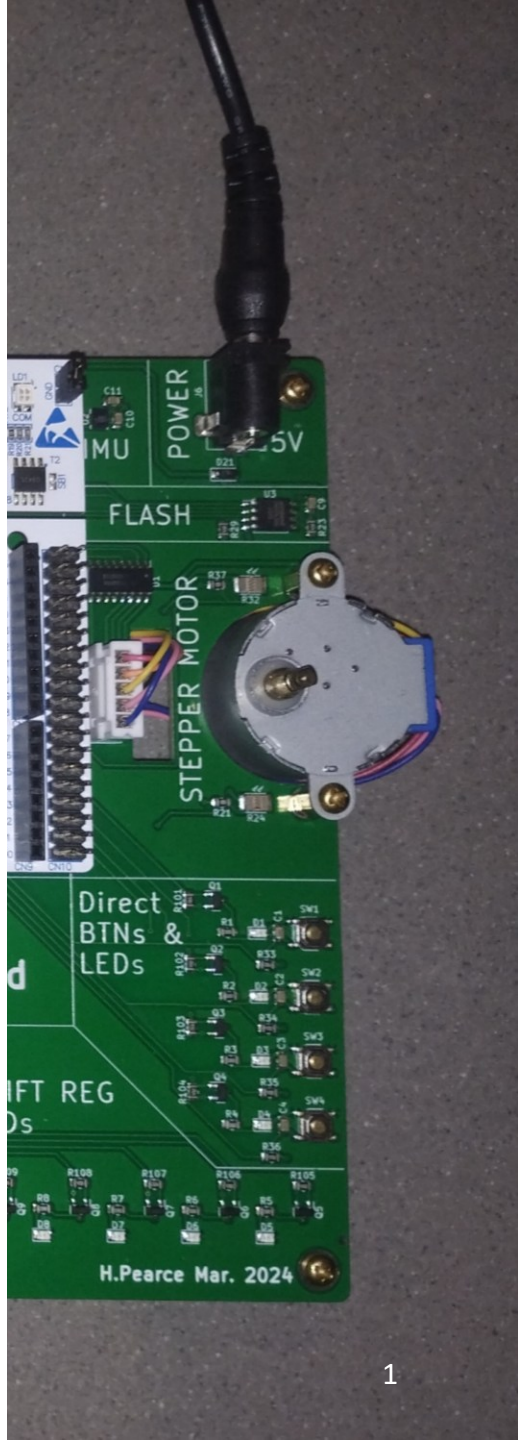
DESN2000 (Computer Engineering) 2026 T2

Stepper Motor

Hasindu Gamaarachchi



Step Angle

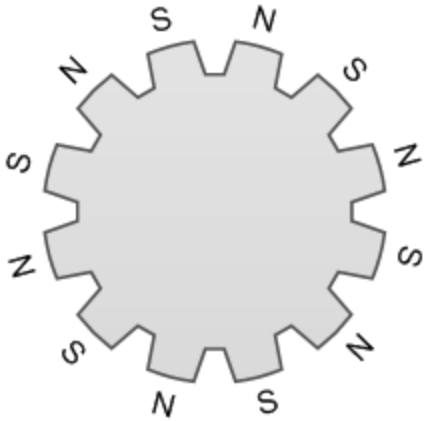
slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C

$$Step\ Angle = \frac{360^{\circ}}{steps\ per\ revolution}$$

$$steps\ per\ revolution = P \times T$$

where P is the total number of phases on the stator, and T is the total number permanent-magnetic poles available on the rotor.

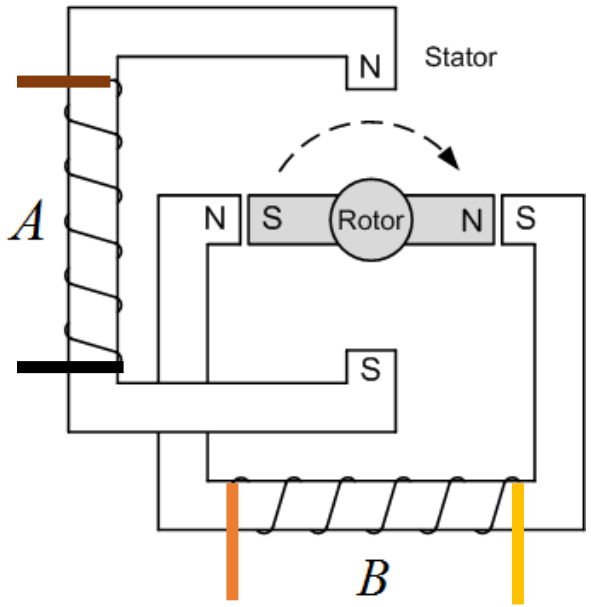
Rotor with only two poles

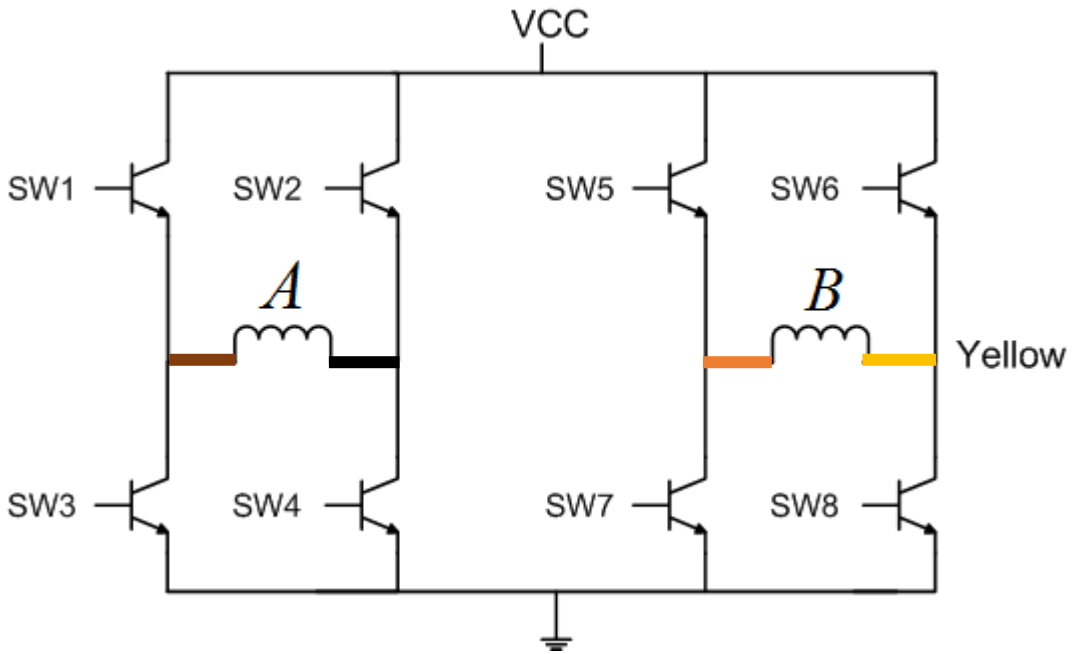


Rotor with 12 poles

Bipolar Stepper Motor

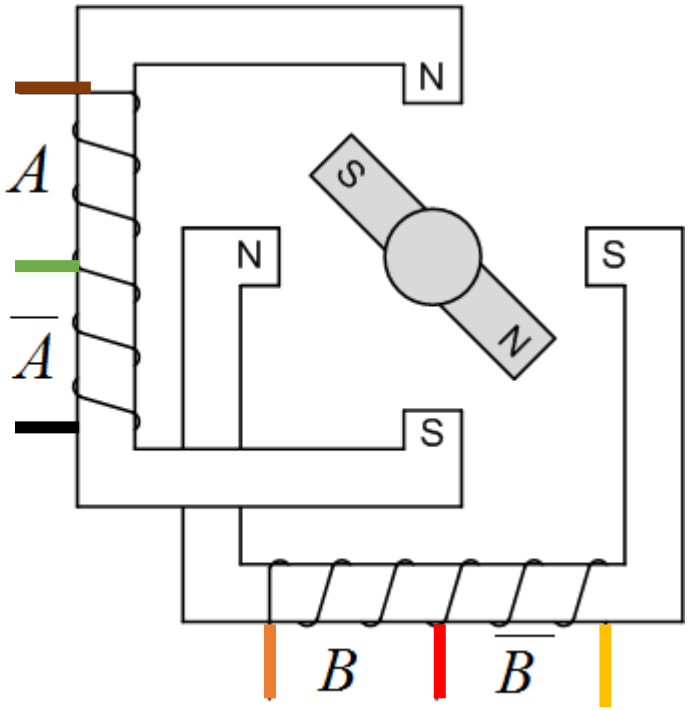
slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C

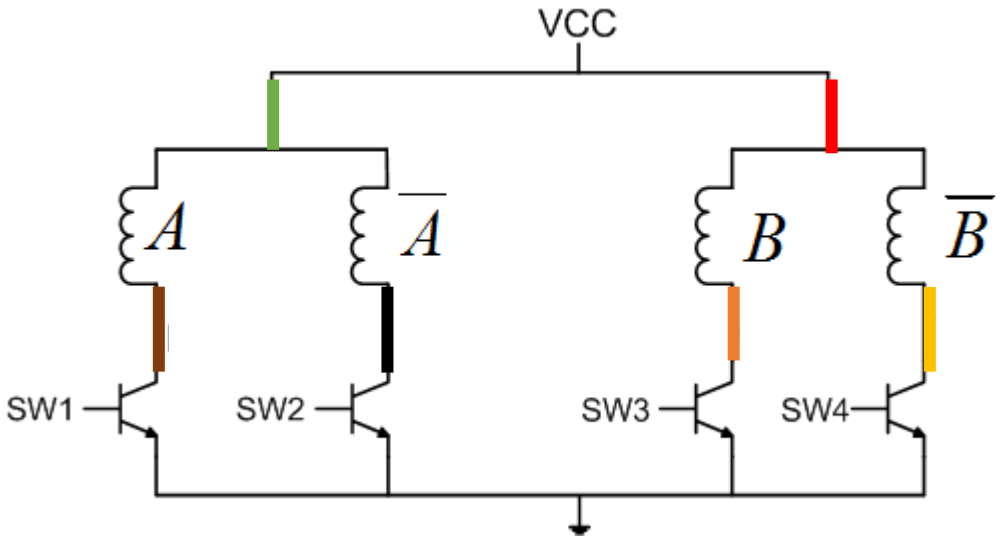




Unipolar Stepper Motor

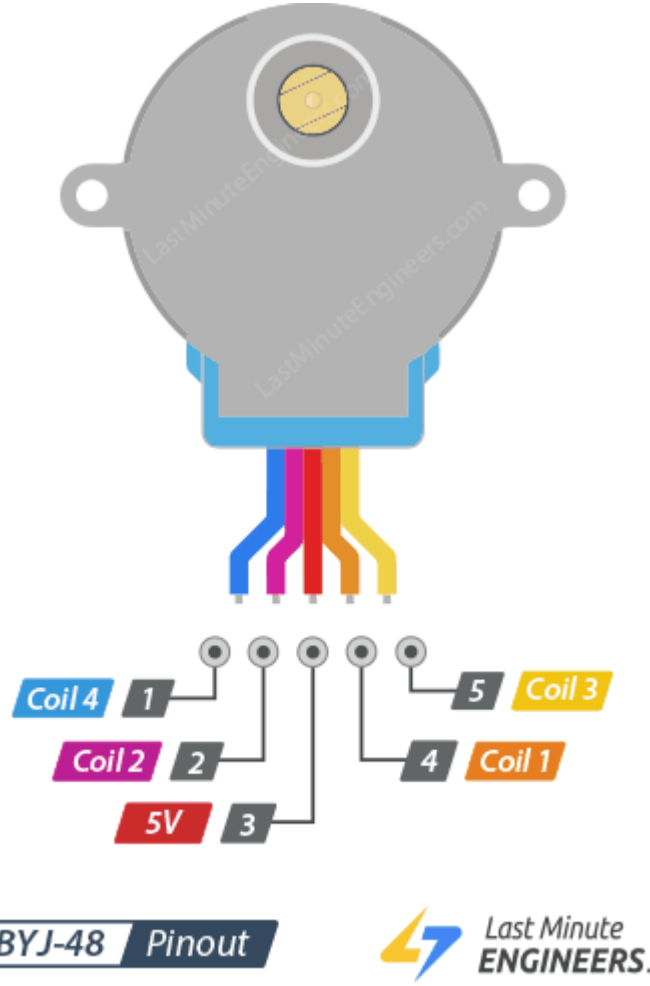
slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C





CoaST board: 28BYJ-48 Stepper Motor

- CoaST board's 28BYJ-48 stepper motor is unipolar



Unipolar Stepper Motor

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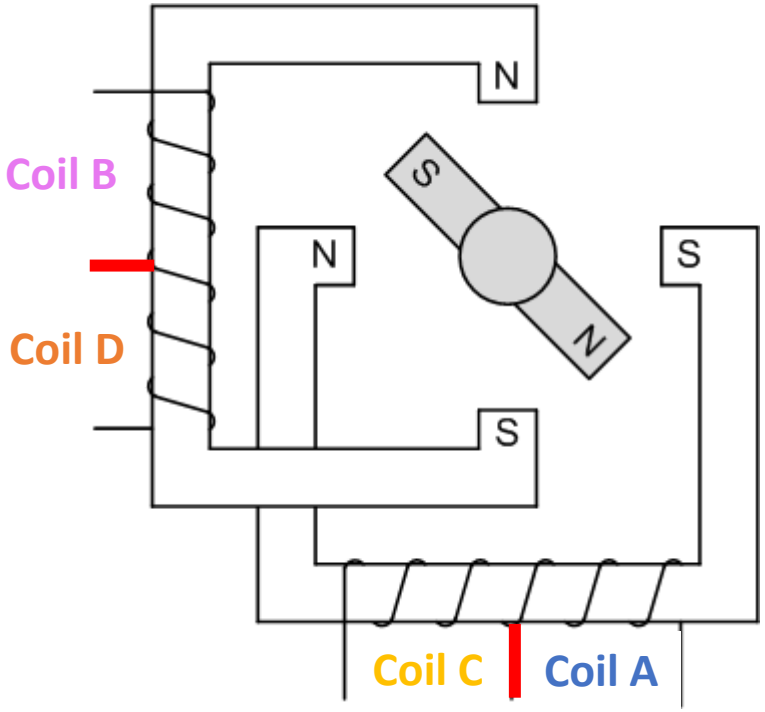
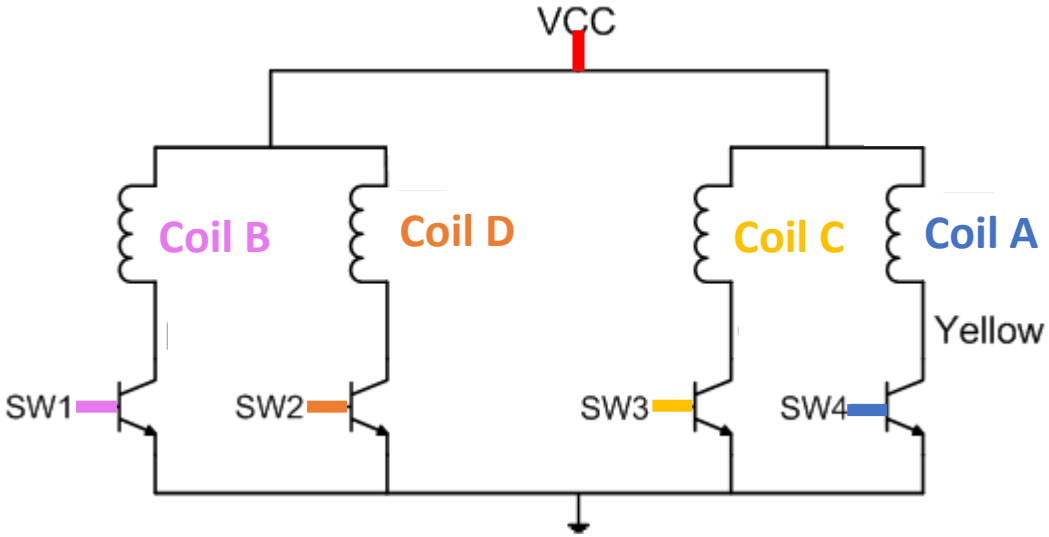
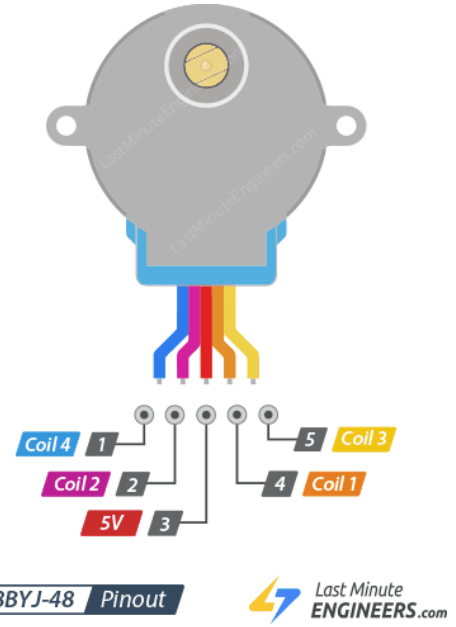
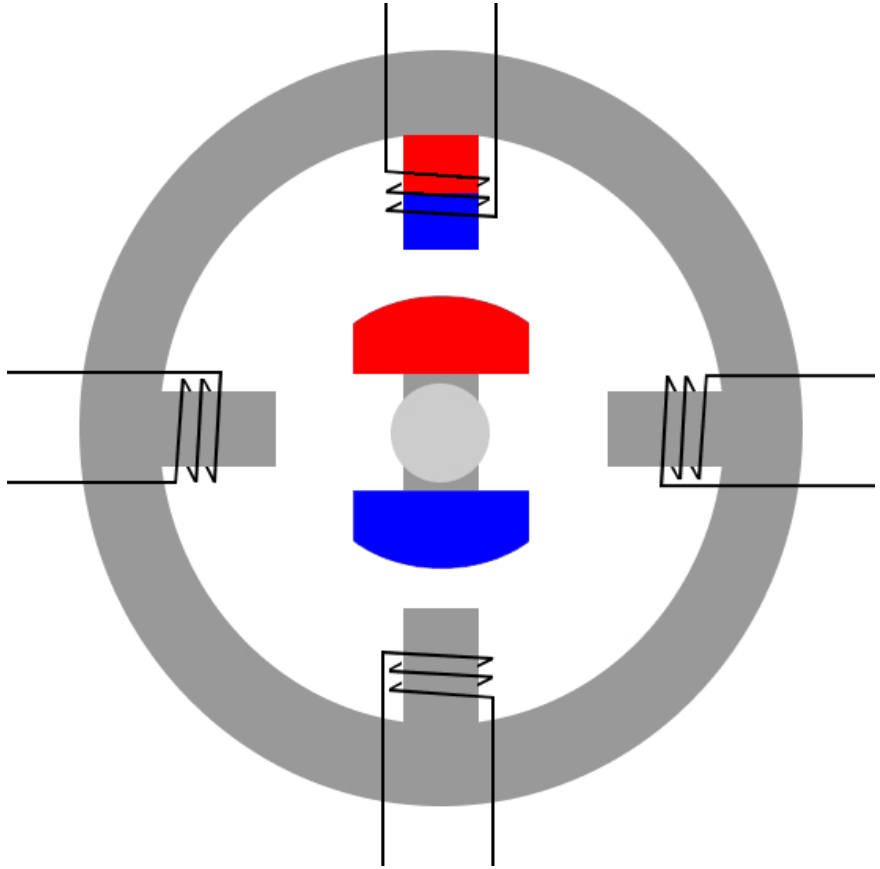






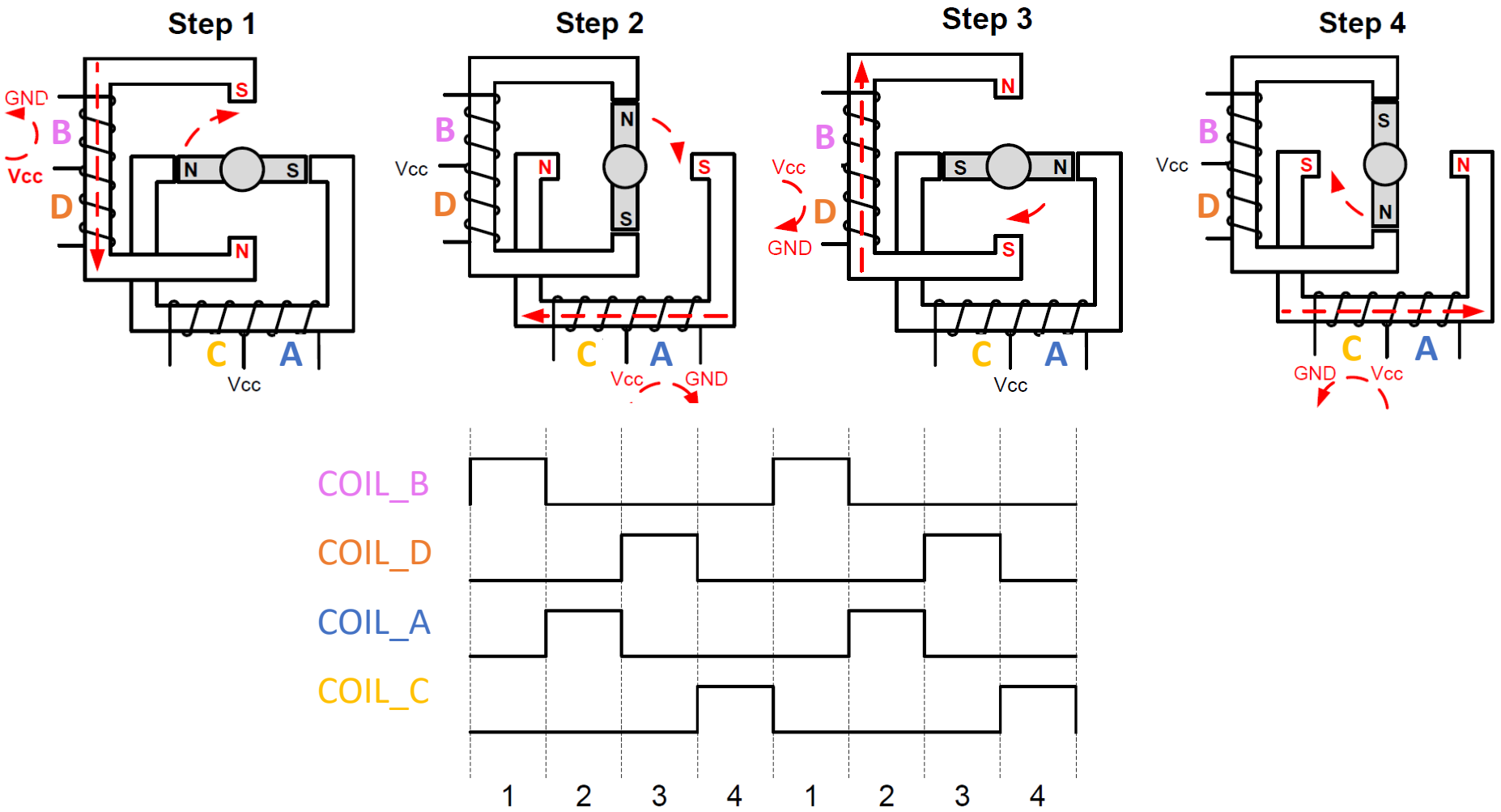
Wave Stepping



https://drufelcnc.com/?c=blog&p=Stepper_motors

Wave Stepping

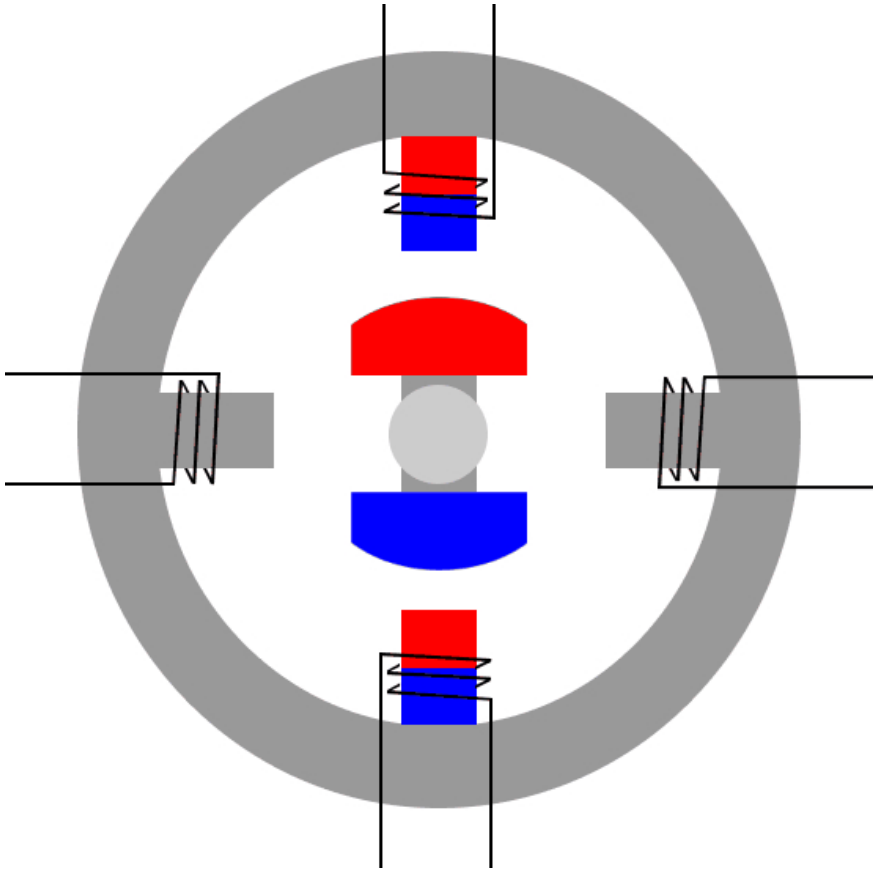
slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C



Example

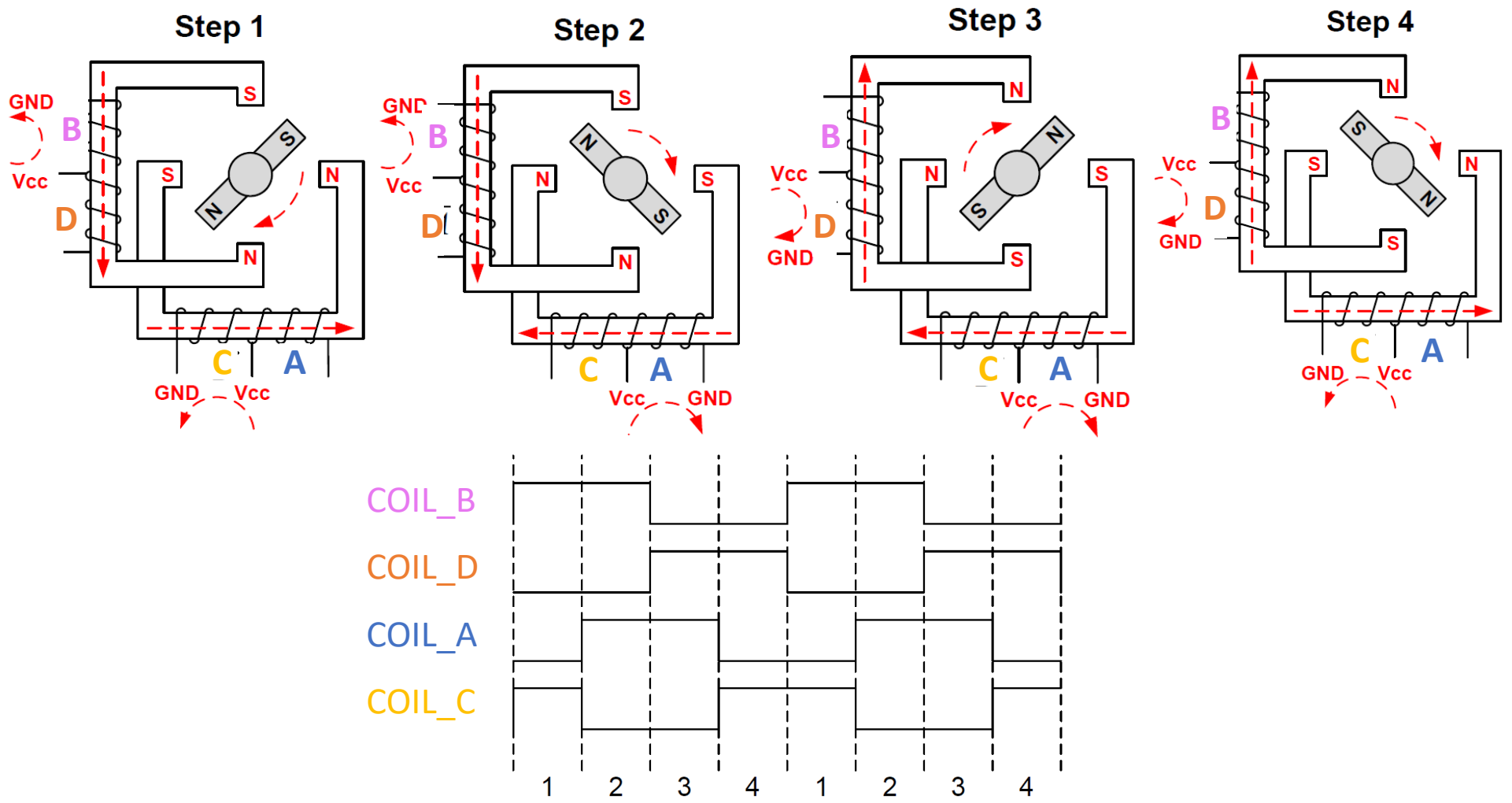
- Write a program that infinitely rotate the motor using wave stepping method

Full Stepping



Full Stepping

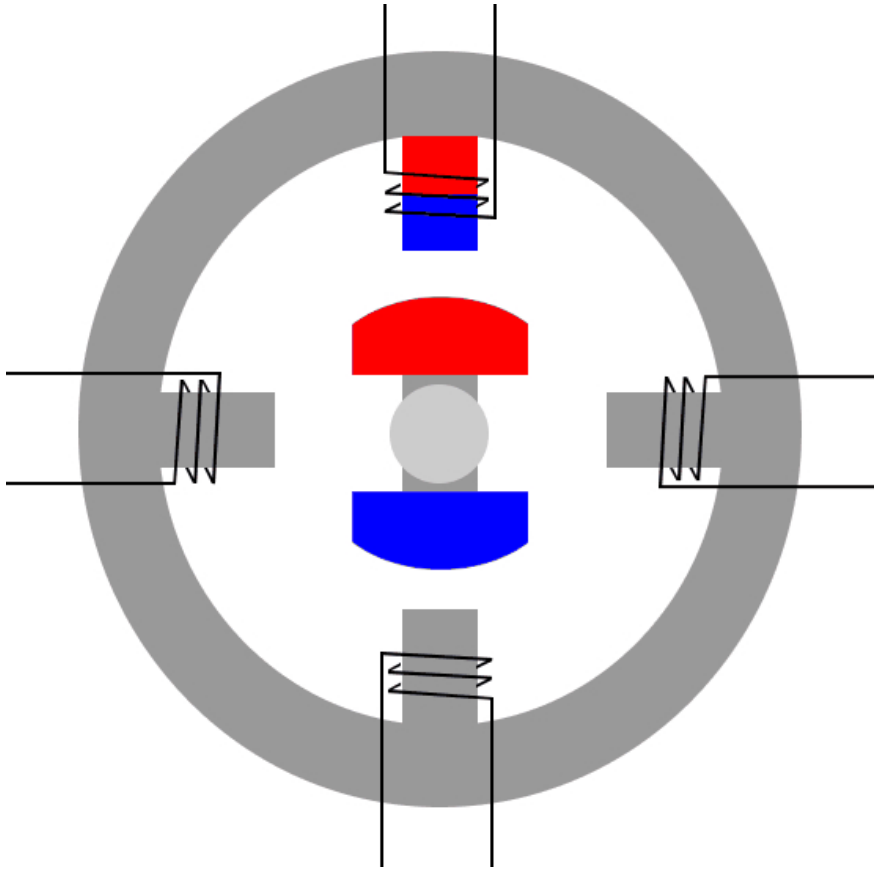
slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C



Example

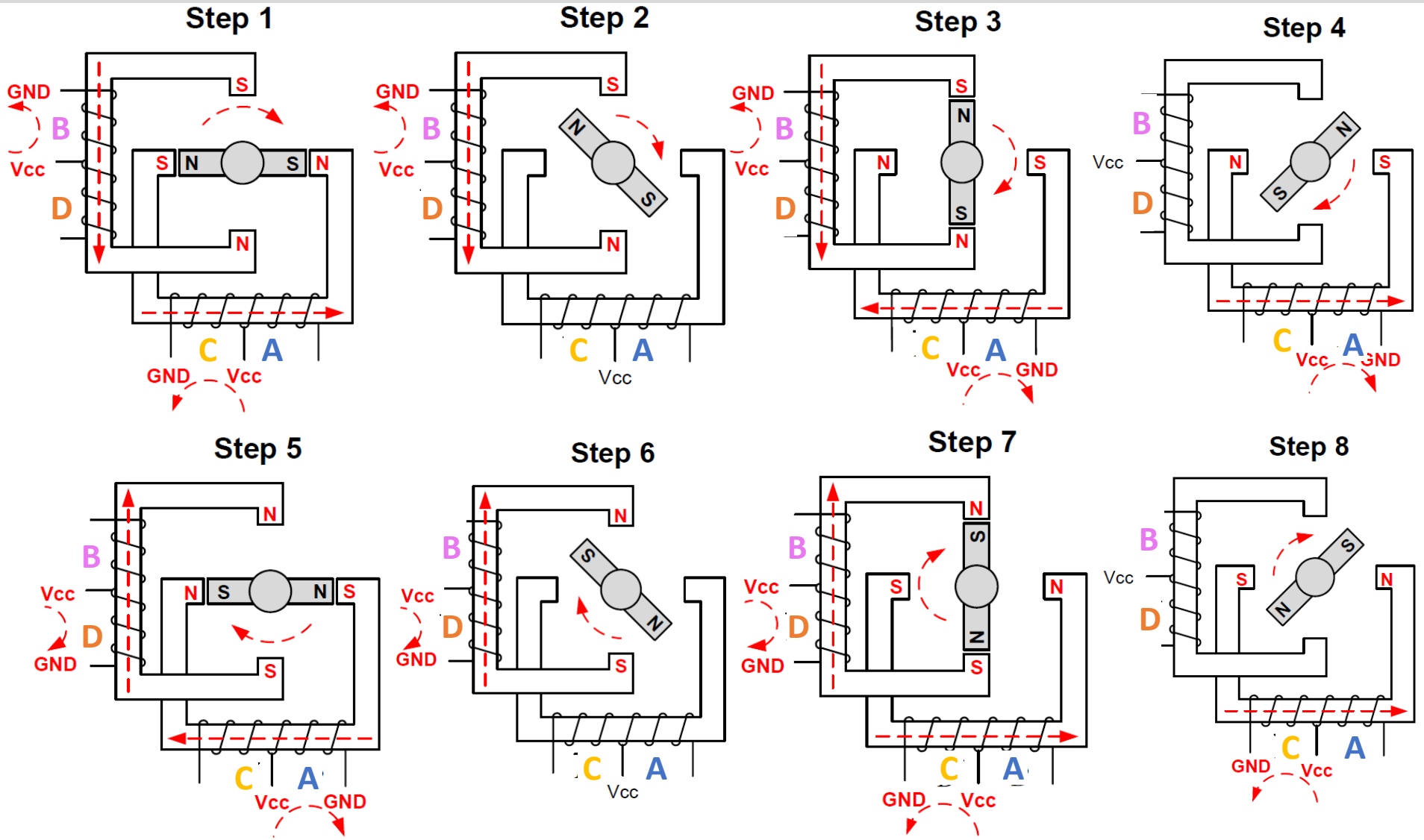
- Write a program that infinitely rotate the motor using full stepping method

Half Stepping

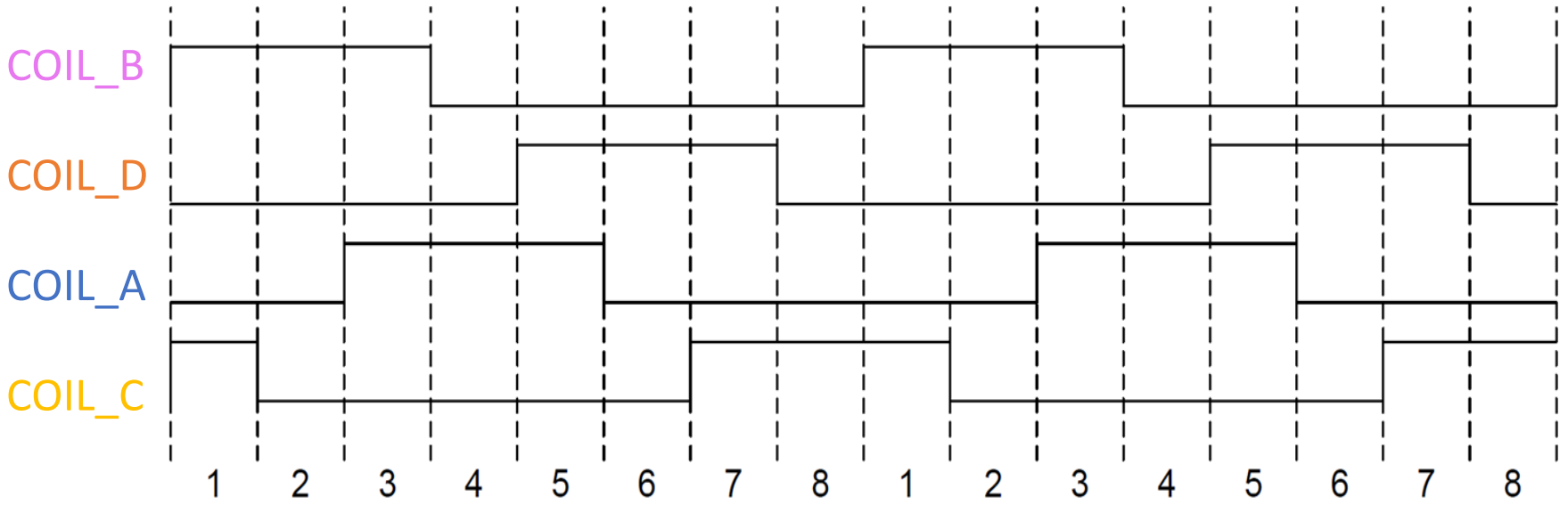


Half-stepping

slide adapted from: Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C



Half stepping



Datasheet for 28BYJ-48

- 5.625 degree per half step
- 11.25 degree per full step
- 1/64 gear reduction
- How many steps per full rotation?
- **2048**
  - **Let’s implement it in code**

Specifications

Rated voltage	5 V **or** 12 V
Coil Resistance	50 Ohms
Coil Type	Unipolar
Diameter – shaft	0.197" (5.00 mm)
Length – shaft and bearing	0.394" (10 mm)
Features	Flatted shaft
Size/dimension	Round – 1.100" dia (28.00 mm)
Mounting hole spacing	Flatted Shaft
Gear reduction	1/64 (see note)
Step angle	Half step mode (**Recommended**): 0.0879°
	Full step mode: 0.176°
Steps per revolution	Half step mode: 4096
	Full step mode: 2048
Termination style	Wire leads with connector
Motor type	Permanent Magnet Gear Motor
Number of phases	4

Learning Resources

"Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Fourth Edition)" – Yifeng Zhu

- General purpose I/O - chapter 15