

Homework6

Page 118. Chinese textbook

Question 4.3

What is voltage source inverter circuit (VSI)? What is current source inverter circuit (CSI)? What are the characteristics of these two inverters?

Question 4.4

What is the purpose of the feedback diode in VSI? Why there isn't one in CSI?

Question 4.5

Consider a three-phase VSI with 180° conduction angle. $U_d = 100V$. Try to derive the magnitude and RMS value U_{UN1m} , U_{UN1} at base frequency in phase voltage, magnitude and RMS value U_{UV1m} , U_{UV1} at base frequency in output line voltage, and RMS value of 5th order harmonic U_{UV5} in output line voltage.

Question 4.9

What are the main forms of multi-level inverter circuits? What are the characteristics of each?

Answer 4.1

If the power supply of DC side of the inverter circuit is voltage source, this inverter circuit is called voltage source inverter (VSI). Meanwhile, supposing the power supply DC side of inverter circuit is current source, the inverter circuit is called current source inverter (CSI).

Differences between VSI and CSI:

1. For VSI, DC side of inverter circuit is voltage source. In another way, the DC side parallel capacitor with high capacitance. So there exists no pulse in the DC side voltage. And the DC circuit shows the characteristic of low resistance.

For CSI, DC side series inductance. So there exists no pulse in the DC side current. And the DC circuit shows the characteristic of high resistance.

2. For VSI, because the clamp effect of DC voltage source, AC side output the rectangle wave, and it has nothing to do with the load impedance angle. However, the voltage waveform is different for different kinds of impedance.

For CSI, because the effect of power switch is to change the flowing circuit of DC current, the waveform of current of AC side is rectangle wave.

3. For VSI, when the reactive power for the resistive load of AC side is needed, the capacitor of DC side can buffer the reactive energy. Therefore, to provide feedback channel for the reactive energy from AC side to the DC side, each arm of inverter bridge parallels a feedback diode.

For CSI, when the reactive power for the resistive load of AC side is needed, the inductance of DC side can buffer the reactive energy. Because the feedback current isn't reverse when feedbacking the reactive energy, it's no need to parallel a feedback diode for the power switch.

Answer 4.4

For VSI, when the reactive power for the resistive load of AC side is needed, the capacitor of DC side can buffer the reactive energy. Therefore, to provide feedback channel for the reactive energy from AC side to the DC side, each arm of inverter bridge parallels a feedback diode.

For CSI, when the reactive power for the resistive load of AC side is needed, the inductance of DC side can buffer the reactive energy. Because the feedback current isn't reverse when feedbacking the reactive energy, it's no need to parallel a feedback diode for the power switch.

Answer 4.5

$$U_{UN1} = \frac{U_{UN1m}}{\sqrt{2}} = 0.45U_d = 0.45 \times 100V = 45V$$

$$U_{UN1m} = \frac{2U_{UN1m}}{\pi} = 0.637U_d = 0.637 \times 100V = 63.7V$$

$$U_{UV1m} = \frac{2\sqrt{3}U_d}{\pi} = 1.1U_d = 1.1 \times 100V = 110V$$

$$U_{UV1} = \frac{U_{UN1m}}{\sqrt{2}} = \frac{\sqrt{6}}{\pi}U_d = 0.78U_d = 0.78 \times 100V = 78V$$

$$U_{UV5} = \frac{U_{UV1}}{5} = \frac{\sqrt{6}}{7\pi}U_d = 0.11U_d = 0.11 \times 100V = 22V$$

Answer 4.9

There are 3 main types of multi-level inverter:

1. Neutral point clamped multi-level inverter

Characteristic: Each arm is composed of two fully controlled components which are both anti-

paralleled with diode. The middle point of two components is connected with the middle point of the clamped diode and the capacitor of DC side.

2. Flying-capacitor multi-level inverter

Characteristic: there are a lot of capacitors needed for this circuit and the voltage of each capacitor should be adjusted. So this circuit is not in great need

3. Cascade H-bridge (series connected H-bridges)

Characteristic: cascade H-bridge multilevel converter uses multiple power units in series to realize high voltage output, and its output mostly adopts multi electric phase shifting PWM control mode.