

Series 6

Power quality in static converters

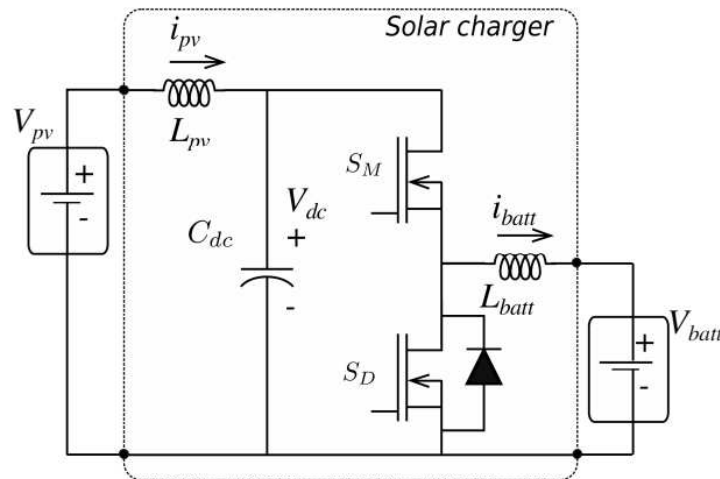
Training:

1. What is power quality?
2. What are the power quality problems in AC systems?
3. Why is power quality important?
4. What are the causes of power quality problems?
5. What are the effects of power quality problems?
6. What is a nonlinear load?
7. What is voltage sag (dip)?
8. What is voltage swell?
9. What are the harmonics?
10. What are the inter harmonics?
11. What are the sub harmonics?
12. What is the role of a shunt passive power filter?
13. What is the role of a series passive power filter?
14. What is an active power filter?
15. What is the role of a shunt active power filter?
16. What is the role of a series active power filter?
17. What is the role of a DSTATCOM?
18. What is the role of a DVR?
19. What is the role of a UPQC?
20. What is a PFC?
21. What is an IPQC?

22. Why is the excessive neutral current present in a three-phase four-wire system?
23. How can the excessive neutral current be eliminated?
24. Which are the standards for harmonic current limits?
25. What are the permissible limits on harmonic current?

Exercise 1:

A buck converter is operated as a solar charger for a battery as shown in Figure 1. The open circuit voltage is 14V , the MPPT voltage of the solar panel is 8V , and the battery voltage is 6V . Power from the PV panel at MPPT condition is 30W. The MOSFET (SM) has and resistance of 13mΩ and the diode characteristics is obtained by operation of MOSFET as a synchronous rectifier (SD) and has equivalent characteristics of $V_{don} = (0.1 + 13m\Omega i_d)V$. The switching frequency is 280kHz and the switching loss data for the MOSFET and Diode at $V_{dc} = 13V$ and $I_{out} = 8.5A$ is as follows: $E_{ON} = 1\mu J$, $E_{OFF} = 0.3\mu J$, and $E_{err} = 0.17\mu J$. Switching power loss exponent k_v and $k_i = 1$, and the $T_{amb} = 60oC$. Also, assume all the other passive components are ideal.



- (a) What is the duty cycle required for the switch SM when the PV panel is charging the battery under MPPT conditions?
- (b) What is the conduction loss and switching loss in SM and SD under MPPT conditions?
What is the corresponding charging power?
- (c) What is the maximum $R\theta(ja)$ that the semiconductors can have so as to keep $T_j < 130oC$?

(d) What is the reduction in power loss that can be obtained by using two parallel MOSFETs for the switch SM?

(e) What is the rms current in Cdc neglecting ripple current in the inductors?

(f) The solar charger cost is Rs.1000/- and the cost of the MOSFET is Rs.25/- and is operated daily for 8hrs at MPPT conditions. Compare the EIC of using 1 or 2 parallel MOSFETs considering factors for initial cost and power loss. Assume that the interest rate is 10%, cost of electricity is Rs.7/kWhr, and ten years of equipment operational life.

Exercise 2:

For type - A chopper of figure below, dc source voltage =230V, load resistance =10Ω. Take a voltage drop of 2V across chopper when it is on. For a duty cycle of 0.4, calculate

a) Average and rms values of output voltage and

b) Chopper efficiency

