

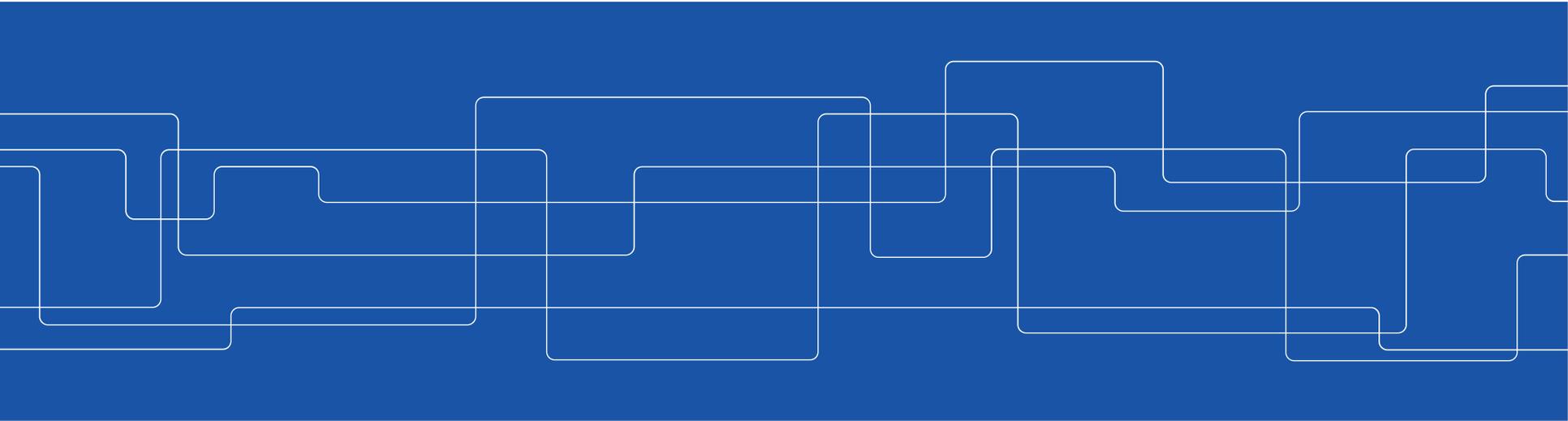


Lightning and Electromagnetic Interference (Lightning protection)

Rajeev Thottappillil

Questions/Exercises

Module 6.5





Outline

Introduction [Module 6.1]

- Types of Lightning
- Overall features

Properties of Lightning which has influence on protection [Module 6.2]

- Currents and charges
- Electromagnetic fields

Lightning Protection

- Buildings [Module 6.3]
- communication towers (or wind turbines) [Module 6.4]
- lightning safety

Questions/Exercises [Module 6.5]



1) A power cable running from the base of a tower to the electronics of the antenna at the top has a dc shield resistance of 8 milliohms/m and a leakage inductance of 1 nanoHenry/m. Tower height is 100 m. The tower is struck by lightning. Assuming that 20% of the lightning current is carried by the cable shield, what will be the approximate peak voltage between the shield and inner conductor at the base of the tower? Assume a peak current of 50 000 A and rise-time of 0.5 microseconds. From among the four choices, select an answer that is most reasonable.

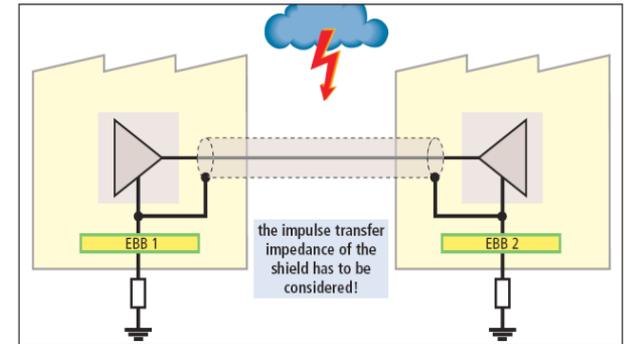
- A) Around 8 000 V
- B) Around 800 V
- C) Around 80 000 V
- D) Around 80 V

2) In a lightning protected structure, all metallic parts that can be connected together are connected together at certain points. This is called bonding. What is the Main purpose of bonding.

- A) To distribute the lightning current between many different paths to ground.
- B) To connect all metallic parts to earth (zero) potential during lightning strike
- C) To avoid overheating and structural damages due to current concentration in some metallic parts
- D) To avoid dangerous over voltages and flashovers between various metal parts during lightning strike

3) Shielded cables are used for connections between circuits in two physically separated buildings. There are various possibilities to connect the ends of shielded cables, with one possibility as shown in the Figure. What is the best choice considering both reliability and security in normal operation and during lightning surge. Explain your choice.

- A) Leave both ends of shield open.
- B) Short (connect) both ends of shield to ground as shown in Figure
- C) Short one end of shield to ground and leave other end open
- D) Short one end of shield to ground and connect other end to ground through a gas-discharge tube





4) In a particular application, a network operating at 230 V has to be protected against lightning surges. There is a requirement that the overvoltage should not exceed 500 V. Which of the following surge components you would consider to use primarily at the input port of the network? Explain why?

A) Metal-oxide varistor

B) Gas discharge tube (Spark gap enclosed in ceramic tube with inert gas filled)

C) Zener diode or Avalanche diode

D) Spark gap in air



5) Reinforced concrete can be used as part of the down conductor system only if: (Also explain your choice)

- A) The concrete is wet during thunderstorms
- B) The steel work inside the concrete are securely connected electrically.
- C) The steel work inside the concrete is externally visible
- D) The concrete is made of conductive cement



6) Often, a series inductor is used between the primary and secondary stages of surge protection; the primary stage composed of a gas discharge tube (spark gap) and the secondary stage composed of a varistor. What is the main purpose of this series inductor (There can be more than one true. Select the most important). Explain your answer.

- A) to protect the varistor from damage from the initial surge
- B) To block high frequencies from the sudden operation of spark gap
- C) as a series blocking device to reduce the peak surge.
- D) to make sure that the voltage drop across the spark gap is sufficiently above the spark over voltage.

7) The structure of a Metal-oxide varistor is shown. To increase the current rating, without changing voltage rating,

- A) Increase the separation between electrode (and fill with more zinc-oxide material)
- B) Increase the grain size of Zinc-oxide elements
- C) Increase the diameter of the electrodes (and fill with more zinc-oxide material)
- D) Combination of A and C above

