JP AVIONICS

VOLTAGE WARNING LIGHT

INSTALLATION MANUAL

Date: 26-11-2010 Rev: 2

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CONTENTS

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PREFACE

Purpose:

This manual describes the physical and electrical specifications of the JP Avionics VWL (Voltage Warning Light). This manual is intended for installers and shall be read and understand before installation of the JP Avionics VWL. Installation shall be carried out or supervised by a qualified person or company.

Scope:

This manual describes the install the of the JP Avionics VWL-12 and JP Avionics VWL-24 voltage warning light. In this manual we will call them both VWL as they are identical except for the warning trigger and reset voltages

Changes:

Rev 1: Added first paragraph on installation chapter, installer's responsibility.
Changed compass safe distance from as referred to 10 cm or 4".
Added wiring diagram.
Changed securing wiring paragraph.
Changed calculating remaining battery capacity paragraph.

Rev 2: Added instruction for non metal structure aircraft.

INTRODUCTION

The JP Avionics VWL is a high and low voltage warning light for installation in all aircraft with either a 12 Volt DC bus or 24 Volt DC bus. The warning light meets the requirements of EASA Part 23 and CS-VLA for such a warning light.
In addition the warning light meets the requirements with respect to the mandatory low voltage warning light for aircraft registered in the United Kingdom.

UK CAA CAP 747 GR 6 (previously issued as Airworthiness Notice No. 88) and UK CAP 562 leaflet 11-10 (previously issued as Airworthiness Information Leaflet No.0130) describe when such an low voltage light is mandatory on an both UK registered EASA aircraft and UK registered annex II aircraft.

Note: *UK CAA CAP 747 GR 6 and CAP 562 leaflet 11-10 only describe a low voltage warning light. The JP Avionics VWL is both a low AND high voltage warning light.*

WORKING PRINCIPLE

So what is the difference with the stock warning light on a lot of aircraft? First of all it's important to understand which principle is used, to understand the consequence.

- Measure if the voltage regulator gets bus voltage *(Known to be used on 12 Volt Cessna aircraft)*

  ***Working principle**:*

  A serviceable alternator can generate output if it turns within the correct speed range and receives field current controlled by the regulator.
  If the voltage regulator doesn't receive battery voltage, it is not able to deliver field current, and thus the alternator won't generate output.

  Disadvantage:

  In the situation described above the warning light will illuminate. The warning light will however not illuminate if:

  - The alternator has NO or LOW output due to defective internal parts.
  - The alternator isn't turning due to sloppy or broken belt.
  - Any of the alternator wires are broken.
  - The voltage regulator is internally defective.
  - You overload the alternator, and the battery supplies power to the loads, draining the battery.
  - You have a high voltage, due to a defect regulator (common problem). A over voltage protection and VWL could protect your precious avionics.

- Measure if the stator delivers voltage *(Known to be used on multi engine aircraft)*

  ***Working principle**:*

  Serviceable alternators will generator power when they turn within the correct speed range and receive field current from the regulator. The field current and turning makes induction in the stator coils possible. This AC voltage is rectified to DC voltage and supplied to the battery.
  The warning light will illuminate when:

  - The regulator doesn't supply field current or has a broken field wire.
  - The rotor coil or all stator coils are broken.
  - The alternator isn't turning due to sloppy or broken belt.

  Disadvantage:

  This kind of warning systems are already better, however, the warning light will not illuminate if:

  - The alternator has LOW output due to defective internal parts.
  - The alternator positive or ground wire is broken.
  - You overload the alternator, and the battery supplies power to the loads, draining the battery
  - You have a high voltage situation due to a defect voltage regulator.

WORKING PRINCIPLE *(Cont'd)*

- Measure voltage drop over a shunt or diode *(Known to be used on single engine Piper aircraft)*

  ***Working principle**:*

  A serviceable alternator or generator and control unit will supply current to the bus bar when the engine is used. Voltage can be measure over a shunt or diode. The voltage drop measured is an indication of the current supplied by the alternator.

  The warning light will illuminate when:

  - The voltage regulator doesn't supply field current or broken field wire.
  - The rotor inside the alternator is broken.
  - All stator windings are broken.
  - The alternator isn't turning due to a sloppy or broken belt.
  - The positive wire is broken.

  Disadvantage:

  This kind or warning system is even better, however, the warning light will not illuminate if:

  - The alternator has LOW output due to defective internal parts.
  - You overload the alternator, and the battery supplies power to the loads.
  - You have a high voltage situation due to a defect regulator.

- Measure the bus voltage *(This is the method used by the JP Avionics VWL)*

  ***Working principle**:*

  By measuring the bus voltage it is know if the alternator or generator delivers enough voltage to supply all equipment AND charge the battery. It does not have any of the disadvantages the other methods have. The warning light will illuminate if:

  - The voltage regulator is inoperative or out of tolerance.
  - Partially defect alternator (leading to low output).
  - Full defect alternator or generator
  - Broken or sloppy alternator or generator belt.
  - Broken or short alternator or generator wiring.
  - Broken alternator or generator circuit breaker.
  - You overload the alternator or generator.
  - The battery (instead of alternator/generator) supplies power to the loads.
  - You have an high voltage situation (due to no or defective over voltage protection).

  Disadvantage:

  None

Measuring the bus voltage is by far the best operating principle for both generator and alternator low, and high, voltage warning systems. JP Avionics VWL will warn you before you drain your battery!

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SPECIFICATIONS

Product	**VWL-12**	**VWL-24**
Compliance	EASA CS-23 EASA CS-VLA UK CAA CAP 747 GR 6 UK CAA CAP 562 leaflet 11-10	
Weight	Approx. 20 grams	
Dimensions (H x W x D)	Approx. 18 x 24 x 55 mm	
Altitude range	-1.000 Ft up to 30.000 Ft *	
Operating temperature	-25°C to +55°C	
Operating voltage	3 to 40 Volt	
Low voltage warning	On: below 12.5 Volt Off: above 13.0 Volt	On: below 25.0 Volt Off: above 25.5 Volt
High voltage warning	On: above 16.0 Volt Off: below 15,5 Volt	On: above 32.0 Volt Off: below 31,0 Volt
Current (normal)	2,3 mA	3,0 mA
Current (maximal)	18 mA	20 mA

- Note – The JP Avionics VWL has been tested from -1.000 Ft up to 30.000 Ft. Please note that this is cabin altitude range, not aircraft altitude range.

INSTALLATION

Follow the guidelines below for installation. The installation must be carried out by or under supervision of an appropriate qualified person or company. Prior to installation of this modification it must be determined that the installation that the interrelationship between this modification and any other previously installed modification(s) and/or repair(s) will not introduce an adverse effect of the airworthiness of the aircraft.

- Select a suitable location. The VWL must be located within the normal scanning view of the pilot. Mark the centre and check whether the annunciator does fit without interference.

- Check distance to the compass is equal or more than 10 cm or 4".

- Make sure the location you've selected is not an essential part of the aircraft structure. Drill a hole for the annunciator. It should measure 16.2 mm or 5/8". Deburr the hole.

- Install the warning light from the front side of the panel.

- Connect the black wire to a proper electrical bus ground. *Note: Not every bolt or screw is a proper ground. Make sure you use a proper ground point.*

- Connect the red wire to the main bus via a circuit breaker or fuse. If the VWL is the only means of checking the alternator or generator output you **MUST** use a dedicated 1 Amp circuit breaker, which can be reset during flight! Mark the function of the circuit breaker.

  If you use the VWL as additional equipment you can share a circuit breaker or fuse with non essential equipment only, this fuse or circuit breaker should be rated 3 Amp maximum. As additional equipment it is also possible to use an inline (1 Amp) fuse.

- Secure the wiring using approved methods as described in AC 43.13-1B. **Do NOT** secure wiring to moving parts!

- Check your installation, make sure **all** controls can move freely.

- Switch on the battery. The VWL will flash twice slowly and twice quickly to show both warning methods. If the engine isn't running it will go into low voltage mode next, and flash slowly.

- Check that the warning light goes out when the engine is started and the alternator or generator is switched on.

INSTALLATION *(Cont'd)*

- Calculating remaining battery capacity after a low voltage warning might be mandatory due to local regulations. It's the installers responsibility to check with your local authorities. If not mandatory we still encourage you to calculate the remaining battery capacity.
  This calculation can be made using the example below as a guideline:

  - Check the nameplate capacity of the battery and assume 72% is available, e.g. 12 Ah = 720 Amp mins
    0,72 * 720 = 518,4 Amp mins available.

  - Estimate the normal cruise electrical power consumption. Assuming 5 minutes for the pilot to shed essential load following the low voltage warning, e.g. 15 Amps * 5 mins = 75 Amp mins.

  - Estimate the minimum cruise load needed to maintain flight after the generator / alternator has failed, e.g. 10 Amps.

  - Estimate the electrical power consumption required during the approach and landing, e.g. 20 Amps * 5 minutes = 100 Amp mins.

  - Calculate remaining capacity:

    $$\frac{(\text{Battery capacity} - \text{Normal load} + \text{landing load})}{\text{Essential load}}$$

    e.g. $\frac{(518{,}4 - 75 + 100)}{10}$

    This results in 34,3 minutes for this example. Total flight duration is 5 minutes load shedding + 34,3 minutes essential cruise + 5 minutes for approach and landing. There will be 44,3 minutes of electrical power available.

- Add supplement to POH, and make user guide available for flight crew.

- Change in W&B is negligible.

There is no maintenance required for continued airworthiness. The VWL had been designed to allow "on condition maintenance". This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required until the VWL does not properly perform it's intended function. If the unit fails the self test on power up, contact supplier or installer.

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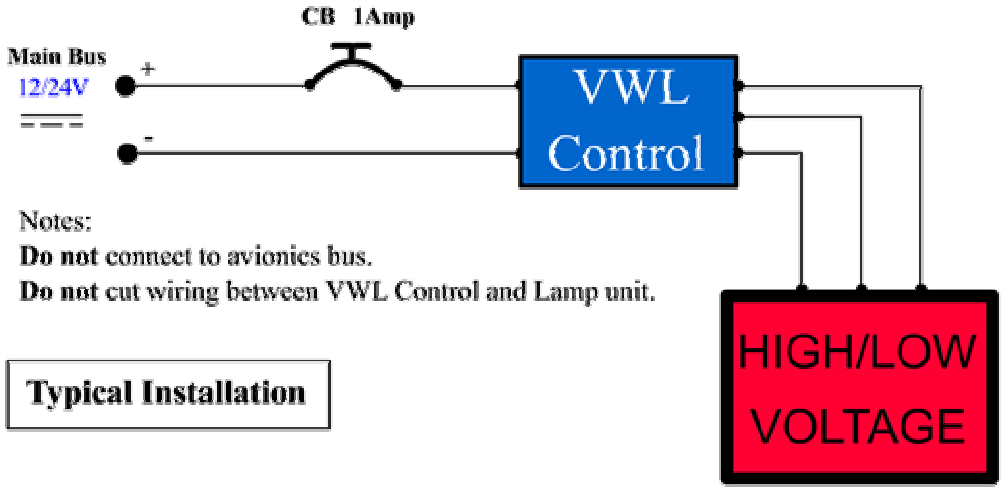
WIRING DIAGRAM



Notes:
Do not connect to avionics bus.
Do not cut wiring between VWL Control and Lamp unit.

Typical Installation

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USER GUIDE

The VWL user interface consists of an annunciator with integrated push button.

The voltage warning light has five different operating modes:

Self test: When power is applied to the aircraft buss the VWL will go into self test mode. The light will flash slowly twice, followed by two quick flashes. This is to test the LED inside the annunciator and to familiarize the user with the low voltage warning and the high voltage warning.

Normal: After a successful self test the unit will go into the normal monitoring state. It will measure the voltage constantly. When the voltage is within limits the light will extinguish, and stay extinguished as long as the voltage stays within limits.

Low voltage: When the voltage drops below to a point where the battery starts to supply the bus bar the unit with switch over to low voltage mode. In this mode the annunciator will flash slowly, with a frequency of 60 flashes per minute to attract the attention of the flight crew. The flight crew can acknowledge the warning by pressing the annunciator faceplate. The warning light will transfer from a flashing output to a steady output. The warning light will automatically reset when the voltage comes back up to an acceptable level where it can charge the battery and power the load.

High voltage: When the power output has such a high level that there is a risk of damaging the battery and the equipment and high voltage warning will occur. During the high voltage warning the annunciator will flash quickly with a frequency of 160 flashes per minute to attract the attention of the flight crew. The flight crew can acknowledge the warning after 20 flashes by pressing the annunciator faceplate. The warning will go from flashing to steady illumination. The warning will reset automatically when the voltage drops within limits.

Press to test: When the annunciator is depressed in normal mode the annunciator will illuminate until released.

ADDITIONAL LIMITATIONS AND INFORMATION FOR CERTIFICATION

Pilot's Operating Handbook Reference: …….

Aircraft Type: ……..……

Registration Mark:…… - ....…….. Aircraft Serial No:…….

VOLTAGE WARNING LIGHT
A Flashing warning light is installed which will illuminate if the generator / alternator output reduces to a level where the battery supplies power to the bus bar, or when there is a high voltage situation which could lead to damage of equipment.

Before engine start

Check that the self test is carried out. After the self test and before start the warning light should flash slowly.

After engine start

Check that the warning light is OFF

If LOW Voltage warning illuminates during flight (flashing slowly)

Cross check with other instruments (if installed)
Reduce electrical load
Remaining battery duration approx: …….. minutes
Land as soon as practical.

NOTE: Warning may illuminate with low engine rpm. Check it goes out when rpm increased.

If HIGH Voltage warning illuminates during flight (flashing quickly)

Cross check with other instruments (if installed)
Switch off alternator / generator
Reduce electrical load
Remaining battery duration approx: …….. minutes
Land as soon as practical.

Approved as part of minor change approval:……..

The limitations and information contained herein either supplement or, in the case of conflict, override those in the flight manual.