GETTING THE PARTS

This alternator setup uses off-the-shelf parts which can easily be found new and used. The parts needed are a Banshee rotor, three-phase stator, regulator rectifier, and the adapter bracket.

ROTOR- This setup uses a rotor [aka Flywheel] from an ’87 – ‘06 Yamaha Banshee (YFZ350). Used ones are plentiful and new ones are available. The rotors do not wear out but they can be damaged. If you buy used, make sure it was removed with the proper puller. I’ve seen guys try to sell ones that were destroyed because they used a claw type puller.

STATOR- The heart of this conversion is a 103mm OD X 42mm ID three phase stator. The stator will look like the one in the picture. It has a laminated steel core with 18 poles. If it has fewer than 18 poles then it is not a three phase stator. The poles are wrapped with enamel coated wire. Coming from the stator is three wires of the same color, usually white or yellow. If there are fewer than three wires then it is not a three-phase stator.

The stator from any of the following bikes should fit. The **bold** items I have personally verified will fit. The others were found by cross referencing numbers so I can’t guarantee they will work with this bracket.

Honda VF500F/F2, 84-86
Honda VF500C / V30 Magna, 84-85
Kawasaki VN800 Vulcan, 00-05
Kawasaki VN800 Classic, 01-05
Kawasaki VN800 Classic, 06
Kawasaki VN800 Drifter, 01-06
Honda VTR250 Interceptor, 88-90
Kawasaki ZX-6, 90-94
Kawasaki ZX600 Ninja ZX-6R, 95-97
Kawasaki ZX-6, 96-98
Kawasaki ZX-6,ZX600 Ninja, 99-01
Suzuki LT-F250 Quadrunner, 88-96
Suzuki LT-F250, 99-01
Suzuki LT-F250F, 99-02
Suzuki LT-F300, 99-02
Suzuki LT-4WD, 87-96
Suzuki LT-F4WDX King Quad, 91-95
Suzuki LT-F4WD King Quad, 97-98
Suzuki VS800GL Intruder, 92-95
Suzuki VS800GL Intruder, 96-05
Suzuki VS800 - M50 Boulevard, 06-07
Suzuki VZ800 Marauder, 97-04
Yamaha XV250 Route 66, 88-90

A used stator can save you a lot of money. Stators are very rugged so used ones are often a safe bet. The first thing to check when buying a used stator is the metal core. Do not buy one if it is rusty. Most stators mount inside the engine where it is bathed in oil so rust is rarely a problem. The common cause of stator failure is breaks in the thin enamel coating on the windings. You can check this with an ohm meter. To check if the windings are shorted to the core, clip one test lead of the ohm meter to the core and touch the other test lead to each of the three stator wires. With the ohm meter on it's highest setting you should see "OL" or a blank screen or whatever your meter reads when there is no connection. Next you should check that the windings are not shorted to other windings. We'll call the three wires A, B, and C. With the ohm meter on it's lowest setting, check the resistance between A + B, A + C, and B + C. All three readings should be the same. NOTE: many cheaper digital meters can not accurately measure the low resistance of stator windings. If you get a reading of zero ohms then find a better meter to double check it. If it is truly zero ohms then the stator is bad.

REGULATOR/RECTIFIER- The stock XS650 regulator/rectifier will not work with a permanent magnet alternator. Luckily, the majority of bikes made in the last three decades use a three phase permanent magnet alternator. That means there are more potential donors than I can possibly list. Even though used parts are plentiful, they can be the hardest part to spot. All regulator/rectifiers look the same, just a finned metal box with wires coming out of it.

If you know what bike the reg/rec came from then you can search for a picture of the stator used on that bike. What I've done is type "stator" and the make and model of the bike into a Google Image search. If the stator looks like the one above [18 poles] then the reg/rec is for a three phase permanent magnet alternator.

If you don't know what bike the reg/rec came from then you can still identify it by the wires coming out of it. Count the number of different color wires coming out of the reg/rec.

- **3 Colors**- The most basic reg/rec has five wires. Three input wires and two output wires. The three input wires hook to the stator and will all be the same color. Like the stator, these wires are usually white or yellow. The two output wires are positive and negative. The positive wire is usually red and the negative wire is usually black or green.

  Some reg/recs have seven wires. Three input, and four output. These are the same as the five wire units except that they have two positive wires and two negative wires. They do this because two wires and connectors can more reliably carry the current than a single wire and connector. Both the positive wires will be the same color, and both of the negative wires will be the same color.

- **4 Colors-** Many permanent magnet reg/recs have an additional voltage sensing wire. Usually orange, brown or black. This wire is hooked to the ignition switch to get power when the switch is turned on. If you aren't running a battery then you can hook it to the positive wire and the reg/rec will operate the same as a standard five wire unit.

If there are more than four different colors then it may or may not be a regulator/rectifier for a permanent magnet alternator. You will need to know what bike it came from and check a schematic to find out what the additional wires are for. Regulator/rectifiers are plentiful so if you're not sure about one then pass on it and buy one you know will work.

CONNECTORS- You are going to need wire connectors to hook everything together. I recommend you stay away from the cheesy insulated (red,blue,yellow) crimp on connectors you get at the auto parts store. These have a poor mechanical connection to the wire and often come loose. Also, because they will be exposed to the elements, they will corrode and cause all kinds of trouble down the road. Not to mention they just look bad. Nothing screams cobbled together electrical system like those smashed red, blue, and yellow insulated connectors.

For butt connectors and loop connectors I use heavy duty non-insulated crimp connectors (found at electrical suppliers or better hardware stores) and marine grade heat shrink tubing. The marine grade tubing has an adhesive in it that seals the connection when it is shrunk to the wire. Crimp the connector to the wire with a good set of non-insulated crimpers, sweat in just a bit of solder to guarantee a good connection, then heat shrink it.

For hooking up components you can either use factory style multi-pin connectors or standard rubber insulated bullet connectors. K&L sells a wide variety of these connectors. Your local motorcycle shops will have a K&L catalog you can order from or you can find connectors on-line. These connectors require an "open barrel" crimping tool. Buy the absolute best pair you can afford. Most electrical troubles can be tracked to bad connections. Do not try to cut corners here or you may end up stuck on the side of the road.

INSTALLATION

The first step is to remove the foot peg, shift lever and side cover.

Next, remove the chain rubbing block from the shifter shaft so you can snake out the stator wires. Then remove the stator.

Now that the rotor is exposed, you can remove it using the proper rotor puller. First remove the nut and lock washer holding the rotor to the crankshaft. An impact wrench makes short work of this. If you don't have an impact wrench then click the tranny into second gear and have a helper hold the back brake to prevent the crankshaft from turning then remove the nut. Screw the body of the puller onto the rotor completely. You don't need to torque it down, just finger tight is fine. Thread in the center bolt of the puller until it reaches the crankshaft. Crank it in a bit more with a wrench. Don't just crank on the puller bolt until the rotor pops off, that requires a lot of force and can damage the threads of the puller. Instead, just make it tight then smack the end of the puller bolt with a hammer. After a couple blows the rotor should just pop off. If it doesn't, then tighten the puller bolt a little more and smack it again. Take the rotor off and remove the woodruff key from the crankshaft.

With the stock alternator removed you can start assembling the permanent magnet alternator.

Test fit the stator to the adapter bracket. Be sure it sits flush all the way around. The bolt pattern of the stator only allows it to be installed one way. There is a large notch in the adapter bracket for the screw that holds the wires to the stator. If your screw is in a different location you will need to grind or file a new notch.

The little bracket that holds the wires may need to be bent to clear the adapter bracket. On some stators, like the VF500, you just need to bend it back and take out some of the curve. On other stators, like the Ninja, the bracket is a big loop and needs to be flattened to clear. On the VS800 stator the bracket had small protrusions that needed to be cut off. The bracket on the LT250 stator I tried would not in any way fit so a new bracket had to be made.

It doesn't matter if the wire bracket is resting against the adapter bracket. Just be sure that the wires themselves are not going to rub against anything. If you rub through the insulation of the wires then it will short out and burn up the stator.

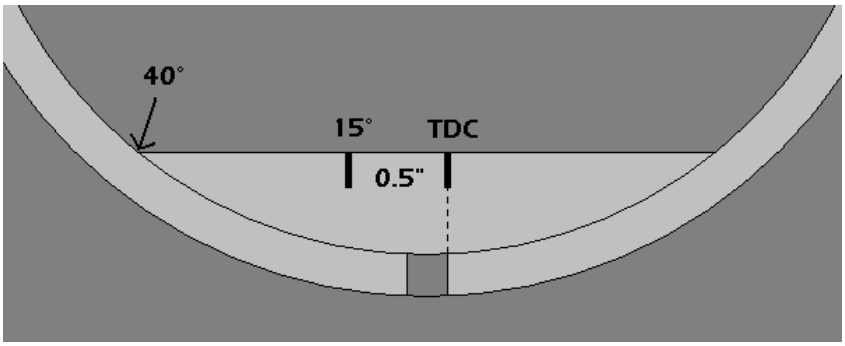
When you know that everything fits properly then you can position the stator on the adapter bracket and start the three screws. Wiggle the stator back and forth to be sure it is seated then torque the screws to 85 in-lb. The screw holes have Heli-Coil Screw-Lock inserts. These work like lock nuts so Loctite is not needed for these screws. Since the Heli-Coils and screws are both stainless you should put anti-seize compound on the threads to prevent galling.

Next you will mount the adapter bracket to the engine. It is machined to fit snug to the case. You may need to tap it in gently until it is fully seated. Don't just use the mounting screws to pull it in as you may strip out the threads in the case. Make sure it goes in evenly. If you force it in crooked you may break off the alignment tabs on the case. With the adapter bracket fully seated, screw in the two flange-head screws to hold it down. **Do not over tighten these screws!** If you over tighten the screws then they can walk out of the slots and break, or strip out the threads in the case. Use some blue Loctite on the threads to prevent them from coming loose and tighten them down so they are snug. **Again, do not over tighten them!**

Slide the rotor onto the crankshaft. A key is not needed because the rotor is not used to trigger the ignition. Push it towards the motor so there is no slop between it and the crank. Spin it and listen if it is scraping on the stator. If the rotor does touch the stator then you need to make sure that the adapter bracket is fully seated in the case, and that the stator is squarely mounted to the adapter bracket. When you are sure that there is no contact between the rotor and stator you can tighten it onto the crank. Slide the supplied flat washer over the crank, then the lock washer and nut you removed from the stock rotor. Torque nut to 29 ft-lb.

Run the wires through the hole in the case making sure that they don't contact the rotor. You need to seal the hole where the wires go through the case so water does not get in. Remember, a rusty stator is a bad stator. A rubber grommet is supplied with the adapter bracket. Wrap the grommet around the wires and jam it into the hole in the case. If it doesn't seal completely around the wires then you can fill the gap with RTV sealer. There should be a bit of rubber sticking out the front of the hole so that it is smashed in tight when the side cover is installed. Run the wires out the same way as the stock wires. Reinstall the chain rubbing block, side

cover, shift lever and foot peg. Before putting the inspection cover back on you should make some timing marks.

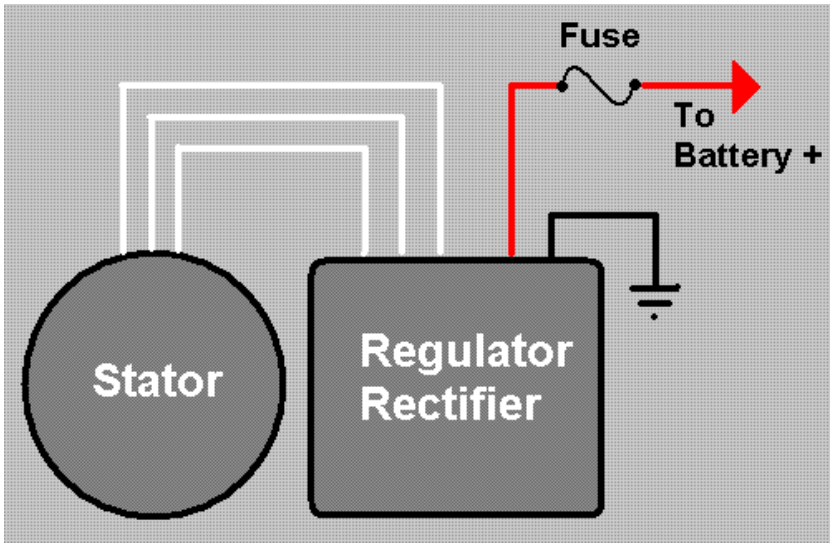


There is a flange at the bottom of the inspection cover opening. Beneath the flange is a notch in the case. Make a mark on the flange directly above the right side of the notch. This will be your Top Dead Center mark. Make another mark 0.5 inches to the left of the TDC mark. This is the 15° initial timing mark which is equivalent to the "F" mark on breaker point bikes, and the "∏" mark on TCI bikes. The 40° total advance point is on the left side where the flange meets the case.

To find top dead center, remove both spark plugs and turn the motor over with a wrench until you can see the piston through the spark plug hole. Stick a plastic drinking straw through the hole and hold it on the top of the piston. [You can use any kind of stick or rod for this but I recommend the straw because it won't damage the engine if it gets smashed by the piston or valves.] Turn the crankshaft back and forth enough that you can see the straw move up and down with the piston. Stop when the straw is at its highest point, TDC. Now, without moving the crank, draw a line on the rotor directly behind the TDC mark on the flange. REMEMBER: Since the rotor was installed without a key, you will have to find and mark TDC any time you install the rotor.

WIRING

The wiring for a permanent magnet alternator is very simple. The stator plugs into the regulator/rectifier which converts the AC current into a regulated DC voltage. The output of the regulator/rectifier is the same as the output of a battery. If your bike has a battery then you simply hook the reg/rec to the battery so there are two voltage sources for the bike. The battery supplies electricity to the bike when the engine is not running and the alternator supplies electricity to the bike when the engine is running. When the alternator is producing electricity, the battery is just another load on the system. It is only taking in electricity, not putting out electricity. So the battery is really only used to operate the starter motor. If you use the kick starter then the battery is optional. Some states require that the lights stay on if the motor dies. If you live in one of these states then you must have a battery.



The first thing to hook up is the stator to the regulator/rectifier. The three stator wires hook to the three input wires on the reg/rec. It doesn't matter which wire you hook to which wire. It is all AC at this point, there is no positive or negative. If the connector on the stator does not match up with the connector on the reg/rec then you will have to install new connectors. You can either use a multi-pin connector or bullet connectors. If you use bullet connectors then put the female connectors on the stator and male connectors on the input wires of the reg/rec.

Hook the positive output wire to the positive battery post through a 20 amp fuse. I recommend using a marine grade in-line fuse holder and 16 gauge wire.

Hook the negative output wire securely to the engine or frame. Or better yet, hook it directly to the negative battery post with 16 gauge wire.

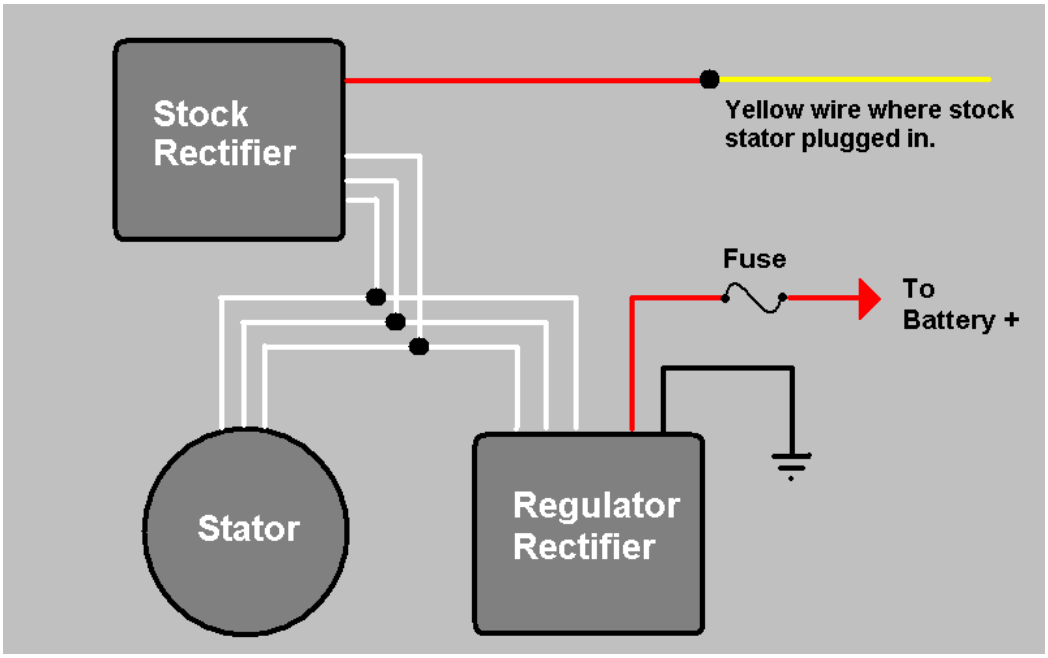
If you're not sure which wire is positive and which is negative then you can check it with a volt meter. Hook the leads of the volt meter to the two output wires and start the engine. If the meter reads a positive voltage then the positive output wire is the one hooked to the positive test lead. If the meter reads a negative voltage then the positive output wire is the one hooked to the negative test lead.

Safety Relay- The safety relay disables the starter motor so you don't accidentally engage it when the engine is running. On the later model bikes it also turned on the headlight when the engine was started. The stock alternator had a yellow (center tap) wire that triggered the safety relay. This alternator does not have the center tap wire. If you're running the stock wiring harness with the safety relay then you will either have to bypass the safety relay or build an adapter to trigger it.

If you have an early model bike with an on/off switch for the headlight then you don't have to do anything to bypass the safety relay. Since it will not get a signal from the alternator, it will allow the starter motor to be engaged at any time. Just remember to not push the starter button while the engine is running.

If your bike does not have an on/off switch for the headlight then you will need to bypass the safety relay. First, disconnect the relay from the harness and make two jumper wires with a female quick disconnect at each end. Use one jumper wire to connect the red/white wire in the harness to the other red/white wire. This allows the starter motor to be engaged. With the other jumper wire connect the blue/black wire in the harness to the red/yellow wire. This will make it so the headlight comes on when you turn on the key. Better yet, run the blue/black wire and red/yellow wire to a switch so you can turn the headlight on and off.

If you would rather keep the safety relay operational an adapter can be made using the stock rectifier. Connect the three white wires on the stock rectifier to the three stator wires. Then connect the red wire on the rectifier to the yellow wire in the harness where the stock stator plugged in. This will work the same whether you have the early rectifier only or the later regulator/rectifier.



Neutral Wire- The wire for the neutral indicator switch is run through the same loom as the stock stator. You will need to replace this wire if you want the neutral light to function or if you have a later model bike that disables the starter motor when the bike is in gear. The neutral switch is located on the top of the engine case, next to the cam chain tensioner. Hook a wire to the little screw in the top of the switch. If you can't find a small enough loop connector then you can simply drill a hole in a standard flat male quick disconnect terminal. Connect another flat male quick disconnect terminal to the other end of the wire and plug it in to the blue wire of the stock harness where the original stator plugged in.

Running Without a Battery- Since this is a permanent magnet alternator it can be run without a battery. Normally the regulator uses the battery as a voltage stabilizer. Think of it like the shock absorber that keeps your bike from bouncing around. The battery keeps the voltage from bouncing around. When you remove the battery the voltage regulator will have trouble maintaining a constant voltage. What you need is a "battery eliminator", which is just a big

capacitor. Capacitors can be scavenged from an old stereo or computer power supply. You can also purchase them new from an electronics supplier. What you are looking for is the larger electrolytic “can” type capacitors. The capacitance is usually measured in mico farads (uf). For this application the values isn't critical but bigger is generally better. The bigger it is the more stable your voltage will be. Find one with at least 1000uf. The voltage rating on capacitors is the maximum voltage they can handle. They can run at any voltage under the rated voltage. Try to find a 16 to 20 volt capacitor. Higher voltage capacitors can be used but are generally larger and more expensive. There are two pins on a capacitor, positive and negative. Usually the negative is marked with a band or arrow. Hook this lead to ground. Hook the other lead to the regulator output, after the fuse. Do not hook it up backwards or it can explode.

Testing the Alternator- Once you have everything hooked up then you should check that the alternator is functioning properly. Hook a volt meter to the battery and start the engine. Don’t rev it up when you start it, just let it idle. Ideally, you want to see about 14.5 volts all the time. At idle the voltage may be down around 13 volts since the rotor isn’t spinning fast. The alternator output is directly related to the rotor speed. The faster the rotor spins, the more power you get from the alternator. Slowly increase engine speed and watch the volt meter carefully. If at any point the voltage goes over 15 volts, SHUT OFF THE ENGINE and double check all of your connections. If you have 14.5 volts all the time above idle then it is working properly and you are done with your alternator installation.

If your alternator is not working properly and you are sure it is wired correctly with solid connections then e-mail me at mrriggs@gofastforless.com. I will walk you through step-by-step how to troubleshoot it.