

Sidereal Technology Servo Configuration Program Document
Copyright (c) 2005 and 2006 by Dan Gray
Version 1.02
Documentation Date: 5-21-06

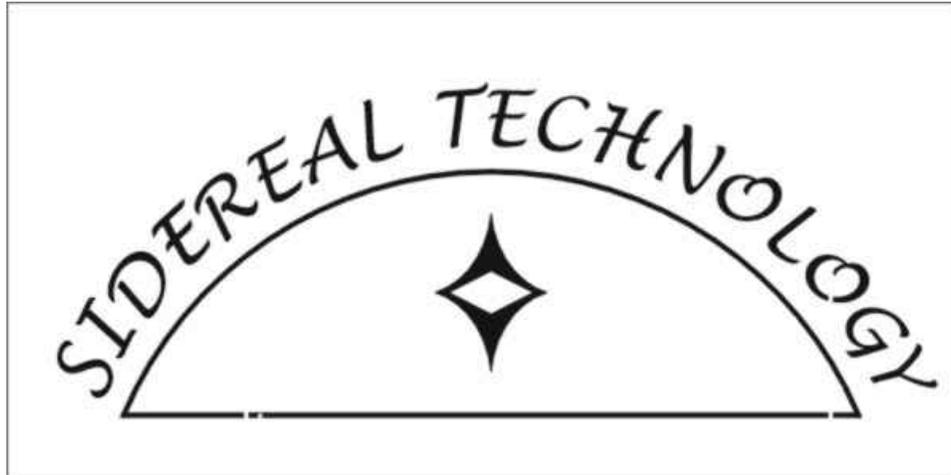


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Purpose and Brief Description:

This software is supplied for your convenience. You may use it as required. It is free software.

ServoConfig software is supplied as is with no guarantee of any kind. Please use at your own risk.

Please visit <http://www.siderealtechnology.com/> for more information.

Also visit <http://www.bbastrodesigns.com/> for more information

You may email me at:

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The purpose of ServoConfig is to make it easier to configure the Sidereal Technology Dual Servo Controller. It is free software.

Safety:

The servo motors are powerful motors that can do extreme damage to equipment, and/or plant and animal life. Please be careful that your telescope doesn't move to a mechanical limit (such as the ground). You may damage the motors or gears, and you may injure yourself or others. Use this product at your own risk.

Should I use ServoConfig if I want to use the SiTech ASCOM driver?

Yes, you must! The following parameters are used by the SiTech ASCOM driver:

1. Motor Encoder Ticks Per Rev (Alt/Az or RA/DEC)
2. Telescope Encoder Ticks Per Rev (Alt/Az or RA/DEC)
3. Slew Speeds, Pan Speeds, and Guide Speeds.
4. Motor Directions
 - a. Azimuth should go clockwise when pressing the right button on the handpad (birds eye view).
 - b. R/A should go clockwise when viewed from Polaris
 - c. Altitude should move up when the up button is pressed
 - d. Declination should move toward the pole when the telescope is looking on the West side of the Meridian.
5. Telescope Encoder Directions: The telescope encoder numbers should change in the same direction as the motors encoder numbers, ie increase while the motor is increasing.

These must be set properly in ServoConfig, then the ASCOM driver will work fine.

Should I use ServoConfig if I use only use ScopeII?

The answer is really up to you, but our philosophy would be to configure everything possible in the controller, and make it work in the stand alone mode perfectly, then start

using ScopeII. There is a feature in ServoConfig that will transfer all common parameters into your ScopeII configuration, so although not totally necessary to use ServoConfig, it is highly recommended, and certainly isn't a waist of time.

One important note: If you only use ScopeII, you may need to know that many of the parameters of the SiTech Servo Controller are also configured in ScopeII, which overwrites the controller parameters, so you may set a slew speed using ServoConfig, then wonder why the slew speed changes when running ScopeII. In order to make the process simpler, we've included an "Update ScopeII Configuration", feature, so the time you spend configuring the controller using ServoConfig, won't have to be duplicated when using ScopeII.

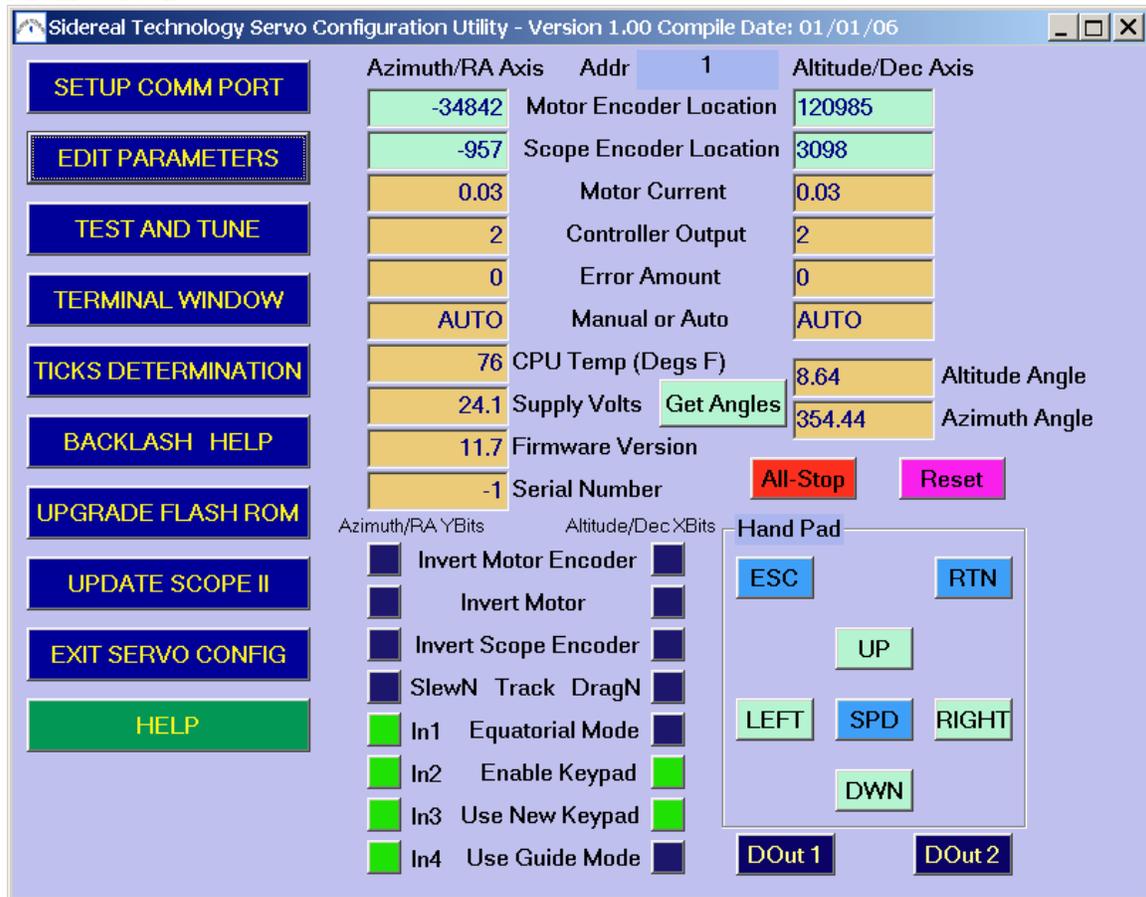
Mel Bartels has provided a configuration screen for the servo controller, but I believe it hasn't been updated with the addition of new features after version 1.5 of the controller firmware.

If you're not using ScopeII, then you will surely want to use ServoConfig.

Apology:

I'm a hardware engineer, and low level micro-processor programmer. Windows programming is new to me, and was a huge learning curve. This fact, coupled with the fact that I'm a programmer, not an artist or author, makes ServoConfig a bit "clunky". I apologize for this, but I tried to be as practical as possible, and include many features to make life easier for us all.

Main Screen:



This is the main screen of the software. Various self explanatory information is updated automatically if there is communication between this program and the SiTech Servo Controller.

If there is no communication, there is a red message that appears at the top of this screen to let you know. If there is communication, the module address is displayed at the top center of the screen. While there is no configuration, the software tries to communicate with addresses 1, 2 and 3. You can see the current address it is trying to communicate with at the top of the screen in the “Addr” box. Don't think it is a comm port that is changing, the comm port is set using “Setup Comm Port” button, and remains the same. The cycling number is the 3 possible addresses of Servo Controllers.

Hold the mouse over any text box to see additional information about it.

The light green boxes are boxes where you can change the values. Simply type in a new value and press the enter key. This will update the controller with the new value. You can do this with the following:

Altitude/Dec MOTOR Location
Azimuth/RA MOTOR Location
Altitude/Dec SCOPE Location
Azimuth/RA SCOPE Location

Also, the same color of buttons are on the 4 directional inputs on the handpad indicator. You can click on these four buttons, and the motors will move correspondingly.

To Stop any motor movement, click on the red E-STOP button.

The ESC, RTN, and SPD virtual buttons are indicators only, and have no effect when clicking on them.

MAIN MENU ITEMS:

Setup Comm Port:

You can select which comm port to use with this button. You can use most USB to serial converters if your computer does not have a 9 pin Serial Port.

Configuration Buttons:

As far as configuration goes, there are 4 different parameters structures relating to this software. A structure is simply an area of memory where the parameters are stored, in the controller, or in this program.

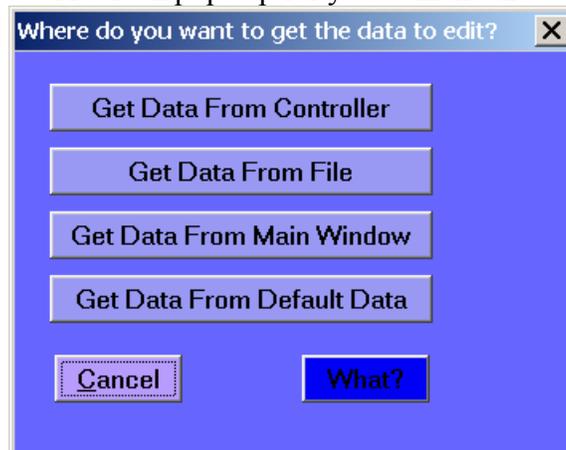
Here are the 4 different structures:

1. The structure when you are at this screen, called the main structure. This software automatically loads a parameter file called "default.car" on startup of the software.
2. The structure when you are in the configuration screen, called the configuration structure
3. The structure currently in the RAM of the controller,
4. The structure currently in the FLASH ROM of the controller

It's important to know which structure you're using or editing.

EDIT PARAMETERS:

When you select Edit Parameters, you must choose where the data you want to edit will come from. You have 4 choices. The controller, A file you've previously saved, the main structure, or default data. A screen pops up for you to make the selection.



TEST AND TUNE:

This brings up another window where you can operate both motors easily, and at the same time, change the PID parameters, along with the acceleration, to get the motors operating smoothly and accurately.

TERMINAL WINDOW:

The Sidereal Technology Dual Servo Controller has many ASCII commands. Using the terminal option allows you to type commands, and see the returning data from the controller. There is a button on this screen that displays the ASCII commands that the controller will accept. Since the controller only “listens” to upper case characters, the characters you type are changed to uppercase automatically if necessary. The line you type is sent after you press the enter key. This allows normal editing changes to the string before the enter key is pressed.

TICKS DETERMINATION:

I've spent a lot of time double checking my encoder counts per scope revolution. I've always done it manually, by using the handpad and also by typing commands using a terminal program. This feature semi-automates this procedure to make the task easier to accomplish. See the following section labeled “Assist Ticks Dialog:” for more information.

BACKLASH HELP:

You can use this feature of ServoConfig to figure out the Backlash of your telescope. Basically follow the directions on the buttons. More on this later.....

UPGRADE FLASH ROM

The current latest version of firmware (2-2006) in the SiTech controller is 1.7. If you have a version of firmware prior to this, you may want to upgrade. You can download version 1.7 at:

<http://www.siderealtechnology.com/V17.BIN>

Download the file and place it in your working directory for this program. Then select this option, browse to this file, and you will be upgraded.

UPDATE SCOPE II

If you use Mel Bartels very accurate and cool software to control the SiTech controller, you may want to update the PID parameters in Scope II that you figure work best using this software. This button will do this for you automatically if you choose.

EXIT SERVO CONFIG

Stops this program.

HELP

Displays a help file with most information from above.

Get Angles Button:

If you have set up the Motor and Telescope Encoder Ticks per rev properly, if you click this button, the actual telescope angle is returned. This works even if you have no

telescope encoders, if you set up the telescope encoder ticks per rev to be the same as the Motor Ticks per rev, and you select the SlewNTrack mode, or the Ignore Scope Encoders option. Note: In the pre-release version of ServoConfig, the azimuth read backwards from this description.

As you move the telescope clockwise (to the west if equatorial), the Azimuth/RA angle should increase.

As you move the telescope up (to the north if equatorial), the Altitude/Dec angle should increase.

You can keep clicking on this button and watch the angles change as you move the scope.

Receiver Digital I/O:

If you have a handpad receiver, there are 4 digital inputs associated with it. You can view the status of these inputs on the Azimuth/RA YBits section, they are labeled In1 through In4. These may toggle on their own if there is nothing connected to them.

Also, if you have a handpad receiver, there are two digital outputs associated with them. You can test them by clicking on the two buttons labeled DOut1 and DOut2.

ServoConfig Config Dialog, Screen One:

Configuring Sidereal Technology Servo Controller

Motors/Encoders AutoTracking Misc. and Action

Azimuth/Right Asc Motor Altitude/Declination Motor

No of Ticks per Scope Rev 1000000 1000000

DPS 3.75 3500000 Slew Speed 3500000 3.75 DPS

MPS 3.2 50000 Pan Speed 50000 3.2 MPS

SPS 15 4000 Guide Speed 4000 15 SPS

dpsps 2.10 1000 Default Acceleration 1000 2.10 dpsps

Proportional Gain 15000 15000

Integral Gain 3000 3000

Derivative Gain 4000 4000

Error Limit 12800 12800

Output Limit 100.0 100.0

Current Limit 2.40 2.40

Integral Limit 22000 22000

Invert Motor Encoder Direction

Invert Motor Direction Hot Mode is OFF

Invert Scope Encoder

HELP OK Read Controller Config Cancel

0 Y BITS X 96

There are 4 structures of parameters that this program uses. They are:

1. The structure when you are at this screen, called the configuration structure.
2. The structure when you are in the main screen, called the main structure
3. The structure currently in the RAM of the controller,
4. The structure currently in the FLASH ROM of the controller

What is displayed on this set of screens is what is in the configuration structure.

When the EDIT CONFIGURATION is first selected, the data you see comes from your choice of places, as described earlier.

It's important to note that any changes made here without using the hot mode, and also using it properly are only made in the configuration structure, not in the controller. You

will have to "Send Configuration To Controller" from the "Misc. and Action" page to send and save the parameters to the controller.

One of the features is a button called "Hot Mode". This button turns Red when in the "Hot Mode". When in the hot mode, every time you press enter after editing a number, the number is sent to the controllers RAM.

Two things to note while in the HOT MODE:

1. The data goes to the controller RAM, not the controller FLASH ROM. To save to the FLASH ROM, you must select the "Misc. and Action" page, and select the item "Save controller configuration to flash rom".

2. The number will not be sent to the controller unless you press the Enter key. Pressing Tab or clicking the mouse in another text box will not send the data to the controller.

Clicking the OK button will return you to the main menu, and the data you've edited will be sent back to the main structure.

Clicking the Cancel button will return you to the main menu, but the data you've edited will be lost (unless you saved it to the controller or to a file using the "Misc. and Action" page). You will be prompted before losing all changes.

All of the Magenta colored text boxes can be edited. The red boxes at the bottom are the XBits and the YBits and are automatically updated when you select the options using the radio buttons.

No OF TICKS PER SCOPE REV:

The Top numbers are the number of MOTOR encoder ticks for one complete revolution of the scope axis. This can be calculated using your gear/roller ratios, or checked by slewing the scope, and looking at the numbers.

It's important to enter these numbers first, or the degrees per second values will be off.

Important Note!!!!

Editing the Motor encoders and the scope encoders is probably the most important item in the configuration. If these aren't set properly, none of the other items, such as slew speed degrees per second, the Local Search Radius and Speed, and many other items will be displayed properly!

SPEED TEXT BOXES:

The numbers with DPS, MPS, or SPS beside them are speeds in Degrees per second, Arc Minutes per second or arc Seconds per second. For these to be accurate, you must enter the number of MOTOR encoder ticks per full revolution of the scope in the top location.

As far as these speeds are concerned, you can enter them in DPS, MPS, or SPS as

indicated, or you can enter the raw numbers the controller uses. Whenever you enter one or the other of these numbers, the other number is updated automatically. As an example if you have 5,000,000 motor encoder ticks per revolution, and you specify 5 DPS, the raw number will change to 2,330,318. Inversely, if you enter 4,000,000 in the "raw" box, the DPS will change to 8.58 degrees per second (better wear a hardhat while slewing your scope!!!!).

Note: It is important to stay below about 6,500,000 raw Slew Speed, regardless of your gear ratio. If your desired Degrees per Second raises the raw speed to greater than this, manually put the raw slew speed values to 6,500,000. With typical ratio's, you will have plenty of slew speed at this number, it will be more than 7 deg's per second.

The slew and Pan speeds are the speeds the motors move when slewing or panning with the handpad.

The guide speed is a bit different. Instead of just making the motors move at a given speed, this speed is added (or subtracted) from the current speed. If a motor is tracking, and the guide mode is used, a motor may simply slow down and speed up, rather than actually change directions. This makes it easier for an autoguider to obtain accurate control.

BTW, the guiding and handpad inputs have undetectable delays. They are nearly instantaneous! The only delay is caused by the switch de-bounce routines, and is on the order of milliseconds.

One more item if you are using version 1.7 of the controller firmware. There is a feature that changes the Pan and Guide rates for the azimuth/RA as you raise in altitude/declination. This feature is called Equal Area Panning and Guiding. What happens when you near the zenith (or pole on an equatorial mount), the azimuth has to move a much farther distance for an equal area of sky while you are pointed at the horizon (or celestial equator). In version 1.7, the pan speed and the guide speed are automatically increased as you move toward the zenith (or celestial pole). This is a truly cool feature, and when experienced, you won't want to go back to the old way!

For this to work properly, the controller needs to know the altitude (or declination). If you are using the DragNTrack mode, the controller already knows the altitude. If you have an alt/az telescope, but are using scopeII or the Argo Navis®, you might consider configuring the scope for the DragNTrack (or SlewNTrack) mode, and point the scope at the celestial pole before turning the power on the controller. The DragNTrack (or SlewNTrack) mode will be run just long enough for the telescope to initialize the altitude, before detecting scopeII or the Argo Navis® and dropping out of the DragNTrack (or SlewNTrack) mode. If you are using the ASCOM driver, you don't need to worry about this, as the ASCOM driver will update the altitude. Mel Bartels has promised to add this to ScopeII in the near future. If you are using the equatorial mode, you will need to set the declination to 0 before powering up the controller for this option to work properly.

ACCELERATION:

The Acceleration is the rate at which the motor ramps up to speed. It's best to figure what works best using the "TEST and TUNE" main menu item. Lower numbers create a very slow ramp. Higher numbers make a faster ramp. I like my telescope to be about 1000 to 1500.

PROPORTIONAL, INTEGRAL, and DERIVATIVE (PID)

The Proportional, Integral and Derivative are motor tuning parameters. Again, these are best adjusted using the "TEST and TUNE" main menu item. There is a more complete description of these parameters on the TEST and TUNE dialog box.

ERROR LIMIT:

The error limit is the point where the controller stops the motor if the motor is not moving properly. The ERROR is the difference (in motor encoder ticks) between where the motor is, and where it should be. If this difference exceeds the ERROR LIMIT value, one of two things happens:

1. If the motor is going in the proper direction at a fairly fast rate, the controller "decides" that things are moving along fine, the motor just can't keep up. Instead of stopping the motors (like most servo chips), the SiTech controller "Holds" this error, and keeps your telescope moving. The motor position setpoint is held to the motor position plus (or minus) the error limit value.
2. If the motor is not moving fast enough, or is moving the wrong direction, as soon as the error reaches the value of the error limit, it stops the motor and puts that particular motor in MANUAL mode.

The advantage of this scheme is when your battery voltage is going a bit low, or there is a lot of friction or inertia, your motors won't stop, and need to be re-initialized. This allows a more rigorous setting, IE, you can run your motors at top speed, without fear of stalling.

OUTPUT LIMIT:

If you are using a 12 volt motor, but supplying the controller with 24 volts, you will want to put an output limit on. The default is 100%, which is full output. With a 12 volt motor supplied with 24 volts, you would want this value to be 50%.

CURRENT LIMIT:

The controllers are rated at max 2.4 amps, each motor, and a maximum of 4 amps, both motors. You can make the current limit be less than the 2.4 amps default, by lowering this value. The value 2.4 represents limiting the current to 2.4 amps. You will have less torque when lowering this value.

INTEGRAL LIMIT:

The Integral portion of the PID control adds more and more to the output over time, until the motor reaches the desired position or the setpoint. Sometimes this can go too far, and it takes too long to "un-correct" when slowing back down. To solve this problem, you can limit the integral windup using this parameter. The default is 22,000.

INVERT MOTOR ENCODER DIRECTION Radio Button

This makes the numbers decrement instead of increment on encoder pulses (or vice versa) for a given motor direction. If your motor runs away quickly then stops, you must either re-wire it, or select this radio button without selecting the "INVERT MOTOR DIRECTION" button.

INVERT MOTOR DIRECTION Radio Button:

This puts out opposite polarity to the motor for a given error. If your motor runs away quickly then stops, you must either re-wire it, or select this radio button without selecting the "INVERT MOTOR ENCODER DIRECTION" radio button.

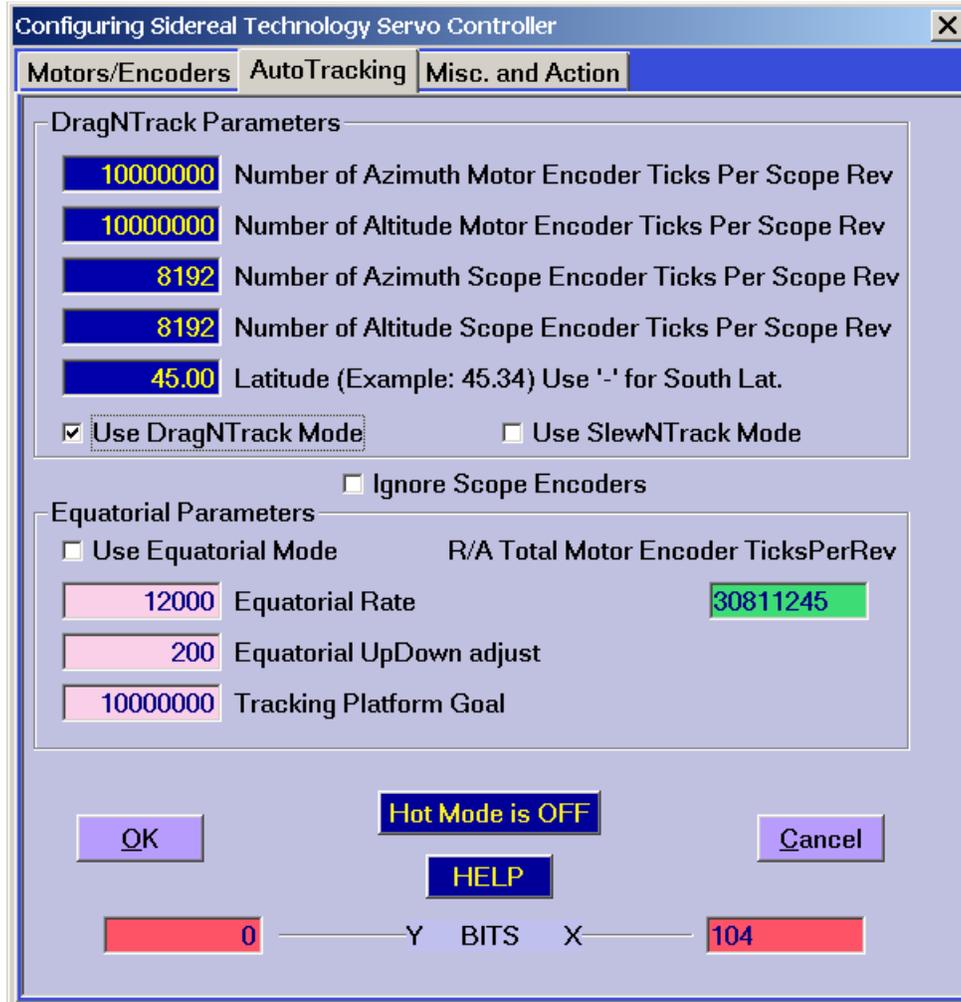
If your motors work properly but move the wrong way, then select (or de-select) both of the above items.

While selecting or de-selecting the above items, especially in the "HOT Mode", it's possible that the motors may run away, and then stop in the manual state. This will be indicated by flashing lights on the servo controller. To go back to automatic mode, save your parameters to flash rom using the "Misc and Action" page, and reboot the controller by selecting "Reset the Sidereal Technology Controller". Alternatively, you can put the controllers back to the AUTO mode by going back to the main menu, selecting "TEST AND TUNE", and selecting the "AUTO" radio buttons.

INVERT SCOPE ENCODERS:

Selecting or de-selecting these radio buttons will make the SCOPE Encoders count the other way.

ServoConfig Auto Tracking Dialog:



One of the most important features is a button called "Hot Mode". This button turns Red when in the "Hot Mode". When in the hot mode, every time you press enter after editing a number, the number is sent to the controllers RAM.

Two things to note while in the HOT MODE:

1. The data goes to the controller RAM, not the controller FLASH ROM. To save to the FLASH ROM, you must select the "Misc. and Action" page, and select the item "Save controller configuration to flash rom".

2. The number will not be sent to the controller unless you press the Enter key. Pressing Tab or clicking the mouse in another text box will not send the data to the controller.

Clicking the OK button will return you to the main menu, and the data you've edited will be sent back to the main structure.

Clicking the Cancel button will return you to the main menu, but the data you've edited will be lost (unless you saved it to the controller or to a file using the "Misc. and Action" page).

All of the Magenta colored text boxes can be edited. The red boxes at the bottom are the XBits and the YBits and are automatically updated when you select the options using the radio buttons.

DRAGNTRACK PARAMETERS:

Note: If you have an equatorial mount, you will use the equatorial mode, not the DragNTrack or SlewNTrack mode.

The DragNTrack mode is a mode where the controller will make your telescope track, without having any computer or hand controller attached. If your main desire is finding and observing the objects, but you want your computer to track, this is a much more desirable feature for large telescopes than a tracking platform, for many reasons.

If you have an accurate mount, and the latitude is programmed correctly, you can track at very high power for long periods of time, without having a computer connected.

For this to work properly, the SiTech controller must "know" the following:

1. How many motor encoder ticks per complete revolution of the scope for both Altitude and Azimuth
2. How many Scope encoder ticks per complete revolution of the scope for both Altitude and Azimuth
3. Where the scope is pointed in Altitude and Azimuth
4. Your observing site's latitude.

NUMBER OF AZIMUTH (OR ALTITUDE) MOTOR ENCODER TICKS PER SCOPE REV:

The Top numbers are the number of MOTOR encoder ticks for one complete revolution of the scope axis. This can be calculated using your gear/roller ratios, or checked by slewing the scope, and looking at the numbers. These numbers are used for two purposes: The main purpose is for calculating the motor tracking rates while using the DragNTrack or SlewNTrack modes. The other purpose is for calculating the Degrees Per Second (DPS) on the Motors/Encoders page.

NUMBER OF AZIMUTH (OR ALTITUDE) SCOPE ENCODER TICKS PER SCOPE REV:

These are the number of telescope encoder ticks per one revolution of the scope. Most telescopes have their encoders directly mounted to the telescope axis's. If that is the case, just enter the encoder resolution here. If you have 2048 Pulse encoders, the Effective

Encoder Counts is 2048 Times 4, or 8192 counts. That is also the default. These values are not really used unless you are using the SlewNTrack or DragNTrack modes.

Important note: If you are using the SlewNTrack mode, these values need to be set the same as the SCOPE encoder ticks per Rev. (This is done automatically for you when you click on the radio buttons).

LATITUDE:

This is the latitude of your observing site. It is used only if you are using the SlewNTrack modes, or the DragNTrack modes. If you are observing south of the equator, enter your latitude as a negative number.

There are two radio buttons for selecting your desired mode. As you select (or de-select) the modes, you will notice the XBits and YBits values changing at the bottom of the dialog box.

If you don't want the DragNTrack, or SlewNTrack modes, but you don't have telescope encoders, it may be wise to select "Ignore Scope Encoders". This will allow you to connect an ArgoNavis(r) or computer using the Tangent "Q" commands to work properly, even though you don't have telescope encoders. Be sure to set the Telescope Encoder Ticks per Rev to the same value as the Motors.

THINGS TO KEEP IN MIND WHEN USING THE DragNTrack or SlewNTrack MODES:

If you are using version 1.3 (or earlier) of the SiTech Firmware, and you are using an old style handpad (a handpad with 1 switch and 6 buttons instead of 7 buttons), the Slew and Pan speeds must be negative values (Change this on the Motors/Encoders page).

When you press the right hand button, the scope must move clockwise.

When pressing the Up button, the scope must move up.

Keep clicking on the "Get Angles" button from the Main Screen, and as you move the telescope clockwise, the azimuth angle must increase, and as you move the telescope Up, the Altitude should increase. If either of these are wrong, but the scope moves the proper direction, you will have to invert the Scope Encoder(s) from the Motors/Encoders page.

Important note: If you are using ServoConfig version 0.9, the azimuth is backwards from the above statement.

EQUATORIAL MODE:

This was formerly called the Platform mode. In the Equatorial mode, the Right Ascension motor starts running automatically at a pre-programmed speed, and the Declination motor only responds to slew or pan handpad inputs, otherwise is stopped.

Again, this will track your equatorial mount accurately, without having a computer connected.

You select the Equatorial mode by clicking on the radio button provided.

In order for this mode to work correctly, the proper equatorial rate must be provided.

There is a green textbox where you can enter the number of MOTOR encoder ticks for one complete revolution of the Right Ascension axis. When you enter a number here, the Raw equatorial rate that the controller uses is updated. When this window is first displayed, or when you enter a new number in the Equatorial Rate box, ServoConfig automatically puts a number in the green box that is a reverse calculation from when you enter a new number in the green box. Don't expect this number to be returned to exactly the same number that you entered in the green box when reloading the configuration. The final number that is saved in the controller is the lower number, the equatorial rate. This number is an integer, and working the formula backwards will create a slight discrepancy. This does effect the accuracy, but it is usually so low it is not worth considering.

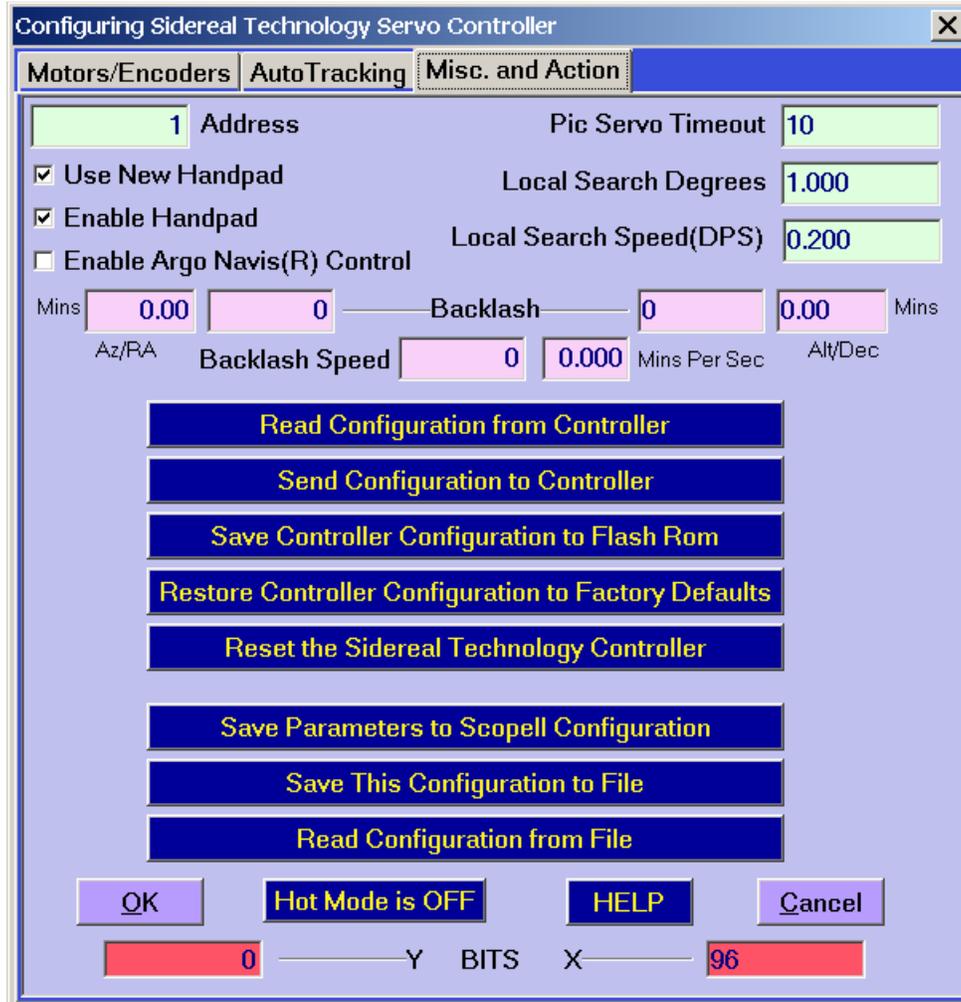
The Equatorial Up/Down adjust value is the value that is added (or subtracted) from the equatorial rate when using the handpad to "tweak" the equatorial rate. This is done by holding down the Top Left key of the handpad, and tapping the Up or Down handpad keys.

TRACKING PLATFORM GOAL:

If you are using a polar mounted telescope, set this value to 3 or 4 times the number of SCOPE encoder ticks for 1 full revolution of the scope. If your scope tracks the wrong direction, you can enter a negative number here, to correct that.

If you are using a tracking platform, you set this number to the end position of your platform. At this point, your scope will stop tracking. You can then "re-wind" your platform to the starting position by pressing both the top left and the top right buttons of your handpad simultaneously.

About The Misc. and Action Screen.



Clicking the OK button will return you to the main menu, and the data you've edited will be sent back to the main structure.

Clicking the Cancel button will return you to the main menu, but the data you've edited will be lost (unless you saved it to the controller or to a file using the "Misc. and Action" page).

ADDRESS:

The first option is the address of the controller. The controller has an open collector RS232 port for communication. This allows more controllers to be on the same communication port. If this is desired, all the connected controllers have to have a different address. There are 3 addresses available, 1 (default), 3, and 5.

If you change the address, the module will respond differently. Now all commands that started with an X or a Y, will have to start with a T and a U for address 3, and V and W for address 5.

After Changing the address in the textbox, it would be a good idea to "Send Configuration To Controller". Otherwise this program may try to communicate with the wrong address.

PIC SERVO TIMEOUT:

The Sidereal Technology servo controller responds to two different communication protocols, ASCII and PIC SERVO. PIC SERVO is a binary protocol. You can read about it here:

<http://www.jrkerr.com/psdata.pdf>

This program communicates with the controller using the ASCII mode. For a list of ASCII commands, see the help from the main menu item "TERMINAL WINDOW". Mel's ScopeII software mostly uses the Pic Servo protocol.

The controller automatically senses a PIC SERVO command, and will immediately switch to the Pic Servo mode upon sensing this.

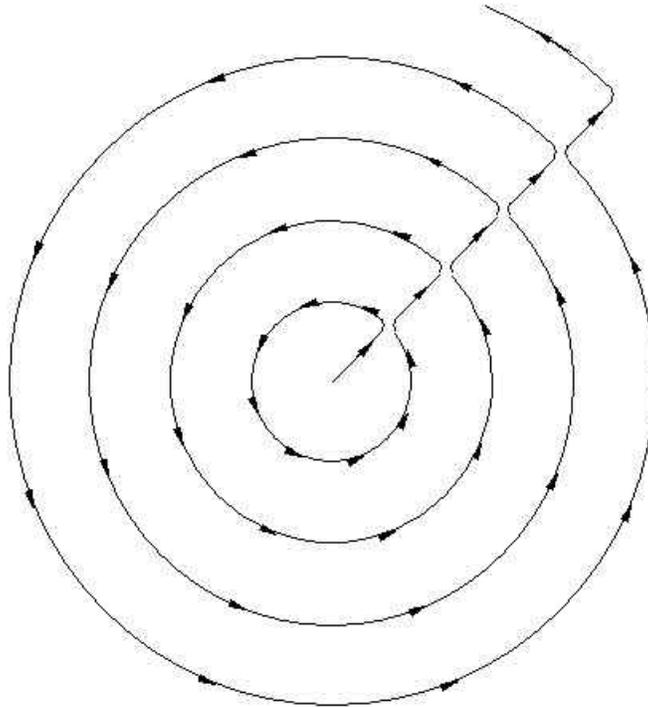
The PIC SERVO timeout is a delay, in which if there is no PIC SERVO commands, the controller reverts back to the ASCII mode, and if moving, stops. This may help if ScopeII gave a command to move a long way, then communication was lost, the scope may end up going too far, and hitting the ground or whatever! The number entered into this text box is how many seconds before reverting back to the ASCII mode, and stopping. The value zero will disable the feature.

LOCAL SEARCH DEGREES:

This is how many degrees the local search radius will be. You need Servo Firmware Version 1.7 for this feature, available 2/2006. As pointed out by Ed Harvey, a Spiral search isn't the most efficient search algorithm, because if you don't want to miss any sky, you will have a lot of overlapping sky. A more efficient algorithm is to move the scope 1 radius out, then do a circle, move another radius out, and do another circle, etc. This is how the local search routine works on the SiTech servo controller. You must have proper data in the controllers Motor Encoder Ticks per rev for the calibrated speed and distances to work properly.

A good starting point is to figure the field of view of your most frequently used high power eyepiece, and enter this number. When you use this eyepiece, initiate with the TOP LEFT / DOWN key. When using a lower power eyepiece, initiate the search with the TOP LEFT / UP key.

Note: It's not really a true circle, but a 16 sided polygon, which looks like a true circle at the eyepiece.



Here is a picture of the search routine:

See the controller document for operation of the Local Search feature, but here is a brief description:

1. Set up the Local Search Distance (radius) and speed (Degrees per second). Make sure the motor encoder ticks per revolution are set up properly too.
2. While aimed at the area of sky you believe the object to be is, hold down the top left key of the keypad, and then press the UP key. You can also initiate it for a higher power eyepiece which halves the circle radius, by holding down the Top Left key, and pressing the DOWN key.
3. To increase the search speed, hold down the Top Left key and press the UP key.
4. To decrease the search speed, hold down the Top Left key and press the DOWN key.
5. To reverse directions and start working inwards, press the DOWN key. You can revert to the normal direction by pressing the UP key. This can be done at any time during the search.
6. To PAUSE the search, press the speed key. To resume, press the UP, DOWN, or the speed key again.
7. To exit the Local Search mode, press the LEFT or the RIGHT direction key.

LOCAL SEARCH SPEED is the speed in Deg's per second the Local Search moves the telescope. A good starting point is about 0.2.

BACKLASH:

The servo controller version 1.7 has a provision for backlash. Mels ScopeII also has this feature. It is extremely important that you don't have backlash enabled in both ScopeII and the servo controller. ScopeII backlash is fairly slow to respond, so we think it would be better to use the controller backlash, as the response is immediate. Also, if the telescope is being controlled by the ASCOM driver, the Argo Navis®, or any other device backlash **MUST** be enabled and adjusted in the controller in order to compensate for your mechanical backlash.

There are two windows for each Backlash axis, 1 is raw motor encoder ticks, the other is in Arc Minutes. You can enter either, and both are adjusted when you press enter or Tab.

BACKLASH SPEED:

When the motor is in the backlash area, it means the telescope isn't being moved when the motor moves. We call this the No-Mans land. The Motor doesn't "like" to be in No-Mans land, and will move out of it in the proper direction as necessary. The speed in which the motor moves out of the No-Mans land is labeled Backlash Speed. This speed is added to the commanded speed, so it will always move out of this area.

For a slow backlash speed, consider about 30,000 raw counts. For a quick backlash speed, consider a value of about 500,000. You need to find the right speed that quickly takes up the backlash, but doesn't jar the telescope when the backlash is taken up. The speed in in Minutes per second is an average of the two axis's, and may be different for each axis, depending on your motor encoder ticks per revolution.

USE NEW HANDPAD:

If you have a handpad for Mels old stepper system, it will work on this controller, but you will not be able to slew both axis's at once. If you have an old handpad and want to use it, de-select this menu item. For the new handpad, select it. You must also change the position of the jumper adjacent to the handpad connector.

USE ARGO NAVIS® :

Check this item if you would like to use the Argo Navis® to control the Servo Controller. If you select this, the controller will not respond to any other commands until it decides that the Argo Navis® is not "listening". This takes about 10 seconds. After this initial delay, if the Argo Navis® is not detected, the Servo Controller will communicate normally with all other protocols. You may see the communication freeze up in this program while the Servo Controller is deciding there is no ArgoNavis® connected. To re-connect to the ArgoNavis® **press** the Top Two handpad buttons simultaneously (same as a GOTO command for the Argo Navis® control.

BUTTONS:

READ CONFIGURATION FROM CONTROLLER

Selecting this button reads the configuration from the controller to the Configuration Structure so you can see it, edit it, or save it.

SEND CONFIGURATION TO CONTROLLER

Selecting this button sends the current Configuration Structure to the controller. What you see on these 3 Configuration Pages is sent to the controller, and saved in the Flash ROM.

SAVE CONTROLLER CONFIGURATION TO FLASH ROM

If you've been using the Hot Mode, the changes will be in effect in the controller, but if the controller was to re-boot, you would lose these changes. To make the controller "remember" them across a power failure, select this button. It is not necessary to save to flash if you send the configuration to controller, it automatically is saved to the flash in that case.

RESTORE CONTROLLER TO FACTORY DEFAULTS

All of the parameters in the controller are set to factory defaults if this item is selected. You are prompted with an "Are You Sure" or equal. There is no "undo" feature!

RESET THE SIDEREAL TECHNOLOGY CONTROLLER

The command resets the controller. Any changes you made using the hot mode are lost unless you saved them to flash. If the controller is forced to manual by a motor fault, you can put them back in auto by clicking on this item.

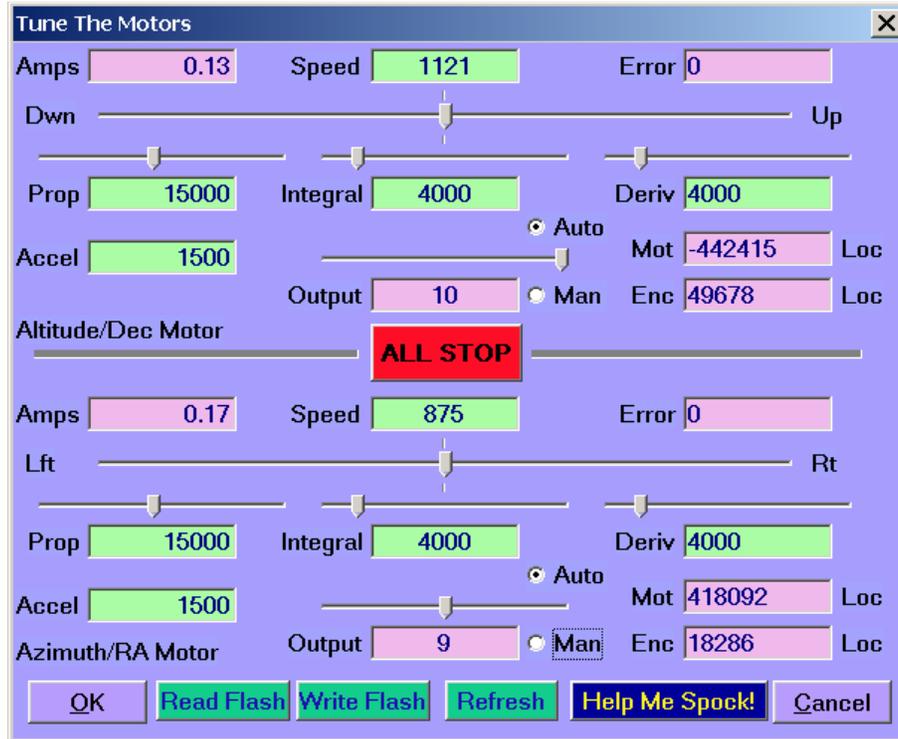
SAVE THIS CONFIGURATION TO FILE

If you want to save your configuration to a file, select this item. The default extension for the files is .car . The configuration sent to the EDIT PARAMETERS dialog is called default.car, and has the same values in it that are the factory defaults.

READ CONFIGURATION FROM FILE

By clicking here, you can load the Parameter structure with a file of your choice (probably one you've previously saved). This doesn't automatically send it to the controller. After loading, you can then Send Configuration To Controller if you want to.

SERVOCONFIG TUNING MOTORS DIALOG:



This dialog screen is a "live" screen, in other words, it continually communicates with the controller, and updates all of the Magenta colored text boxes, and every time you change a green text box or a slider, the new number is sent to the controller.

The green text boxes are not continually updated from the controller. On entry to this dialog box, these values are read from the controller. Every time you change one of the green textbox numbers, it is displayed, and it is also sent to the controller. If there was a communication problem, these values may not be correct. Clicking the "Refresh" button will re-read these values from the controller.

This screen is a powerful tool for tuning your motors. You can obtain smooth, accurate operation of your motors by tuning them properly.

Clicking the OK button will return you to the main menu, and the tuning data you've changed will be sent back to the main structure.

Clicking the Cancel button will return you to the main menu, but the data you've changed will be lost (unless you saved it to the controller).

If there is no communication, there will be a slight delay before this screen appears.

All of the green text boxes can be changed by typing in a new number, or by moving the slider associated with it. The Acceleration doesn't have a slider.

To move a motor, be sure it is in the Auto mode, grab the speed slider with the mouse and move it. The motor should start to move. As an alternative, you can also enter a speed number in the text box.

GENERAL PID TUNING PRINCIPLES:

A complete discussion of Proportional Integral Derivative control is not appropriate here, but there are a lot of places on the Internet if you do a search for it. As it applies to the Sidereal Technology Servo Controller, it is fairly simple to adjust if you follow these directions:

Make sure both motors are stopped, and if they are in manual, click the AUTO radio button. If the controller is address 3 or 5, the indicated auto and manual may be wrong. To be sure, click on the auto radio buttons. You can also look at the lights on the controller. If they are on steady, the controller is in auto. If a light is flashing at a 1 second rate (or so) the axis is in manual.

Step 1. Turn the integral all the way to zero.

Step 2. Turn the proportional down to zero.

Step 3, Adjust the Derivative. The motor should turn sluggishly but freely now, since only the derivative is working. Adjust the derivative higher and higher until the motor starts humming or vibrating. Adjust it back down until it doesn't vibrate, but "resists" you when you move the motor by hand. Typical values are about 4000 to 6000.

Step 4, Adjust the Proportional Band. Bring the Proportional band up, a few thousand at a time. As soon as it is over a few hundred, the motor will "want" to return to its desired position. Keep adjusting this up until the motor becomes unstable. Now back it down until the motor is stable. Typical values are about 15000.

Step 5, Adjust the Integral. To adjust the integral, start increasing the number from about 1000, until the motor becomes unstable. Then back it off until the motor is completely stable. Typical values are about 4000.

Step 7, Run the motor at several speeds, and be sure it operates smoothly at all speeds. If it doesn't, start by working backwards through the steps, first lower the integral, then lower the proportional. Play around until you're happy with the response of the motor.

Pay attention to the Error textbox while operating the motors. When you are moving the

motors very slow, the error should be -1, 0 or 1, with an occasional 2 or -2. If higher than this, increase the Proportional, and if unstable, increase the derivative.

If the two motors are the same type, the same numbers should work in both motors.

During the above testing, the controller may put the motor in manual if the error reaches the error limit. If this happens, simply click on the Auto button, and then you can move the speed slider to start it moving again.

If you are communicating with an address of 3 or 5, the auto and manual radio buttons may not be updated correctly. To be sure they're in the mode you want, just click on the radio button. This will put the controller in the mode you want.

ACCEL:

The Acceleration is the rate at which the motor ramps up to speed. Lower numbers create a very slow ramp. Higher numbers make a faster ramp. I like my telescope to be about 1000 to 1500.

READ FLASH and WRITE FLASH

If you like your settings, and want to save them to flash, there is a button near the bottom of the window labeled "Write Flash". If you think you've messed up the control and want to revert back to the controllers original settings, you can select the "Read Flash" button.

REFRESH

The green text boxes are not continually updated from the controller. On entry to this dialog box, these values are read from the controller. Every time you change one of the green textbox numbers, it is displayed, and it is also sent to the controller. If there was a communication problem, these values may not be correct. Clicking the "Refresh" button will re-read these values from the controller.

Assist Ticks Determination Operation:

The screenshot shows the 'Assist Encoder Ticks Determination' window with the following details:

- Top Section (ALTITUDE/DEC MOTOR):**
 - Slew Speed (DPS): 3.00
 - Ending Deg's: 90.0000
 - Step 1: Aligned (Start), Step 2: Move To End, Step 3: Aligned (End), Step 4: Move To Start (0)
 - Down Averages: 2, 1: M:12537208 (-0.36) S:548308 (1.02)
 - Up Averages: 2, 1: M:12537256 (-0.28) S:548268 (-0.55)
 - Final Averages: Motor Enc 12537416, Average Up and Down 548282, Scope Enc
 - Locations from Controller: Motor Location Degr 0.00, 0; Ticks ALL STOP; Scope Encoder Location Degr -0.00, -1; Ticks
- Bottom Section (AZIMUTH/RA MOTOR):**
 - Slew Speed (DPS): 4.70
 - Ending Deg's: 360.0000
 - Step 1: Aligned (Start), Step 2: Move To End, Step 3: Aligned (End), Step 4: Move To Start (0)
 - Counter Clockwise Averages: 4, 1: M:7875658 (6.52) S:345546 (-0.88)
 - Clockwise Averages: 5, 1: M:7875441 (5.92) S:345546 (-0.88)
 - Final Averages: Motor Enc 7873027, Average CW and CCW 345562, Scope Enc
 - Locations from Controller: Motor Location Degr -44.12, -964908; Ticks; Scope Encoder Location Degr -44.22, -42446; Ticks

If your telescope axis's are all geared, with no clutches or rollers, you will be better off calculating your encoder ticks per scope revolution, and entering these numbers in ScopeII's configuration file, and also the Configuration portion of this program. This dialog window is for users of telescopes with roller or friction drives.

Problem: You want to know how many encoder ticks per revolution your scope has. You've done the math, and have a close estimate, but you're using a roller drive, and reality is not quite the same as the math. ScopeII needs these numbers, as well as the controller itself if you are planning to use the DragNTrack or the SlewNTrack modes.

Solution: Test it out using this software tool.

I've done this many times by hand with my 14" and also my 28" scopes. I've done it by

typing ASCII commands to the servo (or the stepper) controllers, and commanding the scope to move all the way around in azimuth, or horizon/zenith in the altitude, adjusting the final position using the handpad, reading the scope position, commanding the scope to return to the starting position, adjusting the final position using the handpad, then reading the scopes position again. I did this back and forth many times, and averaged the results. The final numbers I plugged into the configuration file.

I had the idea of semi automating this procedure, and here is the result.

I'm sorry the screen is so busy looking, look again, and you will see that only the "Forest Green" items are changeable, so that's not too bad eh? Also, have a look at the steps. It's as easy as 1,2,3,4 for each axis!

General Principal:

Move the scope between two known angular distances as many times as necessary, count the encoder ticks necessary to accomplish this, send the average to ScopeII and the Sidereal Technology controller.

I've discovered using both of my telescopes that there is some difference when moving one direction than the other. This is especially true of the altitude, because any unbalance will tend to make the scope move more in one direction than the other. This is why there are separate average arrays for each direction.

PICKING STARTING AND ENDING POSITIONS:

If you are doing the altitude axis, I've found the best solution to be using a precision square bolted to the altitude axis, and a precision level that is placed on the square at zenith and horizon. In this case, you would select 90 degrees to be your ending position.

If you are doing the Azimuth axis, you can use Polaris for starting and ending position, or a far away tree or radio tower also works well. Another solution would be to clamp a laser to your scope, and mark the position of the red dot a few meters away on a wall, car, or bicycle. In this case, you would select 360 degrees to be your ending position.

One last way I've thought of to pick your starting and ending positions. If you have 8192 ticks per revolution encoders mounted directly on your telescopes axis, you can simply watch the scope encoder ticks in the window to align your starting and ending positions. This would not be as accurate as sighting on a radio tower, but for many purposes, this would be good enough.

GENERAL PROCEDURE:

Align scope on starting position.

Zero the scope axis

move and align scope to the ending position.

Read the scope axis and store number in the Up or Clockwise average array

Move and align scope back to starting position

Read the scope axis and store number in the Down or Counter Clockwise array
Repeat procedure until satisfied that there are enough data points for a good average.
Average the results, and send to ScopeII and the Controller.

SPECIFIC PROCEDURE:

1: Make sure the Ending Degrees is proper for your setup. It's got to be more than 10 degrees. For a typical Alt/Az telescope, normally the Altitude should be 90 degrees and the Azimuth should be 360 degrees. These are the defaults. If you're using a German equatorial, you may be able to have the declination set to 360 degrees as well.

Also make sure before you run this procedure that the Motor Encoder Ticks Per Revolution have been set up to a reasonable proximity of reality. That's not absolutely necessary as you could use the handpad to find the first ending alignment point.

2: Align your scope axis manually on your starting position.

3. Now click Step One (Align Start). If this is the first time step 1 is pressed, the software doesn't take a reading, it simply "zeros" the axis. You should see the position of the scope change to 0 in the Motor Location and Scope Location boxes. On subsequent Step One's, a reading is taken and stored in the average array. Important note: If you want the same number of samples taken in the clockwise (or Up) directions as the opposite direction, Step One should also be the LAST step performed!!!!

4. Now click Step Two (Move to End). The scope will move to the ending position. If this is the first time, it uses whatever Motor Encoder Ticks Per Revolution you've set up using the configuration. When the scope stops (you can stop it with the handpad if necessary) align the telescope up carefully (using the handpad) on the ending position. If this is the azimuth, it's probably going to be the starting position plus 360 degrees. If this is the altitude, you are probably looking at the zenith.

5. Now click Step Three (Aligned End). Your first (or new) reading should appear on the right half of the screen. You will see the number in the drop down choice box, and the clockwise or Up averages will be updated.

6. Now click Step Four (Move to Start (0)). The scope will move to the starting position.

7. Align the scope up on the starting position carefully, and then press Step One again. Now the readings on the left half of the screen will be updated. You will see the new numbers on the drop down choice box, as well as the new updated averages.

Keep repeating the 1,2,3,4 buttons, until you're satisfied with the average numbers.

Always end by pressing the step one button.

After you are done, you can click on "Send to Controller" and/or Send to ScopeII" buttons

to save these numbers in respective locations.

One more thing you may want to do. If your drive system has backlash in it, when aligning to your starting or ending positions, always end up pressing the same direction button before clicking the alignment step button. This will assure that the mechanical hysteresis will be taken up for all the readings. Mels ScopeII software has a parameter for dealing with backlash, but for our purposes here, we just want to know how many ticks a complete revolution takes, all in one direction.

MORE INFO:

1. The number below the "NOP" label is the Number of Points you have taken

2. The text in the drop down choice box has the following format:

N: M: nnnnn (nn.nn) S: nnnn (nn.nn)

The first N is the particular Data Point

the M: is the label, letting you know the first number is the data point from the Motor Encoder.

The number in parenthesis is the deviation from average (in arc minutes)for the Motor Encoder

The S: is the label, letting you know the next number is the data point for the SCOPE encoder.

The ending number in parenthesis is the deviation from average (in arc minutes) for the Scope Encoder If the scope encoder are not giving reasonable numbers, it is flagged as "bad"

3. The Del button to the right of the drop down choice box allows you to delete a reading, if for some reason it is flawed.

4. The left number below the drop down choice box is the current average of the direction readings for the Motor Encoder

5. The right number below the drop down choice box is the current average of the direction readings for the Scope encoder

6. The two numbers in the frame labeled "Final Averages for ScopeII and Controller" are the (left) Motor and (right) Scope Encoder values. There are two buttons on the very right for updating the controller and ScopeII.

7. The lowest frame (for the particular axis) has the current motor and scope locations, in degrees on left, and encoder ticks on right.

Clicking the "SAVE" button will allow you to save your work. Clicking the "LOAD" button will load the previously saved button. There are no filename choices, it always uses the same two files, one for azimuth and one for altitude. If you want to save them to a permanent file, you will have to copy the data file to another file. The filenames are "AlArray.dat" and "AzArray.dat".

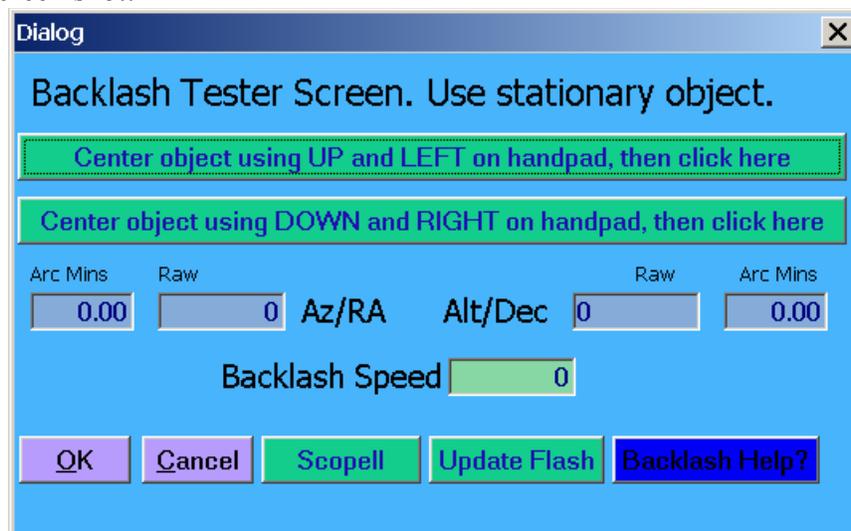
Clicking the "CLEAR" button will erase all of the data points on your screen, and you can now start from scratch. You will be prompted before the erasure.

Clicking the OK button will return you to the main menu, and the data you've edited will be sent back to the main structure if option chosen. You will have a chance to abort.

Clicking the Cancel button will return you to the main menu, but the data you've edited will be lost (unless you saved it to the controller or to a file using the "Misc. and Action" page). You will have a chance to abort.

Using the Backlash Help tool:

Here is a screen shot:



You need to use a crosshair eyepiece, or, alternatively, you could mount a laser on your scope, and look at the dot for movement. The important thing, is it needs to be a stationary object, such as Polaris, a distant radio tower, or something. You shouldn't do this on any other star other than Polaris, or the southern hemisphere equivalent, or the star motion will mess up the calculation. If you select a distant tree, be sure the wind is not blowing, or this could mess you up too (I speak from experience here!!!).

First, line up the object on the crosshairs of a crosshair eyepiece. Be sure that you only use the UP and LEFT buttons on the handpad. If you move too far, then press the DOWN (and/or RIGHT) buttons, until the scope moves, then press the UP (and/or LEFT) again,

until the object is centered. The important thing here is the scope actually is moving when you let up on the UP and also the LEFT buttons to be sure all mechanical backlash is taken up.

Now click the top button labeled "Center object using UP and LEFT on handpad, then click here".

Now line up the same object again, this time using the DOWN and RIGHT buttons. Be sure the DOWN and RIGHT buttons are the last buttons you press, and be sure the scope is moving when you let up the DOWN and RIGHT buttons to be sure all backlash is taken up.

Now click the top button labeled "Center object using DOWN and RIGHT on handpad, then click here".

The new backlash values, both in motor encoder ticks and in arc minutes is displayed for each axis.

If you press the OK button, these values are returned to the main window.

If you press the Cancel button, you return to the main menu without changing the values.

You can choose to update ScopeII and/or the controller flash rom.

If you are using version 1.5 or earlier of the controller firmware, there is no place to save the backlash in the controller configuration.

If you are using version 1.6 of the controller firmware, you can save it to the flash ROM, but it won't do anything.

If you are using version 1.7 or later of the controller firmware, the backlash will be acted upon if it is non-zero in the controller configuration.

Don't forget to set the Backlash Speed so the motor will move out of the backlash area. This is done on the "Edit Parameters/Misc and Action" window, or can also be done at this window. The speed should be set so the motor quickly moves out of "no-mans" land, but doesn't jar the telescope when it leaves the "no-mans" land area.

If you are using version 1.7 or later of the controller firmware, you wouldn't want to use the backlash in ScopeII, as the controller will do it on a much lower level, which is good. It is also much faster to respond, nearly instantaneous. If you do use the backlash in ScopeII, then you should set the controller backlash values to zero. Also, if you are using backlash in the servo controller, you should turn off backlash in scope.cfg.

If you choose to update scopeII, it will simply zero out the backlash in the scope.cfg file.

More notes on backlash:

If one of your telescopes axis's is out of balance, the mechanical system may already take up the backlash. If this is the case, you need to set the backlash to zero.

Another way to test the backlash is to use the "Edit Parameters" menu item, Select the "Misc and Action" tab, turn the Hot Mode to on, then looking through the eyepiece and operating the handpad, manually type in new values until it works properly. You look for almost instantaneous response in movement, without jarring when the backlash is taken up. You should probably use the guide mode or set the pan mode speed to very slow to do this. Watch the eyepiece for movement, and be sure it doesn't jerk when reversing directions.

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