ZEFTRONICS: SOLUTIONS

R251DR

28V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR FOR TWIN ENGINES

Features:	Benefits:
• Voltage Regulation, IC sense referenced	* Increase Regulator. Not temperature sensitive.
• Field-to-Ground Fault Protection (GFP)	* Protects against grounded alternator field. * Helps isolate grounded alternator field in twin engines
• Trouble-Shooting Light (TSL)	* Identifies grounded field. Reduce trouble-shooting time

Voltage Regulation: 27.7V ± 0.4V. Max Field Current (IF): 5A. Field-to-Ground Protection @ IF > 6A

VOLTAGE REGULATION

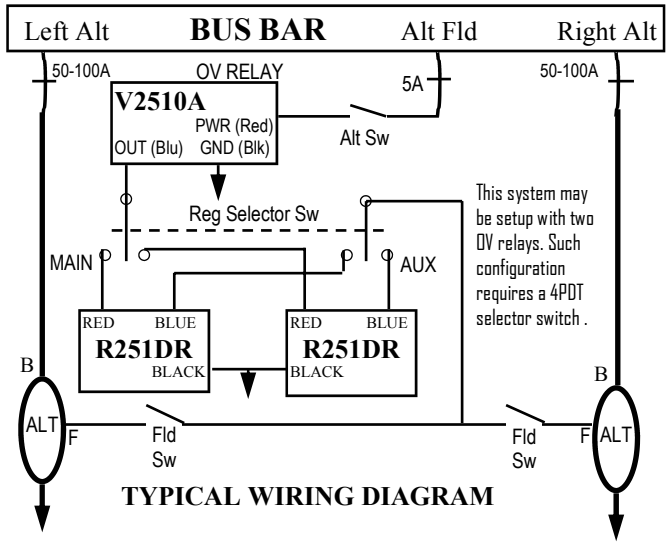
The Voltage Regulator keeps the bus voltage constant by controlling the alternators field current: increasing it when the system load increases and decreasing it when the load drops.

FIELD TO GROUND SHORT PROTECTION

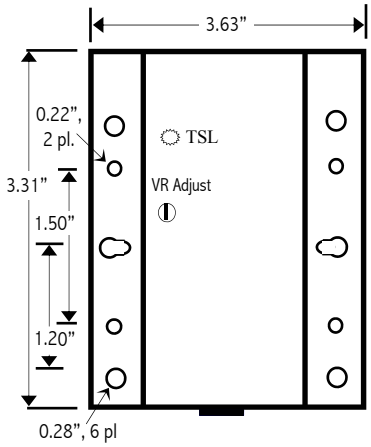
Should either of the alternator's field become shorted to ground (the reason most Voltage Regulators fail), the field-to-ground short protector will deactivate the Voltage Regulator, and switch on the unit's RED field-to-ground short indicator. The defective field may be identified by selectively operating the right or left alternator. The alternator with the faulty field will not come on line, while the good one will allow bus voltage regulation to 27.5V to 28.0V.

TROUBLESHOOTING LIGHT (TSL). The troubleshooting light on the unit is designed to alert the user to the condition of the Alternator / ACU system. The light is normally off.

RED TSL, with master switch on indicates a ground short in the alternator field or controller to field wiring.



TYPICAL WIRING DIAGRAM



Mounting Diagram
Height: 1.10"

The R251DR replaces
- BEECH & CESSNA: 9000591
- CESSNA: 9000591, 11570010-1
- DELCO-REMY: 9000591
- LYCOMING: 74292
- PIPER: 450-395

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ZEFTRONICS
Electrical Charging Systems Solutions

R251DR

28V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR FOR TWIN ENGINES

How the system works

In the typical installation, one R251DR controls the field of two alternators and thus the the system's voltage regulation level.

When the Bat switch is closed battery power is applied to the aircraft Bus. The Over-Voltage Relay (OVR) is powered at the same time through the Alt switch and 5 Amp circuit breaker. The OVR supplies the current to the controller. The R251DR 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 controller 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.

Field to Ground Short Protection. If either alternator's field shorts to ground, the R251DR will turn itself off, removing current from both fields, and switches on its Red TSL to indicate a field-to-ground short. The defective field may be identified by selectively operating the right or left alternator. The alternator with the faulty field will not come on line, while the good one will allow bus voltage regulation to 27.5V to 28.0V.

Trouble-Shooting Light (TSL). The TSL on the unit is designed to alert the user to the condition of the Alternator / ACU system. The light is normally off.

Red TSL, with master switch on indicates a ground short in the alternator field or controller to field wiring.

INSTALLATION INSTRUCTION

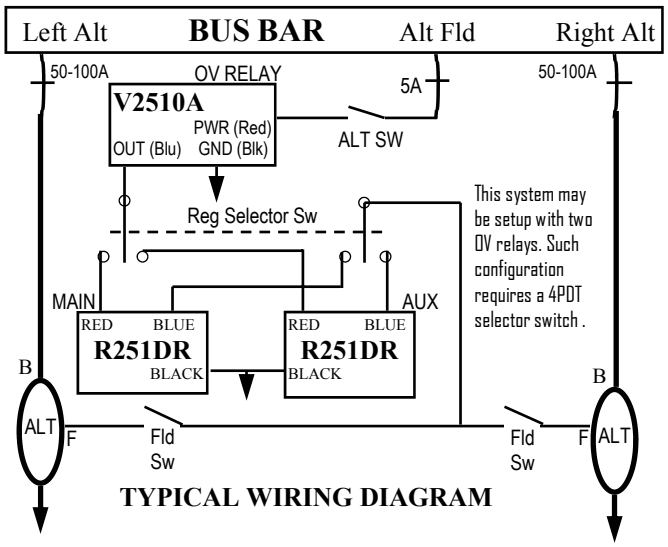
1 Disconnect and remove the present ACU/VR.
2 From wire on the airframe side of the ACU/VR's blue wire, measure the resistance between the field and the ground. The normal resistance is 10.0 to 18Ω. Resistance outside the specified range require checking the alternator field and the connections/wire from the ACU/Regulator's field wire to the alternator's field. 0Ω indicates a field to ground short. Correct fault.
3 Mount and connect the new ACU/VR to the system.
4 Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. For each ACU - Turn on the Master switch and observe: That the ACU's TSL is off. If the TSL is Red, the Field or field wire is shorted to ground. Repair the problem before proceeding.
2. Measure the voltage on Red and Blue wires. The Red should read Battery voltage, while the Blue reads 1-2 volts less than the Red wise.
3. If the steps 1 and 2 are successful, perform step 4.
4. Turn Off all the avionics. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 27.5-28.0V. If the bus voltage exceed these limits, check for voltage drop in the 5A breaker, the Alt switch, and pre-ACU/VR wires.

TROUBLE-SHOOTING THE SYSTEM

For help on how to solve problems in the system, see the Trouble-Shooting Notes (TSN) page and or TechCards.



TYPICAL WIRING DIAGRAM

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TROUBLE-SHOOTING THE SYSTEM

28V Type B alternator system on twin Beech, Cessna, Piper etc

R251DR

With the Bat, Alt, & Reg selector switches turned on, battery voltage is applied to the Bus & OV Relay input.

Take all voltage measurements at test points A, B, C, D, E, F, Fc and F1 referenced to ground.

A. _____, _____ Volts.		B. ____, _____ Volts	
C. _____, _____ Volts.		D. ____, _____ Volts	
E. _____, _____ Volts.		Fc. ____, _____ Volts	
F. _____, _____ Volts.		Fl. ____, _____ Volts	

The voltages measured at A to E should be Bus voltage (around 24V). The voltage on F, Fc and F1 (alternator field and the controller output) should be the same, 0.5 to 2V less than the voltage at A to E.

If the voltage at A is 0.2V more than that on E, check the 5 Amp breaker, switches, and connections between the bus and E for high resistance or open circuit. A high resistance between A and E may lead to flickering / oscillating ammeter and panel lights or show a higher than normal Bus voltage. An open circuit between A & E will not allow current to get to the controller/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 (about 24V).

If the voltage on F1 is 0.3V less than the voltage F, check for poor connection or open circuit between the controller/regulator output and F1 on the alternator. If the resistance between the F and F1 is higher than 0.5Ω, the alternator may not carry its rated load, showing a symptom similar one where there is an open stator wire or open diode in the alternator.

With the master switch on and the controller's pin has battery voltage on it, if the voltage on F1 is 0 or close, check for a ground short on F1 and F or open circuit between F and F1.

If there is a field-to-ground short, the controller turns itself off and turns its Trouble-Shooting Light (TSL) Red.

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.

See TechCard for resistance and voltage measurements.

With the engine off and the Bat, Alt, & Reg selector switches turned on, battery voltage (~24V) is applied to the input of the controller through the 5 Amp FLD circuit breaker, Alt switch and the OV Relay. The applied voltage causes current to flow to the alternator's field through the controller to excite the alternator's field.

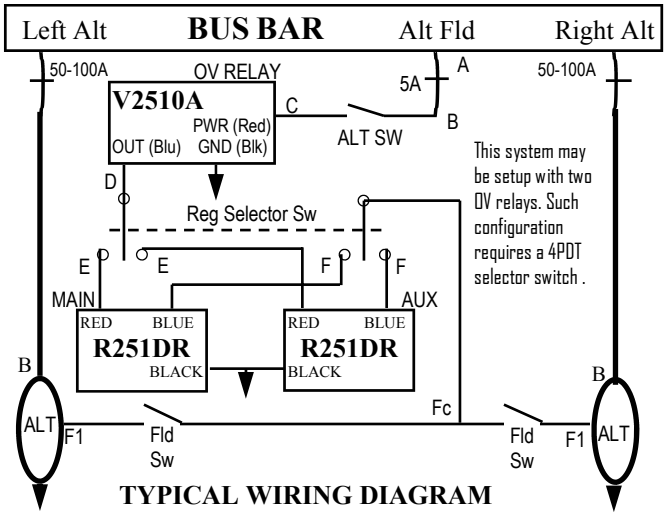
With the engine on and the Bat, Alt, & Reg selector switches on, the ACU/regulator controls the excitation of the alternator to produce a Bus voltage of 27.5 –28.0V. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

The 5 Amp circuit breaker opens if the current going to the alternator's field exceeds 5 amps, after a time lag, to protect the wires from the Bus to the field. *Some wrongly expect this breaker should protect their non-Zeftronics ACU/regulator if the field shorts to ground.*

If the Bus voltage exceeds the preset over-voltage (OV) limit, the OV Relay, which is normally closed, will open up and disconnect the Bus from the ACU/regulator to remove excitation from the alternator's field.

When power is applied to a static (non-rotating) alternator through the ACU/regulator, the F1 voltage is 0.5-2V less than Bus voltage. When the alternator is rotating, F, Fc and F1 voltages will start low and increase with each load increase until the alternator current limits.

See TechCard for resistance and voltage measurements.



TYPICAL WIRING DIAGRAM

In this **Type B** system:the ACU/VReg is between the BUS and the Alt field. To control the bus voltage, the unit switches power to one side of the field several times a second. The OVR opens when OV occurs.

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Frequently Asked Questions & TECHCARD Notes

28V Type B alternator system on twin Beech, Cessna, Piper etc

TROUBLE-SHOOTING THE SYSTEM

TROUBLE-SHOOTING

- With BAT, ALT, REG & FLD switches on and the engine off, the voltage on the Blue wire will be 0.5-2 volts less than the voltage on the Red wire.
- Turn Off all the avionics. Start the engine, and at 1500 RPM measure a bus voltage of 27.5-28.0V. If the bus voltage exceed these limits, check for voltage drop in the input devices (5A breaker, the Alt switch, the OV Relay, Reg selector Sw & pre-VR wires) due to high internal resistances.
- 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. If the resistance is out of that range, check the alternator field or wires/connections/switches/fuses from controller to the field.
- Verify that the input devices have resistances of 0.1Ω or less.
- With the master switch On, verify that the voltage drop from the bus to the Red wire on the is less than 0.2V. If it is higher, find the source of the problem by checking the voltage drop across the input devices.

Both Alternators Drops Off-line

If both alternators drop off-line, check the color of the controller's TSL. A Red TSL indicates an alternator with internally or externally grounded field. Another reason could be that the system experienced an over-voltage fault and the OV relay tripped.

One Alternator Drops Off-line

If one alternator drops off-line, check the condition of the wire to and from the controller 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 in pre-controller input 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.

With the master switch On, verify that the voltage drop across the alternator switch and 5 Amp circuit breaker is less than 0.2V. Another way to do it is to verify that the Alt switch & OV Relay resistance is 0.1Ω or less. If either measurement is higher than indicated, replace the bad part.

No voltage regulation

With the master switch on and Battery voltage measured on the ACU input, The ACU output voltage should be 0.5 to 2V less the bus voltage.

- If the ACU input has no Bus voltage, look for a broken wire, bad connection or input device between the ACU and the 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 output voltage is 0 and the input has battery voltage, look for a grounded alternator field or field wire (as indicated by a Red TSL). If the field resistance is correct as shown in step 5 of the installation tests and the TSL is off, send the ACU in for test/repair.
- If the TSL is Red, repair the field ground fault or replace the alternator.
- 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 what step 5of the installation tests shows, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test/repair.

Except for the field to ground-short protection, the trouble-shooting notes are applicable to systems that use the Delco-Remy 9000591.

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

ZEFTRONICS TECHCARDS

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 24V alternators have 10-18Ω field resistance. Ground shorted alternator field will damage most Voltage Regulators/ACU. **If the alternator has a field to ground short, do not connect the ACU/Regulator to it.**

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

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

	24V Values	**Typical Values**
A. Field resistance at ALT	_____, _____Ω	10 – 18Ω
B. Field resistance at ACU	_____, _____Ω	10 – 18Ω
C. Field SW resistance	_____, _____Ω	0 – 0.1Ω
D. Field C/BKR 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**:

	24V Values	**Typical Values**
A. BUS Volt Engine Off	_____, _____V	24 – 26V
D. ACU/Reg input Volt	_____, _____V	24 – 26V
F. Field Voltage	_____, _____V	0.5-2V <VBus

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

	24V System	**Typical value**
J. Bus voltage. R251DR Main.	_____V	27.5 – 27.9V
K. Bus voltage. R251DR Aux.	_____V	27.5 – 27.9V

Call for tech help & more TechCards:
903-758-6661

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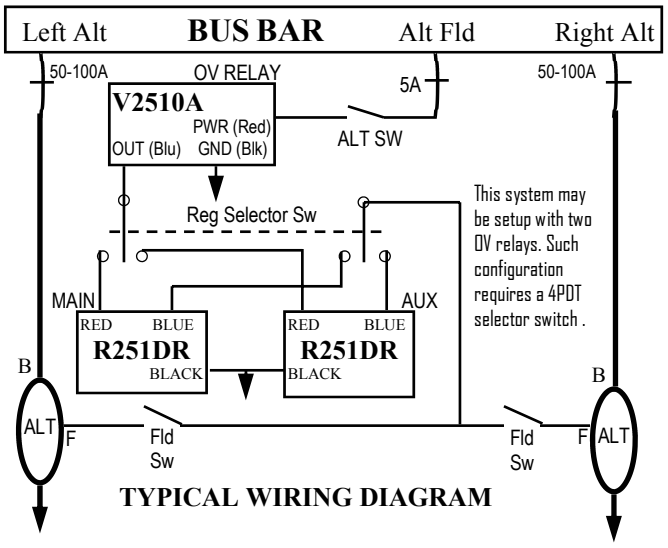

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