# Paramount ME
# User's Guide

### Revision 1.79

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# Table of Contents

# The Paramount ME Robotic Telescope System

Thank you for purchasing the Paramount ME Robotic Telescope System. The Paramount ME is an ultra-precision German equatorial mount that is designed to deliver unmatched performance to the amateur or professional astronomer.

This document covers the basic setup and use of the Paramount ME. It assumes that you are familiar with many fundamental concepts in astronomy and are somewhat experienced using a telescope and or CCD camera in conjunction with a personal computer. If a concept presented here is new to you, consider using a search engine on the Internet to find out more information about the topic. Unfortunately, there's simply no way that all the different facets of setting up and controlling a robotic telescope mount can be covered in a single document.

## What Makes the Paramount ME So Different?

The Paramount ME is designed from the ground up to be a rock solid, reliable mount for instrument payloads up to 68 kg (150 lbs.). The following features ensure that you'll enjoy increased productivity and superior results from your observing efforts.

- Research-grade right ascension gears with seven (7) arcseconds or less peak-to-peak periodic error, before applying periodic error correction (PEC).
- Integration with TheSky6 Professional Edition Astronomy Software to control the mount locally, remotely, or via scripted operation.
- CCDSoft CCD Astronomy Software for controlling CCD cameras, adaptive optics, focusers, and filter wheels, as well as performing image processing, data reduction and research.
- CCDSoft's DirectGuide™ feature eliminates the need for an autoguider cable on the Paramount ME.
- TPoint Telescope Pointing Analysis software with ProTrack™ provides unmatched pointing and unguided, or autoguided, tracking performance.
- Orchestrate™ scripting software automates data acquisition.
- Software Bisque's *MKS 4000™* control system provides precise tracking, accurate periodic error correction and smooth, fast slews.
- The MKS 4000 control system supports a wide dynamic range for slewing and tracking rates. Virtually any slew speed is available between stopped and several degrees per second.
- Configurable acceleration and deceleration rates during slews.
- Accurate homing sensors for rapid initialization and precision repeatability from night to night.
- Homing allows the mount to be quickly reinitialized under any circumstance, including power loss.
- Super-stable physical design that rapidly dampens external vibrations.
- Built-in software slewing limits prevent damage to the mount and telescope by slowly decelerating to limit regions.
- Clutch-free design ensures consistent pointing and tracking from night to night.
- 50 conductors of through the mount cabling to minimize the nightmare of having CCD power, CCD signal, focus, video, dew heater, and other accessory cables routed to the telescope.
- Cable Conduit™ allows adding custom cables, wires or tubes through the mount.
- Integrated equatorial wedge design that accommodates latitude adjustment from 15 to 58 degrees.
- Integrated rotating base allows calibrated azimuth adjustment without affecting altitude.
- Integrated altitude scale to provide an accurate altitude starting point for polar alignment.
- Eight-inch right ascension bearing and six-inch declination provide maximum stability.

- Overall structural design makes the Paramount ME extremely rigid, even with very heavy payloads.

## Optional Accessories

- TheSky Pocket Edition
- TheSky Pocket Edition with Pocket TPoint
- PrecisionPEC™ can be used to accurately determine the Paramount ME's periodic error (under virtually any seeing conditions) to generate an optimal periodic error correction curve for your mount.
- AutomaDome dome control software
- Integrated precision bubble level
- Counterweight shaft extension bar for balancing ultra-heavy payloads
- Latitude Adjustment Wedge for use below 15 degrees and above 58 degrees latitude
- Pier to Wedge Adaptor Plate for mounting the Paramount ME to an existing pier (heavy duty and lightweight models)
- Electronic panel covers/Balance knob covers (future)
- Software Bisque Paramount ME permanent piers

## Unpacking the Paramount ME

We recommend you become familiar with the components of the Paramount ME before attempting to assemble and use the instrument. Although we have taken many steps to ensure ease-of-use, there are several critical steps that must be followed to achieve optimal performance.
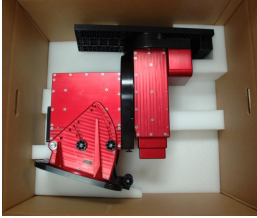
Software Bisque has made every effort to ensure that your new mount arrives just the way it left our facilities: fully operational and ready to use. We want your first experience to be as enjoyable as the hours you'll spend using it under the night sky. Please inspect all boxes for damage of any kind. If you notice anything peculiar, make detailed notes *before* opening the packages (we recommend photographing or video recording the unopened packages if there is any apparent damage).

After very carefully reading this section, remove all components from the packing boxes and check to make sure they are in good order. Also compare the contents with the following packing list.

Please note that the Paramount ME comes fully assembled. In general, you should not have to dissemble any component of the Paramount ME mount before using it. If you think you need to disassemble any component of the mount, for any reason, please contact Software Bisque *before* doing so.
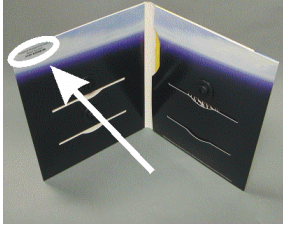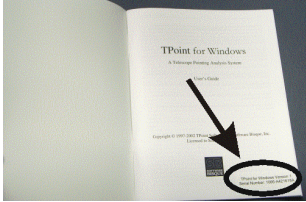
## Packing List

| Item | Photograph | Description |
| --- | --- | --- |

| | | |
|---|---|---|
| **Box 1**<br><br>Dimensions:<br>76.2 x 68.6 x 45.7 cm<br>(30 x 27 x 18 in.)<br><br>Weight: 39.5 kg (87 lbs.) |  | **Paramount ME Mount**<br><br>This box holds the Paramount ME German equatorial mount with the Versa-Plate and Instrument Panel Housing (page 26) mounted to the top of the declination assembly.<br><br>Please carefully read "Removing Paramount ME from Shipping Box" before attempting to lift the mount out of the box. |
| **Box 2**<br><br>Dimensions:<br>61 x 30.5 x 30.5 cm<br>(24 x 12 x 12 in.)<br><br>Weight: 27 kg (60 lbs.) |  | **Paramount Additional Components**<br><br>The Additional Components Box contains the items below. |
| |  | One 4.7 m (15-foot) USB Cable<br><br>Use this cable to control the Paramount ME through its USB port.  (Page 114) |
| |  | Four 3/8-inch, 24 thread-per-inch Base Plate Attachment Knobs<br><br>These knobs attach the mount to the pier.  (Page 30) |
| |  | One Allen Wrench Set<br><br>This set of wrenches can be used to remove the Versa-Plate covers, or remove the mount side panels (if necessary). |
| |  | One Power Supply Cable<br><br>The female end of this cable is plugged into the power supply unit, and the male end into a 120V (or 220V) outlet. |
| |  | Replacement Fuses<br><br>Two 3A Slo-Blo fuses for the adaptor panel.  See "Auxiliary Port 1 and 2 Fuse Replacement" for replacement details.  (Page 101.) |

|  | One 48V Power Supply Unit |
|---|---|
| | Plug the small, round tip into the port labeled **Power** on the Adaptor Panel. (Page 19) Plug the power supply cable into the power supply's three-prong port. |
|  | One Joystick |
| | Insert the RJ11 plug into the joystick port on the Paramount ME Adaptor Panel. See "The Joystick" for details. (Page 35) |
|  | One Counterweight Shaft |
| | Dimensions: 460 mm (18 in.) long and 38 mm (1.5 in.) in diameter. |
| | This shaft holds up to six (6) 9 kg (20 lb.) counterweights. |
| | Attach the counterweight shaft to the base of the counterweight attachment block. See "Attaching the Counterweight Shaft" for details. (Page 25) |

| Thread | Nominal Size |
|---|---|
| Male | 1 1/8-inch x 12 threads per inch (TPI), 60 degree form, UNF |
| Female | 1/2-inch x 24 threads per inch (TPI) |

|  | One 3 m (10-foot) RS232 Serial Cable |
|---|---|
| | The Paramount ME uses either USB or serial communication for software-based mount control. This cable runs from the computer's RS232 port to the port labeled RS232 on the Paramount ME Adaptor Panel. (Page 19.) |
|  | One Counterweight Safety Knob |
| | Screw this knob into the end of the Counterweight Shaft after adding counterweights. This knob prevents the counterweight from sliding off the shaft. See "Attaching the Counterweight Shaft" for details. (Page 25.) |

| | | |
|---|---|---|
| |  | **Counterweights**<br><br>Two 9 kg (20 lb.) counterweights.  Note that two counterweights are supplied with the "standard" Paramount ME.  Contact Software Bisque if you need to order additional counterweights.<br><br>Additional counterweights are shipped separately, in a 30.5 x 30.5 x 30.5 cm (12 x 12 x 12 in.) box that can hold up to three total counterweights.  The weight of this box is either 9 kg (20 lbs.) for one counterweight, 18 kg (40 lbs.) for two additional counterweights, or 27 kg (40 or 60 lbs.) for three additional counterweights.<br><br>Attach the counterweights to the counterweight shaft.  See "Adding Counterweights" for details. (Page 37) |
| **Optional Component** |  | **Counterweight Extension Shaft Bar**<br><br>This is an optional accessory and is not included with the Paramount ME unless ordered separately.  The Counterweight Shaft Extension Bar screws into the end of the Standard Counterweight Shaft for additional counterweight capacity.<br><br>Dimensions: 178 mm (7 in.) long and 38 mm (1.5 in.) in diameter.<br><br>The combined length of the standard counterweight shaft plus the counterweight extension shaft (178 mm or 24-in.) holds up to eight (8) 9 kg (20 lb.) counterweights.<br><br>This product can be purchased from the Software Bisque Store at bisque.com. |
| **Box 3 (inside Box 2)**<br><br>Dimensions:  23 x 30 x 8 cm (9 x 12 x 3 in.)<br><br>Weight: 1 kg (2 lbs.) |  | **Paramount ME Software Suite**<br><br>This box contains:<br>• One Paramount ME User's Guide<br>• One TheSky6 Professional Edition on CD-ROM and DVD.<br>• One CCDSoft version 5 CD-ROM.<br>• One TPoint version 1 User's Manual.<br>• One Paramount ME System CD-ROM that includes installation software for TheSky6 update, USB driver installation, CCDSoft version 5, TPoint Telescope Pointing Analysis Software, |

Location of TheSky6 Professional Edition serial number.



Location of the CCDSoft version 5 serial number.



Location of the TPoint version 1 serial number.

Orchestrate, IAClient and IAServer software and documentation in Portable Document Format (PDF).

Note:

- TheSky6 Professional Edition serial number is located on the inside flap of TheSky6 Professional Edition box.
- The CCDSoft serial number is affixed to the CCDSoft CD-ROM case.
- The TPoint serial number is affixed to the title page of the TPoint manual.

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## Removing Paramount ME from Shipping Box

Please carefully read the following *before* attempting to remove Paramount ME from the shipping box. In order to prevent damage, the right ascension and declination worms are disengaged from the gears during shipment.

**You must manually and properly engage the worm and gear in each axis before removing the Paramount ME from the box!**

### Proper Worm/Gear Engagement Procedure

Engage the right ascension axis worm and gear by turning the right ascension balance knob counterclockwise with one hand while gently wiggling the bottom of the declination axis with the other hand (see Figure 1). Engage the declination axis worm and gear by turning the declination balance knob counterclockwise with one hand while gently wiggling the end of the Versa-Plate with the other hand (see Figure 1.).

This procedure ensures proper that the worm and gear are properly engaged. The mount can now be safely removed from the shipping box.

Figure 1: The black arrow points to the right ascension balance knob; the black circle indicates where to grasp and wiggle the right ascension axis during engagement. The white arrow points to the declination balance knob; the white circle indicates where to grasp and wiggle the declination axis during engagement.

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# The Paramount ME and TheSkyX Professional Edition

*TheSkyX Professional Edition* offers new and expanded features for Paramount ME control that are not included in this document.

If you plan to use *TheSkyX Professional Edition* to operate the *Paramount ME*, please refer to the **Paramount <u>MX</u> User Guide** for details. The **Paramount MX User Guide** can be downloaded in PDF format from the Software Bisque web site using the URL below:

http://www.bisque.com/sc/media/p/50302.aspx

To manually navigate to, and download the **Paramount MX User Guide**,

1. Go to www.bisque.com.
2. Click the Sign In link to sign into the web site.
3. Click the Downloads link.
4. Click the Documentation link in the left column, under Browse Downloads.
5. Click Paramount MX.
6. Click the **Paramount MX User Guide** link in the center of the window.
7. Click the Download link.

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## Mount Nomenclature

Versa-Plate

Declination motor cover

Declination assembly

RA assembly

Counterweight attachment block

Wedge assembly

Counterweights

Pier

Counterweight shaft

Altitude retaining knobs
(2 each side)

Baseplate attachment
knobs (4) with Micro-levelers
underneath (4)

Altitude positioning
device

Azimuth adjustment knobs (2)
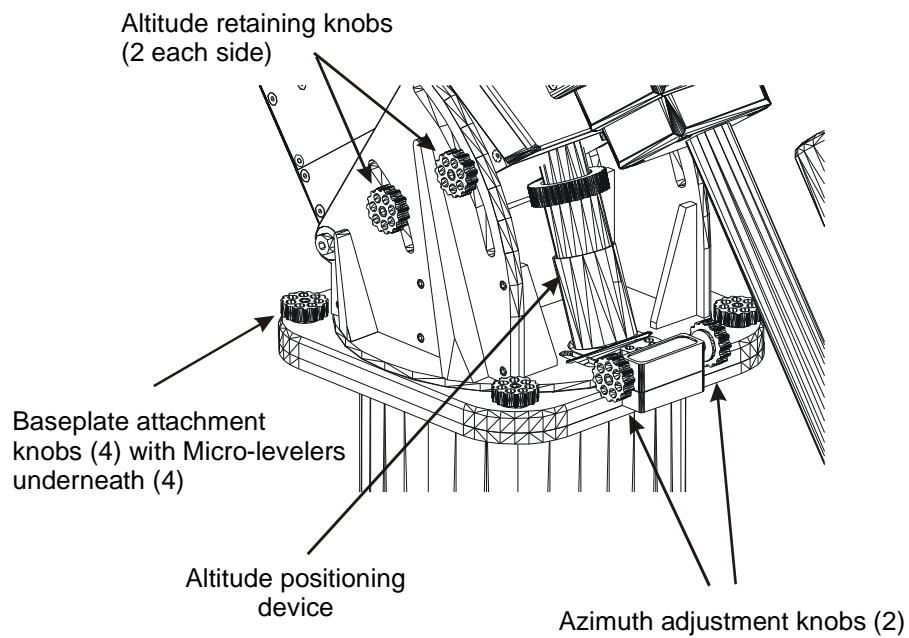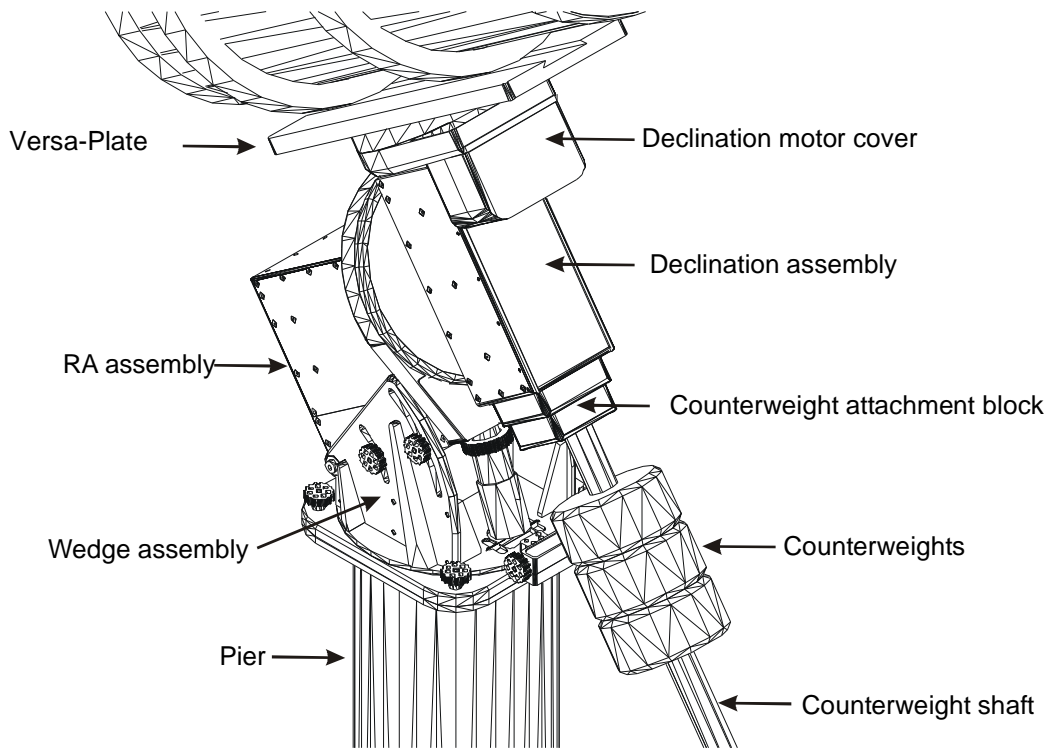
Figure 2: Paramount ME components.
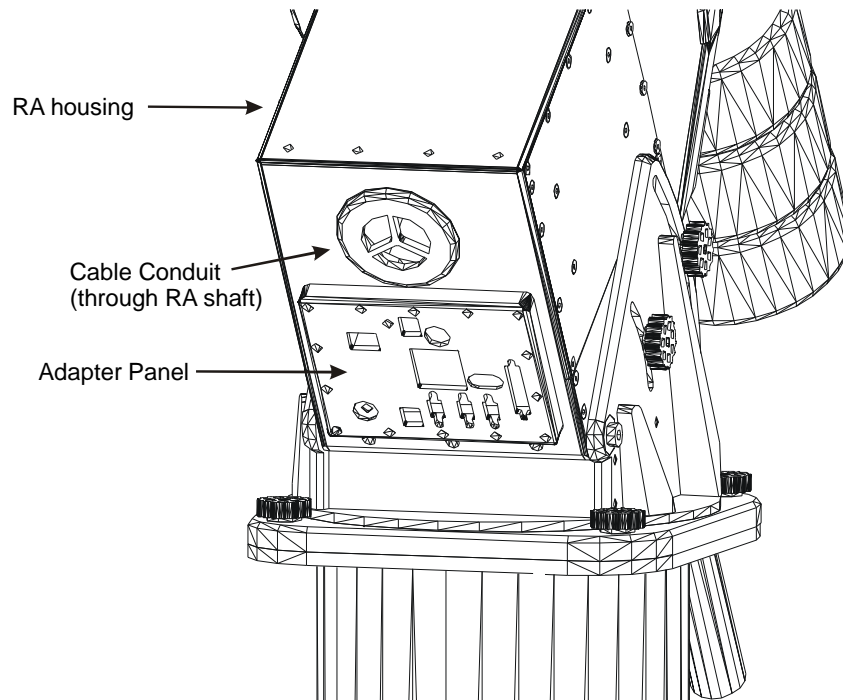
Figure 3: Paramount ME components (rear view).

## Adaptor Panel Basics

The table below describes each component of the Adaptor Panel.
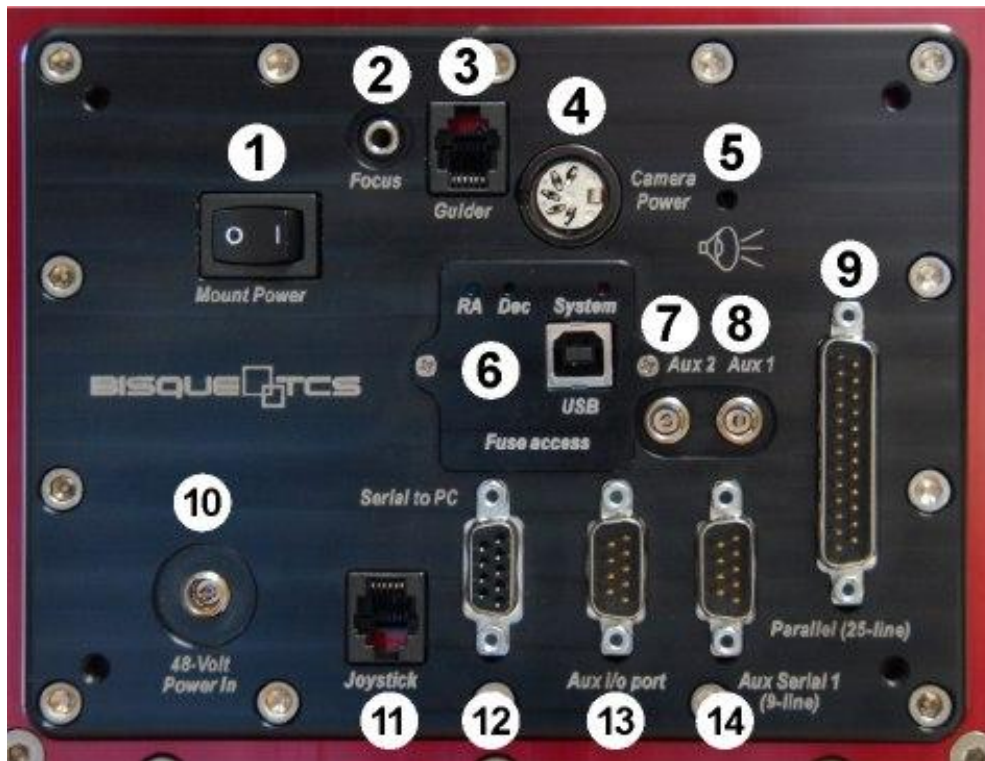


Figure 4: Adaptor Panel (Paramount ME with the MKS4000 control system).

| Number | Label | Description |
|---|---|---|
| 1 | Mount Power | Power switch to turn the mount on and off. |
| 2 | Focus | Input port for a pulse focuser.  This port is identical to the *Focus* port on the Instrument Panel.  (Page 22.)<br><br>To control a pulse focuser from TheSky6 Professional Edition, first plug the pulse focuser into this port (or the identical port on the Instrument Panel), establish communication with the Paramount ME, and then click **Telescope > Options > Focus Control**. |
| 3 | Guider | Input for the autoguider.  Plug the autoguider cable into this port if your autoguiding camera has a separate control box (for example, the SBIG ST-V or ST-6).  This port is identical to the *Guider* port on the Instrument Panel.  Plug the autoguider cable into the Guider port on the Instrument Panel if your camera has a built-in autoguider (such as the SBIG ST-7, ST-8, ST-9, etc.).<br><br>Note: If you use CCDSoft's DirectGuide feature, no guider cable is required.  See the "DirectGuide™" heading for more information. (Page 87) |
| 4 | Camera Power | This port is used to supply power from the base of the mount to the port labeled *Camera Power* on the Instrument Panel.  Early model SBIG cameras used this type of plug for camera power.<br><br>If you own a camera that uses this type of power connector, then plug the camera's power into the Camera Power port, and use a short camera power cable to plug into the Instrument Panel's Camera Power plug and then to the CCD Camera.<br><br>Newer model SBIG cameras use a different type of power plug, so this port is not compatible with these cameras.  See page 53 for information about adding through-the-mount cabling. |
| 5 | Speaker Outlet | The Paramount ME's speaker emits status sounds at startup, when homing and during error conditions.  See for "Audible Feedback" on page 33 for more information.  There is no volume control for the speaker; however, placing a piece of tape over this hole will muffle the sound. |
| 6 | Access to Fuses and USB Port | This panel provides access to the USB port and fuses.  See "Appendix E – USB Driver Installation and Use" for details about controlling the Paramount ME via USB.  (Page 109.) See "Auxiliary Port 1 and 2 Fuse Replacement" for details about replacing fuses (Page 101.)<br><br>This panel originally provided access to internal fuses and DIP switches for the MKS 3200 and earlier control systems.<br><br>See "Visual Feedback" on page 32 for a description of the RA, Dec and |

| | | |
|---|---|---|
| | | System LEDs. |
| 7 | Aux 2 | Auxiliary port two. This is one of two "generic" ports that can be used to supply power to the Instrument Panel's auxiliary ports for accessories such as dew heaters.<br><br>Please carefully read "Aux 1 and Aux 2 Port Specification" on page 23 for details about this port. |
| 8 | Aux 1 | Auxiliary port one. This is one of two "generic" ports that can be used to supply power to the Instrument Panel's auxiliary ports for accessories such as dew heaters.<br><br>Please carefully read "Aux 1 and Aux 2 Port Specification" on page 23 for details about this port. |
| 9 | Parallel (25-line) | 25-pin parallel port. If your camera has a parallel port interface, then plug the camera's parallel cable into this port, and then use a short parallel cable to connect the parallel port on the Instrument Panel to the camera head. |
| 10 | 48-Volt Power In | Plug the 48-Volt power supply into this port (page 13). |
| 11 | Joystick | Plug the Joystick's RJ11 (phone-type connector) into this port. |
| 12 | Serial To PC | This is the RS232 serial port that is used to communicate with a personal computer or Windows Mobile device using a standard serial port. Use the supplied RS232 cable (page 13) to connect this port to a standard male DB9 serial port or USB to serial adaptor. |
| 13 | Aux I/O Port | Do not use this port. This port will be used by future firmware versions of the MKS 4000 and TheSky6 Professional Edition.<br><br>This port contains four general-purpose, high-powered, driver outputs that can be used to drive a DC servomotor or a stepper focus motor, or other device. There are also two general-purpose pins that can be used as inputs or outputs. We are currently looking at possible uses for these functions such as an "abort slew" button, limit switch, or other use.<br>Earlier models of the MKS control system provided three "generic" lines of through the mount cabling through this DB9 port (on pins 2, 3 and 5). |

| 14 | Aux Serial 1 (9-line) | The port provides nine "generic" lines of through-the-mount cabling. |
|---|---|---|

## Instrument Panel Basics
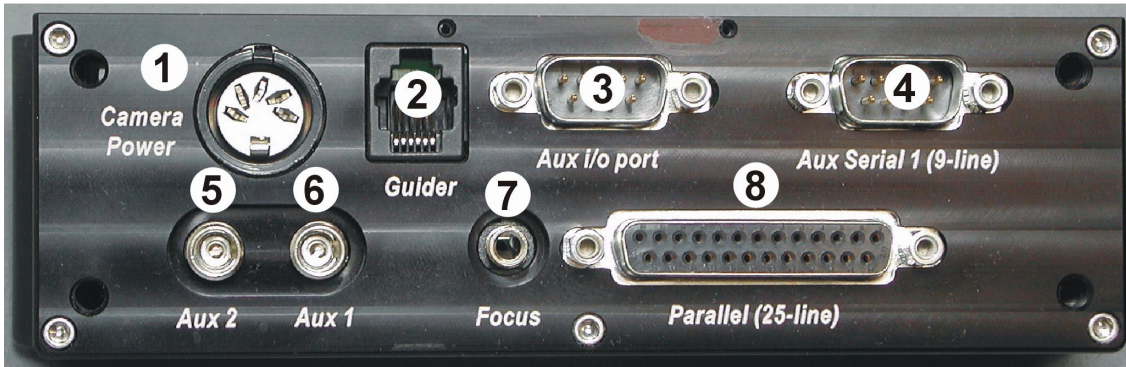


Figure 5: Instrument Panel.

The table below describes each port on the Instrument Panel.

| Number | Label | Description |
|---|---|---|
| 1 | Camera Power | This port is used to provide power from the Instrument Panel to the camera head. Note: power to this port is supplied by plugging an SBIG camera power cable into the *Camera Power* port on the Adaptor Panel. (Page 19.) |
| 2 | Guider | Input for the autoguider. Plug the autoguider cable into this port if your autoguiding camera has built-in autoguider (such as the SBIG ST-7, ST-8, ST-9, etc.).<br><br>Use the port labeled *Guider* on the Adaptor Panel if your autoguider has a separate control box (such as the SBIG ST-V or ST-6).<br><br>This port is identical to the Guider port on the Adaptor Panel. (Page 19.)<br><br>Note: If you use CCDSoft's DirectGuide feature, no guider cable is required. See the "DirectGuide™" heading for more information. (Page 87.) |
| 3 | Aux I/O Port | Do not use this port. This port will be used in future firmware versions of the control system.<br><br>Earlier models of the MKS control system provided three "generic" lines of through the mount cabling through this DB9 port (on pins 2, 3 and 5). |
| 4 | Aux Serial 1 (9-line) | The port provides nine "generic" lines of through-the-mount cabling. |
| 5 | Aux 2 | Auxiliary port two. This is one of two "generic" ports that can be used |

| | | |
|---|---|---|
| | | to supply power to the Instrument Panel's auxiliary ports for accessories such as dew heaters (page 53).<br><br>Please carefully read "Aux 1 and Aux 2 Port Specification" on page 23 for details about this port. |
| 6 | Aux 1 | Auxiliary port one.   This is one of two "generic" ports that can be used to supply power to the Instrument Panel's auxiliary ports for accessories such as dew heaters (page 53).<br><br>Please carefully read "Aux 1 and Aux 2 Port Specification" on page 23 for details about this port. |
| 7 | Focus | Input port for a pulse focuser.  This port is identical to the *Focus* port on the Adaptor Panel.<br><br>To control a pulse focuser from TheSky6 Professional Edition, first plug the pulse focuser into this port (or the identical port on the Adaptor Panel), establish communication with the Paramount ME, and then click **Telescope > Options > Focus Control**. |
| 8 | Parallel (25-line) | 25-pin parallel port.  If your camera has a parallel port interface, then plug the camera's parallel cable into the port labeled *Parallel* on the Adaptor Panel, and then use a short parallel cable to connect the Parallel port on the Instrument Panel to the camera head. |

## Aux 1 and Aux 2 Port Specification

The manufacturing specification for the size of the Paramount ME Aux 1 and Aux 2 ports on the Instrument and Adaptor Panel calls for a 2.1 mm "power" plug (this is a bit of a misnomer since the Paramount ME's Aux ports are not actually powered).  "Lock ring" plugs that fit inside the auxiliary ports can be purchased from Mouser Electronics (http://www.mouser.com), the name of the part is a Kobiconn DC power plug, part number 171-7391.*

*Critical Note

The size of the Aux port connectors on your Paramount ME could be *2.5 mm* instead of *2.1 mm*.  Although Software Bisque tries to ensure the 2.1 mm manufacturing specification, the Instrument and Adaptor Panel boards are manufactured outside Software Bisque by a third-party electronics manufacturing house, and to date, a handful of Adaptor Panels have been shipped with Adaptor Panels that use the 2.5 mm plug for the Aux ports.

You can tell which size your mount uses by comparing the inner post of the 48V Power In plug with the inner post of either Aux port on the Adaptor Panel.  The 48-V Power In plug has a 2.5 mm inner diameter post; the Aux ports' inner post should be noticeably smaller.  If both the 48V Power In plug and Aux ports' inner posts are the same size, then you'll need to use the 2.5 mm power plugs.  The Mouser part number for the 2.5 mm Kobiconn DC is 171-7395.

# Paramount ME Assembly and Setup

Now that you're familiar with each Paramount ME component, it's time to place the mount on your pier and align it to the pole.

## *Approximate Altitude Adjustment*

The mount's altitude is set to the lowest position (15 degrees) for shipping. Before adding equipment or counterweights, use the altitude-positioning device to set the altitude to roughly match the latitude of your observing site.

*Tip*   **Before Making Any Altitude Adjustments**

The Paramount ME allows you to add your own through-the-mount cabling (page 53). Part of this process requires the removal of five small, "non-structural" screws on the base of the RA side panel. Some of these small screws are normally hidden behind the altitude wedge and can only be removed when the mount's altitude adjustment is at the highest position. (The latitude of your observing site ultimately determines whether three or four screws are hidden behind the wedge.)

Software Bisque recommends that you adjust the altitude to its highest setting and then remove these "hidden" screws *before* performing a polar alignment. This ensures that the RA side panel can be removed, (which is required for through-the-mount cabling), *after* polar alignment is complete.
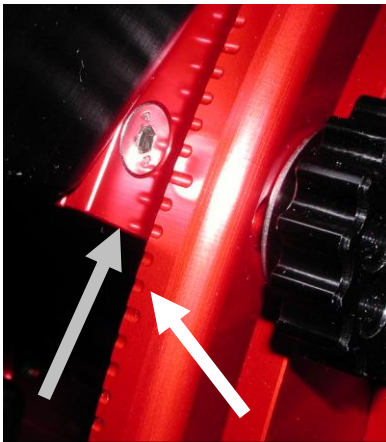


Figure 6: Wedge assembly altitude scale.

### Altitude Divisions

An altitude scale is machined into the wedge assembly. The scale ranges from 15 degrees at the lowest position up to 58 degrees at the highest. A Latitude Adjustment Wedge (sold separately) is required for latitudes outside 15-58 degrees. Contact Software Bisque to order this accessory. (See Figure 27.)

This scale allows you to set the mount's altitude to a fraction of a degree by aligning the base of the right ascension housing (the gray arrow in the photograph) to the center of a "tic mark" (the white arrow in the photograph). The altitude scale is extremely accurate when the mount is level, but provides limited accuracy when not.

There are three different length tic marks on the altitude scale. The longest tic marks represent 10-degree increments, the medium marks represent 5-degree increments and the short marks occur at one degree increments. The lowest setting is 15 degrees altitude, so that first *long* tic mark represents 20 degrees.

In the middle of the latitude range (approximately 36 degrees), one full turn of the altitude positioning-device equals one degree, with slightly different amounts at the extremes. Each tic (or high spot) on the altitude-positioning device knob is equal to two arcminutes (see Figure 26 for the definition of a tic on this knob).
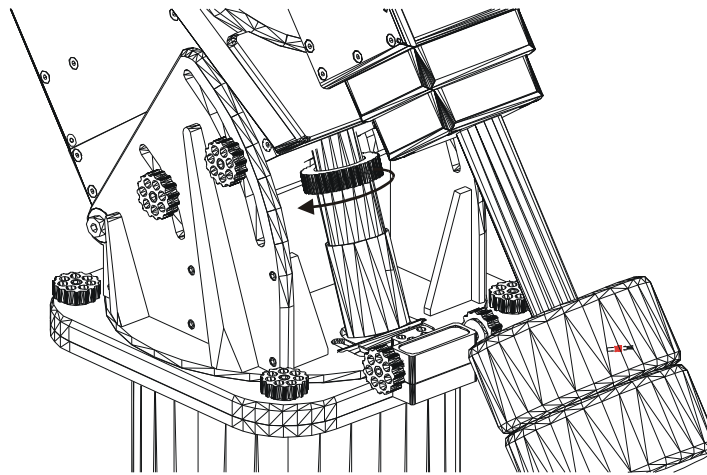
Figure 7: The arrow above shows the rotation direction for lowering altitude using the altitude-positioning device.

Loosen the four altitude retaining knobs (two on each side of the mount) about two complete turns.  This allows the right ascension housing to move freely within the wedge assembly using the altitude-positioning device (Figure 7).

*Tip*　　Remember the "Right Hand" Rule!

The Paramount ME uses "right-handed" threads.  If you need to make an altitude adjustment, and forget which direction to rotate the altitude-positioning device, just use the right hand rule.

For example, suppose you need to increase the mount's altitude.  Point the thumb on your right hand upward.  Rotate the altitude-positioning device in the direction your fingers curl.  Simple!

Initially, consider adjusting the altitude slightly higher than your latitude so that any adjustment during polar alignment is downward.  If the altitude must be adjusted higher, you can lift the declination housing, or counterweight shaft (page 25) to make rotating the altitude-positioning device easier.

### Attaching the Counterweight Shaft

The counterweight shaft should be threaded into the bottom of the declination housing (Figure 8) until tight.  The counterweight safety knob screws into the opposite end of the shaft.  To be safe, this knob should always be in place whenever any counterweights are mounted on the counterweight shaft.

Insert a large hex wrench or screwdriver into the small, unthreaded hole near the "bottom" of the counterweight shaft to help rotate the shaft.
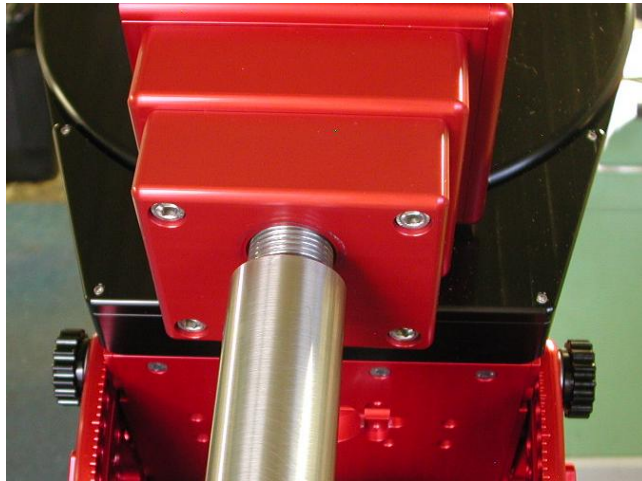
Figure 8: Attaching the counterweight shaft.

## Positioning the Versa-Plate

The Versa-Plate (see Figure 9) measures 7.9 inches by 20.0 inches by 0.9 inches, and is designed to securely hold a wide variety of optical tube assemblies, OTA mounting rings, as well as optics that employ the Losmandy™ dovetail system. It can be mounted in three different positions (forward, middle and back) to accommodate different weight distributions of different equipment.

The Paramount ME is assembled and shipped with the Versa-Plate mounted in the forward-most position. This position should work a wide-variety of equipment and optical tube assembly combinations so that you should not need to change it. However, if you need to adjust the Versa-Plate's position to achieve balance in declination for your optical system and equipment, the following documentation describes how to do so, as well as how to attach the Instrument Panel to the Versa-Plate.
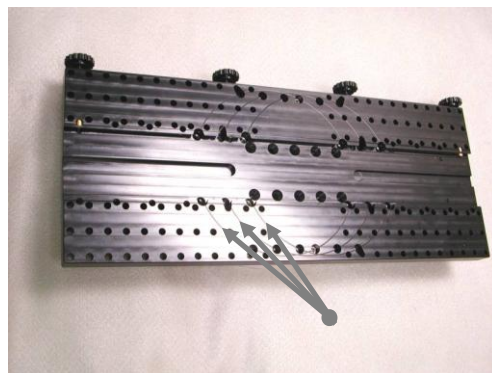


Figure 9: Photograph of the Versa-Plate. The arrows indicate the position of the three grooved circles; each circle represents a different mounting position.

The pattern of holes used to attach the Versa-Plate to the top of the declination housing is repeated in three places on the Versa-Plate. This allows the plate to be centered, or mounted approximately one inch in either direction from center.

The positions of the three mounting locations are represented on the top of the Versa-Plate as eight-inch grooved circles (see Figure 9). Each circle corresponds to the location of the declination housing when the Versa-Plate is mounted at that position. Attaching the Versa-Plate to the middle circle centers it on the

26

declination housing. The Versa-Plate can also be moved about one inch forward (for Schmidt–Cassegrain or similar OTAs) or one-inch backward (for Newtonians or longer OTAs).

There are twelve tapped holes in the top of the Paramount ME declination gear (Figure 10). The four inner holes accept 1-inch, ¼-20 thread, flat socket cap screws (± 0.001 inches). The eight outer holes accept 1-inch ¼-20 socket head cap screws (± 0.001 inches). Normally, the eight outer holes are sufficient for mounting the Versa-Plate. The four inner holes permit attaching smaller (custom-made) top plates to the declination gear, if necessary. Software Bisque attaches all twelve screws when the mount is assembled.
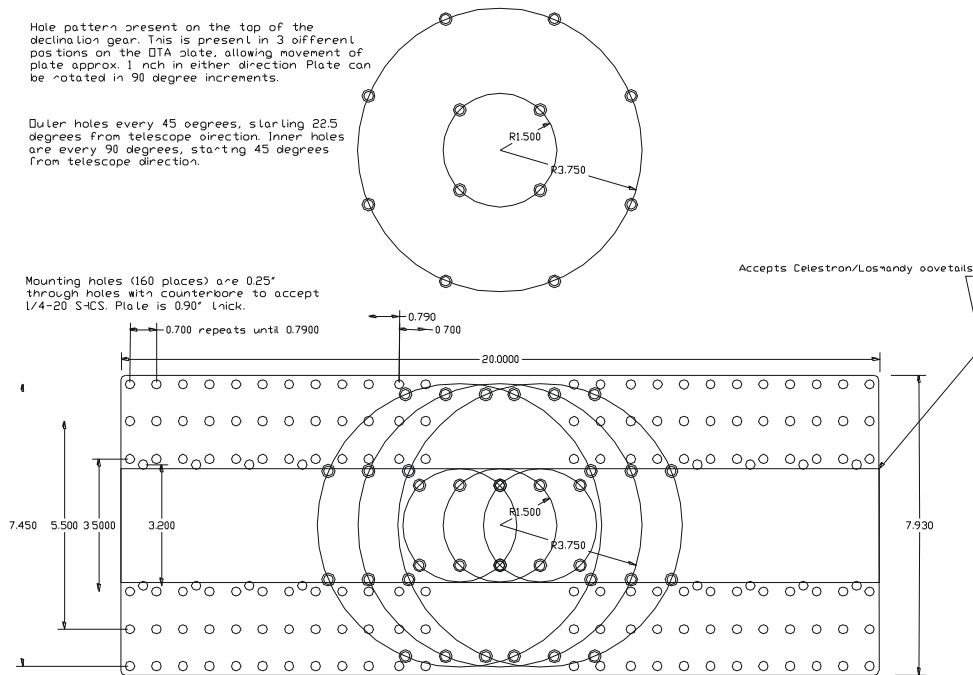
Figure 10: Versa-Plate mounting specifications.

The Paramount ME's declination axis *cannot* rotate a full 360 degrees, regardless of the orientation of the Versa-Plate; therefore, the Versa-Plate must be mounted properly to ensure normal mount operation.

An arrow is machined into the top of the declination housing that indicates the direction of *incoming light* (see Figure 11 and Figure 12) for the optical tube assembly. Use this to arrow to determine the orientation of the Versa-Plate for your optical system.

Notes:
- The machined arrow *should not* point toward the entrance pupil of the optical tube assembly.
- The declination assembly (that is, the component on which the arrow is machined) should *never* be disassembled for any reason.

If you must remove the Versa-Plate for any reason, please take note that an arrow is machined into the declination hub as a guide to ensure that the orientation of the Versa-Plate is correct.

Specifically, attach the Versa-Plate so that this arrow points in the same direction as the light that comes into the optical tube assembly (see Figure 12).
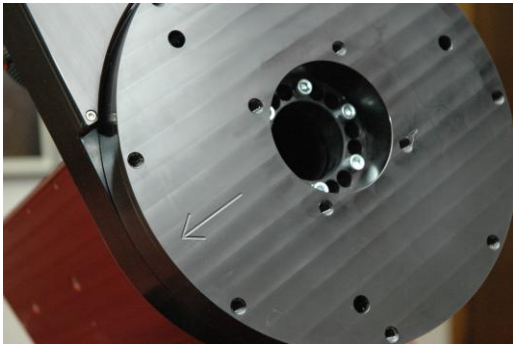
Figure 11: Photograph of the top of the declination housing (note machined arrow).
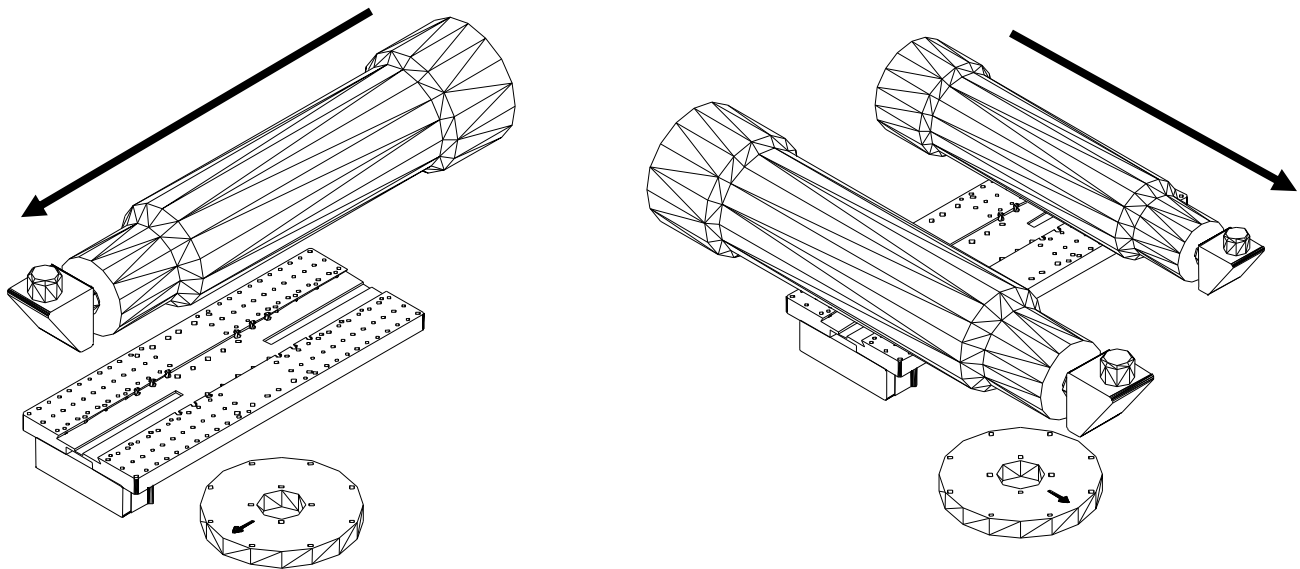


Figure 12: Typical (left) and wide (right) Versa-Plate mounting configurations. The black arrows indicate the direction of incoming light. Note that the machined arrow on the declination hub points *in the same direction* as the incoming light.

The Paramount ME is shipped with the Versa-Plate mounted in the "typical configuration" as shown in the left drawing in Figure 12. Note that the arrow on the declination hub points in the direction of incoming light to the telescope and toward the Instrument Panel (mounted to the bottom of the Versa-Plate). This orientation ensures maximum rotation of the declination axis without hitting the hard stop at -90 degrees declination.

The Versa-Plate can also be mounted at 90 degrees from the typical orientation, offering a wide mounting surface that can accommodate multiple optical tube assemblies. Note the machined arrow on the declination hub still points in the direction of the incoming light, but not toward the Instrument Panel as in the typical configuration.

A third configuration (not pictured) places the Instrument Panel near the entrance pupil of the telescope. In this orientation, cabling to the CCD camera follows the shortest route for Newtonian telescopes. The Versa-Plate is rotated 180 degrees from the typical configuration pictured above.

Note that the machined arrow must *always* point in the direction of incoming light, *regardless of the configuration*.

Attach the Versa-Plate to the top of the declination housing using eight 1-inch ¼-20 socket head cap screws (page 13).

There are two cables that protrude from the top of the declination housing. Both must be directed through the Versa-Plate cable channel. Make sure that you have just enough cable protruding out of the top of the declination housing to reach the Instrument Panel. Extra cable makes assembling the Instrument Panel box difficult. Too little slack and the cables cannot be plugged into the slots on the Instrument Panel's control board.
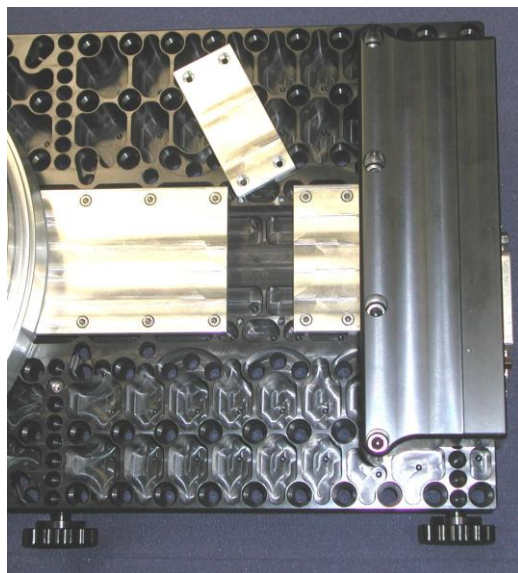


Figure 13: Channel Covers (unanodized for illustration purposes)

The channel covers are shown in Figure 13. There are three channel separate covers to accommodate the three Versa-Plate mounting configurations. The "typical configuration" uses the large cover and only one of the two rectangular covers. The "Schmidt-Cassegrain" configuration uses only the large cover. The "Newtonian configuration," shown above, requires all three channel covers.

### Plugging In the Instrument Panel Electronics

This section describes the procedure for properly plugging in the Instrument Panel electronics, and is included for reference purposes only, since the Paramount ME is now assembled and shipped with the Instrument Panel Housing and electronics already mounted to the Versa-Plate.

After the cables are passed through the Versa-Plate cable channel, they must be plugged into the appropriate slots on the Instrument Panel's control board. Inspect the two cables to identify the alignment notches (see Figure 14). Do not plug these cables in backwards!
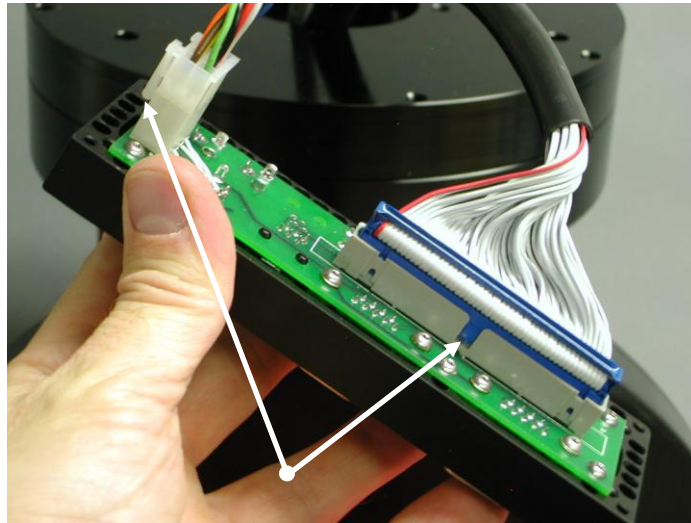
Figure 14: Important!  Make sure the notches are aligned properly to avoid plugging the cables in backwards.

Once these cables are plugged in to the Instrument Panel control board, use a 3/32 hex wrench to connect the front and back of the Instrument Panel box.  Next, use a 5/32 hex wrench to attach the four 1 ½-inch 10/32 socket head cap screws in the back of the Instrument Panel assembly into the bottom of the Versa-Plate (Figure 13).

## Attaching the Mount to the Pier

The Paramount ME uses integrated Micro-Levelers and Base Plate Attachment Knobs to level and secure the mount to the pier or base plate.  Please carefully read the section "Adjusting the Micro-Levelers" before continuing.

### Adjusting the Micro-Levelers

The Paramount ME's Micro-Levelers are used to fine-tune the mount's level.  The maximum amount of adjustment for each leveler is approximately 3 mm or 1/8-inch.  The Micro-Levelers are also used ensure the base plate of the Paramount ME is not distorted by an uneven mounting surface.

Important note: the Micro-Levelers *must* protrude slightly below the surface of the Base Plate before tightening the Base Plate Attachment Knobs.  See the "Critical Micro-Lever Note" below for more information.
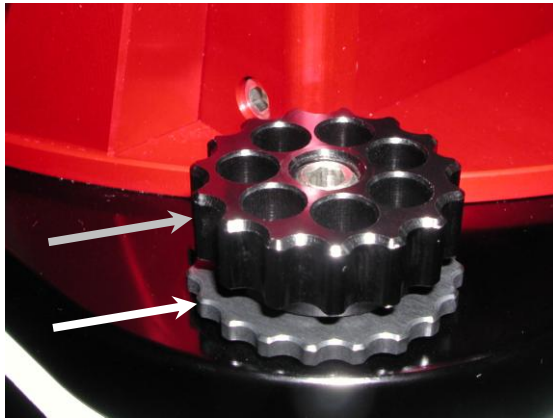
Figure 15: Micro-Leveler (white arrow) and Base Plate Attachment Knob (gray arrow).

The best approach for leveling the mount is to simultaneously rotate two Micro-Levelers so that the mount is tilted either East/West or North/South. The accuracy of the leveling required depends on the long-term use of the mount. If the mount is attached to a permanent pier, without the intent of portable use, leveling is less important. When used in a portable sense, a level mount helps speed the polar alignment process.

**Critical Micro-Lever Note**

The Micro-Levelers and Base Plate Attachment Knobs serve different purposes. The Micro-Levelers stabilize and level the Base Plate. The Base Plate Attachment Knobs secure the Base Plate to the pier. Both components have unique thread patterns, and the two *will bind together* when improperly adjusted.

The weight of the mount must be resting on all four Micro-Levelers, and *not* on the Base Plate. That is, the Base Plate should sit at least one millimeter (or so) above the mounting surface (such as the top of the pier or, or the pier adaptor plate).
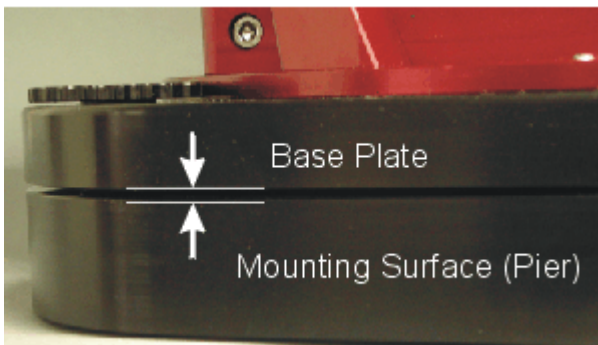


Figure 16: Adjusting Micro-Levelers.

To make sure this occurs, *before* tightening the Base Plate Attachment knobs, rotate each Micro-Leveler clockwise until it makes contact with the mounting surface. Then tighten it about 1/16 of a turn (or so) more. Additional adjustment may be required to accommodate uneven mounting surfaces. You might want also want to gently lift the mount when tightening the Micro-Levelers.

If all four Micro-Levelers are not in contact with the mounting surface, when you attempt to loosen a Base Plate Attachment Knob, both will turn together and bind. They *cannot* be turned in unison because the threads on the Micro-Leveler are larger than the threads on the Base Plate Attachment Knob. If the two become bound, **do not try to force them apart!** Instead *tighten* (yes, tighten) both knobs a small amount until they are no longer bound. At this point, rotate the Micro-Leveler clockwise until it is in full contact with the mounting surface.

**Base Plate Attachment Knobs**

The Paramount ME attaches to the pier using four Base Plate attachment knobs near the corners of the Wedge Base Plate (Figure 17). Typically, tightening them by hand is sufficient to fix the mount into place. Over tightening these knobs is unnecessary and can lead to binding as described above.
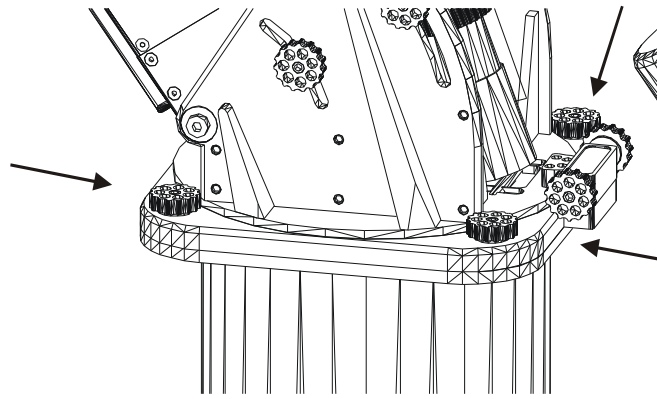
Figure 17: Location of Base Plate Attachment Knobs.

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# First Time Operation

After you have assembled the Instrument Panel and attached the Versa-Plate, verify that the electronic and mechanical components operate by switching the Mount Power button to the on position. (See "Connecting the Electronics and Power" on page 53 for details about connecting the 48-Volt power supply to the Adaptor Panel).



Figure 31: Paramount ME Adaptor Panel.

Note that the Paramount ME *will not* respond to joystick or TheSky6 slew commands and *will not* begin tracking until the control system is homed. See "What Is Homing?" on page 34 for details.

## Visual Feedback

When the mount is turned on, three LEDs provide visual feedback on the status of the control system. Note: The LEDs are only visible when the Adaptor Panel's Access Panel is removed (page 114). An orange LED constantly pulses to indicate that the electronics are functioning normally. Two blue LEDs flash while the control system is being initialized, and remain steady after successful initialization. If one

or both LEDs are not lit after the mount is powered on, it means that there was a problem initializing the control system.

The mount will also emit a continuous beeping sound if this occurs.  Turn the mount off and check to make sure that the joystick is in the center position, and that there are no obstructions that might impede mount's ability to slew before proceeding.

## *Audible Feedback*

While the Paramount ME is turned on, please listen!  The control system emits different sounds to indicate the status of initialization operations, error conditions, and will also "hum" during normal operation.

### Sounds Emitted During Mount Initialization and Operation

Each time the mount is turned on the control system performs a servomotor initialization procedure in each axis.  Two successive beeps (up to about ten seconds or so apart) indicate success.

If the button on the joystick handle is pressed and held down when the mount is turned on, or the joystick is moved from the center position before the servomotor initialization is complete, then the initialization procedure is aborted.  When this happens, the mount emits a *single* beep.  When initialization is interrupted, the control system will not attempt to drive the motors.  Before attempting to slew or home the mount, make sure the joystick is in the center position, power the mount off then on, and then wait for the two beeps that indicate the mount is ready for normal operation.

The table below describes the different sounds that the mount can emit, when the sound occurs, and a description of what the sound indicates.

| Sound | Occurs | Description |
|-------|--------|-------------|
| Two beeps from about five to ten seconds apart. | Shortly after mount is turned on. | Indicates that the control system has located the DC servomotors "index" position in right ascension and declination.  This means that the control system has initialized the servomotors and is ready for normal operation. |
| Single beep. | When the servomotor initialization is interrupted, shortly after mount is powered on.  One or more blue LEDs is not lit. | Mount servomotor initialization can be interrupted by the following actions.<br>• Pressing and holding the joystick button down and turning on the mount.<br>• Moving the joystick from its center position before the servomotors are initialized.<br>• Attempting to slew or home the mount from TheSky6 Professional Edition before servomotor initialization.  For normal initialization, simply turn on the mount and wait for the two successive beeps, without attempting to control the mount via joystick or TheSky6 Professional Edition.<br>• The Balance Knobs on either axis are too tight, and the servomotors cannot turn (page 40). |

| Three successive beeps. | Shortly after the mount has slewed to the home position in each axis. | Indicates that mount has successfully located the home position for one axis. See "What Is Homing?" on page 34 for more information about homing. |
|---|---|---|
| Variable-pitched hum. | Always. | When the Paramount ME is turned on and initialized, the servomotors emit an audible, variable-pitched sound. This sound is the result of the control system checking and adjusting the position of the servomotors about 3,000 Hz, and is normal. This sound serves as the audible "heartbeat" of the mount, and means that the electronics are powered and functioning normally. |
| Continuous, successive, high-pitched beeps. | May occur when attempting to slew the mount after adjusting one or both of the Balance Knobs. | This sound indicates a control system error condition, which prevents the servomotors from turning. Typical causes include: <br>• Worm/gear tension is excessive. Try adjusting the Balance Knobs. (Page 40.) <br>• Ambient temperature is too low for the current tracking and slew speed settings. (Page 85.) <br>• Payload is out of balance, causing the motors to stall. <br><br>See "Troubleshooting Mount Operation" on page 90 for additional troubleshooting tips. |
| Single "click" or "tic" sound | During serial communications. | The Paramount ME with the MKS 4000 control system will emit a single "click" (or "tic") when serial communications between the mount and TheSky6 Professional Edition are interrupted. Interruption can occur, for example, when a camera is downloading an image, or during other processor intensive operations. <br><br>Notes: <br>• The clicking noise is normal and expected behavior. <br>• The clicking noise is not indicative of any problems with the mount. <br>• There is currently no way to "disable" this audible feedback. |

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## What Is AutoHoming?

AutoHoming is an automated initialization process that slews both the right ascension and declination axes to a mechanically fixed position called the *home position*. The control system *must perform* this step *every time* the Paramount ME is turned on to reestablish the mount's absolute position to the nearest one arcsecond.

*Critical Note*     The home position in the northern hemisphere is located at approximately hour angle 2 and 0 degrees declination.  The home position is a fixed, mechanical orientation and *cannot be changed*; it is defined by the *physical position* of the gears relative to internal homing sensors.  If the mount is not physically pointing to approximately hour angle 2 and 0 degrees declination after the home position is located, then either the Versa-Plate is mounted incorrectly (page 41), or the mount's right ascension axis is not aligned north-south.  If the coordinates of the telescope cross hair in TheSky6 show a different position after homing, then TheSky6's time or sync information is incorrect (page 77).

*Critical Note*     *The Paramount ME will not slew or track until the mount is successfully homed.*

When the mount is homed, it slews to the home position and sets the control system's "position registers" to zero.  When star synchronization is performed, the hour angle and declination of the home indexes are stored in the internal flash of the Paramount ME's control system.  Subsequent sessions simply use the local sidereal time, as computed by TheSky6 Professional Edition, to accurately determine the mount's equatorial coordinates.  Make sure TheSky6's time is accurate (see page 51).

Homing provides the following benefits.

- Once a mount is aligned with the celestial pole and homed, extremely repeatable and accurate pointing can be achieved using TheSky6 Professional Edition and the TPoint Telescope Pointing Analysis software.
- After homing, the mount "knows" its orientation and therefore cannot be slewed into the pier. The right ascension limits are approximately 5 degrees past the meridian in each direction (east and west) and in declination the limit is approximately –90 degrees declination.
- The periodic error correction (PEC) function uses this information to calibrate the control system's internal PEC table with the orientation of the worm gear.
- You can quickly recover from power outages or other communication malfunctions.

### Homing the Mount Using the Joystick

To home the mount using the joystick, make sure the mount is powered, and the servomotors are initialized (see page 33), then deliberately tap the button on top of the joystick handle twice.  If you move the joystick during the homing procedure, the mount stops slewing and homing is aborted.  Left-right motion causes the RA axis to stop slewing; forward or backward motion causes the declination axis to stop slewing (see Figure 18).

### Homing Troubleshooting

Remember, the home position is a mechanically fixed orientation near hour angle 2 and declination 0.  If, after homing the mount, TheSky6 Professional Edition reports that the mount is pointing elsewhere, then the mount is not synchronized correctly.  See "Synchronizing the Paramount ME" on page 74 for more information about synchronizing the Paramount ME.

### *The Joystick*

In addition to homing the mount, the joystick can be used to manually slew each axis.
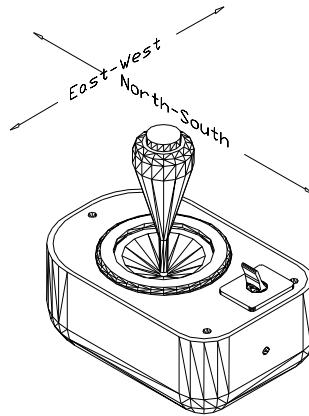
Figure 18: Slewing the Paramount ME with the joystick.

The speed of the slew increases the further the joystick is moved from the center position. A total of fifteen different speeds are traversed as the joystick handle is tilted from center to the outer limit. The first two speeds are slower than the sidereal rate, and they increase up to the maximum speed, as specified in the Bisque Telescope Control System ™ (TCS) Setup dialog box (page 58).

The joystick box has a built-in red LED "flashlight" for use at the telescope. The switch on the top of the joystick control box turns this LED on and off.

### Replacement Joystick Switch Information

Use the information below to order a replacement joystick switch if necessary.

Manufacturer: Omron Electronic Components (http://www.components.omron.com)
Manufacturer Part number: B3W-1050
Mouser Electronics (http://www.mouser.com) part number: 653-B3W-1050

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## *Connecting the Paramount ME to Your Computer*

TheSky6 Professional Edition can control the Paramount ME using either Universal Serial Bus (USB) or RS232 interface.

### USB or RS232 Interface

The Paramount ME can communicate with a personal computer using a standard RS232 serial port, or by USB port. Before the Paramount ME can be controlled via USB port, you must install the *MKS 4000* USB driver first. See "Appendix E – USB Driver Installation and Use" for details. (Page 109.)

### Quick Start for Experienced Users

For this section, an experienced user is someone who is familiar with the operation of a go to telescope.

1. Connect the Paramount ME to your computer using the supplied RS232 or USB cable (USB drivers must be installed first), then turn on the mount.
2. For TheSky6 Professional Edition, click **Telescope > Setup**.

3. On the **Telescope or Control System Name** list, select **Paramount ME by Software Bisque** and then click **Settings**.
4. On the Settings dialog box, select the appropriate **COM** port from the list and then click **OK**.
5. Click **Close**.
6. Click **Telescope > Link > Establish** to establish communications with the Paramount ME.

See "Paramount ME Initialization" on page 50 for additional information.

## Homing the Mount Using TheSky6 Professional Edition

Upon establishing a link with the Paramount ME, TheSky6 Professional Edition displays the dialog box in Figure 19 when the mount has not been homed.
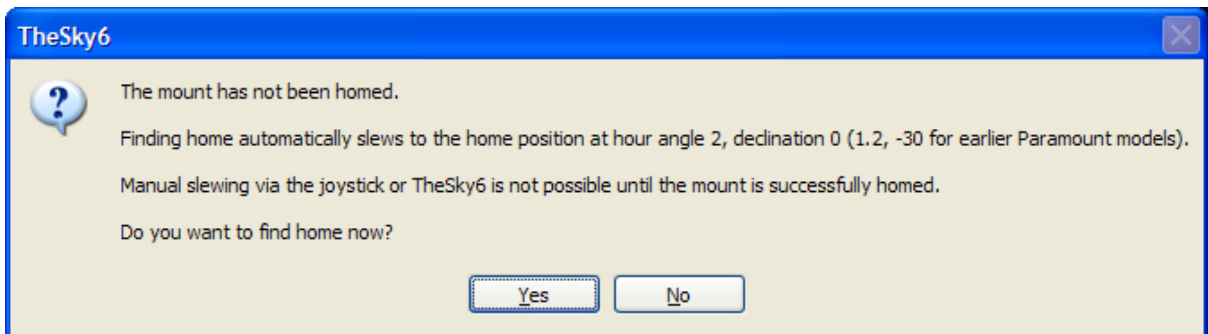


Figure 19: TheSky6 Professional Edition's Find Home dialog box.

Click **Yes** to home the mount. To home the mount at any time using TheSky6 Professional Edition, click **Telescope > Options > Find Home**. See "Quick Start" on page 73 for more information about homing.

The mount can now be controlled from TheSky6 Professional Edition. For practice, click **Telescope > Motion Control** and use the direction buttons to slew the mount so that the counterweight shaft is vertical (when viewed from the rear of the mount).

## Determining the Paramount ME's Equatorial Coordinates

The Paramount ME does not employ conventional "setting circles." Instead, use TheSky6 Professional Edition to determine where the mount is pointing. From TheSky6 Professional Edition, click the Status Bar command from the View menu, mark the Telescope Position option and then click OK. The equatorial coordinates of the telescope are displayed in the Status Bar.

## *Adding Counterweights*

Counterweights should be added to the counterweight shaft only if the counterweight shaft is vertical, or the right ascension gear and worm are disengaged. See "Disengaging the Worm" on page 41 for more information.
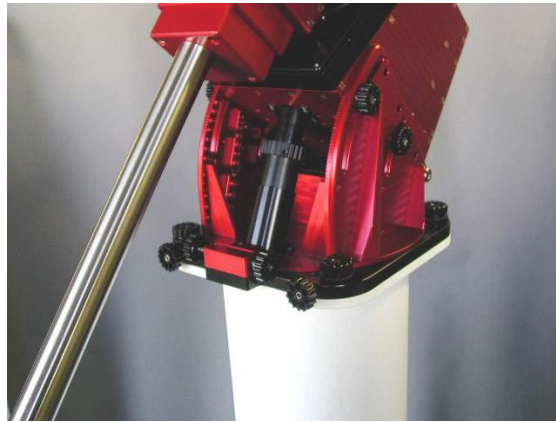
Figure 20: Orientation of the counterweight shaft that exerts the minimum stress on the worm.

| *Note* | *Add the estimated amount of counterweight to balance your equipment before attaching the optical tube assembly to the Versa-Plate.* |
|---|---|

The amount of counterweight required to achieve balance depends on the weight of the optical tube assembly and accessories. Estimate how much counterweight is required, and then add this amount to the counterweight shaft. Err on the heavy side. That is, better the counterweights "outweigh" the optical tube assembly by being too far down the shaft. This way, when fine-tuning the balance, the counterweights will tend rotate downward, instead of your expensive optical tube assembly.

Once sufficient counterweights are added, the right ascension axis should be very "bottom heavy." At this point, adding the optical tube assembly should result in a system that is somewhat close to being balanced.

After the counterweights are added, firmly tighten each of the counterweight knobs to ensure they do not slip. Also, make sure to install the counterweight safety knob on the bottom of the counterweight shaft.

| *Safety Tip* | **Each counterweight weighs approximately 9 kg (20 lb). Use extreme caution so that you do not accidentally drop one and injure yourself or others!** |
|---|---|

Depending on the size and weight of your optical tube assembly (OTA), you might want to solicit a friend (or two) to help lift, orient and attach this component. The Losmandy dovetail mounting brackets provide a stable mounting interface for most off-the-shelf OTAs. Be sure to sufficiently tighten all mounting screws.

To limit the stress placed on the right ascension gear teeth while attaching the OTA to the declination plate, the right ascension axis should be rotated so that the counterweight shaft is vertical as shown in Figure 20. Then estimate the amount of counterweight that is required and mount it to the counterweight shaft. In this configuration, the out-of-balance system is in a static state and the gear teeth are not supporting the entire load of the counterweights. Once the counterweights are in place, the OTA can be attached.

Great care should be taken to center the mass of the OTA near the center of the declination axis. Depending on the type of hardware used to attach the OTA, this adjustment can be made during attachment or by moving mounting rings prior to lifting the OTA to the Versa-Plate.
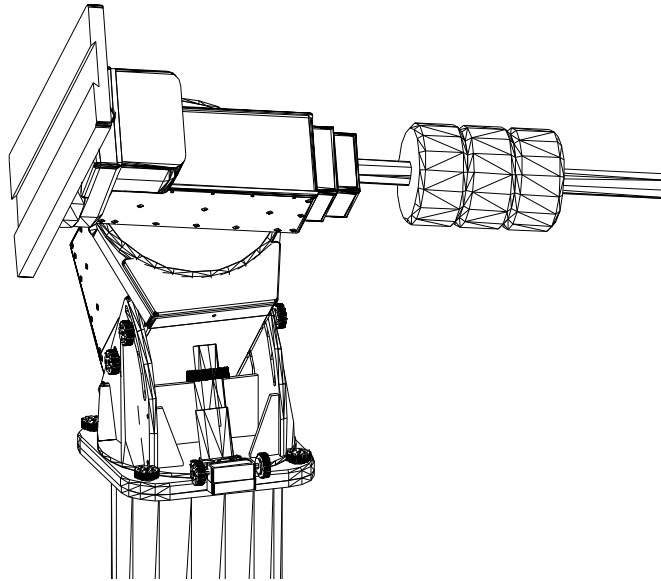
Figure 21: This figure shows a Paramount ME that is ***dangerously*** out of balance.

| | |
|---|---|
| *Caution!* | ***Never*** **position the Paramount ME in the above orientation when the worm gear is engaged!** |
| | The Paramount ME, as pictured in Figure 21, is in an ***unstable*** configuration and places extreme torque on the right ascension gear teeth. The counterweight shaft should remain in the vertical position while the Paramount ME is loaded with counterweights and the OTA has not yet been attached. This minimizes the torque on the right ascension gear teeth and ensures the mount is in a stable position at all times. |

### Balance the System

Attach your CCD camera and all other equipment (focuser, filter wheel, field rotator, dew heater, etc.) to the optical tube assembly while balancing the mount. The telescope will operate best when properly balanced. An unbalanced system can cause numerous problems, such as stalling or "gear chattering" during slews. There is no clutching mechanism on the Paramount ME. To achieve balance, disengage the worm from the gear in each axis, and then adjust the position of the counterweights on the counterweight shaft.

| | |
|---|---|
| *Caution!* | *Always use extreme care when balancing the telescope! Make note of the weight distribution on the telescope before disengaging the worm block assembly from the gear. Always firmly grasp the OTA or counterweight shaft before disengaging the worm and gear so that you maintain control of the telescope.* |

The telescope could be damaged, or you could be seriously injured whenever the worm gear is disengaged from the main gear on an unbalanced system.

The Paramount ME comes with two 9 kg (20 lb.) counterweights to balance the optical tube assembly. To balance the right ascension axis, slide the counterweights up or down the counterweight shaft until the system has no tendency to rotate in either direction.

If you use multiple detectors, such as a video camera to map, and a CCD camera to image, the difference in weight might be enough to cause slewing problems when the detectors are swapped. In this situation, you can quickly rebalance a system without disengaging the worm and gear by marking various positions of counterweights on the shaft for different configurations. It is very important not to change the system after telescope mapping has been completed and a pointing model using TPoint has been created.

The worm blocks on the Paramount ME can permanently disengage the worm from the gear while balancing the system. Though it is always a good idea to have a second person available to help hold the OTA during balancing, this mechanism allows a single person to achieve balance.
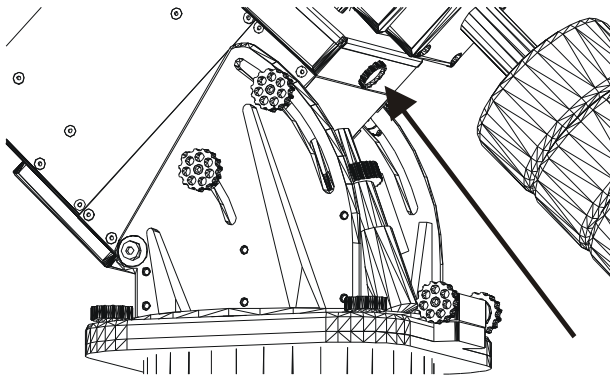


Figure 22: Location of the RA Balance Knob.
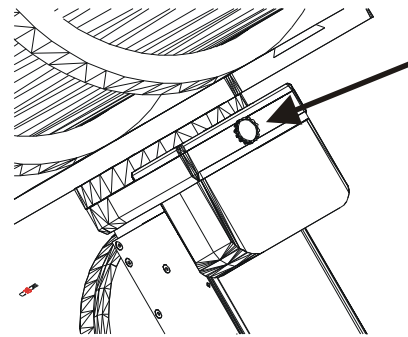
Figure 23: Location of the Declination Balance Knob.

### Balance Knobs

The Balance Knobs serve a dual purpose. When turned clockwise, they pull the worm away from the gear, allowing free rotation of the axis so that the mount's payload can be balanced. When turned counterclockwise, they hold the worm into mesh with the gear, preventing disengagement. The adjustment of this knob, discussed below, is straightforward but very important.

| | |
|---|---|
| *Caution!* | *Always be extremely careful when disengaging the worm from the gear! If the mount is out of balance and not properly secured, you could be injured, or your equipment could be damaged when the axis rotates freely and the heavy end comes to rest at lowest point.* |



## CW=Disengage        CCW=Engage
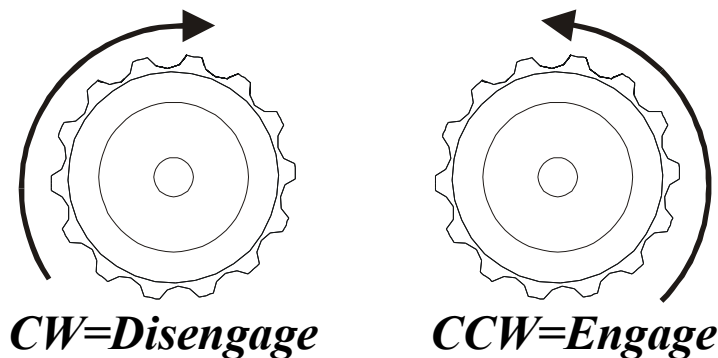
Figure 24: Turn the Balance Knobs clockwise (CW) to disengage, and counterclockwise (CCW) to engage the worm.

**Disengaging the Worm**

To disengage the worm for balancing, make sure you've secured the mount by grasping the counterweight shaft, and then turn the Balance Knob clockwise about 1-1/2 turns. The axis can now rotate freely. The worm will remain disengaged until you re-engage it by rotating the knob in the counterclockwise direction. Before letting go of the counterweight shaft, verify that you have completely disengaged the worm from the gear by very slightly moving the counterweight shaft. Any resistance to rotation means that the worm is not fully disengaged.

**Engaging the Worm**

To engage right ascension axis worm with the gear, first make sure that the axis is balanced properly. Then firmly grasp the counterweight shaft with one hand while turning the RA Balance Knob counterclockwise until you feel the worm and gear make contact. Gently wiggle the right ascension axis using the counterweight shaft to be sure the worm is actually seated into the gear. Again, turn the knob counterclockwise to a full stop.

Once the knob has been rotated counterclockwise to a full stop, rotate it clockwise about one knob click (that is, 1/10 of a turn). This holds the worm very close to the gear and does not allow separation if the mount is out of balance. It also does not force the worm against the gear, which can bind the servomotors.

Note that internal spring plungers on the worm gears apply the actual force that holds the worm into the gear. That is, the balance knobs' purpose is to disengage the worm from the gear and to keep the worm block assembly from disengaging from the gear. The Balance Knobs *are not* used to adjust tension between the worm and the gear. However, the Balance Knobs can be over tightened and bind the servomotors.



Figure 25: RA Balance Knob

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# Attaching the Optical Tube Assembly to the Versa-Plate

## *Dovetail Use*

The Versa-Plate has four knobs to adjust brass plungers that apply pressure on the telescope dovetail. Smaller optical tube assemblies will only utilize two or three of these.

When mounting your OTA, orient the long dimension of Versa-Plate parallel to an East–West line, with the counterweight shaft vertical. When the Versa-Plate is in this orientation, you can mate the dovetails

without the risk of the OTA "falling out." We recommend placing the Versa-Plate knobs "uphill" (that is, with the telescope pointing to the west) so that when they are tightened, you are not trying to lift the OTA.

### Attaching OTA Mounting Rings

The four separate mounting configurations provided on the Versa-Plate accommodate several popular OTA mounting ring systems. The holes are drilled and counter-bored for ¼-20 SHCS (socket head cap screws).

### Cable Channel

The underside of the Versa-Plate has a channel to make room for the "through the mount" cables. Additional cables and accessories (such as video, USB, camera cooling hoses, etc.) can be run through the mount. See "Through the Mount Cabling" on page 53 for more information.

<div align="center">∽</div>

# Initial Polar Alignment

There are numerous methods for estimating the approximate altitude and azimuth settings before starting the polar alignment procedure. Ideally, you will want to get each axis to within one or two arcminutes for portable setups, or to better than an arcminute in each axis if you have a permanent installation.

### Altitude Adjustment

The altitude-positioning device is used to adjust the altitude of the mount. The mount sits at altitude 15 degrees at the lowest setting and 58 degrees at the highest setting. One rotation of the altitude positioning device moves the mount about one degree. Therefore, each "tics" on the altitude positioning handle is equal to two arcminutes of movement.

### Azimuth Adjustment

The Paramount ME uses an innovative design that allows you to adjust the mount's azimuth without changing its altitude. The base plate consists of an outer, fixed plate and an inner rotating plate on which the mount sits. Adjustment in azimuth is achieved by turning the "azimuth adjustment knobs" at the front of the mount (see Figure 26).
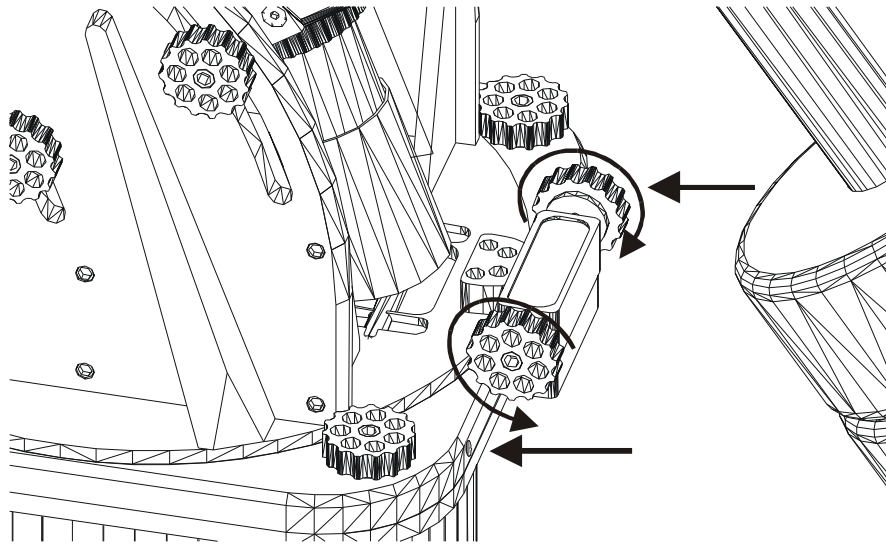
Figure 26: Azimuth adjustment knobs and tensioning screws.

The two azimuth adjustment knobs work in opposition – one must be loosened before the other can be tightened. The knob that is tightened rotates the wedge assembly; the knob that is loosened gives "room" for the mount to rotate. Note that a fully loaded mount may make tightening the knobs by hand difficult. If this is the case, insert a 5/32 Allen wrench into the center of the adjustment knob to assist rotation. Provided the opposite knob is loose, the mount will rotate without having to exert excessive force.
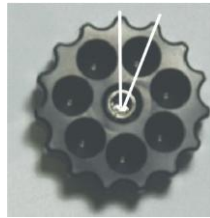


Figure 27: Each high spot or "tic" on the azimuth adjustment knob represents two arcminutes azimuth adjustment.

The azimuth adjustment knobs are calibrated. One rotation results in 30 arcminutes of azimuth adjustment. Therefore, each "knob-tic" (that is, each high point on the knob itself, see Figure 27) equals two arcminutes.

## Azimuth Tensioning Screws

The two azimuth tensioning screws can be adjusted by inserting a hex wrench into the front of the Paramount ME base plate (the two straight arrows in Figure 26). These tensioning screws push pliable Delrin plungers against the internal rotating wedge plate. This means that you can continue to tighten the azimuth tensioning screws without ever feeling a hard stop, so be cautious not to over tighten them.

Adjustment to the azimuth can be performed without loosening the azimuth tensioning screws, but can make turning the azimuth adjustment knobs difficult. Typically, the azimuth tensioning screws are loosened by about one turn before making azimuth adjustments. Once you are satisfied with the polar alignment in azimuth, retighten the azimuth tensioning screws.

Note that each tic on the azimuth adjustment knob represents two arcminutes of rotation of the base plate (Figure 27). These calibrated knobs are especially useful when making quantitative azimuth adjustments that are recommended by TPoint's polar alignment command.

## Additional Azimuth Adjustment
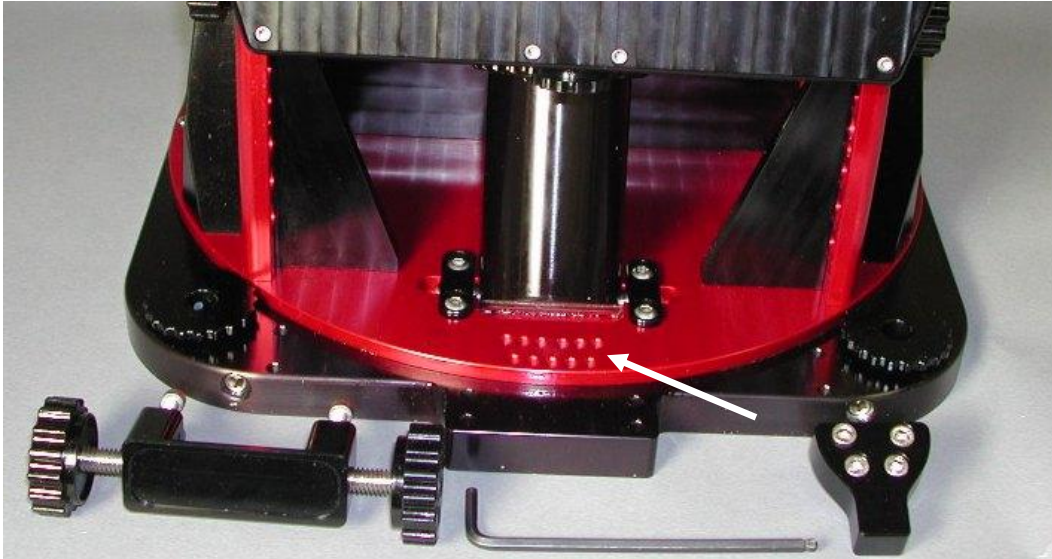


Figure 28: The azimuth "nosepiece" can be repositioned for additional azimuth adjustment.

If you need additional azimuth adjustment, there are two additional sets of mounting holes for the azimuth adjustment "nosepiece" that allow for about two degrees azimuth adjustment in either direction.

The "nosepiece" is the black anodized part that protrudes into the azimuth adjustment block (see Figure 28), by which the mount is rotated. Loosen the two azimuth adjustment knobs and remove the four hex screws from the adjustment knob-mounting bracket. These screws are accessed from the bottom of the mount.
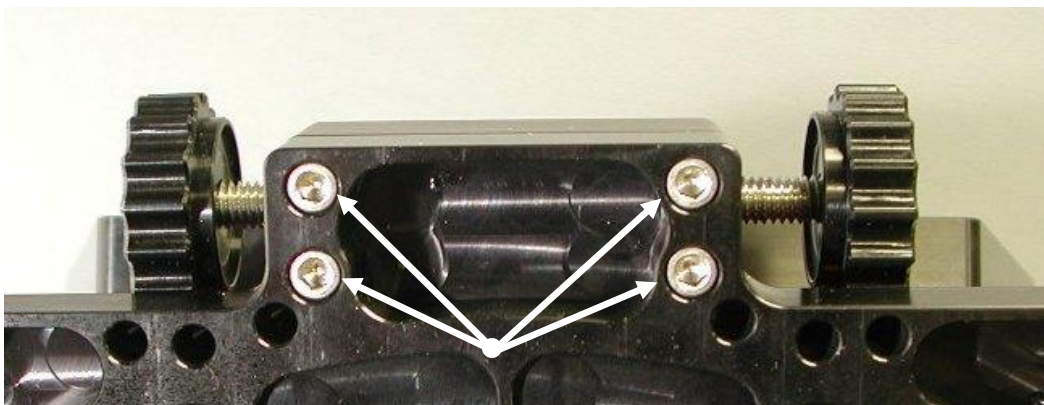


Figure 29: Remove these four screws to access the azimuth nosepiece. (View from the bottom of the mount.)

Next, remove the four hex screws that hold the nosepiece in place. You'll see the additional sets of mounting holes beneath this piece. Remount the nosepiece in the holes that give you the desired azimuth adjustment.

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# Paramount ME Quick Polar Alignment Method

The Paramount ME contains homing sensors that can be used to aid in the first step of polar alignment. Each time the Paramount ME is homed, it returns to the exact same position (that is, to the nearest encoder tic, or a fraction of an arcsecond). This position is very near hour angle 2 and declination 0. This represents a point in the sky two hours west of the meridian on the celestial equator.

Although the mount homes to the exact position each time, the home position is not precisely at hour angle 2.0000 and declination 0.0000. This is in part due to consistency of the position of the emitter-detector pair in the home sensors. Additionally, if the main optic of the system is used for star sighting, it will have inherent non-perpendicularity errors. Therefore, the following procedure can be deemed "very good" as far as estimating polar alignment; however, TPoint should be used to more accurately refine the polar alignment.

For portable operation, if the OTA is attached to the Paramount ME in a consistent manner, the following procedure can result in accurate polar alignment each time the Paramount ME is set up. When the star synchronization is performed, it represents a calibration of many of the polar alignment offset errors.

## *Step-By-Step Procedure*

*Step 1*    *Level the mount, and adjust the Paramount ME's altitude and azimuth as close to the celestial pole as possible.*
In general, the mount need not be level to achieve extremely precise pointing and tracking. However, leveling the mount is required to get good polar alignment using the following alignment technique. Once the mount is level, set the Paramount ME's altitude to the latitude of the observing site (page 42).

*Step 2*    *Make sure that TheSky6 Professional Edition has the correct date and time information, and then Home the mount by clicking Telescope > Options > Find Home.*
TheSky6 Professional Edition can compute the local sidereal time (LST) and therefore knows the current equatorial coordinates of the telescope (to plus or minus ten arcminutes for a mount that is aligned to the pole).

*Step 3*    *Slew to a bright star or planet near the celestial pole.*

Technically, the object should be within five degrees of the pole, or, below the pole and within five degrees of the meridian. Choosing a star elsewhere will introduce spurious adjustments, partly in lieu of hour angle synchronization error, partly because the motion of the star will be insensitive to adjustments in the mount's polar axis.

Take, for example, a star near the zenith. Although the elevation adjuster will work fine, the one in azimuth will not – you can rotate it to your heart's content and the star will not move. A less likely example is a star low in the west or east where adjustments in elevation will not appear to do anything.
For now, we're just trying to get "close" to the pole.

Locate a visible bright object in the sky, preferably one close to celestial equator, and instruct the Paramount ME to slew to that object. This step can even be performed during daylight hours if you point to a planet or very bright star.

*Step 4*      *Using the Altitude Positioning Device and the Azimuth Adjustment Knobs, center the object in the field of view.*

Using the precision altitude/azimuth adjustments on the Paramount ME, adjust the altitude and azimuth (and therefore the telescope) so that the object is centered in the field of view. *Do not use the joystick to slew the mount!*

Remember, the mount and control system are pointing to the correct position for where the object "should be" if the mount was aligned to the pole. Most of the error that caused the telescope to "miss" the object is due to the incorrect polar alignment of the mount.

Now that you have a star centered, you may wish to synchronize the mount on this object. Before doing so, please carefully read "Synchronizing the Paramount ME" on page 74, and note that synchronizing on a star within three degrees of the meridian is not recommended.
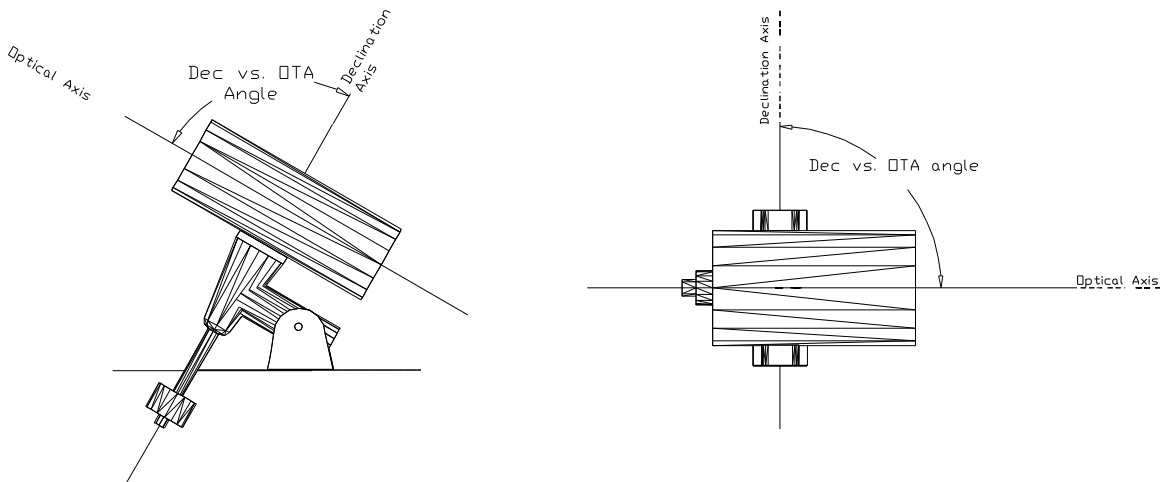


Figure 30: Try to minimize OTA non-perpendicularity errors.

Note that the non-perpendicularity of the telescope and the declination axis also plays a key factor in the quick alignment procedure. If this error is large, the initial polar alignment will not be as accurate. (This error can exceed twenty arcminutes, and makes this procedure less effective.)

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# Precise Polar Alignment

There are many different methods for achieving a precise polar alignment of a telescope system. Unfortunately, many of the more novel approaches assume the telescope/mount system is more or less perfect. Since numerous errors creep into every telescope system, any method that relies on perfect perpendicularity is flawed. As described in the prior section, the optical path is typically non-perpendicular to the declination axis so any method that assumes perpendicularity will be in error.

The old reliable "drift method" does not make these assumptions, but can take hours to complete.

Since an accurate polar alignment is required before the Paramount ME can accurately track objects, the question is, "how accurate?" Subjectively, if the altitude and azimuth are both within two arcminutes of the pole, images that are exposed for few minutes duration can be acquired while maintaining round stars at focal lengths of 2000 mm or so. For the given accuracy of polar alignment, at larger image scales and longer exposures, autoguiding is required since adjustments in both altitude and azimuth are made. Polar alignment becomes increasingly difficult to improve once an axis is within one arcminute of the pole.

## Polar Alignment Using TPoint

Once you have successfully performed a mapping session and developed a TPoint model, you can use TPoint to determine the mount's polar alignment. Use the values computed by TPoint for the *Polar Axis Elevation* and *Polar Axis azimuth (EW)* to make the necessary adjustments to the Paramount ME's altitude and azimuth adjustments. Usually one or two iterations can get each axis within two arcminutes.

## Getting Started Using TPoint

Once you are familiar with the technique of telescope mapping as described in the TPoint User's Manual, you are ready to collect modeling data. If the Paramount ME's polar alignment is way off, even short star-hopping slews may require the destination star to be re-centered in the eyepiece.
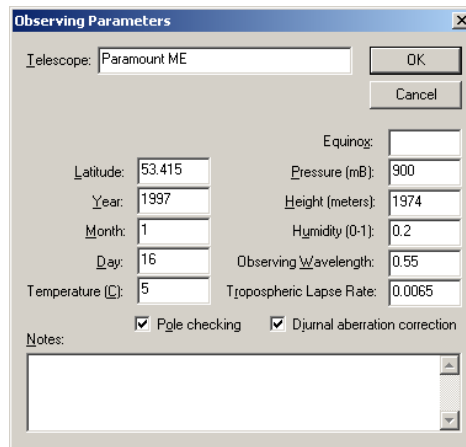


### Telescope Mapping and Polar Alignment Procedure

1.  Set the local time as accurately as possible each night before observing.
2.  Insert a New TPoint model into TheSky6 Professional Edition (**Edit > Insert > TPoint Model**).
3.  After accurately synchronizing the telescope, slew to a nearby star (by identifying the star in TheSky6 Professional Edition and click **Slew To** 🔭 on the Object Information dialog box), center the actual star in the eyepiece, and then click **Map** 🔴 on the Object Information dialog box. This constitutes one data point.
4.  When you have mapped six data points that are close together in the sky, TPoint can begin correcting for errors in the mount and the pointing will improve. Now, you're ready to begin mapping stars over a larger portion of the actual night sky.
5.  After 15-20 data points are collected, add more terms to the TPoint model so that the RMS value is as small as possible. From TPoint, click **Suggest Terms** to quickly determine one to four new terms that improve the pointing most significantly.

6. From TPoint, determine the current polar alignment of the telescope by clicking **Model > Polar Alignment Information.**
7. Adjust the mount according to the TPoint polar alignment information.
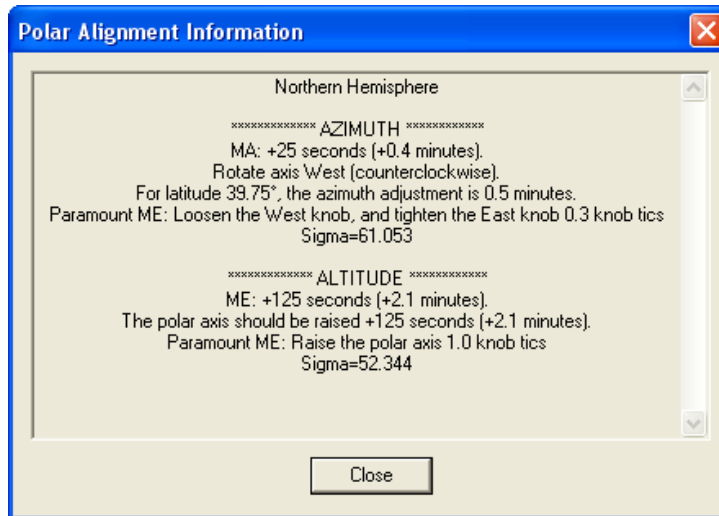


Figure 31: Polar Alignment Information dialog box (TPoint).

Note the specific Paramount ME instructions on the dialog box. These calibrated instructions for the Paramount ME appear only if the **Telescope** text on the **Data > Observing Parameters** dialog box in TPoint reads **Paramount ME** (TPoint version 5.00.504 or later www.bisque.com/download).

After you have carefully made the polar alignment adjustments, delete the TPoint model and start over from Step 2. To remove the red Reference Lines that are created for each mapping run, from TheSky6 Professional Edition, click **Data > User-Defined Data** and then click **Remove All.**

In practice, using at least twenty stars distributed over half of the sky will provide enough information for the first iteration. Note that TPoint generates a statistical model and the values it generates for each of the terms is not an exact value and the correctness of each term is dependent on the entire model. If, for example, there is a large non-perpendicularity of the declination axis and the telescope axis and the CH term is not turned on, the entire model will suffer.

The polar alignment errors are reported on the Polar Alignment Information dialog box in TPoint. Click **Model > Polar Alignment Information** to display the dialog box.

The polar alignment error values can also be extracted from the Fit dialog box as explained below.

The polar axis elevation value (ME) and the polar axis (EW) value (MA) provide an estimation of the polar misalignment in arcseconds. Note that the MA value is the distance in arcseconds at the pole. The actual azimuth angle will be greater as determined by dividing by the cosine of the latitude. This computation is automatically done on the Polar Alignment Information dialog box.

| TPoint Fit Dialog | Meaning | Action |
|---|---|---|
| ME positive (+) | Axis is below celestial pole. | Raise the elevation by turning the altitude positioning device counterclockwise. |
| ME negative (–) | Axis is above celestial pole. | Lower the elevation by turning the altitude |

| | | positioning device clockwise. |
|---|---|---|
| MA positive (+) | Axis is east of celestial pole. | Move the axis west (tighten the east knob and loosen the west knob). |
| MA negative (–) | Axis is west of celestial pole. | Move the axis east (tighten the west knob and loosen east knob). |

For most U.S. latitudes, the actual polar elevation target is not the north celestial pole but rather a point about one arcminute above it to minimize the effects of refraction on longer exposures. See the TPoint User's Manual for a table that displays the offset based on your latitude.

## *Polar Alignment – The Drift Method*

The drift method is an alternative method to achieve polar alignment. Using this procedure, you can achieve very good polar alignment in each axis, though it will probably require considerably more time than using TPoint.

**Drift Method – Azimuth Adjustment**    Locate a star near the meridian (star should be greater than 15 degrees altitude and less than 85 degrees altitude). Determine if the star drifts north or south. If the star drifts north, the polar axis is too far west. If the star drifts south, the polar axis is too far east. Make the appropriate adjustment and repeat the above procedure until the star does not drift for several minutes.

**Drift Method – Elevation Adjustment**    Locate a star near the eastern or western horizon (about 15 degrees altitude) at an hour angle of about 6. If the star is in the east, drift to the north means that the polar axis elevation is too high, while drift to the south means that polar axis elevation is too low. If the star is in the west, reverse these. Continue making adjustments until the star does not drift for 10-20 minutes.

Once you are familiar with TPoint, it provides the best analytical method for determining polar alignment. However, until a TPoint model is established with all of the terms necessary to achieve good pointing, the polar misalignment terms provided by TPoint can be misleading. Again, using 20 or more stars distributed over at least half of the sky should provide good estimates of the actual polar alignment.

### Using a Calibrated Video Display

Although the Paramount ME wedge provides a very accurate means for adjusting the polar axis, the feedback provided by a calibrated video monitor can be extremely valuable when making minute adjustments (less than five arcminutes).

You can actually make polar alignment adjustments to the Paramount ME without significantly loosening the locking knobs (altitude) or screws (azimuth).

When using video feedback for making polar alignment adjustments, pick a star near the celestial equator within an hour of the meridian.

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# Paramount ME Initialization

This section describes the steps necessary to initialize the Paramount ME on the first night of operation and on subsequent nights.

| *Tip* | Discussions related to TPoint modeling, mount initialization, and parking might seem daunting at first. However, these steps are required to achieve consistent, accurate pointing from night to night. |
| --- | --- |
| | In turn, accurate pointing allows enhanced functionality such as scripted operation and imaging without the burden of re-centering objects. Remember, if you wish to simply dead-reckon for an evening without mapping, simply start the telescope and go! The Paramount ME's unmodeled pointing accuracy should exceed virtually every commercial "go to" telescope. |

| *Southern Hemisphere Operation* | See Appendix D – Southern Hemisphere Setup and Use on page 107 for detailed instructions about configuring TheSky6 Professional Edition when operating the Paramount ME in the Southern Hemisphere. |
| --- | --- |

You'll need to perform a few simple initialization procedures with each use so that the Paramount ME can maintain accurate pointing.

## Homing

The Paramount ME can be initialized to exactly the same position using a process called *homing*. Essentially, the homing procedure slews the mount to an absolute position. Using this *home position* and an accurate time base (obtained from TheSky6 Professional Edition), the control system can be initialized very accurately from session to session. Homing provides many other benefits.

- Homing (page 34) permits software imposed slew limits, or "soft limits," so the mount cannot run into the pier, even if an improper synchronization occurs.
- Once a mapping run (page 47) has been completed, the Paramount ME can maintain extremely accurate pointing without additional synchronization.
- In the event of a power outage or other interruption, the mount can always be accurately reinitialized.
- After performing a synchronization (page 74), use the home position to do a quick "reality check" to be sure the time entered in TheSky6 Professional Edition is reasonable.

Once the mount is homed and a TPoint model is built, subsequent sessions only require accurate time to achieve excellent pointing.

In the table below, each of the operations that are required for performing an initialization are listed along with the time needed to accomplish the operation. Please note that the time estimates listed for mapping are for an experienced user. First time mapping runs may take considerably longer.

| Operation | Time required for an experienced user |
| --- | --- |
| Setting the computer's clock | Less than one minute |
| Performing a mapping run | Twenty to 120 minutes (using video or automated mapping) |
| Performing a short mapping run | Five to fifteen minutes |

| Homing | Less than two minutes |
|--------|----------------------|

As you can see, mapping takes the most time. The short mapping run is identical to a normal mapping run except that only 6-12 stars are mapped.

### Why is Maintaining Accurate Time Important?

You can achieve very accurate pointing during a single session without having an accurate time base (that is, if the computer's clock accurate to one or two minutes). However, TheSky6 Professional Edition makes decisions on how to slew to various positions in the sky based on the local time. Objects that are to the east of the meridian require the telescope to be on the west and vice versa (except in the "below-the-pole" case).

*Tip*    *Always do a quick "reality check" by comparing the coordinates of objects in TheSky6 Professional Edition with objects in the night sky. If TheSky6 Professional Edition's Data > Time settings are incorrect, the two will not match!*

Initializing the Paramount ME requires a very accurate time base. TheSky6 Professional Edition uses the computer's clock to compute the local sidereal time (LST). When a link is established between TheSky6 Professional Edition and the "homed" Paramount ME, the LST is used to re-establish the synchronization between the Paramount ME's electronic setting circles and the celestial sphere to within a few arcseconds. Provided the computer's time is accurate, this means that you can just power-up the mount, home, and then start imaging each night.

## Setting the Computer's Clock

The best method to accurately set your computer's clock is with "time server" software. Remember, each second of time translates to fifteen arcseconds of angular distance near the celestial equator. So, telescope pointing will degrade if time is not accurately set from night to night. Inaccurate time causes the mount to slew to objects ahead or behind objects in right ascension by a consistent offset. Software that periodically resets your computer's clock using an accurate time base solves this problem.

There are many web-based programs that can be used to maintain accurate time. Windows XP Professional, for example, has an Internet time server as part of the operating system. If you're using a different operating system, Software Bisque recommends Dimension 4 from Thinking Man Software (www.thinkman.com). Search the web for "time server software" to locate alternatives.

## Parking the Paramount ME

Parking is a command that can be issued to the Paramount ME and performs the following operations:

1. After confirmation by the user, the mount is automatically slewed to a user-defined altitude and azimuth coordinate, called the *park position*. (Page 52.)
2. Once the park position is reached, the Paramount ME's tracking is immediately turned off.
3. Communication between TheSky6 Professional Edition and the mount is terminated.

Note that the park position is not used in subsequent sessions for mount initialization.

**Parking from TheSky6 Professional Edition**

From TheSky6 Professional Edition, establish communication with the mount, and then click **Telescope > Options > Park**. You'll be asked to confirm that you want to slew the mount to the park position and park the mount.

## *Defining the Park Position*

Before parking the Paramount ME, you need to define the park position for your telescope. This is the position that the mount will slew to when the Park command is issued from TheSky6 Professional Edition. Please carefully read "Park Position Rules" on page 52.

With a telescope link established, slew the telescope to the desired park position. From TheSky6 Professional Edition, click **Telescope > Options > Set Park Position**. The park position needs to be set once; the coordinates of the mount (in altitude/azimuth) are automatically saved for future parks.

Software Bisque recommends that the telescope be parked as close to the home position as practical. Since the Paramount ME must be homed at power up, the time required to find the home position is reduced when the park position is near the home position.

**Park Position Rules**

- The Paramount ME must be synchronized correctly before you park the mount, or define the park position. Otherwise, the mount will not return to the park position that you define.
- When defining the park position near the meridian, make sure that the OTA is on the opposite side of the meridian as the equatorial coordinate of the park position. In other words, never define the park position when the counterweight shaft is "above" horizontal.

  Here's an example of a situation that will cause unexpected parking behavior. Suppose you want your telescope to always park in the same orientation "near" the meridian, with the OTA on the east side (and the counterweights on the west side) of the mount. So, you slew the mount to a location near the meridian that also happens to be on the east side of the meridian, and then define the park position.

  Since the Paramount ME allows the OTA to slew up to five degrees *past* the meridian before flipping sides, you've defined a park position that will cause the mount to slew to a different orientation than when the park position was defined. In this example, when you park the mount, the control system will still park the telescope near the meridian, but with the OTA on the west side (and the counterweights on the east side) of the mount.

- For mounts in the northern hemisphere, do not define the park position from due west to due east (through north), and below the *altitude* of the celestial pole. For mounts in the southern hemisphere, do not define the park position from due east to due west (through south) and below the *altitude* of the celestial pole.

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Figure 32: Paramount ME Adaptor Panel.

# Connecting the Electronics and Power

1. Connect the joystick to the RJ11 jack labeled Joystick on Adaptor Panel. Make sure you do not accidentally use the jack labeled **Guider;** it uses the same connector.
2. Plug the serial cable into the appropriate connector on the Adapter Panel (labeled **Serial to PC**). This connection permits communication between the Paramount ME and the computer. See "Appendix E – USB Driver Installation and Use" for details about using the Paramount ME's USB port.
3. Plug the 48-volt power supply into the jack labeled **48 Volt Power In** on the Base Panel. This supplies power to the Paramount ME. Note: The Paramount ME power supply is designed for indoor use only.
4. Turn on the Paramount ME using the rocker switch labeled **Mount Power** on the adapter panel.

On power up, you will hear the motors seeking for the nearest index on the encoders for several seconds. The telescope may slew up to six arcminutes while searching for this index.

We recommended that you wait to add any additional devices that use the built in "through the mount cabling" system until you are comfortable that the mount is operating as expected under joystick and computer control.

## *Through the Mount Cabling*

The through the mount cabling in the Paramount ME provides a means of passing various cables from the south end of the mount up to through the axis of the mount and out near the telescope eyepiece. This type of cable routing is necessary if you plan on using a robotic telescope system remotely.

The current day "state of the art" CCD imaging system typically has numerous cables draped from the telescope focal plane to the observatory floor. These cables tend to snag as the telescope moves from one part of the sky to another, often causing problems that require user intervention. Running the cables through the mount all but eliminates these cable snagging problems.

### Cabling Supplied with the Paramount ME

The Paramount ME has two built in cables that pass from the Adapter Panel at the south end of the mount up through the axis and into the Instrument Panel on the Versa-Plate.
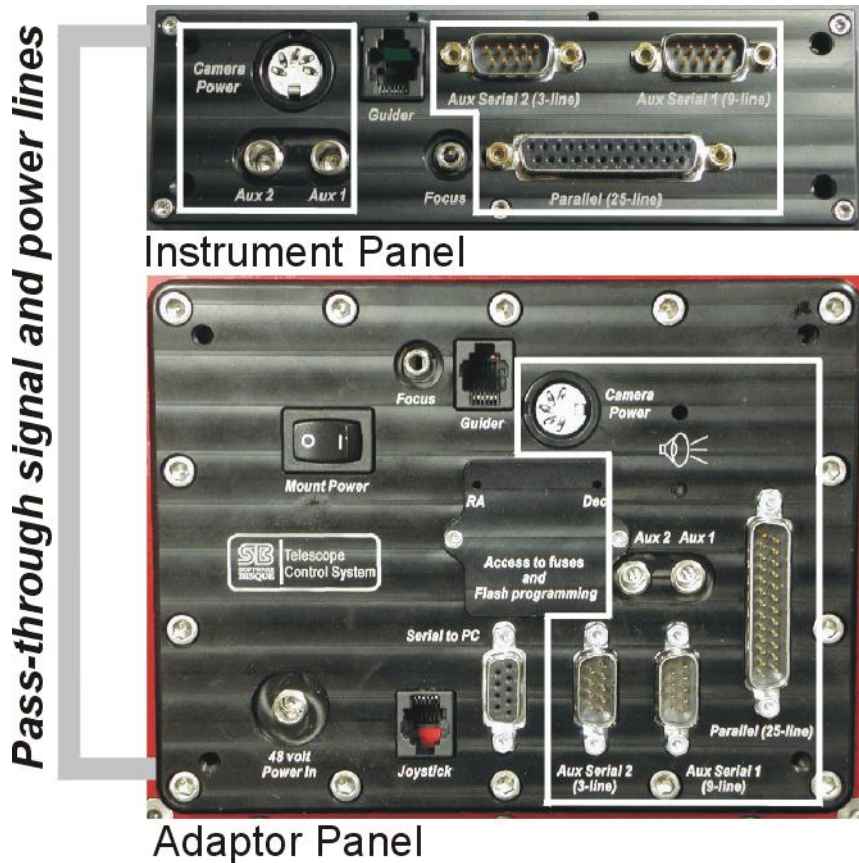
Figure 33: Relationship between Adaptor Panel and Instrument Panel ports.

The outlined areas on this diagram show the connectors that have pass-through wires (that is, no power from the mount is supplied to these cables) in the Paramount ME.

A fifty conductor, 28-gauge round-to-flat ribbon cable carries signals from the Aux 1 Serial (9-line), Aux 2 (3-line) Serial and Parallel (25-line) to the corresponding jacks on the Instrument Panel. An eight conductor 18-gauge cable carries the Aux 1, Aux 2 and Camera Power lines from the Adapter Panel to the Instrument Panel*. The twenty-five line parallel cable is for parallel port-based CCD cameras; camera power is routed through the Camera Power connector.

*Early 2004 Paramount MEs use 22-gauge cables. If your mount is from 2004, please physically inspect the cables on the back of the Adaptor Panel to determine the gauge.

| *Note* | The additional lines in the 50-conductor cable are used to carry focuser and autoguider signals. |
|---|---|

### Cable-Conduit

In addition to the built-in signal and power lines passed through the mount housing, the Paramount ME is designed to provide ample space for additional cabling. Approximately 40 to 50 inches of cabling is required to snake through the mount and allow a small "loop" of cabling inside the declination box. This loop is required so that the declination shaft can rotate freely while the various cables move in tandem with the shaft.
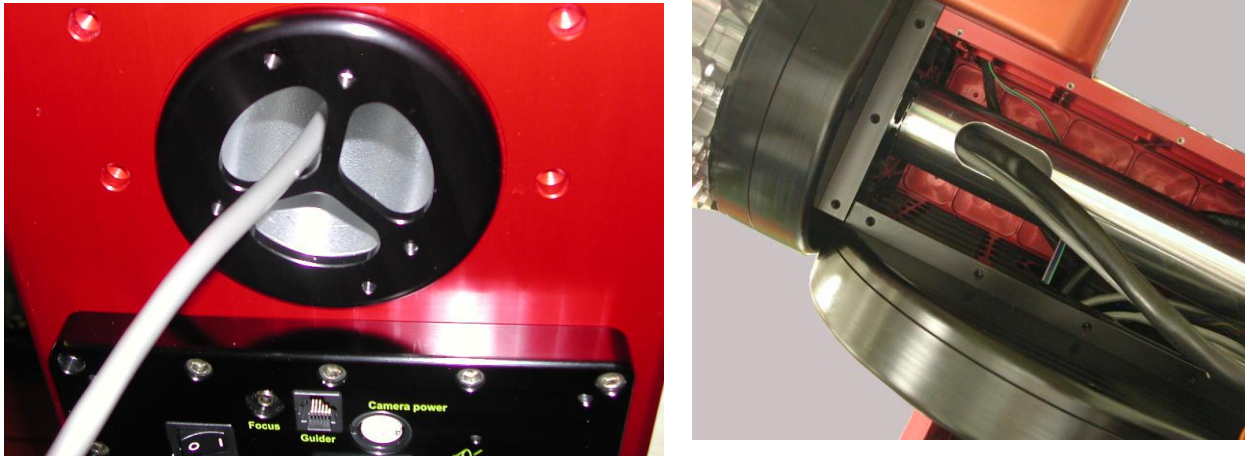
Figure 34: Route of "through the mount" cabling.

Additional cables enter the Paramount ME through the specially designed RA shaft nut on the south end of the mount. From there, they exit the RA shaft inside the declination box where some extra slack in the cable is required before passing the cable up through the declination axis and out through the cable channel on the Versa-Plate.

### Removing the RA and Dec Side Panels

The following procedure describes how to remove the Paramount ME's side right ascension and declination side panels. This procedure is required when adding additional cabling.

*Step 1*        **Preserve the Mount's Elevation Setting**
If the Paramount ME has been aligned to the celestial pole, make a pencil mark on the Altitude Adjustment knob before raising the mount so that you can return the mount to the same elevation (with less than one arcminute of error).

Note the approximate altitude (to the nearest degree) by using the altitude elevation marks on the side of the wedge assembly. Next, make a mark between the rotating Altitude Adjustment knob and the stationary cover on the bottom of the altitude adjustment assembly.

*Step 2*    **Remove the RA Panel**

Remove the RA box panel on the East side of the mount (see Figure 35).  This involves removing eighteen screws:

- Thirteen ¼-in.  flat socket cap screws surrounding the RA panel (numbers 1-13 in Figure 35.
- Five small Phillips flat cap screws, numbers 14-18 in Figure 36) along the bottom of this panel.

Use the short end of the 1/8-in.  Allen head wrench that is provided with the mount to remove the flat socket cap screws.  Use a small Phillips screwdriver to remove the Phillips flat cap screws.

In order to access two (or three, depending upon your latitude) of the Phillips flat head screws, you must increase the mount's polar elevation.  Once removed, these screws can be left out so that future access to the RA box does not require changing the polar elevation.

DO NOT TRY TO REMOVE THE FOUR FLAT CAP SCREWS IN THE CENTER OF THE RA BOX PANEL.  (MARKED WITH A CIRCLED X BELOW.)

Once the eighteen screws are removed, use your fingernails (or other relatively soft, thin material) to separate the top of the RA box panel from the RA box.
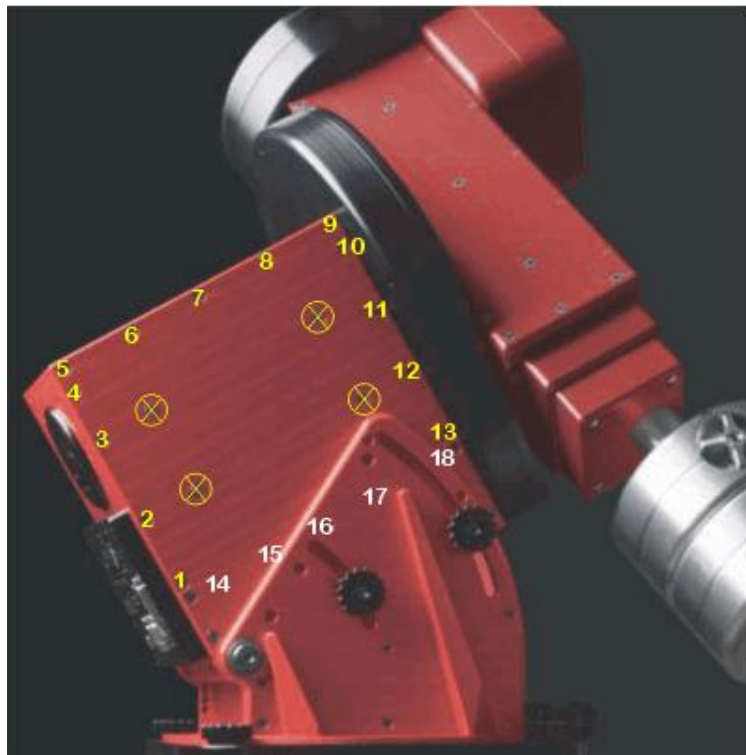


Figure 35: The above photograph shows the location of the screws that must be removed before removing the RA Side Panel.

This photograph is for illustration purposes only.  Please remove all counterweights and the

counterweight shaft before performing this operation.

**Step 3**   **Remove the Declination Box Panel**
Remove the Dec box panel on the East side of the mount (see Figure 36).
This requires removing seventeen screws:

- Eleven 1/2-in. flat socket cap screws surrounding the Dec panel (numbers 1-11 in Figure 36).
- Six socket head cap screws (12-17 in Figure 36) along the "top" of this panel.

Use the short end of the 1/8-in. Allen wrench that is provided with the mount to remove the flat socket cap screws. Use the short end of the 3/32-in. Allen wrench to remove the socket head cap screws.

> DO NOT TRY TO REMOVE THE THREE FLAT SOCKET CAP SCREWS IN THE CENTER OF THE DEC BOX PANEL. (MARKED WITH A CIRCLED X BELOW.)
>
> Once all 17 screws are removed, tighten the 5/64-in. socket head cap screw (number 18 below) to pry the Dec box panel away. The panel should sufficiently separate from the Dec box with a few turns of this screw so that you can remove the panel.



Figure 36: Screws required to remove the Dec Side Panel

This photograph is for illustration purposes only. Please remove all counterweights and the counterweight shaft before performing this operation.

**Step 4**   **Rotate the Declination Axis**
The declination axis must be rotated clockwise (from above) so that the access hole in the RA shaft is accessible.

Use the left hand to firmly grasp the top of the declination axis. Use your right hand to completely tighten the declination balance knob. This disengages the declination worm from the gear. SLOWLY rotate the declination axis counterclockwise until it encounters a hard stop.

*Step 5*        **Add Additional Cabling**

Snake the new cabling up through the mount. Be sure to add a loop around the declination shaft so that the cable as sufficient slack to rotate with the shaft. See photograph below.
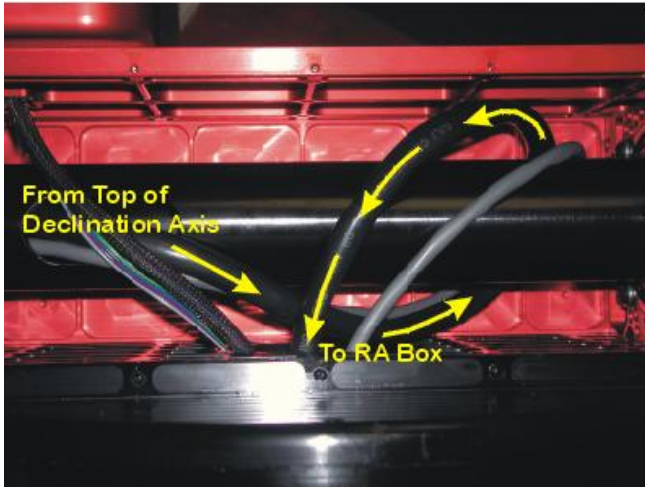


Figure 37: Make sure to loop the cable around the declination shaft.

*Step 6*        **Assemble Mount**

Replace the RA and Dec box panels and firmly snug each screw.

# Interface to TheSky6 Professional Edition

See "The First Night" on page 73 for details about setting up TheSky6 Professional Edition to control the Paramount ME.

Are you using TheSkyX Professional Edition? If so, see "The Paramount ME and TheSkyX Professional Edition" on page 17 for details about operating the Paramount ME from TheSkyX Professional Edition.

## *More Settings Dialog Box*

The default settings for the Paramount ME's control system allow operation right out of the box; typically there is no need to make changes to these settings. However, the control system is very powerful and offers many options, so the default setting of many functions can be altered.
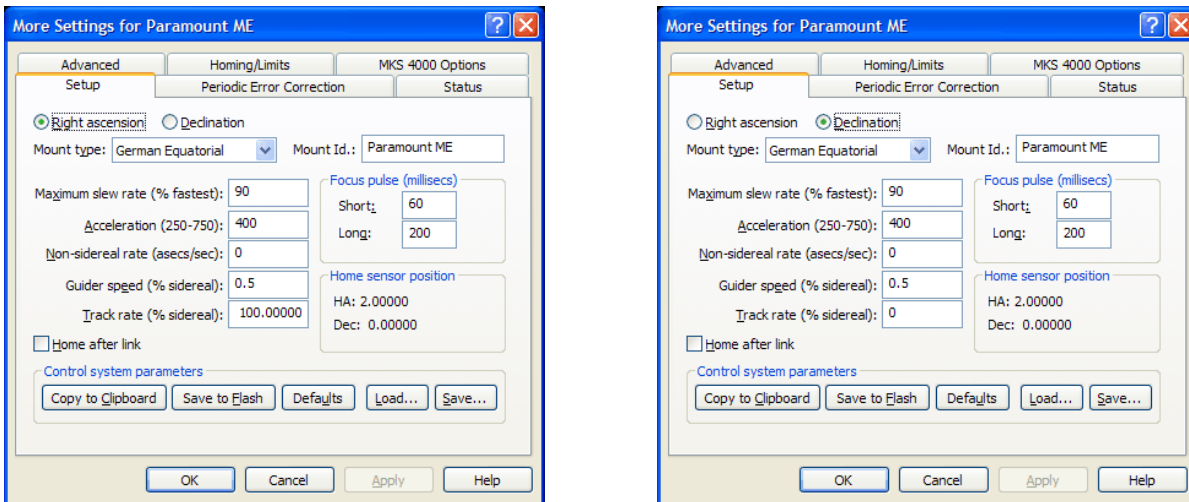
Figure 38: Setup tab (for RA and Declination options) on the More Settings dialog box.

Note that the two dialog boxes pictured above show the default settings for the right ascension and declination axes.

### Mount Type

The Paramount ME is a German Equatorial telescope, so this option should be set to German Equatorial.

### Mount ID

This information is for reference purposes only.

### Maximum Speed

The motors are capable of moving the Paramount ME at approximately six degrees per second in declination and five degrees per second in right ascension. To move at the fastest rate, enter a value of 100% on this input. For large telescopes, these slew speeds are quite fast and values of 50-80% are suggested to minimize wear on components. Or damage, especially in case of a collision with an object in your observatory!

### Acceleration

This prompt allows changing the acceleration/deceleration speeds of the control system. This acceleration eliminates any jolts associated with starting and stopping the large mass of the instrument and counterweights. Values between 250 (slow) and 750 (fast) can be entered here. If you have a very large instrument or just wish to ensure the settling time is minimized, set this parameter to a lower value. If you are trying to catch a gamma ray burst with a lighter optic, you can increase the value.

### Non Sidereal Rate

If you wish for the mount to slew at a rate that is separate from the sidereal rate but cumulative to it, you can enter a value here in arcseconds per second. If you choose a minor planet and select Set Tracking Rate from the Telescope tab, the non-sidereal rate will be set in both right ascension and declination. To set the tracking rates back to normal sidereal, simply click on a star and click **Set Tracking Rates.**

### Guider Speed

This option adjusts the speed at which guider corrections move the motors. The units are fraction of sidereal rate so 0.50 is half of the sidereal rate.

### Track Rate

This input allows you to alter the tracking speed from the sidereal speed. A value of 100 percent causes the mount to track at the sidereal rate.
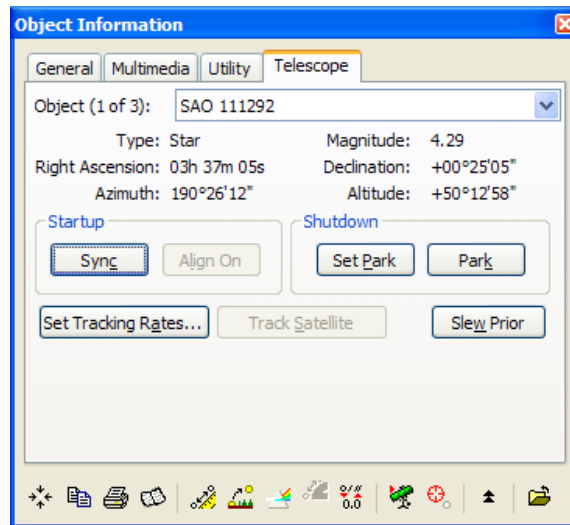


Figure 39: Click the Set Tracking Rates button to track on minor planets, planets and comets.

### Home After Link

When selected, this option automatically homes the mount if it is not yet been homed.

### Focus Pulse

These inputs are used to alter the duration of the DC pulses send to the focuser for the "Slow" focus mode and the "Fast" focus mode.

### Home Sensor Hour Angle and Sensor Declination

When the **Sync** button is clicked, the hour angle and declination of the home position are computed and stored in the flash memory of the control system. For the Paramount ME, these values are approximately hour angle 2 and declination 0 degrees for a mount that is leveled and polar aligned.

Make sure that the telescope is pointing to the correct star. If you click **Sync** when the telescope is pointed to a star other than the one shown in the Object Information dialog, then the hour angle and declination will be incorrect for the geometry of the Paramount ME, and the mount will not slew accurately.

### Save to Flash

When changes are made to the values on the Setup tab, they will remain active until the mount is powered down unless you click the **Save in Flash** button. Note that while the values are saved into flash memory,

the motors are stopped. This does not mean that position information is lost, just that the telescope will stop tracking at the sidereal rate momentarily (approximately one-half second).

## Copy to Clipboard

Click this button to copy the control system parameters report to the Windows Clipboard. To view this text, click the Paste command from the Edit menu of any text editor, such as Notepad. You may be asked to email this information to Software Bisque if there is an issue with the control system. Following is a sample of the information that is copied to the clipboard when this command is used. The comments after the "//"on the right were added by the author.

Software Bisque strongly recommends that you print and save a copy of these parameters for your mount.

```
Bisque Telescope Control System (TCS) Copyright 2002-2005 Software Bisque, Inc.
Mount Id.: Paramount ME    Running at:  3333.333

****************** Axis 0 (RA) Control version: 2.5.19  ******************
Index angle: 1989                                      // Mount dependent number
Base rate: -43067265
Maximum speed: 1080000000
Acceleration: 400
Non-sidereal tracking rate: 0
Minimum position limit: -4960000
Maximum position limit: 1120000
Sensor HA (from sync): 2.0000
Guide: -672926
Tics per revolution: 11520000
PEC ratio: 10
Maximum position error: 1000
Unit Id.: 100
EMF constant: 72
Home velocity high: 660000000
Home velocity medium: 110000000
Home velocity low: 3900000
Home direction, sense: 1100
Home mode, required, Joystick, In-out-in: 2111
Home index offset: 0                                   // Mount dependent number
PEC cutoff speed: 0
Maximum voltage: 15
Maximum gain: 150

****************** Axis 1 (Dec) Control version: 2.5.19  ******************
Index angle: 333                                       // Mount dependent number
Base rate: 0
Maximum speed: 1080000000
Acceleration: 400
Non-sidereal tracking rate: 0
Minimum position limit: -5460000
Maximum position limit: 1700000
Sensor Dec (from sync): 0.0000
Guide: 438102
Tics per revolution: -7500000
PEC ratio: 10
Maximum position error: 1000
Unit Id.: 100
EMF constant: 72
Home velocity high: 660000000
Home velocity medium: 110000000
Home velocity low: 3900000
Home direction, sense: 1100
Home mode, required, Joystick, In-out-in: 2111
Home index offset: 0                                   // Mount dependent number
PEC cutoff speed: 0
Maximum voltage: 15
Maximum gain: 150
```

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## Periodic Error Correction (PEC)

| | |
|---|---|
| *Important Note* | The average periodic error for the Paramount ME is just over three arcseconds peak to peak. Measuring this small error using conventional periodic error measurement techniques offered by TheSky6 can be difficult, since the magnitude of error from seeing normally exceeds the periodic error of the worm.<br><br>Software Bisque offers a powerful periodic error analysis program called *PrecisionPEC*. PrecisionPEC is a Windows-based application that allows you to analyze and quantify the Paramount ME's periodic error using tracking data that is acquired over multiple periods of the worm. PrecisionPEC knows the fundamental harmonics of the mount, and uses them to analyze the tracking data and determine the optimal periodic error curve.<br><br>Once the optimal periodic curve is applied, the typical errors caused by periodic error after applying a PrecisionPEC-generated periodic error curve are about *one arcsecond peak to peak*.<br><br>PrecisionPEC-derived periodic error correction curves essentially make periodic error negligible. Note that PrecisionPEC is sold separately from Software Bisque. Visit http://www.bisque.com/PrecisionPEC for details about this product.<br><br>As such, PrecisionPEC makes TheSky6's Paramount ME-related periodic error correction algorithms (essentially) obsolete. Software Bisque strongly encourages Paramount ME owners to use PrecisionPEC to determine periodic error rather than TheSky6's PEC fitting features described below. |

The Paramount ME's worm/gear drive train has very small periodic error (seven arcseconds peak to peak or less) and the error is very smooth. The *MKS 4000* has advanced periodic error correction (PEC) capability. The majority of periodic error comes from the worm gear and the associated pulley system driving the worm gear.

Great pains must be taken in manufacturing and assembly to reduce the magnitude of the periodic error in any system. Additionally, the worm and gear should be smooth – a necessary requirement for any periodic error compensation function to work effectively.

### Recording the Periodic Error

Recording the Paramount ME's periodic error involves guiding on a star using a CCD camera or manually making guiding adjustments for one revolution of the worm.

Note that the Paramount ME's exceptionally small periodic error may make recording the error difficult. That is, if the atmospheric seeing is poor (two-four arcseconds), you might end up recording errors due to atmospheric noise, rather than from the periodicity of the worm.

The best periodic error recording results are obtained by autoguiding with a CCD camera. In fact, the periodic error of the Paramount ME may be too small for the human eye to reliably detect.
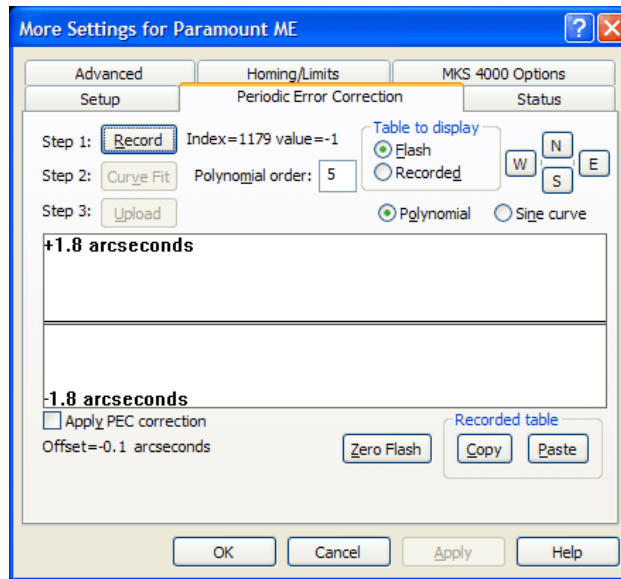
Figure 40: Periodic Error Correction tab on the More Settings Dialog Box (TheSky6 Professional Edition)

## The Periodic Error Correction Tab

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

Click **Telescope > Options > More Settings**, and then click the **Periodic Error Correction** tab to access these options. The Periodic Error Correction tab provides the following options.

- A graphical display of the current periodic error correction (PEC) table read from flash, or a graphical display of the recorded telescope movements.
- A graphical sine or polynomial curve fitting function for generating a smoothed PEC table.
- A real time display of the current "PEC Index" as the worm goes through a revolution.
- Guide-speed telescope adjustments for RA and Dec for manual PEC training.
- The ability to copy the recorded PEC table to the Windows Clipboard so that the data can be pasted into other application (such as Microsoft Excel).
- The ability to paste PEC data from the Windows Clipboard to the PEC graph.
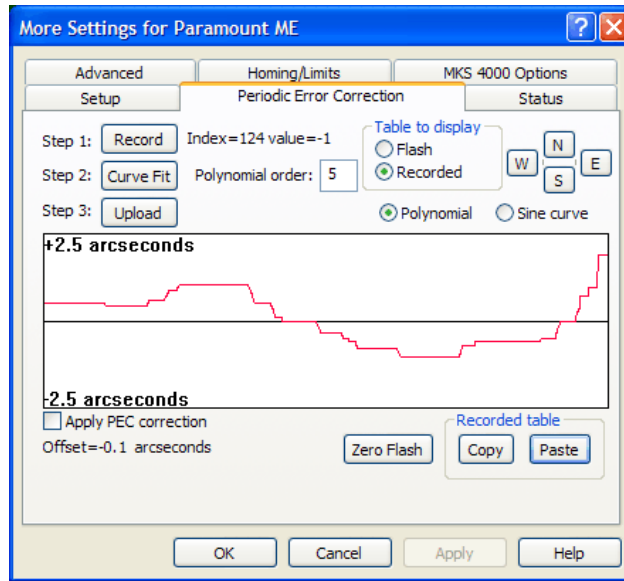
Figure 41: The Periodic Error Correction tab's graph of raw periodic error data (TheSky6 Professional Edition).

## Recording Corrections

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

During the recording phase the angle of the worm relative to where it would be during normal sidereal tracking is measured and stored at a rate of about five times per second. This provides a history of the angle adjustment for a complete rotation of the worm. Note that this function is for correcting periodic error only. For best results, make sure you're mount is well aligned with the pole. If the mount's polar alignment is poor, then you will also observe a drift component in the recorded periodic error data. This drift makes "extracting" the actual periodic error from the recorded data more difficult, and can lead to a less than optimal periodic error correction curve. (This is another reason why Software Bisque developed the PrecisionPEC software described earlier. PrecisionPEC uses periodic error data over several cycles of the worm, and drift from polar misalignment when recording periodic error can be detected and removed.)

The following steps are necessary to successfully train PEC:

1. *Start Autoguiding* – Start autoguiding using a suitable guide star near the celestial equator. Periodic error shows its greatest effects within the range of +15 degrees declination and –15 degrees declination. Choose a star high in the sky (near the meridian) to reduce atmospheric effects. Acquiring data on the west side of the mount ensures you do not run into the "east limit" of German equatorial mounts.
2. *Start Recording* – With the mount initialized and tracking, from TheSky6 Professional Edition, click **Telescope > Options > More Settings**, and then click **Periodic Error Correction** tab. Autoguide for a few of minutes to ensure the system is settled down and to remove the effects of backlash in the worm. When the autoguider is successfully making guiding corrections, click **Record**.
3. *Finish Recording* – Wait until the red status line has crossed the entire graph (about two and one-half minutes) and the **Abort** text reverts to **Record**. Once this is complete, the recorded table is displayed.

4. *Smooth Recorded Table* – Mark the **Polynomial** or **Sine Curve** option. If you've selected the **Polynomial** option, enter a number between 2 and 8 into the **Polynomial Order** text box. Orders of 5-7 seem to provide the best fit. The **Sine Curve** option allows you to adjust the amplitude and phase of the curve by dragging the small white square on the sine curve line. Next, click **Curve Fit** to generate a smooth PEC curve.
5. *Upload the PEC Table to the More Settings* – Click **Upload** to copy the smoothed table from the dialog box into the More Settings.
6. *Turn the Paramount ME Off, then On* – The power on the Paramount ME must be cycled before the new periodic error corrections take effect.

Note that the recording phase of the PEC training only records the periodic error. It does not automatically transfer the recorded table to the *MKS 4000* flash or activate PEC adjustments. To be sure PEC is enabled, don't forget to click the **Upload** button to transfer the table to the telescope control system, and mark the **Apply PEC Correction** option.
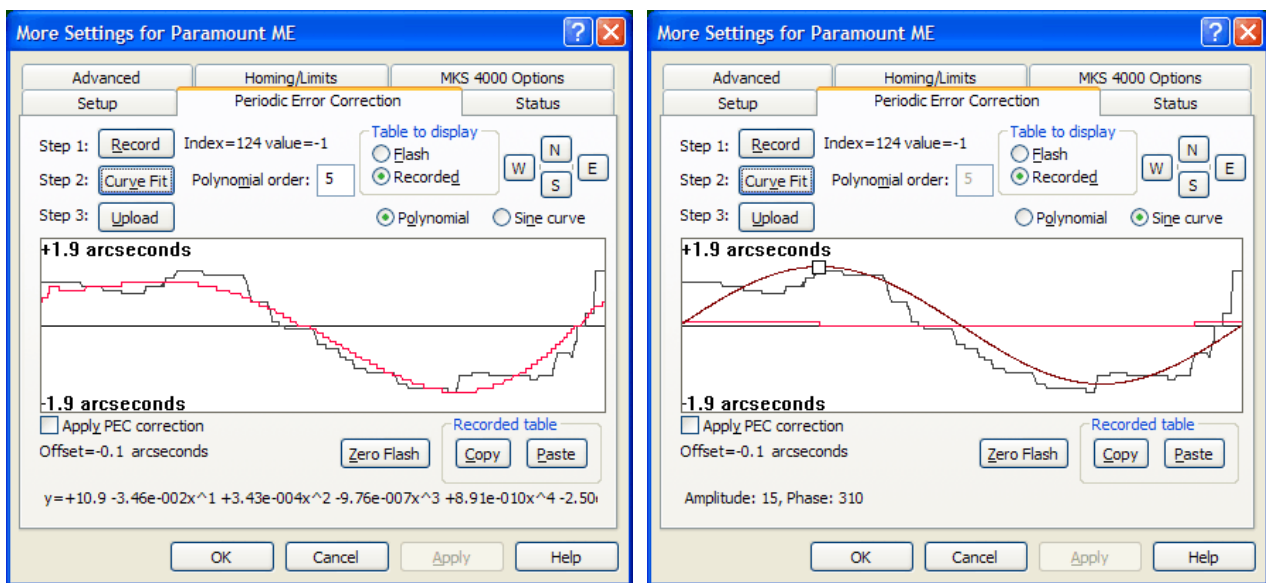


Figure 42: The Periodic Error Correction tab's graph of raw periodic error data with smoothed polynomial and sine curve (TheSky6 Professional Edition).

## Curve Fit: Smoothing the PEC Table

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

Unless the seeing is extremely stable and the autoguiding settings are optimal, the recorded PEC values will contain a considerable amount of noise and therefore must be smoothed before uploading the recorded table into the PEC flash memory on the *MKS 4000*.

## Polynomial/Sine Curve

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

The Paramount ME's motor to worm reduction assembly uses gears with the ratio of 3.3333 : 1 and 3.000 : 1. These additional pulleys add higher order frequencies to the recorded periodic error. Using the **Polynomial** option, the **Curve Fit** button computes a least squares polynomial fit of the order entered in

the **Polynomial Order** text box. The default order is fifth, which will typically result in a very nice curve representing the recorded data.

In addition to the nth order polynomial curve fit, you can also manually fit a sine curve to the PEC data. After recording the periodic error, click the **Sine Curve** option. You will see a small white square plotted in the curve area. Drag this square to change the amplitude and phase of the sine curve. Once you are satisfied with the sine curve data fit, click **Curve Fit** to copy the sine wave into the fitted curve memory. Then click **Upload** to transfer this data into the control system permanent flash memory.

Note: The adjustable sine curve only appears when the **Table to Display** group is set to **Recorded**.

The beginning and end values of the recorded table (that is, the left-most and right-most values on the graph) must be of similar amplitude. If they are not, this may indicate that the polar alignment is poor, causing a significant non-periodic error drift during the recording phase.

Figure 42 shows how the graph looks after clicking **Curve Fit**. Both the original recorded data (the bumpy line) and the computed fit curve are shown. If the higher frequency information is not modeled with the curve, you can change the **Polynomial Order** of the curve to attempt a better fit.

After the **Curve Fit** button is clicked, the equation for the nth order polynomial line, or the amplitude and phase of the sine curve is displayed at the bottom of the dialog box.

## Uploading the PEC Curve

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

Once you have an acceptable fit to the recorded data (if required), it must be transferred to the *MKS 4000*. When you click **Upload**, you will be asked to verify replacement of the existing PEC table.
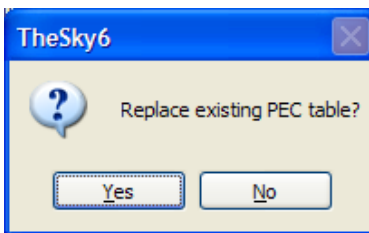


Figure 43: Replace existing PEC table dialog box (TheSky6 Professional Edition).

Click **Yes** to save the PEC curve to the control system's memory. The control system now permanently stores the PEC table and can use it to reduce the effects periodic error while tracking. If you're using the MKS 3000, don't forget to cycle the power on the mount before attempting to use the periodic error corrections!

## Apply PEC Correction

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

Mark the **Apply PEC Correction** option on the **Periodic Error Correction** tab of the **More Settings for Paramount ME** dialog box to enable periodic error corrections. Or, from TheSky6 Professional Edition's main menu, click **Telescope > Options > PEC > Enable** to enable periodic error corrections. Both options perform the same task.

The control system contains a parameter called the "PEC cutoff speed" that allows you to specify the maximum tracking rate at which the PEC table will be ignored. Turning clearing the **Apply PEC Correction** option effectively sets this rate to zero; that is, the PEC table is ignored at all tracking rates.

When the PEC table is activated, corrections are not made at rates greater than twice the sidereal tracking. Interestingly, even small corrections of three to five arcseconds cause an audible (and somewhat annoying) variation to the otherwise smooth sounding motors at higher tracking rates.

**Recorded Table Group**

Please read the Important Note in the "Periodic Error Correction (PEC)" section on page 62 before continuing.

The options in this group apply to the recorded PEC table.

**Copy**

The **Copy** button copies the PEC values to the Windows Clipboard. These units of these values are in encoder tics. The number of entries depends on the PEC ratio computed by the following formula:

*Number of PEC table entries = 125 \* PEC ratio*

So, for the gear reduction system in the Paramount ME, the PEC ratio is 10 (that is, a 10:1 gear reduction before the worm) and the number of PEC table entries is 1,250.

The format of the PEC data can be viewed in Notepad (or any other ASCII text editor) by clicking **Edit > Paste**. It is a simple format, each of the entries are separated by a carriage return/line feed.

**Paste**

This button uses a string of numbers from the Windows clipboard and copies them into the Recorded Table area. You can work to provide a better smoothing in another application or perhaps use multiple tables to come up with a good weighted average. We have found the smoothed tables generated from different parts of the worm to be very similar in shape.

**Zero Flash**

Click this button to erase the Paramount ME control system's existing PEC table.
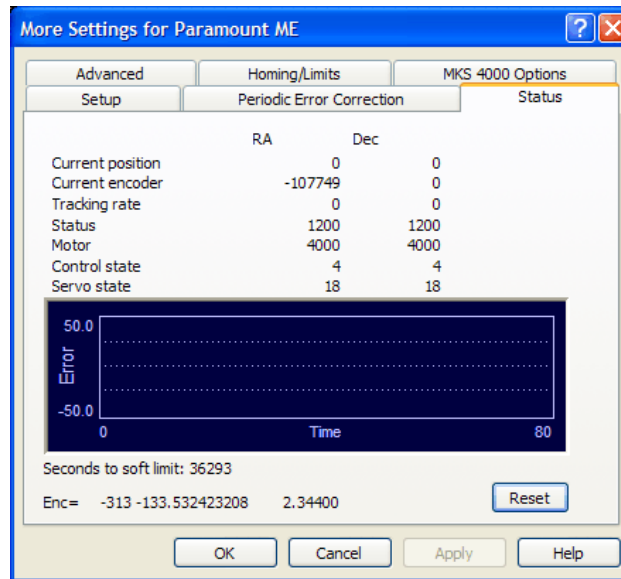
### Status Tab



Figure 44: The Advanced Tab of the More Settings dialog box (TheSky6 Professional Edition).

This dialog is provided simply for diagnostic purposes. Click **Telescope > Options > More Settings**, and then click the **Status** tab to access these options. The encoders' position (in encoder tics) is shown for each axis. Other status values are shown that indicate the state of the motors and control system.

The graph near the bottom of the dialog is a very small sampling of the encoder positioning vs. the desired encoder position.
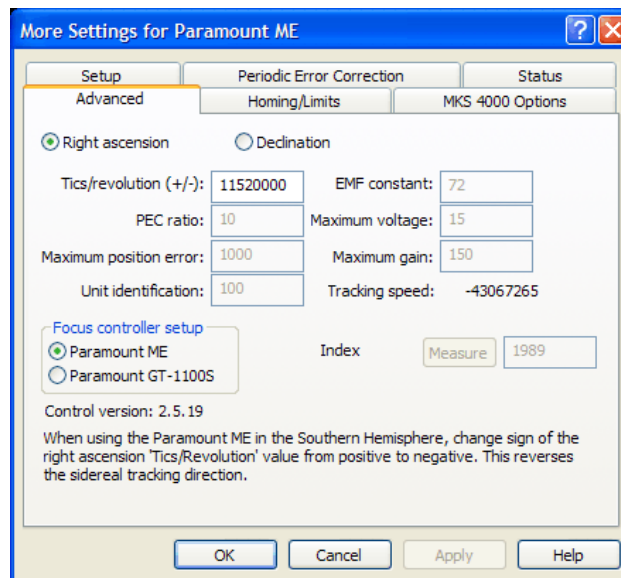
### Advanced Tab



Figure 45: The Advanced Tab of the More Settings dialog box (TheSky6 Professional Edition).

Click **Telescope > Options > More Settings**, and then click the **Advanced** tab to access these options. The only two options that can be changed are the **Tics/Revolution** and Focus axis prompts. The remaining options show the status of various control system parameters.
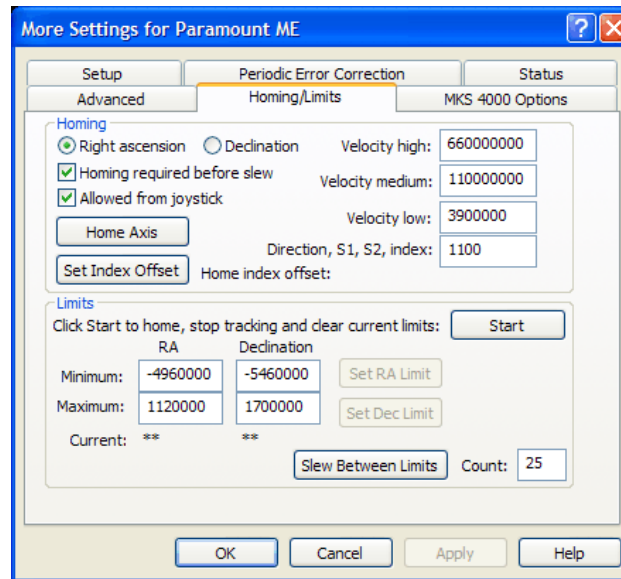
## *Homing/Limits Tab*



Figure 46: Homing/Limits tab of the More Settings dialog box (TheSky6 Professional Edition).

Click **Telescope > Options > More Settings**, and then click the **Homing/Limits** tab to access these options. The **Homing/Limits** tab allows you to change some of the default options of the Paramount ME's control system.

Software Bisque recommends that you do not make changes to any of the values unless you have a clear understanding of how the change will effect the mount's operation. For example, if you set the Minimum Limit to –4,000,000 instead of -3,250,000, the mount may collide with the right ascension stop if the mount is under joystick control or PC control.

### Right Ascension/Declination

Click the appropriate option to modify its limits.

### Homing Required Before Slew

Clear this option to allow the mount to be slewed (via TheSky6 Professional Edition or joystick) without homing.

### Allowed from Joystick

Mark this option to allow homing by double-clicking the button on the top of the joystick controller.

### Home Axis

Click this button to home the selected axis.

### Set Index Offset

This button sets an internal DC-servo motor parameter required for proper mount operation, and should not need to be modified.

## Velocity High/Medium/Low

Enter the relative velocity for the mount's slews.

## Direction S1, S2, Index

Enter the index angle for the servomotors. This value is "factory-programmed," and should not be modified.

## Minimum Limit, Maximum Limit, Set Limit Options

You can set the software limits for each axis to ensure the telescope does not attempt to slew through a hard stop. The right ascension limits are visible by looking at the South side of the mount. The declination hard stops are set at –90º declination (or 90º declination in the Southern hemisphere). When the software limits are set properly, the mount cannot run into a hard stop, as the motor will decelerate to the internal limit.

## Slew Between Limits

Click this button to successively slew the mount to its limit positions, in both right ascension and declination. This feature is used to test the mount, and run in the gears at the factory.

## Count

Enter the number of times to slew the mount between limits.
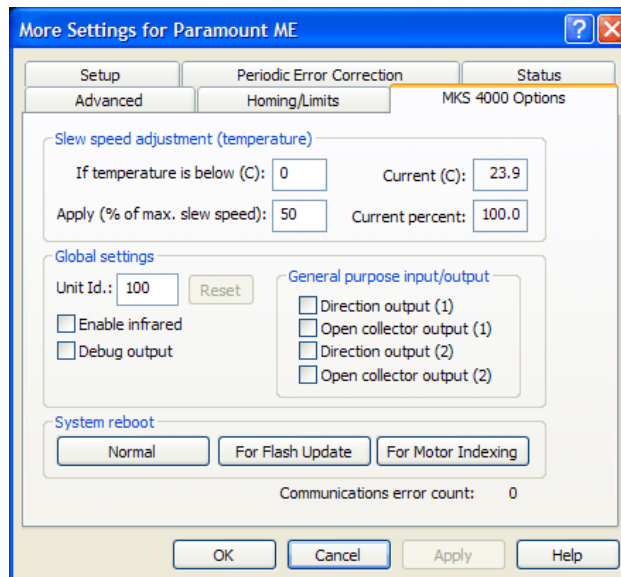
### *MKS 4000 Options Tab*



Figure 47: *MKS 4000* Options tab.

Click **Telescope > Options > More Settings**, and then click the **MKS 4000 Options** tab to access these options. These options apply to the *MKS 4000* model control system only. All Paramount ME's shipped prior to July 2004 use the *MKS 3200* control system, and these options do not apply. The *MKS 4000*,

Software Bisque's third-generation control system, has several new features including USB support, built in thermometer and soft reboot capability.

## Slew Speed Adjustment (Temperature) Group

Use these entries to automatically adjust the slew speed of the mount when the temperature drops. In very cold environments, this is recommended to eliminate the possibility of mount stalls due to the added torque required to overcome less viscous grease in the numerous bearings in the system.

## If Degrees C is Below

Enter the temperature in degrees Celsius below which the slower slew speed will take effect. For example, enter 5 to cause the mount to slew at the slower maximum speed when the ambient temperature drops below 5º C.

## Current (C)

This text box displays the temperature, in degrees Celsius, measured by a thermometer on the *MKS 4000* control board. The thermometer sensor was placed close to one of the mounting holes on the *MKS 4000* board so the reported temperature should be close to the ambient temperature. There may be a lag between the actual and reported temperature due to rapid changes in ambient temperature.

## Current Percentage

This text box will show the current speed adjustment percentage. Typically, the value is 100%.

## Apply (Percent of Maximum Slew Speed)

Enter the percentage of the current maximum slew speed that should be applied if the temperature drops below the specified threshold temperature (that is, the **If Degrees C Is Below** setting). The slew speed adjustment entered here is applied to the current max slew speed as entered on the Setup tab of this dialog. If the current Maximum slew speed is set to 80 percent, and the temperature adjusted slewing of 50% is applied, the mount will slew at 50 percent of 80 percent or 40 percent of full speed.

The temperature is checked before each slew. This slew maximum is not applied to joystick slewing as it is assumed joystick slewing has an operator in the vicinity of the mount.

## Global Setting Group

## Unit Identifier (ID)/Reset

This feature is not yet implemented. At the time of writing this documentation, the management of using different Unit ID for communication with the *MKS 4000* controllers is under construction.

## Enable Infrared

Software Bisque is currently investigating the use of Infrared ports on Pocket PC's as a means of mount control when in *close* proximity to the mount. Please check the Paramount website for any breaking news on this support, late in 2004. Support is subject to factors beyond Software Bisque's control, so we are not guaranteeing infrared support, or a date when it will be available.

**Debug Output Group**

**General Purpose Input/Output**

The *MKS 4000* for external communications has annexed the 9-pin serial connector labeled "3-line serial" with various devices.

There are now four general-purpose, high-powered, driver outputs that can be used to drive a servomotor or stepper focus motor or other device. There are also two general-purpose pins that can be used as inputs or outputs. We are currently looking at possible uses for these functions such as a slew panic button, limit switch, etc.

**Direction Output (1)**

**Open Collector Output (1)**

**Direction Output (2)**

**Open Collector Output (2)**

These options are future *MKS 4000* features and are currently not implemented.

**System Reboot Group**

The *MKS 4000* can be rebooted through software as if power to the mount was cycled. This offers benefits such as restarting the mount after a stall (though stalls should be very rare if these settings are correct, and the mount is properly adjusted) and updating the onboard control software.

**Normal**

This reboot option is similar to cycling the power on the mount. The controller will seek the indexes on each motor

**For Flash Update**

This type of reboot will put the *MKS 4000* in a download ready state for flash updates.

**For Motor Indexing**

Click this button to reboot the control system allows for modification of the motor index angles before the controller seeks the index positions. This option would only be used when replacing or upgrading your control system.

**Communications Error Count**

This prompt simply displays the number of communications errors that the control system detected during communication with the host computer.

✑

# The First Night

If you're not already familiar with the operation of TheSky6 Professional Edition and the TPoint Modeling software, please refer to TheSky6 Professional Edition and TPoint manual for further information.
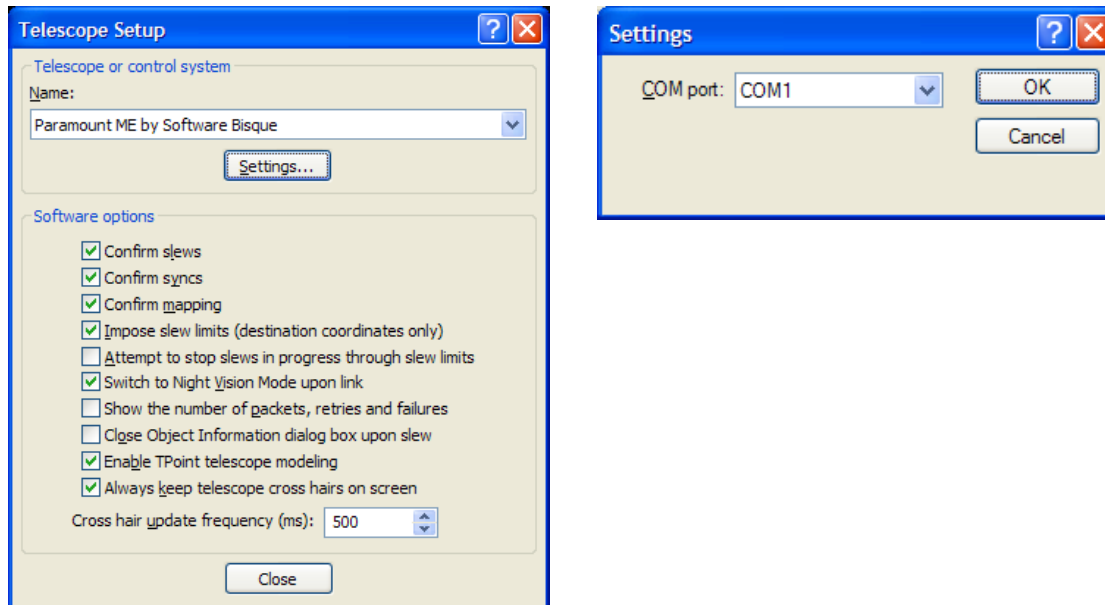


Figure 48: Telescope Setup and Settings dialog boxes.

## Quick Start

1. From TheSky6 Professional Edition, click **Telescope > Setup**.
2. Select **Paramount ME by Software Bisque** from the **Telescope or Control System** list.
3. Click **Settings**, select the serial (COM) port to use and then click **OK**.
4. Click **Close**.
5. Click **Telescope > Link > Establish**. If the mount has not been homed, you will be asked to find home now (see Figure 19).

Click **Yes** to slew the mount to its home position. For each axis, the mount emits three beeps when the home position is found. Clicking **No** causes TheSky6 Professional Edition to display the text **Not Homed** next to the telescope's cross hairs. Note that the mount *cannot slew* (using TheSky6 Professional Edition or the joystick) until it is homed. If you clicked **No** on the Find Home dialog box, click **Telescope > Options > Find Home** to home the mount now.



Figure 49: This text is displayed in TheSky6 Professional Edition when the mount is not homed.

Once the mount has been successfully homed, then next step is to synchronize on a star. See below for details.

## Synchronizing the Paramount ME

Synchronizing ("syncing") the Paramount ME initializes the control system to a specific equatorial coordinate. Synching involves pointing the telescope at a known star, identifying this star in TheSky6 Professional Edition, and then clicking the "Sync" button from TheSky6. See "Performing a Telescope Synchronization" on page 76 for step-by-step instructions.

## What Does the Sync Command Do?

When you synchronize the mount, TheSky6 Professional Edition learns the mount's orientation and can ascertain how to correctly slew the telescope to any position without wrapping cables or running the OTA into the mount. (Provided that the settings in TheSky6 Professional Edition's **Data > Time and Data > Location** commands are correct.)

When the Sync button is clicked, the information needed by TheSky6 Professional Edition to automatically startup on subsequent sessions is stored in the flash memory of the mount's control system.

In theory, after the Paramount ME is aligned with the celestial pole, it can be synchronized once and never again. In practice, you will need to sync the system from time-to-time. The following are examples of changes that will require synchronization and a subsequent mapping (or short mapping) run:

- Changing the polar alignment (requires a full TPoint mapping run).
- Changing the optical tube assembly.
- Changing the pier.

Proper synchronization is essential for proper mount operation. If the mount is not synchronized correctly, it will always slew to the wrong location. Please carefully read the following sections if you're new to astronomy, or have not previously operated a German equatorial mount.

### The Local Celestial Meridian

The local celestial meridian is a great circle on the celestial sphere that runs from the zenith directly overhead to a point due South on the horizon, continuing around to the nadir (directly below) and back up to the zenith. This line divides the celestial sphere into east and west hemispheres.

In order to successfully synchronize the Paramount ME, you must be able to identify the hemisphere in which a star lies. If the telescope is pointing to the west side of the meridian, and you sync on a star that is on the east side, or vice-versa, then synchronization will be wrong, and the mount will not slew to the correct coordinates.

From TheSky6 Professional Edition, click View > Reference Lines, click the Meridian option to turn on the local meridian and then click OK.
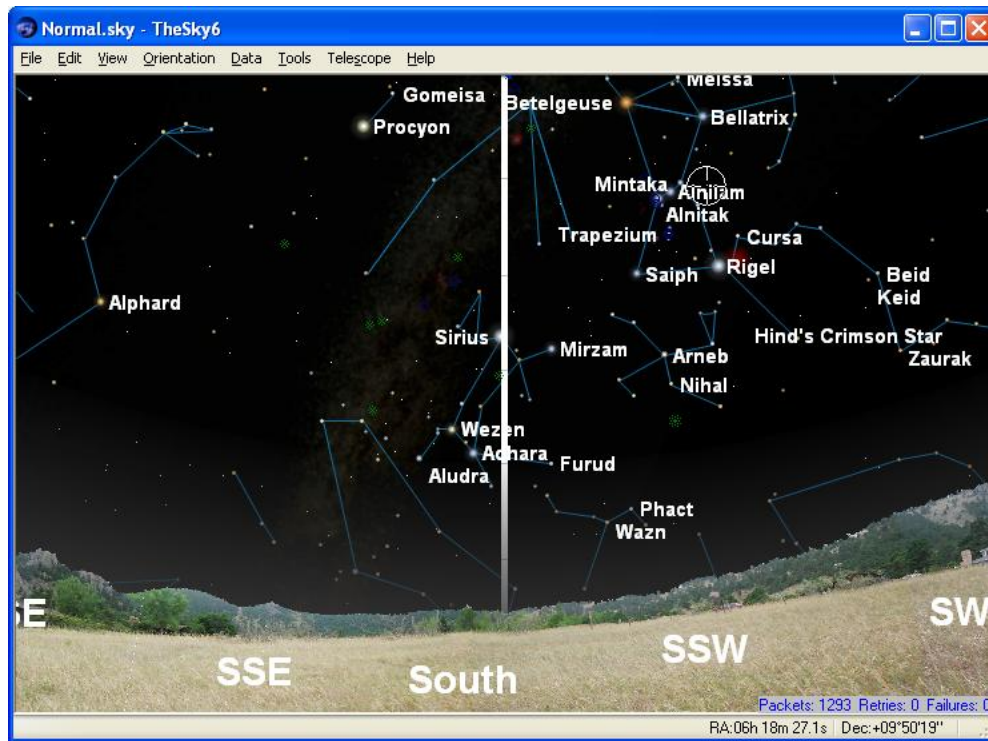
Figure 50: TheSky6 Professional Edition looking south with the meridian turned on.

The white line in Figure 50 is the local meridian. When the Paramount ME is:
- in the northern hemisphere, and
- the Versa Plate is in the "standard orientation" (page 27), and
- Paramount ME at the home position

then the telescope must be pointing to the west side of the meridian, near hour angle 2 and declination 0 (see "What Is AutoHoming?" on page 34 for details about the home position).

If the optical tube assembly is not pointing to a location on the west side of the meridian, or if the telescope cross hairs in the TheSky6 Professional Edition indicate that the home position is elsewhere, then either the Versa-Plate is mounted in the wide configuration (Figure 12 on page 28), or the Versa-Plate is mounted 180 degrees off or TheSky6's is not configured correctly for your location. Check to make sure that TheSky6's location, date, time, time zone and Daylight Saving option settings are correct, and that the Versa-Plate is mounted in the wrong orientation before proceeding.

**Best Synchronization Practices**
- **Avoid Syncing Near the Meridian** – Try to avoid syncing the mount on a star that is within five degrees of the meridian. If you are not sure if the mount is near the meridian, then look at the mount and make sure that the counterweight shaft is not horizontal. When the counterweight shaft is horizontal, the OTA is pointing at the meridian.
- **Avoid Syncing Near the Celestial Pole** – The celestial pole represents a point of "singularity" on the celestial sphere. Do not sync on Polaris (northern hemisphere) or any star above 75 degrees declination or so.

## Performing a Telescope Synchronization

The procedure below ensures that your mount will be synchronized properly. (See "Appendix D: Southern Hemisphere Setup and Use" for details about setting up the Paramount ME in the southern hemisphere.)

1. Set the computer's clock. Accurate time is crucial for consistent, accurate pointing. Consider using an internet time server or a GPS-based clock to regularly update your computer's clock.
2. From TheSky6 Professional Edition, click **Data > Time** and click the Use Computer's Clock button (⏱). Using the computer's clock is required for telescope control.
3. Click **Data > Location** and set your observing site's latitude, longitude, time zone and Daylight Saving option if necessary. Consider using a GPS to obtain your site's latitude and longitude, and make sure the time zone value and daylight saving options are correct for your location. Errors in latitude "appear" to TPoint as a vertical misalignment in the polar axis, and pollute the TPoint model. If your time zone is off by one hour or more, then pointing will be off by the same amount. If the wrong Daylight Saving option is selected, then time will be off by an hour (or more) and the mount will not slew to the correct position.
4. Click **Telescope > Link > Establish**. When prompted, click Yes to home the mount. If you've previously homed the mount, click **Telescope > Options > Find Home** to slew the mount to the home position again.

5. Locate a bright star to sync on that is:
   - on the *west side of the meridian* and
   - relatively near the home position (within a few degrees or so) and
   - more than five degrees away from the meridian.

   Partial clouds or twilight can make this task more difficult than it might seem. When located in the northern hemisphere, the Paramount ME can be synchronized to virtually any position on the celestial sphere on the east or west side of the meridian (See "Best Synchronization Practices" on page 75). In the southern hemisphere, the Paramount ME must be synchronized to a star that is on the *east side* of the meridian. Figure 50 shows the Virtual Sky with the telescope cross hair on the west side of the meridian. Betelgeuse, Bellatrix, Mintaka, Alnitak, Rigel, or Saiph are all good candidates to sync on. Sirius Procyon or Alphard are all on the wrong side of the meridian.

6. Center the bright star in the eyepiece, CCD detector or video display using the joystick or TheSky6's **Telescope > Motion Controls** command.
7. From TheSky6 Professional Edition, click **Edit > Find** to search for this star (or click on the star if it is visible on screen) and display the large Object Information dialog box.
8. Click **Sync** on the Telescope tab of the large Object Information dialog box (see Figure 52). When the Sync Confirmation dialog box appears, click **OK**.

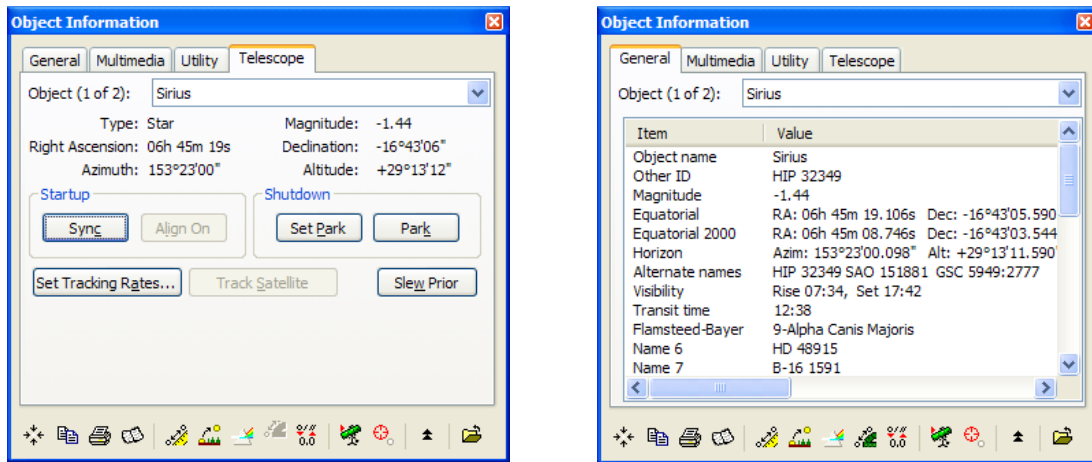| *Note* | **If you are doing the preliminary polar alignment as described in "Initial Polar Alignment" on page 42, you will be centering the star using the polar adjustments rather than synchronizing.** |
|---|---|

Figure 51: Sample TheSky6 Professional Edition large Object Information dialog box showing the Telescope tab (left) and the General tab (right).

| *Important Note* | Software Bisque strongly recommends that the Telescope > Setup, Confirm Syncs option remains checked, since accidentally clicking Sync instead of Map during a mapping run is easy to do (especially late at night), and doing so ruins the current TPoint model. |
| --- | --- |

### Session to Session Pointing Repeatability

In subsequent sessions, TheSky6 Professional Edition can accurately compute the current equatorial and horizon coordinates of the telescope using the stored hour angle and declination of the mount and the local sidereal time. In fact, the Paramount ME's pointing accuracy should be virtually identical from session to session.

As a test, you can verify the repeatability of the Paramount ME's pointing accuracy:
1. Turn the mount off.
2. Turn the mount on.
3. Home the mount (this terminates communication between TheSky6 Professional Edition and the Paramount ME).
4. From TheSky6 Professional Edition, click **Telescope > Link > Establish**. When you re-establish the link with the mount, the telescope cross hairs appear at the home position.
5. Slew the mount to the star you just synced on. The mount should slew back to this star; that is, it should return to the same position in the eyepiece, video or CCD detector. In practice, there may be small pointing errors that are introduced by mirror flop, or slight differences in time, so the star may not be in *exactly* the same position, but it should be very close.

Note that during the process of polar alignment, you will be required to "sync" the mount several times (each time the mount is adjusted to a new altitude and/or azimuth). Once the mount is sufficiently aligned with the celestial pole, you should not have to sync again unless you change optical tube assembly or somehow change the telescope's mounting.

### Making Sure Synchronization Is Correct

The first step to ensure the Paramount ME is properly synchronized is to look at the hour angle and declination of the homing sensors *reported by TheSky6*. After synchronizing the mount, from TheSky6

Professional Edition, click Telescope > Options > More Settings. The Setup tab shows the Home Sensor Position (see Figure 52).

If the mount is properly synchronized, TheSky6's *computed* position for the home sensors will match the *physical* position of the home sensors. Remember, the mount's physical home position cannot change, so TheSky6's reported home position must be near hour angle 2 and declination 0 in the northern hemisphere. If TheSky reports a home position that is significantly different from hour angle 2 and declination 0 in the northern hemisphere, then synchronization is wrong. A small difference is okay, it just means that your telescope/eyepiece/camera is not perfectly aligned with the mount's axes.

See "Starting Synchronization Over" on page 80 to resynchronize the mount if necessary.

Note that the above description above assumes the Paramount ME is located in the northern hemisphere and the Versa-Plate is mounted in the "typical" position (page 28). If the Versa-Plate is mounted in the "wide" position, then TheSky6's reported home position will be 90 degrees from hour angle 2. See "Appendix D: Southern Hemisphere Setup and Use" on page 107 for details about configuring the Paramount ME for use in the southern hemisphere.
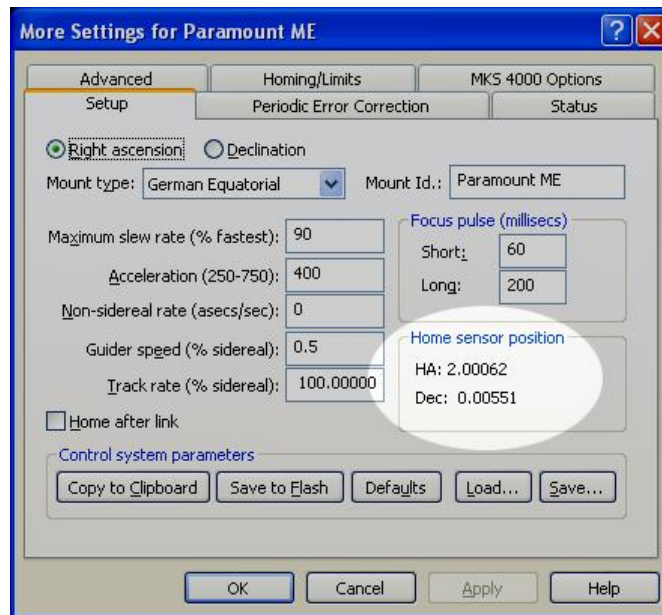


Figure 52: The homing sensor positions computed by TheSky6.

TheSky6 Professional Edition can also provide graphical feedback to help you ensure that the mount is synchronized correctly, and recognizes areas that have unique behavior when tracking or slewing near the meridian. While TheSky6 Professional Edition is connected to the Paramount ME, two regions are drawn near the meridian. If the regions are centered on the meridian, then the synchronization is most likely correct. Note that Paramount ME's tracking and slewing will behave differently when the OTA is pointing within these regions.

## Purple Region

When the optical tube assembly is on the east side of the mount (pointing to the west), the purple region (that is, the region on the east side of the meridian) indicates the area where the mount can be slewed beyond the meridian without flipping sides. If the OTA is on the east side, and you attempt to slew beyond this region, the mount automatically flips sides.

## Red Region

When the optical tube assembly is on the west side of the mount, the red region indicates how far past the meridian the mount can track before encountering a software or hardware limit. If the OTA remains on the west side and the mount tracks to the tracking limit, then tracking is turned off. The red region also indicates the area where, when the OTA is on west side, the mount can be slewed past the meridian without flipping sides.
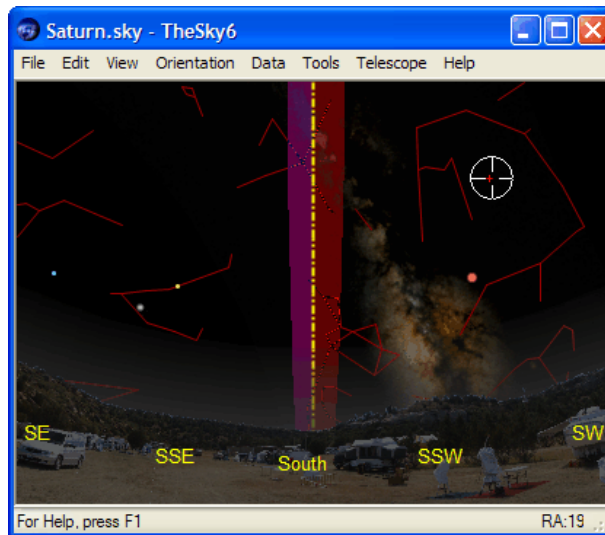


Figure 53: If you've successfully synchronized the Paramount ME, the shaded regions will be centered on the meridian.

To turn on the Meridian Line, click the Display Explorer command from the View menu, and then mark the Meridian option on the Reference Objects > Reference Lines node. Figure 53 represents a normal-looking synchronization, with the shaded regions centered on the meridian.
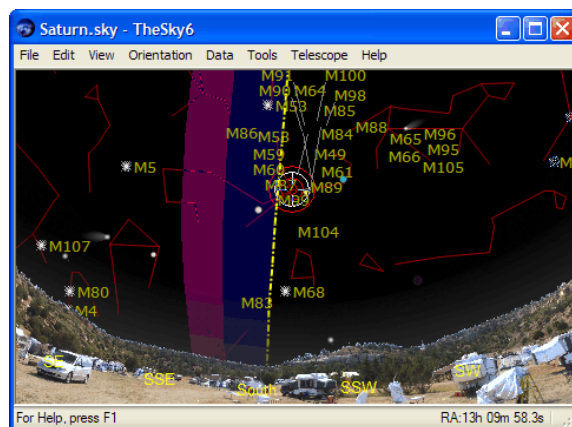


Figure 54: If the shaded regions are not centered on the meridian, or the shaded regions do not appear, then the mount is not properly synchronized.

If you've synchronized the mount using a star that is on the same side of the meridian as the optical tube assembly, and you attempt to slew the mount across the meridian, the following error message is displayed.
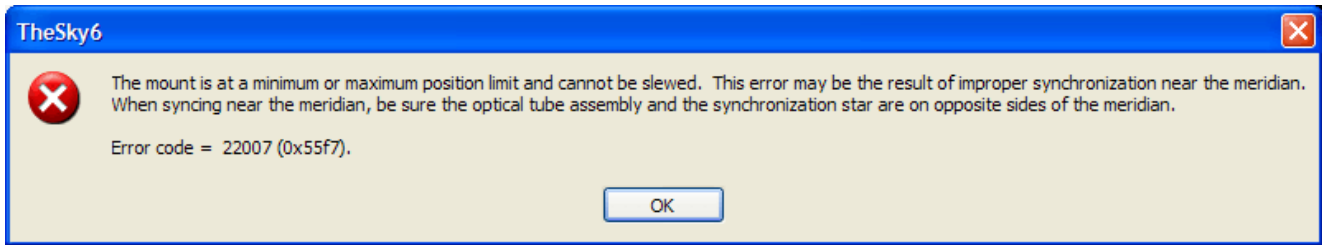
Figure 55: This error message indicates the synchronization is not correct.

### Synchronization Checklist

- Make sure that the computer's time is accurate, and that TheSky6 is configured to use the computer's clock.
- Verify that the star you're synchronizing on is the same star listed in TheSky6's Object Information dialog box.
- In general, do not synchronize on a star near the meridian.
- Do not sync on a star above 75 degrees declination.

### Starting Synchronization Over

If you're ever unsure or confused about synchronization, you can "start from scratch" by reinitializing the control system.

1. If necessary, click **Telescope > Link > Establish**.
2. Click **Telescope > Options > Find Home**.
3. Click **Telescope > Options > More Settings**.
4. On the Setup tab, click **Defaults**.
5. On the Setup tab, click **Save To Flash**.

The control system is now configured to use the default position settings, and the mount is pointing to the Home Position. Slew to a star near the Home Position and click **Sync**.

❧

## Telescope Mapping Overview

Telescope mapping is the process of slewing to a known object, manually centering that object in the eyepiece, then recording the angular differences between the slewed to coordinates and the manually centered coordinates. Mapping a number of known targets allows the TPoint Telescope Modeling Software to analyze systematic errors in your telescope system and create a model to compensate for these errors.

To begin a mapping session, accurately set your computer's clock and establish a link to the telescope. Once connected, slew the telescope to a known star and center it in the eyepiece. Using Find or Identify in TheSky6 Professional Edition, display the Object Identification dialog for the star. When the star information is presented on the Object Identification dialog box, click the Sync button in the Telescope Tab. Once this sync occurs, the telescope's control system is aligned approximately with the celestial sphere. Even though this initial synchronization is never perfect due to imperfections in the system, it establishes the angles in the Paramount ME control system that all subsequent mapped stars will use.

| *Important Note* | During a mapping session, do not re-synchronize the telescope's control system by clicking Sync. If the Paramount ME is synchronized on a star after the mapping session has begun, the session must be started over! |
|---|---|

The star that is "synced on" can also be your model's first mapped point. Click the **Map** to record this point and to begin gathering your pointing data. TheSky6 Professional Edition communicates continuously with TPoint as subsequent points are mapped.

From this point on, you should just have to slew, center and map stars to continue building the model. It is usually easiest to choose stars that are not far away from the sync star until the first six points are mapped. Once you have mapped the initial six stars, TPoint automatically begins compensating for systematic errors and you should notice an improvement in pointing accuracy. Finding the stars in the video (or other) feedback system becomes easier.

The most efficient means of mapping points is to use a low light video camera coupled to the telescope. With a video camera, stars to eighth magnitude are usually detectable and provide a large number of potential mapping targets. Also, the process of centering and mapping takes seconds, allowing you to perform a complete mapping session in under an hour.

### To Prepare For a Mapping Session

1. Use an Internet time server or GPS to accurately set your computer's clock.
2. Power up the Paramount ME.
3. Make settings to TheSky6 Professional Edition to aid mapping. For example:
   - Display only stars to sixth magnitude to limit screen clutter.
   - Turn on the constellation lines for easy identification and turn on the meridian line to stay on one side of the sky while mapping (this is most useful for German equatorial mounts that must "flip" when going from the east to west and vice-versa).

### To Map a Star

1. Identify a bright stellar object in TheSky6 Professional Edition.
2. Instruct the telescope to slew to the above object by clicking the Slew button on the Object Identification dialog box. Make sure the correct object is highlighted in the Object Identification dialog box.
3. Using the telescope's joystick, center the object in your field of view.
4. Click the Map button in the Object Identification dialog box.

Repeat the above procedure for each mapped point. For the best pointing results, map at least thirty to fifty objects distributed evenly across the entire night sky. If you are still working on the polar alignment, 20-30 stars with wide distribution should be sufficient.

## Using ProTrack™

The Paramount ME incorporates the world-renowned TPoint "pointing kernel." This technology (which is used on the 8-meter Gemini telescopes) gives Paramount ME owners the ability to perform professional-quality tracking. That is, TPoint uses the telescope modeling data that makes the telescope point better to also make the mount track better.

**Minimum Requirements for ProTrack**

ProTrack requires the following minimum hardware and software to improve tracking:

1. A Paramount ME, Paramount GT-1100S or other telescope that employs the MKS controller firmware version 1.1.45 or later (the firmware update is supplied with the TheSky6 Professional Edition update).
2. TheSky6 Professional Edition version 6.0.0.27 or later.
3. TPoint for Windows version 1.00.505 or later ([www.bisque.com/download](www.bisque.com/download)).
4. A fixed telescope mirror. Mirror flop makes high-accuracy tracking nearly impossible.
5. A "good" set of TPoint modeling data (200 stars or more recommended).

**Getting Started with ProTrack**

Superb modeled telescope pointing is required for superb modeled telescope tracking. That is, you must first generate a TPoint model with a sufficient number of modeling data points prior to engaging ProTrack.

Here are the keys to getting good ProTrack results:
- Use a high-density TPoint model.
- Obtain an accurate and precise mapping data set.
- Make sure to cleanup and discard bad points in the TPoint model.
- Verify the selection of TPoint modeling terms (correct terms; terms that add real improvements; study the TPoint documentation and meaning of each term).
- Evaluate the TPoint terms based on your actual pointing results.

Here are some general guidelines for getting the most out of TPoint, the Paramount ME, and ProTrack:

- Once you have your desired accuracy in polar alignment, make a high-density TPoint model. Experience suggests that about 250 points is the baseline for high accuracy with ProTrack. The weight, lever arm, off-center components, mirror movement, and other factors in your system will dictate what you can actually achieve. The points for the model need to be set with the highest accuracy you can muster. Use your regular camera, not a video camera, for high-density, high-precision modeling.
- Next step is to add terms to your model. TPoint automatically adds the first six terms for you. Unless you have a demonstrated reason to remove them, keep them. Here is a list of the automatic terms:

  - IH - Index error in RA
  - ID - Index error in Dec
  - NP - Non-perpendicularity in RA/Dec
  - CH - Non-perpendicularity of the OTA in Dec
  - ME - Error in polar axis elevation
  - MA - Error in polar axis azimuth

- Do not just go to the **Suggest Terms** command that allows TPoint add terms; these are merely *suggested* terms, and must be analyzed and evaluated before you can trust them. That's very challenging to do. There's a better way. Add, then evaluate for effect on the model, the following terms:

  - TX – Tangent tube flexure. This is generally better to use than TF; it combines for greater accuracy with the other terms.

- HCES and HCEC – Centering errors in the RA gear.
- DCES and DCEC – Centering errors in the Dec gear.
- DAF – Sag of a cantilevered declination axis.

- The above terms are almost always beneficial.  Next step is to evaluate the other named terms (except those with **AAT** in the name; those are for the Anglo-Australian telescope, not the Paramount ME).  Look for terms that, when used, will significantly reduce the Sky RMS *and* PSD values.  (RMS = root mean square error; PSD = population standard deviation.) Never use a term that increases the PSD, even if it reduces the RMS pointing value.  Terms that provide only minimal improvement (less than 10% better RMS) should not be used.  Terms that do not provide at least 2-3 units improvement in RMS should not be used.  Other useful terms include: HDSD4, HHCH4, and HHSH4.

- At this point, you can now try Suggest terms.  Use the same rules for suggested terms as for named terms: make sure they show enough of an improvement in your point to be included.  However, when suggesting terms, you should always take an additional step: test the term in practice.  Suggested terms can be very useful; they can be completely bogus.  The name says it all: these are _suggested_ terms.  They have been found to be of _possible_ statistical significance; you need to verify that by seeing how they affect real pointing, not just the RMS and PSD.  Having a low RMS value does not necessarily equate to accurate pointing.

Note: Adding and evaluating terms is a non-trivial exercise.  The more you know about mathematics, and statistics in particular, the more effective you can be at selecting, analyzing, and evaluating terms.  Read up on TPoint, the mathematics and the concepts behind telescope modeling – it will make you more effective at selecting terms.  Also, be patient.  It takes time and effort to learn TPoint and the vast logic behind it.  The good news is that the more time you invest in TPoint, the more you will get out of it.

If you experience problems with ProTrack, the first place to look is at the terms you added to your model.  Terms must be evaluated by how they improve or hurt your pointing and/or tracking accuracy.  The next step is to verify that you cleaned out bad data from the list of points.  Look for outliers and mistakes, and mark them so they are ignored.  Next, be aware that when you are closer to the edges of the model, modeling is less accurate.  If you want to image at 45 degrees of elevation with ProTrack, for example, go well below that when mapping points.  How low you can go depends on the point where atmospheric refraction begins to elongate stationary stars for your focal length/pixel size combination.

## Enabling ProTrack

To enable ProTrack, launch TheSky6 Professional Edition, establish communications with the mount, and then click **Telescope > Options > ProTrack Status** (or press CONTROL+K) to display the ProTrack Status dialog box.  Next, mark both the **Activate ProTrack** and **Enable Tracking Adjustments** options.
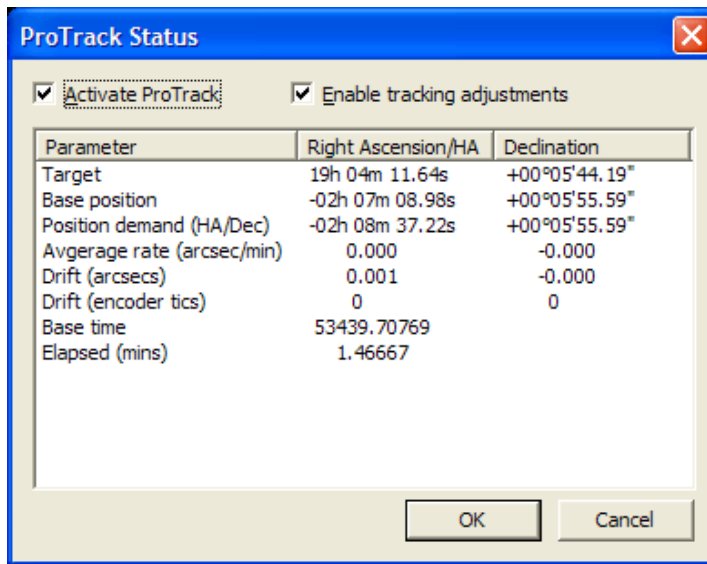
Figure 56: TheSky6 Professional Edition's ProTrack Status dialog box.

**Activate ProTrack**

Mark this option to display the corrections that *will be* applied to the mount using the current TPoint modeling data. This option is useful to examine the magnitude of the corrections before actually applying them. Note that if the **Enable Tracking Adjustments** option is not marked, then no corrections are actually applied.

**Enable Tracking Adjustments**

Mark this option to actually apply the tracking corrections to the current tracking rate.

## *ProTrack Status Report*

The ProTrack Status report lists the parameters used by the TPoint model to improve the telescope's pointing. The table below describes each parameter.

| ProTrack Status Parameter | Description |
| --- | --- |
| Target RA/Dec | The current equatorial coordinates of the telescope. |
| Base position | The hour angle and declination of the telescope when ProTrack is activated. |
| Position demand (HA/Dec) | The corrected hour angle and declination coordinates based on the TPoint model. |
| Average Rate (arcsec/min) | The average tracking rate of the ProTrack corrections, in arcseconds per minute. |
| Drift (arcseconds) | The amount of drift (movement) from the base position, in arcseconds. |
| Drift (encoder tics) | The amount of drift (movement) from the base position, in encoder counts or "tics." |
| Base Time | The absolute time when ProTrack was activated. |
| Elapsed (minutes) | The number of minutes since ProTrack was activated. |

✍

# Tracking Satellites

The Paramount ME and TheSky6 Professional Edition make the normally daunting task of finding, slewing to, and tracking satellites (and other objects that move at a non-sidereal rate) easier.

For example, in order to track a satellite using a Paramount ME, TheSky6 Professional Edition can download the latest two-line element data (TLEs) from the world-wide web, and then all you need to do is find a satellite that is above the horizon using TheSky6's Find command on the Edit menu, and then click the Track Satellite button on the Telescope tab of the Object Information dialog box.  The Paramount ME will automatically slew to the satellite, then slew again to get close to the object, and then continuously update the tracking rates for each axis so that the satellites remains centered on your detector.

### To Track a Satellite

1.  From TheSky6 Professional Edition, click **Telescope > Link > Establish**.
2.  Click **Data > Satellites**, and then load the TLE of the desired satellites using the **Import From Web** button and then click **OK.**
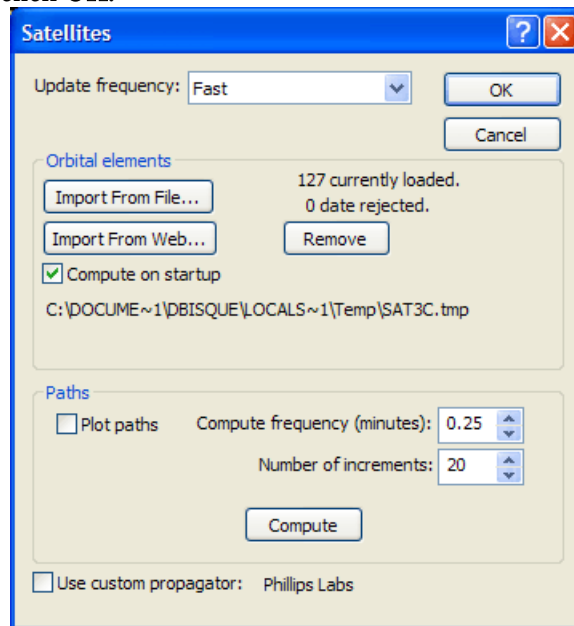


Figure 57: Satellites dialog box

3.  To make the satellites more easily visible on the Virtual Sky, click **View > Display Explorer**, navigate to the **Solar System > Satellites > Labels** node, and then mark the **ID** check box.  The satellites' name will now appear next to the satellite.
4.  Locate the name of a target satellite; for now, any one that is above the horizon will do for this exercise.  Click **Edit > Find**, and mark the **Object Information** option.  This will automatically show the Object Information dialog box for any object that is selected.
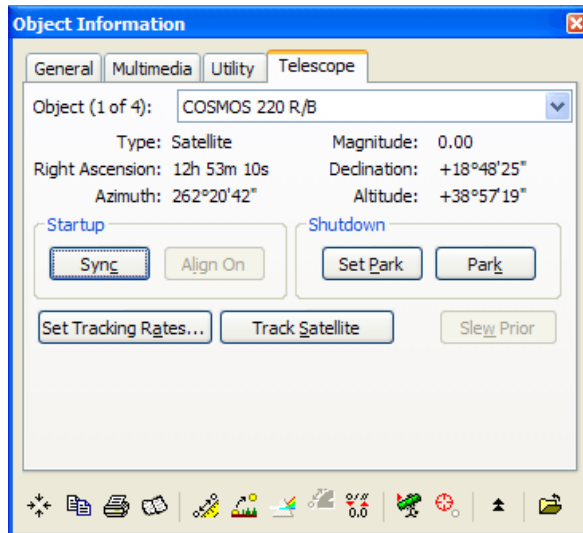
Figure 58: The Track Satellite button on the Object Information dialog box.

5.  On the Find dialog box, navigate to the **Solar System > Satellites** node, and then click the name of the target satellite in the satellite list. From the large Object Information dialog box, click the **Telescope** tab, and then click **Track Satellite** to display the Satellite Tracking dialog box.
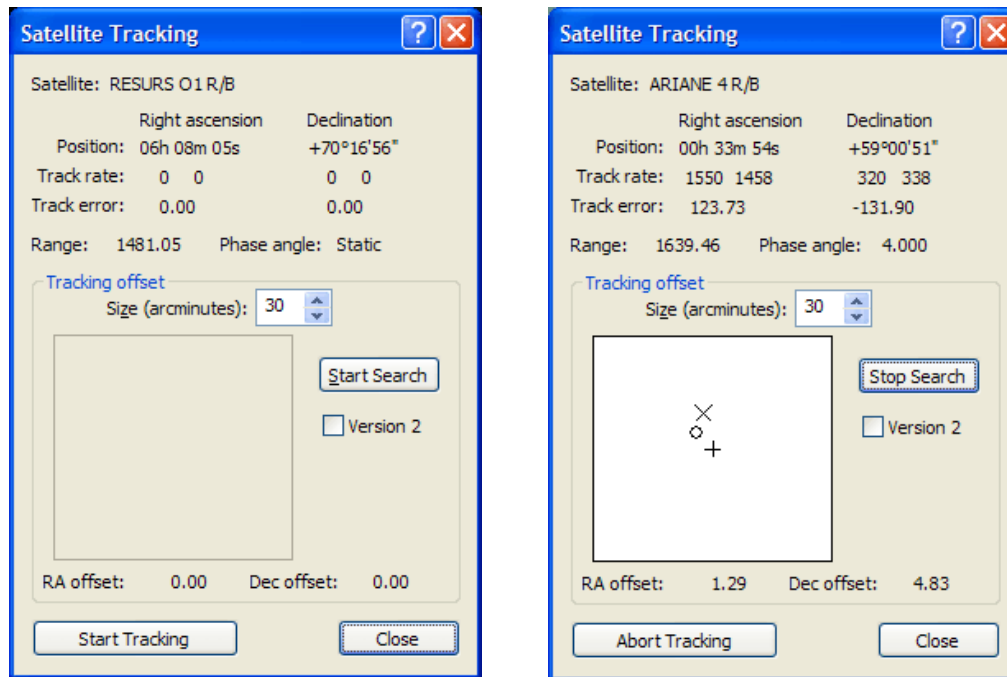


Figure 59: The Satellite Tracking dialog box before and after clicking the Start Search button.

6.  Click **Start Tracking** to slew the mount to the satellite. If the satellite is moving "quickly," once the mount completes the slew to the original satellite's position, TheSky6 Professional Edition must slew again to catch up. Once the mount begins tracking the satellite, the graphic in the Satellite Tracking dialog box shows the computed position of the satellite as a circle, and the relative position of the mount, as an "X". The plus sign indicates the center of the graphic.

**Start/Stop Search**

Click this button to slew the mount in a spiral search pattern, while maintaining the current tracking rates. This can help you locate a satellite that does not fall directly into the field of view.

Software Bisque recommends that you try to track slow-moving geosynchronous satellites to begin, and then move to the faster moving near-earth orbiting (NEOs) satellites once you're comfortable with the procedure.

∽

# DirectGuide™

Telescope mounts require feedback from an autoguiding CCD camera to track the motion of a star over long periods of time. Typically, the autoguider monitors the position of a guide star, and then sends an electronic signal through an autoguider port to open or close a motion relay on the mount. This returns the guide star to the desired position, and provides precise tracking.

The software and hardware combination of CCDSoft version 5, TheSky6 Professional Edition and Paramount ME offers an exclusive technology, called "*DirectGuide*," which bypasses the autoguider port, and sends closed-loop autoguider corrections directly to the MKS 4000 control system. Once CCDSoft is configured to use DirectGuide, (instead of the traditional relay autoguiding method through the camera to the telescope) no autoguider cable is needed.

**To Enable DirectGuide**

1. From CCDSoft, click **Camera > Setup**.
2. Click the **Autoguider** option.
3. Verify that the correct autoguider is selected from the **Autoguider** list.
4. Click the **Autoguide** tab.
5. Click **Settings**.
6. On the Autoguide Settings dialog box, click the **Advanced** option on the **Drive Settings** tab.
7. Select **DirectGuide** from the Autoguide Using list.
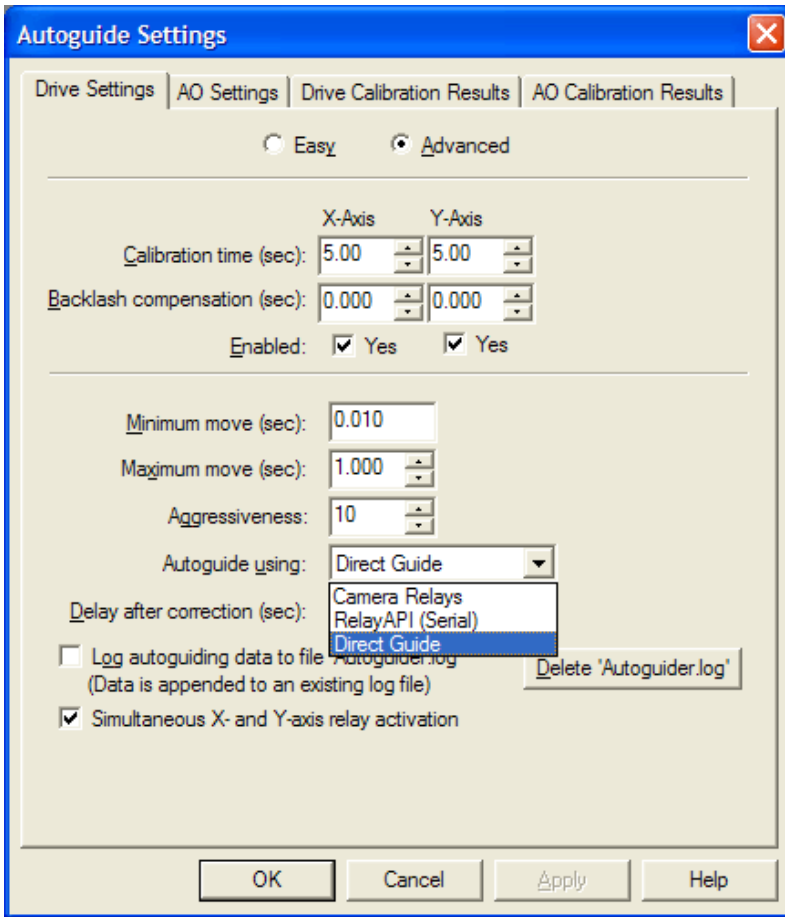
Figure 60: Select Direct Guide from the Drive Setting tab of CCDSoft's Autoguide Settings dialog box.

8. Click **OK**.
9. Important!  CCDSoft's Advanced Drive Settings must be changed when using Direct Guide.  That is, the "units" for "calibration time" when using Direct Guide are more closely related to arcseconds (angular distance), and not the length of time to close the autoguider relays.

   Below are the "typical" Direct Guide settings for the Paramount ME.

   - Calibration Time X = 100-200
   - Calibration Time Y = 100-200
   - Minimum Move = 0.01
   - Maximum Move = 1-10
   - Backlash X = 0
   - Backlash Y = 0
10. Unplug the autoguider cables from the Paramount ME.
11. Autoguide as usual.

CCDSoft will now send autoguider corrections directly to the Paramount ME (via TheSky6 Professional Edition).  You now have one less cable to worry about!

❦

# Cold Temperature Operation

The amount of torque required to turn the Paramount ME's worm-gear interface increases as the temperature decreases. Therefore, the maximum slew rate for the right ascension axis should be reduced when the Paramount ME is operated in cold temperatures (less than 32º F or 0º C). Reducing the maximum slew rate effectively increases the servomotor's maximum torque so that the mount can operate normally.

Software Bisque recommends setting the right ascension slew rate to 50-65 percent under these conditions. See the "MKS 4000 Options Tab" section on page 70 for details about setting the Paramount ME's maximum slew rate based on the ambient temperature. For extremely cold temperature operation, the Paramount ME's acceleration rate may also need to be reduced.

See "Troubleshooting Mount Operation" for additional cold temperature operation issues.

❧

# Maintenance

Like all mechanical systems, the Paramount ME requires some periodic maintenance. Under "normal" operating conditions, Software Bisque recommends lubricating the mount's right ascension and declination worm gears at least once a year. For a step by step tutorial of this procedure, see the *Lubricating the Paramount ME* video here:

http://www.bisque.com/sc/media/p/29184.aspx

If the Paramount ME is used for sky survey applications (all night, every clear night), or is located in a desert environment or in a climate that has particularly high amounts of eolion particulates, or in rodent or insect infested regions, in addition to covering the mount daily, Software Bisque recommends thoroughly cleaning worm block housings and the right ascension and declination housings every six months (in addition to lubrication).

**Before Lubricating the Paramount ME**

Do not add too much grease to the gears! Applying excessive grease can cause the homing sensors to become "plugged," and then homing will fail.

If homing the Paramount ME fails after adding grease, you'll need to manually remove the grease from the homing sensor by removing the gear cover of the affected axis then carefully clean the homing sensor. See the document Paramount ME Home Sensor Replacement and Troubleshooting here: http://www.bisque.com/sc/media/p/30773.aspx for details about how to clean the home sensors.

## Lubrication Specifications

Under normal operating temperatures, Software Bisque recommends using Lubriplate Motor Assembly Grease Series 105 (Manufacturer number L0034-094) for the worm and gears. This product is available at many automotive stores, or online.

Customers report that the Lubriplate Motor Assembly Grease Series 105 (Manufacturer number L0034-094) works well at temperatures near -25 C.  If your mount is operated under extremely cold operating temperatures, consider using Molykote® 33 Extreme Low Temperature Bearing grease, Medium, which is rated for operating temperatures from -73 to 204 C.

http://www.dowcorning.com/applications/search/products/Details.aspx?prod=01889788&type=PROD

Use the "Find a Distributor" link on this page to locate a distributor near you.

### Cleaning Exterior Surfaces and Maintaining the Original Color

Armor All® Multi-Purpose Auto Cleaner (available everywhere) does a good job of cleaning the Paramount ME's external anodized surfaces.  Armor All also helps block the sun's ultra-violet rays, which can cause the color of anodized metals to fade.  Applying a coat of Armor All to the exterior surfaces of your mount monthly will help maintain the original color.

# Troubleshooting Mount Operation

| Problem | Solution |
|---------|----------|
| **TheSky6 Professional Edition cannot communicate with the Paramount ME.** | Communication between a personal computer and hardware device requires that the software and hardware be properly configured.  If you cannot establish a link to the telescope, we recommend trying the following:<br><br>1. Check the cables to the serial communications port (COM).  They must be securely plugged in at both ends.<br>2. Check the communications port with a different device.  For example, connect a different serial device to the port and ensure it is working.<br>3. Make sure the software settings are correct for the communications device (TheSky6 Professional Edition's **Telescope > Setup > Settings > Telescope Setup** dialog box). |
| **The Paramount ME emits continuous, successive, high-pitch "beeps" shortly after startup and will not slew.** | • Check that the balance knobs are adjusted properly (page 40).  If the balance knobs are too tight, then the worm is forced against the gear, and the mount will not slew.  Also read "Sounds Emitted During Mount Initialization and Operation" on page 33 for more information.<br>• Check the mount balance in both axes.  If the Paramount ME stalls or sounds labored while slewing, check to make sure both axes are properly balanced.  Balance becomes more critical with heavier loads.  While the control system has sufficient torque to lift heavy loads, tracking performance and slewing may suffer when the payload is greatly out of balance.<br><br>If the payload is properly balanced, and the behavior persists, check the spring plungers located inside the worm-block assembly housing.  The worm block covers are the "smiley-face" shaped plates that are attached to the gear covers.  Once removed, you will see the worm drive for the axis.  There are one or two small |

| | |
|---|---|
| | spring plungers that can be adjusted to decrease the pressure between the worm and gear. |
| **The mount cannot be homed using the joystick.** | Homing from the joystick takes a bit of practice.  The control system is looking for two button presses, separated by at least one-tenth of a second.  One of the most common causes of homing failure is when the joystick is moved unintentionally during the homing procedure.  Any joystick motion in either axis while homing will cause that axis to abort the homing procedure.<br><br>The best practice is to use TheSky6 Professional Edition's **Telescope > Options > Find Home** command to home the mount. |
| **During cold temperature operation, the mount emits an audible "vibration" sound while slewing.** | A resonance between the worm and gear may occur at colder operating temperatures, which is the cause of the sound.  To eliminate the vibration, remove the right ascension worm-block cover and carefully place two to three drops (no more) of 3-in-1 household oil on the worm-gear interface.  Also see the section "Slew Speed Adjustment (Temperature) Group" on page 71 for additional cold temperature operation suggestions. |
| **Mount cannot locate the Home Position in one or both axes.** | The Paramount ME contains two optical sensors that are used to detect the Home Position.  If homing fails, check the following:<br><br>• The homing sensor cable is plugged in backwards.  Have you altered the internal wiring recently? If so, make sure you've plugged in the cables correctly.<br>• The homing sensor cable is unplugged or unseated from the MKS 4000 electronics board.  If the cable gets snagged or pulled by other cables (normally this occurs when customers add cables through the mount), then homing could fail.<br>• The optical homing sensor is "blocked" (usually from over greasing) so the mount cannot detect the Home Position.  Has the mount been greased recently? If so, you'll need to remove the homing sensor (for the axis that fails) and clean the sensor.<br>• Check for rodent invasion inside the RA or Dec box.  Mice seem to have a taste for internal Paramount ME cabling, and have caused significant damage to many unattended Paramount MEs. |

# Appendix A: Preparing the Paramount ME Pier

## Paramount ME Adapter Plate Specifications

The Paramount ME Wedge to Pier Adapter Plate is mounted between an existing pier or tripod and the Paramount ME's base plate.



Figure 61: Heavy-duty Wedge to Pier Adaptor (unanodized).

### Heavy-Duty Wedge to Pier Adaptor Plate

The heavy-duty base plate (see Figure 61) is solid aluminum and weighs approximately 6.5 kg (14 lbs.) The heavy-duty version is recommended for permanent installations. The Paramount ME attaches using the four black knobs near the corners (9.4-inch spacing).



Figure 62: Bottom view of the unanodized lightweight Base Plate

### Lightweight Wedge to Pier Adaptor Plate

The lightweight Base Plate (see Figure 62) is made of aluminum and has been lightened to approximately 2.7 kg (6 lbs.). All dimensions of the lightweight version are identical to the heavy-duty version. The lightweight version is recommended for portable use on a field tripod.

## Primary Mounting Holes

There are two sets of three mounting holes. The Primary mounting holes can be used for adapting to piers that have a large, flat top. There are built in "washers" on the bottom of these holes in case the mounting surface is not perfectly flat.

## Old Pattern (Paramount S Compatible)

A second set of three holes (see Figure 63) matches the mounting pattern of the Paramount GT-1100 and GT-1100S models. They can be used to adapt the older style piers to the Paramount ME.
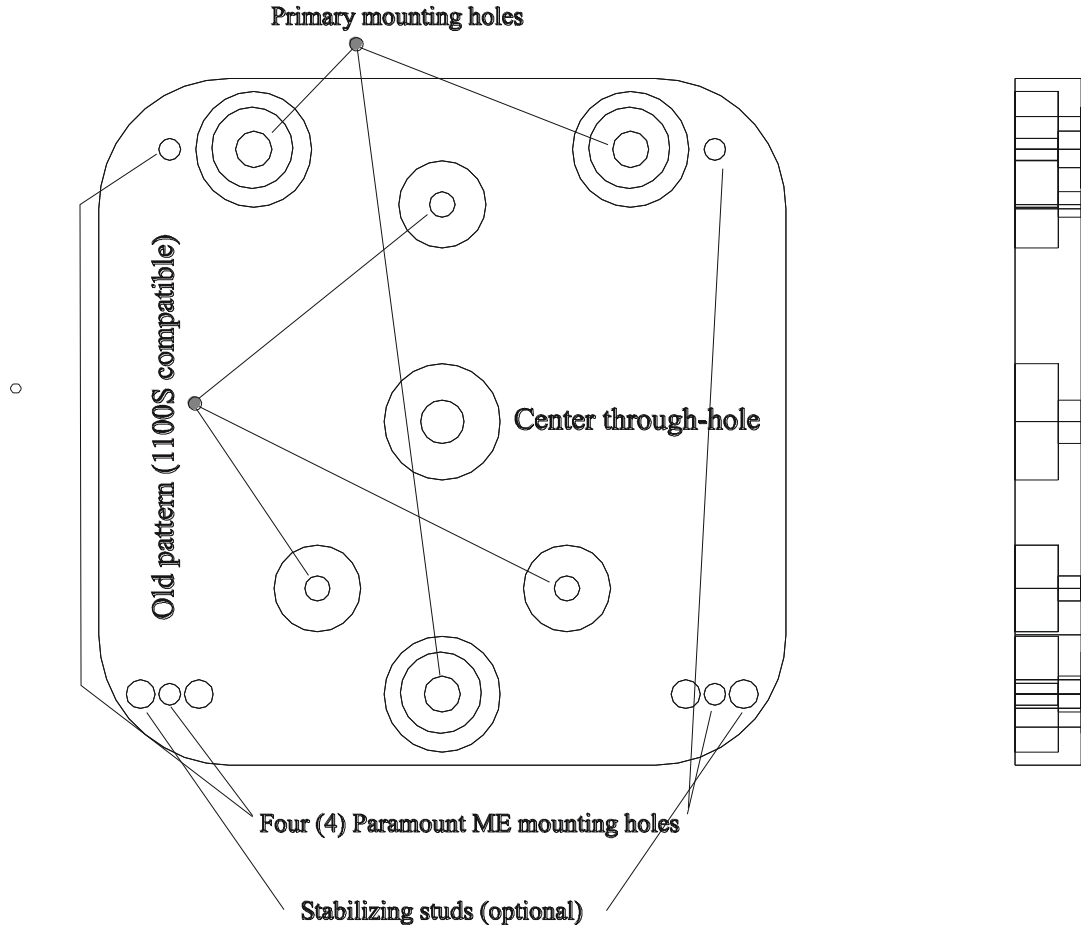
Figure 63: Description of the Wedge to Pier Adaptor hole patterns.
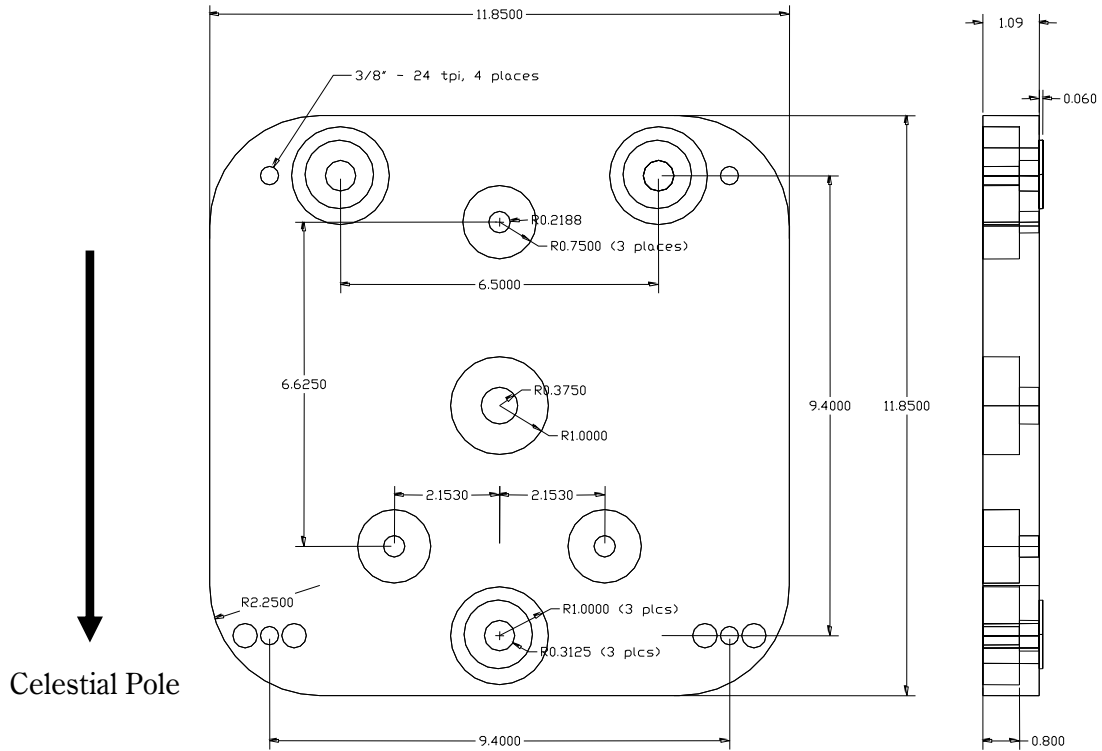
Figure 64: Base Plate dimensions (plan and side view).

In Figure 65, the Celestial Pole is towards the bottom of the page. The three primary mounting holes form an "arrow" that points toward the north when the mount is located in the northern hemisphere or the south in the southern hemisphere.
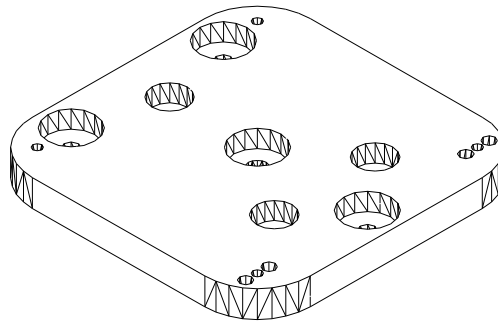


Figure 65: Top view of the Paramount ME adapter plate.
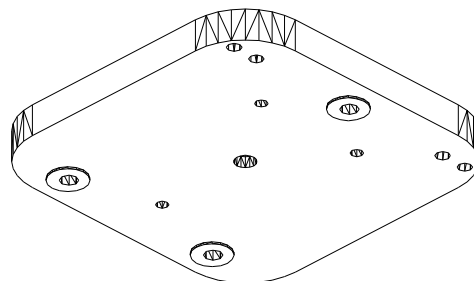
Figure 66: Bottom view of the heavy-duty adapter plate.


## Software Bisque Pier Specifications



Figure 67: Sample 46 cm (18-inch) Paramount ME Pier


The Software Bisque Paramount ME pier is available in heights ranging from 30.5 cm to 122 cm (12-inches to 48-inches). Software Bisque stocks 30.5 cm (12-in), 61 cm (24-in.), 91 cm (36-in.) and 122 cm (48-in.) piers. Custom height piers require up to 10 weeks delivery.

| Pier Height cm (in) | Pier Weight kg (lbs) | Typical Availability |
| --- | --- | --- |
| 31 (12) | 19 (42) | Immediate |
| 46 (18) | 22 (48) | Immediate |
| 61 (24) | 25 (54) | Immediate |
| 76 (30) | 26 (58) | Immediate |
| 91 (36) | 29 (64) | Immediate |
| 107 (42) | 32 (70) | Immediate |
| 122 (48) | 35 (76) | Immediate |
| Custom | 26 (58) + 2.7 (6) per 2.5 cm (1-in) over 76 cm (30-in.) | 8-10 weeks |


The ME Pier is constructed of two steel plates welded to a 10-inch diameter steel tube. The piers are powder coated on both the outside and inside to protect the steel from the elements.

Figure 68: Photograph of pier base plate. Note slotted holes.
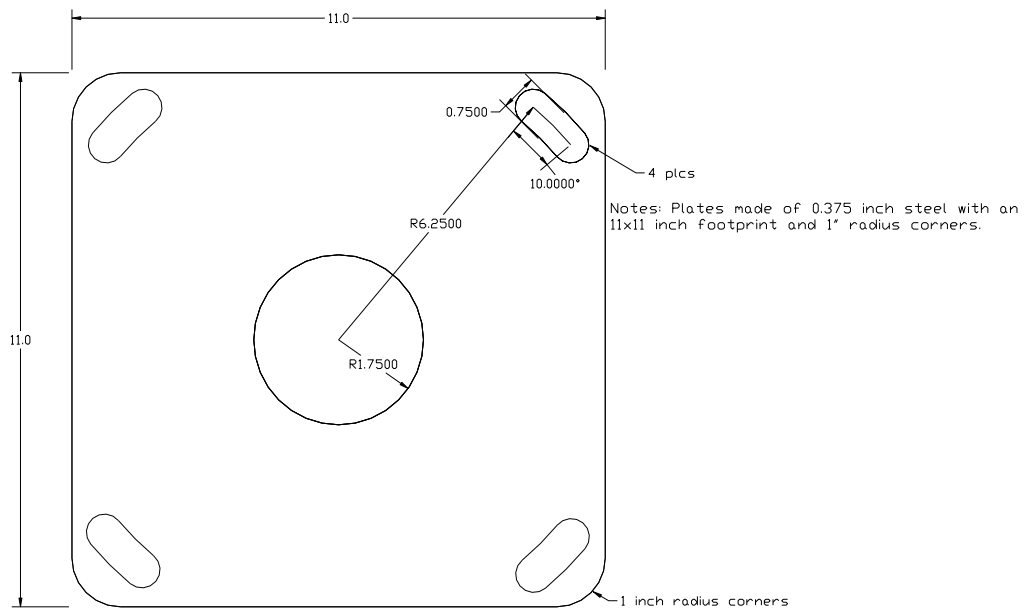


Figure 69: Dimensions of pier base plate.

## *Pier Base Plate*

Figure 69 shows the footprint of the Paramount ME pier. The pier can be mounted using four 0.50-inch J-bolts placed in concrete. Software Bisque recommends that the base plate remain in contact with the cement surface to minimize damping times.
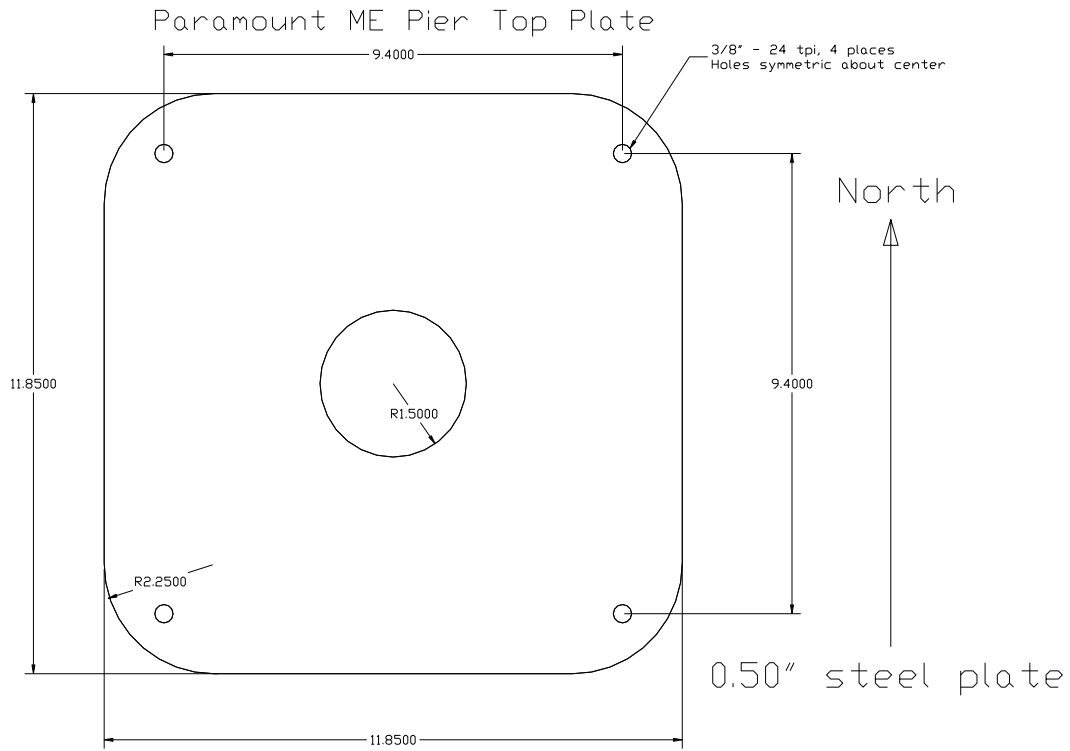
Figure 70: Pier Top Plate dimensions.

## Pier Top Plate

The Paramount ME Pier Top Plate is slightly larger than the Base Plate. It is constructed out of 0.50-inch thick steel plate and is drilled in the corners to accept the Paramount ME. North is indicated in the above drawing. However, since the 9.40-inch hole pattern is symmetric about the center of the pier, and multiple of 90-degrees will also work.



Figure 71: Photograph of pier top plate.

# Appendix B: Miscellaneous Paramount ME Specifications

## *Paramount ME Dimensions*

This section provides dimensions of the Paramount ME in the many possible positions used for pointing a telescope. German Equatorial telescope mountings are very stable by design, yet the requirement of counterweights increases the clearance space required surrounding the telescope and mount.
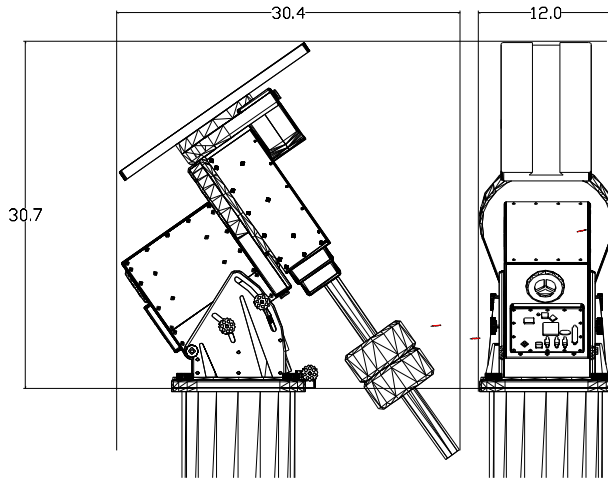


Figure 72: Approximate Paramount ME dimensions (inches).

## *Determining Pier Height*

Use the equation or table below to determine the "height" of the center of your optical tube assembly when the OTA is pointed at the horizon, looking south. This orientation defines the minimum position so that objects near the horizon are visible.

OTA Center Height at the Meridian (cm)      $= 8.2 + \sin (\text{latitude} + 29º) \times 38.3$
OTA Center Height at the Meridian (inches)   $= 3.25 + \sin (\text{latitude} + 29º) \times 15.1$

| Latitude | Approximate OTA Center Height (looking south, at the horizon) |
|----------|----------------------------------------------------------------|
| 20º | 37.1 cm (14.6 in.) |
| 30º | 41.2 cm (16.2 in.) |
| 40º | 44.2 cm (17.4 in.) |
| 50º | 46.0 cm (18.1 in.) |

The height is measured from the base of the Paramount ME to the center of the OTA. This measurement is especially important if the mount is inside a dome, or there are walls around the observatory building that might obstruct the telescope's view. An unobstructed view at the horizon requires the pier top be high enough so that OTA does not point "into the wall" when pointing north or south.

## *Guider Jack Wiring Specifications*

The Adaptor Panel's *Guider* port accepts a male RJ12 modular connector and provides access to the directional switching used during autoguiding.



Figure 73: Pinout diagram for the *camera guider port*.
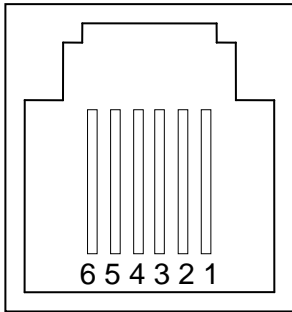
**Pinouts for the Male RJ12 End of Guider Cable that Plugs into the Camera Guider Port**

| RJ12 pin | Color* | Description | SBIG DB15 pin[†] |
|----------|--------|-------------|------------------|
| 1 | WHT | +X | 10 |
| 2 | BLK | +Y | 13 |
| 3 | RED | –Y | 7 |
| 4 | GRN | –X | 4 |
| 5 | YLW | Ground (common) | 5,8,11,14 |
| 6 | BLU | NC (not connected) | |
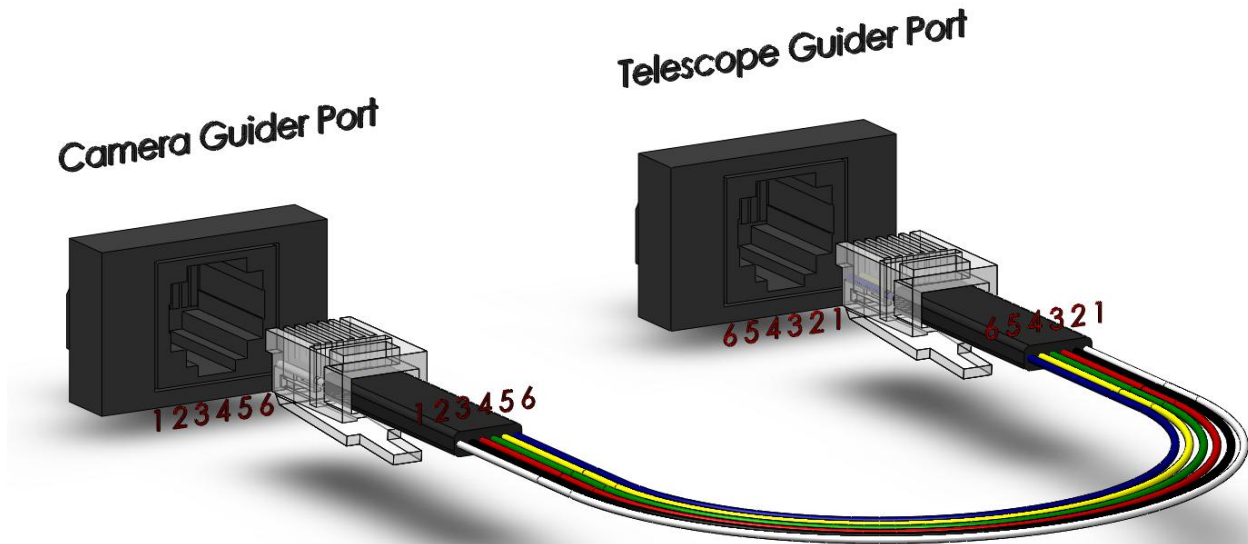


Figure 74: Diagram showing the pinouts for the guider cable and the camera and guider ports.

*Note: The actual wire colors may differ.
[†]This information may be used with SBIG ST-4, ST-5, ST-6 and SG-4 cameras.

See the section labeled "*Guide Port"* in the SG-4 Autoguider Operating Manual for SBIG autoguider cable specifications.

## Radio Shack[®] Cross Reference

The table below shows the Radio Shack® part number of several Adaptor Panel components.

| Description | Part Number | Quantity per Package |
|-------------|-------------|----------------------|
| | | |

| Description | Part Number | Quantity per Package |
|---|---|---|
| 5.5 mm O.D./2.1 mm I.D.  DC power plug | 274-1569 | 2 |
| 3.5 mm phono plug (mono) | 274-286 | 2 |
| RJ12 modular phone plug | 279-421 | 10 |
| DB9P (male) | 276-1537 | 1 |
| DB9S (female) | 276-1538 | 1 |
| DB9 hood (used with DB9P and DB9S) | 276-1539 | 1 |
| DB9 female-to-female cable, 6 ft. | 26-152 | 1 |
| DB25 male-to-male cable, 6 ft. | 26-249 | 1 |
| DB9P-DB25S adaptor | 26-287 | 1 |

## Auxiliary Port 1 and 2 Fuse Replacement

The Adaptor Panel is equipped with two 3A Slo-Blo fuses for the Aux 1 and Aux 2 ports.  If there is no continuity between the Aux Port (1 or 2) on the Adaptor Panel and the Aux Port (1 or 2) on the Instrument Panel, the fuse should be replaced.

To access these fuses, remove the fuse panel on the Adaptor Panel.  Use a pair of needle nose pliers to remove the fuses from the Adaptor Panel.
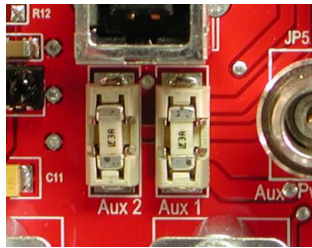


Figure 75: Location of fuses on the MKS 4000.

### Slo-Blo Subminiature Fuses Part Numbers

Littlefuse 3A Slo-Blo subminiature fuses can be purchased online.

Littelfuse part number (manufacturer): 0452003.MR
Digi-key.com (www.digikey.com) part number: F1347CT-ND
Mouser Electronics (www.mouser.com) part number: 576-0452003.MR.

### Camera Power Cable Pin Out Specifications

The wiring pin outs for the 5-pin DIN Camera Power connector on the Instrument Panel and Adaptor Panel are below.

| 5-Pin DIN Connector | Molex 8-pin Connector |
|---|---|
| 1 | 7 |
| 2 | 5 |
| 3,5 | 3 |
| 4 | 1 |

The camera power input is the 5-Pin DIN round connector mounted to the front of the electronic board and is labeled JP3 on the board; the Molex 8-pin connector is the white connector mounted to the backside of the electronic board and is labeled JP7.
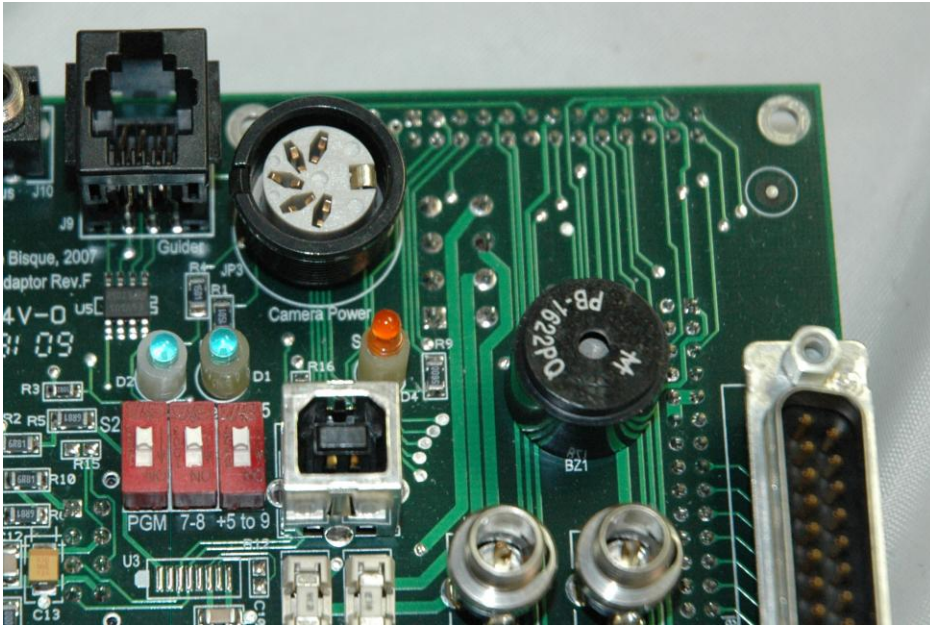


Figure 76: Camera Power 5-pin DIN connector on the Adaptor Panel.
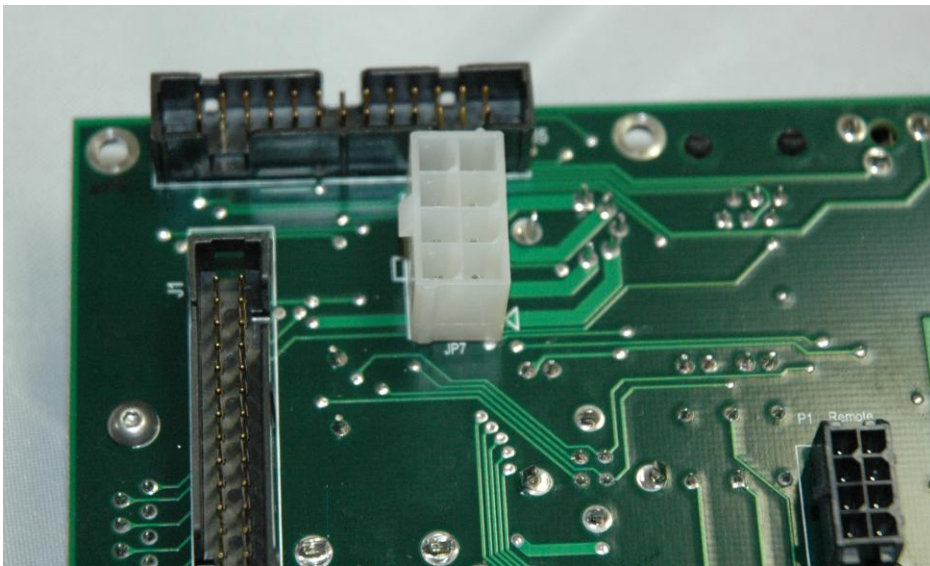


Figure 77: 8-pin Molex connector on the back of the Adaptor Panel.

## Appendix C: Updating the Control Software (Firmware)

 **Critical Notes**

Please carefully read the following before proceeding.

- The most recent version of the *MKS 4000* firmware is 2.8.6.
- All Paramount ME's shipped before July, 2011 have firmware version 2.5.19 installed.
- All Paramount ME's shipped after July, 2011 have firmware version 2.8.6 installed.
- Under normal operating conditions, *MKS 4000* control system's firmware should *never* need to be "reflashed" using the same firmware version.
- The following procedure currently applies only to the older *MKS 3000* and *MKS 3200* control systems.

This appendix describes the procedure to update the Paramount ME with the *MKS 3000*, *MKS 3200* model control system and the Paramount GT-1100S control software.

Before proceeding, verify the control system's current firmware version to determine if an update is necessary. If the version of your control system's firmware is earlier than version 1.1.45, then proceed with the update. If later, then no update is necessary.

**To determine your mount's firmware version**

1. Launch TheSky6.
2. Click **Telescope > Link > Establish**. Home the mount if necessary.
3. Click **Telescope > Options > More Settings**.
4. Click the **Advanced** tab. The firmware or **Control Version** is listed near the bottom of this window. See Figure 74.
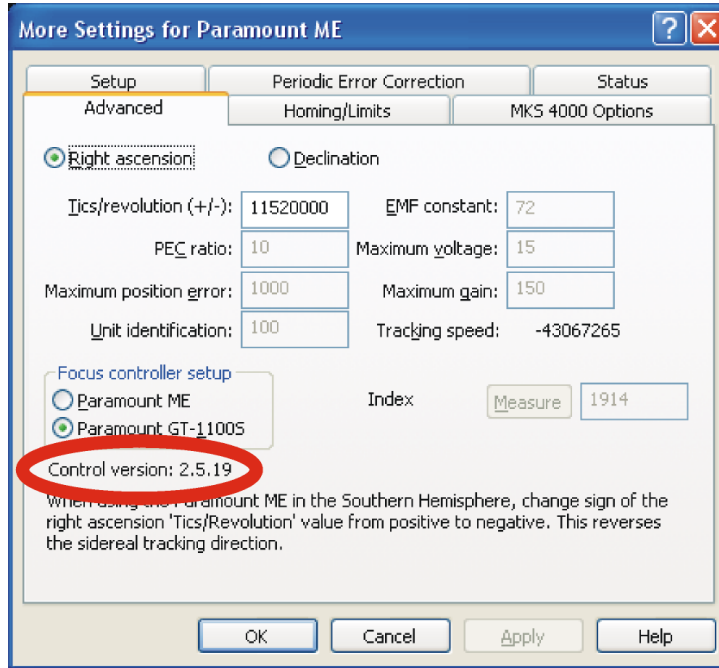
Figure 78: Advanced tab of the Paramount ME More Settings dialog box showing the firmware or "control" version.

1. Download the most recent version of TheSky6 Professional Edition from Software Bisque at www.bisque.com/download.
2. The latest Paramount firmware is version for the *MKS 3000* and *MKS 3200* is 1.1.45. The latest Paramount firmware is version for the *MKS 4000* is 2.8.6. Files named `MKS1145.out` and `MKS4-286.out` contain updated control software (firmware) that will be transferred into Paramount's control system. `MKS1145.out` is located in TheSky6 Professional Edition's folder:

   ```
   <Drive>:\Program Files\Software Bisque\TheSky6\MKSXXXX.OUT
   ```

   where `<Drive>` is the letter of the hard drive where TheSky6 Professional Edition was installed.

   Firmware version 2.8.6 (`MKS4-286.out`) can be downloaded from the Software Bisque web page at:

   http://www.bisque.com/sc/media/p/52428.aspx

   - Firmware updates on the Paramount ME with the *MKS 4000* can be performed without setting any DIP switches. Note that to date there have been no updates to the MKS 4000 control system firmware. From TheSky6, establish communications with the mount, and then click **Telescope > Options > More Settings** command. Click the **For Flash Update** button on the **MKS 4000 Options tab** to select the name of the firmware update file. Enter the name of the firmware update file (MKSxxx.out, where xxxx is the latest firmware version) and then click **Update.**
   - Firmware updates on the Paramount GT-1100S requires removing the side panel (where the power switch and joystick plug in).
   - On the Paramount ME with the MKS 3000, remove the access panel on the control panel mounted on the back of the RA box. Once removed, you will see the adapter board with numerous wires and ribbon cables attached. There are two *DIP switches* on this board labeled

*Program* on one side and *Run* on the other.  Make sure the mount is turned off, and then switch both from *Run* to *Program*.  This will allow TheSky6 Professional Edition to update the control software in the flash memory of the Paramount via the serial port.

After the DIP switches are set to *Program*, turn on the Paramount.  Note that the motors will *not* turn as they do when the DIP switches are set to *Run*.

Next, launch TheSky6 Professional Edition and click **Telescope > Link > Establish**.  Instead of the normal homing question, you will see the following dialog box:
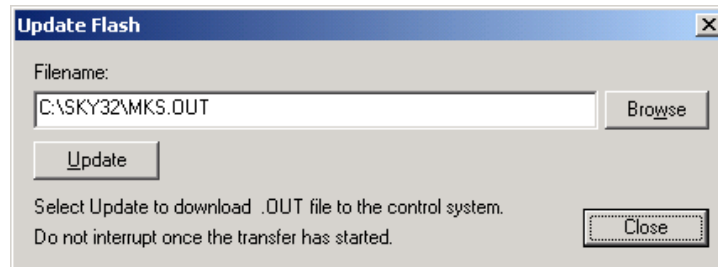
Figure 79: The Update Flash dialog.

Click **Update** to begin updating the firmware.  The entire process takes about 25 seconds to complete.  The message, "**Programming Complete!**" appears if the FLASH is successfully updated.

When you close the Update Flash dialog box, you will see the following:

Figure 80: Update Flash error message.

Don't be alarmed; this error simply indicates that TheSky6 Professional Edition could not connect to the control system normally because the DIP switches are set to the *Program* mode.

Next, turn off Paramount and return both of the DIP switches to the *Run* position.

Replace the side panel on the Paramount GT-1100S, or the access panel on the Paramount ME, and the mount is ready to operate using the new control software.

# Appendix D: Southern Hemisphere Setup and Use

The following directions show how to configure TheSky6 Professional Edition so the Paramount ME or GT-1100S performs properly in the Southern Hemisphere.

See "Paramount ME Initialization" on page 50 for details about connecting your telescope to the computer and establishing communications with the mount.

1. Click **Telescope > Link > Establish** to establish communication with the mount.
2. Click **Telescope > Options > More Settings** to display the More Settings dialog box.

Several parameters must be modified on the More Settings dialog box so that the Paramount works correctly in the Southern Hemisphere.

The differences between Northern Hemisphere and Southern Hemisphere parameters are shown on the tables below.
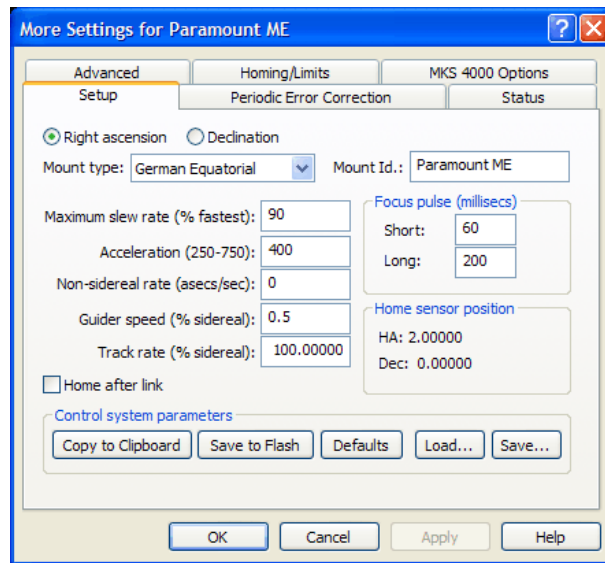


Figure 81: The More Settings dialog box.

| Mount Model | Tics/Revolution for Southern Hemisphere | Integer tracking rate* | Sensor HA and Dec in the Southern Hemisphere† |
|---|---|---|---|
| Paramount ME | -11520000 | 43,067,265 | Approximately 10, 180 |
| Paramount GT-1100S | -7200000 | 26,917,040 | Approximately 10.8, 150 |
| Paramount GT-1100S (with control software 1.1.16 or earlier) | -7200000 | 20,187,780 | Approximately 10.8, 150 |

*This value is automatically computed by clicking **OK** from the TheSky6 Professional Edition More Settings dialog box, and is displayed on **Telescope > Options > More Settings > Advanced tab**).
†These values are shown on the **Telescope > Options > More Settings > Setup tab**.

Note: TheSky6 Professional Edition allows access to the **Advanced** tab on the More Settings dialog box. Download this version from www.bisque.com/download.

Once the encoder tics per revolution (**Tics/Rev**) has been set, click **Save to Flash** on the **Setup** tab to store the changes permanently in the Paramount's permanent flash memory.

## Sensor Hour Angle (HA) and Sensor Declination (Declination)

Note that declination values greater than 90 degrees indicate that the mount is "on the opposite side." This behavior is by design.

| *Critical Note* | When using the Paramount ME in the southern hemisphere, *you must* synchronize the mount on a star that is on the east side of the meridian when the optical tube assembly is on the west side of the meridian. |
|---|---|

| *Tip* | The "best practice" for synchronization is to home the mount, then use the joystick to center the telescope's field of view on the closest, brightest star that is both near the home position and 5 degrees or more away from the meridian, and then sync.  This will ensures that the optical tube assembly is in the correct orientation.  See page 74 for more information about synchronization. |
|---|---|

### Setting Telescope Limits
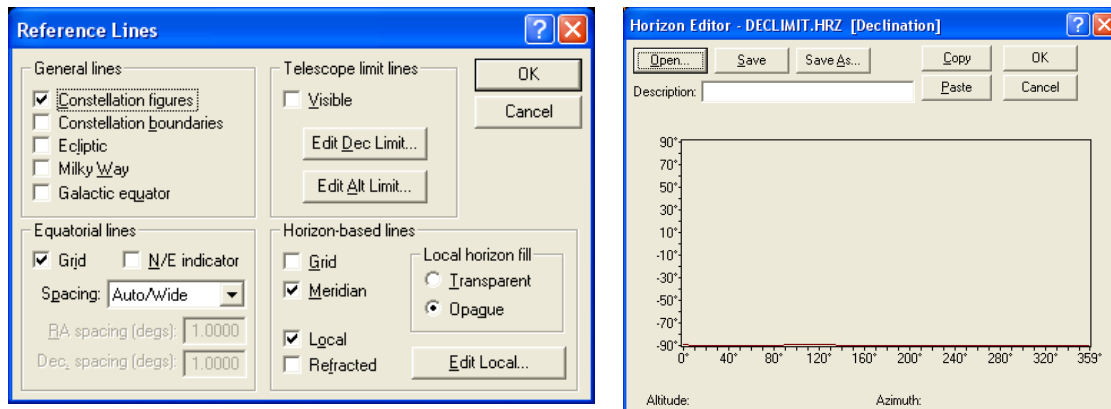


Figure 82: Setting Telescope Limits.

The Declination Limit Lines must be set to –90 degrees for the Paramount ME to function normally in the Southern Hemisphere.  Otherwise, an "exceeded slew limit" warning is issued each time the mount is slewed.  Click **View > Reference Lines > Edit Dec Limit** to access this dialog box.

# Appendix E: USB Driver Installation and Use

Paramount ME and the Bisque Telescope Control System (TCS) products shipped after July 1, 2004 come with the newer model *MKS 4000* control system and include a USB hardware interface port. If you wish to control the Paramount ME via USB, you must install USB drivers first. See "USB Driver Installation" below for details.

The *MKS 4000* can also be controlled via standard RS232 port, and does not require the installation of additional drivers.

## Minimum Requirements for USB Control

Here are the minimum requirements for controlling the Paramount ME through a USB port.
- Paramount ME Robotic Telescope System or the Bisque TCS using the *MKS 4000* control system.
- TheSky6 Professional Edition version 6.0.0.25 or later.
- The *MKS 4000* USB drivers (included on the Paramount ME System disc).
- USB port on your computer.
- One USB cable.

## USB Driver Installation

In order to the USB port, you must first install the *MKS 4000 USB* software driver.

### Notes
- This driver does *not* need to be installed to control the Paramount ME via standard serial (COM) port.
- The USB driver was previously named "Bisque TCS," so Windows may identify your mount as such. The *MKS 4000* USB drivers will control either device.

The *MKS 4000* USB driver installer software is included on the Paramount ME System disc. Note that TheSky6 Professional Edition version 6.0.0.25 or later must also be installed. The installer for the latest TheSky6 update is available on this disc.

### To Install the MKS 4000 USB Drivers

1. Insert the Paramount ME System Disc into your CD or DVD-ROM drive and wait for the introduction screen to appear.
2. Click **Install Software**.
3. Mark the **I Accept the Terms of the License Agreement** and then click **Next**.
4. Click **TheSky6 Update Installer** and the follow the instructions to install the latest version of TheSky6 Professional Edition.
5. Once TheSky6 update is complete, click the **USB Driver Installer** text or graphic to launch the driver installer software.
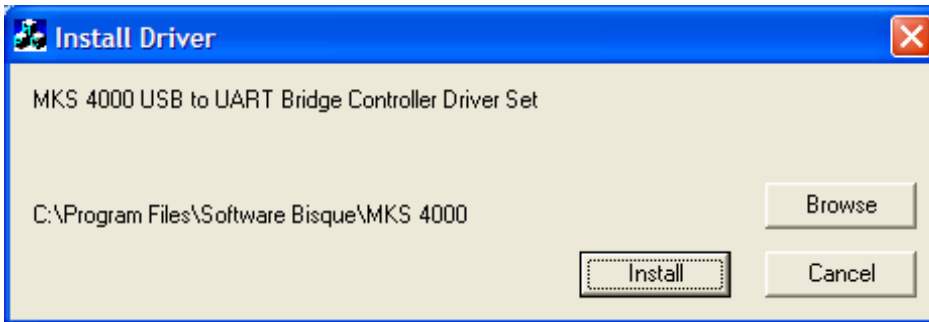
6. Click **Install** to install **the MKS 4000 USB to UART Bridge Controller Driver Set**.
7. During driver installation, the following screen appears twice. Click **Continue Anyway** each time.
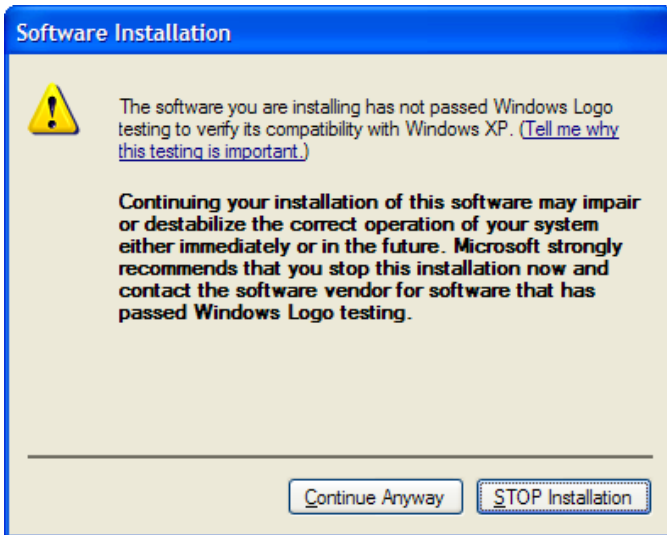


8. Click **OK** on the on **Installation Successful** screen.
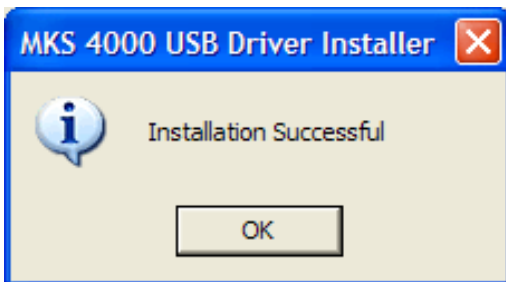


9. Restart the computer.
10. Important: After the computer is restarted, plug the USB cable into the mount. The message "Found New Hardware" should appear in the Task bar and the Windows Add Hardware Wizard should appear to complete the installation of the *MKS 4000* USB drivers. The USB driver installation is not complete just yet.
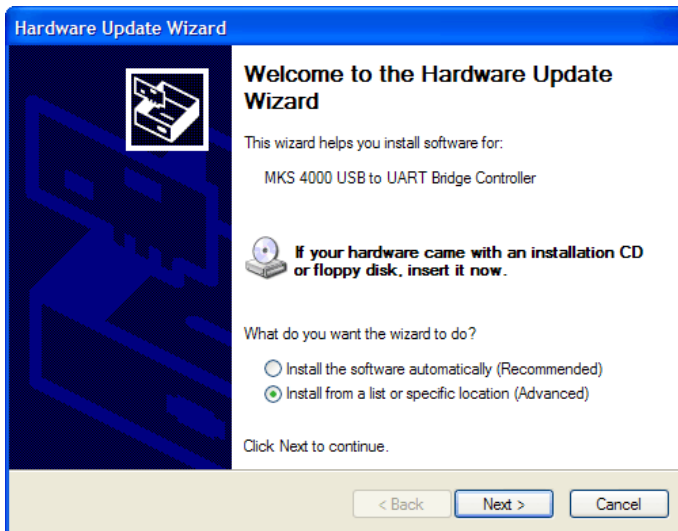
11. Select **Install From a List or Specific Location (Advanced)** and then click **Next.**
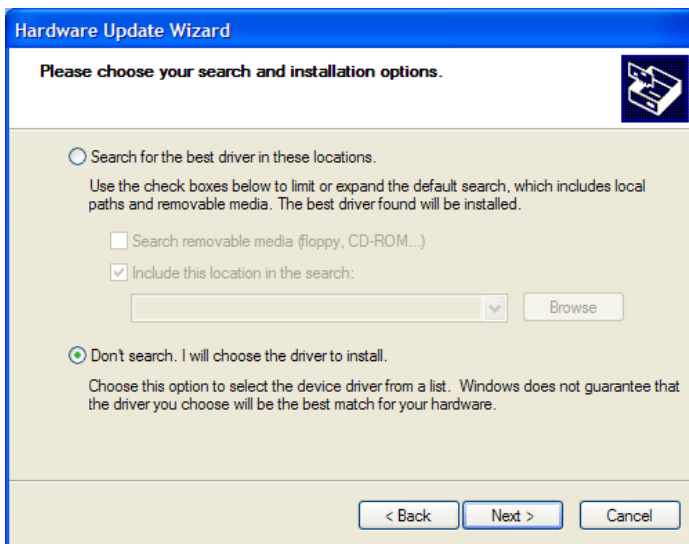


12. When prompted to specify where to search for the drivers, click **Don't Search. I Will Choose the Driver to Install** option. Click **Next.**
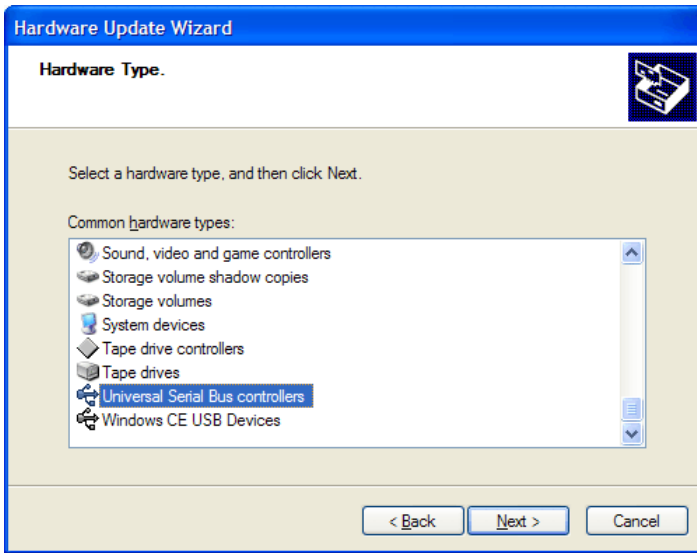
13. Select the **Universal Serial Bus Controller** from the **Common Hardware Types** list and then click **Next.**
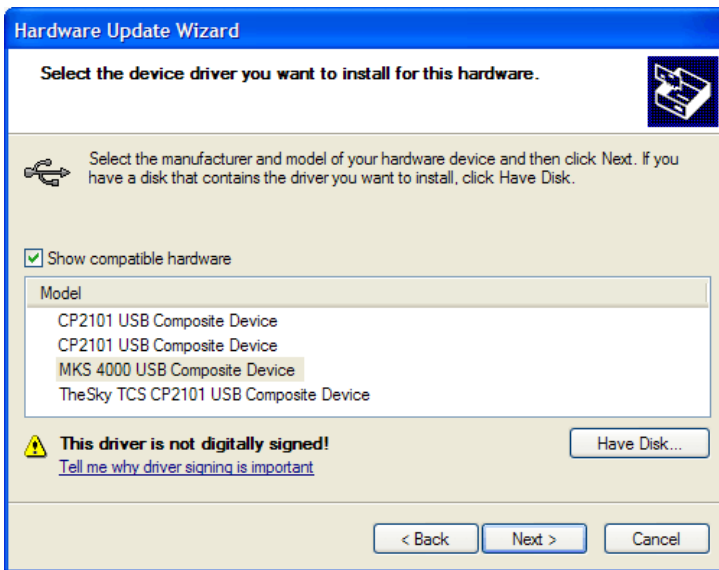


14. Click the **Show Compatible Hardware** option, then select the **MKS 4000 USB Composite Device** from the list, and then click **Next.**  You'll be prompted to verify the installation of the USB drivers. Click **Continue Anyway** twice to complete the installation.
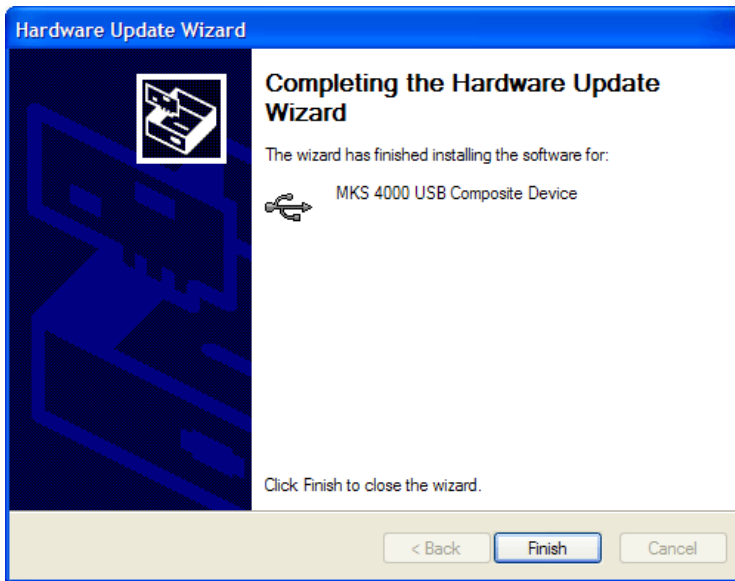
The MKS 4000 USB drivers should now be installed and ready to use.

The following drivers are copied to the Windows System32 folder:
- Slabbus.sys
- SlabWH.sys
- SlabWNT.sys
- MKSUSBUn.u2k
- MKSUSBUn2K.exe

**To Uninstall the MKS 4000 USB Drivers**

1. Click **Start > Control Panel > Add or Remove Programs**.
2. On the Add or Remove Programs window, select the **MKS 4000 USB to UART Bridge Controller** and then click **Change/Remove**.
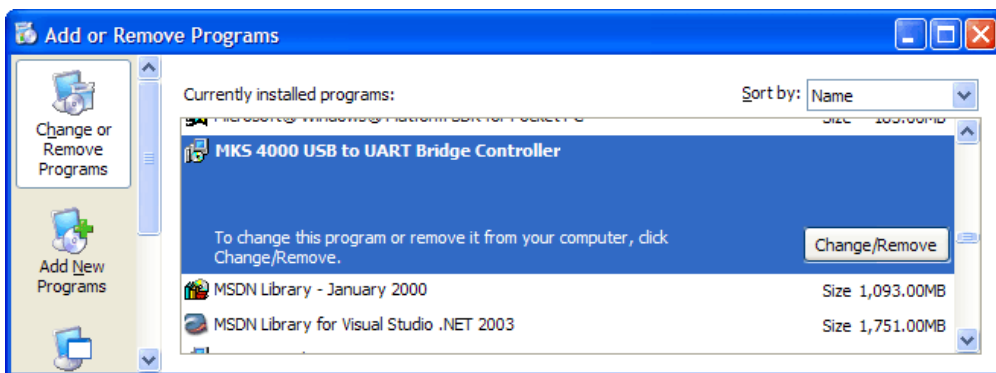


3. When prompted, click **Yes** to complete the removal process.
4. You'll be notified when the "uninstall" is complete.
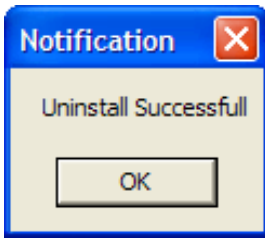
## Using the MKS 4000 USB Port

After the USB drivers are installed and the computer is restarted, you are ready to control the Paramount ME (or the Bisque TCS) via USB port.

1. Use a small Phillips screwdriver to remove the **Access to fuses and Flash programming** cover on the Instrument Panel.



Figure 83: Use a small Phillips screwdriver to remove the cover labeled "Access to Fuses and USB Port" to access the USB port.

2. Plug the USB cable to any USB port on the computer, and into the Paramount ME's USB port.
3. Launch TheSky6 Professional Edition.
4. Click **Telescope > Setup.**
5. After selecting **Paramount ME by Software Bisque** or the **Bisque TCS by Software Bisque** in the **Telescope or Control System** group, click **Settings.**
6. The Windows operating system maps the *MKS 4000* USB driver to the next available serial (COM) port. Select this port from the **COM Port** list and then click **OK.** If you're not sure which port this is, see "Determining the MKS 4000 USB COM Port Number" on page 114 for details on how to do so.

## Determining the MKS 4000 USB COM Port Number

The *MKS 4000* controls system's USB port is recognized by the Windows operating system as a standard serial (COM) port using a special software driver. When the USB drivers are installed, Windows automatically assigns the next available COM port to this driver.

You can determine the COM port number (or change it) using the Windows Device Manager. Note that under Windows NT, 2000 and XP Professional, the user account must be a member of the Administrator's group to alter these settings.

1. Click **Start > Control Panel > Administrative Tools > Computer Management**.
2. Under **Computer Management**, open the **Device Manager**.
3. Open the **Port**s node on the right side of the Computer Management window. One of the Port entries will read: **the MKS 4000 USB to UART Bridge Port Controller (COM N)**, where **N** is the port number that Windows has assigned to this device. Use this COM port number in TheSky6 Professional's **Telescope > Setup > Settings** dialog box.

## Changing the MKS 4000 USB COM Port Number

To change the COM port number assigned to the *MKS 4000* USB driver:

1. Follow the procedure above (step 1-3).
2. Right-click on **the MKS 4000 USB to UART Bridge Port Controller (COM N)** and then click **Properties**.
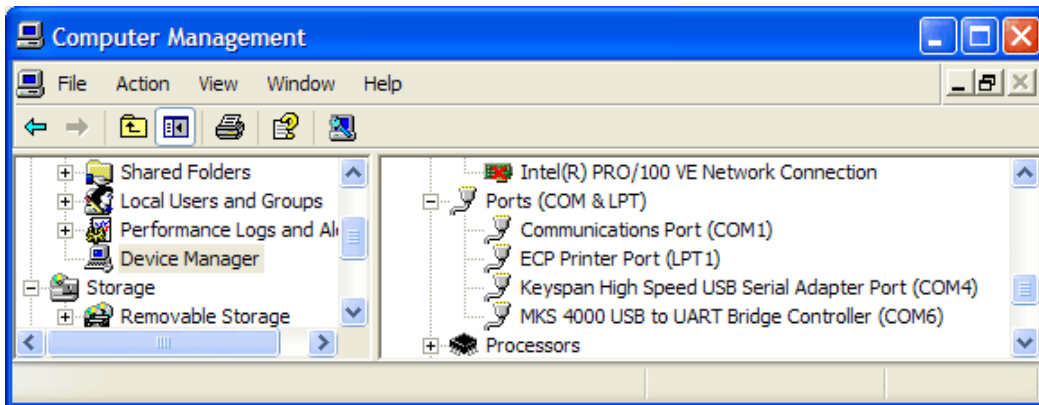


3. On the **MKS 4000 USB to UART Bridge Port Controller** dialog box, click on the **Port Settings** tab. Click **Advanced**.
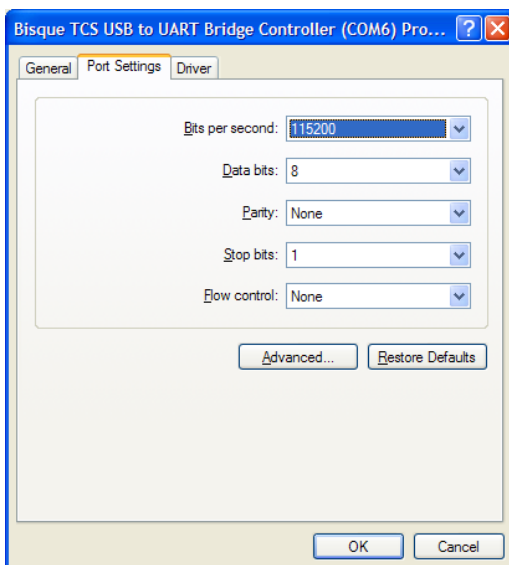
4. On the **Advanced Settings for COM N** dialog box, from the **COM Port Number** list, select the desired COM port to use for the *MKS 4000* USB port.
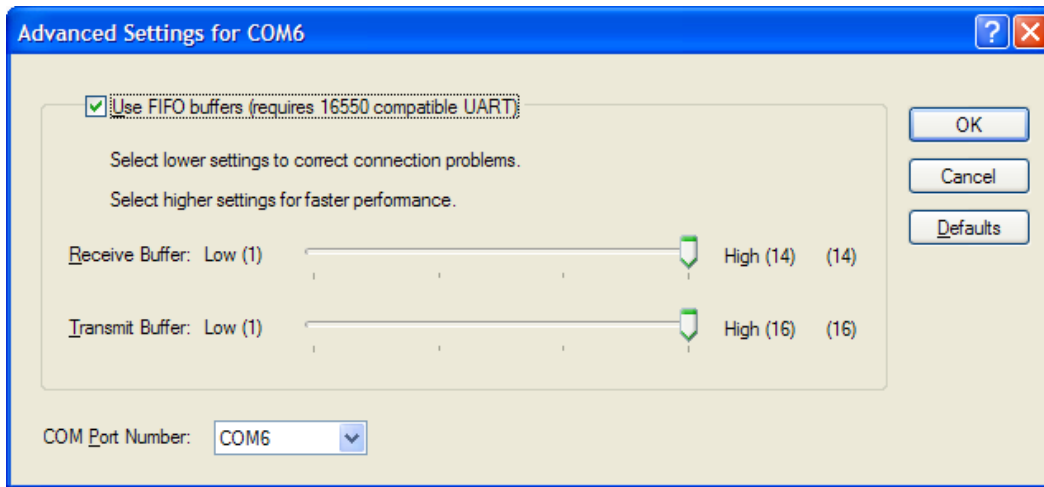
# Appendix F: FCC Compliance Statement

## *Warning*

Changes or modifications to this unit not expressly approved by the party responsible for the compliance could void the user's authority to operate this equipment.

## *Note*

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense. The user is advised that any equipment changes or modifications not expressly approved by the party responsible for compliance would void the compliance to FCC regulations and therefore, the user's authority to operate the equipment.

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