

December 2002 NATIONAL EXAMS

98 – ELEC – B8

Switched Mode Power Supply Design

3 Hours Duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made;
2. “Closed-Book” – Candidates may use one of two calculators, a Casio FX-991 or Sharp EL-540;
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked;
4. All questions are of equal value

Question 1

- a) Explain and give examples of some of the typical causes of conducted and radiated RFI interference in switchmode power supplies.
- b) Describe the difference between differential-mode interference and common-mode interference.
- c) Why is it important to reduce interference noise to the minimum?
- d) Why are line filters of limited value in eliminating common-mode line-borne interference?

Question 2

- a) Quote the three major selection criteria for supply or output fuses.
- b) Why is the voltage rating of a fuse so important?
- c) Under what conditions may the fuse voltage rating exceed the supply voltage?
- d) Why is the I^2t rating of a fuse an important selection criterion?

Question 3

- a) What are the major advantages of proportional drive?
- b) Why does the drive transformer in a proportional drive circuit tend to be larger than the power requirements alone would indicate?
- c) The maximum duty ratio for a transformer-coupled proportional drive circuit tends to be limited to less than 80%. Why is this?
- d) What controls the minimum and maximum inductance of the proportional drive transformer?

Question 4

- a) Explain the meaning of the term “cross conduction” as applied to half-bridge, full-bridge, and push-pull converters.
- b) Describe a method used to reduce the possibility of cross conduction in push-pull converters.
- c) What is the disadvantage of the “dead time” approach to preventing cross conduction?
- d) Describe a method of preventing cross conduction which does not rely on a built-in dead time.

Question 5

- a) Discuss the major disadvantage of switchmode power supplies compared with the older linear regulator types.
- b) Why are power output filters often relatively ineffective in dealing with high-frequency noise?
- c) Why are two-stage filters sometimes used in output filter applications?
- d) In what way does the design of a common-mode choke differ from that of a series-mode choke?

Question 6

- a) From what class of converters is the transformer-coupled forward converter derived?
- b) Why is the utilization for the primary switching device often much greater in the forward converter than in the flyback converter?
- c) A core gap is not normally required in a forward converter transformer. Why is this?
- d) Why is a minimum load required for correct operation of a forward converter?

Question 7

- a) Why is thermal management so important in switchmode power supply design?
- b) When using an electrical model for thermal design, what would be the electrical analogue of a heat-generating transistor junction?
- c) Is the thermal resistance of a heat exchanger directly proportional to its size?
- d) Why is a small amount of forced air cooling so valuable for improving the life of switchmode power supplies?