Full Bridge Inverter (Single Phase) – Autonomous Square Wave Operation (50 Hz)

Maria Basio

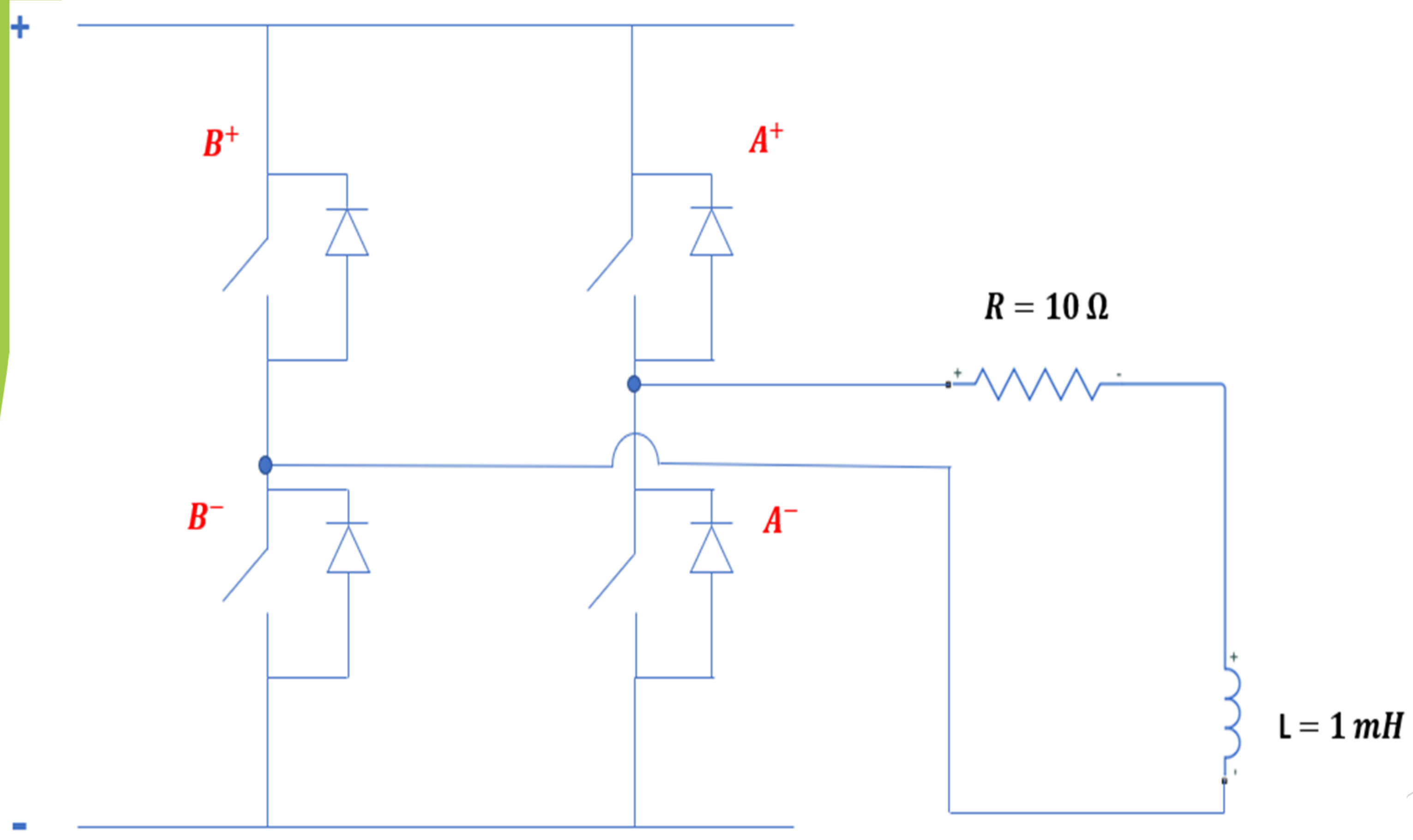
AM: 60604

Theory

- Full bridge inverter is a topology of H-bridge inverter used for converting DC power into AC power. The components required for conversion are two times more than that used in single phase Half bridge inverters. The **circuit of a full bridge inverter** consists of 4 diodes and 4 controlled switches as shown below.

- The general concept of a full bridge inverter is to alternate the polarity of voltage across the load by operating two switches at a time. Positive input voltage will appear across the load by the operation of T1 and T2 for a half time period. The polarity of voltage across load will be changed for the other half period by operating T3 and T4.

The circuit arrangement for the full-bridge inverter is shown in Figure.



$$V_o^2 = \frac{2}{T_o}\int_0^{T_o/2} V_s^2\,dt = \frac{2}{T_o}V_s^2\,\frac{T_o}{2}$$

$$=> V_o = V_s$$

$$V_{o,n} = \frac{4V_s}{\sqrt{2}n\pi} = \frac{2\sqrt{2}V_s}{n\pi}$$

$$=> V_{o,n} = \frac{4V_s}{n\pi}\sin n\,\omega t$$

$$n = 1,3,5,..$$

i) Calculate the V_s ,when $V_{o,s} = 230\ V$

$$V_{o,s} = \frac{4V_s}{\sqrt{2}\pi} = \frac{2\sqrt{2}V_s}{\pi} => V_s = \frac{\pi V_{o,s}}{2\sqrt{2}} = \frac{3{,}14 \cdot 230}{2\sqrt{2}} = 255{,}3\ \mathrm{V}$$

ii) Calculate the active, reactive, and the apparent power at 50 Hz

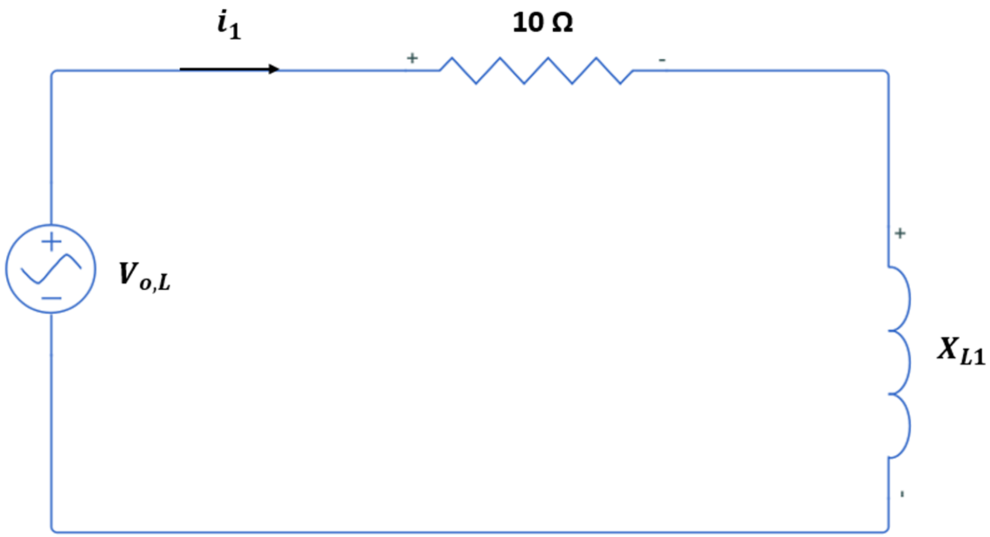
$$X_{L1} = 2\pi f\ 1mH = 0{,}314\ \Omega$$

$$\mathrm{I}_{1,\mathrm{rms}} = \frac{V_{o,L}}{\sqrt{R^2 + X_{L1}^2}} = 23\mathrm{A}$$

$$P_1 = I_{rms}^2 \cdot R = 5290\ W$$

$$Q_1 = I_{rms}^2 \cdot X_{L1} = 166\ VAr$$

$$S_1 = \sqrt{P_1^2 + Q_1^2} = 5293\ VA$$

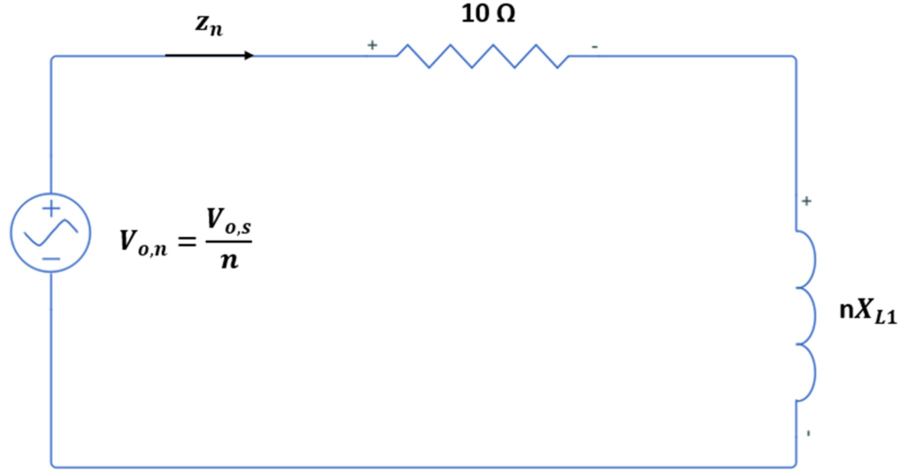


iii) Calculate the THD_v *(%)*

$$THD_v = \frac{V_{oH,rms}}{V_{o,s}} \cdot 100\% = \frac{\sqrt{V_o^2 - V_{o,s}^2}}{V_{o,s}} \cdot 100\% = \sqrt{(\frac{V_o}{V_{o,s}})^2 - 1} \cdot 100\% = 47,9\ \%$$

iv) Calculate the THD_i *(%)* *for* $n_{max} = 21.$

- n- 50 Hz Equivalent Circuit



$$I_{n.rms} = \frac{V_{o,n}}{\sqrt{R^2 + X_{Ln}^2}} = \frac{V_{o,s}}{n\sqrt{R^2 + X_{L1}^2}}$$

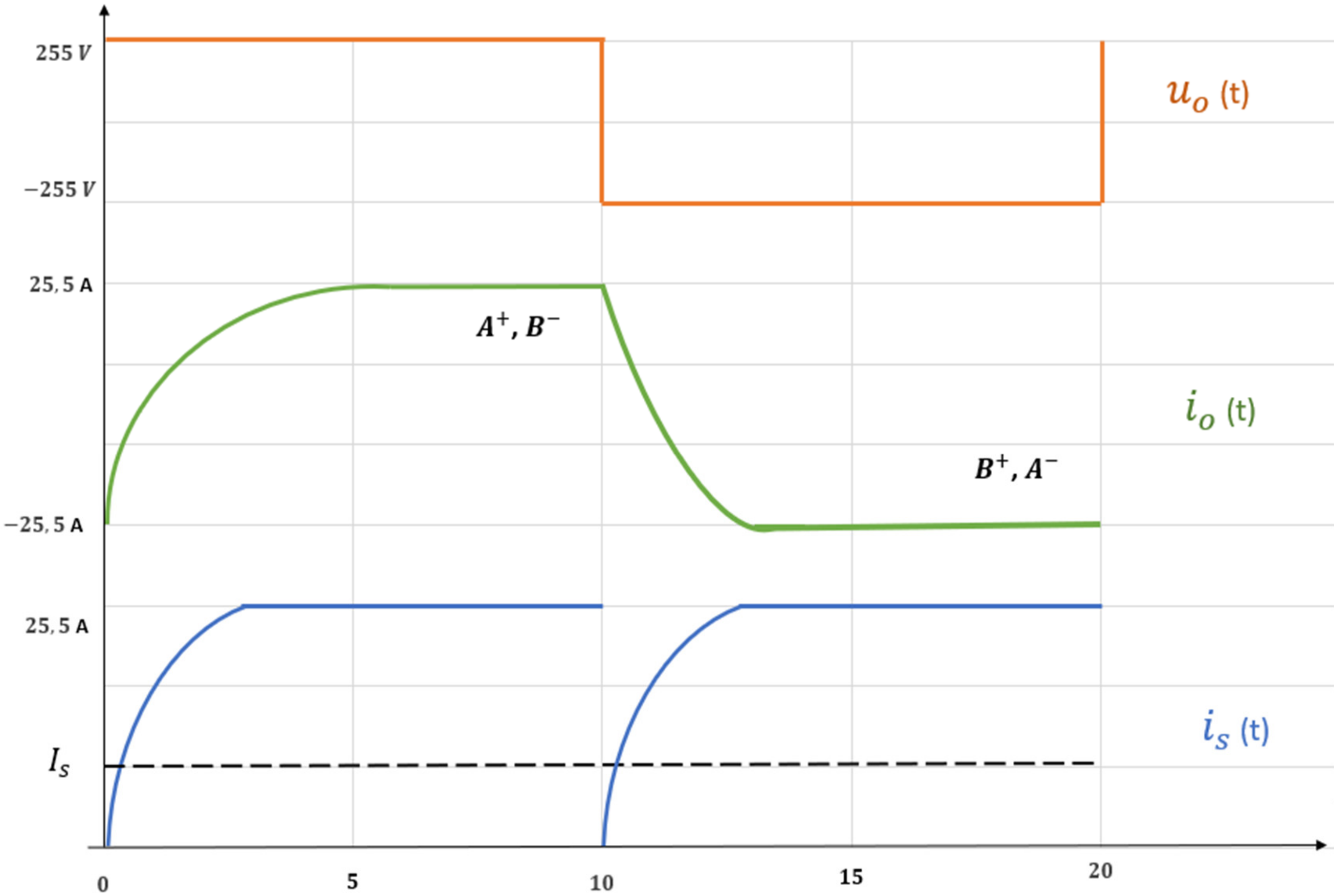
$$I_{o,rms\ H} = \left[\sum_{n=3}^{21} I_{n,rms}^2\right]^{2} = 10,4\ \text{A}$$

$$THD_i\ (\%) = \frac{I_{o,H}}{I_{o,s}} \cdot 100\% = 45,2\ \%$$

$I_{3,rms} = 7,7\ A$	$I_{13,rms} = 1,6 A$
$I_{5,rms} = 4,5\ A$	$I_{15,rms} = 1,4\ A$
$I_{7,rms} = 3,2\ A$	$I_{17,rms} = 1,2\ A$
$I_{9,rms} = 2,5\ A$	$I_{19,rms} = 1\ A$
$I_{11,rms} = 2\ A$	$I_{21,rms} = 0,1\ A$

v) Calculate $u_o(t), i_o(t), i_s(t)$

Figure shows the voltage and current waveforms in the circuit.



- $z = \frac{L}{R} = \frac{1m}{10}\ sec = 0{,}1\ msec$
- $I_p = \frac{V_s}{R} = 25{,}5\ A$

vi) Calculate the I_s

$$I_{o,rms} = \sqrt{I_{os,rms}^2 + I_{oH,rms}^2} = 25{,}2\ A$$

$$P_o = I_{o,rms}^2 \cdot R = 6350{,}4\ W$$

$$P_o = V_s \cdot I_s \Rightarrow I_s = \frac{P_o}{V_s} = 24{,}9\ \text{A}$$