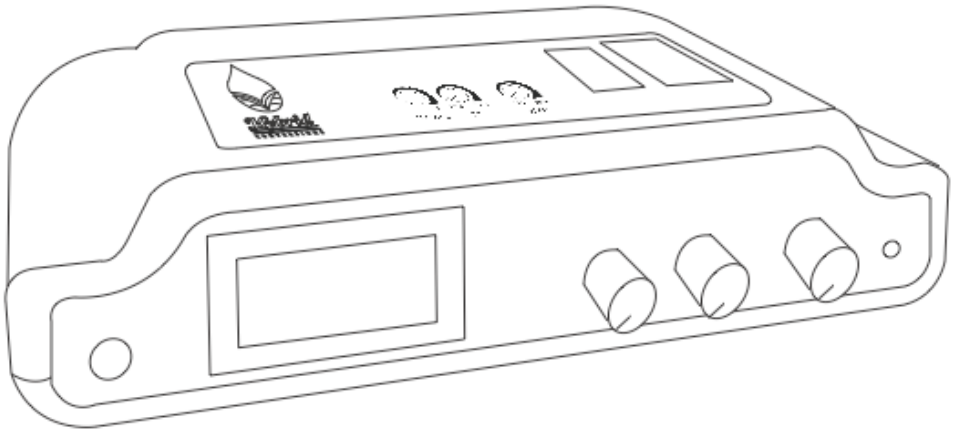
Hybrid
CONVERSIONS

EFIE/MAP/MAF - 001 Manual



HHO (H+H+O or Brown's gas) is produced by your Hybrid Conversions Inc. HHO generator. The HHO gas is drawn into the air intake manifold of your automobile engine via a vacuum air intake line.

The *hydrogen-oxygen mix* increases the gasoline temperature which allows more of the injected gasoline to vaporize, preparing it for combustion. HHO gas thus allows a more complete combustion of the gasoline in the combustion chamber due to a faster flame propagation and higher combustion temp. The result is a cooler, cleaner, more efficient burn of gasoline or diesel fuels.

You will notice an increase in horsepower and gas mileage from the better combustion of the gasoline or diesel. This reduces your engine's need for total fuel and also reduces exhaust emissions.

Normally, any unburned fuel coming out of an engine is burned in your catalytic converter. HHO gas increases the burn efficiency to such a degree that a catalytic converter is no longer needed. Although very little unburned fuel will reach the catalytic converter, the catalytic converter does not need to be removed. The life of the catalytic converter will be extended due to the decrease in unburned hydrocarbons passing through it.

Modern cars are equipped with a computer controller. Your car's computer may be labeled with any the following acronyms: ECM, ECU **or** PCM. The Computer reads all engine sensors and makes fuel, air and timing adjustments according to the ever changing sensor signals. Burning HHO gas will cause a narrow band O2 sensor voltage to read as if the Air Fuel Ratio is leaner in most modern cars. This in turn will cause the Computer to increase the amount of gasoline injected when burning HHO. This is the opposite of what really needs to happen and will result in a negative mpg gain.

For vehicles equipped with narrow band O2 sensors the solution is to install Hybrid Conversions Inc.'s EFIE/MAP/MAF. The EFIE/MAP/MAF allows the end user to adjust the O2 sensor output voltage to the Computer.

Most cars are designed to operate at an air/fuel ratio mix of 14.7 to 1 which is considered as the “bench mark” for cars.

A Narrowband sensor will respond to mixtures of about 14.2 to 1 through to 14.9 to 1. The Sensor functions by comparing the amount of oxygen in the exhaust gas to the amount of oxygen in the air outside of the vehicle. The signal then generates an output voltage which will frequently fluctuate between 0.2 volts and 0.8 volts. When the read out passes below the 14.7 to 1 air/fuel mix point, at 0.2 volts the signal reads as too much oxygen, the computer then responds to the mixture as being too lean (not enough fuel), and will then add more fuel to the mix. In the case of 0.8 volts, the signal reads as too rich (meaning not enough oxygen), the computer will then respond as too much fuel and cut back on the fuel fed to the engine.

The signal voltage will fluctuate regularly from a high to a low and back then to high again as the computer attempts to regulate or “match” the amount of “lean reading” time to the amount of “rich reading” time.

Manually adjusting the AFR with the EFIE will allow for significant mpg gains and reduced exhaust emissions when burning HHO.

Note: *For vehicles equipped with wideband O2 sensors the solution is to install Hybrid Conversions Inc.’s EFIE/MAP/MAF portion of our controller.*

The Electronic Fuel Injection Enhancer (EFIE) circuit is intended to offset the voltage coming from the oxygen sensor, so your vehicle’s computer does not detect the oxygen content of the exhaust has increased. The intent of the EFIE device is to take the original O2 signal and add a very small additional voltage to the incoming signal to read back to the computer. The computer will see a rich fuel condition so the computer will lean the Air Fuel mixture accordingly. It also will allow you to keep the original signal level without leaning out the mixture.

A qualified mechanic can adjust the AFR with the O2 EFIE controller.

Do NOT do this if you do not know what you are doing. Adjusting the sensors too much could do PERMANENT DAMAGE to your engine!

What you must be aware of is if you adjust the EFIE so the fuel mix is set to too rich or high over extended periods of time, the excess fuel being burned in the catalytic converter will raise the temperature high enough to melt the internal components of the converter. If the circuit is adjusted so the mix is too lean, the engine temperature will likely climb high enough to damage your valves and pistons.

Mileage gains from your HHO generator/O2 EFIE system will vary by vehicle. When installing our system every vehicle should be treated as a unique case. Factors affecting miles per gallon gains include your driving habits, number of miles driven city vs. highway and the size of your engine.

Before installation please ensure you have performed the following:

- **Using a Scan Gauge OBDII Testing device identify any engine trouble codes and make repairs, replace sensors and make sure your engine is tuned properly. Make sure the vehicle's engine will operate in "Closed Loop". A check engine light means the computer is managing the engine in "open loop" mode.**
- **Using a Scan Gauge OBDII Testing device obtain a baseline reading of your O2 Sensor output voltage and determine how long it takes for the computer to go into Closed Loop. Know your MPG.**
- **Find out what type of O2 Sensor/s are installed, number of wires, which wires are signal/ground and the physical location of O2 sensors before the Catalytic Converter. (O2 sensors located after the Catalytic Converter are not used by the computer to adjust the AFR.) Note: For a small fee Hybrid Conversions Inc. can provide you with technical data on almost all modern vehicles. You must provide the exact year, make and model.**
- **Identify the location of your vehicle's computer. (For some installations it will be easier to connect the O2 EFIE to the wiring of the computer while others may be easier to connect at the O2 sensor/s.)**

- **You may send your cars computer into open loop while adjusting and installing your EFIE/MAP/MAF- 001 you need to know how to put your cars computer back into closed loop. For vehicles 1996 and newer, an OBDII Scan Gauge Tool usually can clear engine fault codes and reset the check engine light. Sometimes it is possible to clear check engine codes by disconnecting both terminals from the battery and touching the two terminals together while not touching either battery post.**

EFIE/MAP/MAF – 001 INSTALL INSTRUCTIONS

The **EFIE/MAP/MAF – 001** is designed to replace the signal for your vehicles computer (PCM, ECM, or ECU) using an analog MAP sensor operating in the range of 1.25 volts to 7.25 volts and a narrow band O2 sensor operating in the range of -0.00 volts to 3.75 volts.

The **EFIE/MAP/MAF – 001** also has the ability to adjust the pulse width of your O2, when flipping from rich or lean. If you have narrow band O2 sensors with one, two, three, or four wires, the **EFIE/MAP/MAF – 001** will control these four types of sensors**. (**The EFIE will not control the five wire wide band O2 sensors)

If you have a frequency based MAP/MAF sensor and have any one of the four types of narrow band O2 sensors listed previously, you will use the EFIE circuit controls, not the MAP/MAF portion of our controller.

We have designed the **EFIE/MAP/MAF – 001's** circuits to work independently of each other. Our research shows you should adjust the O2 output with the EFIE controller first to get the best results. Most users will get good mpg gains without using the MAP/MAF circuit.

The reasoning for ***modifying the O2 sensors and only the O2 sensors*** is that they are the sensors used during "Closed Loop" ECU functioning.

The MAP/MAF sensor is used during "open loop" mode, so what will happen if you incorrectly adjust the MAP/MAF sensors is your ECU will always stay in open loop mode where the ECU shoots "rich" then "lean" to hit a target A/F Ratio, and never goes into closed loop which is where your ECU is functioning at the best A/F ratio at all times.

This happens in this order, when your car first starts it's in open loop until it figures the required info from all the sensors needed in open loop, i.e temp, altitude, and even some vehicles measure the Fuel combustion (octane) to calculate timing and pulse rate of the injectors.

Once that has all been done the ECU will go into "closed loop" which then basically is adjusting A/F ratio's off of the O2 sensors. So what the EFIE device does is takes the incoming (true) signal from the O2 Sensor and ad's or subtracts minuscule amounts of voltage to that signal and feeds it back to the ECU so it always thinks it is running at the factory set target. This is done during closed loop so it never reverts back to the open loop state because it always sees the "correct" A/F Ratio.

Some devices operate by manipulating the MAP/ MAF sensor signal also, but these are generally used in performance applications where they want "more" fuel and are not concerned with accurate "open loop" sensor readings. But in our case we would not want to mess with the "Open Loop" sensors because if we do it will be counter productive in the long run when the O2 sensor reading is all we need to change.

Also your ECU would never go into "Closed Loop" so your gains would be minimal. The only time we would even consider altering the MAP/MAF sensor signal would be if the vehicle you are working on had a Wide Band O2 sensor which our EFIE will not work with. Then you would only expect an estimated 10% to 15% gain in fuel economy.

The **EFIE/MAP/MAF – 001 is not designed for the Ford BPMAP which is a frequency based sensor!**

The **EFIE/MAP/MAF – 001 is not designed for wide band O2 sensors.**

The **EFIE/MAP/MAF – 001 is not designed for frequency based MAF sensors**

EFIE/MAP/MAF – 001 INSTALL INSTRUCTIONS

Do not install the EFIE/MAP/MAF – 001 under the hood of the car or any other place with temperatures exceeding 150 degrees f.

Install Procedure

EFIE Wiring

1. Locate the oxygen sensor signal wire

Using wiring diagram data, you can get the wire color of the signal wire and trace it to the engine compartment, where it routes to the computer.

1) You can run a pair of wires up to the O2 Sensor and splice near the Harness.

2) You can track the O2 sensor wires back to the ECU and make your splice here, or locate a "pin-out" for your ECU and you won't have to track it down.

3) You can buy an "O2 Sensor Extension Harness" and splice into the middle of it. Then you just unplug your O2 sensor and plug this in between. This way no wires are cut and there is no worry about a bad connection or corrosion.

The sensor can have 2, 3 or 4 wires, and you have to know which one is the signal wire. If you have 4 wires they will be:

1. Heater 12 Volts +
2. Heater ground
3. Oxygen sensor signal +
4. Oxygen sensor signal ground

If you have 2 or 3 wires, then you can have a common ground, or no heater wires etc. The simplest setup is a single wire, which is the signal wire and the sensor get's it's ground from the exhaust pipe. You can use the following procedure to narrow down which wire is which:

1. Disconnect the wire harness, turn on the ignition and probe for a wire that produces 12 volts. This will be the heater circuit.
2. Next find the 2 wires that produce exactly 0 volts. These will be the heater ground and the signal ground. The remaining wire should be your signal wire.
3. Reconnect the wiring harness, then strip a little insulation from the signal wire and measure it to ground with the engine running. You'll get voltage readings constantly fluctuating between 0 and 1 volt, if you have the signal wire. Note, that you have to let the engine warm up a bit before you will get these voltages from the sensor.

- Cut this wire at a convenient location for connecting the EFIE. We'll call the sensor side of this cut the sensor wire, and the other side of the cut, the computer wire.

Note: rarely an oxygen sensor wiring harness will have more than 4 wires. In this case, the sensor is possibly a "wide band" oxygen sensor.

Once you have determined which is the sensor's signal wire, you want to connect to it at the computer. If you used a manual, or wiring diagram, you probably have already located the wire at the computer's wiring harness. If you had to figure out the wires at the sensor itself, then try to find the same wire at the computer's wiring harness. It should be the same colors, but test it with an ohm meter to be sure. Sometimes they use the same colors for different things. Even if it's a pain now, it's worth it to get the signal wire located up by the computer. This makes cutting into it and hooking up the EFIE much easier.

2. Locate 12 volt power and ground
You need to ensure that you have switched power, not power directly from the battery.
Most of the fuel efficiency devices need switched power as well, and you can often piggy back onto them. Note that the EFIE draws negligible power. You can attach it to any circuit. The best choice for a voltage source is a fuel efficiency device, such as our Hydrogen generator. That way the EFIE only activates when the fuel efficiency device is turned on. (*Connect to the smaller yellow wire which is switched power, not the red 10 gauge connected directly to the battery.*)

Note that when power is shut off to the EFIE, or the EFIE's switch is turned off, the original connection between the oxygen sensor and the computer is re-established assuming you have made connections exactly as instructed.

If connecting to your HHO generator power is inconvenient or inappropriate, just use any circuit that is accessory key switched. Your electrical diagram can come in handy here, and if you don't find another device to attach to, you can usually find a spare circuit in the fuse box (you may have to add a fuse). The oxygen sensor's heater power is perfectly acceptable.

Ground can be the vehicle body, engine block or ground from another device, including the ground for the oxygen sensor itself. Just make sure that whatever you choose to use for ground has a negligible resistance (less than 10 ohms) when tested against the negative battery terminal of your car.

Connect the wires. See the wiring diagram page 13 and read the following paragraphs.

You should solder the wires and use heat shrink tubing to insulate the connections from other wires. If you don't have heat shrink, you can use electrical tape. Heat shrink is more professional looking, and less likely to cause a failure.

You may send your cars computer into open loop while adjusting and installing your **EFIE/MAP - 001**
You need to know how to put your cars computer back into closed loop from open loop.

Always install a 3 amp ATO/ATC in-line fuse on the black wire marked 8.

When installing the **EFIE/MAP/MAF - 001**, connect the black number **1** wire for ground, the black number **8** wire for positive, the black number **2** wire for O2 sensor bank 1, the black number **3** wire for O2 sensor bank2, the black number **4** wire for O2 sensor bank 1 computer in, the black number **6** wire for O2 sensor bank 2 computer in, the black number **5** wire for the MAP computer in, and the black number **7** wire MAP sensor. (If only one O2 sensor voltage is being adjusted, then use only wires 2 and 4.)

*When using just the **EFIE circuit**, connect the black number **1** wire for ground, the black number **8** wire for positive, the black number **2** wire for O2 sensor bank 1, the black number **3** wire for O2 sensor bank2, the black number **4** wire for O2 sensor bank 1 computer in, and the black number **6** wire for O2 sensor bank 2 computer in.* (If only one O2 sensor voltage is being adjusted, then use only wires 2 and 4.)

*When using just the **MAP circuit**, connect the black number **1** wire for ground, the black number **8** wire for positive, the black number **5** wire for the MAP computer in, and the black number **7** wire MAP sensor.*

EFIE/MAP/MAF - 001 WIRING INSTRUCTIONS

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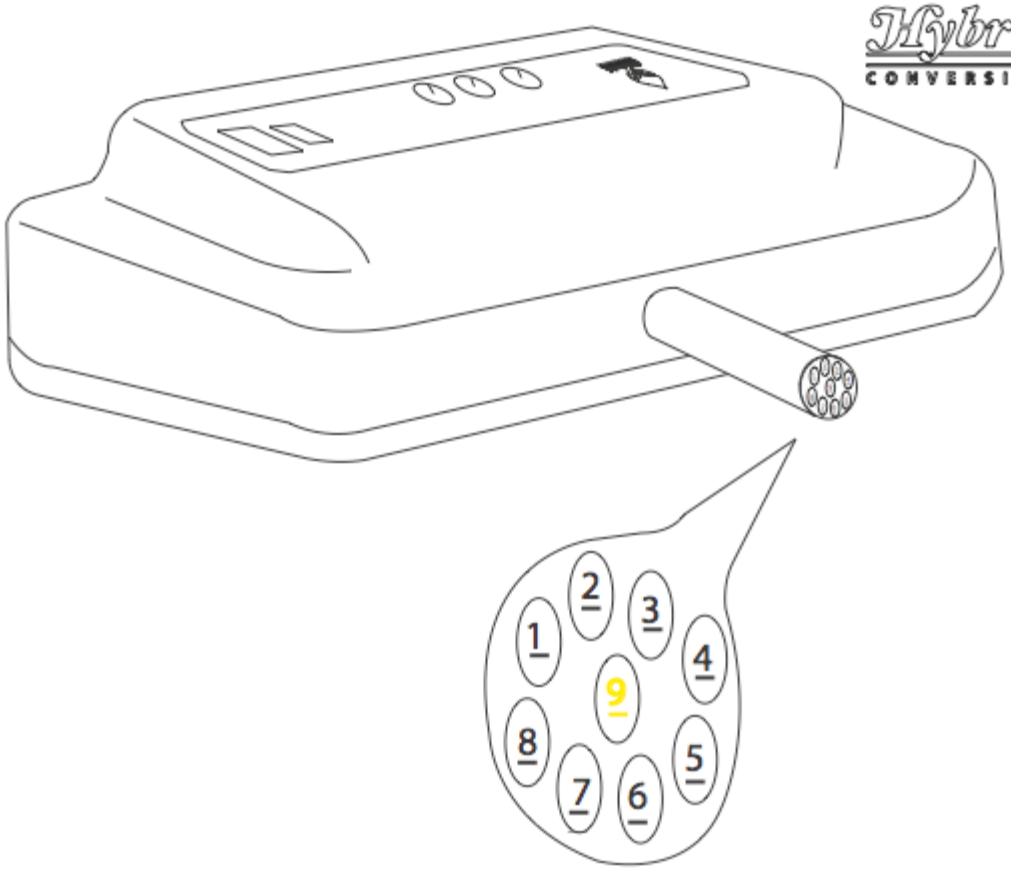

BLK 1	BLK 2	BLK 3	BLK 4	BLK 5	BLK 6	BLK 7	BLK 8	YLLW 9
12 volt DC Ground − negative	O2 sensor 1	O2 sensor 2	O2 sensor 1 PCM, ECM, or ECU computer in	MAP PCM, ECM, or ECU computer in	O2 sensor 2 PCM, ECM, or ECU computer in	MAP sensor	12 volt DC possitive possitive +	Expansion not used

Adjust the O2 Sensor output with the EFIE.

Adjustments should only be made when the EFIE is powered on and the engine is warm and running. At this time do not turn on the HHO generator. The baseline O2 sensor readings taken earlier will now be useful as you adjust the EFIE. Prior to turning on the EFIE power:

Set the MAP lean/rich knob to about 12:00 on a clock dial.

Set the EFIE O2 sync to about 12:00 on a clock dial.

Set the EFIE lean/rich to about 3:00 on a clock dial.

Make sure the smaller switch is set to O2 volts.

With the engine running check the scan gauge OBDII to see if the vehicle's computer is in "Closed Loop". If it is then proceed by turning on the power switch to the EFIE. You will now see a voltage on the EFIE panel meter. Slowly turn the O2 lean / rich control knob until the voltage reads 0.20volts to 0.30 volts. 0.20v to 0.30v can be read as 200mv to 300mv. Try to match the baseline voltage you recorded earlier. With the scan gauge OBDII attached and reading your O2 sensor voltage in real time switch the power on to the HHO generator. You will notice a change in the O2 sensor voltage on the scan gauge OBDII after some time. The O2 voltage should read lower now. As long as the computer is still in closed loop you can now adjust the voltage higher by slowly turning the O2 lean/rich control knob. If your HHO generator has a significant HHO gas output you can adjust the voltage high enough to achieve an "as lean as possible AFR". As lean as possible will produce the highest mpg gains as long as the computer stays in "closed loop" and as long as the HHO gas production remains constant.

Now turn the O2 sync while watching the Scan Gauge OBDII Testing device. Try to match the pulses to the baseline pulses of the O2 sensor recorded earlier. Adjusting the pulse width will help ensure the computer will not go into open loop and cause a “check engine light”.

When it comes to making the actual adjustments to the EFIE for your particular car start out with 200 millivolts. The process of adjusting the EFIE is trial and error. If you're setting the EFIE above 350 millivolts you're starting to get pretty high. Watch for symptoms of too lean a mix such as rough engine, lack of power, "check engine light" coming on, etc. When these show up, you may need to reset the computer and clear the “check engine light”. Note: Some computers will accept an EFIE setting of over 400 millivolts.

MAP/MAF Sensor Connection and Adjustment

There are 2 types of MAP sensors on the market. Most of the world uses a version that has a 5 volt VREF, ground, and DC signal wire. The MAP is a type of potentiometer; like a radio volume knob. Instead of turning the knob with your hand, the knob is turned as the vacuum in the engine changes. A high vacuum reading will give a low voltage signal. A low vacuum reading will give a high voltage signal. Low vacuum means the engine is under load and needs lots of fuel. Look at it this way, low signal voltage, low fuel requirements. High signal voltage, high fuel requirements. If you raise the VREF, then the signal will be higher. If you lower the VREF, then the signal will be lower. A lower signal tells the ECU lower load.

Set the smaller switch to MAP volts.

Observe the voltage output on the panel meter of the EFIE/MAP/MAF-001. Adjust it to 5.0 volts to start with.

To install it on your vehicle, cut the VREF wire going to the MAP. DO NOT TAP THE VREF WIRE COMING OUT OF THE ECU! This will affect all sensors using the same 5 volt signal and will deliver disastrous results. After you cut the wire, connect your adjusted voltage wire to the MAP sensor and tuck and tape the other end of the cut wire back into the harness. It is best to solder connections and seal with heat-shrink tubing. Lowering the VREF voltage will lower your lean limits, but will also advance ignition timing. Less load equals more timing advance. More load equals less timing advance.

When using just the MAP circuit, connect the black number **1** *wire for ground, the black number* **8** *wire for positive, the black number* **5** *wire for the MAP computer in, and the black number* **7** *wire MAP sensor.*

MAF -There are a couple different styles of MAF sensors that have been employed over the years. Early versions were called Vane Air Flow (VAF) sensors. They had a spring loaded door that controlled a wiper arm across a resistive pad. There is a black plastic cover that, once removed, will allow access to this resistive circuit. Raising spring pressure will lower lean-out limits. You can shift the wiper arm to a clean spot on the resistive circuit to extend the life of your MAF while you're in there. Some of the MAF sensors work like the typical MAP sensors in that they have a DC voltage IN, and a DC voltage signal OUT. They can be dealt with the same as the typical MAP sensor.

Most of the modern MAF sensors have a ground, battery voltage input, and frequency based output. Our MAP/MAF controller will not work with this type of MAF sensor.