PARAMOUNT GT-1100 S

ROBOTIC TELESCOPE MOUNT

User's Guide

Revision 0.96

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Introduction

Thank you for purchasing the Paramount GT-1100S Robotic Telescope Mount. The Paramount is a high-precision instrument designed to deliver unmatched telescope performance to the amateur or professional astronomer.

We recommend that you become familiar with all the components of the Paramount 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.

A series of instructional videos (in MPG format) is provided on the Paramount CD-ROM. They can be viewed nonstop from the Installation program; for more control of the playback, double-click on the file from Windows Explorer so you can easily stop, rewind and re-play each instructional video.

We strongly recommend that you study these videos as a first step toward learning how to use the Paramount.

List of MPEG files located in the BIN folder on the Paramount CD-ROM

File name	Contents
Unpacking.mpg	**Unpacking the Paramount GT-1100S**
Mounting1.mpg	**Attaching the Paramount to the pier**
Pier.mpg	**Software Bisque pier overview**
Baseinstr.mpg	**Base Instrument Panel overview**
Dec balance.mpg	**Balancing the declination axis**
Ra balance.mpg	**Balancing the right ascension axis**
Homing.mpg	**Homing the mount**
Polar altitude.mpg	**Adjusting altitude during polar alignment**
Polar azimuth.mpg	**Adjusting azimuth during polar alignment**

What Makes Paramount Different?

The Paramount GT-1100S is designed from the ground up to be a sturdy, reliable mount for instruments up to 45 kg (100 lb). The following features insure increased productivity for astronomer using the GT-1100S:

- Research grade right ascension gears with less than 5 arc-seconds of periodic error peak-to-peak.
- TheSky Astronomy Software, to easily locate your target objects.
- CCDSoft CCD Astronomy Software, for controlling CCD cameras.
- Orchestrate scripting program for running unattended data acquisition sessions.
- TPoint Telescope Error-Modeling Software, to provide unmatched pointing capabilities.
- Software Bisque's MKS-3000 Telescope Drive System, for precise tracking, periodic error correction and slewing.
- Accurate homing for quick startup

Unpacking and Assembling the Paramount GT-1100S

The order of the assembly is important and the steps are listed here. A more detailed description follows.

1. Unpack and inspect.
2. Attach the mount to the pier.
3. Attach the counterweight bar to the declination assembly.
4. Add the counterweights.
5. Attach the optical tube assembly (OTA).
6. Balance the system.
7. Connecting the electronics and power.
8. Turn on and test the mount.

Step 1 — Unpacking the Paramount GT-1100S

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

Quantity	Item
1	Paramount GT-1100S
3	5/16x18x1-inch pier mounting bolts
1	1½ x18-inch counter-weight bar
2	9 kg (20 lb.) ergonomic counter-weights
1	Joystick

For assembly at least the following are required (included):

- 1/16, 1/8, 3/16 and ¼-inch Allen or hex wrenches.

Paramount GT-1100S Assembly and Setup

Once you have thoroughly inspected all components of the mount, you are ready to assemble the Paramount. Software Bisque pre-assembles and tests each mount individually, so the final assembly should go smoothly. Follow the steps below to assemble the mount.

Step 2 — Attach Mount to Pier

Loosen the six altitude adjustment nuts (two right ascension housing nuts and one adjustment bar nut on each side). **Caution!** When all 6 of these have been loosened, the right ascension housing is free to pivot in the wedge. As shipped, the right ascension housing is in the lowest position and therefore has no tendency to fall. Once raised, make sure that at least two of the nuts are tight to insure the right ascension assembly does not fall.

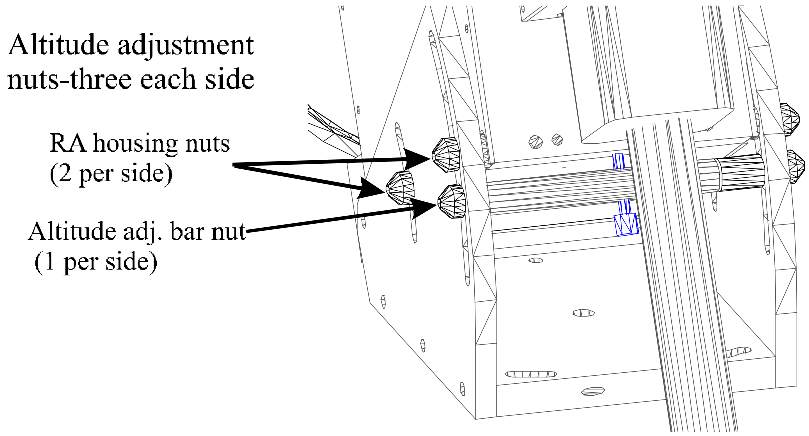


Figure 1— Make sure the two shoulder bolts in the slotted holes to the North are in place before raising the Paramount to its highest altitude position, as it will have a tendency to fall towards the South in this configuration.

Rotate the right ascension housing to the highest elevation and re-tighten the altitude adjustment bolts. When the right ascension housing is in this position, accessing the rear pier mounting bolt is much easier. **Caution!** When lifting the housing to attach the right ascension/wedge assembly to the pier, make sure the right ascension housing nuts are secure or the wedge will be unstable during the lift.

Insert the three pier mounting bolts into the wedge-to-pier attachment holes shown below and hand tighten.

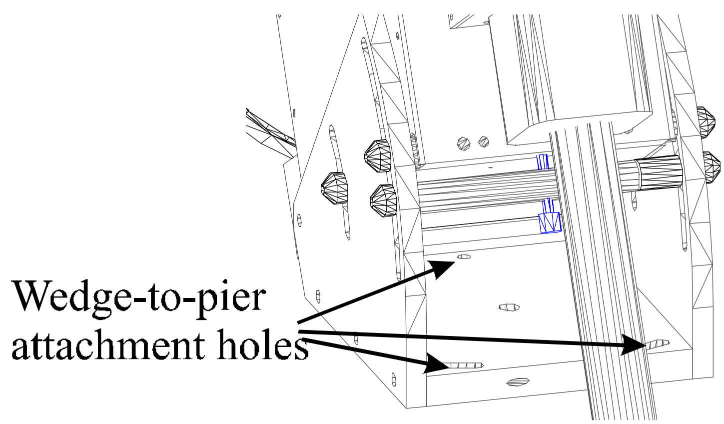


Figure 2 — Pier Attachment Holes

Next, rotate the right ascension assembly to its highest position to make the pivot shoulder bolt more accessible. Now tighten the rear shoulder bolt until it is snug. When making azimuth adjustments, you do not have to loosen this rear shoulder bolt.

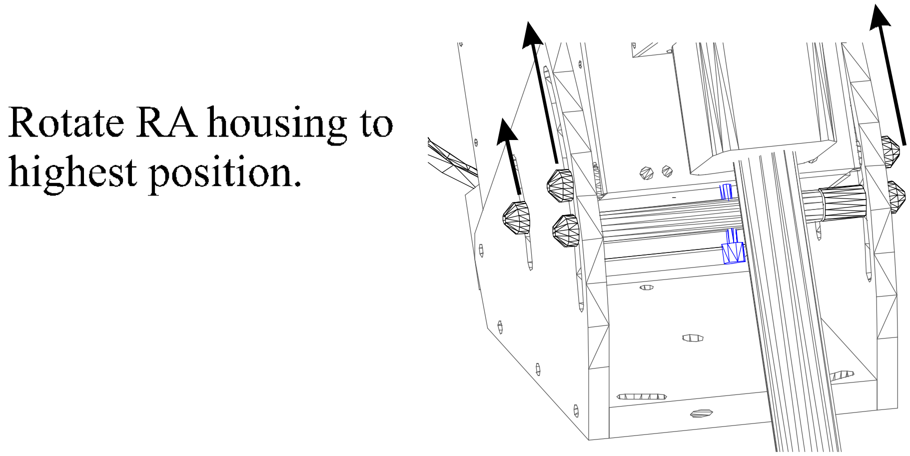
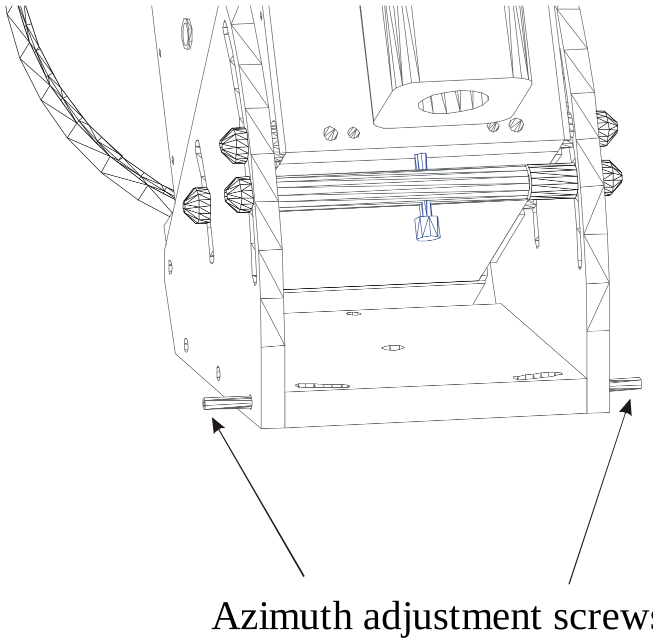
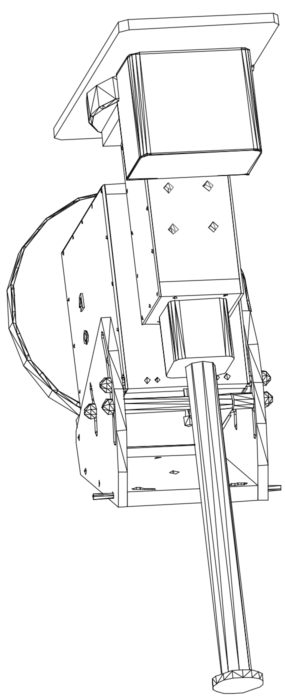


Figure 3 — Preparing the Paramount Wedge for Mounting



Note the azimuth adjustment screws on the East and West sides of the mount. These screws are fine pitch and require a lot of turning to tighten (i.e. 28 turns per inch of movement). Continue to screw in the azimuth adjustment screws until they have contacted the shoulder bolts (the ends of these azimuth adjustment screws become visible in the slotted holes shortly after they have passed through wedge side plate).

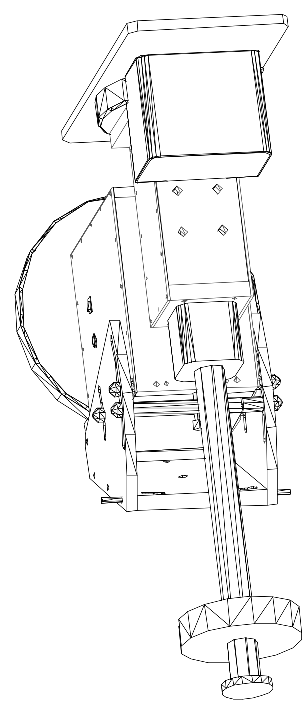


Step 3 — Attach Counterweight Bar to Declination Housing

Locate the counter-weight bar and screw the threaded end into the base of the declination housing. Although this increases the weight of the assembly before it is lifted for attachment to the right ascension housing, it provides a solid handle for lifting the declination axis.

WARNING: If the right ascension worm is not engaged with the right ascension gear, the declination assembly is top-heavy and could cause damage when it falls. See picture on the left.

If a counterweight is added the mount bottom heavy and is in a stable configuration. See picture at right.



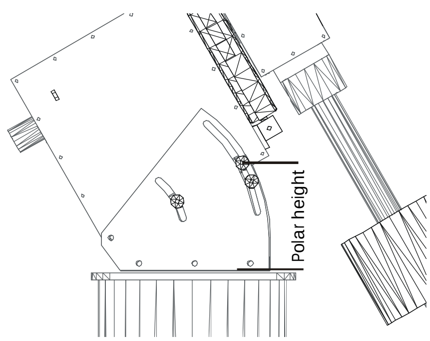
Approximating Polar Elevation

The following table can help you estimate the height right ascension housing measured from the bottom of the wedge assembly.

Here is the equation for determining the height of the center of the socket head cap screw on the GT-1100S:

Polar height = 1.75" + 7.75" * sine(Latitude)

Latitude (degrees)	Height of SHCS center (inches)	Height of SHCS center (cm)
20	4.40	11.2
22	4.65	11.8
24	4.90	12.5
26	5.15	13.1
28	5.39	13.7
30	5.62	14.3
32	5.86	14.9
34	6.08	15.5
36	6.31	16.0
38	6.52	16.6
40	6.73	17.1
42	6.94	17.6
44	7.13	18.1
46	7.32	18.6
48	7.51	19.1
50	7.69	19.5



Step 4 — Add the Counterweights

While the right ascension gear and worm are still not in contact, the counterweights should be placed on the counterweight bar. Note that each counterweight has a brass insert that is used to apply pressure between the counterweight and the declination shaft. This insert does not turn while pressure is applied by turning in the knob, protecting the counterweight bar from scratches.

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. 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.

Be very careful when handling the counterweights so that you do not accidentally drop them. They are heavy enough to make a dent in concrete, so imagine what they could do to your foot!

Step 5 — Attach the Optical Tube Assembly

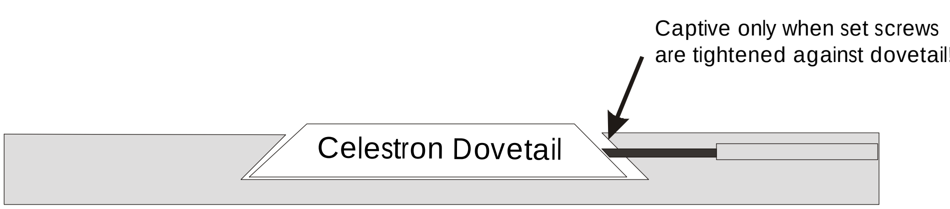
Because the Paramount can accept a wide range of optical tube assemblies, not all of the options are discussed here. The Losmandy™ Dove tail system is one popular system for attaching optical tube assemblies.

Warning!

Please note the difference between the Paramount adapter plate and other dovetail systems.

Some dovetails (such as those supplied with Celestron telescopes) are not captive when placed in the Paramount dovetail plate until the angular contact setscrews are tightened:

Paramount adapter plate



Paramount adapter plate

Once attached, remember that the right ascension axis is free to rotate and if top heavy (that is, the OTA is heavier than the counterweights) the mount is in a dangerous and possibly destructive state. Continue to hold the assembly and spin it using caution to determine the balance. By holding on to the counterweight bar, you can make adjustments to the weight distribution and also prevent the OTA from falling and colliding with the mount. Continue to make adjustments to the position of the counterweights until you can release the declination axis and it remains at rest or rotates very slowly.

Attaching the Optical Tube Assembly

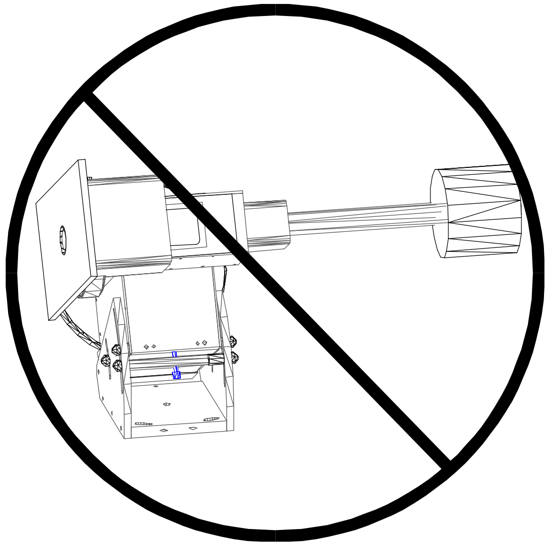
Depending on the size and weight of your optical tube assembly (OTA), you might want to solicit a friend (or two) to help lift and attach this component. The Losmandy dovetail mounting brackets provide a stable mounting interface for most off-the-shelf OTAs. Be sure to sufficiently tighten all mounting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

Tube Rings

Tube rings provide a means of adding a second optic on top of the primary optic. They can also provide a more robust system for mounting the primary optical tube assembly than dovetail systems.



Caution: Do not put the Paramount in the above configuration with the worm gear engaged

Note: The Paramount, as pictured above, is in an unstable configuration that puts extreme forces on the right ascension gear teeth. The counterweight shaft should remain in the vertical position during the time when the Paramount is loaded with counterweights but the OTA has not been attached. This minimizes the force on the right ascension gear teeth and insures the mount is in a stable position at all times.

Step 6 — 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. 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.

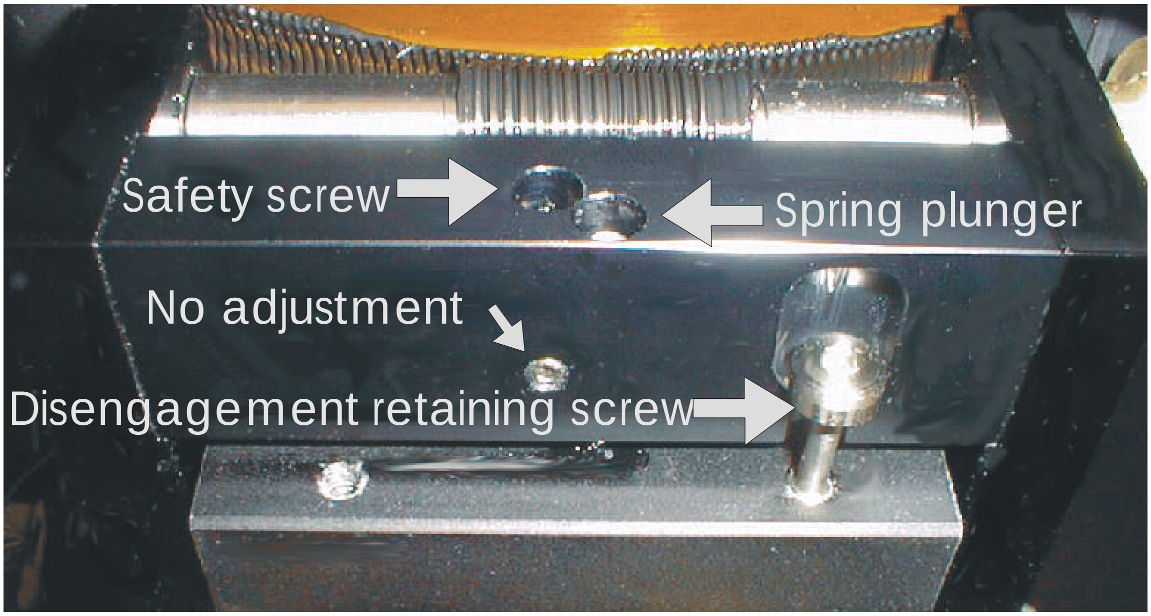
The Paramount comes with two 9 kg (20 lb.) counterweights to balance the optical tube assembly. To balance the right ascension axis, slide the counterweights up or down the counterweight bar until the system has no tendency to fall in either direction.

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 GT-1100S 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.

To access the worm blocks the worm block covers must be removed. Each worm block has the following threaded items:

- A *spring plunger* to provide engagement between the worm and gear.
- A *safety screw* that prevents the worm and gear from disengaging.
- A *disengagement retaining screw* for holding the worm block away from the gear.



Spring Plunger
The spring plunger assures full contact of the worm and gear. Though the motors on the mount can slew with this plunger set to a wide range of pressures, the optimal pressure can be achieved by rotating the spring plunger clockwise until it is in hard contact, then rotating counterclockwise one and one-half full turns.

Safety Screw
To fully disengage the worm from the worm block for balancing purposes, the safety screw must be rotated counterclockwise about two full turns. To properly reengage the safety screw, turn it clockwise until it stops and then rotate counterclockwise about 1/8 of a turn. Verify the safety screw is properly adjusted by pulling the worm away from the gear. It should move slightly but not disengage.

Disengagement Retaining Screw
This screw is used only while balancing a system. To hold the worm away from the gear while balancing, tighten this screw while holding the worm block away from the gear. Once tightened, you can release the worm block and it will not spring back into mesh with the gear.

If two persons are available for balancing, it is not necessary to use this screw to hold the worm block away from the gear as one person can do this.

Note: Now is the best time to mark the various positions the counterweights will be for different instrument configurations.

Counterweights for the Paramount GT-1100S with Sure-Grip™

The counterweights for the GT-1100S have the following features.

- 9 kg (20 lb), all stainless steel.
- Sure-Grip technology. The central bore has a unique profile that provides much more locking friction than a simple straight through bore. Hand tightening provides enough torque to insure zero slippage.
- Ergonomic feel with smooth radius corners.
- Stainless locking handle has a very low profile that is protected in a recessed bore.
- Counterweight can be tightened by hand or using a hex wrench.
- The brass locking-plunger is spring loaded to make adding and removing counterweights easy.

Step 7 — Connecting the Electronics and Power

1. Connect the Joystick to the round din connector on the East side of the Paramount right ascension box. ***Never plug or unplug the joystick while the Paramount is powered.***
2. Plug the serial cable into the appropriate connector on the Base Panel (Serial). This connection permits communication between the Paramount and the computer.
3. Plug the 48-volt power supply into the jack labeled "Mount" on the Base Panel. This supplies power to the Paramount.
4. Turn on the Paramount using the rocker switch above the Joystick connection on the East side of the mount.

On power up, you will hear the motors seeking up to six minutes of arc for the nearest index on the encoders.

We recommended additional devices through the "Base Panel-to-Instrument Panel" cable routing system remain unattached until you are comfortable that the mount is connected to the computer and operates as expected with the joystick and under computer control.

First Slews

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

Note: The Paramount GT-1100S will not slew or begin tracking until it is homed!

What Is Homing?

Homing involves rotating the each axis of the Paramount until the homing index is located. Each axis has an infrared sensor that is used to detect the home position. The home position is at approximately hour angle 1.2 and declination –30 degrees. This position cannot be changed as it depends on the physical position of the gears.

Each time the mount homes, it returns to the exact position and sets the position registers to zero. When synchronization is performed, the hour angle and declination of the home indexes are stored in the internal flash of the Paramount. Subsequent sessions simply use the Local Sidereal Time to determine the pointing direction of the mount.

The homing function of the Paramount GT-1100S provides the following benefits to the astronomer including the following:

- Once a mount is polar aligned, you can achieve extremely accurate pointing by simply homing then using the Paramount under control of TheSky.
- After homing the mount "knows" where the limits are and the mount cannot be driven into itself. The right ascension limits are just past the Meridian in each direction (east and west) and in declination the limit is at approximately –90 degrees declination. In right ascension, this is about 1.2 hours away from the Meridian with the telescope pointing to the West (hour angle 1.3). In declination, the homing position is at approximately –30 degrees declination.
- The PEC function uses this information to calibrate the internal PEC table with the orientation of the worm.
- 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

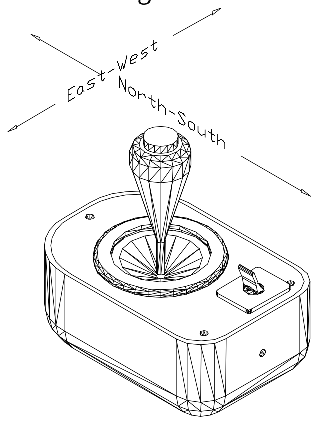
To home the mount using the joystick, "double click" the button on top of the joystick. It is very important that you do not move the joystick while clicking. As a safety feature, you can abort the home in either axis by moving the joystick from the center position. It is easy to stop the homing process by accidentally moving the joystick during a home.

Homing the mount using TheSky software

Upon establishing a link with the Paramount GT-1100S, TheSky will prompt as to whether or not the mount should be homed if it detects that the mount has not already been homed.

The Joystick

In addition to homing the mount, the joystick is used to manually move the Paramount GT-1100S. It also has a built-in LED flash light for use at the telescope.



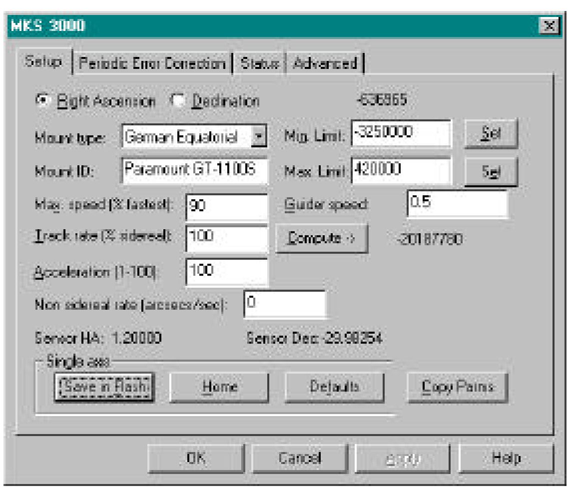
Moving the Paramount with the Joystick

Left and right motion moves the telescope in Right Ascension and up and down motion moves the telescope it in declination. The speed of the mount will increase the further the joystick is moved from the center position. A total of 16 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 MKS-3000 Setup Dialog.

Software Bisque’s MKS-3000 Control System

The MKS-3000 Control System Dialog Box

The “factory” defaults for the Paramount’s control system allow operation right out of the box, and 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.



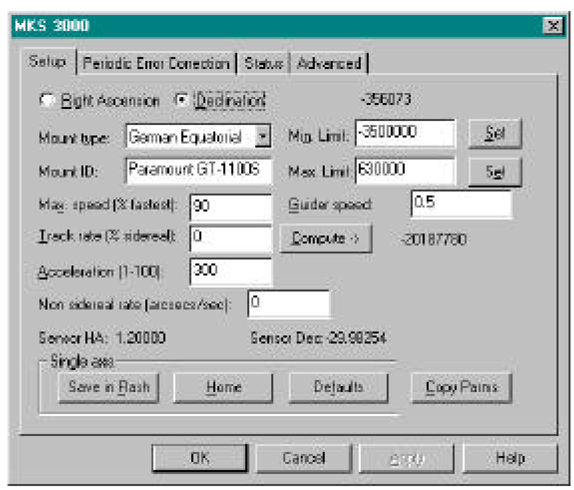


Figure 4 – Setup Tab's on the Object Information Dialog Box

The Setup Tab allows you to change some of the default options of the Paramount'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.

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

Mount Type

The Paramount is a German Equatorial telescope, so this option should be set to German Equatorial, not Fork.

Mount ID

This information is for reference purposes only.

Maximum Speed

The motors are capable of moving the Paramount at approximately 8 degrees per second in declination and 6 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.

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.

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 arc-seconds 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 choose Set tracking rates.

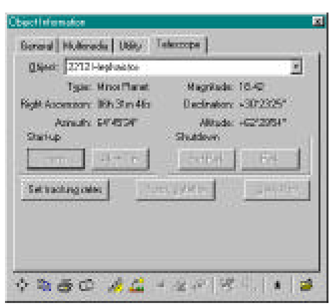


Figure 5 — Click the Set Tracking Rates button to track on minor planets, planets and comets.

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 for those "down under"). When set properly, it is impossible to run the mount into a stop as the motor will decelerate to internal limit.

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.

Compute
This button simply computes the integer sidereal rate and displays it on the setup dialog for diagnostic purposes.

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 GT-1100S, these values are approximately hour angle=1.2 hours and declination = -30 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.

Note that the following three options work on a single axis basis. If you change the maximum slew rate percentage for right ascension and then choose Save In Flash, only the right ascension axis is changed and stored.

Save in Flash (single axis)
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.

Home (single axis)
Select this command to home a single axis.

Defaults (single axis)
Selecting this command sets all of the values for the control system to the defaults values for the GT-1100S.

Copy Parameters

Choosing this option will copy all of the settings for the control system to the 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.

```
MKS-3000 Telescope Control System Copyright (c) 2000 Software Bisque
Mount ID: Paramount GT-1100S
***************** Axis 0 Control version: 0.9.92  *****************  // right ascension
axis
Mount Type: 0
Base rate: -20187780
Max speed: 900000000
Acceleration: 300
Non sidereal rate: 0
Minimum Position Limit: -3320000      // This may be different for your mount
Maximum Position Limit: 390000        // This may be different for your mount
HA/Dec:    1.2000                     // This is altered each time a sync occurs
Guide: -315434
Tics per rev: 7200000
PEC ratio: 10
Maximum position error: 1000
Unit ID: 100
EMF Constant: 96
Index angle: 684                      // Motor dependent, yours may be different
Home velocity high: 500000000
Home velocity med: 90000000
Home velocity low: 3000000
Home dir, sense: 1100
Home mode, required, Joystick, In-out-in: 1111
Home Index Offset:         0
PEC cutoff speed: 40375560
Max Voltage: 15
Max Gain: 150

***************** Axis 1 Control version: 0.9.92  *****************
Mount Type: 0
Base rate:        0
Max speed: 900000000
Acceleration: 300
Non sidereal rate: 0
Minimum Position Limit: -3500000
Maximum Position Limit: 630000
HA/Dec:  -29.9825
Guide: -189260
Tics per rev: -4320000
PEC ratio: 10
Maximum position error: 1000
Unit ID: 100
EMF Constant: 96
Index angle: 673                      // Motor dependent, yours may be different
Home velocity high: 500000000
Home velocity med: 90000000
Home velocity low: 3000000
Home dir, sense: 1100
Home mode, required, Joystick, In-out-in: 2111
Home Index Offset:         0
PEC cutoff speed: 0
Max Voltage: 15
Max Gain: 150
```

Training PEC

This function is run when a CCD autoguider is making guiding adjustments to the system. The PEC training period takes about four minutes to complete. During the PEC training, the graph will be updated showing the progress and adjustments.

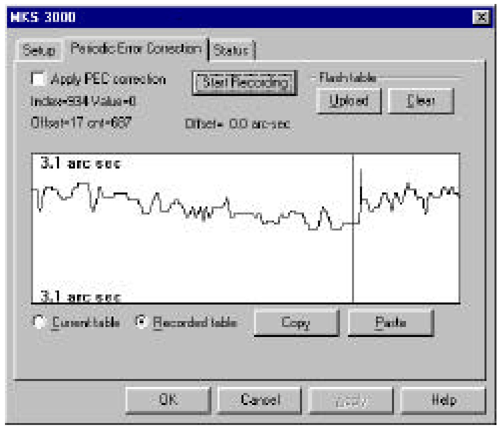


Figure 6 — Periodic Error Correction Tab on the MKS 3000 Dialog Box (TheSky)

The following steps are necessary to successfully train PEC:

1) Display the PEC dialog by choosing Telescope Options More settings.
2) Switch to CCDSoft and start guiding.
3) Switch back to TheSky and choose Start Recording.
4) Wait until the red status line has cross the entire graph (about 4 minutes) and the "Abort Recording" button switches back to Start Recording.

It is important to note that the recording phase of the PEC training only records the values. It does not automatically store them in the flash or activate PEC adjustments. 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 Paramount.

MKS Status Dialog

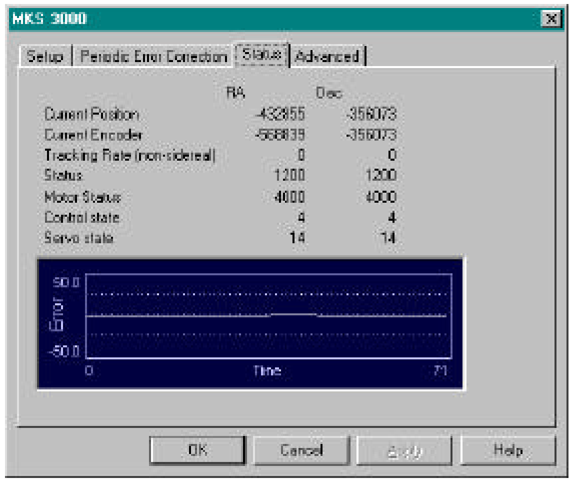


Figure 7 — The Advanced Tab of the MKS 3000 Dialog Box (TheSky)

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.

The MKS Advanced Dialog

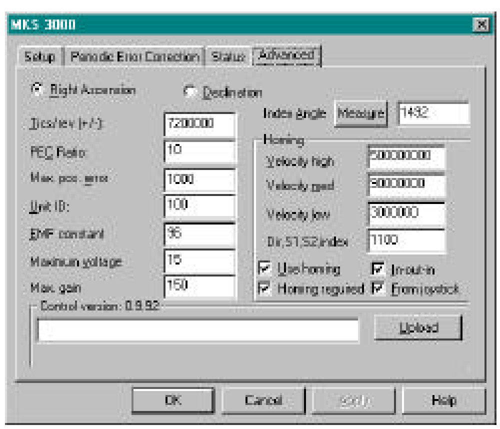


Figure 8 — The Advanced Tab of the MKS 3000 Dialog Box (TheSky)

This dialog is normally hidden and does not appear by default. The values present on this tab of the dialog are critical to proper operation of the mount and should never be altered unless the reason for making the change is perfectly understood.

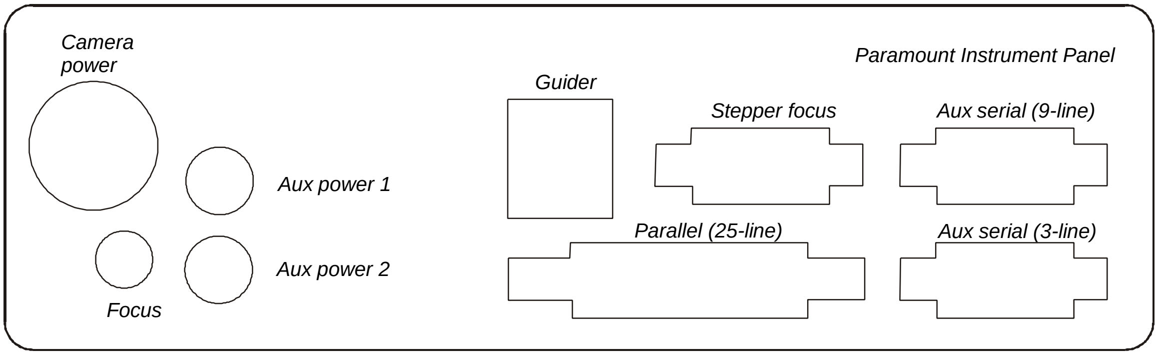


Figure 9 — The Paramount Instrument Panel

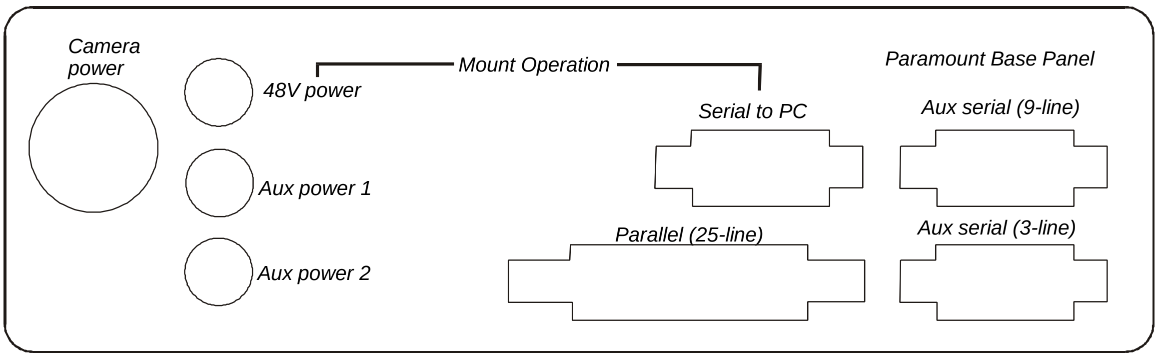


Figure 10 — The Paramount Base Panel

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 GT-1100S from TheSky

The Paramount GT-1100S uses the MKS-3000 control system from Software Bisque. Make sure you do not select Paramount GT-1100 from the list of telescopes, as the prior version of the Paramount used a different control system.

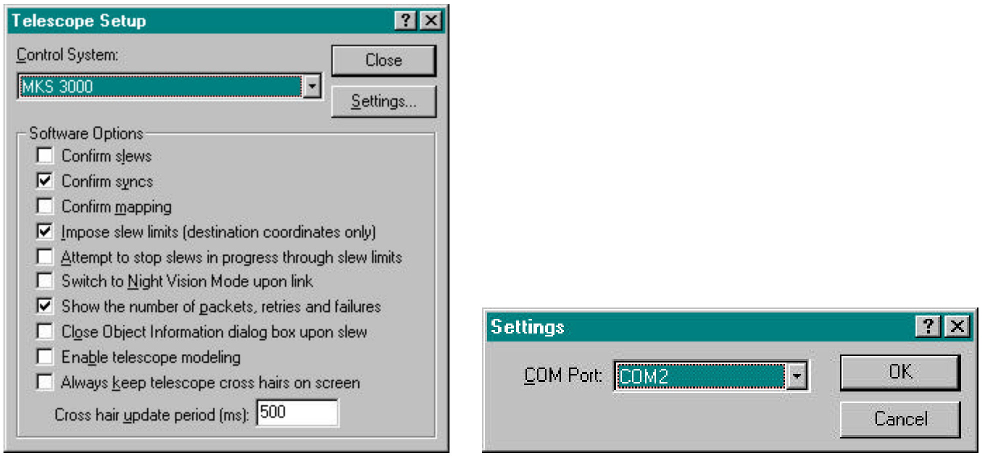


Figure 11 — Telescope Setup and Settings Dialog Boxes

Connecting the Paramount to your Computer

The Paramount communicates through a serial port on your computer. Make sure the MKS-3000 is configured for the correct computer port. From TheSky, click **Settings** on the Telescope Setup dialog box.

Syncing on a Star

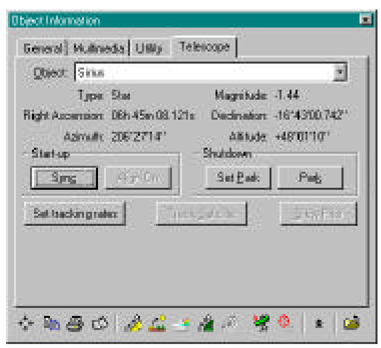


Figure 12 — The Telescope Tab on the Object Information Dialog Box (TheSky)

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.

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'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 of 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 crosshairs 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.

Polar Alignment

Before the Paramount can accurately track objects, an accurate polar alignment is necessary. The question may be asked "how accurate". Subjectively, if the altitude and azimuth are each within 2 arc-minutes 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 arc-minute of the pole it becomes difficult to improve since making the adjustments requires altering the mount from a fixed state to a free state then back to a fixed state again.

Adjusting the Altitude and Azimuth

The Paramount is equipped with precise altitude and azimuth adjustments. The 28-pitch adjustment screws are specially designed so that one complete rotation translates to a small angular motion. One rotation of the *Altitude Adjustment Screw* results in about 16 arc-minutes of motion. One rotation of the *Azimuth Adjustment Screws* results in about 18 arc minutes of motion. These calibrated amounts can be used to fine-tune the polar alignment.

When the telescope and counterweights are in place, it is necessary to reduce the pressure on the altitude adjustment screw by lifting up on the declination housing. Using one hand to apply upward pressure and the other to turn the knob works well in practice.

Polar Elevation Adjustments

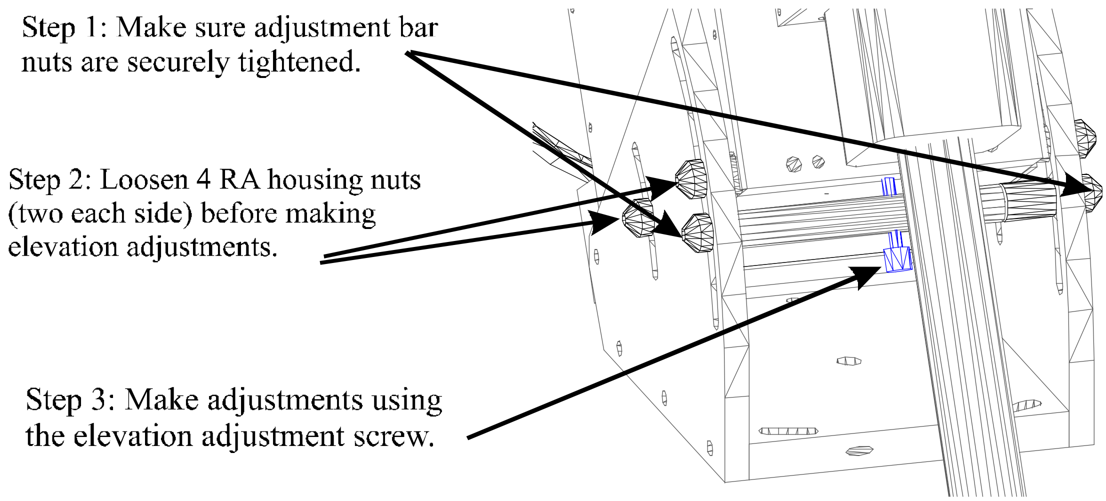


Figure 13 — Paramount Elevation Adjustment Screws

> **Important Note!**
> Before loosening the four right ascension housing nuts, be certain that the two nuts on the altitude adjustment bar are securely tightened. If they are not, the entire assembly, including the telescope, is free to move and will fall to the bottom of the wedge slot. This could cause damage to the Paramount, the OTA or the operator.

Polar Azimuth Adjustments

For a complete closed-loop polar alignment adjustment system, attach a video camera to the telescope and point the telescope near the celestial equator*. The video output gives real time feedback of any adjustments made. If you have calibrated the video output display (i.e. arc-minutes in the x and y directions), you can determine precisely how much the telescope moves during adjustments and rapidly achieve polar alignment.

*Note: When making adjustments for polar alignment using video feedback, make sure the OTA is pointing close to zero degrees declination. Along this line, the units of angular distance match the units of right ascension. As the telescope moves closer to the poles, the angular distance swept by the telescope becomes smaller for a given change in right ascension.

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's Altitude and Azimuth Adjustment screws. Usually two iterations can get each axis within two arc-minutes.

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's polar alignment is way off, even short star-hopping slews may require the destination star to be re-centered in the eyepiece.

Telescope mapping and polar alignment procedure

1. Set your time as accurately as possible each night before observing.
2. Insert a New TPoint model into TheSky (**Edit > Insert > TPoint Model**).
3. Synchronize the telescope on a bright star. When performing a TPoint run synchronize the telescope *once* for each mapping run. Synchronizing more that once will require a new TPoint model.
4. After accurately synchronizing the telescope, slew to a nearby star (by identifying the star in TheSky and clicking the **Slew To** button), center the actual star in the eyepiece, and then click the **Map** button on the Object Information dialog box. This constitutes one data point.
5. 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.
6. After 15-20 data points are collected, add more terms to the TPoint model so that the RMS value is as small as possible. Consult the TPoint User's Manual for instructions on adding terms to a TPoint model.
7. From TPoint, determine the current polar alignment of the telescope by clicking **Model > Polar Alignment Information**.
8. Adjust the mount according to the TPoint polar alignment information.

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. Choose Model Polar Alignment Information to display the dialog. The fine pitch adjustment screws on the elevation and azimuth result in about 15 arc-minutes (300 arc-seconds) per full turn.

The above information can also be extracted from the Fit Dialog as explained below.

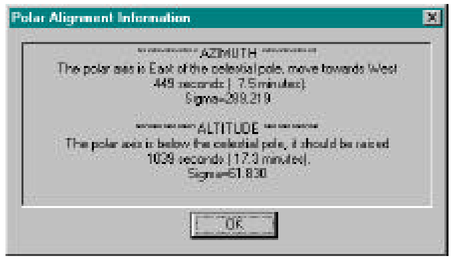


Figure 14 — Sample Polar Alignment Information Dialog Box (TPoint).

The Polar axis elevation value (ME) and the Polar axis EW value (MA) provide an estimation of the polar misalignment in arc-seconds.

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 example, if the Polar axis elevation (ME) value is +600 arc-seconds, the polar axis should be lowered about ten arc-minutes. Ten arc-minutes corresponds to about two full turns of the elevation adjustment screw.

Similarly, when adjusting the polar axis azimuth, look at the Polar Axis EW value reported on the Fit Dialog. If this value is greater than zero, the pole of the mounting is to the right of North so the azimuth adjustment screw on the West should be tightened to move the pole towards the West.

For most U.S. latitudes, the actual polar elevation target is not the North Celestial Pole but rather a point about one arc-minute 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 > 15 degrees altitude and < 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 are sometimes 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 adjustment screws on the Paramount wedge provide a reasonably 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 arc-minutes).

The process of loosening the two shoulder bolts for azimuth adjustment or the right ascension housing nuts for altitude adjustment will usually cause a bit of motion of the entire Paramount. With video feedback, the magnitude and direction of this motion can be noted and then compensated for when re-tightening occurs. This small amount of motion (usually within a couple of arc-minutes) is not a problem when making course adjustments but becomes important when trying to achieve a polar alignment of less than three to four arc-minutes.

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

Paramount Initialization

This section describes the steps necessary to initialize the Paramount GT-1100S on the first night of operation and on subsequent nights.

Tip
The discussions related to TPoint modeling, mount initialization, parking, and so on, may seem daunting at first and leave you with the feeling the Paramount is a complicated system to use. 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 Sync the telescope and go! Paramount's pointing will continue to be better than most commercially available robotic telescopes.

For the Paramount 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 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 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 with ever having to perform a star synchronization.
?? Even if power is lost to the Paramount, the homing function can return the telescope to its previous state.
?? A reality check is performed when the star synchronization is performed 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 (i.e. within a couple of minutes). 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. TheSky uses the computer time to compute accurate Local Sidereal Time (LST). When a link is established between TheSky and the Paramount that has been homed, the LST is used to re-establish the synchronization between the Paramount electronic setting circles and the celestial sphere to within a few arc-seconds. 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 arc-seconds 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.

Parking the Paramount GT-1100S

Before parking the Paramount, 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 you have a roll-off roof observatory 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. Then, each time a Park command is issued, the mount will slew to the park position.

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

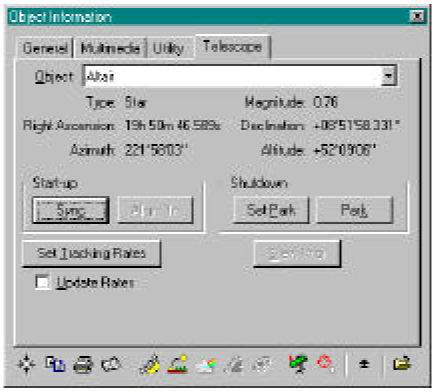
Parking the GT-1100S

Click **Telescope > Options > Park**.

Syncing the Telescope

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.

The date, time and location in the Site Information dialog in TheSky must be entered correctly before telescope synchronization is performed!



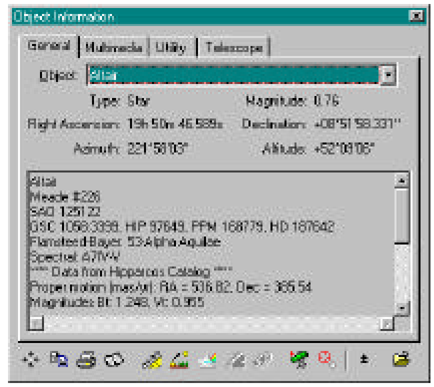


Figure 15 — Sample Object Information dialog box and Telescope Tab (TheSky)

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. The counter-weights 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 the ***Confirm Syncs*** *option on the Telescope Setup dialog is clear, you will not be prompted to confirm the synchronization. We strongly recommended that the* ***Confirm Syncs*** *option is always marked, since accidentally clicking* ***Sync*** *instead of* ***Map*** *during a mapping run is easy (especially at 3:00 a.m.!).*

The Meaning of Sync

Once you have synced the telescope, TheSky now 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. This of course also requires the site information is properly entered in TheSky.

When the Sync is performed, the relevant information needed by TheSky to automatically startup on subsequent sessions is stored in the flash memory of the Paramount. If a different computer is to be used on subsequent nights, you must copy the .SKY file to the folder containing the file named SKY.EXE.

In theory, the Paramount 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.

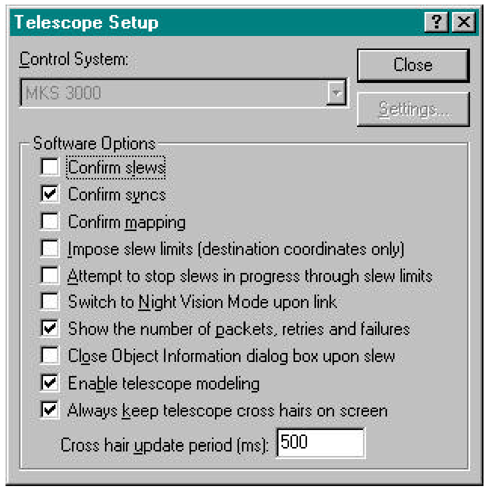


Figure 16 — Telescope Setup Dialog Box (TheSky)

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 control system that all subsequent mapped stars will use.

Important Note*: During a mapping session do not re-sync your telescope control system by clicking the Sync button. If you synchronize on a star after the mapping session has begun, you must start over!*

The sync star can also be your model's first mapped point. Click the Map button to record this point and to begin gathering your pointing data. TheSky communicates continuously with TPoint as each map point is added.

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.
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.

Troubleshooting

Problem: I cannot communicate with the Paramount.

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 (Telescope Setup Dialog).

Problem: The Paramount is having difficulty slewing.

Check the mount balance in both axes.

If the Paramount stalls or sounds very labored as it is slewing, check to make sure both axes are balanced. The heavier the load, the more critical the balance becomes. Even though the control system has sufficient torque for moving heavy loads, tracking and slewing may suffer if the system is slewed greatly out of balance.

Appendix A — Preparing the Paramount Pier

There are a number of options for attaching the Paramount to the pier:

- Use a pier from Software Bisque, which is attached to the ground with 4 bolts.
- Use an existing pier and attach an aluminum Universal Mounting Adapter.
- Use an existing pier and attach a steel mounting adapter from Software Bisque.
- Modify an existing pier to attach the Paramount Wedge by drilling and tapping the required pattern to accept the shoulder bolts.

The Paramount is attached to a pier using three 5/16-inch shoulder bolts. These bolts form a triangular pattern. The wedge (and entire telescope) pivot around the hole that lies on the South side of the pier.

Two slots at the front of the Paramount wedge assembly allow azimuth adjustment to the polar axis. The amount of adjustment is approximately two degrees on either side of center. Therefore, when the pier is installed, true North must be known accurately.

The North side of the pier must be free of obstructions to allow for movement of the counter-weight bar, approximately 30 cm (12 inches).

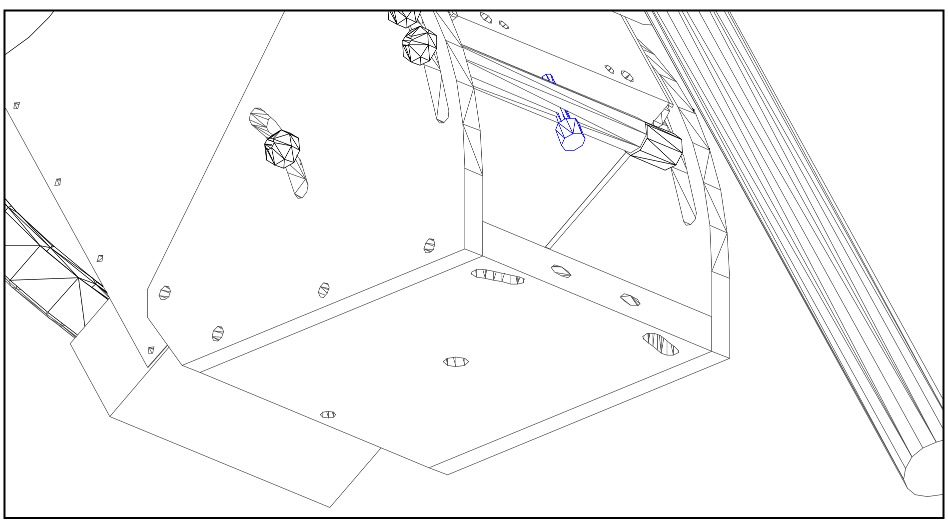


Figure 17 - Bottom View of the Wedge Mounting Holes

Figure 2 shows the bottom of the Paramount wedge. Note the slotted holes in the bottom plate that allow for making azimuth adjustments. Very fine thread adjustment knobs (not shown) are used to make adjustments accurately.

Required Hole Pattern for Attaching the Wedge to the Pier

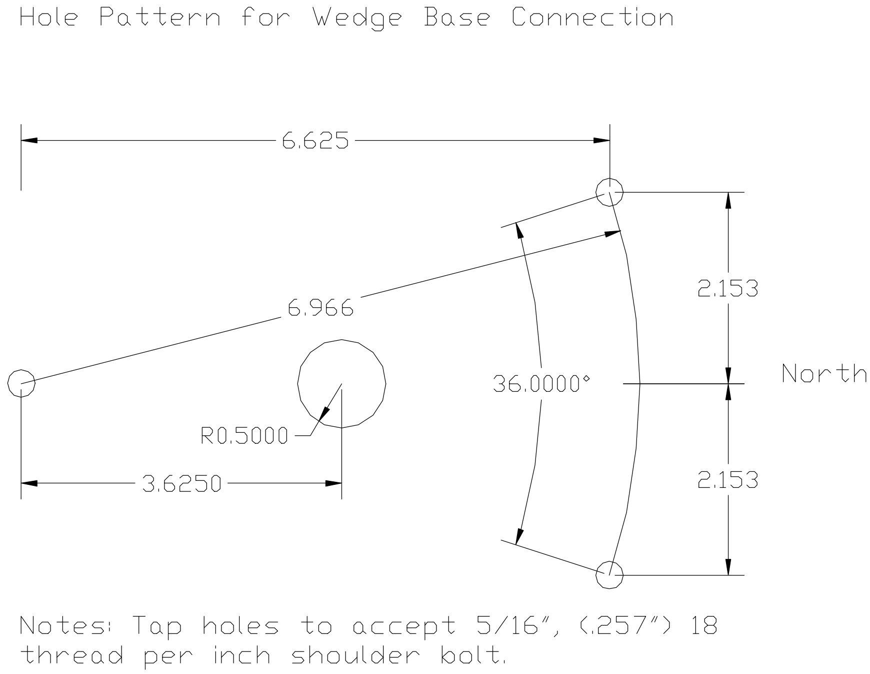


Figure 18 - Pier hole pattern to accept the Paramount Wedge

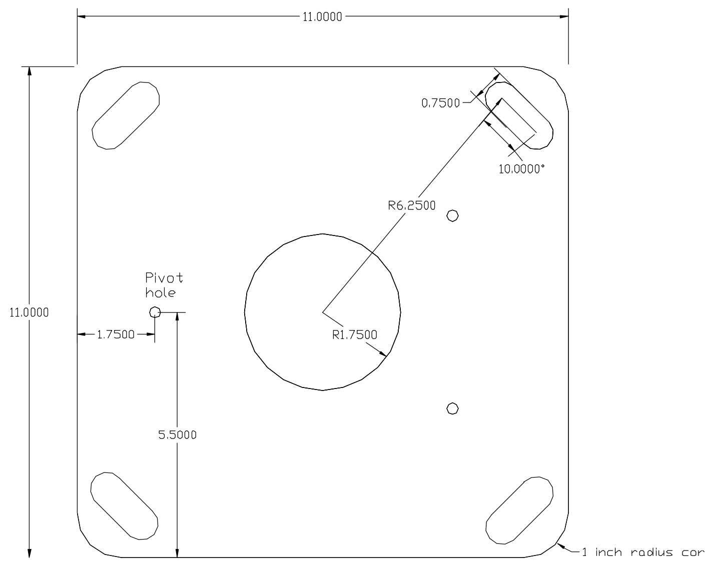
Figure 3 shows the hole pattern required for mounting the Paramount Wedge. Each hole is 18 degrees from a centerline that points directly North.

An optional hole can be placed in the center of the plate (center 3.625 inches to the North of the rotation hole) for routing the Paramount electronic cable down into the pier. The hole diameter is one inch to allow passing of the Paramount cable and end connector.

Paramount Pier from Software Bisque

The following information pertains to the steel piers manufactured by Software Bisque.

Note the bottom plate of the Software Bisque pier contains 4 slotted holes with a radius of 6.25 inches. This design allows the use of four 0.50-inch foundation bolts (such as j-bolts) placed in a concrete base. One edge of the base plate must be aligned with true North. The slotted holes allow for a few degrees of adjustment of the entire pier in addition to the 2 degrees of adjustment available on the wedge using the fine adjust screws of the Paramount.



The pier base plate has a 6.25-inch radius for the mounting holes and an 11x11-inch footprint. Software Bisque piers use the same plate for the top and bottom of the pier. On the top of the pier, the slotted holes provide a convenient place to hang various items.

Figure 19 – Top and Bottom Plate of Paramount Pier

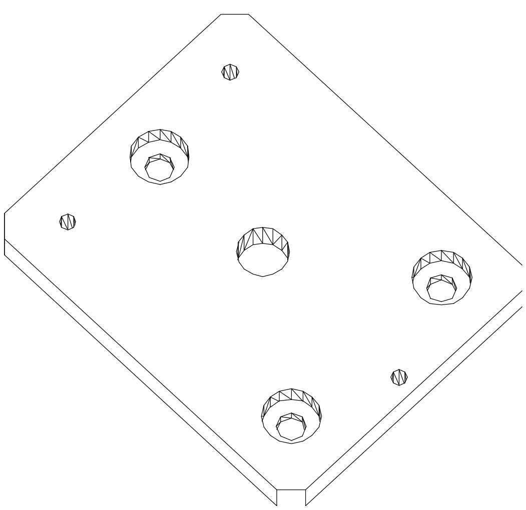


Figure 20 - Universal Mounting Adapter

The Universal Mounting Adapter

A Universal Mounting Adapter pre-drilled with the Paramount Wedge hole pattern is available from Software Bisque. The plate also contains 3 countersunk holes that can accept a ½ inch mounting bolts and nut. The center hole allows the Paramount electronic cable to be directed through the bottom of the wedge and into the pier.

The large holes in the diagram accept the mounting bolts and the countersink is used to keep the nuts below the top mounting surface. Since the wedge slides on this plate when azimuth adjustments are made, the j-bolts must not protrude above the plate top.

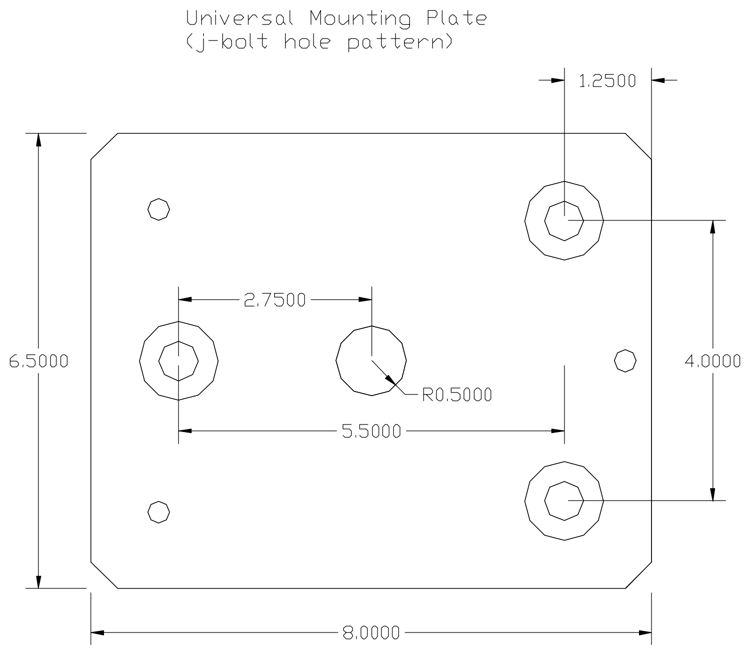
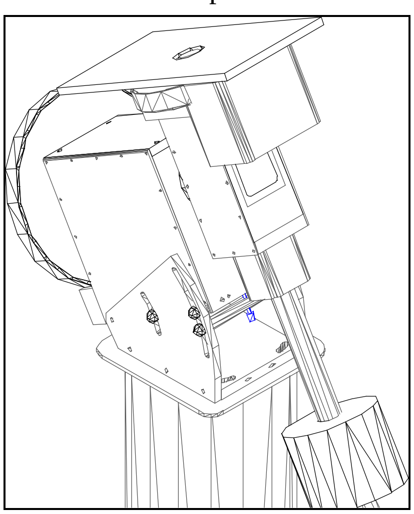


Figure 21 - Mounting hole pattern for the mounting adapter

The above drawing shows the dimensions of the mounting holes that are present on the Universal Mounting Adapter. The plate is machined out of 0.75-inch thick aluminum. If mounting into a concrete pier, the best method of mounting the adapter is to attach the mounting bolts (probably j-bolts) directly to it, then push them into the concrete while holding the adapter. The mounting bolts should not protrude from the concrete surface more than 0.75 inches, the thickness of the adapter plate.

The center holes on the pier and wedge plates are provided as an option to route the electronics cable down into the pier. In situations where the wedge is attached to existing piers that do not provide a central pathway for the cables, the cables turn inside the wedge and exit through the front (North) side of the wedge.



The drawing to the left shows a slightly overhead view of the Paramount. The top plate is used to attach optical tube assemblies. The dimensions of this aluminum plate are 9 x 16 x ½ inches. This plate can easily be modified to accept many different optical tube assemblies.

Figure 22 - Paramount side view showing OTA Mounting Plate

Appendix B — Paramount Dimensions

This section provides dimensions of the Paramount 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.

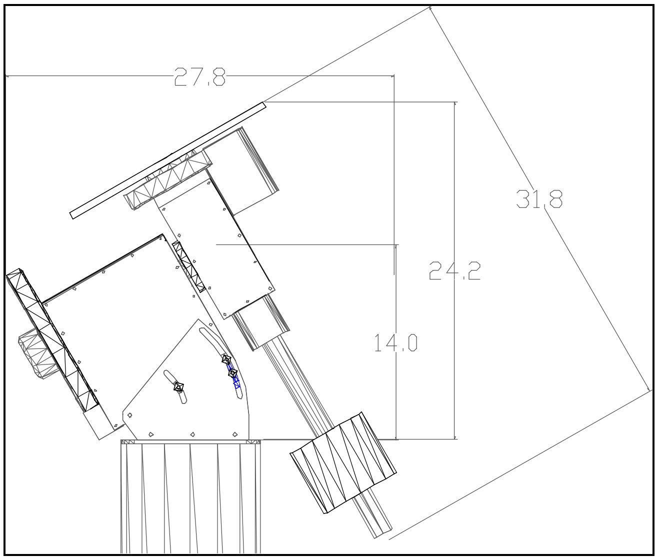


Figure 23 - Approximate Paramount Dimensions

Figure 10 shows the approximate dimensions (in inches) of the Paramount. The 14-inch dimension from the base of the mount to the center of the right ascension axis represents the approximate height of the OTA center when the telescope is pointed near the Meridian.

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

OTA Center height at Meridian (see figure 12 below) =

Metric: Height = 4.45 cm + sin(latitude + 32 deg) x 34.8 cm
Imperial: Height = 1.75 in. + sin(latitude + 32 deg) x 13.7 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 through the walls when pointing in the North or South directions.

Latitude	Approx. OTA Center height at Meridian (inches)
20	11.5
30	13
40	14.5
50	15

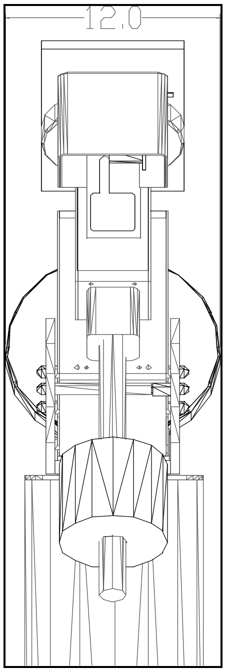


Figure 24 - Width of the Paramount

The widest dimension of the Paramount (i.e. looking North-South) is 12 inches, the width of the right ascension gear cover when the declination assembly is vertical.

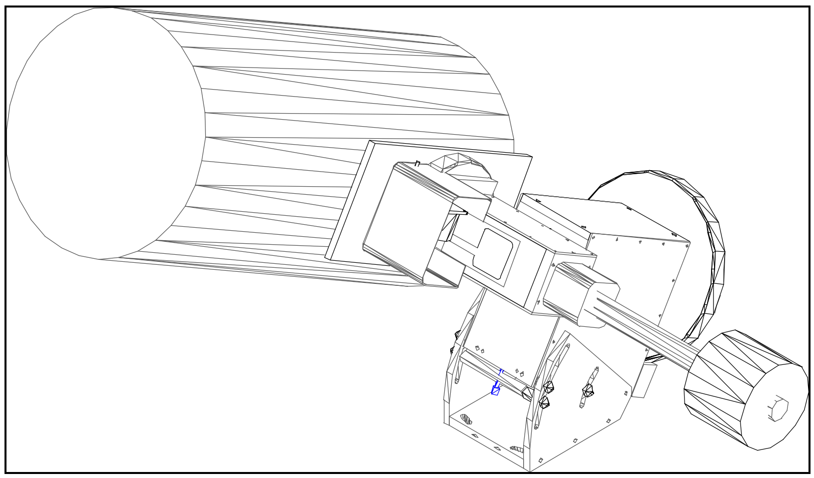


Figure 25 - Perspective drawing of the Paramount with a C-14 tube assembly.

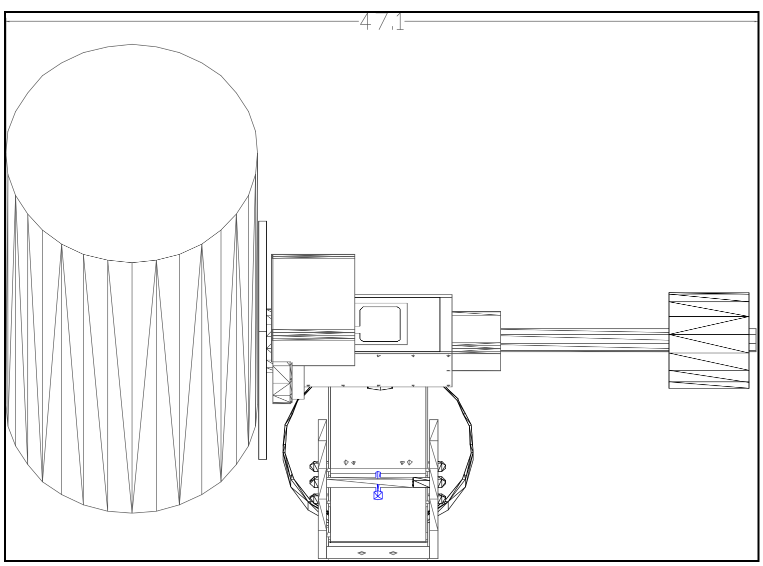


Figure 26 - Approximate width is 47 inches with a C-14 tube attached.

Appendix C — Paramount GT-1100S Cabling

The Paramount GT-1100S has been designed to simplify the process of routing cables to many common electrical devices, such as CCD cameras, filter wheels and focusing motors. For most applications, it is possible to pass all electrical connections through the Paramount's internal wiring, eliminating the danger of disconnecting or even breaking wires during mount movements.

Before making any connections to either the BASE PANEL or INSTRUMENT PANEL, the following information should be read and understood. Failure to observe stated procedures and limitations may result in damage to the Paramount's control electronics and/or any attached auxiliary devices.

Panel Connector Descriptions

Connector	Type	Notes
BASE PANEL		
Mount Power	DC power input	48 VDC tip positive, 1.2A (fused) Power supply is intended for indoor use only.
Camera Power	DC power input	+12VDC, 2A; -12VDC, 1A; +5VDC, 1A
Aux Power 1	DC power input	5-125VDC, 5A (fused)
Aux Power 2	DC power input	5-125VDC, 2A (fused)
Parallel	Parallel data input/output	Host PC-to-Mount communications
Serial	Serial data input/output	Host PC-to-Mount communications
Aux Serial 1	Serial data input/output	Auxiliary communications pass-through‡
Aux Serial 2	Serial data input/output	Auxiliary communications pass-through
INSTRUMENT PANEL		
Camera Power	DC power output	+12VDC, 2A; -12VDC, 1A; +5VDC, 1A
Aux Power 1	DC power output	5-125VDC, 5A (fused)
Aux Power 2	DC power output	5-125VDC, 2A (fused)
Focus	DC power output	12VDC†, 1A* (fused)
Guider	Dual-axis input	Four open-collector TTL logic inputs
Parallel	Parallel data input/output	Mount-to-device communications
Serial	Serial data input/output	Mount-to-device communications

Aux Serial 1	Serial data input/output	Auxiliary communications pass-through‡
Aux Serial 2	Serial data input/output	Auxiliary communications pass-through

†Jumper JF1 on the piggyback Adaptor Board may be used to select 5VDC or 12VDC operation of the focus motor. Variable resistor R1 on the same board may be used to fine-tune the speed of the focus motor.
‡*Aux Serial 1* has pins 1-9 wired straight through, which may be useful for non-communications applications that do not exceed 1 amp per conductor. The other serial connector (3-wire) has only pins 2, 3 and 5 wired.

DC Power

CCD Camera

ST-4, ST-5, ST-6, PixCel 255– The *Aux Power 1* (5A) jack can be used to power the CPU and head. A cable will need to be made to adapt to the CPU's power connector. Construct two 5.5mm O.D./ 2.1mm I.D. DC power plug-to-DB9 adaptor cables– wiring the sleeve to pin 4 (GND), and tip to pin 9 (+12-15VDC). Use a DB9P (male) for the BASE PANEL cable, and a DB9S (female) for the INSTRUMENT PANEL cable.

ST-7, ST-8– The *Camera Power* jack can be used to power one of these cameras. Plug the camera's power supply into the BASE PANEL's *Camera Power* jack, and a 5-pin DIN (180°), male-to-male cable, wired straight through, between the INSTRUMENT PANEL's *Camera Power* jack and the camera. *Do not use less than 22 AWG wire* for this cable, or the camera may not be able to draw enough current for thermal regulation (24 AWG wire may be used if two conductors are ganged for the GND line).

Focuser

A low-amperage (250mA) motorized focuser may be software-controlled through the INSTRUMENT PANEL's *Focuser* jack. This jack accepts the industry-standard 3.5mm phono plug. The power applied to this jack is reversing DC, of user-selectable voltage.

Communications

Paramount

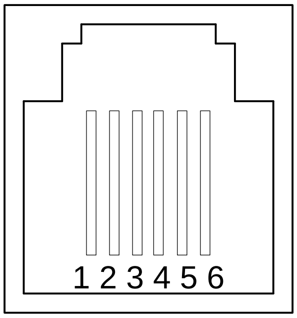
Serial– Connect a DB9 female-to-female cable (included) between the *Serial* connector on the BASE PANEL and a serial port on the host computer.

Instrument-mounted Device (e.g. CCD camera, closed-loop focuser, etc.)

Direct (serial)– Connect the serial communications cable from the device to one of the *Aux Serial* connectors on the INSTRUMENT PANEL. Connect a DB9 female-to-female cable between the corresponding *Aux Serial* connector on the BASE PANEL and a serial port on the host computer.*

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.
1A 5x20mm fast-acting fuse	270-1049	4
2A 5x20mm fast-acting fuse	270-1052	4
5A 5x20mm fast-acting fuse	270-1056	4
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