SE-EFI

Small Engine Electronic Fuel Injection
– Easy Conversion Kit

ECOTRONS

Installation Manual

V1.5.5

Note: Some of the instructions in this manual are only applicable to the scooters with GY6 125cc engines. For different engines, and different vehicles, please contact us for exact installations of the whole kit.


Harness
Communication Cable
ECU
USB-RS232
CDI - ECU controlled
Throttle body & Intake Manifold
Oxygen Sensor
Fuel injector
Fuel Pump
Software-CD
MAP Sensor
Fuel return line
Fuel pressure
regulator
Temperature Sensors
High pressure fuel line
Fuel filter
T-pipes
www.ecotrons.com

SE-EFI Kit

Introduction

SE-EFI is an Electronic Fuel Injection conversion kit for small engines. It is a bolt-on EFI kit to a lot of small engines used on variant applications: motorcycles, scooters, ATVs, snowmobiles. The displacements of the engines can be in the range of 50cc to 250cc. This kit replaces the OEM's carbureted fuel system as bolt-to-bolt compatible, and it requires the minimum modifications of the engine. It is a plug-and-play EFI kit. Tuning is available for those who are interested, and the tuning software is free.

This EFI kit has below features:

- Electronic fuel injection (EFI)
- Quick engine start even at -30°C.
- More power and torque than the carbureted version
- High fuel efficiency and low carbon emissions.
- Decel-fuel-cut-off
- OBD on board diagnosis
- Performance tuning for advanced users.

Parts:

1. ECU
2. Harness (including the connectors)
3. Throttle Body and Intake manifold Assembly
    - Throttle body (including TPS sensor)
    - Intake manifold
    - Fuel injector
4. Fuel pump assembly
    - Fuel pump (outside of the tank)
    - Fuel pressure regulator
    - Fuel filter
    - High pressure fuel line
    - Fuel feed line
    - Fuel return line
    - Fuel bubble separation line
    - T-Pipes
    - Clamps
5. MAP sensor
6. Engine temperature sensor
7. Intake air temperature sensor
8. Oxygen sensor and bungs (optional)
9. Serial communication cable (to a computer)
10. CD for tuning software (downloadable from our website)

Note: **the kit needs 12V charging system for power supply.**

This kit needs tuning to achieve some desired results.

This kit is not certified for any emission regulations. It is the user's responsibility to find out whether it's legal to use it.


ECU


Harness


throttle body and intake manifold


MAP sensor


Temperature sensors


fuel pump assembly

Installation Procedures

Section 1:

1. Replace the carburetor with the throttle body assembly

2.1 un-install the carburetor and the old intake manifold from the motorcycle

2.2 Install the new throttle body and the new intake manifold assembly:

2.2.1 Connecting the throttle body inlet to the air hose from the air filter;

2.2.2 Bolt-on the new intake manifold to the inlet of the engine, with the heat insulator in between (black, like a washer). In case the total length of the intake manifold is a little short to reach the inlet of the engine, you can use 2 heat insulators stacking together.

2.2.3 Install the existing throttle cable to the throttle body.

2.1 Find a secure place to install the MAP sensor, see the picture (a tie-wrapper can do the job).
2.2 Connect the MAP sensor to the intake manifold with the small pipe (4mm diameter)

The example to install the MAP sensor

2. Fuel tank modification

1.1 This kit has a fuel return line which needs to be somehow feed-back to the tank. If your tank has an existing hole on the top (for example the vent hose between the tank and charcoal canister, or a possible hole through the fuel sender fixture). You can take advantage of that, and connect the fuel return line to that hole and make sure the fuel can be returned to the tank from the pressure regulator. (A T-pipe can be used here).

1.2 Otherwise, you need to drill a hole on the tank. First, drain the fuel tank completely! (WARNING: converting the fuel tank with any fuel in it can cause fire!!!)

1.3 Take the fuel tank off, if necessary.

1.4 Drill a hole (diameter: **5mm~6mm**) on the upper wall of fuel tank, or just below the fuel tank cap, see the picture.

1.5 Push the fuel return line into the hole (**about 10mm** in depth), and use Silicone rubber seal it**!** (The silicone rubber can seal the hole as well as hold the fuel return line once it's dry.)

1.6 Clean the fuel tank if any debris falling into it.

1.7 Install the fuel tank back.

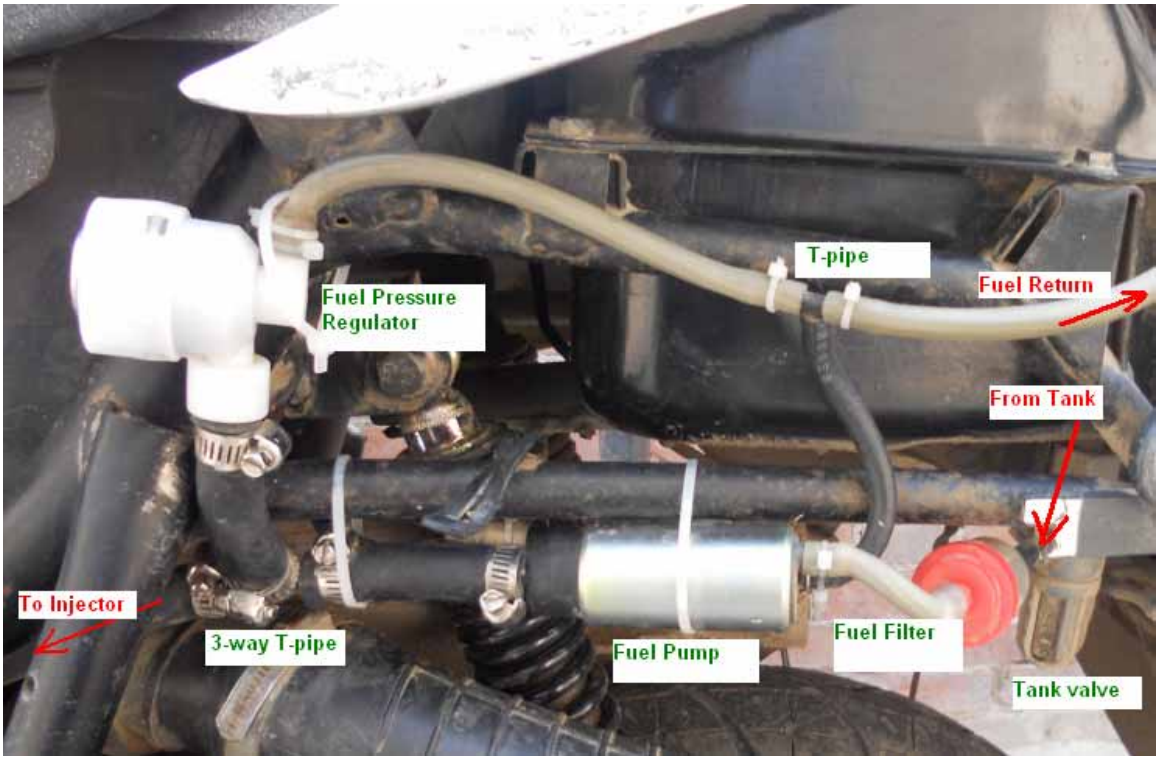
The example to fit the fuel return line

3. Install the fuel pump assembly

3.1 Find a **safe place** to install the fuel pump: it should be between the fuel tank and the intake manifold, so that both the input fuel line and the output lines can be short; and it should be tied to the inside of the frame, so that it is protected by the frame. It should NOT be exposed to any external scratch or bump. It should not touch the ground when the motorcycle lies on the ground.

3.2 Connect the input fuel line from the fuel tank outlet to the inlet of the fuel filter (fuel filter, by default, has been connected to the inlet of the fuel pump).

3.3 Connect the high pressure fuel line outlet from the fuel pump to the fuel injector, which is located on the intake manifold.
3.4 Connect the fuel return line to the T-pipe's outlet. The T-pipe, by default, has both fuel bubble line and the fuel pressure regulator return line connected.
3.5 Secure all fuel lines with supplied clamps, make sure no leak.
3.6 The overview of the fuel supply system should be like the below pictures:



See Appendix I (Fuel supply system schematics)

Note:

- Correct levels of different fuel supply components should be: the fuel injector is lower than the fuel pump, and the fuel pump and the fuel filter must be lower than the lowest point of the fuel tank.
- Some fuel tanks have the bottom valve which requires the vacuum from the intake manifold. Called vacuum **"petcock"**. In this case, you need to replace it with a simpler valve that does not require vacuum, and you can open and close it manually.

4. Install the engine temperature sensor.

Find a place on the cylinder header, where it has the lowest air flow (usually the backside of the engine), attach the sensor to a bolt and fix it.

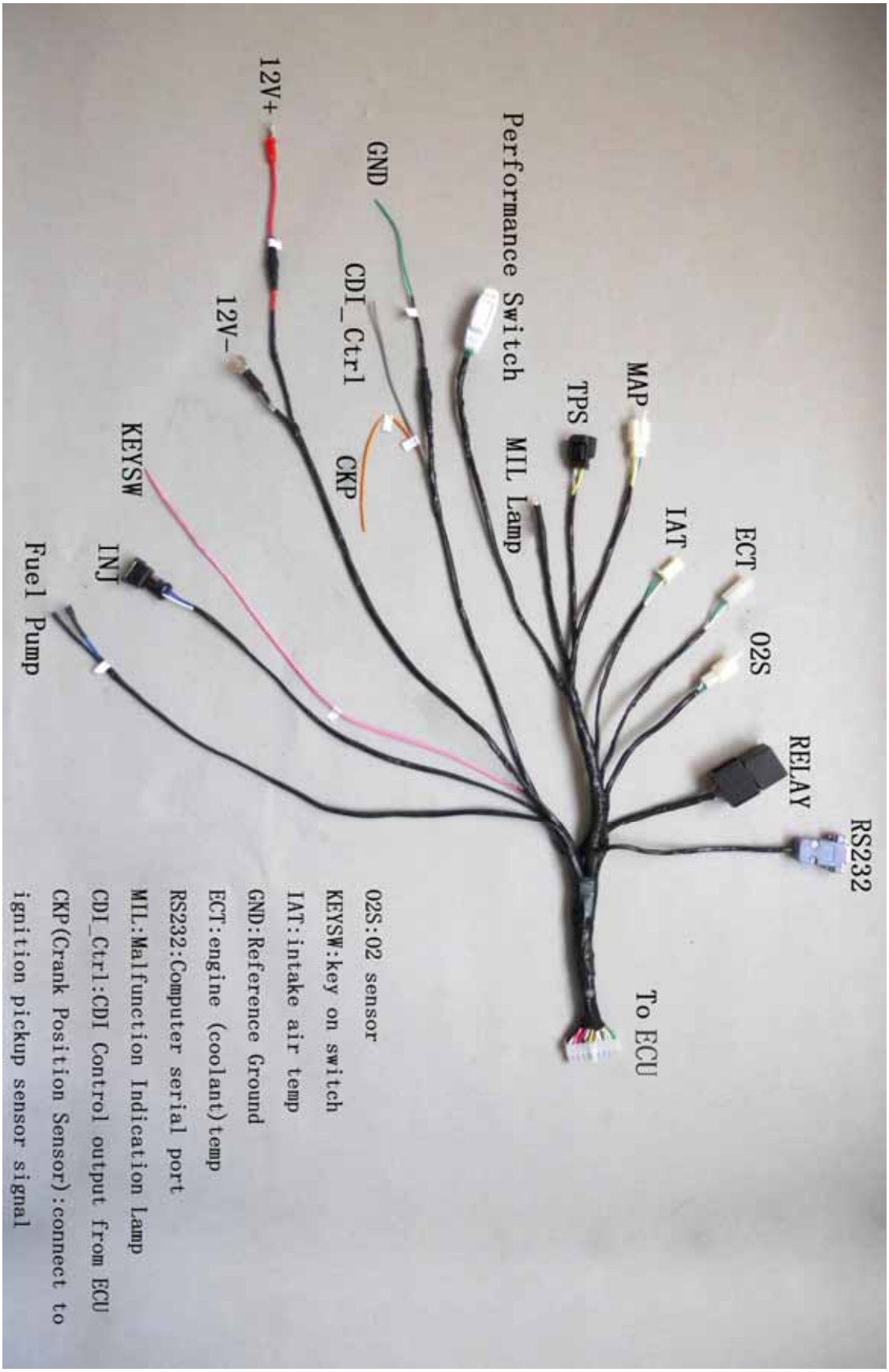
5. Install the intake air temperature sensor.

Insert the sensor into the air filter or somewhere between the air filter and the throttle body (**if a hole is drilled on the air hose, make sure all the debris is cleaned immediately after the drilling!**).

Section 2: Install ECU harness

Note:
The only wire that can be connected to the +12V directly is the RED 12V+ wire.
NONE of other individual wires should be connected to +12V battery directly. Otherwise the ECU could be damaged!

Here is a real harness picture:


RS232
RELAY
02S
ECT
IAT
MAP
TPS
MIL Lamp
Performance Switch
To ECU
GND
CDI_Ctrl
CKP
12V+
12V-
KEYSW
INJ
Fuel Pump
02S:02 sensor
KEYSW:key on switch
IAT:intake air temp
GND:Reference Ground
ECT:engine (coolant)temp
RS232:Computer serial port
MIL:Malfunction Indication Lamp
CDI_Ctrl:CDI Control output from ECU
CKP(Crank Position Sensor):connect to
ignition pickup sensor signal

Label descriptions

label	Descriptions	Notes
ECU	Electronic Control Unit	
RS232	Serial comm.cable to a PC computer	
O2S	Oxygen sensor	
Fuel Pump	Fuel pump power and ground	
12V-	Battery 12V-	
12V+	Battery 12V+	
IAT	Intake Air Temperature sensor	
ECT	Engine (Coolant) Temperature sensor	
Performance switch	Manual switch to select fuel tables: ECO mode vs. Rich mode	
TPS	Throttle position sensor	
MAP	Manifold absolute pressure	
INJ	Injector	
CKP	**Crank Position sensor** **Connect to Ignition pickup wire** (also called **VRS before**)	**Orange**
CDI-Ctrl	CDI control output from ECU (also called CDI-PG before)	**Gray**
GND	Ground (previously called Analog Ground)	**Green**
KEYSW	Key On switch (previously called IGNSW)	**Pink**

Note: the wire color scheme may be different for old versions. If your harness looks different than the one in the picture, please contact us for exact wiring info.

Note: some abbreviations and gloss have been changed compared to previous versions:
CKP = VRS
CDI-Ctrl = CDI-PG
GND = AGND
KEYSW = IGNSW

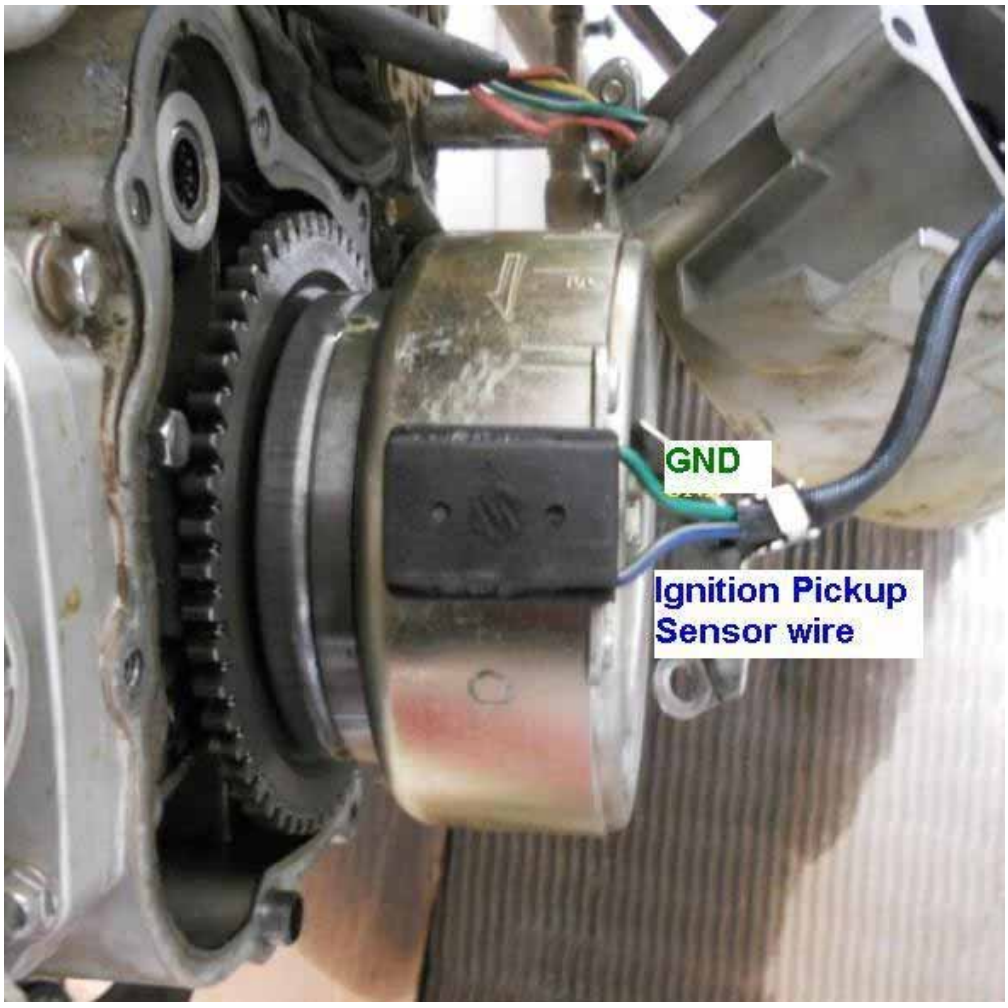
6. Ignition pickup sensor wire splice

6.1 Identify the "**Ignition pickup sensor wire and GND**" on your CDI box, refer to the below picture if you don't know how.

6.2 Tap the "**Ignition pickup sensor wire"** with the ECU **CKP** wire, (**Orange** wire on the ECU harness); and then secure the splice with electrical tape or better solder it.
This wire is the ignition pickup sensor signal (or as we called it, the Crank Position sensor – also called VRS variable reluctant sensor before);

6.3 Connect "**Ignition pickup sensor GND"** to the GND wire (**Green** wire on the ECU harness). If you don't want to use our ECU to control the CDI, **Then go to step 7**.

To tell which wire is the **ignition pickup sensor wire** and the sensor **GND** wire on the connector of CDI, refer to the below picture. Use a multi-meter to check the continuity of the wires between the ignition pickup sensor and the CDI connector.



If you don't use our ECU to control the CDI (it is a good practice not to use the ECU to control the CDI first, get the engine running and then try to use ECU to control the CDI later), Jump to Step 7.

If you want to use our ECU to control the CDI ignition timing, and if you have our 6-pin CDI included in the kit, you need to do: Cut the ignition pickup sensor wire, and connect the wire from the sensor side to the ECU **CKP** input (**Orange** wire on the harness).

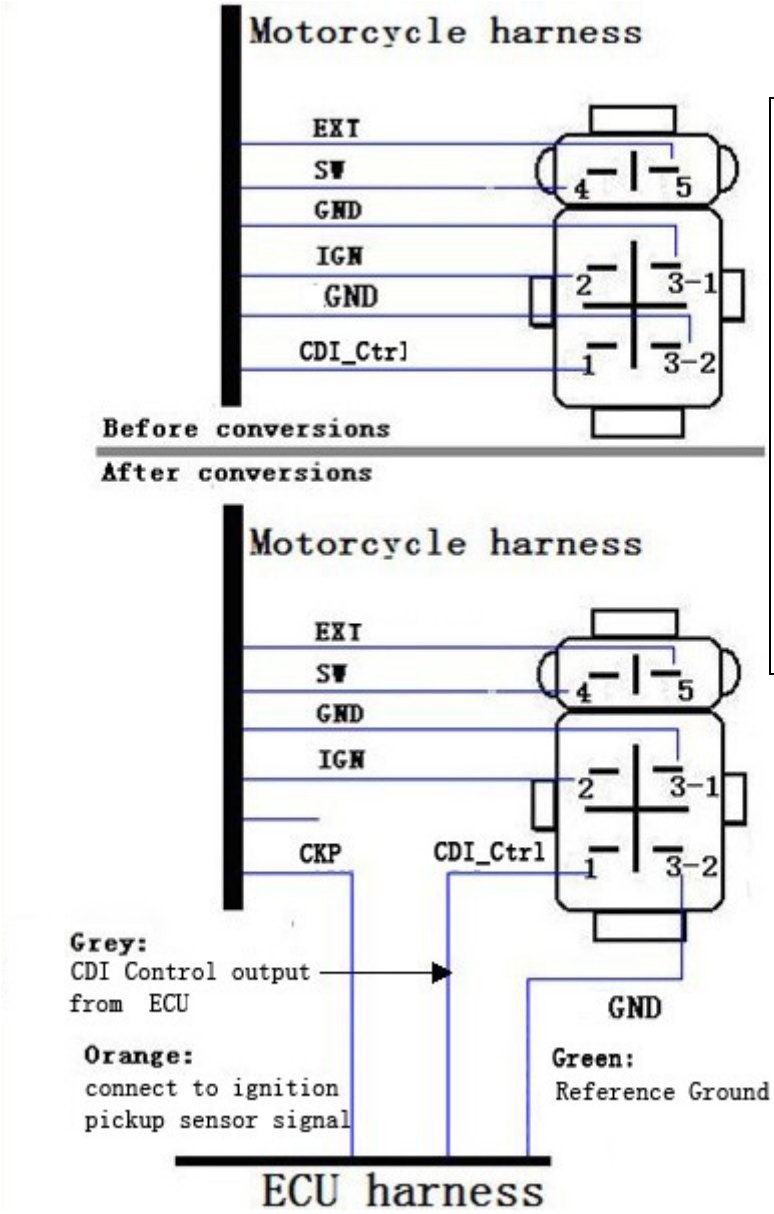
6.4 Then connect the other side of the wire you just cut (which goes into the CDI box) to the ECU **CDI-Ctrl** wire, (**Gray** wire on the ECU harness) . (for GY6 engines, see the picture below for this wire; some manufacturer called it "sensor signal" on the CDI connector).

Note: if you use our ECU to control your own CDI, it may not work, contact us to confirm.

Note: if you use your own CDI, and if you don't know the pin definitions on the CDI connector, DO NOT CONNECT CDI-Ctrl wire!

6.5 Secure both splices of **CKP** and **CDI-Ctrl** wires with electrical tape. Or better, solder them and then tape them.

6.6 For most CDIs, there are 2 ground wires (**GND**) on the CDI connector, and likely only one of them is connected to the chassis ground.. We suggest you to connect the other GND wire to the chassis ground.



EXT: External Charger, from the magneto coils
SW: Kill Switch
GND: ground
IGN: Ignition coil, to the spark plug coil, primary side
GND: analog ground, or ignition pickup sensor ground
CDI-Ctrl: or PG, pulse generation pin, trigger signal from the ignition pickup sensor.
CKP: Crank Position Sensor, to ECU.

GY6 125cc scooter 6-pin CDI wiring diagram

Note: VRS = CKP
PG = CDI-Ctrl
Just different names.

7. **Splice the "key on switch" wire**, and connect it to ECU "**KEYSW**" input (**Pink** wire).
   The "key on switch" is the 12V+ signal coming from the **key-on** signal; for some motorcycles, it also goes through "stop switch / kill switch". The location of the splice should be after the "stop switch" on the motorcycle, or after the "key switch" if there is no "stop switch". This is the ECU power-on trigger. Without this wire connected, ECU will not power on.

"KEYSW" wire can be connected to the 12V+ if there is no key-switch on the vehicle. But you must insert a manual switch between 12V+ and KEYSW input. For some customers, we pre-install a manual switch between KEYSW wire and 12V+ wire as requested.

8. Install the ECU in a safe place (it should be close to the EFI components, for example, under the seat or in the trunk.).
9. Connect all EFI components to the ECU with the provided harness (all connectors are included).
10. Connect the ECU to the 12V battery + and battery -.
11. Make sure your 12V battery– is connected to the chassis ground!
    If your engine or vehicle did not have a 12V battery before, and you just added one,
    you must connect the 12V – to chassis ground.
12. Double check and make sure all wires are connected as they should be.

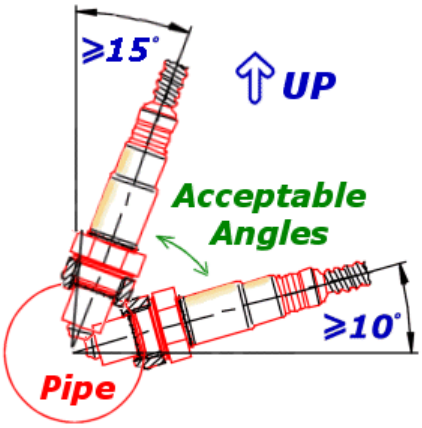
13. If your kit includes an O2 sensor, please follow the below steps to install the O2 sensor:

O2 sensor installation for vertical engines (3-4” downstream of exhaust port)

O2 sensor installation for horizontal engines (> 10 degree tilt angle)

13.1 find the correct the location to install the O2 sensor. It needs to be close to the exhaust port, but not too close (3-4” away). Rule of thumb: the O2 sensor can take the advantage of the exhaust heat, so it does not have to be heated all by itself. But you don’t want it to be heated too much, because the good temperature range is 300C to 900C.

13.2 The sensor needs to installed with a tilt angle, meaning **the sensor head must point down with certain degree**, see the picture below. Otherwise the condensation could damage the sensor.



13.3 drill a hole on the exhaust pipe. Weld the O2 sensor bung (provided) on the hole. Make sure the sensor head can be fully exposed to the exhaust gas; yet NOT to block the exhaust pipe.

13.4 install the sensor in the bung. Connect the O2 sensor cable.

Initial test:

1. Before you do the initial test of the EFI kit, make sure the installation is done as the previous section.
2. Key-on and **KEY-ON ONLY**!
3. You should hear fuel pump noise running for a short while, if this is not happening, you must have some wiring problem. Re-check all your wires!
4. If you hear the fuel pump running and then stop, this indicates the ECU is working. Now you can fill the fuel tank with the regular gasoline.
5. Repeat the above step 3 times, to make sure the fuel supply lines are filled up with fuel.
6. Try to key-start the engine.
7. First time you start the engine, there may be still some air bubbles in the fuel supply system needs to be purged. So don't be surprised that the first start takes longer, or even you need to start multiple times to be successful.
8. If the engine does not start, go to the next section for diagnosis.
9. After the engine starts, if it's rough idling; let it warm up, and let the ECU self-adapting to the engine for a while.
10. After the idle stabilizes, drive the vehicle in a steady state (constant throttles or constant speeds) at different throttle/speeds. Let the ECU self-adapting further.
11. Then you can try different transient conditions, like fast opening of the throttle, etc.

My engine does not start, why?

Please follow the below trouble shooting procedures:

1) Have you followed the installation manual completely?

    1.1) Can you tell that the ECU is controlling the fuel pump?
        1.1.1) When you turn on the key, do you hear the fuel pump running for a few seconds, and then stop? If not, you have wiring issues.
        1.1.2) Key-off for 3s, and key-on, , do you hear the fuel pump running for a few seconds, and then stop? If not, you have wiring issues.
        1.1.3) Every time when you try to start the engine (engine spins for a few revolutions), do you hear the fuel pump running until engine stalls? If yes, your wiring is good.

    1.2) Do you have the fuel pump installed correctly?
        1.1.4) Is the fuel pump lower than the tank? The fuel pump must be lower than the tank to avoid fuel starvation. The fuel pump can be higher than the injector, if limited by the space.
        1.1.5) Have you replaced the “petcock” tank valve with a manual valve? EFI does not work with the petcock.
        1.1.6) Do you have a fuel return line back to the fuel tank? Our EFI kit currently needs a way to return the fuel to the tank.
        1.1.7) Is there impurity in the gasoline? Check your fuel filter.

    1.3) Do you have the ignition pick up sensor connected correctly?
        1.2.1) Do you have a correct pick up signal input to ECU (CKP wire on the harness)?
        1.2.2) Do you have the ground wire of pickup sensor connected to ECU ground wire (GND wire on the harness)?
        1.2.3) Are you using the stock ignition system (to isolate the starting problem, please use the stock ignition system)?
        1.2.4) Can you tell the spark plug is firing whey you try to start?

    1.4) Do you have the MAP sensor installed correctly?
        1.3.1) Is the MAP sensor connected to the throttle tube via the small hose (included in the kit) ?
        1.3.2) Is the intake air system air tight (no other way for free air going into the cylinder except through the throttle)?

2) Do you have the MIL Lamp on (if your harness comes with a MIL Lamp installed)? If yes, go to next step.

3) Install the ProCAL (coming in the CD, or contact us for the latest version):

3.1) ProCAL does not support Windows Vista at this moment. Please use Windows XP (the most tested environment), or Win7.
3.2) I installed the ProCAL into my computer, but it does not talk to the ECU: please check your USB-RS232 convert and the required USB driver. Or better: use an old computer which has a RS232 COM port built-in to rule out the USB converter problem.
3.3) Establish the communication between the ProCAL and the ECU: menu → run → connect ; then menu → run → start measuring; you should see the variables in the "Display Variables" window changing.
3.4) Read diagnostic trouble codes by goto: menu → diagnosis → run diagnosis → read DTC.

4) With the ProCAL communicating with ECU, do the below tests:

4.1) Try to start the engine (with the engine spinning), Read the variables in ProCAL:
4.2) Does the signal "**N**" changing from 0 to some value > 300rpm?
4.3) Does the "**Map**" signal drops from about 1013hPa to below 600hPa?
If either of the above 2 is NO, you could have some wiring problem.
If both the above are YES, you could have fuel supply issue: air bubbles in the fuel lines, or fuel clogged somewhere.

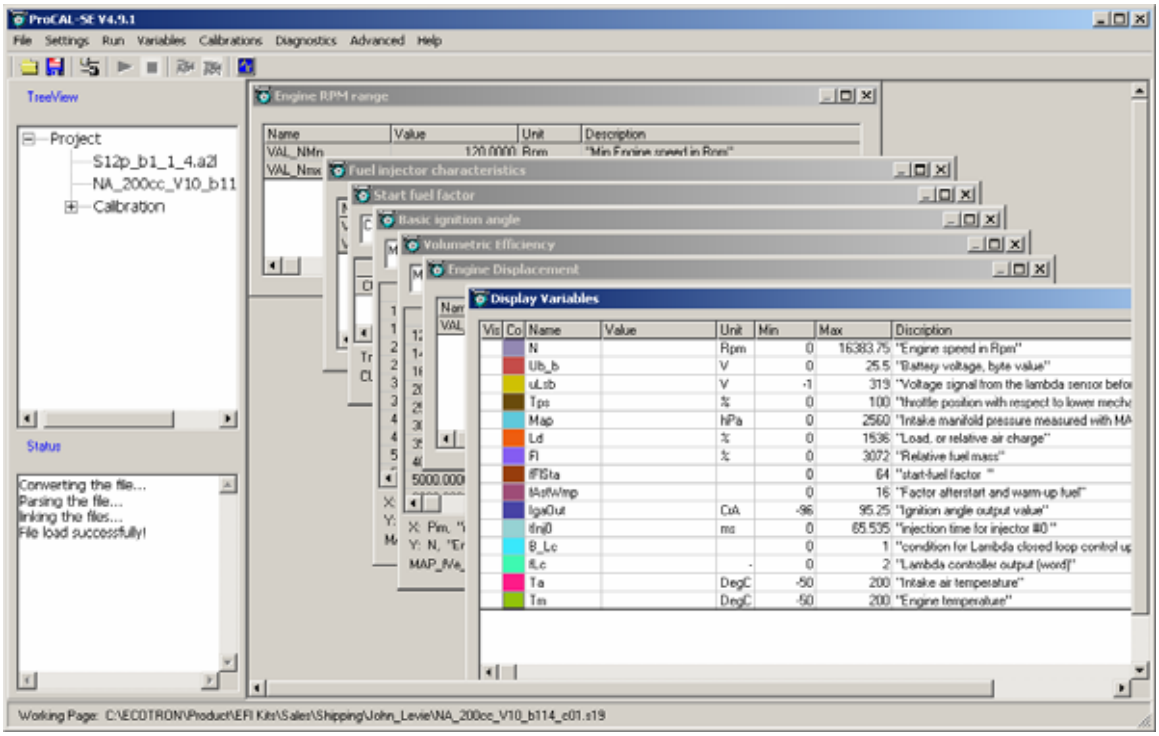
5) To rule out the problem of the ignition pickup sensor, do the below tests:

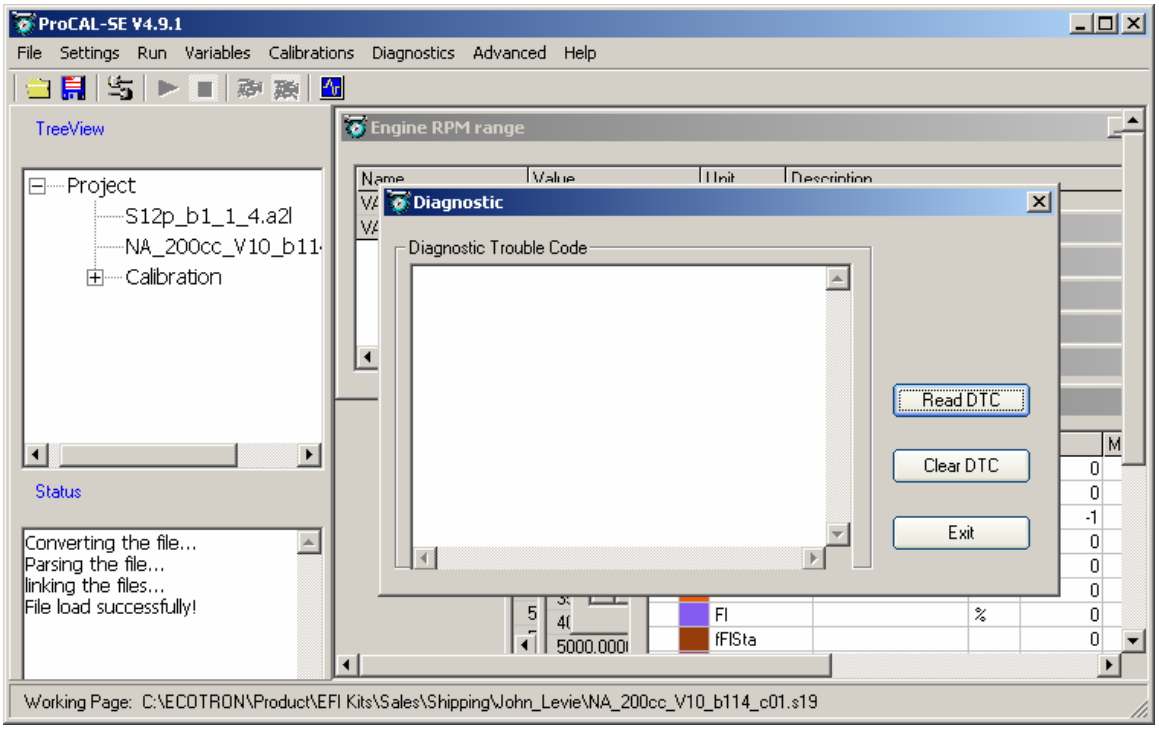
5.1) Disconnect both CKP wire and GND wire from the ignition pickup sensor and tape them;
5.2) Make sure the stock ignition system is untouched;
5.3) Try to start the engine, and check the below :
5.4) Does the signal "**N**" changing from 0 to some value > 300rpm?
5.5) Does the "**Map**" signal drops from about 1013hPa to below 600hPa?
If either of the above 2 is NO, you could have some wiring problem.
If both the above are YES, you could have fuel supply issue: air bubbles in the fuel lines, or fuel clogged somewhere.

6) With all the above questions and tests done, you still can not figure out why the engine does NOT start, please contact us directly: info@ecotrons.com

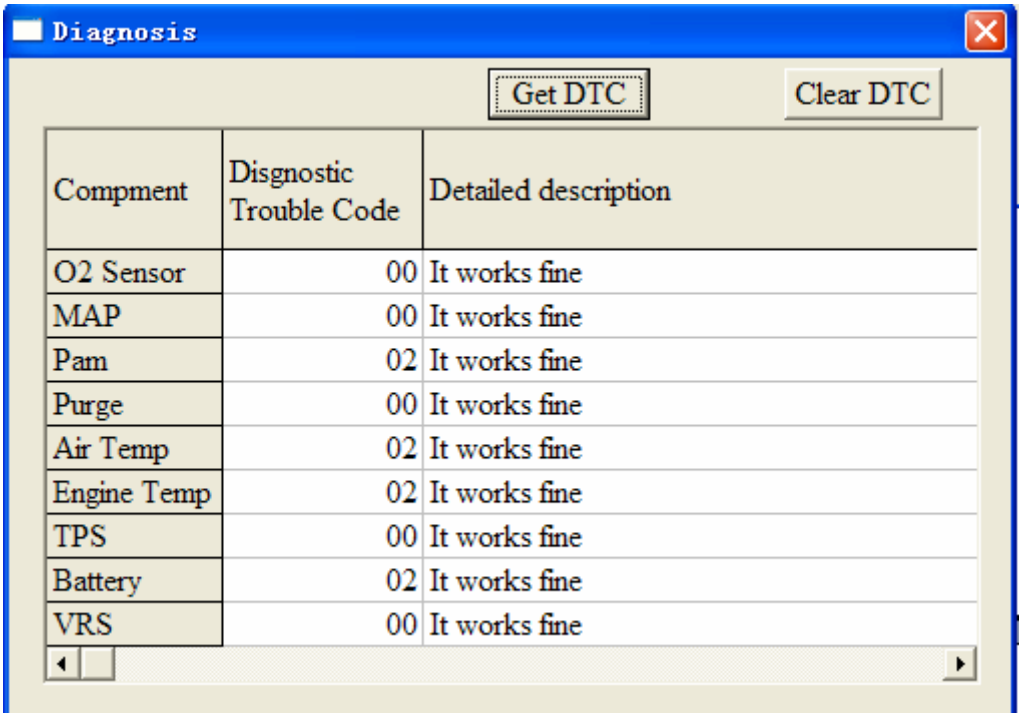
Diagnosis:

1. Install the SE-EFI tuning software, "**ProCAL-SE.exe**", to a personal computer (PC), if you have not done so.
2. Connect the PC to the ECU, via the serial communication cable (RS232 communication).
3. If this computer does not have a serial com port, you need a RS232-to-USB converter.
4. For the USB converter, It may ask you to download the USB driver "PL2303 USB to RS232 driver" from internet (free ware).
5. Run the diagnostic software, "**ProCAL-SE**" from "Start→ Program→ ProCAL-SE".
6. Use the "ProCAL manual", provided in the CD as your reference
7. Password is "abcd", in case you were asked for password. Most likely not needed;
8. Make sure the ECU is key-on (KEWSW is on).
9. In ProCAL menu, goto "Run →Connect".
10. If you can NOT establish the communications between your PC and ECU, follow the next chapter for serial com diagnosis;
11. In ProCAL menu, Goto "Diagnosis".
12. Click "read DTCs".
13. Make sure there is no DTC shown up. Otherwise go to section: Diagnosis of the EFI kits.
14. If there is no DTC, key off wait 5s and then key on again. You should hear some small noise from the fuel pump every time key-on.
15. If after 3-5 times tries, and the engine still does not start, then follow the diagnosis instructions in section Advanced Diagnosis.





Click “Read DTC”:



Supported DTC list (TBD)

Diagnosis of your serial communications:

1.1 Check your serial communication cable, make sure the cable is pushed in completely.

1.2 Check your USB driver installed. You can download the USB driver “PL2303 USB to RS232 driver” from internet.

1.3 Try click the “Advance” button, select COM1 port.

1.4 Or better, try a computer that has a RS232 Serial COM port, to rule out the USB converter problems.

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Advanced Diagnosis:

The advanced diagnosis documentations are still under development, contact us for specific questions…
It is always helpful if you can log the data with ProCAL and send us with your questions:

How to use ProCAL to log data:

1) Run ProCAL (load the correct A2L and CAL file).
2) go to menu -> run -> connect
3) go to menu -> run -> dispaly -> select "number" instead of "gauge"
4) go to menu -> run -> start measuring (the numbers in the display window should change now...)
5) go to menu -> run -> start recording
6) when you done the test, go to menu -> run -> stop recording
7) go to menu -> run -> data analyzer
8) In Data Analyzer, click "load", it will pop up a window, show the folder: "...\record"; that's where the logged files are.
9) Note, every time, the ProCAL can log multiple files, with the same name except the different suffix: _20ms, _100ms and/or _syn; These files are logged at the same time, but at different sampling rates. You will need to copy all those log files, and send them to us.(don't change file names)

How does the performance switch work ?

"Performance Switch" has 2 positions: ECO vs RICH.
In ECO position, the EFI will run the base fuel "map", or stoicometric AFR (normal cases), which gives the best fuel economy, and least emissions.
In RICH mode, the EFI will run the enriched "map", or rich AFR (at high load, high RPM, esp. at WOT), which gives more power.

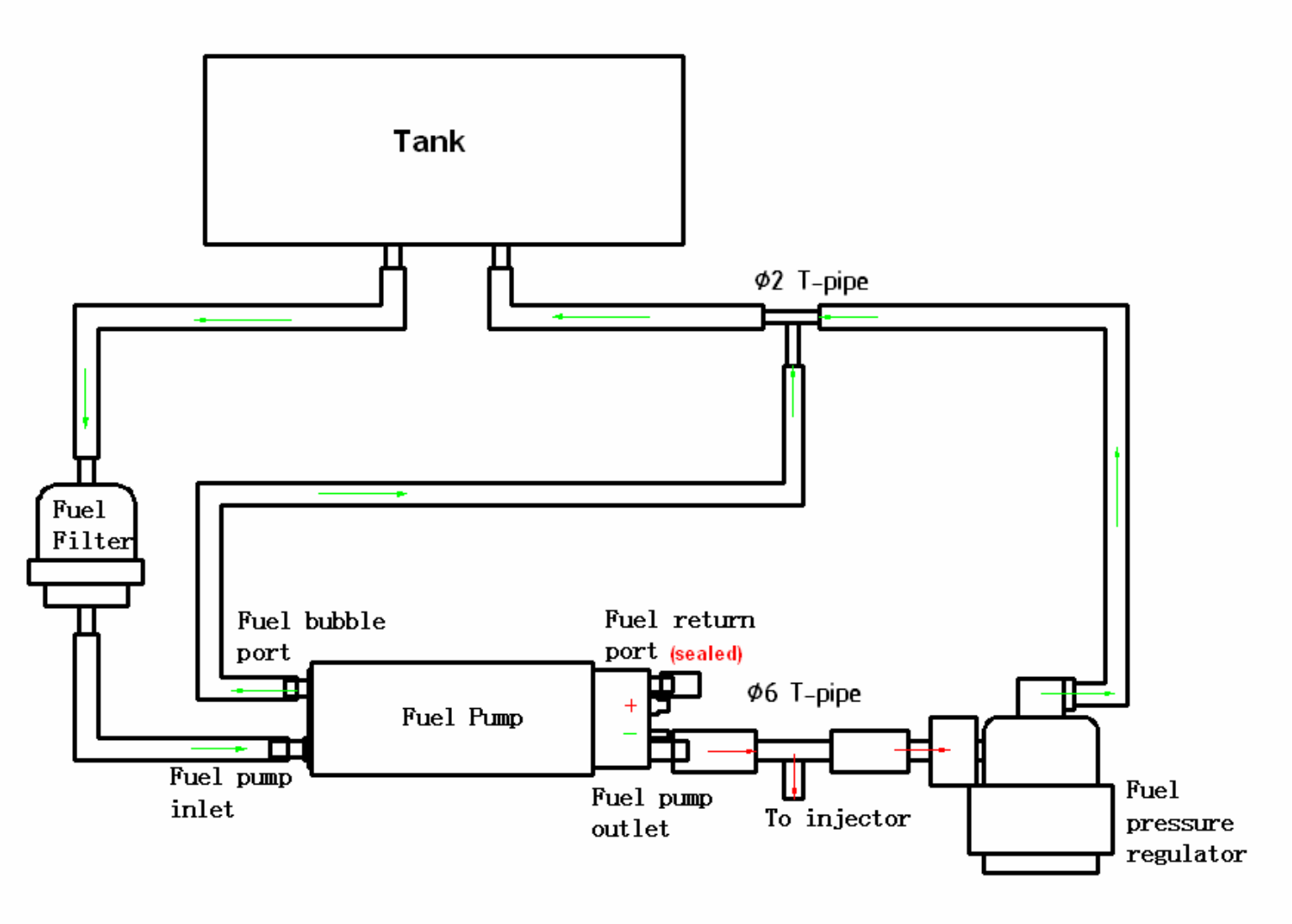
"Performance Switch" is meant to let the user's easily switch between the economy and enrichment modes in real-time, so that he can run for economy when cruising around the town; and can immediately switch to performance mode as he wants.

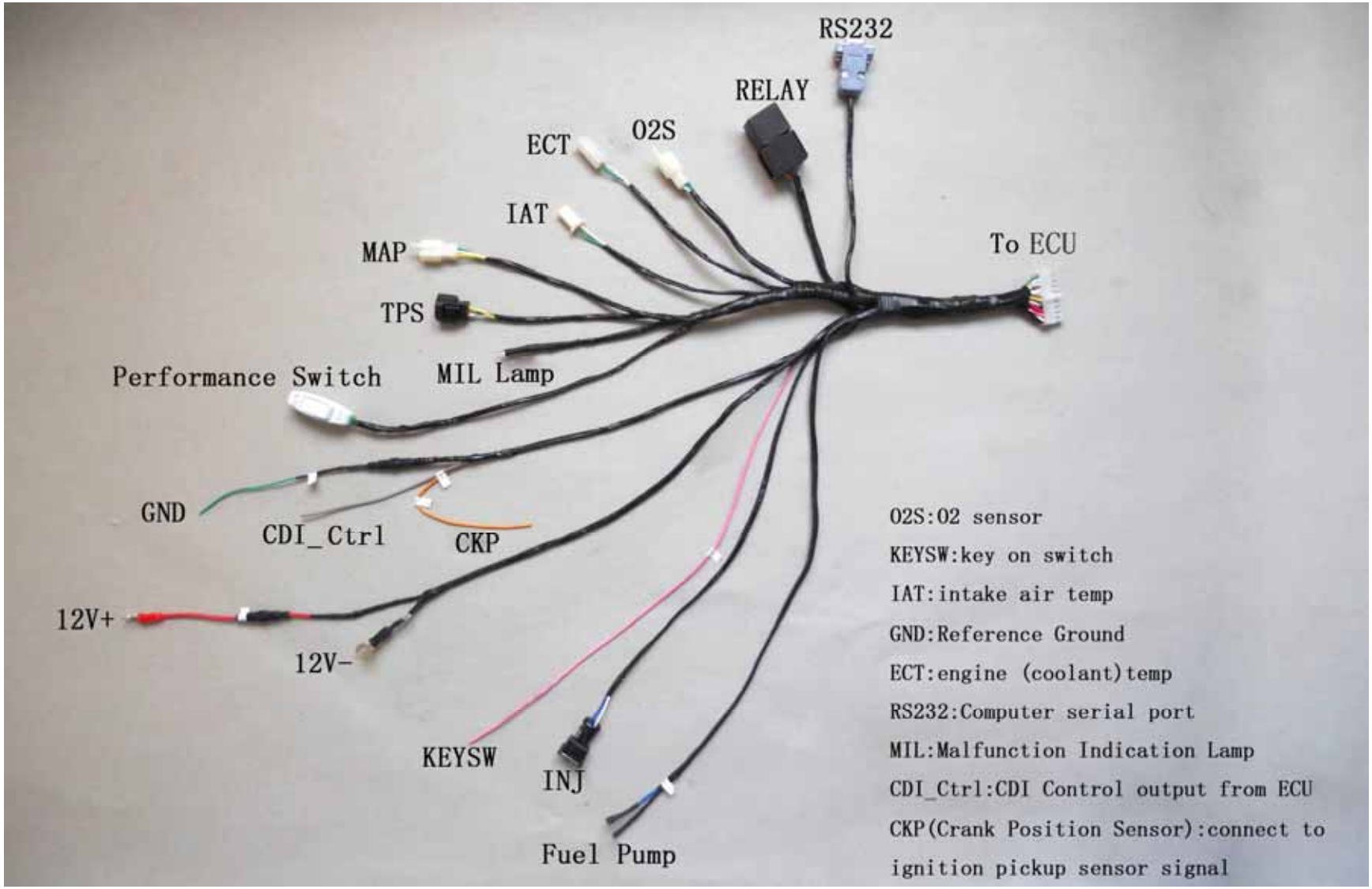
OFF -> ECO -> STOIC
ON -> RICH -> POWER

Appendix: fuel supply systems,

Appendix: Wiring harness diagram

Appendix I: Fuel supply system schematics:




RS232
RELAY
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O2S
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To ECU
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12V+
12V-
KEYSW
INJ
Fuel Pump
O2S:02 sensor
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ignition pickup sensor signal