UNI-K

• Engine Electronic System

UNI-KRM2G/1/1

3.1.10 Starting system

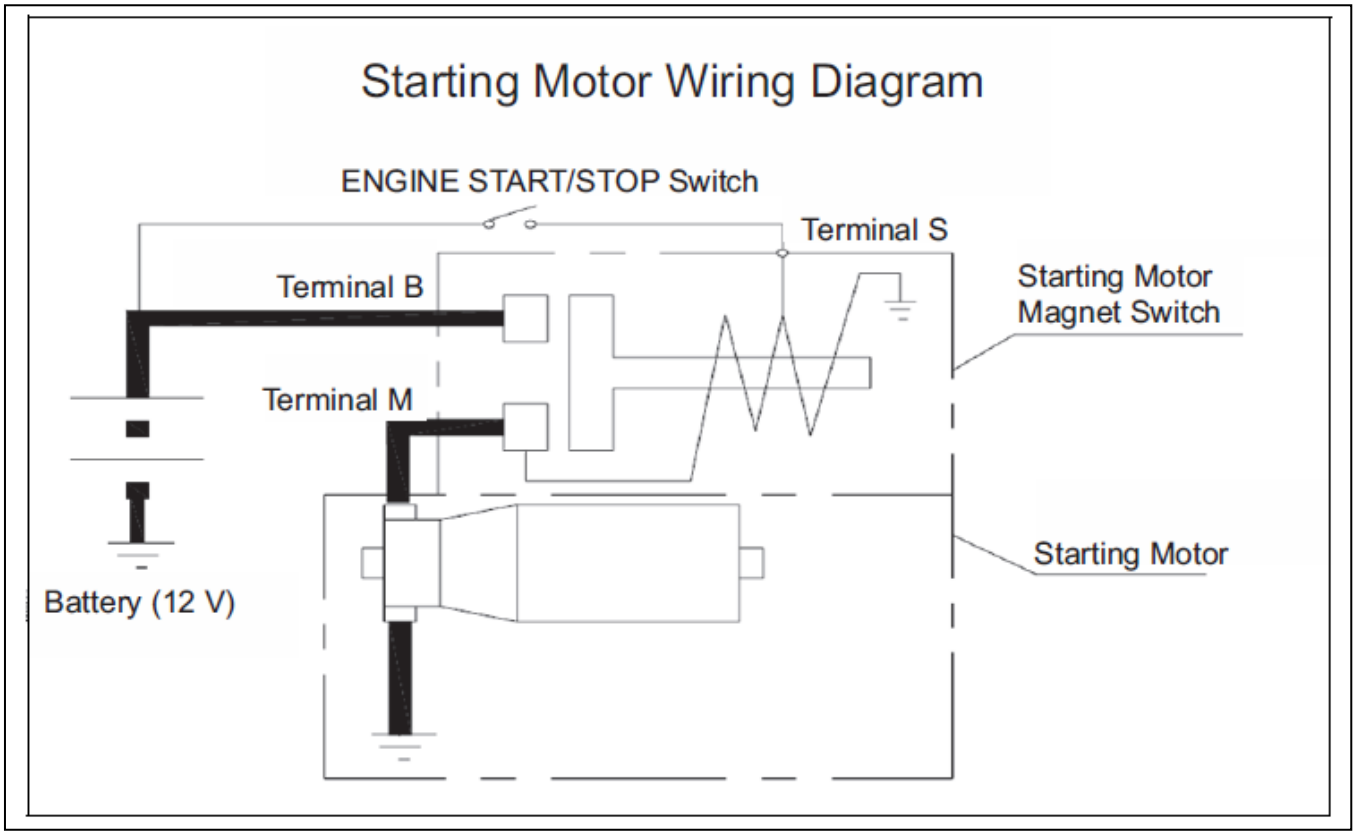
Description and operation

System overview

The starter system mainly consists of battery, ignition switch and starter motor related circuits, all of which are connected by electric wires. When the ignition switch is set to the "ST" position, the power supply supplies the starting motor electromagnetic switch. The electromagnetic switch coil generates a magnetic field to cause the moving iron core and gear transmission rod to move, causing the pinion to mesh with the engine flywheel ring gear. The electromagnetic switch contacts are closed and the starting starts.

When the engine starts, the pinion overspeed clutch protects the armature and prevents the flywheel drive pinion from driving the armature until the switch is disconnected. At this time, the return spring causes the pinion to disengage.

Starter assembly working principle



Use the vehicle key to turn on the ignition switch of the vehicle, power on terminal S of the starter motor electromagnetic switch, pull in the electromagnetic switch, and eject the starter motor unidirectional device to the meshing position with the engine flywheel. At this time, the terminals M and B of the electromagnetic switch are turned on, the battery current flows into the starter, the starter starts to run and drives the flywheel to start the engine; After the key switch is reset, the starter S terminal is powered off, the unidirectional switch is returned, the electromagnetic switch M and B terminals are disconnected, and the starter stops working.

Basic parameters of starter assembly

Index	Conventional starter
Rated voltage	12V
Power	1.2KW
Power supply performance	12 V, 60Ah

General inspection

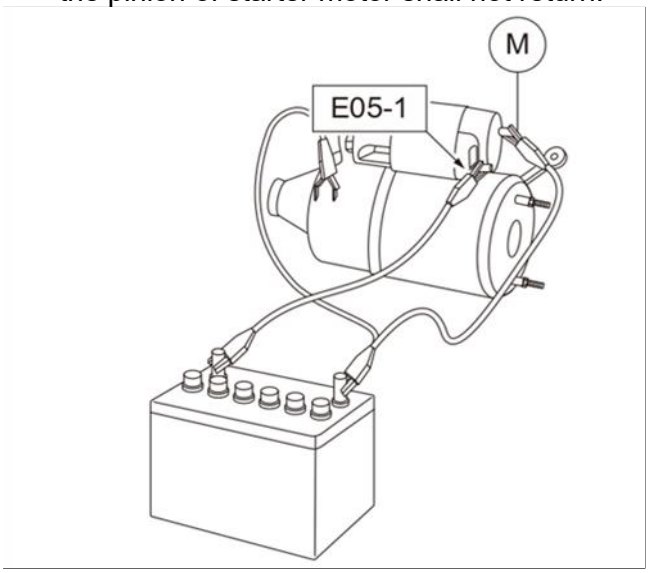
General equipment: Multimeter

Warning: Each test must be completed within 3~5 seconds to avoid coil burnout.

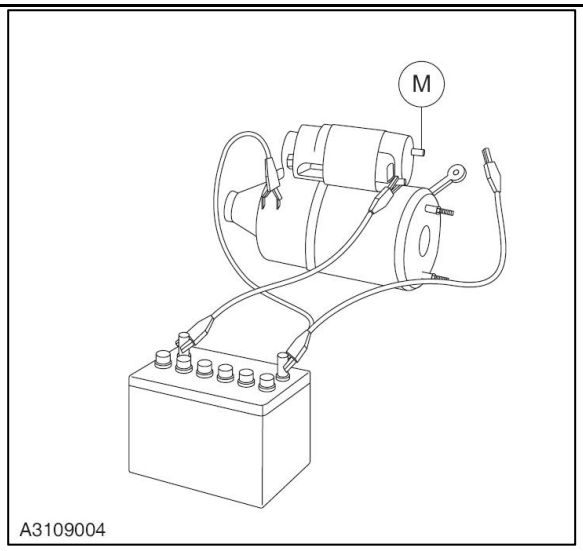
Electromagnetic switch test

Note: The excitation coil and terminal "M" must be disconnected before the test.

1. Remove the starter motor armature wire from the solenoid switch.
2. Use jumper wire to reliably connect starter motor housing and electromagnetic switch housing with battery negative pole.
3. Connect one end of the other jumper wire to battery positive, and the other end to terminal 1 of starter motor harness connector E05.
4. The pinion of the starter motor should move out.
5. Remove the negative wire of "M" terminal, and the pinion of starter motor shall not return.

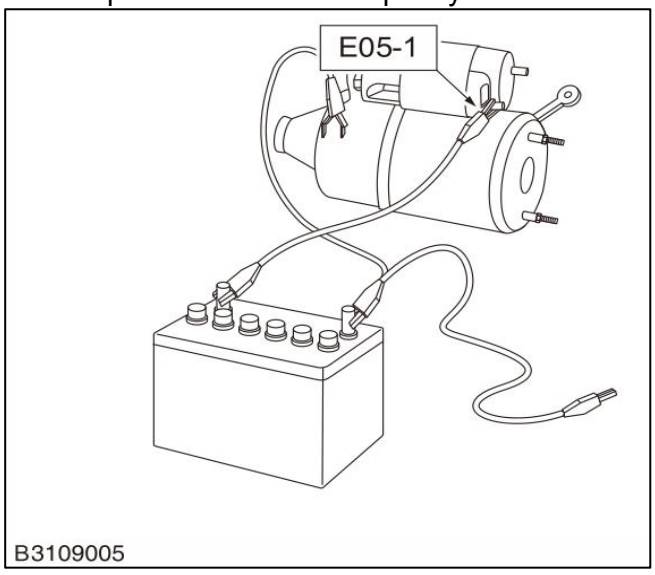


6. Connect the lead pinion as described above, then remove the negative lead of "M" terminal, and check whether the pinion rotates outwards; otherwise, replace the electromagnetic switch.



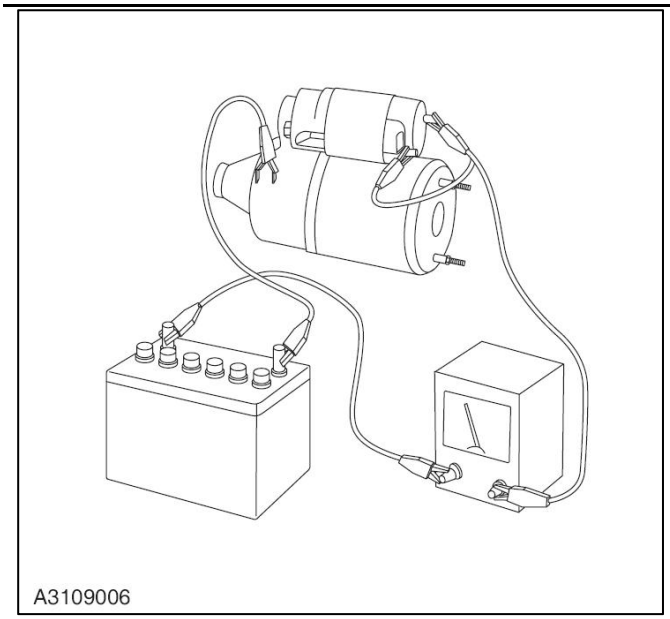
Pinion return test

1. Use jumper wire to reliably connect starter motor housing and electromagnetic switch housing with battery negative pole.
2. Use another pivot jumper wire to connect one end to battery positive, and the other end to connect terminal No.1 of starter motor harness connector E05.
3. The pinion of the starter motor should move out.
4. Disconnect the battery positive jumper wire and the pinion should return quickly.



No load test

1. Make sure that the battery is fully charged.
2. Connect the starter motor, battery and tester as shown in the figure.
3. Run the starter motor and confirm it rotates smoothly. If the starter motor does not rotate smoothly, check the starter motor device.
4. Measure the voltage and current while the starter motor is running.
5. If not, replace the starter motor.



Fault symptom diagnosis and test

General equipment

Multimeter

Inspection and confirmation

1. Confirm the customer's problem.
2. Visual inspection for visible mechanical or electrical damage Trace.

Appearance check list

Mechanical	Electrical
Starter motor	Fuse Battery Starting relay Harness Loose joint or corrosion

3. If the observed or raised problem is obvious and the cause has been found, the cause must be corrected before proceeding to the next step.
4. If the problem passes visual inspection, confirm the fault and refer to the fault symptom table.

Fault symptom table

If the fault occurs but no DTCs are stored in the ECM and the cause of the fault cannot be confirmed in the basic inspection, the fault diagnosis and rule out shall be performed according to the sequence listed in the following table.

Symptoms	Possible causes	Measures
Starter cannot run	• Battery • Start relay • circuit • Starting motor • Ignition switch	• The starter cannot run the diagnostic process
Starter cannot stop running	• Ignition switch • Start relay • Starting motor	The • starter cannot stop the diagnostic process.
Starting motor running slowly diagnosis process	• Battery • Start relay • circuit • Starting motor • Ignition switch • Belt drive system	

Starter fails to run diagnostic process

Test	Details/Results/Measures
1. General inspection	
	A. Inspect the battery positive and negative harness plug for damage, oxidation and connection. Signs of poor contact, loosening, etc. B. Inspect whether the harness connector between battery positive electrode and starter is broken. Signs of damage, aging, poor contact, loose, etc. C. Inspect the engine grounding connection harness plug for damage, aging, Poor contact, loose, etc. Check whether the result is normal? ? Yes Go to step 2. ? No Repair the fault point. Signs of poor contact, loosening, etc. B. Inspect whether the harness connector between battery positive electrode and starter is broken. Signs of damage, aging, poor contact, loose, etc. C. Inspect the engine grounding connection harness plug for damage, aging, Poor contact, loose, etc. Check whether the result is normal? ? Yes Go to step 2. ? No Repair the fault point.
2. Check fuse	
	D. Check starter control circuit fuse SB08. Rated capacity of insurance: 40 A Is the fuse normal? ? Yes Go to Step 3. ? No Overhaul the safety circuit and replace the rated capacity safety.
3. Check battery	

	A. Check the battery voltage. Standard voltage: 11 ~ 14 V Is the voltage normal? ? Yes Go to Step 4. ? No Charge the battery. Reference: 3.1.11 charging system Or replace with a new battery. Reference: 3.1.11 charging system
4. Check starting relay	
	A. Replace a new relay. B. Turn the ignition switch to "ST" position. Is starting normal? ? Yes Replace the relay. ? No Go to Step 5.
5. Check ignition switch	
	A. Turn the ignition switch to "LOCK" position. B. Disconnect ignition switch harness plug P37. C. Turn the ignition switch to "ST" position. D. Measure terminal 4 and terminal 5 of ignition switch harness plug P37. Resistance between. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Go to Step 6. ? No Replace the ignition switch.
6. Check starter power supply circuit	
	A. Measure terminal 1 pair of starter motor solenoid switch harness plug E04. Ground voltage. Standard voltage: 11 ~ 14 V Is the voltage normal? ? Yes Go to Step 7. ? No Repair or replace the relevant harness.
7. Check power supply circuit of electromagnetic switch	

	A. Replace a good starter motor relay. B. Whether the ignition switch is turned to "ST" position is started normally? ? Yes Replace start relay. ? No to step 6
8. Check starter motor	
	A. Perform no load test. Reference: 3.1.10 starting system Is the starter motor tested qualified? ? Yes Replace the starter motor electromagnetic switch. Confirm the system is normal. ? No Replace the starter motor. Reference: 3.1.10 starting system
9. Check power supply circuit of electromagnetic switch	
	A. Turn the ignition switch to "LOCK" position. B. Remove relay ER12 of engine compartment electrical center C01. C. Disconnect starter motor electromagnetic switch harness plug E03. D. Measurement of engine compartment electrical center C01 relay ER12 No.96 Terminal and starter motor electromagnetic switch harness plug E03 terminal No.1 Resistance between. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Go to step 10
10. Check power supply circuit of ignition switch	
	A. Turn the ignition switch to "LOCK" position. B. Remove fuse SB08 of engine compartment electrical center C01. C. Disconnect ignition switch harness plug P37. D. Measure No.65 of fuse SB08 of engine compartment electrical appliance center C01. Electrical between terminal and terminal 5 of ignition switch harness plug P37 Resistance. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Go to Step 11. ? No
11. Check relay ER12 control circuit	

	A. Turn the ignition switch to "LOCK" position. B. Remove relay ER12 of engine compartment electrical center C01. C. Disconnect ignition switch harness plug P37. D. Measure terminal 4 of ignition switch harness plug P37 and engine compartment. Electrical center C01 relay ER12 terminal 98 Resistance. E. Measurement of engine compartment electrical center C01 relay ER12 No.98 Resistance between terminal and body ground. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Go to Step 12. ? No Repair or replace the relevant harness.
12. Check grounding circuit of starting relay	
	A. Turn the ignition switch to "LOCK" position. B. Remove the starter relay ER12. C. Measure terminal 97 of starter relay ER12 and reliable grounding Resistance between. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Go to step 13. ? No Repair starter relay ER12 terminal No.97 and grounding G 302. Circuit for.
13. Replace engine compartment electrical center C01	
	A. Turn the ignition switch to "LOCK" position. B. Replace engine compartment electrical center C01. Confirm the system is normal.

Starting motor cannot stop running diagnostic process

Test conditions	Details/Results/Measures
1. Check automatic return function of ignition switch	
	A. Turn the ignition switch to "LOCK" position. B. Disconnect ignition switch harness plug P37. C. Turn the ignition switch to "ST" position, and quickly release the key. D. Measure terminal 4 and terminal 5 of ignition switch harness plug P08. Resistance between. Standard resistance: 10 MΩ or higher Is the resistance normal? ? Yes Go to step 2. ? No Replace the ignition switch.
2. check starting relay ER12	
	A. Replace a new relay. B. Turn the ignition switch to "ST" position, and quickly release the key. Does the starter motor stop? ? Yes Replace the relay. ? No
3. Inspect the starter relay control circuit is short to power supply.	
	A. Turn the ignition switch to "ST" position, and quickly release the key. B. Measurement of engine compartment electrical center C01 relay ER12 No.98 Voltage between terminal and body ground. Standard voltage: 0 V Is the voltage normal? ? Yes Go to Step 4. ? No Repair engine compartment electrical center C01 relay ER12 No.98 Circuit pair between terminal and terminal 5 of ignition switch harness plug P37
4. Inspect whether the power supply circuit of electromagnetic switch is short	

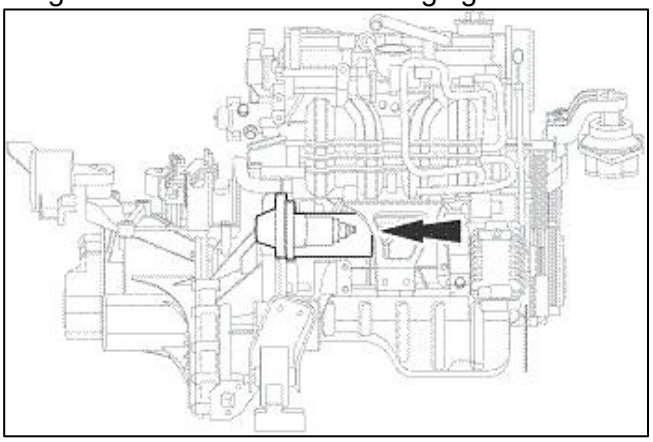
	A. Turn the ignition switch to "ST" position, and quickly release the key. B. Measure terminal 1 of starter electromagnetic switch harness plug E03 and vehicle Voltage between body ground. Standard voltage: 0 V Is the voltage normal? ? Yes Go to Step 5. ? No Repair terminal No.1 of starter solenoid switch harness plug E03 Between terminal 96 of relay ER12 of engine compartment
5. Replace starter motor	
	A. Turn the ignition switch to "LOCK" position. B. Remove the battery negative harness. Replace starter. Reference: 3.1.10 starting system Confirm the system is normal.

Starting motor running slowly diagnosis process

Test	Details/Results/Measures
1. General inspection	
	A. Inspect the battery positive and negative harness plug for damage, oxidation and connection. Signs of poor contact, loosening, etc. B. Inspect whether the harness connector between battery positive electrode and starter is broken. Signs of damage, aging, poor contact, loose, etc. C. Inspect the engine grounding connection harness plug for damage, aging, Poor contact, loose, etc. Check whether the result is normal? ? Yes Go to step 2. ? No
2. Check engine and belt drive system	
	A. Check whether the engine and belt drive system are stuck mechanically. Motor jamming, alternator jamming). Is there jamming? ? Yes Repair the stuck fault. ? No Go to Step 3
3. Check battery	
	A. Check the battery voltage. Standard voltage: 11 ~ 14 V Is the voltage normal? ? Yes Go to Step 4. ? No Charge the battery or replace it with a new one. Reference: 3.1.11 charging system
4. Check starter motor	
	A. Perform no load test. Reference: No load test 3.1.9 starting system, general inspection. Is the starter motor tested qualified? ? Yes Repair engine mechanical fault. Reference: 3.1.3 Mechanical system ? No Replace the starter motor. Reference: 3.1.10 starting system

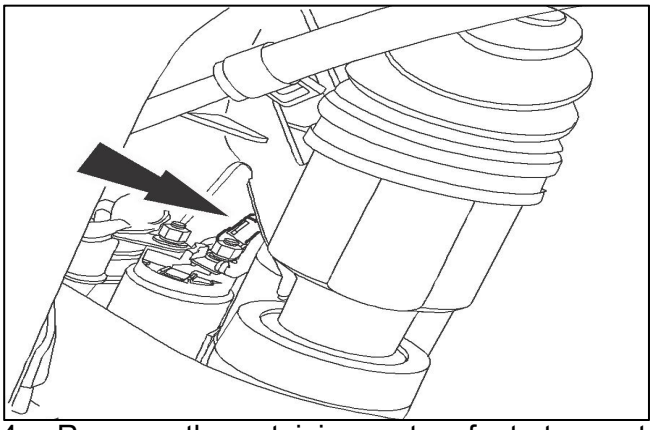
Removal and installation

The starter assembly is installed on the engine as shown in the following figure:

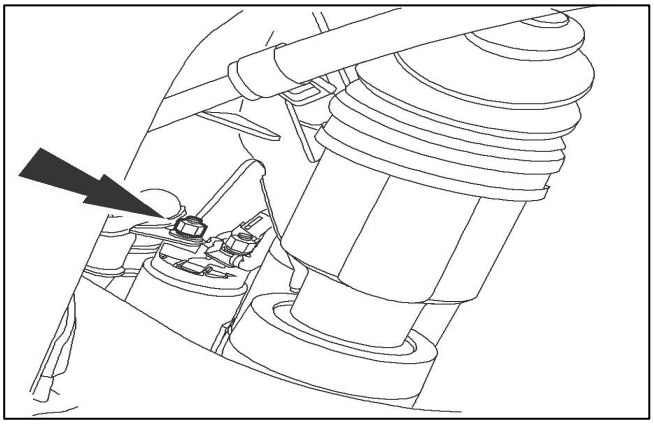


Removal

1. Disconnect the negative battery harness.
2. Jack up the vehicle and support it.
3. Disconnect the starter motor harness connector.

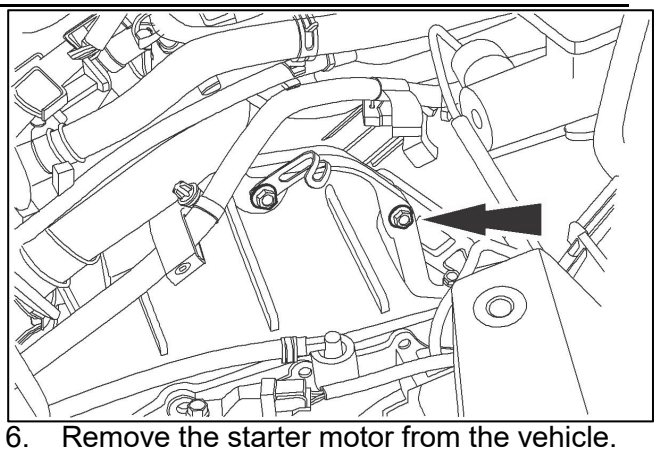


4. Remove the retaining nuts of starter motor solenoid switch harness.



5. Remove the upper and lower retaining bolts of starter motor.

- Separate the harness from the harness retaining clips.
- Remove the upper and lower retaining bolts of starter motor.



6. Remove the starter motor from the vehicle.

Installation

The installation sequence is the reverse of the removal sequence.

3.1.11 Charging system

Specifications

Component specification

Battery specification

Index	Common lead acid battery	AGM battery
Specifications	Maintenance-free L2	Maintenance-free L2
Mass	16.5Kg	17.8kg
Nominal voltage	DC12V	DC12V
20 h rated capacity	60Ah	60Ah
Reserve capacity	≥94min	≥100min
Charging acceptance	≥12A	≥15A
-18℃ Low temperature starting capacity	CCA ≥530 A	CCA ≥680 A

Battery sensor specifications

Index	Specifications
Working voltage range	6-18V
Sensor wake-up current	>250 mA, <-250 mA
Rated working current of sensor	<22.5mA
Sensor quiescent current after complete vehicle sleep	<0.15mA
Measure battery current range	±1500 A
Continuous working current	±155 A
Insulation resistance	≥10MΩ

Generator specification

Generator cold working performance

Index	Conventional generator/weak mixed generator
Rated working speed	6000rpm
Power generation voltage	14V
Rated generating current	140A

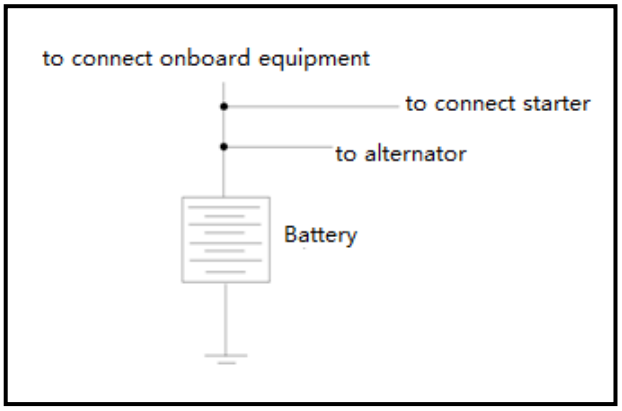
Generator hot working performance

Speed r/min	Output current A	Test voltage V
1,800	Greater than or equal to 80	13.5
2,500	Greater than or equal to 110	
6,000	Greater than or equal to 140	

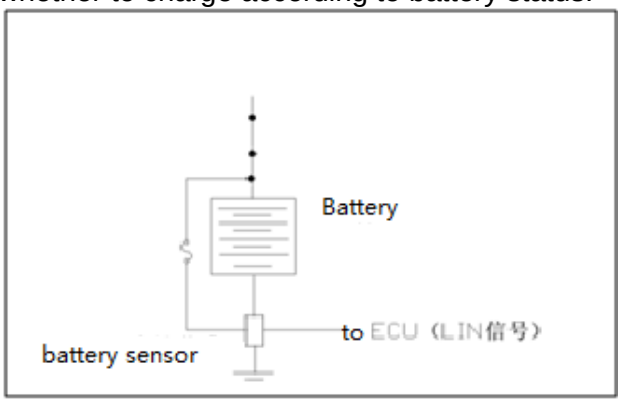
Description and operation

System overview

The common charging system usually consists of the generator and battery assembly. The voltage generated by the generator of the system is usually constant. With the increase of vehicle load, the generator increases the speed and power generation to meet the demand of larger load.



Intelligent charging system is composed of intelligent generator, battery sensor and battery assembly. Intelligent generator is controlled by ECU. Battery sensor collects voltage, current, temperature, SOH and SOC of battery assembly, and transmits information to ECU. ECU judges whether to charge according to battery status.



Component description

Alternator

Alternator features a solid state regulator inside.
Adjustment
All parts of the device are installed in a non-breathable box. Regulator power supply
The brush holder assembly is mounted on the slip ring and the frame together, and the setting power of the generator
Pressure cannot be adjusted.
The generator rotor bearing contains sufficient grease and does not need to be fixed.
Phase lubrication. Two brushes flow current through two slip rings to the rotor
Excitation coil. Under normal conditions, the brush can be maintained for a long time.
Protection.
The stator winding is mounted inside the laminated core, which is the alternator.
Frame element. There are 6 two rectifiers connected to the stator winding
Pole tube composition, which converts AC voltage on stator into alternator input
Output the DC voltage on the terminal. Central diode is used to handle neutral point
Voltage fluctuation is converted into DC to increase generator output.
Capacitor mounted on regulator assembly voltage diode
Protect and suppress interference from radio waves.

Battery

The vehicle adopts maintenance-free battery, which differs from traditional battery.
There is no vent plug on the battery cover, except for small ventilation on both sides of the battery.
The battery outside the hole is completely sealed.
Compared with conventional batteries, this battery has the following advantages:
1. There is no need to add supplemental fluid during the life of the battery.
2. Overcharge protection.
3. is not as easy to leak as conventional battery.
4. Smaller weight and volume, larger capacity.
Battery voltage is often low and the vehicle cannot be started after overnight. Consider the fault causes from the following aspects:
1. The electric equipment in the vehicle is not turned off overnight, resulting in overdischarge of the battery;
2. The driving speed is slow and the running time stops. The generator generates insufficient power at low speed;
3. Electrical load of the vehicle exceeds the generator output, especially of the vehicle Equipped with after-sales equipment;
4. charging system has fault, such as shortness of breath-way electric circuit and alternator belt. Slip, generator fault or voltage regulator fault;
5. Improper use of battery, including failure to maintain battery harness
Terminal is clean and fastened, or battery fixing pressure plate is loose;
6. Mechanical fault in electrical system, such as conductive short circuit or pinch;

Battery self-discharge

In theory, the self-discharge of battery is inevitable. Although the self-discharge of

maintenance-free battery is far less than that of ordinary battery, there is still a certain degree of self-discharge. Even if the open circuit is used for a long time, the battery charge will be obviously lost. Self-discharge of battery is mainly affected by the following factors:

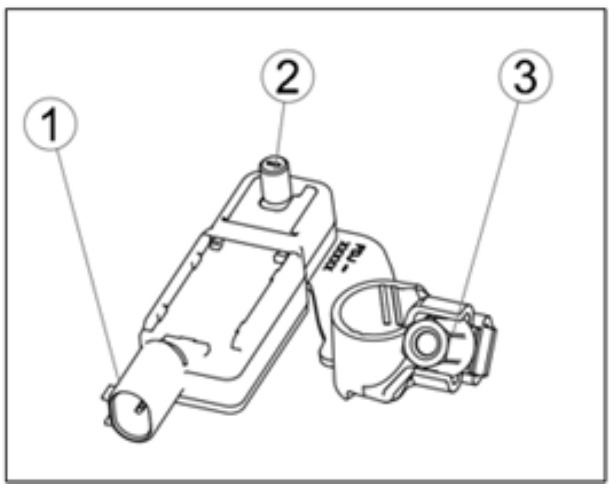
1. The higher the temperature, the higher the self-discharge rate. Generally, the self-discharge rate of the battery will increase by about 2.7 times every time the temperature increases by 10℃. The difference between the battery self-discharge rate of the vehicle stored in summer and winter is large;
2. The storage conditions have great influence, high humidity and high dust, which will aggravate the self-discharge of battery.

⚠Note: The standing time of battery is related to many factors. In general, sufficient batteries can still start the vehicle after being left standing for 6 months with the negative wire removed.

Battery sensor

It is used to collect voltage, current and temperature of battery assembly, calculate and process input signal of battery assembly, provide basis for ECU of vehicle to control engine start-stop system and intelligent generator system, and must match with established battery assembly to ensure more accurate collection value. The matching relationship between battery assembly and battery sensor is as follows:

Battery part number	Battery sensor part number
3703010-MK02	3703020-MK03



①LIN-wire interface, pin 1 is KL30, pin 2 is LIN;

(2) Used to fix M6 bolt post of battery grounding wire;

(3) Sensor negative pliers for fixing battery sensor assembly on battery negative pole.

Notes on battery and battery sensor:

1. Do not easily remove the battery sensor when repairing the vehicle. (To cut off the vehicle battery power supply, remove the harness at the battery sensor end.)

2. If the battery sensor is de-energized, the re-acquisition of start-stop function needs to be based on the following conditions:

a) When the battery and battery sensor are normally connected, turn off all appliances and leave the vehicle standing for more than 4 hours after locking.

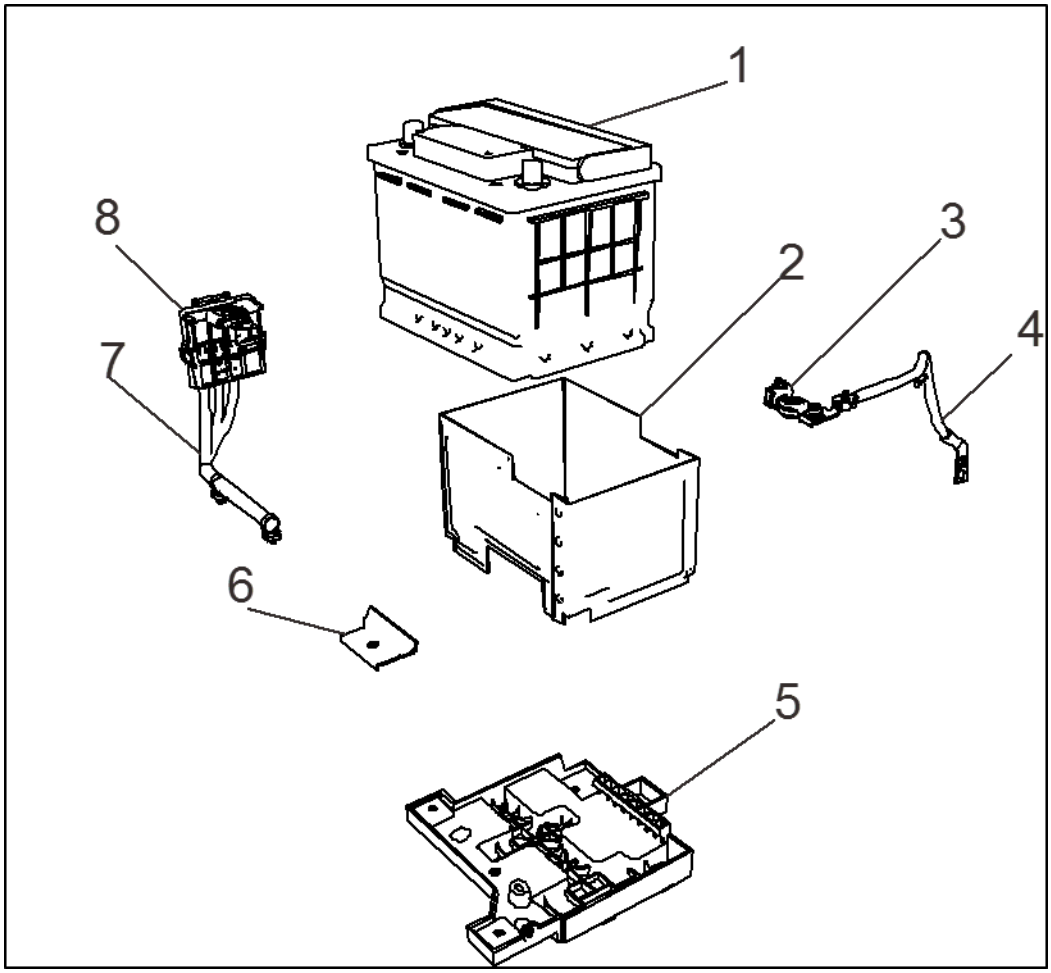
b) Continuously start for more than four times (stop more than 0.3 s in ON position for each start);

3. Without removing the original battery, if external power supply or external battery is required to start the vehicle, please connect the external negative terminal to the battery sensor stud, and do not directly hang on the battery negative terminal on the vehicle. If the battery sensor cannot detect current if it is not connected according to the requirements, it may report battery status error and disable STT function.

4. Battery and battery sensor must use products of manufacturer and model specified by Chang'an Company and shall not be replaced at will. Otherwise, vehicle starting and stopping functions may be affected.

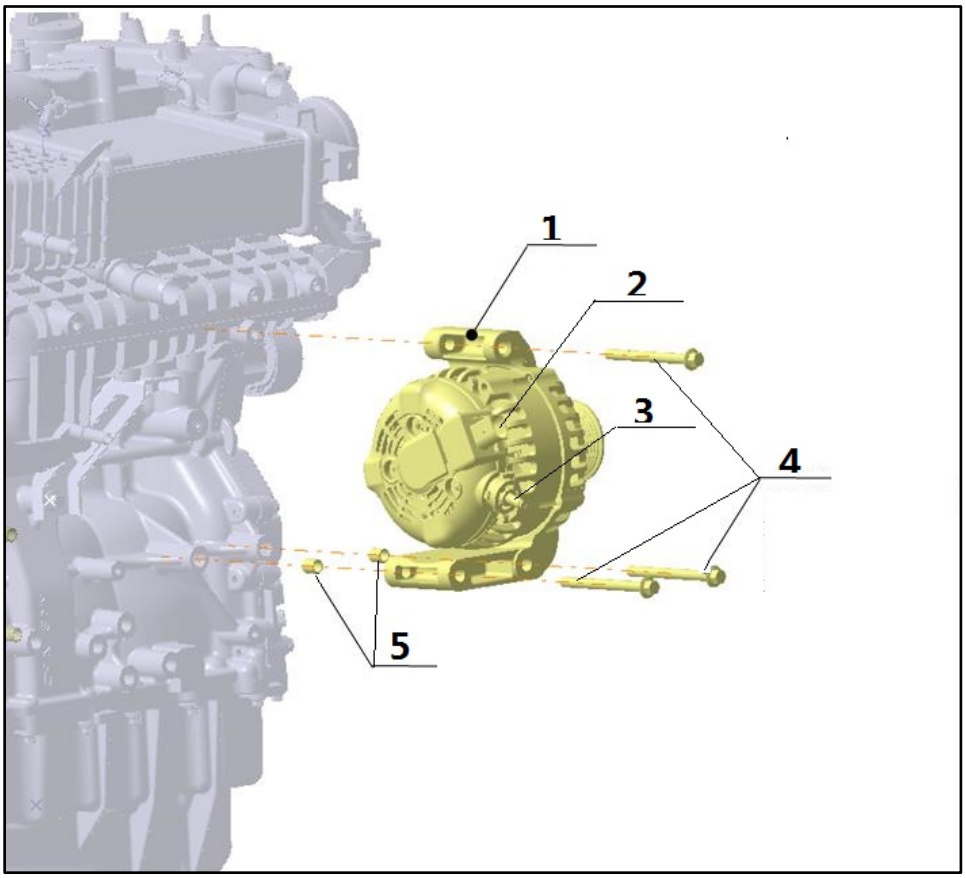
Component position diagram

Battery and accessories



Serial number	Name	Serial number	Name
1	Battery positive fuse box	6	Battery fixing pressure plate
2	Battery sensor	7	Battery tray
3	Battery ground wire	8	Battery assembly
4	Battery heat shield	9	Negative grounding wire retaining nut
5	Hexagon flange bolt		

Alternator



Serial number	Name
1	Generator assembly
2	Alternator harness connector
3	Generator B+ end
4	Alternator retaining bolt
5	Alternator locating pin

General inspection

Charger: In case of AGM battery, Chang'a specified AGM battery charger shall be used.

Battery check

1. Battery appearance inspection

The battery surface shall be free of leaks, the housing shall be free of cracks and damage, the electrode shall be free of corrosion, and the electrode wiring shall be reliably connected.

2. Check with the discharge tester:

Press the corresponding contact firmly on the positive and negative poles of the battery. When the pointer of the discharge detector is in the green range and kept for about 2 S, it indicates that the battery capacity is sufficient to meet the requirements of high current starting. When the pointer of the discharge detector is in the red range and there is no other abnormality, it indicates that the battery capacity is insufficient and the battery shall be replenished.

3. Check with headlamp as load and voltmeter

Connect the voltmeter to the battery according to the method of measuring the battery voltage, read the battery voltage value, and then turn on the headlamp. If the battery voltage does not drop rapidly and remains above 11, the vehicle can be started after the battery is replenished. If the battery voltage drops rapidly after the headlamp is turned on, the battery can be replenished to restore its function. If the idle time is too long, the charging time should be relatively prolonged. It is better to charge and discharge multiple times to fully activate it.

⚠Note: The battery that is being charged and discharged and has just finished charging should not be checked with the discharge detector. Because a large amount of hydrogen and oxygen gas will be generated in the charging process, spark will be generated when the discharge detector or resistance wire is used for moderate inspection, which will cause gas explosion and damage to people.

General equipment

Multimeter

Battery charging

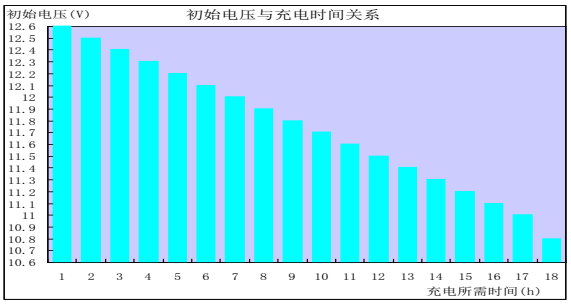
1.Ordinary lead acid battery/EFB battery:

Method 1: Constant voltage current limiting charging(Constant voltage charger)

For ordinary batteries, it is recommended to use constant voltage 14.0 V (maximum 16 V, charging current shall not exceed 15 A) charger to charge the battery to about 1-3A;

Method 2: Constant current charging(Constant current charger)

Constant current charging according to the following specifications: Charging current (A) =C20/10, (C20- 20 h rate capacity, this value can be found on the part surface label in Ah). If multiple batteries are charged in parallel, the current value will increase. Refer to the following figure for the correspondence between charging time and initial battery voltage:



AGM Battery:

(1) Battery voltage at 11 V-12.5 V

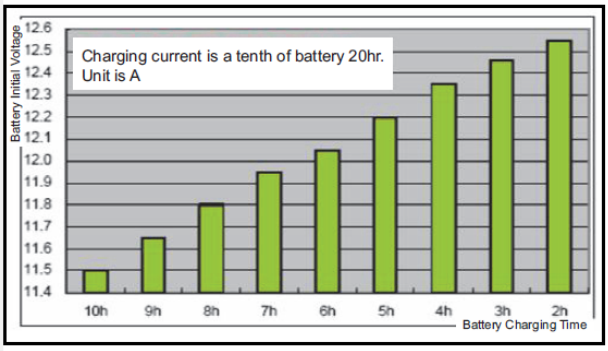
Method 1. Constant voltage current-limiting charging:

Constant voltage 14.2-14.8 V (max. 14.8 V, charging current shall not exceed 6A) is charged. After charging, when the current is reduced to 0.5 A or reduced (about 1-3A) for three hours, it is fully charged at 3-10 hours, depending on the power deficit.

Method 2. Constant current charging:

Strictly control the charging time according to the figure below, and remove the battery when the time is up. No timeout is allowed. Charging current (A) =C20/10, (C20- 20 h

rate capacity, this value can be found on the part surface label in Ah).



(2) Battery voltage below 11 V
In this case, the battery is excessively discharged, and special battery charger designated by Chang'a shall be used for charging. It is recommended to charge the battery to the equipment voltage of 14.8v with a small current of about 2A.

Warning: The battery should be placed where the child cannot get it. The battery contains sulfuric acid to avoid contact with skin, eyes, or clothing. Wear goggles when working close to battery to avoid acid solution spraying to eyes. If the acid solution is sprayed on the skin or eyes, it must be immediately rinsed with clean water for at least 15 minutes and the doctor must be called quickly. If the acid solution is eaten by mistake, please send it to the doctor immediately. Strictly observe the safety rules, otherwise serious casualties may occur.

Warning: Explosive gas will be generated during battery charging and discharging to avoid casualties. Therefore, do not allow flames, sparks or flammable and explosive objects to come close to the battery. When charging or working close to the battery, wear protective protective screen to protect the face and eyes. Often in ventilated position. Strictly observe the safety rules, otherwise serious casualties may occur.

Warning: All manufacturer's instructions must be followed when using any charging equipment. Strictly observe the safety rules, otherwise serious casualties may occur.

Warning: Do not turn on the charging device until the charger is connected to the battery. Strictly observe the safety rules, otherwise serious casualties may occur.

Warning: After charging, turn off the charging device before removing the battery. Strictly observe the safety rules, otherwise serious casualties may occur.

Warning: Do not place the battery in the vehicle for charging. After dismantling, charge and discharge the battery on the charging and discharging equipment. Strictly observe safety guard
Otherwise, serious casualties may occur.

Warning: It is incorrect to rely on the vehicle generator to charge the battery that has discharged power, because the charging system can ensure the battery charging is completed only when the vehicle runs continuously for more than 8h without the load of electrical equipment.

Quiescent loss current (commonly known as dark current) test

If the battery is fully charged and a continuous battery loss occurs on the installed vehicle, perform the following test procedure to check whether the battery has parasitic current.

1. Disconnect negative terminal of battery.
2. The anode pen of the multimeter is connected to the battery anode cable, anode
3. Connect the pen to the battery negative.
4. Ensure that all electrical equipment of the test vehicle is closed, doors, engine
5. Engine cover and trunk cover are reliably fully closed.
6. Select the milliamp range for the multimeter current measurement.
7. After waiting for the vehicle module to sleep, measure the quiescent loss current.

⚠Note: The module sleep time may be different for different vehicle configurations, usually 15 minutes.

Standard value of quiescent loss current: <20 mA

Fault symptom diagnosis and test

General equipment

Digital multimeter.

Inspection and confirmation

1. Confirm the customer's problem.
2. Visually inspect for visible signs of mechanical or electrical damage.
3. If the observed or raised problem is obvious and the cause has been found, the cause must be corrected before proceeding to the next step.
4. If the problem cannot be found obviously, confirm the fault and refer to the symptom table.

Appearance check list

M	Electrical
• FRT gear train belt • Generator	• Fuse • harness • Electrical connector • Battery • Battery harness • charging system warning lamp

Fault symptom table

If the fault occurs but no DTCs are stored in the ECM and the cause of the fault cannot be confirmed in the basic inspection, the fault diagnosis and rule out shall be performed according to the sequence listed in the following table.

Symptoms	Possible causes	Measures
Insufficient battery charge	• FRT gear train belt • Generator regulator • Generator	Reference: Battery undercharging diagnosis process
Battery overcharge	• Generator regulator • Generator	Reference: Battery undercharging diagnosis process
Charging indicator lamp is always on	• Drive belt wear • Front end belt tensioner damaged • Generator • circuit fault	Reference: Charging indicator lamp always on diagnostic process
Charging indicator lamp does not light up	• Instrument light-emitting diode • Instrument • circuit fault Poor contact between • brush and slip ring • voltage regulator	Reference: Charging indicator lamp off diagnostic process
Generator noise	• FRT gear train belt • Bearing • Stator and rotor	Reference: Generator Noise Diagnostic Procedure

Diagnostic process of insufficient battery charge

Test	Details/Results/Measures
1. Check alternator charging voltage	
	A. Start the engine to increase the engine speed from idle speed to 2000 Rpm. B. Measure the voltage of battery positive wire to negative with a multimeter. Is the voltage no less than 14.2 V? ? Yes Go to step 2.
2. Check battery	
	A. Execute battery. Reference: Power storage check (4.2.1 Charging system, general check). Check whether it is normal? ? Yes Go to Step 3. ? No
3. Check generator	
	A. Perform alternator test procedure. Is the test acceptable? ? Yes Charge or replace the battery. ? No Check generator.

Battery overcharge diagnosis process

Test conditions	Details/Results/Measures
1. Check alternator charging voltage	
	A. Start the engine to increase the engine speed from idle speed to 2000 Rpm. B. Measure the voltage of battery positive wire to negative with a multimeter. Is the voltage higher than 16 V? ? Yes Replace the generator.

Charging indicator lamp is constantly on diagnostic process

Test	Details/Results/Measures
1. Check front wheel train belt	
	A. Check the front gear train belt installation. B. Check the front belt tension. Reference: 3.1.3 Mechanical system Is the alternator belt normal? ? Yes Go to step 2. ? No Adjust or replace the front gear train belt or tensioner.
2. Inspect the circuit from combination instrument to alternator.	
	A. Turn the ignition switch to "LOCK" position. B. Disconnect development motor harness connector E24. C. Disconnect combination instrument harness connector P22. D. Measure terminal 16 of combination instrument harness connector P22 and reliable connection Resistance between ground. Standard resistance: 10 MΩ or higher Confirm the resistance meets the standard value? ? Yes Go to Step 3. ? No
3. Check alternator charging voltage	
	A. Start the engine and increase the engine speed to 2000 rpm. B. Measure terminal 1 of alternator output harness connector E23 with a multimeter. Voltage to ground. Is the output voltage between 14.2 and 14.8 V? ? Yes Overhaul the combination instrument circuit and replace the combination instrument if necessary. ? No
4. Check alternator power supply circuit	

	A. Turn the ignition switch to "LOCK" position. B. Disconnect the development motor harness connector E23. C. Turn the ignition switch to "ON" position. D. Measure between terminal 1 of alternator harness connector E23 and reliable ground. Voltage. Voltage standard value: 11 ~ 14 V. Confirm the voltage meets the standard value? ? Yes Replace the generator. ? No 1. Service alternator harness connector E23 terminal No.1 to battery bumper Open circuit between terminals E01, including fuses Fault. 2. replace the battery fuse box if necessary E01.

Charging indicator lamp does not illuminate diagnostic process

Test	Details/Results/Measures
1. Check charging indicator light emitting diode	
	A. Turn the ignition switch to "ON" position. B. Measure harness plug of combination instrument P22 from the rear of combination instrument. Voltage between terminal No. And body grounding. Standard voltage: 11 ~ 14 V Is the voltage normal? ? Yes Go to step 2. ? No Overhaul the instrument circuit or replace the instrument.
2. Inspect the circuit from combination instrument to alternator.	
	A. Turn the ignition switch to "LOCK" position. B. Disconnect development motor harness connector E24 and combination instrument harness connector P22. C. Measure the connection between terminal 1 of alternator harness connector E24 and instrument harness. Resistance between terminal 16 of head P22. Standard resistance: Less than 5 Ω Is the resistance normal? ? Yes Replace the generator. ? No Repair the circuit.

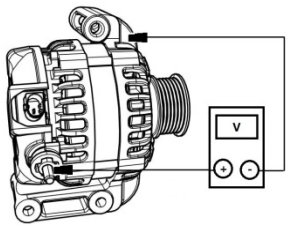
Generator noise diagnosis process

Diagnostic prompt: Alternator noise may be caused by electrical or mechanical noise. Electrical noise (electromagnetic whimpering) usually varies with the electrical load applied to the generator, which is the normal operating characteristic of all generators and should be distinguished during maintenance diagnosis, otherwise it may cause unnecessary customer complaints. When diagnosing the generator with mechanical noise, first check whether the components around the generator are loose, interfere with each other and other abnormal appearance. In some cases, even if the noise sounds very light in the engine compartment, it will be transmitted into the passenger compartment. If this is the case, replacing the generator cannot solve the fault, thus causing misjudgment.

Test	Details/Results/Measures
1. Check front wheel train belt	
	A. Check whether the front gear train belt is missing teeth. B. Check front gear train belt tension. Reference: 3.1.3 Mechanical system Whether the front gear train belt is normal. ? Yes Go to step 2. ? No Repair the front wheel train belt.
2. Check generator noise	
	A. Remove the front wheel train belt. B. Start the engine to run. Is generator noise still burning? ? Yes Check compressor and booster pump noise. ? No Replace the generator.

Intelligent alternator inspection method

Serial number	Test item	Test process and measures
1	Return the ignition key to OFF position and turn on the low beam lamp. Test battery terminal voltage	◆ Read battery terminal voltage ≥12 V? ? Yes Go to Step 2 ? No Charge or replace the battery before proceeding to step 2.
2	Start the vehicle, open the engine compartment cover and check the wheel train.	◆ Check whether the wheel train slips or gets stuck. ? Yes Please handle ? No Go to Step 3
3	Turn off the vehicle, turn the ignition key to ON position, and read the DTC with the diagnostic scanner.	◆ Read out the DTC in step "4." ? Yes Handle according to the maintenance method corresponding to fault code in step "4." ? No Go to Step 5.
4	**Fault code**	**Corresponding processing method**
	Intelligent generator high temperature fault	Clear the DTC with a diagnostic scanner and the vehicle is stationary for 30 minutes. Start the vehicle, and if the intelligent generator high temperature fault is reported subsequently, replace the generator.
	Mechanical fault of intelligent generator	**Replace generator**
	Intelligent generator circuit fault	Check the alternator B+ harness for looseness and corrosion. Please handle it. Use a multimeter to test B+ line on and off. If the B+ line is free of looseness, corrosion and access, replace the alternator.
	LIN bus readback error supporting communication between EMS and smart generator	Check whether the alternator LIN wire connector is loose, the pins are bent, oxidized, etc. Please handle. Test LIN line on and off with a multimeter. If the signal wire path is normal, replace the generator.
	LIN bus response timeout supporting communication between EMS and smart generator	Check whether the alternator LIN wire connector is loose, the pins are bent, oxidized, etc. Please handle. Test LIN line on and off with a multimeter. If the signal wire path is normal, replace the generator.
	LIN bus frame error supporting communication between EMS and smart generator	Check whether the alternator LIN wire connector is loose, the pins are bent, oxidized, etc. Please handle. Test LIN line on and off with a multimeter. If the signal wire path is normal, replace the generator.

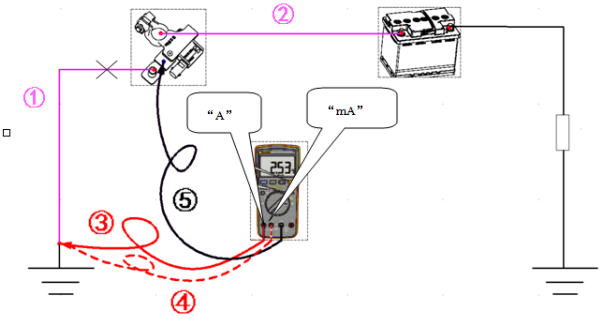
	Lin bus checksum error supporting communication between EMS and smart generator	Check whether the alternator LIN wire connector is loose, the pins are bent, oxidized, etc. Please handle. Test LIN line on and off with a multimeter. If the signal wire path is normal, replace the generator.
5	Return the ignition key to OFF position and disconnect the alternator signal terminal connector. Start the vehicle, depress the accelerator under idle condition, increase the engine speed to no less than 3000 rpm for 5s, turn on the A/C and turn on the headlights. Test the generator terminal voltage, that is, test the generator B+ stud and the generator housing. The test method is shown in the following figure.  	◆ Read whether the alternator terminal voltage is ≥13 V. ? Yes **The intelligent generator has no fault. Please check the battery sensor, battery. Whether the alternator connector is connected reliably. Whether the battery positive wire, transmission grounding wire and battery grounding wire are loose, rusted, etc.** ? No **Please replace alternator** ⚠ **Note: Read voltage in this step must read voltage between alternator B+ stud (multimeter test point should not be placed on harness terminal and connecting nut) and alternator housing, and do not read voltage at both ends of battery.**

Battery assembly

Test conditions	Details/Results/Measures
1. Check whether the complete vehicle cannot be started.	
	A. Check whether the battery voltage is normal. ? Yes(Normally voltage is 11.5~13.5 V) Check starter or other system ? No Go to step 2. Inspect the battery for damage, leakage and acid.
2. Check battery leakage and acid	
	A. Check whether the battery leaks liquid or creeps acid. ? Yes Replace the battery assembly. ? No Please check the cause of power loss.
3. Check the cause of battery loss	
	A. Check battery performance attenuation? ? Yes After repeated charging, the battery rapidly loses power. Please replace the battery assembly. ? No Check whether the quiescent current of the complete vehicle is too large. ? Yes Troubleshooting defective electrical appliances, quiescent loss current test method ? No Check the dynamic electric balance of the complete vehicle. Is the generator insufficient? ? Yes Detect alternator status ? No Check whether the vehicle has abnormal operation of

	electrical equipment. ? Yes Such as forest air system, drive recorder, etc. ? No Please contact Chang'an after-sales technical support

Static loss current test method:

Test equipment	High-precision multimeter (with "mA" gear) or data acquisition equipment, connecting wires, clamps. For vehicles with non-constant dark current (the average quiescent current fluctuation within 1s is greater than 1 mA), the sampling frequency of data acquisition equipment shall be greater than 5-10 times the quiescent current frequency.
Quiescent current test condition	The vehicle is powered off but not locked: 1) Open the door (only for vehicles with power saving function or without door lamp); 2) Open the engine compartment cover; 3) Open the sunroof (sunroof version only); 4) Open the trunk door; 5) The power supply gear is "OFF," and the key is not removed. (Non-PEPS)
Test procedure Wiring diagram 	1) Before dark current test, the vehicle shall start the engine and activate various electrical systems of the vehicle to work normally; 2) After the vehicle stalls, set the power supply gear to "OFF," measure the voltage at both ends of the battery with a multimeter and record it; 3) As shown in the attached left figure, connect the multimeter red probe (3) to "A" position, and connect the red probe (3) and black probe (5) to the battery sensor or battery negative clamp (sensorless model) negative grounding wire terminal and body grounding respectively; 4) Disconnect the original negative grounding wire (1) of the vehicle battery, and the power

	supply of the complete vehicle shall not be interrupted during the wiring process; otherwise, it shall be restarted from step (a). Short the red and black probes of the multimeter with short wiring to avoid burnout of the multimeter;(Refer to the above method for connection mode of data acquisition equipment.) 5) According to the preset vehicle working condition, switch the multimeter to "mA" gear after the vehicle sleeps, disconnect the tool short wiring, observe the display current value of the multimeter or current data acquisition device, and observe the current value for 10 minutes after the current value stabilizes to the minimum value. The current value cannot rebound, and record the result. Note: If the vehicle needs to be unlocked or locked, short the red and black probes of the multimeter. For vehicles with non-constant dark current (the average fluctuation of dark current in 1s is greater than 1 mA), the digital equipment shall be used to collect dark current.

Removal and installation

Battery assembly

Removal

1. Disconnect the battery positive and negative harnesses.

2. Remove the battery assembly fixing pressure plate.

3. Remove the battery heat shield and battery assembly.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Place the battery assembly on the tray stably;

2.The battery pressure plate hole is aligned, and the bolt tightening torque is 8~12N.m;

3.Tighten the positive electrode retaining bolt and negative electrode retaining bolt, and the tightening torque is 5N.m;

Note: When installing the fixing bolts, carefully prevent the battery pole from breaking and avoid the risk of battery leakage in the later stage; The negative grounding wire will generate a short spark, which is a normal phenomenon and should not be excessively worried.

Battery sensor

Removal

1. Disconnect the battery sensor connector.

2. Use M6 sleeve to disconnect negative pliers.

3、 Use M8 sleeve to disconnect battery negative grounding wire.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1.First tighten the battery sensor and negative grounding wire, and the bolt tightening torque is 11N.m

2.Tighten the negative electrode pliers with M6 sleeve, with torque of 5N.m.

3. Connect the battery sensor assembly connector.

Note: After replacing the battery assembly or battery sensor, the sensor shall be stationary for more than 4 hours. Do not start the engine during the sensor recovery process to ensure the sampling accuracy of the battery sensor.

Alternator

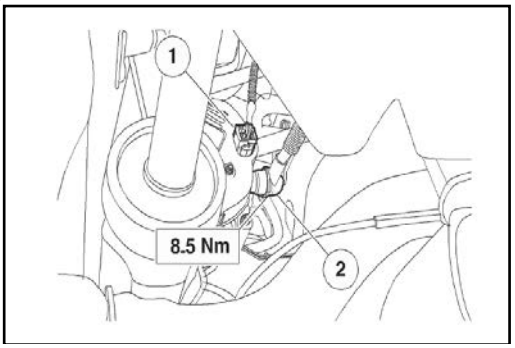
Removal

1、Disconnect the negative battery harness.

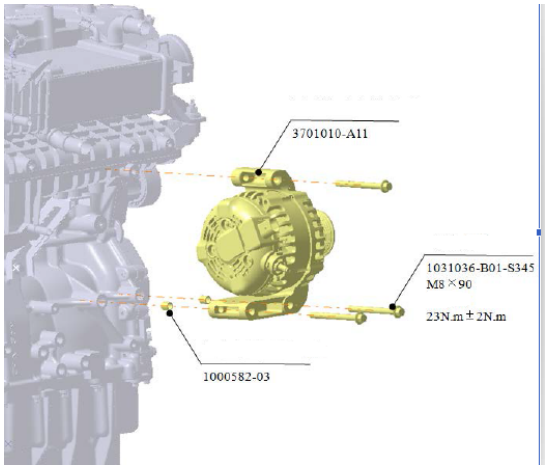
Note: During the next operation, ensure the battery negative harness pile head.

2. Jack up the vehicle and support it.

3.Disconnect alternator harness connector and retaining nut at end B+.

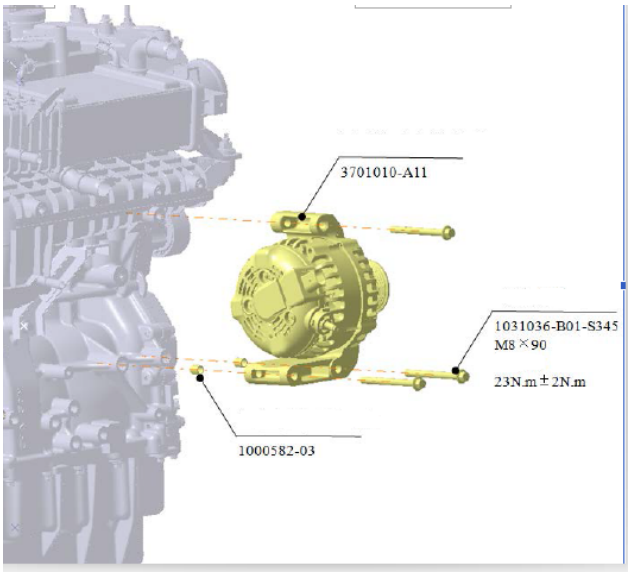


4. Remove the upper and lower retaining bolts of generator.



5. Remove the generator from the vehicle.

Name	Nm	lb-ft	lb-in
Canister control valve outlet trachea assembly and engine assembly intake manifold bolts	5±1		
Canister assembly and body	23±3		



Warning: When the engine is in hot state, do not repair it to avoid burns. When the system is cooled, it can be repaired.

Installation

The installation sequence is the reverse of the removal sequence.

3.1.12 Fuel evaporative emission control system

Specifications

Torque specification

Description and operation

System overview

The fuel evaporation control system includes the safety valve assembly (in the fuel tank assembly), canister assembly, canister control valve assembly, fuel vapor trachea-way and connecting parts, etc. Collect and store the fuel vapor in the fuel tank in the canister, and send the fuel vapor to the cylinder for combustion when the engine reaches a specific working condition.

Fuel evaporation trachea circuit includes canister adsorption connecting pipe, canister desorption connecting pipe assembly, canister desorption connecting pipe assembly II, desorption connecting pipe assembly III, canister to atmosphere connecting pipe assembly I, canister to atmosphere connecting pipe and canister control valve outlet trachea assembly to connect fuel tank assembly, canister assembly and canister control valve assembly to realize fuel vapor transmission.

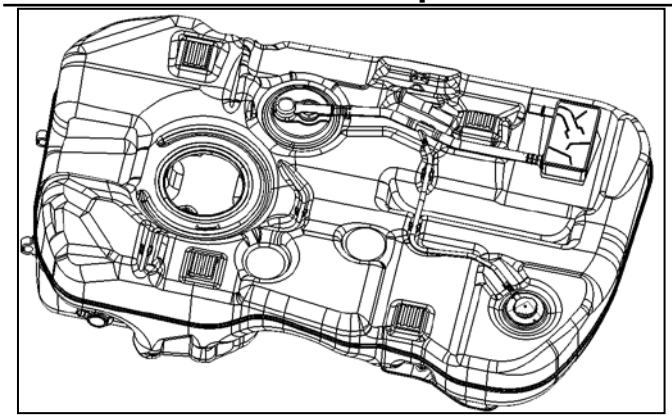
The connecting part includes pipe clamp and fixing bracket to fix the fuel supply pipe to the vehicle body.

The fuel evaporation trachea line is arranged side by side with the fuel supply pipeline, and shares the connection parts.

Component description

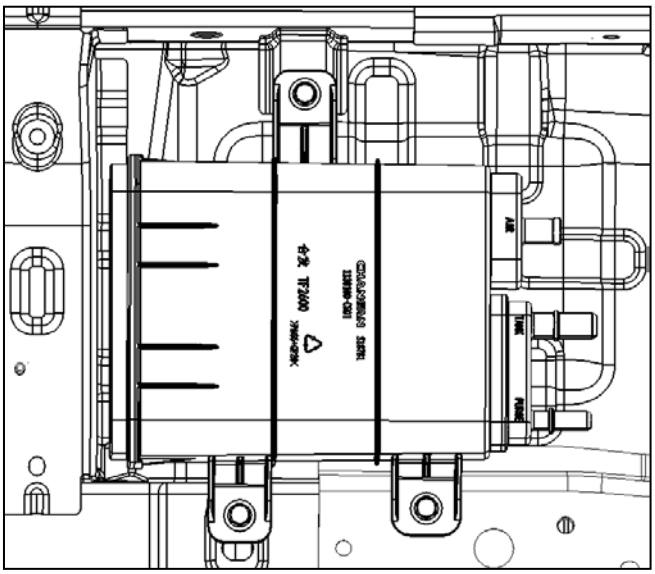
Relief valve assembly

It is installed on the fuel tank and supplied with the fuel tank assembly to balance the air pressure in the fuel tank.



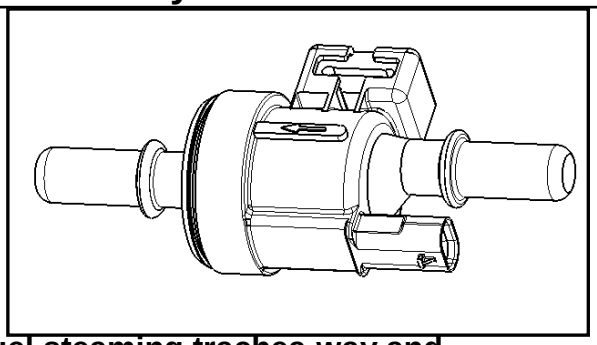
Canister assembly

The canister is an emission control device containing activated carbon particles for adsorption and storage of fuel vapors from the fuel tank. The fuel vapor is stored in the canister all the time. When certain conditions are met, the engine control module will energize the canister control valve, so that the fuel vapor is drawn into the engine cylinder and burns off. Install on the lower body.



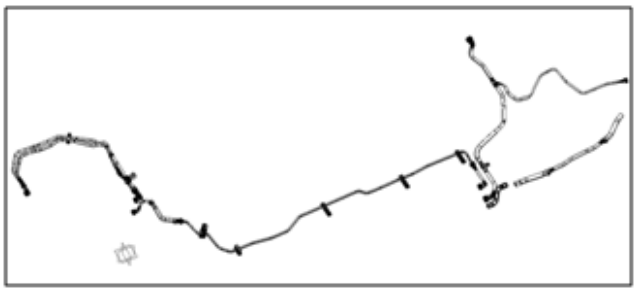
Canister control valve assembly

Canister control valve is opened/closed to control canister adsorption/desorption process.

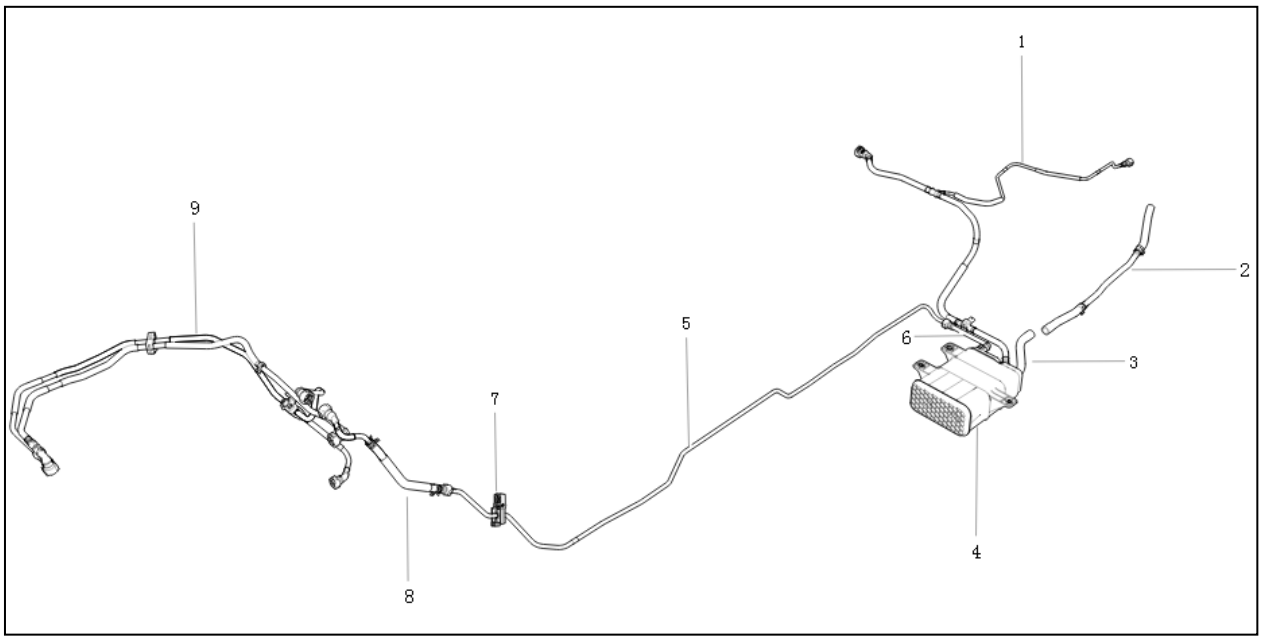


Fuel steaming trachea-way and connecting parts

Fixed to the vehicle body to achieve fuel vapor delivery.



Component position



Serial number	Component name	Quantity
1	Canister adsorption connecting pipe assembly	1
2	Canister atmospheric connecting pipe assy. I	1
3	Canister atmospheric connecting pipe	1
4	Canister assembly	1
5	Canister desorption connecting pipe assy. II	1
6	Canister desorption connecting pipe assembly	1
7	Fuel pipe clamp assembly	1
8	Canister desorption connecting pipe assy. III	1
9	Canister control valve outlet trachea assembly	1

General inspection

Warning: This process contains fuel handling. Pay attention to whether there is fuel spill at any time and pay attention to precautions for fuel treatment, otherwise personal injury may be caused.

Warning: Do not use any form of open flame and do not start the engine when working on fuel components. High flammability mixture generated during operation may be ignited. Improper operation may cause personal injury.

Canister control valve inspection

Visual inspection of 1. canister control valve: No crack, deformation, no corrosion of wiring terminal; if yes, replace;

2. Check the resistance of canister control valve, and the resistance shall comply with 16Ω±4Ω regulations; otherwise, replace it;

3. Remove canister control valve and inhale air into the valve. Canister control valve shall not be ventilated;

4. Remove the canister control valve, apply 12 V battery voltage to the two wiring terminals of the valve, and inhale air into the canister control valve. At this time, the canister control valve should be ventilated.

Canister inspection

1. Check whether the canister vent is blocked; if yes, replace it;

2. Appearance inspection of canister: No crack or deformation; replace if any;

3. Remove the canister and shake it by hand. If there is abnormal sound, replace it;

4. Inspect the connecting pipe on the canister. If it is blocked or damaged, replace it;

5. Use a suitable air source to blow in from one of the canister nozzles, and the other two nozzles should have air flow out. If there is no gas flowing out, replace it.

Fault symptom diagnosis and test

Inspection and confirmation

Warning: This process contains fuel handling. Pay attention to whether there is fuel spill at any time and pay attention to precautions for fuel treatment, otherwise personal injury may be caused.

Warning: Do not use any form of open flame and do not start the engine when working on fuel components. High flammability mixture generated during operation may be ignited. Improper operation may cause personal injury.

1. Confirm the customer's problem;

2. Visually inspect whether there is obvious mechanical or electrical damage;

Mechanical part	Electrical part
Steaming trachea-way damage	Canister control valve damaged
Quick-change joint is damaged	Electrical connector/circuit damage

3. If the apparent cause of the observed or raised problem has been found, the cause must be corrected before proceeding to the next step;

4. If the visual inspection is passed, confirm the fault and refer to the symptom table.

Fault symptom table

Symptoms	Possible causes	Measures
Interior gasoline smell heavy	Filler pipe assy.	Gasoline smell re-diagnosis process
	Fuel/steam trachea-way leakage	
	Canister control valve assembly	
	Canister assembly	

Fault determination

Gasoline smell re-diagnosis process

Warning: This process contains fuel handling. Pay attention to whether there is fuel spill at any time and pay attention to precautions for fuel treatment, otherwise personal injury may be caused.

Warning: Do not use any form of open flame and do not start the engine when working on fuel components. High flammability mixture generated during operation may be ignited. Improper operation may cause personal injury.

1. Inspect whether the O-ring seal is fitted to the lip of the filler pipe assembly after the filler cap is normally assembled. If not, reassemble or replace the filler pipe;

2. Check whether the fuel pipeline and steam trachea circuit are damaged; if so, replace the damaged components;

3. Check whether the canister control valve works normally. If not, overhaul the harness grounding terminal and connector or replace the canister control valve;

4. Inspect whether the steam trachea circuit is blocked, if so, repair or replace the blocked component;

5. Check whether the canister vent is blocked; if so, replace the canister;

6. Check whether the canister is damaged; if it is damaged, replace the canister;

Removal and installation

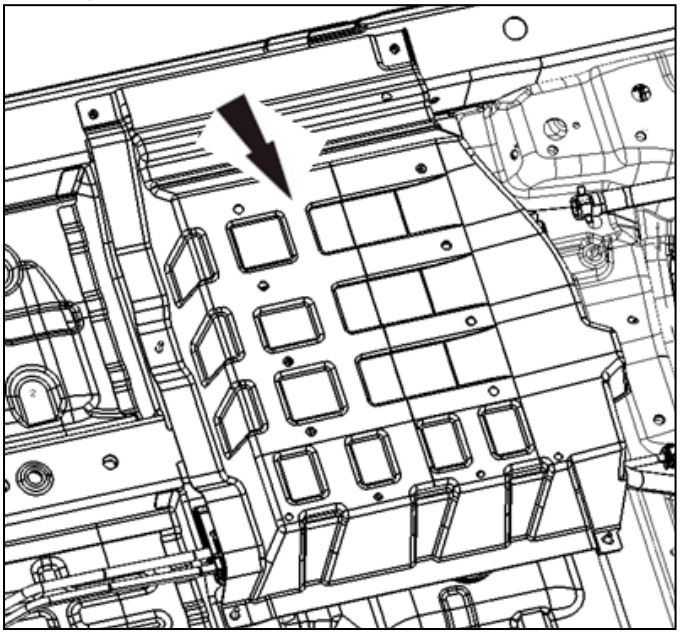
Canister assembly

Warning: This process contains fuel handling. Pay attention to whether there is fuel spill at any time and pay attention to precautions for fuel treatment, otherwise personal injury may be caused.

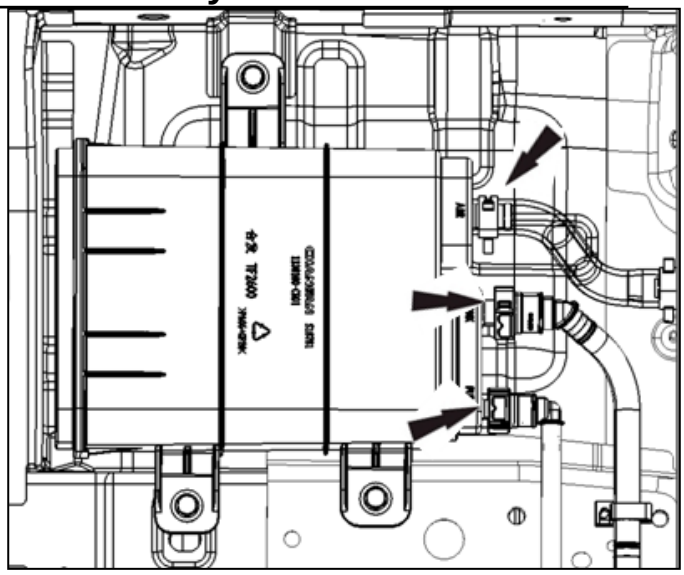
Warning: Do not use any form of open flame and do not start the engine when working on fuel components. High flammability mixture generated during operation may be ignited. Improper operation may cause personal injury.

Removal

1. Remove the chassis rear lower guard plate assembly (left). Refer to the chassis rear lower guard plate assembly (left) removal process for details;

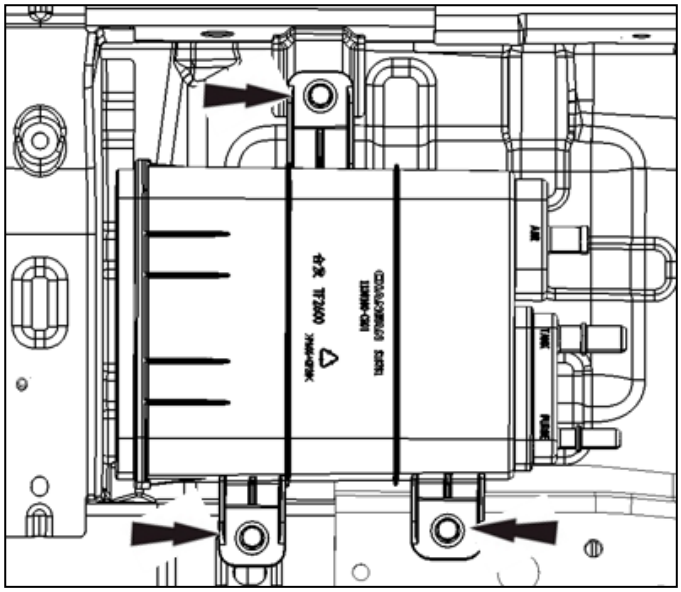


2. Remove the connection between canister assembly and canister desorption connecting pipe assembly, canister adsorption connecting pipe assembly, canister atmospheric connecting pipe, and refer to the nylon pipe quick-change joint removal process for joint removal;



3. Remove the canister assembly.

Hexagon-head bolt spring washer and plain washer assembly Tightening torque: 23±3N.m (7.5 ftlb.)



4. Remove the canister assembly.

Tightening torque of hexagon bolt, spring washer and plain washer assembly, hexagon flange nut: 4±0.5N.m

Installation

The installation process is the reverse of the removal process.

Fuel steaming trachea-way and connecting parts

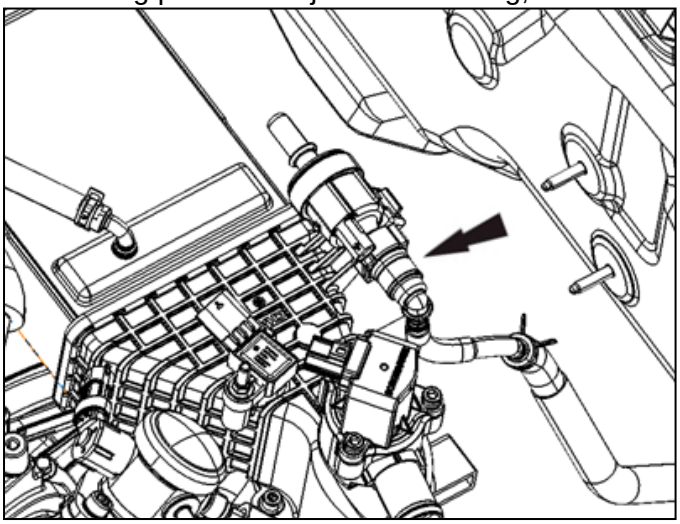
Warning: This process contains fuel handling. Pay attention to whether there is fuel spill at any time and pay attention to precautions for fuel treatment, otherwise personal injury may

be caused.

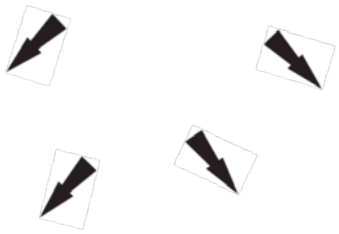
Warning: Do not use any form of open flame and do not start the engine when working on fuel components. High flammability mixture generated during operation may be ignited. Improper operation may cause personal injury.

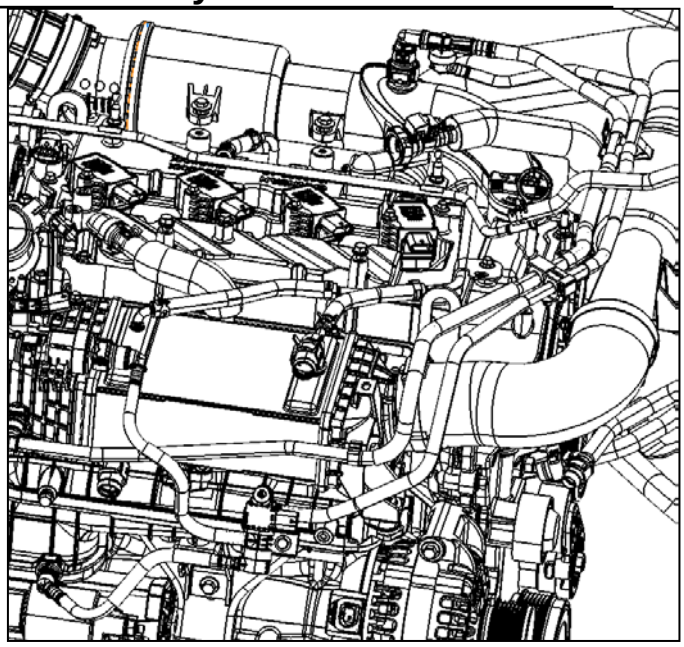
Removal

1. In the engine compartment, dismantle the connection between canister desorption connecting pipe III and canister control valve assembly, and refer to the nylon pipe quick-change joint dismantling process for joint dismantling;



2. In the engine compartment, dismantle the connection between canister control valve outlet trachea assembly and canister control valve assembly, intake manifold, air filter outlet trachea assembly and intercooler assembly. Refer to the nylon pipe quick-change joint dismantling procedure for joint dismantling; Dismantle the connection between the fixed pipe clamp of canister control valve out of trachea assembly and the engine bracket, and dismantle the [illegible]s between the two-way valve of canister control valve out of trachea assembly and the bracket on intake manifold.

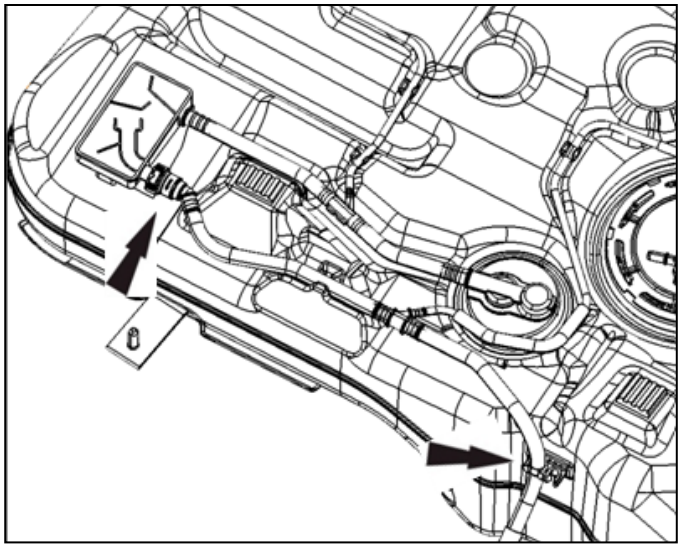




3. Lifting the vehicle;

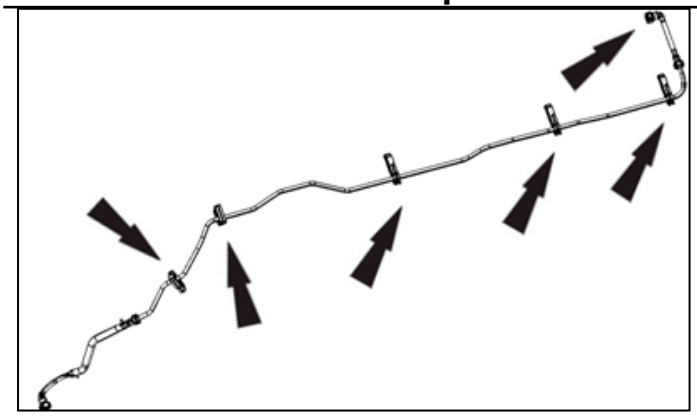
4. Remove the fuel tank assembly, see the fuel tank assembly removal process for details;

5. Remove the canister adsorption connecting pipe assembly and fuel tank oil separator joint connection and fuel tank welded pipe clamp connection.

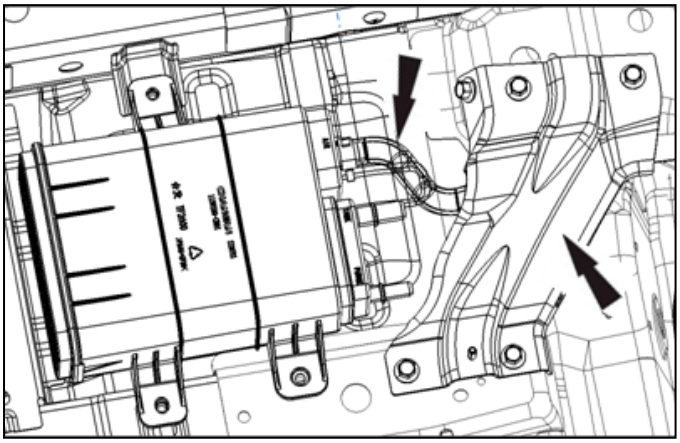


6. Lift the vehicle, and remove the lower floor fuel pipe guard plate assembly;

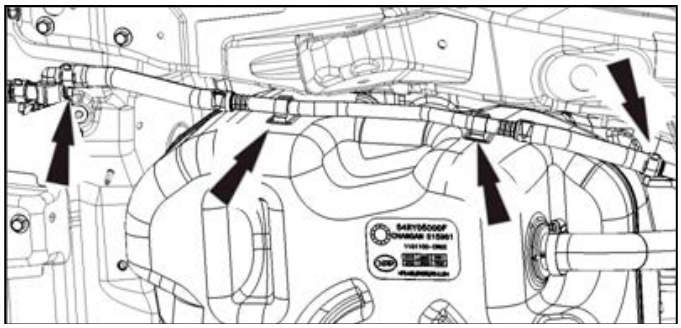
7. Dismantle the connection between canister desorption connecting pipe assembly and canister assembly, and the connection between lower floor fuel steam pipe and fuel pipe clamp;



8. Remove the connection between the rear swing arm reinforcement rod and the body. For the specific removal scheme, refer to the corresponding removal process. Then remove the connection between the canister air connecting pipe and canister stop valve and canister assembly.



9. Dismantle the connection between canister atmospheric connecting pipe assembly I and canister stop valve and filling pipe opening large trachea, and then remove canister atmospheric connecting pipe assembly I from fuel tank welded pipe clamp.



Installation

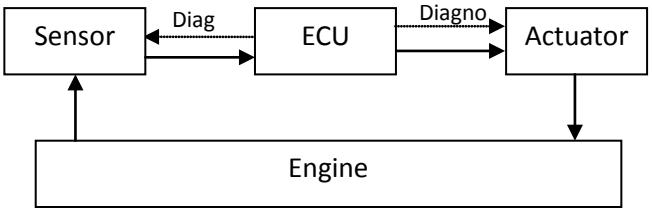
The installation process is the reverse of the removal process.

3.1.13 Engine control system

Description and operation

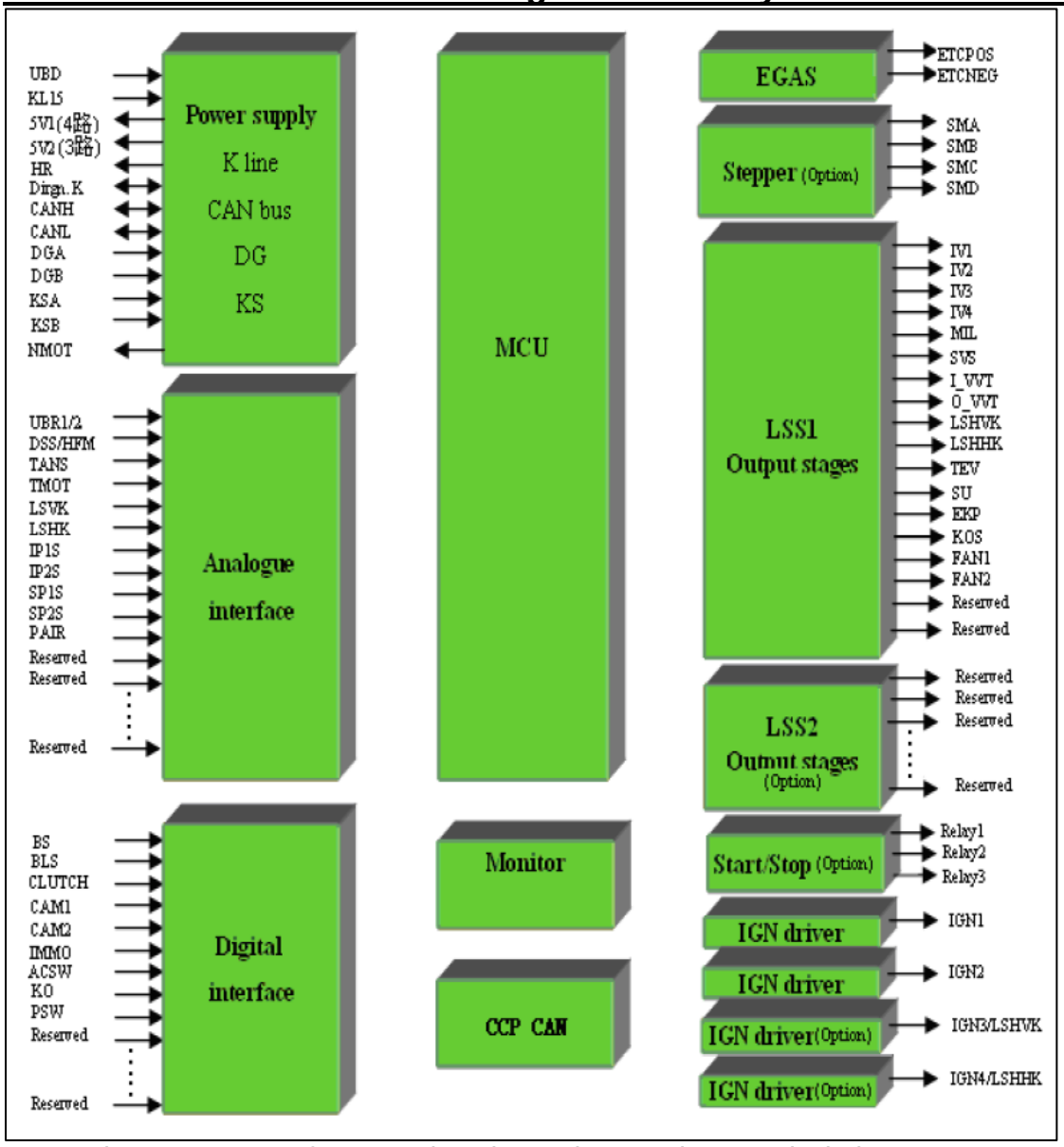
General

The engine management system is generally composed of three parts: Sensor, microprocessor (ECU) and actuator, which controls the intake air quantity, fuel injection quantity and ignition advance angle when the engine works. The basic structure is shown in the figure.



In the engine electronic control system, the sensor is used as an input part to measure various physical signals (temperature, pressure, etc.) and convert them into corresponding electrical signals; The function of ECU is to receive the input signal of the sensor, perform calculation and processing according to the set program, generate corresponding control signal and output to the power drive circuit, and the power drive circuit performs different actions by driving each actuator, so that the engine operates according to the predetermined control strategy; At the same time, the fault diagnosis system of ECU monitors various components or control functions in the system. Once the fault is detected and confirmed, the fault code is stored and the "limp home" function is called. When the detected fault is eliminated, the normal value is restored to use.

The biggest feature of UP6 engine electronic control management system is to adopt torque-based control strategy. The main purpose of the main torque control strategy is to link a large number of different control objectives. This is the only way to flexibly choose to integrate various functions into different variants of ECU according to engine and vehicle model. The structure of UP6 engine electronic control system is shown in the figure below.



Basic components of UP6 engine electronic control system include:

Electronic controller(ECU)	Electronic accelerator pedal
Mass air flow meter(Depending on project)	Fuel injector
Intake pressure/temperature sensor(Depending on project)	Electronic fuel pump
Coolant temperature sensor	Fuel pressure regulator
Electronic throttle body	Fuel pump bracket
Phase sensor	Fuel distribution pipe
Speed sensor	Canister control valve
Knock sensor	Ignition coil
Oxygen sensor	

Engine control unit assembly information:

Name	Part number	ECU version number
Control unit assembly	3600010-YJ31	UP6

UP6-Motronic engine management system is an electronically operated gasoline engine control system. It provides many control characteristics related to operators and vehicles or equipment. The system adopts the combination of open loop and closed loop (feedback) control to provide various control signals for engine operation. The main functions of the system are:

1) Basic management function of engine using physical model

Torque-based system structure
The cylinder load is determined by the intake pressure sensor/air flow sensor
Improved mixture control under static and dynamic conditions
λClosed loop control
Fuel injection in sequence by cylinder
Ignition timing, including cylinder-by-cylinder knock control
Emission control function
Catalyst heating
Canister control
Idle speed control
Limp home
Speed sensing via incremental system

2) Additional functions

Immobilizer function
Torque connection to an external system (e.g. drive mechanism or vehicle dynamic control)
Control of several engine parts
Interface to match, EOL- programming tool and service tool

3) Online diagnosis EOBD

Complete a range of EOBD functions
Management system for diagnostic functions

Torque structure

In UP6 torque-based engine management system, all internal and external engine requirements are defined by engine torque or efficiency requirements, as shown in Figure 2.3. Control variables that convert various requirements of the engine into torque or efficiency, which are then processed first in the central torque demand coordinator module. The UP6 system can prioritize these conflicting requirements, execute one of the most important requirements, and obtain the required fuel injection time, ignition timing and other engine control parameters through the torque conversion module. The execution of this control variable has no effect on other variables. This is the advantage of the torque-based control system.

Also, during engine matching, because the torque control system has variable independence, it only depends on the engine data when matching the engine characteristic curve and pulse diagram, and does not interfere with other functions and variables, thus avoiding repeated calibration, simplifying the matching process and reducing the matching cost.

The main features of the UP6 system are:

The new engine function structure with torque as variable is most compatible with other systems and has strong expansibility;
The new modular software structure and hardware structure are highly portable;
Model-based engine basic characteristic diagram, independent of each other, simplifies the calibration process;
With phase sensor, sequential fuel injection helps to improve emissions;
Improve driving performance through centralized coordination of various torque requirements;

Control signal: System input/output signal

Main sensor input signals of ECUs in UP6 system include:

Intake pressure signal
Accelerator pedal signal
Intake air temperature signal
Throttle angle signal
Coolant temperature signal
Engine speed signal
Phase signal
Knock sensor signal
Oxygen sensor signal
Vehicle speed signal
A/C pressure signal

After entering ECU, the above information is processed to generate required actuator control signals, which are amplified in output drive circuit and transmitted to corresponding actuators. These control signals include:

Electronic throttle valve opening
Injection timing and injection duration
Fuel pump relay

Canister control valve opening
Ignition coil closing angle and ignition advance angle
A/C compressor relay
Cooling fan relay

System function introduction

Starting control

The UP6 provides the starter control function, that is, only when the starter conditions are met (the driver starts the engine and the transmission allows the starter to operate), the ECU engages the starter control relay; Cut off the starter control relay if the starter conditions are not met (if the starter is successfully started and the starter runs for more than a certain time, etc.).

During starting, special calculation methods shall be adopted to control charge, fuel injection and ignition timing. At the beginning of the process, the air in the intake manifold is stationary and the internal pressure in the intake manifold is displayed as ambient atmospheric pressure. The throttle is closed and the idle speed regulator is specified as a fixed parameter depending on the starting temperature.

In a similar process, a specific "injection timing" is designated as the initial injection pulse.

The fuel injection amount varies according to the engine temperature to promote the formation of oil film on the intake manifold and cylinder wall. Therefore, before the engine reaches a certain speed, it is necessary to add rich mixture.

Once the engine starts to run, the system immediately starts to reduce the start-up enrichment until the end of the starting condition (600 …700 min-1) completely cancels the start-up enrichment.

Ignition angle is constantly adjusted under starting conditions. Changes with engine temperature, intake air temperature and engine speed.

Heating and heating control of three-way catalytic converter

After the engine is started at low temperature, the cylinder charge, fuel injection and electronic ignition are adjusted to compensate for the higher torque requirements of the engine; The process continues until the appropriate temperature threshold is reached.

In this stage, the most important is the rapid heating of the three-way catalytic converter, because the rapid transition to the three-way catalytic converter starting to work can greatly reduce exhaust emission. Under this condition, adopt the method of moderately delaying ignition advance angle to conduct "three-way catalytic converter heating" with exhaust gas.

Acceleration/deceleration and reverse drag fuel cut-off control

A portion of the fuel injected into the intake manifold does not reach the cylinder in time to participate in the subsequent combustion process. Instead, it forms an oil film on the intake manifold wall. The amount of fuel stored in the film increases dramatically depending on the increase in load and the increase in injection duration.

When the throttle valve opening increases, part of the injected fuel is absorbed by the fuel film. Therefore, it is necessary to inject the corresponding supplementary fuel amount to compensate it and prevent the mixture from becoming lean during acceleration. Once the load factor decreases, the additional fuel contained in the fuel film on the intake manifold wall will be released again, so the injection duration must be reduced during deceleration.

Reverse towing or towing condition means that the engine provides negative power at the flywheel. In this case, the engine friction and pumping loss can be used to decelerate the vehicle. When the engine is in reverse towing or towing conditions, fuel injection is cut off to reduce fuel consumption and exhaust emissions, and more importantly to protect the three-way catalyst.

The fuel injection system resupplies fuel once the speed drops above the idle speed for a specific recovery fuel supply speed. In fact, there is a range of recovery speed in ECU program. They vary according to changes in parameters such as engine temperature and engine speed dynamics, and prevent the speed from dropping to the specified minimum threshold by calculation.

Once the injection system is refilled, the system begins to refill the fuel with the initial injection pulse and refill the fuel film on the intake manifold wall. After fuel injection is restored, torque-based control system makes engine torque increase slowly and smoothly (smooth transition).

Idle speed control

When idling, the engine does not provide torque to the flywheel. To ensure stable operation of the engine at the lowest possible idle speed, the closed-loop idle speed control system must maintain a balance between the generated torque and the "power consumption" of the engine. A certain amount of power needs to be generated at idle speed to meet various load requirements. They include internal friction from the engine crankshaft and the valve mechanism as well as auxiliary components such as the water pump.

The UP6 system uses torque as the main control strategy to determine the engine output torque required to maintain the required idle speed under any operating conditions based on closed loop idle control. The output torque increases as the engine speed decreases and decreases as the

engine speed increases. The system responds to new "disturbances" by requiring greater torque, such as startup/shutdown of the A/C compressor or shifting of the automatic transmission. In case of low engine temperature, additional torque is also required to compensate for greater internal friction losses and/or to maintain higher idle speeds. The sum of all these output torque requirements is transferred to the torque coordinator, which performs processing calculations to obtain the corresponding charge density, mixture composition and ignition timing.

λClosed loop control

Exhaust aftertreatment in three-way catalytic converter is an effective method to reduce the concentration of harmful substances in exhaust gas. The three-way catalytic converter can reduce hydrocarbon (HC), carbon monoxide (CO) and nitrogen oxides (NOx) to 98% or more and convert them to water (H2O), carbon dioxide (CO2) and nitrogen (N2). However, such high efficiency can be achieved only within a very narrow range near the engine excess air coefficient =1, and the goal of closed loop control is to ensure that the mixture concentration is within this range. λλ

λThe closed loop control system only works with oxygen sensors. The oxygen sensor monitors the oxygen content in the exhaust gas at the three-way catalytic converter side. The lean gas mixture (l) generates a sensor voltage of about 100 mV, and the rich gas mixture (l) generates a sensor voltage of about 900 mV. When =1, the sensor voltage has a jump. The closed loop control responds to the input signal (1= mixture too lean, 1= mixture too rich) modifies the control variable to produce a correction factor as a multiplier to correct the injection duration. λ>λ<λλλ>λ<

Evaporative emission control

The fuel in the tank is heated and fuel vapor is formed due to heat transfer from the outside and the return. These vapors containing large amounts of HC are not allowed to be vented directly into the atmosphere due to evaporative emission regulations. In the system, fuel vapor is collected in the activated carbon canister through the conduit and enters the engine by purging when appropriate to participate in the combustion process. The purge air flow is achieved by the ECU controlling the canister control valve. This control works only when the closed loop control system is closed loop. λ

Knock control

The system detects the characteristic vibration when knock occurs through the knock sensor installed in the appropriate position of the engine, and converts it into electronic signal for transmission to ECU and processing. ECU uses special processing algorithm to detect whether knock occurs in each combustion cycle of each cylinder. Knock closed loop control is triggered once a knock is detected. When the knock hazard is eliminated, the ignition of the affected cylinder is gradually advanced to the predetermined ignition advance angle.

The threshold value of knock control has good adaptability to different working conditions and different fuel grades.

System fault diagnosis function introduction

Fault information record

The ECU constantly monitors sensors, actuators, related circuits, malfunction indicators, battery voltages, etc., and even the ECU itself, and detects the reliability of sensor output signals, actuator drive signals and internal signals (such as closed loop control, coolant temperature, knock control, idle speed control and battery voltage control, etc.). The ECU sets the fault information record in the fault memory of the RAM as soon as a fault is found in a link or a signal value is not trusted. Fault information records are stored in the form of fault codes and displayed in the order of fault occurrence. λ

Faults can be divided into "steady-state fault" and "occasional fault" according to their frequency of occurrence (for example caused by short-circuit of wire harness or poor contact of connector).

Four fault types

DFC_xyzMax Maximum fault, signal exceeds upper limit of normal range.

DFC_xyzMin Minimum fault, signal exceeds lower limit of normal range.

DFC_xyzSig signal fault, no signal.

DFC_xyzNpl unreasonable fault, there is signal,

but the signal is unreasonable.

Xyz: Specific fault path name

Diagnostic scanner connection

ECU can communicate with external diagnostic scanner through "K" cable and perform the following operations:

(For functions and operation of diagnostic scanner, please refer to "Introduction to UP6 Diagnostic Scanner")

I. Engine parameter display

1. Speed, coolant temperature, throttle opening, ignition advance angle, fuel injection pulse width, intake pressure, intake temperature, vehicle speed, system voltage, fuel injection correction, canister scour rate, idle air control and oxygen sensor waveform;

2. Target speed, relative engine load, ambient temperature, ignition closing time, evaporator temperature, intake air flow and fuel consumption;

3.Throttle position sensor signal voltage, coolant temperature sensor signal voltage, intake air temperature sensor signal voltage, intake air pressure sensor signal voltage, knock sensor pin 1# signal voltage, knock sensor pin 2# signal voltage.

II. Status display of EFI system

Anti-theft system status, safety status, programming status, cooling system status, stable operating status, dynamic operating status, emission control status, oxygen sensor status, idle speed status, malfunction indicator status, emergency operating status, A/C system status, automatic transmission/torque request status.

III. Actuator test function

Fault lamp, fuel pump, A/C relay, fan, ignition, fuel injection (fuel cut off for single cylinder).

IV. Odometer display

Operating mileage, operating time.

V. Version information display

Frame number (VIN), ECU hardware number, ECU software number.

VI. Fault display

Intake air pressure sensor, intake air temperature sensor, engine coolant temperature sensor, throttle position sensor, oxygen sensor, oxygen sensor heating circuit, air-fuel ratio correction, fuel injector of each cylinder, fuel pump, knock sensor, speed sensor, phase sensor, canister control valve, cooling fan relay, vehicle speed signal, idle speed, idle speed regulator, system voltage, ECU, A/C compressor relay, evaporator temperature sensor, and fault lamp.

System features

Multi-point sequential injection system;

The new engine function structure with torque as variable is most compatible with other systems and has strong expansibility;

The new modular software structure and hardware structure are highly portable;

Adopt cylinder judgment signal (phase sensor); Use 60-2-tooth signal plate to identify speed signal (speed sensor;

Realize idle torque closed loop control;

Cylinder-by-cylinder independent knock control (knock sensor);

It has the function of heating and protecting the catalytic converter;

It has the function of returning home;

It has flashing code function, etc.

Component structure principle and fault check

Electronic controller unit

Installation position

UP6 ECUs are mounted next to the battery in the engine compartment.

Working principle

• Multi-point sequential injection
• control ignition
• intake control
• Knock control
• Provide sensor power supply: 5V/100 mA
• closed loop control with adaptive λ
• control canister control valve
• A/C switch
• engine malfunction indicator lamp
• Fuel Quantitative Correction
• Fault self-diagnosis
• receives engine load signal, etc.

ECU pin definition

PIN	Function	Interface description	Remarks
20	Voltage	Continuous power supply voltage	
15, 16	Voltage	Non-continuous power supply voltage	
19,37,98, 107	5V voltage 1	External sensor 5V voltage supply 1	
36, 108, 109	5V voltage 2	External sensor 5V voltage supply 2	
64,63, 112, 111	Ground	Power supply ground	
7, 43, 47, 59, 80, 84, 85, 86, 95	Ground	Sensor ground	
6	Clutch pedal switch	Digital signal input 0-12 V	
8	Start/stop STRM	Digital signal input 0-12 V	Reserved
9	Cruise Main Switch/1pin Cruise Input	Digital signal input 0-12 V or Analog signal input 0-5V	Reserved
10	Natural gas enable/fuel type detection sensor/fan speed input/vehicle speed input	Digital signal input 0-12 V(PWM)	Reserved
11	Cruise control resume switch	Digital signal input 0-12 V	Reserved
12	Vacuum pressure sensor/acceleration sensor	Analog signal input 0-12 V	Reserved
13	Starter feedback signal	Digital signal input 0-12 V	Reserved
14	Natural gas changeover switch/electronic load 1	Digital signal input 0-12 V	Reserved
21	Downstream oxygen sensor signal input	Analog signal input 0-5V	Optional 92-pin access via jumper
22	Cruise set switch	Digital signal input 0-12 V	Reserved
23	Brake pedal switch	Digital signal input 0-12 V	
24	A/C medium pressure switch	Digital signal input 0-12 V or	

	(S_PSW)/A/C pressure sensor (PAC)/A/C compressor switch (S_KO)	Analog signal input 0-5V	
25	Stop lamp switch	Digital signal input 0-12 V or Analog signal input 0-5V	
26	Vehicle speed sensor/Airbag/ABS signal	Digital signal input 0-12 V(PWM)	Reserved
27	Neutral switch	Digital signal input 0-12 V	Reserved
28	A/C request switch	Digital signal input 0-12 V	
29	Electronic load 2/ABS signal	Digital signal input 0-12 V(PWM)	Reserved
30	Accelerator pedal sensor 2	Analog signal input 0-5V	
32	IMMO code	Digital signal input 0-5V	
35	KL15 on input	Digital signal input 0-12 V	
44	Clutch position signal/low clutch switch	Digital signal input 0-12 V or Analog signal input 0-12 V	Reserved
45	Accelerator pedal sensor 1	Analog signal input 0-5V	
46	Booster pressure sensor signal	Analog signal input 0-12 V	Reserved
53	A/C compressor switch (S_KO)/cruise cancel switch/ACC wakeup switch	Digital signal input 0-12 V	
60	Engine temperature signal 2/fuel pressure sensor/ambient pressure sensor	Analog signal input 0-5V or Analog signal input 0-12 V	
61	Fuel Level Sensor/Supercharged Intake Temperature Sensor/CBR Position Sensor	Analog signal input 0-12 V	Reserved
62	A/C evaporator temperature/EGR pressure sensor	Analog signal input 0-5V or Analog signal input 0-12 V	Reserved
77	Throttle position sensor 1	Analog signal input 0-5V	
78	Throttle position sensor 2	Analog signal input 0-5V	
79	Supercharge intake air temperature sensor/CBR position sensor/2nd oxygen sensor input	Analog signal input 0-5V or Analog signal input 0-12 V	Reserved
89, 90	Knock sensor		
91	Intake pressure/flow signal(DSS/HFM)	Analog signal input 0-5V or Analog signal input 0-12 V or Digital signal input 0-12 V(PWM)	
93	Pg sensor 1	Digital signal input 0-12 V(PWM)	
96	Engine speed signal A	Magnetoelectric or Hall type: Digital signal input	
97	Engine speed signal B	Magnetoelectric or Hall type: Digital signal input	
101	Engine temperature signal	Analog signal input 0-5V	
102	Intake air temperature signal	Analog signal input 0-5V	
103	Supercharge intake pressure sensor/oil temperature sensor/EGR position sensor/variable intake manifold position sensor	Analog signal input 0-5V or Analog signal input 0-12 V	Reserved
104	Upstream oxygen sensor signal	Analog signal input 0-5V	
105	Pg sensor 2	Digital signal input 0-12 V(PWM)	
106	Generator feedback signal	Digital signal input 0-12 V(PWM)	Reserved
5	Main relay control		

31	Fan 2 control	0-2 .2A	
33	Fuel consumption output/fuel level output/start/stop alarm lamp control	0-500 mA(PWM)	Reserved
34	Engine speed signal output	0-400mA	Reserved
38	Reserve 1/fuel level output/cruise status indicator	0-500mA	Optional, reserved
39	Electronic water pump/secondary air pump relay	0-500mA	Optional, reserved
40	SVS lamp control/anti-theft R-line	0-50mA	
41	Fuel pump relay	0-600 mA(High or low side drive option)	
42	Electronic thermostat/electronic vacuum pump/A/C compressor switch/vehicle speed output/water temperature output/cruise status indicator	0-2 .2A	Reserved
48or 110	Downstream oxygen sensor heating	0-3A	
49	Vehicle speed output/water temperature output/start/stop status lamp control	0-500 mA(PWM)	Optional, reserved
50	Starter relay control	0-1 .5A (high side drive)	Optional, reserved
51	Reserved 3/fuel consumption output/water temperature output	0-500mA	Optional, reserved
52	Reserved 2	0-500mA	Optional, reserved
54	Electronic vacuum pump control	0-500mA	Optional, reserved
55	Cruise status indicator	0-500mA	Optional, reserved
56	Fan1 control/PWM Fan control	0-2 .2A	
57	MIL lamp control/start/stop alarm lamp control	0-50mA	Reserved
58	A/C compressor relay/starter control relay(Low side)	0-600mA	
65	CBR/Exhaust gas recirculation/engine temperature output/fuel consumption output	0-2 .2A	Reserved
66, 81, 82, 83	Stepper drive	0-500mA	Optional, reserved
68	Injector1	0-2 .2A	
72	Injector2	0-2 .2A	
74	Injector3	0-2 .2A	
67	Injector4	0-2 .2A	
69	OutletVVT/Variable camshaft lift/starter relay control/exhaust gas recirculation/secondary air pump relay/level output/fuel consumption output/electronic water pump	0-3A(PWM)	
70	SU/Relief valve control	0-2 .2A	

71	Inlet VVT/variable camshaft lift/level output/EGR/electronic vacuum pump/exhaust gas recirculation/secondary air valve/cruise status indicator	0-3A	
73	Upstream sensor heating	0-3A	
75, 87	Egas drive	0-3 .5A	
100	IGN1	Internal drive: Maximum voltage 370 V, maximum current 17 A External drive: High level 5V output, maximum current 15 mA	
99	IGN2	Internal drive: Maximum voltage 370 V, maximum current 17 A External drive: High level 5V output, maximum current 15 mA	
76	IGN3	Internal drive: Maximum voltage 370 V, maximum current 17 A External drive: High level 5V output, maximum current 15 mA	Optional, reserved
88	IGN4	Internal drive: Maximum voltage 370 V, maximum current 17 A External drive: High level 5V output, maximum current 15 mA	Optional, reserved
94	Canister valve control	0-2 .2A	
1, 17	CAN1 Communication	60ohm termination resistance configured	
4, 3	K-line communication	60ohm termination resistance configured	For calibration only
18	Lin communication		
2	CAN1 Communication		Optional, reserved
92	Communication with external generator	-	Optional, reserved

Limit data

Quantity		Value			Unit
		Minimum	Typical	Maximum	
Battery voltage	Normal operation	9. 0		16.0	V
	Limited function	6.0 to 9.0		16.0 to 18.0	V
Limits and time to withstand battery overvoltage	26.0V	Some functions are maintained to perform fault diagnosis.		60	s
Operating temperature		-40		+70	°C
Storage temperature		-40		+90	°C

Knock sensor assembly

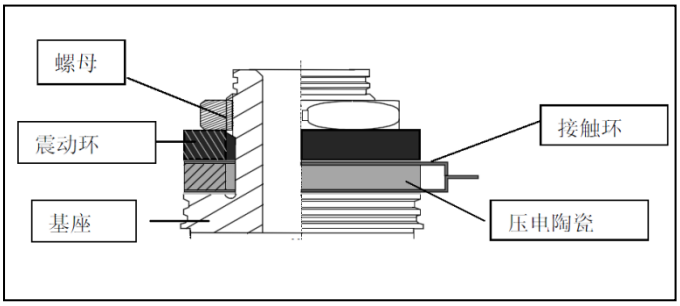
Function:

Knock sensor is installed close to the engine cylinder block, real-time detection

For engine vibration, use piezoelectric effect to convert engine vibration into electrical signal and transmit to ECU for knock detection. When the engine is knocked, the cylinder vibration acceleration will increase rapidly, and the sensor electrical signal will change drastically to determine that the engine is knocked.

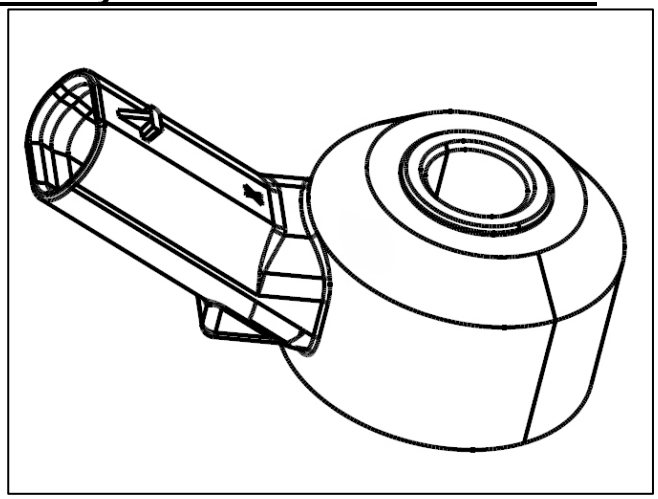
Working principle:

Knock sensor is a kind of vibration acceleration sensor installed on the engine cylinder block. The sensor's sensitive element is a piezoelectric element. The vibration of the engine cylinder block is transmitted to the piezoelectric crystal through the mass in the sensor. Piezoelectric crystal generates voltage on two pole faces due to pressure generated by mass vibration, which converts vibration signal into alternating voltage signal output. Because the frequency of vibration signal caused by engine knock is much higher than that of normal vibration signal of engine, ECU can distinguish knock signal and non-knock signal after filtering the knock sensor signal.

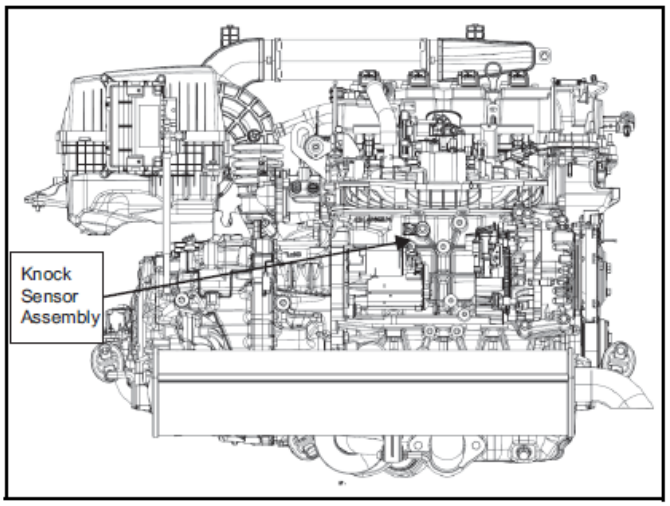


Product structure:

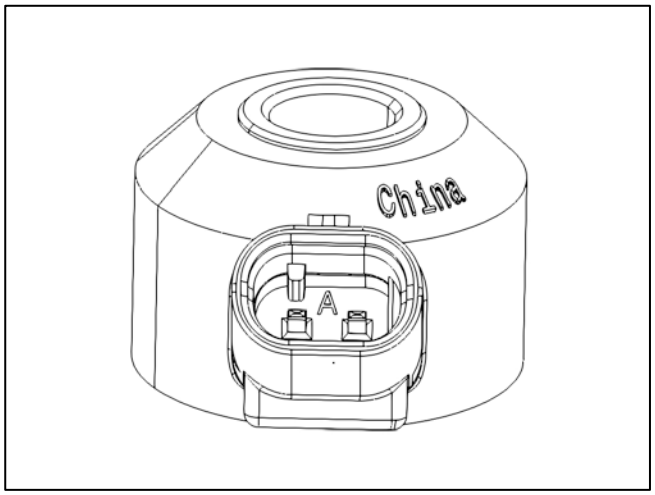
1. Single structure



2. Layout structure



3. Interface definition:



Note: Both PINs have no polarity and are signal output pins.

Features:

1. Insulation resistance between 2PIN at room temperature is greater than 1MΩ.
2. Sensitivity: 5kHzHz: 23~34 mV/g

8 kHz: 22~37 mV/g
13 kHz: 22~40 mV/g
18 kHz: 22~43 mV/g

Product fault and troubleshooting:

⚠ Before performing product unit inspection, perform relevant inspection of harness link first, and then perform product unit inspection after confirming that there is no problem.

⚠ When the engine fault lamp is on to report the relevant faults of knock sensor, if there are other faults such as engine misfire and vehicle jitter that may cause abnormal engine vibration at the same time, rule out other faults before judging the knock sensor.

The inspection steps of the unit are as follows:

1.Check the resistance between the two terminals of the sensor terminal connector with a multimeter (check terminals 1# and 2# with harness products), and the resistance should be between 3.95-5.85 megohms under normal conditions;

2.Turn the multimeter in millivolt gear, knock the cylinder block near the installation point of knock sensor with a small metal hammer, and detect whether there is voltage change between the sensor output terminals (terminals 1# and 2#). If there is voltage change, it proves that the sensor is normal and can identify the vibration signal of the cylinder block.

⚠ When there is a problem, ABA is recommended for interchangeability verification.

Engine oil pressure sensor assembly

Function:

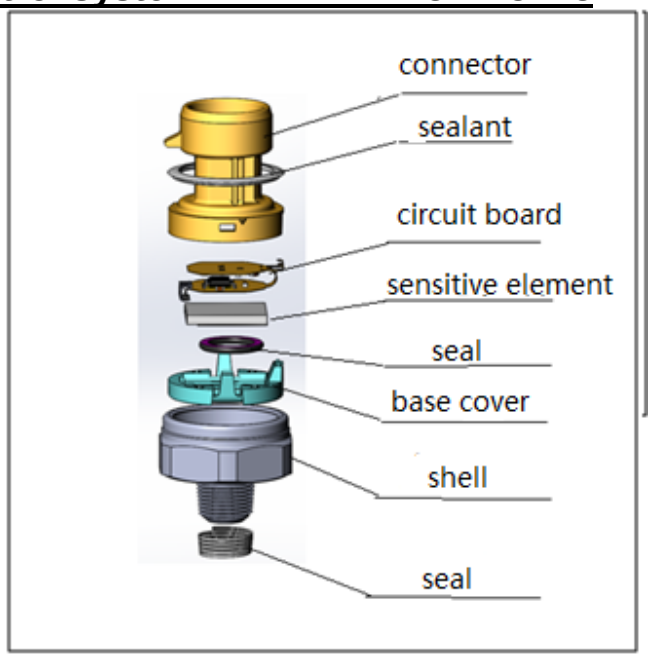
The engine oil pressure alarm assembly is an absolute pressure sensor installed on the engine main oil passage and fed back to the control system oil pressure.

Working principle:

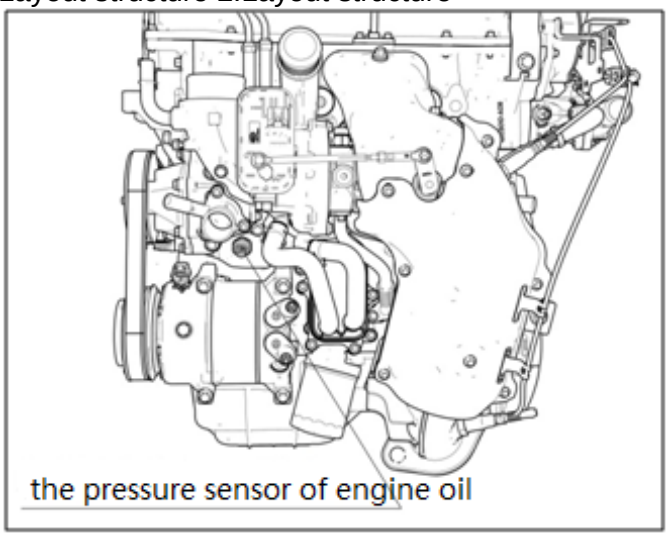
The oil pressure sensor consists of a pressure sensitive element and a signal processing circuit. The engine oil pressure acts on the sensitive element to produce a signal change, which is processed by the signal circuit and outputs a proportional voltage signal corresponding to the pressure input.

Product structure:

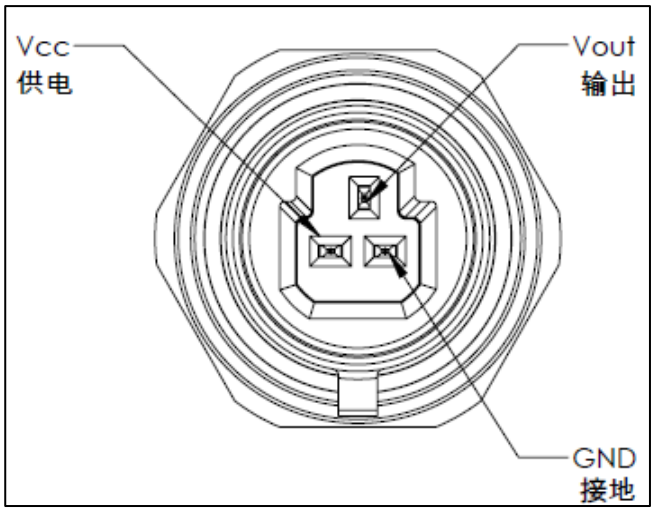
1. Single structure



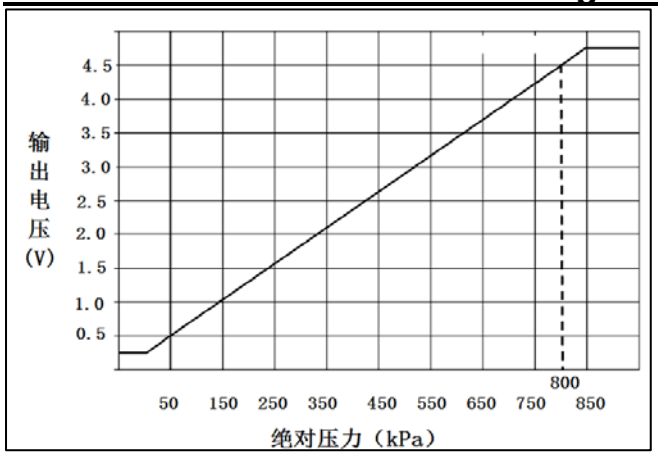
Layout structure 2.Layout structure



Interface definition:



Features:



The oil pressure outputs a voltage signal proportional to the oil pressure.

Product fault and troubleshooting:

Before performing product unit inspection, perform relevant inspection of harness link first, and then perform product unit inspection after confirming that there is no problem.

Unit inspection

1.(Remove the connector) Turn the digital multimeter to the ohmic position. Connect the two probes to the sensor 1# pin and the metal housing of the sensor respectively. When the engine is not started, the resistance is small (generally less than 50Ω). After starting the engine, the resistance is large open circuit.

2. Check the lighting of the oil lamp of the instrument. When the engine is not running, the oil lamp should be on; After the engine runs, the oil pressure is normally established and the oil lamp goes out.

When there is a problem, ABA is recommended for interchangeability verification.

Crankshaft position sensor assembly

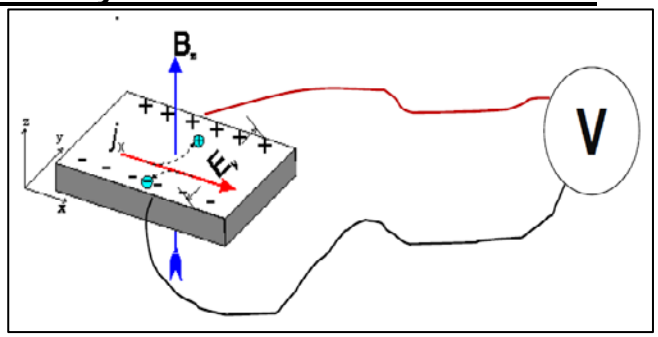
Function:

Crankshaft position sensor: Generally installed on cylinder block or transmission,

It is used to detect the current position of the crankshaft and then determine the top dead center of cylinder 1 of the crankshaft.

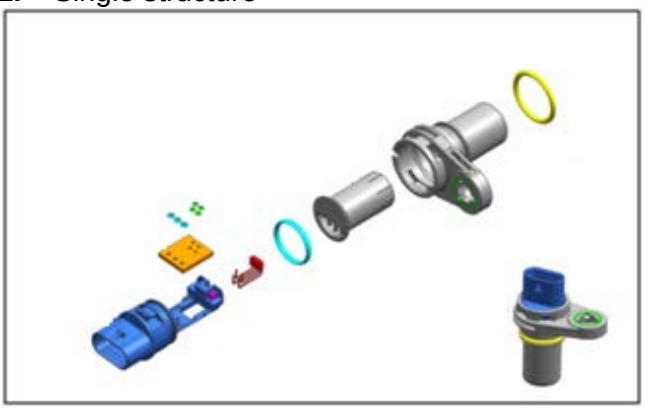
Working principle:

Hall effect principle: If the conductor has current and magnetic field perpendicular to the current, voltage will be generated in the lateral direction.



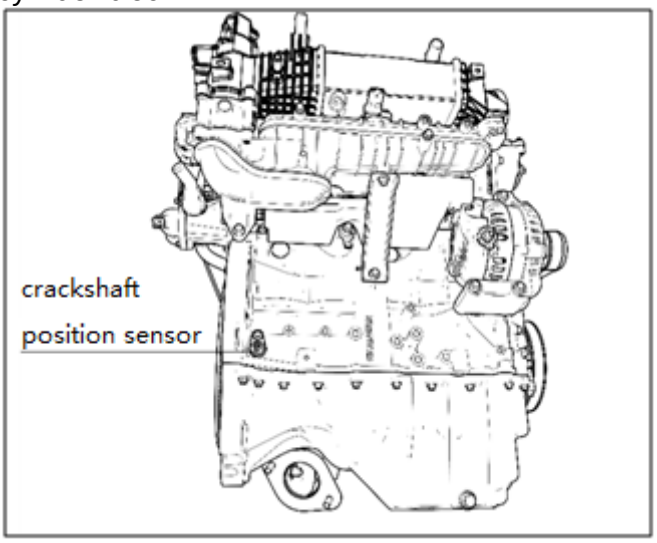
Product structure:

1. Single structure

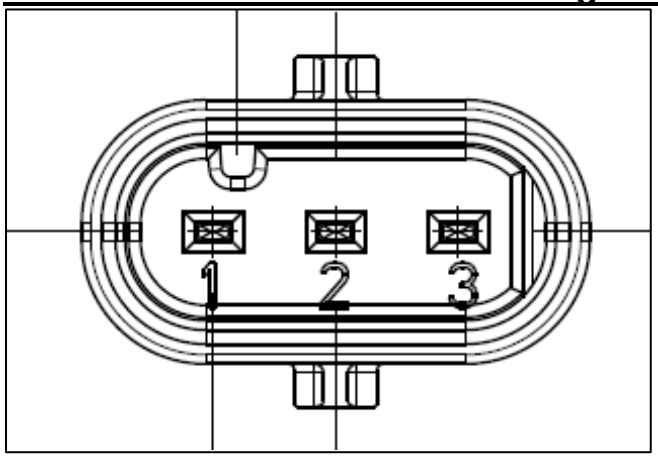


2. Layout structure

The crankshaft position sensor is arranged on the cylinder block.



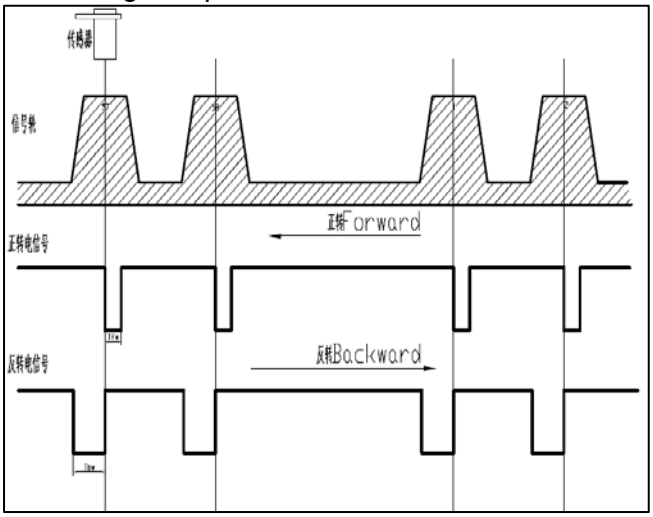
3. Interface definition:



Remarks: 1 power supply; 2 ground; 3 Signal

Features:

1. Voltage output curve:



2. Electrical parameters:

参数	符号	下限值	常规值	上限值	单位	备注
正转输出脉宽	T_{fw}	38.25	45	51.75	us	
反转输出脉宽	T_{bw}	76.5	90	103.5	us	
供电电压	Us	4.75		16	V	
输出信号电压	Uso	0		18	V	
输出信号低电压	Uol			0.5	V	
输出信号高电压	Uoh	Uso-0.5	Uso-0.3		V	

Product fault and troubleshooting:

Note: Before troubleshooting, first check the harness link, and then troubleshoot the product.

Inspect whether the crankshaft position sensor is damaged, whether the housing is cracked, whether the connector terminal is rusted, and whether there is water in the connector.

Crankshaft position sensor inspection:

Use oscilloscope to detect whether the output signal voltage of crankshaft position sensor is within the range of electrical parameters, and whether the pulse width of forward and reverse rotation signals is normal.

Water temperature sensor assembly

Function:

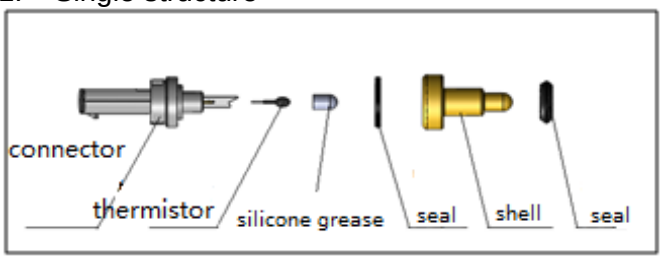
Water temperature sensor is used to monitor engine coolant temperature and provide coolant temperature information for engine ECU, so as to realize more accurate engine operation.

Working principle:

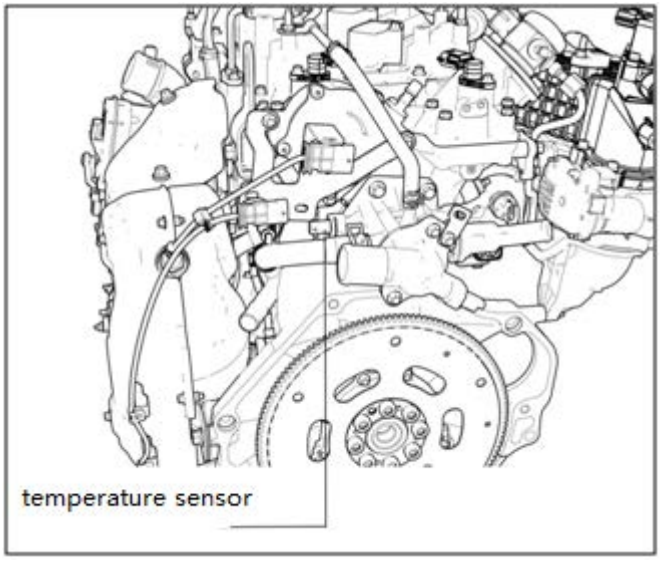
The temperature sensing element of water temperature sensor is a negative temperature coefficient temperature sensor. The higher the temperature, the lower the resistance.

Product structure:

1. Single structure



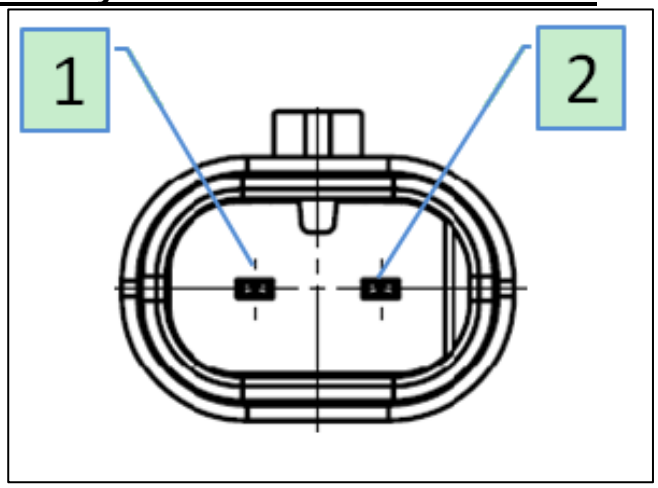
2. Layout structure



D20 model layout

3. Interface definition:

Where 1 and 2 can be interchanged



Features:

R-T Features:

t(℃)	Rmin.(kΩ)	Rmax.(kΩ)
-40	40.66	47.57
-30	23.27	26.90
-20	13.82	15.79
-10	8.477	9.584
0	5.358	6.000
10	3.480	3.862
20	2.318	2.550
30	1.579	1.724
40	1.099	1.191
50	0.7796	0.8390
60	0.5631	0.6021
70	0.4135	0.4394
80	0.3084	0.3258
90	0.2333	0.2452
100	0.1789	0.1870
110	0.1389	0.1445
120	0.1086	0.1135
130	0.0859	0.0902

Product fault and troubleshooting:

Note: Before troubleshooting, first check the harness link, and then troubleshoot the product.

Unit inspection

1. (Remove the connector) Turn the digital multimeter to the ohmic position. Connect the two probes to pins 1,2 of the sensor respectively. The rated resistance at 20℃ is 2.3kΩ-2.5kΩ. Other temperatures can be evaluated by the above table. Start when the vehicle is cold, let the water temperature rise gradually, and observe the change of sensor resistance. When measuring, you can also use the simulation method. Put the sensor head in

the hot water, and the sensor resistance shall gradually decrease as the head temperature rises. The specific value depends on the temperature of the hot water.

2. Check the water temperature parameter in the engine diagnostic scanner, it can be close to the current water temperature energy, and there is obvious change, and judge according to the displayed data value.

Note: In case of difficult problems, ABA is recommended for interchangeability verification.

Special note: For water temperature is always on the center line (the display range of the center line is large 50℃ -110 ° C), it is necessary to read the data stream of water temperature with a diagnostic scanner and judge with the actual water temperature. In summer, due to the high temperature in the engine compartment, it is easy to be on the center line (this is a normal phenomenon).

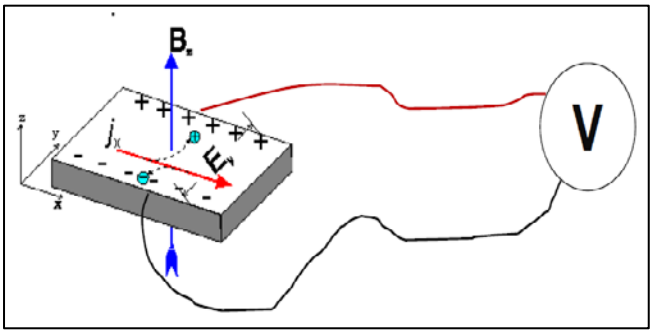
Camshaft position sensor assembly

Function:

Camshaft position sensor: Generally installed on the cylinder head or cylinder head cover, with the crankshaft position sensor signal to determine the current engine cylinder working stroke.

Working principle:

Hall effect principle: If the conductor has current and magnetic field perpendicular to the current, voltage will be generated in the lateral direction.

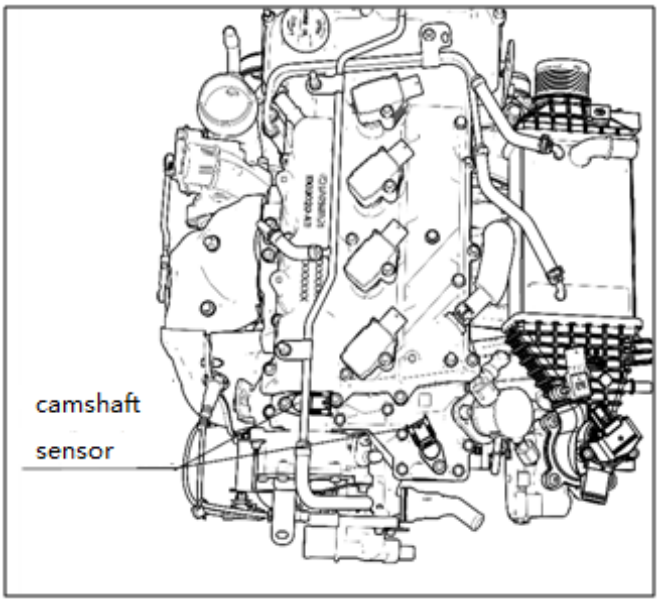


Product structure:

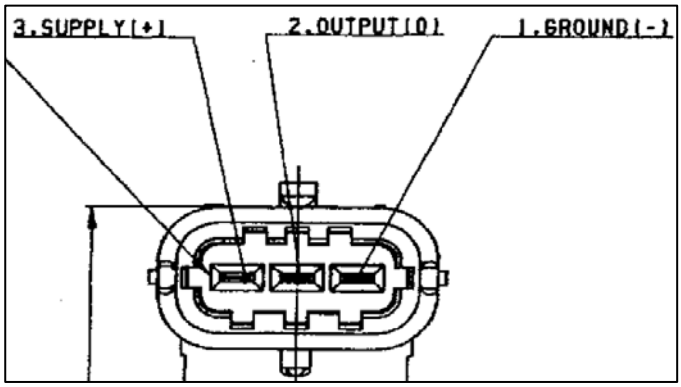
1. Single structure

2. Layout structure

2. Layout structure



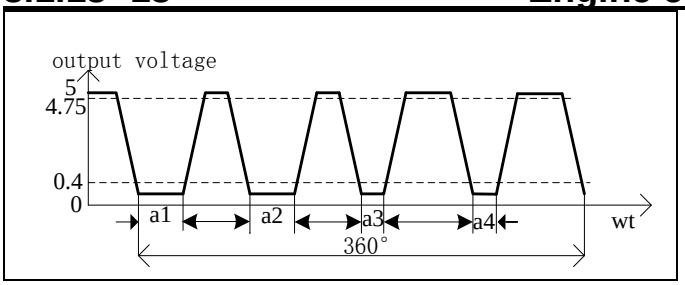
3. Interface definition:



Remarks: 3 power supply; 2 Output; 1 Ground signal.

Features:

Voltage output curve:

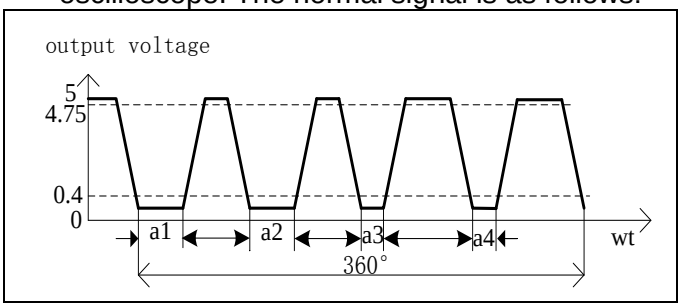


Product fault and troubleshooting:

Note: Before troubleshooting, first check the harness link, and then troubleshoot the product.

Check whether the appearance of camshaft position sensor is damaged, whether the housing is cracked, whether the connector terminal is rusted, and whether there is water in the connector.
Camshaft position sensor check:

4. NE1 is a dual VVT system with two camshaft position sensors; The fault code will distinguish intake camshaft position sensor fault or exhaust camshaft position sensor fault, align the camshaft position sensor, and observe whether the fault code follows the sensor;
5. If the following sensor reports a fault, it can be judged that the camshaft position sensor is damaged. If there is no following camshaft position sensor, check the harness;
6. If the fault code does not judge the intake or exhaust fault, it is necessary to read the camshaft position sensor output voltage with an oscilloscope. The normal signal is as follows:



Boost pressure temperature sensor assembly

Function:

Used in an electronically controlled fuel injection system to provide intake air pressure and temperature signals. Realize closed loop control and improve the control accuracy of ECU for air-fuel ratio. A single vehicle has two boost pressure and temperature sensors, which are installed in front and back of the throttle respectively. The boost pressure and temperature sensor in front of the throttle (intercooled pipe) is used to control the boost degree of the supercharger in a closed loop manner. The boost pressure and temperature sensor in back of the throttle (intake manifold) is used to calculate the inflation model. The intake volume is controlled in a closed loop manner based on the torque and throttle position to ensure the exhaust, power and fuel economy of the vehicle.

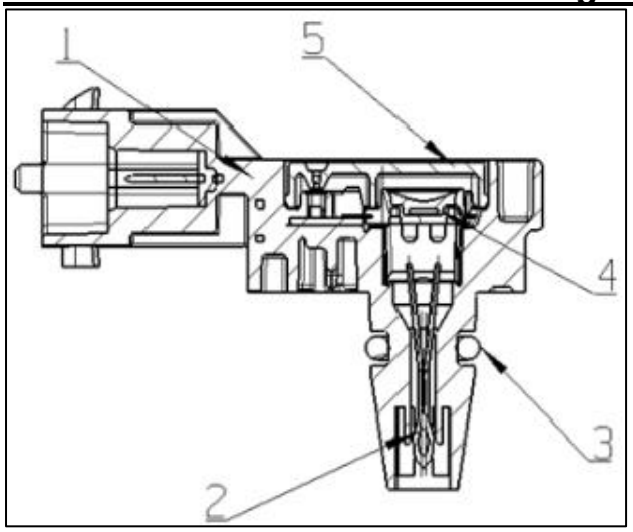
Working principle:

（1） Pressure measurement principle: There is pressure sensing original in the sensor. The pressure sensing original is composed of a chip, and a pressure diaphragm is etched on the chip. The pressure diaphragm has four piezoresistors which form a Wheatstone bridge as strain elements. Besides this pressure diaphragm, the chip also integrates signal processing circuit. The active surface of silicon chip is subject to this near-zero voltage, and its surface is subject to the pressure to be measured. The thickness of silicon chip is only several microns, so the change of measured pressure will cause mechanical deformation of silicon chip, and four piezoelectric resistors will be deformed with the change of resistance value. After passing through the signal processing circuit of silicon chip, the voltage signal with linear relationship with pressure will be formed. , voltage signal is input to ECU, and ECU obtains the measured pressure according to voltage signal and pressure-voltage signal characteristic curve.

（2） Temperature measurement principle: The temperature measurement of supercharging pressure and temperature sensor is of NTC type. The temperature is different and the resistance value of NTC original part is different. Obtain the measurement temperature according to the corresponding relationship between the two.

Product structure:

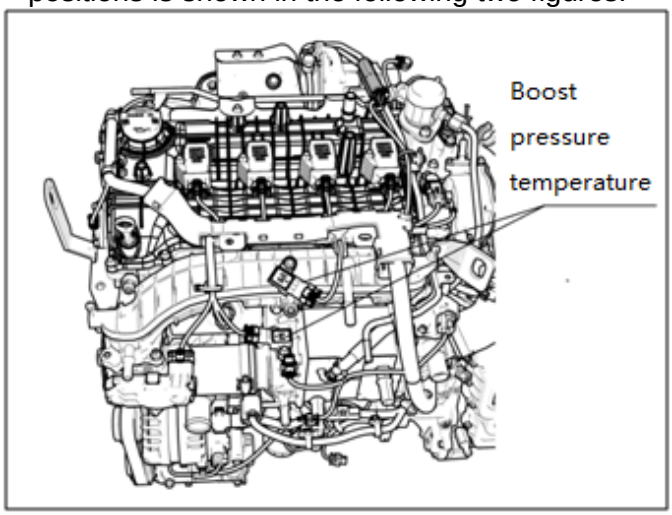
1. Unit structure: The main structure of the boost pressure and temperature sensor assembly (3762020 -MK01) is assembled from the housing, NTCs, sealing rings, pressure chip and cover plate. The detailed structure is as shown in the figure below:



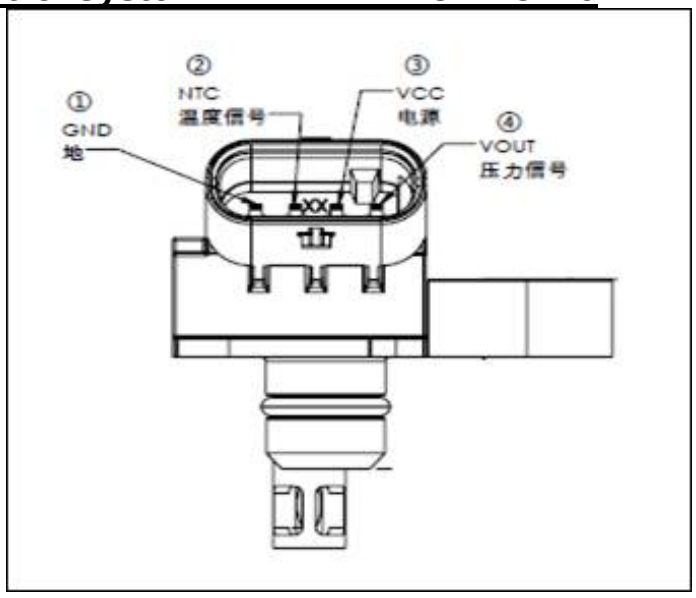
1- Housing 2-NTC 3- sealing ring 4-pressure chip 5-cover plate

2. .Layout structure:

Two boost pressure and temperature sensors are used for each vehicle, one in front and one in front of the throttle, wherein the front of the throttle is located on the intercooler pipe and the rear of the throttle is located on the intake manifold. The arrangement structure of the two positions is shown in the following two figures:



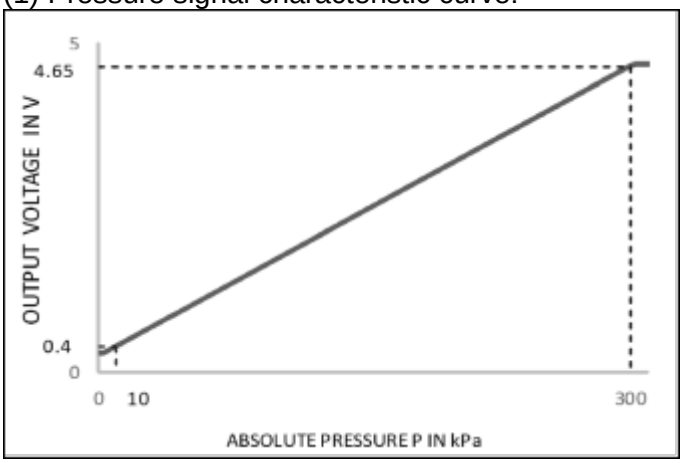
3. Interface definition: This sensor is of 4pin structure and integrates pressure measurement and temperature measurement. The definition of each pin pin is shown in the following figure:



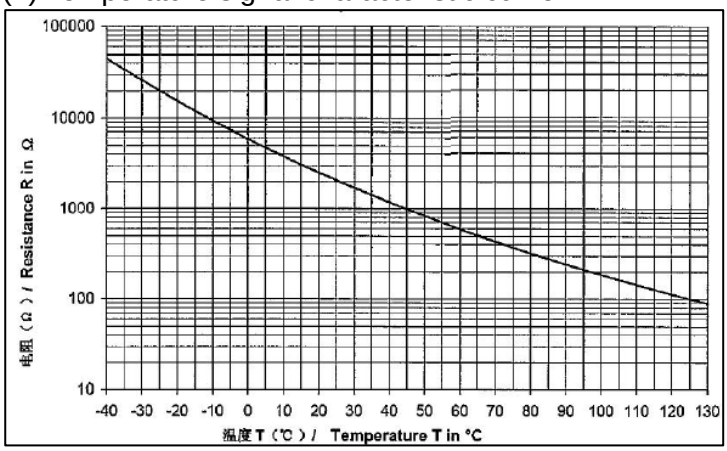
Product characteristics:

This sensor pressure range 10~300kpa, temperature range -40℃~ 130 ° C

(1) Pressure signal characteristic curve:



(2) Temperature signal characteristic curve:



Product fault and troubleshooting:

Note: Before troubleshooting, first check the harness link, and then troubleshoot the

product.

Unit inspection:

1. If a sensor on the vehicle reports a fault, install the front and rear sensors of the throttle valve interchangeably, and observe whether the fault follows the parts. If the fault does not follow the parts, confirm that the parts have no problem. If the fault follows the parts, continue to troubleshoot the sensor unit.
2. Simple measurement method:

Check whether the faulty boost pressure and temperature sensor harness connector terminal is rusted. If not,

(1) Temperature sensor part: Turn the digital multimeter to the ohmic position, the two probes respectively contact the pins 1,2 of the sensor, the rated resistance at 20℃ is 2.5 KΩ±5%, other corresponding resistance values are measured according to the temperature characteristic curve, and the analog method can also be used, specifically, use the hot-spot blowing air to supply air to the sensor (note that it is too close to be reliable), observe the change of the sensor resistance, and the resistance should be reduced at this time.

(2) Pressure sensor part: When the connector is assembled, test the voltage output signal of pins 3 and 4 with fine wire or other methods. In idle speed state, the reference voltage of pin 3 shall be 5V, and the voltage of pin 4 is about 0.5 V-1V (the specific value is related to the vehicle model); In neutral state, slowly step on the accelerator, and the voltage of pin 4 slightly increases; Press the accelerator quickly, the voltage of pin 3V-4V can reach about 3V-4V (the specific value is related to the vehicle model), and then drop to about 0.5 V-1V (the specific value is related to the vehicle model).

⚠ **Note: In case of difficult problems, ABA is recommended for interchangeability verification.**

Oxygen sensor assembly _ front oxygen(Wire oxygen)

Function:

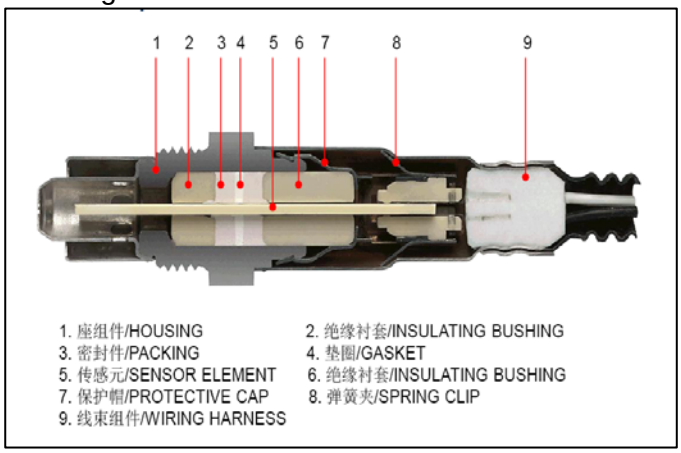
It is used in feedback system of electronically controlled fuel injection device to realize closed loop control and improve the control accuracy of ECU for air-fuel ratio. It is installed on the exhaust gas passage to measure the oxygen content in the exhaust gas and determine whether gasoline and air are completely burned, so as to ensure that the three-way catalytic converter has the maximum conversion efficiency for HC, CO and NOX in the exhaust gas, and ensure the vehicle emission, power and fuel economy.

Working principle:

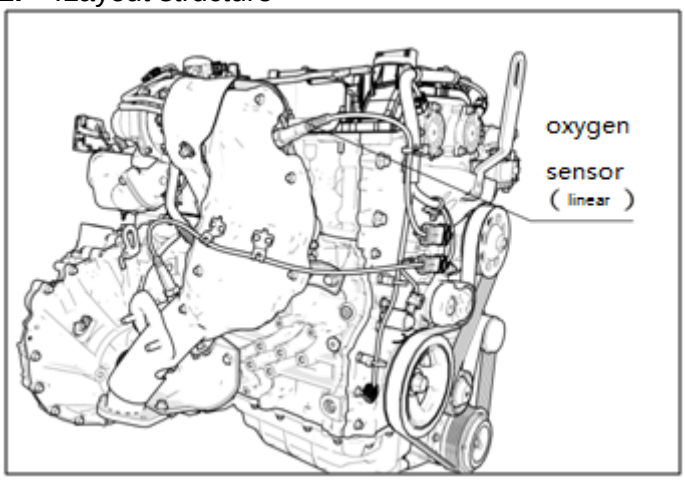
The working principle of zirconia element is equivalent to a simple solid-state primary battery. According to electrochemical principle, there will be potential difference between two electrodes due to difference of oxygen ion concentration. When the engine air-fuel ratio is lean, the oxygen ion concentration in the exhaust gas is relatively high, and the forward current is output; Conversely, when the air-fuel ratio is rich, the oxygen ion concentration in the exhaust gas is relatively low, and the negative current is output.

Product structure:

1. Single structure



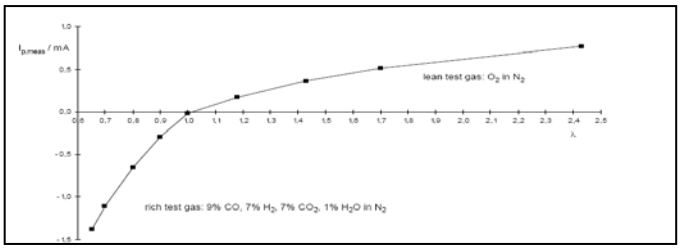
2. .Layout structure



3. .Interface definition:

Features:

1. Voltage output curve:



2. Resistance characteristics:

At normal temperature (23 °C), the heating end (three-pin and four-pin) resistance is 2.6Ω± 0.6Ω.

Product fault and troubleshooting:

Before performing product unit inspection, perform relevant inspection of harness connection first, and then perform product unit inspection after confirming that there is no problem.

Check whether the terminal of oxygen sensor harness connector is rusted and whether the terminal is horizontal; Check the oxygen sensor heating control wire, signal wire and signal ground wire for open circuit or short circuit. If present, replace wiring harness. Because of harness fault, oxygen sensor related fault will also be reported.

1. Check front oxygen signal:

A. Engine running time: More than 2 minutes.

B. Water temperature: Greater than 60℃.

C. Working condition: Idle speed (700 rpm -800 rpm) -high speed (3000 rpm-4000 rpm) -idle speed (700 rpm -800 rpm).

Data reading tool: Diagnostic scanner.

Normal output of sensor lamda signal output is as follows:

Idle speed: The lamda signal should oscillate slightly around one.

Release immediately after pressing the accelerator: The lamda signal should first decrease and then increase, and finally gradually rise to a small oscillation near No.1.

Note: In case of difficult problems, ABA is recommended for interchangeability verification.

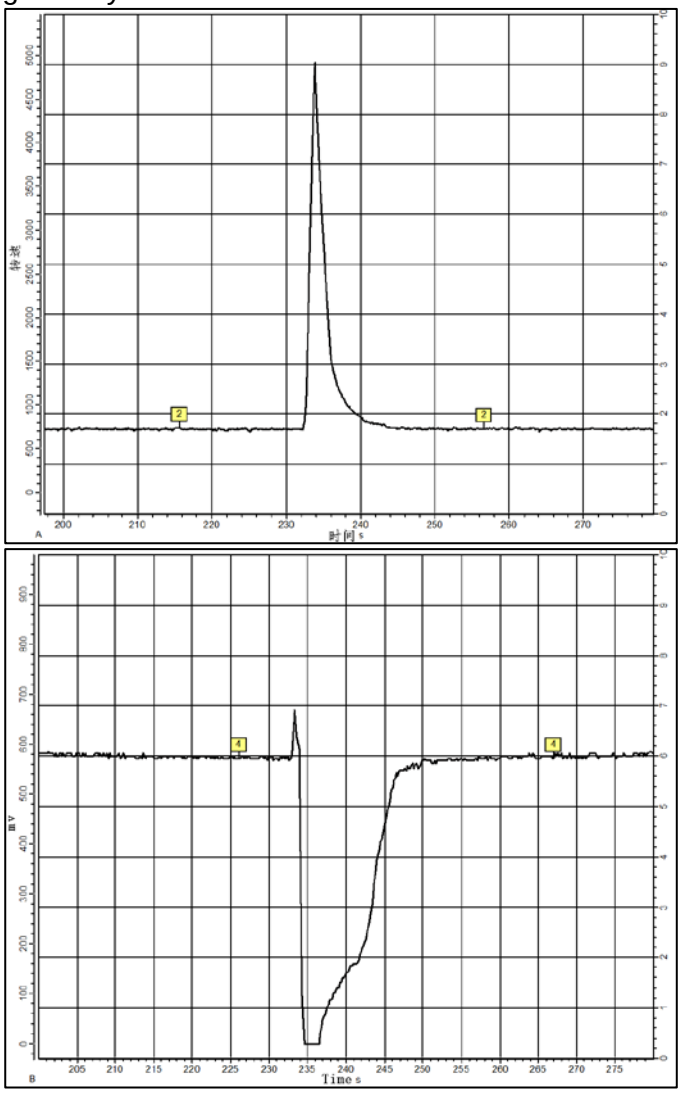
C. Working condition: Idle speed (700 rpm -800 rpm) -high speed (3000 rpm-4000 rpm) -idle speed (700 rpm -800 rpm).

Data reading tool: Diagnostic scanner.

Normal output curve of sensor is as follows:

Idle speed: The signal oscillates in a small range of 600mv-800mv.

Release the accelerator immediately after pressing the accelerator: The sensor signal impulse height (700mv-900mv) drops to 0mv, and then gradually rises and oscillates.



4. Check the resistance characteristics of rear sensor heating end:

Under normal temperature (23 °C) condition, the sensor heating terminal resistance is 9Ω± 2Ω.

When the vehicle is hot, the resistance value will be high, but it will not exceed 20Ω.

When there is a problem, ABA is recommended for interchangeability verification.

Oxygen sensor assembly _ rear oxygen(Switch oxygen)

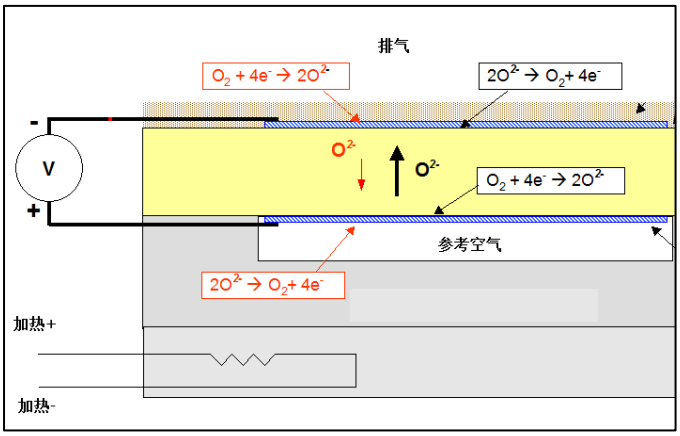
Function:

It is used in feedback system of electronically controlled fuel injection device to realize closed loop control and improve the control accuracy of

ECU for air-fuel ratio. It is installed on the exhaust gas passage to measure the oxygen content in the exhaust gas and determine whether gasoline and air are completely burned, so as to ensure that the three-way catalytic converter has the maximum conversion efficiency for HC, CO and NOX in the exhaust gas, and ensure the vehicle emission, power and fuel economy.

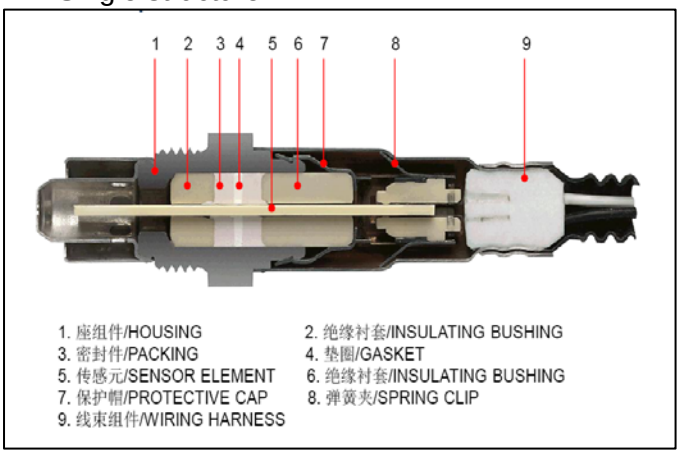
Working principle:

The working principle of zirconia element is equivalent to a simple solid-state primary battery. According to electrochemical principle, there will be potential difference between two electrodes due to difference of oxygen ion concentration. When the engine air-fuel ratio is lean, the oxygen ion concentration in the exhaust gas is relatively high, the oxygen ion concentration difference between the inner and outer electrodes is small, that is, the potential difference is small, and the output voltage signal of the oxygen sensor is close to 0V; Conversely, when the air-fuel ratio is rich, the oxygen ion concentration in the exhaust gas is relatively low, the oxygen ion concentration difference between the inner and outer electrodes is large, that is, the potential difference is large, and the output voltage of the sensor is close to 1V.

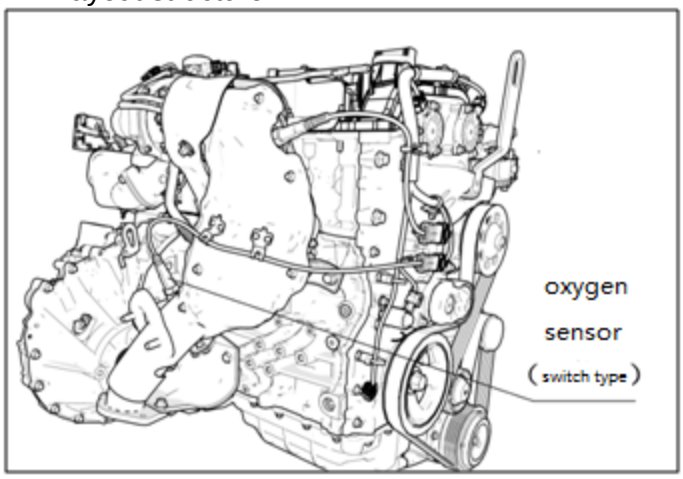


Product structure:

1. Single structure



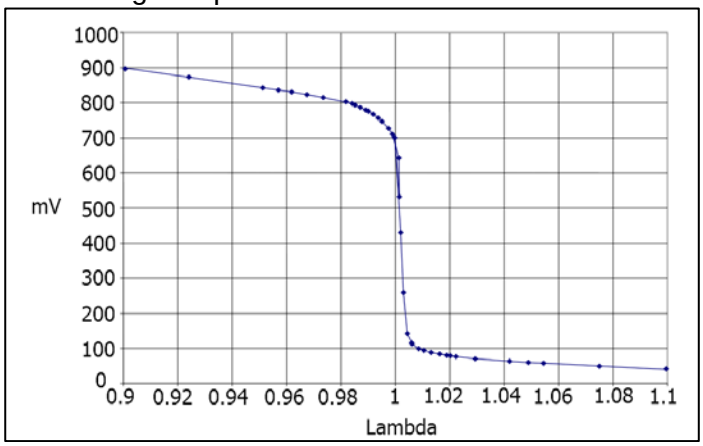
2. Layout structure



3. .Interface definition:

Features:

1. .Voltage output curve:



2. Resistance characteristics:

At normal temperature (23 °C), the heating end (3pin, 4pin) resistance is 9Ω± 2Ω.

Product fault and troubleshooting:

Before performing product unit inspection, perform relevant inspection of harness link first, and then perform product unit inspection after confirming that there is no problem.

Check whether the terminal of oxygen sensor harness connector is rusted and whether the terminal is horizontal; Check the oxygen sensor heating control wire, signal wire and signal ground wire for open circuit or short circuit. If present, replace wiring harness. Because of harness fault, oxygen sensor related fault will also be reported.

1. Rear oxygen signal check:

A. Engine running time is greater than 10 min.

B. Water temperature: Greater than 60℃.

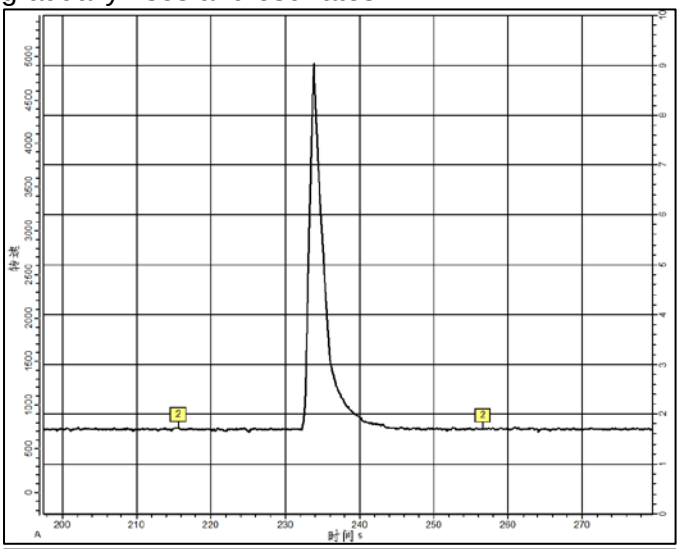
C. Working condition: Idle speed (700 rpm -800 rpm) -high speed (3000 rpm-4000 rpm) -idle speed (700 rpm -800 rpm).

Data reading tool: Diagnostic scanner.

Normal output curve of sensor is as follows:

Idle speed: The signal oscillates in a small range of 600mv-800mv.

Release the accelerator immediately after pressing the accelerator: The sensor signal impulse height (700mv-900mv) drops to 0mv, and then gradually rises and oscillates.



2. Check the resistance characteristics of rear sensor heating end:

Under normal temperature (23 °C) condition, the sensor heating terminal resistance is 9Ω± 2Ω.

When the vehicle is hot, the resistance value will be high, but it will not exceed 20Ω.

Note: In case of difficult problems, ABA is recommended for interchangeability verification.

Vacuum pressure sensor assembly

Product function:

Used in brake system to provide vacuum signal of vacuum booster. Realize closed-loop control of vacuum degree monitoring in enabling STT function and HBB function of ESP to improve driving safety and comfort.

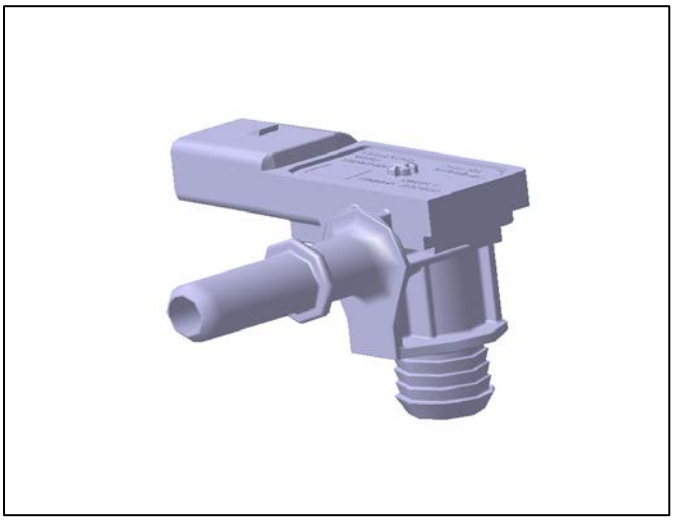
Working principle:

Pressure measurement principle: There is pressure sensing original in the sensor. When the measured pressure is different, the pressure sensing film deformation of the pressure sensing original is different. Change the pressure signal into voltage signal through Wheatstone bridge and input to ECU. ECU will know the measured pressure according to the voltage signal and pressure-voltage signal characteristic curve.

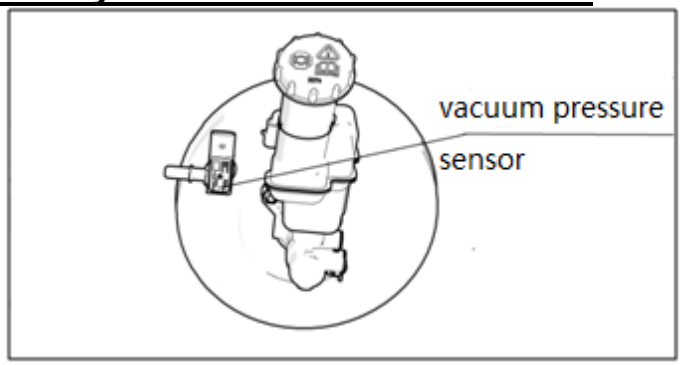
Product structure:

1. Single structure

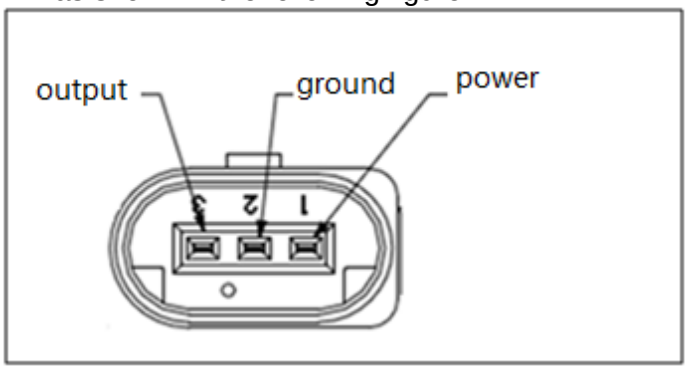
The main structure of the vacuum pressure sensor assembly is assembled by two parts of chip and housing. The vacuum pressure sensor with part number 3762060 -BH01 is an integrated vacuum pressure sensor. The quick plug of the vacuum pressure sensor is connected with the quick joint on the vacuum pipeline. The vacuum pressure sensor slub head is directly mounted on the vacuum booster mounting hole to collect the vacuum degree.



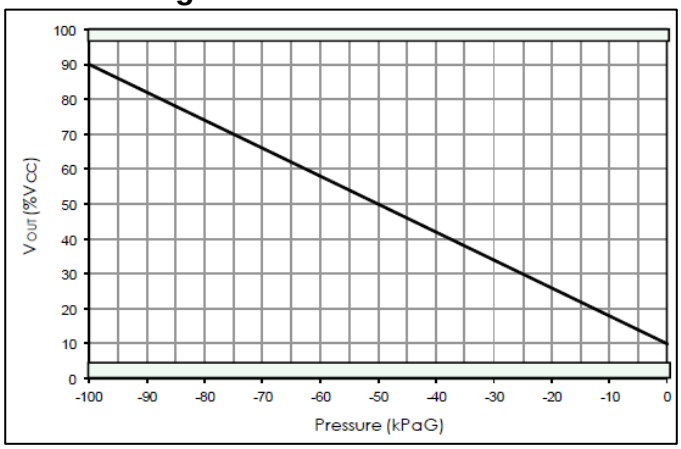
2. Layout structure:



3. Interface definition: This sensor is of 3pin structure, and the definition of each pin pin is as shown in the following figure:



Pressure signal characteristic curve:



Product fault and troubleshooting:

Note: Before troubleshooting, first check the harness link, and then troubleshoot the product.

1. If the fault does not disappear after plugging and unplugging the connector again, check whether the terminal of vacuum pressure sensor harness connector is rusted. If the terminal of the product is not rusted, further check.

2. The complete vehicle cannot be powered on and started. When the connector is assembled, use fine wire or other methods to test the voltage of pins 1 and 3 respectively. Pin 1 shall have a reference voltage of 5 V, and pin 3 shall have a voltage of about 0.5±0.125 V. Start the engine (idle speed),

and the voltage of pin 3 rises above 2.5 V.

Note: In case of difficult problems, ABA is recommended for interchangeability verification.

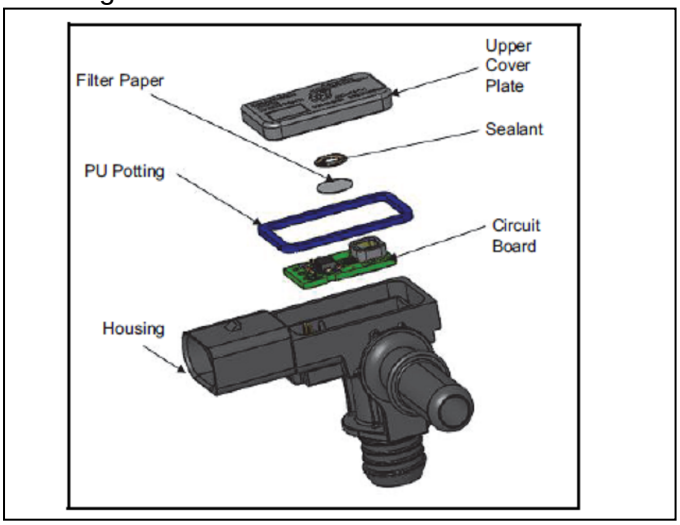
Fuel tank pressure sensor assembly

Function:

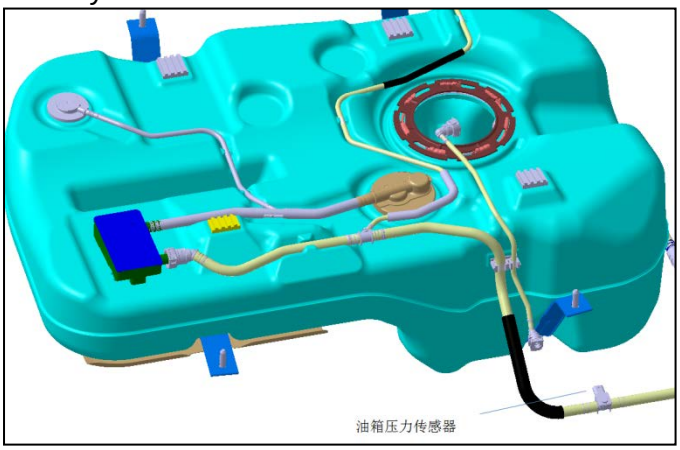
It is used to detect the current pressure value in the fuel evaporation system and transmit it to ECU for determining whether the current system pressure value is reasonable and whether there is leakage.

Product structure:

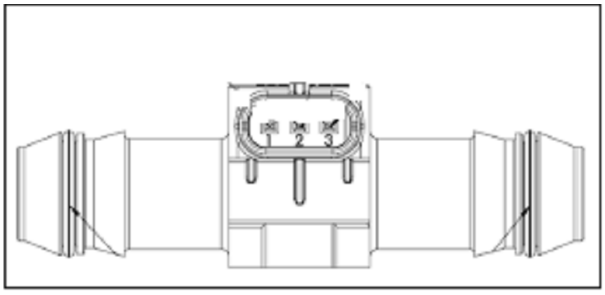
1. Single structure



2. Layout structure



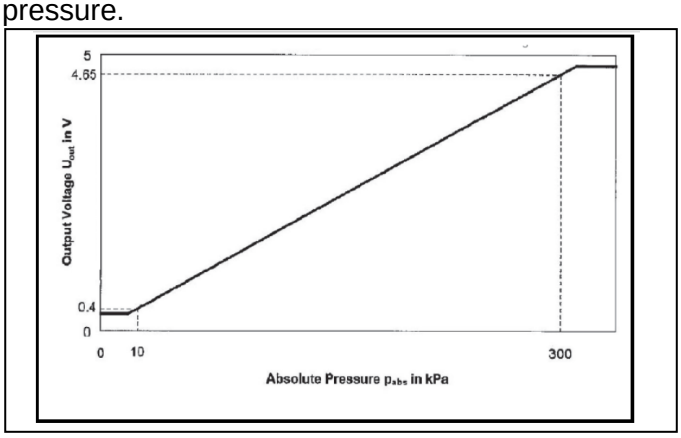
3. Interface definition:



Features:

Voltage output curve:

The sensor is a relative pressure sensor, which represents the pressure difference between the measured gas and the ambient atmospheric pressure.



Product fault and troubleshooting:

Before troubleshooting a single product, check the harness connection first, and then troubleshoot a single product after confirming that there is no problem.

Check whether the terminal of fuel tank pressure sensor harness connector is rusted and whether the terminal is horizontal; Inspect the harness of the corresponding power supply, signal and ground of the sensor for open circuit or short circuit. If present, replace wiring harness. Because of the harness problem, the fuel tank pressure sensor related fault will also be reported.

Tank pressure signal check:

A. Complete vehicle is powered on

B. Open the fuel tank cover to make the internal and external air pressures of the fuel tank equal.

C. Working condition: Do not start in power-on state, read sensor power supply pin PIN shall have 5V voltage; Under normal power supply conditions, the output of fuel tank pressure voltage shall be about 2.6 V; Close the fuel tank door, and it can be judged that there is no fault in the sensor body as long as the fuel tank pressure and voltage fluctuate slightly (may increase or decrease) under any working conditions (rocking the body, rapid acceleration/deceleration).

If the sensor cannot rule out fault after the above troubleshooting, it is necessary to take a new product, plug the original vehicle fuel tank pressure sensor connector to the new product, do not start in the power-on state, the sensor output should be about 2.6 V, block one end of the sensor pipeline, blow/suck air at the other end with a mouth, the sensor voltage changes, the original vehicle sensor fault can be confirmed.

Fix the boost pressure and temperature sensor on the mounting boss with a specified hexagon flange bolt (torque: 10±1 NM);

4. Connect the electric harness assembly and the boost pressure and temperature sensor assembly, and a sound of "click" indicates that it is plugged in place;

5. Check the harness connection.

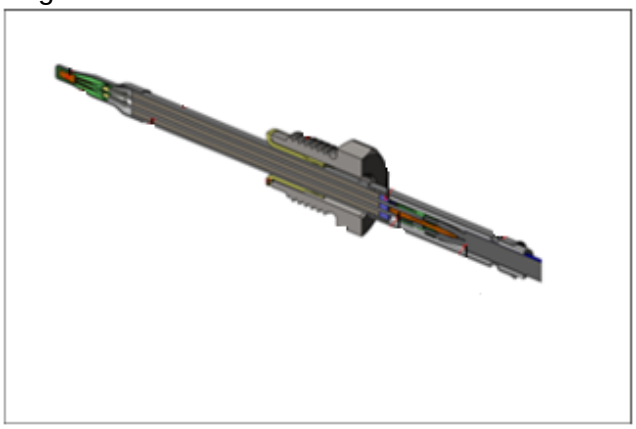
High temperature sensor assembly

Function:

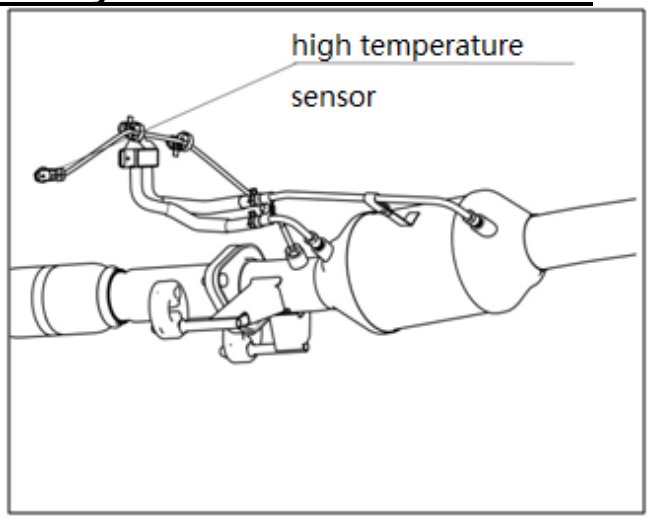
It is used to detect the GPF inlet temperature and feed back the detected temperature to ECUs to determine whether the GPF reaches regeneration temperature.

Product structure:

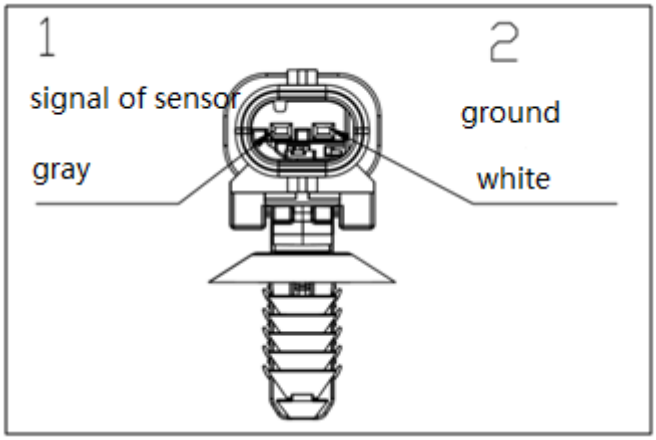
Single structure



Layout structure



Interface definition



Note: Pin 1 and pin 2 can be inversely connected to harness end connector.

Features:

$Rs=Rl+R0(1+\alpha T+\beta T^2)$

$\alpha=3.8285\ 10^{-3}$

$\beta=-5.85\ 10^{-7}$

T (°C)	Rs (Ω)	U0 (V)
−40	169.7±1.9	0.725
−20	185.1±1.9	0.781
0	200.5±1.9	0.835
25	219.6±1.9	0.900
50	238.5±1.9	0.963
100	275.9±1.9	1.081
150	312.7±1.9	1.191
200	349.0±1.9	1.293
250	384.6±1.9	1.389
300	419.7±1.9	1.478
350	454.2±2.2	1.562
400	488.1±2.4	1.640
450	521.4±2.7	1.713
500	554.1±2.9	1.783
600	617.8±3.4	1.909
700	679.2±3.8	2.022
800	738.2±4.2	2.123
850	766.8±4.4	2.170
900	794.9±4.6	2.214

Product fault and troubleshooting:

When high temperature sensor related fault is reported, check according to the following steps:

1、Whether the parts are reliably connected, whether the sensor power supply is normal, whether the connectors are free of foreign matter, whether the harness terminals are normal, and whether the vehicle can be recovered after the connectors are re-connected in place.

2、Check the appearance of the sensor for abnormal damage.

Under normal temperature (23 ℃) conditions, remove the connector and block the resistance of the sensor with a multimeter. If the resistance is between 200 Ω~ 230 ohms, it indicates that the sensor is normal.

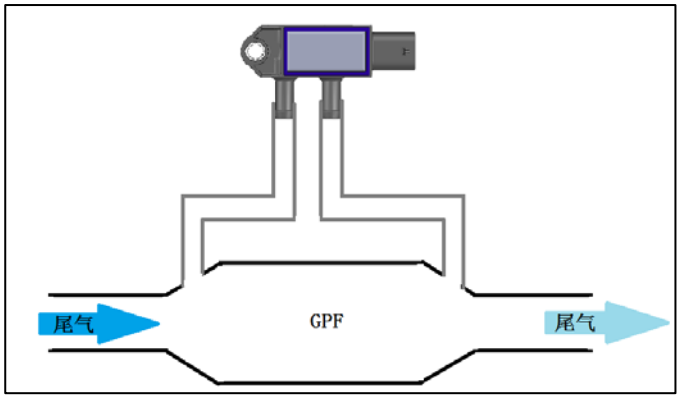
Differential pressure sensor assembly

Function:

Generally installed on the exhaust system GPF, the pressure difference between the front and rear ends of the GPF is fed back for the system to judge GPF blockage.

Working principle:

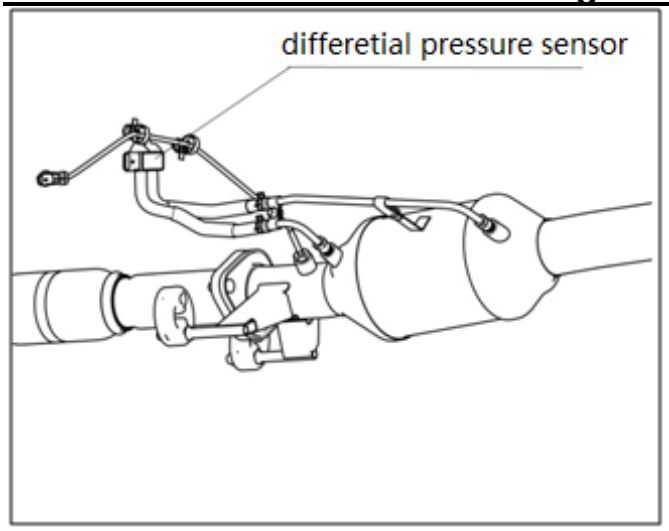
The front and rear pressure of GPF is introduced to both sides of pressure diaphragm of differential pressure sensor through pipeline. The pressure change causes the pressure sensor signal on the diaphragm to change, and the signal is processed to output the digital signal of SENT to the outside.



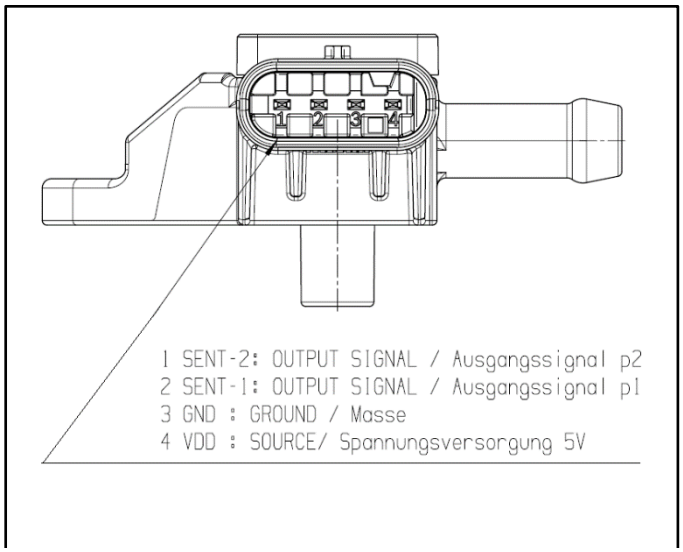
Product structure:

Single structure

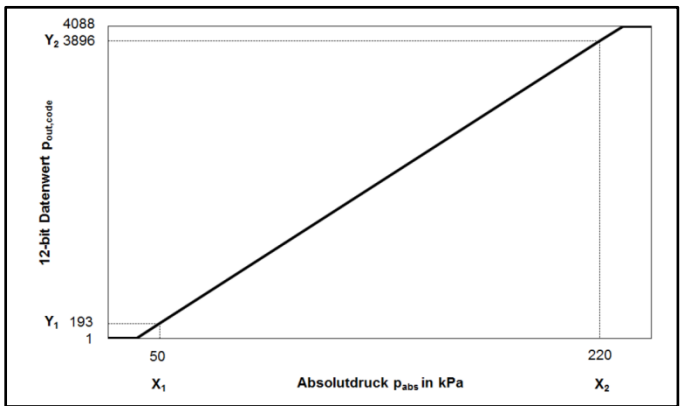
Layout structure



Interface definition



Features:



Product fault and troubleshooting:

Unit inspection

Read the differential pressure signal through the diagnostic scanner, power on only, and when the engine is not running, P1 and P2 are basically the same and equal to the local absolute atmospheric pressure value. After the engine runs, when the engine state is stable, the differential pressure fluctuation of P1-P2 is small. The greater the load, the greater the differential pressure of the P1-P2.

ABA validation is recommended when the problem is complex.

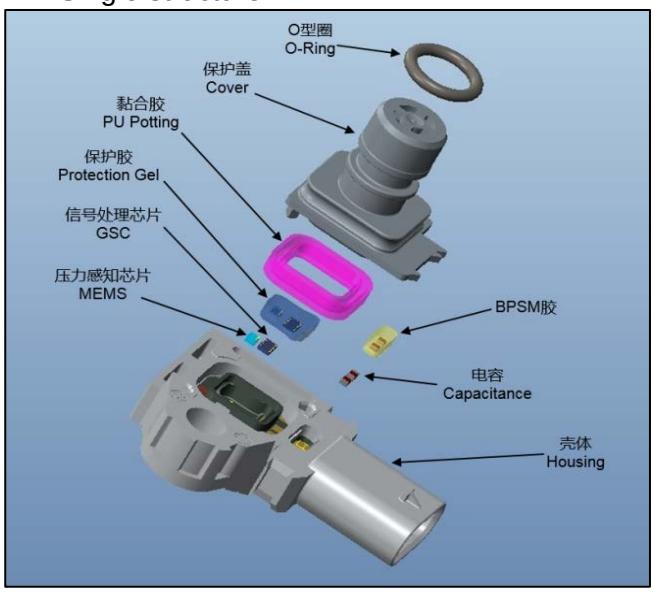
High pressure desorption pressure sensor assembly

Function:

Due to the new requirements of national emission regulation No. 6, it is required to diagnose the leakage of fuel evaporation system. For the pipeline between canister control valve and air filter of supercharger type, it is required to add high-pressure desorption pressure sensor for the pipeline, detect the current pipeline pressure, feed back the detected pressure signal to ECU, and then judge whether the system has leakage through whether the pressure change reaches the expectation.

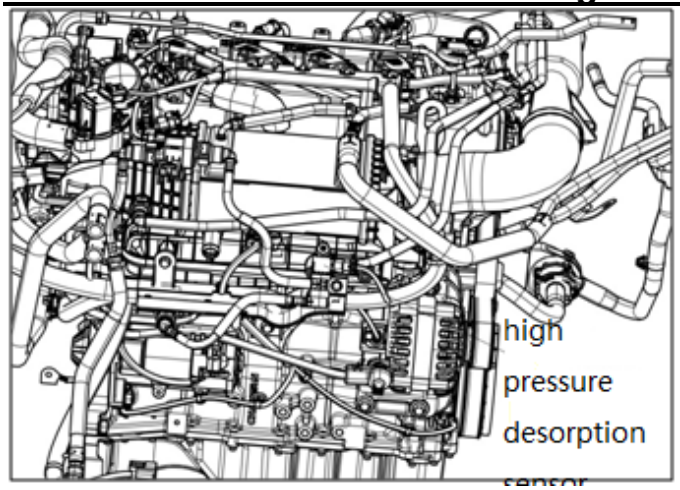
Product structure:

1. Single structure

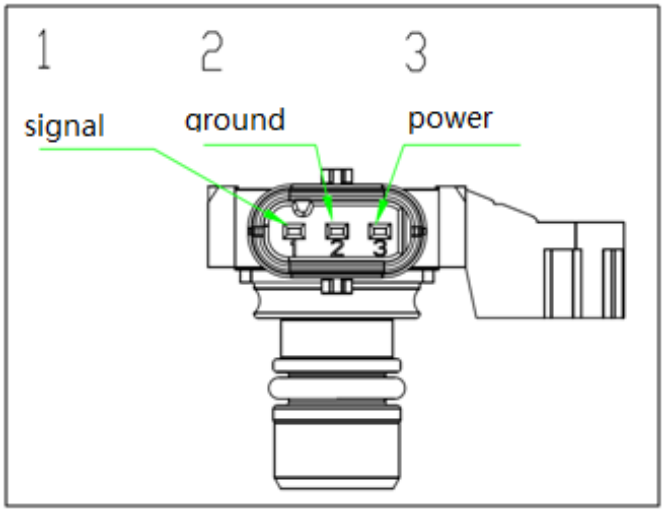


2. Layout structure

D20 layout

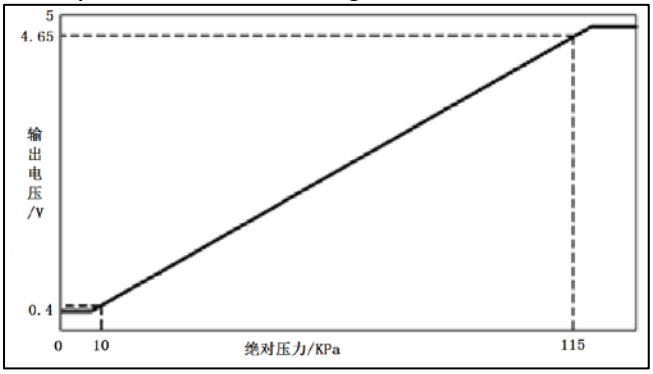


3. Interface definition:



Features:

Output characteristic diagram:



Product fault and troubleshooting:

When high pressure desorption pressure sensor related fault is reported, check according to the following steps:

1. Whether the parts are reliably connected, whether the power supply of the sensor is normal, whether the connectors are free of foreign matter, and whether the harness terminals are normal. After the connectors are re-connected in place, power on three cycles to detect whether the fault still exists.
2. Check the appearance of the sensor for abnormal damage.

Electronic throttle body

Function:

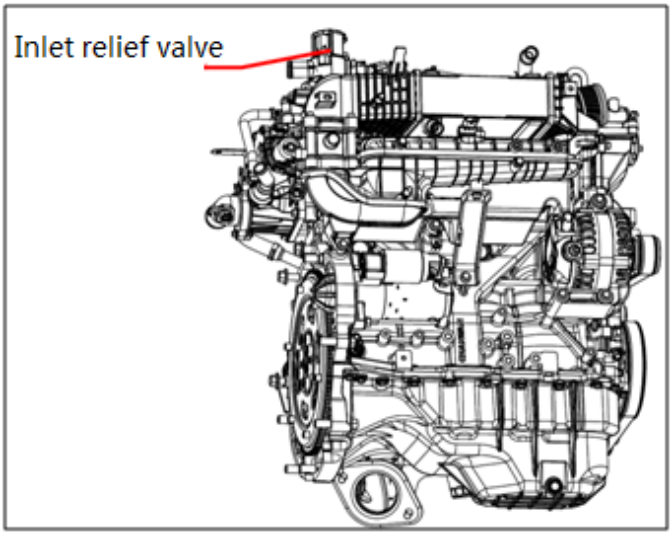
Throttle body is one of the main components of the engine intake system. Its main function is to adjust the intake passage area according to the driver's driving intention, so as to control the intake volume to meet the intake demand under different engine working conditions.

Working principle:

The actuator applies force to the throttle body according to the PWM signal input by the ECU to open the throttle body to the specified angle; The sensor part is designed for two-way redundancy and is used to detect the actual opening angle of throttle valve body, and feed back the signal to ECU for precise control.

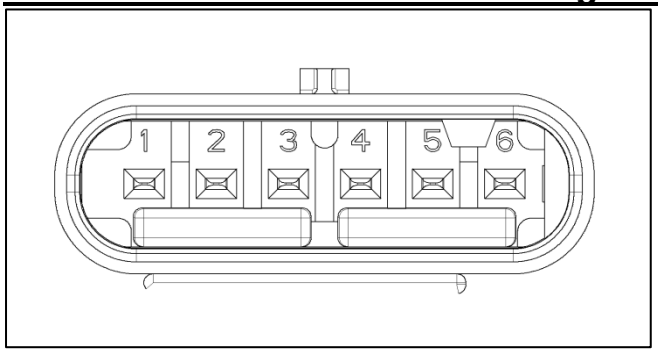
Structure and characteristics:

The throttle body is installed on the intake manifold, mainly including body, actuator and sensor. Actuator part controls throttle valve plate through internal gear transmission structure; The sensor part is divided into contact type and non-contact type according to different detection principles.



Interface definition:

1	2	3	4	5	6
M-	M+	TPS2	VCC	GND	TPS1

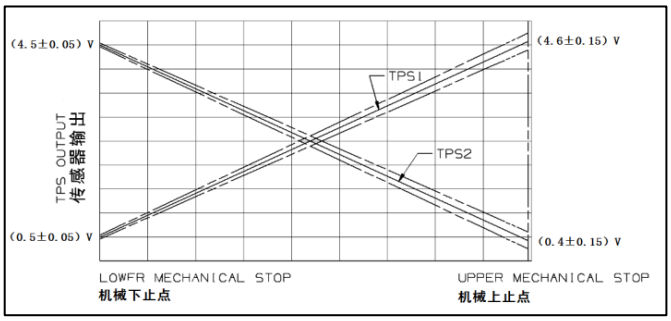


TPS output characteristics:

Temperature: Room temperature 23℃

Sensor working voltage: VCC=5V

	TPS1(V)	TPS2(V)
Mechanical bottom dead center	**0.5±0.05**	**4.5±0.05**
Mechanical top dead center	**4.6±0.15**	**0.4±0.15**



Fault check:

Note: Relevant inspection of harness connection shall be carried out first, and the single product shall be inspected after confirming that there is no problem.

Note: Before product unit inspection, observe whether the main passage of throttle valve body has serious carbon deposit/oil pollution. If yes, clean it according to throttle valve body cleaning manual.

1. Check throttle body sensor

Step on the accelerator pedal, use the EFI system diagnostic scanner to read the throttle body 1 signal voltage value and throttle body 2 signal voltage value, and observe whether the following output characteristics are met. If not, replace the throttle body.

Temperature: Room temperature 23℃

Sensor working voltage VCC=5V

VTPS1: 0.45-4.75 V

VTPS2: 0.25 V-4.55 V

VTPS1+ VTPS2 = VCC

2. Check throttle body actuator

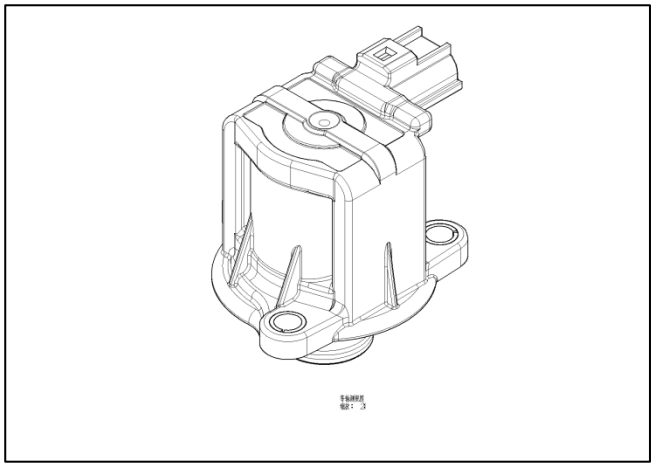
Remove the throttle body, and push the throttle body valve plate by hand for jamming. If yes, replace the throttle body.

Use a digital multimeter to measure whether the resistance between throttle body M+ and throttle body M- is less than 100 ohms. If not, the throttle body motor may have open circuit fault, so it is necessary to replace the throttle body.

Intake relief valve assembly

Function:

The intake relief valve assembly will only be used for the pressurized vehicles, and is arranged on the intake system from the pressurized to the throttle body, with bypass pipeline connected to the pressurized vehicle. Generally, after opening the accelerator, the pressure relief valve can discharge the pressurized gas back to the natural intake side, so as to avoid such faults as supercharger surge caused by excessive gas pressure in the intake system.



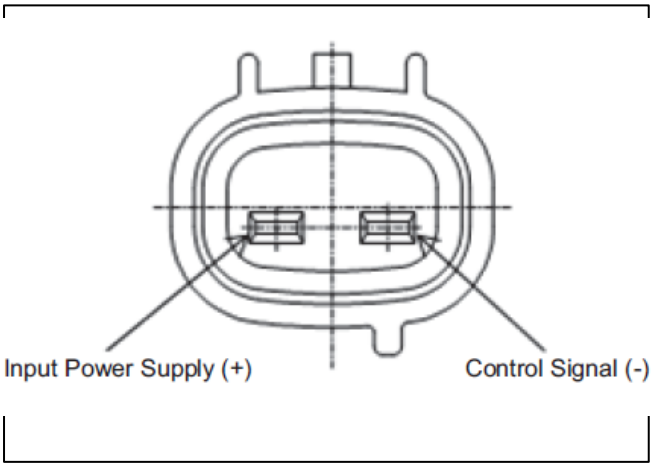
Working principle:

When the intake pressure relief valve is not connected to the switch signal, the intake pressure relief valve is normally closed and forms a sealed chamber with the counterpart. The pressurized gas enters the cylinder through the throttle valve to participate in combustion. When receiving the switch signal, the valve head rises under the action of electromagnetic force, and the pressurized gas

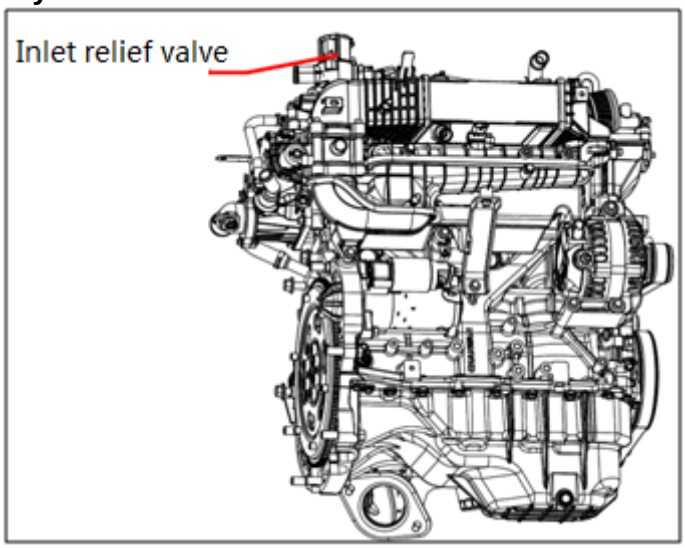
can return to the pressurized front through the bypass pipeline. After pressure relief, the valve head returns to closed state under the action of spring force and gravity.

Structure and characteristics:

Intake pressure relief valve is an electromagnetic switch valve, which is composed of electromagnetic coil, magnetic conductive component and valve core component. The intake relief valve has only two pins, as shown in the figure below:



Layout structure



Characteristic parameters:

Coil resistance: Rw= 12±1 Ω× 1+ Tw-23℃ 0.0039/℃, i.e. at 23℃, the coil resistance of intake relief valve shall be 11~13Ω.

Fault check

Recommended troubleshooting methods:

⚠ **Note: Before inspecting the intake relief valve monomer, please confirm whether the harness connector is connected in place, whether there are problems such as water ingress, corrosion and retreat terminals inside the connector, and whether the whole harness is connected normally.**

1. Connect the two pins of the pressure relief valve with a multimeter and check whether the resistance is normal (about 12ohm);

2. Remove the lower intake relief valve to check whether there is fracture inside the valve head.

⚠ **When there is a problem, ABA is recommended for interchangeability verification.**

Canister control valve

Function:

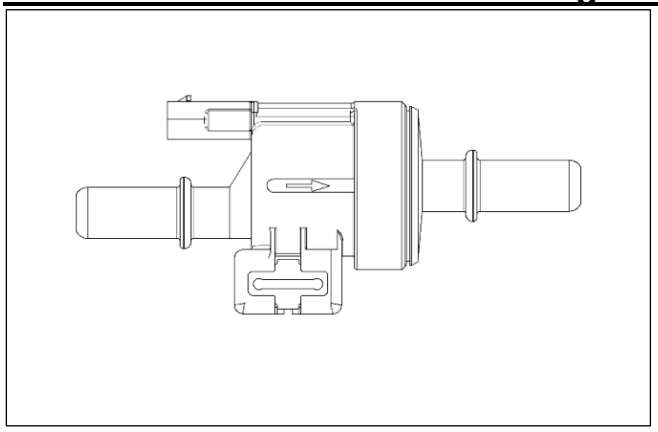
The canister control valve is mounted on the bracket on the charge air cooler in series with the canister to engine line. Under the drive of ECU, it is used to control the flow of fuel vapor entering the engine during canister desorption, and cooperate with the system to complete the leakage diagnosis function of fuel evaporation system.

Working principle:

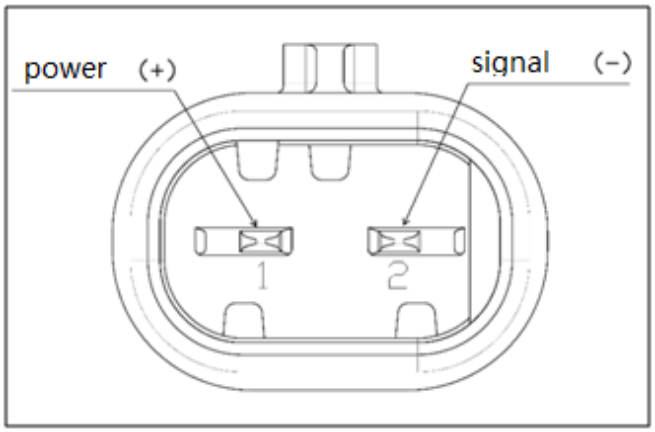
When canister desorbs, the fuel vapor flow through canister control valve is related to the duty ratio of the electric pulse signal output by ECU to canister control valve on one hand, and the pressure difference between inlet and outlet of canister control valve on the other hand. When there is no electrical pulse, the canister control valve is closed.

Structure and characteristics:

Canister control valve is a normally closed solenoid valve, which consists of solenoid coil, magnetic conductive component, spring and valve core component, etc. When there is no electrical signal, the valve element assembly closes the air flow channel under the action of spring force; When there is an electrical signal, the solenoid coil generates an electromagnetic force, and the valve core component opens the airflow channel against the spring force under the electromagnetic force.

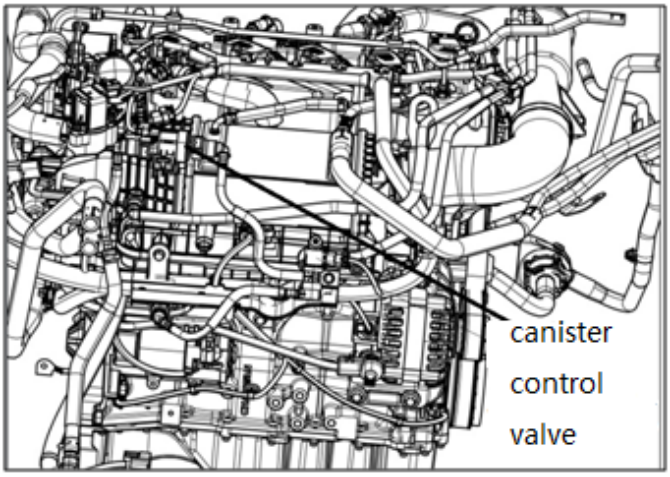


Canister control valve is of 2PIN structure, and the definition of each pin is as shown in the figure below:



At normal temperature, the resistance between pin 2 PIN of canister control valve is 16±2Ω.

Layout structure:



Fault check

⚠ Before performing product unit inspection, perform relevant inspection of harness link first, and then perform product unit inspection after confirming that there is no problem.

1. Internal sealing of canister control valve: In case of no power supply, blow air from either end of the valve to the other end, and observe whether the other end can feel air flow. If it can feel air flow, it indicates that the valve has internal sealing problem.

2.In the case of canister control valve internal solenoid: Use a multimeter to measure the resistance between two pins of canister control valve under normal temperature, and observe whether it is 16±2Ω. If not, it indicates that there is short circuit or open circuit problem in canister control valve internal solenoid.

⚠ When there is a problem, ABA is recommended for interchangeability verification.

Canister stop valve

Function:

Canister stop valve is a normally-open valve, which is installed between canister and ash filter. When it is not working, the valve is normally open and enough gas is allowed to pass through. When working, it is controlled by ECU, close vent and cooperate to complete fuel evaporation system leakage diagnosis.

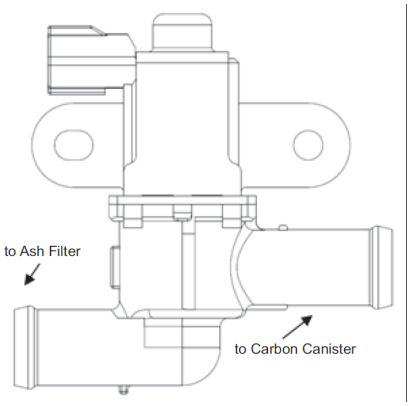
Working principle:

During leakage diagnosis, the stop valve is energized by the ECU switch signal, the internal coil of the stop valve generates excitation function, and the valve stem assembly overcomes the spring

force under the excitation function to realize valve closing, that is, close the vent hole, and complete leakage diagnosis in coordination with the fuel evaporation system. When there is no diagnosis, the stop valve is not energized, the valve is opened and enough gas is allowed to pass.

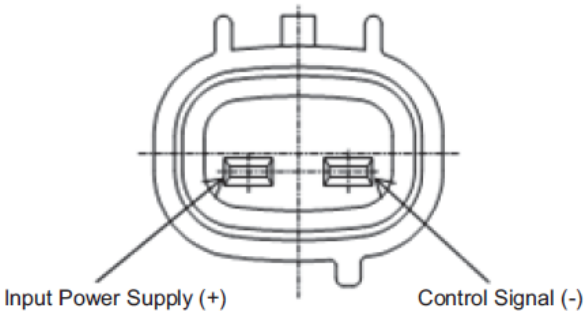
Structure and characteristics:

Canister stop valve is mainly composed of housing, solenoid coil, spring, valve stem component, connector, connecting trachea, etc. When it is not working, it is not energized, it is in valve opening state and enough gas is allowed to pass; when it is working, it is in valve closing state and air vent is closed.

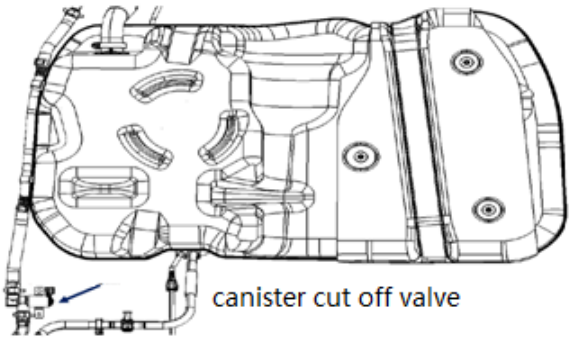


Canister stop valve is of 2PIN structure, and the definition of each pin is as shown in the figure below:

At normal temperature, the resistance between pin 2 PIN of canister stop valve is 59Ω±4Ω.



Layout structure:



Fault check:

Note: Prior to product unit inspection, system pipeline and harness shall be inspected first, and after confirming that there is no problem, product unit inspection shall be conducted:

1) When the leakage fault is reported, first use the leakage test equipment to detect and confirm the leakage point.

2) Check whether the harness is normal or disconnect the harness connector in case of fuel tank suction deflation or frequent refueling jumping gun. The shut-off valve is always closed due to possible short circuit of the harness.

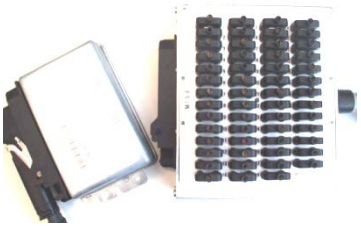
1. Inside sealing of canister stop valve (if leakage fault is reported): When both ends are energized (12 V), blow air from either end of the valve to the other end, and observe whether the other end can feel the air flow. If the air flow can be felt, it indicates that the valve has internal sealing problem.

2. Internal ventilation of canister stop valve (in case of fuel tank suction collapse or frequent refueling jumping gun): In case of no power supply, blow air from either end of the valve to the other end, and observe whether the other end can feel air flow. If air flow can be felt, it indicates that the internal ventilation of the valve is normal; if air flow is not felt, it indicates that the valve is blocked or stuck.

3.Internal circuit connection of canister stop valve: Use multimeter to measure resistance between pin PIN of canister stop valve at normal temperature, and observe whether it is 59Ω±4Ω. If it is not, it indicates that there is short circuit or open circuit in canister stop valve.

Note: In case of difficult problems, ABA is recommended for interchangeability verification.

Service tool(Indicate the tools used in fault check in this section.)

Legend	Name and function	Legend	Name and function
	EFI system diagnostic scanner: Read/clear EFI system fault code, observe data flow, component action test, etc.		EFI system adapter: Check the electrical signal of each pin of the electronic control unit, check the condition of the circuit, etc.
	Ignition timing lamp: Check engine ignition timing, etc.		Digital multimeter: Check the characteristic parameters such as voltage, current and resistance in the EFI system.
	Fuel pressure gauge Check the fuel system pressure and determine the fuel pump and fuel pressure regulator in the fuel system.		Exhaust gas analyzer Check the vehicle exhaust emission, which is helpful to judge the fault of EFI system.

Removal and installation

Engine control module

1. ECU shall be installed at a certain angle with horizontal and vertical positions to avoid water inflow from connectors and short circuit between connectors;
2. The ECU should be installed in a place where the dust is easy to accumulate. A large amount of dust accumulation will affect the working reliability of ECU;
3. The assembling position of ECUs shall be far away from the high-temperature area where the temperature of the housing itself may exceed 85 °C and its nearby position, and the heat released by the surrounding parts shall be prevented from radiating to the ECUs;
4. The ECU shall be located at a position where electromagnetic and RF interference induced by other parts on the ECU and its harness is minimum;
5. The ECU itself shall be firmly and reliably assembled in the cab or engine compartment without loosening;
6. In order to protect ECU and its harness from being easily assembled and damaged during vehicle assembly, sufficient space shall be kept between ECU and passenger compartment or other parts in engine compartment;
7. It is necessary to avoid installing the ECU in the positions where oil pollution, moisture and water droplets are easy to spill;
8. The ECU harness shall be firmly fixed to avoid supporting the harness through the ECU, and the ECU harness shall be arranged to prevent and protect all wires in the harness from damage due to wear and overheating;
9. It is necessary to avoid the possibility that ECU may suffer additional mechanical vibration and external force impact due to the installation position and assembly method of ECU, and it is necessary to avoid installing ECU at the resonance point of vehicle body;
10. It is necessary to avoid assembling ECU in the vicinity of the battery or other acid-alkaline solution easy to exude, and in the vicinity of the ECU easy to be corroded;
11. Avoid assembling the ECU near the battery positive terminal and ignition power terminal.

Knock sensor

Removal

1. Release the knock sensor connector.
2. Loosen the knock sensor bolt and remove the knock sensor.

Installation

1、Fix the knock sensor to the mounting hole with bolts, ensure that the mounting surface of the knock sensor is clean during installation, and tighten the torque 23±1N.M.
2、Connect knock sensor connector in place.

Note: Most of the after-sales faults are caused by matching with the harness connector, and occasional instantaneous interruption causes the fault code to be reported. Therefore, during maintenance, it is necessary to check whether the connector is well fixed, whether the connector is in place, and re-plug the connector to check whether the fault is solved.

Oil pressure sensor

Removal

1. Power off the vehicle;
2. Disconnect the harness connector;
3. Use 24# wrench to remove sensor assembly.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Install the engine oil pressure sensor on the filter bracket (the engine oil pressure sensor is a self-contained adhesive product, which cannot be reused in theory; when it is required to be reused in special circumstances, it is necessary to apply adhesive on the thread to ensure sealing), and tighten the bolts according to the specified torque. (14Nm±1Nm)
2. Connect the connector to the harness end.

Warning: When the engine is running and the engine oil is in hot state, do not repair it to avoid large amount of oil spilling and burns. When the engine stops running and the system cools down, maintenance can be performed.

Crankshaft position sensor

Removal

1. Power off the vehicle;
2. Disconnect the harness connector;
3. Remove the sensor assembly with T-sleeve.

Installation

Note: Before installation, check each part

for deterioration or damage. If any defect is found, replace it.

1. Before installing the sensor into the mounting port, apply a small amount of lubricating oil at the sealing ring, and then gently screw the sensor into the mounting port. It is not allowed to knock;
2. The installation torque should be within the range of 8±2Nm;
3. Clean the mounting hole before mounting the crankshaft position sensor to prevent iron scraps and other debris.

Note: Install torque when replacing crankshaft position sensor.

Warning: Do not replace the crankshaft position sensor when the vehicle is powered on.

Water temperature sensor

Removal

1. Power off the vehicle;
2. Disconnect the harness connector;
3. Remove the buckle and remove the water temperature sensor.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Install the water temperature sensor on the thermostat base and install the buckle.
2. Connect connector with harness end.

Warning: When the coolant is in hot state, do not repair it to avoid burns. When the system is cooled, it can be repaired.

Camshaft position sensor

Removal

1. Power off the vehicle;
2. Disconnect the harness connector;
3. Use T-sleeve to dismantle sensor assembly.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Before installing the sensor into the mounting port, apply a small amount of lubricating oil on the sealing ring, and then gently screw the sensor into the mounting port without knocking;
2. The installation torque should be within the range of 10±2Nm;
3. Clean the mounting hole before mounting the camshaft position sensor to prevent iron scraps and other sundries.

Note: Replace the camshaft position sensor and clean the oil stain.

Warning: Do not replace the camshaft position sensor when the vehicle is powered on.

Oxygen sensor

Removal

1. Disconnect the harness connector.
2. Butt the connector with the harness end and clamp it into the bracket.
3. Fasten the harness with a tie.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Install the oxygen sensor on row trachea, and tighten the bolts according to the specified torque. (50 Nm±5Nm)
2. Butt the connector with the harness end and clamp it into the bracket.
3. Fasten the harness with a tie.

Note: Bundle the harness to avoid tightening the harness.

Warning: When the exhaust manifold is in hot state, do not repair.
Avoid burns. When the system is cooled, it can be repaired.

Vacuum pressure sensor

Removal

1. The vehicle stalls and disconnects the battery;

2. Disconnect the harness connector;

3. Remove the connecting pipeline and the sensor unit.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Press the sensor into the vacuum booster and connect the relevant pipeline.

2. Connect the electric harness assembly and vacuum pressure sensor assembly, and a sound of "click" indicates that it is plugged in place;

3. Check the harness connection.

Boost pressure temperature sensor

Removal

1. Power off the vehicle;

2. Disconnect the harness connector;

3. Dismantle the bolt of fastening sensor with sleeve;

4. Remove the sensor unit.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Before assembling the sensor, apply a little lubricating oil on the sensor 0-ring seal, pay attention not to enter the pressure probe hole;

2. Gently screw the sensor into the mounting hole;

3.Use a specified hexagon flange bolt to fix the boost pressure and temperature sensor on the mounting boss (torque: 10±1 NM);

4. Connect the electric harness assembly and the boost pressure and temperature sensor assembly, and a sound of "click" indicates that it is plugged in place;

5. Check the harness connection.

Electronic throttle body

Removal

1. Do not press the ignition switch;

2. Unplug the throttle body connector;

3.Remove the connecting bolts of throttle body, intake manifold and intercooler outlet trachea, and check whether the sealing ring is in good condition;

4. Remove the throttle body.

Installation

1.Assemble throttle valve body with sealing ring to intake manifold and intercooler outlet trachea, and tighten bolts according to the specified torque of (10±2) m;

2. Connect the throttle body connector, and fix the harness according to the original state.

Throttle body self-learning

Turn the ignition switch to "ON" position and wait for 60 s; Start the vehicle and stop ignition when the idle speed is stable;

Turn the ignition switch to "OFF" position and wait for 10 s; Self-learning completed.

Intake relief valve

Removal

1. Unplug the harness connector;

2. Loosen the three mounting bolts;

3. Remove the intake relief valve assembly from the counterpart.

Installation

The installation process is the reverse of the removal process.

Note: Pay attention to the connector direction during installation; Pay attention to 10±1 N·m of bolt tightening torque when installing; It is necessary to prevent foreign matter such as particles from entering the pressure relief valve.

Canister control valve

Removal

1. Do not press the ignition switch;

2. Unplug the canister control valve connector;

3. Dismantle the pipeline connected at both ends of canister control valve;

4. Remove the canister control valve from the bracket (if there is metal clip on the bracket, remove the metal clip first).

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1. Install the canister control valve on the bracket, pay attention to the direction of arrow on the valve body;

2. Connect the pipelines at both ends of the valve in good condition;

3. Connect the canister control valve connector, and fix the harness according to the original state.

Removal

1. Disconnect the harness connector.

2. Take off the pipe clamp and remove the pipe.

3. Use a wrench to remove the sensor assembly.

Differential pressure sensor assembly

Removal

1. Power off the vehicle;

2. Disconnect the harness connector;

3. Loosen the connecting pipe clamp and dismantle the connecting pipe;

4. Remove the sensor retaining bolt with sleeve, and remove the sensor.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1.Fix the differential pressure sensor on the mounting surface with a specified bolt (torque: 8±2N.m);

2. Connect the electric harness assembly and sensor, and check the harness plug connection;

3. Connect the differential pressure pipeline and install the clamp, and check for air leakage.

Warning: When GPF is in hot state, do not repair to avoid burns. When the system is cooled, it can be repaired.

High temperature sensor

Removal

1. Disconnect the harness connector.

2. Remove the harness binding strap.

3. Dismantle the sensor assembly with the open-end wrench of opposite edge 17.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1.Install the high temperature sensor on the corresponding position of GPF inlet, and tighten the bolts according to the specified torque. (45Nm±4.5Nm).

2. Butt the connector with the harness end and clamp it into the mounting hole.

3. Fasten the harness with a tie.

Note: Bundle the harness to avoid tightening the harness.

Warning: When GPF is in hot state, do not repair to avoid burns. When the system is cooled, it can be repaired.

High pressure desorption pressure sensor assembly

Removal

1. Disconnect the harness connector;

2. Use an open-ended wrench to remove the sensor assembly.

Installation

Note: Before installation, check each part for deterioration or damage. If any defect is found, replace it.

1.Install the high-pressure desorption pressure sensor on the mounting seat of the high-pressure desorption pressure sensor, and tighten the bolts according to the specified torque. The tightening torque requirements are (5Nm±1Nm).

2. Connect connector with harness end.

Fault symptom diagnosis and test

Fault phenomenon and judgment method

1. Fault phenomenon: Unstable idle speed, poor acceleration, unable to start, high idle speed, out-of-standard exhaust gas, difficult start, A/C failure, injector control failure, flameout, etc.
2. Common fault causes: 1. Internal parts of ECU are burnt out due to electrical overload of external device, resulting in failure; 2. The circuit board is rusted due to ECU water. 3. The status of parts changes or the self-learning value is cleared.
3. Maintenance precautions:
   - Do not dismantle ECU randomly during maintenance;
   - Please dismantle the battery head for more than 1 minute before dismantling ECU;
   - Disassemble ECU before electric welding, and store ECU after disassembling;
   - It is forbidden to install any circuit on the ECU connecting line.
4. Simple measurement method:
   - (Connect connector) Read engine fault record with engine data K line;
   - (Remove the connector) Check whether the ECU connection line is in good condition, especially check whether the ECU power supply and grounding circuit are normal;
   - Check whether the external sensor works normally, whether the output signal is credible and whether the circuit is in good condition;
   - Check whether the actuator works normally and whether the circuit is in good condition;
   - Finally replace ECU for test.

Troubleshooting process according to fault code

1. The following troubleshooting is performed only after the current steady state fault has been confirmed. Otherwise, diagnostic errors will be caused.
2. "Multimeter" refers to digital multimeter, and it is forbidden to check the EFI system circuit with pointer multimeter.
3. Overhaul the vehicle with anti-theft system. In case of replacing ECU, pay attention to programming ECU after replacing.
4. If the fault code indicates that a circuit voltage is too low, it means that the circuit may be short to ground; If the fault code indicates that a circuit voltage is too high, it means that the circuit may be shorted to the power supply; If the fault code indicates a circuit fault, it means that there may be open circuit or multiple circuit faults in the circuit.

Diagnostic aid:

1. The fault code cannot be cleared, and the fault is a steady state fault;

In case of accidental fault, check harness connector for looseness.

2. Check according to the above steps, and no abnormality is found;

3. Do not ignore the impact of vehicle maintenance, cylinder pressure and mechanical ignition timing on the system during overhaul;

4. Replace ECU and perform test.

If the fault code can be cleared at this time, the fault position is in ECU; if the fault code still cannot be cleared at this time, replace the original ECU, repeat the process, and perform overhaul again.

Troubleshooting process according to fault symptoms

Before starting the steps of fault diagnosis according to engine fault phenomenon, preliminary inspection shall be carried out first:

1. Confirm the engine malfunction indicator lamp works normally;
2. Check with fault diagnostic scanner and confirm that there is no fault information record;
3. Confirm that the fault phenomenon complained by the owner exists, and confirm the conditions under which the fault occurs.

Then perform visual inspection:

（1）Check whether there is fuel pipeline leakage;
（2）Check whether the vacuum pipeline is broken or kinked, and whether the connection is correct;
（3）Check whether the inlet trachea circuit is blocked, leaking, flattened or damaged;
（4）Check whether the high voltage line of the ignition system is broken and aged, and whether the ignition sequence is correct;
（5）Check whether the harness grounding is clean and firm;
（6）Inspect each sensor and actuator connector for looseness or poor contact.

Important note: If the above phenomenon exists, first carry out maintenance work according to the fault condition, or else it will affect the later fault diagnosis and repair work.

Diagnostic aid:

1. Confirm that the engine has no fault records;

2. Confirm the symptom of complaint;

3. Check according to the above steps, and no abnormality is found;

4. Do not ignore the impact of vehicle maintenance, cylinder pressure, mechanical ignition timing and fuel on the system during overhaul;

5. Replace ECU and perform test.

   If the fault phenomenon can be eliminated at this time, the fault position is in ECU; if the fault phenomenon still exists at this time, replace the original ECU, repeat the process, and perform overhaul again.

When starting, the engine does not rotate or rotates slowly.

General fault position

- Battery;
- Starter motor;
- Harness or ignition switch;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Use a multimeter to check whether there is about 8-12 V between the two battery terminals when the engine is started.	Yes	Next step
		No	Replace battery
2	Keep the ignition switch in the starting position, and use a multimeter to check whether the positive terminal of the starter motor has voltage above 8V.	Yes	Next step
		No	Repair or replace wiring harness
3	Remove the starter motor and check the working condition of the starter motor. Check it for open circuit or stuck due to poor lubrication.	Yes	Repair or replace starter motor
		No	Next step
4	If the fault only occurs in winter, check whether the engine lubricating oil and gearbox oil are improperly selected, resulting in excessive resistance of starter motor.	Yes	Replace the lubricating oil with a proper number.
		No	Next step
5	Check whether the internal mechanical resistance of the engine is too large, causing the starter motor to not rotate or rotate slowly.	Yes	Overhaul engine internal resistance
		No	Diagnostic aid

When starting, the engine can be driven but cannot be started successfully.

General fault position

- Fuel tank is free of oil;
- Fuel pump;
- Speed sensor;
- Ignition coil;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is about 350kPa.	Yes	Next step
		No	Overhaul fuel supply system
2	Connect EFI system diagnostic scanner, observe "engine speed" data item, start the engine, and observe whether there is speed signal output.	Yes	Next step
		No	Overhaul speed sensor circuit
3	Pull out the split line of one cylinder, connect the spark plug, make the spark plug electrode 5 mm from the engine block, start the engine, and check whether there is blue and white high-pressure fire.	Yes	Next step
		No	Overhaul ignition system

4	Check the pressure of each cylinder of the engine, and observe whether the engine cylinder has insufficient pressure.	Yes	rule out Engine mechanical fault
		No	Next step

Hard to start

General fault position

- Fuel water;
- Fuel pump;
- Coolant temperature sensor;
- Fuel pressure regulator vacuum pipe;
- Ignition coil.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is about 350kPa.	Yes	Next step
		No	Overhaul fuel supply system
2	Pull out the split line of one cylinder, connect the spark plug, make the spark plug electrode 5 mm from the engine block, start the engine, and check whether there is blue and white high-pressure fire.	Yes	Next step
		No	Overhaul ignition system
3	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine is started successfully. (Or connect a 300 ohm resistance in series at the coolant temperature sensor connector to replace the coolant temperature sensor, and observe whether the engine starts successfully at this time.)	Yes	Overhaul circuit or replace sensor
		No	Next step
4	Check whether the fuel pressure regulator vacuum pipe is loose or leaks.	Yes	Overhaul or replace
		No	Next step
5	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step

Cold starting difficulty

General fault position

- Fuel water;
- Fuel pump;
- Coolant temperature sensor;
- Fuel injector;
- Ignition coil;
- Throttle body;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is about 350kPa.	Yes	Next step
		No	Overhaul fuel supply system
2	Pull out the split line of one cylinder, connect the spark plug, make the spark plug electrode 5 mm from the engine block, start the engine, and check whether there is blue and white high-pressure fire.	Yes	Next step
		No	Overhaul ignition system
3	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine is started successfully. (Or connect a 2500 ohm resistance in series at the coolant temperature sensor connector to replace the coolant temperature sensor, and observe whether the engine starts successfully at this time.)	Yes	Overhaul circuit or replace sensor
		No	Next step
4	Gently depress the accelerator pedal and observe whether it is easy to start.	Yes	Clean throttle valve and idle airway
		No	Next step
5	Remove the fuel injector, and check the fuel injector for leakage or blockage with the fuel injector special cleaning analyzer.	Yes	Replacement of fault
		No	Next step
6	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
7	Check the pressure of each cylinder of the engine, and observe whether the engine cylinder has insufficient pressure.	Yes	rule out Engine mechanical fault
		No	Next step

Normal speed, difficult to start at any time

General fault position

- Fuel water;
- Fuel pump;
- Coolant temperature sensor;
- Fuel injector;
- Ignition coil;
- Electronic throttle body;
- Intake port;
- Ignition timing;
- Spark plug;
- Engine mechanical part.

General diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked and whether the intake passage is leaking.	Yes	Overhaul intake system
		No	Next step
2	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is about 350kPa.	Yes	Next step
		No	Overhaul fuel supply system
3	Pull out the split line of one cylinder, connect the spark plug, make the spark plug electrode 5 mm from the engine block, start the engine, and check whether there is blue and white high-pressure fire.	Yes	Next step
		No	Overhaul ignition system
4	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
5	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine is started successfully.	Yes	Overhaul circuit or replace sensor
		No	Next step
6	Gently depress the accelerator pedal and observe whether it is easy to start.	Yes	Clean throttle valve and idle airway
		No	Next step
7	Remove the fuel injector, and check the fuel injector for leakage or blockage with the fuel injector special cleaning analyzer.	Yes	Replacement of fault
		No	Next step
8	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
9	Check the pressure of each cylinder of the engine, and observe whether the engine cylinder has insufficient pressure.	Yes	rule out Engine mechanical fault
		No	Next step
10	Check whether the ignition sequence and ignition timing of the engine meet the specifications.	Yes	Next step
		No	Overhaul ignition timing

Normal starting, but unstable idling at any time

General fault position

- Fuel water;
- Fuel injector;
- Spark plug;
- Throttle body and idle bypass passage;
- Intake port;
- Electronic throttle body;
- Ignition timing;
- Spark plug;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked and whether the intake passage is leaking.	Yes	Overhaul intake system
		No	Next step
2	Check whether the idle speed regulator is stuck.	Yes	Clean or replace
		No	Next step
3	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
4	Inspect the throttle body and idle bypass passage for carbon deposits.	Yes	Cleaning
		No	Next step
5	Dismantle the fuel injector, and use the special cleaning analyzer of the fuel injector to check whether the fuel injector has leakage, blockage or flow error.	Yes	Replacement of fault
		No	Next step
6	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
7	Check the pressure of each cylinder of the engine, and observe whether there is large difference in the engine cylinder pressure.	Yes	rule out Engine mechanical fault
		No	Next step
8	Check whether the ignition sequence and ignition timing of the engine meet the specifications.	Yes	Next step
		No	Overhaul ignition timing

Normal starting and unstable idling during warm-up.

General fault position

- Fuel water;
- Coolant temperature sensor;
- Spark plug;
- Throttle body carbon;
- Intake port;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked and whether the intake passage is leaking.	Yes	Overhaul intake system
		No	Next step
2	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
3	Inspect the throttle body for carbon deposits.	Yes	Cleaning related parts
		No	Next step
4	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine idle speed is unstable during warm-up.	Yes	Overhaul circuit or replace sensor
		No	Next step
5	Dismantle the fuel injector, and use the special cleaning analyzer of the fuel injector to check whether the fuel injector has leakage, blockage or flow error.	Yes	Replacement of fault
		No	Next step
6	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
7	Check the pressure of each cylinder of the engine, and observe whether there is large difference in the engine cylinder pressure.	Yes	rule out Engine mechanical fault
		No	Next step

Normal starting, unstable idle speed after warm-up

General fault position

- Fuel water;
- Coolant temperature sensor;
- Spark plug;
- Electronic throttle body;
- Intake port;
- Engine mechanical part.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked and whether the intake passage is leaking.	Yes	Overhaul intake system
		No	Next step
2	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
3	Inspect the throttle body for carbon deposits.	Yes	Cleaning related parts
		No	Next step
4	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine idle speed is unstable during warm-up.	Yes	Overhaul circuit or replace sensor
		No	Next step
5	Dismantle the fuel injector, and use the special cleaning analyzer of the fuel injector to check whether the fuel injector has leakage, blockage or flow error.	Yes	Replacement of fault
		No	Next step
6	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
7	Check the pressure of each cylinder of the engine, and observe whether there is large difference in the engine cylinder pressure.	Yes	rule out Engine mechanical fault
		No	Next step

Normal starting, unstable idle speed or flameout under partial load (e.g. A/C on)

General fault position

- A/C system;
- Idle speed regulator;
- Fuel injectors.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Inspect the throttle body for carbon deposits.	Yes	Cleaning related parts
		No	Next step
2	Observe whether the engine output power increases when the A/C is turned on, that is, observe the change of ignition advance angle, fuel injection pulse width and intake air volume with the EFI system diagnostic scanner.	Yes	Go to Step 4
		No	Next step
3	Connect the EFI system adapter, disconnect the 75# pin connection wire of the electronic control unit, and check whether the harness terminal is high level signal when the A/C is turned on.	Yes	Next step
		No	Overhaul A/C system
4	Check whether the A/C system pressure, compressor electromagnetic clutch and A/C compression pump are normal.	Yes	Next step
		No	Overhaul A/C system
5	Dismantle the fuel injector, and use the special cleaning analyzer of the fuel injector to check whether the fuel injector has leakage, blockage or flow error.	Yes	Replacement of fault
		No	Next step

Normal starting and high idle speed

General fault position

- Throttle body and idle bypass passage;
- Vacuum pipe;
- Idle speed regulator;
- Coolant temperature sensor;
- Ignition timing.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the accelerator cable is stuck or too tight.	Yes	Adjustment
		No	Next step
2	Check the intake system and the connected vacuum pipe for air leakage.	Yes	Overhaul intake system
		No	Next step
3	Remove the idle speed regulator, and check the throttle body, idle speed regulator and idle speed bypass passage for carbon deposits.	Yes	Cleaning related parts
		No	Next step
4	Remove the coolant temperature sensor connector, start the engine, and observe whether the engine idle	Yes	Overhaul circuit or replace sensor

	speed is too high.	No	Next step
5	Check whether the ignition timing of the engine complies with specifications.	Yes	Next step
		No	Overhaul ignition timing

Speed does not go off or flameout during acceleration

General fault position

- Fuel water;
- Intake pressure sensor and throttle position sensor;
- Spark plug;
- Throttle body and idle bypass passage;
- Intake port;
- Idle speed regulator;
- Fuel injector;
- Ignition timing;
- Row trachea.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked.	Yes	Overhaul intake system
		No	Next step
2	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is around 350kPa during acceleration.	Yes	Next step
		No	Overhaul fuel supply system
3	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
4	Remove the idle speed regulator, and check the throttle body, idle speed regulator and idle speed bypass passage for carbon deposits.	Yes	Cleaning related parts
		No	Next step
5	Check whether intake pressure sensor, throttle position sensor and their circuits are normal.	Yes	Next step
		No	Overhaul circuit or replace sensor
6	Remove the fuel injector, and check the fuel injector for leakage or blockage with the fuel injector special cleaning analyzer.	Yes	Replacement of fault
		No	Next step
7	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
8	Check whether the ignition sequence and ignition timing of the engine meet the specifications.	Yes	Next step
		No	Overhaul ignition timing
9	Check whether exhaust of exhaust trachea is smooth.	Yes	Next step
		No	Repair or replace row trachea

Slow response during acceleration

General fault position

- Fuel water;
- Intake pressure sensor and throttle position sensor;
- Spark plug;
- Throttle body and idle bypass passage;
- Intake port;
- Idle speed regulator;
- Fuel injector;
- Ignition timing;
- Row trachea.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Check whether the air filter is blocked.	Yes	Overhaul intake system
		No	Next step
2	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is around 350kPa during acceleration.	Yes	Next step
		No	Overhaul fuel supply system
3	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
4	Remove the idle speed regulator, and check the throttle body, idle speed regulator and idle speed bypass passage for carbon deposits.	Yes	Cleaning related parts
		No	Next step
5	Check whether intake pressure sensor, throttle position sensor and their circuits are normal.	Yes	Next step
		No	Overhaul circuit or replace sensor
6	Remove the fuel injector, and check the fuel injector for leakage or blockage with the fuel injector special cleaning analyzer.	Yes	Replacement of fault
		No	Next step
7	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
8	Check whether the ignition sequence and ignition timing of the engine meet the specifications.	Yes	Next step
		No	Overhaul ignition timing
9	Check whether exhaust of exhaust trachea is smooth.	Yes	Next step
		No	Repair or replace row trachea

Weak during acceleration, poor performance

General fault position

- Fuel water;
- Intake pressure sensor;
- Spark plug;
- Ignition coil;
- Throttle body;
- Intake port;
- Fuel injector;
- Ignition timing;
- Row trachea.

Diagnostic process

Serial number	Operation steps	Test result	Next steps
1	Inspect for clutch slip, low tire pressure, brake drag, incorrect tire size, incorrect four-wheel alignment, etc.	Yes	Repair
		No	Next step
2	Check whether the air filter is blocked.	Yes	Overhaul intake system
		No	Next step
3	Connect the fuel pressure gauge (the access point is the front end of the fuel inlet pipe of the fuel distribution pipe assembly), start the engine, and check whether the fuel pressure is around 350kPa during acceleration.	Yes	Next step
		No	Overhaul fuel supply system
4	Pull out the split line of one cylinder, connect the spark plug, make the spark plug electrode 5 mm from the engine block, start the engine, and check whether the high-pressure fire intensity is normal.	Yes	Next step
		No	Overhaul ignition system
5	Check the spark plugs of each cylinder, and observe whether the type and clearance meet the specifications.	Yes	Next step
		No	Adjust or replace
6	Inspect the throttle body and airway for carbon deposits.	Yes	Cleaning related parts
		No	Next step
7	Check whether intake pressure sensor and throttle circuit are normal.	Yes	Next step
		No	Overhaul circuit or replace sensor
8	Remove the fuel injector, and check the fuel injector for leakage or blockage with the fuel injector special cleaning analyzer.	Yes	Replacement of fault
		No	Next step
9	Check the fuel condition and observe whether the fault phenomenon is caused by just after refueling.	Yes	Replace fuel
		No	Next step
10	Check whether the ignition sequence and ignition timing of the engine meet the specifications.	Yes	Next step
		No	Overhaul ignition timing
11	Check whether exhaust of exhaust trachea is smooth.	Yes	Next step
		No	Repair or replace row trachea

SAIPA YADAK

DAROU PAKHSH St.-KM17 KARAJ MAKHSOOS ROAD-TEHRAN

www.saipayadak.org