

# SE-EFI

Small engine electronic fuel injection  
– Conversion kit.

## Honda GX390 Installation Manual

ECOTRONS LLC

V1.2

<http://www.ecotrons.com/>

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Note: this manual is written based on a conversion with a Honda GX390 engine, but it can also be used as guidelines for other similar engines. Some common sense shall be used to convert different engines. If you are not sure about any specific details, please contact us at [info@ecotrons.com](mailto:info@ecotrons.com).



## SE-EFI Kit

# Introduction

SE-EFI is an Electronic Fuel Injection conversion kit for small engines. This install procedure is a customized version for the Honda GX390. It is only a hardware installation guide. It does not cover any tuning or ECU Programming. The locations of the components are up to you, the ones shown here are preferred locations by some early adopters.

This EFI kit has below features:

- Electronic fuel injection (EFI)
- Quick engine start even at cold temperatures
- 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
  - Throttle body (including TPS sensor)
  - Fuel injector
4. Fuel pump assembly
  - Fuel pump (outside of the tank)
  - Fuel pressure regulator
  - Fuel filter
  - High pressure fuel line
  - Fuel hoses T-Pipes Clamps
5. MAP sensor
6. Engine temperature sensor
7. Intake air temperature sensor
8. Serial communication cable (to a computer)
9. USB adaptor – included
10. Oxygen sensor and bungs (optional)
11. CD for tuning software (downloadable from our website)
12. CDI – ECU controlled (optional, you can use your own CDI).
13. Ignition Coil – Either CDI driven or ECU driven inductive type coil (optional)
14. Hall Effect Sensor (N-pole)

**Note:**

The kit needs 12V charging system for power supply. The charging requirement is 5A current max or 60W power as the minimum. This kit may need tuning to achieve some desired results.

Though the EFI is meant to reduce the emissions than a carburetor system, 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.

**Major components:**



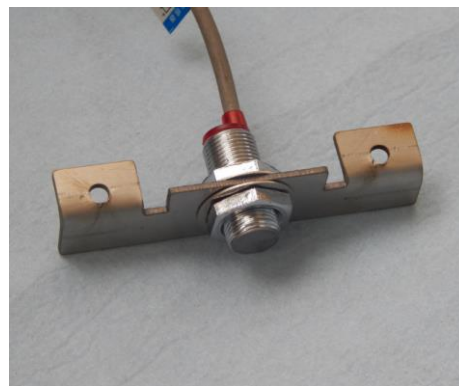
ECU



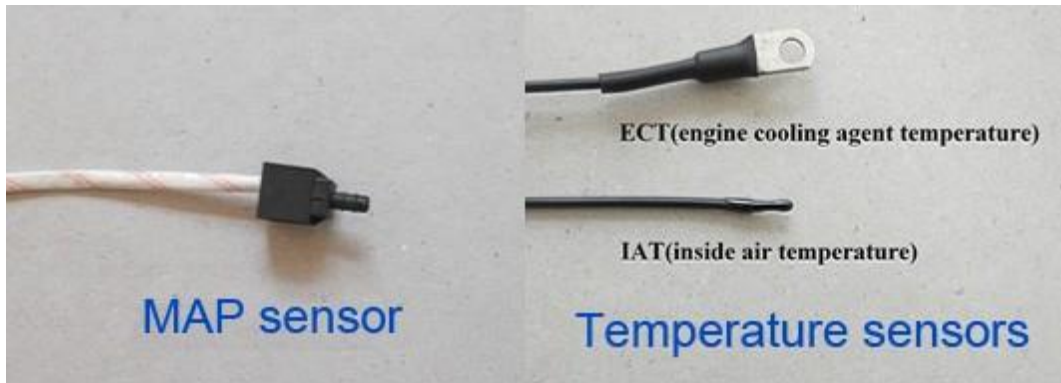
Harness,



Throttle body

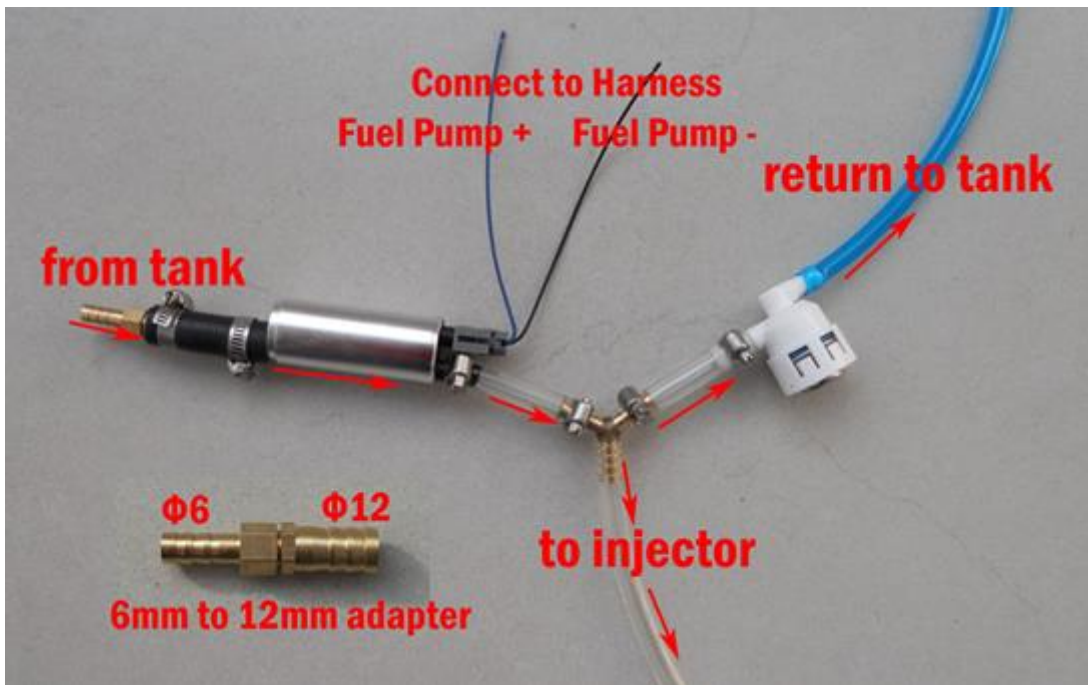


Hall Effect Sensor



Map sensor

Temperature sensors



Small fuel pump assembly (without a bubble port)

# Installation Procedures

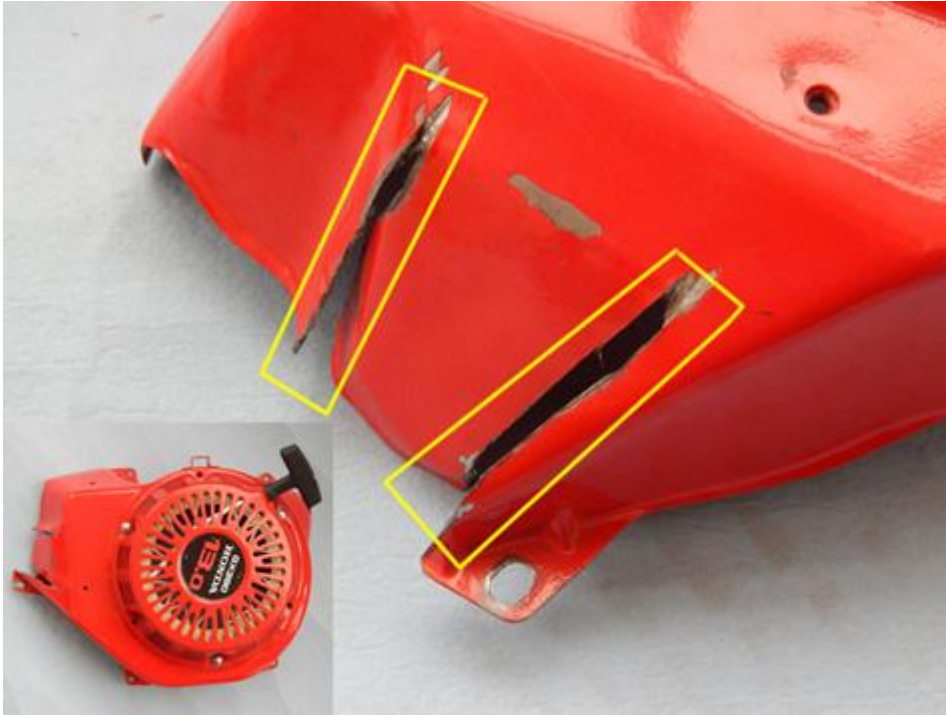
## 1. Replace the carburetor with the throttle body assembly

### 1.1 Remove the air filter, the carburetor and fixed screw.





**1.2 remove the engine case, and use the chainsaw saw two lines.**



**1.3 Install the intake manifold (You need make an intake manifold).**



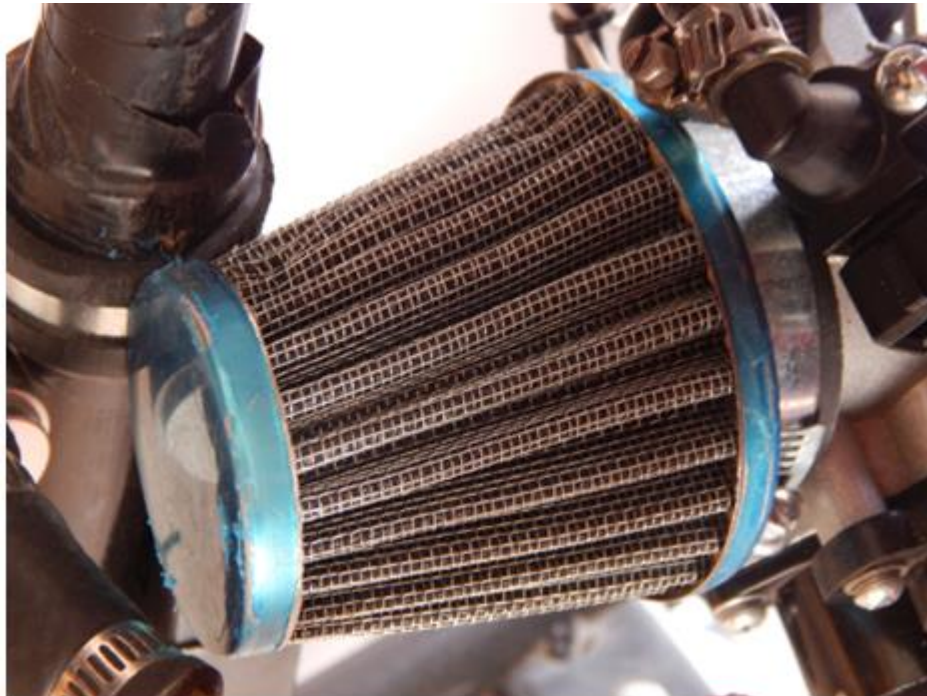


#### 1.4 Install the throttle body:

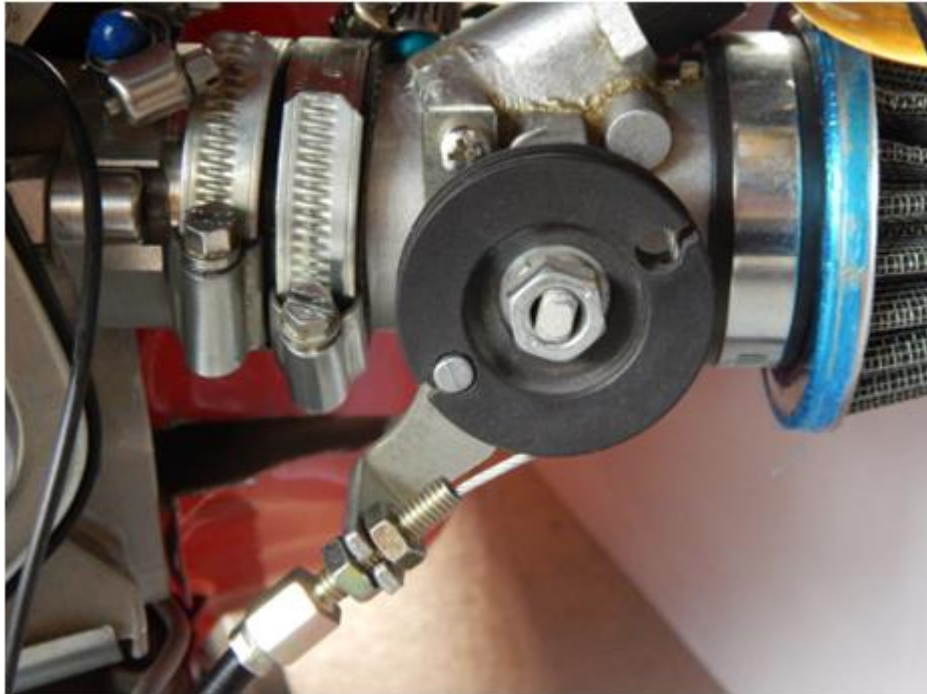


**Note:** The TPS sensor has been installed on the throttle body.

#### 1.5 Connecting the throttle body inlet to the air hose from the air filter;



**1.6 Install one suitable throttle cable to the throttle body. The stock exiting cable can't be used on the throttle body.**



**1.7 Install the MAP sensor.**

Find a secure place to install the MAP sensor. You'd better fix it to the frame which can protect it from hot engine. And Connect the MAP sensor to the intake manifold with the small pipe.



**Note:** Important Notes for installation of the MAP sensor:

- Connect the Map sensor to the manifold or the throttle body (downstream of the throttle plate), and make sure it is air tight! MAP sensor is meant to measure the pressure between the throttle plate and the intake valve.
- You need a short hose to connect; no less than 2 inches or 5cm long, no longer than 4 inches or 10cm. too long a hose can cause some deviation of the sensor reading.
- The MAP sensor should not be too closed to the engine block. Air cooled engine block can get to 200 degree C which is much higher than the MAP sensor working temperature. This can damage the Map sensor.
- MAP sensor itself is not fuel proof. You shall avoid fuel getting into the MAP sensor chamber. This means you shall install the MAP sensor on top of the throttle body or manifold, so that the gravity will pull the fuel down to the manifold, in case the fuel gets into the tube.

Make sure the MAP sensor hose is not severely bent, or not routed in circle; otherwise a pocket could be created and the fuel puddle gets stuck there. Fuel puddle could also get into the MAP sensor and damage it.

## 2. Fuel tank modification

2.1 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).

2.2 We now have a fuel tap for some engines. It has a feed-tube and return-tube built-in. The fuel tap replaces the stock petcock easily. For those engines, you do NOT need to modify the tank any more! Note: this fuel tap does not apply all engines. So far we have it for Ninja 250r engine, DR650 engines, and some others.

2.3 If you don't have an applicable way to return the fuel back to the tank,

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

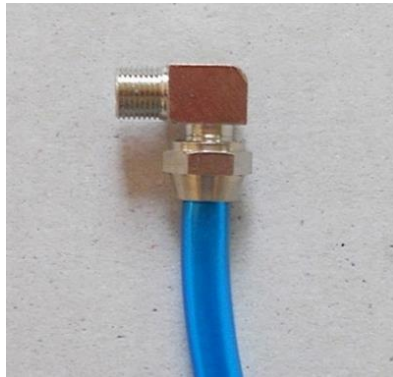
2.4 Take the fuel tank off, if necessary.

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

2.6 Use provided fuel return-line nipple to fit to the tank and tighten it with a nut. And seal it.

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

2.8 Install the fuel tank back.



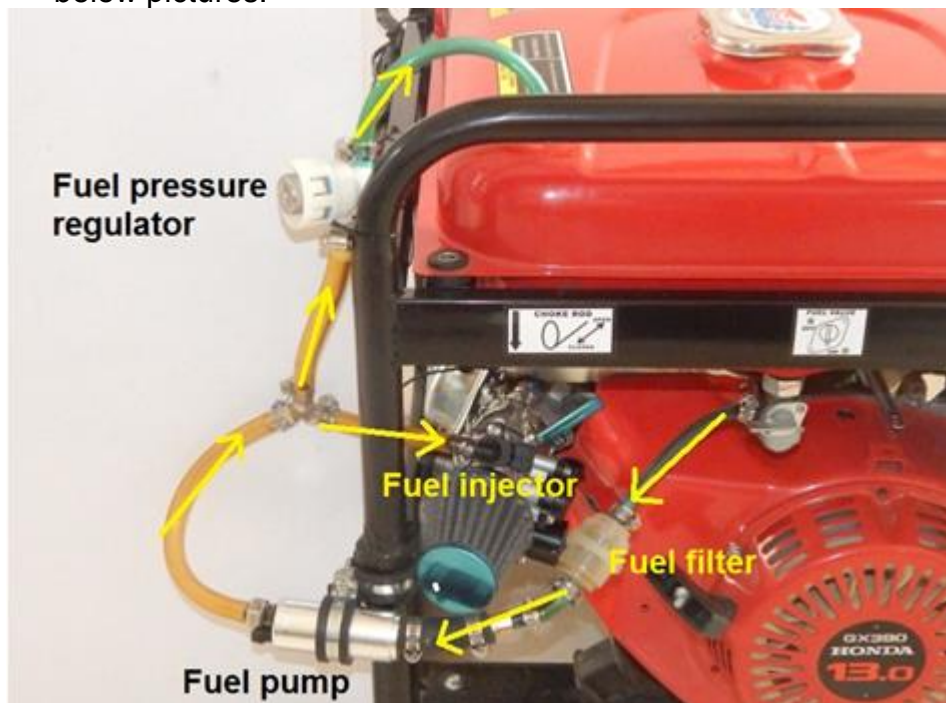
Fit the fuel returns line to the tank with the fuel tap (need to drill a hole)





### 3. Install fuel supply system

- 3.1 Find a **safe place** to install the fuel pump: it should be between the fuel tank and the throttle body, so that both the fuel feed line and the fuel return 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 fuel feed 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 lines from the fuel pump to the fuel injector, which is located on the intake manifold or throttle body, and the fuel pressure regulator.
- 3.4 make the fuel pressure regulator return line return the fuel to the tank.
- 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:

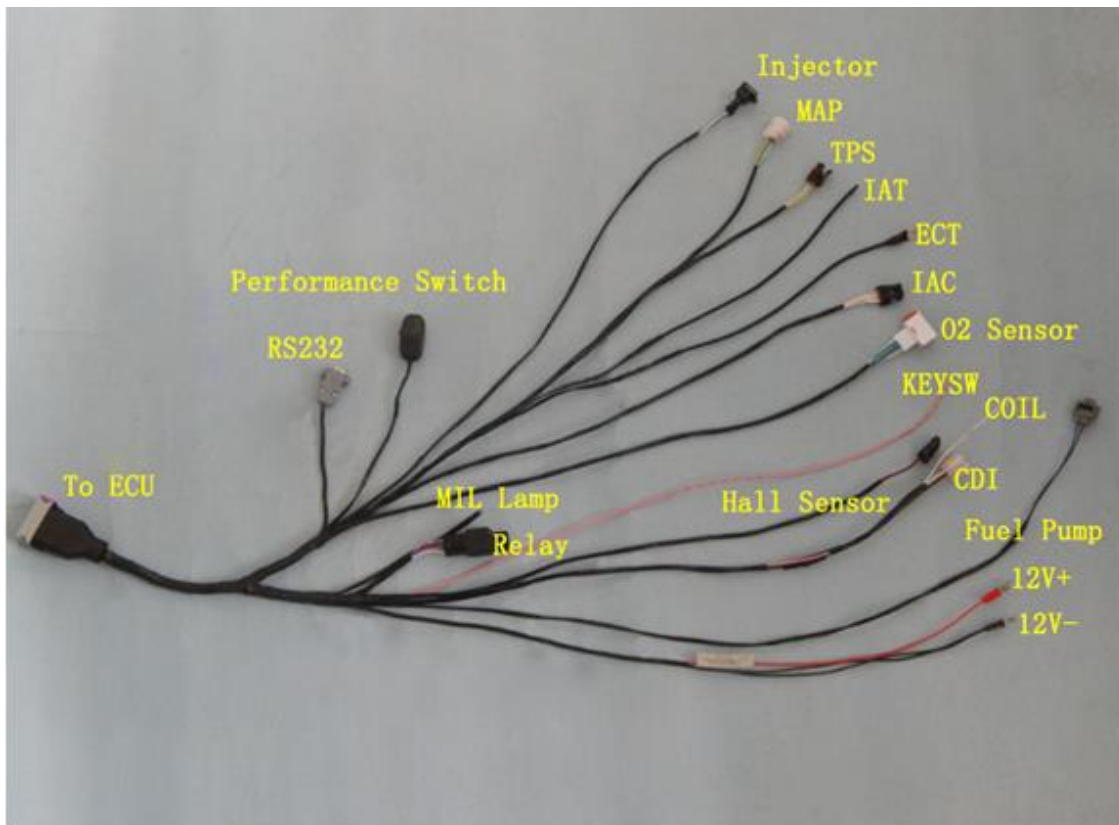


## Section 2: Install ECU harness

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:





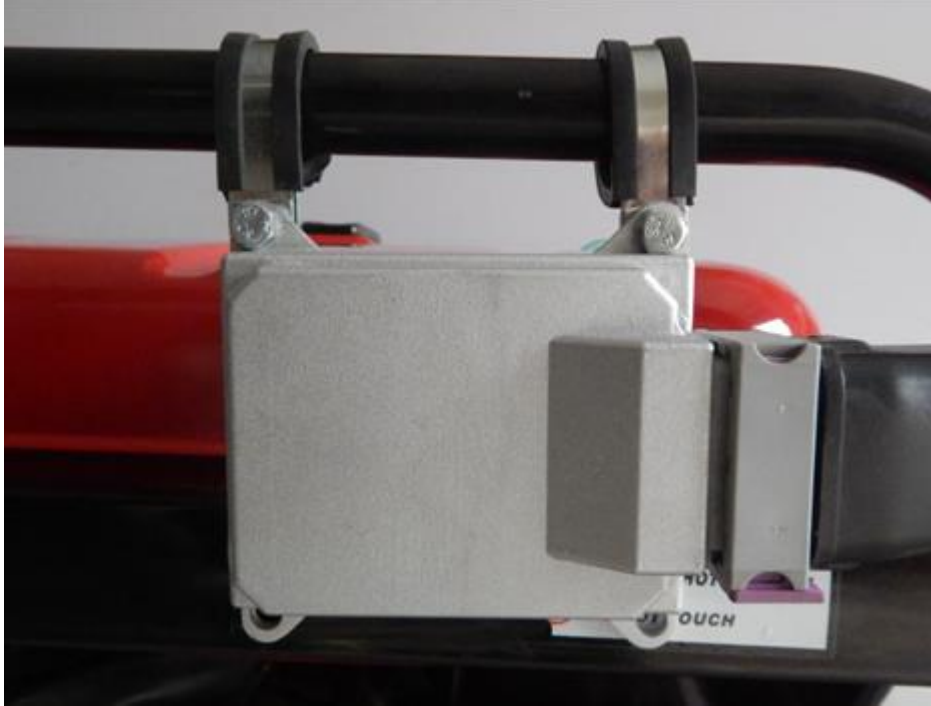
## Label descriptions

<b>label</b>	<b>Descriptions</b>	<b>Notes</b>
ECU	Electronic Control Unit	
RS232	Serial comm. cable to a PC computer	
O2 Sensor	Narrow band 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	
Hall Sensor	Connect HALL Effect sensor	
CDI connector	CDI unit	
COIL	Ignition Coil control output from ECU	<b>white</b>
KEYSW	Key On switch (previously called IGNSW)	<b>Pink</b>
IAC	Idle air control motor	

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.

## 4 Electronic Control Unit.

Install Ecotrons' ECU unit in a suitable place, such as fixed it on the frame.



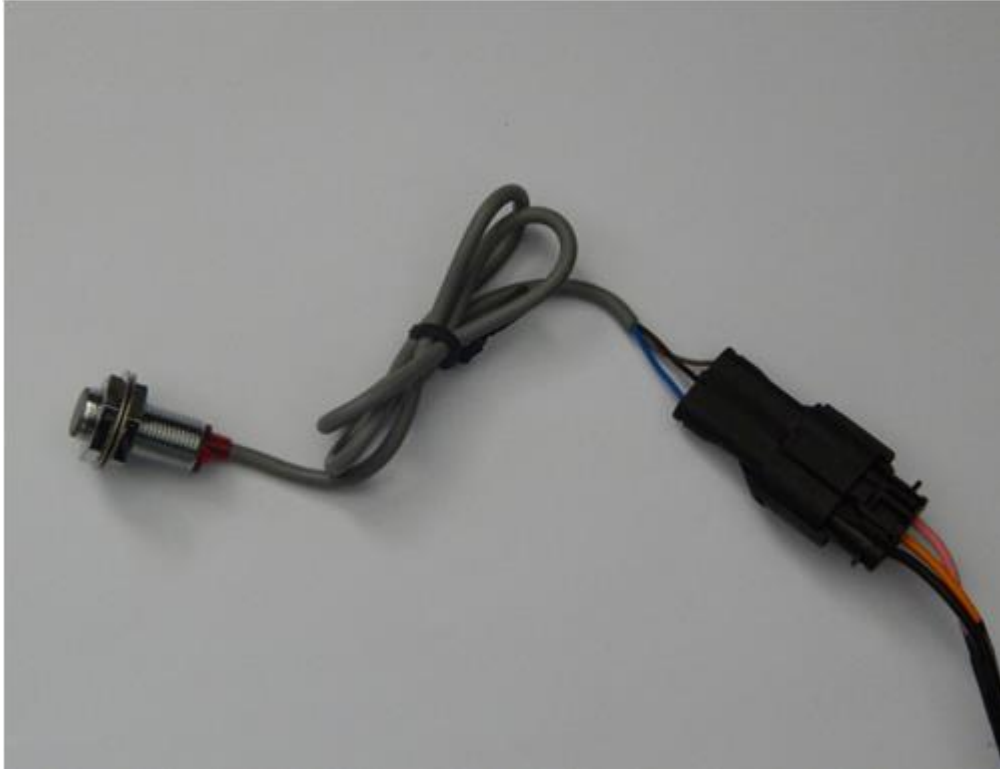
## 5 Harness Routing

Find suitable locations for the harness.

## 6. Install the Hall sensor

Ecotrons supplies hall sensor as your pick up sensor. So you need install it first. If ECU needs control the CDI to fire, you need replace the original ignition coil with the hall sensor and Ecotrons CDI. If not, only install the hall sensor, and do not remove the original ignition coil.

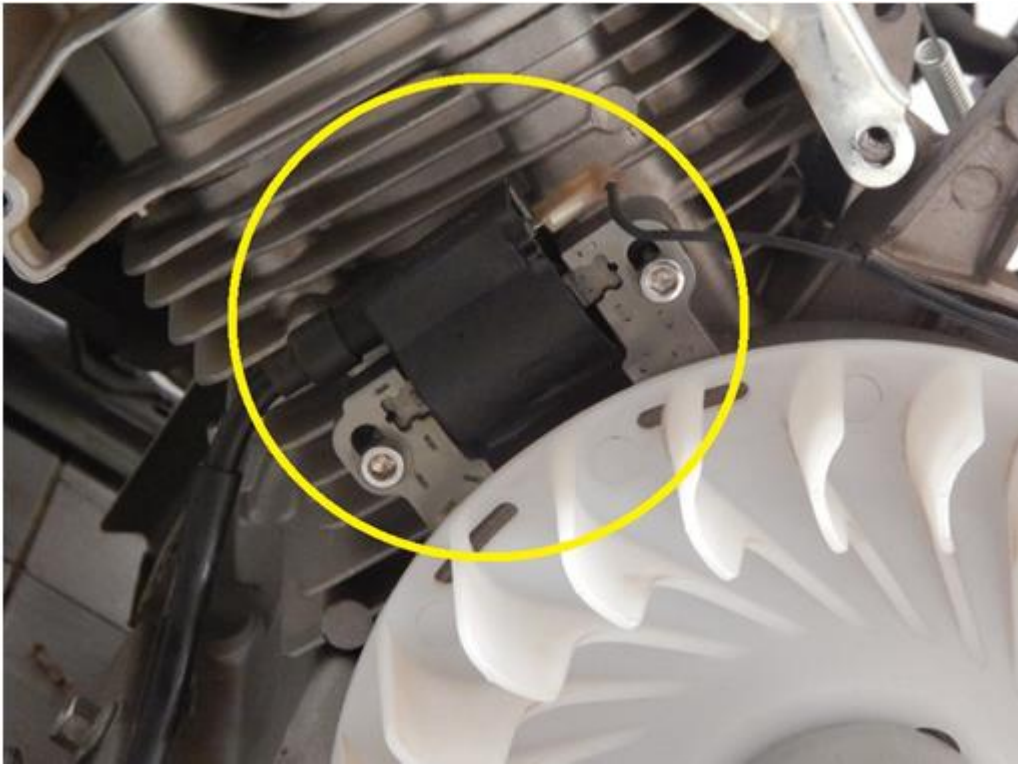
**6.1 The hall sensor connector has been included in the harness.**



## **6.2 Use Ecotrons' CDI to control ignition**

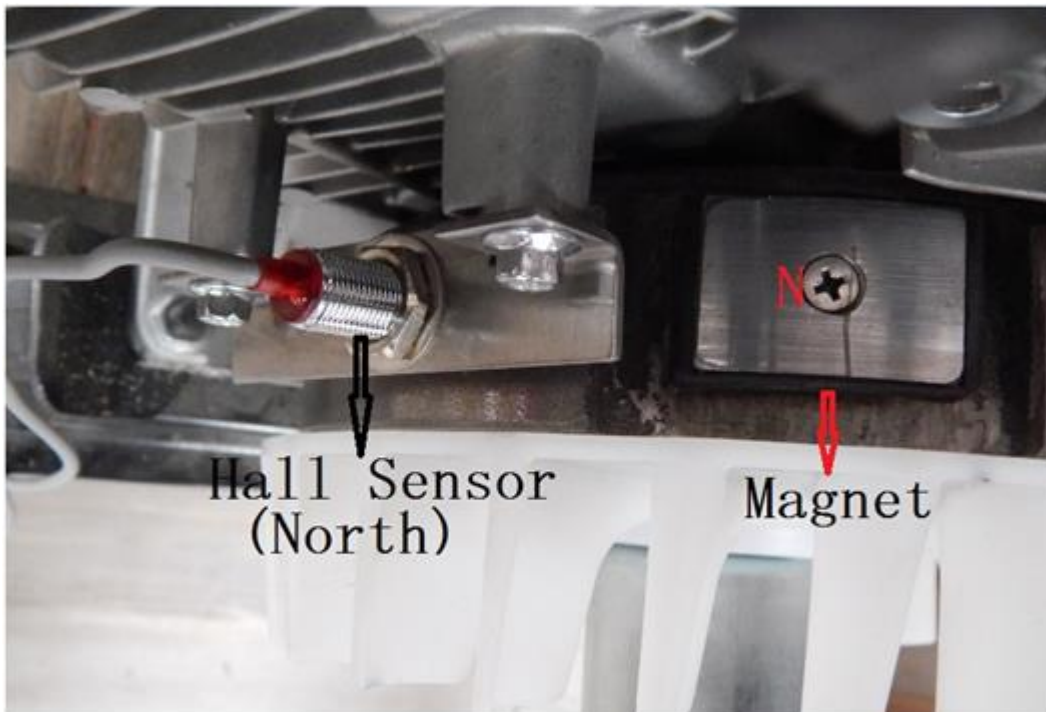
In this case, ECU controls CDI to fire, and controls fuel injection too. You need replace the original ignition coil with Ecotrons' CDI and Coil.

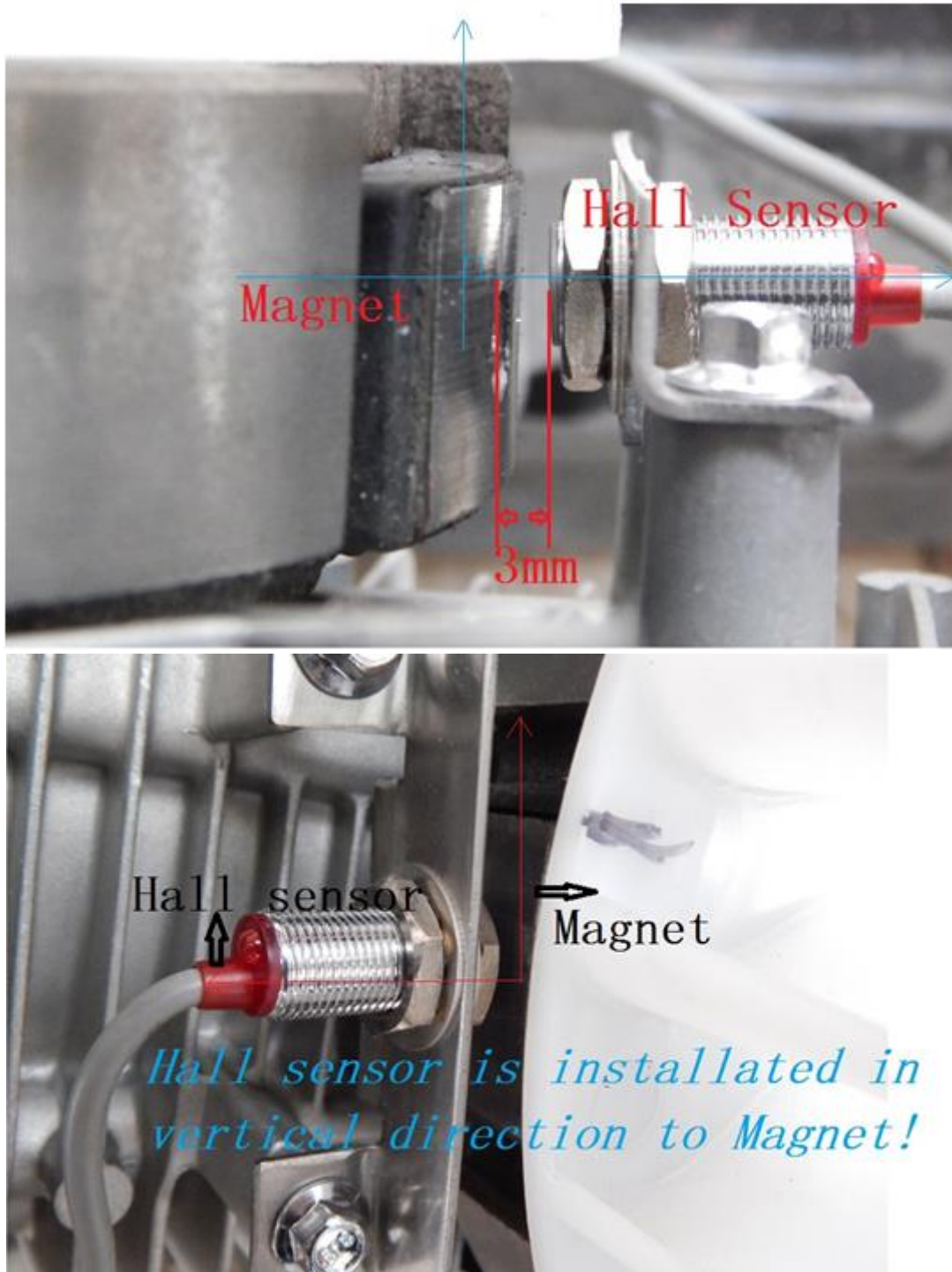
### 6.2.1 Remove the stock ignition coil.



### 6.2.2 Install the hall sensor like below pictures.

There is only one N-pole magnet on the flywheel, so we use the N-pole Hall Effect sensor.





**Note:**

1. The clearance between Hall sensor and Magnet is better at 3-5mm.
2. The Hall sensor location and the clearance between the sensor and the magnet are critical for the Hall sensor to generate the correct pulse signal. The

best way is to use an **oscilloscope** to measure it!

3. The clearance between the Hall Effect Sensor to the magnet is not too close or too far, and the range from 3mm to 5mm is normal. And the Hall sensor must be vertical to the magnet, not tilted.

4. The pulse width of the Hall sensor should be 60 us (micro second) to 15ms (millisecond). You can verify the Signal of Hall sensor with an Oscilloscope when cranking to start:

### **Why the ECU doesn't work when finished installing Hall Effect Sensor?**

1) Q: When install the Hall sensor, the LED is flashing when it passes through the magnet, but ECU can't read any signal.

A: Step 1: Please check the A2I and CAL file whether is suitable for Hall Sensor. Or connect us and send back the A2I and CAL file, we will help you to check it.

Step 2: check the wire connection, the power of Hall sensor, and the signal wire is wired to CKP (Orange) from harness. Check the CKP (Orange wire) pin whether loosed from the ECU connector?

Or take some photos and send to us.

**Note:** If it has a connector in the harness, you just need plug it.

Step 3: Further Check: use an oscilloscope to measure the signal from the CKP wire.

When the Hall sensor is aligned the magnet, the LED is on, the voltage is 0V (low voltage); and when the Hall sensor is not aligned the magnet, the LED is off, the voltage of signal is 12V (high voltage).

If it doesn't have the pulse, the Hall sensor is broken, please change a new one and send the broken sensor to us.

2) Q: when install the Hall sensor, ECU can read RPM signal, but it is not easy to start or running unstable

A: the installation of Hall sensor is not right or suitable, please install the Hall sensor in the right way, and please install the Hall sensor according the sample picture in strict way.



**Note:** The clearance between Hall sensor and Magnet is better at 3-5mm  
Hall sensor is installed in vertical direction to magnet.  
Also the sensor should face to the center of the magnet.  
Both length and width of the magnet must be 12mm at least.

3) Q: I use the stock magnet, but it has two or more magnets on the flywheel, the engine can't start

A: if you use the stock magnet, and it has more two magnets, it may produce more noise signal, the ECU can't read it.

So, please use the corresponding Hall sensor to match the stock magnet, for example, the stock magnet is N-pole, you need use an N-pole Hall sensor; the stock magnet is S-pole, you need use a S-pole Hall sensor.

Other way, you erase the stock magnet, and use the magnet comes with EFI kits.

If more than two magnets, I advise you use the magnet from us and erase the stock magnet.

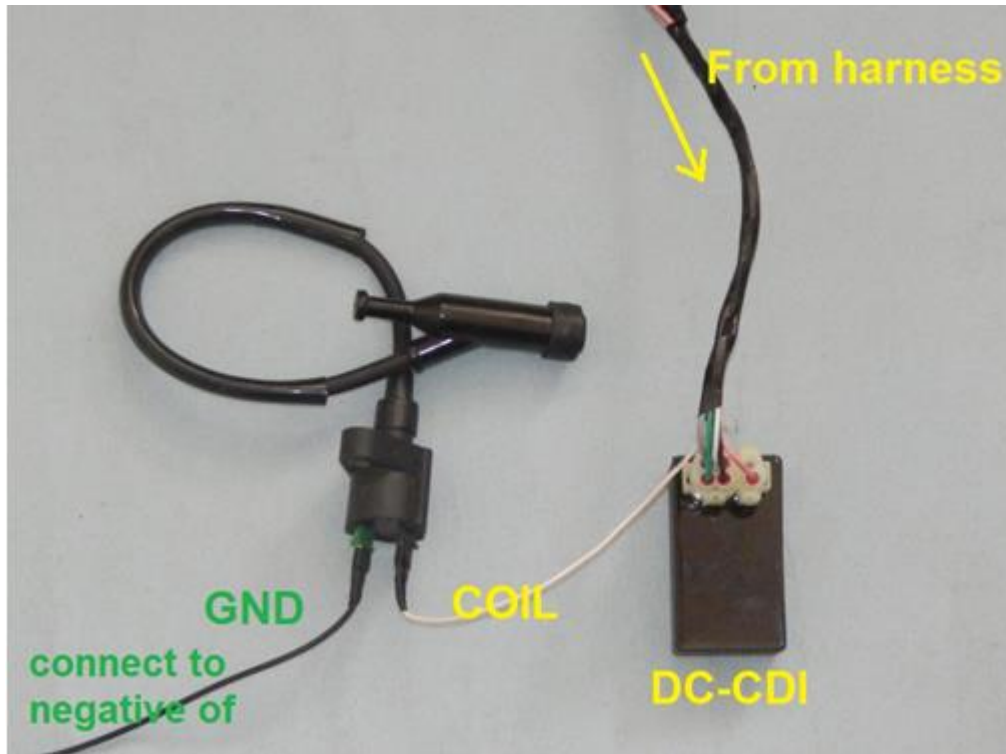
4) Q: I didn't order a Hall sensor, but I install a Hall sensor later

A: please install the Hall sensor in the correct method, and connect us, we will send the software for the Hall sensor system.

### 6.2.3 Install the CDI and Coil

We will provide the Hall Effect sensor, DC-CDI, and Coil on the EFI kits for ignition system.

Find suitable locations for the CDI installation. Connect them as flows.



**Note:** the spark cap of coil is not suitable for the stock spark plug; you need do some things to fit it.

1) This is stock ignition system.



2) Cut off the two coils by using a knife or shears

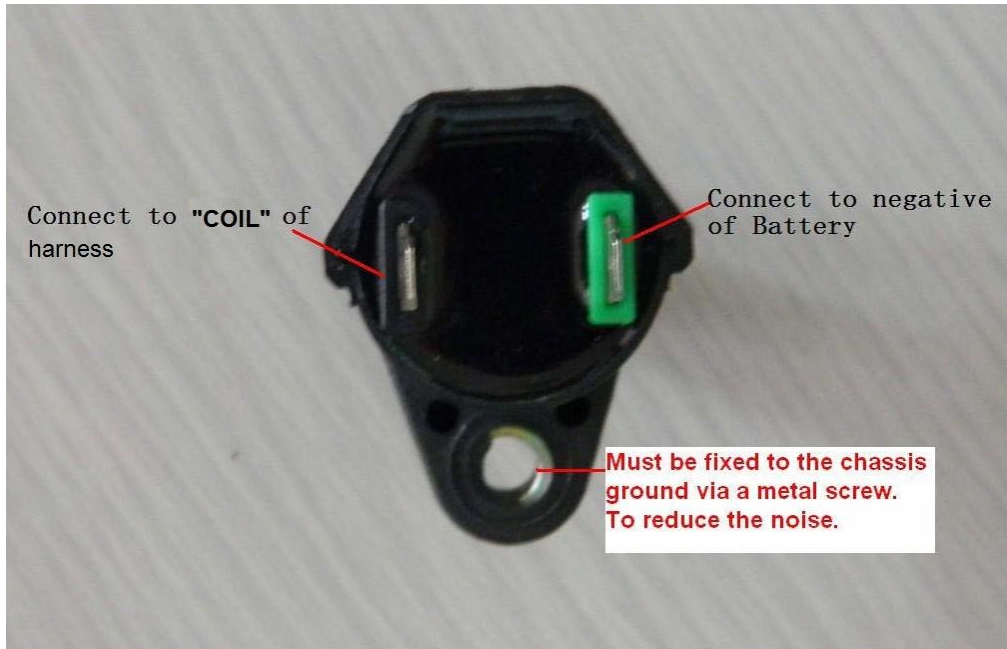


3) Put the Ecotrons high voltage cable and stock high voltage cap together.



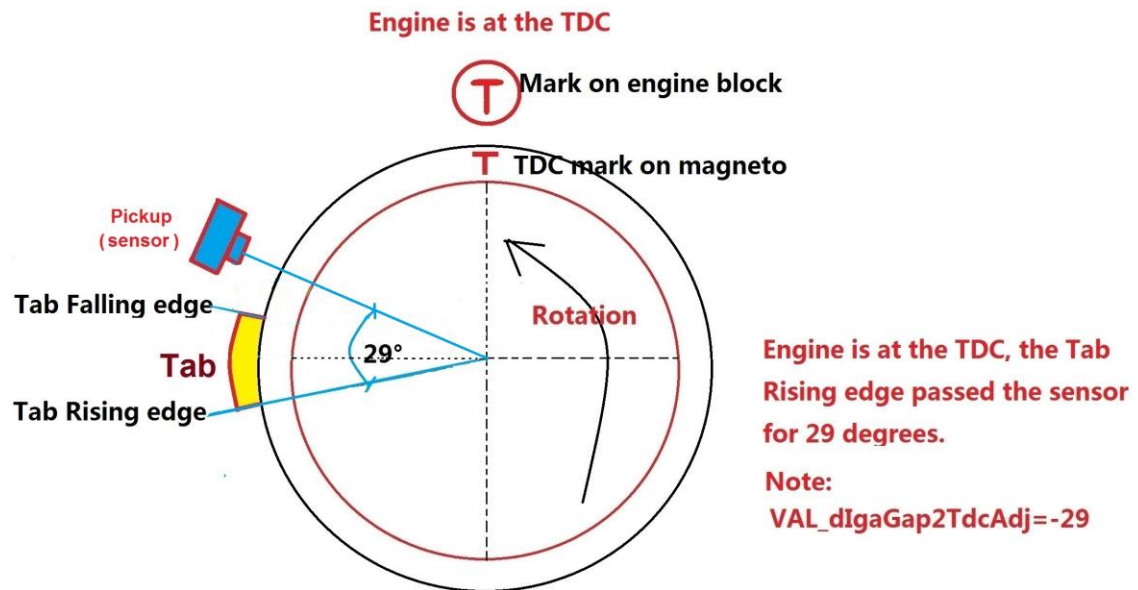
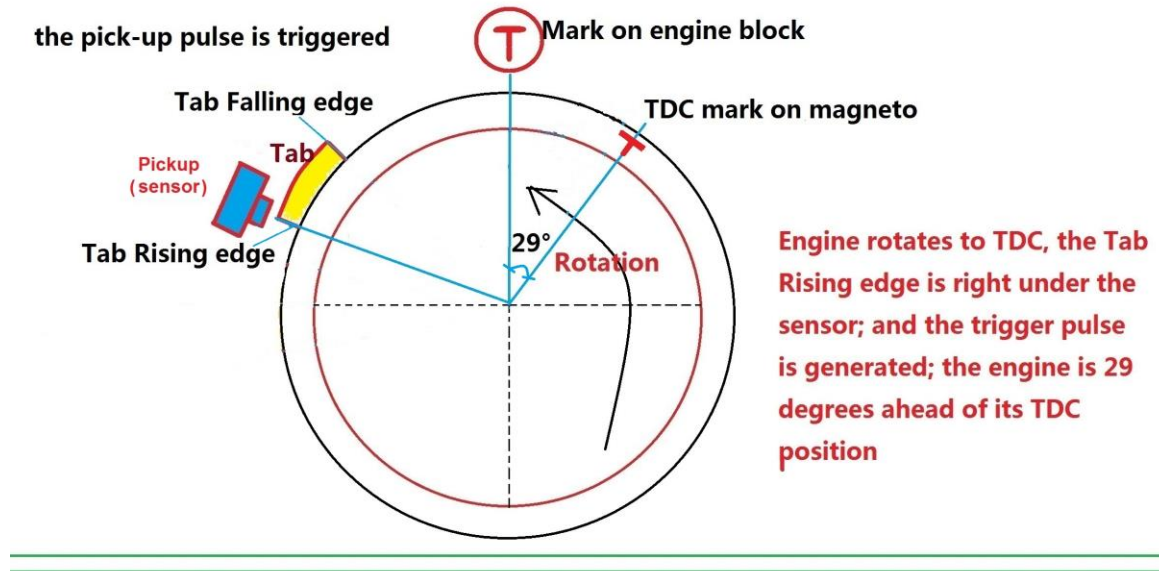
**Note:**

1. We will provide the DC-CDI, Coil on the EFI kits. Find suitable locations for the installation.
2. Because of the high voltage on the cable, about 15k-30k V, make sure to avoid the voltage leak,
3. Details of ignition coil.



## Ignition control by ECU

If you use ECU to control ignition you need to find the angle from Trigger pulse (magnet) to TDC for ignition control



### Note:

1. It is a negative value. It is different than the ignition angle table, where the



negative means after TDC.

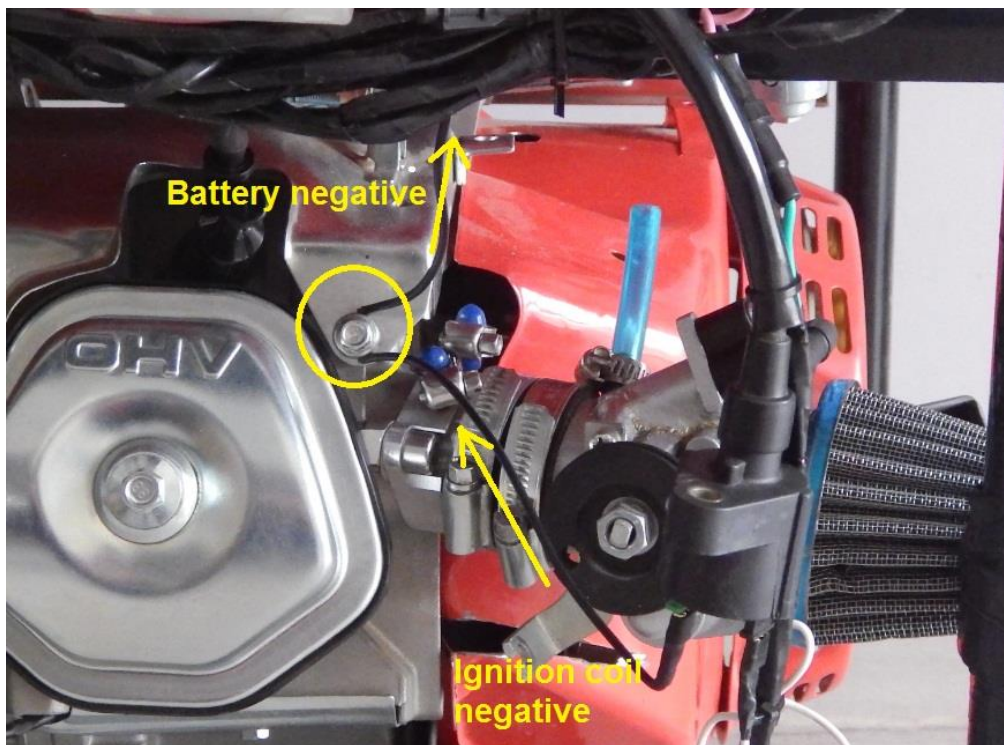
2. This default number (-38) is OK for Gx390 engines with N-pole Hall Effect Sensor, that you don't have to change.

3. VAL\_dIgaGap2TdcAdj has been changed to the positive value with our newest software.

You can find out whether it should be a positive value with your A2L file, such as: "S33\_H1\_L48\_Cr17\_AT3.4\_E4.a2l" if the number is bigger than "Cr17", for example, "Cr18 or Cr19..." it means it is the newer software, the VAL\_dIgaGap2TdcAdj should be positive.

#### 6.2.4. Connect the GND wire to the engine chassis.

Make sure the negative of battery is connected to the chassis ground! If your engine or vehicle did not have a 12V battery before, and you need add one good charging battery, in this case, you must connect the negative of battery to chassis.



## 7. KEY ON Switch

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.



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.

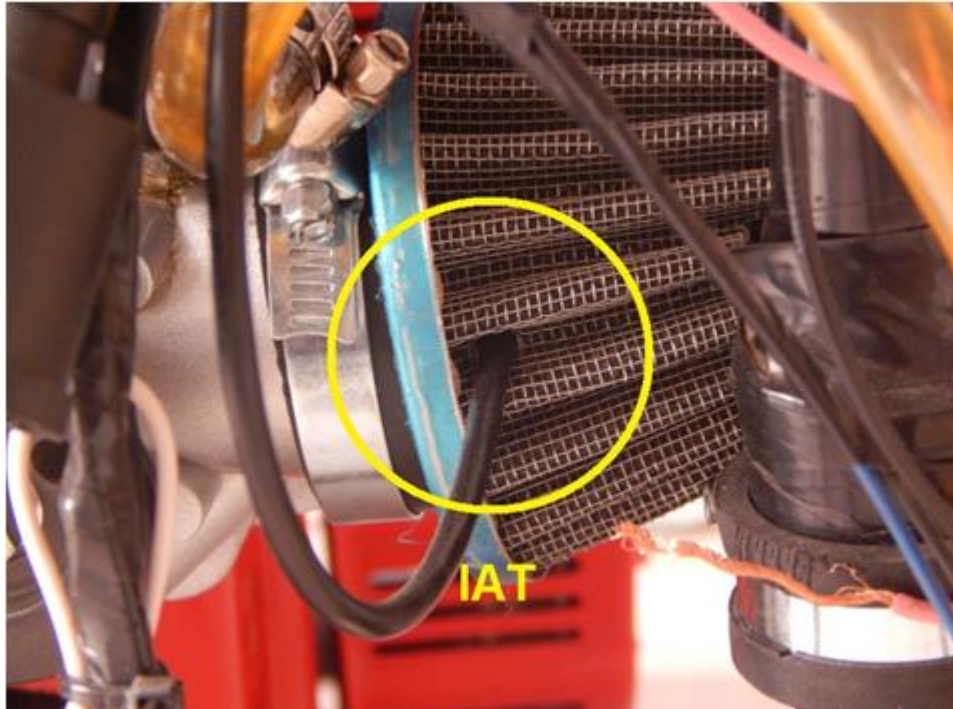


**NOTE:** The GX390 engine does not have a “key on switch”, please add one, which can accept 5A current.

## 8. Install the intake air temperature sensor

It can be placed between the Throttle Body and Air Filter, or any convenient location where the intake air flows through.

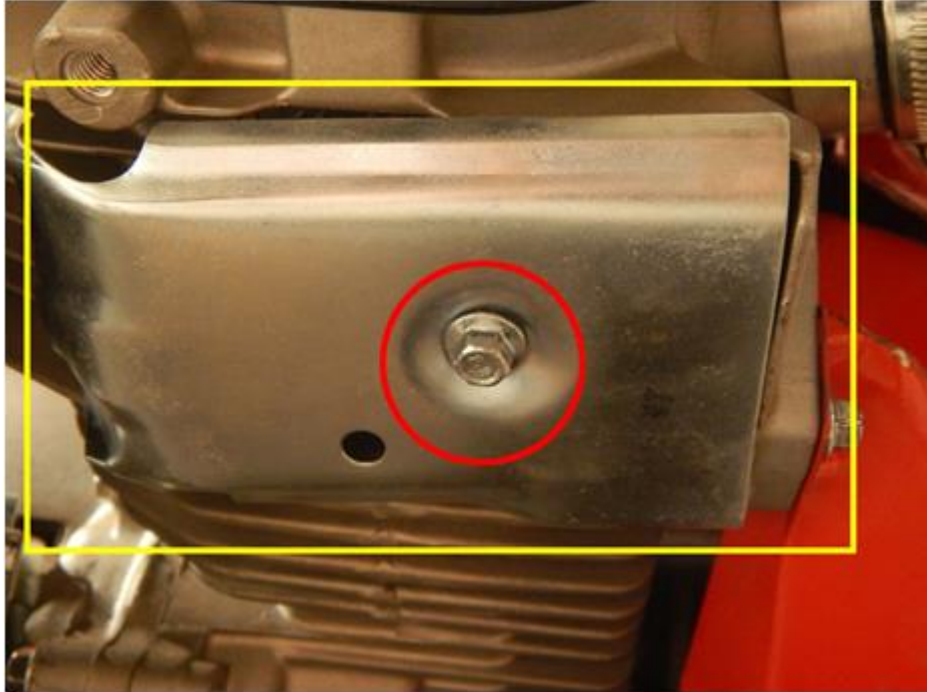
Drill a small hole and insert the Sensor. Bond it with silicon sealer or other sealing agent.



## 9. 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.

### 9.1 remove the shell



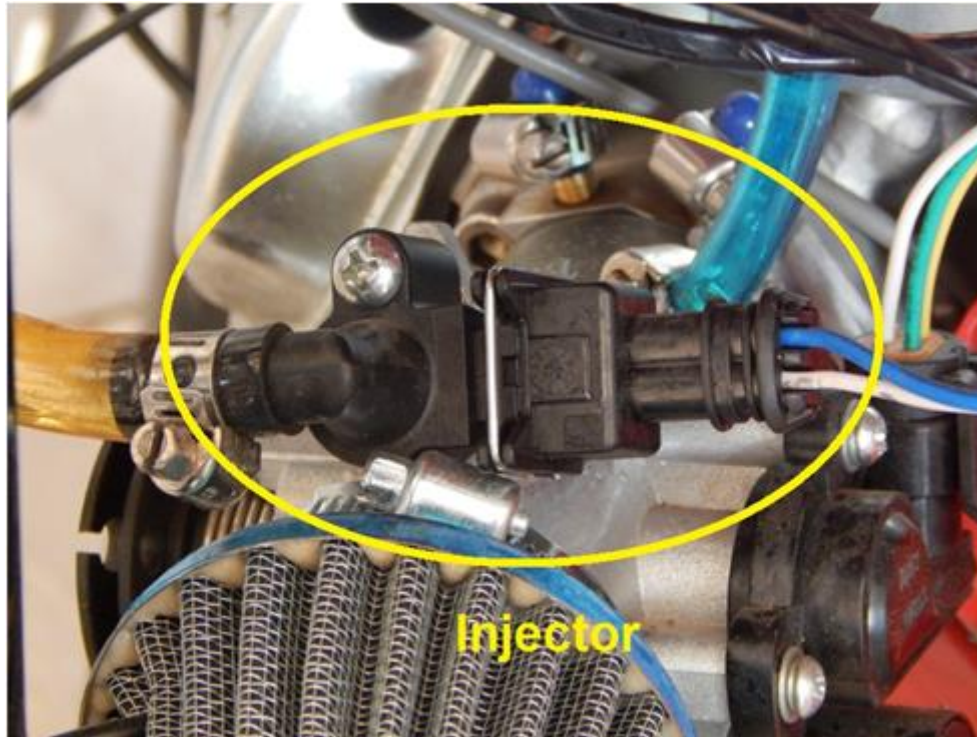
### 9.2 install the ECT



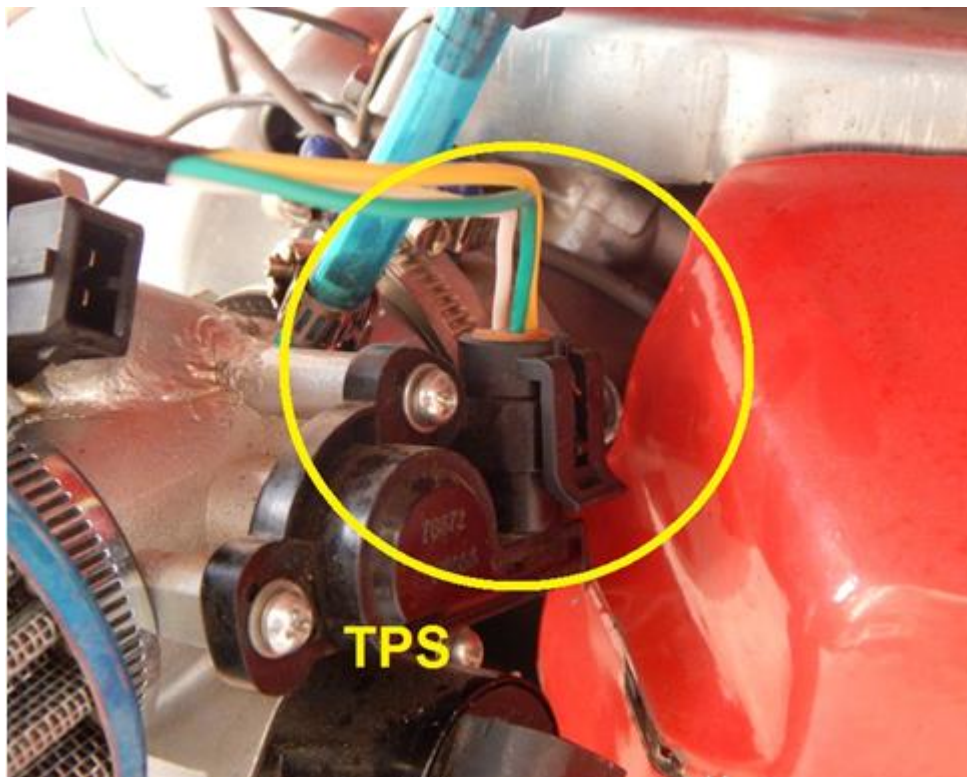
### 9.3 Re-install the wind scooper



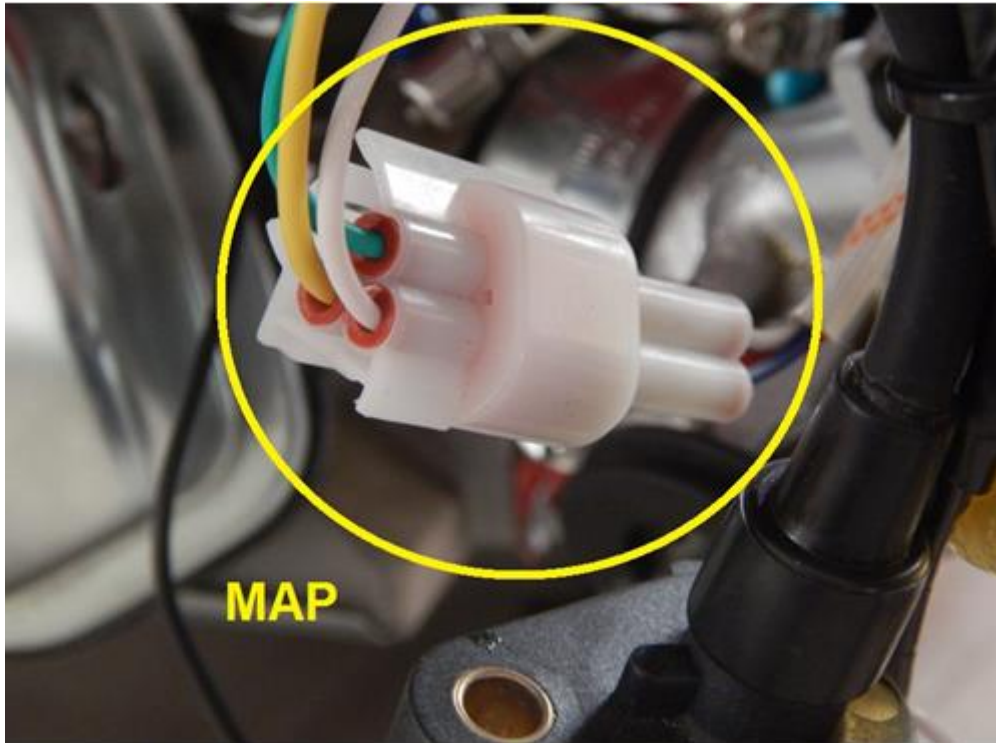
## 10. Install the injector connector to the injector



## 11. Install the TPS sensor connector



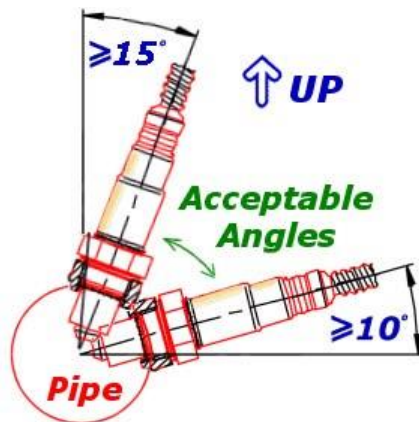
## 12. Install the MAP sensor connector



### 13. Install the O2 sensor.

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

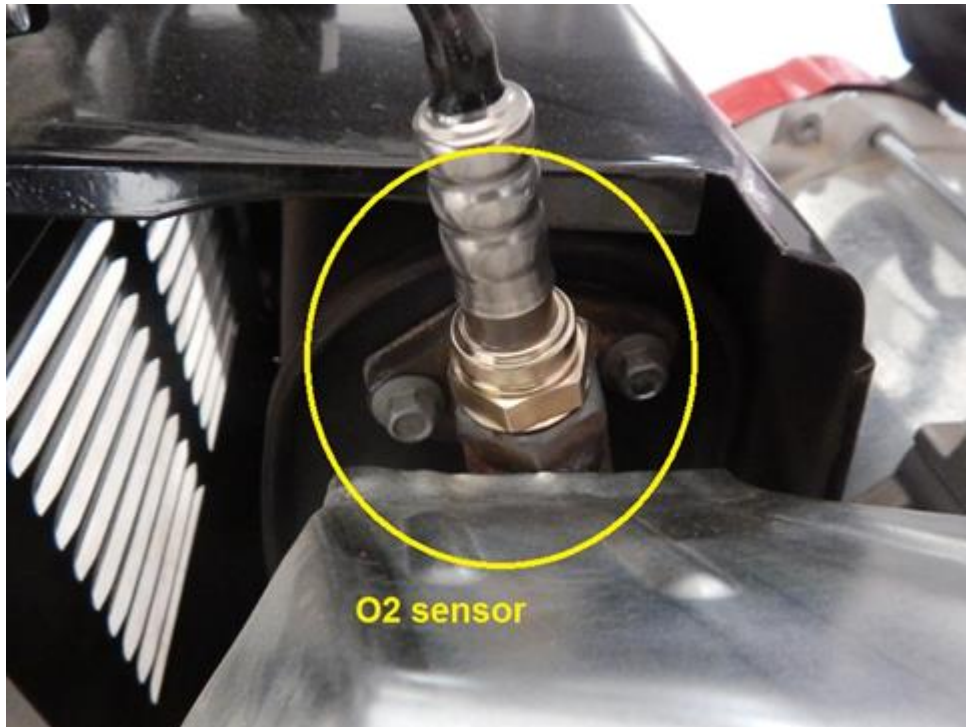
- 1) Find the correct the location to install the O2 sensor. It needs to be close to the exhaust port, but not too close (3-5" away). Rule of thumb: the O2 sensor can take the advantage of the exhaust heat, so it does not have to be heated all by itself. But you don't want it to be heated too much, because the good temperature range is 300C to 900C.
- 2) The sensor needs to install 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.



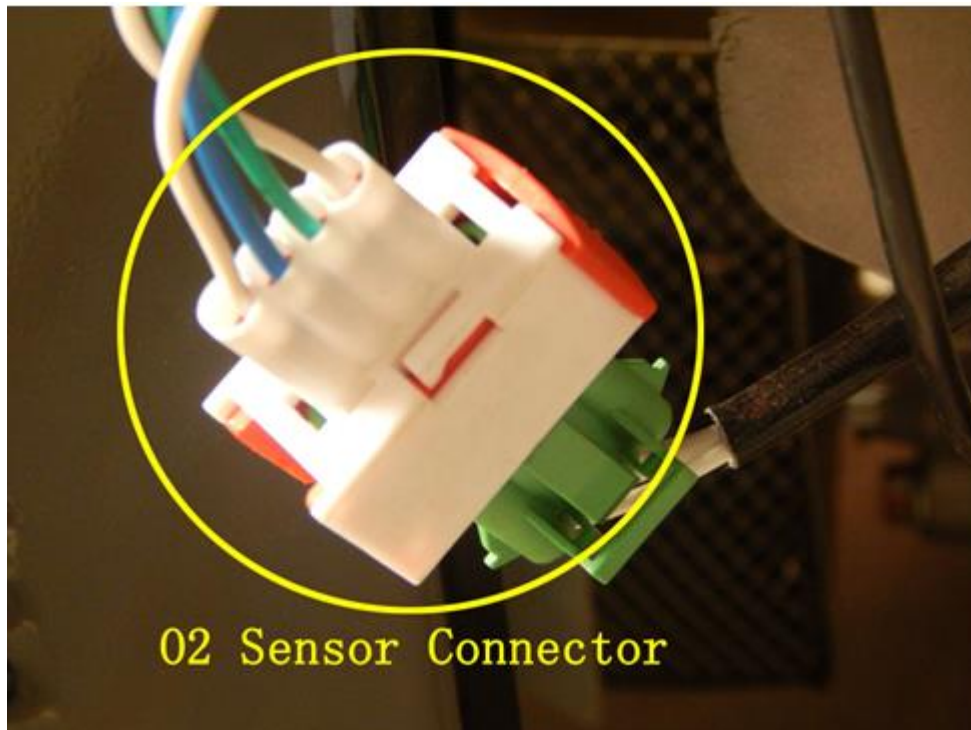
3) Drill a hole on the exhaust pipe. Weld the O2 sensor bung (provided) on the hole. Make sure the sensor head can be fully exposed to the exhaust gas; yet NOT to block the exhaust pipe.

4) Install the sensor in the bung.





5) Connect the O2 sensor cable.



## **14. Attach the Ecotrons ECU to the 12V battery + and battery -.**

Make sure the negative of battery is connected to the chassis ground! If your engine or vehicle did not have a 12V battery before, and you need add one good charging battery, in this case, you must connect the negative of battery to chassis.

**you must connect the 12V – to chassis ground.**

## **15. Double checks and make sure all wire connected normal**

## **16. You have finished with the initial hardware installation of the Honda GX390 Ecotrons EFI kit.**

## 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 few seconds, if this is not happening, you must have some wiring problem. Re-check all your wires! If every wire is sure correctly connected, then the ECU may have a problem.
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. Sometime, you have to manually purge out all the air bubbles in the fuel supply system, because it is possible that if the fuel pump itself has a lot bubbles in there, it could not pump fuel at all, it is only spinning like idle without load. In this case the noise of fuel pump is little higher pitch than with fuel pumping. In this case you will not be able to start no matter what, because no fuel pumping. If you have any doubt that the fuel supply system has some air pocket or air bubbles, you can un-plug the high pressure fuel line, pointing it into a bottle, and key-on, you should see fuel sprout out if fuel pump is working and no air bubbles.
7. In many cases, you can visually see the fuel flow out of the fuel pressure regulator and return back to the tank if the fuel supply system is working normally. This is another indication you can check.
8. After you make sure the fuel supply system is working normally, try to key-start the engine.
9. 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.
10. If the engine does not start, go to the next section for diagnosis.
11. 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.
12. 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.
13. 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), do you hear the fuel pump running until engine stalls? If not, your wiring has issues.
- 1.1.4) if you have key on and off too many times without engine starts, you need to do this: with Key-ON only, disconnect the ECU from the harness, and connect it back. This is to give a power reset of the ECU, so some counters are reset to 0.

1.2) Do you have the fuel pump installed correctly?

- 1.2.1) 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.
- 1.2.2) Have you replaced the “petcock” tank valve with a manual valve? EFI does not work with the petcock that does not have a PRIME position.
- 1.2.3) 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.
- 1.2.4) Is there impurity in the gasoline? Check your fuel filter.

1.3) Do you have the ignition pick up sensor connected correctly?

- 1.3.1) Do you have a correct pick up signal input to ECU (CKP wire on the harness)?
- 1.3.2) Do you have the ground wire of pickup sensor connected to ECU ground wire (GREEN wire on the harness)?
- 1.3.3) Are you using the stock ignition system (to isolate the starting problem, please use the stock ignition system)?
- 1.3.4) Can you tell the spark plug is firing when you try to start?

1.4) Do you have the MAP sensor installed correctly?

- 1.4.1) is the MAP sensor connected to the throttle body tube via the small hose (included in the kit)?
- 1.4.2) 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 install the ProCAL software and read the DTC

## Install the provide ProCAL software into your computer:

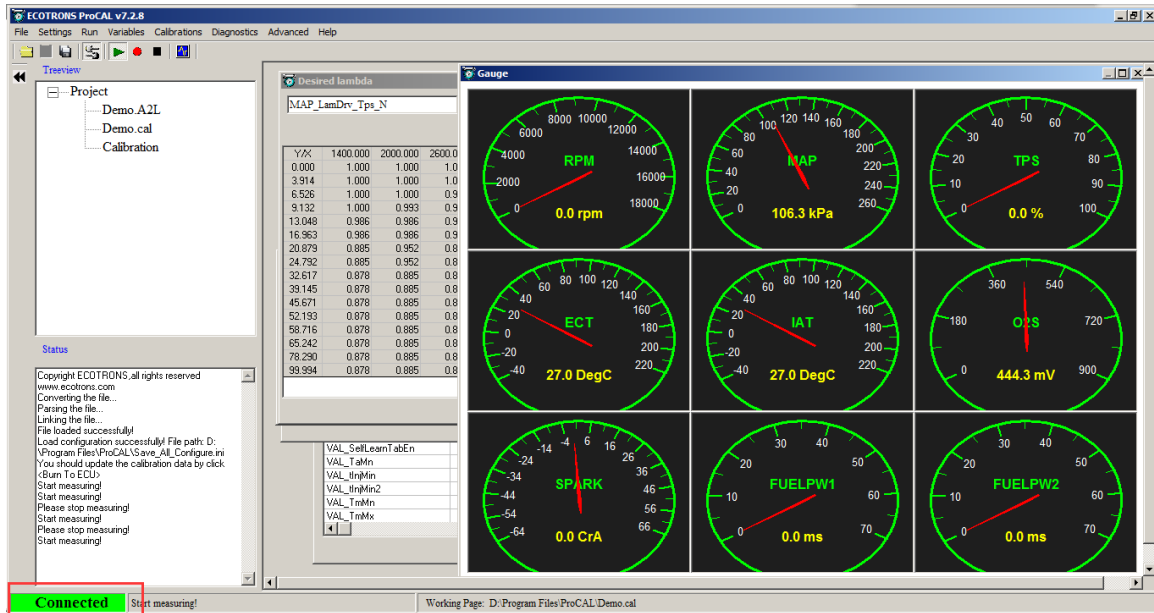
For details on how to use ProCAL software, please refer to the ProCAL manual, downloadable from our website.

**Run ProCAL, you will see below windows (Load the correct A2I and CAL files):**



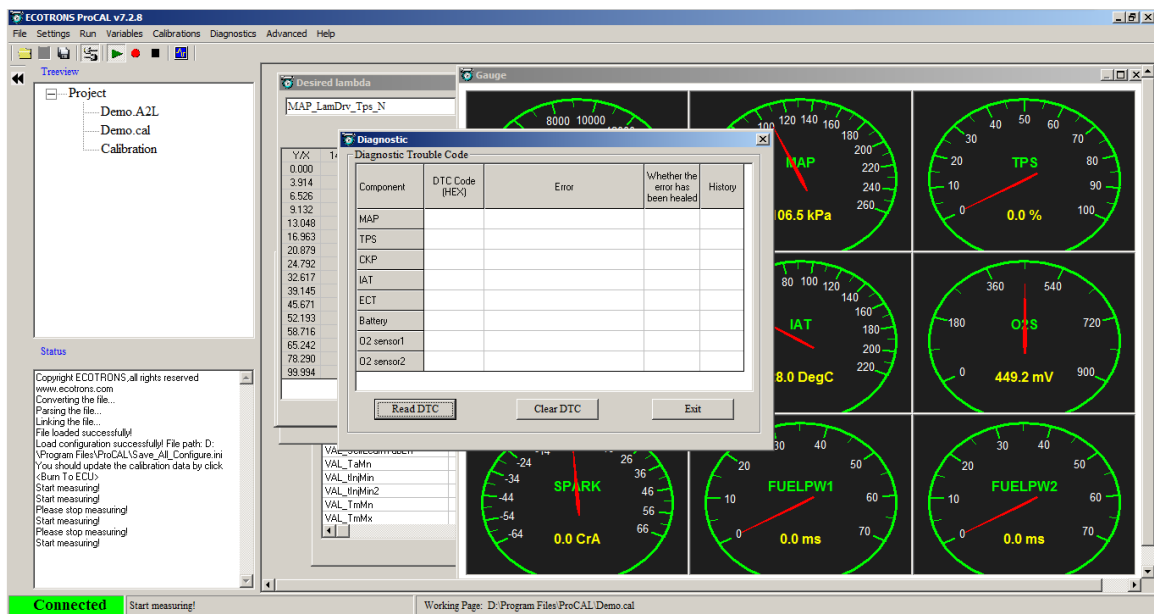
Connect ECU to laptop:



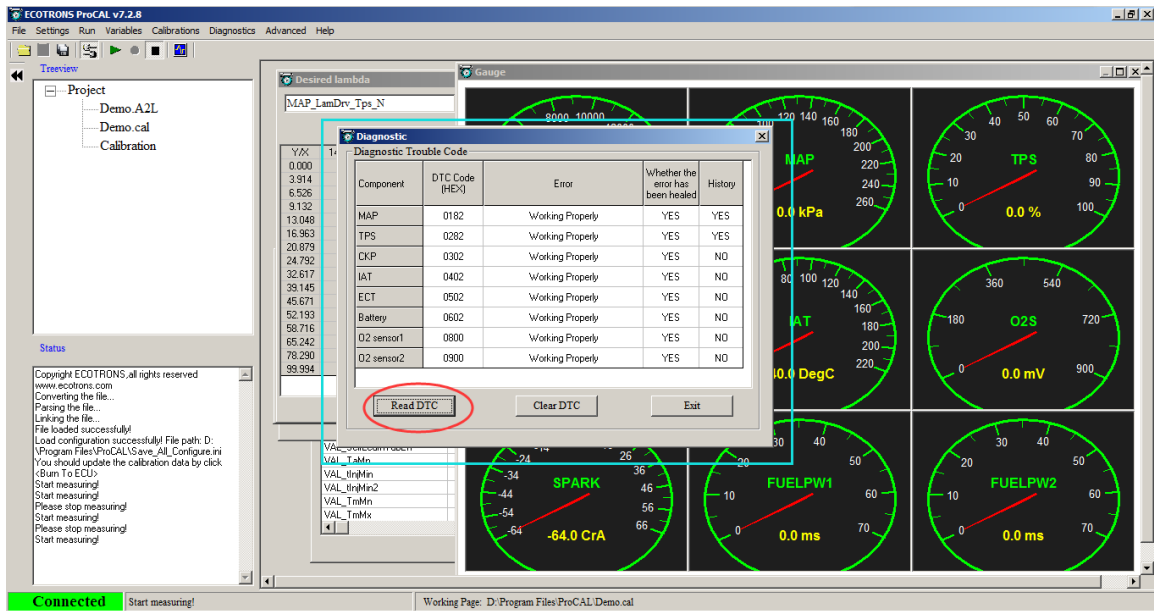


## Read DTC:

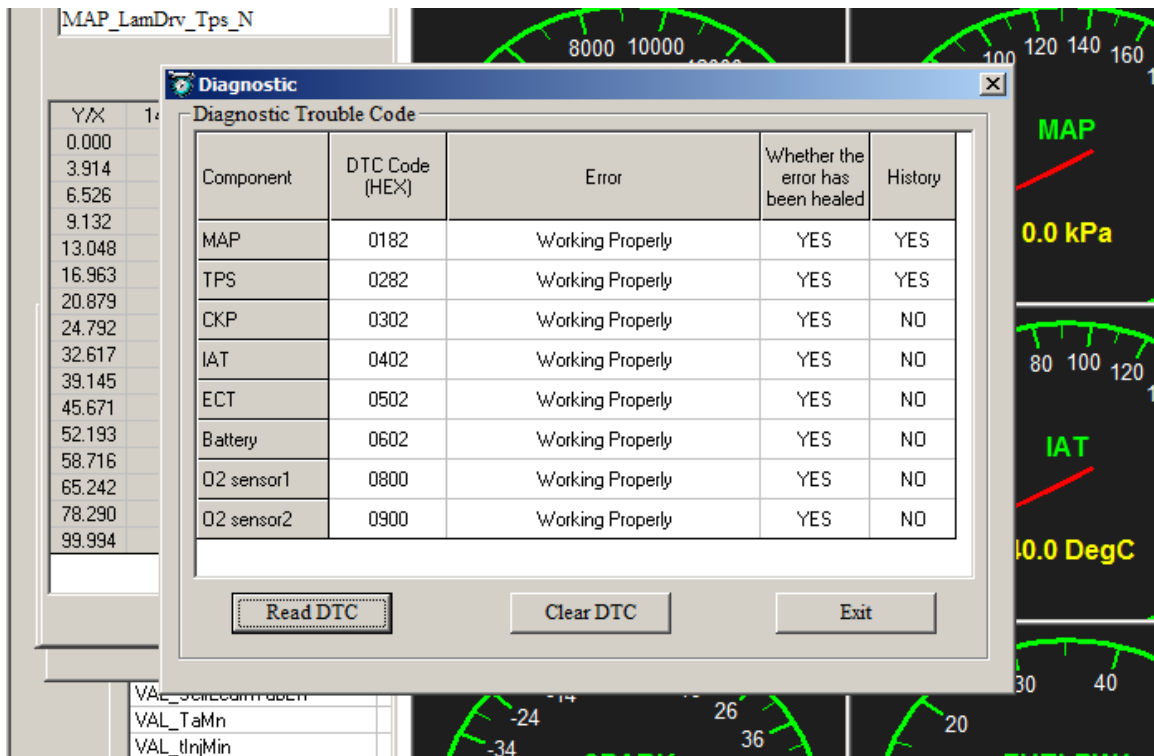
Go to Menu → Diagnostics ->ECU Diagnostics



Click "Read DTC":



Supported DTC list (TBD)



**With all the correct installation and tests done, you still can not figure out why the engine does NOT start, please contact us directly:**

## Diagnosis of the communications between your laptop and ECU:

- 1.1 Check your serial communication cable; make sure the cable is pushed in completely.
- 1.2 Check your USB adaptor; make sure it is fully plugged into your laptop.
- 1.3 If your laptop has a built-in COM port (many old laptops have that); you can use the COM port directly without the USB adaptor.
- 1.4 Go to “Menu→ setting→ communications” select correct port: USB or COM port.
- 1.5 Click “Connect” button in ProCAL.

## 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) Key-on; and Key-on only;
- 3) go to menu -> run -> connect
- 4) Go to menu -> run -> start measuring (the numbers in the window should change now...)
- 5) Go to menu -> run -> start recording

Start the engine, do you test....

Note, you must keep your laptop awake all the time for logging....

6) When you done the test, go to menu -> run -> stop recording

7) Go to menu -> run -> play back

8) In Data Analyzer, click "Open", 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 3 .csv 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 3 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 stoic metric 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.

ECO mode: close loop fuel with O2 sensor feedback, with ECU self-tuning capability.

RICH mode: open loop fuel, fixed map, no ECU self-tuning capability.

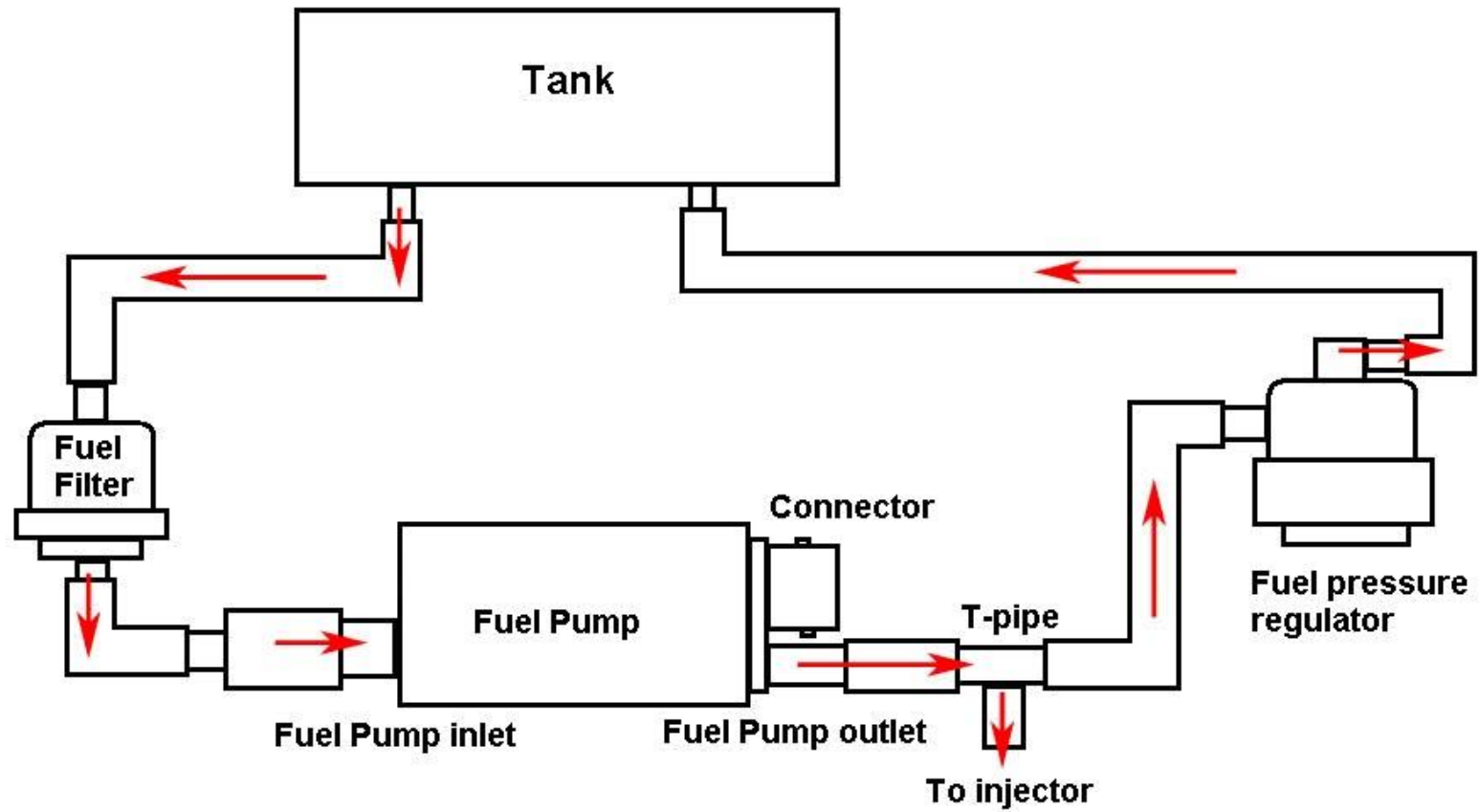
RICH mode is only good if you have a well tuned engine mapping.

Recommend to use ECO mode most of time, and only use RICH mode for temporary fuel enrichment to gain some extra 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.

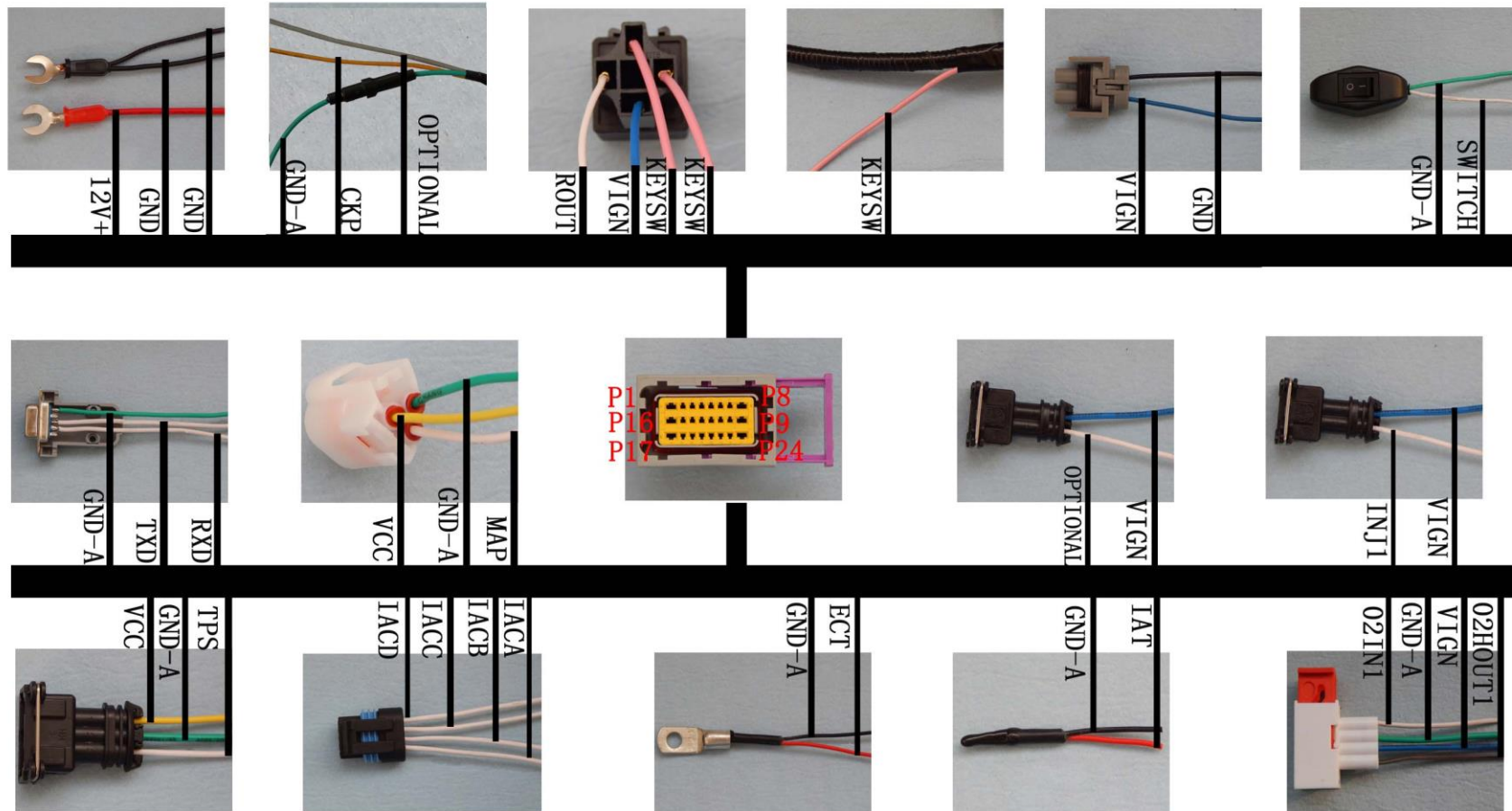
OFF -> ECO -> STOIC ON->RICH -> POWER

## Appendix I: Small Fuel pump





## Appendix II: ECU main connector pin-out



Pin NO.	Component	Color	Description
P1	O2HOUT1	White	O2 Sensor #1 Heater LS Driver output
P2	12V+	Red	Reverse Battery Protected Supply
P3	GND	Black	Power Ground
P4	VCC	Yellow	+5V Volt Supply Output
P5	RXD	White #5	Sent Data to RS232
P6	SWITCH	White #6	Performance Switch
P7	TPS	White #7	Throttle Position Sensor input
P8	GND-A	Green	Analog Ground
P9	IACA	White #9	Idle Air Controller A
P10	MAP	White #10	Manifold Air Pressure Sensor Input
P11	IACD	White #11	Idle Air Controller D
P12	TXD	White #12	Receive data from RS232
P13	IAT	White #13	Intake Air Temperature Sensor
P14	KEYSW	Pink	Key On Switch
P15	OPTIONAL	White #15	Optional
P16	INJ1	White #16	Injector #1 LS Driver Output
P17	GND	Black	Power Ground
P18	OPTIONAL	Gray	Optional
P19	IACC	White #14	Idle Air Controller C
P20	ROUT	White #2	Power relay LS Driver output
P21	ECT	White #3	Engine (coolant) Temperature sensor
P22	IACB	White #4	Idle Air Controller B
P23	O2IN1	White #8	Oxygen Sensor #1 input
P24	CKP	Orange	Crank Position Sensor (connect igniting pickup sensor signal)