MOTOLECTRIC

Motorcycle Technology Overview

~*The Charging System*~

Alternator / Rectifier / Voltage Regulator

Motorcycles are supplied with regulators with two different circuit designs, **SHUNT** and now **SERIES**.

The SHUNT design has been in use for decades, and chances are your bike has a SHUNT regulator.

The newer design is the SERIES regulator.

Bi-Polar Shunt Voltage Regulators / MOSFET Shunt Voltage Regulators

During the run of the SHUNT regs, a change was made to move from Bi-Polar transistors to MOSFETs.

A MOSFET is a ~**M**etal **O**xide **S**ilicon **F**ield **E**ffect **T**ransistor~.

It is a more sophisticated transistor and offers many benefits.

Shindengen was the first company to supply MOSFET regulators that could be fitted to a motorcycle.

In the last 8-10 years, riders have been encouraged to buy and fit a Shindengen MOSFET regulator.

Drawbacks to moving to a MOSFET regulator have been the higher price (for a quality Shindengen unit) and the fact that since the MOSFET regulator design was originally developed for 4-wheel off-road vehicles which have higher output alternators, Shindengen used an elongated shape for their heat sink (with more finning) in order to be able to dissipate the higher level of heat. So, on most motorcycles, an adapter plate is needed to get the reg mounted up.

Another issue is that they also chose to use a different wiring configuration relative to the normal motorcycle style connectors, (in order to handle the higher current flow), which usually results in the requirement that an adapter cable be used to interface to the bike harness.

On most motorcycles, neither of those changes would be required in order to handle the output of a motorcycle alternator. So, these expensive hassles are not really a requirement to properly service a motorcycles electrical system.

The higher cost of the reg and the need for an adapter plate and adapter cabling have resulted in the MOSFET regs being somewhat expensive relative to the Bi-Polar designs.

(Unfortunately, there are now cheap Chinese knockoffs of the Shindengen MOSFET reg, and they copy the heatsink shape to fool people into thinking the knockoff has the same quality and capability - **Heads up!** - **they are not the same quality**.)

Series Voltage Regulators

The newest regulator circuit design is the SERIES which is a different circuit type. The Shindengen MOSFET regs that have been recommended over the last few years are the same circuit design as Bi-Polar regs, (but they use a better type of transistor).

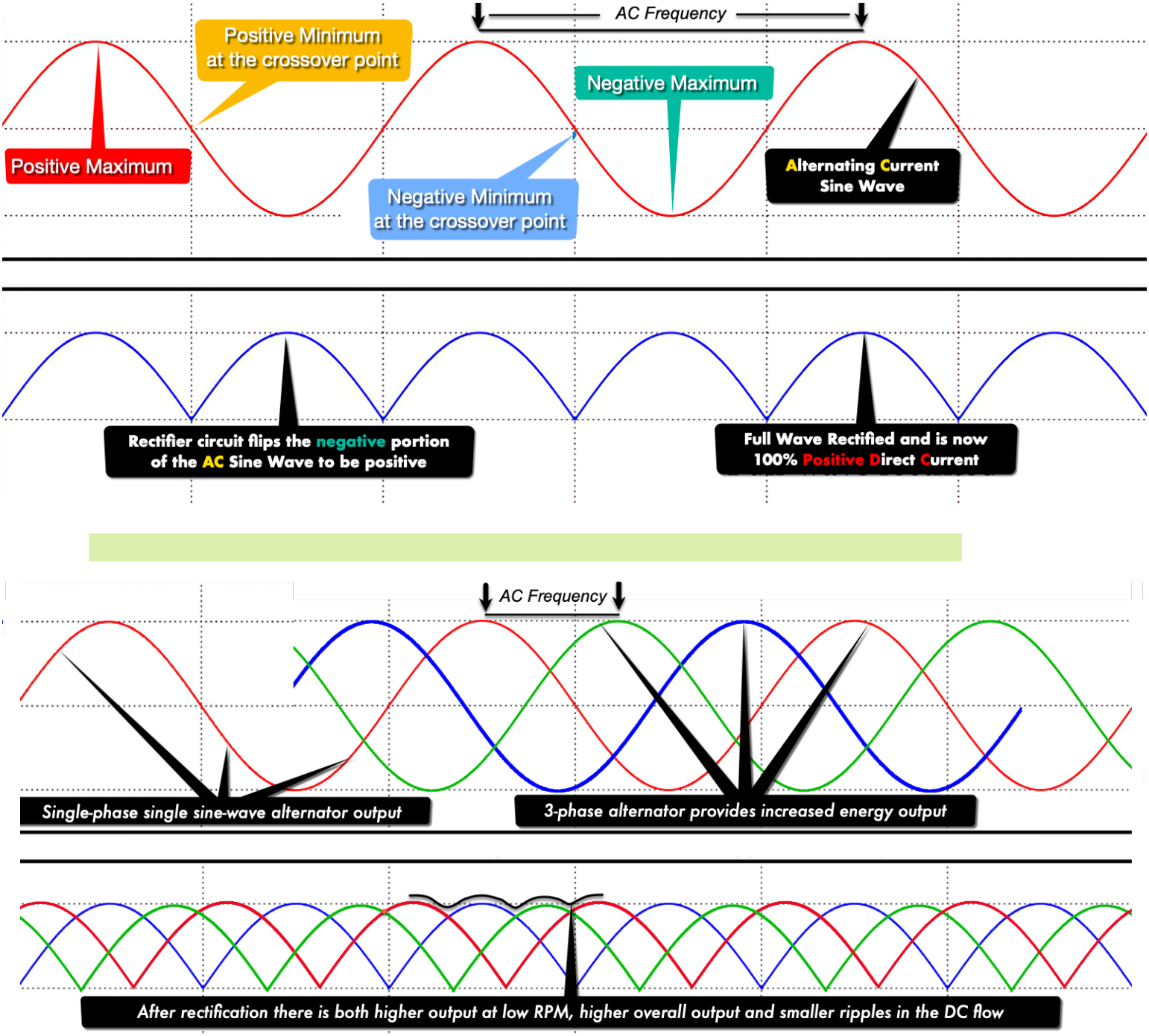
They both control the voltage using the same SHUNT method.

The new Shindengen SERIES regs also require the adapter plate and cable, so the costs of a new Shindengen SERIES reg has been in the $250+ range. And these are usuallly not Plug&Play but sold as a kit that the buyer has to assemble themselves, requiring a decent crimping tool (and the knowledge on how to use it properly). So, many riders just put off upgrading their voltage regulator (as in, if it's not broken, don't fix it). ***But OE Bi-Polar SHUNT regulators are possibly the most failure prone component on a motorcycle.***

Here's how the alternator/rectifier/voltage regulator system works -

(**AC** refers to alternating current, it alternates between positive and negative energy, **DC**, the direct current system, is always 100% positive energy)

A voltage regulator *for a motorcycle* is actually two circuits in 1 case, a rectifier circuit that turns the AC into DC and the regulator circuit which controls the level of the DC voltage and the amount of current that flows to the bike electrical system.



On a motorcycle with a SHUNT-type reg, the alternator's output is controlled solely by RPM.

Depending on the alternator design (single-phase or 3-phase, number of coils, etc.), the alternator will usually reach maximum output somewhere between 2,000 and 3,000 RPM.

The AC output voltage of 40-70 volts and frequency of the AC (how often it switches from positive to negative) will vary with RPM.

That AC energy arrives at the rectifier side of the regulator circuit, and the rectifier takes the negative portion of the sine waves and flips them positive.

Now we have a slightly bumpy all-positive DC flow of energy.

(in electrical parlance, any component in an electrical circuit that uses electricity is referred to as a consumer; lights, ignition, fuel pump, etc.)

The voltage regulator portion of the circuit constantly monitors the needs of the motorcycle consumers and adjusts the available voltage and current to match the needs.

Turn on your high beams? The system needs more energy, flip on the turn signal, it needs more energy but intermittently, etc.

Since the alternator may max out at 350-450-550 watts and at any point in time, the system may only need 125-225-300 watts, the regulator SHUNTs the excess energy to ground to balance the system.

The point here is that the alternator and the regulator must deal with 100% of the energy, even if the system only needs a portion of that total output.

Now, while doing this balancing act, the regulator circuit is trying to maintain a set voltage of approx. 14.5 V +/- .2 V.

And so it has a narrow target window.

A MOSFET SHUNT regulator does all of the above with some improvements;

1) the **MOSFE T**ransistors in the rectifier circuit will turn all the way off when the sine waves cross the point from positive to negative.

Bi-Polar transistors have a small point near the crossover where they do not go all the way down to zero.

You could say they drop to an idle but not 100% off. That idle still creates heat which robs most SHUNT regs of their total output.

A 350-watt reg may actually only deliver 300 watts at maximum output, the other 50 watts was lost as idle current heat.

2) the MOSFET will be able to stay closer to the target of 14.5V due to its faster switching capability.

3) because the MOSFET is not generating the excess heat from the idle current (as in the Bi-Polar version), that lost energy (approx. 50 watts) is now available, so the system can now deliver closer to its full rated output.

4) the recovered power usually allows a MOSFET reg to charge the battery at idle, whereas a Bi-Polar reg will usually need to get up closer to 2,000 RPM to be able to recharge the battery after starting the bike.

5) due to the above, a MOSFET reg tends to run cooler, and since heat is the cause of electrical circuit deterioration and failures, MOSFET regs tend to be more reliable than Bi-Polar units.

SERIES Voltage Regulators

The SERIES regulators do things differently.

Whereas with the SHUNT design, the alternator output was controlled solely by RPM, the SERIES regulator tries to balance the system by turning off (disconnecting from) the alternator to control its production.

The alternator cannot create current flow if the circuit is open (not connected up).

The SERIES reg is sensing the needs of the consumers at all times at the millisecond level.

If the output of the alternator exceeds the needs, it disconnects from the alternator, and during that time, no energy is created, and no heat is generated.

This connecting/disconnecting is done at the milliseconds level (it is imperceptible to you, the rider).

So, instead of receiving 450 watts and shunting 225 to ground, the SERIES reg controls the circuit so that the alternator to rectifier/regulator circuit is only connected up enough time to create the needed 225 watts.

Everything is better; the stator is creating less energy, so it runs cooler, and since the reg only has to flow the wattage needed by the consumers, it also runs cooler.

The SERIES regulators all use MOSFETs as their ability to switch quicker than any other affordable transistor makes them perfect for the job.

New Voltage Rectifier / Regulators from Motolectric

Motolectric now offers a **SERIES** regulator that is the same size and uses the same mounting as the OE Ducati regulators.

It has the proper mating connectors to plug right into the bike harness.

It is built using **MOSFET**s, can handle **50 amps**, and is the highest-performance regulator currently available.

Completely 100% Plug&Play, 2 bolts, 2 polarized connectors and you are done;

List Price $209 / $169 HICAP·SCDC Bundle Price / Free Shipping - When Ordered in Bundle

You can ***easily*** install a state-of-the-art SERIES voltage regulator in a few minutes with 2 bolts and 2 polarized, color-coded connectors.

Upgrade your system for higher performance and reliability - (***experienced rider tip***) - stash the existing *known-good-working* OE reg on your bike as your on-bike backup. ***Any*** regulator can fail (and when they fail on a ride, it is always an expensive and time-consuming hassle).

Reduce the heat load on the stator, extending its life (stators are +$180 for most bikes + a major hassle to change out)

Recharge the battery faster after starting and keep it fully charged more efficiently in stop-and-go traffic.

Recoup approximately 50 watts in all systems, (especially beneficial on low-wattage single-phase systems)

Enjoy each ride with more confidence!