F/IC Installation & Tuning Tips

The new F/IC from AEM is a powerful tuning tool, designed to allow addition of forced induction intake systems to normally aspirated, computer controlled vehicles.

By design, the new F/IC is a “piggyback” style ECU that works in conjunction with the factory ECU. Thus, the key to allowing your engine to run at its full potential is making the F/IC work in harmony with the factory ECU. As technology advances, factory ECU’s are getting smarter. Most modern OBD-II ECU’s are capable of recognizing even the slightest fuel changes and will quickly “correct” the fuel quantity. In order for the F/IC installation to be successful, the engine must be tuned so the closed loop factory fuel conditions remain the same. When in closed loop, the factory ECU will undo any change in fuel quantity you attempt to make. If you try and fight the factory ECU you will not be successful.

It is assumed that the F/IC is going to be installed on a modern, computer controlled engine that originally was normally aspirated but is being converted to forced induction. Ideally, the F/IC can be installed and tested BEFORE the forced induction hardware is installed.

WIRING THE F/IC

The available wiring of the F/IC has many different hookup possibilities. However, most installations will use less than half the wires. To make the install easier and to save you from cutting your factory harness, we recommend the use of a “patch” or “extension” harness. These harnesses are readily available from companies like Boomslang or Autosport Wiring.

The F/IC has many fueling options.

- It can intercept the signals to the stock fuel injectors and modify them. Allowing the user to increase or decrease the injector on time.
- It can drive new additional injectors allowing the user to set an injector on time based on the stock injector on time.
- It can recalibrate the MAF/MAP sensor inputs to the ECU. Allowing a different signal to be fed to the factory ECU that then sensor is outputting.
- It can bias the O2 sensor outputs (either narrow band or UEGO) as a short term aid in transient closed loop fueling.

Our recommendation is to intercept the factory fuel injector outputs to add or subtract fuel at this point. This method, when properly done will allow the engine to start and run exactly as stock in all conditions. We don’t recommend recalibrating the MAF or MAP sensor outputs as the primary fueling technique unless absolutely necessary. Most modern ECU’s can detect even the smallest changes in calibration of these signals. It’s OK to clamp them to hide the new boost level but otherwise it is best to leave them alone. Most modern ECU’s ignore the MAF during startup so bigger injectors will have a tendency to make the car flood or be impossible to start if this is your only method of recalibration.

The F/IC retards the ignition by intercepting and delaying the outputs from the cam and crank position sensors on the engine. You can use up to 3 inputs (1 crank and 2 cam). If you have variable cam control you must intercept all of your cam inputs or your cam position will be incorrect. If you have a fixed cam then it’s possible to intercept only the crank position signal so long as you keep your timing retard levels under 8-10 degrees.

STARTING THE ENGINE & INITIAL F/IC TUNING

If you are using the stock injectors, you should be able to wire in the F/IC and start the engine without making any changes to the base calibration as no change in fuel quantity is required. If larger aftermarket injectors are installed, the fuel map must be adjusted to compensate for the

larger flow rate of the aftermarket injectors. Use the “Injector size change” function to adjust the fuel map.

After adjusting the fuel map, the vehicle should start and idle as it did with the factory injectors. If the car will not start, try installing the bypass plug and double-check your connections. If the car starts with the bypass plug installed, but not with the F/IC installed, you may have some inputs/outputs reversed.

Once the vehicle is running you can go into the timing map and set a conservative timing curve. A commonly accepted rule of thumb is to remove one degree of timing for every psi of boost added. Take the car for a short test run and monitor the closed loop fuel trims via your OBD-II scanner. Adjust the fuel map if needed to get the fuel trims as close to zero as possible. Remember, positive fuel trims indicate too little fuel and negative trims are caused by too much fuel.

Before applying any boost to the engine, the MAF/MAP clamp voltage must be set. This value should represent the maximum value that the ECU would see in a normally aspirated vehicle. Determine this by making a log of a high rpm high load condition. View the logged data and find the highest recorded MAF voltage. If you don’t have a MAF sensor, take the MAP sensor voltage reading with the engine off. Multiply these values by 1.1 and enter it as the Max Voltage Clamp in the MAF section.

FUEL TUNING

Now you can begin tuning the boosted section of the MAP based fuel map. Most cars will be operating in open loop mode by the time the engine starts building boost. Here, fuel can be added to the MAP based fuel map to account for the increased manifold pressure. With the MAF or MAP sensor clamped, the ECU will output a near constant fuel pulse regardless of boost level so all *additional* fuel will have to be supplied by the F/IC. You need to add fuel as soon as boost levels are met. A good rule is to have an extra 125% fuel at 30 PSIa (~15 PSI boost at sea level) as you do at atmospheric manifold pressure (~15 PSIa).

CLOSED LOOP TARGET AFR

The F/IC is capable of biasing the factory O2 signals, causing a change in the closed loop AFR. This is particularly useful when AFR’s other than stoichiometric are desired to achieve optimum engine performance and durability for track days or race events. To date, the most successful installations have used the offset mode for narrow band sensors and the voltage mode for wideband/UEGO sensors. To change the target AFR, go to the O2 table and enter voltage values until the desired AFR is achieved. A good starting value for narrow band sensors is around -.35 volts. A good starting value for wideband/UEGO sensors is around 1.5-2 volts. As always, be cautious and conservative when making changes. It is always a good idea to verify the results at light loads before trying higher loads. Generally speaking, lower voltages yield lower AFR’s. After the desired AFR has been achieved, adjust the MAP based fuel map until the short and long term fuel trims are as close to zero as possible.