TROUBLE-SHOOTING THE SYSTEM

14V Type B alternator system on Beech, Cessna, Grumman, Maule, etc

By: Femi G. Ibitayo

HOW THE SYSTEM WORKS

Figure 1. Closing just the Bat switch causes the battery relay to close. The closed battery relay applies the battery voltage to *pin A* of the alternator controller (ACU, controller, regulator) and the Bus. With voltage on the bus and the Alt switch off, the LV-OV light comes on, indicating that the alternator is off-line. The light comes on because current flows from the battery through the light and the controller's low current path to ground. When there is no power on pin S because the Alt switch is open, pin I has a lower voltage than the bus. This potential difference causes current to flow through the light and the light comes on.

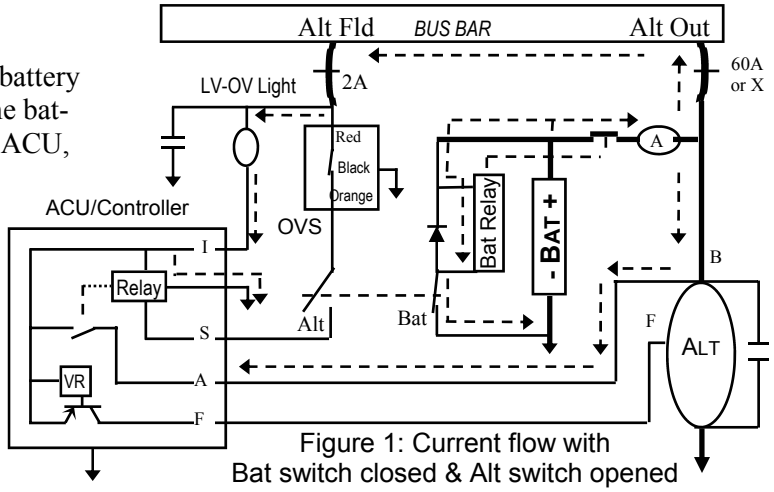

Figure 1: Current flow with Bat switch closed & Alt switch opened

Figure 2. With the battery switch closed and battery voltage applied to the bus, closing the Alt switch applies battery voltage to *pin S* through the Over Voltage Sensor (OVS). The OVS' output controls a relay inside the alternator controller. With power applied to *pin S,* the relay's normally open (NO) contacts closes and connects *pin A* and *pin I*. Connecting pins I and A causes the voltage at pin I and the Bus to be the same, meaning no potential difference exists between the two sides of the LV-OV light. The lack of potential difference means no current flow through the light and the light goes or stays off.

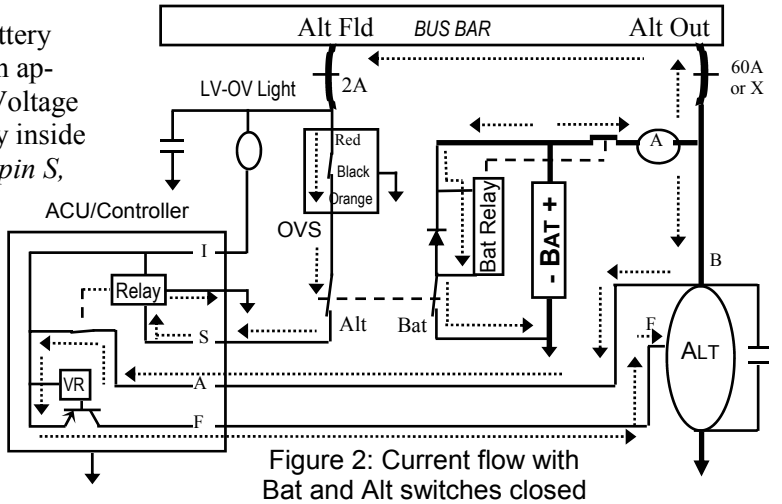

Figure 2: Current flow with Bat and Alt switches closed

Now current flows from the Bat terminal on the Alternator through pin A to the voltage regulator to the field of the alternator. Pin A serves as the Remote voltage sense point and the true power input of the controller. This arrangement avoids the voltage drop problems that is prevalent in systems that have their power input come through the Alt switch, Field circuit breaker, and Over-Voltage (OV) Relay. In this system the primary function of the OV Sensor is to turn off the Controller if the system experiences OV fault.

The problem posed by the whole field current (max about 3.5 Amps) flowing from the alternator's Bat terminal to pin A of the controller, is that abnormal increases in wire, connection, or junction resistances may cause poor voltage regulation and or fluctuating charge meter, panel lights, and bus voltage. For this reason, one recommends that mechanics clean and tighten the airframe alternator controller/regulator connector and the controller connectors every annual inspection.

When the engine is running, with power on *pin S*, current flows from the alternator's Bat terminal through the controller's voltage regulator to the alternator's field. The regulator keeps the bus voltage constant (around 14V) by controlling the alternator's field current. It increases the field current with increase in system load and decreases it, with a decrease in the system load.

If the field of the alternator shorts to ground, the controller will be damaged. Some voltage regulators or alternator controllers like Zeftronics' R15100 Rev A and R15V00 Rev A have built-in **field-to-ground short protection** and trouble-shooting lights on them.

If the bus voltage exceeds about 16V, the Over Voltage Sensor (OVS) will open and thus remove power from *pin S*. Removing power from *pin S* will turn off the controller and take the alternator off line.

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Check the condition of the ACU

1. With the master switch (Bat & Alt) on, at the ACU connector, measure the indicated voltages.

   Pin I: _____ Pin A: _____ Pin S: _____
   Pin F:_____ Bus _____

The voltages on pins I, A, S should equal bus'.

The voltage pin F should be 0.5-2V less than the bus'. *If the pin I voltage is less than bus voltage, look for bad LV-OV light, broken wire from LV-OV light, grounded pin I or damaged controller. If the pin A voltage is less than bus', look for corrosion on the BAT terminal, socket for pin A on the airframe ACU connector, or wire (from ALT Bat to pin A) with high resistance. This may cause fluctuating charge meter or bus voltage, and may cause over-voltage and nuisance tripping (i.e. alternator dropping off-line).*
If the pin S voltage is less than bus', look for a grounded pin S or damaged controller. Pin S to ground on the controller is about 400Ω.
If the pin F voltage is the same as the bus voltage, look for a damaged or un-grounded controller. If it is 0V, look for a grounded ALT field.

2. If the Master switch is a split type, turn off the Alt Sw and measure the indicated voltages.

   Pin I: _____ Pin A: _____ Pin S: _____
   Pin F:_____ Bus _____

The voltages on pins I, S & F should be 0-2V, pin A should be battery or bus voltage.
If pin I has bus voltage on it, look for a short between pins A & I (internal or external to the controller). Disconnect the controller, a resistance of 0-1K between pins A & I indicates a damaged controller. Check the alternator Field & Power input wire

3. Disconnect/Remove the connector on the ACU. Measure the resistance (on/from the airframe side of the connector) at the identified points.

   Pin F to Gnd _____Ω. FLD to Gnd _____Ω
   Pin A to ALT Bat _____Ω

The normal Alt field resistance is 3-6Ω.
A lower or higher resistance may indicate problems with the alternator. Field resistance below 3Ω may indicate a short to ground, while higher than 6Ω dirty brushes or intermittently open field.

BETTER TROUBLE-SHOOTING TECHNIQUE

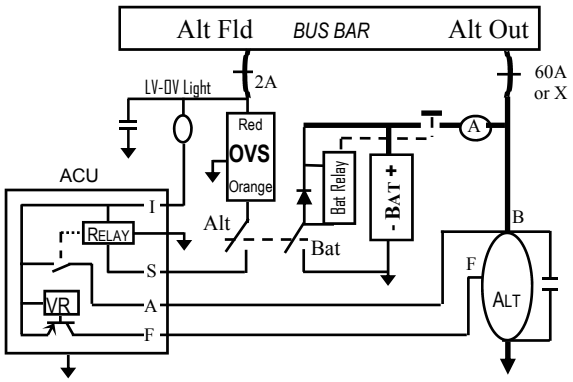
The most common trouble-shooting technique involves replacing suspected defective parts until problem goes away. That shot-gun method is a very expensive and often unsuccessful. Using a more systematic approach to trouble-shooting alerts the user or mechanic to the conditions of the field circuit breaker, alternator switch, alternator controller, and alternator's field. This approach to trouble-shooting looks at the condition of the pre-controller, controller, and post-controller components.

PRE-CONTROLLER CONDITION: Check the condition of the alternator switch, the field circuit breaker, or the wiring from the Alt Bat to *pin* A on the controller is open.

VOLTAGE REGULATOR CONDITION: Are the voltages on pins I, A, S and F according to the installation test data on page 4? If not, use the information on these 4 pages to solve the problem.

ALTERNATOR FIELD CONDITION: Are the field resistances measured from the airframe ACU connector and at the alternator according to the installation test data on page 3? If not, use the information on these 3 pages to solve the problem

Most electrical charging system problems are easily solved by applying the systematic trouble-shooting approach with a good understanding of Ohm's law and basic electricity.



In this **Type B** system: the controller is between the Bus and the Alt field. To control the bus voltage, the unit switches power to the field several times a second. The OVP opens when OV occurs.

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TROUBLE-SHOOTING THE SYSTEM
Frequently Asked Questions & TECHCARD Notes

By: Femi G. Ibitayo

Flickering / oscillating ammeter and panel lights.

Check the connections between the Alternator Bat terminal and the pin A input to the controller for high resistance, corrosion, dirt, loose or intermittent connection..

No voltage regulation

With the engine off and the Master switch on. Pins I, A, and S should measure Battery voltage, pin F should be 0.5 to 2V less the bus voltage.

- If the measured voltage is different, see The voltages on pins I, A, S should equal bus' on page 3 for probable causes for the problem.
- If the pin F voltage is the same as the bus voltage, look for and correct open circuit or high resistance in the alternator's field or the wire between the field and pin F. The controller might not be properly grounded.
- If the pin F voltage is 0V and pins I, A, S have battery voltage, look for a grounded alternator field or field wire. If the field resistance is correct as shown in step 5 of the installation tests, send the ACU in for test/repair. If there is a field ground fault, repair it or replace the defective alternator.
- If the pin F voltage is correct, verify that the field resistance and the condition of the connections and wires between the ACU and the field are good.

Bus voltage remains at battery voltage (about 12V)

To solve this problem, see No voltage regulation.

Alternator carries only about half its rated output.

Look for an open stator wire or open diode in the alternator. Check the shunts and alternator output wires indicating an alternator that is current limiting.

Bus voltage drops with load increase

To solve this problem, see *Alternator carries only about half its rated output and or the condition of the wire/ connections between pin A and the alternator Bat terminal.*

LV-OV light does not work, everything else works

Disconnect the ACU/Regulator. Turn on the Bat switch. On the airframe ACU connector ground pin I. The light should illuminate. If it does not, the lamp is defective or the wires to or from it are broken

OUR GOAL IS TO HELP YOUR SYSTEM OPERATE BETTER AND HELP YOU BETTER UNDERSTAND ITS OPERATION.

INSTALLATION TESTS. BEFORE INSTALLING THIS UNIT, PERFORM TESTS:

☐ 1. Read pages 1 to 3 and this page.

☐ 2. Check for and replace open, frayed, or broken wires. Clean thoroughly or replace corroded, dirty, or oxidized connections, terminals, contact, or poorly soldered wire junction.

☐ 3. Check for Open or Ground-shorted alternator field. Most 12V alternators have 3-6Ω field resistance. Ground shorted alternator field will damage most Voltage Regulators/ACU. Repair or replace an alternator has a field to ground short, do not connect the ACU to it.

☐ 4. With the engine off: Check voltage drops across the Field, Alt switch, Alt field circuit breaker and ACU. High voltage-drop means excessive junction resistance and will lead to many problems like: fluctuation ammeters, charge-meters and panel lights.

☐ 5. Perform and record the following tests with the **Master Switch Off**:

		12V Values	Typical Values
A.	Field resistance at ALT (F-Gnd)	_____Ω	3 – 6Ω
B.	Field resistance at ACU (F-Gnd)	_____Ω	3 – 6Ω
C.	Field SW/C-BKR resistance	_____Ω	0 – 0.1Ω
D.	ALT Bat to Pin A resistance	_____Ω	0 – 0.05Ω
E.	ALT Out C/BKR resistance	_____Ω	0 – 0.05Ω

☐ 6. Perform and record the following tests with the **Master Switch On**:

Engine Off		Bat Switch on	Alt Switch on	Typical Values
A.	Bus Voltage	_____V	_____V	12 – 13V
D.	Pin I Voltage	_____V	_____V	12 – 13V
E.	Pin A Voltage	_____V	_____V	12 – 13V
F.	Pin S Voltage	_____V	_____V	12 – 13V
F.	Field Voltage	_____V	_____V	0.5-2V <VBus

☐ 7. **Post Installation.** If all tests are correct to or per steps 5 & 6, run the engine and record:

		12V System	Typical value
A.	Bus voltage	_____V	13.8 – 14.3V

For tech help & other TechCards, call:
903-758-6661

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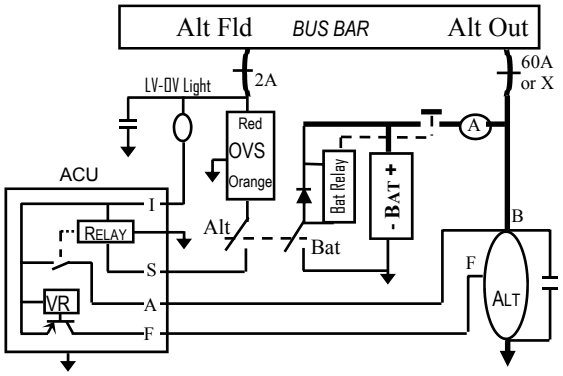

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