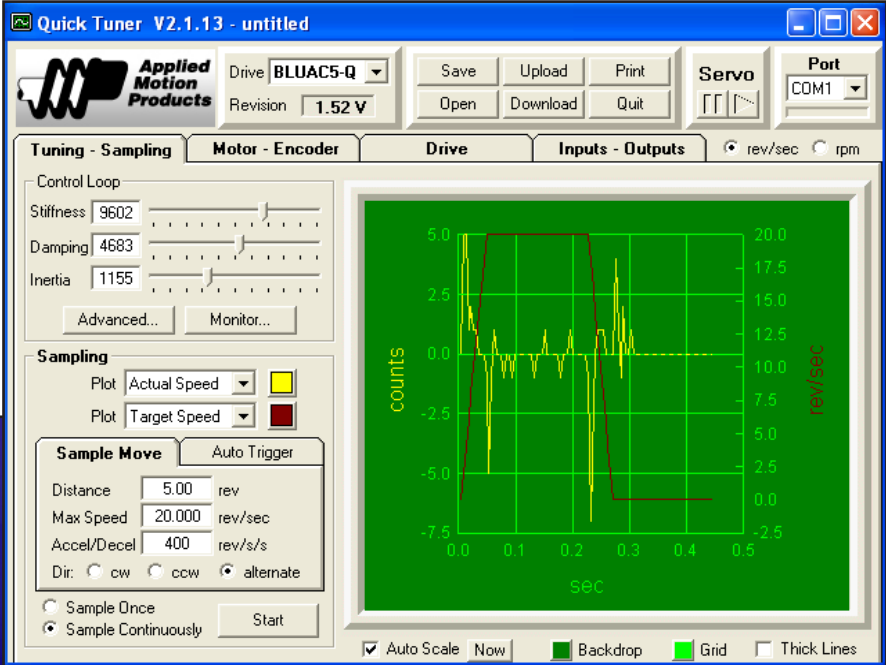


# Quick Tuner Software Manual



Supports all BLu & SV series servo drives



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## Getting Started

Thank you for purchasing an Applied Motion Products servo product. We hope you will find that the performance, price and ease of use make our products the best value for your application.

The *QuickTuner™* software is used to configure and tune all Applied Motion servo products, including the BLu and SV series drives. Programmable units must first be configured with the *QuickTuner™*, then programmed with one of the following software packages:

- *Si Programmer* (for single axis, stand-alone applications) - Now has built-in Tuning!
- *SiNet Hub Programmer* (for multi-axis applications, requires SiNet Hub)
- *SCL Setup Utility* (for host-based systems).
- *Q Programmer* (Complex programming applications).

This manual explains how to install the *QuickTuner™* Windows application and how to set up and tune your servo system.

For information regarding your specific hardware, such as wiring and mounting, please read the hardware manual that came with that product.

The *QuickTuner™* features include:

- Flexible commutation timing: almost any motor can be configured automatically without swapping wires.
- Encoder timing “Wizard” (again, no wire swapping is needed, and most resolutions can be used)
- Programmable current limiting
- Easy, graphical adjustment of servo control terms
- Built-in digital oscilloscope shows you the drive’s response to your parameter choices
- Can save set up files to disk. Configuring future drives is as easy as opening your file and downloading it to the drive.
- Wide selection of sample move profiles
- Advanced trigger capability to capture response to external command signals

To set up and tune your servo drive, you must do the following:

- Connect a motor to the drive. Refer to your drive’s Hardware Manual for this.
- Connect power to the drive. Again, see your Hardware Manual.
- Connect the drive to the PC using the programming cable that came with the drive.
- Install the *QuickTuner™* software onto your PC.
- Have Fun!

Remember, if you have trouble getting your drive or this software to meet your expectations, or if you want to suggest improvements to the product or this manual, give us a call at (800) 525-1609. Or, you can fax us at (831) 761-6544. If you are not calling from North America, dial (831) 761-6555. You can also email us at [tech-support@applied-motion.com](mailto:tech-support@applied-motion.com).

## **Installing the QuickTuner™ Software**

The *QuickTuner™* software comes on a CD. Before you can use the software, you must install it on your hard drive.

To run the *QuickTuner™* software, you must have a computer with the following requirements:

- Microsoft Windows 98, 2000, ME, NT, XP or Vista
- 10 MB available hard drive space
- CD or DVD drive
- A nine pin serial port must be available, preferably COM1. ( if your computer does not have a serial port ,you will need to purchase a USB to Serial adaptor).

The software installation is highly automated, like most Windows programs, so the process is simple:

- Put in the CD.
- Wait. In about ten seconds, the Applied Motion CD browser will appear. If it does not, then the “autorun” feature of your PC may have been disabled. If so, double click on the My Computer icon near the upper, left corner of the screen. A new window will open, showing all of your disk drives. Locate the icon for your CD ROM drive (it should appear as a small CD with the letters “Si” in front of it.) Double click on this icon, and the browser will appear.
- Click on the button that says “Install Software”.

## **Display Settings**

The *QuickTuner™* works well with any display resolution. At 640 x 480, the *QuickTuner™* will exactly fill your screen. At higher resolutions, like 800 x 600 or 1024 x 768, there will be room left over on the screen for the tool windows like the “Monitor” or “Advanced” tuning. When using the oscilloscope function making the application full screen will give you a better view of what is going on. 16 bit or higher color setting is recommended (65,535 colors, sometimes called High Color).

Please use the “Small Fonts” setting when running the *QuickTuner™* software. If you choose “Large Fonts”, our software may not appear correctly on your screen.

The display settings are found under “Start.....settings.....Control Panel”.

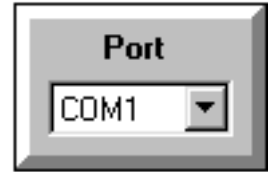
## **Connecting to your PC**

- Locate your computer within 8 feet of the servo drive.
- Your drive was shipped with a 10 foot serial programming cable. Plug the larger end into your PC serial port or USB Serial Adapter, and the other end into the PC/MMI jack on your drive.
- When connecting to the BLuAC5 servo drive make sure the drive and the PC are connected to a common “Earth” ground.

**Never connect the drive to a telephone circuit. It uses the same connectors and cords as telephones and modems, but the voltages are not compatible.**

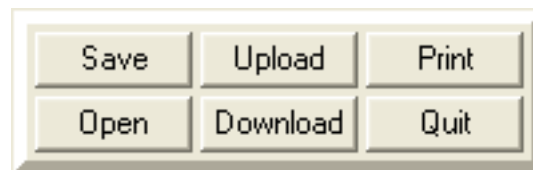
You may also need to set the COM port in the *QuickTuner* software. When the software is loaded, it looks for the first available COM port, but doesn't always find the one you've connected to the drive.

Select the port yourself from the drop down list under the word "Port." If the port exists and is not already in use, the software will use it to communicate with the drive.



*Programming Note: Always apply power to drive after the Quick Tuner software is running on your PC, and after you have selected the proper Com port.*

## Command Buttons



### Upload & Download

Upload lets you copy the set up and tuning parameters from your servo drive into your PC. This is useful if you want to make changes to a system that has already been tuned. BLu and SV drives have an option “automatically upload at power up”. This will do exactly this and upload the settings from the drive into QuickTuner™ when you apply power to the drive.

The Download command is used to copy settings from the *QuickTuner™* software to your drive. Use this if you make a change to a drive setting and want to transfer the information back to the drive.

Sometimes it is useful to exactly duplicate a setup. For example, you may be building a large number of identical machines. In this case, once you have completed development and have the motion control working exactly the way you like it, save your setup to a file. Then, when you build the next machine, open your set up and download it to the next drive.

One of the advantages of programmable, digital control is that you can easily duplicate the settings of a system.

### Save, Open, Print & Quit

In addition to exchanging settings with your drive, the *QuickTuner™* software can also save & load settings using your hard drive, and can print hard copies using your printer.

The Save button lets you save a set up to the hard drive. A file dialog box will ask you to pick a name for the program. You can use “long file names” just as you would with many other “32 bit” Windows programs, such as Microsoft Word and Excel.

The Open button provides you with a dialog box showing all the *QuickTuner™* files on your drive. Click to select one, then click OK to load it.

Print lets you make a hard copy of your program on any printer that’s connected to your computer and installed in Windows. Print uses the standard Windows printer dialog, allowing you to specify which printer to use if you have more than one.

If you call for help, we may ask you to print your settings and fax them to us. If you have a fax modem that acts as a printer, you can use it to fax the program directly to us from the programming software. You’ll have to enter our fax number at some point, which is (831) 761-6544.

The Quit button exits the *QuickTuner™* and returns you to Windows. If you are using a CANopen drive, exiting *QuickTuner™* automatically enables CANopen communication, which is suspended while *QuickTuner™* is in operation.

### RPM or Rev/Sec

A small section of the main screen allows you to choose the units you are going to work with, select between RPM (revolutions per minute) or rev/sec (RPS).

## Using Our Motor? How to Get a Quick Start

Now that you know how to load a servo set up from your hard disk, it's time to learn a little shortcut. You may not realize it, but when you installed the *QuickTuner™* software, you also installed sample set up files for all of the recommended Applied Motion servo motors.

The settings contained in these files will automatically configure that motor current, encoder direction and hall timing for your motor. Opening the file will also set the optimal PID parameters for inertial loads of 1:1 and 5:1 and in some cases 10:1. In many cases, all you need to do is open the file for your motor and load and download it to the drive. You may then skip Step 1 (the motor-encoder setup) and Step 2 (servo tuning) and proceed to Step 3, where you will configure your drive for the type of motion control your application requires.

If your load has high inertia or friction, you will probably want to custom tune it, but the file will give you a good starting point.

### Setup Files for the BLuDC drives

These files can be found in the BLu folder.

Using 24 V motors

Motor	Load Inertia	File Name
A0030-103-2-001	1:1 (9.8 g-cm <sup>2</sup> )	A030V24X1
A0030-103-2-001	5:1 (49 g-cm <sup>2</sup> )	A030V24X5
A0050-103-3-000	1:1 (22.5 g-cm <sup>2</sup> )	A050V24X1
A0050-103-3-000	5:1 (113 g-cm <sup>2</sup> )	A050V24X5
A0050-103-3-000	10:1 (226 g-cm <sup>2</sup> )	A050V24X10
A0100-103-3-000	1:1 (41 g-cm <sup>2</sup> )	A100V24X1
A0100-103-3-000	5:1 (206 g-cm <sup>2</sup> )	A100V24X5

Using 48 V motors

Motor	Load Inertia	File Name
A0050-104-3-000	1:1 (23 g-cm <sup>2</sup> )	A050V48X1
A0050-104-3-000	1:10 (226 g-cm <sup>2</sup> )	A050V48X10
A0100-104-3-000	1:1 (41 g-cm <sup>2</sup> )	A100V48X1
A0100-104-3-000	5:1 (205 g-cm <sup>2</sup> )	A100V48X5
A0200-104-4-000	1:1 (200 g-cm <sup>2</sup> )	A200V48X1
A0200-104-4-000	5:1 (1000 g-cm <sup>2</sup> )	A200V48X5
A0200-104-4-000	10:1 (2000 g-cm <sup>2</sup> )	A200V48X10

## Setup Files for the BLuAC drives

These files can be found in the BLu folder.

A0400-101-4-X0  
A0400-101-4-X1  
A0400-101-4-X5  
A0400-101-4-X10  
A0800-102-5-X0  
A0800-102-5-X10  
A0950-102-5-X0  
A0950-102-5-X8

M0100-101-3-X0	N0100-101-3-X0
M0100-101-3-X1	N0100-101-3-X1
M0100-101-3-X7	N0100-101-3-X7
M0100-101-4-X0	N0100-101-4-X0
M0100-101-4-X1	N0100-101-4-X1
M0100-101-4-X3	N0100-101-4-X3

M0200-101-4-X0	N0200-101-4-X0
M0200-101-4-X1	N0200-101-4-X1
M0200-101-4-X5	N0200-101-4-X5
M0200-101-4-X10	N0200-101-4-X10
M0200-101-5-X0	N0200-101-5-X0
M0200-101-5-X1	N0200-101-5-X1
M0200-101-5-X5	N0200-101-5-X5
M0200-101-5-X10	N0200-101-5-X10

M0400-101-4-X0	N0400-101-4-X0
M0400-101-4-X1	N0400-101-4-X1
M0400-101-4-X5	N0400-101-4-X5
M0400-101-4-X10	N0400-101-4-X10
M0400-102-5-X0	N0400-102-5-X0
M0400-102-5-X2	N0400-102-5-X2
M0400-102-5-X10	N0400-102-5-X10

M0600-102-5-X0	N0600-102-5-X0
M0600-102-5-X1	N0600-102-5-X1
M0600-102-5-X5	N0600-102-5-X5
M0600-102-5-X10	N0600-102-5-X10

M0750-102-5-X0	N0750-102-5-X0
M0750-102-5-X1	N0750-102-5-X1
M0750-102-5-X5	N0750-102-5-X5
M0750-102-5-X10	N0750-102-5-X10

## Setup Files for SV7 drives

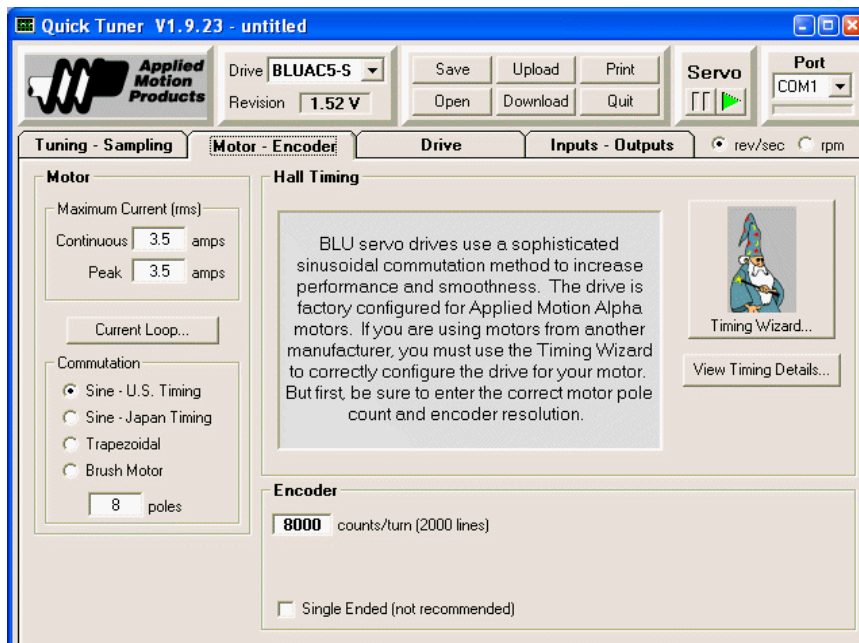
These files can be found in the SV7 folder.

Using 48 VDC

<b>Motor</b>	<b>Load Inertia</b>	<b>File Name</b>
V0050-214-B	1:0 (no load)	V0050 48V 0X
V0050-214-B	1:1 (42 g-cm <sup>2</sup> )	V0050 48V 1X
V0050-214-B	1:5 (210 g-cm <sup>2</sup> )	V0050 48V 5X
V0050-214-B	1:12 (480 g-cm <sup>2</sup> )	V0050 48V 12X
V0100-214-B	1:0 (no load)	V0100 48V 0X
V0100-214-B	1:1 (100 g-cm <sup>2</sup> )	V0100 48V 1X
V0100-214-B	1:4.7 (480 g-cm <sup>2</sup> )	V0100 48V 4.7X
V0100-214-B	1:7.2 (744 g-cm <sup>2</sup> )	V0100 48V 7.2X
V0200-214-B	1:0 (no load)	V0200 48V 0X
V0200-214-B	1:2.5 (480 g-cm <sup>2</sup> )	V0200 48V 2.5X
V0200-214-B	1:2.5 (744 g-cm <sup>2</sup> )	V0200 48V 3.9X
V0200-214-B	1:2.5 (1950 g-cm <sup>2</sup> )	V0200 48V 10X
V0250-214-B	1:0 (no load)	V0250 48V 0X
V0250-214-B	1:1.8 (480 g-cm <sup>2</sup> )	V0250 48V 1.8X
V0250-214-B	1:2.8 (744 g-cm <sup>2</sup> )	V0250 48V 2.8X
V0250-214-B	1:6.2 (1680 g-cm <sup>2</sup> )	V0250 48V 6.2X
V0250-214-B	1:7.2 (1950 g-cm <sup>2</sup> )	V0250 48V 7.2X

## Step 1: The Motor-Encoder Panel

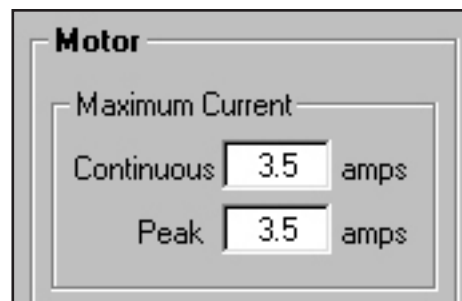
This panel is for setting the Hall timing, motor current, encoder resolution and other details. For some drives, you can also specify the motor type.



### Motor Current

The drive current must be set to match the motor. First, determine the rated current for the motor. If you are using an Applied Motion motor recommended for your drive, then the current rating is listed in the Recommended Motors section of your drive's Hardware Manual. You can automatically load the appropriate current for your motor, along with all other settings, from a file.

If you are manually setting the current, type the value into the Maximum Current text box.



The BLU and SV drives can provide a peak current momentarily. This will provide greater acceleration rates than would otherwise be possible. To assure reliable motor operation, the drive will automatically ramp the current down after one second so that the average current does not exceed the motor's rating. *Never continuously operate a servo motor above its rated current.*

The peak current available varies from model to model, so check your product specifications before setting a value.

## Encoder Resolution

Servo drives rely on feedback from the motor for accurate operation. Therefore, you must use a motor with an incremental encoder, and you must describe the encoder to the drive.

The Applied Motion A, N and M series motors all have 8000 count (2000 lines) encoders. V series motors have 8192 counts/turn. If you are using someone else's motor, then the motor or encoder manufacturer will have to provide this information.

At this point you may be asking yourself “what's the difference between lines and counts?” The short answer is “a factor of 4.” Want the long answer? Okay. Most encoders are constructed from a glass disk which has tiny, precise lines etched into it. There are two photo sensors, spaced slightly apart. Each sensor emits a “low” signal when the line passes by, and a “high” signal when between lines. The precision of these position signals depends on the number of lines that are on the disk. Each time a line passes by the two sensors, each sensor emits a rising edge (when the signal goes from low to high) and a falling edge (when the signal returns to low.) That's four edges. Our electronics count each edge, so the number of “counts” is always four times the number of lines. This is called quadrature decoding and it provides higher resolution (and more precise performance) than counting lines.

## Commutation

With Sinusoidal servo motors, you have the choice of selecting US or Japanese timing patterns. These are very similar, but choosing the correct option will give the best performance from your motor.

Select Trapezoidal for motors that have true trapezoidal windings and you do not want to “Sine” commutate the motor.

The BLu and SV series can also drive Brushed DC servo motors. If you want to use this type of motor please contact Applied Motion for advice and technical information.

## Current Loop

The BLu series provides the option of adjusting the current loop settings for the drive. This should not be attempted without advice from technical staff at Applied Motion. In nearly all cases when using AMP motor setup files with AMP motors user adjustment of these values is not required.

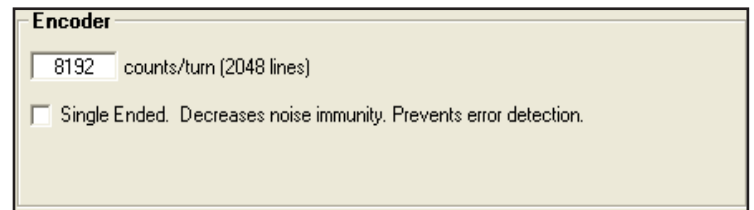
## Hall Timing

Three phase brushless DC motors provide three signals that tell the drive when to switch from one phase combination to another. These are called commutation or Hall signals. The relationship of the commutation signals to the motor phases (called “Hall timing”) is not the same for all manufacturers. That's okay, because the Applied Motion drives can accept motors with nearly any hall timing.

*The one type of motor you cannot use drives is one with 60 degree timing. You must have a motor with 120 degree timing. This means the commutation timing must be equally spaced.*

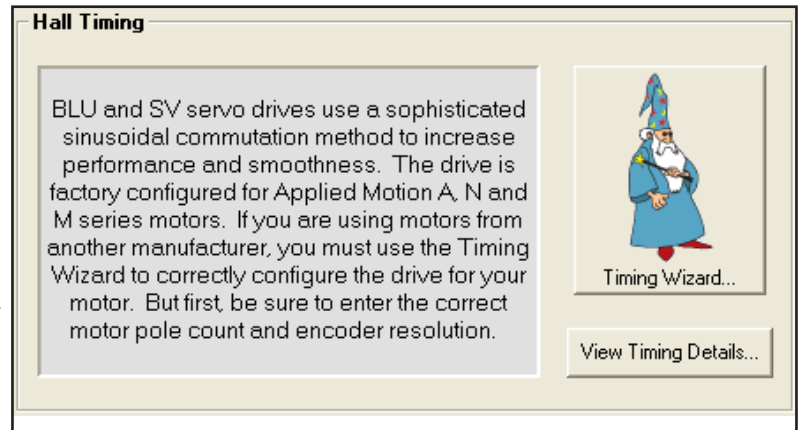
A few motors have unequally spaced Hall signals. These are sometimes called 60° motors. (Evenly spaced hall waveforms are 120° apart.) If you have a 60° motor and its Hall outputs are differential, you can still use it. Just connect the “-” output of Hall 2 to the drive, and the “+” outputs of Halls 1 and 3. That will change the spacing to 120°. If you have a 60° motor with single ended Hall outputs, you cannot use that motor with the BLu and SV series drives.

To set the hall timing, you must first wire your system. That includes connecting the motor to the drive and the drive to a power source. Refer to the hardware manual for your drive when making these connections.



Once you have connected the motor to the drive, you can configure the timing using the “Timing Wizard”. If you are using an Applied Motion Products A, N or M motor, the default drive settings are correct for this type of motor.

If you are using a motor from another manufacturer, try the Hall Timing Wizard first. In most cases, it can automatically detect your motor timing pattern and configure the drive settings for it. The only other way to configure the Hall timing is by trial and error rewiring.



## Hall Timing Wizard

Hall timing varies among motor manufacturers. The timing diagrams supplied with motors (when they are supplied) differ in their format, too, complicating the task of configuring a motor for the first time. To ease this burden, the *QuickTuner™* includes a Hall Timing Wizard that automatically detects the necessary configuration for your motor. To use the Hall Timing Wizard, you must do the following:

*Note: When using BLU or SV servo drives the Encoder Resolution and the number of poles must be entered before the following procedure is attempted. A, N, and M series motors have 8 poles and V series motors have 4 poles.*

1. Connect the motor to the drive. Wire the phases, hall and encoder signals “straight across” as detailed in your drive’s Hardware Manual.
2. Do not connect any load to the motor. It is important that the motor be unloaded and completely free to move during the operation of the Hall Timing Wizard.
3. Connect the programming cable to your PC.
4. Launch the *QuickTuner™* software.
5. Connect and apply power to the drive.
6. Click Download.
7. For BLU drives, you must cycle power if the counts/rev or poles has been changed. SV drives do not require a power cycle for these changes to take effect.
6. In the motor-encoder-drive panel, click on the “Timing Wizard” button.
7. The Wizard will remind you to disconnect the motor from any load.
8. The Wizard will ask you to rotate the motor shaft about one turn in the clockwise direction. Because the drive has no absolute frame of reference, you must provide one by turning it clockwise. Turn the motor until the Wizard tells you to stop.
9. Click OK and the Wizard will do the rest. If successful, the Wizard will determine hall timing and the encoder direction and apply those settings to the servo drive set up. You still must enter the exact encoder counts/turn manually. *You also will need to tune the drive - we don't have a wizard for that.*

## Step 2: Servo Tuning

Like most modern servo drives, ours employ sophisticated algorithms and electronics for controlling the torque, velocity and position of the motor and load.

Sensors are used to tell the drive what the motor is doing. That way, the drive can continuously alter the voltage and current applied to the motor until the motor does what you want. This is called “closed loop control.”

One of the loops controls the amount of current in the motor. This circuit requires no adjustment other than specifying the maximum current the motor can handle without overheating.

The PID loop compares the intended motor position to the actual motor position as reported by the encoder. The difference is called error, and the PID loop acts on this error in three ways: the Proportional term, the Integral term and the Derivative.

The BLu and SV series drives add a number of extra gain terms to enable greater system control. These gain terms are Velocity Feedback and Feedforward and Accel feedback and Feedforward. They have been grouped together to create three gain types; Stiffness, Damping and Inertia.

### Stiffness Gain Terms

#### **P: The Proportional Term**

The simplest part of the PID loop is the proportional, or P, term. The drive applies current to the motor in direct proportion to the error. Here’s an example: if the motor were standing still, and you suddenly turned the shaft by hand, you’d want the drive to increase the motor current so that it goes back into position. The farther you disturb the motor from its target position, the more the torque will increase. The P term (also called P gain) governs how much torque you get for a given amount of error  $U_n$ . In general, if you have more load inertia, you’ll need more torque and therefore a higher P gain.

The torque provided by the P term is  $T = K_p U_n$ .

#### **I: The Integral**

If you think about the previous example for a moment, you may realize that P alone will not give you perfect position. If you applied one ounce-inch of torque to the motor, it would move out of position. The P term will increase the motor torque until it is producing as much torque as you are. Then the motor stops moving. But there is still error. The I term adds up all the error that the drive has seen and produces a torque that is added to the torque command from the P term:

$$T = K_p U_n + K_i \Sigma(U).$$

In our example, the P term allowed the motor to reach equilibrium at a position where the applied torque from your hand equaled the torque of the P term. Thus, the error was not zero. But the I term will keep adding up that error and continue to increase the torque until the motor truly returns to the target position.

## **Damping Gain Terms**

### **D: The Derivative**

So far, we've just talked about a motor that is disturbed when standing still. But the objective of motion control is to get that motor moving on its own. The problem with electric motors is that they tend to be very "springy", a condition known as "underdamped". If you tried to run a motor with a pure PI controller the motor would overreact to small errors, creating ever larger errors, ultimately becoming unstable. If you knew what the motor was going to do before it did it, you could prevent this. For those of you who studied calculus, you may recall that you can predict what something is going to do by its rate of change, or derivative.

If you are driving your car into your garage, do you wait until you are fully in the garage before hitting the brakes? That would be a bad idea for you, your car, and the back wall of the garage. Instead, most people slow down as they see the distance between them and their objective get smaller.

A motor drive can control a motor better if it examines the rate of change of the position error and includes that in its torque calculation. For example, if the motor has error, but the error is decreasing, back off on the torque. That's what the "D" term does.

$$T = K_T [K_P U_n + K_I \Sigma(U) + K_D (U_n - U_{n-1})]$$

where

$U_n$  is the error in encoder counts

$U_{n-1}$  is the error of the previous sample

$K_T$  is the torque constant of the motor.

This calculation is performed 4000 times per second.

### **Vfb: Velocity Feedback**

As motor power per size has gone up so has the size of the loads. As more performance is asked of the servo motor we may need to add more damping. Velocity feedback has been added to the BLu servo drive to provide greater damping for the larger loads.

This term adds in the motor actual Velocity as negative feedback and usually works in conjunction with the Velocity Feedforward term (See below). If the velocity of the motor matches what is expected no feedback value is generated. If however the velocity's do not match the negative feedback helps to "damp" the differences in velocity. Typically both terms are set to the same value.

### **Vff: The Velocity Feedforward**

The Velocity Feedforward term works with the Velocity feedback term to add more damping capability to the servo algorithm. The feed forward value is generated by the "Trajectory Calculation" algorithm. If the servo motor is operating well the Calculated Velocity of the motor will match the actual Velocity value.

## **Inertia Gain Term**

### **Aff: Acceleration Feedforward**

With larger loads typically comes larger load Inertia. These larger inertias can be more easily accelerated or decelerated by anticipating the control system needs. The Acceleration Feedforward term does this by adding an acceleration value to the control value. The Acceleration value is derived from the Trajectory Calculation during the acceleration and deceleration phase.

## Tuning BLu and SV Servo Drives

As motor power per unit size has increased so has the load requirements for servo motors. The basic PID is great for loads that are not greater than 5:1 inertial mismatch (the difference in inertia of the motor and the load). But, to handle the increased demand 3 more control parameters are added to enhance control of high inertial loads. The three new parameters are Velocity Feedback (KVfb), Velocity Feedforward (KVff) and Acceleration Feedforward (KAff). You could say we now have a "PIDVFA" servo control algorithm.

The first thing you may think is "Oh no not more things to adjust and I have no idea what they are". Well it's not really that bad. In QuickTuner™ we have grouped these parameters together in three main functions:

1. Stiffness - KP & KI; These parameters work primarily to keep the servo position with minimal error throughout the move profile.
2. Damping - KD, KVfb & KVff; These work to minimize oscillations and overshoot in the motion profile. The KD works mainly on the higher frequency oscillations while the other two work at lower frequencies especially with high inertia loads.
3. Inertia - KAff; This parameter is specifically used to counter the affects of large inertial loads during acceleration and deceleration.
4. Filters - PID Output and Derivative terms. These low pass filters aid in stabilizing the motor control by helping to eliminate high frequency oscillations.

We have made it so that you can adjust the servo parameters in groups or with the "Advanced" button individually. When tuning the servos we can actually get pretty good control with just the "KP" and "KD" terms.

We have provided "Files" that contain a good starting point for tuning the Servo drive with our motors. We have expanded the range of inertia's and now have files for each motor that cover several load to motor inertia mismatch ratios.

## Getting Ready for Tuning

Before you begin it's good to do some homework on the load the motor is intended to drive. The two primary load issues to consider are the "Frictional" and "Inertial" torque requirements. In a servo system "Frictional Torque" is the easiest to deal with so primarily it is important to know (or estimate) the Inertial Torque. Knowing the Inertial Torque requirement will aid later in know how much gain will be needed in some of the tuning parameters. When calculating or estimating the inertial load you will come up with a number that is in units such as "g-cm<sup>2</sup>" or "oz-in-sec<sup>2</sup>". These are good units to use because AMP Servo motors are rated using them. For AMP Servo motors specifications refer to the product catalog or visit our Web-site.

With a good estimate of the Inertial load and knowing the inertia of the motor you are using you can now select a file from a list generated at the factory that best represents your load. You will need to do a little more math to come up with an Inertia mismatch ratio. The file names list the motor first then the load. The files are available typically in 1:1, 1:5 and 1:10 ratios. Select the nearest one and open it. QuickTuner™ will now be loaded with parameters that will give you a start at tuning the servo system.

We need to give *QuickTuner™* a little more information before we test the servo system. The seemingly obvious things to know are the Max Speed, Acceleration and Distance requirements of the sample move. But what is not so obvious is the profile shape required to operate the load properly. The motor may be able to accelerate the load very quickly but may induce significant "Ring" in the motion profile. It might be better to accelerate slower and go to a higher Velocity to minimize the ringing. Deciding the best profile for a given move is sometimes more "Art" than hard calculation.

With all this said, you will have to make a good first guess at the motion parameters to begin the tuning process. *QuickTuner™* has a sampling Oscilloscope that will allow us to execute a move and display a variety of

measurements.

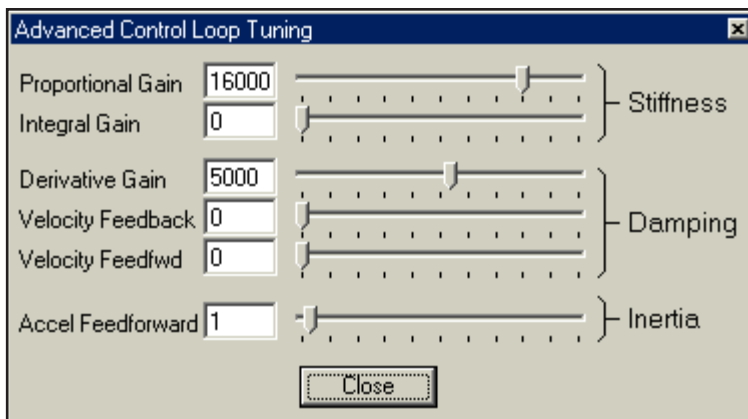
## 1) Entering a Sample Move

Enter move profile values in the “Sample Move” section of the Tuning - Sampling tab. For this example, we will try a move distance of 8 revolutions. We need to choose speeds and acceleration rates that represent the actual application. For this exercise try 30 rps and 200 rev/s/s.

## 2) Start with the KP & KD parameters

Before we try a move let's only start with the Proportional (KP) & Derivative (KD) gain parameters. Record the values of the other parameter settings and “Zero” out their values. Do this in the “Advance Control Loop” screen by clicking the “Advanced” button. The “Accel Feedforward” can only be set as low as “1”.

Starting with only these two terms is a good safe way to begin. They are the minimum required in a servo system.



*Note: If things go wrong (they usually do, e.g. the motor becomes unstable or the motor speed runs away) there is a “Play/Pause” button in the upper right corner of the QuickTuner™ Window under the label “Servo”. Clicking the “Pause” will disable the servo, clicking “Play” will enable the servo. Be ready to click the “Pause” if things don’t go well.*



## 3) Let's Plot a Move

Start by selecting “Actual Speed” and “Position Error” for the “Plot” selections. Make sure the direction is set correctly, in some cases you may want to select “Alternate” to avoid running the mechanism into a hard stop. For now select the “Sample Once” button.

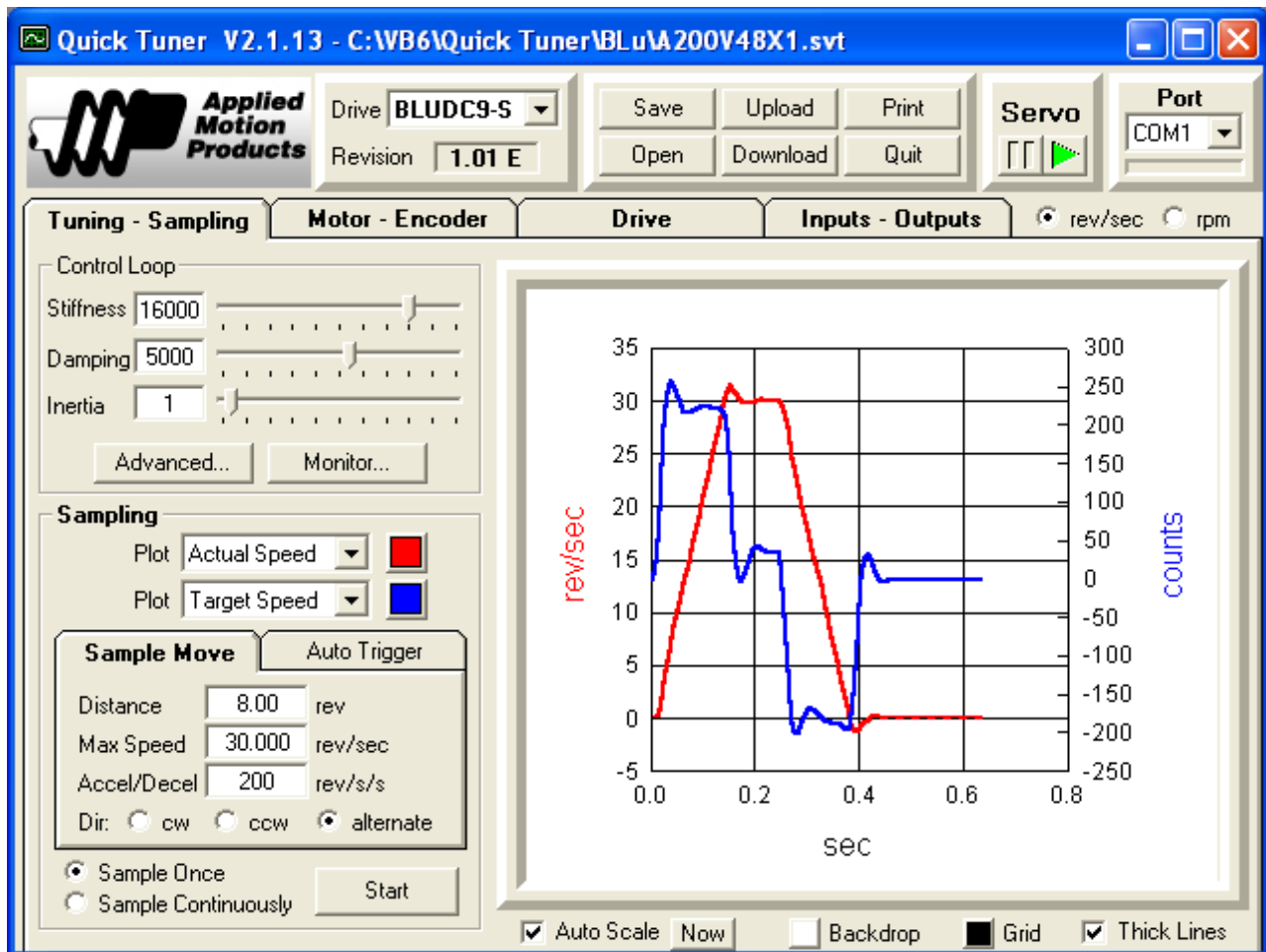
Click the “Start” button and observe the results. It may not look very good as shown in the next figure.

Other problems may have occurred during the move depending on how things were set up. If a “Fault” occurred you will have been asked to clear it, but the drive will be left disabled until the “Play” button is clicked.

NOTE: Clicking the “Pause” button then the “Play” button clears a fault and enables the drive.

4) Now we will adjust the motion parameters to get the desired move profile. You can repeat the move by clicking the “Start” button. If the drive continues to fault you may be exceeding “Current limit” or the “Position Limit”. These can be set in the “Motor -Encoder” and “Drive” tabs.

To see what current is being required of the drive select “Current” in one of the “Plot” lists and click “Start” again to observe a move. This will show the current profile during the move and may give a clue as to why a



“Fault” is occurring.

After a successful move is accomplished you can begin to do a little tuning. Adjust the KP and KD parameters and observe the results. Be careful with the KD parameter: too little gain and the system will oscillate. Too much gain may cause the system to “squeal” from a high frequency oscillation.

In some cases where a very “springy” coupler is used between the motor and load, the KD parameter may need to be reduced until the system is stable.

At this point don’t worry to much about the larger “Position Error”. We will take care of that later.

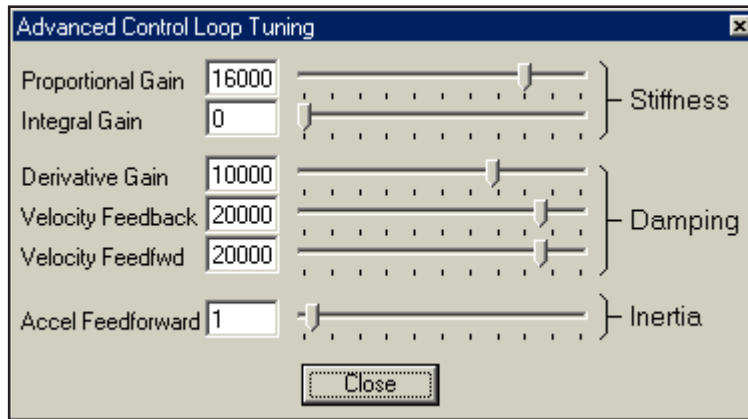
## 5) The return of KVfb and KVff parameters

Now add back in the Velocity Feedback (KVfb) and Velocity Feedforward (KVff) parameters that were zeroed in step 2. For large inertial loads these values can be also be large.

The goal with these terms is to minimize the “Overshoot” and get rid of the “Ringing” when accelerating and decelerating. In the plot on page 38 the red trace shows overshoot when the maximum speed is reached, and again when the motor reaches zero speed. There is no ringing in this plot, so we are almost damped enough.

We don’t need to eliminate all the “Overshoot” at this point because we have another term that will help.

Typically the KVfb and KVff are kept the same. If we want to adjust all the “Damping” values together at the same time use the “Damping” slider on the main QuickTuner™ Window. This control keeps the damping values ratioed to each other when adjusting the gains.



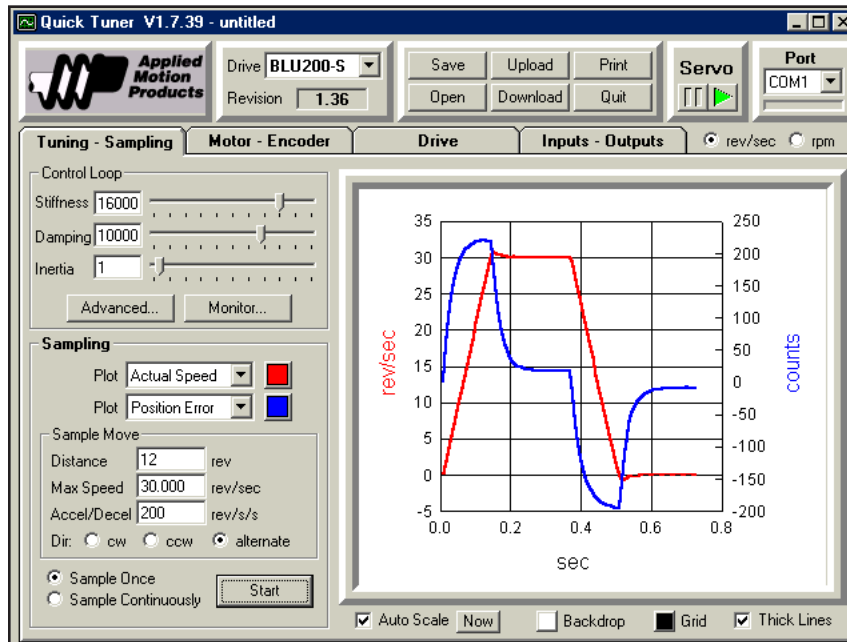
To much gain on the “Velocity” parameters may cause an oscillation, usually apparent when running at the Max Speed or when Stopped. Reduce the gain until the oscillation is acceptable.

As a general guideline the Velocity Gains values are typically 2X the Derivative Gain value.

## 6) Adding in the KAff parameter

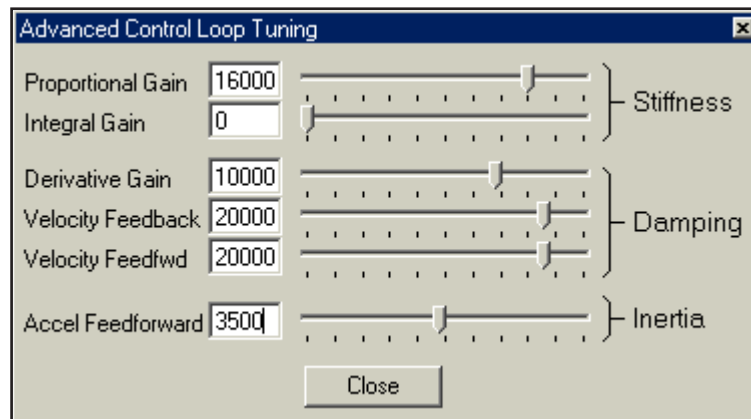
The Acceleration Feedforward (KAff) is a different kind of term from what we have just been working with. This term is used to deal with the inertia of a system. It will request more current during the acceleration and deceleration phases of the move profile.

Start by adding in 1/2 of the recorded value from the “file”.



In order to visually see the effect this will have on Position Error make sure the Autoscale Check Box at the bottom of the window is cleared. Now click the “Start” button and observe the results.

You should notice a reduction in the Position Error (the peak values). The KAff term has a somewhat proportional affect on the Position error. If the error was reduced to half by setting KAff to 3500, then doubling it to 7000 should eliminate the rest of the error. If not you can estimate the next setting. Divide the previous error by the difference in error value then multiply this times the KAff value.

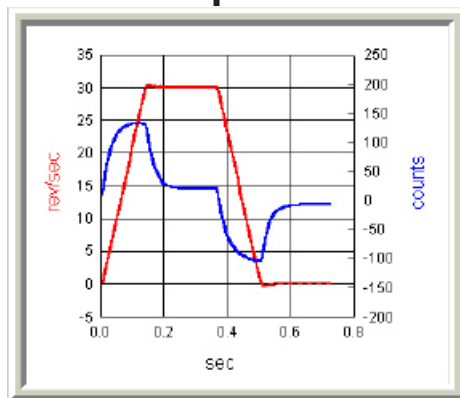


$K_{Aff} = \text{previous error}/\text{delta error} * K_{Aff}$   
 $K_{Aff} = 220/90 * 3500$   
 New  $K_{Aff} = 8555$

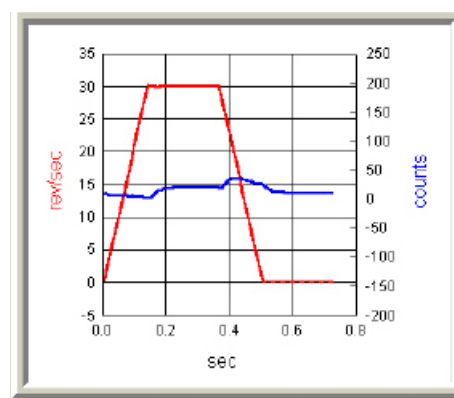
Remember this is an estimation. If after doing this the Position Error goes negative during acceleration, we went too far. Adjust the value in smaller amounts to get as near zero error as possible. At any time you can click the “Now” button near the “Auto Scale” to zoom in on the new Position Error value.

You may have also noticed that the overshoot of the Max Speed and Stopping is now reduced. This is because the servo control is having to do less work to maintain good control.

## 7) Finishing off with the KI parameter



$K_{Aff} = 3500$

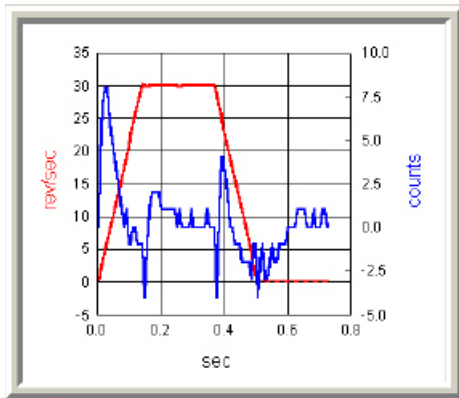
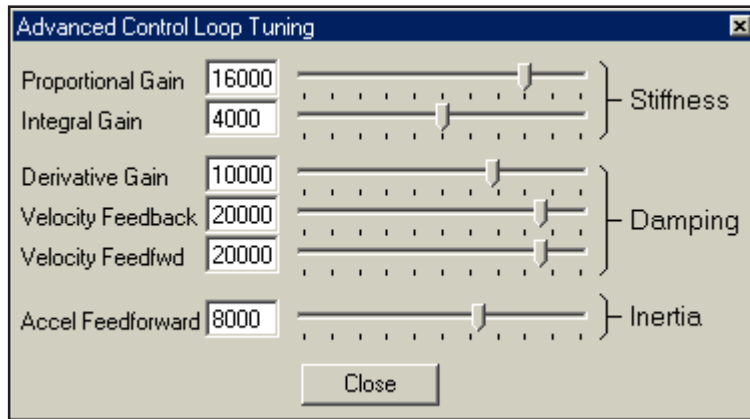


$K_{Aff} = 8555$

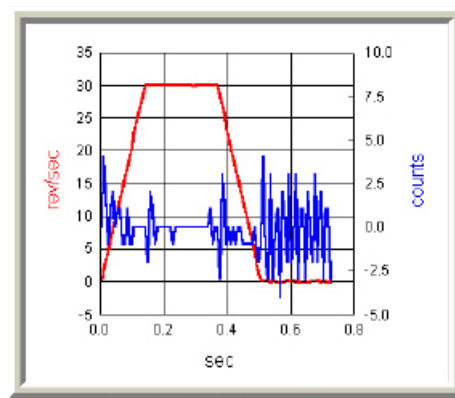
The final value to set is the “Integral Gain (KI)”. The KI value works to minimize steady state position error. This is most often needed to insure very exact positioning when at the new position after the move. It can also help minimize position error during the move.

Again start with a small value and work up.

The KI value affects how fast the position error is acted on; larger values provide faster response times. As the value gets larger you may notice an oscillation in the position error. Adjust the KI value to give the best results without causing an oscillation in the system



KI = 4000

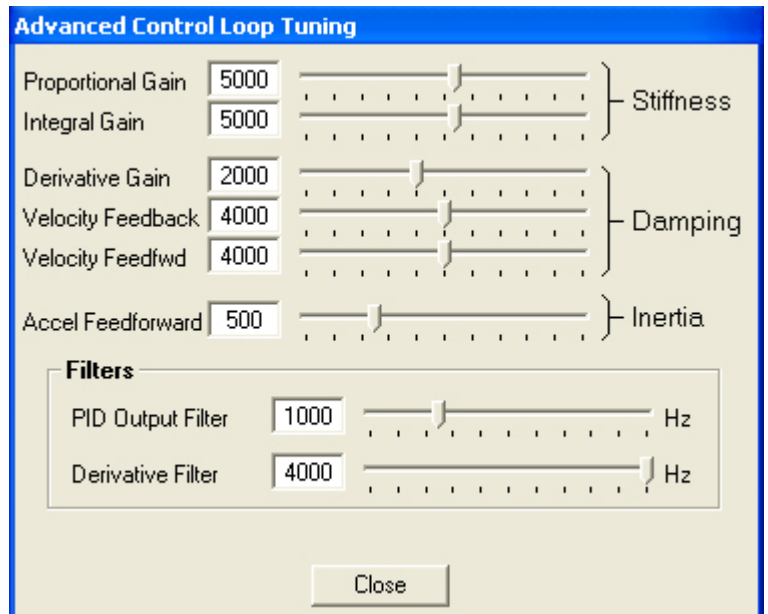


KI = 20000

## 8) Filter parameters

BLuAC5, BLuDC and SV7 servo drives have control loop filters for special situations. *(Note: these filters are not present on BLuDC drives with firmware prior to 1.52).* The most commonly used is the PID Output Filter. If your system is subject to mechanical resonance, you can set this low pass filter below the natural frequency of your system so that the PID output does not excite the resonance.

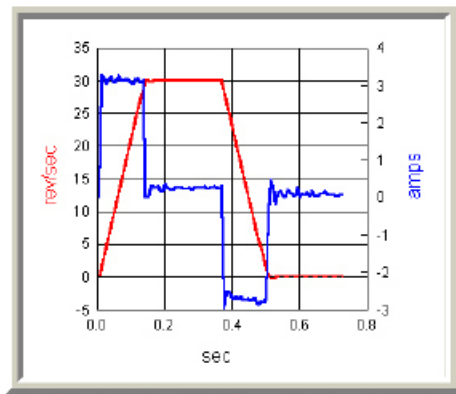
If you have a large inertial load, you'll probably find that you need to set the gain parameters high, especially P and I, to get good response. Then you will want to increase the damping to prevent ringing. Now the system is likely to be so tight that if you have a springy, all metal coupling it may "buzz" or "squawk". Reducing the frequency of the derivative filter can remove this objectionable sound.



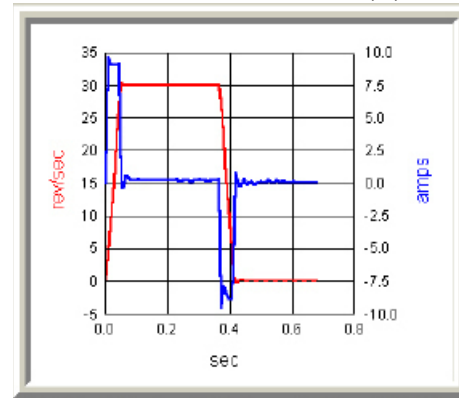
## 9) Verify the Drive Current

This can be done at any time during the tuning process to make sure the current supplied to the motor is not being limited by the drive. You might also want to see how much current is being required and make changes to the move profile.

Acceleration = 200 rev/s/s



Acceleration = 600 rev/s/s



## Step 3: Drive and Motion Control Setup

The BLu and SV drives are highly configurable, with options for command inputs and programming modes. The functionality depends on the drive model and the Command option chosen. The following pages give a summary of the BLu drives and the options available.

This is an example of the main “Drive” tab for a BLuAC5-Q. This screen will change according to the drive model and operating mode. Features and functions not available are not displayed.

A Summary of the Command modes and I/O for each drive model can be found below. Refer to the next section for details.

The screenshot shows the QuickTuner V1.9.23 software interface. The title bar reads "Quick Tuner V1.9.23 - untitled". The main window has a blue header with the Applied Motion Products logo and drive information: Drive: BLUAC5-Q, Revision: 1.52 V. There are buttons for Save, Upload, Print, Open, Download, and Quit. A Servo icon and a Port dropdown menu (set to COM1) are also visible.

The main content area has four tabs: Tuning - Sampling, Motor - Encoder, Drive (selected), and Inputs - Outputs. The Drive tab is active, showing the following settings:

- Drive Options:**
  - Regeneration Clamp Resistor:
    - internal: 50 watts
    - external: 40 ohms, .3125 seconds
  - Positioning Error Fault: ± 2000 counts
  - Maximum Acceleration: 5000 rev/s/s
- Operating Mode:**
  - Torque
  - Velocity
  - Position
  - Multi-axis system with SiNet hub
  - SCL - accept real time commands from a host PC or PLC via RS-232/RS-485
  - Q Programming Language (advanced users only)
- RS-485 Address:**
  - Address field: ! " # \$ % & ' ( ) \* + , - . / 0
  - Address field: 1 2 3 4 5 6 7 8 9 : ; < = > ? @
  - Transmit Delay: 0 msec
- Auto Sync:**
  - Automatically upload from drive at power up
- Analog Input Filter:**
  - 500 Hz
- Enable servo:**
  - Automatically
  - When ServoOn input is closed
  - When ServoOn input is open
  - Only from SCL "ME" command
- Buttons:** Restore Factory Defaults..., SCL Terminal..., Show alarm history...

## Feature Summary: BLuDC4-S, BLuDC9-S, BLuAC5-S, SV7-S

Command Mode	Drive Parameters					Inputs			Outputs		
	Address	Electronic Gearing	Max Accel	Max Speed	Position Error	Alarm Reset	Limit Switches	Servo Enable 4	Fault	Brake	Motion
Analog Torque						•	•	•	•		
Analog Velocity			•	•	•	•	•	•	•		
Analog Positioning					•	•		•	•		
Digital Positioning by Pulse/Direction or Quad. Encoder		•	• 1		•	•	•	•	•		
Multi-axis with Sinet Hub			• 2	•	•	•	•	•	•	•	•
Serial Command Language (RS-232/4853)	•		• 2	•	•	•	•	•	•	•	•

1: In case of pulse interruption or limit  
2: In case of limit or commanded quick stop  
3: RS-485 is optional on SV7  
4: When connected to Quick Tuner, the *Servo Enable* input is overridden by Quick Tuner

## Feature Summary: BLuDC4-Q, BLuDC9-Q, BLuAC5-Q, SV7-Q

Command Mode	Drive Parameters					Inputs			Outputs		
	Address	Electronic Gearing	Max Accel	Max Speed	Position Error	Alarm Reset	Limit Switches	Servo Enable	Fault	Brake	Motion
Analog Torque						•		•	•		
Analog Velocity			•	•	•	•	•	•	•		
Analog Positioning					•	•		•	•		
Digital Positioning by Pulse/Direction or Quad. Encoder		•	• 1		•	•	•	•	•		
Multi-axis with Sinet Hub			• 2	•	•	•	•	•	•	•	•
Serial Command Language (RS-232/485 <sup>3</sup> )	•		• 2	•	•	•	•	•	•	•	•
Q Programming Language	•	•	• 2	•	•	•	•	•	•	•	•

1: In case of pulse interruption or limit  
2: In case of limit or commanded quick stop  
3: RS-485 is optional on SV7

# QuickTuner™ Software Manual

## Feature Summary: BLuDC4-Si, BLuDC9-Si, BLuAC5-Si, SV7-Si

Command Mode	Drive Parameters					Inputs			Outputs		
	Address	Electronic Gearing	Max Accel	Max Speed	Position Error	Alarm Reset	Limit Switches	Servo Enable	Fault	Brake	Motion
Analog Torque						•		•	•		
Analog Velocity			•	•	•	•	•	•	•		
Analog Positioning					•	•		•	•		
Digital Positioning by Pulse/Direction or Quad. Encoder		•	• 1		•	•	•	•	•		
Multi-axis with Sinet Hub			• 2	•	•	•	•	•	•	•	•
Serial Command Language (RS-232/485 <sup>3</sup> )	•		• 2	•	•	•	•	•	•	•	•
Q Programming Language	•	•	• 2	•	•	• 4	• 4	• 4	• 4	• 4	• 4
Si Programming			• 2		•	• 5	• 4	• 5	• 4	• 4	• 4

1: In case of pulse interruption or limit  
2: In case of limit or commanded quick stop  
3: RS-485 is optional on SV7  
4: These inputs and outputs can also be used as general purpose programmable  
5: By program only - no dedicated input for this function

## Operating Modes

Some drives allow the user to select from a number of different operating modes. This may be either selecting from a type of command signal or selecting between different programming modes.

The particular modes available will depend on the drive model. If you have your drives connected and it has been detected by *QuickTuner™*, only the options available on your drive will be shown. Alternatively by selecting your model type from the drop down list at the top of the screen the options screen for your drive will be displayed.

The mode you have selected will be available once you have performed a download, in the case of the X Drive and Si™ programmer you will need to start your programming software and cycle the power to the drive, in the case of command signals the drive will respond to your command signal as soon as you have downloaded the parameter changes to the drive.

**Operating Mode**

- Torque
- Velocity
- Position
- Multi-axis system with SiNet hub
- Si - run a stored program created using Si Programmer software
- SCL - accept real time commands from a host PC or PLC via RS-232/RS-485
- X Drive - run a stored program created using eXposition software

**Command Input**

- Analog
- Digital

Analog Signal Type

- Differential
- Single Ended

Range

Current  A at +10V

Offset  mV

Deadband  mV

## Using Analog Inputs

The BLu Servo drive analog inputs can be used to control the three different modes of operation Torque, Velocity and Position. Configuring the Analog “Command Input” has settings that are generic to all three. One of the settings labeled “Current”, “Velocity” and “Position” is a gain value that is customized for each mode.

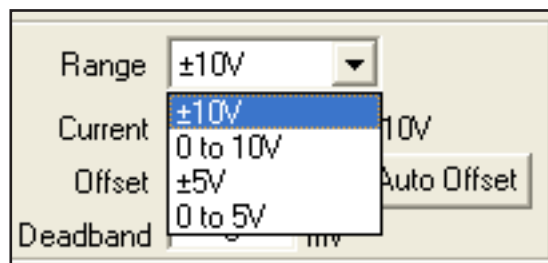
There are five settings that are required for getting the analog inputs to control the desired mode output:

### 1. Analog Signal Type – Differential or Single Ended

There are two analog inputs that can be used for “Differential” mode or one input can be used for Single Ended. Differential provides common mode noise rejection that may enhance the performance in high electrical noise environments.

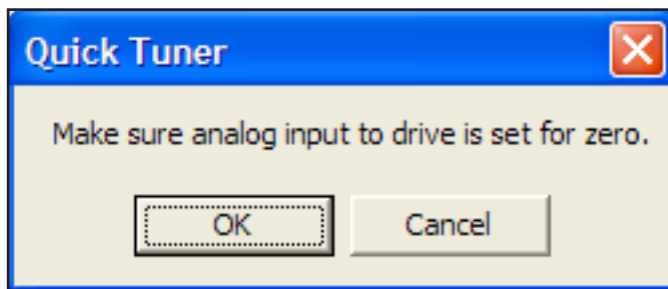
### 2. Range – There are 4 different ranges $\pm 10V$ , $0 - 10V$ , $\pm 5V$ , $0$ to $5V$ .

The range settings are not done in hardware but are a calculation that makes using different input ranges easier. When the Signal Type is “Differential” and  $\pm 10V$  the effective ADC resolution is 13 bits,  $0$  to  $10V$  is 12 bits,  $\pm 5V$  12 bits,  $0$  to  $5V$  is 11 bits. If Single Ended type is used 1 bit is lost at each range.

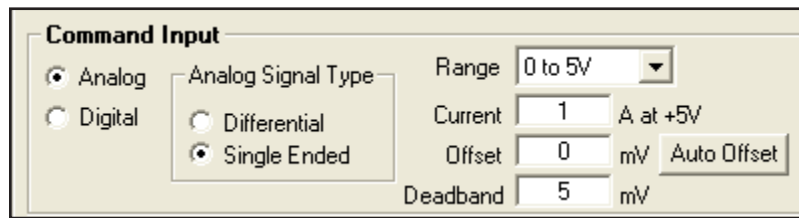


### 3. Current or Velocity or Position – Establishes a gain value that scales the output to the input. For example in Current Mode, if the “Range” is set to $\pm 10V$ and the “Current” is set to $2$ , a $10$ volt input will apply $2$ amps to the motor. A $-10$ volt input will apply $-2$ amps to the motor.

### 4. Offset – Sets an offset value to the input that can null out a voltage bias or it can shift the input voltage value as needed. Often in analog systems it is very difficult to get a true “0” value. Using the offset feature allows adjusting out any unwanted offsets that disturb the desire for a true $0$ volt input from an external controller. The “Auto Offset” function can automatically detect and correct voltage biases on the input.



### 5. Deadband – Inserts a voltage region where the input is seen as “0”. Because of the sometime imprecise nature of analog signals and inputs there may be a need to create a “Dead” zone where the analog input has no effect on the output. This is normally needed around the “0” input. For example, when using a Joystick to operate the motor the user may not want any torque output when the Joystick is at its “Null” position. Most Joysticks are not that precise and may still output a small voltage, adding the deadband can eliminate the effect of the small voltage.



## Torque Mode

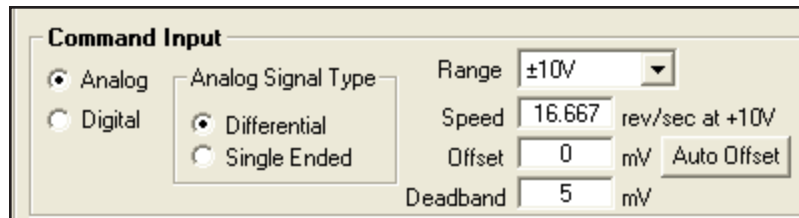
When the drive is set up for Torque mode, it allows you to define the current that will be delivered and thus the torque generated by the motor and the direction it will rotate. In this mode the speed that the motor runs at will depend on the load applied to the motor.

**WARNING - If the motor is not connected to the load or has no load applied, downloading this mode with a command signal may cause the motor to accelerate to high speed.**

### Analog Input - Current

The Current box allows you to define the current that will be applied to the motor with a the given analog settings. For example, if the analog input range is set to  $\pm 10V$  and the Current is set to 1 amp a positive current will be applied to the motor when the input is +10V. A negative current will be applied when the input is -10V.

## Velocity Mode



Velocity mode means that the drive uses the command input signal to set the speed that the motor will run at.

The box labeled “Speed” enables you to define the speed that the motor will reach with a the given analog settings. For example, if the analog input range is set to  $\pm 10V$  and the speed is set to 16.667 rev/sec the motor will spin in the Clockwise (CW) direction at 1000 RPM when the input is +10V. It will spin Counter Clockwise at 1000 RPM when the input is -10V.

By setting the Speed to the maximum for your application, and not the maximum speed of the motor, you will achieve higher resolution on the command input and better control.

The speed value can be entered as a negative value. This will allow you to select which direction the motor will run with a positive command signal voltage.

### Using the Offset

With all analog controllers, there is the possibility that when the controller delivers the command for zero speed, this command may not be exactly 0 volts, as the drive requires. Here you can enter a value for an offset to tell the controller what actual voltage represents zero speed.

To get a value for the offset, give your controller a command signal to force it to demand zero speed from the Motor/Drive. Then using a voltmeter measure the actual voltage being generated from the command output. This is the value that should be entered in the Offset box.

The Auto Offset button causes an internal function to find an offset value that will “Zero Out” whatever input is present during the execution of the function.

## Positioning mode - Analog Signal

Positioning mode using an analog input causes the servo drive to position the motor relative to the analog input value.

The screenshot shows the 'Command Input' configuration window. On the left, 'Analog' is selected with a radio button. The 'Analog Signal Type' section has 'Differential' selected. To the right, 'Range' is set to '±10V' in a dropdown menu. Below that, 'Position' is set to '8000' with the unit 'counts at +10V'. 'Offset' is set to '0' with the unit 'mV' and an 'Auto Offset' button. 'Deadband' is set to '5' with the unit 'mV'.

Analog positioning allows you to move the motor a relative distance according to the value of an analog input. For example the above configuration would move the motor +/-8000 counts from its current position according to the voltage applied, e.g. a signal of +5 volts would move the motor 4000 counts clockwise.

This option can be configured to accept a variety of analog scales. There is also an option for an offset voltage and a deadband. The offset can be used to offset the position in case the 0 volt signal from your analog command does not represent zero position on your application.

TUNING NOTE: Turning off the KD (differential gain) term will minimize analog noise affects. The higher the "Position" gain setting the more analog noise will cause dithering.

## Positioning mode - Digital Signal

Pulse Input Mode is for systems in which the position of the motor is determined by a digital input signal in the form of pulses.

The screenshot shows the 'Command Input' configuration window. On the left, 'Digital' is selected with a radio button. The 'Digital Signal Type' section has 'Pulse & Direction' selected. To the right, 'Direction is CW when' has 'IN2/Dir on' selected. Below that, 'Electronic Gearing' is set to '20000' with the unit 'steps/rev'.

The three modes available are :

Pulse and Direction. Accepts a signal such as that generated by a stepper motor controller. With this mode the frequency of the pulses fed into one input determines the speed, the direction of rotation is determined by a signal fed into another input. You can configure whether an ON or OFF signal represents clockwise motion.

CW and CCW Pulse. The motor will move CW or CCW depending on which input the pulse is fed into. The drive has two inputs allocated to this feature, pulses fed into one input will generate CW motion, pulses fed into the other input will generate CCW motion.

A & B Quadrature. Sometimes called "Slave Mode". The motor will move according to signals that are fed to the drive from a master encoder. This encoder can be mounted on a shaft on the machine or it can be another motor in the system.

For all the Pulse Input modes you will need to determine a value to enter into the Electronic Gearing Box. An explanation on how to do this is given in the next section.

## Electronic Gearing

Allows you to adjust the way that the drive responds to incoming step pulses. This is very useful if you are replacing a step motor drive with a servo system, because you can make the drive have the same number

of steps/revolution as the stepper. For example, you may have a 8000 count encoder, but want the drive to operate at 200 steps/rev, like a full step drive. Or perhaps the system is working in degrees, so you want to operate the drive at 36,000 steps/rev so that there are an even number of steps (100) per degree.

Simply enter the number of steps/rev you want in the “Electronic Gearing” text box.

## Multi-axis System with SiNet Hub

Select this option if you will be using one of AMP’s hubs to create a multi-axis system, this will set the drive to the correct power up mode for use with the hubs. A Hub can be programmed to act as a stand-alone multi axis system or can act as a router for SCL commands from a host system.

Refer to the manual for SiNet Hub Programmer and SCL programming manual for more information.

## SCL

This sets the power up mode for the drive to the correct setting for use with SCL applications.

SCL is Applied Motion’s host command language for applications that require the drives to be sent instructions by a host controller. With SCL, the drives can be operated in both RS-232 and RS-485 mode, the RS-485 option allows you to have multi-axis multi-drop applications with the drives “daisy chained” on one serial link. When this option is selected you will need to set an address for each drive you are working with. Refer to the next section.

## SCL Address

If you plan to use the SCL mode with RS-485 communications you will need to set the address for each drive in your system. Simply select the address character and perform a download, in this way up to 32 drives can be connected together on a single serial link. Refer to the SCL manual for more information on how to send commands to drives on a multi-axis serial link.

RS-485 Address															
!	!"	#	\$	%	&	'	(	)	*	+	.	-	.	/	0
1	2	3	4	5	6	7	8	9	:	;	<	=	>	?	@
Transmit Delay														0	msec

## Si Programmer Mode

*Si™* is Applied Motion’s simple indexer software that allows users to program the drive to perform a complex sequence of moves within an intuitive graphical programming environment.

Selecting this option puts the drive into the correct power up mode for *Si™*.

The *Si Programmer™* software includes built-in servo tuning and configuration facilities, so you can do everything with one software package and store your servo tuning along with your *Si™* program in a single file.

## Q Programmer Mode

Q versions of the drive have the ability to store and run sequences of “Host” commands. They also have a much larger command set with extra commands for executing programs and manipulating parameters.

## CANopen Mode (SV7-C Only)

CANopen is a communication fieldbus standardized by the CAN in Automation Group (CiA). Applied Motion Products drives are compliant to CiA DS301 and DSP402 and use the CAN 2.0b passive physical layer. Detailed information on the Applied Motion CANopen implementation can be found on our website.

## Drive Parameters

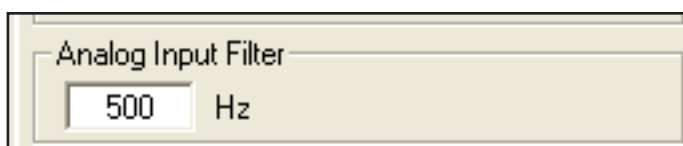
### Auto Sync

The “Drive” tab shows an option for “Auto Sync at power up”. If this option is checked, *QuickTuner™* will upload the parameters stored in the drive when power is applied. Care should be taken as this will overwrite all the parameters currently set on the screen.

### Analog Input filter

The analog input filter sets the frequency in Hertz of the roll off point of a single pole low pass filter. When using any of the Analog Input modes this filter can be used to reduce the effects of analog noise on the mode of operation.

NOTE: Low frequency filter values will cause a lag in the system response.



### Maximum Acceleration

This will set the maximum level of acceleration for the motor. Even if the command input tries to demand a higher level of acceleration, the drive will only accelerate at the maximum set level.

When you select *Si™* the maximum acceleration will be defined within the *Si™* software as part of your program.

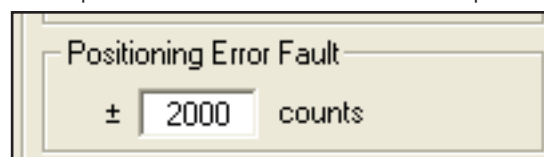
### Maximum Speed

Here you can enter the maximum speed allowable in your application. If your maximum speed is set below the speed your command signal can demand, the final speed achieved will be the speed set in the Maximum Speed parameter.

Note, Maximum Speed only works with Velocity Mode. In Torque Mode you will need to set the Peak and Continuous torques to values that will limit torque in your application. In Pulse Input Mode these values will be limited in your controllers software.

### Positioning Error Fault

Positioning error is the difference, in encoder counts, between the actual position and the commanded position of the motor. A small amount of positioning error is a normal part of a servo system. But sometimes the unexpected can happen. A wire might break, a sensor could fail or the motor may encounter a physical obstruction. You might even one day forget to set up and tune a drive before installing it into a system. In all of these cases, you'll want to know that something is wrong as soon as possible and without damaging anything. For this reason, the servo drives include a position error fault limit. Anytime the position error (as reported by the encoder) exceeds this limit, the drive cuts power to the motor.

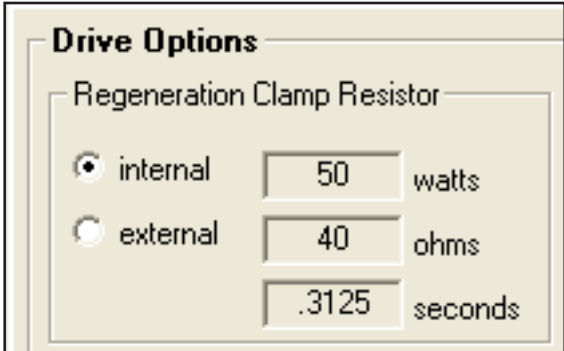


You can set the fault limit to as little as 10 encoder counts, or as much as 32000. When you're first tuning the system, you should set this value high so that the drive doesn't shut down as you experiment with tuning parameters. Once the drive is properly tuned and you know how much error to expect during normal operation,

you can set an appropriate fault limit. For example: set *Quick Tuner's* scope to plot position error. Execute some aggressive sample moves, using the maximum speed and acceleration that you plan to use in your application. If the maximum position error is, say, 50 counts, then you could safely set the fault limit at 100.

## Regen Resistor (BLuAC5 drives only)

When a motor reduces speed, it does in fact turn into a generator, generating a voltage. This voltage gets sent back into the drive, which has to get rid of it. A motor which is driving a large inertia load, can during fast decelerations generate enough voltage to destroy the drive. The BLuAC5 has the ability to absorb a certain amount of voltage or regeneration energy into its internal circuits. It has a number of capacitors and a small internal resistor to do this. But it may be necessary to add an external resistor to “dump” larger amounts of energy. If this is the case you will need to specify the value of the external resistor's resistance, continuous power and peak power duration.



The screenshot shows a dialog box titled "Drive Options" with a sub-section "Regeneration Clamp Resistor". It contains three radio buttons and three input fields:

Option	Value	Unit
<input checked="" type="radio"/> internal	50	watts
<input type="radio"/> external	40	ohms
	.3125	seconds

The BLuDC and SV7 drives, which are powered by external DC power supplies, can also transfer large quantities of regenerative power from the motor and load back into the power supply. In such cases, an RC50 external regeneration clamp is recommended.

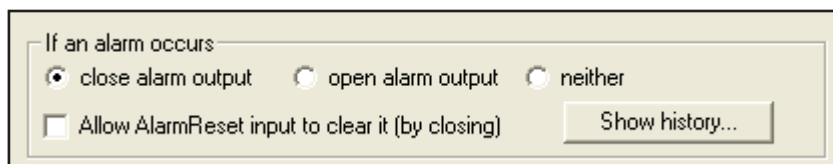
## Step 4: Inputs and Outputs

### Fault Output

Alarms that disable the drive are called faults. The drive features a Fault Output that will be triggered if there is a fault condition. This fault may be a fault within the drive or it may indicate a system fault. If you are running *QuickTuner* while an alarm condition develops, a dialog box will pop up and give you details of the fault. Alarms and faults are also displayed on the drive's front panel LEDs.

### Alarm Reset Input

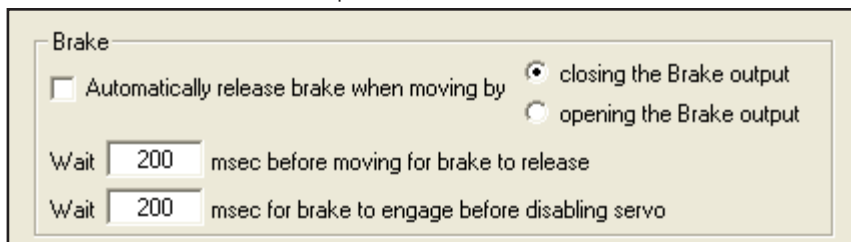
The Alarm Reset input is used to clear alarms and faults. This will clear the Fault Output but will not reset the drive unless you choose for it to do so by checking the other box in the Alarm dialog box. If you do not check this box you will have to cycle the power on the drive to reset the drive. There is good reason for this. An alarm condition may indicate a fault on the drive or it may indicate an error on your machine or system. Resetting the drive at this point will make the drive able to respond to any command signal present and could result in damage to your machine or possibly injury.



When using *QuickTuner™*, the alarm can also be reset by disabling and re-enabling the drive with the “pause” and “run” buttons at the top of the screen.

### Brake Output

For use when your servo motor is fitted with a fail safe holding brake. These are normally used to hold the load in position when the motor is at zero speed, often used when the motor is holding a load against gravity.



Most brakes are fail safe, which means it requires a voltage to hold the brake in the OFF position, allowing the motor to move.

Quick Tuner gives you a choice between closing or opening the brake output to release the brake. Please select this option with care as the wrong choice could damage your system.

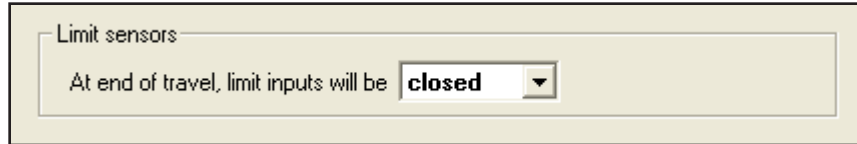
The Brake also has some time delay features.

The first time delay option creates a time delay between the brake being released and the servo drive being enabled. If a move is attempted immediately after the drive is enabled this could create a time lag in your system as the motor will not respond instantly.

The second time delay option creates a time delay between the brake engaging and the servo drive being disabled. This will ensure that the brake is fully engaged before the load is no longer being held in position by the servo motor.

## Limit Switch Inputs

The BLu and SV drives have two inputs that can be configured as end of travel limit switches. These are useful for linear applications such as actuators.



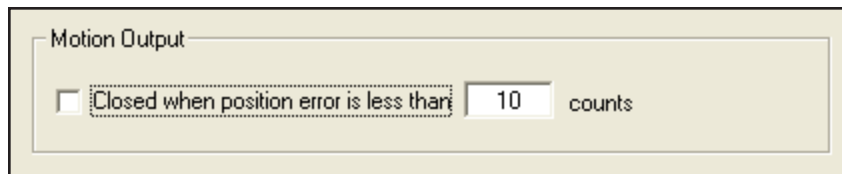
You tell the drive whether your input switches or sensors are Open or Closed when they are activated. You can also select the “Not Used” option for when limit sensors are not present. SCL users can configure these limits to be used as programmable inputs.

What happens when a limit switch is activated will depend on the programming mode you are using and the particular command you are using at the time. Please refer to your programming manual for details of Limit Switch Input errors.

## Motion Output

The Motion output will indicate whether the motor is in motion or it has reached the current programmed position.

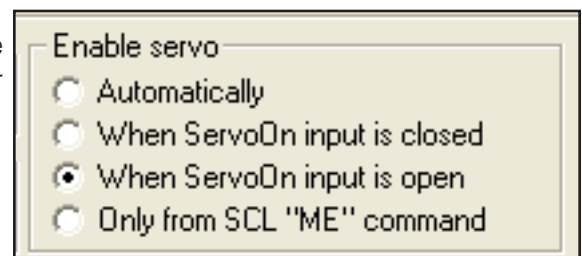
The output will close when the motor is within a given distance of the final position, this distance can be defined in the Motion Output dialog box.



The Motion Output dialog box mentions the “Position Error”. In this case the error is the number of encoder counts between the actual position and the commanded position.

## Servo Enable Input

The Servo Enable Input allows you to turn the power stage of the drive on and off. This means that the drive can be on, with power going to it, but the motor will not be active.



### WARNING

#### Care must be taken when using the Servo Enable input.

If you enable a drive when a command input is present, the motor will attempt to perform the move or achieve the speed or torque demanded. So when you enable the drive be sure it is safe to do so.

Alternatively if you disable a drive during a move the motor will no longer have power and it will be allowed to turn freely. If your motor has a large inertia load, or is holding a load against gravity, the motor will no longer have control of the load.

The Servo Enable can also be activated from within Quick Tuner by using the Servo Pause and Play buttons on the main screen. In fact, the Enable Input isn't used when the servo drive is being controlled by QuickTuner™.

**Warning - Before enabling the drive be sure it is safe to do so. If a command signal is present when the drive is Enabled, the motor will attempt to reach its commanded torque, speed, or position.**

## Tools

QuickTuner includes some specialized tools to help with your commissioning.

### Alarm History

The BLu and SV drives stores a log of previous alarm conditions.

Each time there is an alarm, the drive stores the alarm condition in memory. Since a fault may trigger more than one alarm condition, the drive stores all of them for reference. This information can then be extracted using *QuickTuner* to help with drive and system problem solving. The drive stores up to 8 alarm conditions.

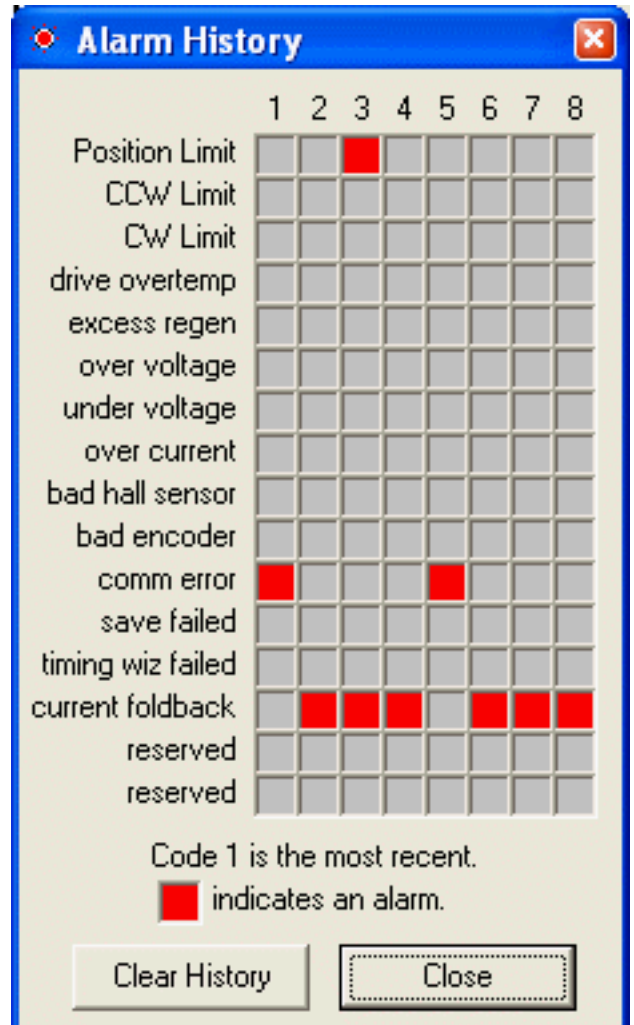
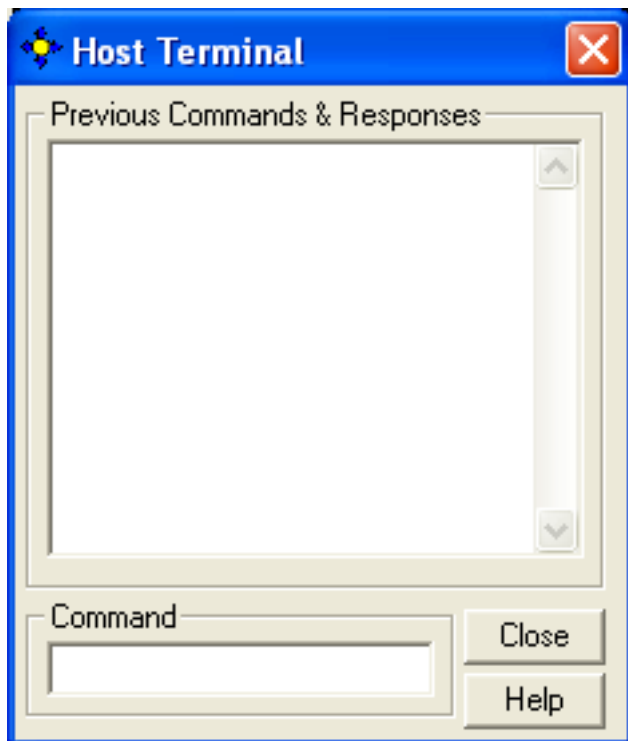
### Restore Factory Defaults

Sometimes things go wrong, and you need to get back to a safe point from where you can start again, the "Restore Factory Defaults" button will reset all the parameters on the drive to the ones that it left the factory with.

Note - this will erase all the parameters you have changed , so you may want to save them to a file first.

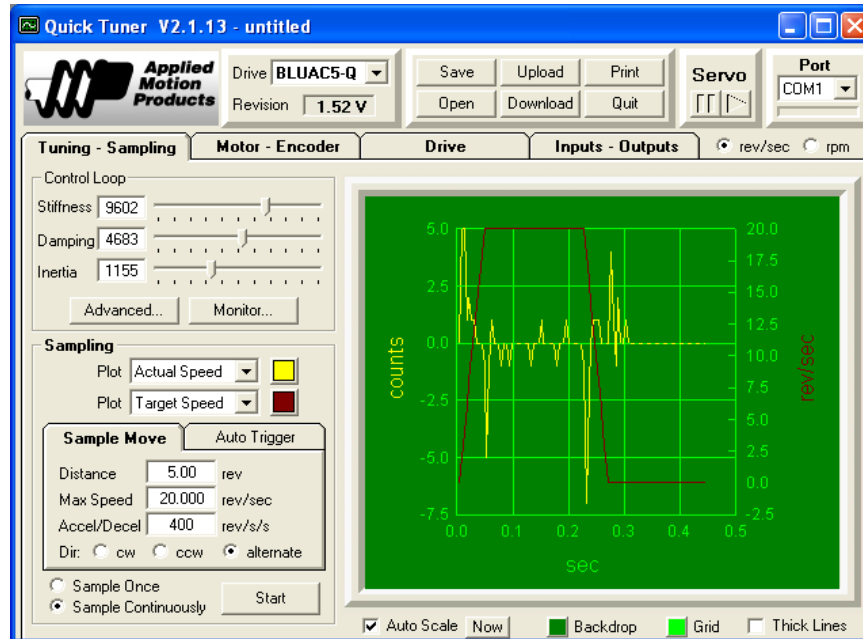
### Host Terminal

The Host Terminal allows you to send SCL commands to the drive, regardless of the Operating Mode. The terminal is also useful as a commissioning tool, allowing you to test your drive and SCL without having to launch a separate application.



## The Sampling Oscilloscope

At some point, you will want to observe the results of your choice of gain parameters. We have included a sampling oscilloscope feature for this reason. All you have to do is select the move profile you'd like to try, by entering a move distance, a maximum speed, and the acceleration rate. You should select a move that is meaningful to your application. There is no point in optimizing your speed around 50 rev/sec if your application only calls for speeds of 10 rps. The same is true for distance and acceleration.



The oscilloscope window can display either one or two measurements at a time. The choices include Actual Speed, Target Speed, Position Error, Current and Supply Voltage. The drive only samples what you have selected, so if you change plot parameters you must sample again to update the display. By making the oscilloscope “full screen” you can get a better display resolution and see your move in more detail.

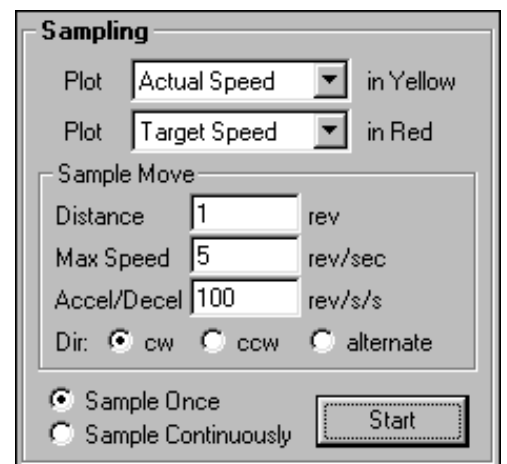
You may also choose clockwise or counterclockwise rotation. If your load is vertical, you may want to observe the differences. If your load is linear, then you can't keep sampling in the same direction or you'll run out of travel. For applications where travel is limited, choose “alternate direction.” Then the drive will change the direction after each move.

If you have selected “Sample Once”, you will get one sample move, and one graph each time you click on “Start.”

Sometimes it is convenient to keep the sampling process running automatically while you adjust the gain parameter slide bars. To do this, select “Sample Continuously.” The drive will start sampling and plotting when you click on “Start” and will not stop until you click “Stop.” (Note: the Start button becomes a Stop button when you click it in Continuous sample mode.)

It is not necessary to click on the Download button when sampling. If *QuickTuner™* detects any changes in the drive settings, it will automatically download the new settings before each sample move.

Each time the settings are downloaded to the drive, they are written into nonvolatile memory, and will still be there the next time you power up the drive.



# QuickTuner™ Software Manual

## Auto Trigger Mode

The Auto Trigger mode enables you to capture a trace for a move commanded by an outside signal such as the analog command from a motion controller. The actual trigger can be any of the sampling data that is displayed on the oscilloscope and the trigger point is when the value rises above or falls below a chosen value.

When the START button has been pressed, the Trigger is "Armed". When the "Trigger" occurs the system will store the chosen sampling data for the time specified, then display it on the screen. If you want to display some data from before the Trigger, enter a nonzero value for Capture Delay.

A trace consists of 100 data points for each of the two sampled data. With this in mind, your selection of trigger level and time span are important for viewing the desired information.

The example on the right shows a sampling selection of the motor "Actual Speed" and the "Target Speed". The trigger is set for "Above" "10 revs/sec" with a capture time of "0.375 sec" and a capture delay of "20%". If you set the capture delay at 20%, then 20% of the trace will contain data from before the trigger.

The trace below shows the results of a capture. When the actual speed exceeded 10 revs/sec the capture began. Notice that the 10 revs/sec threshold is at about 0.075 seconds, which is 20% of the total capture time.

**Sampling**

Plot Actual Speed

Plot Target Speed

**Auto Trigger**

Start capture when Actual Speed goes

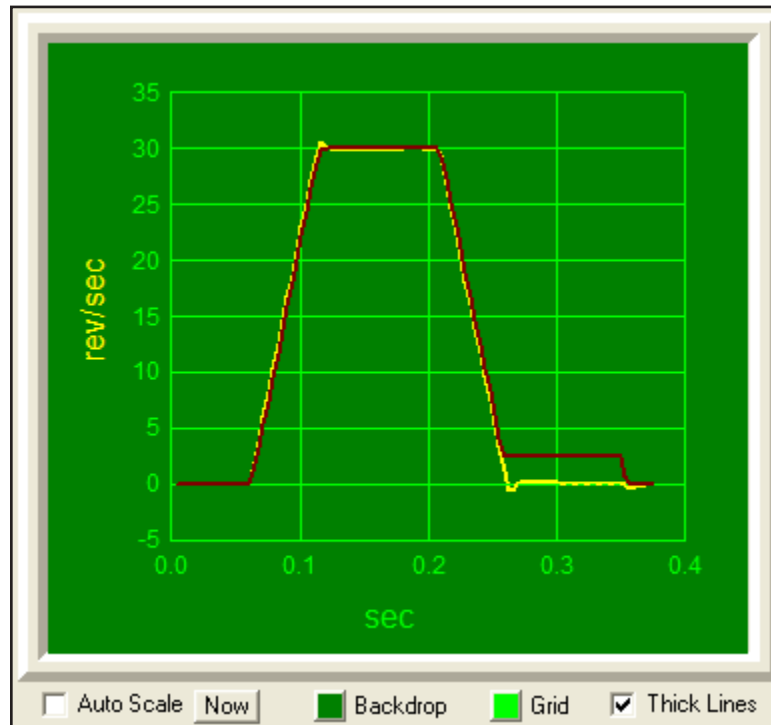
Above 10.000 rev/sec

Capture data for .375 secs

Capture delay 20 %

Sample Once  Sample Continuously

Armed



## Monitor

If a BLu or SV series drive is detected it by *QuickTuner™* it displays the option of opening the Monitor panel. Designed to assist with commissioning and fault finding this configurable screen will display the current condition of the drive I/O, drive status and selected drive parameters.

The monitor features three configurable displays that can show live information about the drive. Each can be configured to display one of the following selected parameters.

- Position Error
- Actual Speed (NOTE 1)
- Command Current
- Supply Voltage
- Encoder Count (NOTE 2)
- Alarm Code
- Target Speed (NOTE 1)
- Actual Current
- Drive Temp
- Ain Voltage

NOTE 1 - this can be in rps ( revs per second ) or rpm ( revs per minute ) depending on the setting that you chose in the *QuickTuner™* main screen.

NOTE 2 - By clicking on the Encoder Count, you can return the value to zero.

