



# TROUBLE-SHOOTING 14V TYPE A ALTERNATOR SYSTEMS

On Piper, Beech, Cessna, Citabria, Grumman, Maule, etc

By: Femi G. Ibitayo

Replacing components until an electrical charging system problem goes away is an expensive and often unsuccessful trouble-shooting method that can overlook the reason the component failed. A better method is a systematic approach that locates and solves the problem. A good way to start analyzing a charging system problem is: Pre-voltage regulator checks, voltage regulator checks, post voltage regulator checks.

## PRE-VOLTAGE REGULATOR

Check the field circuit breaker (1-2), the alternator switch (2-3), wires and terminals, and the OV relay (3-4) for contact resistance build-up: resistance should be less than 0.1Ω. Without the engine running, with Master switch ON, the measured voltages at points 1, 2, 3, and 4 should be the same as the bus voltage. If there is a difference of more than 0.1V between the four points, parts like circuit breaker, switch, or OVR has a high resistance due to age or it is defective.

## AT VOLTAGE REGULATOR

Check the voltage at pin I of the regulator (4). It should be the same as the battery or bus voltage. The voltage at the field terminal of the regulator (5) should be less than 1 volt (unless the field is defective).

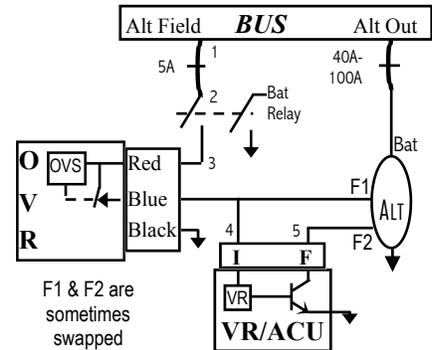
Check to see if the regulator is shorted. With the wires to terminals I and F removed, check the resistance between pins F and I and F and the case of the regulator. If the resistance is less than 1KΩ the regulator is defective.

## POST VOLTAGE REGULATOR:

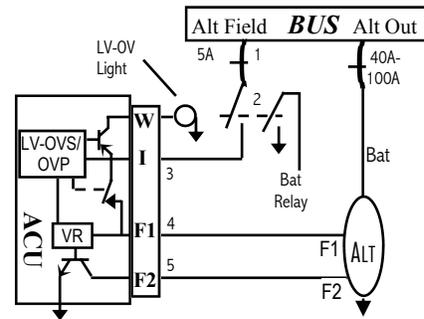
Measure the alternator field resistance. The resistance from F2 to ground should be infinite or open. Resistance from F1 to F2 on the alternator should be from 3 to 6Ω. A resistance of greater than 7Ω usually means dirty brushes, consider changing them. Check the resistance of the meter leads before measuring the field. Check for a “flying” short and other intermittent problems by slowly rotating the alternator while measuring the field resistance. A drop below 3Ω could indicate a bad alternator.

After troubleshooting the system, finding and resolving any faults, run the engine at 1500 RPM. The bus voltage should be steady at 13.8 – 14.3 volts. If you are monitoring the field voltage, you will notice that with little load on the bus, the field voltage will be closer to battery voltage than with a heavy load. In the type A system the field voltage drops towards 0 volts as you increase the system load. In the type B system the field voltage increases with system load.

**Figure 1**  
Separate OV Protection, Low-OV Sensor & Voltage Regulation



**Figure 2**  
ACU combines Voltage Regulation, OV Protection, & Low-OV Sensor



RECORD MEASURED TEST DATA

Test Pt	R1510N	R1510N	R15V0N	R15V0N
1. Volts				
2. Volts				
3. Volts				
4. Volts				
5. Volts				
W. Volts				
R FLD, Alt Ω				
R FLD, ACU Ω				
R. C/B, Ω				
R. Alt Sw, Ω				



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### The Type A Alternator Charging System

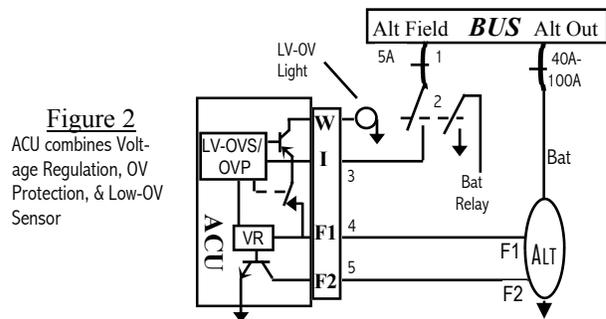
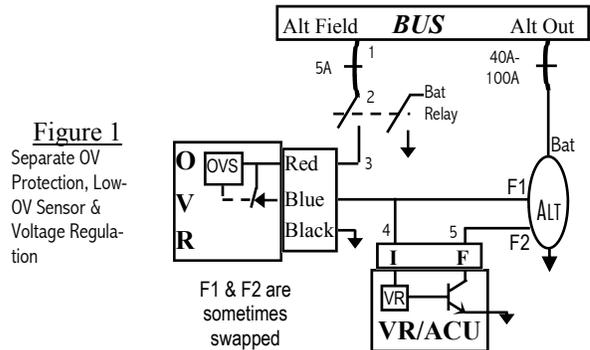
#### An overview

The alternator provides power used in charging the battery and running other electrical systems in the aircraft. The current flowing through the field coils of an alternator controls its output current. The power to excite the alternator's field comes from the aircraft bus through the field circuit breaker, alternator switch and **over voltage relay (OVR)** and the **voltage regulator (VR)**. The field and alternator circuit breakers protect against a ground short circuit in the charging system.

The **voltage regulator (VR)** controls the alternator's field to keep the aircraft electrical system voltage at a specific level. The VR switches the field current on/off so fast (several times a second) that the output voltage of the alternator stays at the VR set point. As long as the alternator's output voltage is less than the VR set point the switch is closed, current flows, and the alternator's output increases. When the alternator's output voltage exceeds the VR set point, the switch opens, current flow stops, and the alternator's output decreases. An **alternator control unit (ACU)** combines the voltage regulator with other functions, such as over voltage protection. The type A regulator, like the R1510N or VSF7203, controls the alternator by switching ground on/off to the "low" side of the alternator field (F2). The other side of the alternator field (F1) is connected to power through the alternator switch and OVR.

In today's general aviation, the type B (power switching) circuit is the most prevalent type of charging system. This is the reason some mechanics, who are used to working on the type B systems, often misdiagnose the type A system. The following guidelines are important to keep in mind when dealing with the type A system:

- **Do not** connect power to the field terminal of the alternator to see if it will produce power. For the type A system, with the engine running, momentarily connect ground to the field (F2) terminal while F1 is connected to the output of the OVR. The voltage will exceed 16V and trip the OV Relay. The If the OVR is not in the system, grounding F2 (in a type A system) while F1 has power on it **will** cause an over voltage condition that could damage radios and other voltage sensitive devices.



### The Type A Alternator Charging System

**Do** check your alternator's field resistance. Low resistance can damage the VR and OVR and is usually caused by a shorting brush or field winding. High resistance will limit the output of the alternator and is usually caused by dirty or worn brushes.

**Do** check the OV Relay (OVR). A common fault in all GA aircraft is the field wire between the VR and the alternator shorting to ground, especially if the wire is shielded. When this happens in the type A system, the fully excited alternator can produce as much as 40 volts. This will damage the battery and possibly other things connected to the bus. Most charging systems have an **OVR** to protect against that very problem, right? Actually many of the older aircraft did not include any type of OV protection. Even worse, it is possible for the original OVR to fail in a closed condition. An OVR that fails in the closed condition will not protect the system when over voltage fault occurs. Check the manufacturer of your OVR. *If your OVR was manufactured by WICO it should be replaced, because its most likely failure mode will be in the closed condition.* Checking your OVR is cheap insurance.