay Control Output	Fuel Pump Relay, Terminal «85»	(B+)* (3)	0*	P1501 P1502 P1541	Engine won't start – Refer to Charts A-2, A-5 (6, 10). Fuel Pump operates continuously – (4).
4	green/black	Idle Air Control Valve Control Output	Idle Air Control Valve, Terminal «A»	Not measured		P1509 P1513 P1514	Stalling. Unstable Idle – (2) Refer to Chart C-4.
5	green/yellow	EVAP Purge Control Output	EVAP Purge Valve, Terminal «A»	(B+)*	(12)**	P0443 P1410 P1425 P1426	Fuel Leaks, Fuel Vapor Smell – (6, 10). Unstable Idle – (4).
6		Not used	No Connection				
7	yellow	Mass Air Flow Sensor Input	Mass Air Flow Sensor, Terminal «5»	0.9-1.1*	1.15-1.4*	P0102 P0103	Low Power, Stalling – (4, 6). No DST-2M Signal – (6).
8	white/black	Camshaft Position Sensor Input	CMP Sensor, Terminal «C»	(17)**	(17)**	P0340	Low Power - (2)
9	grey	Vehicle Speed Sensor Input	Speedometer, VSS, Terminal «2»	(7)**	(7)**	P0500	Vehicle Speed displayed by DST-2M differs from speedometer readings – (2).
10	brown/white	Heated Oxygen Sensors Ground Circuit	HO_2S 1, Terminal «C» HO_2S 2, Terminal «C»	0*	0*	P0133 P0134 P0138	Open Loop Mode. DST-2M displays 450 mV at Heated Oxygen Sensors Output (6).
11	white	Knock Sensor Input	Knock Sensor, Terminal «B»	0*	0*	P0327	Severe Knock – (4, 6). No DST-2M Signal – (6).
12	grey/white	Sensors Power Voltage Output	MAF Sensor, Term. «4» TP Sensor, Term. «A» G-Sensor, Term. «A»	5*	5*	P0102 P0122 P1606 P1616	High Idle – (4, 6).
13		Not used	No Connection				
14	brown	«System Ground» Input	Engine Ground	0*	0*	No	Engine won't start, Low Power – (6). Refer to Diagnostic Charts A.
15	white/red	MIL (Check Engine light) Control Output	Instrument Cluster	(9)*	(9)*	No	MIL does not illuminate – (6, 10), or illuminates continuously - (4). Refer to Diagnostic Charts A, A-1, A-2.
16	black/blue	Cylinder #4 Injector Control Output	Injector Harness, Terminal "F"	(B+)*	(8)**	P0204 P0270 P0271	Low Power, Unstable Idle – (2).
17	black	Cylinder #1 Injector Control Output	Injector Harness, Terminal "B"	(B+)*	(8)**	P0201 P0261 P0262	Low Power, Unstable Idle – (2).
18	red	Battery Voltage Input (constant)	Battery "+"	(B+)*	(B+)*	No	Engine won't start – blown fusible link or Z-fuse, open circuits. Refer to Diagnostic Charts A.
19	brown/blue	«ECM Ground» Input	Engine Ground	0*	0*	No	Engine won't start, Low Power – (6). Refer to Diagnostic Charts A.
20		Not used	No Connection				

ECM Connector



Pin	Wire Color	Pin Function	Connector Cavity	Voltage, Volts Ignition ON	 Eng. Run	DTC(s)	Possible Symptoms From Faulty Circuit
21	grey/red	Electronic Spark Timing Control Output. Cyl.#2,3	Ignition Module, Terminal «A»	0*	(1)**	No	Unstable Idle, Low Power, Stalling – (2).
22	green/white	Idle Air Control Valve Control Output	Idle Air Control Valve, Terminal «B»	Not measured		P1509 P1513 P1514	Stalling. Unstable Idle – (2). Refer to Chart C-4.
23	pink/blue	A/C Compressor Clutch Relay Control Output	A/C Compressor Relay	(5)*	(5)*	No	Inoperative A/C system – (6, 10) A/C operates continuously – (4)
24	brown	«System Ground» Input	Engine Ground	0*	0*	No	Engine won't start, Low Power – (6). Refer to Diagnostic Charts A.
25		Not used	No Connection				
26	green/red	«Sensors Ground» Output	TP Sensor, Term. «B» MAF Sensor, Term. «3» ECT Sensor, Term. «A» G-Sensor, Term. «B»	0*	0*	P0123 P0103 P0117 P1617	Low Power, Stalling. Hard Start, High Emissions. High or Unstable Idle – (6).
27	blue/red	Ignition Switch Signal Input	Ignition Switch. Immobilizer Control Module, Terminal «20»	(B+)*	(B+)*	No	Engine won't start - (4, 6). Refer to Diagnostic Charts A.
28	pink	Heated Oxygen Sensor 1 Input	HO_2S 1, Terminal «A»	0.45*	0.05-0.9*	P0130 P0132 P0133 P0134	Open Loop Mode. DST-2M displays 450 mV at Heated Oxygen Sensor 1 Output (6). Odour – (4).
29	pink	Heated Oxygen Sensor 2 Input	HO_2S 2, Terminal «A»	0.45*	0.05-0.9*	P0136 P0137 P0138 P0140	
30	blue	Knock Sensor Input	Knock Sensor, Terminal «2»	0*	0*	P0327	Severe Knock – (6).
31	grey/blue	Rough Road Sensor Input	Rough Road Sensor, Terminal «C»	(18)*	(18)*	P1606 P1616 P1617	
32	yellow/black	Fuel Consumption Output	Trip Computer	(B+)*	(19)**	No	Trip Computer does not display fuel consumption – (6).
33		Not used	No Connection				
34	black/green	Cylinder #2 Injector Control Output	Injector Harness, terminal «C»	(B+)*	(8)** P0264 P0265	P0202	Low Power, Unstable Idle – (2).
35	black/white	Cylinder #3 Injector Control Output	Injector Harness, Terminal «G»	(B+)*	(8)** P0267 P0268	P0203	Low Power, Unstable Idle – (2).
36	red/black	Main Relay Control Output	Main Relay, Terminal «85»	0*	0*	No	Engine won't start - (6, 10). Refer to Diagnostic Charts A.
37	pink/black	Ignition Feed Input (Ign. switch dependent)	Main Relay, Terminal «87»	(B+)*	(B+)*	No	Engine won't start. Refer to Diagnostic Charts A.
38		Not used	No Connection				

ECM Connector



Pin	Wire Color	Pin Function	Connector Cavity	Voltage, Volts		DTC(s)	Possible Symptoms From Faulty Circuit
				Ignition ON	Eng. Run		
39	blue/black	Idle Air Control Valve Control Output	Idle Air Control Valve, Terminal «C»	Not measured		P1509 P1513 P1514	Stalling. Unstable Idle – (2). Refer to Chart C-4.
40		Not used	No Connection				
41	yellow/white	Oxygen Sensor 2 Heater Control Output	HO_2S 2, Terminal «D»	(B+)*	13)	P0141	Open Loop Mode. DST-2M displays 450 mV at Heated Oxygen Sensor 2 Output (6, 10).
42		Not used	No Connection				
43	brown/red	Engine Speed Signal Output	Tachometer	(B+)*	(16)**	No	Inoperative tachometer – (2).
44	green/blue	Intake Air Temperature Sensor Input	MAF Sensor, Terminal «1»	(20)*	(20)*	P0112 P0113	Hard Start - (4, 6).
45	orange	Engine Coolant Temperature Sensor Input	Engine Coolant Temperature Sensor, Terminal «B»	(14)*	(14)*	P0116 P0117 P0118	Hard Start, High Emissions – (2).
46	black/red	Cooling Fan Relay Control Output	Cooling Fan Relay, Terminal «86»	(5)*	(5)*	P0480	Inoperative Fan – (6, 10). Fan operates continuously – (4).
47	green	A/C Request Input Signal	A/C Harness	(11)*	(11)*	No	Inoperative A/C system – (6, 4) A/C operates continuously – (10)
48	green	Crankshaft Position Sensor Input	Crankshaft Position Sensor, Terminal «B»	0*	(15)**	P0335 P0336	Engine won't start - (2). Misses.
49	white	Crankshaft Position Sensor Input	Crankshaft Position Sensor, Terminal «A»	0*	(15)**	P0335 P0336	Engine won't start - (2). Misses.
50		Not used	No Connection				
51	yellow/blue	Oxygen Sensor 1 Heater Control Output	HO_2S 1, Terminal «D»	(B+)*	(13)	P0135	Open Loop Mode. DST-2M displays 450 mV at Heated Oxygen Sensor Output (6, 10).
52		Not used	No Connection				
53	blue/orange	Throttle Position Sensor Input	Throttle Position Sensor, Terminal «C»	0.3-0.7*	0.3-0.7*	P0122 P0123	High or Unstable Idle – (2). Hard Cold Start. Refer to Diagnostic Chart C-1.
54	blue/white	Idle Air Control Valve Control Output	Idle Air Control Valve, Terminal «D»	Not measured		P1509 P1513 P1514	Stalling. Unstable Idle – (2). Refer to Chart C-4.
55	yellow/black	Diagnostic Line «K»	Immobilizer Control Module, Terminal «18»	Not measured		No	DST-2 displays (X). Refer to Diagnostic Chart A-2.

2.9 C. Diagnostic Charts C

(Component Systems Charts)

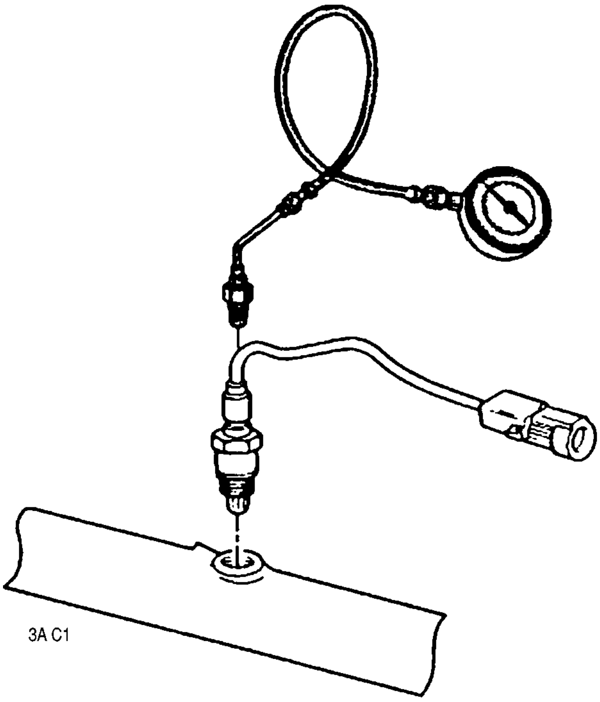


Chart C-1

Exhaust System Backpressure Test

Test Description

1. Carefully remove the HO_2S 1.
2. Install the exhaust system pressure gauge (BT-8515-V, GM or МДВ-1, Samara) in place of the HO_2S 1.
3. Allow the engine to warm up to its normal operating temperature, set engine speed to 2500 rpm and monitor exhaust system backpressure using the pressure gauge.
4. Backpressure above 8.62 kPa indicates restriction in the exhaust system.
5. Inspect the entire exhaust system for bent pipes, thermal damage or possible mufflers internal failures.
6. If no evident causes of high backpressure were detected, the possible cause may be restricted catalytic converter. Replace faulty converter as necessary.

IMPORTANT. Once the test is completed, coat threads with anti-seize compound prior to HO_2S 1 re-installation.

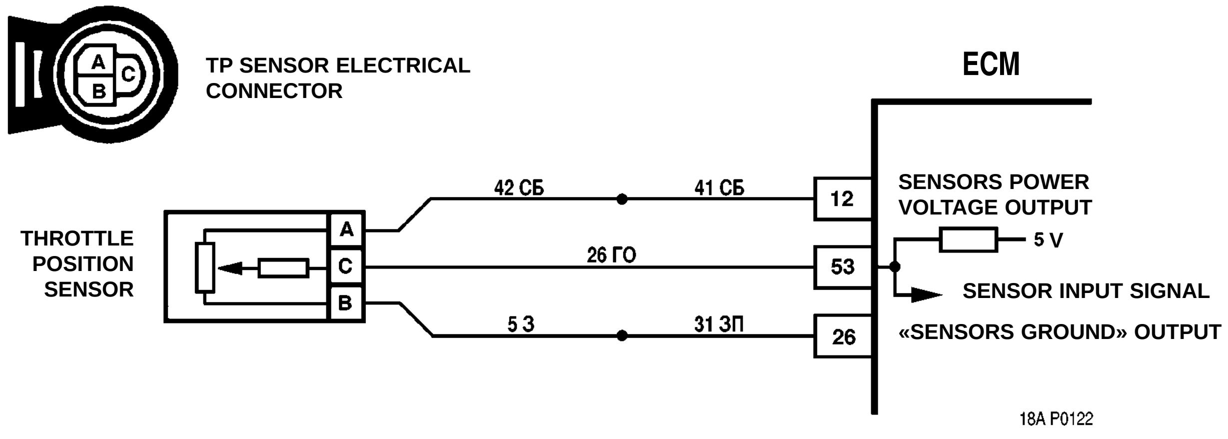


Chart C-2

Throttle Position Sensor Test

Test Description

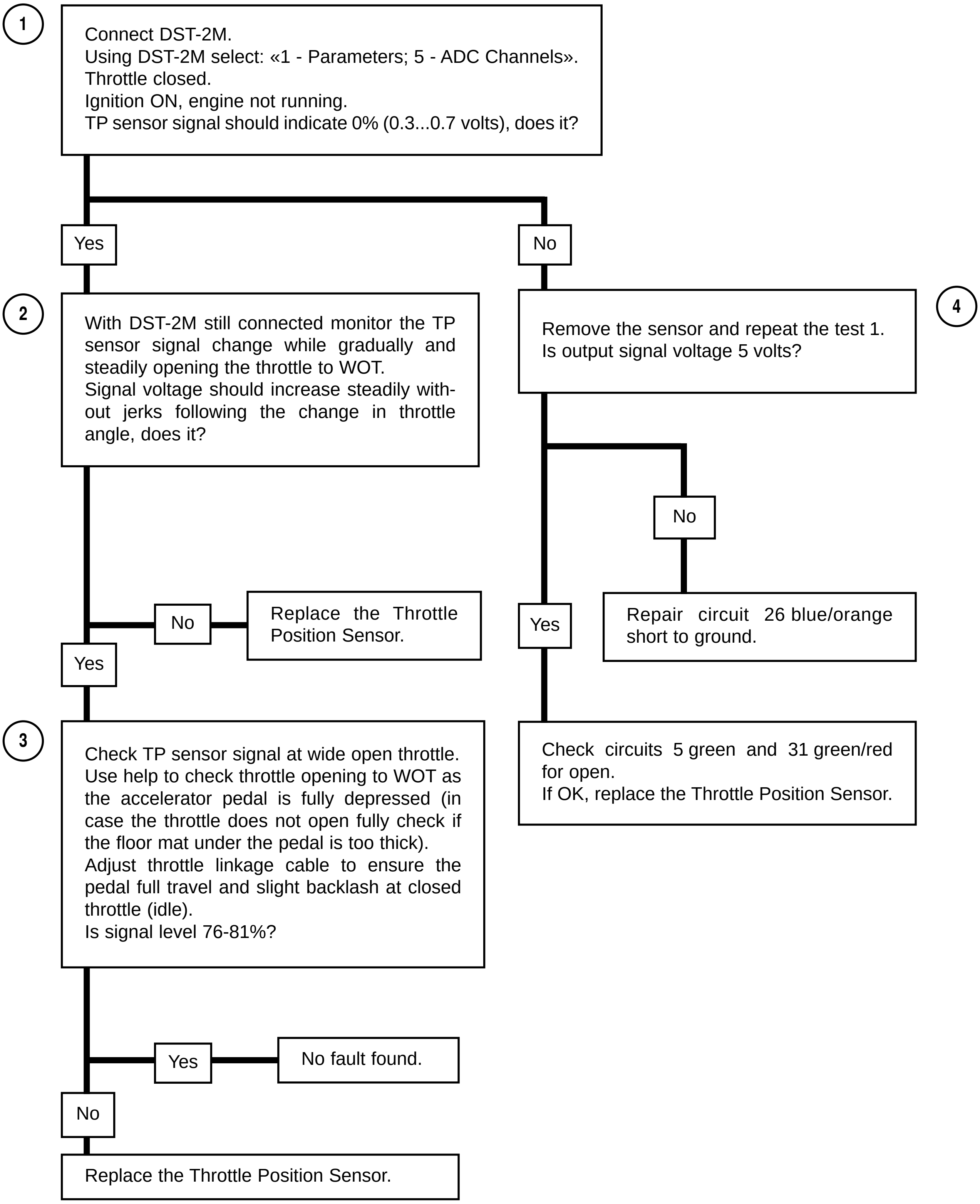
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks TP sensor with the engine stopped.
2. TP sensor signal should follow changes in the throttle angle.
3. TP sensor signal should read 76-81% at wide open throttle.
4. Checks the possible cause of the fault: sensor output signal circuit short to voltage, sensor ground circuit open or faulty TP sensor.

Chart C-2

Throttle Position Sensor Test

If either DTC P0122 or P0123 is set – go to the stored DTC chart first



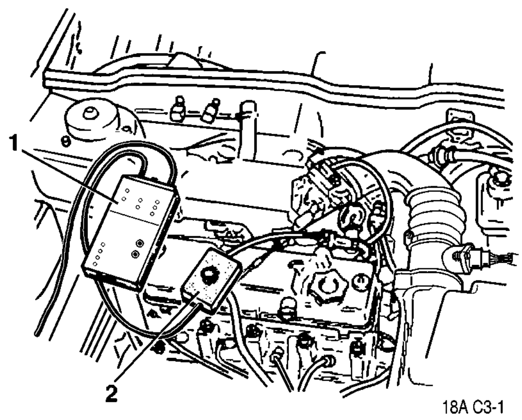


Fig. C3-1
1 - injector tester
2 - tester selector switch

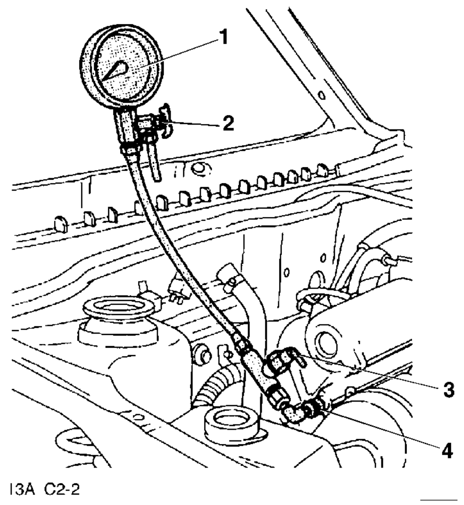


Fig. C3-2
1 - fuel pressure gauge;
2 - air vent;
3 - pressure valve;
4 - fuel pressure test fitting

Chart C-3

Injector Balance Test

Required equipment

1. Injector tester ТДФ-1М, ТДРФХ-1 (РИА, Samara) or GM.

2. Fuel pressure gauge МДФ-1 (РИА, Samara) or GM.

All injectors should be tested under the same conditions (use the same injector tester, fuel pressure gauge, storage battery, fuel temperature, etc.).

The injector tester and the tester selector switch (Fig. C3-1) can be used to activate an injector a certain number of times within certain period, this will inject a known amount of fuel into the intake manifold.

The resulting drop of pressure in the fuel rail can be registered and used to compare injectors.

All injectors should have the same pressure drop (permissible deviation is ± 20% from the mean).

Test Description

Check fuel pressure using Chart A-6 prior to injector balance test.

Step 1

An engine cool-down period (of at least 10 minutes) is necessary in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

A. Ignition OFF.

B. Connect pressure gauge to the fuel pressure test fitting (Fig. C3-2), wrap a shop towel around the connection to avoid fuel spillage.

C. Connect injector tester as described in its operation manual and select injector #1 if necessary (for tester ТДФ-1М, ТДФРХ-1).

D. Ignition ON.

E. Supply voltage to DLC terminal «11» to activate the fuel pump for 10 seconds, then switch the fuel pump OFF. Place a transparent tube connected to the fuel pressure gauge air vent in an approved container. Open the vent and energize the fuel pump until there are no air bubbles in the tube. Close the air vent.

Step 2

A. Energize the fuel pump by supplying power to DLC terminal «G» to achieve maximum fuel pressure. Note fuel pressure after the fuel pump is stopped.

ATTENTION: If the fuel pressure fails to remain constant after fuel pump deactivation, go to Chart A-6 before continuing with this chart.

B. Energize fuel injector #1 by depressing the START button on the fuel injector tester and note the lowest pressure (minor increase of pressure after its drop should be ignored). Subtract the second pressure reading from the first pressure reading to calculate actual pressure drop.

Step 3

A. Repeat step 2 for each injector, using the injector tester switch to select an injector or connecting the injector tester to each injector. Initial (starting) pressure in the fuel rail should be the same for all four injectors.

B. Compare the pressure drop values. Good injectors should have virtually the same pressure drop. If any of the injectors has pressure drop value differing by more than 20% from the average pressure drop, retest the injector. In case the same results are obtained, replace the entire set of injectors.

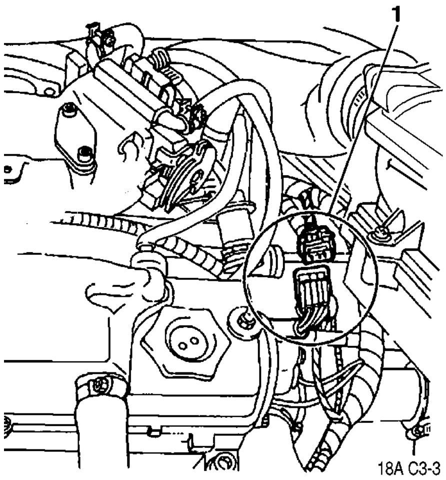


Fig. C3-3
1 - injector harness connector

If the gauge does not indicate pressure drop for any of the injectors, check the tester switch to injector cable for an open or short. Replace the injector set if any of its injectors fails the second test.

If pressure drop for all injectors differs from the average drop by not more than ± 20%, injectors are OK. Reconnect the injector harness connector and try to isolate the fault using driveability symptoms. Refer to Section 2.9 B.

IMPORTANT. Do not repeat the complete check before running the engine in order to prevent the engine from flooding. This also applies to retesting injectors separately.

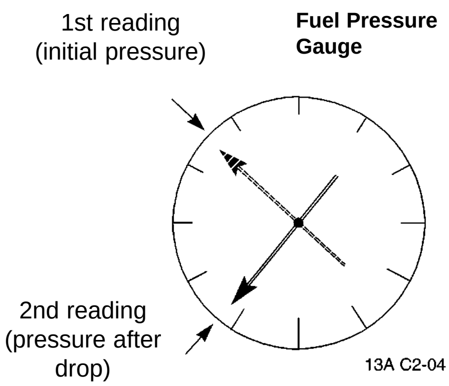
While performing these checks one should keep in mind that the injector balance test implies comparing injectors to each other. Therefore absolute values of fuel pressure drop are of no significance.

Fuel pressure drop value is determined by the following:

- initial pressure value;
- battery voltage;
- fuel supply line and fuel rail capacity;
- material of the rubber hoses;
- accuracy of the pressure gauge and injector tester;
- fuel temperature.

Fuel pressure drop value should, therefore, be different on different vehicles.

An example of injector balance test is given below.



Injectors	1	2	3	4
1st reading, kPa 2nd reading, kPa Pressure drop, kPa	280 230 50	280 235 45	280 230 50	280 245 35
Average pressure drop on other injectors, kPa	43,3	45	43,3	48,3
Deviation of pressure drop from average value, %	15,4	0	15,4	27,6
Pass / Fail	Pass	Pass	Pass	Fail

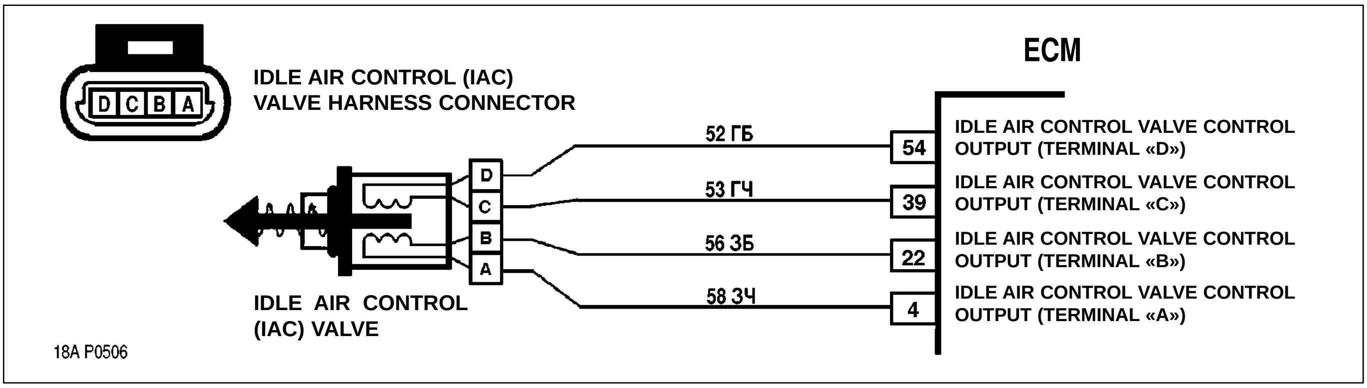


Chart C-4

Idle Air Control Valve Test

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. DST-2M is used to control IAC valve operation. The valve should extend and withdraw smoothly within the specified range.
2. This test checks the IAC valve using tester ТДРХ-1 (Samara) or J-34730-3 (OTC, USA).
3. This test uses a multimeter to check the IAC valve for a fault.

Diagnostic Aids

Low, unstable or high idle may be caused by a fault that cannot be overcome by the IAC valve. The number of steps indicated by DST-2M, which is beyond the IAC valve range, will be above 65 if idle speed is low and below 10 if idle speed is high.

The following checks must be made to repair a non idle control system problem:

System too lean

Idle speed may be low or high. Idle speed may be unstable. Disabling the IAC valve does not remedy the problem. Check fuel metering system for low pressure, water in the fuel or restricted injectors.

System too rich

Low idle speed. Black smoke in the exhaust gasses. Check the fuel metering system for high fuel pressure, leaking injectors or injectors solenoids sticking open.

Throttle Body

Remove the IAC valve and check the bypass airduct for foreign matters. Check the IAC valve connections.

Crankcase Ventilation System

A fault in the crankcase ventilation system may cause unstable idle rpm.

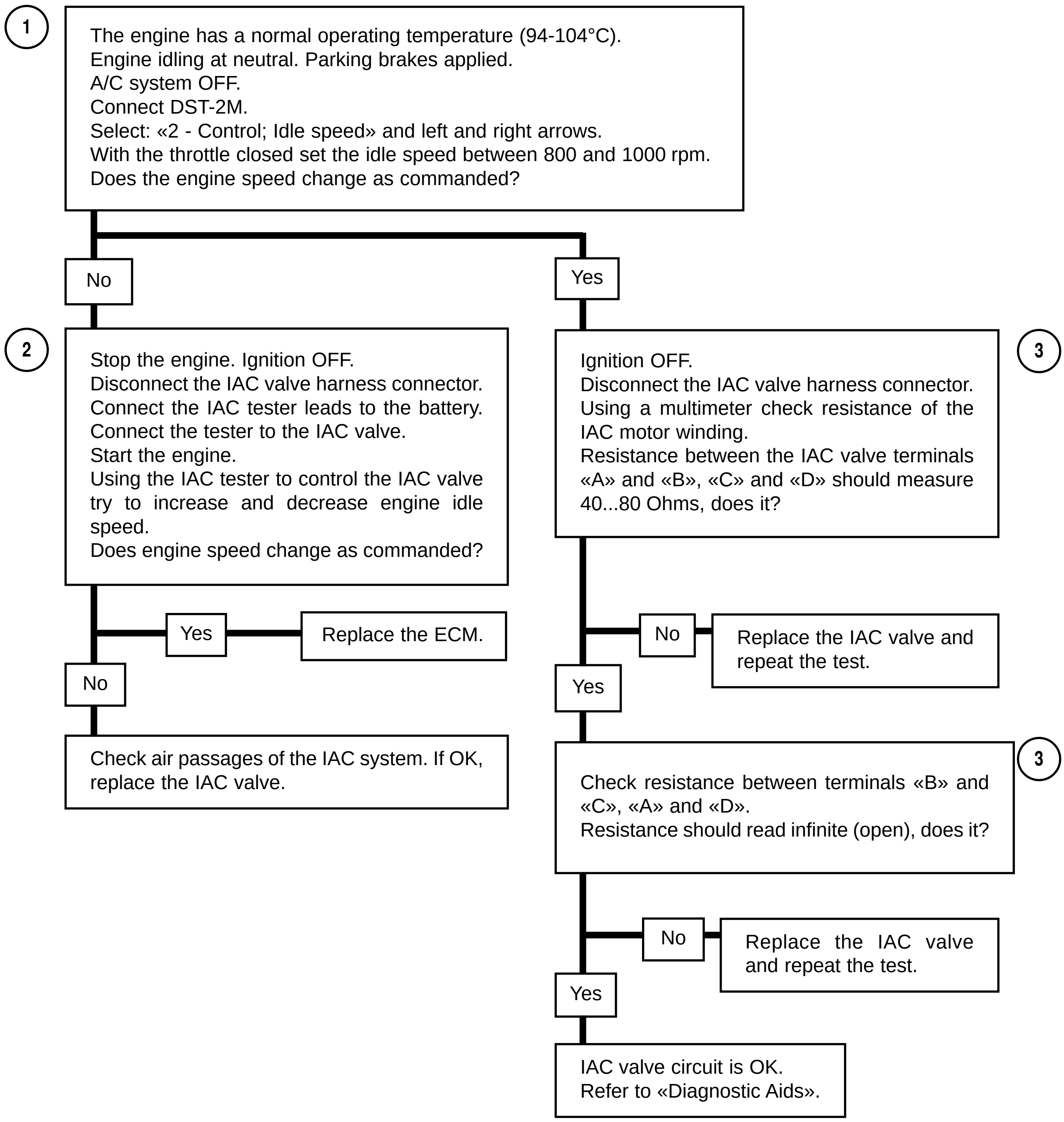
Refer to «Rough, Unstable, or Incorrect Idle, Stalling» in diagnostic charts, Section 2.9 B.

If intermittent driveability or idle control problems disappear when the IAC valve is turned off, thoroughly re-check all connections and resistance between the IAC valve terminals.

Chart C-4

Idle Air Control Valve Test

If either DTC P0506, P0507, P1509, P1513 or P01514 is set – go to the stored DTC chart first



On completing all checks set the IAC valve into its initial position, connect DST-2M and select: «2 - Control; Idle speed» and left and right arrows.

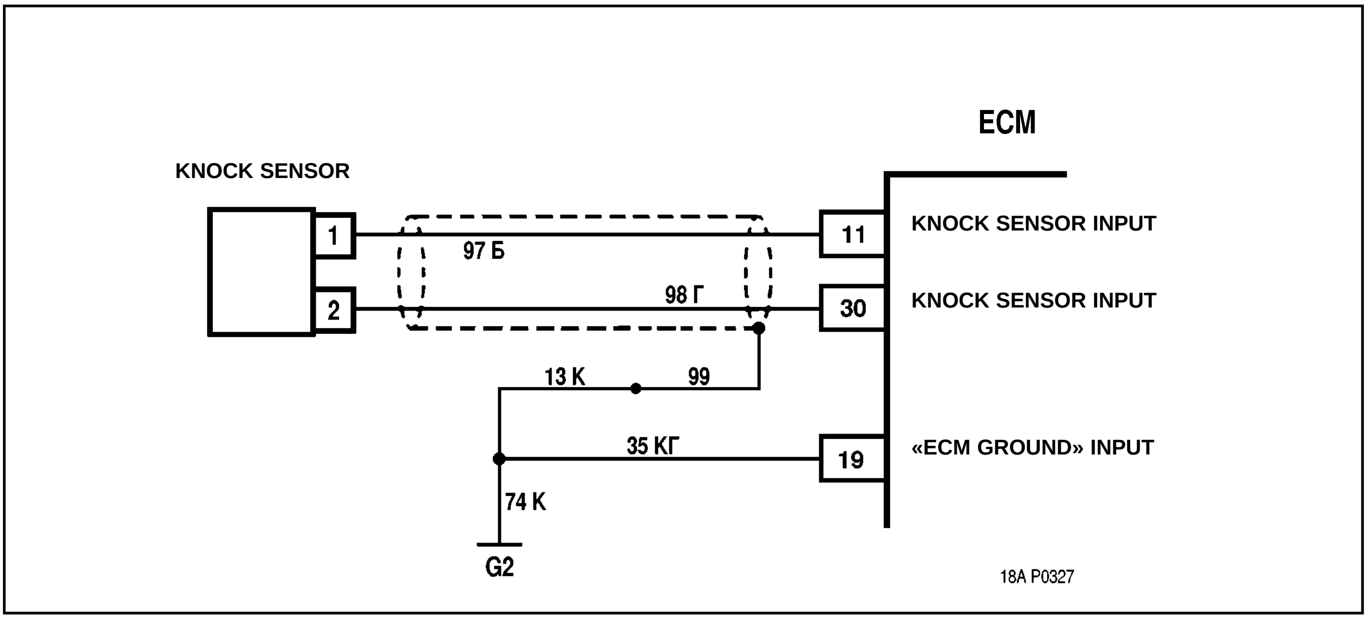


Chart C-5

Knock Sensor System Test

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. No detonation is possible at low idle (760-840 rpm).

2. If the engine has an internal problem causing noise with the frequency of detonation, the KS can detect it.

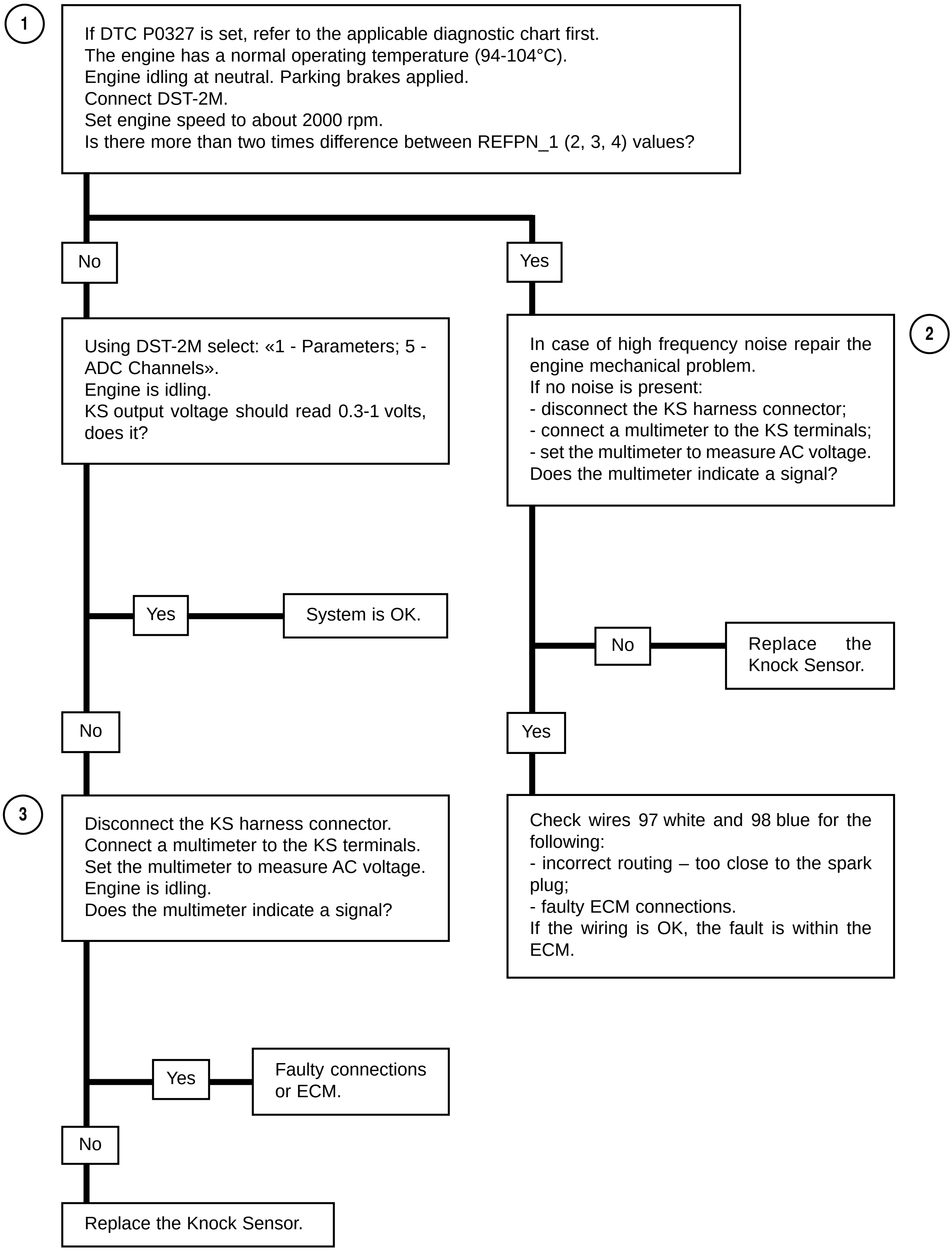
3. This check locates the faulty component – either the KS or the ECM.

Diagnostic Aids

The KS is used to detect knock affected combustion cycles. The ECM uses the KS signal, adaptation parameters and calibration constants to calculate knock retard for the trouble cylinder. The ECM can command knock retard even when no knock is detected. This happens when the engine enters the «operating zone» (determined by engine rpm and load) for which the knock retard counter is set to a certain value. However, if no knock is detected, the knock retard counter for this particular zone will decrease.

Chart C-5

Knock Sensor System Test



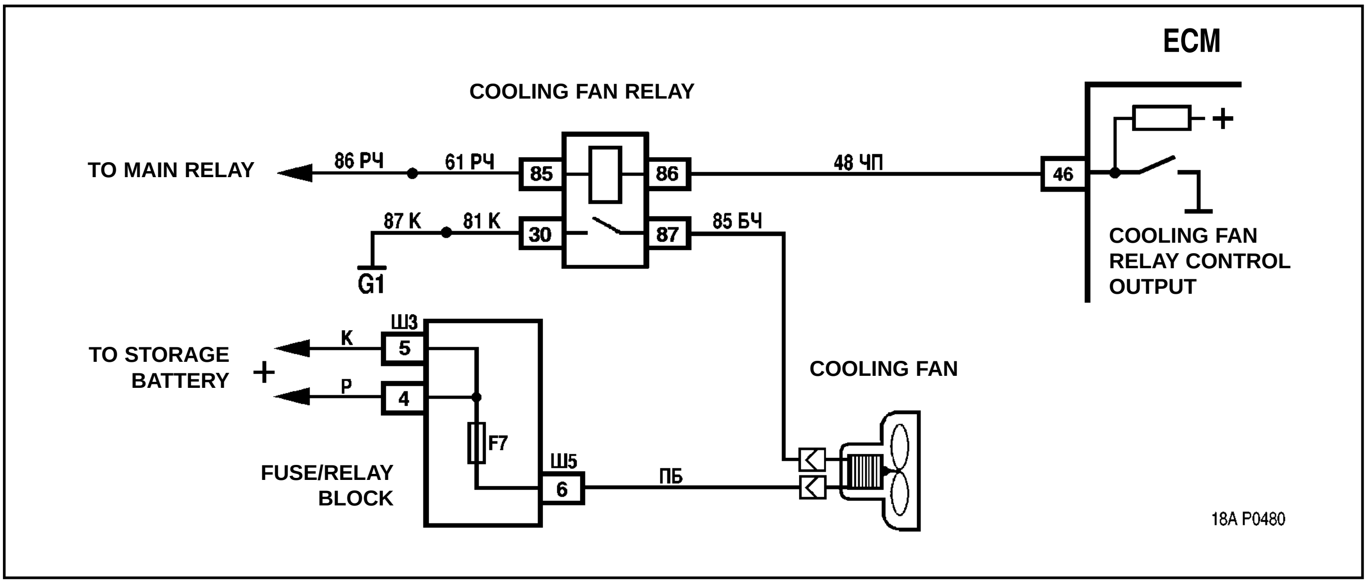


Chart C-6

Cooling Fan Circuit Test

Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

1. The cooling fan should not operate at a cold engine with A/C off and no DTCs P0116, P0117, P0118 or P0480.
2. This test checks if the ECM can control the cooling fan relay.
3. This test checks the cooling fan relay for a fault.
4. Checks the cooling fan control circuit for a fault.

Diagnostic Aids

A faulty thermostat in the engine cooling system may cause continuous operation of the cooling fan.

Chart C-6

Cooling Fan Circuit Test

1 Connect DST-2M and select: «4 - DT Codes; 1 - Interpretation».
Check if DTC P0116, P0117, P0118 or P0480 is set. If any of the DTCs is set refer to the relevant chart to repair the fault.
Start the engine. A/C system is OFF.
Does the cooling fan operate.

- **Yes**: Warm up the engine to 103°C.
Using DST-2M check if DTC P0480 is set.
If no DTC is set, the power circuit to the relay (85 white/black or red/white) is shorted to ground, or the fan relay is faulty.
- **No**: go to 2.

2 Cycle ignition OFF/ON.
Using DST-2M select: «2 - Control; Cooling Fan 1»
Use LEFT and RIGHT arrows to command the cooling fan on/off.
Does the cooling fan turn on/off?

- **Yes**: No fault is found.
Refer to «Intermittents», Section 2.9 B.
- **No**: go to 3.

3 Ignition OFF.
Remove the cooling fan relay.
Ignition ON.
Jumper terminals «30» and «87» of the relay connector.
Does the cooling fan start?

- **Yes**: Faulty relay or poor connection.
- **No**: go to 4.

4 Remove the jumper.
Using a test light connected to power voltage probe terminal «30» of the relay connector.
Does the test light illuminate?

- **Yes**: Power circuit to the relay (85 white/black or red/white) is open, wire 85 white/black is shorted to voltage, or poor connection.
- **No**: Faulty relay or poor connection.

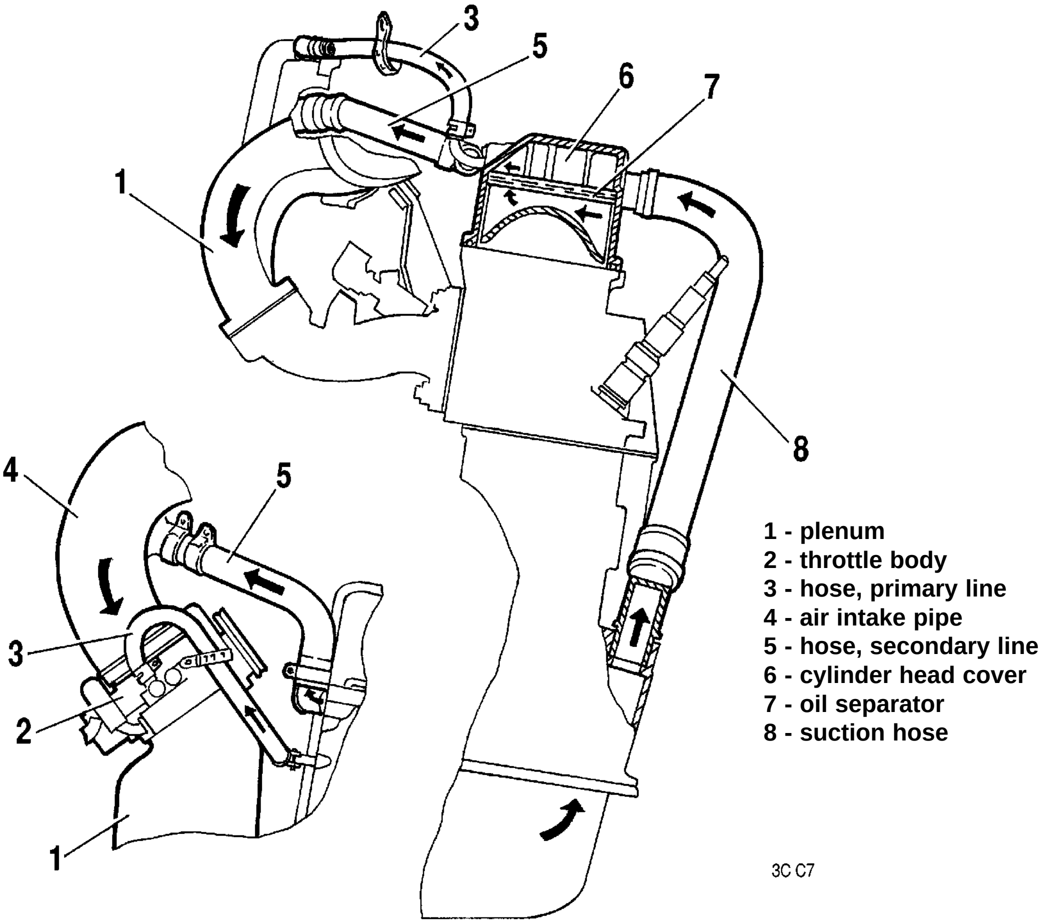


Chart C-7

Crankcase Ventilation System Test

Problems And Their Results

A plugged or damaged orifice or hose may cause the following conditions:

- higher than normal idle air control valve steps;
- oil leaks;
- oil in air cleaner;
- sludge in engine.

Crankcase Ventilation System Functional Check

There are no moving parts in the ventilation system. Maintenance consists of inspecting the hoses to make sure they are clean and in good operating condition. The metering orifice in the throttle body should be inspected on a regular basis to be sure it is not plugged, and cleaned if necessary.

Proper operation of the ventilation system is dependent upon a sealed engine. If oil sludging or dilution is noted, and the ventilation system is functioning properly, check the engine for possible causes and correct as necessary.

3. Engine Management System VAZ-2111 For Vehicles VAZ-21083, -21093 and -21099.

Specific Features of Design and Repair

This Engine Management System has a number of differences in location of some components. For example, the ECM removal and refitting procedure has been changed. The ECM is located inside the instrument panel console (Fig. 3.1).

Location view of the DLC, relay and fuse block is shown in Fig. 3.2.

Location view of the Immobilizer control module and Key Reader in the passenger compartment of VAZ-21083, 21093 and 21099 is shown in Fig. 3.3.

The outlay of the underhood for VAZ-21083, 21093 and 21099 is shown in Fig. 3.4.

The fuel pump removal and refitting procedure for VAZ-21083, 21093 and 21099 has also been changed. Removal of the fuel tank is required to access the fuel pump.

EMS wiring diagram for vehicles VAZ-21083, 21093 and 21099 is shown in Fig. 3.5.

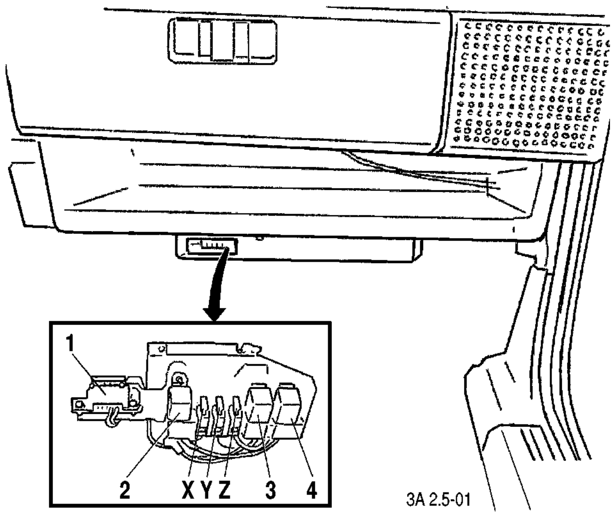


Fig. 3.2. Fuse and Relay location view:
1 - DLC; 2 - Main Relay; 3 - Fuel Pump Relay; 4 - Cooling Fan Relay; X, Y, Z - Fuses

ECM Replacement

ECM Removal

1. Ignition OFF.
2. Disconnect the battery negative cable.
3. Remove the instrument panel console (3).
4. Unscrew the nuts of the retaining bolts holding the ECM to the bracket (2), disconnect the ECM harness connector and remove the ECM (1) (Fig. 3.1).

ECM Refitting

1. Connect the ECM harness connector, install the ECM onto the bracket (2) and tighten the retaining nuts.
2. Refit the instrument panel console.
3. Connect the battery negative cable.

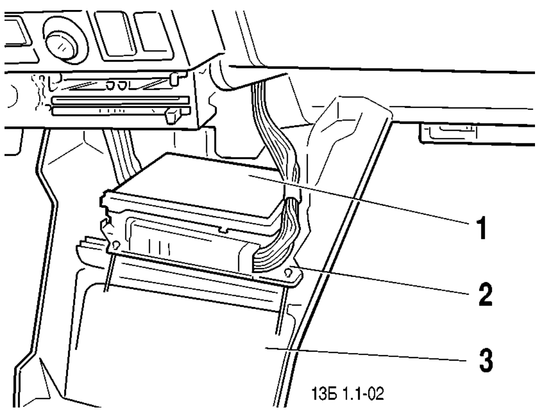


Fig. 3.1. ECM location view:
1 - ECM; 2 - ECM Mounting Bracket; 3 - Instrument Panel Console

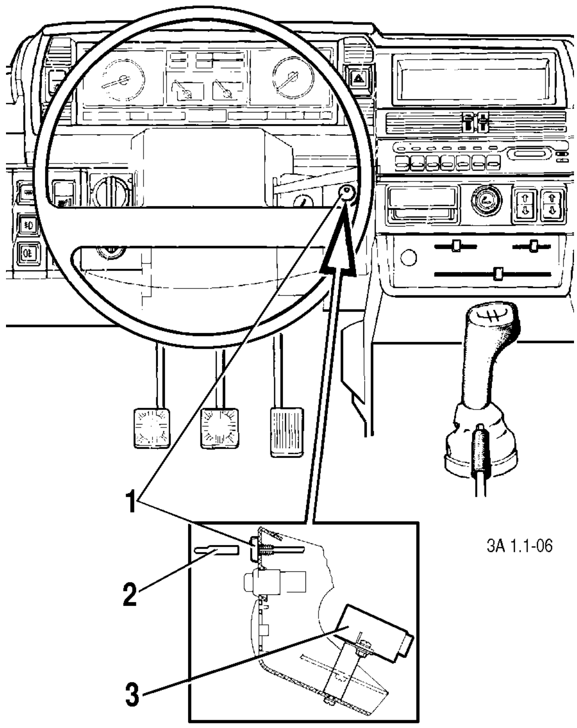
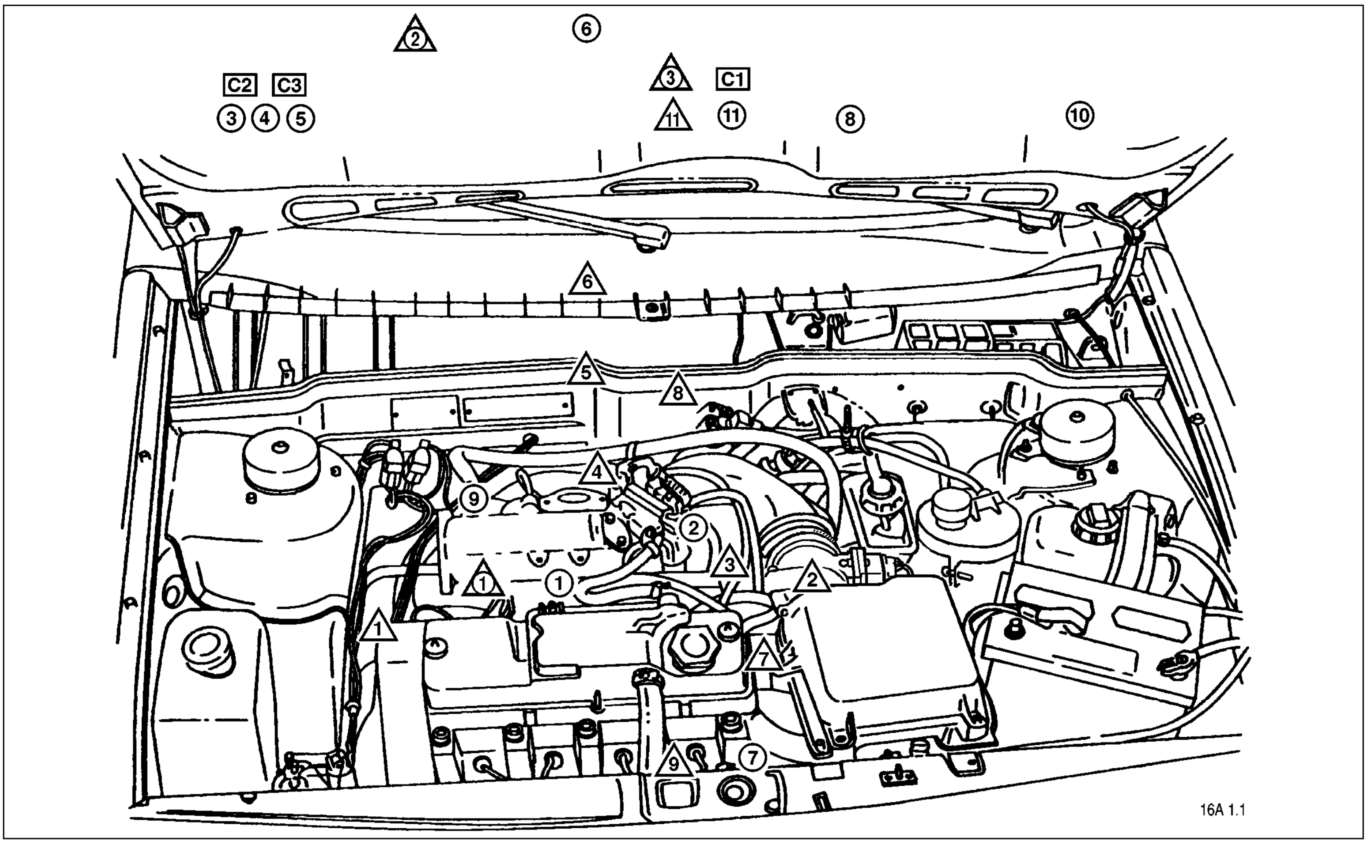


Fig. 3.3. Immobilizer Control Module and Key Reader at VAZ-21083 instrument panel location view:
1 - Key Reader; 2 - Key Fob; 3 - Immobilizer Control Module

Engine Management System VAZ-2111, Sequential Fuel Injection, For Vehicles VAZ-21083, -21093 and -21099. Underhood Outlay



ECM HARNESS

C1. Electronic Control Module (ECM)*
(In instrument panel console)
C2. Data Link Connector (DLC)*
C3. Fuse/Relay Block*

MISCELLANEOUS

1. Fuel Pressure Test Fitting
2. Fuel Filter
3. Vehicle Theft Deterrent System (Immobilizer) Control Module*

CONTROLLED DEVICES

1. Fuel Injectors
2. Idle Air Control Valve
3. Main Relay*
4. Fuel Pump Relay*
5. Cooling Fan Relay*
6. Fuel Pump (Located inside fuel tank)
7. Ignition Module
8. Trip Computer*
9. EVAP Purge Valve
10. Tachometer*
11. Malfunction Indicator Lamp (CHECK ENGINE light)*

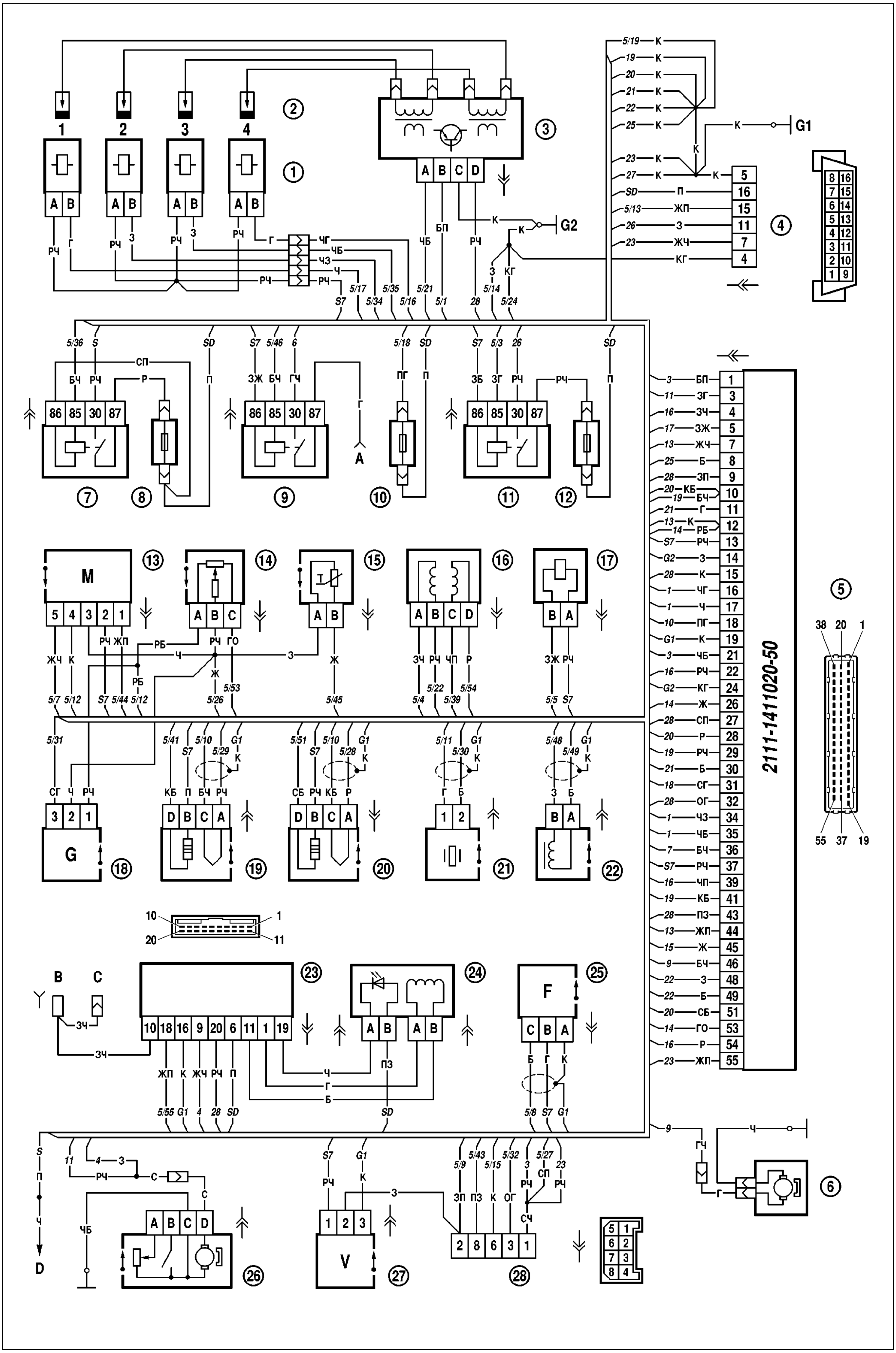
INFORMATION SENSORS

1. Crankshaft Position (CKP) Sensor
2. Mass Air Flow (MAF) Sensor
3. Engine Coolant Temperature (ECT) sensor
4. Throttle Position (TP) sensor
5. Fuel Control Heated Oxygen Sensor (HO_2S 1) (pre-catalyst)
6. Catalyst Monitor Heated Oxygen Sensor (HO_2S 2) (post-catalyst)
7. Camshaft Position (CMP) Sensor
8. Vehicle Speed Sensor (VSS) (Mounted on transmission gearbox)
9. Knock Sensor (KS)
10. Rough Road Sensor (G-Sensor)
11. Vehicle Theft Deterrent (Immobilizer) Key fob reader*

*Located inside vehicle

Fig. 3.4. Wiring diagram for engine 2111 management system, sequential fuel injection, to meet EURO-3 emission standards (ECM MP7.0H), designed for vehicles VAZ-21083, 21093, 21099:
1 - Injectors; 2 - Spark Plugs; 3 - Ignition Module; 4 - Data Link Connector (DLC); 5 - Electronic Control Module (ECM); 6 - Cooling Fan Motor; 7 - Main Relay; 8 - Fuse, to main relay; 9 - Cooling Fan Relay; 10 - Fuse, to cooling fan relay; 11 - Fuel Pump Relay; 12 - Fuse, to fuel pump relay; 13 - Mass Air Flow (MAF) Sensor; 14 - Throttle Position (TP) Sensor; 15 - Engine Coolant Temperature (ECT) Sensor; 16 - Idle Air Control (IAC) Valve; 17 - EVAP Purge Solenoid; 18 - Rough Road Sensor; 19 - Catalyst Monitor Heated Oxygen Sensor (HO_2S 2); 20 - Fuel Control Heated Oxygen Sensor (HO_2S 1); 21 - Knock Sensor (KS); 22 - Crankshaft Position (CKP) Sensor; 23 - Immobilizer Control Module; 24 - Immobilizer System Key Reader; 25 - Camshaft Position (CMP) Sensor; 26 - Electric Fuel Pump with Fuel Level Sensor; 27 - Vehicle Speed Sensor (VSS); 28 - Connector, to instrument panel harness;

A - Wiring, to fuse and relay block (connector «Ш5», terminal «5»); **B** - Wiring, to courtesy light switch; **C** - Wiring, to white/black wiring disconnected from the courtesy light switch; **D** - to battery terminal «+»; **G1**, **G2** - Ground Connections. Alongside letter code of wire color this diagram also has digital marking indicating the number of electrical component to which the wire should be connected, e.g. «-5-». Marking «-S7-» or «-SD-» means that the wire should be connected to component #7 or D through the connection not shown on the diagram. Some markings also indicate pin number (after a slash), e.g. «-5/15-».
Important: A different sequence of fuses may be used while assembling the vehicle.



2111-1411020-50
G1
G2
M
G
V
F
A
B
C
D

4. Engine Management System VAZ-2112 For Vehicles VAZ-21103, -21113 and -2112.

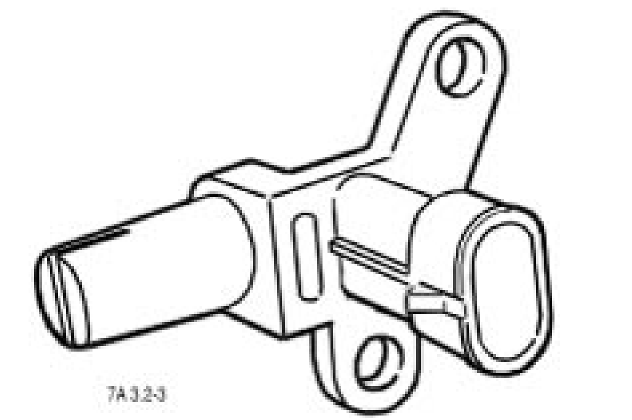


Fig. 4-1. Camshaft Position (CMP) Sensor

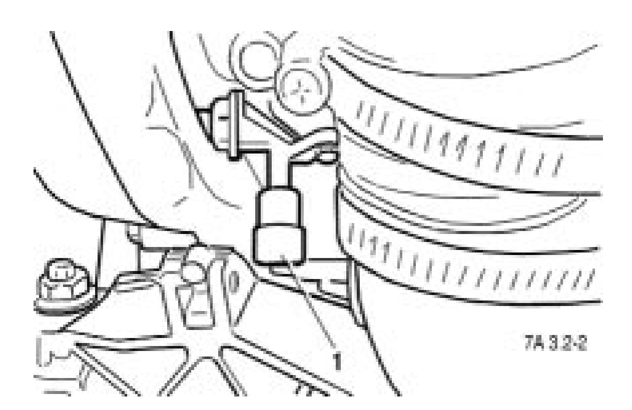


Fig. 4-2. Camshaft Position (CMP) Sensor location view:
1 - Camshaft position sensor

Specific Features of Design and Repair

Vehicles VAZ-21103, -21113 and -2112 feature a 16-valve engine 2112. For that reason the EMS has a number of differences in its design and diagnosis. 2112 EMS features a camshaft position sensor of a different design (Fig. 4-1), wich, nevertheless, has the same principle of operation as described in Section 1.1. The CMP sensor is located on the front left side of the cylinder head (Fig. 4-2). The design of the fuel rail (Fig. 4-3) and the crankcase ventilation system (Fig. 4-4) is also different. Layout of the 2112 EMS in the engine compartment is illustrated in Fig. 4-5.

While carrying out system diagnosis one should remember that some of the scan tool data values have also changed (See Table 4.1).

EMS wiring diagram for vehicles VAZ-21103, -21113 and -2112 is shown in Fig. 4-6.

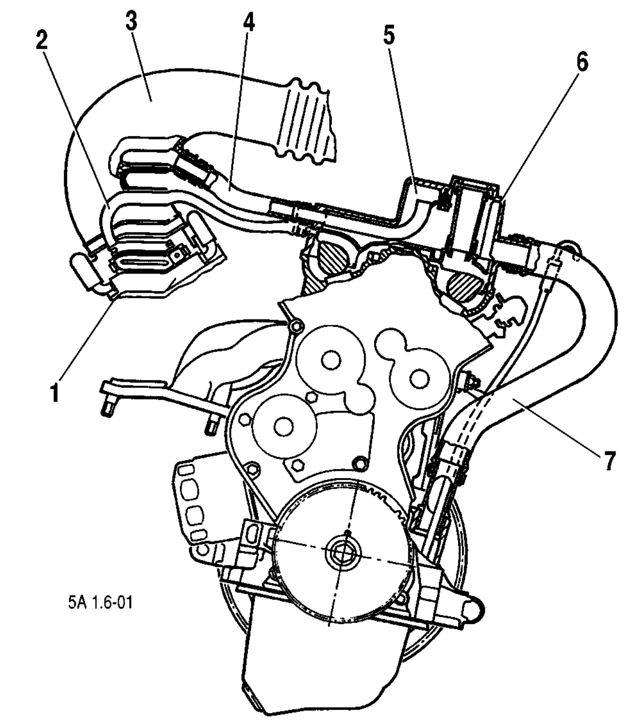


Fig. 1.7-01. Crankcase Ventilation System:
2 - throttle body; 2 - hose, primary line; 3 - air intake pipe; 4 - hose, secondary line; 5 - oil separator; 6 - cylinder head cover; 7 - suction hose

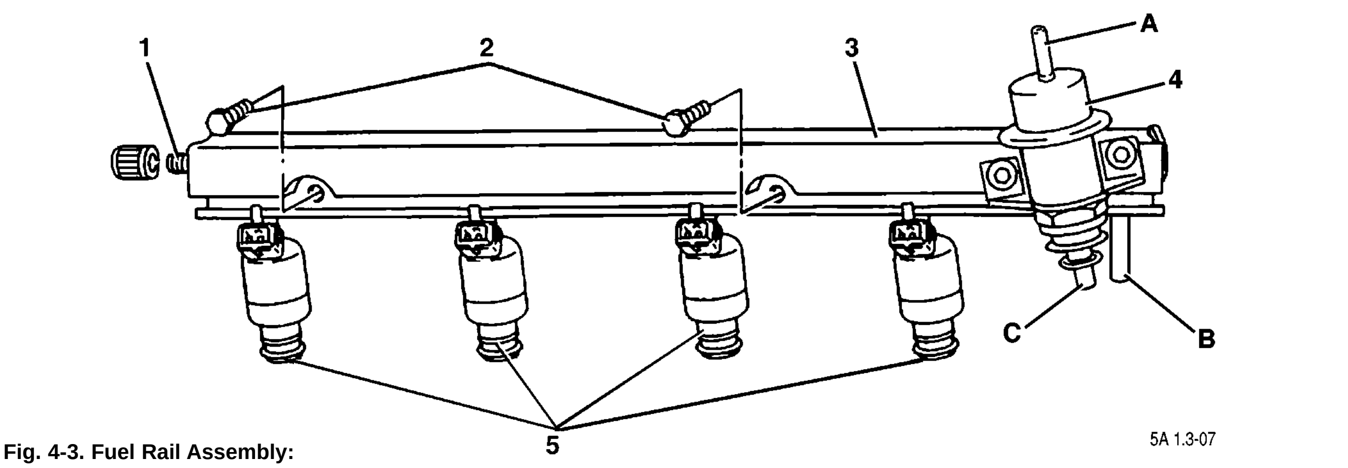


Fig. 4-3. Fuel Rail Assembly:
1 - fuel pressure test fitting; 2 - fuel rail mounting screws; 3 - fuel rail; 4 - fuel pressure regulator; 5 - injectors; A - intake manifold vacuum line fitting; B - fuel supply fitting; C - fuel return line fitting

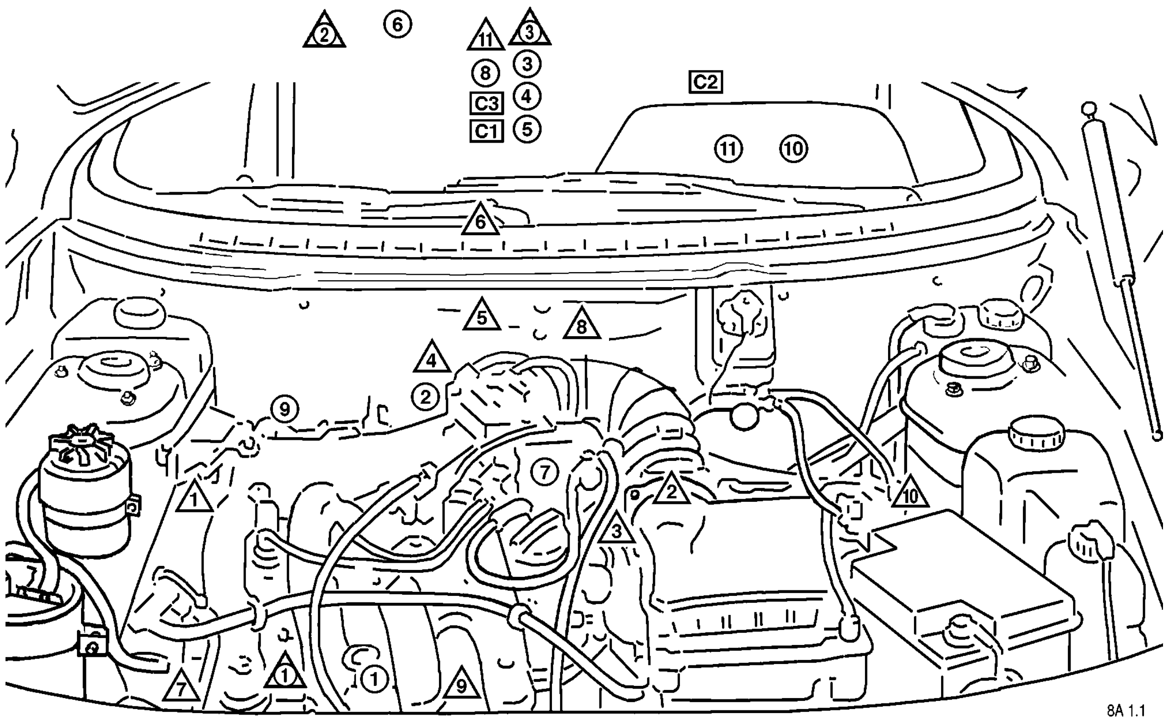
Typical Scan Tool Data Values For 2112 Engine

Parameter	Description	Unit or Status	Ignition ON	Engine Idling 800 rpm	Engine Idling 3000 rpm
TL	Engine Load Signal	msec	(1)	1,4-2,0	1,2-1,5
UB	Battery Voltage	Volt	11,8-12,5	13,2-14,6	13,2-14,6
TMOT	Coolant Temperature	°C	(1)	90-105	90-105
ZWOUT	Spark Advance	°CA	(1)	12±3	35-40
DKPOT	TPS Signal relative to Throttle Zero Position	%	0	0	4,5-6,5
N40	Engine speed with resolution 40 rpm	RPM	(1)	800±40	3000
TE1	Injection time	msec	(1)	2,5-3,5	2,3-2,65
MOMPOS	Idle Air Controller Position	step	(1)	40±10	70-80
N10	Actual Idle Speed with resolution 10 rpm	RPM	(1)	800±30	3000
QADP	IAC Block Learn	kg/h	±3	±4*	±1
ML	Air mass flow	kg/h	(1)	7-10	23±2
USVK	O2 Sensor 1	Volts	0,45	0,1-0,9	0,1-0,9
FR	Lambda Controller Output		(1)	1±0,2	1±0,2
TRA	Additive adaptive mixture correction for air leakage	msec	±0,4	±0,4*	(1)
FRA	multiplicative adaptive mixture correction		1±0,2	1±0,2*	1±0,2
TATE	Duty cycle for canister purge valve	%	(1)	0-15	30-80
USHK	Downstream oxygen sensor output voltage	Volt	0,45	0,5-0,7	0,6-0,8
TANS	Intake air temperature	°C	(1)	-20...+60	-20...+60
BSMW	Zero filter signal acceleration sensor	g	(1)	-0,048	-0,048
FDKHA	Factor Altitude Adaptation		(1)	0,7-1,03*	0,7-1,03
RHSV	Resistance of LS-Shunt catalyst upstream	Ohm	(1)	9-13	9-13
RHSH	Resistance of LS-Shunt catalyst downstream	Ohm	(1)	9-13	9-13
FZABGS	Sum of Emission Relevant Misfirings		(1)	0-15	0-15
QREG	Idle Air Controller	kg/h	(1)	±4*	(1)
LUT_AP	Monitor engine roughness test value		(1)	0-6	0-6
LUR_AP	Monitor engine roughness reference value		(1)	6-6,5 (6-7,5)***	6,5 (15-40)***
ASA	Adaptation mean value		(1)	0,9965-1,0025**	0,996-1,0025
DTV	Additive adaptive Mixture Correction for injector deviation	msec	±0,4	±0,4*	±0,4
ATV	Closed Loop Control Cat. Downstream: Integrator	sec	(1)	0-0,5*	0-0,5
TPLRVK	Oxygen Sensor Signal Period (Catalyst upstream)	sec	(1)	0,6-2,5	0,6-1,5
B_LL	Idle flag	YES/NO	NO	YES	NO
B_KR	Knock control enabled	ON/OFF	(1)	ON	ON
B_KS	Knock protection enabled	ON/OFF	(1)	OFF	OFF
B_SWE	Rough road detected	YES/NO	(1)	NO	NO
B_LR	O2 Sensor 1 Loop Activated	YES/NO	(1)	YES	YES
M_LUERKT	Misfire detected	YES/NO	(1)	NO	NO
B_LUSTOP	Misfire detection disabled	YES/NO	(1)	NO	NO
B_ZADRE1	Condition for sensor wheel adaptation successful, engine speed range 1	YES/NO	(1)	YES*	(1)
B_ZADRE3	Condition for sensor wheel adaptation successful, engine speed range 3	YES/NO	(1)	(1)	YES

(1) This value is not used for diagnosis.
** This parameter resets to zero when the battery cable is disconnected.*
*** This check is relevant only if B_ZADRE1=YES.*
**** The values in brackets represents typical range of the parameter in case ASA parameter has been specified.*

Note*: The table lists parameters for the ambient temperature above zero.*

Engine Management System VAZ-2112, Sequential Fuel Injection, For Vehicles VAZ-21103, 21113 and 2112. Underhood Outlay



ECM HARNESS

C1. Electronic Control Module (ECM)* (In instrument panel console)
C2. Data Link Connector (DLC)*
C3. Fuse/Relay Block*

MISCELLANEOUS

1. Fuel Pressure Test Fitting
2. Fuel Filter
3. Vehicle Theft Deterrent System (Immobilizer) Control Module*

CONTROLLED DEVICES

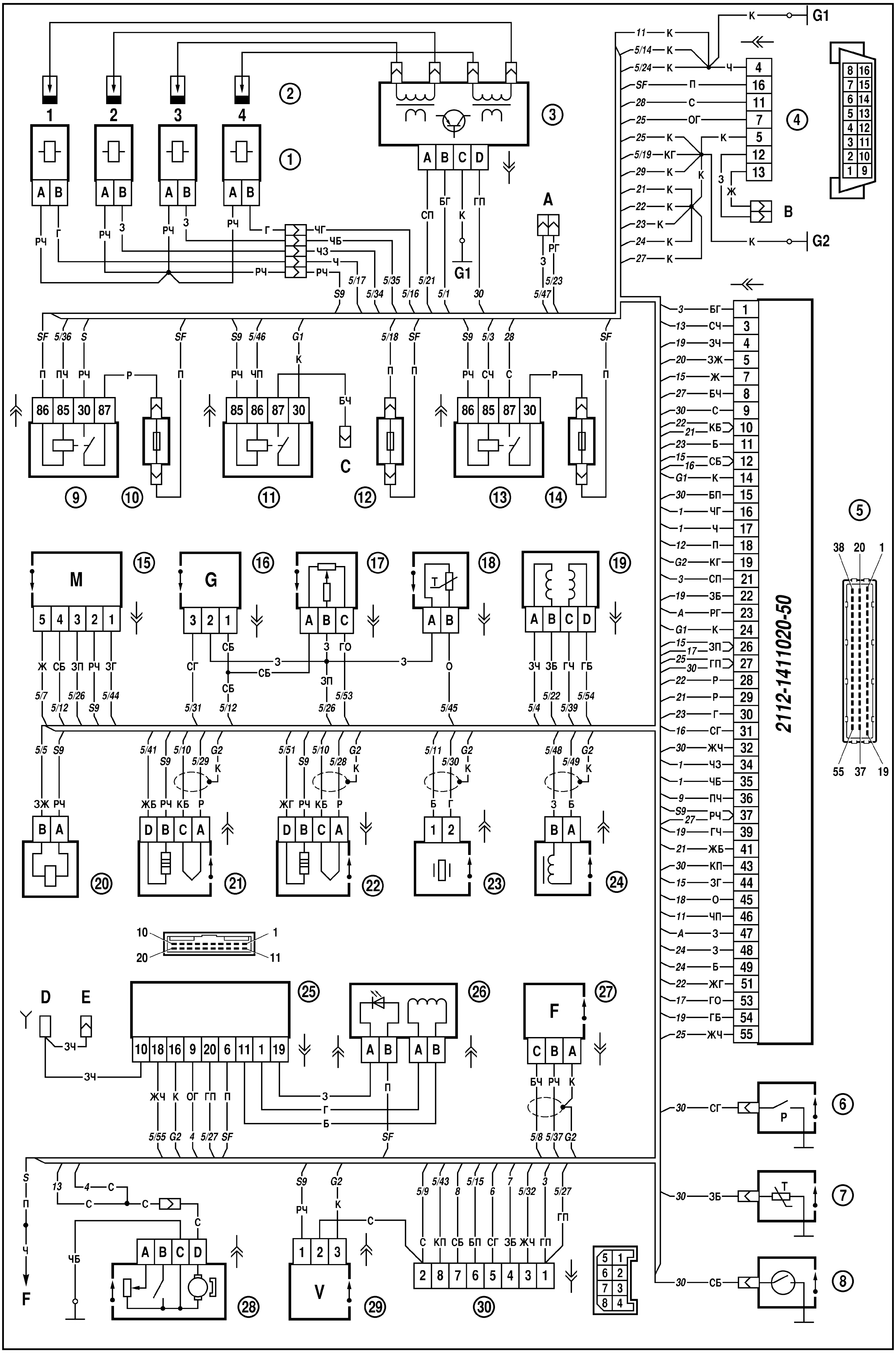
1. Fuel Injectors
2. Idle Air Control Valve
3. Main Relay*
4. Fuel Pump Relay*
5. Cooling Fan Relay*
6. Fuel Pump (Located inside fuel tank)
7. Ignition Module
8. Trip Computer*
9. EVAP Purge Valve
10. Tachometer*
11. Malfunction Indicator Lamp (CHECK ENGINE light)*

INFORMATION SENSORS

1. Crankshaft Position (CKP) Sensor
2. Mass Air Flow (MAF) Sensor
3. Engine Coolant Temperature (ECT) sensor
4. Throttle Position (TP) sensor
5. Fuel Control Heated Oxygen Sensor (HO_2S 1) (pre-catalyst)
6. Catalyst Monitor Heated Oxygen Sensor (HO_2S 2) (post-catalyst)
7. Camshaft Position (CMP) Sensor
8. Vehicle Speed Sensor (VSS) (Mounted on transmission gear-box)
9. Knock Sensor (KS)
10. Rough Road Sensor (G-Sensor)
11. Vehicle Theft Deterrent (Immobilizer) Key fob reader*

*Located inside vehicle

Fig. 4-6. Wiring diagram for engine 2112 management system, sequential fuel injection, to meet EURO-3 emission standards (ECM MP7.0H), designed for vehicles VAZ-21103, 21113, 2112:
1 - Injectors; 2 - Spark Plugs; 3 - Ignition Module; 4 - Data Link Connector (DLC); 5 - Electronic Control Module (ECM); 6 - Oil Pressure Control Light Sensor; 7 - Engine Coolant Temperature Gauge Sensor; 8 - Oil Level Sender; 9 - Main Relay; 10 - Fuse, to main relay; 11 - Cooling Fan Relay; 12 - Fuse, to cooling fan relay; 13 - Fuel Pump Relay; 14 - Fuse, to fuel pump relay; 15 - Mass Air Flow (MAF) Sensor; 16 - Rough Road Sensor; 17 - Throttle Position (TP) Sensor; 18 - Engine Coolant Temperature (ECT) Sensor; 19 - Idle Air Control (IAC) Valve; 20 - EVAP Purge Solenoid; 21 - Catalyst Monitor Heated Oxygen Sensor (HO2S 2); 22 - Fuel Control Heated Oxygen Sensor (HO2S 1); 23 - Knock Sensor (KS); 24 - Crankshaft Position (CKP) Sensor; 25 - Immobilizer Control Module; 26 - Immobilizer System Key Reader; 27 - Camshaft Position (CMP) Sensor; 28 - Electric Fuel Pump with Fuel Level Sensor; 29 - Vehicle Speed Sensor (VSS); 30 - Connector, to instrument panel harness;
A - Connector, to A/C harness; B - Connector, to internal ABS module; C - Connector, to electric fan harness; D - wiring to ignition switch (illumination light); E - Connector, to blue/white wire disconnected from the ignition switch; F - to battery terminal «+»; G1, G2 - Ground Connections. Alongside letter code of wire color this diagram also has digital marking indicating the number of electrical component to which the wire should be connected, e.g. «-5-». Marking «-S9-» or «-SF-» means that the wire should be connected to component #9 or F through the connection not shown on the diagram. Some markings also indicate pin number (after a slash), e.g. «-5/15-».
Important: A different sequence of fuses may be used while assembling the vehicle.


2112-1411020-50
G1
G2
A
B
C
D
E
F
M
G
V

5. Engine Management System VAZ-21214-36 for Vehicles VAZ-21214

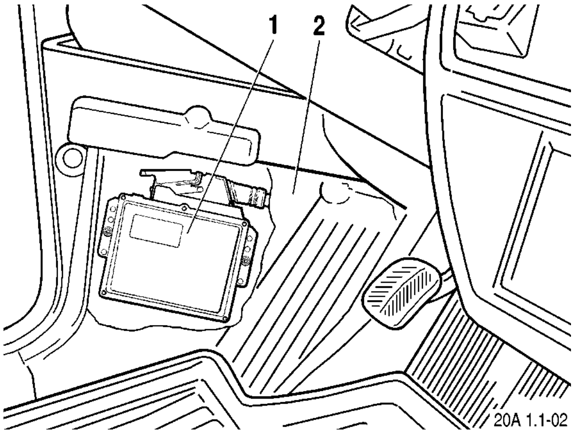


Fig. 5.1. ECM location view:
1 - ECM; 2 - front side trim panel

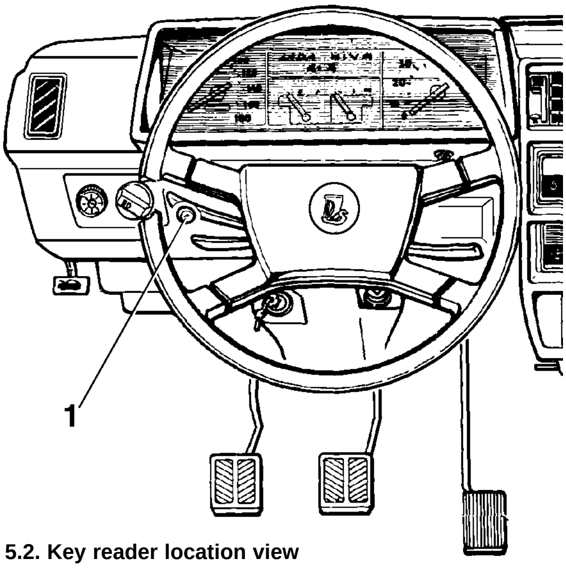


Fig. 5.2. Key reader location view (VAZ-21214 instrument panel):
1 - key reader

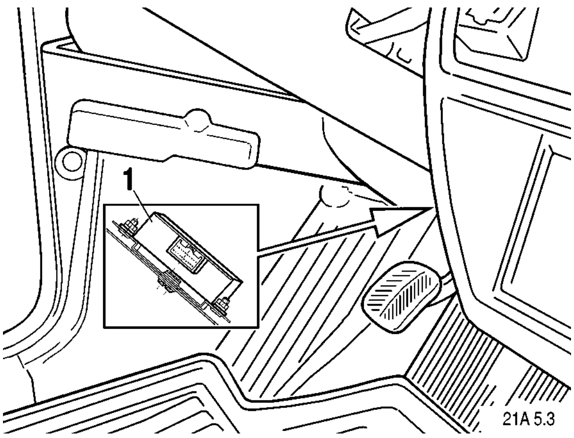


Fig. 5.3. Immobilizer Module location view (VAZ-21214 passenger compartment):
1 - immobilizer module

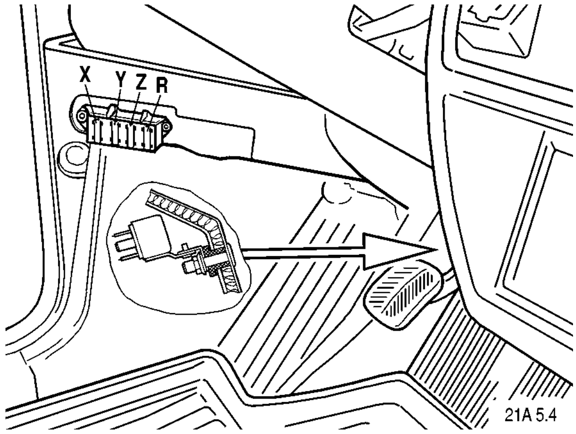


Fig. 5.4. Engine Management System Relay Block and Fusebox location view:
X, Y, Z, R-fuses

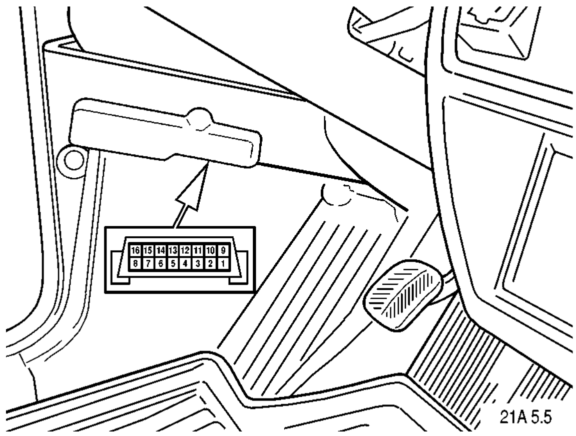


Fig. 5.5. Data Link Connector (DLC) location view

Specific Features of Design and Repair

The 21214-36 Engine Management System for vehicles VAZ-21214 differs from the 2111 Engine Management System for vehicles VAZ-21102, 2111 and 2122 as regards its design and diagnostics, as well as system components location (Fig. 5.1-5.7).

The 21214-36 Engine Management System features a different design Camshaft Position (CMP) Sensor (Fig. 5.8) and electric fuel pump (Fig. 5.9). The principle of their operation is the same as described in Sections 1.1 and 1.3. The design of Crankcase Ventilation System has also been modified (Fig. 5.10).

Some of VAZ-21214 vehicles feature fuel rails (Fig. 5.11) with different location of the fuel pressure test fitting. Fuel pressure is tested using a special adapter (Fig. 5.12).

Layout of the EMS in the engine compartment of VAZ-21214 vehicles is illustrated in Fig. 5.13.

While diagnosing the 21214-36 EMS one should keep in mind that some parameter values displayed by DST-2M have changed (see Table 5.1). Note also that the MIL operation mode is different (see Table 5.2).

EMS wiring diagram for VAZ-21214 vehicles is shown in Fig. 5.14.

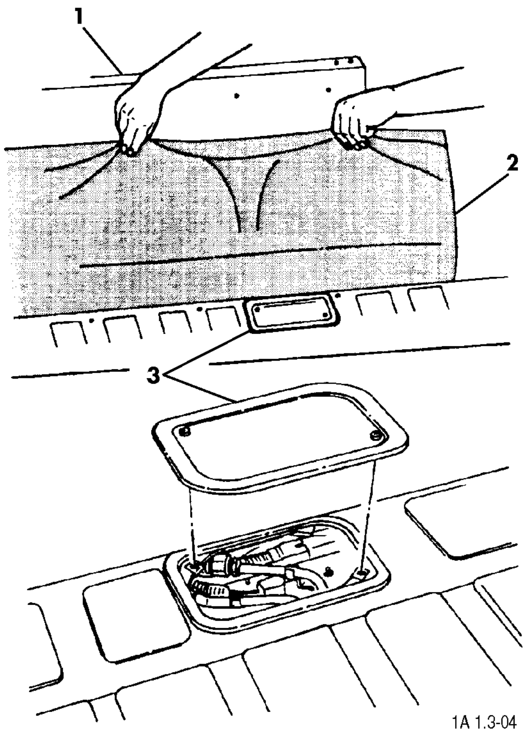


Fig. 5.6. Electric Fuel Pump Assembly location view:
1 - rear seat (folded forward); 2 - luggage compartmen floor mat; 3 - fuel tank access cover

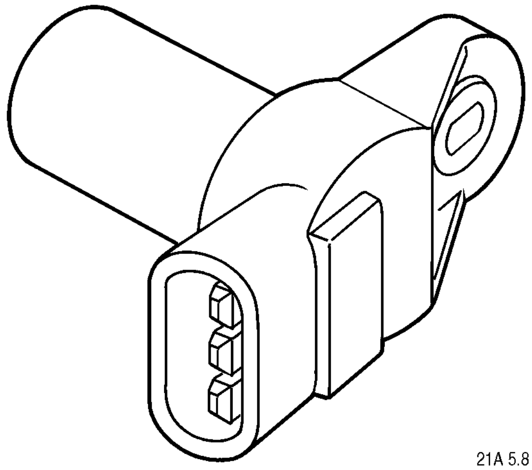


Fig. 5.8. Camshaft Position (CMP) Sensor

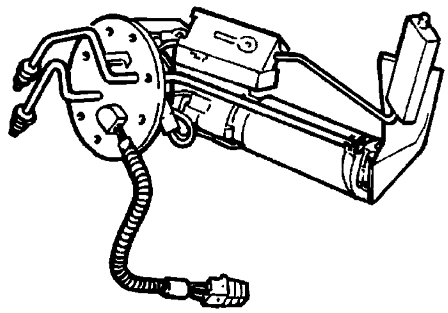


Fig. 5.9. Electric Fuel Pump Assembly

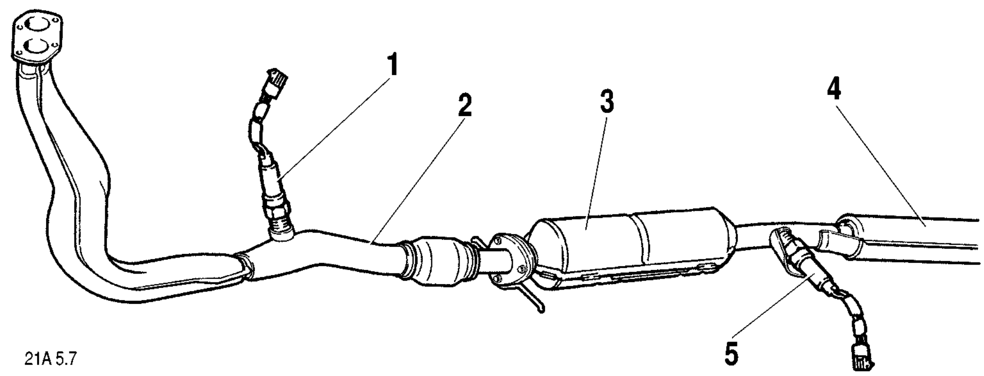


Fig. 5.7. Catalytic Converter and Heated Oxygen Sensors (HO2S) location view:
1 - fuel control heated oxygen sensor (HO2S 1); 2 - front exhaust pipe; 3 - catalytic converter; 4 - auxiliary muffler; 5 - catalyst monitor heated oxygen sensor (HO2S 1)

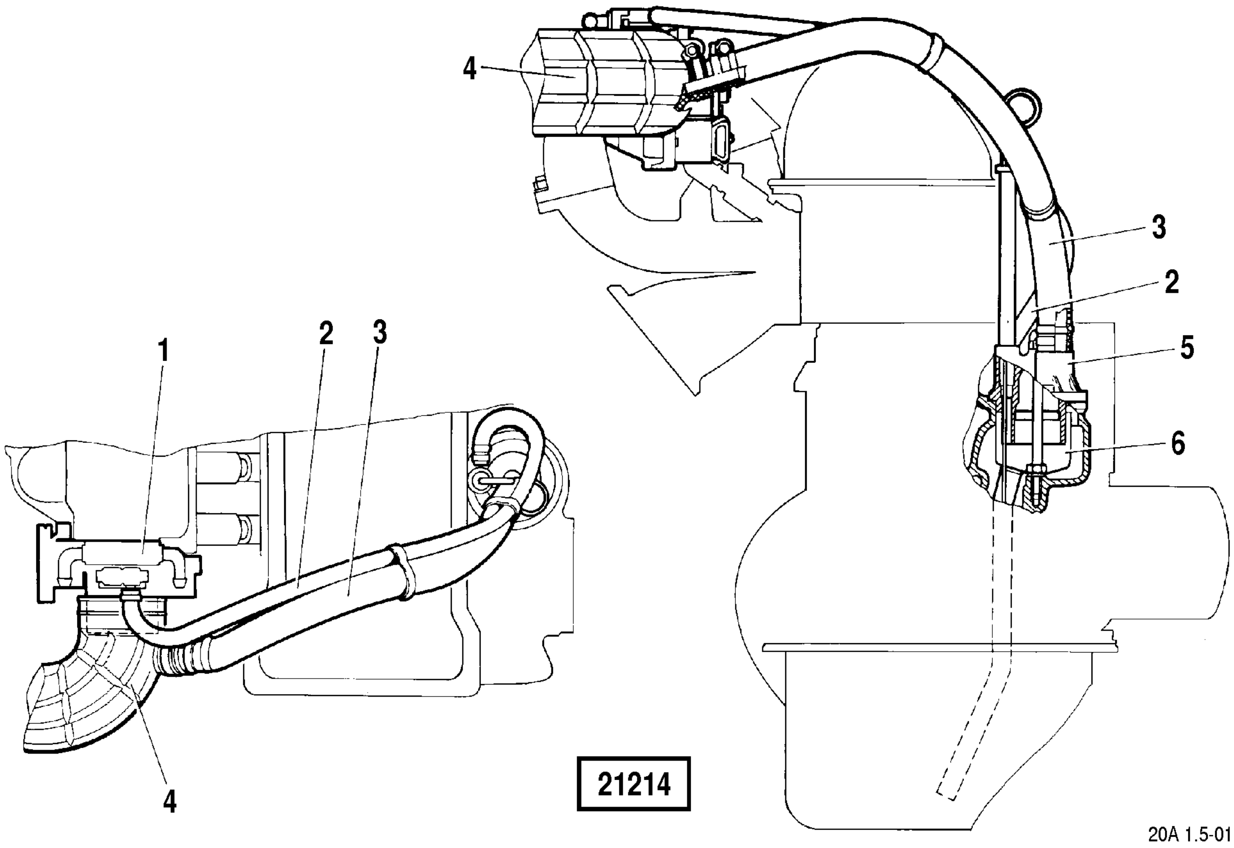


Fig. 5.10. Crankcase Ventilation System layout (left: top view):
1 - throttle body; 2 - hose, primary line; 3 - hose, secondary line; 4 - air intake pipe; 5 - oil separator cover; 6 - oil separator

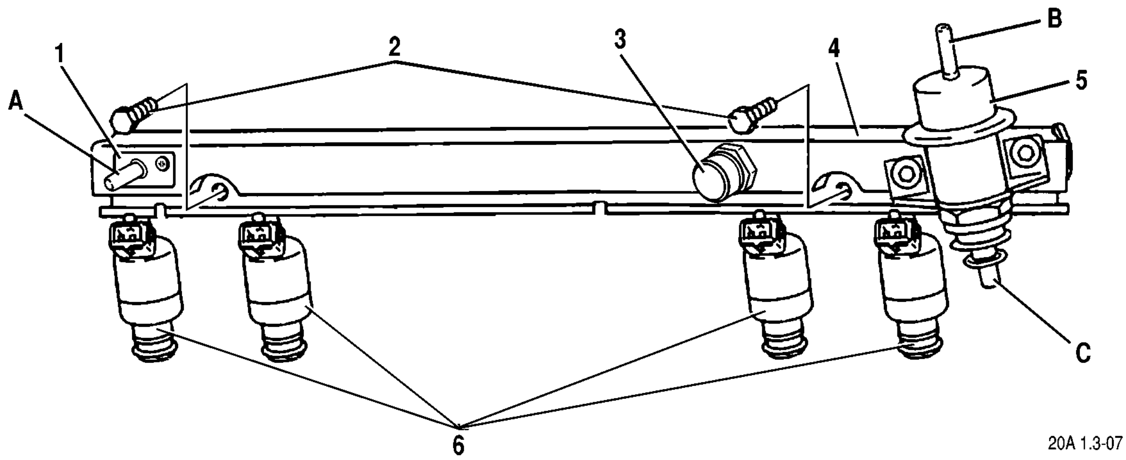


Fig. 5.11. Fuel Rail Assembly:
1 - fuel supply tube retainer; 2 - fuel rail mounting screws; 3 - fuel pressure test fitting; 4 - fuel rail; 5 - fuel pressure regulator; 6 - injectors; A - fuel supply tube; B - intake manifold vacuum line fitting; C - fuel return line fitting

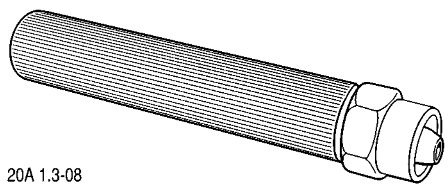
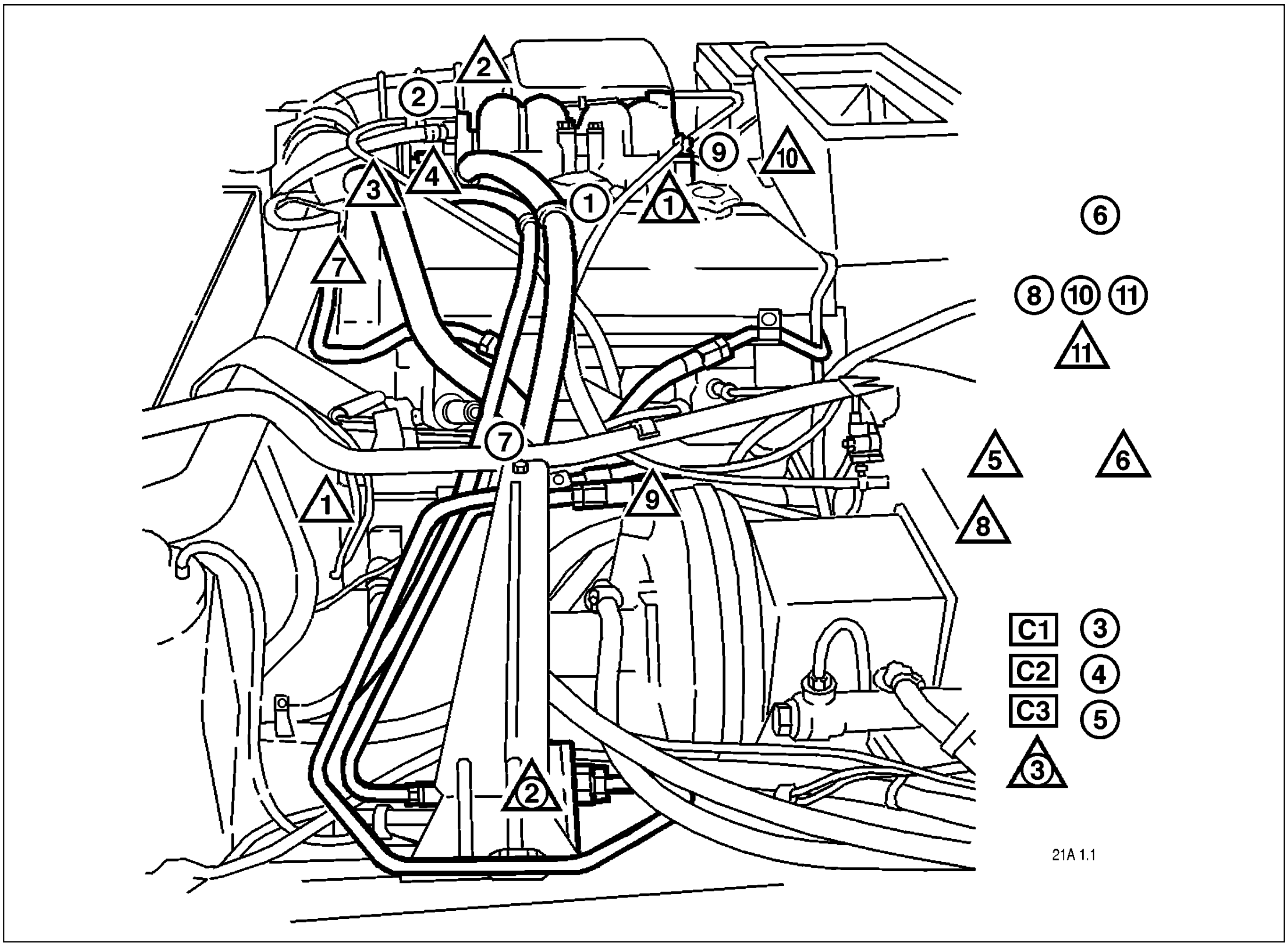


Fig. 5.12. Adapter for fuel pressure testing

Engine Management System VAZ-21214-36, Sequential Fuel Injection, For Vehicles VAZ-21214. Underhood Outlay



ECM HARNESS

C1. Electronic Control Module (ECM)*
C2. Data Link Connector (DLC)*
C3. Fuse/Relay Block*

MISCELLANEOUS

1. Fuel Pressure Test Fitting
2. Fuel Filter
3. Vehicle Theft Deterrent System (Immobilizer) Control Module*

CONTROLLED DEVICES

1. Fuel Injectors
2. Idle Air Control Valve
3. Main Relay*
4. Fuel Pump Relay*
5. Cooling Fans Relay*
6. Fuel Pump (Located inside fuel tank)
7. Ignition Module
8. Trip Computer*
9. EVAP Purge Valve
10. Tachometer*
11. Malfunction Indicator Lamp (CHECK ENGINE light)*

INFORMATION SENSORS

1. Crankshaft Position (CKP) Sensor
2. Mass Air Flow (MAF) Sensor
3. Engine Coolant Temperature (ECT) Sensor
4. Throttle Position (TP) sensor
5. Fuel Control Heated Oxygen Sensor (HO_2S 1) (pre-catalyst)
6. Catalyst Monitor Heated Oxygen Sensor (HO_2S 2) (post-catalyst)
7. Camshaft Position (CMP) Sensor
8. Vehicle Speed Sensor (VSS) (Mounted on transmission gearbox)
9. Knock Sensor (KS)
10. Rough Road Sensor (G-Sensor)
11. Vehicle Theft Deterrent (Immobilizer) Key fob reader*

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*Located inside vehicle

Typical Scan Tool Data Values For 2111 Engine

Parameter	Description	Unit or Status	Ignition ON	Engine Idling 800 rpm	Engine Idling 3000 rpm
TL	Engine Load Signal	msec	(1)	1,4-2,0	1,2-1,5
UB	Battery Voltage	Volt	11,8-12,5	13,2-14,6	13,2-14,6
TMOT	Coolant Temperature	°C	(1)	90-105	90-105
ZWOUT	Spark Advance	°CA	(1)	12±3	35-40
DKPOT	TPS Signal relative to Throttle Zero Position	%	0	0	4,5-6,5
N40	Engine speed with resolution 40 rpm	RPM	(1)	850±40	3000
TE1	Injection time	msec	(1)	4,0-4,4	4,0-4,4
MOMPOS	Idle Air Controller Position	step	(1)	30±10	70-80
N10	Actual Idle Speed with resolution 10 rpm	RPM	(1)	850±30	3000
QADP	IAC Block Learn	kg/h	±3	±4*	±1
ML	Air mass flow	kg/h	(1)	8-10	23±2
USVK	O2 Sensor 1	Volts	0,45	0,1-0,9	0,1-0,9
FR	Lambda Controller Output		(1)	1±0,2	1±0,2
TRA	Additive adaptive mixture correction for air leakage	msec	±0,4	±0,4*	(1)
FRA	multiplicative adaptive mixture correction		1±0,2	1±0,2*	1±0,2
TATE	Duty cycle for canister purge valve	%	(1)	30-40	50-80
USHK	Downstream oxygen sensor output voltage	Volt	0,45	0,5-0,7	0,6-0,8
TANS	Intake air temperature	°C	(1)	+20±10	+20±10
BSMW	Zero filter signal acceleration sensor	g	(1)	-0,048	-0,048
FDKHA	Factor Altitude Adaptation		(1)	0,7-1,03*	0,7-1,03
RHSV	Resistance of LS-Shunt catalyst upstream	Ohm	(1)	9-13	9-13
RHSH	Resistance of LS-Shunt catalyst downstream	Ohm	(1)	9-13	9-13
FZABGS	Sum of Emission Relevant Misfirings		(1)	0-15	0-15
QREG	Idle Air Controller	kg/h	(1)	±4*	(1)
LUT_AP	Monitor engine roughness test value		(1)	0-6	0-6
LUR_AP	Monitor engine roughness reference value		(1)	10,5 ***	6,5 (15-40)***
ASA	Adaptation mean value		(1)	0,9965-1,0025**	0,996-1,0025
DTV	Additive adaptive Mixture Correction for injector deviation	msec	±0,4	±0,4*	±0,4
ATV	Closed Loop Control Cat. Downstream: Integrator	sec	(1)	0-0,5*	0-0,5
TPLRVK	Oxygen Sensor Signal Period (Catalyst upstream)	sec	(1)	0,6-2,5	0,6-1,5
B_LL	Idle flag	YES/NO	NO	YES	NO
B_KR	Knock control enabled	ON/OFF	(1)	ON	ON
B_KS	Knock protection enabled	ON/OFF	(1)	OFF	OFF
B_SWE	Rough road detected	YES/NO	(1)	NO	NO
B_LR	O2 Sensor 1 Loop Activated	YES/NO	(1)	YES	YES
M_LUERKT	Misfire detected	YES/NO	(1)	NO	NO
B_LUSTOP	Misfire detection disabled	YES/NO	(1)	NO	NO
B_ZADRE1	Condition for sensor wheel adaptation successful, engine speed range 1	YES/NO	(1)	YES*	(1)
B_ZADRE3	Condition for sensor wheel adaptation successful, engine speed range 3	YES/NO	(1)	(1)	YES

(1) This value is not used for diagnosis.
** This parameter resets to zero when the battery cable is disconnected.*
*** This check is relevant only if B_ZADRE1=YES.*
**** The values in brackets represents typical range of the parameter in case ASA parameter has been specified.*

***Note**: The table lists parameters for the ambient temperature above zero.*

Table 5.2

Conditions for MIL Illumination

DTC	Description	MIL illuminates
P0102	Mass Air Flow, Signal Low	immediately
P0103	Mass Air Flow, Signal High	immediately
P0112	Intake Air Temperature Sensor, Signal Low	immediately
P0113	Intake Air Temperature Sensor, Signal High	immediately
P0116	Engine Coolant Temperature Sensor, Range	immediately
P0117	Engine Coolant Temperature Sensor, Signal Low	immediately
P0118	Engine Coolant Temperature Sensor, Signal High	immediately
P0122	Throttle Position Sensor, Signal Low	immediately
P0123	Throttle Position Sensor, Signal High	immediately
P0130	O2 Sensor 1, Malfunction	immediately
P0132	O2 Sensor 1, High Voltage	immediately
P0133	O2 Sensor 1, Slow Response	after 2 drive cycles
P0134	O2 Sensor 1, Circuit Inactive	immediately
P0135	O2 Sensor 1 Heater, Malfunction	immediately
P0136	O2 Sensor 2, Malfunction	immediately
P0137	O2 Sensor 2, Low Voltage	immediately
P0138	O2 Sensor 2, High Voltage	immediately
P0140	O2 Sensor 2, Circuit Inactive	immediately
P0141	O2 Sensor 2, Heater Malfunction	immediately
P0171	System Too Lean	after 2 drive cycles
P0172	System Too Rich	after 2 drive cycles
P0201	Injector Circuit Malfunction, Cylinder 1	immediately
P0202	Injector Circuit Malfunction, Cylinder 2	immediately
P0203	Injector Circuit Malfunction, Cylinder 3	immediately
P0204	Injector Circuit Malfunction, Cylinder 4	immediately
P0261	Injector Cylinder 1, Circuit Low	immediately
P0262	Injector Cylinder 1, Circuit High	immediately
P0264	Injector Cylinder 2, Circuit Low	immediately
P0265	Injector Cylinder 2, Circuit High	immediately
P0267	Injector Cylinder 3, Circuit Low	immediately
P0268	Injector Cylinder 3, Circuit High	immediately
P0270	Injector Cylinder 4, Circuit Low	immediately
P0271	Injector Cylinder 4, Circuit High	immediately
P0300	Random/Multiple Misfire Detected	after 2 drive cycles
P0301	Cylinder 1 Misfire Detected	after 2 drive cycles
P0302	Cylinder 2 Misfire Detected	after 2 drive cycles
P0303	Cylinder 3 Misfire Detected	after 2 drive cycles
P0304	Cylinder 4 Misfire Detected	after 2 drive cycles
P0327	Knock Sensor, Low Input	immediately
P0328	Knock Sensor, High Input	immediately
P0335	Crankshaft Position Sensor, Malfunction	does not illuminate
P0336	Crankshaft Position Sensor, Range/Performance	immediately
P0340	Camshaft Position Sensor, Malfunction	immediately
P0422	Main Catalyst Efficiency, Below Threshold	after 2 drive cycles
P0443	EVAP Control, Purge Canister Valve, Malfunction	immediately
P0480	Cooling Fan 1 Control Circuit, Malfunction	immediately

Table 5.2 (continued)

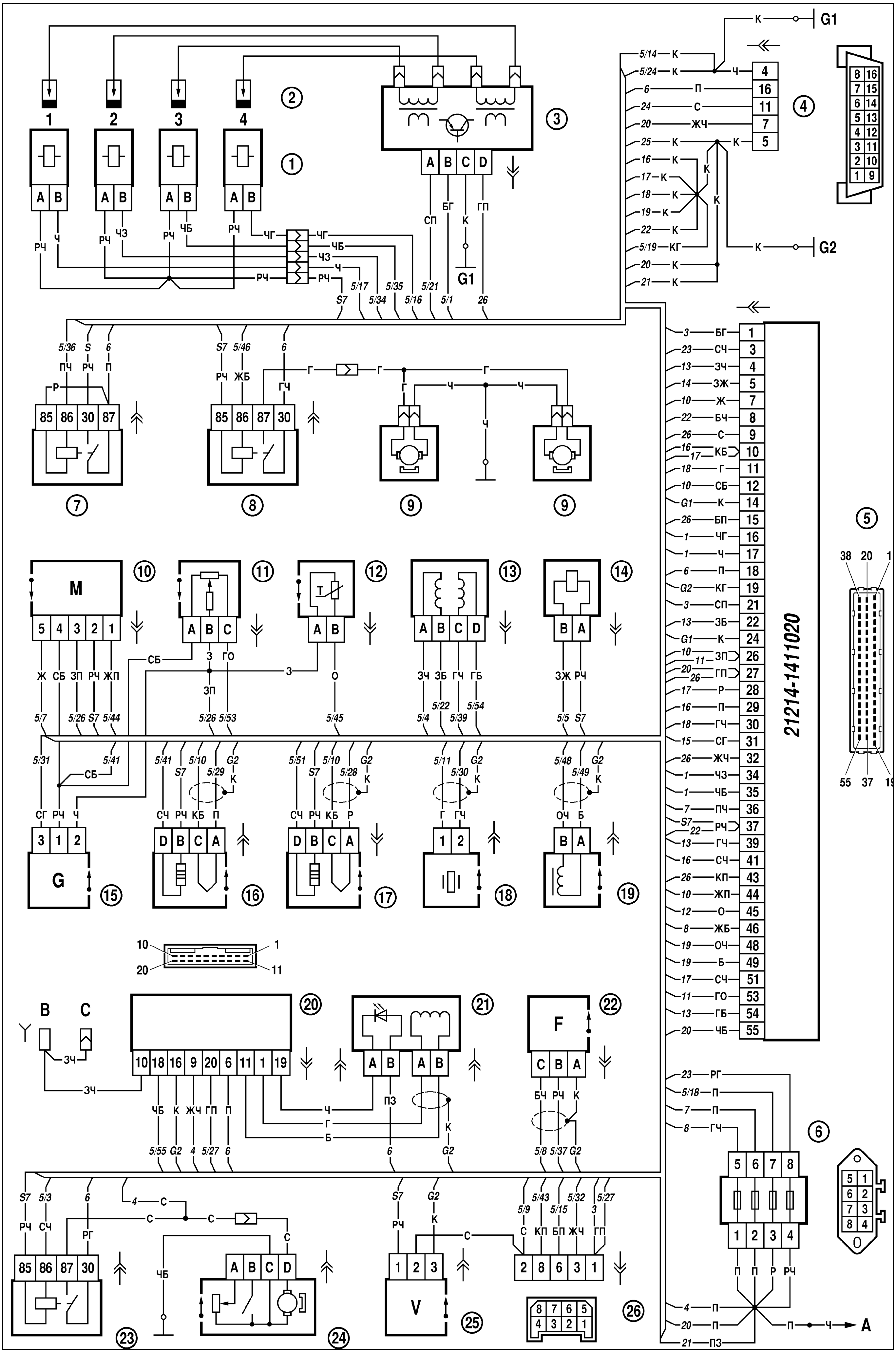
Conditions for MIL Illumination

DTC	Description	MIL illuminates
P0500	VSS Sensor, Malfunction	after 2 drive cycles
P0506	IDLE Control System, RPM Too Low	immediately
P0507	IDLE Control System, RPM Too High	immediately
P0560	System Voltage Malfunction	immediately
P0562	System Voltage Low	immediately
P0563	System Voltage High	immediately
P0601	Internal Check FLASH Memory, Check Sum Error	after 2 drive cycles
P0603	Internal Check RAM-External, Error	after 2 drive cycles
P0604	Internal Check RAM-Internal, Error	after 2 drive cycles
P1140	Load Calculation, Range/Performance	after 2 drive cycles
P1386	Knock Detection, Test Impulse/Zero Test, Malfunction	after 2 drive cycles
P1410	EVAP Control, Purge Canister Valve, Circuit High	immediately
P1425	EVAP Control, Purge Canister Valve, Circuit Low	immediately
P1426	EVAP Control, Purge Canister Valve, Circuit Interrupt	immediately
P1501	Fuel Pump Relay, Circuit Low	immediately
P1502	Fuel Pump Relay, Circuit High	immediately
P1509	Idle Control Valve Power Stage, Overload	immediately
P1513	Idle Control Valve Power Stage, Circuit Low	immediately
P1514	Idle Control Valve Power Stage, Circuit Malfunction	immediately
P1541	Fuel Pump Relays, Circuit Interrupt	immediately
P1570	Immobilizer, Not Positive Answer	after 2 drive cycles
P1602	Permanent Supply Voltage, Circuit Interrupt	does not illuminate
P1606	Rough Road Sensor, Malfunction	after 2 drive cycles
P1616	Rough Road Sensor, Signal Low	after 2 drive cycles
P1617	Rough Road Sensor, Signal High	after 2 drive cycles
P1640	EEPROM Write-Read Test, Error	after 2 drive cycles
P1689	Fault Memory Functionality Check, Error	after 2 drive cycles

Fig. 5.14. Wiring diagram for 21214-36 engine management system, sequential fuel injection, to meet EURO-3 emission standards (ECM MP7.0H), designed for vehicles VAZ-21214:
1 – Injectors; 2 – Spark Plugs; 3 – Ignition Module; 4 – Data Link Connector (DLC); 5 – Electronic Control Module (ECM); 6 – Fusebox; 7 – Main Relay; 8 – Cooling Fan Relay; 9 – Cooling Fan Motors; 10 – Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor; 11 – Throttle Position (TP) Sensor; 12 – Engine Coolant Temperature Sensor; 13 – Idle Air Control (IAC) Valve; 14 – EVAP Purge Solenoid; 15 – Rough Road Sensor; 16 – Catalyst Monitor Heated Oxygen Sensor (HO_2S 2); 17 – Fuel Control Heated Oxygen Sensor (HO_2S 1); 18 – Knock Sensor (KS); 19 – Crankshaft Position (CKP) Sensor; 20 – Immobilizer Control Module; 21 – Immobilizer System Key Reader; 22 – Camshaft Position (CMP) Sensor; 23 – Electric Fuel Pump Relay; 24 – Electric Fuel Pump with Fuel Level Sensor; 25 – Vehicle Speed Sensor (VSS); 26 – Connector, to instrument panel harness;

A - to battery terminal «+»; **B** - wiring, to courtesy light switch electric connector; **C** - wiring, to white/black wire disconnected from the courtesy light switch; **G1**, **G2** - Ground Connections.

Alongside letter code of wire color this diagram also has digital marking indicating the number of electrical component to which the wire should be connected, e.g. «-5-». Marking «-S7-» means that the wire should be connected to component #7 through the connection not shown on the diagram. Some markings also indicate pin number (after a slash), e.g. «-5/27-».


21214-1411020
G1
G2
A
B
C
V
G
M
F

Torque Specifications (N·m)

Throttle Body Retaining Nuts 14.3-23.1
Fuel Pump Retaining Nuts 1-1.5
Idle Air Control Valve Mounting Screws 3-4
Mass Air Flow Sensor Mounting Screws 3-5
Vehicle Speed Sensor 1.8-4.2
Fuel Lines To Fuel Filter Attaching Nuts 20-34
Fuel Rail Mounting Screws 9-13
Fuel Pressure Regulator Mounting Screws 8-11
Fuel Supply Line To Fuel Rail Attaching Nut 10-20
Fuel Return Line To Pressure Regulator Attaching Nut 10-20
Engine Coolant Temperature Sensor 9.3-15
Heated Oxygen Sensor 25-45
Crankshaft Position Sensor Mounting Screw 8-12
Knock Sensor Retaining Nut 10.4-24.2
Ignition Module Retaining Nuts 3.3-7.8
Spark Plugs 30.7-39
Spark Plugs (for VAZ-2112 engine) 20-30

Appendix 2

Special Tools For Repair And Maintenance Of Engine Management System, Sequential Fuel Injection

#	Name	Identification Code	
		GM Catalogue	Equivalents
1	Diagnostic Scan Tool		DST-2M-4EM (NTS, Samara)
2	Injector Tester	J-39021-V (m.3398, OTC, USA)	ТДФ-1М (NTS, Samara)
3	Fuel Pressure Gauge	J-38970-V (m.7630, OTC, USA)	МДФ-1 (NTS, Samara)
4	Idle Air Control Tester	J-34730-3 (m.3320 and m.3053, USA)	ТРДХ-1 (NTS, Samara)
5	Digital Multimeter (voltammeter)	J-39689-78 (m.D-988, PROTEC, USA)	Электроника ММЦ-1 (Penza), MD-88 (FLUKE, USA)
6	Secondary Ignition Voltage Tester (spark tester)	J-26792 (ST-125) (m.7230, OTC, USA)	KD TOOLS 2756 (USA)
7	Fused Jumper	J-36169 (USA)	
8	Circuit/Connections Test Kit	J-35616 (USA)	
9	Set of TORX Screwdrivers	VA-70433 (USA)	
10	Set of TORX Keys	J-33179 (USA)	
11	Test Light (12 V; 0.25 A)	J-36169 (USA)	
12	Adapter	Y 261 A24 300 (BOSCH)	
13	Exhaust System Pressure Gauge	BT-8515-V (USA)	МДВ-1 (NTS, Samara)
14	Vacuum Pump	J-35555 (m.7559, OTC, USA)	
15	Heated Oxygen Sensor Wrench	J-39194-V (USA)	