PlaneWave
INSTRUMENTS

Ascension 200HR German Equatorial Mount Instruction Manual

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Contents

Introduction

Thank you for your purchase of the PlaneWave Instruments Ascension 200 (A200) German Equatorial Mount. The A200 mount is designed to give outstanding performance with up to 275 pounds of payload. It uses 360-tooth, 12.1 inch diameter RA and DEC gears, has built-in homing sensors on each axis, and is supplied with high resolution encoders directly coupled to each axis. The high-resolution encoders correct for residual mechanical errors including periodic error and declination backlash, thereby enabling long, unguided exposures. The stable tracking and precise offsetting supported by the encoders also allow for very long guided exposures.

The Ascension 200 is intended for permanent observatories but can also be used for portable applications. The mount breaks down into three components, making the mount transportable for field work. The heaviest component is 96 pounds.

The PlaneWave Instruments Ascension 200 mounts are beautifully machined and finished, featuring black anodized aluminum with stainless steel complements and fasteners.

Each A200 purchase includes:
- Right Ascension and Declination axis assemblies
- Control electronics based on the Sidereal Technology control system
- Control software and ASCOM driver
- PlaneWave 7.65 inch Saddle - or - PlaneWave tilt-in EZ Saddle for Losmandy style 3-inch dovetail plates
- Counter-weight shaft
- Shipping crate

The Unpacking and Crating section contains a full list of everything that comes with the mount.

Unpacking and Crating

The Ascension 200 comes in one crate as shown in Figure 1. All of the items included in the crate are shown in Figure 2. These items are listed below:

- RA Axis and the Mount Base
- Declination Axis
- Counterweight Shaft
- Counterweight Safety Stop (A200-148)
- RA Base to Pier Bolts (4X 3/8-24 x 1-1/2 SHC)
- Dec to RA Bolts (4X 1/2-13 x 1-1/4 BHC)
- 4 Communication Cables, 2X 4 pin and 2X 8 pin (gray cables with yellow tips), one of each per axis.
- PlaneWave Saddle (200919) or EZ Saddle (600182)
- Saddle Plate Mounting Hardware, 5x ¼-20x1-1/8 flat head or EZ Saddle Mounting Hardware, Mounting Bolts, 4X ¼-20 x 7/8
- 24VDC Power Supply (#2099286) with AC power cord
- 4 Pin to Barrel Power Connector (adapts the power supply to the mount's power input)
- Electronics Box and USB Cable
- Mounting Hardware for electronics box (2X ¼-20x3/8 SHC with plastic thumb screw and 4x plastic washers)
- Hand Paddle and Cable
- USB drive with Software

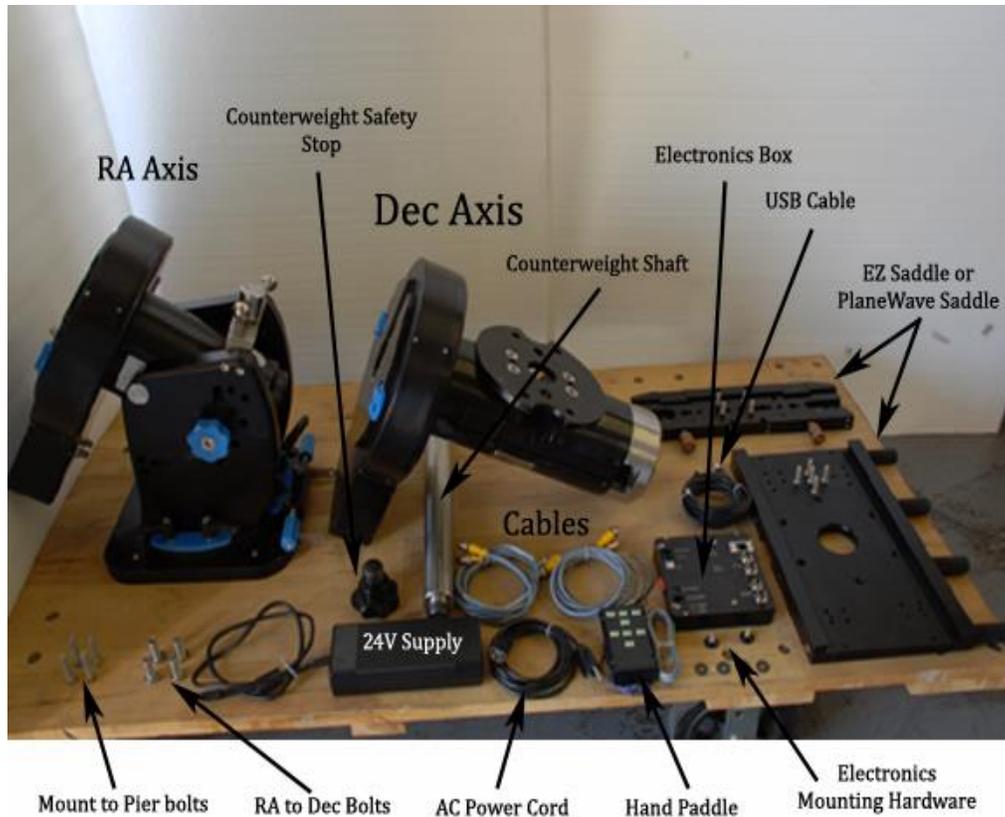
Figure 1 - The crated A200 mount

Figure 2 - All of the major components that come with the A200 mount

Installing the Pier

When installing the pier, take care to ensure that the bolt holes on the top plate of the pier are aligned to within a few degrees of True North. The polar axis of the mount will eventually need to be precisely aligned to point North. The base of the A200 mount can be adjusted in azimuth by up to +/-7.5 degrees, so the pier alignment will need to be within that range.

One technique for aligning the pier is to simply use a compass. However, be aware that Magnetic North can be offset quite a bit from True North depending on your location. The magnetic pole also drifts over time. As of this writing, in the continental United States the offset ranges from about +16 degrees in Washington State, to 0 degrees in the Midwest, to about -16 degrees in Maine. The offset between Magnetic North and True North, called the Magnetic Declination, can be calculated using a service on the NOAA website:

http://www.ngdc.noaa.gov/geomag-web/#declination

Another technique for determining the direction of True North is to hang a plumb-bob and mark the shadow that is cast by the string when the Sun is at its highest point in the sky. This time is known as the transit time or "local noon". The transit time for a particular location and date can be calculated using a service on the USNO website:

http://aa.usno.navy.mil/data/docs/RS_OneDay.php

The base of the Ascension 200 has 4 mounting holes used to bolt the base of the mount onto a pier plate. Please see Figure 3 and note the orientation of North relative to the mounting hole pattern.
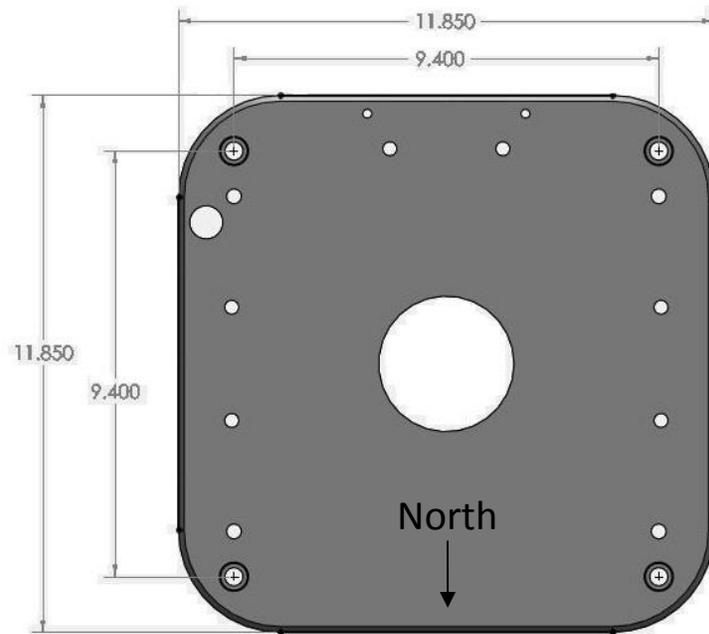
Figure 3 - The base of the A200 mount. The 4 corner holes are used to attach the mount to the pier. The mounting holes are clearance holes for 3/8" socket head cap screws.

Installing the Mount on the Pier or Tripod

The mount is rather heavy so it is best to do the installation in parts. It takes at least two strong people to lift the Base/RA and the Declination assemblies. To install the mount on the pier:

1. Verify that the latitude adjustment bar is installed in the correct position for your current location. Refer to Table 1 and Figure 4. This is normally preset for your site latitude by PlaneWave Instruments, but may be adjusted as needed.

Latitude	Position
0 - 20 degrees	(Requires low latitude kit)
20 - 35 degrees	Position 1
35 - 50 degrees	Position 2
50 - 65 degrees	Position 3
65 - 80 degrees	Position 4
80 - 90 degrees	Position 5

Table 1 - Latitude adjustment bar positions for various site latitudes
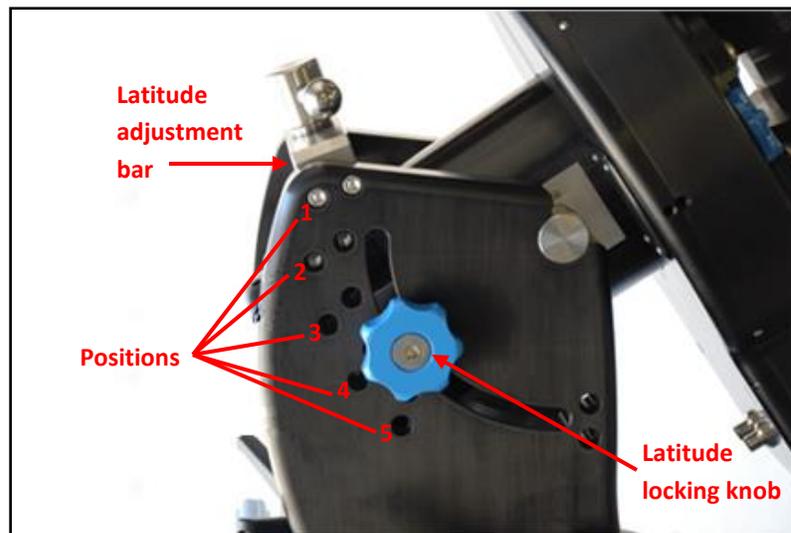
Figure 4 - Latitude adjustment components

If necessary, the latitude adjustment bar may be repositioned using the following procedure:

a. Loosen the blue latitude locking knobs on the either side of the mount's side plates.

b. Rotate the RA axis upward in altitude so it is out of the way, and tighten the blue altitude locking knobs. Make sure the knobs are fairly tight so the RA axis does not slip down during this process.

c. Remove the 4 socket head screws (2 on each side) that hold the latitude adjustment bar in place

d. Slide the latitude adjustment bar to the appropriate position for your latitude. See Table 1 and Figure 4 to find the correct position.

e. Secure the latitude adjustment bar with the 4 socket head screws

f. Hold the RA axis firmly while loosening the blue latitude locking knobs on either side of the mount's side plates. Gently lower the RA axis in altitude until the rear top surface rests against the bottom of the latitude adjustment screw.

2. Place the mount base on top of the pier mounting plate as shown in Figure 5. **NOTE: Be sure to tighten the blue latitude locking knobs to keep the RA axis from moving when you lift it. It is easy to smash your fingers!**

Figure 5 - Placing the mount base onto the pier

3. Use the 4x 3/8-24 socket head cap screws (provided) to secure the base of the A200 to the mounting plate of the pier. Use an Allen wrench to make sure these are tight.

4. Adjust the mount latitude (i.e. polar altitude) to approximately match your site latitude. To measure the approximate altitude angle of the mount, place an inclinometer along the top of the RA axis, as shown in Figure 6. If you do not have an inclinometer on hand, there are many inclinometer / bubble level apps for iPhone and Android phones that can measure inclination with reasonable accuracy.
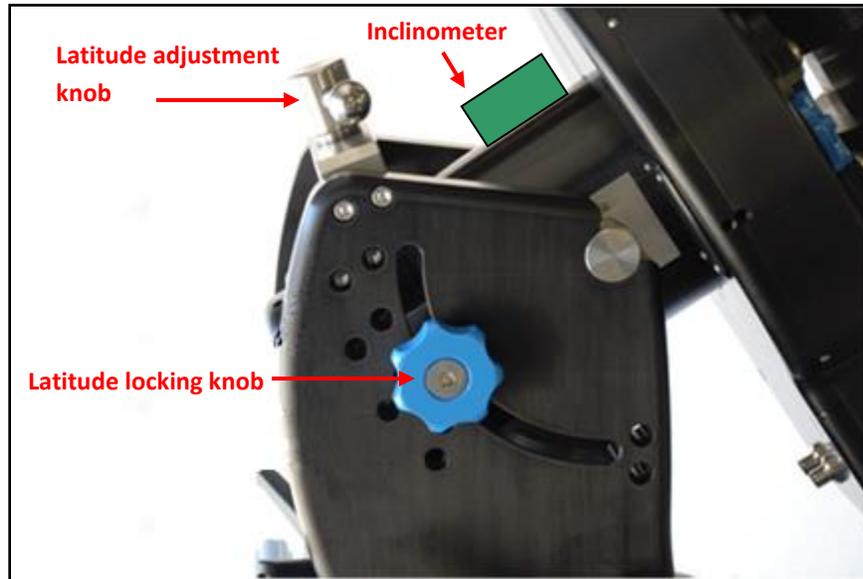

Figure 6 - Refining the mount latitude adjustment

The angle of inclination of the RA axis should roughly equal your site latitude. To adjust the inclination:

a. Loosen the latitude locking knobs (one on each side of the mount)

b. Using a large wrench, turn the latitude adjustment knob clockwise or counterclockwise to raise or lower the polar axis of the mount.

c. Once the measured mount latitude nearly equals the site latitude, tighten both latitude locking knobs.

The latitude adjustment will be refined further in the Polar Alignment step. Note that this adjustment will be somewhat more difficult once the mount is fully loaded. See Figure 9 for an illustration of how to lift up on the counterweight bar to ease the load while making future adjustments.

5. Loosen the Right Ascension clutch knobs and rotate the right ascension axis so that the alignment pins are roughly horizontal. See Figure 7. **Tighten the clutch knobs when finished, or else the axis may slip during installation of the Declination Axis!** You only need to hand tighten these knobs.
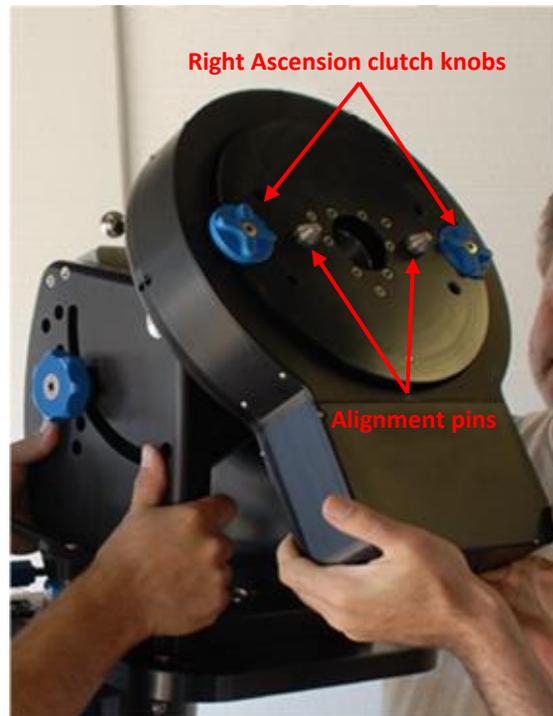
Figure 7 - Location of the Right Ascension clutch knobs and alignment pins

6. Install the Declination axis, after verifying that the RA clutch knobs are at least hand tight. Lift the declination axis with at least two people, as it is somewhat awkward to handle. You can see in Figure 8 how two people can lift it. There are two stainless steel alignment pins on the face of the RA axis, as shown in Figure 7, which will guide the Declination axis into position and hold the axis in place while you get the bolts to secure it. Once mounted, secure the axis with 4x 1/2"-13 button head cap screws (provided).

Figure 8 - Typical installation of the Declination axis

Figure 9 - If you have to adjust the latitude with a fully loaded mount, you can have one person lift the counterweight bar while you are adjusting the latitude knob. This makes the adjustment much easier.

7. Install the counterweight shaft as shown in Figure 10. It is the 20" long stainless steel shaft and it threads into the bottom of the Declination axis. Also install the 8" extension shaft if you have it. See Table 2 below to determine if you need the 8" extension bar.
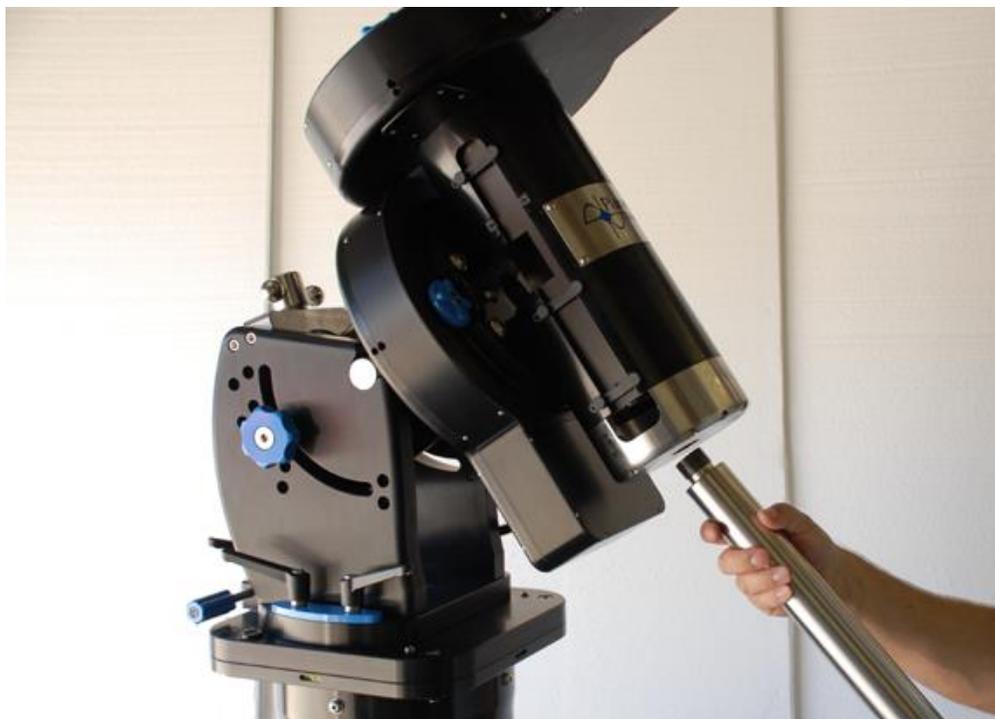
Figure 10 - Installing the counterweight shaft

8. Install the counterweights as shown in Figure 11. If you have a combination of 18lb and 40lb counterweights, you should put the lighter 18lb counterweight on first. Refer to Table 2 to determine the number of counterweights needed to balance select telescopes.

    IMPORTANT: Counterweights should always be installed on a mount BEFORE putting the telescope on the mount. You never want the mount to be top heavy because the RA Axis can suddenly rotate due to gravity. This can result in personal injury as well as damage to the mount, telescope, and imaging equipment.

Telescope	Counterweights	8" extension bar?
CDK24	7X 40lbs counterweights	Yes
CDK20	3X 40lbs counterweights	Yes
CDK17	2x 40lbs counterweights and 1x 18 lbs	No
CDK12.5	1x 40lbs counterweight	Yes

Table 2 - List of the counterweights required for various CDK telescopes.

Figure 11 - Installing the counterweights

9. Install the counterweight safety stop as shown in Figure 12. This prevents the counterweights from accidentally sliding off the counterweight shaft and causing injury.

Figure 12 - Installing the counterweight safety stop

Installing the Telescope on the Mount

1. Run motor and sensor cables through the mount. See Appendix C

2. Run the accessory cables you will be using through the mount. See Appendix C. This needs to be done prior to installing the PlaneWave Saddle Plate or the EZ Saddle. Examples of cables you may want to run include: USB cables, power supply cables, and serial cables. You might also wish to run an AC extension cord to supply power to cameras, filter wheels, and the EFA kit. Finally, you might find it convenient to install a USB hub on the back of the telescope.

3. Install the PlaneWave Saddle Plate (Figure 13) or the EZ Saddle (Figure 14) depending on which one you ordered.
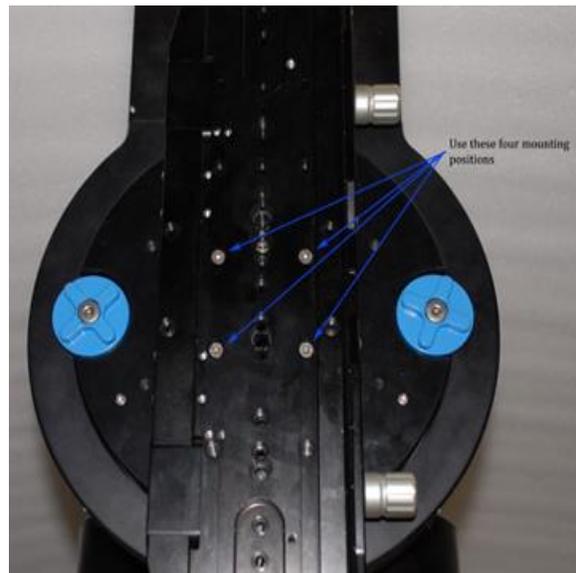

Figure 13 - PlaneWave 7.6" saddle installed

Figure 14 - PlaneWave EZ Saddle installed

4. Install the CDK telescope onto the mount as follows.

   a) Tighten the RA and Dec clutch knobs

   b) Loosen the saddle bolts generously to easily allow the telescope to slide in

   c) Set the leading edge of the dovetail into the saddle

   d) Slide the telescope into the saddle and tighten the saddle bolts. See Figure 15.

   e) Install stop screw(s) if available. See Figure 16.

Figure 15 - Installation of a CDK17 onto an A200 mount using a PlaneWave 7.6" Saddle
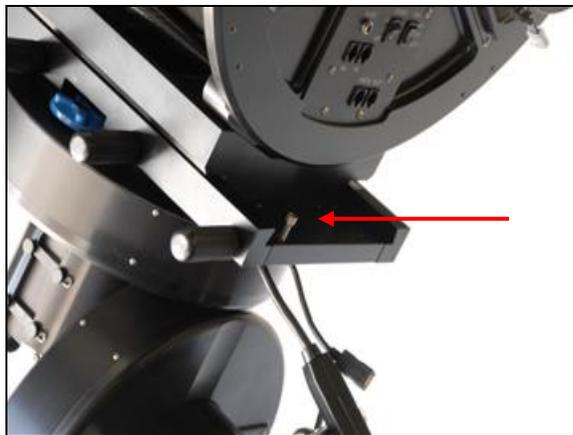

Figure 16 - Once the telescope is installed, you can place a ¼-20 SHC screw in the hole at the end of the dovetail clamp as a safety stop. Depending on the balance of the telescope, this hole may not always be exposed.

Balancing the Telescope

After the telescope is installed, you will need to balance the system.

The first step is to balance the Declination axis.

1. Start with the telescope/mount system in the configuration where the counterweights are pointed down and the optical tube is pointed along the polar axis, as shown in Figure 17. Loosen the two blue clutch knobs on the declination axis, as indicated in Figure 17. **Be sure to hold the telescope in case it is grossly out of balance!** With the clutch loosened, rotate the telescope toward the horizon.

2. In this position, note when you release the optical tube whether the front rotates down or up. If the front rotates down then the telescope is front heavy. If the front of the telescope rotates up, then it is back heavy. If the telescope is front heavy then it needs to be moved back in the saddle plate. If the telescope is back heavy then it needs to move forward in the saddle plate.

3. To move the telescope in the saddle plate:

    a. Put the telescope back in the position shown in Figure 17

    b. Have two people hold the back of the telescope

    c. Loosen the saddle plate knobs to release the telescope

    d. Slowly allow the telescope to slide back or push the telescope forward depending which way you need to move it

    e. Tighten the saddle plate knobs.

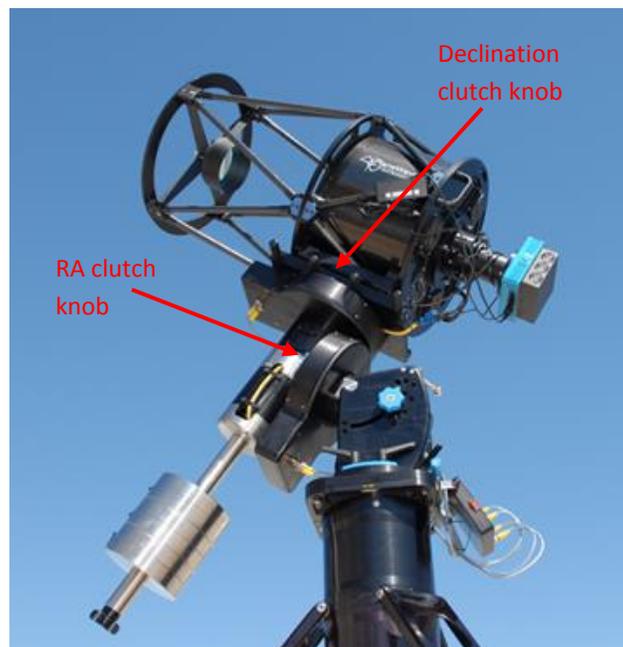4. Repeat steps 1, 2, and 3 until the declination axis is balanced.

Figure 17 - The Ascension 200 mount in the starting position for testing balance

Now the RA axis needs to be balanced.

BEFORE PROCEEDING, VERIFY THAT THE COUNTERWEIGHTS HAVE BEEN PROPERLY INSTALLED!

1. While holding the counterweight shaft, loosen the RA clutch knobs. The counterweight shaft is long and gives you a lot of leverage to easily handle minor imbalances. Hold onto it in case the telescope is top heavy and wants to fall. Rotate the RA Axis so the counterweight shaft is pointed toward the horizon.

2. Notice whether the mount wants to rotate so that the telescope goes down or up. If the telescope side goes down then the telescope side is heavy and the counterweights need to be moved out or down on the counterweight shaft. If the telescope rotates up, then the counterweights need to be moved up on the counterweight shaft. In cases of extreme imbalance, weights may need to be added or removed.

3. When the counterweight shaft is in the horizontal position like this, you can loosen the counterweight knobs and not have to worry about them sliding due to gravity and smashing your fingers. That really hurts, so we recommend avoiding it. While in the horizontal position, loosen the counterweight lock knobs and slide the weights in the appropriate direction to balance the telescope system. When the telescope is balanced, the mount will not rotate with the clutches disengaged, but should glide smoothly in either direction when you lightly push or pull on the end of the counterweight bar.

Note on using the Clutches

Clutches are convenient for balancing the telescope system and quickly pushing the telescope to a particular orientation for maintenance. Clutches are also nice because they allow the drive to slip harmlessly in the event of hitting an obstruction. **The clutch knobs should only be finger tightened. Do not use a tool to tighten the clutches.** When the clutch knobs are finger tight, they will not slip during normal slewing, but they will still be allowed to slip should the telescope run into an obstruction.

Installing the Electronics and Powering up the Telescope

The Ascension 200 mount uses a Sidereal Technology Servo II Dual Axis Telescope controller. We package the electronics with a custom case and cover, and we use high-quality connectors and cabling.

The electronics box as seen in Figure 18 has motor and encoder connectors for both the RA and Dec axes, a USB port, a serial port, a hand paddle port, a 24VDC power input port, a limit switch input port, and an autoguider relay port.

The electronics board attaches to a bracket mounted under the azimuth polar alignment adjustment on the base of the mount, as seen in Figure 19. The electronics case is attached with two ¼-20 x 3/8" SHC screws with thumb knobs. Do not use bolts longer than 3/8" as they can hit the electronics inside the case. There are also 4 nylon washers. On each side, one washer goes between the case and the bracket while the other washer goes between the bolt head and the bracket.
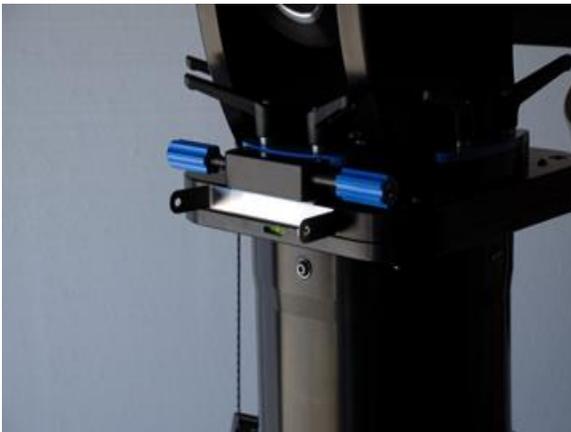
Figure 18 - A200 mount electronics box

Figure 19 - Bracket for mounting the electronics case

Figure 20 - Attaching the electronics

Installing the STI Control Software

The A200 mount is operated via the STI (SiTech Interface) control software. The USB flash drive that comes with the mount includes this manual and the software needed to control the A200 mount or other mounts that use the PlaneWave controller. Figure 21 shows the contents of the USB flash drive.

Name	Date modified	Type	Size
.NET Framework 3.5 SP1 Installer	3/4/2013 2:35 PM	Application	237,054 KB
ASCOMPlatform6SP1	3/4/2013 3:24 PM	Application	24,214 KB
Setup_APM_Catalog	2/19/2013 11:40 PM	Application	415,047 KB
Setup_STI_1.3.9_Final	10/21/2014 6:11 PM	Application	5,859 KB
TheSky6 ASCOM Plugin 5.0.4 Setup	3/4/2013 3:24 PM	Application	426 KB

Figure 21 - Contents of the USB memory stick

Here is an overview of the steps that need to be done for the installation.

1. Install .NET Framework 3.5 SP1 (if not already installed on your computer)
2. Install the STI control software
3. Install the APM catalog for PlateSolve
4. Install the ASCOM Platform (if not already installed)
5. If using TheSky 6, load the ASCOM plugin for TheSky6

1 - Install .NET Framework 3.5 SP1 (if not already installed)

Both the STI control software and the ASCOM Platform 6 require the .NET Framework version 3.5 to be installed in order to operate.

NOTE - Windows 7 includes .NET 3.5 by default, so this step is unnecessary on computers running Windows 7 or later. Additionally, many computers running Windows XP or Windows Vista will already have .NET installed. If you believe that .NET may already be installed, simply proceed to step 2. The STI installer will alert you if .NET 3.5 is not properly installed, and will offer to direct you to the Microsoft website where you can download the installer.

The full .NET 3.5 SP1 installer is included on the USB disk that is distributed with the A200 mount. You may also download .NET 3.5 from:

http://www.microsoft.com/en-us/download/details.aspx?id=22

2 - Install the STI control software

The installer for the STI control software is included on the USB disk that is distributed with the A200 mount under the name "**Setup_STI_1.x.x**"

You may also download the latest version of the A200 control software from http://planewave.com.

This installer will:

- Install the STI program and data files
- Install a USB driver for the SiTech telescope electronics
- Register an STI-compatible ASCOM mount driver
- Install several auxiliary utilities, such as ServoConfig and PlateSolve.

Once finished, you should see a new icon for "PlaneWave STI" on the desktop, and a new group "PlaneWave STI" in the Start menu.

Figure 22 - New desktop icon and start menu entries

3 - Install the APM catalog for PlateSolve

STI uses a program called PlateSolve to match star patterns in camera images against known star positions in a star catalog. PlateSolve is used to build accurate pointing models; this will be discussed later in the manual.

Because the catalog used by PlateSolve is rather large (over 400 MB), the catalog is distributed as a separate file. It may be found on the included USB disk under the name "**Setup_APM_Catalog**".

Note that this process will not create any new icons or program groups. However, it may be uninstalled via "Add or Remove Programs" under Control Panel.

4 - ASCOM Platform

The ASCOM Platform allows third party programs, such as Maxim DL and TheSky, to control the A200 mount via the STI control software. You may download the latest version of ASCOM from:

http://ascom-standards.org/

On the right side of the website, there should be a link to download ASCOM Platform 6 as shown in Figure 23.

Additionally, the latest ASCOM installer as of this writing (ASCOM Platform 6 SP1) is included with the USB disk that comes with the A200 mount.
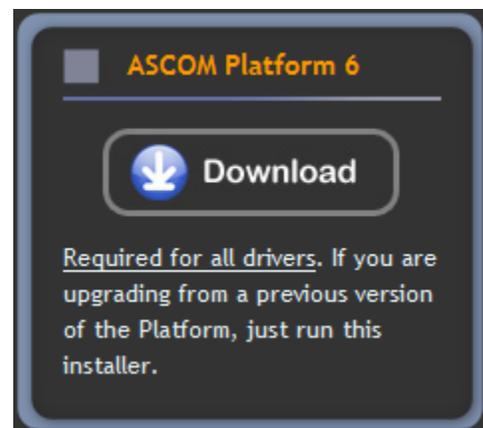

Figure 23 - ASCOM website screenshot

5 - ASCOM Plugin for TheSky6 (not needed for TheSkyX)

If you plan to control your A200 mount from TheSky6 (a planetarium program made by Software Bisque), you will need to install an ASCOM plugin to allow TheSky to communicate with ASCOM devices, including STI. These plugins are distributed on the USB disk that comes with the mount, and you may install them now. However, the mount hardware and software must be fully set up and configured before attempting to connect from TheSky.

For full instructions on controlling the mount via TheSky 6 or TheSkyX, please refer to Appendix G.

Configuring the STI Control Software

STI Control Software is a PC based program that controls the Ascension 200 mount. The motor controller may also be used on other mounts that use the Sidereal Technology motion controller, including mounts made by Mathis Instruments. STI also acts as an ASCOM driver for the mount. The main STI window is shown below.
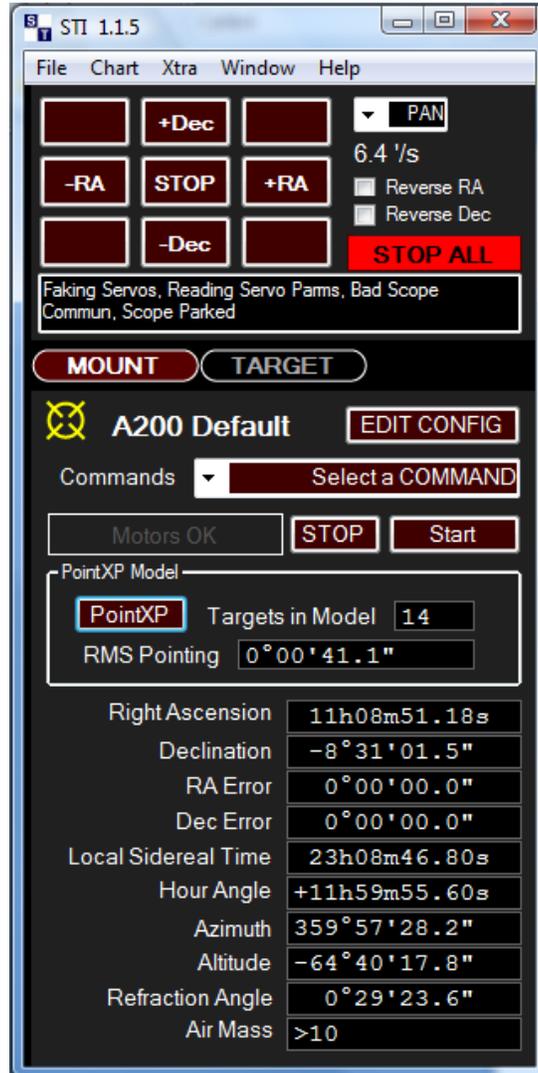

Figure 24 - STI home screen

Begin by connecting the supplied USB cable to the USB port on the mount electronics box, and plugging the other end into the computer or a connected USB hub. Windows should detect the new device and load the proper drivers, which were installed with the STI installer.

Next, launch STI and click on the "EDIT CONFIG" button.


Figure 25 - Edit Config button

Telescope Info Tab
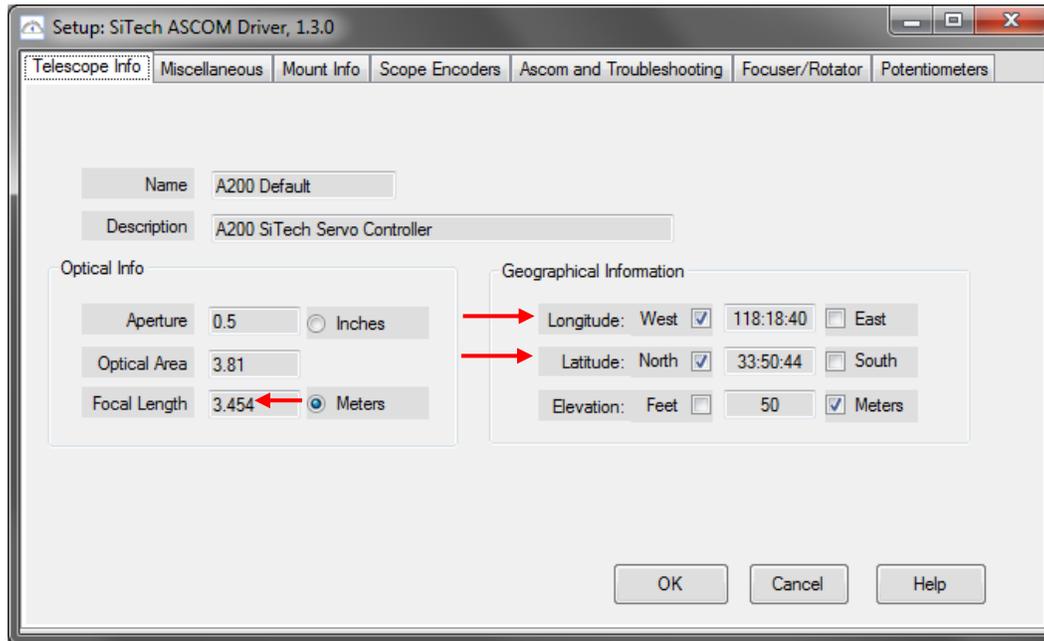
The first tab in the Setup screen contains some basic parameters about your site and telescope. The most important parameters to adjust on this screen are:

- Longitude and Latitude (the mount must know its location in order to accurately point at stars)

- Focal Length of the telescope (in order to reliably find PlateSolve solutions during a mount model.)

Miscellaneous Tab
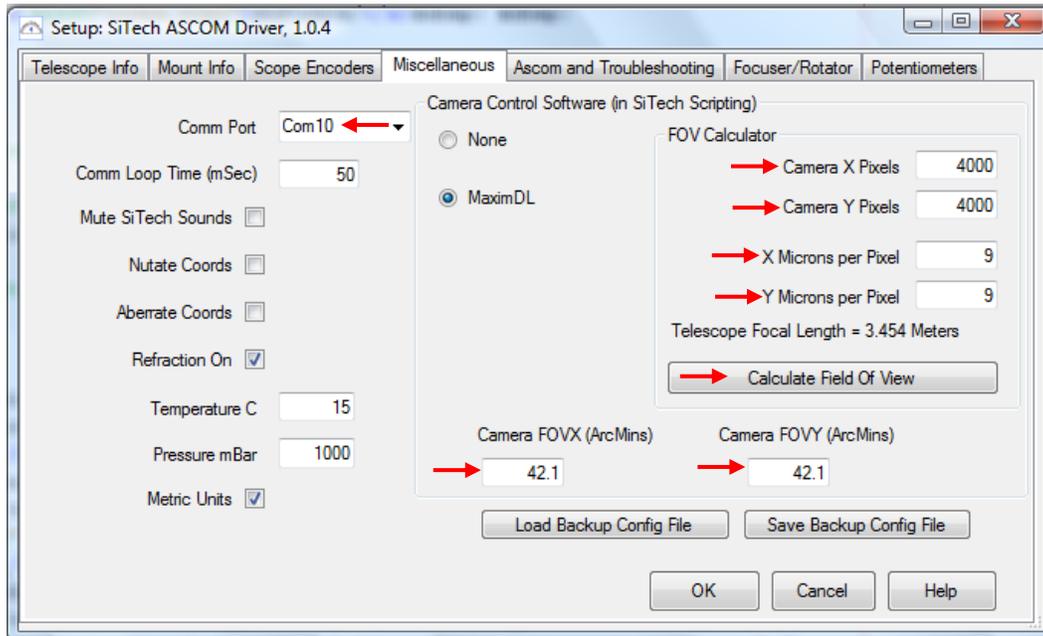
The most important setting on this screen is the "Comm Port". You must set this to the COM port that is associated with the with USB connection on the mount electronics box.

One method for identifying the correct COM port is to open Windows Device Manager, expand the "Ports" category, and look for the port that is listed as a "USB Serial Port". In the example below, the A200 mount is connected on COM8. Note however that some other devices, such as Boltwood II Cloud Sensors, may also be identified as USB Serial Ports.
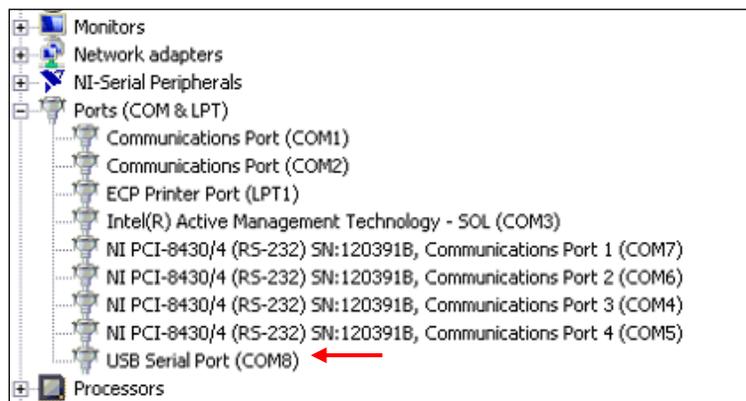
In addition, the "Camera FOVX" and "Camera FOVY" values should be configured to the unbinned field of view for your camera / telescope combination. These numbers are used by PlateSolve during the automated mount modeling process to determine your approximate image scale.

If you do not know your field of view, enter the Camera X Pixels, Camera Y Pixels, X Microns per Pixel, and Y Microns per Pixel (typically available from your camera spec sheet) and click "Calculate Field of View". The field of view will be calculated using these values, as well as the Focal Length value entered on the Telescope Info page.

Mount Info Tab
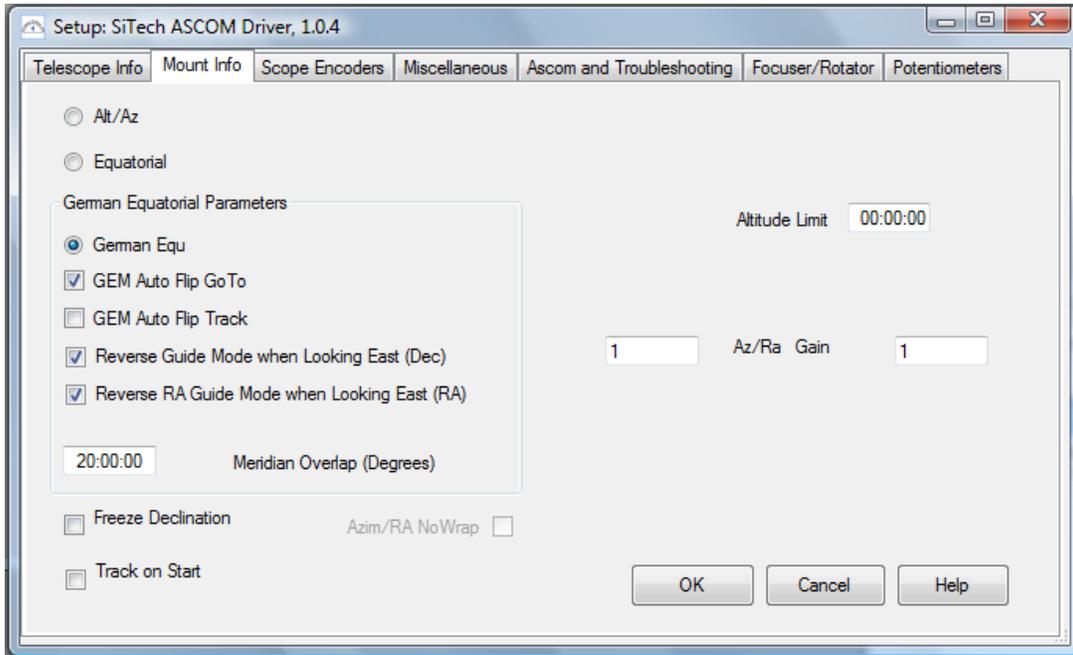
The default settings for the A200 are shown above. It is typically not necessary to change these.

Scope Encoders Tab
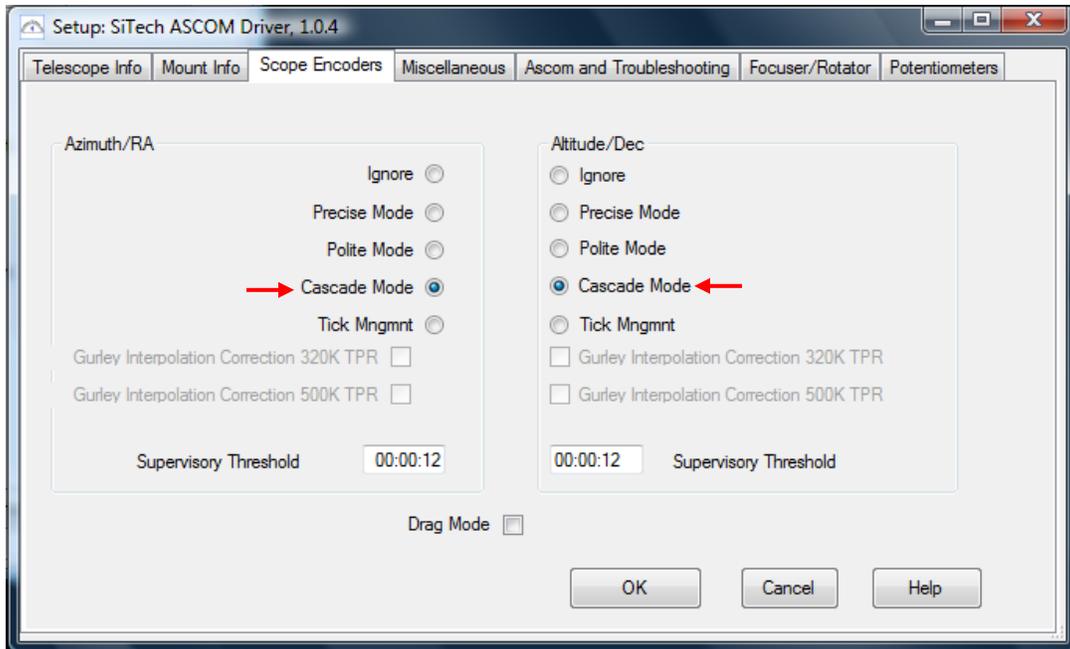
The default settings for the A200 with High-Resolution Axis Encoders are shown above. For mounts with high resolution encoders, like the A200HR, Cascade mode needs to be selected. To disable the axis encoders, select Ignore.

Polar Alignment, First Mount Model and Setting the Home Switches

NOTE: If you are located in the southern hemisphere, please refer to Appendix H before continuing.

The Ascension 200 mount is a German Equatorial mount. This means that when the mount's polar axis is aligned to the Earth's rotational axis, the mount need only track in one axis to counteract the rotation of the Earth.

Polar alignment is the process of adjusting the polar axis of the mount (also known as the Right Ascension axis) to be aligned with Earth's rotational axis. For non-computerized telescopes this is typically done using a process called the Drift method, an iterative process that is time consuming and requires some expertise.

Since the Ascension 200 is a computerized mount with sophisticated star-matching and pointing model software, the process is much easier. The first step is to make a small mount model, in which you align the telescope to about 6 or 8 known stars. Using this information, the mount modeling software will calculate the polar misalignment of the mount.

At that point the mount can be manually adjusted in azimuth and in latitude/altitude by the amount reported by the software. This process will bring the mount closer to proper polar alignment.

Steps before making your first mount model

The mount and the telescope should be installed as described in previous chapters. After the initial installation, the mount should be within +/-5 degrees from true North in azimuth and within +/- 5 degrees of the correct latitude.

Before continuing, make sure that the telescope electronics are powered on, and that STI is properly connected to the mount.

You may also want to align a finder scope to the main imaging telescope before continuing.

Creating a Mount Model using PlateSolveXP

In order to determine the mount's polar misalignment, you will need to create a small mount model. Since the telescope is not polar aligned, the pointing accuracy of the mount will initially be very poor as you move around to different points in the sky. We will start by making a small mount model using an aligned finder scope. We will then make a more accurate automated mount model using the main imaging telescope and CCD camera to precisely determine the mount's polar misalignment.

1. Open STI

2. Open Maxim DL and connect to your CCD camera. If you have a filter wheel, select the "brightest" filter -- that is, the filter that allows the most light through (typically Luminance, Clear, or Empty).

3. Select the Chart menu from the top menu bar of the STI window. Select "Show Sky Chart". This will open the sky chart window.
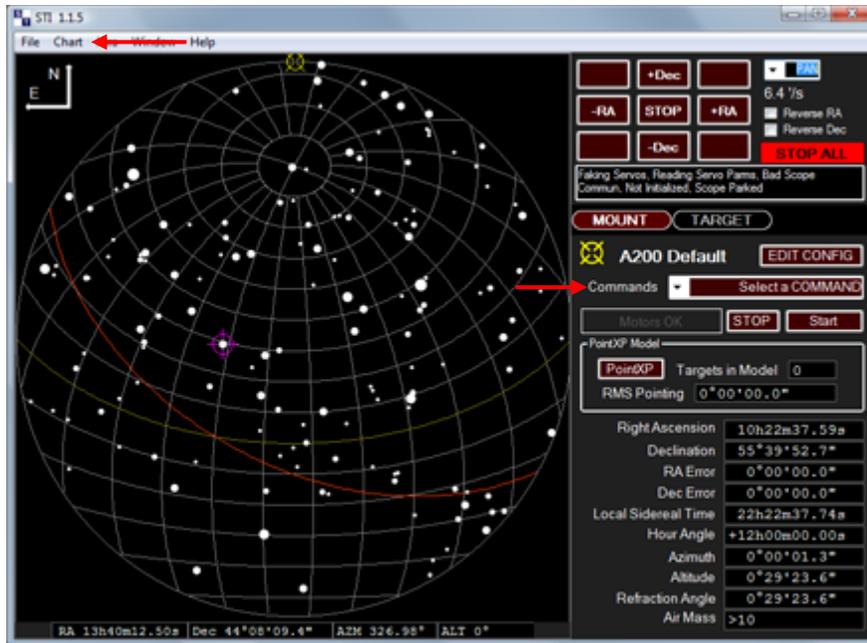
4. Click on the "Commands" menu and select "Home". The Homing Operations Window will open. Press the "Initialize Scope Using Homing Switches" button. The telescope will slew to its home position. For the A200, this corresponds to the orientation in which the counterweight bar is pointed down and the telescope is pointed at the celestial pole. This procedure, called "homing the mount", is used to calibrate the mount axes to a known position at startup.
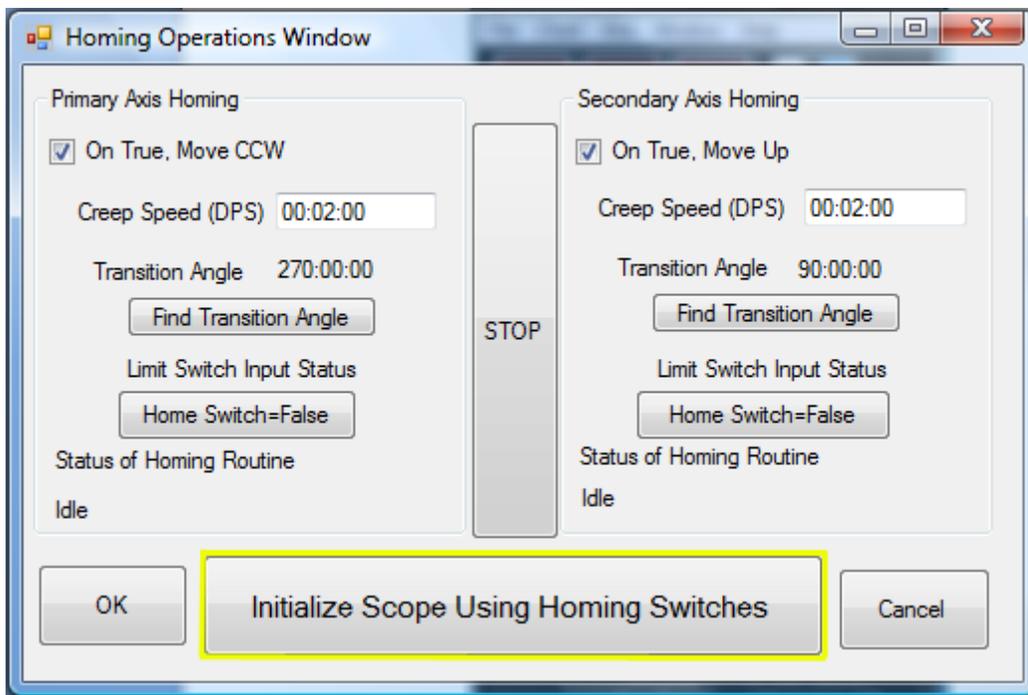
5. If you had previously built a PointXP model (i.e. if "Targets in Model" is not zero), clear the old model by clicking the PointXP button, clicking "Clear Terms and Cal Stars", and then clicking OK.

6. Select a bright, easily identified star on the sky chart. A window will pop up telling you the name of the star. Click the GOTO button and the telescope will move approximately to the star you selected. It is not expected that you will be perfectly centered on the star since the telescope is not polar aligned, a mount model has not been established, and the home switches have not yet been trained.
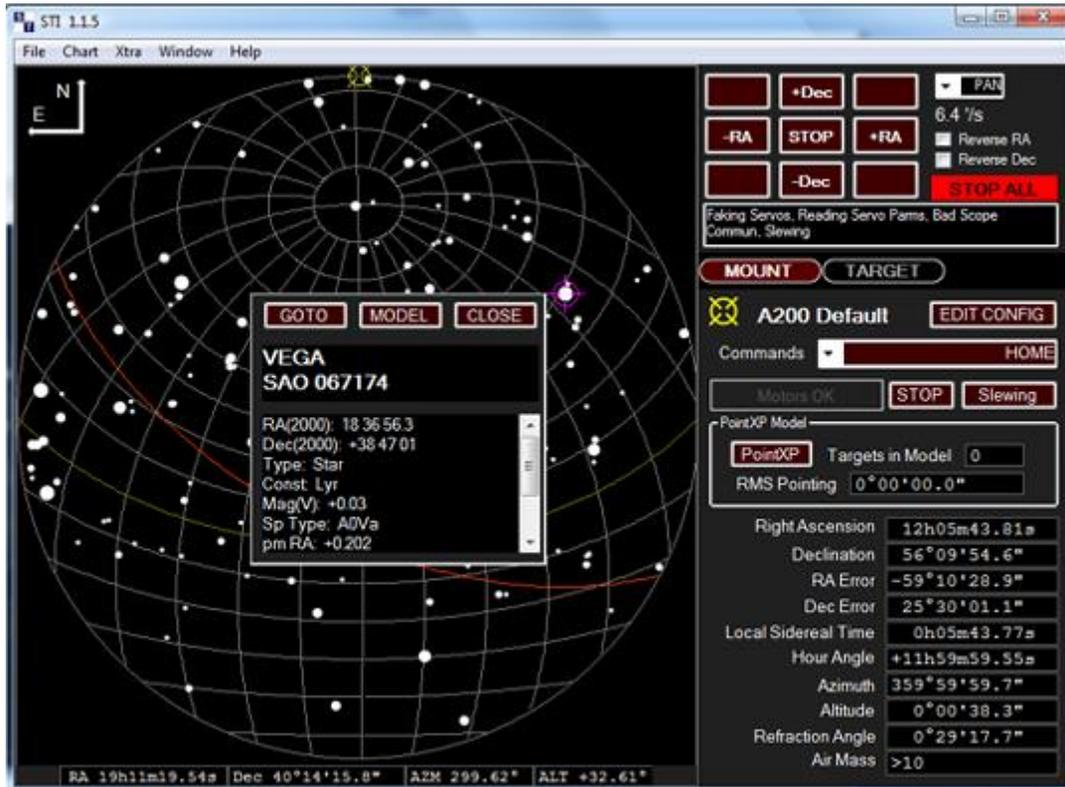
7. Center the star in the finder scope using the hand paddle. Don't bother centering the star perfectly at this point. Press the MODEL button in the Sky Chart window, and the InitPoint window will open. It will assume you are going to do a Simple Offset Init (also known as a "Sync") shown by the yellow arrow below. There will be a 5 second count-down in case you wanted to do something else. A Simple Offset Init will offset the coordinates reported by the telescope so that they perfectly match the star that you have centered.
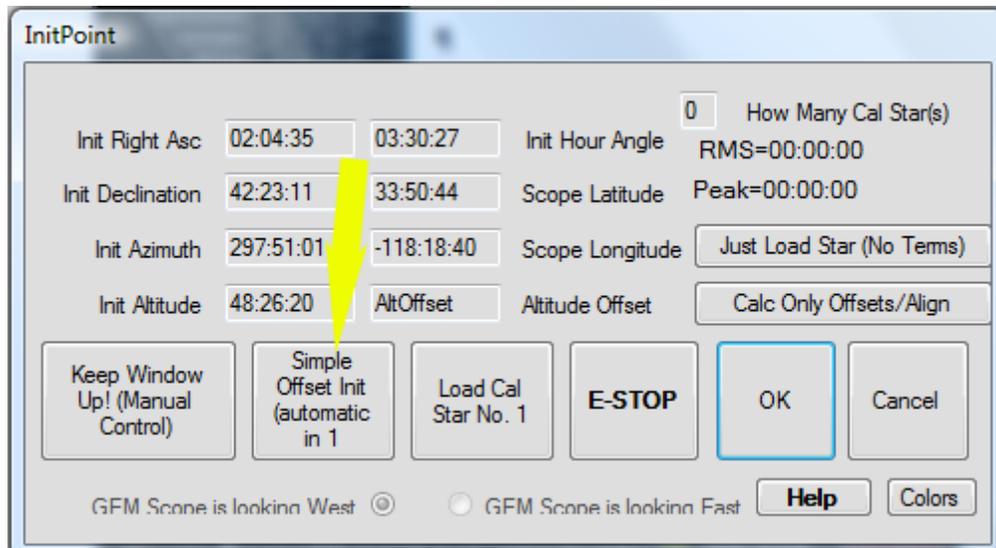

8. The InitPoint window will close. Now press the MODEL button again. This time when the InitPoint window pops up, click the "Load Cal Star" button. This action will add the first calibration point to the PointXP pointing model. Telescope pointing will gradually improve as more calibration points are added to PointXP, and we will eventually use PointXP to determine the polar axis misalignment.

9. Go back to the Sky Chart, choose another bright star, and press GOTO. Center the star in the finder scope and press MODEL. When MODEL is pressed and the InitPoint window opens, be sure to press the Load Cal Star Button. Repeat this process so you have 3 stars on one side of the meridian and 3 stars on the other side of the meridian.

10. Now it is time to build a more accurate mount model using the CCD camera on your telescope. Go to the Commands menu and select Run Script at the bottom.
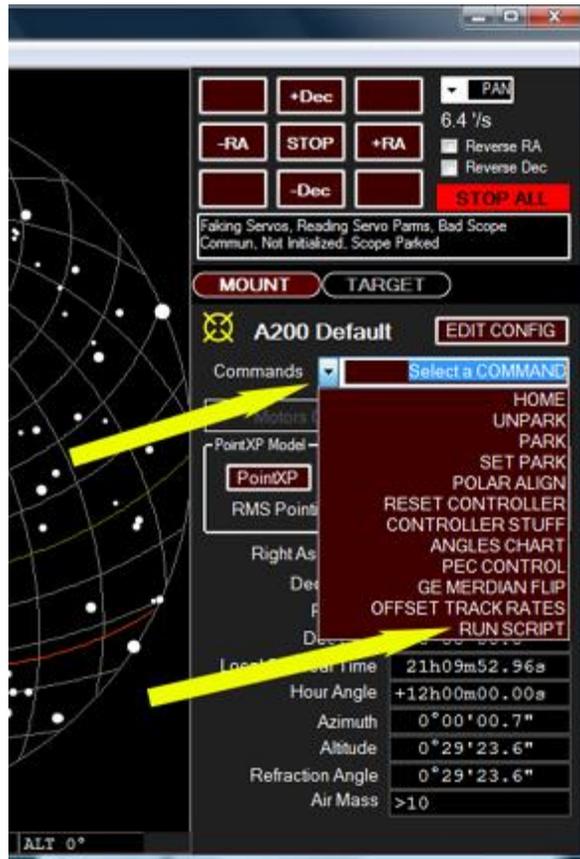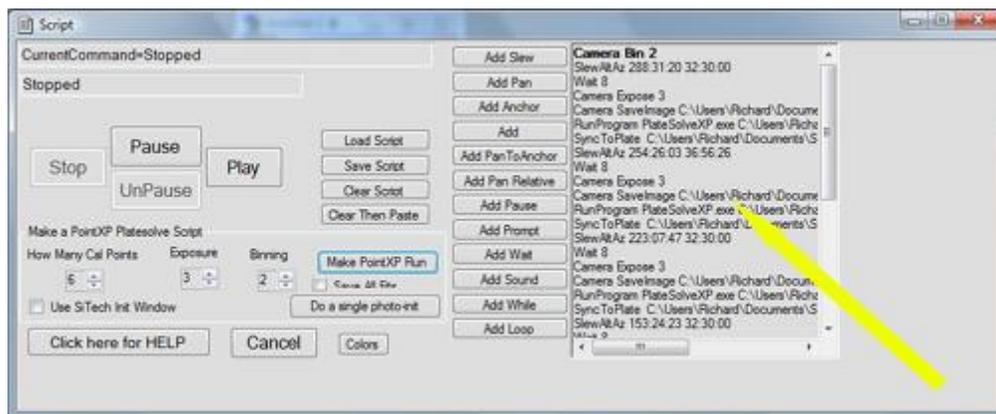

11. The Script window will open as seen below. The three arrows point to the most important settings for doing an automatic mount model run. For this initial polar alignment step, you should change "How Many Cal Points", to 6. Later, when doing a full pointing model, you will want to map 30-40 points. Exposure time depends on your telescope, camera, selected filter, and site conditions. It should be long enough to get at least 10 good star detections that can be used for an automatic PlateSolve. Binning should normally be set to 2.
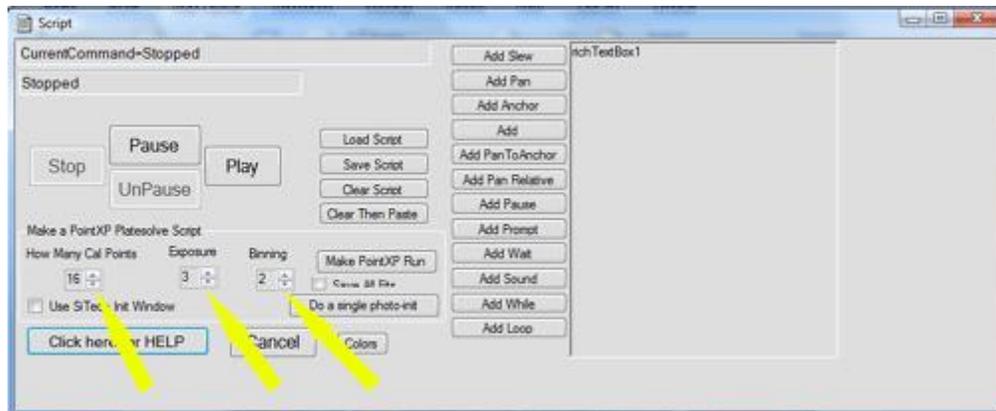
12. Once the parameters described above are set, press the "Make PointXP Run" button. This will open a new program called CalPointsXP which will select the optimum positions for the cal points. The window will automatically close after 60 seconds, but you can simply close it immediately before proceeding.
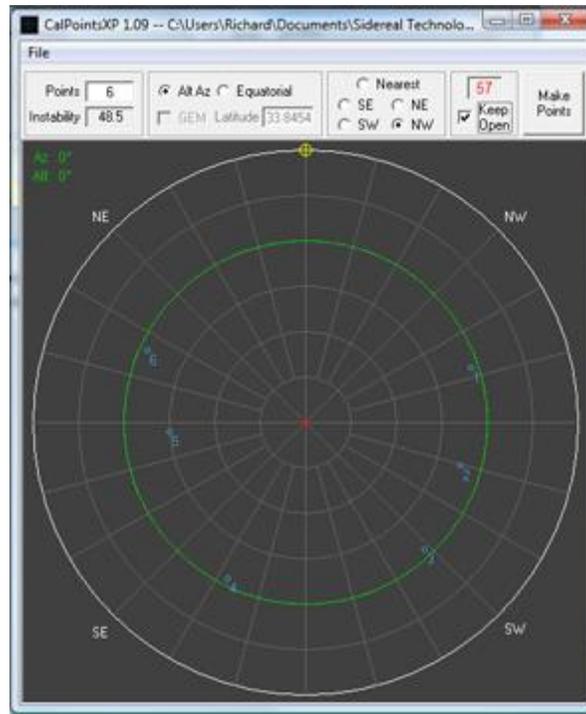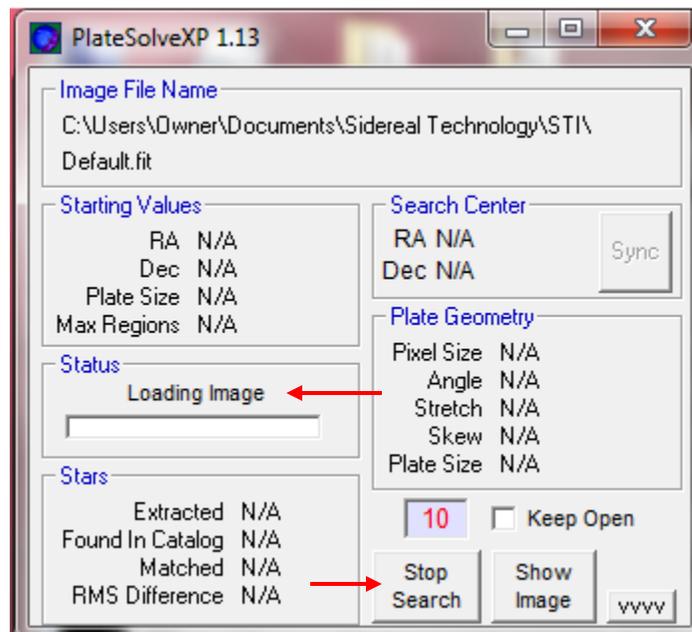

You should now see a pointing run script in the Script window, shown with the yellow arrow below.

13. Press the PLAY button in the Script window. This will run the script and start the auto mapping run. The PointXP script will cause the telescope to slew to the first calibration point position, take an image, plate solve the image (accurately determine the position of the telescope by comparing the stars in the image to a known star catalog), and add the position information to the mount model.

The window that pops up is the PlateSolveXP window. The "Status" section will show the progress of the plate matching process, which involves loading the image, identifying ("extracting") stars in the image, and searching in a star catalog around the region of the mount's reported coordinates to find a match. PlateSolveXP will search up to 999 regions in an expanding spiral pattern before giving up. Once you have a few points in your pointing model, you should typically get a match after searching fewer than 50 regions. If you want to abort a search on a poor-quality image, click "Stop Search", and STI will proceed to the next calibration point.

14. After the mount model is complete, press the PointXP button on STI. The PointXP window will pop up. (Note that the example screenshot below shows a much larger model than you will currently have).

15. Click "Display Cal Stars". This will show a list of the calibration points in the model. Remember that the first several calibration points were added using imperfect centering with a finder scope, and we don't want these points to pollute the model. Click on the "Used" text on the right column to remove these points from the model. If you took 6 points with the finderscope, then you should disable the first 6 points in the model, leaving only the highly accurate PlateSolve-based calibrations in the model. Close the window when finished.

16. In the lower left corner you will see the window labeled "Polar Axis Alignment Error"

In the Polar Alignment Error window, you will see the error is listed as "Move Down dd:mm:ss" (degrees, arcminutes and arcseconds) and "Move Right dd:mm:ss". This tells you how far you will need to lower the polar axis in altitude, and rotate the polar axis in azimuth. In the case of the window above, the polar axis should be lowered 22 arcminutes and 53 arcseconds, and moved to the right 6 arcminutes and 51 arcseconds.

17. To move the polar axis in azimuth, loosen the six azimuth locking knobs shown in Figure 26 below. Assuming the polar axis needs to be moved to the right, first loosen the azimuth adjustment knob on the left, then tighten the Azimuth Adjustment Knob on the right.

    NOTE 1: For the Azimuth Adjustment Knob: 1 turn = 0.4 degrees (24 arcminutes).

    NOTE 2: For a Mathis mount, please see the included mount manual for this information.

    In the example above, the polar alignment needs to be adjusted by 6 arcminutes and 51 arcseconds. That is the same as 6.85 arcminutes. See Appendix D for the conversion equation.

    To calculate how much to turn the azimuth adjustment knobs, take the polar misalignment in arcminutes and divide it by 24. This will give you the number of turns. In our example,

    6.85/24 = .28 turns, or just over a ¼ turn. We would loosen the azimuth adjustment knob on the left by at least 1/4 turn, tighten the azimuth adjustment knob on the right by 1/4 turn (which rotates the entire mount in azimuth), and then tighten the left knob.

    Once the azimuth has been adjusted, tighten the six azimuth lock knobs.

    To move the polar axis in altitude, first loosen the Altitude Lock knobs. In our example, the polar axis needs move down 22 arcminutes and 53 arcseconds, or 22.88 arcminutes. (See Appendix D)

    NOTE: For the Altitude Adjustment Knob: 1 turn = 1/2 degree (30 arcminutes)

    To calculate how many turns to move the Altitude Adjustment Knobs, take the polar misalignment in arcminutes and divide it by 30. This will give you the number of turns. In our example,

    22.88/30 = 0.95 turns, or just about 1 full turn.

    Once the altitude has been adjusted, tighten the Altitude Lock knobs.
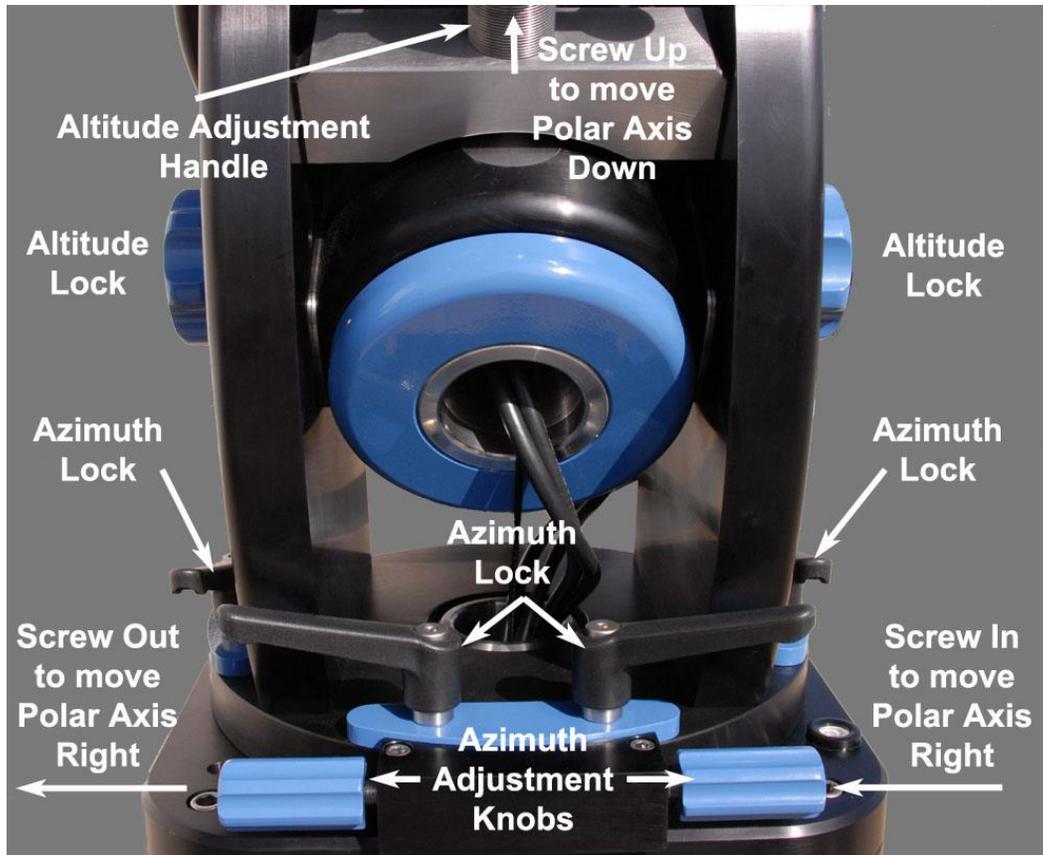
Figure 26 - Polar alignment adjustment components

Your mount should now be much closer to proper polar alignment. A new mount model should be created, as described in the next section. If the new mount model still indicates a significant polar misalignment, repeat these steps until the alignment error is under about 10 arcminutes in each axis. The best you can expect to do with reasonable effort is about 1 arcminute of alignment error in each axis. The PointXP model will be able to compensate for any residual misalignment.

Mount Model

A mount model is a very accurate way of aligning the telescope to the sky. It improves both the pointing and the tracking of the telescope system. It does this by comparing a series of mount positions against positions on the sky, measured by either performing a PlateSolve or manually centering a star in the telescope. The model has several different correction variables, and these variables are fit against the measured position errors to minimize the RMS error and improve telescope pointing. A reasonable model should contain 16-40 points distributed across the sky. However, the mount should begin pointing reasonably well after just 4 or 5 points.

Once a mount model is created, it can be saved and reused each time the telescope is powered on and homed. The model should remain valid until some physical alignment of the mount, telescope, or imaging system changes.

When the mount is first powered on, it is "lost" and needs to be calibrated against some known reference position. There are three common ways of initializing the mount:

1. **"Homing" the mount.** This instructs the mount to slew to a position where a set of "home switches" are triggered. These switches are located at a known position, and can be used to initialize the coordinate system of the mount.

2. **"Parking" and "Unparking" the mount.** When the mount is in a known position, "Parking" the telescope will cause it to slew to a predefined position and then stop all motion. The mount can then be turned off, and turned back on at a later time. When the mount is "Unparked", the control system assumes that the mount is still positioned at the same point as when it was parked, and initializes the coordinate system using that information. (**Note**: If the mount has been moved, e.g. by loosening and tightening the clutch knobs, since the last Park, the mount will not be correctly positioned for an Unpark and must be initialized using one of the other methods.)

3. **Calibrating to a sky position using Offset Init.** At startup, the mount is manually positioned to some reference point in the sky, such as a bright star. When the star is centered, an "Offset Init" is performed, which initializes the mount's coordinate system so that its current position corresponds to the current position of the target star. This is also known as "syncing" the mount.

The procedure for saving and associating a pointing model for each of these initialization techniques will be described below.

Things That May Invalidate the Mount Model

- Changing the collimation of the telescope

- Changing from a camera to an eyepiece with a diagonal, where the diagonal is not perfectly at 45 degrees.

- Changing telescopes – if you change telescopes, or remove and reinstall your existing telescope from the mount, you may need to create a new model

- Adding or removing significant weight from the telescope.

All of these changes will affect the mount model, although in some cases the effect may be small enough to ignore. To evaluate how well the telescope is pointing, try slewing to a few bright stars. For each bright star, take an image and measure how close to the center of the CCD the star is positioned. If the pointing accuracy is negatively impacted enough, you can create another mount model. You can even have multiple mount models, one for each equipment setup if you need it. Contact PlaneWave Instruments for details on how to do this.

Creating a Mount Model

1. Open STI, if it is not already running.

2. Open Maxim DL and connect to your CCD camera. If you have a filter wheel, select the "brightest" filter -- that is, the filter that allows the most light through (typically Luminance, Clear, or Empty).

3. Select the Chart menu from the list of options on the top of the STI window. Select "Show Sky Chart". This will open the sky chart window.
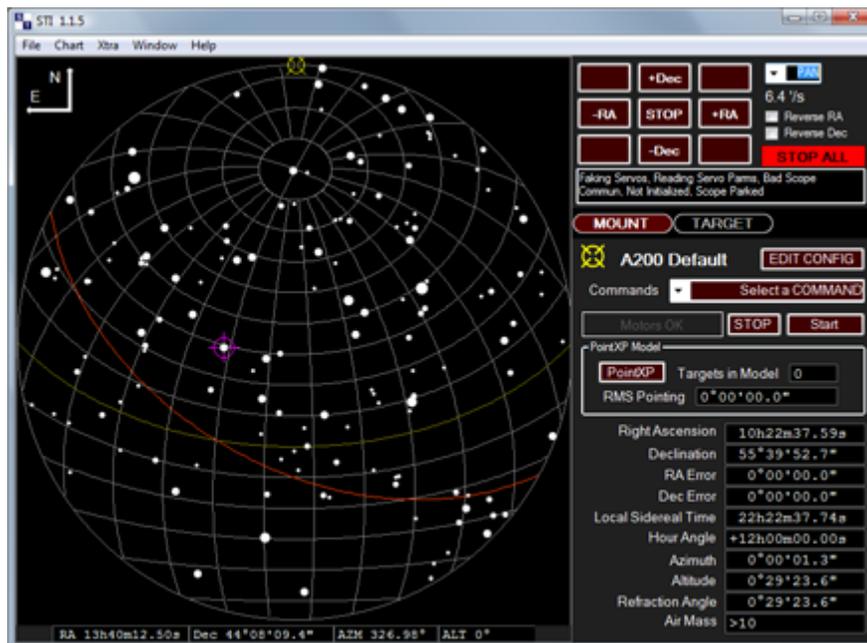
4. Click on the "Commands" menu and select "Home". The Homing Operations Window will open. Press the "Initialize Scope Using Homing Switches" button. The telescope will slew to its home position. For the A200, this corresponds to the orientation in which the counterweight bar is pointed down and the telescope is pointed at the celestial pole.
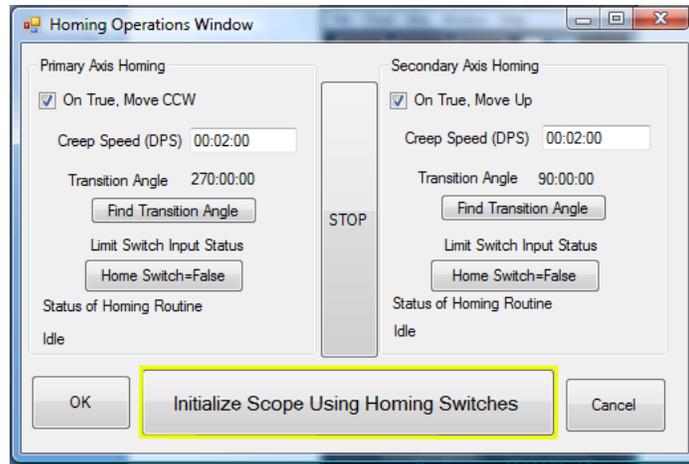
5. Clear the old PointXP model by clicking the PointXP button, clicking "Clear Terms and Cal Stars", and then clicking OK.

6. From the Commands menu, select Run Script.
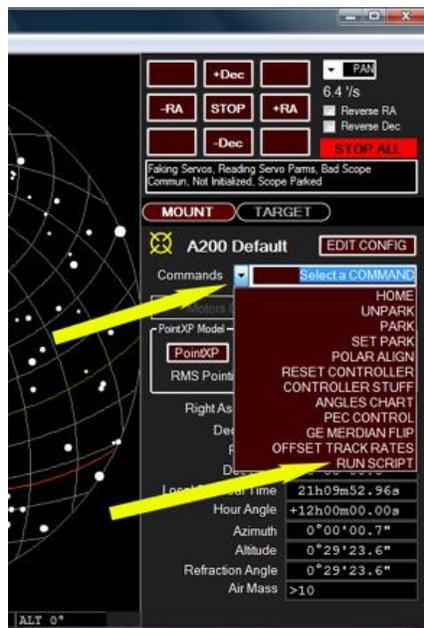
7. The Script window will open as seen below. The three arrows point to the most important settings for doing an automapping run. Since this is going to be the main model for the telescope, set the number of stars to be somewhere between 16 and 40. More points will take longer to acquire, but should result in a more representative mount mode. Set the exposure time so that a typical image will result in at least 10 good star detections in an image. A binning value of 2 is normally OK, but if your stars are undersampled (smaller than 2x2 pixels in the resulting images), change this to 1.
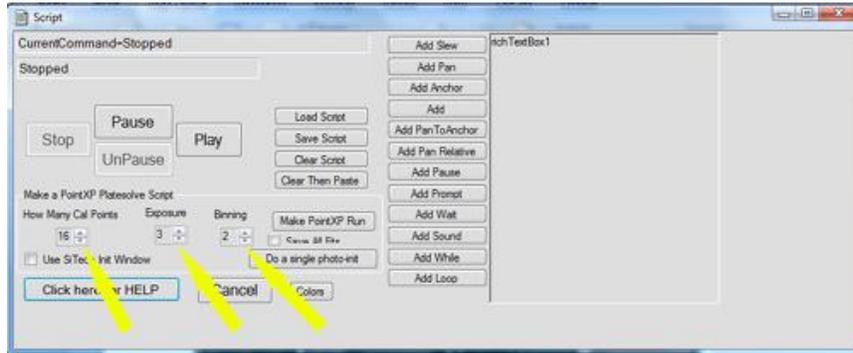
8. Press the "Make PointXP Run" button. This will open a new program called CalPointsXP which will select the optimum positions for the calibration points. You may close the CalPointsXP window immediately.
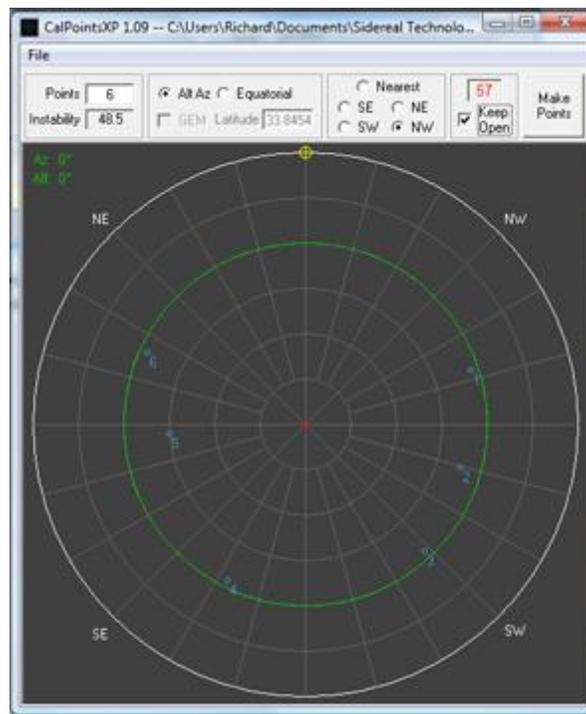
9. An automapping script will be generated in the scripting window, as shown below.

10. Press the PLAY button in the Script window. This will run the script and start the auto mapping run. The PointXP script will cause the telescope to slew to the first calibration point position, take an image, plate solve the image (accurately determine the position of the telescope by comparing the stars in the image to a known star catalog), and add the position information to the mount model.

The window that pops up is the PlateSolveXP window. The "Status" section will show the progress of the plate matching process, which involves loading the image, identifying ("extracting") stars in the image, and searching in a star catalog around the region of the mount's reported coordinates to find a match. PlateSolveXP will search up to 999 regions in an expanding spiral pattern before giving up. Once you have a few points in your pointing model, you should typically get a match after searching fewer than 50 regions. If you want to abort a search on a poor-quality image, click "Stop Search", and STI will proceed to the next calibration point.


11. After the mount model is complete, press the PointXP button on STI and the PointXP window will pop up. You may inspect the model, and reject points that appear to be erroneous.

12. Now that you have a complete mount model, you must calibrate the positions of the home switches using the model information. You must do this one axis at a time. Under Commands list, select HOME. This will open the HOME dialog box as seen below.
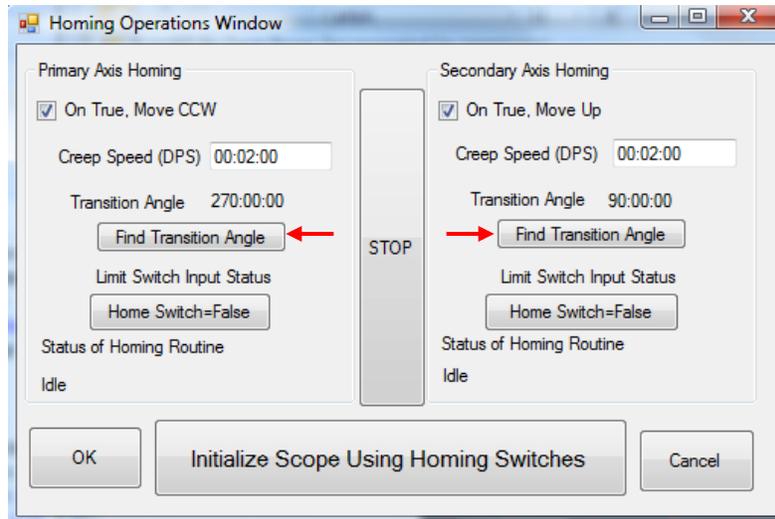
13. Notice that there are two Find Transition Angle buttons on the dialog box, one for the Primary Axis (RA) and one for the Secondary Axis (DEC). Press the Find Transition Angle button for the Secondary Axis first. For the A200, the mount will slew in declination until the telescope is pointed at the pole. A new number for the Transition Angle will be displayed that is close to, but not exactly, 90 degrees. After the Secondary Axis has been calibrated, press the Find Transition Angle for the Primary Axis. For the A200, the mount will slew in right ascension until the counterweight bar is pointed down. When it is complete, the transition angle should be close to, but not exactly, 270 degrees.

14. Press the OK button. This will save the PointXP file as HomePointXP.PXP for future use, and will also save the new home switch transition angles. **Do not click cancel or simply close the Homing Operations window, or this information will be lost and you will need to build a new pointing model!**

15. If desired, set a park position. Slew the telescope manually with the hand pad or the buttons on STI until the telescope is at the desired park position. For roll-off observatories, this usually involves pointing the telescope in a horizontal position so as to clear the roll off roof.

16. Once the telescope is at the desired park position, hit the STOP button to turn off tracking. Then from the Commands menu, select SET PARK. Once this is done, open the Commands menu and select PARK. This writes the current mount model to a file called ParkPointXP.PXP for future use.
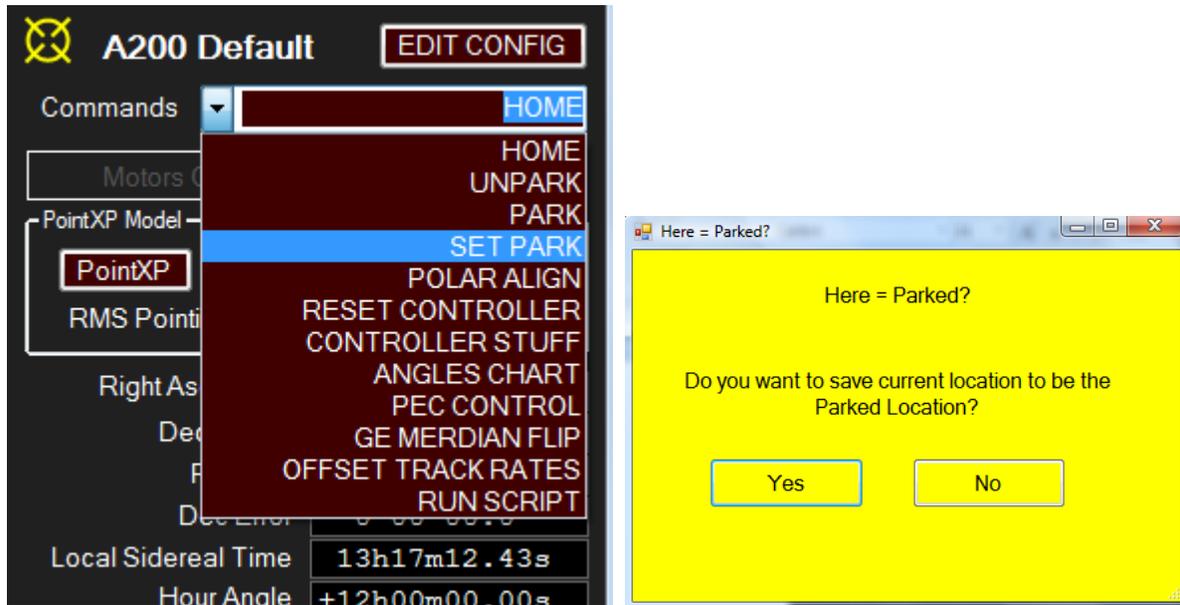
Using the Telescope After Creating a Mount Model

Startup and shutdown of the Mount

Once you have polar aligned and built a PointXP model for the mount, it is ready for general use. Normally the telescope will be used in the evening and shut off during the day. This section talks about how to start up and shut down the mount.

There are three ways to get up and running with an existing mount model. First, if you PARKed the telescope the last time you shut down the mount, you can UNPARK the telescope to retrieve its previous position. Once the mount has been unparked, the "Park" PointXP model will be loaded and the telescope will be ready to slew.

Another method to start up is to initialize the telescope using is home sensors. This assumes that you calibrated the home sensors the last time you build a pointing model. If you open the Commands menu and select the HOME option, the mount will move to its home position, initialize the coordinate system based on the calibrated home switch angles, and load the "Home" PointXP model.

The third option is to recall a previously saved mount model and then perform a Simple Offset Init (also called a "sync") on a reference star.

At the end of an observing session, you can PARK the mount, which will slew the telescope to the position you previously set as the PARK position, and turn off tracking. You can also simply turn off power to the mount, although if you do this you MUST home the mount the next time you turn it on. (You cannot use the UNPARK procedure). Finally, you can simply stop tracking and leave the mount powered on until your next observing session.

Control via external software

The STI control software manages the basic operation of the mount. However, STI does not have an extensive database of interesting targets in the sky beyond some bright stars and Messier objects. It also does not manage extended observing sessions for you. To support these operations, STI may be controlled from other programs using its ASCOM interface. It is very common to operate STI via another program, such as TheSky (see Appendix G), ACP, or CCDAutoPilot.

Autoguiding

Autoguiding is the process of taking repeated images of a guide star, detecting any drift or positioning error on that star, and sending a correction offset to the mount to put the star back at the desired position.

There are two different ways to send these offset signals. One way is called "relay guiding". This is where the guide camera is connected to the motor control box and as the guide star drifts, the CCD camera sends electrical guide signals to the motor control box. In a sense, the guide camera is pressing virtual handpaddle buttons to nudge the mount's position slightly. There is a port labeled "Autoguider" on the motor control box for this use. However, relay guiding bypasses the axis encoders on the A200 and therefore does not produce a highly accurate offset. **Relay guiding is not recommended for the A200 mount or any other mount with high resolution encoders**.

The recommended method of autoguiding for the A200 is called "pulse guiding", also known as "ASCOM guiding". In this method, as the guide star drifts on the guide camera, the camera control software (for example, MaxIm DL)

notes this movement and sends ASCOM commands to STI in order to make the appropriate corrections. Pulse guiding is beneficial because it doesn't use any additional cables and it uses feedback from the high resolution axis encoders to produce extremely accurate offsets.

To set up pulse guiding with MaxIm DL version 5:

1. From the "View" menu, open the "Observatory Control Window

2. In the "Observatory" window, under the "Setup" tab in the "Telescope" section, open the "Options" menu and select "Choose..."
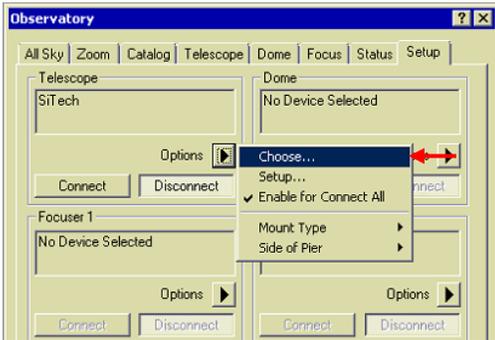
3. In the "ASCOM Telescope Chooser" window, select "SiTech" or "PlaneWave STI" and click "OK".
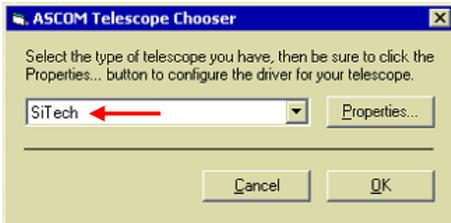
4. In the "Observatory" window under the "Telescope" section, click "Connect"

5. In the main MaxIm DL window, open the "View" menu and select "Camera Control Window"

6. In the "Camera Control" window, select the "Guide" tab and click "Settings"
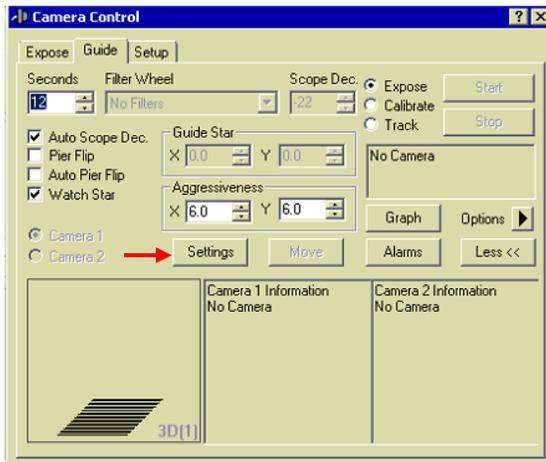
7. In the "Guider Settings" window under "Autoguider Output", pull down the "Control Via" menu and select "Telescope". Click "OK".
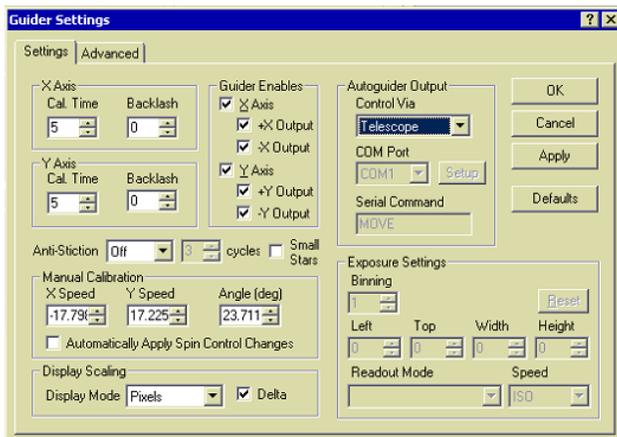
MaxIm will now send all guide commands via ASCOM to the configured Telescope device -- in this case, STI.

Appendix A – Dimensions

Type: Observatory class German Equatorial Mount
Weight: 240 lbs (*108.9 kg*)
Component Weights: Base 50 lbs, RA 76 lbs, Dec 96 lbs, Count Weight Shaft 18 lbs
Max. Load Capacity: 275 lbs (*124.7 kg*)
Latitude Range: 0 to 90 degrees, Northern and Southern hemispheres
Tracking and Slewing Range: 22.5 degrees past meridian, East and West
Finish: Anodized aluminum with touches of powder-coated aluminum and stainless steel complements

Appendix B – Notes on the high resolution axis encoders

The A200HR has built in high resolution encoders that are directly coupled to each axis. The encoders are located directly underneath RA axis gear and the DEC axis gear. They are couple directly to the RA and DEC shafts so the encoders always record the movement of the telescope whether the clutches are engaged or not, or even if the clutches slip.

The high resolution encoders are used to position the telescope, and as a feedback mechanism for high-precision tracking. The mount has anywhere from 5 to 10 arcseconds of peak-to-valley periodic error due to the worm gear and gear train. However, the axis encoders detect and remove any deviation from the desired position at about 20 cycles per second, essentially removing effects such as periodic error, belt slack, backlash, and other motor drive imperfections. The RMS tracking error during calm conditions is typically 0.14 to 0.25 arcseconds.

If you notice RMS tracking errors consistently above 0.25 arcseconds and cannot attribute this to external factors such as wind, then the telescope balance or gear train may need to be adjusted.

The behavior of a telescope system is dictated by numerous variables, and many tradeoffs must be balanced. As an example, a very strongly preloaded worm will make the system more stiff and reduce undesired motion. However, this creates more friction during slewing and normal tracking motion, causing the RMS tracking error to increase. For the smoothest possible tracking, the worms need a weaker spring force preload.

The correct preload setting must balance mount stiffness and tracking smoothness. The spring tension of the worms may be adjusted if needed. The covers will need to be removed in order to access the preload spring.

Encoder Adjustment

The high resolution encoders are very precise measuring devices. The spacing of the encoder read head relative to the encoder disk is critical, and there is a low tolerance for error. The ideal spacing between the read head and the disk is .8mm, with a tolerance of +/-0.1mm. This means that the read head must be positioned within a window of about .008" or 200um. The mount is made from aluminum and the encoder disk is made of stainless steel, so over large temperature swings there is differential expansion/contraction. It is possible that the read head is installed close to the edge of the tolerance zone, in which case a large temperature change could degrade the signal quality. If you suspect the encoder is having problems, you can remove the two set screws on the side of the gear housing. Figure 27 shows the location of these screws on the RA axis. With these set screws removed you can see the encoder status LED. The indicator light will either be green, yellow or red. If the light is yellow or red, then there is a spacing problem.
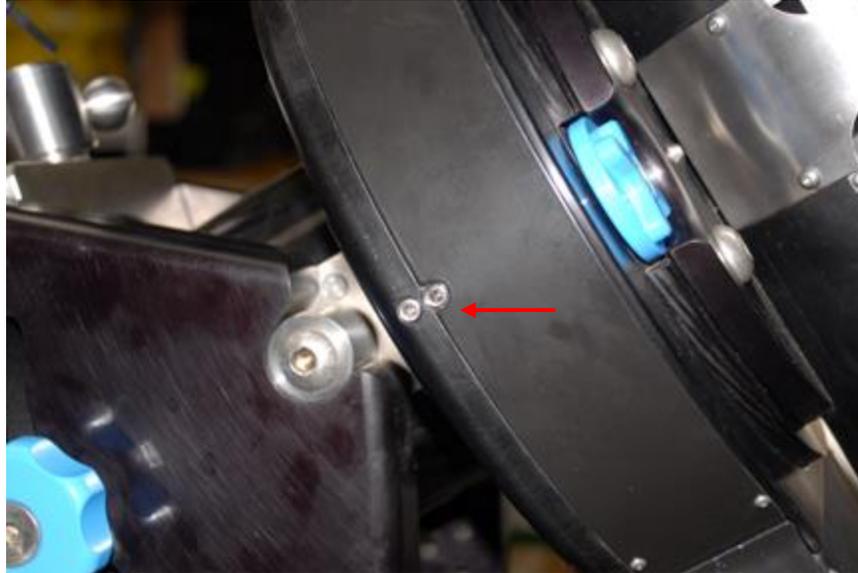
Figure 27 Two set screws for adjusting the read head position and viewing the encoder signal strength LED. Green indicates a strong signal, Orange indicates a weak signal, and Red indicates no signal.

On the underside of each gear housing cover is a panel that can be removed. This panel houses the high resolution encoder read head. If there needs to be adjustment, it can be done by removing this panel. Please contact PlaneWave Instruments for instructions on adjusting the read head.

## Appendix C – Running Cables Through the Mount

The A200 mount is designed to allow cables to easily run through the mount. At minimum, the two cables for the Declination motor and encoder/home switch should run through the mount. In addition, it is very convenient to run cables for CCD cameras, the EFA kit, and other accessories so that there are no dangling cables that can tangle during operation. It may also be convenient to run an AC extension cable through the mount in order to power cameras, filter wheels, the focus motor, and other accessories.

The first step in cabling any A200 mount is to run the Declination motor/sensor cables:

1. Remove the cover that is indicated in Figure 28

2. Run one pair of yellow-tipped cables (one with 4 pins, one with 8 pins) down through the front of the RA axis as shown in Figure 29.

3. Run the pair of cables up along the upper cable channel on either side of the mount, and screw the cables into the plugs on the underside of the Declination gear housing.

4. Use the upper channel retaining clips (similar to those indicated in Figure 30) to hold the cables in place. See Figure 28 for a complete example of the Declination motor/sensor cable routing.
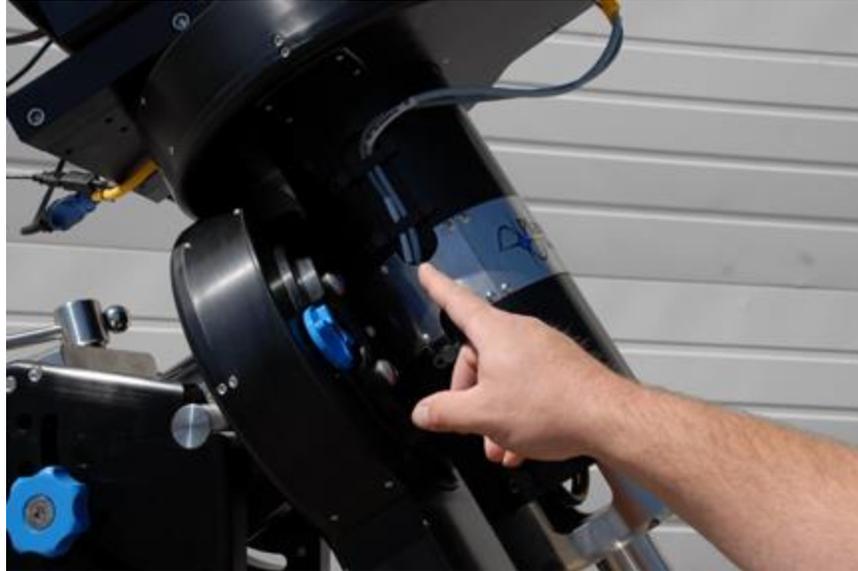
Figure 28 - This access panel should be removed to run cables down the RA axis.
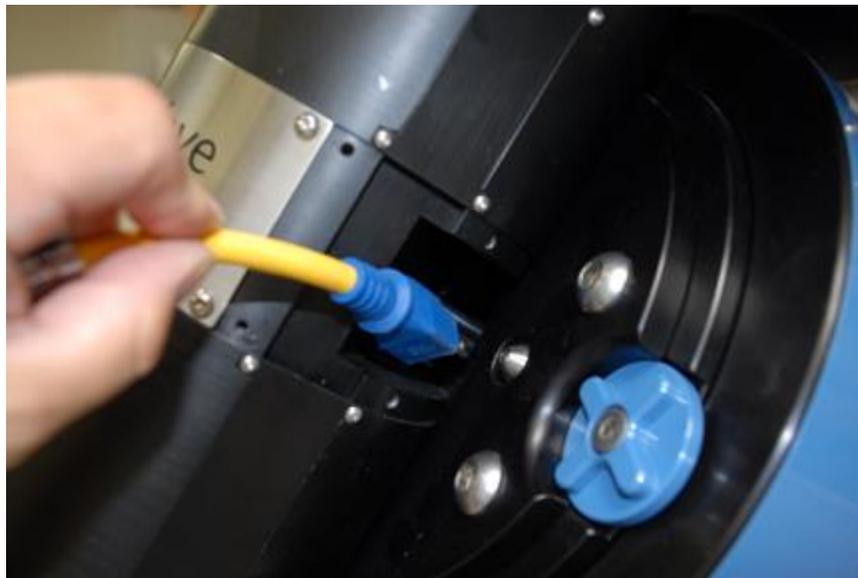
Figure 29 - Running a cable down from the top of the RA axis

Figure 30 - Cable channel retaining clips

To run cables from the back of the telescope through the mount:

1. Remove the telescope and dovetail plate. (Optional in some configurations. The larger CDK telescopes include dovetail plates with slotted holes that cables may run through.)

2. Find the end of the cable that will be connected at the "pier" end of the observatory -- for example, the male end of a 3-prong AC extension cable

3. Drop the cable through the hole at the top of the DEC axis, and look for it to drop out of the bottom of the axis (near the counterweight bar mounting point).

4. Pull the cable out from the side of the DEC axis, run it up along one of the lower cable channels, and drop it down through the top of the RA axis, as shown in Figure 31.

5. Push the cable through the top of the RA axis until it comes out the back of the mount.

When all cables have been run:

1. Secure the cables using the retaining clips shown in Figure 30

2. Replace the side plate shown in Figure 28.

3. Replace the dovetail plate and telescope if they had originally been removed. Note the cable channel between the DEC hub and the dovetail plate. Cables should be run to the back of the telescope via this channel.

Figure 32 shows a fully assembled telescope, with cables running through the mount.

Figure 31 - A cable coming out the bottom of the DEC axis and routed through the top of the RA axis

Figure 32 - Cables running through a fully assembled mount

Appendix D – Converting sexagesimal to degrees and arcminutes

Angles in astronomy are commonly represented in sexagesimal units, which divides an angle into degrees, arcminutes, and arcseconds:

DD:MM:SS

where an arcminute is 1/60 of a degree, and an arcsecond is 1/60 of an arcminute.

For example, a declination of:

12:30:00

represents an angle of 12 degrees, 30 arcminutes, and 00 arcminutes, or 12.5 decimal degrees.

To convert a sexagesimal value DD:MM:SS to degrees, calculate the following:

Degrees = DD + MM/60 + SS/3600

As an example, the declination is Vega is 38:47:01. This converts to 38 + 47/60 + 1/3600 = 38.78361 degrees.

To convert a value in degrees to a value in arcminutes, simply multiply the value in decimal degrees by 60. As an example, a polar alignment offset of 00:05:34 is equal to 0 + 5/60 + 34/3600 = 0.0927 degrees, or 0.0927*60 = 5.566 arcminutes.

Appendix E – Glossary of Terms

- **Cone (or Cone Error)**: Cone is the angular error which measures the non-perpendicularity between the optical axis and the DEC axis / Alt axis. If you had a telescope that had zero cone error and you could induce the error by adding a shim to the front of your dovetail plate, tilting the telescope up slightly. The term "cone" comes from the notion that in a telescope with cone error, the optical axis will trace out a cone shape (rather than a perfect plane) as you rotate 360 degrees in declination.

- **Hub:** Hub is the angular error which measures the non-perpendicularity between the RA and Dec axes, or Azimuth and Altitude for an Alt/Az mount.

- **Offset Init or Offset Initialization**: This defines the mount's position for one point in the sky. If you point to a star in the sky and do an Offset initialization, then the telescope's relative position is defined as the position of that star. This is usually done prior to creating a mount model. The term "Sync" is also commonly used in telescope control software to denote this concept.

- **PlateSolve:** Taking an image of a star field and matching against a known database of stars, thereby defining the true center of the telescope field very accurately. This is useful when creating a telescope mount model as it yields a very accurate pointing position of the telescope + mount system.

- **Polar Alignment:** Equatorial mounts, like the Ascension 200, have two orthogonal axes of motion. One axis is called the Right Ascension axis, or RA. If the RA axis is parallel to the Earth's axis of rotation, then the mount is said to be polar aligned. The advantage of an equatorial mount is that in order to cancel out the rotation of the Earth, the RA axis simply needs to move at a constant rate of 1 rotation every 24 hours (approximately).

- **Mount Model:** A mathematical algorithm that corrects the positioning of a telescope mount for repeatable mechanical, positional, and atmospheric errors. Mechanical errors include flexure, non-perpendicularity of the RA and DEC axes, and non-perpendicularity of the optical axis to the DEC axis. Positional errors include polar misalignment, not being perfectly level, and not having the position of the telescope on Earth perfectly configured. Atmospheric errors include refraction as you change your altitude. By using 16 to 40 modeling points, the mount model algorithm can correct for these errors to improve the pointing and tracking of the telescope.

- **RMS:** Root mean square, a way of characterizing a whole group of data and measuring how far the data as a whole deviates from the average or ideal value. In a telescope system it is generally used as a measurement of error. For example, RMS tracking error describes how much a telescope deviates from perfectly following a moving star, and RMS pointing error describes how well a telescope mount can be expected to center a target after a slew.

Appendix F - Power Requirements

The A200 runs off of 24VDC and requires around 5 amps to run. But it is nice to have a 9 to 10 amp power supply to account for the momentary higher currents being needed. We supply at 100VAC to 240VAC that uses 4 amps and outputs 24VDC, 9.2 amps.

Appendix G - Controlling the mount with TheSky 6 or TheSkyX

The STI control software includes an ASCOM driver which allows third party programs to control the mount. One popular choice for controlling telescopes is to use TheSky, a software package developed by Software Bisque. Recent versions of TheSkyX can communicate with ASCOM mounts without the need for any additional plug-ins. TheSky6 requires an extra plug-in that will allow it to connect to an ASCOM mount driver.

The mount must be plugged in, turned on, and communicating with a properly configured instance of STI before continuing. If you have not done so already, please continue setting up the mount before completing the integration with TheSky.

Connecting to STI from TheSkyX

1. Make sure you are running TheSkyX version 10.2.0 **Build 7773 or later**. (Versions as far back as Build 6949 may work, but have not been tested by PlaneWave Instruments.)

As of October 2014, Software Bisque makes a distinction between "official" releases and Daily Builds. The latest official release as of this writing is 10.2.0 Build 6409, which does **NOT** include build-in support for ASCOM mounts. Even if you use the "Check for Updates" feature under the Help menu when using Build 6409, the software will not report that a new version is available. You must download and install the latest **Daily Build** of TheSkyX from the Software Bisque website in order to use an ASCOM mount driver.
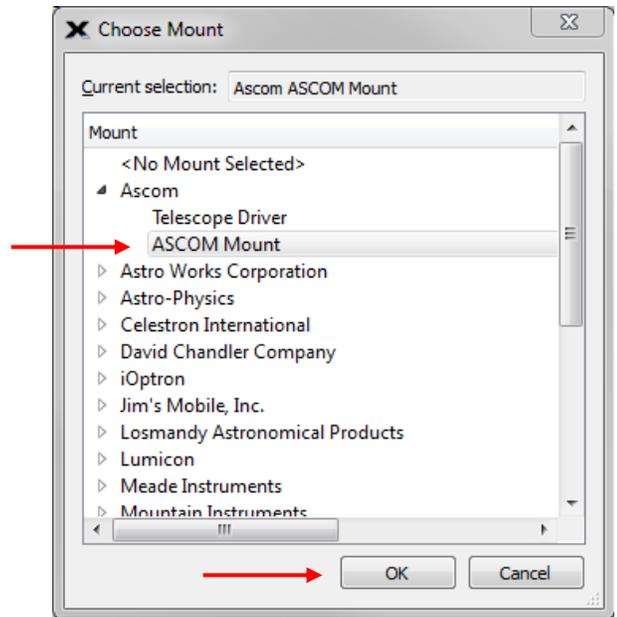

2. Launch TheSkyX

3. Go to the "Telescope" menu and select "Telescope Setup..." to bring up the Imaging System Setup window.

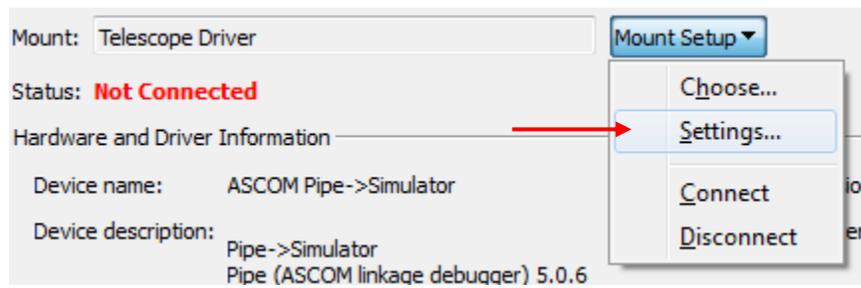4. Click the "Mount Setup" menu and select "Choose..."
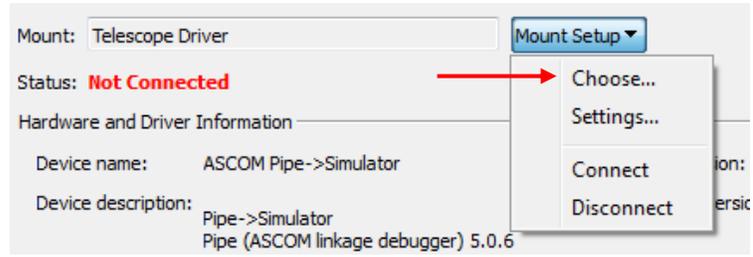
5. Expand the "ASCOM" category, select "ASCOM Mount", and click "OK".
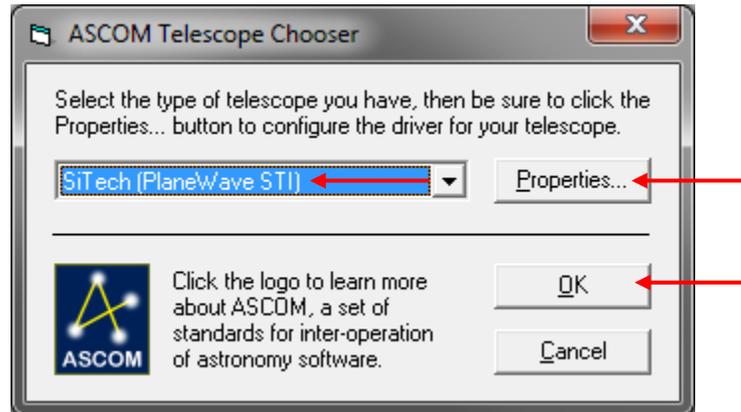

If you do not see "ASCOM Mount" listed, you may need to update to the latest Daily Build of TheSkyX.

6. Click the "Mount Setup" menu and select "Settings...".

7. In the ASCOM Telescope Chooser window, select "SiTech (PlaneWave STI)" and click "OK". If "OK" is disabled, click "Properties" first, close the configuration window that comes up, and then click "OK".

8. Click the "Mount setup" menu and select "Connect" to test the connection to the mount.

Connecting to STI from TheSky6

1. Install "TheSky ASCOM Telescope (TeleAPI) Plug-In for TheSky 5/6", available on the ASCOM Plug-Ins website:

   http://www.ascom-standards.org/Downloads/Plugins.htm

   The latest version of this plug-in as of this writing (5.0.4) has been included on the USB disk that comes with the A200 mount, under the name "TheSky6 ASCOM Plugin 5.0.4".

2. Open TheSky6

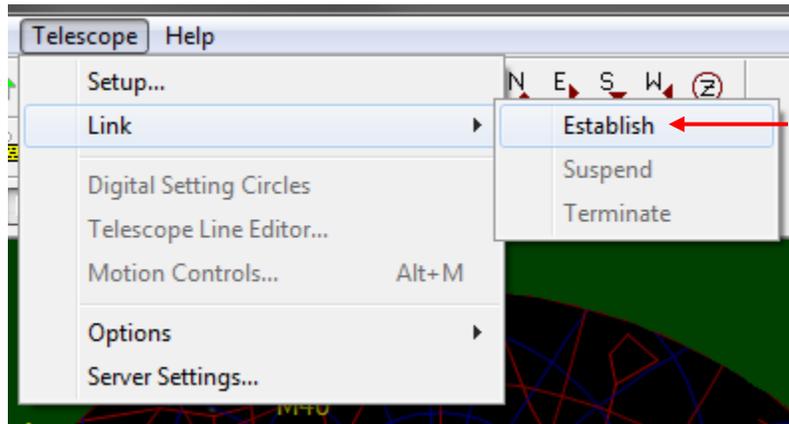3. Click the "Telescope" menu and select "Setup..."
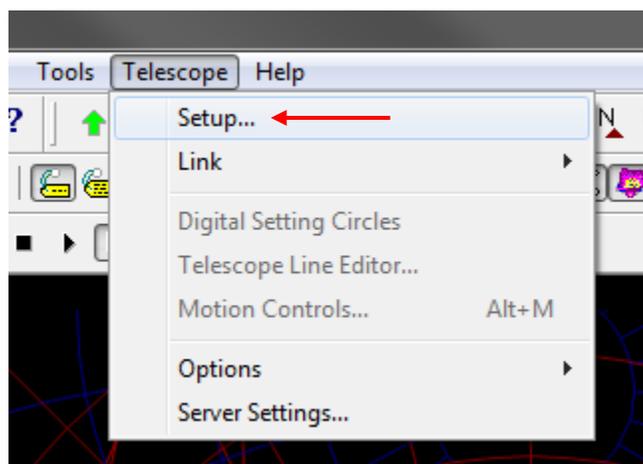
4. Select "Telescope API" from the menu of available telescope drivers, and click the "Settings..." button
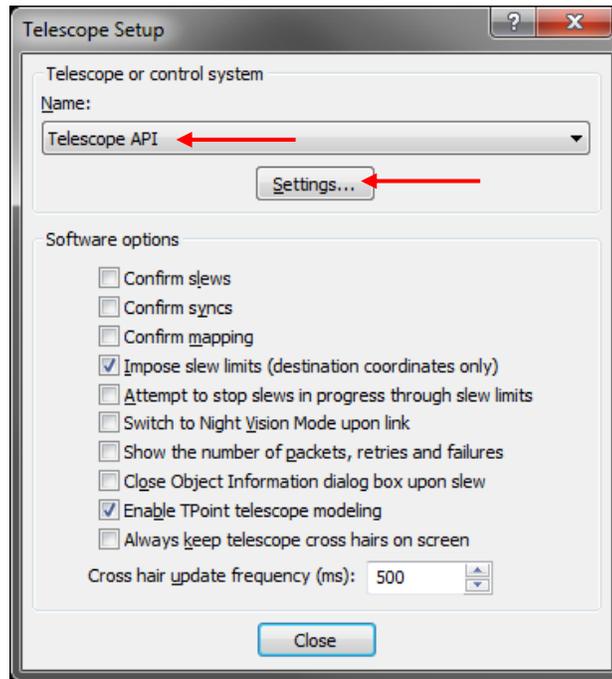
5. In the ASCOM Telescope Chooser window, select "SiTech (PlaneWave STI)" and click OK

6. Try to connect to the mount by clicking the "Telescope" menu, opening the "Link" sub-menu, and clicking "Establish".

Please note that you can check for software updates on the PlaneWave website, http://planewave.com

Appendix H - Configuring the A200 for setup in the Southern Hemisphere

If your observatory is located south of the equator, some additional steps are necessary in order to install and configure your telescope correctly.

First: when physically installing your telescope the polar axis should be oriented towards the South celestial pole rather than the North celestial pole. Once this is done, the following steps will allow you to configure your mount's control system and software for operation in the Southern Hemisphere.

Configuring the SiTech controller

If the mount was specified as being installed in the Southern hemisphere when it was ordered, the SiTech controller may already be configured properly. Check with PlaneWave Instruments to confirm.

If you need to reconfigure the SiTech controller for southern hemisphere operation:

1. Make sure the STI application is closed.
2. Open ServoConfig (available via the Start Menu)
3. Click "Setup Comm Port" and select the correct port for your mount
4. Click "Edit Parameter"
5. Click "Get Data From Controller"
6. Flip the "Invert Motor Encoder Direction" checkbox on both axes
7. Flip the "Invert Motor Direction" checkbox on both axes
8. Flip the "Invert Scope Encoder" checkbox on both axes
9. Switch to the "Misc and Action" tab
10. Click "Send Configuration to Controller"

11. Click "Save This Configuration to File", and name the file whatever you want
12. Click "OK" to get back to the main ServoConfig screen
13. Click "Reset" on the ServoConfig screen
14. Verify the axis directions using the ServoConfig "Hand Pad" buttons:
15. Click "RIGHT", followed shortly after by "All-Stop" and note the motion of the telescope
16. The RA axis should move counter-clockwise if viewed from the south celestial pole. For example, if the telescope was initially pointed at the zenith, it should now be pointed west of the meridian.
17. The "Azimuth/RA Motor Encoder Location" number should increase
18. The "Azimuth/RA Scope Encoder Location" number should increase
19. Click "UP", followed shortly after by "All-Stop"
20. The telescope should move counter-clockwise if viewed from above. For example, if the telescope was pointing at the western horizon, it would start moving towards the south celestial pole.
21. The "Altitude/Dec Motor Encoder Location" number should increase
22. The "Altitude/Dec Scope Encoder Location" number should increase
23. Close ServoConfig

Configuring STI

There are a few settings in the STI application that need to be modified in order to operate correctly in the Southern hemisphere. If you are configuring STI for the first time, the easiest way to get started is to simply copy a Southern Hemisphere version of the configuration file to the correct directory:

1. Download the sample configuration file from:
   http://planewave.com/downloads/get/143
2. Copy SiTech.cfg to the folder:
   Documents\Sidereal Technology\STI\
   If you wish to preserve the old configuration file, make a copy before overwriting it with the new configuration.
3. Launch STI
4. Open the "EDIT CONFIG" window and make any necessary changes. For example, enter the correct latitude and longitude, camera field of view information, etc.

If you wish to preserve your existing configuration, or you run into problems and want to perform the necessary modifications by hand:

1. Close STI if it is running
2. Open "Documents\Sidereal Technology\STI\SiTech.cfg" in Notepad
   a. Change "SecHomePosition" from 90 to 270
   b. PrimHomePosition should also be 270
3. Open STI again
4. In the STI window:
   a. Click "EDIT CONFIG"
   b. Set Longitude and Latitude, being sure to select "South" for latitude
   c. Bring up the HOME window
   d. Click "Init Scope Using Home Switches". Both axes should move towards the home position (counterweights down, telescope pointed towards celestial pole)
   e. If either axis moves in the wrong direction, STOP motion, UNcheck "On True, Move CCW" and/or "On True, Move Up" for whichever axis moved incorrectly, and try again

f. When homing is finished, the yellow crosshairs on the STI sky viewer should be pointed at the south celestial pole
    i. Declination should read close to -90
    ii. Hour Angle should read close to -12
g. Click OK to dismiss the home window. This will save values such as the "On True" checkboxes. **DO NOT X OR CANCEL OUT OF THE WINDOW OR THESE SETTINGS WILL NOT SAVE PROPERLY.**
h. Slew to a star and make sure that pointing is reasonably accurate. For example, if you slew to a star in the southeast, make sure that the telescope is actually pointed to the southeast.

Appendix I - Using the RS-232 Port on the SiTech Controller

The telescope control computer normally connects to the SiTech mount controller via USB. In some cases it may be preferable to connect via a native serial port instead. The SiTech controller includes an RS232 port that can be used for this purpose. A special cable is used to convert from the 4P4C connector on the controller to the DB9 connector commonly used with serial ports. The wiring for this cable is shown below.
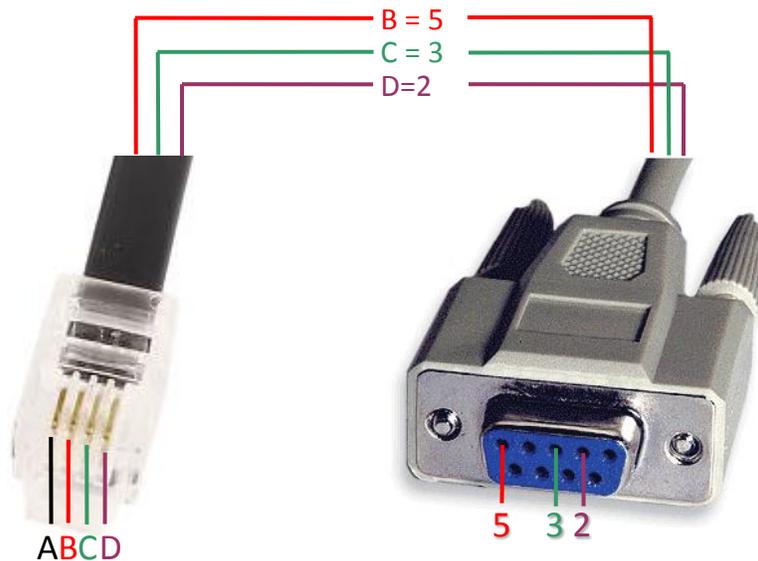

Only one communication port on the controller (USB or RS232) can be enabled at any given time. To disable the USB port and enable the RS232 port:

1. Unscrew the 8 small button-head screws around the perimeter of the controller, identified in the image below.

2. Locate the jumper labeled **JP1** along the bottom edge of the controller board. When the jumper is OFF (sitting on one pin), the USB port is enabled. When the jumper is ON (bridging both pins), the RS232 port is enabled.
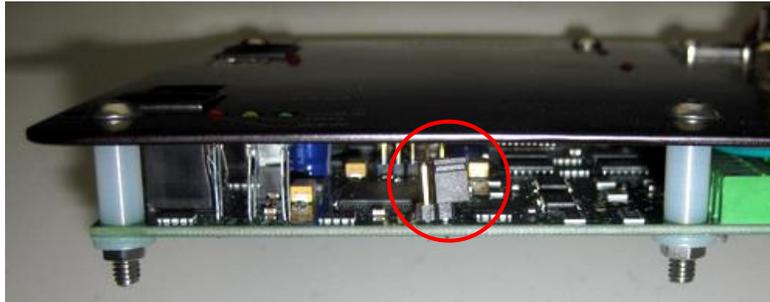
3. Using a pair of needle nose pliers, remove the jumper and re-seat it so that it is bridging both pins.
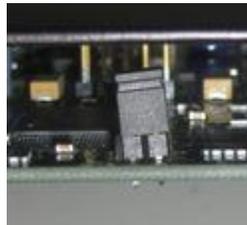
4. Re-assemble the SiTech controller case.