

## Introduction

ADVANCED Motion Controls® DigiFlex® Performance™ servo drives are able to drive two and three phase closed loop stepper motors following essentially the same setup procedure for a high pole count brushless motor. These instructions outline the procedure that should be followed with a few additional notes specific to stepper motors.

For more detailed instructions for any of the procedures given (Loop Tuning, AutoCommutation, Phase Detect) see the DriveWare® Software Manual and Help Files.

**Note: Maximum motor speed is limited to ~600RPM for stepper motors.**

## Setup and Wiring

For a **3-phase stepper motor**, connect the motor leads to the drive motor output pins as recommended by the motor manufacturer (3-lead or 6-lead configuration).

For a **2-phase stepper motor**, tie the two negative motor leads together, and connect the stepper motor leads to the drive motor output pins as follows:

Motor Lead	Drive Motor Pin
A+	MOTOR A
B+	MOTOR B
A-	MOTOR C
B-	

Open DriveWare. Correctly input the motor and feedback parameters according to the motor and feedback datasheets.

1. Select **Motor > Parameters** from the System Browser.
2. Select **Stepper** as the *Motor Type*, and enter the appropriate motor and feedback data.

**Note: Some stepper motors provide the Step Angle, but do not provide the motor pole count. Typical 3-phase stepper motors have a Step Angle of 1.2 and a pole count of 100. If this is not the case, calculate the motor pole count from the Step Angle using the formula given in Figure 1.**

$$Pole\ Count = \frac{360}{(Step\ Angle * \#[\text{of Phases}])}$$

**Figure 1 Motor Pole Count Calculation**

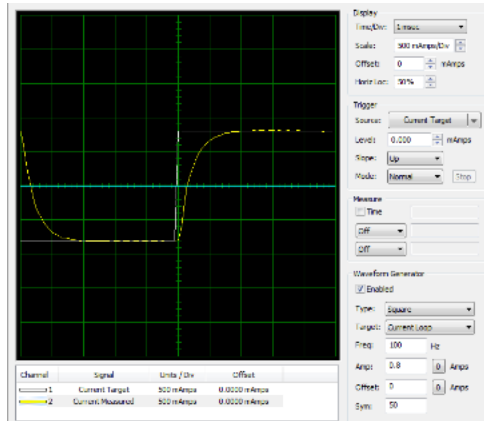
3. Press the Apply button to save the changes.
4. Verify the encoder resolution by rotating the motor shaft by hand and viewing the measured position on the digital oscilloscope or Multimeter.

## Current Loop Tuning

Tune the current loop as outlined in the steps below.

**Note: It may be necessary to clamp down on the rotor to prevent unwanted motion during tuning. Start with a low current command, and then increase it slowly to minimize erratic rotor movement.**

1. Set up the Waveform Generator in the Scope/Tuning window to send a 100 Hz square wave into the current loop. Set the current amplitude within the drive and motor current limits.
2. With the Scope/Tuning window still open, select *Tuning > Current Loop Gains* from the System Browser.
3. Choose *Calculate* from the Current Loop Gains tab as a starting point for signal tuning. *Calculate* uses the data entered in the Motor window to derive a starting point for current loop tuning. If unsure about the accuracy of the motor information, begin with both Proportional and Integral Gain at zero.
4. Choose the Current Scope Preset from the Scope Settings tab to configure the digital oscilloscope. Verify that the “Current Target” square wave is visible on the oscilloscope. Adjust the *Time/Div* (1msec or 500µsec typically) or amplitude scale if necessary.
5. Enable the drive by clicking the Enable icon. Adjust the Proportional Gain until a “knee” is formed, then adjust the Integral Gain as necessary until the measured current closely approximates the target current.



1. Select *Motor > Phase Detect* from the System Browser.
2. Enter the appropriate values in the Phase Detect window.
3. Click the **Phase Detect** button to begin the routine.
4. Monitor the Phase Detect events in the Drive Status panel to determine when Phase Detect has completed successfully. If necessary, adjust the Phase Detect parameters and re-run the routine.

6. Click the Disable icon when complete, and click Apply and Store from the toolbar to save the tuning parameters.

## AutoCommutation

Run the AutoCommutation routine in DriveWare.

1. Enable the drive by clicking the Enable icon.
2. Select *Motor > AutoComm* from the System Browser.
3. Verify that the values in the AutoComm window match the desired data, then click **Start AutoCommutation**. During the process, observe the motor distance traveled in each direction.
4. When AutoCommutation is complete, select whether the motor moved the proper distance. If it did not, verify the pole count in the *Motor > Parameters* window.
5. Verify the proper commutation and synchronization settings.
6. Click Apply and Store to save the settings.

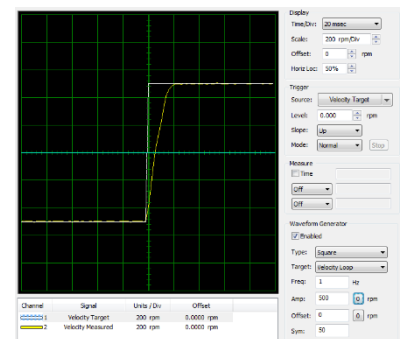
## Phase Detect

Phase Detect is required to establish absolute position for brushless motors that do not use Hall Sensors or an absolute feedback device. The Phase Detect routine will need to be ran each time the drive is power cycled or reset. Run the Phase Detect routine in DriveWare according to the steps below.

## Velocity Loop Tuning

Tune the velocity loop according to the steps below.

1. Set up the Waveform Generator in the Scope/Tuning window to send a 1-3 Hz square wave into the velocity loop. Set the amplitude to approximately 10% of nominal motor speed.
2. Select *Tuning > Gain Set 0* to open the velocity loop gain parameters. Set all the velocity loop gains to zero.
3. Choose the Velocity Scope Preset in the Scope/Tuning window to configure the digital oscilloscope. Verify that the Velocity Target square wave is visible on the oscilloscope. Adjust the *Time/Div* (10-20msec typically) or the amplitude scaling if necessary.
4. Enable the drive by clicking the Enable icon.
5. Adjust the Velocity Loop Proportional Gain until a knee is formed, then adjust the Integral Gain until a slight overshoot in the measured velocity is observed. Typically the Feedback Filter Cut Off Freq (*Tuning > Filters*) should then be set to between 50-1500 Hz to dampen oscillations and noise. The Low Speed Smoothing can



## Stepper Motor Setup Process

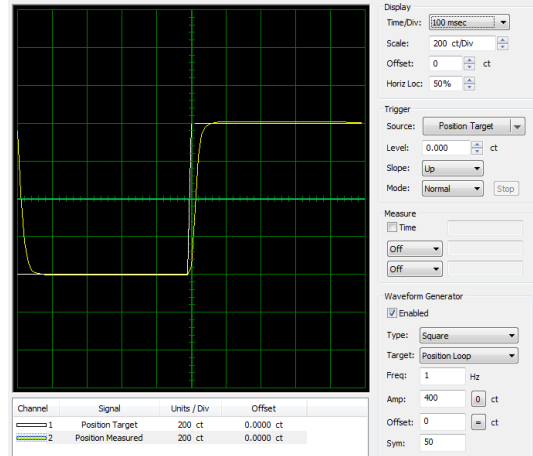
also be increased if the motor is vibrating or making excessive noise.

- When adjustments are complete, click the Disable icon, and click Apply and Store to save the gain settings.

### Position Loop Tuning

Tune the position loop according to the steps below.

- Set up the Waveform Generator in the Scope/Tuning window to send a 1-3 Hz square wave into the position loop. Set the amplitude to between 1/8 and 1/2 revolution.
- Select *Tuning > Gain Set 0* to open the position loop gain parameters. Set all the position loop gains to zero.
- Enter "0" in the *Set Position* field, and click the **Set** button to set the Measured Position and Target Position equal to 0.
- Choose the Position Scope Preset from the Scope/Tuning window to configure the digital oscilloscope. Verify that the Position Target square wave is visible on the oscilloscope. Adjust the *Time/Div* (20-50 msec typically) or the amplitude scaling if necessary.
- Enable the drive by clicking on the Enable icon.
- Beginning with the Position Loop Proportional Gain, adjust the gains as necessary until the measured position closely approximates the target position without excessive overshoot.



- When adjustments are complete, disable the drive by clicking the Disable icon, and click Apply and Store to save the gain settings.