DC Power Supply For Wired Drone Application

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Abstract- *Drone technology has developed to a great extent in recent years. This Unmanned Aerial Vehicle (UAV) is used for various purposes like surveillance, detection of bomb, occasional air strikes, shooting in journalism, disaster management, weight lifting, geographic mapping, agriculture, weather forecasting, etc. This paper focuses on power supplies used for drone applications utilized for given purposes. The paper presents detail information about design, working, applications of high voltage power supply units used for drone applications. Various benefits and costs of such power supply units are also discussed in the paper.*

Keywords- Drone applications, power supply, hardware, surveillance, wired drone

I. INTRODUCTION

Drone applications are one of the best innovative machines used in various fields. It is most important device in military research as well as non-military sectors. There has been radical advancement in batteries, power circuits, electronic components of drone applications. But, drone applications for surveillance and military purposes require highly efficient and user-friendly products. In this paper we have discussed the design and functioning of power supply unit built to support drone application used for surveillance and military purpose as per the requirement of company – Precision Aerial Surveys.

The company Precision Aerial Surveys requires a DC Power supply unit to support the wired drone application used for survey in Indian Airforce. These drone applications are to be used 24x7 with required safety parameters. They demand time efficient and advanced power supply. This project includes developing a cost-time efficient DC high voltage power supply unit including practical application of power circuits.

Objective - The aim is to develop the DC high voltage power supply which will provide power to the wired drone flying in the air. This project includes practical application of the power circuits, actual working of electronic components and building new design for power supply. This application will help the developers (precision Aerial Surveys) to modify their services. Main objective of this project is to develop the most cost-time efficient product which will be at the same time consumer friendly.

Specifications-

- 500 W
- Input - 220V a/c
- Output - 300V d/c
- Interlock Safety Systems
- Alarms for Power Failure
- Suitable Input Output Military Port channel
- Resistive or inductive type load (power factor 0.9-0.95)

II. LITERATURE REVIEW

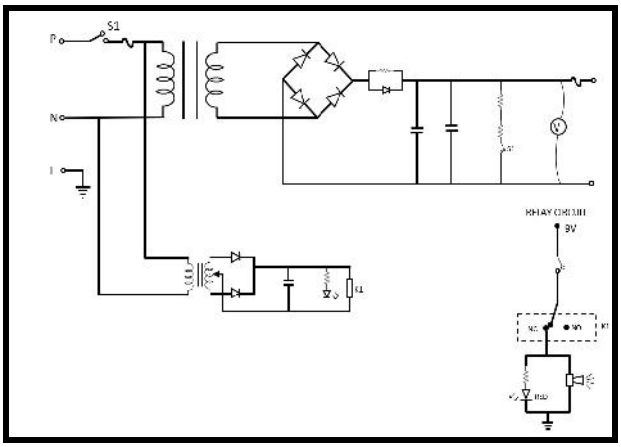
Title of page	Authors	Discussion	Analysis
A critical review on unmanned Aerial Vehicles power supply and energy management; solutions strategies and prospects.	Boukoberine M.N., Zhou Z., Benbouzid M.	The choice of suitable power source with optimum energy management is crucial for efficient UAVs. Review on power supply configuration and energy management systems.	Use of hybrid power supply system architecture is highly mentioned. Technologies for power supply unit like combining batteries with different sources such as fuel cell, solar cells, and supercapacitor
Power line charging mechanisms for drones.	Boaz Ben-Moshe.	NewConcept of a power line charging drone. To equip existing drones with a mechanism and onboard charger to land safely on power lines and charge	Highly dependent on robotic mechanism and requires "Add-on" mechanism. Limited to commercial drones only. High cost estimation
The study of aerial energy power supply systems for UAVs based on energy storage technology.	Khac Lam Phan, Jan Louchter, RadecBystricky, Milos Andrla, Ngoc Nam Phan, Van Thuan Phan	Method of taking advantage of external energy sources and conversion of energy to electrical energy power supply. Calculating required energy and external energy conversion.	Overview of structure, classification, dynamic model and control methods of UAVs. It must fly to high altitude to take advantage of wind energy. Use of various flight scenarios and high dependence on trajectory planning.
The analysis of power supply topologies for tethered drone applications.	Wojciech Walendziuk. Piotr Falkowski, Krzysztof Kulikowski	Technical variance of power supply and topologies of drones as well as functional analysis. Applying proper DC-DC converters to limit power loss caused by current flow within the wire and significant decease in the diameter of the drone wire.	Drone is powered from ground station using generators and battery packs for providing ultimate endurance. Mainly suitable for fix-wing typed drone.

III. HARDWARE REQUIREMENT

1) Transformer 500W, 230V AC-230V AC
2) ON OFF MCB – 5A/6A curve3 (slow single pole)
3) Fuse Holder 1-2 inch (slow fuse)
4) Ac-DC Bridge (clips) 50-100A 700V PIV
5) Buzzer 15-24V DC
6) Relay 2V DC Coil – 2pol NO/NC
7) LED 5mm – Red, Green (each 2)
8) PCB
9) Cables – 1mm 2 – Red, Black, White, Green
10) 9V Battery with connector cable

11) Capacitor – 500V, 1000uF (1)
12) Voltmeter – AC – digital Round
13) Connectors – Military Grade – male/female Panel Mountable
14) Hardware for PCB mounting
15) LM324 quad op-amp
16) NPN transistor BC547
17) Regulator 7812
18) Diodes, Resistors, fuse.

IV. CIRCUIT DIAGRAM



V. WORKING

This circuit diagram will help to get an idea about the circuit connections or basic working of the power supply. As it is a ground power supply it will convert the AC main voltage into the 300V DC output. Firstly, the AC voltage is passed through the isolation transformer. This will isolate the parameter from the input source and we will get all floating outputs. With the help of a rectifiercircuit, we will convert this AC voltage to a constant DC source. This fluctuating DC is further filtered and regulated by using the capacitor filter. The 300v DC voltage is generated at the output of the power supply which will be directly given to the Drone device flying in the air. The drone device itself has a power unit on the air-board. This unit will again regulate and operates the 300V DC voltage given by the ground power supply.

For measurements, indications and safety majors, there is other auxiliary circuit attached to the power supply unit. The Auxiliary Circuit consists of an auxiliary transformer, Auxiliary Rectifier, and control logic. The Auxiliary transformer is a step-down centre-tapped transformer. The transformer steps down the ac voltage to 30Vand using centre-tapped the output voltage received is 15V AC. The green led is continuously ON when the power supply is switched ON and in the running state. This led is connected to the DC output generated by this step-down transformer.

For the indication of the power failure of the system, we have used relay mechanism. A relay circuit is used to make sure a 9V battery replaces the auxiliary circuit to power up a red LED and the buzzer to indicate power failure or power loss. When the power is supplied by the auxiliary circuit then it is normally open (NO), but when it fails it changes to normally connected (NC), where it uses 9V battery.

The capacitors remain charged at the point of switching off the circuit. If the charge remains in the system for too long, can have dangerous effect on the whole power supply system. Hence these capacitors should discharge quickly for safety of the user as well as the power supply unit. To discharge the capacitor, two resistors in series are connected in between the capacitor and the switch. When the switch is OFF, the two resistors help discharge the two capacitors.

Ground Power Supply Box dimensions

Advantages-

1. Simplistic and reliable design assuring no complexity and related issues.
2. Three different logic behavior for emergency power failures or heat burn.
3. Cost and time efficiency, noise sensitivity.
4. Safety measures and requirements as per the order of external mentor from the company.
5. After sales services regarding training, repair and upgrade of power supply with very low maintenance cost.

Disadvantages-

1. The drone flying in the air already has one voltage power regulator which has +/- 5% fluctuations.
2. The power supply unit is not able to get again the original output by feedback mechanism.

VI. CONCLUSION

Power supplies which are currently available in the market are based on SMPS principle and are less sensitive to input voltage variations. They also lack in providing safety majors as per military requirements. Thus, more emphasis was given on designing efficient and safe high voltage power supply unit as per company requirements. This power supply unit can hence support the drone applications 24x7 as per the safety measures given by Precision Aerial survey.

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