Homework 5

Page 123, Chinese textbook

Question 5.1

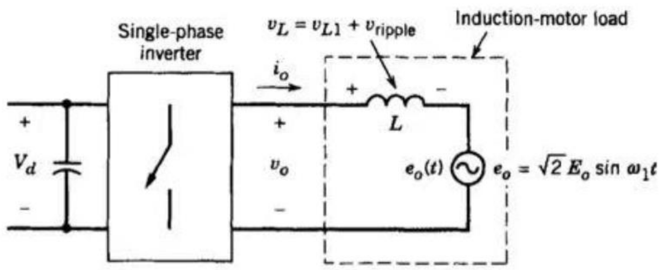
What is a voltage type inverter circuit? What is a current type inverter circuit? What are the characteristics of each?

Page 246, English textbook

Question 5.2

Consider the problem of ripple in the output current of a single-phase full-bridge inverter. Assume V_{o1} = 220 V at a frequency of 47 Hz and the type of load is as shown in Fig. 1 with L =100mH.

If the inverter is operating in a square-wave mode, calculate the peak value of the ripple current.



(a)

Answer 5.1

When the DC side of the invertor circuit is voltage source, we call it a voltage type invertor circuit. When the DC side of the invertor is current source, we call it a current type invertor circuit.

For the voltage type invertor circuit:

1) DC side has a constant voltage and low impedance for it contains voltage source and parallel bulk cap.
2) AC side voltage is square wave or quasi-square wave due to the clamping function of DC voltage source, while AC side current is determined by the load.
3) Anti-parallel diodes (freewheeling diodes, feedback diodes) are required to provide energy feedback path.

For the current type invertor circuit:

1) DC side has a constant current source and high impedance (series large inductor).
2) AC side current is square wave or quasi-square wave, while AC side voltage is determined by the load.
3) No anti-parallel diodes are needed for the current is not reverse during the process of inactive power's feedback. Sometimes series diodes are required to block reverse voltage for other power semiconductor devices.

Answer 5.2

Considering that:

$$U_{o1}=\frac{2\sqrt{2}U_d}{\pi}=0.9U_d$$

where U_d is the amplitude of the load square wave. We can see:

$$U_d=\frac{U_{o1}}{0.9}=\frac{220}{0.9}\approx 244.44\,(V)$$

$$\omega=2\pi f\approx 295.31\,(rad/s)$$

We notice that:

$$e_0=\sqrt{2}\,E_0\sin\omega_1 t$$

Where EMF is a sinusoidal value, so there is no ripple component for EMF here. ($u_{ripple}=u-u_{fundamental}$) Due to the superposition theorem, we can ignore the EMF when analyzing ripple components.

Therefore:

$$u_{oripple}=u_{Lripple}=u_d-u_{o1}$$

$$I_{L\ ripple\ peak}=\frac{1}{L}\int_0^{\frac{T}{4}}\left(U_d-\frac{4U_d}{\pi}\sin\omega t\right)dt=10\int_0^{\frac{\pi}{2}}\frac{1}{295.31}\left(244.44-\frac{4\times 244.44}{\pi}\sin\omega t\right)d(\omega t)\approx 2.46\,(A)$$