



Chapter I

Electric Fuel Injection System



Section I Operating Principle of Key Components

1. Pressure and Intake Temperature Sensor (TEMP)

MT 20 electronic fuel injection system employs the velocity-density-air metrological method to detect the air capacity that flow into the engine, and further accurately control the power output of the engine. At the same time, this system applies the **Intake Pressure Cylinder Detection** technology. The intake pressure sensor is mounted near the air intake of No. 1 cylinder's intake manifold. There is an instantaneous pressure drop in the position of sensor on the moment when the air intake opens. The value of pressure drop is approximate 1Kpa. The ECU can detect this instantaneous pressure drop, receive this signal from the sensor, and then determine the signal of compression upper dead center after the signal is analyzed and processed by software.

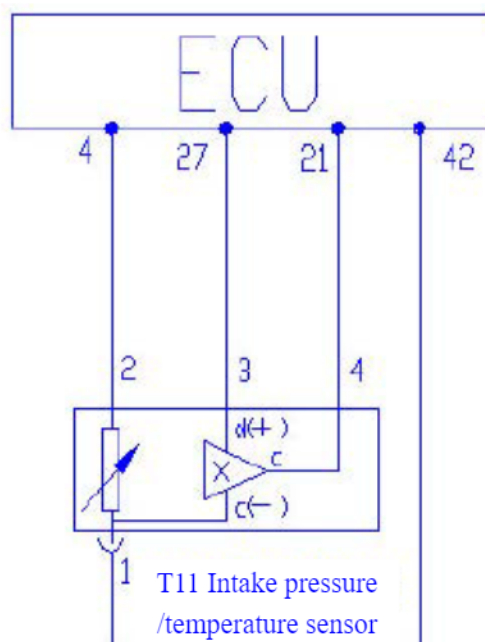
The **Intake Pressure Sensor's** internal pressure membrane connects with the magnetic core placed in a coil. The membrane will move together with the iron core when the intake air pressure in the intake pipe changes. In this case, the output voltage of the sensor will also change. The ECU can convert the output voltage of sensor to the intake capacity of the engine. Based on this signal, another signals will be referred to control the fuel injection volume of the engine.

The **intake temperature** sensor element is a resistor with negative temperature coefficient (NTC), the resistance value of which will decrease as the increase of the intake temperature. The ECU of engine can monitor the change of intake temperature through its internal comparison circuit.

Installation: Installed on the No 1 cylinder's intake manifold, and the cylinders are detected based on the instantaneous pressure drop when the air intake opens.



Absolute pressure/intake temperature sensor for intake manifold



Circuit Diagram of the absolute pressure/intake temperature sensor for intake manifold

Troubleshooting:

- 1) Mainly examine the short or open circuit between the four wires on sensor and the ECU.
- 2) Examine the clog of the sensor's detection hole.
- 3) Examine the short or open circuit and the grounding among the harnesses of sensor.
- 4) Examine the sensor's impact received to cause the sensor failure.
- 5) **Detection pressure range: 10kPa to 110 kPa**

Trouble Diagnosis:

- 1) Short circuit of the sensor's wire (shorted to earth, or shorted to supply);
- 2) Open circuit of the sensor's wire;
- 3) The intake pressure detected by sensor is greater than its upper limit;
- 4) The intake pressure detected by sensor is less than its upper limit;

Pin:

- 1) No.1 (A) for the signal from intake pressure sensor (to ECU 42#);
- 2) No.2 (B) for the standard 5V power supply (to ECU 4#);
- 3) No.3 (C) for the signal from the intake temperature sensor (to ECU 27#);
- 4) No.4 (D) for the ground wire of sensor (to ECU 21#).

Operating temperature range: -40°C to 125°C**Operating Voltage: 5.0V $\pm$ 0.1V**

2. Throttle Position Sensor (TPS)

Application: MT20U TPS (Throttle Position) sensor is available to provide the ECU with the information about the throttle's **opening angle** and **angular velocity** and the **idle position** of the engine. Based on the information, ECU can obtain the engine's information on load and operating condition (such as startup, idle, reverse towing, part load and full load) as well as acceleration and deceleration. This sensor is a three-wire sensor. And the ECU detects the opening of throttle through the monitoring on the voltage change.



Profile of a throttle position sensor



Structure and Principle: This sensor is with the slip resistance structure (i.e. the linear variable resistance structure). The ECU monitors the voltage among the signal output terminals and gets the opening signal of the throttle through the circuits comparison conducted inside the computer. In the ECU, the voltage signal is not received directly but rather the input-to-output signal ratio is detected, which can avoid the signal fluctuation generated due to the voltage fluctuation.

Trouble Diagnosis:

The signal from throttle position sensor is greater than the measuring range;

The signal from throttle position sensor is less than the measuring range;

Short circuit of the throttle position sensor signal connection;

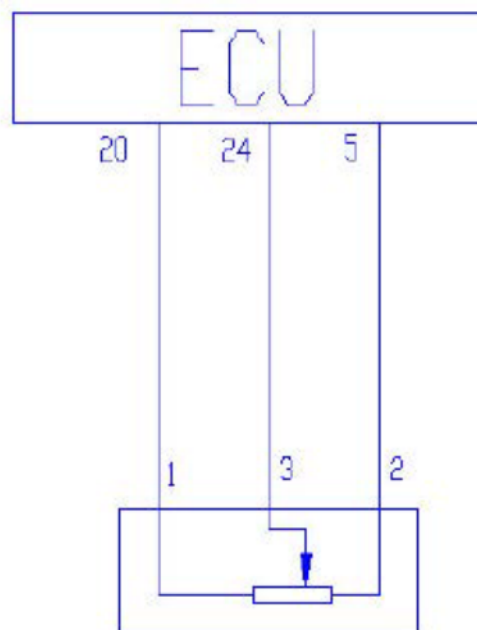
Open circuit of the throttle position sensor signal connection;

WARNING: It is generally prohibited to disassemble the throttle position sensor which has adjusted to its optimal position before it leaves factory.

Installation: The allowable tightening torque of the tightening screw is 1.5 Nm to 2.5 Nm.

Troubleshooting:

- 1) Mainly examine the short or open circuit between the three wires on sensor and the ECU.
- 2) Examine the short or open circuit and the grounding among the harnesses of sensor.
- 3) Examine the jump between the sensor signal terminal and the ground wire, which is detected with the universal meter.
- 4) Examine the sensor's resistance which is evidently greater than the standard value, the reason of which may be that the interior of sensor is dirty.



T11 Throttle Position Sensor

Circuit diagram of the throttle position sensor

Pin:

- 1) No.1 (A) for the standard 5V power supply (to ECU 20#);
- 2) No.2 (B) for the ground wire of sensor (to ECU 5#).
- 3) No.3 (C) for the signal from the sensor (to ECU 24#);

Operating Voltage: 5 ± 0.1 V

Opening Range: 7% to 93%

Resistance of Sensor: 3 k Ω to 12 k Ω

Output signal during the close of throttle:
0.612 to 0.588 V

Output signal during the full open of throttle:
4.15 to 4.65 V

3. Coolant Temperature Sensor (THW, CTS)

Application: This sensor is used to provide the information about the coolant's temperature. It can offer an engine's ECU the water temperature signal which is available to control the startup, idle, ignition timing during the normal operation, and fuel injection pulse width. At the same time, it also offers instruments the water temperature signal which is applied for the water temperature display of the instruments. The water temperature signal is the most signal for the cold start of the engine. During the period of **cold start**, the fuel injection quantity depends on the signal proved by the water temperature sensor.

Structure and Principle: This sensor is a thermistor with negative temperature coefficient (NTC), whose resistance reduces as the coolant temperature rises, and increases as the coolant temperature drops, but it isn't linear. Based on the output signal from the sensor, the ECU monitors the change of water temperature through its internal comparison circuit.

Trouble Diagnosis:

- 1) The water temperature signal is higher than the limit value;
- 2) The water temperature signal is lower than the limit value;
- 3) The open or short circuits of the water temperature sensor.

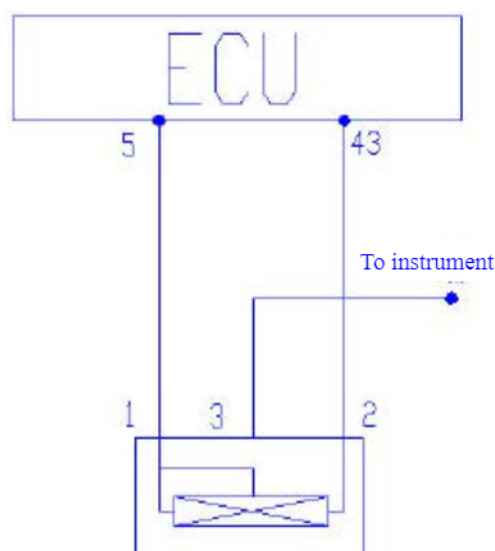
Resistance value data at normal temperature:
 $2.5 \pm 5\% K \Omega$

Installation Hint: The max. tightening torque is 20 Nm.

Hint: This vehicle is equipped with the three-wire water temperature sensor. This kind of sensor features with the cost-effective and the system consistency.



Profile of a coolant temperature sensor



T11 Water Temperature Sensor

Circuit diagram of coolant temperature sensor

Pin:

This sensor has three pins in total, which can be exchanged each other.

- 1) No1 (A) for the sensor grounding wire (to Ecu 5#);
- 2) No 2 (B) for the water temperature sensor signal wire (to ECU 43#);
- 3) No 2 (C) for the water temperature gauge of the instruments;



The **three wires** of the sensor are respectively:

- The 5V standard power supply wire;
- The sensor signal wire (for ECU);
- The sensor signal wire (for instruments).

Characteristic Parameters (Standard Value):

-10℃	16120 Ω
0℃	9399 Ω
20℃	3511 Ω
60℃	671 Ω
90℃	241 Ω

Troubleshooting:

- 1) Mainly examine the short or open circuit between the three wires on sensor and the ECU or instruments.
- 2) Examine the short or open circuit and the grounding among the harnesses of sensor.
- 3) Examine the bad wire earth or earth, which easily cause the over-high temperature indicated on the water temperature gauge of the engine.

Operating Voltage: 5V DC

Opening Temperature Range: -40 ℃ to 135℃

4. Knock Sensor (KS, KNK)

Application: This sensor is used to provide the ECU with the knock information of the engine to conduct the knock control.

Structure and Principle: The knock sensor is a kind of vibration acceleration sensor mounted on the cylinder body of an engine. It is generally installed between the No 2 cylinder and the No 3 cylinder, which is in favor of the knock balance of the engine. The ECU utilizes the vibration frequency signal output from the knock sensor to determine the knock of the engine through the wave filtering inside the ECU. When the knock signal is detected, the ECU will gradually reduce the knock till there is no knock, and then gradually resume the knock till up to the upper limit of knock. Repeat this procedure above.



Profile of a knock sensor with cable

Trouble Diagnosis: The ECU monitors the knock sensor, power amplification circuit and testing circuit. The fault flag of the knock sensor will be set if one of the following conditions occurs:

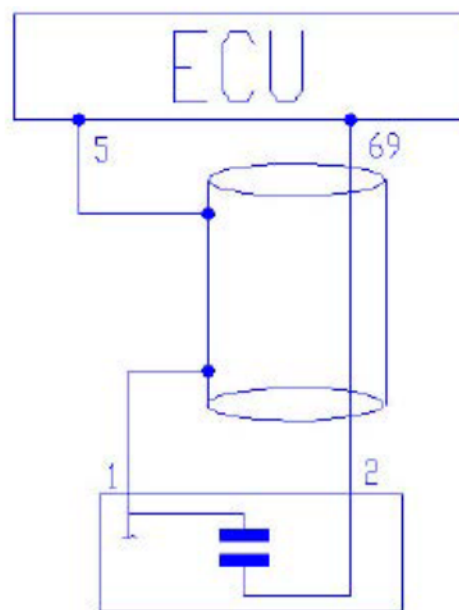
- 1) The knock sensor fails;
- 2) The knock control data processing circuit fails;
- 3) There are some insincere cylinder detection signals;
- 4) The sensor wire fails.

After the fault flag of the knock sensor is set, the closed-loop control for knocking closes and then the ignition advance angle stored in the ECU is identified as a safety angle by the software program. The fault flag resets when the error frequency drops down to the setting value below.

Installation Hint: The tightening torque is $20 \pm 5\text{Nm}$.

Troubleshooting:

- 1) Mainly examine the short or open circuit between these two wires on sensor and the corresponding ECU pins.
- 2) Examine the installation torque of sensor and whether the gaskets are added when the sensor is installed.
- 3) Examine the bad press fit between the sensor and the cylinder body, or the foreign material between the sensor and the cylinder body.



T11 Knock Sensor

Circuit diagram of the knock sensor

Pin:

- 1) No 1 (A) for the knock sensor signal 1 (to ECU 5#)
- 2) No 2 (B) for the knock sensor signal 2 (to ECU 69#)

Operating temperature range: -40°C to 150°C

Resistance value: $> 1\text{M}\Omega$

5. Oxygen Sensor (O₂S)

Application: This sensor is used to provide the information about whether the oxygen is superfluous after the fuel injected into the engine cylinder fully combust together with air intake. Based on these information, the ECU can conduct the fuel quantitative closed-loop control to convert and purify three main toxic components, i.e. HC, CO and Nox which exist in the engine exhaust, with the help of three-way catalytic converter.

Structure and Principle: The sensing element of the oxygen sensor is a kind of ceramic tube with small holes, which the outside of tube wall is surrounded by the engine exhaust while the inside is full of air. Based on the oxygen concentration difference between the inside and the outside, the sensor indirectly figure out the pulse width of the fuel injection, transmit the width to the ECU, and then the ECU controls the fuel injection again. At the same time, The output data from the rear oxygen sensor are detected, and, in the ECU, the data from the front and rear oxygen sensors are compared to monitor the operation of three-way catalytic converter.

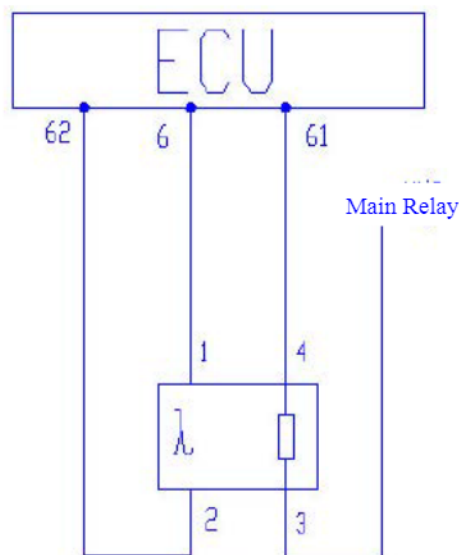
The operating voltage of the oxygen sensor fluctuates at the range of 0.1 to 0.9 V, and changes 5 to 8 times every 10 seconds. If the change frequency is less than this specified frequency, it indicates that the sensor is aged which needs to replace. This sensor is difficult to repair.

Trouble Diagnosis:

The ECU detects the oxygen sensor, wires and the power amplification circuit and testing circuit inside ECU. The fault flag of oxygen sensor will be set if one of the following conditions occurs:



Profile of a oxygen sensor



T11 Oxygen Sensor

Circuit diagram of front oxygen sensor

All front oxygen sensors have the cables. The other end of a cable is the electrical connection. There is a layer of asbestos fireproof covering around the outside of the sensor



- 1) There is the insincere battery voltage;
- 2) There are some insincere intake manifold absolute pressure signals;
- 3) There are some insincere engine coolant temperature signals;
- 4) The fuel injector driving level fails.

After the fault flag of the oxygen sensor is set, the fuel quantitative closed-loop control closes, and then the basic injection time stored in the ECU is applied to determine the fuel injection quantity.

Installation Hint: The tightening torque of the oxygen sensor is 50 to 60 Nm. After the oxygen sensor is replaced, apply a layer of antirust oil on the new oxygen sensor to avoid that the sensor is difficult to be disassembled after rustiness.

Troubleshooting: Mainly examine the good connection of several wires on the sensor, and the short or open circuit among them.

The damage of sensor is generally caused due to the lead or phosphorus poisoning. So, you shall pay more attention to the fuel quality. At the same time, the excessive consumption of the engine oil also easily creates the sensor failure.

During the specified time interval, the number of the oxygen sensor change shall not be less than the specified number.

Any connection has four pins:

- 1) No 1 (A) for the oxygen sensor signal low level (to ECU 6#);
- 2) No 2 (B) for the oxygen sensor signal high level (to ECU 62#);
- 3) No 3 (C) for the power supply of the main relay;
- 4) No 4 (D) for the sensor heater wire control (to ECU 61#).



Rear Oxygen Sensor (RO₂S)

The structure and detection of the rear oxygen sensor are similar to the front oxygen sensor, but the purpose that a vehicle equips with the front/rear oxygen sensor is considerably different

Purpose:

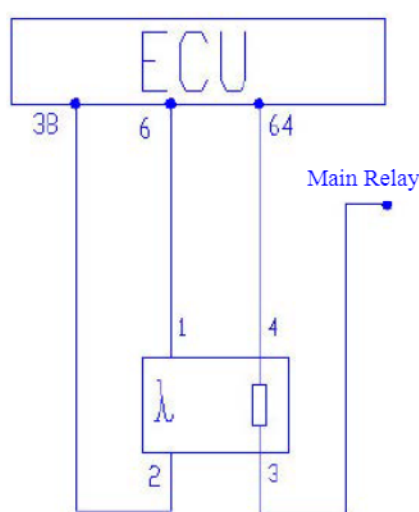
Front Oxygen Sensor is mainly used to detect the oxygen content of the exhaust and further determine the fuel injection quantity. The sensor converts the oxygen content of exhaust after combustion into the electric signal, and then transmits the signal to the ECU. The ECU utilizes these signals to control the pulse width of fuel injection, regulate the air-fuel ratio, and indirectly control the exhaust emission of the engine.

Rear Oxygen Sensor is mainly used to detect the oxygen content of exhaust after the completion of three-way catalytic conversion. The sensor converts this signal into the point signal, and transmits it to the ECU. The ECU compares the signals from the front and rear oxygen sensors and then determines the operation of the three-way catalytic converter.

The **trouble diagnosis, troubleshooting, signal detection** and other characteristics of the rear oxygen sensor are the same as the front oxygen sensor.



Internal structural diagram of a oxygen sensor



T11 Oxygen Sensor

Circuit diagram of rear oxygen sensor

Any connection has four pins:

- 1) No 1 (A) for the oxygen sensor signal low level (to ECU 6#);
- 2) No 2 (B) for the oxygen sensor signal high level (to ECU 38#);
- 3) No 3 (C) for the power supply of the main relay;
- 4) No 4 (D) for the sensor heater wire control (to ECU 64#).

6. Electronic Control Unit (ECU)

Application:

An ECU is an electric engine control center based on the microprocessor, with the sensor signal input interface and actuator drive circuit. It receives and processes the engine status signals from any sensor, and transmits the control signal to the actuators to enable the engine to operate in accordance with the preset procedure. It makes the engine in the optimal condition and ensures the better dynamics, fuel-effective and emission.



Profile of a ECU

Functions:

Multipoint sequential fuel injection system;
Grouping ignition system;
Idle control;
Automatic knock closed-loop control;
Provide sensor with the power supply:
5V/100mA;
 λ closed-loop control, with the self-adapting;
Dual oxygen sensors;
Emission canister control;
A/C ECU control;
Engine failure lamp;
Engine speed signal output;
Trouble self-diagnosis, with the flash code function;
Receive the engine load signal.

Normal operating voltage: 9 to 16V

Overvoltage protection: +24V/-12V < 60 s

Structure: with the shielded casing and PCB (Printed Circuit Block). There are a majority of electronic control units in a circuit board, which is applicable for the control of electronic fuel injection system.

Installation: Mounted under the water chute of the front windscreen with the help of a support and vehicle computer (ECU). Pay more attention to waterproof.

Operating temperature: -40°C to 105°C

Troubleshooting: ECU is an electronic control unit. Due to its lower fault rate, in general, it is not recommended to adapt the ECU replacement to solve all problems. Carefully examine the faults of the periphery circuits, sensors and other components, confirm that there is no fault in the periphery components, and then it is considered to replace the ECU.

7. Electric Fuel Pump (PUMP)

Application: With the specified fuel pressure and flow rate, this pump transmits the fuel from the fuel tank to the engine's main fuel supply pipe, and keeps the stable fuel pressure (by the fuel pressure regulator).

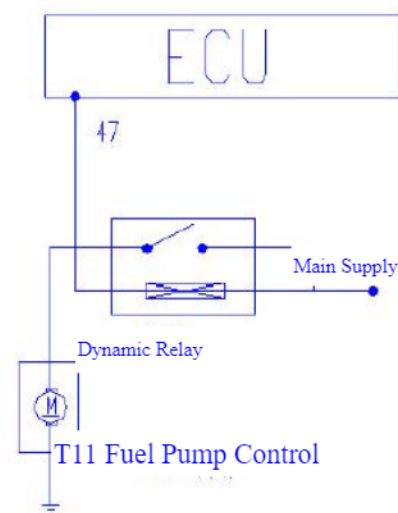
Structure and Principle: The electric fuel pump consists of the DC motor, vane pump, end cover which integrates with the check valve, decompression valve and EMI components) and other elements. The pump is installed coaxially together with the motor, and sealed in the same casing. The maximum pressure of the electric fuel pump outlet depends on the decompression valve, the range of which is **450 kPa to 650 kPa**. However, the pressure of the whole fuel system depends on the fuel pressure regulator, and, **for the MT 20U electronic fuel injection system, the pressure is generally 350 kPa.**

CAUTION: In case that the fuel tank of a vehicle is short or lack of fuel for a long time, the fuel pump will be difficult to obtain the full lubrication, which makes the fuel pump sintered. Especially, for the engine taking CNG and LPG as its fuel, the fuel tank of this kind of engine is generally in the state of **no fuel** or **lack fuel** for a long time, and its fuel pump fails to be fully lubricated for a long time, which result in the damage of fuel pump.

The temperature of fuel makes more influence on the performance of fuel pump. When the fuel pump operates at the high temperature for a long time and the temperature of fuel is greater than the specified temperature, the fuel pumping pressure of the fuel pump will drop steeply. Thus, if the engine fails to start during the period of vehicle warm up, please carefully examine and confirm whether the high temperature operating performance of the fuel pump is bad.



Profile of a electric fuel pump



Circuit diagram of electric fuel pump

Pin: The electric fuel pump has two pins which connect to the fuel pump relay. There are symbols “+” and “-” stamped on the fuel pump casing near these two pins, which means the connection to the positive and negative electrode respectively.

ECU 46# pin is applied to control the fuel pump relay.



The fuel pump lubricating and cooling are implemented with the help of the gasoline in the fuel tank.

The fuel tank of this vehicle is a saddle-shaped tank, with two fuel pump openings.

Decompression pressure: < 900 kPa

Operating voltage: 8 to 16 V

Fuel pump resistance: < 130 Ω

Troubleshooting: The fuel pump failures are generally the fuel pressure shortage, non-pumping and etc. During the period of troubleshooting, examine the fuel pressure of the system is within the specified range, and also examine the leakage of pipeline.

In addition, both the positive and the negative pressure will make influence on the fuel system.

The injection pump in the reserve tank is used to pump the fuel return to the main fuel tank.

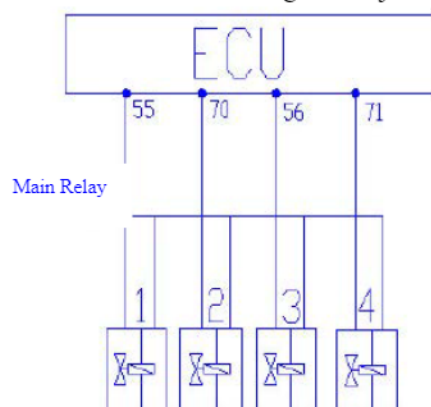
8. Electromagnetic Injector (INJ)

Application: MT 20U employs the sequential fuel injection technology. The sequential injection signals are provided by the intake pressure sensor (TEMP). If the TEMP is damaged, the mode of grouping injection is applied to control the fuel injection in accordance with the ignition sequence. Based on the instructions from ECU, the fuel injector injects the fuel within the specified time, offers engine the fuel and atomizes them.

Structure and Principle: The ECU emits the electrical pulse to the injector coil, which forms the magnetic field force. When the magnetic field force rises up enough to conquer the resultant force of the return spring pressure, gravity force of needle valve and frictional force, the needle valve starts to rise, and the fuel injection process begins. When the fuel injection pulse ends, the pressure of return spring enable the needle valve to be closed again.



Profile of a electromagnetic injector



T11 Fuel Injector Group

Circuit diagram of electromagnetic fuel injector



Installation Hint: For the specified fuel injector, the specified plugs must be applied, without mixing.

To install the injector conveniently, it is recommended to apply the un-silicon **clean engine oil** on the surface of upper O-ring which connects to the fuel distribution pipe. Pay attention not to let the oil contaminate the interior of fuel injector and its injection hole. During installation, the lower opening of injector must be sealed at all times, otherwise, it is possible to cause the intake system air leak.

Install the fuel injector on the fuel injector mount in the direction vertical to the injector mount, and then use the clips to fix the injector on the fuel injector mount.

CAUTION: For the vehicle out of service for a long term, due to the adhesive of gasoline in the injector, the vehicle will be difficult to start up after a long time of outofcommission. In this case, please examine carefully whether the fuel injector is adhesive.

Trouble Diagnosis: MT 20U electronic fuel injection system doesn't conduct the trouble diagnosis on the fuel injector, but conducts the trouble diagnosis on the fuel injector driver. When there is short circuit between the fuel injector driver and the battery, or short or open circuit between the fuel injector driver and the earth, or the fuel injector driver is overloaded, its fault flag is set. In this case, the oxygen sensor closed-loop control and its self-learning precontrol shall be switched off, and the last self-learning data is effective. The fault flag resets after the completion of troubleshooting.

Pin:

- 1) No 1 for No 1 cylinder fuel injector control electrode (to ECU 55#);
- 2) No 2 for No 2 cylinder fuel injector control electrode (to ECU 70#);
- 3) No 3 for No 3 cylinder fuel injector control electrode (to ECU 56#);
- 4) No 4 for No 4 cylinder fuel injector control electrode (to ECU 71#).

The other wires of four injectors **connect** together each other, power supply of which is provided through the main relay of engine. The ECU controls the injector earth.

Troubleshooting: Due to the long period of engine operation, it generally results the bad fuel injection and atomization of fuel nozzle. Regularly rinse the fuel nozzle.

The short or open circuit of the internal circuit of fuel nozzle will also cause the fuel injection system failure.

The short or open circuit of the system wires will cause the injection system failure.

Due to the long period of use of unqualified fuel, the fuel will adhesive to the injection hole of nozzle, which easily cause the fault of unstable idle.

Operating pressure: 350 kPa

Resistance of fuel injector: 11 to 16 Ω

Operating temperature: -40 to 130°C

9. Idle Actuator Stepper Motor (IDLE)

Function: Control the air flow area of bypass channel in the throttle valve, and further control the air intake quantity of the engine. Based on the signals from all sensors, the ECU can control the engine speed within the target speed range which can be calibrated in accordance with the **coolant temperature**.

Structure and Principle: In fact, a stepper motor is a micro-motor. Since the coil of motor passes through different directional currents, the motor will rotate in different direction. The rotary shaft of the motor will drive the threaded spindle movement and indirectly control the opening of the valve. MT 20U emits the digital square wave signal to control the ahead-reverse rotation and further control the stroke of the stepper motor.

Trouble Diagnosis: The ECU can monitor the short or open circuit of two coils of the idle stepper motor, and light the engine failure lamp when these troubles occur, which means that the engine switches to the failure mode.

It also monitors the short or open circuit between the four wires of sensor and the ECU.

ECU can't monitor the troubles generated by the mechanical part of the motor.

Troubleshooting: Examine the short or open circuit of four wires connection between the stepper motor and the ECU.

Examine the jamming of the stepper motor.

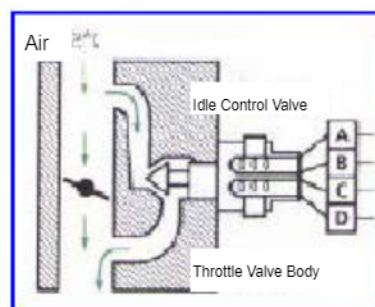
Examine the short or open circuit inside the stepper motor.

Disassemble the stepper motor, power on, and then examine the flexibility of the stepper motor.

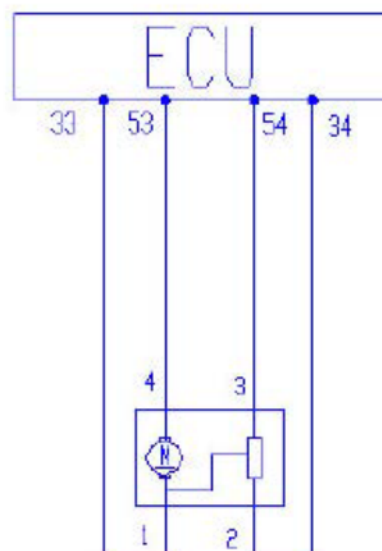
The carbon deposit and dirty material in the intake system will make an influence on the operating performance of stepper motor.

Resistance of motor coil: 58.3 to 47.7 Ω

Operating voltage: 7.5 to 16V



Profile of idle actuator stepper motor



T11 Idle Stepper Motor

Circuit diagram of idle actuator stepper motor

Pin:

- 1) No 1 (B) for idle actuator stepper motor control (to ECU 33#);
- 2) No 2 (A) for idle actuator stepper motor control (to ECU 34#);
- 3) No 3 (D) for idle actuator stepper motor control (to ECU 54#);
- 4) No 4 (D) for idle actuator stepper motor control (to ECU 53#);

10. Ignition Coil (COIL)

Function: The ignition coil changes the low voltage passing through primary winding to the high voltage through the secondary winding, creates the sparkle with the help of the ignition plug discharge to ignite the fuel-air mixture in the engine.

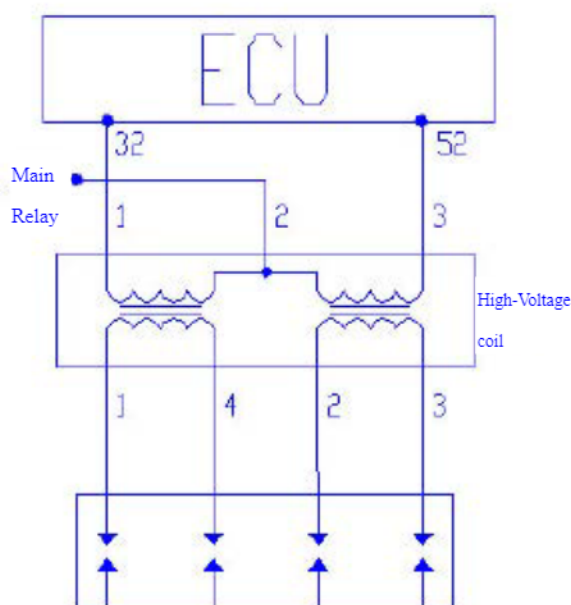
Structure and Principle: MT 20U adapts the grouping ignition technology, which, based on this principle that the mutual inductance of electromagnetic coils can create higher energy, controls the power on hours and power off time of the primary coil. It applies the high voltage generated in the secondary coil to break down the ignition plug clearance, create strong sparkle and ignite the mixture. Due to there are many ionized airs, lower electrical resistance during the stroke of engine exhaust, only lowest voltage is required to break down the ignition plug clearance. Thus, this system employs the grouping ignition technology, which can't waste the energy and may save cost.

Trouble Diagnosis: The ECU doesn't have the function to conduct the trouble diagnosis on the ignition coil. Thus, if the ignition coil fails to operate, it doesn't create any fault code. Only examination of ignition coil resistance is available to determine the normal operation of ignition coil. In the normal condition, the heating value of ignition coil is great during the operation of the coil, but the over-high temperature of the ignition coil will result in the increase of its resistance value, and further cause the unstable engine operation, automatic stop operation and other failures. However, the ECU can monitor the **control wires** of the ignition coil:

- 1) Control wires short circuit to earth;
- 2) Control wires short circuit to power supply;
- 3) Control wires open circuit.



Profile of ignition coil



T11 Ignition Coil Group
Circuit diagram of ignition coil

Pin:

- 1) No 1 (C) for the coil primary winding (to ECU 32#);
- 2) No 2 (A) for the coil primary winding (to ECU 52#);
- 3) No 3 (B) for the coil power supply (to the main relay of the system)



Measures on troubles: Once one ignition coil failure is detected, close the fuel injector of the corresponding cylinder.

CAUTION: The over-high temperature of ignition coil may cause the bad operation of engine ignition system.

Resistance of ignition coil primary winding:
0.55 to 0.45 K Ω

Resistance of ignition coil secondary winding: 5.6 to 4.8 K Ω

High-voltage side:

These pins No 1, 2, 3 and 4 connect to the ignition plugs of No 1, 2, 3 and 4 engine cylinders respectively via the distribution wire.

Troubleshooting:

- 1) Short or open circuit inside coil;
- 2) Electricity leakage of coil, and crack of casing;
- 3) The coil aging causes the shortage of ignition electricity quantity.

11. Steel Fuel Distributing Pipe Assy.

Application: It is used to store and distribute the fuel supplied from the fuel pump, provide a more stable pressure environment for the fuel injection system to balance the fuel supply pressure and quantity of all cylinders and enable the engine to operate smoothly.

Structure: The fuel distributing pipe assy. consists of a fuel distributing pipe and a fuel injector.

Installation Requirement: The quick connection of fuel outlet/inlet hose and fuel supply pipe must connect reliably. The vehicle shall take a trail run in situ after the repair of fuel system so as to ensure there is no fuel leakage in the fuel system. And, only this, the vehicle can be delivered.

Trouble Diagnosis: In normal condition, the probability of the fuel supply main pipe failure is very small. The failures are caused mostly due to the inappropriate assembly that enables the fuel system to leak. Thus, you shall pay more attention to the following highlights during assembly: the used O oil-seal shall not be applied again; and some lubricating oils may be applied properly during assembly.



Fuel distributing pipe assy.

CAUTION:

The pressure must be released firstly before the fuel system is repaired, and it must be ensured that there is no pressure oil in the fuel pipeline. Pull out the connection of fuel pump, and then put on the brake till the vehicle stops. In this case, there is already no pressure oil in this system. After repair, the fuel shall be pumped to the system firstly when the vehicle starts initially, the method of which is: to turn on the ignition switch, and turn off it after the completion of self-checking. Repeat this procedure 3 to 4 times.

12. Crankshaft Position Sensor (Speed Sensor) (CKPS)

Application: The crankshaft position sensor is used to provide the ECU with the engine's **speed, turning angle, top dead center** signals which are applied in the engine ignition, fuel injection and timing system.

Structure and Principle: The MT 20U electronic fuel injection system employs the magnetic induction coil type speed sensor, applies the rotation to cut the magnetic force lines and generate the alternating current and voltage signals. The ECU receives the alternating signals, shapes these signals, and then changes them into the digital signals that can be identified by the ECU and applied in the system control of engine. The flywheel ring gear is installed together with the signal wheel. The latter adapts the 58X gear form, and provides the ECU with **speed, turning angle, top dead center**. There is the No 1 cylinder's top dead center in the continuous gap.



Profile of a crankshaft position sensor

Trouble Diagnosis:

The ECU will real-time monitor the sensors and wires:

- 1) The sensors has no signal output;
- 2) The sensor's output signal is distorted;
- 3) The sensor signal wire is short circuit;
- 4) The sensor signal wire is open circuit.

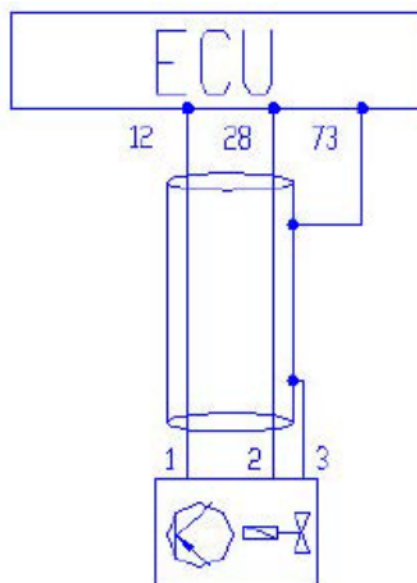
Troubleshooting:

- 1) Examine the wires of sensor, and the earth or short circuit of wire;
- 2) Apply the three-way instrument to connect the joints between the sensor and harness and examine the connection of power supply, earth wire and signal wire.

Operating temperature: -40 to 150°C

Clearance between the sensor and ring gear:
0.3 to 1.5 mm

Resistance of sensor: 504to 616 Ω



T11 Crankshaft Position Sensor

Circuit diagram of crankshaft position sensor

Pin:

- 1) No 1 (A) for sensor signal wire high level (to ECU 12#);
- 2) No 2 (B) for sensor signal wire low level (to ECU 28#);
- 3) No 3 (C) for sensor earth (to ECU 73#).

13. Canister Control Solenoid Valve (EVAP)

Application: It is used to control the rinse air flow from the canister to the intake main pipe. The adsorptive capacity of the canister is limited. If the evaporated gasoline adhesive to the canister aren't used out, the gasoline will volatilize to the outside and pollute the air as well as increase the insecure factors.



Profile of a canister control solenoid valve



Structure and Principle: There is a solenoid valve organization inside the canister control solenoid valve. The digitalized control pulse square wave from the engine will control the opening of the solenoid valve. Based on the different operation conditions of the engine, the openings of the canister control solenoid valves are different. When the engine is operating with large load and idle, the canister control valve doesn't put into operation in order to ensure the output power of engine.

Trouble Diagnosis:

- 1) The sensor-earth wires are short circuit;
- 2) The sensor-supply wires are short circuit;
- 3) The sensor wires are open circuit.

Troubleshooting:

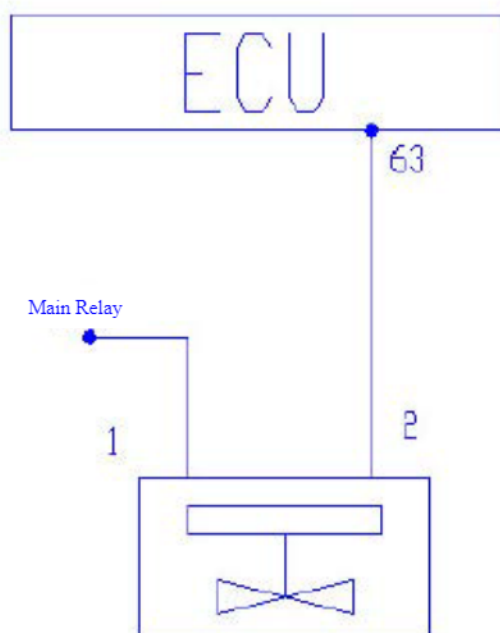
- 1) Examine the short or open circuit of sensor wires;
- 2) Examine the wire jumping among harnesses;
- 3) Examine the short circuit between the sensor and power supply;
- 4) Examine the jamming inside the canister control solenoid valve and its ventilation.

Operating temperature: -40 to 120°C

Resistance of coil: 19 to 22 Ω

Operating voltage: 8 to 16 V

Rated operating voltage: +12V



T11 Canister Control Solenoid Valve

Circuit diagram of canister control solenoid valve

Pin:

- 1) No 1 (A) for the solenoid valve control (to ECU 63#);
- 2) No 2 (B) for the power supply of main relay.

14. Air Conditioning Control System (A/C)

Principle: Turn on these A/C switches. If both the A/C pressure and the data detected by the evaporator temperature sensor are normal, the A/C request signal will pass through these switches and get to the ECU. The ECU controls the A/C relay attracting after it detects this signal. At the same time, it gives stepper motor a speed-increasing signal, and switches on the electronic fan. And the A/C system begins to operate.

Conditions to switch off A/C system:

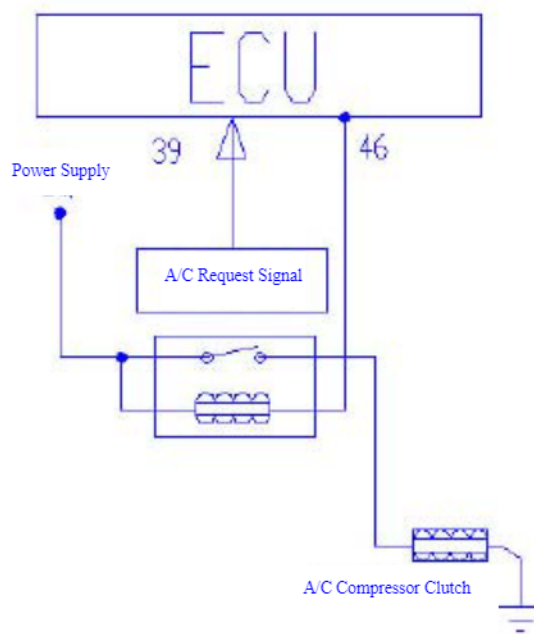
- 1) Throttle position sensor failure;
- 2) Vehicle speed sensor failure;
- 3) When the engine is with large load;
- 4) Evaporator temperature sensor failure;
- 5) The evaporator temperature is less than 1.5°C ;
- 6) The engine speed is overspeed;
- 7) The coolant temperature is greater than 108°C ;
- 8) Refueling is too quick.

Trouble Diagnosis:

- 1) Short circuit of A/C relay wire to earth;
- 2) Short circuit of A/C relay wire to power supply;
- 3) Open circuit of A/C relay wire;
- 4) Too-low evaporator temperature sensor temperature;
- 5) Over-high evaporator temperature sensor temperature.

Troubleshooting:

- 1) Examine the wire of A/C system;
- 2) Examine the damage of A/C system's evaporator temperature sensor;
- 3) Examine the wire jumping inside the harness.



Circuit diagram of A/C control system

Pin:

- No 1 for the A/C request signal (to ECU 39#);
No 2 for the A/C relay control (to ECU 46#).

15. Fan Control (FAN)

MT 20U controls the fan's low/high speed. Based on the water temperature, air conditioning and other signals, the control system can control the fan's low and high speed operation. If the condition is applicable, the **MT 20U** will control the fan system delay.

Control Mode:

For 1st gear, the fan is switched on at 98°C and switched off at 94°C;

For 2nd gear, the fan is switched on at 105°C and switched off at 101°C;

If the water temperature is greater than 101°C after the fan is switched off, the fan continues to operate for 1 minute;

If the water temperature is greater than 94°C after the fan is switched off, the fan continues to operate for 0.5 minute;

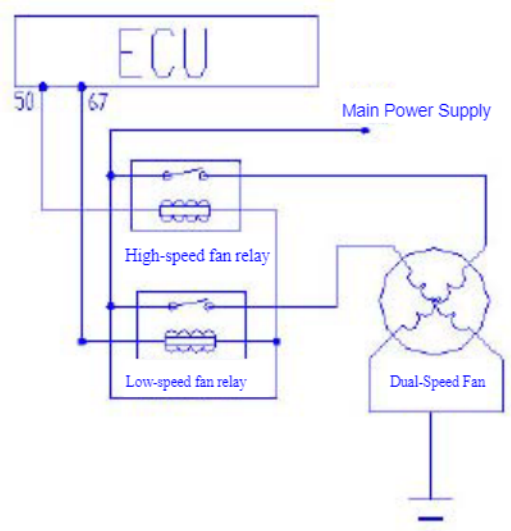
If the water temperature is less than 85°C after the fan is switched off, the fan stops;

Trouble Diagnosis:

- 1) Short circuit of high-speed relay wire to power supply;
- 2) Short circuit of high-speed relay wire to earth;
- 3) Open circuit of high-speed relay wire;
- 4) Short circuit of low-speed relay wire to power supply;
- 5) Short circuit of low-speed relay wire to earth;
- 6) Open circuit of low-speed relay wire;

Troubleshooting:

In ECU side, examine the short or open circuit of these wires in accordance with the pins shown in the left figure.



Circuit diagram of fan control system

In this figure above, the high/low speed pins are the same as the actual pins. But the actual circuit diagram is different from this circuit diagram above. The latter is for reference only.



16. Definition of ECU Pins

Pin	Connection Point	Type	Pin	Connection Point	Type
1	Ignition switch control fire wire (supply)	Input	2	Unused	
3	Speed signal sensor	Input	4	5V standard power supply	Output
5	5V standard supply earth wire	Earth	6	Front oxygen sensor signal (low level)	Input
7	Unused		8	Unused	
9	Unused		10	Unused	
11	Diagnosis communication	Output	12	Speed sensor signal (high level)	Input
13	Unused		14	Unused	
15	Unused		16	Unused	
17	Battery supply (+12V)	Input	18	Battery supply (+12V)	Input
19	Unused		20	5V standard power supply	Output
21	5V standard power supply earth wire	Earth	22	Unused	
23	Unused		24	Throttle position sensor signal	Input
25	Unused		26	A/C evaporator temperature sensor	Input
27	Intake manifold temperature sensor	Input	28	Speed sensor signal (low level)	Input
29	Unused		30	Diagnosis request	Input
31	Engine failure lamp	Input	32	Ignition switch 1 and 4	Input
33	Idle stepper motor drive coil B	Output	34	Idle stepper motor drive coil A	Output
35	Unused		36	Unused	
37	Unused		38	Rear oxygen sensor signal (low level)	Input
39	A/C request signal	Input	40	Unused	
41	Unused		42	Air intake pressure sensor signal	Input
43	Coolant temperature sensor signal	Input	44	Unused	
45	Engine speed signal	Output	46	A/C relay control	Output
47	Fuel pump relay control	Output	48	Unused	
49	Unused		50	Fan high-speed control	Input
51	Unused		52	Ignition coil 2 and 3	Input
53	Idle stepper motor coil C	Output	54	Idle stepper motor coil D	Output
55	Fuel injector 1#	Input	56	Fuel injector 2#	Input
57	Unused		58	Unused	
59	Unused		60	Unused	
61	Front oxygen sensor heating control	Input	62	Front oxygen sensor signal (high level)	Input
63	Canister control solenoid valve control	Input	64	Rear oxygen sensor heating control	Input
65	Unused		66	Unused	
67	Fan low-speed control	Input	68	Unused	
69	Knock sensor signal	Input	70	Fuel injector 3#	Input
71	Fuel injector 4#	Input	72	Unused	
73	Motive earth	Earth	No		



Section II Basic Principles of Trouble Diagnosis

1. Basic Principles

1) Failure Information Record

MT 20U electronic control unit continuously detect sensors, actuators, related circuits, failure lamps, battery voltage and etc, even detect the electronic control unit itself, and conduct the reliability detection on the sensor output signal, actuator drive signal and internal signal (such as oxygen closed-loop control, knock control, idle speed control, battery voltage control and etc.). Once one failure in a certain process occurs, or one signal value is unreliable, the electronic control unit will immediately set a failure information record in the failure register of RAM. The failure information record will be stored with the form of failure code, and displayed in the sequence of failure occurrence.

These failures can be divided into “**Stable Failure**” and “**Chance Failure**” (such as the failures caused by the transient harness short-circuit or the bad contact of connecting parts) in accordance with their frequency of occurrence.

2) Failure State

If the duration of a identified failure occurrence is initially greater than the setting stabilized time, the ECU will confirm it is a stable failure, and store it as the “Stable Failure”. If this failure disappears, it will be stored as “Chance Failure” and “Nonexistent”. If this failure is identified again, it still be a “Chance Failure”, but a “existent” history failure doesn’t make an influence on the normal operation of a engine.

3) Failure Type

- a. Short circuit to the positive electrode of power supply;
- b. Short circuit to earth;
- c. Open circuit;
- d. Signal unreliable.

4) Four Failure Types

Failures of All Electronic Fuel Injection Vehicle Are Basically Defined As These Types.

- a. Max. failure, which means its signal is greater than the upper limit of normal range.
- b. Min. failure, which means its signal is less than the lower limit of normal range.
- c. Signal failure, without signal.
- d. Unreasonable failure, with signal, but the signal is unreasonable.



5) Limp-home

For some identified important failures, when their duration exceeds the setting stabilized time, the ECU will apply appropriate software countermeasure to maintain the operation of the engine and enable the vehicle not to stop in its way.

6) Failure Alarm

MT 20U electronic fuel injection system is equipped with a failure lamp. When some important parts, such as the ECU, intake manifold absolute pressure sensor, throttle position sensor, coolant temperature sensor, knock sensor, oxygen sensor, fuel injector, two drivers of idle actuator stepper motor, A/C relay, fan relay and etc, fail to operate and the corresponding failure flags are set, the ECU will enable the failure lamp to flash and give alarm to warn the owner of the vehicle that your vehicle has already entered into the failure mode, till the failure flag is reset.

7) Definition of Diagnosis Connector Interface

Definition of Diagnosis Connector Interface

8	NULL	16	+12 V
7	Communication	15	NULL
6	NULL	14	NULL
5	Earth Wire	13	NULL
4	Earth Wire	12	NULL
3	NULL	11	NULL
2	NULL	10	NULL
1	Diagnosis	9	NULL



8) Failure Readout by Engine Failure Lamp

When the engine system or its components failure occurs during the operation of engine, the engine failure lamp will light automatically to remind the driver to examine and repair his/her vehicle in time.

During the emergency failure handling, you also may conduct some special operations to enable the engine failure lamp to flash frequently so as to read the engine failure code, which is the most economical means to obtain the failure code. Its operation method is as follows:

Examine and Confirm:

- The voltage of battery shall ensure the engine gets its startup speed;
- The engine and the whole vehicle's accessories shall be in the state of shutdown;
- The throttle is fully closed;
- The transmission is placed in the neutral gear;



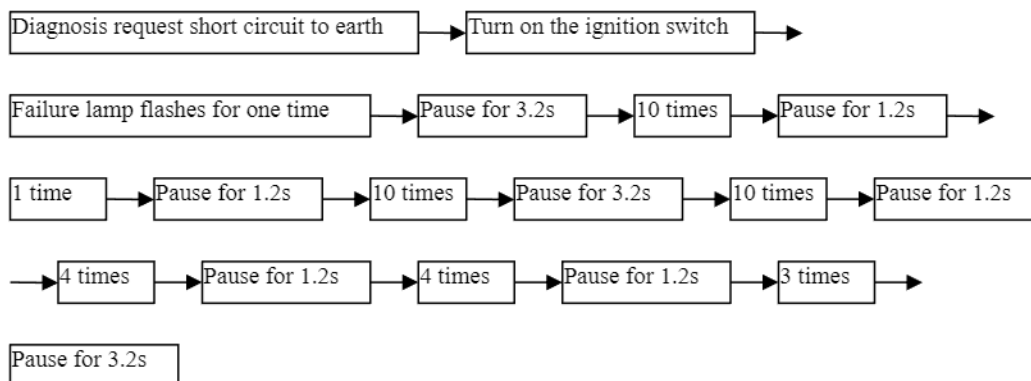
- e. The ignition switch is turned off;
- f. Apply wires to enable the **diagnosis request terminal 1** of the **failure diagnosis connectors** to short circuit with the **earth wire terminal 4 or 5**;
- g. Turn the ignition switch to ON, but don't start up the engine;

In this case, if the system currently has a **failure** or a **history failure code** uncleared after the failure removal, the engine failure lamp will flash in accordance with a certain rule, and the output system detects the code of failure; (the failure code is read out and, at the same time, the **idle control valve** will conduct the reset action);

After the completion of failure code readout, the ignition switch is turned off and the diagnosis request short-circuit wire is removed;

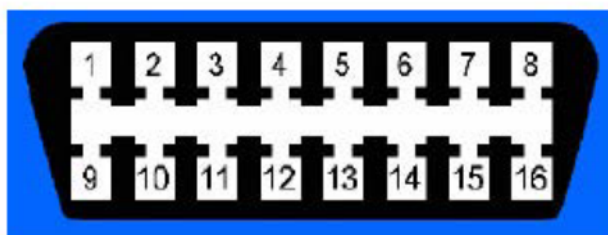
The rules that the failure lamp flashes to report the failure are:

- Report the failure in accordance with the sequence of failure code memorized;
- 3.2 s pause between two failure codes. The digits flash at the frequency of light for 0.4 s and extinguish for 0.4s, with 1.2 s pause between two digits;
- The number 0 flashes 10 times, and other numbers corresponds to the flash numbers;
- Taking the failure code 0110 and 0443 as an example:



→ If the diagnosis request doesn't interrupt, restart to report 0110 failure code

CAUTION: After the removal of failure, it is recommended to apply the failure diagnosis instrument to clear these failure codes so as not to make an influence on the failure detection during the next repair.



ISO 9141-2 Standard Diagnosis Connector

9) Removal of Failure Information Record

After a failure is removed, the failure information record stored in a memory shall be cleared. Although failure information has occurred when the ignition switch is turned on, it isn't recorded if it isn't kept up to the end of stabilized time.

After the engine starts up successfully the specified times, the failure code will be cleared automatically.

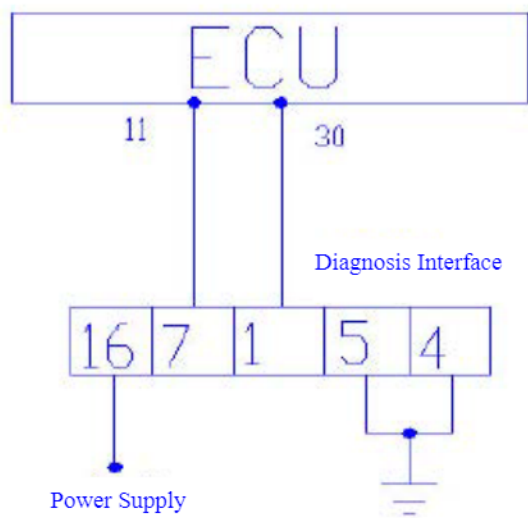
Apply a failure diagnosis instrument and the "Failure Memory Reset" instruction to clear the failure information record.

Pull out the connector from ECU or remove the wires of battery to clear the failure information record stored in the external RAM.

10) Failure Search

After a failure information record is obtained with the help of the means above, only the approximate location where the failure occurs is known, but it doesn't mean that the failure is found because the reason to create a failure information may be the damage of a electrical component (such as sensor or actuator or ECU, etc.), open circuit of a wire, short circuit of a wire to earth or the positive electrode of battery, even may be a mechanical fault.

The failure is inherent, and its external expressive results are various kinds of symptoms. After a symptom is found, it is required firstly to use a failure diagnosis instrument or some flash codes to check whether there are some failure information records. And, based on these information records, the related failure shall be removed. Then, you can search the failure in accordance with the symptom of the engine.





2. Engine Failure Code Table

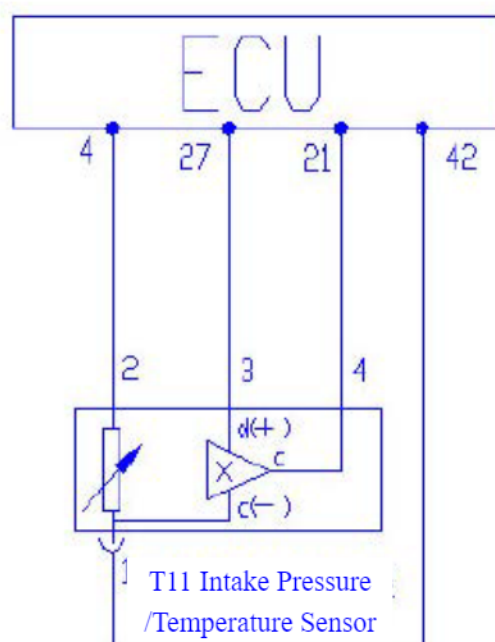
Delphi MT 20U Engine Management System Failure Code Table

Code	Description	Code	Description
P0105-1	Over-high intake manifold absolute pressure sensor signal	P0443-1	Short-circuit between the wire of canister control solenoid valve and the positive of electrode power supply
P0105-2	Too-low intake manifold absolute pressure sensor signal	P0443-2	Open circuit of the wire of canister control solenoid valve or short circuit to earth
P0110-1	Too-low intake temperature sensor signal	P0480-1	Short circuit of radiator low-speed fan relay drive circuit to the positive electrode of power supply
P0110-2	Over-high intake temperature sensor signal	P0480-2	Open circuit of radiator low-speed fan relay drive circuit or short circuit to earth
P0115-1	Too-low coolant temperature sensor signal	P0481-1	Short circuit of radiator high-speed fan relay drive circuit to the positive electrode of power supply
P0115-2	Over-high coolant temperature sensor signal	P0481-2	Open circuit of radiator high-speed fan relay drive circuit or short circuit to earth
P0120-1	Over-high throttle position sensor signal	P0482-1	Short circuit of A/C cooling fan relay drive circuit to the positive electrode of power supply
P0120-2	Too-low throttle position sensor signal	P0482-2	Open circuit of A/C cooling fan relay drive circuit or short circuit to earth
P0130-4	No oxygen sensor signal	P0500-0	No vehicle speed sensor signal
P0135-1	Short circuit of oxygen sensor heating circuit to the positive electrode of power supply	P0505-0	Idle control error
P0135-2	Open circuit of oxygen sensor heating circuit or short circuit to earth	P0560-1	Over-high system voltage
P0170-1	Over-long oxygen sensor indication of time of rich air-fuel-ratio	P0607-0	Knock control system failure
P0170-2	Over-long oxygen sensor indication of time of lean air-fuel-ratio	P0650-1	Short circuit between the failure lamp wire and the positive electrode of power supply
P0201-0	Fuel injector A (No 1 cylinder) circuit failure	P0650-2	Open circuit of the failure lamp wire or short circuit to earth
P0202-0	Fuel injector B (No 3 cylinder) circuit failure	P1230-1	Short circuit of main relay circuit to the positive electrode of power supply
P0203-0	Fuel injector C (No 4 cylinder) circuit failure	P1230-2	Open circuit of main relay circuit or short circuit to earth



P0204-0	Fuel injector D (No 2 cylinder) circuit failure	P1530-1	Short circuit of A/C compressor relay circuit to the positive electrode of power supply
P0230-1	Short circuit of fuel pump relay to the positive electrode of power supply	P1530-2	Open circuit of A/C relay circuit or short circuit to earth
P0230-2	Open circuit of fuel pump relay or short circuit to earth	P1604-0	EEPROM error
P0325-0	Bad connection to the knock sensor	P1610-0	Anti-theft controller error
P0335-0	No 58X crankshaft position sensor signal	P1610-8	ECM and anti-theft controller communication error
P0335-8	58X crankshaft position sensor signal error	P2000-1	Over-high temperature of front A/C evaporator
P0342-0	Low camshaft position signal	P2000-2	Too-low temperature of front A/C evaporator
P0342-2	High camshaft position signal	P2001-1	Over-high temperature of rear A/C evaporator
P0351-1	Short circuit between the ignition coil 1-4 cylinder drive circuit and the positive electrode of power supply	P2001-2	Too-low temperature of rear A/C evaporator
P0351-2	Open circuit of the ignition coil 1-4 cylinder drive circuit or short circuit to earth	P2100-2	Short circuit of rear A/C trip relay to battery
P0352-1	Short circuit between the ignition coil 2-3 cylinder drive circuit and the positive electrode of power supply	P2100-8	Open circuit of rear A/C trip relay or short circuit to earth
P0352-2	Open circuit of the ignition coil 2-3 cylinder drive circuit or short circuit to earth		

3. Method of Trouble Shooting



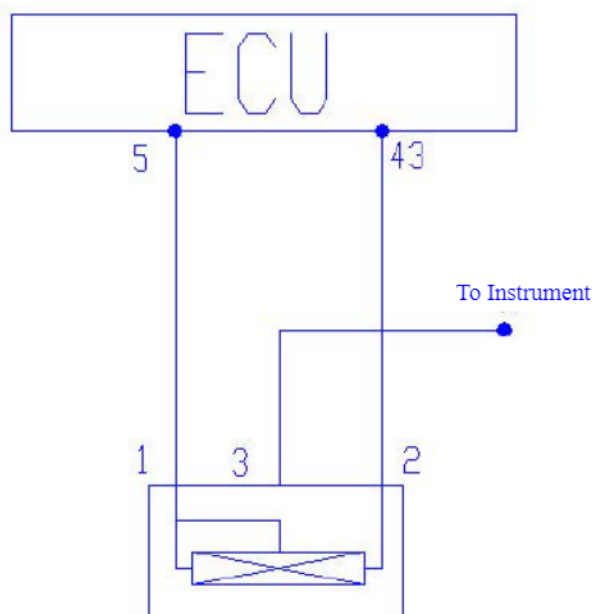
Failure Code:	P0105-1	Over-high intake manifold absolute pressure sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● When the engine stops: 90 kPa ● When the engine idles: = 45 kPa ● When the engine operates: the pressure of manifold changes as the opening of throttle ● If the cylinder pressure detection technology is applied, there is 50% of probability that the fuel injection sequence has 360 degree of ram off.			
Connection terminal:		MT 20U		Pressure/Temperature Sensor	Normal Measurement Signal
5V reference voltage:		04		B	5V
Manifold pressure signal:		42		A	0.5 to 4.5V
Sensor signal earth:		21		D	0V
Condition for Determination		Possible Reason			Actions
Engine operation No TPS failure MAP > 98.117 kPa TPS < 19.141% Failure duration > 2.5 s		1) Short circuit of harness pressure signal circuit to 5V reference voltage circuit or the positive electrode of power supply 2) Sensor damaged 3) ECM's pressure signal input interface failure			1) Repair harness 2) Replace sensor 3) Replace ECM



Failure Code:	P0105-2	Too-low intake manifold absolute pressure sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● When the engine stops: 90 kPa ● When the engine idles: = 45 kPa ● When the engine operates: the pressure of manifold changes as the opening of throttle ● If the cylinder pressure detection technology is applied, there is 50% of probability that the fuel injection sequence has 360 degree of ram off.			
Connection terminal:		MT 20U		Pressure/Temperature Sensor	Normal Measurement Signal
5V reference voltage:		04		B	5V
Manifold pressure signal:		42		A	0.5 to 4.5V
Sensor signal earth:		21		D	0V
Condition for Determination		Possible Reason			Actions
No TPS failure MAP < 14.047 kPa RPM < 1050 rpm TPS > 18.75% Failure duration > 2.5 s		1) Unreliable connection of the connecting parts 2) Open circuit of harness pressure signal circuit 3) Short circuit of harness pressure signal circuit to earth 4) Open circuit of 5V reference voltage circuit 5) Open circuit of sensor signal earth wire 6) Harness 5V reference voltage direction is reverse with the reference earth wire (this failure may cause the damage of sensor) 7) Sensor damaged 8) ECM's pressure signal input interface failure			1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Repair harness 6) Repair harness 7) Replace sensor 8) Replace ECM



Failure Code:	P0110-1	Too-low intake temperature sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air intake temperature shall be equal to the coolant temperature, but not more than 44.25℃			
Connection terminal:		MT 20U		Pressure/Temperature Sensor	Normal Measurement Signal
Intake temperature signal:		27		C	0.5 to 4.5V
Sensor signal earth:		21		D	0V
Condition for Determination		Possible Reason			Actions
Engine operation time > 120 s MAT < -38.25℃ Failure duration > 2 s		1) Unreliable connection of the connecting parts 2) Open circuit of temperature signal circuit 3) Open circuit of sensor signal earth 4) Short circuit of temperature signal wire to the positive electrode of power supply 5) Sensor damaged 6) ECM's this signal input interface failure			1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace sensor 6) Replace ECM
Failure Code:	P0110-2	Over-high intake temperature sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air intake temperature shall be equal to the coolant temperature, but not more than 44.25℃			
Connection terminal:	MT 20	MT 20U	Intake Temp. Sensor	Pressure/Temperature Sensor	Normal Measurement Signal
Intake temperature signal:	35	27		C	0.5 to 4.5V
Sensor signal earth:	28	21		D	0V
Condition for Determination		Possible Reason			Actions
Engine operation time > 60 s MAT > 148.5℃ Failure duration > 2 s		1) Short circuit of temperature signal circuit to earth 2) Sensor damaged 3) ECM's this signal input interface failure			1) Repair harness 2) Replace sensor 3) Replace ECM

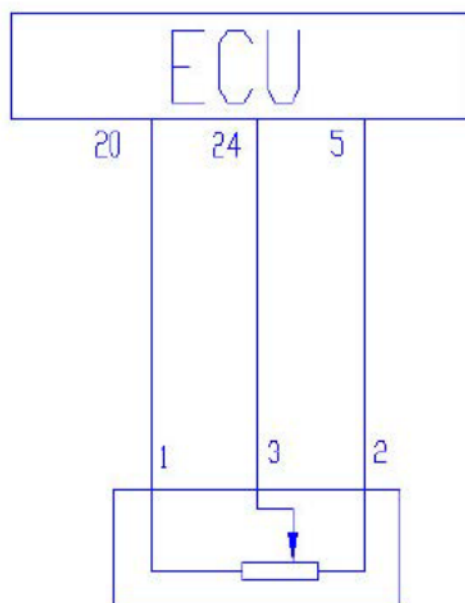


T11 Water Temperature Sensor

Failure Code:	P0115-1	Too-low coolant temperature sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Apply the intake temperature during startup, gradually increase up to 79.5℃ and then keep this temperature.			
Connection terminal:		MT 20U		Coolant Temperature Sensor	Normal Measurement Signal
Coolant temperature signal:		43		B	0.5 to 4.5V
Sensor signal earth:		05		A	0V
Condition for Determination		Possible Reason			Actions
Engine operation time > 10 s CTS < -38.25℃ Failure duration > 2 s		1) Unreliable connection of the connecting parts 2) Open circuit of temperature signal circuit 3) Open circuit of sensor signal to earth 4) Short circuit of temperature signal circuit to the positive electrode of power supply 5) Sensor damaged 6) ECM's this signal input interface failure			1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace sensor 6) Replace ECM



Failure Code:	P0115-2	Over-high coolant temperature sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Apply the intake temperature during startup, gradually increase up to 79.5℃ and then keep this temperature.			
Connection terminal:	MT 20	MT 20U		Coolant Temperature Sensor	Normal Measurement Signal
Coolant temperature signal:	34	43		B	0.5 to 4.5V
Sensor signal earth:	37	05		A	0V
Condition for Determination		Possible Reason			Actions
Engine operation time > 2 s CTS > 135℃ Failure duration > 2 s		1) Short circuit of temperature signal circuit to earth 2) Sensor damaged 3) ECM's this signal input interface failure			1) Repair harness 2) Replace sensor 3) Replace ECM

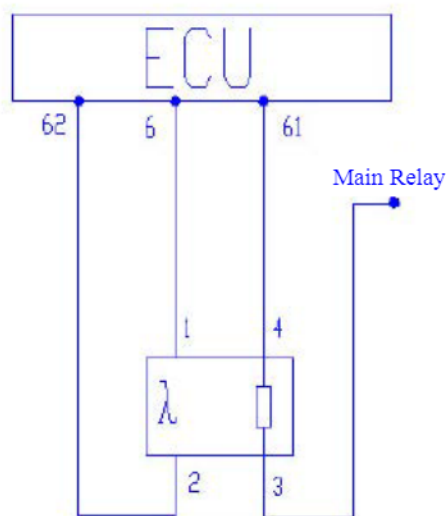


T11 Throttle Position Sensor

Failure Code:	P0120-1	Over-high throttle sensor signal		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● During idle, set the opening of throttle position sensor as 0%; for other speeds, the opening of throttle position sensor changes as speed. ● The throttle position sensor automatic reset function pauses ● The function to clear the remained fuel and air in a cylinder pauses.		
Connection terminal:		MT 20U	Throttle Position Sensor	Normal Measurement Signal
5V reference voltage:		20	A	5V
Throttle position signal:		24	C	0.5 to 4.5V
Sensor signal earth:		05	B	0V
Condition for Determination		Possible Reason		Actions
Engine operation, but speed < 3000 rpm No MAP failure, and MAP < 70 kPa Failure duration > 2 s		1) Short circuit of sensor signal circuit to the positive electrode of power supply or the 5V reference voltage circuit 2) Sensor damaged 3) ECM's this signal input interface failure		1) Repair harness 2) Replace sensor 3) Replace ECM



Failure Code:	P0120-2	Too-low throttle sensor signal		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● During idle, set the opening of throttle position sensor as 0%; for other speeds, the opening of throttle position sensor changes as speed. ● The throttle position sensor automatic reset function pauses ● Clear function pauses.		
Connection terminal:	MT 20	MT 20U	Throttle Position Sensor	Normal Measurement Signal
5V reference voltage:	36	20	A	5V
Throttle position signal:	26	24	C	0.5 to 4.5V
Sensor signal earth:	37	05	B	0V
Condition for Determination		Possible Reason		Actions
Failure duration > 2 s		1) Unreliable connection of the connecting parts 2) Open circuit of sensor signal circuit 3) Short circuit of sensor signal circuit to earth 4) Sensor damaged 5) ECM's this signal input interface failure		1) Connect again 2) Repair harness 3) Repair harness 4) Replace sensor 5) Replace ECM



T11 Oxygen Sensor

Failure Code:	P0130-4	No oxygen sensor signal			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air-fuel-ratio can't be closed-loop controlled			
Connection terminal:		MT 20U	Heating-type Oxygen Sensor		Normal Measurement Signal
System main power supply:		\	C		12V
Heating drive:		61	D		0V
Oxygen sensor's high signal:		62	B		0 to 1000mV fluctuation
Oxygen sensor's low signal:		06	A		0V
Condition for Determination		Possible Reason			Actions
360.24mV < oxygen sensor signal < 538.19mV Engine operation time > 40 s No TPS and MAP failure Coolant temperature > 72℃ Enter the closed-loop fuel control state TPS > 10.156% Failure duration > 15 s		1) Unreliable connection of the connecting parts 2) Open circuit of sensor signal circuit 3) Sensor poisoning or failure due to over-heating 4) ECM's this signal input interface failure			1) Connect again 2) Repair harness 3) Replace sensor 4) Replace ECM

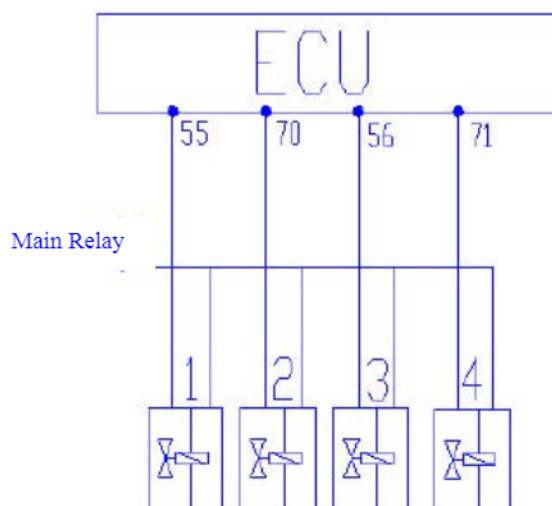


Failure Code:	P0135-1	Short circuit of oxygen sensor heating circuit to the positive electrode of power supply			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears, and turn off the ignition switch ● System closed-loop operating time postponed			
Connection terminal:		MT 20U	Heating-type Oxygen Sensor		Normal Measurement Signal
System main power supply:		\	C		12V
Heating drive:		61	D		0V
Oxygen sensor's high signal:		62	B		0 to 1000mV fluctuation
Oxygen sensor's low signal:		06	A		0V
Condition for Determination		Possible Reason			Actions
Failure duration > 1 s		1) Short circuit of heating drive circuit to the positive electrode of power supply 2) Sensor damaged 3) ECM's this signal input interface failure			1) Repair harness 2) Replace sensor 3) Replace ECM
Failure Code:	P0135-2	Open circuit of oxygen sensor heating circuit or short circuit to earth			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears, and turn off the ignition switch ● System closed-loop operating time postponed			
Connection terminal:		MT 20U	Heating-type Oxygen Sensor		Normal Measurement Signal
System main power supply:		\	C		12V
Heating drive:		61	D		0V
Oxygen sensor's high signal:		62	B		0 to 1000mV fluctuation
Oxygen sensor's low signal:		06	A		0V
Condition for Determination		Possible Reason			Actions
No main relay failure Failure duration > 1 s		1) Unreliable connection of the connecting parts 2) Open circuit of harness's this heating drive circuit 3) Short circuit of harness's this heating drive circuit to earth 4) Sensor damaged 5) ECM's this signal input interface failure			1) Connect again 2) Repair harness 3) Repair harness 4) Replace sensor 5) Replace ECM



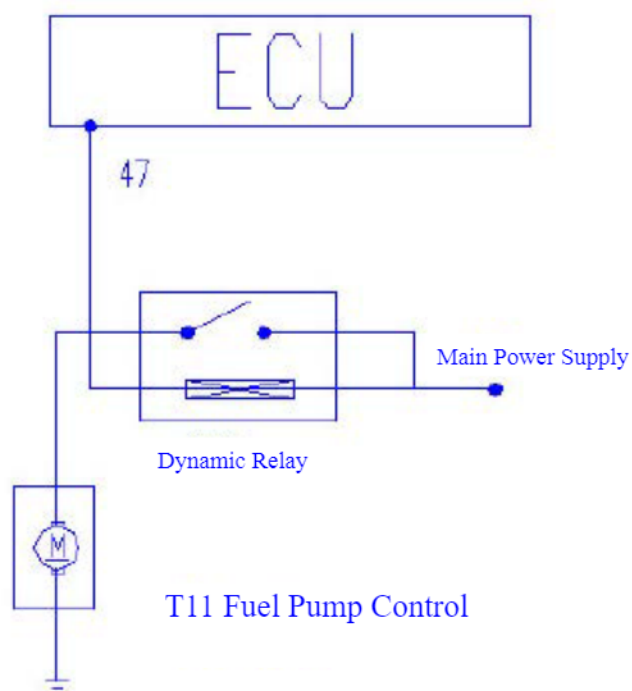
Failure Code:	P0170-1	Over-long oxygen sensor indication of time of rich air-fuel-ratio			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air-fuel-ratio can't be closed-loop controlled			
Connection terminal:		MT 20U	Heating-type Oxygen Sensor		Normal Measurement Signal
System main power supply:		\	C		12V
Heating drive:		61	D		0V
Oxygen sensor's high signal:		62	B		0 to 1000mV fluctuation
Oxygen sensor's low signal:		06	A		0V
Condition for Determination		Possible Reason		Actions	
Oxygen sensor signal > 998.26mV Engine operation time > 40 s No TPS and MAP failure Coolant temperature > 72℃ Enter the closed-loop fuel control state TPS > 10.156% Failure duration > 15 s		1) Short circuit of sensor signal circuit to 5V or 12V circuit 2) Sensor damaged 3) ECM's this signal input interface failure		1) Repair harness 2) Replace sensor 3) Replace ECM	

Failure Code:	P0170-2	Over-long oxygen sensor indication of time of lean air-fuel-ratio			
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air-fuel-ratio can't be closed-loop controlled			
Connection terminal:		MT 20U	Heating-type Oxygen Sensor		Normal Measurement Signal
System main power supply:		\	C		12V
Heating drive:		61	D		0V
Oxygen sensor's high signal:		62	B		0 to 1000mV fluctuation
Oxygen sensor's low signal:		06	A		0V
Condition for Determination		Possible Reason		Actions	
Oxygen sensor signal < 52.083mV Engine operation time > 40 s No TPS and MAP failure Coolant temperature > 72℃ Enter the closed-loop fuel control state TPS > 10.156% Failure duration > 15 s		1) Short circuit of sensor signal circuit to earth 2) Sensor high/low signal circuit reverse 3) Sensor damaged 3) ECM's this signal input interface failure		1) Repair harness 2) Repair harness 3) Replace sensor 4) Replace ECM	



T11 Fuel Injector Group

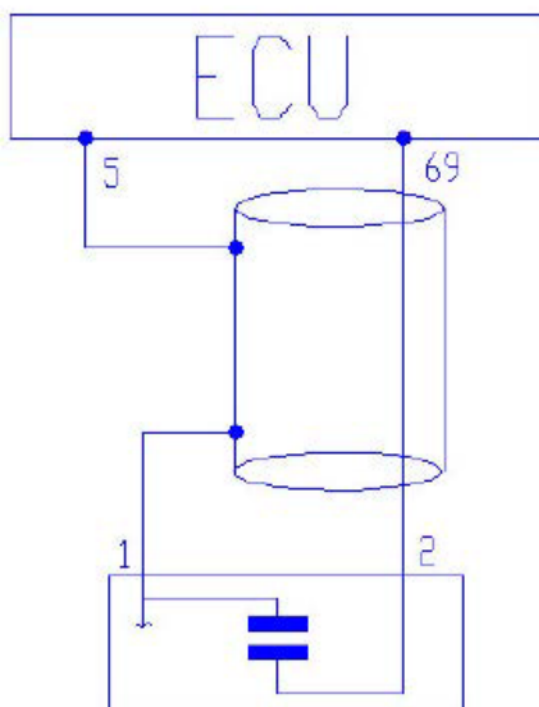
Failure Code:	P0201-0	Fuel injector A (No 1 cylinder) circuit failure		
	P0202-0	Fuel injector B (No 3 cylinder) circuit failure		
	P0203-0	Fuel injector C (No 4 cylinder) circuit failure		
	P0204-0	Fuel injector D (No 2 cylinder) circuit failure		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Fuel Nozzle	Normal Measurement Signal
System main power supply:		\	A	12V
Fuel injector A (No 1 cylinder):		55	B	0 to 12V approx. square
Fuel injector B (No 3 cylinder):		56	B	0 to 12V approx. square
Fuel injector C (No 4 cylinder):		71	B	0 to 12V approx. square
Fuel injector D (No 2 cylinder):		70	B	0 to 12V approx. square
Condition for Determination		Possible Reason		Actions
Ignition switch is turn on Fuel pump operation normal Ignition voltage > 10V		1) Short circuit of corresponding nozzle circuit to the positive electrode of power supply or to earth 2) Open circuit of corresponding nozzle circuit 3) Unreliable Sensor high/low signal circuit reverse 4) Nozzle circuit damaged 5) ECM's this signal output interface failure		1) Repair harness 2) Repair harness 3) Connect again 4) Replace 5) Replace ECM



Failure Code:	P0230-1	Short circuit of fuel pump relay to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Fuel Pump Relay	Normal Measurement Signal
System main power supply:		\	Refer to Electrical System Description	12V
Relay drive:		47	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 1.5625 s		1) Short circuit of relay drive circuit to the positive electrode of power supply 2) Relay damaged 3) ECM's this signal output control interface failure		1) Repair harness 2) Replace relay 3) Replace ECM

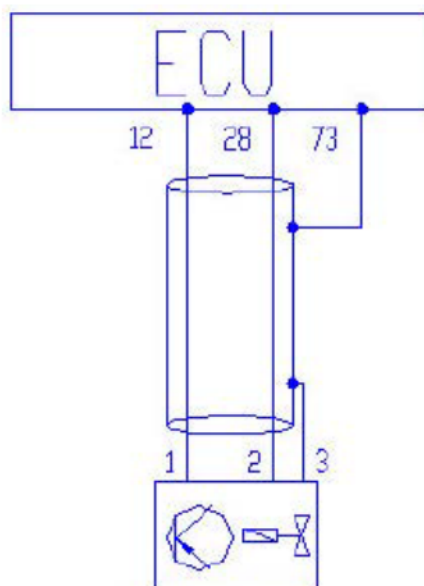


Failure Code:	P0230-2	Open circuit of fuel pump relay or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Fuel Pump Relay	Normal Measurement Signal
System main power supply:		\	Refer to Electrical System Description	12V
Relay drive:		47	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 1.5625 s		1) Unreliable connection of the connecting parts 2) Open circuit of the connection system main power supply circuit 3) Short circuit of relay drive circuit to the negative electrode of power supply 4) Open circuit of relay drive circuit 5) Relay damaged 6) ECM's this signal output control interface failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM



T11 Knock Sensor

Failure Code:	P0325-0	Bad connection to knock sensor		
Set emergency control scheme:		● Switch on the failure lamp till the ignition switch is turned off ● Apply the safety ignition advance angle table		
Connection terminal:		MT 20U	Knock Sensor	Normal Measurement Signal
Knock signal:		69		0 to 1 V
Sensor signal earth:		05		0V
Condition for Determination		Possible Reason		Actions
Failure duration > 1.5625 s		1) Unreliable connection of the connecting parts 2) Open circuit of knock signal circuit 3) Short circuit of sensor signal circuit to earth 4) Short circuit of knock signal circuit to other circuits 5) Sensor damaged 6) ECM's this signal output control interface failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM

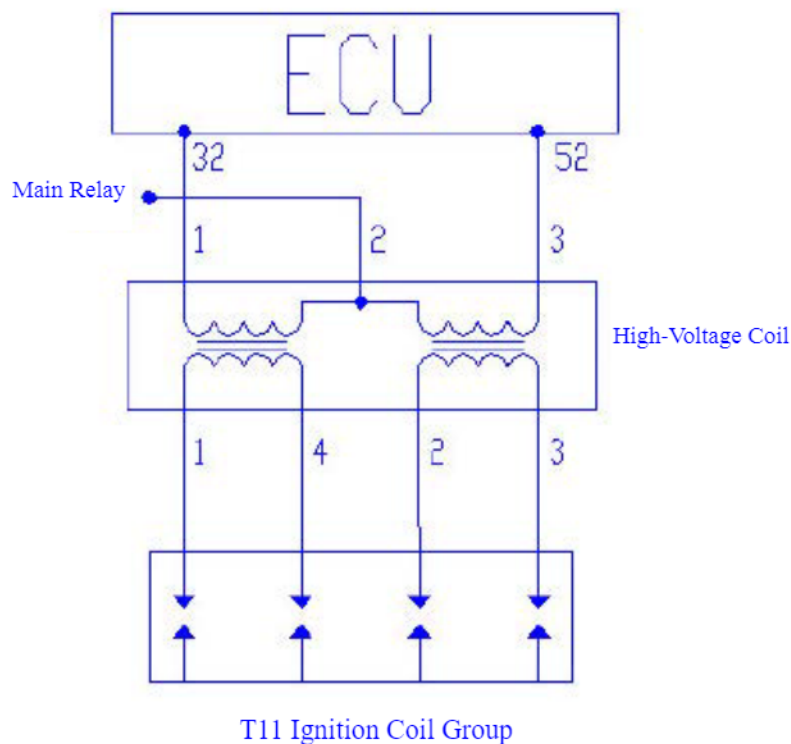


T11 Crankshaft Position Sensor

Failure Code:	P0335-0	No 58X crankshaft position sensor signal		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL ● Engine is difficult to start up		
Connection terminal:		MT 20U	Crankshaft Position Sensor	Normal Measurement Signal
High signal from crankshaft:		12	A	> 400mV sinusoidal wave (with sensor B)
Low signal from crankshaft:		28	B	> 400mV sinusoidal wave (with sensor A)
System earth wire:		73	C	0V
Condition for Determination		Possible Reason		Actions
Start up the engine No engine speed signal MAP decreases by 2.9509 kPa System voltage decreases by 0.8V Vehicle speed < 4 km/h Failure duration > 2 s		1) Unreliable connection of the connecting parts 2) Reserve connection of high/low signal 3) Open circuit of signal circuit 4) Short circuit of signal circuit to other circuits 5) Sensor damaged 6) ECM's this signal input interface failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM



Failure Code:	P0335-0	No 58X crankshaft position sensor signal		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Crankshaft Position Sensor	Normal Measurement Signal
High signal from crankshaft:		12	A	> 400mV sinusoidal wave (with sensor B)
Low signal from crankshaft:		28	B	> 400mV sinusoidal wave (with sensor A)
System earth wire:		73	C	0V
Condition for Determination		Possible Reason		Actions
Engine operation The number of teeth entering into ECM isn't equal to 58 during 5 continuous cycles		1) Bad shielding of signal circuit 2) Foreign metal materials in the 58X gear ring		1) Apply the shielded wire 2) Clean the 58X gear ring



Failure Code:	P0351-1	Short circuit between the ignition coil 1-4 cylinder drive circuit and the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Stop the fuel injection for 1-4 cylinder ● The target idle steps up to 1,200 rpm		
Connection terminal:		MT 20U	Ignition Coil	Normal Measurement Signal
System main power supply:		\	B	12V
1-4 cylinder drive:		32	C	0 to 12 V approx. square wave signal Induction peak value > 300 V
2-3 cylinder drive:		52	A	0 to 12 V approx. square wave signal Induction peak value > 300 V
Condition for Determination		Possible Reason		Actions
Failure duration > 1.25 s		1) Short circuit of 1-4 cylinder drive circuit to the positive electrode of power supply 2) Ignition coil damaged 3) ECM failure		1) Repair harness 2) Replace ignition coil 3) Replace ECM



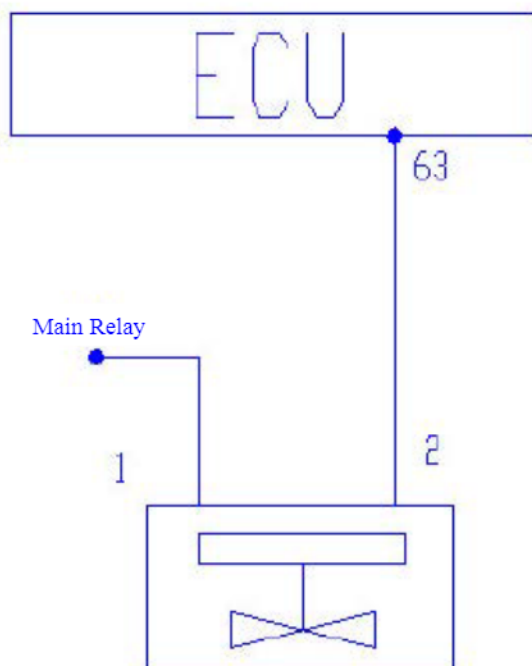
Failure Code:	P0351-2	Open circuit of the ignition coil 1-4 cylinder drive circuit or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Stop the fuel injection for 1-4 cylinder		
Connection terminal:		MT 20U	Ignition Coil	Normal Measurement Signal
System main power supply:		\	B	12V
1-4 cylinder drive:		32	C	0 to 12 V approx. square wave signal Induction peak value > 300 V
2-3 cylinder drive:		52	A	0 to 12 V approx. square wave signal Induction peak value > 300 V
Condition for Determination		Possible Reason		Actions
Failure duration > 1.25 s		1) Unreliable connection of the connecting parts 2) Short circuit of 1-4 cylinder drive circuit to the negative electrode of system power supply 3) Open circuit of 1-4 cylinder drive circuit 4) Ignition coil damaged 5) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Replace ignition coil 5) Replace ECM



Failure Code:	P0352-1	Short circuit between the ignition coil 2-3 cylinder drive circuit and the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Stop the fuel injection for 2-3 cylinder ● The target idle steps up to 1,200 rpm		
Connection terminal:		MT 20U	Ignition Coil	Normal Measurement Signal
System main power supply:		\	B	12V
1-4 cylinder drive:		32	C	0 to 12 V approx. square wave signal Induction peak value > 300 V
2-3 cylinder drive:		52	A	0 to 12 V approx. square wave signal Induction peak value > 300 V
Condition for Determination		Possible Reason		Actions
Failure duration > 1.25 s		1) Short circuit of 2-3 cylinder drive circuit to the positive electrode of power supply 2) Ignition coil damaged 3) ECM failure		1) Repair harness 2) Replace ignition coil 3) Replace ECM



Failure Code:	P0352-2	Open circuit of the ignition coil 2-3 cylinder drive circuit or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Stop the fuel injection for 1-4 cylinder		
Connection terminal:		MT 20U	Ignition Coil	Normal Measurement Signal
System main power supply:		\	B	12V
1-4 cylinder drive:		32	C	0 to 12 V approx. square wave signal Induction peak value > 300 V
2-3 cylinder drive:		52	A	0 to 12 V approx. square wave signal Induction peak value > 300 V
Condition for Determination		Possible Reason		Actions
Failure duration > 1.25 s		1) Unreliable connection of the connecting parts 2) Short circuit of 2-3 cylinder drive circuit to the negative electrode of system power supply 3) Open circuit of 2-3 cylinder drive circuit 4) Ignition coil damaged 5) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Replace ignition coil 5) Replace ECM

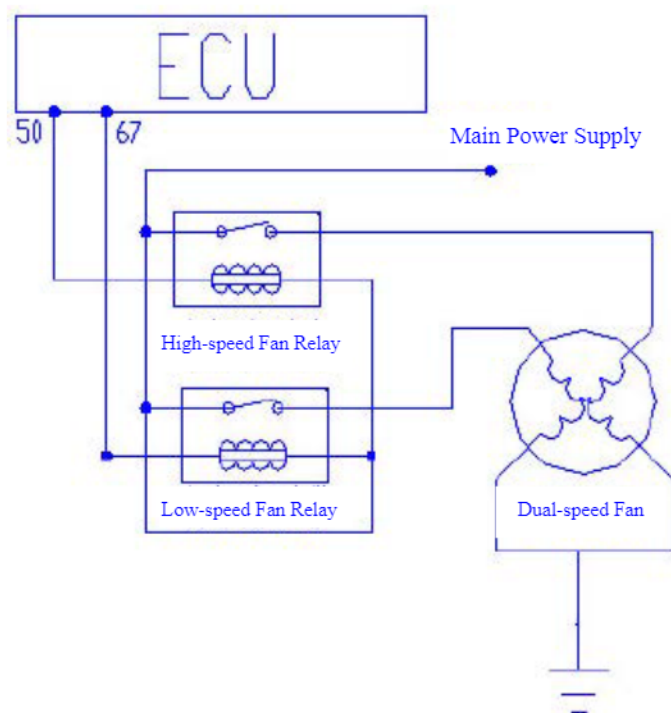


T11 Canister Control Solenoid Valve

Failure Code:	P0443-1	Short-circuit between the wire of canister control solenoid valve and the positive of electrode power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Shut off the canister control solenoid valve		
Connection terminal:		MT 20U	Canister Control Solenoid Valve	Normal Measurement Signal
System main power supply:		\	B	12V
Solenoid valve drive:		63	A	0 to 12 V square wave signal
Condition for Determination		Possible Reason		Actions
Failure duration > 2 s		1) Short circuit of solenoid valve drive circuit to the positive electrode of power supply 2) Solenoid valve damaged 3) ECM failure		1) Repair harness 2) Replace solenoid valve 3) Replace ECM



Failure Code:	P0443-2	Open circuit of the wire of canister control solenoid valve or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Shut off the canister control solenoid valve		
Connection terminal:		MT 20U	Canister Control Solenoid Valve	Normal Measurement Signal
System main power supply:		\	B	12V
Solenoid valve drive:		63	A	0 to 12 V square wave signal
Condition for Determination		Possible Reason		Actions
Failure duration > 5 s		1) Unreliable connection of the connecting parts 2) Short circuit of solenoid valve drive circuit to the negative electrode of system power supply 3) Open circuit of solenoid valve drive circuit 4) Open circuit with system main power supply connection circuit 5) Solenoid valve damaged 6) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace solenoid valve 6) Replace ECM



Failure Code:	P0480-1	Short circuit of radiator low-speed fan relay drive circuit to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL ● Fan doesn't operate, till the water temperature increases to 98℃ and then the high-speed fan activates		
Connection terminal:		MT 20U	Low-speed Fan Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12V
Relay drive:		67	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 3 s		1) Short circuit of relay drive circuit to the positive electrode of power supply 2) Relay damaged 3) ECM failure		1) Repair harness 2) Replace relay 3) Replace ECM

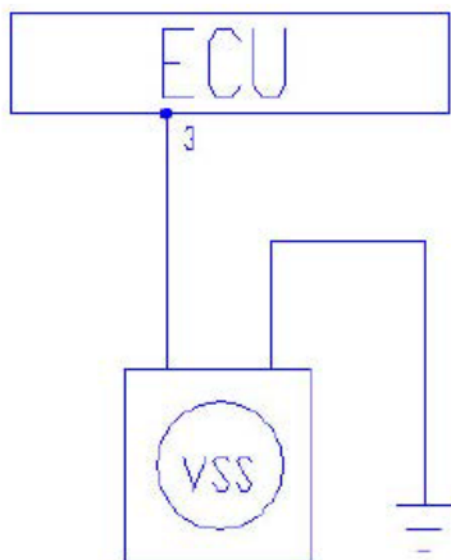


Failure Code:	P0480-2	Open circuit of radiator low-speed fan relay drive circuit or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL ● Fan doesn't operate (open circuit), till the water temperature increases to 98℃ and then the high-speed fan activates ● Fan operates normally (short circuit to earth)		
Connection terminal:		MT 20U	Low-speed Fan Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12V
Relay drive:		67	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 3 s		1) Unreliable connection of the connecting parts 2) Short circuit of relay drive circuit to the negative electrode of power supply 3) Open circuit of relay drive circuit 4) Open circuit with the battery connection circuit 5) Relay damaged 6) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM

Failure Code:	P0481-1	Short circuit of radiator high-speed fan relay drive circuit to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	High-speed Fan Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12V
Relay drive:		50	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 3 s		1) Short circuit of relay drive circuit to the positive electrode of power supply 2) Relay damaged 3) ECM failure		1) Repair harness 2) Replace relay 3) Replace ECM

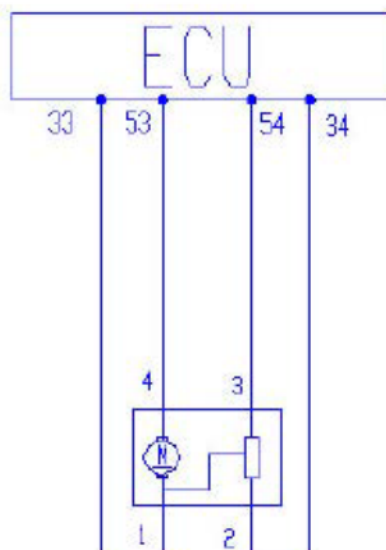


Failure Code:	P0481-2	Open circuit of radiator high-speed fan relay drive circuit or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL ● Fan operates normally (short circuit to earth)		
Connection terminal:		MT 20U	High-speed Fan Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12V
Relay drive:		50	Refer to Electrical System Description	0V (Operating) and 12V (Stop)
Condition for Determination		Possible Reason		Actions
Failure duration > 3 s		1) Unreliable connection of the connecting parts 2) Short circuit of relay drive circuit to the negative electrode of power supply 3) Open circuit of relay drive circuit 4) Open circuit with the battery connection circuit 5) Relay damaged 6) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM



T11 Vehicle Speed Sensor

Failure Code:	P0500-0	No vehicle speed sensor signal		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL ● It is possible to take some driving limit measures		
Connection terminal:		MT 20U	Vehicle Speed Sensor	Normal Measurement Signal
Sensor signal earth:		03	/	0 to 12V square wave
Condition for Determination		Possible Reason		Actions
Engine operation Vehicle speed < 2 km/h MAP < 25.82 kPa 1,200 rpm < engine speed < 5000 rpm Throttle closed Failure duration > 5 s		1) Unreliable connection of the connecting parts 2) Interrupt of signal circuit from the automatic transmission to instruments 3) Interrupt of harnesses from instruments to ECM 4) Vehicle speed sensor damaged 5) Instrument failure 6) ECM failure		1) Connect again 2) Replace flexible shaft or signal wire 3) Repair harness 4) Replace vehicle speed sensor 5) Repair or replace instrument 6) Replace ECM

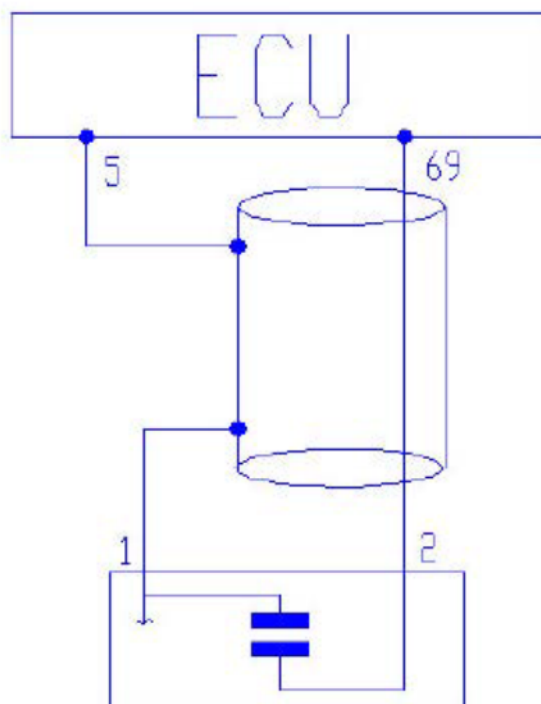


T11 Idle Stepper Motor

Failure Code: P0505-0		Idle Control Error		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● Pause the idle control		
Connection terminal:		MT 20U	Idle Control Valve	Normal Measurement Signal
Idle control valve A-high:		54	D	0 to 12V square wave (with idle valve C)
Idle control valve A-low:		53	C	0 to 12V square wave (with idle valve D)
Idle control valve B-high:		33	B	0 to 12V square wave (with idle valve A)
Idle control valve A-low:		34	A	0 to 12V square wave (with idle valve B)
Condition for Determination		Possible Reason		Actions
Engine idle operation Water temperature reaches the normal value No TPS and VSS failure Deviation from the target speed > 180 rpm Failure duration > 15 s		1) Unreliable connection of the connecting parts 2) Open circuit of any circuit of idle valve 3) Error of corresponding relation between the idle valve connecting parts and ECM connecting parts 4) Intake manifold leakage 5) Idle control valve damaged 6) ECM failure		1) Connect again 2) Repair harness 3) Repair harness 4) Remove the leakage failure 5) Replace idle control valve 6) Replace ECM

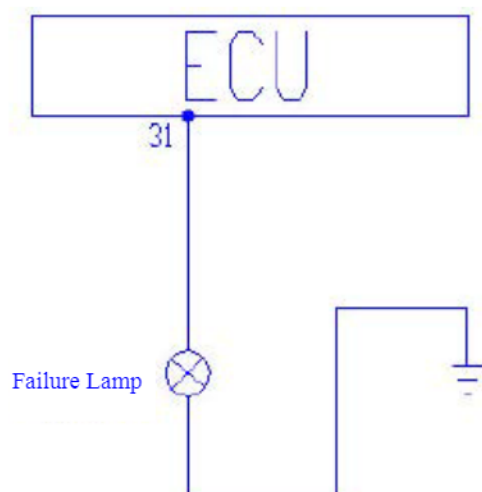


Failure Code:	P0560-1	Over-high system voltage		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The system stops fuel injection		
Connection terminal:		MT 20U	Ignition Switch	Normal Measurement Signal
Ignition switch:		01	Refer to Electrical System Description	12V
Condition for Determination		Possible Reason		Actions
Turn on the ignition switch System voltage > 17.2 V Failure duration > 5 s		1) Generator regulator damaged 2) Mistakenly apply the high-voltage battery		1) Replace the damaged voltage regulator 2) Apply proper battery



T11 Knock Sensor

Failure Code:	P0607-0	Knock control system failure		
Set emergency control scheme:		● Switch on the failure lamp till the ignition switch is turned off ● The ignition advance angle will postpone (apply safety ignition advance control)		
Connection terminal:	69#	MT 20U	ECM	Normal Measurement Signal
ECM:	ECM internal failure			\
Condition for Determination		Possible Reason		Actions
		1) ECM failure		1) Replace ECM



Failure Code:	P0650-1	Short circuit between the failure lamp wire and the positive electrode of power supply		
Set emergency control scheme:		● No light		
Connection terminal:		MT 20U	System Failure Lamp	Normal Measurement Signal
Ignition switch:		\	Refer to Electrical System Description	12 V
Lamp drive:		31	Refer to Electrical System Description	12 V (ON) and 0 V (OFF)
Condition for Determination		Possible Reason		Actions
Failure Duration > 2 s		1) Short circuit of harness J1-31 wire to the positive electrode of system power supply		1) Repair harness

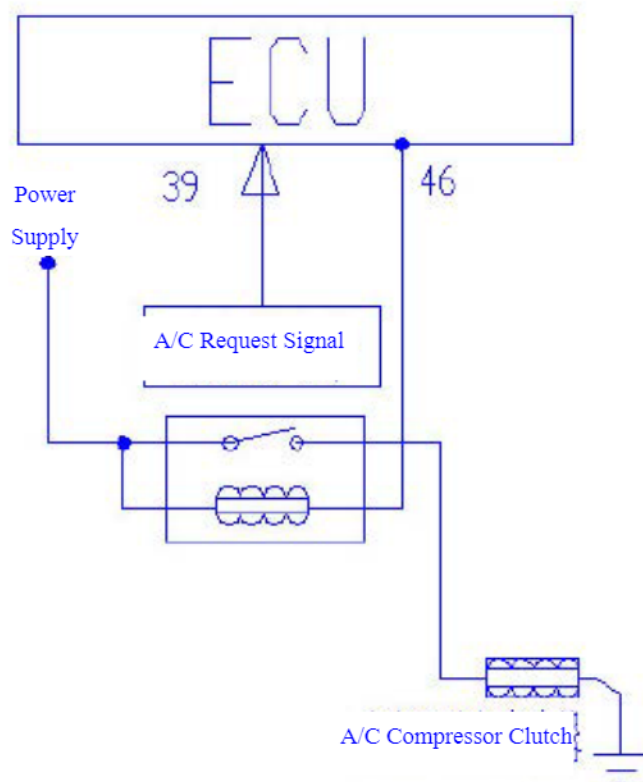


Failure Code:	P0650-2	Open circuit of the failure lamp wire or short circuit to earth		
Set emergency control scheme:		● No light (open circuit) ● Normal light (short circuit to earth)		
Connection terminal:		MT 20U	System Failure Lamp	Normal Measurement Signal
Ignition switch:		\	Refer to Electrical System Description	12 V
Lamp drive:		31	Refer to Electrical System Description	12 V (ON) and 0 V (OFF)
Condition for Determination		Possible Reason		Actions
Failure Duration > 2 s		1) Bad installation of failure bulb 2) Failure of circuit to ignition switch 3) Short circuit of drive circuit wire to the negative electrode of power supply 4) Failure bulb damaged		1) Reinstall the bulb 2) Repair harness 3) Repair harness 4) Replace bulb

Failure Code:	P1230-1	Short circuit of main relay circuit to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● It is difficult to start up		
Connection terminal:		MT 20U	System Failure Lamp	Normal Measurement Signal
Ignition switch:		\	Refer to Electrical System Description	12 V
Relay drive:		58	Refer to Electrical System Description	12 V (operating) and 0 V (stop)
Condition for Determination		Possible Reason		Actions
Failure Duration > 1 s		1) Short circuit of relay drive circuit to the positive electrode of power supply		1) Repair harness



Failure Code:	P1230-2	Open circuit of main relay circuit or short circuit to earth		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● It is difficult to start up (open circuit) ● Normal startup is available (short circuit to earth)		
Connection terminal:		MT 20U	Main Power Supply Relay	Normal Measurement Signal
Ignition switch:		\	Refer to Electrical System Description	12 V
Relay drive:		58	Refer to Electrical System Description	12 V (operating) and 0 V (stop)
Condition for Determination		Possible Reason		Actions
Failure Duration > 1 s		1) Bad installation of relay 2) Failure of circuit to ignition switch 3) Open circuit of relay drive circuit 4) Short circuit of relay drive circuit to the negative electrode of power supply 5) Relay damaged		1) Reinstall the relay 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay



Failure Code:	P1530-1	Short circuit of A/C compressor relay circuit to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air conditioner is out of service		
Connection terminal:		MT 20U	Main Power Supply Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12 V
Relay drive:		58	Refer to Electrical System Description	12 V (operating) and 0 V (stop)
Condition for Determination		Possible Reason		Actions
Detect and find the A/C system Failure Duration > 3 s		1) Short circuit of repair harness circuit to the positive electrode of power supply 2) Relay damaged 3) ECM failure		1) Repair harness 2) Replace relay 3) Replace ECM



Failure Code:	P1530-2	Short circuit of A/C compressor relay circuit to the positive electrode of power supply		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● The air conditioner is out of service (open circuit) ● Air conditioner operates normally (short circuit to earth)		
Connection terminal:		MT 20U	Main Power Supply Relay	Normal Measurement Signal
Battery:		\	Refer to Electrical System Description	12 V
Relay drive:		46	Refer to Electrical System Description	12 V (operating) and 0 V (stop)
Condition for Determination		Possible Reason		Actions
Detect and find the A/C system Failure Duration > 3 s		1) Unreliable connection of the connecting parts 2) Open circuit to the battery connecting wire 3) Short circuit of the repair harness circuit to the negative electrode of power supply 4) Open circuit of the repair harness circuit 5) Relay damaged 6) ECM damaged		1) Connect again 2) Repair harness 3) Repair harness 4) Repair harness 5) Replace relay 6) Replace ECM

Failure Code:	P1604-0	Knock control system failure		
Set emergency control scheme:		● Switch on the failure lamp ● The vehicle model is with the anti-theft measures, and the engine is difficult to start up ● The mileage accumulation function loses		
Connection terminal:	69#	MT 20U	ECM	Normal Measurement Signal
ECM:		ECM internal failure		\
Condition for Determination		Possible Reason		Actions
A failure exists		1) ECM failure		1) Replace ECM



Failure Code:	P2000-1	Over-high temperature of front A/C evaporator		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Front Evaporator Temperature Sensor	Normal Measurement Signal
Temperature signal:		26	Refer to Electrical System Description	0.5 to 4.5 V
Sensor signal earth:		05	Refer to Electrical System Description	0 V
Condition for Determination		Possible Reason		Actions
Temperature indicated > 144°C Failure Duration > 3 s		1) Short circuit of temperature signal wire to the negative electrode of power supply 2) Sensor damaged 3) ECM failure		1) Repair harness 2) Replace sensor 3) Replace ECM

Failure Code:	P2000-2	Too-low temperature of front A/C evaporator		
Set emergency control scheme:		● Switch on the failure lamp till the failure disappears ● NULL		
Connection terminal:		MT 20U	Front Evaporator Temperature Sensor	Normal Measurement Signal
Temperature signal:		26	Refer to Electrical System Description	0.5 to 4.5 V
Sensor signal earth:		05	Refer to Electrical System Description	0 V
Condition for Determination		Possible Reason		Actions
Temperature indicated < -36°C Failure Duration > 3 s		1) Unreliable connection of the connecting parts 2) Short circuit of temperature signal wire to the positive electrode of power supply 3) Open circuit of temperature signal wire 4) Relay damaged 5) ECM damaged		1) Connect again 2) Repair harness 3) Repair harness 4) Replace relay 5) Replace ECM



4. Typical Malfunction

1) Engine doesn't operate or operates slowly when startup

Starter's own problems (such as seized, internal short circuit), over-great engine resistance force, and circuit system (voltage, earth).

No.	Operation Step	Detection Result	Subsequent Step
1	Apply a multimeter to detect whether there is approximate 10 to 12.5 V between both connecting terminals of battery.	Yes	Next step
		No	Repair or replace battery
2	Place the ignition switch on the "ON" position, and apply a multimeter to detect whether there is approximate 10 to 12.5 V voltage between the connecting terminals which connect to the positive electrode of battery.	Yes	Next step
		No	Repair connecting terminal or replace conducting wire
3	Keep the ignition switch on the start gear, and apply a multimeter to detect whether there is above 8V voltage between the connecting terminals on the ignition switch which connect to the pull-in winding of starter motor.	Yes	Next step
		No	Repair or replace the ignition switch
4	Apply a multimeter to detect whether the circuit of starter motor is short or open circuit.	Yes	Repair or replace the starter motor
		No	Next step
5	Examine and confirm whether the engine is seized firmly due to the bad lubrication.	Yes	Remove the failure
		No	Next step
6	If in winter, examine and confirm whether the resistance force of starter motor is over great due to improper selection of engine lubricating oil and gearbox oil (if with high viscosity, the engine resistance force is great).	Yes	Change with appropriate oil
		No	Examine the other parts



2) The engine can operate manually but it is difficult to start up successfully during the engine starts

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failures
		No	Next step
2	Pull out the subcylinder line, and connect up the sparkle plug to make the sparkle plug’s electrode be 5 to 10 mm away from the engine body, then apply the starter motor to enable the engine to operate and examine and confirm whether there is blue-white high-voltage fire.	Yes	8
		No	Next step
3	Examine the resistance value of high-voltage wire (no less than 4K ohm)	Yes	Next step
		No	Repair or replace high voltage wire
4	Examine the damage of the subcylinder high-voltage wire and sparkle plug	Yes	Replace
		No	Next step
5	Examine the damage of crankshaft position sensor	Yes	Replace
		No	Next step
6	Examine the normal operation of the ignition coil	Yes	Next step
		No	Replace
7	Examine the connection condition of intake pressure sensor connecting parts (MT 20U is with the intake pressure cylinder detection technology)	Yes	Next step
		No	Connect the male contact
8	Place the ignition switch on the “ON” position, and examine and confirm whether the fuel pump relay and fuel pump can operate.	Yes	Next step
		No	Repair the fuel pump circuit
9	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 70 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	13
10	Pull out the fuel distributing pipe together with the fuel injector, and pull out the fuel injector connector on the harness one by one, directly supply 12V voltage to fuel injector from the battery, and examine and confirm whether the fuel injector is available to inject fuel.	Yes	12
		No	Next step
11	Rinse the fuel injector, and, after that, reexamine and confirm whether the fuel injector is available to inject fuel.	Yes	Next step
		No	Replace fuel injector



12	Examine and confirm whether the fuel deteriorates or contains water	Yes	Replace fuel
		No	18
13	Examine and confirm whether the fuel pressure is below 350 kPa .	Yes	Next step
		No	17
14	Shut off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	16
15	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly (fuel pump aging, operating capacity decrease not exclusive)	Yes	Replace fuel pressure regulator
		No	Repair or replace fuel injector or fuel pipe
16	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace fuel pump
17	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
18	Connect up an adaptor between ECU and harness, examine the voltage of No 1, 17 and 18 pins of ECU, and examine and confirm whether the positive power wire connecting with ECU pins above and the earth wire connecting with No 37 pin of ECU are normal.	Yes	Next step
		No	Repair or replace harness
19	Examine the air leakage of the intake system components.	Yes	Repair
		No	Next step
20	Examine and confirm whether the intake manifold absolute pressure and temperature sensor is jammed.	Yes	Repair or replace
		No	Next step
21	Examine and confirm whether the coolant temperature sensor is normal.	Yes	Next step
		No	Repair or replace



22	Examine and confirm whether the unsuccessful startup is caused due to the mechanical reasons such as too big clearance between the piston and cylinder, cylinder leakage and etc.	Yes	Remove the mechanical fault
		No	Replace ECU

The fuel injector control coil must be disconnected during this experiment is conducted so as to avoid that the excessive fuel enter into the three-way catalytic converter, which may burn down the three-way catalytic converter after the engine starts smoothly.

3) Warm start difficult

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the "ON" position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 87 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	9
3	Disconnect the connecting fuel pipe, turn off the ignition switch, and, after 1 hour, view whether the pressure of fuel system is still between 250 kPa and 300 kPa (otherwise, there is leakage inside the system).	Yes	Next step
		No	Repair the fuel system leakage
4	Connect the connecting pipe, and apply the fuel return immobiliser to block the fuel return pipe, at the same time, turn off the fuel pressure gage valve and ignition switch, and, after 1 hour, view whether the pressure of fuel system is still between 250 kPa and 300 kPa .	Yes	Replace fuel pressure regulator
		No	Next step
5	Examine the fuel leakage of the fuel injector and fuel pipe.	Yes	Replace fuel injector and fuel pipe
		No	Next step
6	Pull out the connector of water temperature sensor to enable the engine to start, and view whether it can be able to start successfully.	Yes	Examine the coolant temperature and circuit
		No	Next step



7	Connect up an adaptor between ECU and harness, examine the voltage of No 1, 17 and 18 pins of ECU, and examine and confirm whether the positive power wire connecting with ECU pins above and the earth wire connecting with No 37 pin of ECU are normal.	Yes	Next step
		No	Repair or replace harness
8	Replace fuel, conduct the warm start again, and view whether it can be able to start successfully.	Yes	End
		No	Replace ECU
9	Examine the jamming or bending of the fuel return pipe, and the normal operation of fuel pump regulator.	Yes	Next step
		No	Repair or replace
10	Apply a multimeter to detect the battery voltage of both ends of fuel pump connecting parts.	Yes	Next step
		No	Repair or replace the fuel pump relay and conducting wire
11	Apply a multimeter to detect the proper resistance value of fuel pump..	Yes	Next step
		No	Replace fuel pump
12	Examine and confirm whether the fuel pump is clipped tightly.	Yes	Replace fuel pump
		No	Replace ECU

4) Normal engine speed, while it always starts difficultly

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
3	After the success startup, detect and confirm whether the pressure of intake manifold during idle is between 35 kPa and 55 kPa .	Yes	Next step
		No	Remove the intake system leakage failure



4	Step on the throttle slightly, and view whether it is easy to start.	Yes	Replace and examine the throttle and idle channel
5	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 87 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	9
6	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	8
		No	Next step
7	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
8	Replace fuel, and examine and confirm whether the fuel deteriorates or contains water.	Yes	Replace fuel
		No	14
9	Examine and confirm whether the fuel pressure is less than 350 kPa .	Yes	Next step
		No	13
10	Turn off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Replace the fuel pressure regulator
		No	Repair/replace fuel injector or fuel pipe
11	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly.	Yes	Replace the fuel pressure regulator
		No	Repair or replace the fuel injector or fuel pipe
12	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace the fuel pump
13	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace fuel return pipe
		No	Replace the fuel pressure regulator
14	Pull out the idle actuator connector on the harness before the	Yes	Next step



	engine coolant temperature reaches 35°C, and view whether the engine speed decreases (the engine enters the Fault Mode).	No	Repair or replace the idle actuator
15	Place the ignition switch on the “ON” position. Examine and confirm whether the voltages of the following ECU pins are normal: for No 1, 17 and 18 pins , its voltage is approx. 12V battery voltage; and for No 73 pin , 0V.	Yes	Next step
		No	Examine harness and connecting parts
16	Enable the engine to conduct idle operation, and examine and confirm whether the ignition advance angle is normal after the coolant temperature reaches the normal value..	Yes	Next step
		No	Search the others
17	Examine and confirm whether the cylinder compression pressure of engine is normal.	Yes	Next step
		No	Remove the failure
18	Examine and confirm whether the intake manifold absolute pressure and temperature sensor is jammed.	Yes	Repair or replace
		No	Next step
19	Examine and confirm whether the coolant temperature sensor is normal.	Yes	Replace ECU
		No	Repair or replace

**5) Cold start difficult**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Apply a multimeter to detect whether the coolant temperature sensor is normal. (It is also available to serially connect a 1.5K ohm resistance between the No 43 and 05 pins of ECU, which is used to substitute the coolant temperature sensor to start a engine. If start is available, it indicates that the coolant temperature is off normal.)	Yes	Next step
		No	Replace sensor
3	Turn on the ignition switch. Connect an adaptor between the ECU and harness, and examine and confirm whether the voltages of the following pins are normal: for No 17 and 18 pins , its voltage is approx. 12V battery voltage; and for No 73 pin , 0V.	Yes	Next step
		No	Examine harness and connecting parts
4	Examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
5	After the success startup, detect and confirm whether the pressure of intake manifold during idle is between 35 kPa and 55 kPa .	Yes	Next step
		No	Remove the intake system leakage failure
6	Step on the throttle slightly, and view whether it is easy to start.	Yes	Examine the throttle and idle channel
		No	Next step
7	Pull out the idle actuator connector on the harness before the engine coolant temperature reaches 35°C, and view whether the engine speed decreases (the engine enters the Fault Mode).	Yes	Next step
		No	Repair or replace the idle actuator
8	Connect the fuel pressure gage valve (the connecting point changes as the vehicle model). Directly earth the No 86 pin of fuel pump relay. Turn on the ignition switch to enable the fuel pump relay and fuel pump to operate. Examine and confirm whether the fuel pressure is less than 350 kPa .	Yes	Next step
		No	12
9	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	11
		No	Next step
10	Rinse the fuel injector, and then reexamine the normal	Yes	Next step



	operation of fuel injector.	No	Repair/replace fuel injector
11	Examine and confirm whether the fuel deteriorates or contains water.	Yes	Replace fuel
		No	17
12	Examine and confirm whether the fuel pressure is less than 350 kPa .	Yes	Next step
		No	16
13	Turn off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	15
14	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly.	Yes	Replace the fuel pressure regulator
		No	Repair or replace the fuel injector or fuel pipe
15	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace the fuel pump
16	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
17	Examine and confirm whether the cylinder pressure of engine is normal.	Yes	Next step
		No	Remove the failure
18	Examine the leakage of engine intake system.	Yes	Repair
		No	Next step
19	Examine and confirm whether the intake manifold absolute pressure and temperature sensor is jammed.	Yes	Repair or replace
		No	Replace ECU

**6) Unstable idle at any time**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the stepper motor idle actuator is seized.	Yes	Repair or replace the idle actuator
		No	Next step
3	Turn on the ignition switch, and examine and confirm whether the connecting wires among the water temperature sensor, idle stepper motor and ECU are normal.	Yes	Examine harness and connecting parts
		No	Next step
4	Enable the engine to operate at idle speed, shut down these cylinders one by one, and view whether the engine speed decreases and fluctuates.	Yes	8
		No	Next step
5	Examine and confirm whether the operating condition of fuel injector of any cylinder is normal.	Yes	Next step
		No	Examine the fuel injector and harness
6	Examine and confirm whether the resistance value of high-voltage wire of any cylinder is normal.	Yes	Next step
		No	Replace
7	Examine and confirm whether the ignition switch is damaged.	Yes	Replace
		No	Next step
8	Examine and confirm whether the spark plug is normal.	Yes	Next step
		No	Replace spark plug
9	Connect the fuel pressure gage valve. Short circuit the No 30 and 87 pins of fuel pump relay to enable the fuel pump relay and fuel pump to operate. Examine and confirm whether the fuel pressure is approx. 350 kPa .	Yes	Next step
		No	13
10	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	12
		No	Next step
11	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
12	Examine and confirm whether the fuel deteriorates or contains water.	Yes	Replace fuel
		No	18
13	Examine and confirm whether the fuel pressure is less than 350	Yes	Next step



	kPa.	No	17
14	Turn off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	16
15	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly.	Yes	Replace the fuel pressure regulator
		No	Repair or replace the fuel injector or fuel pipe
16	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace the fuel pump
17	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
18	Examine and confirm whether the sensing holes of intake manifold pressure and intake temperature sensor are jammed.	Yes	Clean
		No	Next step
19	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the closed-loop control activated temperature, view whether the operation of oxygen sensor is normal. (Fluctuate between 0V and 1V.)	Yes	Next step
		No	Examine oxygen sensor and harness
20	Examine the leakage of engine intake system.	Yes	Remove the leakage
		No	Next step
21	Examine and confirm whether the cylinder pressure of engine is normal.	Yes	Next step
		No	Remove the failure
22	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Replace ECU
		No	Examine the others

**7) Unstable idle during warm up**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
3	Enable the engine to operate at idle speed, and detect and confirm whether the pressure of intake manifold during warm up is between 35 kPa and 55 kPa .	Yes	Next step
		No	Remove the intake system leakage failure
4	Switch off the engine, turn off the ignition switch, connect an adaptor between the ECU and harness, and examine and confirm whether the voltages of intake temperature sensor, water temperature sensor and ECU's No 4 and 20 pins (applied for 4.5 to 5V sensor power supply) are normal.	Yes	Next step
		No	Examine and repair
5	Pull out the idle actuator connector on the harness before the completion of warm up, and view whether the engine speed changes (the engine enters the Fault Mode).	Yes	Next step
		No	Replace the idle actuator
6	Examine and confirm whether the coolant temperature sensor operates normally.	Yes	Next step
		No	Replace
7	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Replace ECU
		No	Examine the others

**8) Unstable idle after the completion of warm up**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Place the ignition switch on the “ON” position. Connect up an adaptor between ECU and harness, and examine and confirm whether the voltages of ECU’s intake manifold absolute pressure sensor output, intake temperature sensor output, coolant temperature sensor output, oxygen sensor output pins, and the voltage of ECU’s (outputs to idle actuator) pins are normal.	Yes	Next step
		No	Repair or replace harness and its corresponding parts
3	Stop the engine, and examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
4	Detect and confirm whether the pressure of intake manifold during idle operation is between 35 kPa and 55 kPa .	Yes	Next step
		No	Remove the intake system leakage failure
5	Connect the fuel pressure gage valve (the connecting point changes as the vehicle model). Short circuit the No 30 and 87 pins of fuel pump relay to enable the fuel pump relay and fuel pump to operate. Examine and confirm whether the fuel pressure is approx. 350 kPa .	Yes	Next step
		No	9
6	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	8
		No	Next step
7	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
8	Examine and confirm whether the fuel deteriorates or contains water.	Yes	Replace fuel
		No	14
9	Examine and confirm whether the fuel pressure is less than 350 kPa .	Yes	Next step
		No	13
10	Turn off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	12
11	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn’t fuel return, and examine and confirm whether it is able to establish the fuel	Yes	Replace the fuel pressure regulator



	pressure quickly.	No	Repair or replace the fuel injector or fuel pipe
12	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace the fuel pump
13	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
14	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Next step
		No	Adjust the ignition advance angle
15	Pull out the coolant temperature sensor, and view whether the engine operates normally.	Yes	Replace the coolant temperature sensor
		No	Next step
16	Examine and confirm whether the cylinder compression pressure of engine is normal.	Yes	Next step
		No	Remove the failure
17	Examine and confirm whether the resistance value of high-voltage wire of any cylinder is normal.	Yes	Next step
		No	Replace
18	Examine and confirm whether the ignition coil and high-voltage wire are damaged or have cracks and etc.	Yes	Replace
		No	Next step
19	Examine and confirm whether the spark plug operates normally.	Yes	Replace ECU
		No	Replace spark plug

**9) Unstable idle or shut-down when the load (such as air conditioner and etc.) is applied**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Turn on the A/C switch, connect an adaptor between the ECU and harness, and measure the signal input of the ECU’s A/C switch and pressure.	Yes	Next step
		No	Examine and repair A/C circuit
3	Examine and confirm whether the A/C system pressure, compressor’s electromagnetic clutch and A/C pump are normal..	Yes	Next step
		No	Repair or replace
4	Place the ignition switch on the “ON” position, and examine and confirm whether the voltages of ECU’s No 33, 34, 53 and 54 (output to the idle actuator) pins are normal.	Yes	Next step
		No	Examine the control circuit
5	Disassemble the stepper motor, and examine and confirm whether the stepper motor is seized or operates inflexibly.	Yes	Repair or replace the stepper motor
		No	Next step
6	Start the engine, switch on the air conditioner, and apply the failure diagnosis instrument to examine with the help of steps of stepper motor and confirm whether the idle actuator operates normally.	Yes	Replace ECU
		No	Replace the idle actuator

**10) Periodical instability (ECU must self-learn again after power off)**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
3	Enable the engine to operate at idle speed, and examine and confirm whether the intake pressure is between 35 kPa and 55 kPa .	Yes	Next step
		No	Remove the air intake and leakage
4	Enable the engine to operate at idle speed, shut down these cylinders one by one, and view whether the engine speed decreases and fluctuates.	Yes	7
		No	Next step
5	Place the ignition switch on the “ON” position. Connect up an adaptor between ECU and harness, and examine and confirm whether the voltages of ECU’s intake manifold absolute pressure sensor output, intake temperature sensor output, coolant temperature sensor output, oxygen sensor output, electronic earth and ignition switch pins, and the voltages of ECU’s No 33, 34, 53 and 54 (outputs to idle actuator) pins are normal.	Yes	Next step
		No	Repair or replace harness
6	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Replace ECU
		No	Examine the others
7	Examine and confirm whether the sensing holes of intake manifold pressure and intake temperature sensor are jammed.	Yes	Clean
		No	Next step
8	Examine and confirm whether the fuel deteriorates or contains water.	Yes	Replace fuel
		No	Next step
9	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	Next step
		No	Examine and repair the fuel injector and related harness
10	Examine and confirm whether the resistance value of high-voltage wire of any cylinder is normal.	Yes	Next step
		No	Replace
11	Examine and confirm whether the ignition coil and high-voltage wire are damaged or have cracks and etc.	Yes	Replace
		No	Next step
12	Examine and confirm whether the spark plug operates normally.	Yes	Replace ECU
		No	Replace spark plug

**11) Over-high idle (ECU must self-learn again after power off)**

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the backstay cable connecting to the accelerator pedal is seized tightly or too tight.	Yes	Adjust or replace
		No	Next step
3	Examine and confirm whether the canister control valve, furl pressure regulator, crankcase force ventilation vacuum pipe and brake system vacuum boost hose are installed reliably or damaged. .	Yes	Repair or replace
		No	Next step
4	Enable the engine to operate, apply the neutral gear, step on the brake pedal, and view whether the idle speed is overhigh.	Yes	Next step
		No	6
5	Clip the vacuum boost hose, and view whether the idle turns into the normal.	Yes	Repair or replace the vacuum booster
		No	Next step
6	Clip the crankcase force ventilation vacuum pipe, and view whether the idle turns into the normal.	Yes	Replace PVC valve
		No	Next step
7	Clip the canister control valve hose, and view whether the idle turns into the normal.	Yes	Replace canister control valve
		No	Next step
8	Examine and confirm whether the idle actuator is inflexible or seized tightly.	Yes	Repair or replace
		No	Next step
9	Examine and confirm whether there is leakage in the other positions of intake pipe..	Yes	Repair or replace
		No	Next step
10	Examine and confirm whether the seal ring of fuel injector is in good condition.	Yes	Next step
		No	Replace the seal ring
11	Examine and confirm whether	Yes	Replace ECU
		No	Replace sensor



12) The engine speed increases difficultly or the engine shuts down when acceleration

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the "ON" position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
3	Enable the engine to operate at idle speed, and examine and confirm whether the speed is normal during idle operation.	Yes	Next step
		No	Refer to the idle failure items to examine and repair
4	Enable the engine to operate at idle speed, and examine and confirm whether the intake pressure is 35 to 55 kPa .	Yes	Next step
		No	Examine and repair
5	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Next step
		No	Adjust the ignition advance angle
6	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 87 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	10
7	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	9
		No	Next step
8	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
9	Examine and confirm whether the fuel deteriorates or contains water	Yes	Replace fuel
		No	15
10	Examine and confirm whether the fuel pressure is below 350 kPa .	Yes	Next step
		No	14
11	Shut off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	13
12	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish	Yes	Replace fuel pressure regulator



	the fuel pressure quickly.	No	Repair or replace fuel injector or fuel pipe
13	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace fuel pump
14	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
15	Place the ignition switch on the “ON” position. Connect up an adaptor between ECU and harness, and examine and confirm whether the voltages of the output terminal of ECU’s throttle position sensor, earth terminal, and No 4 and 20 pins (applied for 4.5 to 5.0V sensor power supply) are normal.	Yes	Next step
		No	Repair or replace harness
16	Examine and confirm whether the ignition coil, high-voltage wire and sparkle plug operate normally.	Yes	Replace ECU
		No	Replace related parts

**13) Slow response when acceleration**

Whether the fuel meets the standard requirement and whether there are the intake pressure sensor and throttle position sensor failures.

No.	Operation Step	Detection Result	Subsequent Step
1	Place the ignition switch on the “ON” position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
2	Shut down the engine, and examine and confirm whether the air cleaner is unobstructed.	Yes	Next step
		No	Replace
3	Enable the engine to operate at idle speed, and examine and confirm whether the speed is normal during idle operation	Yes	Next step
		No	Refer to the idle failure items to examine and repair
4	Enable the engine to operate at idle speed, and examine and confirm whether the intake pressure is 35 to 55 kPa .	Yes	Next step
		No	Examine and repair
5	Place the ignition switch on the “ON” position. Connect up an adaptor between ECU and harness, and examine and confirm whether the voltages of the output terminal of ECU’s throttle position sensor, earth terminal, and No 4 and 20 pins (applied for 4.5 to 5.0V sensor power supply) are normal.	Yes	Next step
		No	Repair or replace harness
6	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Next step
		No	Examine the others
7	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 87 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	11
8	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	10
		No	Next step
9	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
10	Examine and confirm whether the fuel deteriorates or contains water	Yes	Replace fuel
		No	16
11	Examine and confirm whether the fuel pressure is below 350 kPa .	Yes	Next step
		No	15



12	Shut off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	14
13	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly.	Yes	Replace fuel pressure regulator
		No	Repair or replace fuel injector or fuel pipe
14	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace fuel pump
15	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
16	Examine and confirm whether the exhaust system and three-way catalytic converter are jammed.	Yes	Replace or clean
		No	Replace ECU

**14) Bad acceleration performance and force shortage when acceleration**

Confirm whether the fuel meets the standard requirements and whether the manual brake and brake drag.

No.	Operation Step	Detection Result	Subsequent Step
1	Examine and confirm whether there are clutch slip, tire pressure low, brake dragging, tire size improper, four wheels positioning incorrect and other failures.	Yes	Repair
		No	Next step
2	Examine and confirm whether the throttle fully opens.	Yes	Next step
		No	Replace or repair the throttle
3	Place the ignition switch on the "ON" position, and apply the failure diagnosis instrument to examine and confirm whether there are some failure information records.	Yes	Remove the displayed failure
		No	Next step
4	Enable the engine to operate at idle speed, and, after the coolant temperature reaches the normal value, examine and confirm whether the ignition advance angle is normal.	Yes	Next step
		No	Examine the others
5	Place the ignition switch on the "ON" position. Connect up an adaptor between ECU and harness, and examine and confirm whether the voltages of ECU's intake manifold absolute pressure sensor, throttle position sensor, intake temperature sensor, coolant temperature sensor pins, ECU's oxygen earth terminal and signal output terminal pins, ECU sensor's signal earth terminal and ECU's No 4 and 20 pins (applied for 4.5 to 5.0V sensor power supply) are normal.	Yes	Next step
		No	Repair or replace harness
6	Enable the engine to operate at idle speed, and examine and confirm whether the intake pressure is 35 to 55 kPa .	Yes	Next step
		No	Examine and repair
7	Connect the fuel pressure gage valve, short circuit the No 30 pin and No 87 pin of the fuel pump relay to enable the fuel pump to operate, and examine and confirm whether the fuel pressure is approximate 350 kPa .	Yes	Next step
		No	11
8	Apply the special connecting terminal to directly supply the fuel injector 12 V voltage from the battery, and examine the normal operation of fuel injector.	Yes	10
		No	Next step
9	Rinse the fuel injector, and then reexamine the normal operation of fuel injector.	Yes	Next step
		No	Replace the fuel injector
10	Examine and confirm whether the fuel deteriorates or contains water	Yes	Replace fuel
		No	16
11	Examine and confirm whether the fuel pressure is below	Yes	Next step



	350 kPa.	No	15
12	Shut off the fuel gage valve, turn on the ignition switch again to enable the fuel pump to operate again, and examine and confirm whether the fuel pressure can be established.	Yes	Next step
		No	14
13	Turn on the fuel gage valve, apply the fuel return immobiliser to clip the fuel return pipe tightly so as to make it hasn't fuel return, and examine and confirm whether it is able to establish the fuel pressure quickly.	Yes	Replace fuel pressure regulator
		No	Repair or replace fuel injector or fuel pipe
14	Examine the leakage or jamming of the fuel intake pipe.	Yes	Repair or replace the fuel intake pipe
		No	Replace fuel pump
15	Examine the jamming or bending of the fuel return pipe	Yes	Repair or replace the fuel return pipe
		No	Replace the fuel pressure regulator
16	Examine and confirm whether the data from intake manifold absolute pressure and intake temperature sensors are normal.	Yes	Next step
		No	Replace sensors
17	Examine and confirm whether the ignition coil, high-voltage wire and spark plug operate normally.	Yes	Next step
		No	Replace or repair
18	Examine and confirm whether the failure is caused due to the A/C system.	Yes	Examine the A/C system
		No	Replace ECU

**15) A/C system failure**

No.	Operation Step	Detection Result	Subsequent Step
1	Examine and confirm whether the system has sufficient coolants, the A/C system's belts are normal, and the A/C clutch, pressure switches operate normally.	Yes	Next step
		No	Remove the failure
2	Enable the engine to operate at idle speed, turn on the A/C switch, and apply the failure diagnosis instrument to examine and confirm whether there is a A/C thermistor failure.	Yes	Remove the displayed failure
		No	Next step
3	Turn on the A/C switch, connect up the adaptor between the ECU and harness, and measure whether the ECU's A/C switch and A/C pressure have the signal input.	Yes	Next step
		No	Examine harness
4	If the vehicle is equipped with the low level control, examine and confirm whether the A/C system still operates when the A/C system shuts down.	Yes	Repair harness
		No	Next step
5	Examine and confirm whether the earth terminal of A/C system relay pull-in coil has the low level output.	Yes	Repair the A/C relay and harness
		No	Replace ECU

5. Electronic fuel injection system failure diagnosis:

In general, the engine electronic fuel injection system failure is generated due to the following reasons:

- (1) The engine electronic fuel injection system match problem. This problem generally occurs in the early stages of vehicle coming into market, such as: unstable idle, shutdown and etc, at the same time, these problems are by batch. This kind of problem is basically difficult to be solved via the mode of maintenance. Thus, if you find this kind of problem, please actively contact the Chery After-sales Service Department.
- (2) In the electronic fuel injection system, the problem that occurs frequently is the failure caused due to the bad contact of connecting parts. A majority of these problems can be removed after the completion of some parts replacement. However, if these used parts are installed on the other vehicles, these vehicles still can operate normally. Thus, it is recommended that it is best to firstly examine the connection of related components of the electronic fuel injection system when the similar problems occur.
- (3) The electronic fuel injection system parameter and data flow are very important during the course of maintenance. Thus, it is recommended that it is best not to determine problem relying on the failure codes only during the course of maintenance, we shall integrate the data flow to determine and solve these problems.