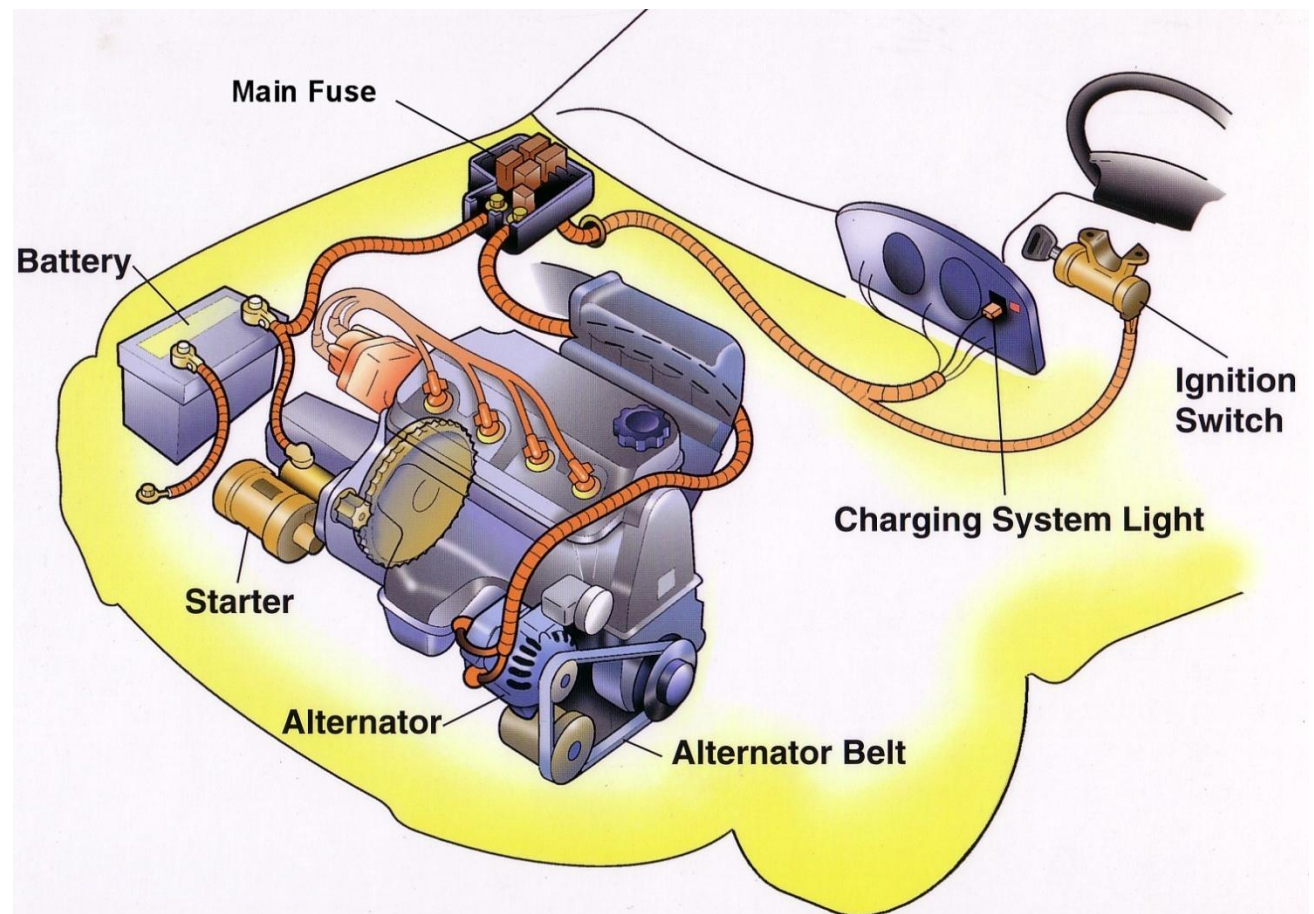


ATASA 5th Charging Systems

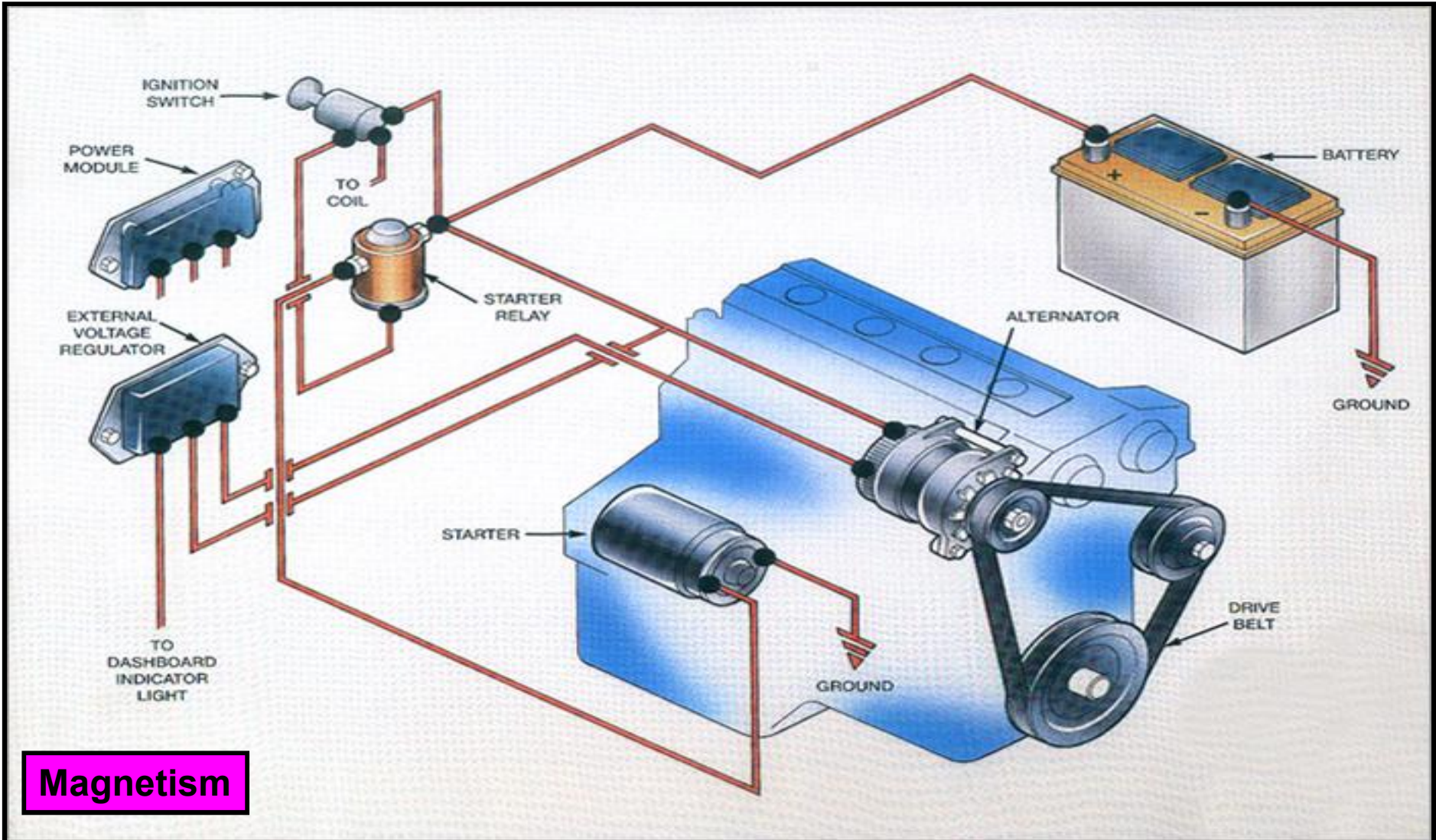
ATASA 5TH Study Guide
Chapter 19 Pages 571-595
Charging Systems
42 Points

Please Read The Summary



ATASA 5th Charging Systems

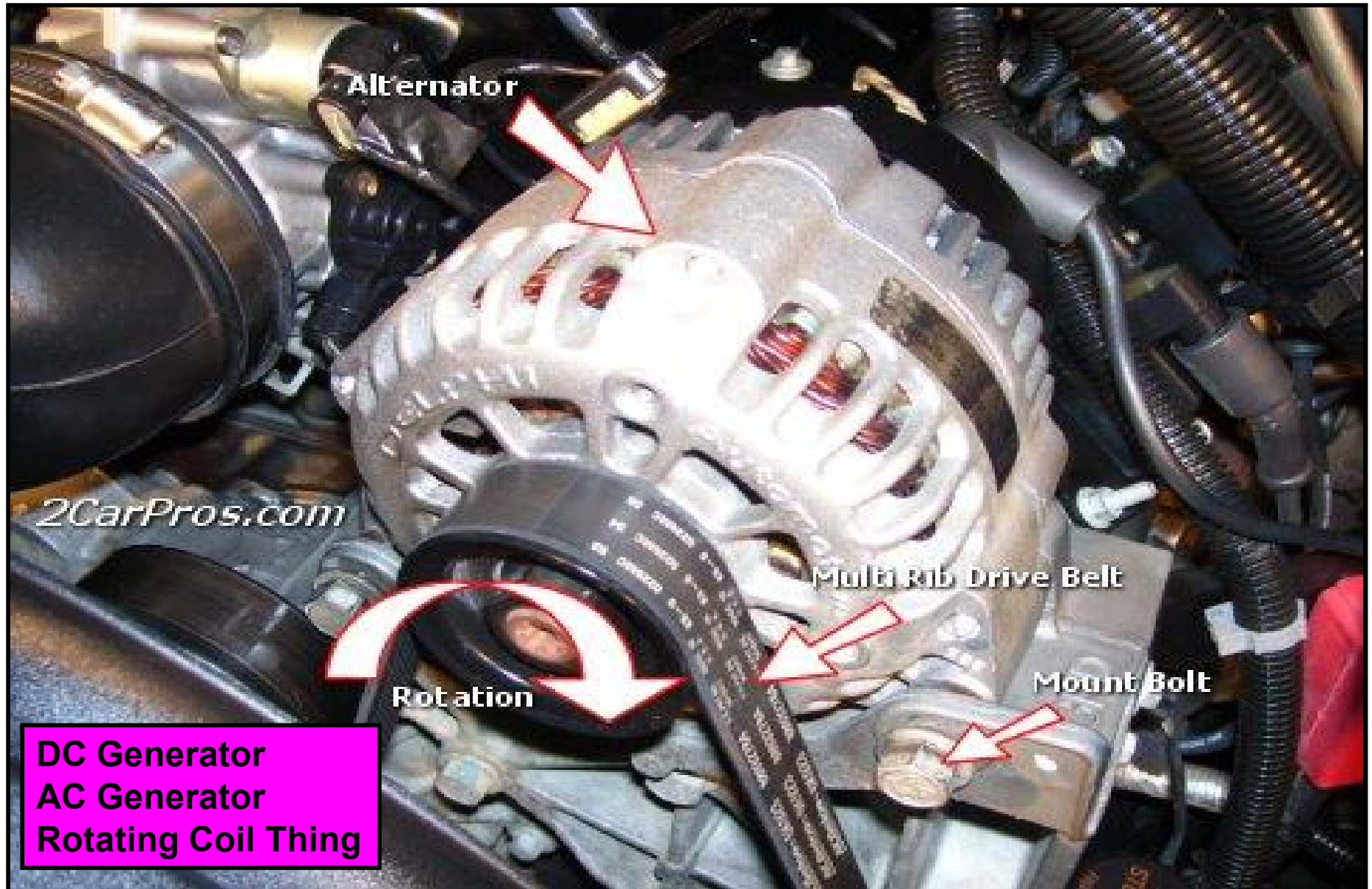
2. Using principles of _____ and *induced voltage*, a low amps charge (compared to starter draw) also meets the current demands of all loads in the electrical system with the engine running.



Magnetism

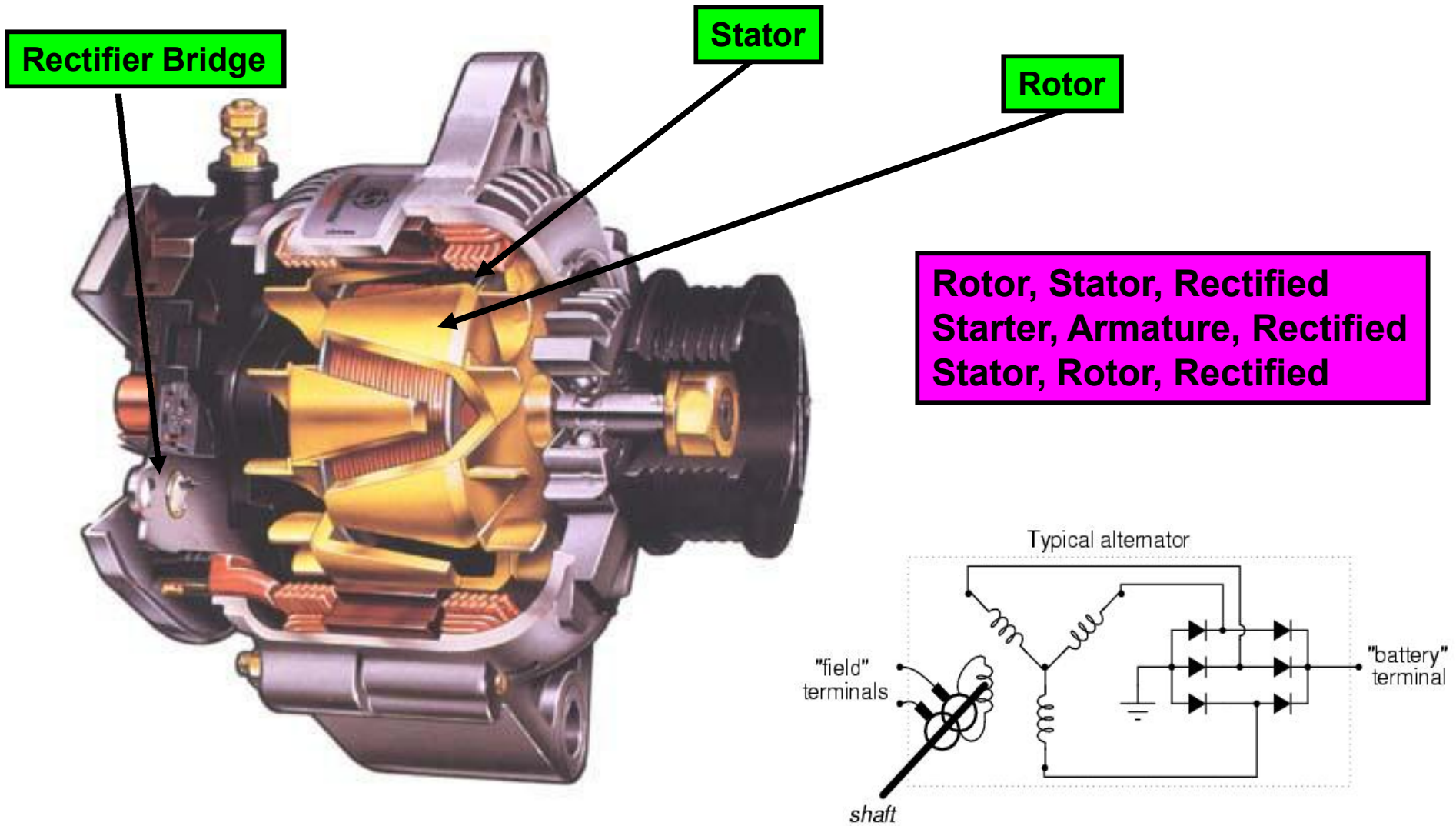
ATASA 5th Charging Systems

3. The **OBDII terminology** for the alternator is _____.



ATASA 5th Charging Systems

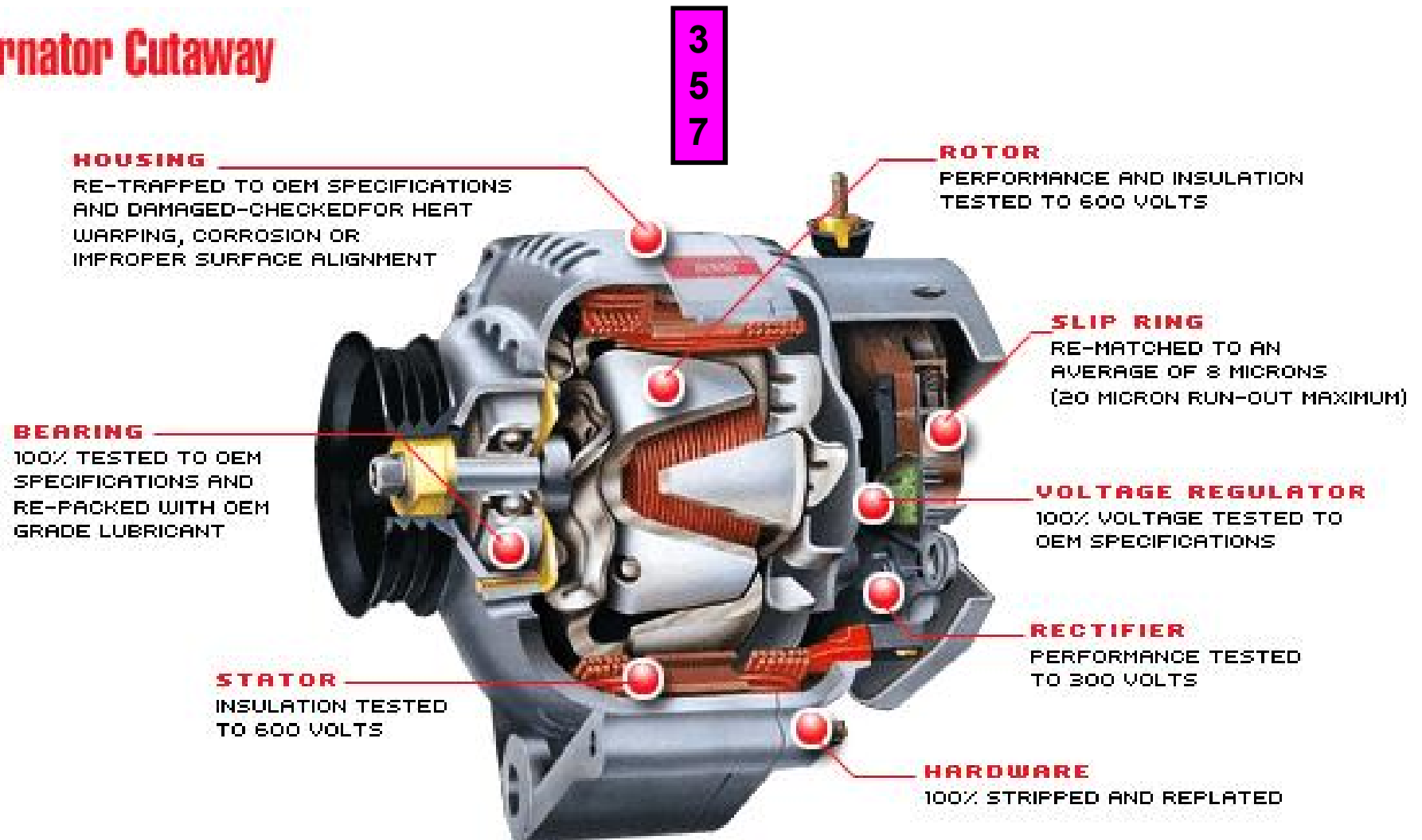
4. An alternator spins *electromagnetic fields* of the _____ past coils of wire in the _____ to create AC voltage which then needs to be _____ to DC by a bridge of diodes.



ATASA 5th Charging Systems

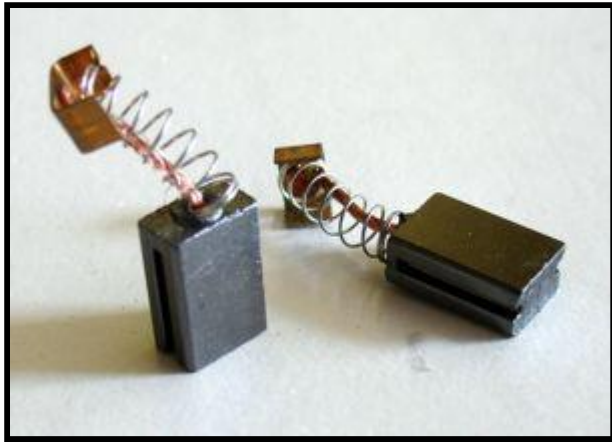
5. A typical rotor has ____ north magnetic pole pieces & ____ south magnetic fingers for a total of 14.

Alternator Cutaway

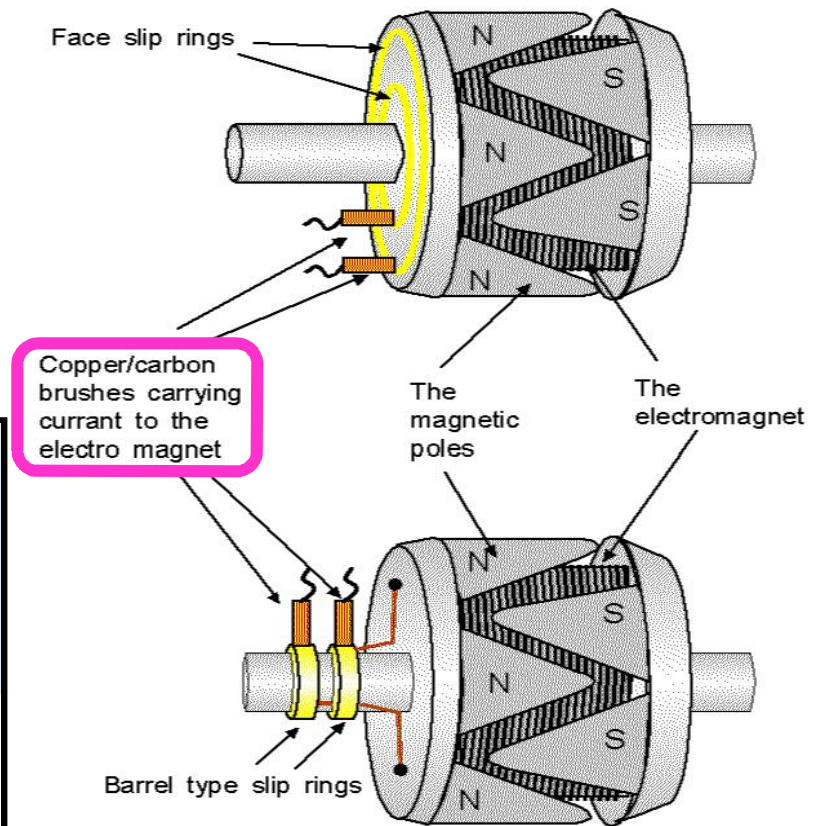
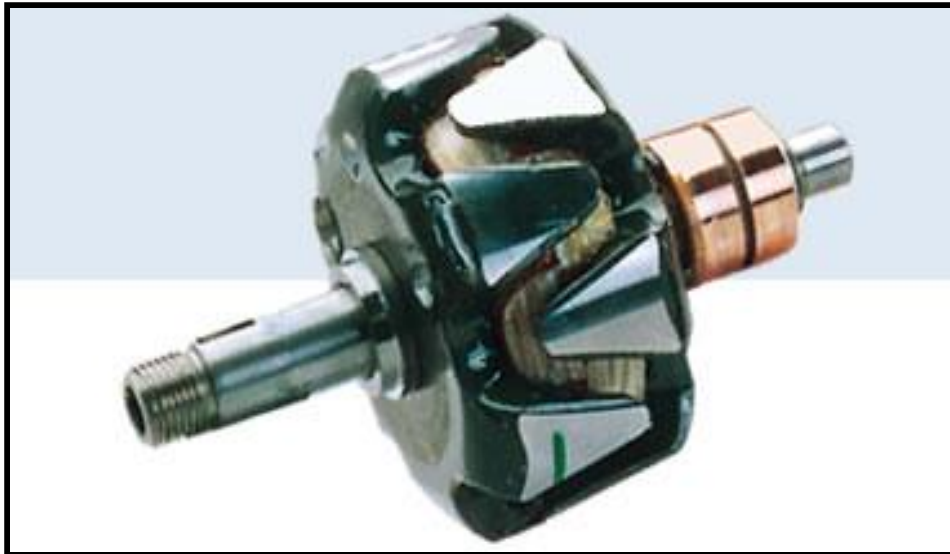


ATASA 5th Charging Systems

6. Rotor magnetic field strength is controlled by varying the current supplied through the _____ and *copper slip rings*.
Either the voltage regulator or the PCM is responsible for this control.



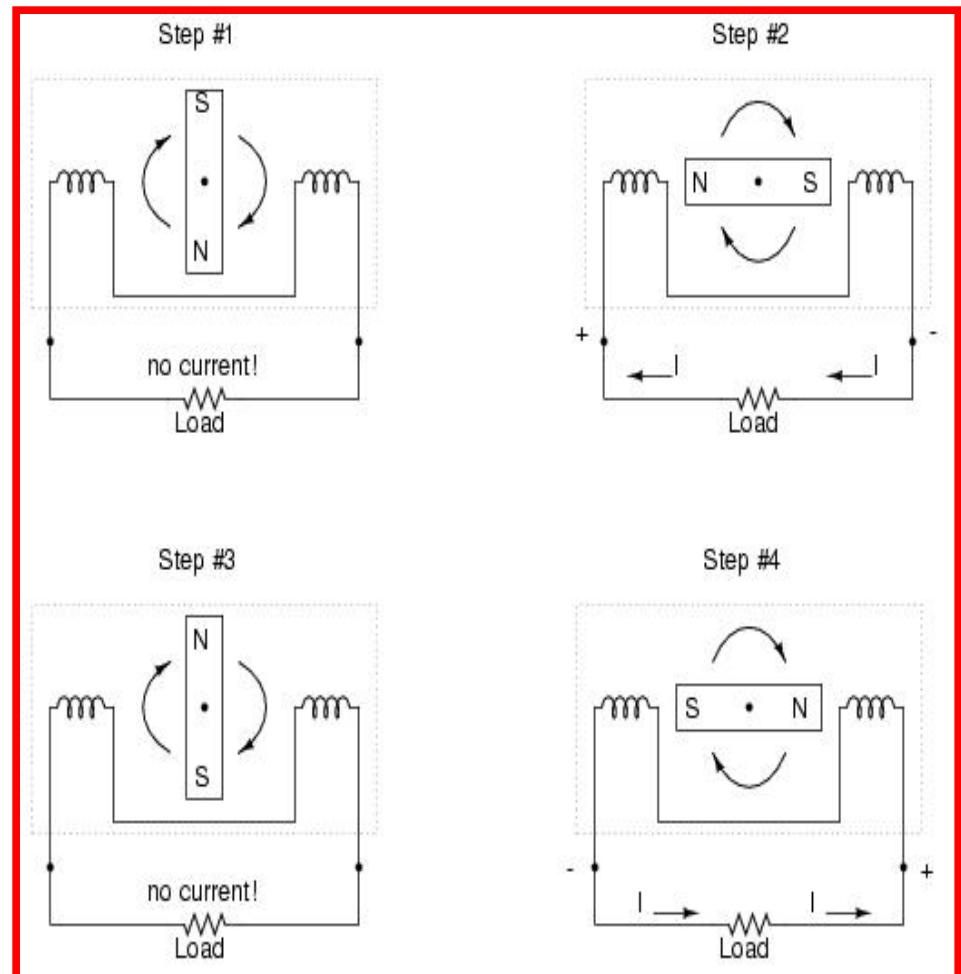
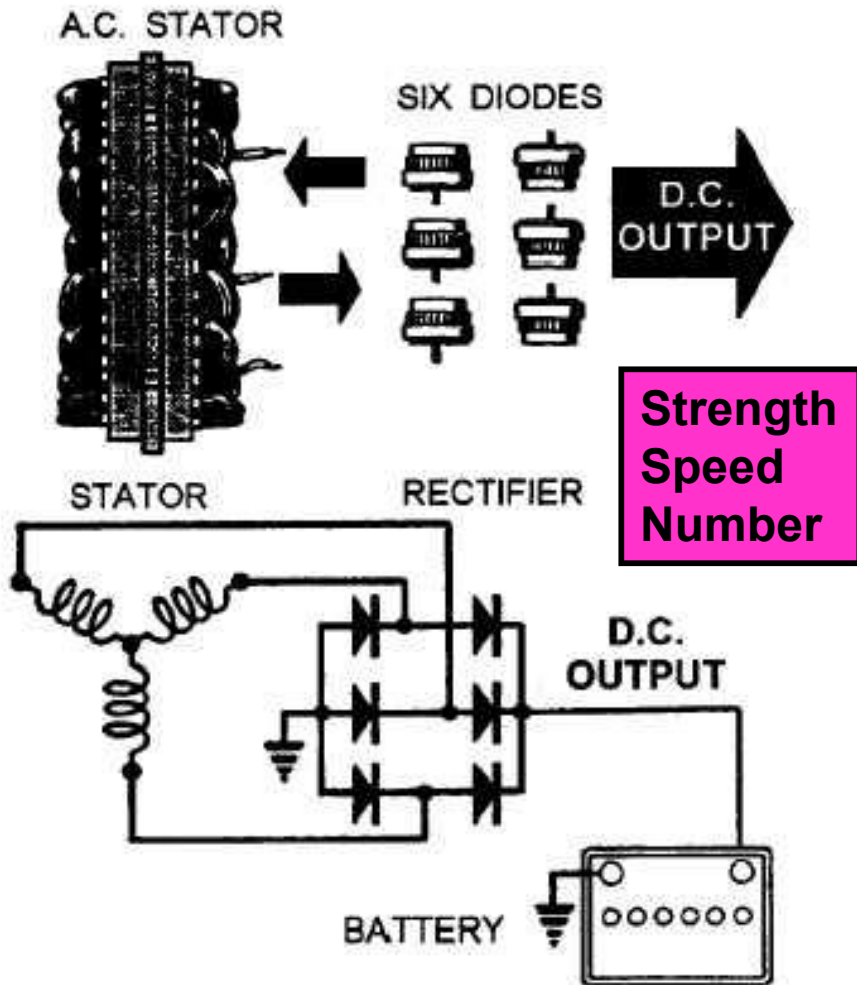
**Brushes
Bushes
Bushings**



T
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ATASA 5th Charging Systems

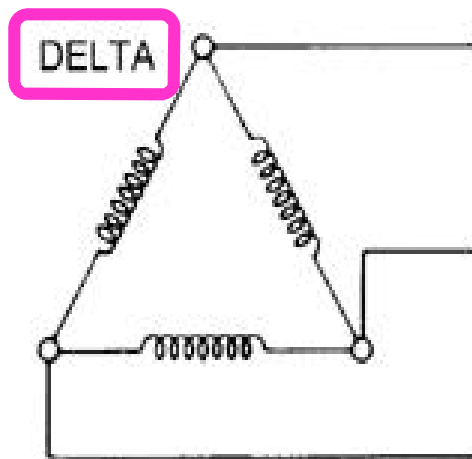
7. Magnitude of *induced voltage* depends upon the _____ of the magnetic field, the _____ at which the magnetic field is cut through, the _____ of conductors, and how close the conductors and magnetic fields are to right angles to one another.



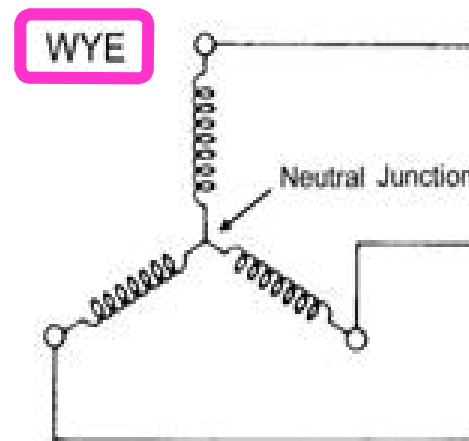
ATASA 5th Charging Systems

8. **Stators with 3 windings are either ___ wound for high amp output @ high speeds or ___ wound for high charging voltage at low engine speeds. Three-phase voltage is the output.**
Three-phase voltage is the output.

Stator Designs



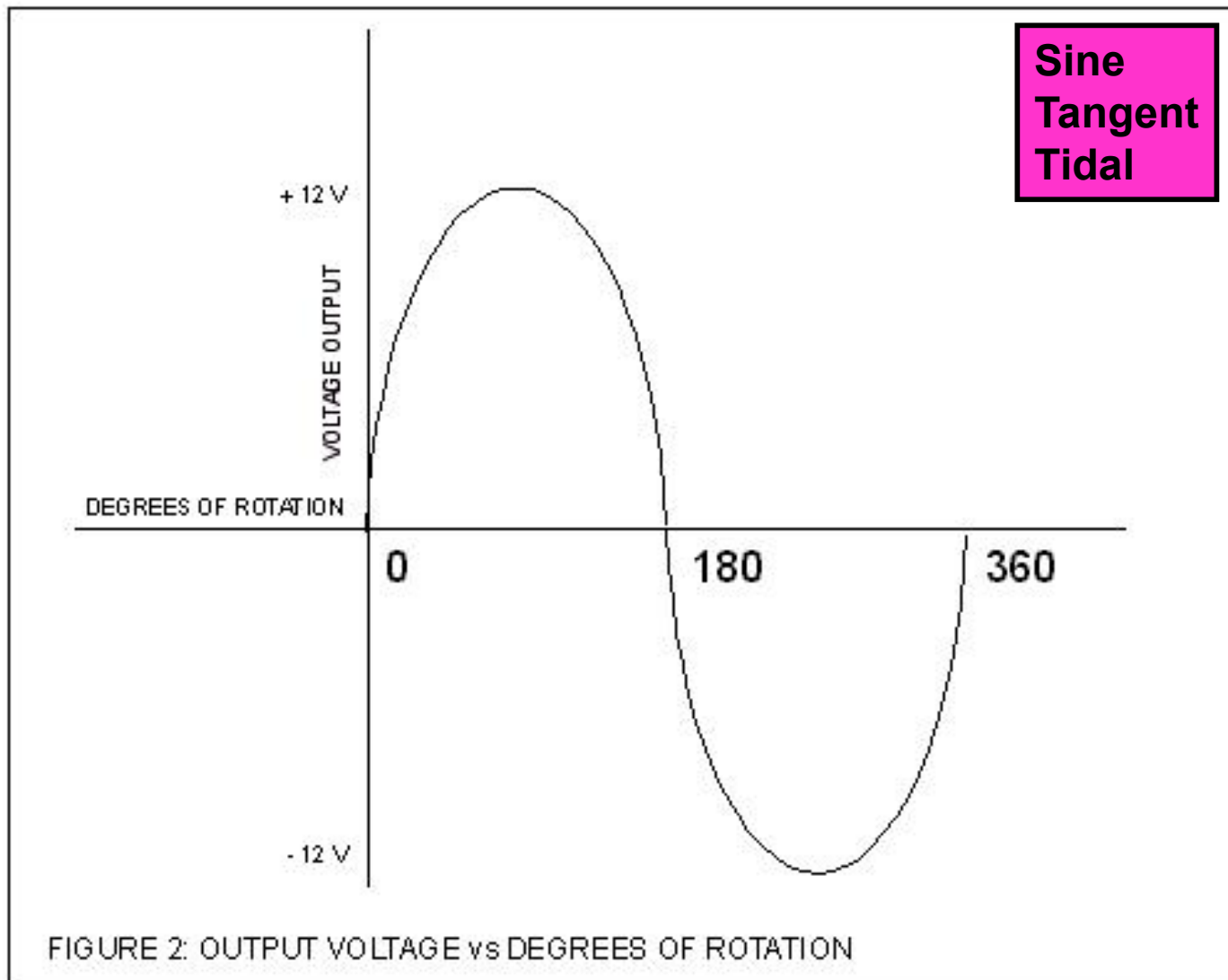
Delta wound stators can be identified by having only three stator leads, and each lead will have the same number of wires attached.



Wye style has four stator leads. One of the leads is called the Neutral Junction. The Neutral Junction is common to all the other leads.

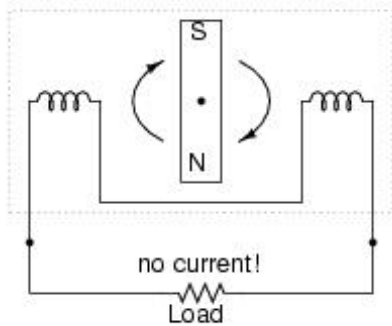
ATASA 5th Charging Systems

9. The positive & negative charging pulses produce a _____ wave when viewed on an oscilloscope.

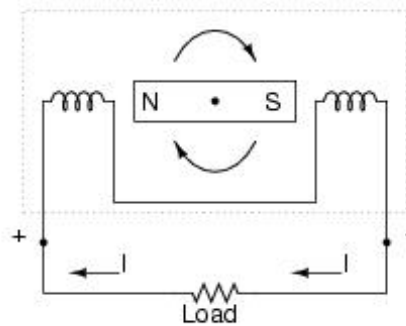


ATASA 5th Charging Systems

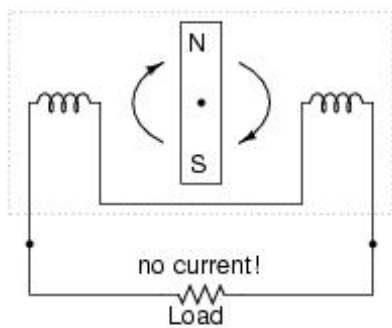
Step #1



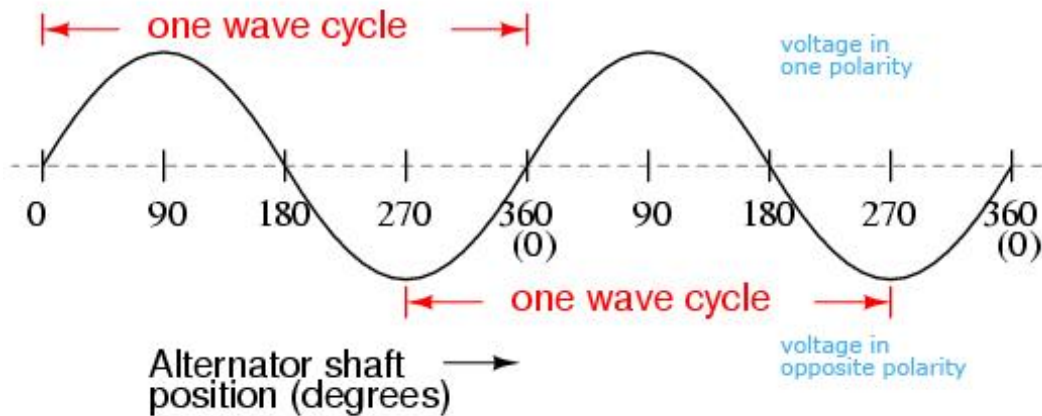
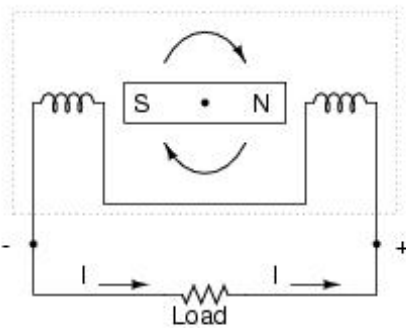
Step #2



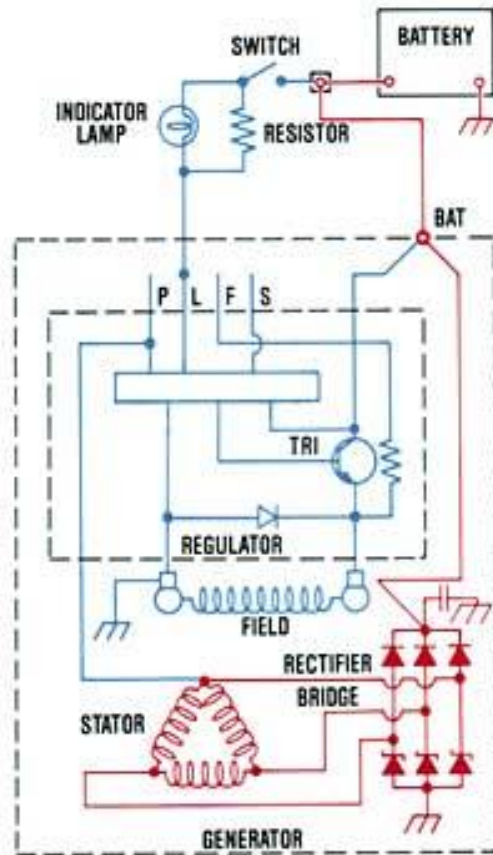
Step #3



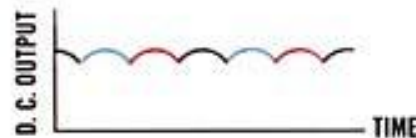
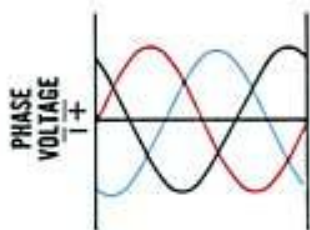
Step #4



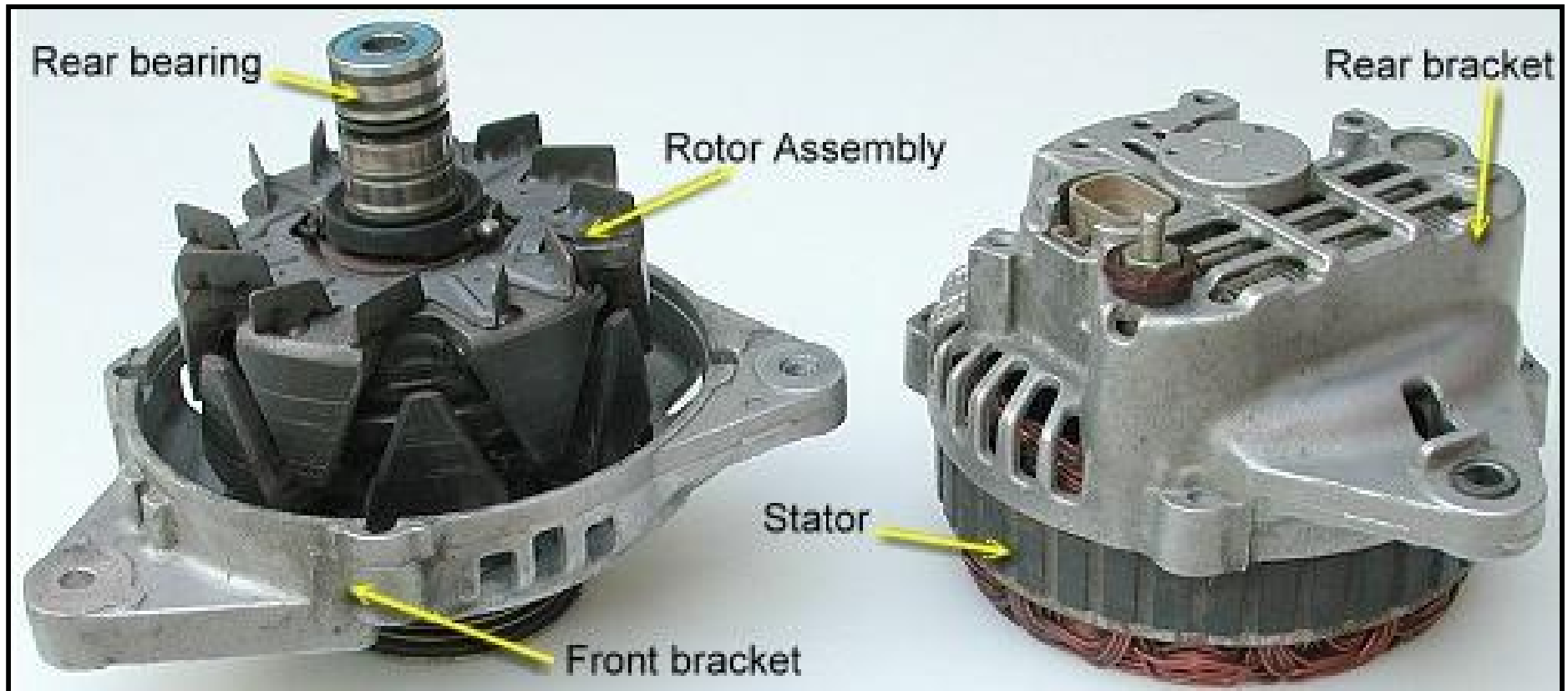
ATASA 5th Charging Systems



3-Phase AC Input + Rectifier Bridge = DC Output

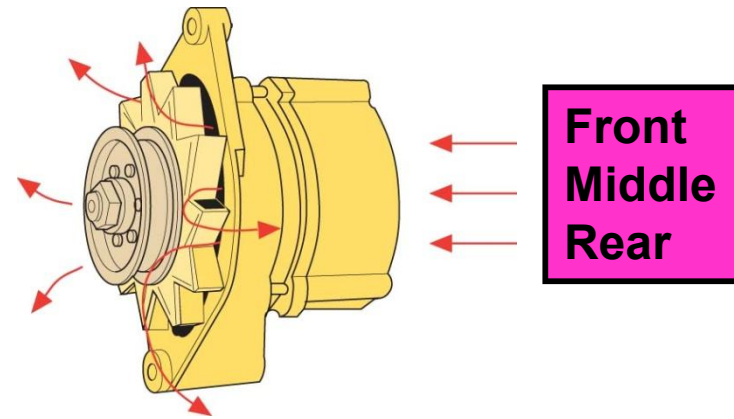
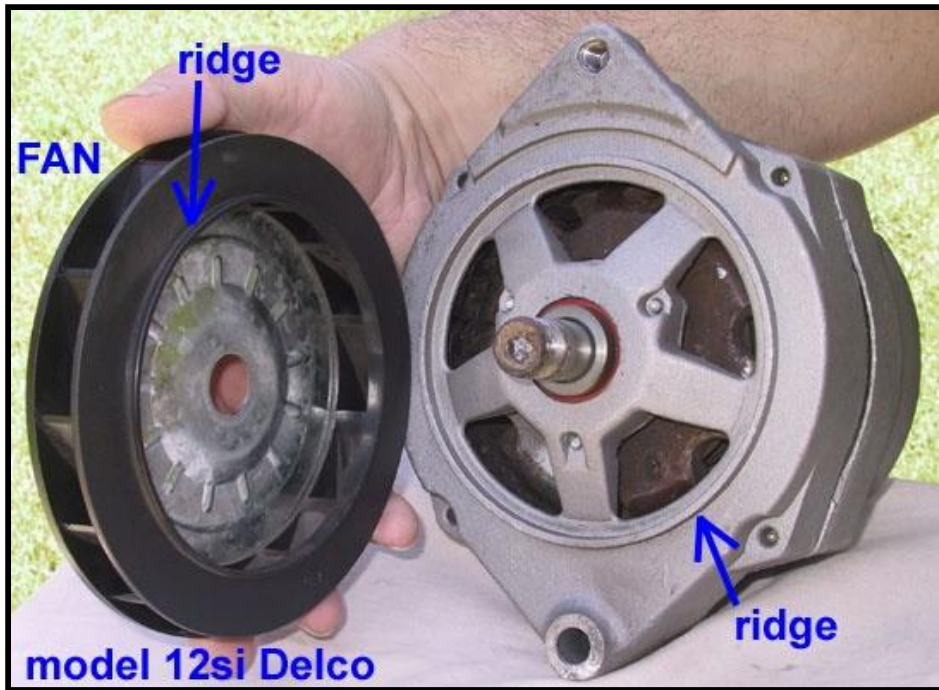


ATASA 5th Charging Systems



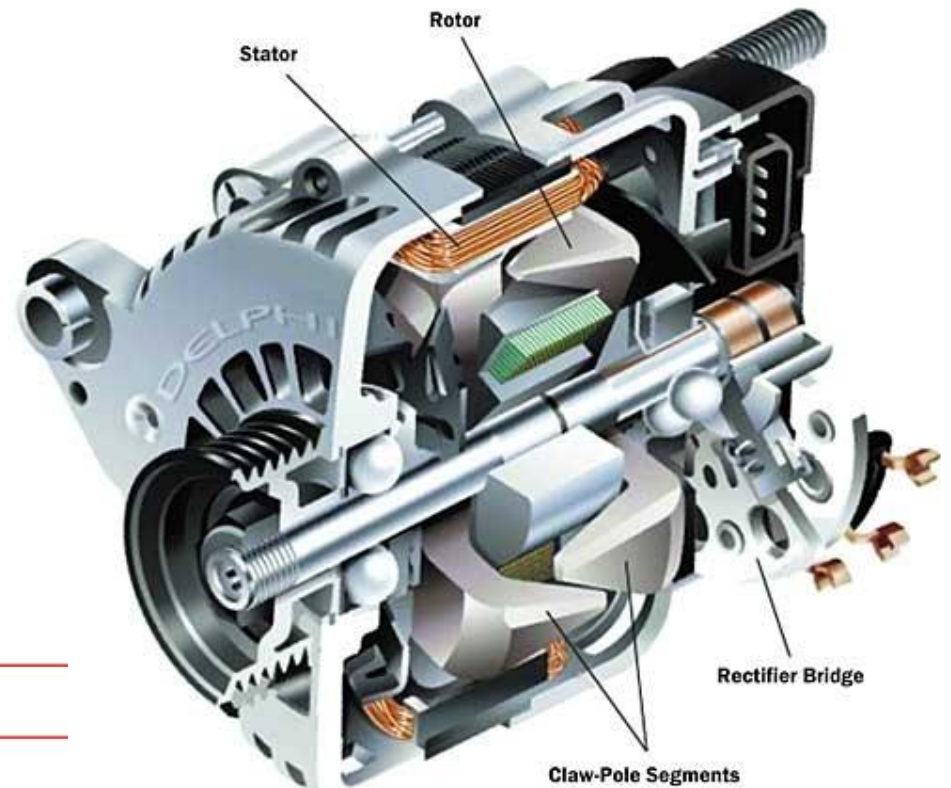
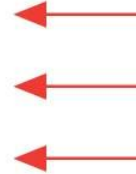
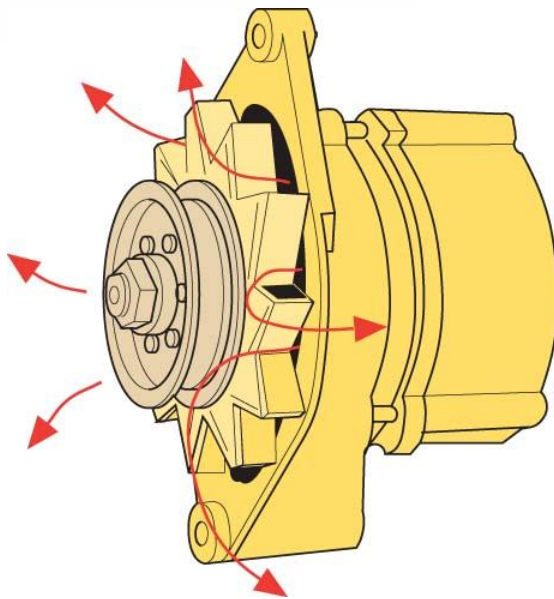
ATASA 5th Charging Systems

10. The fan draws air through from the _____ of the alternator to cool the diode heat sinks.



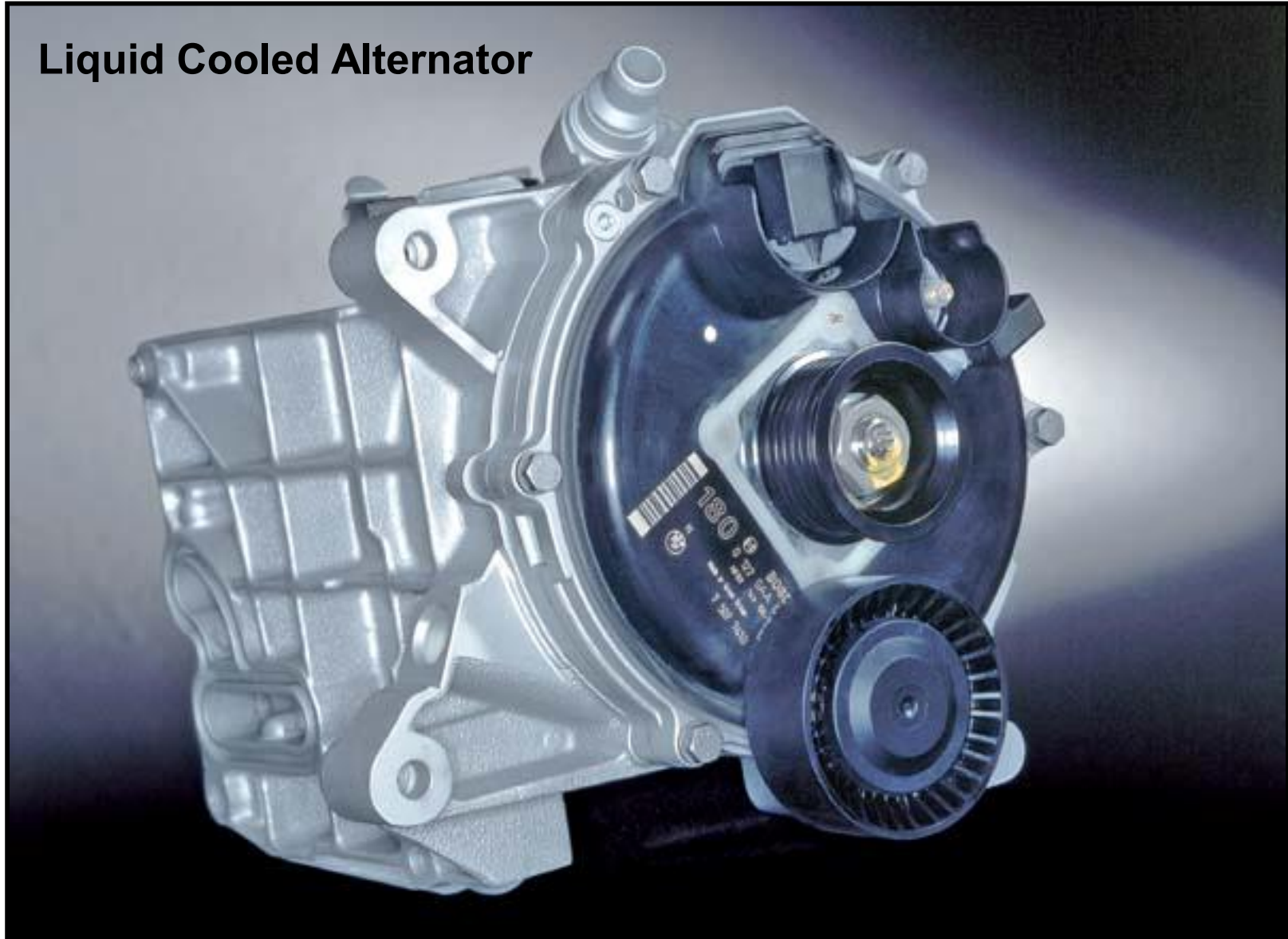
ATASA 5th Charging Systems

11. Some alternators have dual fans, internal fans, and are even liquid cooled.
True or False



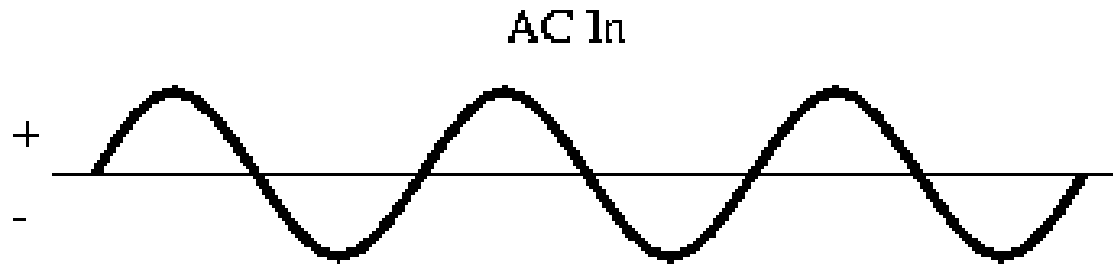
ATASA 5th Charging Systems

Liquid Cooled Alternator

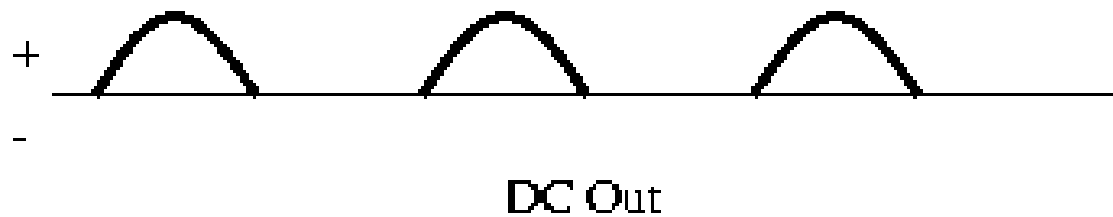
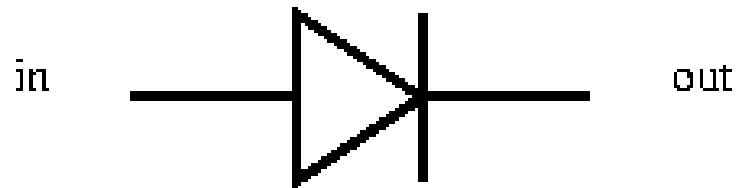


ATASA 5th Charging Systems

12. _____ - wave rectification *only allows half of the AC pulses to pass through* for charging.

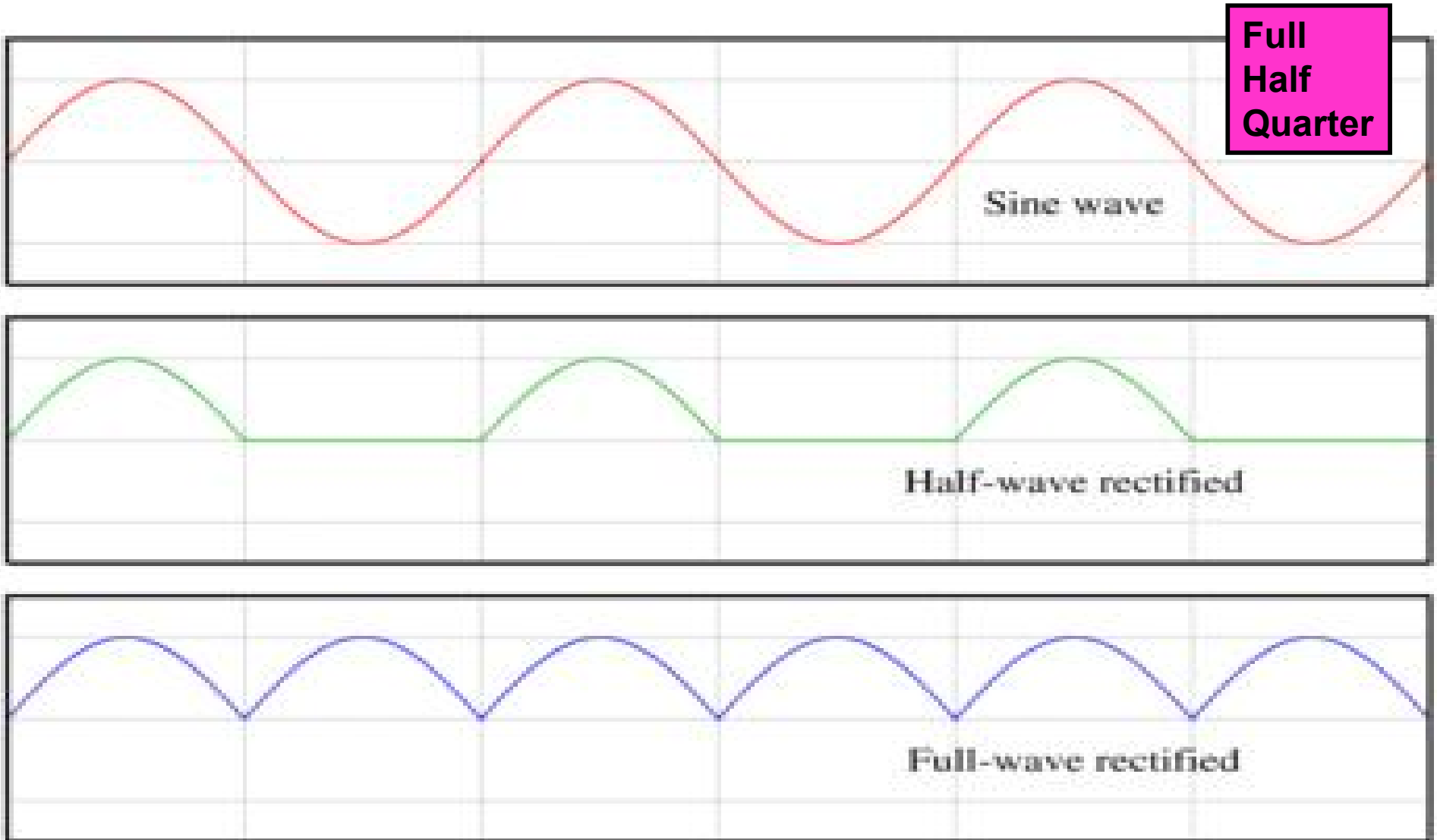


Full
Half
Quarter



ATASA 5th Charging Systems

13. - wave rectification of AC done with 6 diodes in a rectifier bridge *changes all of the alternating current to direct current* output for charging and operating electrical loads. (3 phase)



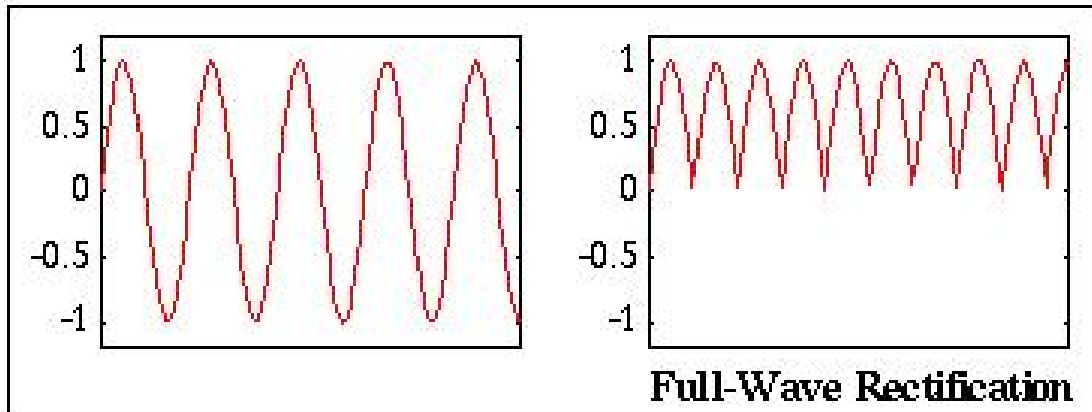
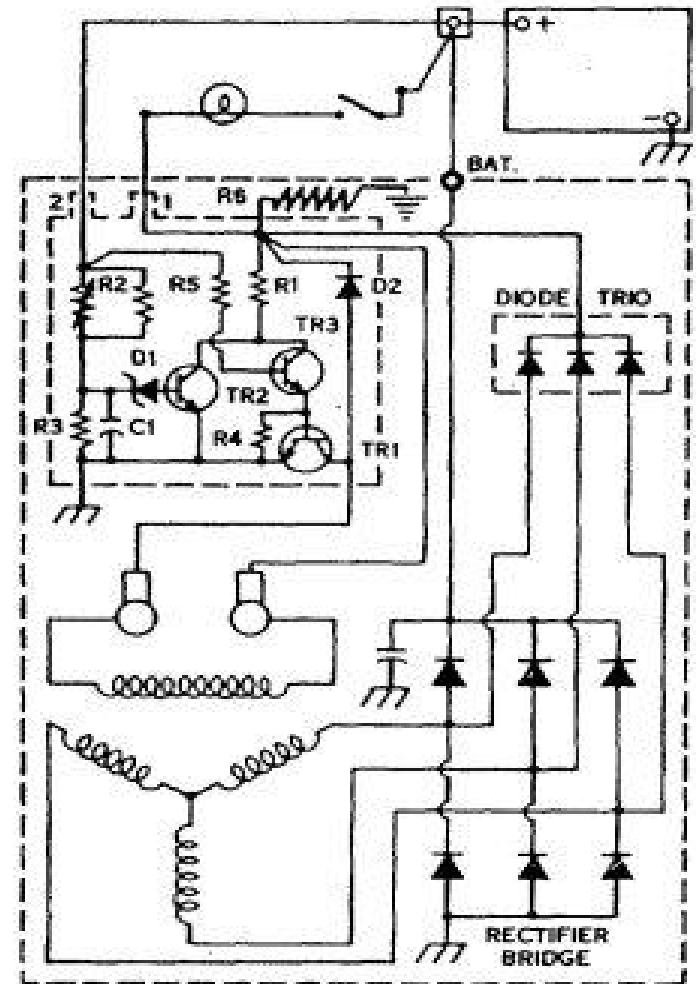
ATASA 5th Charging Systems

14. Use of an extra _____ allows stator output to be immediately used to excite or energize the rotor's field coil.

This eliminates extra wiring from the battery to the voltage regulator.

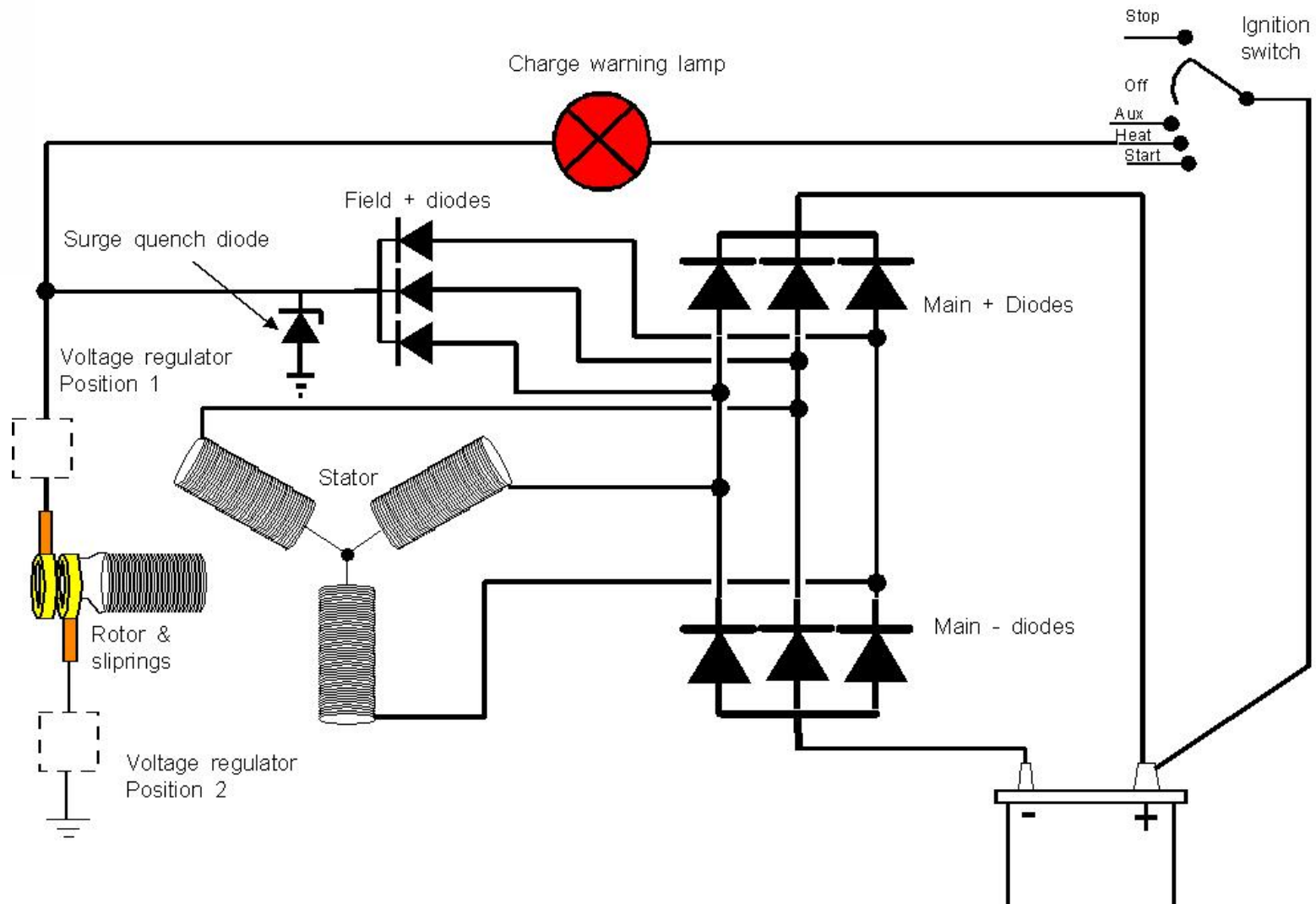


Diode Trio
Diode Duo
Diode Gang



ATASA 5th Charging Systems

15. Regulation of voltage is accomplished by varying the amount of _____ current flowing through the rotor's field coil. *This current enters through the carbon brushes contacting the copper slip rings.*

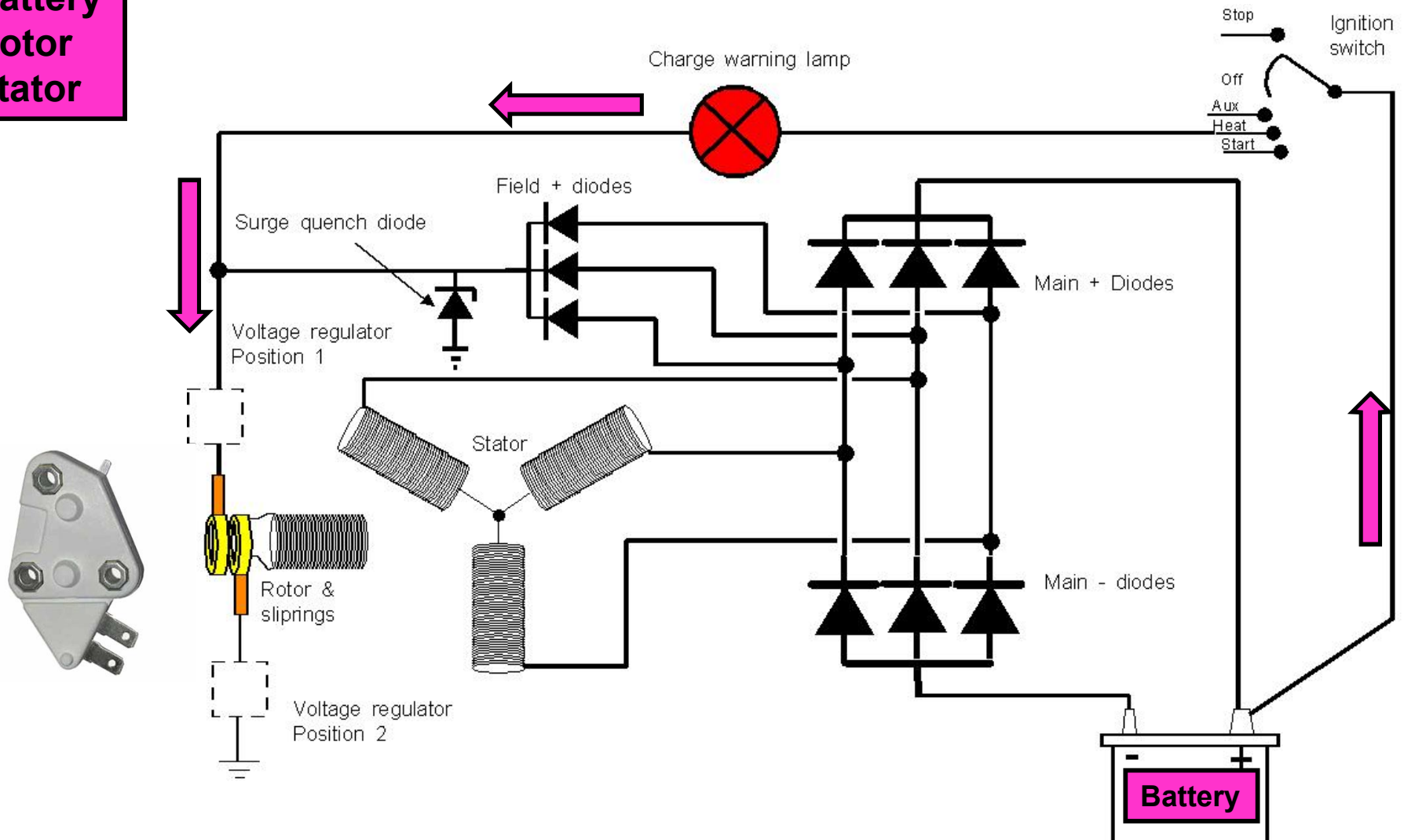


Battery
Rotor
Stator

ATASA 5th Charging Systems

15. Regulation of voltage is accomplished by varying the amount of _____ current flowing through the rotor's field coil. *This current enters through the carbon brushes contacting the copper slip rings.*

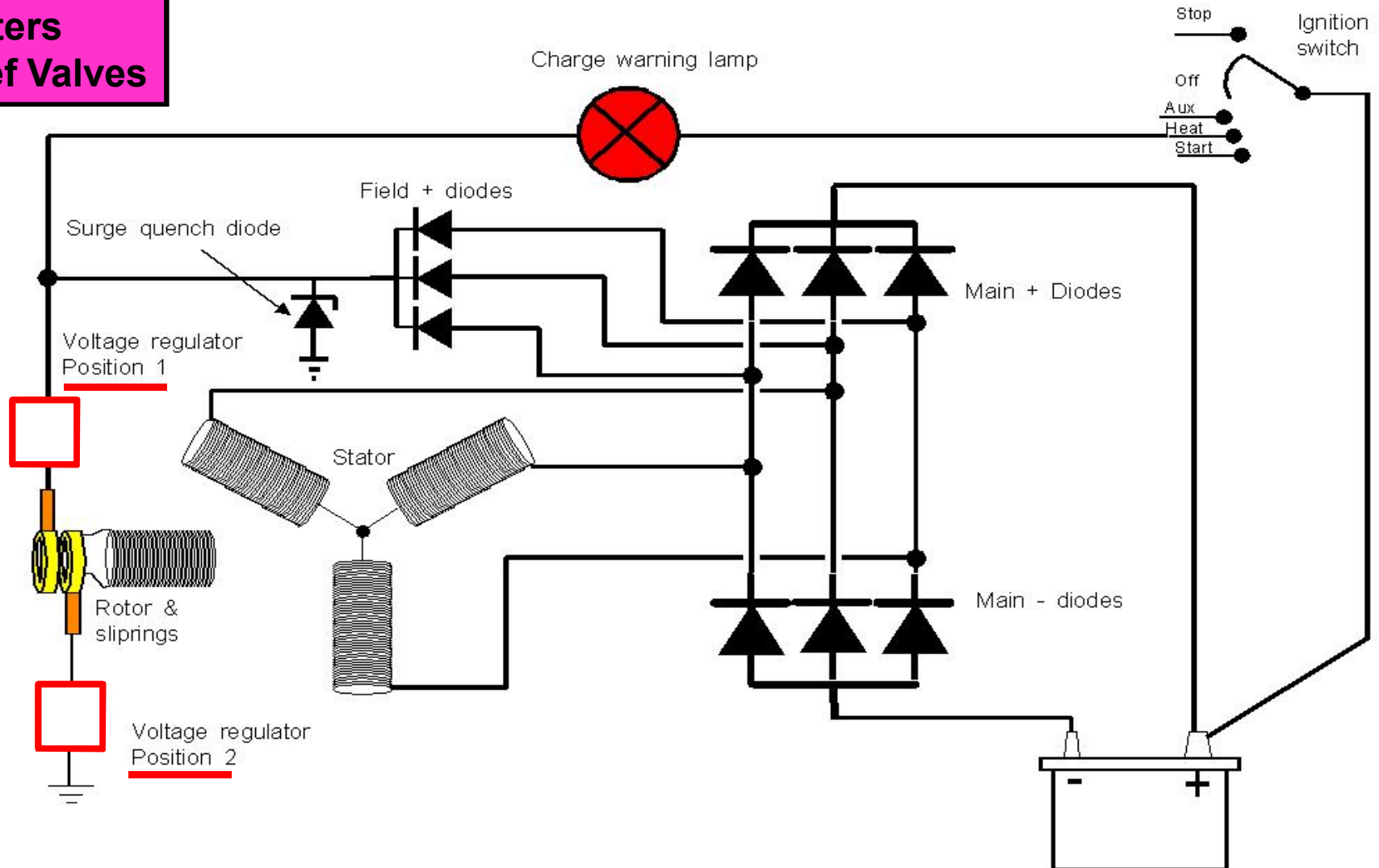
Battery
Rotor
Stator



ATASA 5th Charging Systems

16. Voltage _____ can control either the ground side or the power side of the field circuit.

Regulators
Limiters
Relief Valves



ATASA 5th Charging Systems

17. Regulators use *pulse width* _____ to vary the amount of time that the rotor field coil is energized. *This is a controlling of the field-coil “on-time” or duty cycle measured in %.*

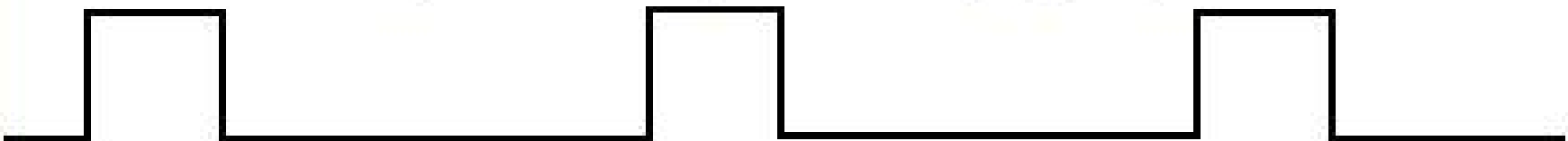
1a: 1:1 mark-space ratio (50% duty cycle)



1b: 3:1 mark-space ratio (75% duty cycle)



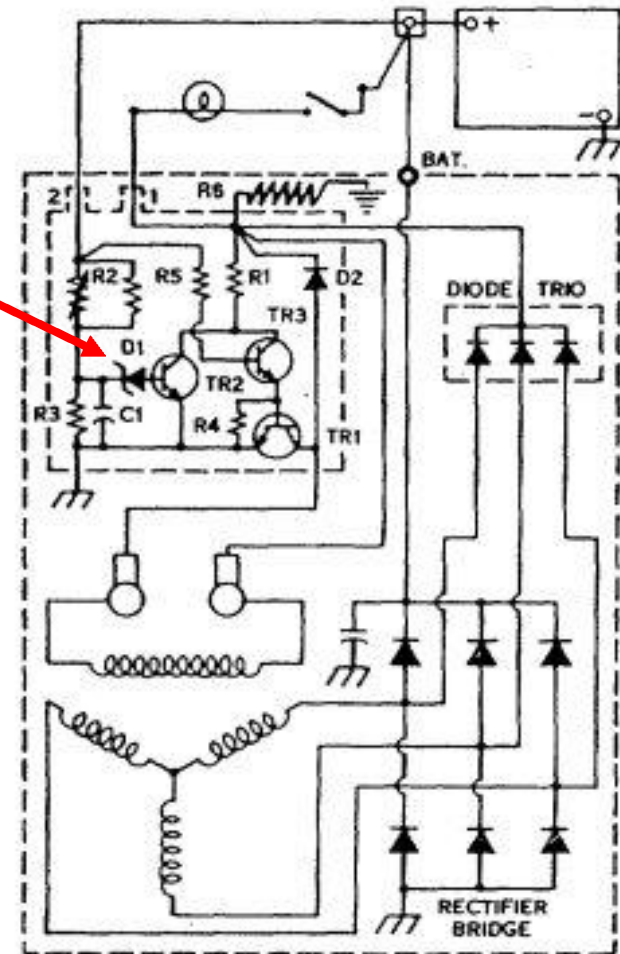
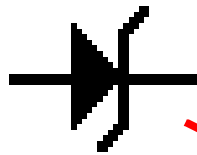
1c: 1:3 mark-space ratio (25% duty cycle)



Pulse width modulation waveforms

ATASA 5th Charging Systems

18. The classic use for a _____ diode is inside of the voltage regulator where it's *ability to allow reverse current flow* is used to limit the maximum charging voltage.

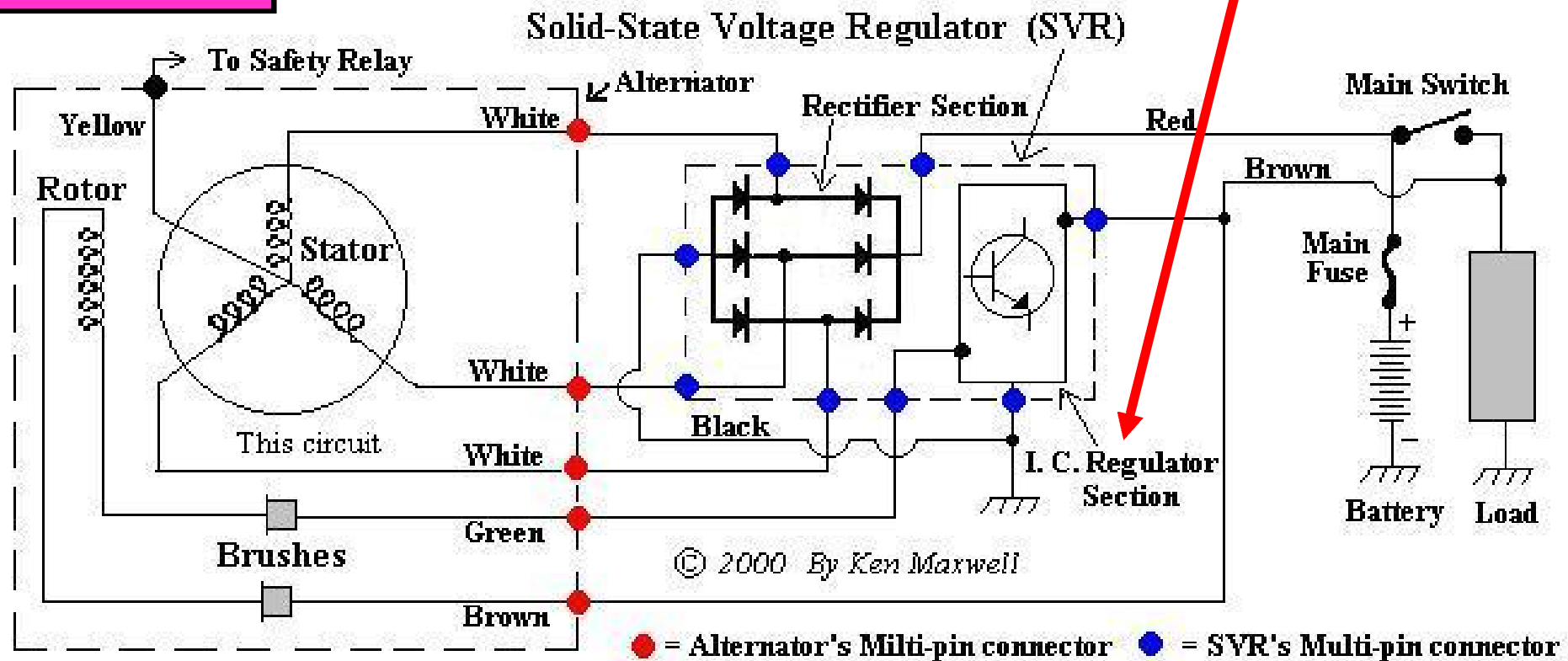


Clamping
Photo
Zener

ATASA 5th Charging Systems

19. Many voltage regulators contain _____ - _____ circuitry to limit runaway charging rates which could damage many of the vehicles delicate electrical & electronic circuits and components.

Limp - In
Fail - Safe
Clear - Flood

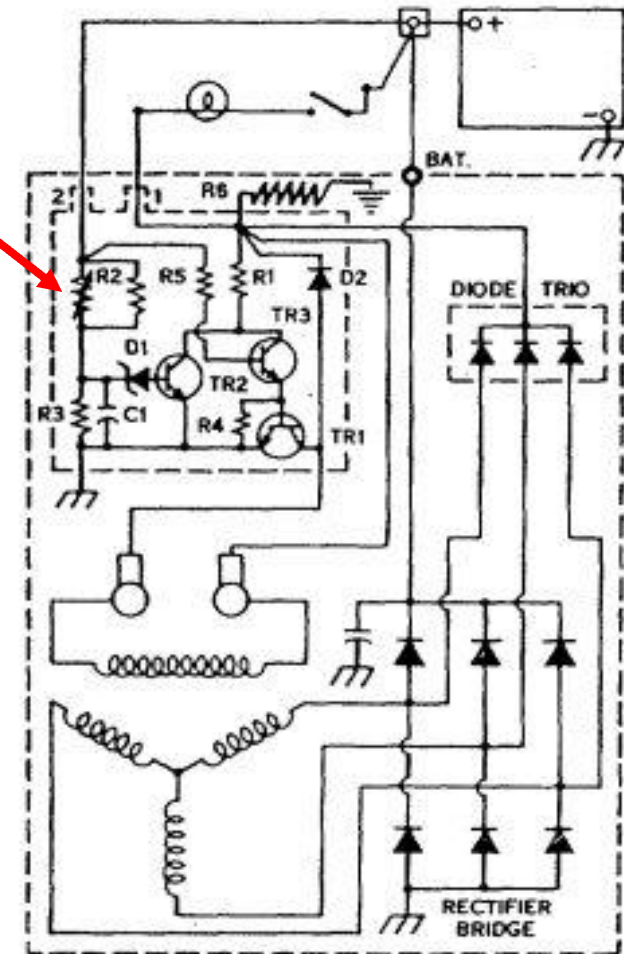
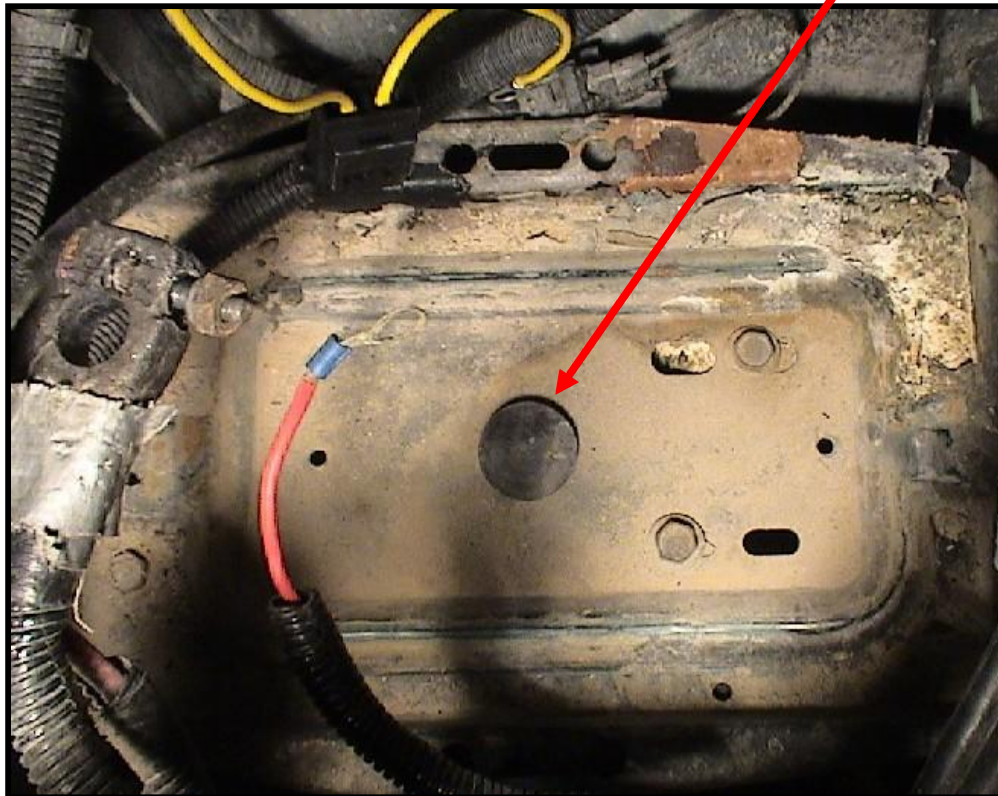


ATASA 5th Charging Systems

20. PCM controlled voltage regulation makes *ambient* _____ sensitive, precise management of the charging rate possible.
Better fuel mileage is also a result of this control.

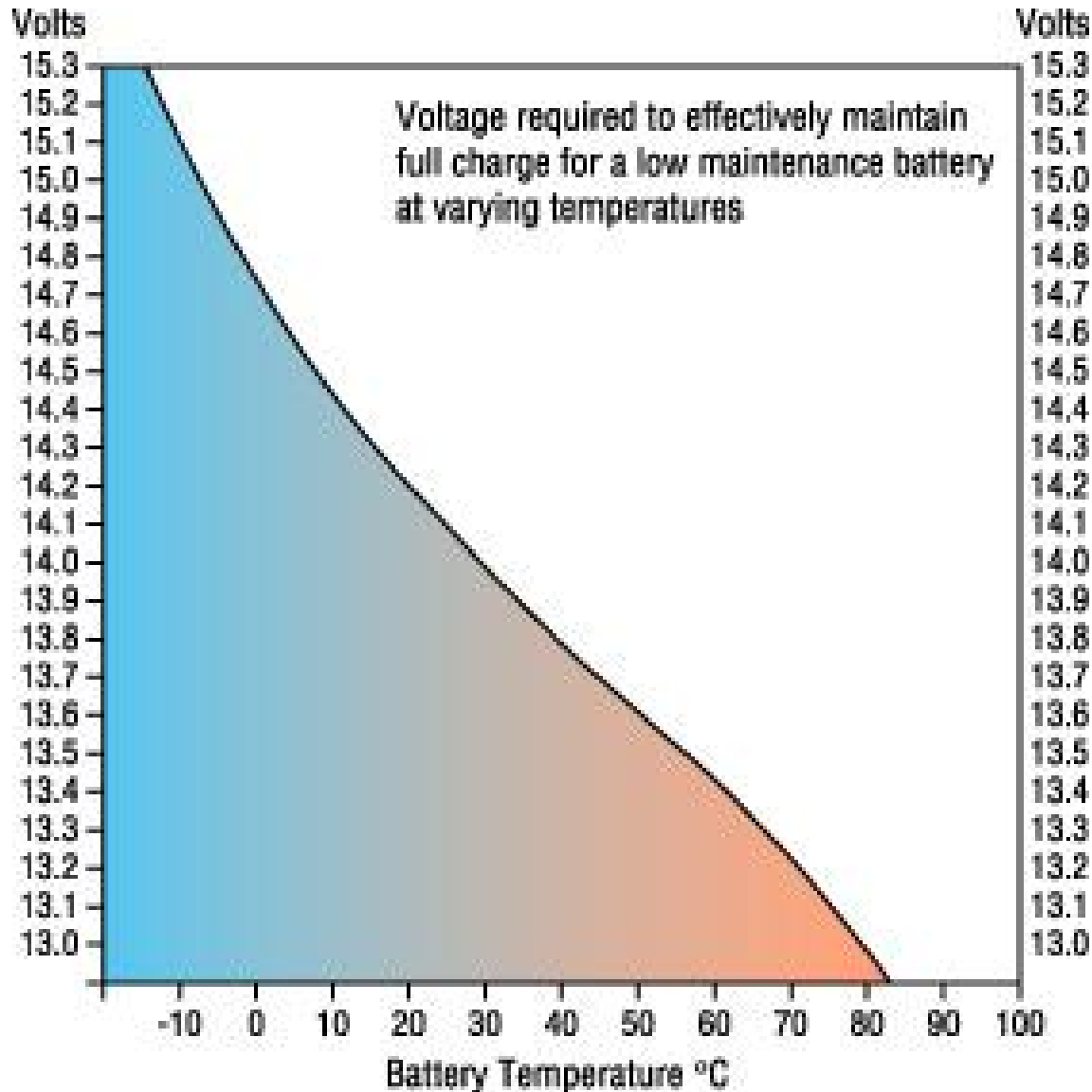
Humidity
Barometric Pressure
Temperature

Thermistors



ATASA 5th Charging Systems

21. Charging rate is typically about 2 volts higher than _____ - _____ battery voltage. (OCV)

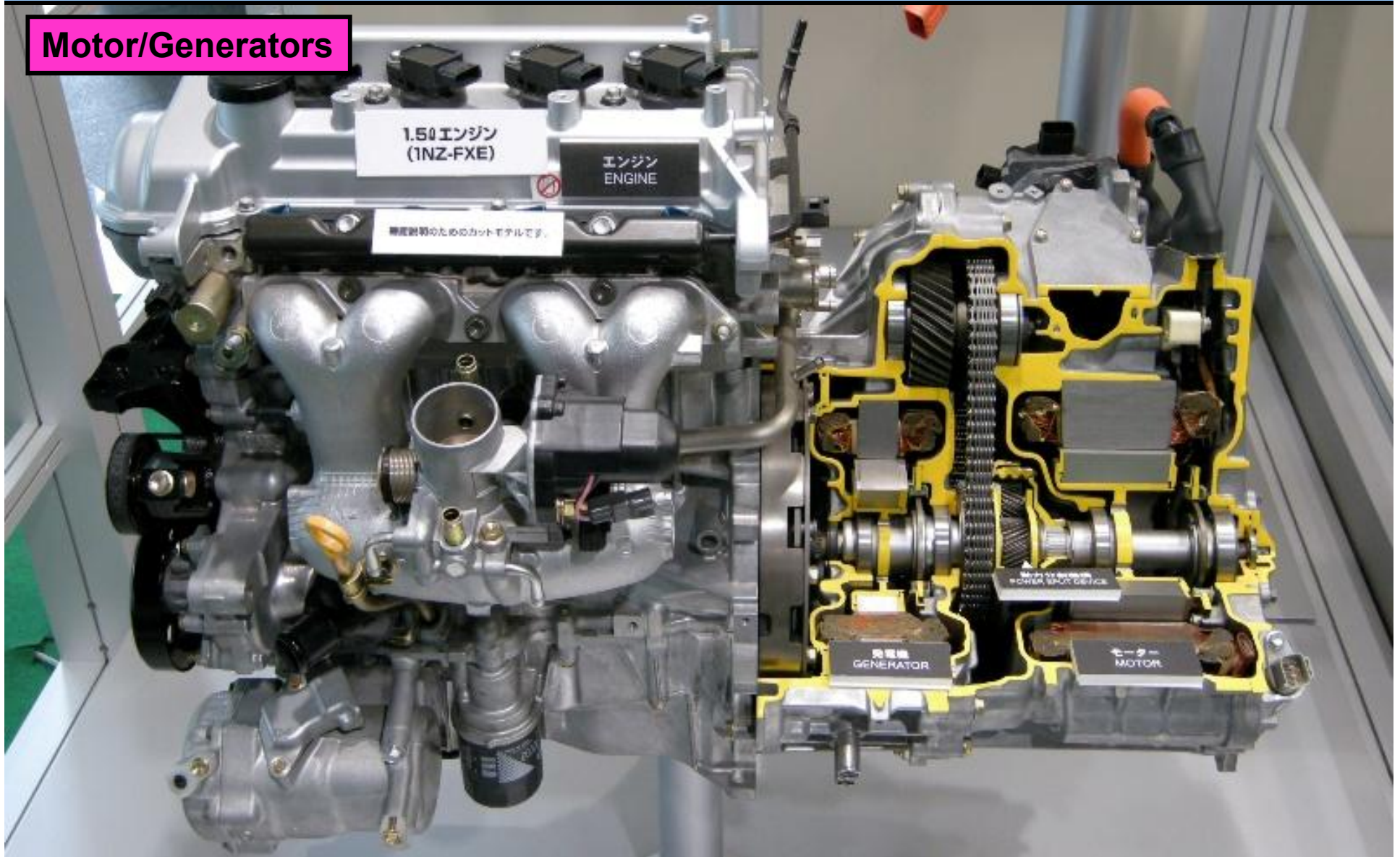


Open - Circuit
Closed - Circuit
Short - Circuit

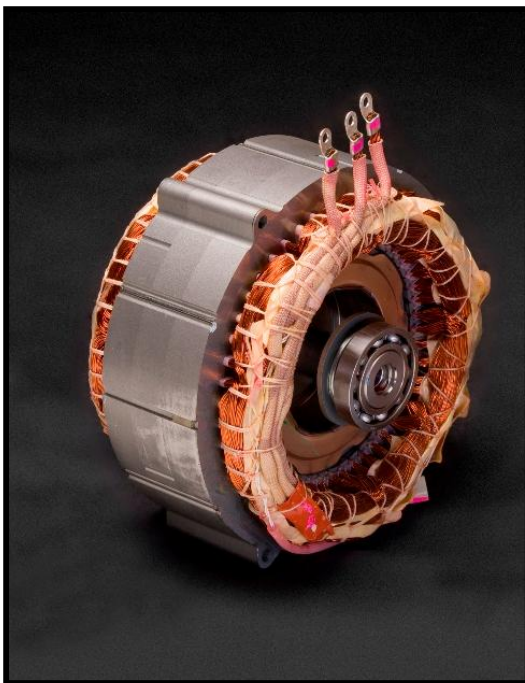
ATASA 5th Charging Systems

22. Hybrid vehicles use _____ / _____ to charge, crank, operate stop-start, provide regenerative braking, and for electric assist.

Motor/Generators

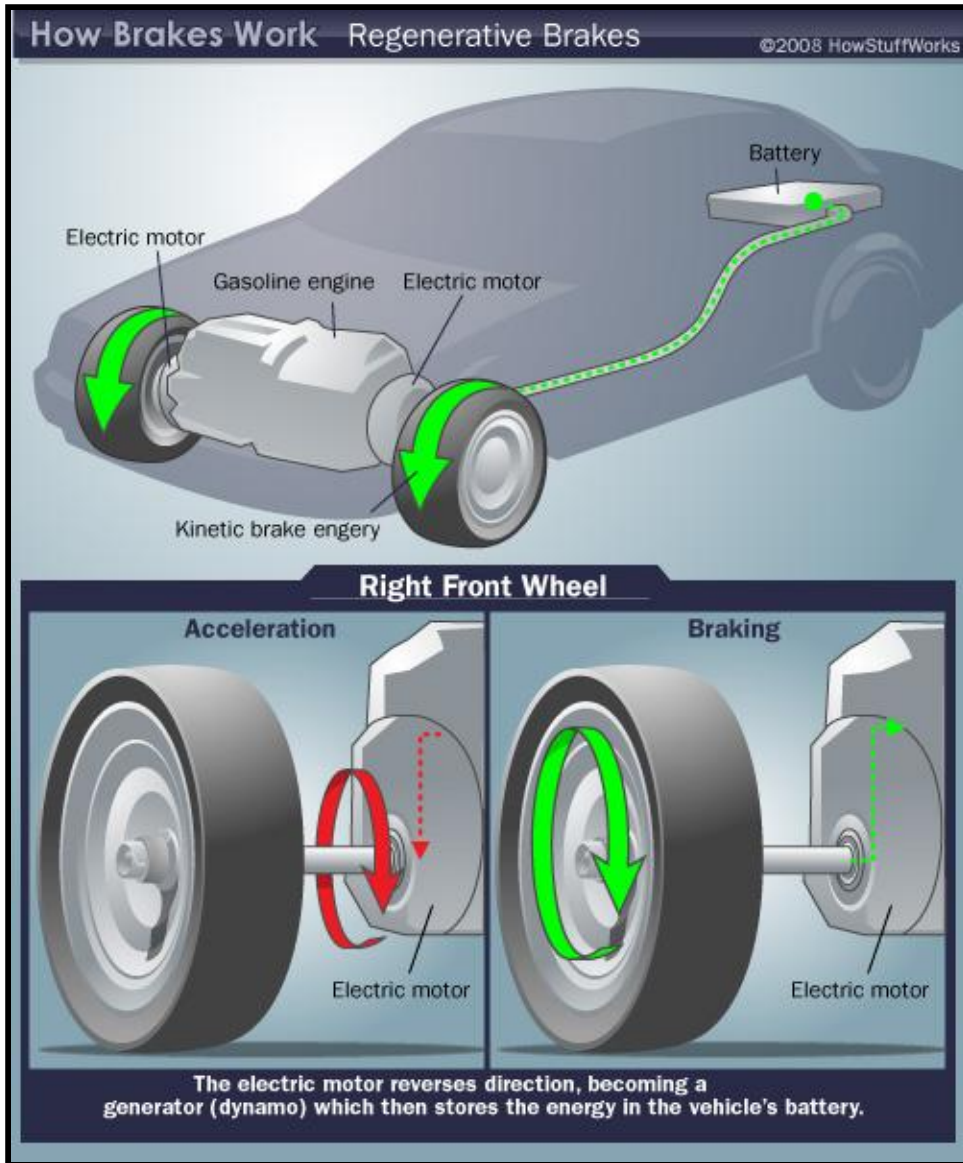


ATASA 5th Charging Systems



ATASA 5th Charging Systems

23. *Regenerative braking* not only recharges the battery _____, but helps slow the vehicle.



Pack
Rack
Stack



ATASA 5th Charging Systems

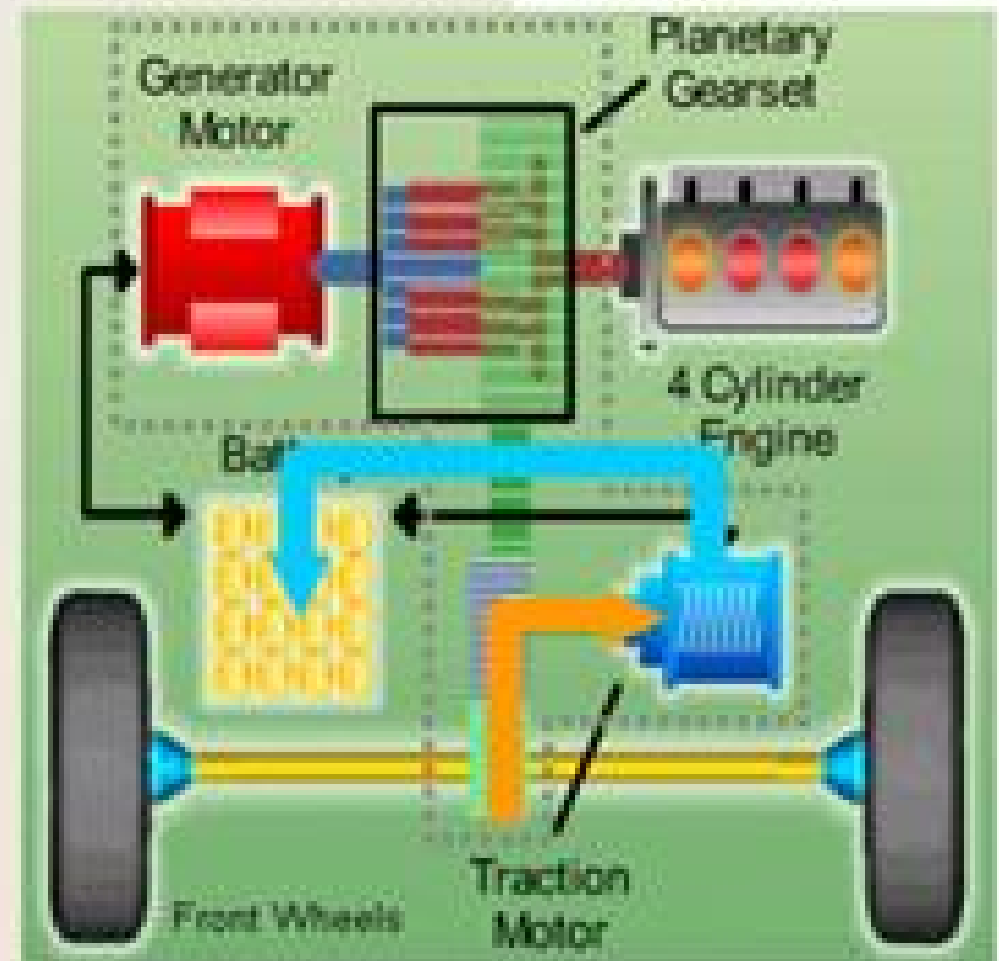




Powersplit Full Hybrid

Regenerative Braking

- Conditions:
 - Brakes are applied
 - Accelerator pedal is lifted
- Hybrid Operation:
 - Motion of the front wheels spins the Traction Motor to charge the HV Battery
- Impacts – positively affects fuel economy (captures a large portion of energy normally dissipated as heat).



Orange Mechanical Path

Blue Electrical Path



ATASA 5th Charging Systems

24. Diagnosis of PCM-controlled charging systems will generate _____ for system faults.



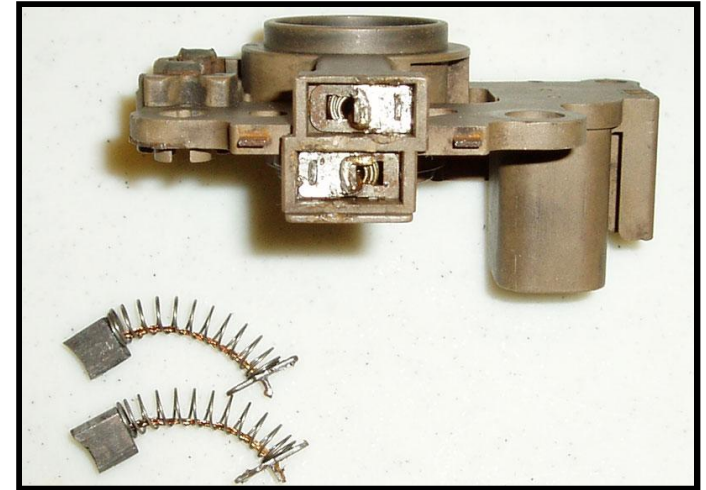
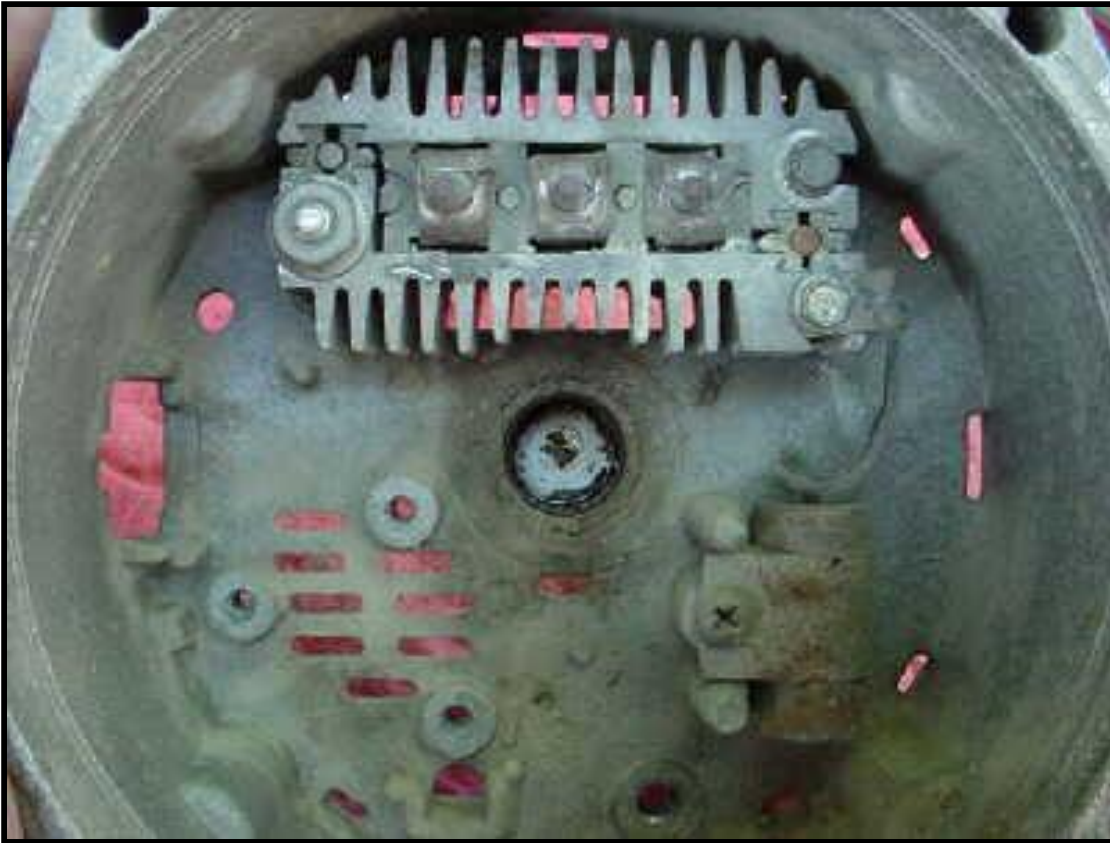
DTC's
DLC's
PCM's

0560	System Voltage Malfunction
0561	System Voltage Unstable
0562	System Voltage Low
0563	System Voltage High

0620	Generator Control Circuit Malfunction
0621	Generator Lamp "L" Control Circuit Malfunction
0622	Generator Field "F" Control Circuit Malfunction

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25. Charging system diagnosis may begin with _____ interpretation. Noise can be caused by bad diodes, belts & tensioners, bad bearings, loose mounting brackets, or by spinning parts rubbing.



Noise
Vibration
Harshness

ATASA 5th Charging Systems

26. Both *voltage output* & *current output* tests require the use of a _____
_____ rheostat tester to load the charging circuit by simulating accessory
drains during key on engine running. (KOER)



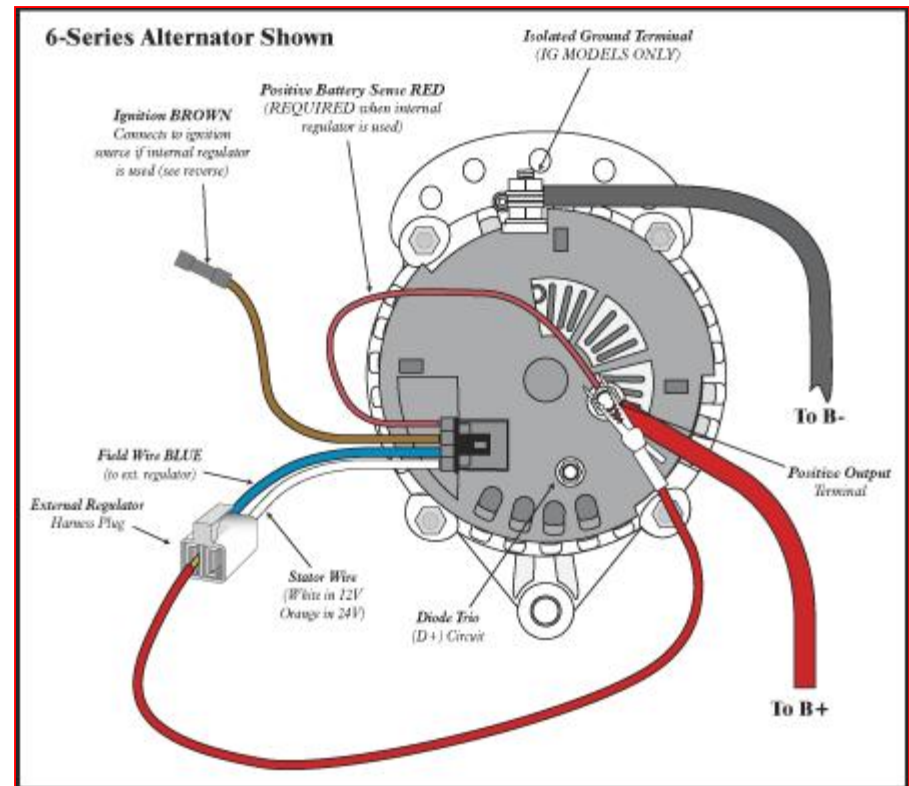
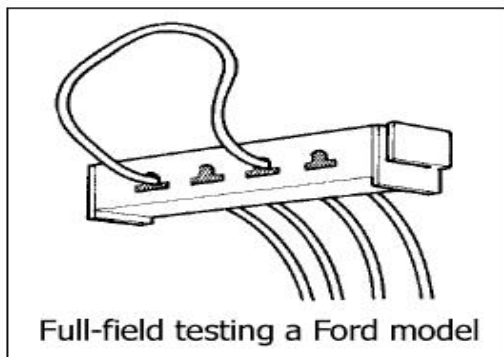
Friendly Smile
Carbon Pile
Stay Awhile

ATASA 5th Charging Systems

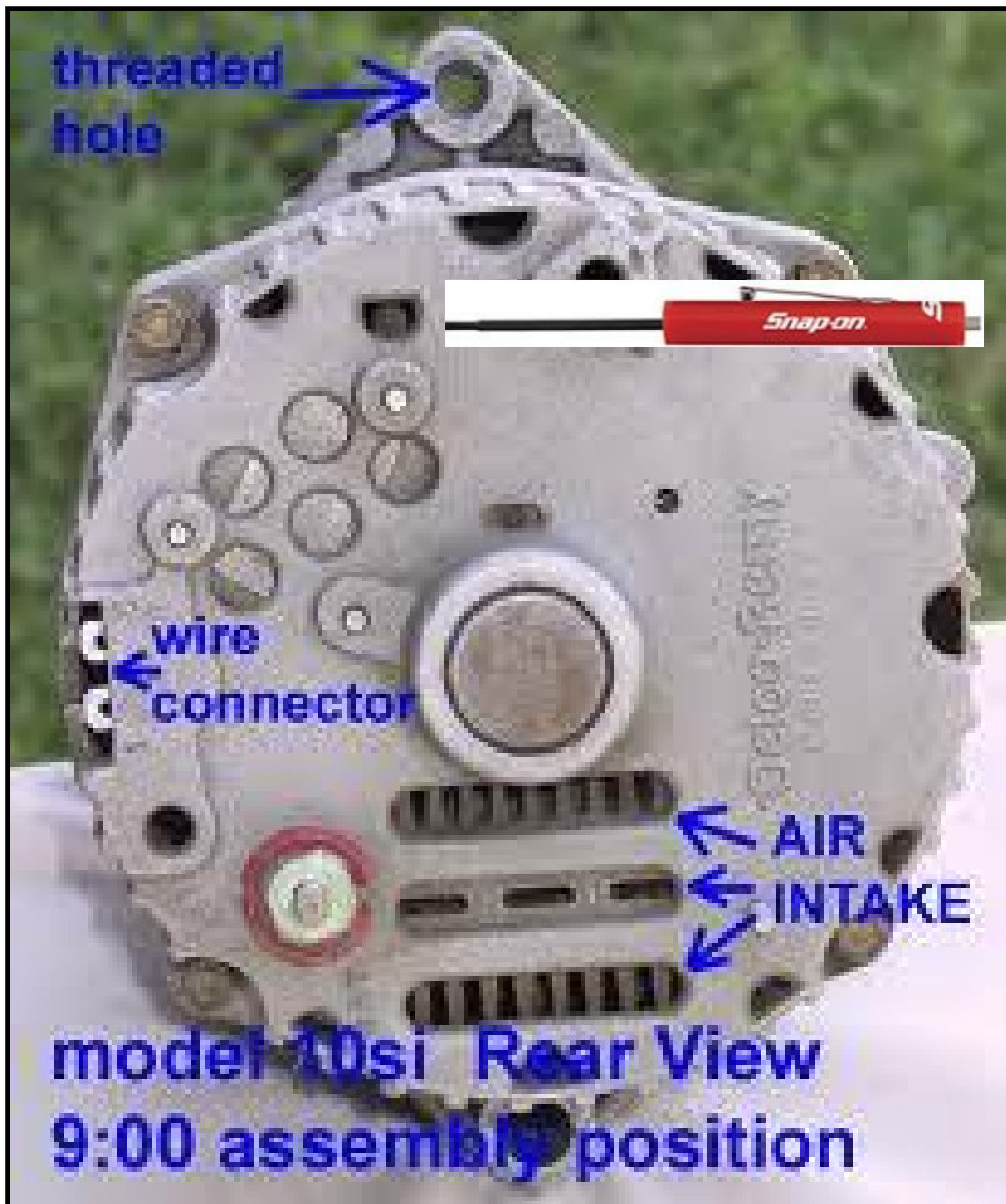
27. Applying full battery voltage to the rotor field coil to test maximum voltage & amperage output is known as the _____ - _____ test.
This can be done using scanners with bi-directional controls.



Full Field
Plowed Field
Magnetic Field



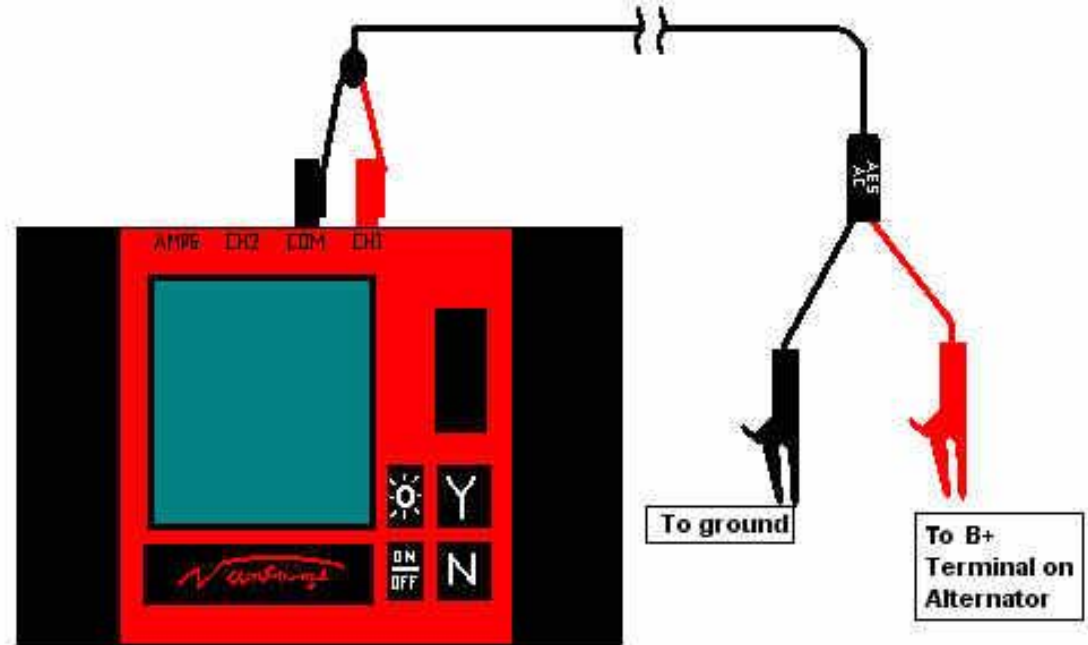
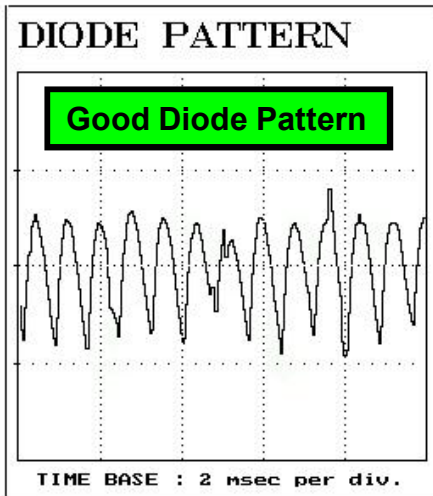
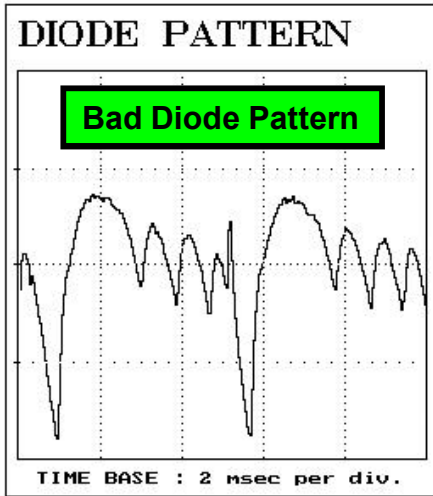
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To Full-Field a GM Alternator:
With the engine running
Probe into the half-round hole
Touch to both the tab & the case
Observe Charging Rate...
No Charge = Bad Alternator
Now It Charges = Bad Regulator

ATASA 5th Charging Systems

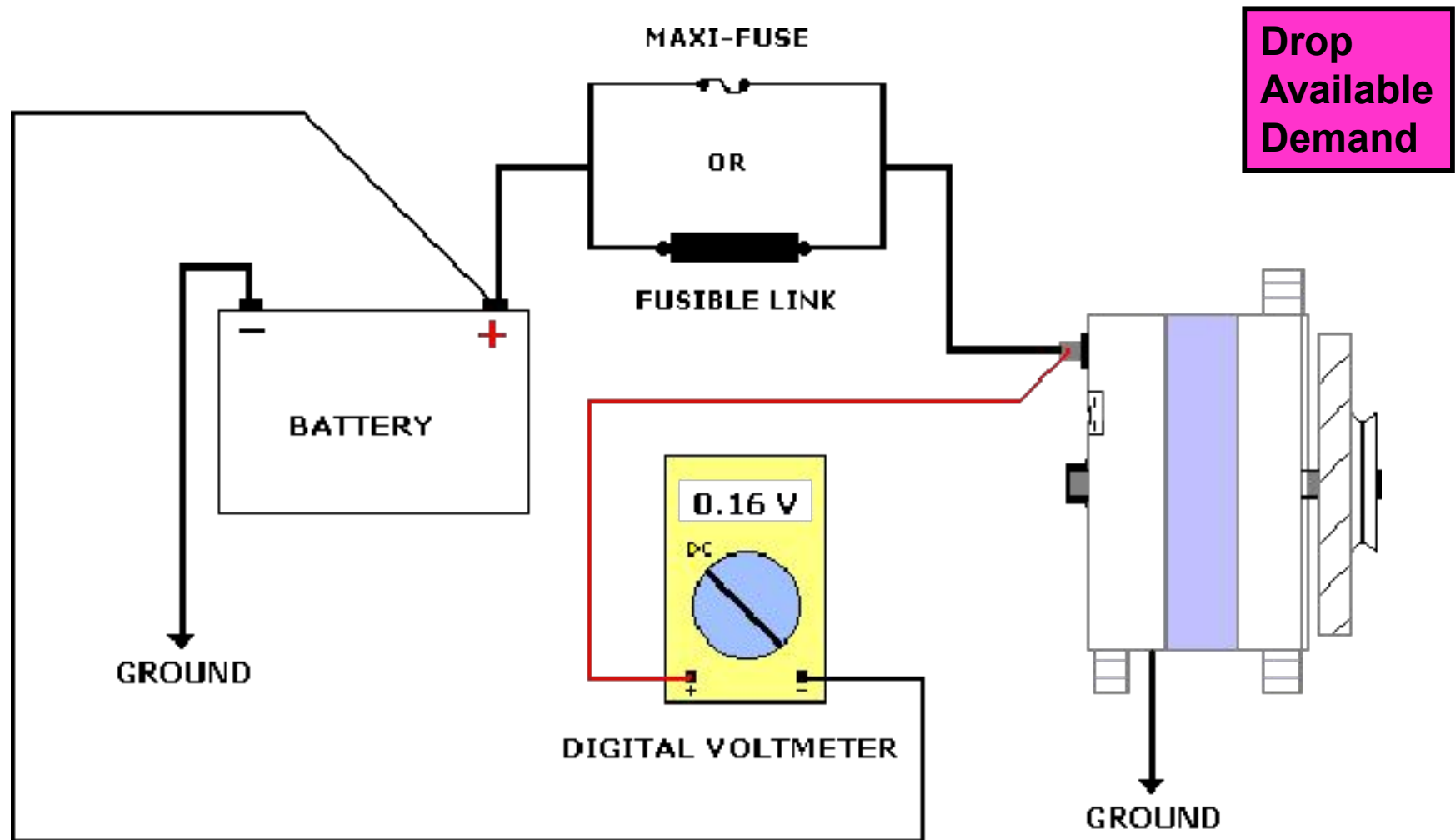
28. AC _____ (diode ripple) should be less than 0.5 VAC in the alternator output wire running. Measured inductively, less than 0.5 milliamps of current draw on the output wire KOEO is normal.



Leakage
Sneakage
Creakage

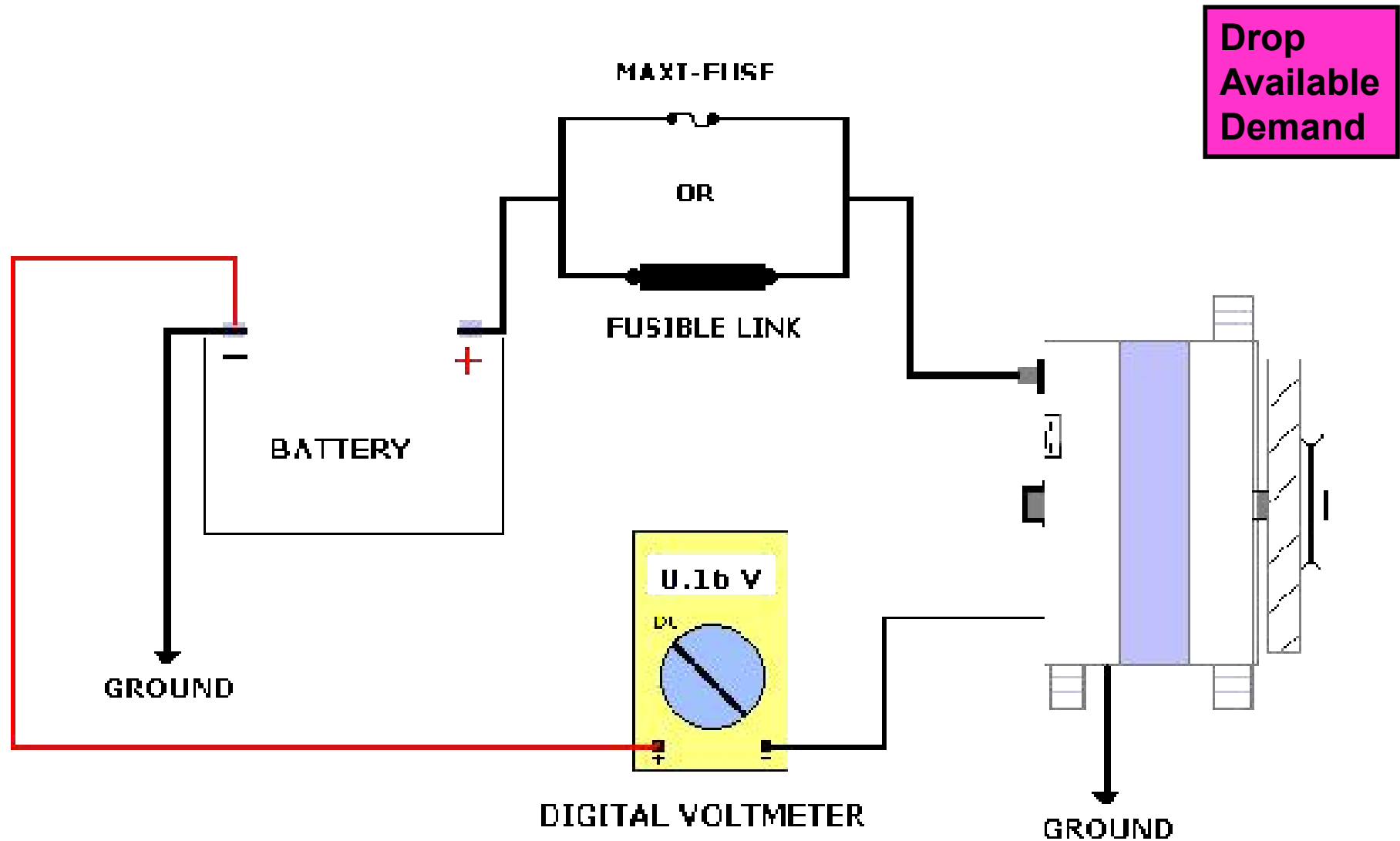
ATASA 5th Charging Systems

29. Voltage _____ of both the insulated & the ground wiring should be under .2 volts.



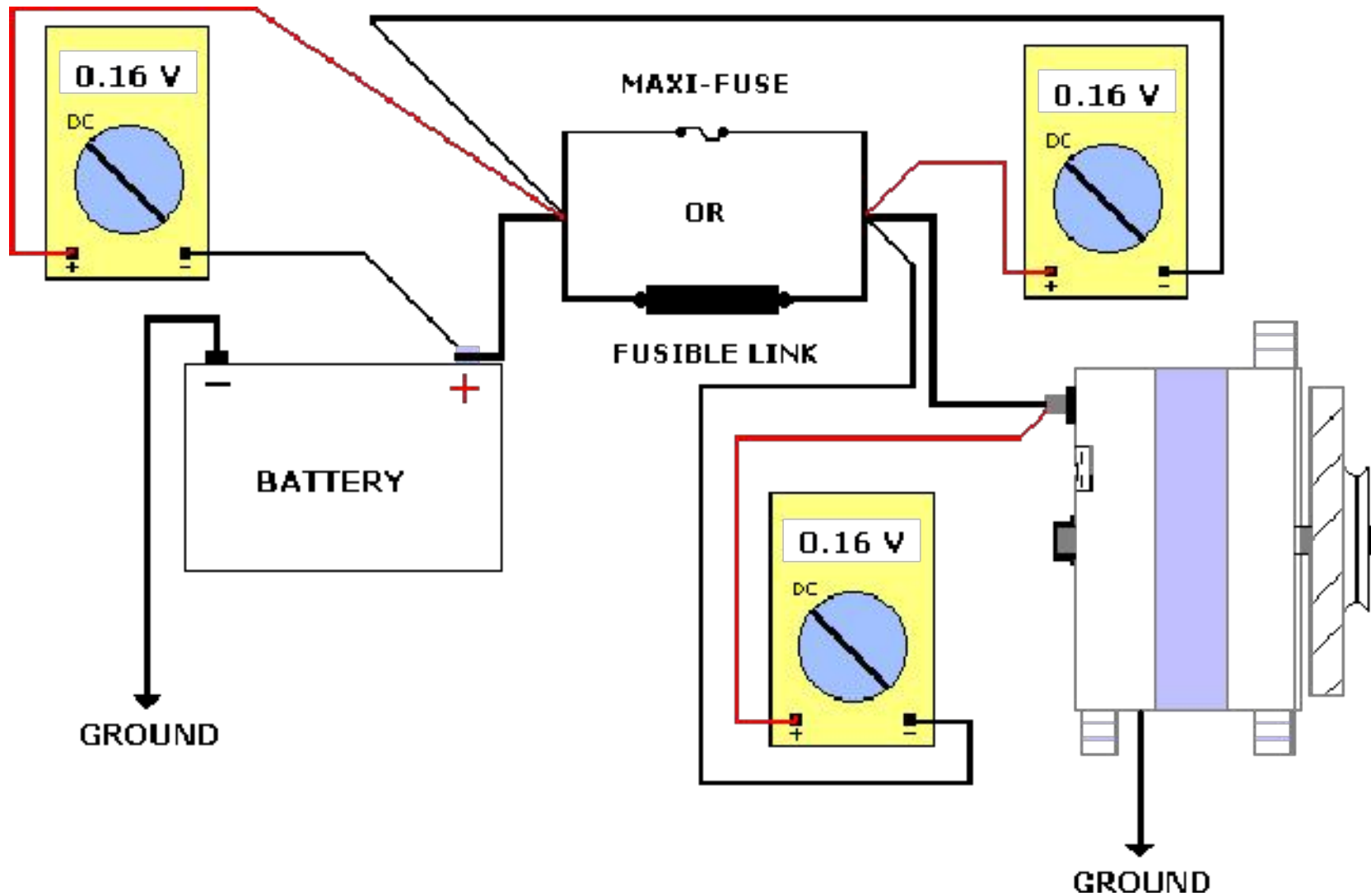
ATASA 5th Charging Systems

29. Voltage _____ of both the insulated & the ground wiring should be under .2 volts.



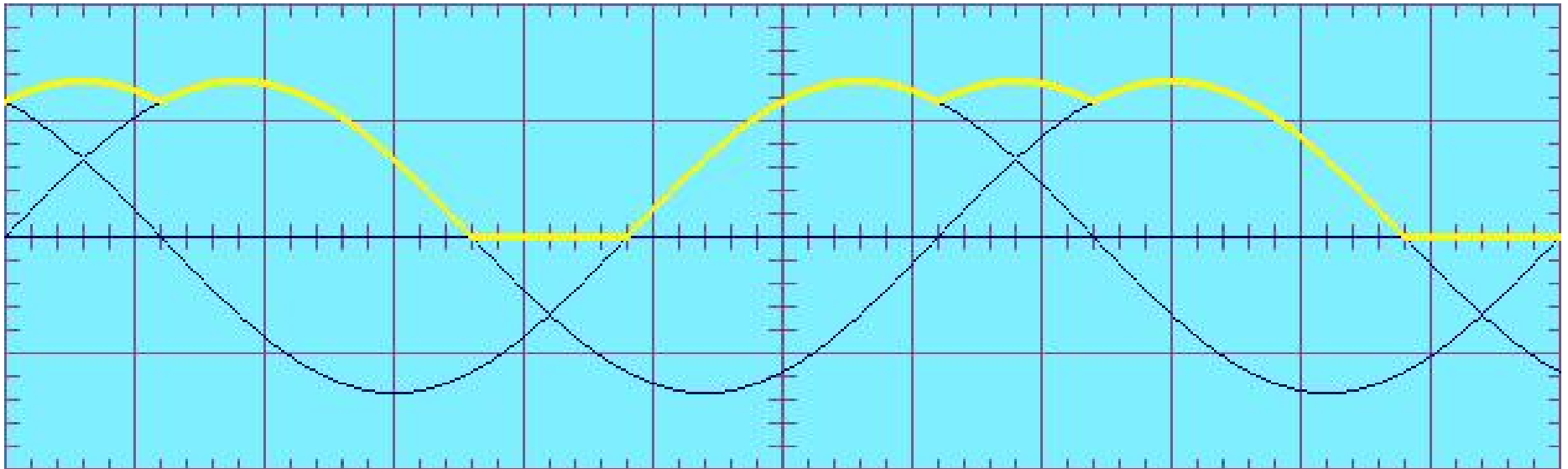
ATASA 5th Charging Systems

Voltage Drop Testing is Crucial to Understand!

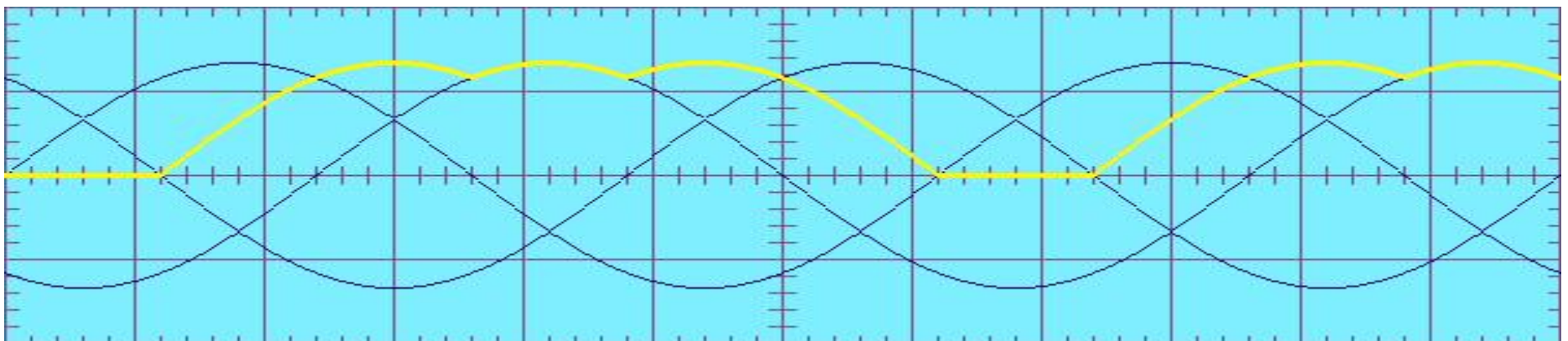


ATASA 5th Charging Systems

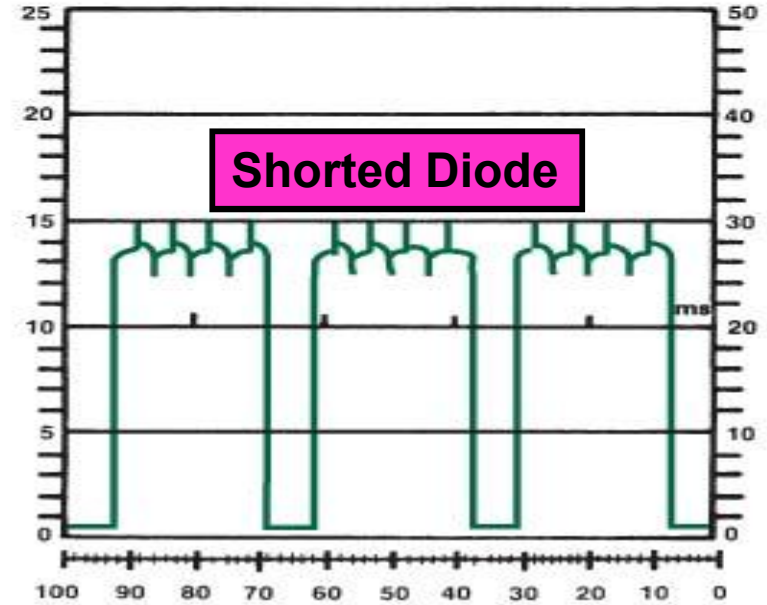
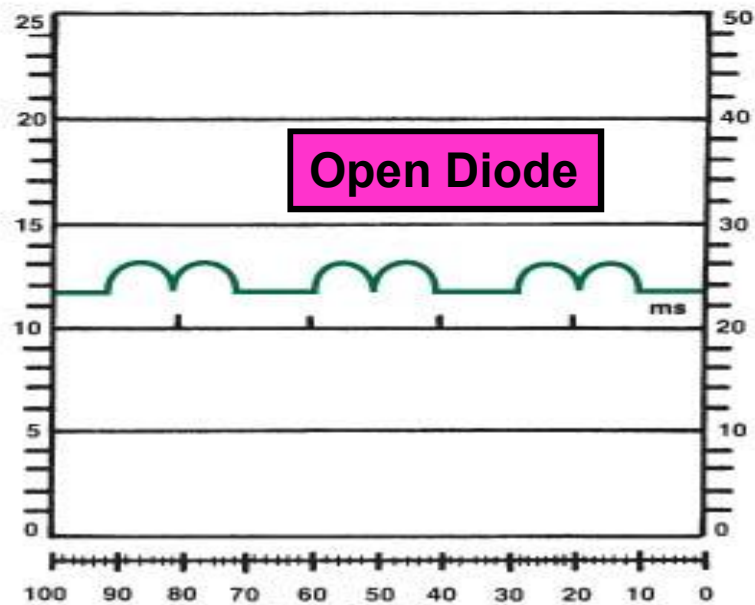
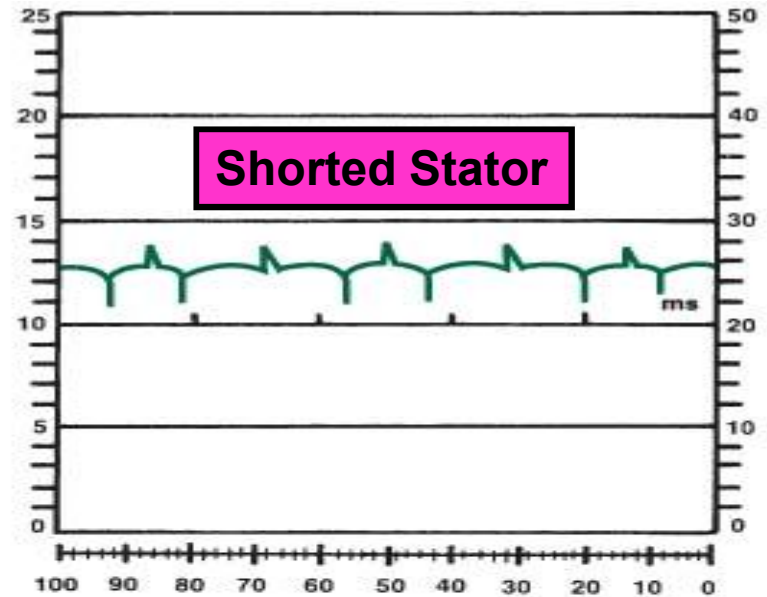
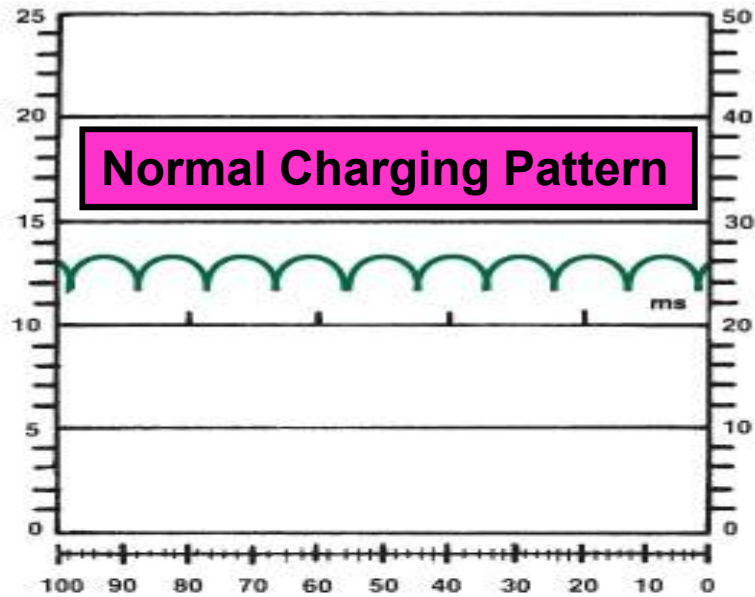
30. Oscilloscopes can be used to detect both _____ & _____ diodes in the rectifier bridge.



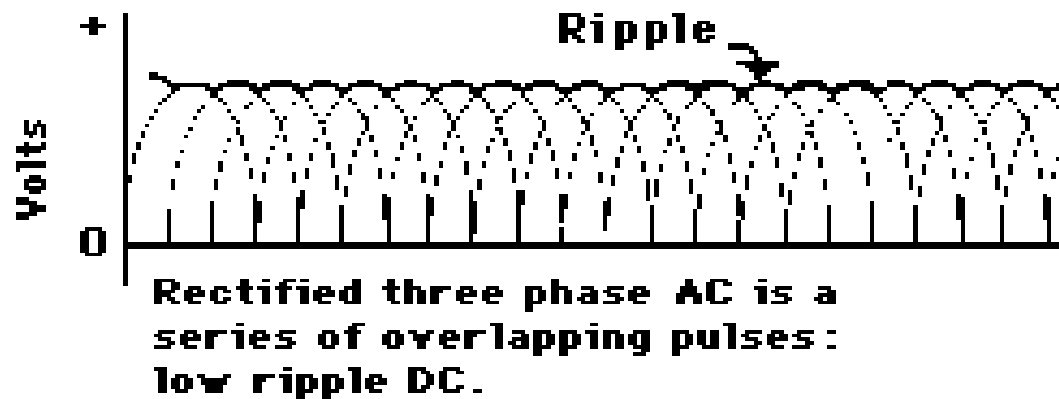
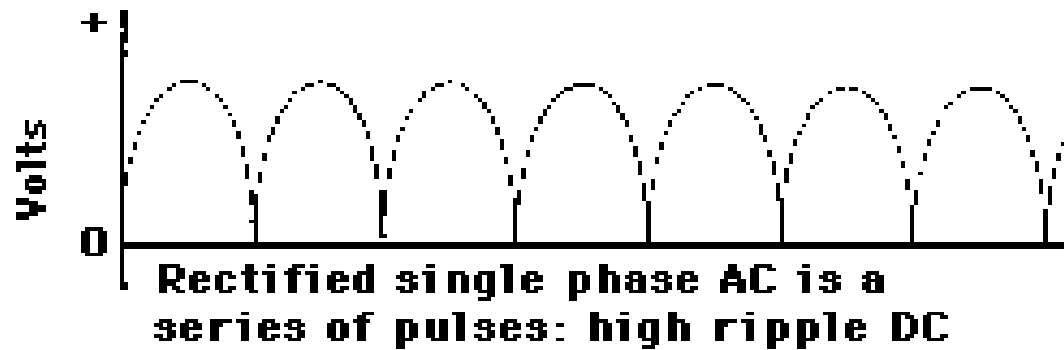
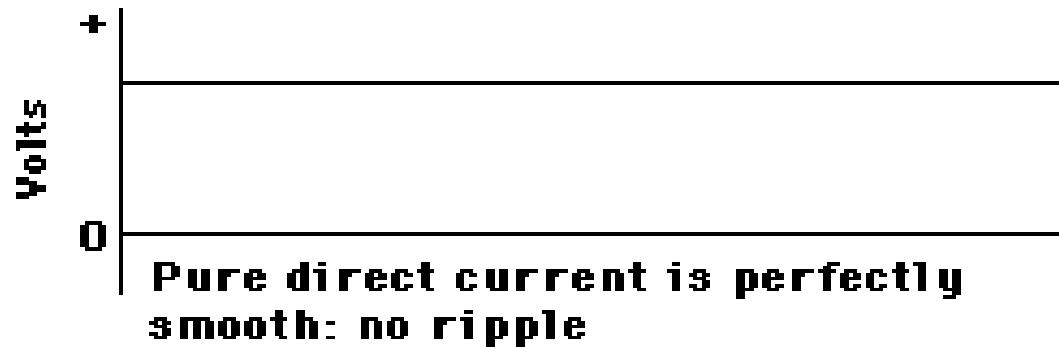
Open & Shorted
Open & Resistant



ATASA 5th Charging Systems

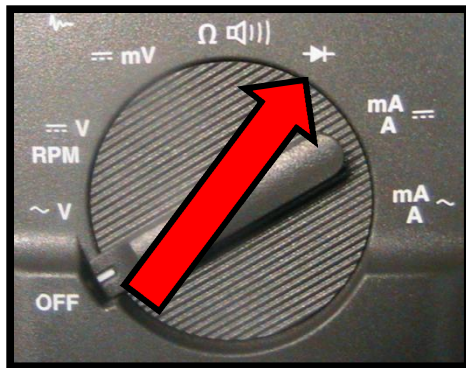


ATASA 5th Charging Systems

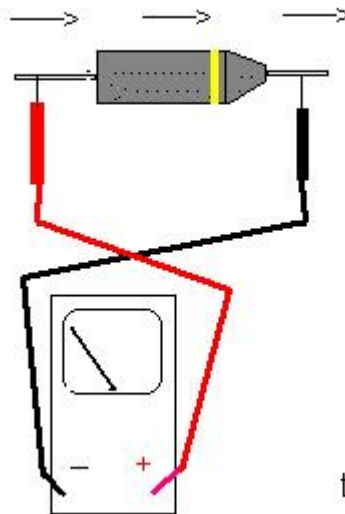


ATASA 5th Charging Systems

31. Use a *DMM* set to the _____ test scale is a best for checking diode trios & rectifier bridges.

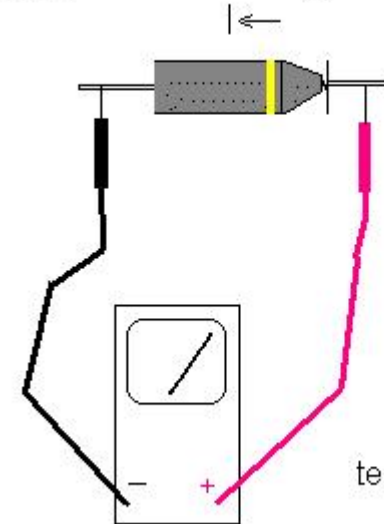


Current Flow = Low resistance

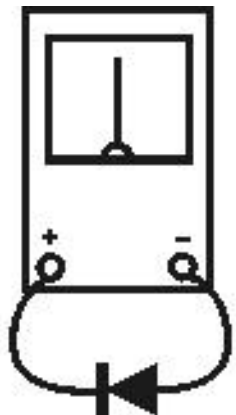


test 2

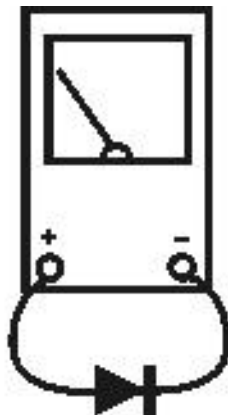
Current restricted = High resistance



test 1



Check forward conductance



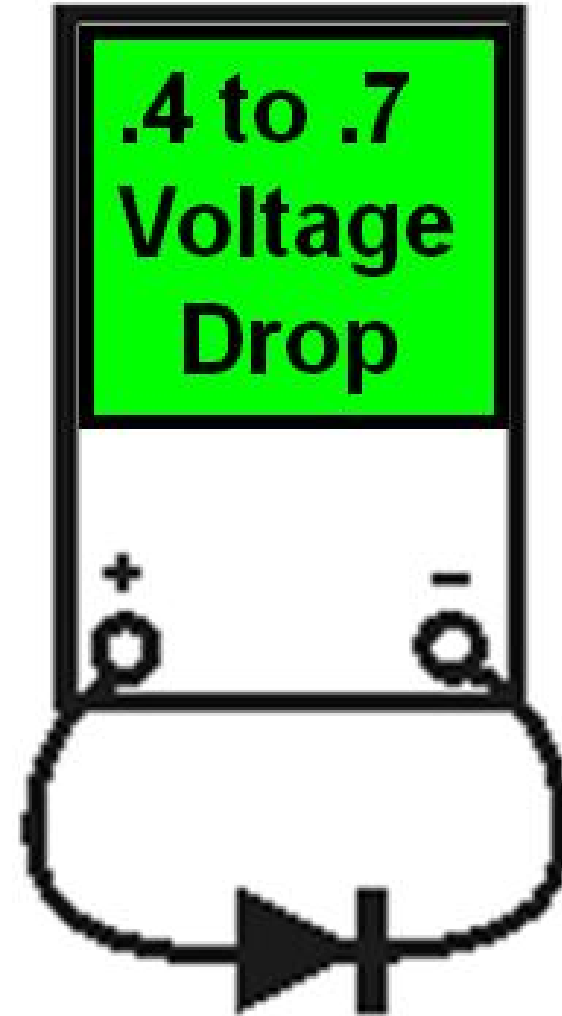
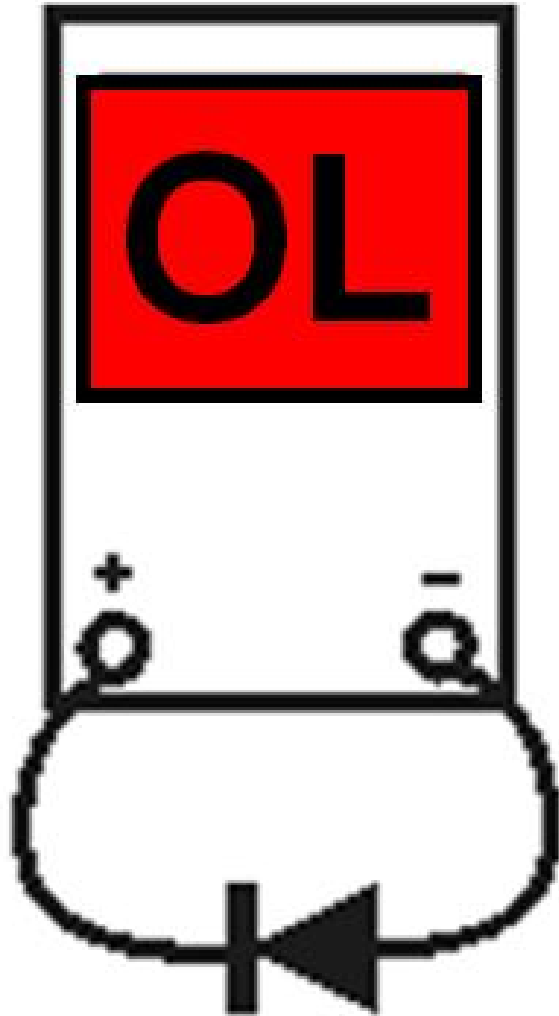
Check reverse conductance



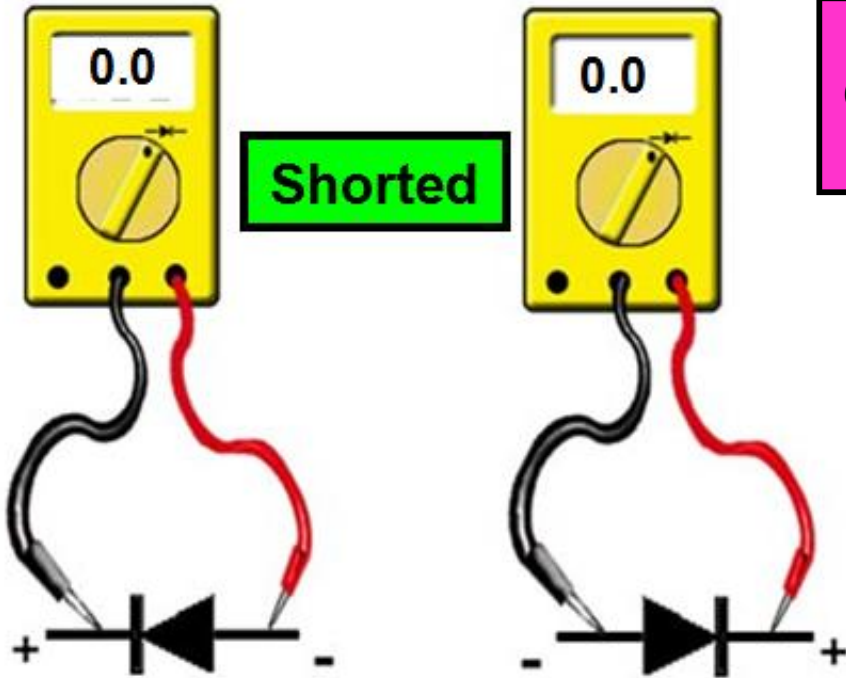
MIN/MAX
Diode
Hertz

ATASA 5th Charging Systems

Normal Diode When Tested With A DMM

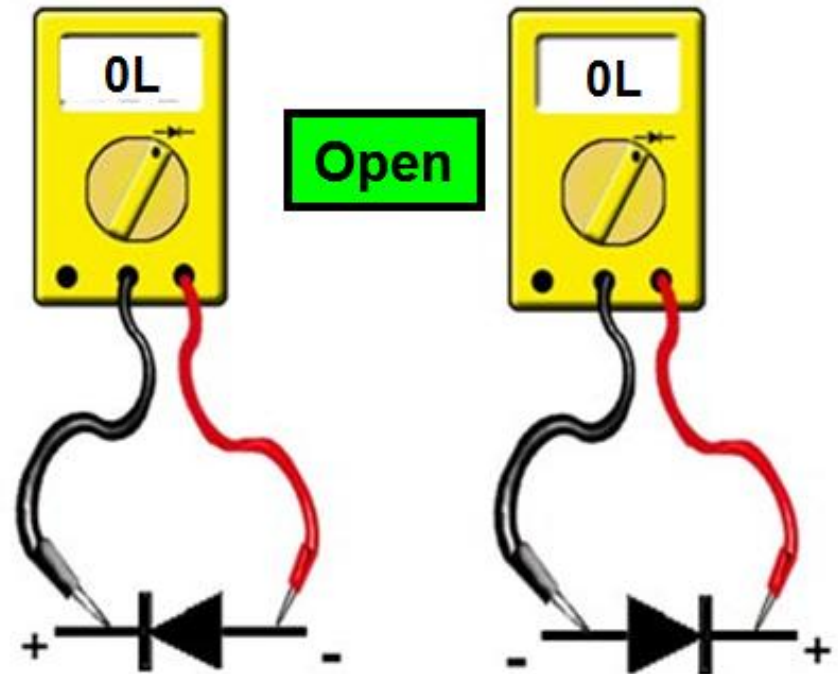


ATASA 5th Charging Systems

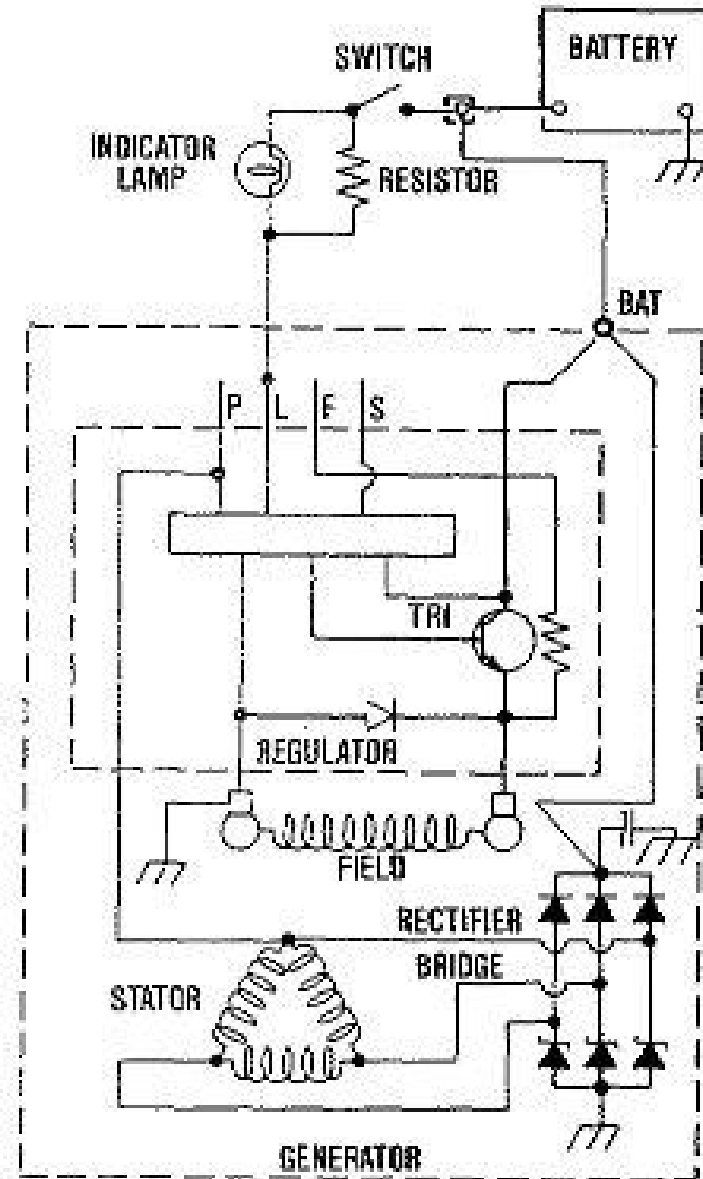
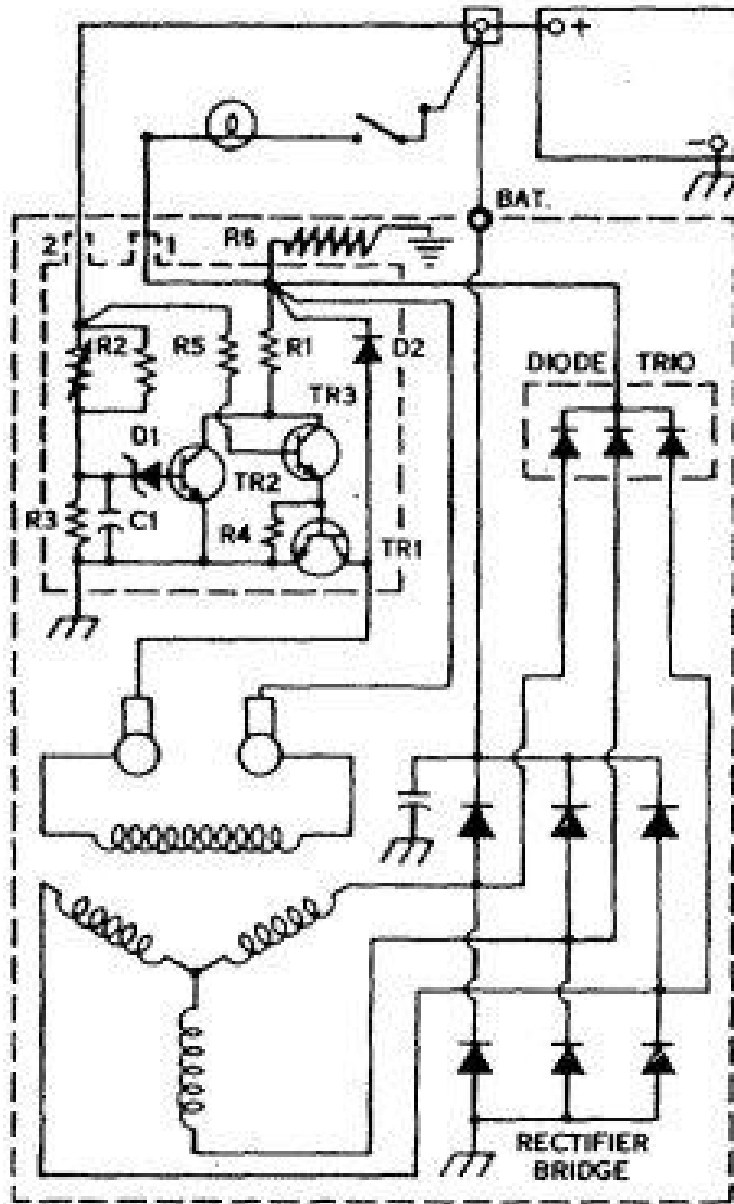


**Shorted Diode
Conducts Perfectly in Both Directions
0.0 Both Ways**

**Open Diode
Does Not Conduct In Either Direction
OL Both Ways**

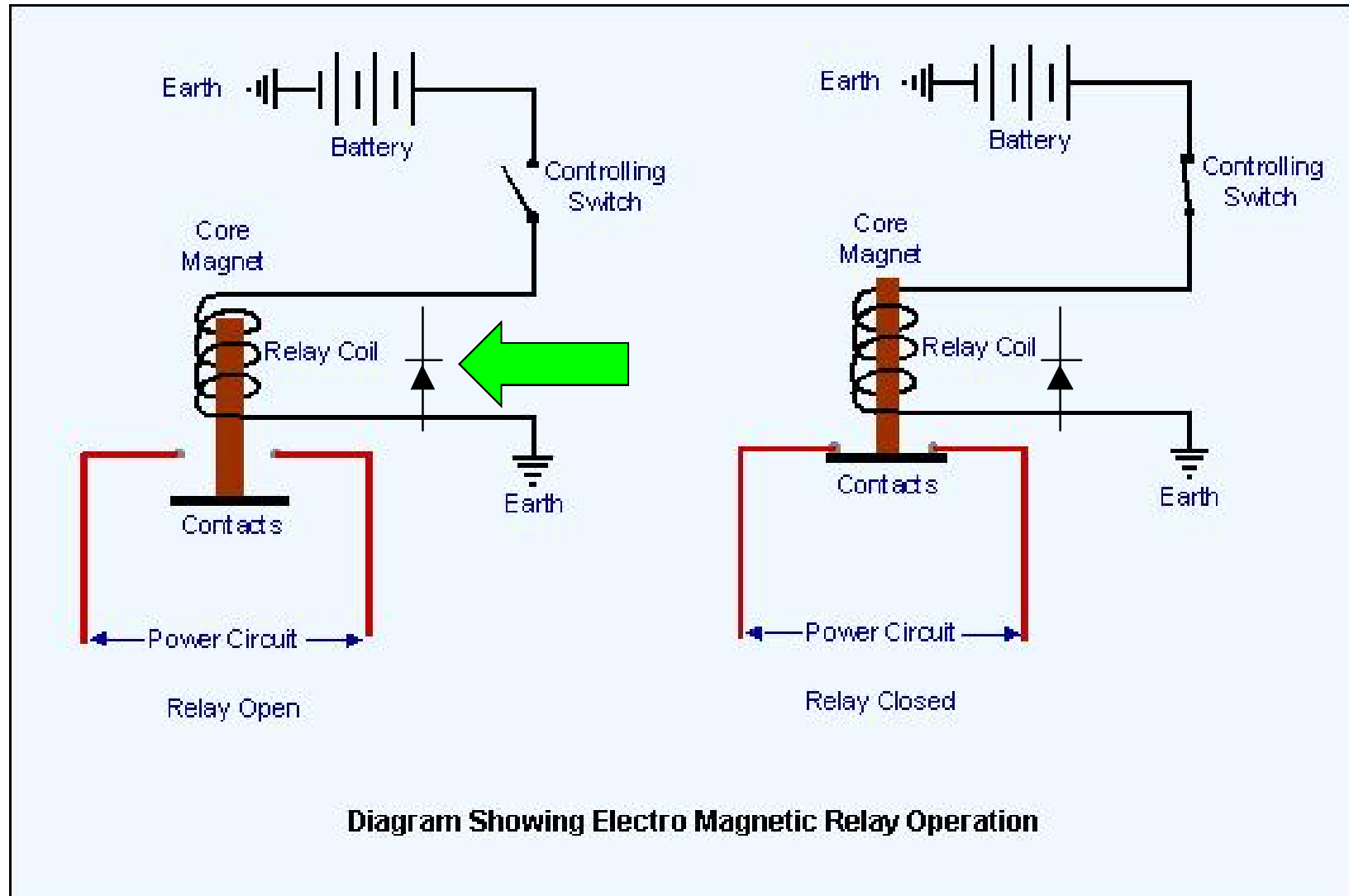


ATASA 5th Charging Systems

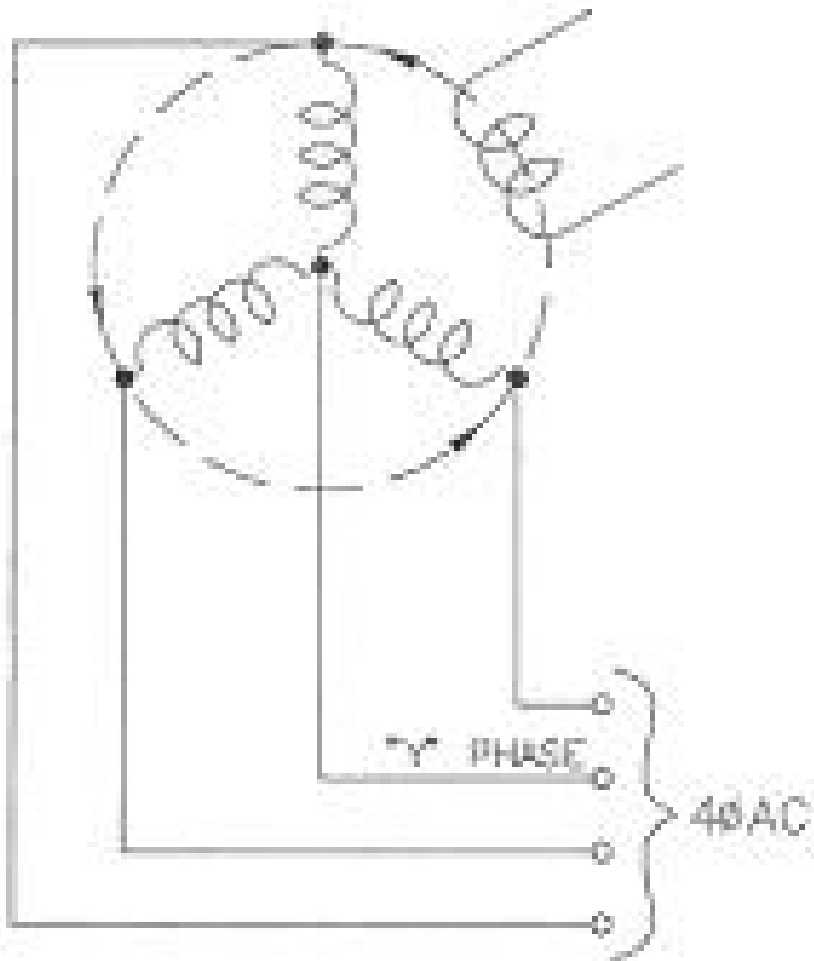


ATASA 5th Charging Systems

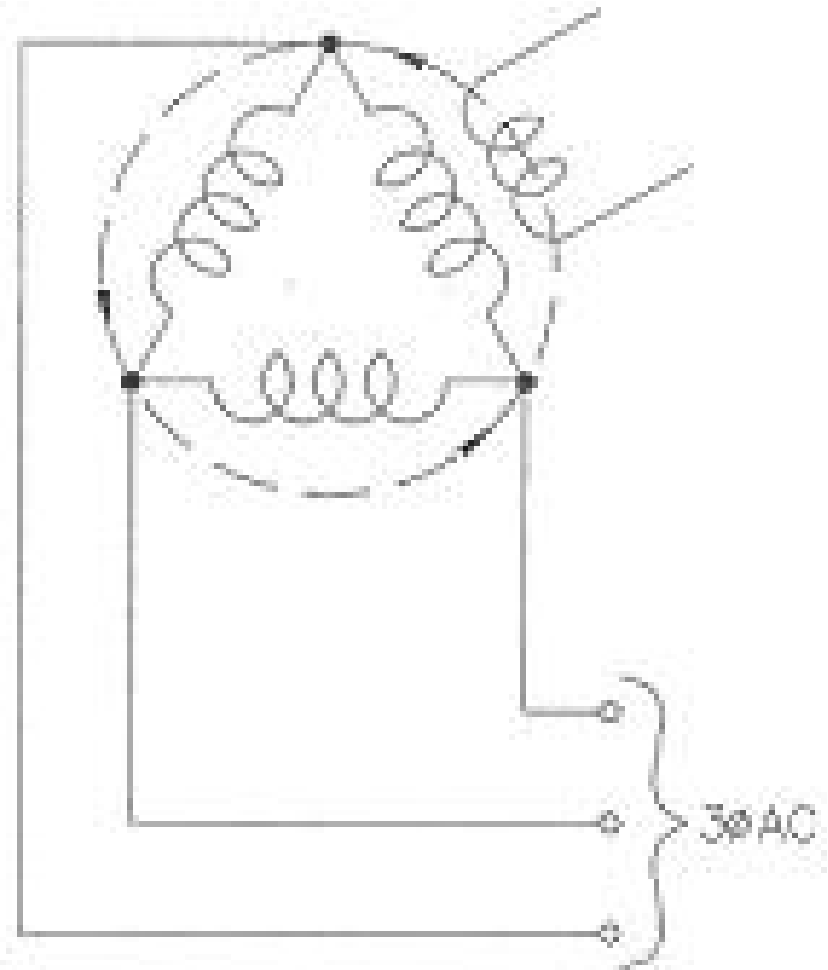
Note: Clamping diodes are *connected in parallel across coils of wire* to prevent damage from induced voltage spikes returning to the PCM and other electronic components as the coils shut off.



ATASA 5th Charging Systems

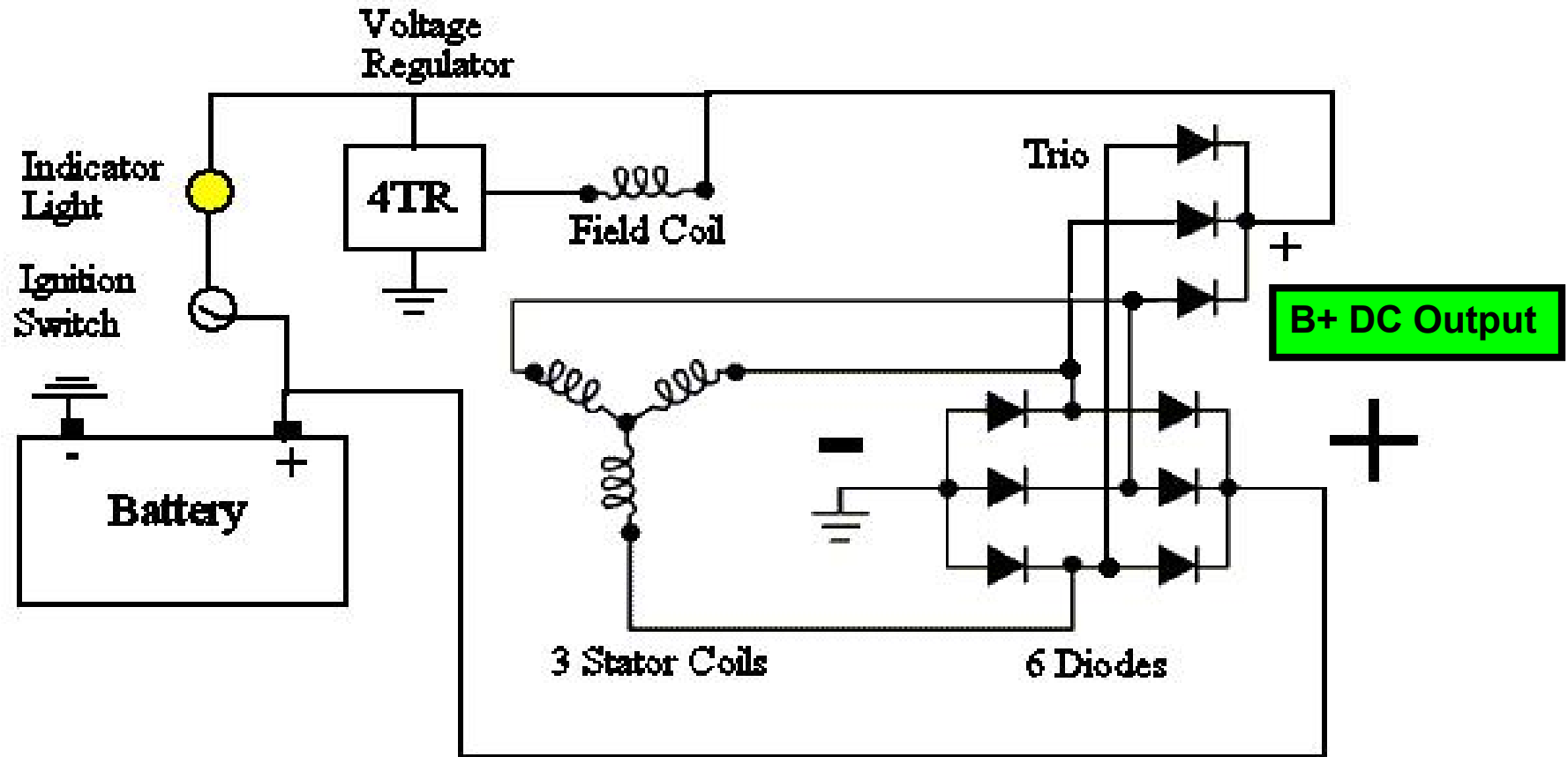


Wye-wound Stator

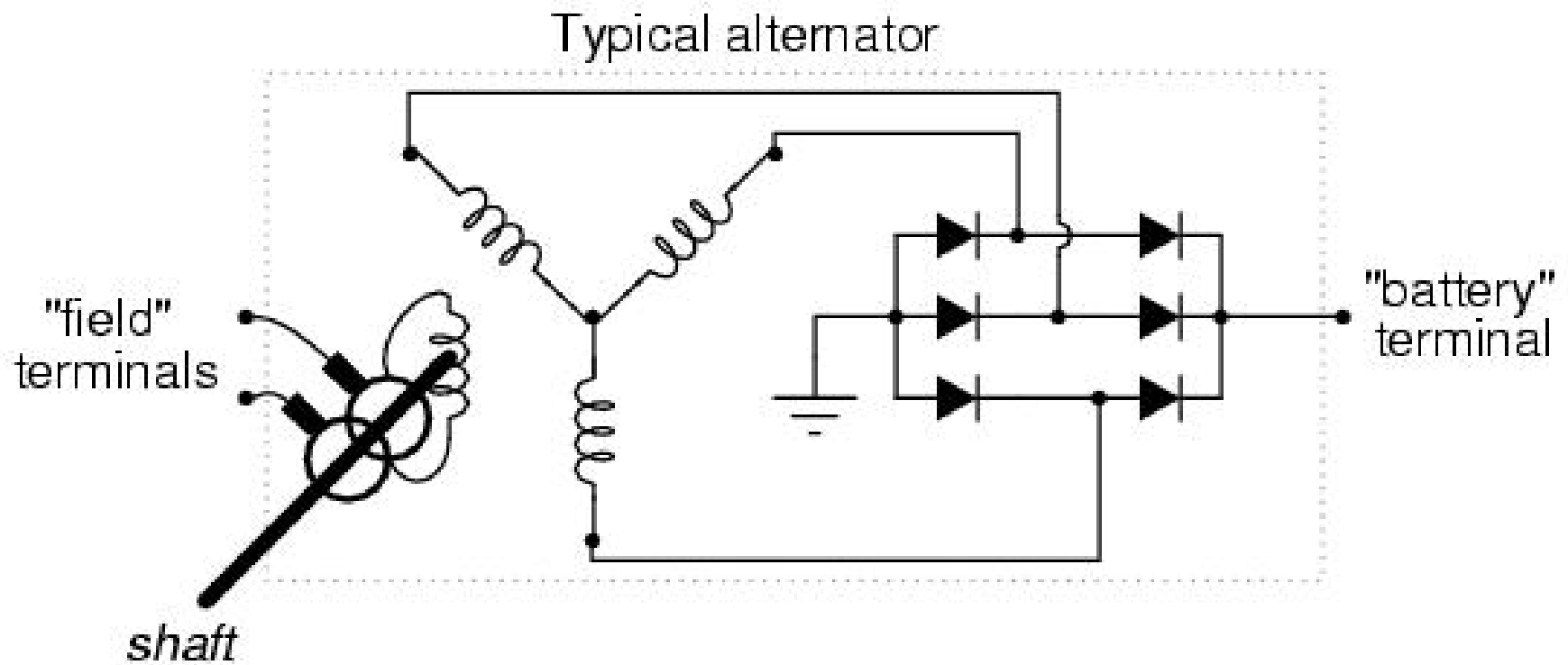


Delta-wound Stator

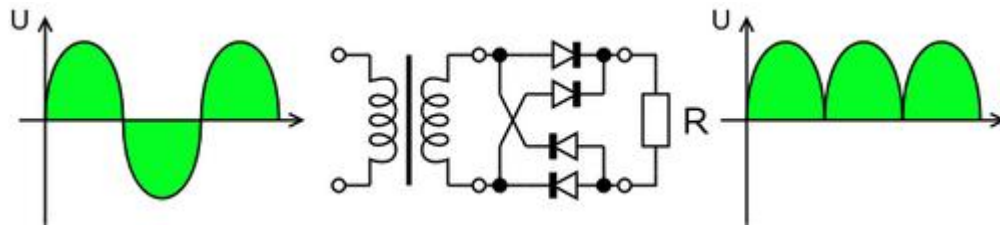
ATASA 5th Charging Systems



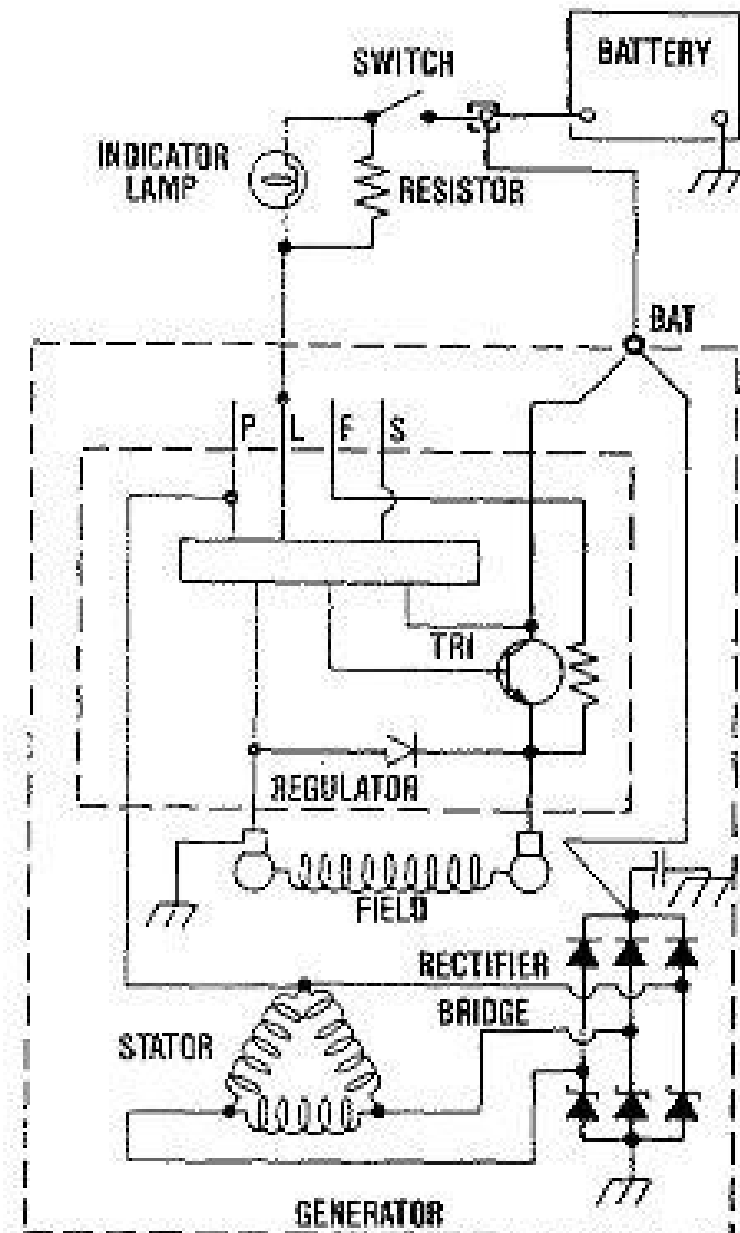
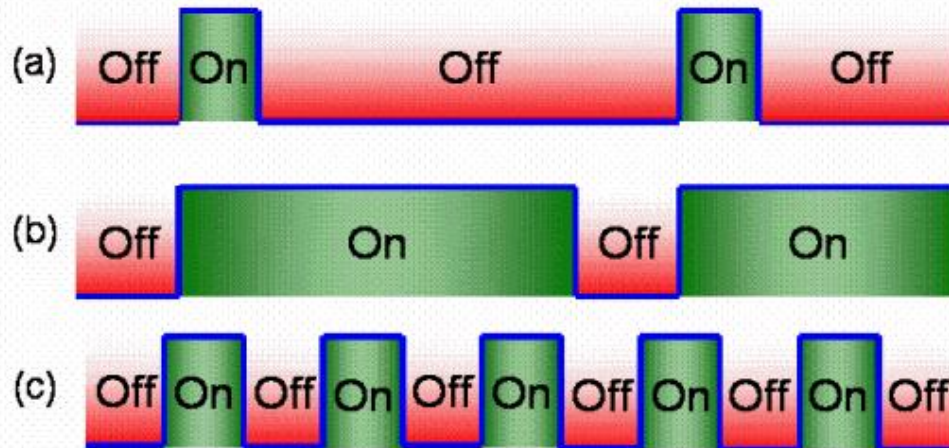
ATASA 5th Charging Systems



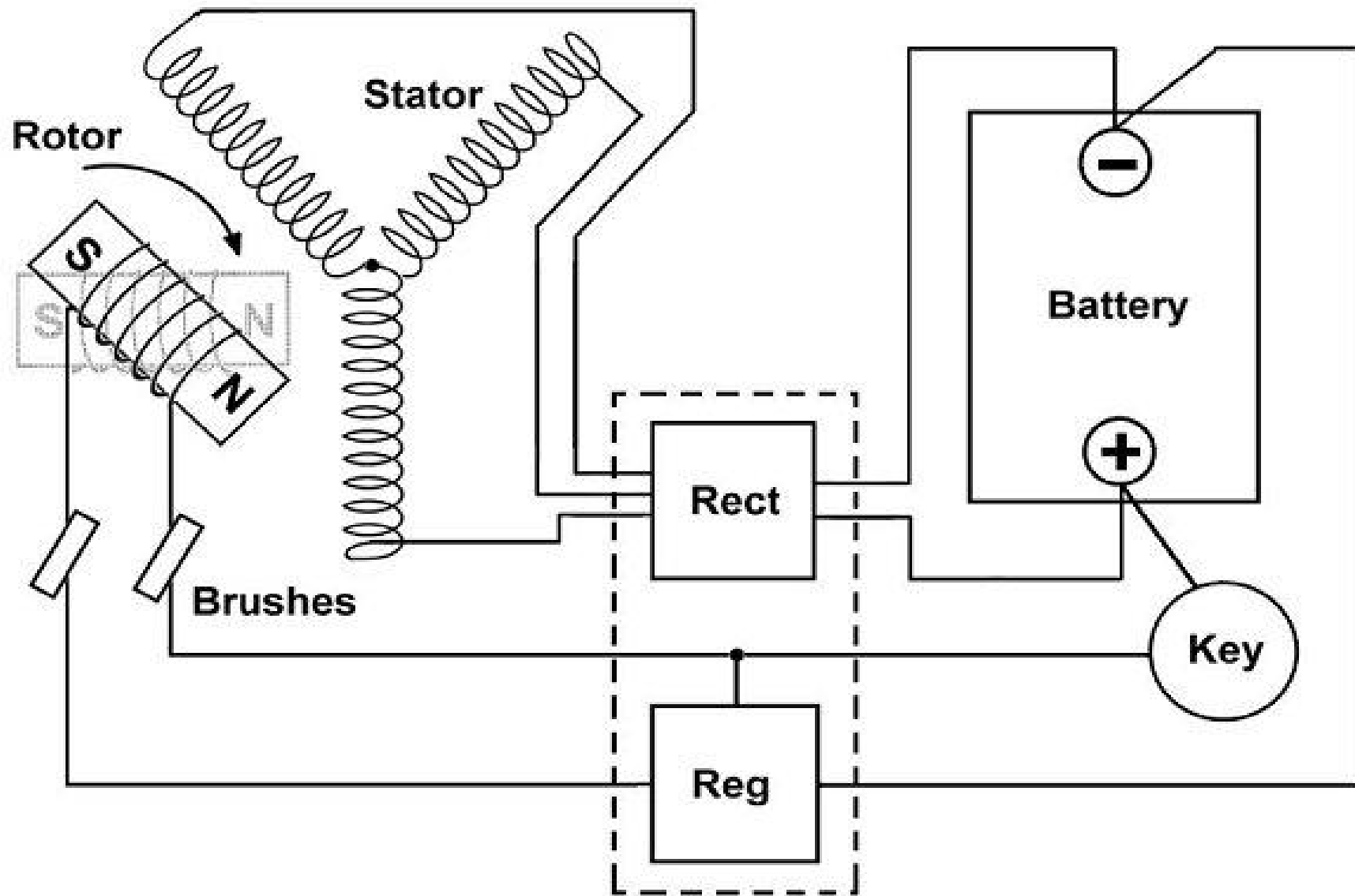
ATASA 5th Charging Systems



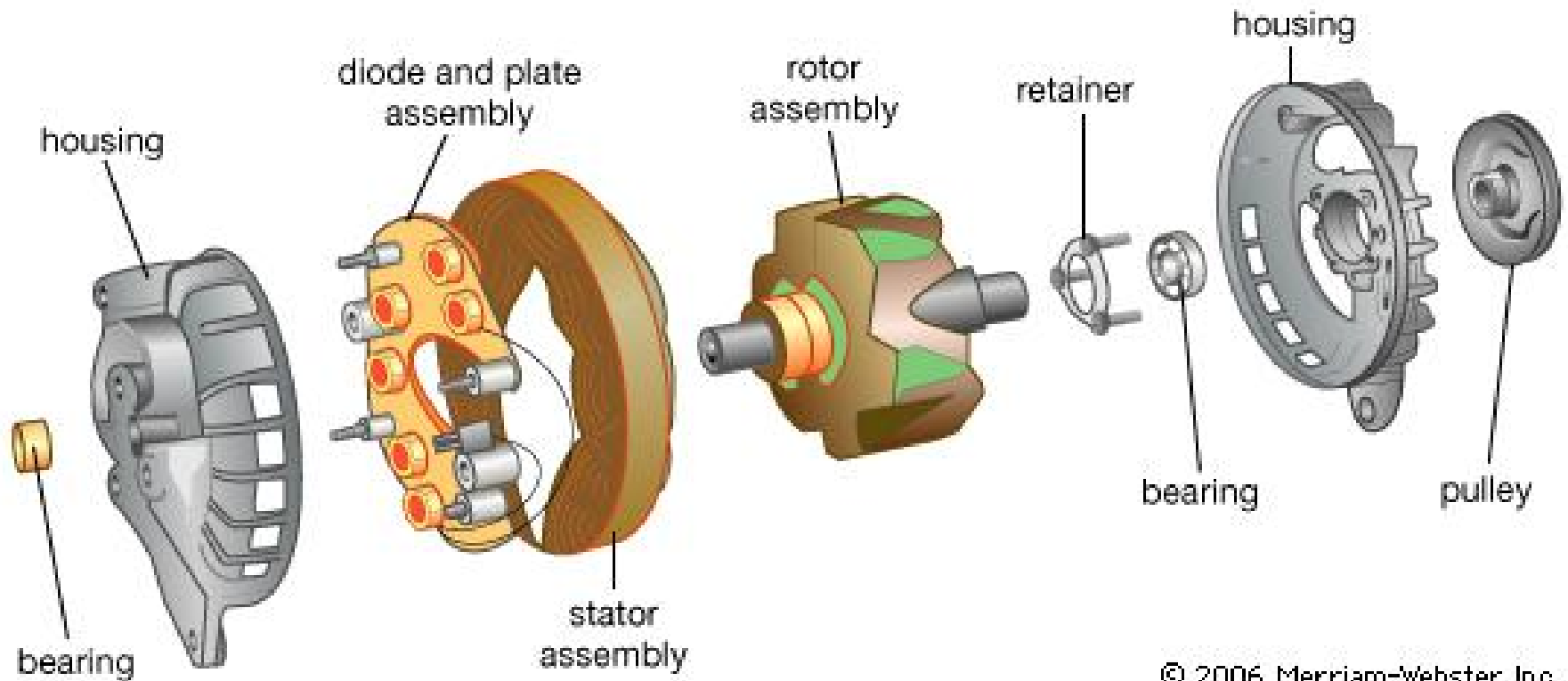
PWM duty cycles



ATASA 5th Charging Systems



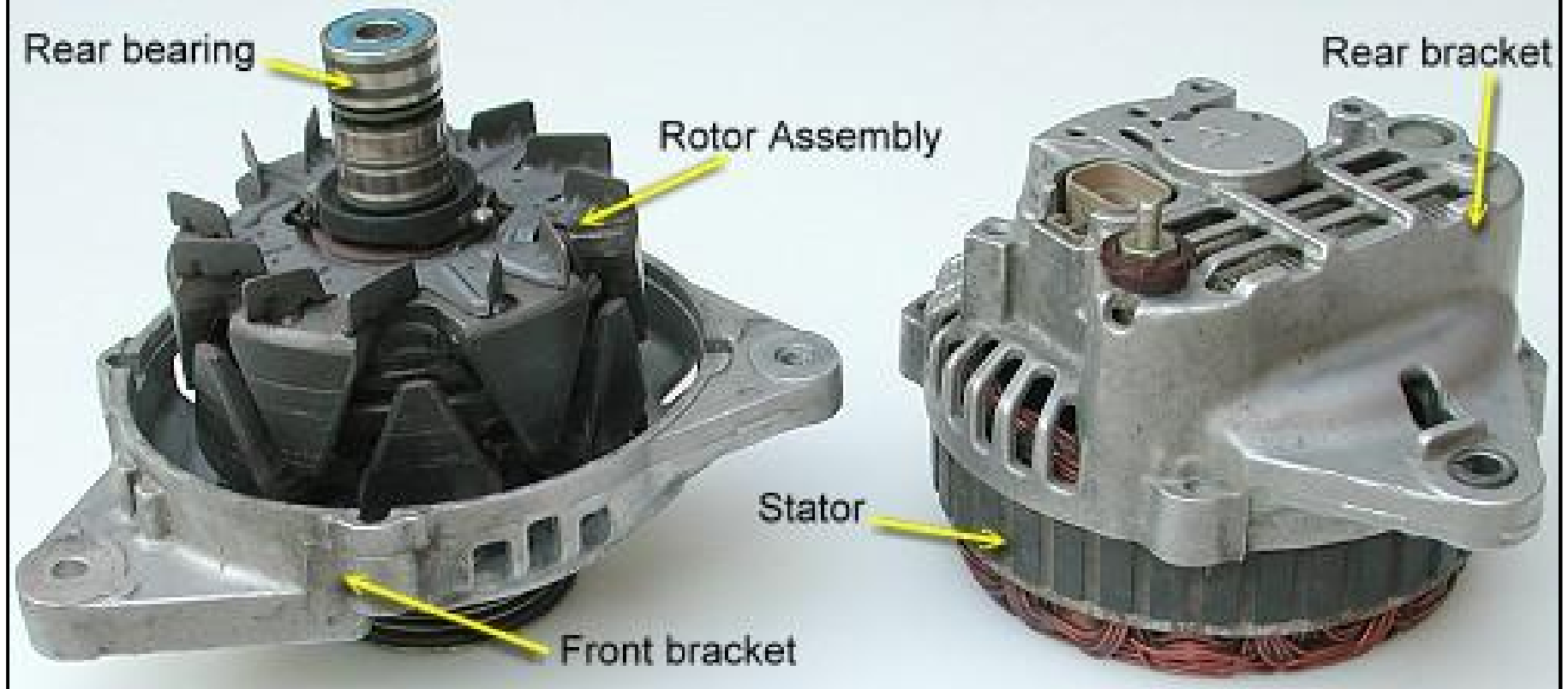
ATASA 5th Charging Systems



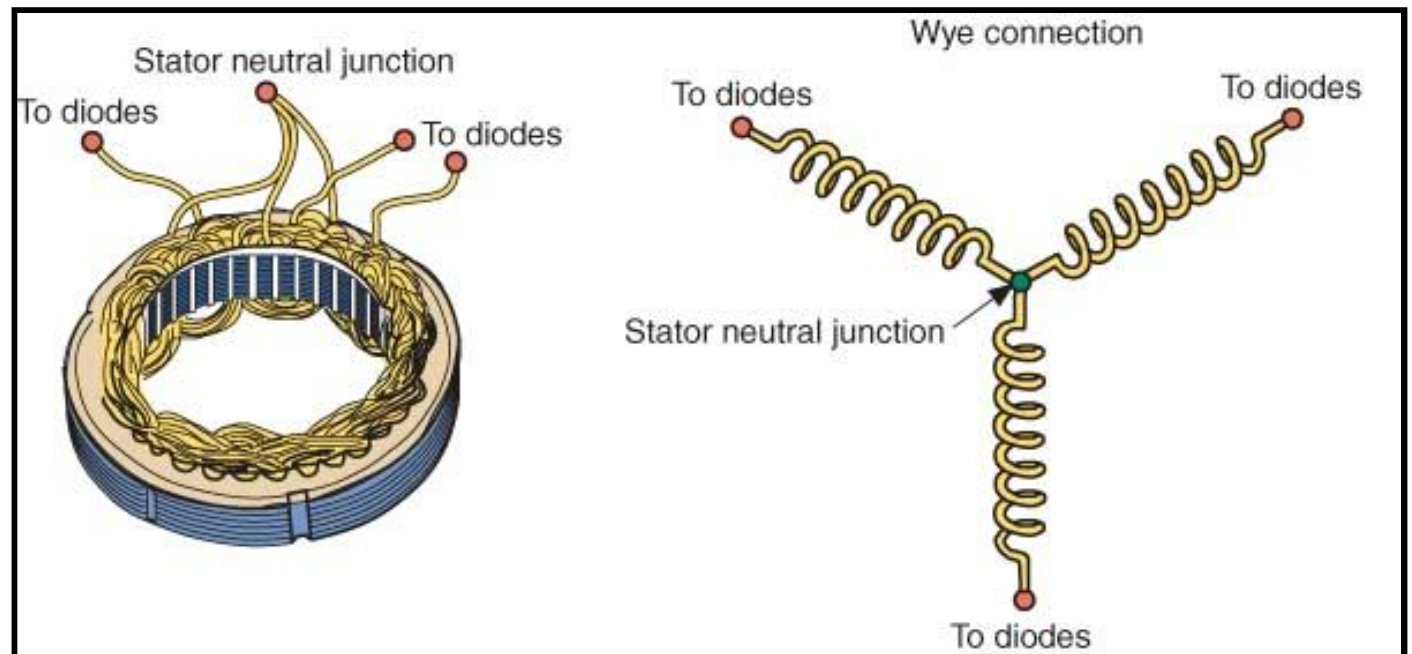
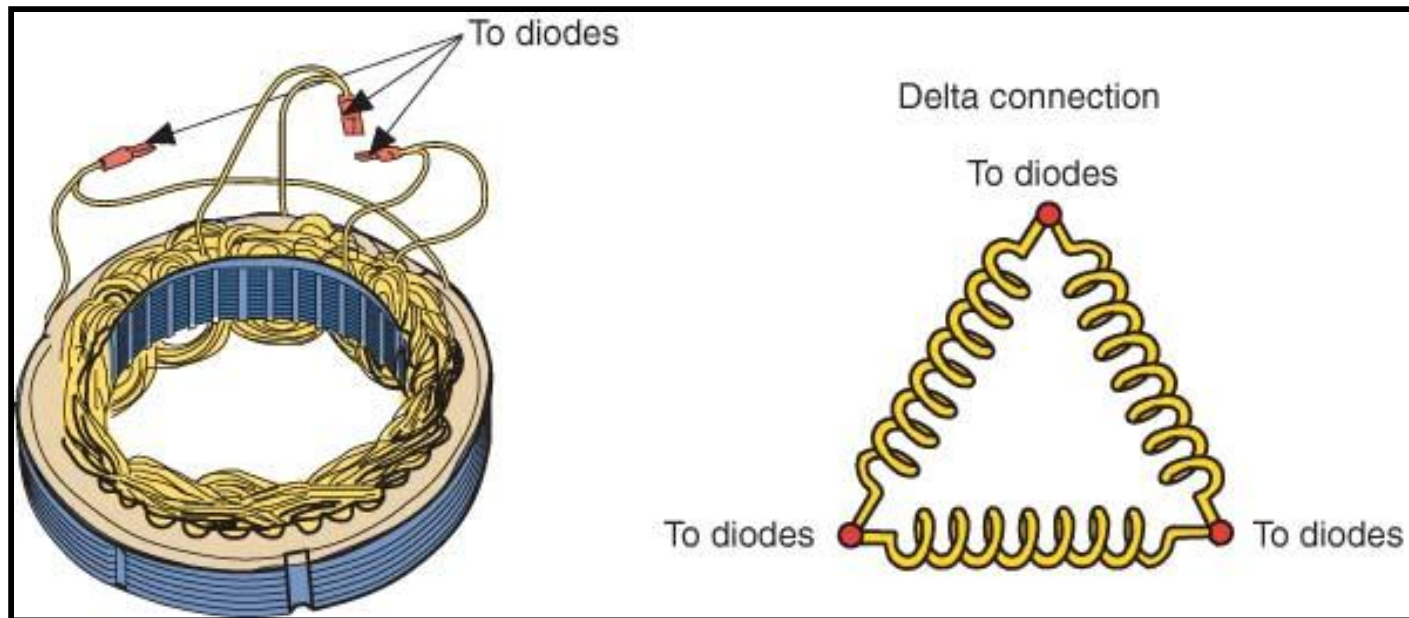
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Mitsubishi A4T01493 Alternator MD150657

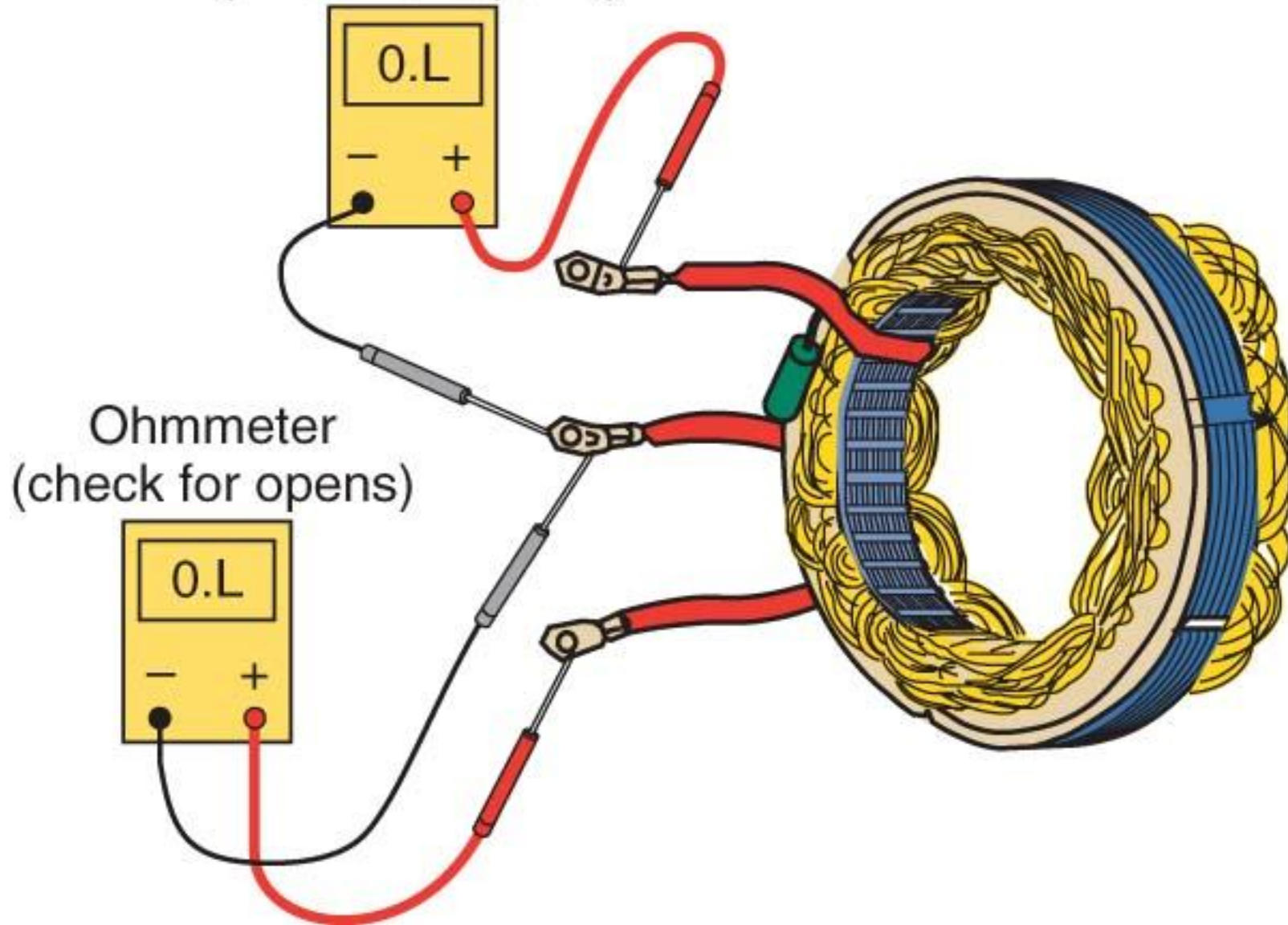


ATASA 5th Charging Systems

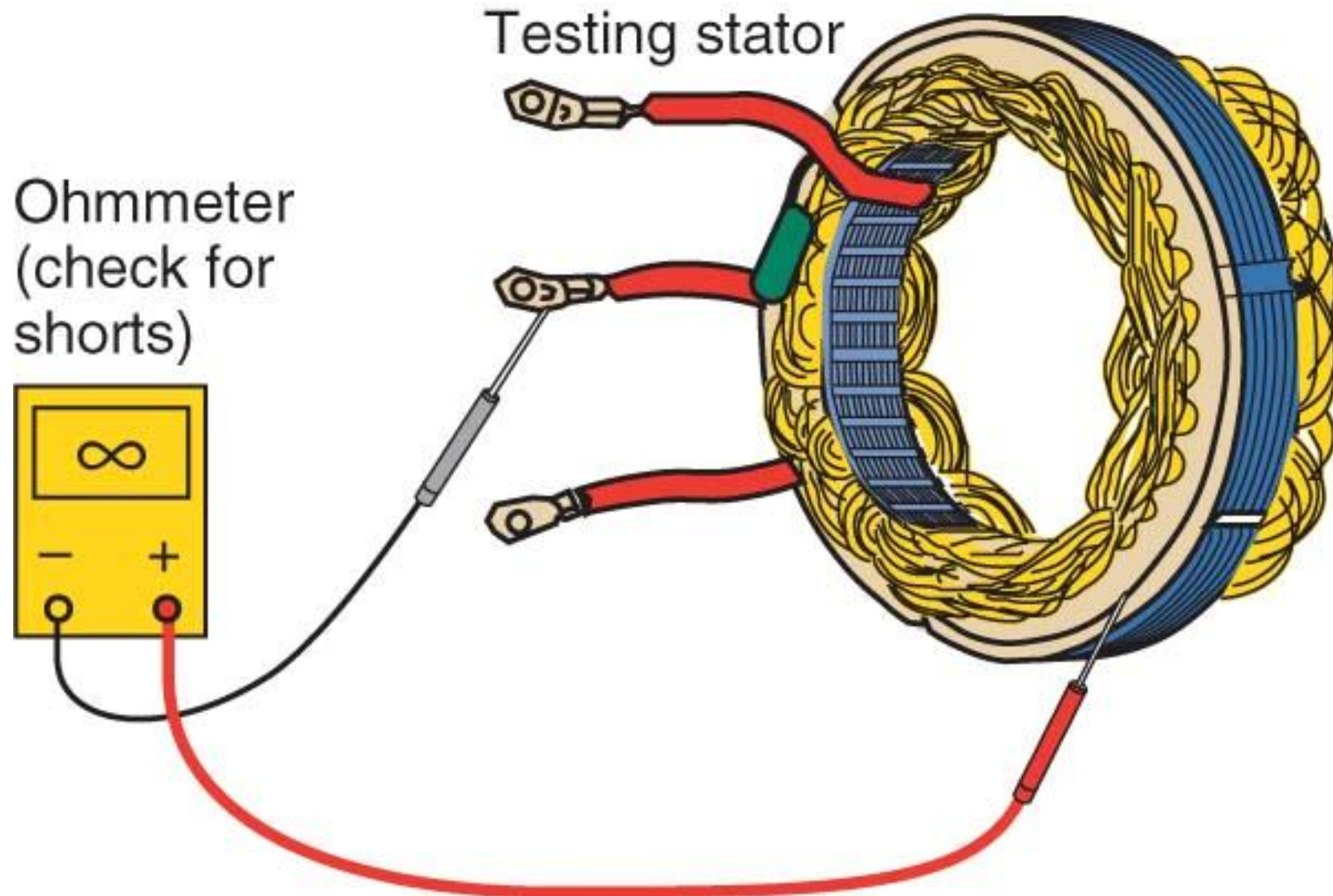


ATASA 5th Charging Systems

Ohmmeter
(check for opens)

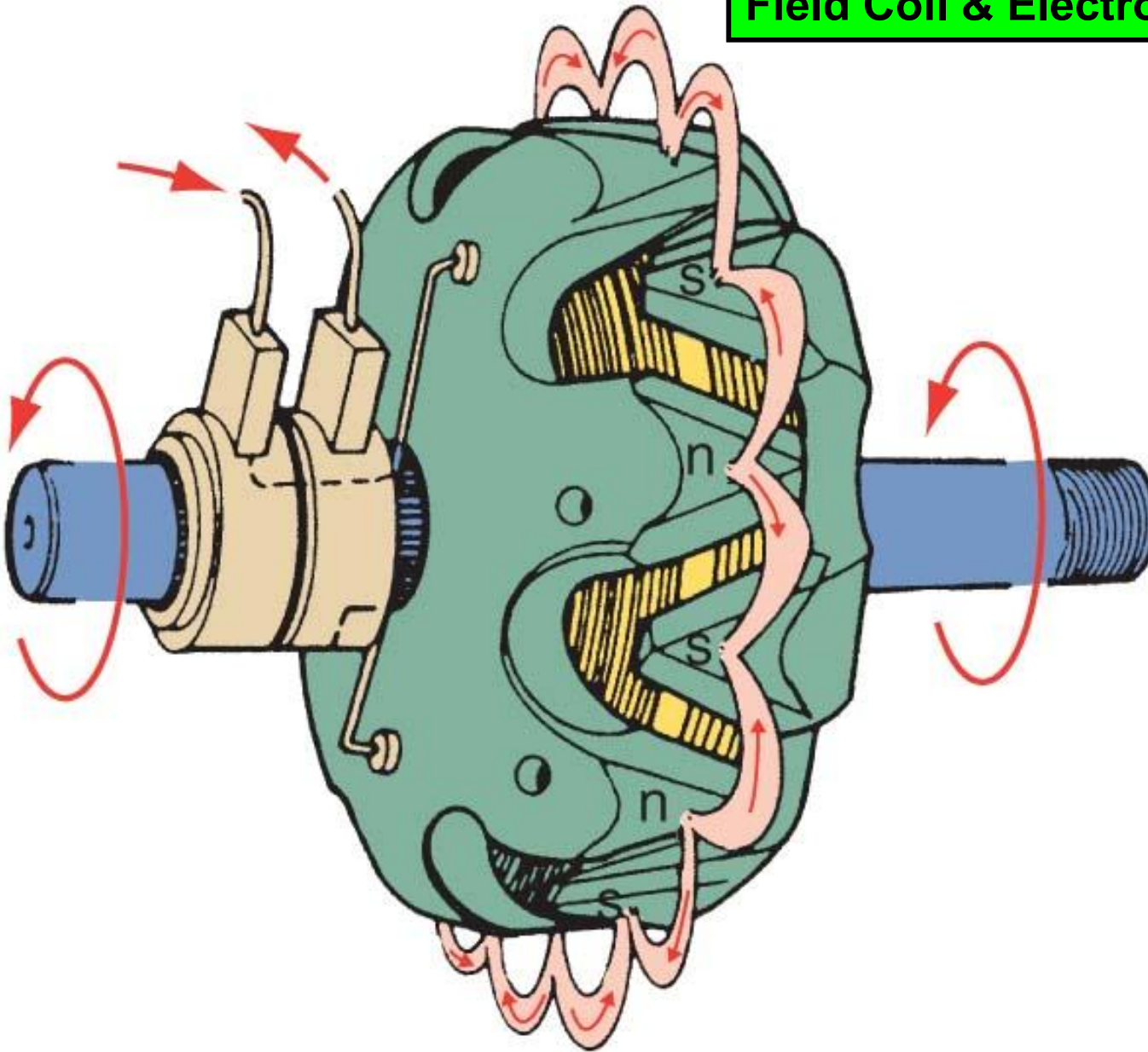


ATASA 5th Charging Systems



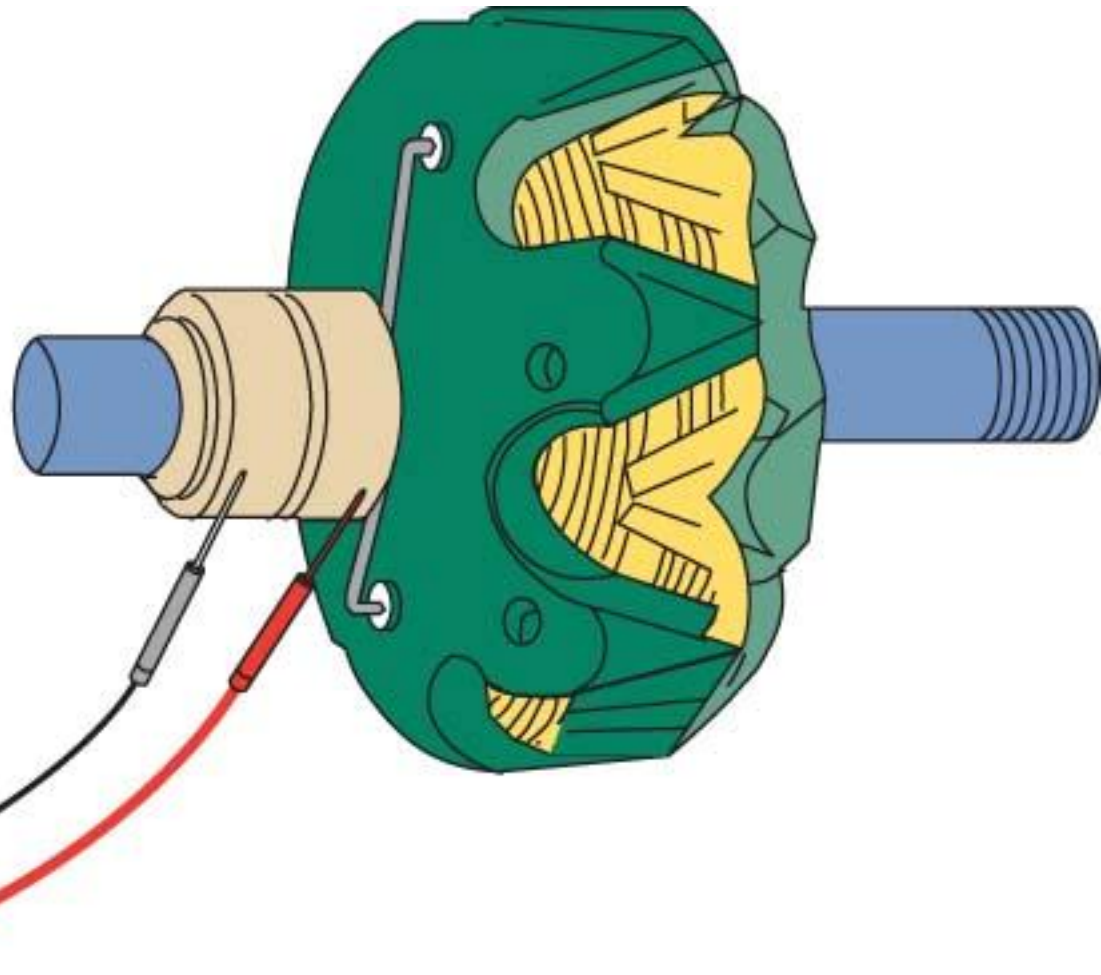
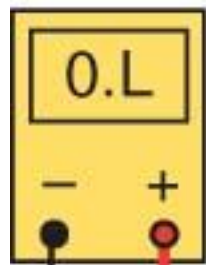
ATASA 5th Charging Systems

Rotor with Brushes, Slip Rings, Field Coil & Electromagnetic Poles



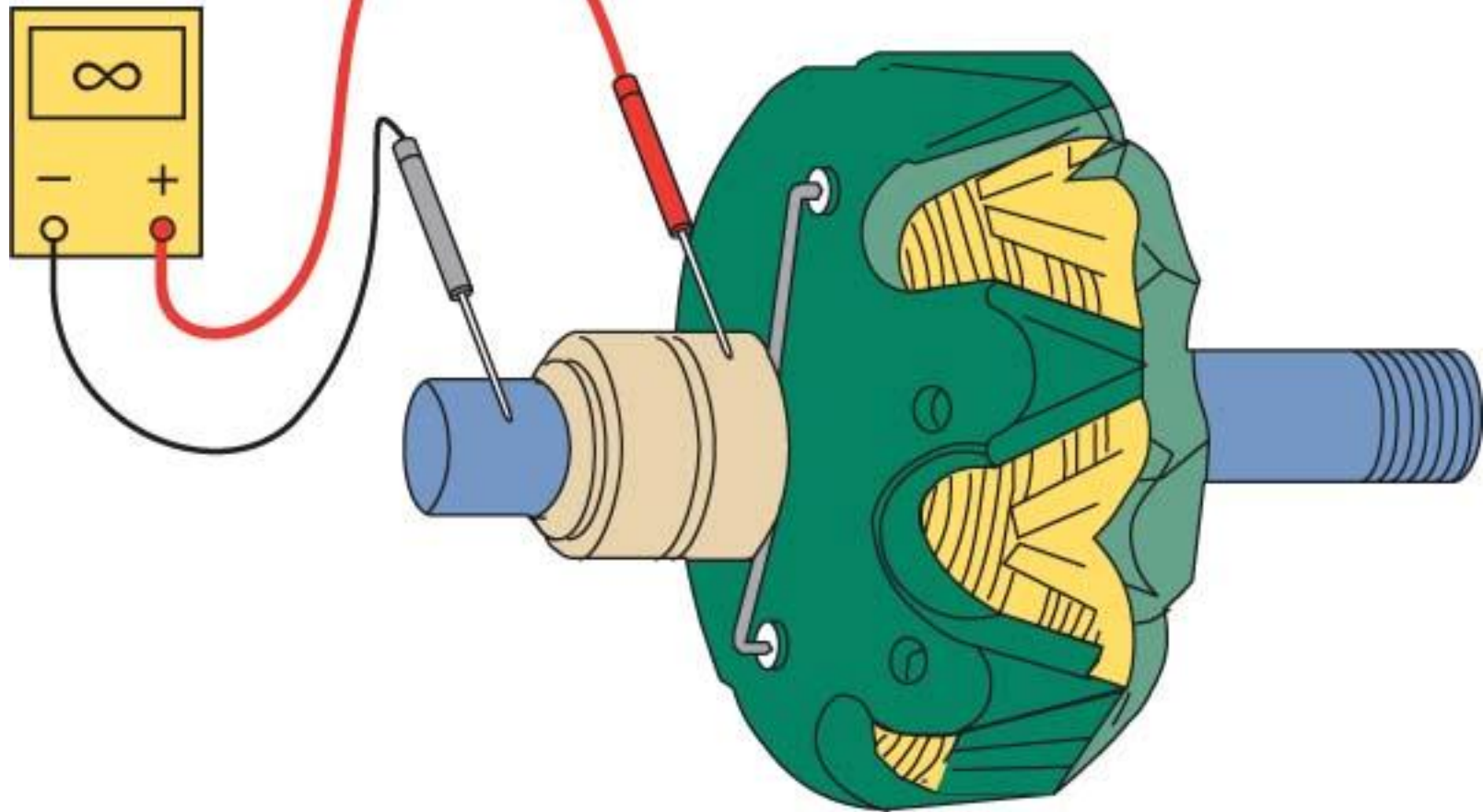
ATASA 5th Charging Systems

Ohmmeter
(check for opens)

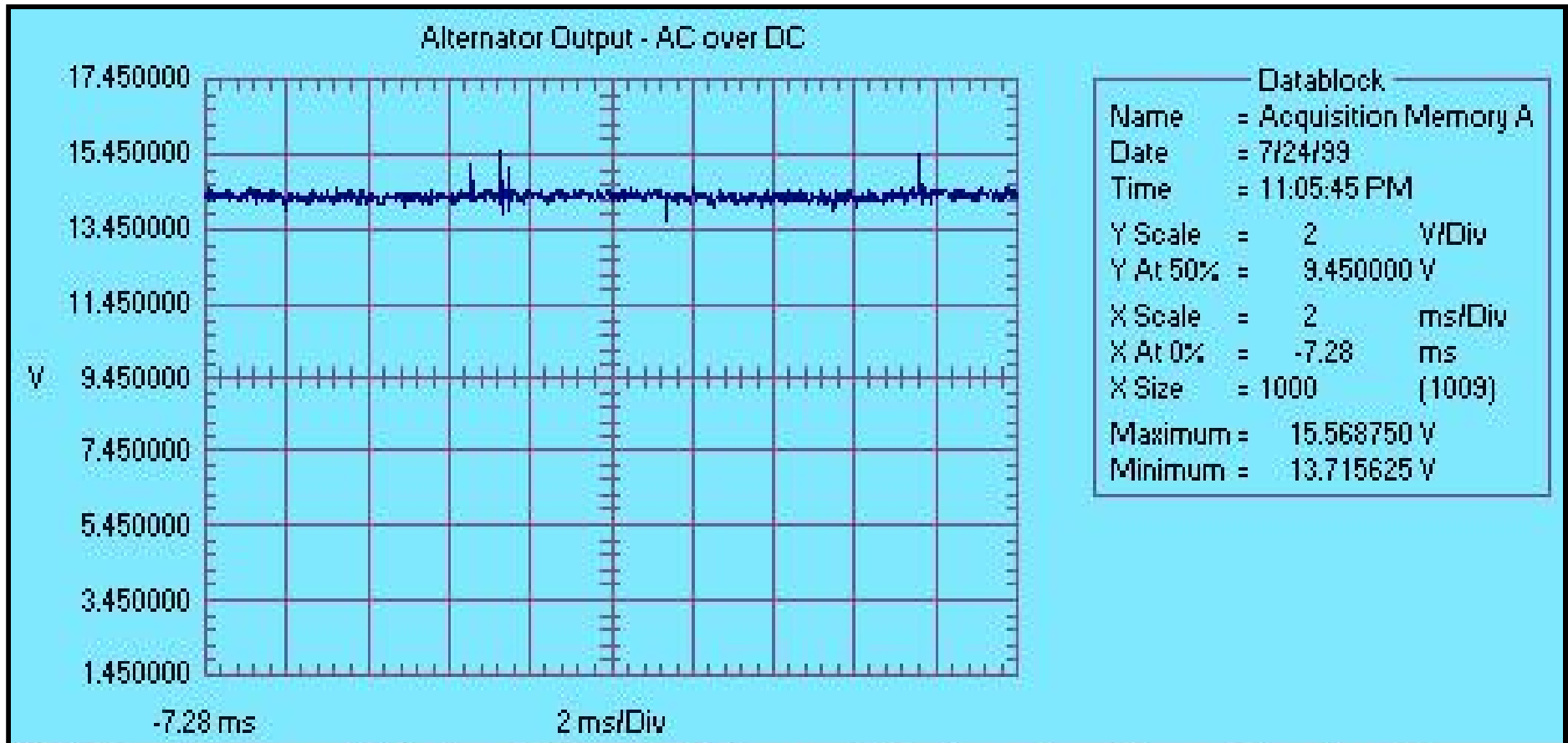


ATASA 5th Charging Systems

Ohmmeter
(check for shorts)

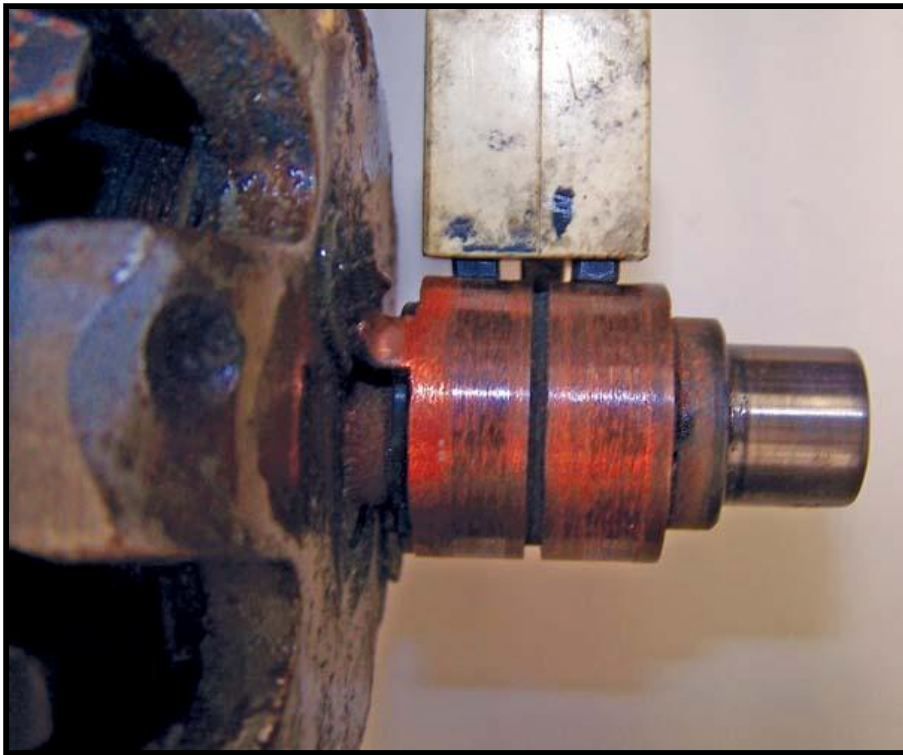


ATASA 5th Charging Systems

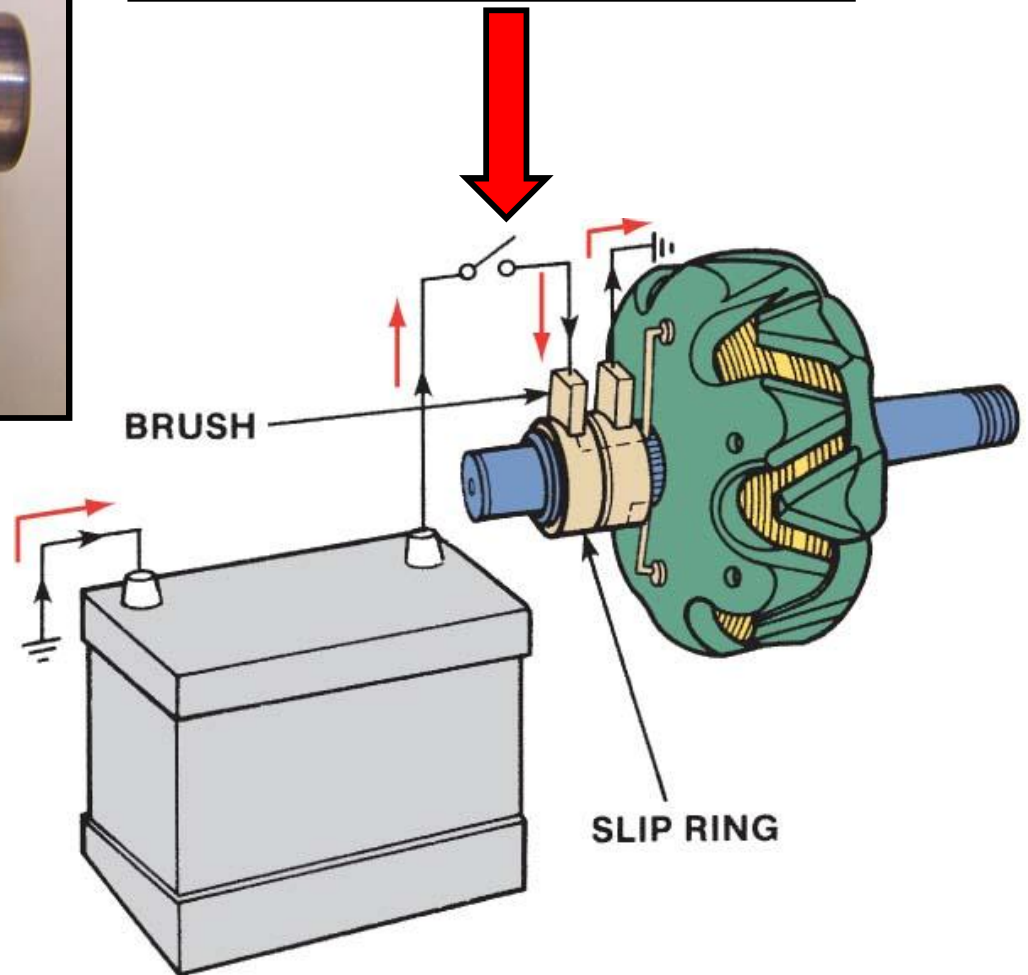


This is a (reasonably) clean DC output from a GM alternator. The spikes should represent ignition noise (this measurement was not taken direct from the alternator mains). Note the very low AC waveform (which happens to be 0.080 VAC). A shot rectifier diode will cause a significant increase in the AC pattern.

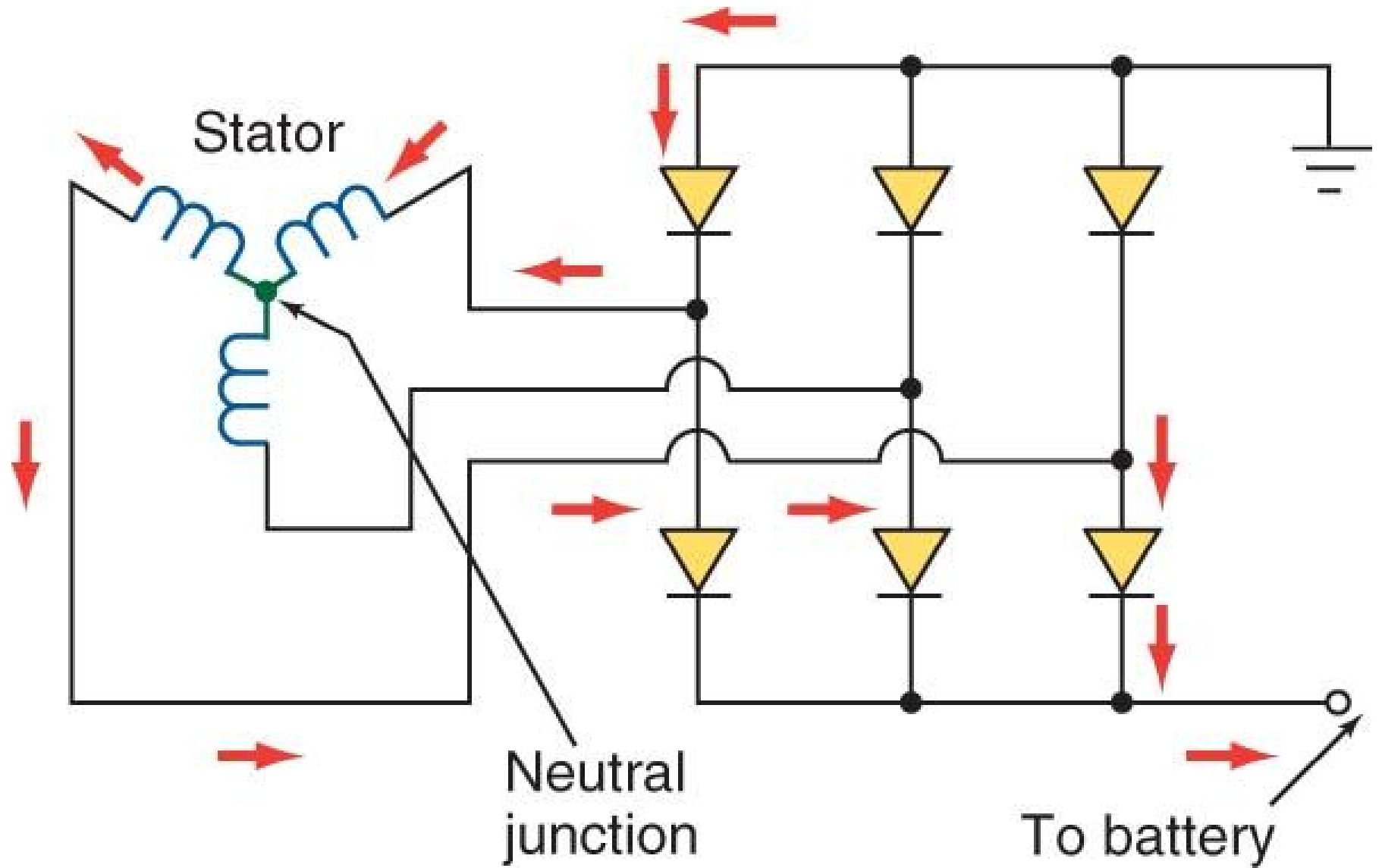
ATASA 5th Charging Systems



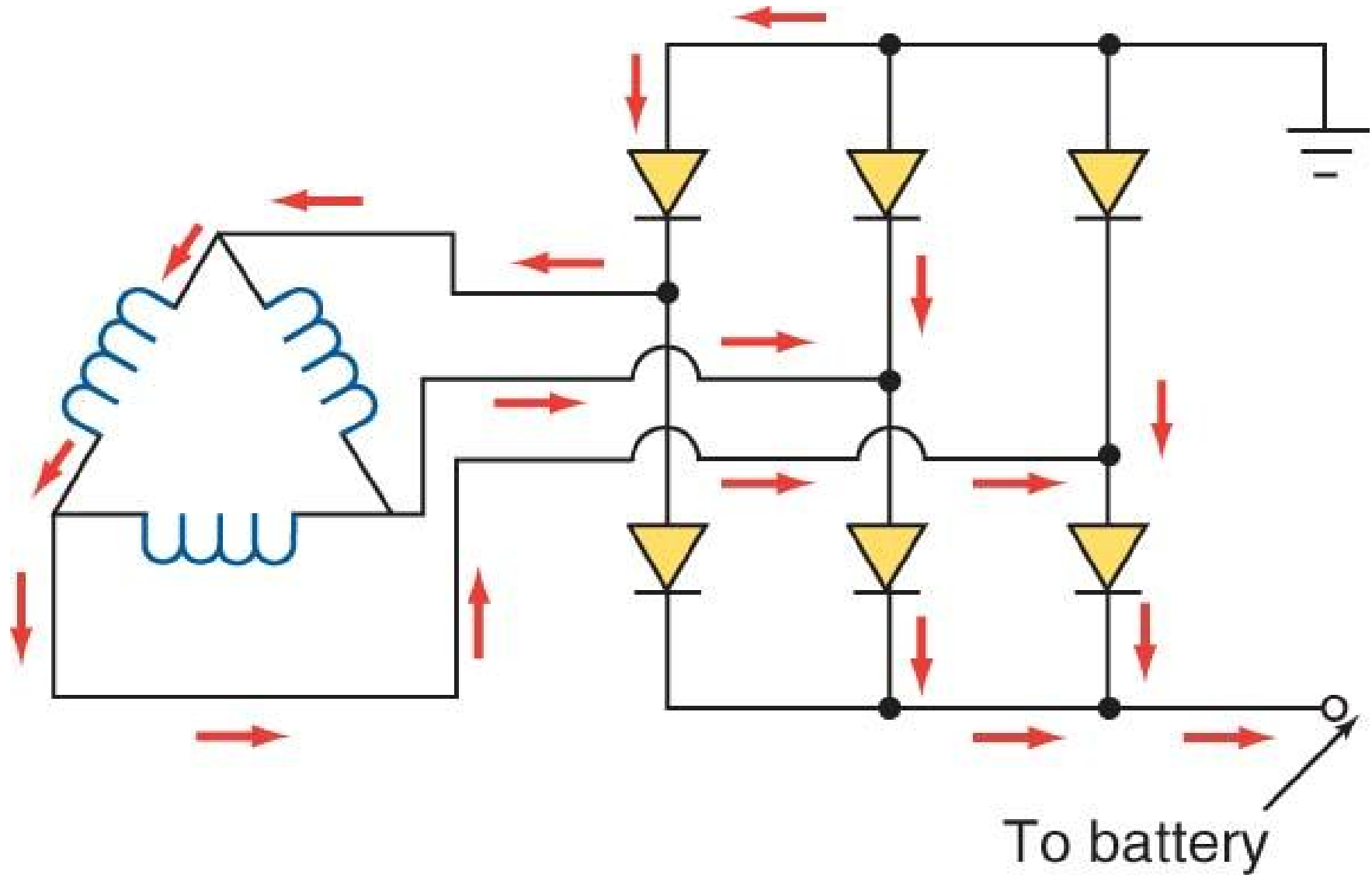
Switch Simulates
Voltage Regulator Position



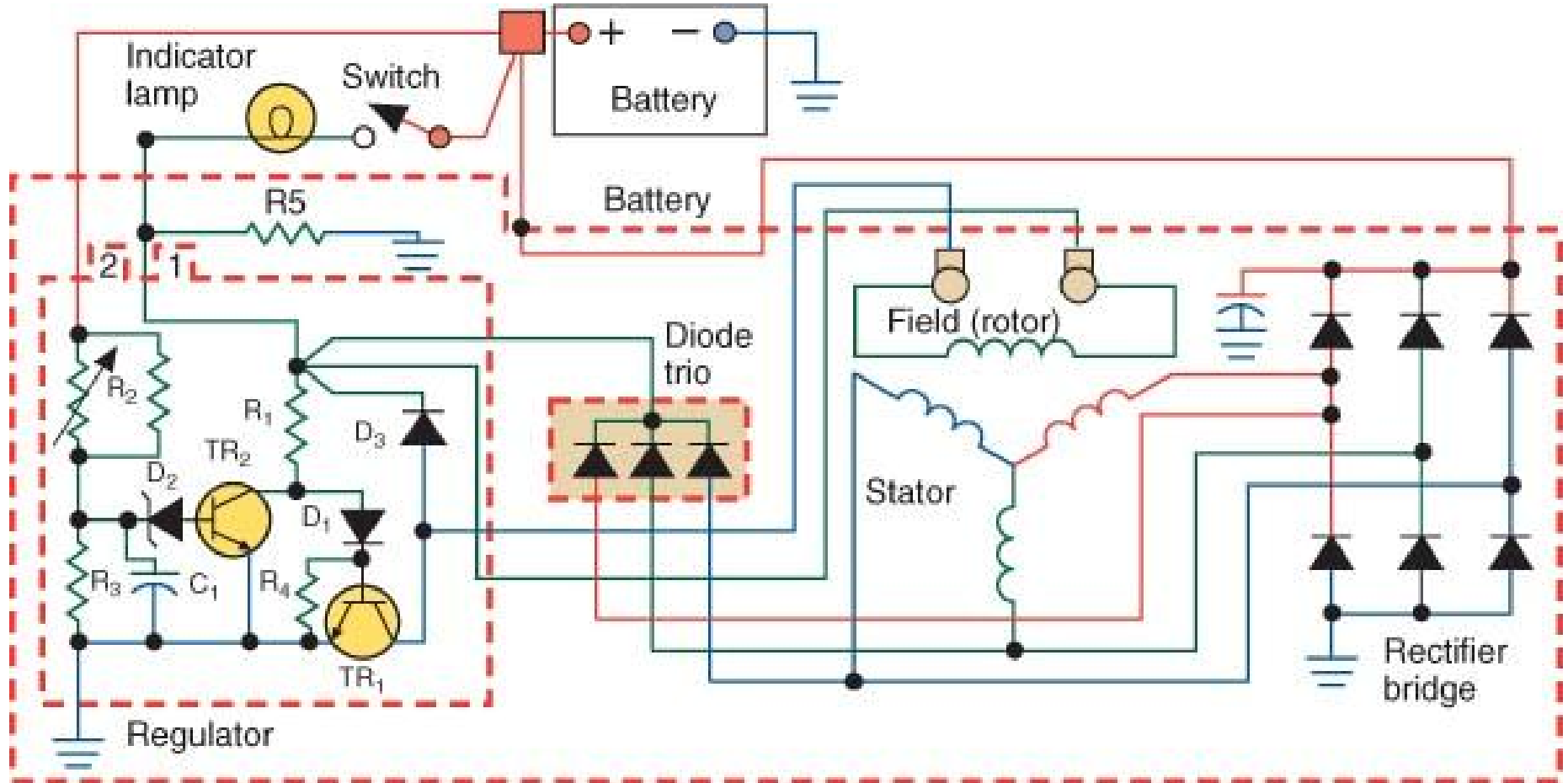
ATASA 5th Charging Systems



ATASA 5th Charging Systems

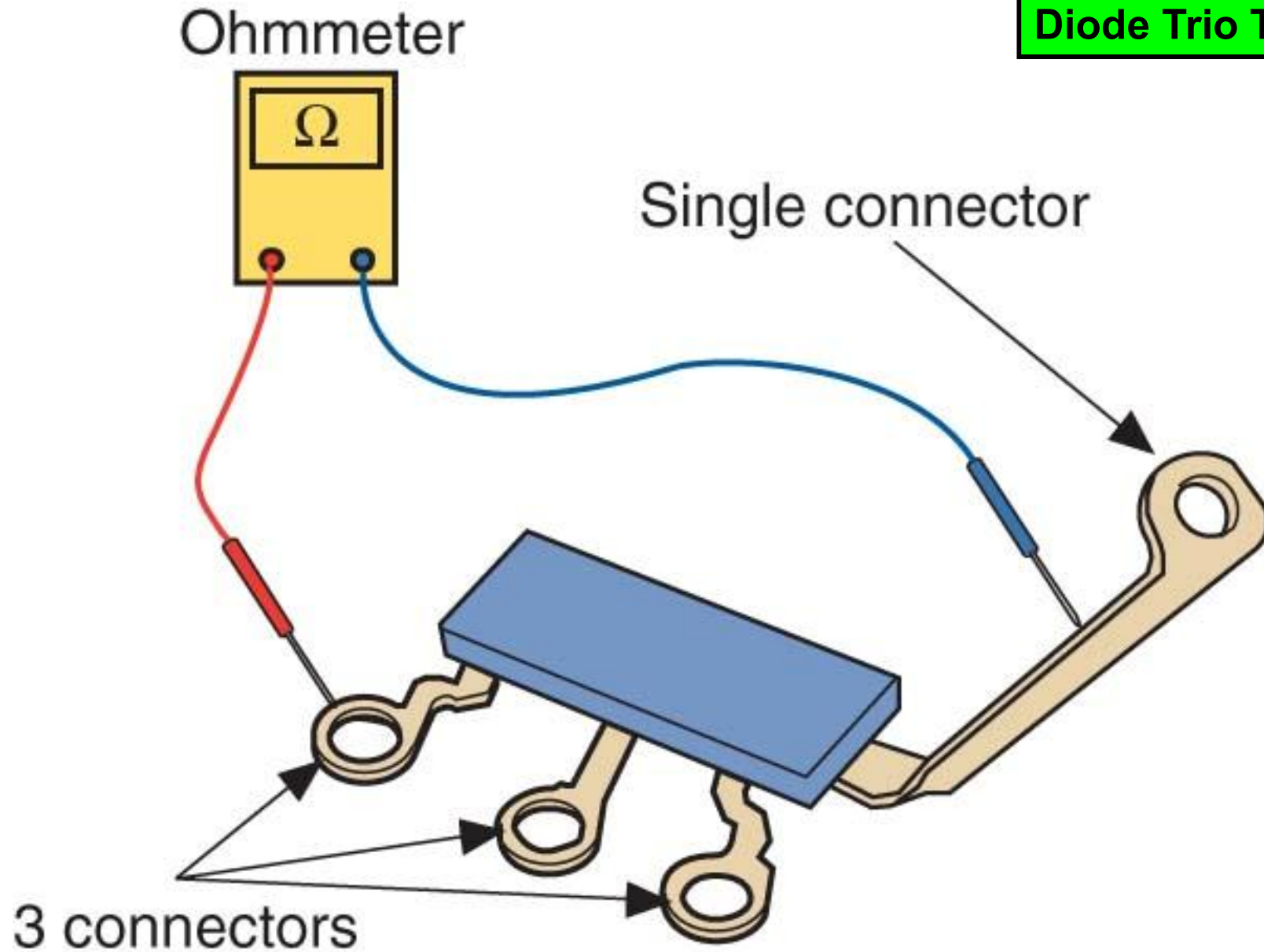


ATASA 5th Charging Systems

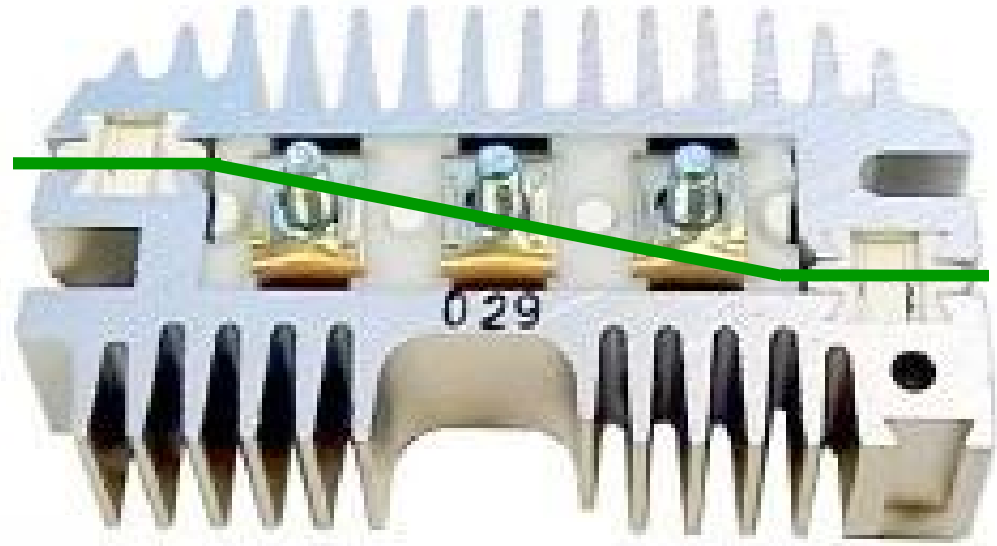
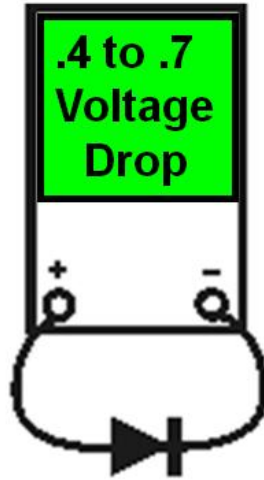
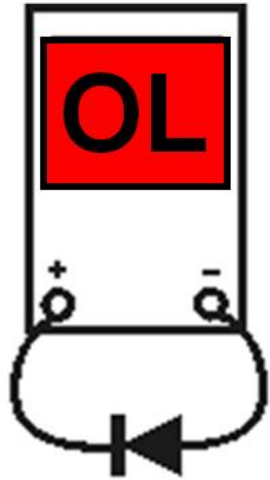


ATASA 5th Charging Systems

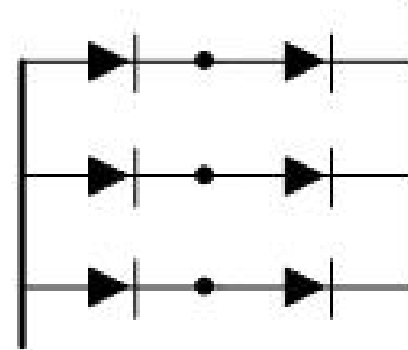
Diode Trio Test



ATASA 5th Charging Systems

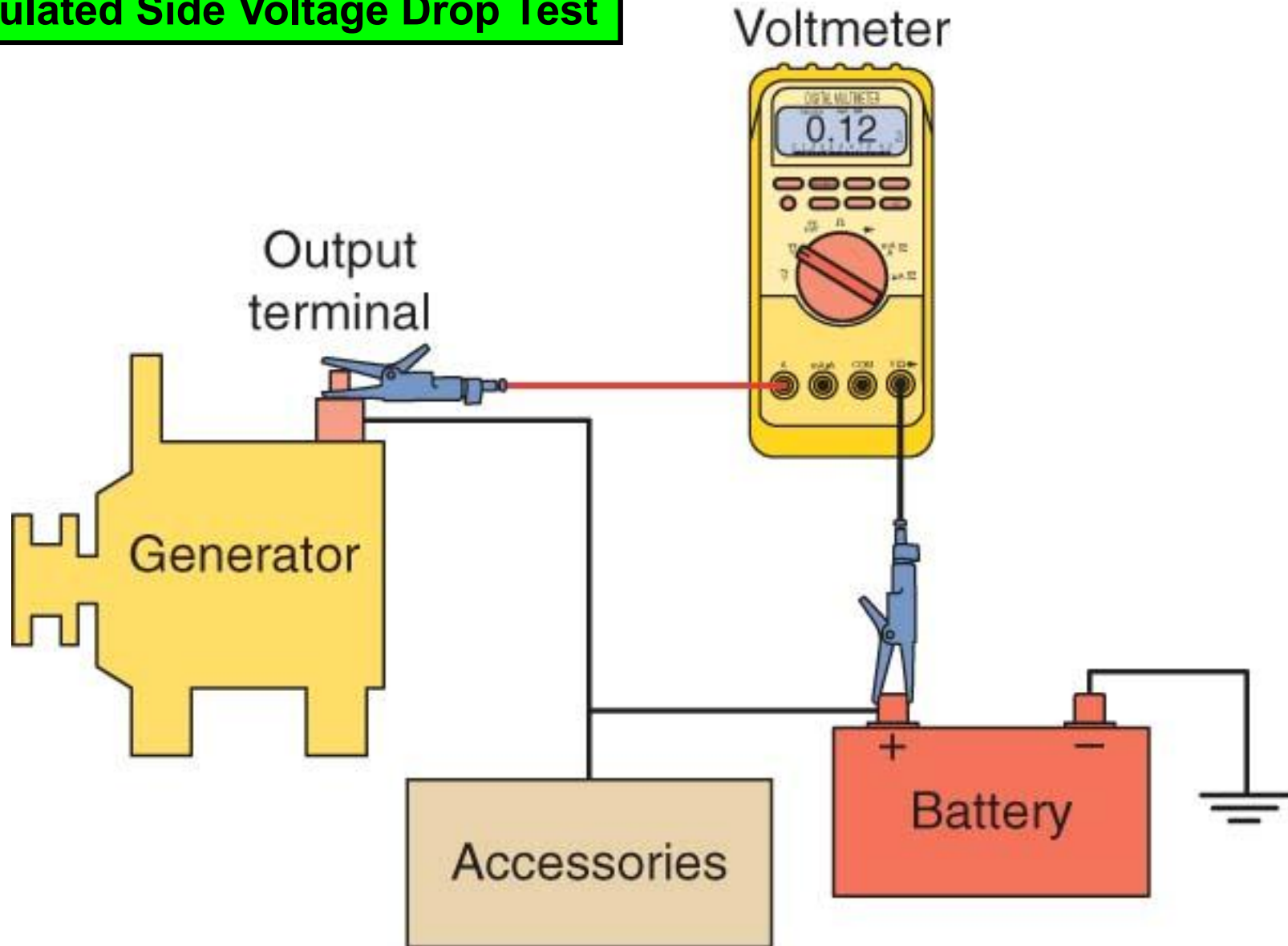


Test each diode in the rectifier bridge



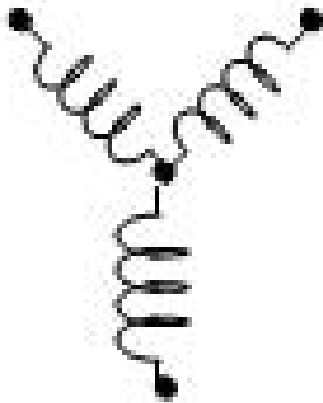
ATASA 5th Charging Systems

Insulated Side Voltage Drop Test

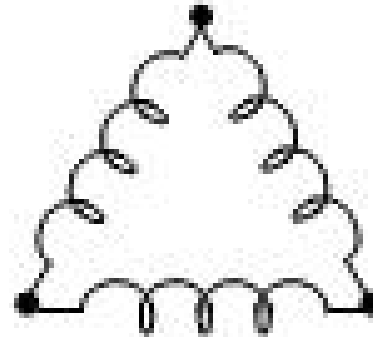


ATASA 5th Charging Systems

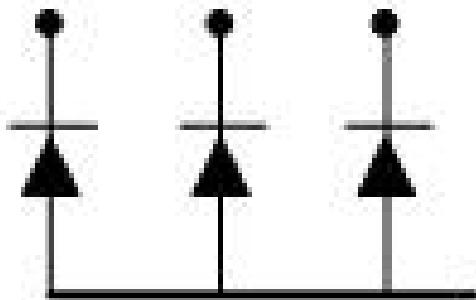
32. Identify the charging system schematic symbols:



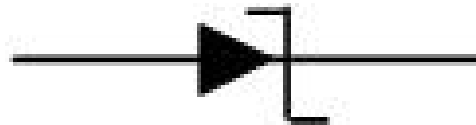
Wye-wound Stator



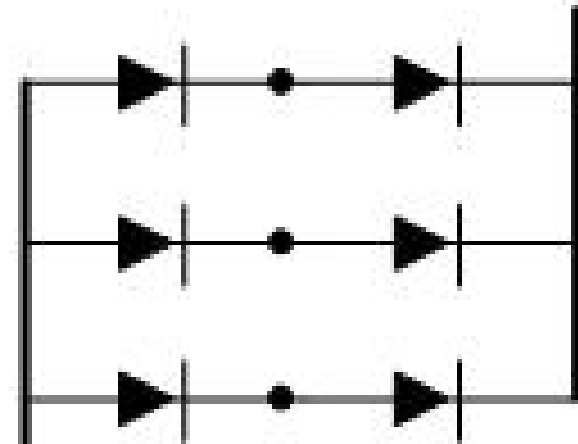
Delta-wound Stator



Diode Trio



Zener Diode



Rectifier Bridge

ATASA 5th Charging Systems

32. Identify the charging system schematic symbols:

