TROUBLE-SHOOTING DUAL ALTERNATOR SYSTEMS

14V and 28V VOLTAGE REGULATOR FOR TWIN ENGINES

B00286-X, B00288-X, B00296-X, B00301-X, B00307-X. By Femi G. Ibitayo

How the system works

In the typical twin engine installation, one LAMAR voltage regulator (VR) controls the field of one alternators and uses its parallel (PAR) function to monitor and influence what is happening on the other side of the alternator system. The Voltage Regulator keeps the bus voltage constant by controlling the alternator's field current: increasing it when the system load increases and decreasing it when the load decreases.

Closing the Bat switch applies battery power to the aircraft Bus to power the the Over-Voltage Relay (OVR) through the Alt switch and 5 Amp circuit breaker. The OVR supplies current to the Regulator which controls the alternator's field current to regulate the bus voltage.

The OV Relay. The OVR, a normally closed switch, monitors the bus voltage for excessive voltage (Over-Voltage) that could damage batteries and other voltage sensitive equipment. If the OVR senses an OV condition, it opens the current path to the controller and thus disables the alternator field.

The Voltage Regulator. The Regulator monitors the bus voltage and compares it to an internal voltage reference. If the bus voltage exceeds the preset level, it reduces the field current to return the bus voltage to preset level. If the voltage falls below the preset level, it increases the field current to return the bus voltage to preset level. Increasing or decreasing the field current regulates the bus voltage by the how it excites the alternator.

The Parallel (EQ) Function. The Regulator's parallel function monitors the alternator's field voltage and compares it to that of the other alternator's field voltage. If the one field voltage exceeds the other, current flows from one regulator to the other until the field voltages match and presumably, according to Lamar's design philosophy, the alternator would carry the same load because they share the system load.
As many mechanics can attest, this system does not always load share as intended because, it very difficult to cause the dual alternator system employing these Lamar and similar Electrodelta voltage regulators to parallel.

The **Alternator Out Sensor** monitors the Aux or Stator output of the alternator for a level of voltage which will indicate that the alternator is on-line. If the alternator is off-line while the engine is rotating, the Sensor turns on the Alt Out Light by providing a ground path for it.

Paralleling (Load Sharing) the Regulators

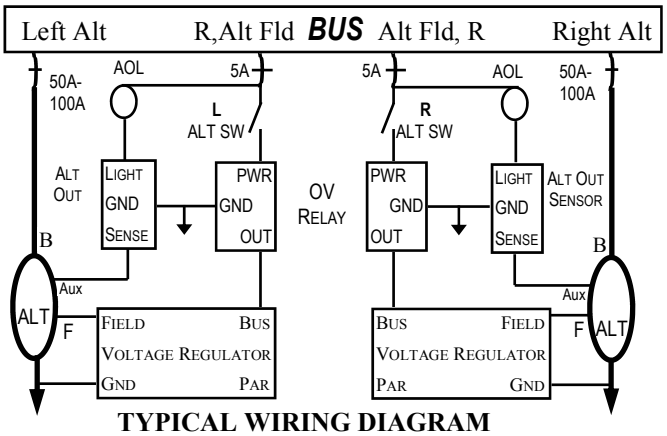
Most mechanics know the pain of trying to parallel the Lamar and similar Electrodelta voltage regulators in the typical twin engine installation.

The problem has two sources: the first is the design of the voltage regulator and the second is the design of the system. Since the regulator parallels by comparing field voltages, the two alternator systems must have similar speed, regulator input voltages, wiring/contact resistances, alternator field resistances and other characteristics. Inequities in any of these characteristics often lead to an imbalance in the load output.

Zeftronics' multi-engine Alternator Controllers replace these problem prone Lamar and Electrodelta voltage regulators with its unique auto-parallel feature. These Auto-Parallel Alternator Controllers (APAC) solve the 30 years paralleling headache of the Lamar units.

The procedure suggested on page 2/3, which many mechanics have successfully implemented, simplifies the process of balancing loads on these systems. It refers to the diagram shown below. We strongly recommend using a high quality Digital Multi-Meter.

The information presented in this document does not preclude the maintenance practices set for in the appropriate OEM service manuals.



TYPICAL WIRING DIAGRAM

1622 E. Whaley St., Longview, TX 75601. USA
Ph: 903-758-6661; Fax: 903-236-9766. E-mail: Tech@zeftronics.com
Ph: 1-800-362-8985. Web Site: www.zeftronics.com

Balancing Dual Alternator Systems

14V and 28V VOLTAGE REGULATOR FOR TWIN ENGINES

B00286-X, B00288-X, B00296-X, B00301-X, B00307-X. By Femi G. Ibitayo

TROUBLE-SHOOTING

Our practice is to consider trouble-shooting the charging system from the pre-regulator, at the regulator, post regulator and para-regulator point of view. This systematic approach, as opposed to the shot-gun method, reduces trouble-shooting time, saves money and minimizes the frustration known by most mechanics.
For each test point, record the measurement without the engine running and, with the engine running in a manner that is safe (*to avoid rotating props, omit the tests that may get you in contact with them*).

Pre-regulator tests: involves test points 1, 2, 3, 4.
For the right and left sides of the system, take all voltage measurements at identified test points referenced to ground.

1. _____, _____ Volts. 2. _____, _____ Volts
3. _____, _____ Volts. 4. _____, _____ Volts

Measure resistance with Bat Sw off, Alt Sw on, at test points 1 to 2 _____Ω, 2 to 3 _____Ω, 1 to 4 _____Ω,

The voltages measured at 1 to 4 should be Bus voltage and the resistance from 1 to 4 should less than 0.1Ω.
If the voltage at 1 is 0.2V more than that on 4, look for high resistance or open circuit in the 5 Amp breaker, switches, and connections between the bus and 4 for. *A high resistance between 1* and *4 may lead to poor Load Sharing, flickering / oscillating ammeter and panel lights or show a higher than normal Bus voltage. An open circuit between 1* and *4 will not allow current to get to the regulator and subsequently no current to the alternator's field and no voltage regulation. When there is no voltage regulation, the Bus voltage remains at battery voltage.*

Regulator & Post Regulator tests: involves test pints 4, 5, F.
For the right and left sides of the system, take all voltage measurements at identified test points referenced to ground.

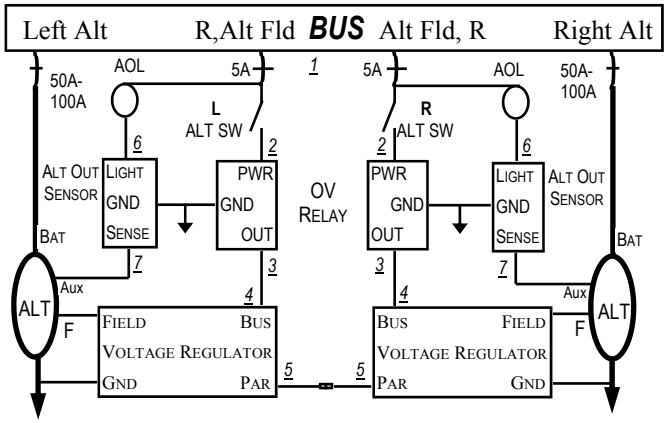
5. _____, _____ Volts. F. _____, _____ Volts
Resistance @ ALT (VR wire disconnected): F to Gnd _____Ω
@ VR, wires off, Field to Bus _____Ω, Field to Gnd _____Ω

The voltage on F (alternator field) and the regulator output should be the same, 0.5 to 2V less than the voltage at 1 to 4 .
If the voltage on regulator Field is 0.2V or more higher than the voltage on F, check for poor connection or open circuit between the Field and F on the alternator. If the resistance from F to Field is higher than 0.5Ω, the ALT may not carry its rated load, showing a symptom similar to one where there is an open stator wire or open diode in the ALT. 12V ALTs have typical field resistance of 3.5-6Ω, while the 24V ones have 10-18Ω.

With the master switch on the Regulator's Bus has battery voltage on it, if the voltage on F is 0 or close to 0, check for a ground short on F or open circuit between F and the regulator.

ALT OUT SENSOR

6. _____, _____ Volts. 7. _____, _____ Volts
With the engine off the voltage at 6 is close to 0. With the engine running, it is from 2V to 50% of the alternator's output voltage.



Balancing Dual Alternator Systems

1. Disconnect and insulate one end of the parallel wire that is between the two voltage regulators.
2. With the engine off, turn on the BAT and FLD switches for both engines. On each side measure the voltages at the identified test points. If the voltage difference between 1 and 3 is greater than 0.2V, check for high resistance in the field circuit breaker, ALT switch, OV Relay, as well as at connections and terminals of wires and components that precede the regulator. Ensure that all terminals are clean and tight.
3. Verify that the voltage on the regulator's Field terminal is the same as the one on the alternator's Field, F.
4. Run the right engine. At 1500 RPM, measure the voltage at point 1 with about 10A load on the bus. If the voltage is not at the OEM specified level. Adjust the VR for the specified system bus voltage. Turn off the right ALT switch.
5. Repeat step 4 for the left engine. Set the bus voltage **exactly** the same as the right Regulator. Make sure the bus voltage is the same for both sides.

   Where necessary turn on both engines before performing the next steps.
6. Connect a voltmeter between the PAR terminals of the two Regulators.
7. Make sure both engines are on, turn on both ALT and BAT switches.
8. Put about 20A load on the bus. Observe that the meter reads 0-0.3V. The closer to 0 V the better. If necessary slightly adjust the pot on the regulator to achieve this result. *If the bus voltage was correctly set in steps 4 & 5, you should not need make any adjustment here. If this 0-0.3V is difficult to obtain, look for voltage drops between the bus and the input to the regulators.*

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Frequently Asked Questions & Notes

Type B alternator system on twin Beech, Cessna, Piper etc

TROUBLE-SHOOTING THE SYSTEM

By Femi G. Ibitayo

TROUBLE-SHOOTING

Our practice is to consider trouble-shooting the charging system from the pre-regulator, at the regulator and post regulator point of view. This systematic approach, as opposed to the shot-gun method, reduces trouble-shooting time, saves money and minimizes the frustration experienced by most mechanics.

- With BAT, ALT switches on and the engine off, at Regulator, the voltage on the BUS will be 0.3-2 volts more than the voltage on Field.
- Turn Off all the avionics. Start the engine, and at 1500 RPM measure the OEM specified bus voltage. If the bus voltage exceeds these limits, check for voltage drop in the input devices between the Bus and the Regulator. With engine at about 1500 RPM, depending on the system load, the field voltage will increase from 1 to 24V. Loading the alternator beyond its rating (at a given speed) causes it to Current Limit.
- Normal Field resistance is 10 to 18Ω (for 24V alternators) and 3.5 to 6Ω (for 12V alternators). If the resistance is out of that range, check the alternator field or wires/connections/switches/fuses from Regulator to the field.
- Verify that the input devices resistance is below 0.1Ω.

Both Alternators Drops Off-line

If both alternators drop off-line and the ALT Out light is on, check for a short between Bus and Field on the Regulators—one Regulator at a time. *To identify which side is causing the problem, run one side at a time.* Either side may be causing an over-voltage fault due to an internally shorted Regulator (and the OV relay trip) or have a ground shorted field.

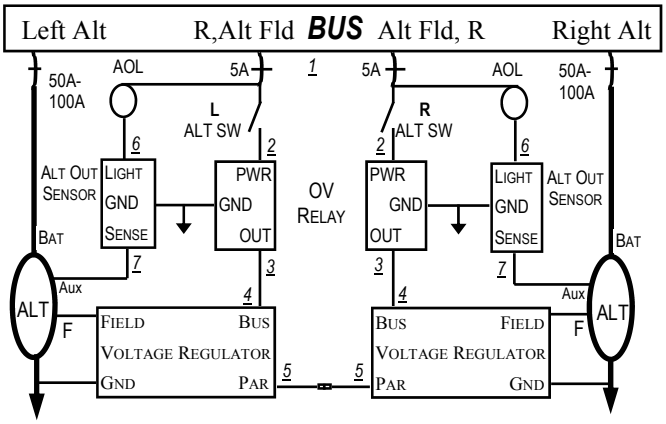
One Alternator Drops Off-line

If one alternator drops off-line, check the condition of the wire to and from the Regulator and the field switch. If the system has separate field fuses, check the condition and connection of the fuses. Also check the resistance of the field. The field could be open or have a high resistance.

Fluctuating Charge-meter or Flickering Panel Lights

This problem is usually caused by a resistance build-up input or pre-regulator devices like the ALT switch or OV relay, the 5Amp breaker, or bad wires/connections between the Bus and the Red wire on the Regulator. Sometimes defective Regulators cause this problem.

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



No voltage regulation

With the master switch on and Battery voltage measured on the Regulator Bus, the Field voltage should be 0.5 to 2V less the Bus voltage.

- If the Regulator has no Bus (input) voltage, look for a broken wire, bad connection or input device between the Regulator and the aircraft bus.
- If the input voltage is more than 0.2V lower than the bus voltage, look for and correct or replace the input device that is causing the problem.
- If the Field voltage is 0 and the input has battery voltage, look for a grounded alternator field or field wire. If the field resistance is correct send the Regulator in for test/repair.
- If the output and input voltages are the same, look for an open alternator field or field wire. If the field resistance is higher than 10 to 18Ω (for 24V alternators) and 3 to 5Ω (for 12V), send the alternator in for test/repair. If the resistance is correct, send the Regulator in for test/repair.

An open stator wire or open diode in the alternator causes the alternator only able to carry about half its rated output. For example, a 60A 24V alternator has a 28V output with about 30A load on it. When the load is increased to 40A, the bus voltage drops to 26 to 27V, indicating an alternator that is current limiting.

MORE FAQ TO COME .....

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