ASTRO-PHYSICS
MODEL 400 GERMAN EQUATORIAL MOUNT WITH DUAL AXIS QUARTZ DRIVE AND MANUAL CONTROL KNOB (400HDA)

MODEL 400 PARTS LIST

1 400 Equatorial Head with stepper motors on right ascension and declination axes
1 Cradle Plate with four ¼-20 x ½ socket head cap screws (SHCS) or Dovetail Plate and Dovetail Center Bar with two ¼-20 x ½ socket head cap screws (SHCS)
1 Stainless counterweight shaft with washer stop and black plastic knob (5/16-18 threaded rod)
1 Dual axis quartz frequency control box
1 "Y" connector cable
1 D.C. power cord (cigarette lighter adapter)
3 Black plastic knobs with ¼-20 threaded rod
1 Hex key set .050" to 5/16"
2 Red caplugs
1 Piece of Velcro (to attach hand controller to surface of your choice)

In order to fully assemble your mount, you will need the following items sold separately: pier or tripod and counterweights.

BASIC OPERATION OF THE MOUNTING

The purpose of an equatorial mount is to allow a single axis movement that will follow the motion of the stars across the sky. With the R.A. axis pointed at the celestial pole (see Polar Alignment instructions), the mount will accurately follow the motions of the sun, moon, planets, and stars.

The 400 equatorial mount has two axes to point the telescope to any desired location in the sky. These axes can be unclamped so they can be swung around freely, or they can be locked down for astrophotography or for detailed study of one particular object for a period of time. Locking and unlocking the axes is done with the R.A. and Dec. axis clutch levers (see the following diagram). If the telescope is properly counterbalanced, these clutches can be left partially engaged. This will allow you to move the telescope easily without constantly clamping and unclamping the axes. Please do not overtighten these clamping levers because any inadvertent movement of the telescope will place a severe strain on the driving gear teeth.

In the 400 mount, we have made provision to disconnect both Dec. and R.A. drive motors so you can drive the two axes manually (see manual operation). This will allow you to make fine adjustments to your pointing position or follow the stars manually if your battery should fail. Please follow the instructions carefully or you can severely damage the drive motor gears. The drive motors can be quickly re-engaged at any time for full electric tracking (see motor drive operation).

The 400 equatorial has two other motions besides the right ascension and declination, the azimuth and altitude axes. These are only used for polar alignment, and they will allow you to quickly and accurately zero in on the celestial pole. To adjust these axes, it is necessary to loosen the appropriate locking screws (see the section on Altitude and Azimuth Adjustments). After making the adjustments, these locking screws must be tightened down again to insure that the mount will not move or vibrate in the wind.

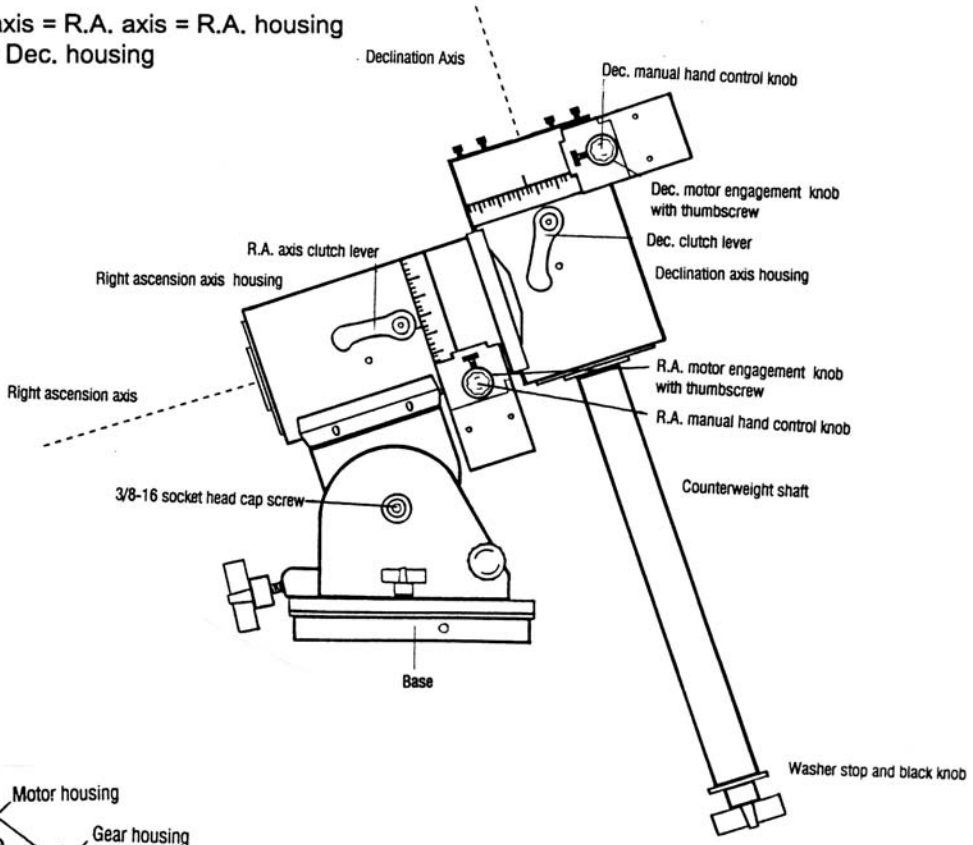
The drive controller in the 400 mount uses a very accurate quartz clock specifically calibrated for the drive gear. The calibration is made to the King sidereal rate, which compensates for atmospheric refraction over a large part of the sky. With this tracking rate, it is easier to maintain critical guiding at high power. For the most sophisticated tracking of celestial objects, the 400 mount controller has a built-in provision for attaching an ST-4 autoguider. With the autoguider it is possible to take long exposure astrophotos totally unattended. You can walk away from the setup and enjoy other observing activities while your astrograph is in operation.

ASSEMBLY INSTRUCTIONS

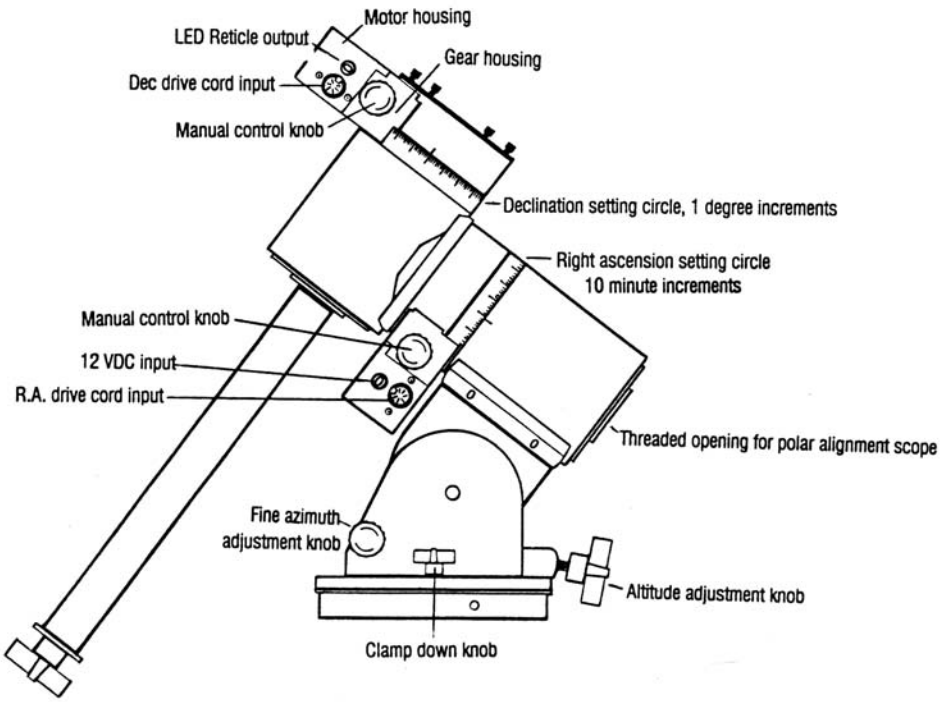
Please read all instructions before attempting to set up your 400 mount. The Model 400 is very rugged; however like any precision instrument, it can be damaged by improper use and handling. Please refer to the diagrams below for illustrations of both sides of the mount. The parts are labeled so that we can establish common terminology.

The following terms and abbreviations are used interchangeably in these instructions:

polar axis = right ascension axis = R.A. axis = R.A. housing
declination axis = dec. axis = Dec. housing



Note: The Dec motor housing should be oriented to the front of the mount as shown here. This will prevent interference as the telescope is moved to different positions



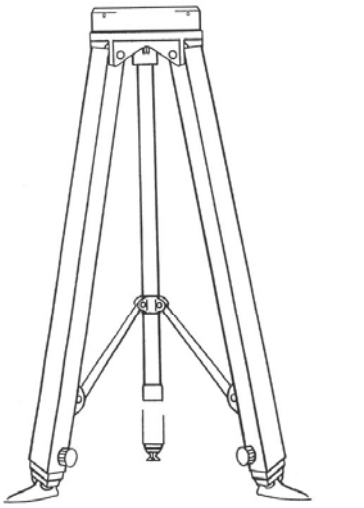
ASSEMBLE PIER OR TRIPOD

Begin by assembling the pier or tripod at the observing location.

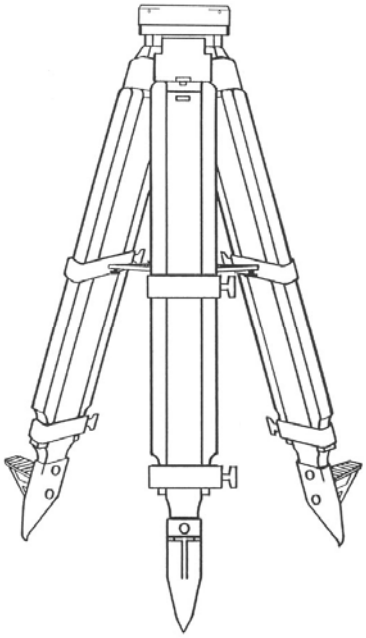
ADJUSTABLE ALUMINUM TRIPOD: Extend the legs to the desired height; secure with the locking levers. Adjust the distance between the legs. Place the legs far enough apart to provide a solid base of support. Please refer to diagram below.

ADJUSTABLE HARDWOOD TRIPOD: Remove the tripod from its carrying case and attach the shelf to each of the three legs with the knobs provided. Adjust legs to the desired height and spread. Lock in position with the hand knobs. Please refer to diagram below.

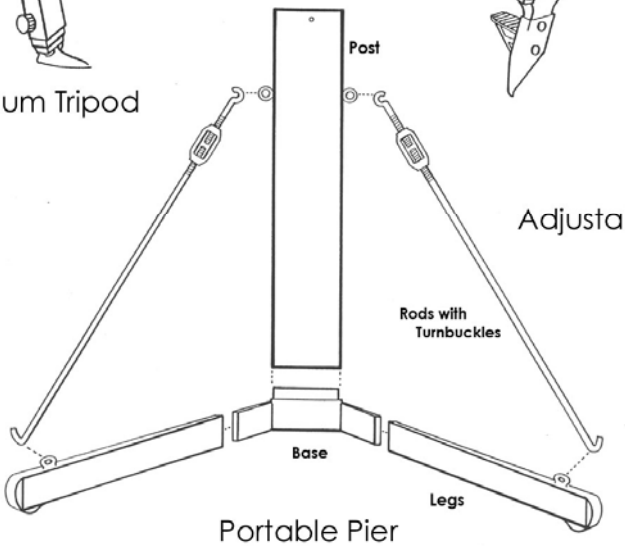
PIER: Slide the three legs onto the nubs of the base. Place the pier post on the base and attach the tension rods. The turnbuckles should be drawn tight until the whole assembly is stiff enough to support your weight without movement. Please refer to diagram below.



Adjustable Aluminum Tripod



Adjustable Wood Tripod



Portable Pier

ASSEMBLE MOUNT TO PIER OR TRIPOD

In order to track the motion of astronomical objects, the polar axis must be positioned so that an imaginary line drawn through the hollow shaft points toward the celestial pole. At this stage of the assembly process, you want to position the mount so that it points roughly north. Place the mount into the top of the pier or tripod so that the threaded R.A. axis hole is on the south side of the pier/tripod. Line up the holes of the mount and pier/tripod. Screw in the three hand knobs to hold the mount in place.

ALTITUDE AND AZIMUTH ADJUSTMENTS – ROUGH POLAR ALIGNMENT

Follow these instructions if you want to rough polar align your mount. If not, you may skip this section and move onto *Assemble Cradle Plate and Counterweight Shaft*. You may make these adjustments with the telescope mounted or not according to your preference. If you plan to mount your scope at this stage, refer to the *Assemble Cradle Plate and Counterweight Shaft* section first.

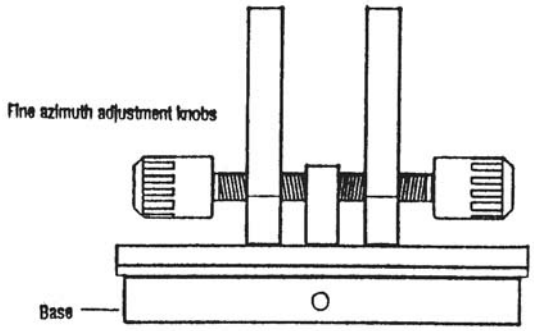
1. If you examine the polar axis assembly, you will see that center of the polar shaft is hollow. You may need to rotate the internal Dec. shaft by moving the top of the declination axis (or the cradle plate if it is attached) to align the sight hole that has been drilled into it. Now, you can look through the shaft to the other side. The end of the R.A. axis is threaded to accept the optional polar alignment telescope used for polar alignment. You do not need the polar alignment scope for this part of the process.

2. Loosen the two black plastic clamp knobs on each side of the mount. Use the 5/16" hex key to loosen the 3/8-16-socket head cap screw on the side of the mount base. If your scope is mounted, support its weight with your other hand since you are loosening a critical bolt.

3. Your goal is to sight the celestial pole when looking through the polar alignment sight hole in the center of the polar axis. You will need to make altitude and azimuth adjustments to the position of the mount.

4. Altitude (latitude) adjustments: Move the polar axis up or down with the large altitude adjustment knob located at the rear of the mount assembly.

5. Azimuth adjustments: Move the entire pier or tripod east or west until the mount is oriented approximately towards the pole. Use the two fine azimuth adjustment knobs, one on each side of the mount, to make fine adjustments in azimuth. You must back off the opposing azimuth knob in order to move the other knob in that direction. Please refer to the diagram below.



6. You will continue to make adjustments in azimuth and altitude until you can see the celestial pole through the polar alignment sight hole. At this point, you have achieved rough polar alignment, which may be sufficient for most casual visual observations. When the R.A. motor is engaged, it will compensate for the rotation of the earth and keep the target object within the eyepiece field of view. Your target object will slowly drift since polar alignment at this stage is only approximate. However, you can make corrections with your hand controller, as we will discuss later.

7. If rough polar alignment is sufficient, snug the two black plastic clamp knobs and one 3/8-16 screw to lock the mount into position. If you require more exact polar alignment, proceed to the next section.

POLAR ALIGNMENT

Follow these instructions if you want to fine-tune the polar alignment of your mount. If not, you may skip this section and move onto *Assemble Cradle Plate and Counterweight Shaft*.

1. Polar alignment telescope – The north celestial pole can be viewed through the polar axis with our optional polar axis telescope.

2. If you do not have a polar alignment telescope, you may use the star drift method.

3. When the proper alignment has been achieved, snug the two black plastic clamp knobs and one 3/8-16 screw lightly to secure the polar axis and recheck alignment. If no movement has occurred, finish tightening the screw as much as possible to prevent movement when the telescope and counterweights are attached.

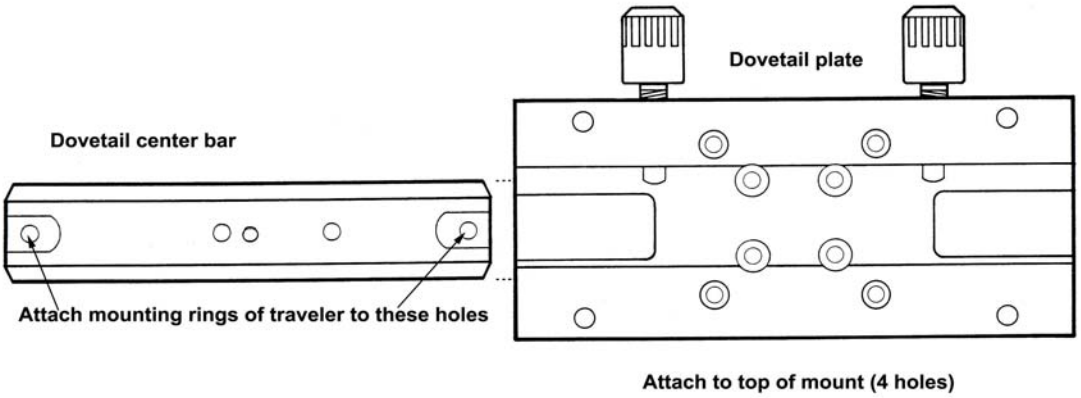
   IMPORTANT: Failure to tighten the side screw can cause the axis to slip with resultant damage to the mount.

ASSEMBLE CRADLE PLATE AND COUNTERWEIGHT SHAFT

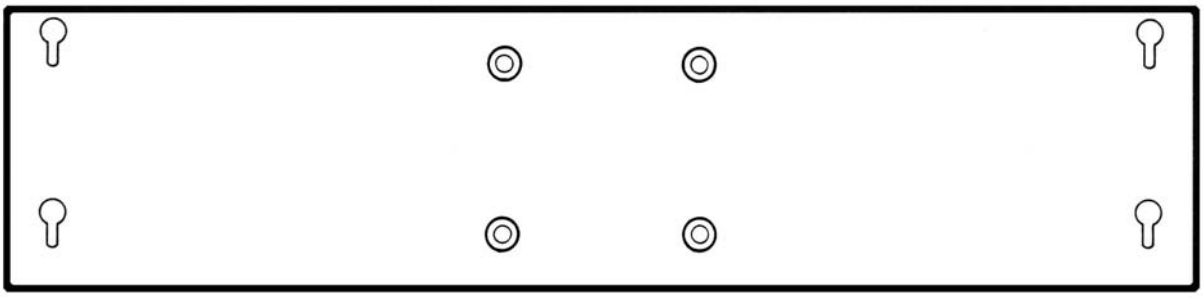
IMPORTANT: Always attach the counterweight before mounting the telescope to prevent sudden movement of an unbalanced tube assembly, which may cause damage or injury. Remember, counterweights are heavy and will hurt if they fall on your toe.

1. Cradle Plates – Please refer to diagrams below

   a. Dovetail plate – Attach it to the Dec. axis with the four ¼-20 x ½ SHCS. Attach the dovetail center plate to the two Traveler rings using one ¼ -20 x ½ SHCS each.



   b. Mounting plate for refractors larger than 4” – Attach it to the Dec. axis with the four ¼-20 x ½ SHCS.



2. Thread counterweight shaft onto the Dec. axis.

3. Remove the hand knob and washer from the base of the counterweight shaft. Add sufficient counterweights (optional, purchase 6 or 9 lb. counterweight separately) to the counterweight shaft to balance the telescope you intend to use. Always use two hands to attach or move them on the shaft. Reattach the hand knob and washer to the end of the counterweight shaft. This will help to prevent injury if someone accidentally loosens the counterweight hand knob.

   NOTE: A firm tightening of the counterweight knob will not damage the surface of the counterweight shaft. The pin that tightens against the stainless counterweight shaft is constructed of brass. Likewise, the bronze sleeve that has been press fit into the center of the counterweight will prevent marring of the shaft as you move the counterweights.

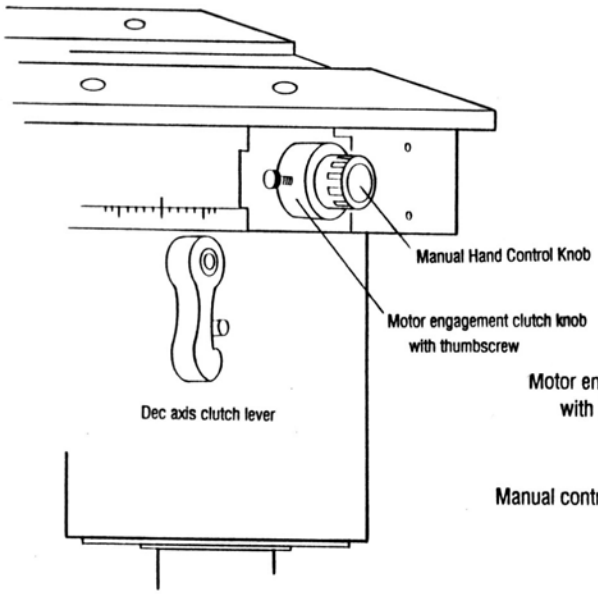
   NOTE: During disassembly, the cradle plate may remain attached to the declination axis or removed as desired. When you remove the counterweight shaft, a threaded black anodized piece may remain attached to your counterweight shaft. This is of no concern as it can be threaded back onto the mount.

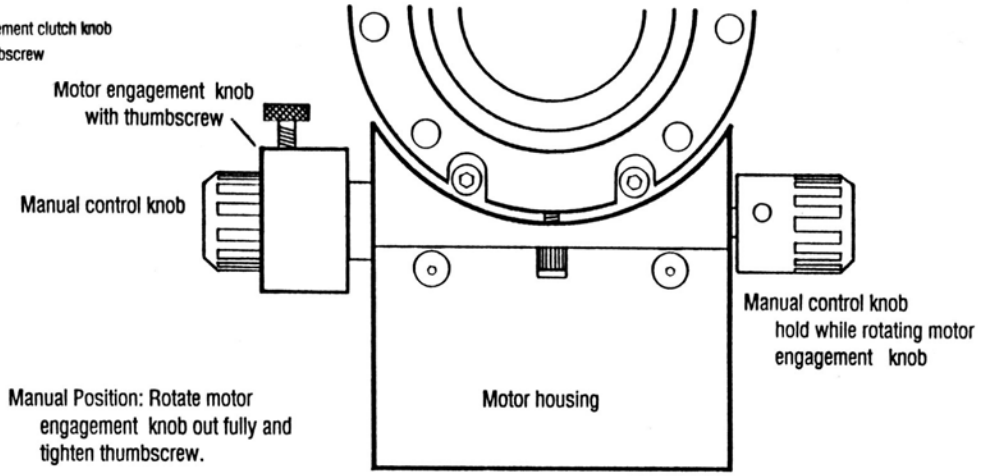
OPERATION OF THE MOUNTING

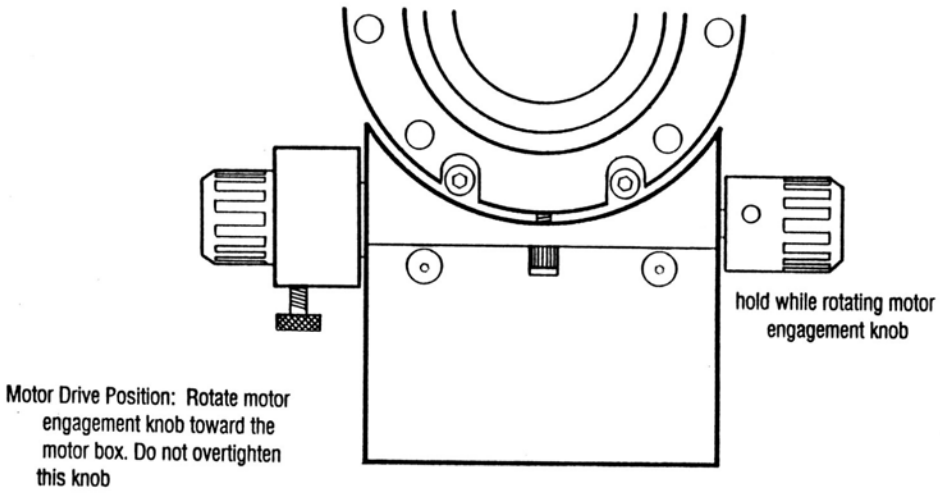
The mounting has a motor engagement knob (silver-colored) with thumbscrew and black clutch lever on both R.A. and Dec. axes.

Motor Engagement Clutch Knob: The position of the motor engagement knob will determine whether the manual control knobs can be used or whether the motor drive system is engaged. Please note that although you cannot turn the manual control knobs when the motor drive system is operational, you can readily switch from one function to another quite easily as described below.

Clutch Lever: There are two black painted clamps, one located on the R.A. axis and the other on the Dec. axis. If the levers are loosened, the axes can be swung around freely. If the telescope is properly counterbalanced, the clutches can be left partially engaged. This will allow you to move the telescope easily without constant clamping and unclamping the axes. For astrophotography, snug up a bit more. Please do not over-tighten these clamping levers. If the levers are very tight and you try to move the telescope manually by grasping the tube (as you probably do habitually), you will place severe strain on the driving gear teeth.







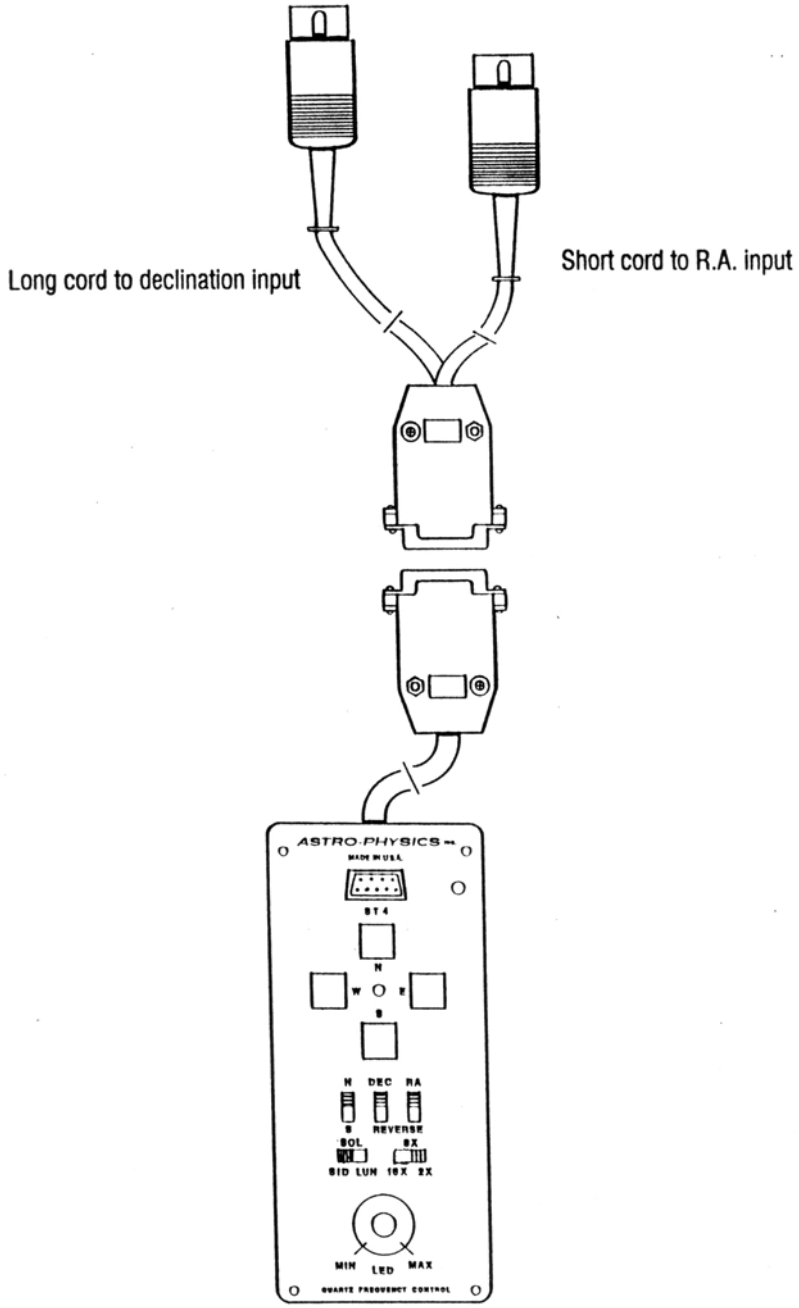
Manual Operation: To operate manually, rotate the motor engagement knobs out fully and tighten the thumbscrew. Hold the hand knob on the opposite side firmly. Engage the black clutch clamp and rotate hand knobs to move the telescope. DO NOT over-tighten the black clutch lever. Please refer to the preceding diagrams.

Motor Drive Operation: To operate with the stepper motor drive, rotate the motor engagement knob toward the motor box. Hold the hand knob on the opposite side firmly and lightly engage the motor engagement knob. It is not necessary to make the motor engagement knob tight. Lock the motor the black clutch lever. Please refer to the preceding diagrams.

Balancing Your Telescope: For proper operation, the telescope must be adequately counterbalanced. Start by balancing the tube assembly. Tighten the black R.A. axis clutch clamp; loosen the black Dec. axis clutch clamp so that the telescope tube rotates on the declination axis. If you are using the dovetail plate, loosen the two side thumbscrews and move the sliding bar, with scope attached, forwards and backwards. Now, tighten the declination axis with the clutch clamp and loosen the R.A. clutch clamp. Move the counterweights up or down to achieve balance in R.A. Remember to allow for the extra weight of diagonals, eyepieces, and finder scopes. If the scope moves by itself, even when the clutches are loose, the scope is not fully counterbalanced properly.

OPERATION OF THE CONTROLLER

The push button controller contains all the circuitry for driving the two motors. The controller will be operational when attached to both the motors of the mount and a power source. There is no on-off switch. Remember that the motor engagement clutch knobs must be in the correct position in order for the motors to operate. Please refer to the previous diagram. The diagram below illustrates the controller and cables.



CABLES: Place the DC power cord into the phono plug outlet of the R.A. motor box. Plug the short length of the “Y” cable into the R.A. motor box and the long length into the Dec. motor box. Complete the cable assembly by joining the control box cable to the “Y” cable. The control box and motors are designed to work at 12 volts DC. Suggested power sources include: portable rechargeable battery pack, auto battery, or power inverter for 110 volts.

DRIVE ROTATION: If you are operating the 400 mount north of the equator, the HEMISPHERE switch must be set to “N”. If south of the equator, set the switch to “S”.

PUSH BUTTONS: The four red buttons are arranged so that the left and right buttons control the right ascension and top and bottom buttons control the declination. This is the normal orientation of objects in the eyepiece field. If the star moves down when you push the “N” button, move the DEC REVERSE switch into the opposite position. Pushing the right hand button “E” will cause the star to move to the right. If it moves to the left, move the RA REVERSE switch to the other position. When properly set up, the controller buttons will cause the object to move according to your orientation at the eyepiece.

MODE SWITCH: There are three guiding modes (rates): a 2x guiding rate and a 8x and 16x slew rate. The slew rates are for positioning objects in the field, the guide rate is for fine guiding at high powers during astrophotography. Move the switch to select the mode that you prefer.

Please note that due to a printing error the 16x and 2x settings on the hand controller are reversed, i.e., the controller will operate at the 2x speed when the switch is set to 16x.

SELECT BUTTON: The control box has three drive rates to choose from SID (sidereal), SOL (solar), and LUN (lunar). Select the position appropriate for the object under observation.

King Sidereal:	Tracking rate for observing planets, stars, galaxies and other distant objects.
Solar:	Tracking rate for observing the sun.
Lunar:	Tracking rate for observing the moon

LED KNOB: There is an LED output available on the 400 Dec. axis motor housing as shown in the diagram on page 2. You may insert your LED reticle to this plug. Brightness can then be controlled using the MIN to MAX setting of the LED knob.

ST4 or ST6 CONNECTION: If you own a Santa Barbara Instrument Group (SBIG) ST4 or ST6 Star Tracker/Imaging system you connect it to the controller via this 9 PIN connector. Call Astro-Physics to purchase a separate cable for this connection. The cable that we offer will allow your mount and ST-4 (ST-6) to operate from the same power source.

MOUNT MAINTENANCE AND ALIGNMENT

Under normal operating conditions, no maintenance is required. Your 400 is a precision instrument with very accurate worm and wheel adjustments. Please be careful if you place the mount on a flat surface, i.e. the ground or trunk of your car. The gear alignment may be affected if the R.A. and Dec. motor/gear box assemblies sustain undue lateral force. This is true of any fine instrument. We suggest that you transport and store the mount in a case or in a well-padded box

NOTE: If your battery runs low, the declination motors will stop first, through the R.A. will continue to drive until the power is drained.

If any problems occur, please don't hesitate to contact Astro-Physics for assistance.

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MOTOR ENGAGEMENT IMPROVEMENT NOTICE

We have improved our motor engagement knob design and offer to you, free of charge, replacement motor engagement knobs.

Please follow these instructions to upgrade your mount using this feature. Refer to the diagrams in the 400 mount instructions prior to installation.

1. Remove manual hand knob on clutch side of the mount by loosening setscrew (use 3/32 hex key) and pulling knob off.
2. Rotate motor engagement knob out and off of the threaded worm gear shaft.
3. This old knob will not be used and can be discarded.
4. At this time, please take note of the position of the flat spot on the threaded worm gear shaft. This will be important in step 6.
5. Thread on the new motor engagement knob with the thumbscrew temporarily removed, until it stops. DO NOT tighten.
6. Taking note of the flat on the threaded shaft, slide on the manual hand knob and position the setscrew over the flat.
7. While holding the manual hand knob in position, rotate out the motor engagement knob until the setscrew in the manual hand knob can be accessed through the hole in the motor engagement knob.
8. Using the 3/32 hex key tighten the setscrew against the flat.
9. Replace the thumbscrew in the motor engagement knob and follow mount instructions for use of this feature under mount operations.