



Paramount ME II and Paramount MX Robotic Telescope System User Guide

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Telescope Operation Disclaimer

Robotic telescope mounts do not have an unlimited range of movement. The telescope's shape, the way it is mounted, or the addition of accessories can prevent it from pointing at particular parts of the sky. If the telescope is forced past these points, the telescope, its mounting, or accessories might be damaged.

TheSkyX Professional Edition includes a "limit line" feature that lets you specify these inaccessible positions; *TheSkyX Professional Edition* will try to prevent the telescope from entering or crossing them. This feature is provided as a *convenience*, not as a panacea. Since any telescope can run into its mechanical limits through accident, carelessness, or component failure, Software Bisque cannot be responsible for any damage to your telescope that occurs when using *TheSkyX Professional Edition* to control it.

Furthermore, Software Bisque cannot be held responsible for damage caused by plugging cables into electronic devices. We strongly recommend turning off all electronic devices (computers, mobile devices, telescopes, focusers, dew heaters, CCD cameras, etc.) before attaching any cabling or power supplies.

Sun Warning



NEVER attempt to observe the Sun through your telescope! Without a specially designed solar filter, viewing the Sun – for even a fraction of a second – will cause instant, irreversible eye damage. When observing during the day, do not point the telescope near the Sun. Do not use *TheSkyX Professional Edition's* automatic slew feature to find objects during the day.

The Paramount Robotic Telescope System

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

This user guide covers the basic setup and use of both the *Paramount ME II* and *Paramount MX* model mounts. Both models appear and function similarly; the Paramount ME II is physically larger and can carry a larger payload than the Paramount MX; otherwise, for the most part, operating either mount is essentially identical.

This document assumes 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 searching the Internet to find out more information about it. Unfortunately, there is simply no way that all the different facets of setting up and controlling a robotic telescope mount can be covered in a single document.

The Paramount German equatorial mount includes a host of features that are designed to help foster memorable and productive observing experiences.

The table below lists the major features found in each model.

| Feature | Paramount ME II | Paramount MX |
|---|-----------------|--------------|
| Software Bisque's fourth generation dual axis control system (MKS 5000™) provides precision, reliable performance. | ✓ | ✓ |
| Integration with <i>TheSkyX Professional Edition</i> for Mac or Windows control. | ✓ | ✓ |
| <i>Camera Add On™</i> software provides single software telescope, camera, focuser, filter wheel, SBIG AO and rotator control. | ✓ | ✓ |
| <i>TPoint Add On™</i> with Super Model™ and ProTrack™ provides the same telescope pointing correction software that is used on most professional telescopes. | ✓ | ✓ |
| The <i>Multi-OS and Six License Add On</i> lets you install <i>TheSkyX Professional Edition</i> and related Add Ons on up to six (6) different Mac and Windows computers. | ✓ | ✓ |
| Research-grade right ascension gears with seven (7) arcseconds or less peak-to-peak periodic error, before applying periodic error correction (PEC). | ✓ | ✓ |
| Optimal periodic error correction curve fitting that can produce | ✓ | ✓ |

| Feature | Paramount ME II | Paramount MX |
|--|-----------------|--------------|
| "seeing agnostic" periodic error curves. | | |
| <i>Direct Guide™</i> that allows optimal guiding without the need of a guider cable. | ✓ | ✓ |
| Both the right ascension and declination axes include a mechanical switch to easily change between balancing the payload and tracking. (The Paramount MX includes a third position on the mechanical switch that allows the axis to be locked. The Paramount ME II's axes may be locked in place by installing locking bolts.) | ✓ | ✓ |
| Clutch-free worm block design preserves the mount's physical orientation for accurate and repeatable TPoint modeled pointing and tracking. | ✓ | ✓ |
| The 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. | ✓ | ✓ |
| Integrated homing sensors that allow rapid mount initialization to produce precision and reliable repeatability from night to night, or if power is lost. | ✓ | ✓ |
| Super-stable physical design that rapidly dampens external vibrations. | ✓ | ✓ |
| Configurable 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. | ✓ | ✓ |
| Fifty separate conductors of through the mount cabling to minimize the tedium of having CCD power, CCD signal, focus, video, dew heater, and other accessory cables routed to the telescope. | ✓ | ✓ |
| Integrated Cable Conduit™ allows adding custom cables, wires through the mount. | ✓ | ✓ |
| Integrated equatorial wedge for polar axis altitude adjustment. | 14° – 68° | 10° – 65° |
| Integrated rotating base allows calibrated azimuth adjustments | ✓ | ✓ |

| Feature | Paramount ME II | Paramount MX |
|--|----------------------------------|--------------------------------|
| to be made without affecting the mount's altitude. | | |
| Integrated altitude scale to provide an accurate altitude starting point for polar alignment. | ✓ | ✓ |
| Oversized right ascension bearing and declination bearings provide maximum stability. | 20.3 cm/8-in. | 15.2 cm/6-in. |
| Structural design is extremely rigid, even at maximum payload capacity. | ✓ | ✓ |
| Landing lights under the mount can be turned on to illuminate dark working areas during setup. | ✓ | ✓ |
| High total payload capacity to mount weight ratio. | 109 kg/38 kg (240 lb./84 lb.) | 41 kg/23 kg (90 lb./50 lb.) |
| Two counterweights and one counterweight shaft included standard. | ✓ | ✓ |
| Power supply included with mount. | 200W max | 80W max |

Paramount ME II vs. Paramount MX

The Paramount ME II and Paramount MX are very similar in function and design. The table below lists the “significant” differences between these two models.

| Feature or Specification | Paramount ME II | Paramount MX |
|--|---|---|
| Maximum payload capacity (that is, the total instrument capacity not including counterweights) | 109 kg/240 lb. | 41 kg/90 lb. |
| Physical dimensions | See technical drawing on page 144. | See technical drawing on page 144. |
| Versa-Plate dimensions and optional mounting accessories (page 49) | 25 cm x 51 cm x 2.5 cm (9.9-in. x 20-in. x 1.0-in.) <ul style="list-style-type: none"> Four dovetail mounting knobs. Optional mounting rails for attaching large OTAs. | 16 cm x 41 cm x 1.8 cm (6.4-in. x 16-in x 0.72 in.) <ul style="list-style-type: none"> Three dovetail mounting knobs. |
| Number of Altitude Adjuster Thrust Knobs (page 80) | Four (4) | Two (2) |
| Routing custom cabling through the mount | See “Through the Mount Cabling” on page 33 for | See “Through the Mount Cabling” on page 33 for |

| Feature or Specification | Paramount ME II | Paramount MX |
|---|--|--|
| | details. | details. |
| Mechanical switch on right ascension and declination axes (page 59) | <p>The <i>Two Position Switch</i> engages the worm with the gear, or permits payload balance by separating the worm from the gear.</p> <p>The right ascension and declination axes can be locked in place for transport, or when adding payload, by installing two locking bolts on each axis.</p> | The <i>Three Position Switch</i> engages the worm with the gear, permits payload balance by separating the worm from the gear, or locks the gears to prevent axis rotation during shipment or transport. |
| Physical hard stops that permit tracking past the meridian without the optical tube assembly flipping sides | Configurable. Five different positions, located at a minimum of seven minutes to up to two (2) hours past the meridian. | Fixed, non-configurable hard stop position that allows a maximum of two (2) hours tracking past the meridian. |
| Micro Levelers to level the base plate | See “Micro Levelers (ME II Only)” on page 82. | Micro levelers are not included. |
| <i>Optional</i> absolute encoders | Designed for integrated absolute encoders for each axis. (The estimated availability of this option is in the third quarter of 2013.) | Not available. |

Optional Accessories

The table below lists optional accessories for each model.

| Optional Accessory | Paramount ME II | Paramount MX |
|---|-----------------------------|---------------------------|
| TheSkyX Professional Edition Dome Add On | ✓ | ✓ |
| TheSkyX Professional Edition Database Add On | ✓ | ✓ |
| Counterweight Shaft Extension Bar | 8-in. long, 1.875-in. wide | 8-in. long, 1.5-in. wide |
| Paramount ME/MX Counterweights | 14kg/30 lb., 1.875-in. bore | 9 kg/20 lb., 1.5-in. bore |
| Software Bisque Paramount Permanent Piers | ✓ | ✓ |
| 48V 5AH Portable Power Supply or 48V 10AH Portable Power Supply | ✓ | ✓ |
| Power supply cables to use in conjunction with the mount’s built-in through the mount power | ✓ | ✓ |

| Optional Accessory | Paramount ME II | Paramount MX |
|--|-----------------|--------------|
| cabling (page 147) | | |
| Base to Pier Adaptor Plate for mounting the Paramount to an existing pier | ✓ | ✓ |
| Polar alignment scope, mounting hardware, and cover | ✓ | ✓ |
| Software Bisque Pyramid™ Portable Pier | ✓ | ✓ |
| Latitude Adjustment Wedge for use below 10 degrees and above 65 degrees latitude | ✓ | ✓ |

Getting Help

If you have questions about your Paramount, please carefully review the information in this document. If you still cannot find an answer, join the Software Bisque support community at www.bisque.com/support and click the **Write a New Post** link on the Paramount ME II Support Forum (<http://www.bisque.com/sc/forums/114.aspx>), or on the Paramount MX Support Forum (<http://www.bisque.com/sc/forums/96.aspx>) to ask your question. The Software Bisque support staff monitors this forum between 9 a.m. to 4 p.m. Mountain Time Monday-Friday. Other knowledgeable astronomers are there to help outside regular office hours.

What You Need to Know

Successful operation of a Paramount requires a solid understanding of many basic astronomy concepts, a familiarity with controlling German equatorial mount as well as an understanding of how to configure and control a mount using *TheSkyX Professional Edition*.

If you are new to the Paramount, operating a German equatorial mount, or just getting into astronomy, please peruse the following section. Based on years of supporting the Paramount ME and Paramount MX, even sage astronomy veterans can often misstep on some of the following fundamental concepts.

- What are the differences between right ascension, azimuth and hour angle?
- Why does the meridian matter?
- What exactly is synchronization?
- What is homing and what does it actually do?
- What is mount parking?
- How does atmospheric refraction affect mount performance?
- Why is polar alignment so important?

In addition to these basics, if you have never controlled a robotic German equatorial mount with *TheSkyX Professional Edition*, please carefully read the following sections and then use *TheSkyX Professional Edition's* Telescope Simulator feature before setting up and connecting to and operating the Paramount.

Coordinate Systems

The three most common coordinate systems used when working with equatorial mountings are described below. Making sure you understand the differences between each system now will really help troubleshooting issues in the future.

The Horizon Coordinate System

The horizon or “horizontal” coordinate system is used to specify the position of celestial objects relative to the local horizon.

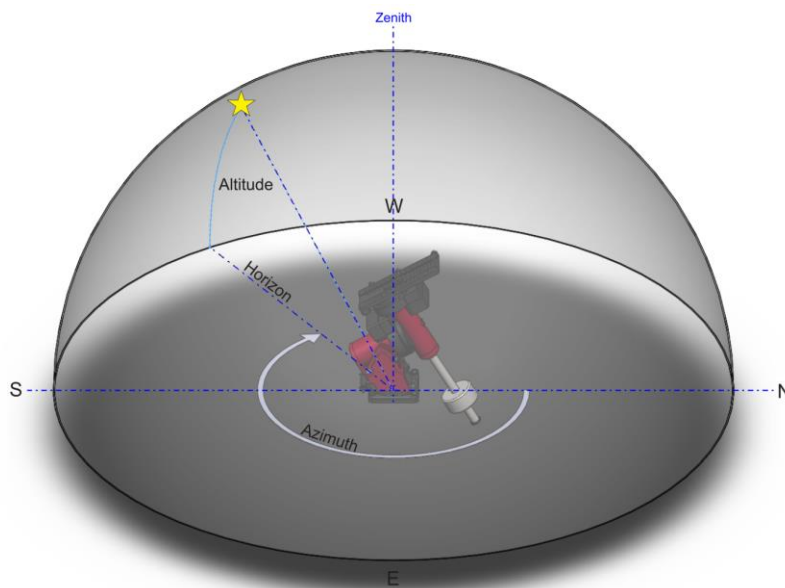


Figure 1: The horizon-based altitude and azimuth coordinate system.

Altitude

The altitude (alt) of an object is expressed as the number of degrees from the horizon (the ground at a far distance) to the object, and is always between minus 90 and plus 90 degrees. Objects that have a negative altitude are below the horizon. For example, the Sun just after sunrise is close to the horizon so it has an altitude of a couple of degrees, and just after sunset its altitude is minus one or two degrees.

Azimuth

The azimuth (az) of an object is generally reckoned from North, increasing in the clockwise direction, and ranges from 0 to 359 degrees. North is 0 degrees, east is 90 degrees, south is 180 degrees and west is 270 degrees.

When the Paramount is controlled by *TheSkyX Professional Edition*, attempting to slew the mount below the local horizon is not permitted and will result in an error message.

The Equatorial Coordinate System

The horizon coordinate system is not convenient for specifying the location of celestial objects because the horizon coordinates of stars and other objects are continuously changing with time (due to the rotation of the Earth).

The exception occurs with objects near the north and south celestial poles. These positions are unique since they are near to the axis of rotation of the Earth and therefore move only in small circular paths. Polaris, the North Star, for example, remains at a nearly constant altitude and azimuth. In the equatorial coordinate system, the coordinates of all celestial objects remain fixed* from hour-to-hour, day-to-day and so on.

An object's equatorial coordinates remain the same regardless of from where on Earth the object is viewed. This allows astronomers to create star maps that apply to any place on Earth, or publish the anticipated position of an upcoming comet so that astronomers everywhere know where it is located among the stars.

The equatorial coordinate system used to specify the positions of celestial objects is directly analogous to the latitude-longitude coordinate system used on Earth. In fact, if you were to expand the latitude and longitude grid of the Earth so that it is out beyond all stars, you would have a sphere with identical geometry to the celestial sphere.

We suppose that all stars and deep-sky objects are located on a very large sphere (out beyond all stars). We call this the celestial sphere. For purposes of describing the positions of celestial objects, we consider all stars and deep sky objects to be on the celestial sphere, when actually they are all positioned at varying distances from the Earth.

** Equatorial coordinates change over long periods of time due to precession (wobbling of the Earth). TheSkyX computes this change in stars' position for the current date. Precession, however, does not change the relative positions of objects with respect to one another.*

Right Ascension

The geometry of the right ascension (RA) lines on the celestial sphere is the same as the longitude lines on Earth. Longitude lines divide the Earth into 360 degrees. Right ascension lines divide the celestial sphere into 24 hours, based on one revolution of Earth. Therefore one hour of right ascension equals 15 degrees (360 divided by 24). See the definition of Local Sidereal Time for additional information on why 24 hours are used for right ascension instead of 360 degrees.

Zero degrees longitude passes through Greenwich, England and is the designated reference line for longitude. What, then, is the reference line for zero hour's right ascension? Astronomers use the *vernal equinox*, the location where the Sun crosses the celestial equator during its apparent annual motion against the background stars, as a "starting point" for right ascension.

The term "right ascension" comes from the fact that when viewed from the equator, all stars rise (or ascend) at right angles to the horizon, so their times of rising are called their times of right ascension.

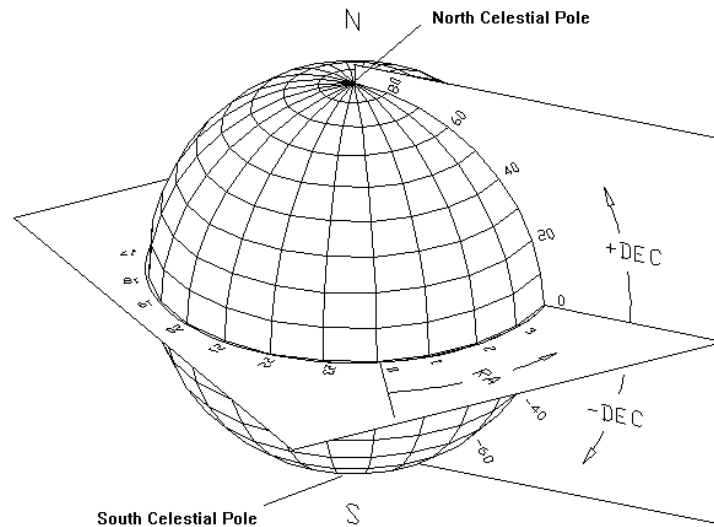


Figure 2: Right ascension and declination relative to the celestial sphere.

Declination

The declination (dec) lines on the celestial sphere are similar to latitude lines on Earth, ranging from -90 degrees to $+90$ degrees. The "declination" of an object is the angle measured from the celestial equator (0 degrees declination) along a meridian line through the object. Polaris, the North Star has a declination of just over 89 degrees so it is very close to the north celestial pole.

Hour Angle

Hour angle (HA) is measured from the meridian westward, along the celestial equator and uses the same units as right ascension (hours, minutes, and seconds). A celestial object on the meridian is located at hour angle 0 . Six hours of time later, the object is located at hour angle $+6$. Twelve hours later, when the object rises, its hour angle is $-6h$.

Hour angle can be used to describe a telescope's mechanical orientation with respect to a horizon-based hemisphere. For Paramount mounts with AutoHoming™, when the mount finds home, the home position is a fixed, mechanical mount orientation. In the northern hemisphere, when homing is successful, the mount *always* points to hour angle 2 and declination 0 .

Smaller hour angles equate to positions of optimal observing, so your telescope will probably spend a great deal of the time pointing to and tracking objects near hour angle zero.

Note that *TheSkyX Professional Edition* can be used to configure the Paramount's "flip hour angle" in order to maximize the length of time a particular object can be tracked near the meridian for longer exposures.

Local Sidereal Time

Local sidereal time (LST) is always equal to the instantaneous right ascension of the local meridian. When you know the LST, you can look at star maps and determine which objects are near the meridian (those with a right ascension close to the LST). For example, if the LST is 6:10:00, this means that stars with a right ascension of about 6 hours are visible along the meridian.

If everyone reckoned time based on the Sun crossing the meridian, then each longitude on earth would have a different time of day. That means noon, or the time the Sun crosses the meridian, would come a few minutes earlier for someone living 60 miles to the east. Only those people living at the same longitude would share a common time.

In the late 1800's time zones were established to minimize the problem of having different time in populous regions. The time within these zones is called *zone time*. Zone Time places all locations on Earth into various time zones. By definition, time zone zero is at zero degrees longitude, and increases by one each 15 degrees in longitude (more or less).

The Paramount relies on *TheSkyX Professional Edition* having the correct time zone for your observing site. When *TheSkyX Professional Edition's* time zone is not correct, the position of the telescope cross hairs will be offset by the time zone hour error when viewing horizon-based Sky Charts.

Atmospheric Refraction

The effects of atmospheric refraction on the position of celestial objects, as well as its effect on the sidereal tracking rate, are often overlooked or even ignored by many amateur astronomers.

The refraction nuisance (and other system errors like tube flexure) means the "sidereal tracking rate" is simply not good enough to precisely track objects. Refraction also displaces the position of the celestial pole and makes precise polar alignment more difficult.

Some other interesting and significant facts about how refraction affects an object's apparent position include:

- For a sea-level site, the refraction at 45 degrees zenith distance (ZD) is about 60 arcseconds (one arcminute).
- Except low down in the sky, the refraction goes roughly as the tangent to ZD, so at ZD = 70 degrees, or, at 20 degrees above the horizon, it is up to 165 arcseconds. (It reaches a *1800 arcseconds*, or 0.5 degrees at the horizon.)
- Refraction is proportional to pressure, so at high-altitude sites the refraction comes down significantly. For example at Mauna Kea, 4,205 meters above sea level, the refraction is about 60 percent of the sea level amount.
- Refraction is roughly inversely proportional to absolute temperature, so at -5C the refraction is about 10 percent more than at 20C.
- Humidity has little effect in the optical, though it matters a lot at radio wavelengths.

- The color of the observed object matters, blue being refracted a few arcseconds more than red at ZD 70.

When you use your Paramount to take long, unguided exposures at modest or longer focal lengths, refraction becomes an important source of tracking error that is not taken into account in the standard sidereal tracking rate.

TPoint can be employed to take care of the atmospheric refraction details for you.

- TPoint's Super Model feature and Polar Alignment Report automatically determines the position of the refracted pole and give recommendations on how to proceed, including how much to rotate the altitude and azimuth knobs when adjustment is necessary.
- It accounts for and applies refraction when acquiring telescope calibration data as well as corrects the telescope's position when the mount is slewed.
- TPoint's ProTrack feature can be used to apply tracking corrections to the mount based on the point calibration data.

Polar Alignment Basics



For optimal performance, the equatorial axis of a German equatorial mount must be aligned to the *refracted pole* to within 100 arcseconds.

If the mount's equatorial axis is not "closely" aligned with the celestial pole...

- Stars will drift in of the field of view, mostly in declination; quickly when polar alignment is particularly poor.
- When you tell TheSkyX Professional Edition where the mount is pointing, through a process called "synchronization" (page 23), the synchronization results will be incorrect, or "skewed" by the amount of the polar alignment error. For example, if the polar axis is ten degrees "low" in altitude, then the resulting synchronization positions computed by TheSkyX Professional Edition will be off by this same amount in declination. The result is that the mount will not point with any accuracy or repeatability.
- The mount's "TPoint unassisted pointing accuracy" will be disappointing, especially when the OTA switches sides of the pier.

These symptoms may make you frustrated with the performance of your Paramount and leave you wondering, "What am I doing wrong?" Mastering the polar alignment techniques described below (or using your trusted method) is critical.

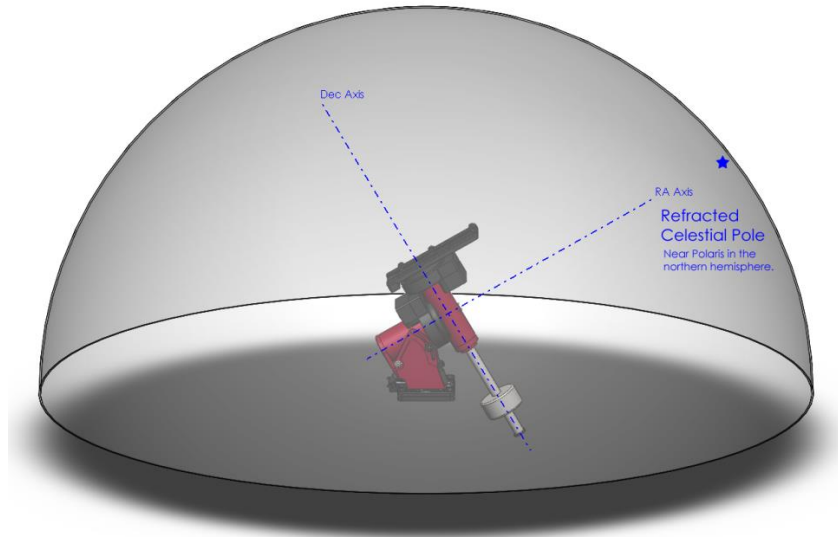


Figure 3: Paramount aligned with the refracted celestial pole in the northern hemisphere.

Software Bisque recommends the following polar alignment methods to ensure efficient and optimal polar alignment.

- Step 1 Use the “Quick Polar Alignment Method” (page 86) to align the mount’s polar axis to within five arcminutes of the pole, even during daylight.
- Step 2 If the pole is visible, and you have a polar alignment scope (page 91), use it to quickly align the mount to the celestial pole.

-Or-

Use the *TPoint Add On* to quantify the mount’s polar alignment error. The *TPoint Add On*’s Polar Alignment Report indicates exactly how much the altitude adjuster (page 72) and azimuth adjuster knobs (page 72) need to be rotated so that both axes are aligned to the refracted pole.

See “How To Polar Align” on page 86 for the best ways to achieve optimal polar alignment.

Homing



Mount synchronization is one of the least understood and most confusing processes for new Paramount users; understanding exactly what homing a Paramount does is a very close second. Please carefully read the following to avoid falling into the “my mount is not homing to the correct position” trap.

Finding the home position, or “homing” the Paramount is an automated initialization process. When the Paramount control system receives the “find home position command”, the mount’s right ascension *and* declination axes are slewed to an **absolute, mechanically fixed** orientation.

Homing *must be performed every time* the Paramount is powered on so that the control system can establish the mount's position and restore the synchronization information, when possible.

Once the mount is homed, and the previous session's synchronization information is applied by *TheSkyX Professional Edition*, the telescope will know its orientation and have the same pointing accuracy as the last observing session.



- The home position is located at hour angle 2 and 0 degrees declination. The home position is a *fixed, mechanical orientation* and *cannot change*; it is defined by the *physical position* of the gears relative to fixed internal homing sensors. See “Physically Marking the Home Position” on page 22 for a simple procedure to demonstrate the mount's absolute home position.
- If the mount is not physically pointing to approximately hour angle 2 and 0 degrees declination after finding home, then either the Versa-Plate is mounted incorrectly, the mount's polar axis is not oriented north-south.

If, after homing is complete, the coordinates of the telescope cross hairs displayed by *TheSkyX Professional Edition* indicate that the mount is pointing anywhere other than the home position, then either *TheSkyX Professional Edition's* location, date, time or time zone is not correct, or the mount has been synchronized incorrectly. See “Synchronization” on page 23 for more information.



The Paramount cannot slew and will not track at the sidereal rate until after the mount is successfully homed.

When a **Find Home** command is issued from the hand controller (page 82) or *TheSkyX Professional Edition* (page 95), the mount slews to the home position and zeros the control system's “position registers”. When the mount is subsequently synchronized on a star, the computed hour angle and declination of the home indices are stored in the internal flash of the Paramount's control system.

Subsequent observing sessions use *TheSkyX Professional Edition's* local sidereal time to determine the mount's equatorial coordinates. Make sure the computer's clock is accurate (page 27).

Homing provides the following benefits.

- Once a mount is aligned with the celestial pole and homed, extremely repeatable and accurate pointing from night to night can be achieved using *TheSkyX Professional Edition* and the *TPoint Add On*.
- After homing, the mount “knows” its orientation and therefore cannot be slewed into the pier (see “Software Slew Limits” on page 132).
- The control system's periodic error correction (PEC) uses this information to calibrate the control system's internal PEC table with the orientation of the worm gear.

- The mount's orientation can be restored after power outages or other communication malfunctions.
- The home position can be used to align the polar axis to the celestial pole (see "Quick Polar Alignment Method" on page 86).
- Once the mount is homed and a TPoint model is established, subsequent sessions require only accurate time to achieve excellent pointing.

Labeling the Home Position on the Sky Chart

Synchronizing the mount (page 23) on the wrong star or configuring *TheSkyX Professional Edition* to use the wrong location, date, time or time zone for your location means the Paramount will be "lost in space". The telescope cross hairs will appear in the "wrong" place on the Sky Chart and the mount will apparently not slew to the correct coordinates when commanded to do so. If the coordinates of the telescope cross hairs do not match the actual physical orientation of the Paramount, or it does not slew to the correct coordinates, you will be scratching your head wondering what is wrong. The next step is to post a support question asking, "Why is my mount pointing to the wrong coordinates?"

For this reason, Software Bisque strongly recommends creating a label that shows the location of the mount's *absolute home position* (page 123) directly on the Sky Chart to provide a constant visual reminder of where the telescope cross hairs *must be* after finding home.

If, after homing the mount, the telescope cross hairs do not end up very near hour angle 2 and declination 0 (or hour angle -2.0, declination 0 in the southern hemisphere), either *TheSkyX Professional Edition's* site information is wrong or the mount has been synchronized on the wrong star.

Remember, the *absolute home position* of the Paramount *cannot change*. So, if the mount's *relative home position* is wrong (or the telescope cross hairs do not appear in the correct location on the Sky Chart), please double check the synchronization (page 23) and *TheSkyX Professional Edition's* location, date and time settings for your location before submitting a support request.

To Label the Home Position in Software

The following procedure assumes this is a first time mount synchronization.

1. From *TheSkyX Professional Edition*, choose the **Location** command from the **Input** menu and make sure the settings on the **Custom** tab match your observing site.
2. Choose the **Verify TheSkyX Time** command from the **Tools** menu to make sure your computer's time matches an independent time source.
3. Choose the **Connect** command from the **Telescope** menu. The mount **Status** text will show **Not Homed**.
4. Choose the **Find Home** command from the **Start Up** pop-up menu on the **Telescope** window. The mount will slew to the home position. The mount **Status** text will show **Not Synced**.
5. Choose the **Turn Tracking Off** command from the **Tools** pop-up menu on the **Telescope** window. Turn tracking off to pin the mount to this position.
6. Choose the **TPoint Add On** command from the **Telescope** menu.

7. Then turn off the **Apply Pointing Corrections** checkbox on the **Setup** tab and click **Close**. TPoint will change the position of the telescope cross hairs based on the current model and we want the label to show the “unmodeled” cross hair position.
8. Click on the center of the telescope cross hair and note the exact altitude and azimuth of this position. This is the horizon-based coordinate of the home position.
9. Choose the **My Chart Elements** command from the **Input** menu.
10. Click the **Add Object** button (the upper-left most button on the **Manage** tab), then click the **Add and Edit** button to add an object to the Sky Chart.
11. On the **Add/Edit Chart Element** window, turn on the **Horizon** radio button, then enter the azimuth (**Azm**) and altitude (**Alt**) of the telescope cross hair. In the **Label** text box, enter the text **Absolute Home Position** and then click **OK**.

The Sky Chart now shows a label at the absolute home position of the mount. To double-check the accuracy of this position, choose the **Find Home** command. Note that, when compared to the absolute home position, the position of the telescope cross hairs on the Sky Chart will also be affected by the following:

- Synchronizing the mount on a star introduces small pointing errors.
- A TPoint pointing model will change the position of the telescope cross hairs based on the pointing calibration data.

The above two items necessarily introduce a small offset between the mount’s absolute home position and the position of the telescope cross hairs after finding home (once the mount has been synchronized and a TPoint model is established).

Physically Marking the Home Position

If, after finding the home position, the cross hairs that are displayed on the Sky Chart are at the wrong coordinates, one or more of the following is probably true:

- The mount is not aligned to the celestial pole. (Believe it or not, Software Bisque has had several support cases claiming that the mount could not point the telescope correctly, only to discover the Paramount’s polar axis was mounted in the wrong direction; for example, the polar axis was pointing south in the northern hemisphere, in other words, 180 degrees off.)
- The optical tube assembly is mounted “backwards” on the Versa-Plate.
- In TheSkyX Professional Edition’s location, date, time, time zone or Daylight Saving Time settings are wrong for your observing site.
- The wrong star was centered in the eyepiece when the mount was synchronized. Improper synchronization results in the telescope cross hairs to be displayed at the wrong spot on the Sky Chart. And this error is particularly apparent after the mount is homed.

Many come to the incorrect conclusion when the telescope cross hairs on the Sky Chart are wrong, there must be something wrong with the homing process. Homing is generally very reliable and rarely

fails. The procedure below demonstrates that, after homing, the Paramount is *always in the same mechanical position*.

1. Home the mount.
2. On each axis, place a piece of masking tape over the rotating portion and cut the tape between the rotating parts of the mount. The “vertical” edges of the tape mark the home position in that axis.
3. Use the joystick (or TheSkyX Professional Edition) to slew the mount to any orientation.
4. Double-tap the joystick to find home again.



Figure 4: Marking the Paramount's home position.

The Paramount will dutifully return to the identical position in each axis.

This “homing repeatability test” will hopefully give you confidence that, after finding home, the mount is always pointing to hour angle 2 and declination 0 (in the northern hemisphere), and will help narrow down the *actual causes* of pointing errors (most commonly, an invalid synchronization, incorrect settings in TheSkyX Professional Edition, or poor polar alignment).

Synchronization

Synchronizing (or “syncing”) the Paramount initializes the control system to a specific equatorial coordinate. In short, you tell the mount, “You are here!” Synchronization involves centering a known star in the eyepiece, identifying this star in *TheSkyX Professional Edition* then choosing the **Synchronize** command from the **Start Up** pop-up menu on the **Telescope** window.

Once the Paramount has been synchronized on a star, *TheSkyX Professional Edition* uses the equatorial coordinates of the star to determine the mount's mechanical orientation and software slew limits.

TheSkyX Professional Edition stores this synchronization position so that the mount's orientation can be restored in subsequent observing sessions.

In theory, after a *permanently mounted* Paramount is aligned with the celestial pole (page 18), it need be synchronized only once. In practice, the mount will have to be synchronized:

- Each time the mount is setup for portable use.
- When the mount's polar alignment is changed.
- When the optical tube assembly (OTA) is changed.

Synchronization is an essential first step to “normal” mount operation. If the mount is not synchronized correctly, the actual orientation the telescope will not match the simulated telescope's position on the Sky Chart. And, when commanded to slew from *TheSkyX Professional Edition*, the telescope will end up pointing at the wrong place in the sky.

Best Synchronization Practices

- **Do not synchronize on stars near the celestial pole** – The celestial pole represents a point of “singularity” on the celestial sphere. As a best practice, do not synchronize on Polaris (in the northern hemisphere) and **avoid stars above 60 degrees declination or so**.
- **Use brighter, easily identifiable stars** – Fainter stars can be hard to identify, making synchronization more difficult.

Step by Step Synchronization

Carefully follow the procedure below to ensure that synchronization is performed correctly. If you make a mistake and point the telescope at the wrong star, for example, see “Starting Synchronization Over” on page 27 to restore the default settings and try again.

1. Set the computer's clock accurately. Accurate time is crucial for consistent, accurate pointing and synchronization. Consider using an Internet time server or a GPS-based clock to regularly update your computer's clock and keep it accurate. See “The Local Celestial Meridian” on page 27 for more information.
2. Choose the **Location** command from the Input menu to set the observing site's latitude, longitude, time zone and Daylight Saving option if necessary.



Consider using a GPS to also obtain your site's latitude and longitude. Make sure the time zone and daylight saving options are correct for your location (a GPS does not supply this information).

- Errors in latitude “appear” to TPoint as a vertical misalignment in the polar axis, and will pollute synchronization (and the TPoint model, if one is in place).
- 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.

3. Choose the **Connect** command from the **Telescope** menu.
4. Choose the **Find Home** command from the **Start Up** pop-up menu on the **Telescope** window.
5. Locate an easily identifiable, bright star to use for synchronization.

Partial clouds or twilight can make this task more difficult than it might seem. The Paramount can be synchronized to virtually any position on the celestial sphere on the east or west side of the meridian (See “Best Synchronization Practice” on page 24).

6. Center the bright star in the eyepiece, photo or video display using the joystick on the hand controller or *TheSkyX Professional Edition*’s **Motion Controls** on the **Telescope** window.
7. From *TheSkyX Professional Edition*, enter the name of the bright star in the **Search For** text box and click the **Find** button on the **Telescope** window to identify the star. Or, click on the star if it is visible on the Sky Chart.
8. Choose the **Synchronize** command on the **Start Up** pop-up menu in **Telescope** tab. When the **Telescope Synchronization** window appears, click the **Sync** button.

The mount is now synchronized on the bright star.

Session to Session Pointing Repeatability

In subsequent observing sessions, *TheSkyX Professional Edition* computes 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’s pointing accuracy should be virtually identical from session to session.

Please verify the *repeatability* of the Paramount pointing before proceeding (this test assumes that the mount’s polar axis is aligned with the celestial pole):

1. Turn the mount off.
2. Turn the mount on (this terminates communication between *TheSkyX Professional Edition* and the *Paramount*).
3. Home the mount.
4. From *TheSkyX Professional Edition*, choose the **Connect** command from the **Telescope** menu. The telescope cross hairs appear at the *relative home position* (see page 123 for an explanation of the difference between the *absolute* and *relative* 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 synchronize the mount several times (each time the mount is adjusted to a new altitude and/or azimuth). For permanent installations, once the mount is sufficiently aligned with the celestial pole, it should not have to be synchronized again unless the optical tube assembly or the telescope’s physical mounting changes.

Portable setups must synchronize the mount each session, or, if a TPoint pointing model will be used, a Portable Recalibration, as described in the TPoint Add On User Guide, must be performed first.

Making Sure Synchronization Is Correct

The first step to ensure the Paramount is properly synchronized is to look at the hour angle and the declination of the homing sensors *reported by TheSkyX Professional Edition*.

When the mount has been properly synchronized, *TheSkyX Professional Edition's* relative position of the home sensors should approximately match the *absolute* position of the home sensors. Remember, the mount's absolute home position cannot change, so *TheSkyX Professional Edition's* reported home position must be near hour angle 2 and declination 0 in the northern hemisphere. If *TheSkyX Professional Edition* reports a relative home position that is significantly different from hour angle 2 and declination 0, then the mount's 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 27 to restore the default settings and resynchronize the mount.

Note that the above description assumes the Paramount is located in the northern hemisphere and the Versa-Plate is mounted in the standard orientation (page 53). When the Versa-Plate is mounted in the wide orientation, then reported home position will be 90 degrees from hour angle 2.

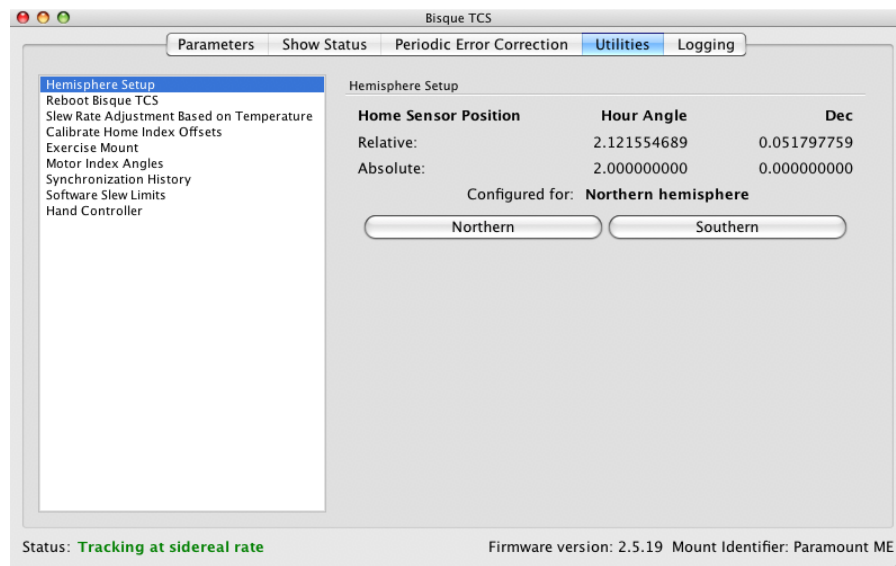


Figure 5: The absolute and relative homing sensor positions.

The Sky Chart provides graphical feedback to help verify the mount is synchronized correctly and identifies the regions near the meridian that have unique behavior when tracking or slewing. While *TheSkyX Professional Edition* is connected to the Paramount, two regions are drawn near the meridian. If the regions are centered on the meridian, then the synchronization is most likely correct.

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. Note that the Paramount will not automatically flip sides of the meridian and continue tracking in this situation. 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.

Synchronization Checklist

- Make sure that the computer's time is accurate, and that *TheSkyX Professional Edition* is configured to use the computer's clock.
- Verify that synchronization is performed using the star listed in *TheSkyX Professional Edition's* Object Information Report. When clicking the Sky Chart to identify an object, the Object Information Report can list other objects that are "near" the mouse click position.
- In general, avoid synchronizing on a star that is located near the meridian.
- Avoid synchronizing on stars above 60 degrees declination.

Starting Synchronization Over

If you are ever unsure about synchronization, you can "start from scratch" by reinitializing the control system.

1. Choose the **Connect** command from the **Telescope** menu.
2. Choose the **Bisque TCS** command from the **Tools** pop-up on the **Telescope** window.
3. On the **Bisque TCS** window, click the **Utilities**.
4. Select **Synchronization History** on the left side of the window.
5. Click the **Remove All** button to remove the synchronization history.

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.

From *TheSkyX Professional Edition*, expand **Reference Lines and Photos** in the **Chart Elements** window and turn on the **Meridian** checkbox.

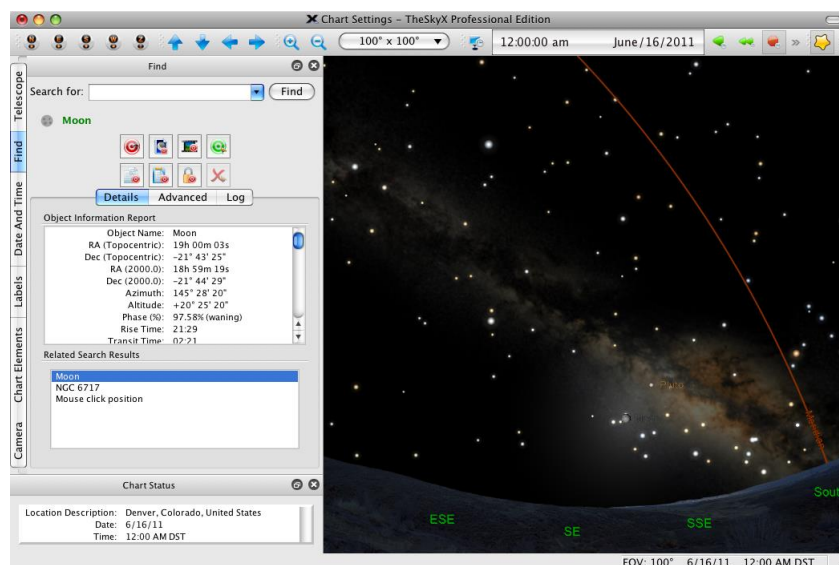


Figure 6: *TheSkyX Professional Edition* with the meridian reference line turned on.

The arcing line in Figure 6 represents the local celestial meridian. When the Paramount is at the home position, the telescope must be pointing to the west side of the meridian, near hour angle 2 and declination 0 in the northern hemisphere. (Or, hour angle -2.0 and declination 0 in the southern hemisphere).

If the optical tube assembly is not pointing to the home position, or if the telescope cross hairs in the *TheSkyX Professional Edition* indicate that the home position is anywhere else (by more than a few arcminutes or so), then one or more is the case:

- *TheSkyX Professional Edition* is not configured correctly for your location.
- The Versa-Plate is mounted in the wide configuration (page 53).
- The Versa-Plate is mounted 180 degrees off.

Before continuing, make sure that *TheSkyX Professional Edition's* location, date, time, time zone, and Daylight Saving Option are correct. Also make sure the Versa-Plate is mounted in the correct orientation before proceeding.

Maintaining Accurate Time

The Paramount can provide very accurate all sky pointing during a single session without an accurate time base (that is, if the computer's clock is accurate to one or two minutes or so). However, *TheSkyX Professional Edition* must make decisions on how to slew to various positions in the sky based on the local time. For example, an object that is on the east of the meridian may require the telescope be slewed to west side of the pier and vice versa. So, maintaining accurate time is important.



Always perform "reality check" by comparing the coordinates of objects in *TheSkyX Professional Edition* to objects in the night sky. If *TheSkyX Professional Edition's*

location or time is not accurate, the two will not match!

Choose the **Verify TheSkyX Time** command on the **Tools** menu to compare the computer's date, time and time zone settings with a web-based time source.

Initializing the Paramount requires a very accurate time base. *TheSkyX Professional Edition* uses the computer's clock to compute the local sidereal time (LST). When a connection is established between *TheSkyX Professional Edition* and the "homed" Paramount, the LST is used to re-establish the synchronization between the Paramount's "electronic setting circles" and the celestial sphere to within a few arcseconds. If the computer's time is accurate, 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 error in time translates to *fifteen arcseconds error in angular distance near the celestial equator*. So, telescope pointing will degrade if time is not accurately maintained 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.

Many applications maintain accurate time and most operating systems can be configured to update the computer's clock automatically. Windows users might consider Dimension 4 from Thinking Man Software. Search the web for "time server software" to locate alternatives.

Parking the Paramount

Parking is a command that can be issued to the Paramount from *TheSkyX Professional Edition* 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*.
2. Once the park position is reached, the Paramount's tracking is immediately turned off.
3. Communication between *TheSkyX Professional Edition* and the mount is terminated.

Note that the park position is not used to initialize the mount.

Parking from TheSkyX Professional Edition

From *TheSkyX Professional Edition*, connect to the mount, and then choose the **Park** command from the **Shut Down** pop-up menu on the **Telescope** window. You will 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, you need to define the park position. This is the position that the mount will slew to when the Park command is issued from *TheSkyX Professional Edition*. Please carefully read “Park Position Rules” below.

With a telescope link established, slew the telescope to the desired park position. From *TheSkyX Professional Edition*, choose the **Set Park Position** command from the **Shut Down** pop-up menu on the **Telescope** window. 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, if possible, the telescope be parked as close to the home position as practical. Since the Paramount 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 must be correctly synchronized *before* the mount is parked and before the park position can be defined. Otherwise, the mount will not return to the correct park position.
- 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 is 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 allows the OTA to slew *past* the meridian (two hours maximum for the Paramount ME II and 2.5 hours for the Paramount MX) before flipping sides, you have now 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.


Audible Control System Feedback

Each time the mount is turned on the control system performs both an electronics and servomotor initialization procedure, and emits different sounds based on the status of the initialization. A short whistle is emitted immediately after the power switch is turned on and indicates successful initialization

of the control system electronics; two successive beeps (usually occurring a few seconds or so apart) indicate servomotor initialization success. The three LEDs on the Electronics Box, labeled TCS, RA, and Dec, provide additional visual feedback of mount initialization. See “Electronics Box Components” on page 63 for details.

The initialization procedure is terminated if the joystick button 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. In this situation, the mount emits a *single* beep. When initialization is interrupted for any reason, the mount will not slew or track. 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 explains what the sound means. Visit the [Videos and Audio Clips](#) page on the Software Bisque web site to listen to recordings of these sounds. To get there, navigate to www.bisque.com, click the **Downloads** link, then click the **Video and Audio Clips** link under **Browse Downloads** in the left column of the **Downloads** page. The audible feedback recordings are listed on the right of the web page.

| Sound | Occurs | Description |
|--|---|---|
| Short whistle | Immediately after turning the power on. | The sound indicates the control system is operational. |
| Two beeps from about two seconds apart | Shortly after mount is turned on. | <p>Indicates that the control system has successfully located the DC servomotor’s “index” position in right ascension and declination. The mount is ready for normal operation.</p> <p> Exactly <i>when</i> the two beeps occur will be different for each mount and will vary depending on the mount's current mechanical orientation. The beeps may even occur simultaneously so that only a single beep is audible.</p> <p>If the LEDs on the Electronics Box are illuminated, and the mount homes, the control system is functioning normally.</p> |
| Single beep | When the servomotor initialization is interrupted, shortly after mount is powered on. | <p>Servomotor initialization can be interrupted by the following actions.</p> <ul style="list-style-type: none"> • Pressing and holding the joystick button down and turning on the mount. • Moving the joystick from its center position before the servomotors are initialized. • Attempting to slew or home the mount from |

| Sound | Occurs | Description |
|---|---|---|
| | | <p><i>TheSkyX Professional Edition</i> 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 <i>TheSkyX Professional Edition</i>.</p> <ul style="list-style-type: none"> One or both of the Three Position Switches is in the Lock position (page 59). |
| Ba-dink (lower pitch), ba-dink (higher pitch) | Shortly after the mount has slewed to the home position in each axis. | Indicates that mount has successfully located the home position (page 18). |
| Continuous, successive, high-pitched beeps. | May occur when attempting to slew the mount. | <p>This sound indicates a control system error condition if the mount cannot slew. “Something” is preventing the servomotors from rotating, so the mount cannot slew or track normally.</p> <p>Typical causes include:</p> <ul style="list-style-type: none"> The mount encountered a fixed object while slewing. For example, the counterweight shaft has run into a step stool that has been placed next to the pier. Payload is significantly out of balance and exceeds the maximum torque output of the motor. Make sure payload is balanced before proceeding. Increased drive train torque demands during cold temperature operation can prevent slews. |
| Single “click” or “tic” sound | During communication with <i>TheSkyX Professional Edition</i> . | <p>The Paramount will emit a single “click” (or “tic”) when serial communications between the mount and <i>TheSkyX Professional Edition</i> are interrupted. Interruption can occur, for example, when a camera is downloading an image, or during other processor intensive operations.</p> <p>Notes:</p> <ul style="list-style-type: none"> The clicking noise is normal and expected behavior. The clicking noise is not indicative of any problems with the mount. Audible feedback cannot be disabled. |
| Variable-pitched | After motor initialization | When the Paramount is turned on and initialized, the |

| Sound | Occurs | Description |
|--------------------|--|---|
| high-frequency hum | and whenever the mount is powered on and tracking. | servomotors emit an audible, variable-pitched “humming” sound. This sound is the result of the control system checking and adjusting the position of the servo— about 3,333 Hz, and is normal. This sound serves as the audible “heartbeat” of the mount, and means that the electronics are powered and functioning normally. |

Visual Control System Feedback

The three LEDs on the Electronics Box are illuminated based on the status of the control system. See “Electronics Box Components” on page 63 for details.

Through the Mount Cabling



The Paramount through the mount cable conduits are intended to house *low voltage* and *low current* direct-current (DC) cabling only.

- Software Bisque recommends using cables that will carry a maximum of +12V DC, 1.0A (12W max).
- Never install through the mount cabling to carries an alternating current (AC) power source; for example, +120V or greater (at any amperage).



Always keep fingers clear from the cable conduit access hole!

- While the declination axis rotates during mount slews, an internal shaft in the declination assembly is also being rotated by a very high torque servomotor.
- When the declination axis is being balanced (page 59), the internal shaft can rotate freely and may do so with a high angular velocity when the mount’s payload is even slightly out of balance.

In both cases, the rotating internal shaft creates a potentially dangerous pinch point with the outer declination axis assembly that can cut, crush or sever fingers.

Always keep fingers clear during mount slews and use extreme caution when routing cables through the mount, or aligning the declination shaft’s “through-hole” during polar scope alignment.

The Paramount allows custom cables to be passed through the mount, entering at the cable conduit through the right ascension and declination axis up to the top of the declination axis and out to the Instrument Panel. Routing cables through the mount has many advantages, particularly during remote operation.

Most imaging systems have numerous cables draped from somewhere near the telescope to the observatory floor. These cables are prone to snag “something” as the telescope slews from one part of the sky to another and often causes problems that require human intervention. Running the cables through the mount all but eliminates these and many other issues.

Routing Cables through the Paramount MX

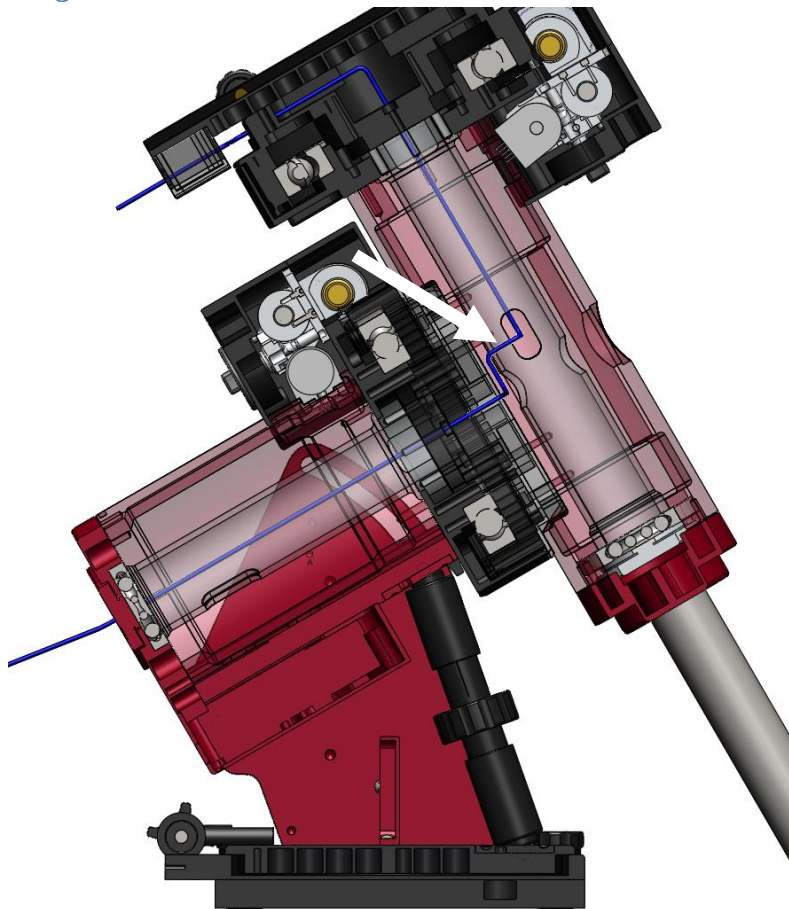


Figure 7: Paramount MX cross section showing path of cable through the mount.

1. Make sure the additional cable is long enough to go from the Instrument Panel (or from a device mounted on the OTA), through the mount and to its destination, then add an additional eight to 10 inches to accommodate a loop in the declination axis (described below).
2. Remove the cable conduit access cover (page 69).
3. Place the declination axis' Three Position Switch in the balance position.
4. Looking down the polar axis through the declination cable conduit access hole, rotate the declination axis from hard stop to hard stop. Doing so reveals two sets of access holes

machined into the internal shaft. When aligned with the polar axis, the two larger holes allow light to pass through the mount for polar scope alignment. The two smaller holes (slightly further “up” the shaft) provide a separate passage for the through the mount cabling. Your goal is to snake the cable through one of the two smaller holes (see green arrow in Figure 7).

5. Rotate the declination axis until the unoccupied hole in the internal declination shaft is aligned with the right ascension axis.
6. Loop a 15-inch cable tie the “wrong way” (so the cable tie can be easily removed later) around the end of the cable.



Figure 8: A 15-inch cable tie looped around the cable.

7. Insert the cable tie into the RA Cable Conduit until the end is visible through the cable conduit access cover. The cable tie (and cable) *must be threaded through the outside of the internal shaft* and cannot pass directly through the lower access holes. Rotate the cable tie so that its natural bend forces the tie toward the outside of the shaft. Use a pair of needle-nose pliers to grab the end of the tie then pull the cable all the way through the right ascension axis.
8. Remove the cable tie and feed the end of the cable up the declination shaft, through the upper access hole until it appears at the top of the declination axis.
9. Run the top end of the cable through the access shaft that is machined into the top of the declination axis and the Versa-Plate, out to the left side of the Instrument Panel (page 55).
10. Once the cable has been passed all the way through the mount, make an 8-inch loop in the cable and carefully tuck this loop inside the outer shaft of the declination assembly to allow the declination axis to rotate completely without any interference from the cable itself (see Figure 9). Rotating the declination axis from hard stop to hard stop more or less does the work for you, but allowing additional slack in the cable is recommended.

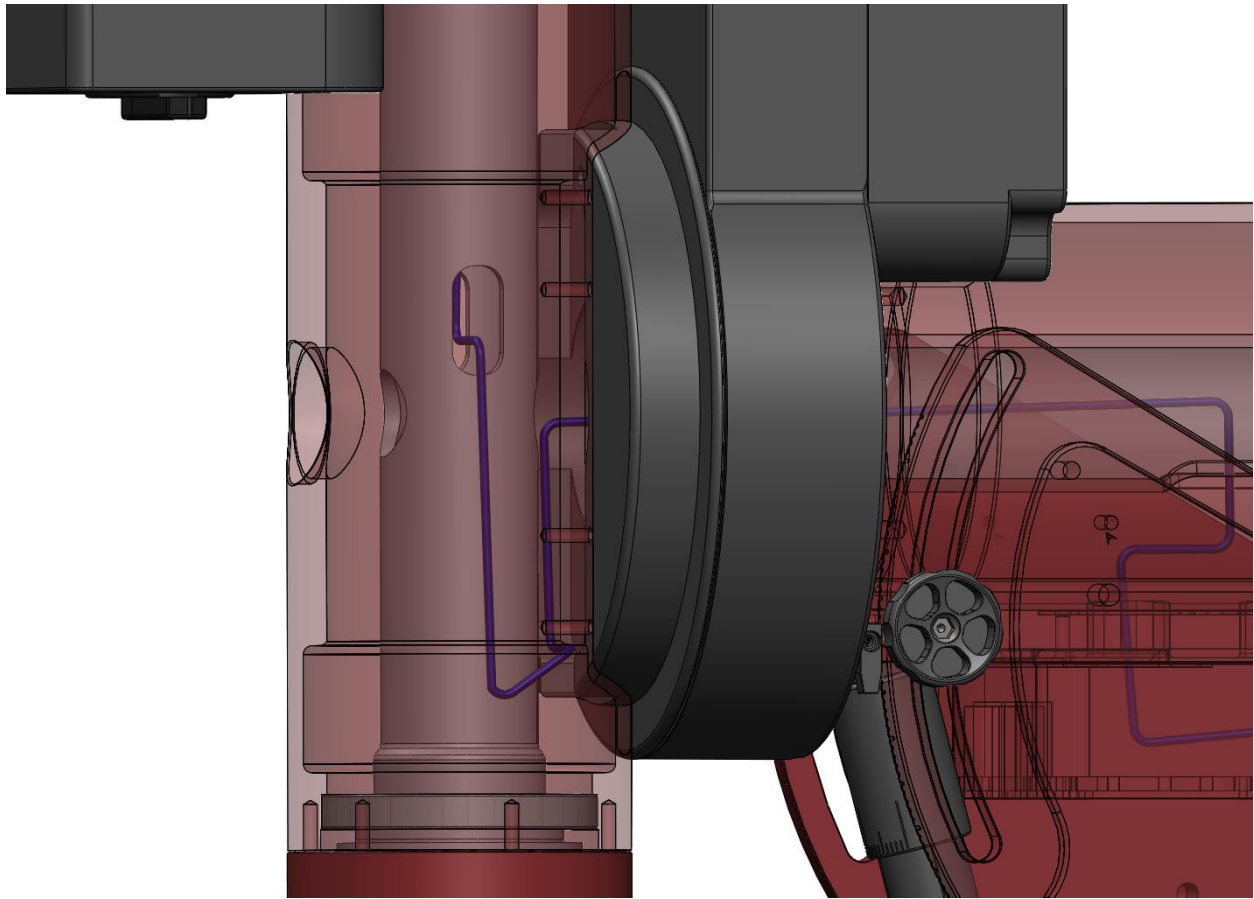


Figure 9: Close up view showing the proper routing of the through the Paramount MX declination axis.



A 24-inch flexible wire grabber can help pull stiffer cables through the mount and up to the Instrument Panel, even when an OTA is in place.



Figure 10: A flexible wire grabber.

Routing Cables through the Paramount ME II

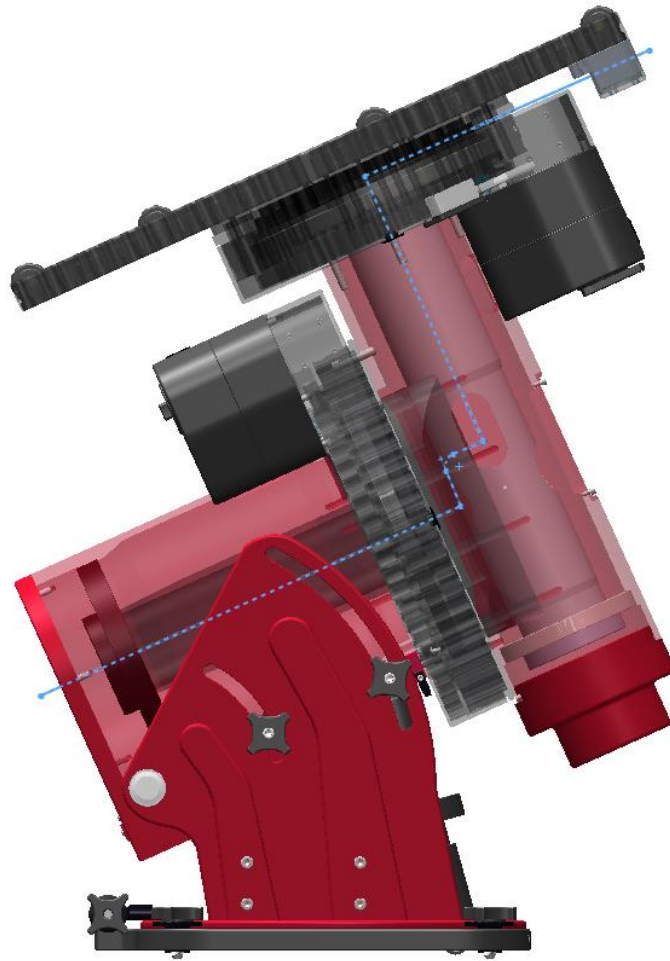


Figure 11: Paramount ME II cross section showing path of cable through the mount.

Compared to the smaller Paramount MX, routing custom cables through the Paramount ME II is a relatively straightforward procedure.

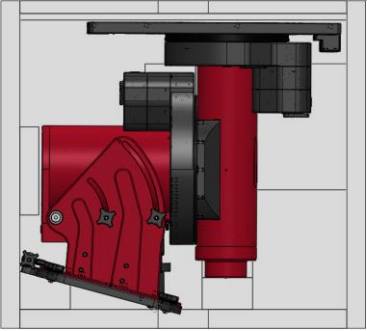
1. Remove the two Right Ascension Rear Cover (Figure 15) mounting screws and the cover.
2. Remove the two Cable Conduit Cover screws (Figure 32) and the cover.
3. Attach a cable tie to the end of the cable to be installed (Figure 8).
4. Insert the pointed end of the cable tie into the Right Ascension Cable Conduit and continue threading the cable upward, through the access hole in the declination axis until the cable tie can be grasped by hand, or by a flexible wire grabber inserted into the Cable Conduit Access Hole on the declination axis housing.
5. Pull the cabling up and into the declination axis.
6. Thread the cable tie up the declination shaft until it exits the top of the declination shaft. Once the cable tie can be grasped, continue pulling it outward until the cable itself exits the top of the axis.
7. Thread the cable through the Instrument Panel access hole.

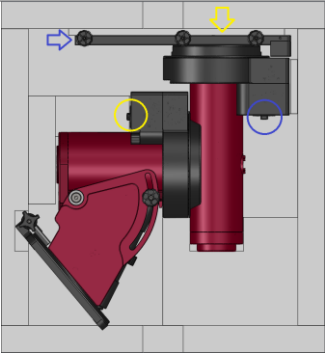
Note that this procedure can be performed with a telescope in place.

Packing List

The Paramount is shipped in two separate boxes. The larger box (Box 1) contains the Paramount mount itself, the smaller box (Box 2) contains the User Guide, manual and mount accessories. Please make sure the following items are included in the Paramount boxes. In the event one or more items are missing, please [contact Software Bisque](#) immediately to obtain a replacement.

Box 1 Contents

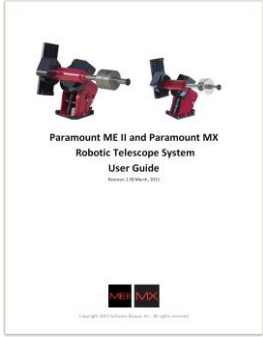

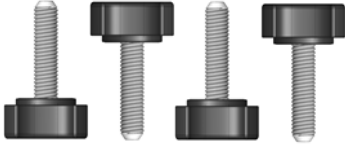


| ME II | | |
|-------|--|--|
| Qty | Photo | Description |
| 1 |  | <p>Paramount ME II Robotic Telescope Mount with Versa-Plate attached.</p> <p>Box Dimensions:</p> <p>74 cm x 66 cm x 41 cm (29" x 26" x 16")</p> <p>Shipping Weight (including the Paramount ME II): 43 kg (95 lb.)</p> |






| MX | | |
|-----|---|--|
| Qty | Photo | Description |
| 1 |  | <p>Paramount MX Robotic Telescope Mount with Versa-Plate attached.</p> <p>Box Dimensions:</p> <p>33 cm x 62 cm x 66 cm (13" x 24.5" x 26")</p> <p>Shipping Weight (including the Paramount MX): 29 kg (65 lb.)</p> |





Important Packing Material Notes


The Paramount is shipped encased in two ultra-dense white Styrofoam inserts inside two double-walled cardboard shipping boxes. Software Bisque strongly recommends that you keep both the shipping boxes and the two Styrofoam inserts as these packing materials are specifically designed to protect your mount during transport.

Box 2 Contents (Accessories Box)

| Qty | Photo | Description |
|-----|---|--|
| 1 |  | The Paramount ME II and Paramount MX User Guide. |
| 1 |  | USB 2.0 cable. |
| 4 |  | Base Thrust Mounting Knobs (page 67). |
| 1 |  | Hex key wrench set. |
| 1 |  | Power Supply Unit or PSU (page 85). |

| Qty | Photo | Description |
|-----|--|---|
| | <p>Paramount ME II PSU</p>  <p>Paramount MX PSU</p> | |
| 1 |  | <p>Power Supply Extension Cable (Paramount ME II only).</p> <p>See “Plugging Power Supply Unit” on page 64 for details.</p> |
| 1 |  | <p>Power Cable for the Power Supply Unit.</p> |
| 1 |  | <p>Hand Controller with joystick (page 82).</p> |
| 1 |  | <p>Counterweight Shaft (page 74).</p> |
| 1 |  | <p>Counterweight Safety Knob (page 78).</p> |

| Qty | Photo | Description |
|-----|---|--|
| 2 |  | Counterweights (page 75). |
| 1 |  | Paramount ME II (only) Altitude Adjuster Wrench (page 86). |
| 1 |  | <p>Paramount ME II (only) Accessory Pouch</p> <p>This pouch is used to store the following items when not in use:</p> <ul style="list-style-type: none"> • Two (2) 3/8" shoulder bolt hole plugs for holding the two (2) 5/16-in. x 2-1/4-in right ascension locking shoulder bolts and two (2) declination locking shoulder bolts. • Four (4) Delrin washers. When locking the Paramount ME II's right axis (page 70), use two of these washers to protect the surface of the mount from being marred by the steel shoulder bolts. • Four (4) plastic plugs to cover the outer side of the right ascension axis locking holes (page 70) and the declination axis locking holes (page 82). <p>This bag can be conveniently stowed behind the Altitude Adjuster beneath the right ascension housing.</p> |
| 1 |  | Cable tie to help route cables through the mount (Figure 8). |
| 2 | | <ul style="list-style-type: none"> • One (1) <i>TheSkyX Professional Edition for Mac</i> DVD ROM. • One (1) <i>TheSkyX Professional Edition for Windows</i> DVD ROM. |

| Qty | Photo | Description |
|-----|---|---|
| |  | |
| 1 | <div>Product Serial Number:</div> <div>XXXX-YYYYYYYY</div> | Serial number for <i>TheSkyX Professional Edition</i> for Windows.* |
| 1 | <div>Product Serial Number:</div> <div>XXXX-YYYYYYYY</div> | Serial number for the <i>TPoint Add On</i> (Mac or Windows) to <i>TheSkyX Professional Edition</i> .* |
| 1 | <div>Product Serial Number:</div> <div>XXXX-YYYYYYYY</div> | Serial number for the <i>Camera Add On</i> (Mac or Windows) to <i>TheSkyX Professional Edition</i> .* |
| 1 | <div>Product Serial Number:</div> <div>XXXX-YYYYYYYY</div> | <p>Serial number for the <i>Multi-OS and Six License Add On</i> to <i>TheSkyX Professional Edition</i>.*</p> <p><i>This serial number should be used to install TheSkyX Professional Edition for Mac.</i> It can also be used to install TheSkyX Professional Edition for Windows.</p> |

Locating Your Serial Numbers

*The Paramount and software serial numbers are attached to the altitude adjuster (Figure 12). Please retain this card for your permanent records.

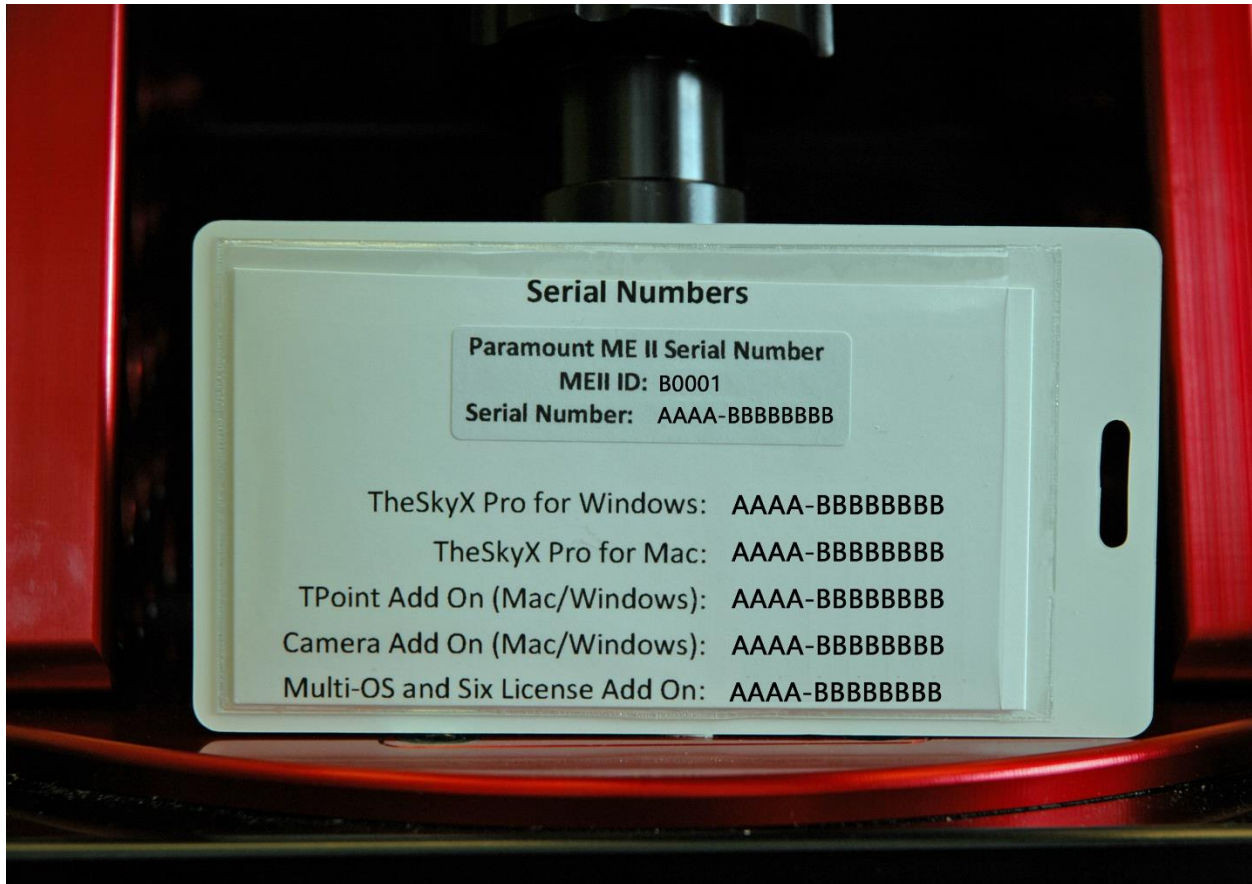


Figure 12: Serial numbers are attached to the altitude adjuster.



Before installing the software that is included with the Paramount, please carefully read the *Paramount Quick Start Guide*. This document located on top of the inner Paramount shipping box.

Paramount and Software Serial Number Registration

Please register all five serial numbers with Software Bisque. Visit the Software Bisque Product Registration Page at <http://www.bisque.com/register> to do so.

Serial number registration gives your Software Bisque account access to software installers, software updates, control system firmware updates (page 125) and the latest MKS 5000 USB drivers (page 140).



- Registering the Paramount serial number, alone, does not register the software serial numbers, and is not sufficient to access software installers and updates. You must also individually register each software serial number, too.
- Software Bisque does not automatically register your serial numbers for you.

Unpacking the Paramount

We trust you are excited to unpack and start using your Paramount as soon as possible. Please resist the urge to simply remove everything from all the boxes, try to use the mount, and then consult the documentation only *after* something goes wrong. Taking a few moments now to review and understand the basic mount design will hopefully avoid potentially harmful accidents or damage to your mount.

Your Safety is Paramount

The Paramount is extremely rugged and designed to provide years of reliable service, but, like any precision instrument, you must become familiar with certain basic features and operating procedures to ensure proper use and your personal safety.



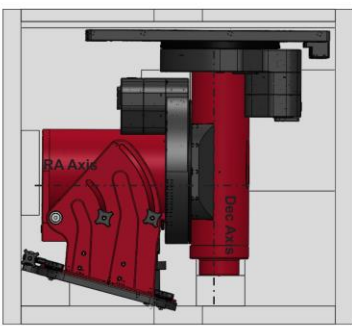
When you remove the packing tape on the Paramount ME II or Paramount MX shipping box, and lift the cardboard flaps, please stop and carefully read the enclosed insert (shown in Figure 14) *before removing the mount from the box!*

The insert describes very important basic mount features and the correct procedure to prepare the mount for handling once it has been removed from the shipping box.

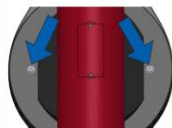
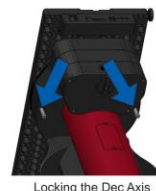
Paramount ME II Unpacking Insert

⚠ BOTH AXES ARE LOCKED BEFORE THE PARAMOUNT ME II IS BOXED FOR SHIPMENT

The Paramount ME II is shipped with both axes locked and the Two Position Switch in the Balance Position. (These switches are described in the middle column).

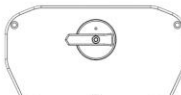



The RA Axis is locked by inserting two shoulder bolts and washers, then securing them with nuts. The Dec Axis is locked by two shoulder bolts screwed into the Dec gear. Remove these shoulder bolts only after counterweight shaft has been attached (see third column of this sheet).






Locking the RA Axis Locking the Dec Axis



THE TWO POSITION SWITCH

Track Position

Balance Position

Lock Axis

The RA Axis and Dec Axis have an arrow-shaped knob as part of a rotatable, mechanical Two Position Switch. This switch can be rotated to one of two positions and each position places the mount in the operational state described below.

Track Position

Rotate the switch fully counterclockwise to engage the worm with the gear for normal operation.


Balance Position

Rotate the switch to the center position to disengage the worm from the gear for balancing the payload.

Lock Axis

Remove shoulder bolts to unlock each axis.

⚠ DO NOT PLACE THE TWO POSITION SWITCHES TO THE BALANCE POSITION UNLESS THE COUNTERWEIGHT SHAFT IS ATTACHED OR THE LOCKING SHOULDER BOLTS ARE IN PLACE!



Without a counterweight shaft attached, the RA Axis is out of balance and "top heavy". The above diagram demonstrates what happens when the Two Position Switch is rotated to the Balance Position without the counterweight shaft attached.

To prevent sudden or unexpected rotation, remove locking shoulder bolts from the RA Axis only *after* attaching the counterweight shaft.

See the Paramount ME II User Guide for further details on setting up the Paramount ME II for first use.

Figure 13: Please carefully read the above flyer and the warning below before unpacking the Paramount ME II.

DANGER

**IMPROPER USE OF THE
PARAMOUNT ME II
CAN RESULT IN SEVERE
PERSONAL INJURY
OR DEATH!**

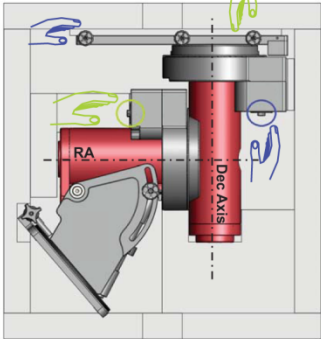
**Never remove the right
ascension or declination
locking bolts with the
counterweight shaft
removed, or when the
mount's payload is out of
balance!**

Paramount MX Unpacking Insert

! YOU MUST LOCK BOTH AXES BEFORE REMOVING THE PARAMOUNT MX FROM THE BOX!

The MX is shipped with both mechanical Three Position Switches in the Balance Position. The switches are highlighted by green and blue circles below, and described in the center panel.

To prevent mount damage or personal injury, BEFORE LIFTING THE MX FROM THE BOX, rotate both Three Position Switches to the Lock Position.



To Lock the RA Axis (green hands):

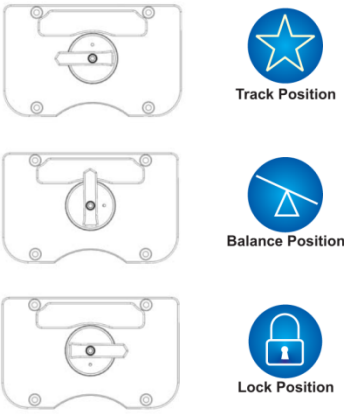
1. With your right hand grasp the top of the declination axis and gently wiggle it up and down.
2. While performing step 1, rotate the RA Axis Three Position Switch to the Lock Position.*

To Lock the Dec Axis (blue hands):

1. With your left hand grasp the end of the Versa-Plate and gently wiggle it up and down.
2. While performing step 1, rotate the Dec Axis Three Position Switch to the Lock Position.*

*The Three Position Switch drops slightly into the worm gear cover when the axis is locked.

THE THREE POSITION SWITCH



Track Position

Balance Position

Lock Position

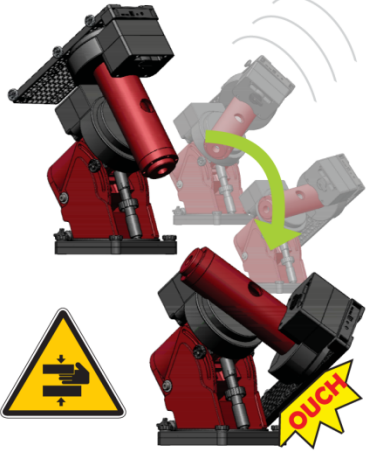
The RA Axis and Dec Axis have an arrow-shaped knob as part of a rotatable, mechanical Three Position Switch. This switch can be rotated to one of three positions and each position places the mount in the operational state described below.

Track Position Rotate the switch fully counterclockwise to engage the worm with the gear.

Balance Position Rotate the switch to the center position to disengage the worm from the gear for balancing the payload.

Lock Position Rotate the switch fully clockwise to separate the worm from the gear and lock the axis in place.

! DO NOT ROTATE THE THREE POSITION SWITCH TO THE BALANCE POSITION UNLESS THE COUNTERWEIGHT SHAFT IS ATTACHED!



! DO NOT ROTATE THE THREE POSITION SWITCH TO THE BALANCE POSITION UNLESS THE COUNTERWEIGHT SHAFT IS ATTACHED!

After locking both axes, carefully lift the Paramount MX from the box and set it upright on a flat, stable surface.

Without a counterweight shaft attached, the RA Axis is out of balance and "top heavy". The above diagram demonstrates what happens when the Three Position Switch is rotated to the Balance Position without the counterweight shaft attached.

To prevent sudden or unexpected rotation, unlock the RA Axis only after attaching the counterweight shaft.

See the Paramount MX User Guide for details on setting up the Paramount MX for first use.

Figure 14: Please carefully read this flyer *before* unpacking the Paramount MX.

Please see the "RA Worm Block Switch" on page 59 for details about using the three position mechanical switch.

Packing the Paramount for Transport

Always make sure to perform the following steps when packing up the Paramount for shipment or transport.

1. Rotate the right ascension axis' switch to the Balance position.
2. Rotate the right ascension axis so that the counterweight shaft is "down".
3. Rotate the right ascension axis' switch to the Lock position on the Paramount MX. Install the locking shoulder bolts on the Paramount ME II (page 70). These should remain in place during shipment.
4. Carefully remove the payload from the Versa-Plate.
5. Carefully remove the counterweight safety knob.
6. Carefully remove the counterweights.
7. Carefully remove the counterweight shaft.
8. Rotate the Versa-Plate *fully clockwise* to the hard stop position. In this position, the Versa-Plate is parallel to the sides of the mount so that the mount will lay flat in the box. The Versa-Plate will not be parallel with the sides of the mount when rotated fully counterclockwise.

9. Remove the four Base Thrust Mounting Knobs.
10. Lift the mount off the pier or tripod and gently place it in the packing foam.
11. For the Paramount MX, rotate the right ascension axis and declination axis' Three Position Switch to the Balance position. Both axes' Three Position Switch should always be in the Balance position when the mount is being transported.

Paramount Components

Please carefully review how to use each Paramount component before attempting to operate the mount.

Paramount ME II Front View

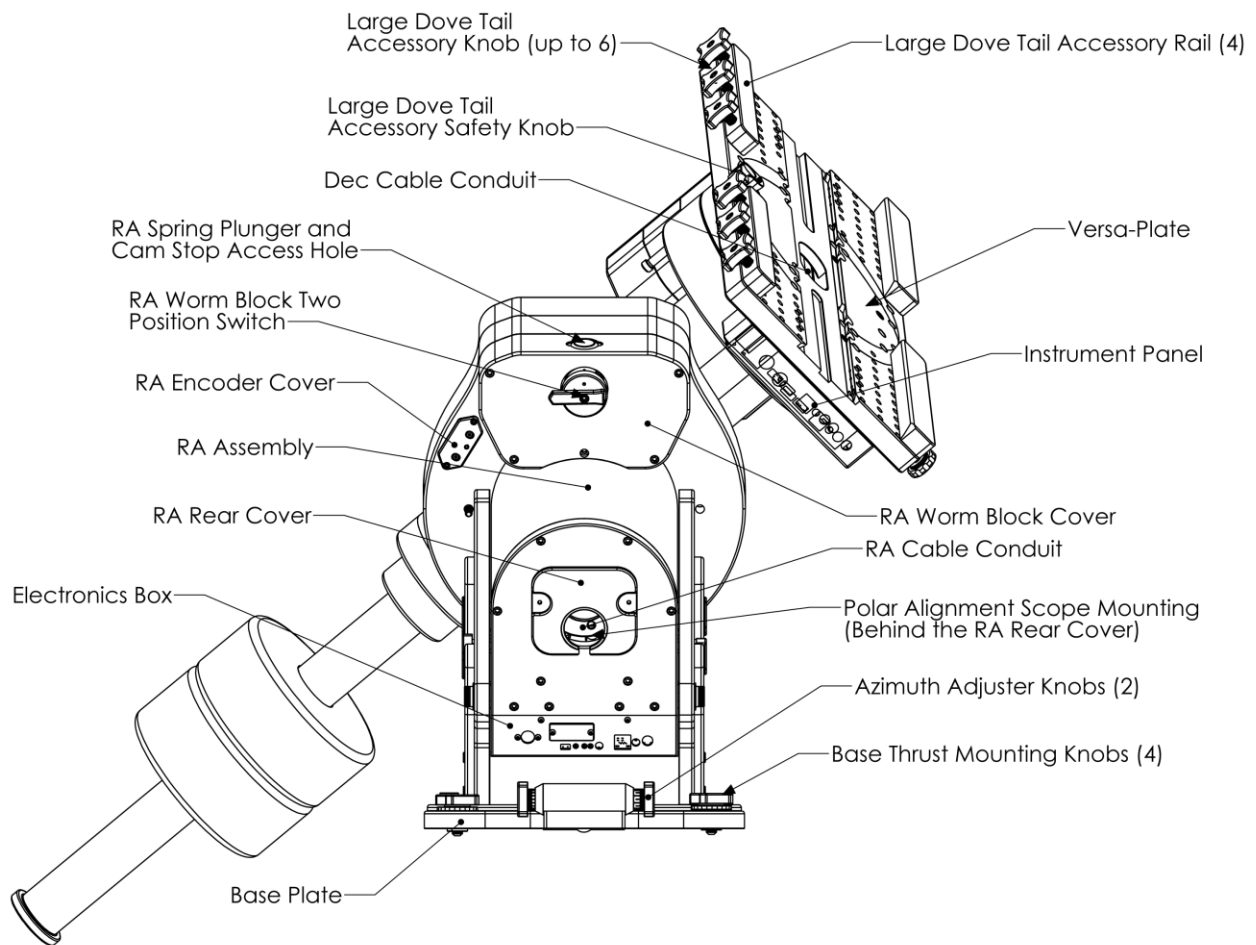


Figure 15: The front view of the Paramount ME II.

Paramount MX Front View

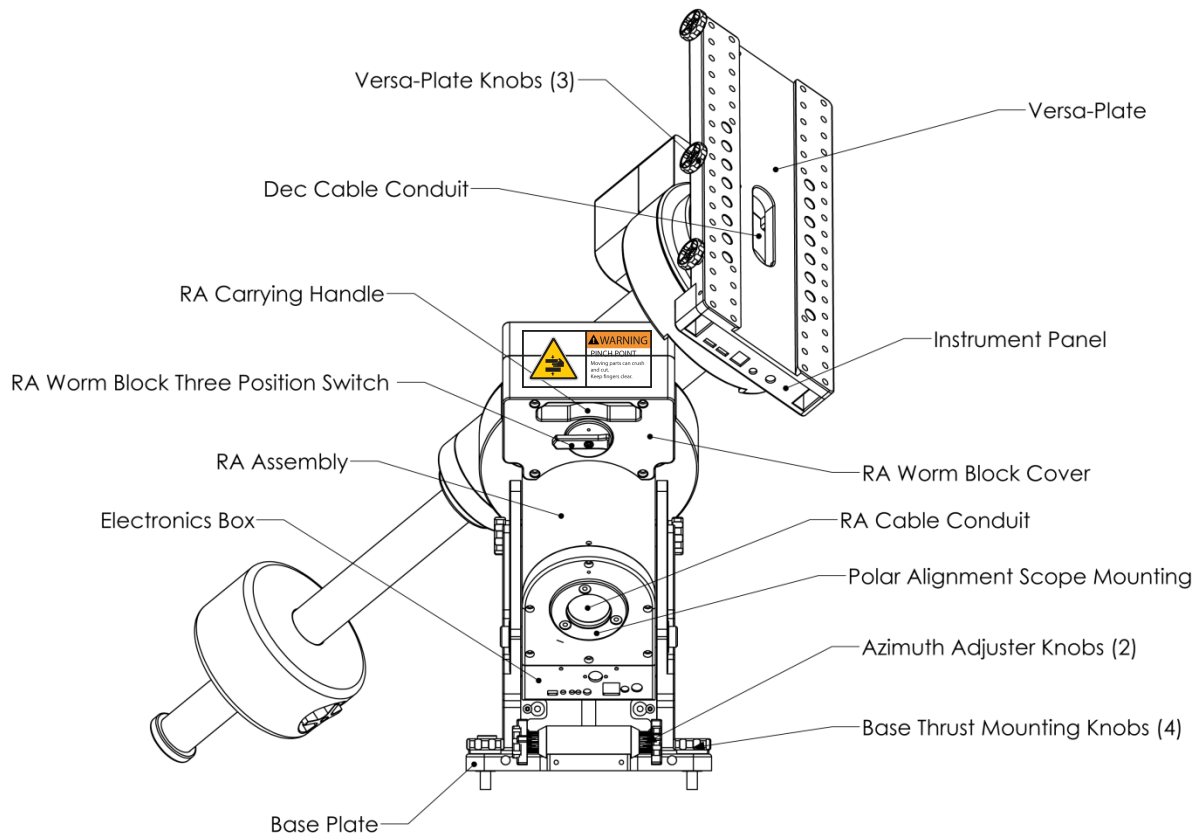


Figure 16: The front view of the Paramount MX.

RA Worm Block Cover



Always keep hands and fingers away from the right ascension axis worm block cover!

A “pinch point” is created as the declination axis rotates past the right ascension axis worm block cover.

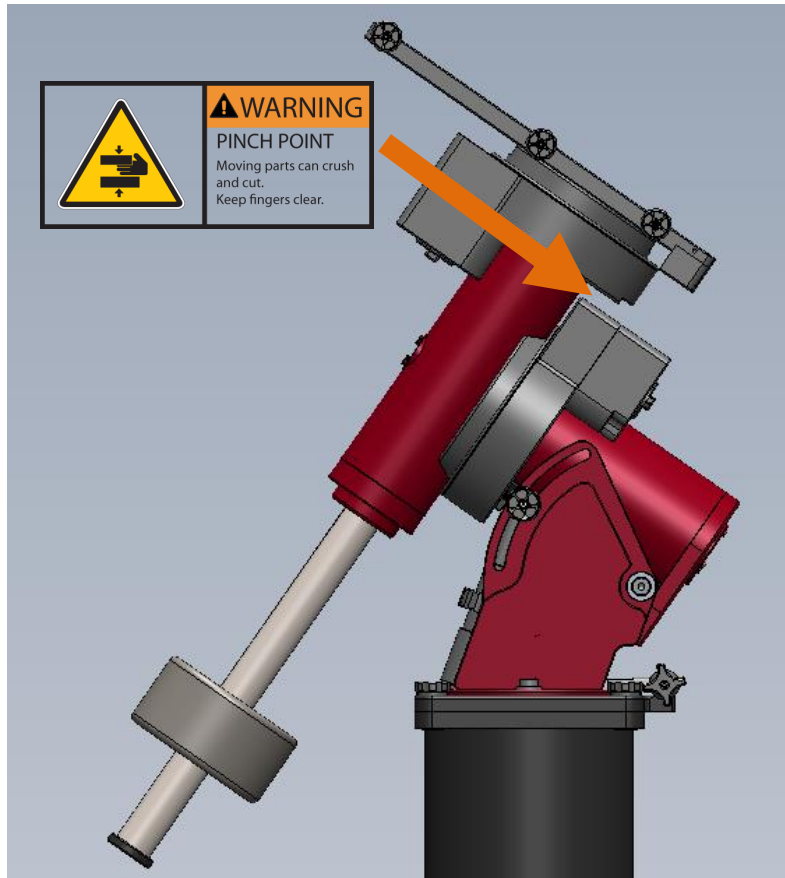


Figure 17: Caution: Always keep hands clear of this area!

Payload Mounting Plate (Versa-Plate)

The Paramount Versa-Plate provides a stable mounting platform to carry a variety of astronomical equipment. The optical tube assembly can be attached using the integrated Losmandy and Celestron dovetail rail-compatible dovetail, a telescope cradle, or telescope mounting rings. The Instrument Panel (page 55) mounted to the bottom rear of the Versa-Plate places power ports, two USB 2.0 ports, and custom through the mount cables near the camera-end of the telescope, right where they're needed.

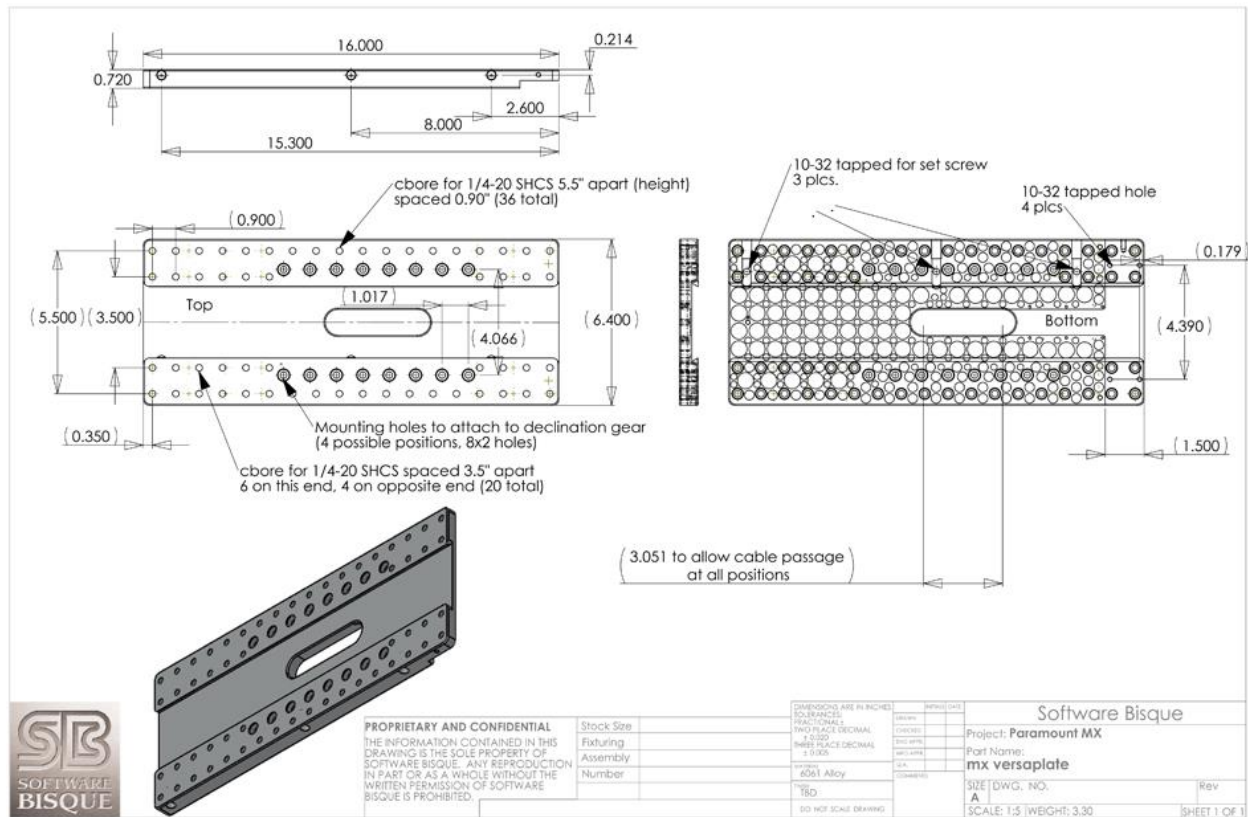


Figure 18: The Paramount MX Versa-Plate technical specifications.

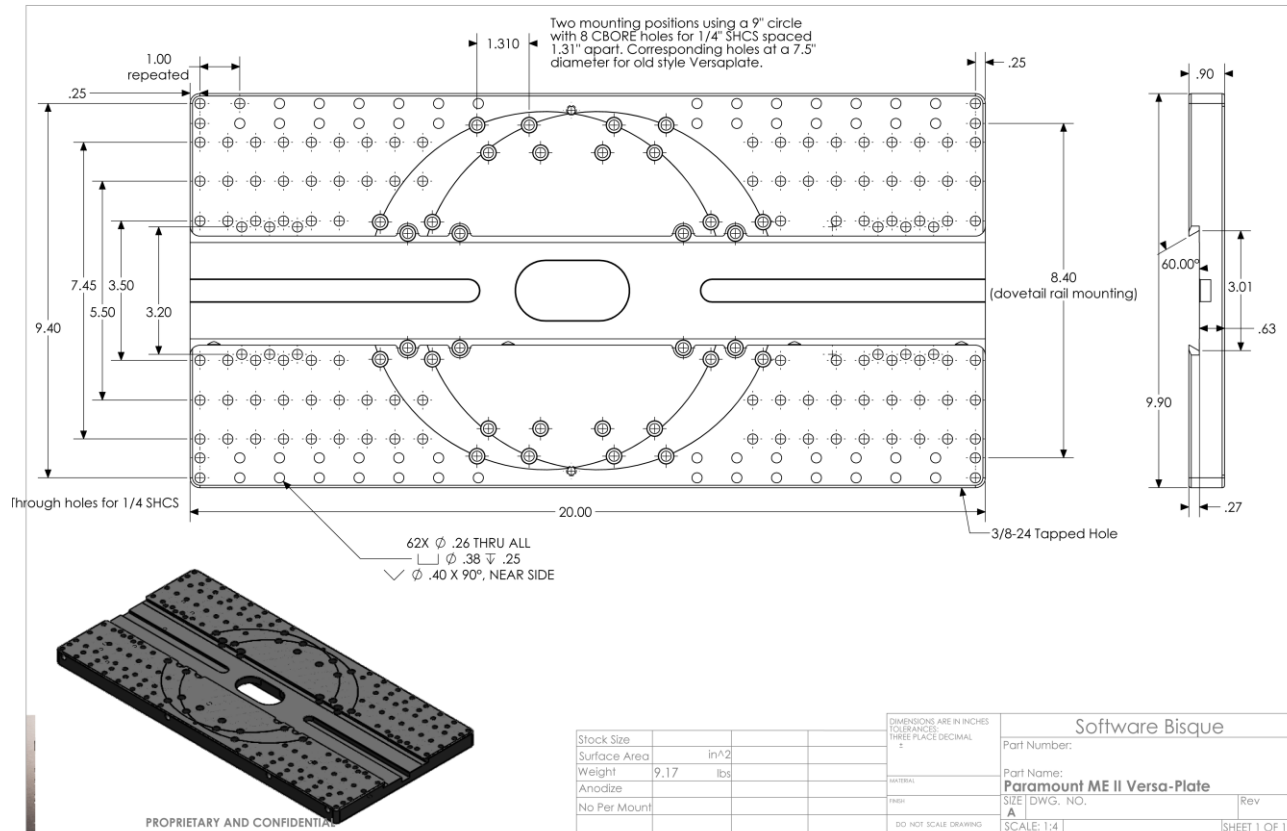


Figure 19: The Paramount ME II Versa-Plate technical specifications.

The table below lists the most common hardware used to mount telescopes (or *optical tube assemblies*) and the advantages and disadvantages of each system.

OTA Mounting

Advantages

Disadvantages

Losmandy-compatible Dovetail

- Mounting the OTA to the Versa-Plate is relatively fast and easy.
- Hardware is available, or integrated into telescopes from several different manufacturers, including:
 - ADM Accessories
 - Celestron International
 - Losmandy Astronomical Products
 - Meade Instruments
 - Officina Stellare

- Dovetails are not always rigidly mounted to the OTA itself. This can introduce flexures that affect overall pointing accuracy and repeatability.

Homeyer Scope Cradle

- Extremely rigid mount-to-telescope attachment.
- Allows multiple optics to be rigidly mounted.

- Hardware is usually more expensive.



| OTA Mounting | Advantages | Disadvantages |
|---|---|---|
| Parallax Instruments OTA Tube Rings | <ul style="list-style-type: none"> • Repeatable all sky pointing. • Extremely rigid mount-to-telescope attachment. • Allows multiple optics to be rigidly mounted. • Repeatable all sky pointing. | <ul style="list-style-type: none"> • Hardware is usually more expensive. |

Paramount Versa-Plate Knobs

The Versa-Plate Knobs (three on the Paramount MX, four on the standard Paramount ME II and up to six with the optional Large Dovetail Accessory Rail) are designed to securely captivate a male Losmandy-compatible dovetail. Rotating the knob clockwise advances an angled brass plunger on the inside of the dovetail. The angled brass plunger wedges the male dovetail to the opposite side of the female dovetail to prevent any slippage or rocking of the payload, regardless of the mount's orientation.

To mount an OTA with a male dovetail to the Versa-Plate:

1. With the counterweight shaft down, lock the right ascension axis in place.

| | |
|--|---|
|  | Install the right ascension locking bolts (page 70). |
|  | Rotate the right ascension axis Three Position Switch to the Lock position (page 59). |

2. Carefully slide the male dovetail on the OTA into the Versa-Plate's dovetail until the OTA is approximately balanced in the declination axis.



Figure 20: The brass plunger compresses the male dovetail (from left to right in the above diagram).

3. *Hand tighten* each Versa-Plate knob until the brass plungers securely hold the dovetail in place. While tightening the knobs, push slightly on the OTA in the same direction as the advancing brass plungers to make sure the dovetail plate is securely compressed against opposite side of the dovetail wedge (Figure 20). Also ensure that the male dovetail plate is securely captivated by **at least two** of the Versa-Plate Knobs before letting go of the OTA or testing declination axis balance. Securing a heavy or expensive payload with one knob is not sufficient. The length of the male dovetail varies by manufacturer. For best results and when the length of the male dovetail permits, always tighten all three knobs to hold it securely in place.

4. Test the declination axis balance, then make adjustments to the position of the payload as needed.
5. After the payload in the declination axis is balanced and the knobs are hand tightened, definitively secure each knob by inserting a 1/4-in hex wrench and tighten it an additional *one-quarter turn only*. **Do not over tighten these knobs or the internal threads can be damaged.** Note that when two or three of the knobs are “hand tightened”, the dovetail will not slide. The final 1/4 turn with the hex wrench ensures that your heavy and expensive payload is mounted securely and will not move when the mount slews.

Versa-Plate Mounting Positions

The Versa-Plate can be mounted to the top of the declination axis in four different positions and can be adjusted depending on the weight distribution of the payload. The gray circles in Figure 21 represent the top of the declination axis at each mounting position.

If your payload is “camera-end heavy” mount the Versa-Plate at the forward most position so that the payload can be more easily balanced. Remove the six 1-inch socket head cap screws (SHCS) using a 3/16-in hex wrench, then adjust the position of the Versa-Plate accordingly. The mounting position depends on your equipment, so there may be a bit of trial and error to find the optimal spot. The four SHCS should be tightened snugly so that the Versa-Plate cannot wiggle or shift when carrying the payload, but not too tight.

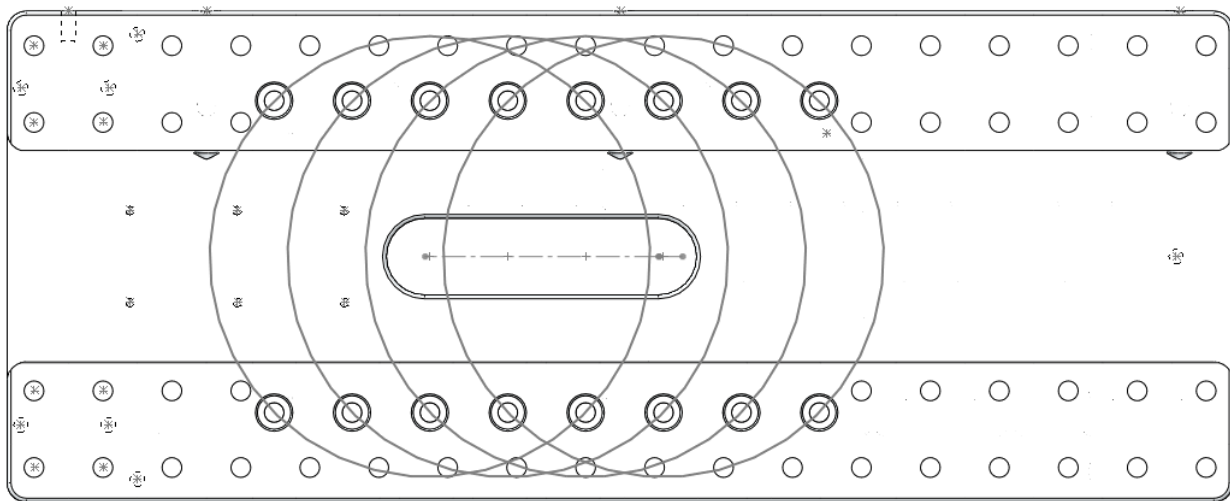


Figure 21: Machined circles mark the four mounting positions on the Paramount MX Versa-Plate. (The Instrument Panel end is to the left.) The Paramount ME II's Versa-Plate has two mounting positions.

Standard versus Wide Mounting Versa-Plate Orientation

The Paramount is shipped with the Versa-Plate in the standard orientation. The Versa-Plate can also be mounted at 90 degrees from the typical orientation, offering a wider mounting to accommodate multiple optical tube assemblies.



The design of the Versa-Plate allows the optical tube assembly to be mounted facing two directions, 180 degrees apart. When attaching an SCT, RC, or refractor, make sure the eyepiece (or camera) end of the OTA is located near the Instrument Panel. The eyepiece end of a Newtonian telescope should be mounted opposite the Instrument Panel.

The simple litmus test is to home the mount. If the telescope is pointing toward the ground, the OTA is mounted in the wrong direction.

To change the orientation of the Versa-Plate:

1. Remove the six 1-inch $\frac{1}{4}$ -20 $\frac{3}{16}$ socket head cap screws on the top of the Versa-Plate.
2. Rotate the Versa-Plate 90 degrees. The top of the declination axis has “indentations” to accommodate the instrument panel and through the mount cabling.
3. Align the mounting holes on the Versa-Plate with the mounting holes at the top of the declination axis and replace four of the six screws. Only four socket head cap screws are used in the wide orientation.

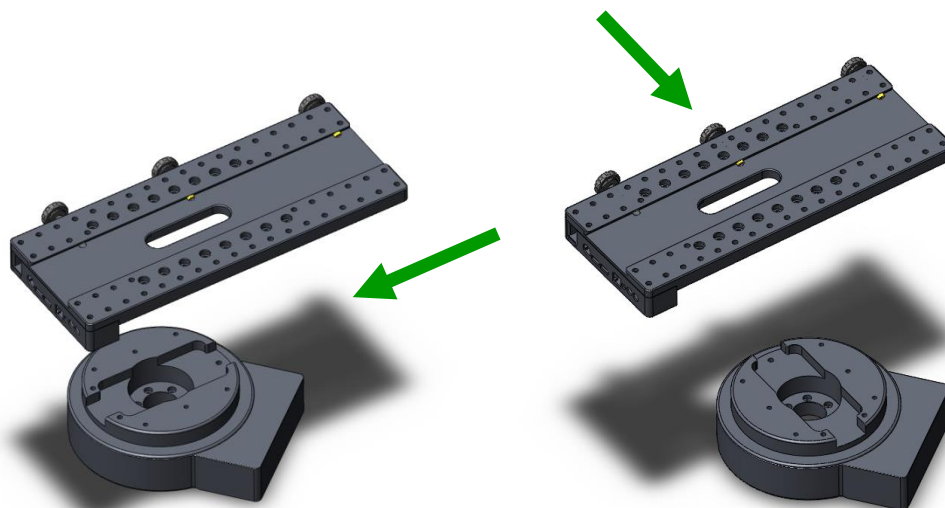


Figure 22: The standard (left) and wide (right) Versa-Plate mounting orientations (Paramount MX shown above, applies to the Paramount ME II also). The arrows show the direction of incoming light when the OTA is mounted.

Figure 22 shows the standard and wide orientations of the Versa-Plate relative to the top of the declination axis. The arrows show the direction of *incoming light* for the optical tube assembly mounted on the Versa-Plate.



Mounting the Versa-Plate in the wrong orientation will prevent the Paramount from operating normally.

Large Dovetail Accessory Rail (ME II, Optional)

The Paramount ME II can accept optical tube assemblies with a PlaneWave Instruments dovetail mounting plate using the optional Large Dovetail Accessory Rails. Four “rails” and the rotating safety knob mount directly to the existing Versa-Plate and offer six mounting knobs to securely attach and carry 20-inch class optical tubes. The safety knob allows a heavy optical tube assembly to be mounted by placing one edge of the male side of the dovetail into place, then rotating the telescope to meet the other side, rather than having to slide the entire payload along the length of the dovetail. Once the OTA is in place, rotate the safety knob to *temporarily* captivate the OTA and then proceed to tighten each Versa-Plate knob until the OTA is secure.

Instrument Panel

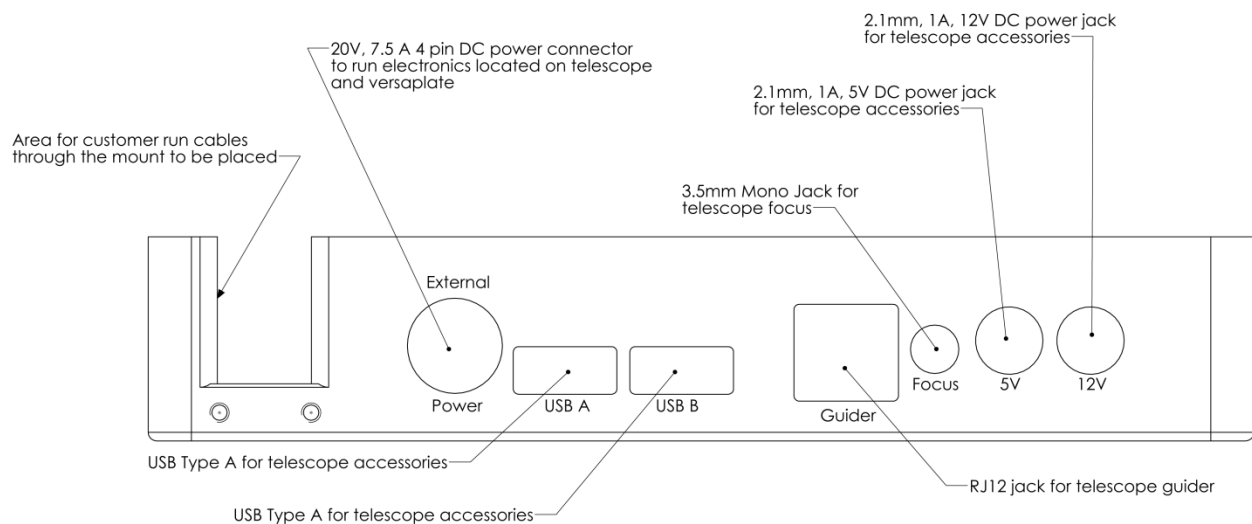


Figure 23: The Instrument Panel housing is mounted to the bottom of the Versa-Plate.

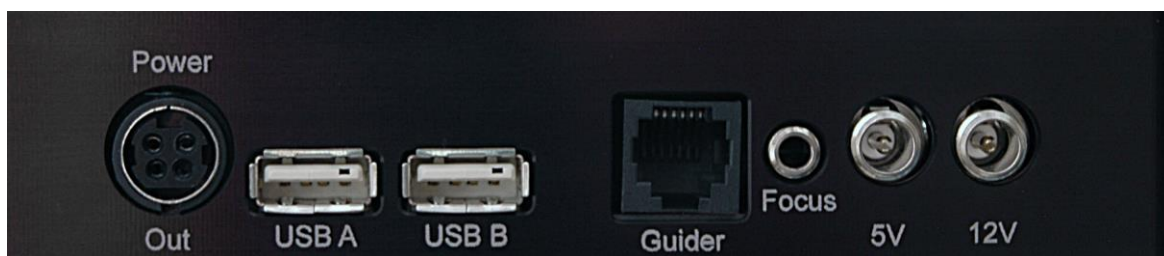


Figure 24: Photograph of the Instrument Panel.

Instrument Panel Components

The Instrument Panel provides two USB 2.0 ports, a guider port, a focuser for pulse focuser control and ports that can be used to supply power to your devices.

Powering Devices (Power Out)

The Instrument Panel port labeled *Power Out* is the *output* port for the mount's built-in through the mount power cabling. The input port for the through the mount cabling is labeled *Power In* on the Electronics Box (page 63).

These ports are designed to satisfy the power requirements for a variety of astronomical devices, including dew heaters, video cameras, and other instruments. The “stock” through the mount cabling for this connector uses a 16-gauge wire to carry relatively heavy electrical loads and the 4-pin Kycon KPPX-4p series connectors (Mouser part number 806-KPPX-4P) are rated to carry a maximum of 20 volts at 7.5 amps.



The External Power connectors on the Instrument Panel and on the Electronics Box **do not supply power** nor do they have anything to do with the Paramount MX power supply.

These connectors act as a conduit to route an external power source that is connected to the Power In connector located Electronics Box to the Power Out connector on the Instrument Panel.

Software Bisque offers cable sets that can be used to route power through the mount for many model cameras, as well as a generic “pig tail” cable set if you want to supply power to different device. See “Appendix C: External Power Cable Sets” on page 148 for these cable specifications.

If you plan on making your power own cables, the KPPX series snap and lock power connectors have many advantages, including:

- Self-locking
- Small footprint
- Inexpensive
- Readily available
- Rated for relatively heavy power loads
- Available in board mount or straight-through configurations

Search for “KPPX video assembly” on the [Kycon web site](#) for printed and video-based assembly instructions.

USB Ports (USB A and USB B)

These two USB ports are part of an integrated USB hub on the MKS 5000 electronics board. The Instrument Panel's two USB ports can connect any two USB 2.0 devices to a computer's USB port.

To allow USB communication between these ports and the computer, plug the square end of the mini-USB cable to the Electronics Box's mini-USB port and the flat end into your computer's USB port. Next, plug the rectangular end of the device's USB cable into either USB A or USB B and power on the mount.



Both USB ports on the Instrument Panel are powered by the Paramount control system.

If a USB camera plugged into one of these ports and the mount's power is turned off, the USB camera will no longer be able to communicate with the computer that is connected to the mini USB port on the Electronics Box.

Guider Port (Guider)

This RJ12 port is based on pin outs from the standard SBIG guider connector that is used by virtually every astronomical camera. See the "Guide Port" section of the [SG-4 Autoguider Operating Manual](#) for the SBIG autoguider port specifications.

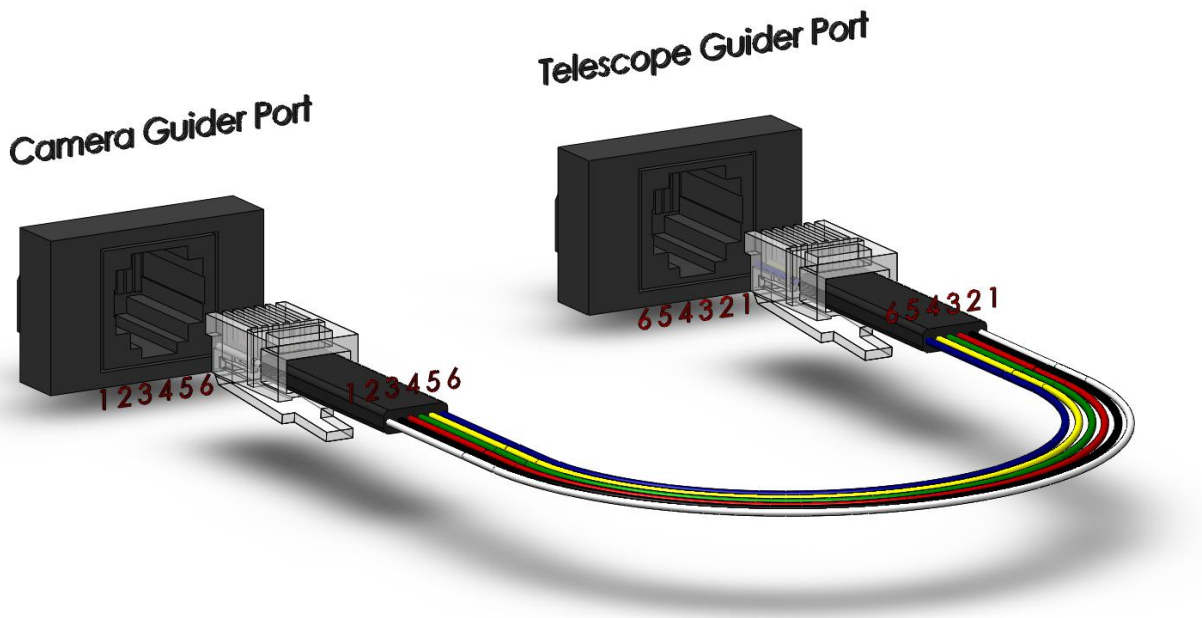


Figure 25: Diagram showing the pin outs for the guider cable and the camera and guider port.

Focuser Port (Focus)

Use this port to connect your pulse focuser to the mount so that *TheSkyX Professional Edition* or other software (using *TheSkyX Professional Edition* as a server) can be used to "remotely" adjust the focuser's position.

Plug the pulse focuser into this port, establish communication with the Paramount, then use the **Focus Controls** on *TheSkyX Professional Edition's Telescope* window to adjust focus.

5 Volt Power Jack (5V)

Use this 5V "low amperage" (1A maximum current) DC port to power devices that draw relatively low voltages and low amperages.

Power is supplied *from the MKS 5000 control system*, so the mount must be plugged in and turned on for it to be operational. The 2.1 mm DC power connector is manufactured by Kobiconn (Mouser part number 1710-0721 with no locking collar or part number 171-7391 that includes a locking collar).



Attempting to power a device that draws more than 5W (5V at 1A) will cause the MKS 5000 control system to emit successive beeps, indicating an “error condition.”

Unplug the device that exceeds the maximum power specification from the Instrument Panel’s 5V port to resume normal mount operation.

12 Volt Power Jack (12V)

This connector supplies 12V power (1A maximum current) that can be used to power most video cameras. Power is supplied *from the MKS 5000 control system*, so the mount must be plugged in and turned on for it to be operational. The 2.1 mm DC power connector is manufactured by Kobiconn (Mouser part number 1710-0721 with no locking collar or part number 171-7391 that includes a locking collar).



Attempting to power a device that draws more than 12W (12V at 1A) will cause the MKS 5000 control system to emit successive beeps, indicating an “error condition.”

Unplug the device that exceeds the maximum power specification from the Instrument Panel’s 12V port to resume normal mount operation.

RA Worm Block Cover

The RA Worm Block Cover incorporates the following features:

- Protects the internal right ascension worm block components from dust and debris.
- Provides a convenient handle to grasp when lifting the mount.
- Houses the right ascension axis Three Position Switch (page 59).

RA Cable Conduit

This access hole in the right ascension shaft allows custom cables to be passed through the mount. See “Through the Mount Cabling” on page 33 for more information.

This access hole is dome-shaped to serve as an integrated carrying handle and is covered by the RA Gear Cover.

RA Gear Cover (ME II Only)

The RA Gear Cover provides an access hole for through the mount cables.

Dec Cable Conduit

This access hole in the declination shaft allows custom cables to be passed through the mount. See “Through the Mount Cabling” on page 33 for more information.

Right Ascension Carrying Handle

Use the integrated carrying handle to lift the mount. On the Paramount MX, place the Three Position Switch in the Lock position before lifting the mount. The Paramount ME II’s RA Cable Conduit access hole is dome-shaped and serves as the integrated carrying handle (remove the RA Gear Cover to access it).

RA Worm Block Switch

The Paramount’s RA and Dec Axis have an arrow-shaped knob as part of a rotatable, mechanical switch. (The Paramount ME II switch has two positions and is referred to as the Two Position Switch. The Paramount MX switch has three positions and is referred to as the Three Position Switch). This switch can be rotated to one of two or three positions and each position places the mount in a different operational state as described in the table below.

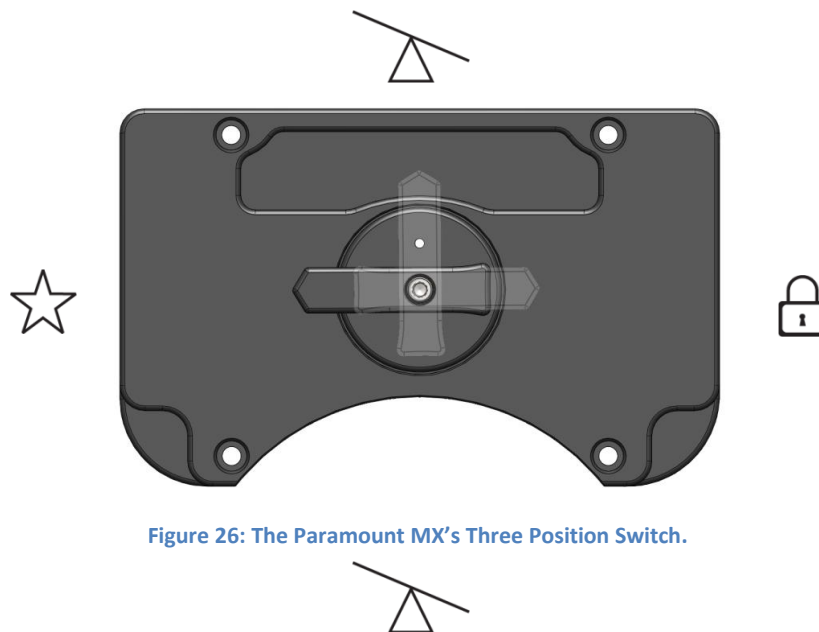


Figure 26: The Paramount MX's Three Position Switch.

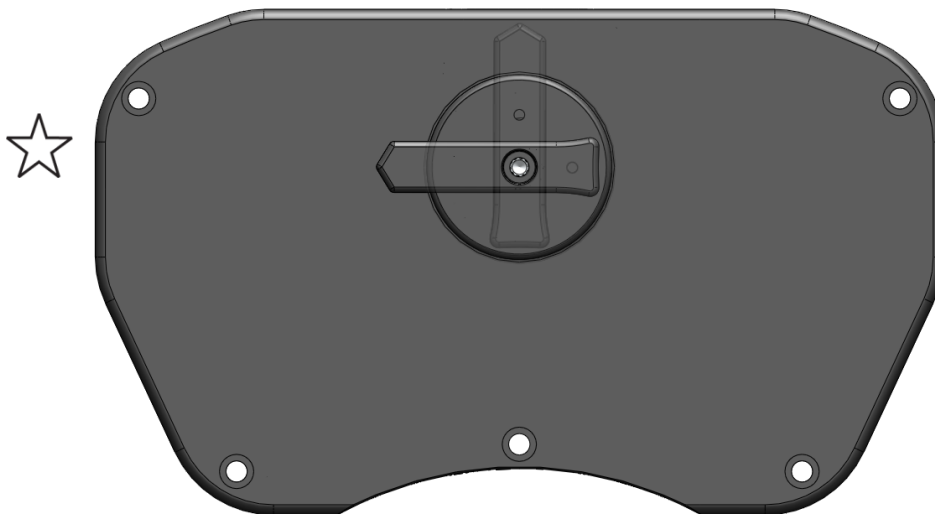


Figure 27: The Paramount ME II's Two Position Switch.

The balance, star and lock symbols shown in Figure 26 are etched into the top of the cover of the Paramount MX, where they are most visible when setting up the mount.

Only the balance and star symbols appear on the Paramount ME II, as its two-position switch does not allow locking the axis; separate locking bolts must be installed to do so. See “Right Ascension Axis Locking Hole (ME II Only)” on page 70 and “Declination Axis Locking Hole (ME II Only)” on page 82 for details about locking the Paramount ME II axes.



ADJUSTING THE PARAMOUNT’S MECHANICAL SWITCH ALWAYS REQUIRES BOTH HANDS!

Rotating the Two or Three Position Switch for both the RA axis and the Dec axis requires the use of both hands to prevent sudden or unexpected rotation of the mount.

- Before rotating the Dec Axis Two or Three Position Switch with your right hand, firmly grasp the Versa-Plate with your left hand to prevent sudden rotation of this axis from an unbalanced payload.
- Before rotating the RA Axis Two or Three Position Switch with your right hand, firmly grasp the Counterweight Shaft with your left hand to prevent sudden rotation of this axis from an unbalanced payload.

When the switch is rotated to, or passes through the Balance Position, the axis will rotate freely. Unexpected rotation of either axis due to an unbalanced payload can cause personal injury or serious damage to the mount!

Always use extreme caution and, please, always use BOTH HANDS!



Track Position: Rotate the arrow on the switch fully counterclockwise to engage the worm with the gear. This position is used during normal mount operation.



Balance Position: Rotate the arrow on the switch to the center position to disengage the worm from the gear so that the axis rotates freely.



Balancing either the right ascension or declination axis of the Paramount is always a two-handed operation! Please carefully read the document shown in Figure 14 for details about where to grasp each axis before placing the Three Position Switch in the Balance Position.

This position is for balancing the payload and is the recommended position to place the switch *after* the mount has been placed inside the shipping container box and while the mount is being transported. If the mount is subjected to a severe impact during shipping, both axes will rotate freely. Unrestricted motion in each axis can help minimize damage to the worms and gears.



The Paramount must always be homed after balancing either axis! Otherwise, the mount will be “lost in space” and potentially slew beyond the software slew limits.



Lock Position (Paramount MX only): Rotate the switch fully clockwise to separate the worm from the gear *and* lock the axis in place. Always lock both axes before lifting the mount.

An axis can be locked to any position, at 5 degree increments. Note that physically rotating the switch to the Lock Position inserts an internal *locking shaft* into one of 72 *locking holes* that are machined into the internal gear. You will usually need to wiggle the axis a few degrees back and forth in order to align the locking shaft with one of the locking holes. When the shaft enters the hole, the entire Three Position Switch will drop slightly into worm gear cover. Once locked, the axis can no longer rotate.

Rotating the switch away from the Lock Position causes the locking shaft to be removed from locking hole and the axis will rotate freely. Note that the entire switch itself will rise slightly out of the worm block cover as a result.

RA Spring Plunger and Cam Stop Access Hole (ME II Only)

This hole provides access to the Paramount ME II spring plunger and cam stop adjustment. See the Paramount ME II Cam Stop Adjustment Instructions document here:

<http://www.bisque.com/sc/media/p/75503.aspx>

for details.

RA Encoder Cover (ME II Only)

This cover provides access to the absolute encoder module and is reserved for future use.

RA Assembly

The RA Assembly houses an internal shaft that can be used to snake additional cables through the mount and allows light to pass through the mount for the polar alignment telescope.

Electronics Box

The Electronics Box includes the mount power switch, USB 2.0 cable input, status lights, ports that can be used to run power through the mount to the Instrument Panel, a hardware park port and an expansion slot access panel.

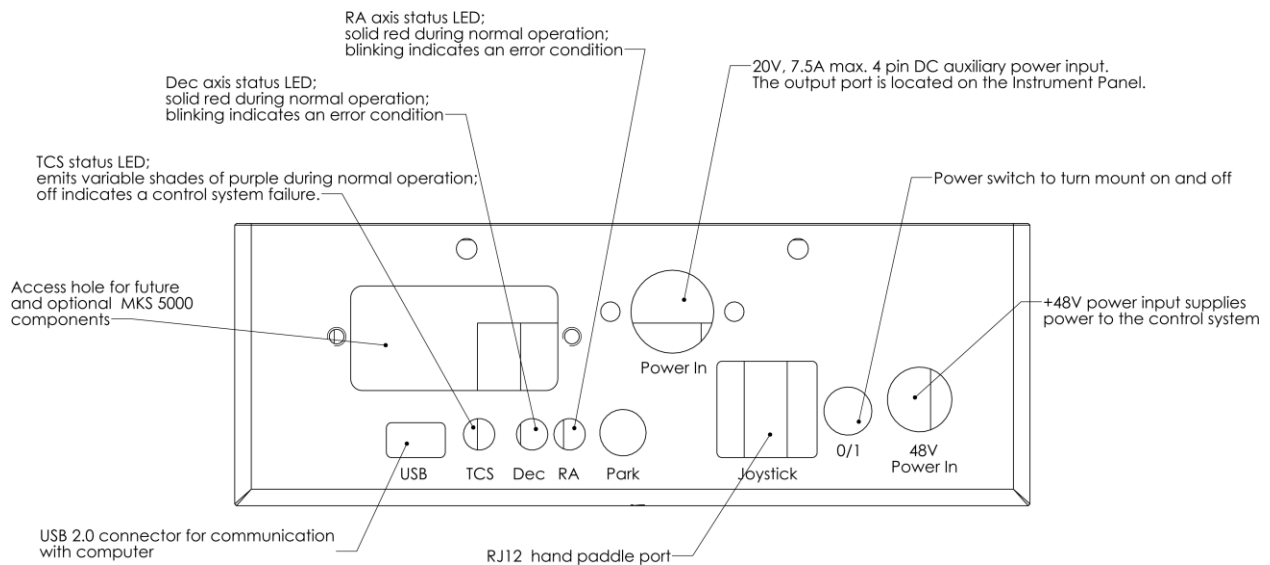


Figure 28: Technical drawing of the Paramount MX Electronics Box labeling each component.



Figure 29: Photograph of the Paramount ME II Electronics Box.

Electronics Box Components

Mini USB Port (USB)

The mini USB 2.0 port accepts the square end of the standard mini USB cable connector (supplied with the mount). Plug the rectangular end of the USB cable into the computer's USB port.

TCS Status LED (TCS)

The Telescope Control System (TCS) status light emitting diode (LED) "pulsates" from bright to faint to provide visual confirmation that the control system is operating normally. If this LED is not illuminated after turning the mount on, there is a problem with the Bisque TCS control system. Please contact Software Bisque technical support for further troubleshooting advice (see "Getting Help" on page 13).

Right Ascension and Declination LEDs (Dec and RA)

The right ascension and declination LEDs show the status of the DC-servo motors. The LEDs blink while the motors are being initialized. When the LEDs shine steadily, the motor is operating normally and ready for use. If either LED is not illuminated, motor initialization failed. An unbalanced payload, uncentered joystick, or depressed joystick button can cause motor initialization failure. Turn the power off, make sure the mount payload is properly balanced, the joystick on the hand controller is centered, and the joystick button is not pressed before repowering the mount to see if the behavior persists.

Hardware Parking (Park)

Reserved for future use. This port will offer the ability to "hardware park" the Paramount using an external voltage. This capability offers an alternative to parking the mount using *TheSkyX Professional Edition* and can be crucial as a backup parking method when operating the mount remotely.

Hand Controller or Joystick Port (Joystick)

Plug the RJ12 connector on the Paramount hand controller or the Paramount ME joystick to manually home and slew the mount. See page 82 for details about this component.

External Power (Power In)

This 4-pin DC power connector can be used to run up to 20 volts at up to 7.5 amps power through the mount to the Instrument Panel. See "Powering Devices (Power Out)" on page 55 for specifications for this connector.

See page 148 for the pin out specifications and connector part numbers.



The External Power connectors on the Instrument Panel and on the Electronics Box **do not supply power** nor do they have anything to do with the Paramount power supply.

These connectors act as a conduit to route an external power source that is connected to External Power connector located in the Electronics Box to the External Power connector in the Instrument Panel.

Mount Power Switch (On/Off)

This switch turns the mount on (up position) and off (down position).



Power Input (48V Power In)

This port is used to supply power to the mount's control system. The Electronics Box's female 48V Power In port accepts a 2.5 mm Kobiconn DC power plug with a locking collar (Mouser Electronics part number: 171-7395, <http://www.mouser.com>).

The Paramount ME II and Paramount MX PSUs use tip positive plugs. See "Power Supply Unit" on page 86 for more information.

Plugging Power Supply Unit into the Electronics Box

The Paramount MX PSU can be plugged directly into the 48V Power In port on the Electronics Box; the Paramount ME II requires an additional power extension cable. The table below describes how to physically connect the PSU of each model from the external power source to the 48V Power In port (page 64) on the Electronics Box.

| Model | Connecting PSU to 48V Power In Port | Connecting the PSU to External Power |
|---|--|---|
|  | <ol style="list-style-type: none"> 1. Plug the 4-pin locking male Kycon connector on the PSU into the female Kycon connector on the Power Supply Extension Cable. <i>Do not attempt to plug the 4-pin Kycon connector on the PSU into the Electronics Box port labeled Power In.</i> 2. Plug the male Kobiconn DC power plug on the Power Supply Extension Cable into the port labeled 48 V Power on the Electronics Box. | Plug the female end of the Power Cable for the Power Supply Unit (page 40) into the PSU's power input. Plug the male end into an external power supply. |
|  | Plug the male Kobiconn DC power plug on the Power Supply Extension Cable into the port labeled 48 V Power on the Electronics Box. | Plug the female end of the Power Cable for the Power Supply Unit (page 40) into the PSU's power input. Plug the male end into an external power supply. |

Expansion Slot Cover

The removable cover on the front of the Electronics Box provides access to a plug in "expansion slot" on the MKS 5000 electronics board. This expansion slot may be used to provide future control system enhancements. For now, there is no reason to remove this cover.

Polar Alignment Scope Mounting

The Paramount can be fitted with an optional polar alignment scope to optically align the mount's polar axis with the celestial pole. The Paramount Polar Alignment Scope includes the optics, a reticle illuminator, an extension tube, a threaded machined aluminum cover that protects the scope during

transit and a mounting bracket that provides space for custom through the mount cabling to exit the mount.

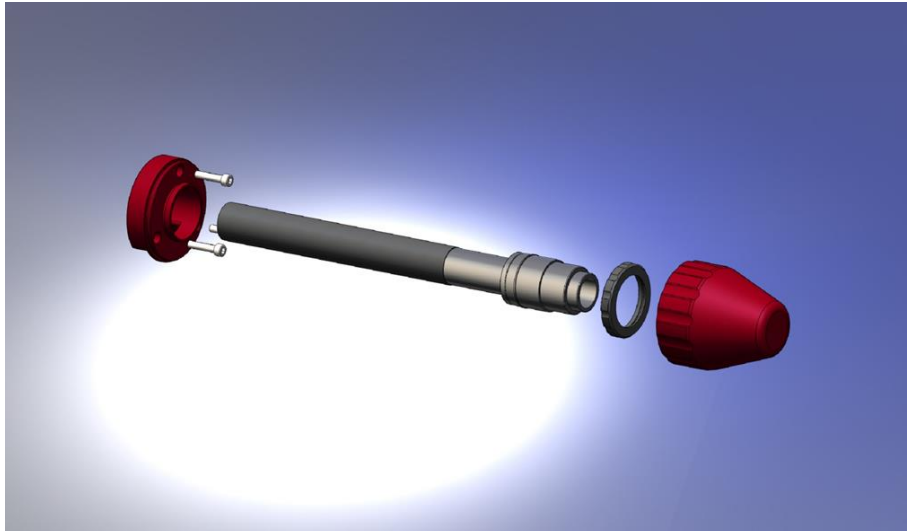


Figure 30: Polar Alignment Scope and mounting hardware.

Download the PDF document named “Paramount Polar Alignment Scope Installation and Use” from the Software Bisque Downloads page for more information:

<http://www.bisque.com/sc/media/p/58136.aspx>

Type the URL below into your web browser’s **Address** bar to purchase the Paramount Polar Scope:

<http://www.bisque.com/sc/shops/store/MXPolarScope.aspx>

Polar Axis Adjustments

A common problem with many commercial mounts when making polar alignment adjustments is that changes to the position of the altitude axis also changes the position of the azimuth axis, and vice-versa.

In other words, the basic mechanical design is flawed in that it prevents independent motion in azimuth and altitude. This makes precise polar alignment more difficult than it should be.

The Paramount base consists of an outer, fixed plate that is mounted to the pier, and an inner rotating plate on which the mount sits. Adjustments in azimuth are achieved by rotating the Azimuth Adjustment Knobs at the front of the mount (Figure 31). For a level mount, rotation of this plate does not affect the altitude of the polar axis.

The altitude axis is held in place using a separate mechanical system that includes the Altitude Adjuster Thrust Knobs (Figure 41) and the Altitude Adjuster (Figure 33). For a level mount, adjustments in altitude will not change the azimuth of the polar axis.

Azimuth Adjuster Knobs

The Azimuth Adjustment Knobs work in *opposition* – one must be loosened before the other can be tightened. The knob that is tightened rotates the azimuth axis; the knob that is loosened provides “clearance” for the axis to rotate.

Provided the opposite knob is sufficiently loose, the azimuth axis can be rotated without applying excessive force. Note that a fully-loaded mount may make tightening the knobs by hand more difficult. If necessary, insert a 5/32 hex wrench into the center of the adjustment knob to assist rotation.

- Tightening the right knob moves azimuth east.
- Tightening the left knob moves azimuth west.

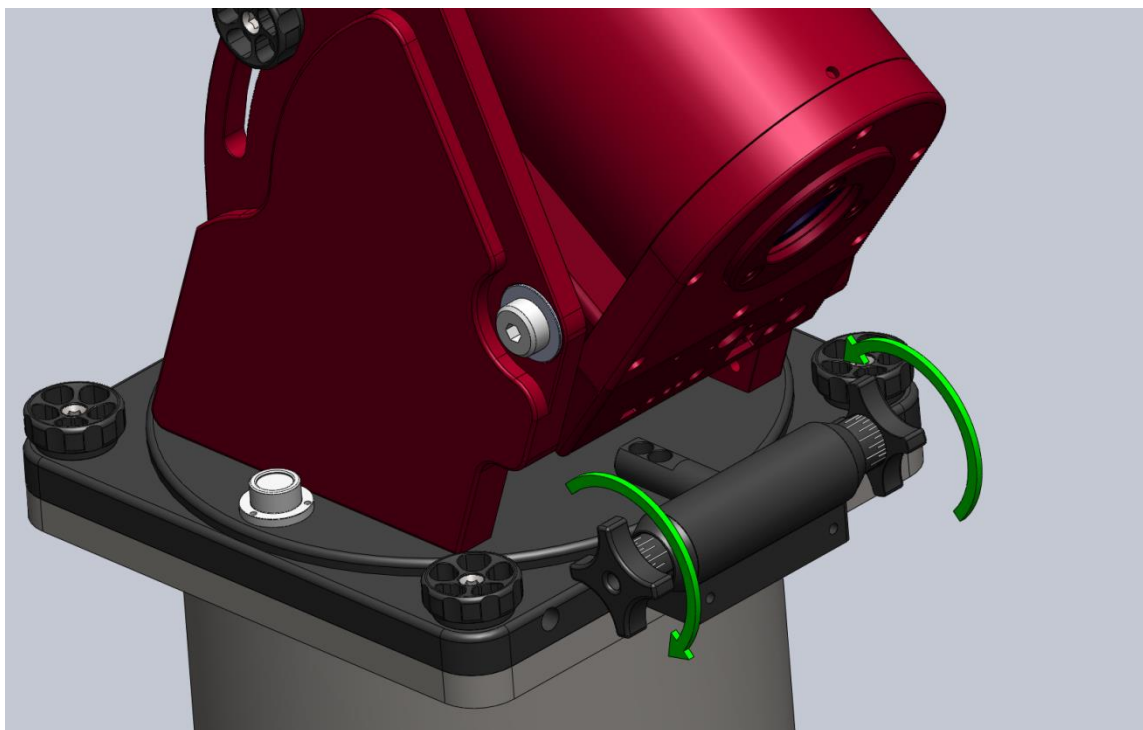


Figure 31: Rotate the Azimuth Adjuster Knobs to adjust the azimuth axis (Paramount MX pictured above).

Azimuth Vernier Scale

Both Azimuth Adjuster Knobs include Vernier scales that can be used for refining the position of the azimuth axis. The longest tic marks represent *approximately* 4 arcminutes rotation in azimuth. The medium length marks are *approximately* 2 arcminutes rotation and the shortest tics marks are *approximately* 1 arcminute.

So, for example, if the *TPoint Add On's* Polar Alignment Report suggests to “rotate the azimuth axis 180 arcseconds east,” you would have to rotate the right knob clockwise three tics (about three arcminutes) on the Vernier scale.



The azimuth axis polar axis adjustment range is plus or minus seven (7) degrees from center position. Make sure to orient your permanent pier within three (3) degrees (or so) of the celestial pole so that polar alignment can be achieved without having to rotate the permanently mounted pier itself.

- Software Bisque Permanent piers have slotted mounting holes that provide additional azimuth rotation (plus or minus five degrees from the center position).
- The Software Bisque Pyramid Portable Pier allows unlimited rotation in azimuth, so the mount's initial orientation does not matter.

Base Thrust Mounting Knobs

Use these four mounting knobs to securely attach the base of the Paramount base to the top of the pier, tripod or other mounting surface.



Always immediately secure the Paramount to the top of your pier or tripod before attaching the counterweight shaft, adding counterweights, or optical equipment! Forgetting to do so is relatively easy, but can have disastrous results.

| Model | Total Length | Thread Specification |
|-------|----------------|-------------------------------|
| MEII | 3.8 cm (2 in.) | 3/8-inch, 24 threads per inch |
| MX | 5 cm (1.5 in.) | 3/8-inch, 24 threads per inch |

The Paramount ME II also includes an integrated micro leveler than can help level the Base Plate on a slightly uneven mounting surface. Please carefully read “Micro Levelers (ME II Only)” on page 82 for details about using this component.

Base Plate

The base plate incorporates four precision thrust mounting knobs that are used to attach the Paramount mount to top of the pier or tripod.



There are two set screws located on the side of the Base Plate that compress a Delrin plunger against the side of the integrated rotating plate and prevent lateral motion of the plate.

These set screws should never be adjusted.

The set screw access holes on the Paramount MX are located on the *same side* of the Base Plate as the Altitude Adjuster Knobs. (One is shown to the left of the Azimuth Adjuster Knob in Figure 31.). On the Paramount ME II, they are located on the opposite side of the Altitude Adjuster Knobs.

Paramount ME II Rear View

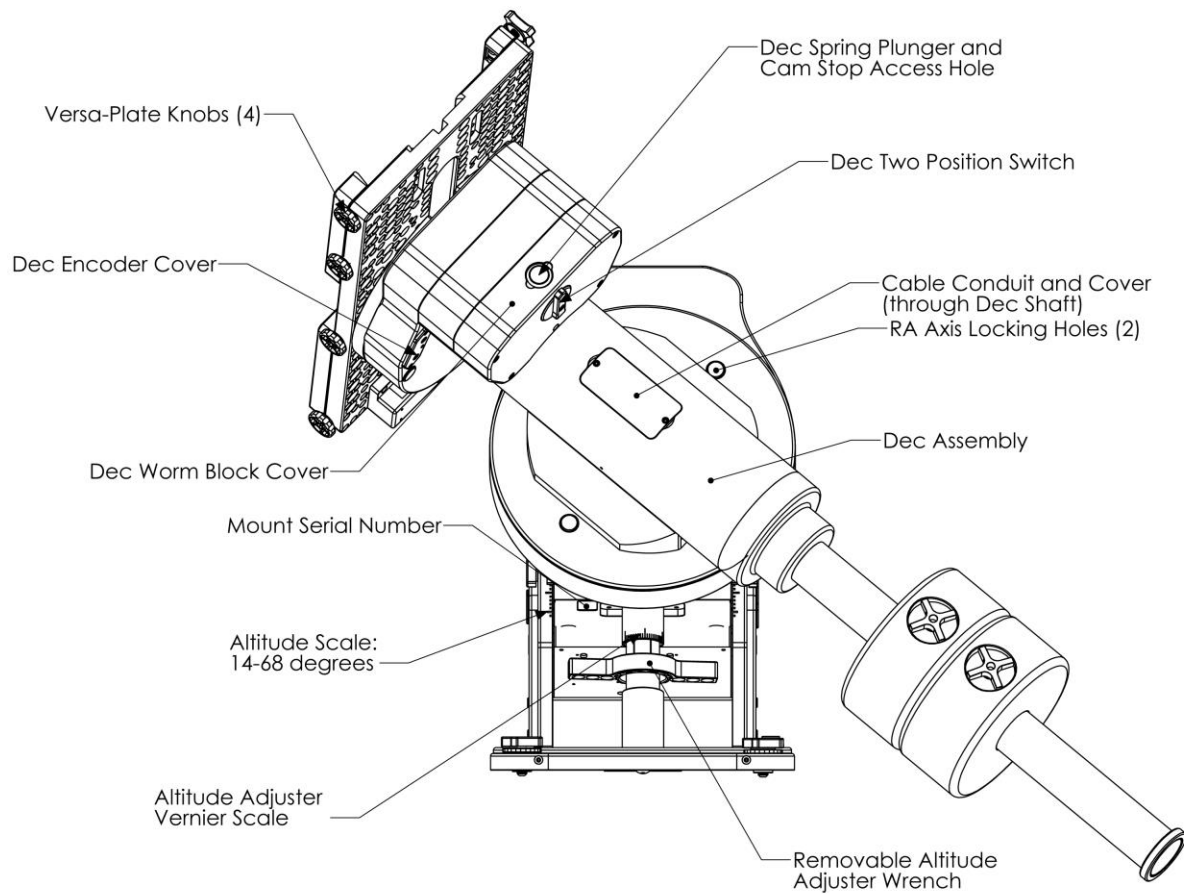


Figure 32: Paramount ME II rear view.

Paramount MX Rear View

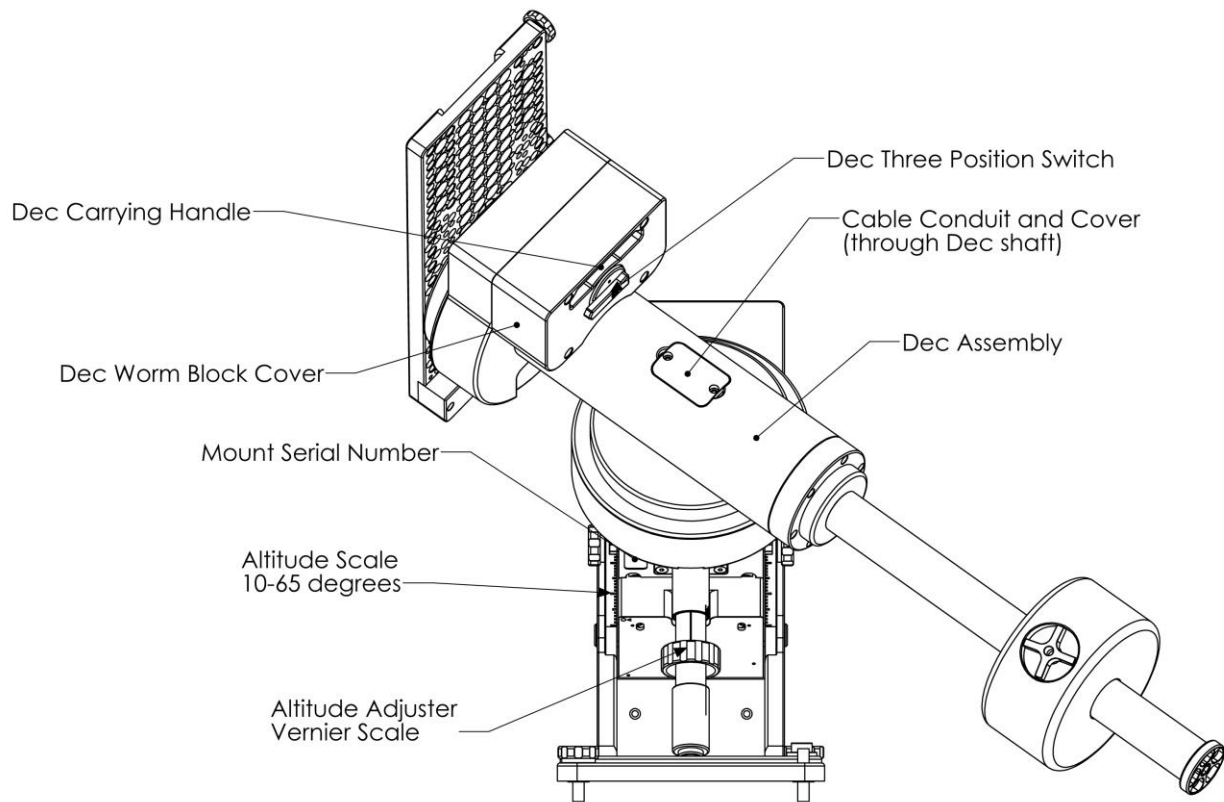


Figure 33: The rear view of the Paramount MX.

Declination Carrying Handle (MX Only)

Use the integrated carrying handle (located above the Declination Three Position Switch) to lift the mount. Remember to always place both Three Position Switches in the Lock position before lifting the mount (page 59).

Declination Axis Three Position Switch (MX Dec Three Position Switch)

See the “RA Worm Block Switch” description on page 59 for details about using this component.

Cable Conduit Access Hole and Cover

The Paramount has an optional polar alignment scope that can be used to quickly align the mount to the polar axis. “Line of site” for the polar alignment scope is achieved by removing the Cable Conduit Cover and rotating the declination axis until the through holes in the internal shaft allow incoming light to pass through the mount.

Early models of the Paramount MX used a circular aluminum nut instead of a curved plate to cover the declination axis access hole, as shown in Figure 34.

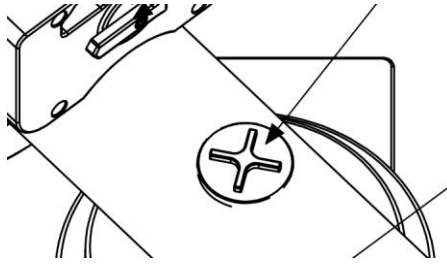


Figure 34: The original Paramount MX cable conduit access hole cover.



Always keep fingers clear from the cable conduit access hole!

- While the declination axis rotates during mount slews, an internal shaft in the declination assembly is also being rotated by a very high torque servomotor.
- When the declination axis' Three Position Switch is in the Balance Position (page 59), the internal shaft can rotate freely and may do so with a high angular velocity when the mount's payload is even slightly out of balance.

In both cases, the rotating internal shaft creates a potentially dangerous pinch point with the outer declination axis assembly that can cut, crush or sever fingers.

Always keep fingers clear during mount slews and use extreme caution when routing cables through the mount, or aligning the declination shaft's "through-hole" during polar scope alignment.

Right Ascension Axis Locking Hole (ME II Only)

The Paramount ME II's right ascension axis can be locked into one, and only one, position by orienting the counterweight shaft vertically and then inserting two shoulder bolts (supplied with mount) into both Right Ascension Axis Locking Holes and through the right ascension gear. The bolts can be permanently mounted (before shipment, for example) by threading a nut on end of the bolt that protrudes through the back side of right ascension gear housing.

The reason the right ascension axis can only be locked when the counterweight shaft is vertical is to prevent unbalanced payloads from damaging the mount. If the mount's right ascension axis were to be locked in any other orientation, unbalanced payload could potentially exert destructive torque on the locking mechanism.



When installed, the right ascension and declination axis locking bolts are designed to prevent the axis from rotating during shipment or while adding payload to the mount.

As a best practice, always try to maintain a relatively balanced payload, even when mounting equipment.

The shoulder bolts are not designed to carry the mount's entire payload. If you mount an excessively unbalanced payload on the declination axis, for example, you run the risk of bending one or both of the bolts, making removal difficult.

The specifications for right ascension axis locking shoulder bolt are:

- 18-8 stainless steel shoulder screw
- 5/16-in. shoulder diameter
- 2-1/4-in. long shoulder
- 1/4 in.–20 thread

The declination axis locking shoulder bolt has the same specifications, but is 1-3/4-in. long.

Configurable Hard Stop Positions (ME II Only)

The Right Ascension Locking Holes also provide access bolts that define the Paramount ME's configurable hard stop position. For each "side of the meridian", there are six different positions where a physical hard stop mounting bolt can be installed.

After placing the Two Position Switch in the Balance mode, rotate the right ascension access and look into one of the Right Ascension Locking Holes. As the axis is rotated, you will see five threaded holes that do not contain a bolt and the sixth, at the maximum hard stop limit, with a bolt installed. The position of this bolt defines the maximum allowable rotation for the axis in this direction.

Normally, the hard stop position need not be altered, and the configurable software slew limits (page 132) are used to prevent the mount from slewing to undesired positions.

To change the position of the hard stop, remove the hard stop bolt using a square-ended hex wrench. A square-ended hex wrench bolt captivates the socket head cap screw so that it can be extracted from the Right Ascension Locking Hole. Once removed, the socket head cap screw can be placed at the desired hard stop position.

Declination Axis Assembly (Dec Assembly)

The declination assembly is a permanent component of the Paramount and cannot be removed.

Paramount Serial Number (Serial Number)

The Paramount serial number is affixed to the base of the right ascension assembly. It also appears on your invoice or packing slip (page 42).

Altitude Scale

The Altitude Scale is a series of tic marks machined into the edge of both altitude wedge plates. The longer tic marks represent *approximately* ten degree increments, the medium tics are *approximately* five degree increments and the shorter tics are *approximately* one degree increments. When the mount's base is close to level, this scale can be used to set the altitude of the mount's polar axis to an accuracy of plus or minus fifteen arcminutes or so.

The current altitude of the mount's polar axis can be read on the scale by looking at the intersection of the bottom of the altitude reference block and the nearest tic mark on the Altitude Scale.



- **The lowest position on the Paramount ME II Altitude Scale is 14 degrees; the highest position is 68 degrees.**
- **The lowest position on the Paramount MX Altitude Scale is 10 degrees; the highest position is 65 degrees*.**

*The Paramount MX's polar axis can actually be adjusted to exceed the maximum scale by about one degree, so that the highest "reachable" latitude is closer to 66 degrees.

Software Bisque manufactures the Paramount MEII or Paramount MX Latitude Adjustment Wedge that allows the mounts polar axis to be adjusted for lower or higher latitudes.

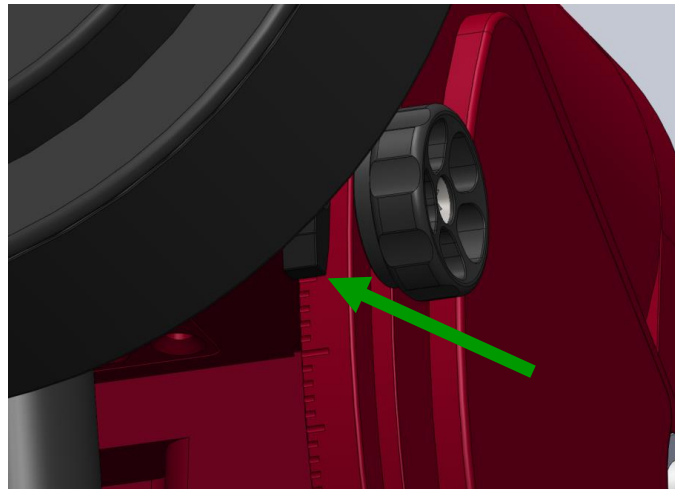


Figure 35: The tic mark beneath the bottom of the Altitude Reference Block represents the current altitude.

Altitude Adjuster

The Altitude Adjuster is used to make precise adjustments to the mount's altitude axis during polar alignment. The elevation of this axis should match the *latitude* of your observing site. The adjuster uses right-handed threads so that, when viewed from above, rotating the Altitude Adjuster knob counterclockwise raises the elevation of the polar axis.

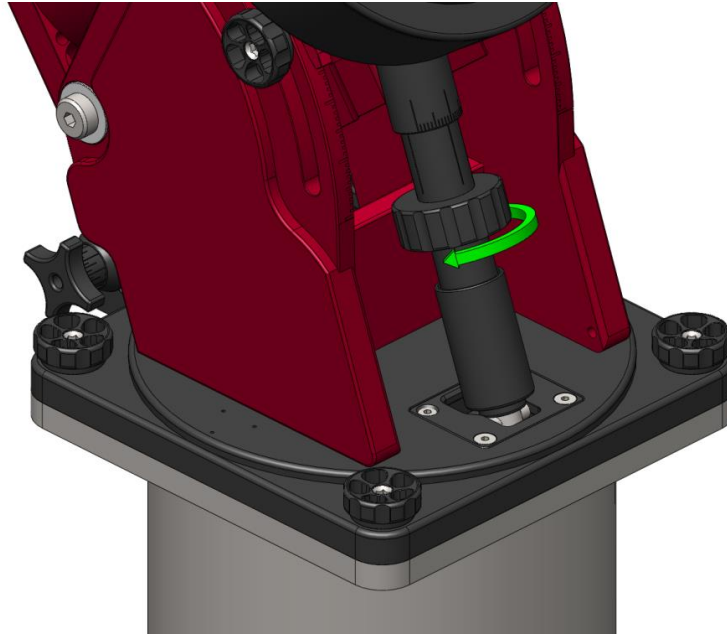


Figure 36: Rotating the Altitude Adjuster in the direction of the arrow lowers the axis.

To adjust the altitude of the polar axis:

1. Loosen the Altitude Adjuster Thrust Knobs (page 80).
2. Grasp and rotate the large central knob (near the arrow in Figure 36) to raise or lower the polar axis. The threads are right handed, so, when using your right hand, your thumb will point up or down based on the direction of rotation (which follows the natural bend of your fingers).

The Paramount ME II includes a removable Altitude Adjuster Wrench (page 86) that makes rotating the Altitude Adjuster Knob easy, even with the heaviest payloads.

See page 85 for details on how to adjust the polar axis to get “close” to the pole.

Altitude Adjuster Vernier Scale

In addition to the Altitude Scale tic marks on the wedge, the Altitude Adjuster knob has a fine-position Vernier scale that allows the mount’s elevation to be adjusted to an accuracy of plus or minus 15 arcseconds (Figure 37.)

So, for example, when the *TPoint Add On’s* Polar Alignment Report states “raise the mount’s polar axis 62 arcminutes,” it means that one complete revolution of the Altitude Adjuster, plus two positive tic marks on the Vernier scale from the vertical line labeled A should place the elevation of the mount very close to the refracted pole.

The arrow on Figure 37 shows the location of the fine-position Vernier scale. This scale shows elevation adjustments from approximately +10 to –10 arcminutes. The medium height tick marks represent approximately 5 arcminute divisions; the small tic marks represent approximately 1 arcminute divisions.

One rotation of the Altitude Adjuster knob is close to one degree of elevation adjustment. The rotating knob cover directly beneath the Vernier scale has four vertical lines labeled with the letters A, B, C, and D that can be used to make absolute elevation adjustments. These vertical lines are 90 degrees apart and represent fifteen arcminute increments in elevation.

The Vernier scale also allows the mount's elevation to be placed at a specific position and is useful for restoring a specific elevation if the mount is used at multiple observing sites. For example, suppose your observatory's elevation is 39 degrees plus "an additional rotation that aligns the vertical B line with the – 4.5 tic mark on the Vernier scale". You can subsequently use this position to precisely restore the altitude of the polar axis each time the mount is setup.

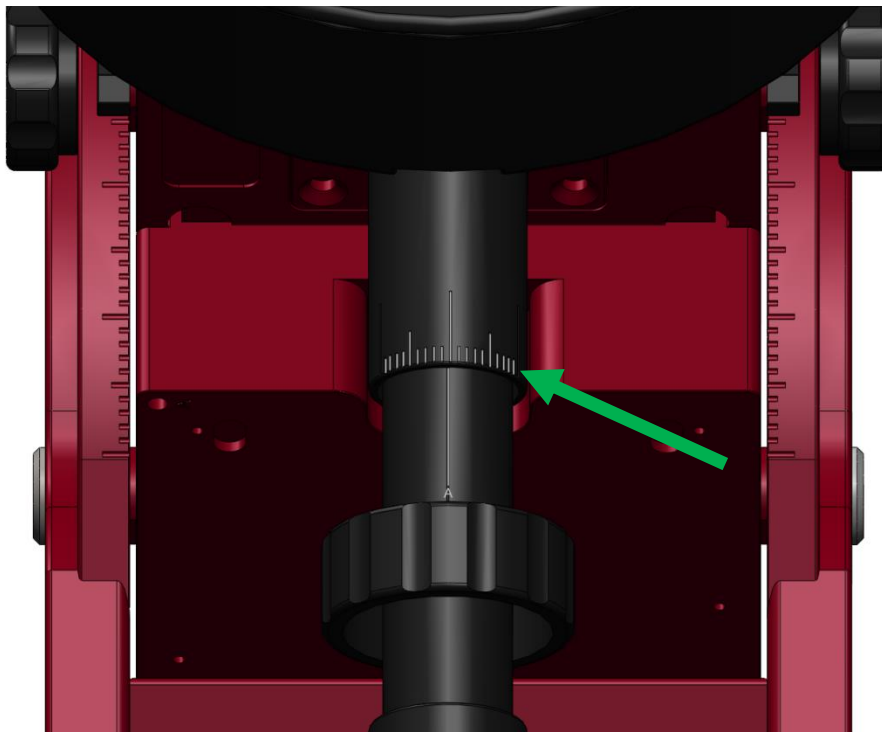


Figure 37: The Vernier scale on the Altitude Adjuster.

Counterweight Shaft

To attach the stainless steel counterweight shaft to the Paramount, insert the threaded end into the bottom of the declination assembly (Figure 33) and rotate the shaft clockwise until it is hand tight. The counterweight shaft changes the mount's center of mass and may make the unit "top heavy", so make sure to install the secure the mount to the pier or tripod first.

| Model | Length | Diameter (in.) | Max. Counterweights |
|-------|------------------|----------------|---------------------|
| ME II | 47 cm (18.5 in.) | 1.875 | 6 (30 lb.) |
| MX | 41 cm (16 in.) | 1.5 | 6 (20 lb.) |



Always make sure the Counterweight Shaft is attached **before operating the mount**. The weight of the Counterweight Shaft helps balance the unloaded right ascension axis. Attempting to slew the mount when either axis is severely out of balance may cause the motors to stall and the control system will emit successive beeps.



Counterweight Shaft Extension Bar (Optional)

The optional Counterweight Shaft Extension Bar (sold separately) screws into the end of the Paramount Standard Counterweight Shaft. This bar both extends the moment arm and allows up to two additional counterweights for ultra-heavy payloads.

Counterweights

Two counterweights are included with the Paramount and can be mounted on the counterweight shaft to balance the mount's payload. Slide the counterweight to the approximate balance position, and then rotate the counterweight knob until the knob is hand tight. A softer metal brass plunger on the end of the knob holds the counterweight in place and will not score or gouge the stainless steel shaft.

The table below shows the specifications for each mount.

| Model | Counterweight Specifications |
|---|---|
|  | 14 kg (30 lb.), 1.875 in. bore* Technical drawing URL: http://www.bisque.com/sc/media/p/74654.aspx |
|  | 9 kg (20 lb.), 1.5 in. bore Technical drawing URL: http://www.bisque.com/sc/media/p/70864.aspx |

**In addition to the 1.875-in. diameter counterweight shaft, the Paramount ME II can also accept the 1.5-in. diameter Paramount ME/MX counterweight shaft.*

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. The counterweights should “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.



Counterweights are extremely heavy! Please use extreme caution so that you do not accidentally drop one and injure yourself or

others!

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.

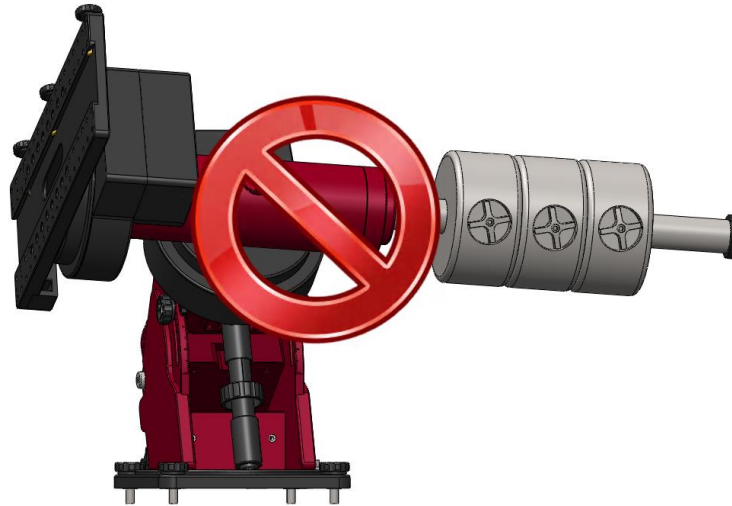


Figure 38: Please, *never ever* position the Paramount mount in this orientation, not even with a single counterweight.



Never position the Paramount in the above orientation, with or without counterweights!

Figure 38 shows the Paramount in an ***unstable*** configuration that places extreme and potentially destructive lateral force on the teeth of the right ascension worm and gear. The counterweight shaft should always remain in the vertical position while the Paramount is being loaded with counterweights and payload (telescope, camera, etc.).

If you must orient the mount's payload in a severely out of balance position, for the Paramount MX, place the Three Position Switch in the Lock position first (page 59) or install the Paramount ME II locking bolts.

Even when mount's axis is locked, the excessive imbalance demonstrated above could bend, mar or otherwise damage the shaft or bolts that lock the axis in place. Please do not abuse your precision mount in this manner.

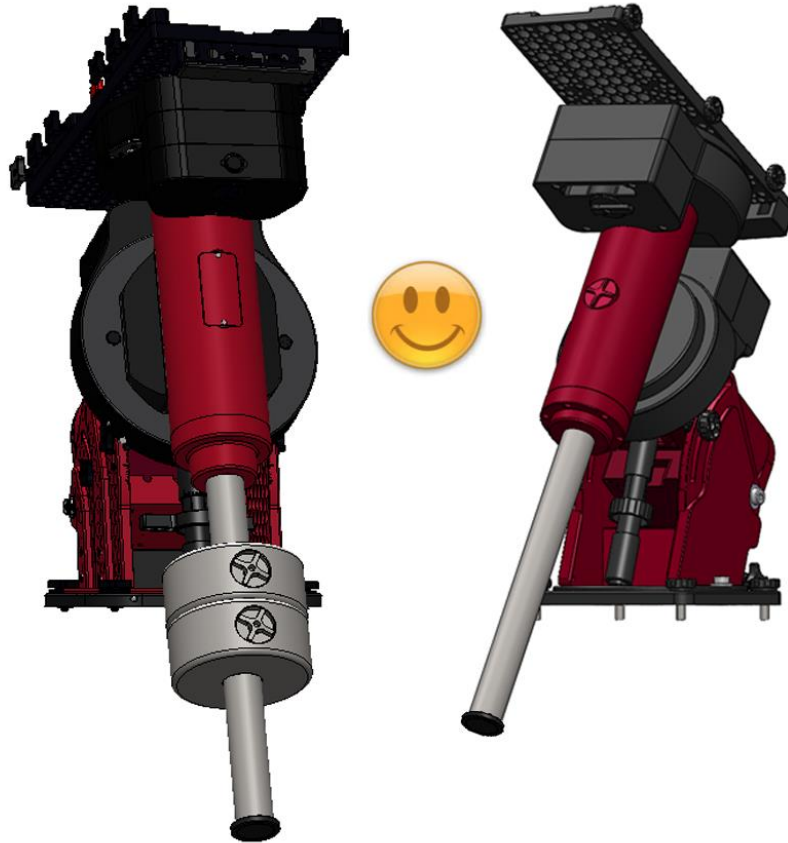


Figure 39: The Paramount's in their happy place with the counterweight shaft oriented vertically.

Payload Imbalance Cause and Effect

When the counterweight shaft is oriented “non-vertically” *and* one or more counterweights are on the counterweight shaft, *and* the right ascension Three Position Switch is in the Track position, the extreme lateral force placed on the right ascension worm and gear will cause the worm to separate from the gear. The right ascension axis will then freely rotate to a “balance” position, and you will hear a chattering noise caused by the teeth of the precision gear bouncing past the teeth of the precision worm gear.

Despite the gut wrenching feeling this sound brings on, damage to the worm and gear is usually minimal. The recommended procedure is to exercise the mount (page 128) and to please try not to make this a habit.

Balancing the Payload

After attaching the counterweights, mount your optical tube assembly, camera, and all other equipment (focuser, filter wheel, field rotator, dew heater, etc.) to the Versa-Plate, then begin balancing each axis, starting with right ascension. The Paramount operates best when the payload is properly balanced, which means that, when the worm and gear are separated for a given axis, the axis does not tend to

rotate in either direction. An unbalanced payload can cause numerous problems, such as stalling or “gear chattering” during slews.

By design, there is no clutching mechanism on the Paramount. So, to achieve balance, you must disengage the worm from the gear. When balancing the right ascension axis, first orient the counterweight shaft vertically, then slide the counterweights up or down on the counterweight shaft to change the balance point. After carefully tightening each counterweight knobs, until both the counterweight end and the optical tube assembly end of the axis remain at rest.



Always use extreme care when balancing the telescope!

- ***Make note of the weight distribution on the telescope before placing the mount’s mechanical switch in the Balance position.***
- ***Always firmly grasp the OTA or counterweight shaft so that you can maintain control of the telescope.***

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. To balance the declination axis, slide the OTA forward or backward.

If you routinely swap cameras or other components, the difference in weight might be enough to cause slewing problems. In this situation, you can quickly rebalance a system by marking the positions of counterweights on the counterweight shaft for each configuration.

Counterweight Safety Knob

The counterweight safety knob screws into the threaded hole on the end of the counterweight shaft. Always attach the counterweight safety knob immediately after adding counterweights to prevent an improperly mounted counterweight from sliding off the end of the shaft.

Paramount ME II Side View

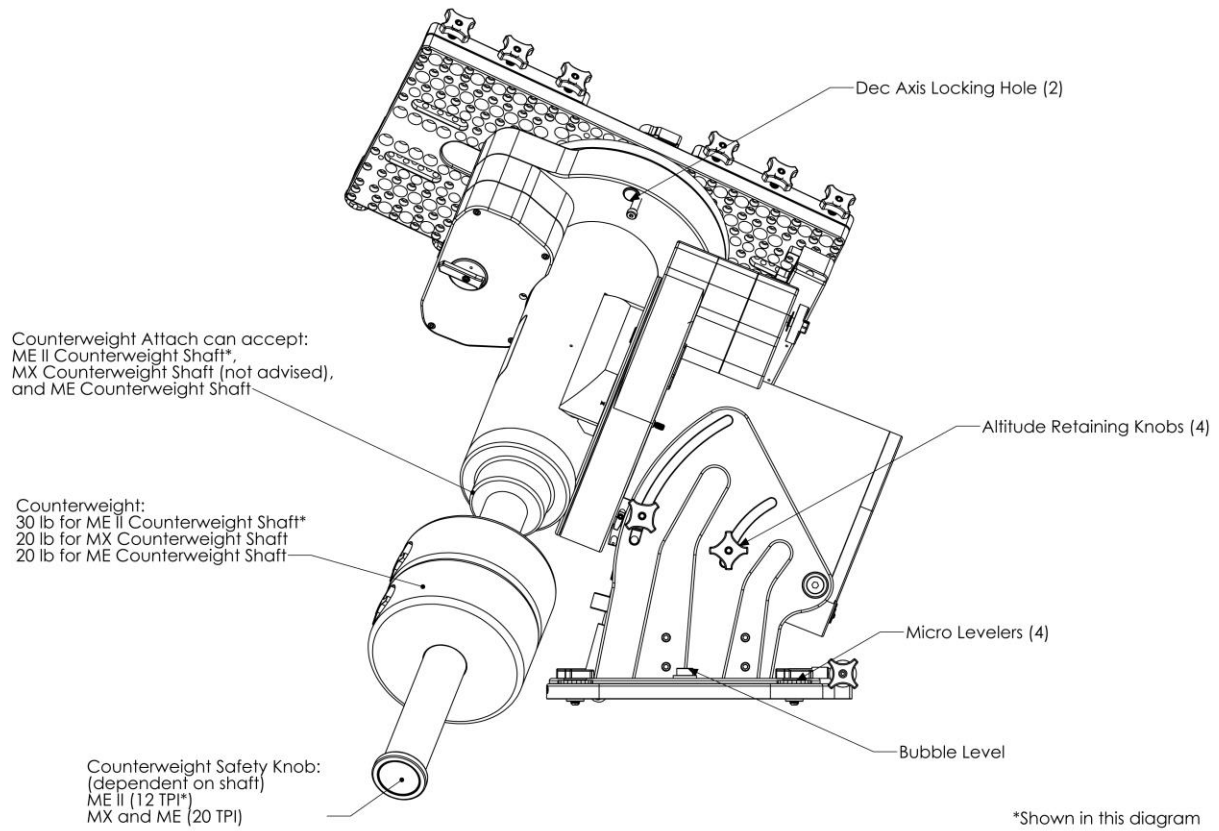


Figure 40: Paramount ME II side view.

Paramount MX Side View

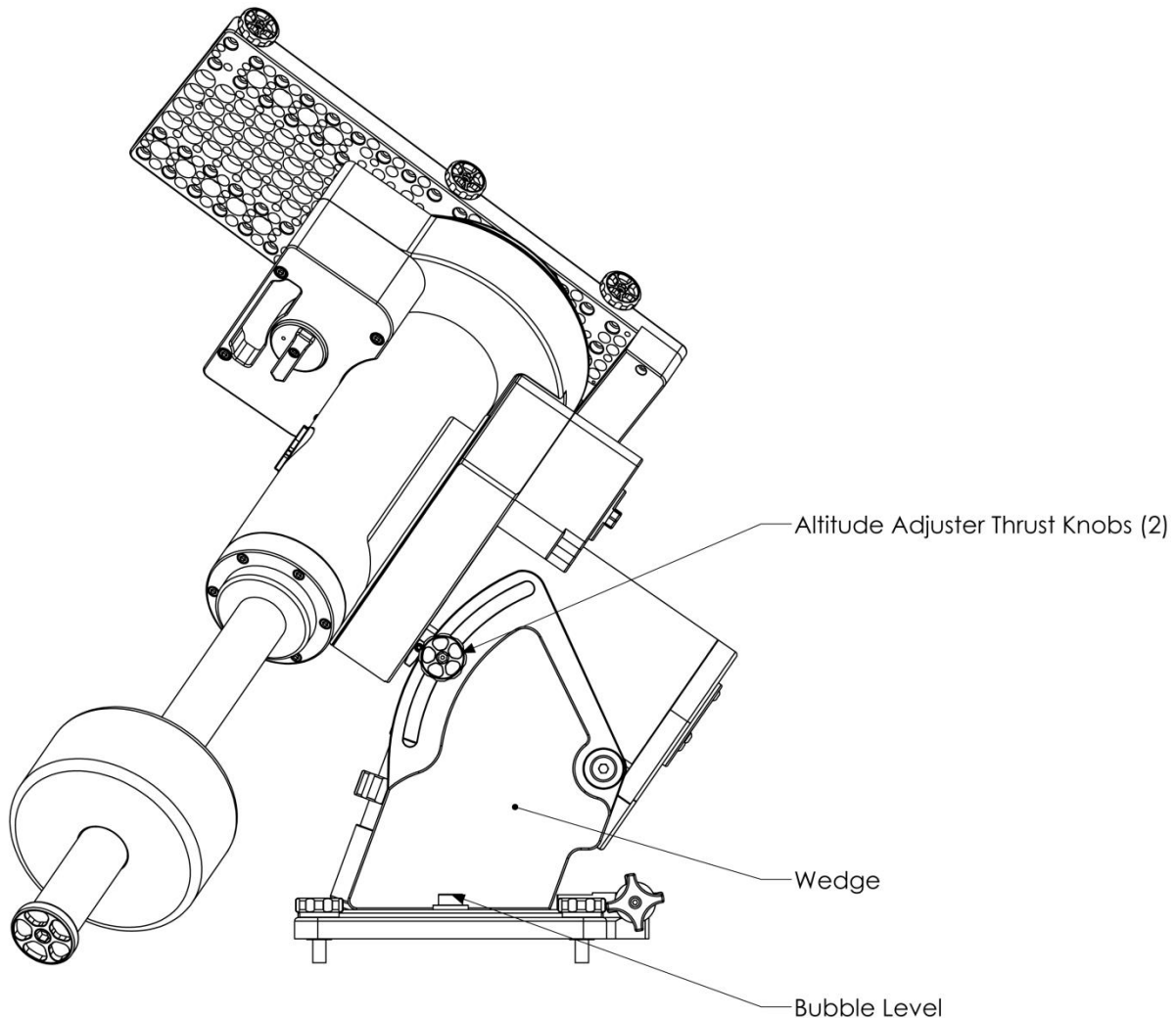


Figure 41: Paramount MX side view.

Altitude Adjuster Thrust Knobs



The Altitude Adjuster Thrust Knobs are designed to lock the altitude component of mount's polar axis in place, without changing the position of the azimuth axis. (Adjusting either axis during polar alignment for many commercial mounts can be a frustrating trial and error process when trying to clamp down on one axis actually moves the position of the other.)

Make sure to completely loosen each knob (four on the Paramount ME II and two on the Paramount MX) before attempting to rotate the Altitude Adjuster.

Wedge

The integrated Paramount wedge allows the altitude of the mount's polar axis to be adjusted to match the celestial pole. The table below shows the minimum and maximum elevation for each model.

Software Bisque manufactures and sells a Paramount Latitude Adjustment wedges if astronomy takes you outside these latitudes.

| Model | Minimum and Maximum Altitude of Wedge |
|---|---|
|  | 14° – 68° URL for Latitude Adjustment Wedge (for latitudes outside this range): https://www.bisque.com/sc/shops/store/Latitude-Adjustment-Wedge.aspx |
|  | 10° – 65° URL for Latitude Adjustment Wedge (for latitudes outside this range): http://www.bisque.com/sc/shops/store/MXLatitudeAdjustmentWedge.aspx |

Bubble Level

The Paramount bubble level is suitable for the most demanding astronomy work, and can make polar alignment easier when no polar alignment scope is available.



Figure 42: Center the bubble in the black ring for best results.

One-tenth of one inch motion in the level bubble's level equates to 45 arcminutes of angular "tilt." Positioning the bubble in the center of the black ring means the mount is level to within 5 arcminutes.

Remember, the base of a German equatorial mount does not *have to be* perfectly level to achieve precision tracking. As an extreme example, provided the equatorial axis is pointed to the refracted celestial pole, the base of a GEM can be vertical and still track at the sidereal rate.

Using the quick polar alignment method (page 86), when the base of the mount is close to horizontal, adjustments in the height of the altitude axis do not have a significant horizontal component. Likewise, adjustments to the azimuth axis do not have a significant vertical component, so the accuracy of the

initial polar alignment is improved. The polar alignment advice offered by TPoint's Polar Alignment Report can be used with greater confidence as well.

If the mount's base is not close to horizontal, adjusting one axis pollutes the position of the other axis and makes the process of polar alignment more difficult.

Declination Axis Locking Hole (ME II Only)

The Paramount ME II's declination axis can be locked into position by screwing two shoulder bolts (supplied with mount) into these holes.



When installed, the right ascension and declination axis locking bolts are designed to prevent the axis from rotating during shipment and while adding payload. As a best practice, always try to maintain a balanced payload, even when mounting equipment.

The shoulder bolts are not designed to carry the mount's entire payload. If you mount an excessively unbalanced payload on the declination axis, for example, you run the risk of bending one or both of the bolts, making removal difficult.

The specifications for right ascension axis locking shoulder bolt are:

- 18-8 stainless steel shoulder screw
- 5/16-in. shoulder diameter
- 2-1/4-in. long shoulder
- 1/4 in.-20 thread

The declination axis locking shoulder bolt has the same specifications, but is 1-3/4-in. long.

Micro Levelers (ME II Only)

The Paramount ME II 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 following section before continuing.

Adjusting the Micro-Levelers

The Paramount ME II'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 to ensure that the base plate of the Paramount ME II 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 Leveler Note" below for more information.

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.

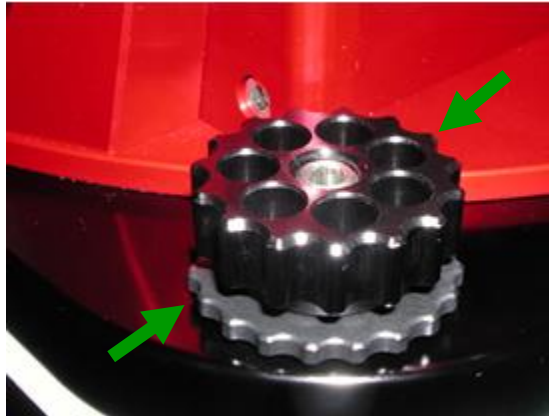


Figure 43: Micro-Leveler (lower left arrow) and Base Plate Attachment Knob (upper right arrow).



Critical Micro Leveler Note

The Micro-Levelers and Base Plate Attachment Knobs both serve different purposes. The Micro-Levelers stabilize and level the Base Plate on the mounting surface.

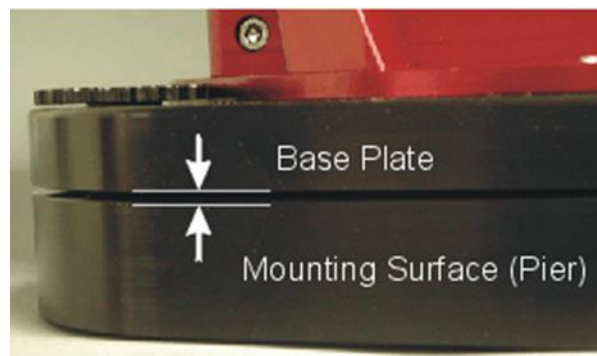


Figure 44: Adjusting Micro-Levelers.

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* against the surface of the Base Plate. In other words, 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).

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.

Hand Controller

The Paramount includes a hand controller that can be used to slew and home the mount without the need of *TheSkyX Professional* Edition, as well as turn on mount lighting and an integrated LED flashlight.

To use the joystick, plug the RJ12 phone-type connector on the end of the hand controller's 15-foot coiled cable into the Joystick port on the Electronics Box (page 62). The hand controller includes an integrated mini joystick and a large five position rate switch that allows single-handed slews and slew rate control. Double-tap the joystick to optionally issue the **Find Home** command (no external software required).



Figure 45: The Paramount hand controller.

The three position rocker switch located on the side of the hand paddle turns the mount's lighting features on or off.

- Rock and click the switch downward (toward the bottom of the hand paddle) to turn on and illuminate the bright red LED located on the top of the housing. The hand paddle now acts as a night-vision preserving flashlight. Return the switch to the center position to turn the LED off.
- Rock the switch upward (toward the top of the hand paddle) to turn on several bright LEDs that are located in the Electronics Box and Instrument Panel. The “landing lights” are handy to illuminate your working area when setting up, during polar alignment or shutting down for the night. When released, the switch automatically returns to the center position and does not stay in the forward position. (Note that a Paramount ME equipped with the MKS 4000 control system does not have landing lights.)
- Press and hold the switch upward to turn on the LED flashlight (while the switch is held in the forward position) and the landing lights simultaneously.

The large cable loop on the top of the hand controller can be used to hang it in a convenient location when not in use.

Slew Rate Switch

The slew rate switch can be adjusted to five positions. Positions 1-4 are labeled on the hand paddle cover and by default the higher the number, the faster the rate. Rotating this switch counterclockwise to the unmarked position disables slewing via the joystick. The default slew rates are shown below.

| Switch Position | Default Slew Rate (x Sidereal) |
|---------------------------------------|--------------------------------|
| Fully counterclockwise (unlabeled) | 0x* |
| 1 | 0.33x |
| 2 | 3x |
| 3 | 600x |
| 4 | 1200x |

* The slew rate for this position cannot be changed.

The rates for slew rate switch positions 1-4 can be configured when the hand controller is plugged into the MKS 5000 control system. See “Hand Controller Settings” on page 134 for information how to do so.



The hand controller is compatible with the Paramount ME (specifically, MKS 4000 control systems using firmware version 2.8.6 or later). However, the hand controller’s slew rates are not configurable when used in conjunction with the MKS 4000. In other words, the default slew rates are configurable only via the MKS 5000 control system.

Other Paramount Accessories

USB 2.0 Cable

The USB 2.0 cable has a Mini-B USB style plug that plugs into USB port on the Electronics Box and a standard USB-A plug that plugs into the PC.

Hex Wrenches

The Paramount MX comes with a set of standard Imperial-size hex wrenches that can be used to tighten the Versa-Plate knobs (page 52), add or remove the polar alignment scope (page 64), loosen the base (page 67) or altitude adjuster thrust knobs (80), and other common setup tasks.

Power Supply Unit (PSU)

The Paramount power supply unit is compatible with either +120 or +240V power sources and includes a NEMA 5-style three pronged connector. Country-specific power plugs can be purchased at many hardware or electronics shops. The table below shows the PSU specifications for each model.

| Model | Power output (max) | Input | Output |
|-------|--------------------|---------------------------|----------------|
| MEII | 221W | 100-240VAC 50/60 Hz 4.0A | 48V 4.6A max. |
| MX | 80W | 100-240VAC ~47-63 Hz 1.9A | 48V 1.66A max. |

Altitude Adjuster Wrench (ME II Only)

The Paramount ME II includes a removable Altitude Adjuster Wrench that makes rotating the Altitude Adjuster Knob easy, even with the heaviest payloads.

The circular section of this wrench fits over the Altitude Adjuster Knob and will drop into place on the top of the knob when the wrench and knob tics are aligned. Once seated, you can rotate the knob using the increased leverage from the protruding arms to make polar axis elevation adjustments.

How To Polar Align

Once the Paramount has been securely mounted to the pier or tripod, the next step is to align the mount's polar axis with the celestial pole. Make sure to review "Polar Alignment" on page 18 for an explanation why polar alignment is so critical for an equatorial mount.

Software Bisque recommends starting with the quick polar alignment method, then using either the polar alignment 'scope or TPoint to refine the alignment. If a different polar alignment technique works for you, by all means, use it!

Quick Polar Alignment Method

When the base of the Paramount is level, the fixed mechanical orientation of the mount's home position can be leveraged in conjunction with *TheSkyX Professional Edition* to help align the altitude axis to within about five arcminutes of celestial pole (which is a good *starting point*).

When the Paramount is positioned at the home position, the mount's mechanical orientation and position is always identical (to about one arcsecond or so). In the northern hemisphere, this position is very near hour angle 2.0 and declination 0.0. For a mechanically perfect imaging system, the telescope

would be pointing to a position on the celestial sphere that is exactly two hours west of the meridian on the celestial equator.

Provided the base of the mount is close to horizontal, and the altitude of the polar axis closely matches the observing site's latitude, *TheSkyX Professional Edition* (and accurate location, date, time and time zone settings) can be used to slew the mount to the *computed* position of an object (usually a star or other bright object) on the celestial sphere.

Once the telescope has been slewed to the object, the mount's ***mechanical azimuth axis*** (not the telescope's position) can be adjusted until the bright object is centered in the eyepiece. This technique relies on the uses the home position and the computed equatorial coordinates of an object to approximately align the mount's polar axis to the celestial pole.

The quick polar alignment method can be performed during the daylight hours by slewing to a planet, bright star or even the sun (provided the proper solar filters are used). Another advantage to this technique is that the celestial pole need not be visible.

Note that while the home position is mechanically fixed, the telescope itself will not necessarily precisely point to hour angle 2.0000 and declination 0.0000. This is in part due to slight variations in the position of the emitter-detector pair in the home sensors, as well as optical and mechanical non-perpendicularities. For this reason, the quick polar alignment method should be deemed a "good" but not "precise" polar alignment technique.

After performing a quick polar alignment, TPoint or the polar alignment scope can be used to further refine polar alignment.

Step-By-Step Quick Polar Alignment Procedure

For portable setups, provided the telescope is mounted on the Versa-Plate consistently, the quick polar alignment procedure can produce fairly accurate and repeatable polar alignment.

Step 1 Use the bubble level (page 81) to level the base of the mount.

For German equatorial mounts in general, the base of the mount does not need to be "perfectly level" to achieve extremely precise pointing and tracking. However, to get the optimal polar alignment using the quick polar alignment procedure, the base of the mount should be within one degree or so of horizontal.

Step 2 Adjust the height of Paramount's altitude axis to match the latitude of your observing site.

See "Altitude Adjuster" on page 72 for details about how to adjust the altitude of the polar axis. Use a GPS or your favorite Earth-based mapping software to determine the latitude of your observing site.

Remember, when the mount is level, and the elevation of the polar axis is set to the

site's latitude, then the only remaining "unknown" in the polar alignment equation is the azimuth adjustment.

Step 3 *Adjust the azimuth axis as close to the celestial pole as possible.*

Finding true north (or south) any at observing site can be tricky. If you do not have the aid of a polar alignment scope, or the pole is not currently visible, one sure-fire method is to use a shadow cast by the transiting sun.

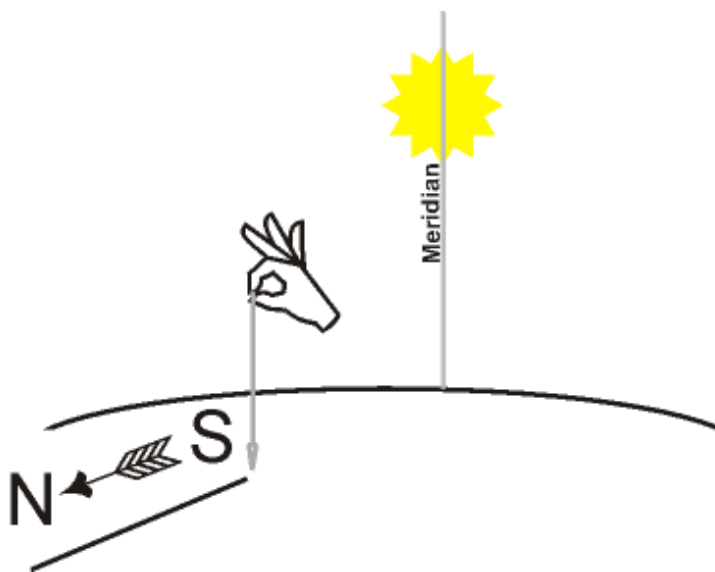


Figure 46: Using the Sun's shadow and *TheSkyX* to locate true north or south.

The sun's shadow points due north (or south in the southern hemisphere) when it crosses the meridian, or transits. Click on the sun in *TheSkyX Professional Edition* to determine its transit time for today (the sun's transit time varies throughout the year). The shadow cast by a plumb bob or other vertical object defines true north at the Sun's transit time.

See "Polar Axis Adjustments" on page 65 for details how to adjust the azimuth of the polar axis.

Step 4 *Verify *TheSkyX Professional Edition* is correctly configured for the observing site's date, time, location and time zone.*

- Double-check the settings on the **Custom** tab of the **Location** window.
- If an Internet connection is available, choose the **Verify *TheSkyX Time*** command on the **Tools** menu to confirm *TheSkyX Professional Edition* is configured correctly.

Step 5 *Choose the **Find Home** command on the **Start Up** pop-up menu from the Telescope*

window.

The mount will slew to the fixed, mechanical home position.

Step 6 Clear the existing synchronization.

See “Starting Synchronization Over” on page 27 for the step-by-step procedure to clear the existing synchronization.



The Paramount does *not* have to be synchronized during the quick polar alignment procedure.

After the Paramount has been successfully homed, the control system now “thinks” the optical tube is pointing to a position on the celestial sphere that corresponds to the mechanical home position (page 18). Normally at this stage, you would synchronize the mount (page 23) to define the offset between the absolute home position and the relative home position (page 123).

Step 7 Using TheSkyX Professional Edition as the mount controller (not the joystick), click on and slew to a bright star or planet.



Technically, the object should be within 5 degrees of the pole, or, below the pole and within 5 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.

After slewing the mount to the *computed position* of the star (that is, where the mount would slew if the polar axis was aligned with the pole) the **azimuth** of the mount’s polar axis can be adjusted until the bright object is centered in the field of view.

From this point on, *do not use the hand controller or TheSkyX Professional Edition* to slew the mount.

Step 8 Using the mount’s mechanical Azimuth Adjuster, rotate the base of the mount until

the object is centered in the telescope's field of view.

Do not use any other method to adjust the position of the mount, including the joystick on the hand controller or TheSkyX Professional Edition's Move To or Slew commands.

Remember, the mount and control system are pointing to the equatorial coordinate where the object "would be" if the mount is aligned with the pole.

Once the object is centered on the eyepiece, the mount's polar axis should be within about five arcminutes of the pole. You might want to repeat the above procedure just to make sure you have done everything right.

After adjusting the mechanical axis to center the object in the eyepiece, synchronize on the object from *TheSkyX Professional Edition*. From here, slewing to a star from *TheSkyX Professional Edition* should now place the object in an eyepiece that produces a moderate sized field of view.

Note that the above advice contradicts the "Best Synchronization Practices" described on page 24. However, the Quick Polar Alignment Procedure is intended to *approximately* align the mount's polar axis with the celestial pole, only. If, at the end of the Quick Polar Alignment Procedure, Polaris, or another high-declination star happens to be centered in the eyepiece go ahead and sync on it. From there, try slewing to stars at lower declinations. If the mount is close to the pole, stars should fall in the eyepiece.

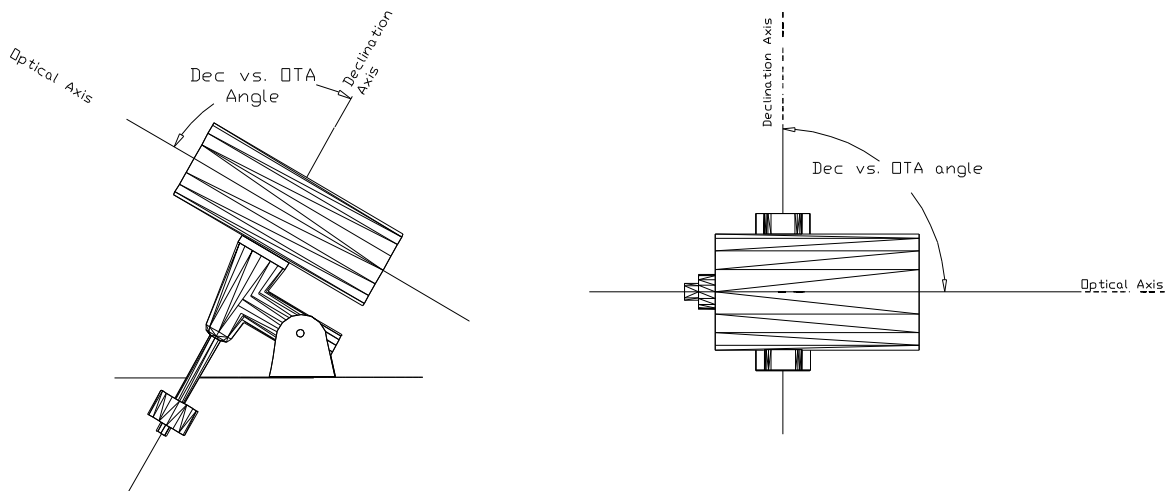


Figure 47: The OTA's optical and mechanical non-perpendicularity errors degrade the accuracy of the quick polar alignment method.

Note that optical and mechanical non-perpendicularities in the telescope and the declination axis play a key factor in the accuracy of the quick polar alignment procedure. If these misalignments are large (in the order of 30 arcminutes or greater), the initial polar alignment will necessarily not be as accurate.

Precise Polar Alignment

The mount's equatorial axis should be aligned to within 100 arcseconds of the refracted pole for optimal tracking performance. Software Bisque recommends using the TPoint Add On's Polar Alignment Report or the Paramount polar alignment scope to align the mount with the celestial pole.

Using TPoint for Precise Polar Alignment

The *TPoint Add On* window includes a **Polar Alignment Report** that quantifies the mount's polar alignment derived from pointing calibration data via the Super Model command. The report also shows the amount of adjustment required in each axis to align polar axis to the *refracted* pole.

If you are not familiar with TPoint, pointing calibration, Super Model, or the **Polar Alignment Report**, please refer to the *TPoint Add On* User Guide for more information. This document can be viewed in PDF format by clicking the **TPoint Add On User Guide** command from TheSkyX Professional Edition's Help menu. Or, the latest revision can be downloaded from the Software Bisque web page by clicking **Downloads > Documentation > TheSkyX User Guides > TPoint Add On User Guide**. The URL to this document is: <http://www.bisque.com/sc/media/p/28065.aspx>

TPoint Polar Alignment Quick Start Guide

1. Use the "Quick Polar Alignment Method" (page 85) to align the mount close to the pole.
2. Follow the **Step by Step Automated Calibration** procedure described in the *TPoint Add On* User Guide. In Step B, part 1, when creating pointing calibration targets, adjust the **More/Fewer** slider until about 20 targets or so appear. The **Number** text box shows this value.
3. Turn on the **Randomize** checkbox.
4. Continue following Step B part 2 to collect the calibration targets and close the Automated Pointing Calibration Run window.
5. Once the calibration targets have been collected, click the **Super Model** button on the **Model** tab of the *TPoint Add On* window. This lets TPoint analyze the pointing data to determine, among other errors, the polar alignment errors.
6. Click the **Polar Alignment** tab and carefully review the contents of the **Polar Alignment Report**.
7. Make the recommended adjustments to the mount's altitude and azimuth axis.
8. Repeat steps 1-8 until the report shows that the polar alignment is good enough or excellent and no other adjustments are necessary.

Using the Polar Alignment Scope

After mounting the polar alignment scope to the front of Paramount (page 64), follow the manufacturer's instructions to calibrate the scope, and then place Polaris in the polar scope's reticle.

The Paramount and TheSkyX Professional Edition

The Paramount ME II, Paramount ME and Paramount MX Robotic Telescope Mounts utilize the *Bisque Telescope Control System* (Bisque TCS) featuring the MKS Series dual axis motion controller electronics. This control system provides ultra-precise pointing and tracking, configurable software slew limits, current limited motor shut down, auto homing, high frequency position monitoring, and much more.

The version of the Bisque TCS that came with your Paramount depends on the model and date of purchase:

- The MKS 5000 is included with the Paramount ME II, Paramount MX, and Bisque TCS units shipped after December 2012. (An optional MKS 5000 upgrade is planned for Paramount ME mounts at some point in the future.)
- The MKS 4000 is included with all Paramount ME mounts from 2003 through May 2012 (when production of this model ended).
- The MKS 3200 was included with Paramount ME mounts from 2002-2003.
- The MKS 3000 was included with Paramount GT-1100S mounts from 1999-2002.

See the Paramount ME User Guide for details on the MKS 4000 and earlier control systems.

Paramount Minimum System Requirements

The Paramount requires the following minimum hardware and software to operate:

- A Mac or Windows computer with *TheSkyX Professional Edition* installed. See *TheSkyX Professional and Serious Astronomer Edition User Guide* for minimum hardware requirements.
- One free USB port on the computer. The MKS 5000 communication port uses a USB 2.0 hardware interface.
- One USB 2.0 cable (included). Optional USB cable extenders can be used to allow the length of the USB cable to be increased to 30 m or so. If the distance between the computer and mount is greater than 30 m, consider using a high-quality USB Ethernet Extender.



The Paramount's USB 2.0 port and the USB 2.0 hub on the Instrument Panel have been tested extensively with many common commercial cameras and other USB-based astronomical devices on Mac and Windows operating systems. Using a 15-foot USB cable between the computer and the mount, both the USB port and the USB hub are extremely reliable and provide consistent hardware to software communications.

Extending the length of the USB cable between the mount and computer using inexpensive USB cable extenders, or plugging in a second, inexpensive USB hub to the USB 2.0 hub on the Instrument Panel will, most likely, introduce inconsistent and unreliable communication between either the mount or the camera or other

USB device. See “Longer USB Cable Runs” on page 138 for more information on this topic.

- One Paramount power supply (included).

-Or-

- An optional 48V *Paramount ME II/MX Portable Power Supply*. This battery comes in 5AH and 10AH models and can be purchased from the Software Bisque Store.

First Time Paramount Setup

Please make sure to carefully read the instructional insert in the Paramount box before unpacking the mount.

After the Paramount has been unboxed and safely mounted to your tripod or pier, the next step is to connect the power and communication cables to the Electronics Box so that mount can be turned on.

1. Plug the round end of the Paramount power cable into the port labeled *48V Power In* on the Electronics Box and the other into an electric outlet.
2. Plug the mini USB end of the USB 2.0 cable into the Electronics Box port labeled USB and the other end into a free USB port on the computer.
3. Flip the On/Off switch up to the on position.

When the Paramount is turned on, three LEDs on the Electronics Box are illuminated and a short “whistle” is emitted to indicate the control system has been successfully initialized. (The LEDs labeled RA and Dec are orange; LED labeled TCS varies from blue to purple). Two successive beeps are emitted shortly afterward indicating the servomotors have been initialized.

An example audio clip for a successful startup is available here:

<http://www.bisque.com/sc/media/p/50821.aspx>



Exactly *when* the two beeps occur may be *different for each mount* and will *vary depending on the mount's current mechanical orientation*. The beeps may even occur simultaneously so that only a single beep is audible.

If the LEDs on the Electronics Box are illuminated, and the mount homes, the control system is functioning normally.

Paramount USB Driver Installation

Before attempting to control the Paramount from *TheSkyX Professional Edition*, make sure to install the necessary drivers for your operating system.

Mac OS X

Software drivers need *not* be installed to operate the Paramount on the Mac. Plug the USB cable into the mount and into one of the computer's USB ports then follow the instructions below to configure *TheSkyX Professional Edition* for Mac.

Windows

The Software Bisque MKS 5000 USB driver must be installed before the Paramount can be operated by *TheSkyX Professional Edition* for Windows (both 32- and 64-bit Editions). See "Appendix A: Installing the MKS 5000 USB Windows Driver" on page 140 for step by step installation instructions.

Controlling the Paramount with TheSkyX Professional Edition

After installing the MKS 5000 driver (Windows only), and plugging the USB 2.0 cable into the mount and computer, you must configure *TheSkyX Professional Edition* to control the *Paramount*.

1. Make sure the mount is turned on so that the computer recognizes the Paramount USB port.



The Paramount must be turned on before the operating system will recognize the built-in USB port on the Electronics Box.

2. From *TheSkyX Professional Edition*, choose the **Telescope Setup** command from the **Telescope** menu.
3. On the **Imaging System Setup** window, highlight **Mount** in the **Imaging System** list.
4. Select the **Choose** command from the **Mount Setup** pop-up menu.
5. Expand **Software Bisque**, select **Paramount ME II** or **Paramount MX** and click **OK**.
6. Choose the **Settings** command from the **Mount Setup** pop-up menu.



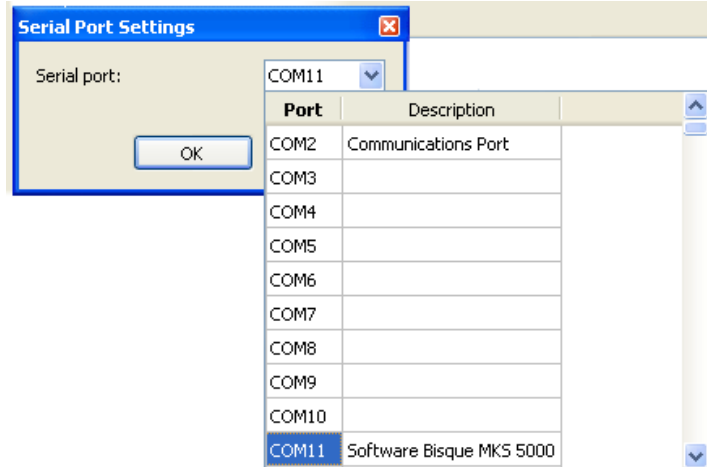
On the Mac, the Paramount control system name is "usbmodem" with a "numerical identifier" (see Figure 48). The numerical identifier in the name varies depending on which version of Mac OS X is installed.



Figure 48: The Mac Serial Device Settings window.



On Windows, select the COM port number assigned to the Paramount MX's USB port (see page 141 for details about installing the MKS 5000 driver) and click **OK**. The **Description** of the **Port** in the **Serial Port** list will appear as **Software Bisque MKS 5000**.



- Click the **Connect** command from the **Telescope** menu and then click the **Close** button on the **Imaging System Setup** window.
- The **Telescope** window's **Status** text shows the current state of the mount.

Getting Started with TheSkyX Professional Edition

If you are not familiar with *TheSkyX Professional Edition's* basic telescope controls, please refer to *TheSkyX Professional Edition User Guide* for details about basic mount control features, including:

| Feature | Quick Start Reference |
|--|---|
| Adding <i>TPoint Add On</i> Pointing Samples | Add Pointing Sample button on the Telescope window |
| Centering the Telescope Cross Hairs | Center Cross Hairs button on the Telescope window |
| Clearing the Park Position | Clear Park Position command from the Shut Down pop-up menu on the Telescope window. |
| Connecting, Disconnecting the Mount | Connect, Disconnect commands from the Telescope menu |
| Finding Home | Find Home command from the Start Up pop-up menu on the Telescope window or double-tap the joystick |
| Mount Status | Shown on Telescope window |
| Moving or Jogging the Mount | Move/Jog controls on the Telescope window |

| Feature | Quick Start Reference |
|--------------------------------------|---|
| Parking | Park command from the Shut Down pop-up menu on the Telescope window |
| Setting the Park Position | Set Park Position command from the Shut Down pop-up menu on the Telescope window |
| Slewing | Slew button on the Telescope window |
| Star Searching | Star Search command from the Tools pop-up menu on the Telescope window |
| Star Synchronization | Synchronize command from the Start Up pop-up menu on the Telescope window |
| Telescope Configuration | Telescope Setup command from the Telescope menu |
| Tracking Spacecraft | Track Satellite button on the Telescope window |
| Tracking Stars, Comets, or Asteroids | Set Track Rates button on the Telescope window |
| Turning Sidereal Tracking On | Turn Sidereal Tracking On command from the Tools pop-up menu on the Telescope window |
| Turning Tracking Off | Turn Tracking Off command from the Tools pop-up menu on the Telescope window |
| Unparking | Unpark command from the Shut Down pop-up menu on the Telescope window |
| Virtual Mount | Virtual Mount command from the Tools pop-up menu on the Telescope window |

The Bisque TCS Window

The **Bisque TCS** window can be used to set every Bisque TCS parameter directly from *TheSkyX Professional Edition*. Earlier versions of *TheSky* required a separate application to view and configure advanced settings.

The **Bisque TCS** window also allows saving and restoring the mount's current firmware settings, provides advanced periodic error correction curve fitting, shows mount status, synchronization history and offers many other useful tools for monitoring the mount's status and providing troubleshooting information.

To view the **Bisque TCS** window, connect to the mount by choosing the **Connect** command from the **Telescope** menu. Next, choose the **Bisque TCS** command from the **Tools** pop-up button on the

Telescope window. If the **Telescope** window is hidden, click the **Telescope** command from the **Display** menu to show it.

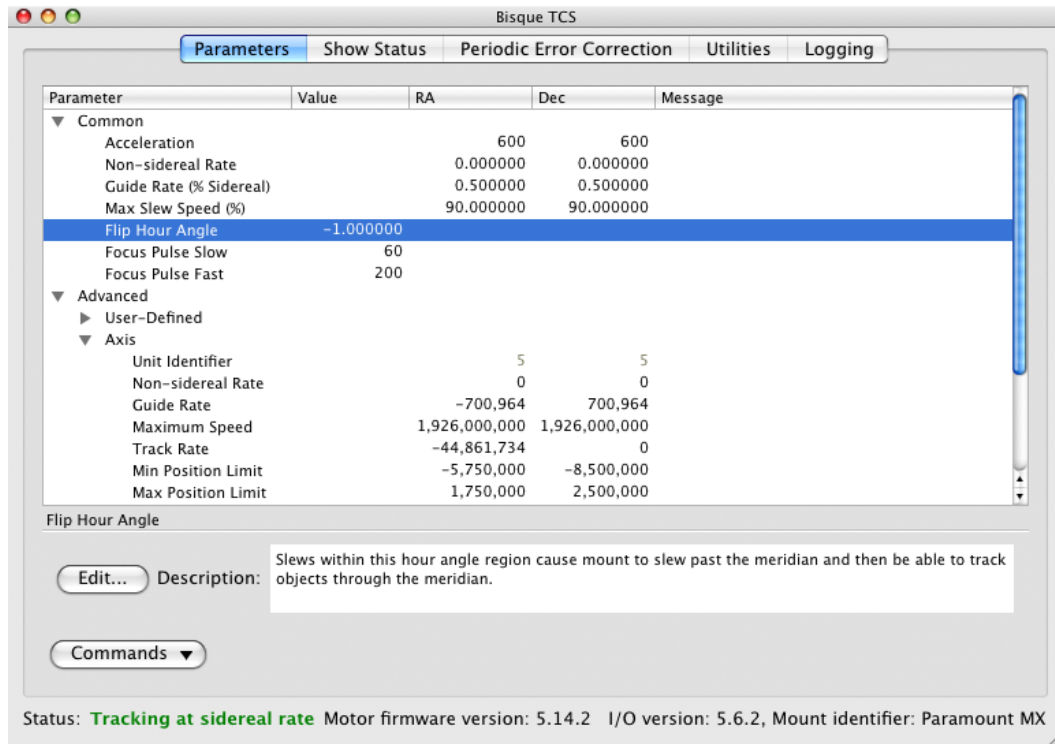


Figure 49: The Parameters tab of the Bisque TCS window.

The **Bisque TCS** window includes the **Parameters**, **Show Status**, **Periodic Error Correction**, **Utilities** and **Logging** tabs.

Status Messages (Status Text)

The always visible **Status** message on the bottom of the window shows color-coded text about the mount's current state. (Mount status messages are repeated on the **Telescope** window.) See "Mount and Status" in *TheSkyX Professional Edition User Guide's* Telescope documentation for a detailed explanation of each status message.

Firmware Version and Mount Identifier

The bottom right side of the Bisque TCS window shows the current firmware version of the Bisque TCS, as well as the mount identifier: *Paramount MEII*, *Paramount ME*, *Paramount MX*, or *Bisque TCS*.

Parameters Tab

The **Parameters** tab shows the various Bisque TCS settings that can be modified. Parameters are divided into **Common** and **Advanced** categories. The common parameters, such as the mount's acceleration, are often modified based on your mount's payload or other personal preferences (For example, you

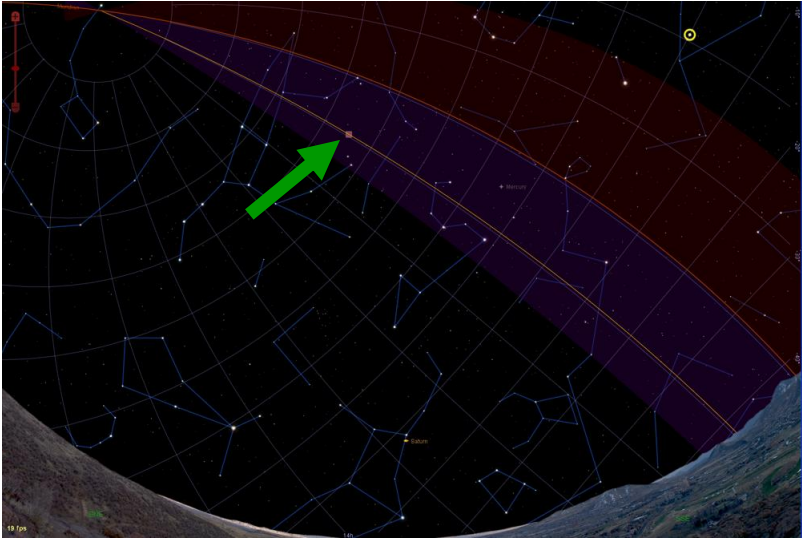
might want to lower the maximum slew rate because, “I don’t want my expensive equipment slewing around so fast!”)

Advanced settings are mount-specific control system configuration options that are used for custom (non-Paramount) mounts. Most advanced parameters **should not be modified for Paramount ME or Paramount MX mounts**. Each parameter is displayed in the **Description** text box at the boom of the window. Click the parameter’s name in the tree list to view its current value. Click the **Edit** button to change the value for this parameter; altered parameters appear in red text.

Common Parameters

The most commonly changed Bisque TCS parameters are described below.

| Common Parameter Name | Description |
|--------------------------------|--|
| Acceleration | The motor's relative acceleration/deceleration setting. Lower numbers (for example, 250) yield slower acceleration and deceleration while higher numbers (for example, 750) yield faster acceleration and deceleration. |
| Non-sidereal Rate | <p>The non-sidereal rate, in arcseconds per second, is the rate added to or subtracted from the sidereal tracking rate.</p> <p>Although this rate can be set manually, <i>TheSkyX Professional Edition</i> can set the rate automatically. See the Set Track Rates button documentation for details how to do this.</p> |
| Guide Rate (% Sidereal) | <p>When the Bisque TCS guiding lines are activated, the increase or decrease in control system’s position occurs at this rate.</p> <p>The general rule of thumb is that the fewer number of corrections to the mount’s position that are made during autoguided exposures the better the resulting star profile. So, a the guide rate of fifty-percent of sidereal rate (the default setting) is the optimal value to achieve this goal.</p> |
| Max Slew Speed (%) | <p>The percentage of the mount's maximum slew rate that is used when slewing the mount. The default 90 percent.</p> <ul style="list-style-type: none"> • The Paramount ME’s maximum slew rate in right ascension is 3.5 degrees per second and 5 degrees per second in declination, so the maximum default slew rate is approximately 3.2 and 4.5 degrees per second. • The Paramount ME II’s maximum slew rate is over 4 degrees per second in both axes. |

| Common Parameter Name | Description |
|-----------------------------|--|
| | <ul style="list-style-type: none"> The Paramount MX's maximum slew rate in both right ascension and declination is 4 degrees per second. The default maximum slew rate in both axes is 3.6 degrees per second. |
| Flip Hour Angle (HA) | <p>Slews within this hour angle region (expressed in decimal hours) cause mount to slew past the meridian and then track through the meridian.</p> <p>Configuring Flip Hour Angle Graphically</p> <p>When <i>TheSkyX Professional Edition</i> connects to the Paramount, the current flip hour angle is represented on the Sky Chart as an orange line drawn from the horizon to 90 degrees declination.</p>  <p>Figure 50: The orange line on the Sky Chart represents the current flip hour angle.</p> <p>To dynamically change the flip hour angle, click and drag the orange “dragger” square on the flip hour angle line (see the green arrow on Figure 50).</p> <p>The mount will perform a meridian flip when it is slewed to an object on the “opposite” side of this line.</p> <p>The default value of this parameter is minus 1.0 (–1.0) for the Paramount MX and minus 0.3 (–0.3) for the Paramount ME and minus 3.0 (–3.0) for the Paramount ME II.</p> |
| Focus Pulse Slow | The number of milliseconds the built in focuser will be pulsed when the SLOW focus button is pressed. |

| Common Parameter Name | Description |
|-------------------------|---|
| Focus Pulse Fast | The number of milliseconds the built in focuser will be pulsed when the FAST focus button is pressed. |

Advanced Parameters

Advanced parameters are divided into the following categories:

- Axis
- Homing
- Initialization
- Motor Parameters
- Periodic Error Correction
- System
- User-Defined

Most advanced parameters should not need to be changed unless you are using the Bisque TCS on a custom mounting. You may wish to change certain parameters, such as the maximum slew rate, based on the mount's payload or to suit your personal preferences.

| Axis Parameters | Description |
|--------------------------|--|
| Unit Identifier | This number relates to the TCS version and cannot be changed. |
| Non-sidereal Rate | <p>The non-sidereal rate, in arcseconds per second, is the rate added to or subtracted from the sidereal tracking rate.</p> <p>Although this rate can be set manually, <i>TheSkyX Professional Edition</i> can perform this automatically. See the Set Track Rates button documentation for details how to do this.</p> |
| Guide Rate | <p>When the Bisque TCS guiding lines are activated, the increase or decrease in control system's position occurs at this rate.</p> <p>The general rule of thumb is that the fewer number of corrections to the mount's position that are made during autoguided exposures the better the resulting star profile. So, a guide rate of fifty-percent of sidereal rate (the default setting) is the optimal value to achieve this goal.</p> |
| Maximum Speed (%) | The percentage of the mount's maximum slew rate that is used to slew the mount. |
| Track Rate | The sidereal tracking rate in control system tracking units. |

| Axis Parameters | Description |
|--------------------------------------|--|
| Min Position Limit | The Bisque TCS will not drive the motors beyond this minimum limit (decelerating stop). |
| Max Position Limit | The Bisque TCS will not drive the motors beyond this maximum limit (decelerating stop). |
| Joystick Center | The calibrated center position of the joystick. |
| Homing Parameters | |
| Relative Home Sensor Position | <p>The <i>relative</i> home sensor position is computed using both the mount's fixed homing sensor location and the equatorial coordinates supplied to <i>TheSkyX Professional Edition</i> when the mount was synchronized on a star.</p> <p>For a perfect mount that has no optical or mechanical misalignments, mechanical flexures or polar alignment errors, the relative home position would identically match the absolute mechanical home position. This is never the case. Misalignments in the mount's mechanical axis and the telescope's optical axis, for example, always introduce telescope pointing errors so there will always be a difference between the relative and absolute home position after synchronization.</p> <p>When the mount is synchronized to a known star, the "relative location of the home position" changes based on the pointing error introduced by the mechanical and optical misalignments.</p> <p>When the relative and absolute home sensor positions are equal, it means the mount has not yet been synchronized on a star.</p> <p>After synchronizing the mount, choose the Get All Bisque TCS Parameters command from the Commands pop-up menu on the Parameters tab (see page 106) to retrieve the control system's current settings. Retrieving all the settings takes several seconds, so their values are not updated in "real time".</p> |
| Home Required? | If set to 1, homing is required before slewing will occur (as with the joystick, etc.). |
| Home Direction | Initial direction to slew when searching for the home position "interruptor" (that is, the physical component on the gear that blocks the optical path of the homing sensor to signal the homing position). |
| Home Sense | Specifies whether the control system is looking for line high versus line |

| Axis Parameters | Description |
|---|--|
| | low from the homing sensor. |
| Home Mode | 1 = None, 2 = One sensor. |
| Home In-Out-In | Always set to 1. |
| Home Velocity High | This is the rate at which the homing process begins looking for the home sensor. |
| Home Velocity Medium | After the first pass of the interruptor, the motor reverses direction and searches at this rate. |
| Home Velocity Low | After the second pass of the interruptor, the motor searches at this rate. |
| Home from Joystick? | When set to 0, double-tapping the joystick button will not find the home position. Set this value to 1 to allow homing with the joystick. |
| Absolute Home Sensor Position | <p>These values represent the coordinates of the home position based on the mount's mechanical homing sensor location.</p> <p>The Paramount ME, Paramount ME II, and Paramount MX's home position is hour angle (HA) 2.0 and declination 0.0 in the northern hemisphere and HA -2.0 and declination 0 when the mount is configured for the southern hemisphere (see "Hemisphere Setup" on page 122). These values cannot be changed.</p> |
| Initialization Parameters | |
| Focus Multiplier | A number between 1 and 100 that can be used to increase the mount's pulse focuser adjustment. The default value is 1. |
| Flip Hour Angle | See Flip Hour Angle on page 99 for a description of this parameter. |
| Temperature Slew Rate Reduction Percentage | Reduce the slew rate by this percentage when the ambient temperature drops below the <i>Temperature Slew Rate Threshold</i> value. |
| Temperature Slew Rate Threshold | When the ambient temperature, in Celcius, drops below this value, reduce the slew rate by the <i>Temperature Slew Rate Reduction Percentage</i> . |
| Kernel State | <p>The state of the ProTrack kernel.</p> <p>0 – Tracking adjustments off.</p> |

| Axis Parameters | Description |
|---|--|
| | 1 – Tracking adjustments on. See “Activating ProTrack” on page 136 for more information. |
| Call Level Logging | When turned on, all call level functions will be logged and displayed on the Logging window. |
| Packet Level Logging | When turned on, all packet level communications will be logged and displayed on the Logging window. |
| Focus Pulse Slow | The number of milliseconds the built in focuser is pulsed when the Slow focus button is clicked. |
| Focus Pulse Fast | The number of milliseconds the built in focuser is pulsed when the Fast focus button is clicked. |
| Home After Connect | If set to 1, the mount will be homed after connecting if it is not already homed. |
| Show Limits | If set to 1, the telescope limits will be drawn either side of the meridian. |
| Log Slews | If set to 1, slewing information will be logged and displayed on the Logging window. |
| Motor Parameters | |
| Index Angle | Both DC-Servo motors have a unique index angle, which is a number between 0 and 2000. A sticker is affixed to each motor with this number. |
| EMF Constant | This value is based on DC servo motor type and motor size. |
| Max Voltage | Always set to 15. |
| Max Gain | Always set to 150. |
| Max Position Error | The maximum number of encoder tics from target before the Bisque TCS aborts slewing or tracking and begins to emit position error beeps. |
| Periodic Error Correction Parameters | |
| PEC Motor to Worm Gear Ratio | Specifies the gear ratio between the motor and the worm gear. |
| PEC Cutoff Speed | Set to two times the sidereal rate, this insures periodic error correction is not applied to higher slew rates. Attempting to apply PEC at high slew |

| Axis Parameters | Description |
|---------------------------|---|
| | speed results in very labored sounding slews. |
| PEC Harmonics | The number of harmonics to use when TheSkyX computes optimal PEC curve. |
| PEC Ratio 1 | The first gear ratio between the motor and worm. |
| PEC Ratio 2 | The second gear ratio between the motor and worm. |
| PEC Ratio 3 | The third gear ratio between the motor and worm. |
| PEC Scale | The scale in arcseconds per pixel of the imaging system used to generate the PEC tracking log file. |
| PEC Teeth on Gear | <p>The number of teeth on the mount's main gear. This value defines the length of time for one revolution of the worm when the mount is tracking at the sidereal rate.</p> <ul style="list-style-type: none"> • The Paramount ME and Paramount ME II's right ascension gear has 576 teeth. Tracking at the sidereal rate, one revolution of the worm takes 149.6 seconds (2 minutes 29 seconds). • The Paramount MX right ascension and declination gears have 375 teeth. Tracking at the sidereal rate, one revolution of the worm takes about 230 seconds (3 minutes 50 seconds). |
| PEC Worm Periods | Number of worm revolutions to use in PEC curve determination. |
| System Parameters | |
| Mount Type | <p>Defines the physical telescope mounting type:</p> <p>0 = German Equatorial Mount (GEM).</p> <p>1 = Asymmetric equatorial fork mount.</p> |
| Sync Version | <p>0 = Paramount ME, Paramount ME II, Paramount MX and Bisque TCS mounts.</p> <p>1 = Paramount GT-1100S mount.</p> |
| User Space Version | Shows the current version for the format of the user-defined data that is saved to the control system's flash memory. |
| Focus Axis | MKS 3200. MKS 4000, MKS 5000 and later should be set to 1. Otherwise, |

| Axis Parameters | Description |
|-------------------------------------|---|
| | set this value to 0. |
| Mount Identifier | One of the following: <ul style="list-style-type: none"> • Paramount ME • Paramount ME II • Paramount MX • Bisque TCS |
| Debug Output? | Set this value to 1 to show control system diagnostics. |
| Startup Test Joystick RA | If set to 1, then Bisque TCS will abort startup and emit a single beep if the joystick is not centered when power is turned on. |
| Startup Test Joystick Dec | If set to 1, then Bisque TCS will abort startup and the control system's speaker will emit a single beep if the joystick is not centered when power is turned on. |
| Startup Test Joystick Button | If set to 1, then Bisque TCS will abort startup and the control system's speaker will emit a single beep if the joystick button is pressed when power is turned on. |
| Startup Test Guider | If set to 1, then Bisque TCS will abort startup and the control system's speaker will emit a single beep if any of the guider lines are high when power is turned on. |
| Play Guider Sound | If set to 1, the Bisque TCS speaker will emit a single "click" each time the guider state changes. |
| IR Enabled | If set to 1, then the infrared communications port is enabled (MKS 4000 only). |
| Hand controller rate 1 | Hand controller rate number 1. |
| Hand controller rate 2 | Hand controller rate number 2. |
| Hand controller rate 3 | Hand controller rate number 3. |
| Hand controller rate 4 | Hand controller rate number 4. |
| General Purpose I/O 1 | General purpose output direction 1. |
| General purpose I/O 2 | General purpose input/output toggle. |

| Axis Parameters | Description |
|--------------------------------------|---|
| General Purpose I/O 3 | General purpose output direction 2. |
| General purpose I/O 4 | General purpose input/output toggle. |
| User-Defined Parameters | |
| Acceleration | The motor's relative acceleration/deceleration setting. Lower numbers (for example, 250) will yield slow acceleration/deceleration while higher numbers (for example, 750) will yield very fast acceleration. |
| Max Slew Speed (%) | The percentage of the mount's maximum slew rate that is used to slew the mount. |
| Track Rate (% Sidereal) | The mount's tracking rate, based on the percentage of the sidereal rate. |
| Non-sidereal Rate | The non-sidereal tracking rate in arcseconds/second. |
| Guide Rate (% Sidereal) | See page 100 for a description of this parameter. |
| Tics/Revolution | <p>The total number of encoder tics per one complete revolution of the RA axis, computed by multiplying the gear ratio by 2000. For mounts located in the southern hemisphere, the RA value must be negative.</p> <p>See Hemisphere Setup in the Utilities Tab on page 122 for details about configuring the mount for the southern hemisphere.</p> |
| Relative Home Sensor Position | See page 101 for a description of this parameter. |

Commands Pop-up Menu

Use the **Commands** pop-up menu on the **Parameters** tab to retrieve the current settings from the Bisque TCS and to set the Bisque TCS settings.

Restore Defaults

Choose this command to display the **Restore Bisque TCS Defaults** window that can reset all the mount's parameters to default values. Note that the mount's synchronization history and periodic error correction table are preserved.

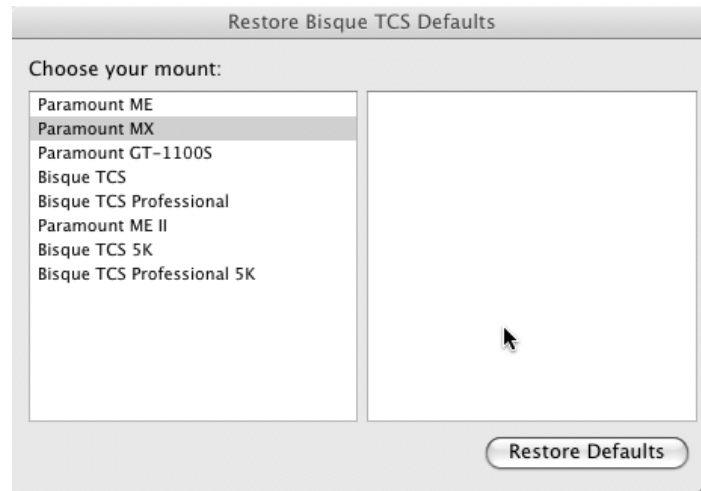


Figure 51: The Bisque TCS Configuration window.

The right side of the Bisque TCS Configuration window lists the mount models that use the MKS control system.

- Paramount ME
- Paramount ME II
- Paramount MX
- Paramount GT-1100S
- Bisque TCS
- Bisque TCS Professional
- Bisque TCS 5K
- Bisque TCS Professional 5K

The default parameters differ for each model mount, so make sure to choose the right one before clicking the **Restore Defaults** button.

Restore Defaults Button

Click this button to reset the mount's parameters to default settings. When prompted, click **Yes** to save the settings to the control system's flash memory.

Read All Parameters From Mount

Choose this command to read the mount's parameters from the control system and update them on the **Bisque TCS** window. Reading every parameter from the mount's internal memory is a relatively lengthy operation and this command may require fifteen seconds or so to complete.

Save All Parameters To Mount

Choose this command to save the mount's parameters to the control system's flash memory. Saving every parameter to the mount's flash memory is a relatively lengthy operation and this command may require 15 seconds or so to complete.

Save the TCS Configuration File (Save As Command)

Save the current Bisque TCS parameters to a file. (Files are saved using the extension *.tcs*). This allows you to store different mount configurations and retrieve them as necessary using the **Open** command on the **Commands** pop-up menu.

Open Bisque TCS Configuration File (Open Command)

This command allows you to select and open a Bisque TCS configuration file.

Copy Parameters (From This Window To Clipboard)

Choose this command to copy a report of the current Bisque TCS parameters to the Clipboard in ASCII text format. Use the **Paste** command from any text editor to view and save this report.



Software Bisque strongly recommends printing a copy of your mount's Bisque TCS Parameters and storing it with your permanent records. In particular, the values for the MKS_INDEX_ANGLE (both RA and Dec) are required if the control system electronics need to be replaced for any reason.

Example Bisque TCS parameters text file for the Paramount MX:

| Bisque TCS Parameter | RA Value | Dec Value |
|----------------------------|-----------------|------------|
| MKS_INDEX_ANGLE | , 3978 , | 375 |
| MKS_UNIT_ID | , 5 , | 5 |
| MKS_ACCELERATION | , 800 , | 800 |
| MKS_HOME_VEL_HI | , 1600000000 , | 1600000000 |
| MKS_HOME_VEL_MED | , 1500000000 , | 1500000000 |
| MKS_HOME_VEL_LOW | , 5900000 , | 5900000 |
| MKS_HOME_REQD | , 1 , | 1 |
| MKS_HOME_JOYSTICK | , 1 , | 1 |
| MKS_HOME_INDEX_OFFSET | , 0 , | 0 |
| MKS_CREEP_RATE | , 0 , | 0 |
| MKS_GUIDE_RATE | , -700964 , | 700964 |
| MKS_EMF_CONSTANT | , 30 , | 30 |
| MKS_MAX_SPEED | , 1080000000 , | 1080000000 |
| MKS_BASE_RATE | , -44861734 , | 0 |
| MKS_MIN_POS_LIMIT | , -6250000 , | -8500000 |
| MKS_MAX_POS_LIMIT | , 2250000 , | 2500000 |
| MKS_PEC_RATIO | , 8 , | 8 |
| MKS_HOME_DIR | , 1 , | 1 |
| MKS_HOME_SENSE | , 1 , | 1 |
| MKS_HOME_MODE | , 2 , | 2 |
| MKS_HOME_IN_OUT_IN | , 1 , | 1 |
| MKS_PEC_CUTOFF_SPEED | , 89723468 , | 0 |
| MKS_MAX_VOLTAGE | , 15 , | 15 |
| MKS_MAX_GAIN | , 150 , | 150 |
| MKS_MAX_POS_ERROR | , 2000 , | 2000 |
| MKS_JOY_CENTER | , 2184 , | 2184 |
| MKS_USER1_TICS360 | , 12000000 , | -12000000 |
| MKS_USER1_dEXPECTED_HOME | , 2.0000000 , | 0.0000000 |
| MKS_USER1_dHOME_SENSOR | , 2.0000000 , | 0.0000000 |
| MKS_USER1_dBASE_RATE_PERC | , 100.0000000 , | 0.0000000 |
| MKS_USER1_dCREEP_RATE_ASPS | , 0.0000000 , | 0.0000000 |
| MKS_USER1_dGUIDE_RATE_FACT | , 0.5000000 , | 0.5000000 |
| MKS_USER1_dMAX_SLEW_PERC | , 90.0000000 , | 90.0000000 |
| MKS_USER1_NMOUNT_TYPE | , 0 | |


```

MKS_USER1_SYNC_VERSION      ,      10000
MKS_USER2_NVERSION          ,           0
MKS_USER2_FOCUS_AXIS        ,           1
MKS_OTHER_MOUNT_ID          , Paramount MX
MKS_OTHER_DEBUG_OUTPUT      ,           0
MKS_OTHER_STARTUP_JS_RA     ,           0
MKS_OTHER_STARTUP_JS_DEC    ,           0
MKS_OTHER_STARTUP_JS_BUTTON ,           0
MKS_OTHER_STARTUP_JS_GUIDER ,           0
MKS_OTHER_SOUND_GUIDER      ,           0
MKS_OTHER_GP_IO_1           ,           0
MKS_OTHER_GP_IO_2           ,           0
MKS_OTHER_GP_IO_3           ,           0
MKS_OTHER_GP_IO_4           ,           0
MKS_OTHER_JOY_RATE_1        ,      277581
MKS_OTHER_JOY_RATE_2        ,      2523471
MKS_OTHER_JOY_RATE_3        ,      66123104
MKS_OTHER_JOY_RATE_4        ,     1322462080
MKS_INI_FOCMULT              ,           1
MKS_INI_FLIPHA               ,    -18.0000000
MKS_INI_SPEEDPERC            ,           60
MKS_INI_SPEEDTHRESH         ,           5
MKS_INI_KERNEL_STATE        ,           1
MKS_INI_CALLLEVELLOGGING    ,           0
MKS_INI_PACKETLEVELLOGGING  ,           0
MKS_INI_FOCUSPULSESLOW      ,           60
MKS_INI_FOCUSPULSEFAST      ,          200
MKS_INI_HOMEAFTERCONNECT    ,           0
MKS_INI_SHOW_LIMITS         ,           0
MKS_INI_LOG_SLEWS           ,           0
MKS_INI_PPEC_HARMONICS      ,           2
MKS_INI_PPEC_RATIO1         ,      1.0000000
MKS_INI_PPEC_RATIO2         ,      8.0000000
MKS_INI_PPEC_RATIO3         ,      1.0000000
MKS_INI_PPEC_SCALE          ,      1.0000000
MKS_INI_PPEC_TEETH          ,          375
MKS_INI_PPEC_PERIODS        ,           1

```

Paste Parameters (From Clipboard To This Window)

Choose this command to import the Bisque TCS parameters from the Clipboard. If the Clipboard holds the appropriately formatted text, the parameter values displayed in the **Bisque TCS** window are updated. Choose the **Save All Parameters to Mount** command to save the parameters to the mount's flash memory.

Show Status Tab

The spreadsheet on the top of **Status** tab shows the current control system and motor status values for both the right ascension and declination axes. These values are useful for verifying the current tracking rate, slew limit conditions and other control system settings.

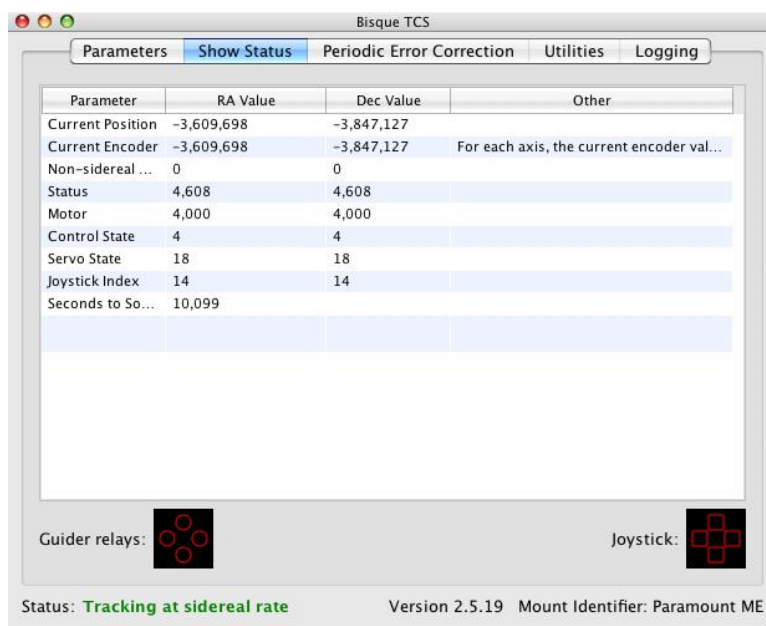


Figure 52: The Show Status tab on the Bisque TCS window.

| Parameter | Description |
|--------------------------|--|
| Current Position | Shows the value of the mount's current position. |
| Current Encoder | Shows the current encoder position for both axes. For each axis, the current encoder value changes when mount is tracking; it remains fixed when not tracking. |
| Non-sidereal Rate | <p>Shows a number that represents the incremental tracking rate (above or below the sidereal rate).</p> <p>When the mount is tracking at the sidereal rate, values for both RA and Dec are zero. If either rate is non-zero, the mount is tracking at a non-sidereal rate.</p> <p>See the Set Track Rates command in <i>TheSkyX Professional Edition User Guide</i> details about setting tracking rates.</p> |
| Status | Shows an internal motor status value. |
| Motor | Shows the motor status. |
| Control State | A number that indicates the current "state" of the control system. |
| Servo State | A number value that indicates the current "state" of the DC Servo motor. |
| Joystick Index | A number that shows the joystick's index position. |

| Parameter | Description |
|---|---|
| <i>Seconds to Software Limit</i> | The total number of seconds until the mount encounters a software slew limit. |

The two graphics on the bottom of the Status window show the state of the guider relays (either open or closed) and the relative position of the joystick (centered or moving the mount in a particular axis or axes).

Guider Relays

The **Guider Relays** graphic on the bottom left side of the **Show Status** tab (see Figure 52) shows four red circles (clockwise from the top) that represent North, East, South and West mount relays. The color of the circle changes when the relays are open or closed.

- A black-filled circle indicates that the relay is open so that no guider corrections are being made.
- A green-filled circle indicates that the relay in this axis is closed and guider corrections are being applied to the mount.

If the graphic shows that the relay is unexpectedly closed (for example, if there is no autoguiding taking place), here are possible causes:

- The relays on some SBIG camera models are always closed when the camera is turned off. Turn the camera on to open the relays and show black-filled circles.
- A shorted or otherwise improperly wired autoguider cable is causing unwanted guider corrections in one or more directions. Try unplugging the guider cable from both the Electronics Box on the Paramount (ME II or MX) or the Adaptor Panel on the Paramount ME and the Instrument Panel. If the relays are now closed, replace the guider cable.
- Corrosion or other containments are causing a short in the relay port. Try spraying electronics cleaner on both the cable and directly in the guider relay port to see if the behavior persists.

Joystick (MKS-3000, MKS-3200 and MKS-4000 only)

The **Joystick** graphic on the bottom right side of the **Show Status** tab (see Figure 52) shows four red outlined squares that represent North, South, East and West. The fill color of each square changes from black to green when the mount is being slewed by the joystick in that direction.

- A black-filled square indicates that the joystick is centered and the mount is not slewing via the joystick inputs.
- A green-filled square indicates that the joystick is issuing slew commands to the highlighted axis.

The joystick can issue slew commands in one or two axes at a time (N, E, S, W or NE, NW or SE, SW).

Periodic Error Correction Tab

The **Periodic Error Correction** tab is used to generate and manage periodic error curves for the Bisque TCS control system. The **Bisque TCS PEC Table** tab is used to retrieve, save, delete and view the periodic

error correction curve. The **Compute PEC Curve** tab is used to determine the optimal periodic error curve based on mount tracking data.

The Paramount has precision worms and gears that slew the mount's axes and track the earth's relative motion compared to the stars. As the worm rotates, imperfections in the drive system (on the order of *one twenty-millionths of one inch*) introduce a predictable "back and forth" drift at the eyepiece.

This drift is called *periodic error* and is present in all worm and gear drive systems. The mount's periodic error can be virtually eliminated using *periodic error correction*. Here is an overview of the periodic error correction process. Step by step details follow.

How to Train and Apply Periodic Error Correction

1. Create a *tracking log* that records the magnitude of the mount's periodic error over three or more revolutions of the worm. See "Collecting and Using Periodic Error Tracking Data" on page 116 for details how to create a tracking log.
2. Open the tracking log in the **Compute PEC Curve** tab.
3. Fit an optimal periodic error curve to the tracking log data.
4. Save and permanently store the optimized periodic error curve to the mount's firmware.
5. Turn on the **Apply PEC Corrections** checkbox to apply periodic error corrections.

The importance of applying periodic error correction to tracking depends on several factors:

- The magnitude of the mount's periodic error. All mounts have slightly different periodic error due to machining variations. The greater the periodic error, the more noticeable the back and forth "drift" in right ascension and more elongated stars in photos.
- The scale of the imaging system. Tracking demands for an imaging system with an image scale of four arcseconds per pixel or larger are less demanding than on a system with an image scale of one arcsecond per pixel or less.
- The local seeing and weather conditions. A turbulent jet stream caused by nearby mountain ranges (here in Golden, Colorado, for example) can produce average seeing errors from three to five arcseconds per pixel and rarely better. A laminar, more stable atmosphere in regions like Florida or Southern New Mexico in the USA often produce periods of sub arcsecond seeing.

As an example of periodic error versus seeing versus image scale, if the mount's total periodic error is three arcseconds peak to peak and the local seeing conditions average four arcseconds, then the tracking error caused periodic error is *less than* the tracking errors caused by seeing conditions, so correcting the mount's periodic error is not critical.

However, if the local seeing averages one arcsecond and the optical system's image scale is one arcsecond per pixel or smaller, you want to make sure that the periodic error is as small as possible for optimal results.

TheSkyX Professional Edition is used to compute, retrieve and save a periodic error correction curve to the Bisque TCS firmware.

When the **Apply PEC Corrections** checkbox is turned on, the resulting corrected periodic error of the mount should be less than one arcsecond (usually 1 arcsecond peak to peak error or less), which is normally less than the errors introduced by local seeing conditions (typically 1-5 arcseconds, depending on the location, weather conditions, etc.).



Figure 53: The Bisque TCS PEC Table tab on the Periodic Error Correction tab (Bisque TCS window).

Apply PEC Corrections

Turn this checkbox on to apply periodic error corrections during sidereal tracking. Note that periodic error correction will not be applied when tracking fast moving objects, such as spacecraft.

Bisque TCS PEC Table Tab

The **Bisque TCS PEC Table** tab on the **Periodic Error Correction** tab shows a graph of the mount's periodic error correction table. Note that you must first retrieve or **Get** the periodic error table that is stored in the mount's firmware. The message **No Table Present** is displayed on the graph if the periodic error data has not been retrieved from the mount, or the mount does not have a periodic error curve. The green line on the graph shows the corrections that are applied over one period of the worm. The black vertical line shows the current position of the worm in the PEC table.

The shaded purple region shows a graph of the mount's periodic error or PEC table. The X-axis represents the time for one revolution of the worm. The Y-axis shows the magnitude of the correction at a given worm position. The red line shows the actual periodic error correction, in arcseconds that is applied over one revolution of the worm.

Retrieve PEC Table from Control System (Get Button)

Click the **Get** button to retrieve the PEC table that has been saved to the mount's firmware. The **PEC Table** graph shows the text **Reading PEC Table...** while the data is being retrieved from the Bisque TCS.

Delete PEC Table from Control System (Delete Button)

Click the **Delete** button to permanently delete the PEC table that is stored in the Bisque TCS. The PEC Table graph shows the text **Deleting PEC Table...** while the data is being deleted from the Bisque TCS.

Paste Custom PEC Table (Paste Button)

Retrieve the periodic error correction table values from the Clipboard and display them on the PEC graph.

Copy Custom PEC Table (Copy Button)

Click this button to copy the current periodic error correction table values from the graph to the Clipboard in ASCII text format. The format of the ASCII text data is two space delimited columns:

- The zero-based table index (0-999 for the Paramount MX, 0-1249 for the Paramount ME and Paramount ME II).
- The relative mount-specific periodic error correction.

Column values must be separated by a minimum of one space character (no tabs), with carriage return line feed pairs at the end of the line.

The following text shows an example ASCII PEC table.

```
0<0x20><0x20><0x20>-9<CR><LF>
1  -9<CR><LF>
2  -9<CR><LF>
3 -10<CR><LF>
4 -10<CR><LF>
5 -10<CR><LF>
6 -10<CR><LF>
7 -11<CR><LF>
8 -11<CR><LF>
9 -11<CR><LF>
10 -11<CR><LF>
. . .
1248 -8<CR><LF>
1249 -9<CR><LF>
```

PEC Table Index

This number represents the position of the worm in the PEC correction table.

| Model | PEC Index Values |
|-------|------------------|
| ME | 0 – 1249 |
| MEII | 0 – 1124 |
| MX | 0 – 999 |

Compute PEC Curve Tab

The Paramount's (ME, ME II and MX) periodic error *specification* is a maximum of 7 arcseconds peak to peak periodic error *before* periodic error correction. The *actual* periodic error of most Paramount mounts before correction is around 3.5 arcseconds peak to peak. The difference between the mount's

actual periodic error and the specified periodic error can be caused by minute variations in the mount's internal components (gears, worms, pulleys, belts, etc.).

Ultimately, the tracking of any Paramount that has a periodic error of less than 7 arcseconds peak to peak can be corrected so that the *corrected periodic error* is below errors introduced by local atmospheric turbulence or “seeing”. In other words, the periodic error is “in the noise” and not detectable at the eyepiece or in the measured FWHM of stars on a CCD photo.

Under all but extremely good seeing conditions, measuring periodic error can be difficult, even using an autoguider because the random errors caused by local seeing conditions are often larger than the actual periodic error of the worm and gear.

The **Compute PEC Curve** tab offers an extremely powerful algorithm that can be used to precisely determine the mount’s periodic error, independent of the errors introduced by local seeing conditions.

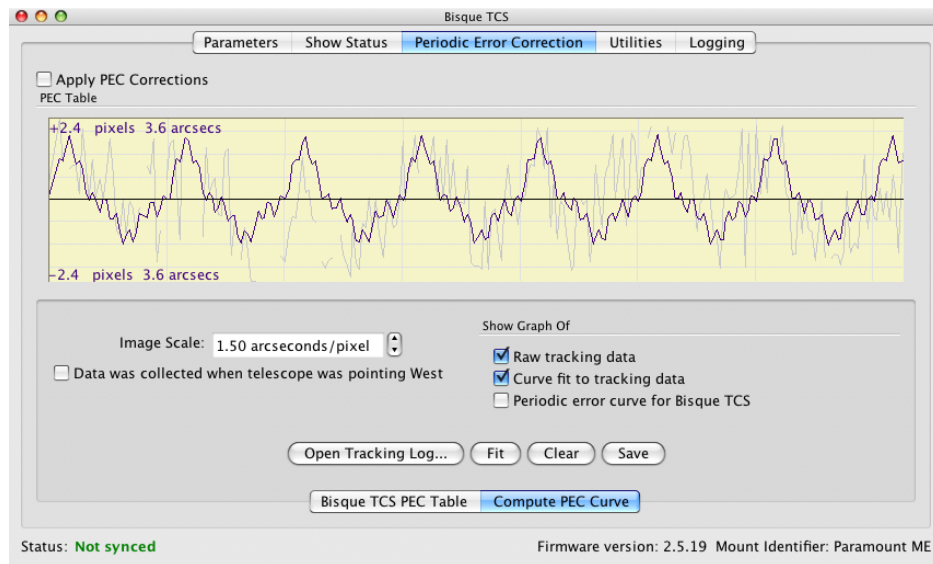


Figure 54: The Compute PEC Curve tab on the Periodic Error Correction tab (Bisque TCS window).

PEC Table Graph

The yellow shaded region can be used to show a graph of the tracking log data, the “best fit” curve to that data and the actual periodic error curve derived from the best fit curve that is stored to the Bisque TCS flash memory.

Use the mouse scroll wheel to adjust the relative scale of the graph. Scrolling forward expands the scale on the graph, scrolling backward magnifies the graph.

Image Scale

Enter the image scale of the optical system, in arcseconds per pixel. Image scale is critical for computing the correct periodic error from the tracking log data. If you are unsure of the photo’s image scale, use *TheSkyX Professional Edition’s* Image Link feature to compute it for you.

Data Was Collected When Telescope Was Pointing West

Turn this checkbox on if the tracking log data was collected when the telescope was pointing to the West side of the meridian.

Raw Tracking Data

Turn on this checkbox to show the positions of the star's centroid from the tracking log data as a light gray line.

Curve Fit To Tracking Data

Turn on this checkbox to show the optimal periodic error curve computed by clicking the **Fit** button.

Periodic Error Curve For Bisque TCS

Turn on this checkbox to show a graph of the periodic error curve to be saved to the Bisque TCS control system's flash memory. Turning this checkbox on automatically hides the raw and fit graphs.

Open Tracking Log

Click this button to open a tracking log that was generated by the *Camera Add On*.

Fit

Click this button to compute and display the graph of an optimal periodic error curve for the tracking log data.

Clear

Click this button to remove or delete the existing tracking log.

Save To Mount

Click this button to save the fit periodic error curve to the Bisque TCS.

Collecting and Using Periodic Error Tracking Data

Follow the steps below to obtain and apply the optimal periodic error correction curve for your mount.

Step 1 Collect the Tracking Log

The first step is to obtain a *tracking log* for your Paramount. A tracking log is a record of the position of a star's centroid over four or more revolutions of the worm, without making *any* tracking corrections to the mount's position. (Technically, a tracking log is merely an autoguider log without any guider corrections.)

In order to successfully acquire a tracking log, you must place a star on the detector, and that star must stay inside a "tracking box" for ten to fifteen minutes without making any corrections to the mount's position (for several periods of the worm) so that the position of the star during that time can be recorded.

The Paramount, *TheSkyX Professional Edition* and the *Camera Add On* must be configured to:

- Turn off periodic error corrections (page 113).

- Turn off or disable autoguiding (see below).
- Turn off *TPoint Add On* modeling (see below).
- Turn off tracking corrections from ProTrack (see below).
- Set the mount to track at the sidereal tracking rate (page 95).
- Remove, turn off or disable adaptive optics devices.
- Unplug all guider cables from the mount.
- Unplug the mount's joystick or hand paddle.
- Physically rotate the CCD camera to orient it [north up](#).

Remember, the tracking log cannot be acquired when guider corrections are made; instead the star's *uncorrected* position must be recorded over time as the mount tracks at the sidereal rate. Collecting tracking data is typically less demanding than autoguiding since mount calibration is not required.

The resulting tracking log file (named "autoguider.log" since this log is normally used to log autoguiding data) allows *TheSkyX Professional Edition* to determine the best fit periodic error curve for your mount.

On the Paramount

1. Unplug the autoguider cable from the mount's Electronics box (Paramount ME II and Paramount MX), Adaptor Panel and Instrument Panel (Paramount ME).
2. Unplug the joystick from the Adaptor Panel (Paramount ME) or the hand paddle from the Electronics Box (Paramount ME II or Paramount MX).
3. Make sure your camera is rotated approximately north "up":

Camera Orientation Requirements

Make sure the CCD camera is oriented correctly. The camera's detector must be oriented so that telescope motion in right ascension closely corresponds to x-axis motion on the detector (see diagram below). If the detector is not oriented properly, then the maximum magnitude of the periodic error is not recorded. Note that precise orientation is not crucial; the detector should be within 5 degrees of North (or South).

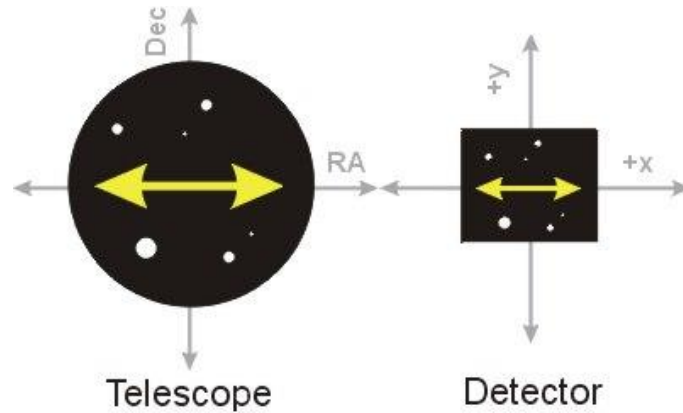


Figure 55: The telescope's orientation versus CCD detector orientation.

**From TheSkyX
Professional Edition**

1. Choose the **Connect** command from the **Telescope** menu to connect to the Paramount.
2. Turn off the **Apply Pointing Corrections** checkbox on the **Setup** tab of the **TPoint Add On** window. (Click **Telescope > TPoint Add On** to show the **TPoint Add On** window.)
3. Turn off the **Activate ProTrack** checkbox on the **ProTrack** tab of the **TPoint Add On** window.
4. Open the **Bisque TCS** window (see page 96).
5. Click the **Periodic Error Correction** tab.
6. Turn off the **Apply PEC Corrections** checkbox.
7. Click **OK**.

Note that you can use your autoguider or imaging camera to create the tracking log. We recommend using the larger imaging camera to make the process easier.

1. Click the **Telescope Setup** command from the **Telescope** window and expand **Autoguider**.
2. Double-click **Camera** and select your main imaging camera imager for the detector that will collect the tracking log data.
3. **DISABLE AUTOGUIDING CORRECTIONS IN BOTH AXES.** Click the **Autoguider** tab. (Click the **Autoguider** command from the **Display** menu if this window is not visible.)
4. On the **Autoguide** tab, click the **Setup...** button.
5. On the **Relay Settings** tab, turn off both **Yes** checkboxes for **Relay Enabled** in the **X-Axis** and **Y-Axis** columns (Figure 56). Turning these options off prevents the **Camera Add On** from making corrections to the position of the guide star.

6. Click **OK**.

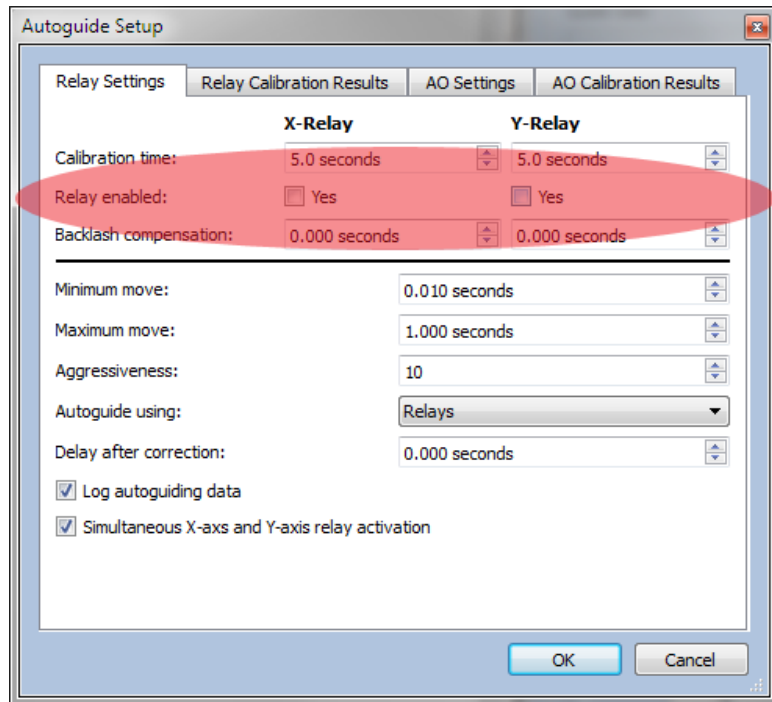


Figure 56: The *Relay* tab on the Camera Add On's *Autoguide Setup* window.

7. On the **Autoguide** tab, click the **Clear Log** button to delete the autoguider log file. Click **Yes** to confirm deletion. (You will not be prompted when no log file exists).
8. Turn on the **Log Autoguiding** checkbox.
9. Locate an appropriate guide star and then click the **Autoguide** button to begin collecting tracking log data.

Periodic Error Tracking Data Collection Recommendations

- The guide star must be a relative bright star on the west side of the meridian, near 0 degrees declination and near the meridian (within a few degrees).
- Track the star for at least *four* periods of the worm; 10 minutes using a Paramount ME or Paramount ME II, about 15 minutes 30 seconds using the Paramount MX.
- Make sure to compute and record the image scale for your imaging system. It is required for the next step.

Step 2 Generate the PEC Curve

After the position of the guide star has been logged for at least four periods of the worm, you

are ready to generate the PEC curve and save it to the control system's "PEC table".

1. From *TheSkyX Professional Edition*, connect to the Paramount by clicking the **Connect** command on the **Telescope** menu.
2. Open the **Bisque TCS** window (see page 96).
3. Click the **Periodic Error Correction** tab.
4. Click the **Open Tracking Log** button.
5. Select the tracking log file and click **Open**. The "raw" periodic error data shown on Figure 57. Your results will vary, but the noisy-looking data is normal. For this example, each pixel of motion recorded in the tracking log equates to one arcsecond of error. The maximum and minimum error values are displayed on the right side of the graph (these values are not easily visible in Figure 57).

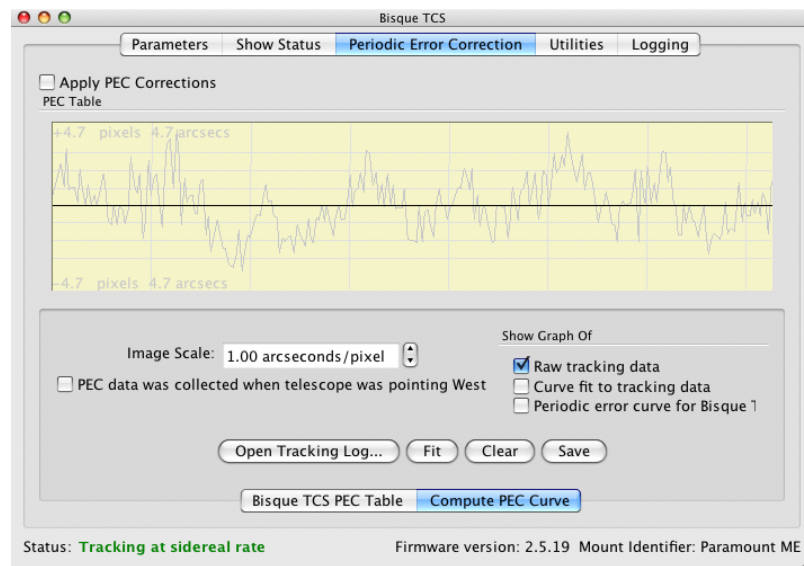


Figure 57: Graph of tracking log data.

5. Enter the image scale of your optical system in arcseconds per pixel. If you do not know the scale, use *TheSkyX Professional Edition*'s Image Link to determine this value.
6. Turn on the **PEC Data was Collected when Telescope was Pointing West** checkbox if the tracking log data was collected using a star on the west of the meridian. This information is needed to determine the phase of the error. Turning this checkbox on when the mount was pointing to the east while recording the tracking log results in a "doubling" of the periodic error. So, if the periodic error is higher after applying PEC, chances are this is the cause. Simply turn off the check box, and proceed with the next step.
7. Click the **Fit** button. The **PEC Table** graph is updated with the optimal periodic error curve for your mount.

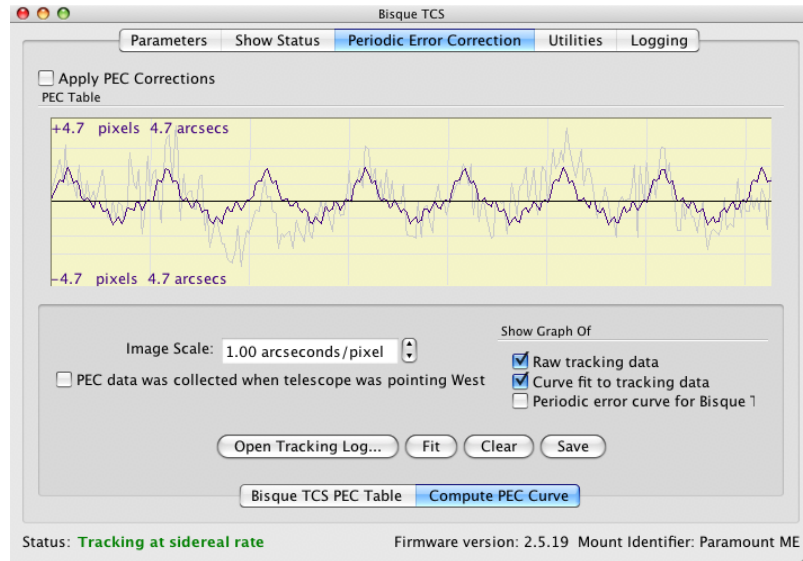


Figure 58: After clicking the Fit button, the graphs show both the raw and “fitted” data.

8. Click the **Periodic Error Curve for Bisque TCS** checkbox to display the graph of the curve that will be transferred to the Paramount control system's PEC table.

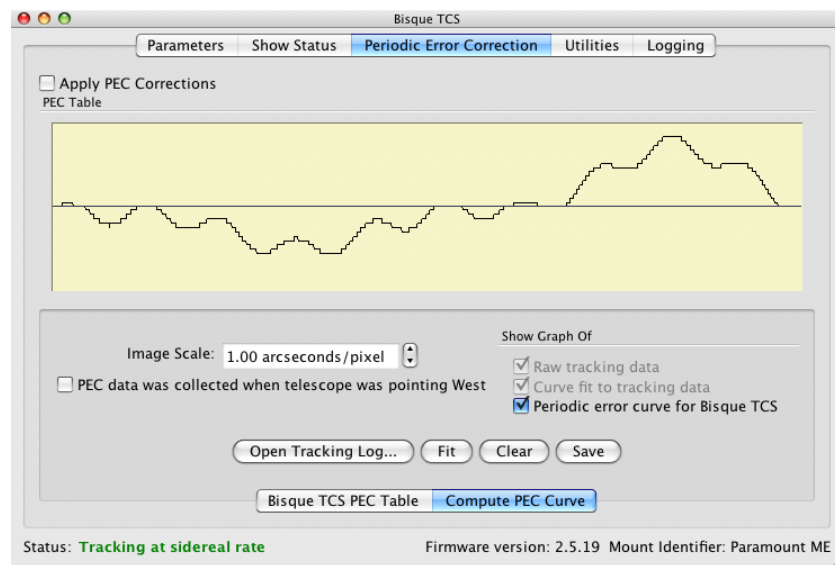


Figure 59: This periodic error curve should be saved to the mount's PEC table.

The above PEC curve is not "smooth" by design. The graph shows the minimum resolution for mount "moves" (approximately 0.01 arcseconds) when applying periodic error corrections. This data is saved to the control system's Flash RAM, and will be always be used to correct the mount's periodic error (provided the **Apply PEC Corrections** checkbox is turned on).

Step 3 Save the PEC Curve to the Paramount Firmware

Click the **Save** button to save this curve into the Paramount's PEC table (that is, the curve is

saved in the control system's flash RAM for permanent use).

Step 4 Apply PEC Corrections

1. From *TheSkyX Professional Edition*, connect to the Paramount by clicking the **Connect** command on the **Telescope** menu.
2. Open the **Bisque TCS** window (see page 96).
3. Click the **Periodic Error Correction** tab.
4. Turn on the **Apply PEC Corrections** checkbox.

Your Paramount will now use the optimal PEC curve for the errors in your worm/gear.

Utilities Tab

The Utilities tab provides access to higher-level control system settings.

Hemisphere Setup

Click the **Hemisphere Setup** text on the right side of the **Utilities** tab to configure the mount's tracking direction and show hemisphere-specific mount status. (The home sensor values are shown only when the mount is connected.)

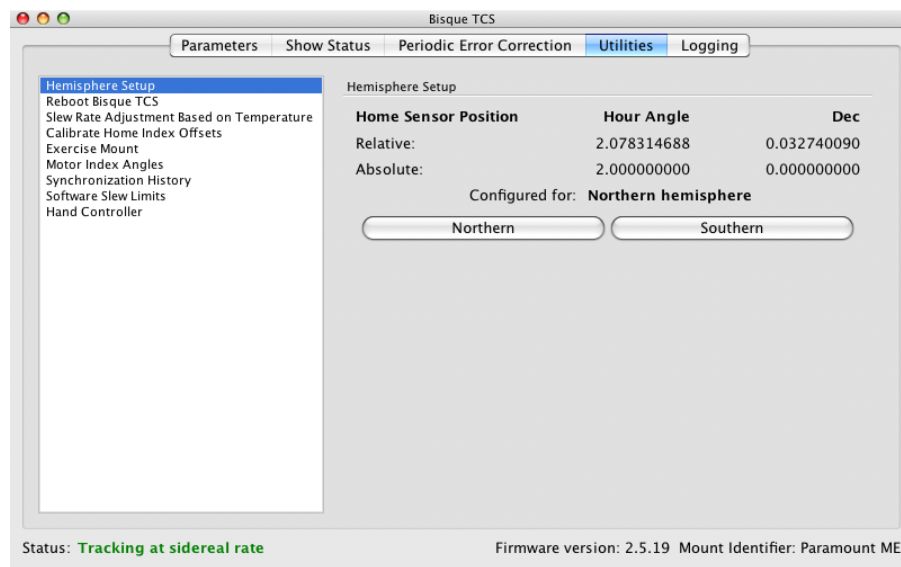


Figure 60: Example hemisphere settings for the northern hemisphere.

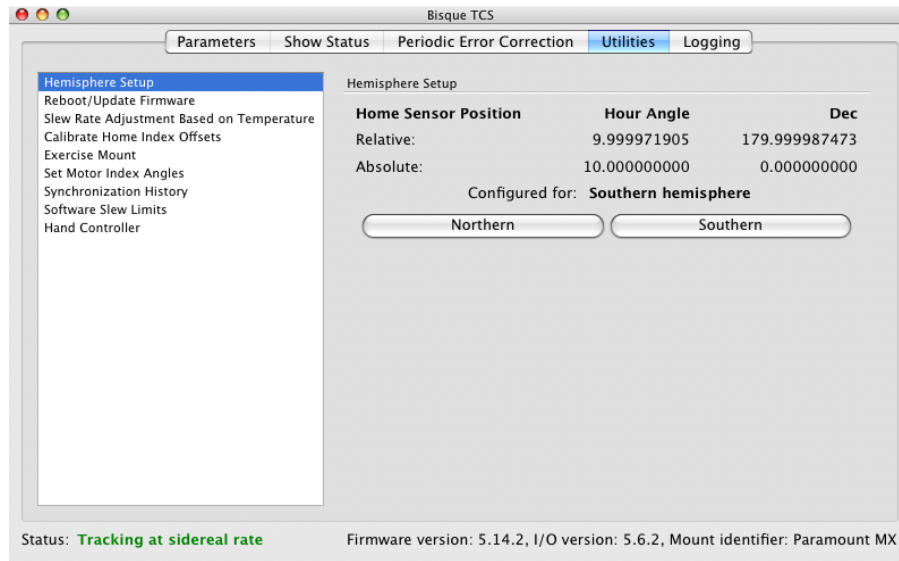


Figure 61: Example hemisphere settings for the southern hemisphere.

Relative Home Sensor Position (Hour Angle)

Shows the hour angle of the homing sensor based on the mount's synchronization information.

Relative Home Sensor Position (Declination)

Shows the declination of the homing sensor based on the mount's synchronization information.

Absolute Home Sensor Position (Hour Angle)

This text box shows the mechanically fixed hour angle of the homing sensor. This value cannot be changed for the Paramount ME, Paramount ME II or Paramount MX mounts and is always HA = 2.0 and Dec = 0.0.

Absolute Home Sensor Position (Declination)

This text box shows the mechanically fixed declination of the homing sensor. This value cannot be changed for the Paramount ME, Paramount ME II or Paramount MX mounts.

See the "Advanced Parameters" on page 100 for a discussion of the differences between the relative and absolute homing position.



Note on Southern Hemisphere Hour Angle and Declination Values

Figure 61 shows the home sensor's *absolute position* and *relative position* for the southern hemisphere. Both values reflect the *mechanical position of the mount*, not actual *sky coordinates*. This convention allows *TheSkyX Professional Edition* to know which side of the pier the OTA is on.

To convert the mechanical hour angle to the sky hour angle, subtract 12. Take 180 minus the declination to convert the mechanical declination to sky declination.

Configured For Text Box

This text box shows the current hemisphere configuration.

Northern and Southern Buttons

The Northern and Southern buttons are used to configure the mount for operation in either hemisphere. The default configuration is for the northern hemisphere. When the mount is located in the southern hemisphere, click the **Southern** button so that the sidereal tracking direction is reversed and the homing sensor positions can be updated. The control system is automatically “rebooted” so that these changes take effect.

Reboot/Update Firmware

If control system is emitting continuous beeps (for example the mount has encountered a fixed object like the side of the pier so that the motors have stopped) the control system should be restarted and then homed (page 18). To restart the control system, click the **Reboot/Update Firmware** text on the right side of the **Utilities** tab, then click the **Normal** button under **Reboot Bisque TCS** on the left side of this window.

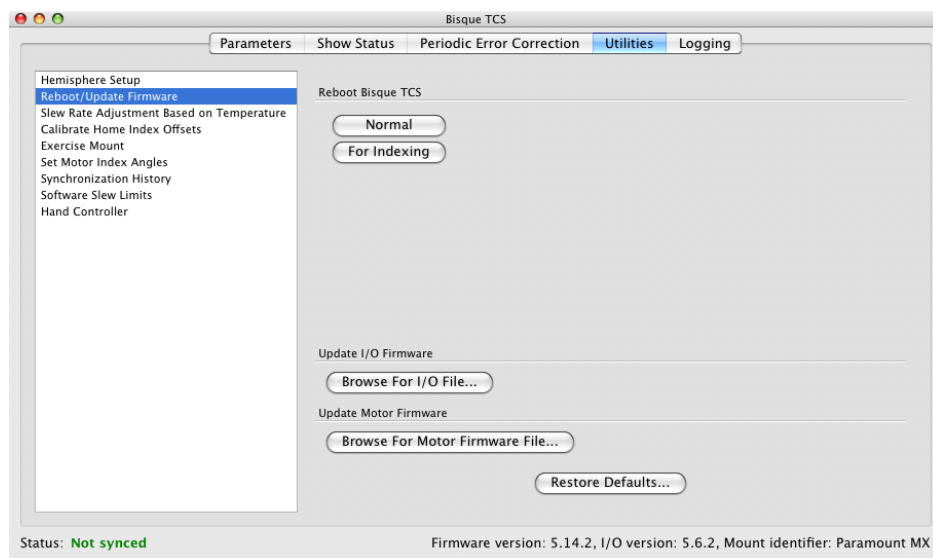


Figure 62: The Reboot/Update Firmware settings on the Utilities tab.

Normal

Click this button, then click the **Yes** button on the confirmation window to restart the control system for normal operation.

For Indexing

Click this button to restart the control system when updating the mount’s motor index angles.

Firmware Updates

The MKS 5000 control system includes two separate micro-controllers; each uses different firmware. The input/output or *I/O firmware* handles the USB communications and the *motor firmware* controls with the DC servo motors.

While every attempt is made to include the latest firmware versions when the mount is shipped, Software Bisque may periodically release newer versions. The firmware versions are listed on the bottom of the Bisque TCS window.



Do not attempt to reinstall the same version of Paramount firmware unless specifically instructed to do so by Software Bisque.



You must register your Paramount ME II or Paramount MX serial number to access to the MKS 5000 firmware updates. (Access to these downloadable files will be denied otherwise.)

Update I/O Firmware

When available, MKS 5000 firmware updates are posted to the Downloads page on the Software Bisque web site. (The name of the file that contains the update ends with the three letter extension “.hex”.)

Click the **Browse For I/O File** button to select the MKS 5000 firmware update. After downloading and saving the update to your computer, navigate to the folder where the I/O firmware update file is saved, select the file name and then click the **Open** button. A message appears when update is completed. At this point, power the mount off, then back on, to complete the firmware update.



The I/O firmware update applies to the MKS 5000 control system only.

See “Update Motor Firmware” on page 125 for step by step instructions to update the firmware on the MKS 4000 control system.

Update Motor Firmware

When available, MKS 5000 motor firmware updates are posted to the Downloads page on the Software Bisque web site. (The name of the file that contains the update ends with the three letter extension “.bin” for the MKS 5000 or “.out” for the MKS 4000 control system.)

Step by Step MKS 5000 Motor Firmware Update Instructions

1. If necessary, sign into the Software Bisque web site at www.bisque.com.
2. If you have not already done so, register your Paramount serial number at: www.bisque.com/register. Registering your serial number gives your account permission to access to the MKS 5000 firmware downloads. Access is denied otherwise.
3. On the Software Bisque web site, click the **Downloads** link, then click the **MKS 5000** link in the left column (under the **Browse Downloads** text). Immediately beneath the **MKS 5000** link, click

the **Firmware Updates** link. (If these links are “missing” it means there is no Paramount serial number registered to the current account.) The available MKS 5000 firmware updates are listed in the center of the web page.

4. Click the **MKS 5000 Motor Controller Firmware Latest Version** link under the **Name** column in the center of the page.
5. Click the **Download** link on the left side of this page to download the file to your computer.
6. Extract the file named *mks5k_motor.X.YY.Z.bin* (where X, YY, Z are numbers that represent the latest firmware version) from the zip file. Make sure to note the folder where this file is saved.
7. From *TheSkyX Professional Edition*, choose the **Connect** command from the **Telescope** menu.
8. On the **Telescope** window, click the **Bisque TCS** command on the **Tools** pop-up menu.
9. On the **Bisque TCS** window, click the **Utilities** tab.
10. Select the **Reboot/Update Firmware** text in the left column.
11. Click the **Browse for Motor Firmware File** button.
12. On the **Choose Motor Firmware** window, navigate to the folder from Step 6 above, select the firmware update file and click the **Open** button.
13. When prompted if you are sure you want to update the firmware version, click **Yes**.

The MKS 5000 motor controller firmware should now be updated to the latest version. Make sure this is the case by comparing the firmware version listed on the bottom of the Bisque TCS window with the firmware version listed on the MKS 5000 Motor Controller Firmware Latest Version on the Downloads page. If the update was performed correctly, the two versions will match.

Step by Step MKS 4000 Motor Firmware Update Instructions

1. If necessary, sign into the Software Bisque web site at www.bisque.com.
2. On the Software Bisque web site, click the **Downloads** link, then click the **Classic Windows Installers and Updaters** link in the left column of this page.
3. Click the **Paramount ME and MKS 4000 USB Driver and Utilities** link in the left column of this page.
4. Near the center of the page, click **MKS 4000 Firmware Version X.Y.Z** where x, y and z are numbers that represent the firmware version.
5. Click the Download link on the **MKS 4000 Firmware Version X.Y.Z** page.
6. Most browsers offer an option to save the file to a folder on your computer. Do so now. Some browsers automatically save the file in your computer’s Downloads folder. Make sure to note the folder where this file is saved.
7. From *TheSkyX Professional Edition*, choose the **Connect** command from the **Telescope** menu.
8. On the **Telescope** window, click the **Bisque TCS** command on the **Tools** pop-up menu.
9. On the **Bisque TCS** window, click the **Utilities** tab.
10. Select the **Reboot/Update Firmware** text in the left column.
11. Click the **Browse for Motor Firmware File** button.
12. On the **Choose Motor Firmware** window, navigate to the folder from Step 6 above, select the firmware update file and click the **Open** button.
13. When prompted if you are sure you want to update the firmware version, click **Yes**.

The MKS 4000 motor controller firmware should now be updated to the latest version. Make sure this is the case by comparing the firmware version listed on the bottom of the Bisque TCS window with the firmware version listed on the MKS 4000 Motor Controller Firmware Latest Version on the Downloads page. If the update was performed correctly, the two versions will match.

Browse For Motor Firmware File

Click this button to select the motor firmware update file.

Navigate to the folder where the motor firmware update file was saved, select the file name and then click the **Open** button. A message appears when update is completed. At this point turn the power to the mount off, then back on to complete the process.

Restore Defaults

Click this button to restore the default Bisque TCS settings (page 106).

Slew Rate Adjustment Based On Temperature

The Paramount's slew rate is automatically lowered when the ambient temperature drops below this value. (Lowering the slew rate provides more torque to the servomotors. This additional torque can minimize potential motor stalls from increased frictional forces at colder temperatures.)

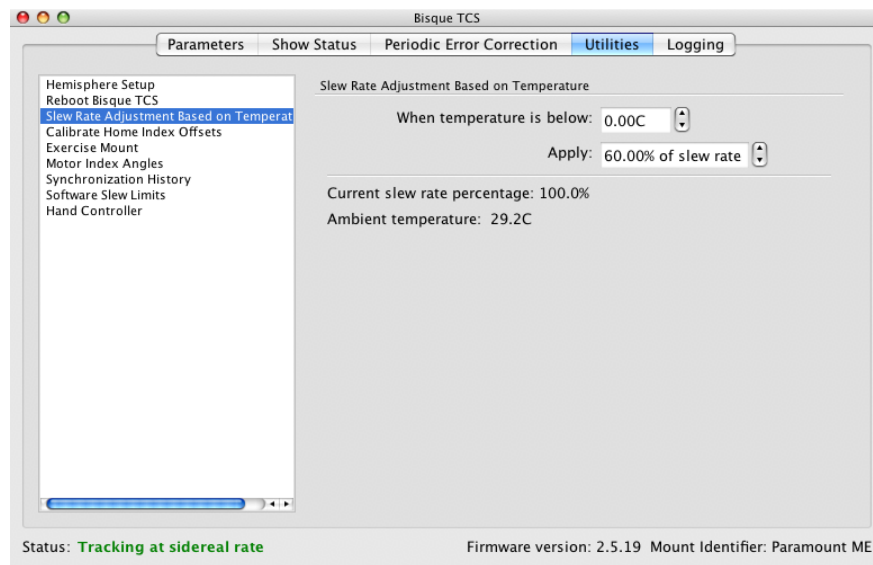


Figure 63: The Slew Rate Based on Temperature settings on the Utilities tab.

Click **Slew Rate Adjustment Based On Temperature** on the right side of the **Utilities** tab to change the maximum slew rate and the temperature below which this slew rate is applied.

When the Temperature Is Below (C)

Enter the temperature, in degrees Celsius, below which the maximum slew rate of the mount will be reduced.

Apply (Percentage of Slew Rate)

Enter the percentage of the maximum slew rate to apply at lower temperatures.

Suppose the slew rate is set at 2 degrees per second for “normal operating temperatures”. Then, based on the values in Figure 63, when the temperature drops below 0C the slew rate is set to 60 percent of 2 degrees per second, or 1.2 degrees per second.

Current Slew Rate Percentage

This text shows the current temperature-adjusted slew rate percentage. A value of 100 percent means the temperature inside the mount is above the **When the Temperature Is Below** value.

Ambient Temperature

Shows the ambient temperature measured by the mount’s internal temperature sensor.

Calibrate Home Index Offsets

Use these controls to measure the home sensor index angle offsets.

Measure RA

Click this button to measure the home index offset on the right ascension axis.

Measure Dec

Click this button to measure the home index offset on the declination axis.

Exercise Mount

Before leaving Software Bisque, each Paramount undergoes a “run in” or exercise procedure that slews the mount between the software slew limits to ensure that the gear train, motors and electronic systems are functioning normally.

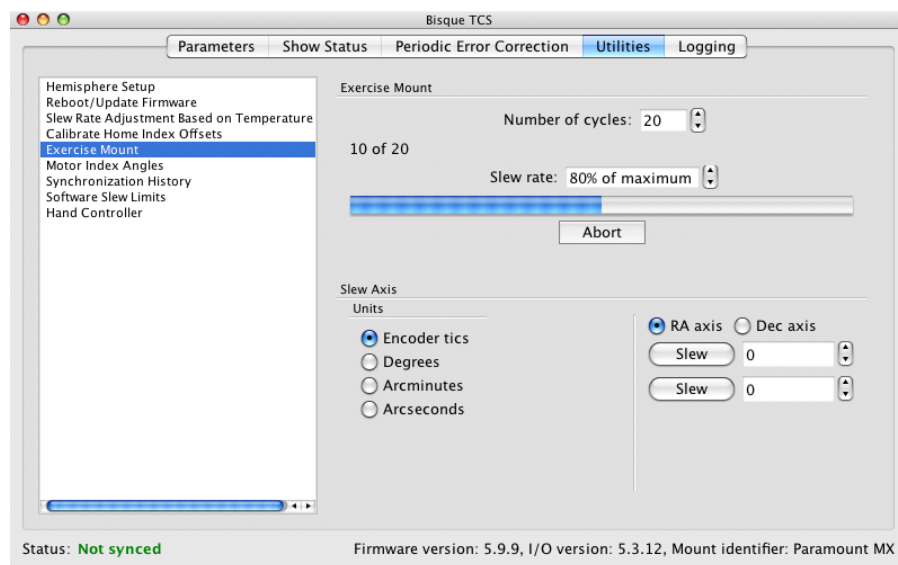


Figure 64: The Exercise Mount settings window on the Utilities tab.

You may wish to exercise the mount after the gears have been re-lubricated, or after installing through the mount cabling to make sure there are not stalling issues when the mount slews from slew limit to slew limit in both axes.

- Exercising slews both mount axes from limit to limit at the current **Slew Rate**, specified as a percentage of the maximum slew rate.
- The telescope cross hairs displayed on the Sky Chart will not follow the position of the telescope during the exercise process.

Number of Cycles

Enter the number of times to slew the mount between the software limits.

Slew Rate

Enter the rate, as a percentage of the mount's maximum slew rate, at which the mount is slewed during the exercise process.

Exercise Mount/Abort

Click this button to begin exercising the mount. While the mount is slewing, the text changes to **Abort**. Click **Abort** to end the exercise process.

Slew Axis Settings

These settings can be used to slew the RA or Dec axis using different four different "slew units".

Units

Enter the unit of measurement to slew the selected axis.

- **Encoder Tics** – Specifies the smallest division or angular rotation of the DC servo motor. The relative angular size of a Paramount encoder tic is one third of one arcsecond.
- **Degrees** – Slew the mount in angular degrees.
- **Arcminutes** – Slew the mount in arcminutes.
- **Arcseconds** – Slew the mount in arcseconds.

Slew

After entering the number of units to slew the mount in the adjacent text box, click the **Slew** button to perform the slew.

By design, two **Slew** buttons and two unit input text boxes appear so that slews using two different units can be performed.

Motor Index Angles

Every DC servomotor has a unique *motor index angle* that must be stored in the control system's firmware for normal mount operation. The **Motor Index Angle** settings allow the control system to measure and record these angles.

Measuring and retrieving index angles is required when installing a new motor or a new control system on a Paramount, only. Do not attempt to change or set the firmware's motor index angles otherwise.

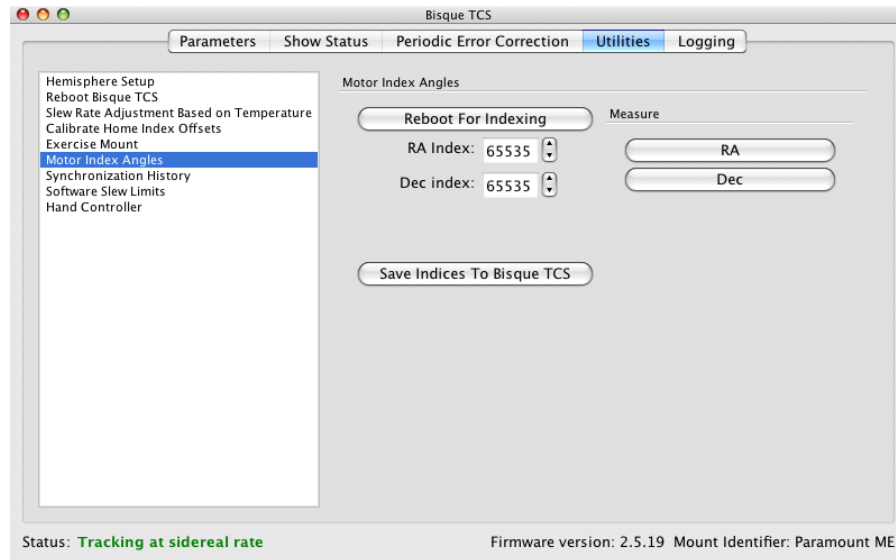


Figure 65: The Motor Index Angles settings on the Utilities tab.

Reboot For Indexing

Click this button to restart the Bisque TCS so that DC servomotor's unique *motor index angle* can be measured.

RA Index

Enter the motor index angle for the right ascension motor.

Dec Index

Enter the motor index angle for the declination motor.

Measure RA (RA Button)

Click this button to measure the right ascension motor index angle. When measuring the motor index angle, there can be no load on the motor, so you must remove the drive belt before proceeding.

Measure Dec (Dec Button)

Click this button to measure the declination motor index angle. When measuring the motor index angle, there can be no load on the motor, so you must remove the drive belt before proceeding.

Save Indices to Bisque TCS

Click the button to save the **RA Index** and **Dec Index** motor index angles to the Bisque TCS firmware. The motors and control system will not operate normally if the wrong motor index angles are saved, so please double-check these values before proceeding.

Synchronization History

Each time the Paramount is synchronized on a star, the previous synchronization information is logged and displayed in the Synchronization History report.

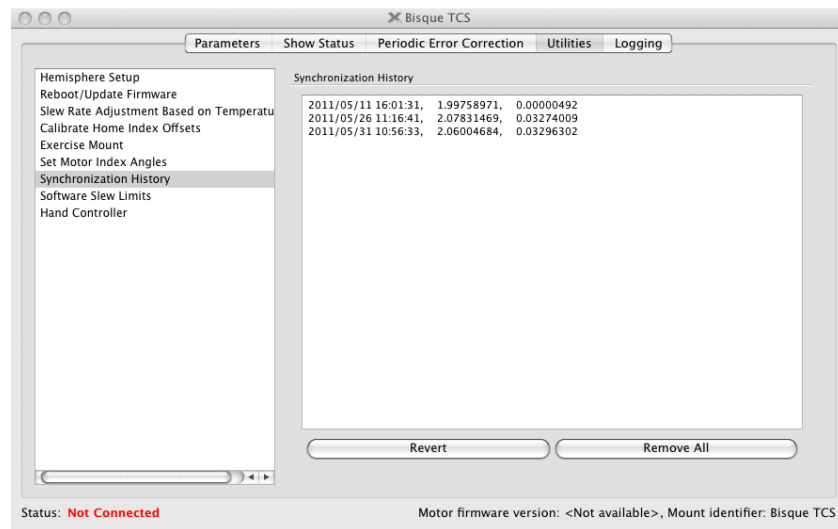


Figure 66: The Synchronization History settings on the Utilities tab.

Historical synchronization information can be useful if you ever synchronize on the wrong star and need to restore a previous synchronization, or as a “sanity check” to compare the most recent synchronization to earlier synchronizations.

Synchronization History Report

Each line on the **Synchronization History** report shows details about past synchronizations, including (from left to right, separated by commas):

- Date and time of the synchronization
- Relative hour angle of the home sensor position (page 102)
- Relative declination of the home sensor position (page 101)

For a given optical system, if the telescope is pointed to the correct star *and* TheSkyX Professional Edition’s location, date, time, time zone and Daylight Saving option match the observing location, the resulting hour angle and declination of the home position should remain fairly consistent (but not necessarily identical) for each synchronization.

Since star synchronization is critical to the Paramount’s normal operation, if the relative hour angle or the relative declination of the home sensor position is appreciably different between successive synchronizations, most likely the wrong star was used for the synchronization (and the Paramount can no longer point accurately). Revert to an earlier synchronization, or synchronize the Paramount to the “right” star to correct this situation.

Revert

Highlight a line in the **Synchronization Report** and then click this button to restore this synchronization.

Remove All

Click this button to permanently remove all of the entries in the **Synchronization History** list.

Software Slew Limits

Generally, a German equatorial mount is oriented “normally” when the optical tube assembly end of the declination axis is on one side of the pier when the observed object is on the opposite side of meridian. In this orientation, the mount’s payload can never run into the side of the pier so there is no risk of damaging your equipment.

Operating a GEM in an “abnormal” orientation (see Figure 67), that is, when the optical tube assembly end of the declination axis and the observed object are on the same side of the meridian offers several advantages:

- An observed object can be tracked “through the meridian” without having to flip sides during the exposure. This maintains the orientation of the field of view. Switching sides rotates the image plane by 180 degrees.
- Guide stars do not have to be reacquired. Flipping sides requires reacquisition of the guide star when the mount slews to the “the other side of the pier”.

One significant disadvantage of operating a GEM in an abnormal orientation is that the mount’s payload may encounter the side of the pier. While the Bisque TCS is current limited so that running into a fixed object will automatically stop slewing, and tracking, it is always best to keep your expensive optical equipment from running into *anything*.

The **Software Slew Limits** options allow the Bisque TCS software limits to be configured such that the payload of a GEM cannot encounter the side of the pier.

After mounting the payload (camera, optical tube assembly and other equipment) to the Versa-Plate, use the hand controller or joystick to orient the mount in the non-standard GEM orientation. The counterweights will be “above horizontal” and the payload will run into the side of the pier at some declinations.

In order to properly configure the software slew limits the mount must be oriented at the “maximum slew position” in both right ascension and declination. Start by turning tracking off (choose the **Turn Tracking Off** command from the Tools pop-up menu on the **Telescope** window) to ensure the mount stays at the limit position.

Next, use the hand controller or joystick to carefully slew the right ascension axis until the mount is in the abnormal position, without running the equipment into the side of the pier. You know the right ascension axis is oriented at the maximum slew position after slewing the declination axis 180 degrees always clears the side of the pier by at least one inch.

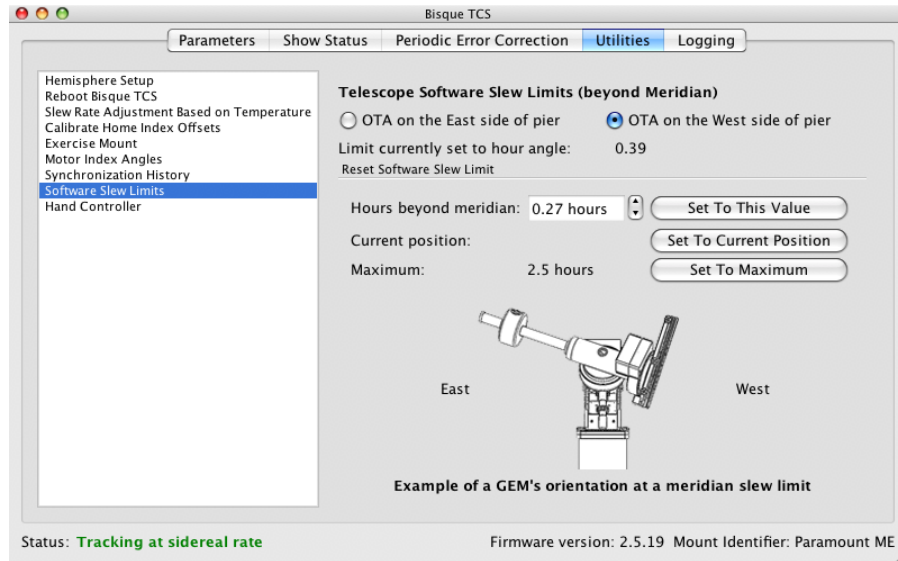


Figure 67: The Software Slew Limits settings on the Utilities tab.

OTA on the East Side of Pier

Turn this option on to set the slew position limit when the optical tube assembly is on the East side of the pier. Once the desired slew limit position is determined, click the **Set to Current Position** button to save this limit to the mount's firmware.

OTA on the West Side of Pier

Turn this option on to set the slew position limit when the optical tube assembly is on the West side of the pier. Once the desired slew limit position is determined, click the **Set to Current Position** button to save this limit to the mount's firmware.

Limit Current Set to Hour Angle

This text box shows the hour angle of the software slew limit for the selected axis.

Hours Beyond Meridian

Manually enter the "hour angle hours" for the software slew limit and then click the **Set To This Value** button to permanently save this setting to the control system's firmware.

Set to Current Position

Click this button to use the mount's current position to define the software slew limit.

Set To Maximum

Click this button to set the mount's maximum hour angle slew limit.

- Paramount ME – 0.33 hours
- Paramount ME II – 2.0 hours
- Paramount MX – 2.5 hours
- Custom mount using the Bisque TCS – Not defined



These limits are permanently saved to the mount's internal memory and used each time the mount is turned on.

The software slew limits must be reconfigured if the **Restore Defaults** command (page 106) is issued. You may wish to write down the hour angle of the software slew limit so that it can be restored later if necessary.

The graphic on the bottom of the **Software Slew Limits** window is intended to convey an *example* of the orientation as German equatorial mount at the East and West meridian slew limits. This graphic is *not* intended to be "mount specific" (in other words, the graphic will be the same whether the Paramount ME, Paramount ME II or Paramount MX mount is selected in the *TheSkyX Professional Edition's Telescope Setup* window).

Hand Controller Settings

The four slew rates on the Hand Controller slew rate switch can be configured from the **Hand Controller** settings on the **Utilities** tab.

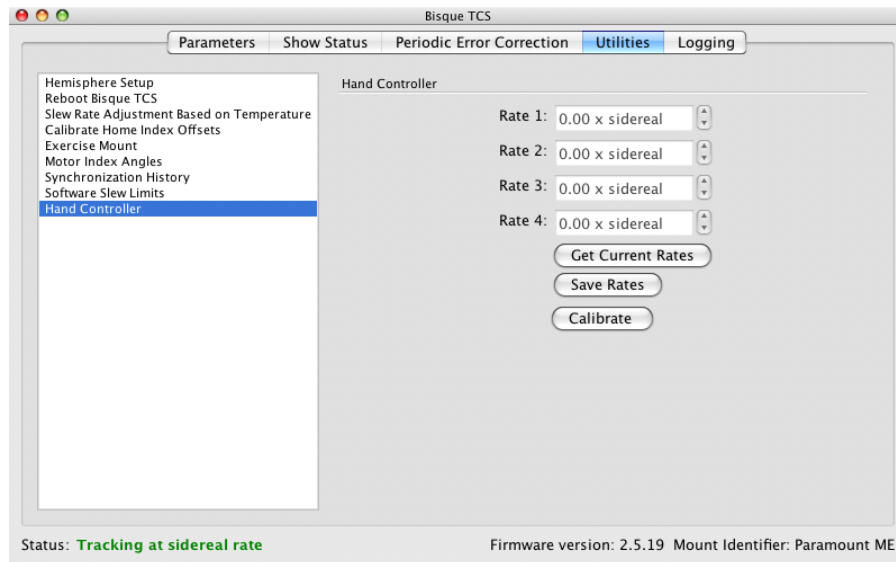


Figure 68: The Hand Controller settings on the Utilities tab.

Rate 1-4

Enter the desired slew rate for the corresponding rate position, based on the sidereal rate. For example, to configure switch position 3 to slew the mount two times the sidereal rate, enter the number **2** in the **Rate 3** text box, then click the **Save Current Rates** button.

Get Current Rates

Click this button to retrieve the current slew rates from the control system.

Save Rates

Click this button to permanently save the current slew rates to the control system's firmware.

Calibrate Joystick

The **Calibrate** button determines the center position of the hand controller's joystick. If you plug in a new hand paddle, or homing unexpectedly fails, joystick calibration may be necessary.

The MKS 4000 control system will automatically abort the homing process when the joystick is moved from the center position in either or both axes. If the joystick is not calibrated properly, then homing process will fail because the control system "thinks" the joystick is not centrally located.

To calibrate the joystick:

1. Launch TheSkyX.
2. Plug the hand paddle cable into the **Joystick** port on the Electronics Box (page 62).
3. Click the **Connect** command from the **Telescope** menu to connect to the Paramount.
4. Choose the **Bisque TCS** command from the **Tools** pop-up menu on the **Telescope** window.
5. Highlight **Hand Controller** in the list on the left side of the **Utilities** tab on the **Bisque TCS** window.
6. Click the **Calibrate Joystick** button.
7. **Important!** Choose the **Save All Parameters** to the **Mount** command from the **Commands** pop-up menu on the **Parameters** tab of the **Bisque TCS** window.

Logging Tab

The **Logging** tab shows debugging output for the mount's control system that can be useful when using the Bisque Telescope Control System for custom telescope mountings.

Using ProTrack™

ProTrack™ is *TPoint-specific* software technology that improves the Paramount's tracking accuracy. Based on your pointing calibration data, and the resulting pointing model, small corrections are periodically made to the telescope's position that actually compensate for mechanical tracking errors, such as tube flexure and out of round gears as well as other systematic errors, such as atmospheric refraction. This same tracking enhancement technology is used on many of the world's largest telescopes, such as the 8-meter Gemini telescopes.

ProTrack gives amateur astronomers the ability to take long unguided exposures (up to 20 minutes at 100-inch focal length) with pinpoint stars. *Unguided exposures* of this duration at moderate to long focal lengths, with pinpoint stars, are simply not possible without this type of software and hardware integration.

ProTrack works best with a Super Model based on an extensive set of pointing calibration data set, and is typically used in permanent installations. However, ProTrack can provide useful tracking corrections using a smaller number of pointing samples, making it useful for semi-portable or mission critical portable setups.

ProTrack Minimum Requirements

ProTrack requires the following minimum hardware and software.

1. A Paramount MX, Paramount ME, Paramount ME II, or MKS Series Software Bisque Telescope Control System (Bisque TCS).
2. TheSkyX Professional Edition.
3. *TPoint Add On*.
4. A fixed mirror telescope. (Errors due to mirror flop make high-accuracy tracking nearly impossible.)
5. An extensive set of TPoint modeling data (50 to 200 stars or more recommended).

Getting Started with ProTrack

A robust mount coupled with superb modeled telescope pointing is required for superb modeled telescope tracking. Here are the keys to getting excellent ProTrack results:

- Make sure every component of the imaging system is robust, from the pier mounting to the camera mounting and everything in between. Loose mechanics, or even poorly mounted cabling can introduce random errors that cannot be corrected by TPoint and therefore degrade ProTrack's performance.
- Use the *TPoint Add On's* Automated Pointing Calibration feature to obtain an accurate pointing calibration data set.
- Employ a TPoint Super Model that is based on a large number of pointing calibration samples.

Activating ProTrack

1. From *TheSkyX Professional Edition*, choose the **Connect** command from the **Telescope** menu to connect to the Paramount.
2. Turn on the **Activate ProTrack** checkbox on the **ProTrack** tab of the **TPoint Add On** window to view a table of ProTrack corrections that will be applied to tracking.
3. Turn on the **Enable Tracking Adjustments** checkbox to apply the corrections to the mount's position while tracking.

Details about the **ProTrack** tab on the **TPoint Add On** window can be found in the *TPoint Add On* User Guide.

Troubleshooting Mount Operation

| Problem | Solution |
|---|---|
| TheSkyX Professional Edition cannot communicate with the Paramount. | <p>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, please try the following:</p> <ol style="list-style-type: none"> 1. Make sure the mount is powered on. 2. Make sure the plugs on each end of USB 2.0 cable are seated properly. 3. Make sure the software settings are correct. 4. See “Longer USB Cable Runs” on page 138. |
| Paramount does not find the home position reliably. Sometimes the home position appears to be successfully located, other times not (resulting in successive beeps emitted by the control system). | <p>The center position of the joystick on the hand controller may need to be calibrated.</p> <p>To Calibrate the Joystick</p> <ol style="list-style-type: none"> 1. Install TheSkyX Pro Latest Update: http://www.bisque.com/sc/media/p/45732.aspx. 2. Install TheSkyX Pro Daily Build (when available): http://www.bisque.com/sc/media/p/45603.aspx. 3. Launch TheSkyX. 4. Choose the Connect command from the Telescope menu. If prompted to find the home position, click No. 5. Choose the Bisque TCS command from the Tools menu on the Telescope window. 6. Click the Utilities tab. 7. Click Hand Controller on the left side of this window to reveal the Hand Controller pane. 8. Click the Calibrate Joystick button. |
| The Paramount will not slew. | <p>Make sure the Three Position Switches in both right ascension and declination are in the Track position (page 59).</p> |
| The Paramount emits continuous, successive, high-pitch “beeps” shortly after startup and will not slew. | <ul style="list-style-type: none"> • Check that the balance knobs are adjusted properly. If the balance knobs are too tight, then the worm is forced against the gear, and the mount will not slew. • Check the mount balance in both axes. If the Paramount 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 |

| Problem | Solution |
|---------|---|
| | lift heavy loads, tracking performance, and slewing, may suffer when the payload is greatly out of balance. |

Longer USB Cable Runs and USB Hubs

To achieve reliable communication, the USB 2.0 specification states that the maximum length of a USB cable is about 16 feet (5 m). Longer cable runs introduce delays in the USB communication which means the computer cannot “talk to” the attached device.

The Paramount is supplied with a standard USB cable that is roughly 15 feet (4.6 m) long. This cable, when used in conjunction with an approximately 3 foot long, high-quality USB cable to connect the USB port on the Instrument Panel to the camera head, will reliably control the Paramount and a CCD camera simultaneously.

If you need a longer USB cable run anywhere in the chain, Software Bisque strongly recommends using one of the USB extension solutions from ICRON (<http://www.icron.com>). Although the ICRON USB extender solutions are more expensive, they work. In general, externally powered USB extensions work better than extenders that are powered using only the 5V supply in the USB line. We have found, in general, USB extenders with hardware at both ends of the extension work most reliably.

Software Bisque has experimented with many inexpensive USB extenders and most of them just *do not work*. Even worse, some work “some of the time” but often result in strange or unpredictable behavior.

After adding *any* USB extender to the Paramount, if you encounter *any* unusual behavior with the Paramount or device connected to the USB ports on the Instrument Panel, please see “Troubleshooting Communication Problems” below.

Using Multiple USB Devices

Unfortunately, Software Bisque cannot guarantee the Paramount will work with every possible USB/USB Hub/USB Extension/USB Device configuration. The number of hardware permutations is virtually endless, and, based on Software Bisque’s experience inexpensive USB extenders and inexpensive USB hubs introduce communication problems.

For example, we’ve encountered a configuration where an “innocent looking” USB hub in the chain of computer/Paramount/Apogee Instruments CCD camera not only caused artifacts on the CCD photos, *TheSkyX Professional Edition* would lose communication when the camera download photos. No USB hub, no problems.

Generally speaking, do not buy inexpensive USB extenders or to connect a wide variety of USB devices (hubs), you will regret it.

Troubleshooting Communication Problems

After adding a USB hub, USB cable extender or any other USB peripheral device to the Paramount USB cable, if *TheSkyX Professional Edition* is unable to connect to the Paramount (with frequent timeout errors or poor communication errors), remove every USB device except for the supplied 15-foot USB cable. Then use the process of elimination and add one USB device at a time to determine which one is problematic.

Appendix A: Installing the MKS 5000 USB Windows Driver

When used with the Windows operating system, the Paramount MKS 5000 control system requires a one-time software driver installation before *TheSkyX Professional Edition* for Windows can be used to control the mount.

Windows USB Driver Installation and Use

The following procedure describes how to install the MKS 5000 USB driver under Windows 8, Windows 7 and Windows XP (32-bit and 64-bit editions) and configure *TheSkyX Professional Edition* to use this port once the driver has been installed.

1. From Windows Explorer, double-click the file named *MKS 5000 Driver Installer.exe* located in the *MKS 5000 Driver* folder on *TheSkyX Professional Edition* for Windows DVD you received with your mount.

This installer can also be downloaded from the Software Bisque web site from the following URL: <http://www.bisque.com/MKS5000>. Remember, you must sign in and *register your Paramount serial number* at www.bisque.com/register before your Software Bisque account can download this file.

2. Follow the installation instructions to complete the installation.
3. Once driver installation is complete, plug the USB 2.0 cable into the USB port on the Electronics Box and the USB 2.0 connector into a free USB port on the computer.



The Paramount must be turned on before the operating system will recognize the USB port on the Electronics Box and load the MKS 5000 driver.

4. Flip the Paramount power switch to the on position.
5. From *TheSkyX Professional Edition's* mount **Settings** window, select the COM port on the **Telescope > Telescope Setup > Mount Setup pop-up > Settings > Serial Port** list with the description **Software Bisque MKS 5000** (Figure 69).

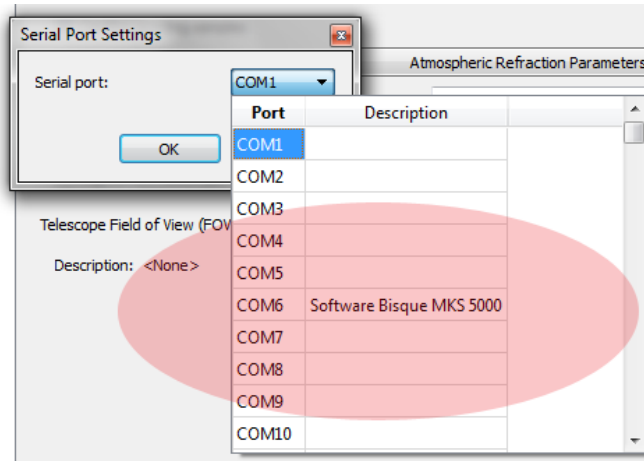


Figure 69: Selecting the COM port from *TheSkyX Professional Edition for Windows*.

The Windows Device Manager can also be used to determine the COM port number that is assigned to the MKS 5000.

Accessing Windows Device Manager

If necessary, use the Windows Device Manager to determine the COM port number that is assigned to the MKS 5000 driver, or to check the status of the driver.

Windows 8

1. Press the Windows Key+X.
2. Click the **Device Manager** command from the **Power User Menu**.

Windows 7 and Windows Vista

1. Click **Start**.
2. In the **Search Programs and Files** text box, type **Device Manager**, then click the magnifying glass graphic, or press **Enter**.

Windows XP

1. Click **Start > Settings > Control** and double-click the **System** icon.
2. On the **System Properties** window click the **Hardware** tab.
3. Click the **Device Manager** button on the **Hardware** tab.

With the Paramount's USB cable plugged in to the computer and into the mount's USB port, expand the **Unknown USB Devices** node to view the COM port number: **Software Bisque MKS 5000 (COMN)**, where N represents the communications port number.

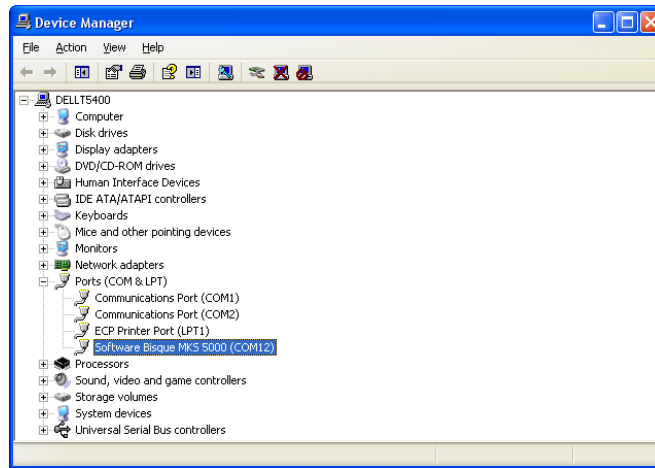


Figure 70: Windows XP Device Manager showing the COM port number assigned to the Paramount's USB port.

Uninstalling the MKS 5000 Driver

The procedure below describes how to uninstall the MKS 5000 driver.

1. Start Windows Device Manager. See "Accessing Windows Device Manager" above for your operating system.
2. On the **Device Manager** window, expand **Ports (COM & LPT)**. Note that Windows Device Manager lists the driver only when the Paramount is turned on and a USB cable is plugged into the mount and the computer's USB port.
3. Right-click **Software Bisque MKS 5000 (COMN)**, where "N" is the COM port number that Windows assigned to the driver.
4. Choose the **Uninstall** command from the pop-up menu (Figure 71).

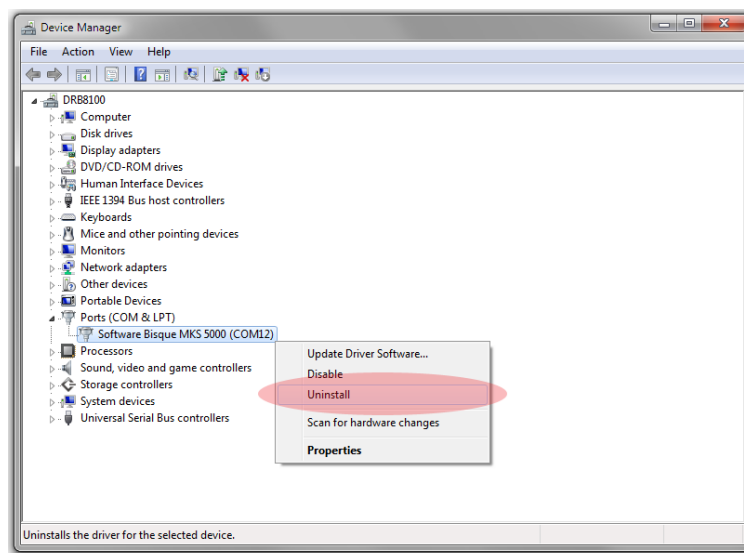


Figure 71: Uninstalling the MKS 5000 driver from the Device Manager.

5. On the Confirm Device Uninstall window, turn on the Delete this driver software for this device checkbox if you wish to delete the drivers from the computer's hard drive, then click OK to finish.

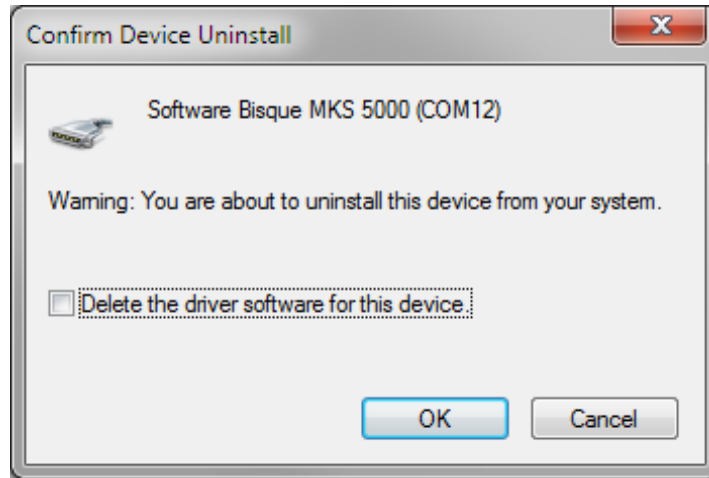




Figure 72: Confirm uninstallation.

The Software Bisque MKS 5000 driver is now uninstalled.

Appendix B: Paramount Technical Drawings

Technical drawings of many Paramount components are available in PDF format and can be downloaded from the Software Bisque web site. A SolidWorks eDrawing can also be used to determine many “non-standard” mount dimensions.

Click on the link below to visit the Software Bisque web page and download the drawing. Note that you must be signed in to the Software Bisque site to access these files. Windows users must install a PDF reader to view them. If the link below is not accessible, visit www.bisque.com, sign in, then click the Downloads link, then click the Documentation link in the left column of this page.

| Name | URL of Drawing | |
|---|---|---|
| |  |  |
| Base Plate to Pier Adaptor Plate | http://www.bisque.com/sc/media/p/28014.aspx | http://www.bisque.com/sc/media/p/45115.aspx |
| Basic Dimensions | http://www.bisque.com/sc/media/p/71810.aspx | http://www.bisque.com/sc/media/p/47243.aspx |
| Counterweight Shaft Extension Bar | http://www.bisque.com/sc/media/p/74385.aspx | http://www.bisque.com/sc/media/p/47380.aspx |
| Electronics Box | http://www.bisque.com/sc/media/p/48279.aspx | http://www.bisque.com/sc/media/p/48279.aspx |
| Instrument Panel | http://www.bisque.com/sc/media/p/48280.aspx | http://www.bisque.com/sc/media/p/48280.aspx |
| Paramount Wedge Assembly and Base Plate | http://www.bisque.com/sc/media/p/75443.aspx | http://www.bisque.com/sc/media/p/44777.aspx |
| Permanent Pier | http://www.bisque.com/sc/media/p/75436.aspx | http://www.bisque.com/sc/media/p/48198.aspx |
| Pier Mounting Options | | http://www.bisque.com/sc/media/p/47058.aspx |

| Name | URL of Drawing | |
|---------------------|---|---|
| Pier Top Plate | http://www.bisque.com/sc/media/p/47833.aspx | http://www.bisque.com/sc/media/p/47833.aspx |
| SolidWorks eDrawing | http://www.bisque.com/sc/media/p/66949.aspx | http://www.bisque.com/sc/media/p/44932.aspx |
| Versa-Plate | http://www.bisque.com/sc/media/p/75171.aspx | http://www.bisque.com/sc/media/p/45114.aspx |

Computing Dome Offset Distance

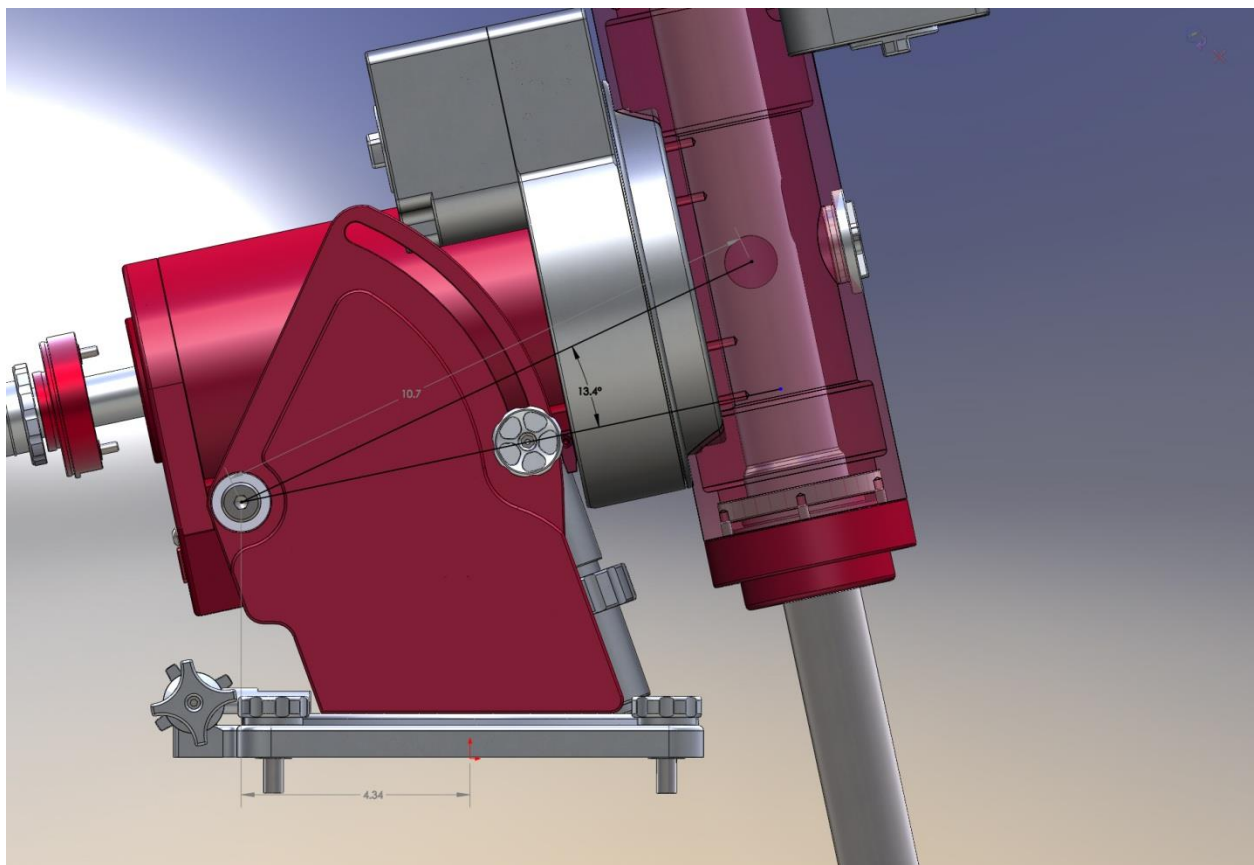


Figure 73: Diagram showing the derivation of dome offset equation for the Paramount MX.

You may wish to permanently mount your Paramount so that center of the dome is coincident with the center of the intersection of the mount's right ascension and declination axes.

One of the required measurements to do so is the distance from the center of the Paramount to the intersection of the mount's right ascension and declination axes (which changes with latitude).

Use the following equation to compute the distance from the center point of the Paramount mount to the intersection of the right ascension and declination axes.

| Model | Equation to Compute Mount Center | |
|-------|--|---|
| | in. | cm. |
| MEII | Distance = $14 * \cos(\text{latitude} + 15.7^\circ) - 4.8$ | Distance = $35.6 * \cos(\text{latitude} + 15.7^\circ) - 12.2$ |
| MX | Distance = $11 * \cos(\text{latitude} + 13.7^\circ) - 4.3$ | Distance = $27.9 * \cos(\text{latitude} + 13.7^\circ) - 10.9$ |

The table below shows the distance to the base center over a range of latitudes.

| Latitude (°) | Distance to Base Center (cm/in.) | |
|--------------|----------------------------------|-----------|
| | MEII | MX |
| 10 | 19.9/7.8 | 14.7 /5.8 |
| 13 | 19/7.5 | 14.0/5.5 |
| 16 | 18.1/7.1 | 13.3/5.3 |
| 19 | 17.1/6.7 | 12.6/5.0 |
| 22 | 16/6.3 | 11.8/4.6 |
| 25 | 14.8/5.8 | 10.9/4.3 |
| 28 | 13.5/5.3 | 9.9/3.9 |
| 31 | 12.2/4.8 | 8.9/3.5 |
| 34 | 10.8/4.3 | 7.9/3.1 |
| 37 | 9.4/3.7 | 6.8/2.7 |
| 40 | 7.9/3.1 | 5.6/2.2 |
| 43 | 6.3/2.5 | 4.4/1.7 |
| 46 | 4.7/1.8 | 3.2/1.2 |
| 49 | 3/1.2 | 1.9/0.7 |
| 52 | 1.3/0.5 | 0.6/0.2 |
| 55 | -0.4/-0.2 | -0.8/-0.3 |

| Latitude (°) | Distance to Base Center (cm/in.) | |
|--------------|----------------------------------|-----------|
| 58 | -2.2/-0.9 | -2.1/-0.8 |
| 61 | -4.0/-1.6 | -3.5/-1.4 |
| 64 | -5.8/-2.3 | -5.0/-2.0 |
| 67 | -7.7/-3.0 | -6.4/-2.5 |

For the northern hemisphere, a positive value indicates that the intersection of the ra/dec axes is north of the center of the mount. A negative value indicates the intersection of the ra/dec axes is south of the center of the mount.

Appendix C: External Power Cable Sets

Software Bisque sells “sets of two cables” that can be used to supply power to a camera that is mounted on the optical tube assembly using the standard power supply from the manufacturer in conjunction with the External Power connectors on the Electronics Box (page 63) and the Instrument Panel (page 56).



The External Power connectors on the Instrument Panel and on the Electronics Box **do not supply power** nor do they have anything to do with the Paramount power supply.

These connectors act as a conduit to route an external power source that is connected to External Power connector located Electronics Box to the External Power connector in the Instrument Panel.

External Power Cable Sets can be purchased from the Software Bisque Store for Apogee/QSI cameras, SBIG ST-7 series (5-pin DIN) or ST-L series cameras (6-pin DIN). A “generic” cable set is available for conversion from other power sources and camera.

One end of the “bottom” cable plugs into the camera manufacturer’s power connector and the other end plugs into the External Power connector on the Electronics Box. One end of the “top” cable plugs into the External Power connector on the Instrument Panel and the other into the camera body.

Apogee/QSI/SBIG ST-402/STF-8300 Model Camera External Power Cable Set Specifications

Figure 74 shows the wiring specifications for the Apogee, QSI and newer SBIG model camera’s bottom cable. Figure 75 shows the specifications for the top cable in this set.

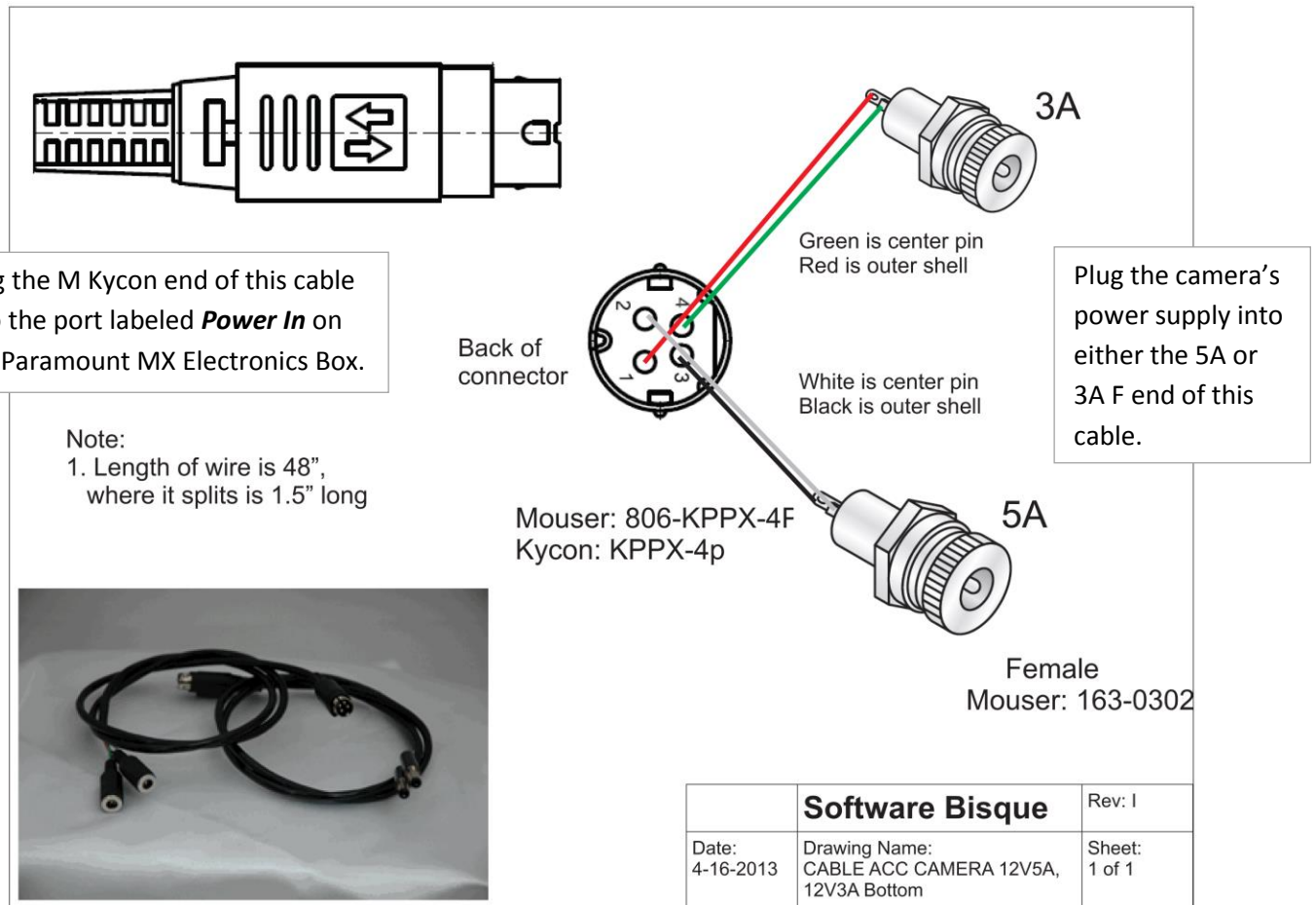


Figure 74: Apogee, QSI and newer model SBIG power connectors on the 36-inch (91 cm) bottom cable.

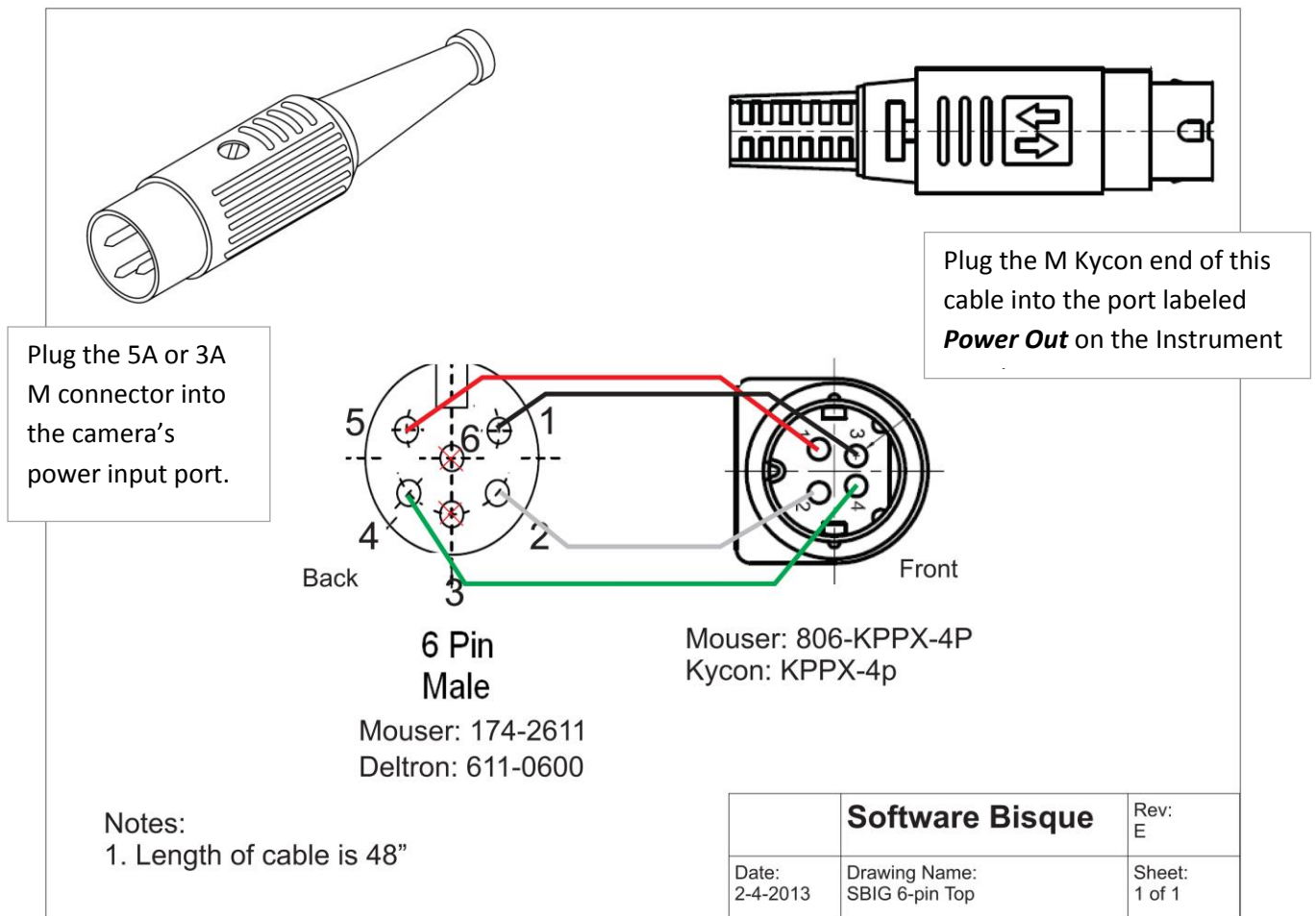


Figure 75: Apogee, QSI and SBIG ST-402 power connectors on the 36-inch (91 cm) top cable.

Visit the URL below to purchase this cable from the Software Bisque Store:

<http://www.bisque.com/sc/shops/store/MXPowerCableApogeeQSI.aspx>

SBIG ST-7 Series (5-Pin) External Power Cable Set Specifications

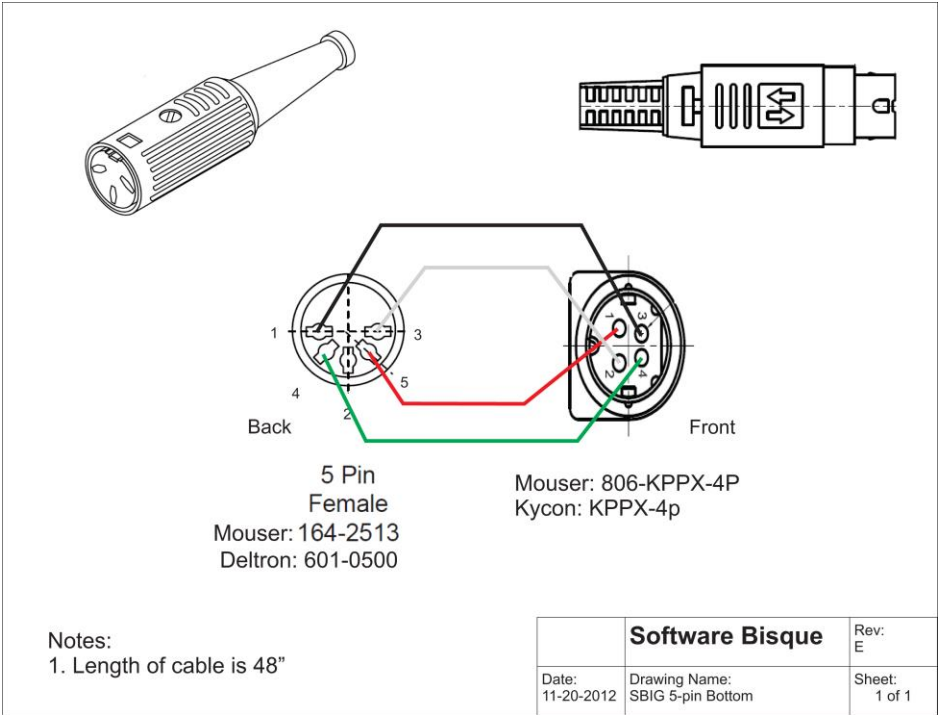


Figure 76 shows the wiring specifications for the SBIG ST-7 series 5-pin bottom cable. Figure 77 shows the specifications for the top cable in this set.

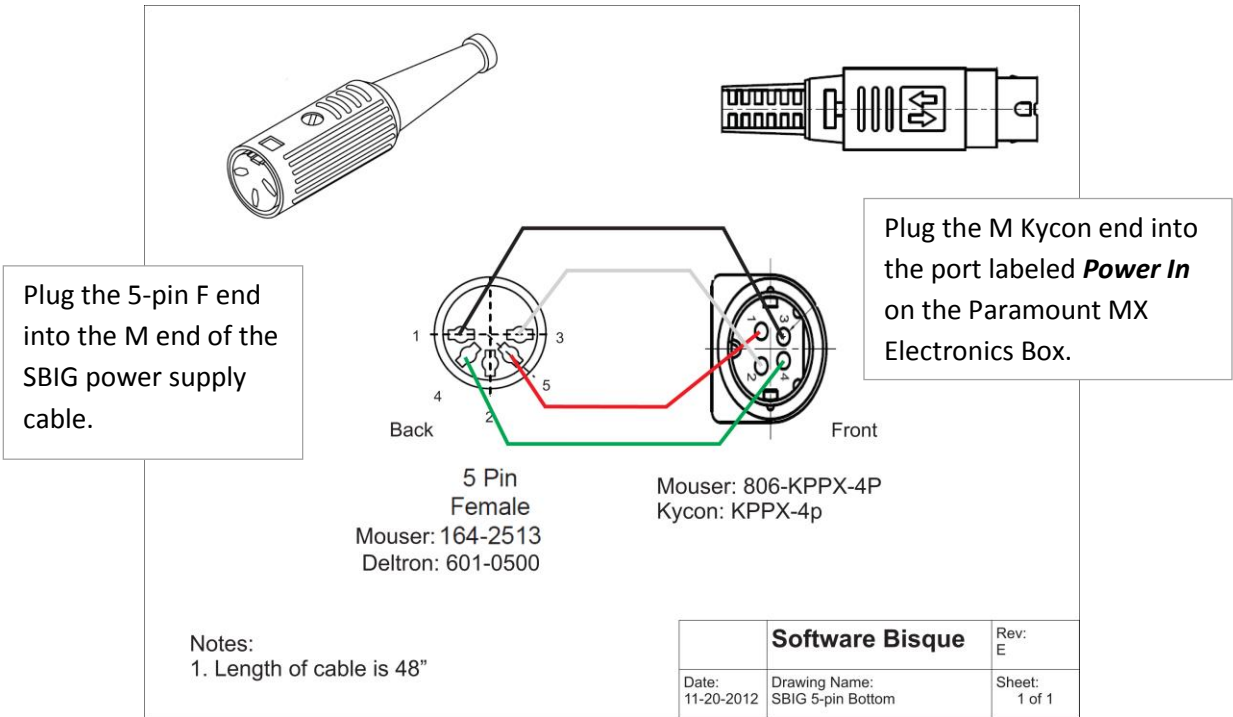


Figure 76: 5-pin SBIG ST-7 type power connectors on the 36-inch (91 cm) bottom cable.

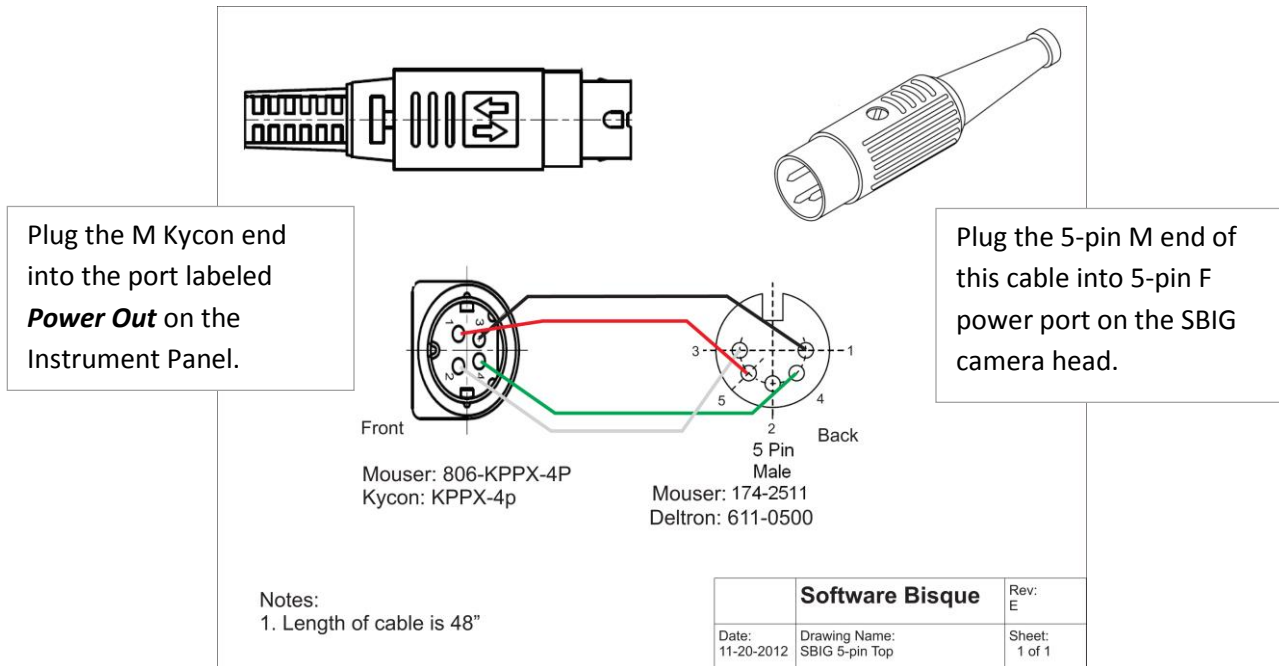


Figure 77: 5-pin SBIG ST-7 type power connectors on the 36-inch (91 cm) top cable.

The SBIG ST-7 Series (5-Pin) External Power Cable Set is compatible with all SBIG camera models that use the 5-pin power connector.

Visit the URL below to purchase this cable from the Software Bisque Store:

<http://www.bisque.com/sc/shops/store/MXPowerCableSBIGST7.aspx>

SBIG ST-L Series (6-Pin) External Power Cable Specs

Figure 78 shows the wiring specifications for the SBIG STL series 6-pin bottom cable. Figure 79 shows the specifications for the top cable in this set.

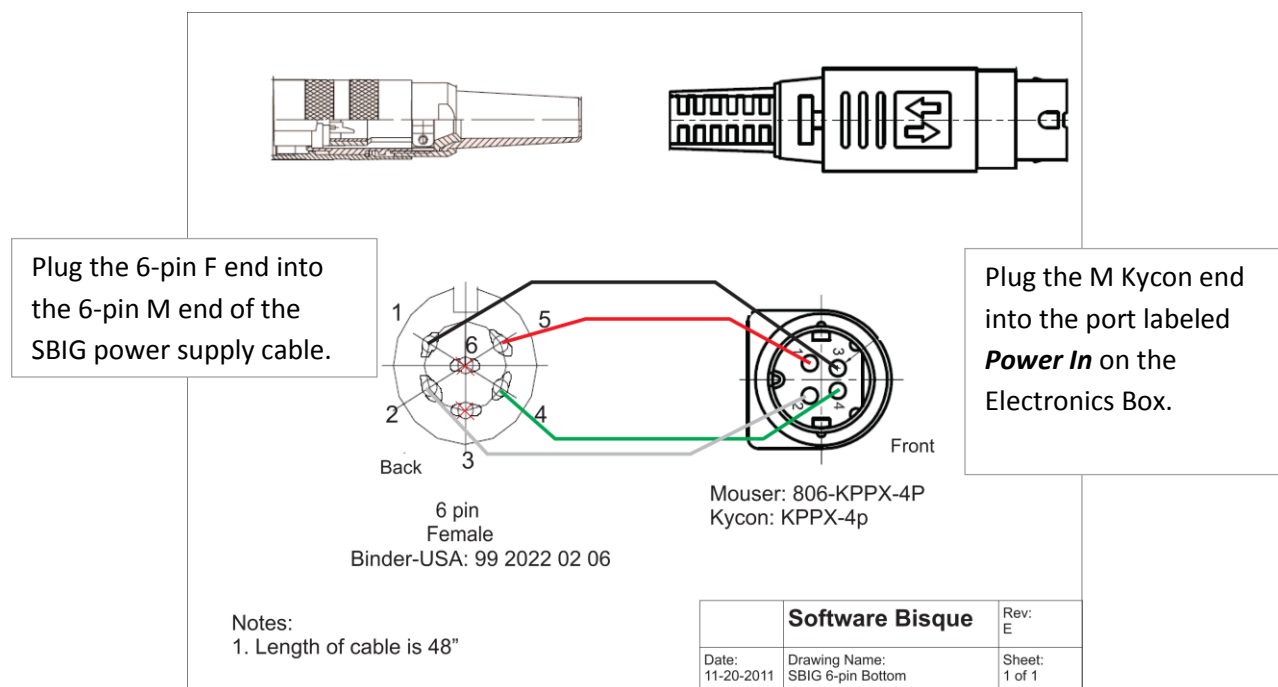


Figure 78: 6-pin SBIG ST-L type power connectors on the 36-inch (91 cm) bottom cable.

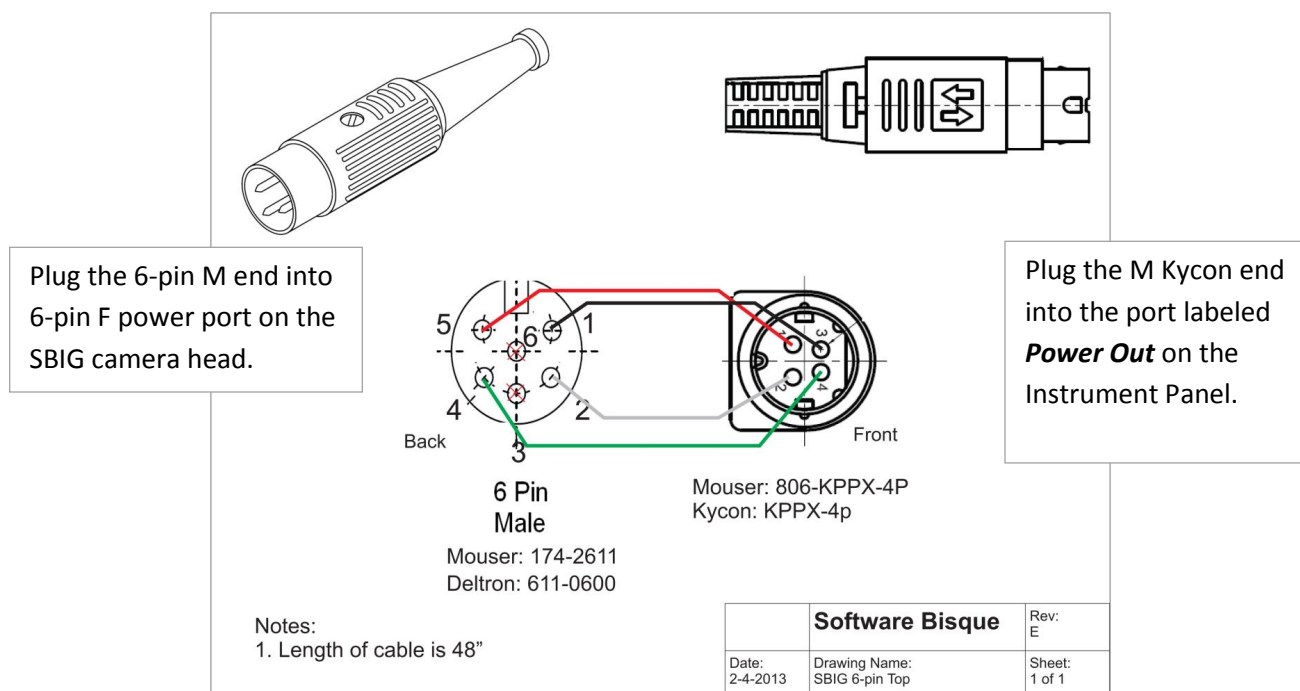


Figure 79: 6-pin SBIG ST-L type power connectors on the 36-inch (91 cm) top cable.

The SBIG ST-L Series (6-Pin) External Power Cable Set is compatible with all SBIG camera models that use the 6-pin power connector.

Visit the URL below to purchase this cable from the Software Bisque Store:

<http://www.bisque.com/sc/shops/store/MXPowerSBIGSTL.aspx>

Finger Lakes Instruments External Cable Specs

The Finger Lakes Instruments power supply uses a four pin male Kycon connector that is *normally* plugged directly into the FLI camera head (see the port labeled *12V power supply in* in Figure 82).

To power an FLI camera using the Paramount's built-in through the mount cabling, plug one end of the male-to-male FLI External Power Cable (Figure 81) into the port labeled *Power Out* on the Instrument Panel, and the other end into the port labeled *Power* on the FLI camera head (Figure 82).

Next, plug the male Kycon connector on the FLI power supply into the port labeled *Power In* on the Electronics Box.

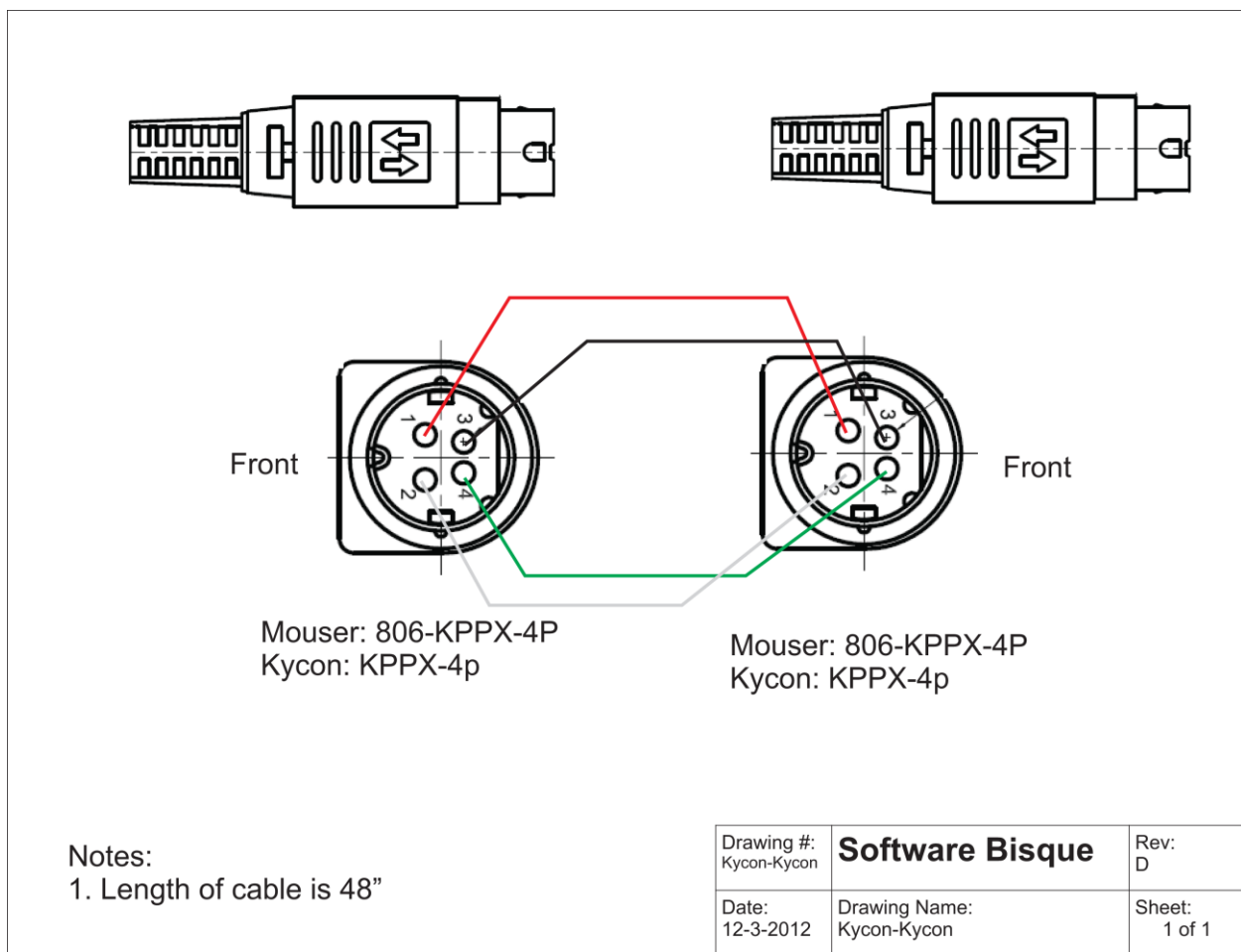


Figure 80: Finger Lakes Instruments external power cable wiring specifications.



Figure 81: Photograph of the Finger Lakes Instruments external power cable.

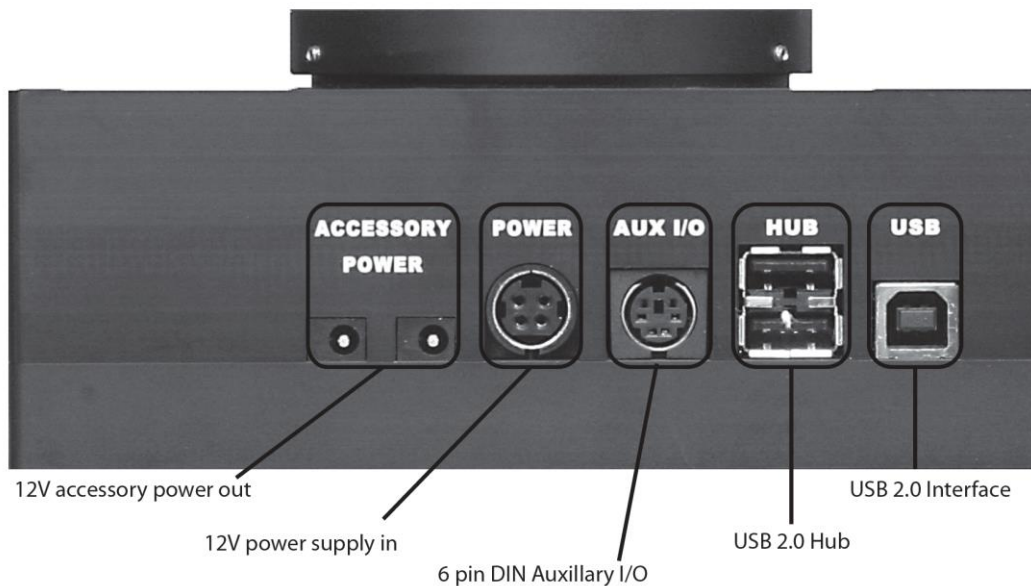


Figure 82: Finger Lakes camera input ports. Diagram copyright Finger Lakes Instruments.

Visit the URL below to purchase this cable from the Software Bisque Store:

<http://www.bisque.com/sc/shops/store/MXExtCableFLI.aspx>

Generic External Power Cable Specs

The generic external power cable set consists of two identical cables, one end incorporates the Kycon KPPX-4p connector and the other end terminates in four shielded wires. How these four conductors are used is up to you!

Visit the URL below to purchase this cable from the Software Bisque Store:

<http://www.bisque.com/sc/shops/store/MXPowerCableGeneric.aspx>



Figure 83: Generic external power cables.

Appendix D: Paramount Warranty

Software Bisque warrants to the original owner that the Paramount will be free from defects in mechanical parts (for two years) and all electrical parts (for one year) from the date of delivery.

Software Bisque's limited warranty covers only those defects that are the result of normal use, and do not apply to any improper or inadequate maintenance or modification or operation outside the product's specifications.

If any component on the Paramount fails for any reason, please submit a post to the Paramount ME II or Paramount MX support forum at: www.bisque.com/support so that a support technician can assist in troubleshooting. Please also include the exact description of the problem as well as the exact wording of any error messages you encountered when connecting to or controlling the mount from TheSkyX Professional Edition.

If Software Bisque determines a replacement component is necessary, we'll email you a Returned Merchandise Authorization (RMA) form. Once this form has been completed and returned, you will be issued an RMA number. When returning items, please clearly print the RMA number on the outside of shipping boxes; shipments received without an RMA number will be rejected.

The following section describes the warranty and non-warranty replacement policy and procedure for the MKS 5000 Electronic Board.

MKS 5000 Warranty Replacement Procedure and Policy

Once Software Bisque has determined that a replacement MKS 5000 is necessary, and the mount (or component) is under warranty, then you are eligible to receive a replacement.

- A \$300.00* deposit is required to order a warranty replacement electronic board.
- The failed MKS 5000 must be returned to Software Bisque.
- When Software Bisque receives the failed electronics, your account will be credited the amount of the deposit.
- Customer is responsible for shipping costs to Software Bisque.
- Software Bisque is responsible for the return shipping costs.

To proceed with a warranty replacement,

1. If you have not already done so, register your Paramount serial number which serves as proof of purchase.
2. Send an email message the Software Bisque Front Desk to request a Returned Merchandise Authorization form (FrontDesk@bisque.com).
3. Once the RMA form has been completed and returned to Software Bisque, an RMA number and a Coupon Code will be emailed to you. The coupon code allows you to "purchase" the warranty

replacement board for the cost of the deposit only (shipping charges apply). Again, the deposit will be refunded when Software Bisque receives the failed board. The RMA number must appear on the outside of the shipping box when you return the failed component to Software Bisque (see the bottom of this page for the shipping address).

MKS 5000 Non-Warranty Replacement Procedure and Policy

Once Software Bisque has determined that a replacement is necessary, and the component is *not* under warranty, you are eligible to receive a replacement MKS 5000 board for \$500.00* (this price does not include shipping and handling costs).

An additional \$300.00 deposit is required when ordering a non-warranty replacement MKS 5000 electronic board from the Software Bisque Store.

- A \$300.00* deposit is required to order a warranty replacement electronic board.
- The failed MKS 5000 must be returned to Software Bisque.
- When Software Bisque receives the failed electronics, your account will be credited the amount of the deposit.
- Customer is responsible for shipping costs to and from Software Bisque.

To proceed with a non-warranty replacement,

1. If you have not already done so, register your Paramount MX serial number which serves as proof of purchase.
2. Purchase this product.
3. Send an email message the Software Bisque Front Desk (FrontDesk@bisque.com) to request a Returned Merchandise Authorization (RMA) form.

Once the RMA form has been completed and returned to Software Bisque, you will be emailed an RMA number. The RMA number must appear on the outside of the shipping box when you return the failed component.

Shipping Address

Software Bisque's shipping address is:

Software Bisque, Inc.
862 Brickyard Circle
Golden, CO 80403-8058
USA

Please do not forget to print the RMA number on the outside of the shipping box!

* Prices subject to change without notice.

Appendix E: Revision History

The table below describes the changes in each revision of this user guide.

| Revision | Description of Changes |
|----------|---|
| 1.71 | <ul style="list-style-type: none"> Added note about a minor design change in the Paramount MX cable conduit cover. Removed references to the discontinued Paramount MX ScopeGuard case. |
| 1.70 | <ul style="list-style-type: none"> Correct the technical drawing for the top SBIG ST-L External Power Cable. |
| 1.69 | <ul style="list-style-type: none"> Updated technical drawings for the through the mount power cables. Documented the Remove All button in the Synchronization History documentation. |
| 1.68 | <ul style="list-style-type: none"> Updated the procedure to install the MSK 5000 driver. Updated FLI external power cable documentation. Updated warranty policy and procedure. |
| 1.67 | <ul style="list-style-type: none"> Added a photo to clarify Paramount MX declination axis through the mount cabling. |
| 1.66 | <ul style="list-style-type: none"> Corrected the PEC table index range for the Paramount ME II. |
| 1.64 | <ul style="list-style-type: none"> Added Power Supply Extension Cable to packing list and attempted to clarify how to use this cable to supply power the Paramount ME II. Updated technical drawing of the Electronics Box. Added a reference to the Paramount Quick Start Guide document. |
| 1.63 | <ul style="list-style-type: none"> Clarified the differences between the Paramount ME II and the Paramount MX with respect to the location of the Base Plate set screw access holes. Corrected the description of the location of the physical hard stops on the Paramount ME II and the hours past the meridian specification. |
| 1.62 | <ul style="list-style-type: none"> Corrected the Paramount ME II vs. MX power supply specifications on page 84. |
| 1.61 | <ul style="list-style-type: none"> Clarified that the Paramount ME II's Versa-Plate can be mounted in the Standard or Wide Orientation, similar to the Paramount MX. |

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