Advantages of High-Resolution

2-Phase High-Resolution Stepping Motors

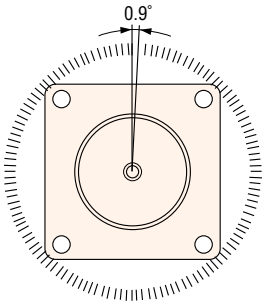
The 2-phase, high-resolution (0.9° per step) stepping motor has half the step angle of the standard (1.8° per step) stepping motor. The high-resolution type increases motor resolution from 200 pulses (360° /1.8°) to 400 pulses (360° /0.9°). If an even smaller step-angle is needed, half-step driving and micro-step driving are other options. Such options, however, do not improve accuracy. The excitation coil of the 2-phase, high-resolution stepping motor is located in exactly the same position, the number of rotor teeth is twice as many as standard stepping motors. Other structures are exactly the same as the standard motors.

Features

1. High Resolution

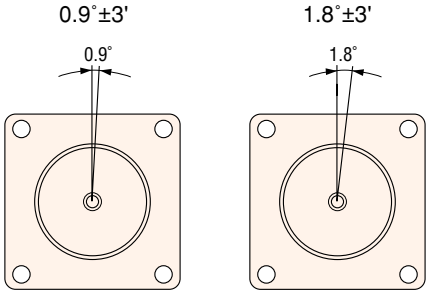
Even with the same fundamental structure as the standard stepping motor, doubling the number of rotor teeth (100 rotor teeth) produces high-resolution with 0.9° per step (400 pulses per revolution).

400pulses/rev.



2. Improved Positional Accuracy

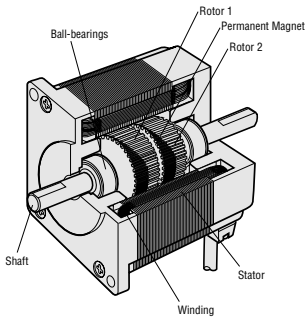
Positioning accuracy is important, especially in bi-directional positioning. The high-resolution motor (0.9° per step) has higher positioning accuracy than the standard stepping motor (1.8° per step).



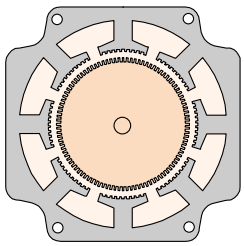
High Resolution　　Standard

Structure

The magnet coil is set in exactly the same position as in the 2-phase 1.8° stepping motor. But the number of teeth is doubled to 100 at rotor and stator. See the following figures for structural details and the cross-sectional structure of the 2-phase 0.9° stepping motor.



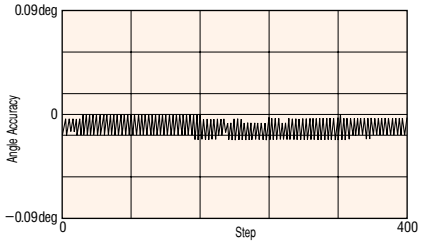
Structure of the 2-Phase High-Resolution Stepping Motor (0.9˚ per step)



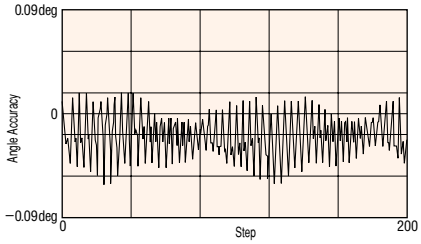
Cross-Section Perpendicular to Shaft

Angle Accuracy

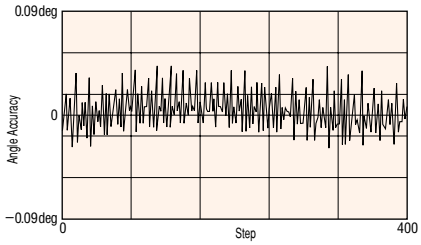
There are a variety of reasons why step angle errors can occur. In most cases, angle differentials occur in conjunction with the total accuracy of the machinery. Each part of the motor is manufactured with high accuracy. However, when they are assembled, composite errors usually occur. Static angle differential is less than ±0.05°, under no-load condition. The angle discrepancy is closely related to the number of teeth. About 0.5-1 % of the pitch angle of the teeth causes such errors. The following figures show the static angle discrepancy for each (1) full-step 2-phase high-resolution stepping motor, (2) full-step 2-phase standard stepping motor, (3) half-step 2-phase standard stepping motor.
Even though (1) and (3) rotate with the same 0.9°, (1) shows smaller errors. Comparing (2) and (3) indicates that the half-step driving of the standard stepping motor does not improve accuracy.
In short, although it is possible to make each step-angle smaller by the driver, it does not contribute to increasing accuracy. Rather, angle discrepancy per step increases. The 2-phase standard stepping motor (1.8° per step) can use half step driving to achieve 0.9° per step. However, this does not produce the same accuracy as the 2-phase high-resolution stepping motor (0.9° per step) run at full step. Half-step driving is not for improving accuracy, but for solving other problems like vibration and irregular rotation.



(1) 2-Phase 0.9˚ Stepping Motor (Full Step)



(2) 2-Phase 1.8˚ Stepping Motor (Full Step)

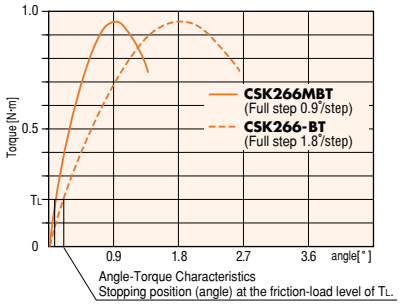


(3) 2-Phase 1.8˚ Stepping Motor (Half Step)

Figure 3 Angle Accuracy

Frictional Load Drivers Positional Errors

The positional errors of machinery do not depend solely on the angle accuracy of the motor. Different load levels for each step naturally contribute to positional inaccuracy. Even under stable loading, it creates positional inaccuracy when used in bi-directional positioning. In such cases, the magnitude of the positional accuracy is several times worse than the angle inaccuracy of the motor itself.
The following figure shows one of the fundamental characteristics of two stepping motors. Those curves compare the 2-phase standard stepping motor and the 2-phase high-resolution stepping motor, by showing their angle-torque characteristics. The peak of each curve illustrates its holding torque (maximum static torque at excitation).



Angle - Torque Characteristics

These curves display the angle discrepancy between ideal and actual positions, against loading under static excitation status.
The 2-phase high-resolution stepping motor reaches its peak at half angle, comparing to the 2-phase standard motor. The slope of the high-resolution motor's load-torque characteristic curve is steeper than the one for the standard motor's. The former yields half the discrepancy of the latter, even under the same load. Since the slope of the curve varies, based on the number of teeth and torque. The positional accuracy of the high-resolution motor under actual load is quite higher. When a stepping motor is used in practice for the purposes mentioned above, sufficiently large torque is normally selected, in the attempt to minimize the positional discrepancy on loading. The 2-phase high-resolution stepping motor is the most suitable.