Buell 1125CR Charging System Overhaul

This writeup covers the charging system work I did on my 2009 Buell 1125CR. It should apply to any 2009 or 2010 Buell 1125 motorcycle. This writeup is provided for informational purposes only; I accept no responsibility for the results of applying this information.

Introduction

The 2009 and 2010 Buell 1125 motorcycles (the 1125R and the 1125CR) are notorious for their charging system issues. In 2009, the stator output was increased, and due to the use of a shunt-style regulator, this lead to higher stator temperatures. Take this increased heat and add the fact that there is very little air or oil flow to the stator, and it's easy to see why these stators fail often. Eventually, the heat breaks down the insulation on the stator windings, causing a short. A shorted winding takes out two of the three phases, leaving you at roughly one-third electrical capacity.

When I bought my 2009 1125CR, it still had the original factory charging system. I began to make some preventive upgrades, but the damage was already done. Once my stator failed, I was lucky enough to have research and discussion from several other people available to me online. Leveraging this, I overhauled my charging system. My new system has been rock solid for the past several thousand miles, and I am confident that the original shortcomings have been fixed, and that the problem is solved for good on my bike.

Many others have purchased and installed 2008-spec stators and rotors, as those were reliable. However, this solution didn't appeal to me. My goal was to fix the 2009-spec system, and maintain the higher charging system output. These machines tend to run hot and, when running on full blast, the electric cooling fans can overtax the charging system while idling. Getting caught in traffic with a motorcycle on a hot day can be stressful enough without worrying about your charging system!

My solution is similar to one by Gregory Hildstrom. In fact, his extensive documentation is what inspired me to tackle the task. There is a link to his writeup, among other useful links, in the *more reading* section at the bottom.

The overhauled charging system on my machine has been changed in several ways:

- Rotor was replaced with one that sprays oil on the stator
- Stator was rewound with high temperature wire and high temperature epoxy
- Regulator was replaced with a series regulator

Rotor Replacement

The stock rotor is nothing special. It's pretty typical of similar charging systems – just a spinning permanent magnet whose purpose is to induce electrical current in the stator windings. It forms a pretty close fit with the stator, and doesn't allow very much oil or air past it at all. For a stator that's constantly overheated, lack of oil- and air-flow is not your friend.

It turns out that the crankshaft has an oil port where the rotor bolts on. Very convenient, as this means with a specially machined rotor, we can get some oil flow to the stator.

Erik Buell Racing, in their very gracious support of the 1125 platform, developed and released such a rotor! The cost of this rotor is $425, $250 of which is a core charge that gets refunded upon return of your original rotor.

I purchased one for installation on my machine. I needed to tear it down to do a valve check anyway, so this gave me the perfect opportunity to kill two birds with one stone.

If you look carefully at the photo of the rotor above, you can see the tiny oil spraying hole in the area circled in yellow. It looks tiny, but it doesn't take a very big hole to spray enough oil to cool things down.

Materials Required

When I did this, some parts had to be ordered from Harley Davidson. Now, EBR offers most, if not all, of these parts.

- EBR modified rotor
- Hardened crankshaft locking tool
- Replacement rotor nut
- Loctite 272 (or Permatex 27200 - same thing, same company, but much easier to find) - for rotor nut
- Loctite 648 - for sprag clutch bolts
- Ignition cover gasket - it's only paper, and easy to tear during removal

Installation

Installation of this new rotor is definitely not for the faint of heart. The nut that holds it on needs to be heated up for removal, and needs to be installed to a high torque value.

Crankshaft Locking Tool

A special locking tool is required to lock the crankshaft in place while applying the torque required to remove and install the rotor nut. From time to time, you can buy one of these from EBR. However, it was out of stock for quite a while when I was looking for one, and I was ultimately unable to source one. I attempted to make my own, but it didn't work out very well.

I drilled out an appropriately sized bolt (to protect the threads in the engine casing), and used an appropriately sized hardened steel rod.

I was able to get the crankshaft locked with the tool, however, the tool slipped out of the hole with only around 50 ft-lbs of torque applied. Rotor nut installation requires 295 ft-lbs, so this was nowhere near enough! *Note: I wouldn't recommend attempting to DIY this tool, unless you or someone you know is skilled in toolmaking. I've read reports of others not faring as lucky as I did, and having the tool break off rather than slip. If you have something break off in the crankshaft, it* ***will*** *ruin your day!*

I had an air impact that was rated for 300 ft-lbs tightening, which is just beyond the torque spec from EBR. Many people recommend not using an impact wrench for installing bolts like this. I did, and it worked out fine, but you will have to weigh the risks involved before deciding to do so yourself.

Removal of Rotor Nut and Rotor

Removal of the rotor begins with dissembling the motor to get to the rotor. This isn't particularly difficult, but there are several steps involved. I'd recommend consulting a service manual here if you're not familiar with the process. The rotor nut torquing process has been revised by EBR, however. The torquing instructions and threadlocker specifications I give below will disagree with your service manual, but are in fact correct as of this writing.

Since the locking tool I made wouldn't hold enough torque to remove the nut, I used the impact to remove it. The DIY locking tool *did* hold enough to keep the crankshaft still during impact use, but in retrospect, it was probably a bad idea to continue using the tool in this manner.

Some folks report being able to remove the nut with very little force and without needing to heat the nut to release the Loctite already installed. I had no such luck. I used a small hand-held torch to apply heat to the nut for several seconds, then hit it with the impact. After going back and forth a couple of times, it came off. Careful with the heat though – too much can affect the magnets in the rotor – so try and keep it localized to the nut.

After removing the nut, the rotor (and sprag clutch attached to the back) slid right off the crankshaft.

Preparation of New Rotor

The new rotor came bare, so I had to detach the sprag clutch assembly from the back of the old rotor and transfer it to the new. Just a few bolts are involved with this. Be sure to apply Loctite to the bolts when installing on the new rotor. Loctite 648 is recommended here, but I couldn't source any, and used Permatex 27200 (Loctite 272). This is probably going to make removing these bolts later, if necessary, a nightmare though.

Installation of Rotor and Rotor Nut

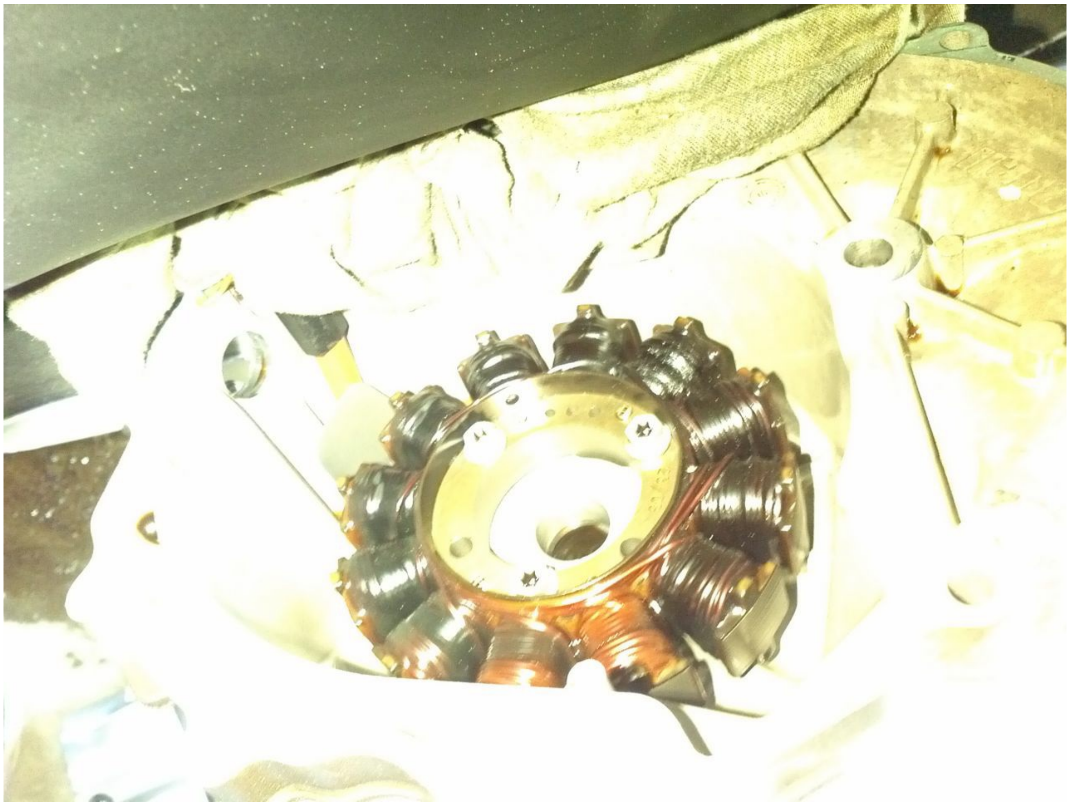
Once the splines are lined up properly, the new rotor slides right on the crankshaft. I cleaned up the crankshaft threads with brake cleaner, and applied threadlocker, and loosely put the nut on. The recommended torquing procedure is to tighten to 210 ft-lbs, back the nut off 2 full turns, then tighten to 295 ft-lbs. This is to get the thread locker activated and such. I had to improvise here, so I lightly torqued the nut on with the impact, backed it off a couple of turns, then tightened it on. Since my impact was rated for 300 ft-lbs, I let it work nut on for a couple seconds.

Afterwards, reassemble the engine, and it's done!

A quick note on the threadlocker: Loctite 272 is recommended. However, this isn't the easiest thing to find in small quantities. Permatex 27200 is the same thing, just with a different name. Permatex and Loctite are the same company.

Stator Rewinding

Unfortunately, when installing the new rotor, I could tell that my stator was almost toast. It had the tell-tale burnt epoxy and looked in bad shape. So, I began investigating options for a new stator.



There are several options now for having your stator rewound with high quality materials. When I made the decision to rewind mine myself, there were less options, and they cost more. Thanks to Gregory Hildstrom's writeup, I was able to source my wire from the same place he did (and for a similar cost), and purchase one of the epoxies he discussed.

Materials Required

- Wire - I purchased the same wire as Hildstrom (AWG 16 size magnet wire with double polyimide insulation, good to 240C) I, also, opted to purchase 1000 feet. Somewhere around 150 feet is required, however, I was quoted a significantly lower price when buying in bulk, such that 1000 feet barely cost more than the 150 required. The decision to purchase extra turned out to be a good one.
- Epoxy - Duralco 4461. This stuff is fairly expensive, though research indicates it's quite durable, good at penetrating windings, and is electrically resistant properties. It is rated to 500F, which slightly higher than the rating of the wire. The epoxy is important for holding the windings in place against engine vibration.
- Rescue tape - high temperature, self-fusing silicone tape. I used this as wrapping around the junctions where the stator windings hook to the harness. It's oil/chemical resistant, electrically insulative, and can withstand high temperature.
- Loctite 243 (a.k.a. Permatex 24300) - for the bolts that hold the stator in place.

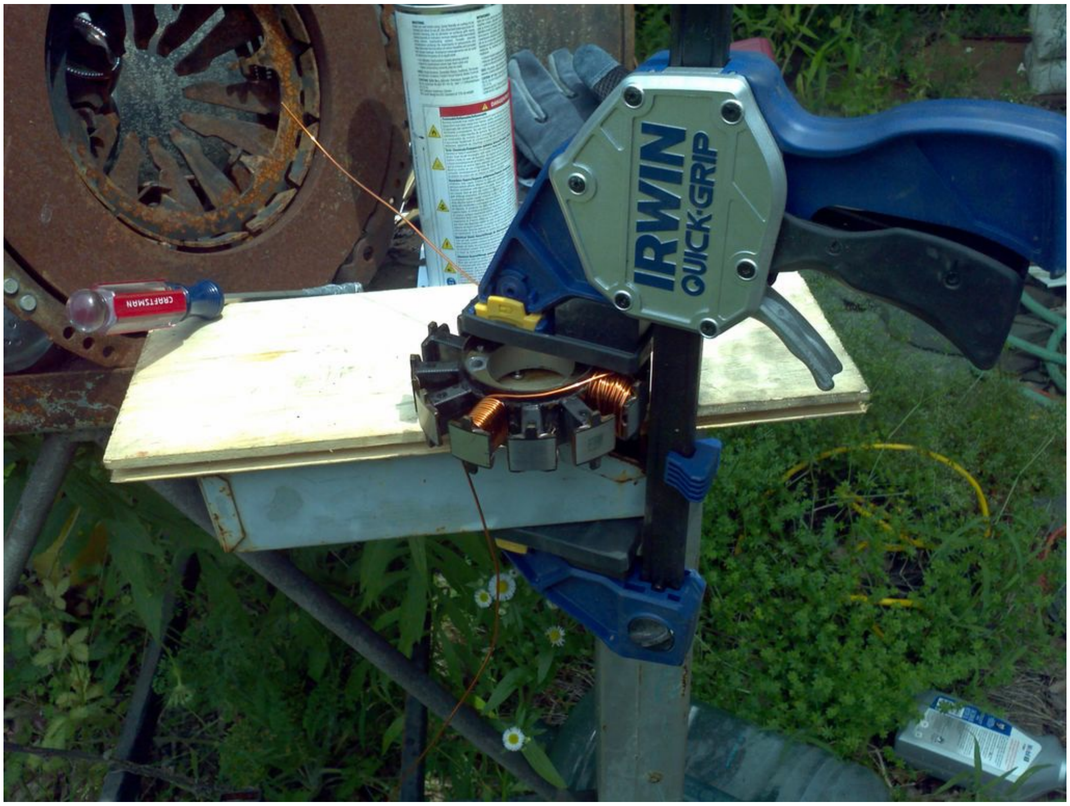
More discussion of wire and epoxy can be found in Hildstrom's writeup (see *more reading*).

Re-winding

I won't go into too much detail here, as Hildstrom's writeup (see *more reading*) already does an excellent job of this.

Take One, Failure

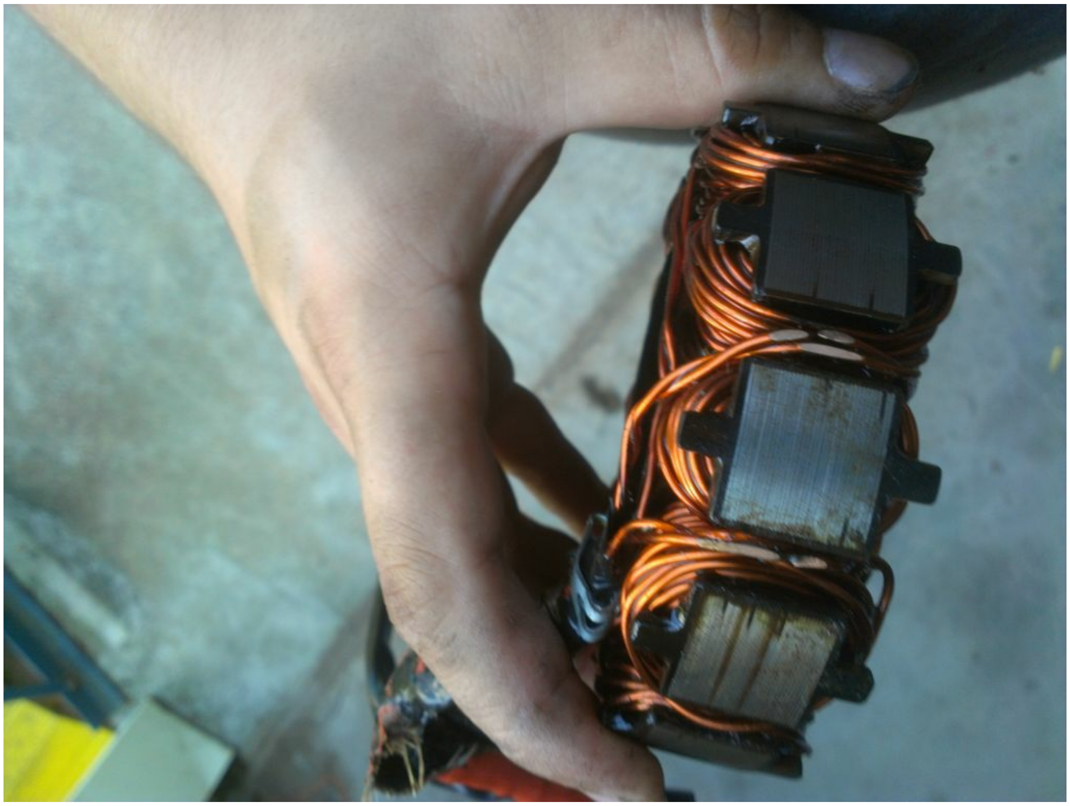
My first rewound stator failed. This was due to my windings being messy. I'm almost embarassed to show pictures…


IRWIN
QUICK-GRIP
CRAFTSMAN

I got everything buttoned up, and on the stock regulator, voltage output was fine.

After the rewind, I bought the CE-605 SB regulator. My first one failed relatively quickly after installation, and after receiving a replacement, I started having charging issues. I rode using the stock regulator for a while, and didn't rewind the stator again until I was preparing for a cross-country trip.

I took the stator out, and immediately saw why it failed:

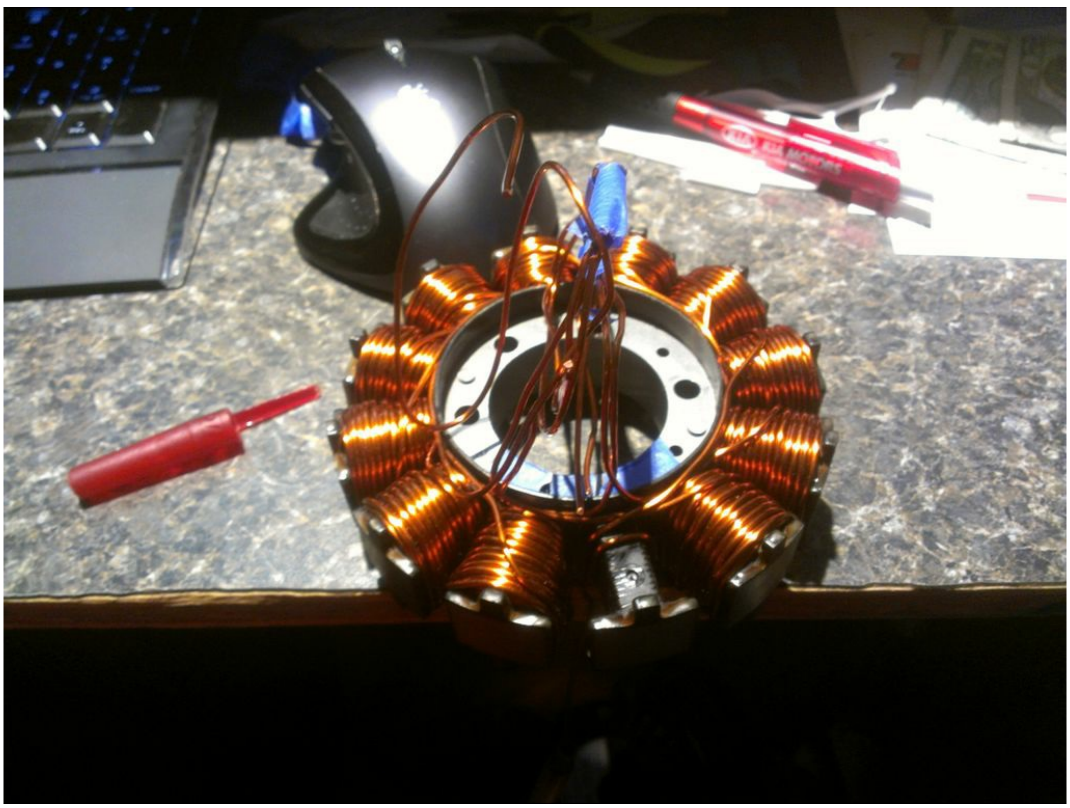


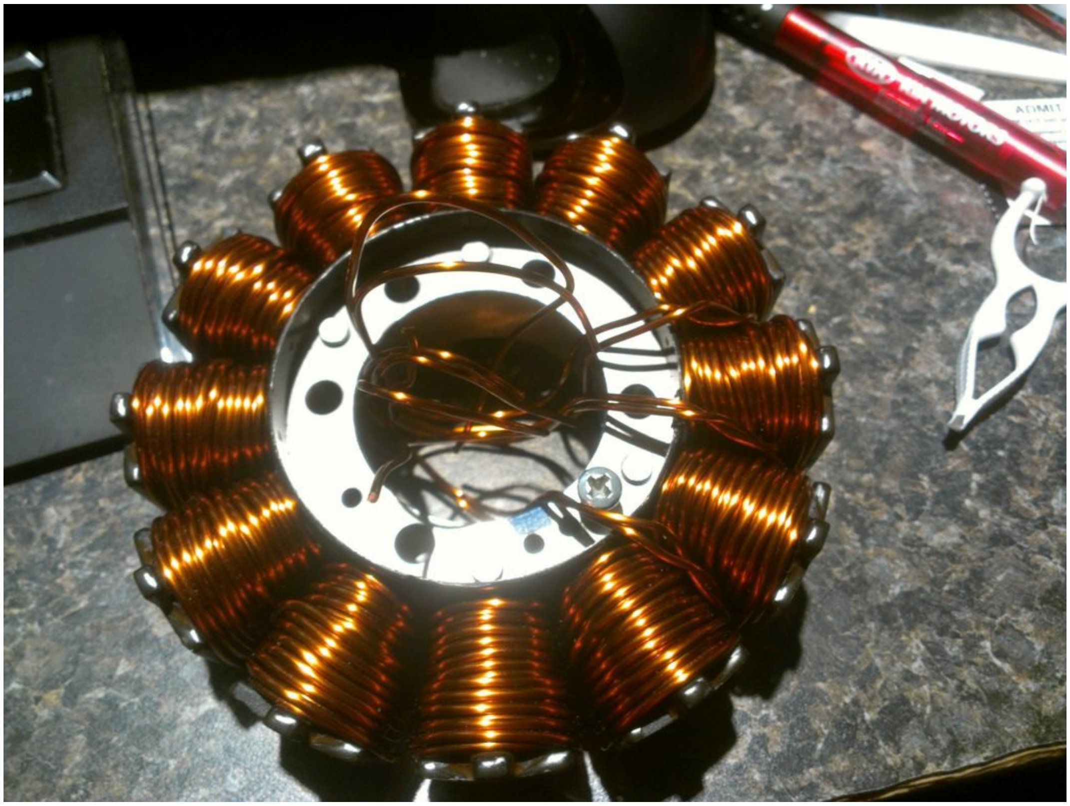
The windings were too messy, and some made contact with the rotor, and eventually rubbed through. Unfortunately, this took a toll on my new rotor as well. Rotor is still working fine, it just looks ugly. Next time I have the motor apart for a valve check/adjustment, I'm going to fill in the damaged section with epoxy.

The stator lasted several thousand miles before failing, and almost all of that time was spent on the stock, shunt regulator (I'll discuss this in the regulator section, but shunt regulators short the stator out to bring it down to the regulated voltage, so stator is always running at maximum output). The stator, aside from the damage, still looked brand new, so I'm confident in the wire and epoxy choice:

Take Two, Success!

I rewound another failed stator core, this time taking more care in keeping the windings neat and compact. It's still not as good as Hildstrom's job, but it did come out *much* neater. I'm happy with the result.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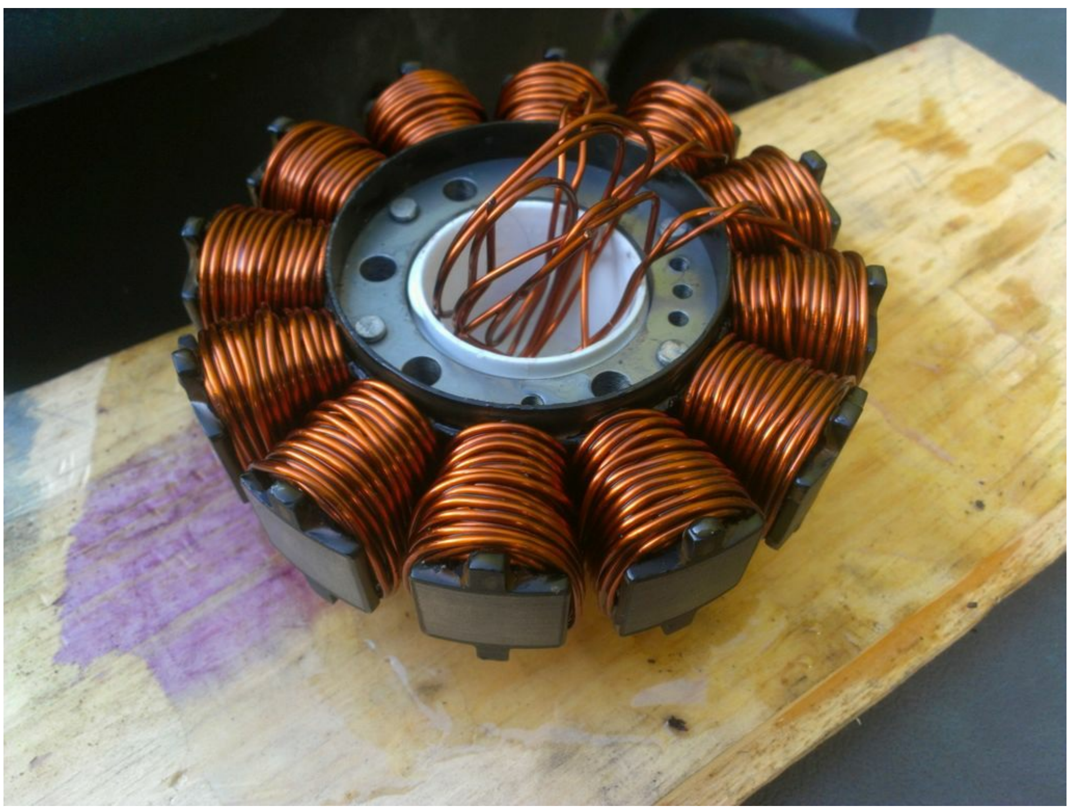


I got everything buttoned up, again, and tested it out. Note that the picture was taken with the bike under high electrical load (hot motor, fans running on high, high beams on). This is also with the CE-605 SB regulator hooked up, which works nicely with a properly working stator.

New Regulator

The stock regulator used on the 1125 is a shunt regulator. The way it regulates voltage is by, essentially, shorting the stator out enough to bring voltage down to the proper value. This means any excess power not being drawn from the charging system is consumed and thrown away anyhow, effectively running the stator at maximum output all the time.

Although I am confident that the stator rewind and rotor replacement is enough to fix the issue, I still wanted to replace the regulator to reduce stator load as well.

I chose the CE-605 SB. This is a series regulator, which means it regulates power to the charging system, only conducting enough power to fulfill the electrical demands. The stator is not shorted out to bleed off any extra power, meaning the stator is no longer run at full load (unless full load is actually being drawn), and less heat is generated.

Another option is the Compufire series regulator. However, I must recommend against purchasing this. The company refuses to discuss use of their regulator on the 1125 platform, and considers warranty void when installed on these machines. I've heard reports of at least one person receiving one dead from the factory, and being left high and dry by the company. Their solution was to sell him a new one at cost, rather than replacing the failed one outright.

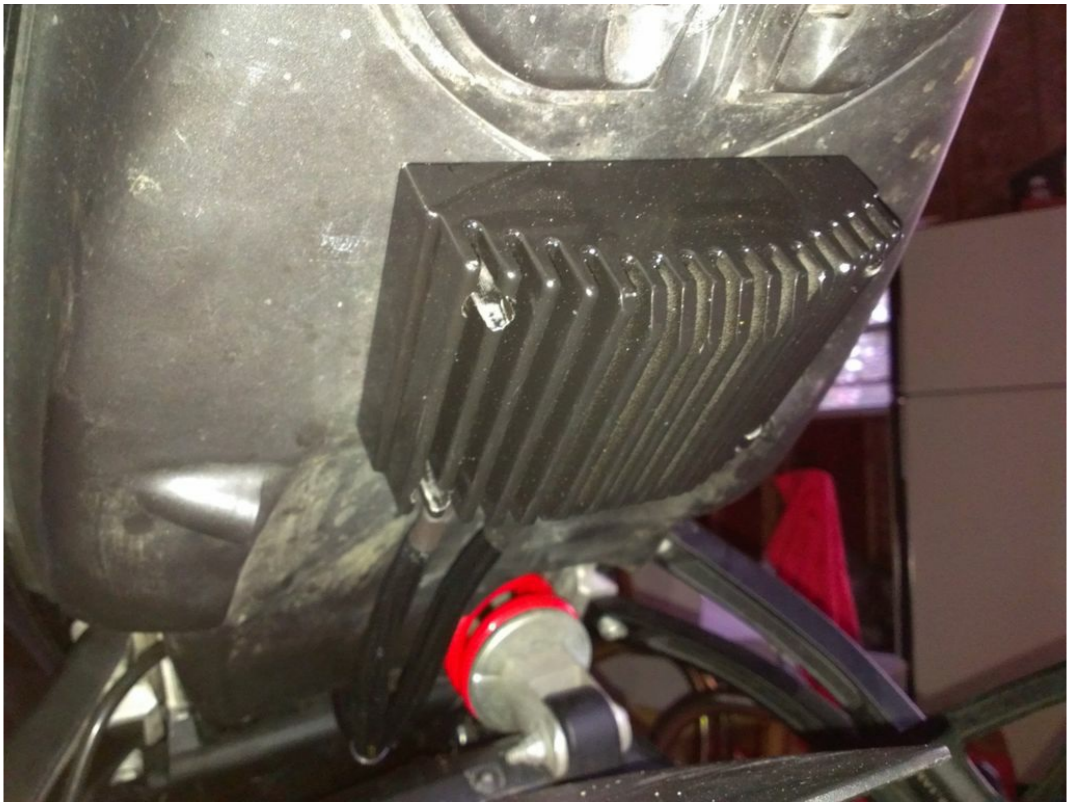
I personally received a faulty CE-605 SB – it failed shortly after firing up the bike for the first time after installing it. The company who sold it to me stood behind the product 100% and quickly replaced it for me. Additionally, I've heard report from an individual who had to return the regulator to the manufacturer for a warranty issue, and also received prompt service. In both cases, it was known that the application of the regulator was on the Buell 1125.

Materials Required

- CE-605 SB Regulator
- Deutsch DTP04-4P connector (w/ stamped pins, for stator connection)
- Three matching Anderson SB50 connectors (for output to bike harness)
- Techflex mesh wire wrapping

Installation

I mounted the regulator underneath the tail section. The instructions tell you to keep it out in direct airflow, however this is the best place I had for attaching it, and have not had any issues with the regulator staying cool.



I used a new Deutsch connector to mate with the stator connector, so as to leave the stock regulator in place. I needed to cut the harness off the stock regulator, as it is a non-standard connector, and I did not want to cut the harness on the bike. I then put an Anderson SB50 connector on the harness, the leads from the CE-605SB, and on the leads from the stock regulator. This allows me to swap back to the stock regulator by swapping the two connectors, so if something happens to the new regulator, I won't be stranded.

The instructions do tell you to wire the regulator straight to the battery. However, I'd rather not route all of the electrical demands of the bike through the battery fuse in the long run. I chose to hook it into the harness where the stock regulator hooked in, to preserve the original electrical design. There's no issue with the wiring harness, so I saw no need to bypass it.

I also removed the band-aid charging "upgrade harness" from the bike. This uses a relay to turn off 2/3 of the stator to try and manage heat. This is incompatible with the CE-605 SB, and is no longer applicable with the oil spraying rotor.

Results

Voltage runs a little higher than with the stock regulator. On cool mornings, I'll see 14.4-14.5 volts (indicated by the cluster, 14.2 indicated by digital multimeter at the battery). Voltage usually settles in around 14.2 volts indicated, and will slowly drop and maintain in the mid-13v range during extended idling when the fans are running on high. Overall, voltages maintain 0.4-0.5 volts higher than stock regulator under most conditions.

Overall Results

Aside from the stator mishap with my first rewind, this setup has been rock solid. After rewinding the stator the second time, I proceeded to ride the bike down the east coast, through Tennessee, Georgia, Florida, and back. I got stuck in my fair share of traffic, both in cool and in hot weather, and the bike ran flawlessly through it all.

Unfortunately, someone hit me while riding the 1125, totaling it all out, so I never did get to evaluate the extremely long term prospects of the charging system overhaul.

Here's the final timeline for the work I did:

- EBR rotor installed at 12,627 miles.
- Factory stator dead, first re-wind attempt at 12,954 miles.
- First re-wind faulty and dead before 14,505 miles. Second re-wind attempt was installed at 14,505 miles.
- Bike totaled at 21,028 miles.

Unfortunately, I wasn't in a good condition to be wrenching on the bike, so I didn't have the opportunity to check out the stator condition before the insurance company took the bike. I suspect it was in good condition though. Voltages were still the same as they were after installing the second stator re-wind. The second stator spent all of its life with the CE-605 regulator attached.

More Reading

Be sure to check out the following for more reading on the topic:

- Gregory Hildstrom's Modifications (http://hildstrom.com/projects/buellstator/index.html)
- DIY thread on BadWeb (http://www.badweatherbikers.com/buell/messages/290431/674357.html)
- Discussion on rotor replacement (http://www.badweatherbikers.com/buell/messages/290431/694256.html)
- Discussion on stator rewind options (http://www.badweatherbikers.com/buell/messages/290431/684861.html)
- Discussion on Compufire and regulator wiring (http://www.badweatherbikers.com/buell/messages/290431/664657.html)
- Discussion on Compufire vs CE-605 SB (http://www.badweatherbikers.com/buell/messages/290431/704732.html)
- BadWeb 1125 stator forum - plenty more info (http://www.badweatherbikers.com/buell/messages/290431/646530.html)