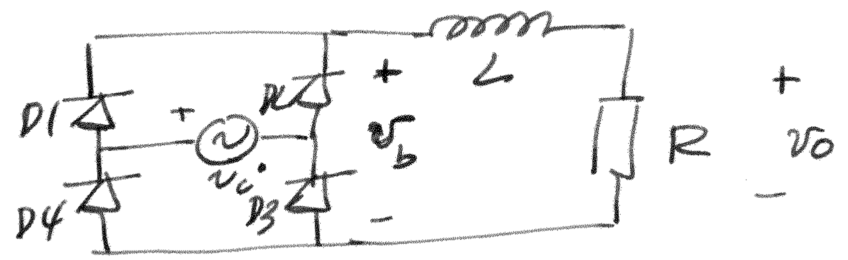
Full bridge rectifier with LR load

28/2/2013

(1)



* the main goal is: $v_{o(t)} \cong$ constant $= V_0|_{DC}$

(HINT):

· $v_{b(t)}$ is unknown (you can think about the bridge with resistive load, or with RC load)

$v_{b(t)}$ is different in both cases.

In fact $v_{b(t)}$ depends on:

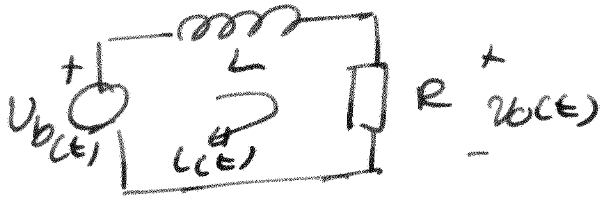
1) the full bridge rectifier

2) The load.

* Let's assume that $v_{b(t)}$ is:

① periodic ② $\overline{v_{b(t)}} \neq 0$ (DC level).

If it's so, the LR circuit analysis is performed as follows:

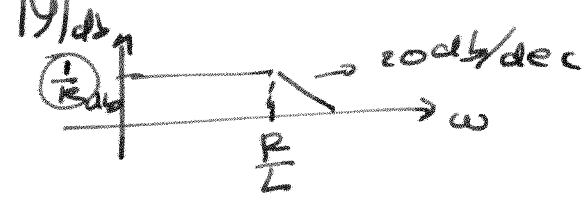


Fourier series

$$v_b(t) = V_{DC} + \tilde{v}_{DC}(t) = V_{DC} + \underbrace{a_0 \cos(2\pi f_c t + \phi_0) + a_1 \cos(4\pi f_c t + \phi_1) + a_2 \cos(6\pi f_c t + \phi_2) + \ldots}_{\text{Fourier series}}$$

Laplace analysis:

$$Y(s) = \frac{I(s)}{V_b(s)} = \frac{1/L}{s + \frac{R}{L}} \longrightarrow$$



If $\frac{R}{L} \ll 2\pi f_0$ (this meaning $L \uparrow\uparrow$),

the ~~AC~~ components in $i(t)$ can be neglected,

and $i(t) \simeq I_{DC} = \frac{V_{DC}}{R}$.

Then $V_o|_{DC} = I_{DC} \cdot R = V_{DC}$, that is

$V_o|_{DC}$ is equal to the DC level of $v_b(t)$.

So: If $\frac{R}{L} \downarrow\downarrow \Longrightarrow \begin{cases} i(t) \simeq I_{DC} \text{ (constant)} \\ v_o(t) \simeq V_o|_{DC} \text{ (constant)} \end{cases}$

where $I_{DC} = \frac{V_b|_{DC}}{R}$.

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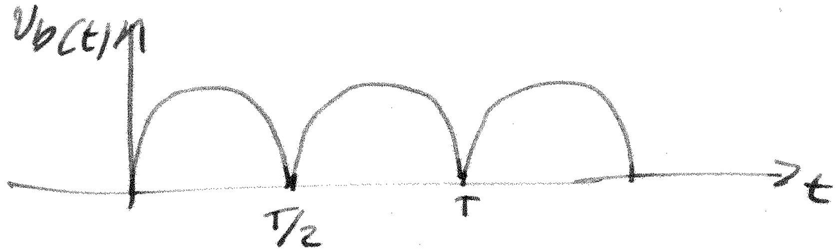
③

let's see ~~about~~ $v_b(t)$:

if $i(t) \simeq I_{DC}$ (constant), the ~~diodes are~~ bridge ~~is~~ ~~supplying~~ supplies intensity, this is in every moment $\begin{cases} (D1, D3) \text{ ON } (D2\ D4 \text{ OFF}) \\ \text{OR} \\ (D2, D4) \text{ ON } (D1, D3 \text{ OFF}) \end{cases}$

this meaning that



The frequency of the periodic wave $v_b(t)$ is $2f_i$ ($f_i \equiv$ frequency of v_i)

Then:

$f_0 = 2f_i$, this leading to: ~~that~~

$$2f_i \cdot 2\pi \gg \frac{R}{L} \Rightarrow L_{min} = \frac{R}{4\pi f_i} \cdot 10$$

"ten times criterion"