

HOW TO

TUNE YOUR EFI SYSTEM

Help from the pros

By the staff of Dirt Wheels

Let's face it, electronic fuel injection (EFI) is here to stay. Every manufacturer (except KTM) offers ATVs utilizing this fairly new technology. For an average trail rider, EFI systems will help the ATV's engine automatically compensate for varying air temperature and altitude changes. However, contrary to early reports, most stock EFI systems will not compensate enough for even minor intake, exhaust or internal engine modifications. So when it comes time to making any engine modifications, the EFI system needs to be tuned as well, just like a carburetor would.

Race engine builders like EFI because they can manipulate fuel delivery and ignition timing for cer-

tain track conditions, riding styles or other preferences.

Still, EFI systems can be a mystery to some of us working with them for the first time. To help you out, we asked some of the sport's top engine builders a few questions about electronic fuel injection and this is what they told us.

DIRT WHEELS: *Why are your EFI products better than the others offered?*

ALBA ACTION SPORTS: We utilize two different EFI modules for tuning purposes: Dobeck Performance private-labels our primary unit. This module works in-line with the fuel injector to increase the pulse width of the injector. It has no side-effects since

the ECU does not even know it is there. We have to upload an initial "map" into it prior to shipping. These maps can be easily adjusted by the user once the unit is installed. It takes only a few minutes to install (once you have gained access to the fuel injector plug). No computer is required to make adjustments.

We here at Alba have spent significant time and attention in the development of the custom maps, and therefore for many applications this is a "plug and play" device. Once the map is uploaded, customers can make adjustments to the three primary sections of the map within seconds by pressing the buttons on the face of the unit to adjust for the previously



Yamaha is the latest manufacturer to include EFI on their 450cc high performance sport quads. They were the first to include it on a high performance trail quad when they added it to the Raptor 700.



mentioned atmospheric changes. With the engine running, all you have to do to adjust the modes is press the "mode" button once, twice, or three times to adjust the correlating mode.

To make it even easier, Mode 1 has the exact same effect as adjusting the "Pilot jet" in a carb, mode 2 is like the "Needle" setting, and mode 3 is like the "Main jet." This allows customers to make easy and predictable adjustments to their EFI. Furthermore, once the initial map has been uploaded, the range of adjustability can be increased or decreased to allow more or less adjustability as well as increase or decrease the increments of adjustability.

For the Yamaha (2008-2009) Rhino we use the MSD Powersports Charge FI Controller. This ECU (Engine Control Unit) is revolutionary in design, capability, and user interface. This device works "piggy-back" to the stock ECU. Like the Dobeck, we will have a map uploaded into it when we sell the unit. This system requires a computer to interface and change any of the available settings. The software

comes with the module and loads easily onto any computer. The software has a graphical display for the fuel and ignition curves, making it very easy to see and understand what is taking place. This ECU allows the user to manipulate the rev-limiter, fuel mapping, and ignition timing.

Furthermore, it also has a MAP sensor input (Manifold Air Pressure). This will allow users with forced air induction (super or turbo chargers) to retard the ignition timing proportional to the boost increase. To make things even better, the unit has a ten-position switch and each switch position can have its own rev-limiter, fuel map, timing curve, and boost curve. This allows customers to have setups for a variety of different atmospheric conditions, engine setups (example: with and without exhaust quiet cores!) as well as set "handicaps" for younger riders. We also do direct modifications to Raptor 700, Rhino 700 and LT-R450 throttlebodies. We bore the throttlebodies from approximately 43.8 mm to approximately 46 mm to match the output of our big bore kits.

DUNCAN RACING: We are the exclusive U.S. distributor for Vortex ATV products. We use two Vortex products to tune ATV engines. First, the Vortex EFI Interceptor has True 3D Mapped fuel adjustment based on TPS and rpm inputs (most others do not have a TPS input to accurately measure engine load). We pre-program each unit with a performance fuel map. They have two levels of adjustment: 1, Simple switches on the Interceptor which give a visual feedback as to exactly where you have made adjustments and 2, Fully programmable via Vortex EFI Interceptor Software. This unit is designed specifically for dirt applications such as vibration damping and waterproofing. Our unit plugs into standard wiring harness with no cutting of wires.

Our next product is the Vortex ECU (Engine Control Unit). This is the only dedicated ECU replacement on the market. It gives access to all areas of engine control such as fuel and spark mapping, rev limits, engine data, air, engine temperature and altitude compensation tables, including the all

EFI

fuel mixture setting for their ATV. No laptop computers are required, nor are any complicated spread sheets (with hundreds of different settings) no internet downloads, or dynamometer interfaces. We spend countless hours on the dyno and real world ride testing to achieve a properly programmed unit that gives the consumer the best possible controller for their application.

Our dyno testing consists of numerous runs with different applied loads to simulate as many riding conditions as possible while being monitored by our air/fuel ratio software programs. This allows us to achieve the perfect starting point for our EFI controller for each individual engine. Many companies use the "out of the box program" that is supplied with the controller, but our testing has proven that some additional fine tuning is required. The parameters that we set in our controller not only include how much fuel is available, but also when it becomes effective. This allows a much closer starting point and a finer tuneability with our programmed controllers than with the standard programs.

DW: What model EFI equipped ATVs need the most help?

ALBA: The fuel injection system on an ATV is known as an "open-loop fuel injection system". This means that the fuel injection system does not recalibrate itself for use of a performance exhaust system, or for any other motor modification. It only compensates for changes in atmospheric pressure (elevation) and temperature.

A lot of the newer street bikes are starting to use O₂ sensors in the exhaust, which technically does make it a "closed-loop" system. However,

While EFI systems don't require you to deal with fuel-soaked carburetors, they do force you to use a computer in some cases. Once you get the hang of things, transferring a new mapping program from a laptop to your quad is as easy as writing an e-mail.

important fuel enrichment tables (an electronic version of the pumper in a carb which adds additional fuel over the standard map based on rate of throttle opening).

This unit also has two levels of adjustment: 1, Simple switches pilot, needle and main jet replication which give a visual feedback as to exactly where you have made adjustments, plus ten fuel and spark maps, and 2, Fully programmable via Vortex ECU Software; this will allow sophisticated dyno and track testing and adjustments giving live data analysis.

LRD PERFORMANCE: Our Pro 4 FIC units are designed to maximize the power output of the modifications that you make to your ATV. Our FIC units are pre-programmed with para-

meters tested for LRD products and modifications, but feature a wide range of adjustment so they can be used to tune ATVs with other products as well. Our unit uses carburetor-tuning logic with end-user tuning modes that replicate a pilot jet, needle, main jet, and accelerator pump. The most significant feature is the ability to tune fuel based on load sensitivity rather than just rpm and throttle position. This allows tuning for every gear and applied loads (rider weight, hills, etc...) on the engine.

TRINITY RACING: The controller we use is built by Dobeck Performance, and we feel it's the best for several reasons. First and foremost is its very user friendly, it allows anyone the ability to achieve an optimum

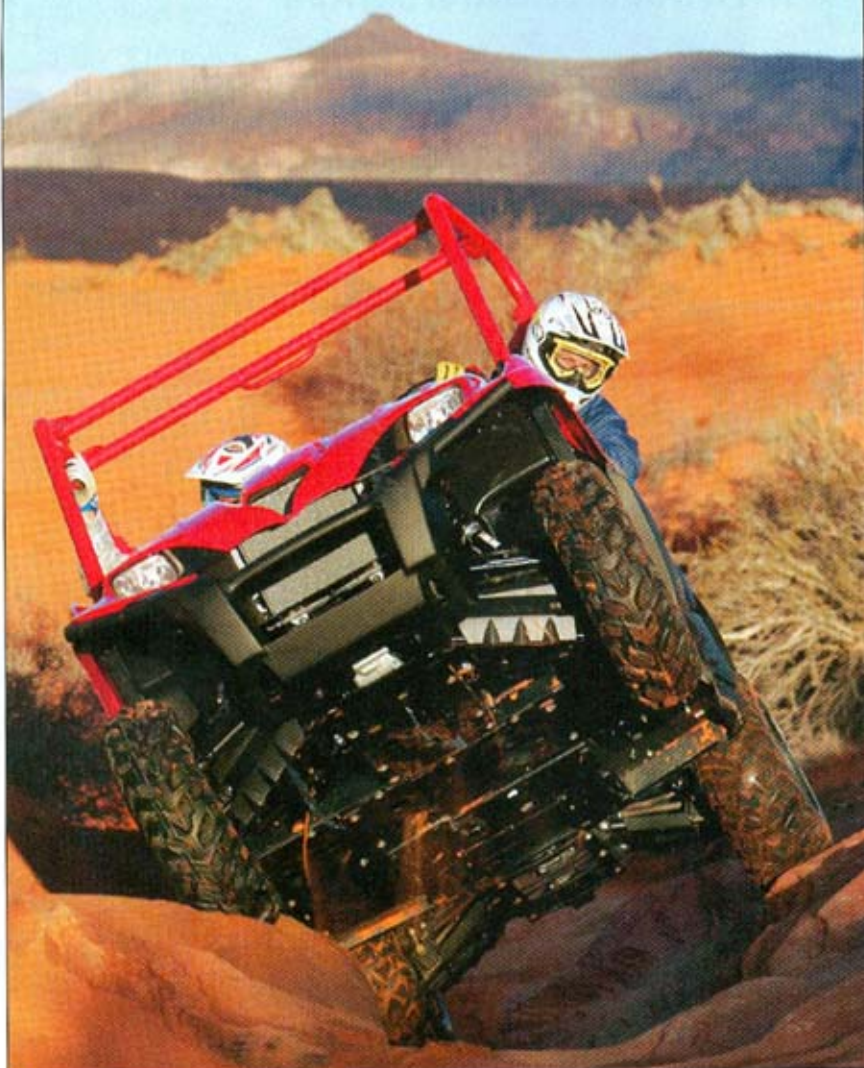


The Vortex Raptor unit is tuneable in the field using only a small flat blade screwdriver. Each Interceptor includes three rotary switches, which represent 0-33 percent, 34-66 percent and 61-100 percent throttle openings. The switches act in a similar fashion to the pilot, needle and main jet on a conventional carburetor.



LRD/Dobeck EFI controller, Price: \$249-\$289

EFI



For 2009, Kawasaki added EFI to the Teryx UTV. This will give its V-Twin engine quicker throttle response and better fuel mileage. The EFI system will be easier to adjust than the old dual carb setup.

the amount of adjustability is severely limited, and still requires fuel modules to tune for aftermarket performance modifications. We do not know of any ATV's which have O₂ sensors in them yet. Therefore if you use a good performing exhaust (like ours) or perform engine modifications without a fuel management module, your engine will run "lean." These modules allow us to "re-map" the fuel curve to accommodate for any changes made to the ATV or UTV.

DR: Any model that is modified in any way to increase engine flow, e.g. pipe, filter or flow porting.

LRD: Some models need more fuel than others, but if you are going to install modifications (filter, exhaust, etc...) they all need help! The big misconception about EFI equipped ATVs is that they will "self-adjust" for modifications. Unfortunately, these EFI systems are open-loop and do not have

the sensor necessary to measure the exhaust gases and constantly re-map themselves, and therefore need an external tuning unit like our Pro 4 FIC.

TRINITY: All models need the ability to change EFI settings as soon as performance mods such as exhaust systems, intake modifications and so on are changed. The stock unit will adjust slightly to try and compensate for changes, but will usually fall short and be on the lean side. Even with just a simple mod to the intake system, a lean condition can occur. When you move up to some other mods like a big bore kit or even our Stage IV Pipe kits, it's impossible for the stock controller to supply the fuel required. This is why we set our programs to allow for these kinds of dramatic differences.

DW: Where is the first place an ATV owner needs to start when adjusting their EFI system, and why?

ALBA: Any engine modification will

require a change in fuel delivery. Some more or less than others. Though even a high-flow filter will cause one of these machines to run "lean". I would not even take the air box lid off without using a fuel module!

DR: They need to test the ATV on a dyno with a Wideband Air/Fuel sensor data reader to see if they are lean or rich anywhere in the rpm or throttle range. Without this you are flying blind. Using a Vortex ECU or EFI Interceptor will rectify any shortcomings due to minor engine changes, however, anything more major will require either further adjustment via the fuel adjustment switches or full custom mapping for extreme cases.

LRD: Typically, there needs to be adjustments at multiple throttle openings and loads. Start at the idle adjustment then move on to the cruise (off idle to 1/4 throttle). Once that is dialed, move to the acceleration (1/4 to 3/4 throttle) and then to the full throttle (3/4 to WOT). Our FIC unit also has adjustments to change the switch points on where each mode is activated. This allows tuning for various riding styles where different throttle responses are desired.

TRINITY: The first thing is to ride the quad and feel the rideability and response. If all you have done to the quad is add a pipe and intake modification you will probably not have any changes needed; if not, a simple adjustment may be in order. If you feel that there is a stumble right off the bottom, then you may want to make a one light adjustment to mode one this is done simply by pushing the mode button once which takes you to mode one and then all you do is hit the "plus" to go up to the next higher light on the array and you are one setting richer. Jetting from the seat of your bike; how easy is that? Welcome to the 21st century. The rest of the adjustments are just as easy. When we sell a



This Vortex Suzuki LT-R450 unit is fully programmable and can be remapped to suit engine modifications, such as cam, head and compression changes. This can be done using the optional Vortex EFI Software and interconnection hardware.

controller they are pre-set for a pipe and intake system. We also supply very extensive, easy to follow instructions that will allow the end user to make adjustments for his/her modifications that are just as easy as our example above. This is why the programmed starting points and adjustment profiles are so critical to the end user. One light with the standard setting may be too far and there may be no in between setting to go to. That's why we spend the time with our pro-

grams so the end user won't get stuck looking for an adjustment he can't find (because it was programmed with too much spread)

DW: What EFI adjustments will help an ATV owner when adding other mods like pipes, cams, head work, etc?

ALBA: The fuel modules we sell (Both the Dobeck and the MSD) are made specifically to address the "lean" issues presented by aftermarket high performance pipes, cams, head work, etc. It is always best to have an authorized shop with the proper equipment (Dynamometer, wide-band O₂ sensor, etc) to set up the fuel system. After the initial base map is generated, minor adjustments can usually be safely made by the customer. However, trying to map a fuel system from scratch without a facility such as ours is a lot like shooting a gun blindfolded. "Jetting" one of these vehicles by plug checks is only accurate if you have something to compare it to which you know is perfectly jetted and has been run for the exact same amount of time. A perfectly jetted plug will look different after ten hours vs. five hours. So to try to use it as a comparison is difficult unless you are extremely experienced. Furthermore trying to jet by feel is very inaccurate, and you need to lean out until you reach the perfor-



The MSD ECU (Engine Control Unit) for the 2008 and newer Yamaha Rhinos works piggy-back to the stock ECU. Alba will have a map uploaded into it when it is delivered to you. This system requires a computer to interface and change any of the available settings.

mance apex. This means you will be running it lean for some time before you realize it. This method can cause fuel detonation on high performance engines.

DR: Getting the Air/Fuel ratio right with a EFI Interceptor or even better with the Vortex ECU (more accurate and more control). Getting the spark time correct to match the engine modes and also the revised Fuel mapping. This is critical for correct operation.

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LRD: Each modification will benefit from fuel adjustments. Although you may be able to get away not adjusting for certain mods, the vehicle will not be performing at its optimum. Adjusting the fuel for performance modifications will allow the owner to

maximize their investment in the modifications.

TRINITY: There are five adjustments on our controller. The first three control the quantity of fuel and the last two control when that quantity is available. These parameters are

pre-set by each company according to their own possible wants or need; again, this is why all controllers are not created equal, every performance company should be setting these parameters to achieve their customers objectives. □

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