How do I tell which regulator will fit my engine/vehicle

There are different types of electrical systems in use on small engines. The descriptions are for motorcycles but they are common for other small engines. Here is how to identify what kind of electrical system you are dealing with.

1950s and 1960s

The electrical systems for these vehicles were mainly AC systems. These have a flywheel generator and no rectifier regulator on the system. They may have a battery to power some of the signal lights. They tend to be kick started. Usually the battery is charged using a trickle charger fed from a selenium rectifier to keep the battery topped up. These regulators do not work on this type of system. The flywheel generator may not be able to stand the current induced in the windings when the regulator shunts it.

1970s

These systems have a bridge rectifier and regulator circuit as separate modules. They are single phase systems and do not have any sort of regulator. They rely on the battery being able to be refilled as the water in the electrolyte breaks down into oxygen and hydrogen.

1980s to Present

These systems can be 2 phase or 3 phase systems. They may have a combined rectifier/regulator or separate rectifier and regulator modules. These systems will work with the VREGxx series of rectifier/regulators. They have a stator with the windings on it and a permanent magnet that creates the moving magnetic field to induce energy into the windings. The VREGxx series replaces both the rectifier and regulator.

The VREGxx series of regulators can be used on flooded lead acid battery systems. Using the VREG series of regulators requires that the battery be changed to sealed lead acid (SLA). You will then get the advantages of a sealed lead acid battery.

The other type of system in use is an alternator type of design where the regulator feeds a field winding in the alternator. The output from the stator goes to a rectifier to provide DC for the rest of the electrical system. This system is more complex but also is capable of much higher output powers which is why it is used for automotive electrical systems. The magnetic field that can be created by an electromagnet is much higher than the field from a permanent magnet. The VREGxx regulator cannot be used in this type of electrical system. It can be identified by looking for the field coil connected to the regulator. If there is a field coil, this is an alternator type of generator which will not work with this regulator.

If you have any questions please submit a query to see if the regulator will work with your engine. We will need the make, model and year of the equipment. If you have the wiring diagram for the equipment, it would also be helpful.

Determination of the required regulator size

Since you might be replacing a regulator that is defective, it is sometimes not possible to measure the current on the output of the regulator. A simplified schematic of a typical vehicle electrical system is shown in *Figure 1*.

The schematic is simplified because some vehicles have switches on some of the phases and the system load is just represented by a resistor.

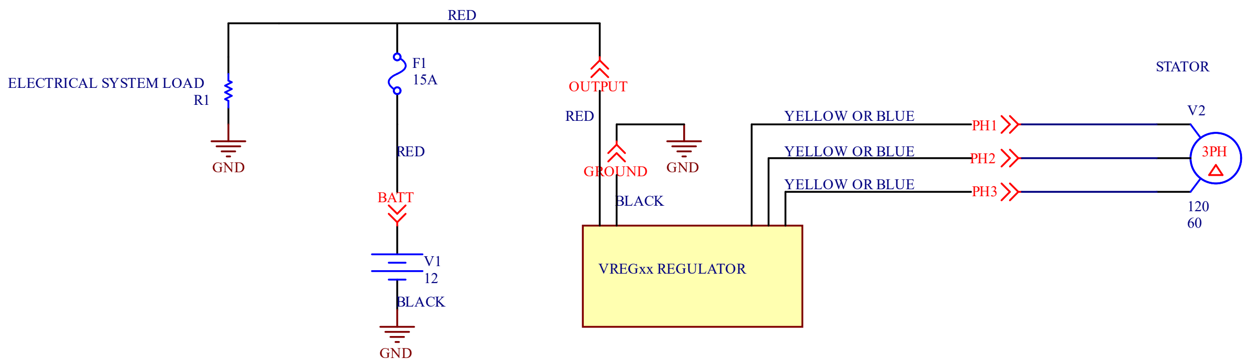

Figure 1 – Simplified schematic of the vehicle electrical system

There are a few methods to determine what the regulator current will be. These are:

- Measure the actual load (current through R1)
- Estimate the load from the main fuse size (F1 rating)
- Estimate the load by adding up the loads in R1

Measure the electrical system load.

If the engine can be started and run without the regulator, it is possible to perform the following steps:

1. Connect an ammeter or DC current clamp in series with the main battery fuse. It is important to note that many current clamps do not measure DC.
2. Turn on the ignition and start the motor.
3. Measure the current from the battery into the electrical with all of the loads turned on.

This should give you a current for the regulator. Add a few amps for battery charging. On the example vehicle (1983 Suzuki GS400) this current measured 5.35A. Adding a few amps for battery charging, the load will be just less than 10A. Next compensate for the battery voltage being lower than the operating voltage by adding 20%. A 20A regulator will comfortably work in this application.

Estimate the load from the main fuse size

The main fuse will be sized big enough that it will not blow out on starting the engine on a hot day with all of the loads on. Usually this derating is about 50%. In the case of the example vehicle, the fuse is rated for 15A, so the maximum load would be about 10A. A 20A regulator would be big enough.

Estimate the load by adding up the loads

This works fairly well for electrical systems where the load is just a bunch of light bulbs. For the example motorbike, there are the following loads

Load	Wattage
Head Light	60
Tail Light (maximum, includes break light)	27
Turn Signal	12
Instrument cluster	5
Ignition system (estimate)	5

For a total wattage of 109W or 9A. Add some margin (about 20 to 30%) for voltage (bulbs are rated at 12V, normally operating at 14V). This puts the load at 10.8A so the 20A regulator should suffice.

Things do get hard to predict when there is fuel injection, stereos, heaters or other non static loads on the electrical system. If you plan on using extra loads then add some extra capacity for these. It is important to note that the power and current available is usually limited by the stator design.

Capacitive Discharge Ignition Systems

This is a modification on the standard stator/flywheel system as there are additional windings added to the stator and the flywheel can have additional magnets imbedded in it. These additional windings and magnets are used for detection of the position of the engine. These windings are not usually connected to the regulator but will be connected to a capacitive discharge ignition (CDI) system. The windings you need to connect to this regulator are the high current alternator windings. The other windings connecting to the CDI remain unchanged. It just means that you have additional wires from the stator.

AC regulator systems

These electrical systems are not very compatible with VREGxx series of regulators. These electrical systems usually only have a single phase stator and are usually low powered. There is no rectifier on the main load of the system (hence AC system). The regulation action is provided by a small circuit which acts like a high powered zener diode that clamps the stator voltage to +/-12V (approximately). Usually the case of the regulator is tied to ground of the electrical system. The main drawback with this system is that it wastes a lot of power in the zener diode circuit. The output power of the stator is proportional to the engine speed so at low (idle) RPM, the lights may flicker, but at high engine speeds, the regulator dissipates more power than the load uses. It is quite common to have a single wire from the stator to the regulator and rest of the electrical system. Having a ground point on the stator side of the rectifier/regulator makes it difficult to fit the VREGxx regulators.

The other problem with trying to fit the VREG regulator into this type of electrical system is that some electrical systems use the phase information from the stators for ignition timing.

These electrical systems are common for engines with pull starters.

Document Revision

Revision	Change
1.0	Initial release
2.0	Added AC regulator systems(info) and capacitive discharge ignition systems