STEPPER MOTOR

We are surrounded by stepper motors without even realizing it, as they are used in so many everyday items, including window blinds, 3D printers, DVD players, security cameras, and CNC machines. We're a lot closer to stepper motors than you think.

Stepper motors fall somewhere between a conventional DC motor and a servo motor. They can rotate continuously like DC motors and be positioned precisely (in discrete steps) like servo motors.

If you're just getting started with stepper motors, the 28BYJ-48 is a great choice. They typically come with a ULN2003-based driver board, making them very simple to use.

The 28BYJ-48 Stepper Motor

The 28BYJ-48 is a 5-wire unipolar stepper motor that runs on 5V. It's perfect for projects that require precise positioning, like opening and closing a vent.

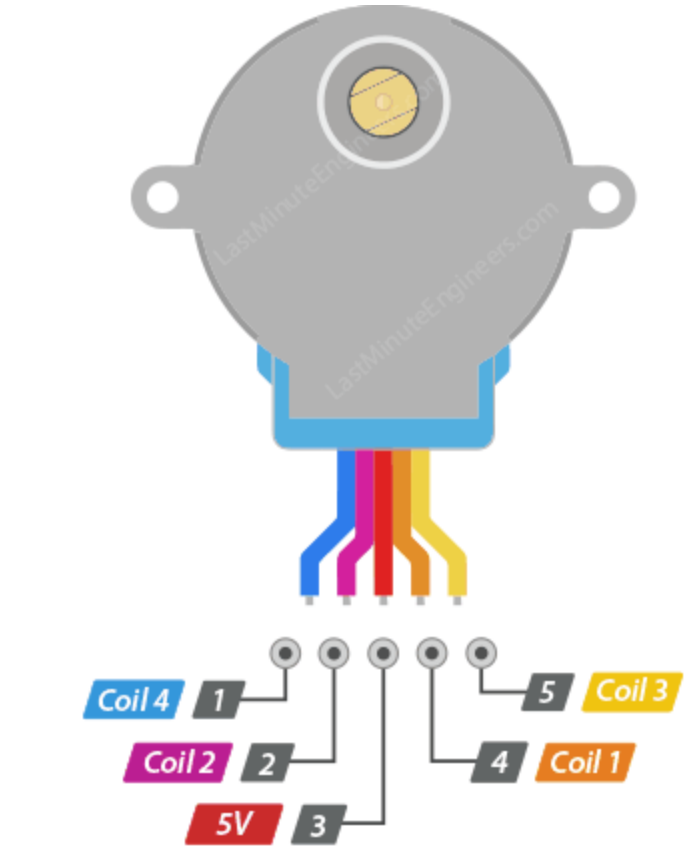
Because the motor does not use contact brushes, it has a relatively precise movement and is quite reliable.

Despite its small size, the motor delivers a decent torque of 34.3 mN.m at a speed of around 15 RPM. It provides good torque even at a standstill and maintains it as long as the motor receives power.

The only drawback is that it is somewhat power-hungry and consumes energy even when it is stationary.

PINOUT

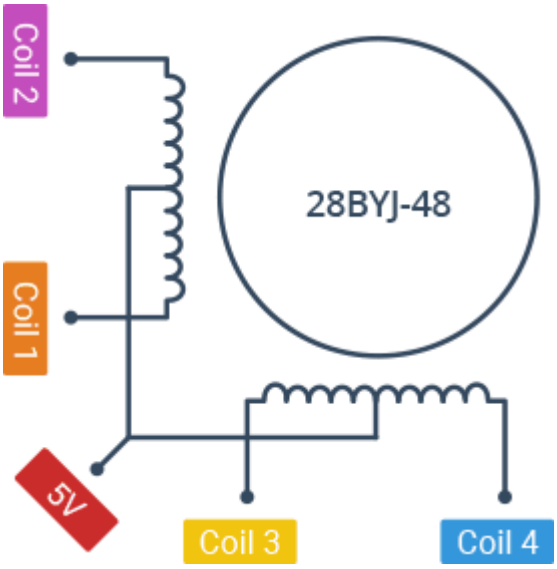
The 28BYJ-48 stepper motor has five wires. The pinout is as follows:



28BYJ-48 Pinout

The 28BYJ-48 has two coils, each of which has a center tap. These two center taps are connected internally and brought out as the 5th wire (red wire).

Together, one end of the coil and the center tap form a Phase. Thus, 28BYJ-48 has a total of four phases.



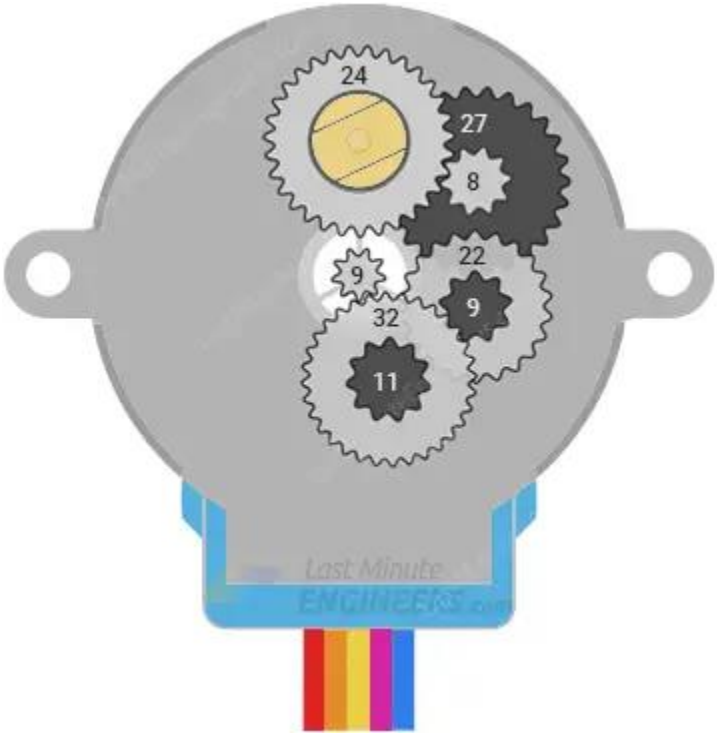
The red wire is always pulled HIGH, so when the other lead is pulled LOW, the phase is energized.

The stepper motor rotates only when the phases are energized in a logical sequence known as a step sequence.

GEAR REDUCTION RATIO

According to the data sheet, when the 28BYJ-48 motor is operated in full-step mode, each step corresponds to a rotation of 11.25°. This means there are 32 steps per revolution (360°/11.25° = 32).

In addition, the gearbox inside the motor has a 64:1 gear reduction. This results in 2048 (32*64) steps per revolution.



Gear Ratios:

- 32 / 9
- 22 / 11
- 27 / 9
- 24 / 8

Multiplying the gear ratios:

$$\frac{32}{9} \times \frac{22}{11} \times \frac{27}{9} \times \frac{24}{8} = 64$$

This gives us a **64:1** gear ratio

POWER CONSUMPTION

The 28BYJ-48 typically draws about 240 mA.

Because the motor consumes a significant amount of power, it is preferable to power it directly from an external 5V power supply rather than from the Arduino.

It is worth noting that the motor consumes power even when it is at rest in order to maintain its position.

TECHNICAL SPECIFICATIONS

Here are the specifications:

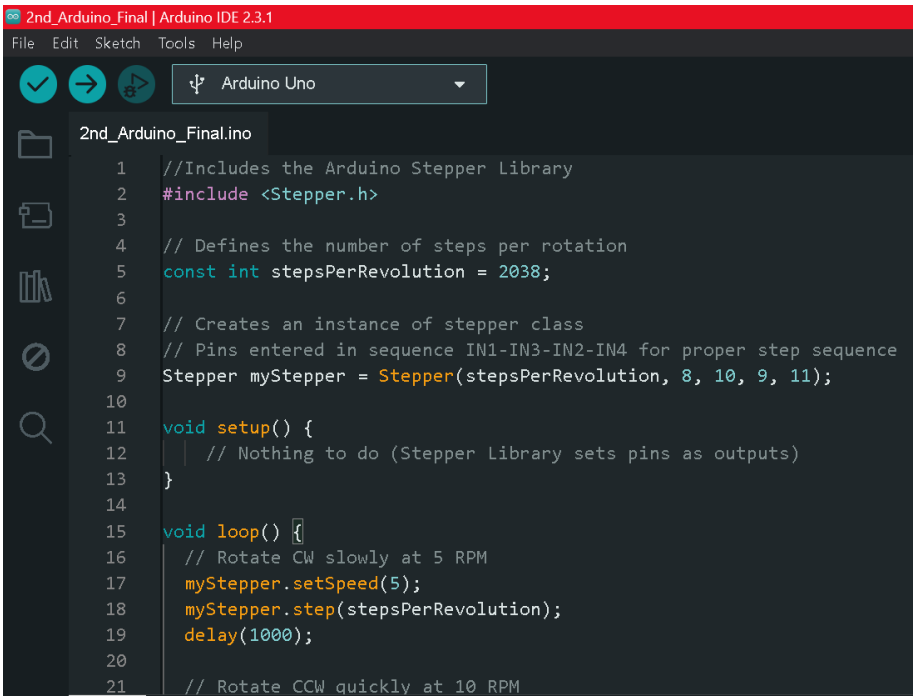
Operating Voltage	5VDC
Operating Current	240mA (typical)
Number of phases	4
Gear Reduction Ratio	64:1
Step Angle	5.625°/64
Frequency	100Hz
In-traction Torque	>34.3mN.m(120Hz)
Self-positioning Torque	>34.3mN.m
Friction torque	600-1200 gf.cm
Pull in torque	300 gf.cm

ARDUINO CODE

For our first experiment, we'll use the Arduino Stepper Library, which comes with the Arduino IDE.

The Arduino stepper library handles the stepping sequence and allows you to control a wide range of unipolar and bipolar stepper motors.

Here is a simple sketch that turns the motor slowly in one direction, then rapidly in the opposite direction.



```
21    // Rotate CCW quickly at 10 RPM
22    myStepper.setSpeed(10);
23    myStepper.step(-stepsPerRevolution);
24    delay(1000);
25  }
```

REFERENCE:

https://lastminuteengineers.com/28byj48-stepper-motor-arduino-tutorial/#google_vignette