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ANALYSIS OF MULTIPLE OUTPUT SMPS TOPOLOGY FOR PC APPLICATION

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Abstract: Now a days used of double stage switch mode power supply is used in computer devices. Owing used of switch mode power supply can provide flexibility while dealing with DC regulated power supply. Due to ability of handling different DC loads SMPS topology can be used in medical application. This project proposes the use of SMPS topology for PC application & Medical application. As considering concern of electrical power quality and voltage regulation due to use of nonlinear load in medical application, the SMPS provide greater reliability & Performance. The results are verified using MATLAB Simulink.

Keywords* — *Switched mode power supply (SMPS), nonlinear load, Power factor, Voltage regulation.

I. INTRODUCTION

Traditional diode based rectifier used in SMPS draw pulsed current from the input main which deteriorates the line voltage, produce electromagnetic interference leading to the poor efficiency & power factor. To improve input power factor of SMPS, a power factor correction circuit is used in order to force line current to follow line voltage. PFC circuits can be categorized as passive and active - in passive PFC, passive elements are used in addition to the diode bridge rectifier. Recent innovations in power electronics have enabled the elimination of the diode bridge rectifier at the front end in order to achieve acceptable power quality even under varying input voltage and load condition[1].Two stage dc-dc converters are now used in power supplies where the first stage is used for input current shaping followed by an isolated dc-dc converter stage for output dc voltage regulation. This configuration can be used to obtain a good PF with very fast output dynamics with a reduction in sensor requirement and improved input power quality as well[2].The power quality standard for low power equipments such as IEC6I000-3-2 requires a sinusoidal current to be drawn from the single phase ac mains with PF close to unity [1]. In a few research papers [2] [3], efforts have been made to design a multiple output SMPS with a single DC-DC converter.A bridgeless Cuk converter allows the current to flow through minimum number of switching devices compared to the conventional Cuk based ac-d conversion topologies .DCM operation of these converters is preferred due to the advantages of single voltage sensor operation and inherent PFC with less control complexity. In DCM, switching cycle is independent of previous switching cycle. So inherently power factor correction is possible in DCM without any extra control[4].

II. SMPS TOPOLOGY

There are several topologies commonly used to implement SMPS. Any topology can be made to work for any specification however, each topology has its own unique features, which make it best suited for a certain application. To select the best topology for a given specification, it is essential to know the basic operation, advantages, drawbacks, complexity and the area of usage of a particular topology.

The following factors help while selecting an appropriate topology:

a) Is the output voltage higher or lower than the whole range of the input voltage?

b) How many outputs are required?

c) Is input to output dielectric isolation required?

d) Is the input/output voltage very high?

e) Is the input/output current very high?

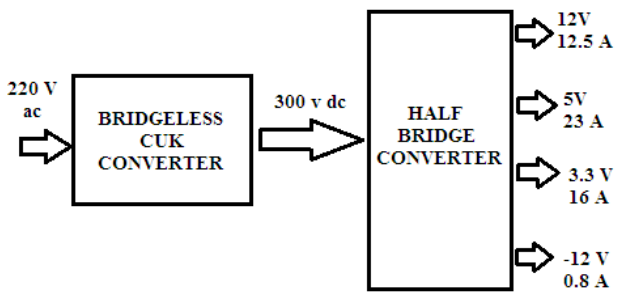

Fig.1 SMPS Topology

The general SMPS topologies are used in various applications are:

1. Buck converter
2. Boost converter

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3. Buck-boot converter

III. SIMULATION MODEL

Single stage SMPS for PCs are less popular because of poor output voltage regulation, excessive component stress, high output capacitance value and complex control.

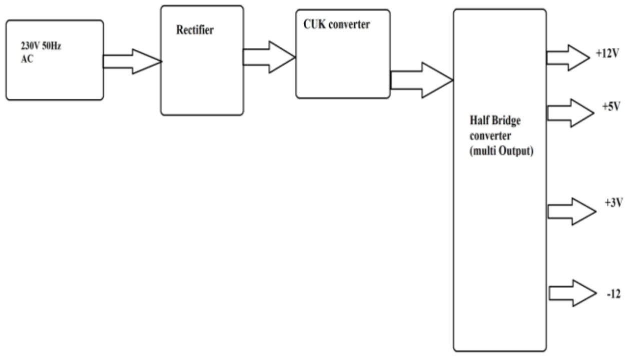

Fig.2 Block diagram for multiple output SMPS

On the other hand single stage conversion improves the efficiency and number of components is less as compared to two stage SMPS. Two stage SMPS offers regulated dc output voltage, improved input power factor and reduced harmonic distortion resulting in reduced value of output filter capacitors and also offers fast dynamic response.

For obtaining output voltage regulation half bridge converter is used operated in continuous conduction mode. Single phase ac input is given to bridge less Cuk converter, from which unregulated dc is given to the half-bridge converter for achieving multiple output voltages. For controlling the output voltage of the half bridge converter, an average current control scheme is used. The highest rated winding output voltage is sensed and compared with constant reference value and error signal is given to PI controller and its output is compared with the saw-tooth signal to generate PWM switching signals to maintain the output voltage constant

(2) Design of SMPS Unit:

he SMPS unit for PC was designed for 330 W whose output voltages and current are +12V/12.5A, +5V/23A, +3.3V/16A and 7.5V/O.8A. The switching frequency is taken as very high compared to the line frequency for averaging the quantities in one PWM switching cycle. A single-phase AC voltage is applied to a diode bridge rectifier.

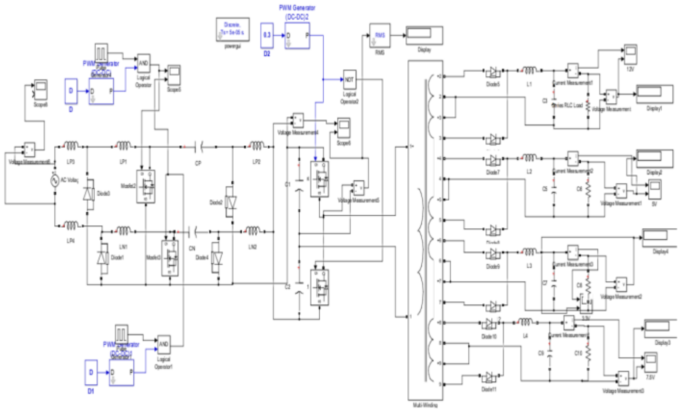

Fig.2 SMPS model without application

The design of an SMPS (Switched-Mode Power Supply) unit involves several steps, which are as follows:

(i) **Determine the Input Voltage**: The first step in designing an SMPS unit is to determine the input voltage range that the power supply will be designed to operate on. This can vary based on the application, but commonly used input voltages for SMPS units are 120VAC or 240VAC.

(ii) **Choose the Topology:** The next step is to choose the SMPS topology that best fits the requirements of the application. The most commonly used topologies are Fly back, Forward, Push-Pull, and Half-Bridge.

(iii) **Select Components:** After selecting the topology, the next step is to select the components required for the SMPS unit. This includes choosing the power MOSFET, diodes, inductors, capacitors, and other passive components.

(iv) **Calculate the Transformer Turns Ratio:** The turns ratio of the transformer is calculated based on the desired output voltage and the input voltage. This determines the number of turns required on the primary and secondary windings.

(v) **Design the Feedback Circuit:** The feedback circuit is responsible for regulating the output voltage of the SMPS unit. It uses a voltage divider circuit to monitor the output voltage and provide feedback to the PWM controller.

IV. RESULT AND DISCUSSION

Step change in load is applied to all outputs of SMPS unit ie, +12V, +5V, +3.3V, 7.5V respectively. To analyze proper working of SMPS under varying load conditions only normal working condition is considered. Load is varied from initial low load condition to full load for all outputs. For + 12V output is varied from 80% to 100%, +5V output is varied from 60% to 100%, +3.3V output is varied from 40% to 100% and -12V output varied from 20% to 100% at 0.05 sec. Multiple output voltages of SMPS unit remain constant under load varying condition.

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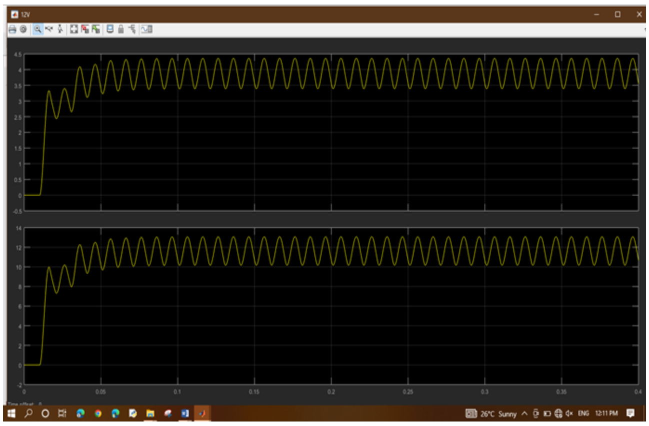

Fig.3 Output waveform for 12 v

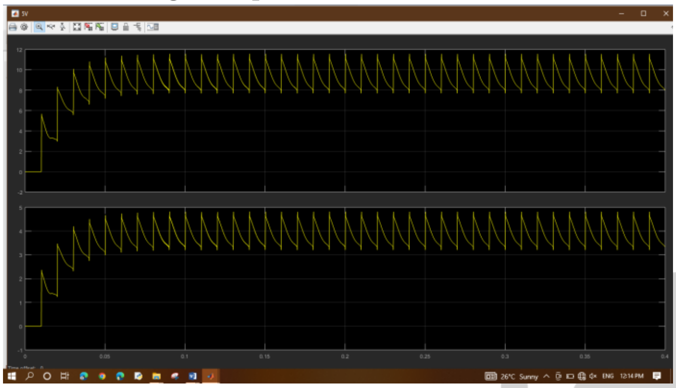

Fig.4 Output waveform for 5 v

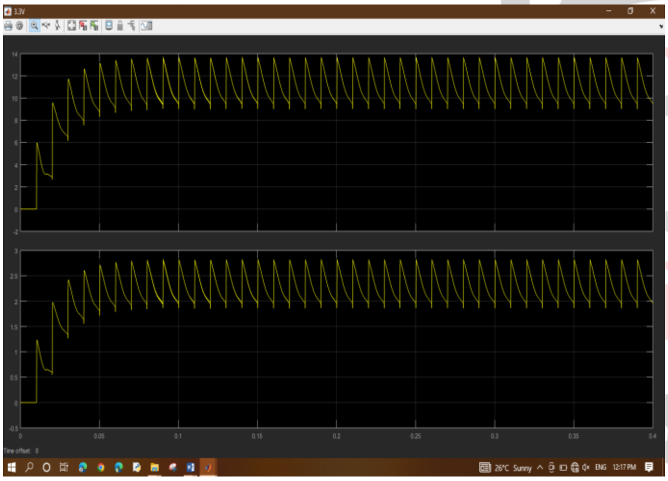

Fig.5 Output waveform for 3 v

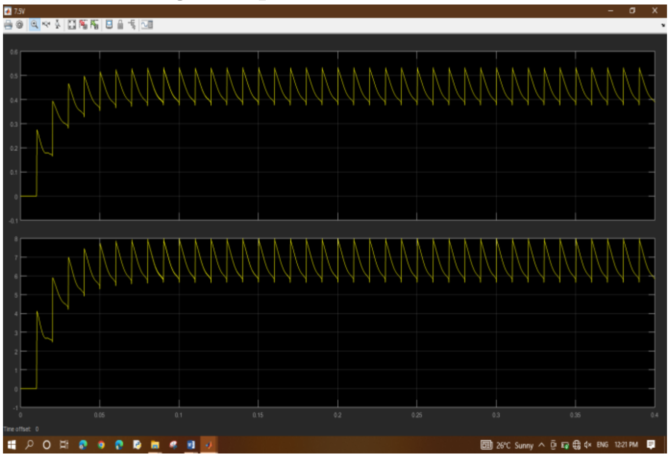

Fig.6 Output waveform for 7.5 v

V. CONCLUSION

SMPS unit is developed using bridgeless Cuk converter. A bridgeless Cuk converter at front end is designed to operate in discontinuous conduction mode which is having power factor correction capability and output voltage is maintained constant independent of changes in voltage and load. Half bridge converter in continuous conduction mode is used for obtaining multiple output as required by the PC such as + 12V, +5V, +3.3V, 7.5V. The proposed configuration with the specified design values is effective in handling variations in load and supply voltage, and is capable of yielding excellent dynamic performance.

References

[1] "Comparison of Flyback and Forward Converter for AC to DC Power Supply" by Sandeep Kumar and Jitender Kumar, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2013.

[2] "Design and Comparison of Push-Pull and Half-Bridge Flyback Converters for High-Power Applications" by Marcelo G. Ortiz, et al., IEEE Transactions on Power Electronics, 2008.

[3] "A Comparative Analysis of Buck, Boost, Flyback, Forward, Push-Pull, Half-Bridge, and Full-Bridge DC-DC Converters" by J. M. Alonso, et al., IEEE Transactions on Industrial Electronics, 2011.

[4] "Design and Implementation of a Low-Cost Single-Stage Three-Phase Inverter-Based Power Supply" by S. K. Panda and S. S. K. Siva Kumar, International Journal of Engineering and Technology, 2018

[5] "High-frequency, high-efficiency power supply design using LLC topology" by M. M. Jovanovic, et al., IEEE Transactions on Power Electronics, 2004.

[6] "Design and Analysis of Switched-Capacitor DC-DC Converters for Portable Applications" by D. W. Kim, et al., IEEE Transactions on Circuits and Systems I: Regular Papers, 2010.

[7] "Design of High-Frequency DC-DC Converters for Industrial Applications" by J. A. Sabate, et al., IEEE Transactions on Industrial Electronics, 2011.

[8] "Design of a Switched-Mode Power Supply for LED Lighting Applications" by M. Ciobotaru, et al., IEEE Transactions on Power Electronics, 2011.

 DOI : 10.35291/2454-9150.2023.0092