



Glory 600 Training courseware

-- HD15M1A Engine system



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Course targets



- Be able to understand the differentiation of HD15M1A engine.
- Be able to understand the detection number of HD15M1A engine sensors and actuators.
- Be able to master fault diagnosis of HD15M1A engine.

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1. HD15M1A Introduction to engine system



1. System overview

Mechanically, HD15M1A engine belongs to Miller cycle engine. The difference between Miller cycle engine and traditional engine is that the intake valve is closed before the piston moves to BDC during the intake stroke, and the crankshaft rotation drives the piston to continue moving into the compression stroke. Simply put, the valve is closed in advance during the air intake process to reduce the air intake and pump air loss. During the compression process, the piston only needs to compress a smaller amount of air to reduce the work loss of the piston compressed air. However, during the ignition stroke, the piston still moves from top dead center to bottom dead center, resulting in a special situation that the expansion ratio is greater than the compression ratio. The compression ratio is small, so the fuel consumption is low, and the expansion ratio is large, so the power is large. On the other hand, in order to avoid engine knock caused by too high compression ratio (early ignition).

In the aspect of electronic control, the engine management system of the United Microelectronics system is still adopted in the aspect of electronic control, and the system with the engine control module (ECM) as the core. Its characteristics are computer closed-loop control, direct injection in multi ignition cylinders, direct ignition without distributor, turbocharging, and three-way catalytic converter after the national six year plan. Only in the aspect of variable timing, the BorgWarner timing control system is adopted, so that the control range of valve timing is wider.



1. HD15M1A Introduction to engine system

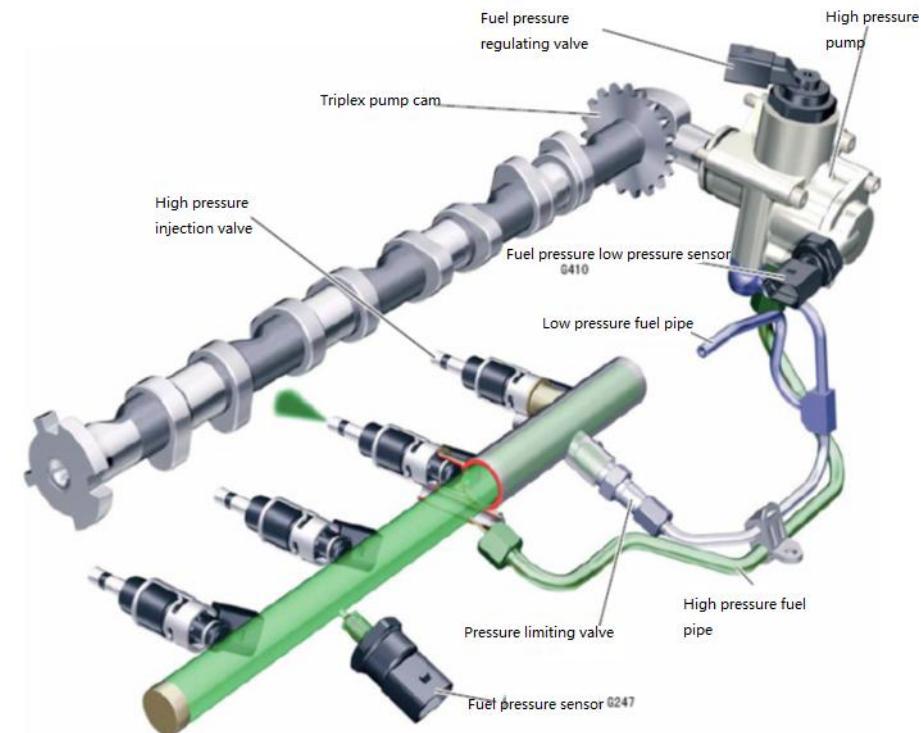
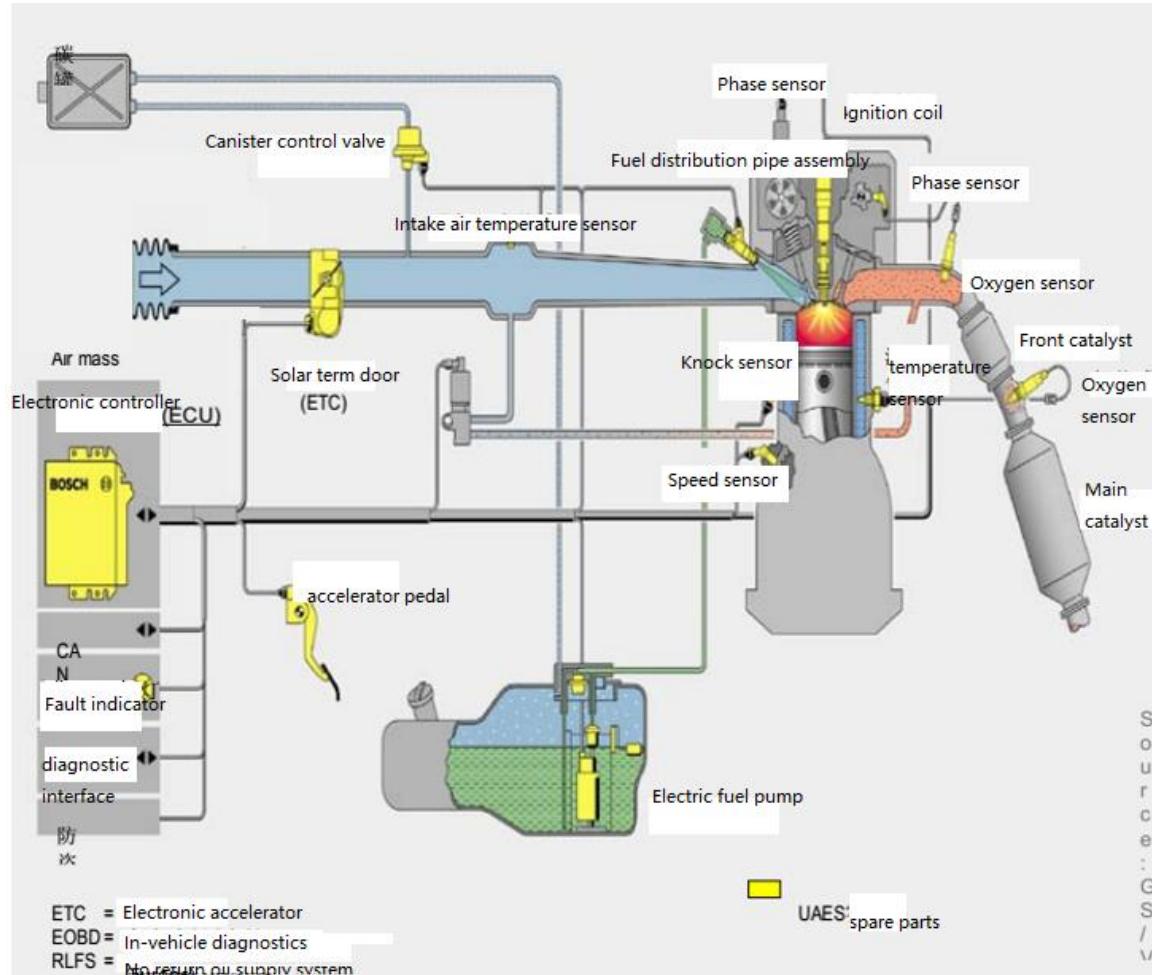
2. HD15M1A Engine appearance differentiation



1. HD15M1A Introduction to engine system



3. The United Microelectronics Corporation system composition



1. HD15M1A Introduction to engine system



(2) The main sensor input signals of ECU in the **UMC** system include:

1. Accelerator pedal signal
2. Boost pressure / temperature signal
3. ETC throttle angle signal
4. Coolant temperature signal
5. Engine speed signal
6. Phase signal
7. Knock sensor signal
8. Oxygen sensor signal
9. Manifold pressure / temperature sensor
10. Tank pressure sensor
11. High desorption pressure sensor
12. Crankcase ventilation conducting pipe
13. Two way water temperature sensor

(3) The main actuator driving signals of ECU in the **UMC** system include:

1. Electronic throttle opening
2. Injection timing and injection duration
3. Oil pump relay
4. Carbon canister control valve opening
5. Ignition coil closing angle and ignition advance angle
6. Air conditioning compressor relay
7. **VFS solenoid valve of VVT system**
8. Turbocharger exhaust and pressure reducing opening
9. Oxygen sensor heating
10. Cooling, condensing fan, compressor relay control
11. Cruise execution
12. Carbon canister is driven by atmospheric solenoid valve

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2. Electronic controller ECU function



1. Electronic controller ECU control function

(1) multi point sequential injection	(8) air conditioning switch
(2) control ignition	(9) engine fault indicator
(3) air intake control	(10) fuel quantity correction
(4) knock control	(11) output of engine speed signal (TN signal)
(5) provide sensor power supply: 5 v/100ma	(12) input of vehicle speed signal
(6) closed loop control with white adaptation	(13) fault self diagnosis
(7) control carbon canister control valve	(14) accept engine load signal

2. Electronic controller ECU function



2. System function introduction

2.1. Crankshaft position reference and speed measurement

The system judges the crankshaft position and measures the engine speed according to the 58x tooth signal, and accurately controls the engine ignition and injection timing.

2.2. Air measurement by velocity density method

ECM calculates the amount of air entering the cylinder through the intake air temperature and intake manifold pressure sensors, and controls the fuel supply to make the air-fuel ratio meet the requirements of various operating conditions.

2.3. Cylinder judging technology of engine sequence control

In order to realize the sequential control of the system to the engine, the system needs to obtain the cylinder judgment signal. Delphi EFI system adopts the camshaft cylinder judgment Technology.

2.4. Camshaft cylinder judgment

The camshaft position sensor works together with the gear ring installed on the camshaft to transmit the information of the top dead center of cylinder 1 of the engine to the EMS, which determines the working sequence of each cylinder of the engine.

2.5 . Closed-loop control

The system adopts closed-loop control for the fuel supply and idle speed of the engine; The advantage of closed-loop control is that the system control has the ability to eliminate the differences caused by manufacturing and use wear of the system and related mechanical parts, and improve the overall consistency of the whole vehicle.

2.6 . Sequence control

The fuel supply and ignition time (knock) of the engine are controlled in sequence by the system; The advantage of sequential control is that it can be controlled separately according to the differences between the cylinders of the engine, so as to improve the comprehensive performance of the engine

2. Electronic controller ECU function



2.7. Group control

The system divides the four cylinders of the engine into 1-4 and 3-2 for ignition control.

2.8. fuel injection system

- The system adopts the speed density method, multi-point sequential direct injection in the cylinder, implements accurate fuel supply in each engine cycle by controlling the main pulse width and trimming the pulse width, and has the functions of closed-loop control and self-learning;
- The hardware adopts **the sixth generation** fuel injector of **UMC** and the latest high-pressure oil pressure regulator.

2.9. Ignition control

- The system adopts sequential ignition;
- The system adopts "magnetization and discharge" logic to accurately control the magnetization and discharge time of ignition coil.

2.10. Knock control

- The knock sensor is of frequency response type , and EMS needs to filter the received signal;
- The system controls the ignition timing of each cylinder of the engine independently.

2.11. Idle speed control system

- On the engine equipped with electronic throttle valve body, the idle flow will be directly controlled in real time through the engine electronic control module, and the idle operating condition of the engine will be optimized and adjusted according to the current environmental conditions and various engine parameters.

2. Electronic controller ECU function



2.12. Exhaust emission control

- The system uses a three-way catalytic converter to post-process the gas after combustion of the engine, so that it is converted into harmless gas and discharged into the atmosphere;
- EMS adopts closed-loop fuel control according to the signal of the oxygen sensor, so that the catalytic converter reaches the highest conversion rate efficiency.

2.13. Three-way catalytic converter protection function The system has three-way catalytic converter protection function. The three-way catalytic converter protection is to first fill in the temperature of the catalytic converter measured by the vehicle on the rotating drum into the calibration according to the working conditions as the vehicle running time. The estimated temperature of the catalytic converter, the EMS software estimates the temperature of the three-way catalytic converter according to the operating conditions of the engine. When the estimated temperature is higher than the temperature that the three-way catalytic converter can withstand for a long time, the EFI system will increase the air-fuel ratio by increasing the temperature. The cooling method is used to achieve the purpose of catalytic converter protection.

2.14. Evaporative emission pollution control

Using Delphi's new generation carbon canister solenoid valve, the system controls the cleaning rate of the activated carbon canister according to the engine operating conditions.

2.15. Overvoltage protection

When the charging system fails and the voltage is too high, the system will enter a protection state to avoid damage to the EMS .

2.16. Turbocharger control

Takes the boost pressure as the control source and control target , and controls the opening of the wastegate valve through the EMS output duty cycle signal , so as to achieve closed-loop control of the boost pressure

2. Electronic controller ECU function



2.17. System electronic anti-theft device function

The ECM can communicate according to the specific communication protocol of the electronic anti-theft device, and reliably realize the anti-theft function according to the feedback information of the electronic anti-theft device; this function of the system is a plug-and-play type for **the UMC** anti-theft system.

2.18. Fault diagnosis function (OBD system)

- After the system enters the working state, the ECM controls the work of all parts of the system and detects them in real time. Once the system or parts fail, the system will light up "engine failure". The indicator light" reminds the driver of the vehicle to repair it in time.
- In the event of a system failure, the ECM will activate the backup "emergency control scheme" function.

2.19. Communication interface and communication protocol

- the system communicates with the body control modules BCM , TCU , ABS/ESP , EPS and ABM according to the CAN communication protocol ;
- the system communicates serially with external devices through the fault diagnosis socket according to the CAN protocol; Through the fault diagnosis port, we can connect the fault diagnosis instrument or install PChud The computer of the software performs fault diagnosis and analysis of the system working condition.

2.20. Automobile accessories control

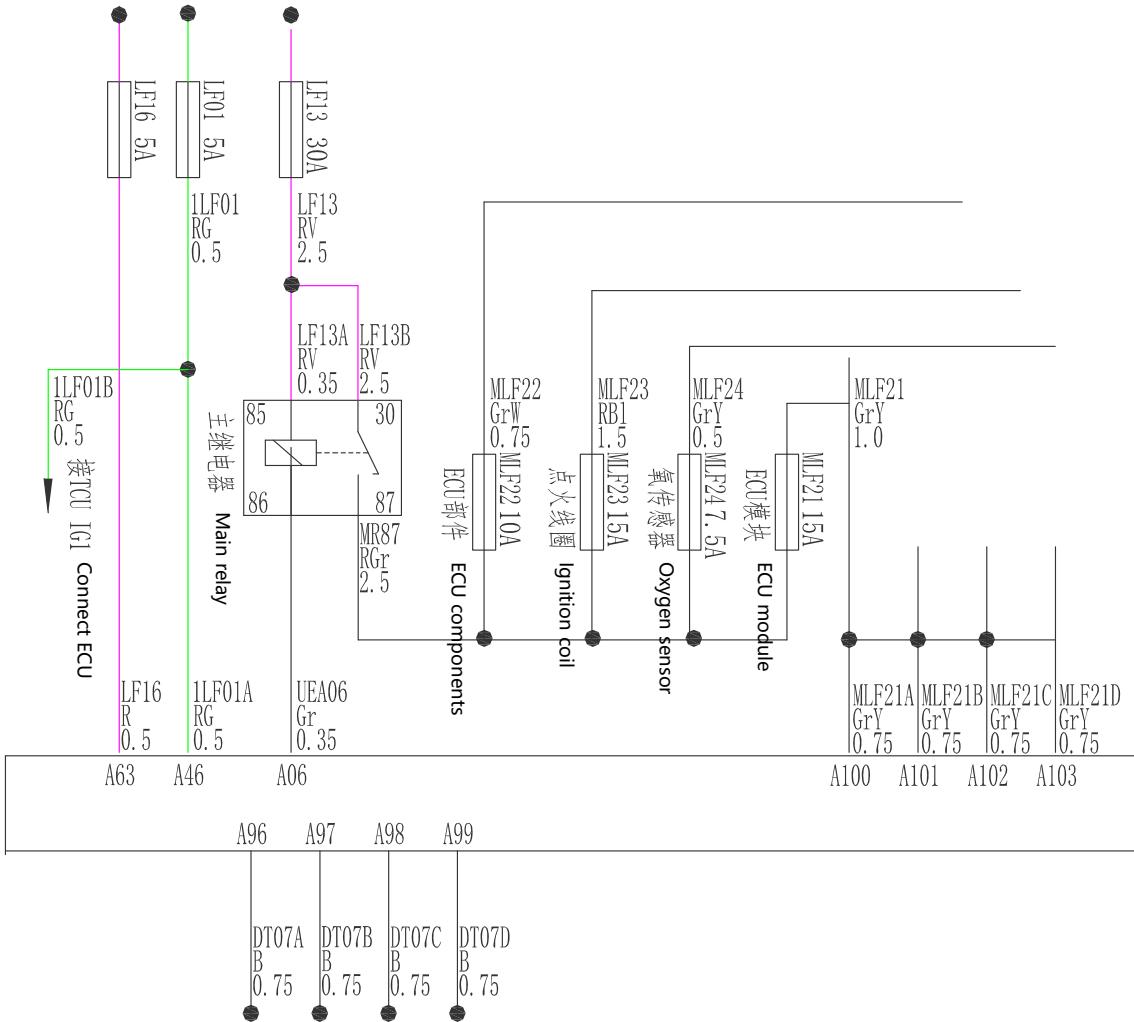
UMC engine control system controllable accessories include:

- The system controls the electronic engine coolant tank fan and the air conditioner condenser fan;
- EMS senses the air conditioner temperature through the evaporator outlet air temperature sensor and operates the air conditioner compressor through relays Implement control

2. Electronic controller ECU function



3. Engine computer ECU circuit



4. ECU failure failure phenomenon and cause :

Fault phenomenon:

unstable idle speed, poor acceleration, inability to start, high idle speed, excessive exhaust gas, difficulty in starting, failure of air conditioner, failure of injector control, flameout, etc.

General failure reasons :

1. The internal parts of the ECU are burned out due to the electrical overload of the external device , resulting in failure ;
2. The circuit board is corroded due to water in the ECU .

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3. Sensor function and detection

Serial number	Name	Function description
1	Crankshaft speed sensor	Accurately calculate the engine speed and crankshaft position for the calculation of ignition timing, fuel injection timing and ignition advance angle fuel injection quantity, and has the function of monitoring engine misfire.
2	Camshaft position sensor	The judgment cylinder and crankshaft sensor determine the top dead center of a cylinder together, and have the function of monitoring the working performance of the VVT .
3	Knock sensor	It is used to monitor the vibration of the engine and correct the ignition advance angle.
4	Boost pressure temperature sensor	Measure the intake air temperature after supercharging, correct the fuel injection quantity and timing, and protect against overheating. Measure the boost pressure to calculate the load, calculate the intake air volume together with the intake air temperature, and integrate it with the intake air temperature.
5	Intake pressure temperature sensor	It is used to detect the pressure and temperature of the intake manifold to determine the quality and density of the intake air.
6	High desorption pressure sensor	The desorption pressure sensor can monitor whether the pressure of the carbon canister desorption system is within the normal range in real time, so as to improve the desorption capacity of the fuel vapor system and reduce the emission standard.
7	Fuel tank pressure sensor	The main function is to measure the pressure change in the fuel tank, which is convenient for early detection of vehicle failures caused by oil and gas leakage or other abnormal pressure changes.
8	Electronic wastegate	The main function is to monitor the opening of the wastegate in order to control the work of the wastegate motor, which is also equivalent to the motor position feedback signal.



3. Sensor function and detection



Serial number	Name	Function description
9	Fuel rail pressure sensor	The function is to measure the real-time pressure of fuel in the fuel rail with sufficient accuracy and in a short time, and convert the pressure signal into a voltage signal and transmit it to the ECU at the same time, so as to realize the control of the injection precision and injection timing.
10	Cooling water temperature sensor	Measure cooling water temperature, used for cold start, target idle speed calculation, etc., and also used to correct ignition and fuel injection, overheat protection, etc.
11	Conductive PCV tube	Function is to detect whether the conductive PCV tube falls off or the crankcase leaks.
12	2 Coolant temperature sensor	Diagnose thermostat leakage or stuck faults through two water temperature sensors in the engine water outlet and the large circulation of the cooling system.
13	Accelerator pedal position sensor	Detecting the driver's will (idle speed, opening, frequency) is the main signal for controlling the throttle opening.
14	Electronic throttle position sensor	Detecting the opening of the throttle valve sends the driver's intention to the controller ECU for ignition and fuel injection correction. When the intake pressure fails, the throttle position sensor and the engine speed sensor calculate the intake pressure.
15	Oxygen Sensor	The front oxygen sensor is used to monitor the concentration of the mixture in the previous cycle to correct the fuel injection amount, and the lower oxygen sensor is used to monitor the conversion efficiency of the three-way catalysis.
16	Brake switch, clutch switch, neutral switch	Instrument sends the vehicle speed signal to the engine ECU, which is used to calculate the gear position correction ignition correction fuel injection amount when driving.

3. Sensor function and detection

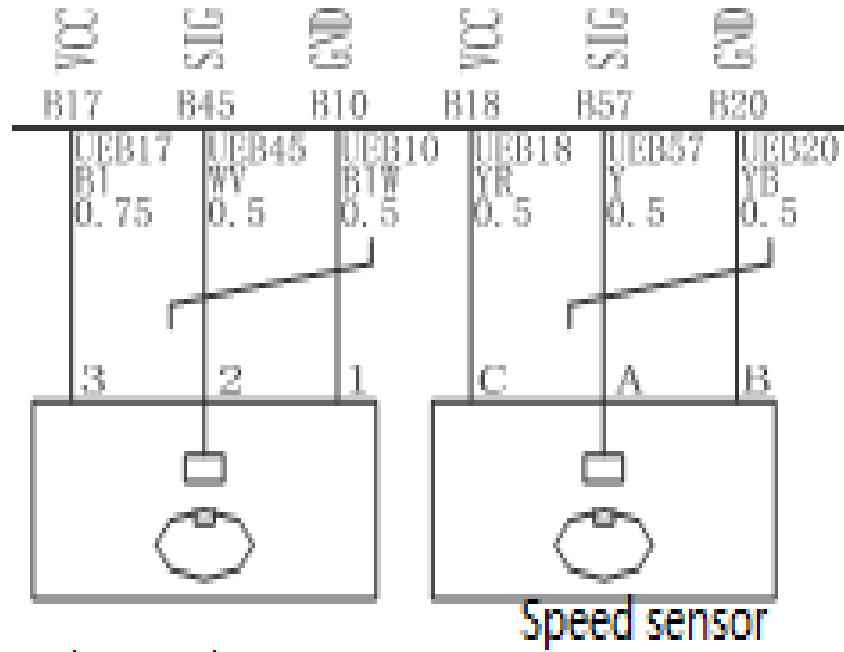


1. Crankshaft speed sensor

(1) Crankshaft speed sensor



(2) Circuit diagram of
crankshaft speed sensor



Exhaust phase sensor

Crankshaft position sensor

3. Sensor function and detection



(3) Detection of crankshaft speed sensor

Sensor interface shape					
Type	Hall effect				
Line number	Thread color	Function definition	Detection parameters		
			Wire break measurement	Online measurement of idle speed	Resistance
1	YR (/)	Sensor power	5V (/)	5V (/)	/
2	Y (/)	Sensor signal line (ground)	5V (/)	4.76V (/)	
3	YB (/)	Sensor ground (signal wire)	0.01V (/)	0.06V (/)	

(4) Fault phenomenon and reason :

Fault phenomenon: The engine cannot calculate ignition and fuel injection, the engine cannot catch fire, and the tachometer has no indication when starting.

Causes of failure: sensor damage, sensor line failure, sensor gap exceeding the standard, sensor adsorption of metal dust.

3. Sensor function and detection

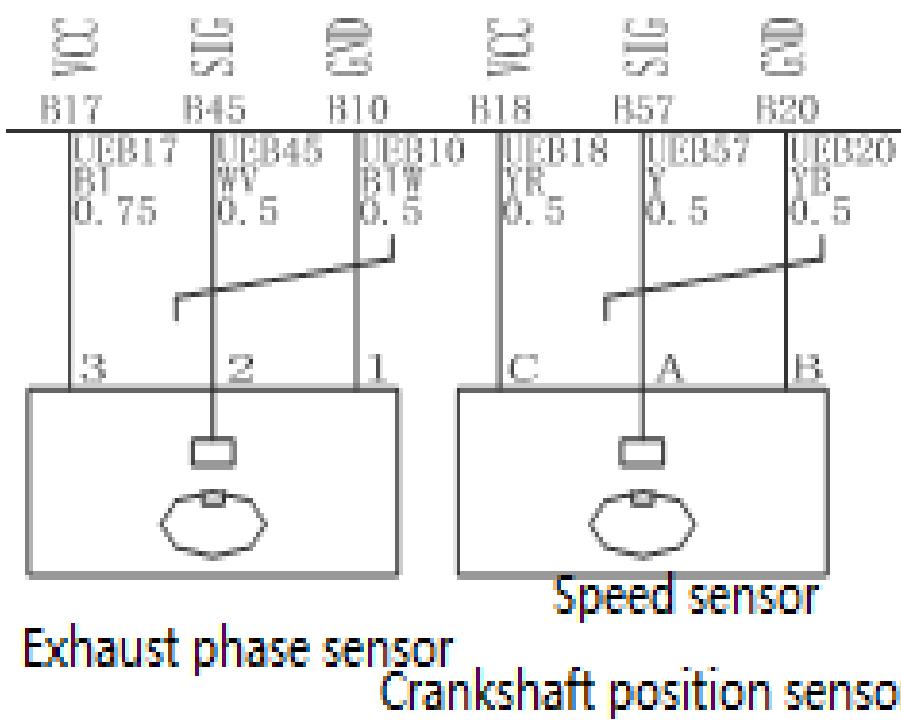


2. Exhaust camshaft position sensor

(1) Exhaust camshaft position sensor



(2) Circuit diagram of exhaust camshaft position sensor



3. Sensor function and detection



(3) Detection of camshaft position sensor

Sensor interface shape					
Type	Hall effect				
Line number	Thread color	Function definition	Detection parameters		
			Wire break measurement	Online measurement of idle speed	Resistance
1	Blue and white (/)	Sensor ground (power supply)	0.01V (/)	0.01V (/)	/
2	White purple (/)	Sensor Signal Line (Ground)	5.0 V (/)	3.19~1.91V change (/)	
3	Blue (/)	Sensor power cable (output)	5.02V (/)	5.02V (/)	

(4) Fault phenomenon and reason

Fault phenomenon: difficult to start, excessive emissions, increased fuel consumption .

Cause of failure: sensor damage, sensor line failure, sensor gap exceeding the standard.

3. Sensor function and detection

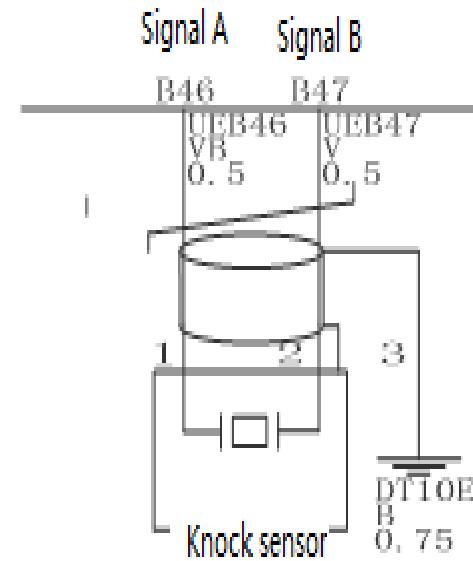


3. Knock sensor

(1) Outline of knock sensor



(2) Knock sensor circuit



3. Sensor function and detection



(3) Knock sensor detection

Sensor interface shape					
Line number	Thread color	Function definition	Detection parameters		
			Line status	When working	Resistance
A	Purple black (brown and white)	Sensor signal A	2.5V	AC 20-120MV	Gigantic
B	Purple (brown yellow)	Sensor signal B	2.5V		
C	Black	Sensor signal C	0V	Shield ground	

(4) Knock sensor failure phenomenon and reasons:

Symptoms: Poor engine acceleration.

Cause of failure: The sensor is damaged by corrosion, the line is damaged, and the torque of the sensor mounting bolt is too large.

3. Sensor function and detection

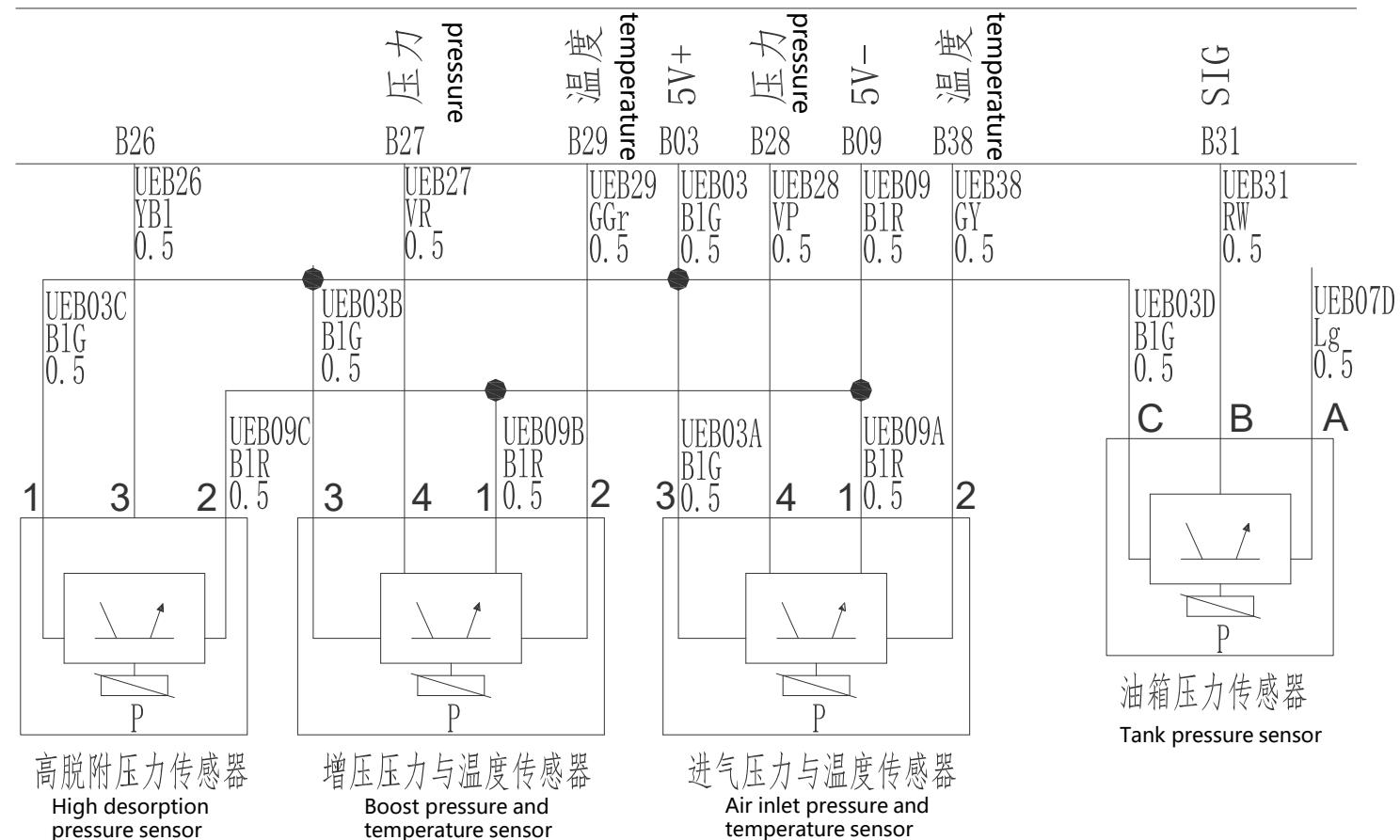


4. Boost pressure / temperature sensor

(1) Outline of boost pressure /
temperature sensor



(2) Boost pressure / temperature sensor circuit diagram



3. Sensor function and detection



(3) Detection of boost pressure / temperature sensor

Sensor interface shape	The color of the wiring harness is confirmed by the vehicle			
Line number	Thread color	Function definition	Detection parameters (Ignition switch ON)	
			Open circuit	Operating status
1	Blue red	Sensor common ground	0.01V	2.5KΩ ±0.5KΩ (20 °C)
2	Green grey	Boost temperature signal line	5.02V	
3	Blue-green	Boost pressure power cord	5.02V	
4	Purple	Boost pressure signal line	0.02V	1.9~3.2V

(4) Fault phenomenon and reason:

Fault phenomenon : the supercharger does not work, the pipeline falls off, etc.

General failure reasons :

1. There is abnormal high voltage or reverse large current during use ;
2. The repair process damages the pressure chip.

3. Sensor function and detection



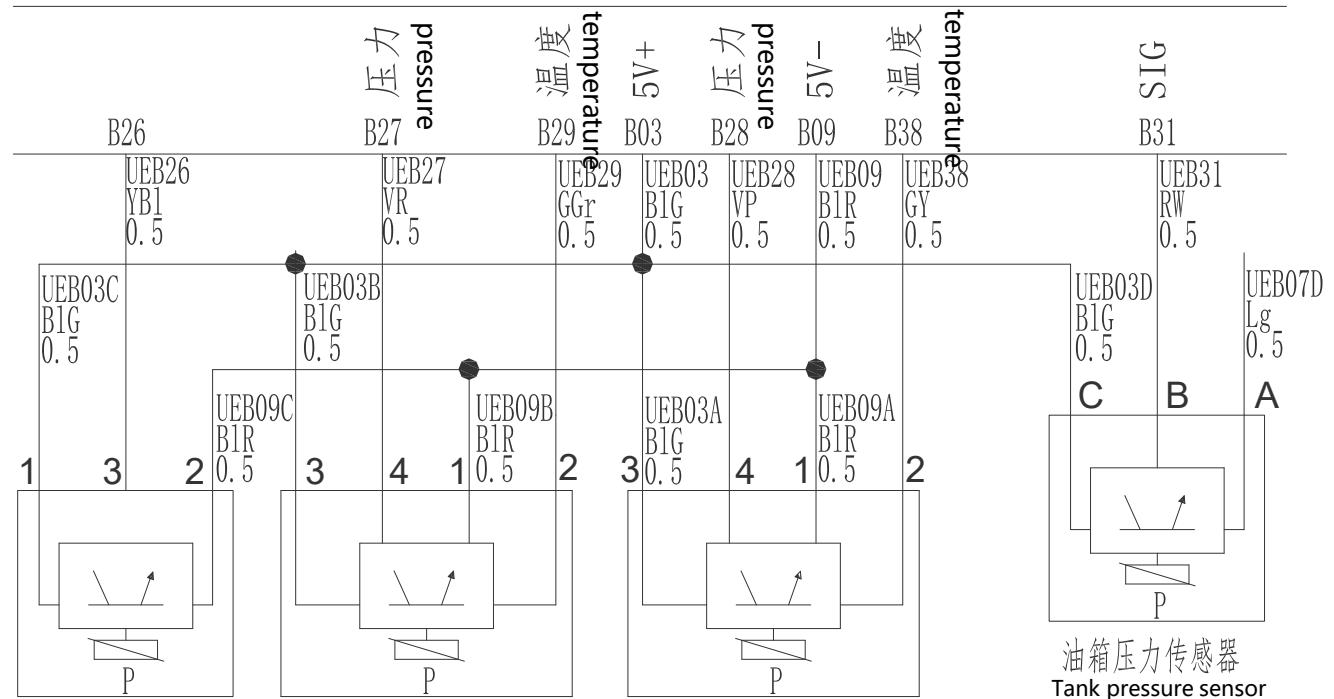
5. Intake pressure / temperature sensor

(1) Outline of manifold pressure / temperature sensor



- Pressure range: 10 kPa – 300 kPa ;
- Working temperature: -40—130°C ;
- Working voltage: 5.0V±0.25V ;
- Working current: ≤ 12.5 mA ;

(2) Intake air pressure / temperature sensor circuit diagram



高脱附压力传感器
High desorption pressure sensor

增压压力与温度传感器
Boost pressure and temperature sensor

进气压力与温度传感器
Air inlet pressure and temperature sensor

油箱压力传感器
Tank pressure sensor

3. Sensor function and detection



(3) Detection of intake pressure / temperature sensor

Sensor interface shape	The color of the wiring harness is confirmed by the vehicle			
Line number	Thread color	Function definition	Detection parameters (ignition switch ON)	
			Open circuit	Operating status
A	Blue red	Sensor common ground	0.01V	2.5KΩ ±0.5KΩ (20 °C)
B	Breen yellow	Manifold temperature signal line	5.02V	
C	Blue-green	Manifold Pressure Power Cord	5.02V	
D	Purple pink	Manifold Pressure Signal Line	0.02V	0.9~4.0V

(4) Fault phenomenon and reason

Fault phenomenon: the engine cannot be started; the engine accelerates poorly; the engine idle speed is unstable; the engine stalls.

General failure cause: abnormal high voltage or reverse high current during use.

3. Sensor function and detection



6. High desorption pressure sensor

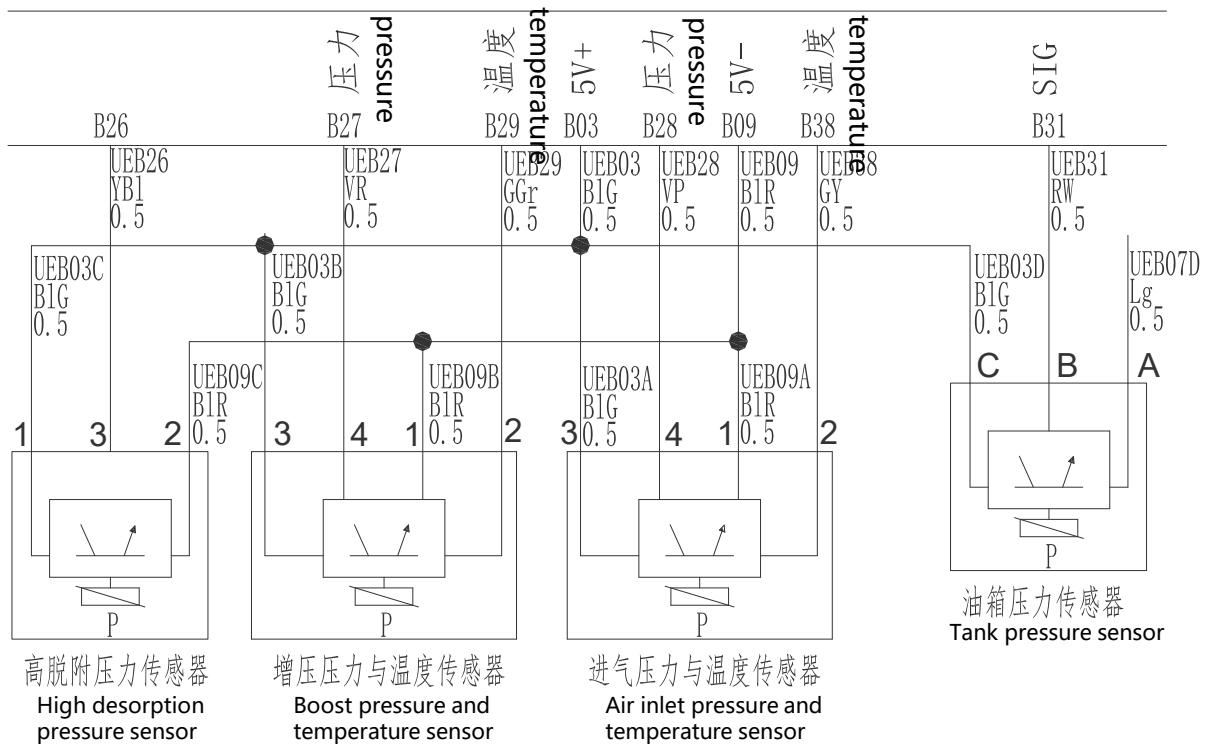
(1) Outline of high desorption pressure sensor



High desorption pressure sensor;

1. Working voltage (5 ± 0.25)V
2. Operating temperature range (-40~130) °C
3. Response time 2 ms
4. Working pressure: (10~115) kPa
5. The accuracy of the pressure sensor: ± 1.6 kPa

(2) Circuit diagram of high desorption pressure sensor



3. Sensor function and detection



(3) Detection of high desorption pressure sensor

High desorption pressure sensor sensor					
Serial number	Terminal function	Wire color	Ignition switch ON gear to ground voltage		Remark
			Wire break measurement	Online measurement of idle speed	
1	Sensor power	Blue green	5.02V	5.02V	
2	Sensor ground wire	Blue red	0.01V	0.01V	
3	Sensor signal line	Yellow blue	0.01V	3.98V	The gas pedal doesn't change much

(4) Fault phenomenon and reason:

The color of the wiring harness is confirmed by the vehicle

Fault phenomenon: engine torque limit, insufficient power, etc.

Cause of issue:

1. The pipeline falls off or the sensor is damaged ;
2. Pipeline vacuum leakage, etc.

3. Sensor function and detection



7. Fuel tank pressure sensor

(1) Outline of tank pressure sensor

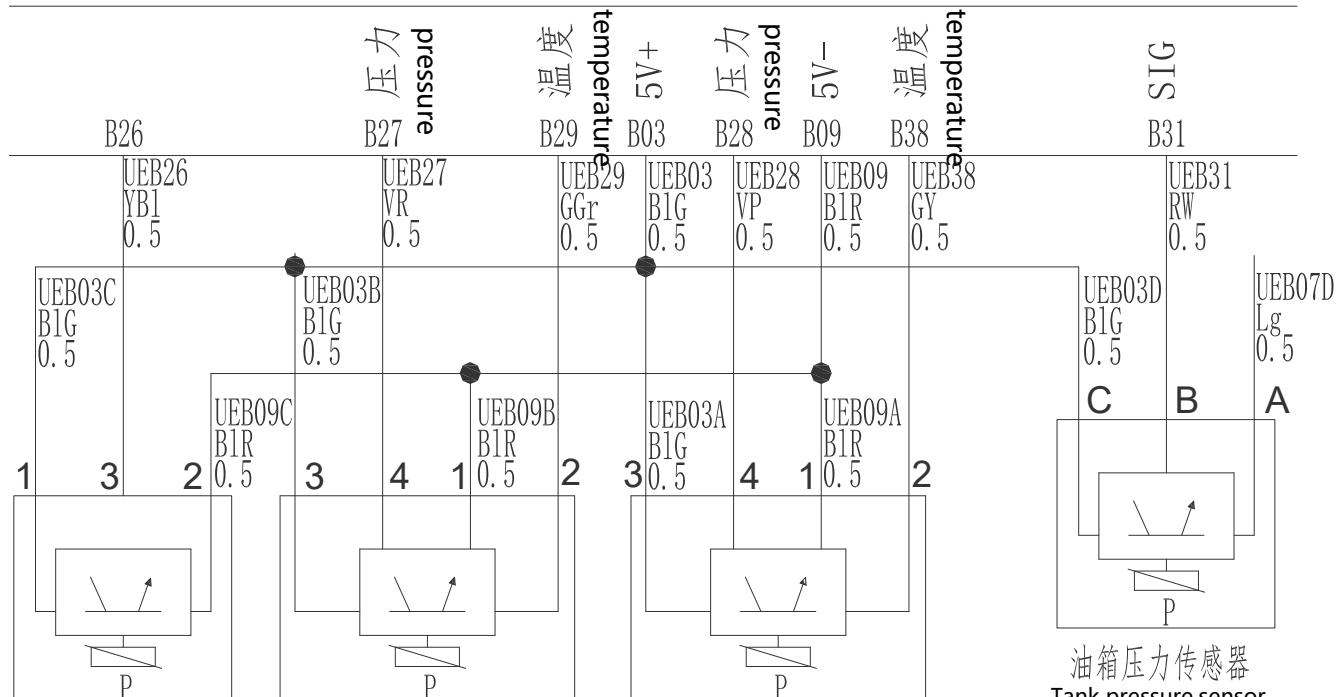


Integrated NTC temperature sensor and pressure sensor;

Operating temperature range: - 40 to 130°C

Working pressure range: 50 ~ 400 kPa

(2) Circuit diagram of fuel tank pressure sensor



高脱附压力传感器
High desorption pressure sensor

增压压力与温度传感器
Boost pressure and temperature sensor

进气压力与温度传感器
Air inlet pressure and temperature sensor

油箱压力传感器
Tank pressure sensor

3. Sensor function and detection



(3) Detection of fuel tank pressure sensor

Fuel tank pressure sensor sensor					
Serial number	Terminal function	Wire color	Ignition switch ON gear to ground voltage		Remark
			Wire break measurement	Online measurement of idle speed	
1	Sensor power	Blue green	5.02V	5.02V	
2	Sensor signal line	Red white	0.01V	1.5V	Opening the fuel cap doesn't change much
3	Sensor ground wire	Light green	0.01V	0.01V	

(4) Fault phenomenon and reason:

Fault phenomenon: engine torque limit, insufficient power, etc.

Cause of issue:

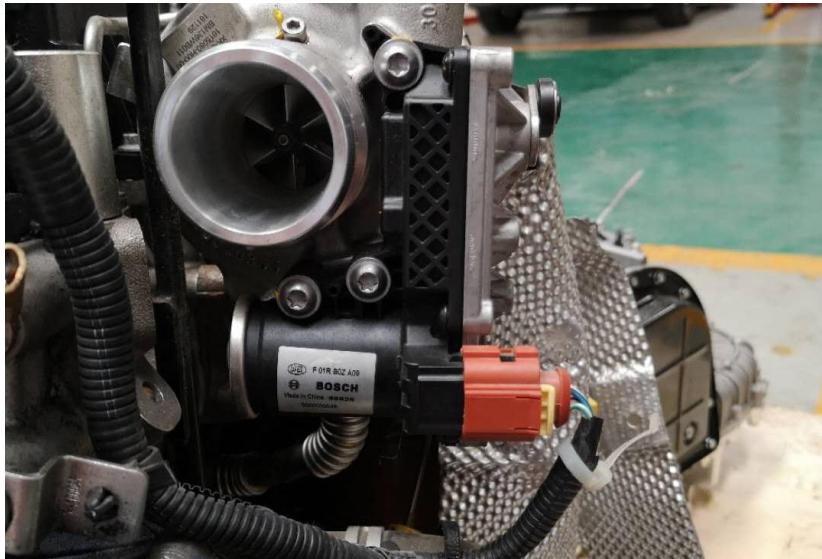
1. The fuel tank pressure sensor falls off or is damaged ;
2. Fuel tank vacuum leakage, etc.

3. Sensor function and detection

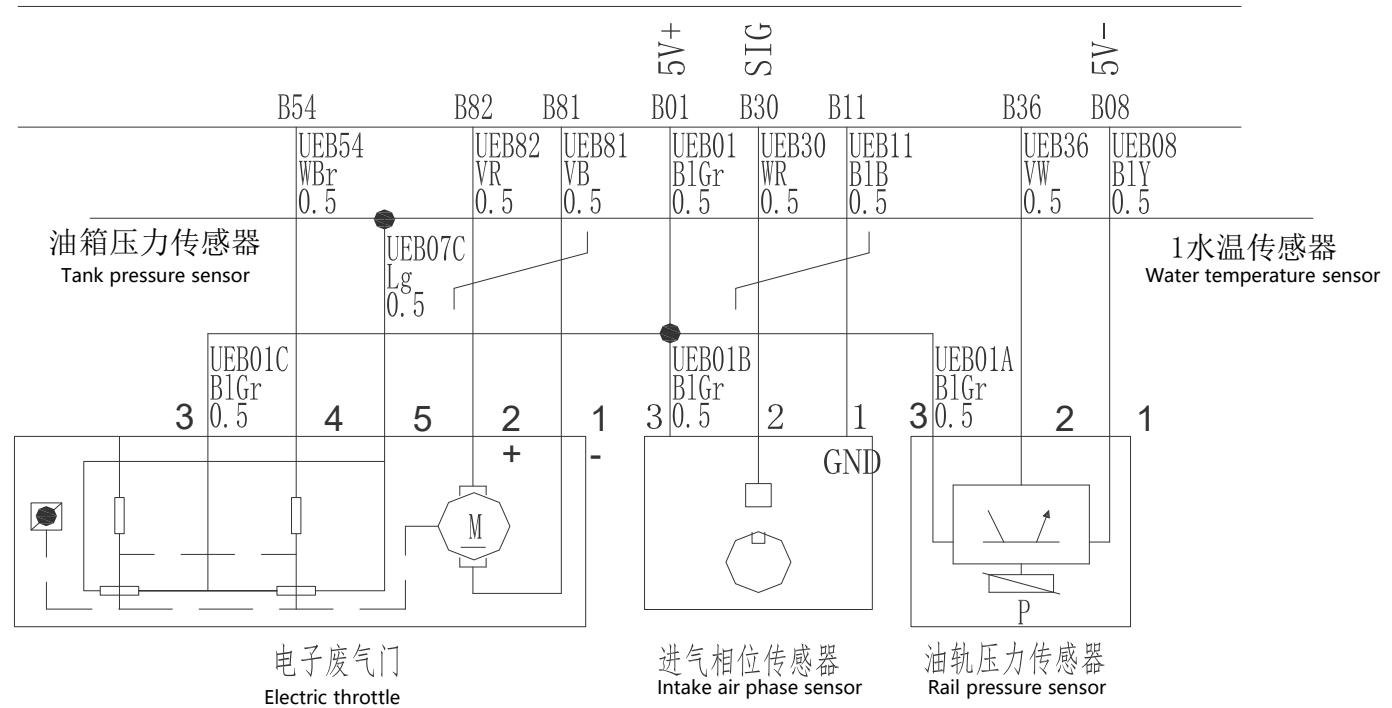


8. Electronic wastegate

(1) Shape of electronic wastegate



(2) Electronic wastegate control circuit



3. Sensor function and detection



(3) Electronic wastegate brake valve circuit detection

Electronic wastegate interface outline					
Line number	Thread color	Function definition	Detection parameters		
			Online test	Working status	Resistance
2	Purple	Exhaust control valve power supply	1.81V	0~12V change	$22.5 \pm 1.5\Omega$
6	Purple black	Exhaust control valve power control line	1.82V		
3	Light green	Position sensor ground	0V	0~ 4 V change	
5	White brown	Position sensor signal	0.5V		
1	Blue grey	Position sensor power supply	5.02V	5.02V	

(4) Symptoms and causes of circuit failures of the leakage control valve and exhaust control valve:

Fault phenomenon: The leakage control valve and exhaust control valve are invalid, and the turbocharger is overloaded and damaged.

Causes of failure: The leakage control valve and the waste gas control valve are damaged, the control circuit is damaged, and the valve is ablated at high temperature.

3. Sensor function and detection

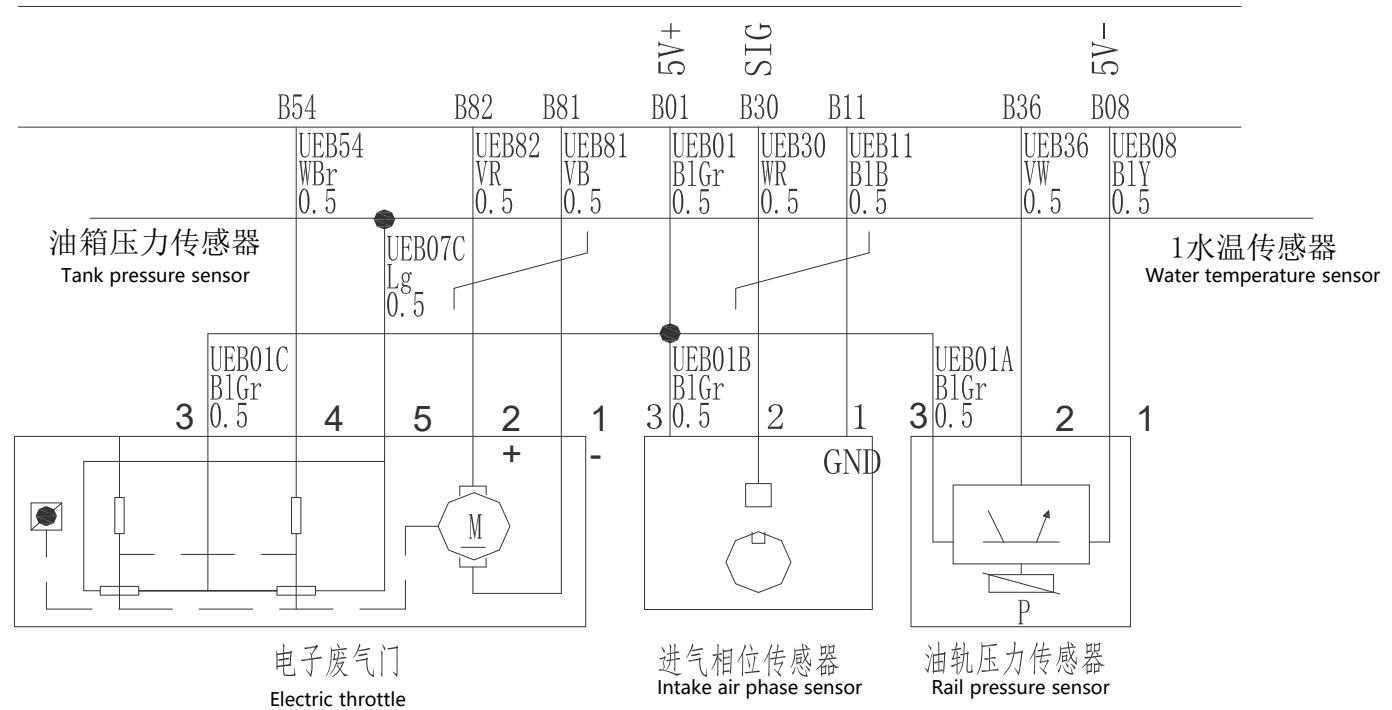


9. Camshaft position sensor

(1) Intake camshaft position sensor



(2) Intake camshaft position sensor circuit diagram



3. Sensor function and detection



(3) Detection of camshaft position sensor

Sensor interface shape					
Type	Hall effect				
Line number	Thread color	Function definition	Detection parameters		
			Wire break measurement	Online measurement of idle speed	Resistance
1	Blue black	Sensor ground	0.01V	0.01V	/
2	White Red	Sensor signal line	5.0V _	3.19~1.91V change	
3	Blue grey	Sensor power cable	5.02V	5.02V	

(4) Fault phenomenon and reason

Fault phenomenon: difficult to start, excessive emissions, increased fuel consumption .

Cause of failure: sensor damage, sensor line failure, sensor gap exceeding the standard.

3. Sensor function and detection

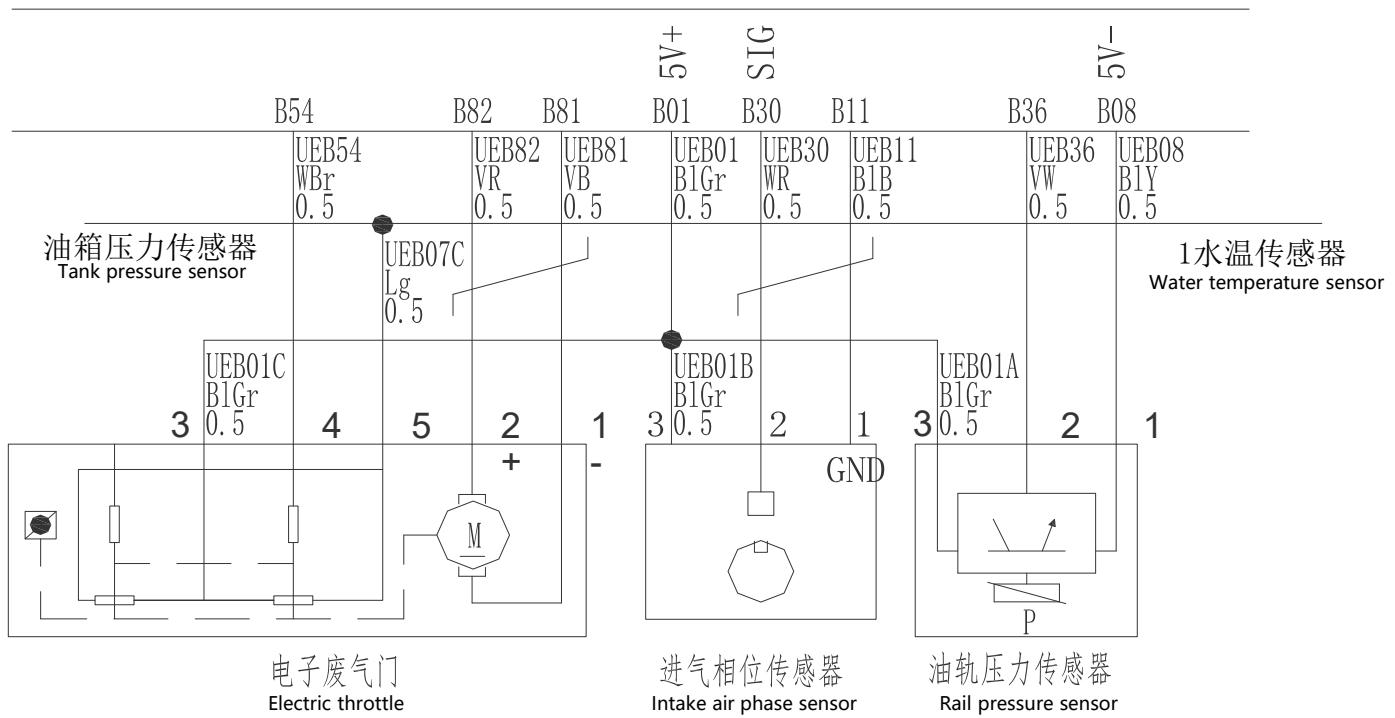


10. Fuel rail pressure sensor

(1) Outline of oil rail pressure sensor



(2) Oil rail pressure sensor circuit



3. Sensor function and detection



(3) Oil rail pressure sensor detection

Sensor interface shape	The color of the wiring harness is confirmed by the vehicle			
Line number	Thread color	Function definition	Detection parameters (ignition switch ON)	
			Wire break measurement	Online measurement of idle speed
1	Blue grey	Fuel rail pressure sensor power supply	5.02V	5.02V
2	Blue yellow	Fuel rail pressure sensor ground wire	0.02V	0.5-4.0V (idle speed 1.5~1.6V)
3	Purple white	Fuel rail pressure sensor signal line	5.02V	

(4) Oil rail pressure sensor failure

Fault phenomenon: engine fault indicator light is on, engine torque is limited, engine is difficult to start

Causes of failure: sensor damage, line damage, too much fuel colloid, injector blockage, etc.

Three、Sensor function and detection

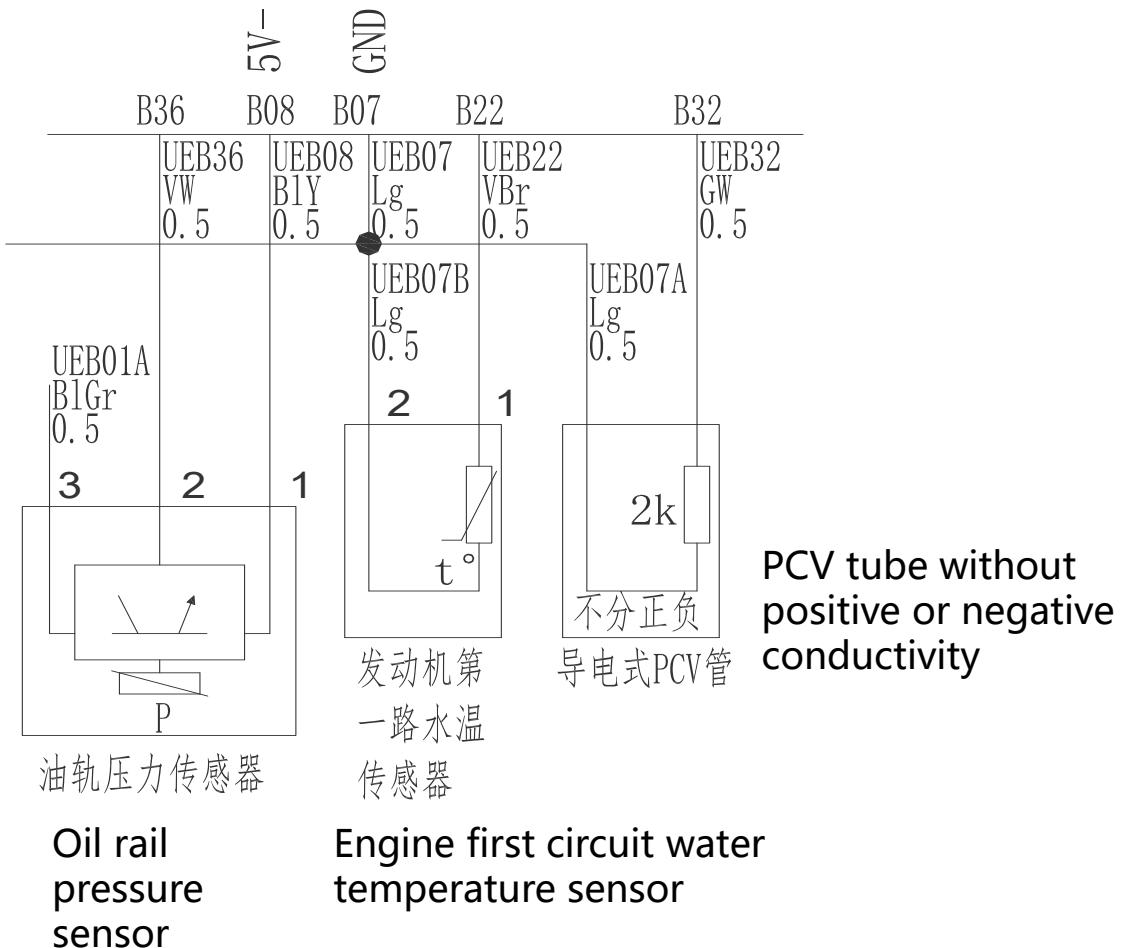


11. Coolant Temperature Sensor



(1) Coolant Temperature Sensor

(2) Coolant temperature sensor circuit diagram



三、Sensor function and detection



(3) Coolant temperature sensor detection

Sensor interface profile				
Line No.	Line Color	Function Definition	Test parameters (ignition switch ON)	
			Disconnected state	Operation State
A	light green	Coolant temperature sensor ground wire	0.02V	2.5KΩ±0.5KΩ(20°C)
C	purple brown	Coolant temperature sensor signal line	5.02V	

(4) Fault phenomenon and cause:

Specific information needs to be confirmed for the entire vehicle

Failure phenomenon: Engine start difficulty, fan often turn, engine torque is limited

General causes of failure: Sensor damage, wiring damage.

Three、Sensor function and detection



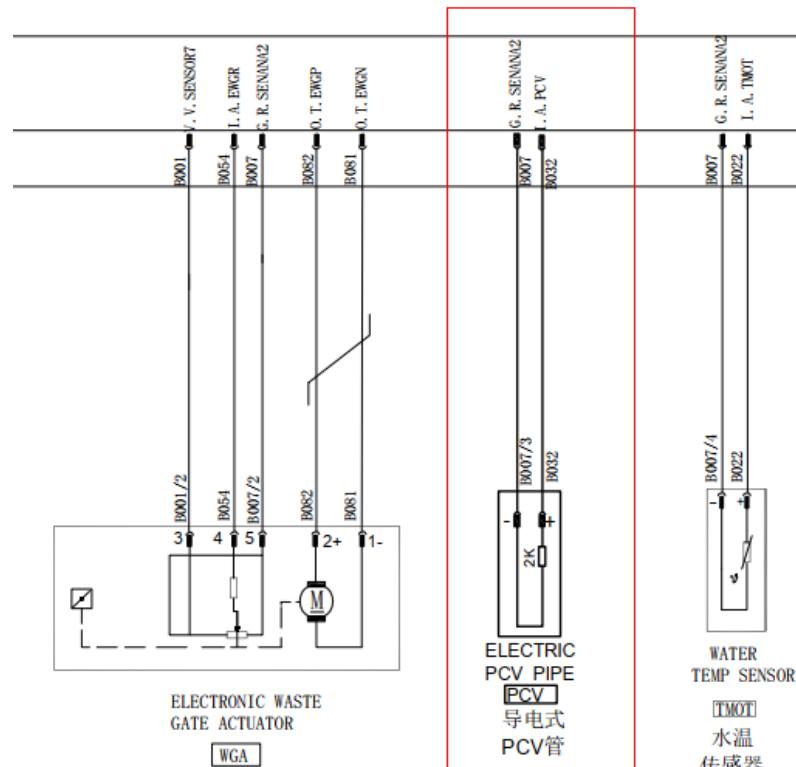
12. Conductive PCV tube

(1) Conductive PCV tube profile



(2) Conductive PCV tube circuit

B007	G_R_SENANA2	Analog Sensor Ground 2 模拟传感器地 2	Analog Sensor 2
B032	I_A_PCV	Electric PCV Pipe 导电式PCV管	Conductive PCV tube



Electronic valve

Conductive PCV tube

Water temperature sensor

Three、Sensor function and detection



(3) Testing of conductive PCV tube

Crankcase Ventilation Duct					
Serial number	Terminal Function	Wire color	Ignition switch ON gear voltage to ground		Note
			Disconnect plug voltage (V)	Plugged in voltage (V)	
1	Ventilation duct A power supply	green and white	5.04	3.26	1.99KΩ (Resistance at 20°C)
2	Ventilation duct inspection line	light green	0.01	1.64	

Does it refer to the harness end color or the vent tube wire color?

Need to retest to confirm

Three、Sensor function and detection

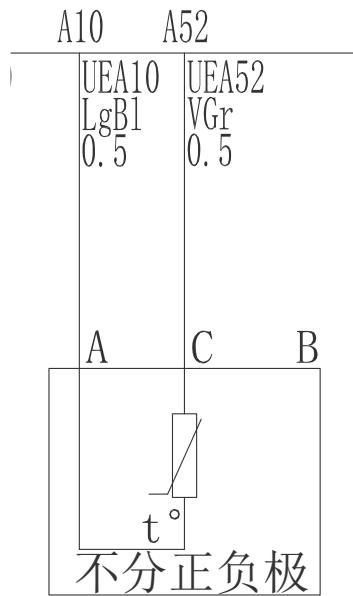


13.2 No. 2 coolant temperature sensor

(1) No. 2 coolant temperature sensor



(2) No. 2 coolant temperature sensor circuit diagram



发动机第
二路水温
传感器

No distinction between
positive and negative poles

Engine second circuit water
temperature sensor

Three、Sensor function and detection



(3) No. 2 coolant temperature sensor detection

Sensor interface profile				
Line No.	Line Color	Function Definition	Test parameters (ignition switch ON)	
			Broken wire measurement	Idle speed online measurement
A	light green blue	Coolant temperature sensor ground wire	0.02V	2.5KΩ±0.5KΩ(20°C)
C	purple gray	Coolant temperature sensor signal line	5.02V	

(4) Fault phenomenon and cause :

Failure phenomenon : Engine start difficulty, fan often turn, engine torque is limited

Specific information needs to be confirmed for the entire vehicle

Failure Cause : Sensor damage, wiring damage

Three、Sensor function and detection

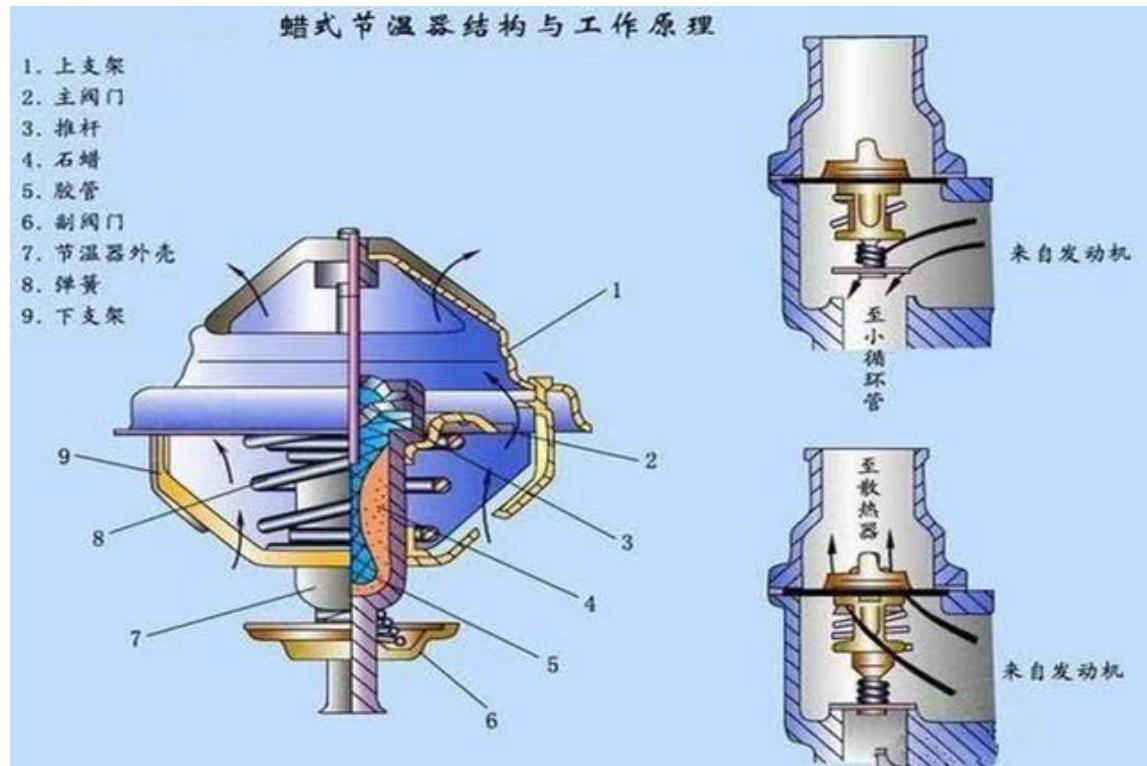


(5) Engine cooling system monitoring

The role of the two-way water temperature sensor

The National 6 system supports the option of dual water temperature sensors for thermostat diagnostics. Diagnosis of thermostat leaks or seizure failures by means of two water temperature sensors arranged in the engine outlet and in the cooling system's main circulation, respectively. The coolant should be in small circulation during the engine warm-up process. If the thermostat leaks, the temperature of the large circulation water circuit will continue to rise, the temperature difference between the engine outlet and the large circulation water temperature sensor will continue to decrease, when the difference between the two is less than the calibrated threshold, the system determines that the thermostat leakage failure. For the diagnosis of the coolant temperature sensor, a water temperature model is established to predict the minimum and maximum theoretical temperature of the engine cooling system. When the indicated temperature of the main water temperature sensor at the engine outlet is lower than the minimum theoretical temperature or higher than the maximum theoretical temperature, the system determines that the water temperature sensor has a signal drift failure.

Wax thermostat construction and working principle



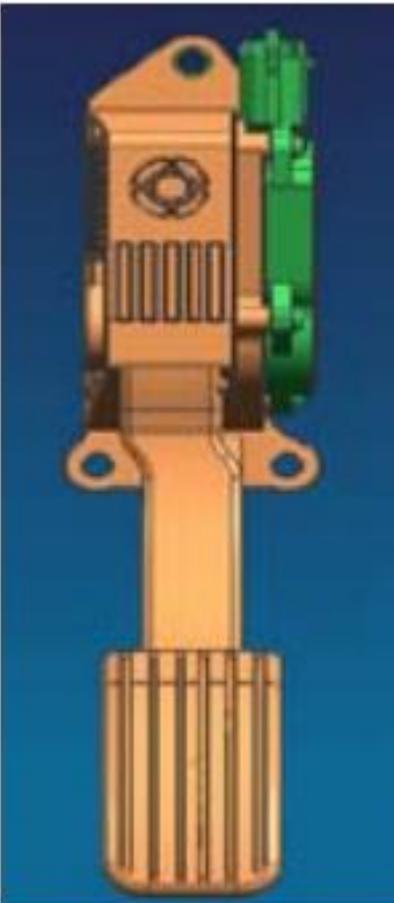
1. Upper bracket
2. Main valve
3. Pusher
4. Paraffin wax
5. Hose
6. Sub-valve
7. Thermostat housing
8. Spring
9. Lower bracket

Three、Sensor function and detection

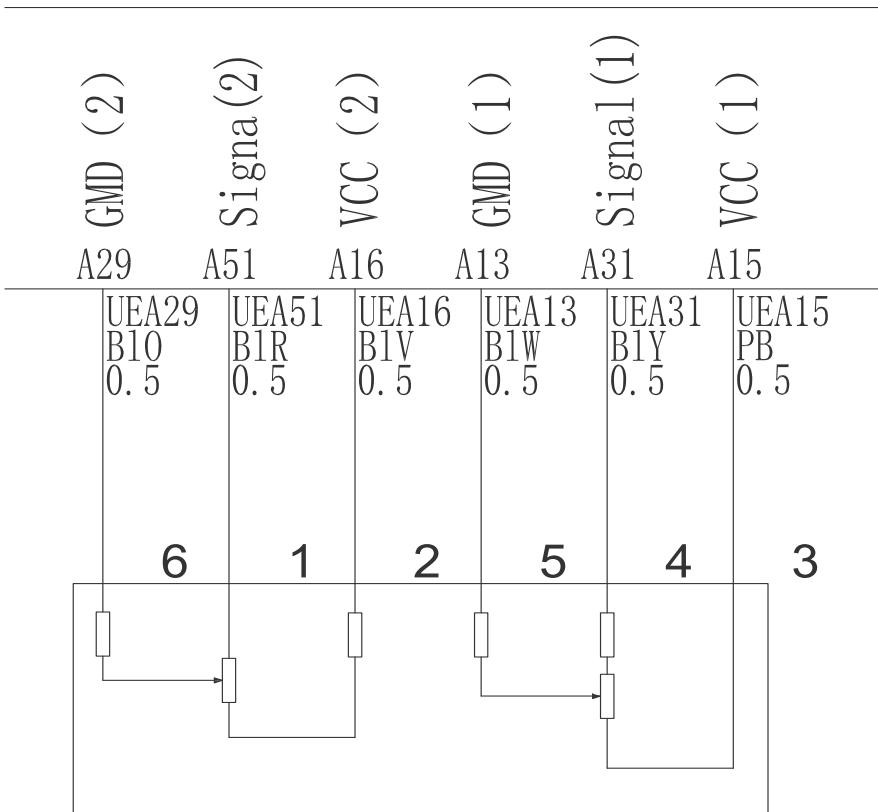


14. Accelerator pedal position sensor

(1) Accelerator pedal position sensor



(2) Accelerator pedal position sensor circuit



加速踏板模块
Accelerator pedal module

Three、Sensor function and detection



(3) Accelerator pedal position sensor testing

Sensor interface profile						
Line No.	Line Color	Function Definition			Test parameters (ignition switch ON)	
					Disconnected state	Operation State
1	Blue&Yellow	Sensor 1 signal line			0.01V	0.38V(idle speed), step to the end2.1V
2	Pink& Black	Sensor 1 power line			5.02V	1.7KΩ±0.8KΩ
6	Blue& White	Sensor 1 ground line			0.01V	
4	Blue& Red	Sensor 2 signal line			0.01V	0.75V(idle speed) , step to the end4.2V
3	Blue& Purple	Sensor 2 power line			5.02V	1.2KΩ±0.5KΩ
5	Blue& Orange	Sensor 2 ground line			0.01V	

(4) Failure phenomenon and cause

Failure phenomenon : The engine speed does not rise when the pedal is depressed

General causes of failure : Accelerator pedal sensor or circuit failure

Three、Sensor function and detection

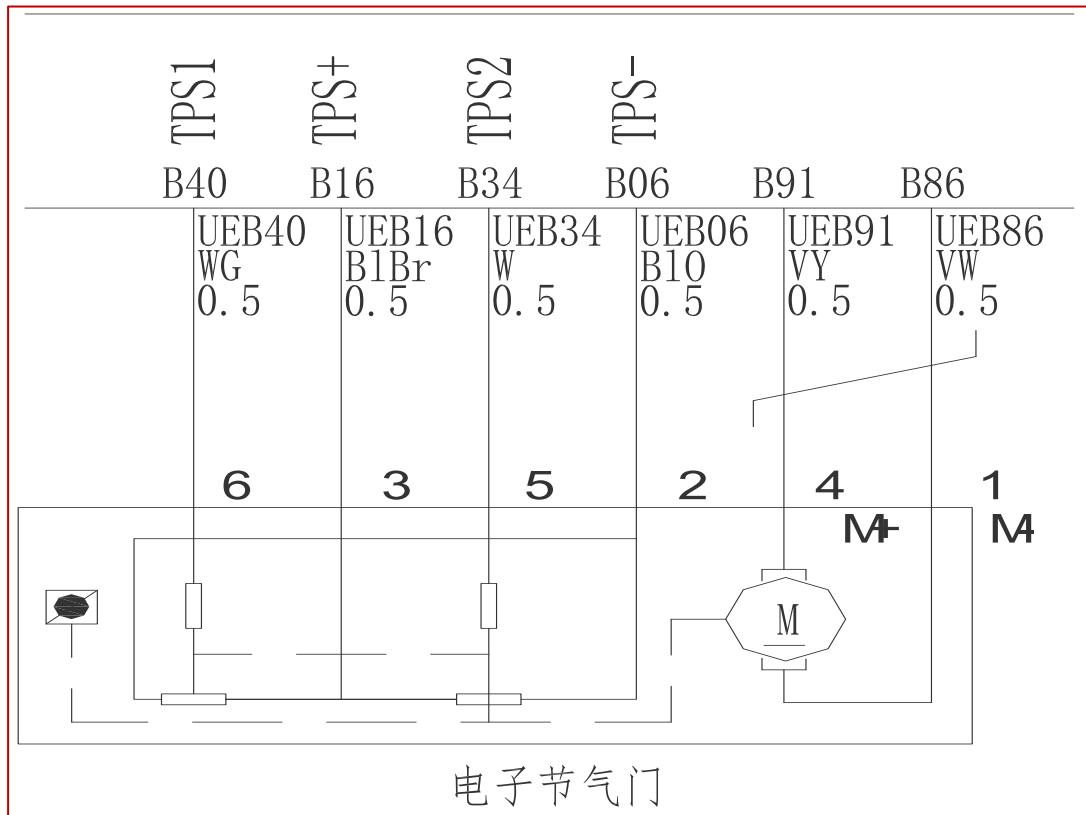


15. Electronic throttle position sensor

(1) Electronic throttle assembly



(2) Electronic throttle system circuit



At a differential pressure of $(60 \pm 2.5)\text{kPa}$ between the front and rear of the throttle, an air pressure of 100kPa , an air temperature of $(24 \pm 2)^\circ\text{C}$ and a relative air humidity of 40%, the air flow value is $\leq 3\text{kg/h}$ with the throttle plate at the mechanical lower stop; the air flow value is $(28 \pm 3.4)\text{kg/h}$ with the throttle plate in the default idle position;

At a differential pressure of $(6 \pm 0.5)\text{kPa}$ between the front and rear of the throttle and an air pressure of 100kPa and an air temperature of $(24 \pm 2)^\circ\text{C}$ with a relative air humidity of 40%, the air flow rate at full throttle opening is $\geq 400\text{kg/h}$;

Electronic Throttle

Three、Sensor function and detection



(3) Electronic throttle system testing

Sensor interface profile				
Line No.	Line Color	Function Definition	Test parameters (ignition switch ON)	
			Disconnected line measurement	Idle speed online measurement
1	Purple & White	Motor power control line	2.28V	4.25V
4	Purple & Yellow	Motor power control line	2.28V	4.25V
3	Blue & Brown	Sensor power supply 5V	5.02V	5.02V
2	Blue & Orange	Sensor ground line	0.01V	0.01V
5	White & Green	Sensor 1 signal line	0.02V	Specific information needs to be confirmed for the vehicle
6	White	Sensor 2 signal line	0.02V	

(4) Electronic throttle system failure phenomenon and causes :

Failure phenomenon : The vehicle accelerates weakly, and the throttle valve tabs frequently return or seize.

Cause of failure : Damaged electronic throttle, damaged electronic throttle line, wrong matching.

Three、Sensor function and detection



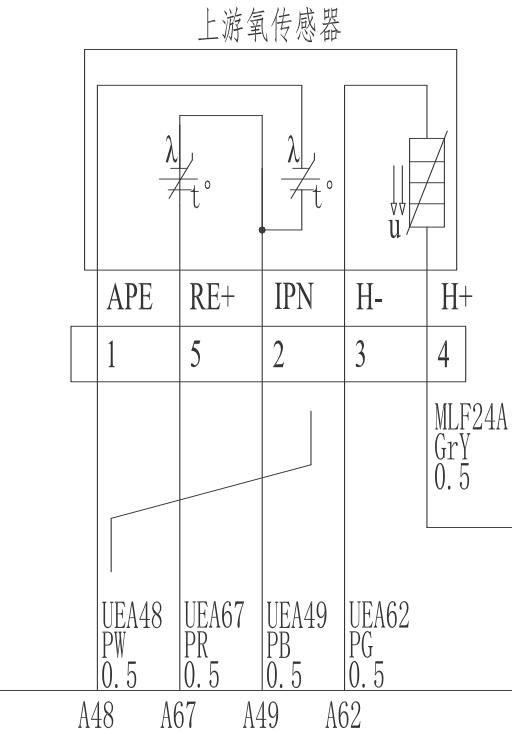
16. Oxygen Sensor

(1) Oxygen Sensor

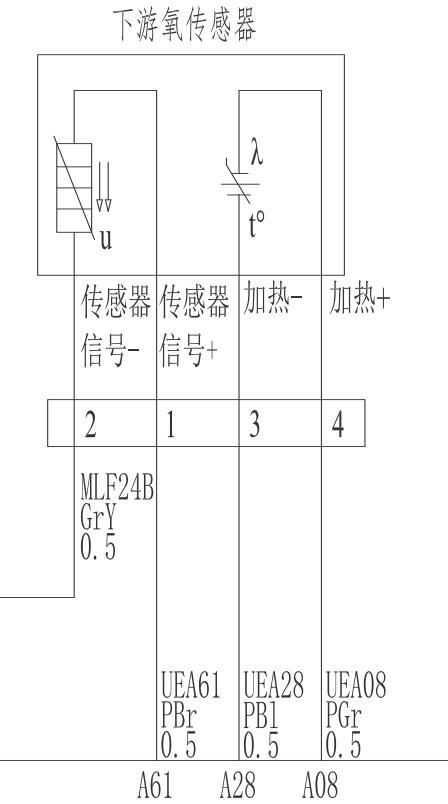


(2) Upstream and downstream oxygen sensor circuits

Upstream sensor



Downstream sensor



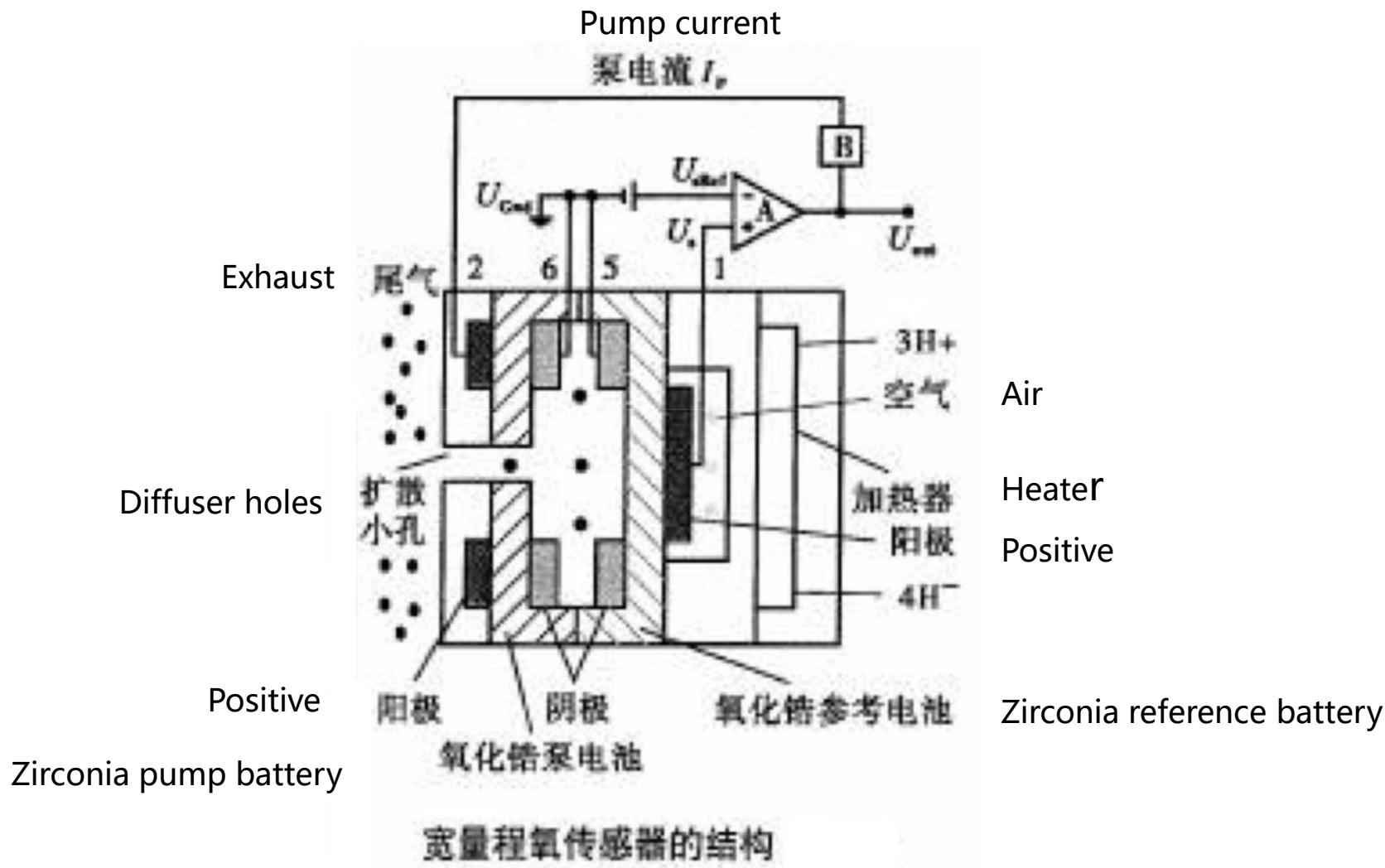
Sensor signal-

Sensor signal +

Heating-

Heating +

Three, Sensor function and detection



Structure of the wide-range oxygen sensor

Three、Sensor function and detection



(3) Oxygen sensor testing

Sensor interface profile						
Line No.	Line Color	Function Definition	Test parameters (ignition switch ON)			Resistance value
			Line state	Working state		
D	Gray&yellow	12V sensor heating power supply	12.0V	12.0V		2~4Ω
C	Pink&Green	Sensor heated position	3.6V	Duty cycle control		
A	Pink&Black	Unit pump	0.3V			640Ω
B	Pink&White	Unit pump	0.3V			
E	Signal	Sensor signal line	2.7V	2.5V Change 2.0-2.5V as a concentrated mixture ; 2.5-3V as a dilute mixture		
F	Pink&Black	Sensor signal ground line	2.5V			

(4) Oxygen sensor failure phenomena and causes :

General causes of failure : Damaged sensor, damaged sensor line, sensor poisoning

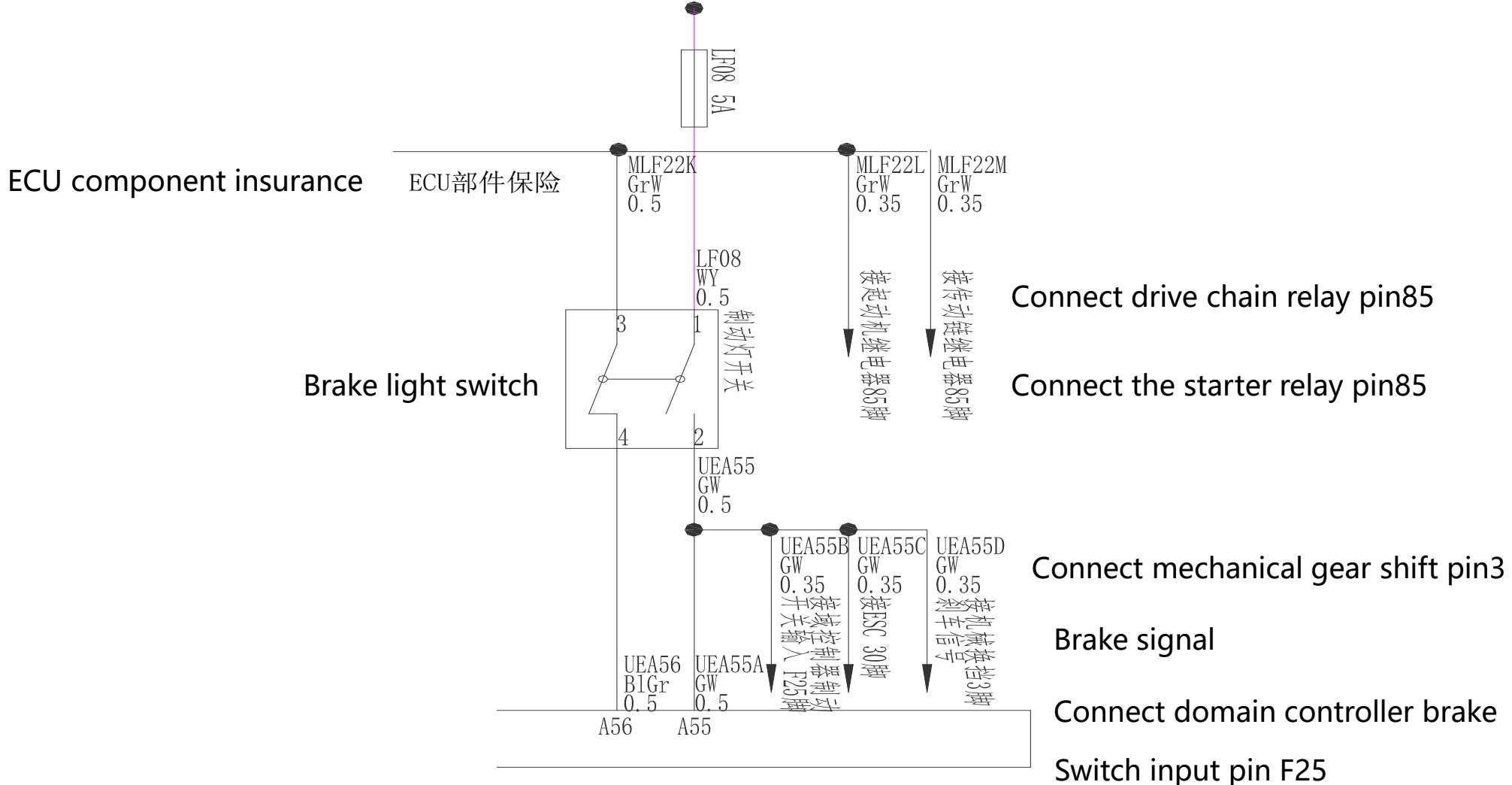
Failure phenomenon : Poor idle speed, poor acceleration, excessive exhaust fumes, excessive fuel consumption, etc.

Incorrect information, exact confirmation required for the vehicle

Three、Sensor function and detection



17. Vehicle brakes



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gine system
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analysis**

Four、Actuator function introduction



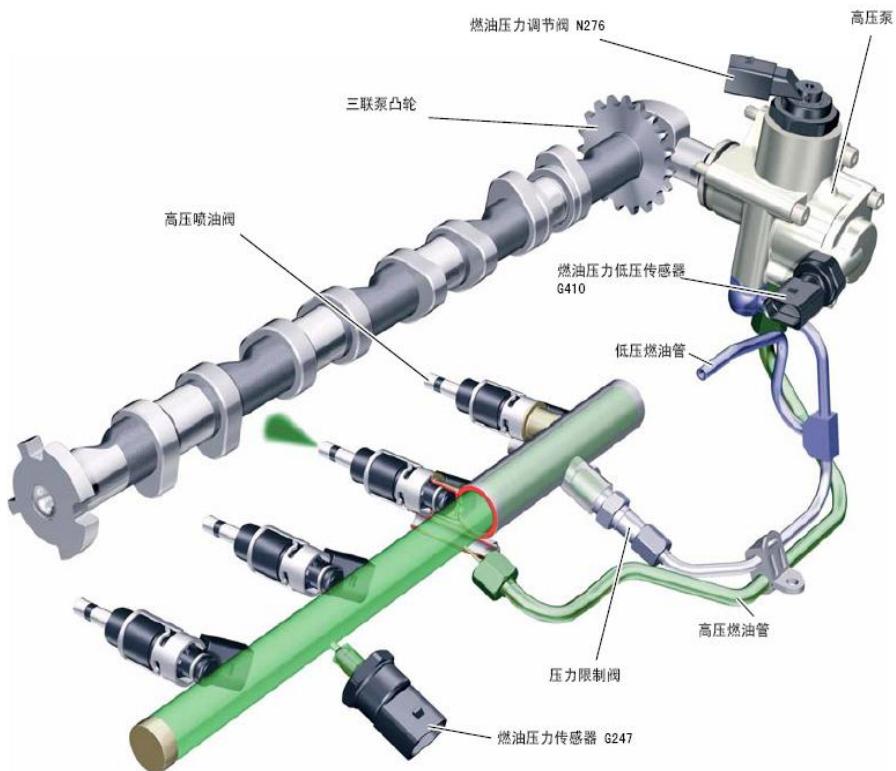
No.	Name	Function Description
1	Fuel Injector	Receive commands from the ECU and injects fuel into the intake branch at regular intervals to mix with air to form a combustible mixture.
2	High pressure oil pump control valve	Control the oil pressure output from the high pressure oil pump according to the ECU command.
3	Carbon can solenoid valve	Receive commands from the ECU to work and control the fuel tank purge airflow.
4	Carbon can shut-off valve	Turn the fuel tank ventilation on or off as instructed by the ECU.
5	Variable valve timing valve	Receive the command work from the ECU and introduce a certain pressure of oil into the VCP camshaft controller.
6	Pressure relief control valve	Work according to the command of ECU, control the supercharger unloading, pressurization working state
7	Ignition Control System	Receive commands from the ECU, the primary coil is energized to produce a magnetic field and the primary coil is de-energized. The secondary coil generates high voltage electricity.
8	Fuel pump control	Receive commands from the ECU to work to establish oil pressure for the operation of the fuel supply system
9	Air conditioning compressor control	Work according to the command of ECU to control the compressor working state
10	Engine start control	Control the starter relay operation according to ECU command.

Four、Actuator function introduction

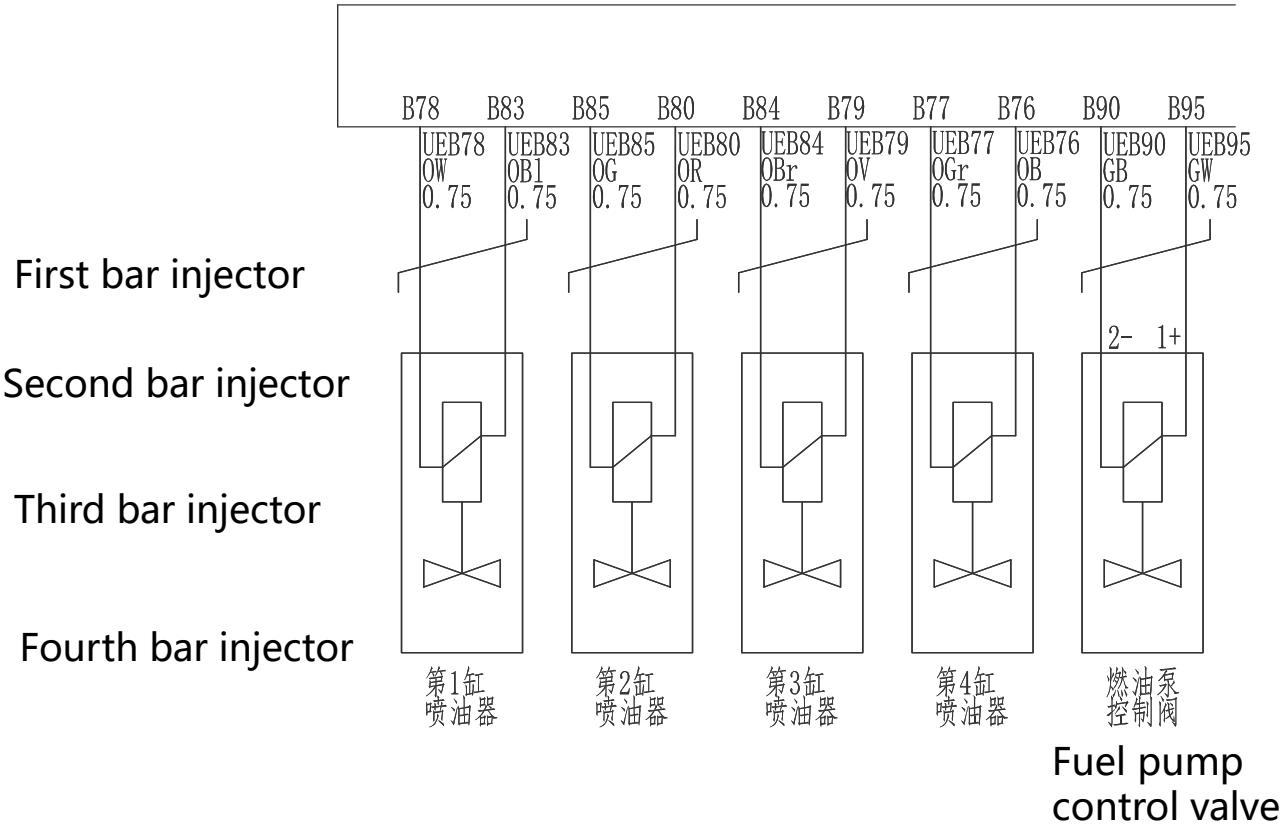


1. Fuel Injector

(1) Fuel Injector



(2) Injector control circuit



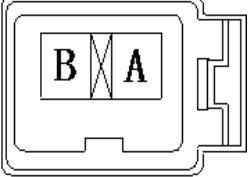
- Working temperature : -30 ~ 130°C;
- Oil supply pressure : 400KPa ~30000KPa

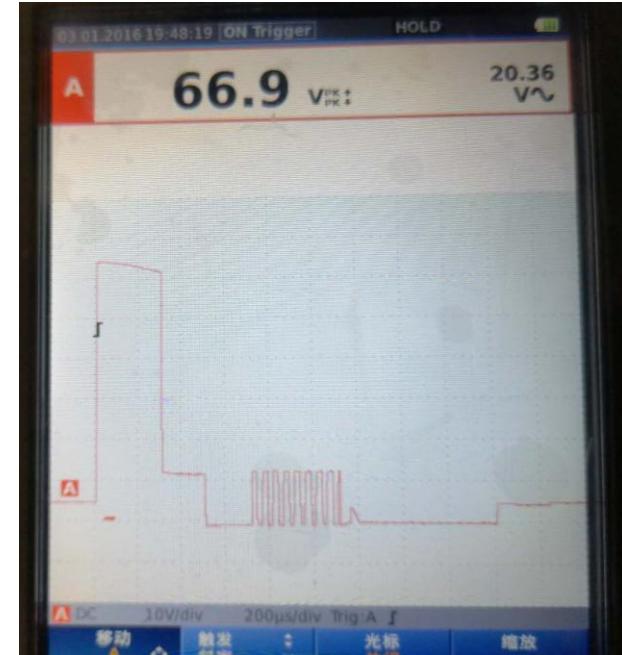
- Working temperature : -40 ~ 130 °C;
- Minimum working voltage : 6 V;
- Static coil resistance : $1.83 \pm 0.09 \Omega$ @ $23 \pm 5^\circ\text{C}$

Four、Actuator function introduction



(3) Injector control circuit testing

Fuel injector interface profile V					
Line No.	Line Color	Function Definition	Test parameters (Ignition switch ON)		
			Disconnected state	Connected state	Resistance value
A		Fuel injector power line	4.55V	4.55V	1.73-1.92Ω
B		Injector power control line	1.72V	4.55V	



(4) Injector control system failure phenomena and causes

Failure phenomenon : Bad idle speed, bad acceleration, can't start (difficult to start), etc.

General causes of failure : Damaged injector, damaged line, too much fuel gum and clogged injector, etc.

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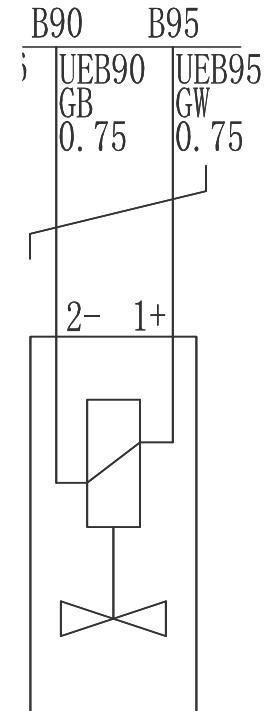


2. High pressure oil pump control valve

(1) High pressure oil pump control valve



(2) High pressure oil pump control valve circuit



燃油泵
控制阀

Fuel pump control valve

Four、Actuator function introduction



(3) High pressure oil pump control valve testing

Fuel injector interface profile		Wire harness color confirmed by the whole car					
Line No.	Line Color	Function Definition	Test parameters (Ignition switch ON)			Resistance value	
			Disconnected state	Connected state			
A	Green & White	Power supply	4.55V	4.55V		0.495-0.545Ω	
B	Green & Black	Power control line	1.72V	4.55V			

(4) High pressure oil pump control system failure phenomenon and causes

Failure phenomenon : Cannot be started (difficult to start), etc.

General causes of failure : Damaged oil pump, damaged wiring, too much fuel gum and clogged intake valve bonding, etc.

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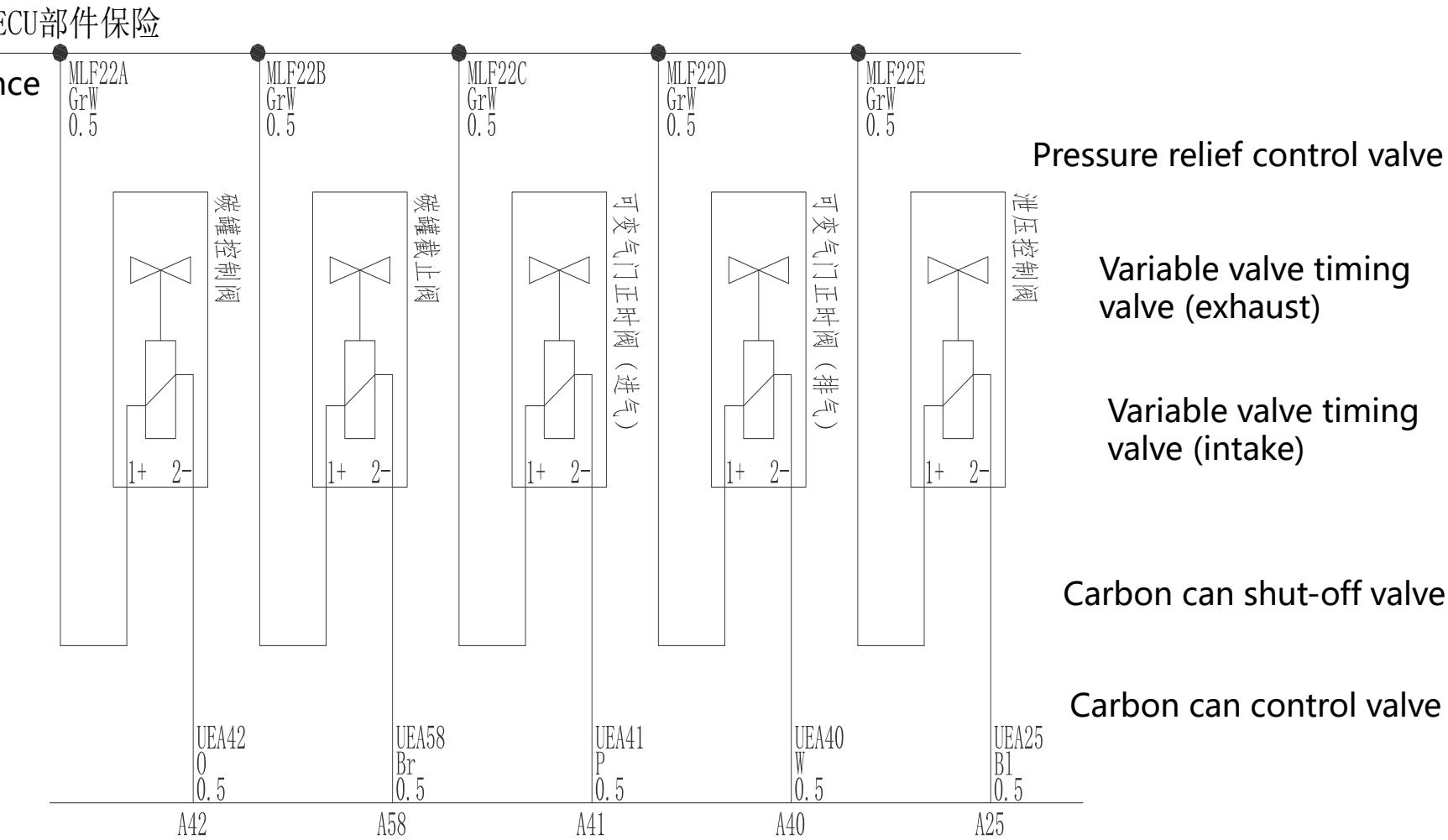


3. Carbon can solenoid valve control

(1) Carbon can solenoid valve



(2) Carbon can solenoid valve control circuit



Four、Actuator function introduction



(3) Carbon can solenoid valve control circuit testing

Carbon can solenoid valve interface profile					
Line No.	Line Color	Function Definition	Test parameters (Ignition switch ON)		
			Line state	Working state	Resistance value
A (/)	Gray (/)	Carbon can solenoid valve power line	12V (/)	12V (/)	19-22Ω (/)
B (/)	Orange (/)	Carbon can solenoid valve power control line	3.5V (/)	0-12Pulse (/)	

Two pins, one positive and one negative. No separation of polarity

(4) Carbon can solenoid valve control failure phenomena and causes:

Failure phenomenon : Carbon can control valve performance failure, unstable idle speed, abnormal emissions, etc.

General causes of failure : Damaged carbon can control valve, damaged carbon can control valve line, activated carbon pellet failure.

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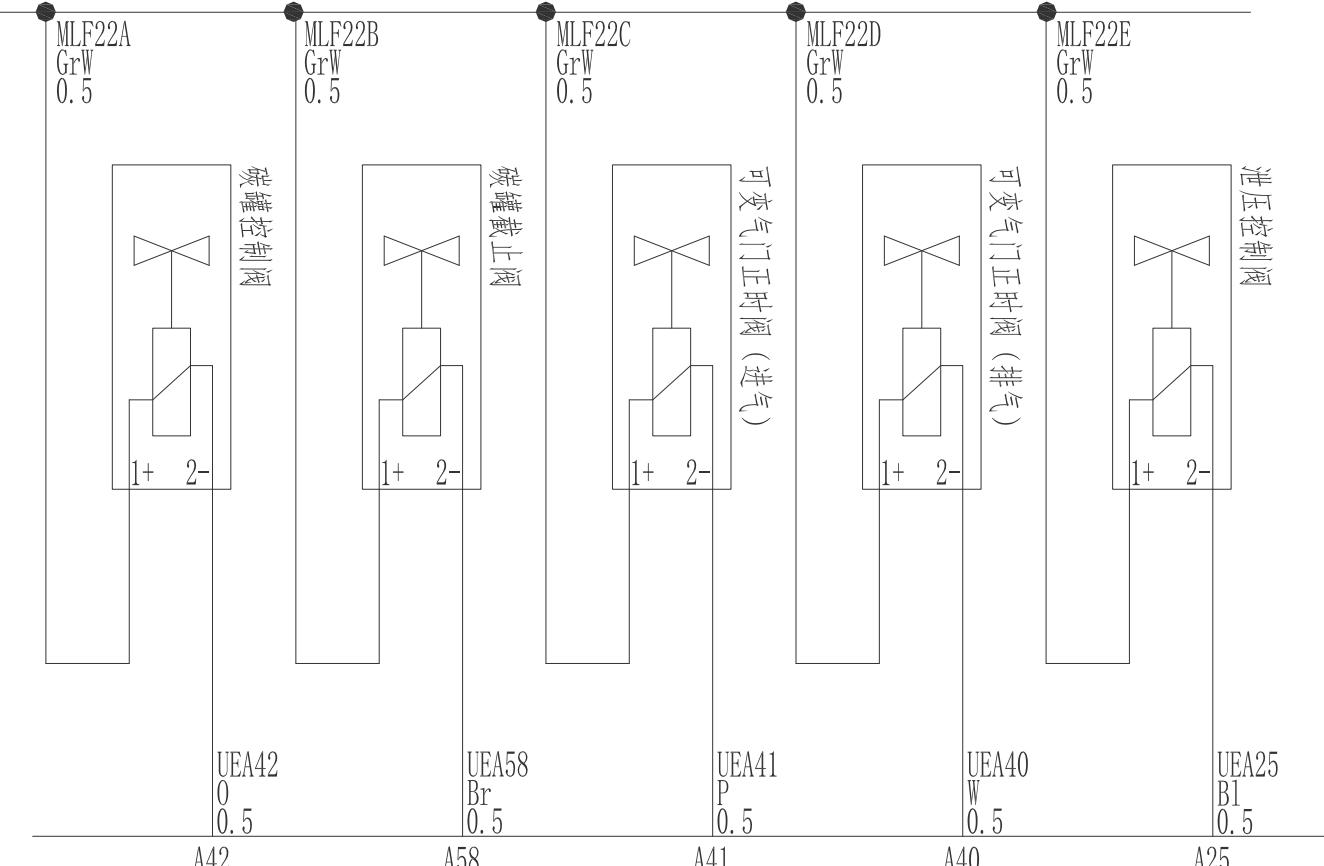
4. Carbon can shut-off valve

(1) Carbon can shut-off valve profile



(2) Carbon can shut-off valve control circuit

ECU component insurance
ECU部件保险



Four、Actuator function introduction



(3) Carbon can shut-off valve testing

Carbon can through-air solenoid valve					
Serial No.	Terminal Function	Line color	Ignition switch ON gear voltage to ground		Note
			Disconnect plug voltage (V)	Plugged in voltage (V)	
1	Power supply for solenoid valve	Gray	12.61	12.61	22Ω (Resistance at 20°C)
2	Sensor signal line	Brown	3.23	12.51	

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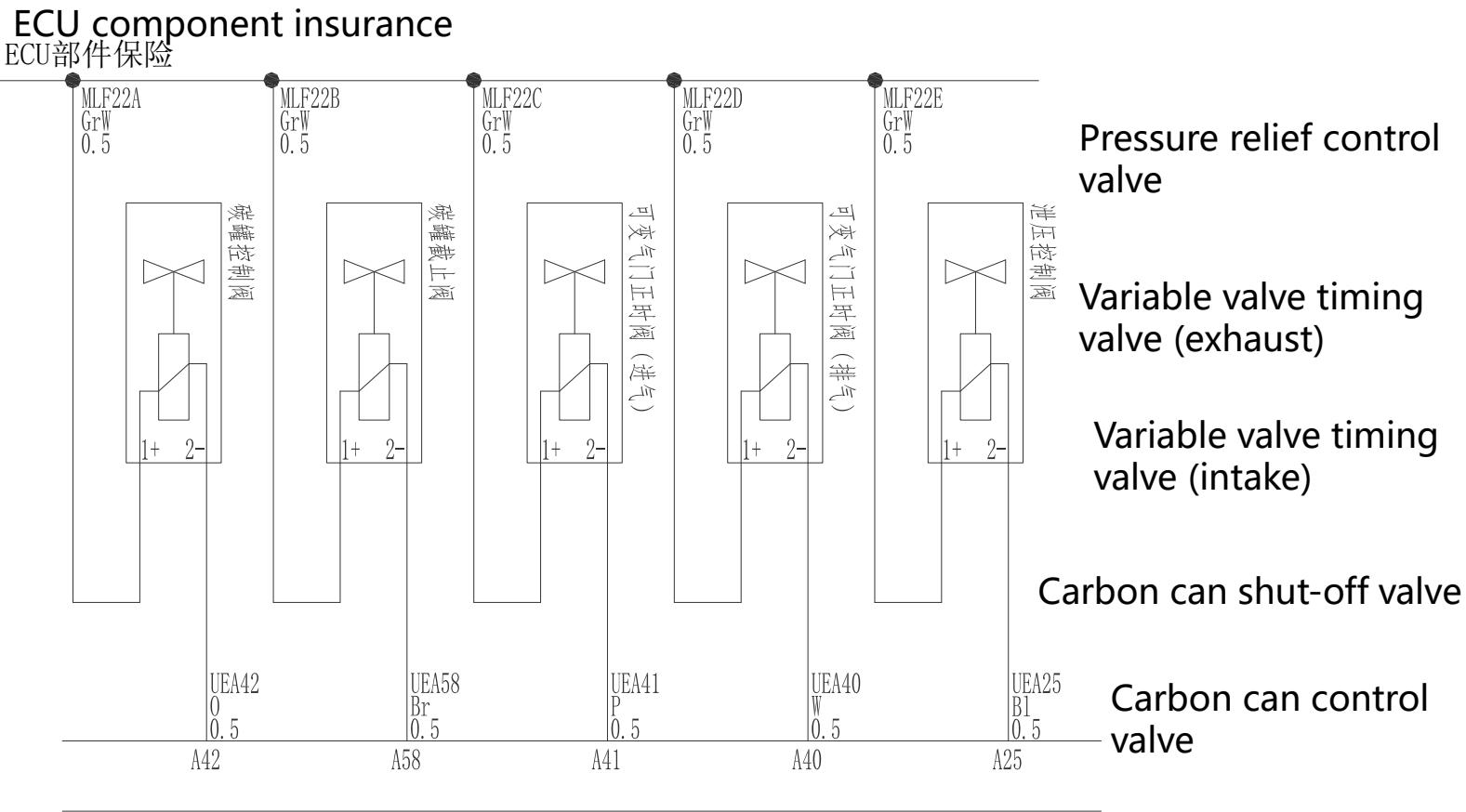


5. Variable valve timing valve control circuit

(1) Variable valve timing valve



(2) Variable valve timing valve control circuit



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(3) Variable valve timing valve control circuit testing

VFS valve interface profile					
Line No.	Line Color	Function Definition	Test parameters		
			Line state	Working state	Resistance value
A(/)	Gray(/)	Variable valve timing valve power line	12V(/)	0~12VChanges(/)	7.0±0.5Ω(/)
B(/)	Pink&, white(/)	Variable valve timing valve coil power control line	3.5V	Two pins, one positive and one negative. No separation of polarity	

(4) Variable valve timing valve failure phenomena and causes

Failure phenomenon : VFS solenoid valve assembly performance failure, unstable idle speed, poor acceleration, etc.

General causes of failure : Damaged VFS solenoid valve assembly, damaged control circuit, and clogged lubricant.

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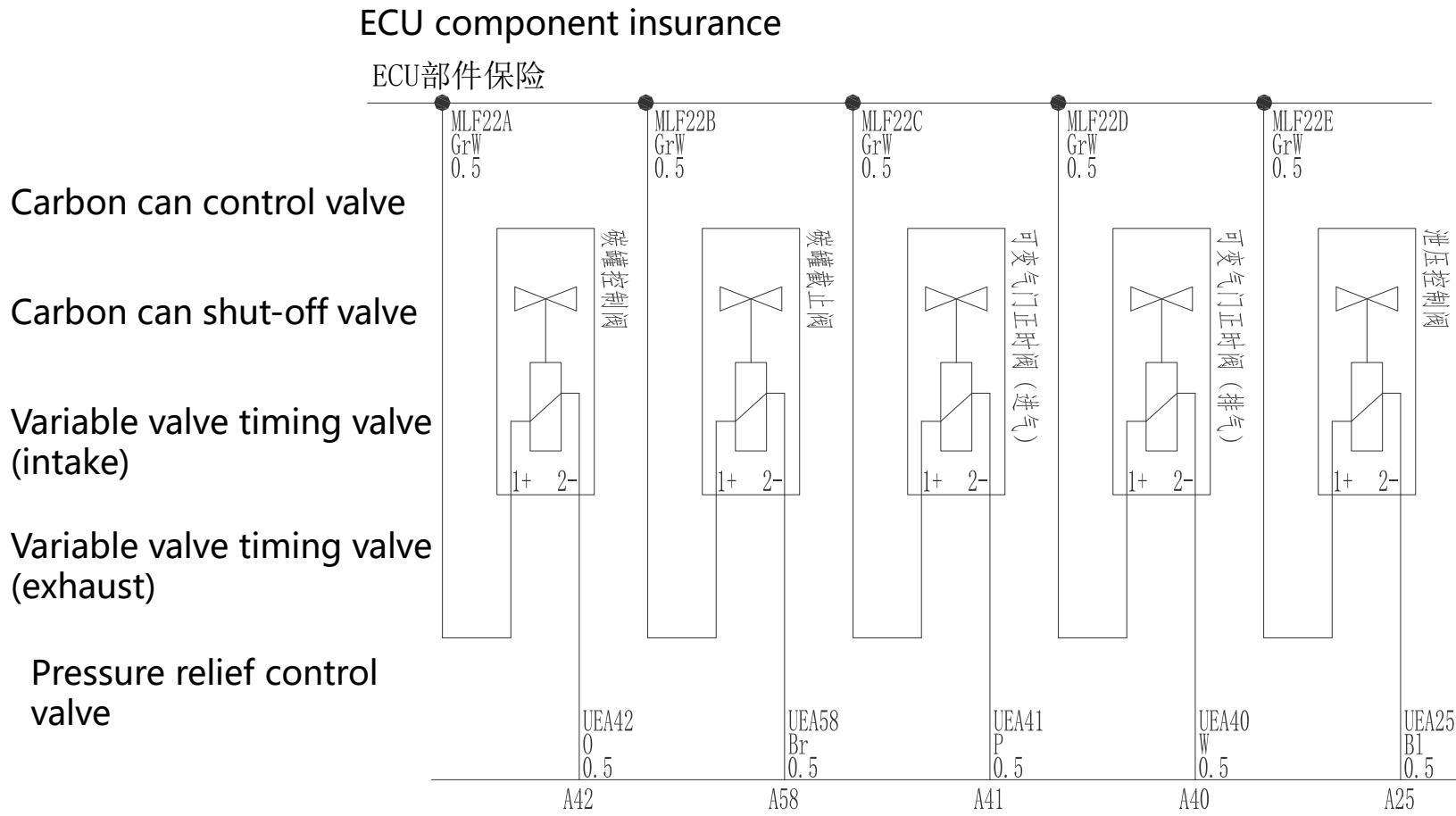


6. Pressure relief control valve

(1) Pressure relief control valve profile



(2) Pressure relief control valve control circuit



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(3) Pressure relief control valve control circuit testing

Pressure relief control valve interface profile					
Line No.	Line Color	Function Definition	Test parameters		
			Disconnected line measurement	Idle speed online measurement	Resistance value
1	Gray	Pressure relief control valve power line	Battery voltage	14.5~12V; 0V when accelerating and decelerating pedal sharply	$14.3 \pm 0.5\Omega$
2	Blue	Pressure relief control valve coil power control line	2.5V		

(4) Pressure relief control valve failure phenomena and causes

Failure phenomenon : Pressure relief control valve performance failure, unstable idle speed, poor acceleration, lack of power, etc.

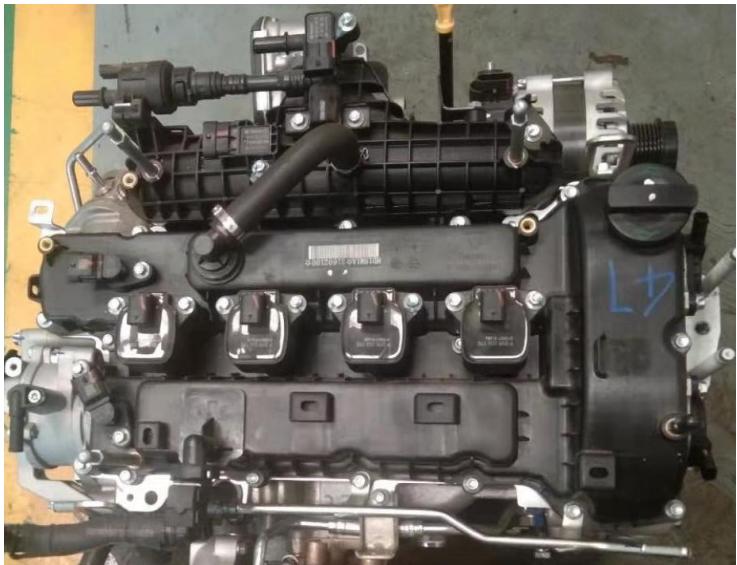
Cause of failure : Damaged pressure relief control valve assembly, damaged control line, stuck control valve.

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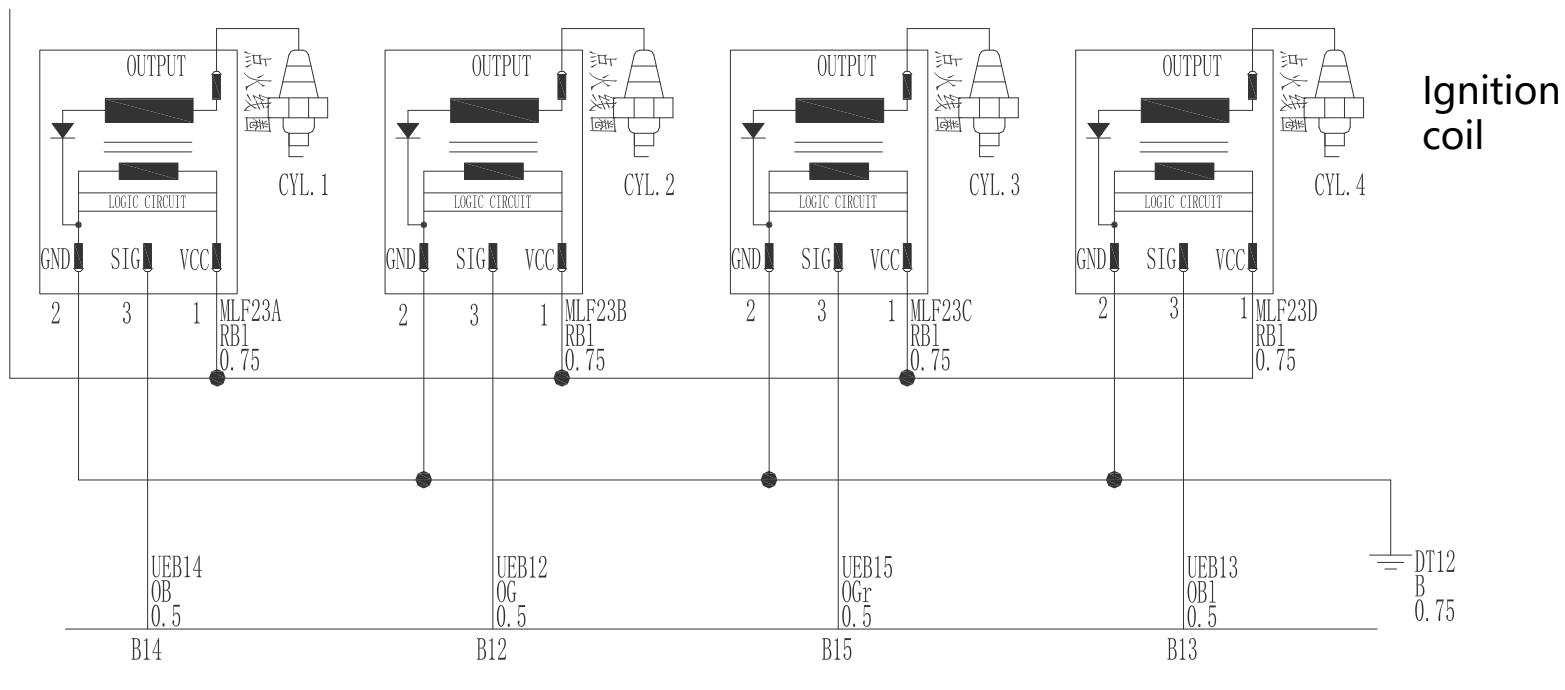


7. Ignition control circuit

(1) Ignition control system



(2) Ignition control system circuit



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(3) Ignition control system circuit testing

Ignition coil interface profile	Vehicle definition	Harness end	Ignition coil end		
Line No.	Line Color	Function Definition	Test parameters		
			Line state	Working state	Resistance value
A	Red & Blue	Ignition coil power line	14V	0~14VChange	520mΩ× (1±8%)
C	Orange & Black	Ignition coil power control line	2.5-5.5V		
B	Black	Grounding line		Secondary winding	3.8KΩ× (1±8%)
High voltage jack		High voltage jack			

(4) Ignition control system failure phenomenon

Failure phenomenon : Ignition coil burned out, no high voltage, can not start the car. Ignition coil local short circuit, so that the engine shaking, misfire, etc.

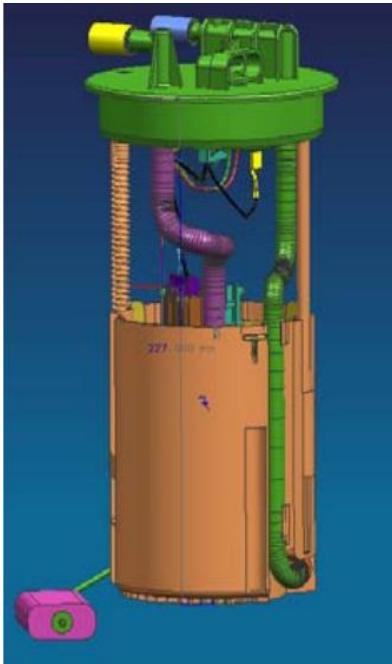
General causes of failure : Ignition coil burned out, ignition coil control circuit damaged.

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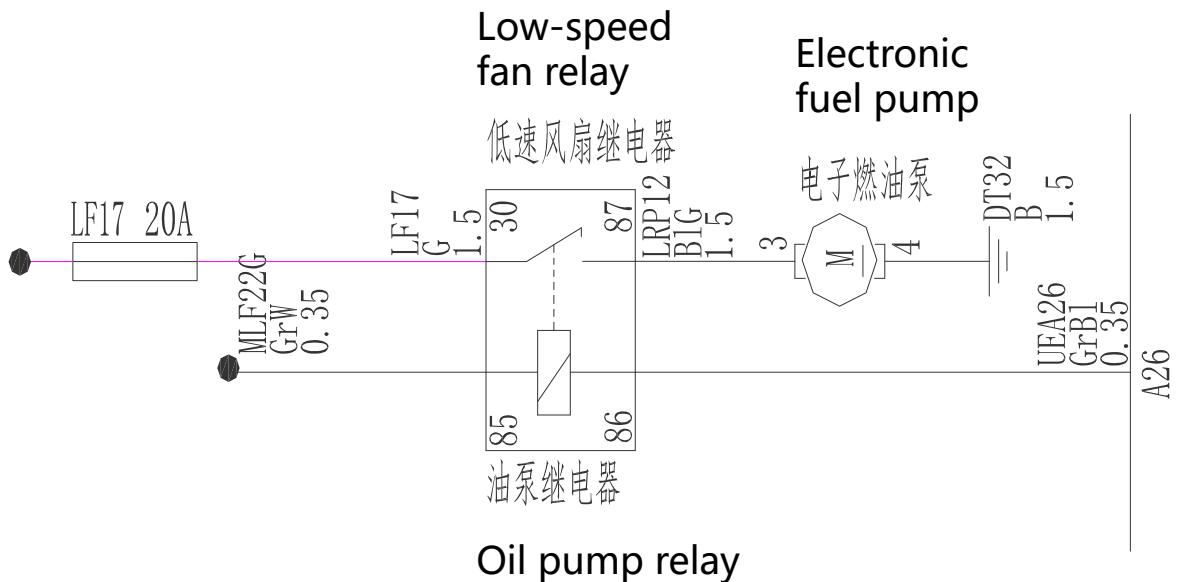


8. Fuel pump control

(1) Fuel Pump



(2) Fuel pump control circuit



(3) Fuel pump control system failure phenomenon

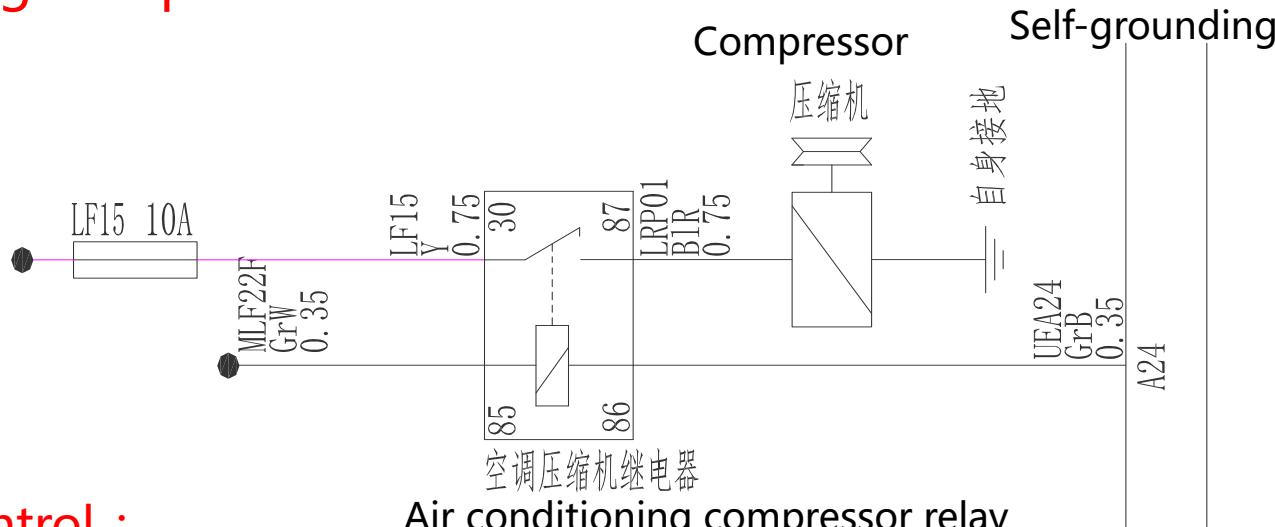
Failure phenomenon : Bad acceleration, can't start (difficult to start), unstable oil pressure, strange noise of oil pump, etc.

General causes of failure : Damaged fuel pump, damaged fuel pump line, excessive fuel impurities, motor shaft clamping.

Four、Actuator function introduction



9. Air conditioning compressor control



Cooling water fan control :

- The engine ECU collects the signal from the water temperature sensor to control the cooling fan relay , When the water temperature reaches 92.5°C the ECU controls the power control wire of the fan relay to ground, the cooling fan relay attracts the cooling fan operation, and the fan stops rotating when the engine water temperature drops to 86.5°C.
- When the water temperature sensor fails, to prevent the engine water temperature is too high cooling fan often turn.

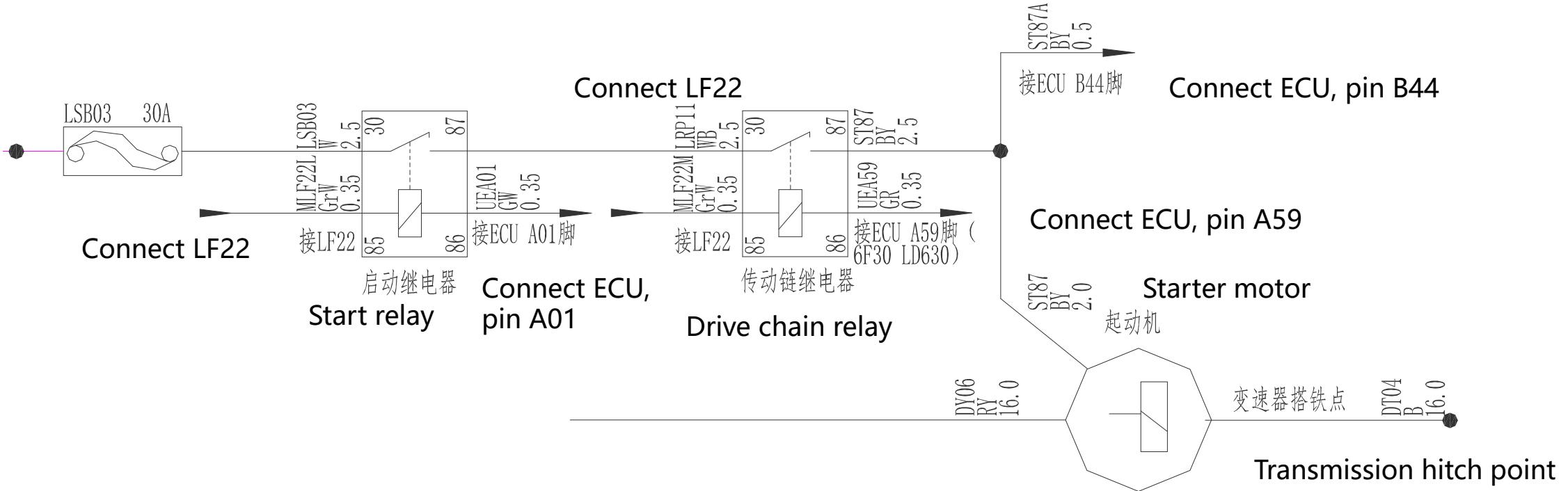
Air conditioning relay and condenser relay control :

The engine ECU receives the CAN request signal from the automatic air conditioning ECU to control the air conditioning relay and the condensing fan relay.

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10. Engine start control



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Five、HD15M1A engine system failure analysis



Engine does not start or has difficulty starting

Cause of failure	Exclusion methods
<p>1. Starter system failure, battery voltage is insufficient battery connection is poor, fuse is broken</p> <p>Starter failure Ignition switch failure</p>	<p>Charging Clean the terminals, tighten the battery line to replace the fuse Repair or replace the starter Repair or replace the ignition switch</p>
<p>2. Ignition system failure point</p> <p>Fire coil harness loose cylinder sequence is not correct</p> <p>Damaged ignition coil</p> <p>Loose crankshaft position sensor harness</p> <p>Magnetic degradation or damage of the crankshaft position sensor, crankshaft position sensor adsorbs foreign objects</p> <p>Improper spark plug electrode clearance</p> <p>Spark plug moisture or electrode on the accumulation of carbon spark plug insulator rupture</p> <p>Loose electronic controller connector</p> <p>Damaged electronic controller</p>	<p>Plug in the wire harness Replace the ignition coil by connecting the coil to the spark plug according to the coil tip Plug in the wire harness Replace crankshaft position sensor clean sensor Replace spark plug Drying or removing carbon, replace spark plugs Plug in the wire harness Replace electronic controller</p>

Five、HD15M1A engine system failure analysis



Cause of failure	Exclusion methods
3. Oil supply system failure	
Low fuel tank level	Add fuel
Oil inlet tube leakage	Replace the oil inlet tube
Insufficient fuel supply from electric fuel pump	Repair or replace electric fuel pump
Damaged gasoline pump relay	Replace gasoline pump relay
Damaged oil pressure regulator	Replace oil pressure regulator
Damaged or blocked fuel injector	Replace or clean fuel injector
Damaged electronic controller	Replace electronic controller
Insufficient fuel supply to the high-pressure fuel pump	Repair or replace high pressure fuel pump
Clogged gasoline line or air resistance	Clean piping or remove air resistance
Gasoline specifications do not match	Select gasoline according to this manual
4. Idle speed control system failure	
Throttle harness disconnected	Plug in the wire harness
Throttle volume carbon	Clean the throttle body
Electronic controller often supply power interruption	Repair of wire harnesses
Electronic controller failure	Replace electronic controller

Five、HD15M1A engine system failure analysis



Cause of failure	Exclusion methods
5. Intake/exhaust system failure	
Clogged air filter	Clean the air intake and replace the filter
Clogged three-dimensional catalytic converter	
1、Broken catalytic converter	Replace the three-dimensional catalytic converter
2、Burning foreign body blockage	Repair engine, replace the three-dimensional catalytic converter
3、Intake manifold air leakage	Check intake manifold and liner and tighten nut
6. Poor condition of gasoline engine	
Leaky or burnt valves	Repair or replace valve
Damaged cylinder gasket	replace
Piston, piston ring and cylinder block assembly wear	Repair or replace

Five、HD15M1A engine system failure analysis



Gasoline engine can not accelerate or weak acceleration

Cause of failure	Exclusion methods
1. Ignition system failure spark plugs work poorly , ignition coil damage	Check or replace the spark plug, replace the ignition coil
2. Oil supply system failure Clogged injector	Clean the relevant oil circuit or replace the faulty injector, replace the throttle
Damaged throttle position sensor	
Damaged turbocharger electric controller	Replace turbocharger
2. Intake/exhaust system failure	
Poor air intake system	Clean the air intake and replace the air filter
Intake manifold air leakage	Check intake manifold and liner and tighten nut
Booster air intake pressure and temperature sensor hole blockage	Clean the boost intake pressure and temperature sensor probe hole, Replace if necessary
Boost intake pressure temperature sensor damaged	Replace the boost intake pressure and temperature sensor
Poor exhaust system	Inspection of exhaust system and three-dimensional catalytic converter
3. Gasoline engine failure valve leakage or burnt cylinder gasket leakage	Repair or replace the valve, replace the cylinder gasket

Five、HD15M1A engine system failure analysis



Gasoline engine powerless

Cause of failure	Exclusion methods
1. Ignition system failure , ignition coil damage , spark plug work poor	Replace ignition coil, clean, adjust or replace spark plug
2. Oil supply system failure	
Damaged or clogged injector	Clean or replace fuel injector
Damaged throttle position sensor	Replace throttle
Damaged turbocharger electric controller	Replace turbocharger
Insufficient fuel supply pressure of electric fuel pump	Repair or replace electric fuel pump
Dirt buildup in the gasoline tank	Clean oil tank, replace if necessary
Clogged gasoline line	Clean gasoline line
Air in the fuel system	Check and tighten the connections
3. Intake/exhaust system	
Poor air intake system	Clean the air intake and replace the air filter
Intake manifold air leakage	Check intake manifold and liner and tighten nut
Booster air intake pressure and temperature sensor hole blockage	Clean the booster intake pressure and temperature sensor probe hole and replace if necessary
Boost intake pressure temperature sensor damaged	Replace the boost intake pressure and temperature sensor
Poor exhaust system	Inspection of exhaust system and three-dimensional catalytic converter

Five、HD15M1A engine system failure analysis



4. Gasoline engine failure	
Valve Leakage	Grinding valve
Insufficient or broken valve spring	Replace valve spring
Cylinder gasket leakage	Replace cylinder gasket
Piston ring sticks or breaks	Replace piston ring
Piston or cylinder block assembly, excessive cylinder bore wear	Repair or replacement of relevant parts
5. Gasoline specifications do not match	According to the provisions of this manual to choose gasoline see this chapter nine content
6. Gasoline engine overheating	

Five、HD15M1A engine system failure analysis



Gasoline engine backfire, discharge, deflagration

Cause of failure	Exclusion methods
1. Ignition system failure , ignition system line loose , spark plug work poor, spark plug thermal value improper	Check and tighten the joints Clean, adjust or replace the spark plug with a spark plug of proper thermal value
2. Improper gas mixture composition Poor gasoline supply Intake manifold air leakage	See this chapter III-3 Tighten the nut or replace the gasket
3. Valve mechanism failure, valve leakage or sticking valve spring elasticity is insufficient	Grind or replace valves, replace valve springs
4. Cylinder head condition bad combustion chamber carbon accumulation Cylinder head assembly overheating, poor cooling Damaged cylinder head assembly	Carbon removal Exhaust the air from the cooling water jacket to replace the cylinder head assembly
5. Gas distribution phase Crankshaft timing sprocket timing marks not aligned Intake and exhaust VCP parts timing marks not aligned VVT plugging error	Adjust the timing chain so that the three blue links on the chain correspond to the arrows on the intake and exhaust camshaft sprockets and the dot mark on the crankshaft timing sprocket, respectively. Check the harness plug
6.Improper Ignition Timing	Adjusting Ignition Timing

Five、HD15M1A engine system failure analysis



Abnormal idle speed of gasoline engine

Cause of failure	Exclusion methods
High idle speed	
Damaged throttle sensor	Replace electronic throttle
Air intake system leakage	Check and repair the air intake system
Damaged water temperature sensor	Replace the water temperature sensor
Low idle speed	
Throttle harness disconnected	Plugging the harness firmly
Throttle volume carbon	Clean of throttle body
Low fuel tank level	Add fuel
Clogged fuel filter	Replace fuel filter
Oil inlet pipe leakage	Replace the oil inlet tube
Clogged three-dimensional catalytic converter	Replace catalytic converter, repair engine if necessary
Whether the air intake system is clogged	Clean the air intake and replace the filter
Damaged oil pressure regulator	Replace oil pressure regulator
Low pressure fuel pump pressure is not enough	Replace fuel pump
Electronic controller failure	Replace electronic controller
Unstable idle speed	
Poor spark plug lead connection	Reconnect
Inconsistent spark plug gap	All adjusted to 0.7 mm ~ 0.8 mm
Oil pressure regulator vacuum tube dislodged or damaged	Inspection or replacement of vacuum tubes
Individual injector blockage	Clean or replace defective injectors

Five、HD15M1A engine system failure analysis



Gasoline engine with internal noise

Cause of failure	Exclusion methods
1. Loose piston pin	Replace piston pin
2. Piston, piston ring and cylinder block assembly wear	Inspection and repair, replacement
3. Wear of the connecting rod tile	Replace the connecting rod shaft bearing
4. Wear of main shaft tile	Replace the main shaft tile
5. Wear of crankshaft thrust piece	Replace crankshaft thrust piece
6. Camshaft assembly thrust clearance is too large	Replace camshaft assembly

Excessive gasoline consumption

Cause of failure	Exclusion methods
1. Gasoline line leakage	Tighten all joints and clamps
2. Clogged air filter	Check and clean the air filter
3. Ignition coil failure	Ignition coil replacement
4. Spark plug failure	Check or replace spark plugs
5. Poor compression of gasoline engine	See 1 of this chapter III
6. Improper tire pressure	Adjust tire inflation pressure
7. VVT Follows badly	Change VVT
8. Oxygen sensor failure	Replace oxygen sensor

Five、HD15M1A engine system failure analysis



Abnormal fuel evaporation emission

Cause of failure	Exclusion methods
1. Rupture of carbon can connecting pipe	Replacement of connecting pipe
2. Damaged carbon can	Replacement of carbon can
3. Carbon can solenoid valve harness failure	Repair of wire harnesses
4. Damaged carbon can solenoid valve	Replace carbon can solenoid valve
5. Double one-way valve failure	Replace double one-way valve

Gasoline engine overheating

Cause of failure	Exclusion methods
1. Insufficient cooling water	Adding cooling water
2. Water pump belt is loose or damaged	Adjust the belt tension or replace the belt
3. Water pump failure	Repair or replace the water pump
4. Thermostat failure	Replace thermostat
5. Clogged or leaking radiator, cylinder block water jacket, cylinder head water jacket and piping	Clean, repair or replace relevant parts
6. Excessive carbon buildup in the combustion chamber of the cylinder head assembly	Remove carbon deposit
7. Too little oil or too low viscosity	Add or change oil
8. Gas in the water circuit	Ventilation

Five、HD15M1A engine system failure analysis



Excessive oil consumption

Cause of failure	Exclusion methods
1. Oil leakage	
Loose oil pan drain screw plug	Tighten the oil drain plug
Loose oil pan fixing bolt	Tighten the fixing bolt
Uneven glue application on the oil pan	Re-gluing
Damage to oil pump gasket	Replace oil pump gasket
Damaged front and rear crankshaft oil seals	Oil seal replacement
Oil pressure alarm loose	Tighten the oil pressure alarm
2. Excessive wear or damage to the piston ring	Replace piston ring
3. Piston and cylinder block assembly wear	Replace piston or bore
4. Wrong position of piston ring opening	Adjust piston ring opening position
5. Damaged valve oil seal	Replace valve oil seal
6. Severe wear on throttle stems or throttle guide	Replace throttle or throttle guide
7. Clogged crankcase ventilator	inspection, cleaning, de-clogging
8. PCV valve failure	
PCV valve blockage	Replace PCV valve
PCV valve normally open	Replace PCV valve

Five、HD15M1A engine system failure analysis



Oil pressure too low

Cause of failure	Exclusion methods
1. Oil leakage	See VIII 1 of this chapter
2. Oil is too little or too thin	Add or change oil
3. High oil temperature	Cooling of gasoline engines, inspection of cooling systems
4. Oil pump pressure reducing valve failure	Inspection and repair of pressure reducing valves
5. Oil pump failure	Repair or replace the oil pump
6. Filter collector clogged, oil pan leaking	Clean and unclog, tighten the oil pan bolts
7. Oil pressure alarm malfunction	Replace the oil pressure alarm
8. Excessive wear of main shaft and connecting rod shaft	Replace the corresponding shaft shank
9. Oil filter clogged	Change oil filter
10. Piston cooling nozzle damage	Replace piston cooling nozzle

Five、HD15M1A engine system failure analysis



Cause of failure	Exclusion methods
1. Leaded gasoline was used, causing damage to oxygen sensors and three-way catalytic converters	Use unleaded gasoline, replace oxygen sensors and three-way catalytic converters
2. Ignition system failure caused by lack of fire and long-term use, the oxygen sensor and three-way catalytic converter damage	Repair the ignition system, replace the oxygen sensor and three-way catalytic converter
3. The exhaust system is leaking and the electronic controller is not getting the correct signal from the oxygen sensor, causing the air-fuel ratio to become thicker	Inspection of exhaust system

VVT does not work

Cause of failure	Exclusion methods
1. insufficient oil pressure	check the oil dipstick, whether the amount of lubricant meets the requirements, add lubricant when insufficient; check the oil pump pressure relief valve and the oil outlet seal, replace when needed
2. clogged lubricating oil circuit	check whether the lubricating oil path is smooth; check whether the central control valve screen is blocked, clean with kerosene and blow clean to install or replace the screen to install
3. broken circuit or short circuit	check the circuit and replace damaged components
4. VCP Failure	VCP replacement



TANHKS

