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Design of SMPS and Its Application

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ABSTRACT

SMPS stands for switched mode power supply. It is known by a wide range of names like power supply, supply unit, regulator, or switcher in an electronic power supply. It incorporates a switching regulator to convert electrical power efficiently. It is mainly used for obtaining a controlled dc power supply as output.

It is used to convert power (voltage) using switching devices that are turned on and off alternatively at high frequencies. It uses storage components like inductors or capacitors to supply power when the switching device is in its non-conduction state (off-state). SMPS possesses high efficiency and is widely used in various electronic equipment such as computers, battery chargers, and other sensitive equipment requiring a stable and efficient power supply.

KEYWORDS: Switched Mode Power Supply SMPS, DC power supply

1. INTRODUCTION

Power Electronics is the art of converting electrical energy from one form to another in an efficient, clean, compact, and robust manner for convenient utilisation. The never ending drive towards smaller and lighter product poses serious challenges for power supply designers. The aim of the project is to design, test and implement a switched mode power supply (SMPS) circuit for AC to DC conversion, having a power MOSFET for switching operation and a PWM based feedback circuit to drive the MOSFET switch using NI MULTISIM circuit design environment and NI ELVIS Breadboard.

A Switched-Mode Power Supply (SMPS) is a type of power supply that uses a switching regulator to convert electrical power efficiently. Unlike traditional linear power supplies, which regulate the voltage by dissipating excess power as heat, SMPS regulates the voltage by rapidly switching the power supply on and off. The switching regulator consists of a power MOSFET or transistor, a diode, an inductor, and a capacitor. These components work together to efficiently convert high voltage, low current power from an AC or DC source to low voltage, high current power that can be used to power electronic devices. SMPS are commonly used in a wide range of electronic devices, including computers, mobile phones, TVs, and other consumer electronics. They are preferred over linear power supplies due to their smaller size, lighter weight, higher efficiency, and lower heat dissipation.

SMPS can be designed to work with different input voltages and output voltages and currents. They can also be designed with various protection features such as overvoltage protection, overcurrent protection, and short-circuit protection.Overall, SMPS are essential components in modern electronic devices and have

revolutionized the way power is supplied to electronic systems.

2. OBJECTVIES OF THE PROPOSED WORK

The objective of a thesis on SMPS (Switched-Mode Power Supply) can vary depending on the specific research question and the scope of the study. However, here are some possible objectives for a thesis on SMPS: Design and Optimization: The thesis can focus on the design and optimization of SMPS circuits. The objective would be to develop new circuit topologies, control strategies, or optimization techniques that improve the performance of SMPS in terms of efficiency, power density, and cost Control and Modulation Techniques: Another objective could be to investigate the different control and modulation techniques used in SMPS.

Modeling and Simulation: The objective of the thesis could be to develop accurate models and simulations of SMPS circuits to predict their behavior under different operating conditions. This could involve the use of simulation tools such as SPICE, PSIM, or MATLAB/Simulink.

Power Electronics Applications: The thesis could focus on the application of SMPS circuits in various power electronics systems, such as renewable energy systems, electric vehicles, and data centers. The objective would be to investigate the challenges and opportunities of using SMPS in these applications and propose solutions to address the issues.

Comparison with Other Power Supply Topologies: Another objective could be to compare SMPS with other power supply topologies, such as linear regulators and resonant converters. The thesis could investigate the advantages and disadvantages of each topology in terms of efficiency, size, and cost, and provide recommendations for selecting the appropriate topology for a given application.

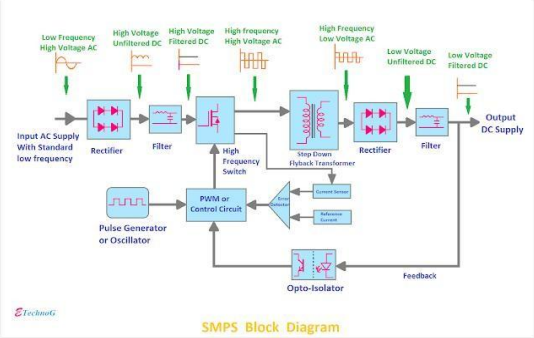
3. SWITCHED MODE POWER SUPPLY

The 'Switched Mode Power Supply' owes its name to the dc-to-dc switching converter for conversion from unregulated dc input voltage to regulated dc output voltage. The switch employed is turned 'ON' and 'OFF' (referred as switching) at a high frequency. During 'ON' mode the switch is in saturation mode with negligible voltage drop across the collector and emitter terminals of the switch where as in 'OFF' mode the switch is in cut-off mode with negligible current through the collector and emitter terminals. On the contrary the voltage- regulating switch, in a linear regulator circuit, always remains in the active region. In this thesis firstly a simplified schematic switching arrangement is described that omits the transformer action. In fact there are several other switched mode dc-to-dc converter circuits that do not use a high frequency transformer. In such SMPS circuits the unregulated input dc voltage is fed to a high 15 frequency voltage chopping circuit such that when the chopping circuit (often called dc to dc chopper) is in ON state, the unregulated voltage is applied to the output circuit that includes the load and some filtering circuit. When the chopper is in OFF state, zero magnitude of voltage is applied to the output side.

The ON and OFF durations are suitably controlled such that the average dc voltage applied to the output circuit equals the desired magnitude of output voltage. The ratio of ON time to cycle time (ON + OFF time) is known as duty ratio of the chopper circuit. A high switching frequency (of the order of 100 KHz) and a fast control over the duty ratio results in application of the desired mean voltage along with ripple voltage of a very high frequency to the output side, consisting of a low pass filter circuit followed by the load. The high frequency ripple in voltage is effectively filtered using small values of filter capacitors and inductors. SMPS technology rests on power semiconductor switching devices such as Metal Oxide Semiconductor Field Effect Transistors (MOSFET) and Insulated Gate Bipolar Transistors (IGBT).

These devices offer fast switching times and are able to withstand erratic voltage spikes. Equally important, they dissipate very little power in either the On or Off states, achieving high efficiency with low heat dissipation. For the most part, the switching device determines the overall performance of an SMPS. Key measurements for switching devices include: switching loss, average power loss, safe operating area, and more.

4. BLOCK DIAGRAM



SMPS stands for Switched-Mode Power Supply, and it is an electronic power supply that uses a switching regulator to convert electrical power efficiently. The working principle of SMPS can be explained in the following steps:

AC to DC conversion: The first step in SMPS operation is converting the incoming AC voltage to DC voltage using a rectifier circuit.

Filtering: The DC voltage obtained from the rectifier circuit is filtered using a capacitor to smooth out the voltage ripple.

Switching: A switching transistor is used to turn the DC voltage on and off at a high frequency, typically in the range of tens or hundreds of kHz.

Pulse Width Modulation (PWM): The duty cycle of the switching transistor is controlled by a PWM circuit. By varying the duty cycle, the output voltage of the SMPS can be regulated

Inductor and Capacitor: An inductor is used to store energy in its magnetic field during the "on" time of the switching transistor and releases it during the "off" time. A capacitor is used to filter the output voltage.

Output Voltage Regulation: The output voltage of the SMPS is regulated by comparing it to a reference voltage and adjusting the duty cycle of the PWM circuit accordingly.

Output Filtering: The output voltage is then filtered using a capacitor to remove any remaining ripple. Overall, the switching action of the transistor in the SMPS allows for high efficiency and small size compared to traditional linear power supplies.

5. RESULTS AND DISCUSSION

The Output of the SMPS (Switched Mode power supply) of 5v has been displayed with pure regulated Dc output voltage on the Digital multi meter.

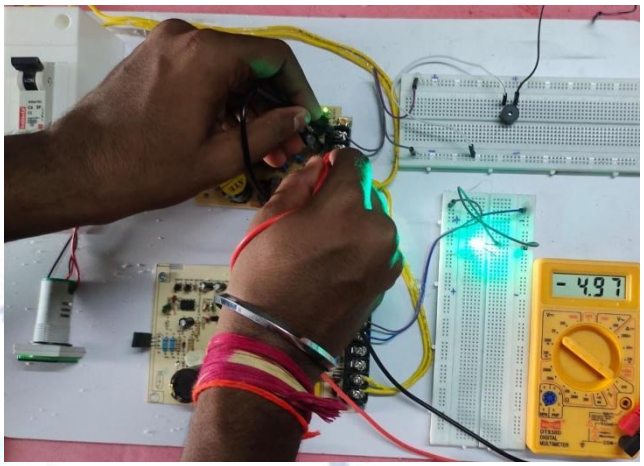


Fig 1 starter contact

The Output of SMPS (5V) can be seen in the Multi meter of approximate 4.97 volts and the output voltage of SMPS (5V) can be used for application purpose of various electronic devices by installing Bread boards as shown in the above Figure 2. Similarly the Output of SMPS (12V) can also be obtained by placing the output ports of the Multi meter in the output Terminals of 12V SMPS.The Output is displayed on the screen of the Multi meter as shown in the below Fig 2 of approximate 12.1 Volts.

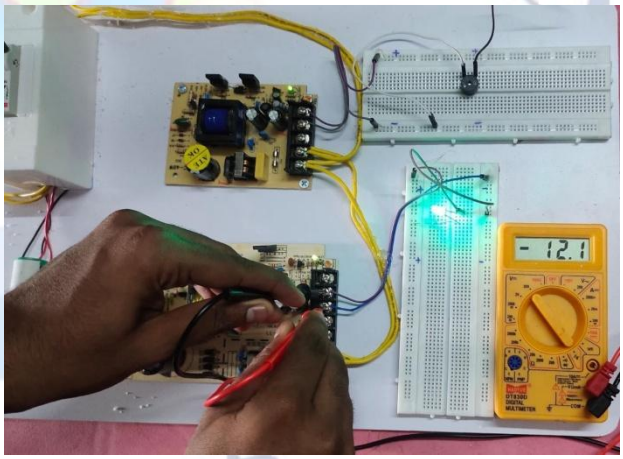


Fig 2 Output Of SMPS

6. CONCLUSION

Switched Mode Power Supplies (SMPS) are widely used in various industries where high efficiency, compact size, and precise regulation of power are required. SMPS provide a reliable and stable power source that can operate in harsh environments, withstand high temperatures and vibrations, and offer a high level of precision and control over the output voltage and

current. From consumer electronics to industrial automation, medical equipment to renewable energy, SMPS have proven to be a highly versatile and efficient power conversion solution that can meet the needs of a wide range of applications. The continued development of SMPS technology is expected to bring further improvements in efficiency, performance, and reliability, making them an essential component in many modern electronic devices and system.

The Design of SMPS can be operated of the respective voltage levels (5V & 12 V) and produces regulated output DC voltages from the operation of SMPS .The Bread boards are also installed for the Real time applications for the initial purpose here we installed an LED and Buzzer.

From the Output voltage of SMPS this applicances are operated at the respective rated voltages so the Design of SMPS & its Applications has been concluded successfully.

This project uses a system to start a 3 phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt DC relays in star mode first and then to delta mode by an electronically adjustable timer. It still retains its application for a 3 phase motor starting with single phasing prevention also. The project also has the provision of single phasing protection since 3 phase motors get burnt if any one phase goes missing during running. The output to the lamps shall be completely cut-off in the event of any phase failure.Further the project can be enhanced by using a thyristors in firing angle control principle for soft start of the induction motor that would overcome all the drawbacks of star delta starter.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] T. H. Cho, Design of a high efficiency flyback converter for universal input applications, in Proceedings of the IEEE International Telecommunications Energy Conference, Oct. 2022, pp. 160-165.

[2] R. Redl, T. Engleder, and M. P. Mayer, EMC compliant design of switched mode power supplies, in Proceedings of the IEEE International Symposium on Electromagnetic Compatibility, Aug. 2021, pp. 585-590.

[3] M. B. Kassakian, Switching power converters: past, present and future, in Proceedings of the IEEE Power Electronics Specialists Conference, June 2010, pp. 1-6.

[4] C. J. Pavlatos and J. G. Kassakian, Design of resonant switched-capacitor converters for high voltage applications, in Proceedings of the IEEE Applied Power Electronics Conference and Exposition, Feb. 2018, pp. 8-15.

[5] D. Boroyevich, R. Burgos, and Y. Li, An overview of power electronics in renewable energy systems, in Proceedings of the IEEE Power Electronics Specialists Conference, June 2011, pp.

[6] M. M. Jovanovic and F. C. Lee, Novel zero-voltage and zero-current-switching PWM converters, in Proceedings of the IEEE Applied Power Electronics Conference and Exposition, Mar. 2020, pp. 425-431.

[7] B. H. Cho, J. W. Baek, and Y. J. Choi, A novel interleaved boost converter with active-clamp and soft-switching for high-efficiency applications, in Proceedings of the IEEE Power Electronics Specialists Conference, June 2013 pp. 1234-1238.

[8] C. C. Ennett, Recent advances in high-frequency resonant power conversion, in Proceedings of the IEEE Power Electronics Specialists Conference, June 2018 pp. 1-5.

[9] D. C. Hamill and J. A. Sabate, A review of high frequency transformer design for power electronics applications, in Proceedings of the IEEE Applied Power Electronics Conference and Exposition, Feb. 2010, pp. 9-16.

[10] D. Boroyevich, R. Burgos, and Y. Li, An overview of power electronics in renewable energy systems, in Proceedings of the IEEE Power Electronics Specialists Conference, June 2014, pp. 1-7.