Importance of Switched Mode Power Supply

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Abstract: Switched Mode Power supplies are important for use in personal computers and several other electronic instruments. The main cause of the using switched mode power supply is to provide quality power supply to the equipments which prevents unwanted damage of those. The proposed scheme is designed and simulated by using PSIM electronic simulation software. The obtained results show better performance of the power supply with respect to its output voltage regulation and input power quality.

Keywords: Switched Mode Power Supply, rectifier, Input power quality, output voltage regulation, output transformer.

INTRODUCTION

A switched mode power supply (SMPS) is basically a converter which uses various switching devices like MOSFET, Power BJT etc. It is a device which provides power to any electrical load and involves in some kind of switching action[1]. There are five blocks present in SMPS:

i) Input rectifier and filter
ii) Chopper
iii) Transformer
iv) Output rectifier and filter
v) Feedback circuit
SMPS works on very high frequencies. The frequency should be increased first [2]. So, AC input is converted to dc first and then chop it at high frequency to get pulsating dc output which is then applied to rectifiers and filters. Feedback helps to maintain the level of output signal.

SWITCHING MODE POWER SUPPLY (SMPS)

- SMPS means Switch Mode Power Supply. This is used for D.C to D.C conversion. This works on the principle of switching regulation. The SMPS system is highly reliable, efficient, noiseless and compact because the switching is done at very high rate in the order of several KHz to MHz.
- It offers high power conversion efficiency and design flexibility.
- It can step down or step up output voltage.
- Power supply convert alternating current to the direct (DC) current mainly convert 110-240v AC
- Three types of power supply:
  - Linear power supply
  - Switched mode (SMPS)
  - Uninterrupted (UPS)
- Power SMPS stands for Switch Mode Power Supply.
- This receives 230V AC and translates it into different DC levels such as +5V, -5V, +12V, -12V. Fig 1 and Fig 2 shows the block diagram of SMPS[3].
Fig 1: SWITCH MODE POWER SUPPLY BLOCK DIAGRAM 1

Fig 2: SWITCH MODE POWER SUPPLY BLOCK DIAGRAM 2
Fig 3 shows schematic diagram of SMPS [3].

Regulation

- The relaxation oscillator produces a square wave. The square wave is integrated to get a triangular wave, which drives the non-inverting input of a triangular to pulse converter. The pulse train out of this circuit then drives the Pass Transistor. The output is sampled by a voltage divider and fed to a comparator. The feedback voltage is compared with a reference voltage. The output of the comparator then drives the input of the triangular to pulse converter.

- If the output voltage tries to increase the comparator produces a higher output voltage which raises the reference voltage of the triangular- to pulse converter. This makes the pulse that drives the base of the switching transistor narrower. That means duty cycle is reduced. Since the duty cycle is lower the output becomes less which tries to cancel almost all the original increase in output voltage.
Conversely, if the regulated output voltage tries to decrease, the output of the comparator decreases the reference voltage of the triangular-to-pulse converter. This makes the pulse wider and the transistor conducts for larger time and more voltage comes out of the L.C.filter. This cancels out the original decrease in output voltage.

Fig. 3 Pulse width modulation

Fig 4 : Principle of Regulation
Duty cycle of the Transistor \( D = \frac{\text{On Time}}{\text{cycle time}} \)

The output voltage = Input voltage \( \times D \)

For example

If I/P voltage is 200 volts and \( D=0.25 \)
O/P voltage \( = 200 \times 0.25 \) \( = 50V \).

Regulation is achieved by modifying the Duty cycle. Duty cycle depends on onetime of transistor, which in turn depends on the width of the pulse applied to the base of the transistor, which is controlled by ‘Pulse width modulation’ by regulator circuit. Fig 4 and Fig 5 shows principle of regulation [3].

AT and ATX/NLX power supply

- PC using XT, AT,babyAT and LPX form factor uses switch to turn on the computer.
- Newer versions of motherboard send signals through motherboard to power supply.
  - AT
  - ATX/NLX
- Doesn’t connect directly to power button
- It uses five DC voltage,20 pin connector.
  - PS-ON: when it is low SMPS is ON or else OFF.
  - 5VSB:supplies power supply to circuits
  - PW-OK:power good signal.
- Front side power connector to SMPS
- AT style SMPS provides DC output on two 6-pin connectors(carries DC power to motherboard)
  and two 4-pin connectors.
ATX/NLX type SMPS

Fig 6 shows pin diagram[3].

AT type SMPS

- Front side power connector to SMPS
- AT style SMPS provides DC output on two 6-pin connectors (carries DC power to motherboard) and two 4-pin connectors
- Power good flag is set
- Output voltage stable
Fig 7: AT type SMPS
Fig 7 shows AT type SMPS and Fig 8 shows its Pin diagram [3].

**SMPS working**

- Convert AC to DC voltage with rectifier
- Which is unregulated DC voltage sent it to filter
- Inverter convert DC to AC with help of power oscillator.
- Output transformer inverts AC voltage up to down to the required output level.
- Output rectifier and filter: AC output from transformer is rectified.
- For lower voltage uses silicon/schottky diodes used and smoothing the rectified output by using filter [4-6].
- This reduces the amount of the voltage passed through the transformer.
• So the output voltage will be maintained normally.
• Then it is sent to the output of the power supply.
• A sample of this output is sent back as feedback signal for regulation.

Advantage of SMPS over Linear Power Supplies:

1. Lower weight
2. Smaller size
3. Higher efficiency
4. Lower power dissipation
5. Wide ac input voltage range
6. Reduced costs

Disadvantage of SMPS over Linear Power Supplies:

1. Complexity of the circuit

Conclusion

➢ The most common Smpsttopologies:flyback,push-pull, half bridge and full bridge converters have been outlined .
➢ Each has it’s own particular operating characteristics and advantages ,which makes it suitable to particular application
➢ Some of the most common application of SMPS have been discussed.

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