

Ryan Everaert

Application Note

Team - I

Application Note for Toshiba Bipolar Stepper, Part
Number TB6560AHQ

Executive Summary of Operation and Application

The Toshiba bipolar stepper driver integrated circuit (part number TB6560AHQ) is used to drive a bipolar hybrid stepper motor. Control of such a motor requires large currents, power circuitry, and also accurate timing logic. This particular chip, the TB6560AHQ, has within it the timing, power, and logic circuitry necessary to fully drive a bipolar stepper motor. The chip only requires a separate power supply for the motor and a handful of control logic signals (usually provided by a microcontroller or microprocessor). Stepper motors are often implemented where precise and controlled motion is required. Properly controlled stepper motors can achieve precise, repeatable motion because their rotors move in discrete angular displacements, called “steps.”

Keywords

bipolar

step

full step

half step

Topic and Objective of This Application Note

The goal of this application note is to provide a general understanding of stepper motor operation through use of an intermediary integrated circuit, in this case, the Toshiba TB6560AHQ. This note will discuss the implementation, external circuitry, and operation of a complete stepper motor configuration. The discussion will be detailed, yet in general enough terms such that information contained herein can be applied to a large variety of applications with minimal modifications.

Setting Up the Toshiba TB6560AHQ Stepper Driver Circuit

In addition to the TB6560AHQ, some external circuit components are required to ensure proper operation of the circuit. A wiring diagram demonstrating a typical configuration of the driver circuit is shown on the following page in Figure 1.

Depending on the application of the motor, certain pins on the TB6560AHQ may be left permanently grounded or wired to 'high' logic. For example, if a motor is only desired to be operated in a clockwise direction, pin 21 can be permanently grounded. A top-down view of the pin configuration of the TB6560AHQ can be viewed in Figure 2.

TB6560AHQ

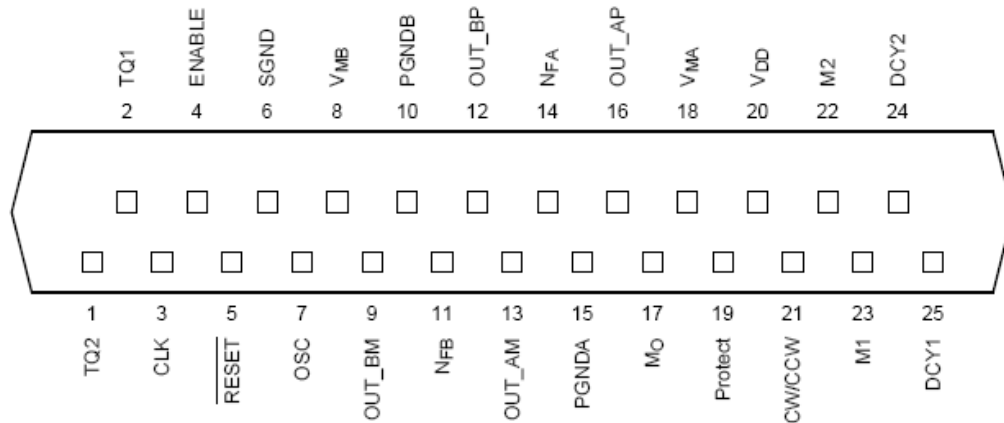


FIGURE 2

Bipolar stepper motors can be driven in two main operating modes: half step and full step. The application in which the motor is to be used should determine how these pins are handled. Greater torque is achieved in full stepping mode, but half stepping mode offers higher resolution (steps per revolution). On the TB6560AHQ, the state of pins M1 and M2 determines the motor's operating mode.

Generic Application Example

A useful example to consider is a linear positioning application. If a stepper motor has a gear attached to the rotor such that the teeth of the gear drive a toothed linear actuator, the position of the actuator can be accurately controlled with a stepper motor, the TB6560AHQ, and a microcontroller. As shown in Figure 1, the microcontroller send signals to the appropriate pins on the TB6560AHQ , ultimately offering complete control over the motion of

the motor. After the configuration, including the actuator, has been assembled, measurements can be made to determine the displacement of each full step or half step. For this example, assume torque is more important than step resolution, thus the motor will be operated in full step mode (M1 and M2 set to 0 logic from the microcontroller). Also assume rotation in the clockwise direction extends the actuator, while counterclockwise rotation retracts the actuator, and 200 steps produce linear displacement of 200 millimeters. For this example, assume the actuator is to extend to 300mm, then fully retract while pausing briefly at 30mm intervals. To accomplish this, the microcontroller would first set pin 21 to 'low,' setting the device to drive in clockwise motion (extension of the actuator). Then the microcontroller would need to send 300 pulses to the TB6560AHQ to achieve the desired displacement of 300mm. To pause at 300mm, no subsequent pulses would be sent to the TB6560AHQ. During this pause, the microcontroller can change the logic on pin 21 to 'high,' enabling counterclockwise rotation (retraction of the actuator). Then the microcontroller can send pulses 30 at a time, pausing in between each group, until the home position is reached. The home position will be exactly 300 steps total in the counter clockwise direction. Note that 'pulse' is defined as the rising edge of a square wave pulse that can be output from the microcontroller.

The following is pseudo code to achieve the above described operation of a stepper motor using the TB6560AHQ and a microcontroller:

Program code

```
pin21 = 0;                                //This sets the device to clockwise rotation

for(count = 1; count< 600;count++) //This 'for' loop must execute twice to generate one pulse
{
    pin3 = !pin3;
}

pause routine                             //Pause at desired extension

pin21 = 0;                                //This sets the device to counterclockwise rotation

for(loop = 1; loop< 10, loop++)
```

```

{
    for(count=1; count<60;count++)
    {
        pin3 = !pin3;          //This nested loop moves back to the home position in 30 step increments
    }

    pause routine             //Pause between each set of 30 pulses
}

... program code

```

The TB6560AHQ has more advanced operation configurations than were demonstrated above, but those avenues can be further researched as the need to implement them arises. Again, the application purpose of the motor will ultimately determine how the TB6560AHQ should be configured and operated. The operation of the TB6560AHQ is very common among stepper driver IC's, and comparable chips can be found and considered. As a result, further documentation for application suggestions and troubleshooting is widely available.

References

1. Toshiba Semiconductor

http://www.semicon.toshiba.co.jp/docs/datasheet/en/LinearIC/TB6560AFG_TB6560AHQ_en_datasheet_080407.pdf

2. Wikipedia

http://en.wikipedia.org/wiki/Stepper_motor

**Electronic references accessed on 11-2-2008.