



DigiFlex[®] Digital Servo Drive Startup Guide

DR and DQ Series DriveSuite Software



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Foreword

This interactive guide will provide an overview of connection and basic setup instructions for Advanced Motion Controls DR and DQ Series DigiFlex® digital servo drives, using the DriveSuite software. The basic setup of a DigiFlex® drive is designed to be analogous to the set up and tuning of an analog amplifier. These instructions will walk you through the following steps necessary to start up your drive and motor:

1. Connect to a drive
2. Enter motor data
3. Set application current, voltage, position and temperature limits
4. Tune the drive current control loop
5. Determine motor commutation (brushless and linear motors)
6. Tune the drive velocity control loop (if necessary)
7. Tune the drive position control loop (if necessary)
8. Analog command setup

These instructions are written for use with either a brush type motor or a brushless motor with any of the following feedback sources:

- Encoder with hall sensors
- 1V_{p-p} sin/cos encoder with hall sensors
- Encoder only
- 1V_{p-p} sin/cos encoder only
- Resolver

Save your project often to the Drive Suite\My Projects directory.

Assistance for topics not covered in this guide is available through any of the following:

- DriveSuite Help files
- www.a-m-c.com
- Technical Assistance via phone: 805-389-1935
- Technical Assistance via e-mail: techsupport@a-m-c.com.

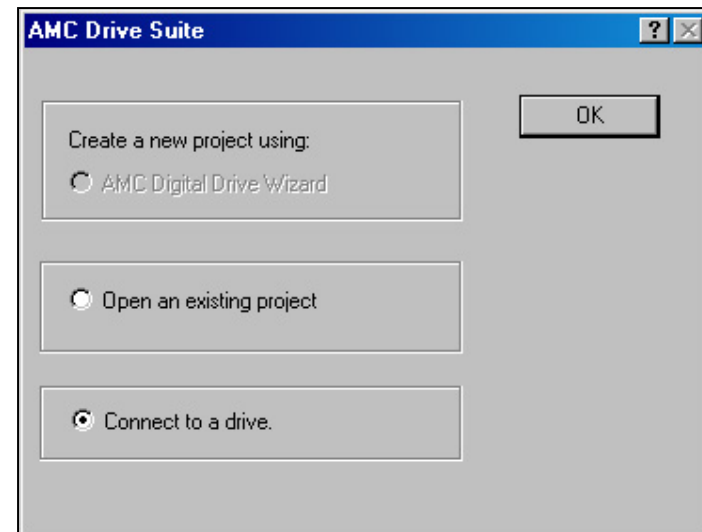
Connect to a Drive

1. Install the AMC DriveSuite software onto your PC.
2. For a DR Series DigiFlex[®] drive, connect an available RS-232 communications port on your PC to the serial interface on the drive. Use a straight-through cable (not null-modem.)
3. For a DQ Series SynqNet[™] DigiFlex drive, connect the SynqNet[™] controller to the SynqNet[™] interface on the drive.
4. Connect motor feedback (hall sensor, encoder, resolver), as applicable, to the appropriate feedback connector.
5. If desired, connect an Inhibit/Enable circuit to one of the Programmable Digital Input pins on the I/O connector. See the appropriate product data sheet for digital input specifications.
6. Connect the motor phase wires to the motor phase terminals on the motor connector.
Note: if using a brush type motor, connect to MB and MC terminals.
7. Apply power to the drive.
8. Double click on AMC_DriveSuite.exe to start the setup software.

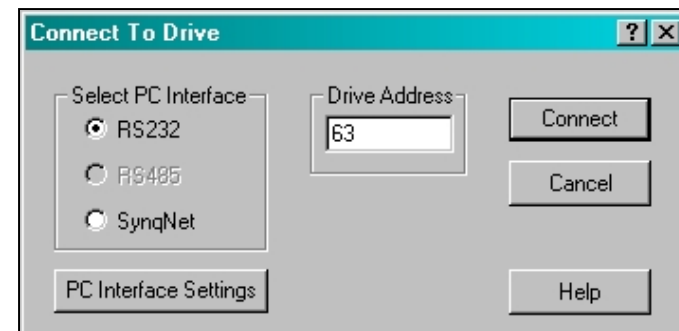
Connect to a Drive

For the DR Series DigiFlex® drives, proceed as follows.
For DQ Series SynqNet™ drives, proceed to step 15 on page 6:

9. At the opening screen, select *Connect to a drive* and click "OK".

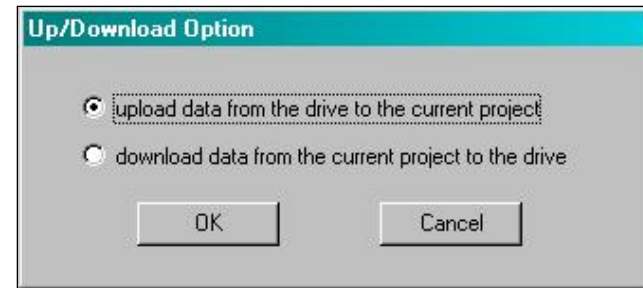


10. Select *PC Interface Settings* and set the appropriate communications parameters to connect to the drive. If unknown, select *Auto Detect*.

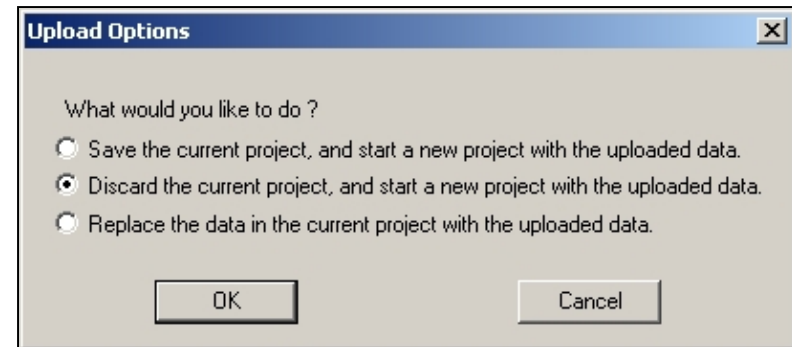


Connect to a Drive

11. If connecting for the first time, select *Upload data from the drive to the current project*





12. The Upload Options window provides options on whether to *Save the current DriveSuite* project before uploading from the drive; *Discard the current DriveSuite* project before uploading from the drive; or upload the data from the drive to *Replace the data* in the current DriveSuite project. If connecting to a drive immediately after starting DriveSuite, the only available option is to *Discard the current project and start a new project with the uploaded data*.



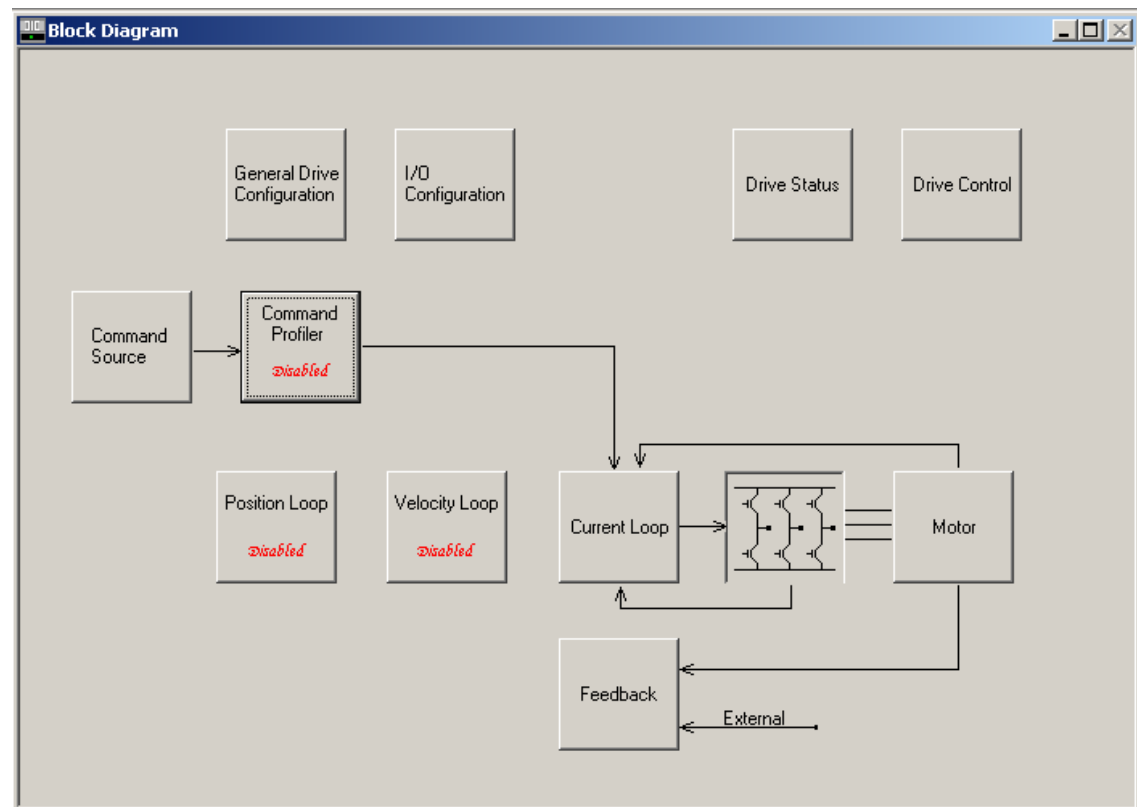
You are now connected to the drive. The status indicators on the bottom right corner of the DriveSuite main window should indicate "BRIDGE DISABLED" and "CONNECTED."

Connect to a Drive

13. To change the RS-232 communications baud rate, perform the following steps:
 - a. On the Menu bar, select *Communication* → *Connect* (or click the *Connect* icon )
 - b. Click the *PC Interface Settings* button to open the RS-232 Settings window.
 - c. Select the appropriate baud rate.
 - d. Click *Connect* in the Drive Connection Window to set the selected baud rate.
 - e. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.

Note: Some PC's may not communicate reliably at higher baud rates. If increasing the communications baud rate results in communications errors, use a lower rate.

14. Proceed to "Enter Motor Data" on page 7.



Connect to a Drive

To connect to a DQ series SynqNet™ servo drive, proceed as follows:

15. Establish SynqNet™ communications with the drive using Motion Engineering's Motion Console software.
16. At the DriveSuite opening screen, select *Connect to a drive* and click "OK".

17. Under *Select PC Interface*, select *SynqNet*.

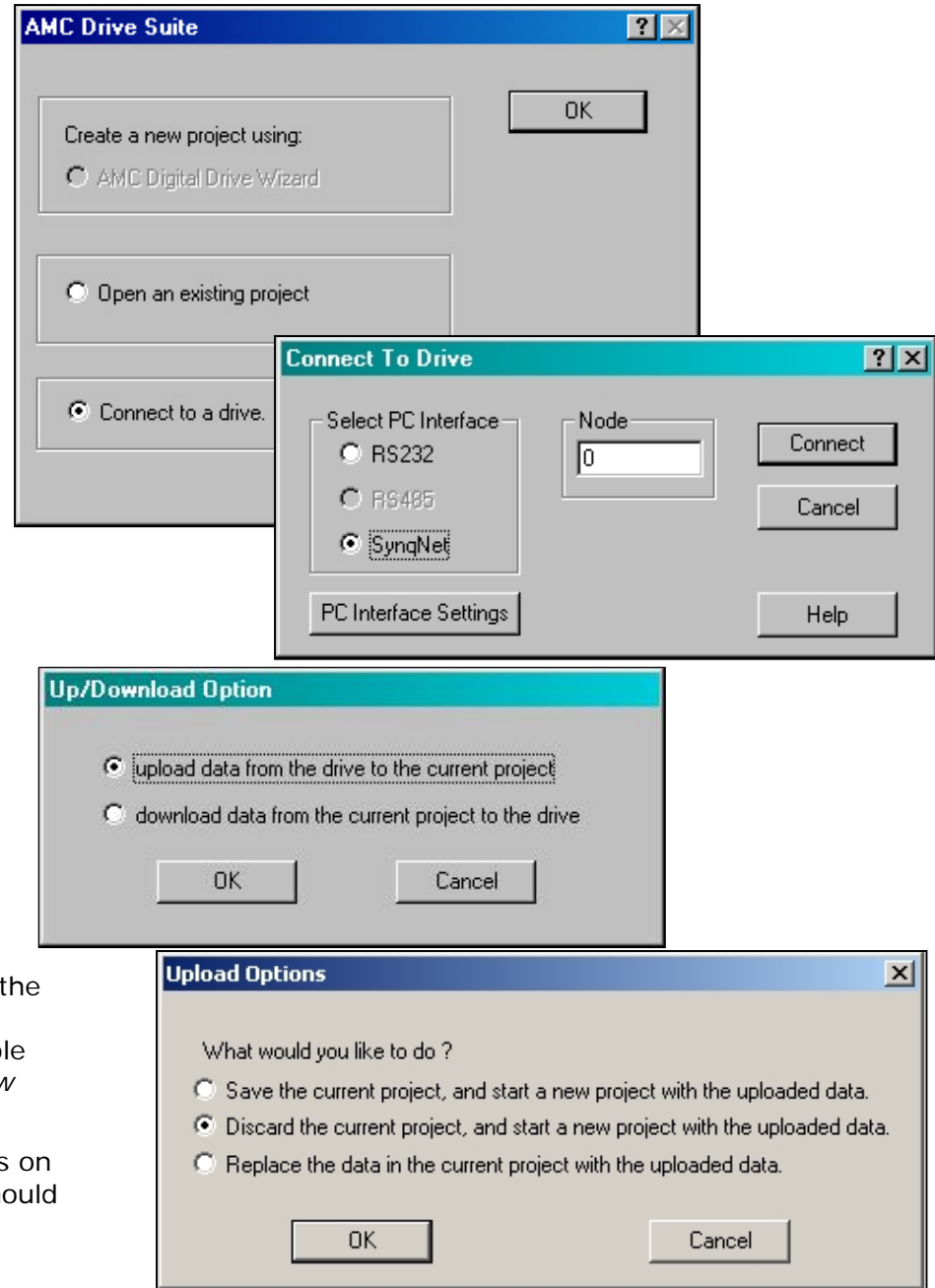
18. Enter the appropriate SynqNet™ *Node* number (normally zero if the drive is the first device on the network).

19. Click *Connect*.

20. If connecting for the first time, select *Upload data from the drive to the current project*.

21. The Upload Options window provides options on whether to *Save the current DriveSuite project* before uploading from the drive; *Discard the current DriveSuite project* before uploading from the drive; or upload the data from the drive to *Replace the data* in the current DriveSuite project. If connecting to a drive immediately after starting DriveSuite, the only available option is to *Discard the current project and start a new project with the uploaded data*.

You are now connected to the drive. The status indicators on the bottom right corner of the DriveSuite main window should indicate "BRIDGE DISABLED" and "CONNECTED."




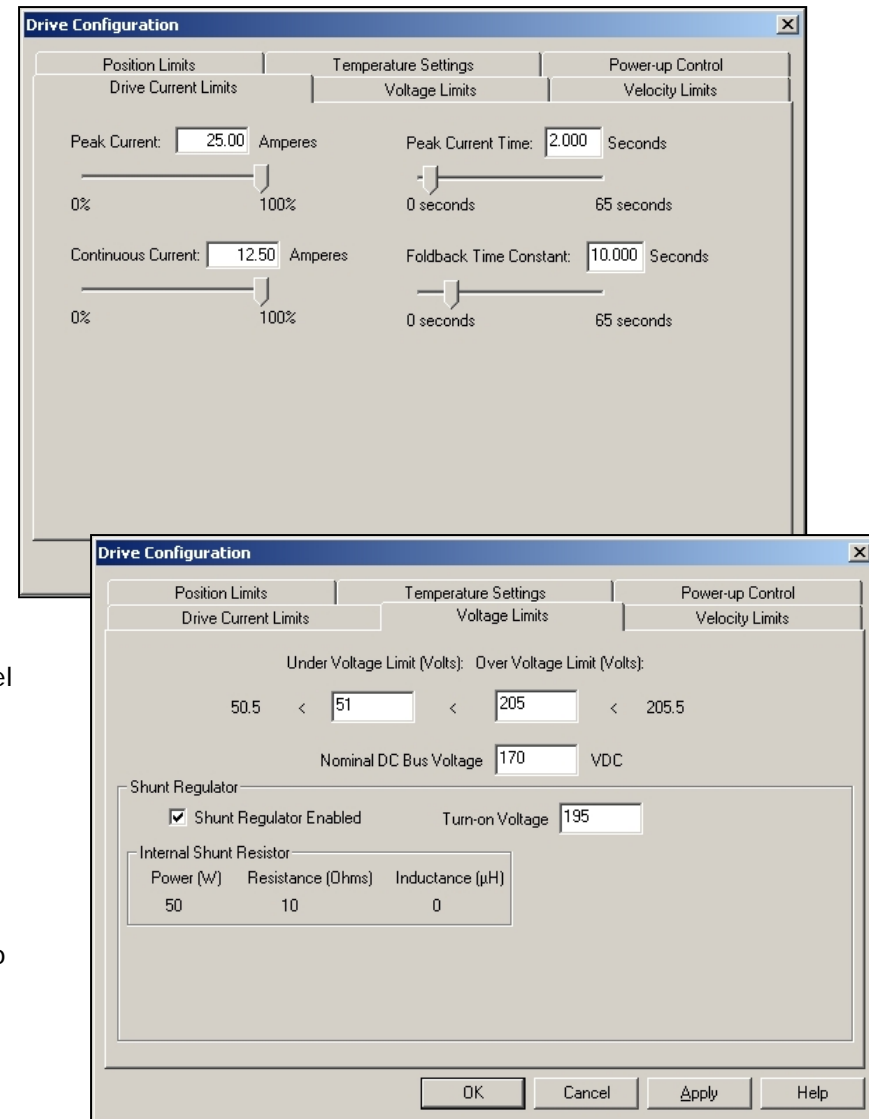
Enter Motor Data

1. In the Block Diagram window, select *Motor* to open the Motor Data window.
2. Enter the *Manufacturer* name and motor *Model* number.
3. Select the appropriate *Motor Type*.
4. Select the *Motor Constants* tab.
5. Enter data from the applicable motor data sheet into the appropriate block in the Motor Data window. **The following *Motor Constants* fields are required for proper operation and are shown circled in red:**
 - a. Maximum Current
 - b. Rated Current
 - c. Number of Poles
 - d. Maximum Speed
6. If desired, select the appropriate color or numerical wire designations in the *Wire Identification* section.
7. Select the *Primary Feedback* tab.
8. Enter accurate Hall Sensor and Encoder data (**all required**).
9. For motors with Resolver feedback, select either low- or high-resolution interpolation. (See the appropriate drive data sheet for resolution options.)
10. To save the motor data to a local database on your PC, click *Save to Database*.
 - a. Saved motor data can be recalled by clicking *View Database*.
11. If desired, select the appropriate color or numerical wire designations in the *Wire Identification* section.
12. Click OK to close the Motor window (this will automatically save the motor data to the drive nonvolatile memory).

The image displays two screenshots of the 'Motor Data' configuration window. The top screenshot shows the 'Motor Constants' tab with the following fields: Manufacturer (AMC Default Motors), Model (Default Brushless), Motor Type (Brushless), Feedback Model (120° Halls, 5000 Line Encoder), Voltage Constant (20 V/Krpm), Torque Constant (1 N·m/A), Resistance (0.5 Ohm), Inductance (1 mH), Thermal Time Constant (2 minutes), Max Motor Temperature (100 °C), Maximum Current (100 Amps), Rated Current (50 Amps), Number of Poles (8), and Maximum Speed (3000 RPM). The bottom screenshot shows the 'Primary Feedback' tab with the following fields: Hall Sensors (checked), Motor Encoder (checked), Primary Feedback Polarity (Standard), Line Count (5000 Lines/Rev), Index (checked), # of Indices per Revolution (1), Rotation Direction (Standard), and Wire Identification (Hall 1 Connector, Hall 2 Connector, Hall 3 Connector, Encoder Channel A, Encoder Channel B, Encoder Index).

Set Current, Voltage, Velocity, Position, and Temperature Limits

1. In the block diagram window, select *General Drive Configuration*.
2. Set the peak and continuous current limits based on those indicated in the motor data sheet (or as needed).
3. Set the maximum peak current time and foldback time constant based on system requirements and motor data sheet.
 - a. Foldback time constant is the time, in seconds, for the linear decrease from the amplifier peak current setting to the amplifier continuous current setting.
4. Select the *Voltage Limits* tab.
5. Set the Over- and Under-Voltage limits based on system requirements.
6. If available, set the Shunt Regulator turn-on voltage (model dependent)
 - a. Note: If unsure, set approximately 10V above nominal bus voltage.
7. If necessary, set the External Shunt Resistor specifications (model dependent).
8. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.



Set Current, Voltage, Velocity, and Temperature Limits

9. Select the *Velocity Limits* tab
10. Enter values for the *Motor Over Speed* and *Zero Velocity Window* (in rpm).

Note: The value for *Motor Over Speed* is limited by the motor *Maximum Speed* value in the *Motor Data* window.

The screenshot shows the 'Drive Configuration' dialog box with the 'Velocity Limits' tab selected. The 'Position Limits' and 'Temperature Settings' tabs are also visible. The 'Velocity Limits' section contains the following fields:

Parameter	Value	Unit	Limit
Motor Over Speed	3000	RPM	
Zero Velocity Window	10	RPM	
At Velocity Window	10	RPM	
Velocity Following Error	20	RPM	
Positive Velocity Limit	3000	RPM	≤ Motor Over Speed
Negative Velocity Limit	3000	RPM	≤ Motor Over Speed

11. Select the *Position Limits* tab.
 12. Enter values for *Max* and *Min Measured Position Limit*.
- Notes: For general tuning purposes, the other *Position Limit* fields can be left at their default values.

Position Limits can be disabled by selecting *Disable Position Limits*.

The screenshot shows the 'Drive Configuration' dialog box with the 'Position Limits' tab selected. The 'Drive Current Limits', 'Voltage Limits', and 'Velocity Limits' tabs are also visible. The 'Position Limits' section contains the following fields:

Parameter	Value	Unit
In-Home Position Window:	100	counts
In-Position Window:	100	counts
Position Following Error Window:	100	counts
Home Position Value:	0	counts
Measured Position Value:	0	counts
Max Measured Position Limit:	10000000	counts
Min Measured Position Limit:	-10000000	counts
Max Target Position Limit:	10000000	counts
Min Target Position Limit:	-10000000	counts

☐ Disable Position Limits

Buttons: OK, Cancel, Apply, Help

Set Current, Voltage, Velocity, and Temperature Limits

13. Select the *Temperature Settings* tab.
14. Set the *Motor Over Temperature* setpoint for *Event Action Active* and *Event Action Inactive*.
 - a. Note: Maximum motor temperature is determined by the value entered into the *Motor Data* window.
15. Select the input source for motor temperature (if desired).
16. If available, set the values for *User Drive Over Temperature* (model dependent).

The screenshot shows the 'Drive Configuration' dialog box with the 'Temperature Settings' tab selected. The 'Motor Over Temperature' section is visible, containing two rows of settings. The first row is for 'Event Action Active Level' with a value of 100 °C and a range of 100 °C. The second row is for 'Event Action Inactive Level' with a value of 95 °C and a range of 95 °C. To the right of these settings is a 'Select Source:' section with three radio button options: 'Analog Input 3' (selected), 'Interface Input 1', and 'Not Assigned'. Each option has a small button next to it. At the bottom of the dialog are four buttons: 'OK', 'Cancel', 'Apply', and 'Help'.

Drive Current Limits	Voltage Limits	Velocity Limits
Position Limits	Temperature Settings	Power-up Control

Motor Over Temperature


Event Action	Level	Unit	Range	Select Source
Event Action Active Level	100	°C	≤ 100 °C	<input checked="" type="radio"/> Analog Input 3 ...
Event Action Inactive Level	95	°C	≤ 95 °C	<input type="radio"/> Interface Input 1 ...
				<input type="radio"/> Not Assigned

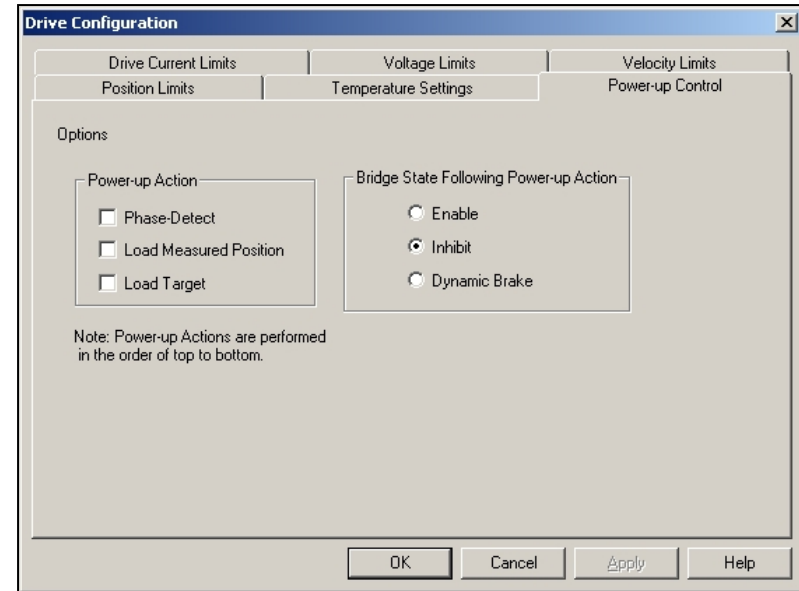
OK Cancel Apply Help

Power-Up Options

1. If not already open, select *General Drive Configuration* in the Main Block Diagram.
2. Select the *Power-Up Control* tab.
3. Select the *Power-up Action*, if any, that you would like to occur on power-up. (Optional)
4. Select the desired *Bridge State Following Power-up Action* (e.g. drive enabled, drive inhibited) that you would like to occur after the *Power-up Action*, if any, has completed.



Note: The Power-up state of Enable or Inhibit applies to the state of the Commanded Inhibit only. User inhibits, asserted by I/O or SynqNet, are still capable of inhibiting the drive.

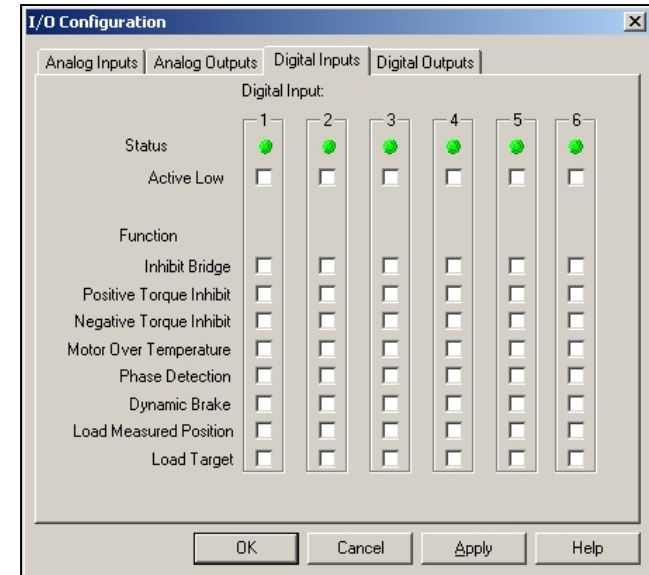
5. Click *OK* to accept the data entered.
6. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.



Current Loop Tuning

Caution: Disconnect motor from the load and secure the motor. Sudden motion will occur.

1. For the DR Series DigiFlex® drives, set up for tuning as follows:
 - a. Click the I/O Configuration Block
 - b. Select the *Digital Inputs* Tab
 - c. If an external Inhibit/Enable circuit is used during setup, use the check boxes to assign the Inhibit function and proper polarity (e.g.: active high or active low) to the appropriate *Digital Input* channel.
 - d. If no external Inhibit/Enable circuit is used during setup, clear check boxes for all inhibits. Inhibit/Enable will be controlled solely through the DriveSuite *Enable/Disable Drive* icon /.
 - e. Continue to step 3.



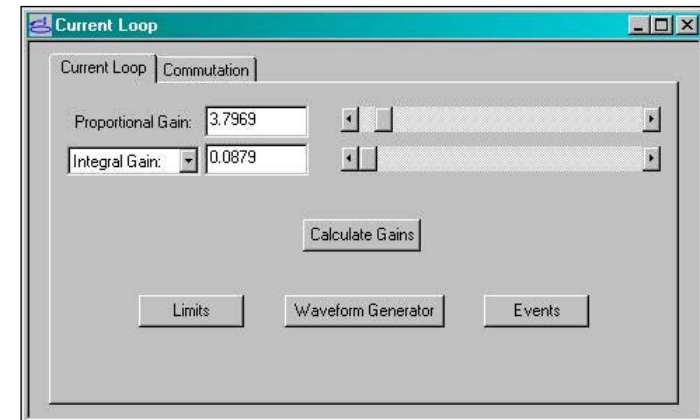
2. For the DQ Series SynqNet™ drives, set up for tuning within MEI Motion Console as follows:
 - a. Set the *Output Limit* in the Filter window to zero.
 - b. Set the *Error Limit Action* to "None" in the appropriate Motor window
 - c. Clear any faults.
 - d. Set the *Drive Enable* check box.

Note: Consult the Motion Engineering documentation or Motion Engineering technical support for assistance with Motion Console.

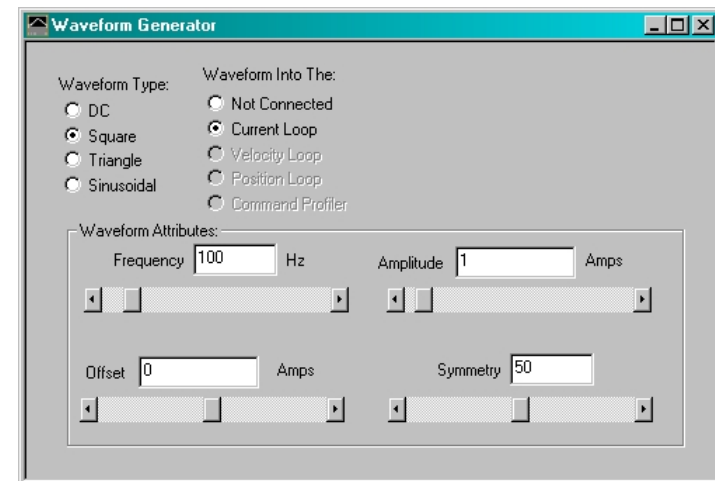
Current Loop Tuning

3. On the Main Block Diagram, click *Current Loop* to open the current loop tuning parameters.
4. To set starting values for proportional and integral gains, click the *Calculate Gains* button.



Note: *Calculate Gains* utilizes the values entered into the Motor Data and General Drive Configuration screens. Accuracy of the calculated values is determined by the accuracy of the motor *Resistance* and *Inductance* settings, as well as the application *Nominal Bus Voltage* setting. If accurate motor winding data is not available, begin with *Proportional Gain* = 1, and *Integral Gain* = 0.

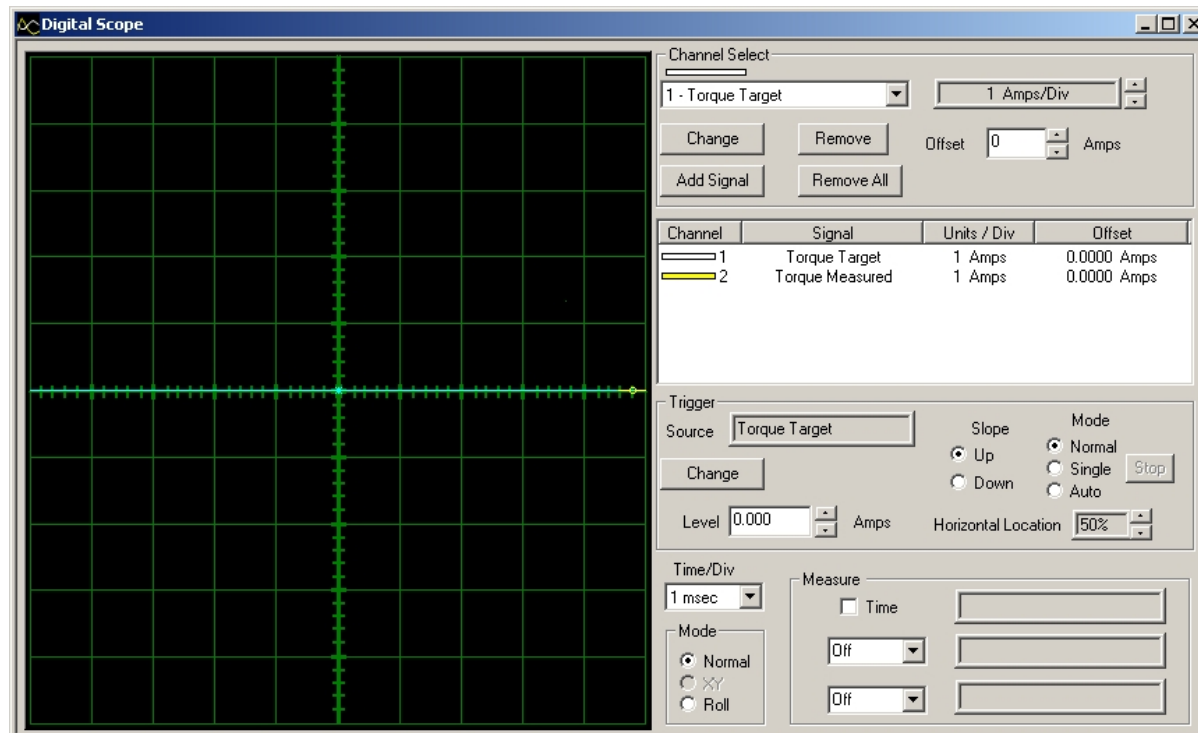


5. In the Current Loop window, click the *Waveform Generator* button (or select Tools → Waveform Generator on the menu bar) to open the Waveform Generator screen. Set up the Waveform Generator as follows:
 - a. Select a *Square* Waveform Type.
 - b. Set the *Frequency* to 100Hz.
 - c. Ensure *Offset* is zero.
 - d. Ensure *Symmetry* is 50%.
 - e. Select *Waveform into the Current Loop*
 - f. Set the waveform amplitude to an appropriate value.
 - i. Begin with ~10% of the drive continuous current rating, or ~50% of the continuous current setting, whichever is lower.





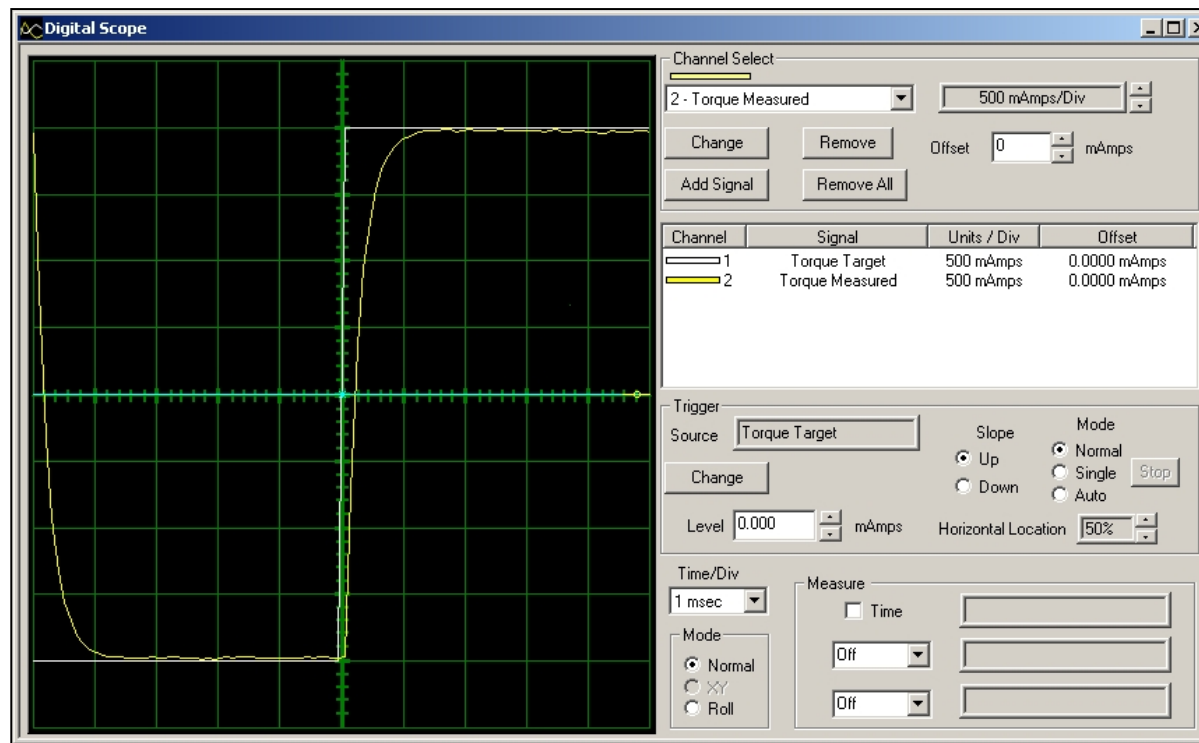
Current Loop Tuning

6. On the menu bar, select Tools → Oscilloscope to open the digital oscilloscope (or click the Oscilloscope icon ) Set up the scope view as follows:
 - a. In the *Channel Select* area of the scope, use the *Change*, *Add Signal*, and *Remove* buttons as necessary to set the *Torque Target* signal on Channel 1 and the *Torque Measured* signal on Channel 2.
 - b. In the *Trigger* area of the scope, use the *Change* button as necessary to establish *Torque Target* as the Trigger Source at a level of zero amps, Up Slope, and Normal Mode.
7. Position the Scope, Waveform Generator, and Current Loop windows such that a majority of all three windows is visible.
8. Enable the drive by clicking the *Enable/Disable Drive* icon .



Current Loop Tuning


9. Use the *Proportional Gain* and *Integral Gain* sliders or arrow buttons to adjust the *Torque Measured* waveform on the oscilloscope to match the *Torque Target* as closely as possible, without overshooting the *Torque Target*.
10. On the Waveform Generator, readjust the current amplitude as necessary:
 - a. For contouring applications, use a small signal amplitude (i.e. motion profile rms current.)
 - b. For point-to-point applications, use a larger signal (i.e. continuous current limit.)
11. Readjust *Proportional Gain* and *Integral Gain* settings as necessary.
12. Disable the drive by clicking the *Enable/Disable Drive* icon .
13. When current loop gain adjustments are complete, click *Not Connected* on the Waveform Generator to remove the command signal from the drive.
14. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.

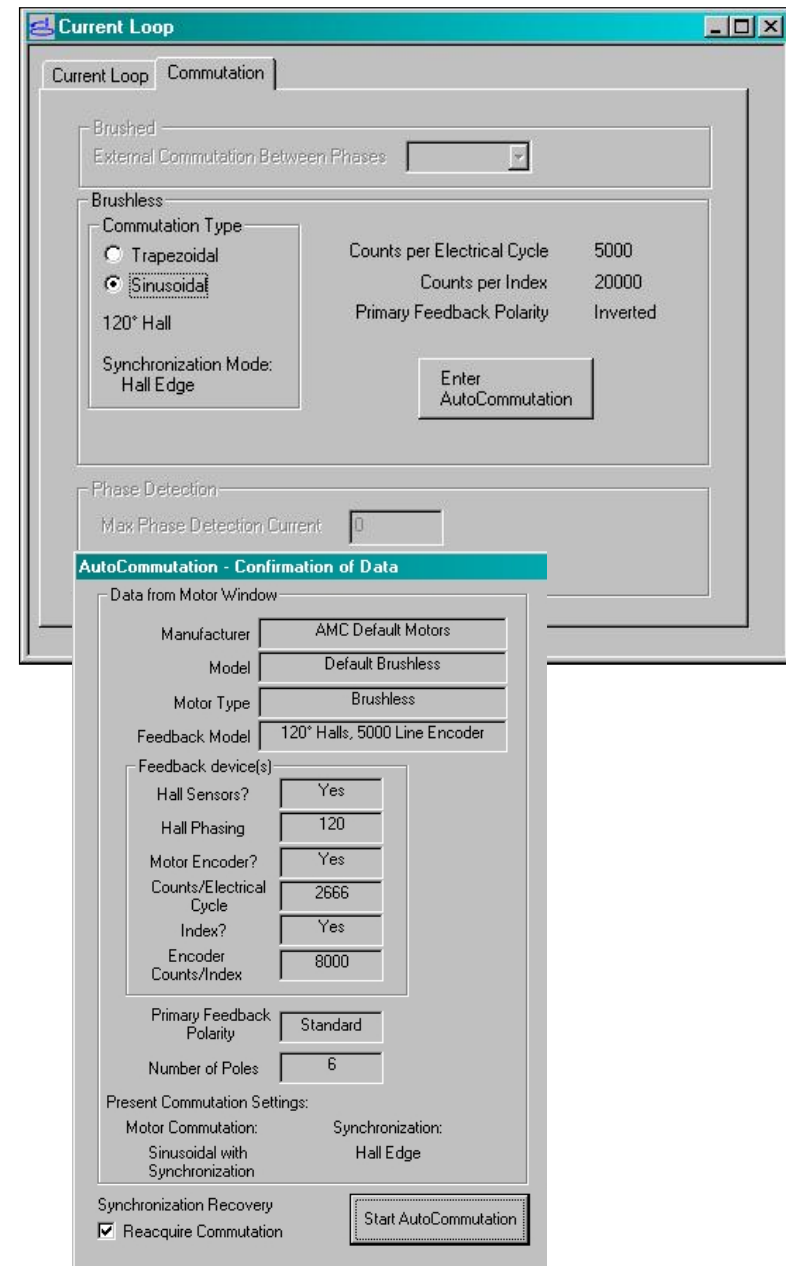


Auto Commutation

For brushless and linear motors with insufficient travel distance (two revolutions plus one electrical cycle for rotary motors, or three electrical cycles for linear motors), please contact technical support for assistance. For brushless and linear motors with sufficient travel distance, proceed as follows:

Caution: De-couple motor from any load and secure the motor chassis. Sudden motion will occur.


1. In the Current Loop window, select the *Commutation* tab.
2. Ensure *Sinusoidal* commutation is selected.
3. Verify that indicated *Counts per Electrical Cycle*, *Counts per Index*, and *Number of Poles* values are correct. (The *Primary Feedback Polarity* will be determined during AutoCommutation.)
4. If drive is disabled, click the *Enable/Disable Drive* icon  to enable the drive.
5. Click *Enter AutoCommutation* to open the Commutation Data window.
6. Ensure the *Reacquire Commutation* check box is checked.
7. Click *Start AutoCommutation* to begin the process.
 - a. During the AutoCommutation process, monitor the distance traveled in each direction.
 - i. Rotary motors will turn two revolutions plus one electrical cycle in each direction.
 - ii. Linear motors will move three electrical cycles in each direction.



The screenshot displays the 'Current Loop' software interface. The 'Commutation' tab is selected, showing settings for 'Brushless' commutation. The 'Commutation Type' is set to 'Sinusoidal', and the 'Synchronization Mode' is 'Hall Edge'. The 'Counts per Electrical Cycle' is 5000, and the 'Counts per Index' is 20000. The 'Primary Feedback Polarity' is 'Inverted'. A button labeled 'Enter AutoCommutation' is visible. Below this, the 'AutoCommutation - Confirmation of Data' window is open, showing a summary of motor parameters: Manufacturer (AMC Default Motors), Model (Default Brushless), Motor Type (Brushless), Feedback Model (120° Halls, 5000 Line Encoder), Feedback device(s) (Hall Sensors? Yes, Hall Phasing 120, Motor Encoder? Yes, Counts/Electrical Cycle 2666, Index? Yes, Encoder Counts/Index 8000), Primary Feedback Polarity (Standard), and Number of Poles (6). The 'Present Commutation Settings' are listed as 'Motor Commutation: Sinusoidal with Synchronization' and 'Synchronization: Hall Edge'. At the bottom, the 'Synchronization Recovery' checkbox is checked, and a 'Start AutoCommutation' button is present.

Auto Commutation

8. When AutoCommutation has completed, select whether or not the motor has moved the proper distance.
 - a. If the motor did not move the proper distance, verify the pole count or pole pitch in the Motor Data window. Click OK in Motor Data to return to the Auto Commutation window.
9. Select the appropriate mode of commutation synchronization.
 - a. For motors with Hall sensor and encoder feedback select *Sinusoidal with Synchronization* and select *Hall Edge* for the synchronization signal. Click OK.
 - b. For motors using encoder with index channel only or resolver, select *Sinusoidal with Synchronization* and select *Encoder Index* for the synchronization signal. Click OK.
10. In some cases, the AutoCommutation results will slightly differ from Motor Data (e.g. *Counts/Electrical Cycle*, *Counts/Index*). In those cases, you may choose between using the value determined by Auto Commutation or use the values from Motor Data ("Use Value").

11. Click *Accept* to apply the AutoCommutation parameters.
 - a. If the *Accept* button is not available, the Motor Data feedback parameters entered were not correct. Click *Edit Motor Data*, and AutoCommutation will automatically correct the feedback data (this does not apply to serial absolute encoders). Click OK in the Motor Data page to return. The *Accept* button should now be available.
12. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.

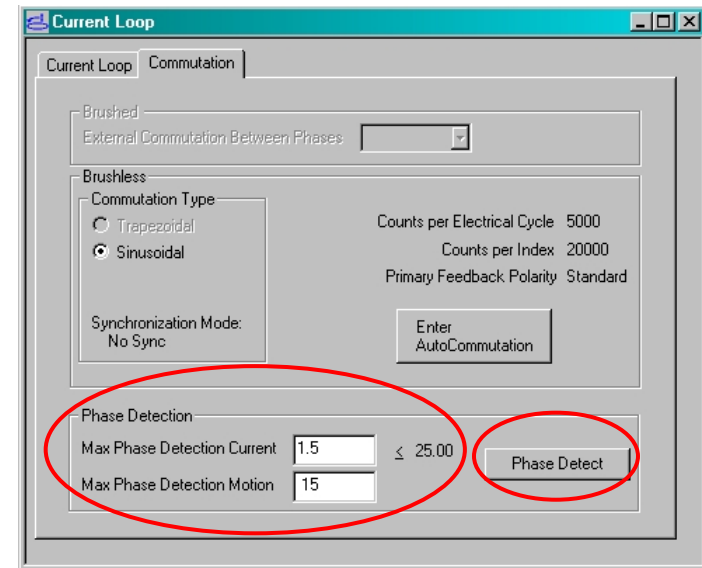
Phase Detect

If the motor is using encoder-only feedback or a serial-interface absolute encoder, the *Phase Detect* function must be used directly following powerup, as well as any time there is a loss of sinusoidal commutation. *Phase Detect* re-establishes sinusoidal commutation.

1. From the main Block Diagram, open the *Current Loop* window. Select the *Commutation* tab.
2. Enter the *Max Phase Detection Current* (Amps) and *Max Phase Detection Motion* in electrical degrees (these settings don't apply for serial communication absolute encoders).

Note: *Max Phase Detection Current* is empirically determined. For most uncoupled motors, approximately 0.5 to 0.75A will suffice.

3. To activate Phase Detect from within DriveSuite, proceed as follows:
 - a. From the main Block Diagram, open *DriveStatus*.
 - b. Enable the drive.
 - c. Click the *Phase Detect* button on the *Commutation* tab of the *Current Loop*.
 - d. Monitor the *Phase Detect Complete* indication in *Drive Status*. When this indication is activated, click *End Phase Detect*.
4. To activate Phase Detect via external trigger of a digital input, proceed as follows:
 - a. From the main Block Diagram, open the *I/O Configuration* window and select the *Digital Inputs* tab.
 - b. Assign the appropriate Digital Input to the *Phase Detection* function and, if necessary, select *Active Low*.
 - c. For *Phase Detect Complete* indication, assign the appropriate Digital Output and, if necessary, select the *Active Low* check box. Click "OK" to close the *I/O Configuration* window.
 - d. Enable the drive.
 - e. Activate the appropriate digital input to begin the Phase Detect process. The motor will slightly vibrate back and forth.
 - f. When motion is complete (*Phase Detect Complete* indication in *Drive Status*), deactivate the digital input to terminate Phase Detect.

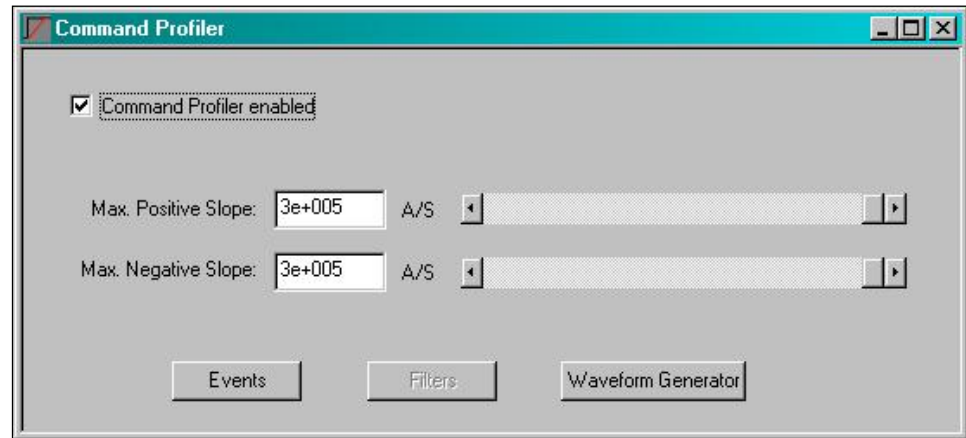


Current Loop Command Profiling

While in torque mode, the Command Profiler can be used to limit the rate of change of current and, subsequently, the rate of change of acceleration (commonly referred to as “jerk”).

1. From the Main Block Diagram, open the *Command Profiler*.
2. Activate the check box for *Command Profiler Enabled*.
3. Using the slider bars or numerical entry, enter a value for the maximum change in current (amps per second). Different values can be entered for both positive and negative slopes (di/dt).

Note: To use the command profiler when utilizing the Waveform Generator, select the *Waveform Into the: Command Profiler*. The output of the Command Profiler, while in Torque Mode, is the *Target Torque*.

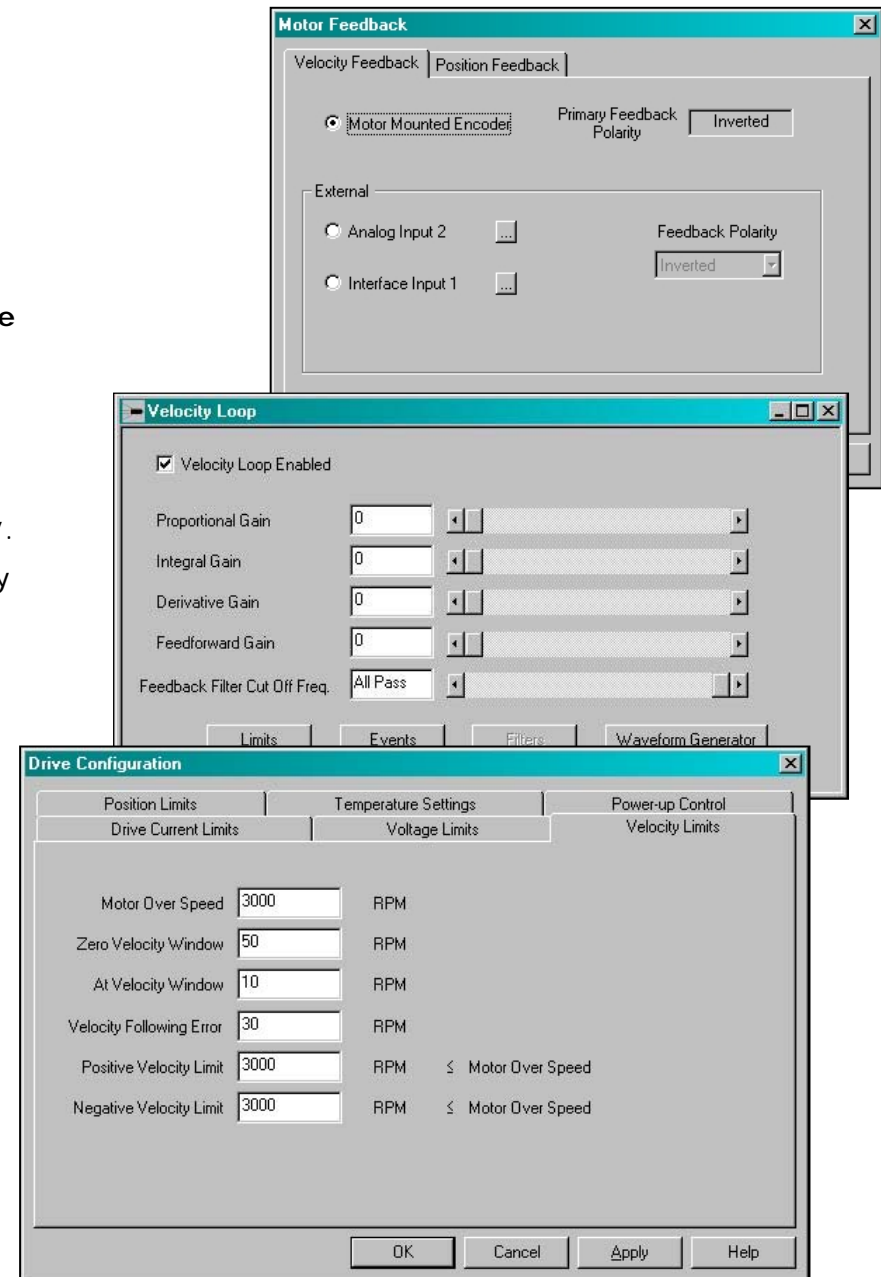


Velocity Loop Tuning

Notes: DigiFlex® servo drive Velocity Loop control is not supported by SynqNet™.

Velocity loop tuning is dependent on the mechanical load of the motor and, therefore will change with any mechanical system changes. Velocity loop tuning should be performed with the motor installed in the system.

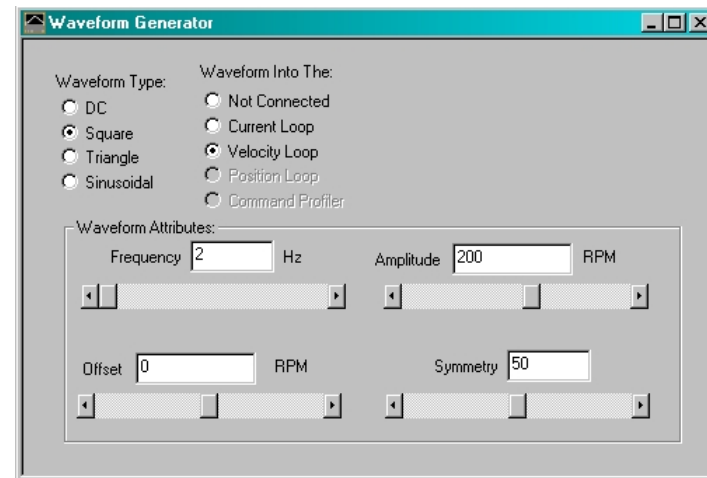
1. Verify that the drive is disabled (🔴).
2. From the Main Block Diagram, open the Feedback window and select the *Velocity Feedback* tab.
3. Select the appropriate velocity feedback source. Click "OK".
Note: If Auto Commutation was performed, the velocity feedback polarity has been automatically determined.
4. From the Main Block Diagram, open the *Velocity Loop* window.
5. Select the check box for *Velocity Loop Enabled*.
6. In the *Velocity Loop* window, click the *Limits* button to open the *Velocity Limits* tab in *General Drive Configuration*.
7. Enter values for *At Velocity Window*, *Velocity Following Error*, *Positive Velocity Limit*, and *Negative Velocity Limit*.
Note: Velocity limit values cannot exceed the Maximum Speed rating of the motor (from the Motor Data window).
8. Click "OK" to accept values and close *General Drive Configuration*.




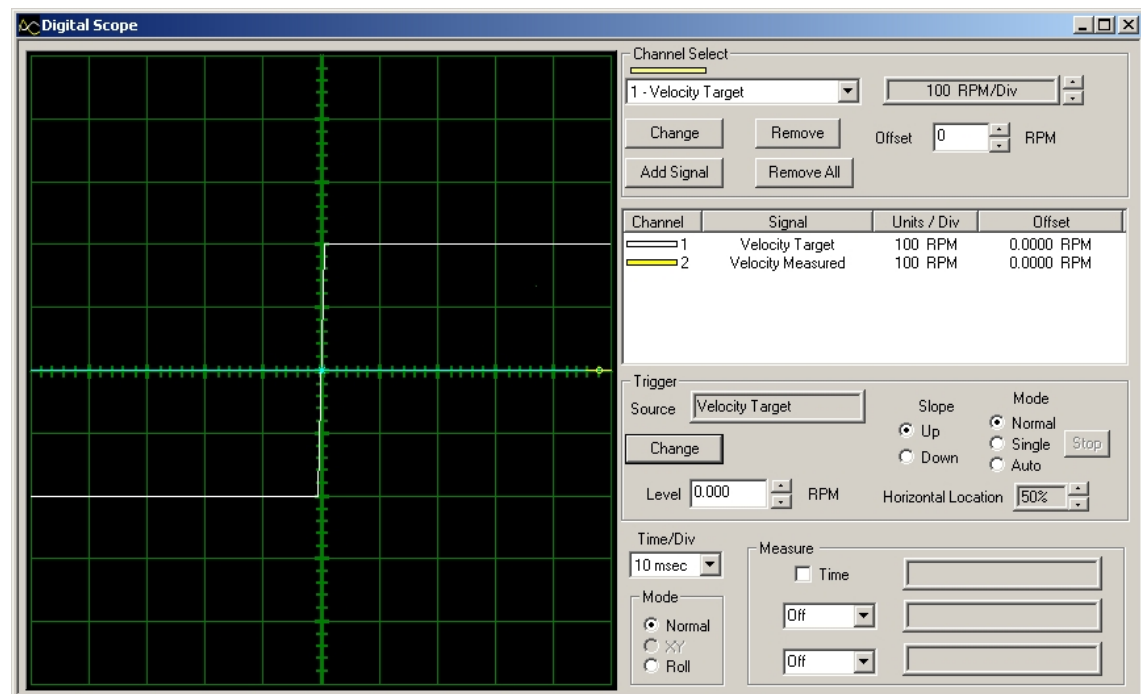
Velocity Loop Tuning

9. In the *Velocity Loop* window, click the *Waveform Generator* button to open the Waveform Generator.
10. With the Waveform Generator, establish a *Square* wave into the *Velocity Loop* with an amplitude of approximately 10% of nominal motor speed. The *Frequency* should be slow enough to achieve the commanded velocity, but fast enough to prevent the system from reaching a mechanical limit (e.g.: 2-3Hz).

Note: The accuracy of velocity loop tuning is dependent on the quality and resolution of the velocity feedback. Sources with relatively low resolution or higher noise will require tuning at a higher velocity in order to overcome the effects of these limitations. It is best to experimentally determine the optimum tuning setup.




11. On the menu bar, select Tools → Oscilloscope to open the digital oscilloscope (or click the Oscilloscope icon ) Set up the scope view as follows:
 - a. In the *Channel Select* area of the scope, use the *Change*, *Add Signal*, and *Remove* buttons as necessary to set the *Velocity Target* and the *Velocity Measured* signals on Channels 1 and 2.
 - b. In the *Trigger* area of the scope, use the *Change* button as necessary to establish *Velocity Target* as the Trigger Source at a level of zero RPM, Up Slope.



12. Ensure Trigger Mode is *Normal*


Velocity Loop Tuning


13. Enable the drive by clicking the *Enable/Disable Drive* icon .

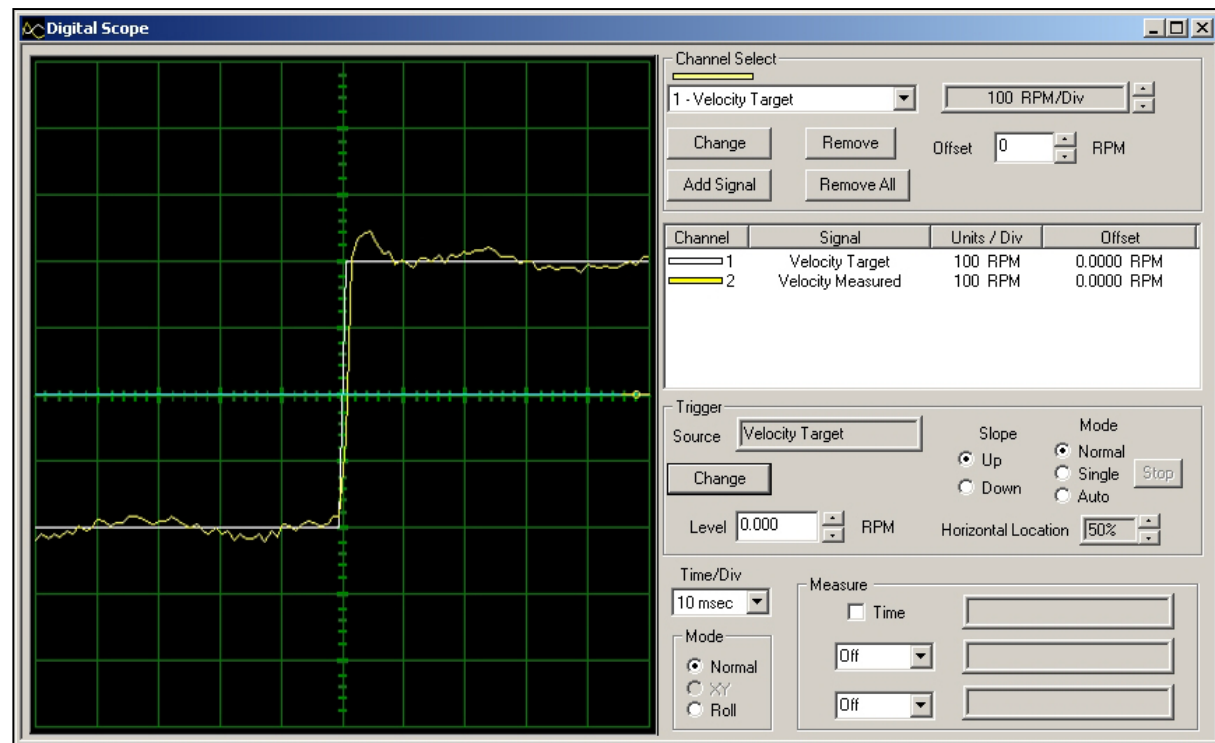
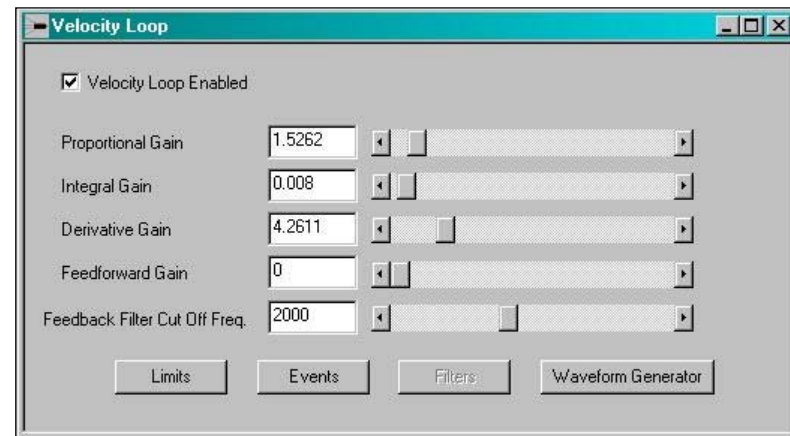
14. Use the *Proportional Gain*, *Integral Gain*, *Derivative Gain*, *Feedforward Gain*, and *Feedback Filter Cut Off Frequency* sliders or arrow buttons to adjust the *Velocity Measured* waveform on the oscilloscope and match the *Velocity Target* as closely as possible, but with 10-20% overshoot on the leading edge.

Note: While reducing the value of the *Feedback Filter Cut Off Frequency* can be used to minimize the effects of noise and enhance stability, a higher value will increase system response and bandwidth. The final tuning must be empirically determined as a compromise between the two results.

The effect of the *Feedback Filter Cut Off Frequency* can be seen by comparing the *Velocity Feedback* (unfiltered) and *Velocity Measured* (filtered) signals on the oscilloscope.

15. When tuning is complete, disable the drive with the *Enable/Disable Drive* icon  and select *Not Connected* on the Waveform Generator.

16. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.



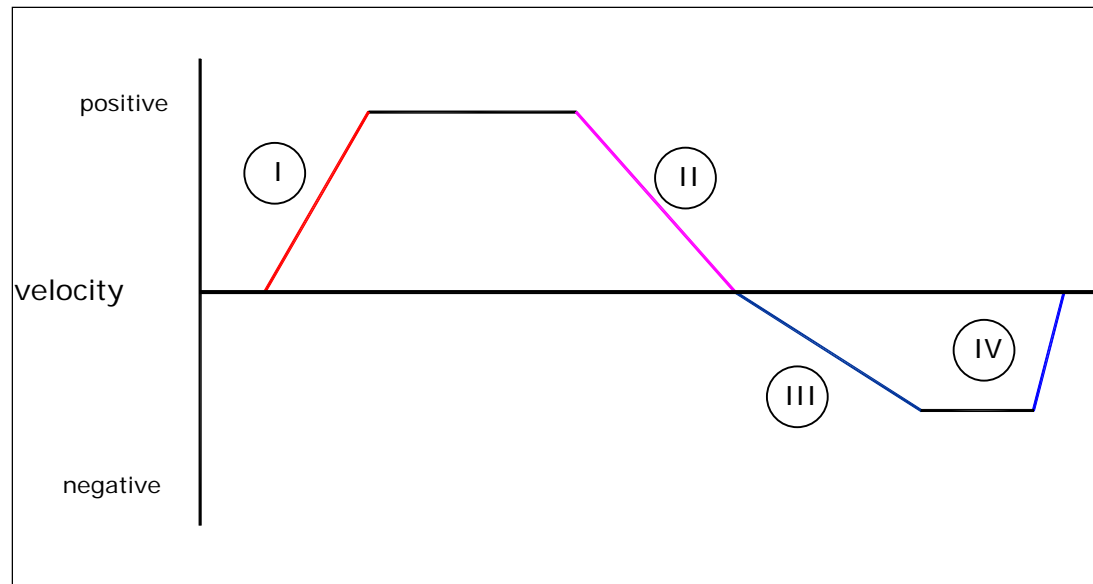
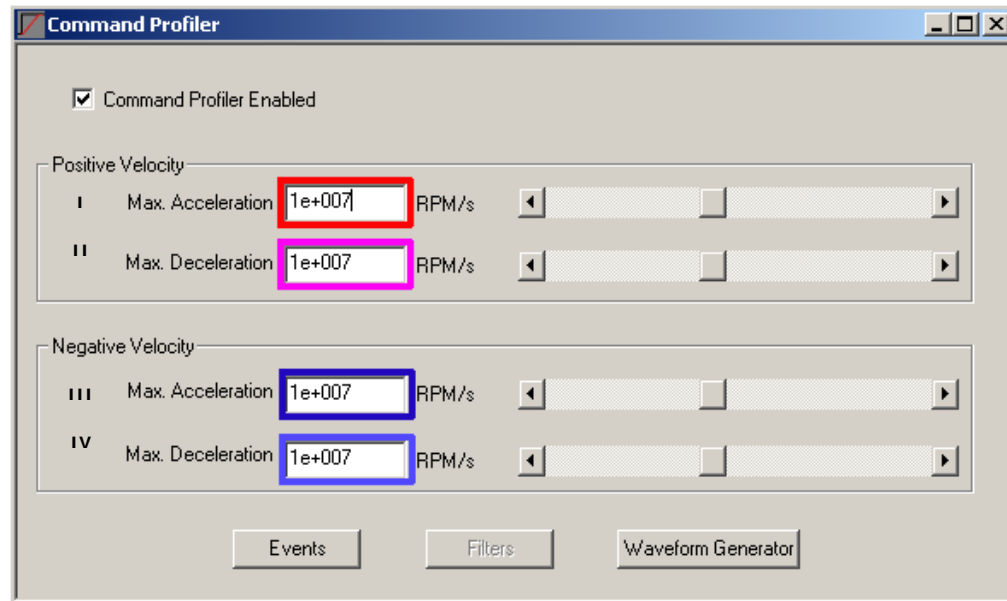
Velocity Loop Command Profiling

While in velocity mode, Velocity Loop Command Profiling can be used to limit the rate of change of velocity or apply a constant acceleration to step velocity commands. The command profiler provides independent control of acceleration and deceleration in both the positive and negative velocity directions.

1. From the Main Block Diagram, open the *Command Profiler*.
2. Activate the check box for *Command Profiler Enabled*.
3. Using the slider bars or numerical entry, enter values for the maximum rates of change in velocity (RPM/sec).

Independent values can be entered for both acceleration and deceleration in both the positive and negative directions.

- I. Positive velocity, acceleration
- II. Positive velocity, deceleration
- III. Negative velocity, acceleration
- IV. Negative velocity, deceleration

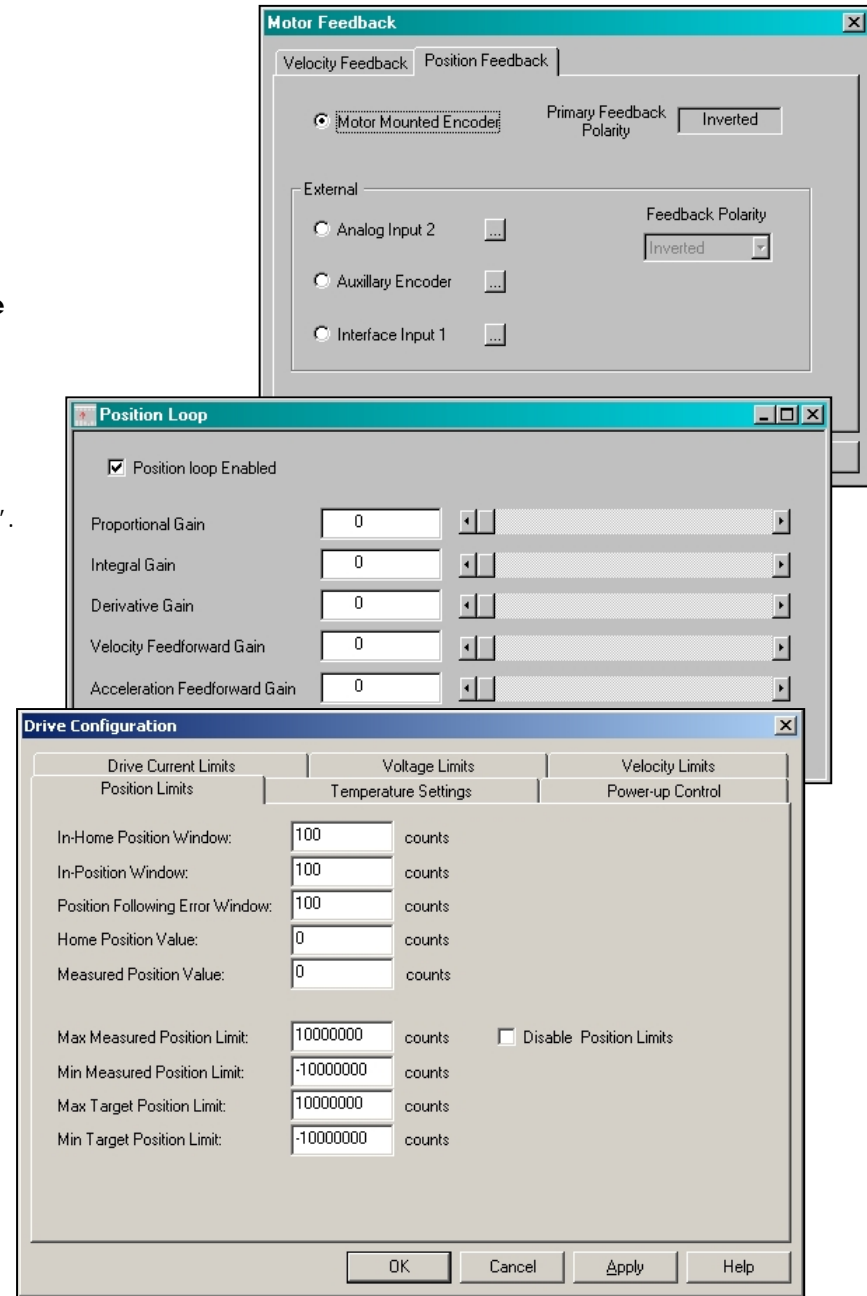


Position Loop Tuning

Note: DigiFlex® servo drive Position Loop control is not supported by SynqNet™.

Note: Position loop tuning is dependent on the mechanical load of the motor and, therefore will change with any mechanical system changes. Position loop tuning should be performed with the motor installed in the system.

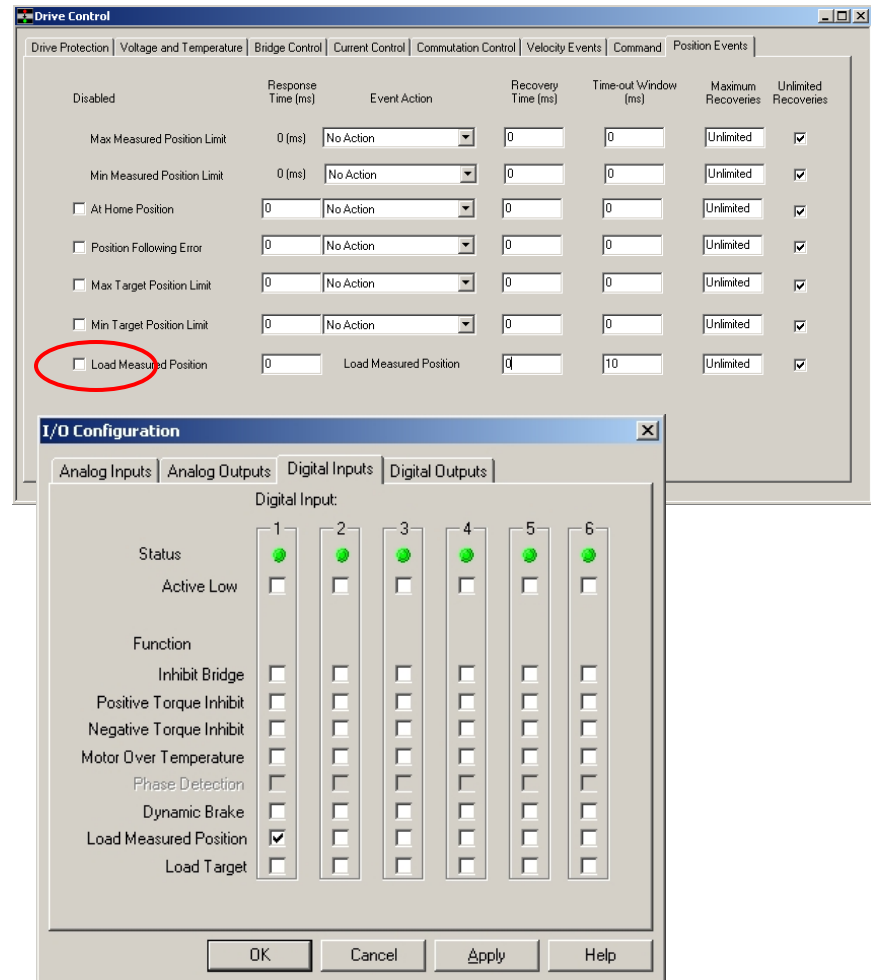
1. Verify that the drive is disabled (🔴).
2. From the Main Block Diagram, open the Feedback window and select the *Position Feedback* tab.
3. Select the appropriate position feedback source. Click "OK".
4. For $1V_{p-p}$ sin/cos encoders, select the level of interpolation (pre-quadrature).
5. From the Main Block Diagram, open the *Position Loop* window.
6. Select the check box for *Position Loop Enabled*.
7. In the *Position Loop* window, click the *Limits* button to open the *Position Limits* tab in *General Drive Configuration*.
8. Enter values for *In Position Window*, *Position Following Error Window*, and *Max* and *Min Target Position Limit*.
9. Set the *Measured Position Value* to zero (0) counts.
10. Click "OK" to accept values and close *General Drive Configuration*.



Position Loop Tuning

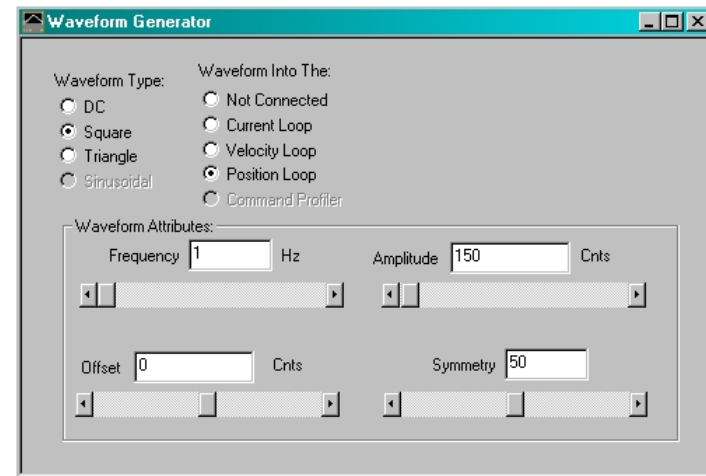
Note: Loading the Measured Position may be necessary in order to start with the Position Target and Position Measured matching up initially. If these do not match, and the position loop has non-zero gains, the motor will run until the measured meets the target.


11. Open *Drive Control* to the *Position Events* tab and ensure that the *Load Measured Position* event is not disabled
12. From the Main Block Diagram, click *I/O Configuration* and select the *Digital Inputs* tab.
13. Set the Measured Position to zero by checking *Load Measured Position* under an unassigned input and click the *Apply* button.
14. Clear the check box checked in step 13 and once again click *Apply*.
15. Click OK to close the *I/O Configuration* window.



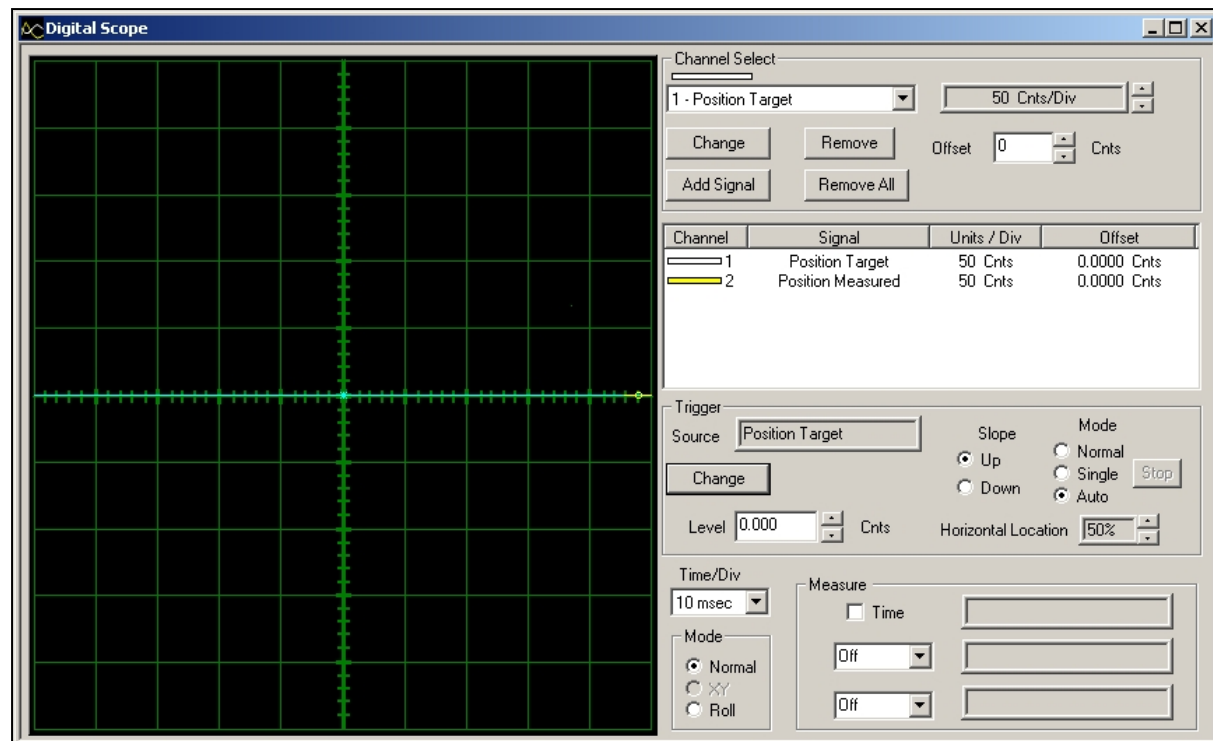
Position Loop Tuning

16. In the *Position Loop* window, click the *Waveform Generator* button to open the Waveform Generator.
17. With the Waveform Generator, establish a *Square* wave into the *Position Loop* with an amplitude of approximately 1/8 of one revolution. The frequency should be slow enough to allow the motor to settle in position (e.g. 1-2Hz).






18. On the menu bar, select Tools → Oscilloscope to open the digital oscilloscope (or click the Oscilloscope icon ) Set up the scope view as follows:

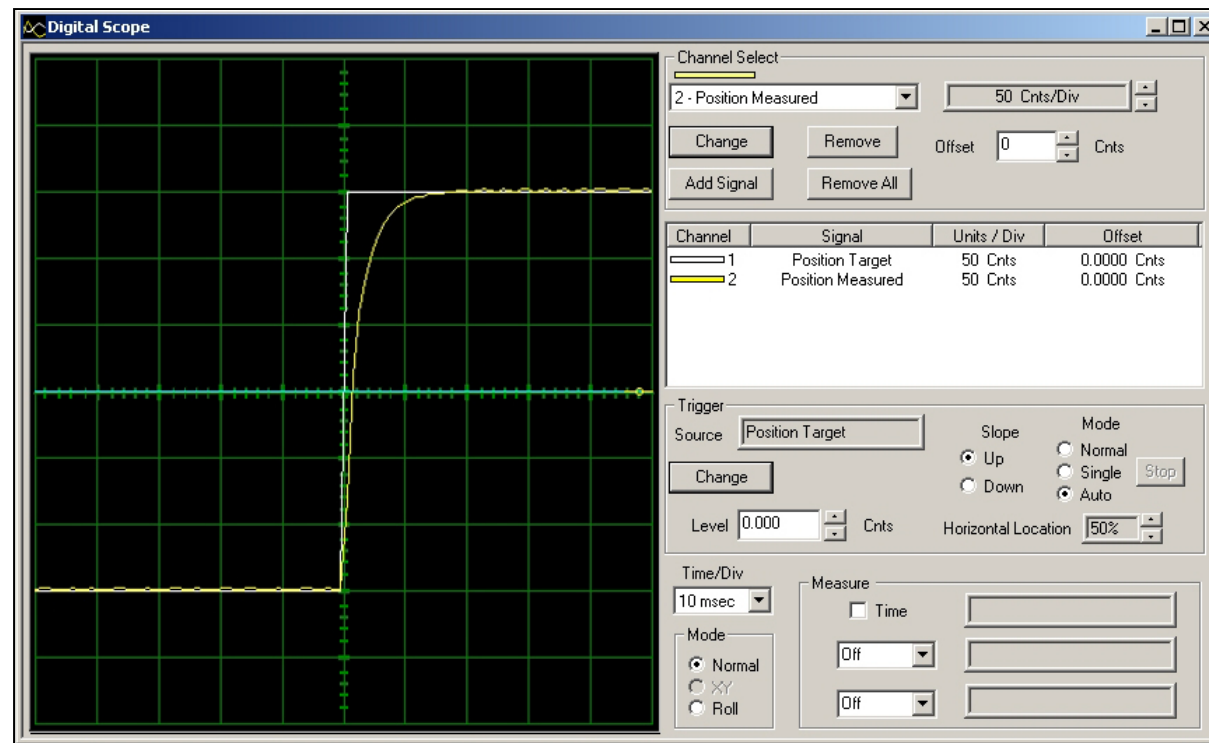
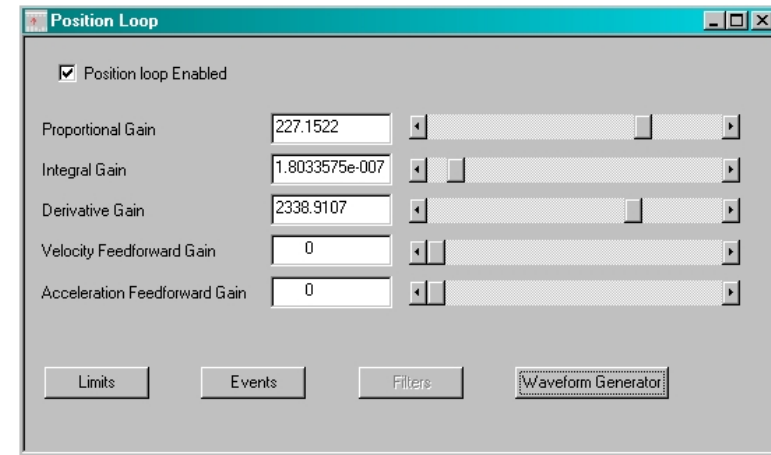
- c. In the *Channel Select* area of the scope, use the *Change*, *Add Signal*, and *Remove* buttons as necessary to set the *Position Target* and the *Position Measured* signals on Channels 1 and 2.
- d. In the *Trigger* area of the scope, use the *Change* button as necessary to establish *Position Target* as the Trigger Source at a level of zero Counts, Up Slope.



19. Ensure Trigger Mode is *Normal*.


Position Loop Tuning

20. Enable the drive by clicking the *Enable/Disable Drive* icon .
21. Use the *Proportional Gain*, *Integral Gain*, *Derivative Gain*, *Velocity Feedforward Gain*, and *Acceleration Feedforward Gain* sliders or arrow buttons to adjust the *Position Measured* waveform on the oscilloscope and match the *Position Target* as closely as possible.
22. When tuning is complete, disable the drive with the *Enable/Disable Drive* icon  and select *Not Connected* on the Waveform Generator.
23. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.

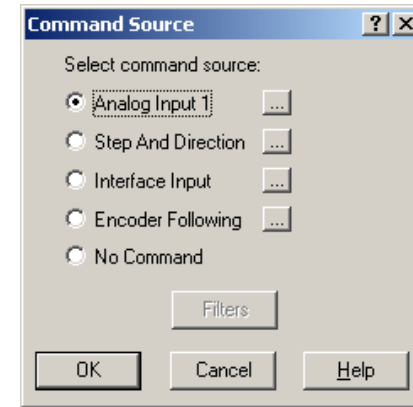


Command Source Selection

Note: For the DQ series, the Command Source is automatically assigned as the SynqNet™ network interface.


1. Select the command source as follows:
2. In the Block Diagram window, select the *Command Source* block.
3. Select the appropriate command source
 - a. Analog Input (torque, velocity, or position)
 - b. Step and Direction (torque, velocity, or position)
 - c. Interface Input (torque, velocity, or position)
 - d. Encoder Following (position)
4. Clicking the ellipsis button, , accesses additional parameters such as step and direction and encoder following scaling; parameters for *Load Target*; and selection of a specific analog input.
5. Click *OK* on the Command Source window.

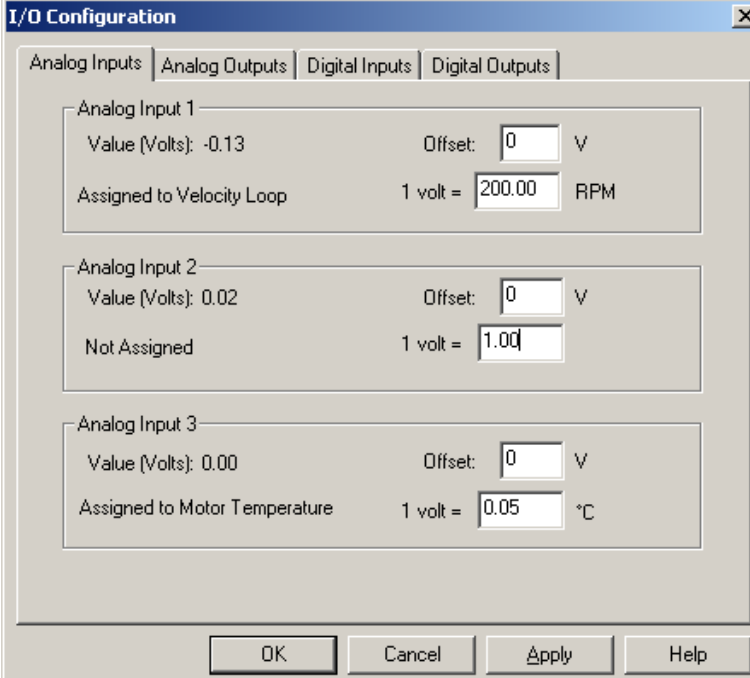
Note: *No Command* is designed to be a non-operation input source. If the drive is in velocity or current mode, *No Command* will always provide a command of zero. If the drive is in position mode, when the command is set to *No Command* the drive sets *Position Target* equal to the *Position Measured* to prevent sudden motion.



Analog Input Scaling

Note: If the Command Source was set to Analog Input, use the following to set the scaling of the input.

1. Set the analog command scaling as follows:
 - a. In the Block Diagram window, select *I/O Configuration*.
 - b. For the appropriate Analog Input, (as previously selected,) set the required scaling (e.g. Amps/Volt, Cts/sec/Volt) and command offset voltage.
 - c. Command polarity can be inverted by changing the sign (+/-) on the Analog Input scaling.
 - d. Click *Apply* or *OK* to set any modified values.
2. On the Menu Bar, select *Communication* → *Store* (or click the *Store Settings* icon ) , then OK to store parameters to the drive nonvolatile memory.
3. The Analog Input may now be used to apply a current, velocity, or position command to the drive.



The I/O Configuration dialog box has four tabs: Analog Inputs, Analog Outputs, Digital Inputs, and Digital Outputs. The Analog Inputs tab is active, showing three input configurations:

Analog Input	Value (Volts)	Offset	Unit	Assigned to	1 volt =	Unit
Analog Input 1	-0.13	0	V	Assigned to Velocity Loop	200.00	RPM
Analog Input 2	0.02	0	V	Not Assigned	1.00	
Analog Input 3	0.00	0	V	Assigned to Motor Temperature	0.05	°C

At the bottom of the dialog are four buttons: OK, Cancel, Apply, and Help.

Further assistance is available through any of the following:

- DriveSuite Help files
- www.a-m-c.com
- Technical Assistance via phone: 805-389-1935
- Technical Assistance via e-mail: techsupport@a-m-c.com.

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