# SE-EFI

Small Engine Electronic Fuel Injection

-- Conversion Kit

# Installation Manual

ECOTRONS

V2.9

http://www.ecotrons.com/

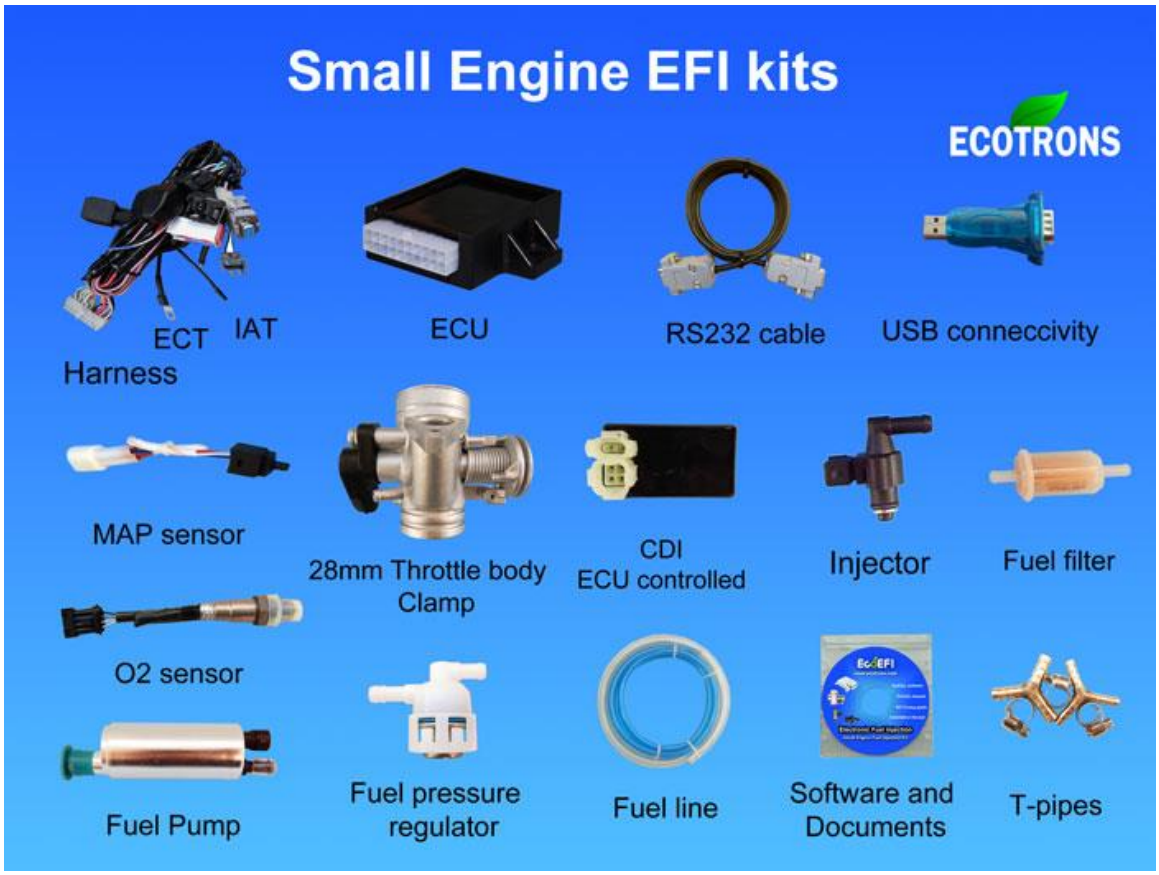
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Note: many EFI parts in this manual are installed on a GY6 scooter engine as an example, and they can also be used as guidelines or illustration for all other small engines. Some common sense shall be used to convert a different engine.

If you are not sure about any specific details, please contact us info@ectorons.com.

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Small Engine EFI kits
ECOTRONS
ECT
IAT
Harness
ECU
RS232 cable
USB conneccivity
MAP sensor
28mm Throttle body
Clamp
CDI
ECU controlled
Injector
Fuel filter
O2 sensor
Fuel Pump
Fuel pressure
regulator
Fuel line
Software and
Documents
T-pipes

SE-EFI Kit

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# 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, Go-Carts, boats, snowmobiles, etc. The displacements of the engines can be in the range of 35cc up to 1200cc. This kit replaces the OEM's carbureted fuel system completely, and it requires the minimum modifications of the engine. It could be a plug-and-play EFI kit for some popular small engines like GY6 engines, or monkey bike engines in the range of 50cc, 125cc, 150cc; 180cc, etc. For many other engines, you may need to do some mechanical adaptations, like a throttle body adapter, etc. And you also need to do some fine tuning. You will get the pre-loaded software with the kit that will most likely start and run your engine after you install it. The ECU is fully programmable, and tuning is made easy for those who are interested, and the tuning software is free, downloadable.

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 and Intake manifold Assembly


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- Throttle body (including TPS sensor)
- Fuel injector (mounted on the throttle body)

4. Fuel pump assembly
   - Fuel pump assembly (outside of the tank)
   - Fuel filter
   - High pressure fuel line
   - Fuel hoses, T-Pipes ,Clamps
5. MAP sensor
6. Engine temperature sensor
7. Intake air temperature sensor
8. Oxygen sensor and bungs
9. Serial communication cable (to a computer)
10. USB adaptor - included
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. Bluetooth adapter (optional, very convenient for data logging with Ecotrons Droid phone app).

Note: The kit requires a 12V battery and charging system for power supply by default. The charging requirement is typically 3.5A current or 50W power as the minimum.

Ecotrons does have variant EFI system setup and some of them are very low power consumption, like **0.5A** or less current draw for specific applications. And those are for small OEMs usually.

Ecotrons does have some battery-less EFI systems available, but those require customer specific setup and software. And usually they are designed for small OEMs.

This kit may need to do some tuning to get some desired results.

Though the EFI system reduces the emissions than a carb 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.



**ECU-20P**




**Harness-20pin**



**ECU-24P**




**Harness-24pin**



**MAP sensor**




**Temperature sensors**













**Throttle bodies**

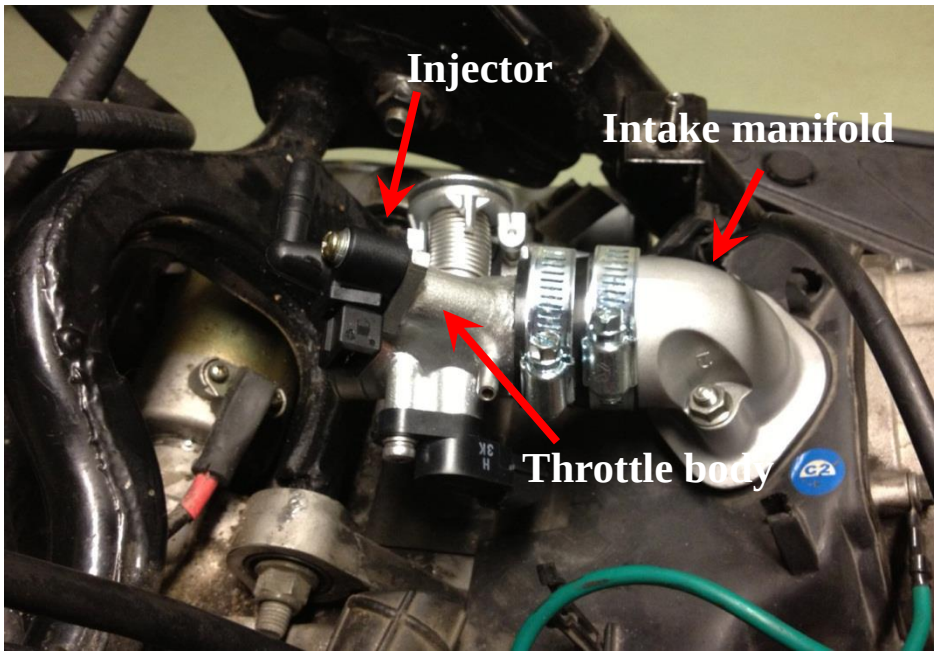


**Fuel supply assembly**

# Chapter 1 Installation Procedures of EFI

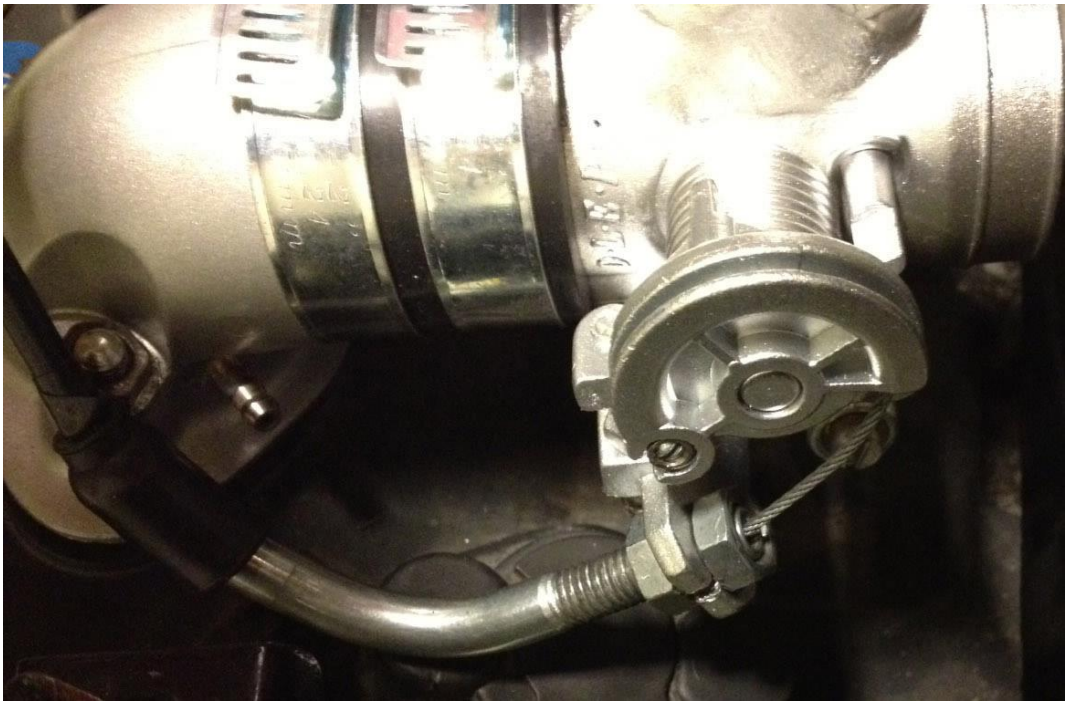
## 1.1. Install the throttle body assembly

Please remove the carburetor from the motorcycle, and install the new throttle body at the same location of the carburetor. You may re-use the old intake manifold. You may need to find an after-market intake manifold (intake boot) to install the throttle body. Or you may need to make an adapter if there is no such manifold can be fit.




Please connect the inlet of throttle body to the air hose from the air filter. 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.

Install the existing throttle cable to the throttle body.



## 1.2 Install the Map sensor

For 2 stroke engine, you only need to put the MAP sensor in the atmosphere.

For 4 stroke engine, you need to connect the MAP sensor to the intake manifold. And the intake manifold is sealed and air tight, MAP sensor must read the vacuum during engine start process. Please install MAP sensor as the following steps:

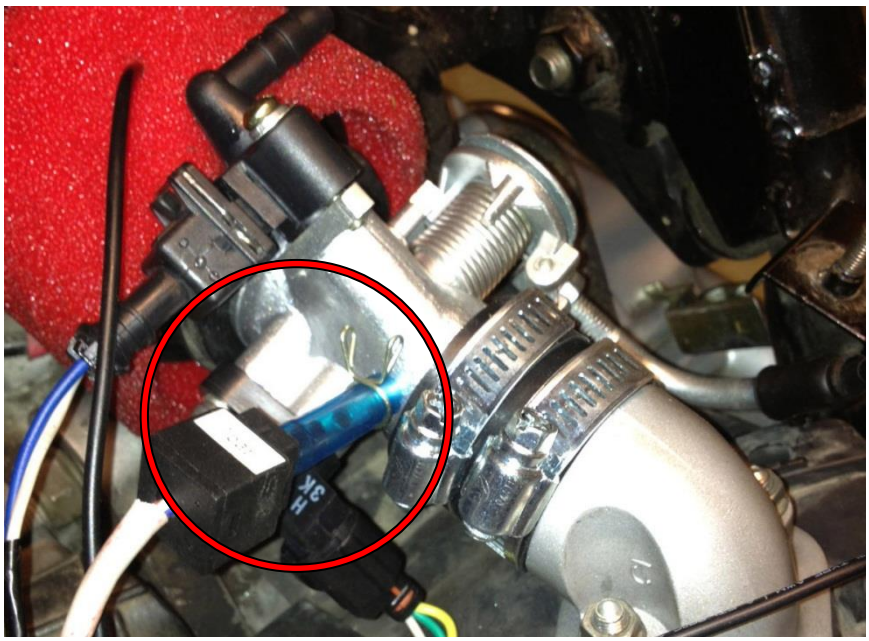
1) Find a secure place to install the MAP sensor, if there is one small pipe from throttle body, you can use this to install the MAP sensor. You need to make an adapter to install the MAP sensor. Usually, please install the MAP sensor on top of the throttle body or manifold.




2) You need a short hose to connect the map sensor; no less than 2 inches (5cm) long, no longer than 4 inches (10cm) , one too longer hose can cause some deviation of the sensor reading.

3) Connect the MAP sensor to the intake manifold with the small pipe (6mm diameter), the MAP sensor should not be too closed to the engine block. sample picture:

   **Note:** For 4 stroke two cylinders engine, the MAP sensor need to be installed close to the #1 cylinder intake manifold.



**Note: Incorrect installation of the MAP sensor can cause not-able-to-start engine, or it can short the MAP sensor life.**

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

- Make sure the Map sensor installation is air tight!
- Make sure the MAP sensor is not too closed to the engine block
- Make sure fuel will not get into the MAP sensor chamber.
- Make sure the MAP sensor hose is not severely bent, or not routed in circle。

## 1.3 Install the fuel injector

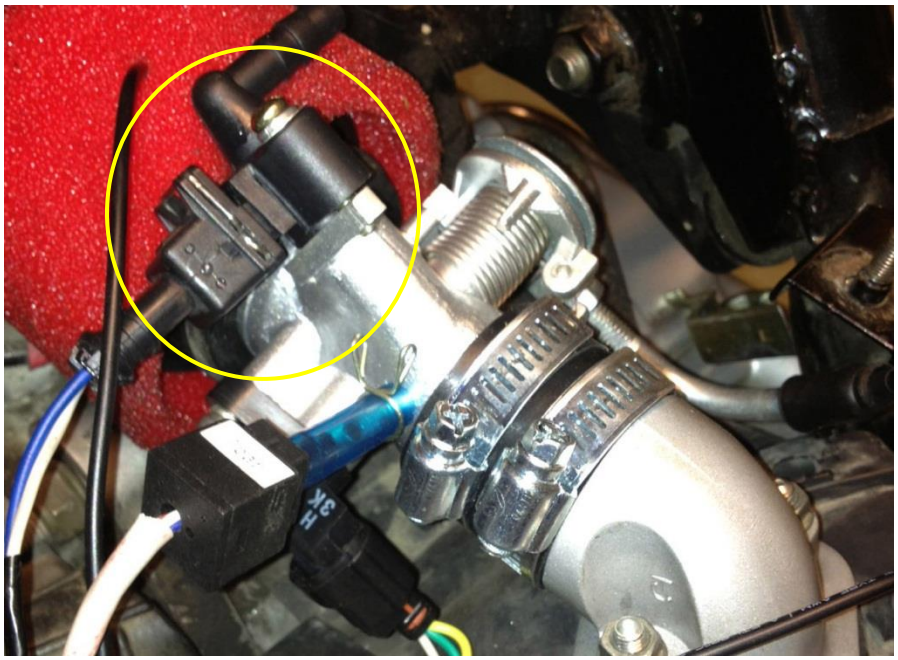
Install the fuel injector on the throttle body if there is injector seat on throttle body. You need to make an adapter to mount the injector if there is no injector seat, for example,45mm, 50mm, 55mm throttle body, etc, You can Install the injector seat on the manifold.



Throttle body without injector seat



injector seat



**Install dual fuel injectors for two-stroke EFI system:**

We will provide two fuel injectors, one smaller and one bigger fuel injector if the two-stroke engine's Max RPM is higher than 10k RPM. So the correct installation and connection of two fuel injectors is very important, see the flowing pictures.

**Injector #1 (INJ1) is on the top, smaller one, downstream the throttle plate.**

**Injector #2 (INJ2) is on the bottom, bigger one, upstream the throttle plate.**




## 1.4. Fuel tank modification

This kit has a fuel return line, which needs to be routed to the tank. If your tank has an existing hole on the top, (for example the vent hose, 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 that the fuel can be returned to the tank

from the pressure regulator.

If you don't have an existing 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: This will cause fire if you modify the fuel tank with any fuel!!!) Please do as the following steps.

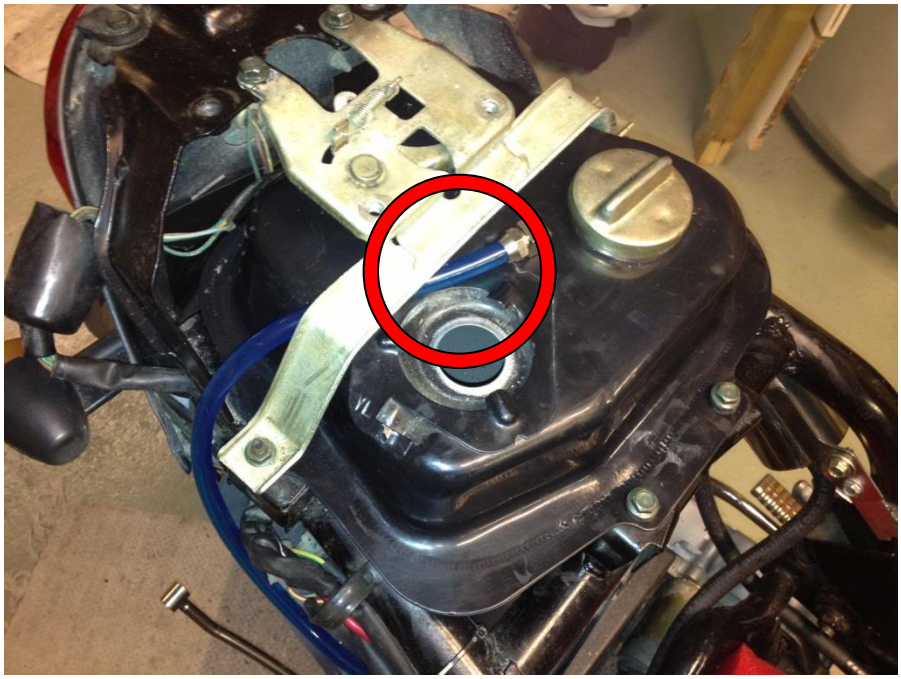
1) Please take the fuel tank off if necessary.
2) Drill a hole (diameter: 5mm~6mm) on the upper wall of fuel tank, or just below the fuel tank cap.

3) You can use the provided fuel tank adapter to fit the tank and to tighten it with a nut. And seal it.

4) Then clean the fuel tank if any debris falls into it. Install the fuel tank back finally.



Fuel tank adapter



## 1.5 Install the fuel pump assembly

1) The fuel pump should be between the fuel tank and the throttle body, and it should be tied to the inside of 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.

**The correct order** of fuel supply components should be (from high to low locations):

Tank → fuel filter → Fuel Pump

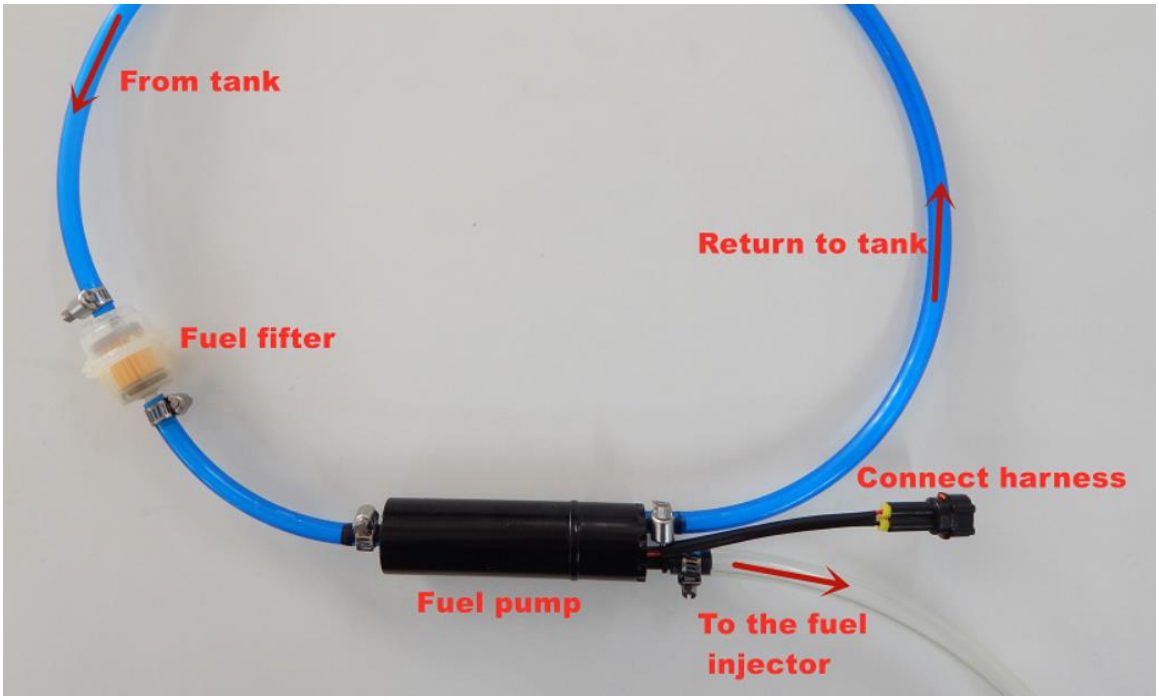
**The fuel pump must be lower than the lowest point of the fuel tank.**

2) Connect the fuel feed line from the fuel tank outlet to the inlet of the fuel filter and fuel filter has been connected to the inlet of the fuel pump.

3) Connect the high pressure fuel lines from the fuel pump to the fuel injector.

4) Connect the fuel-return line to the tank.

5) Secure all fuel lines with supplied clamps, make sure no leak.







**Note:**

**1)** Some fuel tanks have a tank valve which requires the vacuum from the intake manifold to open, called **"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. Or if your petcock valve has a "Prime" position, that does not require vacuum, and set it to "**PRI**" position.

**2)** We recommend that you use the fuel line from ECOTRONS, other fuel line

may be damage to the fuel supply system.

## Fuel Pump wire connection

There are mainly 2 sizes of fuel pumps supplied by Ecotrons, Small size and medium size.

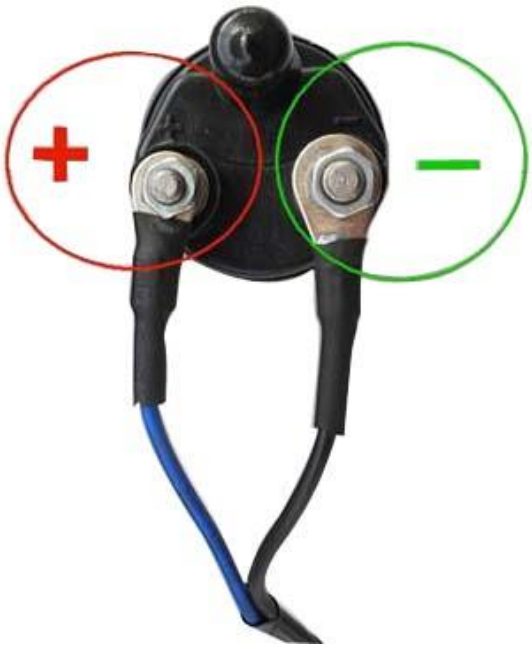
Small fuel pump has a flow rate of 25L/H;

Medium pump has a flow rate of 45L/H. There are 2 wires on the harness to be connected to the fuel pump.

Both fuel pumps have 2 electrical terminals, and they are driven by 12v power. One terminal is "+" and one is "-". As shown in the below pictures:




**Small fuel pump terminals**




**Medium fuel pump terminals**

## 1.6 Install the engine temperature sensor

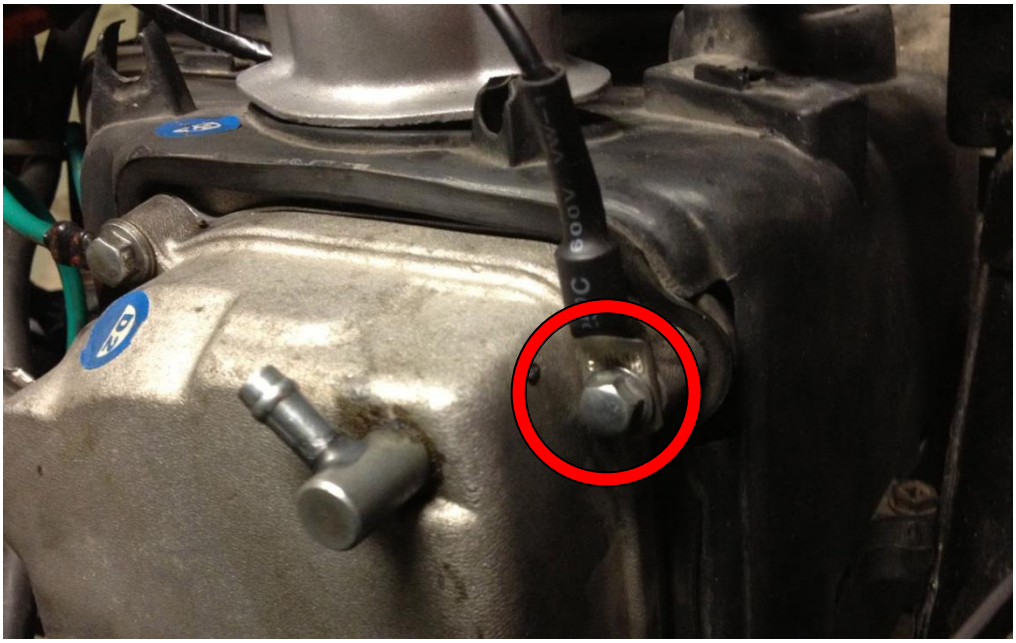
Find a suitable place on the cylinder header, where it has the lowest air flow (usually the backside of the engine), attach the ECT sensor to bolt and fix it.

**Note：**

1) Make sure that the sensor is mounted tight.

2) Make sure there is no twisting stress on the sensor wire.

3) Make sure do NOT damage the sensor when you install it.



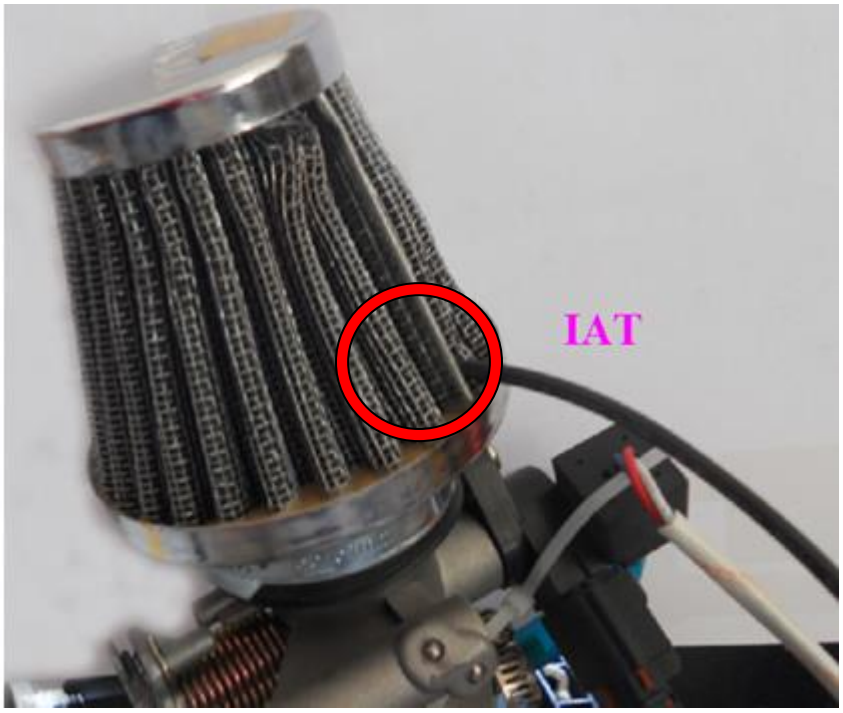
## 1.7 Install the intake air temperature sensor

Insert the IAT 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 that all the debris is cleaned immediately after the drilling!**).

**Note：**

1) Make sure there is no twisting stress on the IAT wire after finish IAT installation.

2) Make sure do NOT damage the sensor when you install it.




## 1.8 Install the Ecotrons CDI ignition system

For some popular scooter engines like GY6 150cc engine, Ecotrons CDI is compatible and can be installed immediately. Ecotrons EFI will control both fuel and sparks with this way. For those engines, the harness comes with CDI connectors already in place.

If you want to keep the stock ignition system, ECU controls fuel only, please connect the wire labeled as CKP from the ECU harness to the pick-up signal of your stock CDI ignition. The other wire of the pickup sensor usually is grounded in your stock system. Connect the green GND wire from the EFI harness to the pickup ground. So please skip the chapter1.8 and 1.9.

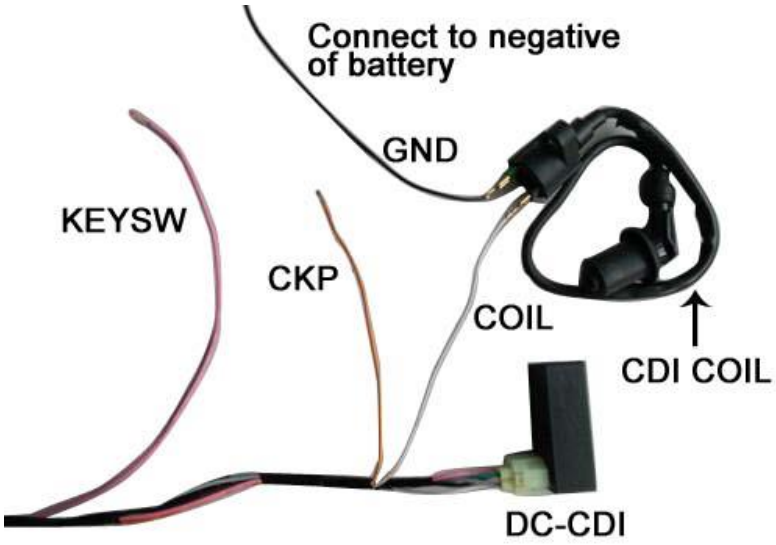
If you want to use the EFI to control the CDI ignition timing, and if you have Ecotrons CDI included in the kit, you need to do this: Cut the ignition pickup sensor wire, and connect the wire from the sensor side to the wire labeled **CKP** from harness.

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).

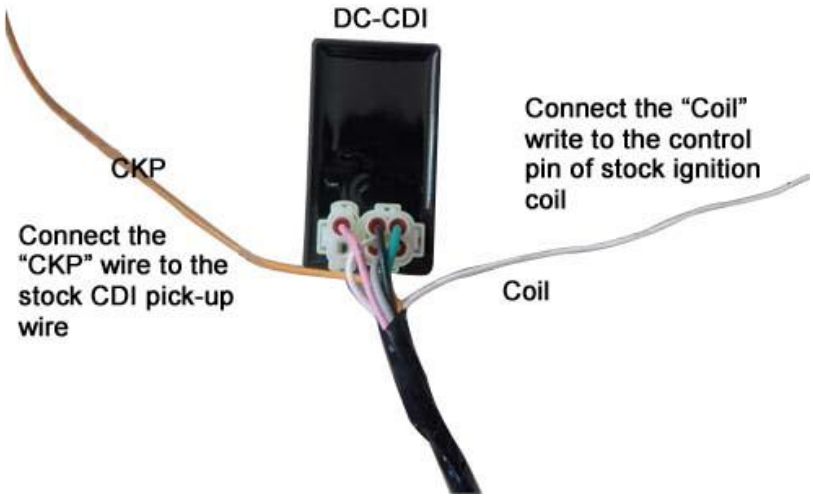
**Note: if you use our ECU to control your own CDI, it may not work, please contact us to confirm it.**

**Note: if you use stock CDI, and if you don't know the pin definitions on the CDI connector, DO NOT connect CDI-Ctrl wire! Mis-connection of Pickup and CDI-Ctrl wires can damage the ECU.**

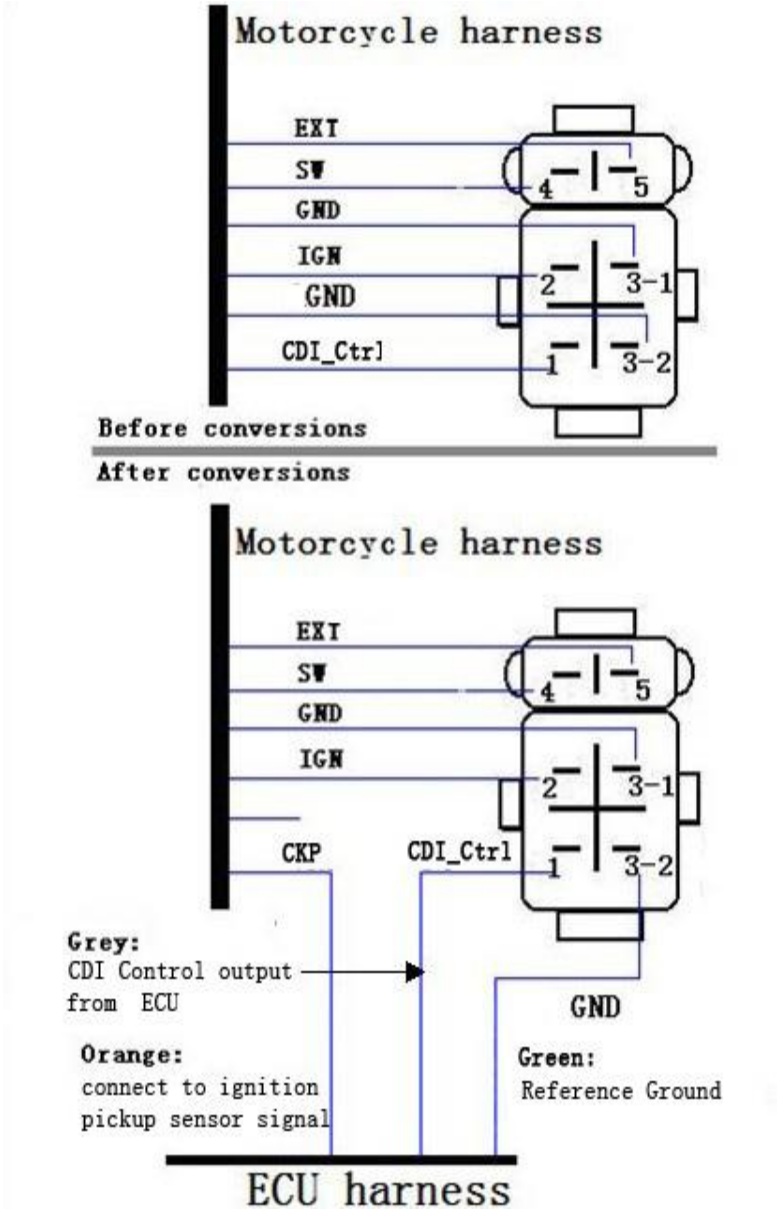
Use Ecotrons CDI and Ecotrons Coil to control the ignition system, see below pictures:




Use Ecotrons CDI and stock coils to control ignition system, if stock ignition system is CDI type, you can use the stock ignition coil and Ecotrons CDI to control ignition system. See following picture:




Secure the splices of CKP and CDI-Ctrl wires with electrical tape, or better, solder them and then tape them. 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.

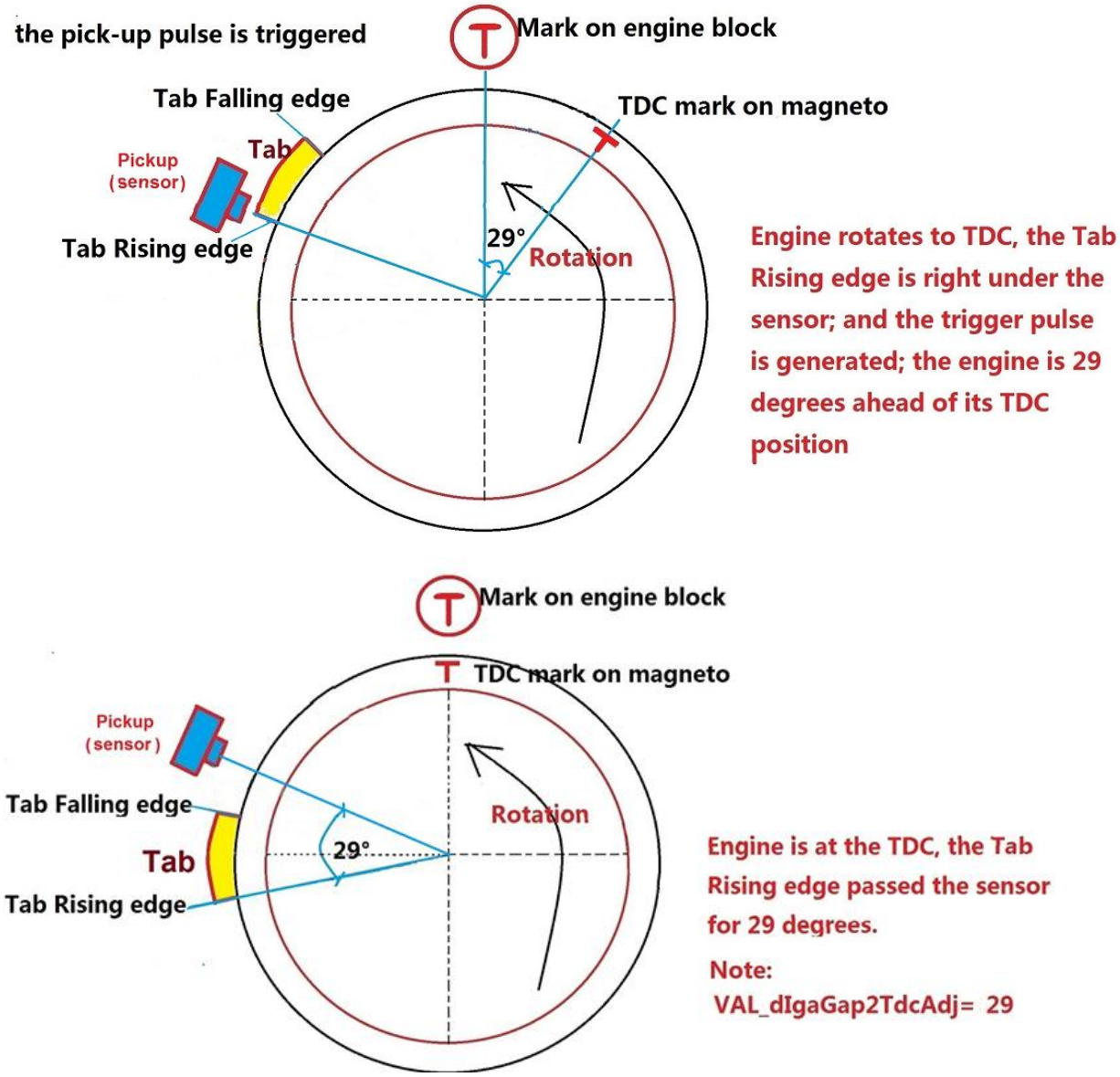



**EXT**: External Charger, from the Battery
**SW**: Kill Switch
**GND**: Reference Ground
**IGN**: Ignition coil, to the spark plug coil, primary side
**CDI_Ctrl**：CDI Control output from ECU
**CKP (Crank Position Sensor)**：Connect to ignition pickup sensor signal

**GY6 125cc scooter 6-pin CDI wiring diagram**

**Note: If you use ECU to control the ignition, you must find out the angle between pickup and TDC, this is very important for ignition control**

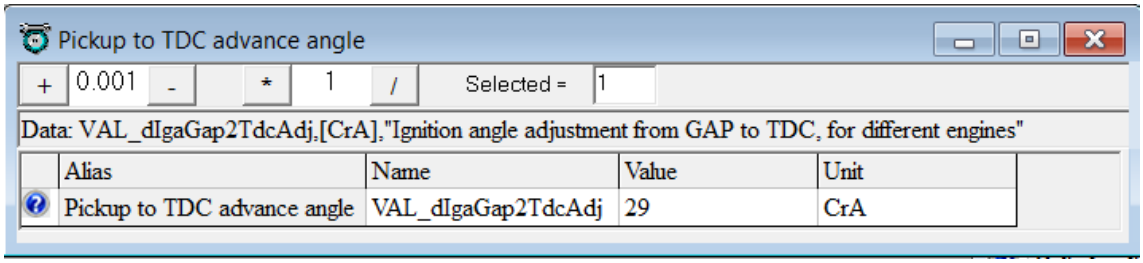
**The method to find the angle from the pickup to TDC:**




VAL_dIgaGap2TdcAdj: "Ignition angle adjustment from GAP to TDC, GAP is the pickup pulse location."

**Please set the offset angle in EcoCAL:**

Menu → Variables → Calibration Selection →




**Note:**

1) This is the first calibration you need to be sure. It determines the engine TDC position in regarding to the pulse generation.

2) The default is 29 CrA. That means 29 degrees in advance to the TDC. It is a positive value 29 degree of crankshaft angle (CrA).

3) VAL_dIgaGap2TdcAdj needs to be set in old software. The negative is corresponding for advance angle, the positive is corresponding for lag angle value. You can find out whether it should be a negative value with your A2L file, such as:"S33_H1_L48_Cr17_AT3.4_E4.a2l" if the number less than or equal to "Cr17", for example, "Cr17or Cr15…."

## 1.9 Install Ecotrons ignition coil

The Ecotrons ignition coil shall be installed as below, if you have one included.

**Note**: Most carburetor engines have a spark plug with no internal resistance. This type of spark plug generates a lot EMI noises which can easily interrupt the ECU's normal running. If you experience severe ECU resetting, or misfiring events with no clue, you have checked everything, the EMI noises may be the cause. Contact us to confirm.

To fix this issue, you can put the ignition coil into a metal box, so that the EMI noise is emitted less. You can also put ECU into a metal box, so it's less affected. But if it does not work yet, you may have to replace the spark plug with one that has a built-in resistance. In fact, all OEM engines with EFI system are using the spark plug with resistance built-in.




## 1.10 Install the 12V battery

If your engine or vehicle did not have a 12V battery once, and you just add one, our EFI kit needs the 12V battery as the power supply. The EFI system will not run normally.

Make sure your engine block is connected to the 12V negative, so all grounds are common!

**Note: You must connect the 12V negative to chassis ground.**

## 1.11 Install KEYSW

**Splice the "key on switch" wire, and connect it to EFI "KEYSW" input.**

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. ECU will not work at all if you don't connect the wire**

"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. Like the below picture:




## 1.12 Install O2 sensor

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



**O2 sensor installation for vertical engines (6-10" downstream of exhaust port)**

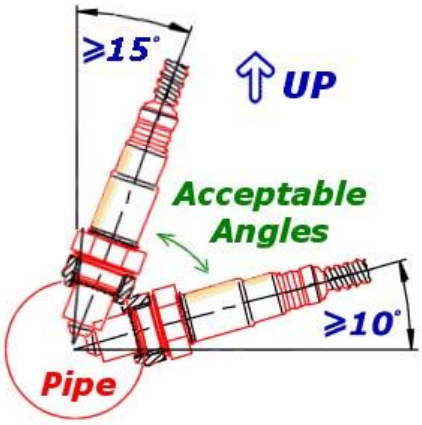


**O2 sensor installation for horizontal engines (> 10 degree tilt angle)**

1) Find the correct the location to install the O2 sensor. It needs to be close to the exhaust port, but not too close (6-10" 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 that the sensor head can be fully exposed to the exhaust gas, but NOT to block the exhaust pipe.

4) Install the sensor in the bung. Connect the O2 sensor cable.

# Chapter2 ECU harness

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

## 2.1 Install ECU

Find a safe place to mount the ECU, avoid the severe vibration and severe hot conditions. Do not expose it to water / fluids.

Note:

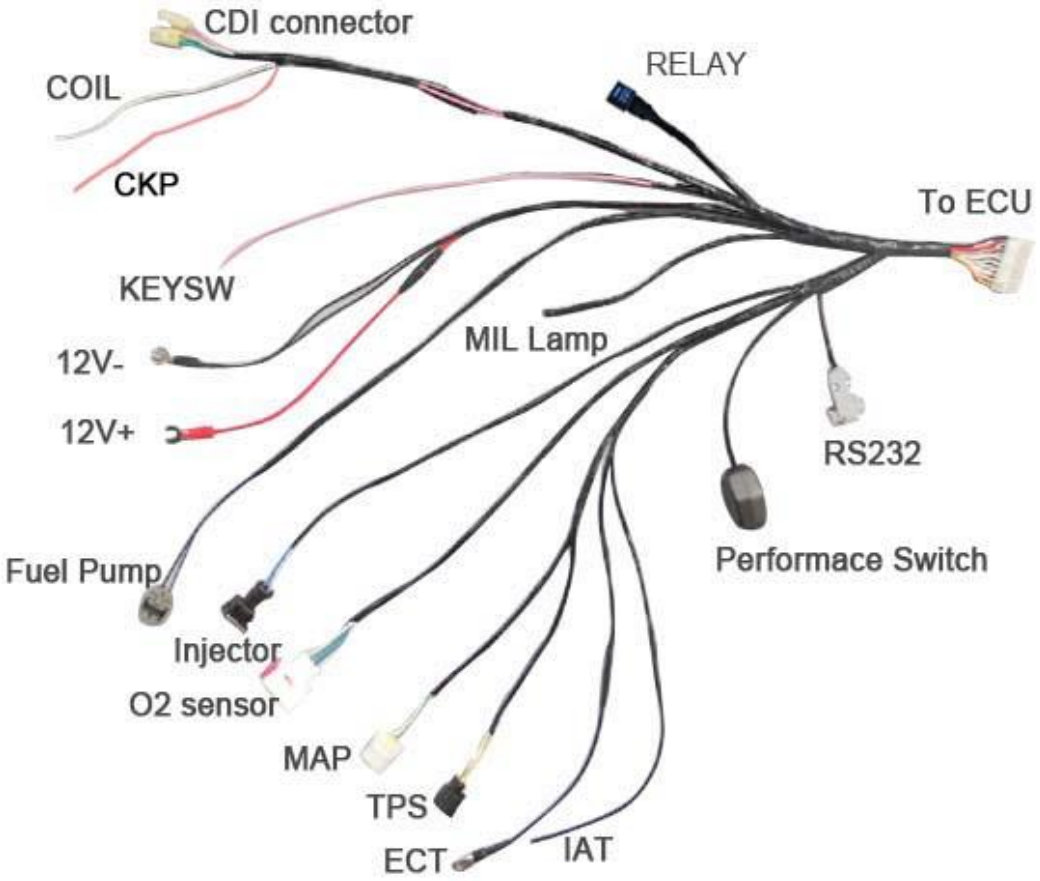
1. You need to add the thermal insulation between the engine and ECU.
2. Avoid the dirty, wet, and splash water.

## 2.2 Mount harness

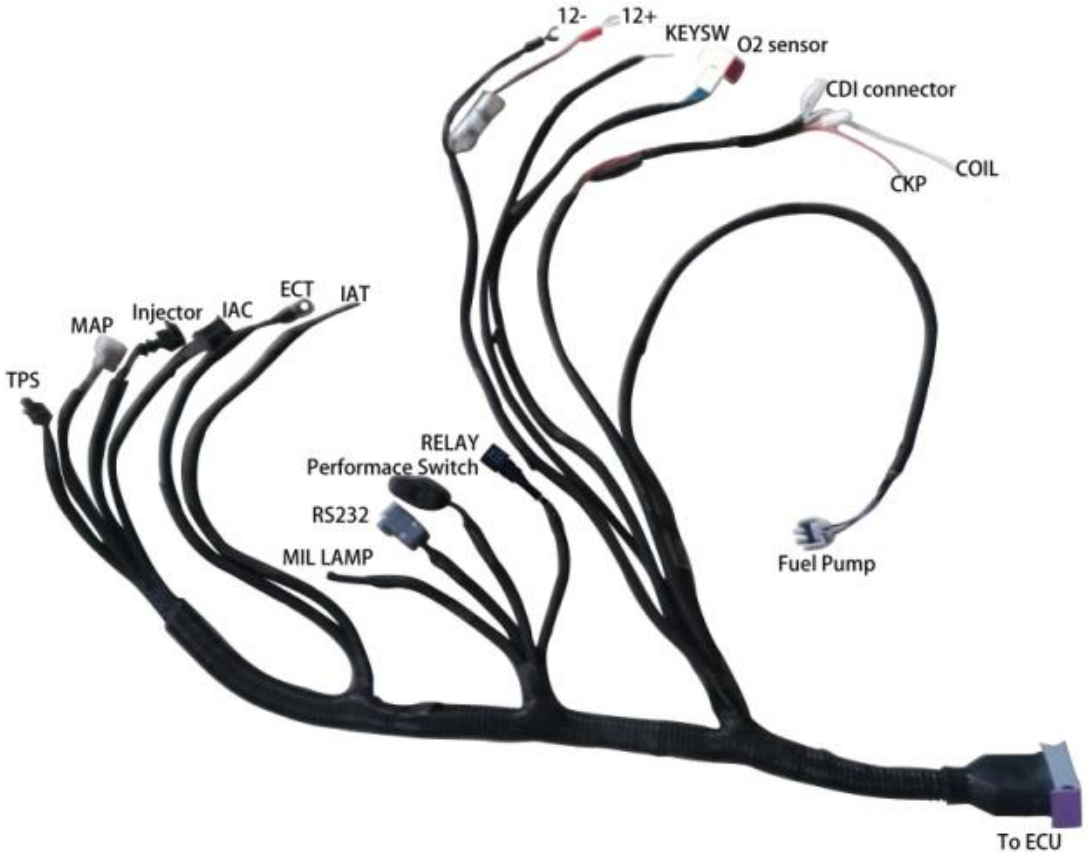
Find suitable locations for the harness. Connect all EFI components connectors included to ECU harness.

**Here is a real harness picture:**

**20-pin harness:**




**24-pin harness**




## Harness label descriptions

| label | Descriptions |
|---|---|
| ECU | Electronic Control Unit |
| RS232 | Serial Communication 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 |
| CDI-Ctrl | CDI control output from ECU |
| GND | Ground |
| KEYSW | Key On switch |

# Chapter 3 Pickup sensor / Crank Position Sensor

## 3.1 Why EFI needs a pick-up sensor?

SAE name of the pickup is CKP (Crank Position Sensor).

Crank-shaft pick-up input is the most important for EFI system. It tells the ECU the engine timing, or TDC position. The ECU uses it to calculate the RPM; and it also uses it to trigger the fuel injection once per cycle, and to command the spark at the specific crankshaft angle.

**Without the correct pickup (or CKP input), EFI will NOT work, period.**

There are a few types of pickups our EFI can work with.

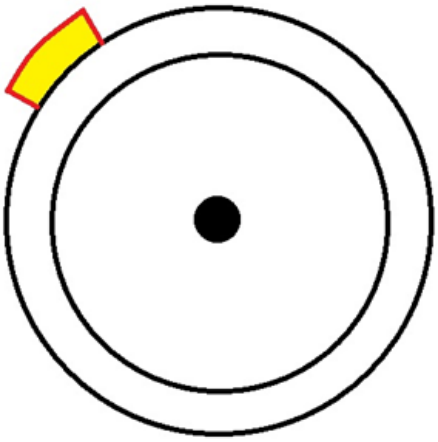
Depending on what type of ignition system you have with your engine, our EFI can use the below types of the pickups:

- CDI ignition pickup
- TCI ignition kill wire
- Hall effect sensor pickup
- Multi-tooth trigger wheel crank sensor

## How many pulses per revolution are there?

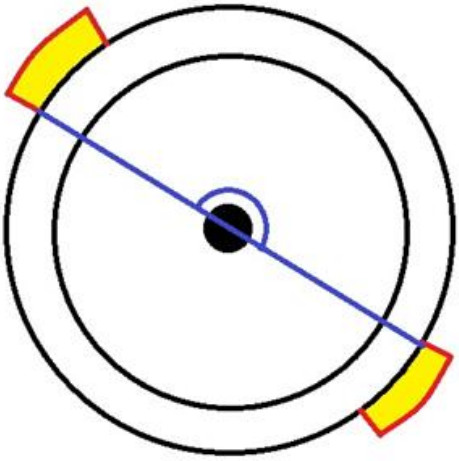
For our EFI system, you need to confirm how many pulses per revolution of pick-up sensor, the easy way is to open the crankcase to count the # of tabs or magnets on the flywheel.

1) If there is only one tab or magnet on the flywheel as the following picture showing, it means there is only one pulse per revolution. Then calibrate the total tooth number: VAL_nTeethTot=1

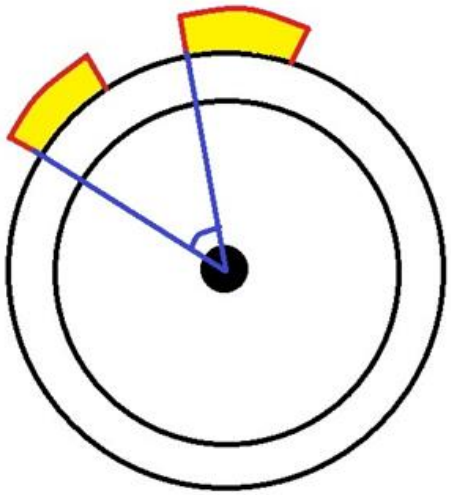


2) there are two tabs or magnets on the flywheel

2.1) They are separated by 180 degrees, it will produce two pulses per revolution, so VAL_nTeethTot=2



2.2) They are very close, and less than 90 degrees separated, it also produces two pulses per revolution, but because of they are too close, so you need ignore one pulse with software filtering. Do following calibrations.



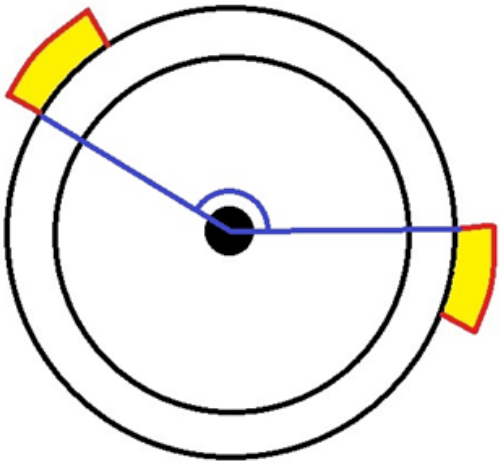
VAL_nTeethTot=2

VAL_Ignore_second_tooth_enable = 1

VAL_Ignore_second_tooth_x_apart = 2

**Note:** if you can't know how to tune it, please log some data and send us, and take some photos of flywheel to send us, we help you to check and calibrate it.

2.3) The two tabs or magnets are seperated between 90 and 180 degrees.



For this, you need to updata a new software or erase one tab(magnet), please contact us.

## 3.1.1 CDI ignition system

**CDI stands for Capacitor Discharge Ignition system.**

Most small engines use a small pickup coil as the trigger source to send a pulse to the CDI. The CDI then fires the spark. This is the default and the easiest option for our EFI to use as the pickup signal. You just need to connect the CKP wire from the EFI harness to the CDI pickup source.

This pickup coil is usually installed on the crankcase, or the stator, next to the flywheel. There is one metal tab or a magnet on the rotor (some engines have two), or on the flywheel external surface; and when this metal tab passes by the pickup coil, it generates a pulse, and triggers the CDI. This is how CDI knows when to fire the ignition. Our ECU uses this same pickup as the timing input to determine when to fire the injector and ignitions.

There are usually 2 wires coming out of this pickup sensor. One is trigger wire, the other is usually grounded.

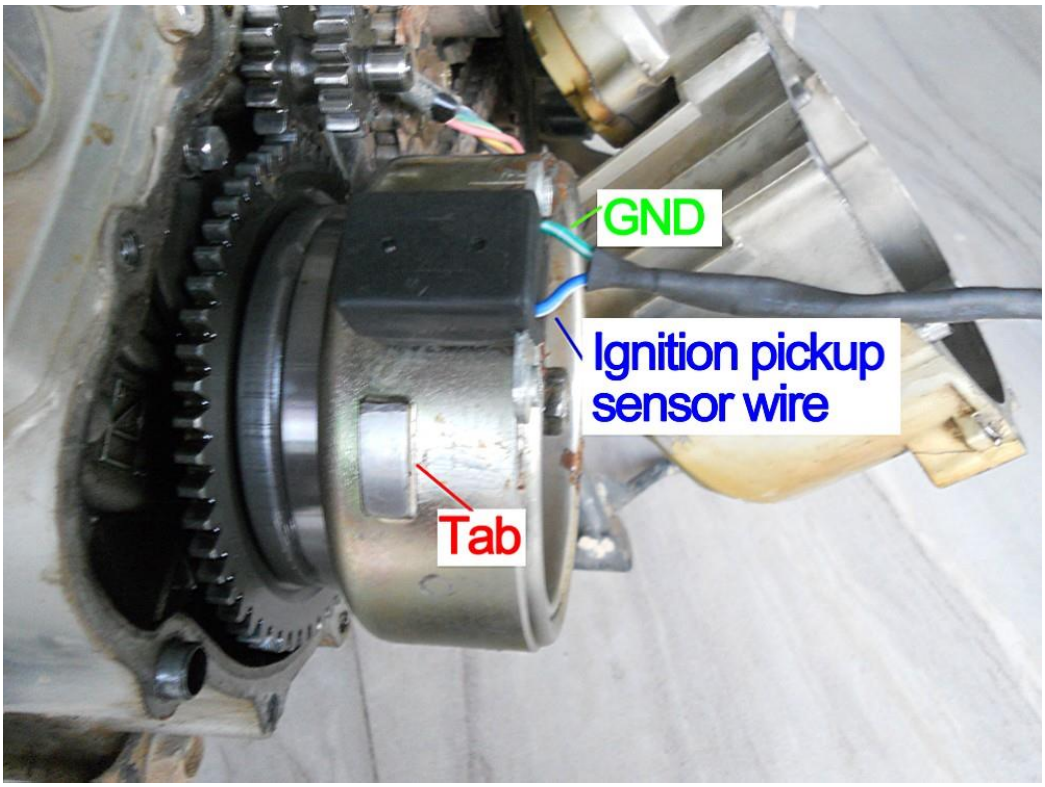
Identify the "**Ignition pickup sensor wire and GND wire**" on your CDI box, refer to the below picture if you don't know how.

Most CDIs use a small pickup sensor which is installed on the crankcase, next to the flywheel, as the trigger source. There is one metal tab/tooth (some engines have two), on the flywheel external surface; and when this metal tab passes by the pickup sensor, it generates a pulse, and triggers the CDI. This is how CDI knows when to fire the ignition. Our ECU uses this same pickup as the timing input to determine when to fire the injector and ignitions.

There are usually 2 wires coming out of this pickup sensor. One is trigger signal wire, the other is usually grounded.

To tell which wire is the **ignition pickup sensor wire** and which is 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.



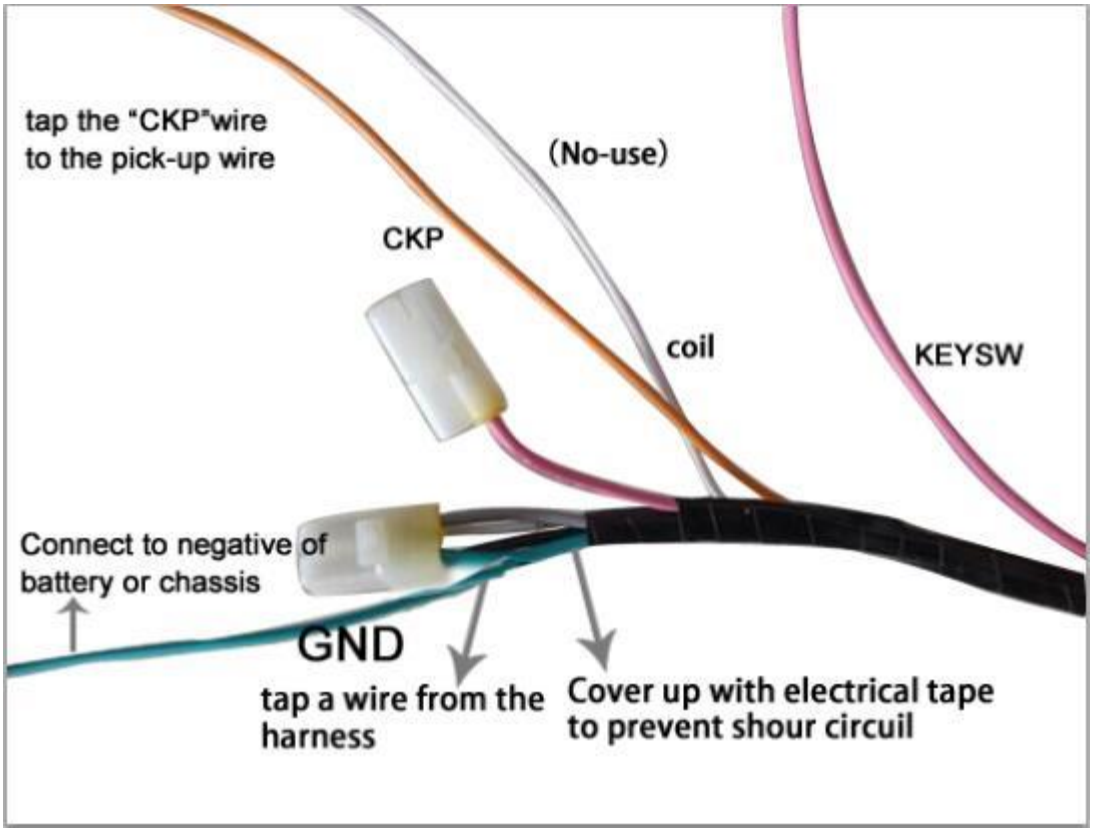

**1)** Tap the "**Ignition pickup sensor wire"** with the wire labelled **CKP** wire on the ECU harness; and then secure the splice with electrical tape or better solder it. This wire is the ignition pickup signal (or as we called it, the Crank Position sensor - also called VRS, variable reluctant sensor,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

**2)** Tap the "**Ignition pickup sensor GND"** with the **GND** wire (**Green** wire on the ECU harness). ). Note, some engines have only one wire coming out of the pickup sensor, the ground wire is connected to chassis internally. In this case, you need to connect ECU **GND** wire (**Green** wire on the CDI connector) to the same chassis too.

**Note**, some engines have a CDI using both pickup "+" and Pickup "-"; meaning

none of the 2 pickup wires are grounded. In this case, you need to figure out which one is the Pickup "+" and tap our CKP wire to it. And connect the ECU **GND** wire (**Green** wire on the CDI connector) to chassis.

For many engines, which have their own special CDI, it is a good practice NOT to use the Ecotrons CDI first, and get the engine running first with the stock ignition system, and uses Ecotrons CDI later. Or you can simply keep the stock ignition system and never install Ecotrons CDI, which reduce a big variable here.




**Note: the white wire labelled "COIL" is not used when you use the stock ignition system. Like above picture, you only need to install THREE wires, labelled GND, CKP, KEYSW.**

**If you want to keep the stock CDI ignition system, or if you don't want to use**

**Ecotrons CDI. Then skip the chapter 1.8, 1.9, jump to chapter 1.10 to do installation.**

## 3.1.2 TCI ignition system

There are many engines that do not have a CDI. Instead, it has an integrated ignition module, called TCI (Transistorized Charging Ignition) system. For example, Honda GX200, GX390, etc. and Briggs & Stratton engines, those engines have an ignition module installed right next to the flywheel. And there is a magnet built in the flywheel. When the magnet passes by the ignition module, it triggers the coil inside and fires the spark plug directly via a high voltage cable. For this type of ignition system, there is no standalone pickup sensor. The only wire that comes out of the ignition module is the kill wire.

This kill wire could be used as the pickup because it is basically connected to the primary side of the coil. . The primary side of the coil will generate a big pulse with some oscillations when the magnet passes by the coil. After all, when you press the kill button, the kill wire is to ground the primary coil to suppress the trigger pulse so the secondary coil does not fire at all.

As said, the kill wire can pass the trigger pulse from the primary coil to ECU, but may do it with a lot of the noises. The noises are generated by the firing event of the secondary coil. To use the kill wire signal as the CKP input, some intensive filtering process is needed. The ECU has some built in filters to handle noises. In most cases, it can handle the kill wire signal with noises. But because there are so many different engines out there, some kill wire noises may not be filtered. In that case, you can use a dedicated Hall-effect sensor as the pickup.

To do that, you need to confirm with us that you need a Hall-effect sensor, an Ecotrons CDI, and an ignition coil from us. These 3 components will replace the stock integrated ignition module. You will need to install the Hall Effect sensor at

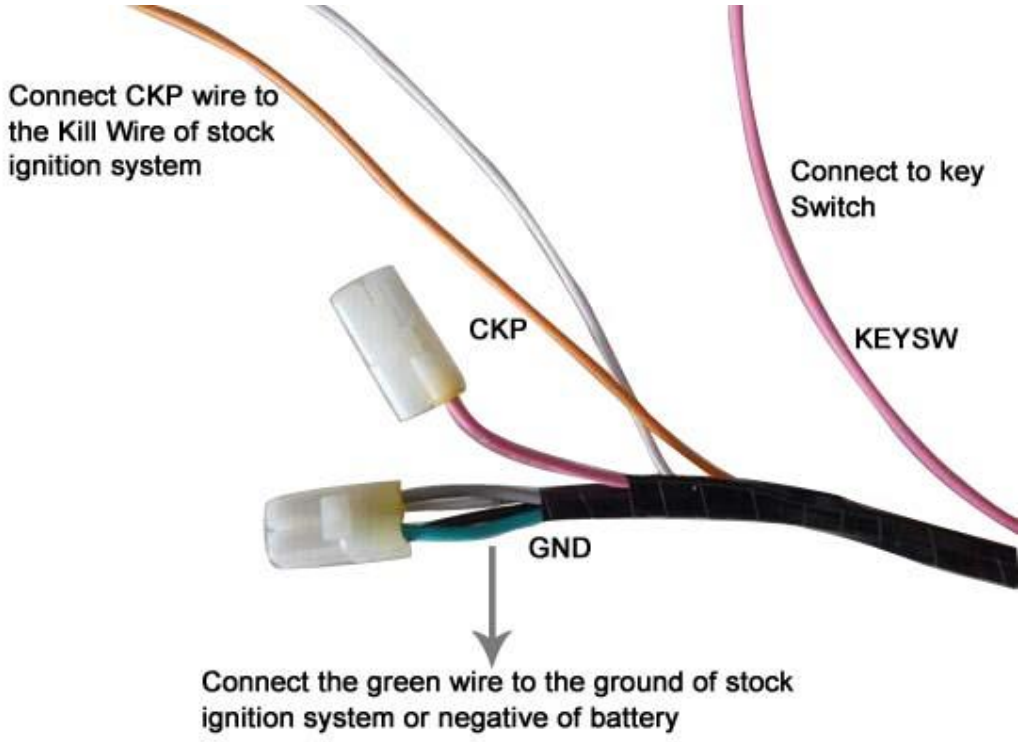
the same location of stock ignition module. It seems complicated. But it gives the ECU the critical pickup input (from the Hall sensor); also, you get the fully programmable ignition control system as a result!

**1) EFI Controls fuel only**

For this type of ignition system, you can use the signal from kill switch wire as the pick-up signal. Keep the stock ignition system, and the EFI just controls the fuel. You need to connect the wire labeled CKP from the EFI harness to the kill wire and connect the EFI green wire which labeled as GND to the ground of your ignition system.

Please connect it as below:

**Note: The 2 small white connectors are for Ecotrons CDI. You don't have to connect them if you are not using Ecotrons CDI.**



**2) EFI Controls both fuel and ignition system with the Hall sensor**

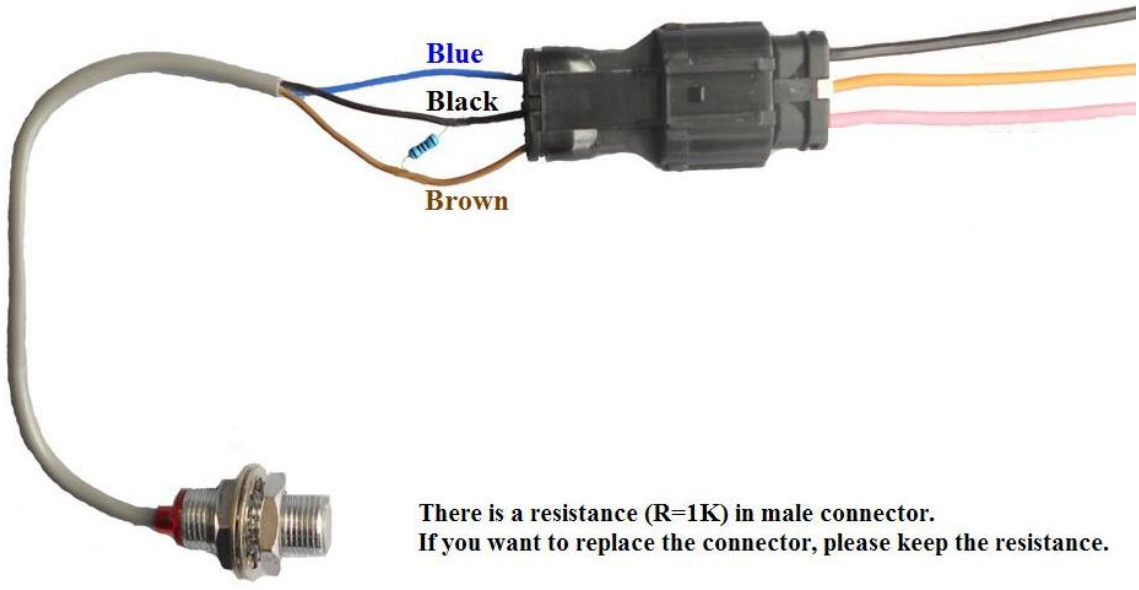
Because the kill switch wire from this type coil can have a lot of noise, it may not work completely. You can convert this type ignition system to CDI ignition system.

To convert, you can use 3 of our components to replace this one integrated ignition coil, namely: Hall-effect sensor, CDI, and ignition coil.

The Hall-effect sensor acts like a pickup; it shall be installed at the same location as the stock ignition coil. A bracket may be needed. The CDI is controlled by our ECU; and the coil is driven by the CDI, and fires the spark plug. It seems more complicated, but the benefit is a fully controlled ignition system, you can program the ignition maps as you want!

**The Hall Effect sensor and ECU harness**

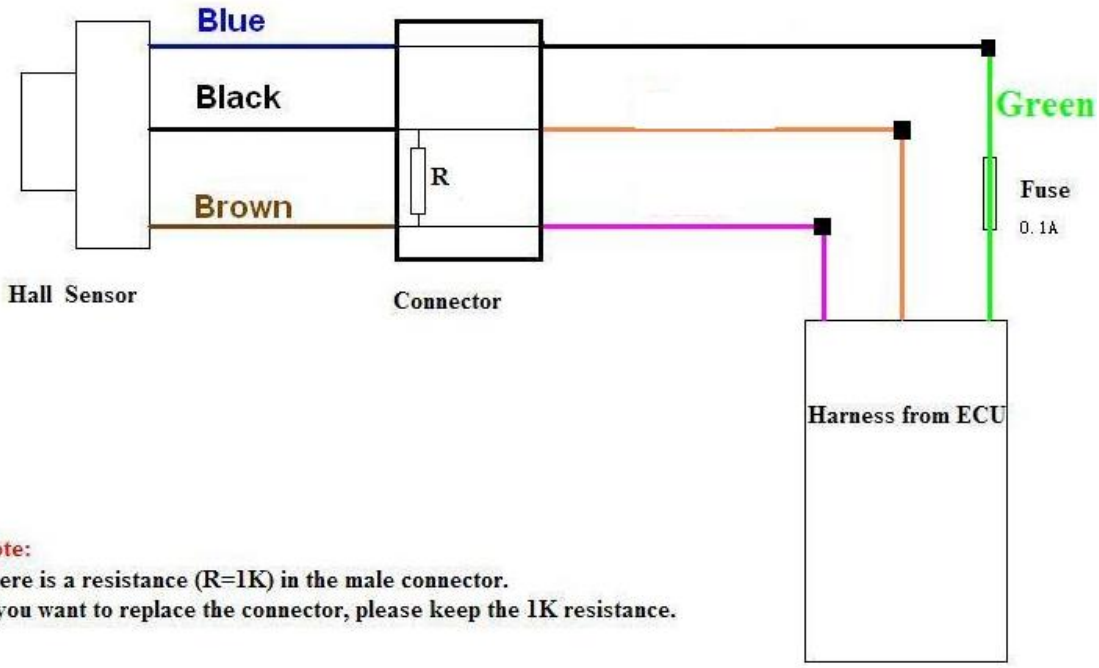
(1). Hall Effect sensor pin-out:



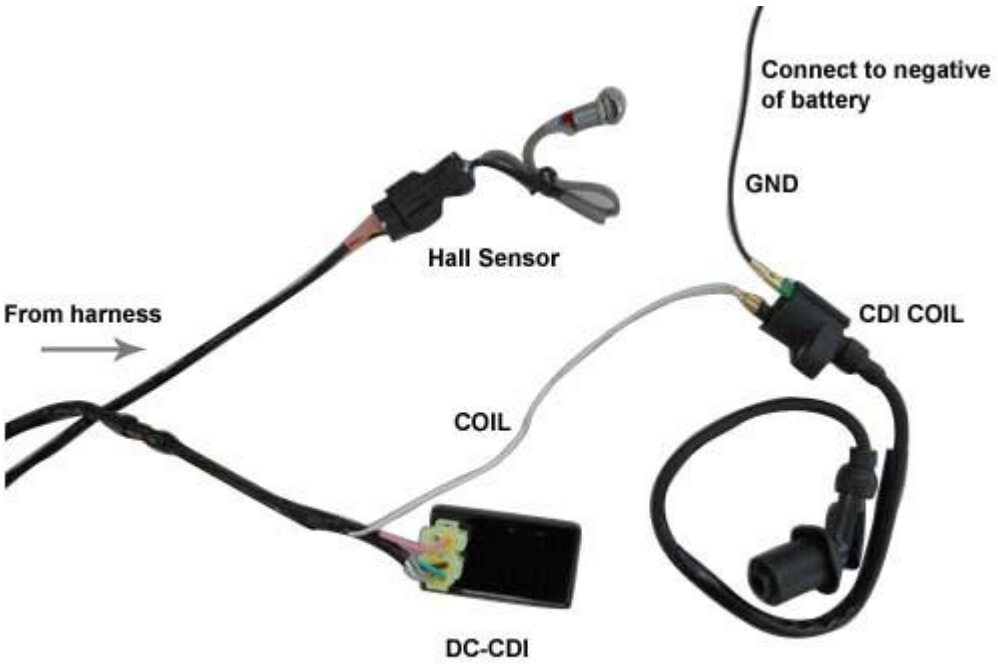

**Brown** wire: power +

**Blue** wire: power –

**Black** wire: signal wire




The Hall sensor is pre-selected, the EFI harness will come with Hall sensor connector, and CDI connectors, so you don't need install the 1K resistance again. See below for the simplicity of the harness.

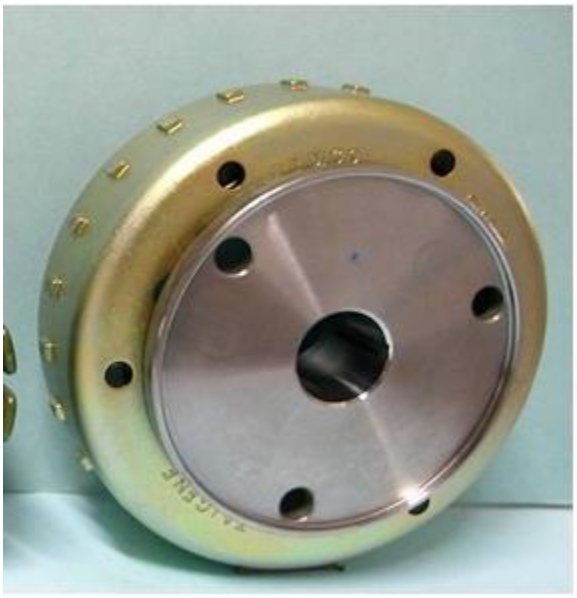



### 3.1.3 Mechanical break-point style ignition system

There are still a lot of vintage bikes (vehicles) that are running on break-point style ignition systems. In this case you may have to convert it to electrical ignition system. You may want to convert it anyway, since it has already created a lot of headache to you. There are 2 ways to convert this type of ignition system:

- Convert it to CDI system: good for single engines; you need to install a magnet on the flywheel, or somewhere that synchronizes with the crankshaft; and install our Hall effect sensor to be triggered by the magnet; then our CDI and coil will be controlled by our ECU;
- Install a high-tooth trigger wheel on the crankshaft: good for 2 cylinder or multi-cylinder engines. You need to get a multi-tooth

trigger wheel, like a 12-1, 24-1, 36-2; or even 60-2 tooth wheel; and then install a VRS type sensor (variable reluctant sensor, which we can provide). The VRS sensor will read the crankshaft position. Then our ECU will control our inductive coils directly and fire the spark plugs, like most modern cars! This is the best solution though requiring most efforts.



**Multi-tooth trigger wheel (built-in on the flywheel)**

## 3.2 Pick-up sensors installation

### 3.2.1 Examples of Hall Effect sensor installation

For some engines, such as Honda GX160, GX390, or similar, the stock magnet is North polarity. And the some engines, such as Gx35, the stock magnet is South polarity. Our Hall Effect Sensor is by default South-Pole Magnet trigged.

If you install this Hall sensor to an engine which has a North-pole magnet, you will have 2 pulses per revolution, one at the leading edge of the magnet; one

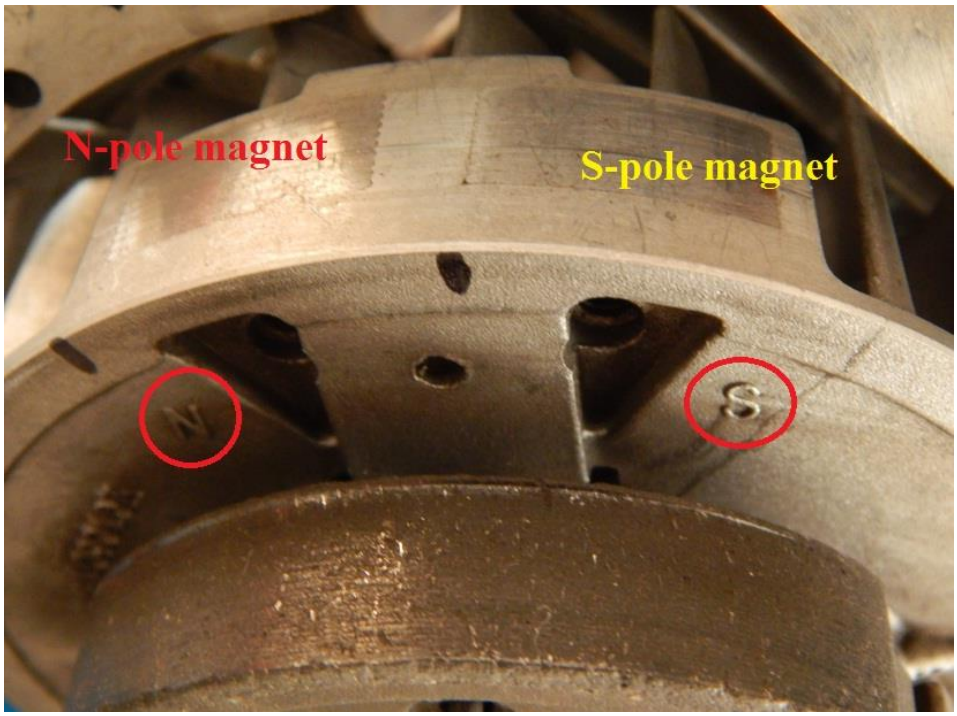
is at the trailing edge. This will confuse the ECU and you may not even able to start the engine. You may start the engine, sometime, but the running may be unstable or stall at high RPM.

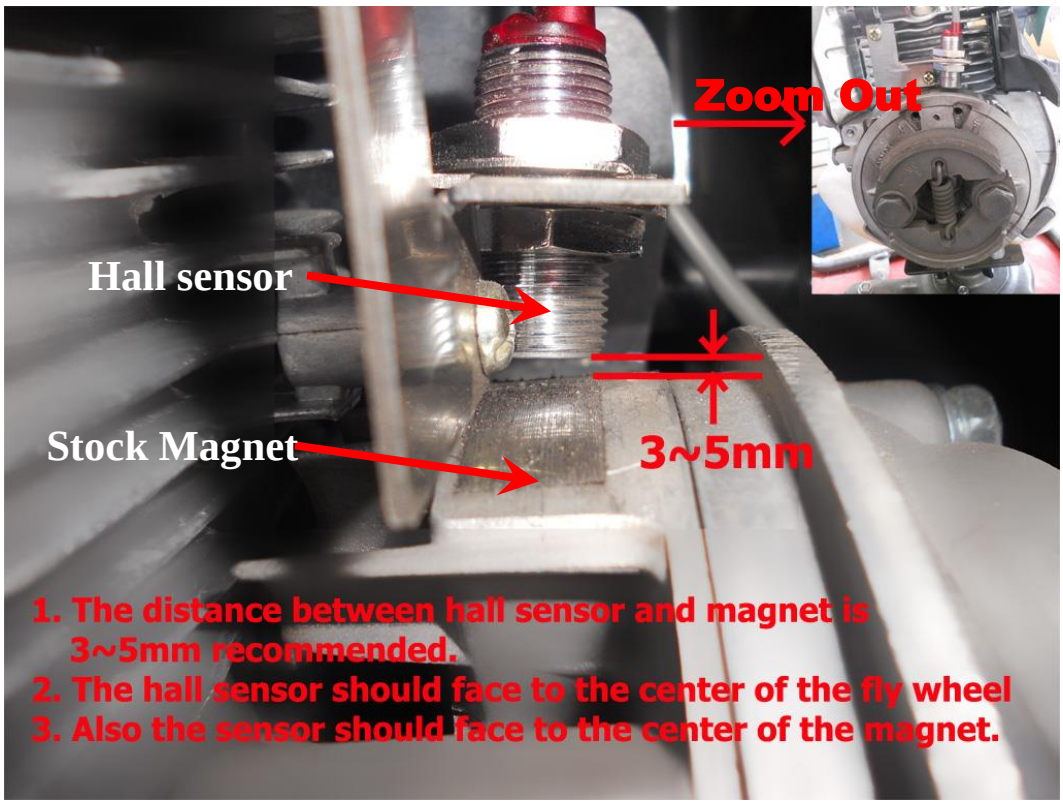
To fix this, we can provide a North Pole Hall effect sensor as the pick-up sensor, so you don't need install an extra South Pole magnet. But you must tell us before the shipping of the EFI kit. So we can replace the S-pole Hall sensor with a N-pole sensor.

Also it is critical to install the Hall Effect sensor correctly!

**Example on Gx35 engine with S-pole Hall Effect Sensor**

**Note**: There are two magnets on the flywheel, but Hall Effect sensor from Ecotrons is preferred to work with **S polarity** type of the magnet to trigger.

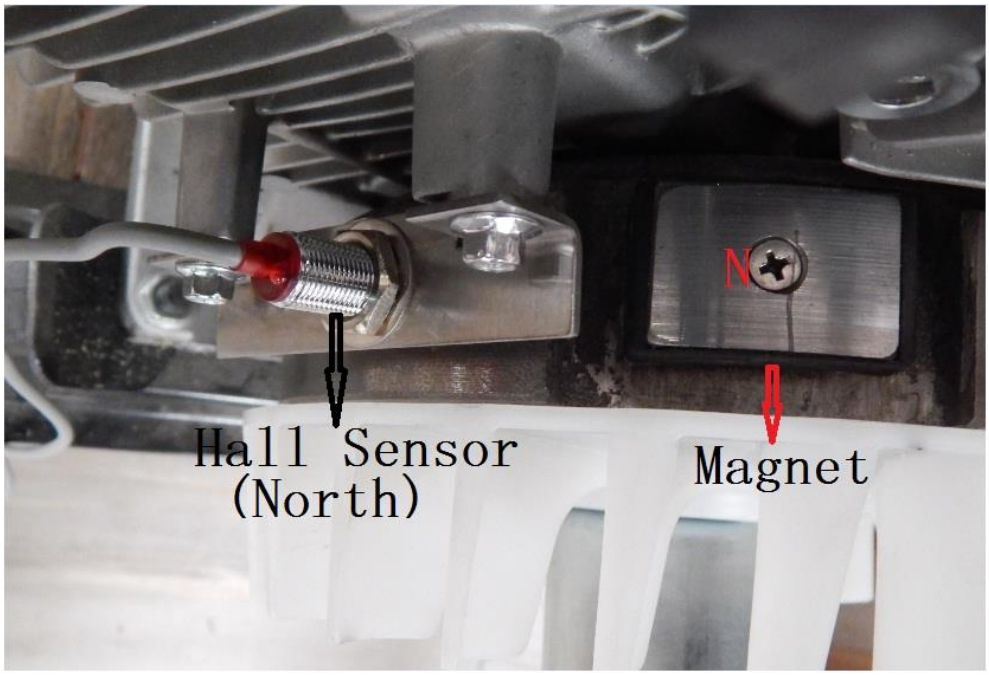




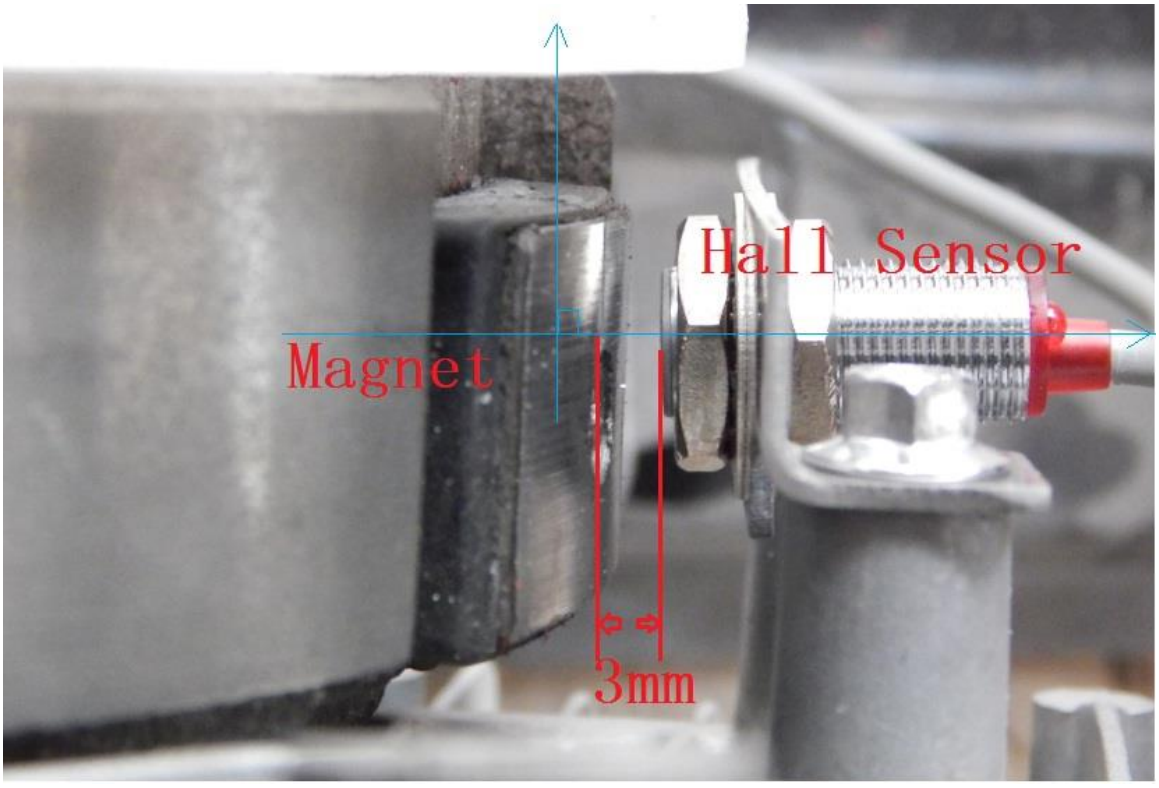

Hall sensor works with S polarity of magnet, when it works, the LED will be light.

**Use GX390 as an example:**

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




**Install Hall Sensor and Magnet:**



**Note: The clearance between Hall sensor and Magnet is better at 3-5mm.**

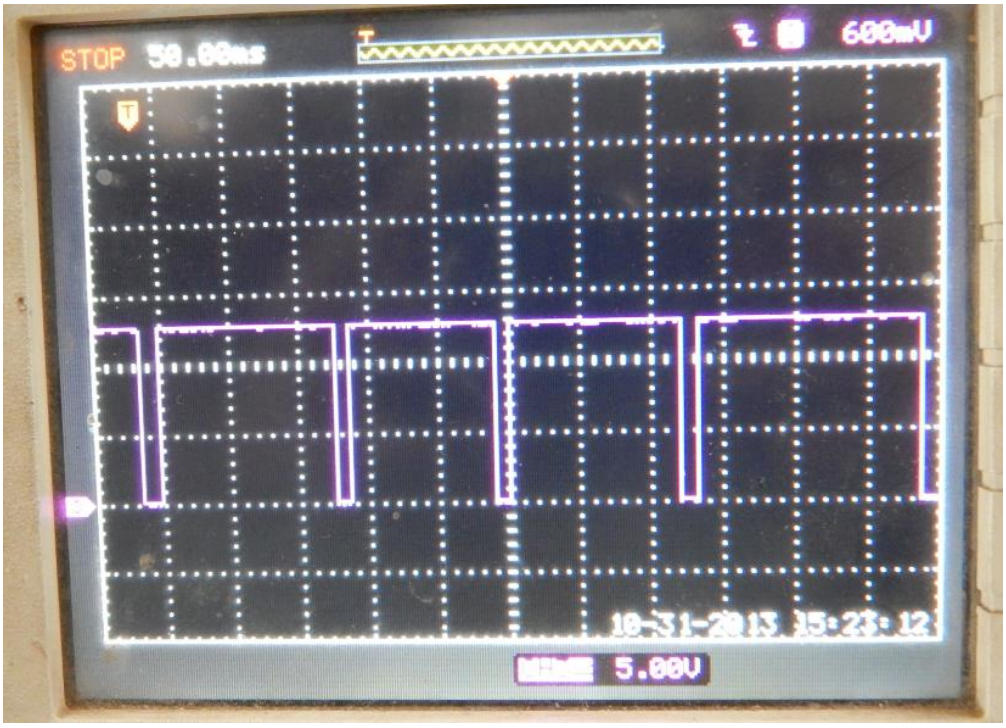
The Hall sensor location and the clearance between the sensor and the magnet are critical for the Hall sensor to generate the correct pulse signal. See below for a correct signal. The best way is to use an **oscilloscope** to measure it!

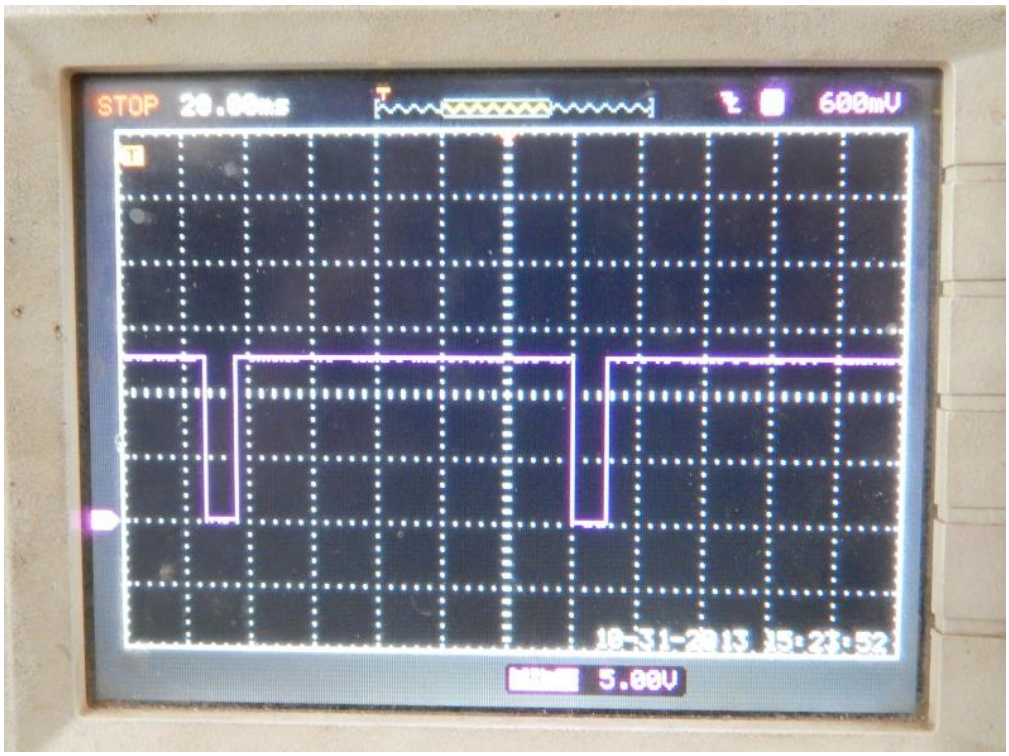
If there is no magnet on the flywheel, you need place one magnet.
**"30-40 degree ahead of TDC should be the magnet is placed on the flywheel."**

**Note**: 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.

The pulse width of the Hall sensor signal should be bigger than 60 us (micro second) and smaller than 15ms (millisecond). This means the magnet width should be in the range of 10mm to 50mm depending on the RPM range.

**You can verify the Signal of the Hall sensor with an Oscilloscope when cranking to start:**


STOP
600mV
10-31-2013 15:23:12
5.00V


STOP
600mV
10-31-2013 15:23:52
5.00V

**Why the EFI doesn't work after the Hall Effect Sensor installed?**

**Q: After installing the Hall sensor, and if I rotate the crankshaft, the LED is on and off when the magnet passes through the Hall sensor. But EFI does not do anything.**

**A**: **Step 1**: If you ordered the EFI without the Hall sensor but added the Hall sensor later, likely you do not have the right ECU software. Please check the A2l and CAL file and make sure it is suitable for the Hall Sensor. Or contact us and send back the A2l and CAL file, we will help you to check it.

**Step 2:** Check whether the Hall sensor polarity is same as the magnet polarity. If the sensor LED only turns on at the edge of the magnet, but turns off in the center of the magnet, this means they have opposite polarity. You need contact us to get a different polarity Hall sensor, like a N-pole sensor.

**Step 3:** Double check the wire connection if it is from you connected the individual wires. The power wire connection of Hall sensor, and the signal wire connects to CKP wire; the ground wire to harness ground or 12v negative.

You can take some photos and send to us for confirmations.

If you ordered the EFI with the Hall sensor and the harness comes with the Hall sensor connector, then you don't need to worry this step.

**Step 4**: The ultimate check: use an oscilloscope to measure the signal from the CKP wire. Most people don't have a scope; some may have it in the lab. It is a bullet proof way for those who have a scope.

When the Hall sensor is aligned with the magnet, the LED is on, the voltage

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

**Q: After installing the Hall sensor, ECU can read the RPM signal, but it is not easy to start or it is not running stable**

**A**: Likely the installation of Hall sensor is not perfect. The sensor may be mis-aligned with the magnet, or skewed against the flywheel. Please double check the alignment, and please read closely the previous section, and pictures there; and adjust the Hall sensor position precisely.

**Note**: The clearance between Hall sensor and Magnet is better at 3-5mm
Hall sensor is installed as vertical 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.

**Q: I use the stock magnet, but there are two magnets on the flywheel, the engine can't start**

**A**: The 2 magnets may have different polarity. One is N-pole, one is S-pole. Check which magnet turns the Hall sensor LED on. If the LED turns on more than once in a full revolution, then ECU gets confused,
In this case, you need to identify what is the polarity of the leading magnet, and get a Hall sensor for that magnet,
If the LED only turns on only once, and it turns on during full magnet length, not just at the edges of the magnet, the sensor is matching, and you may need the correct software (CAL file).

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 an S-pole Hall sensor.

Another way, you can get rid of the stock magnets, or not to use the stock magnets, and use the magnet comes with the EFI kit (if you ordered the Hall sensor with the EFI, there is one magnet included).

**Q: I didn't order a Hall sensor, but I installed a Hall sensor later**

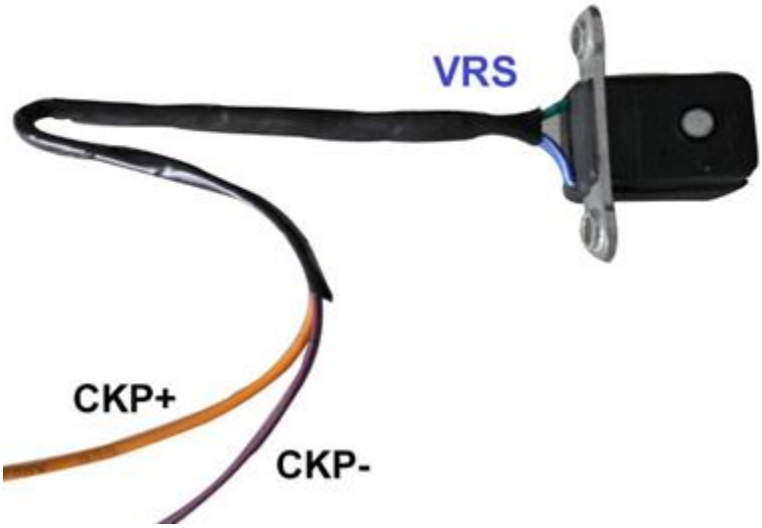
**A**: please install the Hall sensor in the correct method, and contact us for the correct software for the Hall sensor system. Our generic EFI kit comes by default to work with a VRS type of sensor, Variable Reluctant Sensor. It generates a positive pulse to ECU. It is High assertive.

The Hall Effect sensor generates a reversed polarity pulse, and it is low assertive. So in this case, you need a new CAL file from us (software file).

You may be able to change the CAL if you can find it: VAL_CKP_Pulse_Polarity = 1.

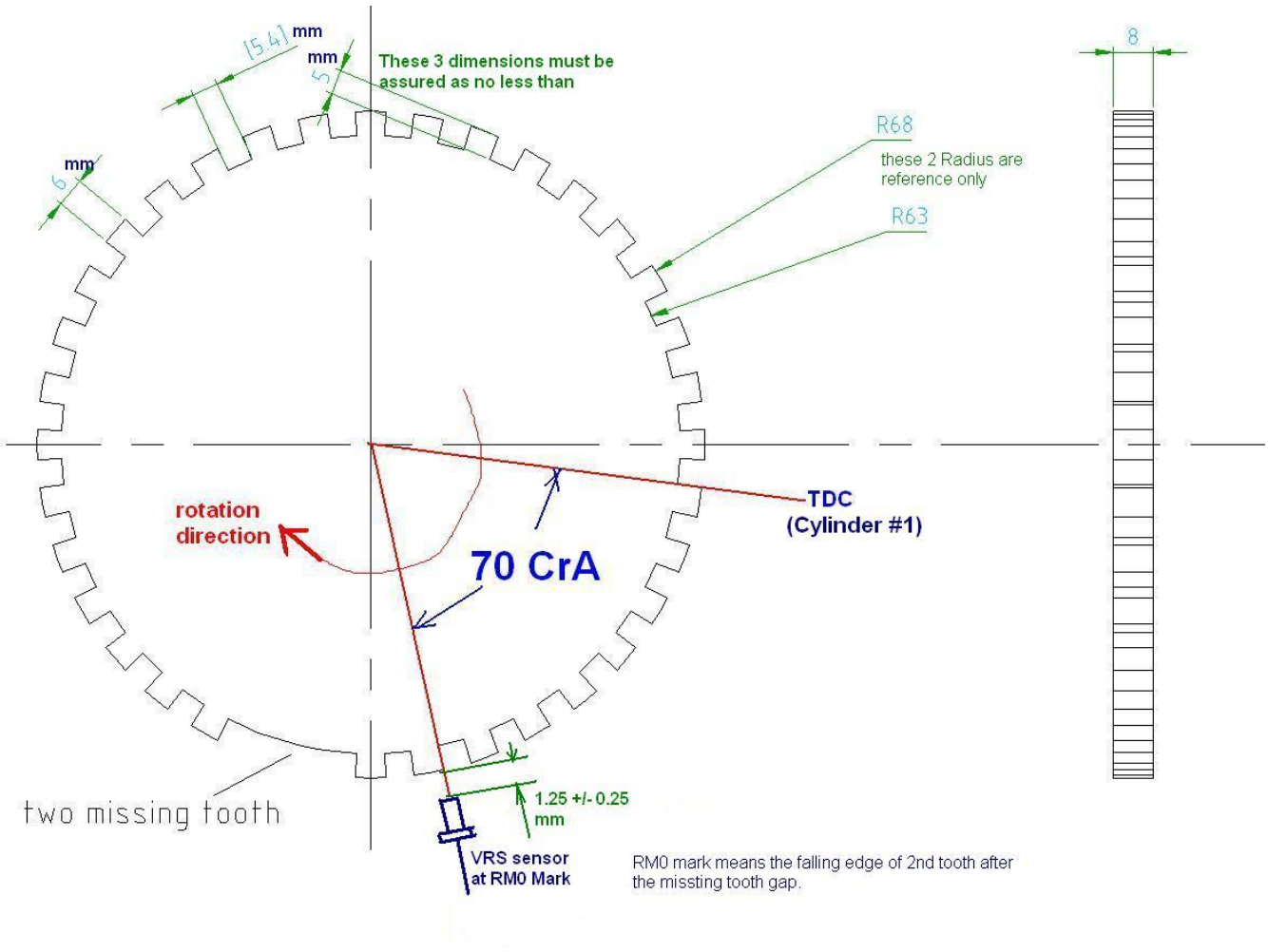
### 3.2.2 The installation and connection of VRS sensor

For some custom EFI system, we provide the VRS sensor (Crank sensor) for multi-tooth trigger wheel. So you need to know how to install and connect it to ECU harness.




**Note: the signal + wire (Blue/white) from VRS sensor is connected to orange wire (CKP+) from ECU harness.**

**And the signal – wire (Green/white) from VRS sensor is connected to purple wire (CKP-) from ECU harness**

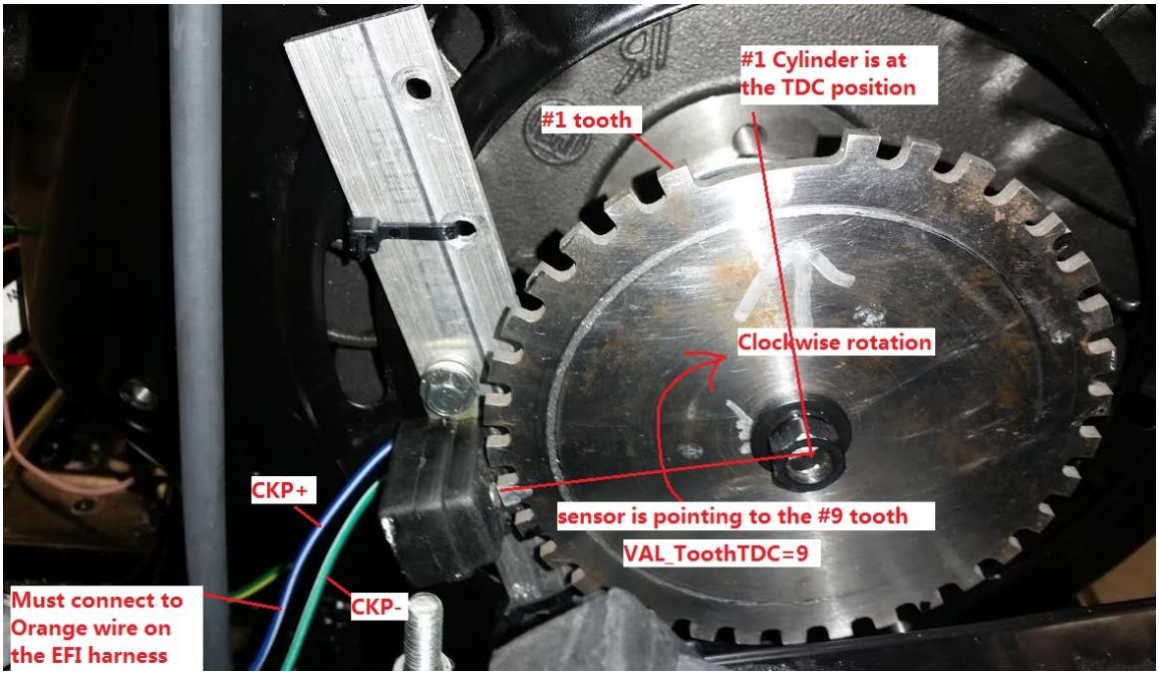



**Note**: the VRS sensor need be installed 50-80 degrees before TDC, and the missing tooth should be at 80-110 degrees before TDC. See above picture as a reference.

The metal sensing element (sensor head) needs to align well with the multi-tooth wheel.

And the tooth width need be bigger than the sensing head, if the sensing head of VRS is much bigger than the tooth, the signal will not be correct, and ECU will not get the correct tooth signal, then ECU will not inject fuel.

**Example:**


#1 Cylinder is at the TDC position
#1 tooth
Clockwise rotation
CKP+
sensor is pointing to the #9 tooth
VAL_ToothTDC=9
Must connect to Orange wire on the EFI harness
CKP-

# Chapter 4 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

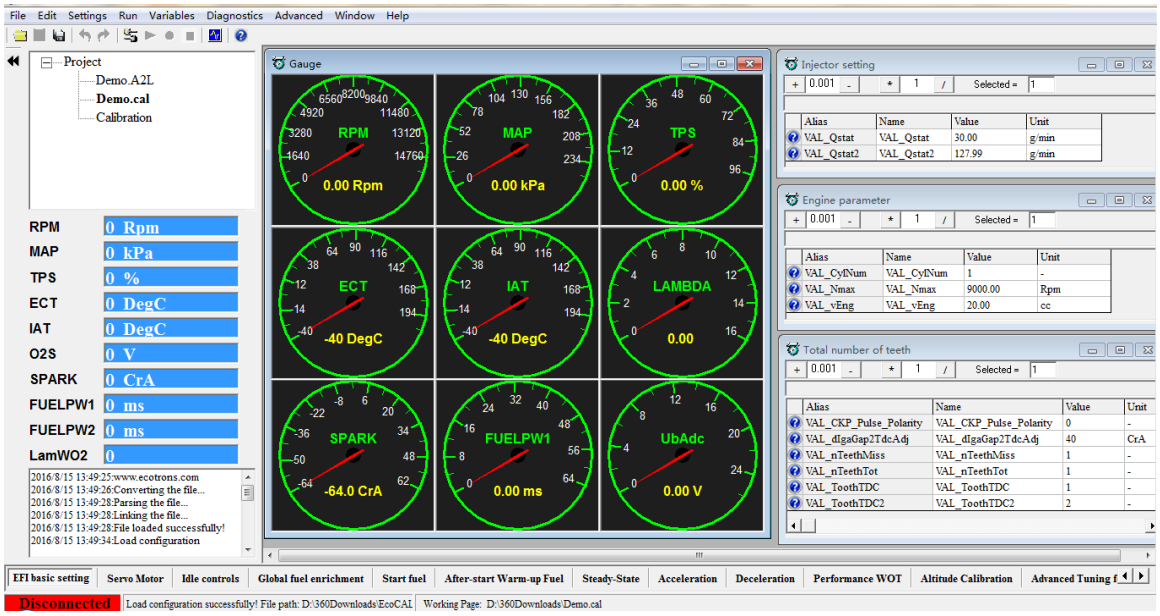
# Chapter 5 How to install the provided EcoCAL software to your computer?

For details on how to use EcoCAL software, please refer to the EcoCAL User Manual, downloadable here:

www.ecotrons.com/support

**Run EcoCAL, you will see below windows:**

When you start the EcoCAL at the first time when you finish installation, the EcoCAL will load the Demo files automatically with the default page settings.




**Note**: If EcoCAL does NOT automatically load the default configuration, likely you do not have the necessary A2L file and CAL file, in the installation folder of "C:\EcoCAL". You should copy and paste the necessary A2L file and CAL file into that folder, if the folder contains no such files.

## Connect ECU to laptop:

**Go to menu->Run->Connect**

You also can use the shortcut button ( ) of “Connect” to Connect to ECU

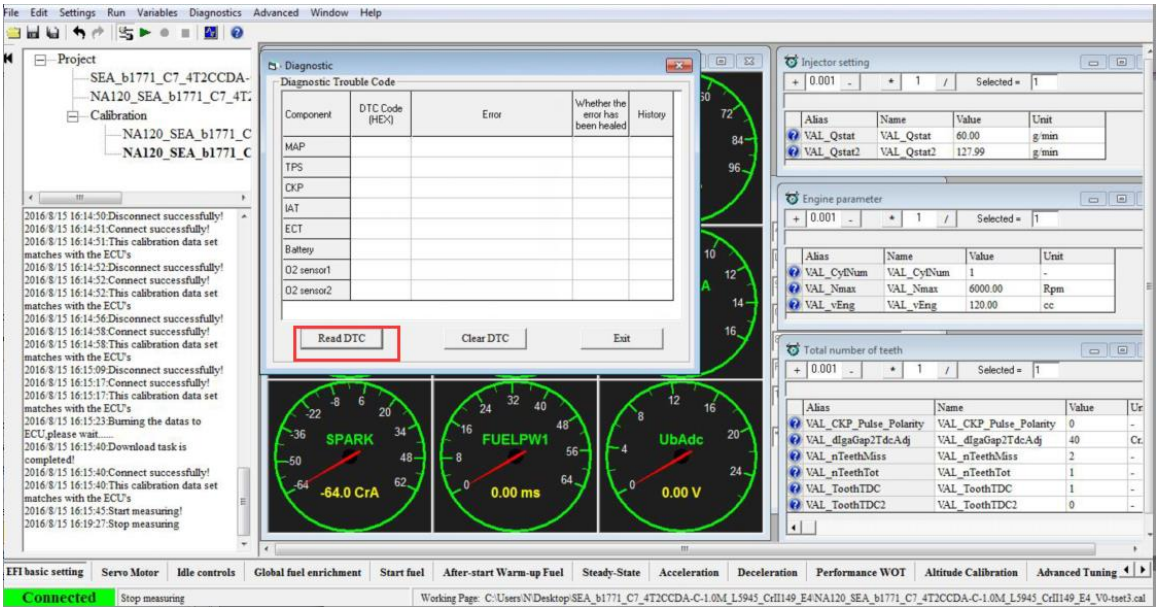



## Read DTC:

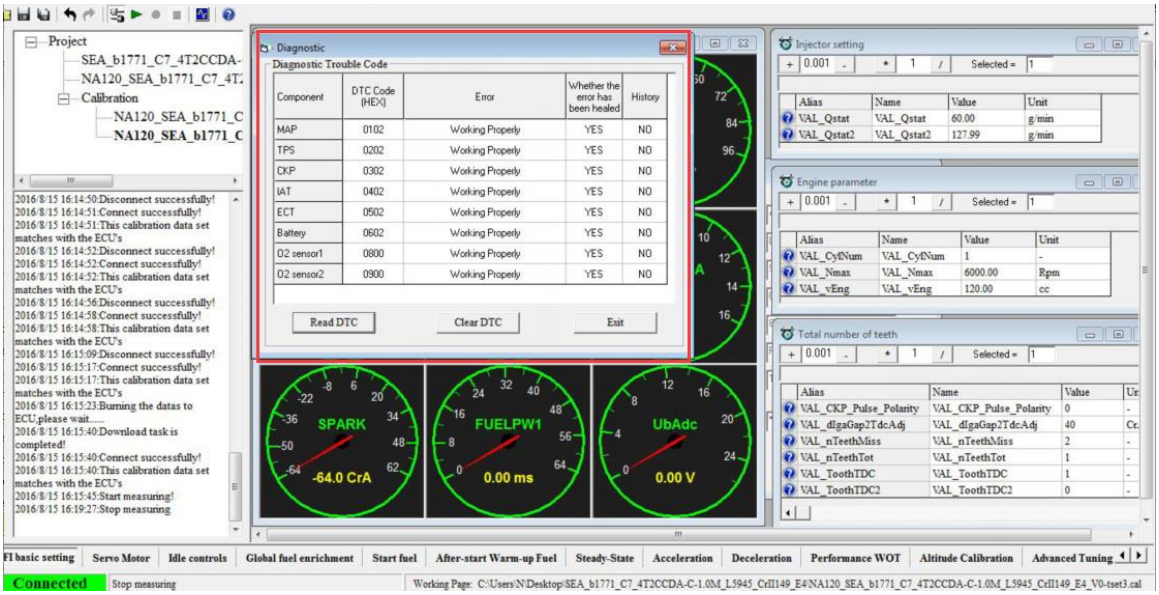
**Go to menu->Diagnostics->ECU Diagnostics**




## Click "Read DTC":




## Supported DTC list (TBD)




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

1.1 Check your serial communication cable; make sure the cable is plugged 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→ communication settings" select correct port: USB or COM port or other.

1.5 Click "Connect" button in EcoCAL.

## How to use EcoCAL to log data:

1) Run EcoCAL (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,** 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: "xxx\record"; that's where the logged files are.

Or you can go to: "**C:\EcoCAL\Record**"

9) When you click down the button, EcoCAL will record the data automatically. And save the record file at the installation path of EcoCAL, "C:\EcoCAL\record", and it is named with the time of recording. For example, the record named "2015-7-25-9-31-35-986" is the record file in record. If you need us to help you on tuning, please send the recorded files to us. (**Don't change the file names**)

# Chapter 6 Initial test and diagnostics after the installation

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. No air pocket! No bubbles!
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?

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.

1.2) 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) Are there some 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 whey you try to start?

1.4) Do you install the MAP sensor correctly?

1.4.1) Does the MAP sensor connect to the throttle body tube via the small hose (included in the kit)?

1.4.2) Is there whether the intake air system is 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 EcoCAL, and choose "Menu → Diagnostics → ECU Diagnostics →" ,to get what's the TDC.

3) Install the EcoCAL (coming in the CD, or downloadable from our website):

3.1) EcoCAL does not support Windows Vista at this moment. Please use Windows XP (the most tested environment), or Win7, Win8.

3.2) EcoCAL can't talk to ECU when you finish installing EcoCAL on your

computer: please check whether the USB adaptor is fully plugged in computer and whether EcoCAL communication setting is set to USB. More details, you can refer to our EcoCAL User Manual.
Or better: Use an old computer which has a built-in COM port to resolve the USB converter problem.

3.3) Establish the communication between the EcoCAL and the ECU: Menu → Run → Connect; then Menu → Run → Start measuring.

3.4) Read diagnostic trouble codes: Menu → Diagnosis → ECU diagnosis → Read DTC.

4) When the EcoCAL communicates with ECU successfully, please do the below tests:

4.1) Try to start the engine (with the engine spinning), Read the measurement variables in EcoCAL:
4.2) Does the signal "RPM" 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, there are maybe some wiring connecting problems. If both the above are YES, you could have fuel supply issue: air bubbles in the fuel lines, or fuel clogged somewhere.

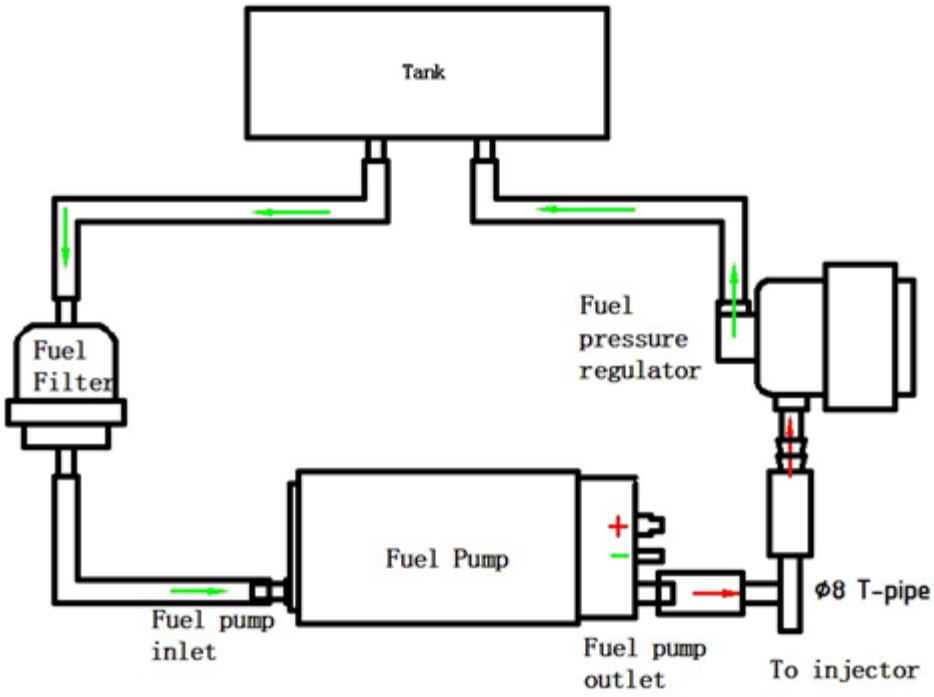
5) To rule out the problem of the pickup sensor, please do the below tests:
5.1) Please disconnect both CKP wire and GND wire from the ignition pickup sensor and tape them to make them not short circuit;
5.2) Please make sure that the stock ignition system is untouched;
5.3) Try to start the engine, and check the below:
Does the signal "RPM" changing from 0 to some value > 300rpm?
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.

With all the above questions and tests done, you cannot figure out why the engine does NOT start yet, please contact us directly:

info@ecotrons.com

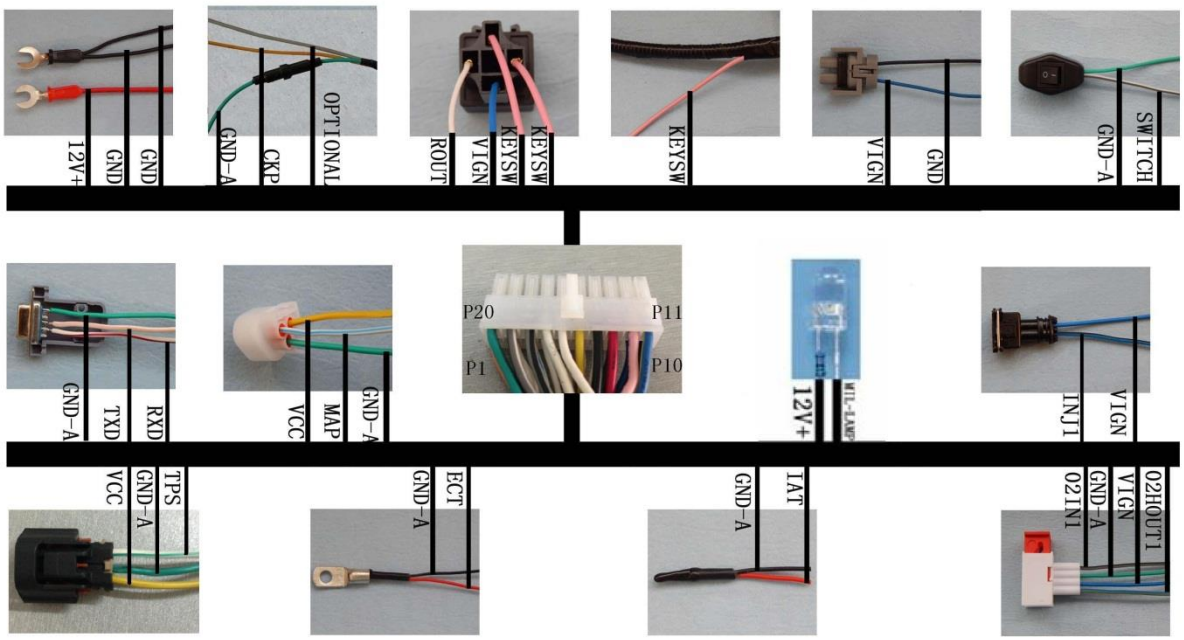
# Appendix I: Fuel supply system schematics:



# Appendix II: ECU main connector pin-out (20-pin)

The wiring schematic is for 4-stroke 1 cylinder engine (1 injector, 1 O2 sensor) settings.

For different engines, like 2-stroke, 1 cylinder, w/ 2 injectors, some pin-out definitions are different.

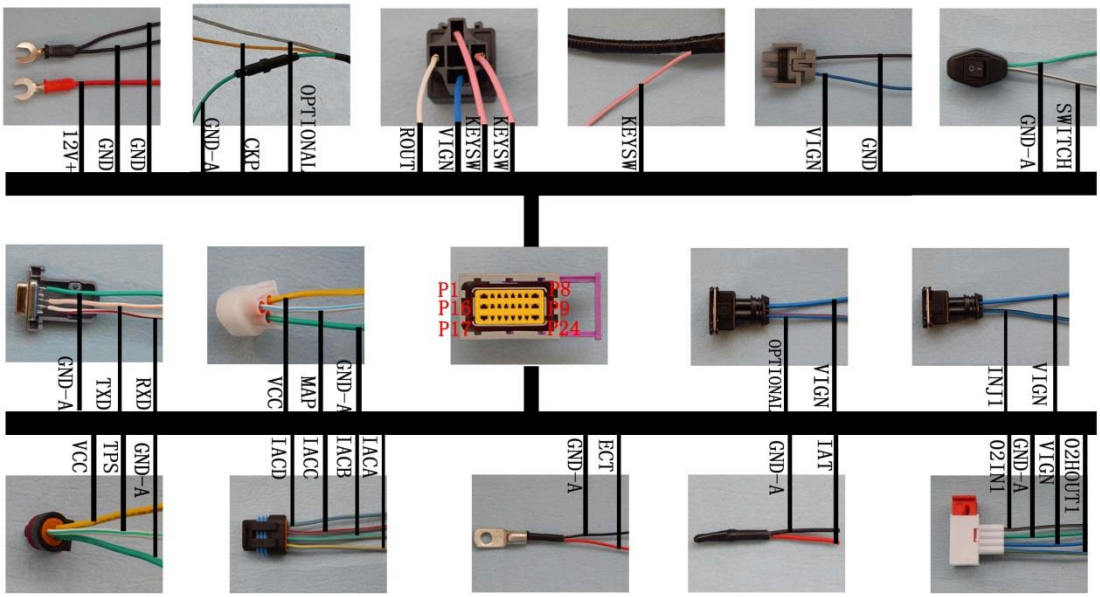


| Pin NO. | Component | Color(Version 2) | Color(Version 1) | Description |
|---|---|---|---|---|
| P1 | CKP | Yellow/Black | Orange | Crank Position Sensor (connect igniting pickup sensor signal) |
| P2 | Optional | Orange/Black | White/Black | Mil-lamp (Optional, Inj2: Blue/Red) |
| P3 | MAP | White/Blue | White/Blue | Manifold Air Pressure Sensor Input |
| P4 | IAT | White | White/Yellow | Intake Air Temperature Sensor |
| P5 | RXD | White/Red | White/Red | Sent Data to RS232 |
| P6 | TXD | Blue/Red | White/Pink | Receive data from RS232 |
| P7 | ROUT | Light/Blue | White | Power relay LS Driver output |
| P8 | CDI-CTRL | Gray | Gray | CDI control signal |
| P9 | INJ1 | Purple/White | Blue/Black | Injector #1 LS Driver Output |
| P10 | GND | Black | Black | Power Ground |
| P11 | O2HOUT1 | Blue/Yellow | Blue/Yellow | O2 Sensor #1 Heater LS Driver output |
| P12 | KEYSW | Purple | Pink | Key On Switch |
| P13 | 12V+ | Red | Red | Reverse Battery Protected Supply |
| P14 | GND | Black | Black | Power Ground |
| P15 | VCC | Yellow | Yellow | +5V Volt Supply Output |
| P16 | ECT | Blue | White/Brown | Engine (coolant) Temperature sensor |
| P17 | TPS | White/Green | White/Green | Throttle Position Sensor input |
| P18 | O2in | White/Black | Gray/Black | Oxygen Sensor signal input |
| P19 | Per-SW | Orange | Gray/White | Performance Switch |
| P20 | GND-A | Green | Green | Analog Ground |

# Appendix III: ECU main connector pin-out (24-pin)

The wiring schematic is for 4-stroke 1 cylinder engine (1 injector, 1 O2 sensors) with idle control motor (4 wires) and CDI ignition control. It is also compatible for two fuel injectors system.

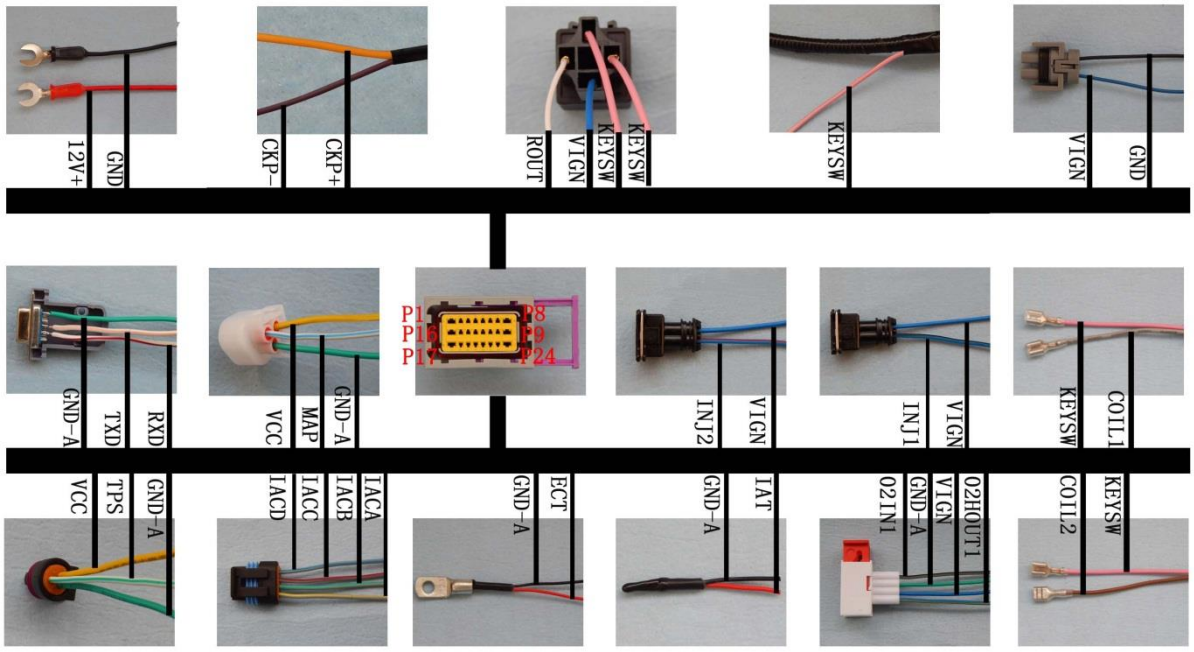
For different engines, like 2-stroke, 2 cylinders, w/ 2 injectors, some pin-out definitions or connector types are different.



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

The wiring schematic is for 4-stroke 2 cylinders engine (2 injector, 1 O2 sensors) with idle control motor (4 wires) and inductive Coil control. It can support multi-tooth trigger wheel, such as 12-1, 24-1, 36-2, etc.

It is also compatible for two-stroke with two fuel injectors or one fuel injector.



| Pin NO. | Component | Description |
|---|---|---|
| P1 | O2HOUT1 | O2 Sensor #1 Heater LS Driver output |
| P2 | 12V+ | Reverse Battery Protected Supply |
| P3 | IACC | Idle Air Controller C |
| P4 | VCC | +5V Volt Supply Output |
| P5 | RXD | Sent Data to RS232 |
| P6 | IACA | Idle Air Controller A |
| P7 | TPS | Throttle Position Sensor input |
| P8 | GND-A | Analog Ground |
| P9 | CKP- | Crank Position Sensor Negative |
| P10 | MAP | Manifold Air Pressure Sensor Input |
| P11 | IACD | Idle Air Controller D |
| P12 | TXD | Receive data from RS232 |
| P13 | IAT | Intake Air Temperature Sensor |
| P14 | KEYSW | Key On Switch |
| P15 | INJ2 | Injector #2 LS Driver Output |
| P16 | INJ1 | Injector #1 LS Driver Output |
| P17 | GND | Power Ground |
| P18 | COIL1 | Ignition Coil #1 LS Driver output |
| P19 | COIL2 | Ignition Coil #2 LS Driver output |
| P20 | ROUT | Power relay LS Driver output |
| P21 | ECT | Engine (coolant) Temperature sensor |
| P22 | IACB | Idle Air Controller B |
| P23 | O2IN1 | Oxygen Sensor #1 input |
| P24 | CKP+ | Crank Position Sensor Positive |