# Explanation of the Dynamic Torque Curve

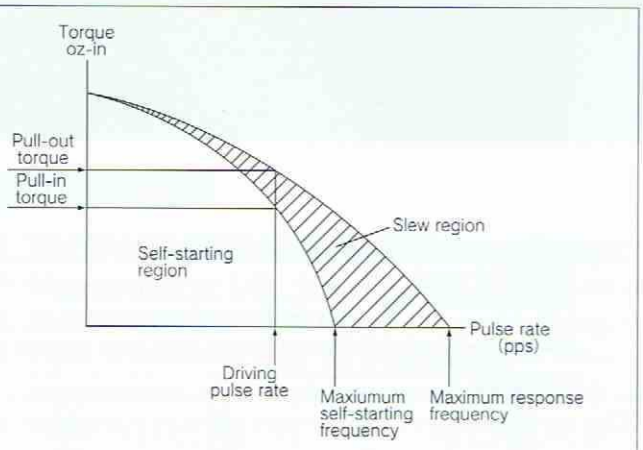


Fig. 1 Torque/speed characteristics curve

### Self-starting region

This is the region in which motors can be started and stopped instantaneously.

### Pulse rate

The number of pulses in a unit of time, and is shown in the unit "pps" which means "pulses per second". The relation between pulse rate, speed (rpm) and angular velocity (rad/s) is given below.

$$\omega = \frac{\pi}{180}\,\theta s \cdot P \rightarrow P = \frac{180}{\pi} \cdot \frac{\omega}{\theta s}$$

$$N = \frac{1}{6}\,\theta s \cdot P \rightarrow P = \frac{6N}{\theta s}$$

where $\omega$ : Angular velocity (rad/s)
$\theta s$ : Step angle (deg.)
N : Speed (rpm)
P : Driving pulse rate (pps)

### Maximum self-starting frequency (pps)

This is the maximum pulse rate in the self-starting region. Care must be taken, because it varies depending on the load inertia.

### Slew region

In this region, driving is possible only by slow acceleration/slow deceleration control.

### Maximum response frequency (pps)

This is the maximum pulse rate in the slew region.

### Pull-in torque

This is the torque generated when started in the self-starting region. It is also called the "synchronization torque".

### Pull-out torque

This is the torque generated when driven in the slew region.

### Pull-out

This means the motor is coming out of synchronized operation by being not able to follow the pulse signal from the pulse generator.
Over-loading is the general cause, but noise (Electric/ Electro-magnetic) is also a cause in some cases.

### Slow acceleration/slow deceleration

This is a kind of control to raise or lower the pulse rate to drive stepping motors in the slew region so they exhibit their full capability. There are various methods but one example, called trapezoidal driving, is shown in Fig. 2.

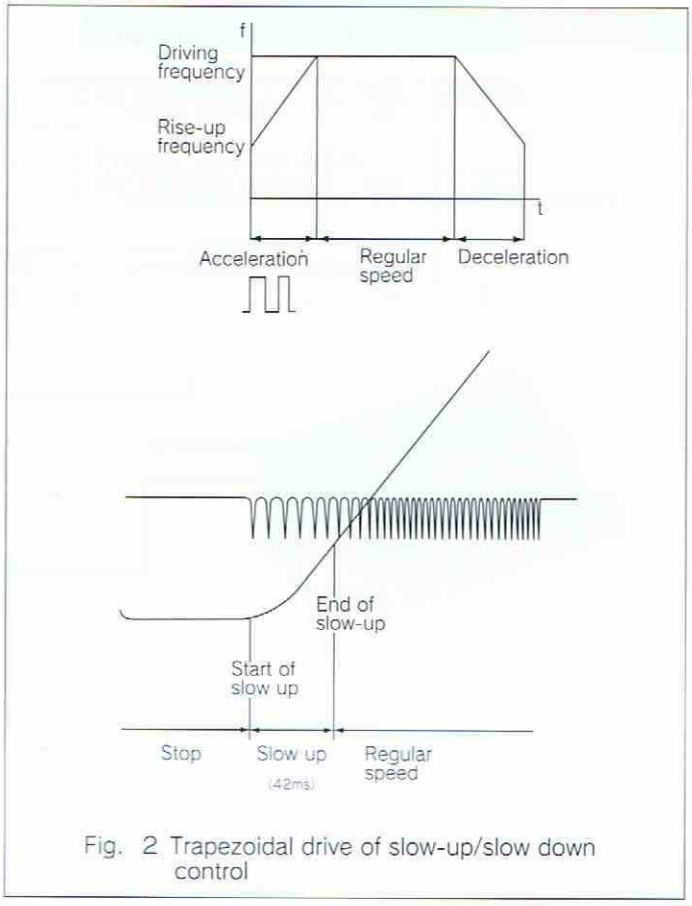


Fig. 2 Trapezoidal drive of slow-up/slow down control

### Resonance phenomenon

When stepping motors are driven, torque decrease, miss-steps, vibration and other unfavorable phenomena may occur at some specific frequencies. This is called a "Resonance phenomenon", and is caused by the coincidence of intrinsic vibration frequency and input pulse frequency of the motor. It is experienced generally in the range of 100 to 200 pps. It is impossible to eliminate this resonance fully, but the defect can be reduced by changing the excitation mode or providing damper.

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