Electronics for IoT

H-Bridge

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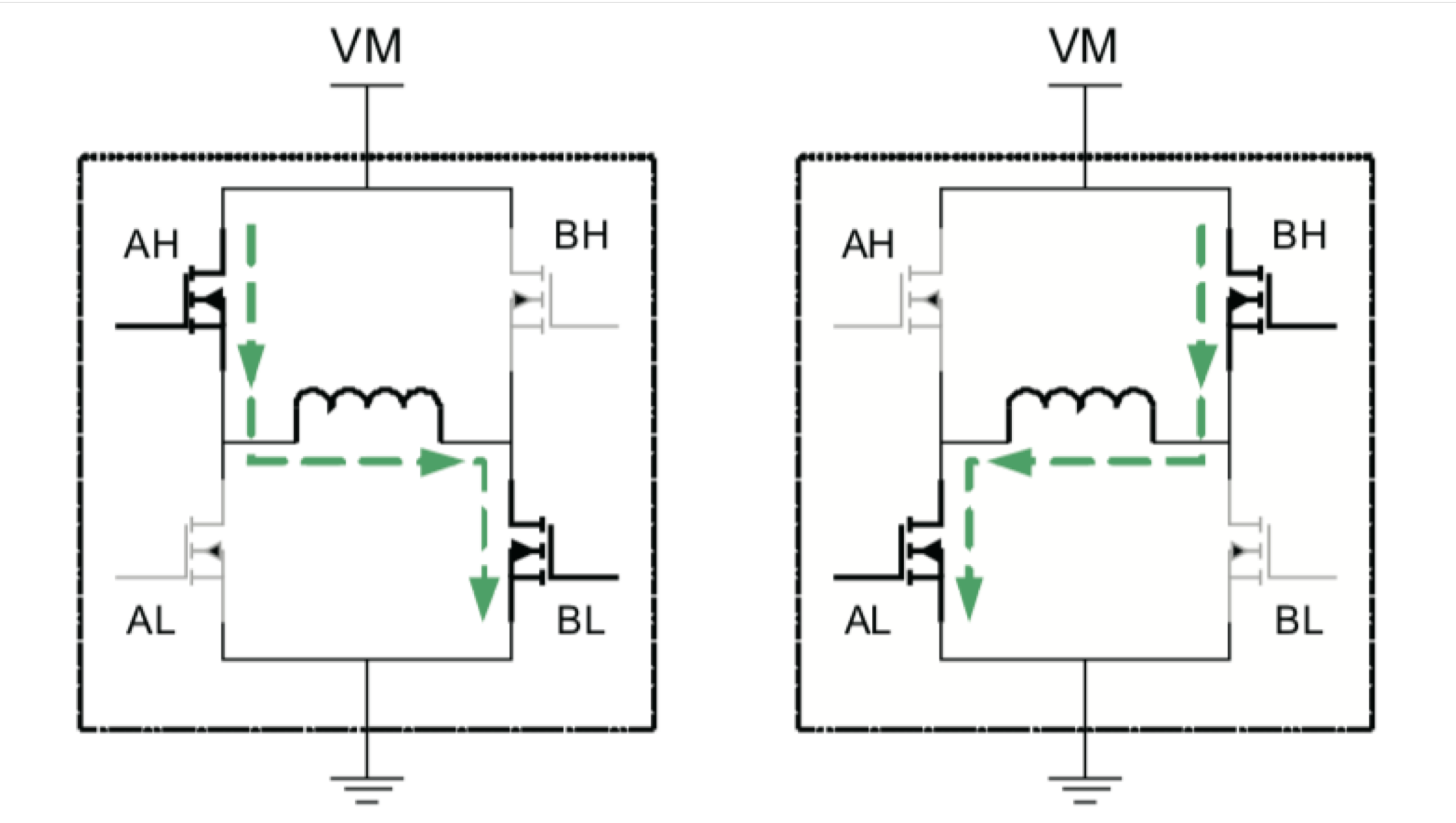
DC Motor Speed (RPM) Control

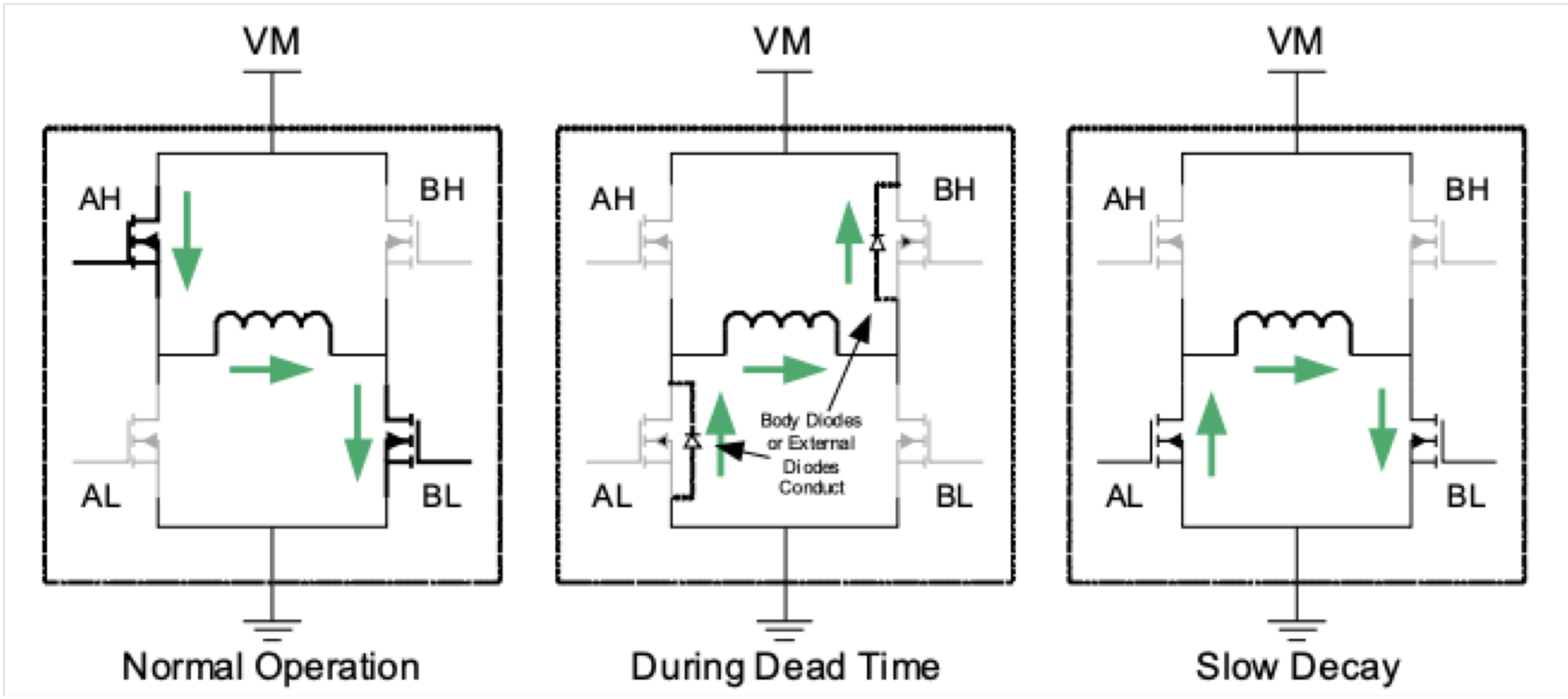
- Objective: control
  - Direction of Rotation
  - Speed / Torque
- Forward:
  - Vary voltage to set speed
  - E.g. 6V → full speed, 3V → half speed
- Reverse:
  - Flip terminals: e.g. -6V
- Brake: Short terminals
- Never: open terminals
  - Why?

DC motor:
2 electrical terminals to apply power

H-Bridge

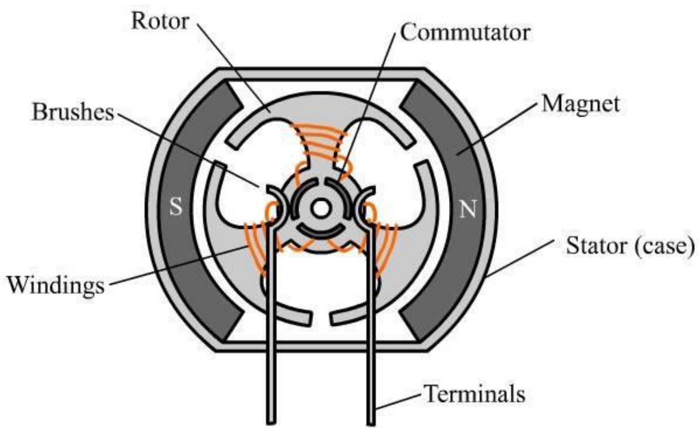


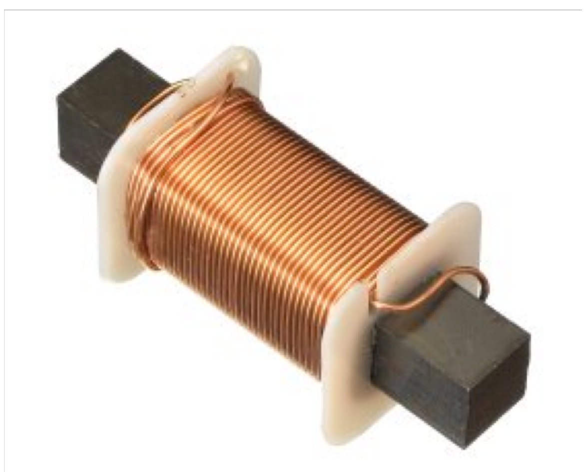
On-Off Control



Inductance

Typical Brushed Motor in Cross-section

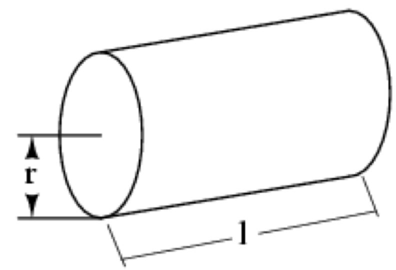




Calculate (just like inertia). E.g.

$$L = \frac{N^2 \mu A}{l}$$

$$\mu = \mu_r \mu_0$$



Where,

L = Inductance of coil in Henrys

N = Number of turns in wire coil (straight wire = 1)

μ = Permeability of core material (absolute, not relative)

μ_r = Relative permeability, dimensionless (μ_0=1 for air)

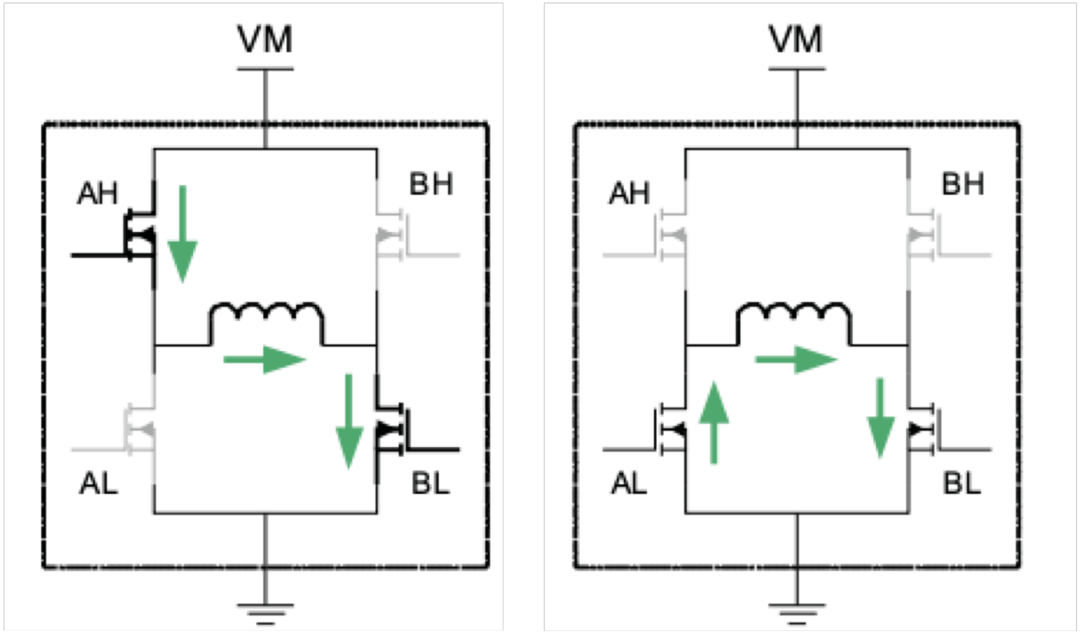
μ_0 = 1.26 x 10^{-6} T-m/At permeability of free space

A = Area of coil in square meters = πr^2

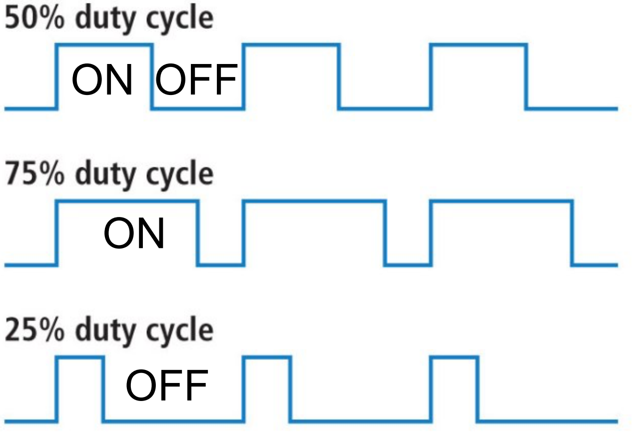
l = Average length of coil in meters

Finite element simulation for more complicated geometries

PWM Speed Control



"ON" "OFF"



DRV8833 H-Bridge

TEXAS INSTRUMENTS

DRV8833

SLVSAR1E – JANUARY 2011 – REVISED JULY 2015

DRV8833 Dual H-Bridge Motor Driver

1 Features

- Dual-H-Bridge Current-Control Motor Driver
  - Can Drive Two DC Motors or One Stepper Motor
  - Low MOSFET ON-Resistance: HS + LS 360 mΩ
- Output Current (at V_M = 5 V, 25°C)
  - 1.5-A RMS, 2-A Peak per H-Bridge in PWP and RTY Package Options
  - 500-mA RMS, 2-A Peak per H-Bridge in PW Package Option
- Outputs can be in Parallel for
  - 3-A RMS, 4-A Peak (PWP and RTY)
  - 1-A RMS, 4-A Peak (PW)
- Wide Power Supply Voltage Range: 2.7 to 10.8 V
- PWM Winding Current Regulation and Current Limiting
- Thermally Enhanced Surface-Mount Packages

3 Description

The DRV8833 device provides a dual bridge motor driver solution for toys, printers, and other mechatronic applications.

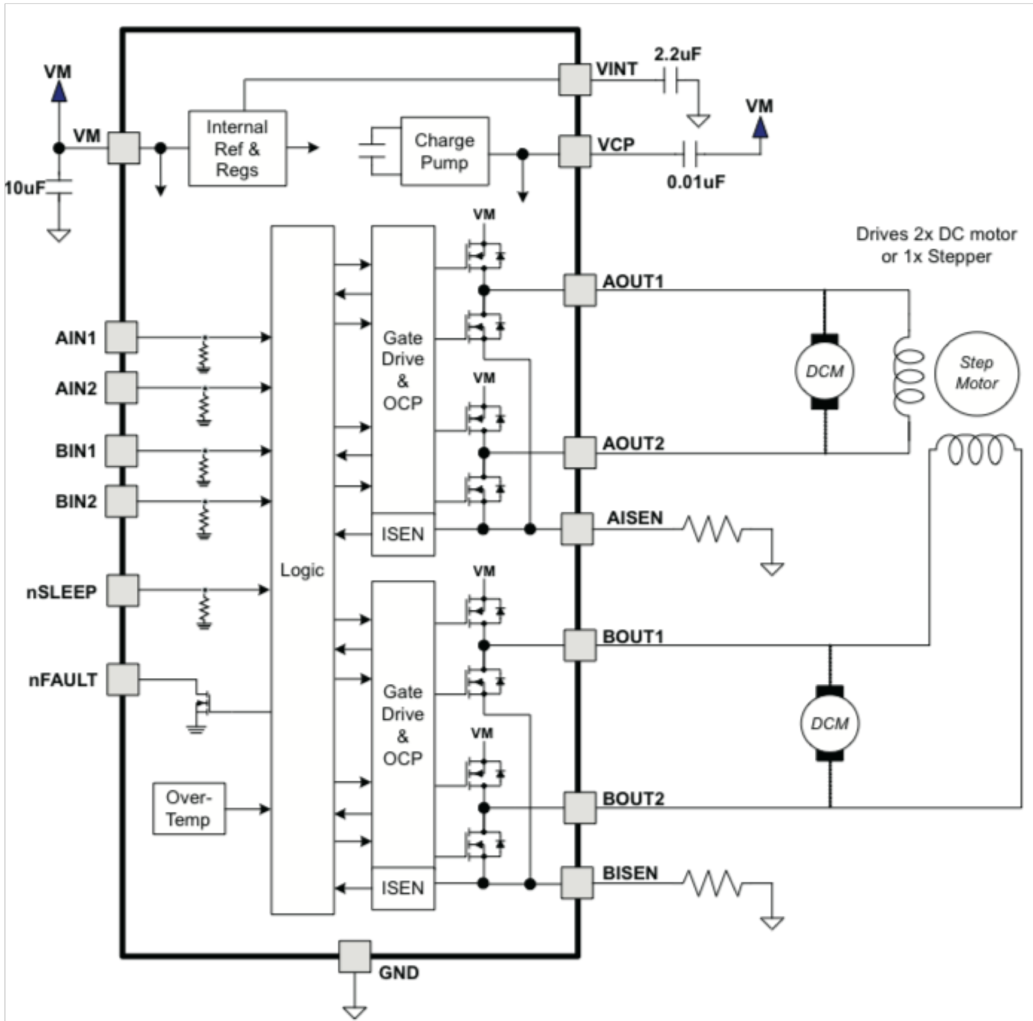
The device has two H-bridge drivers, and can drive two DC brush motors, a bipolar stepper motor, solenoids, or other inductive loads.

The output driver block of each H-bridge consists of N-channel power MOSFETs configured as an H-bridge to drive the motor windings. Each H-bridge includes circuitry to regulate or limit the winding current.

Internal shutdown functions with a fault output pin are provided for overcurrent protection, short-circuit protection, undervoltage lockout, and overtemperature. A low-power sleep mode is also provided.

The DRV8833 is packaged in a 16-pin WQFN package with PowerPAD™ (Eco-friendly: RoHS & no Sb/Br).

Block Diagram



PWM Control

Table 2. PWM Control of Motor Speed

xIN1	xIN2	FUNCTION
PWM	0	Forward PWM, fast decay
1	PWM	Forward PWM, slow decay
0	PWM	Reverse PWM, fast decay
PWM	1	Reverse PWM, slow decay

Breakout Board Wiring