Content

Part 1 Motorola Multi-port electric fuel injection motor system

Part 2 M&M Multi-port electric injection engine systems

Preface

MOT and M&M multi-port motors are applied in CHERY cars, and the detailed matching and establishment rules are as follows

Electric injection type	Motor model No.	Gear box type	Ex factory No.
MOT	SQR480EB	MT	“SQR480EB*EB××××××”
MOT	SQR480EC	AT	“SQR480EC*EC××××××”
M&M	SQR480ED	MT	“SQR480ED*ED××××××”

Note: due to the difference between MOT and M&M systems, every maintenance point should pay attention to the difference when repair them.

Part 1 Motorola Multi-port electric injection motor system

FOREWARD

Either MOT or M & M multi-port fuel injection system is installed on Chery sedan with following differences:

EI	Engine	Transmission	Factory Number
MOT	SQR 480EB	MT	SQR480EB*EB×××××××
MOT	SQR 480EC	AT	SQR480EC*EC×××××××
M&M	SQR 480ED	MT	SQR480ED*ED×××××××

Note: MOT and M & M are two different systems, and understand which system is installed when servicing.

Part MOT multi-port electric fuel injection engine system

SQR480EC electric fuel injection system

I. System description

Electric fuel injection system is a complete functions system and mainly consists of fuel system, air system and electric control system. It also includes ignition control and exhaust control functions etc.

Fuel system

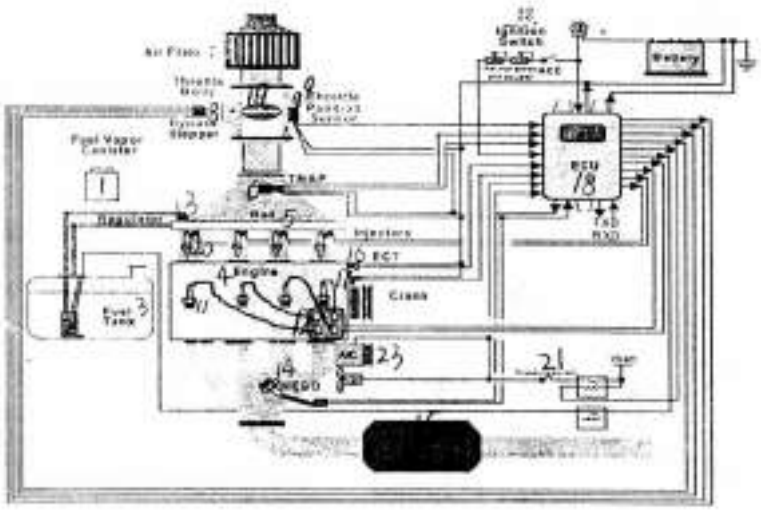
Fuel passes through fuel tank built-in oil pump to fuel filter, and is pressed to oil rail after filtering, then sprayed into cylinder via fuel injector, and then returns to fuel tank through fuel pressure adjuster, which can maintain constant fuel pressure. Fuel injector locates at the air intake port of each cylinder and spray fuel into cylinder.

Air system

Air system includes air intake system air cleaner, air pressure sensor, temperature sensor, throttle valve body, air intake hose and manifold, and idle adjuster valve and idle adjuster screw for idle adjusting.

Electric Control System

Consists of sensor, ECU and actuator, including ECU, air intake temperature and pressure sensor, water temperature sensor, throttle valve position sensor, oxygen sensor, electric oil pump, fuel injector, ignition coi land throttle valve body etc.



1 Fuel Vapor Tank (carbon canister)
Oil pump
Fuel tank
Engine
Fuel rail
Air Intake Temperature And Pressure Sensor
Air cleaner
Idle step motor
Throttle position sensor
Throttle valve body
Spark Plug 12 Ignition coil
13 Oil pressure adjuster
14 Oxygen sensor
15 3-way catalyst converter
Engine coolant temperature sensor (water temperature sensor)
17 Crankshaft position RPM sensor
18 ECU
19 Battery
20 Electric fuel injector
21 Pressure switch
22 Ignition switch
23 A/C compressor

II. Operation

SQR480EC electric fuel injection system controls ignition, fuel injection, idle ect. upon engine speed signal, air intake pressure, throttle position signal, air temperature signal, oxygen sensor signal and coolant temperature signal. The system utilize an advanced control strategy, and selected components and a complete set of strict production process, and is an electric fuel injection system featuring intelligence and stability, meets the strict technological demands of car manufacturer with the exhaust meeting the Euro II standard. The fuel system offers a 2.5 Bar fuel supply pressure.

2.1 electric control system

2.1.1 ECU

Parameter	Unit	Minimum	Maximum
Operating voltage	Volt	6.5	16
Operating current	Ampere	0.01	0.1
Operating temperature	Centigrade	-40	85
Humidity	%RH	20	85
Vibrating frequency	HZ	…	1000

ECU operation ambient temperature range is -40℃---+85℃, therefore, before baking varnish for the automobile body, it should be removed first, and the temperature should be under strict control to avoid ECU being damaged.

2. ECU damage has a low damage probability (damage ratio less than 1/1000 after 100000 KM mileage) and do not suspect the ECU damage. Even ECU damage is suspected, do not attempt to disassemble it (replace the internal core) because a defective ECU can not be repaired.

EI system wiring harness

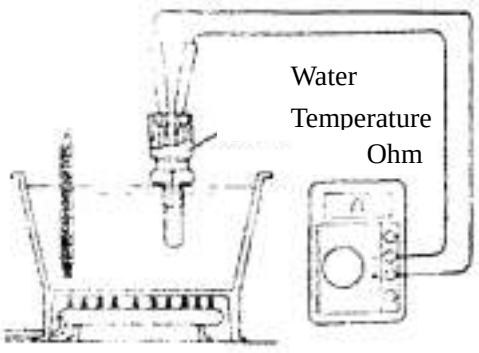
For MPI-ECU wiring harness assembly (multi-port fuel injection---ECU wiring harness), see illustration.

Engine wiring harness

See illustration.

Water Temperature Sensor

Sensor has 2 leads, one is signal lead (pin B10) and the other is ground lead (pin B23)



●Measuring Method

a ohmmeter method

Measure resistance with an ohmmeter, and determine if water temperature sensor operates upon measured engine coolant temperature and below diagram. Remove coolant temperature sensor, immerse into water and heat water. The sensor has different resistance at corresponding temperature.

Water Temperature Sensor Resistance Specification

Temperature(℃)	Resistance(Ω)	Temp.(℃)	Resistance(Ω)	Temp.(℃)	Resistance(
-40	100865	25	2795	90	241.8
-35	72437	30	2240	95	207.1
-30	52594	35	1806	100	178.0
-25	38583	40	1465	105	153.6
-20	28582	45	1195	110	133.1
-15	21317	50	980	115	115.7
-10	16120	55	809	120	100.9
-5	12261	60	671	125	88.3
0	9399	65	559	130	77.5
5	7263	70	469	135	68.3
10	5658	75	395	140	60.3
15	4441	80	334	145	53.4
20	3511	85	283	150	47.5

b voltmeter method

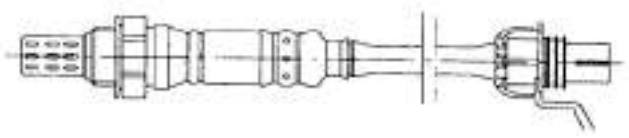
Install the sensor on the motor, and crank engine. Connect sensor signal lead to voltmeter, there are different voltage drop at different temperature.

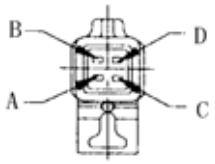
Oxygen sensor

Oxygen sensor is installed on exhaust pipe and accurately regulate excess air co-efficiency .

Oxygen sensor has 4 leads: C. voltage lead (pin A16) B. signal lead (pin B1)

A. signal ground (pin B23) D heater ground (pin B16)





PIN	Function
C	Sensor voltage lead
B	Sensor signal output
A	Signal ground
D	Heater ground

Oxygen sensor heater resistance impedance specification table

when temperature is 23℃, impedance is	13.2+/-10%
Resistance Heat Co-efficiency of impedance (23-800℃) (ppm/℃)	1150

When temperature is 800℃, impedance is	25.0+/-10%
When temperature is -40℃, heater impedance is	12.2+/-10%

●Detecting Method:

a、voltage signal method

Before testing oxygen sensor, engine must be under normal operation temperature.

【Note】Only digital voltmeter can be used to test oxygen sensor, otherwise oxygen sensor will be damaged.

● During testing, the insulation may be pricked. Before testing, digital voltmeter leads must be connected to oxygen sensor ground lead and signal lead. When engine idles and under normal temperature, if air/fuel ratio has some difference with ideal air/fuel ratio, the oxygen sensor output voltage will vary from low to high periodically. The voltage periodically varies from 0.3V to 0.8V. After testing, apply silicon seal gum on pricked area.

● A continuously high voltmeter reading indicates an rich air/fuel ratio polluted oxygen sensor ambient temperature silicon seal gum or antifreeze agent polluted oxygen sensor or leaded fuel used in engine.

A continuously low voltmeter reading indicates an poor air/fuel ratio, sensor fault. A medium reading maintained indicates a possible oxygen sensor fault.

● Remove oxygen sensor from engine. Connect a digital voltmeter lead to sensor, and combust sensor sensitive element on propane welding torch flame. The propane flame could isolate the sensitive element from oxygen, which will generate voltage. When sensitive element is on flame, the voltage is approximately 1V, and when moved away the flame, the voltage will drop to 0V. If sensor voltage does not change as specified, replace the oxygen sensor.

◆Heating wire diagnostic

If the heater on sensor does not work, sensor pre-heating will be delayed, and computer work time will also be prolonged. Then computer send a wrong rich air/fuel ratio signal, wasting the fuel.

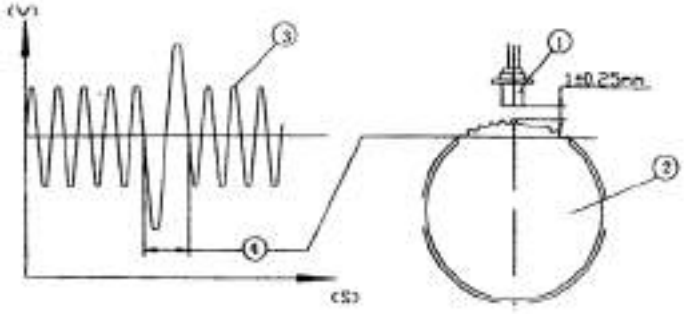
b、Ohmmeter method

Remove oxygen sensor and connect the ohmmeter between the heating wire and ground wire. Referring to above diagram, if the resistance measured is not as specified, replace it

2.1.5 Speed sensor

◆ If speed sensor is damaged, the engine can not be started.

Speed sensor has 2 leads, one is signal lead (pin B7) and the other is ground wire (pin B6)



⑷ signal corresponding to 2
mis-teeth.

Speed sensor determines firing and fuel injection time by monitoring the teeth on the flying wheel, engine speed and crankshaft position signal.

● Testing method

a ohmmeter method: the coil resistance is 515Ω,

b oscilloscope method:

Use oscilloscope to monitor pulse waveform, and a voltage pulse will generate when a tooth pass by. The flying wheel on this engine have 60-2 teeth.

2.1.6 Ignition coil

Ignition Coil Electrical Specification

Primary coil induction	5.80±15%mH
Primary coil resistance	0.53±10%Ω
Secondary coil induction	12.8±10%kΩ
Secondary coil resistance	40.0±20%H
Testing voltage	2Vdc
Testing current	7.0Amps
Output (no load)	40kvMin
Output (50Pf load)	40.0±7%mJ
Energy storage time (reference)	6.3ms
Secondary peak value current	74mA±7%
I firing delayed time	3.6ms±3%
Coil number ratio	83:1

● Testing method

Ohmmeter method: referring to above chart and check ignition coil resistance.

● Ignition wire

Remove ignition wire and 5-8mm away from cylinder. Turn on ignition switch, start engine and watch flame. A strong blue flame indicates a operational ignition coil. Otherwise, check ignition coil. Using ohmmeter method, referring to above chart, check and remove injector connector before checking.

● **Monitoring** each cylinder misfire

Remove each cylinder spark plug, and connect to appropriate high-tense wire, ensuring spark plug thread reliably ground on cylinder body. Start engine and monitor spark plug misfire.

2.1.7 Throttle position sensor (TPS)

TPS fault may cause unsmooth acceleration, engine stalling and rough idle etc. TPS has 3 leads, a current lead (Pin B22), a ground lead (Pin B23) and a signal lead (B17).

● Testing method

a ohmmeter method:

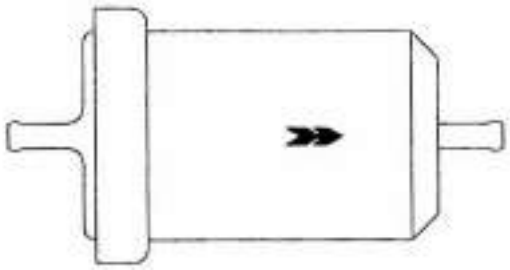
Remove TPS connector. Depress throttle slowly and monitor resistance. Measuring resistance at wide open throttle (WOT), resistance is 5KΩ±20% at WOT. Verify resistance change smoothly when throttle closed.

b voltmeter method:

Remove sensor connector, turn ignition on, measure 5V reference voltage at sensor connection. Connect a voltmeter between Pin B22 and ground. If 5V reference voltage is not sufficient, check ECU voltage at this wire. If ECU voltage is normal but not sufficient at sensor, repair 5V reference voltage wire. If ECU voltage is low, test ECU. Connector sensor connector, turn ignition on, connect a voltmeter between sensor signal wire (Pin B17) and ground wire. Voltmeter reading shows throttle open signal from sensor to ECU. Depress throttle slowly and watch voltage change. Voltage reading should be even and increase gradually. Voltage output should be 0.5±0.02V when engine idles and ≤4.85V at throttle wide open.

Fuel supply system

2.2.1 fuel filter



a DO NOT install fuel filter at an opposite direction, otherwise a new one should be installed (even it has been used for a short time). There is an arrow marked on fuel filter house showing fuel direction.

b Fuel filter should be replaced every 20000-30000km. After replacement, start engine and check if there exists fuel leakage.

2.2.2 fuel injector

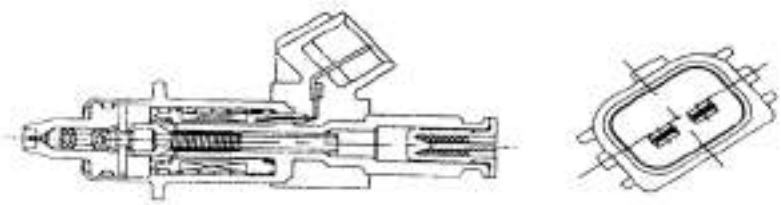
If vehicle is not used for a long time, run engine for 3-5 minutes every 2-3 months to avoid fuel injector being blocked.

Fuel injector must be washed at least one time once a year.

Fuel injector specifications:

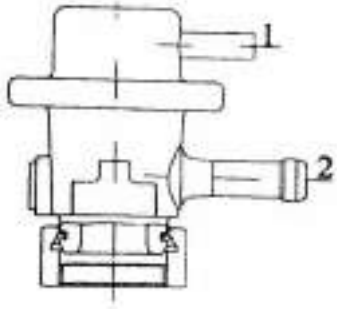
Coil resistance: 13.7±0.68Ω

Coil induction: 19.6±1.9Mh



2.2.3 fuel pressure regulator

Fuel pressure regulator is used to maintain fuel pressure to fuel injector within specification. Remaining fuel is returned to fuel tank through fuel return pipe.



1 Connecting to vacuum connector

2 Connecting to return pipe, maintaining a constant pressure to fuel tank.

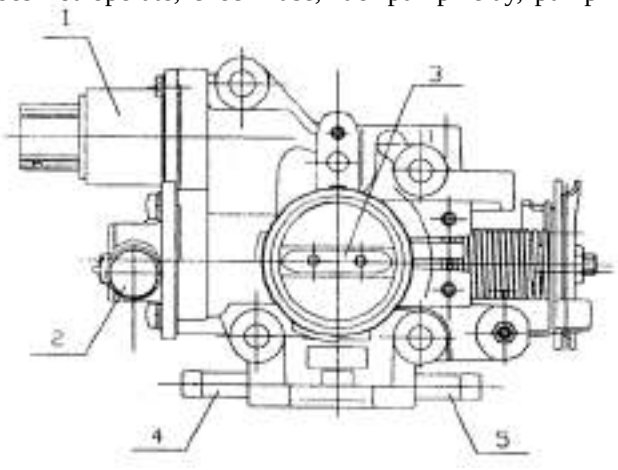
2.2.4 Fuel pump

Fuel is pumped to fuel hose by fuel pump and then supplied to fuel injector. Fuel pressure in fuel pipe is maintained at 3.942±0.049Bar.

Testing Method

Listening：

Once ignition is turned to ON position and engine still off, fuel pump running sound can be heard for 1 second and then stops. An operational pump can be determined by the sound when starting engine. If fuel pump does not operate, check fuse, fuel pump relay, pump voltage circuit and then fuel pump.



Air system

2.3.1 Throttle valve body

1 Idle step motor

2 Throttle position sensor

Throttle valve

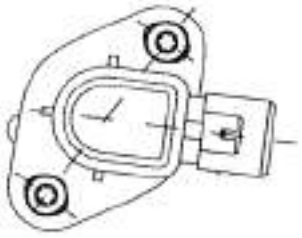
Joint-connecting to water outlet elbow

Joint-throttle valve water outlet

Preheating water hose outlet pipe.

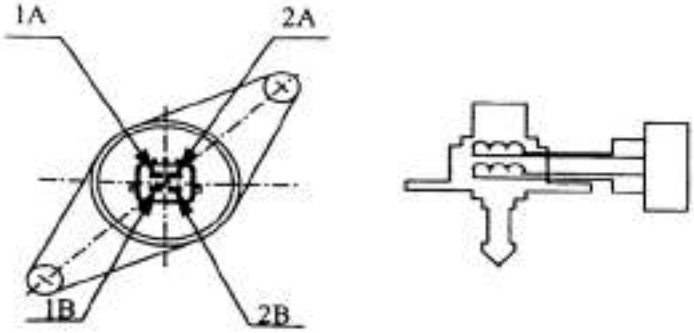
2.3.1.1 The throttle position sensor

The throttle position sensor is composed of a potentiometer，and the moving part is driven by throttle shaft. During traveling, electric controller ECU supply voltage to sensor the measured parameter is the variable generated by minimum throttle opening.



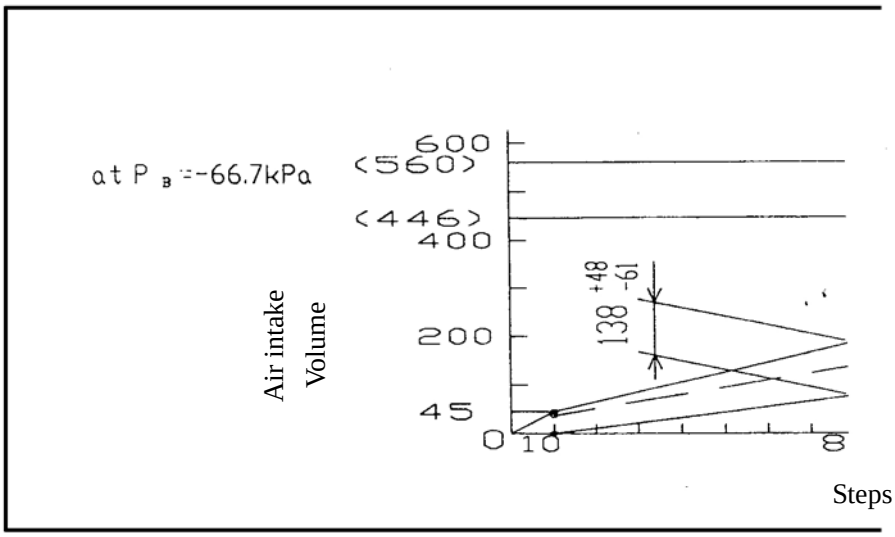
2.3.1.2 idle controller

This system utilizes step motor actuator. Because this actuator controls a comparatively much air, the air valve could be cancelled, and can carry out idle control during warming up.



Electronic Specification

ITEM	CONDITION	IDEL GOAL
Coil resistance	Temp: 27	48±2.4Ω
Coil induction	1kHz sine wave input	38±6mH



●Testing method

a Ohmmeter Method

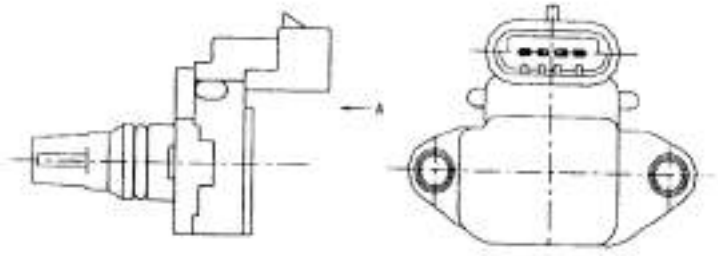
Remove step motor connector, measure resistance between 1A~1B and 2A~2B. Remove ECU connector, measure resistance between A71~A8 and A5~A6.

b Hand Sensing Method

When ignition switch is turned on, short-time vibration should be felt.

2.3.2 Air Intake Temperature (AIT) Pressure Sensor

AIT pressure sensor has 4 leads, votage supply wire (pin B22), pressure signal (pin B19), temperature signal (pin B18), and ground wire (pin B23).



TMAP Resistance-Temperature Specification			
Temperature(℃)	R Specified	R Min..(Ω)	R Max. (Ω)
-40	49932.9	43142.0	56723.7
-30	26628.4	23406.3	17396.9
-20	15701.2	14005.4	17396.9
-10	9538.8	8623.1	10454.5
0	5958.7	5452.2	6465.2

10	3820.2	3537.5	4102.9
20	2509.3	2346.2	2672.4
5	2051.3	1928.2	2174.4
30	1686.0	1584.9	1787.1
40	1157.1	1088.8	1225.4
50	810.0	763.0	857.0
60	577.6	548.7	606.5
70	419.1	395.6	442.6
80	309.0	292.0	326.0
90	231.4	218.7	244.1
100	175.7	166.2	185.2
110	135.2	127.0	143.3
120	105.4	98.6	112.2
130	83.1	77.3	88.9

●Testing method:

a Ohmmeter method

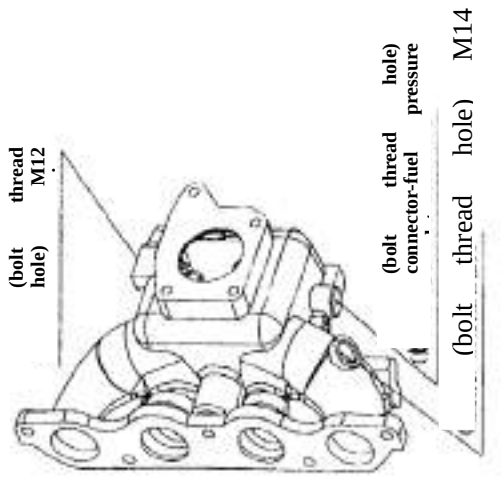
Using ohmmeter measure resistance. Determine if ECU sensor operates by abve engine air intake temperate-resistance chart. Remove air intake temperature sensor, and heat sensor in water (refer to diagram 4.3). Sensor has a corresponding resistance with different temperature.

b Voltmeter method

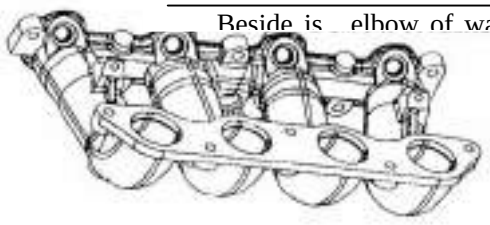
Install sensor on engine, start engine. Connect voltmeter to sensor signal lead. For different air intake temperate, voltmeter has a corresponding voltage drop. Voltage decrease as temperature increase.

2.3.3 air intake manifold

2.3.3.1 air intake manifold upper body



2.3.3.2 air intake manifold lower body



2.4 fuel vapor control system

In order that air could be exchanged for fuel tank, and to prevent fuel vapor from exhausting to atmosphere, fuel vapor is absorbed by active carbon and stored in it. Upon engine operating condition, stored fuel vapor will be timely and adequately sent to air intake hose and burned with mixture in combustion chamber.

SQR480EC multi-port fuel injection system using and servicing

3.1 fuel and purge system using and servicing

3.1.1 Fuel grade used in Chery engine must be higher than 93#RON, and leaded gasoline or fuel grade lower than 93#RON CAN NOT be used. Leaded oil could do harm to the 3-way catalyst, resulting in the loss of oxidization and reduction function to harmful materials in exhaust. Lower grade gas will cause fuel injector being blocked, pin valve and regulator etc. being damaged, shortening components lifetime. Using leaded gasoline will cause a damaged 3-way catalyst converter, after which 3-way catalyst converter function will not recover even the right gas is used. If leaded fuel is added, the vehicle should be driven to specified repairing workshop and repaired as soon as possible.

★ 3-way catalyst converter lose its function under following conditions, which should be avoided.

Burned under high temperature. The ideal temperature for a high purge ratio and long life time is s 400-800℃. A higher temperature will cause overheat catalyst, fast ageing, losing catalyst function;

Catalyst hole blocked;

(3) Under an over 800℃ temperature and last for 30 seconds, remaining gas in catalyst will cause 3-way catalyst converter being damaged. Therefore when engine operating, removing ignition coil wire for an operational engine is absolutely forbidden.

3.1.3 Poor engine operation may cause 3 way catalyst converter being damaged. Therefore, scheduled technique service must be done as per Servicing Manual.

3.1.4 Before engine stalls, let engine idle for some time and cool down gradually, lower heat impact strength which will do good to a prolonged engine components and 3 way catalyst converter life time.

3.1.5 After a long-time driving, the vehicle CAN NOT be immediately parked in a place where the 3-way catalyst may reaches flammable materials to avoid accidents caused by high temperature 3 way catalyst converter.

3.1.6 DO NOT depress throttle pedal when starting. ECU determines engine operating conditions upon throttle position. Once throttle pedal is depressed, throttle is opened and ECU cannot determine if engine is under operating condition and can not supply fuel correctoly.

3.1.7 After cool starting, the engine is in fast idle. With water temperature increasing, engine speed decrease. After engine warming up (water temperature above 85 ℃), engine speed stabilize at 950±50r/min.

3.1.8 Wrap pipe connector with plastic cloth when servicing fuel pipe, preventing fuel splash. DO NOT smoke or fire to avoid fire hazard.

3.1.9 DO NOT remove injector to check fuel injecting condition. DO NOT spray to sky to avoid explosion and combustion from spark.

3.1.10 Check whole fuel pipe circuit leakage frequently and fuel leakage problem should be immediately repaired..

3.1.11 Set screw for controlling throttle idle position on throttle valve has been precisely adjusted and any adjustment is forbidden.

3.2 Electrical system using and servicing

3.2.1 Stop vehicle and turn ignition off after stopping.

3.2.2 Lead on battery MUST BE removed before removing electrical connector.

3.2.3 Voltage supplied to engine is battery voltage and to avoid ECU damaging for over voltage, any other external voltage supply such as fast-charging, starter voltage stabilizing power CAN NOT be used to start engine.

3.2.4 ECU, sensor and actuator elements must be protected from humidity, static electricity, and strong electronic interference (wiring harness must be at least 50 cm away from high-tense wire),. Avoid equipments falling and dropping when servicing..

3.2.5 Do not start engine when loose connection or battery leads exist.

3.2.6 Disconnecting battery from vehicle circuit is absolutely forbidden when engine is under normal operating condition; otherwise a permanent ECU damage will be caused.

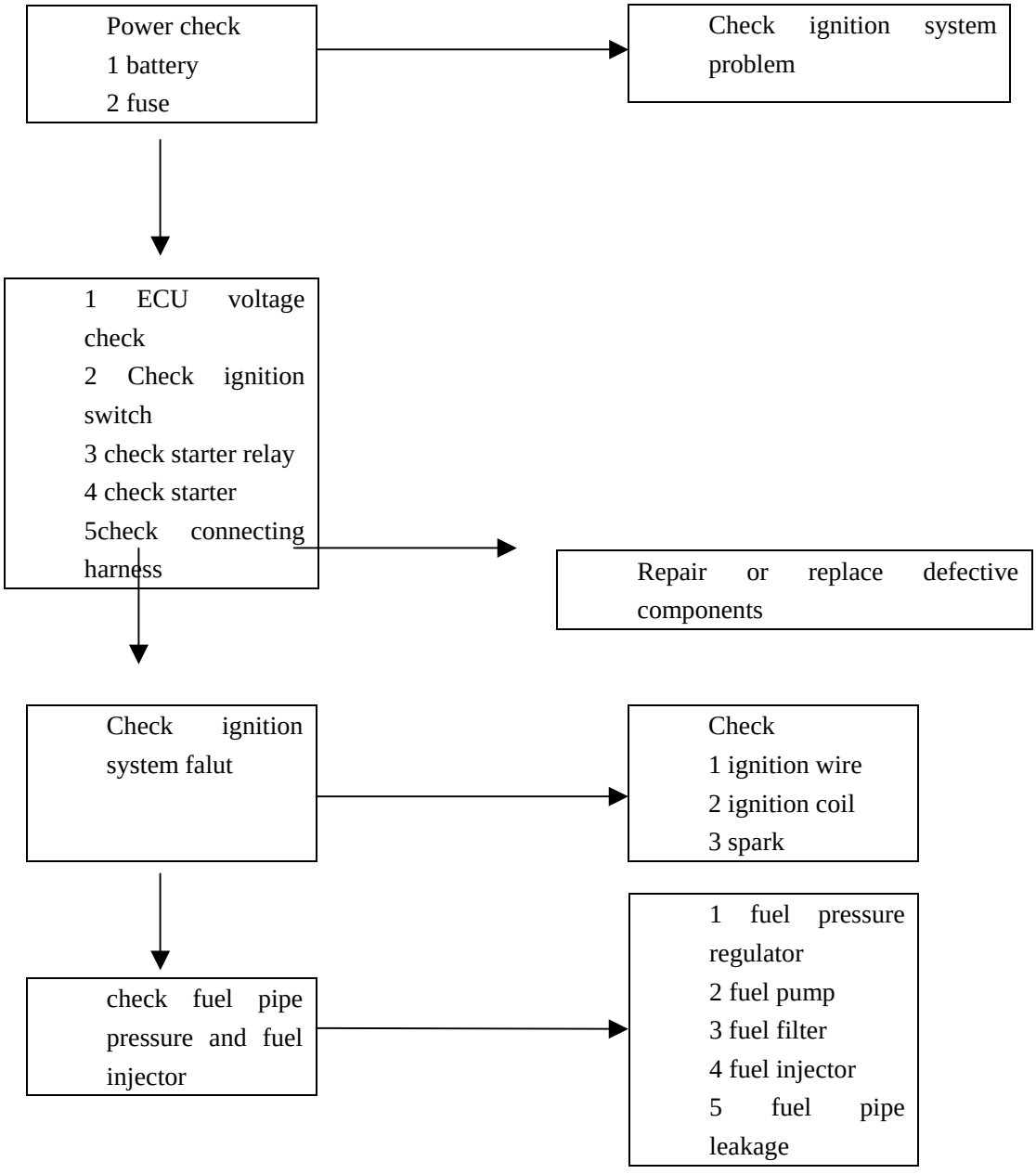
3.2.7 Disconnecting battery from all vehicle circuits when fast-charging battery.

3.2.8 DO NOT remove and connect harness connectors on ECU when ignition key is at ON position avoiding ECU being damaged by over voltage.

3.2.9 SQR480EC engine utilize high impedance spark and wire, which are special parts for such engine, and can not be replaced with common high-tension wire, otherwise ECU will be damaged and affect system normal operating.

III. SQR480EC EI system faults and trouble shooting

4.1 CAN NOT START ENGINE



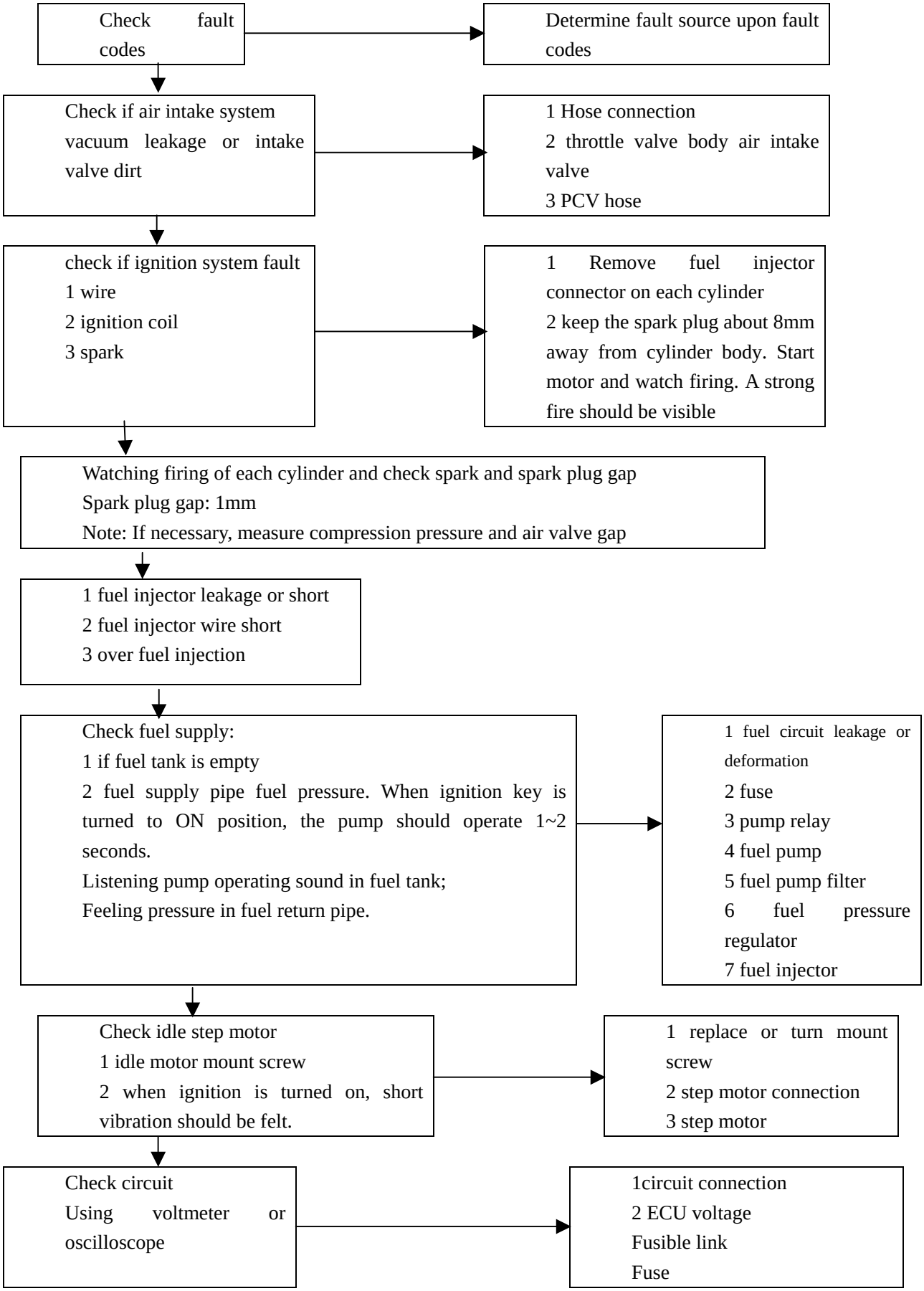
★ ECU power wire diagnostic

Measure ECU voltage with a digital voltmeter, Pin A16 is positive and pin B16 is negative. When ignition is turned on, this pin voltage is 12V. If the voltage is not 12V, check ECU fuse and related circuit.

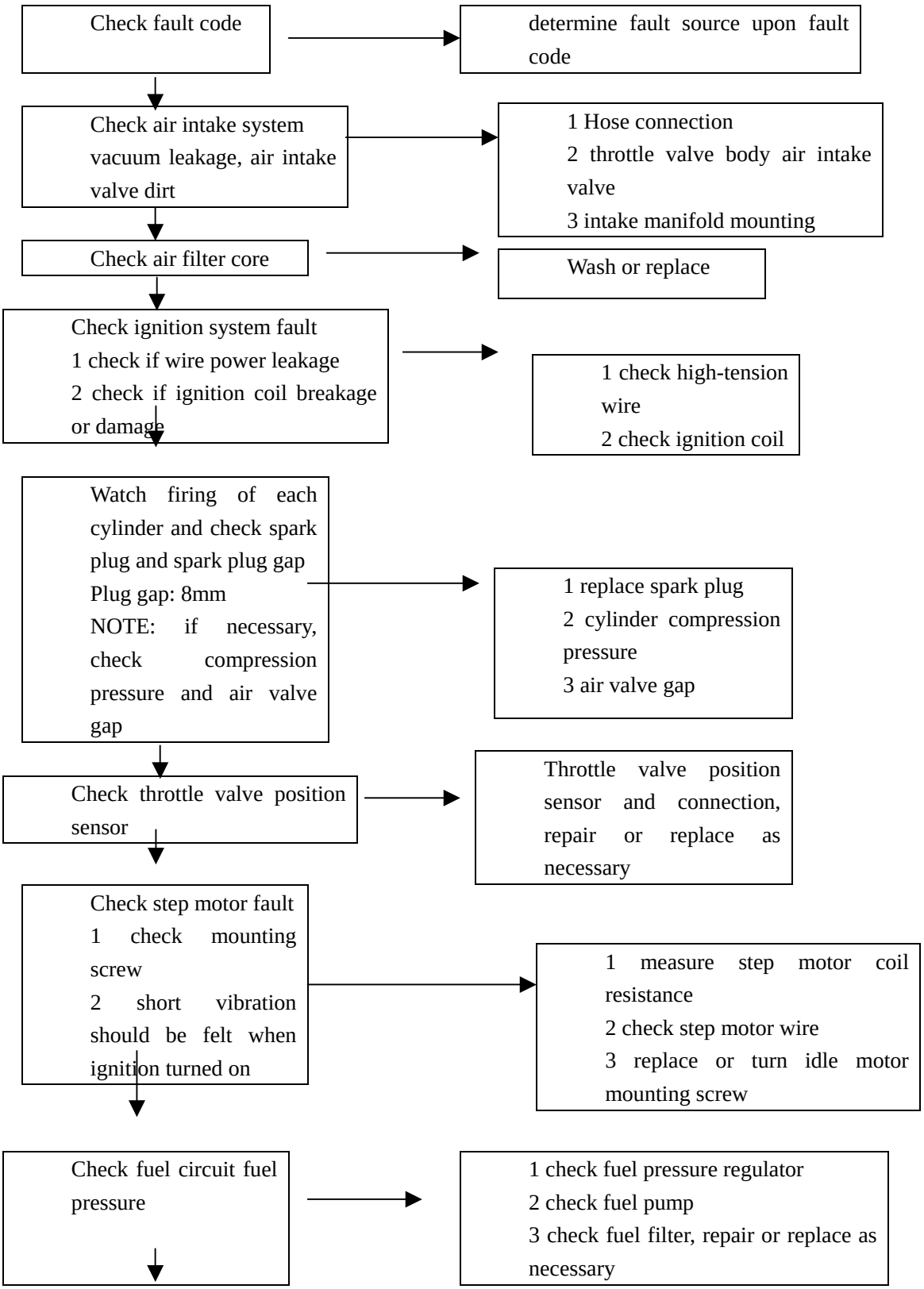
★ Power and ground fault diagnostic

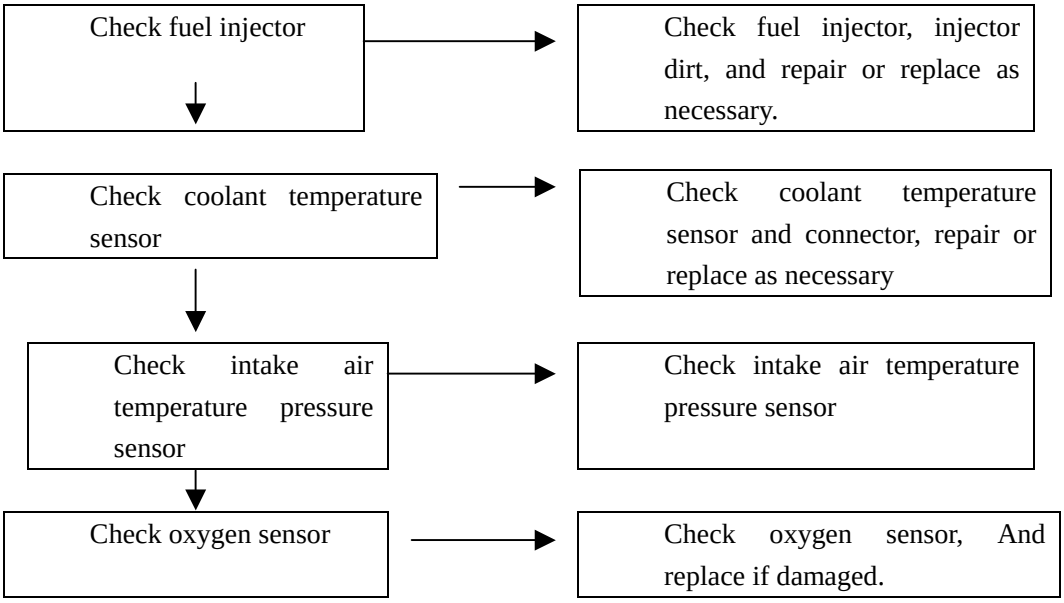
Computer ground lead is generally connected to battery negative lead.

4.2 Hard to start

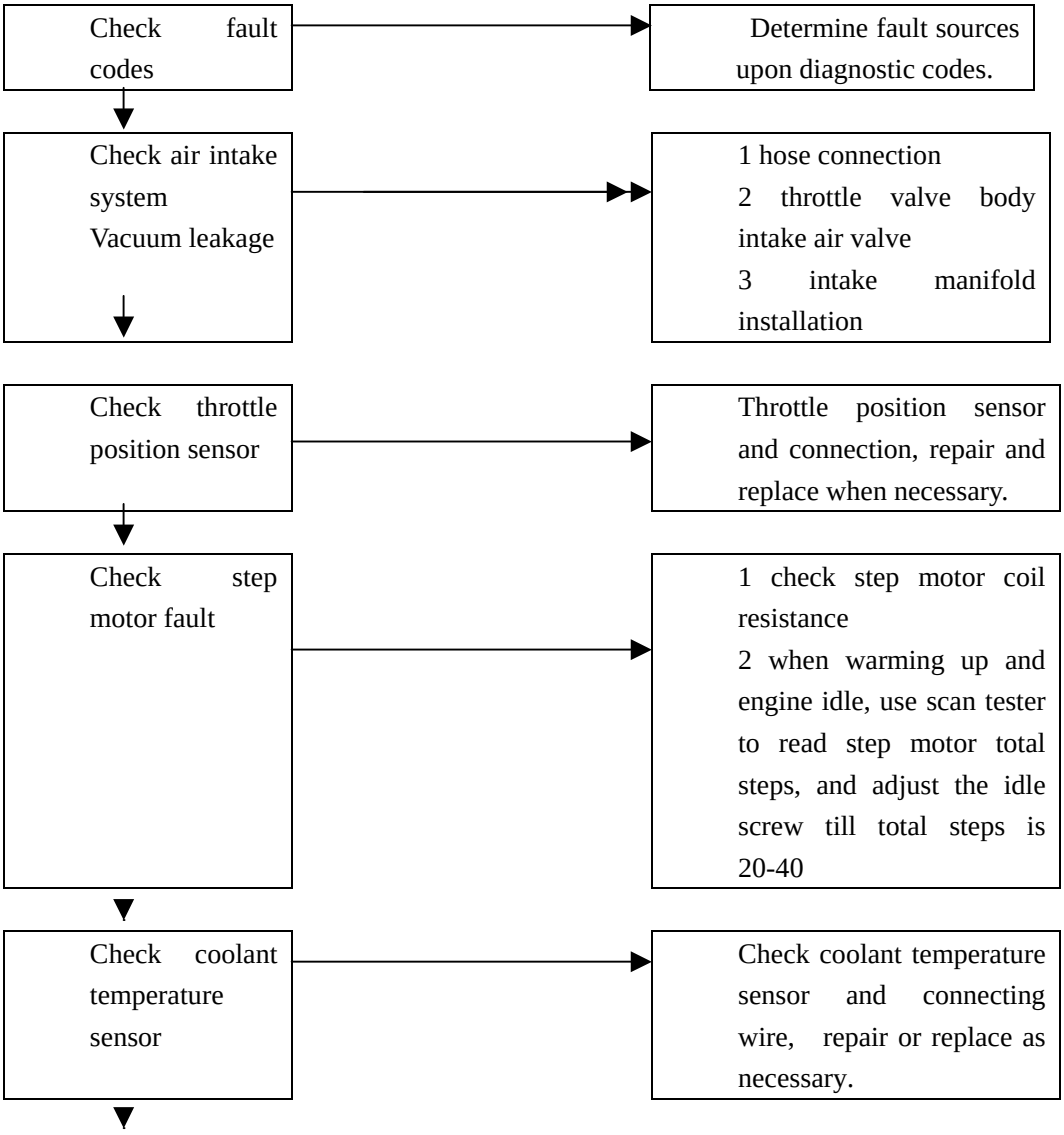


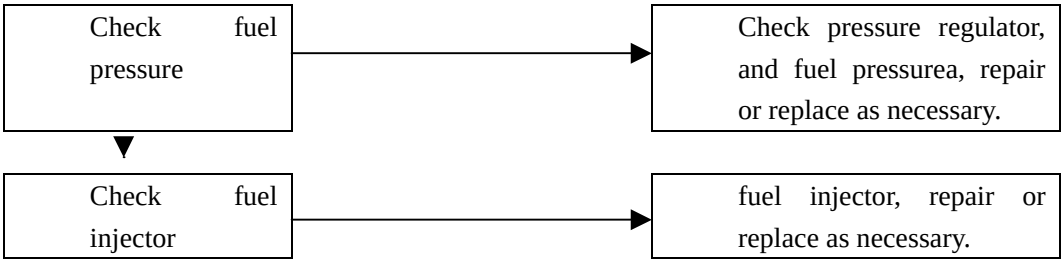
4.3 Rough Idle





4.4 High Idle Speed





4.5 Low idle speed

If engine idle speed is low referring to each actuator and sensor mentioned above, check following components:

Engine coolant temperature sensor fault: check engine coolant temperature sensor and wire, repair or replace as necessary.

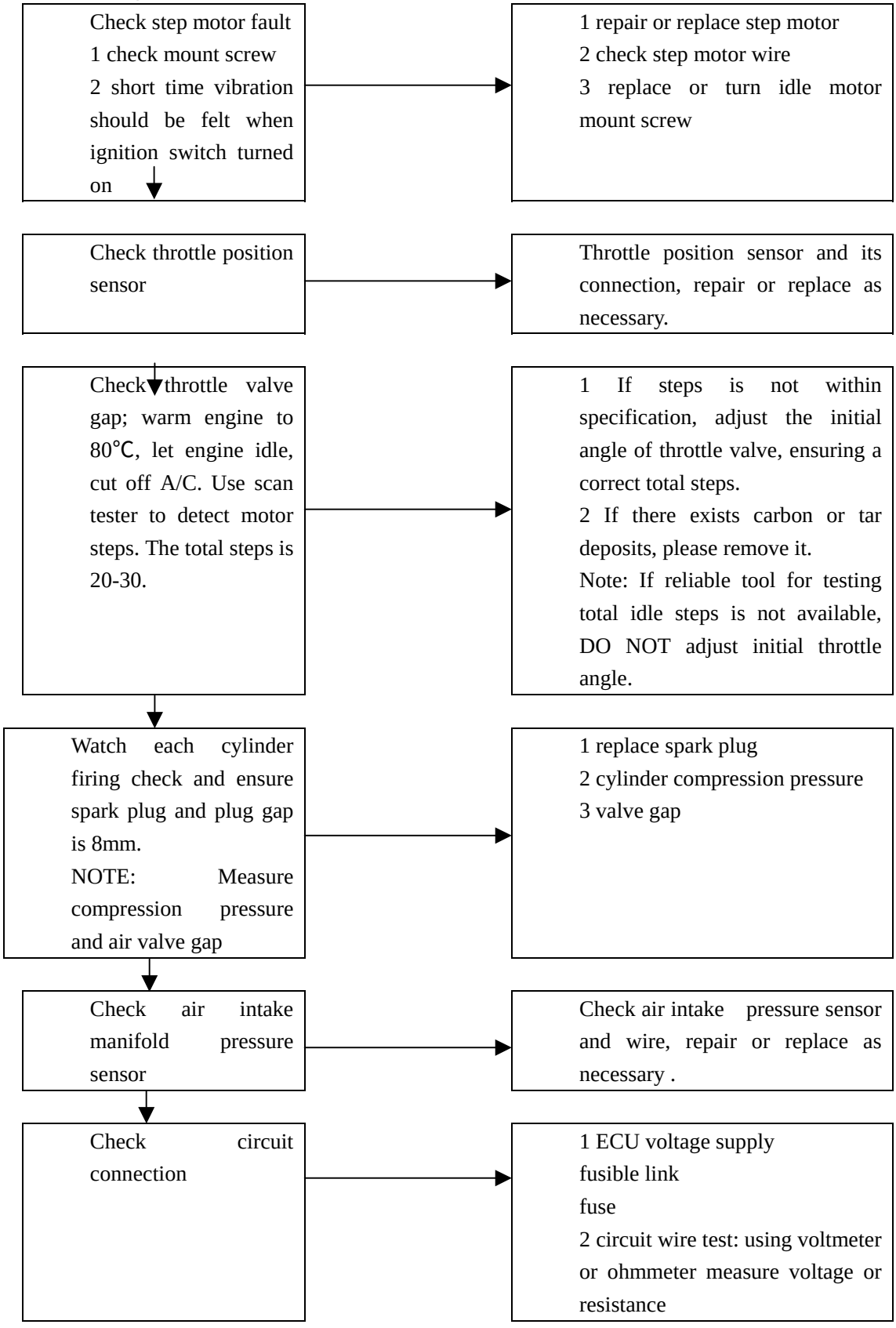
Air intake temperature sensor fault: check air intake temperature sensor and wire,repair or replace as necessary.

Step motor fault or stuck

Throttle position sensor fault: check engine throttle position sensor and wire, repair or replace when necessary.

Fuel pressure and injector

4.6 engines often stalls

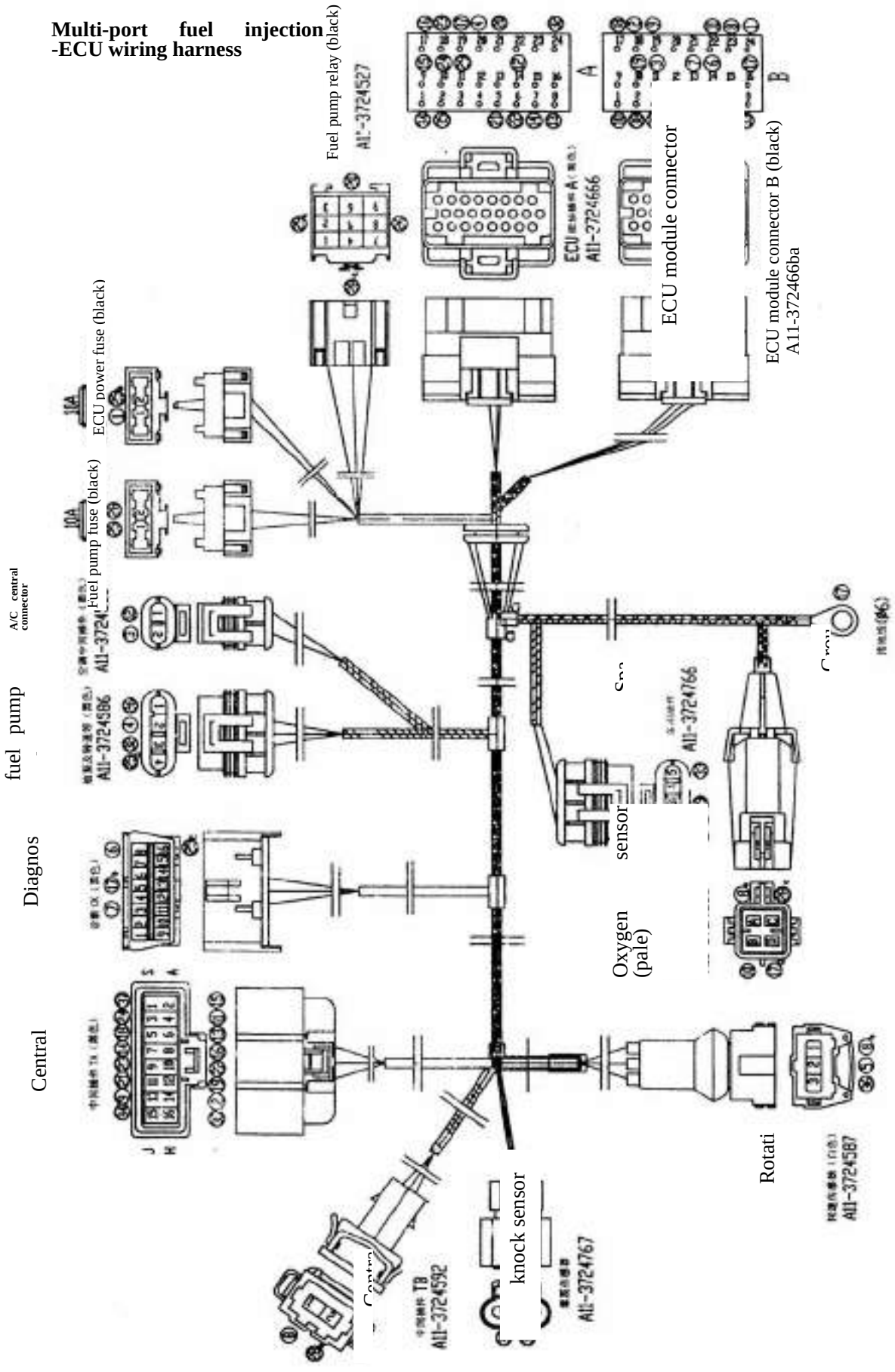


★ If engine stalls, check following components:

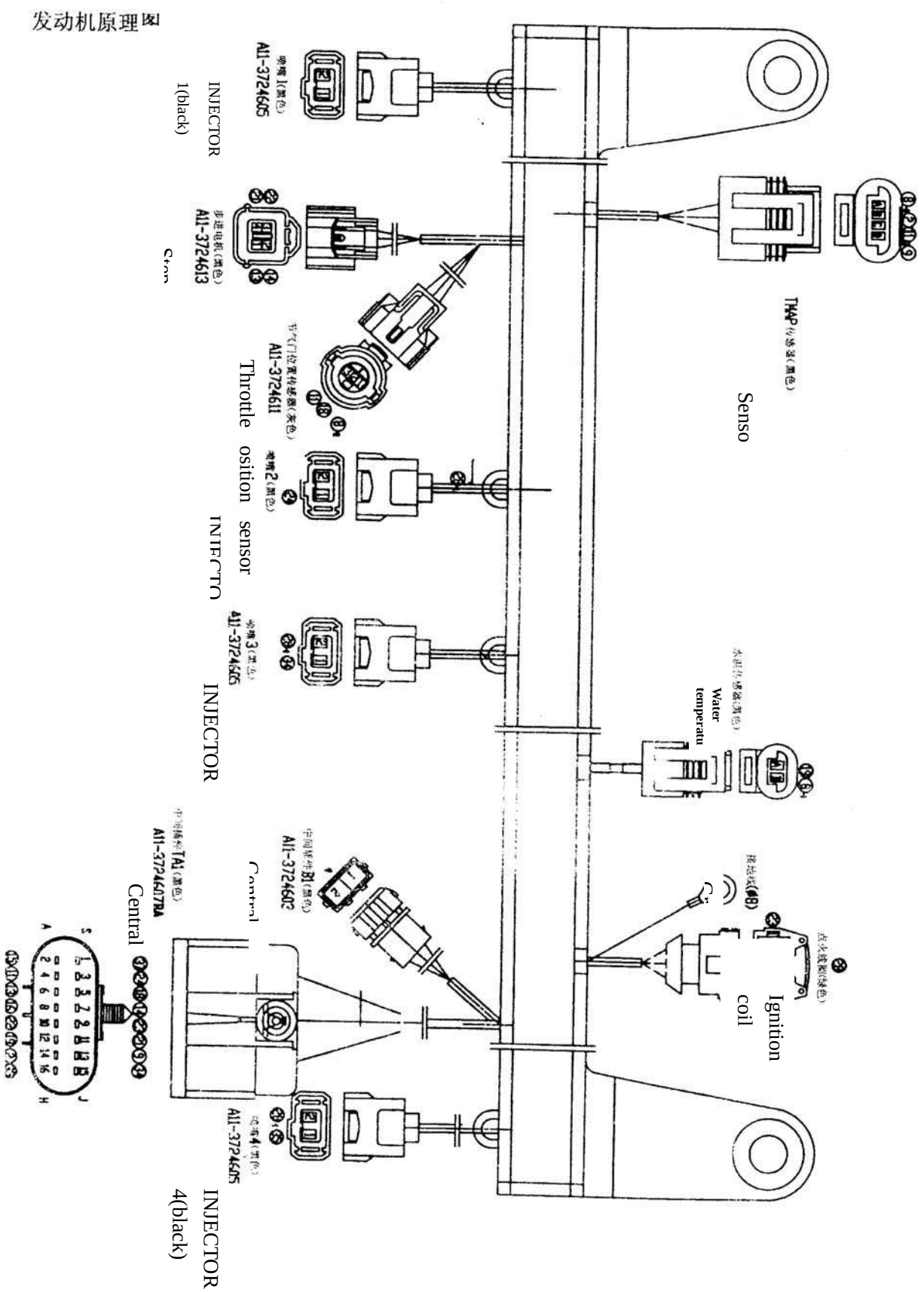
Air system leakage check

Ignition system fault check
Fuel circuit pressure, fuel injector, and fuel pump check
Engine compression pressure check

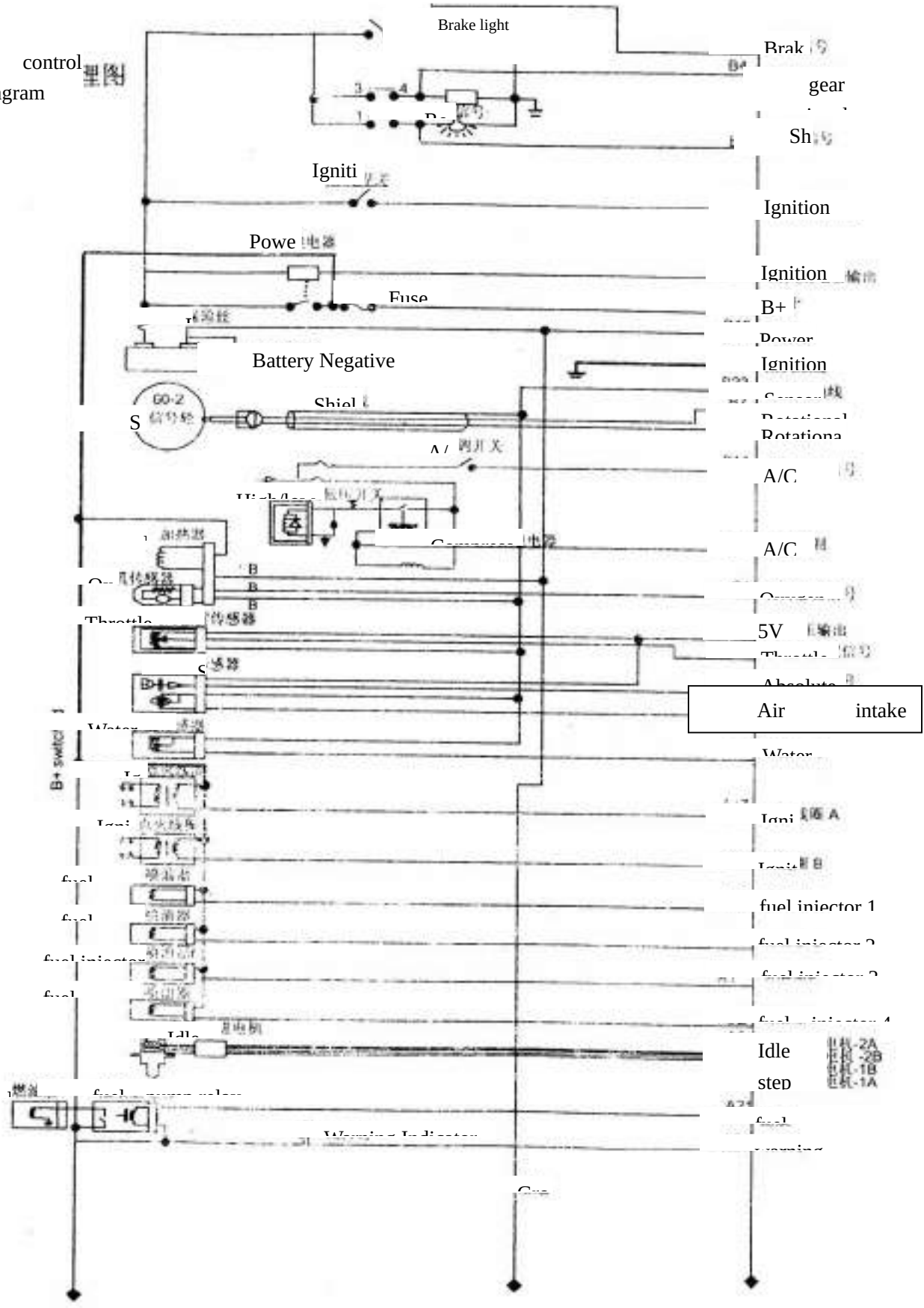
Multi-port fuel injection -ECU wiring harness

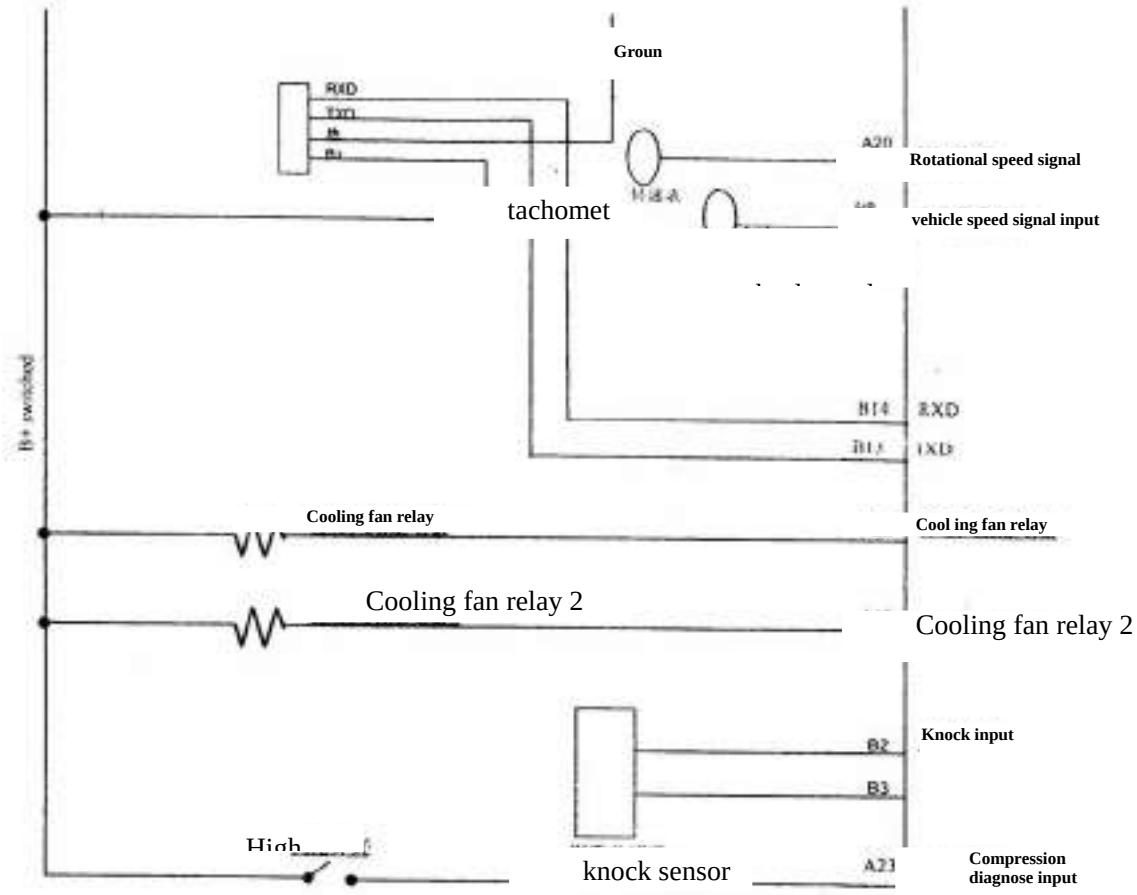


Engine Theory Diagram



Electric control heoryt diagram 里图





·This diagram is used for SQR480EB and SQR480EC engine

·The italic parts means functions under development.

Socket A

ECU Pin	Function	Input/Output (I/O)
1	Cylinder 3fuel Injector Control	Output
2	not used	not used
3	not used	not used
4	not used	not used
5	Step Motor-2A	Output
6	Step Motor -2B	Output
7	Step Motor -1B	Output
8	Step Motor -1A	Output
9	Cylinder 1 fuel Injector Control	Output
10	Cylinder2 fuel Injector Control	Output
11	Brake Signal Output	Input
12	not used	not used
13	not used	not used
14	A/C Pressure Signal	Output
15	not used	not used
16	Power (+)	Input
17	Ignition Coil A	Output
18	Ignition Coil B	Output
19	Ignition Coil Ground	Ground
20	Rotational Speed Signal	Output
21	not used	not used
22	No.4 Cylinder Oil Injector Control	Output
23	not used	not used
24	Warning Indicator Signal	Output

Socket B

ECU Pin	Function	Input/Output (I/O)
1	Oxygen Sensor	Input
2	not used	not used
3	not used	not used
4	P/N gear Signal	Input
5	P gear Signal	Input
6	Rotational Speed Sensor (-)	Input
7	Rotational Speed Sensor (+)	Input
8	Vehicle Speed	Input
9	Fuel Pump	Output
10	Water Temperature Sensor Signal	Input
11	A/C Demand Signal	Input
12	not used	Output
13	TXD	Output
14	RXD	Output
15	not used	Output
16	B-	
17	Throttle Position	Input
18	Air Intake Temperature Signal	Input
19	Absolute Pressure Signal	Input
20	not used	Output
21	not used	output
22	5V Voltage Output	Output
23	Sensor Ground Wire	Input
24	B+	

Part II

M&M MULTI-PORT ELECTRIC INJECTION ENGINE SYSTEM

Operation And Maintenance Instruction For SQE480ED Engine Sequential Multi-port Fuel Injection System

1. Description

SQR480Ed electric injection utilize M&M sequential multi-port fuel injection system which is of λ Speed Density Type (engine speed, air density, air/fuel mixture control) and can control sequential fuel injection and distributor less ignition.

The system consists of 4 essential parts.

1：Air system　2：Fuel Supply System　3：Control system　4：Ignition system

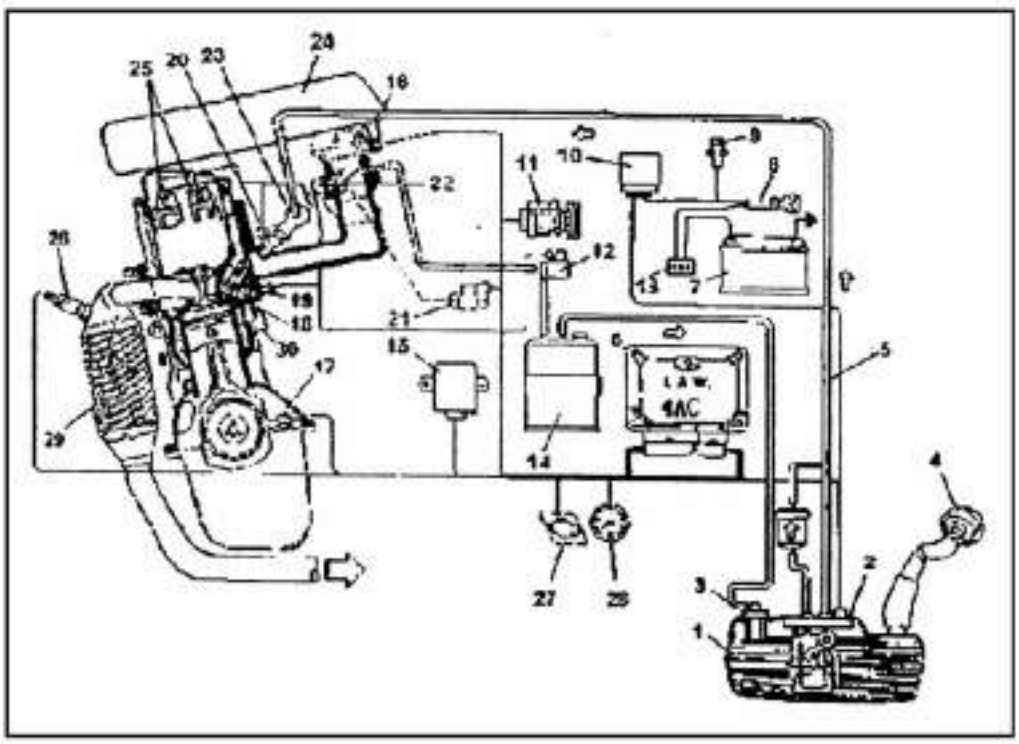


Fig 1　SQR480ED Electric Injection System Theory Illustration

1.Fuel Tank 2.Fuel pump 3.Multi-function valve 4.Check valve 5.Fuel Feed Pipe 6.Engine ECU 7.Battery 8. Ignition switch 10.system relay 11.A/C compressor 12.Carbon canister solenoid 13.Fuse 14 Active carbon canister 15. Anti-theft unit 16.Absolute pressure and temperature sensor 17.Crankshaft speed and position sensor 18.Spark plug 19. Coolant temperature sensor 20. Fuel injector 21. Throttle position sensor 22.idle step motor 23. Fuel rail 24. Air Filter 25. Ignition coil 26. Oxygen sensor 27. Warning Indicator 28. RPM sensor 29. way catalyst converter 30. Knock sensor

2. Operation Theory

The system enable the actual measured air/fuel ratio to approach chemical reaction equivalent proportion, protecting 3 way catalyst converter and reducing exhaust pollution. Oxygen sensor real-time analyzes oxygen content of exhaust , which enables ECU to

correct air/fuel ratio by controling injected fuel quantity.

Fuel is directly sprayed into intake manifold beside the intake valve under pressure of 3.5bar. The fuel injector of each cylinder takes correspondingly phase control upon sequence of air intake and open time of intake valve. Injection terminal is stored in ECU MAP Diagram and will change with engine speed and intake manifold pressure. ECU can correct all basic control strategy of engine under all operation condition upon signals from various sensors in the system.

Idle speed is kept steady by step motor controlling by-pass valve opening and changing ignition advance angle. Idle speed cannot be regulated manually.

The system utilize inductive discharge ignition, and control time is managed by power supply module in ECU. Advance angle of ignition is calculated upon engine compression pressure ratio and air intaked.

3. Fuel Injection System Control Strategy

3.1 Start-up

During the start-up of engine, ECU injects fuel to all cylinders simultaneously to reduce start-up time, and then injects in phase sequence.

3.2 Idle speed

After start-up, engine needs idling for several minutes to warming up. The normal idle speed is 880±50rpm(coolant temperature≥85℃). When engine is cold, engine runs at a high idle speed warming up under the ECU control. With rising of coolant temperature, idle speed decrease to normal speed gradually. When engine idles, if A/C is turned on, ECU will increase idle speed by 100rpm.

3.Accelarating

During accelerating, ECU adds fuel injection upon engine load increasing and handles signals from throttle position sensor, intake manifold absolute pressure sensor and Top Dead Center/speed sensor. “ Basic Injection Time” multiplies a correction coefficient calculated upon engine coolant temperature, throttle opening rate and intake manifold pressure increment. When the injector is closed, if fuel injection time is calculated to have an abrupt change, ECU will add fuel injection time according to above-mentioned factor, namely reopen injector and compensate fuel injection as much as possible.

4. Decelerating

During decelerating, engine should reduce fuel injection to decrease exhaust pollution. ECU identify this stage by high level to low level throttle potentiometer signal but not to idle speed, and using buffer strategy to reduce torque output. When throttle potentiometer signal shows throttle is closed and engine maximum limit speed reaches, ECU will regard the condition is met and reduces by-pass air charge by step motor.

5. fuel cuttingoff

ECU will carry out fuel cutting-off stragety when warm engine speed is over 150rpm and an idle speed position throttle (throttle potentiometer signal) is identified. During engine warming up, ECU takes an engine speed of which engine water temperature increasing

strategy works. When throttle is not closed and warm engine speed is less than 1400rpm, it will recover fuel supply.

6. Full load

When engine is under full load, ECU will prolong basic injection time to obtain the maximum output power and guarantee 3 way catalyst converter temperature is within specification.

7.Speed limit

When engine speed exceeds threshold valve for10 seconds or instantaneously exceeds a specified threshold value , ECU will stop injection control function. When speed returns to normal, ECU restart injection control.

8. Atmosphere pressure correction

The atmosphere pressure changes with altitude, which brings change of volume efficiency.and needs to correct the basic calibration (injection time and by-pass air charge).

9. Self-adapting

ECU has air/fuel ratio self-adapting ability and can stores difference between basic MAP diagram and correction value of oxygen sensor during operation. These differences will be stored permanentlyallowing system and components to be correct gradually as a new one. This function contains automatic conformance check and automatic diagnosis of memory parameter.

10. Power balance

When normal electrical components operating cause battery voltage below 12.2V, the electricity demand of electrical components is over than generator ability. ECU will gradually increase engine idle speed to generate enough electricity energy. When power balance is positive, increased idle speed will cancel.

4. Structural composition

4.1 Fuel supply system

The fuel supply system is semi-none-fuel-return type, only one pipe connecting fuel tank and fuel rail. The system has the following advantages:if accident occurs, the fire hazard possibility will be lowered to minimum by none-fuel-return pipe, little fuel vapor in fuel tank, low fuel temperature in fuel tank.

The fuel supply system includes: electric fuel pump, diaphram fuel pressure regulator, fuel pipe, fuel filter, fuel rail, quick coupler, fuel injector etc.

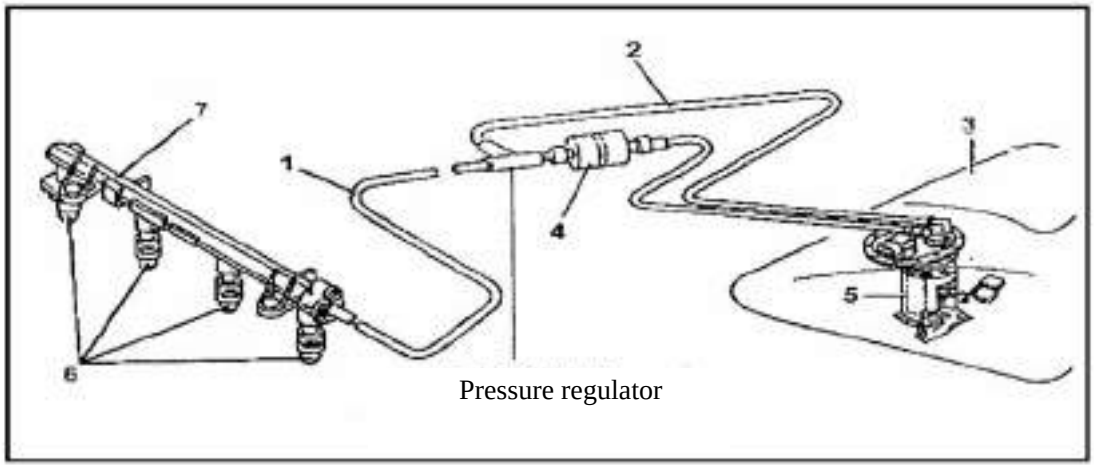


Fig.2 Oil Supply System

1. fuel pipe 2. fuel return pipe 3.fuel tank 4.fuel filter 5.fuel pump 6.fuel injector 7.

(1) Fuel pump

Fuel pump is located in the fuel tank with a mesh filter on pump inlet. The rotor is driven by motor whose power is supplied by relay. A pressure relief valve is installed on pump, which cut off fuel supply and suction to avoid motor overheat when pipe pressure is above 7 bar. Pump operates under fuel temperature is within -30℃～+70℃ and normal flow rate is 90L/Hr under 12 voltage.

ECU control pump through relay as followings:

－When ignition key is turned on for 2 seconds, engine off, pump start to operate;

－When engine is operatingand vehicle is running , pump operates continuously;

－When engine speed is lower than a specified value (about 50rpm), pump stops operating.

(2) Fuel pressure regulatorFuel pressure regulator is inside the fuel tank, calibrated at 3.5bar fixed pressure.

(3) Fuel filter

Fuel filter is located outside of fuel tank. The fuel filter consists of housing and low filter core of high filtering quality. Due to fuel injector is excessively sensitiveto foreign materials in fuel feed circuit, fuel filter is a necessary part to engine’s normal operating.

Note：Arrowhead is marked on the housing of fuel filter, indicating the flowing direction of gasoline. During installing, fuel filter is not allowed to install in a reverse direction. Otherwise, the fuel filter must be replaced with a new one. Replace fuel filter every 2000-3000km.

(4) Quick coupler

The fuel pump inlet and outlet is connected to fuel pipe via a quick coupler, red quick coupler connects to outlet and white quick coupler connects to inlet.

Removing quick coupler as shown in Fig 3.

* Hold the seat collar, push fuel pipe inward as arrow

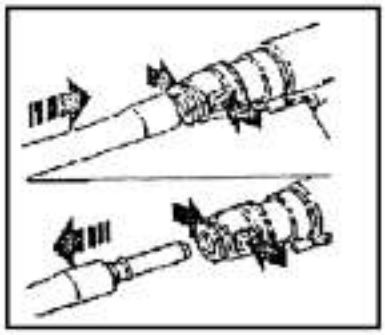


Fig3 Quick Coupler Removing

direction, loosen fuel pipe.

* Hold seat collar firmly, pull fuel pipe off as arrow direction.

(5) Fuel rail

Fuel rail is used for distributing fuel into fuel injector and fixing fuel injector.

(6) Fuel injector

This system uses top fuel supply single hole fuel injector. Fuel injection pressure is 3.5bar，output fuel is continuously atomized and in cone angle (15 ° angle from fuel injector axes)。

The control logic of fuel injector is: phase, sequence control. Four fuel injectors is controlled according to four cylinders air intake sequence, opening in power stroke till intake stroke start. Fuel injectors are fixed on fuel rail. Fuel rail press injector onto the fixed seat of intake manifold, and is sealed by 2 O-rings.

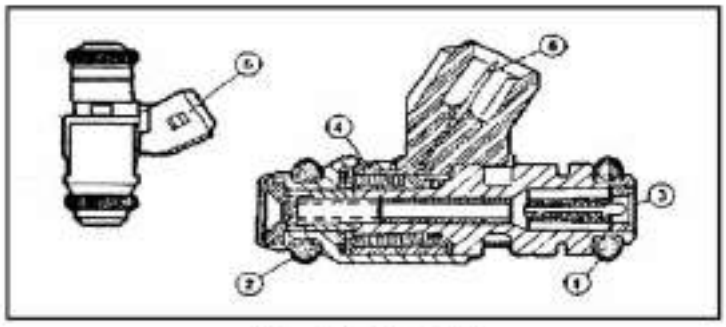


Fig4 Fuel Injector Diagram

1.upper O-ring 2.lower O-ring 3. fuel inlet 4.coil 5.wire terminal 6.electrical connector

2. Air system

Air intake system mainly consists of air filter, intake hose, intake manifold, idle step motor and throttle valve body of throttle position sensor.

(1) Throttle valve body

Throttle valve body calculate air intake volume upon throttle pedal depressing status. Auxiliary air intake volume is regulated by step motor when engine idles.

To avoid condensation and freezing under some conditions, throttle valve regulator bar is against anti-stuck screw preventing throttle from full closed. . The anti-stuck screw is adjusted during throttle valve body calibrating by manufacturer and do not turn the screw.

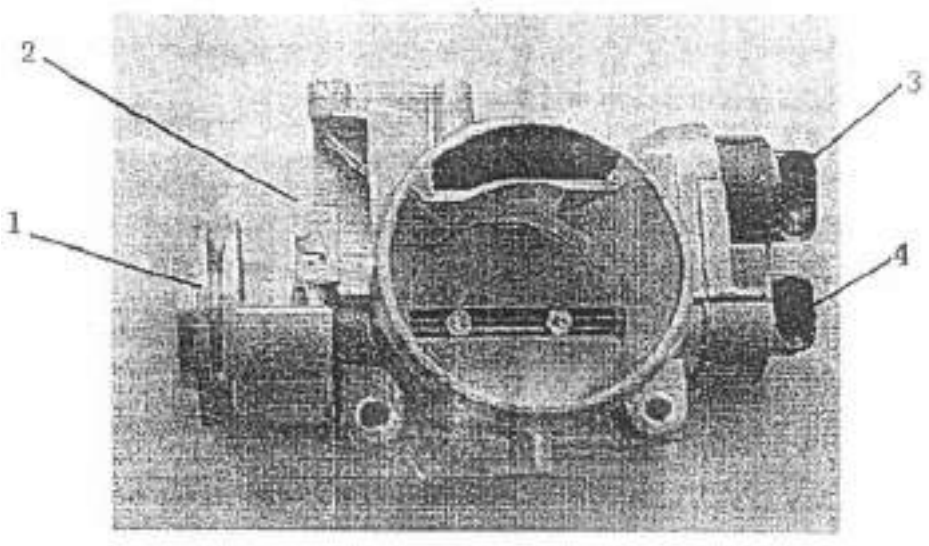


Fig 5 Outside Drawing of Throttle valve

1. throttle cable coil 2. Anti-stuck Screw 3.step motor 4.throttle position sensor

(2) Idle step motor

Idle step motor is used for controlling idle speed ,directly fixed on throttle valve body consists of one step motor and screw/worm retard unit which change the rotational movement of locking pin to linear movement. After receiving control command of ECU, step motor axially moves valve spindle (about 0.04mm/step) using screw/worm unit , by which change by-pass air charge volume when engine idles to control idle speed.

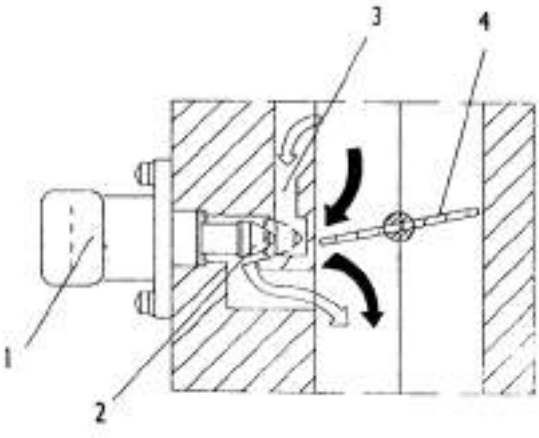


Fig 6 Idle Control Valve Operation Theory

1.Step motor 2. control valve 3.by-pass hole 4.throttle valve

When temperature is at 20℃, coil resistance is R=53±10Ω. The maximum air charge is achieved through backing 200 steps of locking valve. The amounts of working step is determined upon engine operating conditions including warming up, A/C on etc.

3. Control system

(1) ECU

ECU is located in the cabin of engine, connected to wiring harness via 80-pin interface. ECU is used for handling signals from various sensors and controlling actuators to obtain optimum operating conditions..

Comparing to the previous mode, it has added many functions. But due to using of many customized circuits of special functions, it has powerful integration, compact structure, and small size.

ECU handle following signals:

- battery voltage;

-intake manifold absolute pressure ；

-Top Dead Center；

-throttle position；

-air intake temperature；

-Engine coolant temperature；

-A/C operation；

-oxygen sensor signal；

-knocking sensor signal。

Air charge efficiency is calculated upon managed intake manifold absolute pressure, intake air temperature, engine speed and throttle position, by which air charge volume in cylinder is obtained.

ECU controlsas below:

- Control fuel injection by controlling open time of fuel injector；

-Idle step motor；

-Four high voltage output ignition coil；

-carbon canister solenoid；

-A/C compressor；

- Warning indicator

Besides those functions, ECU can also controls：

-all self-diagnostics strategies on input sensors and output actuators；

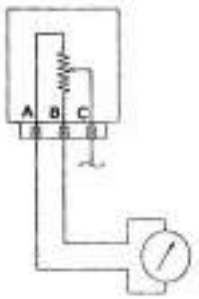


Fig 7. Throttle valve position sensor

A. Voltage positive B. ground C.

-“Wrong” signal recovery strategy on basic valid input signal；

-Engine anti-theft function

(2) Throttle position sensor

Throttle position sensor is used for measuring throttle opening, determining idle, full

load and accelerating/decelerating operating conditions, and carry out fuel injection volume control corresponding with throttle opening. Throttle position sensor includes a potentiometer, and the moving parts is operated by throttle shaft. During operation, ECU supply 5V voltage to sensor and measured parameter is variable of throttle opening from minimum to maximum.

Operation Operational theory of throttle position sensor is shown as fig 7.

(3) TMAP sensor (air intake temperature, pressure sensor)

★ TMAP sensor combined air intake temperature sensor and air intake pressure sensor .

Air intake pressure sensor is an important sensor, which utilize pressure-resistance effect of semi-conductor element, transferring pressure change in intake manifold to voltage change.

Air intake temperature sensor is used to measure air intake temperature, which is a negative temperature coefficient (NTC) resistance thermo-sensitive element.And the resistance decrease with temperature increasing.

(4) Crankshaft speed and position sensor

This system adopts electromagnetic crankshaft speed and position sensor with inner composition of watered magnet round cylinder and coil. Crankshaft speed and position sensor are fixed on transmission housing, corresponding with sensor signal gear tooth. Sensor signal gear has 60-2 teeth. When 1-4 cylinder is in Top Dead Center position，the sensor is at the 20^{th} tooth counting from signal gear absent tooth; and when 2-3 cylinder is in Top Dead Center position，the sensor is at the 50^{th} tooth counting from signal gear absent tooth.

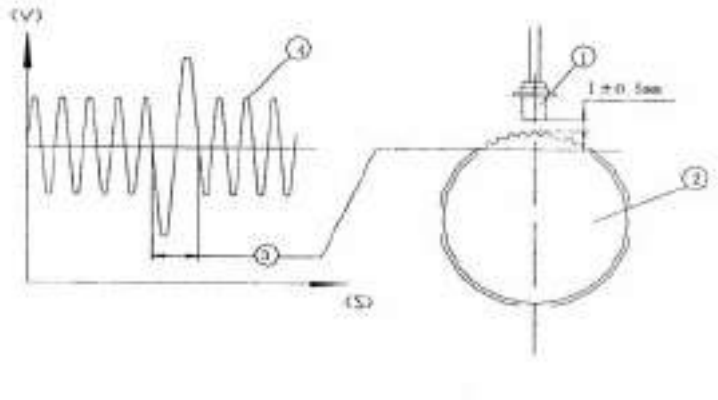


Fig 7. Crankshaft speed and position sensor Operation Theory

1. Crankshaft speed and position sensor 2. Signal gear 3. Corresponding signal with 2nd absent tooth 4. Signal

Besides identification of Top Dead Center position，signal can be used by ECU for:

-Managing of ignition (ignition advance angle and charging duration)；

-generating rotaional speed signal；

-Confirming synchronization of each engine revolution by identifying the two absent teeth.

Under the condition of other factors not changing, the peak value of sensor output voltage is determined on the distance between crankshaft rational speed and position sensor and gear tooth. The clearance between the head of crankshaft rotational speed and position sensor and the top of signal gear tooth is 1±0.5mm.

(6) Oxygen sensor

Oxygen sensor is used for detecting the content of oxygen in exhaust, which is a major component for ensuring actual air/fuel ratio of engine to approaching theoretical air/fuel ratio.

Oxygen sensor is mounted on the exhaust front pipe, before 3-way catalyst converter. Oxygen sensor mainly consists of a ceramics shell made of zirconium oxidize，on which the internal/external surface of closed side is coated with platinum, with a protect tube out the ceramics and a metal housing out the ceramics for protecting. The external surface of zirconium oxidize is exposed to exhaust gas and internal surface is exposed to atmosphere.

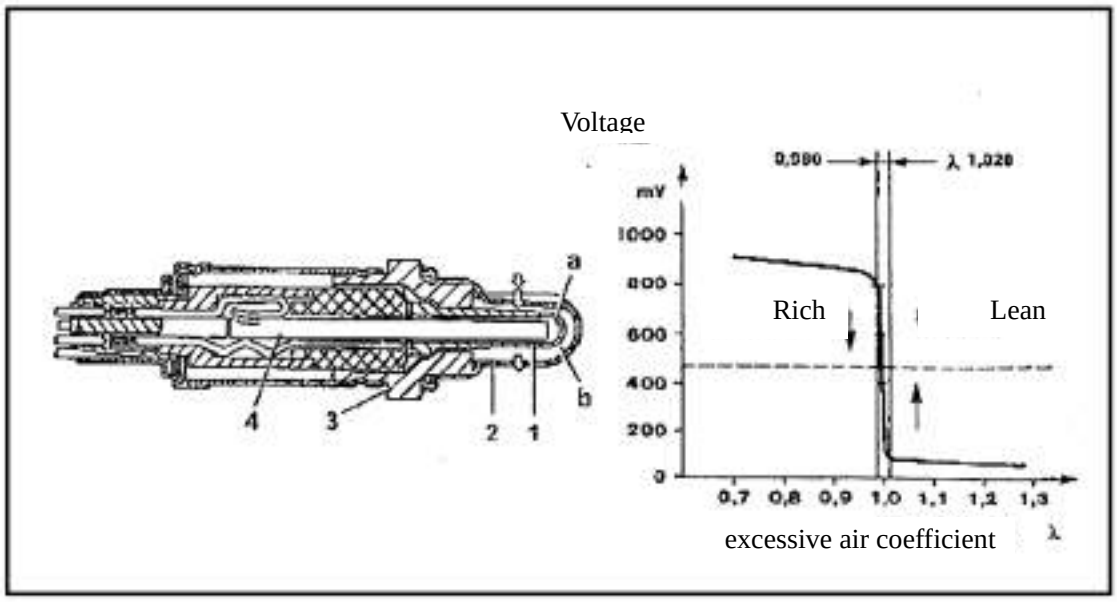


Fig 9 Oxygen Sensor and Performance Character Chart
ceramics body 2. Protecting tube 3.outer metal shell of sensor 4. heating resistor
a. signal positive(+) , exposed to air b. signal negative(-) exposed to exhaust gas

Oxygen sensor operation theory: when temperature is over 300℃， zirconia can separate ox ion from of oxygen in the exhaust gas passing through oxygen sensor. If contents of oxygen in two sides of oxygen sensor are different, a potential difference between two sides will generate. Measuring the potential difference will obtain the difference of oxygen contents between two environments (gas air side and exhaust gas side), and then the information will be sent to ECU. Due to different voltage is corresponding to different air/fuel ratio, ECU can control fuel injection of injector to regulate gas air/fuel mixture, making air/fuel mixture approach theoretical value to realize closed loop control. Under fuel cutting-off and engine full load condition, oxygen sensor does not operate, which is called open loop.

The oxygen sensor is heated oxygen sensor, which can enter operating mode much early. Under normal operating condition, oxygen sensor voltage periodically varies within 0.1～0.9V.

Note: Because lead has inhibitory action to platinum oxidation and leaded gasoline will make oxygen sensor lose function quickly and deteriorate exhaust gas. Therefore leaded gasoline is absolutely forbidden.

(7) 3-way catalyst converter

3 way catalyst converter is installed on exhaust, before muffler and can decrease 3 kinds of pollutants' content in exhaust gas simultaneously: carbon monoxide (CO), unburned hydrocarbon (HC) and oxide (NOX). When the air/fuel ration of engine is approaching to theoretical air/fuel ratio, the catalyst efficiency of 3-way catalyst converter reaches the maximum. When harmful gas under 300℃～800℃ pass through the center of 3 way catalyst converter, it will be catalyzed by precious metal on the ceramic element, taking oxidizing and reducing reaction, and converts to harmless gas.

4. Ignition system

Ignition system is a grouped electronic control ignition system (1—4 cylinders in one group, 2—3 cylinders in the other group). The ignition system is integrated with fuel injection system, which is an electronic system with a built-in power supply module, and canprovide with all kinds of optimal ignition value Upon input instaneous physical parameters related with engine operating condition, all kinds of optimal ignition values can be wrote into program via a managing circuit.

ECU controls 2 primary coils on and off. Secondary coil will generate a high voltage due to secondary induction when primary coil current is suddenly cut off, and 1-4 cylinder and 2-3 cylinder spark plugs connected to secondary coil final terminal via ignition wire will obtain high voltage and therefore firing is achieved.

Basic ignition advance angle is regulated and determined upon engine coolant temperature and air temperature. Under most conditions, ECU dynamically compensate basic ignition advance angle upon engine rotational speed and air intake manifold absolute pressure to obtain optimum ignition advance angle. Under a very low engine idle speed condition, ignition advance angle keep constant.

(2) Static state high voltage output ignition coil

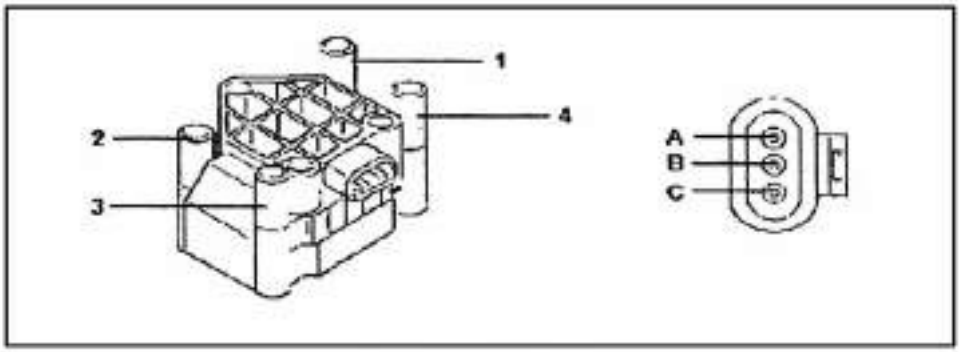


Fig 10 Ignition Coil Schematic

1. Cylinder-1 ignition terminal 2. cylinder-2 ignition terminal 3. cylinder-3 ignition terminal

The system uses a closed magnetic circuit coil packed in a plastic container with a coat of epoxy outside, which has special ability of non-electric conduct, mechanicalness, thermal characteristic and high temperature resistance. The part of primary coil near iron core lessens the flow of magnetic current causing secondary coupling can reach maximum and has the following capabilities:

- High ignition voltage storage;

-High energy transmission performance of secondary coil;

-Long ignition duration;

- Rapid secondary voltage increasing

(3) Knock sensor

High temperature, mechanical parts aging and wearing, low octane gasoline etc may be possible knock causes. Since knock may damage engine, to prevent continuous knock,,

advanced identification and correction strategy such as enrich air/fuel mixture shall be adapted to reduce ignition advance angle.

Operational theory: Knock sensor consist of piezoelectric non-resonant quartz and converts electric signal into mechanical energy in form vibrations. The sensor is connected to engine ECU through a shielded wire. When knock occurs, ECU will receive peak values of high-energy signal, which is discriminable from normal combustion signal. During knocking, air/fuel mixture shall accordingly enrich to ensure exhaust temperature is within the safe specification when appropriate reducing of ignition advance angle is needed,

The knock sensor is installed on the cylinder body between cylinder2 and cylinder3, on the side of intake manifold. Tighten torque is 19.6±4.9Nm. USE SPECIAL CARE to this torque specification.

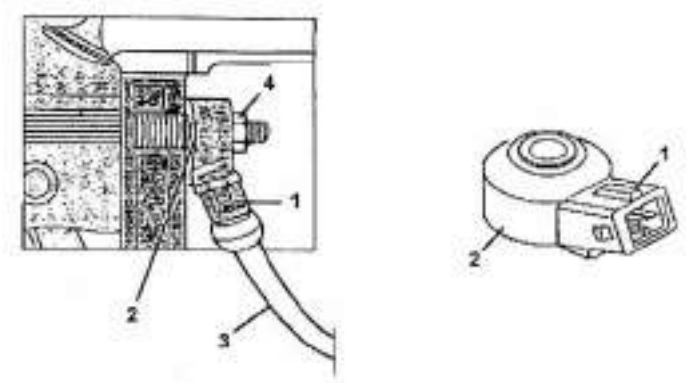


Fig 11 Konck Sensor

1. Knock sensor connector 2. Knock sensor 3. Sensor wiring 4. locking nut

5. Preventing fuel from evaporating and fuel vapor recycle system

By this system, fuel vapor formed in fuel tank and fuel feed system is combusted in engine combustion chamber after filtering, prevent fuel vapor from being exhausted into atmosphere.

(1) Active carbon canister

Active carbon canister is used for absorbing and storing fuel vapor in fuel tank and fuel vapor is then transferred into air intake manifold through carbon canister control solenoid.

(2) Carbon canister solenoid

Under the control of ECU, carbon canister solenoid has the following functions:

1. When ngine stop running and under stop condition, carbon canister solenoid prevent fuel vapor in fuel tank from entering air intake manifold. When ignition key is turned to MAR position, closed carbon canister solenoid will start to work. l start to work.

2. At the stage of engine start-up, carbon canister keep closed to prevent fuel vapor over enriching air/fuel mixture, which will last till engine

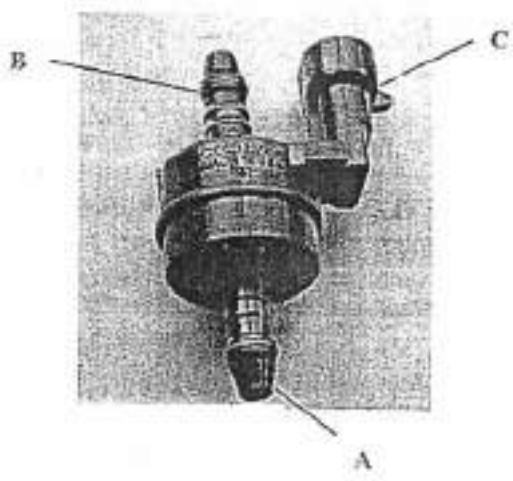


图 12 碳罐电持阀

A. 进气歧管侧 B. 活性炭罐侧 C. 电器接头

coolant temperature reaches specified value (about 65℃). When engine warming up, ECU will send a square wave signal to carbon canister. Carbon canister on and off is regulated by cycle ratio of signal itself. Therefore ECU may control fuel vapor quantity input to intake manifold, preventing mixture richness making an abrupt change.

When throttle is at idle position, engine speed less than 1500 rpm, intake manifold pressure lower than a preset value and air/fuel mixture richness self-adapt, carbon canister solenoid keep closed to ensure an more optimum engine performance.

(3) Fuel tank ventilation safety valve

it has the following functionsThe valve is installed on filter cover and has following functions upon pressure inside fuel tank:

1. When pressure inside fuel tank exceeds 0.1—0.18bar, fuel vapor will be given out from outlet (safety function).

2. When 0.020—0.030bar vacuum is generated in the fuel tank, air is drawn in (ventilation function)

6. Engine anti-theft system (optional)The engine anti-theft unit is an alien frequency radar anti-theft unit.

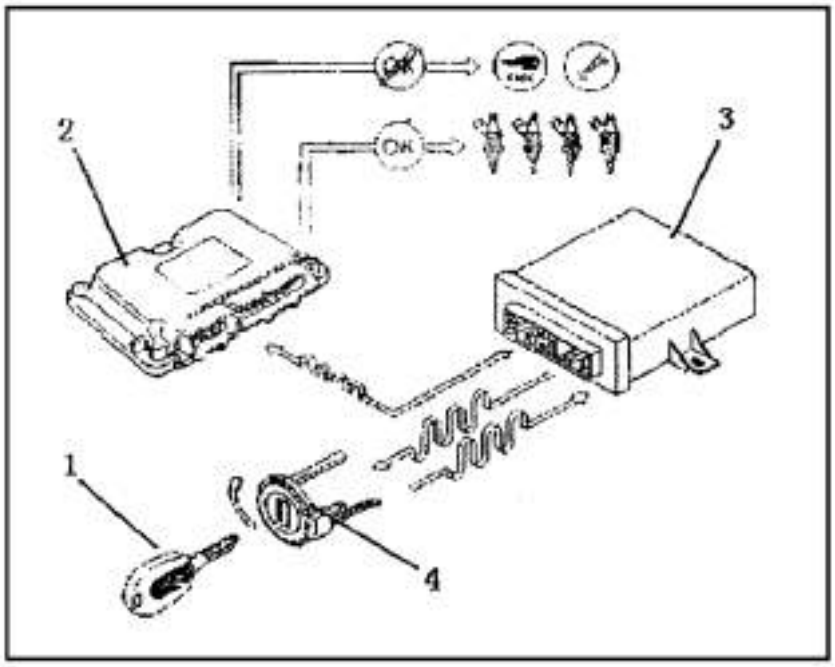


Fig 13 Engine anti-theft unit schematic

1. Anti-theft ECU (ignition key) 2. Engine ECU 3.Anti-theft unit ECU

The alien frequencies radar anti-theft system is an electric device, connecting with engine control system, prevent vehicle from disoperation. One of characteristics engine anti-theft unit on and off need no additional operation by user. When use alien frequency radar transponder, the function is on as the key turns off and the function is off as the key turns on. Each time the key turn on, the engine ECU needs a special authentication code. The authentication code is processed upon code stored in ignition switch circuit. Only this condition meets can the engine start.

Alien frequency radar anti-theft unit mainly consists of 3 components: anti-theft ECU, antenna and transponder.

Anti-theft unit ECU is in a black plastic box and usually located on instruments panel. Its electric device is in-line with alien frequency radar transponder and connects with engine ECU. Antenna is fixed in a special channel in ignition switch and consists of copper coil wrapped by a plastic jacket and a connector, which can connect with anti-theft ECU. The

structure of anti-theft ECU is as shown in fig 14.

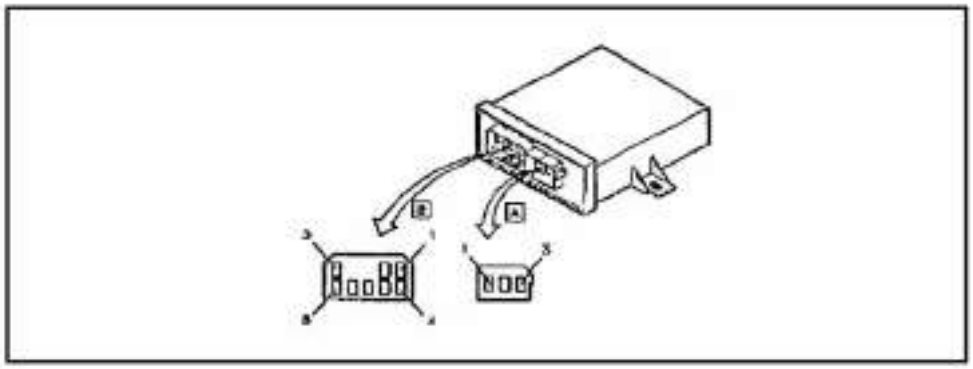


Fig 14 Anti-theft ECU

Anti-theft ECU pin definition

8-pin connector		3-pin connector	
1	Not used	1	Antenna positive
2	warning indicator	2	not used
3	+30(12V)	3	Antenna negative
4	ground		
5	Not used		
6	to ECU serial surface		
7	Not used		
8	+15 (ignition switch positive)		

Warning indicator

Warning indicator on instruments panel is controlled by anti-theft ECU, indicating user state information. Warning indicator will flicker under following conditions:

1. The key is stored;
2. 2.5 seconds after the key turned on, the warning indicator begins to flicker, indicating system is operating but engine will not be protected until the key is stored.

5. Electronic Control Fuel Injection System Maintenance

(1) Fuel

ONLY high quality vehicle unleaded gasoline of RESEARCH RULE octane value RON90 or above (conform to SH0041 standard, lead content〈=0.005g/L〉, otherwise, the electronic control fuel injection system and 3 way catalyst converter will be damaged, affecting exhaust performance.. In addition, sulfur or lead can damage heated oxygen sensor.

(2) Start-up

The electronic control fuel injection system can provide appropriate injection fuel width under all conditions. Therefore depressing pedal is not necessary before or after hot or cold

start.

During engine starting, if throttle is at wide open position, injected fuel will reduce a lot, which providing a method of cleaning fuel from fuel spilling engine and need not remove and wash spark plug.

It may take a long time to start engine during first starting (new car or after repairing fuel system) because fuel pipe need to be charged with appropriate fuel pressure. After repairing or refilling fuel again, turn ignition key to ON position and wait for 3 seconds, repeat procedures for several times to recover fuel rail pressure.

3. Stall

Let engine idle for some time before stalling, which will let engine cool down gradually, decrease heat impact strength, and do good for prolong engine operating components and 3 way catalyst converter life time.

4.Fuel circulation

Fuel pressure is up to 3.5 bar, therefore fuel inlet and return circuit must be firmly connected and fastened with clamps.

During checking fuel circuit, starting engine after fuel rail and fuel pipe being removed is absolutely forbidden. Otherwise fuel will flow out and may cause fire hazard. Fuel pressure must be relieved before removing fuel system components.

Fuel pressure regulator blockage or fuel return pipe restriction will cause incorrect fuel circuit pressure.

5.Fuel injector

If vehicle is not driven for a long time, the engine should be started for 3~5 minutes every 2~3 months to avoid fuel injector blocking. Fuel injectors shall be washed at least every one year. Fuel injector O ring is life time component and can not be reused.

6. 3 way catalyst converter

When ignition switch is at ON position or engine is under normal operating condition, checking firing by removing spark plug or ignition wire is absolutely prohibited. before check firing, remove all fuel injector connectors, spark plugs and then connect spark plug to corresponding cylinder high-tension wire ensuring spark plug thread part is reliably grounded on cylinder body, start engine and check firing. Otherwise catalyst will be damaged.

NOTE: If the engine has been running for a long time, the 3 way catalyst converter will be very hot. Do remember to wear protecting glove when servicing to avoid scalding.

7. Throttle body

Adjustment to anti-stuck screw on throttle valve body by user is forbidden. This screw position is precisely adjusted when assembled at factory. Improper adjustment may cause high idle speed, engine stalling or idle stability, exhaust and fuel economic performance to be affected.

8. Engine error indicator

Engine error indicator is located on front instruments panel. When serious error occurs, engine error indicator will light. Such case must be repaired by professional person using appropriate tools immediately once occurs.

9. Miscellaneous

Electric fuel injection system frequent problems are caused by poor contact, therefore al connecting points must be clean and have good contact. .ECU is of high quality component, and itself seldom has problem. When checking, must use special tool and do not remove and

perform unwarranted repairing.

When ignition is on, DO NOT remove any electrical devices to avoid electric components being damaged by inductive electromotive force generated in circuit.

6. Electric fuel injection system faults and repairing

1. Basic knowledge for electric control fuel injection system repairing

The electric control fuel injection system is a complicated system. Operational person should have a good command of system theory, structure, repairing procedures and tester using methods. When repairing an engine problem, which may has relation with electric fuel injection system, determine if the problem related with electric fuel system first. If engine fails and indicator does not light, it is generally not related with electric fuel injection system and should be checked and repaired as a carburetion engine.

When checking and repairing, some instruments and gauges are often used. Frequently used instruments and gauge include special scan tester, circuit test light, voltmeter-ohmmeter and oscilloscope etc.

Main methods for checking electronic controlled components includes ohmmeter, voltmeter method, scan tester methods etc. Ohmmeter is often used to measure electronic controlled components resistance under all conditions. Voltmeter is often used to measure electronic controlled components voltage under all conditions and scan tester is used to determine if an electronic controlled component operative upon indicated value on display (such as monitoring coolant temperature sensor, air intake temperature pressure etc.)

2. Electric control fuel injection system problem diagnostic precaution

(1) No matter engine is running or not, when ignition is on, any electrical units absolutely CAN NOT be removed, such as any battery lead, idle control valve, fuel injector, electric fuel pump, ignition system cable, ECU circuit, A/C circuit.

(2) When checking ignition circuit, fuel pipe and electrical circuit to be tested must be disconnected before starting engine. Disconnecting ignition wire is absolutely forbidden when engine is running.

(3) Ohmmeter and indicator used to check sensor and electric controller resistance must be over than 10kΩ, otherwise sensor and ECU may be damaged.

(4) ECU is a high quality integrated circuit, the failure ratio is very low, and do not suspect its failure.

(5) Preventing water splashing to system wiring harness and sensor which will cause short.

(6) Before welding vehicle circuit, removing battery negative terminal.

(7) Electrical arch welding operating must be far away from ECU and sensor

3. Electric control fuel system fault and repairing

(1) Engine does not start or hard to start

No	Problem causes	Actions
1.	Fuel injector fault	check if fuel injector operating condition normal using scan tester.
2	Crankshaft speed and position sensor fault	Using feeler gauge, check clearance crankshaft speed and position sensor head and signal wheel tooth top. Check sensor circuit.
3	ECU socket fault	Check if good contact between socket and ECU.
4	Idle speed control valvel fault	Using scan tester, check idle speed control valve operating condition, and inspect if connector contact is good.
5	Loosen throttle valve body mounting screw	Tighten throttle valve body mounting screw

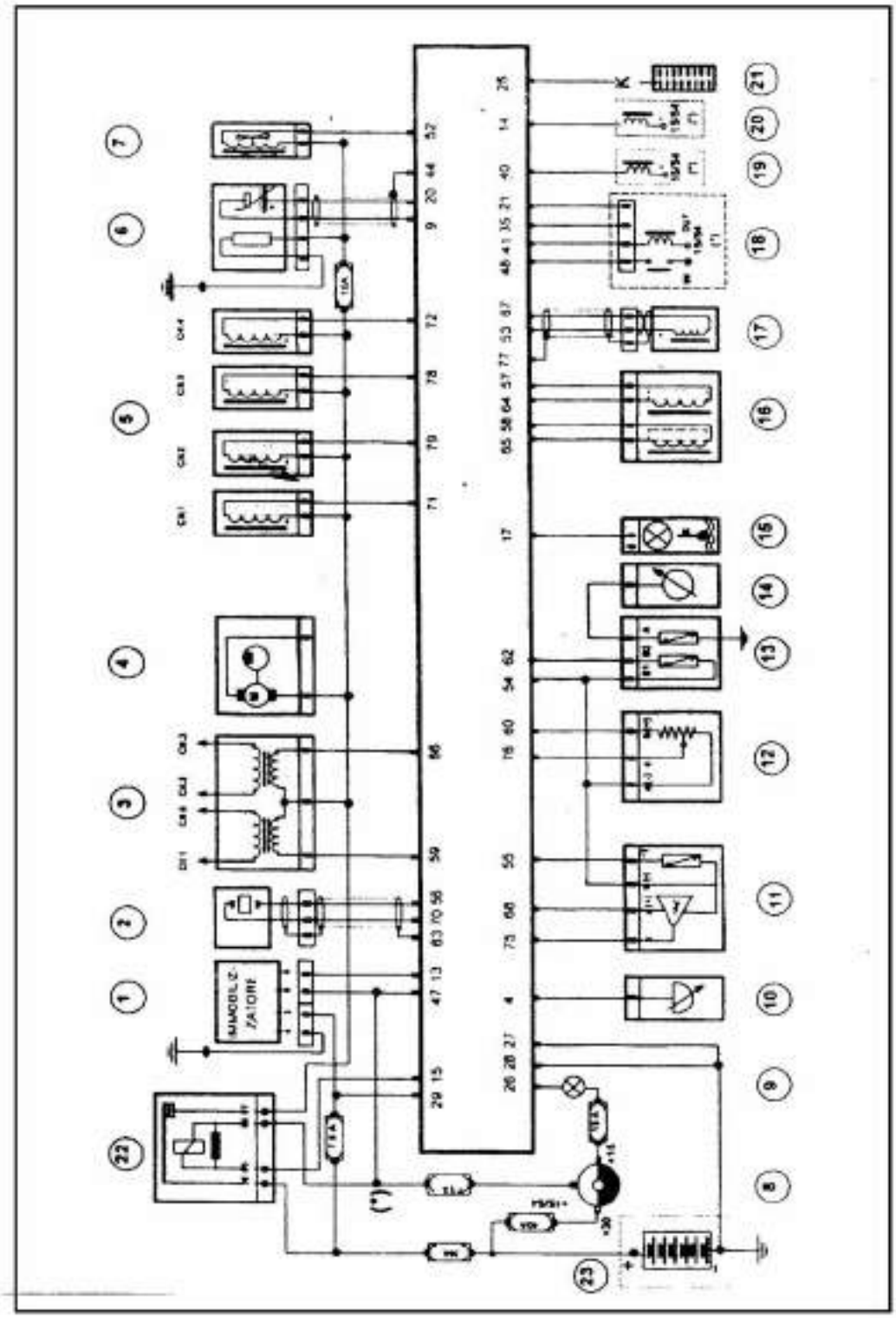
(2) Insufficient engine power

No.	Problem Causes	Actions
1	Poor electric fuel pump operation	Check if all connections good. Check electric fuel pump, replace as necessary.
2	Blocked fuel filter or pipe	Check if fuel filter and fuel pipe blocked, clean or replace fuel pipe as necessary.
3	Insufficient or unstable fuel feed pressure	Check fuel circuit and electric fuel pump. Check if fuel injection pressure is within specification.
	Insufficient air intake	Check air intake pipe
	Damaged fuel injector	Check fuel injector performance data and injection hole, replace as necessary
3	Damaged air intake pressure sensor	Check air intake pressure sensor performance data, replace as necessary.
	Damaged crankshaft speed and position sensor	Check crankshaft speed and position sensor performance data, replace as necessary/
	Damaged throttle position sensor	Check throttle position sensor performance data, replace as necessary.
	Optimum ignition time not reached	Replace ECU

(3) Unstable idle speed

No.		Problem Causes	Actions
1	throttle valve body	Air leakage	Fasten throttle valve body mounting screw.
		Failed idle control valve	Repair or replace the throttle valve body
		Failed throttle position sensor	Check throttle opening. Check if throttle position sensor operating parameter within specification.
		Abnormal throttle opening	Check if throttle cable installed correctly.
			Move throttle and check if throttle stuch.
			Check throttle opening (angle is within 0~0.6 at throttle is closed)
			If throttle angle is correct, check if throttle position sensor connector contact is good.

Wiring
diagram



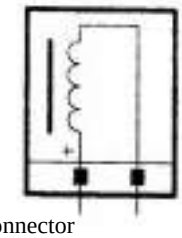
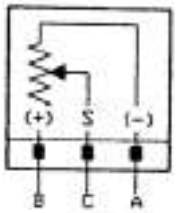
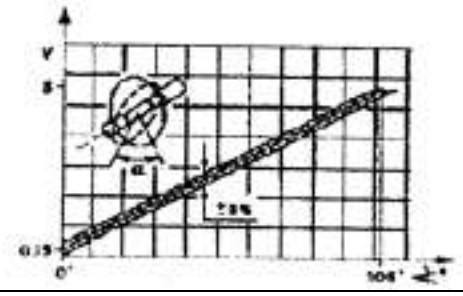
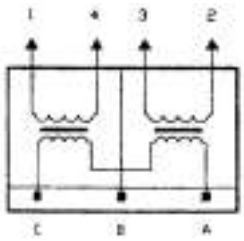
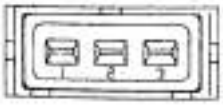
Key words

1.ECU anti-theft device
2.knock sensor
3.ignition coil
4. fuel pump
5.fuel injector
6.oxygen sensor
7.carbon canister solenoid
8.ignition switch
9.System failure warning indicator
10. speedometer
11.air pressure/temperature sensor
12 throttle position sensor
13.coolant temperature sensor
14.coolant temperature meter
15.coolant overheat indicator
16.idle step motor
17.Top Dead Center/speed sensor
18.A/C
19.Fan relay (first stage speed)
20.Fan relay(second stage speed)
21.diagnostic socket
22.relay
22.relay
23.battery

Diagnostic Socket

Vehicle is equipped with lots of ECU self-diagnostic functions; therefore a single 16-pin connector (called EOBO type connector) is used for performing self-diagnostic. Connect diagnostic socket and tester with an appropriate adapter. Select specified diagnostic cable upon used ECU.

Appendix 2：Electrical Components Specification

Part ： Electrical fuel injector Code：IWP116 	Internal expanded view  Connector 	Specification： Fuel injector shape, single hole Operating temperature：-30℃～+110℃ Nominal resistance：13.8～15.2Ω10%(at 20℃) voltage：12V fuel injection pressure：3.5bar
Part ： Throttle valve position sensor (irreplaceable) code：IPF2C 	Internal expanded view  Connect  A=Negative B=Power supply (+5V) C=signal	Specification： Effective electric power angle：90 ° ±2 Mechanical angle：105 ° ±4 ° Full mechanical travel：110 ° ±8 ° Temperature operating range：-30℃～+125℃ Resistance between A and B =1200Ω 20%(at 23℃) 
Part：Electric fuel injector Code：BQE02 	Internal expanded view  Connect 	Specification： Primary coil resistance (A-B or C-B) 0.4Ω±10%(at 23 ° ±5 °) HTtap secondary coil resistance (1—4 cylinder or 2—3 cylinder)； 4900Ω10%(at 23 ° ±5 °)