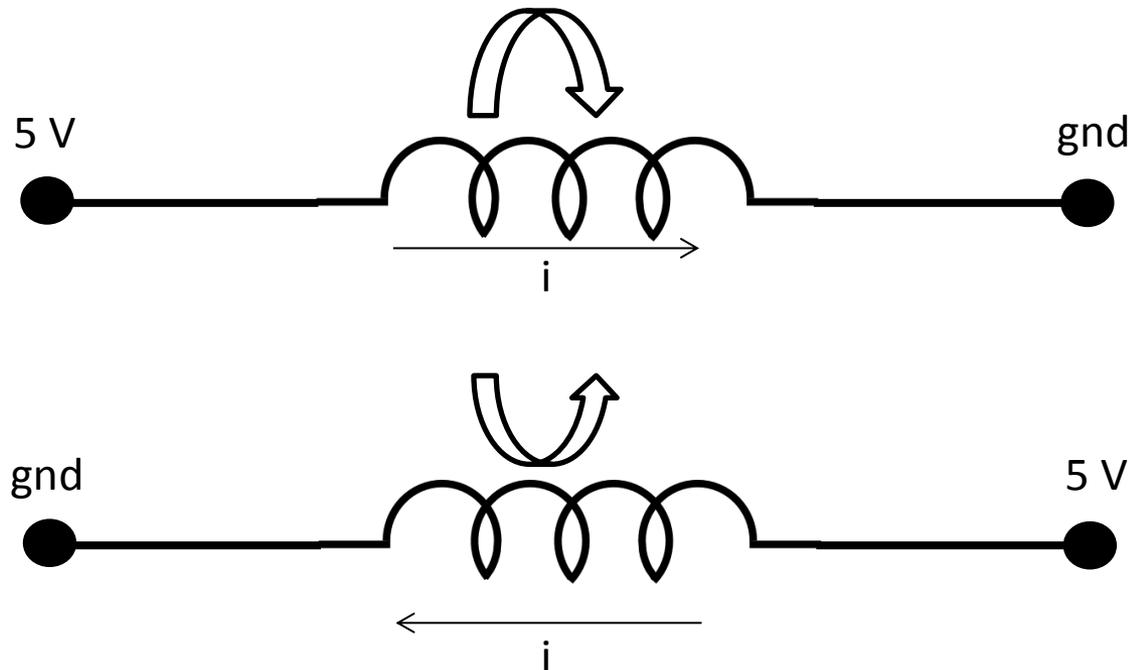


Introduction to H-Bridge



How does a motor turn?



- If you want to change the direction of the rotation, change the direction of current flow

How much current does a motor need?



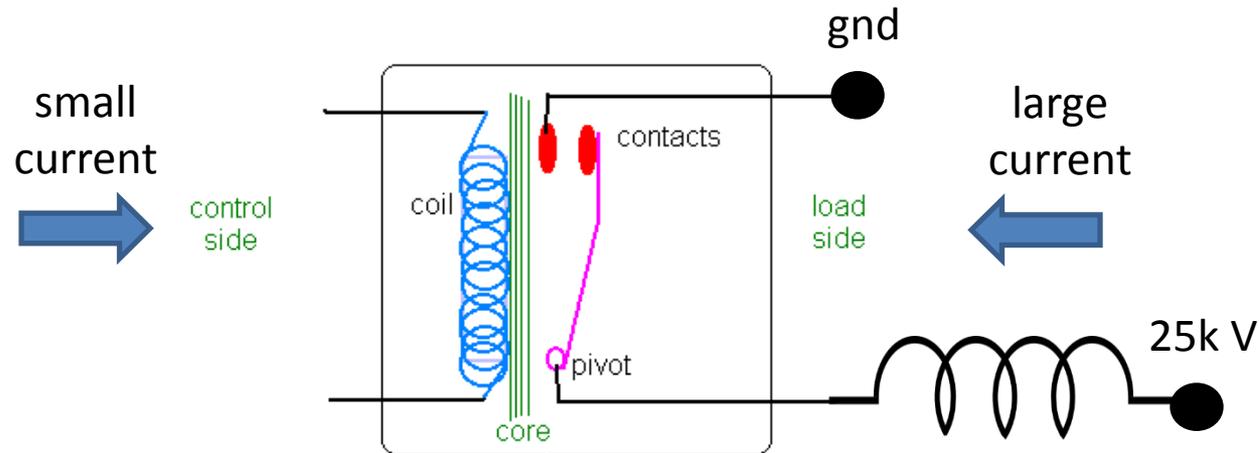
- Your nano board works @ 5 V, 0.5 Ams AT MOST
- Depending on the application, motors need huge amount of voltage and current

How much current does a motor need?

- Can I connect my Nano board to 25K Volts?
- Yes you can
 - Please inform me before doing it, I will run away from you as far as possible
- You should use electric switch
 - Relay
 - Transistor/h-Bridge



Relay : Electro mechanical switch

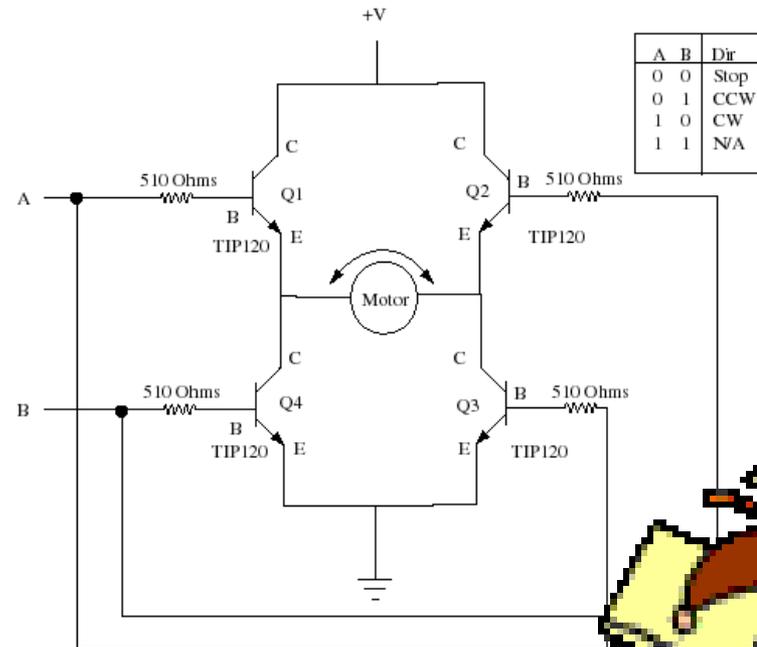
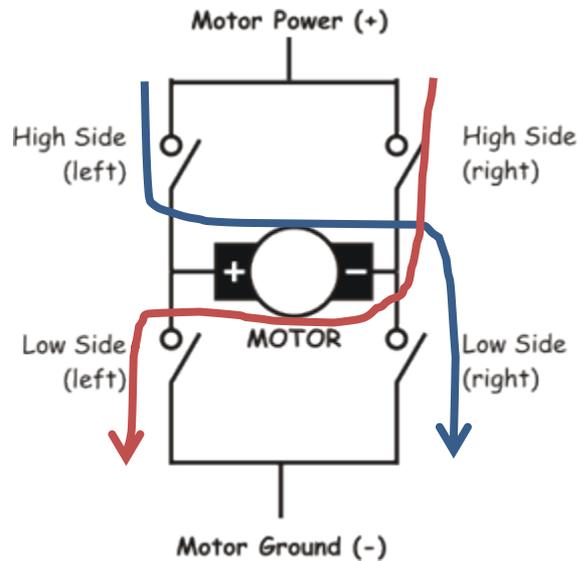


INSIDE A SPST RELAY

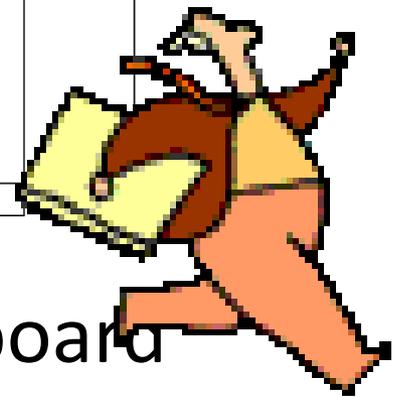
pic r-1a

- The small current flowing from coil creates electro-magnetic force which attracts the pivoted contact and circuit is closed on the large current side
 - Provides isolation
 - Slow reaction due to mechanical motion

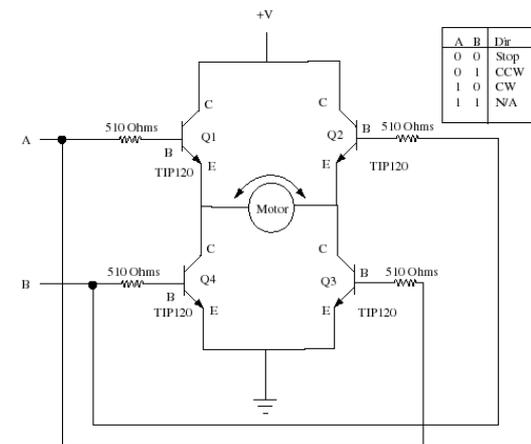
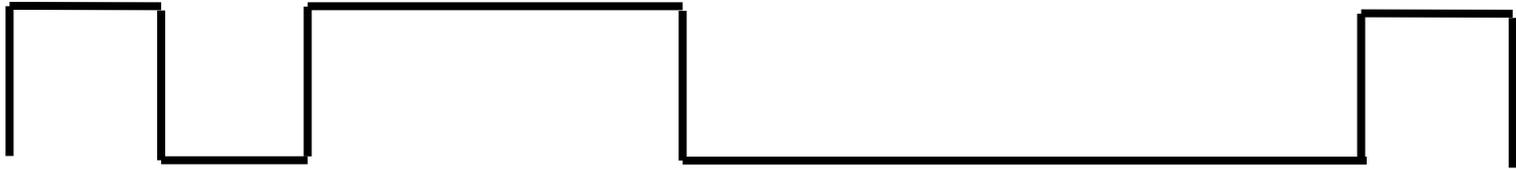
H-Bridge



- Drive signal A & B from your Nano board
 - Transistor is an electronic switch
 - What happens if $A = 1$, $B = 1$ and $V = 25\text{ K}$?



H-Bridge

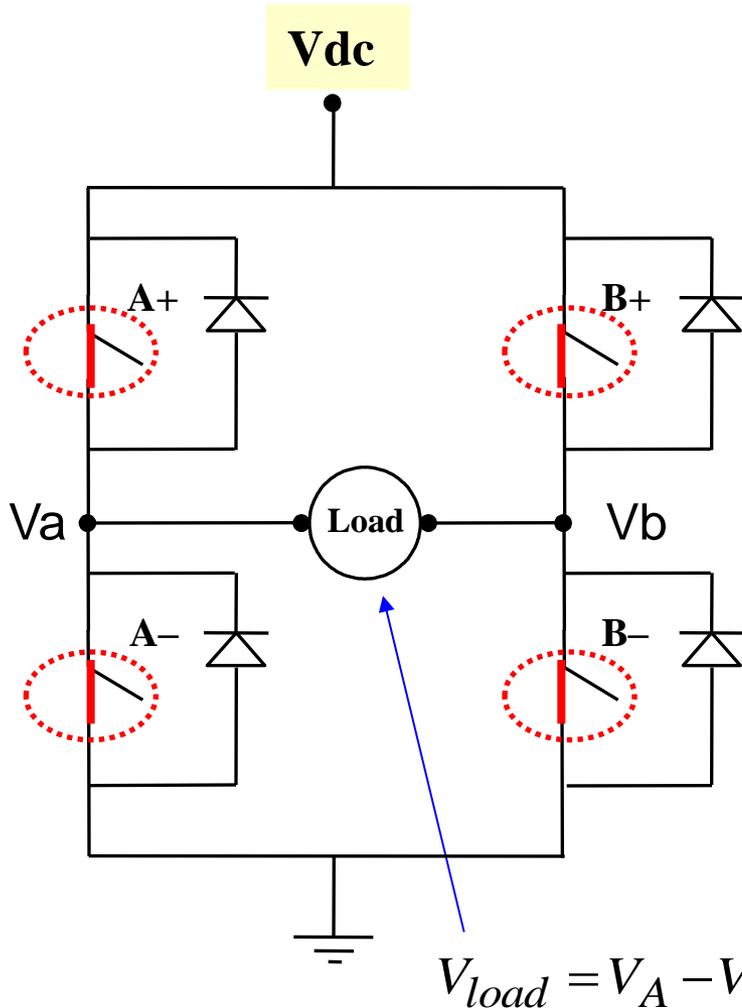


- A & B must be driven by square wave pulses as shown above
 - Have you seen such square wave before?

H-Bridge Inverter Basics – Creating AC from DC



Single-phase H-bridge (voltage source) inverter topology:



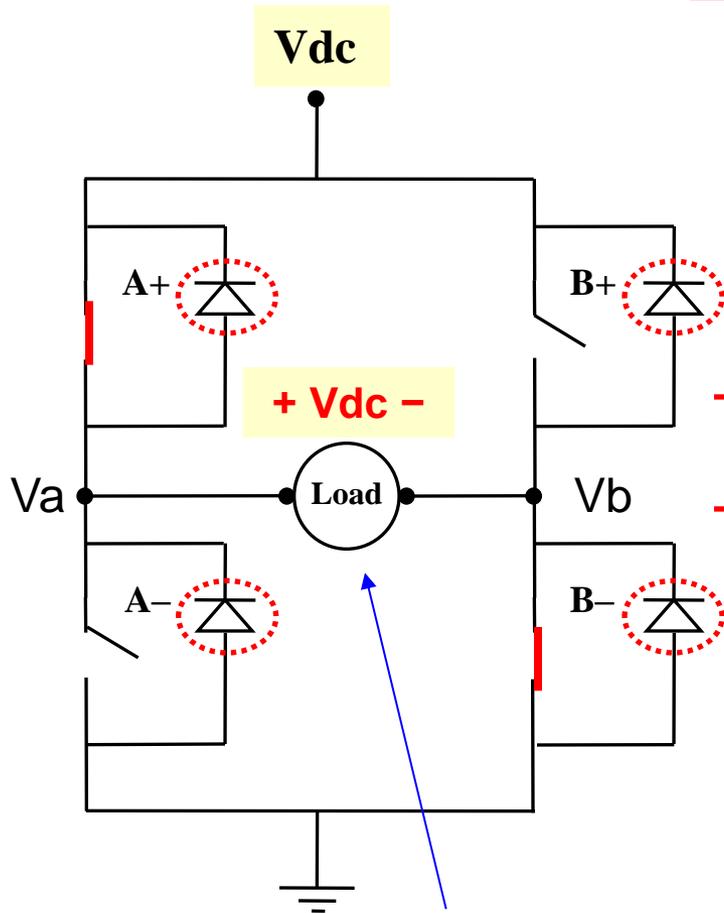
Switching rules

- • Either A+ or A- is closed, but **never** at the same time *
- • Either B+ or B- is closed, but never at the same time *
- *same time closing would cause a short circuit from Vdc to ground (shoot-through)
- *To avoid shoot-through when using real switches (i.e. there are turn-on and turn-off delays) a dead-time or blanking time is implemented

Corresponding values of Va and Vb

- • A+ closed, $V_a = V_{dc}$
- • A- closed, $V_a = 0$
- • B+ closed, $V_b = V_{dc}$
- • B- closed, $V_b = 0$

H BRIDGE INVERTER

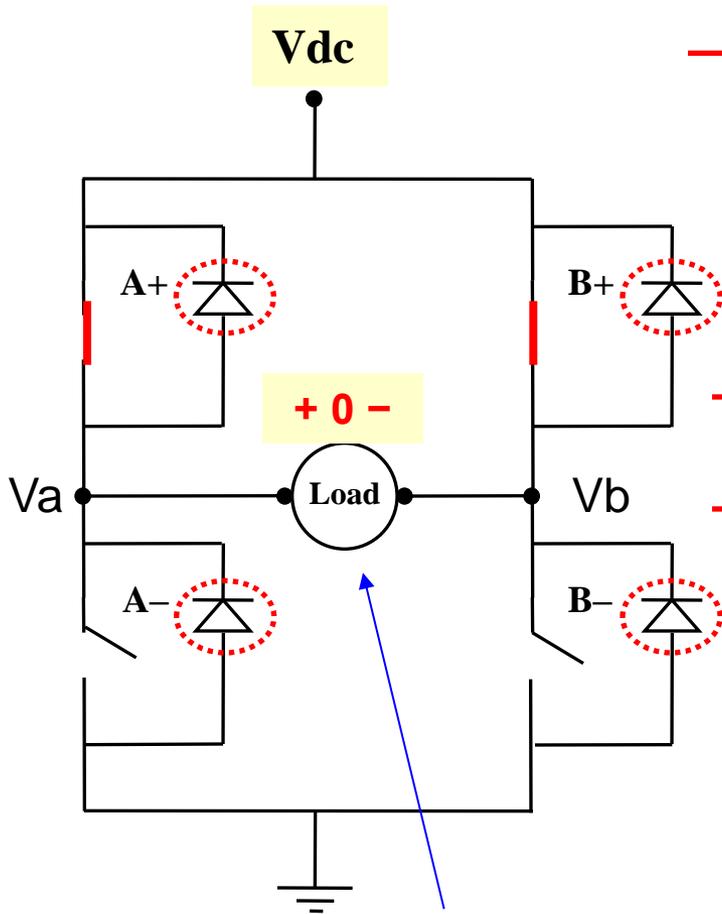


- Corresponding values of V_{ab}
- A+ closed and B- closed, $V_{ab} = V_{dc}$
 - A+ closed and B+ closed, $V_{ab} = 0$
 - B+ closed and A- closed, $V_{ab} = -V_{dc}$
 - B- closed and A- closed, $V_{ab} = 0$

- The free wheeling diodes permit current to flow even if all switches are open
- These diodes also permit lagging currents to flow in inductive loads

$$V_{load} = V_A - V_B = V_{AB}$$

H BRIDGE INVERTER

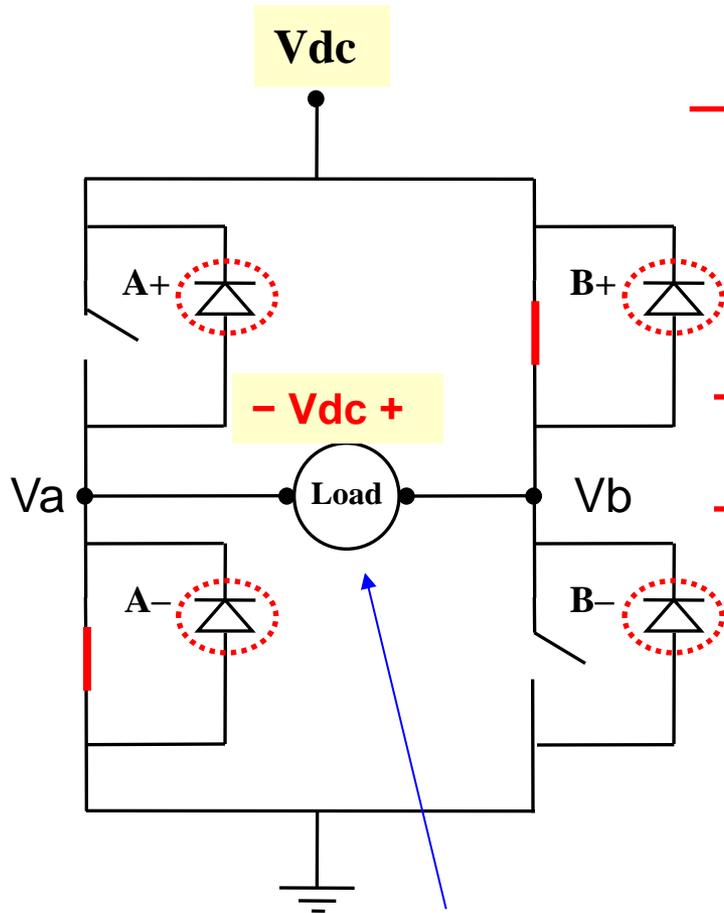


- Corresponding values of V_{ab}
- A+ closed and B- closed, $V_{ab} = V_{dc}$
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H BRIDGE INVERTER



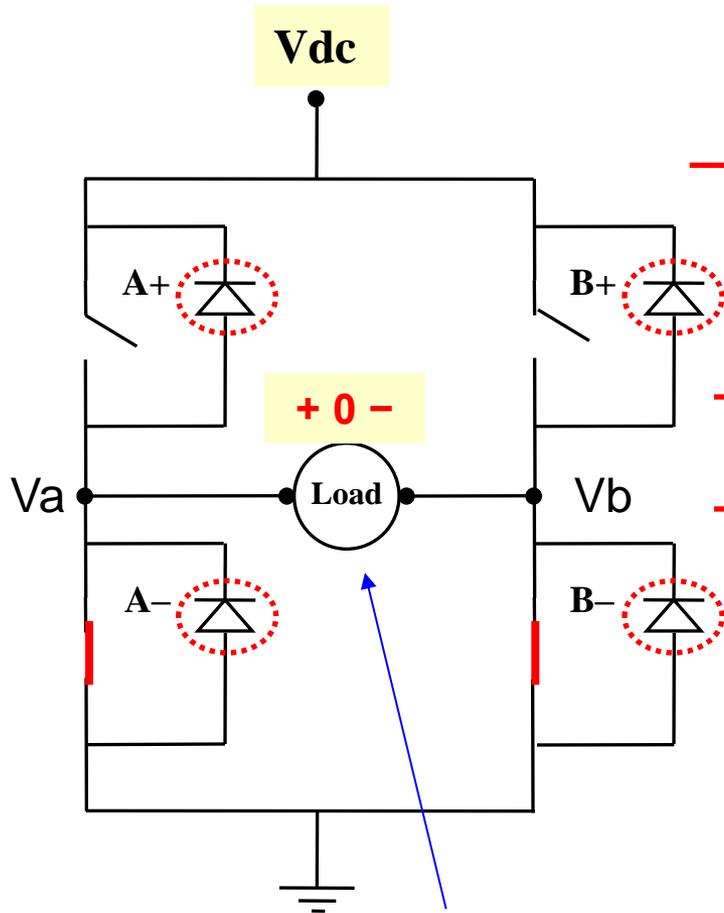
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H BRIDGE INVERTER



Corresponding values of V_{ab}

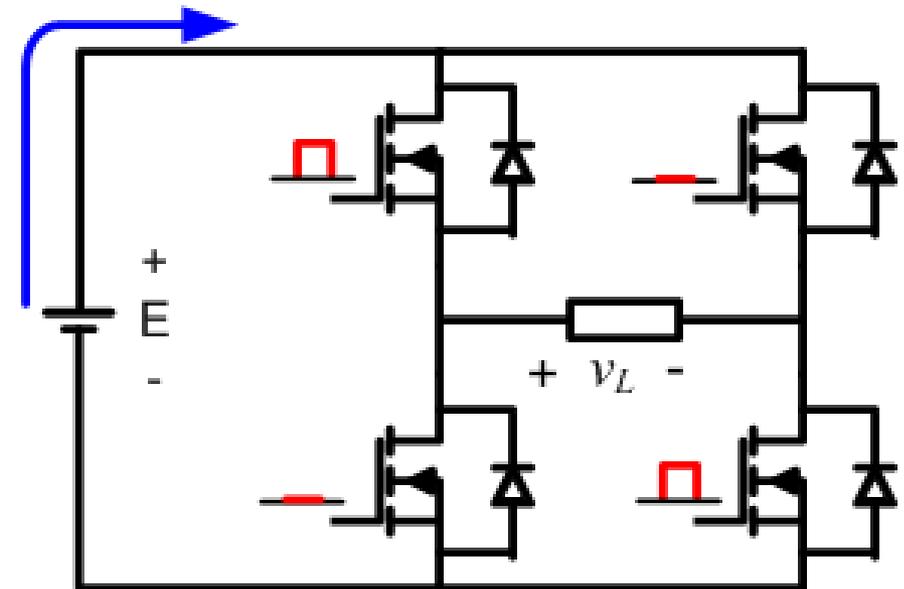
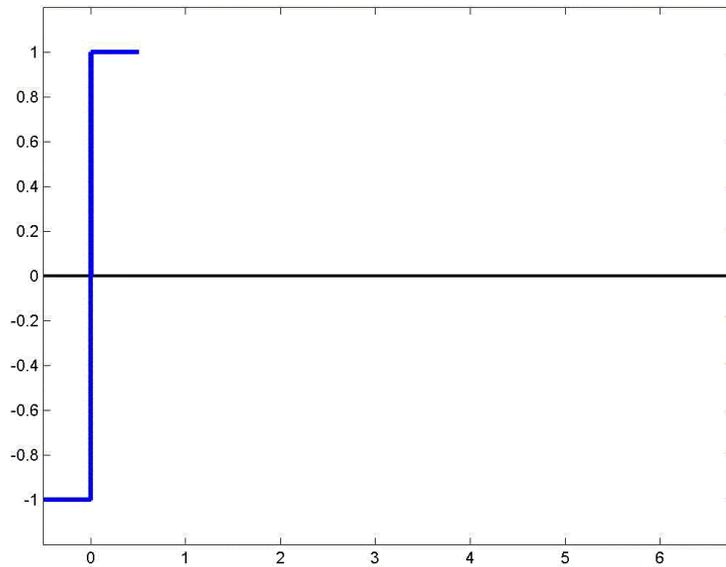
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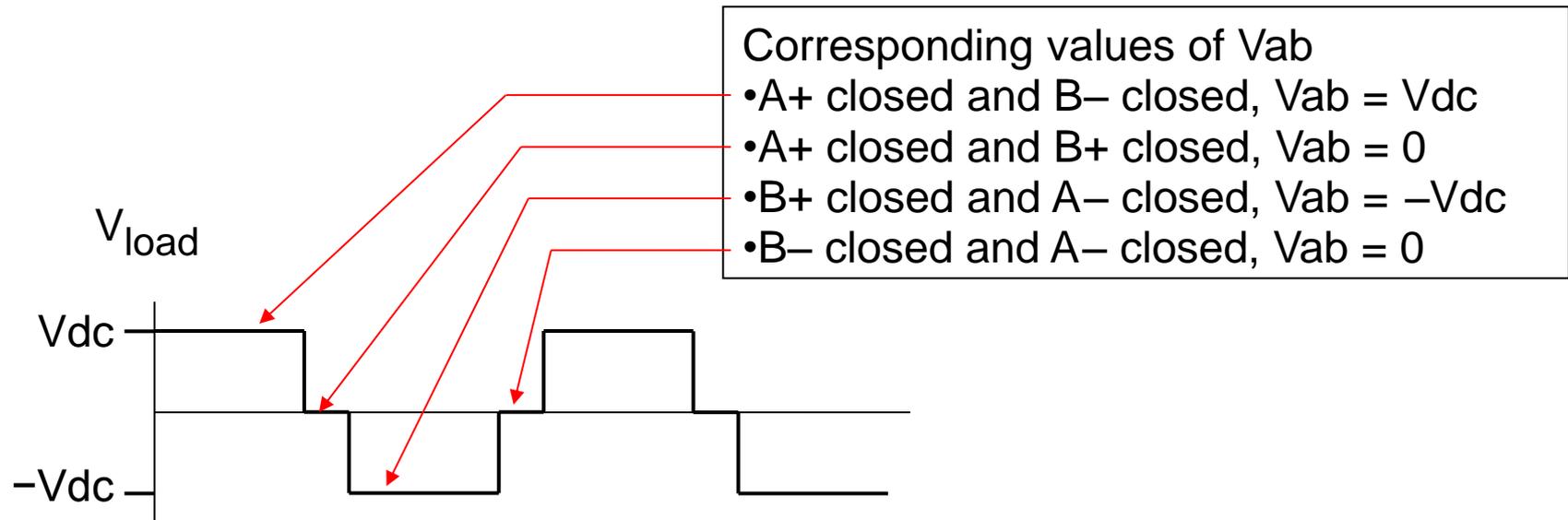
$$V_{load} = V_A - V_B = V_{AB}$$

H-Bridge Inverter

- Square wave modulation:



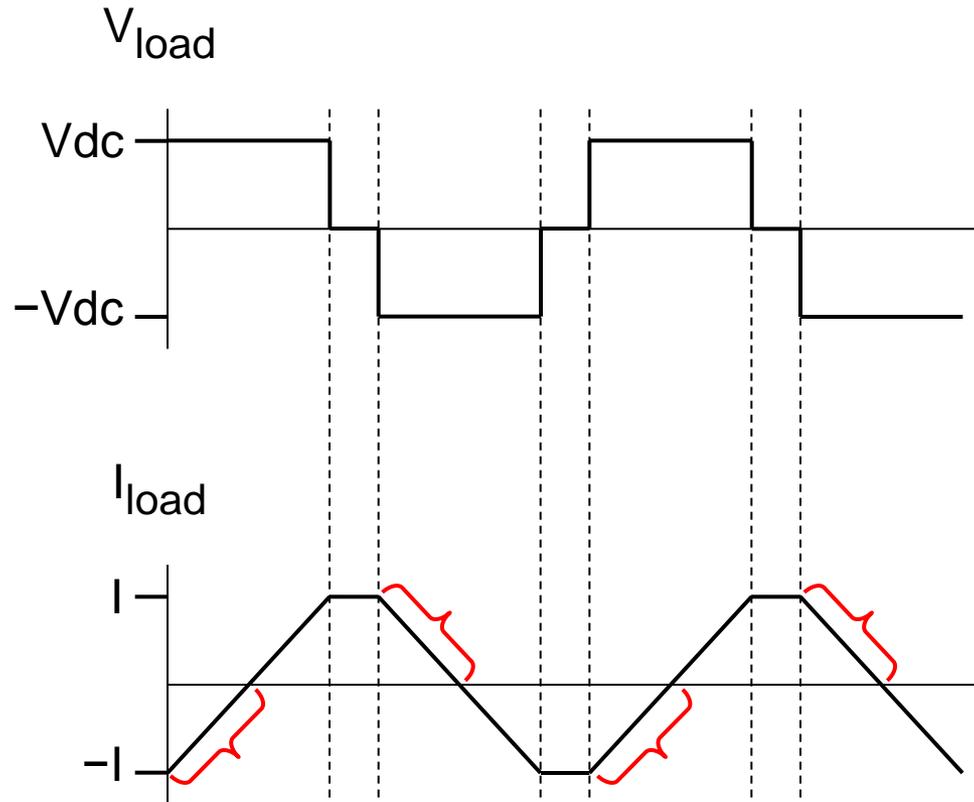
Basic Square Wave Operation (sometimes used for 50 Hz or 60Hz applications)



The $V_{ab} = 0$ time is not required but can be used to reduce the rms value of V_{load}

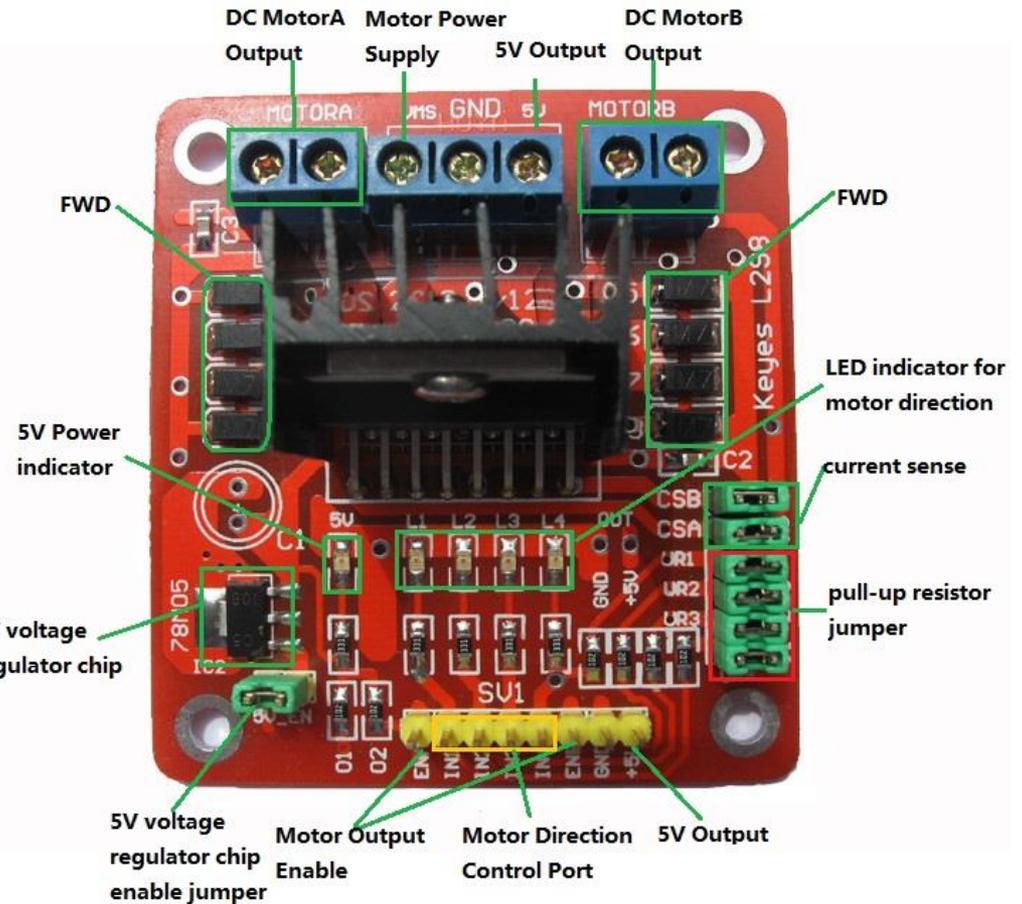
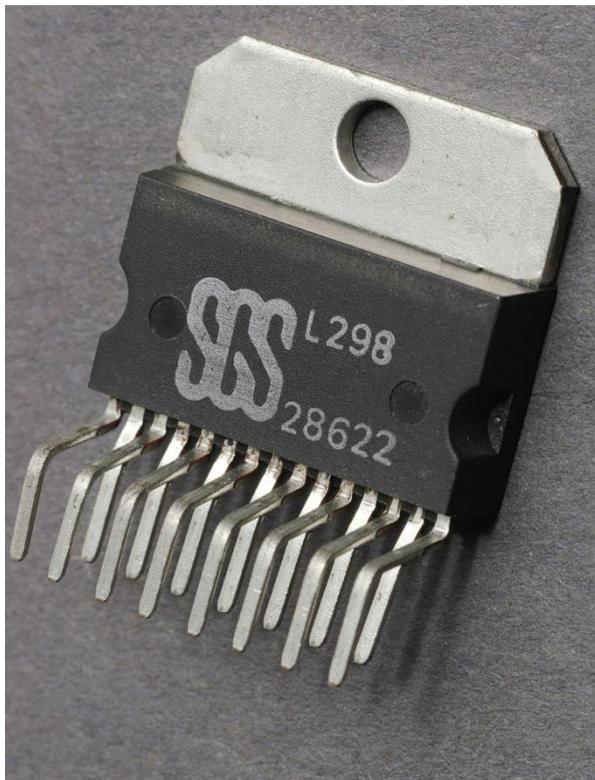
Many Loads Have Lagging Current – Consider an Inductor

There must be a provision for voltage and current to have opposite signs with respect to each other



Component: H-bridge Circuit

■ L298 chip & Circuit



Driving Mode



7/26/2015

Kai.Huang@tum

17



Goals

- Forward
- Backward
- Rotate clockwise
- Rotate anticlockwise

- Free running (Option)



Drive Forward

- All wheels
 - Same speed
 - Rotate forward



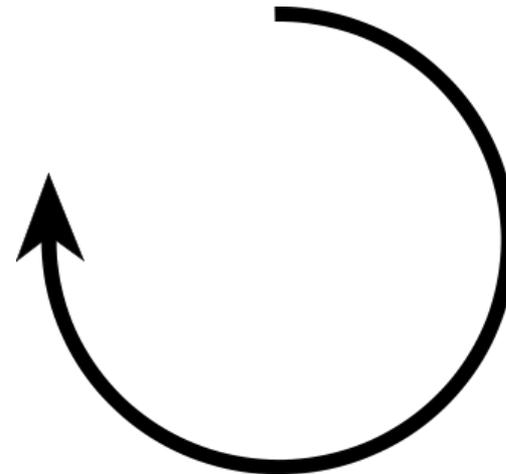
Drive Backward

- All wheels
 - Same speed
 - Rotate backward



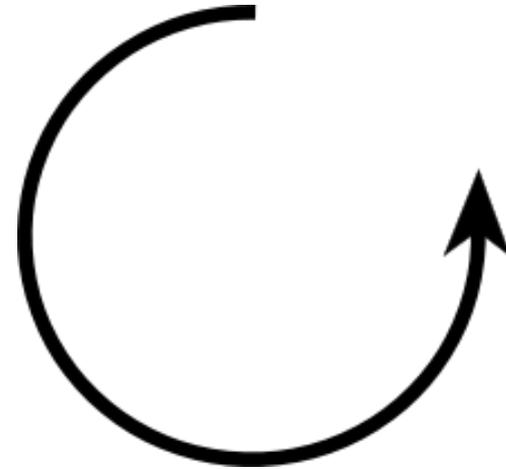
Rotate Clockwise

- The left wheel
 - Same speed
 - Rotate clockwise
- The right wheels
 - Same speed
 - Rotate anticlockwise



Rotate Anticlockwise

- Two left wheels
 - Same speed
 - Rotate anticlockwise
- Two right wheels
 - Same speed
 - Rotate clockwise



Let's dance

- Control application in different modes
 - Use timer to switch modes



Questions

