



A25ELX-MJ

28V AUTO-PARALLEL ALTERNATOR CONTROLLER (APAC)



Features:

- Voltage Regulation, Pulse Width Modulated
- Remote Voltage Sensing
- Low & Over Voltage Sensor /Indication
- Field-to-Ground Fault Protection (GFP)
- Trouble-Shooting Light (TSL)
- Over-Voltage Protection
- Auto-Parallel (Equalizer, EQ Load Sharing)
- No Battery Build-up of Alternator to 28V

Benefits:

- * Increased Regulator life. Reduced panel lights flicker
- * Improved Voltage Regulation. Reduced panel light flicker
- * Improves safety—Warns of Low voltage & OV condition
- * Protects against grounded alternator field
- * Identifies grounded field. Reduce trouble-shooting time.
- * Protects system loads against overexcited alternator
- * Automatic Load Sharing. Improved system operation
- * Control the Alternator output when the Battery is off-line

Voltage Regulation: 28.5V ± 0.4V. Max Field Current: 5A. Field-to-Ground Protection

The A25ELX-MJ Auto-Parallel Alternator Controller (APAC) works in 24Vdc twin engine aircraft alternators systems. It has the following features—

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.

AUTO-PARALLELING (LOAD SHARING): Two ACUs connected together will allow two alternators to share load (parallel) to within a given tolerance level. The parallel function automatically performs load sharing at various loads and speeds.

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

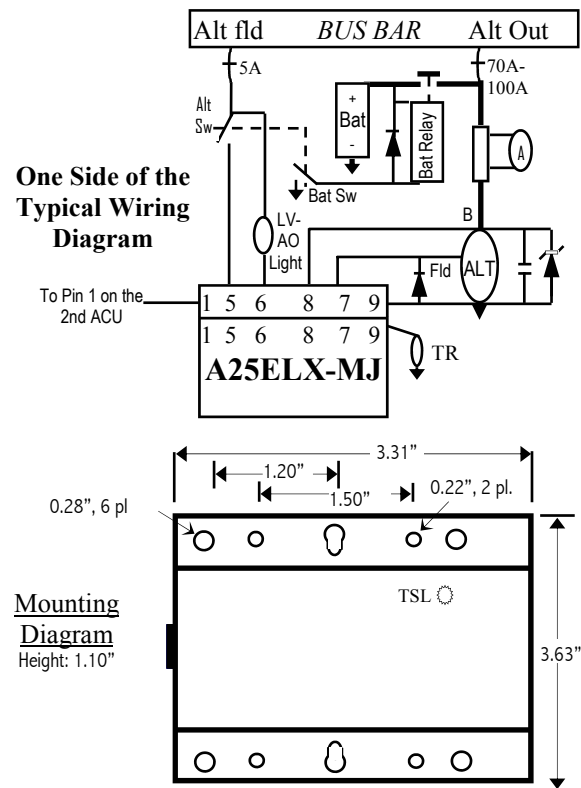
REMOTE VOLTAGE SENSOR (RS). The RS senses the alternator's battery terminal voltage to provide better voltage regulation and eliminate flickering charge-meter and panel lights. Losing the RS wire or voltage sense will turn off the ACU, taking the alternator offline.

ALTERNATOR OFF-LINE (AO) & LOW VOLTAGE SENSOR (LV). The LV-AOI light will come on if the

- Bus voltage drops below the prescribed LV level
- ALT switch is off/open while the battery switch is on
- Field-to-ground short protection (GFP) activates
- OV protection turns off the alternator.

TROUBLE-SHOOTING LIGHT (TSL)

The TSL (on the unit) is designed to alert the user to the condition of the Alternator / ACU system. See page 2 for more on the TSL.



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 TSL, and the LV-AOI light on the instrument panel.

No Battery Build-up of Alternator to 28V when the Battery is off-line is a feature that might be helpful if the battery relay fails to close.



A25ELX-MJ, 28V APAC

HOW THE SYSTEM WORKS

Closing the Bat switch applies battery power to the aircraft bus. The ACU is powered through the 5 Amp circuit breaker. The ACU supplies controlled current to the alternator's field to regulate the bus voltage.

The Voltage Regulator (VR). To control the bus voltage, the VR monitors the alternator output voltage (Remote Sense) and compares it to an internal reference. The VR regulates the bus voltage by increasing or decreasing the field current. The VR increases the field current if the bus voltage drops below a preset level, and decreases the field current if the voltage exceeds the preset level.

Paralleling (Load Sharing): Two ACUs connected together will automatically perform load sharing for two alternators at various loads. The ACUs maintain the current outputs of the two alternators at about the same level. The Auto-Parallel design compensates for some ACU input voltage differences—the two sides will still share load even when there is a prescribed difference in their voltage regulation point. This Auto-Parallel feature is unique to Zeftronics APAC series.

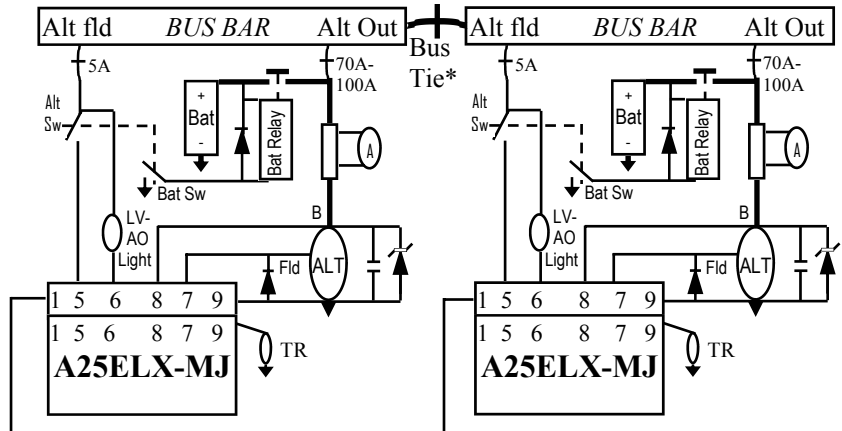
Remote Voltage Sensor (+RS) & Protection: By monitoring the voltage at the alternator's battery terminal, the +RS circuit allows the ACU to provide better voltage regulation and eliminate flickering charge-meter and panel lights problems. If the RS wire breaks, the OV Protection function turns off the ACU, taking the alternator offline.

Over Voltage Protection (OVP). The OVP circuit monitors the bus voltage for excessive voltage (Over-Voltage, OV) that could damage batteries and other voltage sensitive equipment. If it senses an OV condition, it opens the current path to the ACU (to disable the alternator field) and turns the on-unit TSL Red & LV-AOI light in the cockpit.

Alternator Off-Line (AO) & Low Voltage (LV). The LV-AOI light will also come on (illuminate) if:

- The bus voltage drops below the LV level
- The ALT switch is off/open while the Bat Sw is on
- The field-to-ground short protection (GFP) function
- OV protection turns off the alternator.

FIELD-TO-GROUND SHORT PROTECTION (GFP): If either of the alternator's field becomes shorted to ground the field-to-ground short protector will deactivate the ACU and switch on it's Red TSL as well as the LV-AOI light on the instrument panel.



<i>A25ELX-MJ FEATURES</i>	<i>SPECIFICATION</i>
Voltage Regulation, PWM	28.5 ± 0.4V
Remote Voltage Sensor / Protection	Yes
Field Current, Max	5A dc
Parallel (Load Share), % of System Load	±10%
Alt Off- line/Low Voltage Sensor/Warning	24.7 ± 0.6V
Over Voltage Protection / Warning	32.0 ± 0.8V
Field-to-Ground Short Fault Protection	YES
Trouble-Shooting Light	YES

Field-to-Ground Short Protection continued ...

The GFP trip is selective: if one alternator drops off line due to a field-to-ground fault, the un-tripped ACU on the other side keeps the side on-line.

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 28V, **Green TSL** indicates correct alternator output voltage.

With the engine running, master switch on, and bus voltage @ about 20-26V, **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 damaged.

*Do not ground pin 1 (EQ bus), it will turn off the ACU.
Do not apply power to pin 1, it may damage the ACU.
Only connect pin 1 to pin 1 on the other ACU.*



A25ELX-MJ, 28V APAC TROUBLE-SHOOTING SYSTEM

If the bus voltage is 0.2V more than that on pin 5, check the 5 Amp breaker, ALT switch, and connections between the bus and pin for high resistance or open circuit. A high resistance between the bus and pin 5 or between the Alternator's Bat terminal and pin 8 may lead to flickering / oscillating ammeter and panel lights.

An open circuit between the bus and pin 5 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 pin 7 is 0.3V more than the voltage on Fld, check for poor connection or open circuit between the ACU and Fld on the alternator. If the resistance between the pin 7 and Fld 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.

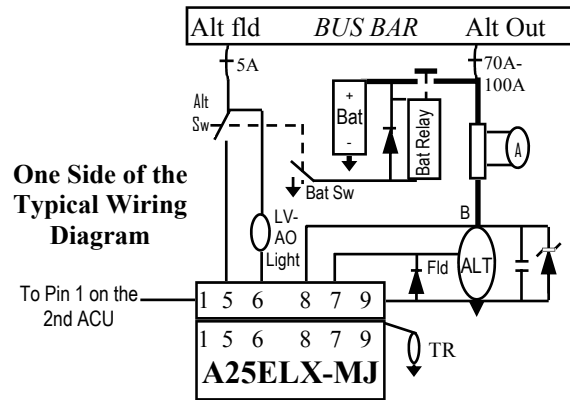
If the voltage on pin 7 is 0 or close, check for a ground short on Fld on the alternator or wire from pin 7 on ACU. If there is a field-to-ground short, the ACU will turn itself off and turn its built-in (TSL) Red.

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 26 to 24V, indicating an alternator that is current limiting.

If the LV-AOI (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 6 is 0-3V. If pin 6 has 0-3V, disconnect the ACU and ground pin 4 on the airframe side of the connector. The LV lamp 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 6. If pin 6 has the bus voltage on it, check the condition of the LV lamp as prescribed earlier. If the lamp is good, send the ACU to Zeftronics for test and evaluation or overhaul.

See page 4 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.



With the engine off, Bat Sw on and Alt Sw on, measure the Bus Voltage _____ V and also the following:

Pin	Function	Voltage	Notes
1	Parallel	1-4V from V_{BUS}	Avoid ground or power to pin 1
5	Power in	Bus voltage	Acceptable if 0.1-0.3V less*
6	LV-OVI	0-4V	Light On to indicate Alt off-line
7	+RS	Bus voltage	Acceptable if 0.1-0.3V less*
8	Field	22-25V	Depends on Bus voltage
9	Ground	0 Volt	Connected to the unit's case

*depends on the Battery voltage.

Trouble-Shooting light

- | | | | |
|----|-----|-------|------------------------------|
| 1. | TSL | Green | ACU is sending field current |
| 2. | TSL | Red | Alt Field has ground fault |

Turning on 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 28.3-28.7. 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 ACU turns it off before the circuit breaker opens.

If the Bus voltage exceeds the preset 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 pin 7 voltage that is 0.5-2V less than Bus voltage. When the alternator is rotating, the field voltage starts low and increases with each load increase until the alternator current limits.



Installation Instruction & TECHCARD Notes

28V Type B Dual Alternator System on Maverick Jets

1. Disconnect and remove the present ACU.
2. Perform the tests and take the measurements listed in the installation tests: steps 1 to 4.
3. Mount and connect the new ACU to the system.
4. Perform the tests and take the measurements listed in the installation tests: steps 5 to 6.

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-AOI light is on. A Red TSL indicates a grounded field or field wire.
2. For each side, turn on the Bat & Alt only and observe: that the LV-AOI 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 5.
3. If the steps 1 to 2 are successful, perform step 4.
4. Turn off all the avionics and voltage sensitive loads. Start the engines.
 - A. With only the Right Alt switch on, with 10A load on the bus, measure bus voltage at 1500-1600 RPM. If it exceeds 28.3-28.7V, check for voltage drop in the 5A breaker, Alt switch, and pre-ACU wires. Record the voltage in step 7 of the IT.
 - B. Turn off the Left Alt switch.
 - C. Repeat step 4A for the Left side.
 - D. With the Left and Right Alt switches on, measure and record the bus voltage.
 - E. Increase the system load and verify that the two side share load to within 6A.
 - F. With about 40-50A load on the system and both alternators on, observe the load carried by each side.
 - G. Turn off one side, note the Bus voltage and load (current). The other side should carry all the load.
 - H. Turn the side back on, note the Bus voltage and load (current). Verify that the two side share load to within 6A.
 - I. Reduce the load to 10A. Shut down or operate the system according to the OEM pro-

Noise filtering recommendation: install a filter capacitor & a transient voltage suppressor across the B terminal & ground. Put a diode between the field & Ground.

*Other options: Use a common bus for both sides or use a protected Bus Tie Relay.

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

INSTALLATION TESTS (IT). 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. Before connecting the ACU, check for Open or Ground-shorted alternator field. Ground shorted alternator field will damage most ACU. Repair or replace an alternator has a field-to-ground short.
4. At the airframe's ACU connector & at the alternator, perform and record the following tests with the **Master Switch Off**:

24V Values Typical Values

- | | | |
|----------------------------------|---------|-----------|
| A. Field resistance (R) at ALT | _____ Ω | 10 – 18Ω |
| B. Field R at ACU (pin 7 to 9) | _____ Ω | 10 – 18Ω |
| C. Field Sw/Bkr R (Bus to pin 5) | _____ Ω | 0 – 0.1Ω |
| D. ALT Out C/BKR resistance | _____ Ω | 0 – 0.05Ω |

5. If the measurements are as specified, connect the ACU, if not correct the identified problem and then connect the ACU.

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

24V Values Typical Values

- | | | |
|------------------------|---------|--------------|
| A. BUS Volt Engine Off | _____ V | 24 – 26V |
| B. ACU input Volt | _____ V | 24 – 26V |
| C. ACU input to Bus | _____ V | 0.1- 0.5V |
| D. Field Voltage | _____ V | 0.5-2V <VBus |

High voltage-drop from Bus to ACU input (pin 5) means excessive junction resistance and will lead to many problems like: fluctuation ammeters, charge-meters and panel lights.

7. **Post Installation.** If all tests are correct to or per steps 4 to 6, run the engine and record:

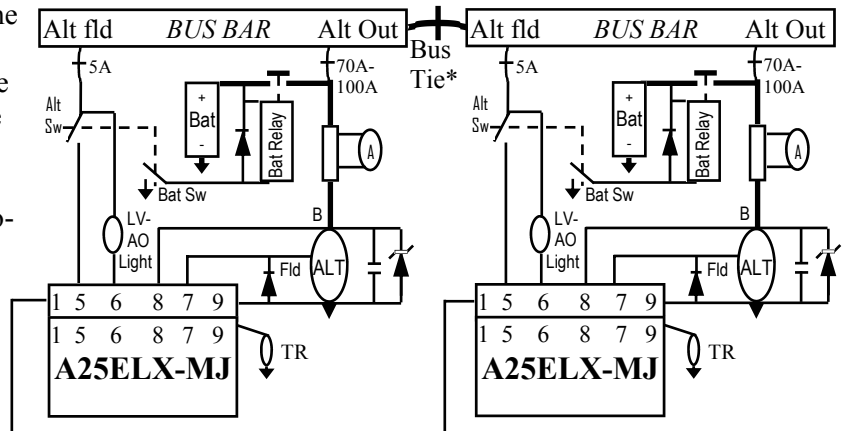
24V System Typical value

- | | | |
|----------------------------------|---------|--------------|
| A. Bus voltage (Right side only) | _____ V | 28.3 – 28.9V |
| B. Bus voltage (Left side only) | _____ V | 28.3 – 28.9V |
| C. Bus voltage (both side on) | _____ V | 28.3 – 28.9V |

For tech help & other TechCards:

call **903-758-6661**

email tech@zeftronics.com



TYPICAL WIRING DIAGRAM: DUAL ALTERNATOR SYSTEM