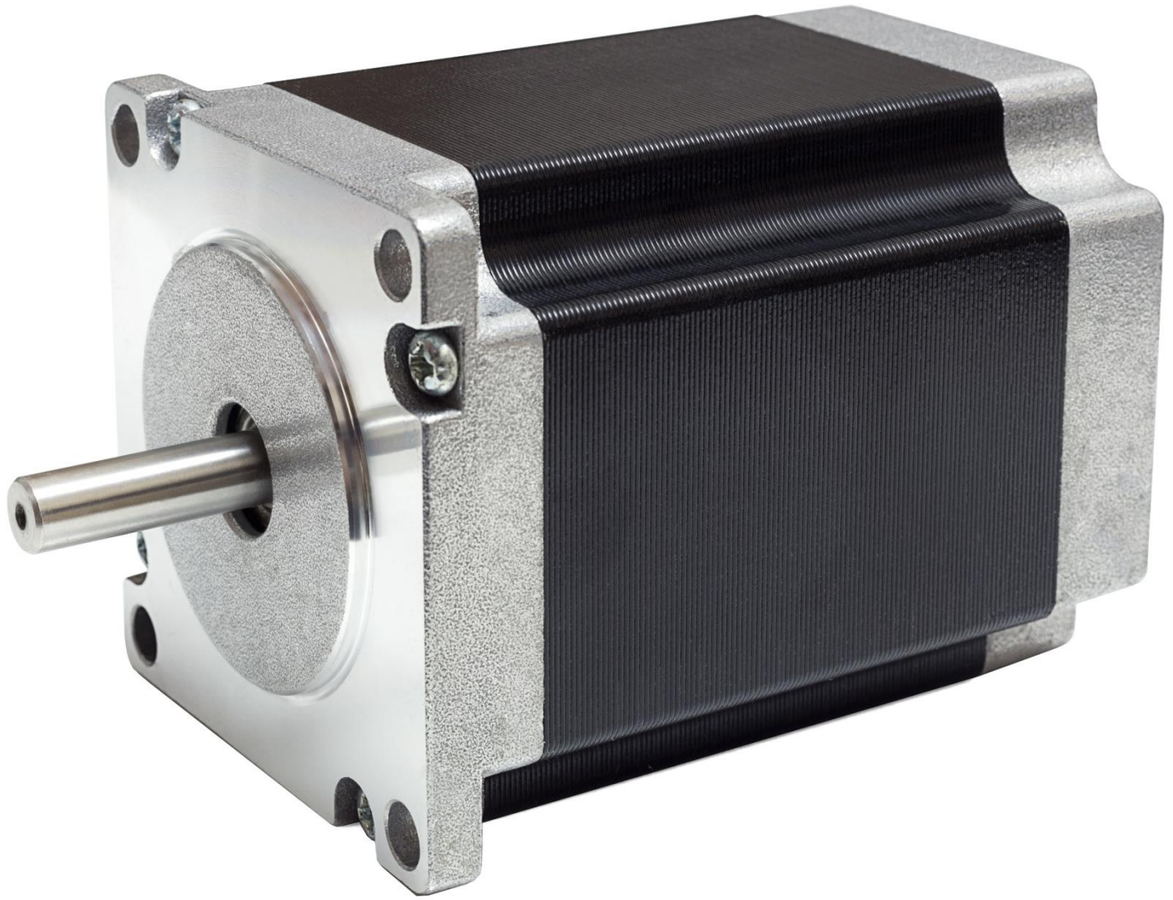
Stepper Motor 1: Basics

TI Precision Labs – Motor Drivers

Presented and prepared by James Lockridge

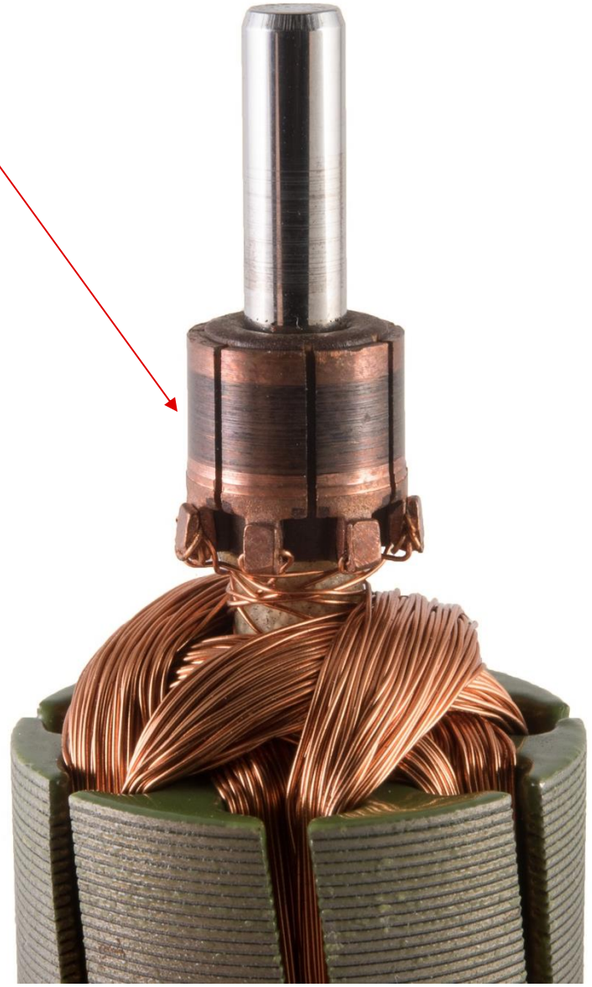
What is a stepper motor?

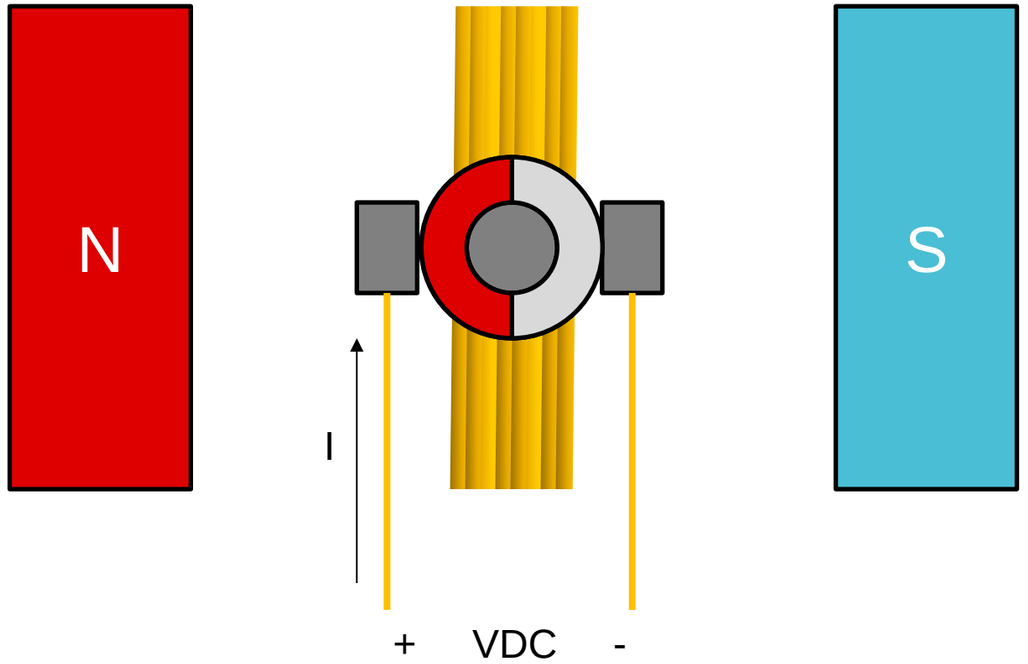
- Basic function: uses electrical signals to control rotor position
- Advantages:
  - Hold rotor in place for long periods of time
  - Precise positioning without sensors
  - Low cost
  - Easy to control



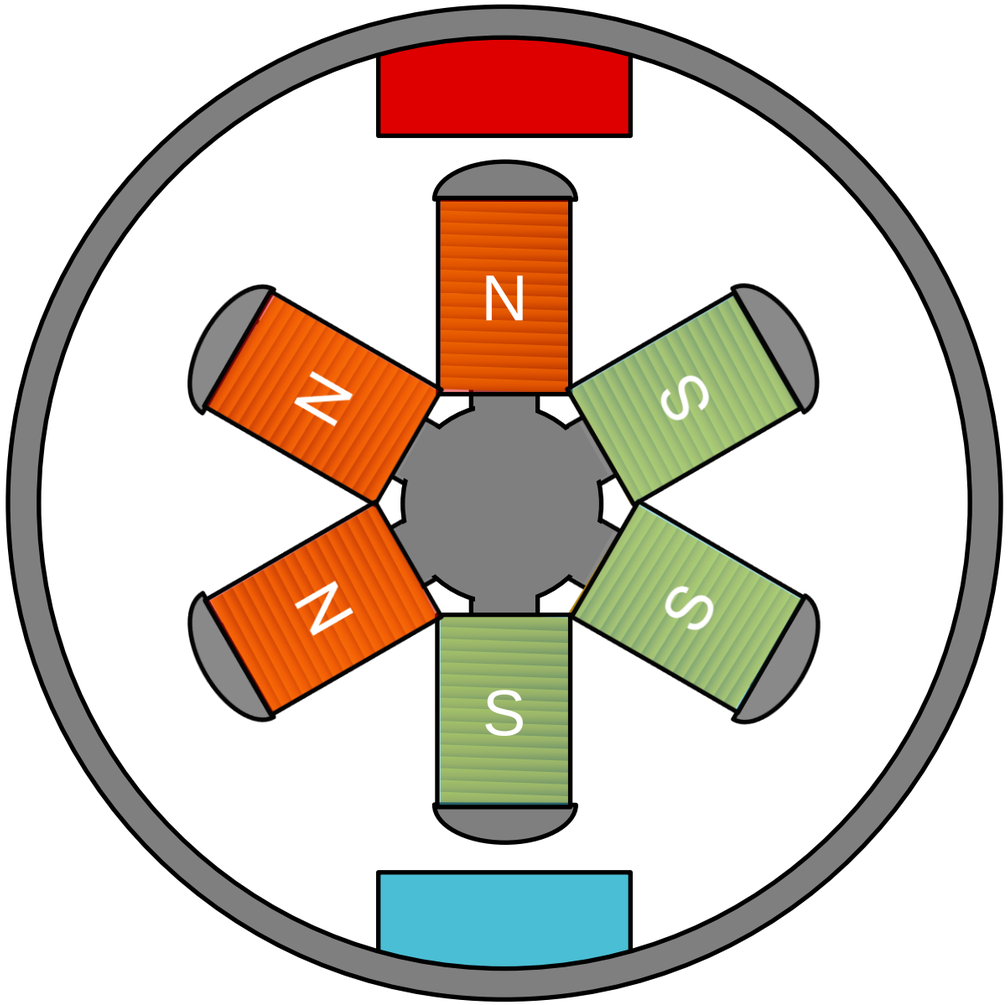
Brushed DC (BDC) motors

Commutator on rotor for brushes

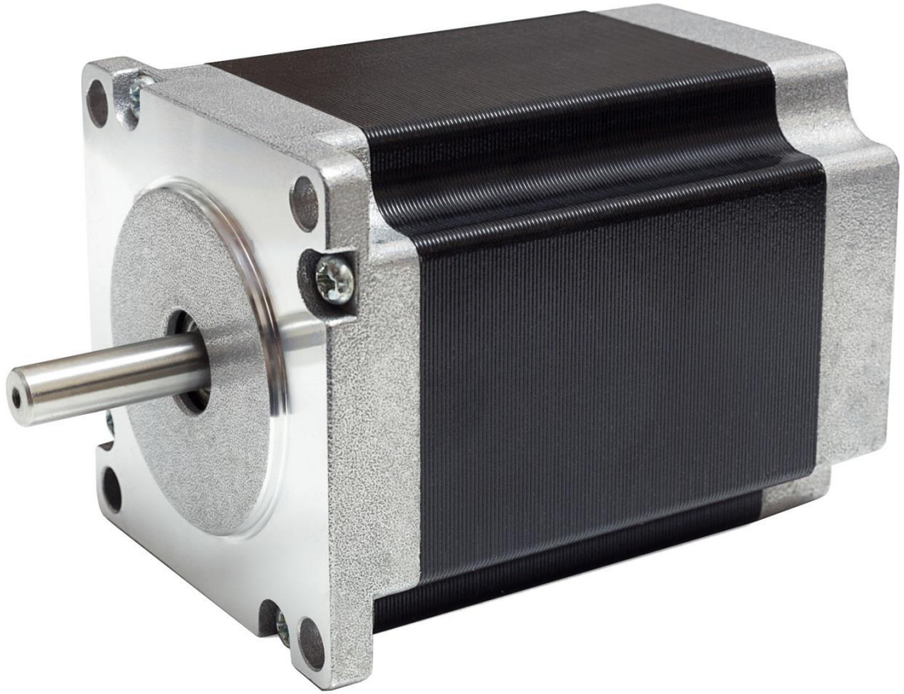


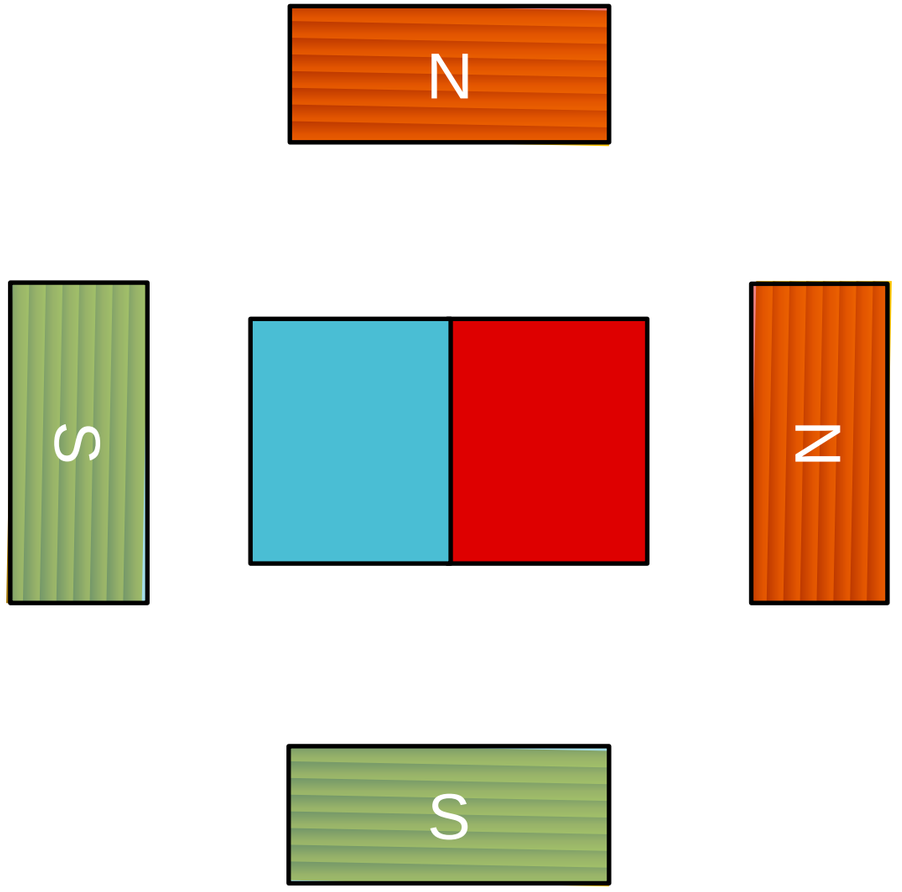


Brushless DC (BLDC) motors



Stepper motor

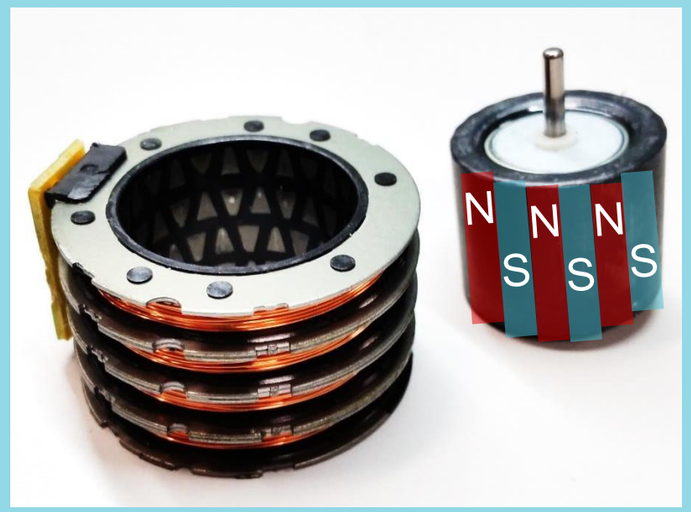




Stepper motor construction

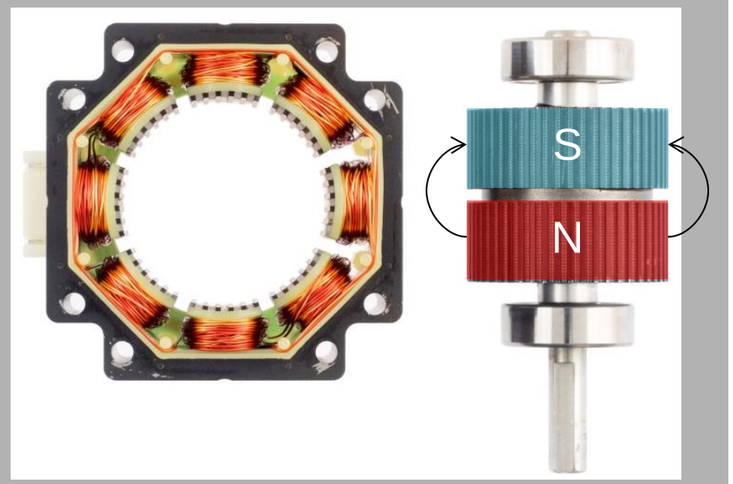
Permanent magnet

- Permanent magnet in rotor [2]
- Teeth on stator only [2]
- Typically 2 phases [1]
- Step angles 3.6º-18º
- Low torques



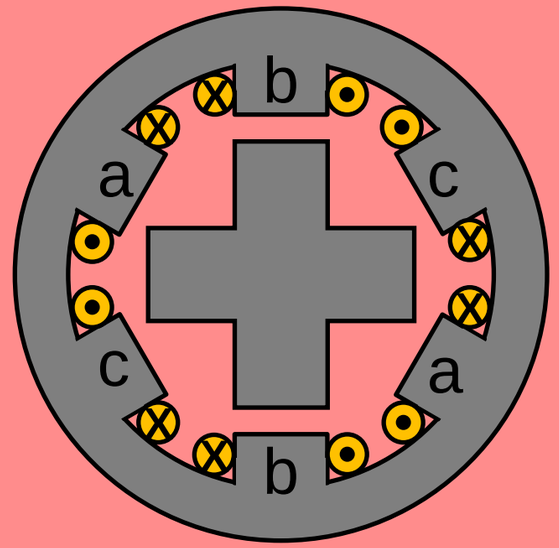
Hybrid

- Permanent magnet in rotor [2]
- Teeth on stator *and* rotor [2]
- Typically 2 phases [1]
- Step angles 0.9º-1.8º
- Wide range of torque options



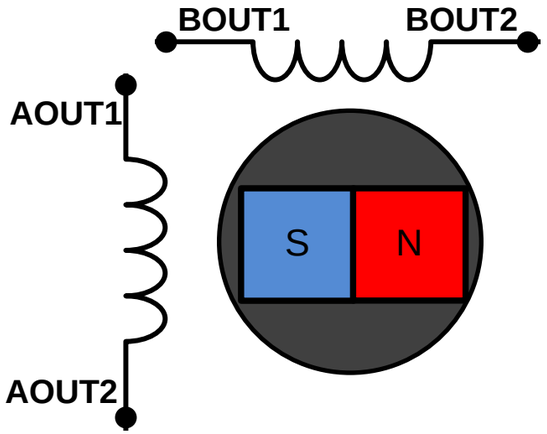
Variable reluctance

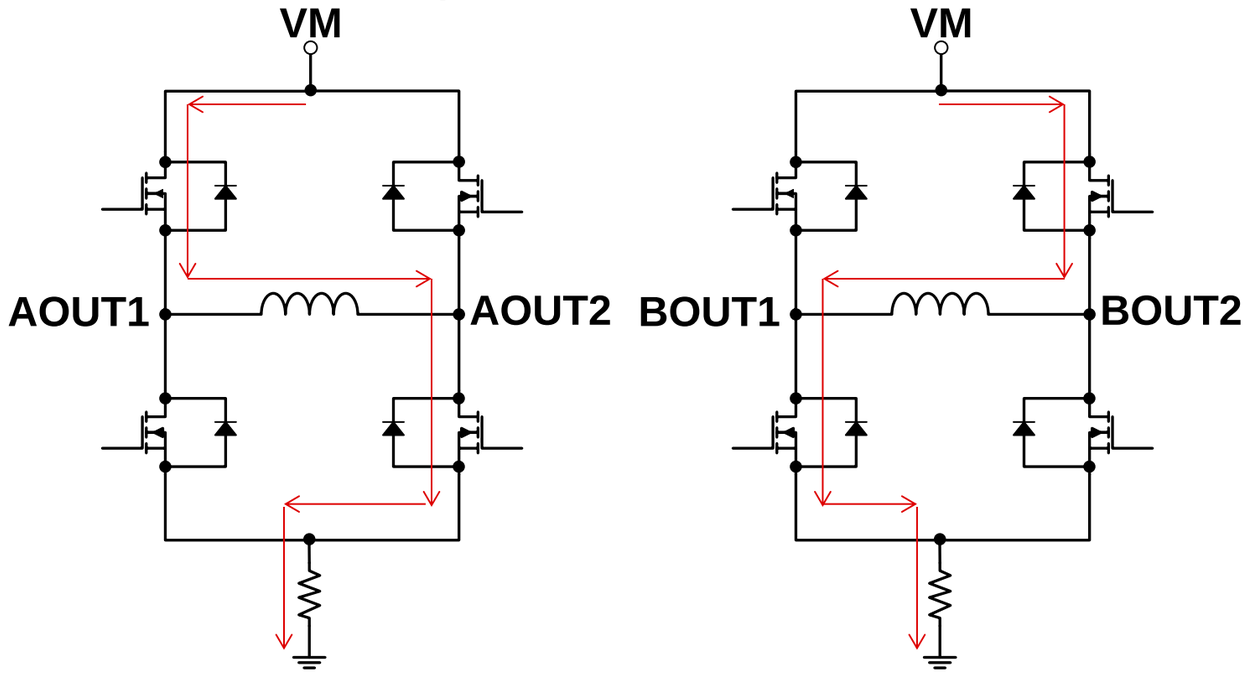
- No magnets [1]
- Teeth on stator *and* rotor [2]
- Rotor made of magnetic steel [1]
- ≥3 phases [1]



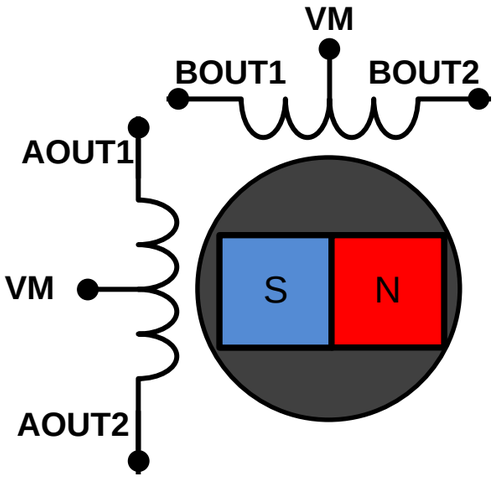
Bipolar vs. unipolar

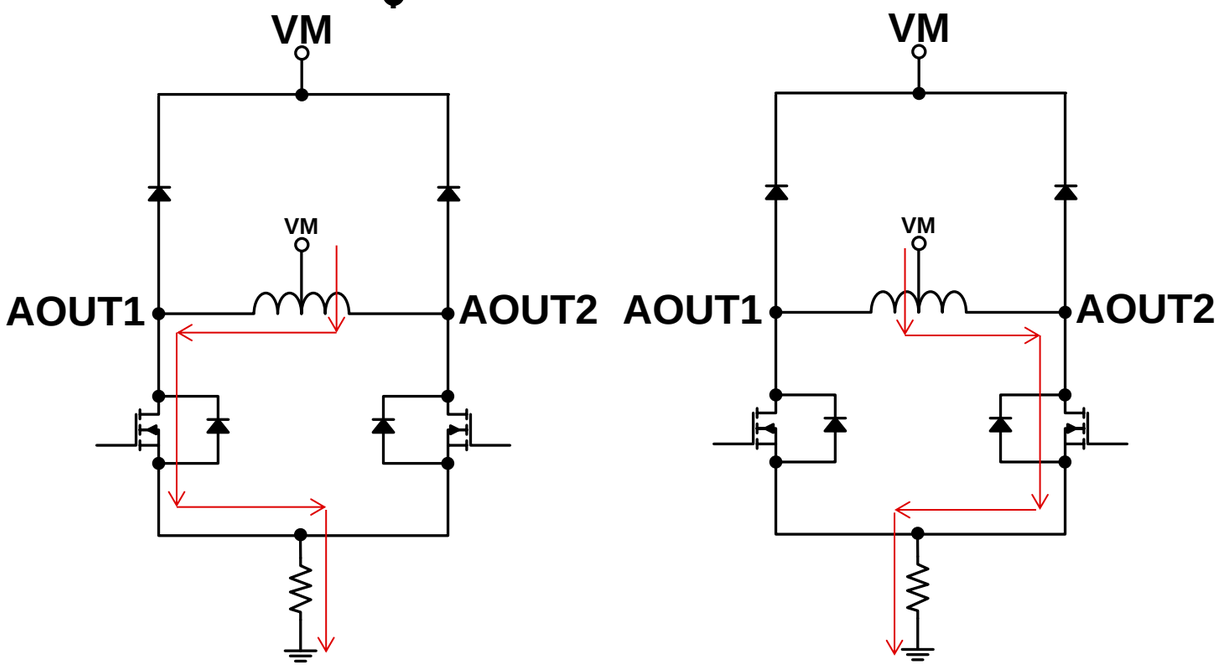
Bipolar motor



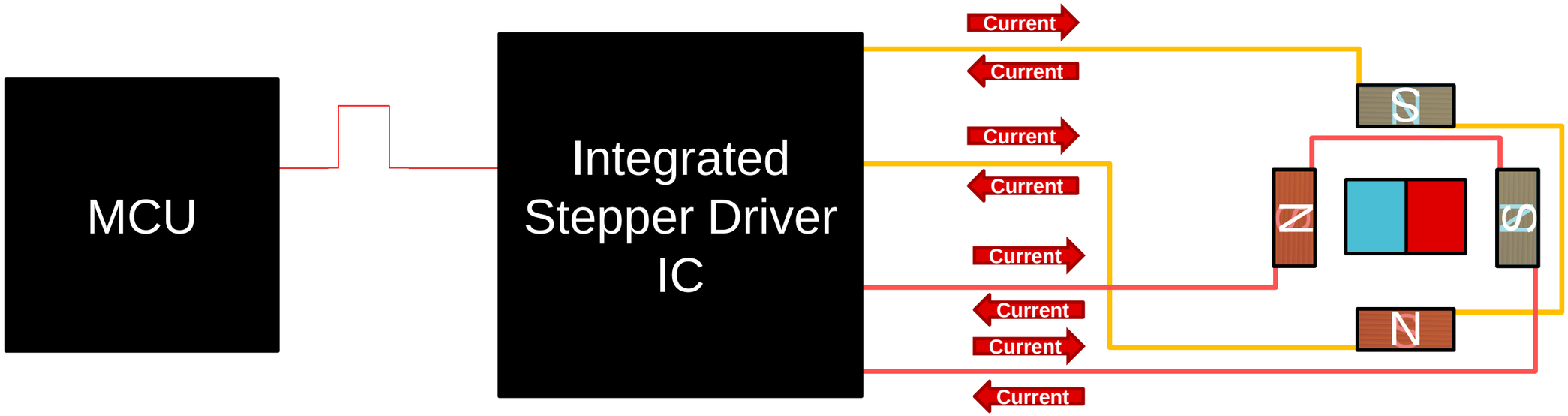


Unipolar motor





Basic stepper driving



To find more stepper driver technical resources and search products, visit http://www.ti.com/motor-drivers/stepper-driver/overview.html

Resources

- [1] Acarnley, Paul P. *Stepping motors: a guide to theory and practice.* 4th ed., Institution of Engineering and Technology, 2007.
- [2] Collins, Danielle. "Stepper motors: Differences between permanent magnet, variable reluctance, and hybrid types," *Linear Motion Tips*, 26 April 2018.