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Manual of EFI system

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I. Composition and working principle

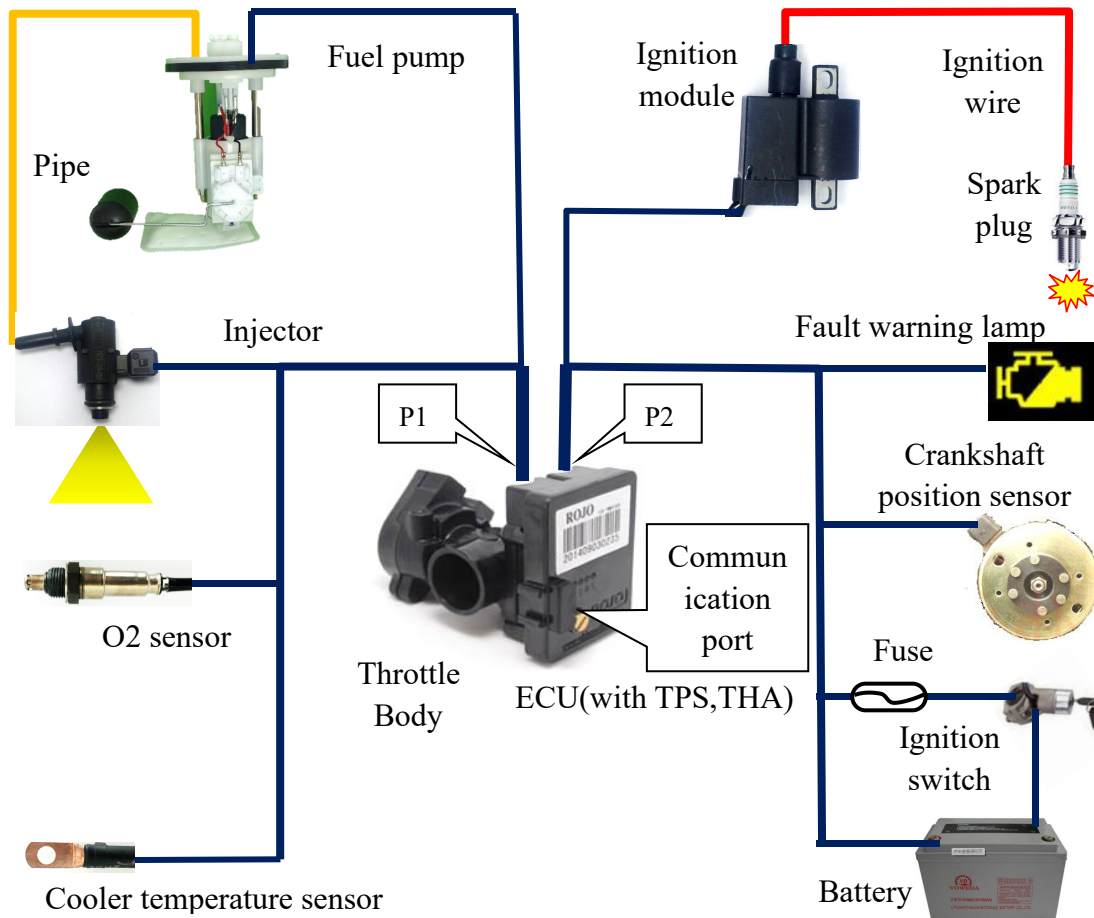


Fig. 1 Schematic diagram of EFI system

The functions of EFI are fuel injection management and ignition management, which is by the following parts:

- 1、 **ECU**(Electronic control unit), attached to the throttle body, there are throttle position sensor (TPS) and intake air temperature sensor (THA) in it. It is the "brain" of the system, which undertaking the task of receiving signals from sensors, making control strategies, and outputting the control signals.
- 2、 **Fuel supply device**, composed of fuel pump, pipe and injector. The fuel pump is installed in the tank, it pressurizes the fuel to 2.5 bar. The injector is installed in the engine intake pipe, it perform fuel injection timing and amount. The pump and injector are both controlled by ECU.
- 3、 **Ignition device**, composed of ignition module, ignition wire and spark plug. The ignition module contains DC capacitor igniter and ignition coil, it boosts the 12V battery voltage to more than 15,000 V, and transfers it to the spark plug to produce spark discharge through the ignition wire.
- 4、 **Sensors**, including:
 - (1) O2 sensor, mounted on the exhaust pipe, its function is detecting the oxygen concentration in the exhaust gas and achieves closed-loop regulation of the fuel mixture concentration. It outputs alternating signal from 0 V to 0.9V when in closed- loop regulation state.
 - (2) Cylinder temperature sensor, installed on the engine cylinder head, is used to measure the engine temperature, which is used to calculation start fuel injection amount.
 - (3) Crankshaft position sensor, integrated in the magnetic motor, is used to measure crank angle signal, which is the time base for injection and ignition control.

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(3) Intake air temperature sensor, built in the ECU, is used to measure intake air temperature, which is used to calculate the intake air density.

(4) Throttle position sensor, built in the ECU, is used to measure the throttle valve rotation angle.

5、 Others, including:

(1) Throttle body, which controls the intake air amount through the throttle line.

(2) Fault warning light, installed on the dashboard, is used for fault alarm.

(3) Battery, ignition switch and fuse, they undertake the task of power supply to the EFI system.

II. Common troubleshooting methods

1、 Startup failed

1) If the fault warning lamp is always on, you can pull the throttle twice in one second, and make the system into flashing code mode. Determine the faults according to Annex 1 "Flash code description of fault warning light".

2) You can also determine the faults according to Annex 2 "ECU indicator light" after turning on the ignition switch, and starting the engine.

3) If the problem remains, pull out the ignition wire which connected to the spark plug, keep the end of it about 1 cm to the engine body or motorcycle frame, then start the motor, if no spark, or weak spark occurs, please exclude and deal with the following failures by step till the spark is normal when start the motor: Ignition module connector failure, ignition module failure, the gap between the crankshaft position sensor and the magnet motor boss is too large (normal gap is between 0.3 ~ 0.8mm)

4) If the spark is normal, but startup is still failure, you can remove the injector from the intake pipe (note: do not remove the pipe and electrical plug connected to it), start the motor, observe if there is fuel spray from it, and the atomization quality. If there is problem, you can exclude injector failure and then pump failure by replacement method, you can also measuring pipe pressure by a pressure gauge, the normal pressure is more than 2.4 bar.

2、 Misfire

1) Exclude the following factors firstly: Whether the spark plug or spark plug cap was replaced by non-resistive type? Whether the rectifier was replaced by semi-wave type? Whether the connection location of the signal ground was changed? If the above factors exist, correct them firstly.

2) If the problem still exists, you can then exclude the possibility that idling intake air is too large. Do idle intake air adjustment according to Annex 3.

3) If the problem still exists, try replacing the spark plug.

4) If the problem still exists, check the fuel pressure by a pressure gauge (normal pressure is more than 2.4 bar). You can also try replacing the pump.

5) If the problem still exists, try changing the ignition module.

6) If the problem still exists, try changing the injector.

3、 The power output is not continuous, or exhaust pipe blasting

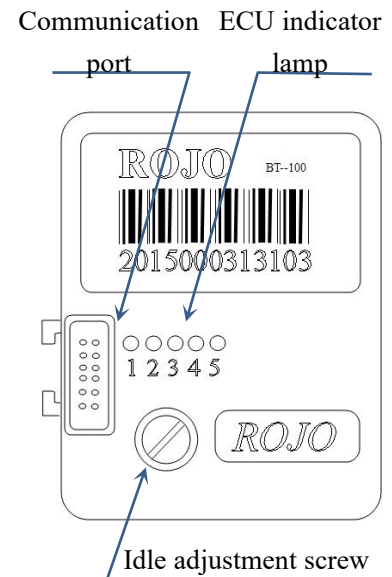


Fig. 2 ECU panel

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- 1) Referring to Annex 2, if the NO.4 ECU lamp is always off even if the engine has warmed up, it indicates that open circle or sensor failure occurred in O2 sensor. Re-insert the O2 sensor's connector, if the problem isn't solved, replace the sensor. Temporary approach: Separate the connector of the O2 sensor, do a fast self-learning according to Annex 4.
- 2) If the problem still exists, check the supply pressure of the fuel pump by pressure gauge or try replacing it.
- 3) If the problem still exists, try replacing the injector.

4. Idle speed is too high

- 1) According to Annex 2, judge if there is throttle opening calibration error by No. 4 ECU lamp. If the error exists, re-calibration the throttle opening according to Annex 3.
- 2) If the problem still exists, try reducing the idle intake air according to Annex 4.

III. Precautions in maintain

- 1) Don't add excessive lubricating oil in engine, or blue smoke will appear, and damage the O2 sensor.
 - 2) Every 5,000 km running, you should take out of the fuel pump from the tank and replace the fuel filter on it, otherwise injector plug or the pump stuck might occur.
 - 3) Don't arbitrarily change the connection location of the signal ground, or the EFI system will works abnormally.
 - 4) All the electrical plug should be combined firmly, or they will separated in using.
 - 5) Wire harness and pipes should be bundled by standard, or it will break in use, and resulting in short circuit or oil spills.
 - 6) When the spark plug cap or spark plug is replaced, the replacement must be resistance type, the resistance value is between $4K\Omega \sim 8K\Omega$.
 - 7) When the rectifier is replaced, the replacement must be qualified full-wave rectifier, otherwise it will make the EFI system working unsteadily. Simple judgment method: when the engine is running, move away the fuse above the battery, if the engine can still working normally, it is qualified.
 - 8) When the motorcycle is out of the run-in period, it is recommended to reduce the idle intake air (under the premise without affecting the cold start performance), according to Annex 4.
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Annex 1 Description of the flashing code

If the fault warning lamp light, you can pull the throttle twice in one second to make the system into flashing code mode. The code is described in the following table

flashing code	Fault source	Fault information	Troubleshooting
2	Idle valve(Note: Applies only to types with idle valves installed)	Open or short circuit	Check the connector, Measure the resistance between the idle valve electrodes, If a short circuit or an open circuit fault occurs, replace the valve.
3	Electromagnetic interference	The ECU is reset by interference	Check in this turn: Is the spark plug and spark plug cap with resistance? Was the connection location of signal ground changed? Is the rectifier failed and the charge voltage is more than 15.6V?
4	Crankshaft position sensor	Open circuit error, or the signal is disturbed	Is the connector reliable? Is the distance between the wiring harness and the ignition wire is more than 2 cm? Is the spark plug and spark plug cap with resistance?
5	Battery voltage	Voltage is more than 15.6V	Replace the rectifier (Note: It must be full wave type)
6	O2 Sensor	Oxygen heating circuit is open or short; Oxygen signal is abnormal	Check the O2 sensor connector. If the problem cannot be resolved, try replacing the oxygen sensor
7	Cooler temperature sensor	The signal is over reasonable range	Check the connector, or replace the sensor
8	Injector	Open or short circuit	Check the connector, try replacing the injector
9	Pump	Open or short circuit	Check the connector, try replacing the fuel pump
10	Ignition output	Open circuit	Check the connector, try replacing the ignition module
11	Throttle position sensor	Calibration error, or over reasonable range	Re-calibration throttle opening according to Annex 3. If the problem is not resolved, try replacing the throttle body.
12	ECU	Software failure	Eliminate interference factors as the flashing code 3 before replace the ECU
13	Intake air temperature	The signal is over reasonable range	Replace ECU

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Annex 2 Description of the ECU indicator lamp

ECU indicator lamp, located on the ECU panel, as shown in Figure 2

Number	Name	Normal Performance	Abnormal Performance and Notice	Troubleshooting method
1	Fuel Pump Indicator Lamp	light 2-3 seconds after turning on the ignition switch.	Always off, meaning the pump circuit is open	Check fuel pump connections and wires, If the fault still exists, try replacing the pump
2	Injector Indicator Lamp	flashing when the engine is starting or running	Always off, meaning the injector circuit is open	Check injector connection and Wiring harness , If the fault still exists, try replacing the injector
3	Ignition Indicator Lamp		Always off, meaning no ignition signal output. If 2,3 lamp are all off, it means no crankshaft position signal input	Check the crankshaft position sensor, wiring harness , connector, and The gap between the sensor and the magnet motor boss(reasonable value is 0.3 ~ 0.8mm)
4	O2 sensor indicator lamp	Indicates throttle position when the engine is stop, the lamp lights when the throttle is in the maximum or minimum position	If the lamp can't light in the two limit position, throttle calibration error occurs	Re-calibrate the throttle according to the procedure in Annex 3 "Throttle Calibration"
		Indicates the O2 sensor voltage when the engine is running, it lights 1-3 times per second after the engine is warming up.	Always off, indicating no O2 signal received	Check the sensor connector, wiring harness , if the fault still exists, try replacing the O2 sensor
5	Fault alarm lamp(same as the fault alarm lamp on the dashboard)	The lamp lights for 2-3 seconds after the ignition switch is turn on, and then off.	If it is always on, pull the throttle twice in one second, the system will then enter into flashing mode.	Refer to Annex 1 "Description of the flashing code "
			If unstable light and dark during engine operation, ECU is	Eliminate the interference factors referring to flashing code 3 in the Annex 1

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			likely to get interfered	
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Annex 3 Throttle calibration

If the idle speed is too high, throttle opening calibration error should be firstly ruled out by this method: turn on the ignition switch, keep the engine stop, pull the throttle to the minimum and maximum opening, if the No. 4 ECU indicator lamp can all lights, it means the throttle opening calibration is correct, otherwise is wrong, and need to be re-calibration by the following steps:

- (1) Pull the throttle to the maximum opening;
- (2) Turn on the ignition switch, keep in maximum opening till the fault warning lamp (on dash board or ECU panel) is off.
- (3) Relax throttle to minimum opening, turn off the ignition switch to finish the calibrating process.
- (4) Check: Turn on the ignition switch again, check the throttle opening by NO. 4 ECU indicator lamp, if correct, the process is end.

Note: This is also the process to restore self-learning value to the factory settings. If the acceleration performance deteriorates after this process, do a fast self-learning according to Annex 5.

Annex 4 Adjustment of idle intake air

If the idle air intake is too low, cold start will be difficult, and easy to flameout at cold engine condition. If the idle air intake is too large, the engine idling will be high and is easy to flameout at hot engine condition. After the run-in period, the individual motorcycles will appear the problem that idling intake air is too large. The adjustment steps are as the following:

- (1) Pull the throttle to the maximum opening;
- (2) turn on the ignition switch, loose throttle in 1 seconds, then the EFI will work in "fast self-learning" mode.
- (3) Start the engine, pull the throttle to fast warm the engine, stay the throttle in idle position, look the fault light, under normal circumstances it will go off after self-study process is over in idle position. If rapid flash occurs, it indicating that the idle intake air is too small, you should adjust the "Idle adjustment screw" (Figure 2) counterclockwise, if slow flashing occurs, it indicating that the intake air is too large, you should adjust the "Idle adjustment screw" clockwise.
- (4) Simpler method: If the engine idling speed is too high, or easy to misfire when the engine is warm up, try adjusting the idle adjustment screw 1 to 2 turns clockwise, if the engine is difficult to start, or is easy to misfire, when the engine is cold, try adjusting the idle adjustment screw 1 to 2 turns counterclockwise. Maintain if improvement, restore if deterioration.

Annex 5 fast self-learning

Referring to annex 4, make the engine into "fast self-learning" mode. You can also do it after completing the "Adjustment of idle intake air" (don't stop the engine), the step is as follows:

- (1) There are 5 self-learning nodes, the corresponding throttle opening are: 0% (idle opening), 8%, 25%, 50%, 100%;
- (2) When the throttle close to the above nodes, the fault alarm lamp will light, stay in the node until the self-learning process of this node finishes and the lamp is turn to off, pull the throttle to the next self-learning node;

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- (3) The optimal self-learning order is: 2 -----3 ----- 4 ----- 1 ----- 5;
- (4) When all the nodes have completed self-learning, the engine will automatically stop running. If the engine is still running, it means there is still uncomplete node, pull the throttle to find the node where the lamp lights, stay until the lamp is off.
- (5) after the engine stop running automatically, turn off the ignition switch to finish the self-learning process.

Annex 6 Description of the wiring harness

The diagram of wiring harness A and B is shown in Figure 3. Their corresponding relationship with the ECU socket is shown in Figure 1.

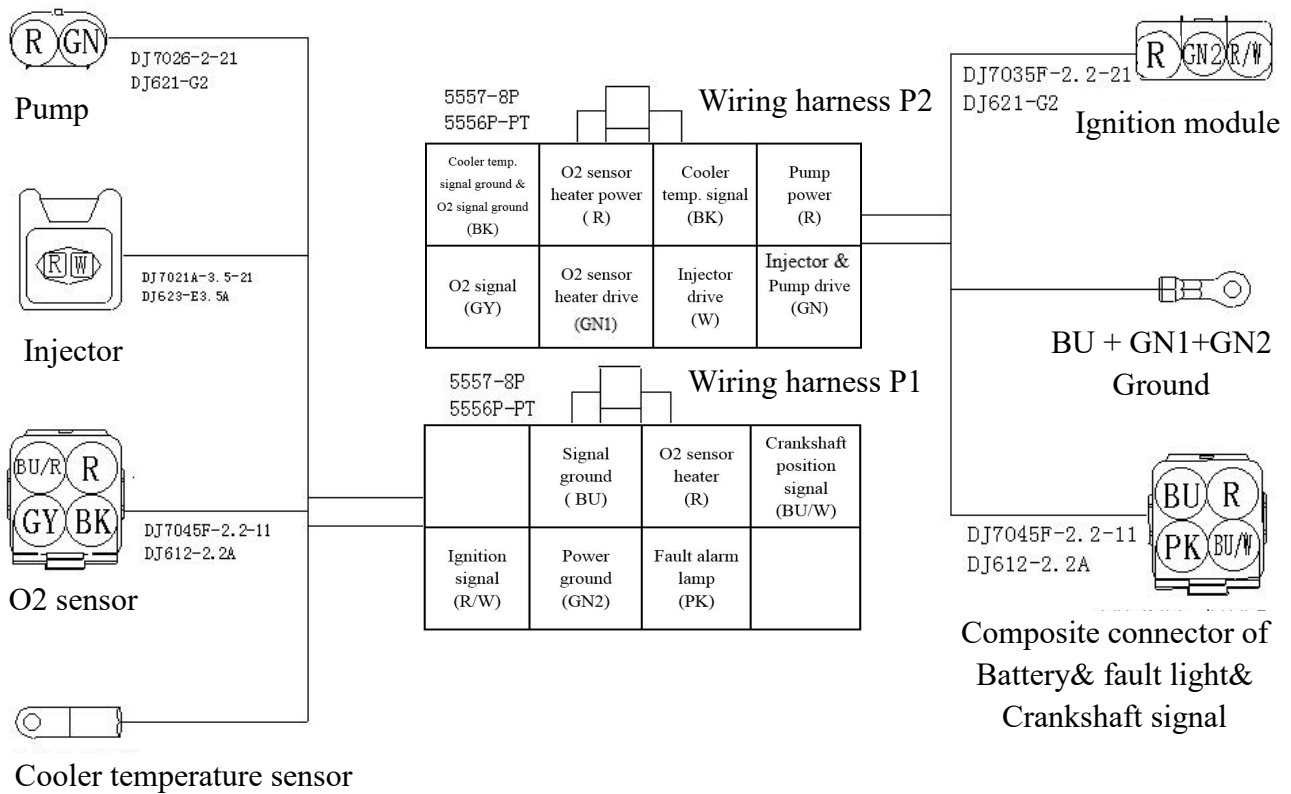


Fig. 3 Wiring harness diagram

