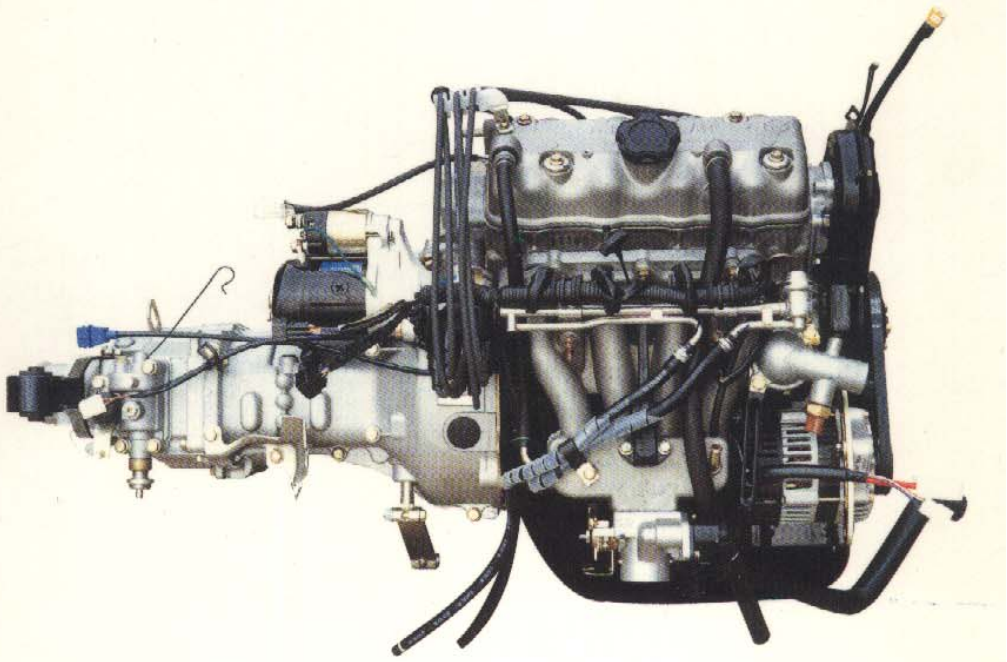
Engine Electronic Control System

Service Manual



长安汽车（集团）有限责任公司
（重庆长安汽车股份有限公司）

Preface

Chang'an Co has newly developed the electronic fuel injection (EFI) engines, F series, Jiangling brand on the basis of the original Jiangling engines, F series, with the advanced electronic control technique of Germany Bosch Co.

This engine is designed as multipoint-injection one equipped with an oxygen sensor for accurate control of air-fuel ratio, as well, it is equipped with a catalyst to lessen the emission, therefore, not only the sufficient power and lower fuel consumption (economical efficiency) are obtained, but the lower emission can meet the current strict regulations at home, even more, it can reach the extreme requirement of the emission regulations in the future. It is a so-called "green and environmental protection engine".

When the engines of F series take experiments in severe conditions such as in extreme cold , high temperature or high altitude area, they are indicative of the characteristics of easy startup, stead idle speed, smooth acceleration, large power and low fuel consumption. Since either the engine or a/c system can be controlled by ECU, the a/c amplifier can be omitted, thus, the performances of a/c have greatly been improved. It is believed that this engine will attract the customers all around the country along with it being put into the market.

This manual describes the structure of Electronic Control（engine management） System, principles and functions of elements and components, diagnosis of faults and procedure and method to eliminate typical faults. In association with reading the related manual of the engine, F series, this manual can meet the need of the repairmen and give the engineers and technicians hints for reference.

The members of compiling group are Luo Jun, He Jugang, Yang Bailin, Wen Chengfu, Xu Shaowen, Zhong Shixue etc.

During compiling the manual, we have got a great support from the leaders, Qing Jianzhong and Cheng Hongbing of the After-sale Service Department, Chang'an Sale Co., and from the relevant persons of UAES Co, Shanghai. Thanks to all the persons stated above in good faith.

Compiler

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Content

1 Precaution……(4)
2 Summary……...(6)
2.1 Intake system……(7)
2.2 Fuel delivery system……(8)
2.3 Engine electronic control system……..(9)
2.3.1 Throttle position sensor……...(11)
2.3.2 Intake pressure and temperature sensor……..(12)
2.3.3 Hall sensor……..(13)
2.3.4 Coolant temperature sensor……(14)
2.3.5 Oxygen sensor……(15)
2.3.6 Knock sensor……...(16)
2.3.7 Speed sensor……...(17)
2.3.8 Temperature sensor on A/C evaporator……..(17)
2.3.9 Ground wires No 1, No2 for enriching mixture gas….(17)
2.3.10 Ignition correction ground wire……(17)
2.3.11 Electronic control unit (ECU)……...(18)
2.3.12 Fuel injector……..(18)
2.3.13 Ignition coil……...(19)
2.3.14Idle stepping motor……(19)
2.3.15 Canister purge valve……(20)
2.4 Ignition system……(21)
2.5 Emission control system……(21)
2.6 A/C control system……...(22)
3 Diagnosis of faults……..(23)
3.1 Read out and clear self-diagnostic fault information……...(24)

3.2 Read out status parameter of engine ………………………...(25)
3.3 Diagnosis of connections and harness………………………(25)
3.4 Power of engine electronic control system & ignition switch circuit…(25)
3.5 Self-diagnostic circuit……………………………… ……..(27)
3.6 Intake pressure and temperature sensor circuit……… ……....(28)
3.7 Throttle position sensor circuit……………………… ……(29)
3.8 Oxygen sensor circuit……………………………… ……..(30)
3.9 Hall sensor circuit………………………………… ………(31)
3.10 Coolant temperature sensor circuit…………………… ……(32)
3.11 Knock sensor circuit……………………………… ……..(33)
3.12 Speed sensor circuit……………………………… ……...(34)
3.13 Enriching mixture gas circuit at high altitude ……… ……(35)
3.14 Ignition angle correction circuit………………………… ….(35)
3.15 Idle adjustment stepping motor circuit……………………..(36)
3.16 Canister purge) control valve circuit…………………………… ….(37)
3.17 Fuel injector circuit……………………………… ………(38)
3.18 Powered fuel pump circuit………………………… …….(39)
3.19 Main relay circuit…………………………………… …...(40)
3.20 Ignition coil circuit……………………………… ……….(41)
3.21 Air conditioner control circuit…………………… ………(42)
4 Fault elimination…………………………………………… ….(44)
4.1Intake system…………………………………………………...(45)
4.1.1 Throttle body (dismantle, check and assemble)………..(45)
4.1.2 Idle stepping motor(dismantle, check and assemble)….(46)
4.1.3 Throttle position sensor………………………………..(46)
4.1.4 Intake manifold………………………………………..(47)
4.2 Fuel delivery system………………………………………..(47)
4.2.1 Check fuel pressure……………………………………(47)

4.2.2 Check fuel pump……(47)
4.2.3 Check fuel pressure regulator……(47)
4.2.4 Check fuel injector……..(47)
4.3 Electronic Control（engine management）System ……(48)
4.3.1 ECU (dismantle, assemble)……(48)
4.3.2 Intake pressure and temperature sensor……(49)
4.3.3 Coolant temperature sensor……(49)
4.3.4 Oxygen sensor……(50)
4.3.5 Knock sensor……..(50)
4.3.6 Main relay/fuel pump relay/A/C relay……(51)
4.4 Emission control system……(51)
4.4.1 Check canister purge control valve……...(51)
4.5 Ignition system……...(52)
4.5.1 Distributor system……...(52)
4.5.2 Ignition spark inspection……(52)
4.5.3 Ignition timing adjustment……(52)
4.6 Air conditioner control system……..(52)
4.7 Primary faults checking flow……(53)
4.7.1 Difficult to start or not to start……(53)
4.7.2 Poor idle speed……(54)
4.7.3 Insufficient power……...(55)
4.7.4 Engine responded sluggishly……..(56)
4.7.5 Unsteady vehicle speed ……(57)
4.7.6 Over consumption of fuel……...(58)
4.7.7 Emissions exceed limits……..(59)
4.7.8 λ Self-adaptation value out of limit……(60)

4.8 Circuit diagram of engine electronic control system, engine F series……..(61)

1. Precaution

It is important to observe the follows during use, check, diagnosis and maintenance of the engine, F series.

（1）When checking the electric elements without need of power, disconnect the cathode of battery.

（2）When disconnecting the electrodes of battery, disconnect the cathode first, then the anode, when connecting the battery, do it in reverse order.

（3）Whenever using seal parts, new gasket and “O” ring should be chosen as far as possible, and the surface should be cleaned up to keep the tightness.

（4）After repairing any line, check all related pipes and joints for leakage or chokage.

（5）Never disconnect the fuel delivery pipe between pump and nozzle, before the fuel pressure drops down, or the pressurized fuel will spray out.

（6）Since the engine is equipped with a catalytic converter, unleaded gasoline can be used only.

（7）It must be prohibited to introduce the unburned fuel into the exhaust pipe, or the catalytic converter will be damaged.

（8）Ignition spark test may only be performed as actual demand is required, but the experiment duration is as short as possible with the throttle being closed.

（9）Never unplug the high tension lead of spark plug while the engine is running.

（10）Prevent the engine from flameout.

（11）When connecting or disconnecting the electric elements, turn the ignition switch to “Off” position, otherwise the element will be damaged.

（12）Do not touch the element pins with finger, or the static electricity from body may burn out the element.

（13）When measuring the circuits, a multitester with high input impedance is required to use.

（14）When measuring the circuits, it is prohibited to pierce the isolating layer of the wire , if in this way, the insulatibity will be affected.

（15）When measuring the connectors, pay more attention not to bend the pins.

（16）Observe the connection(connecter) conditions and check if any bent male pins and expanded sockets, in addition, check if any unlocked connectors, any dirt and corrosion.

（17）Measure if the voltage of battery is equal to or over 11V, before check the electric system and measure circuit voltage.

（18）When installing the electronic devices, such as antitheft device, wireless or mobile telephone, the following points will be observed:

1) The antenna will be placed to the Electronic Control（engine management） System as far as possible.
2) Do not connect any other wire onto the harness of Electronic Control（engine management） System.

(19) When the vehicle is in demand of weld or bake, remove the ECU before doing so.

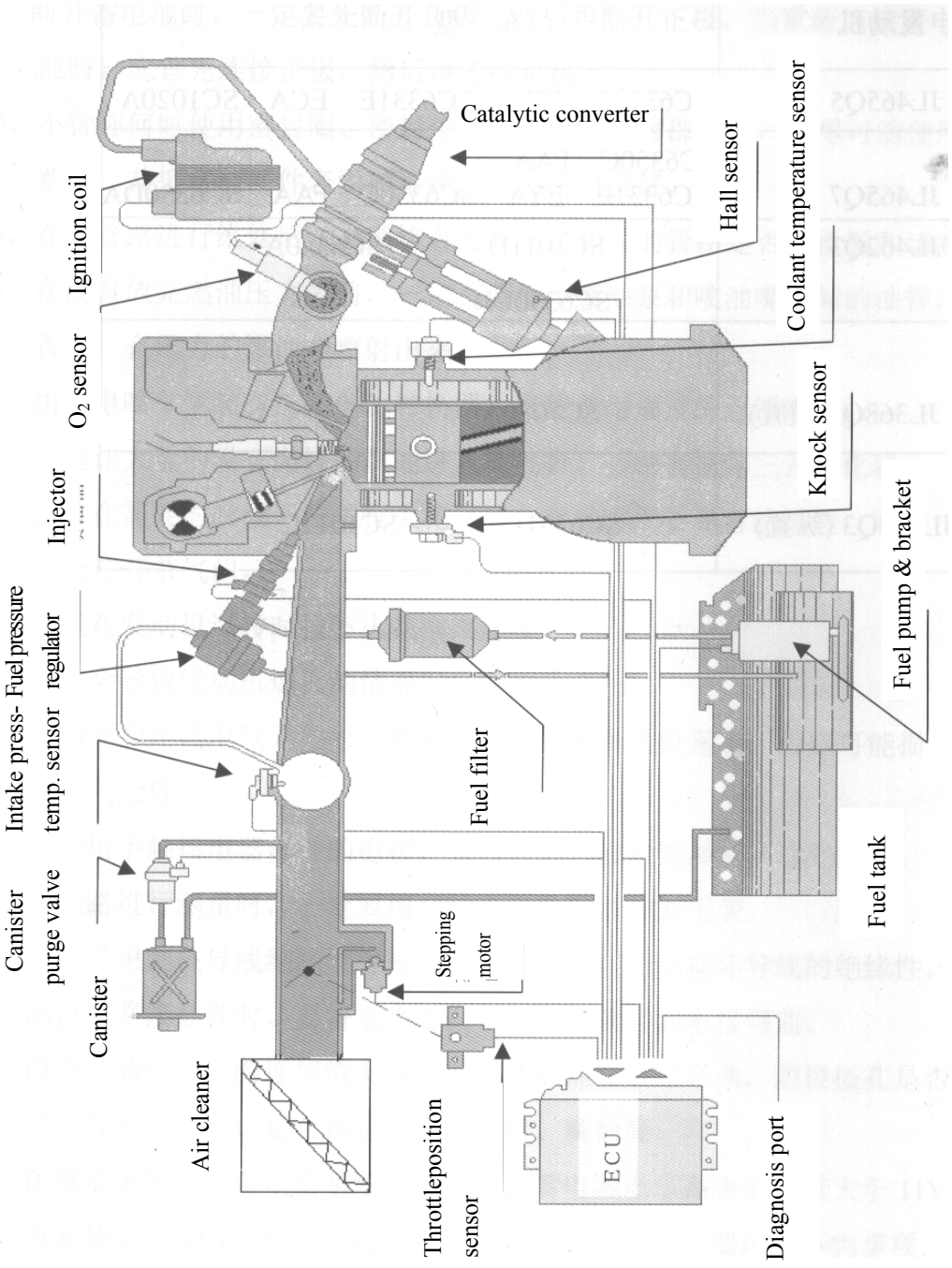
(20) This manual is suitable for the electronic control engine (MPI engine), F series, Jialing brand and the relevant vehicle, Chang’an brand.

Engine model	Vehicle model
JL465Q5	SC6350 FHA , SC6331E ECA , SC1020A
JL465Q7	SC6350C FAA, SC6331 EYA, SC6330C FAA , SC6330DA

JL462Q3	SC1011D, SC6320A, SC633DB
JL368Q3(Horizontal)	SC7080A
JL368Q3(longitudinal)	SC6331D, SC1012C

2. Summary

The Electronic Control（engine management） System of the engine, F series is composed of 6 subsystems, such as intake system, fuel delivery system, control system, ignition system, emission system and air conditioner system



Sketch of Electronic control engine (MPI engine)

2.1 Air intake system

It is composed of air cleaner, throttle body, idle stepping motor and manifold etc.

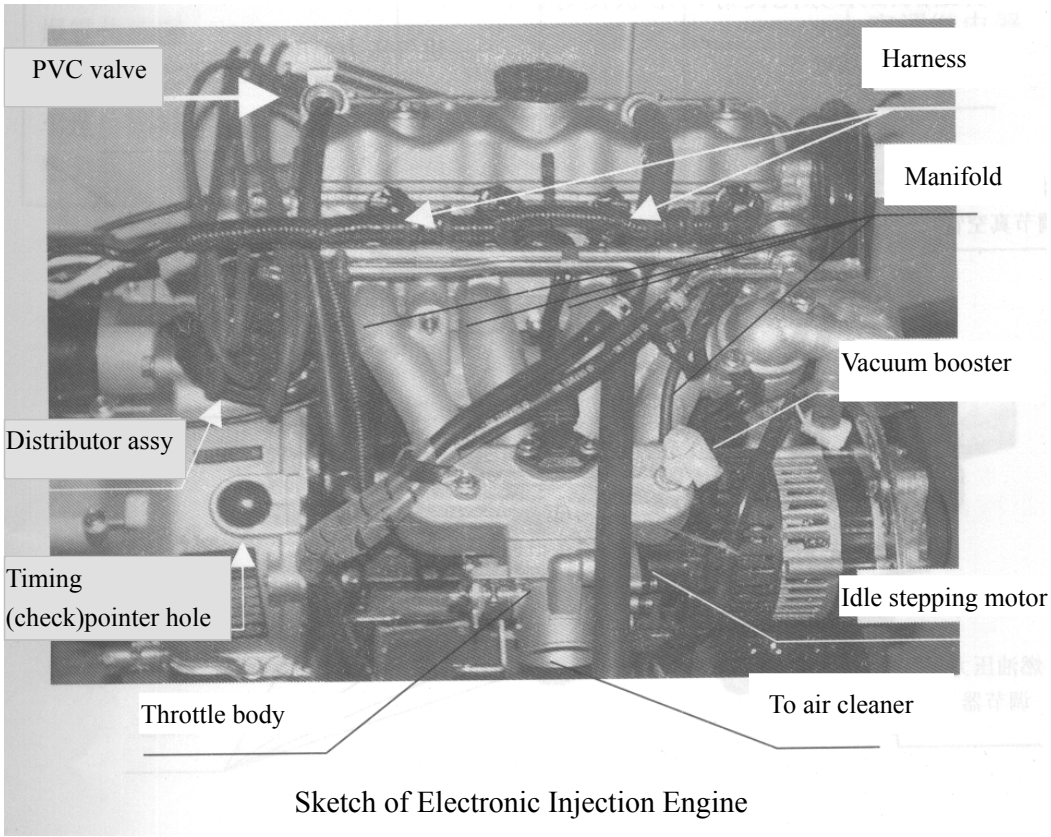
Function expression(Function description):

Fresh air is filtered by air cleaner, then it is distributed into the

combusting chamber through the manifold at a certain air flow rate controlled by throttle body. When the engine running at idle speed, the idle stepping motor actuates according to the command from ECU to control the air intake rate. The intake manifold will generate vacuum pressure to supply the whole vehicle as a negative pressure source.

General requirement:

The air cleaner must have the function to filter the impurity (dust) from the atmosphere and have the intake resistance as small as possible. The throttle can operate smoothly and its internal face (surface) keeps clear. The air valve operated by the idle stepping motor must be clear without any obstruction. There is not any crack, air and water leakage on the manifold.



Sketch of Electronic Injection Engine

2.2 Fuel delivery system

It is composed of fuel tank, fuel pump, fuel filter, fuel rail, fuel pressure regulator, fuel injector and fuel pipe etc.

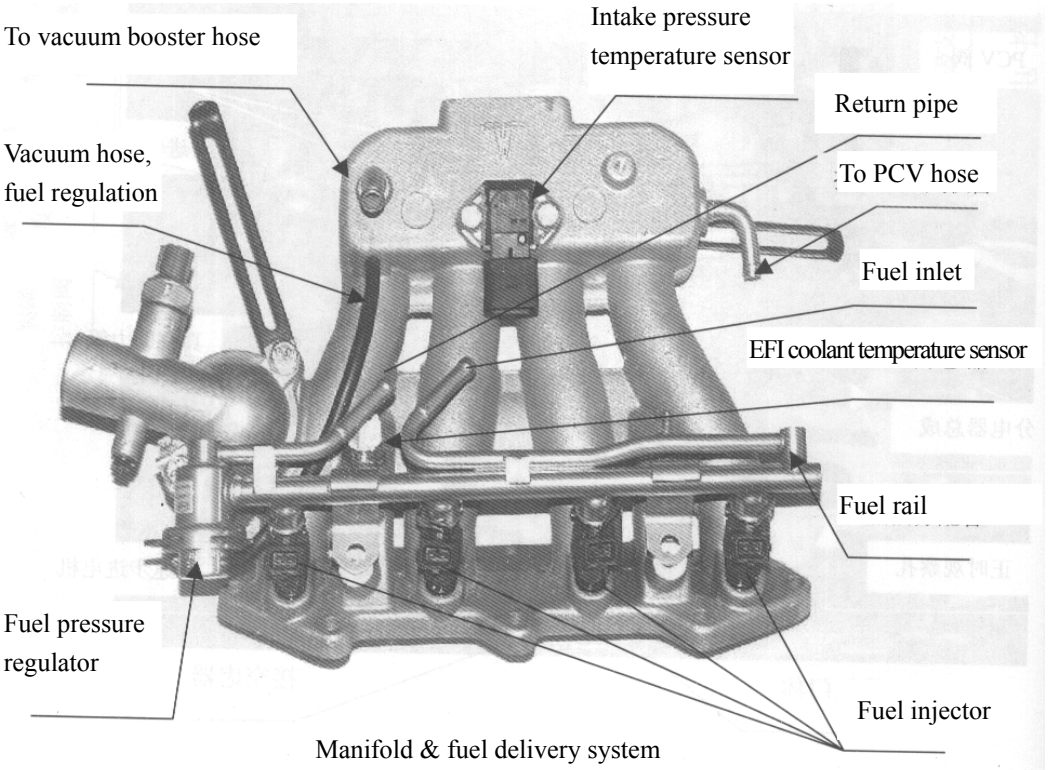
Function expression(Function description):

Fuel in the tank is pumped out to each injector through the fuel pipe,

filter and fuel rail, the pressure regulator integrated with the fuel rail has the function to keep the fuel pressure in the injector 300Kpa higher than that in the intake manifold, and to let most fuel come back to the fuel tank through the return pipe. The injector is controlled by ECU, thus, appropriate pressurized fuel injects into the combustion chamber close to the valve on the cylinder head.

General requirement:

The fuel filter is able to filter the impurity (dust) in the fuel with small pressure loss so as not to block the fuel injector. The fuel pressure regulator is able to adjust the fuel pressure to a correct level subject to the pressure in intake manifold, therefore the fuel can properly atomize in a good pattern.



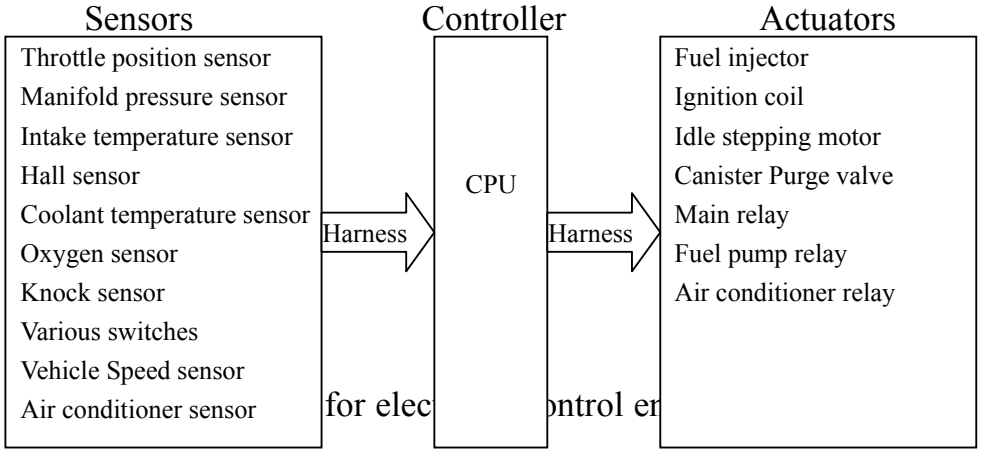
Manifold & fuel delivery system

2.3 Electronic Control（engine management） System

It is composed of the follows:

1) Various sensors that are used to probe the running status of engine and other information demanded for proper work.

2) ECU, which is used to analyze and process the output signals from the sensors and control the actuators.
3) Various actuators that are controlled by ECU.
4) Harness, which is used to connect sensors, ECU and actuators.



for elec ntrol er
series

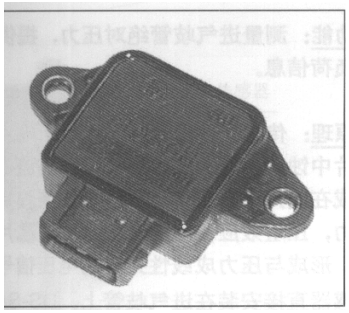
Relational table of input and output signals of electronic control engine (MPI engine), F series

Input signals \ Output signals	Actuators						
	Fuel injector	Ignition coil	Idle stepping motor	Canister purge control	Main relay	Fuel pump relay	A/C relay
Throttle position sensor	○	○	○	○			○
Manifold pressure sensor	○	○	○	○			
Intake temperature sensor	○	○	○				
Hall sensor	○	○	○	○		○	
Coolant temperature sensor	○	○	○	○			○
Oxygen sensor	○						
Knock sensor	○	○					

Speed sensor		○					
A/C evaporator sensor		○					○
Air conditioner switches		○					○
Fuel Enriching(enrich) ground wire, No 1	○						
Fuel Enriching(enrich) ground wire, No 2	○						
Ground wire, ignition timing		○					
Ignition switch	○	○	○	○	○	○	○

The function and general requirement are described as follows:

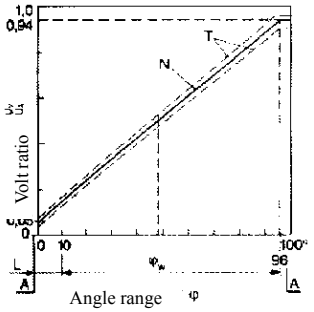
1) Throttle position sensor:



<u>Function</u>: it supplies information about the engine load and operating condition.

<u>Principle</u>: In fact, this sensor is a swivel arm potentiometer with linear output characteristics. The swivel arm is coaxially mounted with the throttle. When the throttle turning, the swivel arm goes along with the throttle to indicate a certain resistance, therefore the voltage signal output of the potentiometer is proportional to the position of throttle

Characteristics curve



U_A: Output signal voltage

U_V: Operating voltage

N: Theoretical characteristics curve

T: Characteristics curve deviation

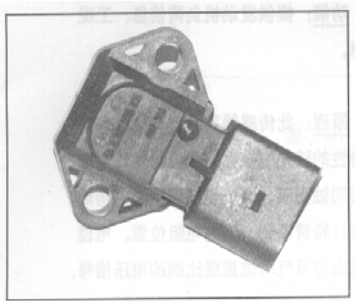
Technical specifications

Electronic angle range	**≤96°**
Rotation direction	**Arbitrary**
Resistance	**2KΩ ±20%**
Operating voltage	**5V**
Operating temperature	**-30℃~+110℃, -40℃~120℃ (in short term)**
Protection resistance for swivel arm	**710Ω~1380Ω**
Permitted current for swivel arm	**≤18μA**
Service life	**2,000,000 cycles**

General requirement:

The output signal value should be in conformity with the aperture width of the throttle, prevent the sensor from showering, impacting and shocking, keep the connector in good appearance without dirt, deformation and corrosion.

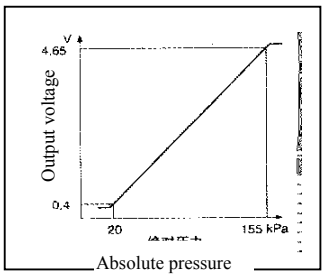
2) Intake pressure temperature sensor



Function: It is used to gauge the absolute pressure in the intake manifold and supply the information on engine load

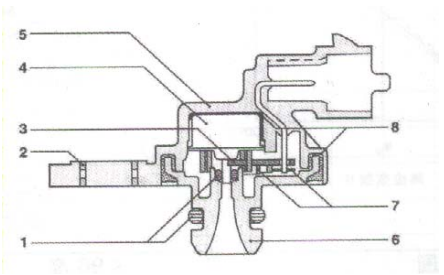
Principle: This sensor is composed of a Si chip. The pressure diaphragm is etched on the chip, the fixed-value and rectifying circuits are also integrated on the chip. Variation of air pressure will deform the diaphragm by force, and its resistance changes on the effect of piezoresistance. After processing by the chip, the voltage signal is generated in linear relation with the pressure. This sensor is direct mounted on the manifold. To the sensor, model DS-S/TF, the air pressure and temperature sensors are integrated in one.

Features: It adopts the advanced sensing technique, and has the advantages of light body, compact structure and small occupation in the manifold.



Characteristics curve

Section of pressure sensor, model DS-S



1. Seal ring
2.Stainless steel bush
3.PCB base
4.Sensing element
5.Case
6.Pressure bracket
7. Welded connection
8. Bonded connection

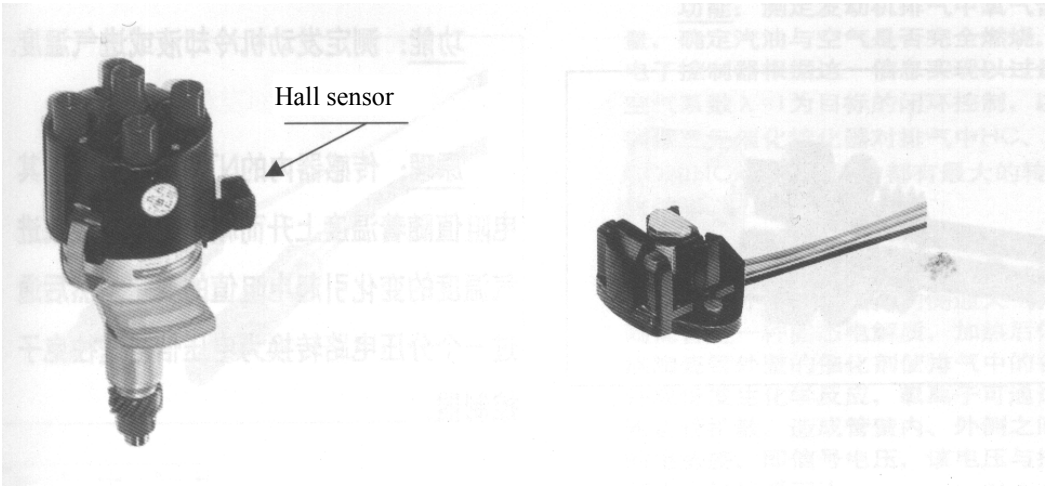
Technical specification:

Pressure range (To turbine engine)	**25kpa~115kpa (Max. 250kpa)**
Input voltage	**5.0±0. 5V**
Weight	**Approx. 18g~27g**
Vibration resistance (withstand)	**Harmonic wave: 250m/s^2 Peak: 600m/s^2**
Current	**9mA**
Temperature sensor resistance at 20℃	**2.5KΩ±5%**
Operating temperature range	**-40℃~+125℃**
Trigger time	**0.2ms**
Measuring error (Measuring tolerance), pressure	**±1. 5%**

General requirement:

Keep the connectors in good appearance without dirt, deformation and corrosion.

3) Hall sensor (in the distributor):



Function expression(Function description):

It supplies ECU with engine speed signal and crankshaft phase signal，these signals will be taken as a reference time for injection and ignition.

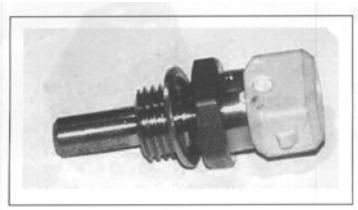
Technical specification:

Power voltage (Power Supply voltage) within the following temperature: **-40℃~+80℃** **-40℃~+150℃**	 **4.5V~30V** **4.5V~24V**
Supply current, when Uv=16V	**≤21mA**
Output voltage, when Uv=20V	**0~Uv**
Output current	**0~20mA**
Saturated output voltage	**≤0. 4 V**
On-off time at the point of 10% or 90% output voltage	**9 μ s**
Operating ambient temperature	**-40℃~+130℃**
Limiting temperature in short term	**-40℃~+150℃**

General requirement

Keep the connectors in good appearance without dirt, deformation and corrosion.

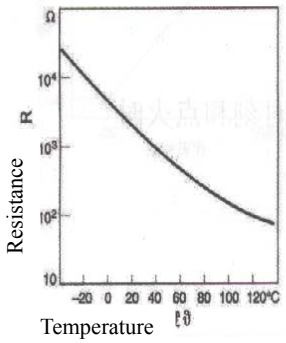
4) Coolant temperature sensor



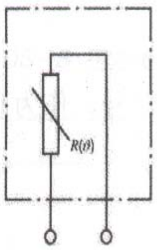
<u>Function</u>: It is used to measure the coolant temperature and intake air temperature.

<u>Principle</u>: In the sensor, there is a NTC thermistor, its resistance will drop, when the temperature rises. The variation of coolant temperature or intake air temperature will result in the change of resistance, then, the varied resistance will be transduced into a voltage signal with a divider circuit and send to the controller.

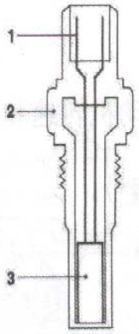
Characteristics curve



Diagram



Structure chart



1. Connector
2. Case
3. NTC resistor

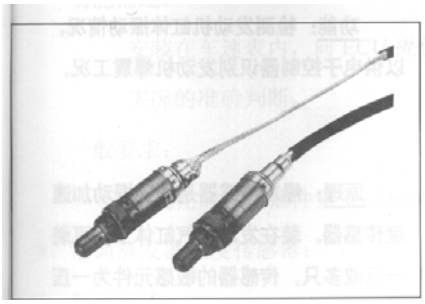
Technical specification

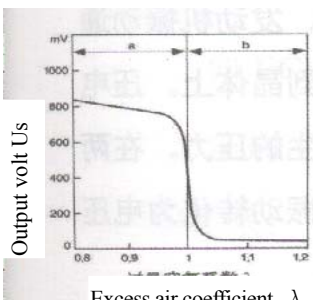
Measuring range	**-30℃~+130℃**
Max measuring current passed through sensor	**5mA**
Nominal resistance at 20℃	**2.5KΩ ±5%**
Max energy loss, at 23℃(static water) , ΔT=1K	**15mW**
Nominal voltage	**5V**
Vibration resistance (withstand)	**600m/s^2**
Response time in water	**Approx 15s**

General requirement

Keep the connectors it in good appearance without dirt, deformation and corrosion.

5) Oxygen sensor:



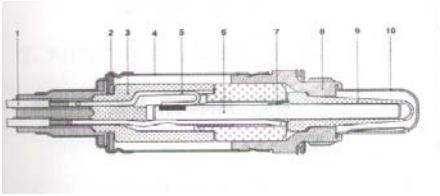


Function: It is used to determine if the mixture gas(mixture) is in the state of complete combustion by means of measuring the content of oxygen. The electronic controller executes a closed loop control to realize the purpose of the excess air coefficient λ＝1, according to the information from the sensor, so as to ensure the catalytic converter has got the maximum conversion ratio for the emissions of HC, CO, and NOx.

Principle: The element of oxygen sensor is composed of a ceramic tube, the atmosphere goes through inside of the tube and the exhausted gas vents from the outside. This ceramic tube is a solid electrolyte , after

heating, the catalyzer on the external wall activates various compositions in the gas to produce chemical reactions, the diffuse of oxygen ion on the tube generates a potential difference between the internal wall and external wall, i.e. a signal voltage which is proportional to the content of oxygen in the exhausted gas.

Features: It has the advantages of leadproof, little dependence on exhaust temperature, rapid entrance into closed loop control after starting.



1)Cable 2) Disc spacer3) Lower insulating bush
4) Protective sheath 5) Contacting wire
6) Heating rod 7) Contacting shim 8) sensor seat
9) Ceramic probe 10) Protective tube

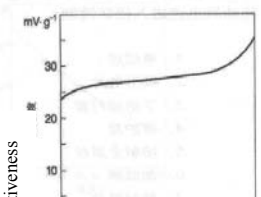
Technical specification

Tightening torque	**40Nm~60Nm**
Protective tube	**3 slots**
Operating temperature: **Ceramic probe (exhaust) 200℃~850℃** **Hexagon nut ～570℃** **Cable outlet ~ 250℃** **Connectors ~150℃**	
Temperature gradient in Ceramic probe	**Max 100k/s**
Lifetime	**>160,000km**

General requirement

Keep connectors in good appearance without dirt, deformation and corrosion. It is required to exist no breakage to the lead, no abnormal noise when shaking the sensor and no oil stain at the end of the oxygen

6) Knock sensor



<u>Function</u>: It is used to check knocks from cylinder block, so that the operation condition of the engine is able to be identified by the electronic controller.

<u>Principle</u>: The knock sensor is a vibration acceleration sensor. One or more are mounted on the cylinder block. The pressure sensitive element of the sensor is

a piezoquartz。When the engine is knocking, the vibration delivers to the piezoquartz from a probing piece in the sensor. A voltage is produced at the electrodes of the piezoquartz under the action of the vibration, thus the mechanical vibration transduces into the output voltage signal.

Features: It has the advantages of compact and secured structure, high sensitiveness.

Technical specification

Frequency range	**1kHz~20kHz**
Measuring range	**0.1g~400g**
Sensitiveness at 5kHz	**26±8mV/g**
Linearity between 3kHz and 15kHz	**±15% comparable to 5kHz**
Primary harmonic frequency	**>20kHz**
Impedance	**>1MΩ**
Capacitance	**800~1600pF**
Temperature coefficient of sensitiveness	**≤0.06mV/(g. ℃)**
Operating temperature	**-40℃~+130℃**

General requirement

Keep connectors in good appearance without dirt, deformation and corrosion. It is required to exist no breakage to the lead.

7) Speed sensor:

Function expression(Function description):

It is mounted in the speedometer to supply the ECU with the speed signal for accurate determination of the engine operation condition running at idle speed.

General requirement:

Keep the connectors in good appearance without deformation and corrosion. It is required to exist no breakage to the lead.

8) Air conditioner sensor

Function expression(Function description):

It is used to supply the ECU with the evaporator temperature signal for control of air conditioner relay, and indirect control of the a/c compressor.

General requirement:

The sensor must be placed in correct position to reflect the evaporator temperature. It is required to exist firm connection and no breakage to the lead.

9) Enriching(enrich) ground wires, No1, No 2 i.e. pin No 8 of ECU (white with blue tracer wire) and pin No 52 (green wire):

Function expression(Function description):

Two round plugs are placed in front of battery under the driver seat (for vehicle SC6350C) or near the girder (for other models). If they are manually connected to the ground, ECU will thicken the mixed gas automatically to obtain sufficient power in the plateau region with thinner atmosphere.

General requirement:

Never connect them to the ground if not necessary, or it will make higher fuel consumption, and deteriorate emissions.

Special precautions:

For the vehicles with JL465Q5 engines (e.g. SC6350C THA, SC6331E ECA), the pin No 8 (white with blue tracer wire) should connect the ground at any time, but the pin No 52 (green wire) hangs up as a rule.

10) Ignition timing wire to the ground:

Function expression(Function description):

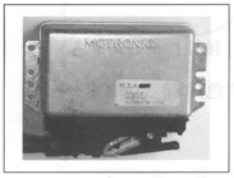
The square plug close to the Enriching(enrich) ground wire must connect to the ground when ignition timing adjustment is performed with a timing lamp. Do not adjust the ignition timing, before ECU determines the ignition advance angle.

General requirement:

After complete adjustment of ignition advance angle, do not forget to disconnect the plug, or serious problems will occur, such as insufficient

power and catalytic converter overheat.

11) ECU controller:



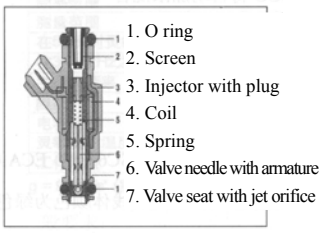
Function expression(Function description):

It is used to analyze and process the signals from various sensors, and deliver the related commands to the actuators.

General requirement:

Prevent the controller from showering, impacting, shocking and overheating, and avoid touching the ECU pins with finger, keep the connectors in good appearance without dirt and corrosion.

12) Fuel injector



Function expression(Function description):

It injects an appropriate mixed fuel close to the intake valve.

General requirement:

It is required to atomize fuel in proper spray pattern and to keep the connector in good contact without dirt and corrosion.

13) Ignition coil

Function expression(Function description):

It generates high tension to the spark plug, which can ignite the mixed gas in the combustion chamber at appropriate intervals.

General requirement:

The ignition coil is able to produce

sufficient high tension. Prevent the coil from showering and keep the connector in good contact without dirt and corrosion.

14) Idle stepping motor

Function expression(Function description):

It is used to control the intake rate of bypass air according to the commanded current from ECU, as a result, the idle speed of the engine is regulated to run steadily.

General requirement:

Keep the stepping motor turning smoothly and prevent it from showering and oil stain, and keep the connector in good contact without dirt.

15) Canister(Canister Purge) control valve:

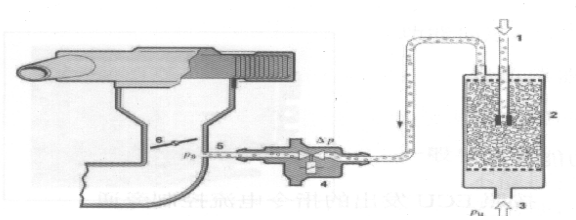
<u>Function</u>: It is used to control the flow rate of reproduced gas in the evaporation emission system.

<u>Principle</u>: The Canister(Canister Purge) in the evaporation emission control system absorbs the fuel vapor from the tank till the

fuel vapor has saturated. The electronic controller opens the Canister(Canister Purge) control valve to mix the fresh air and saturated fuel vapor and form reproduced gas flow, which is introduced into the engine intake pipe. Depending on the engine running conditions, the solenoid coil in the valve controls the aperture width of the valve by means of the duty ratio of impulse signal delivered from the electronic controller. In addition, the aperture width is also effected by the pressure difference between two ends of the valve.

Features: it has the advantages of wide operating range, accurate control to flow rate and good tightness.

System diagram



1. From tank
2. Canister
3. Atmosphere
4. Canister control valve
5. To intake manifold
6. Throttle

Δ P is a pressure difference between ambient pressure Pu and intake manifold pressure Ps

Technical specification

Flow rate	**2 or 3 m2/h, at 200mbar**
Air tightness	**<2000cm2/h**
Control frequency	**30Hz**
Min control pulse	**7ms**
Current consumption	**0.5V at 13.5V**
Resistance	**26Ω**
Operating voltage	**9V~16V**
Inductance	**48mH, f=1kHz**
Operating temperature	**-30℃~+120℃**

General requirement:

Keep the connectors in good contact without dirt, chokage and leakage.

16) Main relay, fuel pump relay, A/C relay

Function expression (Function cription):

They are used to turn on or off the related

apparatus according to the commands from ECU.

General requirement:

Prevent the relays from showering, maintain the switches with smooth and reliable operation and keep the connectors in good contact without dirt.

2.4 Ignition control system

It is composed of distributor assembly, knock sensor, ECU, ignition coil, high tension wire and spark plug.

Function expression (Function description):

ECU is used to estimate the relevant operation conditions of the engine depending on the input signals from various sensors, and deliver the relevant ignition signals to fire the mixed gas in the combustion chambers of the engine for a normal run.

General requirement:

Keep the elements and spark plug in good condition and reliable contact. Adjust the timing reference of ignition properly, remain clear in the distributor assembly and no looseness for the signal panel.

2.5 Emission control system

It is composed of activated carbon canister, Canister (Canister Purge) control valve, PCV, catalytic converter and related pipes.

Function expression (Function description):

It is used to lessen the fuel vapor, the emission from crankshaft and tail gas pollutant.

General requirement:

Keep the all components in good condition, and keep the line in air tightness without any chokage and leakage.

2.6 Air conditioner control system

It is composed of A/C switch, fan motor switch, temperature sensor of evaporator, ECU, A/C relay, compressor and related harness.

Function expression(Function description):

ECU controls the A/C relay, i.e. switches indirectly on or off the compressor subject to various input signals and operation condition of the engine.

General requirement:

Keep all switches and harness in good contact and perfect condition. The other requirements refer to the chapter about air conditioner.

3. Fault diagnosis

Summary:

To the engine, F series, ECU of the Electronic Control（engine management） System has equipped with a memory for storing faults information. During operation, ECU continues to perform the self diagnosis on the relevant parts and their work conditions of the system, it will record the faults or error codes into the memory as soon as any abnormal cases are found. This stored information can be read out and gives the service persons some prompts on faults for easy and rapid elimination.

If the faults are caused by temporary cable breakage or poor contact, such sort of faults will be recorded as an occasional fault. The occasional fault recorded in the memory will be cleaned out automatically by ECU, if it does not occur again within 40 times of engine starts.

If a setup error of air-fuel ratio occurs, the error will not be recorded within 4 minutes.

The fault information in ECU will be cleaned out if the power supply is cut off, e.g. unplug the controller or disconnect the lead on the terminal of the battery.

Notice:

1) If it is necessary to cut off the power of ECU during repair, at first, read out and record various fault information in the memory of ECU.
2) Clean out the fault information in the memory, and read out the fault information again after trial drive, pay more attention to the repeated faults and check them carefully.
3) The fault diagnosis instrument can only clean out the fault information in ECU, instead of fault elimination.

3.1 Read out and clean the self diagnosis information in ECU

To read out or clean the self diagnosis information in ECU, please use the fault diagnosis instrument for electronic injection system recommended by Chang'an Co, do not operate it before reading its instruction manual carefully. The diagnosis interface is placed under the driver seat or near the girder, it bands together with the Enriching(enrich) ground wire and ignition timing wire. The fault information in ECU can easily be read out and cleaned just connect the interface with that of the fault diagnosis instrument and turn on the ignition switch.

Notice: To read out the fault information in ECU correctly, it is best to take a trial run

1) Trial run

- The trial time must be longer than 4 minutes.
- Trial run must be taken for 3 minutes at the coolant temperature above 70℃
- Trial run must be taken for 10s in the condition of throttle aperture width above 75°.
- The engine must keep running at idle speed for 30s before it flameouts.

3.2 Read out status parameter of the engine

By means of the fault diagnosis instrument for electronic injection system recommended by Chang'an Co, the status parameters of the engine can be read out during the engine running, e.g. speed, coolant temperature etc, these parameters is in aid of the service men to determine where the fault takes place and repair the vehicle. The operation of the instrument refers to the instruction manual.

Notice:

Do not turn on the ignition switch before the diagnosis instrument connects with the Electronic Control（engine management） System. If the diagnosis instrument has no response for a long time, press the reset

key.

3.3 Diagnosis on connectors and harness

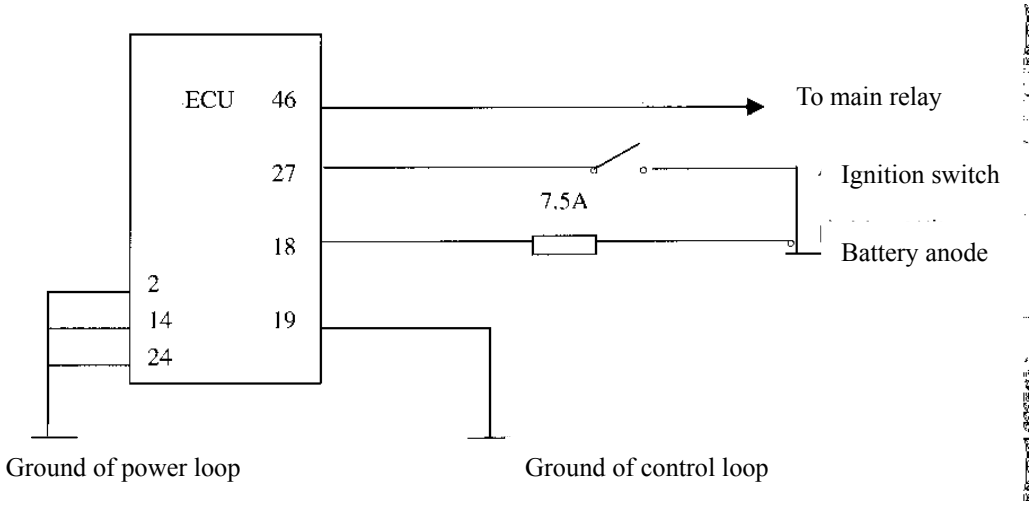
The fault of connectors and harness may have 4 sorts as follows:

1) Broken circuit: The poor contact or broken wire has happened in this circuit.
2) Short circuit to the anode: A part of the circuit connects to the anode, where it is not allowed to do so.
3) Short circuit to the cathode: A part of the circuit connects to the cathode, where it is not allowed to do so.
4) Short circuit to each other: the independent circuit connects to another one or electric leakage takes place.

If the faults stated above have been found during diagnosis, eliminate the faults according to the requirement for circuit repair, the circuit must be in good contact and isolation to the other circuit nearby after repair, then handle this circuit with moistureproof treatment.

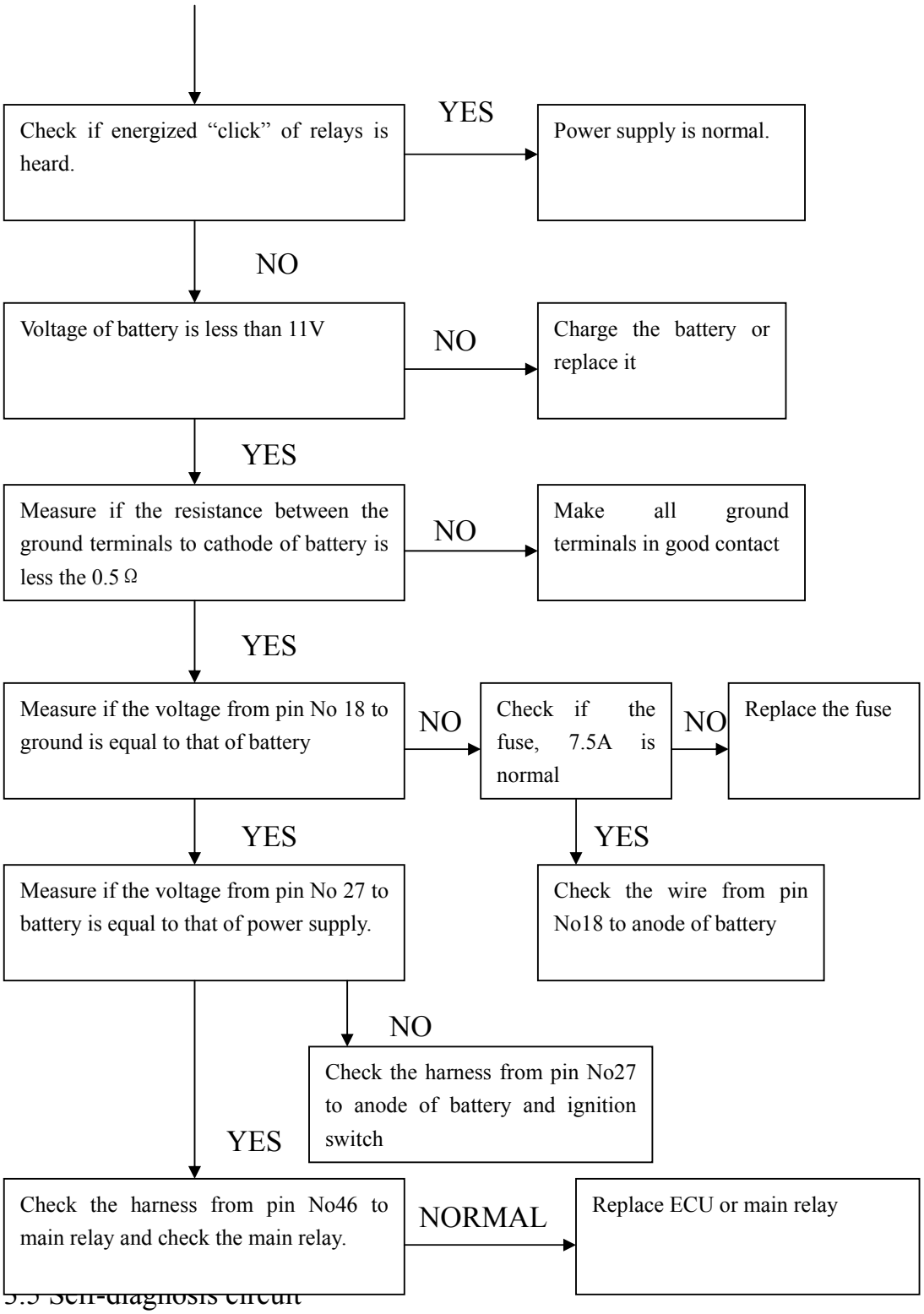
3.4 Power of Electronic Control（engine management） System and ignition switch circuit

Circuit diagram



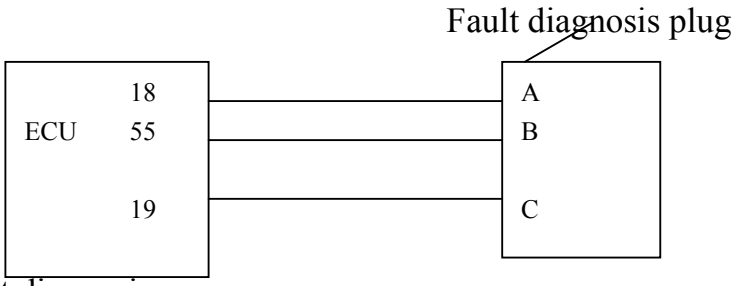
Fault diagnosis

Repeat turning on and off ignition switch.



3.3 Self-diagnosis circuit

Circuit diagram



Fault diagnosis

Connect the fault diagnosis instrument with the interface and turn on ignition switch

Check if the fault diagnosis instrument can communicate with ECU

YES → The fault diagnosis instrument is normal.

NO

Check if power supply is normal.

NO → Repair power supply circuit or ignition switch circuit.

YES

Measure if the resistance between terminal C and ground is less than 0.5 Ω.

NO → Repair harness to terminal C.

YES

Measure if the voltage between terminal A and ground is equal to that of battery.

NO → Check the harness from terminal A to anode.

YES

Measure if the resistance between terminal B and pin No 55 of ECU is less than 0.5 Ω.

NO → Check the harness from terminal B to pin No 55 of ECU.

YES

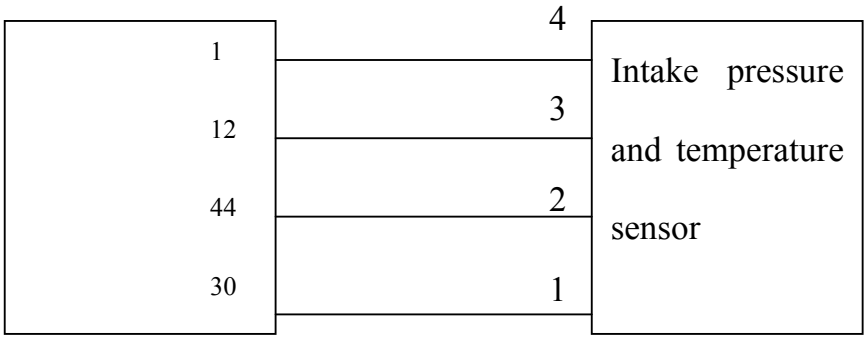
Check if the fault diagnosis instrument is abnormal.

YES → Replace the fault diagnosis instrument and the connecting wire.

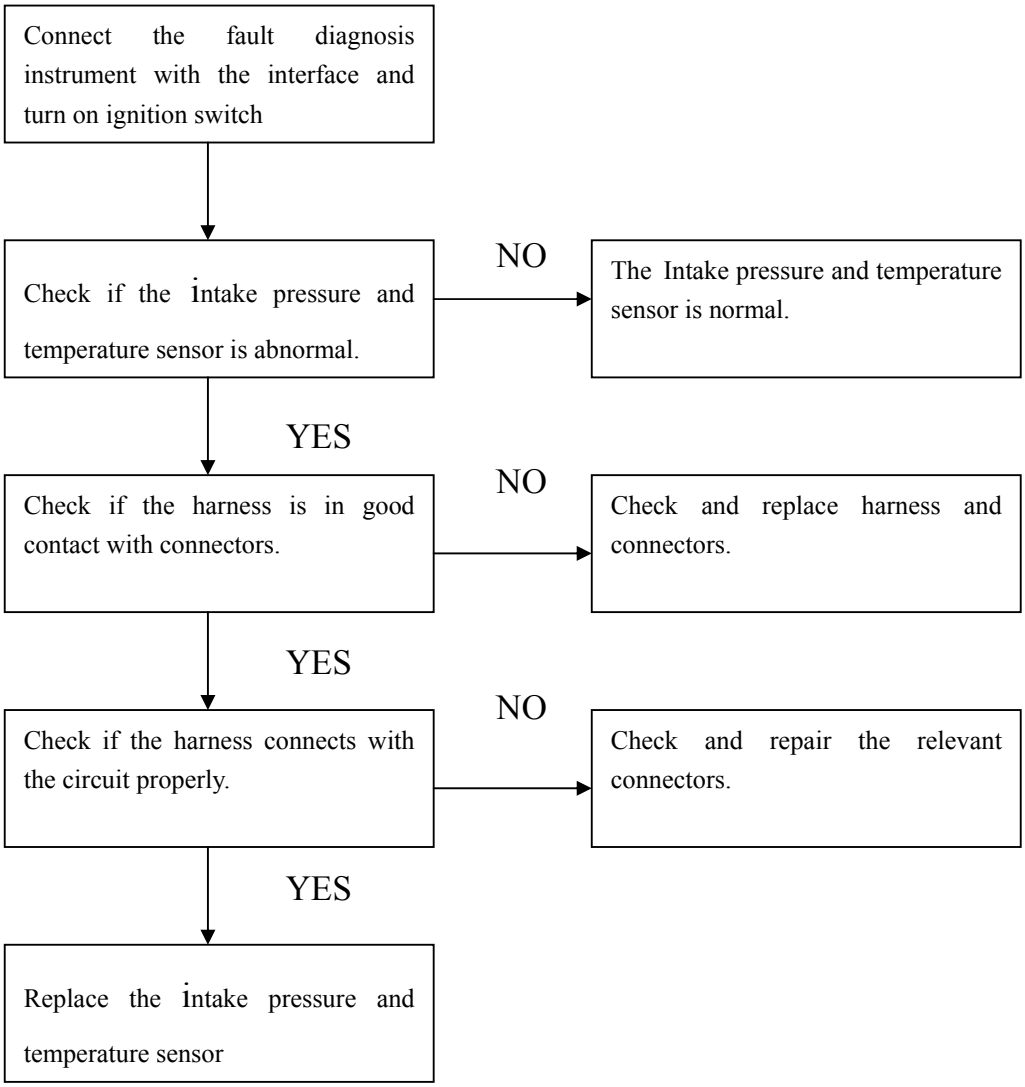
NO

Replace ECU.

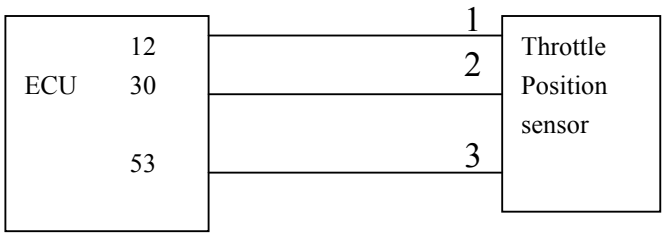
3.6 Intake pressure and temperature sensor circuit Circuit diagram



Fault diagnosis



3.7 Throttle position sensor circuit, Circuit diagram



Fault diagnosis

Connect the fault diagnosis instrument with the interface and turn on ignition switch

↓

Check if there is any fault information on the throttle position sensor.

↓ YES

Check if there are any broken circuit or short circuit for connectors or harness. → YES → Eliminate the circuit fault.

↓ NO

Read out the aperture width of throttle with the fault diagnosis instrument

↓

Check if it is equal to the actual aperture width. → YES → The throttle position sensor circuit is normal.

↓ NO

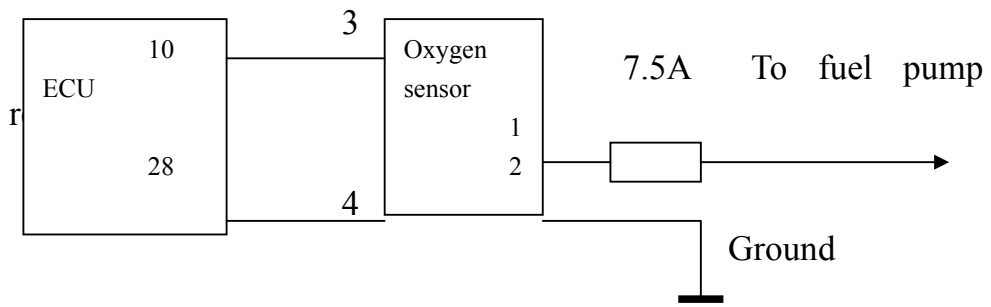
Check if the throttle position sensor is installed with the throttle shaft properly. → NO → Replace throttle position sensor

↓ YES

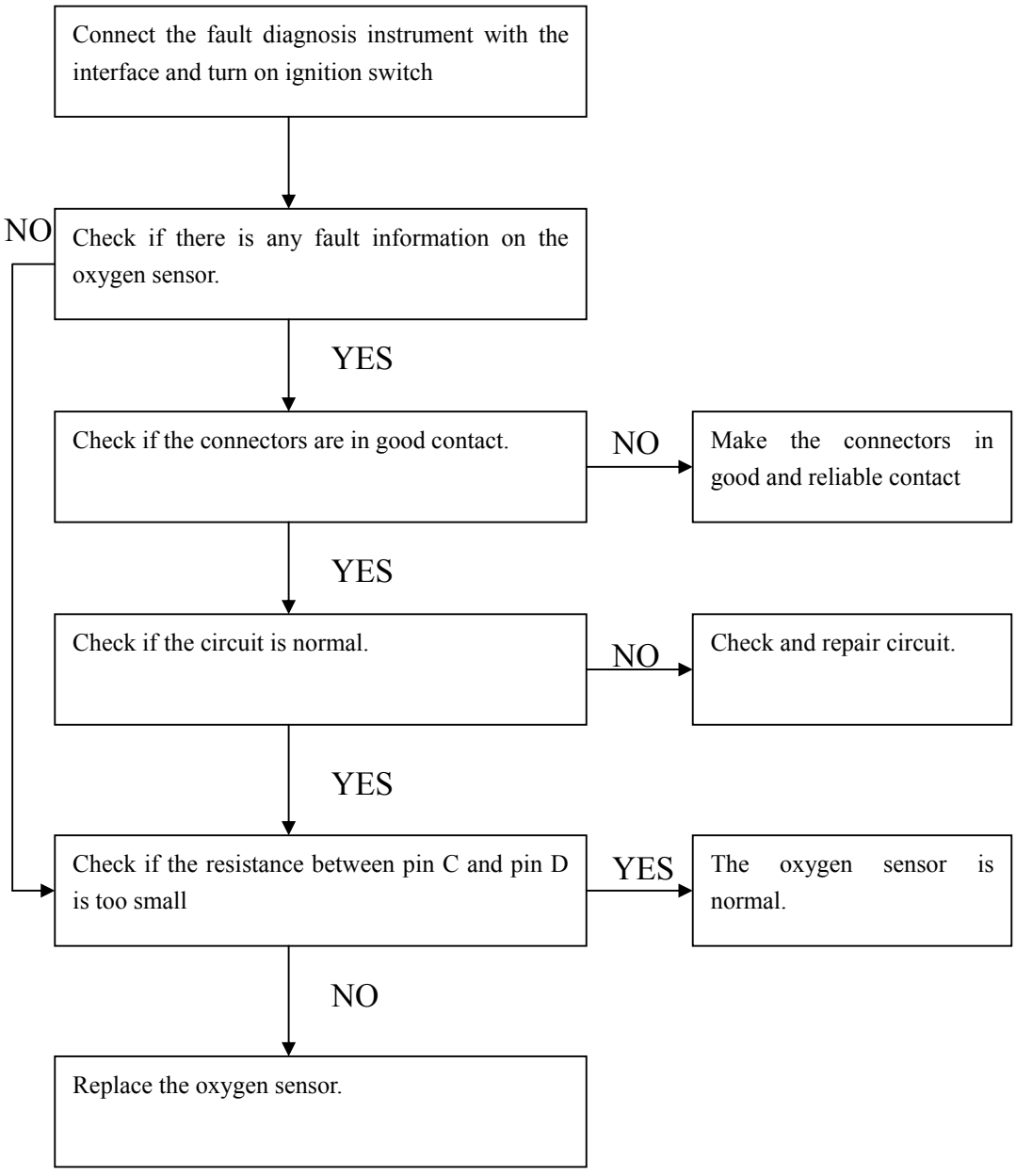
Replace throttle body assy.

3.8 Oxygen sensor circuit

Circuit diagram

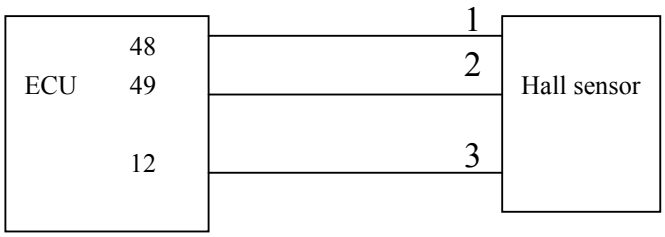


Fault diagnosis

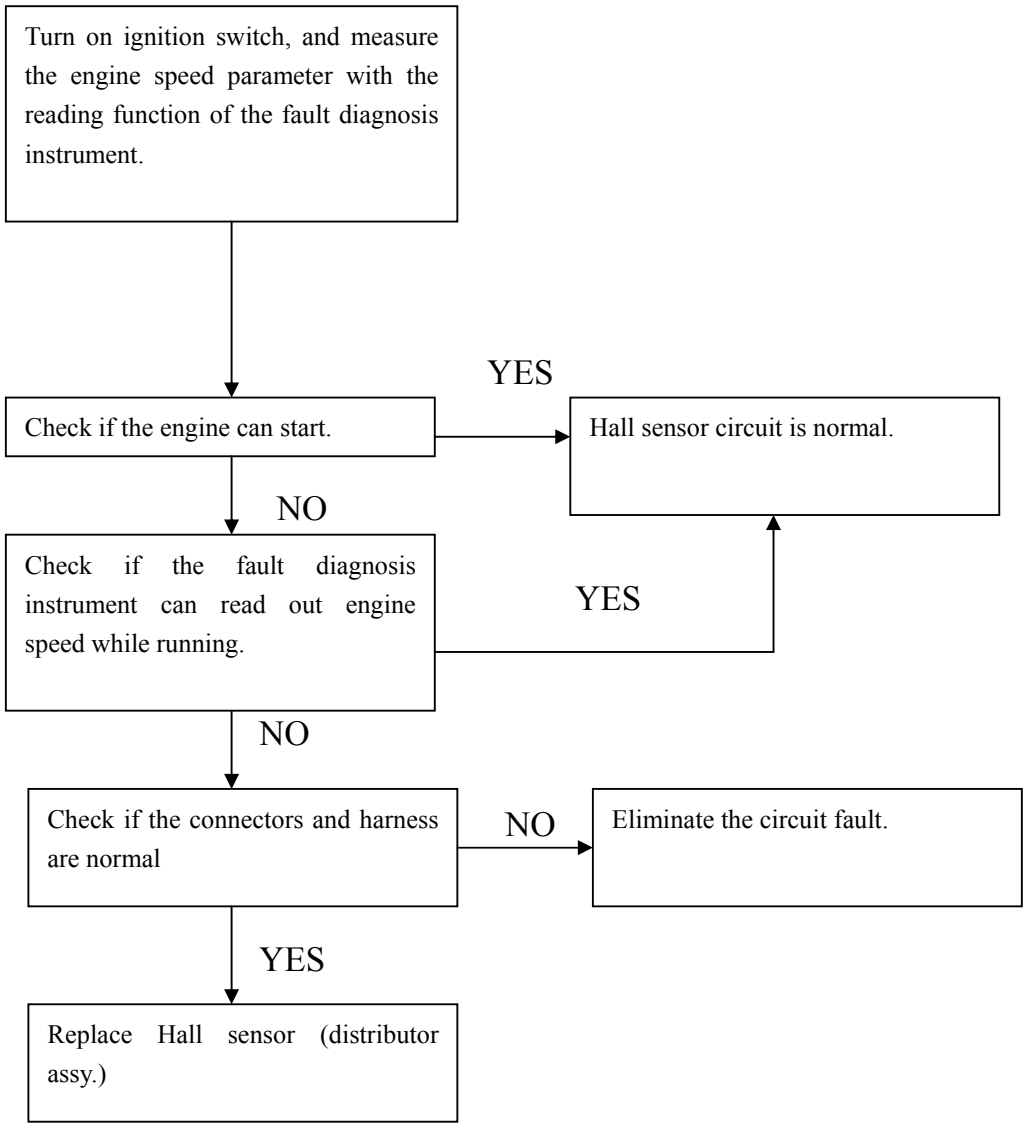


3.9 Hall sensor circuit

Circuit diagram

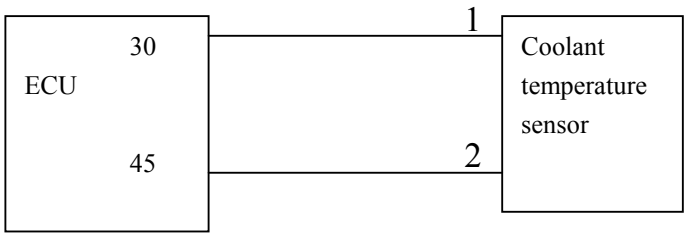


Fault diagnosis

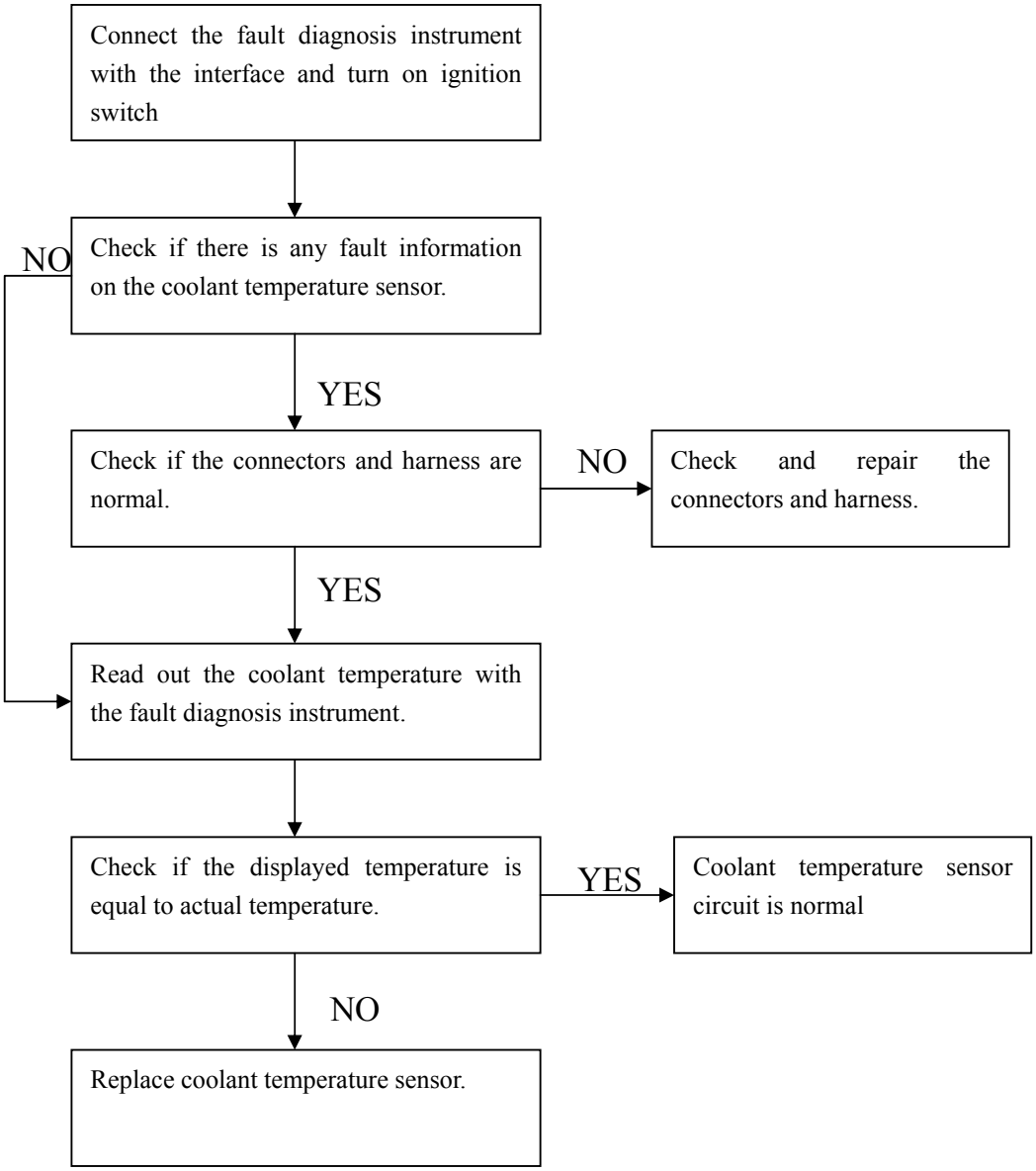


3.10 Coolant temperature sensor circuit

Circuit diagram

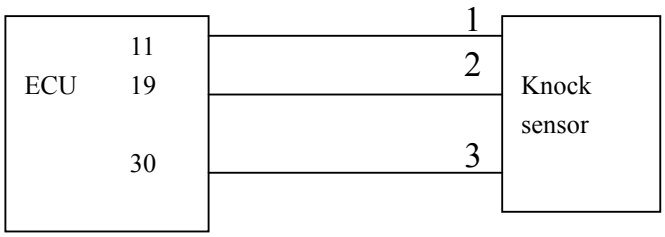


Fault diagnosis

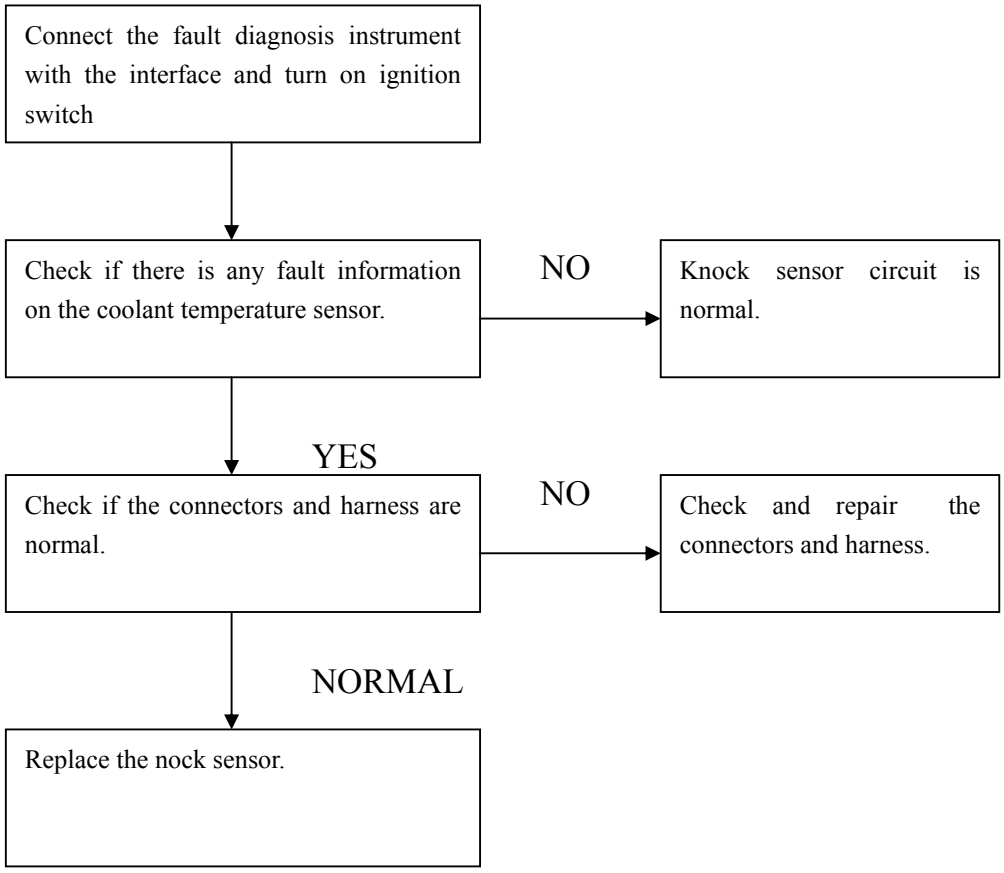


3.11 Knock sensor circuit

Circuit diagram

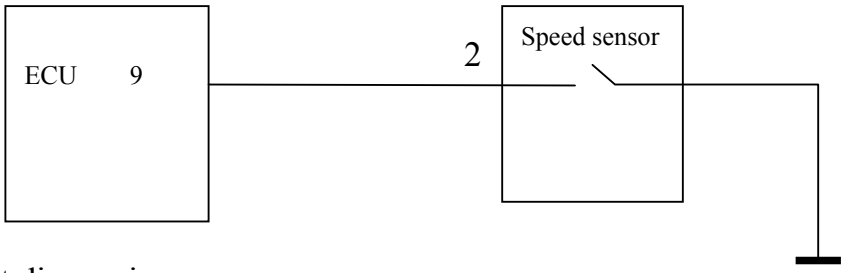


Fault diagnosis

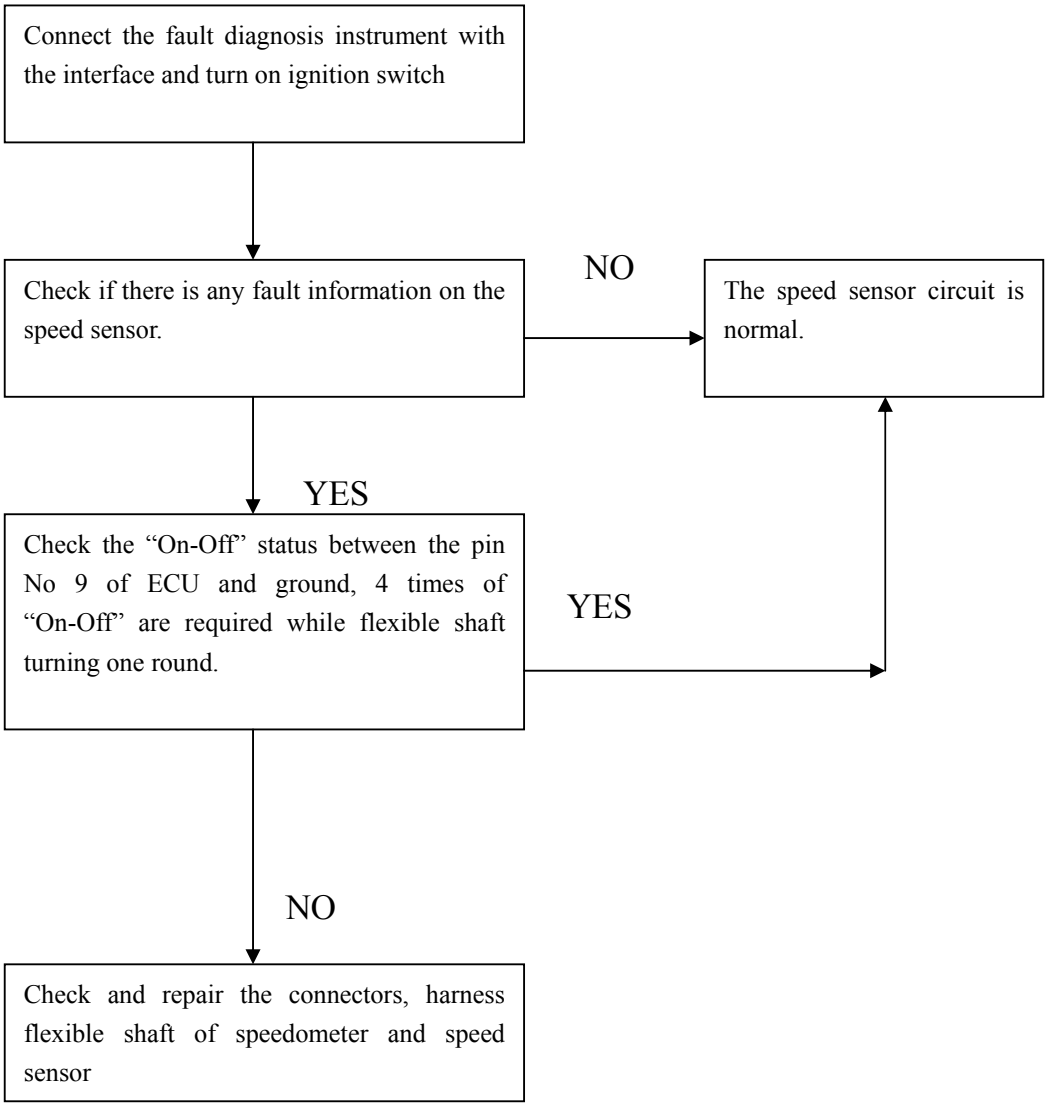


3.12 Speed sensor circuit

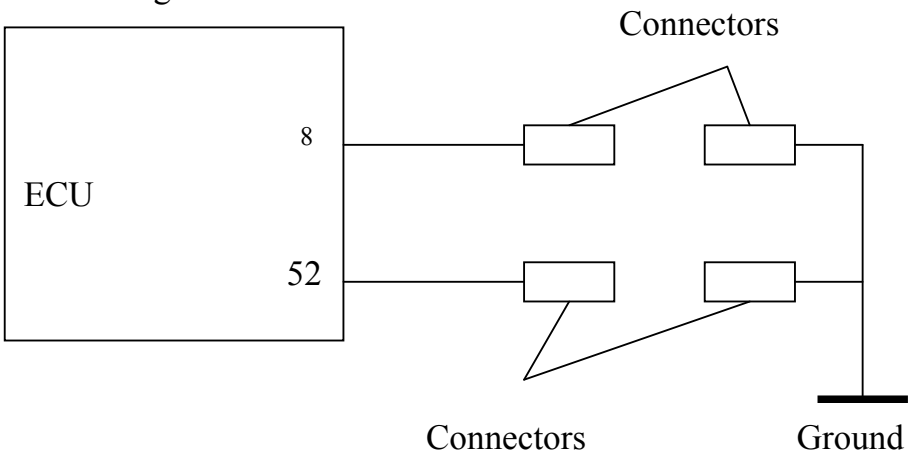
Circuit diagram



Fault diagnosis



3.13 Plateau fuel Enriching(enrich) circuit
Circuit diagram

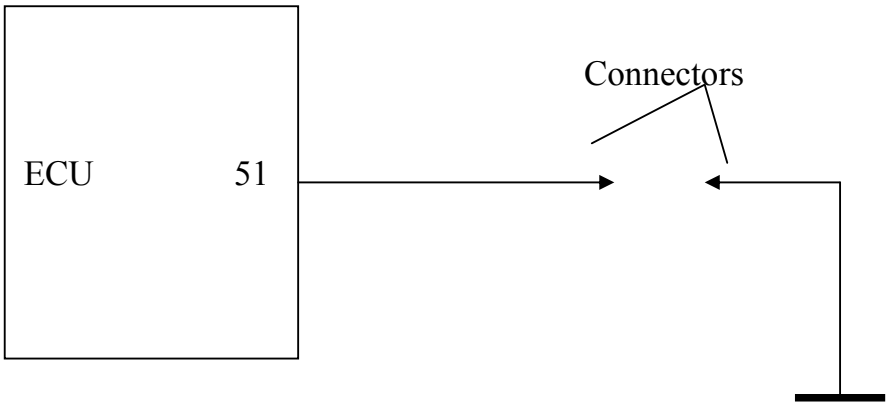


Special precaution: To the vehicles (e.g. SC6350C, SC6331EAC) equipped with the engines JL465Q5 (displacement is 1.012L), the pin No8 of ECU (white with blue tracer) should be connected to the ground permanently.

Fault diagnosis

Disconnect the fuel Enriching(enrich) wire from the ground as a usual, measure the voltage between the Enriching(enrich) wire and the ground, the voltage should be less than 4 V, if not, check the harness for electric leakage. Connect the Enriching(enrich) wire to the ground only if the power is insufficient on the plateau or the engine degraded.

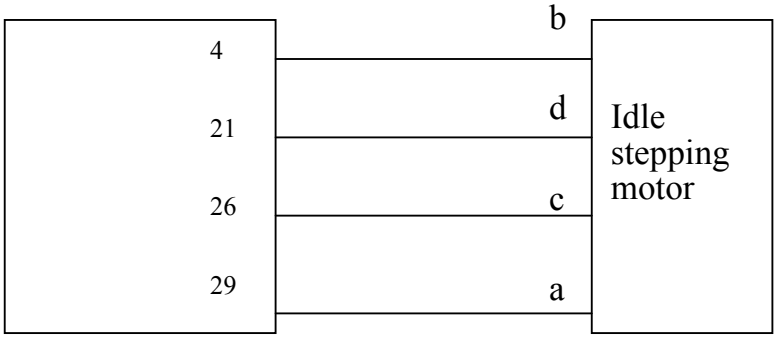
3.14 Ignition advance angle correcting circuit
Circuit diagram:



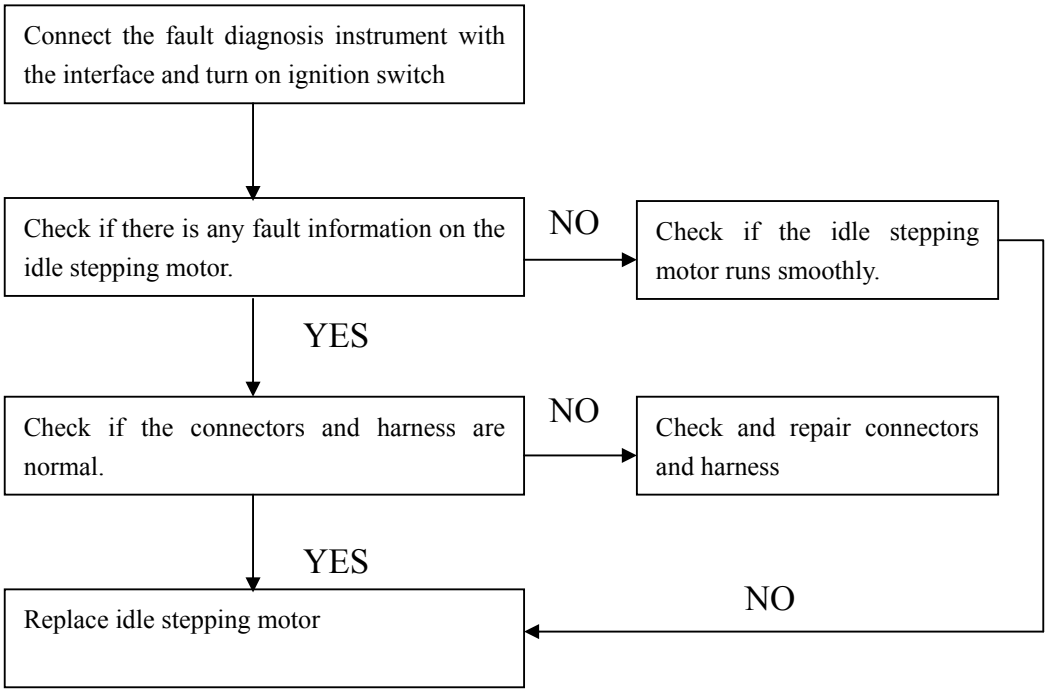
Fault diagnosis:

When the engine runs properly, disconnect the connector, check the ignition advance angle with ignition timing lamp at various running speeds, in this case, the angle should have a greater change, otherwise, check if the lead of pin No51 connects to the ground or has some leakage to the ground.

3.15 Idle stepping motor circuit

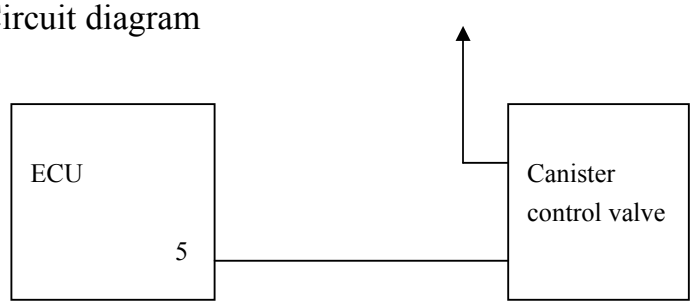


Fault diagnosis

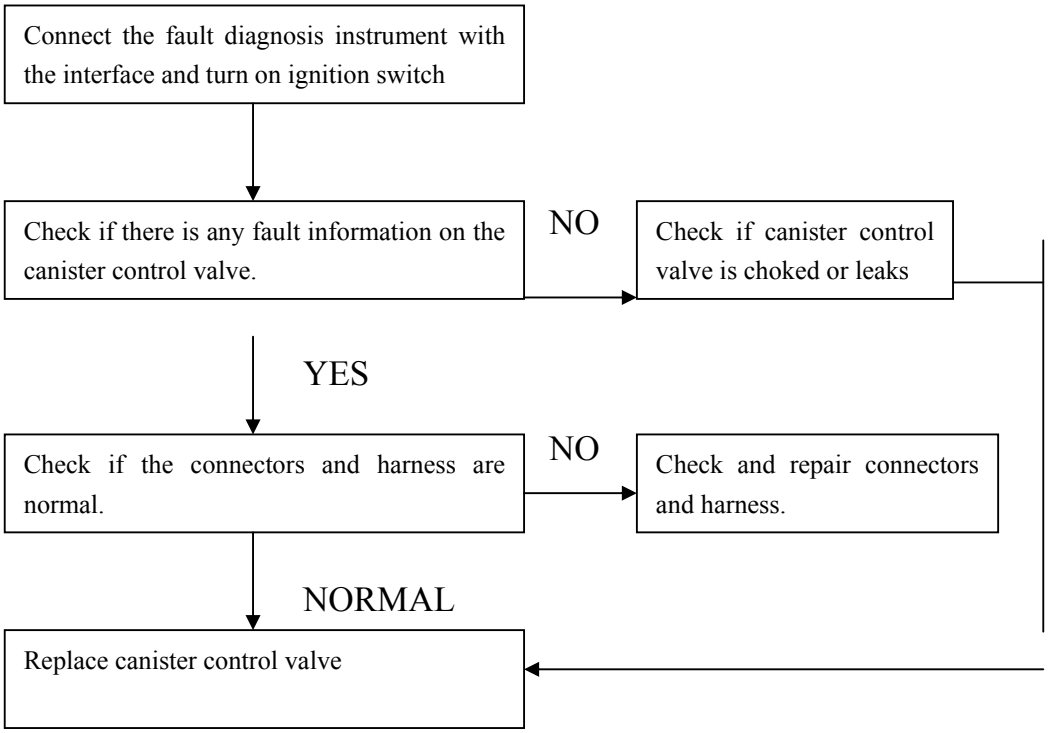


3.16 Canister(Canister Purge) control valve circuit

Circuit diagram

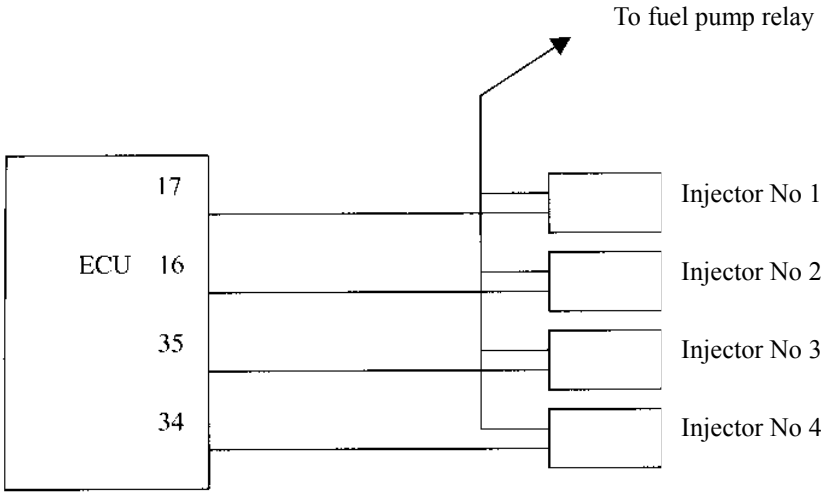


Fault diagnosis

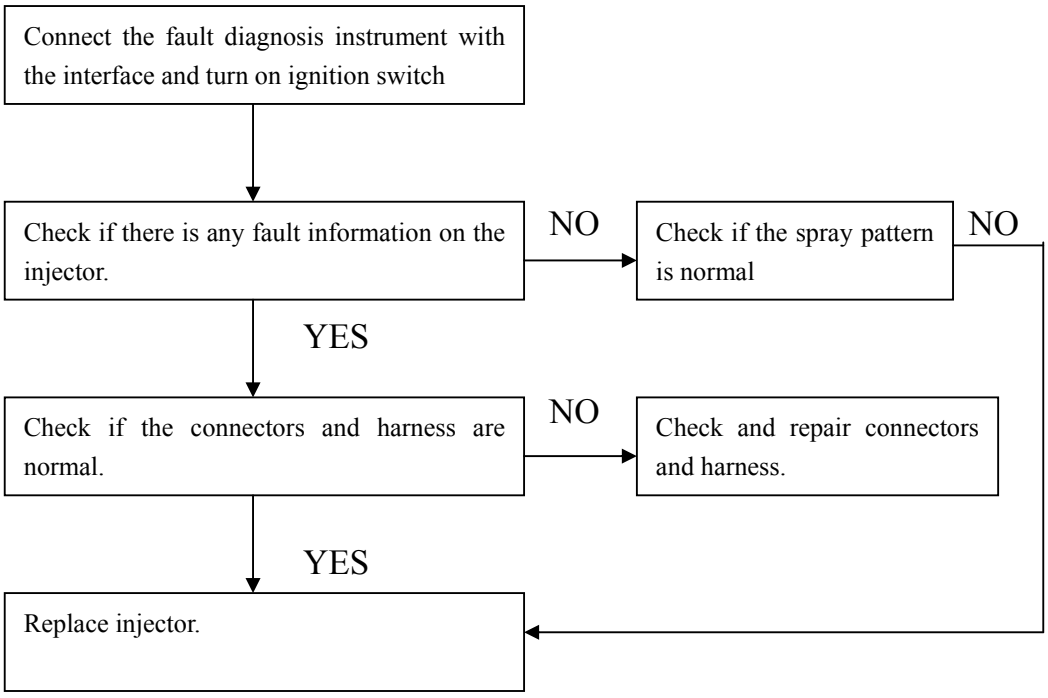


3.17 Injector circuit

Circuit diagram

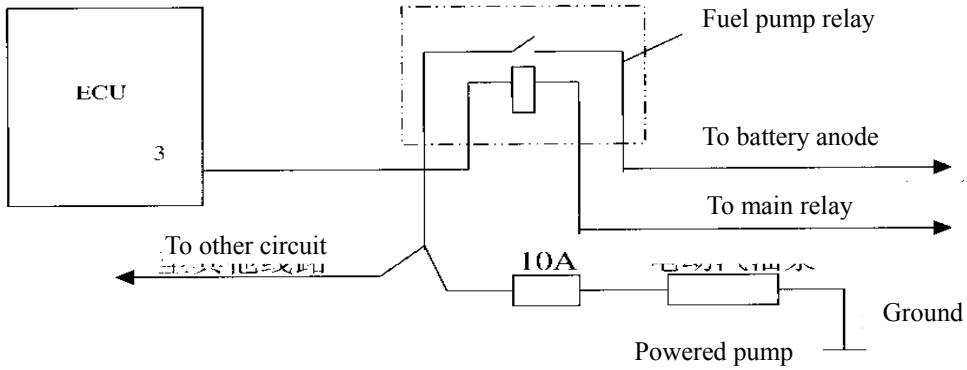


Fault diagnosis

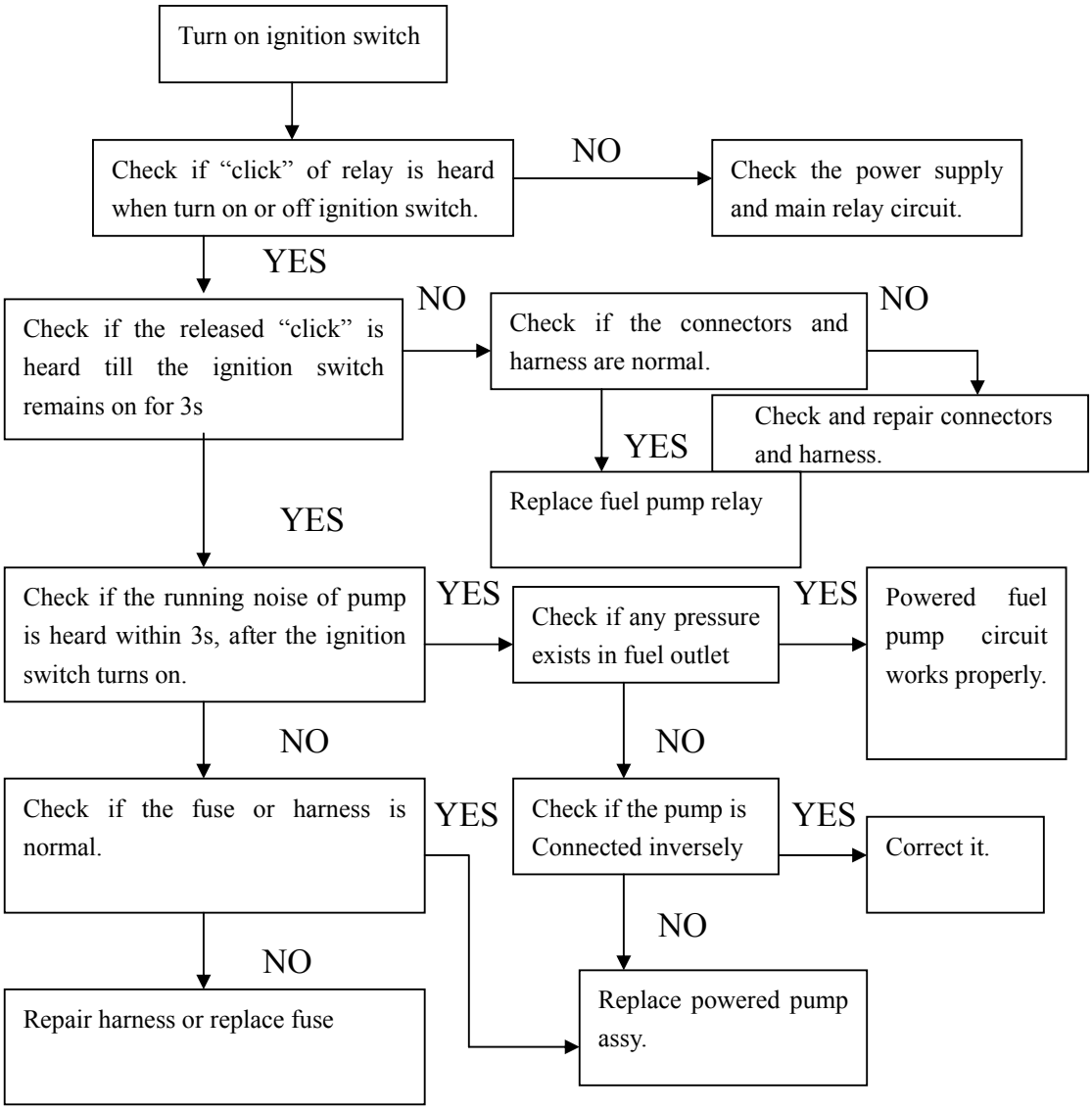


3.18 Powered fuel pump circuit

Circuit diagram

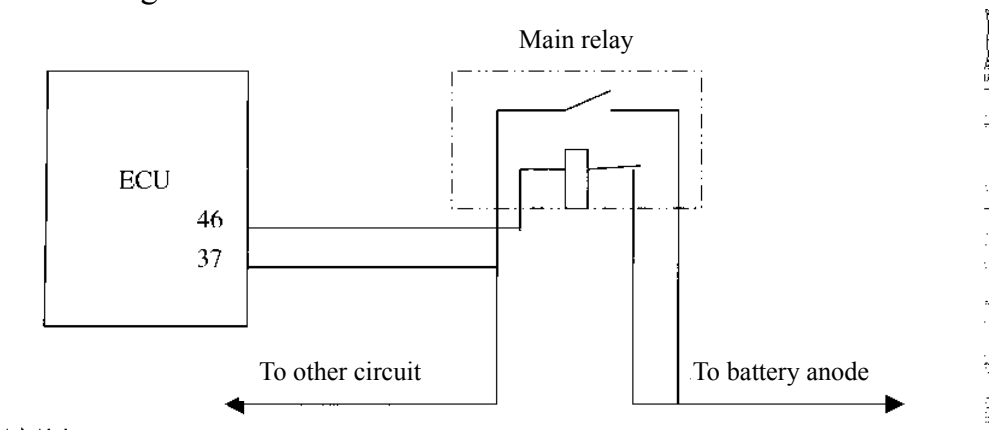


Fault diagnosis

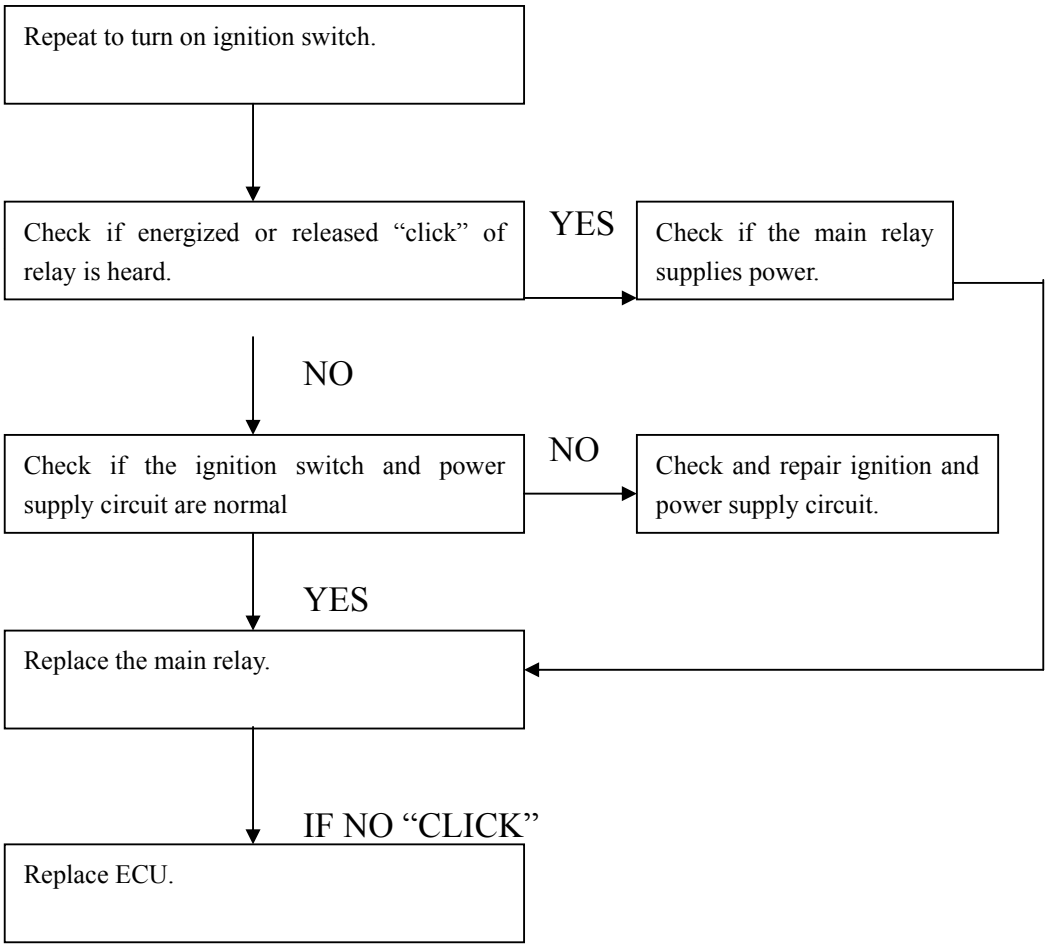


3.19 Main relay circuit

Circuit diagram

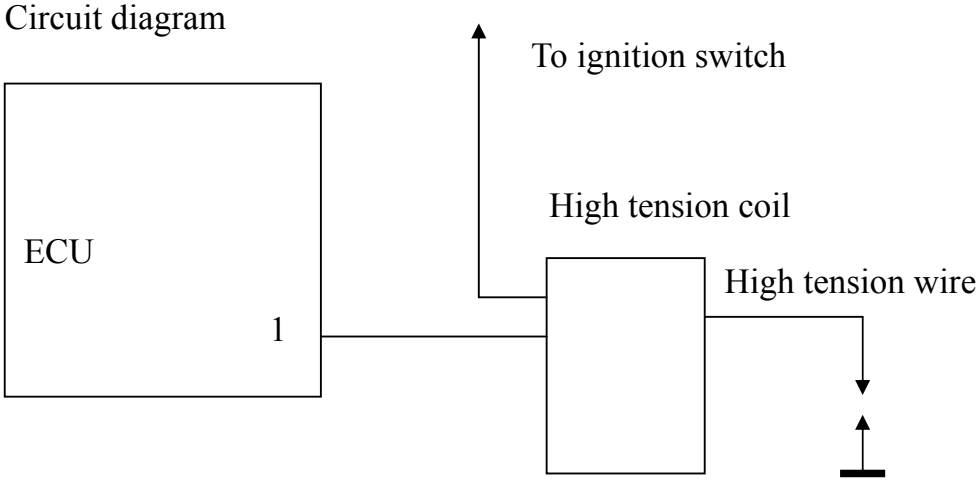


Fault diagnosis

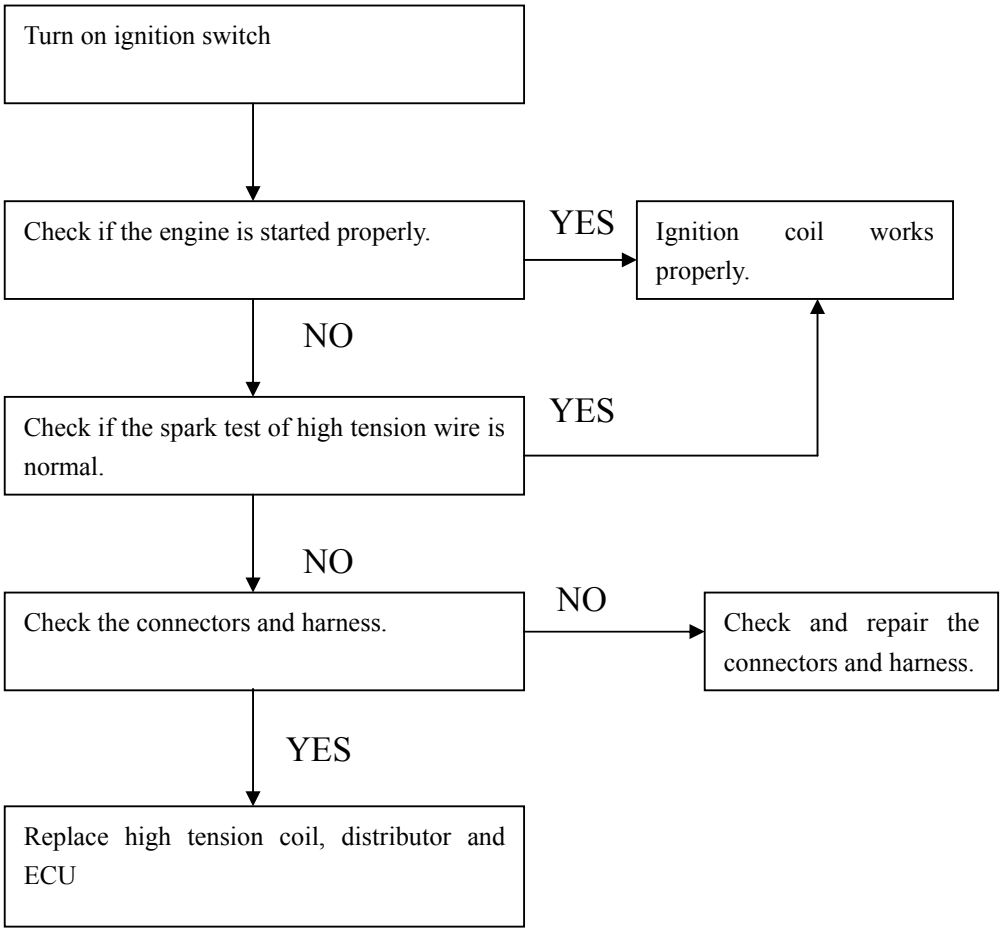


3.20 Ignition coil circuit

Circuit diagram

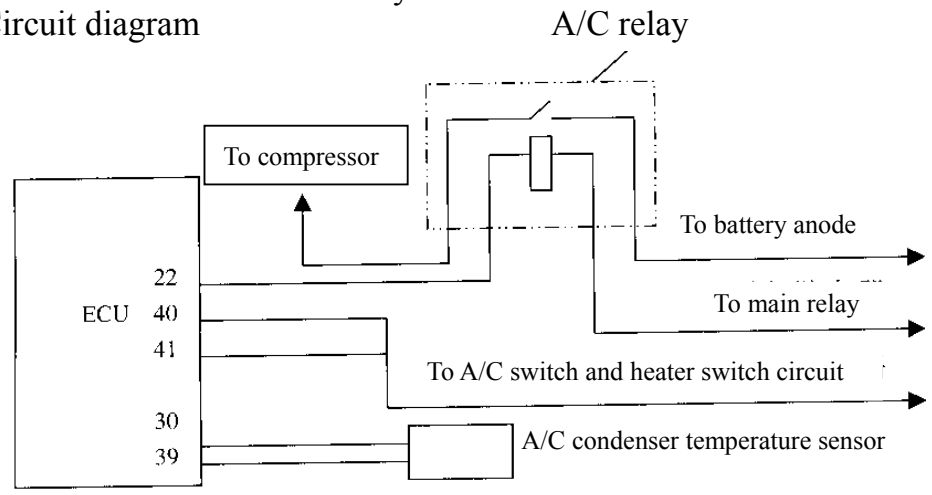


Fault diagnosis



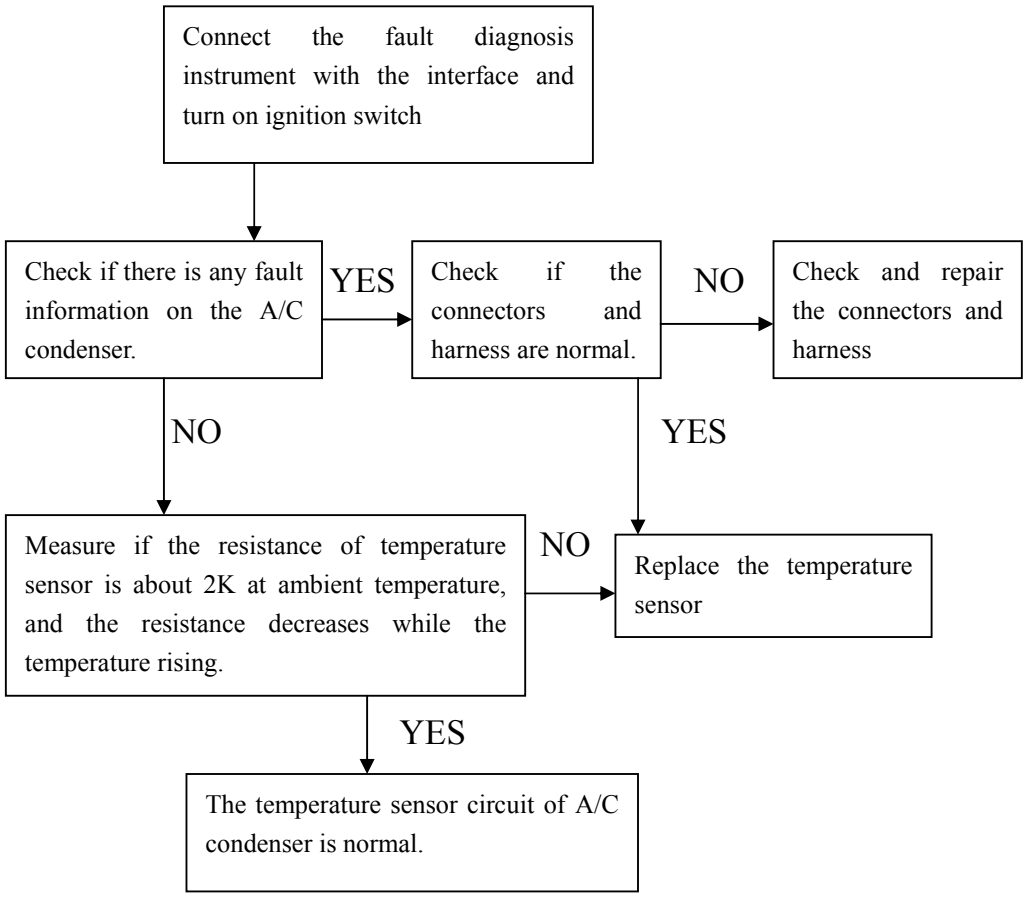
3.21 Air conditioner control system circuit

Circuit diagram



Fault diagnosis

1. Diagnosis on A/C condenser temperature sensor

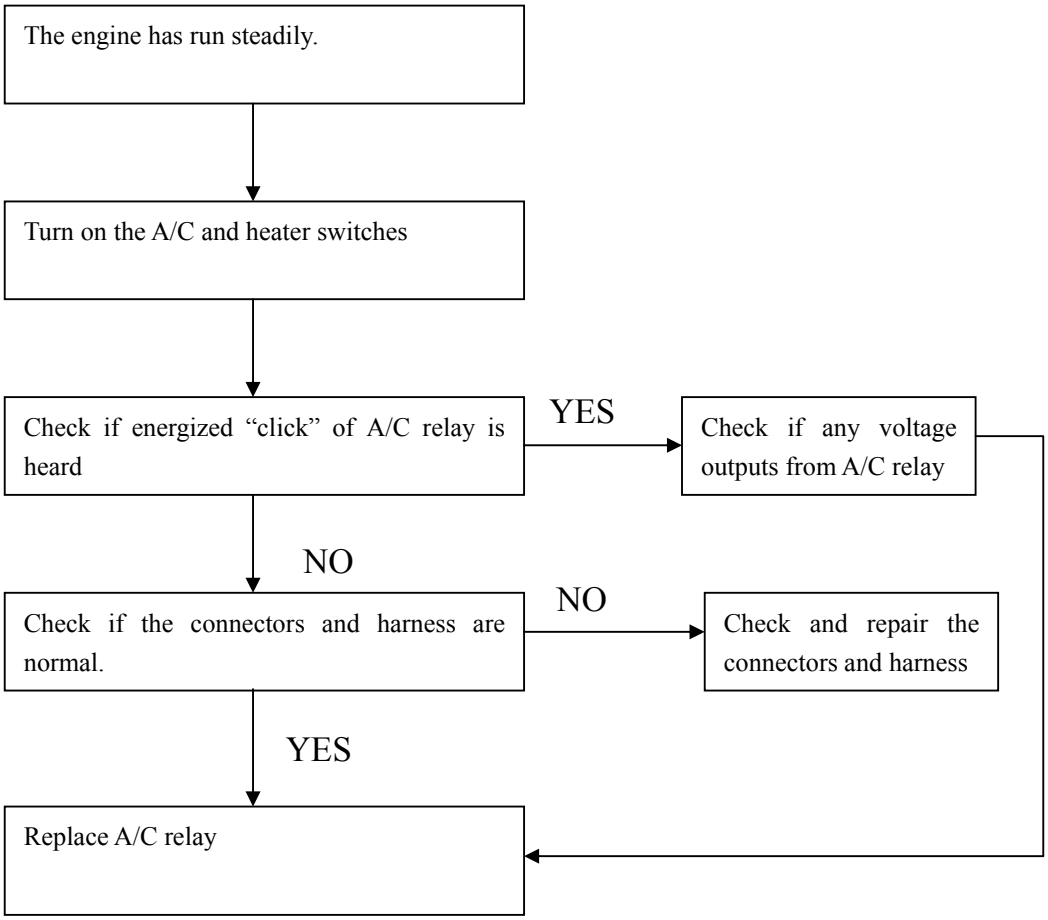


2. Diagnosis on the voltage between the pinNo40 and pin No41 of ECU:

When the A/C switch and heater switch are turned off simultaneously， The engine will increase 100 rounds at the idle speed, the voltage should be less than 0.5V from the pin No41 and Pin No40 to the ground, in other case, such voltage is equal to power supply, otherwise, check the relevant circuits

3. Diagnosis on A/C relay

After finishing steps 1 and 2 above, perform the following diagnosis:



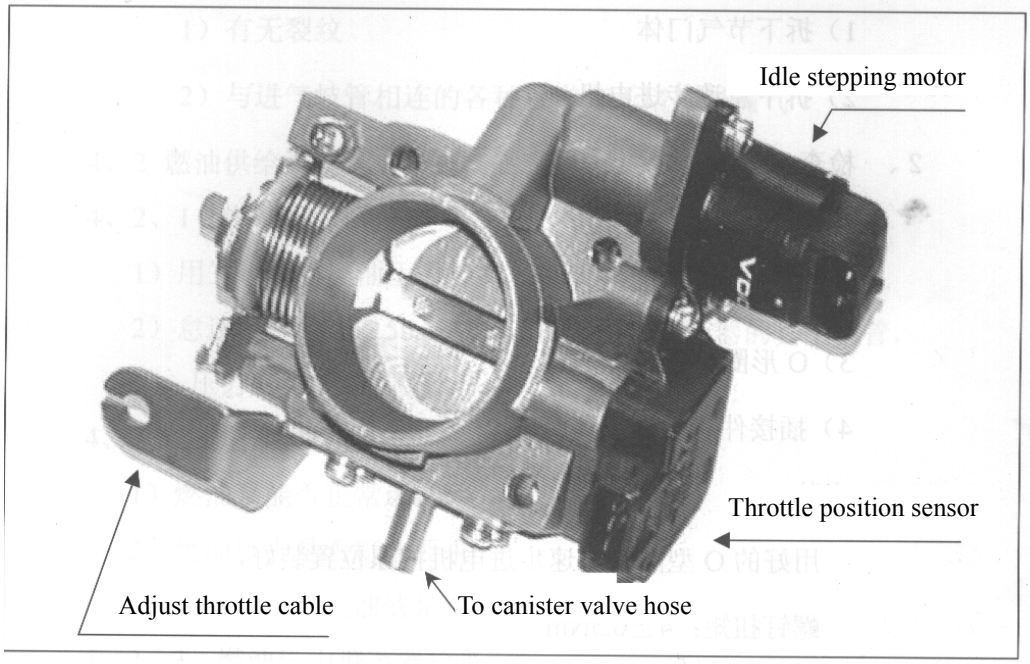
4. Fault elimination
Special precaution:

1) When measuring the cylinder pressure, The Hall sensor plug must be disconnected from the distributor.
2) When determining the operating condition to each cylinder, just unplug the relevant fuel injector, instead of disconnecting the high tension wire of spark plug.
3) If it is necessary to dismantle the pipe joint, the oil stain around the joint must be cleaned out carefully.
4) The fuel delivery system is under pressure, so when loosening the joint, wrap the joint with a dry cloth to suck the fuel exuded from the pipe and remove the pipe carefully.
5) The hose for fuel delivery system is a specific high-pressure hose, never use general-purpose hose instead of the specific one. As well, the similar clamp is required to use.
6) ECU self teaching function: When first start of the engine is done after disconnection of the plug of ECU or the terminal of battery, turn the ignition key to the ignition position and remain in this place over 10s, then, restart the engine. If not, the idle speed of the engine may be unsteady.
7) Since the reliability of the Electronic Control（engine management）System elements is very high, the possibility of fault is very small to the system elements. In general, do not repair or replace the elements before complete elimination of the mechanical faults.
8) When a fault happens to the Electronic Control （engine management） System, the most possible cause may come from the connectors or harness, so lay stress on examination of connectors and harness.
9) When it is necessary to disassemble the intake manifold, the coolant must be drained out completely, or the oxygen sensor and cleaner may be damaged.
10) In general, the wires and connectors are fastened with lock, unlock the connectors before disconnect them, otherwise, the connectors may be damaged. When reinstall the connector, ensure the

connectors are in position by hearing a “click”.

4.1 Intake system service

4.1.1 Throttle body



1) Adjust throttle cable

   Adjust the cable nut so that the throttle can be opened or closed completely. Read out the aperture width with the fault diagnosis instrument, the reading is 0° when the throttle is fully closed, and the reading is more than 80° , when it is fully opened.

2) Dismantle the throttle

   ① Dismantle the cable from the throttle body.

   ② Disconnect the connectors of throttle position sensor and idle stepping motor.

   ③ Dismantle the hoses of the air cleaner and canister

   ④ Dismantle the throttle body from the intake manifold.

3) Check if the throttle rotates smoothly.

4) Assemble the throttle body

   Assemble the throttle body in inverse order of disassembly, pay attention to use of a good gasket for the throttle body.

4.1.2 Idle stepping motor

1) Dismantle

① Dismantle the throttle body.

② Dismantle the idle stepping motor.

2) Check

① if it is clear.

② if it rotates smoothly

③ if the “O” ring is in good condition.

④ if the re is any deformation and corrosion to the connectors.

3) Assemble:

Assemble the idle stepping motor in the original position, and replace the old “O” rings with good ones, tightening torque: 4±0.5Nm.

4.1.4 Throttle position sensor

1) Dismantle

① Dismantle the throttle body.

② Dismantle the throttle position sensor.

2) Check

① if the “O” ring is in good condition.

② if the re is any deformation and corrosion to the connectors.

③ if the throttle shaft is assembled with tight fit.

4) Assemble:

Assemble the throttle position sensor into the original position, tightening torque: 2±0.5Nm.

4.1.3 Intake manifold

Check

① if there is any crack.

② if there is any leakage or chokage to the pipes which connect with the intake manifold.

4.2 Fuel delivery system

4.2.3 Check fuel pressure

① Connect a pressure gauge to the fuel delivery pipe with a 3-way.

② The pressure should be 2.5 bar at idle speed, and the pressure is about 3 bar when the vacuum hose of the pressure regulator is removed.

4.2.4 Check fuel pump

① if the fuel pump operates normally

② if the fuel pressure meets the requirement.

③ if the fuel filter is clear.

4.2.5 Check fuel pressure regulator

① Check the fuel pressure.

② Check the vacuum hose of the pressure regulator.

4.2.6 Fuel injector

1) Dismantle

① Disconnect the connectors

② Dismantle the vacuum hose

③ Unscrew the mounting screws of the fuel distribution pipe.

④ Dismantle the fuel injector with the fuel distribution pipe.

2) Check

① if the spray orifice is clear without chokage.

② if the “O” ring is in good condition.

③ if there is any deformation or corrosion to the connectors.

④ The fuel dripping rate is less than 2 drip/min. when the fuel pressure is 3 bar,

⑤ Start the engine after connection(connecter) of plugs, check if the spray pattern of atomized fuel is uniform to each injector and in good shape.

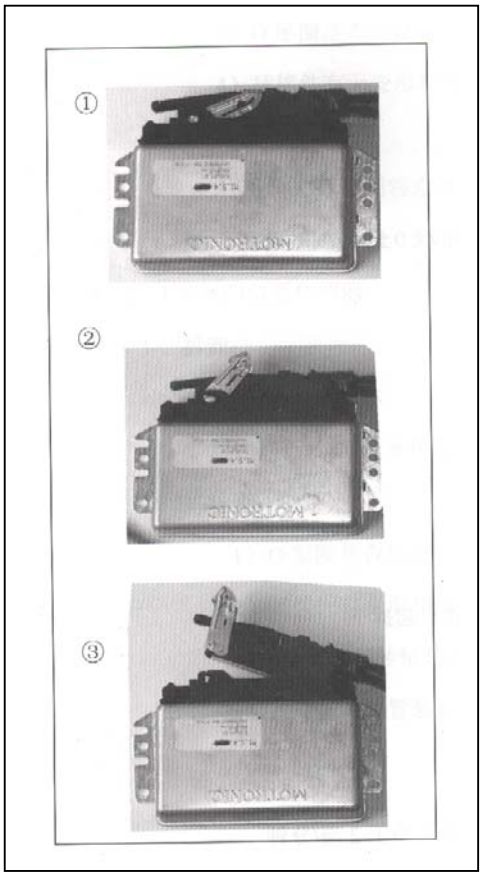
3) Assemble

① Apply little grease on the “O” ring to the spray nozzle.

② Assemble it in inverse order of disassembly.

4.3 Electronic Control（engine management） System

4.3.1 Dismantle and assemble the connectors of ECU



1) Dismantle:

① Unlock the connectors

② Rotate the plug

③ Pull out the plug

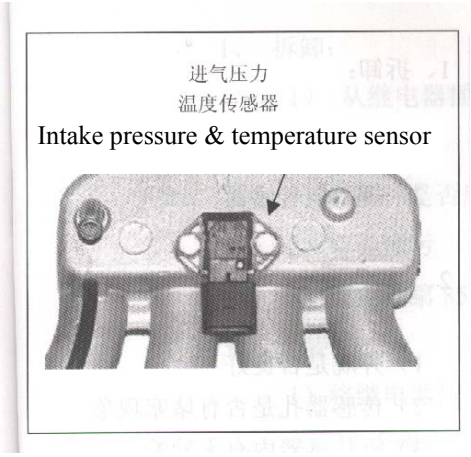
2) Check:

① if there is any deformation or corrosion to the connectors.

3) Assemble:

Assemble it in inverse order of disassembly, and lock the plug in position

4.3.2 Intake pressure and temperature sensor

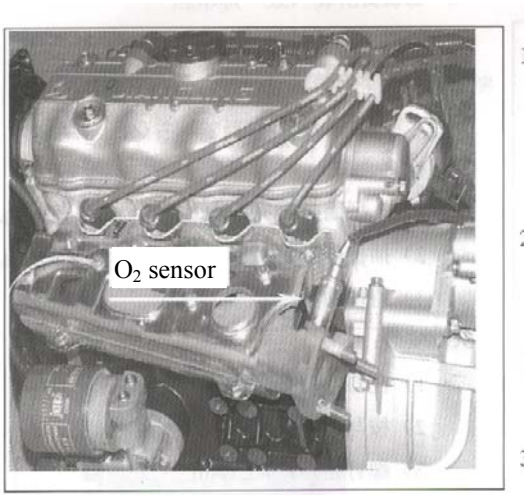


1) Dismantle:
   ① Disconnect the connectors.
   ② Dismantle the mounting
   ③ Remove the sensor.
2) Check:
   ① if the "O" ring is in good condition.
   ② if there is any deformation or corrosion to the connectors.
   ③ if the sensor is clear.
3) Assemble:
   ① Apply little grease on the "O" ring.
   ② Assemble it in inverse order of disassembly.
   ③ Tightening torque: 7±1Nm

4.3.3 Engine coolant temperature sensor:

1) Dismantle:
   ① Drain the coolant from the engine.
   ② Disconnect the connectors
   ③ Dismantle the coolant temperature sensor.
2) Check:
   ① if the appearance is in good condition.
   ② if there is any corrosion to the connectors
3) Assemble:
   ① Assemble it in inverse order of disassembly.
   ② Tightening torque: 20Nm.

4.3.4 Oxygen sensor



1) Dismantle:
① Disconnect the connectors
② Dismantle the oxygen sensor

2) Check:
① if the appearance is in good condition.
② if there is any chokage in the sensing hole
③ if there is any abnormal noise in the sensor.

3) Assemble:
① Apply little high-temperature grease on the thread part, but it is not allowed to penetrate the grease into the sensing hole.
② Assemble it in inverse order of disassembly.
③ Tightening torque: 50Nm

4.3.5 Knock sensor

1) Dismantle:
① Dismantle the knock sensor from the cylinder block.

2) Check:
① if the appearance is in good condition.
② If there is any dirt or corrosion to the connectors.

3) Assemble:
① Assemble the knock sensor direct on the cylinder block without any washer.
② Tightening torque: 20Nm
③ It must tightened to the specified torque.

4.3.6 Main relay, fuel pump relay and A/C relay

1) Dismantle:

① Dismantle the relays from the holders.

2) Check:

① if there is any corrosion to the connectors.

② if there is any oil stain.

③ if the pins No85,86 of the relay are in open circuit.

3) Assemble:

① Assemble the relays in the original direction.

② It is allowed to alternate the three relays.

4.4 Emission control system

4.4.1 Canister(Canister Purge) control valve

1) Dismantle:

① Disconnect the connectors

② Dismantle the inlet and outlet hoses

③ Dismantle the Canister(Canister Purge) control valve

2) Check:

① if the appearance is in good condition.

② if there is any air leakage and chokage.

3) Assemble:

① Assemble the Canister(Canister Purge) control valve in inverse order of disassembly.

② Connect the inlet and outlet hoses to the manifold.

4.5 Ignition system

4.5.3 Distributor assy.

Check if there is any looseness or play to the distributor disc, or any high tension leakage from the distributor, and check if the distributor cap is tightened in position, and the distributor track is in good condition.

4.5.4 Spark test

1) Disconnect the connectors of the injector.
2) Connect the spark plug to the high tension damping wire or ignition coil, connect the spark plug shell to the ground.
3) Start the engine to check the spark generated by the spark plug.

4.5.5 Ignition timing adjustment

1) Start the engine, and keep the engine running at idle speed.
2) Connect the pin No 51 of ECU to the ground with an ignition timing adjustment wire.
3) Observe the ignition timing signal from the cylinder No1 in aid of ignition timing lamp, adjust the distributor to obtain that the ignition advance angle is $7 \pm 1^{\circ}$.
4) Disconnect the ignition timing wire from the pin No51 of ECU, hang it up.

Notice:

It will make a serious problem, if the ignition timing wire is not disconnected from the pin No 51 of ECU.

4.6 Air conditioner control system

Refer to the fault diagnosis.

4.7 Check procedure of primary fault

Notice: Check coolant, machine oil, fuel and voltage before repair the engine.

1) It is difficult to start up the engine or not able to start it. (The starting motor works normally.)

The causes may be:

（1）There is no fuel in the tank.

（2）The fuel pump or other circuits are abnormal.

（3）The fuel pressure regulator is out of work..

（4）The fuel delivery line or spray nozzle is choked.

（5）The idle stepping motor does not operate properly.

（6）The intake pressure temperature sensor and coolant temperature sensor does not work properly.

（7）Ignition time and ignition order are not right.

（8）There is something wrong with distributor, ignition coil, high tension wire or spark plug.

（9）The main relay and fuel pump relay have got fault.

（10）ECU has broken.

（11）The Intake line is choked.

（12）The other mechanical faults.

Repairing procedure

（1）Make sure sufficient fuel in the tank.

（2）Eliminate all faults determined by the fault diagnosis instrument.

（3）Check and eliminate the ignition circuit fault.

（4）Check and eliminate the fuel pressure fault.

（5）Check and eliminate the spray nozzle fault.

（6）Check the pressure in the cylinder.

（7）Check and eliminate the mechanical fault, such as improper throttle gap.

2) The idle speed of the engine is not steady or in poor performance

The causes may be:

（1）Ignition time and ignition order are not right.

（2）There is something wrong with distributor, ignition coil, high tension wire or spark plug.

（3）The fuel or pressure is insufficient.

（4）The idle stepping motor does not operate properly.

（5）The throttle position sensor or coolant temperature sensor is out of work.

（6）The throttle cable has fault.

（7）There are some air leakage from various pipes mounted with intake manifold.

（8）The Canister(Canister Purge) control valve does not work properly.

（9）A self-adaptive teaching is not performed by the controller.

（10）A/C signal is not normal.

（11）Abnormal voltage.

（12）Mechanical faults such as lower pressure in the cylinder.

Repairing procedure

（1）Make sure sufficient fuel in the tank.

（2）Eliminate all faults determined by the fault diagnosis instrument.

（3）Check and adjust the throttle cable.

（4）Check and eliminate the leakage fault to various vacuum hoses.

（5）Check and eliminate the ignition system fault.

（6）Check the chokage in the pipe for idle speed.

（7）Check and eliminate the fuel delivery system fault.

（8）Check and eliminate the A/C signal circuit fault.

（9）Replace the distributor.

（10）Check and eliminate the mechanical fault, such as improper cylinder pressure or valve lash.

3. Insufficient power from the engine.

The causes may be:

（1）The throttle cable is not adjusted properly.

（2）The fuel pressure is insufficient..

（3）The spray nozzle has fault.

（4）The intake pressure temperature sensor and coolant temperature sensor does not work properly.

（5）The idle stepping motor does not operate properly.

（6）The ignition timing wire connects to the ground.

（7）There is something wrong with distributor, ignition coil, high tension wire or spark plug.

（8）Ignition timing adjustment is improper.

（9）Intake and exhaust are not smooth.

（10）Mechanical faults such as incorrect pressure in the cylinder, clutch fault etc.

Repairing procedure

（1）Adjust the throttle cable.

（2）Check the ignition timing correcting circuit.

（3）Eliminate all faults determined by the fault diagnosis instrument.

（4）Check and eliminate the fuel delivery system fault.

（5）Check and eliminate the ignition system fault.

（6）Check the intake and exhaust system.

（7）Check and eliminate incorrect pressure in the cylinder, clutch fault.

4. The engine operates in dull response.

The causes may be:

（1）The throttle position sensor or intake pressure and temperature sensor is out of work.

（2）There are something wrong with distributor, ignition coil, high tension wire and spark plug.

（3）The fuel delivery system has fault.

（4）The idle stepping motor does not operate properly.

（5）Ignition timing adjustment is improper.

（6）Mechanical faults such as insufficient pressure in the cylinder.

Repairing procedure

（1）Eliminate all faults determined by the fault diagnosis instrument.

（2）Check the ignition advance angle at idle speed.

（3）Check and eliminate the ignition system fault

（4）Check and eliminate the fuel delivery fault.

（5）Check and eliminate the other mechanical faults.

5. The engine operates unsteadily.

The causes may be:

（1）There is something wrong with distributor, ignition coil, high tension wire or spark plug.

（2）The throttle position sensor or coolant temperature sensor is out of work.

（3）The fuel pressure is not steady.

（4）The spray nozzle has fault.

（5）The idle stepping motor does not operate properly.

（6）The voltage is too low (e.g. the generator is damaged).

（7）There is a fault on ECU.

（8）Mechanical faults such as insufficient pressure in the cylinder

Repairing procedure

（1）Eliminate all faults determined by the fault diagnosis instrument.

（2）Check and eliminate the ignition system fault

（3）Check and eliminate the fuel delivery fault.

（4）Check and eliminate the other mechanical faults.

6. Fuel consumption is too high.

The causes may be:

（1）There is something wrong with distributor, ignition coil, high tension wire or spark plug.

（2）Ignition timing adjustment is improper.

（3）The fuel pressure regulator, spray nozzle do not work properly.

（4）The throttle position sensor or coolant temperature sensor does not work properly.

（5）There is a fault on ECU.

（6）Intake and exhaust are not smooth.

（7）The fuel Enriching(enrich) wire connects to the ground.

（8）Intake pressure and temperature sensor is choked.

（9）There is air leakage in front of or near the oxygen sensor

（10）Other mechanical faults.

Repairing procedure

（1）Eliminate all faults determined by the fault diagnosis instrument.

（2）Check and eliminate the ignition system fault.

（3）Check and eliminate the fuel delivery system fault.

（4）Check and eliminate the intake and exhaust system faults.

（5）Check and eliminate mechanical faults, such as insufficient pressure in the cylinder.

7) The emission exceeds limits.

The causes may be:

（1） There is something wrong with distributor, ignition coil, high tension wire and spark plug.

（2） The fuel delivery system has fault on fuel pressure regulator or spray nozzle

（3）The catalytic converter is not fully preheated.

（4）The catalytic converter has degraded.

（5）The engine does not run at a normal temperature.

（6）The oxygen sensor has fault.

（7）There are some air leakage from exhaust system.

（8）The throttle position sensor or coolant temperature sensor does not work properly.

（9）Ignition time is not right.

（10）Intake and exhaust are not smooth.

（11）There is a fault on ECU.

（12）Other mechanical faults.

Repairing procedure

（1）Eliminate all faults determined by the fault diagnosis instrument.

（2）Check and eliminate the ignition system fault.

（3） Make the engine and catalytic converter to reach the normal temperature.

（4） Check and eliminate chokage and leakage faults in intake or exhaust system

（5）Replace the catalytic converter or oxygen sensor.

（6）Check and eliminate the fuel delivery system fault.

（7）Check and eliminate the mechanical fault, such as insufficient cylinder pressure.

8. Self adaptive value λ exceeds lower and upper limits.

The causes may be:

（1）Intake and exhaust system are not smooth or they are leak.

（2）The fuel pressure regulator, spray nozzle do not work properly.

（3）There is something wrong with distributor, ignition coil, high tension wire and spark plug.

（4）The oxygen sensor has fault.

（5）There are mechanical faults, such as improper cylinder pressure or valve lash.

（6）The intake pressure sensor works improperly.

（7）There is a fault on ECU.

Repairing procedure

（1）Eliminate all faults determined by the fault diagnosis instrument.

（2）Check and eliminate the ignition system fault.

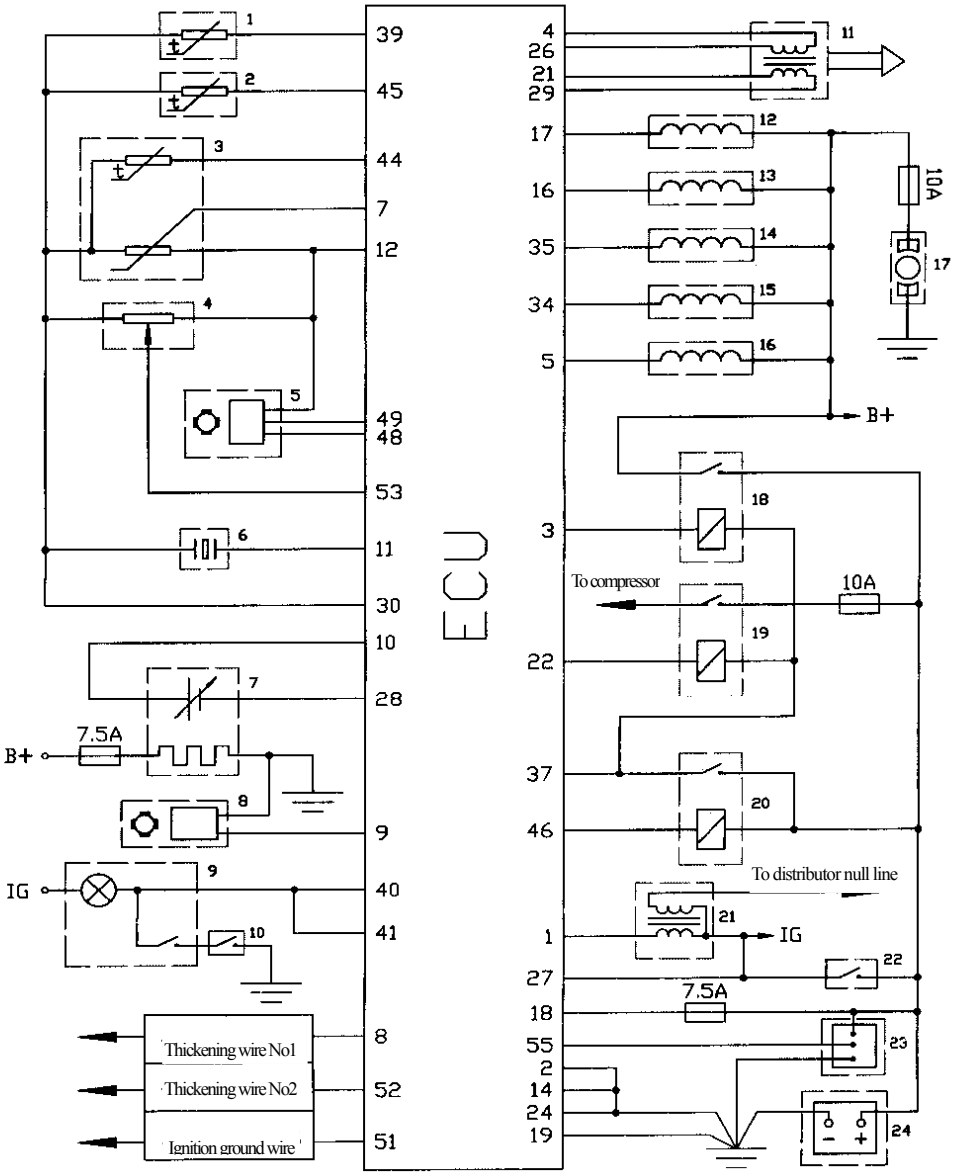
（3）Check and eliminate the fuel delivery system fault.

（4）Check and eliminate the intake and exhaust system.

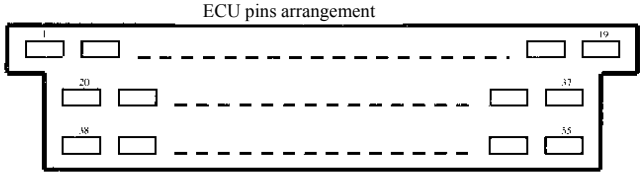
（5）Check and eliminate the mechanical fault, such as insufficient cylinder pressure.

（6）Replace the intake pressure sensor.

（7）Replace ECU.



ECU pins arrangement



1. A/C evaporator temperature sensor 9 (原稿没有，应增加)
2. Coolant temperature sensor
3.Intake pressure and temperature sensor
4.Throttle position sensor
5.Hall sensor
6.Knock sensor
7. Oxygen sensor
8. Speed sensor
9.Air conditioner switch
10.Heater switch
11.Idle stepping motor
12. Spray nozzle in cylinder No 1
13. Spray nozzle in cylinder No 2
14. Spray nozzle in cylinder No 3
15.Spray nozzle in cylinder No 4 (4-cylinder engine); Canister(Canister Purge) control valve (3-cylinder engine)
16. Canister(Canister Purge) control valve (4-cylinder engine)
17.Powered fuel pump
18.Fuel pump relay
19.A/C relay
20.Main relay
21.High tension coil
22.Ignition switch
23. Faults diagnosis interface
24.Battery