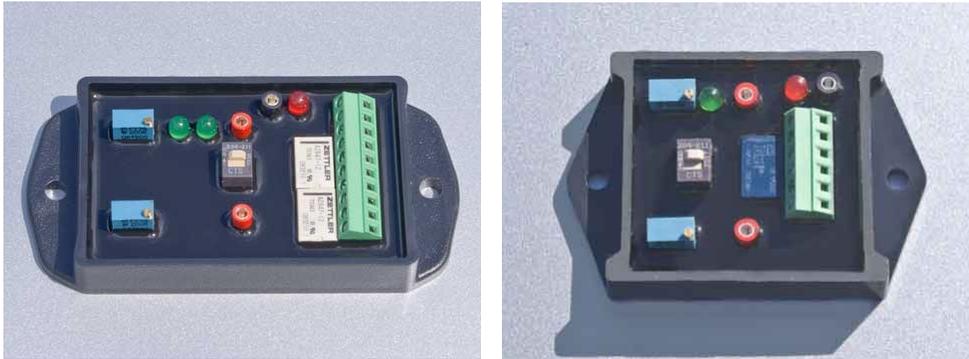


# Digital EFIE Max Installation Instructions



## Install your fuel efficiency device

The EFIE is not intended to be a fuel saver by itself. You should install a device that is designed to get more energy out of the same fuel, such as a hydrogen gas electrolyzer, a fuel vapor production unit, fuel heater, or other device that gets more power out of the same fuel by increasing the efficiency of the burn.

## Locate the oxygen sensor signal wire

The easy way to do this is to look it up in your Haynes, Clymer or Chilton manual for your car. If you don't have one of these, I have also found a resource at [www.autozone.com](http://www.autozone.com) where you can find sensor information and diagrams for many vehicles.

If none of these options are available, you'll need to locate the oxygen sensor and then locate the signal wire by testing. 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:

- Heater 12 Volts +
- Heater ground
- Oxygen sensor signal +
- 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. Stick straight pins into the sensor's wires and measure them to ground with then engine running. One of these will show 12 volts, and this will be power for the heater.
2. Next find any wires that produce 0 volts. These will be ground wires. The remaining wire should be your signal wire.
3. Measure the signal wire to ground with the engine running. The voltage on this wire will vary from nearly 0 to about 1 volt. Since your meter will not be fast enough to see the lows and highs, it will average them out to about .2 to about .8 volts. The fluctuations will be so fast you have a hard time reading the numbers. Note, that you have to let the engine warm up a bit before you will get these voltages from the sensor.
4. 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. In this case you need an EFIE from our Wide Band series.

Once you have determined which is the sensor's signal wire, you want to get it located up close to 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. 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. There is no electrical reason for locating the EFIE connection close to the computer. It's only a matter of convenience, and if it's not convenient then locate a place that makes it easy for you to access the wires.

**Note:** *Once you have determined the signal wire, you should always test it. The most common reason for installation failures is an incorrectly located signal wire. To test the wire, you want to have the engine running, and you want to measure the voltage between the signal wire and ground.*

**Note:** *Chrysler vehicles have been known to put 2.5 volts on the sensor's "sig low" wire. This raises the signal high wire by 2.5 volts. Instead of seeing 0 to 1 volt you'll see 2.5 to 3.5 volts on the signal wire. If you find you have one of these, you will need to put the switch in the "off" position on our Quad Digital EFIE Max. That makes the EFIE work in the 2.5 volt range of these Dodge/Chrysler systems. In this case, all of the instructions below for your digital EFIEs should have 2.5 volts added to the voltages given in the instructions.*

**Note:** *Vehicles fitted with an LPG system (Liquified Petroleum Gas) will have 2 computers. If you have one of these systems, you'll know it because you have to use special fuel. The oxygen sensors will be connected to both the LPG system computer as well as the vehicle's normal computer. Be sure to attach the EFIE at a point that connects to both computers.*

## Locate 12 volt power and ground

You need to ensure that you have switched power, not power directly from the battery. You don't want the EFIE running 100% of the time. It's not that the unit couldn't run 100% of the time, it probably could. But it would slowly drain your 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. In other words, your oxygen sensor signal goes back to stock, and is unaffected by the EFIE. The EFIE will only alter the circuit when it has power on it's red wire. All of our EFIEs have this feature.

Most of the fuel efficiency devices need switched power, and you can often piggy back onto them. Note that the EFIE draws negligible power. You can attach it to any 12 volt DC voltage source. The best choice is from the same source as your fuel efficiency device. That way the EFIE only activates when the generator is turned on. If connecting to your fuel saver's 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 attach to, you can usually find a spare circuit in the fuse box (you may have to add a fuse).

Ground should be to a wire that leads back to the battery. Bonding to the body is sometimes problematic in that the body is sometimes not well bonded to battery ground. However, you can usually find a good ground wire existing that you can tie into. Just make sure that whatever you choose to use for ground has a negligible resistance when tested against the negative battery terminal of your car.

## Mount the EFIE

You can use the mounting ears to screw down the EFIE to a suitable location on the vehicle body or firewall. Some people like to mount the device inside the passenger compartment of the car. I personally like my EFIE under my hood, because once I have it set, I don't mess with it.

## Attach the wires

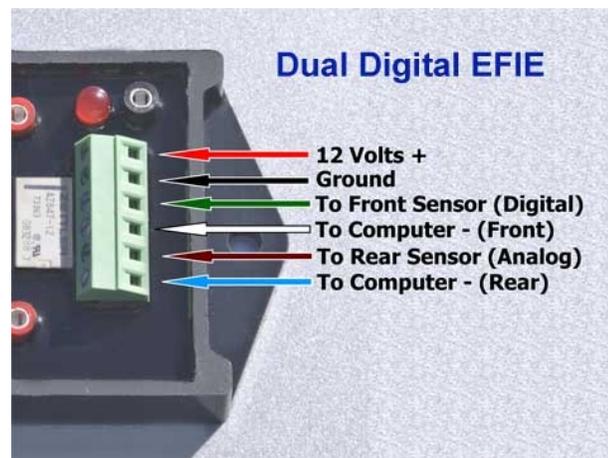
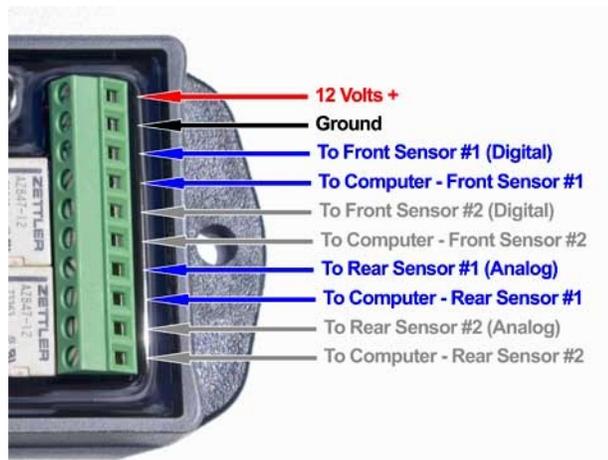
Connect your wires to the EFIE as per the diagram below. Note that the Digital EFIE circuits are designed for use with front oxygen sensors only. Front sensors are the sensors that are upstream from the catalytic converter. Use analog EFIEs for all sensors that are downstream from any catalytic converter. Just make sure not to mix up the upstream and downstream oxygen sensor circuits.

I'm sometimes asked about what wire size you should use. Well, any wire will do. The power drawn by a Digital EFIE is so minimal, that a 30 gauge wire would be plenty. The circuits going to and from the sensors use even less current. However, 30 gauge wire is not practical because it is so small and fragile, that if you bumped it with a tool, you could break it. We usually use 24 or 22 gauge wire. I also prefer stranded wire, because it is less likely to being damaged by moving it around. But again, that's a preference. Solid or stranded wire will both work fine electrically.

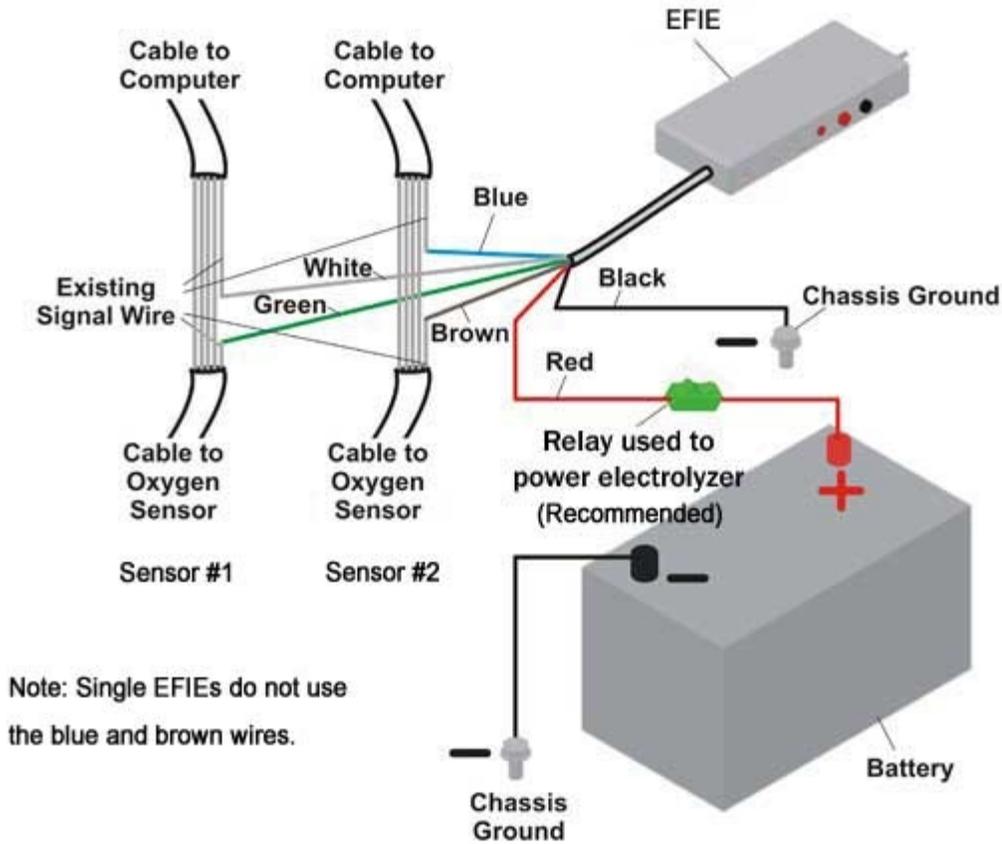
If you have more digital EFIE circuits than you have front oxygen sensors, then you can just not hook up any unused EFIEs. However, you should ground the input of any digital circuits you are not using. By that I mean connect the terminal that is supposed to go to the oxygen sensor to ground. See "Additional Notes #5" below for more information on this.

The first diagram below shows a Quad Digital EFIE Max. The Dual Digital EFIE Max, in the next image down, hooks up the same way, except for the fact that you have two fewer EFIEs.

### EFIE Connection Diagrams

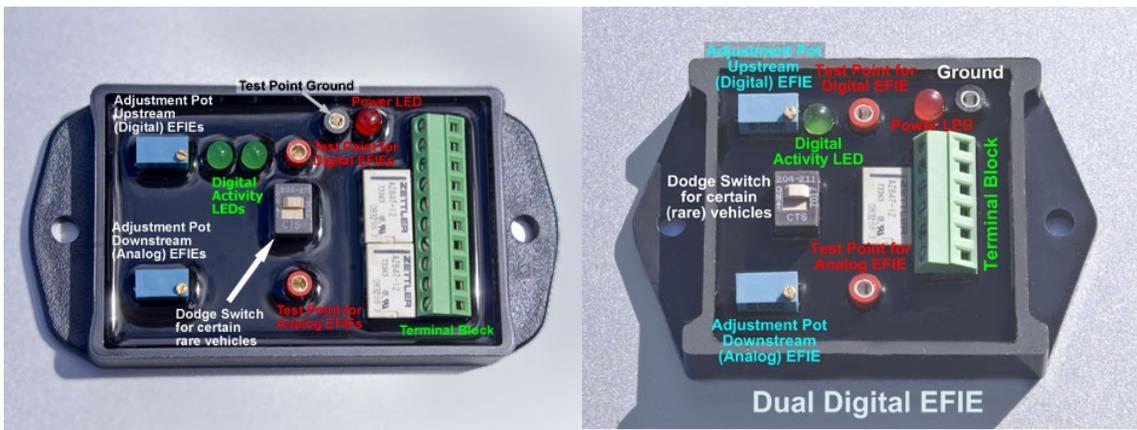


The image below is borrowed from our older analog series installation instructions. It shows graphically how the EFIE circuit is inserted between the sensor and the computer. The model shown here used wire wire colors that are not used on the newer EFIEs, so don't be confused by them.



### Adjust the EFIE (Digital)

All of the Digital EFIEs have one control for each pair of EFIEs. The EFIE pairs have been designed to work together. One pair should be installed to the front 2 oxygen sensors. These are controlled with the single pot on the Dual Digital EFIE, and the top adjustment pot on the Quad EFIE. The Quad EFIE will also control the rear sensors by using the lower pot.



## Setting A Digital EFIE

Setting a Digital EFIE is entirely different than setting any other type of EFIE. While it's not necessary to understand how the Digital EFIE works in order to set it properly, it certainly helps. **For Digital EFIEs, you lower the voltage to make the mix leaner. For analog EFIEs you raise the voltage to make the mix leaner.**

First plug your meter probes into the black and red test ports for the Digital EFIE. Your black probe goes into the black port, and red goes into the red port. Set your meter for DC volts. When the unit first powers on, or any time it loses power or is shut off, it will start a timing delay when it's powered back on. The starting voltage you will read is in the range of .42 to .45 volts, and at this reading the EFIE will have no effect on your air/fuel ratio. After about 25 seconds the voltage will start changing and will then move to your set point. The delay is there by design so that the engine is not being leaned out during initial startup. You can't set the EFIE until after it has gone through the startup delay. Only after the delay will you see the EFIE's set point voltage.

The adjustment screw turns clockwise to lower the voltage. Lowering the voltage causes the engine to run leaner. We have designed all of our EFIES so that clockwise turning of the pot increases the effect of the EFIE, thus making the engine leaner. When you are reading your meter however, the voltage will be going lower. You turn clockwise to lower the voltage, and to lean the engine. If you are accustomed to other types of EFIE, this is the opposite behavior to what you are used to. Analog EFIEs raise the voltage when the set screw is turned clock-wise, but this still means leaner. This is the primary difference between the two types.

After the startup delay, adjustment of the pot will change the voltage that you read at the test points from near 0 to 450 millivolts (0 - .45 volts). The range that you are interested in is about 150 to 350 millivolts. Start out at 350 millivolts, and with the engine running, turn the adjustment clockwise. As you turn the pot clockwise, the mix will get leaner as the voltage goes lower. At some point it may start lugging the engine. If this occurs, then turn the pot back up 15 millivolts or so, until the engine is running smooth again. Be sure to then road test the vehicle and make sure there is no loss of power. If there is, then you need to back off the setting (raise the voltage), until this symptom completely disappears.

Note that many vehicles computers will not lug down no matter how far you turn the pot. This is because they have been designed to have a minimum limit to the fuel they will deliver at idle. No matter what the sensors are reading, they won't go below that level of fuel delivery, so won't lug down. The green activity LEDs should be blinking. See "Additional Notes #4" below for more info.

If the engine idle doesn't change when adjusting the EFIE, you will have to set it by trial and error. I would try setting it at 250 mv or so, and try driving. See if you get a lack of horsepower. If you do, raise the setting until any symptoms go away. If not, try lower. Note, that if you can't get any affect using this method, first double check that you have the device installed correctly. If so, you may need to treat the down stream sensors as well. Some vehicles will not budge unless all of the sensors are treated.

After you have completed the process of setting your EFIE, always do a driving test. if the engine seems more sluggish than it was before, that's an indication that you have set the engine too lean. You'll need to back off on the pot until the condition is corrected. However, there is one other cause of these symptoms when setting the EFIE that you must make sure doesn't exist. If the combustion efficiency is not being improved, such as will happen if the HHO is not getting into the engine, the EFIE will cause these symptoms even though you have it set correctly. The point is make sure you're getting good HHO gas production and that it's getting into the engine before deciding the EFIE setting is too lean.

## Additional Notes:

1. The black test port is connected to ground, and is a convenient place to attach a probe to ground for any electrical measurements you need to do.

2. The adjustment potentiometer (or "pot" for short) is designed to turn 18-20 full revolutions. This is so that the voltage offset can be tuned to a fine degree of control. Adjustments as small as a few millivolts can be made. However, these pots don't have a stop on them, and therefore you should always set them while using a meter. That way you can see if it is reaching the end of its range.

3. A couple of adjustment tips: 1) If your "check engine" light comes on, you've likely set the EFIE too lean, and the computer thinks your oxygen sensor is on the fritz. This can also be caused by mis-wiring the

EFIE, so make sure you're hooked up correctly. 2) If you lose horsepower, you've got an incorrect setting, as fuel efficiency devices should increase horsepower proportionately with the increase in MPG (as well as decrease emissions). 3) If you have a high temperature probe, run down the highway with the fuel efficiency devices turned off, long enough to get the engine up to full operating temperature, and note the temp of your exhaust pipe, near the exhaust manifold. As you increase your EFIE setting, this temperature may increase. Don't let it raise more than 180 degrees from your initial test.

4. The green LEDs are for the 2 Digital EFIE circuits. Each LED is for one of the digital circuits. The LED comes on when the output of that digital circuit is high, and goes off when it is low. When the car is in closed loop operation, meaning that the computer is using the sensors to calculate the air/fuel ratio, then the green LEDs should be blinking on and off. This is normal. In a correctly installed and set EFIE, the only time the blinking will stop is when the engine is under heavy load, such as going up hill or acceleration. But when you are idling or cruising, if you don't see the green LEDs blinking, then something is wrong. It will mean that the EFIE is set with too low of a voltage at it's set points (turned the pot clockwise too far), you have the dip switch in the wrong position for your engine, or you have connected to the wrong wire, and the voltage on that wire is above the set point all the time. If the LEDs are never lighting up, then something is very wrong. Either the EFIE has no power, or there is no voltage on the sensor wire, or the dip switch is in the wrong position.

5. If you have only one of the digital EFIEs hooked up, then only that one LED will show activity. We recommend connecting a jumper wire from the ground terminal to the input port of the unused digital EFIE. Otherwise the LED for the unused EFIE will randomly turn on or off, and can be confusing. There is no other harm to leaving the unused port ungrounded. But jumpering it as above will cause the LED for the unused EFIE to be off all the time, making the other LED much easier to use.

6. There is a new switch added that was placed directly between the 2 red test points. The switch is only needed for making the EFIE work on 2.5 volt, narrow band sensors such as are used on some Dodge/Chrysler engines. For these, the switch should be placed in the "off" position. For all other vehicles, the switch should be left in the "on" position. You can also tell which setting is selected by measuring the upper red test port with your meter. If the voltage is between 0 and .45 volts, its set for a normal engine. If it's between 2.5 and 3.5 volts, then it's set for the Dodge/Chrysler modification.

## Setting The Analog (Downstream) EFIEs

Downstream sensors should be treated with analog EFIEs. Analog EFIEs work better on downstream sensors than digital EFIEs due to the nature of the signal they generate. But analog EFIEs also work differently than the digital EFIEs and must therefore be adjusted differently. **For Digital EFIEs, you lower the voltage to make the mix leaner. For analog EFIEs you raise the voltage to make the mix leaner.**

Once again, to keep things simple, all of our EFIEs make the mix leaner when you turn the adjustment screw clockwise, and richer when you turn the adjustment counter clockwise. When you turn the Digital EFIE clockwise, the voltage gets lower, and the mix gets leaner. When you turn the analog EFIE clockwise the voltage goes higher, but the mix gets leaner.

We're sorry that this can be a bit confusing, but the 2 types of EFIE work on a different technology. We recommend starting out your rear sensors at about 200 mV. Once again, you will need to experiment with the settings on these sensors, and make adjustments based on your fuel mileage gains. In general, you shouldn't ever need to go above 350 mV on any analog EFIE.

We also recommend fine tuning the front EFIEs first, with the rear EFIEs set at about 200 mv. Then, you can try experimenting with raising the rear EFIEs to see if you get better results. But realize that the bulk of your results will come from the front sensors.

As with any of our products, if you have trouble please contact [support@hydrogenmonkey.com](mailto:support@hydrogenmonkey.com). We will be happy to help you however we can to be successful with your project.