Lecture # 28, 12/8/21

- Final exam = next Monday, 4:30 - 6:20 pm } • do a review on Friday. See Canvas for guiding documents.
  - Closed notes, eqn sheet provided (on Canvas now)

- HW 8 due Friday

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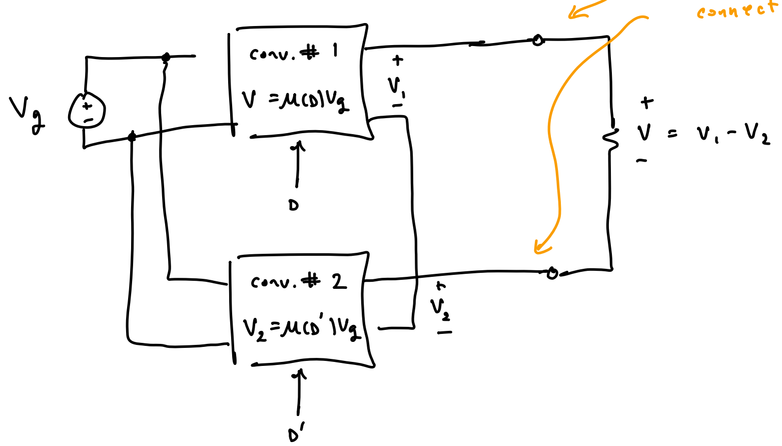
- Final Report for lab due Weds 12/15 @ Noon.

- Last time: Flyback converter (isolated converters)
- Today: Ch 6, voltage source inverters
  ↑ dc-ac converters

  - Differential Connections

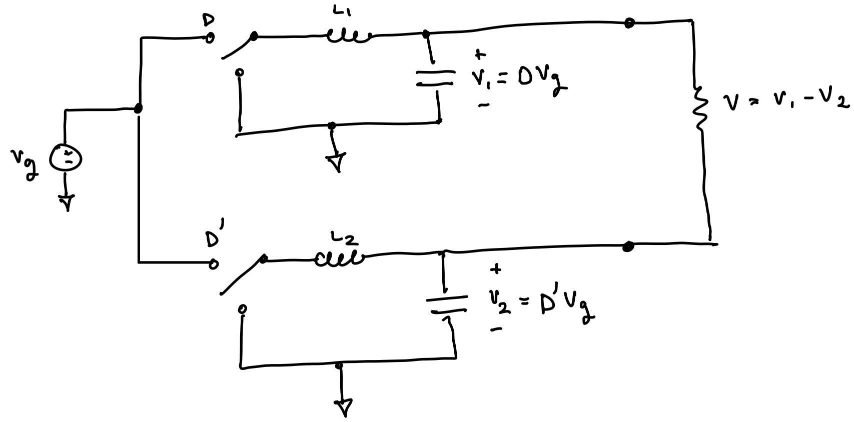
    * Enables generation of ac waveforms.

"differential connection"



Even if v_1 & V_2 are ⊕, the diff $v_1 - v_2$ can be manipulated to produce an ac waveform.

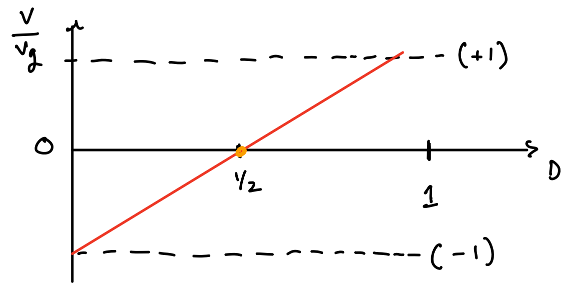
- 2 differential Bucks



$$V = V_1 - V_2$$

$$= DV_g - \underbrace{(1-D)}_{D'}V_g$$

$$= V_g\,(2D - 1) \qquad (1)$$

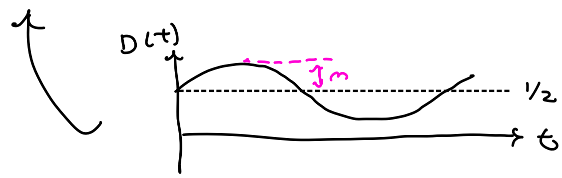


to get ac waveform, pick duty

$$D(t) = \frac{1 + m\sin(\omega t)}{2} \qquad (2)$$

often called "modulation depth"

$0 < m < 1$

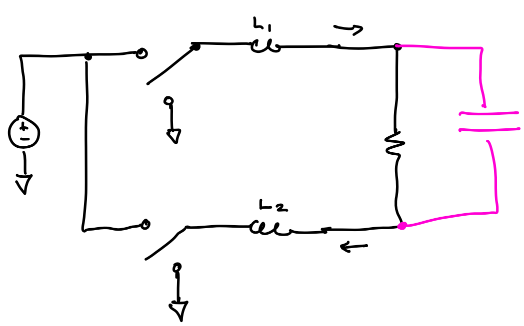


(2) → (1) to get

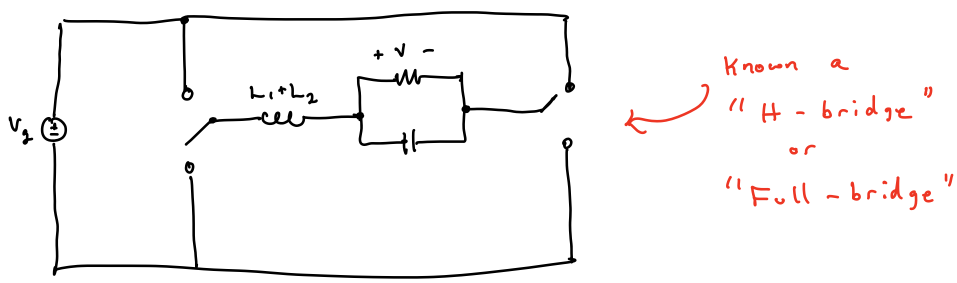
$$V = V_g\, m \sin(\omega t)$$

- Modify ckt to get "practical" realization

Step #1: move filter caps across load



step #2: Lump L_1 & L_2 together



↳ gives an ac waveform @ v

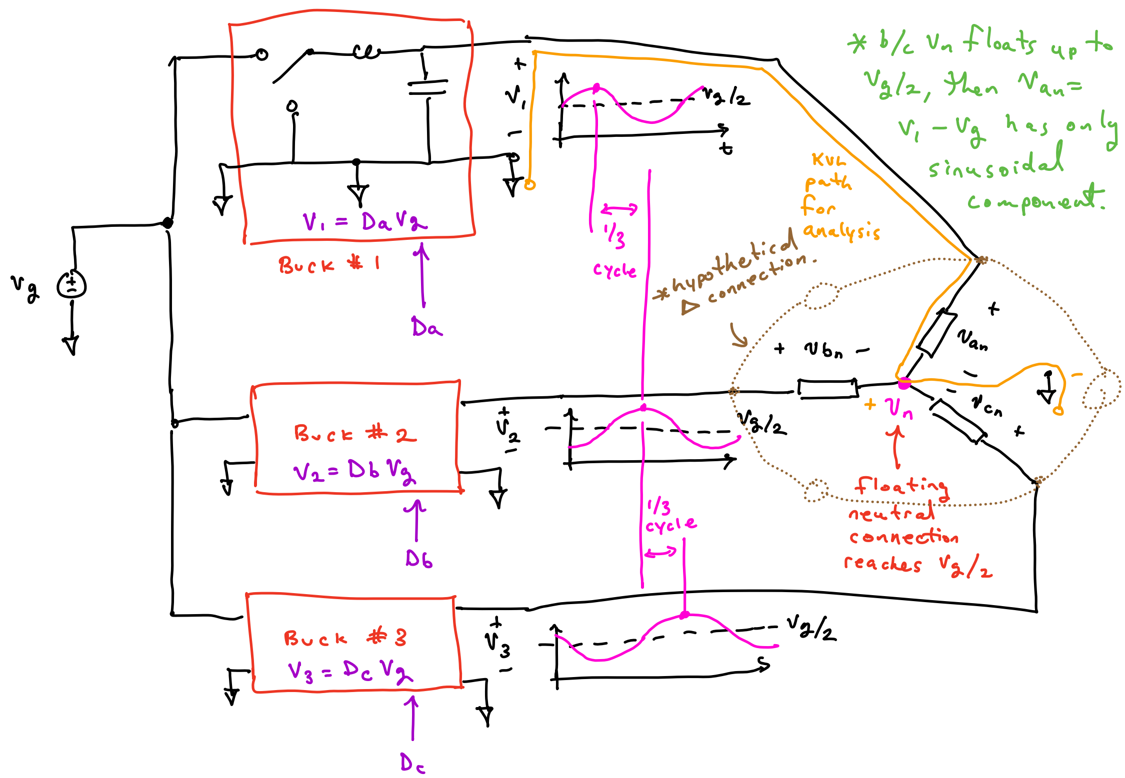
↳ called a "single-phase" inverter

* key idea:

$|v| < V_g$ ⟶ preserves "step-down / buck" behavior.

– 3 phase ac

- start w/ 3 bucks



For balanced 3Φ ac, pick duties

$$D_a = \frac{1 + m\sin(\omega t)}{2} \longrightarrow v_1 = V_g D_a = \frac{V_g}{2}\left(1 + m\sin(\omega t)\right)$$

$$D_b = \frac{1 + m\sin\left(\omega t - \frac{2\pi}{3}\right)}{2} \longrightarrow v_2 = \text{''} = \text{- - -} \quad \omega t - 2\pi/3))$$

$$D_c = \frac{1 + m\sin\left(\omega t + \frac{2\pi}{3}\right)}{2} \longrightarrow v_3 = \text{''} = \text{- - -} \quad \omega t + 2\pi/3))$$

- Look @ KVL for each phase loop

$\boxed{\text{KVL for A gives}}$ $v_1 - v_{an} = v_n$

'' B $\quad V_2 - V_{an} = V_n$

'' C $\quad v_3 - v_{cn} = v_n$

sum eqns

$$v_1 + v_2 + v_3 - \underbrace{(v_{an} + v_{bc} + v_{cn})}_{0 \text{ b/c balanced load}} = 3v_n$$

$$\Longrightarrow \quad v_n = \frac{1}{3}\left(v_1 + V_2 + V_3\right) = \text{avg of 3 buck voltages}$$

$$= \frac{V_g}{2}$$