Electrodelta (FAA/PMA Approved):

Part No.	Description	Replacement For:	Application Eligibility:
GPM-001	28V Ground Power Monitor	Cessna C593005-0101	Cessna: 208 Series
OS100-0101	28V Overvoltage Sensor	Cessna C593003-0101	Cessna: Series 152, 172, R172, T41D, 180, A185, 210, T210, V206, TV206, 207, T207, 177, 177RG, P210, and R182.
OS100-0102	28V Overvoltage Sensor	Cessna C593003-0102	Series 188
OS60	14V Overvoltage Sensor	Cessna C5930001-0101	Cessna: All Cessna Models w/14V System.
OS75-14	14V Overvoltage Sensor	Piper 450397	Piper Series PA-28, PA-32, PA34 and PA-44
OS75-28	28V Overvoltage Sensor	Pilatus Britten-Norman 342401046	Piluatus Britten Norman Models Islander: BN2A, BN2B, BN2T, BN2T-4. Trislander: Model BN2A MK III Series.
VR200	14V Voltage Regulator	Piper 484121	Piper: PA-38.
VR200A	14V Voltage Regulator	Piper 484121 Electrosystems Model VR-200.	Piper: PA-38.
VR286	28V Voltage Regulator	Cessna 9910126-1,-2,-3 Lamar B-00286-1; B-00306-1, -2,-3; B-00296-1,-2,-3 Piper 550390, 584042	Piper Models: PA-23-235, PA-23-250, PA-31, PA-31-300, PA-31-325, PA-31-350, PA-31P, PA-34-220T, PA-60, PA-60-601, PA-60-601P, PA-60-602P, PA-60-700P. Any Beech Twin Engine Aircraft 28 Volt equipped with Lamar's B-00306-1, B-00306-2, B-00306-3 Voltage Regulator.Any Cessna Twin Engine Aircraft 28 Volt equipped with Lamar's B-00296-1, B-00296-2, B-00296-3 Voltage Regulator.
VR300-14-20	14V Voltage Regulator	Cessna 0413205-4, -5, and -12	Cessna: 120, 140, TCDS A768, 140A, TCDS 5A2, 170, 170A, 170B, TCDS A799.
VR300-14-35	14V Voltage Regulator	Cessna 0413205-6, -8 and -10	Cessna Models 180, TCDS 5A6.
VR300-14-50	14V Voltage Regulator	Cessna 0413205-7, -9 and -11. Beech 35-380142-9	Cessna Models 180, 180A, 180H, TCDS 5A6. Beech Models 35-B33, 35-C33, E33, F33, P35, V35-A, S35, H35, J35, K35, M35, N35.
VR300-28-25	28V Voltage Regulator	Beech 35-380142-13	Beech Models D95A, E95, 95-B55, 95-C55, 95-A55, 95-55, 95, B-95, B95A.
VR300-28-40	28V Voltage Regulator	Beech 35-380142-15	Beech Models 95-B55, 95-C55, 95-A55, 95-55, D95A, E95, 95, B95, B95A.
VR371	14V Voltage Regulator	Lamar B-00371-1, Piper 557-337	Piper Models PA-28 Series, PA-32 Series, PA-38
VR382	28V Voltage Regulator	Lamar B-00382-2	Piper Models: PA-31P-350, PA-34-220T, PA-46-310, -350.
VR392	14V Voltage Regulator	Lamar B-00392-1	Piper Models: PA-44-180, 180T.
VR415	14V Voltage Regulator	Mooney 88016-501	Mooney: M20J, M20K
VR500-0101	28V Voltage Regulator	Cessna C611004-0101	All Cessna Single Engine Aircraft and Model 337 w/Voltage Regulator set at 27.7V.
VR500-0102	28V Voltage Regulator	Cessna C611004-0102	All Cessna Single Engine Aircraft and Model 337 w/Voltage Regulator set at 28.8V.
VR515F	28V Voltage Regulator	Cessna C611501-0102	Cessna: 152, A152, 172, R172, 172RG, 182, T182, 210, T210.

Electrodelta (FAA/PMA Approved) (Cont.):

Part No.	Description	Replacement For:	Application Eligibility:
VR515F	28V Voltage Regulator	Cessna C6611005-0101	All Single Engine Aircraft Equipped w/28V Alternator Control Unit.
VR515G	28V Voltage Regulator	Cessna C611005-0103	Cessna Single Engine Aircraft Equipped w/28V Alternator Control Unit.
VR515G-2	28V Voltage Regulator	Schweizer Aircraft 269A4985	Schweizer Model 269C.
VR515GA	28V Voltage Regulator	Cessna C611005-0103 Electrosystems VR515G	Cessna Single Engine Aircraft Equipped w/28V Alternator Control Unit.
VR580	28V Voltage Regulator	Cessna C61108-0101	Cessna 208 Series.
VR600	14V Voltage Regulator	Beech 33-38001D Cessna C6611001-0201	Beech: 35C33, 35B33, 35A33, H35 thru P35, E33 ,E33B, F33. All Cessna Aircraft Equipped w/14V Systems.
VR801	28V Voltage Regulator	Cessna C611007-0101	All Cessna Models T303 & 210 Equipped w/Dual Alternator Option.
VSF7203A	12V Voltage Regulator	Pitts Aerobatic P/N 61230 TCM P/N 649684-1	Pitts: S-1S, S-1T, S-2, S-2A, S-2B, S-2S. TCM: IO-520-CB on Windbecker Eagle; IO-520-D on Cessna 185 & 188; IO-520-K on Bellanca Viking 300
VSF7403A	24V Voltage Regulator	TCM 649684-2	TCM: IO-520-E on Colemill Conversion of Aero Commander 500A, Cessna 310, Beech Baron, Prlnair Dehavilland; IO-520-F on Cessna 206, 207; TSIO-520-B on Cessna T310, 320D; TSIO-520-E on Cessna 335, 401, 402.

R15100

14V ELECTRONIC ALTERNATOR CONTROLLER

Features:	Benefits:
• Voltage Regulation, Remote Voltage Sensed	* Increased Regulator life. Reduced panel lights flicker
• Low – Over Voltage Warning Light Output[1]	* Warns the Pilot of Low & OV Conditions

Voltage Regulation: 14.2V ± 0.2V. Max Field Current: 5A.

The R15100 alternator controller works with 12V alternators on many aircraft models. It requires an external Over-voltage (OV) sensor for OV protection.

VOLTAGE REGULATION.

The Voltage Regulator, with Remote Voltage sense of the Alternator output, 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 drops.

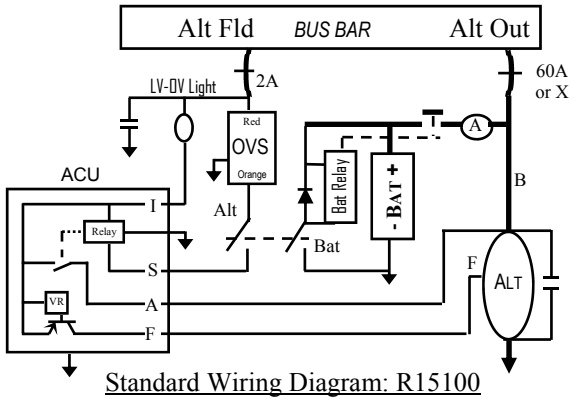
OVER VOLTAGE (OV) PROTECTION. Not Built-in

The external OV Sensor provides OV protection by turning off the OV relay inside the controller if the bus voltage exceeds 16V. With the relay off, the Controller and the alternator turn off to protect sensitive avionics equipment and the battery.

LOW & OVER VOLTAGE WARNING.

A warning light connected between pin I and the bus comes on to warn the pilot if the buss voltage exceeds the OV level or the alternator is off-line because there is no voltage on pin S.

[1] The LV-OV output functions through the OV Sensor or actions of the Alt switch.



Standard Wiring Diagram: R15100
Separate OVS & Voltage Regulator

The R15100 replaces
- CESSNA P/N: C611001-0201,CESSNA P/N: C611001-0101, -0102
- BEECH P/N 33-380010
- ELECTRODELTA P/N VR 600
- PFT/LAMAR P/N: DGR6
- FORD P/N: D4FF-10316-BA, CA.

OTHER OPTIONS

↓FEATURES PART NUMBER→	R15100 Rev A	R15V00	R15V00 Rev A
FIELD-TO-GROUND SHORT PROTECTION	Yes		Yes
TROUBLE-SHOOTING LIGHT ON THE UNIT	Yes	Yes	Yes
OVER-VOLTAGE (OV) PROTECTION	No	Yes	Yes

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ZEFTRONICS
Electrical Charging Systems Solutions

R15100

14V ELECTRONIC ALTERNATOR CONTROLLER

HOW THE SYSTEM WORKS

Closing the Bat switch applies the battery voltage to *pin A* of the alternator controller (ACU, regulator). With voltage at *pin A* (Alt switch off), the LV light comes on, indicating that the alternator is off-line.

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,* that relay's normally open (NO) contacts connects *pin A* and *pin I*.

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.

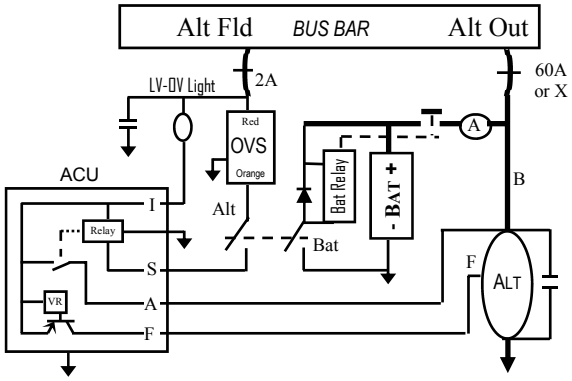
Since the whole field current (max about 3.5 Amps) flows from the alternator's Bat terminal to pin A of the controller, abnormal increases in wire, connection, or junction resistances will cause poor voltage regulation and or fluctuating charge meter, panel lights, and bus voltage.

If the field of the alternator shorts to ground, the controller will be damaged. To get **field-to-ground short protection** update to the R15100 Rev A.

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.

LV-OV Light

The LV-OV light on the instrument panel indicates the condition of the charging system. See the trouble-shooting section for how this function operates.



INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU/VR.
2. Measure the Alternator's Field Resistance between the field wire of airframe's VR connector and Ground. 3.5 to 6Ω is normal resistance. If is less than 3Ω or greater than 8Ω, check the alternator field or the field wire for problems. 0Ω means Fld-Gnd short.
3. Check the ALT switch resistance: 0.1Ω is normal.
4. Mount and connect the new ACU to the system.
5. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. With the engine off, turn on the Alt & Bat switches, on the instrument panel, observe that the LV-OV light is off. Verify that the voltage drop across the alternator switch and 5 Amp circuit breaker is less than 0.2V.
2. Verify that the voltage drop from the alternator BAT terminal to pin A is less than 0.2V.
4. If the steps 1 to 3 are successful, perform steps 5 & 6.
5. Turn off all the avionics and any other voltage sensitive devices.
6. Start the engine, and at 1500 RPM measure a bus voltage of 13.9-14.4V. If the bus voltage exceed these limits, check for voltage drops from the alternator BAT terminal to pin A and wires/ connection from the ACU (F) to the alternator's field.

TROUBLE-SHOOTING THE SYSTEM

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

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS MAINTENANCE

This device is not field repairable or serviceable. For all service, repair or overhaul needs, return it to ZEFTRONICS or a ZEFTRONICS approved repair station.
For all periodic inspection and test requirement, use the pre and post installation procedure listed above.
Contact us with tech support questions that are not addressed at Zeftronics.com or in the TSN or TechCards.

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ZEFTRONICS
Electrical Charging Systems Solutions

TROUBLE-SHOOTING THE SYSTEM

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

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 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

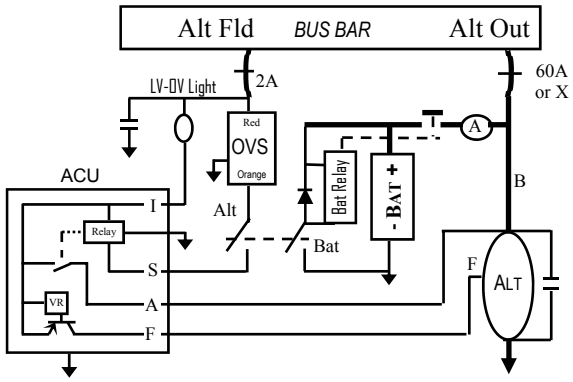
The most common trouble-shooting technique involves replacing suspected defective parts until problem goes away. That shot-gun method is a very expensive and often unsuccessful. Using a more systematic approach to trouble-shooting alerts the user or mechanic to the conditions of the field circuit breaker, 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 4? If not, use the information on these 4 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 one side of the field several times a second. The OVP opens when OV occurs.

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Frequently Asked Questions & TECHCARD Notes

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

TROUBLE-SHOOTING THE SYSTEM

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. Turn on the Bat switch. 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.

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 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	_____Ω	3 – 6Ω
B.	Field resistance at ACU	_____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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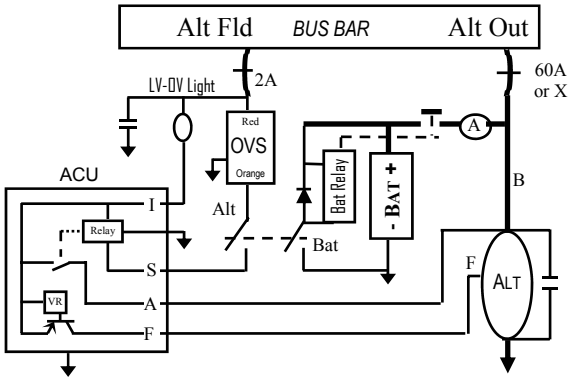

In this **Type B** system: the controller is between the Bus and the Alternator's field. To control the bus voltage, the unit switches power to the field several times a second. The OVS opens when OV occurs.

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ZEFTRONICS
Electrical Charging Systems Solutions

R15V00

14V ELECTRONIC ALTERNATOR CONTROLLER

Features: **Benefits:**

- **Voltage Regulation, Remote Voltage Sensed** * **Increased Regulator life. Reduced panel lights flicker**
- **Low – Over Voltage Warning Light Output** * **Warns the Pilot of Low & OV Conditions**
- **Over-Voltage Protection** * **Protects system loads against overexcited alternator**

Voltage Regulation: 14.2V ± 0.2V. Max Field Current: 5A. OV: 16.0 ± 0.4V

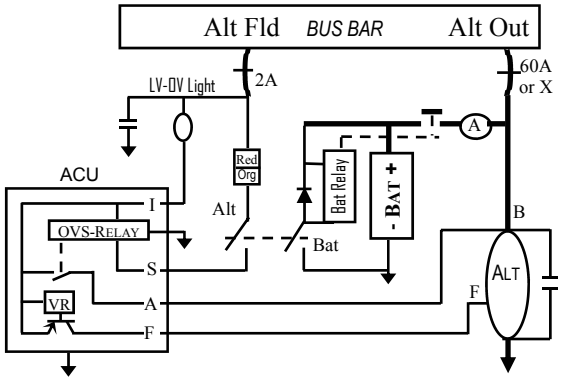
The R15V00 alternator controller (ACU) combine the voltage regulator and over-voltage (OV) sensor functions in one unit. This ACU simplifies the system wiring while providing protection against OV fault.

The R15V00 wiring diagram shows the simplified diagram while the standard wiring diagram shows the use of separate OV Sensor and voltage regulator.

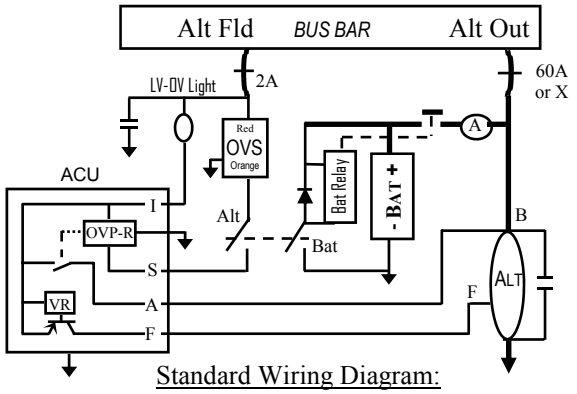
VOLTAGE REGULATION.
The Voltage Regulator, with Remote Voltage sense of the Alternator output, keeps the bus voltage constant by controlling the alternator's field current: increasing it when the system load increases and decreasing it when the load drops.

OVER VOLTAGE (OV) PROTECTION. Built-in
The OV Protector (OVP) deactivates (turns off) the Voltage Regulator and the alternator if the bus voltage exceeds 16V to protect sensitive avionics equipment and the battery.

LOW & OVER VOLTAGE WARNING.
A warning light connected between pin I and the buss comes on to warn the pilot if the bus voltage exceeds the OV level or the alternator is off-line due because there is no voltage on pin S.



R15V00 Wiring Diagram
Combined OVS & Voltage Regulator



Standard Wiring Diagram:
Separate OVS & Voltage Regulator

The R15V00 replaces
- CESSNA P/N: C611001-0201, -0101, -0102 & OVS
- BEECH P/N 33-380010 & OVS
- ELECTRODELTA P/N VR600 & OS60
- PFT/LAMAR P/N: DGR6 & OVS
- FORD P/N: D4FF-10316-BA, CA. & OVS

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ZEFTRONICS
Electrical Charging Systems Solutions

R15V00

14V ELECTRONIC ALTERNATOR CONTROLLER

HOW THE SYSTEM WORKS

Closing the Bat switch applies the battery voltage to *pin A* of the alternator controller (ACU, regulator). With voltage at *pin A* (Alt switch off), the LV light comes on, indicating that the alternator is off-line.

Closing the Alt switch applies battery voltage to *pin S.* The internal Over Voltage Sensor's (OVS) output controls a relay inside the alternator controller. With power applied to *pin S,* that relay's normally open (NO) contacts connects *pin A* and *pin I*.

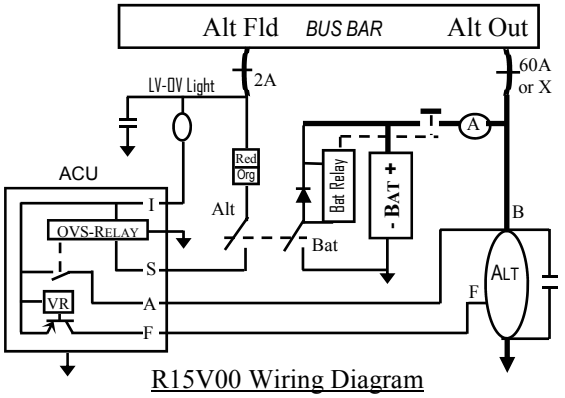
With power on *pin S*, current flows from the alternator's Bat terminal through the controller's voltage regulator to the alternator's field. The regulator keeps the bus voltage constant (around 14V) by controlling the alternator's field current. It increases the field current with increase in system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

Since the whole field current (max about 3.5 Amps) flows from the alternator's Bat terminal to pin A of the controller, abnormal increases in wire, connection, or junction resistances will cause poor voltage regulation and or fluctuating charge meter, panel lights, and bus voltage.

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.

LV-OV Light

The LV-OV light on the instrument panel, tells the pilot the condition of the charging system. See the trouble-shooting section for how this function operates.



R15V00 Wiring Diagram
Combined OVS & Voltage Regulator

INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU/VR.
2. Measure the Alternator's Field Resistance between the field wire of airframe's VR connector and Ground. 3.5 to 6Ω is normal resistance. If is less than 3Ω or greater than 8Ω, check the alternator field or the field wire for problems. 0Ω means Fld-Gnd short.
3. Check the ALT switch resistance: 0.1Ω is normal.
4. Mount and connect the new ACU to the system.
   - Remove the OVS. Connect the wire from the field breaker to the wire from Alt switch.
5. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. With the engine off, turn on the Alt & Bat switches, on the instrument panel, observe that the LV-OV light is off. Verify that the voltage drop across the alternator switch and 5 Amp circuit breaker is less than 0.2V.
2. Verify that the voltage drop from the alternator BAT terminal to pin A is less than 0.2V.
4. If the steps 1 to 3 are successful, perform steps 5 & 6.
5. Turn off all the avionics and any other voltage sensitive devices.
6. Start the engine, and at 1500 RPM measure a bus voltage of 13.9-14.4V. If the bus voltage exceed these limits, check for voltage drops from the alternator BAT terminal to pin A and wires/ connection from the ACU (F) to the alternator's field.

TROUBLE-SHOOTING THE SYSTEM

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

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS MAINTENANCE

This device is not field repairable or serviceable. For all service, repair or overhaul needs, return it to ZEFTRONICS or a ZEFTRONICS approved repair station.
For all periodic inspection and test requirement, use the pre and post installation procedure listed above.
Contact us with tech support questions that are not addressed at www.zeftronics.com or in the TSN or TechCards.

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TROUBLE-SHOOTING THE SYSTEM

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

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 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

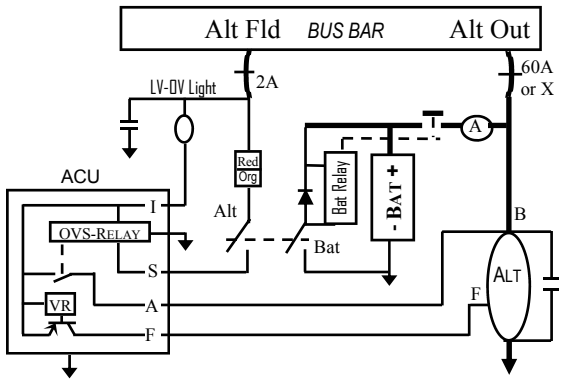
The most common trouble-shooting technique involves replacing suspected defective parts until problem goes away. That shot-gun method is a very expensive and often unsuccessful. Using a more systematic approach to trouble-shooting alerts the user or mechanic to the conditions of the field circuit breaker, 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 4? If not, use the information on these 4 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.



R15V00 Wiring Diagram
Combined OVS & Voltage Regulator

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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Frequently Asked Questions & TECHCARD Notes

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

TROUBLE-SHOOTING THE SYSTEM

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	_____Ω	3 – 6Ω
B. Field resistance at ACU	_____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**:

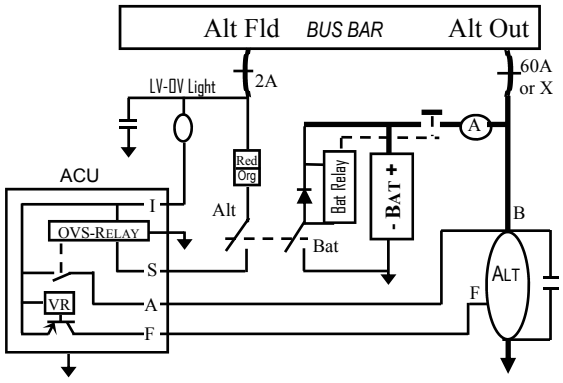
Engine Off	**Bat Switch on**	**Alt Switch on**	**Typical Values**
A. Bus Voltage	_____V	_____V	12 – 13V
D. Pin I Voltage	_____V	_____V	12 – 13V
E. Pin A Voltage	_____V	_____V	12 – 13V
F. Pin S Voltage	_____V	_____V	12 – 13V
F. Field Voltage	_____V	_____V	0.5-2V <VBus

☐ 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***

ZEFTRONICS
Electrical Charging System Solutions



In this **Type B** system: the ACU 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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R15V0N

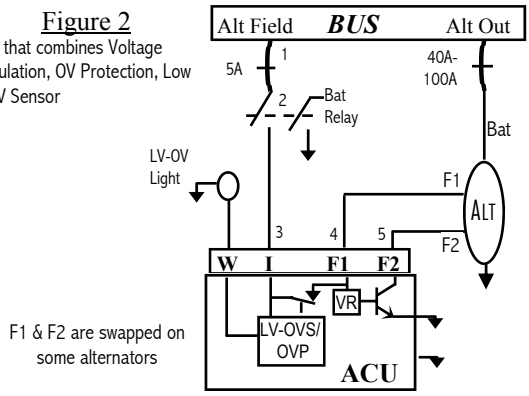
ALTERNATOR CONTROLLER: VREG, OV RELAY, LOW-OV WARNING

FOR TYPE A 14V ALTERNATOR SYSTEMS

Features:	Benefits:
• Voltage Regulation, IC Sense Referenced	* Increase Regulator Life. Not Temperature Sensitive
• Over Voltage (OV) Protection	* Protects System Against Overexcited Alternator Field
• Low Voltage & OV Sensor & Light Output	* Warns of Low & OV Conditions
• Field Controller Generates Low Heat	* Increase Regulator Life
• Externally Adjustable Voltage Regulation	* Increased Ease of Ownership
• Light Weight and Repairable	* Reduced Long-term Ownership Cost

Voltage Regulation: 14.2V ± 0.4V. Max Field Current: 7A.

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



VOLTAGE REGULATION

Using the voltage sensed from the OV Relay output, the 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 drops. The Regulator controls the field by grounding or opening the one side of the field connected to pin F.

The R15V0N works in the one alternator (single engine) application as well as in the dual alternator (single or dual engine application. It is the best replacement for the Prestolite VSF7203 type Voltage Regulator.

OVER VOLTAGE (OV) PROTECTION (NOT IN THE UNIT)

The external OV Protector (OVP) or OV Relay deactivates the Voltage Regulator by removing power to its input and one side of the field if the bus voltage exceeds 16V. This removes the alternator field excitation and thus protects sensitive avionics equipment and the battery.

TYPE A VOLTAGE REGULATION:

This controller has a "Type A" regulator which excites the field of the alternator by providing controlled ground to one side of the alternator field (F2), with the other side (F1) powered by the OVR output.

The R15V0N replaces
- PRESTOLITE: VSF7203,2,1,4 & OV RELAY
- ELECTRODELTA: VSF7203A & OS75-14
- TCM: 649684-1 & OV RELAY
- LYCOMING: LW10185 & OV RELAY
- PIPER: 550-583 & OV RELAY

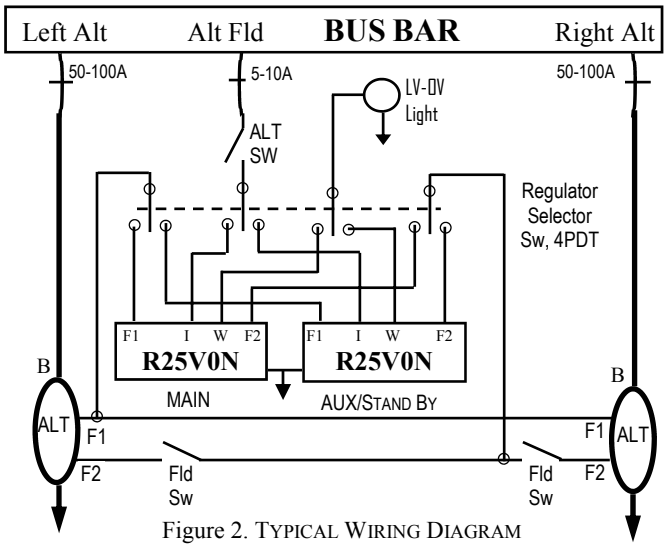


Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

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ZEFTRONICS
Electrical Charging Systems Solutions

R15V0N ALTERNATOR CONTROLLER
FOR TYPE A 14V ALTERNATOR SYSTEMS

HOW THE SYSTEM WORKS:
REFER TO FIGURE 1 & 2 PAGES 1 & 3

Turning on the master switch applies battery voltage to the input of the Alternator Controller or Voltage Regulator (VR) through the Over-Voltage Relay (OVR).

In this "Type A" charging system configuration, the VR applies controlled grounding to one side of the alternator's field while the other side has power on it from the OVR. Without the engine running, the field voltage is typically 0-2V. With the engine running, the field voltage is 13-0.5V while the bus voltage is at 14V. *The field voltage starts out high and decreases with increased system load.* If the field voltage becomes 0, the system will experience an OV condition, and the OV Relay will open to turn off the VR thereby removing excitation from the alternator's field.

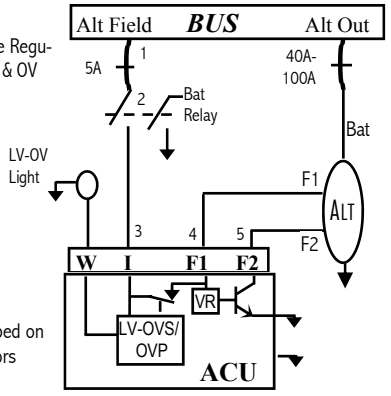
Over Voltage Protection

The OV Relay is a normally closed switch which opens when the bus voltage exceeds 16V. It has a time delay that prevents nuisance tripping caused by system noise or voltage spikes.

The regulated bus voltage is normally about 14V unless the alternator is self-current limiting[1] or if there is voltage drop in the alternator field circuit breaker, alternator switch, OV Relay, or wiring and connections between the bus and the red wire on the VR. These voltage drops across the different components and connections occur when current, up-to 3 Amps in some instances, passes through the resistance built-up in them. *The resistance build-up causes flickering ammeter and instrument panel lights.*

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

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



INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU/VR.
2. At the ACU/VR, measure the alternator's field resistance: i.e. resistance between the F1 (I) and F2 (F). A resistance of 3.5 to 6Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the alternator's field wire (at the ACU/VR) to field wire to the OVR ouput wire. 0Ω indicates a field to ground short. Correct fault found.
3. Verify that the input (Alt Switch, Field breaker, etc) resistance to the OVR is below 0.1Ω. Correct the faults found.
4. Mount the ACU/VR and connect the OVR and ACU/VR to the system.
5. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and measure
   - Bus voltage _____V. _____V.
   - I voltage _____V. _____V.
   - F1 voltage _____V. _____V.
   - F2 voltage _____V. _____V.
   - W voltage _____V. _____V.

   The inputs should read bus voltage. VR output voltage on the "type A" should read 0-2V.
2. If the step 1 is successful, perform step 3.
3. Turn Off all the avionics. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 13.8 – 14.4V. 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

See the Trouble-Shooting Notes (TSN) page and or TECHCARDS for information on how to solve problems in the system.

WIRING DIAGRAMS

See pages 1 and 3 for wiring diagrams of the dual alternator system.

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TROUBLE-SHOOTING THE SYSTEM WITH R15V0N

14V Type A alternator system on Beech, Cessna, Piper, Twin Commander etc

TROUBLE-SHOOTING

1. With BAT, ALT, REG & FLD switches on and the engine off, the voltage on pin I of the R15V0N will be the same as the bus voltage. If it is more than 0.2V less, look for high resistance in the 5-10A breaker, the Alt switch, the OV Relay, the Reg selector switch, or connections at any of those devices). None of the devices should have a voltage drop that is higher than 0.1V.
2. Turn Off all the avionics. Start the engine, and at 1500 RPM measure a bus voltage of 13.8-14.4V. If the bus voltage exceed these limits, verify that the voltage adjustment on the controller and the voltage drops of the power input devices.
   At that speed, depending on the system load, the voltage on the field will decrease from about 13V to 0.5V. Loading the alternator beyond its rating (for a given speed) will cause it to self current limit. Current limit is indicated by a drop in bus voltage which occurs as system load current exceeds a certain point.

One or Both Alternators Drop Off-line

Make sure that the 5-10A breaker is okay. Then check the condition of the Alt switch, the OV Relay, and Reg switch. Verify that the voltage on pin I is the same as the bus voltage.

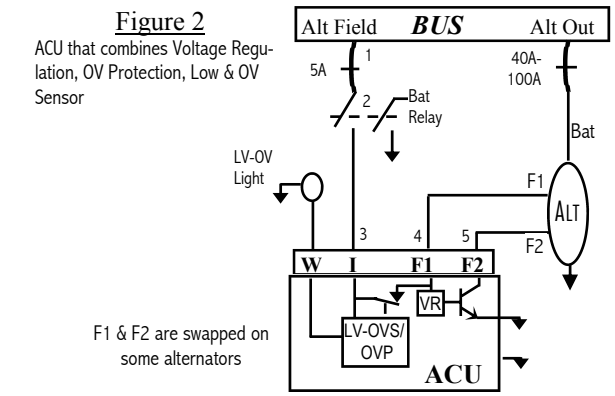
Check one unit at a time. On the R15V0N, if there is no voltage on pin F1, the OVR may have tripped due to a grounded ALT field or field wire. At the R15V0N and at the alternator's field, check the field resistance: it is normally 3.5 to 6Ω. If the resistance is out of range, check the ALT field or wires/connections/switches/ fuses from the regulator to the field. An alternator with a grounded field/field wire will cause an OV fault**.** Test the system again with only one alternator field switch on at a time.

Fluctuating Charge-meter / Flickering Panel Lights

This problem is usually caused by a resistance build-up in 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 5-10Amp 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.

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



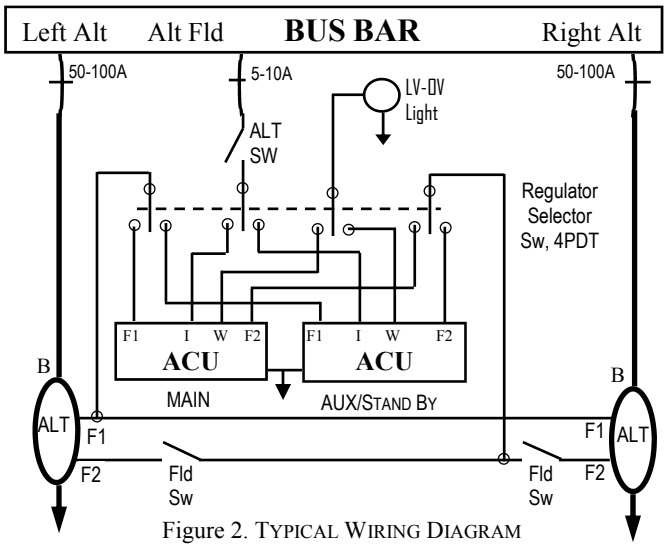


Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

TROUBLE-SHOOTING

Checking the condition of the voltage regulator/controller & OVR

1. With the Bat & Alt switches on, engine off, measure the voltages at the indicated (refer to the wiring diagram).

Single Alt /figure 1. BUS: _____ 5A Bkr: _____ I PWR: _____
F1 : _____ F2: _____ W:_____ R Fld: _____ R Fld: _____

Dual Alt /figure 2.
Main Reg Selected. BUS: _____ 5A Bkr: _____ I PWR: _____
F1 : _____ F2: _____ W:_____ R Fld: _____ R Fld: _____

Aux Reg Selected. BUS: _____ 5A Bkr: _____ I PWR: _____
F1 : _____ F2: _____ W:_____ R Fld: _____ R Fld: _____

Checking the condition of the alternator Field & Power input devices

2. Disconnect pin F1 & F2 on the controller. Measure the resistances indicated below:

F2 to F1 ALT _____Ω. Pin I to BUS _____Ω. F2 to F1 ACU _____Ω
The field resistance is normally 3.5 to 6Ω.If the resistance is out of that range, check the alternator field or wires/connections/switches/fuses. The resistance from pin I to bus should be 0-0.1Ω. A higher resistance may lead to fluctuating ammeter or panel lights or erratic bus voltage.

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Frequently Asked Questions & TECHCARD Notes
14V Type A alternator system on Beech, Cessna, Piper, etc

Flickering / oscillating ammeter and panel lights.
Check the components and connections between A and D for high resistance or intermittent connection..

No voltage regulation
With the master switch on and Battery voltage measured on the OV Relay output, look for Bus voltage on the VR input and output.

- If the is no Bus voltage on the ACU input, look for a broken wire between the ACU and the OVR.
- If the input voltage is more than 0.2V lower than the bus voltage, look for & correct the device (5A breaker, ALT switch, OVR or connection or wire) that is causing it.
- If the output voltage is 0 and the input has 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 VR in for test/repair.
- If it is internally shorted, repair the field ground fault or replace the alternator.
- If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the VR in for test/repair.

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. In some Piper aircraft, check the condition of the diode between the bus and alternator output. Check the shunts and alternator output wires. indicating an alternator that is current limiting.

Bus voltage drops with load increase
See *Alternator carries only about half its rated output*.

OUR GOAL IS TO HELP YOUR SYSTEM OPERATE BETTER AND TO 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 3.5-6Ω 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.

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

		12V Values		Typical Values
A.	Field resistance at ALT	_____Ω	_____Ω	3.5 – 6Ω
B.	Field resistance at ACU	_____Ω	_____Ω	3.5 – 6Ω
C.	Field SW resistance	_____Ω	_____Ω	0 – 0.1Ω
D.	Field C/BKR resistance	_____Ω	_____Ω	0 – 0.05Ω
E.	ALT C/BKR resistance	_____Ω	_____Ω	0 – 0.05Ω

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

		12V Values		Typical Values
F.	BUS Volt Engine Off	_____V	_____V	12 – 13V
G.	ACU/Reg input Volt	_____V	_____V	12 – 13V
H.	Field Voltage	_____V	_____V	Vbus to 0.5V

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

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

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

ZEFTRONICS
Electrical Charging System Solutions

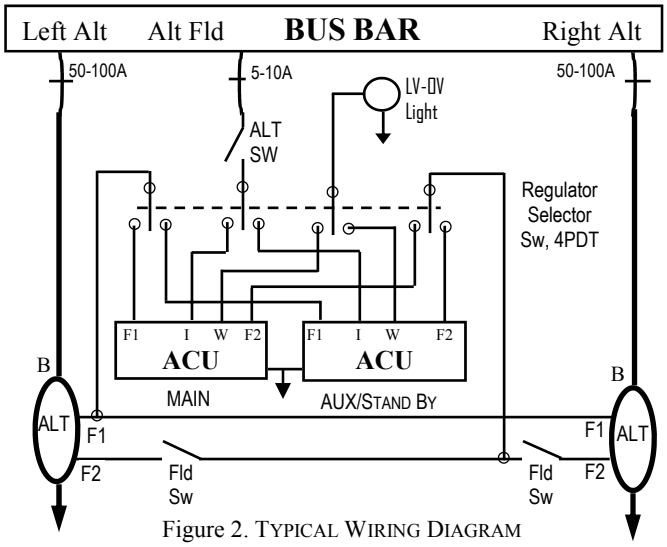
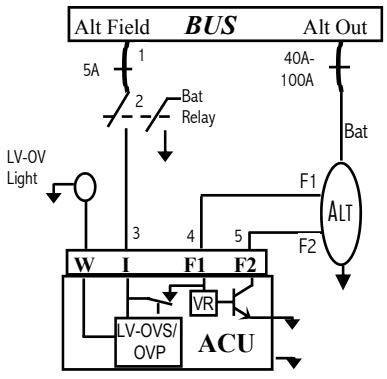


Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

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

F1 & F2 are swapped on some alternators



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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

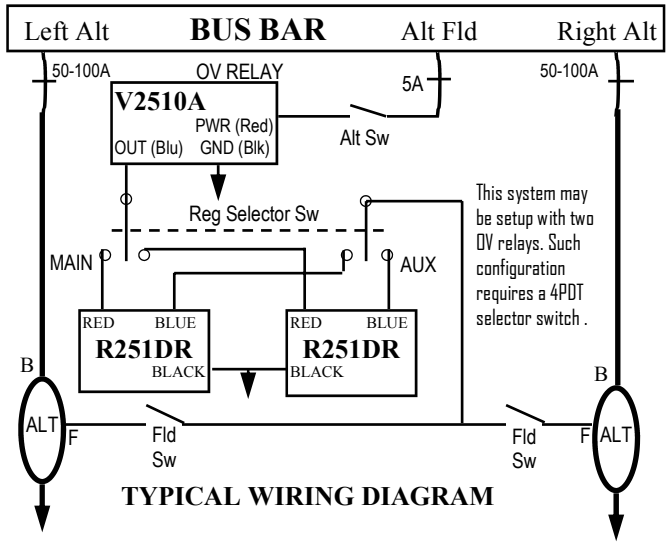
The Voltage Regulator keeps the bus voltage constant by controlling the alternators field current: increasing it when the system load increases and decreasing it when the load drops.

FIELD TO GROUND SHORT PROTECTION

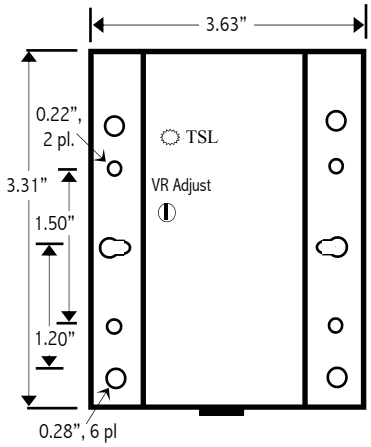
Should either of the alternator's field become shorted to ground (the reason most Voltage Regulators fail), the field-to-ground short protector will deactivate the Voltage Regulator, and switch on the unit's RED field-to-ground short indicator. The defective field may be identified by selectively operating 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

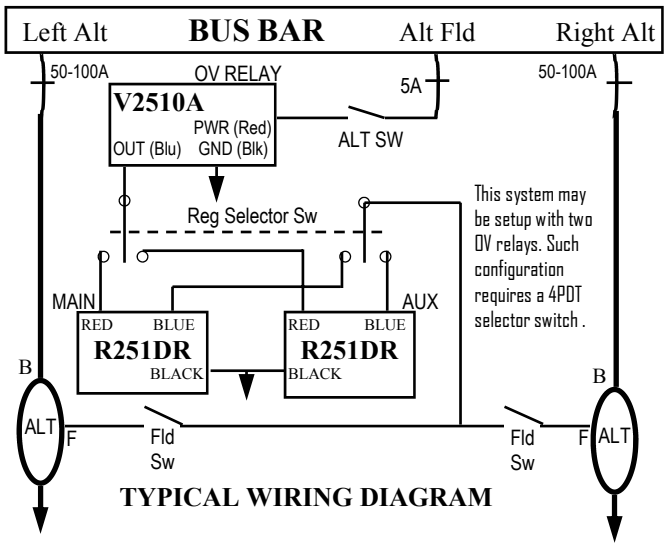
1 Disconnect and remove the present ACU/VR.
2 From wire on the airframe side of the ACU/VR's blue wire, measure the resistance between the field and the ground. The normal resistance is 10.0 to 18Ω. Resistance outside the specified range require checking the alternator field and the connections/wire 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.

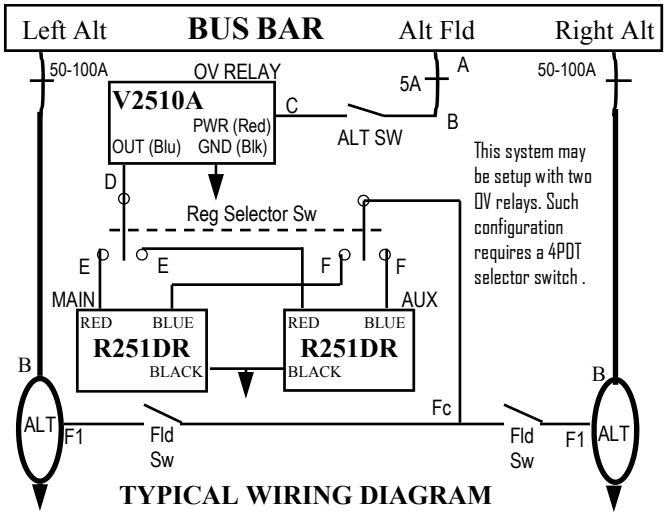
With the engine on and the Bat, Alt, & Reg selector switches on, the ACU/regulator controls the excitation of the alternator to produce a Bus voltage of 27.5 –28.0V. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

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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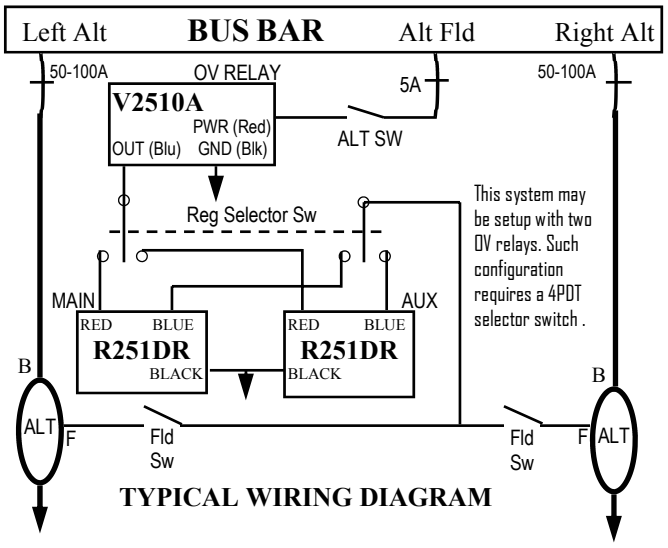
Electrical Charging System Solutions



TYPICAL WIRING DIAGRAM

By Femi G. Ibitayo

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ZEFTRONICS: SOLUTIONS

R2510N

ALTERNATOR CONTROLLER / VOLTAGE REGULATOR

FOR TYPE A 28V ALTERNATOR SYSTEMS

Features:	Benefits:
• Voltage Regulation, IC sense referenced	* Increase Regulator Life. Not temperature sensitive
• Field Controller Generates Low Heat	* Increase Regulator Life
• Externally Adjustable* Voltage Regulation	* Increased Ease of Ownership
• Light Weight and Repairable	* Reduced Long-term ownership cost

Voltage Regulation: 28.4V ± 0.4V*. Max Field Current: 7A.

VOLTAGE REGULATION

Using the voltage sensed from the OV Relay output, 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 drops. The Regulator controls the field by grounding or opening the one side of the field connected to pin F.

The R2510N works in the one alternator (single engine) application as well as in the dual alternator (single or dual engine application. It is the best replacement for the Prestolite VSF7403 type Voltage Regulator.

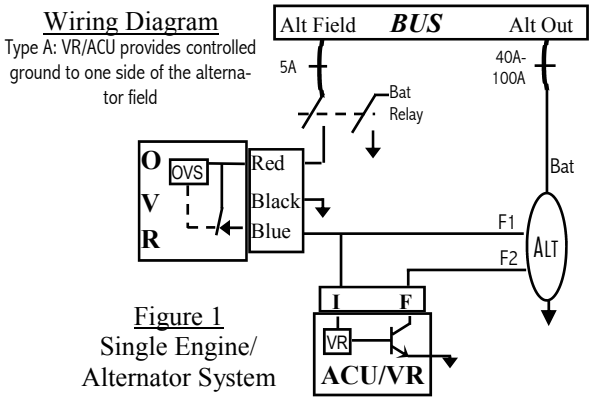

Figure 1
Single Engine/
Alternator System

OVER VOLTAGE (OV) PROTECTION (NOT IN THE UNIT)

The external OV Protector (OVP) or OV Relay deactivates the Voltage Regulator by removing power to its input and one side of the field if the bus voltage exceeds 32V. This removes the alternator field excitation and thus protect sensitive avionics equipment and the battery.

TYPE A VOLTAGE REGULATION:

This controller has a "Type A" regulator which excites the field of the alternator by providing controlled ground to one side of the alternator field (F2), with the other side (F1) powered by the OVR output.

The R2510N replaces
- PRESTOLITE: VSF7401, 7402, 7403, 7404
- ELECTRODELTA: VSF7403A
- TCM: 649684-2, 649440-2
- LYCOMING: LW101079, 77347
- PIPER: 550-581

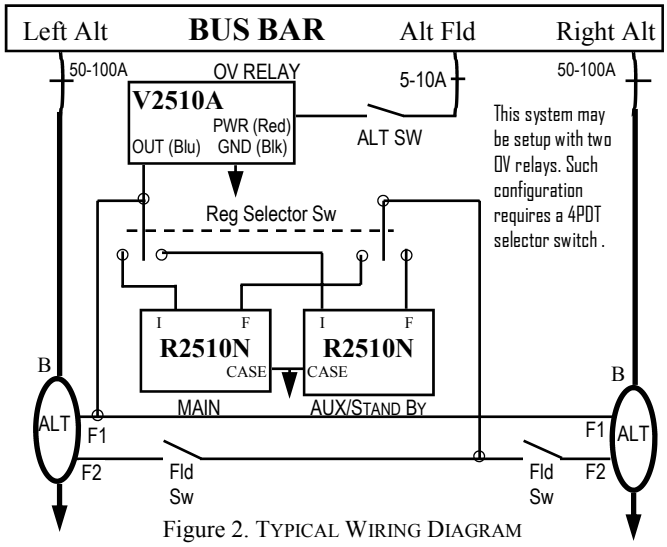

Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

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ZEFTRONICS
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R2510N

TYPE A 28V ALTERNATOR CONTROLLER / VOLTAGE REGULATOR

HOW THE SYSTEM WORKS:

REFER TO FIGURE 1 & 2 PAGES 1 & 3

Turning on the master switch applies battery voltage to the input of the Alternator Controller or Voltage Regulator (VR) through the Over-Voltage Relay (OVR).

In this "Type A" charging system configuration, the VR applies controlled grounding to one side of the alternator's field while the other side has power on it from the OVR. Without the engine running, the field voltage is typically 0-2V. With the engine running, the field voltage is 27-0.5V while the bus voltage is at 28V. *The field voltage starts out high and decreases with increased system load.* If the field voltage becomes 0, the system will experience an OV condition, and the OV Relay will open to turn off the VR thereby removing excitation from the alternator's field.

Over Voltage Protection

The OV Relay is a normally closed switch which opens when the bus voltage exceeds 32V. It has a time delay that prevents nuisance tripping caused by system noise or voltage spikes.

The regulated bus voltage is normally about 28V unless the alternator is self-current limiting[1] or if there is voltage drop in the alternator field circuit breaker, alternator switch, OV Relay, or wiring and connections between the bus and the red wire on the VR. These voltage drops across the different components and connections occur when current, up-to 3 Amps in some instances, passes through the resistance built-up in them. *The resistance build-up causes flickering ammeter and instrument panel lights.*

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

Wiring Diagram

Type A: VR/ACU provides controlled ground to one side of the alternator field

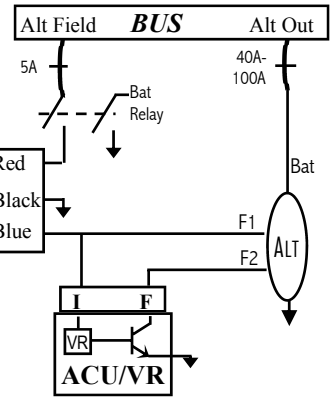

Figure 1
Single Engine/ Alternator System

INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU/VR.
2. At the ACU/VR, measure the alternator's field resistance: i.e. resistance between the F1 (I) and F2 (F). A resistance of 10 to 18Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the alternator's field wire (at the ACU/VR) to field wire to the OVR ouput wire. 0Ω indicates a field to ground short. Correct fault found.
3. Verify that the input (Alt Switch, Field breaker, etc) resistance to the OVR is below 0.1Ω. Correct faults found.
4. Mount the ACU/VR and connect the OVR and ACU/VR to the system.
5. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and measure
   - Bus voltage _____V.
   - OVR Red wire (input) voltage _____V
   - OVR Blue wire (output) voltage _____V
   - VR I (input) voltage _____V
   - VR F (output) voltage _____V

   The inputs should read bus voltage. VR output voltage on the "type A" should read 0-2V.
2. If the step 1 is successful, perform step 3.
3. Turn Off all the avionics. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 27.5V - 28.5V. 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

See the Trouble-Shooting Notes (TSN) page and or TECHCARDS for information on how to solve problems in the system.

WIRING DIAGRAMS

See pages 1 and 3 for wiring diagrams of the dual alternator system.

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TROUBLE-SHOOTING THE SYSTEM WITH R2510N OR VSF7403

24V Type A alternator system on Beech, Cessna, Piper, Twin Commander etc

TROUBLE-SHOOTING

1. With BAT, ALT, REG & FLD switches on and the engine off, the voltage on pin I of the R2510N will be the same as the bus voltage. If it is more than 0.2V less, look for high resistance in the 5-10A breaker, the Alt switch, the OV Relay, the Reg selector switch, or connections at any of those devices). None of the devices should have a voltage drop that is higher than 0.1V.
2. Turn Off all the avionics. Start the engine, and at 1500 RPM measure a bus voltage of 27.5-28.5V. If the bus voltage exceed these limits, verify the voltage adjustment on the controller and the voltage drops of the power input devices.
   At that speed, depending on the system load, the voltage on the field will decrease from about 27V to 0.5V. Loading the alternator beyond its rating (for a given speed) will cause it to self current limit. Current limit is indicated by a drop in bus voltage which occurs as system load current exceeds a certain point.

One or Both Alternators Drop Off-line

Make sure that the 5-10A breaker is okay. Then check the condition of the Alt switch, the OV Relay, and Reg switch. Verify that the voltage on pin I is the same as the bus voltage.

Check one unit at a time. On the R2510N, if there is no voltage on pin I, the OVR may have tripped due to a grounded ALT field or field wire. At the R2510N and at the alternator's field, check the field resistance: it is normally 10 to 18Ω. If the resistance is out of that range, check the alternator field or wires/connections/ switches/fuses from the regulator to the field. An alternator with a grounded field/field wire will cause an OV fault**.**

Test the system again with only one alternator field switch on at a time.

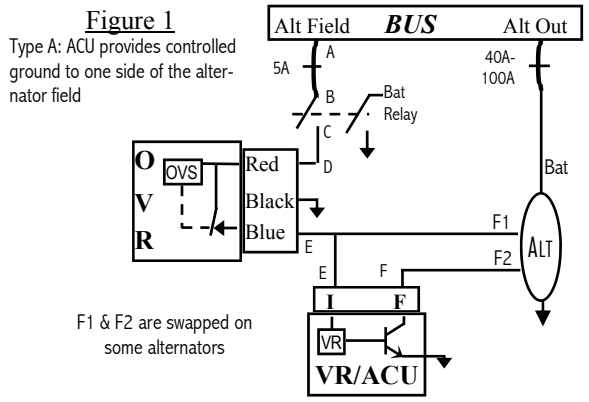
Fluctuating Charge-meter / Flickering Panel Lights

This problem is usually caused by a resistance build-up in 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 5-10Amp 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.

Figure 1

Type A: ACU provides controlled ground to one side of the alternator field



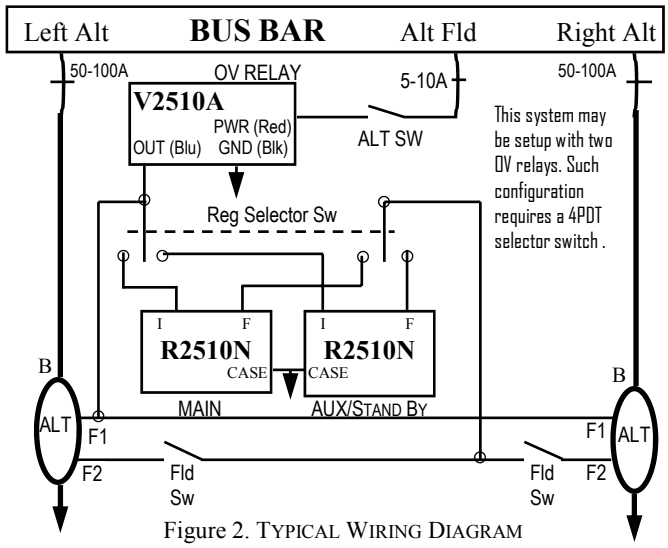


Figure 2. TYPICAL WIRING DIAGRAM DUAL ALTERNATOR SYSTEM

TROUBLE-SHOOTING

Checking the condition of the voltage regulator/controller & OVR

1. With the Bat & Alt switches on, engine off, measure the voltages at the indicated (refer to the wiring diagram).

Single Alt /figure 1. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 1: _____

Dual Alt /figure 2.
Main Reg Selected. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 1: _____

Aux Reg Selected. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 2: _____

Checking the condition of the alternator Field & Power input devices

2. Disconnect pin F on the R2510N (or voltage regulator). Measure the resistance indicated below:

Fld 2 to 1 _____Ω. Pin I to BUS _____Ω. Fld 2 to 1 _____Ω.
The field resistance is normally 10 to 18Ω.If the resistance is out of that range, check the alternator field or wires/connections/switches/fuses. The resistance from pin I to bus should be 0-0.1Ω A higher resistance may lead to fluctuating ammeter or panel lights or erratic bus voltage.

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ZEFTRONICS
Electrical Charging Systems Solutions

Frequently Asked Questions & TECHCARD Notes

Trouble-Shooting 28V Type A alternator system on Beech, Cessna, Piper, etc

Flickering / oscillating ammeter and panel lights.

Check the components and connections between A and D for high resistance or intermittent connection.

No voltage regulation

With the master switch on and Battery voltage measured on the OV Relay ouput, look for Bus voltage on the VR input and out put.

- If the is no Bus voltage on the ACU input, look for a broken wire between the ACU and the OVR.
- If the input voltage is more than 0.2V lower than the bus voltage, look for & correct the device (5A breaker, ALT switch, OVR or connection or wire) that is causing it.
- If the output voltage is 0 and the input has 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 VR in for test/repair.
- If it is internally shorted, repair the field ground fault or replace the alternator.
- If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the VR in for test/repair.

Bus voltage remains at battery voltage (about 24V)

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. In some Piper aircraft, check the condition of the diode between the bus and alternator output. Check the shunts and alternator output wires. indicating an alternator that is current limiting.

Bus voltage drops with load increase

See *Alternator carries only about half its rated output.*

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.

☐ 5. 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 C/BKR resistance	_____Ω	0 – 0.05Ω

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

	24V Values	**Typical Values**
F. BUS Volt Engine Off	_____V	24 – 26V
G. ACU/Reg input Volt	_____V	24 – 26V
H. Field Voltage	_____V	Vbus to 0.5V

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

	24V System	**Typical value**
I. Bus voltage	_____V	27.4 – 28.5V

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

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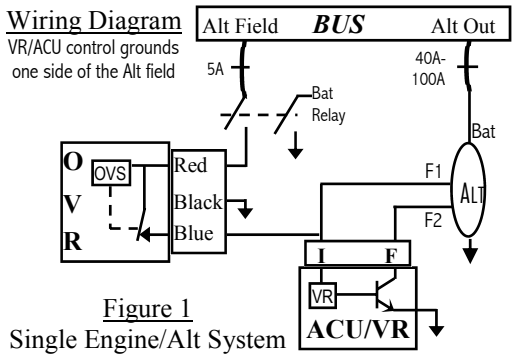

Figure 1
Single Engine/Alt System

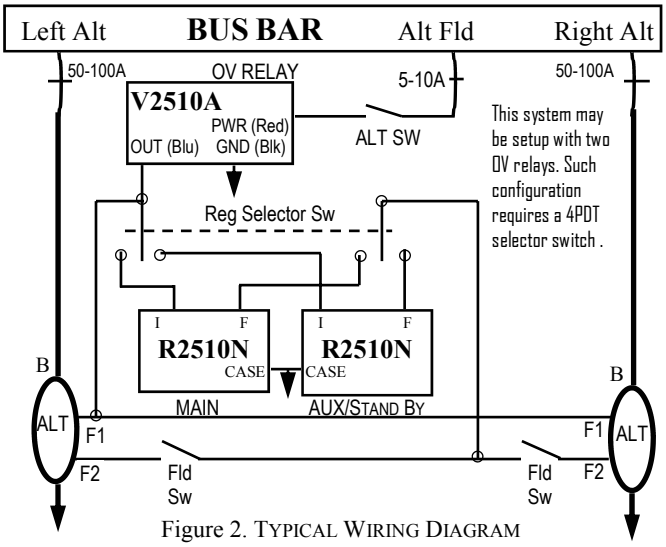

Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

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ZEFTRONICS
Electrical Charging Systems Solutions

R25400

28V ELECTRONIC ALTERNATOR CONTROLLER

Features:		Benefits:
• Voltage Regulation, IC voltage reference	*	Increased Regulator life. Not temperature sensitive.
• Remote Voltage Sensing	*	Improved Voltage Regulation. Reduced panel light flicker
• Low & Over Voltage Sensor /Indication	*	Improves safety—Warns of Low voltage & OV condition
• Field-to-Ground Fault Protection (GFP)	*	Protects against grounded alternator field
• Trouble-Shooting Light (TSL)	*	Identifies grounded field. Reduce trouble-shooting time.
• Over-Voltage Protection	*	Protects system loads against overexcited alternator

Voltage Regulation: 28.7V ± 0.4V. Max Field Current: 5A. Field-to-Ground Protection

VOLTAGE REGULATION.

The 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.

REMOTE VOLTAGE SENSOR

By sensing the alternator's battery terminal voltage, the ACU provides better voltage regulation and eliminates flickering charge-meter and panel lights.

LV / OV SENSOR & INDICATION

The LV warning light connected to pin 4 comes ON when the alternator drops off-line. the bus voltage drops below the LV level, or the OV trips the ACU off-line.

OVER VOLTAGE (OV) PROTECTION.

To protect sensitive avionics equipment and the battery, the OV protector deactivates (turns off) the Regulator and the alternator if the bus voltage exceeds 32V.

FIELD TO GROUND SHORT PROTECTION (GFP)

If the alternator's field shorts to ground, the field-to-ground short protector deactivates the Voltage Regulator and switches on the unit's Trouble-Shooting Light (TSL) red and the aircraft LV warning light.

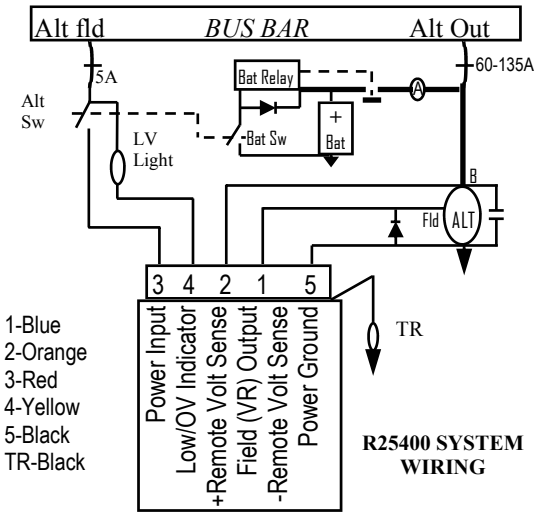
TROUBLE-SHOOTING LIGHT (TSL)

The TSL (on the unit) is designed to alert the user to the condition of the Alternator / ACU system.

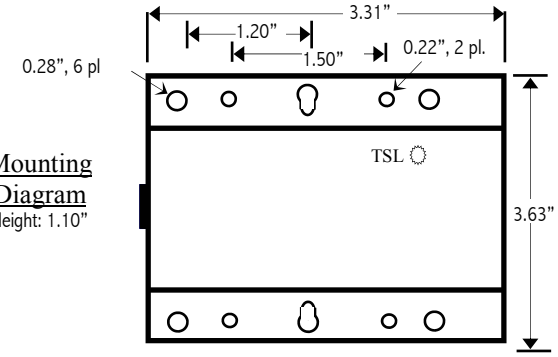
Red TSL indicates: An internal or external ground short in the alternator field circuit

Without the engine running but master switch on, **Green TSL i**ndicates that the ACU is supplying current to the alternator's field.

With the engine running, master switch on, and bus voltage @ 28.5 to 28.9V, **Green TSL** indicates correct alternator output voltage.



R25400 SYSTEM WIRING



Mounting Diagram
Height: 1.10"

Trouble-Shooting Light Continued ….

With the engine running, master switch on, and bus voltage @ 24V-26V, **Green TSL** indicates that current is flowing from the ACU but the alternator field or field wire to it is open.

With the master switch on, if the **TSL** is off, that indicates that one power input device (e.g. switch, circuit breaker, or wiring) is open or the ACU is defective.

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ZEFTRONICS
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R25400

28V ELECTRONIC ALTERNATOR CONTROLLER

HOW THE SYSTEM WORKS

Turning on the Master switch applies battery voltage to the input of the ACU through the input devices (Alt switch, 5A circuit breaker and wires from the bus). The ACU controlled current passes to the field of the alternator. Without the engine running, the field voltage is typically 0.5-2V less than the bus or battery voltage.

VOLTAGE REGULATION

When the engine is running, 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 drops. The regulated bus voltage is normally 28.5V-28.9V unless the alternator is self-current limiting[1] or if there is voltage drop in the devices before or after the ACU (excluding the alternator).

OVER VOLTAGE PROTECTION.

To protect sensitive avionics equipment and other system loads, if the bus voltage exceeds 32V the OV Protector (OVP) deactivates (turns off) the Voltage Regulator to remove the alternator's field current. The ACU stays latched off until the alternator switch is reset.

FIELD TO GROUND SHORT PROTECTION (GFP)

If the alternator's field shorts to ground, the field-to-ground short protector deactivates the Voltage Regulator and switches on the unit's Trouble-Shooting Light (TSL) red and the aircraft LV warning light.

TROUBLE-SHOOTING LIGHT (TSL)

The TSL on the unit alerts the user to the condition of the Alternator / ACU system. The TSL has three color/states: Red, Green, and Off.

Red TSL indicates: An internal or external ground short in the alternator field circuit

Without the engine running but master switch on, **Green TSL** indicates that the ACU is supplying current to the alternator's field. An **Off TSL** indicates that one of the power input devices is open or the ACU is defective.

With the engine running, master switch on:

At bus voltage of 28.5V-28.9V, **Green** TSL indicates correct alternator output voltage.

At bus voltage of 24V-26V, **Green** TSL indicates that current is flowing from the ACU but the alternator field or field wire to it is open.

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit is current and voltage output at a given speed.

INSTALLATION INSTRUCTION

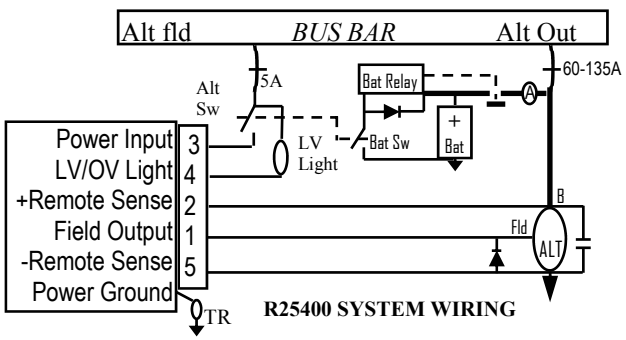
1. Disconnect and remove the present ACU.
2. At the ACU, measure the alternator's field resistance: i.e. resistance between the field (the ACU's pin 1) and the ground wire (the ACU's pin 5). A resistance of 10 to 18Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the ACU's field wire to ground. 0Ω indicates a field to ground short. Correct the fault.
3. Mount and connect the new ACU to the system.
4. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch (BAT only) and observe: On the ACU the TSL light is off and on the instrument panel, the LV light is on. A Red TSL indicates a grounded Field or field wire.
2. Turn on the Master switch (BAT & ALT only) and observe: that the LV light is Off, on the ACU the TSL is Green. A Red TSL indicates a ground shorted Field. An off TSL may indicate an open circuit between the Alt Sw and the ACU airframe connector's pin 3.
3. If the TSL is Green, measure the voltage on pins 3 and 1. Read Battery voltage on pin 3. Pin 1 should read 0.5-2 volts less than what is on pin 3.
4. If the steps 1 to 3 are successful, perform step 5.
5. Turn off all the avionics and voltage sensitive loads. Start the engine. At 1500-1600 RPM measure bus voltage: With 10A load, bus should read 28.3V - 28.9V. If it exceeds these limits, check for voltage drop in the 5A breaker, Alt switch, and pre-ACU 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.



R25400 SYSTEM WIRING

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R25400 28V ELECTRONIC ALTERNATOR CONTROLLER
TROUBLE-SHOOTING THE R25400 SYSTEM

Turning on the master switch (ALT & BAT) applies battery voltage to the Bus & ACU input.

Refer to figure TS1. Take all voltage measurements at test points A, B, D, E, F1 and H referenced to ground.

A. _____ Volts.	B. _____ Volts		
D _____ Volts.	E. _____ Volts		
F _____ Volts.	Fl. _____ Volts		
H _____ Volts.	J _____ Volts		

The voltages measured at A, B, D and H should be equal, Bus voltage (24-26V). The voltage on F1 (field or ACU output) will be 0.5 to 2V less than the voltage at A, B, D or H. The voltage at F1 will be the same as F.

If the voltage at A is 0.2V more than that on D, check the 5 Amp breaker, ALT switch, and connections between the bus and D for high resistance or open circuit. A high resistance between A & D may lead to flickering / oscillating ammeter and panel lights. An open circuit between A & D will not allow current to get to the ACU and no current to the alternator's field, resulting in 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.

If the voltage on F1 is 0 or close , check for a ground short on F1 on the alternator or wire from F on ACU. If there is a field-to-ground short, the ACU will turn itself off & turn its built-in Trouble-Shooting Light (TSL) Red.

An open stator wire or open diode in the alternator will make the alternator only able to carry about half its rated output. For example, a 70A 24V alternator has a 28V output with about 30A load on it. When the load is increased to 40A, the bus voltage drops to 22 to 26V, indicating an alternator that is current limiting.

See TechCard for resistance and voltage measurements.

In this Type B system: the ACU 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 OVP grounds the field when OV occurs.

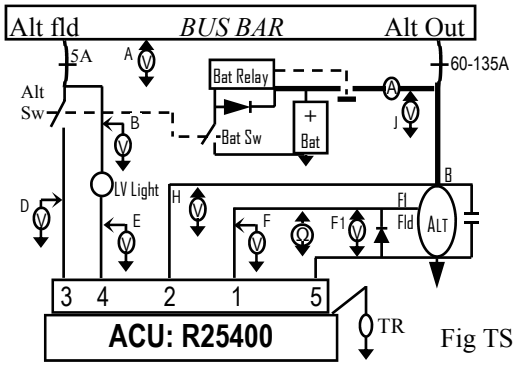

Fig TS1

Turning the master switch (ALT & BAT) on with the engine off, applies battery voltage to the input of the ACU through the 5 Amp FLD circuit breaker, and ALT switch. To excite the alternator's field, the ACU passes controlled current to the alternator's field.

With the engine on and the master switch on, the ACU controls the excitation of the alternator to produce a Bus voltage of 28.3-28.9. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

Normally, the 5 Amp circuit breaker opens if the Field current exceeds 5 amps beyond a preset time lag thus protecting the wire from the Bus to the field. The built-in electronic circuit breaker of the R25400 turns the ACU off before the circuit breaker opens.

If the Bus voltage exceeds the preset over-voltage (OV) limit, the OV Protector will ground the field to turn off the alternator.

Applying power to a static (non-rotating) alternator through the ACU produces F1 voltage that is 0.5-2V less than Bus voltage. When the alternator is rotating, F1 voltage starts low and increases with each load increase until the alternator current limits.

If the LV light does not come on with only the Bat side of the Master switch on, with the ACU still connected, verify that the voltage on pin 4 or test point E is 0-2V. If pin 4 has 0-2V, disconnect the ACU and ground pin 4 on the airframe side of the connector. The LV light should illuminate. If it does not, the LV lamp is bad or there is an open circuit on the line from the Bus to pin 4.

See TechCard for resistance and voltage measurements.

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Frequently Asked Questions & TECHCARD Notes

28V Type B alternator system on Beech, Mooney etc

TROUBLE-SHOOTING THE SYSTEM

Flickering / oscillating ammeter and panel lights.

Check the 5 Amp breaker, ALT switch, and connections between the bus and the input to the ACU for high resistance or intermittent connection..

No voltage regulation or *Bus voltage remains at battery voltage (about 25V)*

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 Bus voltage, look for a broken wire, bad connection or input device (5A circuit breaker or Alt switch) 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 0V and the input has battery voltage, look for a grounded alternator field or field wire (as indicated by a Red ACU TSL). If the field resistance is correct as shown in step 5 of the installation tests and the ACU's Trouble-Shooting Light (TSL) is off, send the ACU in for test/repair.
- If the TSL is Red, repair the field ground fault or replace or repair the defective alternator.
- If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test or repair.

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*.

***NO LIGHT** on the unit*, with the Master Switch on. This means that one power input device (Alt switch, 5A circuit breaker, or wiring) or ACU is damaged. To confirm a damaged ACU, remove the field wire from the alternator. The presence of voltage on its input (pin 3) and no voltage on its output (pin 1) confirms that the ACU is defective.

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. 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**:

	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**
A. Bus voltage	_____V	28.3 – 28.9V
H Bus voltage	_____V	28.3 – 28.9V
J Bus voltage	_____V	28.3 – 28.9V

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

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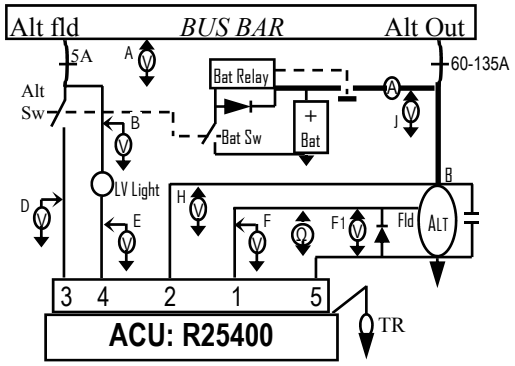
TROUBLE-SHOOTING THE R25400 SYSTEM



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ZEFTRONICS
Electrical Charging Systems Solutions

R25101 Rev A, R25102 Rev A

28V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR

Features:

- **Voltage Regulation, IC sense referenced**
- **Field-to-Ground Fault Protection (GFP)**
- **Trouble-Shooting Light (TSL)**

Benefits:

- **Increase Regulator Life. Not temperature sensitive.**
- **Protects against grounded alternator field.**
- **Identifies grounded field. Reduce trouble-shooting time**

Voltage Regulation: 27.7V ± 0.4V for R25101 Rev A, 28.7V ± 0.4V for R25102 Rev A
Max Field Current: 5A. Field-to-Ground Protection @ Field current > 6A

VOLTAGE REGULATION

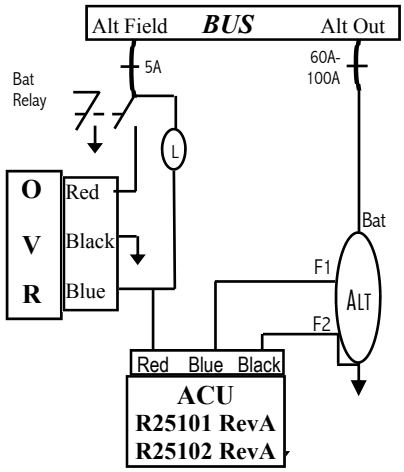
The Voltage Regulator keeps the bus voltage constant by controlling the alternator's field current: increasing it when the system load increases and decreasing it when the load drops.

FIELD TO GROUND SHORT PROTECTION

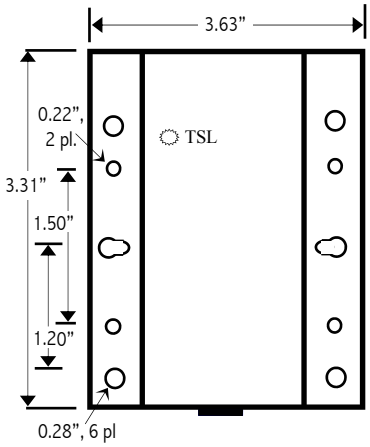
Should the alternator's field become shorted to ground (the reason most Voltage Regulators fail), the field-to-ground short protector will deactivate the Voltage Regulator, and switch on the unit's RED field-to-ground short indicator.

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



Wiring Diagram



Mounting Diagram
Height: 1.10"

The R25101 Rev A replaces
- CESSNA: C611004-0101, C611002-0205
- ELECTRODELTA: VR500-0101
- PFT/LAMAR: DGR
- LYCOMING:

The R25102 Rev A replaces
- CESSNA: C611004-0102
- ELECTRODELTA: VR500-0102
- PFT/LAMAR: DGR
- LYCOMING:

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ZEFTRONICS
Electrical Charging Systems Solutions

R25101 Rev A, R25102 Rev A

28V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR

HOW THE SYSTEM WORKS

When the master switch is turned on, battery voltage is applied to the input of the alternator controller/voltage regulator through the Over-Voltage Relay (OVR).

The current passing through the voltage regulator is applied to the field of the alternator. Without the engine running, the field voltage is typically 0.5-2V less than the bus or battery voltage.

Voltage Regulation

When the engine is running, 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 drops.The regulated bus voltage is normally about 28V unless the alternator is self-current limiting[1] or if there is voltage drop in the alternator field circuit breaker, alternator switch, OV Relay[2], or wiring and connections between the bus and the red wire on the control unit/voltage regulator. Voltage drops across the different components and connections occur when current, up-to 2 Amps in some instances, passes through the resistance built-up in them. *The resistance build-up often causes flickering ammeter and instrument panel lights.*

Field-to-Ground Short Protection

Should 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.

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.

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

[2] OV Relay—OverVoltage Protection Relay opens its normally closed contacts when the bus voltage exceeds 32V or the OV trip point.

INSTALLATION INSTRUCTION

1 Disconnect and remove the present ACU/VR.
2 From pin 2 on the airframe side of the ACU/VR connector, 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.

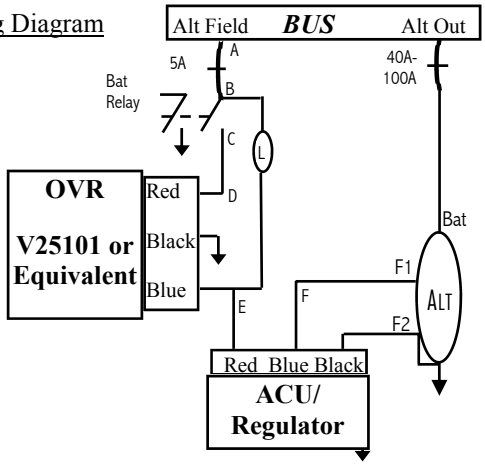
POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and observe: On the ACU the 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 (pin 1) and Blue (pin 2) wires. The Red should read Battery voltage, while the Blue reads 1-2 volts less than the Red wire.
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 27.5-27.9V (R25101 Rev A) and 28.5-28.9V (R25102 Rev A) . 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.

Wiring Diagram



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TROUBLE-SHOOTING THE SYSTEM

28V Type B alternator system on Cessna, etc

R25101 Rev A, R25102 Rev A

When the master switch (Alt & Bat) is turned on, battery voltage is applied to the Bus & OV Relay input.

Take all voltage measurements at test points (TP) A, B,D, E and F referenced to ground.

A. _____ Volts.		B. _____ Volts	
D _____ Volts.		E. _____ Volts	
F _____ Volts.		Fl. _____ Volts	

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

If the voltage at A is 0.2V more than that on E, check the 5 Amp breaker, ALT switch, and connections between the bus and E for high resistance or open circuit. A high resistance between A & 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 0.2V or more 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, when the master switch (Alt & Bat) is turned on, battery voltage (~24V) is applied to the input of the ACU/regulator 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 ACU/regulator to excite the alternator's field.

With the engine on and the master switch on, the ACU/regulator controls the excitation of the alternator to produce a Bus voltage of 27.5 –27.9V (R25101 Rev A) or 28.5 –28.9V (R25102 Rev A). This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

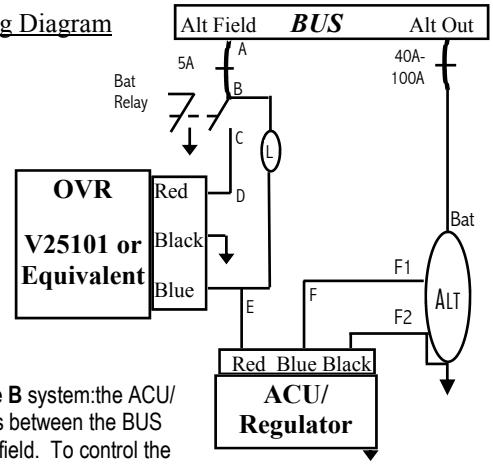
The 5 Amp circuit breaker opens if the current going to the ALT field exceeds 5 amps beyond a preset time lag thus protecting the wire from the Bus to the field. *Some wrongly expect this breaker should protect their non-Zeftronics ACU/regulator if the field shorts to ground.*

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, F1 voltage will start low and increase with each load increase until the alternator current limits.

See TechCard for resistance and voltage measurements.

Wiring Diagram



In this **Type B** system:the ACU/Regulator 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 Cessna, etc

TROUBLE-SHOOTING THE SYSTEM

Flickering / oscillating ammeter and panel lights.

Check the 5 Amp breaker, ALT switch, OV Relay and connections between the bus and the OV Relay's output for high resistance and or intermittent connection..

No voltage regulation

With the master switch on and Battery voltage measured on the OV Relay output:
Look for Bus voltage on the ACU/Regulator input and out put.

- If the ACU input has no Bus voltage, look for a broken wire between the ACU and the OVR.
- If bus voltage is greater than the input voltage by more than 0.2V, look for & correct the device (5A breaker, Alt switch, OVR or connection or wire) that is causing it.
- If the ACU output voltage is 0V and the input has 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 and the ACU's Trouble-Shooting Light (TSL) is off, send the ACU/Regulator in for test/repair.
- If the TSL is Red, repair the field ground fault or replace the alternator.
- If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test/repair.

Bus voltage remains at battery voltage (about 24V)

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

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.

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**:

	12V 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. R25101 Rev A.	_____V	27.5 – 27.9V
K. Bus voltage. R25102 Rev A.	_____V	28.5 – 28.9V

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1-903-758-6661

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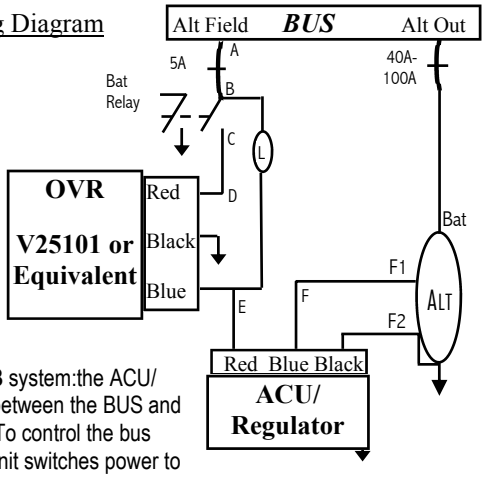
Electrical Charging System Solutions

Wiring Diagram



In this **Type B** system:the ACU/ Regulator 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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ZEFTRONICS: SOLUTIONS

R15V0L

14V ELECTRONIC ALTERNATOR CONTROLLER

Features:	Benefits:
• Voltage Regulation, Pulse Width Modulated	* Increased Regulator life. Reduced panel lights flicker
• Field-to-Ground Fault Protection (GFP)	* Protects against grounded alternator field
• Trouble-Shooting Light (TSL)	* Identifies grounded field. Reduce trouble-shooting time.
• Over-Voltage Protection	* Protects system loads against overexcited alternator

Voltage Regulation: 14.2V ± 0.2V. Max Field Current: 5A. Field-to-Ground Protection @ Field current > 6A

VOLTAGE REGULATION.

The Voltage Regulator with Pulse Width Modulated (PWM) field control 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 drops.

OVER VOLTAGE (OV) PROTECTION.

The OV Protector (OVP) deactivates (turns off) the Voltage Regulator and the alternator if the bus voltage exceeds 16V to protect sensitive avionics equipment and the battery.

OV & FIELD-GROUND SHORT WARNING.

A warning light connected between the white wire and ground comes on to warn the pilot of the bus voltage exceeding the OV level or alternator Field-to-Ground Fault Protection (GFP).

FIELD TO GROUND SHORT PROTECTION.

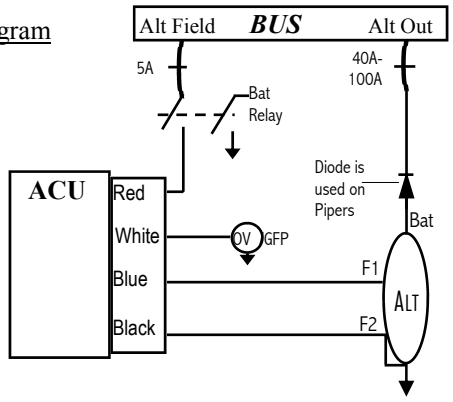
If the alternator's field shorts to ground, the field-to-ground short protector will deactivate the Voltage Regulator, and switch on the unit's RED field-to-ground short indicator, and the GFP/ OV indicator on the instrument panel.

TROUBLE-SHOOTING LIGHT (TSL)

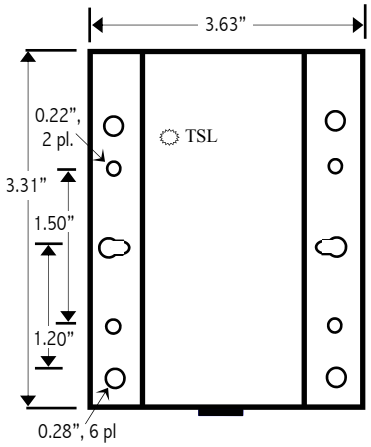
The TSL (on the unit) is designed to alert the user to the condition of the Alternator / ACU system.

RED TSL indicates: An internal or external ground short in the alternator field circuit
Without the engine running but master switch on, **GREEN TSL indicates** that the ACU is supplying current to the alternator's field.
With the engine running, master switch on, and bus voltage @ about 14V, **GREEN TSL indicates** correct alternator output voltage.

Wiring Diagram



Mounting Diagram
Height: 1.10"



Trouble-Shooting Light Continued ….

With the engine running, master switch on, and bus voltage @ about 12V, **GREEN TSL indicates** that current is flowing from the ACU but the alternator field or field wire to it is open.

With the master switch on, if the **TSL is off** , that indicates that one power input device (e.g. switch, circuit breaker, or wiring) is open or the ACU is defective.

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ZEFTRONICS
Electrical Charging Systems Solutions

R15V0L
14V ELECTRONIC ALTERNATOR CONTROLLER

HOW THE SYSTEM WORKS

When the master switch is turned on, battery voltage is applied to the input of the R15V0L or similar alternator controller/voltage regulator through the input devices and wires from the bus. The current passing through the voltage regulator is applied to the field of the alternator. Without the engine running, the field voltage is typically 0.5-2V less than the bus or battery voltage.

Voltage Regulation

When the engine is running, 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 drops.The regulated bus voltage is normally about 14V unless the alternator is self-current limiting[1] or if there is a voltage drop in the input devices preceding ACU.

OVER VOLTAGE PROTECTION.

To protect sensitive avionics equipment and other system loads, if the bus voltage exceeds 16V the OV Protector (OVP) deactivates (turns off) the Voltage Regulator to remove the alternator's field current. The ACU stays latched off until the alternator switch is reset.

Field-to-Ground Short Protection

Should the alternator's field become shorted to ground the field-to-ground short protector turns off the Voltage Regulator, and switches on the ACU's Red field-to-ground short TSL and the instrument panel's OV light .

TROUBLE-SHOOTING LIGHT (TSL)

The TSL on the unit alerts the user to the condition of the Alternator / ACU system. The TSL has three color/ states: Red, Green, and Off.

Red TSL indicates: An internal or external ground short in the alternator field circuit

Without the engine running but master switch on, **Green TSL** indicates that the ACU is supplying current to the alternator's field. An **off TSL** indicates that one of the power input devices is open or the ACU is defective.

With the engine running, master switch on:

A bus voltage @ about 14V, **Green** TSL indicates correct alternator output voltage.

A bus voltage @ about 12V, **Green** TSL indicates that current is flowing from the ACU but the alternator field or field wire to it is open.

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU.
2. At the ACU, measure the alternator's field resistance: i.e. resistance between the field and the ground wire. A resistance of 3.5 to 6Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the ACU's field wire to ground. 0Ω indicates a field to ground short. Correct the fault.
3. Mount and connect the new ACU to the system.
4. Perform the Post Installation Test Procedure.

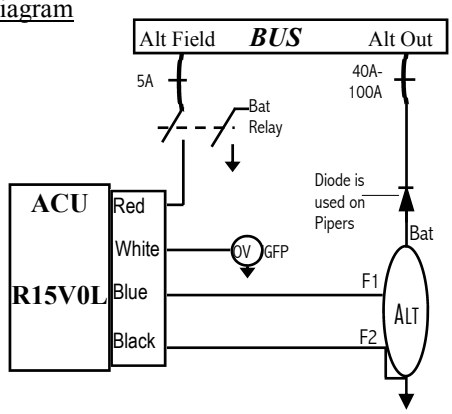
POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and observe:
   On the ACU the TSL light is on. A Red TSL indicates that the Field or field wire is shorted to ground.
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 wire.
3. If the steps 1 and 2 are successful, perform step 4.
4. Turn off all the avionics and voltage sensitive loads. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 13.8V - 14.4V. If the bus voltage exceed these limits, check for voltage drop in the 5A breaker, the Alt switch, and pre-ACU 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.

Wiring Diagram



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TROUBLE-SHOOTING THE SYSTEM

14V Type B alternator system on Beech, Piper, etc

R15V0L or similar Controller/ACU

When the master switch (ALT & BAT) is turned on, battery voltage is applied to the Bus & OV Relay input.

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

A. _____ Volts.		B. _____ Volts	
D _____ Volts.		E. _____ Volts	
F _____ Volts.		Fl. _____ Volts	

The voltages measured at A, B, D, and E should be the same, Bus voltage (around 12V). The voltage on F (field or alternator controller/voltage regulator output) will be 0.5 to 2V less than the voltage at A, B, D, or E. The voltage at F1 will be the same as F.

If the voltage at A is 0.2V more than that on D, check the 5 Amp breaker, ALT switch, and connections between the bus and D for high resistance or open circuit. A high resistance between A & D may lead to flickering / oscillating ammeter and panel lights. An open circuit between A & D 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 12V).

If the voltage on F1 is 0.2V or more 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.

If the voltage on F1 is 0V or close , check for a ground short on F1 on the alternator or wire from F on the controller/regulator.

If there is a field-to-ground short, the R15V0L will turn itself off and turn its built-in Trouble-Shooting Light (TSL) Red.

An open stator wire or open diode in the alternator will make the alternator only able to carry about half its rated output. For example, a 70A 12V alternator has a 14V output with about 30A load on it. When the load is increased to 40A, the bus voltage drops to 12 to 13V, indicating an alternator that is current limiting.

See TechCard for resistance and voltage measurements.

With the engine off, when the master switch (Alt & Bat) is turned on, battery voltage (12V) is applied to the input of the ACU 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 ACU to excite the alternator's field.

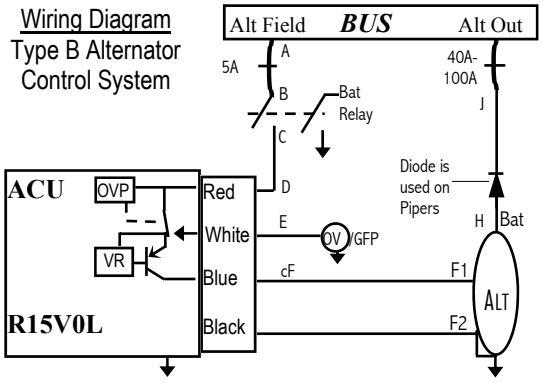
With the engine on and the master switch on, the ACU controls the excitation of the alternator to produce a Bus voltage of 13.8 –14.3V. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

The 5 Amp circuit breaker opens if the current going to the ALT field exceeds 5 Amps, after a preset time lag, to protect the wire from the Bus to the field. *Some wrongly expect this breaker to protect their non-Zeftronics ACU.*

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 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, F1 voltage will start low and increase with each load increase until the alternator current limits.

See TechCard for resistance and voltage measurements.



In this **Type B** system: the ACU 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 OVP opens when OV occurs.

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ZEFTRONICS
Electrical Charging Systems Solutions

Frequently Asked Questions & TECHCARD Notes

14V Type B alternator system on Piper, Beech, etc

TROUBLE-SHOOTING THE SYSTEM

Flickering / oscillating ammeter and panel lights.

Check the 5 Amp breaker, ALT switch, and connections between the bus and the input to the ACU for high resistance or intermittent connection..

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 there is no Bus voltage on the ACU input, look for a broken wire, bad connection or input device (5A circuit breaker or Alt switch) 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 0V and the input has battery voltage, look for a grounded alternator field or field wire (as indicated by a Red ACU TSL). If the field resistance is correct as shown in step 5 of the installation tests and the ACU's Trouble-Shooting Light (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 voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test/repair.

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. In Piper PA 28 & 32 series, check the condition of the diode between the bus (J) and alternator output (H). 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*.

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 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.

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

		12V Values	Typical Values
A.	Field resistance at ALT	_____Ω	3 – 6Ω
B.	Field resistance at ACU	_____Ω	3 – 6Ω
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**:

		12V Values	Typical Values
A.	BUS Volt Engine Off	_____V	12 – 13V
D.	ACU/Reg input Volt	_____V	12 – 13V
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:

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

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

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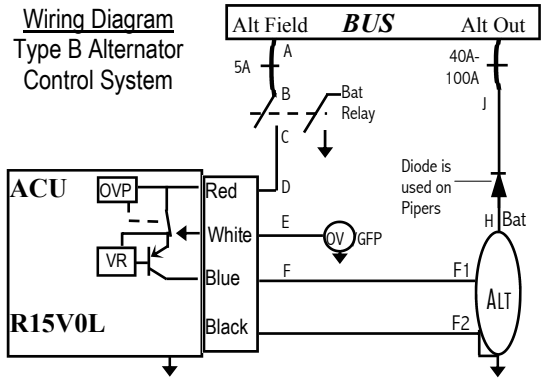
Electrical Charging System Solutions

Wiring Diagram
Type B Alternator
Control System



In this **Type B** system: the ACU 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 OVP opens when OV occurs.

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ZEFTRONICS
Electrical Charging Systems Solutions

R1510L

14V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR

Features:

- **Voltage Regulation, Pulse Width Modulated**
- **Field-to-Ground Fault Protection (GFP)**
- **Trouble-Shooting Light (TSL)**

Benefits:

- **Increased Regulator life. Reduced panel lights flicker**
- **Protects against grounded alternator field**
- **Identifies grounded field. Reduce trouble-shooting time.**

Voltage Regulation: 14.2V ± 0.2V. Max Field Current: 5A. Field-to-Ground Protection @ Field current > 6A

VOLTAGE REGULATION

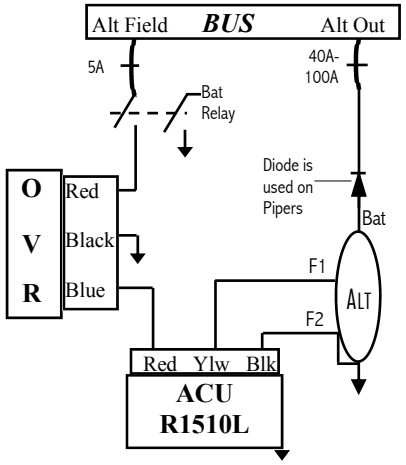
The Voltage Regulator keeps the bus voltage constant by controlling the alternator's field current: increasing it when the system load increases and decreasing it when the load drops..

FIELD TO GROUND SHORT PROTECTION

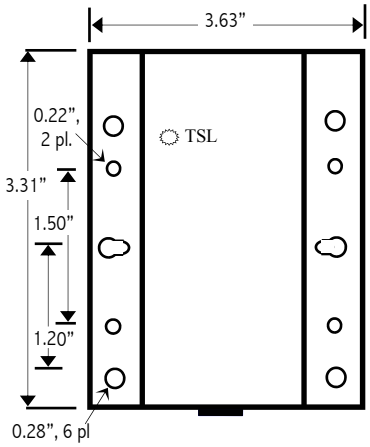
Should the alternator's field become shorted to ground (the reason most Voltage Regulators fail), the field-to-ground short protector will deactivate the Voltage Regulator, and switch on the unit's RED field-to-ground short indicator.

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



Wiring Diagram



Mounting Diagram
Height: 1.10"

The R1510L replaces

- PIPER: 450-392; 484-121; 68804-03; 756-055
- BEECH: 169-380063
- WICO: X16300B; X17990; X18150
- ELECTRODELTA: VR200; A
- PFT/LAMAR: B00267-1,-2; B00331-1, -2
- COMMANDER: 1816110
- PRESTOLITE: FVR4004, 4224
- RBM: 87-87102-21
- LYCOMING: LW-11357, LW-12747

Consider upgrading to the R15V0L Alternator Controller. The R15V0L combines the R1510L with Over Voltage Protector and Dual Color Trouble-Shooting light.

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R1510L

14V ELECTRONIC ALTERNATOR CONTROLLER /VOLTAGE REGULATOR

HOW THE SYSTEM WORKS

Turning on the master switch applies battery voltage to the input of the R1510L or alternator controller/ regulator through the Over-Voltage Relay (OVR).

The current passing through the voltage regulator is applied to the field of the alternator. Without the engine running, the field voltage is typically 0.5-2V less than the bus or battery voltage.

Voltage Regulation

When the engine is running, 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 drops.The regulated bus voltage is normally about 14V unless the alternator is self-current limiting[1] or if there is a voltage drop across the alternator field circuit breaker, alternator switch, OV Relay[2], or wiring and connections between the bus and the red wire on the control unit/voltage regulator. Voltage drops across the different components and connections occur when current, up-to 4 Amps in some instances, passes through the resistance built-up in them. *The resistance build-up causes flickering ammeter and instrument panel lights.*

Field-to-Ground Short Protection

Should 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 TSL.

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

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

[2] OV Relay—Over Voltage Protection Relay opens its normally closed contacts when the buss voltage exceeds 16V or the OV trip point.

INSTALLATION INSTRUCTION

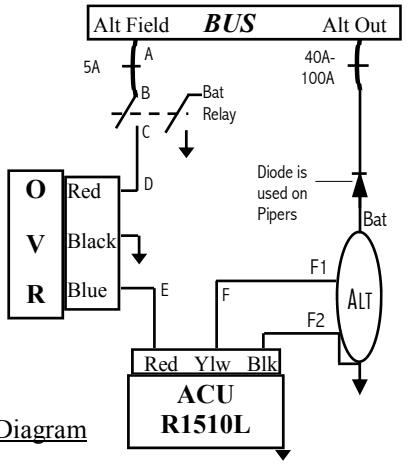
1 Disconnect and remove the present ACU/VR.
2 At the ACU/VR, measure the alternator's field resistance: i.e. resistance between the field and the ground wire. A resistance of 3.5 to 6Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the alternator's field wire (at the ACU/Regulator) to ground. 0Ω indicates a field to ground short. Correct fault.
3 Mount and connect the new ACU to the system.
4 Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and observe: On the ACU the TSL light is off. If the light is Red, the Field or field wire is shorted to ground.
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 wire.
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 13.8V - 14.4V. 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

See the Trouble-Shooting Notes (TSN) page and or TECHCARDS for information on how to solve problems in the system.



Wiring Diagram

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TROUBLE-SHOOTING THE SYSTEM

14V Type B alternator system on Piper, Beech, etc

R1510L or other ACU/regulator

When the master switch (ALT & BAT) are turned on, battery voltage is applied to the Bus & OV Relay input.

Take all voltage measurements at test points (TP) A, B, D, E and F referenced to ground.

A. _____ Volts.		B. _____ Volts	
D _____ Volts.		E. _____ Volts	
F _____ Volts.		Fl. _____ Volts	

The voltages measured at A, B, D, and E should be the same, Bus voltage (around 12V). The voltage on F (field or alternator controller/voltage regulator output) will be 0.5 to 2V less than the voltage at A, B, D, or E. The voltage at F1 will be the same as F.

If the voltage at A is 0.2V more than that on E, check the 5 Amp breaker, ALT switch, and connections between the bus and E for high resistance or open circuit. A high resistance between A & E may lead to flickering / oscillating ammeter and panel lights. 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 12V).

If the voltage on F1 is 0.2V or more 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 1Ω, 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.

If the voltage on F1 is 0V or close , check for a ground short on F1 on the alternator or wire from F on the controller/regulator.

If there is a field-to-ground short, the R1510L will turn itself off and turn its built-in Trouble-Shooting Light (TSL) Red.

An open stator wire or open diode in the alternator will make the alternator only able to carry about half its rated output. For example, a 70A 12V alternator has a 14V output with about 30A load on it. When the load is increased to 40A, the bus voltage drops to 12 to 13V, indicating an alternator that is current limiting.

See TECHCARD for resistance and voltage measure-

With the engine off, when the master switch (ALT & BAT) is turned on, battery voltage (12V) is applied to the input of the ACU/regulator 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 ACU/regulator to excite the alternator's field.

With the engine on and the master switch on, the ACU/regulator controls the excitation of the alternator to produce a Bus voltage of 13.8 –14.3V. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

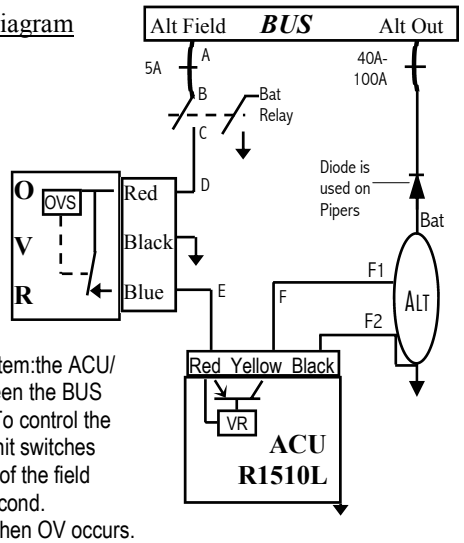
The 5 Amp circuit breaker opens if the current going to the ALT field exceeds 5 amps, beyond a time lag, to protect the wires from the Bus to the field. *Some wrongly expect the breaker to protect their non-Zeftronics regulator.*

If the Bus voltage exceeds the preset over-voltage (OV) limit, the OV normally closed Relay, 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, F1 voltage will start low and increase with each load increase until the alternator current limits.

See TECHCARD for resistance and voltage measurements.

Wiring Diagram



In this **Type B** system:the ACU/Regulator 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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ZEFTRONICS
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Frequently Asked Questions & TECHCARD Notes

14V Type B alternator system on Piper, Beech, etc

TROUBLE-SHOOTING THE SYSTEM

Flickering / oscillating ammeter and panel lights.

Check the 5 Amp breaker, ALT switch, OV Relay and connections between the bus and the OV Relay's output for high resistance or intermittent connection.

No voltage regulation

With the master switch on and Battery voltage measured on the OV Relay output,

- Look for Bus voltage on the ACU/Regulator input and out put.
  - If the is no Bus voltage on the ACU input, look for a broken wire between the ACU and the OVR.
  - If the input voltage is more than 0.2V lower than the bus voltage, look for & correct the device (5A breaker, ALT switch, OVR or connection or wire) that is causing it.
  - If the output voltage is 0V and the input has 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 and the ACU's Trouble-Shooting Light (TSL) is off, send the ACU/Regulator in for test/repair.
  - If the TSL is Red, repair the field ground fault or replace the alternator.
  - If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test/repair.

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. In Piper PA 28 & 32 series, check the condition of the diode between the bus and alternator output. 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*.

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 12V alternators have 3-6Ω 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**:

		12V Values	Typical Values
A.	Field resistance at ALT	_____Ω	3 – 6Ω
B.	Field resistance at ACU	_____Ω	3 – 6Ω
C.	Field SW resistance	_____Ω	0 – 0.1Ω
D.	Field C/BKR resistance	_____Ω	0 – 0.05Ω
E.	ALT C/BKR resistance	_____Ω	0 – 0.05Ω

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

		12V Values	Typical Values
F.	BUS Volt Engine Off	_____V	12 – 13V
G.	ACU/Reg input Volt	_____V	12 – 13V
H.	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:

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

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

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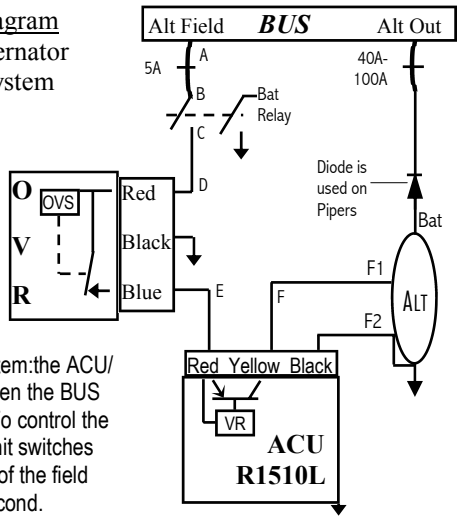
Wiring Diagram
Type B Alternator
Control System



In this **Type B** system:the ACU/ Regulator 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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ZEFTRONICS
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R1510N

ALTERNATOR CONTROLLER / VOLTAGE REGULATOR

FOR TYPE A 14V ALTERNATOR SYSTEMS

Features:	Benefits:
• Voltage Regulation, IC sense referenced	* Increase Regulator Life. Not temperature sensitive
• Field Controller Generates Low Heat	* Increase Regulator Life
• Externally Adjustable	* Increased Ease of Ownership
• Light Weight and Repairable	* Reduced Long-term ownership cost

Voltage Regulation: 14.2V ± 0.4V. Max Field Current: 7A.

VOLTAGE REGULATION

Using the voltage sensed from the OV Relay output, 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 drops. The Regulator controls the field by grounding or opening the one side of the field connected to pin F.

The R1510N works in the one alternator (single engine) application as well as in the dual alternator (single or dual engine application. It is the best replacement for the Prestolite VSF7203 type Voltage Regulator.

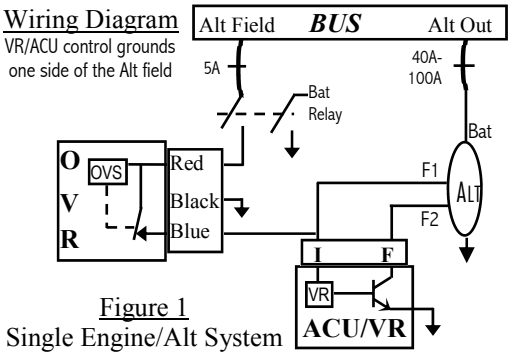

Figure 1
Single Engine/Alt System

OVER VOLTAGE (OV) PROTECTION

The external OV Protector (OVP) or OV Relay deactivates the Voltage Regulator by removing power to its input and one side of the field if the bus voltage exceeds 16V. This removes the alternator field excitation and thus protect sensitive avionics equipment and the battery.

TYPE A VOLTAGE REGULATION:

This controller has a "Type A" regulator which excites the field of the alternator by providing controlled ground to one side of the alternator field (F2), with the other side (F1) powered by the OVR output.

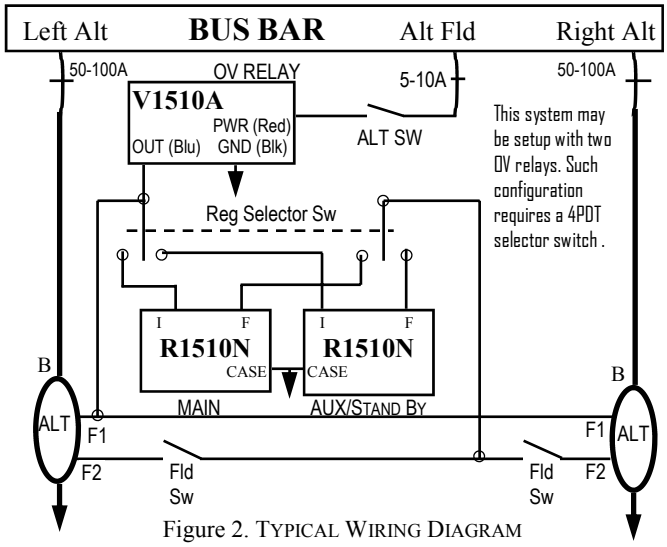

Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

The R1510N replaces
- PRESTOLITE: VSF7201, 7202, 7203, 7204
- ELECTRODELTA: VSF7203A
- TCM: 649684-1
- LYCOMING: LW10185
- PIPER: 550-383

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R1510N

ALTERNATOR CONTROLLER / VOLTAGE REGULATOR

FOR TYPE A 14V ALTERNATOR SYSTEMS

HOW THE SYSTEM WORKS:

REFER TO FIGURE 1 & 2 PAGES 1 & 3

Turning on the master switch applies battery voltage to the input of the Alternator Controller or Voltage Regulator (VR) through the Over-Voltage Relay (OVR).

In this "Type A" charging system configuration, the VR applies controlled grounding to one side of the alternator's field while the other side has power on it from the OVR. Without the engine running, the field voltage is typically 0-2V. With the engine running, the field voltage is 13-0.5V while the bus voltage is at 14V. *The field voltage starts out high and decreases with increased system load.* If the field voltage becomes 0, the system will experience an OV condition, and the OV Relay will open to turn off the VR thereby removing excitation from the alternator's field.

Over Voltage Protection

The OV Relay is a normally closed switch which opens when the bus voltage exceeds 16V. It has a time delay that prevents nuisance tripping caused by system noise or voltage spikes.

The regulated bus voltage is normally about 14V unless the alternator is self-current limiting[1] or if there is voltage drop in the alternator field circuit breaker, alternator switch, OV Relay, or wiring and connections between the bus and the red wire on the VR. These voltage drops across the different components and connections occur when current, up-to 3.5 Amps in some instances, passes through the resistance built-up in them. *The resistance build-up causes flickering ammeter and instrument panel lights.*

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit its current and voltage output at a given speed.

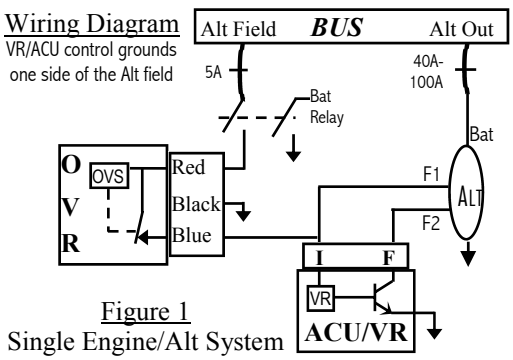

Figure 1
Single Engine/Alt System

INSTALLATION INSTRUCTION

1. Disconnect and remove the present ACU/VR.
2. At the ACU/VR, measure the alternator's field resistance: i.e. resistance between the F1 (I) and F2 (F). A resistance of 3.5 to 6Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the alternator's field wire (at the ACU/VR) to field wire to the OVR ouput wire. 0Ω indicates a field to ground short. Correct fault found.
3. Verify that the input (Alt Switch, Field breaker, etc) resistance to the OVR is below 0.1Ω. Correct faults found.
4. Mount the ACU/VR and connect the OVR and ACU/VR to the system.
5. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and measure
   - Bus voltage _____V.
   - OVR Red wire (input) voltage _____V
   - OVR Blue wire (output) voltage _____V
   - VR I (input) voltage _____V
   - VR F (output) voltage _____V

   The inputs should read bus voltage. VR output voltage on the "type A" should read 0-2V.
2. If the step 1 is successful, perform step 3.
3. Turn Off all the avionics. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 13.8V - 14.4V. 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

See the Trouble-Shooting Notes (TSN) page and or TECHCARDS for information on how to solve problems in the system.

WIRING DIAGRAMS

See pages 1 and 3 for wiring diagrams of the dual alternator system.

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TROUBLE-SHOOTING THE SYSTEM WITH R1510N OR VSF7203

TROUBLE-SHOOTING

1. With BAT, ALT, REG & FLD switches on and the engine off, the voltage on pin I of the R1510N will be the same as the bus voltage. If it is more than 0.2V less, look for high resistance in the 5-10A breaker, the Alt switch, the OV Relay, the Reg selector switch, or connections at any of those devices). None of the devices should have a voltage drop that is higher than 0.1V.
2. Turn Off all the avionics. Start the engine, and at 1500 RPM measure a bus voltage of 13.8-14.4V. If the bus voltage exceed these limits, verify the voltage adjustment on the controller and the voltage drops of the power input devices.
   At that speed, depending on the system load, the voltage on the field will decrease from about 13.5V to 1V. Loading the alternator beyond its rating (for a given speed) will cause it to self current limit. Current limit is indicated by a drop in bus voltage which occurs as system load current exceeds a certain point.

One or Both Alternators Drop Off-line

Make sure that the 5-10A breaker is okay. Then check the condition of the Alt switch, the OV Relay, and Reg switch. Verify that the voltage on pin I is the same as the bus voltage.

Check one unit at a time. On the R1510N, if there is no voltage on pin I, the OVR may have tripped due to a grounded ALT field or field wire. At the R1510N and at the alternator's field, check the field resistance: it is normally 3 to 6Ω. If the resistance is out of that range, check the alternator field or wires/connections/ switches/fuses from the regulator to the field. An alternator with a grounded field/field wire will cause an OV fault**.**

Test the system again with only one alternator field switch on at a time.

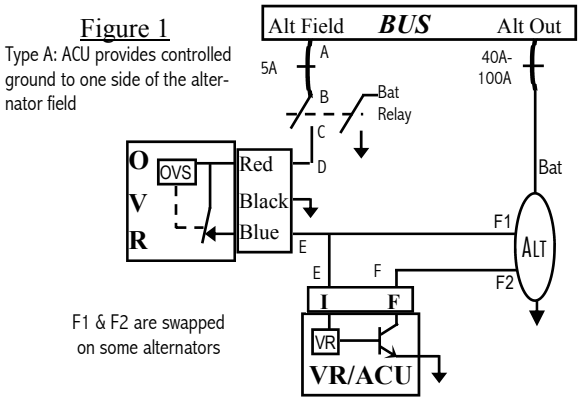
Fluctuating Charge-meter / Flickering Panel Lights

This problem is usually caused by a resistance build-up in 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 5-10Amp 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.

Figure 1

Type A: ACU provides controlled ground to one side of the alternator field



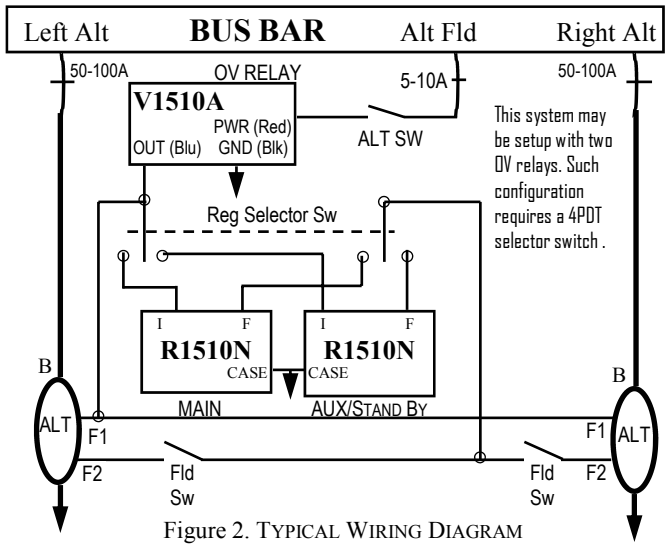


Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

TROUBLE-SHOOTING

Checking the condition of the voltage regulator/controller & OVR

1. With the Bat & Alt switches on, engine off, measure the voltages at the indicated (refer to the wiring diagram).

Single Alt /figure 1. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 1: _____

Dual Alt /figure 2.
Main Reg Selected. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 1: _____

Aux Reg Selected. BUS: _____ 5A Bkr: _____ OVR PWR: _____
OVR OUT: _____ I VR: _____ F VR:_____ Fld Alt 2: _____

Checking the condition of the alternator Field & Power input devices

2. Disconnect pin F on the R1510N (or voltage regulator). Measure the resistance indicated below:

Fld 2 to 1 _____Ω. Pin I to BUS _____Ω. Fld 2 to 1 _____Ω.
The field resistance is normally 3 to 6Ω.If the resistance is out of that range, check the alternator field or wires/connections/switches/fuses. The resistance from pin I to bus should be 0-0.1Ω A higher resistance may lead to fluctuating ammeter or panel lights or erratic bus voltage.

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Frequently Asked Questions & TECHCARD Notes
14V Type A alternator system on Piper, Beech, etc

Flickering / oscillating ammeter and panel lights.
Check the components and connections between A and D for high resistance or intermittent connection.

No voltage regulation
With the master switch on and Battery voltage measured on the OV Relay output, look for Bus voltage on the VR input and output.

- If the is no Bus voltage on the ACU input, look for a broken wire between the ACU and the OVR.
- If the input voltage is more than 0.2V lower than the bus voltage, look for & correct the device (5A breaker, ALT switch, OVR or connection or wire) that is causing it.
- If the output voltage is 0 and the input has 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 VR in for test/repair.
- If it is internally shorted, repair the field ground fault or replace the alternator.
- If the output voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the VR in for test/repair.

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. In some Piper aircraft, check the condition of the diode between the bus and alternator output. Check the shunts and alternator output wires. indicating an alternator that is current limiting.

Bus voltage drops with load increase
See *Alternator carries only about half its rated output.*

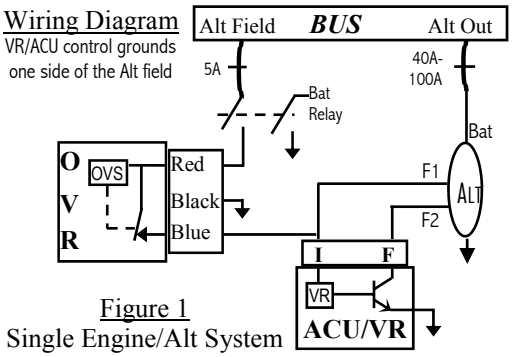

Figure 1
Single Engine/Alt System

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. **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.

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

	12V Values	**Typical Values**
A. Field resistance at ALT	_____Ω	3 – 6Ω
B. Field resistance at ACU	_____Ω	3 – 6Ω
C. Field SW resistance	_____Ω	0 – 0.1Ω
D. Field C/BKR resistance	_____Ω	0 – 0.05Ω
E. ALT C/BKR resistance	_____Ω	0 – 0.05Ω

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

	12V Values	**Typical Values**
F. BUS Volt Engine Off	_____V	12 – 13V
G. ACU/Reg input Volt	_____V	12 – 13V
H. Field Voltage	_____V	Vbus to 0.5V

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

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

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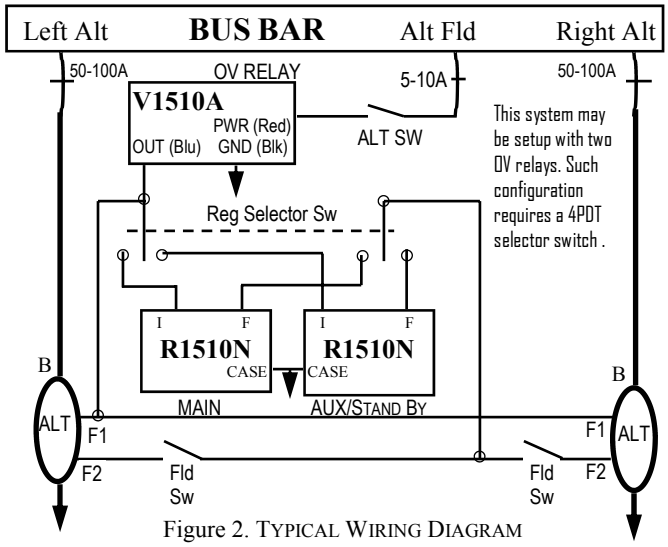

Figure 2. TYPICAL WIRING DIAGRAM
DUAL ALTERNATOR SYSTEM

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ZEFTRONICS
Electrical Charging Systems Solutions

R1530L

14V ELECTRONIC ALTERNATOR CONTROLLER (ACU)

Features:		Benefits:
• Voltage Regulation, Pulse Width Modulated	*	Increased Regulator life. Reduced panel lights flicker
• Field-to-Ground Fault Protection (GFP)	*	Protects against grounded alternator field
• Trouble-Shooting Light (TSL)	*	Identifies grounded field. Reduce trouble-shooting time.
• Over-Voltage Protection	*	Protects system loads against overexcited alternator
• Low & Over Voltage Sensor /Indication	*	Improves safety—Warns of Low voltage & OV condition

Voltage Regulation: 14.2V ± 0.2V. Max Field Current: 5A. LV: 12.7 ± 0.5V. OV: 16.0 ± 0.4V. GFP @ I_{Field} > 6A

VOLTAGE REGULATION.
The Voltage Regulator with Pulse Width Modulated (PWM) field control 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 drops.

OVER VOLTAGE (OV) PROTECTION.
To protect sensitive avionics equipment and the battery, if the bus voltage exceeds 16V, the OV Protector (OVP) turns off the Voltage Regulator and the alternator.

LOW VOLTAGE (LV) & ALTERNATOR OFF-LINE (AO).
The LV/AOI light will come on if:
- The bus voltage drops below the LV level
- The ALT switch is off while the battery switch is on
- The field-to-ground short protection (GFP) trips
- OV protection turns off the alternator.

FIELD TO GROUND SHORT PROTECTION.
If the alternator's field shorts to ground, the GFP will turn off the Voltage Regulator and switch on the unit's Red field-to-ground short TSL, and the LV/AOI light on the instrument panel.

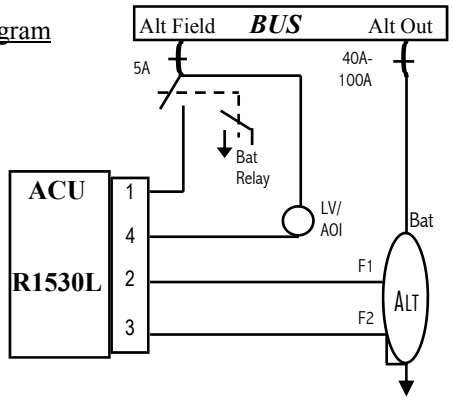
TROUBLE-SHOOTING LIGHT (TSL)
The TSL (on the unit) is designed to alert the user to the condition of the Alternator / ACU system.

Red TSL indicates: An internal or external ground short in the alternator field circuit.

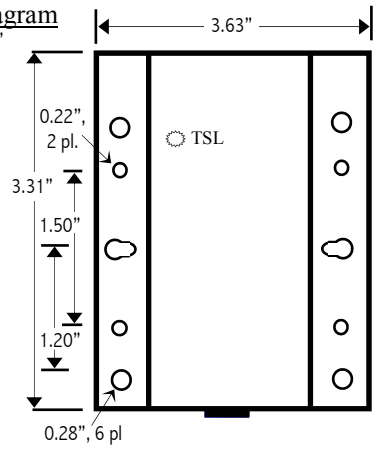
Without the engine running but master switch on, **Green TSL i**ndicates that the ACU is supplying current to the alternator's field.

With the engine running, master switch on, and bus voltage @ about 14V, **Green TSL** indicates correct alternator output voltage.

Wiring Diagram



Mounting Diagram
Height: 1.10"



Trouble-Shooting Light Continued ….

With the engine running, master switch on, and bus voltage @ about 12V, **Green TSL** indicates that current is flowing from the ACU but the alternator field or field wire to it is open.

With the master switch on, if the **TSL is off** , that indicates that one power input device (e.g. switch, circuit breaker, or wiring) is open or the ACU is defective.

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R1530L 14V ACU
HOW THE SYSTEM WORKS & INSTALLATION INSTRUCTION

HOW THE SYSTEM WORKS

Turning on the master switch applies battery voltage to the input of the ACU through the input devices and wires from the bus. The ACU passes current to the field of the alternator. Without the engine running, the field voltage is typically 0.5-2V less than the bus or battery voltage.

Voltage Regulation
When the engine is running, 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 drops. The regulated bus voltage is normally about 14V unless the alternator is self-current limiting[1] or if there is voltage drop in the input devices preceding ACU.

OVER VOLTAGE PROTECTION.
To protect sensitive avionics equipment and other system loads, if the bus voltage exceeds 16V the OV Protector (OVP) deactivates (turns off) the Voltage Regulator to remove the alternator's field current. The ACU stays latched off until the alternator switch is reset.

Field-to-Ground Short Protection
Should the alternator's field short to ground, the field-to-ground short protector turns off the Voltage Regulator, and switches on the ACU's Red field-to-ground short TSL and the instrument panel's LV-AOL light .

TROUBLE-SHOOTING LIGHT (TSL)
The TSL on the unit alerts the user to the condition of the Alternator / ACU system. The TSL has three color/ states: Red, Green, and Off.

Red TSL indicates: An internal or external ground short in the alternator field circuit
Without the engine running but master switch on, **Green TSL** indicates that the ACU is supplying current to the alternator's field. An **Off TSL** indicates that one of the power input devices is open or the ACU is defective.
With the engine running, master switch on:
A bus voltage @ about 14V, **Green** TSL indicates correct alternator output voltage.
A bus voltage @ about 12V, **Green** TSL indicates that current is flowing from the ACU but the alternator field or field wire to it is open.

[1] self-current limiting—Internal characteristics of the alternator that causes it to limit is current and voltage output at a given speed.

INSTALLATION INSTRUCTION

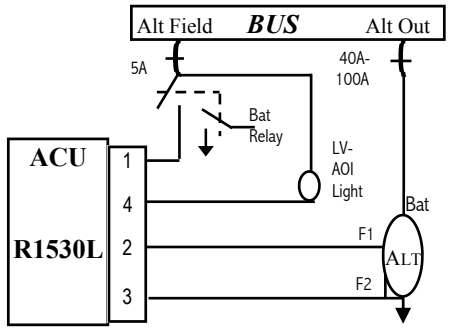
1. Disconnect and remove the present ACU.
2. At the ACU, measure the alternator's field resistance: i.e. resistance between the field and ground . A resistance of 3.5 to 6Ω is normal. If the measured resistance is outside the specified range, check the alternator field and the connections/wire from the field wire of the ACU to ground. 0Ω indicates a field to ground short. Correct the fault.
3. Mount and connect the new ACU to the system.
4. Perform the Post Installation Test Procedure.

POST INSTALLATION TEST PROCEDURE

1. Turn on the Master switch and observe:
   On the ACU the TSL light is on. A Red TSL indicates that the Field or field wire is shorted to ground.
2. Measure the voltage on Red (pin 1) and Blue (pin 2) wires. The pin 1 should read Battery voltage, while pin 2 reads 1-2 volts less than the pin 1.
3. If the steps 1 and 2 are successful, perform step 4.
4. Turn off all the avionics and voltage sensitive loads. Start the engine. At 1500-1600 RPM measure bus voltage: It should read 13.9V - 14.4V. If the bus voltage exceed these limits, check for voltage drop in the 5A breaker, the Alt switch, and pre-ACU wires.

TROUBLE-SHOOTING THE SYSTEM
For help on how to solve problems in the system, see the Trouble-Shooting Notes (TSN) page and or Tech Cards.

Wiring Diagram



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TROUBLE-SHOOTING THE SYSTEM

14V TYPE B ALTERNATOR SYSTEM ON LANCAIR: R1530L

Turning on the master switch (ALT & BAT) applies battery voltage to the Bus and ACU.

Refer to figure TS1. Take all voltage measurements at test points A, B,D, E and F referenced to ground.

A. _____ Volts.		B. _____ Volts	
D _____ Volts.		E. _____ Volts	
F _____ Volts.		Fl. _____ Volts	

The voltages measured at A, B, and D should be the same, Bus voltage (around 12V). The voltage on F (field or pin 2 on the ACU) will be 0.5-2V less than the voltage at A, B, or D. The voltage at F1 will be the same as F.

If the voltage at A is 0.2V more than that on D, check the 5 Amp breaker, ALT switch, and connections between the bus and D for high resistance or open circuit. A high resistance between A & D may lead to flickering / oscillating ammeter and panel lights. An open circuit between A & D 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 12V).

If the voltage on F1 is 0.2V or more 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.

If the voltage on F1 is 0V or close , check for a ground short on F1 on the alternator or wire from F on the controller/regulator.

If there is a field-to-ground short, the ACU will turn itself off and turn its built-in Trouble-Shooting Light (TSL) Red.

An open stator wire or open diode in the alternator will make the alternator only able to carry about half its rated output. For example, a 70A 12V alternator has a 14V output with about 30A load on it. When the load is increased to 40A, the bus voltage drops to 12 to 13V, indicating an alternator that is current limiting.

See page 4 for resistance and voltage measurements.

With the engine off, turning on the master switch (ALT & BAT) applies battery voltage to the input of the ACU through the 5 Amp FLD circuit breaker, and ALT switch. The applied voltage causes the ACU current to flow to the alternator's field excite the alternator's field.

With the engine on and the master switch on, the ACU controls the excitation of the alternator to produce a Bus voltage of 13.8 –14.3V. This regulated voltage charges the battery and allows the alternator to power all the electrical system loads in the aircraft.

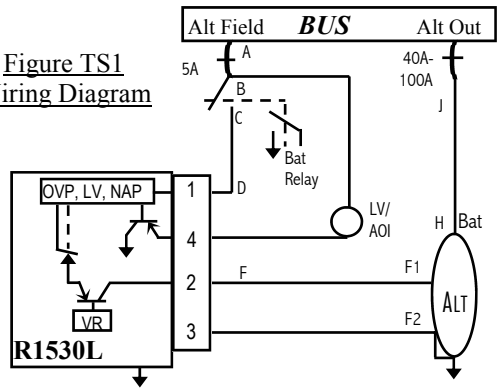
The 5 Amp circuit breaker opens if the current going to the ALT field exceeds 5 amps beyond a preset time lag thus protecting the wire from the Bus to the field. *Some people wrongly expect this breaker should protect their non-Zeftronics ACU.*

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 to remove excitation from the alternator's field.

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

See page 4 for resistance and voltage measurements.

Figure TS1
Wiring Diagram



In this **Type B** system: the ACU 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 OVP opens when OV occurs.

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Frequently Asked Questions & TECHCARD Notes
TROUBLE-SHOOTING THE SYSTEM

Flickering / oscillating ammeter and panel lights.

Check the 5 Amp breaker, ALT switch, and connections between the bus and the input to the ACU for high resistance or intermittent connection..

No voltage regulation

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

- If there is no Bus voltage on the ACU input, look for a broken wire, bad connection or input device (5A circuit breaker or Alt switch) 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 0V and the input has battery voltage, look for a grounded alternator field or field wire (as indicated by a Red Trouble-Shooting Light, TSL, on the ACU). If the field resistance is correct as shown in step 5 of the installation tests and the TSL of the ACU 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 voltage is the same as the input voltage, look for an open alternator field or field wire. If the field resistance is higher than what is shown in step 5 of the installation tests, send the alternator in for test/repair. If the field resistance is correct, send the ACU in for test/repair.

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*.

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

INSTALLATION TESTS. BEFORE INSTALLING THIS UNIT, PERFORM TESTS:

1. Read pages all the pages of this document.
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	_____Ω	3 – 6Ω
B.	Field resistance at ACU	_____Ω	3 – 6Ω
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**:

		12V Values	Typical Values
A.	BUS Volt Engine Off	_____V	12 – 13V
D.	ACU/Reg input Volt	_____V	12 – 13V
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:

		12V System	Typical value
A.	Bus voltage	_____V	13.9 – 14.3V
H	Bus voltage	_____V	13.9 – 14.3V
J	Bus voltage	_____V	13.9 – 14.3V

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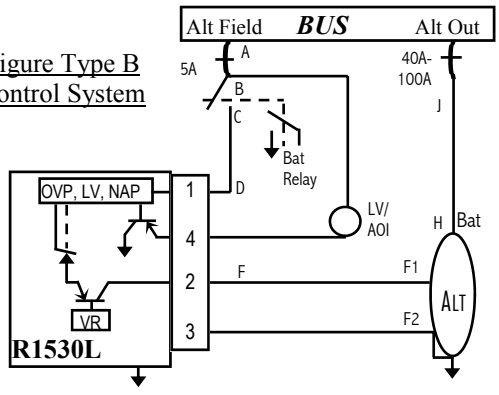
Figure Type B
Control System



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