Basics of the VFR Electrical System, Sources of Regulator/Rectifier Problems and Recommended Solutions

by Bruce Wilson

This very interesting and comprehensive article was written by Bruce Wilson who has graciously allowed me to place it here . This work should be helpful to those trying to figure out possible regulator/rectifier (R/R) problems and it has certainly cleared up some things for me. Read and enjoy!

Background of Regulator/Rectifier Problems

There are about 13% of VFR owners who are experiencing R/R problems according to Mike Troutman's excellent VF/VFR Survey who has collected some data on this problem. Bruce has done some rather expensive study and work on thinking through the potential common source of these problems.

A Basic Understanding of How this Mysterious Electrical System Works

The VFR charging system is really quite simple and once you understand how it works, it is no longer mysterious or daunting. The following description is exactly for a '94-'97 VFR, the '90-'93 VFRs are very similar and would imagine the '98+ VFR800s work on the same principle.

On the left end of the crankshaft is a 3 phase AC Alternator that generates AC (alternating current) as the engine runs. The 3 wires (yellow) exit the alternator, run between the engine V to the right side of the VFR to a connector visible with removal of the right middle fairing; 3 yellow wires in, 3 yellow wires out. The 3 yellow wires then go into the main wiring harness, running towards the rear of the bike, until they exit the main wiring harness about 6 inches before 5-pin connector at the R/R. The R/R takes the AC current, changes it to DC current and sends the DC output towards the battery to keep it charged. The two (2) other wires in the R/R 5-pin connector are red and green. The red is the (+) DC, the green is the (-) or ground. These two (2) wires disappear into the wiring harness again, but split up soon. The green wire goes to a frame ground just above and to the right of the R/R. There are two (2) connectors at this grounding point held to the frame by a 10mm headed bolt.

Other than the negative battery terminal, this is the main grounding point for the entire electrical system. The red wire (which sends DC to the battery as it's charging source) winds its way through the wiring harness and exits at the starter relay (in front of the battery) into the 4-pin connector. The starter relay also has two (2) other connections, both large gauge wires held in place by allen head bolts. One is the (+) lead from the battery, a very short and heavy gauge wire.

The other goes directly to the starter and is also heavy gauge compared to all the other wires we have discussed. And that ladies and gentleman, is the **entire** charging circuit of the VFR. Simple huh? But way too many connections to not give problems.

Briefly, lets look at what happens when you turn the key to ON. The 12+ DC volts of the battery now are allowed to flow to the starter relay providing 12 volts to run the bike. Remember the 4-pin connector at the starter relay? We have only used one (1) wire so far, the output of the R/R to send DC to the battery to keep it charged. The 3 other wires in this relay do the following. One takes the 12+ volts DC from the battery and sends it down a wire through the main wiring harness all the way to the fuse box to provide power to the entire bike (except the starter which we will look at in a minute).

The other two (2) wires perform an important task, but only for very short moments. When you push the starter button, you want as much juice as possible to get to the starter and there are certain electrical devices you want to temporarily disconnect (like the headlights, tail lights, etc). **But** there are certain electrical items you still want to get power, like the ignition coils and the ignition module. The other two (2) wires in the starter relay cut power temporarily to non-essential components so all the power from the battery can be sent to the starter when you push the starter button on the handlebar. And that, other than a few other connectors and bulbs, etc. is your entire electrical system.

I think it is really important to have a basic understanding of how this mysterious electrical system works because once de-mystified, people won't be afraid to go in and look at things. Now lets look at where the problems in the charging circuit "hide".

Main Sources of the R/R Failure Problems

I have done much research into this problem and want to share with you what I feel are the main problem areas.

1. The location of the R/R is poor for ventilation and cooling. Heat sinking would help but the physical confines of the stock mounting location make this difficult.
2. There are 14 connection points in just the charging system that must be clean and corrosion free for the charging circuit to perform properly. Three (3) at the alternator output, five (5) at the R/R, the R/R input to the starter relay, the ground (common) for the R/R at the frame, the positive (+) battery connection at both the battery and the starter relay, and the negative (-) at the battery and the frame ground. Any corrosion at any of these points adds resistance (and inductance) and changes the values of the entire charging circuit.
3. The R/R does not have a negative (-) connection directly to the battery or even to the battery negative (-) connection to the frame. They are grounded in two (2) different locations. This is a stupid design just asking for trouble.
4. There is no **direct** connection between the (+) output of the R/R and the (+) terminal on the battery. It must run through the 4-pin connection on the starter relay and then through the connection of the (+) terminal from the battery on the starter relay. Again, stupid design.
5. The wiring gauge is too small from the alternator output connector to the R/R and from the (+) output of the R/R to the 4-pin on the starter relay.
6. A bad battery **will** take out (and keep taking out) a R/R.
7. I am somewhat suspect of the oil some VFR owners are running in their bikes in that I feel that some oils do not do a good job of carrying away the heat from the alternator. This is just speculation on my part however.
8. Dissimilar metals for ground (common) by definition will start corroding and showing resistance under even normal use.

Recommended Solutions to R/R Problems

So what are the solutions? In my experience, more than 50% of the repeated R/R problems would probably go away if people cleaned their connections and grounds every time they changed their oil (gives you something to do while the oil is draining anyway). Applying a good anti-oxidant/anti-corrosion product such as GB Electrical OX-GARD will improve the connections and reduce the need for frequent cleaning of the connections and grounds.

The only REAL solution is a separate charging system wiring harness that does the following.

- New heavier gauge wire running from the alternator output to the R/R.
- A new fused (+) lead from the R/R (with heavier gauge wire) to the (+) terminal on the battery.
- A new (-) lead from the (-) on the R/R to the battery directly and to a frame ground (added safety against grounding corrosion).
- Installing an electrical "buffer" in the R/R that prevents damage to the R/R when the battery

goes south.
- And moving the R/R to an area that gets more airflow.

This would not be hard to do and Honda **should** have done it. BUT, it would be too costly to build and sell to where anyone would buy them. But this would eliminate 90%+ of all problems, the last 10% or so being related to bad alternators.

Recently Experiences with R/R Problems

Let me tell you about several recent experiences I've witnessed with R/R problems in just the last 3 weeks.

- A VFR Lister who was getting ready to take a very long summer trip noticed his digital voltmeter he had installed was showing a lower reading than it used to. After several emails off list with him, I told him to clean **all** his ground connectors and he picked up the 1/2-volt he had lost.
- The service manager of a dealership in Tennessee (also a friend) lost charging on his '96 VFR750. The connector at the R/R was fried, generally indicating a bad R/R. He replaced the connector and found corrosion on the (-) battery terminal and the (-) connection at the frame. Connections cleaned, charging system working properly without replacing the R/R.
- Similar to above, but the battery was bad. R/R connector replaced and new battery installed and everything working fine.
- When most VFR owners (and unfortunately most mechanics) see a charging problem, they think it is a bad R/R, replace it and then have the problem reoccur in 50-500 miles. I have seen this happen over and over.

Maybe my research and experience will shed a little insight into this problem and cause people to spend an hour cleaning and conditioning all their grounds and connections. In my opinion, this would eliminate 50% of the charging problems experienced in VFRs and many other motorcycles as well.

Bruce in Tucson
'96 VFR750F

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