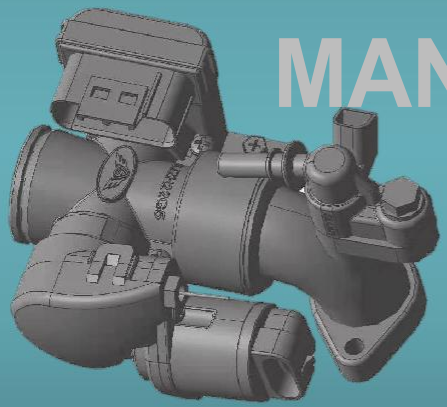
SACIN
三鑫摩托

E5 EFI WORKSHOP MANUAL



SKyTEAM

BRIEF INTRODUCTION

1. This workshop manual is only for SKYTEAM E5 SKYMAX/SKYMINI/SKYBONGO/T-REX series.
2. Since E5 required, our company has started to use this new highly-performed and highly-integrated EFI system, which is easy to mount and get repaired; compared to our old E4 EFI system, this new EFI has been much improved and upgraded.

① ECU--changed from the previous split plug-in unit to the combined water-proof unit, with the advantages of good look, easy disassembly and convenient repair, also this new ECU can avoid the problems like water inlet, poor touch of the plug-in unit, etc..

② FUEL PUMP—changed from external type to internal, and can avoid the problems like poor fuel supply because of air lock, leaking, short circuit of motor cable, etc..

③ FUEL INJECTOR—changed to Keihin, with smaller size and plug-in unit, same for 50cc and 125cc.

④ LAMBDA SENSOR—changed from M14 to M12 thread, with smaller size and higher universality.

⑤ IGNITION COIL—with features like smaller size, higher ignition energy, unnecessary ground touch etc..

⑥ IDLE STEPPING MOTOR—with additional idle speed motor, so the idle speed can be better controlled and also have wider adjusting scope.

INDEX

A. BASIC PRINCIPLE OF EFI

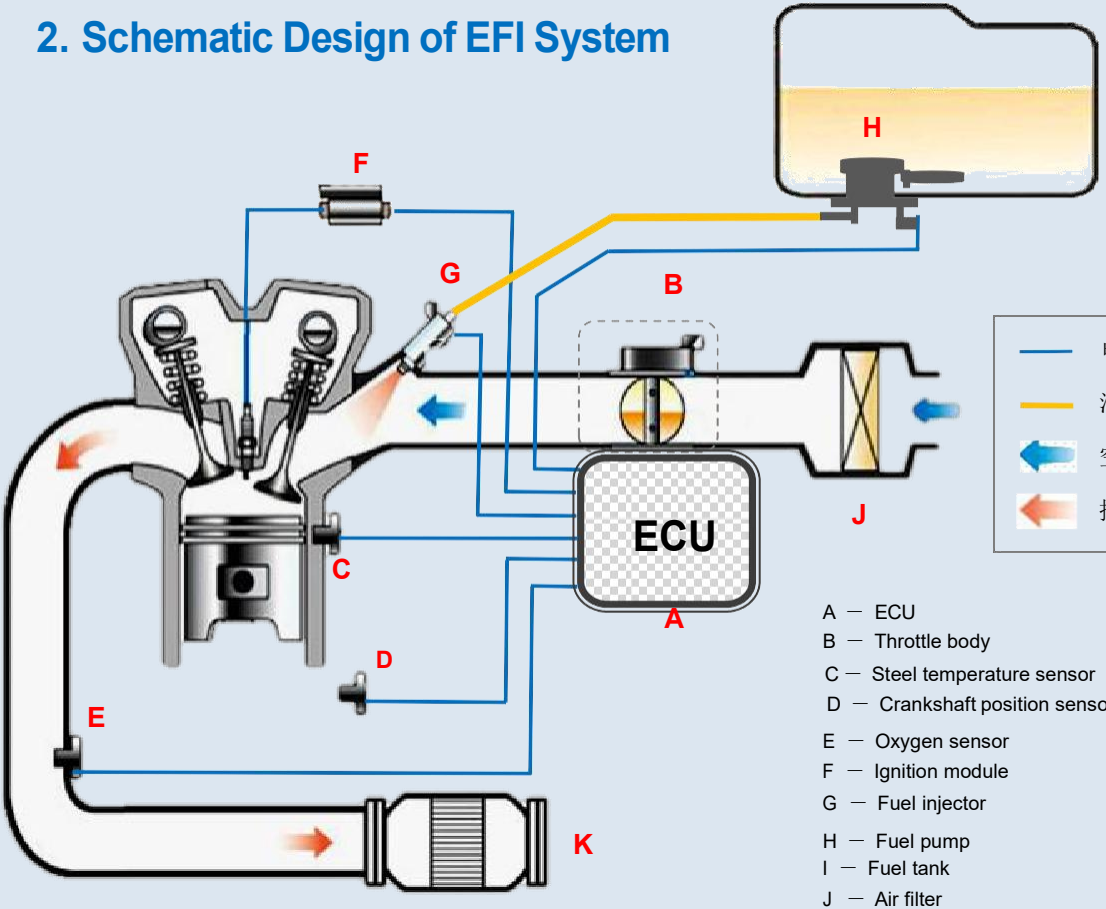
1. General Information of the System

Fuel injection system, with a electronic control module (called computer or ECU) as control center, making the use of different sensors on different position of the engine, measures all the working parameter of the engine; and according to the control program set in the ECU, precisely controls the injecting volumn and ignition advanced angle through controlling the injection, consequently, the engine can get the most suitable mixture air under all kinds of conditions then work with the best performance.

This system is using the closed-loop fuel control system. And the so called “closed-loop fuel control” means the oxygen sensor assembled on the emission system, measures the change of oxygen volume in emission through the sensor, and also the air-fuel ratio of then engine, then revise and compensate the engine actual fuel supply according to the feedback of the sensor signal.

The purpose of closed-loop is to make sure the engine can supply the ideal air-fuel ratio to control the fuel supply system under most conditions.

2. Schematic Design of EFI System

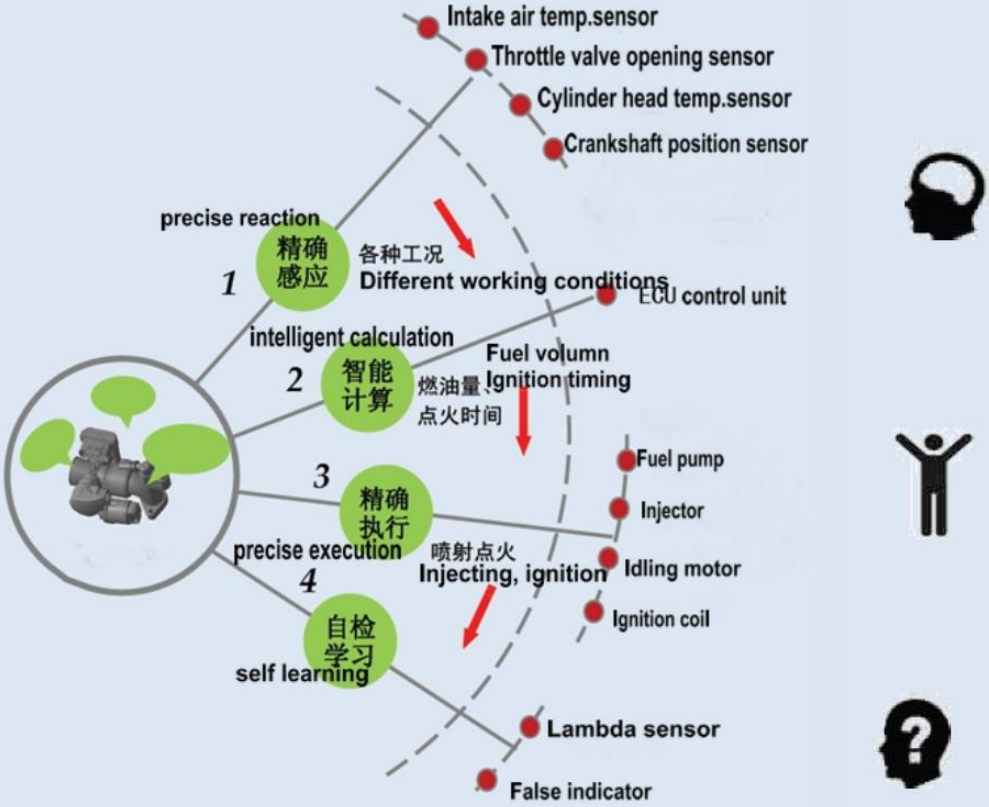


电路	circuit
油路	Oil way
空气	Air
排气	exhaust

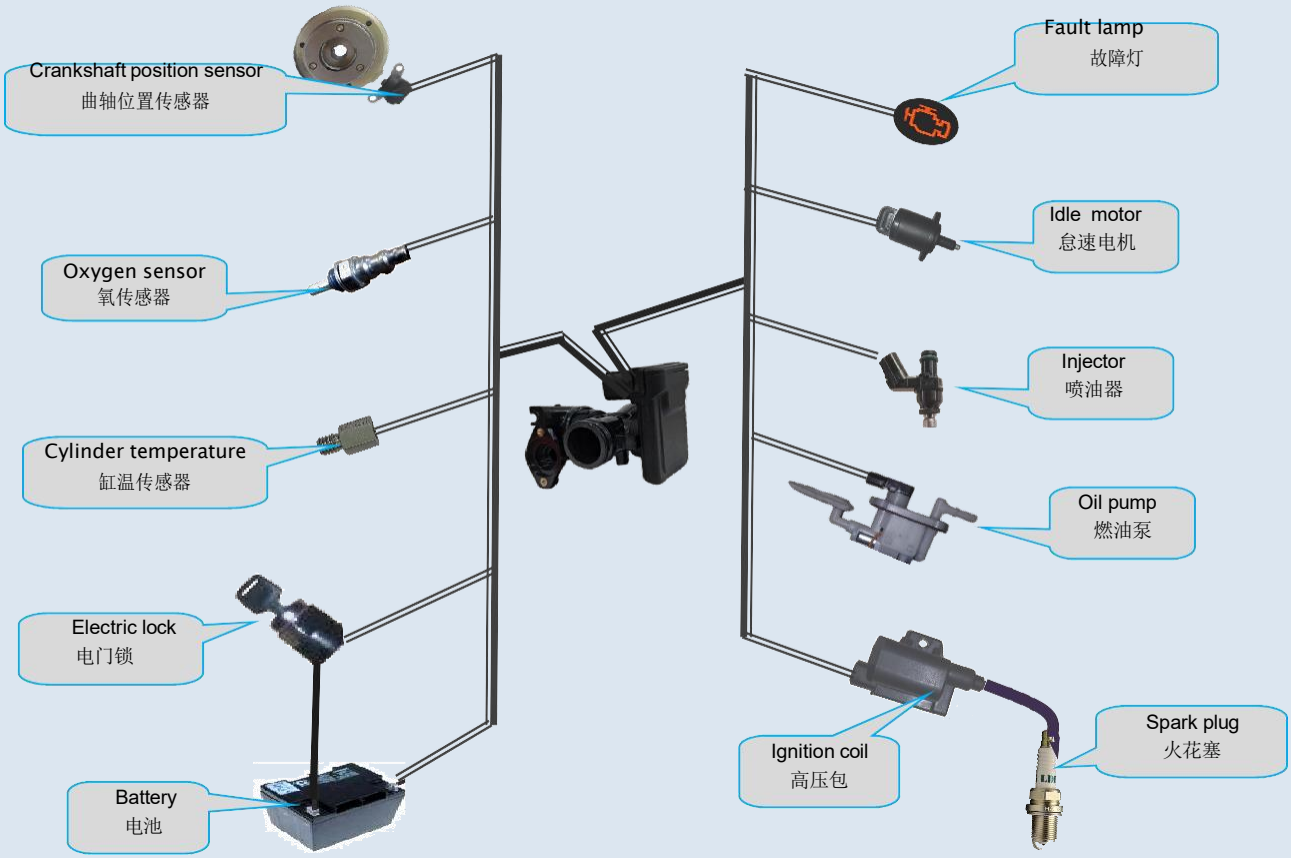
A — ECU
B — Throttle body
C — Steel temperature sensor
D — Crankshaft position sensor
E — Oxygen sensor
F — Ignition module
G — Fuel injector
H — Fuel pump
I — Fuel tank
J — Air filter
K — Three-way catalytic converter

3. Basic Principle of EFI

Five organs on face + skin
Sensos are just like the five organs on face and skin of human, which can feel the temp. and the engine running condition.



4. Basic Structure of EFI System



4.1 EFI system is composed of three main parts,

① Controller: ECU

② Sensors: Intake Air temp. Sensor, Cylinder Head Temperature Sensor, Throttle Valve Opening Sensor, Oxygen Sensor, Crankshaft Position Sensor

③ Actuator: Fuel pump, injector, idling stepping motor, ignition coil

4.2 The function of EFI components:

① Controller, System operation, data acquisition, data analysis operation, actuator control, in the system Just like human "brain."

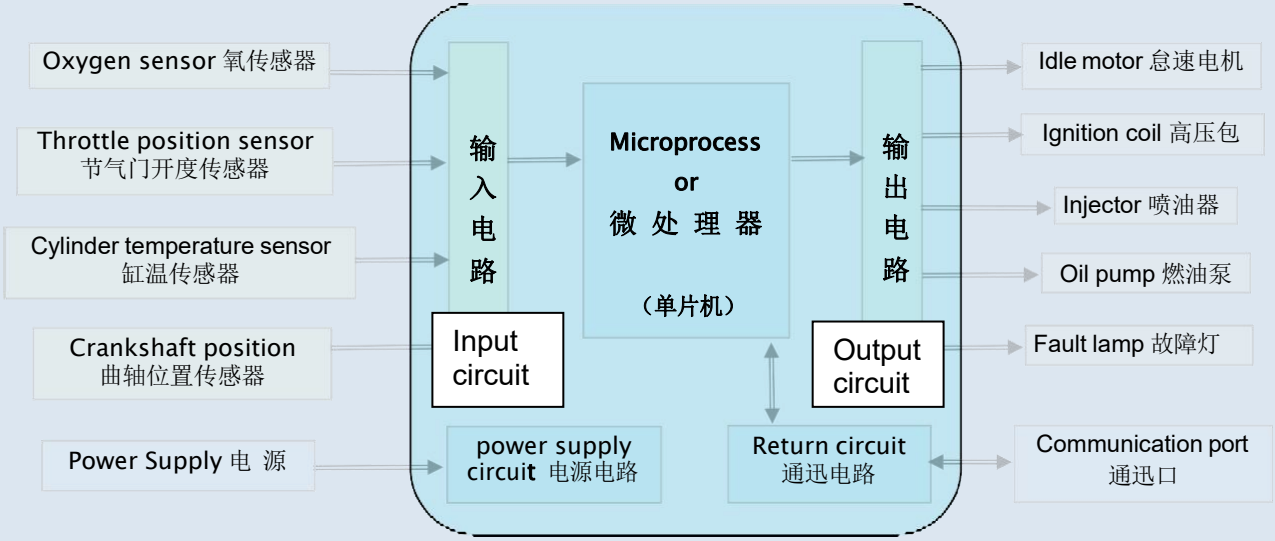
② Sensor: monitoring the working condition of relative parts constantly, collecting the data and uploading to ECU, in the system just like human "eyes and ears"

③Actuator: implement the fuel injection of the relative parts and ignition operation for ECU, in the system just like human "arms and legs"

B. ECU MODULE

1. ECU Function & Principle

ECU is an electronic control unit in the fuel injection system of an engine. It consists of three parts, input circuit, microprocessor, and output circuit.



1.1 The input circuit accepts the signals from sensors and other devices, filters and amplifies the signals, then converted into input level with certain volt. The signals sent from the sensors to ECU input circuit have both analog and digital signals, the converter in the input circuit converts the analog signal into the digital type, then pass it to the microprocessor.

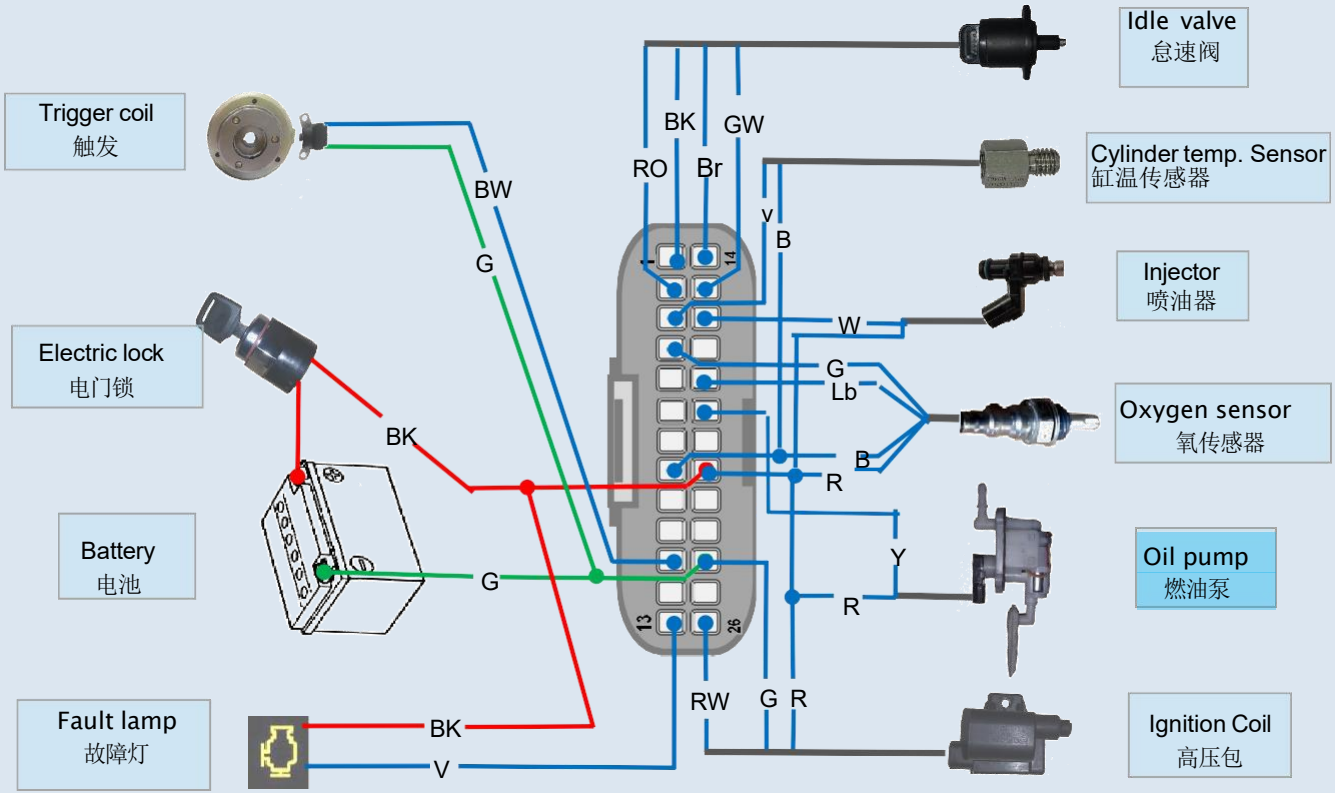
1.2 The microprocessor processes the above mentioned pre-processed signals and sends the processing data to the output circuit.

1.3 ECU has the function of operation and control, when the engine is working, it collects the signals of each sensor, perform operations, and transforms the result of the operation into a control signal, control the work of the actuator.

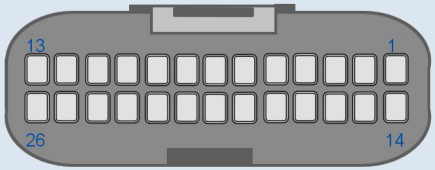
1.4 The ECU controls the memory (ROM, RAM), the input / output interface and other external circuits; The program stored in the memory ROM is based on accurate calculations and a large number of experimental data, when the engine is in operation, this inherent program continually compares and calculates with the signals collected by the sensors. It controls the ignition, air - fuel ratio, idle and many other parameters of the engine with the results after comparison and calculation.

1.5 ECU has self - Trouble shooting and protection functions; when the system meets any problem, it can automatically record the fault code in RAM, carry out the protection methods by reading the replacement programs from the inherent program mentioned above to keep the the engine working , so that the bike can be ridden to the repair shop.

2. ECU Pins and Connection Diagram



3. Definition of ECU pins and cable colors

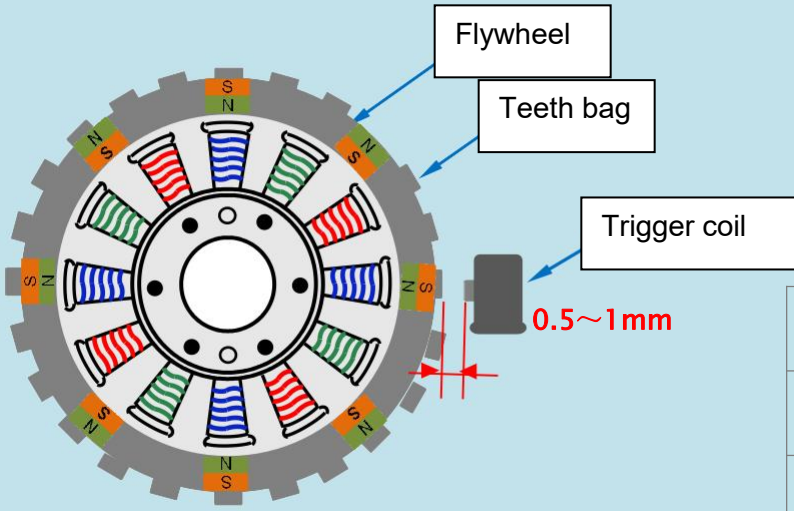


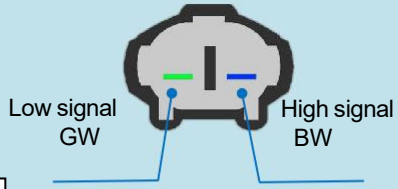
Pin	Function	Cable Color	Pin	Function	Cable Color
P - 1	Idle Motor 2B	black	P - 14	Idle Motor 1A	Coffee /white
P - 2	Idle Motor 2A	red/orange	P - 15	Idle Motor 1B	green/white
P - 3	Cylinder Temp.	purple	P - 16	Injector Control Signal	white
P - 4	Oxygen Signal	grey	P - 17	/	/
P - 5	/	/	P - 18	Oxygen Heating	Sky blue
P - 6	/	/	P - 19	Fuel Pump	yellow
P - 7	/	/	P - 20	/	/
P - 8	Earth Wire Signal	blue	P - 21	Power Supply +12V	red
P - 9	CANL	Orange/black	P - 22	Speed Limit Cable	Grey/white
P - 10	CANH	black./white	P - 23	/	/
P - 11	Trigger Signal+	Blue/white	P - 24	Power Earth	green
P - 12	RPM Signal	orange	P - 25	/	/
P - 13	False Indicator	pink	P - 26	Ignition Signal	Red/white

C.SENSOR

- the sensors consist of cylinder head temperature sensor, throttle valve position sensor, oxygen sensor, and crankshaft position(trigger) sensor.
- the throttle valve position sensor is integrated in ECU
- They are just like the human ”ears and eyes”, monitering the working condition of the relative positions and collecting data to upload to ECU

1. Crankshaft Position Sensor



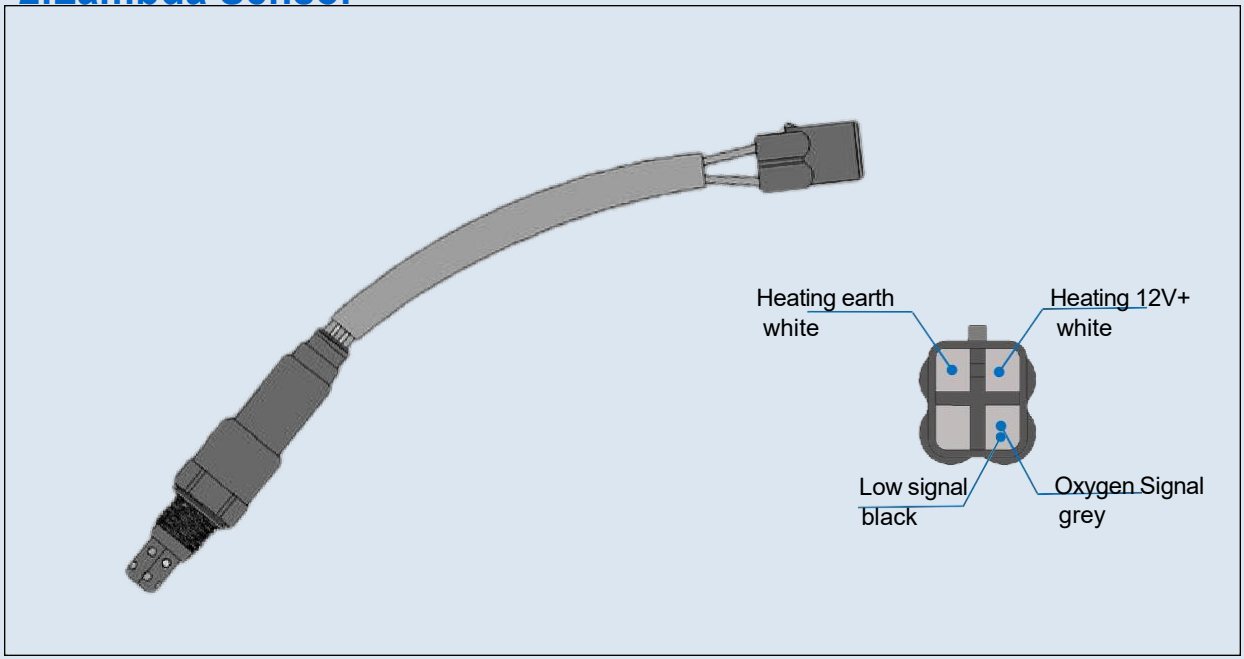


Trigger coil resistance	118Ω
Trigger coil voltage	1.5V
Trigger coil clearance	0.5～1mm

1.1 Crankshaft position sensor is also called Trigger and Impulse coil, a sensor integrated in magneto coil.

1.2 The flywheel uses the 23 teeth convex structure.

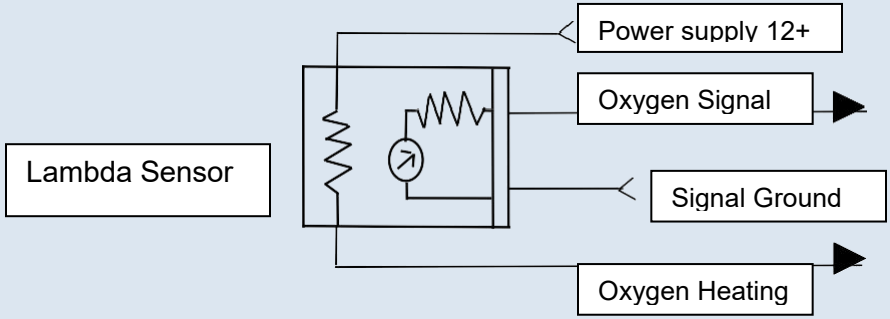
2.Lambda Sensor



2.1 Lambda Sensor Parameter

Model	RY12H	Thread size	M12X1.25 thin
Signal Feature	Thin domain (jump type)	Material Type	ZRO
Signal Voltage Value	0～0.99V	Heating Type:	Heating
The best working temp.	300～600℃	Cable QTY.	4 cables

2.2 Principle of Lambda Sensor



2.3 Main Fault Forms

① No signal, mainly caused by the broken ceramic body because the muffler is waterlogged

② Slow react, mainly caused by carbon pollution, e.g. adding too much machine oil, blue smoke of the exhaust

2.4 Appearance and color check of Lambda Sensor

Check whether the vent hole on the sensor shell is blocked or not, whether the ceramic core is damaged or not, if damaged please replace

Tell the fault by checking the color of sensor top position,

①Grey, correct color

②White, caused by silicon pollution, at this time the oxygen sensor must be replaced

③Brown, caused by lead pollution, if serious, the oxygen sensor must be replaced

④Black, caused by carbon laydown, can continue to use after cleaning the carbon laydown.

Warning:

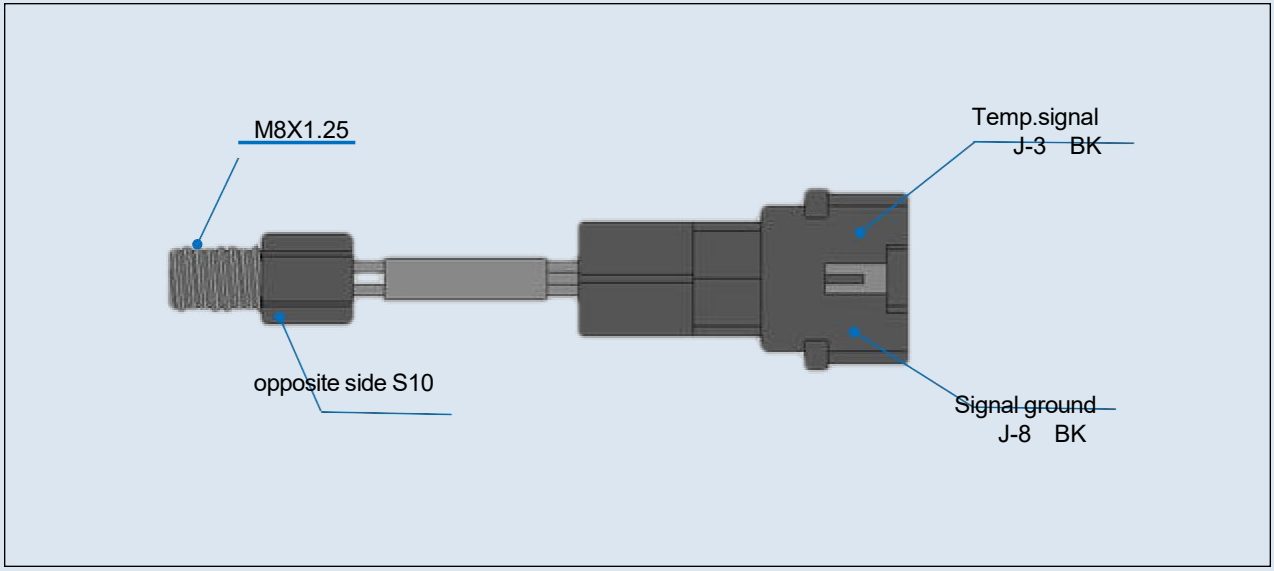
1. Do not remove the oxygen sensor without permission, otherwise, it will lead to unstable engine performance and increased fuel consumption and so on
2. Cannot clean the lambda sensor by cleaning agent

3. Cylinder Temperature Sensor

3.1 The cylinder head temp. sensor is on the top of cylinder head, right side, which can feel the temperature and transfer to usable output signal.

3.2 Monitor the actual engine temperature and transfer to digital signal which can be sent to ECU, analyze and tell whether the engine is under cold start condition, so the ECU can control the injecting volume precisely and get the best start performance

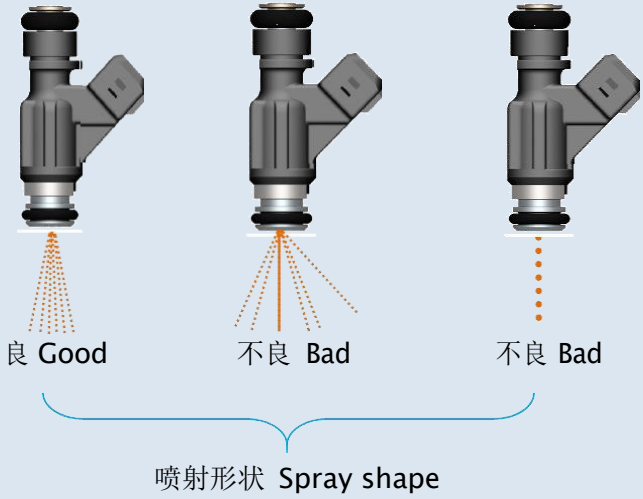
3.3 The thread size of the cylinder head temp. sensor is M8×1.25



D. ACTUATOR

- The actuator mainly consists of injector, fuel pump, idle motor, ignition module(ignition coil) and fault indicator.
- In the system actuator is just like human "arms and legs", which can complete the fuel injection and ignition operation of relevant parts for ECU

1. Injector



MODEL	RP80A1
INJECTING VOLUME	80g
INJECTING ANGLE	Off-center 15°
INJECTING HOLES	6

1.1 Injector is a closed-type electronic flow valve, which controls the injecting volume precisely through regulating the opening time by ECU impulse signal.

1.2 Injector works once every two rounds of the engine

1.3 Injector is just an electromagnetic valve, without positive and negative polarity.

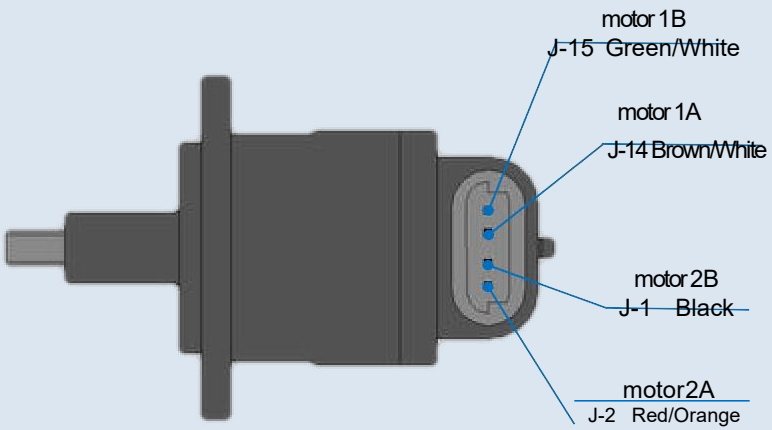
Warning

- Forbidden to replace the injector without permission; the injector with the same model is required

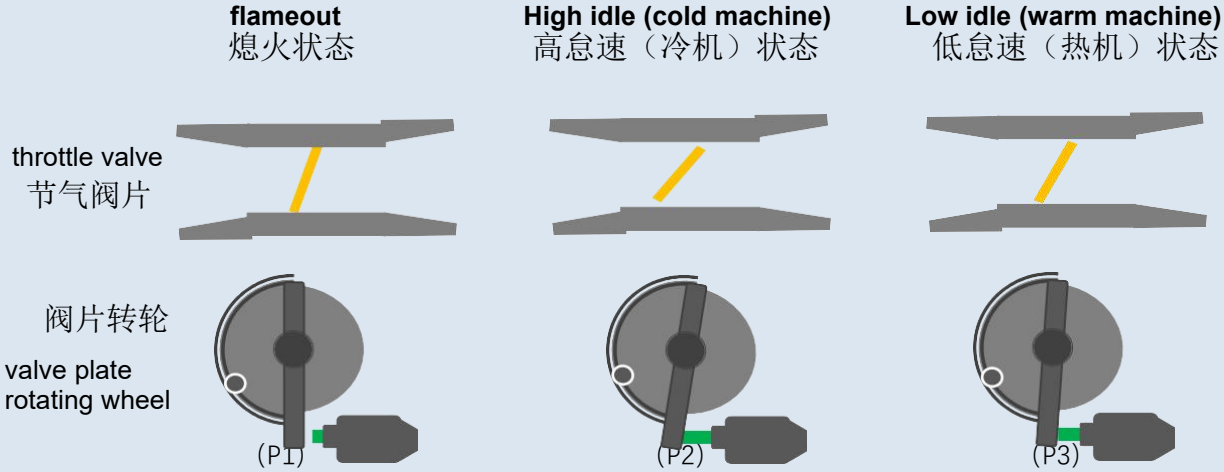
2. Idle Stepping Motor

2.1 Idle motor is also called stepping motor, which controls the idling air inlet volume precisely through the throttle valve plates pushed by screw rod, and the screw rod is moved through the motor rotation by ECU impulse signal; thus, the idle motor can keep the idling speed around the target value.

Model:RJP01



2.2 Working diagram of stepping motor



①The stepping motor is controlled by the ECU. It's a actuator to achieve idle speed at a set target value.

②When the power is switched off, the push rod of the stepping motor will return to the bottom state (as P1).

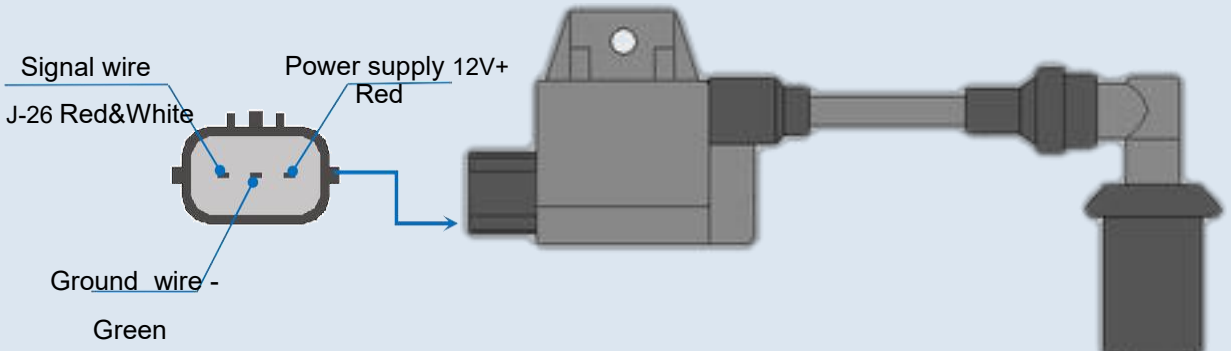
③ After the power is switch on, the push rod of the stepping motor will push outward, so it can ensure the idle speed is around 2000 rpm (P 2)

④ After warm-up, the push rod of the stepping motor will go back until the rotational speed back to the set target value (P3).

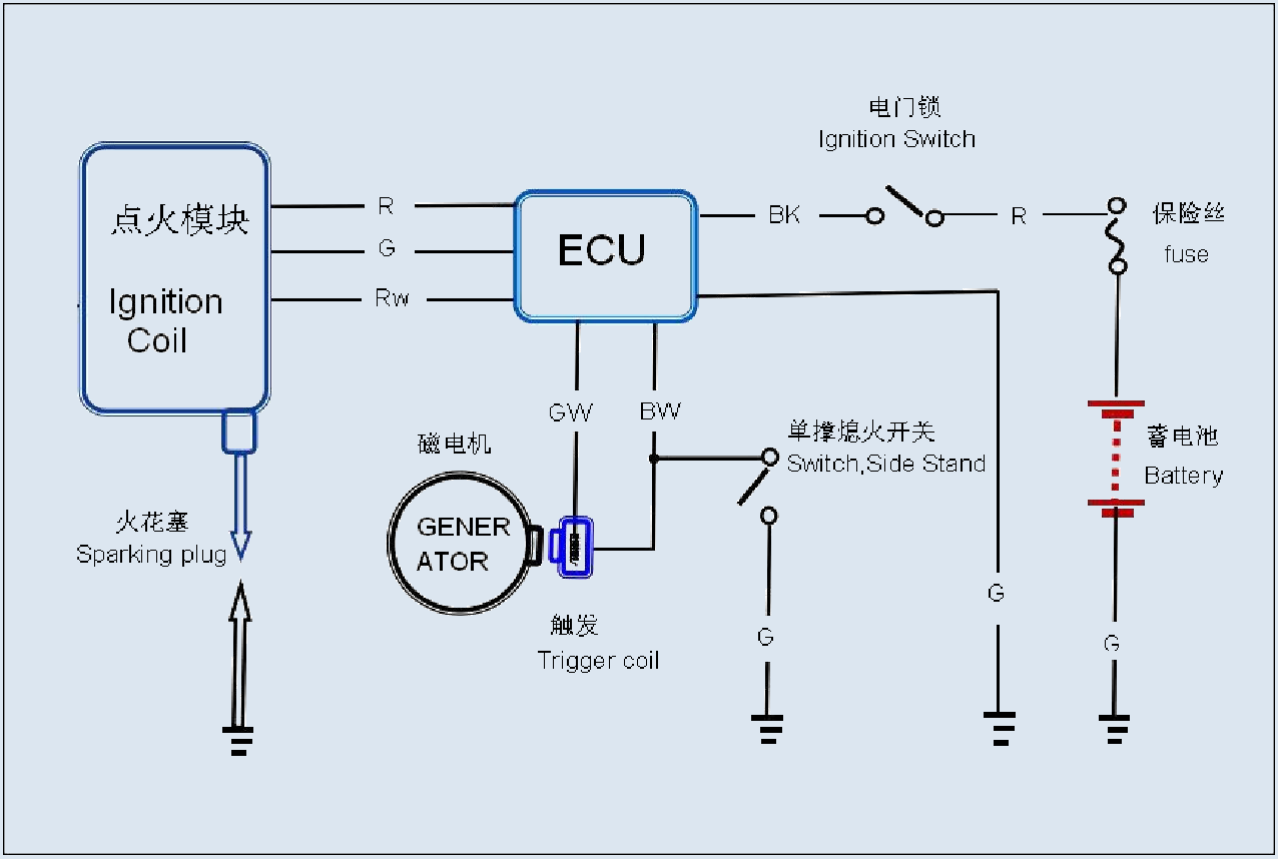
⑤ Summary: When the idle speed is high, the push rod will go back, vice versa.

3. Ignition Unit

3.1 Ignition Unit is composed of igniter and ignition coil.

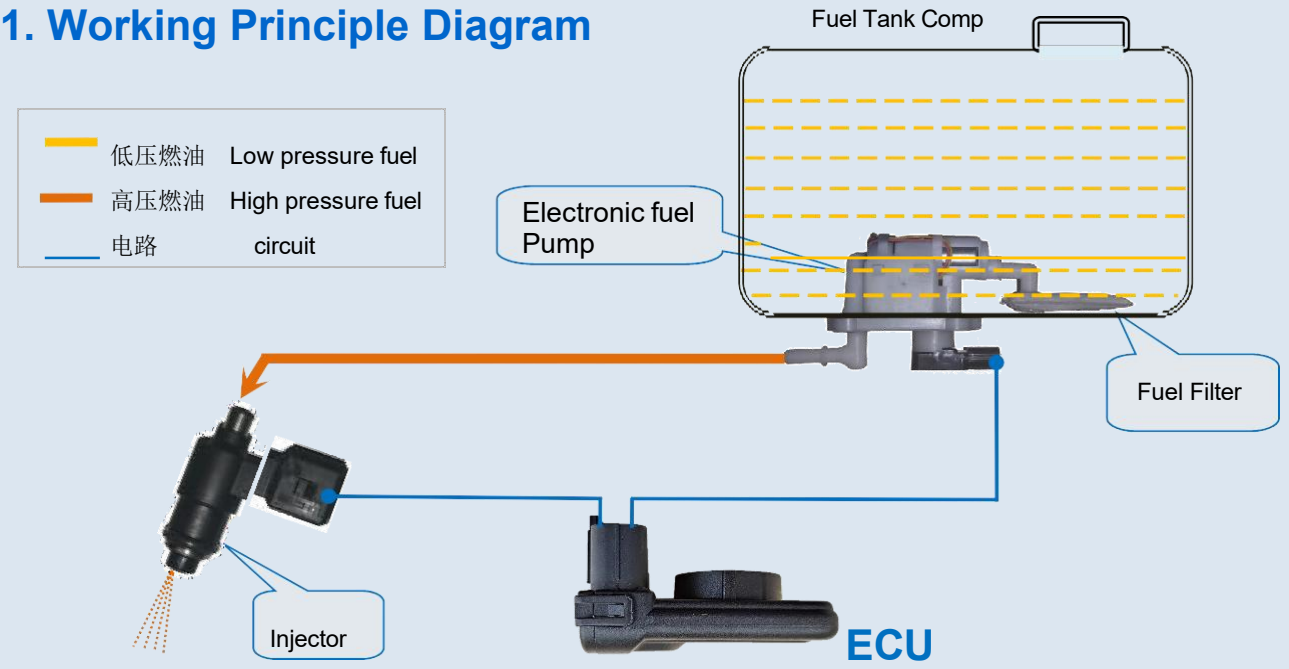


Ignition coil	Resistance	Voltage
Primary	3.7 Ω	12 V
Secondary	23.5 KΩ	23K V
Model	RM1A1	
Resistance value	10 KΩ	


点火模块
Ignition Coil
R
G
Rw
ECU
BK
电门锁
Ignition Switch
R
保险丝
fuse
蓄电池
Battery
GW
BW
磁电机
GENER ATOR
单撑熄火开关
Switch,Side Stand
火花塞
Sparking plug
触发
Trigger coil
G
G
G

E. Fuel Supply System

1. Working Principle Diagram

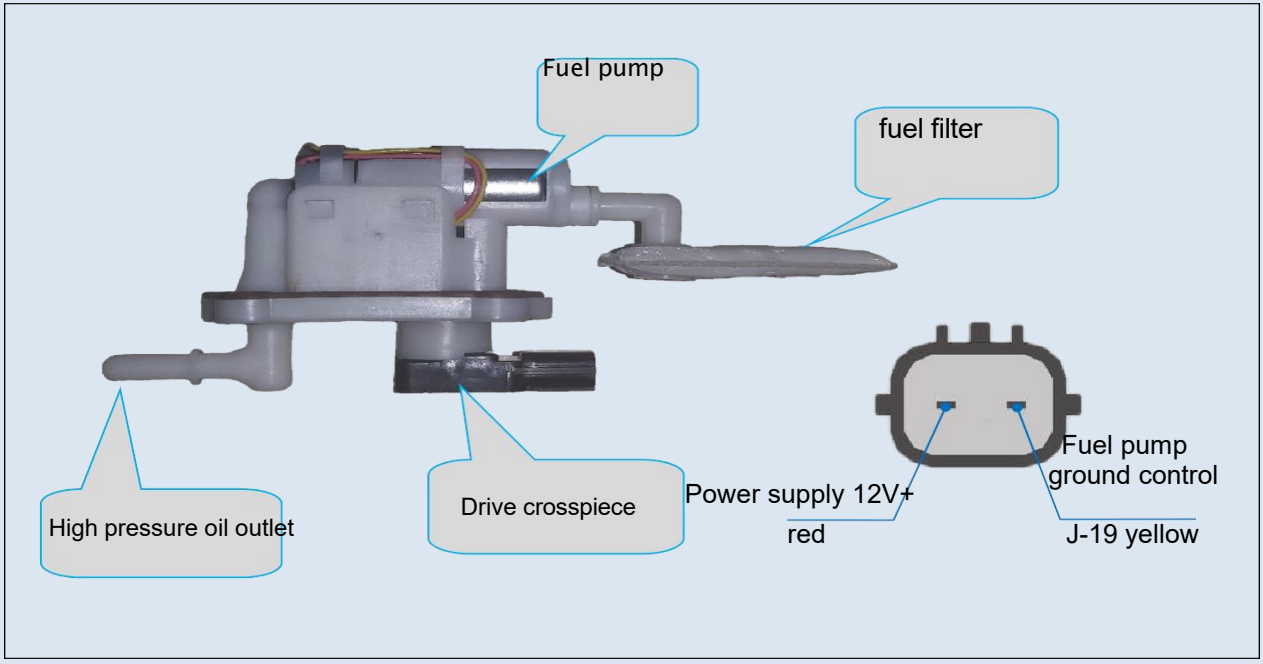


The fuel pump is controlled by the ECU, there is a one-way valve at the oil outlet of the fuel pump. When the engine is not working, the fuel in the fuel pipe will not back to the fuel tank. This ensures that the fuel pump supply pressure is 300KPa when the engine is started again.

2. Fuel pump

2.1 The electric fuel pump assy mainly consists of: pump core, decompression valve, one-way valve, filter and drive module.

2.2 This fuel pump uses the brushless motor pump core, and its advantages: small size, low noise, long life, etc.



2.1 Technical parameters of fuel pump

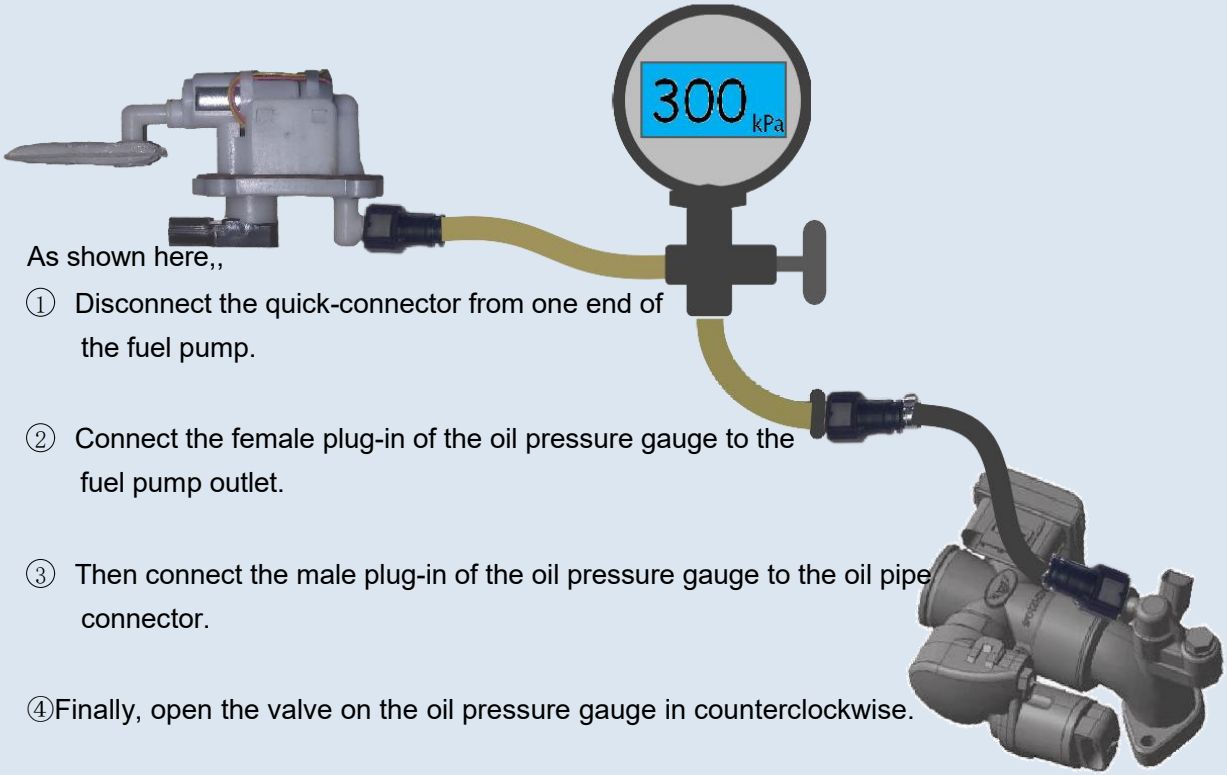
allowable working voltage	DC9V~16 V	Operating temperature	30℃~65℃
Operating current	<1.8A	Rated injection pressure	300KPa
flow rate	Voltage DC12±0.1 pressure 300KPa±10 ≥25L/H		

The electric fuel pump can deliver sufficient fuel to the injectors and maintain the rated pressure to ensure effective injection under all operating conditions. The electric fuel pump is an extremely important actuator of the fuel supply system and plays a very important role in ensuring the smooth flow of fuel. It can deliver a sufficient amount of gasoline to the EFI engine continuously. Once the electric fuel pump has problem, the engine will not work normally, or even flameout.

Warning

1. Do not disassemble the fuel pump
2. Do not running the fuel pump for a long time without gasoline. This will cause the fuel pump to overheat and probably make the permanent damage on fuel pump.

3. Check the Fuel Pump Pressure



As shown here,,

① Disconnect the quick-connector from one end of the fuel pump.

② Connect the female plug-in of the oil pressure gauge to the fuel pump outlet.

③ Then connect the male plug-in of the oil pressure gauge to the oil pipe connector.

④Finally, open the valve on the oil pressure gauge in counterclockwise.

⑤Open the ignition, start the engine, and measure the value of oil pump pressure.

F. Troubleshooting

1. Fault indicator

1.1 Fault indicators are displays on the speedometer and the shape complies with the regulations.

1.2 The operating instructions for the fault indicator are as follows

① in normal mode and without current fault code:

Turn on the ignition switch, the ECU is initialized and the fault indicator lighting and light off after 5S.

② When the current fault code exists:

when the engine is running, if there is a fault, the fault indicator will be lighting, to alert the driver that a fault has occurred.When the engine is switched off, the current fault will be converted to the historical fault and stored in the ECU.The fault indicator will not lighting when a historical fault code exists.

③ in fault light flashing mode, it has fault codes.

2. Fault Code Table

Fault code 故障码	Fault name 故障名称	Fault detection criteria 故障检测标准	Monitoring Strategy 检测策略
P0110	进气温度线路故障 Intake air temperature circuit fault	信号电压大于 3.2V 或者小于 0.07V Signal voltage more than 3.2V or less than 0.07V	连续监测 Continuous monitoring
P0115	缸头温度线路故障 Cylinder head temperature circuit fault	信号电压大于 3.2V 或者小于 0.07V Signal voltage more than 3.2V or less than 0.07V	连续监测 Continuous monitoring
P0118	缸头温度过高 cylinder head temperature is too high	缸头温度大于 150 °C Cylinder head temperature > 150 ºC	连续监测 Continuous monitoring
P0121	节气门位置传感器超范围 Throttle position sensor out of range	信号电压大于 3.2V 或者小于 0.01V Signal voltage more than 3.2V or less than 0.07V	连续监测 Continuous monitoring
P0132	氧传信号电压过高或消失Voltage of lambda sensor signal isl too high or missing	信号电压大于 1.1V 或者小于 0.01V Signal voltage more than 1.1V or less than 0.01V	连续监测 Continuous monitoring

P0139	氧传感器电路响应慢 Slow reaction of the lambda sensor circuit	氧气信号从贫态切换到富态响应速率的时间比某些校准值要长The oxygen signal switches from less to more, the response rate takes longer than calibration values	软件检查 Software check
P0335	曲轴传感器线路故障 crankshaft sensor circuit fault	信号电路开路 Signal circuit :open circuit	连续监测 Continuous monitoring
P0135	氧传感器加热电路故障 lambda sensor heating circuit fault	电路开路或者短路 Circuit: open circuit or short circuit	停机时检测 Check after switch off
P0230	油泵电路故障 fuel pump circuit fault	电路开路或者短路Circuit: open circuit or short circuit	停机时检测 Check after switch off
P0301	失火检测 Fire inspection	失火事件制造 Fire incident	软件检查 Software check
P0350	线圈电路故障 Coil circuit fault	信号电路开路 Signal circuit :open circuit	停机检测 Check after switch off
P0201	喷油器电路故障 Injector circuit fault	电路开路或者短路 Circuit: open circuit or short circuit	停机检测 Check after switch off
P0563	系统电压过大 Excessive system voltage	系统电压大于 15.6V System voltage more than 15.6V	连续监测 Continuous monitoring

3. Troubleshooting methods

When the fault indicator is lighted, then it means the fuel injection system has problem, which requires check and repair. The methods are as follows

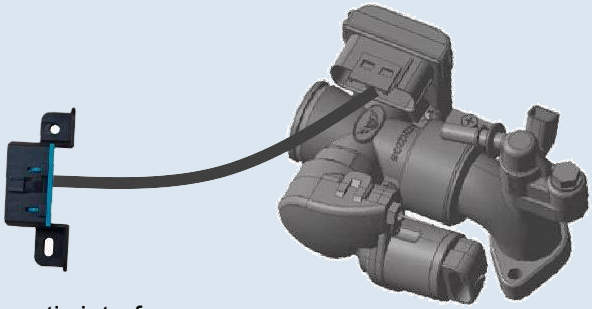
① read fault codes by the diagnostic instrument;

② read the fault code by the Bluetooth adapter and APP on the mobile

3.1 Diagnostic instrument

Diagnostic instrument

诊断议



Diagnostic interface

诊断接口

3.1.1 Diagnostic instrument functions: reading fault codes, clearing fault codes, dynamic data stream display, status identification display, etc.

① Connect the diagnostic interface to the ECU diagnostic interface

② turn on the ignition switch

③ Read the fault code; check the maintenance manual book to confirm the defective components and types ; make maintenance plans based on information and experience.

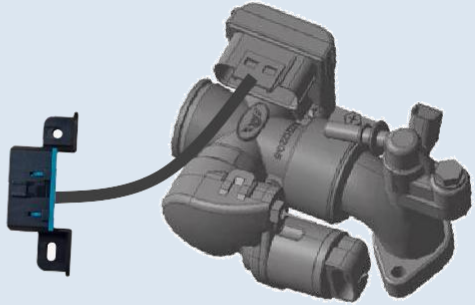
④ After troubleshooting, clear the historical fault codes with a diagnostic instrument

3.1.2 For more information of the diagnostic instrument, please check the "Diagnostic Instrument user's Manual"

3.2 Mobile APP Diagnosis

Mobile phone 手机

Bluetooth 蓝牙



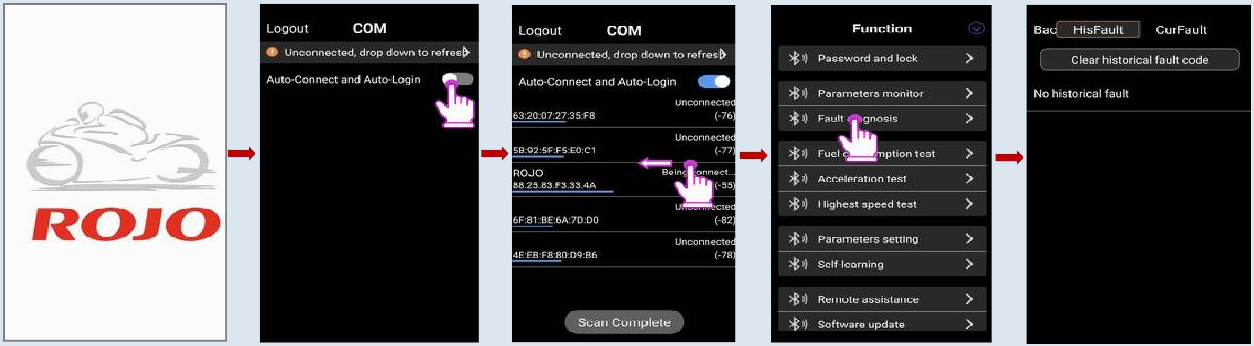
Diagnostic interface 诊断接口

① turn off the ignition switch

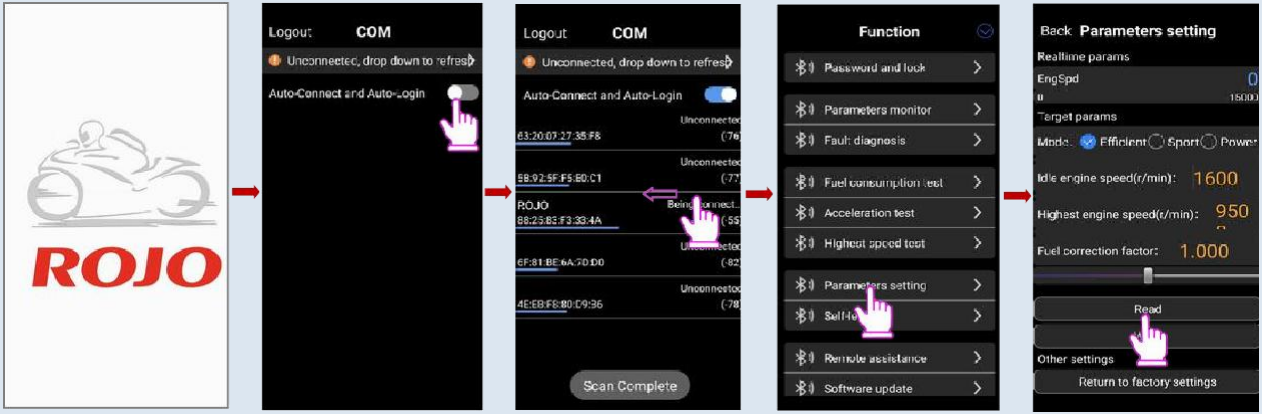
② Connect the Bluetooth adapter to the ECU

③ turn on the ignition switch by key

④ Open ROJO app on your phone, enter the software interface and click on "Bluetooth Connection" (as pictures shown here)



3.3 use phone APP to modify parameters



1. The parameters on this interface are the software initialization parameters.
2. You must click on the "Read" button first, then it can display the parameters from the ECU, otherwise the parameters in this interface are not correct.

You have to click on the "Send" button after modifying the parameters; otherwise the modified parameters cannot be saved.

4. Factory Reset

4.1 make a quick self - learning after factory reset, so the engine performance can be at the best level.

4.2 the factory reset is calibration of throttle angle:

① Turn off the ignition switch to "OFF" by key.

② Rotate the throttle grip to the biggest angle and keep it

③ Turn on the ignition switch to "ON" by key

④ When the fault light off ,loose the throttle grip to the smallest angle.

⑤ Then turn off the ignition switch to "OFF", that is calibration end.

Warning

1. Before the calibration, please check whether the throttle cable has empty stroke, rotate it well.

2. Throttle calibration action is also the factory reset, so make a quick self - learning after doing this action, and then the engine performance can be at the best level.

5. Quick Self-learning

5.1 When the EFI bike is with high fuel consumption, poor power or easy to flameout, try a quick self - learning

5.2 if in the high altitude area, it is recommended to make a quick self - learning before use

5.3 the power should be the best condition after the successful learning, if there is another problem, you can repeat the learning until it reaches the ideal condition.

5.4 how to make quick self - learning

- Start the engine, rotate the throttle for warming the machine about 10 seconds
- Turn off the key, rotate the throttle to the biggest angle, and turn on the ignition switch, then release the throttle grip after 2 seconds. When the fault indicator keeps lighting, it means successfully entered the debug mode.
- Start the engine, keep the idle position, then begin to the low rotate speed self - learning, the fault indicator will be off after learning. After learning, if the throttle is not rotate within 10 seconds,the engine will turn off automatically, then close the key and finish the low rotate speed self- learning process.
- After the rotate speed self- learning,if rotate the throttle within 10 seconds, then begin to the high rotate speed self - learning, totally 3 points, the corresponding throttle angle (percent presentation) is 25%, 50%, 100%, the fault indicator will lighting when throttle near the learning point, keep the throttle without any move at this time until the learning light completely off.
- After learning, the engine will turn off automatically, close the key and finish the learning process.

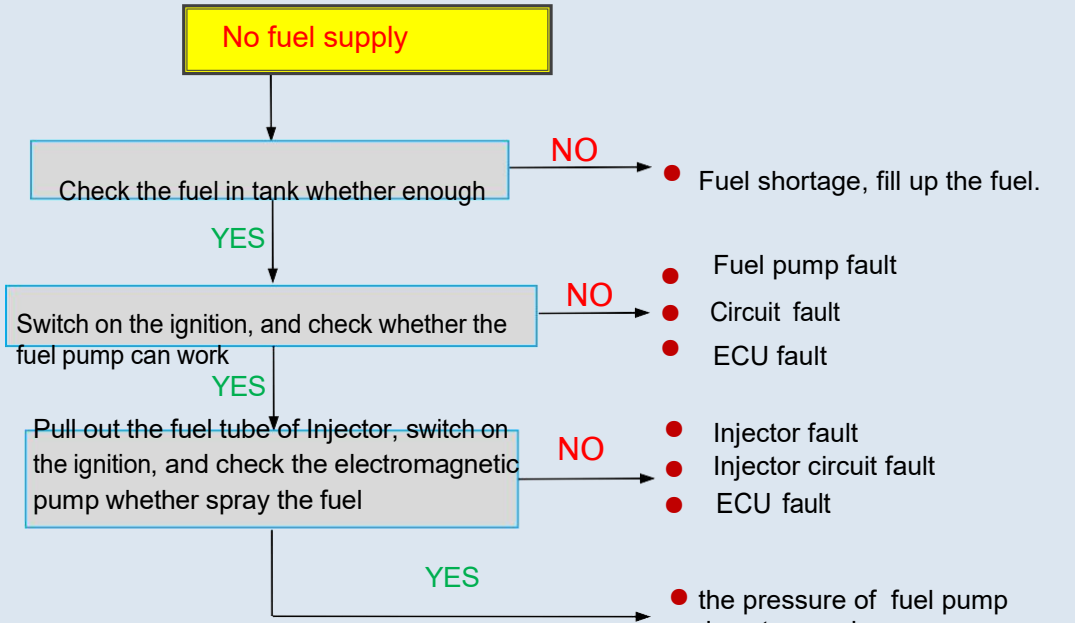
G. Trouble shooting

1. Common Troubleshooting

No	Failure phenomenon	Cause of failure	Solutions
1	Unable to start	no fuel supply、 low fuel pressure	Check the fuel supply and check the pressure whether enough
		no ignition or abnormal ignition	Check the ignition or try to replacing the ignition module
2	Difficult to start, unstable idle speed, abnormal middle to high revs	Trigger coil wire is reversed	Check the magneto trigger coil wire whether reversed
		Magneto gap <0.5 mm	On high speed condition, angle sensor is abnormal， it should increased the gap
3	start and idle speed is correct, mid and high speed is abnormal	the pressure of fuel pump supply is not enough	Check the pressure of fuel pump, or try replace it
4	start and idle speed is correct, high speed is abnormal	The clearance between trigger coil and magneto flywheel is more than 1mm	Move the trigger coil close to the flywheel
5	start is correct, but no idle speed	Idle motor fault	Turn on the key and check whether the idle motor can push the throttle valve, If not, please replace it
6	difficult to start the cold machine at low temperatures, but warm machine is ok	cylinder head temperature sensor fault	Replace the cylinder head temperature sensor

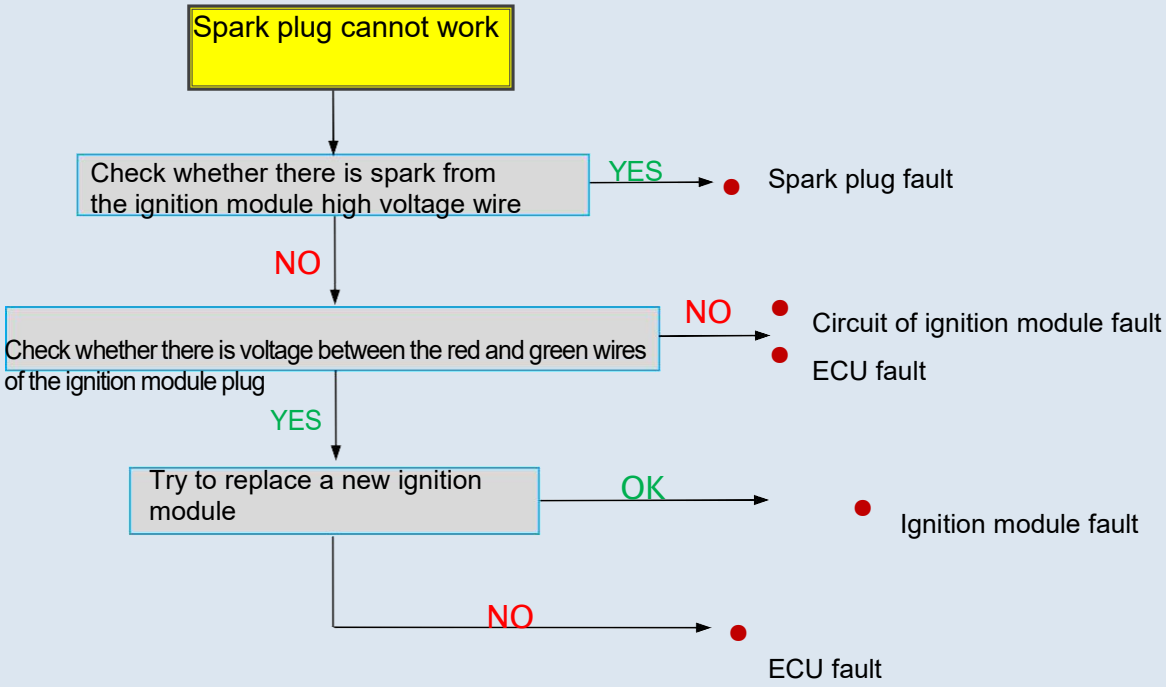
Note: When abnormal situation occurs, firstly try the factory reset, this will eliminate faults caused by the system!

2. Fuel Supply Fault



details of how to check fuel pump pressure please check page 24

3. Ignition System Fault



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