VREG20 Installation Instructions

The main steps for the installation are:

1. Determine the size of the new regulator that you need.
2. Remove the old regulator.
3. Check the stator
4. Drill the mounting plate.
5. Attach the mounting plate.
6. Connect the regulator.
7. Attach the regulator to the mounting plate
8. Testing and verification.

Determination of the regulator needed.

This is covered in detail in the application note “Selecting_VREGxx_regulator.pdf” available in the application notes.

What is included with the regulator

The VREG regulator kits include the following:

- The regulator itself shown in *Figure 1*
- Mounting plate for the regulator shown in *Figure 2*
- 2pcs of #8-32 nylock nuts

The materials you will need to provide are the electrical connectors and the hardware for fastening the mounting plate to the vehicle.

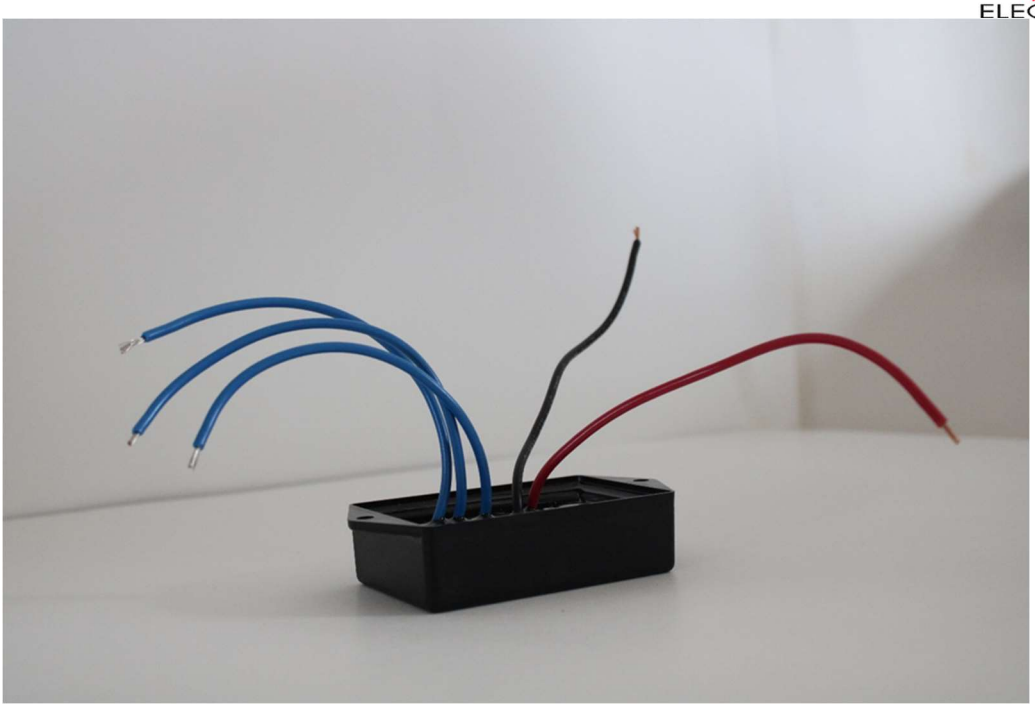

Figure 1 – VREG20 regulator picture

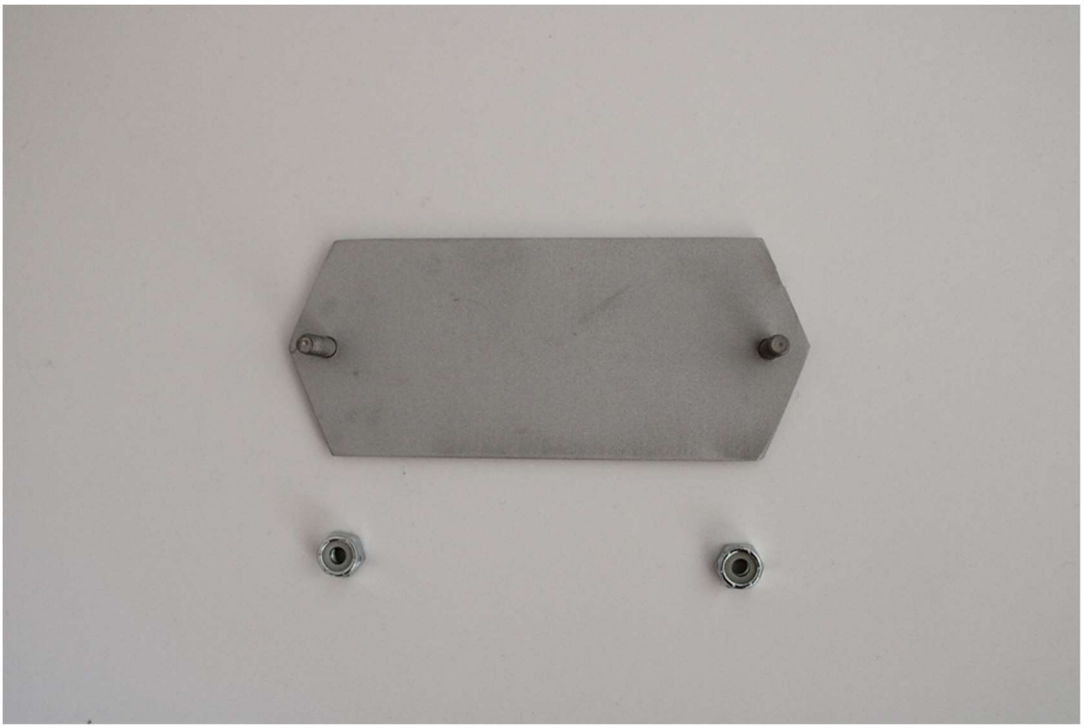

Figure 2 – VREG20 mounting plate

Remove the old rectifier and regulator

This is usually straightforward. Use the following steps:

1. Disconnect the battery.
2. Remove the connector from the existing regulator.
3. Remove the hardware holding the old regulator in the vehicle.
4. Cut the old connector off the wiring harness.

This usually just involves removing a couple of screws and disconnecting the wiring harness from the rectifier and regulator. On some motors from the late 1970s to early 1980's the rectifier and regulator are separate units. The VREGxx-SLA series of rectifier/regulators replace both of these parts. The VREGxx-SLA is intended to be used with sealed lead acid batteries. If you are using a flooded lead acid battery, it will need to be changed out for SLA depending.

You will also want to identify the leads coming from the stator. On some vehicles, the wiring goes around to other switches components. Some of this was that the designer was trying to (or have the option to) minimize the stress on the battery by enabling and disabling the phases/windings. This is no longer needed so all of the phases from the stator can connect directly to the rectifier/regulator.

Many times, there is a connector on the existing regulator. Since this is different on the different vehicles, it will need to be removed and replaced with inline terminals. Cut off the wires as close to the body of the connector as possible.

Check the Stator

It is possible for a defective stator to cause overheating or damage to the rectifier/regulator. This happens when there is a short in the stator windings to ground near one of the output leads (a few turns down the winding) and there is low load on the regulator. In this case, the low load results in the shunt action of the regulator shorting the output of the winding to ground. This creates a situation where there are a few turns around the stator that are shorted together. This results in a high current that can cause damage. The checks that should be performed are:

Check the stator for shorts to ground

Measuring the resistance from each winding output to the engine ground is usually sufficient to find most shorts. The resistance should be high (over 100k). It is possible that shorts are intermittent, but a high voltage test is likely more trouble and requires more equipment than might be available. The test is shown in *Figure 3*.

To check the stator follow the following steps:

- Disconnect all the stator windings from the regulator.
- Measure the resistance from each winding to a ground point on the vehicle. If you are using a frame part as the ground, check to make sure it is connected to the engine ground.
- The resistance should be over 100kohms. In the

If the stator passes this test, then the stator faults will not damage the regulator.

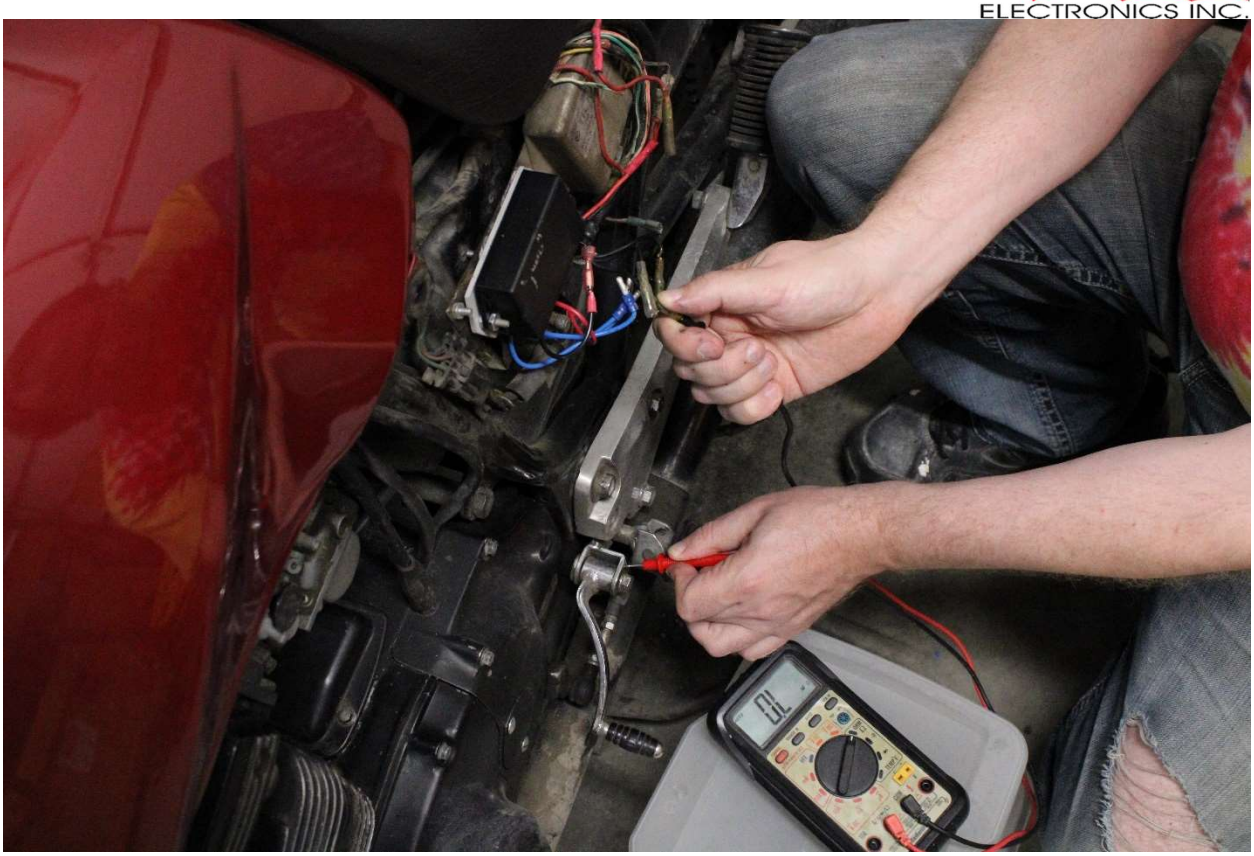

Figure 3 - Measuring resistance from stator winding to ground

Check the stator for open windings

This is an optional test. Measure the resistance of each winding. This resistance should be low (probably in the range of 10 ohm or less). The engine service manual should have the wiring diagram for the stator. Single phase systems will just have the 2 wires coming off the stator. 3 phase systems have 3 wires coming off the stator. 3 phase systems usually have continuity between all 3 wires. If a stator winding is open, the stator will need to be replaced to get full power out of the charging system. The measurement is shown in *Figure 4*.

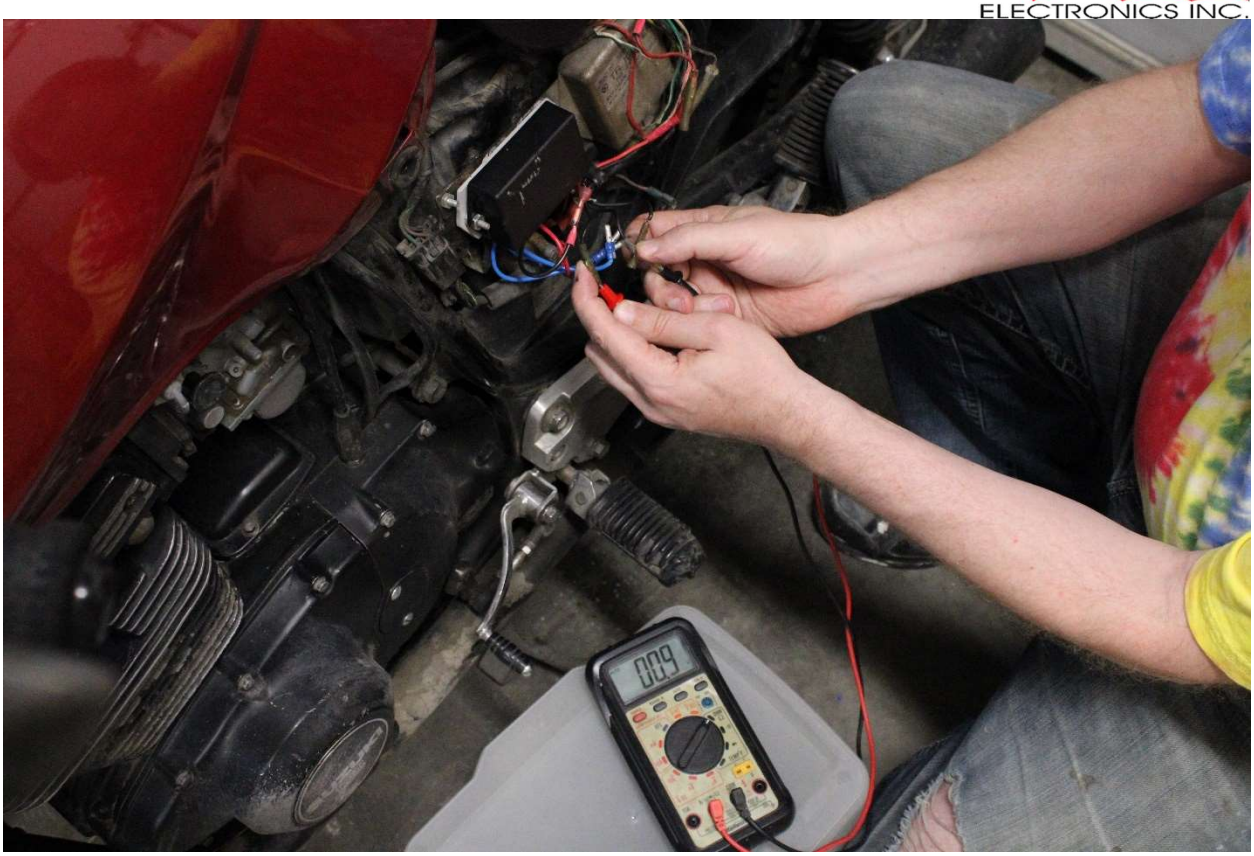

Figure 4 - Measuring the stator winding resistance

Check the stator for shorted windings

This is an optional test. If this fault exists, it can reduce the electrical system capacity. For 3 phase systems, connect an AC voltmeter to each 2 wires. With the engine running at the same speed, the AC voltage on each pair of wires should be the same. If the voltage is significantly low on one pair, then the stator should be checked for shorted windings on a growler.

Drill the mounting plate

A drawing of the mounting plate is shown in *Figure 5*. The area between the two lines are where the screws for attaching the mounting plate to the equipment can be installed. The head of the screws should not go over the line since this is where the regulator sits on the mounting plates. If a screw must be put in this area, a countersunk screw may be used. Locating the holes is shown in *Figure 6*. An alternate mounting arrangement would be to drill the surface where the existing regulator is mounted and then mount the regulator directly to this surface using 8-32 hardware. This will not work in some applications (such as if there are blind holes used to mount the regulator).

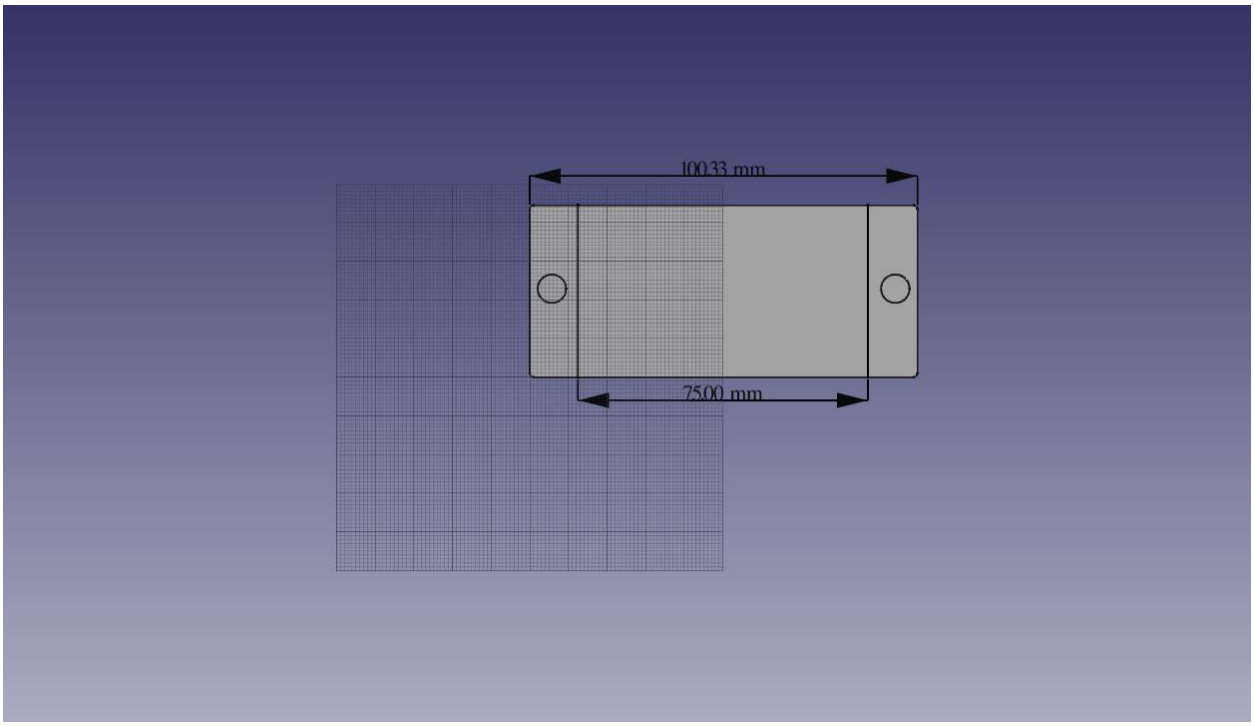

Figure 5 - Mounting plate hole drill area

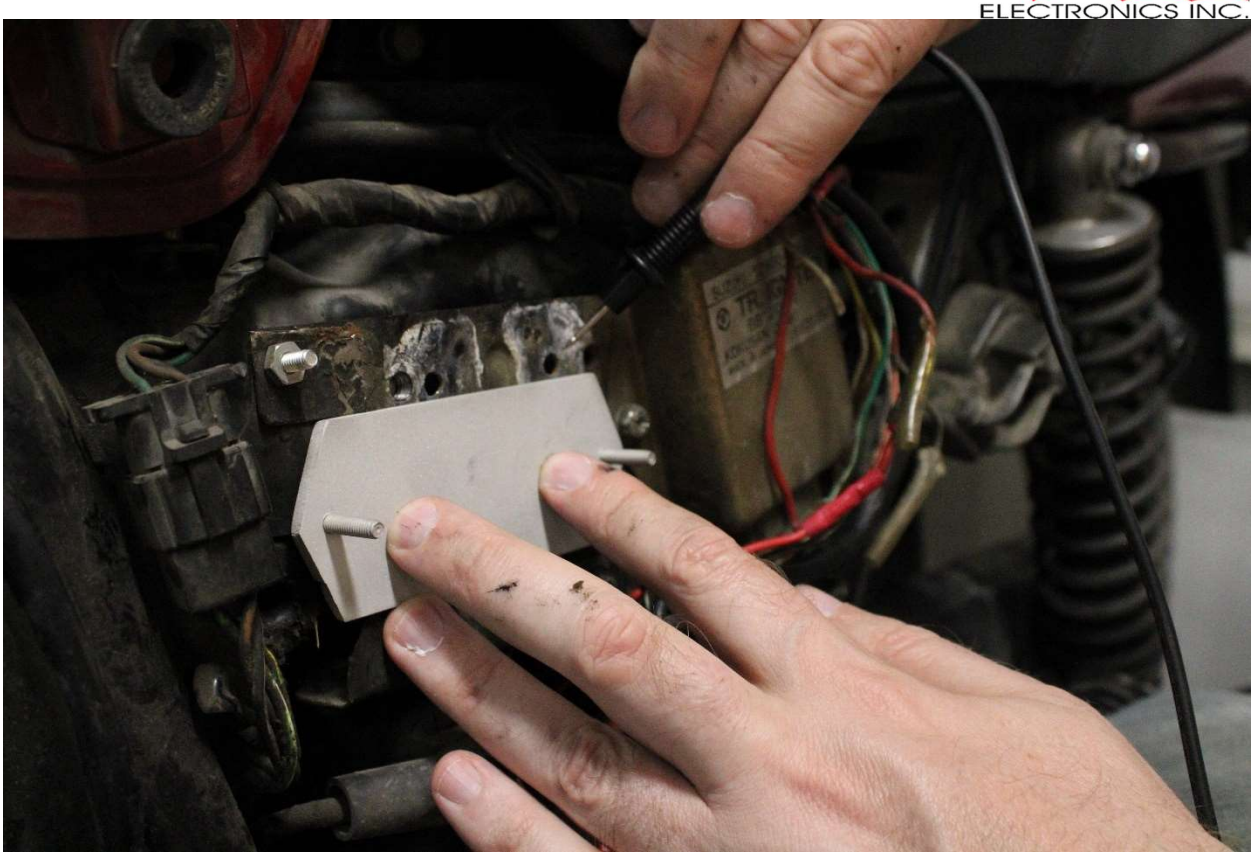

Figure 6 - Locate holes for mounting plate

It is best to use the hole pattern in the vehicle for drilling as the regulators tend to have slots which are difficult to drill.

The mounting plate is aluminum so use good aluminum drilling techniques. This would be:

- Use a lubricant to prevent the bit from overheating and getting dull. A drop of motor oil will work.
- For a precise hole, drill it out first using a small bit and then work up to the bigger bits

For the VREG20 and VREG40 regulators, there is a gap along both edges at the top and bottom that is big enough to bring the wires for the regulator out without pinching them.

For the VREG60, you do need to cut the plastic case for where the wires will enter and exit from under the regulator. It is a good idea to plan on how the wires are going to be dressed prior to wiring up the regulator.

Attach the mounting plate

Once the plate is drilled, it should just be a matter of screwing the plate down in the vehicle. It is worth noting that the thickness of the mounting plate is usually less than the thickness of the original regulator. Make sure this extra length on the screw is not going to impact anything when the plate is mounted. If this is a problem, a shorter screw may be needed. The attached mounting plate is shown in *Figure 7*.

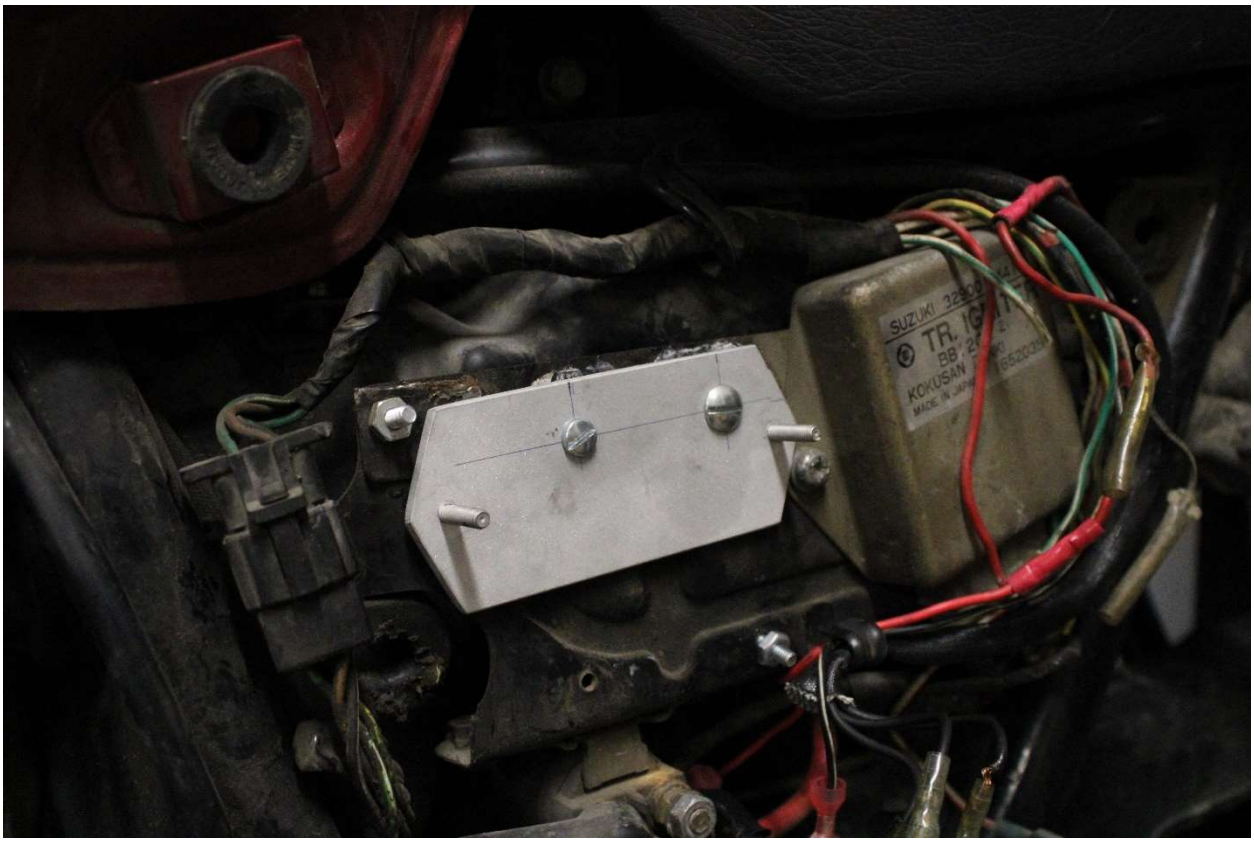

Figure 7 - Attach the mounting plate to the vehicle

Attach the regulator to the mounting plate

The mounting plate has a pair of studs that the regulator case slides onto.

The nylock nut is holding on ABS plastic so a huge amount of torque is not necessary. 5 to 10 in-lb should be sufficient. The flanges should be flat against the mounting plate. The regulator installed on the mounting plate is shown in *Figure 8*.

If extra space is needed between the regulator and the mounting plate (for wires, hardware or other reasons), #8 stainless steel nuts may be used to space the regulator off the mounting plate.

Figure 8 - Attach regulator to mounting plate and connect wires

Connect the regulator

The wiring diagram for the charging system is shown in Figure 9.

There are 5 wires to connect the VREGxx regulators. There is the 3 wires for the stator windings (3 yellow wires), positive output(red) and negative output(black). The stator windings connect directly to the 3 yellow wires. In the picture the proto is using blue wires for the stator. For 2 phase systems(with only 2 wires coming off the stator) the stator connects to 2 of the yellow wires and the third wire should just be insulated and left unconnected. The black connects to the ground on the wiring harness which should connect to the frame or chassis of the equipment. The red should connect to the battery positive right after the main fuse (F1) to the battery. This connection should be after the fuse in case there is any fault in the wiring or regulator, the fuse will blow.

Sometimes there is additional wiring to enable and disable phases on the stator depending on the load (such as enabling a phase when the high beam headlights are turned on). The regulator should just be connected directly to the stator and this additional wiring can be disconnected or disabled. If this wiring is left in the circuit, it will not damage the regulator, but may result in slower charging.

Usually, the connector for the old regulator is not used and can be removed. Quick connects are good option for the connections. Female connectors should be used on the side of the connection that will be live if the connection opens up. The female connectors should be on the stator end of the stator to regulator connectors. The female connectors should be on the equipment side of the equipment to regulator connection. The quick connects should be the right size for the wire in use. This is listed in the specifications. A drawing for the connection is in Figure 9. Quick connects are handy for debugging and repairs. Try to avoid crossing the wires under the regulator as this can prevent the regulator sitting flat (and also placing excess pressure on the wires).

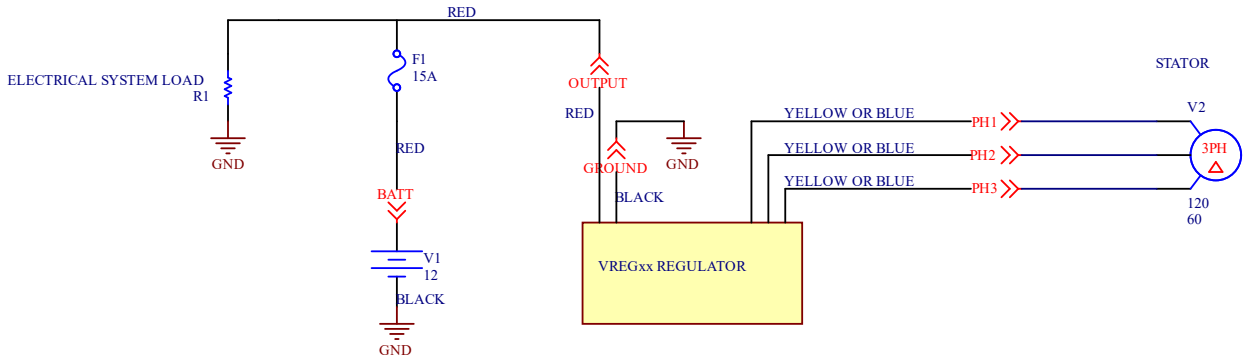

Figure 9 - Simplified schematic of charging system

Model	Male Connector	Female Connector
VREG20	Panduit EBV18-4MB-Q	Panduit EBNF18-4FIB-Q
VREG40	Panduit EBV14-4MB-Q	Panduit EBNF14-4FIB-Q
VREG60	Panduit DNF10-250FIMB-K	Panduit DV10-250-2K

Table 1 - Suggested Connectors

Testing the installed regulator in the electrical system

Testing the regulator requires a few steps.

- If the battery is discharged, then charge up the battery.
- Reconnect the battery to the vehicle electrical system.
- Start the vehicle.
- Measure the battery voltage. At low engine speeds the voltage may be as low as 12.6V.
- Rev the engine to about 1/3 full speed (3000 RPM on the GS400)
- The voltage should go up to 13.8VDC to 14.2VDC.

If the voltage is correct, you are done. Insulate any exposed connections and put the vehicle back together.

If the voltage is low, check over the wiring and make sure the regulator is running cool. Check the battery for shorted cells. The battery voltage should be 12.6V+/-0.6V when fully charged and unloaded. Shorted cells will not damage the regulator, but the battery can build up pressure in the working cells and leak acid through the vent. Replace the battery and test again.

California Proposition 65 Warning

Warning: This product contains chemicals (lead, lead oxide) known to the State of California to cause cancer, birth defects or other reproductive harm.

This warning is included for the reason that the user should safely dispose of unwanted electrical or electronic equipment through the proper electronics recycling processes in the area.

Document Revision

Revision	Change
1.0	Initial release
2.0	Moved section on sizing regulator to “how do I tell which regulator to use”, small edits made.
3.0	Added prop 65 and recycling information