

Paramount ME User's Guide

Revision 1.10



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Warning

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

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

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

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Table of Contents

FCC COMPLIANCE STATEMENT	3
WARNING	3
NOTE	3
SOFTWARE BISQUE END USER LICENSE AGREEMENT	4
<u>THE PARAMOUNT ME ROBOTIC TELESCOPE SYSTEM</u>	10
WHAT MAKES PARAMOUNT ME DIFFERENT?	10
OPTIONS	11
UNPACKING THE PARAMOUNT ME	11
PACKING LIST	12
<u>MOUNT NOMENCLATURE</u>	16
<u>PARAMOUNT ME ASSEMBLY AND SETUP</u>	17
ROUGH ALTITUDE ADJUSTMENT	17
ALTITUDE DIVISIONS	17
ATTACHING THE COUNTERWEIGHT SHAFT	18
ATTACHING THE VERSA-PLATE	19
PLUGGING IN VERSA-PLATE INSTRUMENT PANEL	22
ATTACHING THE MOUNT TO THE PIER	23
MICRO-LEVELERS	23
FIRST SLEWS	24
WHAT IS THAT SOUND?	24
WHAT IS HOMING?	24
HOMING THE MOUNT USING THE JOYSTICK	25
THE JOYSTICK	25
HOMING THE MOUNT USING THE SKY	26
ADDING THE COUNTERWEIGHTS	26
BALANCE THE SYSTEM	28
BALANCE KNOBS	29
PULLING THE WORM AWAY FROM THE GEAR	29
ENGAGING THE WORM AND GEAR	30
<u>ATTACHING THE OPTICAL TUBE ASSEMBLY TO THE VERSA-PLATE</u>	30
DOVETAIL USE	30
ATTACHING RINGS	30
CABLE CHANNEL	31
<u>INITIAL POLAR ALIGNMENT</u>	31
ALTITUDE ADJUSTMENT	31

AZIMUTH ADJUSTMENT	31
AZIMUTH TENSIONING SCREWS	31
ADDITIONAL AZIMUTH ADJUSTMENT	32
<u>PARAMOUNT ME QUICK POLAR ALIGNMENT METHOD</u>	33
<u>PRECISE POLAR ALIGNMENT</u>	34
POLAR ALIGNMENT USING TPOINT	35
GETTING STARTED USING TPOINT	35
TELESCOPE MAPPING AND POLAR ALIGNMENT PROCEDURE	35
POLAR ALIGNMENT – THE DRIFT METHOD	37
<u>PARAMOUNT ME INITIALIZATION</u>	38
HOMING	38
WHY IS ACCURATE TIME IMPORTANT?	39
<u>SETTING THE COMPUTER CLOCK</u>	39
<u>PARKING THE PARAMOUNT ME</u>	40
SETTING THE PARK POSITION	40
PARKING THE PARAMOUNT ME	40
<u>CONNECTING THE ELECTRONICS AND POWER</u>	40
THROUGH THE MOUNT CABLING	41
CABLING SUPPLIED WITH THE PARAMOUNT ME	41
CABLE-CONDUIT	43
<u>INTERFACE TO THE SKY ASTRONOMY SOFTWARE</u>	43
THE THE SKY TCS CONTROL SYSTEM DIALOG BOX	43
MOUNT TYPE	44
MOUNT ID	44
MAXIMUM SPEED	44
ACCELERATION	44
NON SIDEREAL RATE	44
GUIDER SPEED	45
TRACK RATE	45
HOME AFTER LINK	45
FOCUS PULSE	45
HOME SENSOR HOUR ANGLE AND SENSOR DECLINATION	45

SAVE TO FLASH	45
TEXT TO CLIPBOARD	46
<u>TRAINING PERIODIC ERROR CORRECTION (PEC)</u>	47
RECORDING THE PERIODIC ERROR	47
RECORDING CORRECTIONS	48
CURVE FIT: SMOOTHING THE PEC TABLE	49
UPLOADING THE SMOOTHED CURVE TO THE THESKY TCS.	50
APPLY PEC	50
COPY	50
PASTE	50
THESKY TCS™ STATUS DIALOG BOX	51
THESKY TCS™ ADVANCED DIALOG BOX	51
THESKY TCS™ HOMING/LIMITS DIALOG	52
MINIMUM LIMIT, MAXIMUM LIMIT	52
<u>THE FIRST NIGHT</u>	53
SELECTING THE CONTROL SYSTEM IN THE SKY	53
CONNECTING THE PARAMOUNT ME TO YOUR COMPUTER	53
SYNCHRONIZING ON A STAR	54
<u>SYNCHRONIZING THE PARAMOUNT ME</u>	55
STEPS FOR PERFORMING A TELESCOPE SYNCHRONIZATION	55
WHAT DOES THE SYNC COMMAND DO?	55
TELESCOPE MAPPING OVERVIEW	56
USING PROTRACK™	58
MINIMUM REQUIREMENTS FOR PROTRACK	58
GETTING STARTED WITH PROTRACK	58
ENABLING PROTRACK	60
COLD TEMPERATURE OPERATION	61
TROUBLESHOOTING MOUNT OPERATION	61
PROBLEM: I CANNOT COMMUNICATE WITH THE PARAMOUNT ME.	61
PROBLEM: THE PARAMOUNT ME EMITS A NON-STOP, HIGH-PITCH “BEEP” SHORTLY AFTER STARTUP AND WILL NOT SLEW.	61
PROBLEM: I CANNOT HOME USING THE JOYSTICK.	61
PROBLEM: DURING COLD TEMPERATURE OPERATION, THE MOUNT EMITS AN AUDIBLE “VIBRATION” SOUND WHILE SLEWING.	62
<u>APPENDIX A – PREPARING THE PARAMOUNT ME PIER</u>	63
PARAMOUNT ME ADAPTER PLATE SPECIFICATIONS	63
HEAVY-DUTY BASE PLATE	63
LIGHTWEIGHT BASE PLATE	63
PRIMARY MOUNTING HOLES	64
OLD PATTERN (PARAMOUNT S COMPATIBLE)	64

PARAMOUNT ME PIER SPECIFICATIONS **66**

PARAMOUNT ME PIER FROM SOFTWARE BISQUE **66**

PIER BASE PLATE **67**

PIER TOP PLATE **68**

APPENDIX B – PARAMOUNT ME DIMENSIONS **69**

GUIDER **70**

RADIO SHACK® CROSS REFERENCE **70**

APPENDIX C – UPDATING THE CONTROL SOFTWARE ON THE PARAMOUNT ME AND PARAMOUNT GT-1100S **71**

APPENDIX D – SETTING UP AND USING THE PARAMOUNT IN THE SOUTHERN HEMISPHERE **73**

SENSOR HOUR ANGLE (HA) AND SENSOR DECLINATION (DECLINATION) **74**

SETTING THE TELESCOPE LIMITS **74**

The Paramount ME Robotic Telescope System

Thank you for purchasing the Paramount ME Robotic Telescope System. The Paramount ME is a high-precision instrument designed to deliver unmatched telescope performance to the amateur or professional astronomer.

The Paramount ME represents an evolution of the popular “go to” telescopes of the 1990’s. Though these telescopes provided increased ease of use over their manual predecessors, they lacked numerous design features that are required for efficient image acquisition and unattended operation. Most of the earlier “go to” telescopes and mounts were designed as primarily visual instruments that fared only marginally well for CCD imaging. Efficient CCD imaging demands numerous additional capabilities not present in systems that are “good enough” for visual use.

What Makes Paramount ME Different?

The Paramount ME is designed from the ground up to be a sturdy, reliable mount for instruments up to 57 kg (125 lbs.). The following features insure increased productivity for astronomer using the ME:

- Research-grade right ascension gears with less 5 arcseconds or less peak-to-peak periodic error.
- TheSky Astronomy Software integration to remotely control the mount.
- CCDSoft CCD Astronomy Software, for controlling CCD cameras.
- Orchestrate scripting program for running unattended data acquisition sessions.
- TPoint Telescope Pointing Analysis Software with ProTrack™, to provide unmatched pointing and tracking capabilities.
- Software Bisque’s TheSky TCS Telescope Drive System, for precise tracking, periodic error correction and slewing.
- Accurate homing for quick startup and exact repeatability night to night.
- Super stable design dampens rapidly.
- Built in soft-limits prevent damage to the mount and telescope by decelerating softly into limits.
- Clutch free design insures consistent pointing and tracking from night to night.
- 56-bit internal precision in the control system for a wide speed range. Virtually any speed is available between stopped and several degrees per second.
- Advanced periodic error correction with polynomial fitting function.
- 50 conductors of through-the-mount cabling minimize the cabling nightmare that usually results from CCD power, CCD signal, focus, video and other cables routed to the telescope.
- Cable Conduit™ allows for passing additional cables, wires or tubes through the mount.
- Wedge design accommodates latitudes from 15 to 58 degrees.
- Altitude divisions provide an accurate altitude starting point for polar alignment.
- 8-inch RA bearing and 6-inch declination provide maximum stability.
- Numerous internal webbings and external buttresses make the ME extremely rigid, even with heavy payloads.

Options

- TheSky Pocket Edition
- TheSky Pocket Edition with Pocket TPoint
- Integrated precision level bubble
- Extended counterweight shaft for ultra-heavy payloads.
- Declination hub extender (future)
- Electronic panel covers/Balance knob covers (future)
- Star-sighter (future)

Unpacking the Paramount ME

We recommend that you become familiar with all the components of the Paramount ME before attempting to assemble and use the instrument. Although we have taken many steps to ensure ease-of-use, you will learn that there are many critical steps you must follow to obtain optimal telescope performance. Please familiarize yourself with the parts and components diagrams before unpacking your new mount.






Software Bisque has made every effort to ensure that your new mount arrives just the way it left our facilities, ready to run. We want your first experience with our product to be as enjoyable as the many hours you will spend with it under the night sky. Upon receiving the shipping packages, please inspect all boxes for damage of any kind. If you notice anything peculiar, make detailed notes *before* opening the packages (we recommend photographing or video taping the unopened packages if there is any apparent damage).







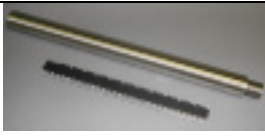
Remove all components from the packing boxes and check to make sure they are in good order. Also compare the pieces with the following Packing List.




Packing List


Item	Photograph	Description
<p>Box 1</p> <p>Dimensions: 63.5 x 63.5 x 45.7 cm (25 x 25 x 18 in.)</p> <p>Weight: 34 kg (80 lbs.)</p>		<p>Paramount ME Mount and the software and documentation box</p>
		<p>8 Versa-Plate mounting screws (1-inch 1/4-20 socket head cap screws)</p> <p>See “Attaching the Versa-Plate” on page 19 for details.</p>
		<p>4 Versa-Plate mounting screws (1-inch 1/4-20 flat socket cap screws)</p> <p>See “Attaching the Versa-Plate” on page 19 for details.</p>
		<p>Note that the Versa-Plate mounting screws (12 total) are packed inside the opening at the top of the declination axis.</p> <p>See “Attaching the Versa-Plate” on page 19 for details.</p>
		<p>Software and Documentation box</p> <p>This box is packed inside Box 1 and includes:</p> <ul style="list-style-type: none"> • TheSky for Windows Level IV • CCDSOft version 5 CD-ROM • CCDSOft version 5 printed User's Manual. • TPoint User's Manual. • The Paramount ME System CD-

		<p>ROM that includes installation software for TheSky update, CCDSoft version 5, TPoint, Orchestrate, IAClient and IAServer software.</p> <p>Note: The CCDSoft and TPoint serial numbers are affixed to the title page of the manual. TheSky serial number is located inside TheSky box.</p>
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Item	Photograph	Description
<p>Box 2</p> <p>Dimensions: 61 x 25.4 x 15.2 cm (24 x 10 x 6 in.)</p> <p>Weight: 11.3 kg (26 lbs.)</p>		<p>Accessories Box</p> <p>Contains the Paramount ME accessories listed below.</p>
		<p>1 1.2 m (4-foot) SBIG Camera Power Cable</p> <p>This cable runs from the Camera Power port on the Paramount ME Instrument Panel to the SBIG camera power input.</p>
		<p>4 3/8-inch, 24 thread per inch base plate attachment knobs.</p> <p>These knobs secure the mount to the pier.</p>
		<p>1 3 m (10-foot) parallel cable</p> <p>This cable runs from the computer's parallel port to the Parallel (25-line) port on the Adaptor Panel for parallel port cameras.</p>
		<p>1 Allen wrench set</p> <p>This set of wrenches can be used to mount the Versa-Plate covers, or remove the mount side panels (if</p>

	remove the mount side panels (if necessary).
	1 0.9 m (3-foot) parallel cable This cable runs from the Parallel (25-line) port on the Interface Panel to the camera's parallel port.
	1 Power Supply cable This cable is plugged into the power supply unit and a 120V (or 220V) outlet.
	1 Instrument Panel Housing This component is mounted to the Versa-Plate. See "Attaching the Versa-Plate" on page 19 for details.
	Extra fuses 1 1.6 amp fuse (for Paramount ME Adaptor Panel) 2 5 amp fuses (power supply)
	1 Power supply unit Plug the small round tip into the port labeled Power on the Adaptor Panel. Plug the power supply cable into the power supply's cable jack.
	1 Joystick Insert the RJ11 plug into the Joystick port on the Paramount ME Adaptor Panel. See "The Joystick" on page 25 for details.
	1 Counterweight shaft Screw the counterweight shaft into the base of the counterweight attachment block. See "Attaching the Counterweight Shaft" on page 18 for

		details.
		1 Versa-Plate to attach the OTA Attach the Versa-Plate to the top of the Declination axis. See “Attaching the Versa-Plate” on page 19 for details.
		1 3 m (10-foot) RS232 serial cable The Paramount ME uses serial communication for software-based mount control. This cable runs from the computer's RS232 port to the port labeled RS232 on the Paramount ME Adaptor Panel.
		1 Counterweight Safety Knob. Screw this knob into the end of the Counterweight Shaft after mounting the counterweights to prevent the counterweight from accidentally falling off the shaft. See “Attaching the Counterweight Shaft” on page 18 for details.

Item	Picture	Description
<p>Box 3</p> <p>Dimensions: 30.5 x 30.5 x 30.5 cm (12 x 12 x 12 in.)</p> <p>Weight: 18 or 27 kg (40 or 60 lbs.)</p>		<p>2 or 3 Counterweights</p> <p>2 (or 3) 9 kg (20 lb.) counterweights. Note that 2 counterweights are supplied with the Paramount ME. Addition counterweights are \$150.00 each</p> <p>Mount the counterweights to the counterweight shaft. See “Adding the Counterweights” on page 26 for details.</p>

Mount Nomenclature

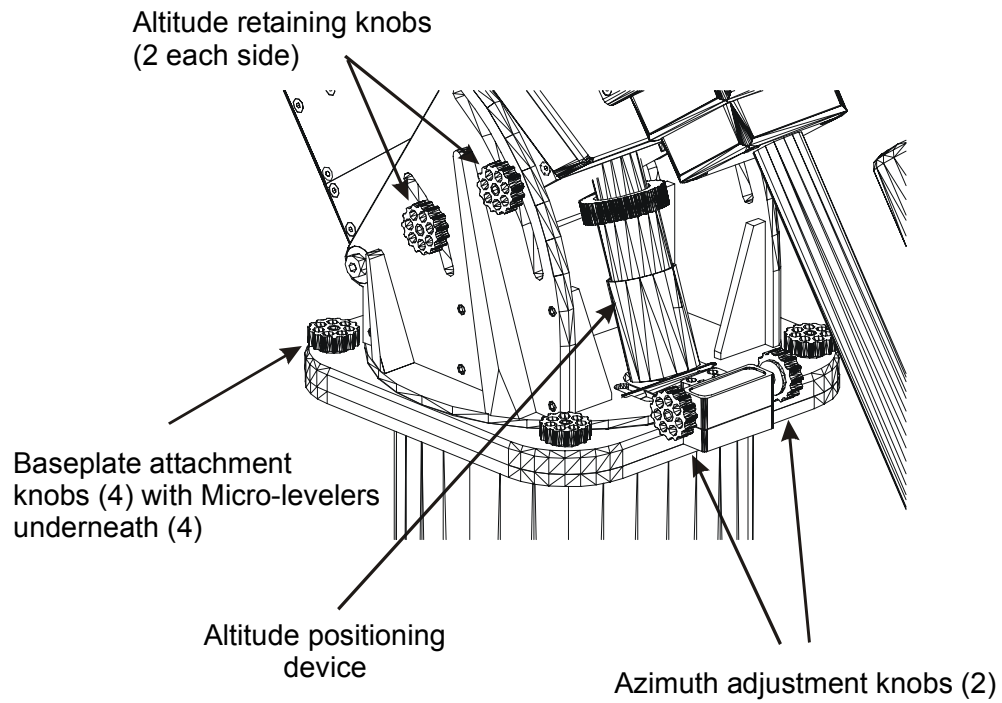
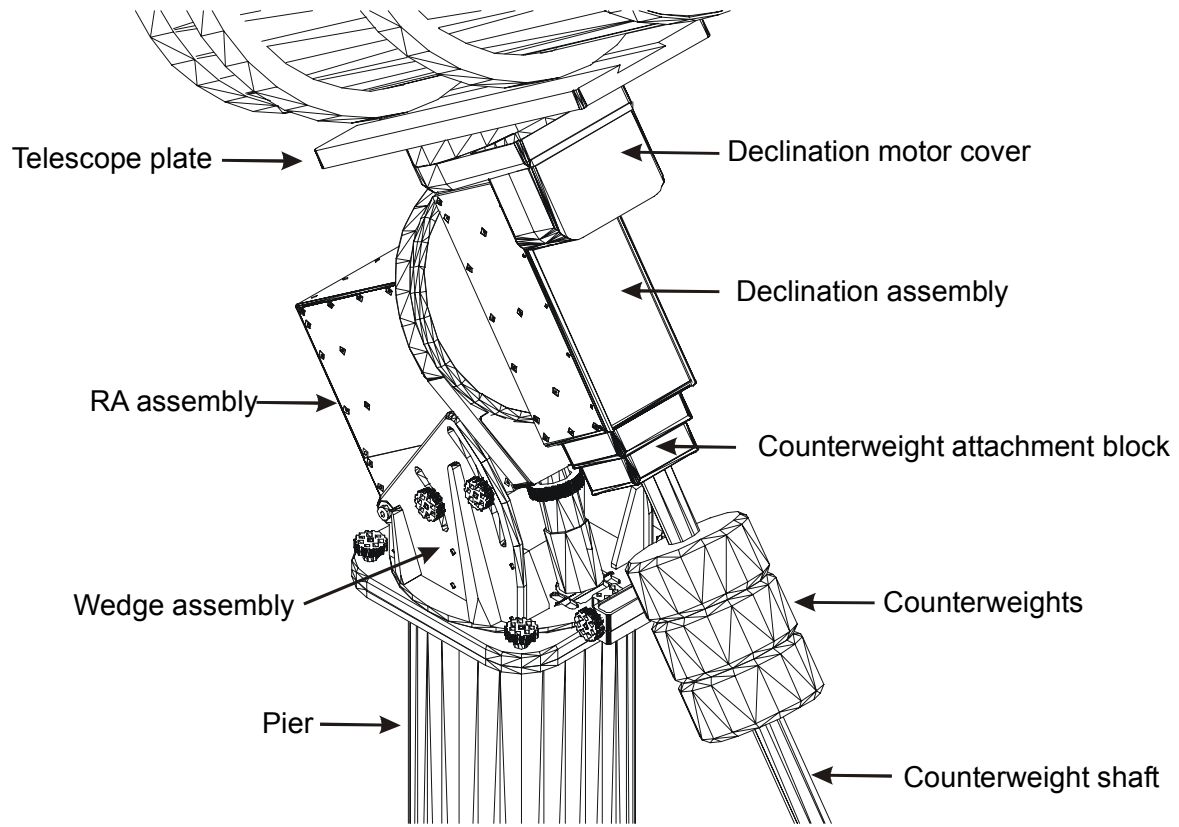


Figure 1 – Paramount ME components.

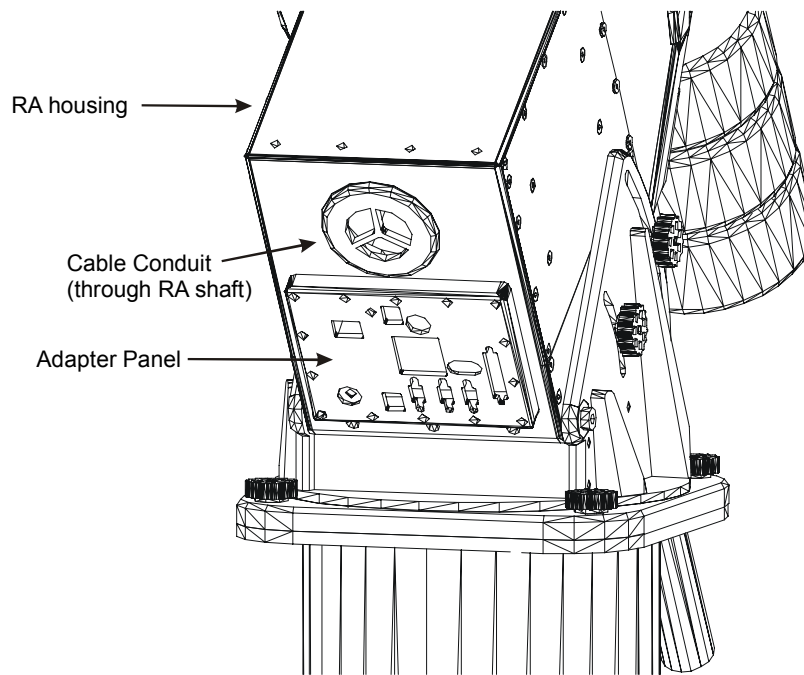
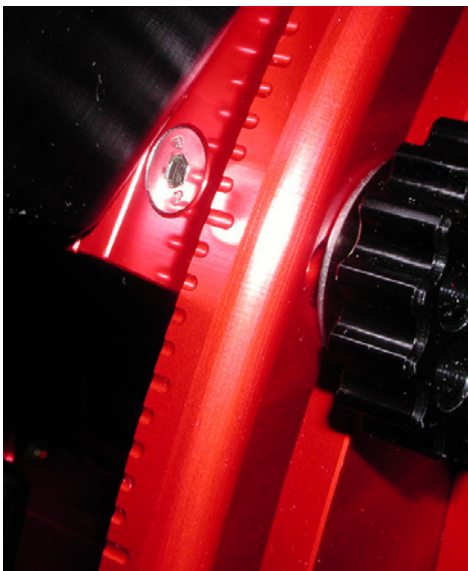


Figure 2 – Paramount ME components (rear view).

Paramount ME Assembly and Setup

Rough Altitude Adjustment

When the boxed Paramount ME arrives, the altitude (which corresponds to your latitude) is set to the lowest possible position of 15 degrees. Before adding any additional weight to the top of the mount, adjust the altitude-positioning device to your approximate latitude.



Altitude Divisions

The altitude divisions machined into the side of each wedge plate allow estimating the latitude to within a fraction of a degree. These divisions are very accurate if the mount is level, and limited accuracy if not.

The larger tics are machined every 10 degrees, the medium tics every 5 degrees and the small every degree. The starting value is 15 degrees so that first large tic is 20 degrees. One full turn of the precision positioning device on the altitude is one degree in the middle of the latitude range (approximately 36 degrees) and slightly different at each of the extremes. Each tic on the knobs of the azimuth adjustment is two arcminutes.

Figure 3 – Altitude divisions.

The altitude adjustment range is from 15 degrees to 58 degrees. Outside of this range, you will need to tilt the pier mounting plate to accommodate the difference.

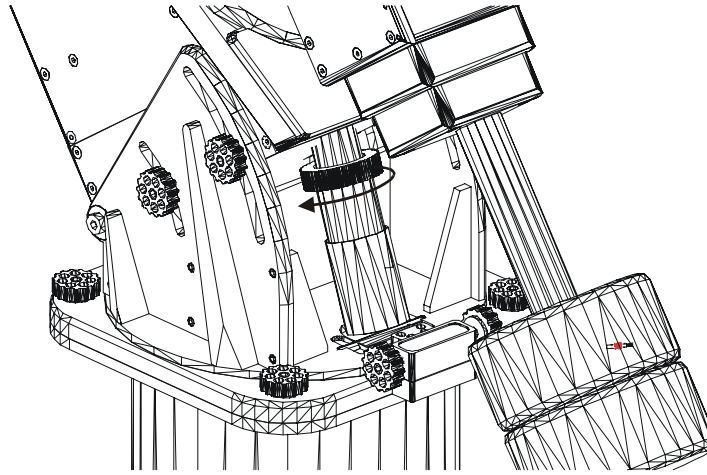


Figure 4 – The arrow above shows the rotation direction for lowering altitude.

Loosen the four altitude-adjustment retaining knobs (two on each side of the mount) so that they are free to turn. This allows the mount to be adjusted within the wedge assembly, using the altitude-positioning device (the cylindrical mechanism with the large knob underneath the mount). You can see the motion of the mount relative to the wedge by watching the altitude divisions on the wedge side plates as the altitude-positioning device is rotated.

If you are placing a very heavy instrument on the ME, it is beneficial to purposely adjust the altitude slightly higher than your latitude. This insures that the altitude adjustment will be in the direction downward and gravity will be aiding in the movement of the instrument and counterweights as the altitude-positioning device is rotated. Otherwise, you may need to “help” the positioning device by lifting upward on the counterweight shaft while turning it.

Attaching the Counterweight Shaft

The counterweight shaft should be threaded into the bottom of the declination housing. The safety knob screws into the opposite end of the shaft. This knob should always be in place when counter weights are present on the counterweight shaft to stop them from accidentally sliding off of the shaft if the knobs are not tightened properly.

At the bottom end of the shaft, there is a small hole drilled in the side of the shaft that can be used as an aid for tightening the shaft into the declination assembly. This is done by inserting large hex wrench (or other suitable cylindrical object) into the hole and using it as a lever to turn the shaft.

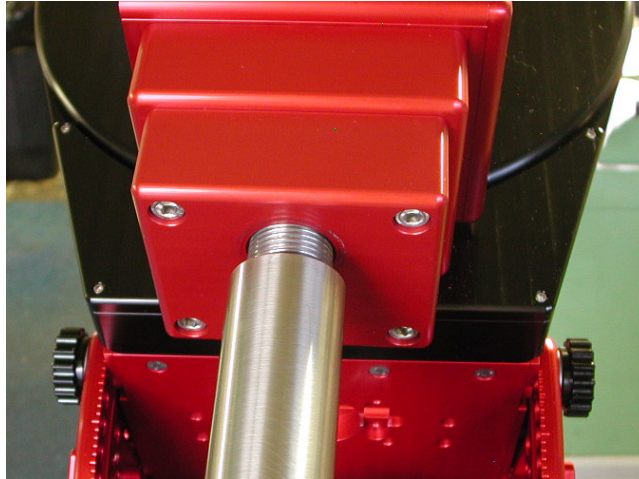


Figure 5 – Attaching the counterweight shaft.

Attaching the Versa-Plate

A small amount of assembly is required before using the Paramount ME. One procedure requires attaching the Versa-Plate on the declination axis in the configuration that matches your optical equipment.

The Versa-Plate that comes with the Paramount ME is 7.93 inches by 20.0 inches by 0.90 inches thick. The Versa-Plate was designed to accommodate a large number of optical tube assemblies based on various ring designs (hence the numerous holes) as well as the popular Losmandy™ dovetail system.

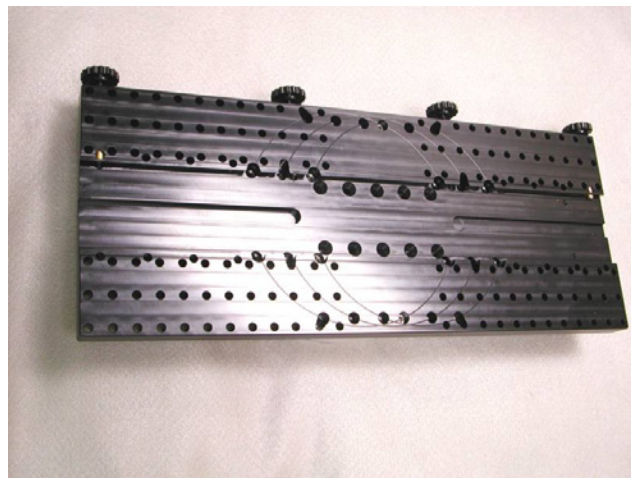


Figure 6 – Versa-Plate

The hole pattern that is present on the top of the declination gear is repeated in three places on the Versa-Plate. This allows moving the plate approximately one inch in either direction from center. The positions of the three possible mounting locations are shown on the top of the Versa-plate as 8-inch circles that correspond to the location of the declination hub/gear

in each of the positions. Attaching the plate to the central circle will make the plate central to the declination axis. The plate can also be moved about one inch towards the stars (for Schmidt-Cassegrain or similar) or one-inch further from the stars (for Newtonians or longer scopes).

There are 12 tapped holes in the top of the Paramount ME declination gear. The four inner holes accept 1-inch, 1/4-20 thread, flat socket cap screws. The eight outer holes accept 1-inch 1/4-20 socket head cap screws. Normally, using just the eight outer holes is sufficient for mounting the Versa-Plate. The four inner holes permit attaching smaller (custom) top plates to the declination gear, if required.

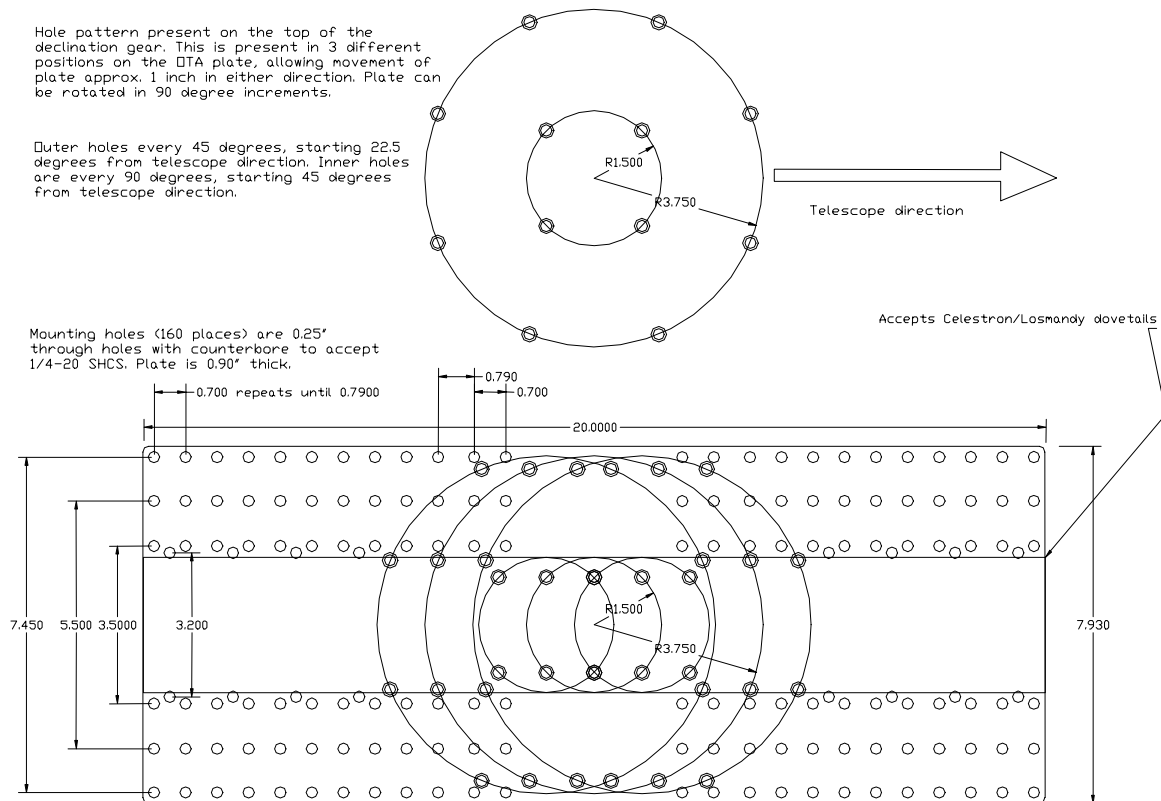


Figure 7 – Versa-Plate mounting specifications.

In all mounting orientations, note that the declination hub/gear cannot rotate 360 degrees; therefore the Versa-Plate must be attached properly. An arrow machined into the declination gear/hub indicates the direction of incoming light. Use this to arrow to determine how to mount the Versa-Plate for your optical system.

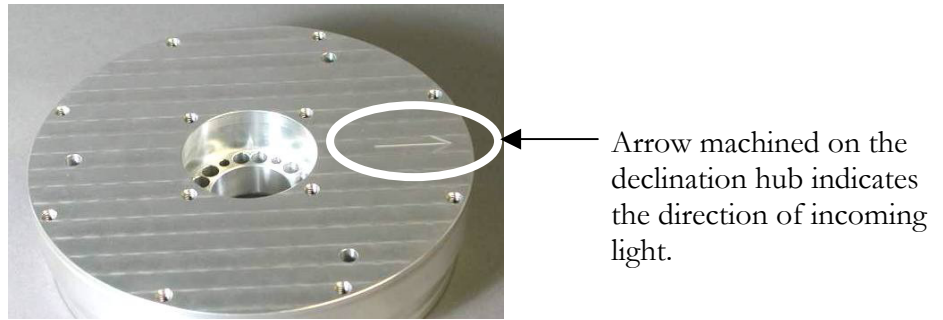


Figure 8 – Unanodized declination gear (note machined arrow).

Once you decide on the desired position for the Versa-Plate, mount the plate with the hardware provided.

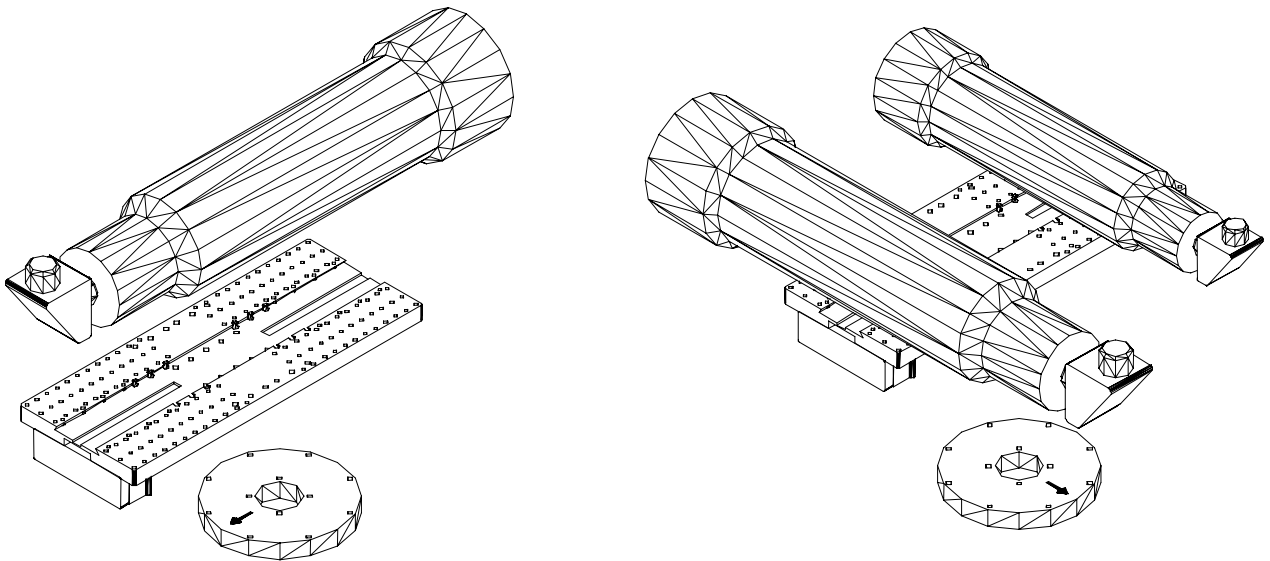


Figure 9 – Versa-Plate configurations (typical and wide).

The typical orientation for the Versa-Plate is shown above in the first drawing. Note the arrow on the declination gear is pointing in the direction of incoming light to the telescope and towards the instrument panel attached to the Versa-Plate. This is the proper orientation to insure full motion without hitting the hard stop at -90 degrees declination.

The Versa-Plate can also be rotated 90 degrees offering a wide plate to accommodate multiple optical assemblies. Note the arrow on the declination gear still points in the direction of the incoming light, but not towards the instrument panel as in the typical configuration.

A third possible configuration (not pictured) permits having the Instrument Panel near the open aperture of the telescope so that cabling to the CCD camera follows the shortest route.

In this configuration, the Versa-Plate is rotated 180 degrees from the typical configuration pictured above.

Once the Versa-Plate configuration is determined, the plate can be attached to the top of the Paramount ME. There are two cables protruding from the top of the ME declination gear that must be directed through the Versa-Plate cable channel. There is one tricky part of this operation. Make sure that you have just enough cable protruding out of the top of the declination gear to reach the instrument panel. Extra cable makes instrument panel box assembly difficult. Too little cable and the cables cannot be plugged into the instrument panel.

The Versa-Plate is attached using eight 1/4-20 socket head cap screws (included).

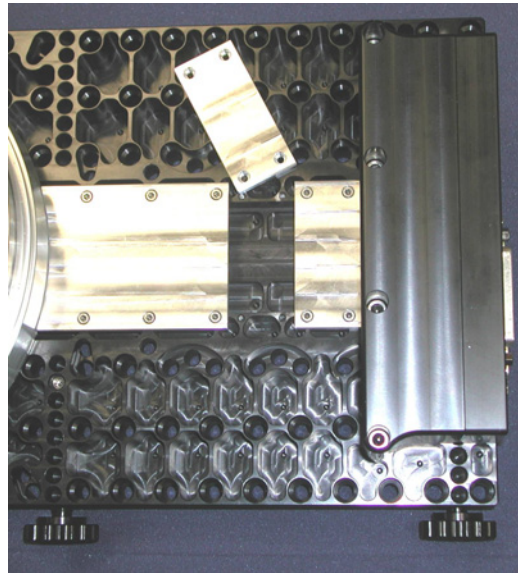


Figure 10 – Channel Covers (unanodized for illustration purposes)

The channel covers are shown in Figure 10. There are three channel separate covers to accommodate the three Versa-Plate mounting configurations. The “typical configuration” uses the large cover and only one of the two rectangular covers. The “Schmidt-Cassegrain” configuration uses only the large cover. The “Newtonian configuration” is shown above, and all three channel covers are used.

Plugging In Versa-Plate Instrument Panel

After the cables are passed through the Versa-Plate cable channel, they must be plugged into the Instrument Panel. Inspect the two cables to identify the alignment notches (see Figure 11). Do not plug these cable in backwards!

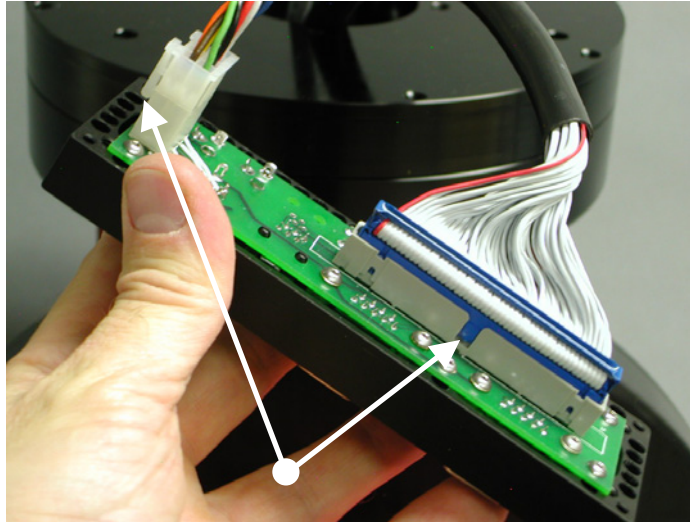


Figure 11 – Make sure the notches are aligned properly to avoid plugging the cables in backwards.

Once the “through the mount” cables are properly plugged in to the Instrument Panel control board, use a 3/32 hex wrench to attach the front of the Instrument Panel box to the back of the Instrument Panel box. Next, use a 5/32 hex wrench to attach the entire Instrument Panel assembly to the bottom of the Versa-Plate (see Figure 10).

Attaching the Mount to the Pier

The first step is to attach the ME to the pier or tripod that will be used for operation or testing. The Paramount ME attaches to the pier using four attachment knobs near the corners of the wedge base plate. The Micro-Levelers can be used to level the mount prior to tightening the four attachment knobs.

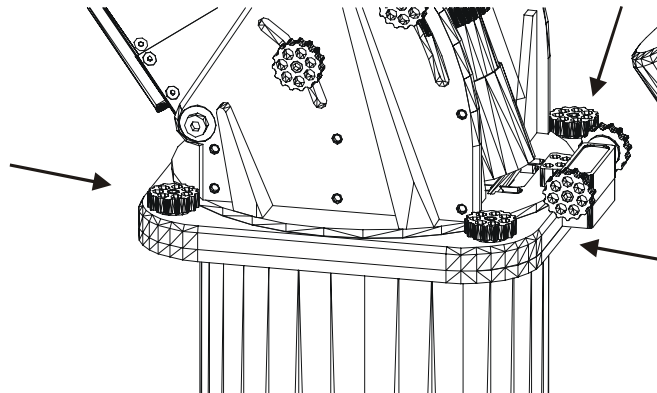


Figure 12 – Location of base plate attachment knobs.

Micro-Levelers

The Paramount ME's Micro-Levelers are used to make small adjustments (approximately 3 mm or 1/8-inch) to the level of the mount. They are not intended for doing large leveling

adjustments, but rather to provide a small amount of fine-tune leveling. Additionally, they can be used insure the base plate of the ME is not distorted by a non-flat mounting surface. A slightly concave mounting surface would tend to bend the bottom plate of the ME, but when the Micro-Levelers protrude slightly below the surface of the base plate, they act as “legs” to stabilize the mount base.

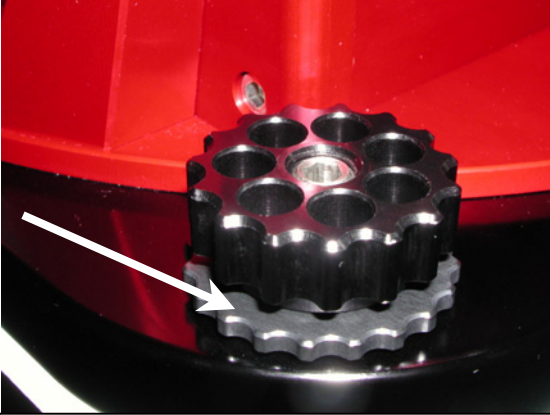


Figure 13 – Micro-Leveler (see arrow) and base plate attachment knob.

The best approach for leveling the mount is to simultaneously adjust two Micro-Levelers so that the mount is tilted either East/West or North/South. The accuracy of the leveling 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 actually less important. When used in a portable sense, insuring that the mount is level helps to quickly polar align the mount.

The Micro-Levelers have a relatively small surface area of contact and are not intended to lift the mount. Take care not to unnecessarily

over tighten them.

First Slews

Once you have assembled the mount and connected all the electronic wiring, verify that all the electronic and mechanical components function by turning on the mount.

It is important to note that the Paramount ME will not respond to joystick commands and will not start tracking until it is homed.

What is that Sound?

When the Paramount ME is turned on and initialized, the servomotors emit an audible variable-pitched sound. This is the sound caused by the control system checking and adjusting the position of the DC servo motors over 3,000 times per second and is normal. This sound serves as the “heartbeat” of the mount and provides an audible indicator that the electronics are powered and functioning.

What Is Homing?

Homing is the automated process of slewing each axis until the homing indexes are located. The right ascension and declination axes have sensors that are used to detect the home position. The home position is at approximately hour angle 2 and declination 0 degrees. This position is fixed and cannot be changed as it depends on the physical position of the gears and the internal sensors.

Note: The Paramount ME will not slew or track until the mount is successfully homed!

Each time the mount is homed, it returns to the same home position and sets the position registers to zero. When star synchronization is performed, the hour angle and declination of the home indexes are stored in the internal flash of the Paramount ME. Subsequent sessions simply use the Local Sidereal Time, as computed from the inputs in TheSky software, to accurately determine the pointing direction of the mount.

Homing the Paramount ME provides the following benefits:

- Once a mount is aligned with the celestial pole and homed, extremely accurate pointing can be achieved using the Paramount ME under control of TheSky.
- After homing, the mount “knows” its slewing limits and the mount cannot be slewed into itself. The right ascension limits are just approximately 5 degrees past the Meridian in each direction (east and west) and in declination the limit is at approximately -90 degrees declination.
- The PEC function uses this information to calibrate the internal PEC table with the orientation of the worm gear.
- You can quickly recover from power loss to the mount or other personal computer malfunctions using the homing feature.

Homing the Mount Using the Joystick

To home the mount using the joystick, tap the button on top of the joystick twice deliberately, with perhaps a small hesitation in between. If you move the joystick after the homing procedure has started the homing process will be aborted. This behavior is provided as a safety feature, allowing you to stop the telescope in one or both axis by moving the joystick away from center. Left-right motion causes the RA axis to stop; up-down motion causes the declination axis to stop (see the diagram below).

The Joystick

In addition to homing the mount, the joystick is used to manually move the Paramount ME. It also has a built-in red LED flashlight for use at the telescope.

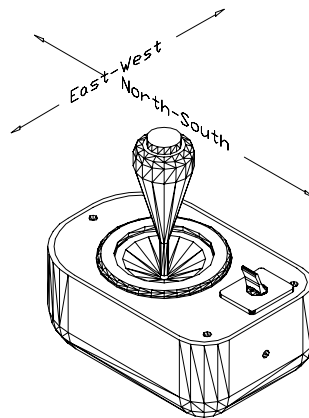


Figure 14 –Slewing the Paramount ME with the joystick.

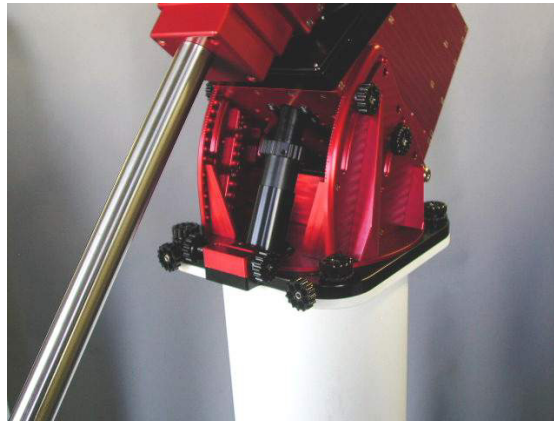
Left and right motion moves the telescope in right ascension; up and down motion moves the telescope in declination. The speed of the slew increases the further the joystick is moved from the center position. A total of 15 different speeds are traversed as you move the joystick from center all the way to the edge. The first two are slower than sidereal rate, and they increase up to the maximum speed, as entered in the TheSky TCS™ Setup Dialog.

Homing the Mount Using TheSky

Upon establishing a link with the Paramount ME, TheSky will prompt as to whether or not the mount should be homed if it detects that the mount has not already been homed.

Adding the Counterweights

While the right ascension gear and worm are NOT in contact, the counterweights should be placed on the counterweight bar.



Note: Add the estimated amount of counterweight before attaching the optical tube assembly!

The amount of counterweight depends on the weight of the optical tube assembly. Try to make a close estimate to how much counterweight is required and add this to the declination counterweight bar. It is best if the counterweights are too far down the bar (i.e. too heavy) for the optical tube assembly at the start. This way, when fine-tuning the balance, gravity will not be working to flop the optical tube downward.

Once added, the right ascension axis will be bottom heavy yet will be in a safe state since the axis is free to hang downward due to gravity. Adding the optical tube assembly will now result in a system that is close to balance.

After the counterweights are added, firmly tighten each of the counterweight knobs to insure the weights do not slip. Also make sure you add the counterweight safety stop on the bottom of the counterweight bar.

Safety Tip

Each counterweight weighs approximately 9 kg (20 lbs). Use extreme caution so that you do not accidentally drop them and injure yourself or others!

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

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

Care should be taken to center the mass of the OTA near the center of the declination axis. Depending on the type of hardware used to attach the OTA to the declination axis, this adjustment can be made during attachment or by moving mounting rings prior to lifting the OTA to the declination plate.

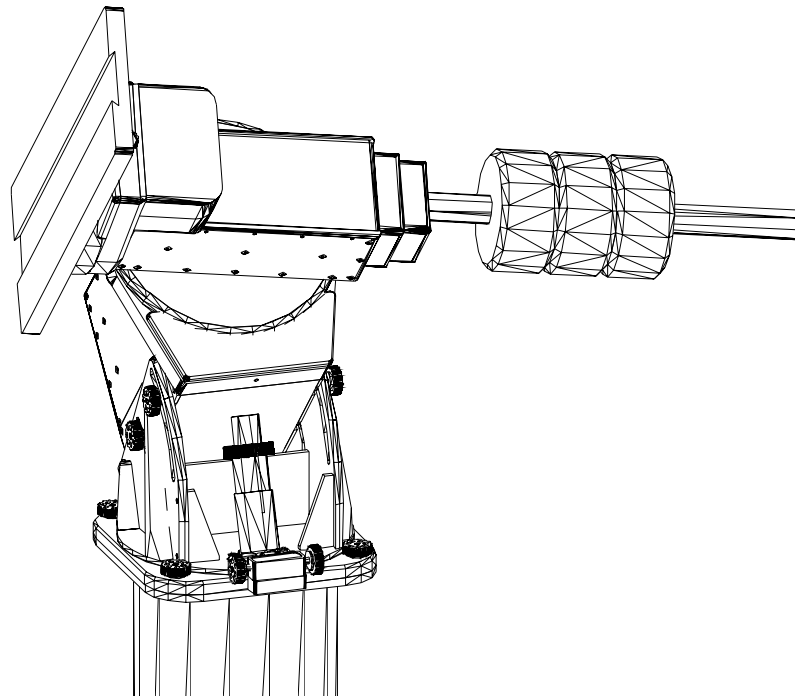


Figure 15 – The above figure depicts a mount that is terribly out of balance.

Caution! Never position the Paramount ME in the above orientation when the worm gear is engaged!

Note: The Paramount ME, as pictured in Figure 15, is in an **unstable** configuration and places extreme forces on the right ascension gear teeth. The counterweight shaft should remain in the vertical position while the Paramount ME is loaded with counterweights and the OTA has not yet been attached. This minimizes the force on the right ascension gear teeth and insures the mount is in a stable position at all times.

Balance the system

Attach your CCD camera and all other equipment (focuser, dew heater, etc.) to the optical tube assembly while balancing the mount. The telescope will track and slew best when properly balanced. An unbalanced system can cause numerous problems, such as stalling or “gear chattering” during slews. There is no clutching mechanism on the Paramount ME. This means that balance is achieved by disengaging the worm from the gear in each axis.

Caution!

Use extreme care when balancing the telescope! Make note of the weight distribution on the telescope before pulling the worm block assemblies away from the gears. Always grab hold of the OTA or counterweight arm before disengaging the worm and gear so that you maintain control of the telescope.

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

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

If you use multiple devices, such as a video camera to map and a CCD to image after mapping, the difference in weight might be enough to cause slewing problems when the instruments are interchanged. By marking various positions of counterweights on the shaft for different configurations, you can quickly rebalance a system without disengaging the worm and gear. It is very important not to change the system after mapping has been completed and a model is created for the mount/OTA.

The worm blocks on the ME provide a mechanism for disengaging the worm from the gear and holding this configuration while balancing. Though it is always a good idea to have a second person available for aid in holding the OTA during balancing, this mechanism allows for single person balancing.

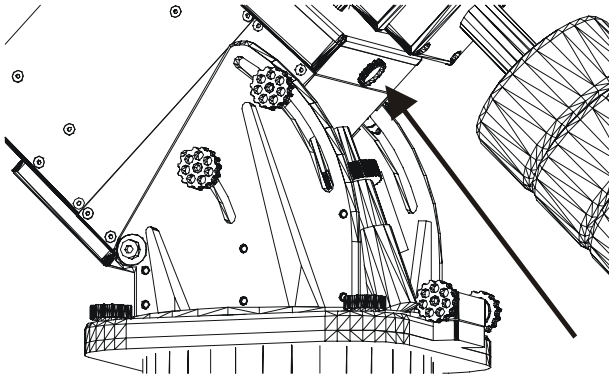


Figure 16 – RA Balance Knob

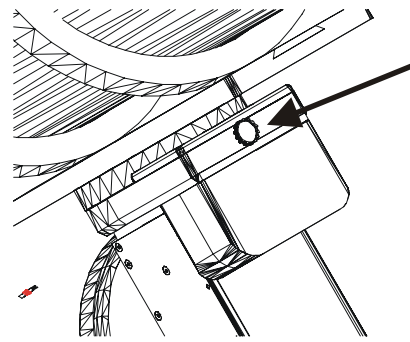


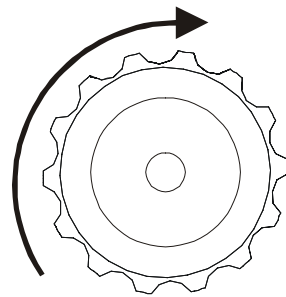
Figure 17 – Declination Balance Knob

Balance Knobs

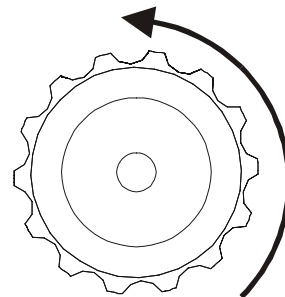
The Balance Knobs serve a dual purpose. When turned clockwise, they pull the worm block away from the gear, allowing free rotation of the axis so that the mount's payload can be balanced. When turned counterclockwise, they push the worm block (and therefore the worm) into mesh with the gear, preventing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

Caution!

Always use extreme caution when disengaging the worm from the gear. If the telescope is out of balance with the counterweights, you, your equipment or your mount can be damaged when the axis rotates freely and the heavy end comes to rest at lowest point.



CW=Disengage



CCW=Engage

Pulling the Worm Away from the Gear

To move the worm away from the gear for balancing, turn the Balance Knob clockwise about 1-1/2 turns. The worm will be disengaged from the gear wheel and the axis will rotate freely. The worm block will remain in this position until you re-engage it by rotating the knob in the counter-clockwise direction. Test to insure you have rotated the knob sufficiently by carefully moving the axis, insuring there is no contact between the worm and the gear.

Engaging the Worm and Gear

To engage RA axis worm with the gear, first make sure that the axis is balanced properly. Then grab the counterweight shaft with one hand and turn the RA balance Knob counterclockwise until you feel that the worm and gear have made contact. Gently wiggle the RA axis using the counterweight bar to be sure the worm is actually seated into the gear. Again turn the knob counterclockwise to a full stop.

Once the knob has been rotated counterclockwise to a full stop, rotate it clockwise about one knob click (that is, 1/10 of a turn). This will hold the worm very close to the gear, not allowing it to pull away in an out-of-balance situation, while not actually forcing the worm into the gear. Spring plungers on the worm gears accomplish the actual force that holds the worm into the gear.

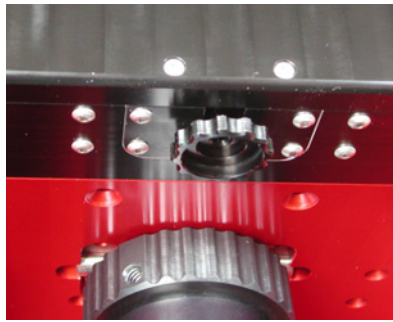


Figure 18 – RA Balance Knob



Attaching the Optical Tube Assembly to the Versa-Plate

Dovetail Use

The Versa-Plate has four custom knobs that are attached to brass plungers for applying pressure on the telescope dovetail. Smaller optical tube assemblies will only utilize two or three of these. It is best to place the Versa-Plate in the east-west direction with the counterweight shaft vertical. With the plate in this orientation, you can muscle the telescope into position without the risk of it sliding off. We recommend placing the dovetail knobs “uphill” (that is, with the telescope pointing to the west) so that when they are tightened you are not trying to lift the telescope while loading the brass plungers.

Attaching Rings

The four separate mounting configurations provided on the Versa-Plate accommodate several popular telescope ring systems. The holes are drilled and counter-bored for 1/4-20 SHCS (socket head cap screws).

Cable Channel

On the lower side of the Versa-Plate there is a channel that carries two cables used for “through the mount cabling.” Only a portion of the channel area is used for the built in cables and additional cables (such as video, USB, etc.) can be run through the mount. More information on the internal cabling is present in the “Through the Mount Cabling” section.

Initial Polar Alignment

There are numerous methods for estimating the approximate altitude and azimuth for starting the polar alignment procedure. Ultimately, you will want to get each axis to within 1-2 arcminutes, and better than an arcminute in each axis if you have a permanent installation.

Altitude Adjustment

The altitude-positioning device is used to adjust the altitude of the mount. In its fully compressed state, the mount is at altitude 15 degrees and in the fully extended state the mount is at altitude 58 degrees. One full turn of the altitude-positioning device moves the mount very near one degree. Each of the “tics” on the altitude-positioning handle is equal to two arcminutes of movement.

Azimuth Adjustment

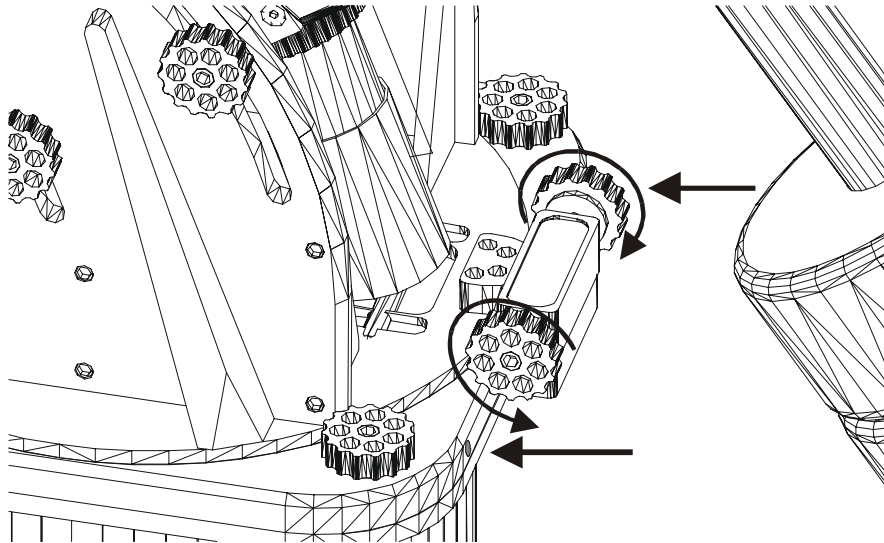


Figure 19 – Azimuth adjustment knobs and tensioning screws.

Azimuth adjustment on the ME is performed by rotating the two “azimuth adjustment knobs” near the front side of the ME (near the counterweights). The azimuth adjustment knobs work in tandem—one must be loosened before the other can be tightened resulting in rotation of the wedge assembly. Each full turn of an azimuth knob translates into 30 arcminutes of movement. Therefore, each “knob-tic” is equal to two arcminutes.

Azimuth Tensioning Screws

Access the two azimuth tensioning screws by inserting a hex wrench into the front of the Paramount ME base plate (see the two straight arrows in Figure 19 – Azimuth adjustment

knobs and tensioning screws). These tensioning screws push the internal rotating wedge plate tight against the dovetail profile. Note that there is a segment of compressible material between the end of the screw and the rotating base plate. This means that as you continue to tighten the screw without ever feeling a hard stop, so be cautious not to over tighten it.

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

Note that each tic on the azimuth adjustment knobs represents two arcminutes of movement of the base plate. When making the adjustments as recommended by TPoint, fine increments can be estimated quite accurately using these tics.

Additional Azimuth Adjustment

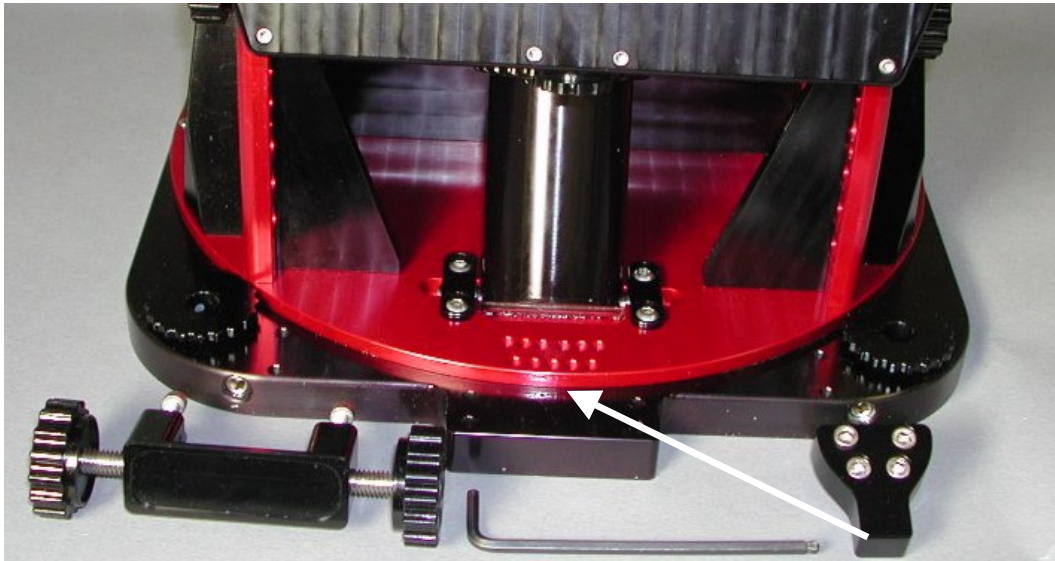


Figure 20 – The azimuth “nosepiece” can be repositioned for additional azimuth adjustment.

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

The “nosepiece” is the black anodized part that protrudes into the azimuth adjustment block (see Figure 20), by which the mount is rotated. Loosen the two azimuth adjustment knobs and remove the four hex screws from the adjustment knob mounting bracket. These screws are accessed from the bottom of the mount.

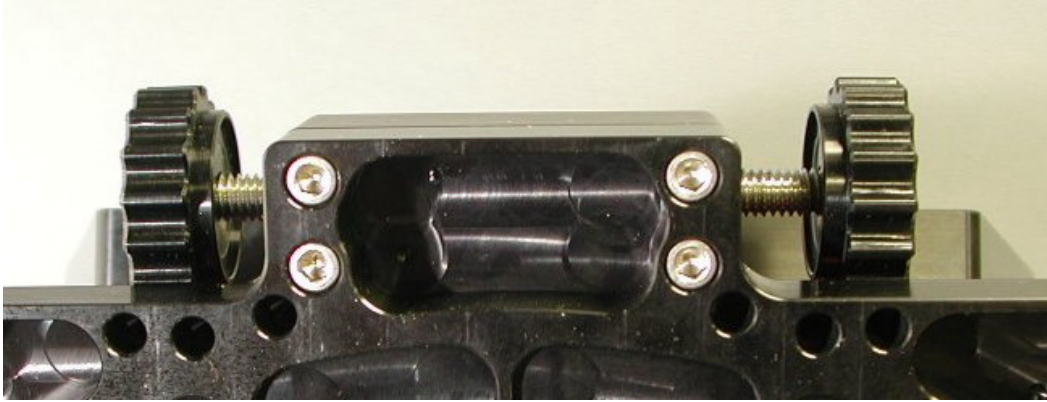


Figure 21 – Remove these four screws to access the azimuth nosepiece. (View of bottom of the mount.)

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



Paramount ME Quick Polar Alignment Method

The Paramount ME contains homing sensors that can be used aid in the first step in polar alignment. Each time the Paramount ME is homed, it returns to the exact same position (i.e. to an encoder tic, or a fraction of an arcsecond). This position is very near hour angle 2.0 and declination 0.0. This is a point two hours west of the Meridian on the celestial equator.

Though the mount does home to the exact same position each time, it is not precisely at hour angle 2.0000 and declination 0.0000. This is in part due to consistency of the position of the emitter-detector pair in the sensors used. Additionally, if the main optic of the system is used for star sighting, it will have inherent non-perpendicularity errors. Therefore, the following procedure can be deemed “very good” as far as estimating polar alignment, but the full procedure using TPoint will refine the alignment to the desired level of accuracy.

However, if you are consistent in attaching your OTA to the ME, you will find that this procedure will be very accurate each time the ME is set up. When the star-sync is performed, it represents a calibration of many of the errors.

Step 1 – Level the mount, and set the altitude and azimuth as close as possible.

A level mount is not required for extremely precise operation, but it is necessary for the purposes of the following alignment procedure. Using the gradations on the side of the wedge assembly, estimate the altitude based on the latitude of the observing site.

Step 2 – Home mount with the proper date/time information in TheSky.

By homing the mount from TheSky software with the proper time and date information, the Local Sidereal Time (LST) will be computed and therefore the position of the telescope, if it were aligned properly with the pole, is known to within ± 10 arcminutes.

Step 3 – Slew to a bright star or planet near the Meridian.

Pick a bright object in the sky that is visible, preferably close to celestial equator, and instruct the Paramount ME to slew to that object. Often times this can be done even during daylight hours if planets or very bright stars are used.

Step 4 – Center the object in the telescope using the altitude/azimuth adjusters on the Paramount ME.

Using the precision altitude/azimuth adjustments on the Paramount ME, move the mount (and telescope) so that the selected object is centered in the field of view. *Do not use the hand paddle to slew the mount!* Remember that the mount and control system are pointing to the correct position for where the object should be. Most of the error that caused the telescope to miss the object is due to the incorrect polar alignment of the mount.

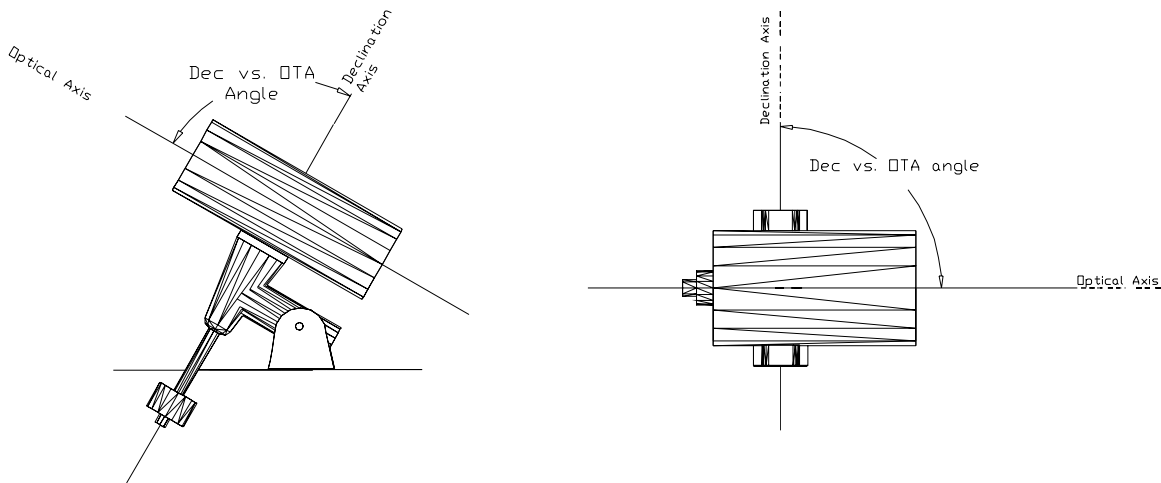


Figure 22 – Try to minimize OTA non-perpendicularity errors.

Note that the non-perpendicularity of the telescope and the declination axis also plays a factor in this alignment procedure. If the magnitude of this error is large, the accuracy of the initial polar alignment will be affected. This angle often may exceed 20 arcminutes.

Precise Polar Alignment

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

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

An accurate polar alignment is required before the Paramount ME can accurately track objects. The question may be asked “how accurate?” Subjectively, if the altitude and azimuth are each within 2 arcminutes of the pole, images of a few minutes can be taken maintaining round stars at focal lengths of 2000mm or so. At greater image scales and longer exposures, guiding will become necessary where adjustments in both altitude and azimuth are made. Once an axis is within one arcminute of the pole it becomes increasingly more difficult to improve.

Polar Alignment Using TPoint

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



Getting Started Using TPoint

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

The screenshot shows the 'Observing Parameters' dialog box with the following values:

Telescope:	Paramount ME	OK	Cancel
Latitude:	53.415	Equinox:	
Year:	1997	Pressure (mB):	900
Month:	1	Height (meters):	1974
Day:	16	Humidity (0-1):	0.2
Temperature (C):	5	Observing Wavelength:	0.55
		Tropospheric Lapse Rate:	0.0065
		<input checked="" type="checkbox"/> Pole checking	<input checked="" type="checkbox"/> Diurnal aberration correction
Notes:			

Telescope mapping and polar alignment procedure

1. Set the local time as accurately as possible each night before observing.
2. Insert a New TPoint model into TheSky (**Edit | Insert | TPoint Model**).
3. After accurately synchronizing the telescope, slew to a nearby star (by identifying the star in TheSky and click **Slew To**  on the Object Information dialog box), center the actual star in the eyepiece, and then click **Map**  on the Object Information dialog box. This constitutes one data point.
4. When you have mapped six data points that are close together in the sky, TPoint can begin correcting for errors in the mount and the pointing will improve. Now, you're ready to begin mapping stars over a larger portion of the actual night sky.

5. After 15-20 data points are collected, add more terms to the TPoint model so that the RMS value is as small as possible. From TPoint, click **Suggest Terms** to quickly determine one to four new terms that improve the pointing most significantly.
6. From TPoint, determine the current polar alignment of the telescope by clicking **Model | Polar Alignment Information**.
7. Adjust the mount according to the TPoint polar alignment information.

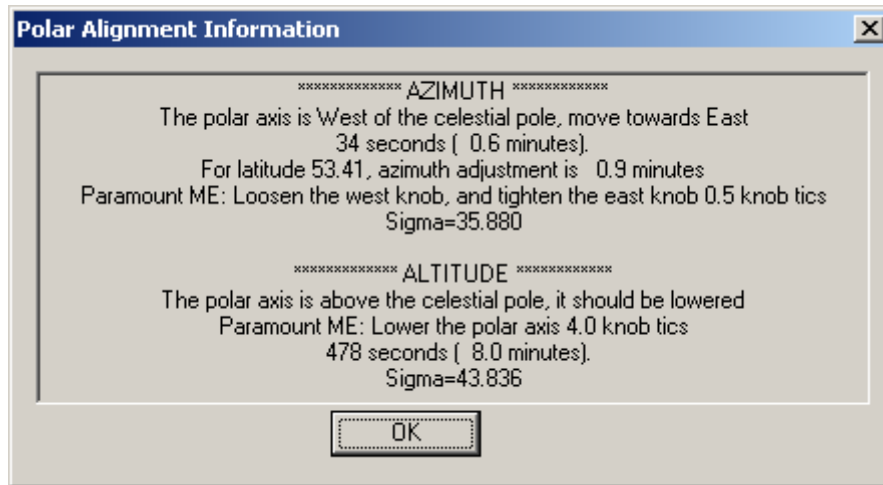


Figure 23 – Polar Alignment Information dialog box (TPoint).

Note the Paramount ME instructions on the dialog box. These calibrated instructions for the Paramount ME appear only if the “Telescope” prompt on the **Data | Observing Parameters** dialog box in TPoint is set to “Paramount ME” (TPoint version 5.00.504 or later).

After you have carefully made the polar alignment adjustments, delete the TPoint model and start over from Step 2. To remove the red Reference Lines that are created for each mapping run, from TheSky, click **Data | Add User Data Remove All**.

In practice, using at least 20 stars distributed over half of the sky will provide enough information for the first iteration. Note that TPoint generates a statistical model and the values it generates for each of the terms is not an exact value and the correctness of each term is dependent on the entire model. If for example, there is a large non-perpendicularity of the declination axis and the telescope axis and the CH term is not turned on, the entire model will suffer.

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

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

The Polar axis elevation value (ME) and the Polar axis EW value (MA) provide an estimation of the polar misalignment in arcseconds. Note that the MA value is the distance in arcseconds at the pole. The actual azimuth angle will be greater as determined by dividing

by the cosine of the latitude. This computation is automatically done on the Polar Alignment Information dialog box.

TPoint Fit Dialog	Meaning	Action
ME positive (+)	Axis is below celestial pole.	Raise elevation.
ME negative (-)	Axis is above celestial pole.	Lower elevation.
MA positive (+)	Axis is East of celestial pole.	Move axis West (tighten West and loosen East).
MA negative (-)	Axis is West of celestial pole.	Move axis East (tighten East and loosen West).

For most U.S. latitudes, the actual polar elevation target is not the North Celestial Pole but rather a point about one arcminute above it to minimize the effects of refraction on longer exposures.

Polar Alignment – The Drift Method

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

Drift Method – Azimuth Adjustment

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

Drift Method – Elevation Adjustment

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

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

Using a Calibrated Video Screen

Although the adjustments on the Paramount ME wedge provide a very accurate means of making adjustments to the polar axis, there are advantages to watching a calibrated video monitor while making small adjustments (less than 5 arcminutes).

Adjusted properly, you can actually make polar alignment adjustments to the ME without significantly loosening the locking knobs (altitude) or screws (azimuth).

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

Paramount ME Initialization

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

Tip

Discussions related to TPoint modeling, mount initialization, parking, etc., might seem daunting at first. However, these steps are necessary to achieve consistent, accurate pointing from night to night. In turn, accurate pointing allows enhanced functionality such as scripted operation and imaging without the burden of centering objects. Remember, if you wish to simply dead-reckon for an evening without mapping, simply start the telescope and go! The Paramount ME's pointing accuracy will still exceed most commercially available "go to" telescopes.

Southern Hemisphere Operation

See Appendix D – Setting Up and Using the Paramount in the Southern Hemisphere on page 73 for detailed instructions about configuring TheSky when operating in the Southern Hemisphere.

For the Paramount ME to point accurately from night to night, there are a number of requirements that must be met. The amount of time saved when target objects consistently fall into the field of view warrants the additional steps needed to accomplish this. Once you have been through the entire process a couple of times, Paramount ME initialization will not seem as confusing as it might the first time.

Homing

The mount is homed at startup so that the mount is initialized in exactly the same position each time it is used. The homing function of the Paramount ME provides many benefits to the CCD imager:

- Homing permits soft limits so the mount never crashes into itself, even if an improper star synchronization occurs.
- Once a mapping run has been completed, it will continue to provide excellent pointing without having to perform a star synchronization.
- Even if power is lost to the Paramount ME, the homing function can return the telescope to its previous state.
- When the star synchronization is performed, it is easy to do a quick "reality check" to be sure the time entered in TheSky is reasonable.

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

In the table below, each of the operations that are required for performing an initialization are listed along with the time needed to accomplish the operation. Please note that the time estimates listed for mapping are for an experienced user. The very first time you perform a mapping run might take considerably longer.

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

Operation	Time required for an experienced user
Setting the computer clock	2 minutes
Performing a mapping run	20 to 120 minutes (using video)
Performing a short mapping run	5 to 15 minutes
Homing	0-2 minutes

Why is Accurate Time Important?

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

Always do a quick "reality check" of the computer's time by comparing the simulated sky to the night sky!

A very accurate time base is required when initializing Paramount ME. TheSky uses the computer time to compute accurate Local Sidereal Time (LST). When a link is established between TheSky and the Paramount ME that has been homed, the LST is used to re-establish the synchronization between the Paramount ME electronic setting circles and the celestial sphere to within a few arcseconds. Being able to simply power-up and start imaging makes each evening more productive.

Setting the Computer Clock

From TheSky, click **Data | Site Information** and select the Date and Time tab to access the Time Service function of TheSky. This is the best method for setting the computer's clock accurately. If you cannot use the "dial-up" Time Service feature of TheSky, you can set the time manually. Remember, each second of time translates to 15 arcseconds of motion near the celestial equator. If the night-to-night time base is not set accurately, pointing will be compromised. The time error will be cause objects to fall a consistent amount in right ascension ahead or behind the target. There are also many web-based programs that accurately set the computer's clock. Windows XP has an Internet time server as part of the operating system. If you're using a different OS, we recommend Dimension 4 from Thinking Man Software (www.thinkman.com).

Parking the Paramount ME

Before parking the Paramount ME, you need to set the preferred park position for your telescope. This position (in altitude/azimuth coordinates) is stored to a file named `paramnt.cfg`.

For example, if your observatory has a roll-off roof, and the roof can only close when the telescope is in a particular orientation, the **Set Park Position** command is used to define that orientation. The mount will automatically slew to this park position each time the **Park** command is issued.

Setting the Park Position

With a telescope link established, first slew the telescope to the desired position. Next, from TheSky, click **Telescope | Options | Set Park Position**.

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

Parking the Paramount ME

From TheSky, click **Telescope | Options | Park**.

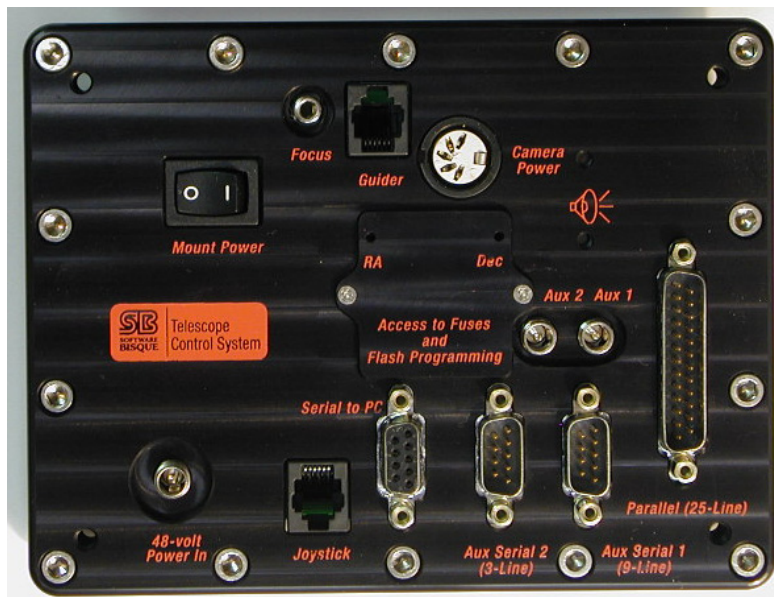


Figure 24 – Paramount ME Adaptor Panel.

Connecting the Electronics and Power

1. Connect the joystick to the RJ11 jack on the south side of the Paramount ME. Make sure you do not accidentally plug it into the Guider jack that uses the same connector.
2. Plug the serial cable into the appropriate connector on the Adapter Panel (labeled Serial to PC). This connection permits communication between the Paramount ME and the computer.

Important Note: Inexpensive brands of USB-to-serial converters may not reliably communicate with the Paramount ME. If you encounter unexpected error messages when establishing a link between TheSky and the Paramount, or frequent communication errors during normal operations, try using a standard serial port on your computer.

3. Plug the 48-volt power supply into the jack labeled **Mount** on the Base Panel. This supplies power to the Paramount ME. Note: The Paramount ME power supply is designed for indoor use only.
4. Turn on the Paramount ME using the rocker switch labeled **Mount Power** on the adapter panel.

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

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

Through the Mount Cabling

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

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

Cabling Supplied with the Paramount ME

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

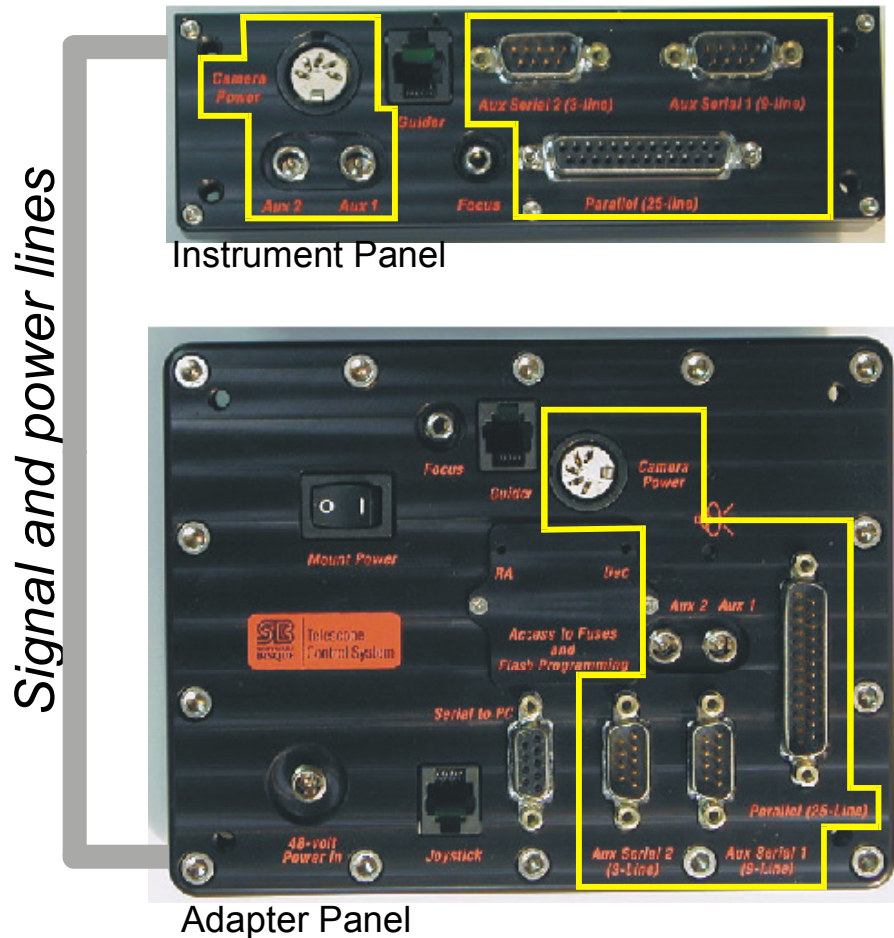


Figure 25 – Relationship between Adaptor Panel and Instrument panel ports.

The outlined areas on this diagram show the connectors that have pass-through wires in the Paramount ME.

A 50-conductor round-to-flat ribbon cable (28 gauge) carries signals from the Aux 1 Serial (9-line), Aux 2 (3-line) Serial and Parallel (25-line) to the corresponding jacks on the Instrument Panel. An eight-conductor 22-gauge cable carries the Aux 1, Aux 2 and Camera Power lines from the Adapter Panel to the Instrument Panel. The 25-line parallel cable is commonly used to carry the CCD camera signals, and the CCD camera power is routed using the Camera Power plug.

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

The 3-line and 9-line serial ports can be used to carry focuser, serial camera signals and even video if the proper adapters are made.

Cable-Conduit

In addition to the built-in signal and power lines passed through the Paramount ME, the ME is designed to provide ample space for passing additional cabling. The length of cabling required is approximately 40-50 inches to make it through the mount and allow a small “loop” of cabling inside the declination box. This extra cable is required so that the declination shaft can rotate freely while the various cables move in tandem with the shaft.

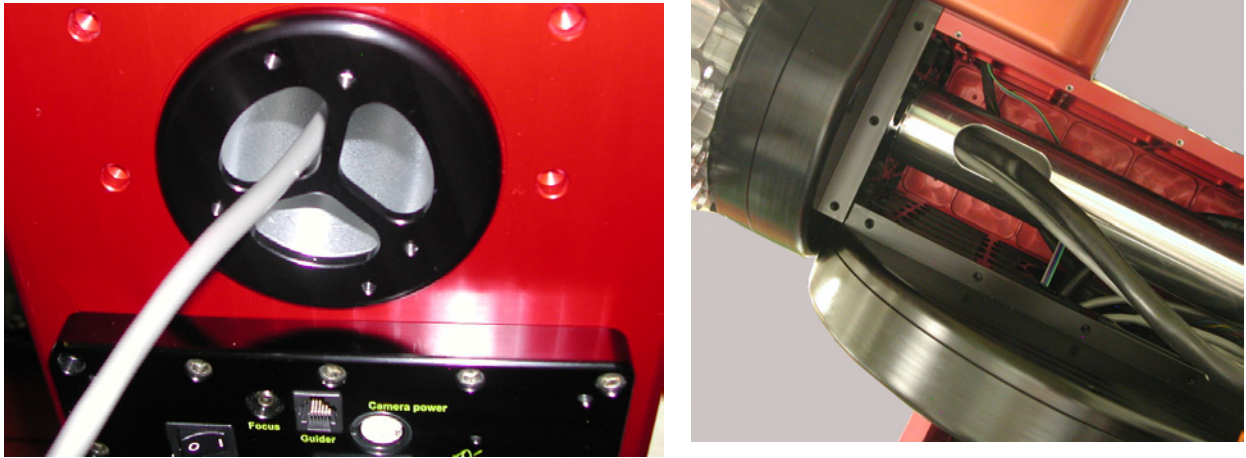


Figure 26 – Route of “through the mount” cabling.

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



Interface to TheSky Astronomy Software

The TheSky TCS Control System Dialog Box

The default settings for the Paramount ME's control system allow operation right out of the box; typically there is no need to make changes to these settings. However, the control system is very powerful and offers many options, so the default setting of many functions can be altered.

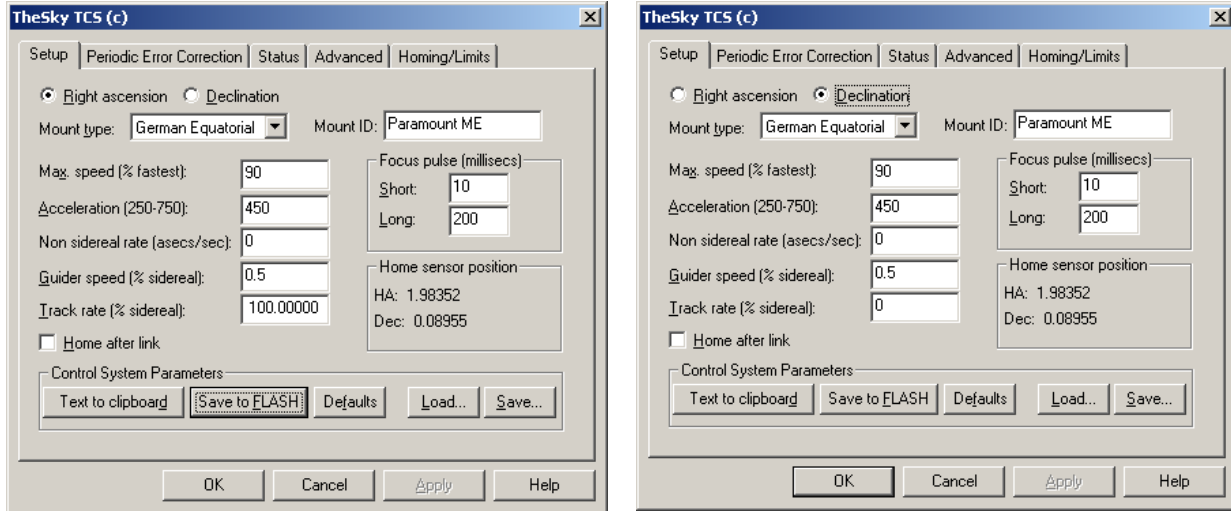


Figure 27 – Setup tab (for RA and Declination options) on the TheSky TCS dialog box.

Note that the two dialog boxes pictured above show the Right Ascension and Declination default settings.

Mount Type

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

Mount ID

This information is for reference purposes only.

Maximum Speed

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

Acceleration

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

Non sidereal rate

If you wish for the mount to slew at a rate that is separate from the sidereal rate but cumulative to it, you can enter a value here in arcseconds per second. If you choose a minor planet and select Set Tracking Rate from the Telescope tab, the non-sidereal rate will be set

in both right ascension and declination. To set the tracking rates back to normal sidereal, simply click on a star and click **Set Tracking Rates**.

Guider Speed

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

Track rate

This input allows you to alter the tracking speed from the sidereal speed. A value of 100% will rotate the mount at the sidereal rate.

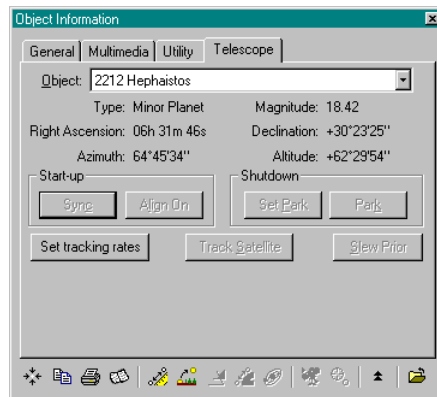


Figure 28 – Click the **Set Tracking Rates** button to track on minor planets, planets and comets.

Home after Link

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

Focus Pulse

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

Home Sensor Hour Angle and Sensor Declination

When the Sync command is performed, the hour angle and declination of the Home Position are computed and stored in the flash memory of the control system. For the Paramount ME, these values are approximately hour angle = 2 hours and declination = 0.0 degrees for a mount that is leveled and polar aligned.

If for example you choose the Sync command from the Telescope tab when the telescope is actually pointed to a star other than the one shown in the Object Information dialog, then these values will be incorrect for the geometry of the Paramount ME.

Save to Flash

When changes are made to the values on the Setup screen, they will remain active until the mount is powered down unless Save in Flash is chosen. It is important to note that while the values are saved into flash memory, the motors are stopped. This does not mean that

position information is lost, just that the telescope will stop tracking at the sidereal rate momentarily (approximately 0.50 seconds).

Text to Clipboard

Click this button to copy all of the settings for the control system to the Windows Clipboard. You can then paste them into a word processor or the Windows Notepad application for viewing. You may be asked to email this information to Software Bisque if there is an issue with the control system. Following is a sample of the information that is copied to the clipboard when this command is used. The comments after the “//” on the right were added.

```
TheSky TCS Copyright (c) 2002 Software Bisque
Mount ID: Paramount ME      Running at: 3333.333
***** Axis 0 (RA) Control version: 1.1.45 *****
Mount Type: 0
Base rate: -43067265
Max speed: 1080000000
Acceleration: 400
Non sidereal rate: 0
Minimum Position Limit: -4960000
Maximum Position Limit: 1120000
Sensor HA (from sync): 2.0000
Guide: -672926
Tics per rev: 11520000
PEC ratio: 10
Maximum position error: 1000
Unit ID: 100
EMF Constant: 72
Index angle: 1299 // Mount dependent
Home velocity high: 660000000
Home velocity med: 110000000
Home velocity low: 3900000
Home dir, sense: 110602
Home mode, required, Joystick, In-out-in: 2111
Home Index Offset: -398 // Mount dependent
PEC cutoff speed: 0
Max Voltage: 15
Max Gain: 150

***** Axis 1 (Dec) Control version: 1.1.45 *****
Mount Type: 0
Base rate: 0
Max speed: 1080000000
Acceleration: 400
Non sidereal rate: 0
Minimum Position Limit: -5460000
Maximum Position Limit: 1700000
Sensor Dec(from sync): 0.0000
Guide: 438102
Tics per rev: -7500000
PEC ratio: 10
Maximum position error: 1000
Unit ID: 100
EMF Constant: 72
Index angle: 1523 // Mount dependent
Home velocity high: 660000000
Home velocity med: 110000000
Home velocity low: 3900000
Home dir, sense: 1100
Home mode, required, Joystick, In-out-in: 2111
Home Index Offset: 0 // Mount dependent
PEC cutoff speed: 0
Max Voltage: 15
Max Gain: 150
```



Training Periodic Error Correction (PEC)

TheSky TCS has advanced Periodic Error Correction capability. The majority of periodic error comes from the worm gear and the associated pulley system driving the worm gear. On the Paramount ME, the periodic error is low in magnitude (that is 5 arcseconds peak to peak or less) and is very smooth.

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

Though PEC training and playing algorithms exist on many telescopes, few have the ability to show the training data and then the ability to fit a smooth curve to the data. By exploiting the computing power of the personal computer, the PEC algorithm of TheSky TCS can provide better and more consistent results than those running in a small microprocessor.

Recording the Periodic Error

Recording the periodic error involves guiding on a star using a CCD camera or manually making adjustments for one worm revolution. The best results come from a CCD camera because it is not subject to fatigue during the multi-minute recording period, and centroids of the guide star can be computed more accurately with a CCD than a human eye.

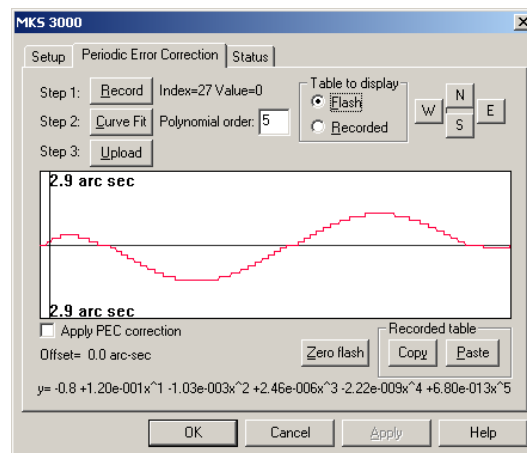


Figure 29 – Periodic Error Correction Tab on TheSky TCS Dialog Box (TheSky)

The PEC Dialog Box

The PEC dialog for TheSky TCS provides the following:

- A graphical display of the current PEC table read from flash –OR– a graphical display of the recorded telescope movements.
- A polynomial curve fitting function for producing a smooth PEC table.
- A real time display of the current “PEC Index” as the worm goes through a revolution.
- Guide-speed telescope adjustments for RA and Dec for manual PEC training.

- The ability to Copy the recorded table to the clipboard (for pasting in Excel for example) and to Paste a Text table from the clipboard.

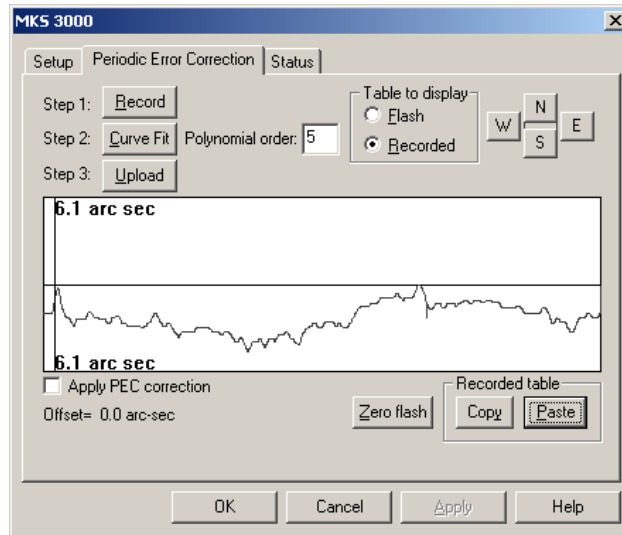


Figure 30 – The Periodic Error Correction tab's graph of raw periodic error data (TheSky).

Recording Corrections

During the recording phase, the angle of the worm, relative to where it would be during normal sidereal tracking, is measured and stored at a rate of about 5 times per second. The recording then provides a history of the angle-adjustment for a complete rotation of the worm. Note that this function is for correcting periodic error only, and if the mount is not well polar aligned it will not also introduce any drift into the system.

The following steps are necessary to successfully train PEC:

1. **Start Autoguiding:** Start auto-guiding using a suitable guide star near the Celestial Equator. Periodic error shows its greatest effects within the range of +15 degrees declination and -15 degrees declination. Choose a star high in the sky (near the meridian) to reduce atmospheric effects. Shooting on the West side will insure you do not run into the "East limit" of German Equatorial mounts.
2. **Start Recording:** With the telescope initialized and running, display the PEC dialog in TheSky by choosing Telescope Options More settings, then selecting the **Periodic Error Correction** tab. With the auto-guider happily guiding, click **Record** from the PEC dialog box. Autoguide for a few of minutes to insure the system is settled down and to remove the effects of backlash in the worm.
3. **Finish Recording:** Wait until the red status line has cross the entire graph (about four minutes) and the **Abort** text reverts to **Record**. When this is completed the recorded table will be displayed.
4. **Smooth Recorded Table:** Click **Curve Fit** to smooth the curve. You can select different "orders" for the polynomial fit. Orders of 5-7 seem to provide the best fit.
5. **Upload the Table to the TCS:** Click **Upload** to copy the smoothed table from the dialog into TheSky TCS.

6. **Turn the Paramount ME Off, then On.** The power on the Paramount ME must be cycled before the new periodic error corrections take effect.

Note that the recording phase of the PEC training only records the error values. It does not automatically transfer the recorded table to the flash or activate PEC adjustments.

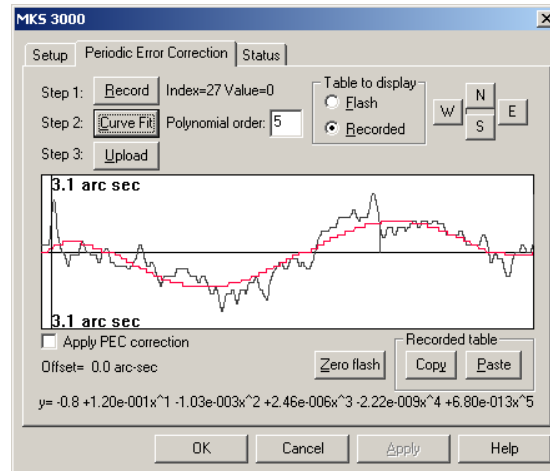


Figure 31 – The Periodic Error Correction tab's graph of raw periodic error data with smoothed polynomial fit (TheSky).

Curve Fit: Smoothing the PEC Table

Unless the seeing is very good and the autoguiding settings are optimal, the recorded PEC values will contain a considerable amount of noise and must be smoothed before the Upload command is used to transfer the recorded table into the PEC memory on the TheSky TCS.

Because there are typically several pulleys in addition to the worm on the mount, the smoothed curve resulting from the noisy recorded PEC data will have higher order terms than a simple sine wave. The Curve-Fit function will compute a least squares polynomial fit of the order entered in the “Polynomial order:” edit control. The default order is fifth, which will typically result in a very nice curve representing the recorded data.

It is important that the beginning and end values of the recorded table (i.e. the left-most and right-most values on the graph) are of similar magnitude. If they are not, it may indicate that the polar alignment is poor, causing a significant drift during the recording phase.

The graphic above shows how the graphic will look after the Curve Fit function has been selected. Both the original recorded data (the bumpy line) and the computed fitted curve are shown. If it appears that higher frequency information is not modeled with the curve, you can change the Order of the curve and experiment for a better fit.

The equation for the fitted line is also displayed at the bottom of the dialog once the **Curve Fit** button is clicked.

Uploading the Smoothed Curve to the TheSky TCS.

Once you have an acceptable fit to the recorded data, the new curve must be transferred to the flash memory in TheSky TCS. When you click **Upload**, you will be asked to verify replacement of the PEC table in the Paramount ME's memory.



Figure 32 – PEC overwrite verification window (TheSky).

Click **Yes** to write the smoothed PEC curve to control system's memory. Next, the curve will be read in to verify the data was written properly. The control system now holds the PEC table and can use it to reduce the effects of cyclical errors on your images. Don't forget to cycle the power on the mount first!

Apply PEC

The Apply PEC checkbox must be checked to activate the corrections. Even with a PEC table present in flash memory, no corrections are made unless this option is selected.

The control system contains a parameter called the "PEC cutoff speed" that allows for setting the speed at which the PEC table will be ignored. Turning off the PEC effectively sets this speed zero, i.e. the PEC table is ignored at all speeds.

When the PEC table is activated, it is ignored at all speeds more than double that of sidereal tracking. Interestingly, even small corrections of 3-5 arcseconds cause an audible (and somewhat annoying) variation to the otherwise smooth sounding motors at higher speeds.

Copy

The Copy command simply copies the PEC values to the clipboard. These units of these values are in encoder tics. The number of entries depends on the PEC ratio computed by the following formulae:

$$125 * \text{PEC Ratio}$$

So if the PEC ratio is 10 (that is, a 10:1 gear reduction before the worm) then the number of entries is 1,250.

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

Paste

This command will take a string of numbers from the clipboard and copy them into the Recorded Table area. You can work to provide a better smoothing in another application or

perhaps use multiple tables to come up with a good weighted average. We have found the smoothed tables generated from different parts of the worm to be very similar in shape.

TheSky TCS™ Status Dialog Box

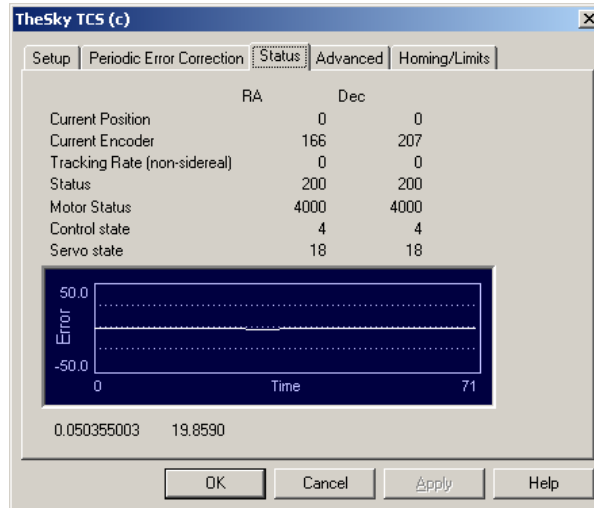


Figure 33 – The Advanced Tab of TheSky TCS dialog box (TheSky).

This dialog is provided simply for diagnostic purposes. The encoders' position (in encoder tics) is shown for each axis. Other status values are shown that indicate the state of the motors and control system.

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

TheSky TCS™ Advanced Dialog Box

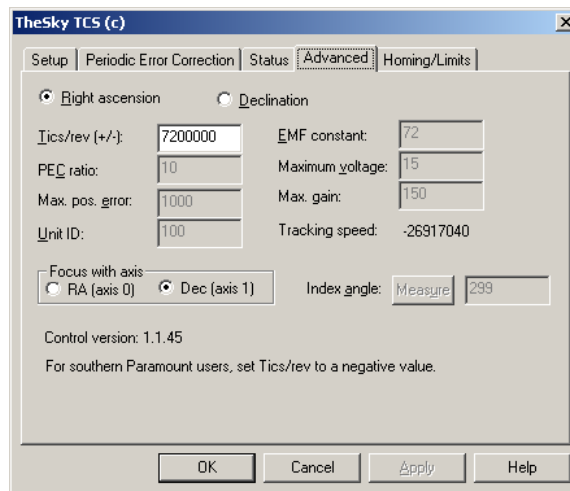


Figure 34 – The Advanced Tab of TheSky TCS dialog box (TheSky).

For the Paramount ME, the only two input prompts that are necessary on this dialog are the Tics/rev and Focus axis prompts.

TheSky TCS™ Homing/Limits Dialog

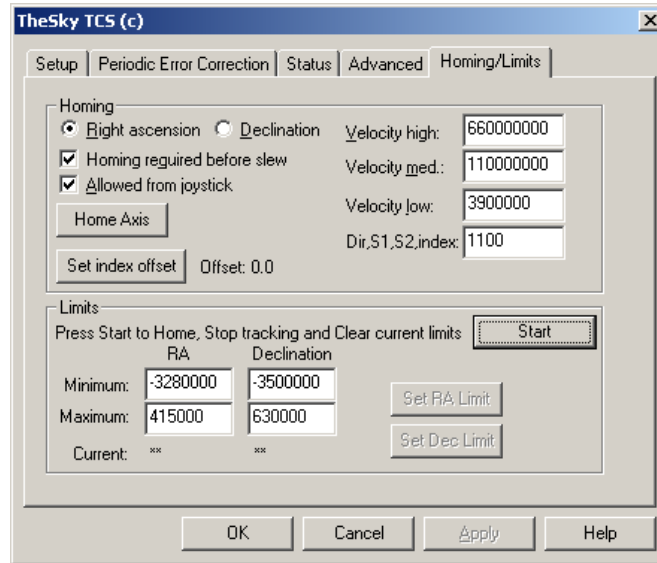


Figure 35 – Homing/Limits tab of TheSky TCS dialog box (TheSky).

The Homing/Limits Tab allows you to change some of the default options of the Paramount ME's control system. It is recommended that you do not make changes to any of the values unless you have a clear understanding of how the change will effect the mount's operation. For example, if you set the Minimum Limit to $-4,000,000$ instead of $-3,250,000$, the mount may collide with the right ascension stop if the mount is under joystick control or PC control.

Minimum Limit, Maximum Limit

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

The First Night

You should already be very familiar with the operation of TheSky Astronomy Software and the TPoint Modeling software before attempting to use these two applications “under the stars.” If you are not familiar with these applications, please refer to their documentation for further information.

Selecting the Control System in TheSky

From TheSky, click **Telescope | Setup**. On the Telescope Setup dialog box, select the Paramount ME with TheSky TCS as the Control System.

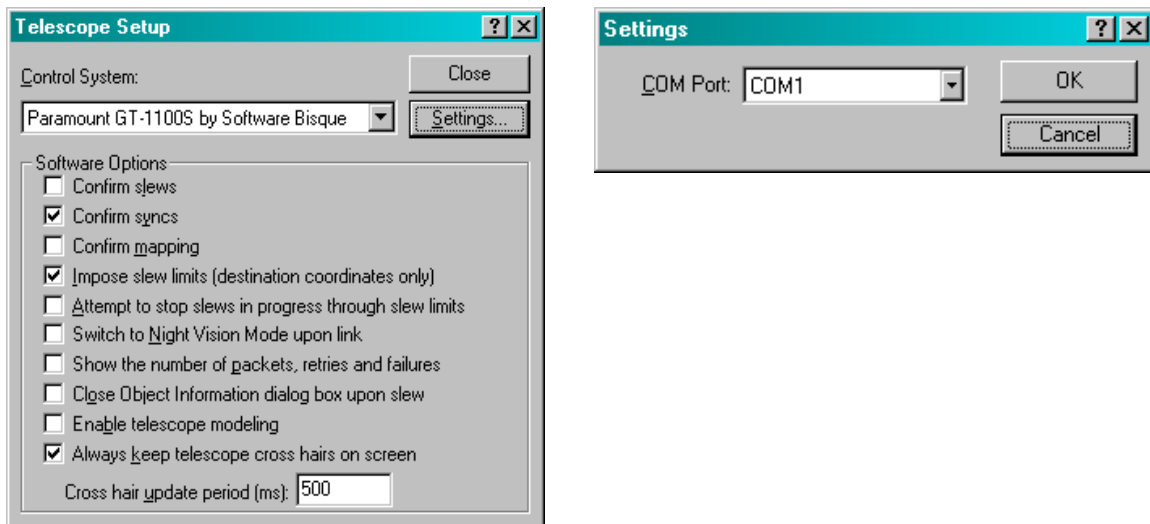


Figure 36 – Telescope Setup and Settings dialog boxes.

Connecting the Paramount ME to your Computer

The Paramount ME communicates through a serial port on your computer. Make sure the TheSky TCS is configured for the correct computer port. From TheSky, click **Settings** on the Telescope Setup dialog box.

Synchronizing on a Star

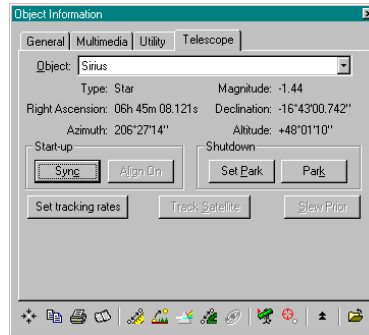


Figure 37 – The Telescope Tab on the Object Information dialog box (TheSky).

Once the mount is up and running and you have estimated the polar alignment, you can Sync on a star to initialize the mount. The Sync button can be found in the Object Information dialog on the Telescope tab.

Note: *If you are doing the preliminary polar alignment as described in the “Initial Polar Alignment” section (page 32), you will be centering the star using the polar adjustments rather than synchronizing.*

While you are aligning the mount to the pole, you will be syncing the mount several times. Once the mount is aligned with the pole, you will not have to sync again unless you change optical tube assemblies or somehow alter your setup otherwise in a significant manner.

Following is a short overview of what transpires when **Sync** is clicked.

The mount was homed before the sync so the angles are computed between the home position and the current position of the mount when the sync occurs. Using these angles, the hour angle and the declination of the home position is computed and stored inside the Paramount ME's flash memory.

By accessing the stored hour angle and declination of the mount and using the computed Local Sidereal Time, TheSky can compute the current pointing location of the telescope. In fact, it should point identically on subsequent sessions as it does on this session.

As a quick test, turn off the mount, then turn it back on and home it. This will cause the link between TheSky and the mount to be lost.

When you re-establish the link with the mount, you will see the cross hairs appear on the sky display at the current location of the home position. Now slew the mount to the star you synced on, and it should fall in nearly the same place in the eyepiece, video or CCD that you are using. In practice there are small movements due to mirror flop or slight time differences so the star may not be in exactly the same position, but it should be very close.

Synchronizing the Paramount ME

Synchronizing or “syncing” the telescope involves pointing the telescope system at a known object (usually a star) then pressing **Sync** from the Telescope Tab on the Object Information dialog box.

TheSky's date, time your location must be entered correctly before telescope synchronization is performed! Click Data | Site Information to change these parameters.

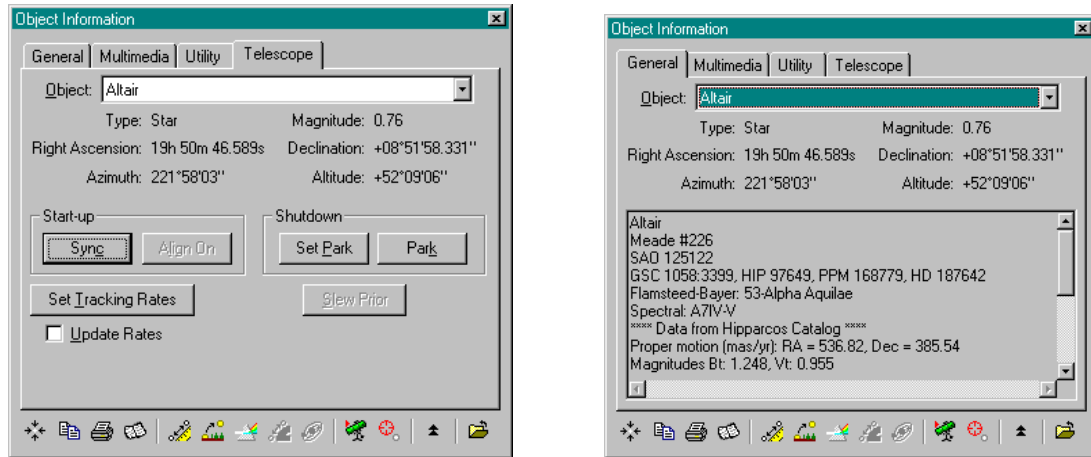


Figure 38 – Sample Object Information dialog box showing the Telescope tab (left) and the General tab (right) (TheSky).

Steps for performing a telescope synchronization

1. Choose a bright star in the sky that you definitely can identify (partial clouds or twilight can make this more difficult than it seems). Make sure the star is on the correct side of the Meridian (i.e. the counterweights should never be higher than the telescope when a Sync is performed).
2. Use the preferred method for mapping (video, reticle eyepiece or CCD) to center the object.
3. From TheSky, click **Edit | Find** (or click on the object) to display the Object Information dialog for the bright star.
4. Click **Sync** on the Telescope tab of the Object Information dialog box. When the confirmation dialog appears, click **OK***.

*Note: If **Confirm Syncs** on the Telescope Setup dialog is unchecked, you will not be prompted to confirm synchronizations. We strongly recommend that the **Confirm Syncs** option remains checked, since accidentally clicking **Sync** instead of **Map** during a mapping run is easy (especially at 3:00 a.m.!).*

What Does the Sync Command Do?

Once you have synced the telescope, TheSky knows the orientation of the telescope and can ascertain how to correctly slew the telescope to reach any position in the sky without

wrapping up cables or running the telescope into the mount. (Provided that the settings in TheSky's **Data | Site Information** command are correct.)

When a Sync command is issued from TheSky, the relevant information needed by TheSky to automatically startup on subsequent sessions is stored in the flash memory of the Paramount ME.

In theory, the Paramount ME is synced once and never again. In practice, you will be syncing the system from time-to-time. Following are a few examples of changes that will require a Sync and subsequent mapping (or short mapping) run:

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

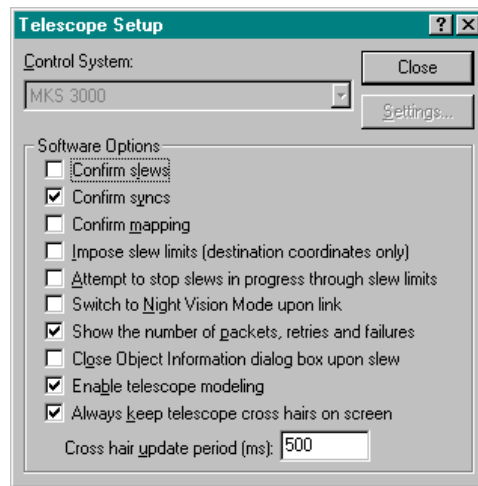


Figure 39 – Telescope Setup dialog box (TheSky).

Telescope Mapping Overview

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

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

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

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

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

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

To Prepare For a Mapping Session

1. Use the TheSky's Time Service (or similar application) to accurately set your computer's clock.
2. Power up the Paramount ME.
3. Make settings to TheSky to aid mapping. For example:
 - Display only stars to sixth magnitude limiting screen clutter.
 - Turn on the constellation lines for easy identification and turn on the Meridian line to stay on one side of the sky while mapping (this is most useful for German equatorial mounts that must “flip” when going from the east to west and vice-versa).

To Map an Object

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

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

Using ProTrack™

The Paramount ME incorporates the world-renowned TPoint “pointing kernel.” This technology (which is also used on the 8-meter Gemini telescopes) brings professional-quality tracking capabilities to amateur astronomers. TPoint uses the telescope modeling data that makes the telescope point better to also make the mount track better.

Minimum Requirements for ProTrack

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

1. A Paramount ME, Paramount GT-1100S or other telescope that employs TheSky's Telescope Control System using firmware version 1145 or later (the firmware update is supplied with the TheSky update).
2. TheSky Level IV for Windows version 5.00.043 or later.
3. TPoint for Windows version 1.00.505 or later (www.bisque.com/download).
4. A fixed telescope mirror. Mirror flop makes high-accuracy tracking nearly impossible.
5. A “good” set of TPoint modeling data (200 stars or more recommended).

Getting Started with ProTrack

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

Here are the keys to getting good ProTrack results:

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

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

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

- ID - Index error in Dec
 - NP - Non-perpendicularity in RA/Dec
 - CH - Non-perpendicularity of the OTA in Dec
 - ME - Error in polar axis elevation
 - MA - Error in polar axis azimuth
- Do not just go to **Suggest Terms** command that allows TPoint add terms; these are merely *suggested* terms, and must be analyzed and evaluated before you can trust them. That's very challenging to do. There's a better way. Add, then evaluate for effect on the model, the following terms:
 - TX – Tangent tube flexure. This is generally better to use than TF; it combines for greater accuracy with the other terms.
 - HCES and HCEC – Centering errors in the RA gear.
 - DCES and DCEC – Centering errors in the Dec gear.
 - The above terms are almost always beneficial. Next step is to evaluate the other named terms (except those with **AAT** in the name; those are for the Anglo-Australian telescope, not the Paramount ME). Look for terms that, when used, will significantly reduce the Sky RMS *and* PSD values. (RMS = root mean square error; PSD = population standard deviation.) Never use a term that increases the PSD, no matter if it also reduces the RMS. Terms that provide only minimal improvement (less than 10% better RMS) should not be used. Terms that do not provide at least 2-3 units improvement in RMS should not be used. I have found that the following terms are commonly useful for me; your results may vary – check every term's impact on your model! Other useful terms include: HDSD4, HHCH4, HSH4
 - At this point, you can now try Suggest terms. Use the same rules for suggested terms as for named terms: make sure they show enough of an improvement in your point to be included. However, when suggesting terms, you should always take an additional step: test the term in practice. Suggested terms can be very useful; they can be completely bogus. The name says it all: these are *_suggested_* terms. They have been found to be of *_possible_* statistical significance; you need to verify that by seeing how they affect real pointing, not just the RMS and PSD. Having a low RMS is not the same as having great pointing!

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

If you experience problems with ProTrack, the first place to look is at the terms you added to your model. Terms must be evaluated by how they improve or hurt your pointing and/or

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

Enabling ProTrack

To enable ProTrack, launch TheSky and then press **CONTROL+K** to display the ProTrack Status dialog box. Next, mark both the **Activate ProTrack** and **Enable Tracking Adjustments** options.

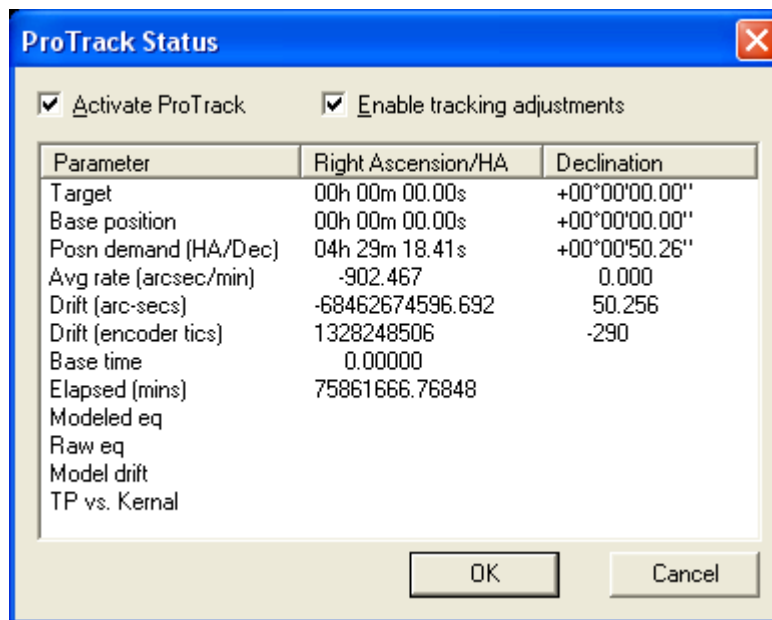


Figure 40 – ProTrack Status dialog box.

Activate ProTrack

Mark this option to display tracking corrections that will be applied to the mount using the current TPoint modeling data. The result of these corrections is displayed in the report below.

Enable Tracking Adjustments

Mark this option to apply the tracking corrections.

Cold Temperature Operation

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

We recommend setting the right ascension slew rate to 50-65 percent. See the "The TheSky TCS Control System Dialog Box" section on page 43 for details about setting the Paramount ME's maximum slew rate. For extremely cold temperature operation, the Paramount ME's acceleration rate may also need to be reduced.

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

Troubleshooting Mount Operation

Problem: I cannot communicate with the Paramount ME.

Communication between a personal computer and hardware device requires that the software and hardware be properly configured. If you cannot establish a link to the telescope, we recommend trying the following:

1. Check the cables to the serial communications port (COM). They must be securely plugged in at both ends.
2. Check the communications port with a different device. For example, connect a different serial device to the port and insure it is working.
3. Make sure the software settings are correct for the communications device (TheSky's **Telescope | Setup | Settings | Telescope Setup** dialog box).

Problem: The Paramount ME emits a non-stop, high-pitch "beep" shortly after startup and will not slew.

Check the mount balance in both axes. If the Paramount ME stalls, or sounds very labored during slews, check to make sure both axes are balanced. Balance becomes more critical with heavier loads. Even though the control system has sufficient torque for lifting heavy loads, tracking and slewing may suffer if the system is slewed greatly out of balance.

If the mount is in balance and this problem persists, check the spring plungers under the worm covers. The worm covers are the "smiley-face" shaped covers that are attached to the gear covers. Once removed, you will see the worm drive for the axis. There are one or two small spring plungers that can be adjusted to decrease the pressure between the worm and gear.

Problem: I cannot home using the joystick.

Homing from the joystick takes a bit of practice. The control system is looking for two button presses, separated by at least a 1/10 of a second. One of the most common causes of homing failure is when the user unintentionally moves the joystick during the homing

procedure. Motion of the joystick in either axis during the homing procedure will cause that axis to abort the homing procedure.

Problem: During cold temperature operation, the mount emits an audible “vibration” sound while slewing.

A resonance between the worm and gear may occur at colder operating temperatures, which is the cause of the sound. To eliminate this behavior, remove the right ascension worm-block cover and carefully place two to three drops (no more) of 3-in-1 household oil on the worm-gear interface. Also see the section “Cold Temperature Operation” on page 61 for additional cold temperature operation advice.

Appendix A – Preparing the Paramount ME Pier

Paramount ME Adapter Plate Specifications

The Paramount ME Adapter Plate is mounted between an existing pier or tripod and the Paramount ME robotic telescope mount.

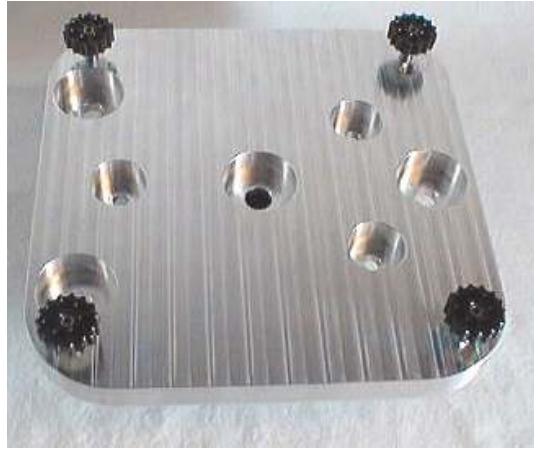


Figure 41 – Heavy-duty base plate (unanodized).

Heavy-duty Base Plate

The heavy-duty base plate (see Figure 41 – Heavy-duty base plate (unanodized).) is made of solid aluminum and weighs approximately 6.5 kg (14 lbs.) The heavy-duty version is recommended for permanent installations. The Paramount ME attaches using the four black knobs near the corners (9.4-inch spacing).



Figure 42 – Bottom view of the unanodized lightweight Base Plate

Lightweight Base Plate

The lightweight Base Plate (see “Figure 42 – Bottom view of the unanodized lightweight Base Plate”) is made of aluminum and has been lightened to approximately 2.7 kg (6 lbs.).

All dimensions of the lightweight version are identical to the heavy-duty version. The lightweight version is recommended for portable use on a field tripod.

Primary Mounting Holes

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

Old Pattern (Paramount S Compatible)

A second set of three holes (see Figure 43 – Description of Base Plate hole patterns.) matches the mounting pattern of the Paramount GT-1100 and GT-1100S models. They can be used to adapt the older style piers to the Paramount ME.

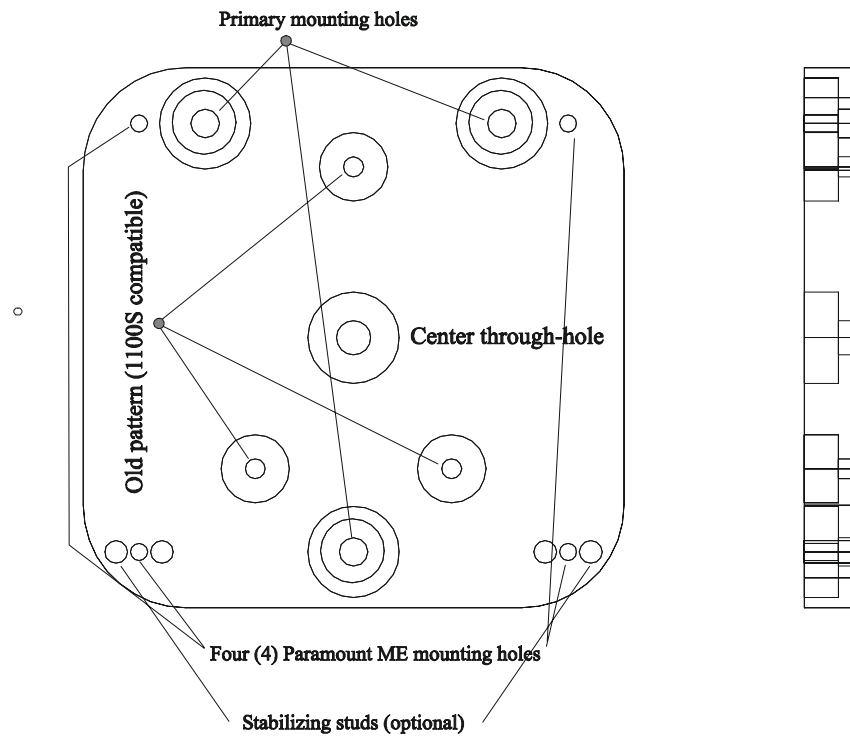


Figure 43 – Description of Base Plate hole patterns.

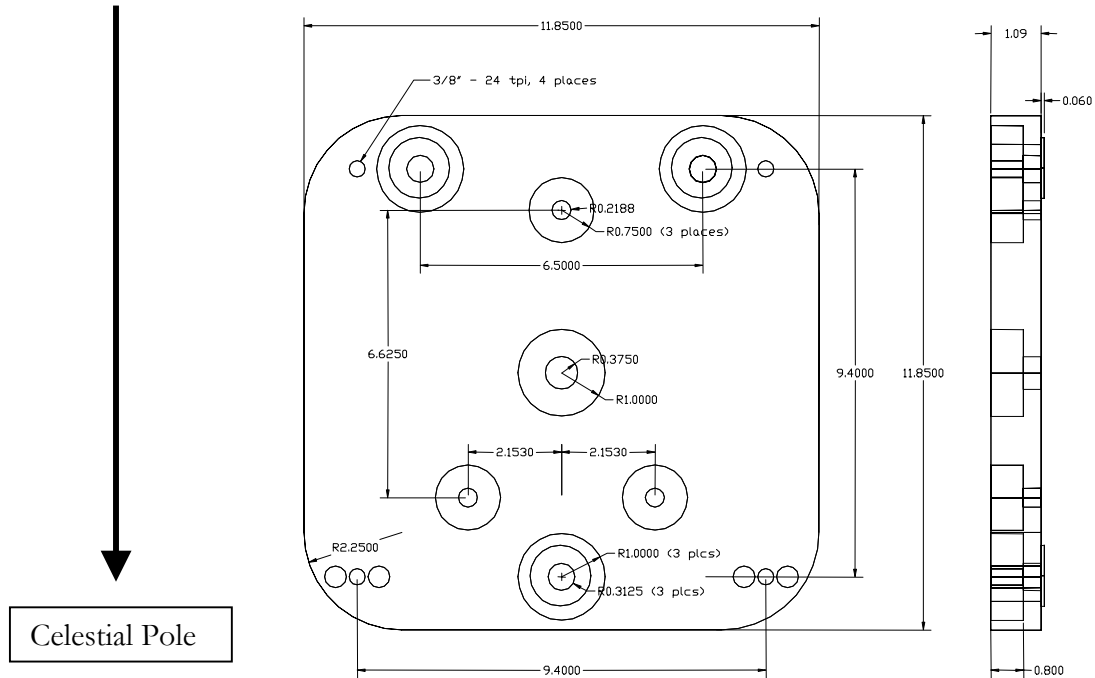


Figure 44 – Base Plate dimensions (plan and side view).

In Figure 4, the Celestial Pole is towards the bottom of the page. The three primary mounting holes make an “arrow” that points towards the North.

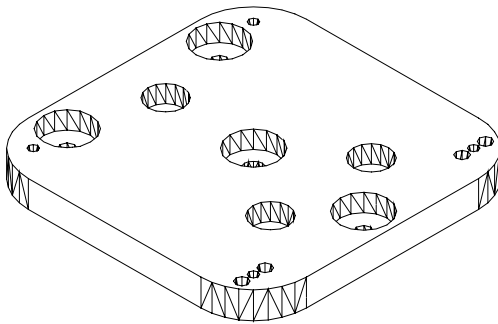


Figure 45 – Top view of the Paramount ME adapter plate.

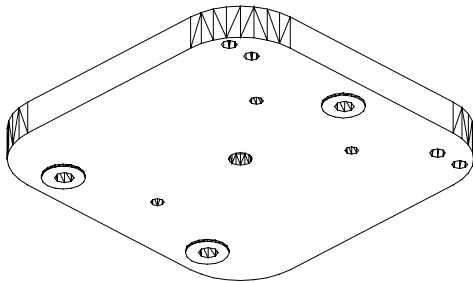


Figure 46 – Bottom view of the heavy-duty adapter plate.

Paramount ME Pier Specifications



Figure 47 – Sample 46 cm (18-inch) Paramount ME Pier

Paramount ME Pier from Software Bisque

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

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

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

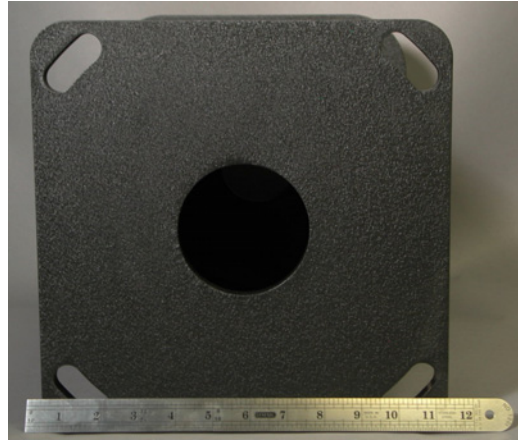


Figure 48 – Photograph of pier base plate. Note slotted holes.

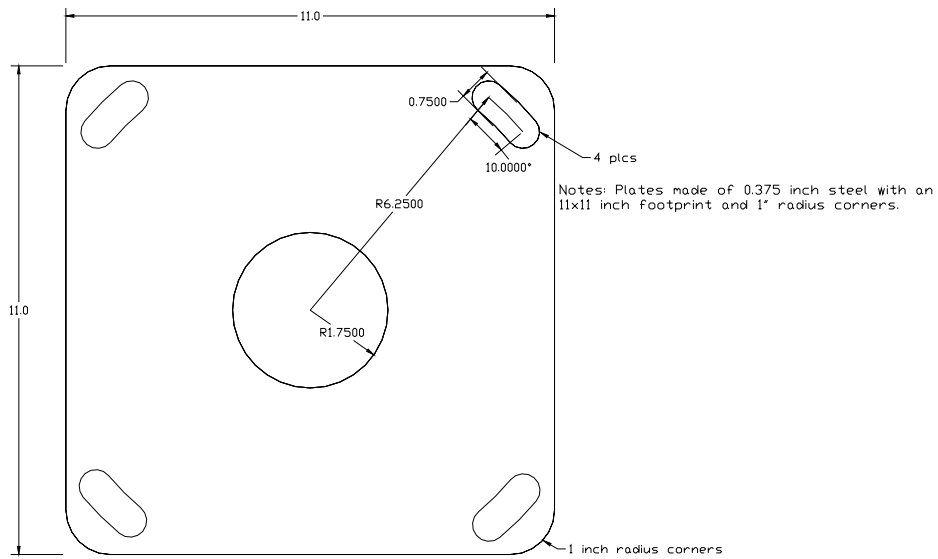
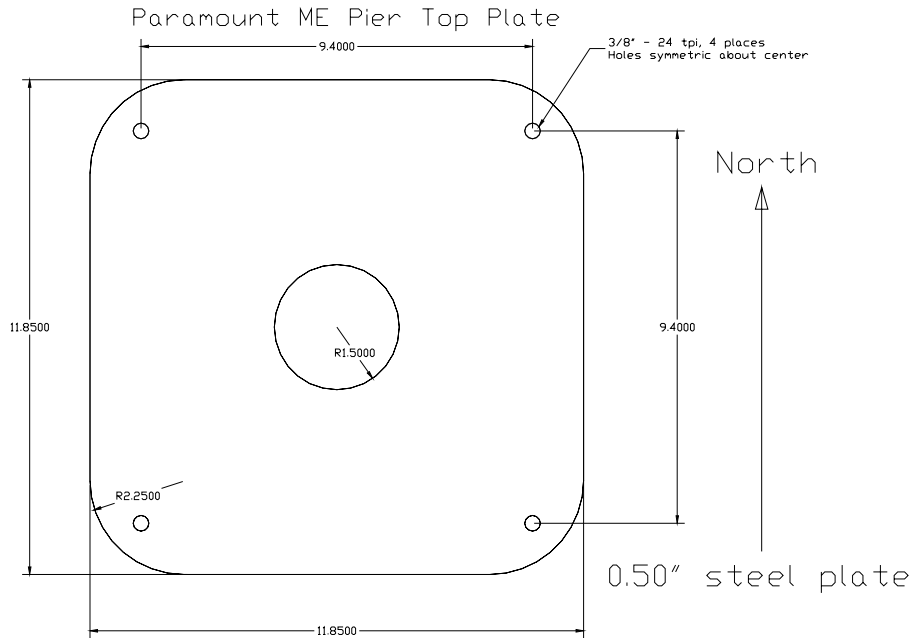


Figure 49 – Dimensions of pier base plate.

Pier Base Plate

Figure 49 shows the footprint of the Paramount ME pier. The pier can be mount using four 0.50-inch J-bolts placed in concrete. Software Bisque recommends that the base plate remain in contact with the cement surface to reduce damping times.



Pier Top Plate

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



Figure 50 – Photograph of pier top plate.

Appendix B – Paramount ME Dimensions

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

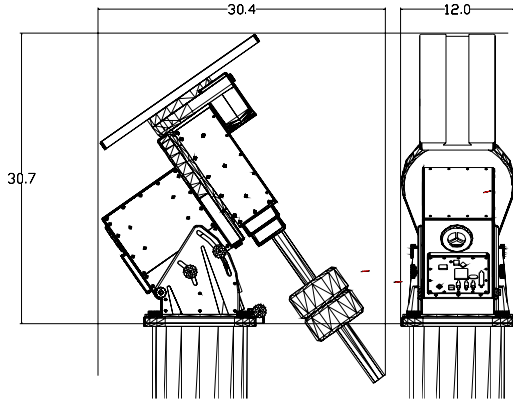


Figure 51 – Approximate Paramount ME Dimensions (inches).

Figure 51 shows the approximate dimensions (in inches) of the Paramount ME.

For various latitudes the height in inches and can be computed from the following formula.

OTA Center height at Meridian (see table below) =

Metric units: height = 8.2 cm + sin(latitude + 29 deg) x 38.3 cm

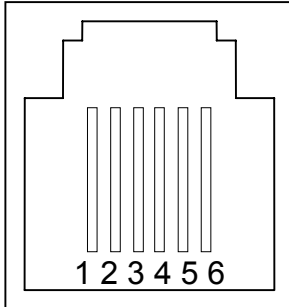
Imperial units: height = 3.25 in. + sin(latitude + 29 deg) x 15.1 in.

This dimension is important if there are walls around the observatory building. An unobstructed view at the horizon requires the pier top be high enough so that OTA does not point “into the wall” when pointing North or South.

Latitude (degrees)	Approximate OTA Center Height at Meridian
20	37.1 cm (14.6 in.)
30	41.2 cm (16.2 in.)
40	44.2 cm (17.4 in.)
50	46.0 cm (18.1 in.)

Guider

The *Guider* jack accepts an RJ12 modular plug, and provides external access to the directional switching.



RJ12 pin	Color*	Description	SBIG DB15 pin†
1	BLU	+X (R.A. "East")	10
2	YEL	+Y (Dec. "North")	13
3	GRN	-Y (Dec. "South")	7
4	RED	-X (R.A. "West")	4
5	BLK	GND (common)	5,8,11,14
6	WHT	N/C (no connection)	

*Note: The actual wire colors may differ, depending upon their placement within the RJ12 plug.

†This information may be used with ST-4, ST-5 and ST-6 cameras.

Radio Shack® Cross Reference

Description	Part Number	Qty./Pkg.
1.6A 5x20mm slow-blow fuse		
5A 5x20mm slow-blow fuse		
5A 5x20mm slow-blow fuse		
5.5mm O.D./2.1mm I.D. DC power plug	274-1569	2
3.5mm phono plug (mono)	274-286	2
RJ12 modular phone plug	279-421	10
DB9P (male)	276-1537	1
DB9S (female)	276-1538	1
DB9 hood (used with DB9P and DB9S)	276-1539	1
DB9 female-to-female cable, 6 ft.	26-152	1
DB25 male-to-male cable, 6 ft.	26-249	1
DB9P-DB25S adaptor	26-287	1

Main: 1.6A/250V fuse on the main (F1) and a 5A/250V fuse on Aux 1 and 2 (F1 and F2).

Appendix C – Updating the Control Software on the Paramount ME and Paramount GT-1100S

This appendix describes the procedure to update the Paramount ME and Paramount GT-1100s internal control software.

1. Download the most recent version of TheSky from Software Bisque at www.bisque.com/download.
2. The latest Paramount firmware is version 1145. The file named “MKS1145.out” contains the latest, updated control software that will be transferred into Paramount’s control system. This file is located in TheSky’s folder:

```
<Drive>:\Program Files\Software Bisque\TheSky\MKS1145.OUT
```

where <Drive> is the letter of the hard drive where TheSky was installed.

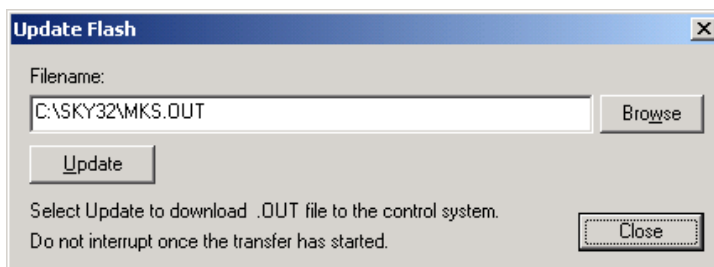
Programming the flash in the Paramount GT-1100 requires removing the side panel (where the power switch and joystick plug in). On the Paramount ME, remove the access panel on the control panel mounted on the back of the RA box.

Once removed, you will see the adapter board with numerous wires and ribbon cables attached. There are two *DIP switches* on this board labeled **Program** on one side and **Run** on the other.

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

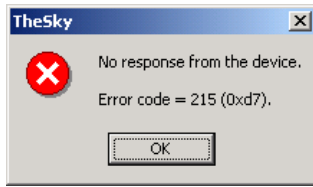
After the DIP switches are set to **Program**, turn on the Paramount. Note that the motors will *not* turn as they do when the DIP switches are set to **Run**.

Next, launch TheSky and click **Telescope | Link | Establish**. Instead of the normal homing question, you will see the following dialog box:



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

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



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

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

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

Appendix D – Setting Up and Using the Paramount in the Southern Hemisphere

The following directions show how to configure TheSky Astronomy Software so the Paramount ME or GT-1100S performs properly in the Southern Hemisphere.

See the Paramount ME Initialization on page 38 for details about connecting your telescope to the computer and establishing communications with the mount.

1. Click **Telescope | Link | Establish** to establish communication with the mount.
2. Click **Telescope | Options | More Options** to display TheSky TCS© dialog box.

Several parameters must be modified on the TheSky TCS© dialog box so that the Paramount works correctly in the Southern Hemisphere.

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

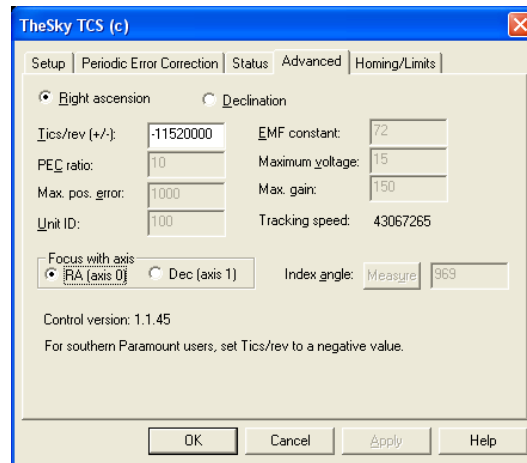


Figure 52 – TheSky TCS dialog box.

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

This value is automatically computed by clicking **OK from the TheSky TCS dialog box, and is displayed on **Telescope | Options | More Options | Advanced** tab).*

*[†]These values are shown on the **Telescope | Options | More Options | Setup** tab.*

Note: TheSky version 5.00.014 and later allows access to the **Advanced** tab on TheSky TCS© dialog box. Download this version from www.bisque.com/download.

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

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

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

ALWAYS SYNCHRONIZE (SYNC) IN THE EAST, THAT IS, ON THE SAME SIDE THAT THE MOUNT HOMES!

Setting the Telescope Limits

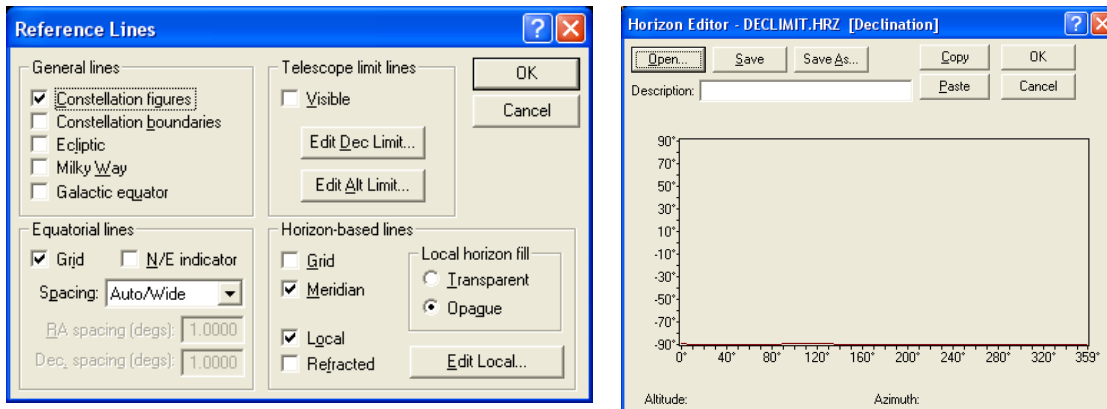


Figure 53 – Setting Telescope Limits.

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